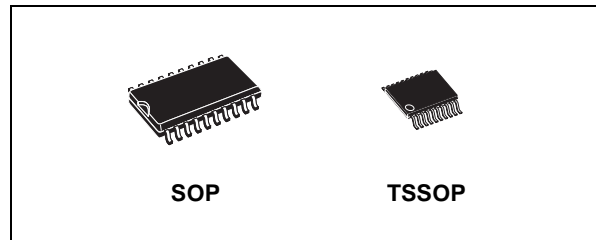




# 74LVC244A

## LOW VOLTAGE CMOS QUAD BUS BUFFERS (3-STATE) HIGH PERFORMANCE

- 5V TOLERANT INPUTS
- HIGH SPEED:  $t_{PD} = 5.9\text{ns}$  (MAX.) at  $V_{CC} = 3\text{V}$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA}$  (MIN) at  $V_{CC} = 3\text{V}$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}(\text{OPR}) = 1.65\text{V}$  to  $3.6\text{V}$  (1.2V Data Retention)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 244
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:  
HBM > 2000V (MIL STD 883 method 3015);  
MM > 200V



### ORDER CODES

PACKAGE	TUBE	T & R
SOP	74LVC244AM	74LVC244AMTR
TSSOP		74LVC244ATTR

It can be interfaced to 5V signal environment for inputs in mixed 3.3/5V system.

G control output governs four BUS BUFFERS.

This device is designed to be used with 3 state memory address drivers, etc.

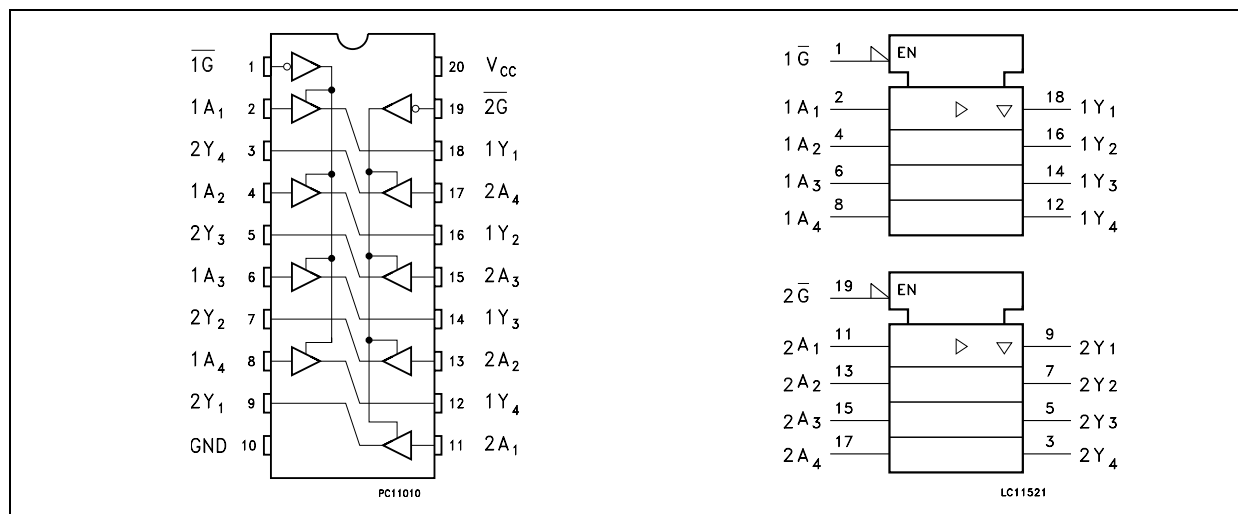
It has more speed performance at 3.3V than 5V AC/ACT family, combined with a lower power consumption.

