



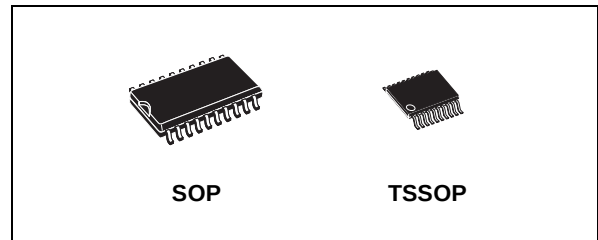
# 74LVX244

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

- HIGH SPEED:  
 $t_{PD}=4.5ns$  (TYP.) at  $V_{CC} = 3.3V$
- 5V TOLERANT INPUTS
- POWER-DOWN PROTECTION ON INPUTS
- INPUT VOLTAGE LEVEL:  
 $V_{IL} = 0.8V$ ,  $V_{IH} = 2V$  at  $V_{CC} = 3V$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu A$  (MAX.) at  $T_A=25^{\circ}C$
- LOW NOISE:  
 $V_{OLP} = 0.5V$  (TYP.) at  $V_{CC} = 3.3V$
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 4 mA$  (MIN) at  $V_{CC} = 3V$
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- 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 74LVX244 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 low power, battery operated and low noise 3.3V applications.

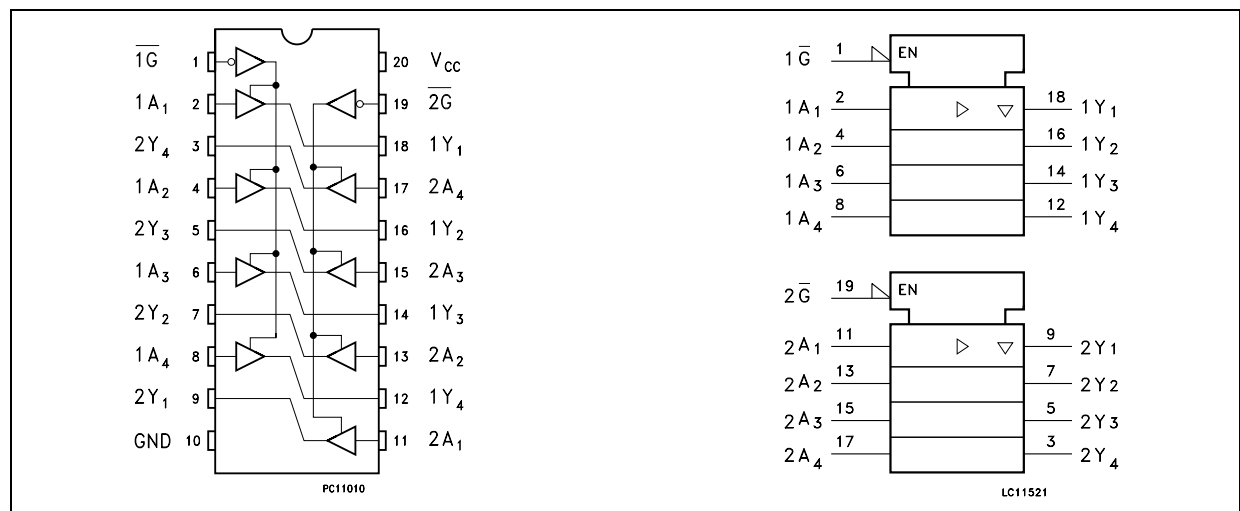


### ORDER CODES

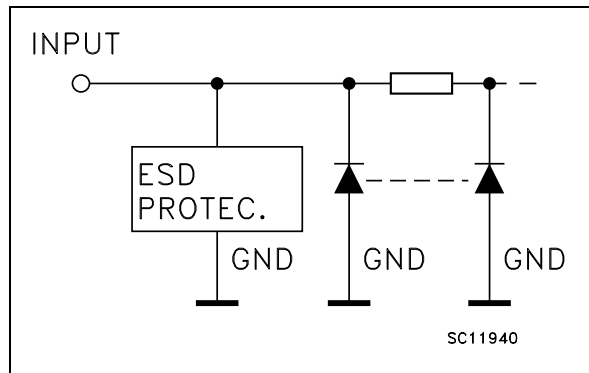
| PACKAGE | TUBE      | T & R       |
|---------|-----------|-------------|
| SOP     | 74LVX244M | 74LVX244MTR |
| TSSOP   |           | 74LVX244TTR |

