



# STP08DP05

## Low voltage 8-Bit constant current Led sink with full outputs error detection

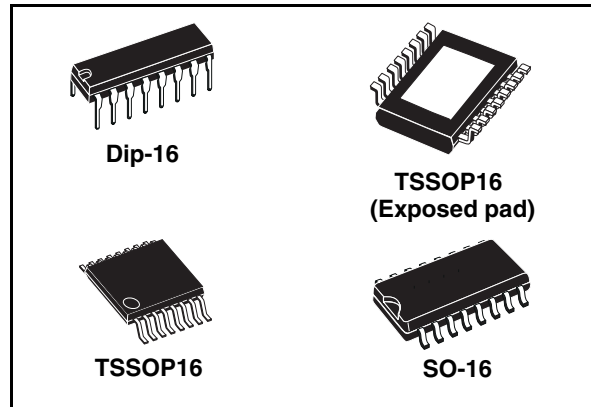
### Features

- Low voltage power supply down to 3V
- 8 constant current output channels
- Adjustable output current through external resistor
- Short and open output error detection
- Serial Data IN/Parallel data OUT
- 3.3V micro driver-able
- Output current: 5-100mA
- 30MHz clock frequency
- Available in high thermal efficiency TSSOP exposed pad
- ESD protection 2.5kV HBM, 200V MM

### Description

The STP08DP05 is a monolithic, low voltage, low current power 8-bit shift register designed for LED panel displays. The STP08DP05 contains a 8-bit serial-in, parallel-out shift register that feeds a 8-bit D-type storage register. In the output stage, eight regulated current sources were designed to provide 5-100mA constant current to drive the LEDs.

The STP08DP05 is backward compatible in the functionality and footprint with STP8C/L596 and extends its functionality with open and short detection on the outputs. The detection circuit checks 3 different conditions that can occur on the output line: short to GND, short to  $V_O$  or open line. The data detection results are loaded in the shift register and shifted out via the serial line output.



The detection functionality is implemented without increasing the pin number, through a secondary function of the output enable and latch pin (DM1 and DM2 respectively), a dedicated logic sequence allows the device to enter or leave from detection mode. Through an external resistor, users can adjust the STP08DP05 output current, controlling in this way the light intensity of LEDs, in addition, user can adjust LED's brightness intensity from 0% to 100% via  $\overline{OE}/DM2$  pin.

The STP08DP05 guarantees a 20V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 30MHz, also satisfies the system requirement of high volume data transmission. The 3.3V of voltage supply is well useful for applications that interface any micro from 3.3V. Compared with a standard TSSOP package, the TSSOP exposed pad increases heat dissipation capability by a 2.5 factor..

**Table 1. Device summary**

Part Number	Package	Packaging
STP08DP05B1R	DIP-16	25 parts per tube
STP08DP05MTR	SO-16 (Tape & Reel)	2500 parts per reel
STP08DP05TTR	TSSOP16 (Tape & Reel)	2500 parts per reel
STP08DP05XTTR	TSSOP16 Exposed-Pad (Tape & Reel)	2500 parts per reel

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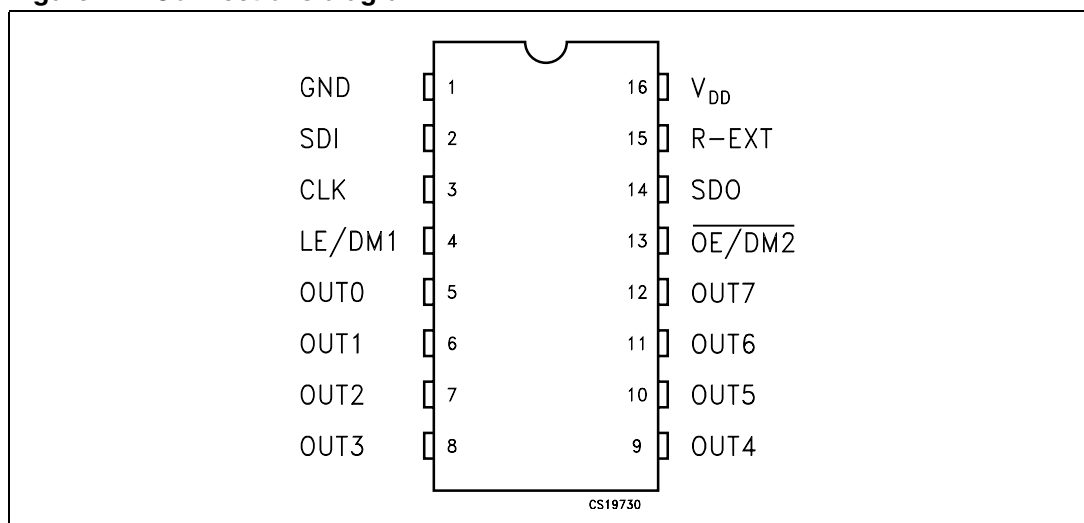
# 1 Summary description

**Table 2. Typical current accuracy**

Output voltage	Current accuracy		Output current
	Between bits	Between ICs	
≥1.3V	±1.5%	±5%	20 to 100mA

## 1.1 Pin connection and description

**Figure 1. Connections diagram**



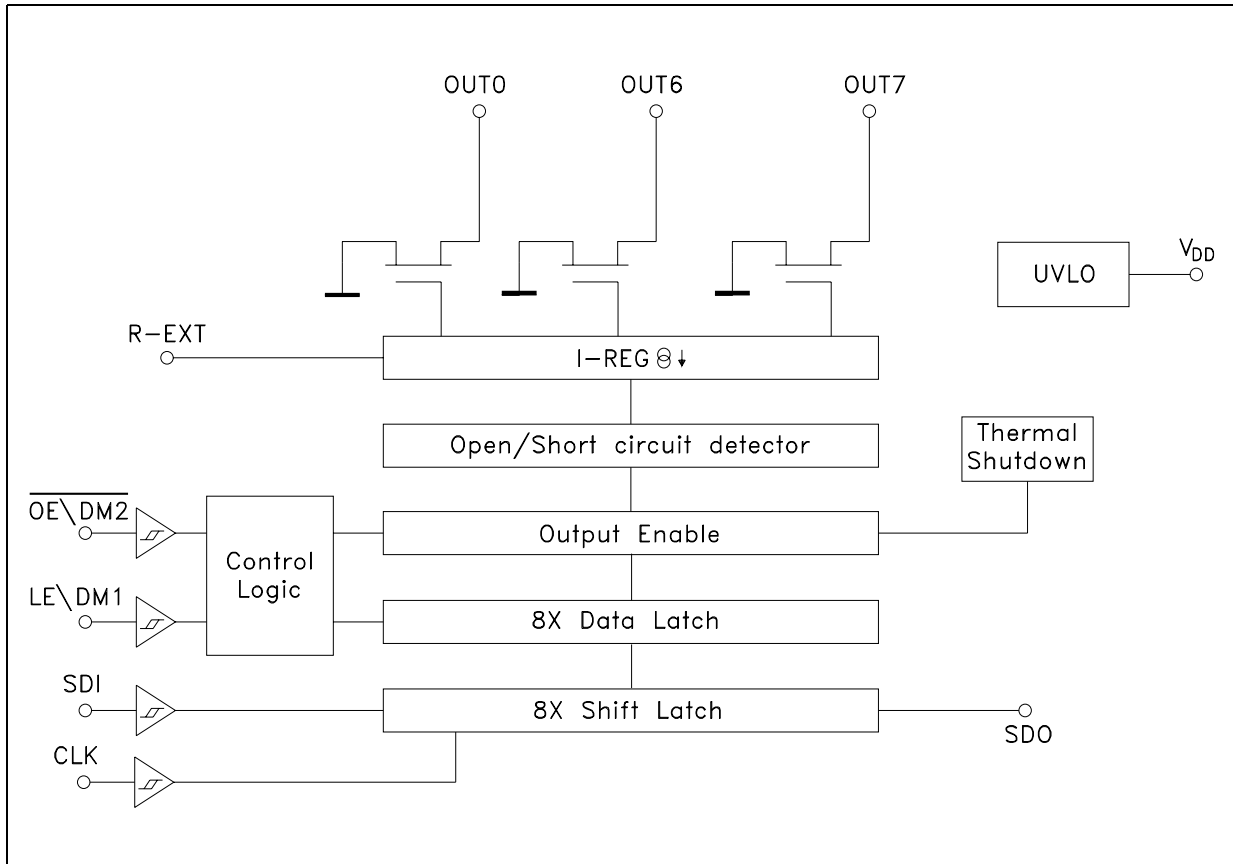
*Note:* The Exposed-pad is electrically not connected

**Table 3. 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/DM1	Latch input terminal
5-12	OUT 0-7	Output terminal
13	$\overline{OE/DM2}$	Output enable input terminal (active low)
14	SDO	Serial data out terminal
15	R-EXT	Constant current programming
16	$V_{DD}$	5V Supply voltage terminal

## 2 Block diagram

Figure 2. Normal mode - block diagram



### 3 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.

#### 3.1 Absolute maximum ratings

**Table 4. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply voltage $I_{GND}$	0 to 7	V
$V_O$	Output voltage	-0.5 to 20	V
$I_O$	Output current	100	mA
$I_{GND}$	GND terminal current	800	mA
$f_{CLK}$	Clock frequency	50	MHz
$T_{OPR}$	Operating temperature range	-40 to +125	°C
$T_{STG}$	Storage temperature range	-55 to +150	°C

#### 3.2 Thermal data

**Table 5. Thermal data**

Symbol	Parameter	DIP-16	SO-16	TSSOP-16	TSSOP-16 <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