All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

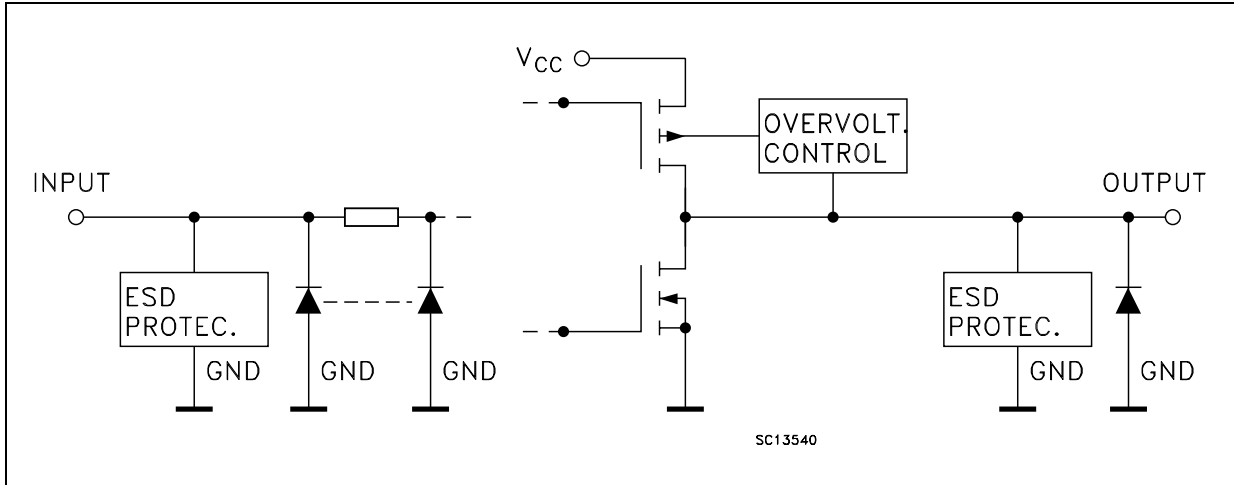
### DESCRIPTION

The 74LVC244A is a low voltage CMOS OCTAL BUS BUFFER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology. It is ideal for 1.65 to 3.6 V<sub>CC</sub> operations and low power and low noise applications.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1	1G	Output Enable Input
2, 4, 6, 8	1A1 to 1A4	Data Inputs
9, 7, 5, 3	2Y1 to 2Y4	Data Outputs
11, 13, 15, 17	2A1 to 2A4	Data Inputs
18, 16, 14, 12	1Y1 to 1Y4	Data Outputs
19	2G	Output Enable Input
10	GND	Ground (0V)
20	V <sub>CC</sub>	Positive Supply Voltage

TRUTH TABLE

INPUTS		OUTPUT
$\overline{G}$	A <sub>n</sub>	Y <sub>n</sub>
L	L	L
L	H	H
H	X	Z

X : Don't care  
Z : High Impedance

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7.0	V
V <sub>I</sub>	DC Input Voltage	-0.5 to +7.0	V
V <sub>O</sub>	DC Output Voltage (High Impedance or V <sub>CC</sub> = 0V)	-0.5 to +7.0	V
V <sub>O</sub>	DC Output Voltage (High or Low State) (note 1)	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	- 50	mA
I <sub>OK</sub>	DC Output Diode Current (note 2)	- 50	mA
I <sub>O</sub>	DC Output Current	± 50	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current per Supply Pin	± 100	mA
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

- 1) I<sub>O</sub> absolute maximum rating must be observed
- 2) V<sub>O</sub> < GND

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage (note 1)	1.65 to 3.6	V
$V_I$	Input Voltage	0 to 5.5	V
$V_O$	Output Voltage (High Impedance or $V_{CC} = 0V$ )	0 to 5.5	V
$V_O$	Output Voltage (High or Low State)	0 to $V_{CC}$	V
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 3.0$ to $3.6V$ )	$\pm 24$	mA
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 2.7$ to $3.0V$ )	$\pm 12$	mA
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 2.3$ to $2.7V$ )	$\pm 8$	mA
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 1.65$ to $2.3V$ )	$\pm 4$	mA
$T_{op}$	Operating Temperature	-55 to 125	$^{\circ}C$
dt/dv	Input Rise and Fall Time (note 2)	0 to 10	ns/V

