

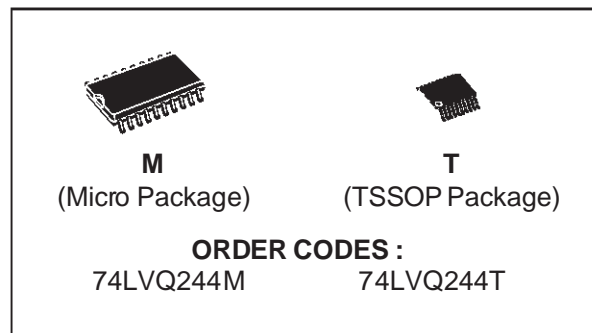
# 74LVQ244

## LOW VOLTAGE OCTAL BUS BUFFER WITH 3 STATE OUTPUTS (NON-INVERTED)

- HIGH SPEED:  
 $t_{PD} = 6 \text{ ns}$  (TYP.) at  $V_{CC} = 3.3\text{V}$
- COMPATIBLE WITH TTL OUTPUT
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- LOW NOISE:  
 $V_{OLP} = 0.4\text{V}$  (TYP.) at  $V_{CC} = 3.3\text{V}$
- $75\Omega$  TRANSMISSION LINE OUTPUT DRIVE CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 12 \text{ mA}$  (MIN)
- PCI BUS LEVELS GUARANTEED AT 24mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 2V to 3.6V (1.2V Data Retention)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 244
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The LVQ244 is a low voltage CMOS OCTAL BUS BUFFER fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS



technology. It is ideal for low power and low noise 3.3V applications.

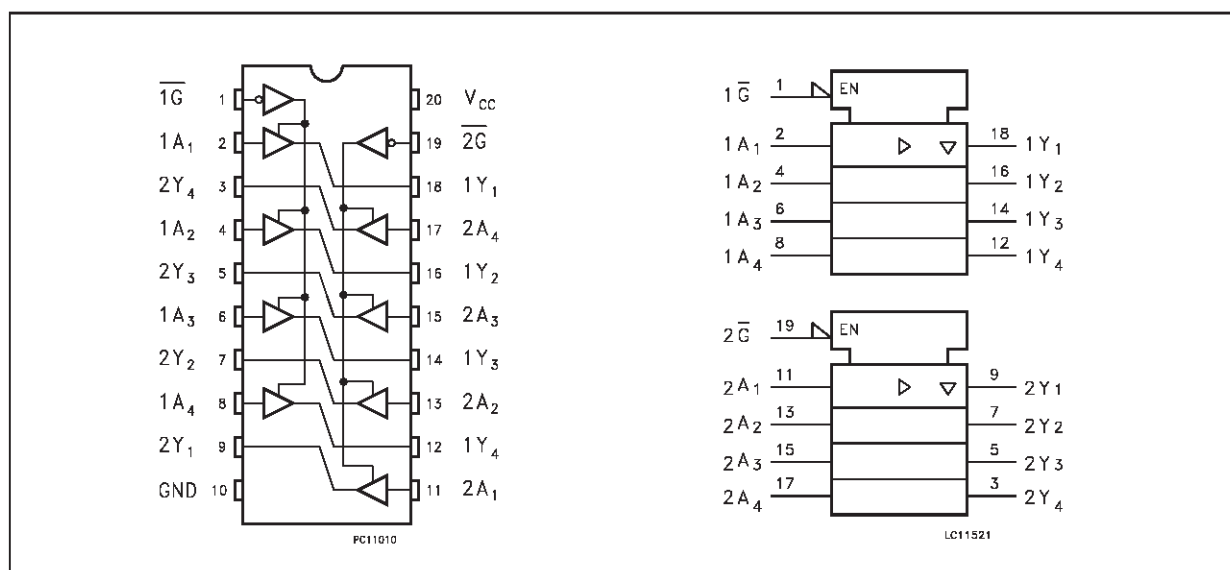
It has better speed performance at 3.3V than 5V LSTTL family combined with the true CMOS low power consumption.

$\overline{G}$  output control governs four BUS BUFFERs.