### 3.3 Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{DD}$	Supply voltage		3.0		5.5	V
$V_O$	Output voltage				20	V
$I_O$	Output current	OUTn	5		100	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/DM1 pulse width	$V_{DD} = 3.0$ to $5.0V$	20			ns
$t_{wCLK}$	CLK pulse width		20			ns
$t_{wEN}$	$\overline{OE/DM2}$ pulse width		200			ns
$t_{SETUP(D)}$	Setup time for DATA		7			ns
$t_{HOLD(D)}$	Hold time for DATA		4			ns
$t_{SETUP(L)}$	Setup time for LATCH		15			ns
$f_{CLK}$	Clock frequency		Cascade operation <sup>(1)</sup>			30

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

## 4 Electrical characteristics

**Table 7. Electrical characteristics**

 ( $V_{DD}=3.3V$  to  $5V$ ,  $T = 25^{\circ}C$ , 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	$V_{OH} = 20V$		0.5	10	$\mu A$
$V_{OL}$	Output voltage (Serial-OUT)	$I_{OL} = 1mA$		0.03	0.4	V
$V_{OH}$	Output voltage (Serial-OUT)	$I_{OH} = -1mA$	$V_{OH} - V_{DD} = -0.4V$			V
$I_{OL1}$	Output current	$V_O = 0.3V, R_{ext} = 3.9k\Omega$	4.25	5	5.75	mA
$I_{OL2}$		$V_O = 0.3V, R_{ext} = 970\Omega$	19	20	21	
$I_{OL3}$		$V_O = 1.3V, R_{ext} = 190\Omega$	96	100	104	
$\Delta I_{OL1}$	Output current error between bit (All Output ON)	$V_O = 0.3VR_{EXT} = 3.9k\Omega$		$\pm 5$	$\pm 8$	%
$\Delta I_{OL2}$		$V_O = 0.3VR_{EXT} = 970\Omega$		$\pm 1.5$	$\pm 3$	
$\Delta I_{OL3}$		$V_O = 1.3VR_{EXT} = 190\Omega$		$\pm 1.2$	$\pm 3$	
$R_{SIN(up)}$	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)	$R_{EXT} = 980$ OUT 0 to 7 = OFF		4	5	mA
$I_{DD(OFF2)}$		$R_{EXT} = 250$ OUT 0 to 7 = OFF		11.2	13.5	
$I_{DD(ON1)}$	Supply current (ON)	$R_{EXT} = 980$ OUT 0 to 7 = ON		4.5	5	
$I_{DD(ON2)}$		$R_{EXT} = 250$ OUT 0 to 7 = ON		11.7	13.5	
Thermal	Thermal protection <sup>(1)</sup>			170		$^{\circ}C$

1. Guaranteed by desing (not tested)  
The thermal protection switches OFF only the outputs current

## 5 Switching characteristics

**Table 1. 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, $\overline{CLK-OUTn}$ , $LE\overline{DM1} = H$ , $OE\overline{DM2} = L$	$V_{DD} = 3.3V$ $V_{IL} = GND$ $I_O = 20mA$ $R_{EXT} = 1K\Omega$ $V_{IH} = V_{DD}$ $C_L = 10pF$ $V_L = 3.0V$ $R_L = 60\Omega$	$V_{DD} = 3.3V$		35	70	ns
			$V_{DD} = 5V$		18	35	
$t_{PLH2}$	Propagation delay time, $LE\overline{DM1} - \overline{OUTn}$ , $OE\overline{DM2} = L$		$V_{DD} = 3.3V$		48	90	ns
			$V_{DD} = 5V$		30	60	
$t_{PLH3}$	Propagation delay time, $OE\overline{DM2} - \overline{OUTn}$ , $LE\overline{DM1} = H$		$V_{DD} = 3.3V$		55	110	ns
			$V_{DD} = 5V$		36	75	
$t_{PLH}$	Propagation delay time, CLK-SDO		$V_{DD} = 3.3V$		7	14	ns
			$V_{DD} = 5V$		4	8	
$t_{PHL1}$	Propagation delay time, $\overline{CLK-OUTn}$ , $LE\overline{DM1} = H$ , $OE\overline{DM2} = L$		$V_{DD} = 3.3V$		10	20	ns
			$V_{DD} = 5V$		7	14	
$t_{PHL2}$	Propagation delay time, $LE\overline{DM1} - \overline{OUTn}$ , $OE\overline{DM2} = L$	$V_{DD} = 3.3V$		24	50	ns	
		$V_{DD} = 5V$		20	40		
$t_{PHL3}$	Propagation delay time, $OE\overline{DM2} - \overline{OUTn}$ , $LE\overline{DM1} = H$	$V_{DD} = 3.3V$		20	40	ns	
		$V_{DD} = 5V$		17	35		
$t_{PHL}$	Propagation delay time, CLK-SDO	$V_{DD} = 3.3V$		22	30	ns	
		$V_{DD} = 5V$		18	25		
$t_{ON}$	Output rise time 10~90% of voltage waveform	$V_{DD} = 3.3V$		25	60	ns	
		$V_{DD} = 5V$		10	25		
$t_{OFF}$	Output fall time 90~10% of voltage waveform	$V_{DD} = 3.3V$		5	15	ns	
		$V_{DD} = 5V$		4	12		
$t_r$	CLK rise time <sup>(1)</sup>				5000	ns	
$t_f$	CLK fall time <sup>(1)</sup>				5000	ns	

