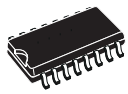
# 74LVX139

## LOW VOLTAGE CMOS DUAL 2 TO 4 DECODER/DEMULTIPLEXER

- HIGH SPEED :
  $t_{PD}$ = 6.0ns (TYP.) at $V_{CC}$ = 3.3V
- 5V TOLERANT INPUTS
- INPUT VOLTAGE LEVEL :
  $V_{IL}$=0.8V, $V_{IH}$=2V at $V_{CC}$=3V
- LOW POWER DISSIPATION:
  $I_{CC}$ = 2 µA (MAX.) at $T_A$=25°C
- LOW NOISE:
  $V_{OLP}$ = 0.3V (TYP.) at $V_{CC}$ = 3.3V
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 4mA (MIN)
- 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 139
- IMPROVED LATCH-UP IMMUNITY
- POWER DOWN PROTECTION ON INPUTS



**SOP**

**TSSOP**

### ORDER CODES

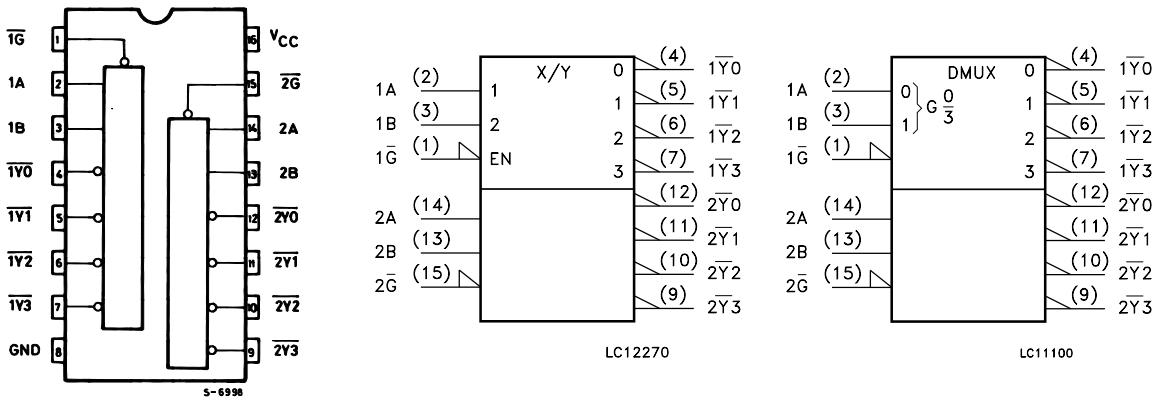
| PACKAGE | TUBE | T & R |
|---|---|---|
| SOP | 74LVX139M | 74LVX139MTR |
| TSSOP | | 74LVX139TTR |

### DESCRIPTION

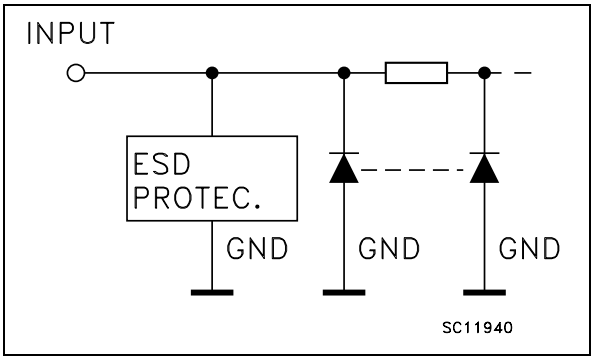
The 74LVX139 is a low voltage CMOS DUAL 2 TO 4 DECODER/DEMULTIPLEXER fabricated with sub-micron silicon gate and double-layer metal wiring $C^2MOS$ technology. It is ideal for low power, battery operated and low noise 3.3V applications.

