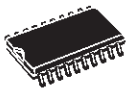
# 74LVX374

## LOW VOLTAGE OCTAL D-TYPE FLIP FLOP (3-STATE NON INV.) WITH 5V TOLERANT INPUTS

- HIGH SPEED:
  $f_{MAX}$ = 160 MHz (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 µA (MAX.) at $T_A$ = 25 °C
- LOW NOISE:
  $V_{OLP}$ = 0.3 V (TYP.) at $V_{CC}$ = 3.3V
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 4 mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:
  $V_{CC}$ (OPR) = 2V to 3.6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 374
- IMPROVED LATCH-UP IMMUNITY



**M**
(Micro Package)

**T**
(TSSOP Package)

**ORDER CODES :**
74LVX374M 74LVX374T

### DESCRIPTION

The LVX374 is a low voltage CMOS OCTAL D-TYPE FLIP FLOP with 3 STATE OUTPUT NON INVERTING fabricated with sub-micron silicon gate and double-layer metal wiring $C^2MOS$ technology. It is ideal for low power and low noise applications.

This 8 bit D-Type flip-flop is controlled by a clock input (CK) and an output enable input ($\overline{OE}$).

On the positive transition of the clock, the Q outputs will be set to the logic state that were setup at the D inputs.

While the ($\overline{OE}$) input is low, the 8 outputs will be in a normal state (high or low logic level) and while high level the outputs will be in a high impedance state.

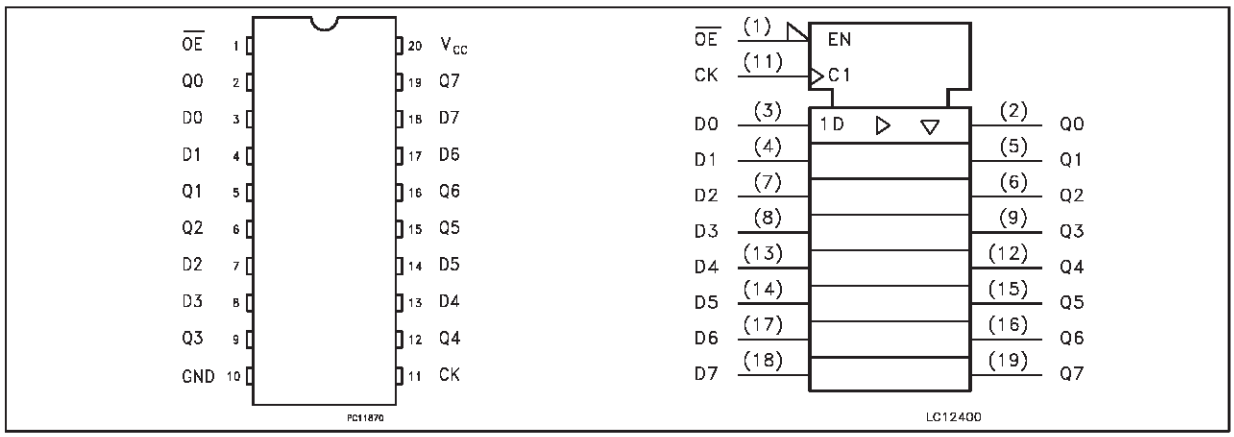
The output control does not affect the internal operation of flip flops; that is, the old data can be retained or the new data can be entered even while the outputs are off.

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

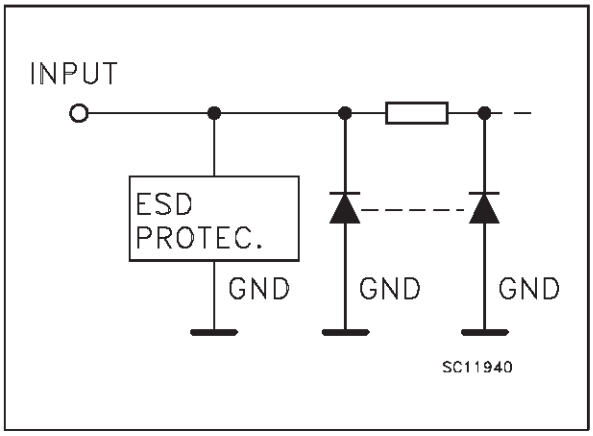
Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage. This device can be used to interface 5V to 3V.