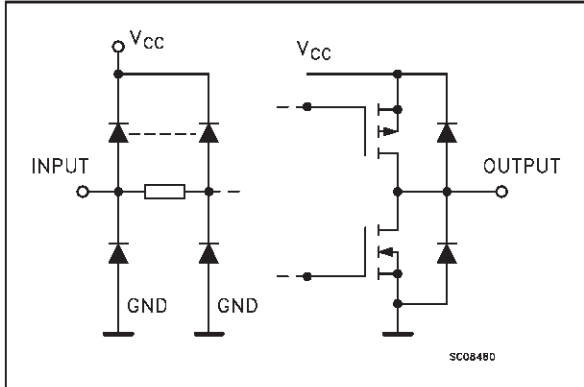
This device is designed to be used with 3 state memory address drivers, etc.

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

### PIN CONNECTION AND IEC LOGIC SYMBOLS



**INPUT AND OUTPUT EQUIVALENT CIRCUIT**



**PIN DESCRIPTION**

PIN No	SYMBOL	NAME AND FUNCTION
1	$\overline{1G}$	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	$\overline{2G}$	Output Enable Input
10	GND	Ground (0V)
20	V <sub>CC</sub>	Positive Supply Voltage

**TRUTH TABLE**

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

X: "H" or "L"  
Z: High impedance

**ABSOLUTE MAXIMUM RATING**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
V <sub>O</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	±20	mA
I <sub>OK</sub>	DC Output Diode Current	±20	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	±400	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 condition is not implied.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage (note 1)	2 to 3.6	V
V <sub>I</sub>	Input Voltage	0 to V <sub>CC</sub>	V
V <sub>O</sub>	Output Voltage	0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature:	-40 to +85	°C
dt/dv	Input Rise and Fall Time (V <sub>CC</sub> = 3V) (note 2)	0 to 10	ns/V

1) Truth Table guaranteed: 1.2V to 3.6V  
2) V<sub>IN</sub> from 0.8V to 2V

## DC SPECIFICATIONS

Symbol	Parameter	Test Conditions		Value					Unit	
				V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.		Max.
V <sub>IH</sub>	High Level Input Voltage	3.0 to 3.6		2.0			2.0		V	
V <sub>IL</sub>	Low Level Input Voltage					0.8		0.8		V
V <sub>OH</sub>	High Level Output Voltage	3.0	V <sub>I</sub> <sup>(*)</sup> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> = -50 μA	2.9	2.99		2.9		V
				I <sub>O</sub> = -12 mA	2.58			2.48		
				I <sub>O</sub> = -24 mA				2.2		
V <sub>OL</sub>	Low Level Output Voltage	3.0	V <sub>I</sub> <sup>(*)</sup> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> = 50 μA		0.002	0.1		0.1	V
				I <sub>O</sub> = 12 mA		0	0.36		0.44	
				I <sub>O</sub> = 24 mA					0.55	
I <sub>I</sub>	Input Leakage Current	3.6	V <sub>I</sub> = V <sub>CC</sub> or GND				±0.1		±1	μA
I <sub>OZ</sub>	3 State Output Leakage Current	3.6	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>O</sub> = V <sub>CC</sub> or GND				±0.5		±5	μA
I <sub>CC</sub>	Quiescent Supply Current	3.6	V <sub>I</sub> = V <sub>CC</sub> or GND				4		40	μA
I <sub>OLD</sub>	Dynamic Output Current (note 1, 2)	3.6	V <sub>OLD</sub> = 0.8 V max						36	mA
I <sub>OHD</sub>			V <sub>OHD</sub> = 2 V min						-25	

1) Maximum test duration 2ms, one output loaded at time

2) Incident wave switching is guaranteed on transmission lines with impedances as low as 50 Ω.

(\*) All outputs loaded.

## DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Conditions		Value					Unit	
				V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.		Max.
V <sub>OLP</sub>	Dynamic Low Voltage Quiet Output (note 1, 2)	3.3	C <sub>L</sub> = 50 pF		0.4	0.8			V	
V <sub>OLV</sub>				-0.8	-0.5					
V <sub>IHD</sub>	Dynamic High Voltage Input (note 1, 3)	3.3				2				
V <sub>ILD</sub>	Dynamic Low Voltage Input (note 1, 3)	3.3		0.8						

1) Worst case package

2) Max number of outputs defined as (n). Data inputs are driven 0V to 3.3V, (n-1) outputs switching and one output at GND