1. In order to achieve high cascade data transfer, please consider  $t_r/t_f$  timings carefully.



## 6 Equivalent circuit and outputs

Figure 3.  $\overline{OE}/DM2$  terminal

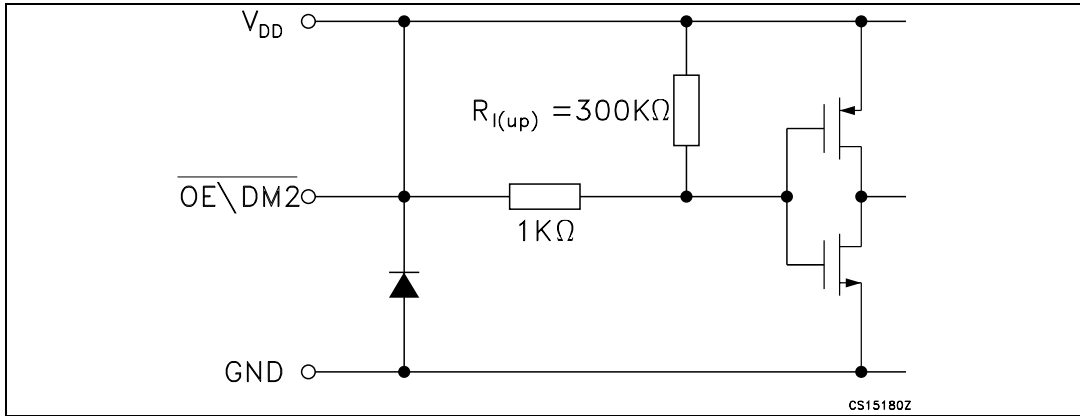


Figure 4.  $LE/DM1$  terminal

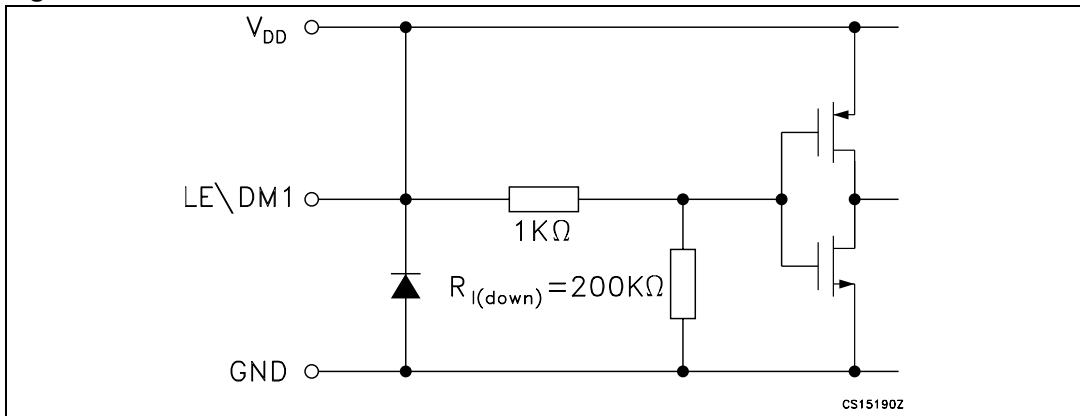


Figure 5. CLK, SDI terminal

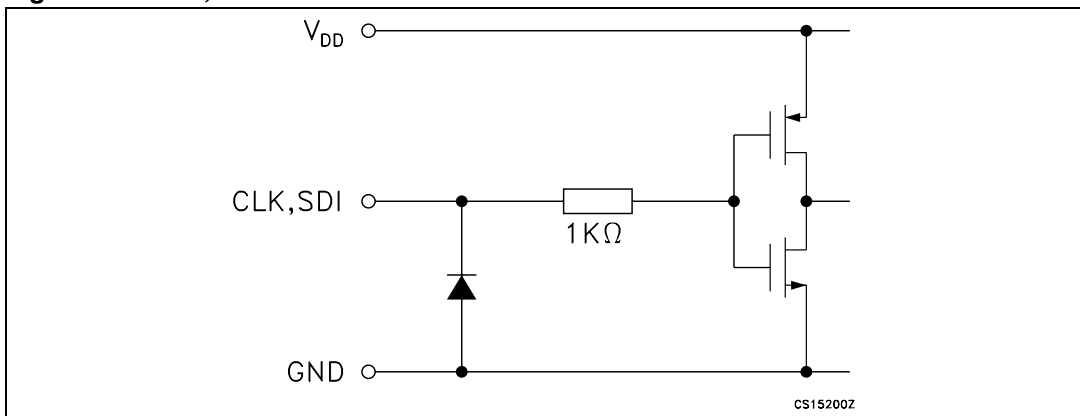
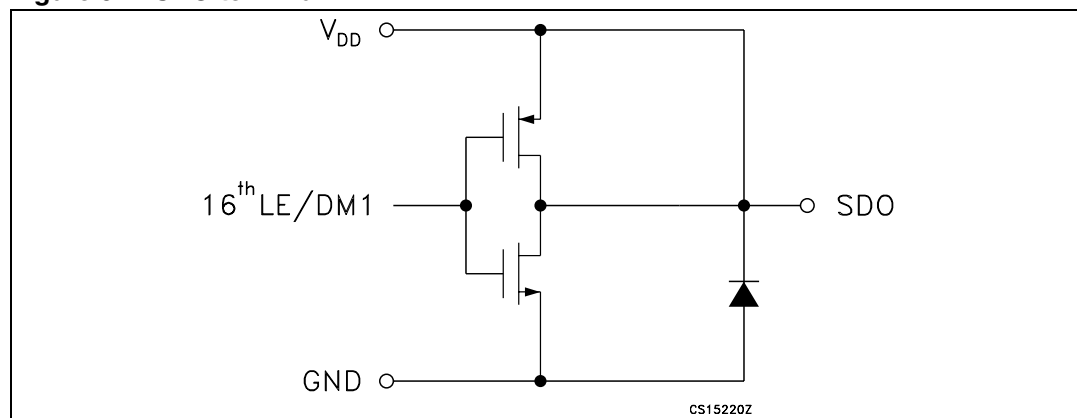







Figure 6. SDO terminal



## 7 Truth table and timing diagram

### 7.1 Truth table

Table 8. Truth table

Clock	LE/DM1	$\overline{OE}/DM2$	SDI	$\overline{OUT0}$ ..... $\overline{OUT0}$ ..... $\overline{OUT7}$	SDO
	H	L	Dn	Dn ..... Dn -5 ..... Dn -7	Dn -7
	L	L	Dn + 1	No Change	Dn -7
	H	L	Dn + 2	$\overline{Dn +2}$ ..... $\overline{Dn -3}$ ..... $\overline{Dn -5}$	Dn -5
	X	L	Dn + 3	$\overline{Dn +2}$ ..... $\overline{Dn -3}$ ..... $\overline{Dn -5}$	Dn -5
	X	H	Dn + 3	OFF	Dn -5

Note:  $OUT0$  to  $OUT7$  = ON when Dn = H;  $OUT0$  to  $OUT7$  = OFF when Dn = L.