$\overline{G}$  output enable governs four BUS BUFFERS  
 Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage.  
 This device can be used to interface 5V to 3V. It combines high speed performance with the true CMOS low power consumption.  
 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 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 | $\overline{1Y1}$ to $\overline{1Y4}$ | Data Outputs            |
| 19             | $\overline{2G}$                      | 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                    | -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                    | ± 25                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current | ± 50                          | 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

## 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 5.5             | V    |
| V <sub>O</sub>  | Output Voltage                                           | 0 to V <sub>CC</sub> | V    |
| T <sub>op</sub> | Operating Temperature                                    | -55 to 125           | °C   |
| dt/dv           | Input Rise and Fall Time (note 2) (V <sub>CC</sub> = 3V) | 0 to 100             | ns/V |

1) Truth Table guaranteed: 1.2V to 3.6V

2) V<sub>IN</sub> from 0.8V to 2.0V

## DC SPECIFICATIONS

| Symbol          | Parameter                             | Test Condition         |                                                                                                | Value                 |      |       |             |       |              | Unit  |      |
|-----------------|---------------------------------------|------------------------|------------------------------------------------------------------------------------------------|-----------------------|------|-------|-------------|-------|--------------|-------|------|
|                 |                                       | V <sub>CC</sub><br>(V) |                                                                                                | T <sub>A</sub> = 25°C |      |       | -40 to 85°C |       | -55 to 125°C |       |      |
|                 |                                       |                        |                                                                                                | Min.                  | Typ. | Max.  | Min.        | Max.  | Min.         |       | Max. |
| V <sub>IH</sub> | High Level Input Voltage              | 2.0                    |                                                                                                | 1.5                   |      |       | 1.5         |       | 1.5          |       | V    |
|                 |                                       | 3.0                    |                                                                                                | 2.0                   |      |       | 2.0         |       | 2.0          |       |      |
|                 |                                       | 3.6                    |                                                                                                | 2.4                   |      |       | 2.4         |       | 2.4          |       |      |
| V <sub>IL</sub> | Low Level Input Voltage               | 2.0                    |                                                                                                |                       |      | 0.5   |             | 0.5   |              | 0.5   | V    |
|                 |                                       | 3.0                    |                                                                                                |                       |      | 0.8   |             | 0.8   |              | 0.8   |      |
|                 |                                       | 3.6                    |                                                                                                |                       |      | 0.8   |             | 0.8   |              | 0.8   |      |
| V <sub>OH</sub> | High Level Output Voltage             | 2.0                    | I <sub>O</sub> =-50 μA                                                                         | 1.9                   | 2.0  |       | 1.9         |       | 1.9          |       | V    |
|                 |                                       | 3.0                    | I <sub>O</sub> =-50 μA                                                                         | 2.9                   | 3.0  |       | 2.9         |       | 2.9          |       |      |
|                 |                                       | 3.0                    | I <sub>O</sub> =-4 mA                                                                          | 2.58                  |      |       | 2.48        |       | 2.4          |       |      |
| V <sub>OL</sub> | Low Level Output Voltage              | 2.0                    | I <sub>O</sub> =50 μA                                                                          |                       | 0.0  | 0.1   |             | 0.1   |              | 0.1   | V    |
|                 |                                       | 3.0                    | I <sub>O</sub> =50 μA                                                                          |                       | 0.0  | 0.1   |             | 0.1   |              | 0.1   |      |
|                 |                                       | 3.0                    | I <sub>O</sub> =4 mA                                                                           |                       |      | 0.36  |             | 0.44  |              | 0.55  |      |
| I <sub>OZ</sub> | High Impedance Output Leakage Current | 3.6                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = V <sub>CC</sub> or GND |                       |      | ±0.25 |             | ± 2.5 |              | ± 2.5 | μA   |
| I <sub>I</sub>  | Input Leakage Current                 | 3.6                    | V <sub>I</sub> = 5.5V or GND                                                                   |                       |      | ± 0.1 |             | ± 1   |              | ± 1   | μA   |
| I <sub>CC</sub> | Quiescent Supply Current              | 3.6                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        |                       |      | 4     |             | 40    |              | 40    | μA   |

## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Parameter                                    | Test Condition         |                        | Value                 |      |      |             |      |              | Unit |      |
|------------------|----------------------------------------------|------------------------|------------------------|-----------------------|------|------|-------------|------|--------------|------|------|
|                  |                                              | V <sub>CC</sub><br>(V) |                        | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                  |                                              |                        |                        | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| V <sub>OLP</sub> | Dynamic Low Voltage Quiet Output (note 1, 2) | 3.3                    | C <sub>L</sub> = 50 pF |                       | 0.5  | 0.8  |             |      |              |      | V    |
| V <sub>OLV</sub> |                                              |                        |                        | -0.8                  | -0.5 |      |             |      |              |      |      |
| V <sub>IHD</sub> | Dynamic High Voltage Input (note 1, 3)       | 3.3                    |                        | 2.0                   |      |      |             |      |              |      |      |
| 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** (Input  $t_r = t_f = 3\text{ns}$ )

| Symbol                                 | Parameter                             | Test Condition         |                        |  | Value                 |      |      |             |      |              | Unit |      |
|----------------------------------------|---------------------------------------|------------------------|------------------------|--|-----------------------|------|------|-------------|------|--------------|------|------|
|                                        |                                       | V <sub>CC</sub><br>(V) | C <sub>L</sub><br>(pF) |  | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                        |                                       |                        |                        |  | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time                | 2.7                    | 15                     |  |                       | 6.1  | 11.4 | 1.0         | 13.5 | 1.0          | 15.0 | ns   |
|                                        |                                       | 2.7                    | 50                     |  |                       | 8.6  | 14.9 | 1.0         | 17.0 | 1.0          | 18.0 |      |
|                                        |                                       | 3.3(*)                 | 15                     |  |                       | 4.5  | 7.1  | 1.0         | 8.5  | 1.0          | 9.5  |      |
|                                        |                                       | 3.3(*)                 | 50                     |  |                       | 7.2  | 10.6 | 1.0         | 12.0 | 1.0          | 13.0 |      |
| t <sub>PZL</sub><br>t <sub>PZH</sub>   | Output Enable Time                    | 2.7                    | 15                     |  |                       | 7.1  | 13.8 | 1.0         | 16.5 | 1.0          | 17.5 | ns   |
|                                        |                                       | 2.7                    | 50                     |  |                       | 9.6  | 17.3 | 1.0         | 20.0 | 1.0          | 21.0 |      |
|                                        |                                       | 3.3(*)                 | 15                     |  |                       | 5.5  | 8.8  | 1.0         | 10.5 | 1.0          | 12.  |      |
|                                        |                                       | 3.3(*)                 | 50                     |  |                       | 8.0  | 12.3 | 1.0         | 14.0 | 1.0          | 15.0 |      |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub>   | Output Disable Time                   | 2.7                    | 50                     |  |                       | 11.6 | 16.0 | 1.0         | 19.0 | 1.0          | 20.5 | ns   |
|                                        |                                       | 3.3(*)                 | 50                     |  |                       | 9.7  | 11.4 | 1.0         | 13.0 | 1.0          | 14.5 |      |
| t <sub>OSLH</sub><br>t <sub>OSHL</sub> | Output to Output Skew Time (note 1,2) | 2.7                    | 50                     |  |                       | 0.5  | 1.0  |             | 1.5  |              | 1.5  | ns   |
|                                        |                                       | 3.3(*)                 | 50                     |  |                       | 0.5  | 1.0  |             | 1.5  |              | 1.5  |      |