1) Truth Table guaranteed: 1.2V to 3.6V

2)  $V_{IN}$  from 0.8V to 2V at  $V_{CC} = 3.0V$ 

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value				Unit
		$V_{CC}$ (V)		-40 to 85 $^{\circ}C$		-55 to 125 $^{\circ}C$		
				Min.	Max.	Min.	Max.	
$V_{IH}$	High Level Input Voltage	1.65 to 1.95		$0.65V_{CC}$		$0.65V_{CC}$		V
		2.3 to 2.7		1.7		1.7		
		2.7 to 3.6		2		2		
$V_{IL}$	Low Level Input Voltage	1.65 to 1.95			$0.35V_{CC}$		$0.35V_{CC}$	V
		2.3 to 2.7			0.7		0.7	
		2.7 to 3.6			0.8		0.8	
$V_{OH}$	High Level Output Voltage	1.65 to 3.6	$I_O = -100 \mu A$	$V_{CC} - 0.2$		$V_{CC} - 0.2$		V
		1.65	$I_O = -4 \text{ mA}$	1.2		1.2		
		2.3	$I_O = -8 \text{ mA}$	1.7		1.7		
		2.7	$I_O = -12 \text{ mA}$	2.2		2.2		
		3.0	$I_O = -18 \text{ mA}$	2.4		2.4		
$V_{OL}$	Low Level Output Voltage	1.65 to 3.6	$I_O = 100 \mu A$		0.2		0.2	V
		1.65	$I_O = 4 \text{ mA}$		0.45		0.45	
		2.3	$I_O = 8 \text{ mA}$		0.7		0.7	
		2.7	$I_O = 12 \text{ mA}$		0.4		0.4	
		3.0	$I_O = 24 \text{ mA}$		0.55		0.55	
$I_I$	Input Leakage Current	3.6	$V_I = 0$ to $5.5V$		$\pm 5$		$\pm 5$	$\mu A$
$I_{off}$	Power Off Leakage Current	0	$V_I$ or $V_O = 5.5V$		10		10	$\mu A$
$I_{OZ}$	High Impedance Output Leakage Current	3.6	$V_I = V_{IH}$ or $V_{IL}$ $V_O = 0$ to $5.5V$		$\pm 5$		$\pm 5$	$\mu A$
$I_{CC}$	Quiescent Supply Current	3.6	$V_I = V_{CC}$ or GND		10		10	$\mu A$
			$V_I$ or $V_O = 3.6$ to $5.5V$		$\pm 10$		$\pm 10$	
$\Delta I_{CC}$	$I_{CC}$ incr. per Input	2.7 to 3.6	$V_{IH} = V_{CC} - 0.6V$		500		500	$\mu A$

## DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Condition		Value			Unit
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C			
				Min.	Typ.	Max.	
V <sub>OLP</sub>	Dynamic Low Level Quiet Output (note 1)	3.3	C <sub>L</sub> = 50pF V <sub>IL</sub> = 0V, V <sub>IH</sub> = 3.3V		0.8		V
V <sub>OLV</sub>					-0.8		

1) Number of output defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the LOW state.

## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition				Value				Unit
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	R <sub>L</sub> (Ω)	t <sub>s</sub> = t <sub>r</sub> (ns)	-40 to 85 °C		-55 to 125 °C		
						Min.	Max.	Min.	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time	1.65 to 1.95	30	1000	2.0		9.0		12	ns
		2.3 to 2.7	30	500	2.0		7.9		10.5	
		2.7	50	500	2.5	1.5	6.9		8.3	
		3.0 to 3.6	50	500	2.5	1	5.9		7.1	
t <sub>PZL</sub> t <sub>PZH</sub>	Output Enable Time	1.65 to 1.95	30	1000	2.0		11		14.3	ns
		2.3 to 2.7	30	500	2.0		9.6		12.5	
		2.7	50	500	2.5	1	8.6		10.3	
		3.0 to 3.6	50	500	2.5	1	7.6		9.1	
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output Disable Time	1.65 to 1.95	30	1000	2.0		9.0		11.7	ns
		2.3 to 2.7	30	500	2.0		7.8		10.1	
		2.7	50	500	2.5	2	6.8		8.2	
		3.0 to 3.6	50	500	2.5	2	6.5		7.8	
t <sub>OSLH</sub> t <sub>OSHL</sub>	Output To Output Skew Time (note1, 2)	2.7 to 3.6					1		1	ns