## 7.2 Timing diagram

Figure 7. Timing diagram - normal mode

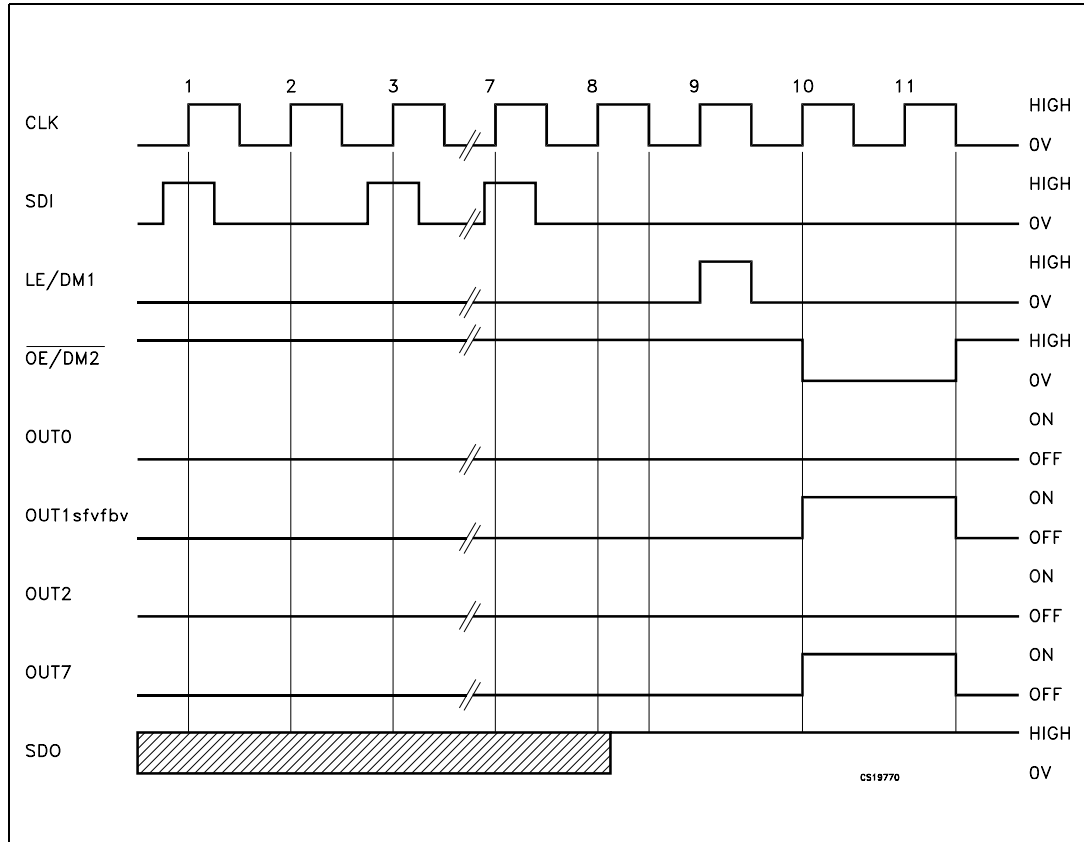


Figure 8. Clock, serial-in, serial-out

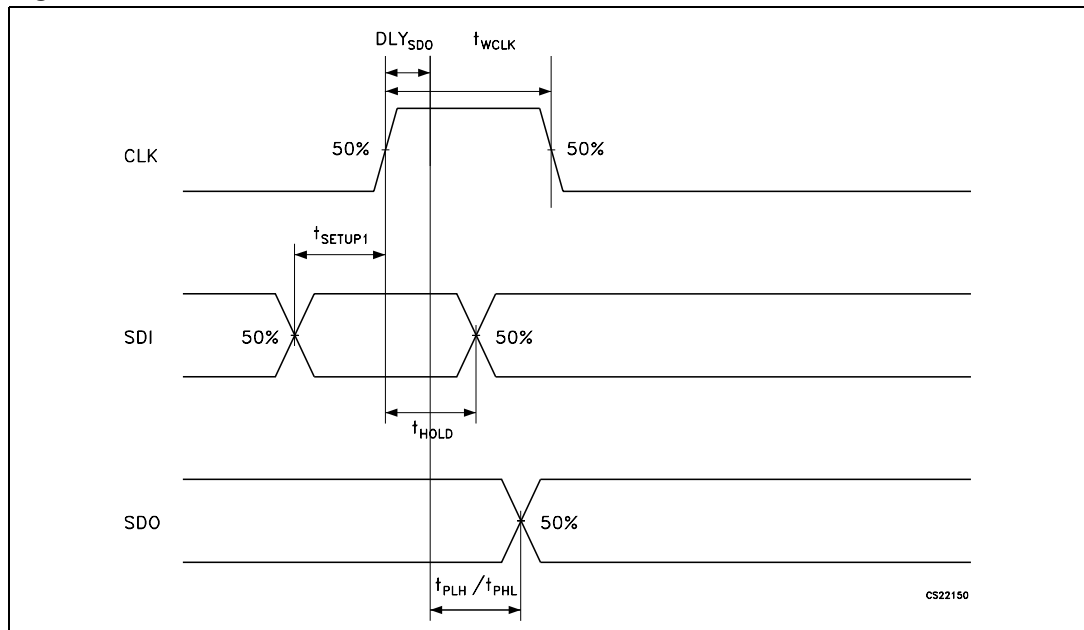


Figure 9. Clock, serial-in, latch, enable, outputs

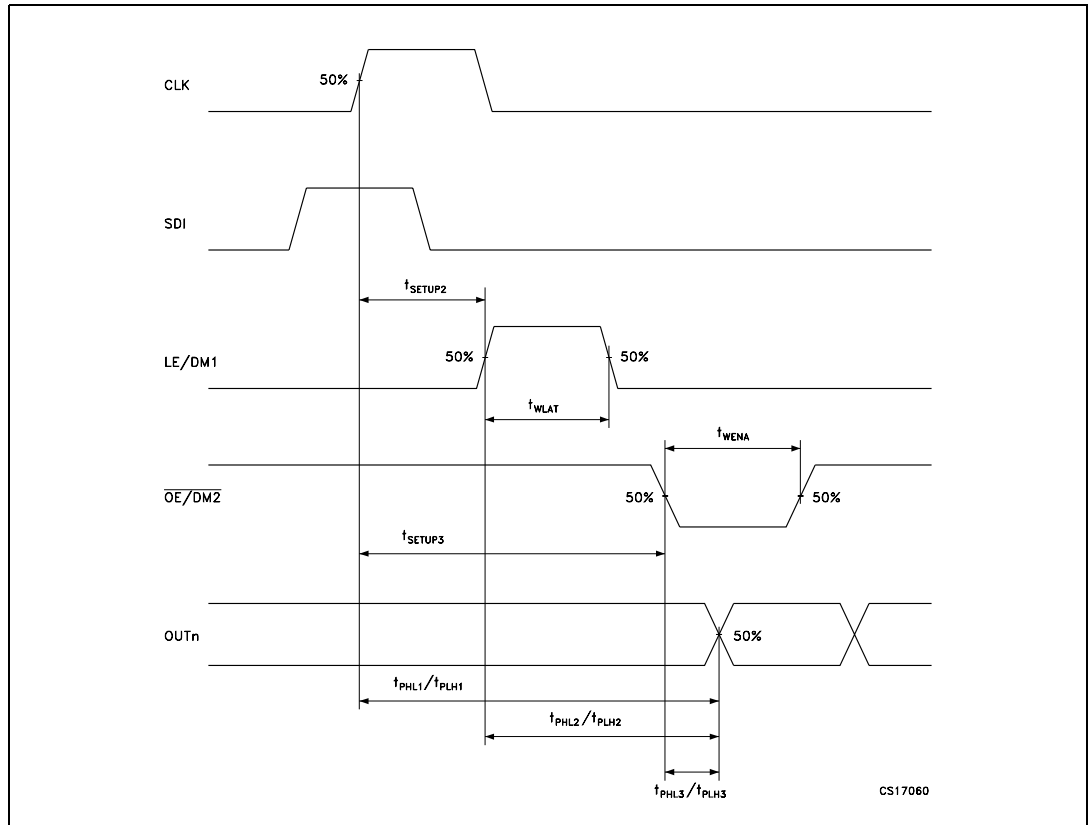
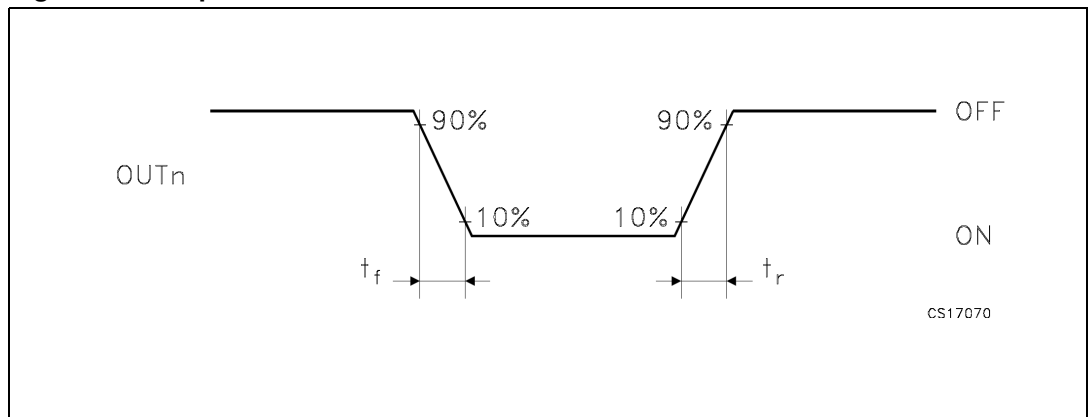


Figure 10. Outputs



## 8 Typical characteristics

Figure 11. Output current- $R_{EXT}$  resistor

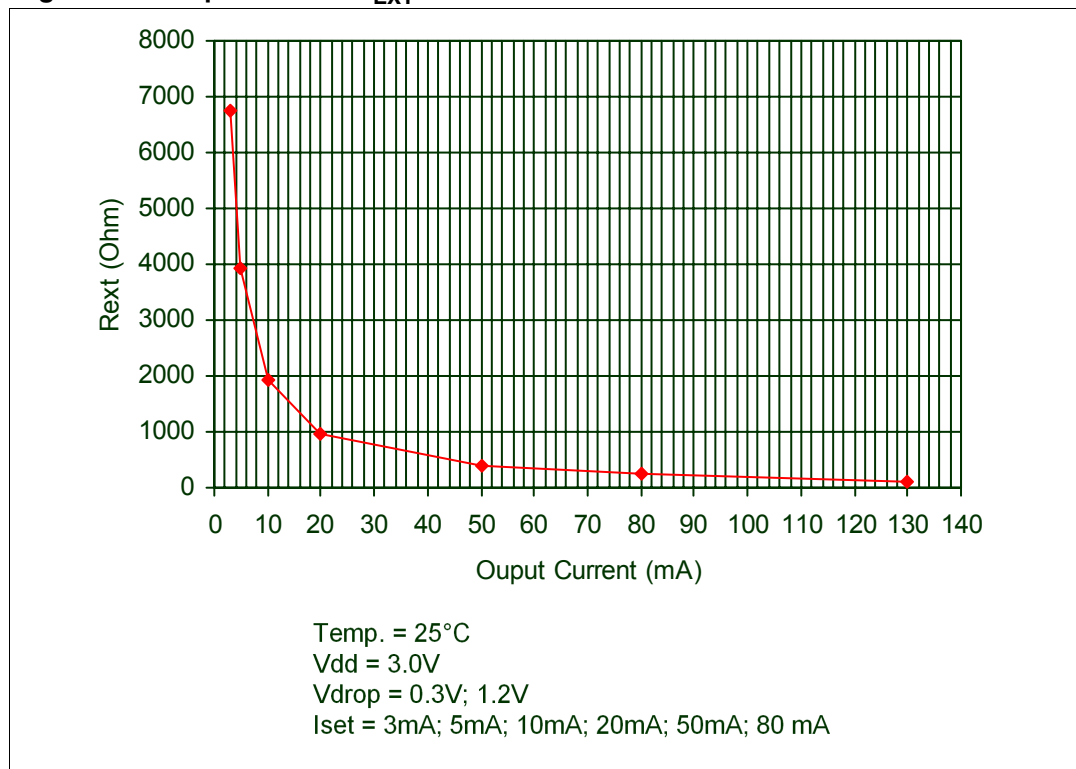
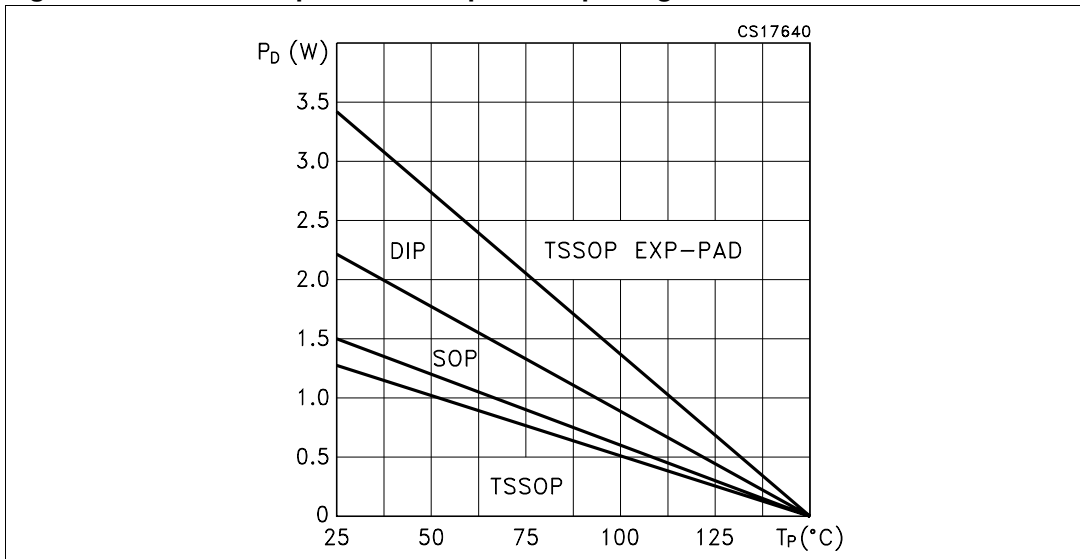


