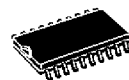


## LOW VOLTAGE OCTAL BUS BUFFER WITH 3 STATE OUTPUTS (INVERTED)

- **HIGH SPEED:**  
 $t_{PD} = 6 \text{ ns (TYP.) at } V_{CC} = 3.3\text{V}$
- **INPUT & OUTPUT TTL COMPATIBLE LEVELS**
- **LOW POWER DISSIPATION:**  
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- **LOW NOISE:**  
 $V_{OLP} = 0.4\text{V (TYP.) at } V_{CC} = 3.3\text{V}$
- **75Ω 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:**  
 $V_{CC} \text{ (OPR)} = 2\text{V to } 3.6\text{V (1.2V Data Retention)}$
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 240**
- **IMPROVED LATCH-UP IMMUNITY**

### DESCRIPTION

The LVQ240 is a low voltage CMOS OCTAL BUS BUFFER fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS



**M**  
(Micro Package)



**T**  
(TSSOP Package)

### ORDER CODES :

74LVQ240M

74LVQ240T

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

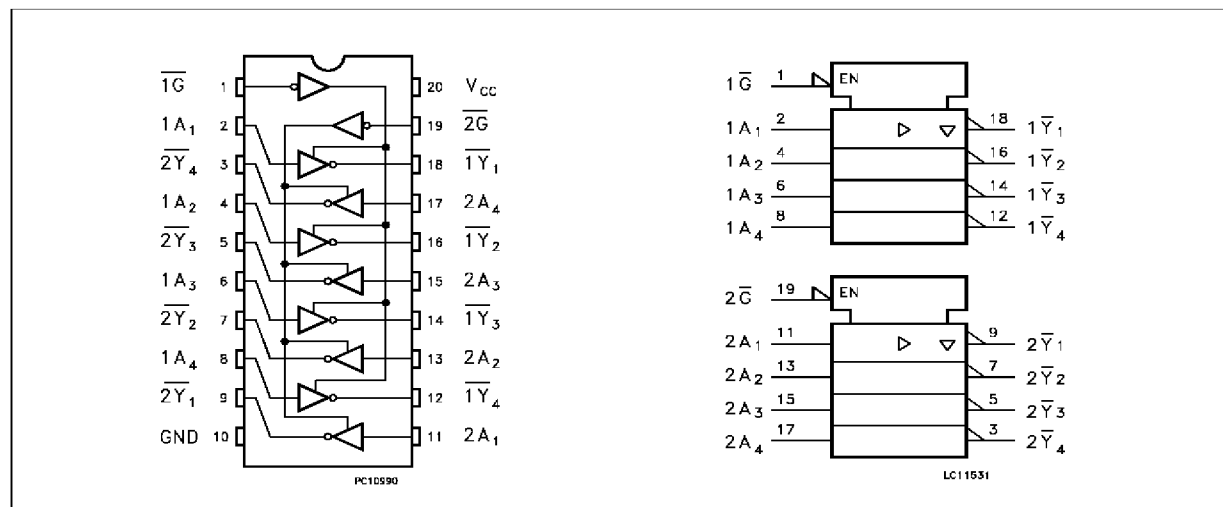
It has better speed performance at 3.3V than 5V LSTTL family combined with the true CMOS low power consumption.

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

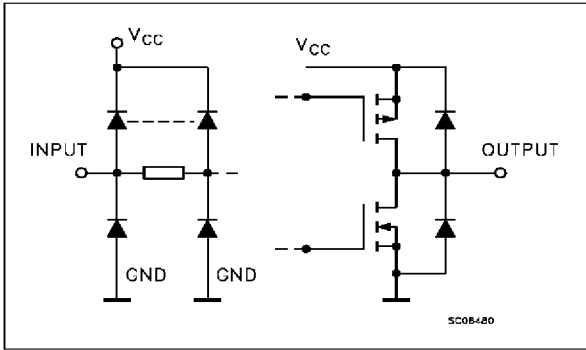
This device is designed to be used with 3 state memory address drivers, etc.