1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW (t<sub>OSLH</sub> = |t<sub>PLHm</sub> - t<sub>PLHn</sub>|, t<sub>OSHL</sub> = |t<sub>PHLm</sub> - t<sub>PHLn</sub>|)

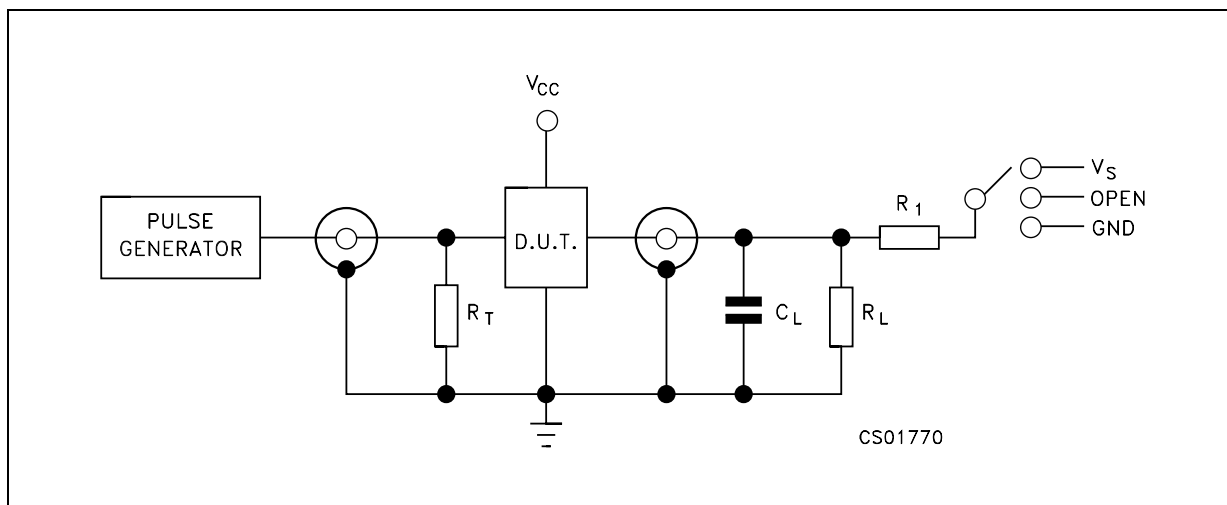
2) Parameter guaranteed by design

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value			Unit
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C			
				Min.	Typ.	Max.	
C <sub>IN</sub>	Input Capacitance				4		pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	1.8	f <sub>IN</sub> = 10MHz		28		pF
		2.5			30		
		3.3			34		

1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. I<sub>CC(opr)</sub> = C<sub>PD</sub> × V<sub>CC</sub> × f<sub>IN</sub> + I<sub>CC</sub>/n (per circuit)