Table 9. Output current- $R_{EXT}$  resistor

Output Current (mA)	3	5	10	20	50	80	130
Rext (Ω)	6740	3930	1913	963	386	241	124

Figure 12. Power dissipation vs temperature package



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

## 9 Test circuit

Figure 13. DC characteristics

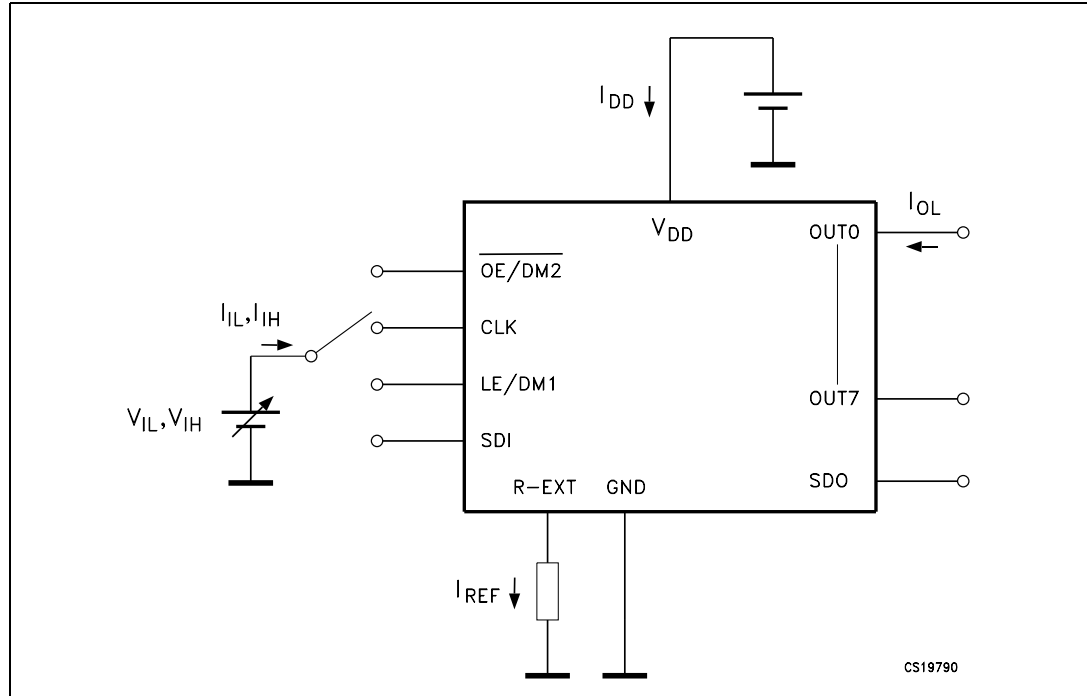


Figure 14. AC characteristics

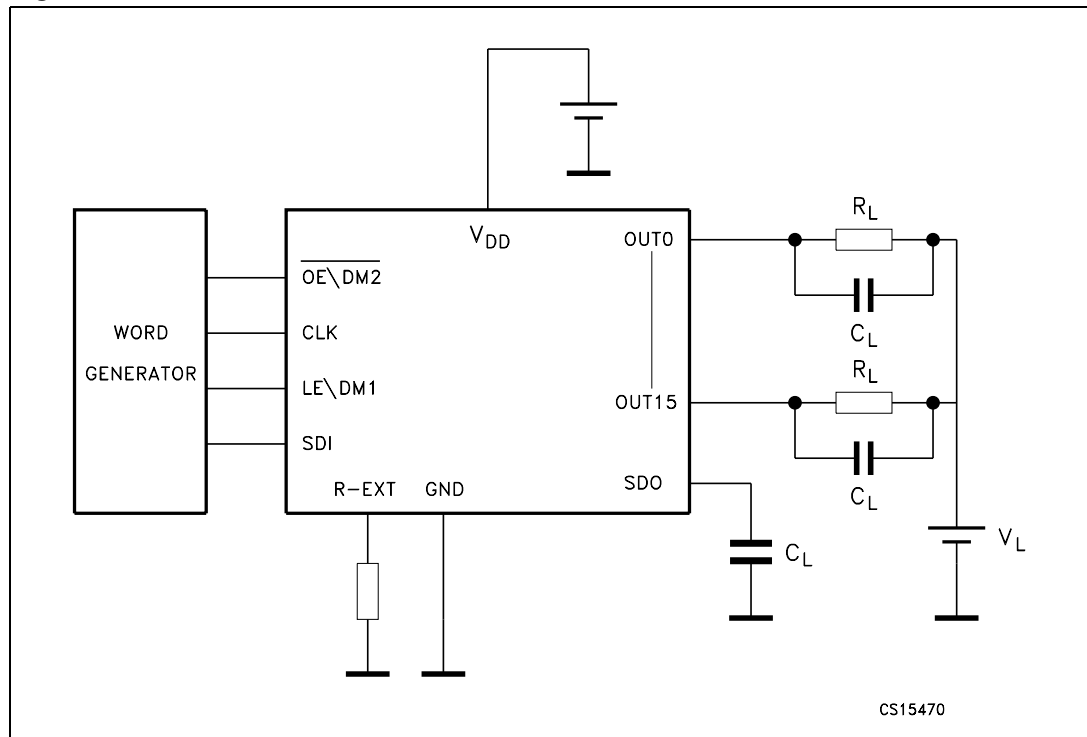
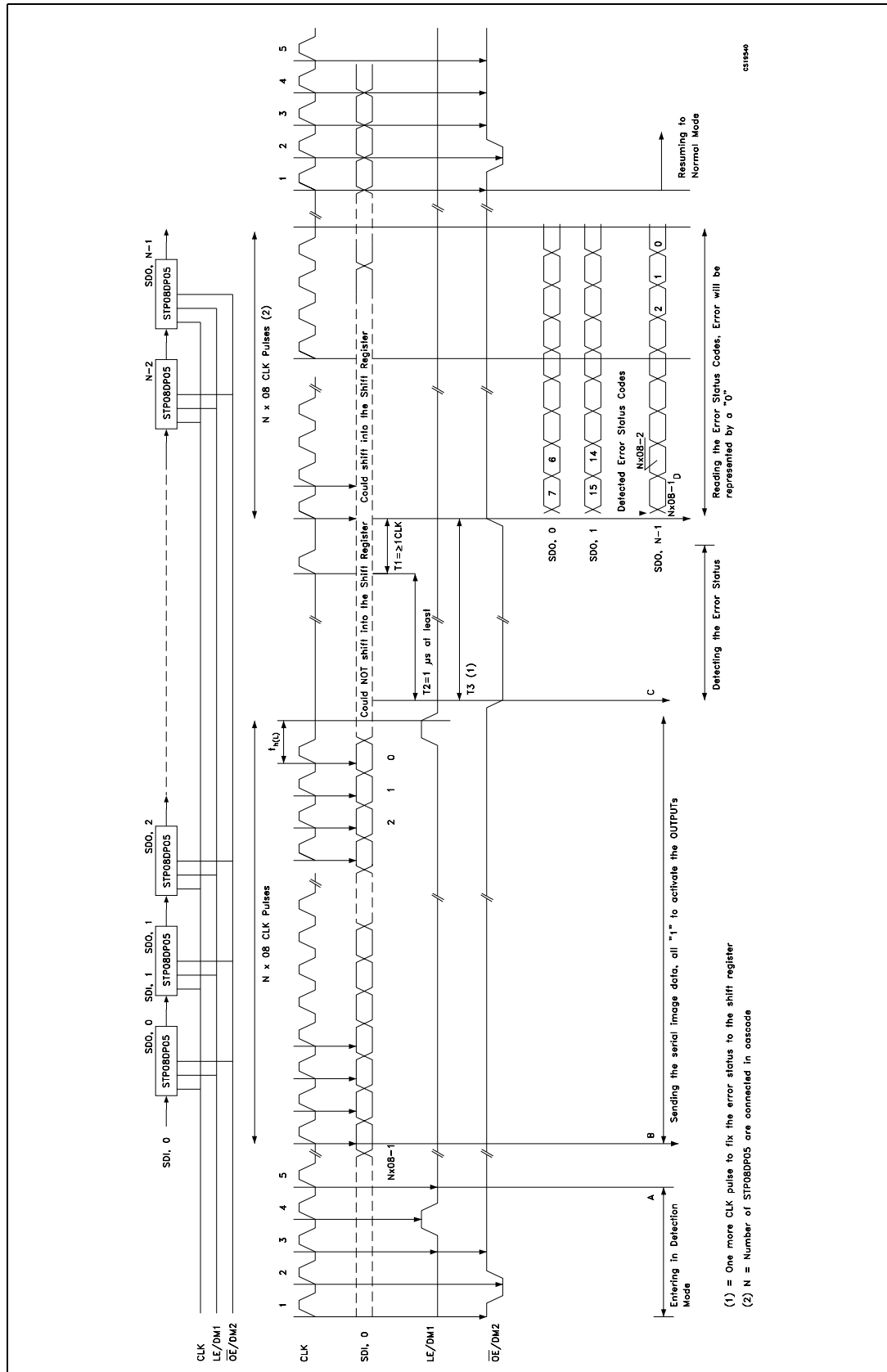




Figure 15. Timing example for open and/or short detection



# 10 Detection mode functionality

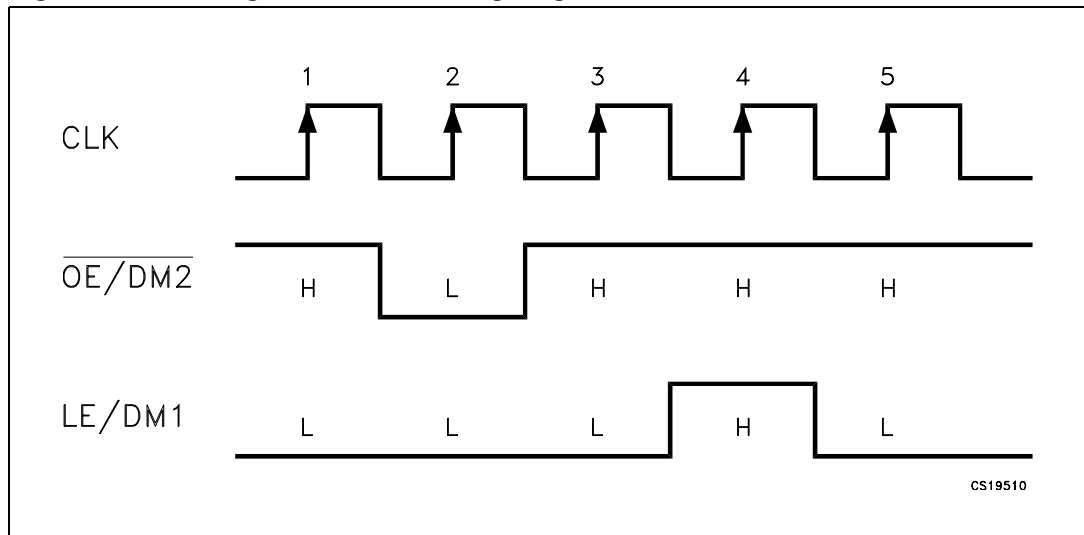
## 10.1 Phase one: “entering in detection mode“

From the “Normal Mode” condition the device can switch to the “Error Mode“ by a logic sequence on the  $\overline{OE/DM2}$  and LE/DM1 pins as showed in the following table and diagram:

**Table 10. Entering in detection truth table**

CLK	1°	2°	3°	4°	5°
$\overline{OE/DM2}$	H	L	H	H	H
LE/DM1	L	L	L	H	L

**Figure 16. Entering in detection timing diagram**

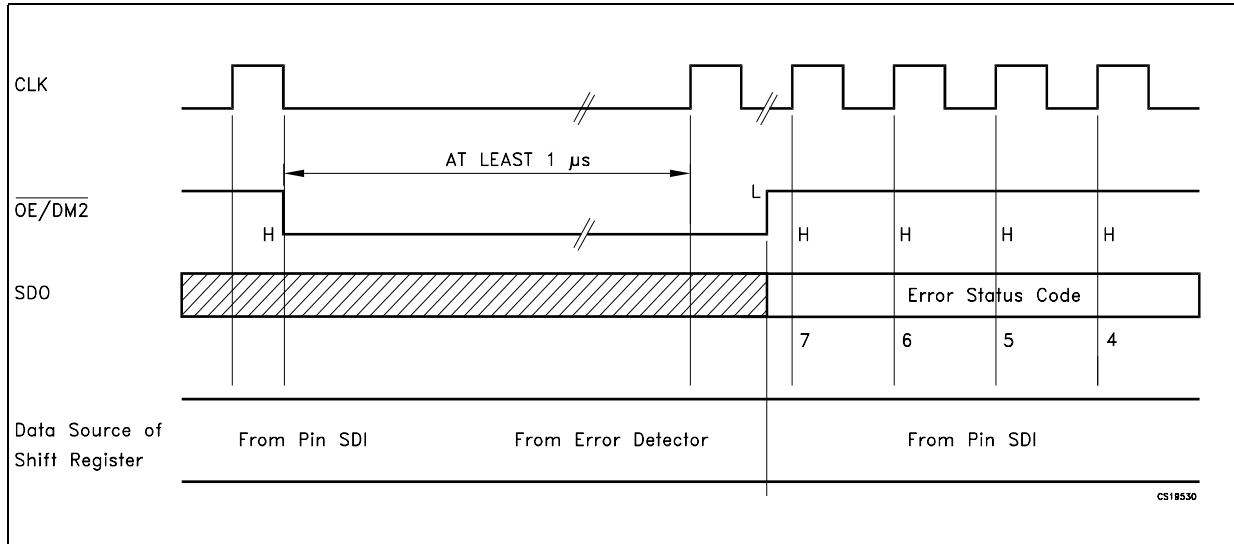


After these five CLK cycles the device goes into the “Error Detection Mode“ and at the 6<sup>th</sup> rise front of CLK the SDI data are ready for the sampling.

## 10.2 Phase two: “error detection“

The eight data bits must be set “1“ in order to set ON all the outputs during the detection. The data are latched by LE/DM1 and after that the outputs are ready for the detection process. When the Micro controller switches the OE/DM2 to LOW, the device drives the LEDs in order to analyze if an OPEN or SHORT condition has occurred.

Figure 17. Detection diagram



The LEDs status will be detected at least in 1 microsecond and after this time the microcontroller sets  $\overline{OE/DM2}$  in HIGH state and the output data detection result will go to the microprocessor via SDO.

Detection mode and normal mode use both the same format data. As soon as all the detection data bits are available on the serial line, the device may go back to normal mode of operation. To re-detect the status the device must go back in normal mode and re-entering in error detection mode .

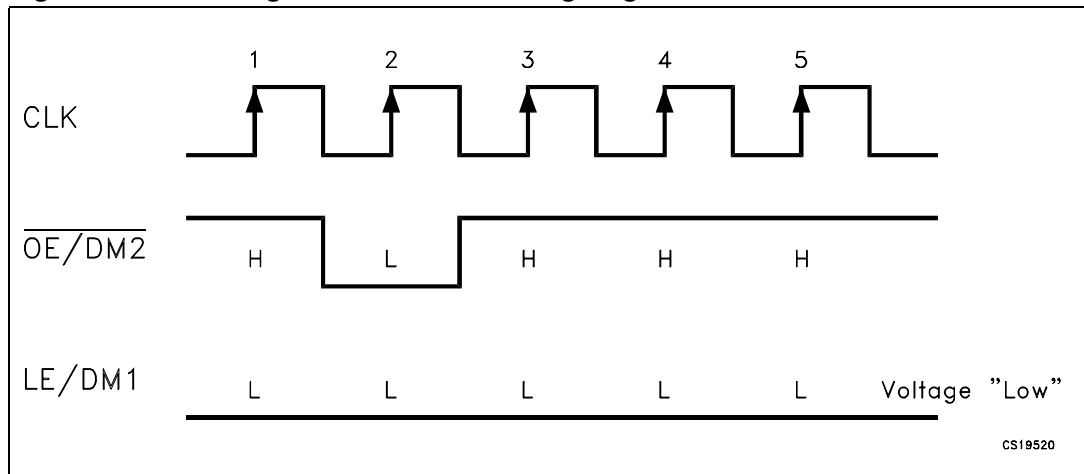
### 10.3 Phase three: “resuming to normal mode”

The sequence for re-entering in normal mode is showed in the following Table and diagram:

**Table 11. Resuming to normal mode timing diagram**

CLK	1°	2°	3°	4°	5°
$\overline{\text{OE/DM2}}$	H	L	H	H	H
$\text{LE/DM1}$	L	L	L	L	L

**Figure 18. Resuming to normal mode timing diagram**



*Note:* For proper device operation the “Entering in detection” sequence must be follow by a “Resume Mode” sequence, isn’t possible to insert consecutive equal sequence.

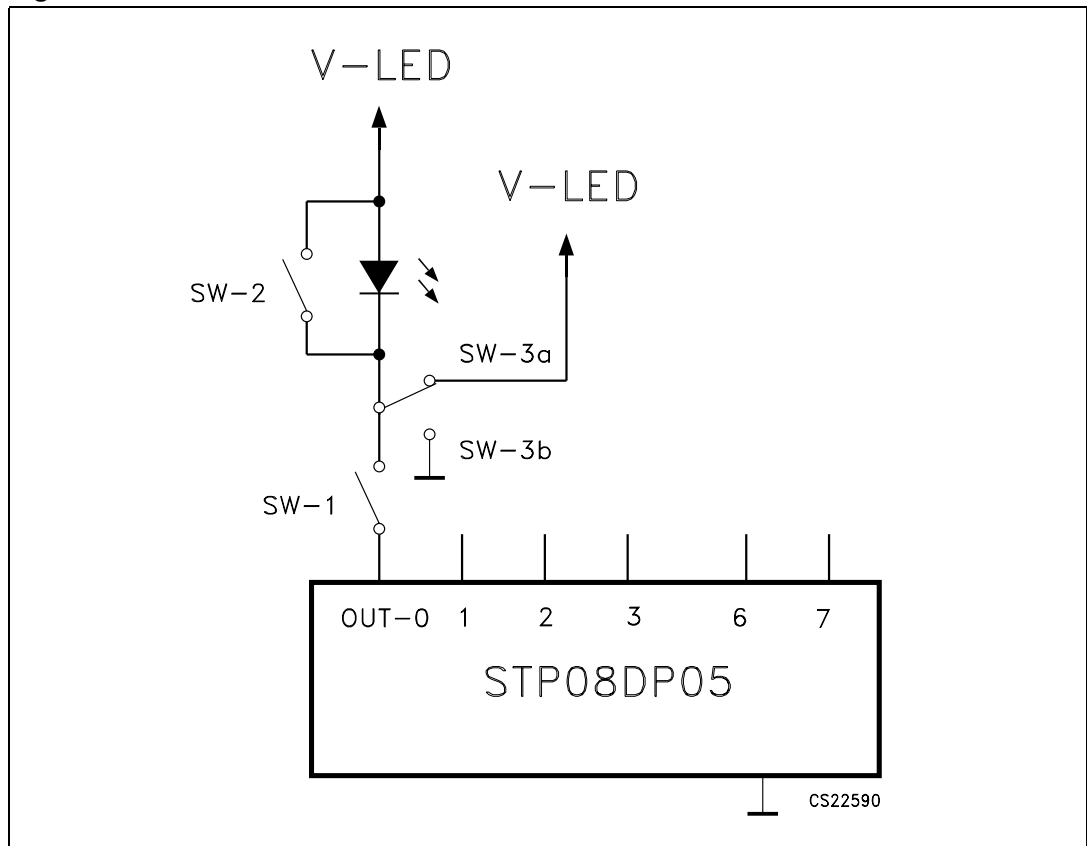
### 10.4 Error detection conditions

**Table 12. Detection condition** ( $V_{DD} = 3.3$  to  $5$  V Temperature range  $25^{\circ}\text{C}$ )

<b>SW-1 or SW-3b</b>	Open Line or Output Short to GND detected	$\implies I_{ODEC} \leq 0.5 \times I_O$	No error detected	$\implies I_{ODEC} \geq 0.5 \times I_O$
<b>SW-2 or SW-3a</b>	Short on LED or Short to V-LED detected	$\implies V_O \geq 2.5\text{V}$	No error detected	$\implies V_O \leq 2.2\text{V}$

*Note:* Where:  $I_O$  = the output current programmed by the  $R_{EXT}$ ,  
 $I_{ODEC}$  = the detected output current in detection mode.