3) max number of data inputs (n) switching. (n-1) switching 0V to 3.3V. Inputs under test switching: 3.3V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>). f = 1MHz

**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50 \text{ pF}$ ,  $R_L = 500 \text{ } \Omega$ , Input  $t_r = t_f = 3 \text{ ns}$ )

Symbol	Parameter	Test Condition		Value					Unit	
				V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.		Max.
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time	2.7 3.3 <sup>(*)</sup>			7 6	13 9		14 9.5	ns	
t <sub>PZL</sub> t <sub>PZH</sub>	Output Enable Time	2.7 3.3 <sup>(*)</sup>			8.5 7	17 12		18 12.5		ns
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output Disable Time	2.7 3.3 <sup>(*)</sup>			9 7.5	19 13.5		20 14	ns	
t <sub>OSLH</sub> t <sub>OSHL</sub>	Output to Output Skew Time (note 1, 2)	2.7 3.3 <sup>(*)</sup>			0.5 0.5	1.5 1.5		1.5 1.5		ns

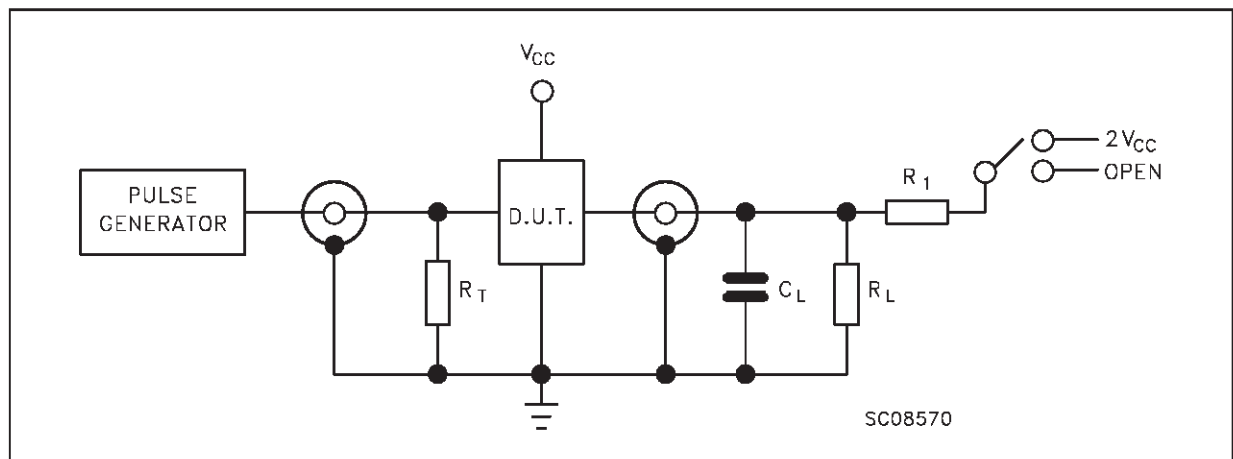
1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ( $t_{OSLH} = |t_{PLHm} - t_{PLHr}|$ ,  $t_{OSHL} = |t_{PHLm} - t_{PHLr}|$ )  
 2) Parameter guaranteed by design  
 (\*) Voltage range is  $3.3V \pm 0.3V$

**CAPACITIVE CHARACTERISTICS**

Symbol	Parameter	Test Conditions		Value					Unit	
				V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.		Max.
C <sub>IN</sub>	Input Capacitance	3.3			5				pF	
C <sub>OUT</sub>	Output Capacitance	3.3			10				pF	
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	3.3	f <sub>IN</sub> = 10 MHz		15				pF	