## TEST CIRCUIT

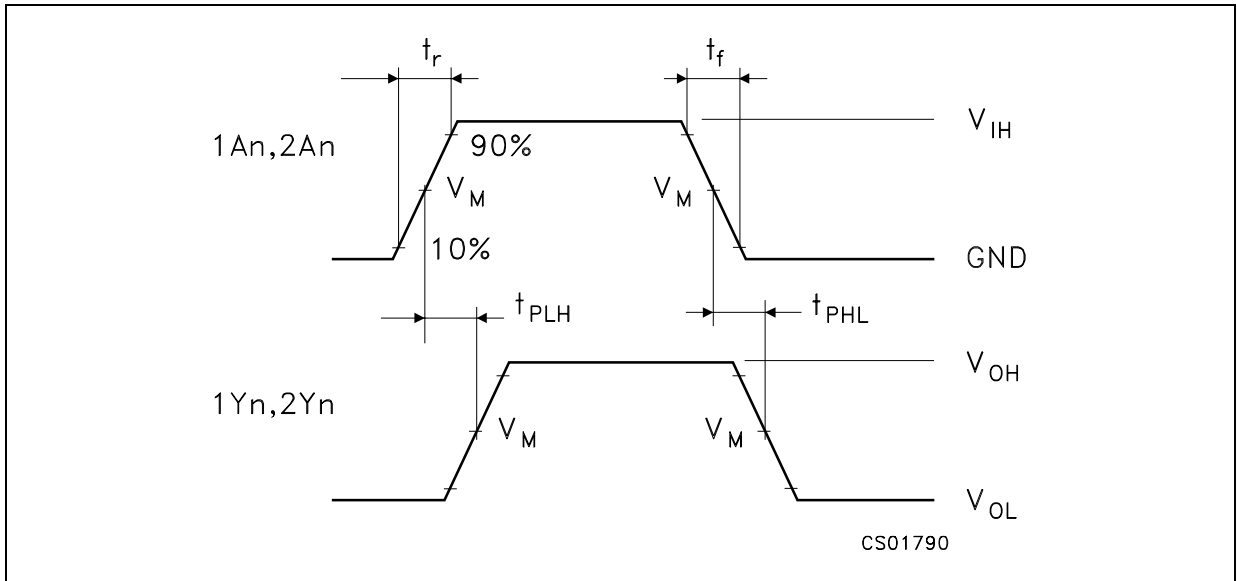


$R_T = Z_{OUT}$  of pulse generator (typically 50 $\Omega$ )

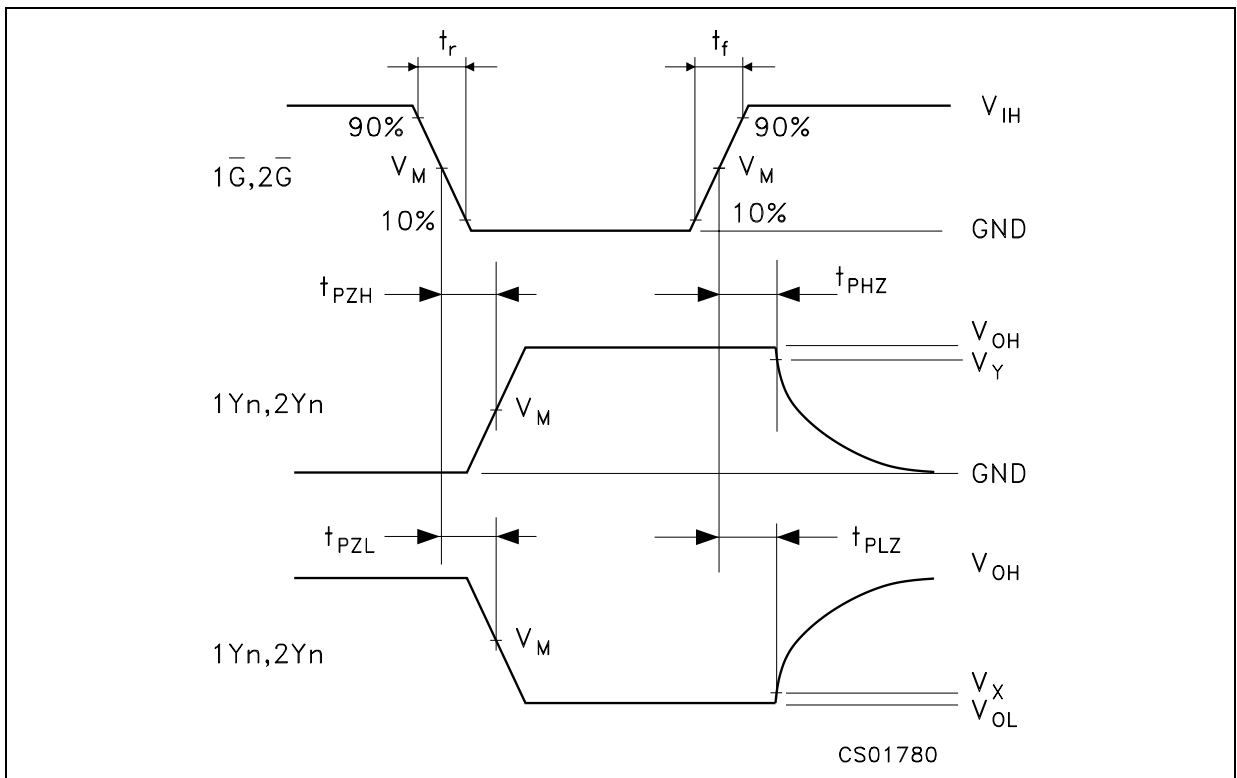
## TEST CIRCUIT AND WAVEFORM SYMBOL VALUE