**Figure 19. Detection circuit**

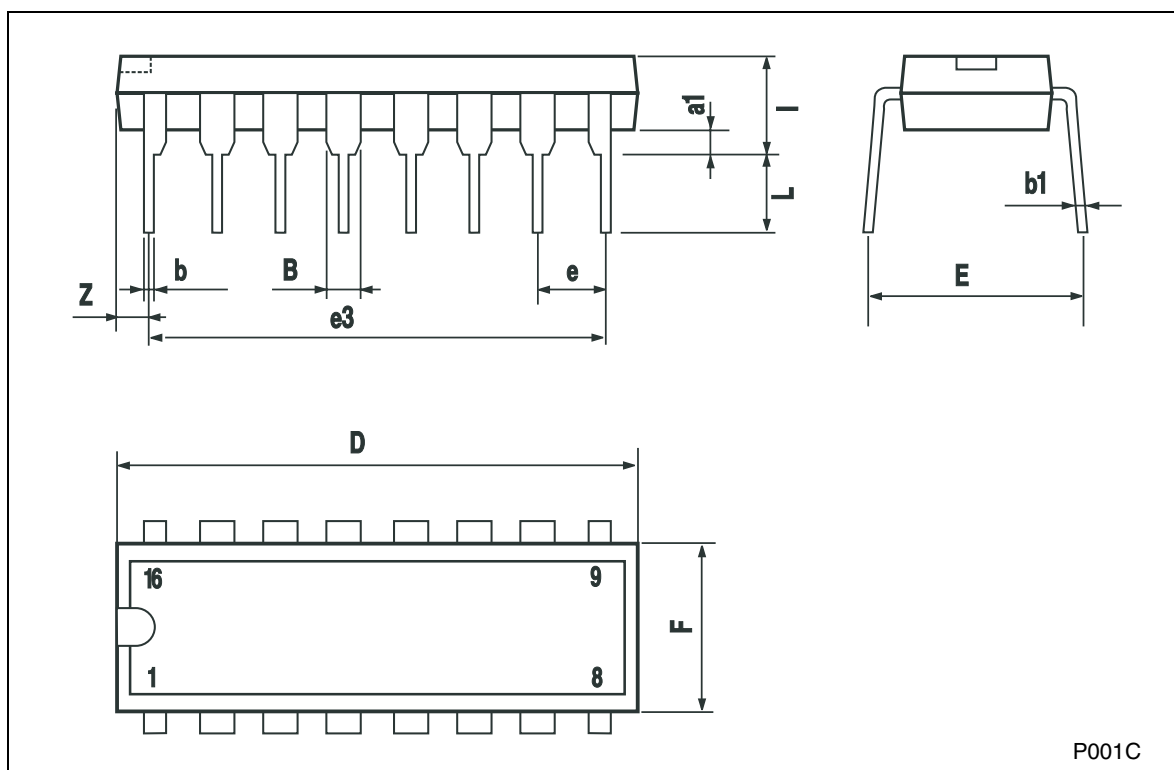


## 11 Package mechanical data

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).

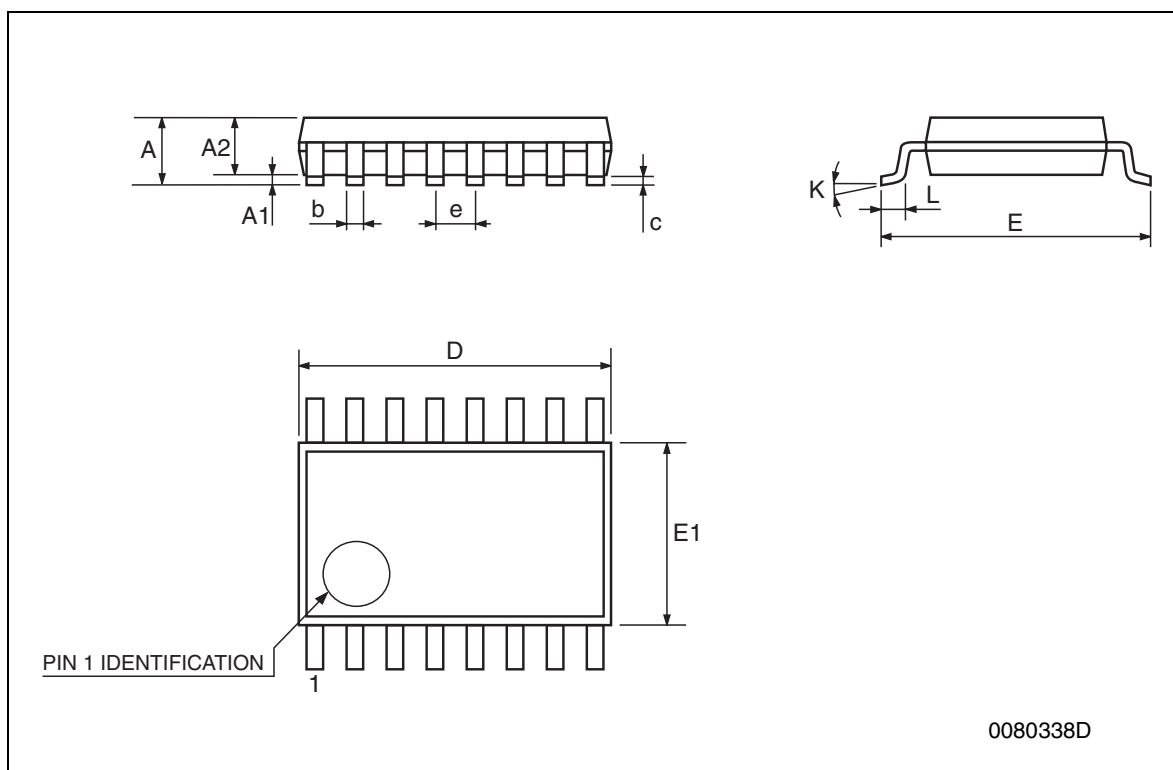
**Plastic DIP-16 (0.25) MECHANICAL DATA**

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



**TSSOP16 MECHANICAL DATA**

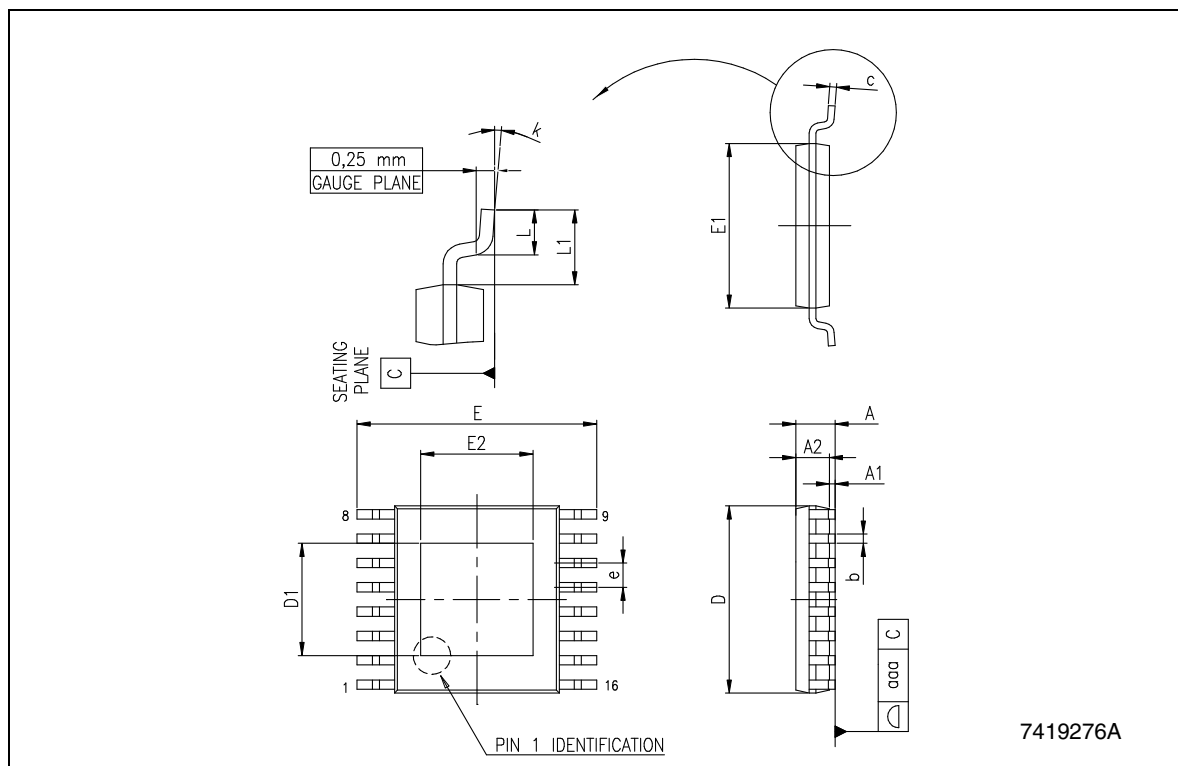
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030