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

2) Parameter guaranteed by design

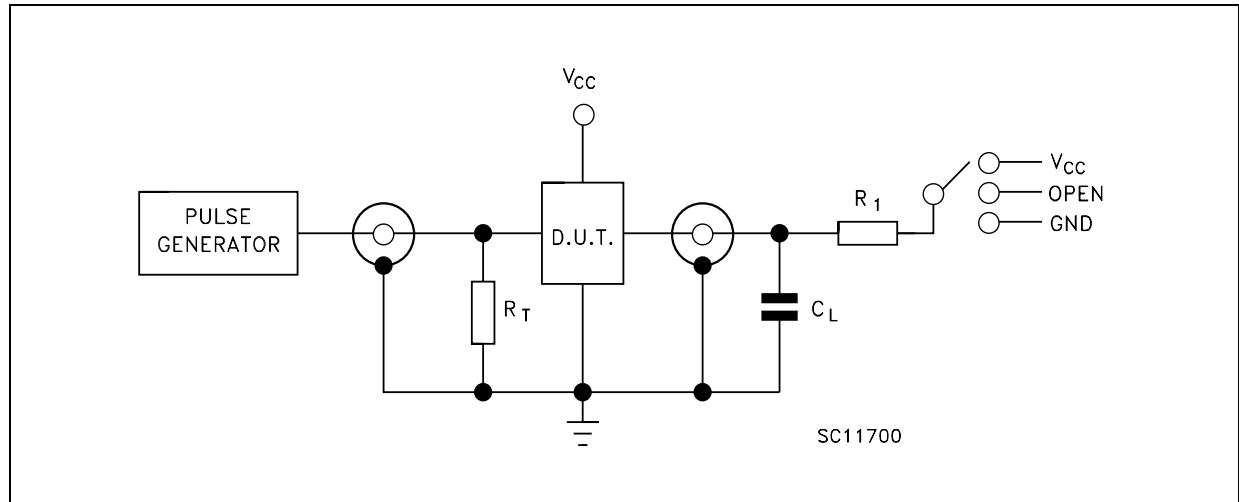
(\*) Voltage range is  $3.3\text{V} \pm 0.3\text{V}$

**CAPACITIVE CHARACTERISTICS**

| Symbol           | Parameter                              | Test Condition         |                         | Value                 |      |      |             |      |              | Unit |      |
|------------------|----------------------------------------|------------------------|-------------------------|-----------------------|------|------|-------------|------|--------------|------|------|
|                  |                                        | V <sub>CC</sub><br>(V) |                         | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                  |                                        |                        |                         | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| C <sub>IN</sub>  | Input Capacitance                      | 3.3                    |                         |                       | 4    | 10   |             | 10   |              | 10   | pF   |
| C <sub>OUT</sub> | Output Capacitance                     | 3.3                    |                         |                       | 6    |      |             |      |              |      | pF   |
| C <sub>PD</sub>  | Power Dissipation Capacitance (note 1) | 3.3                    | f <sub>IN</sub> = 10MHz |                       | 19   |      |             |      |              |      | pF   |

1)  $C_{PD}$  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.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$  (per circuit)

## TEST CIRCUIT

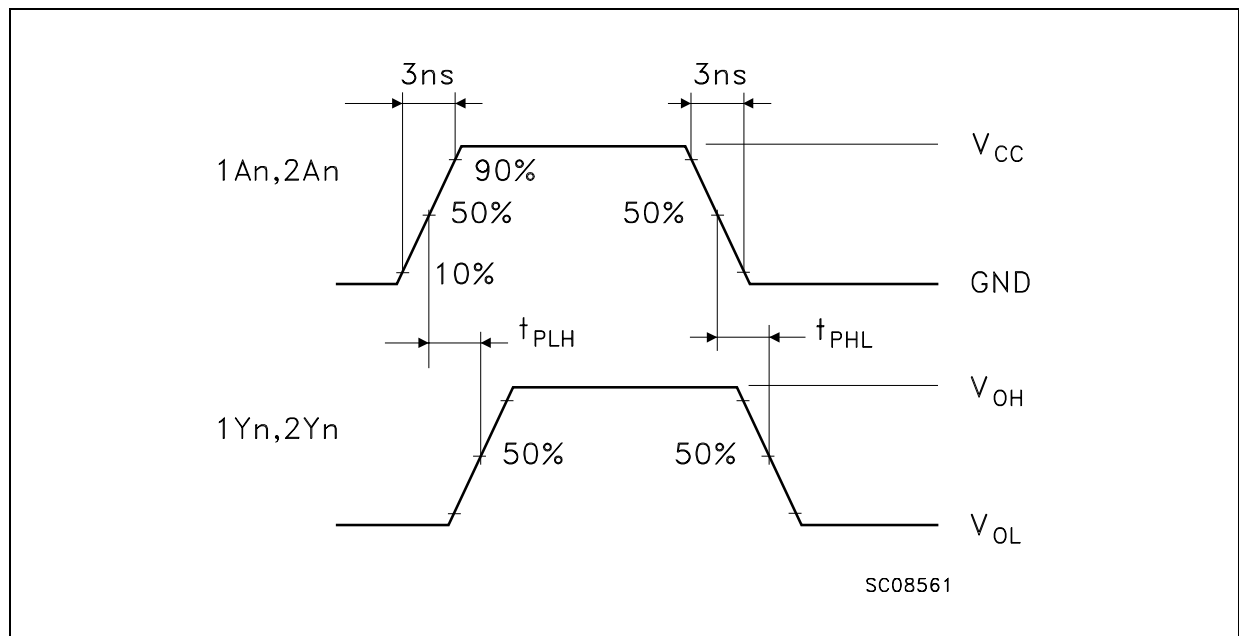


| TEST                  | SWITCH   |
|-----------------------|----------|
| $t_{PLH}$ , $t_{PHL}$ | Open     |
| $t_{PZL}$ , $t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}$ , $t_{PHZ}$ | GND      |