Symbol	$V_{CC}$			
	1.65 to 1.95V	2.3 to 2.7V	2.7V	3.0 to 3.6V
$C_L$	30pF	30pF	50pF	50pF
$R_L = R_1$	1000 $\Omega$	500 $\Omega$	500 $\Omega$	500 $\Omega$
$V_S$	$2 \times V_{CC}$	$2 \times V_{CC}$	6V	6V
$V_{IH}$	$V_{CC}$	$V_{CC}$	2.7V	2.7V
$V_M$	$V_{CC}/2$	$V_{CC}/2$	1.5V	1.5V
$V_{OH}$	$V_{CC}$	$V_{CC}$	3.0V	3.0V
$V_X$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$
$V_Y$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$
$t_r = t_f$	<2.0ns	<2.0ns	<2.5ns	<2.5ns

WAVEFORM 1: PROPAGATION DELAYS (f=1MHz; 50% duty cycle)

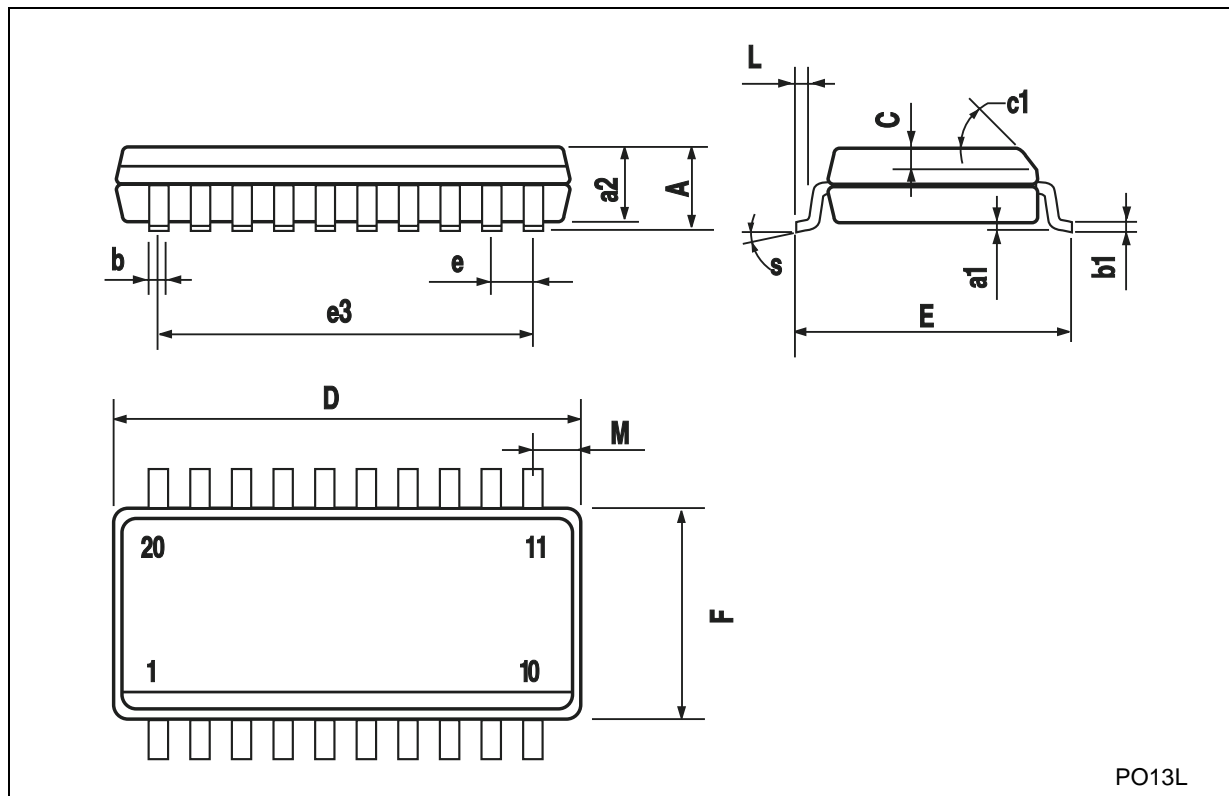


WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)