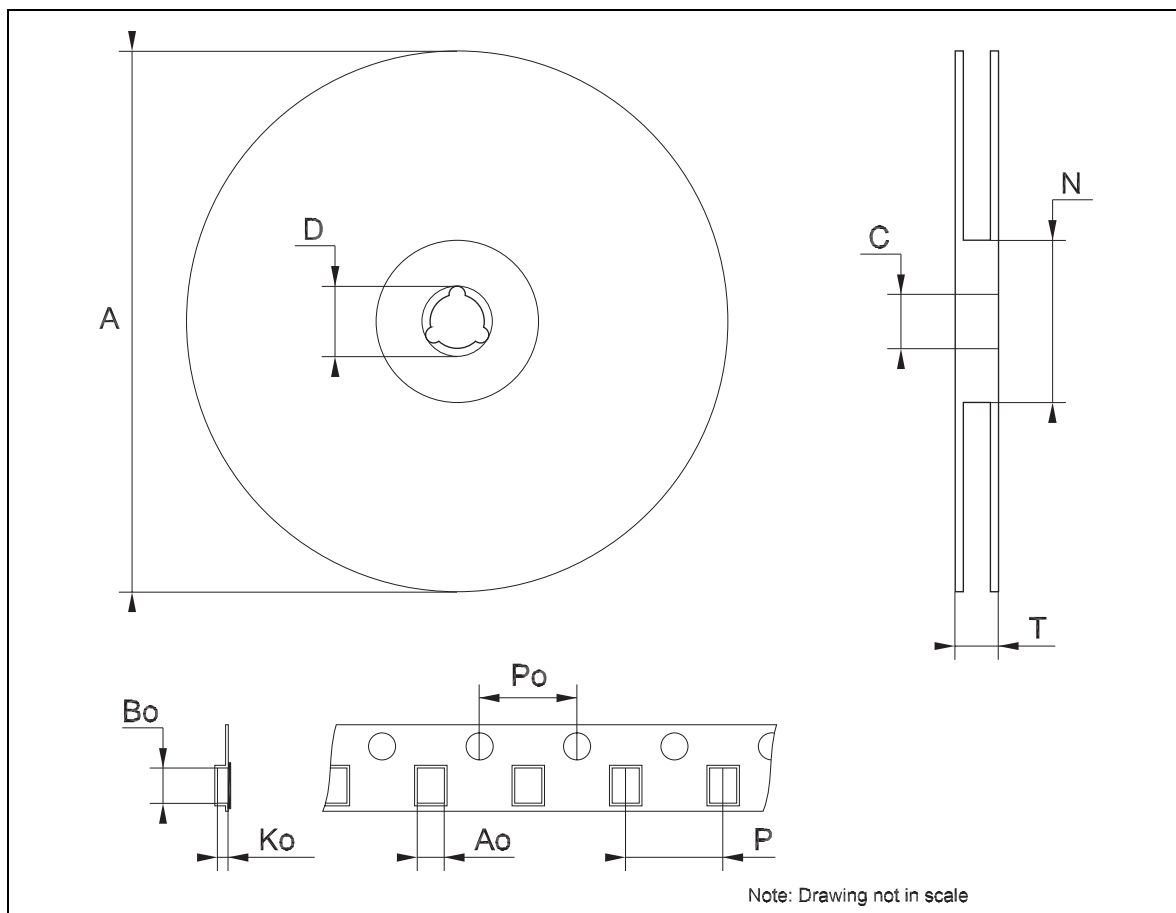
**TSSOP16 EXPOSED PAD MECHANICAL DATA**

DIM.	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	4.9	5	5.1	0.193	0.197	0.201
D1	1.7			0.067		
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



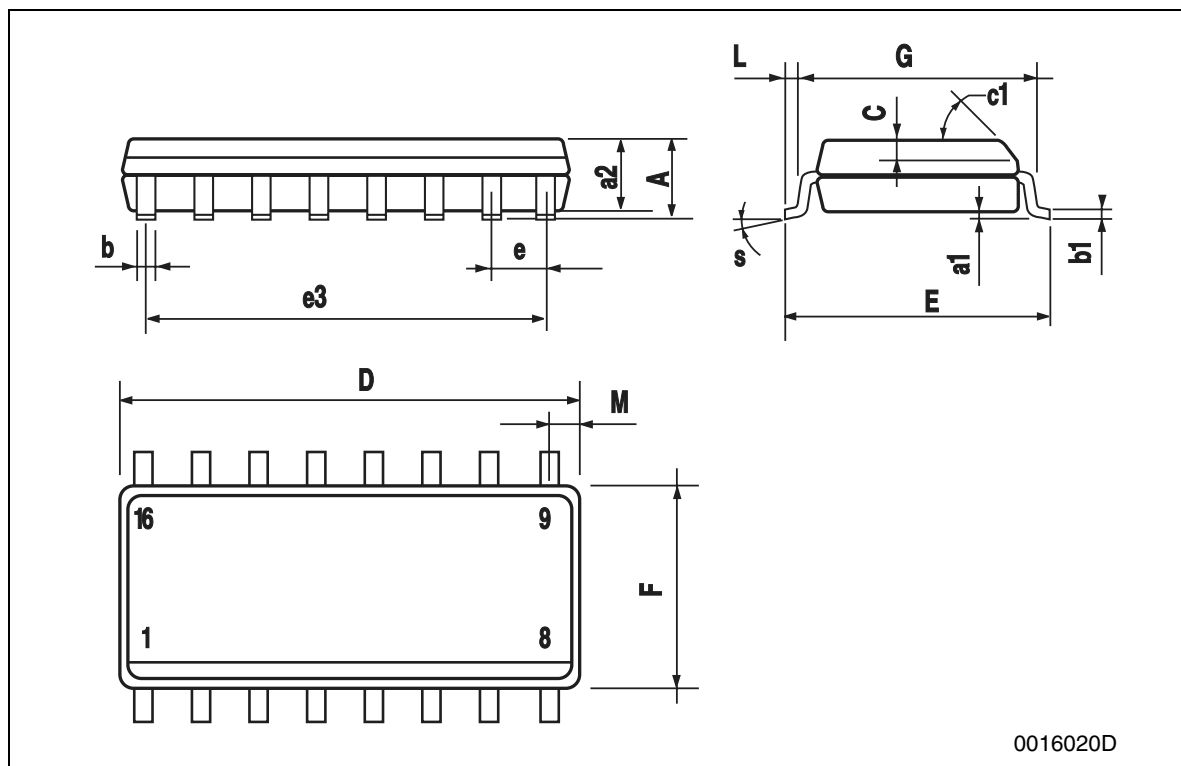
**Tape & Reel TSSOP16 MECHANICAL DATA**

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



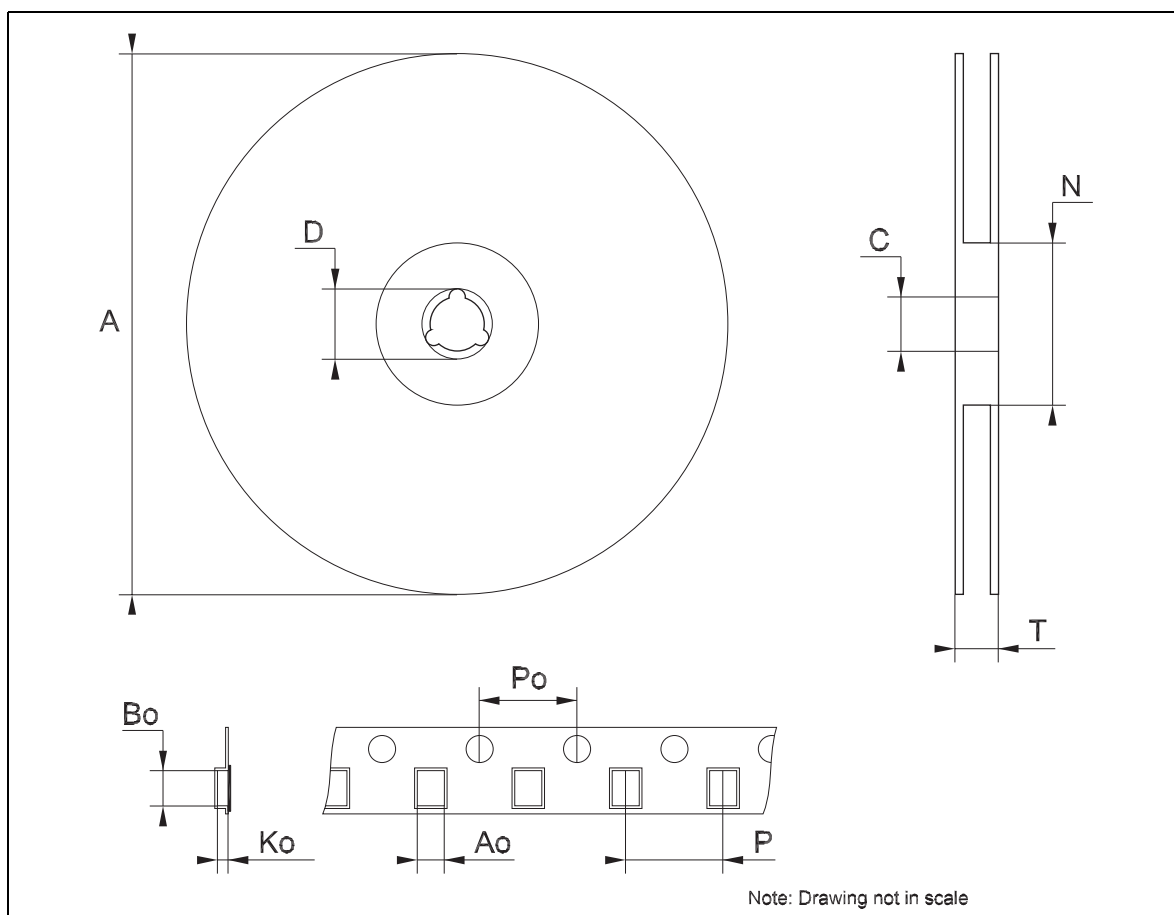
## SO-16 MECHANICAL DATA

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.)					



**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



## 12 Revision history

**Table 13. Revision history**

Date	Revision	Changes
3-Apr-2007	1	First release
21-May-2007	2	Updated <a href="#">Table 7 on page 7</a>

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