The active low enable input can be used for gating or as a data input for demultiplexing applications. While the enable input is held high, all four outputs are high independently of the other inputs.
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 system. 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

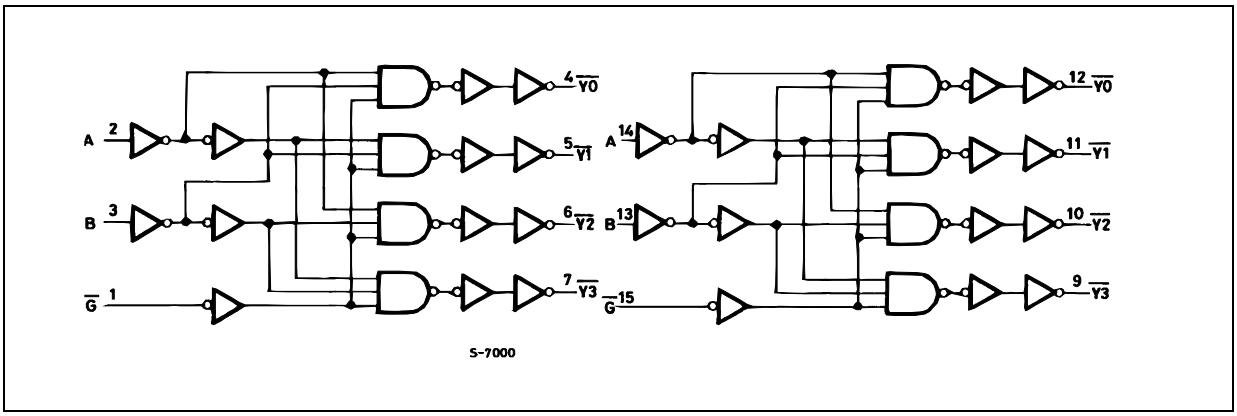
| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 15 | $1\overline{G}$, $2\overline{G}$ | Enable Inputs |
| 2, 3 | 1A, 1B | Address Inputs |
| 4, 5, 6, 7 | $1\overline{Y0}$ to $1\overline{Y3}$ | Outputs |
| 12, 11, 10, 9 | $2\overline{Y0}$ to $2\overline{Y3}$ | Outputs |
| 14, 13 | 2A, 2B | Address Inputs |
| 8 | GND | Ground (0V) |
| 16 | $V_{CC}$ | Positive Supply Voltage |

## TRUTH TABLE

| INPUTS | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|
| ENABLE | SELECT | | | | | |
| $\overline{nG}$ | nB | nA | $n\overline{Y0}$ | $n\overline{Y1}$ | $n\overline{Y2}$ | $n\overline{Y3}$ |
| H | X | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |
| L | H | L | H | H | L | H |
| L | H | H | H | H | H | L |

X : Don't Care
n: 1, 2.

## LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | -0.5 to +7.0 | V |
| $V_I$ | DC Input Voltage | -0.5 to +7.0 | V |
| $V_O$ | DC Output Voltage | -0.5 to $V_{CC}$ + 0.5 | V |
| $I_{IK}$ | DC Input Diode Current | - 20 | mA |
| $I_{OK}$ | DC Output Diode Current | ± 20 | mA |
| $I_O$ | DC Output Current | ± 25 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 50 | mA |
| $T_{stg}$ | Storage Temperature | -65 to +150 | °C |
| $T_L$ | 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 |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage (note 1) | 2 to 3.6 | V |
| $V_I$ | Input Voltage | 0 to 5.5 | V |
| $V_O$ | Output Voltage | 0 to $V_{CC}$ | V |
| $T_{op}$ | Operating Temperature | -55 to 125 | °C |
| dt/dv | Input Rise and Fall Time (note 2) ($V_{CC}$ = 3.3V) | 0 to 100 | ns/V |

1) Truth Table guaranteed: 1.2V to 3.6V
2) $V_{IN}$ from 0.8V to 2.0V

## DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $V_{IH}$ | 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 | | |
| $V_{IL}$ | 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 | |
| $V_{OH}$ | High Level Output Voltage | 2.0 | $I_O$=-50 µA | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | 3.0 | $I_O$=-50 µA | 2.9 | 3.0 | | 2.9 | | 2.9 | | |
| | | 3.0 | $I_O$=-4 mA | 2.58 | | | 2.48 | | 2.4 | | |
| $V_{OL}$ | Low Level Output Voltage | 2.0 | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 3.0 | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 3.0 | $I_O$=4 mA | | | 0.36 | | 0.44 | | 0.55 | |
| $I_I$ | Input Leakage Current | 3.6 | $V_I$ = 5.5V or GND | | | ± 0.1 | | ± 1 | | ± 1 | µA |
| $I_{CC}$ | Quiescent Supply Current | 3.6 | $V_I$ = $V_{CC}$ or GND | | | 2 | | 20 | | 20 | µA |

## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $V_{OLP}$ | Dynamic Low Voltage Quiet Output (note 1, 2) | 3.3 | $C_L$ = 50 pF | | 0.3 | 0.5 | | | | | V |
| $V_{OLV}$ | | | | -0.5 | -0.3 | | | | | | |
| $V_{IHD}$ | Dynamic High Voltage Input (note 1, 3) | 3.3 | | 2 | | | | | | | |
| $V_{ILD}$ | 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 ($V_{ILD}$), 0V to threshold ($V_{IHD}$), f=1MHz.

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f$ = 3ns)

| Symbol | Parameter | Test Condition | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time A, B to $\overline{Y}$ | 2.7 | 15 | | | 7.5 | 12.0 | | 14.0 | | 16.0 | ns |
| | | 2.7 | 50 | | | 9.4 | 15.0 | | 17.0 | | 19.0 | |
| | | 3.3(*) | 15 | | | 6.0 | 8.5 | | 10.0 | | 11.5 | |
| | | 3.3(*) | 50 | | | 7.6 | 11.0 | | 12.5 | | 14.5 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time $\overline{G}$ to $\overline{Y}$ | 2.7 | 15 | | | 7.3 | 12.0 | | 14.0 | | 16.0 | ns |
| | | 2.7 | 50 | | | 9.2 | 15.0 | | 17.0 | | 19.0 | |
| | | 3.3(*) | 15 | | | 5.8 | 8.5 | | 10.0 | | 11.5 | |
| | | 3.3(*) | 50 | | | 7.2 | 11.0 | | 12.5 | | 14.5 | |
| $t_{OSLH}$ $t_{OSHL}$ | Output To Output Skew Time (note1, 2) | 2.7 | 50 | | | 0.5 | 1.0 | | 1.5 | | 1.5 | ns |
| | | 3.3(*) | 50 | | | 0.5 | 1.0 | | 1.5 | | 1.5 | |

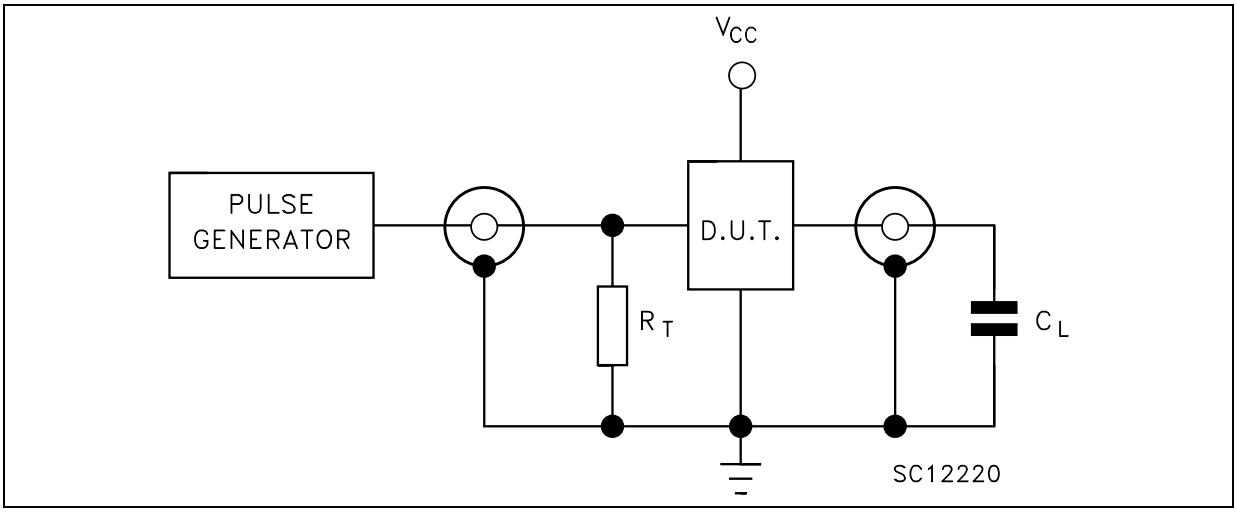
1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW
2) Parameter guaranteed by design
(*) Voltage range is 3.3V ± 0.3V

## CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $C_{IN}$ | Input Capacitance | 3.3 | | | 5 | | | | | | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | 3.3 | $f_{IN}$ = 10MHz | | 13 | | | | | | pF |

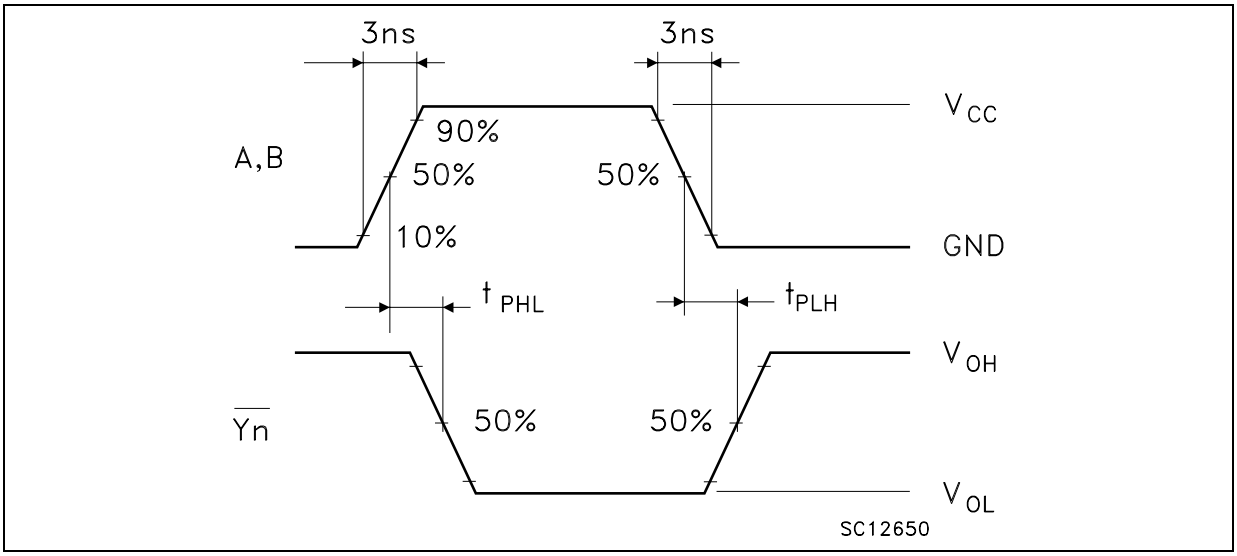
1) $C_{PD}$ is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per Decoder)