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     | $\overline{2Y1}$ to $\overline{2Y4}$ | 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 Enabel Input     |
| 10             | GND                                  | Ground (0V)             |
| 20             | V <sub>CC</sub>                      | Positive Supply Voltage |

TRUTH TABLE

| INPUT          |                | OUTPUT           |
|----------------|----------------|------------------|
| $\overline{G}$ | A <sub>n</sub> | $\overline{Y_n}$ |
| L              | L              | H                |
| L              | H              | L                |
| 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

## DC SPECIFICATIONS

| Symbol           | Parameter                      | Test Conditions        |                                                                                                |                        | Value                  |       |      |              |      | Unit |
|------------------|--------------------------------|------------------------|------------------------------------------------------------------------------------------------|------------------------|------------------------|-------|------|--------------|------|------|
|                  |                                | V <sub>CC</sub><br>(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> =<br>V <sub>IH</sub> or<br>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> =<br>V <sub>IH</sub> or<br>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><br>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         | 3.6                    | V <sub>OLD</sub> = 0.8 V max                                                                   |                        |                        |       |      | 36           |      | mA   |
| I <sub>OHD</sub> | (note 1, 2)                    |                        | V <sub>OHD</sub> = 2 V min                                                                     |                        |                        |       |      | -25          |      | mA   |

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.

## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Parameter                              | Test Conditions        |                        | Value                  |      |      |              |      | Unit |
|------------------|----------------------------------------|------------------------|------------------------|------------------------|------|------|--------------|------|------|
|                  |                                        | V <sub>CC</sub><br>(V) |                        | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                  |                                        |                        |                        | Min.                   | Typ. | Max. | Min.         | Max. |      |
| V <sub>OLP</sub> | Dynamic Low Voltage                    | 3.3                    | C <sub>L</sub> = 50 pF |                        | 0.2  | 0.8  |              |      | V    |
| V <sub>OLV</sub> | Quiet Output (note 1, 2)               |                        |                        | -0.8                   | 0.2  |      |              |      |      |
| 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** ( $C_L = 50 \text{ pF}$ ,  $R_L = 500 \Omega$ , Input  $t_r = t_f = 3 \text{ ns}$ )

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

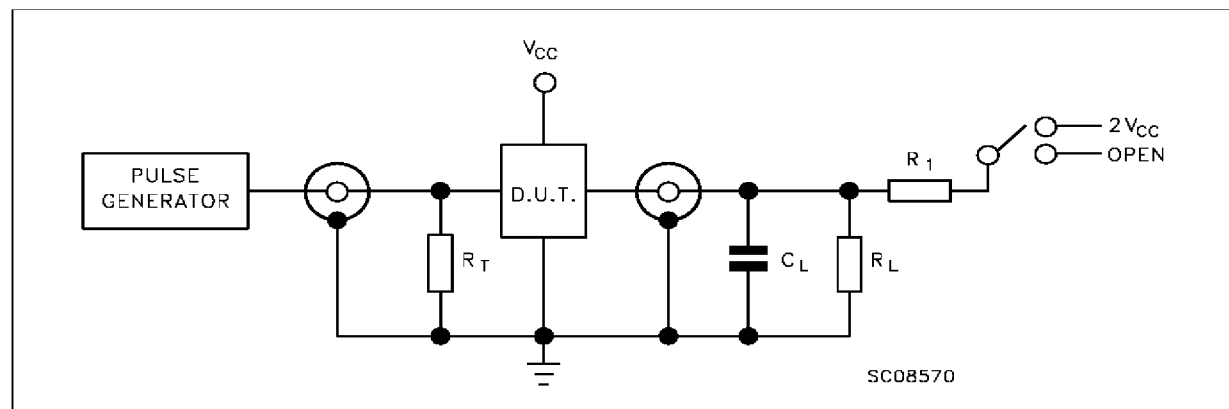
2) Parameter guaranteed by design

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

**CAPACITIVE CHARACTERISTICS**

| Symbol           | Parameter                              | Test Conditions        |                          | Value                  |      |      |              |      | Unit |
|------------------|----------------------------------------|------------------------|--------------------------|------------------------|------|------|--------------|------|------|
|                  |                                        | V <sub>CC</sub><br>(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)  $C_{PD}$  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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CCQ}$  (per circuit)