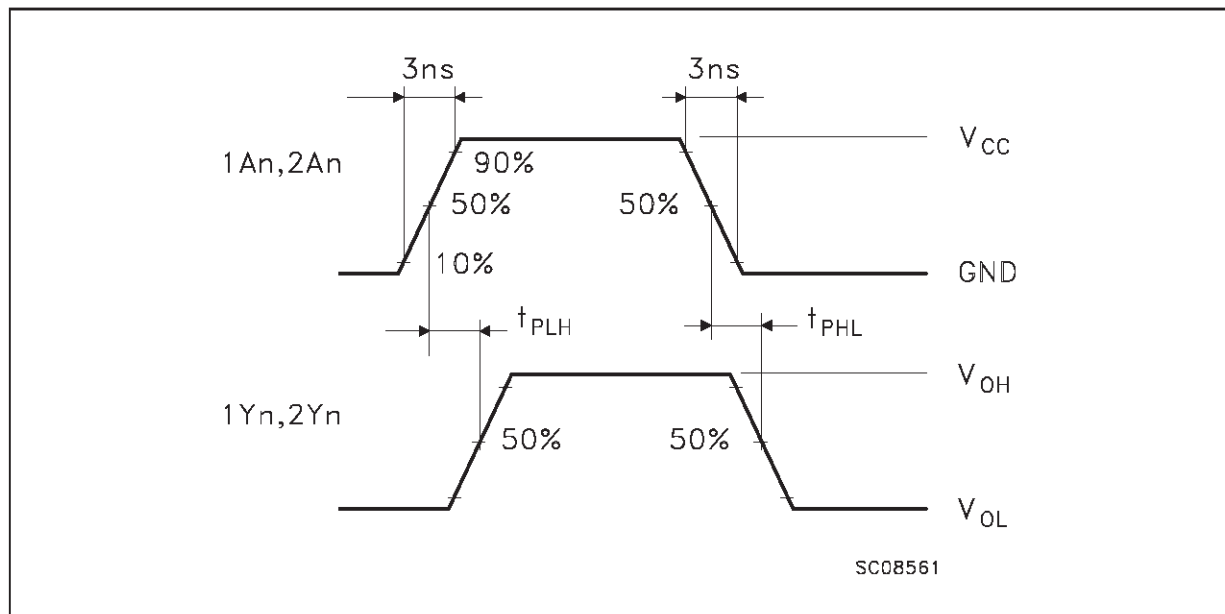
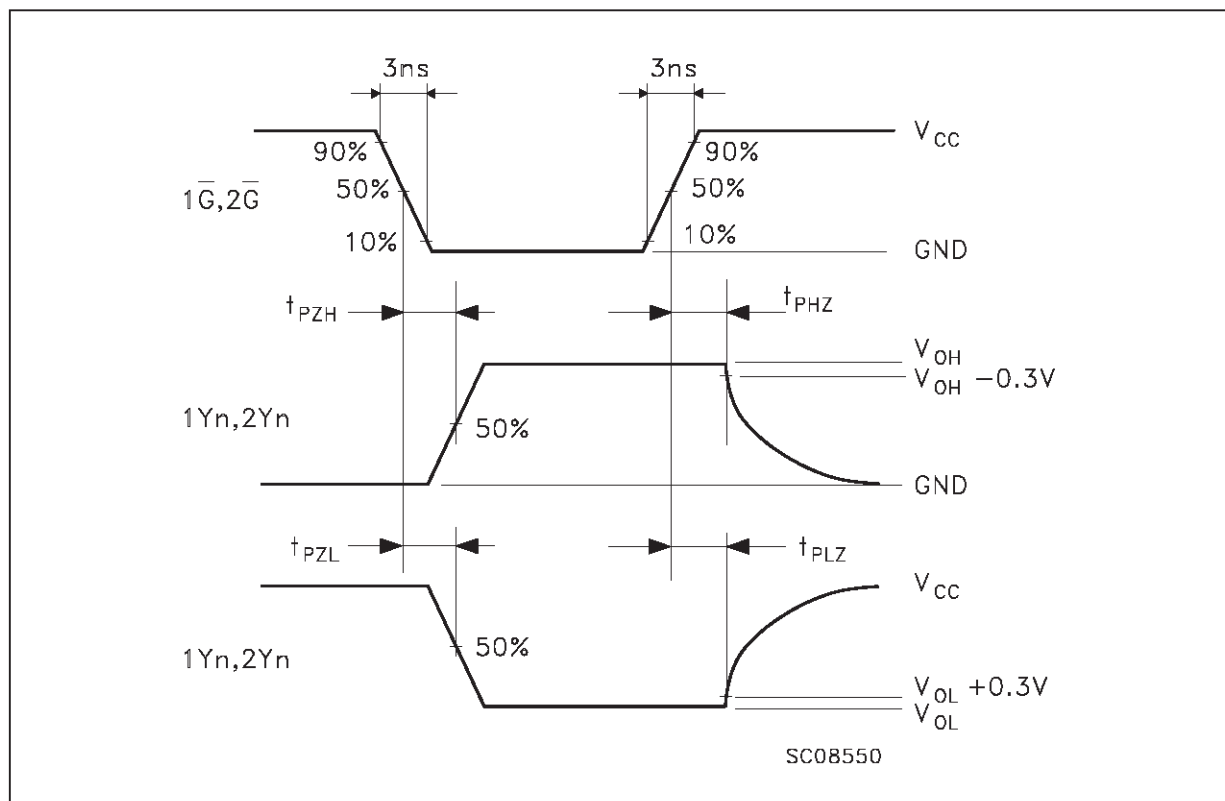
1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{cc}/8$  (per circuit)