## TEST CIRCUIT

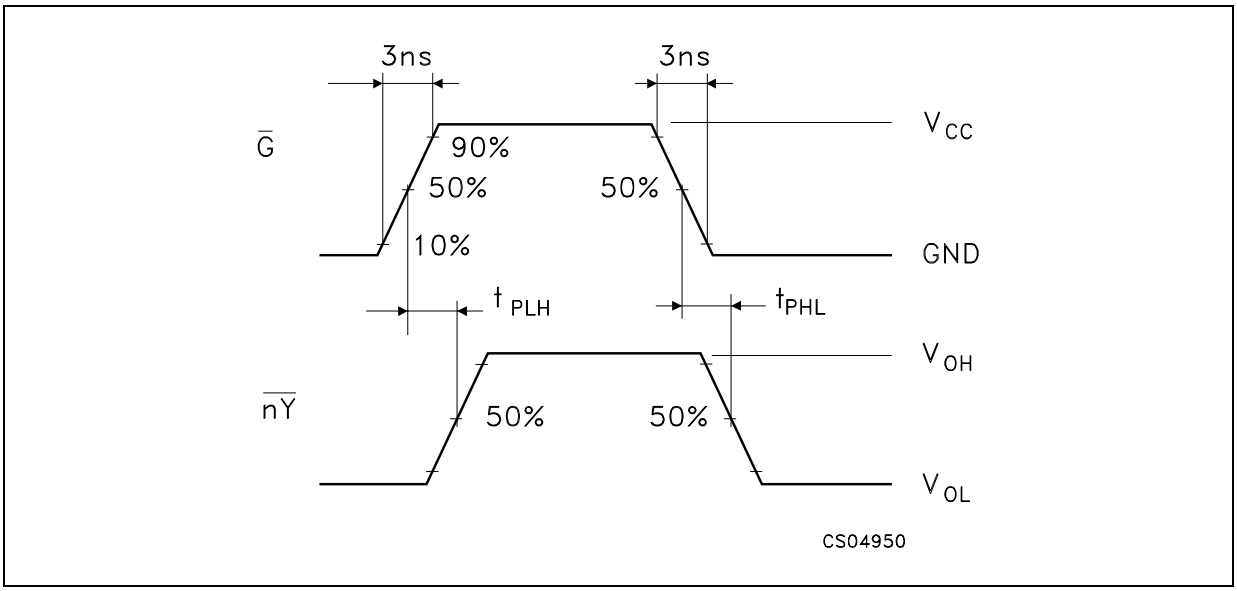



$C_L$ =15/50pF or equivalent (includes jig and probe capacitance)
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS** (f=1MHz; 50% duty cycle)

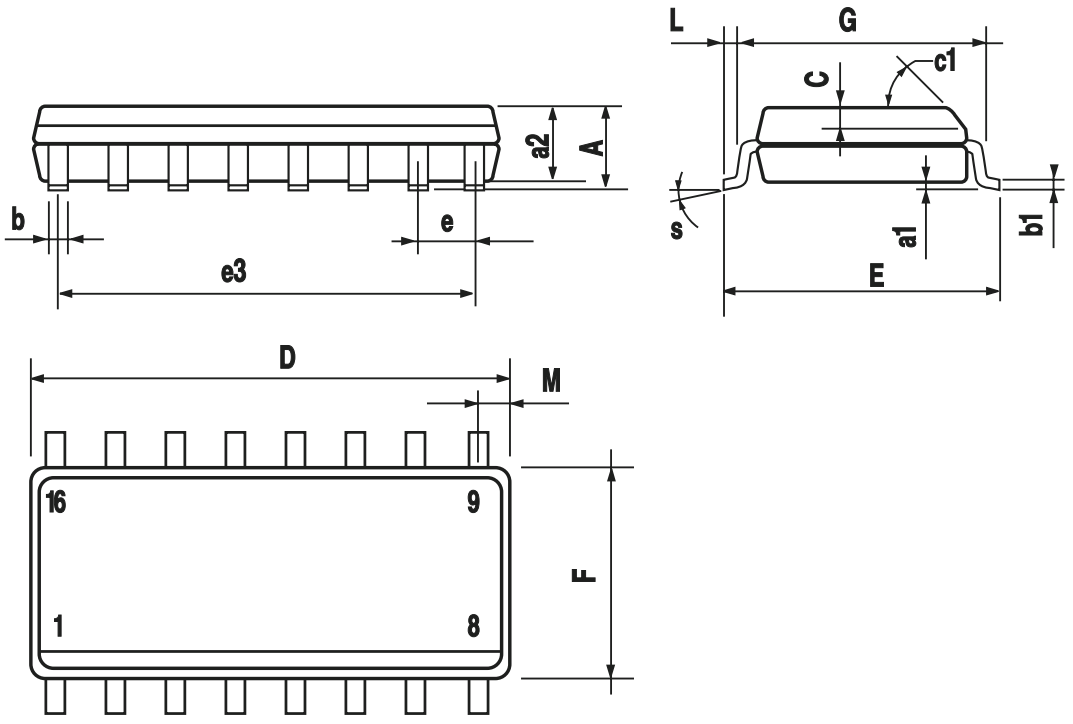



**WAVEFORM 2: PROPAGATION DELAYS FOR NON-INVERTING OUTPUTS** (f=1MHz; 50% duty cycle)



## SO-16 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| 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.) | | | | | |




PO13H

## 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 | | 0.0089 |
| 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 |