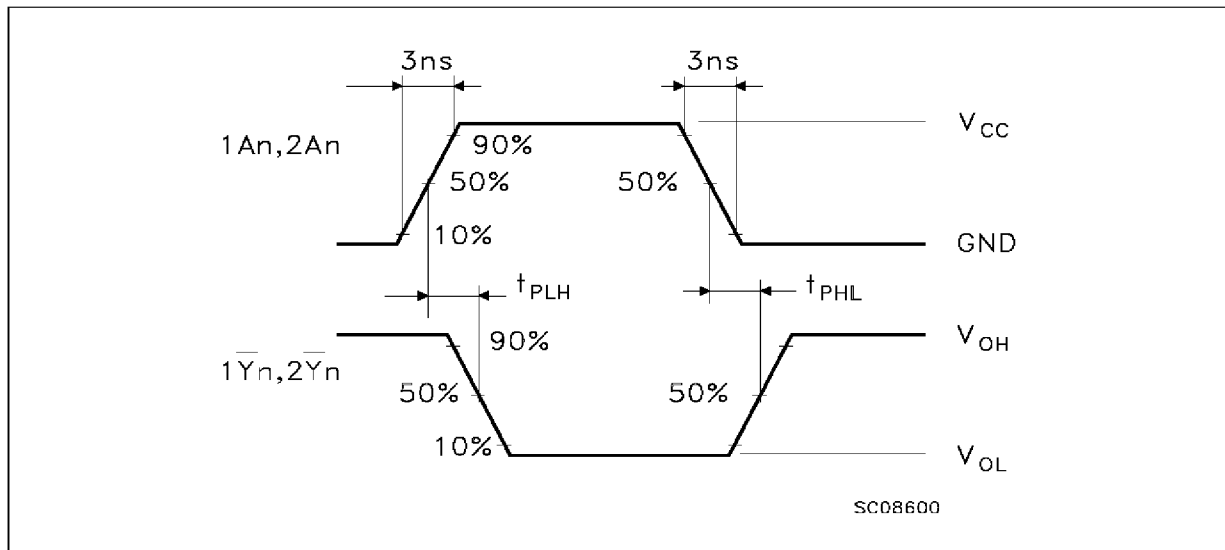
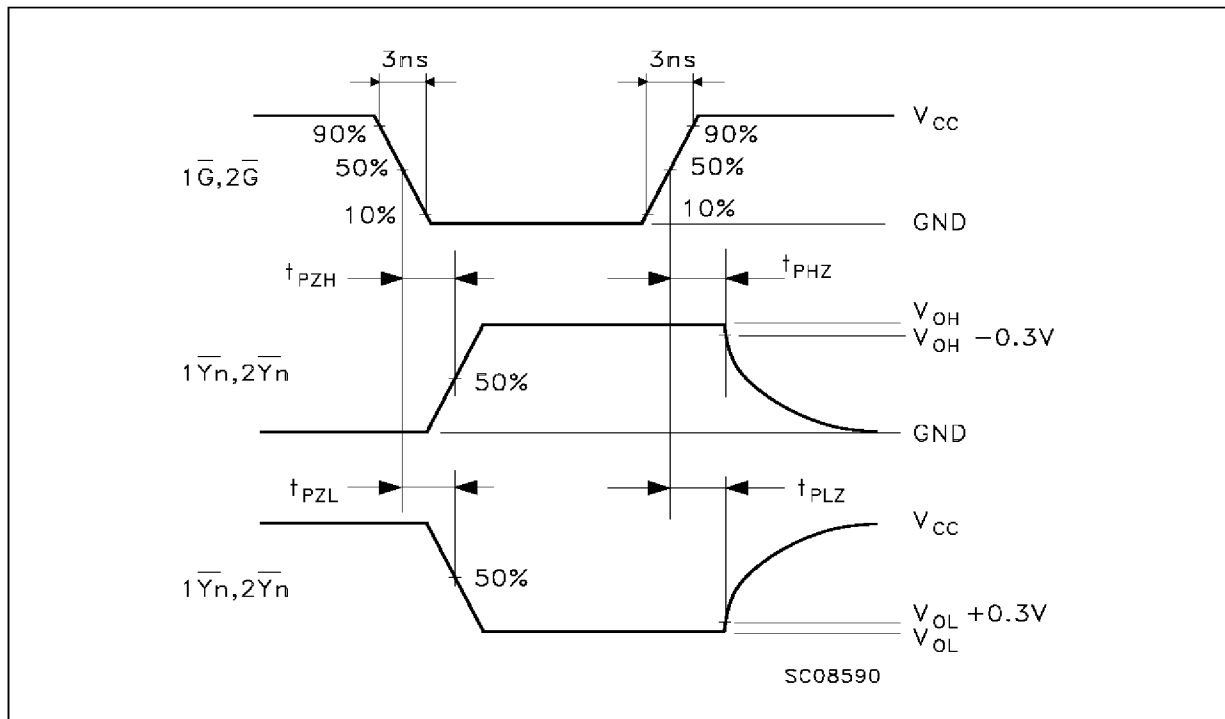
**TEST CIRCUIT**