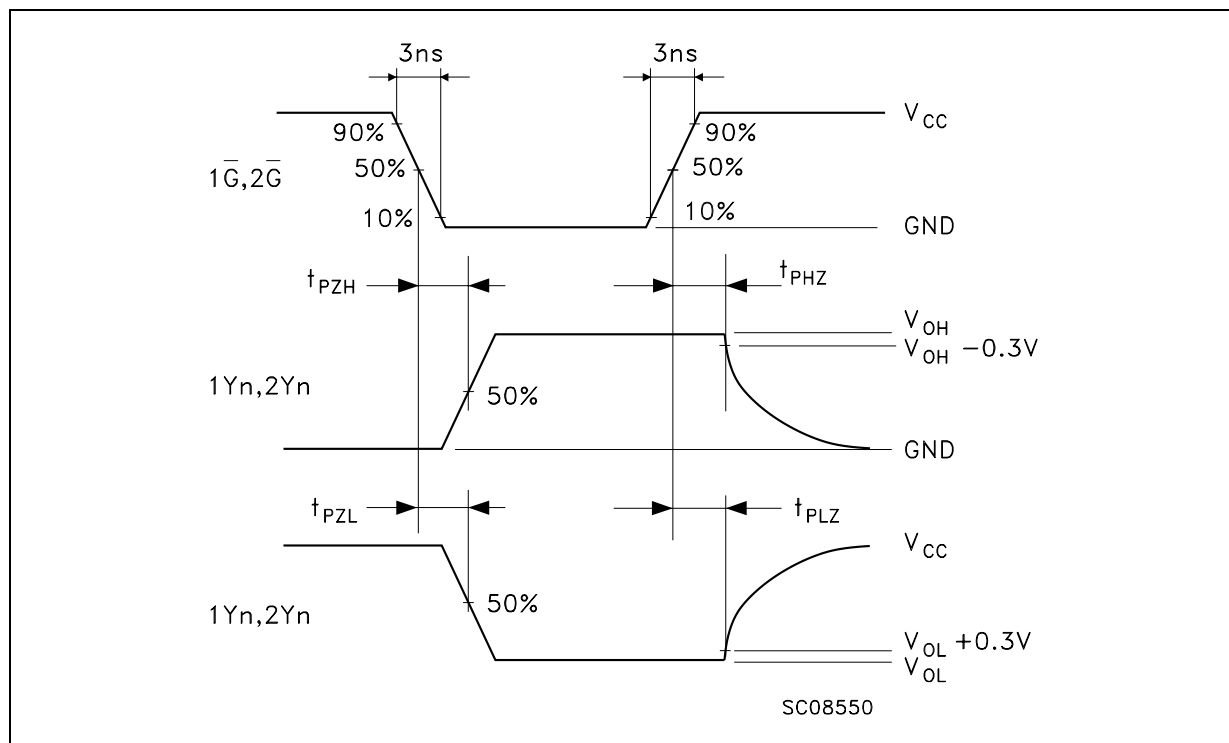
$C_L = 15/50\text{pF}$  or equivalent (includes jig and probe capacitance)