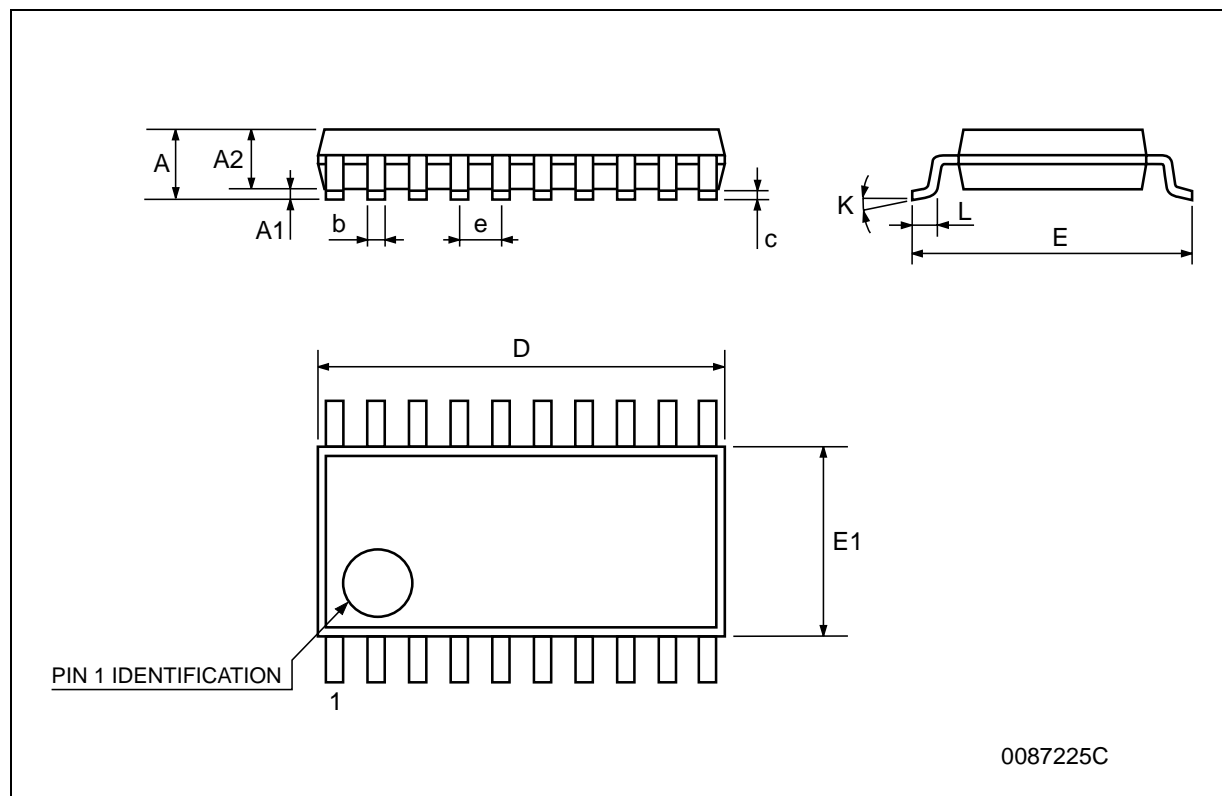
## SO-20 MECHANICAL DATA

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	12.60		13.00	0.496		0.512
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		11.43			0.450	
F	7.40		7.60	0.291		0.300
L	0.50		1.27	0.020		0.050
M			0.75			0.029
S	8° (max.)					



## TSSOP20 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		0.0089
D	6.4	6.5	6.6	0.252	0.256	0.260
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





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