| TEST                  | SWITCH    |
|-----------------------|-----------|
| $t_{PLH}$ , $t_{PHL}$ | Open      |
| $t_{PZL}$ , $t_{PLZ}$ | $2V_{CC}$ |
| $t_{PZH}$ , $t_{PHZ}$ | GND       |

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

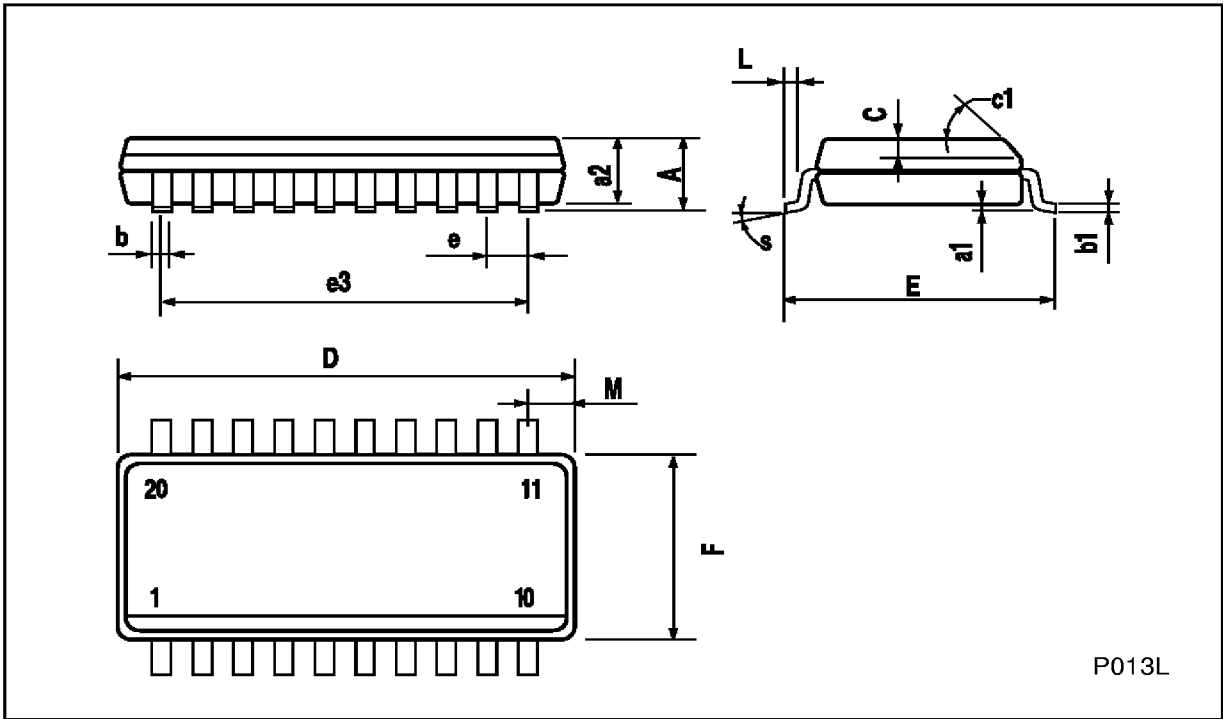
$R_L = R_1 = 500\Omega$  or equivalent

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

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

SO20 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.)  |       |       |       |       |       |



## 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   |      | 0.9      |      |        | 0.354      |        |
| b    | 0.18 |          | 0.30 | 0.0071 |            | 0.0118 |
| c    | 0.09 |          | 0.18 | 0.0035 |            | 0.0071 |
| 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  |