$R_L = R_1 = 1\text{K}\Omega$  or equivalent

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

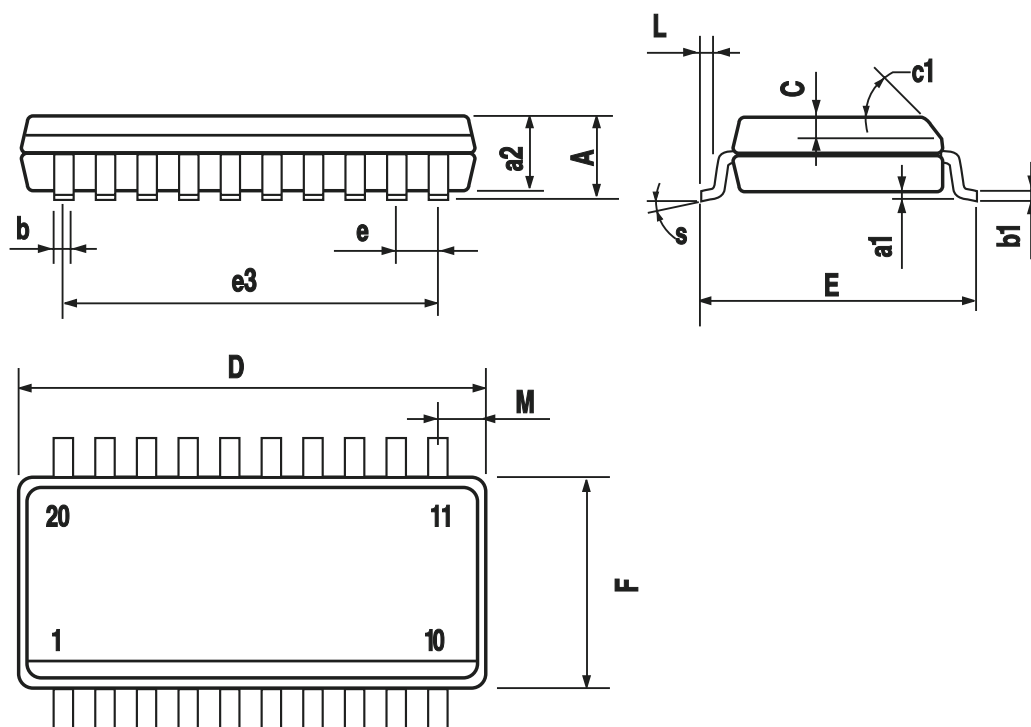
WAVEFORM 1 : PROPAGATION DELAYS ( $f=1\text{MHz}$ ; 50% duty cycle)

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



## SO-20 MECHANICAL DATA

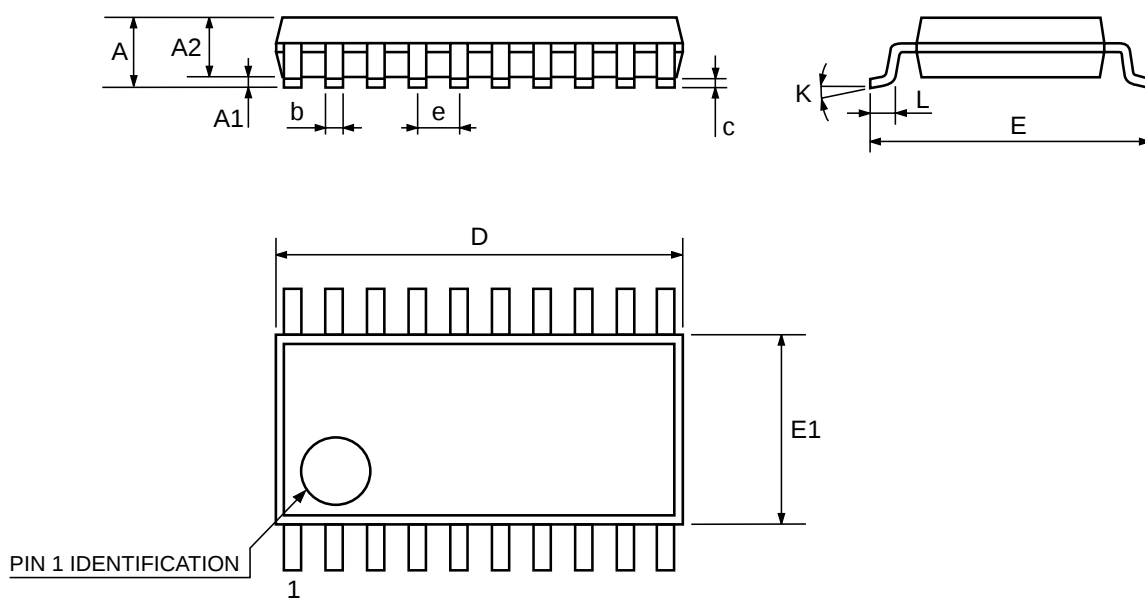
| DIM. | mm.        |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP   | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.1        |       | 0.2   | 0.004 |       | 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.)  |       |       |       |       |       |



PO13L

## 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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