**TEST CIRCUIT**



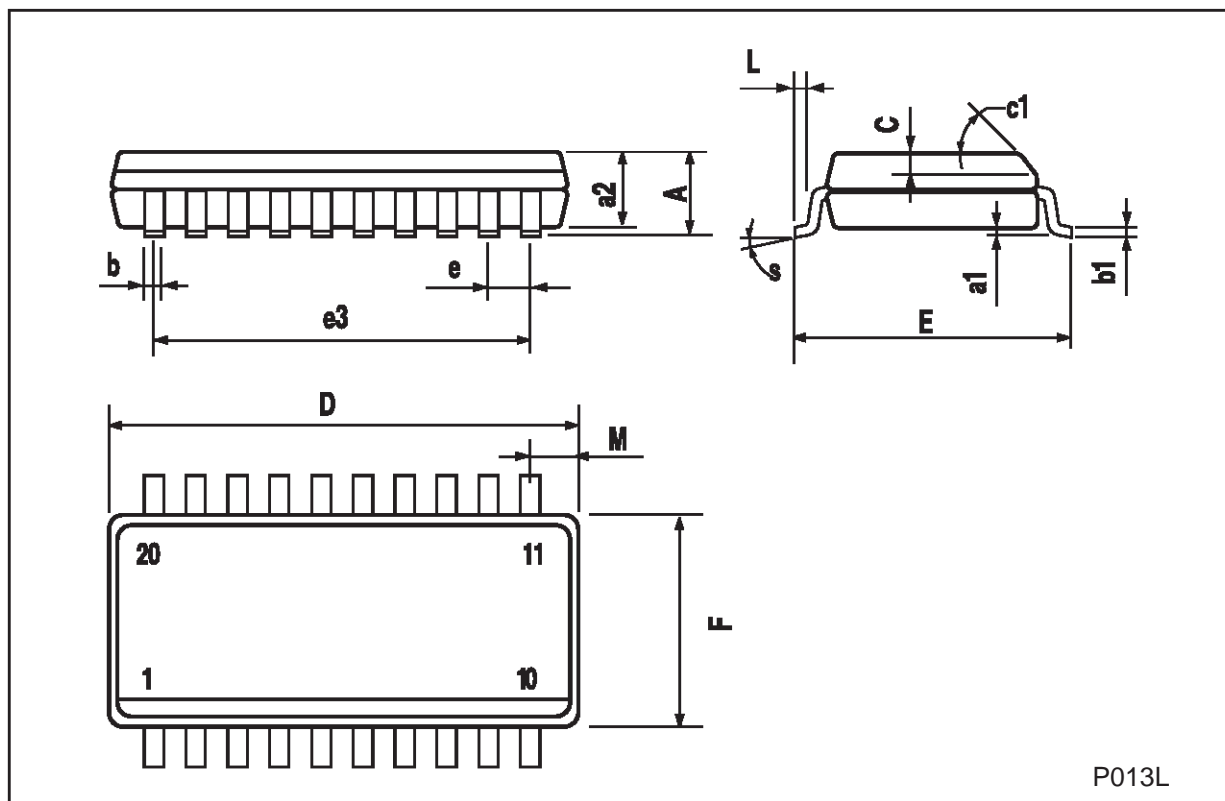
TEST	SWITCH
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
t <sub>PZL</sub> , t <sub>PLZ</sub>	2V <sub>CC</sub>
t <sub>PZH</sub> , t <sub>PHZ</sub>	OPEN

C<sub>L</sub> = 50 pF or equivalent (includes jig and probe capacitance)  
 R<sub>L</sub> = R<sub>1</sub> = 500Ω or equivalent  
 R<sub>T</sub> = Z<sub>out</sub> of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS** ( $f=1\text{MHz}$ ; 50% duty cycle)**WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)

## SO-20 MECHANICAL DATA

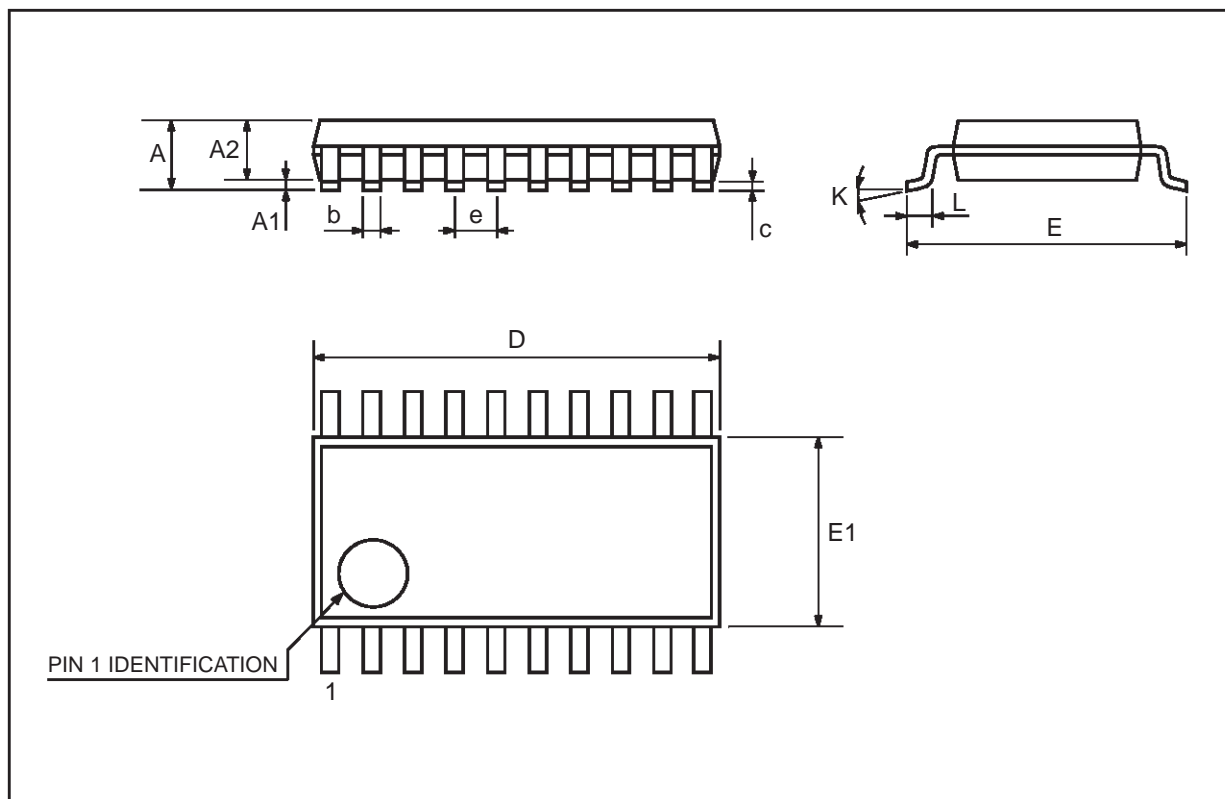
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.10		0.20	0.004		0.007
a2			2.45			0.096
b	0.35		0.49	0.013		0.019
b1	0.23		0.32	0.009		0.012
C		0.50			0.020	
c1	45 (typ.)					
D	12.60		13.00	0.496		0.512
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		11.43			0.450	
F	7.40		7.60	0.291		0.299
L	0.50		1.27	0.19		0.050
M			0.75			0.029
S	8 (max.)					



P013L

## TSSOP20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.1			0.433
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.85	0.9	0.95	0.335	0.354	0.374
b	0.19		0.30	0.0075		0.0118
c	0.09		0.2	0.0035		0.0079
D	6.4	6.5	6.6	0.252	0.256	0.260
E	6.25	6.4	6.5	0.246	0.252	0.256
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°	4°	8°	0°	4°	8°
L	0.50	0.60	0.70	0.020	0.024	0.028



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