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

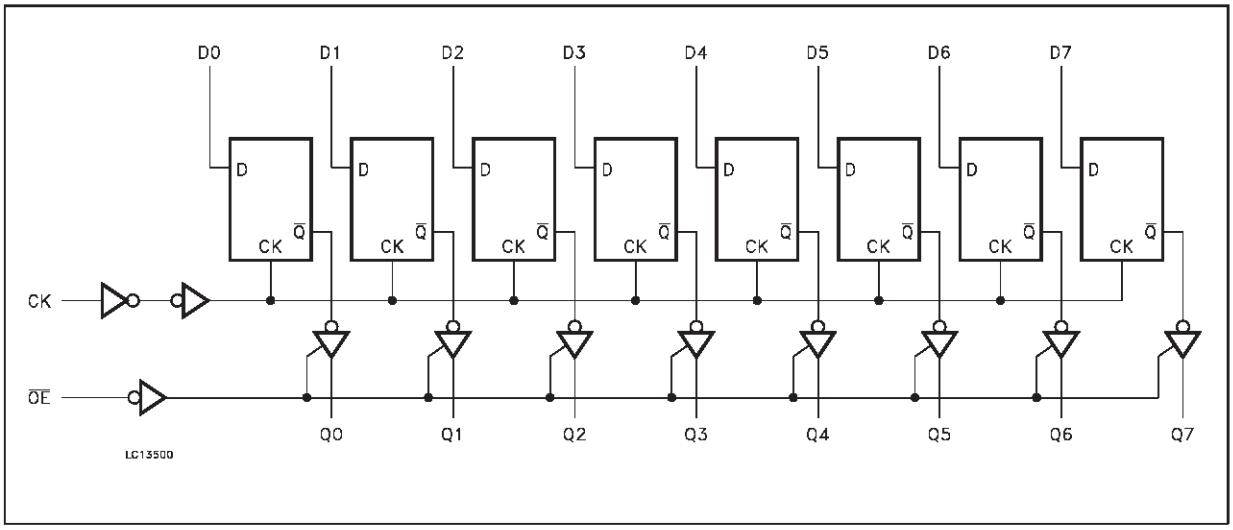
| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1 | $\overline{OE}$ | 3 State Output Enable Input (Active LOW) |
| 2, 5, 6, 9, 12, 15, 16, 19 | Q0 to Q7 | 3 State Outputs |
| 3, 4, 7, 8, 13, 14, 17, 18 | D0 to D7 | Data Inputs |
| 11 | CLOCK | Clock Input (LOW to HIGH, edge triggered) |
| 10 | GND | Ground (0V) |
| 20 | $V_{CC}$ | Positive Supply Voltage |

## TRUTH TABLE

| INPUTS | | | OUTPUTS |
|---|---|---|---|
| $\overline{OE}$ | CK | D | Q |
| H | X | X | Z |
| L | ↓ | X | NO CHANGE |
| L | ↑ | L | L |
| L | ↑ | H | H |

X: Don't Care
Z: High Impedance

## 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 | $^oC$ |
| $T_L$ | Lead Temperature (10 sec) | 300 | $^oC$ |

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 |
|---|---|---|---|
| $V_{CC}$ | 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: | -40 to +85 | $^oC$ |
| dt/dv | Input Rise and Fall Time ($V_{CC}$ = 3V) (note 2) | 0 to 100 | ns/V |

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

## DC SPECIFICATIONS

| Symbol | Parameter | Test Conditions | | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | |
| $V_{IH}$ | High Level Input Voltage | 2.0 | | | 1.5 | | | 1.5 | | V |
| | | 3.0 | | | 2.0 | | | 2.0 | | |
| | | 3.6 | | | 2.4 | | | 2.4 | | |
| $V_{IL}$ | Low Level Input Voltage | 2.0 | | | | | 0.5 | | 0.5 | V |
| | | 3.0 | | | | | 0.8 | | 0.8 | |
| | | 3.6 | | | | | 0.8 | | 0.8 | |
| $V_{OH}$ | High Level Output Voltage | 2.0 | $V_I$(*) = $V_{IH}$ or $V_{IL}$ | $I_O$=-50 µA | 1.9 | 2.0 | | 1.9 | | V |
| | | 3.0 | | $I_O$=-50 µA | 2.9 | 3.0 | | 2.9 | | |
| | | 3.0 | | $I_O$=-4 mA | 2.58 | | | 2.48 | | |
| $V_{OL}$ | Low Level Output Voltage | 2.0 | $V_I$(*) = $V_{IH}$ or $V_{IL}$ | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | V |
| | | 3.0 | | $I_O$=50 µA | | 0.0 | 0.1 | | 0.1 | |
| | | 3.0 | | $I_O$=4 mA | | | 0.36 | | 0.44 | |
| $I_I$ | Input Leakage Current | 3.6 | $V_I$ = 5V or GND | | | | ±0.1 | | ±1 | µA |
| $I_{OZ}$ | 3 State Output Leakage Current | 3.6 | $V_I$ = $V_{IH}$ or $V_{IL}$<br>$V_O$ = $V_{CC}$ or GND | | | | ±0.25 | | ±2.5 | µA |
| $I_{CC}$ | Quiescent Supply Current | 3.6 | $V_I$ = $V_{CC}$ or GND | | | | 4 | | 40 | µA |

(*) All outputs loaded.

## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Parameter | Test Conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| $V_{OLP}$ | Dynamic Low Voltage Quiet Output (note 1, 2) | 3.3 | $C_L$ = 50 pF | | 0.3 | 0.8 | | | V |
| $V_{OLV}$ | | | | -0.8 | -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 $t_r = t_f$ =3 ns)

| Symbol | Parameter | Test Condition | | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time CK to Q | 2.7 | 15 | | | 8.5 | 16.3 | 1.0 | 19.5 | ns |
| | | 2.7 | 50 | | | 11.0 | 19.8 | 1.0 | 23.0 | |
| | | 3.3(*) | 15 | | | 6.7 | 10.6 | 1.0 | 12.5 | |
| | | 3.3(*) | 50 | | | 9.2 | 14.1 | 1.0 | 16.0 | |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Time | 2.7 | 15 | $R_L$ = 1 kΩ | | 7.6 | 14.5 | 1.0 | 17.5 | ns |
| | | 2.7 | 50 | | | 10.1 | 18.0 | 1.0 | 21.0 | |
| | | 3.3(*) | 15 | | | 5.9 | 9.3 | 1.0 | 11.0 | |
| | | 3.3(*) | 50 | | | 8.4 | 12.8 | 1.0 | 14.5 | |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable Time | 2.7 | 15 | $R_L$ = 1 kΩ | | 11.5 | 18.5 | 1.0 | 22.0 | ns |
| | | 3.3(*) | 50 | | | 9.6 | 13.2 | 1.0 | 15.0 | |
| $t_w$ | Clock pulse Width, HIGH or LOW | 2.7 | 15 | | | | 7.5 | | 8.0 | ns |
| | | 3.3(*) | 50 | | | | 5.0 | | 5.5 | |
| $t_s$ | Setup Time D to CK HIGH or LOW | 2.7 | 15 | | | | 6.5 | | 6.5 | ns |
| | | 3.3(*) | 50 | | | | 4.5 | | 4.5 | |
| $t_h$ | Hold Time D to CK HIGH or LOW | 2.7 | 15 | | | | 2.0 | | 2.0 | ns |
| | | 3.3(*) | 50 | | | | 2.0 | | 2.0 | |
| $f_{MAX}$ | Maximum Clock Frequency | 2.7 | 15 | | 60 | 115 | | 50 | | MHz |
| | | 2.7 | 50 | | 45 | 60 | | 40 | | |
| | | 3.3(*) | 15 | | 100 | 160 | | 85 | | |
| | | 3.3(*) | 50 | | 60 | 95 | | 55 | | |
| $t_{OSLH}$ $t_{OSHL}$ | Output to Output Skew Time (note 1, 2) | 2.7 | 50 | | | 0.5 | 1.0 | | 1.5 | ns |
| | | 3.3(*) | 50 | | | 0.5 | 1.0 | | 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

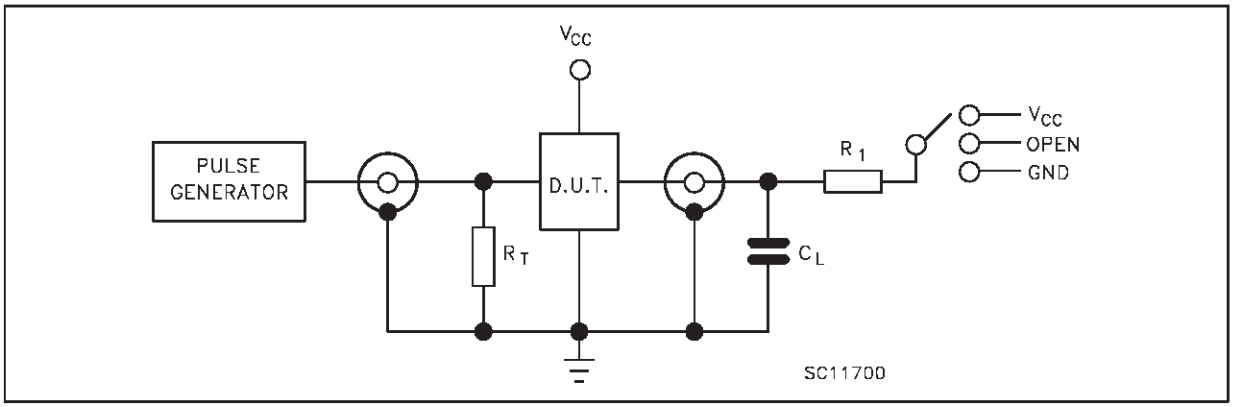
2) Parameter guaranteed by design

## CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25 °C | | | -40 to 85 °C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| $C_{IN}$ | Input Capacitance | 3.3 | | | 4 | 10 | | 10 | pF |
| $C_{OUT}$ | Output Capacitance | 3.3 | | | 6 | | | | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | 3.3 | $f_{IN}$ = 10 MHz | | 32 | | | | 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 operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/8$ (per circuit)

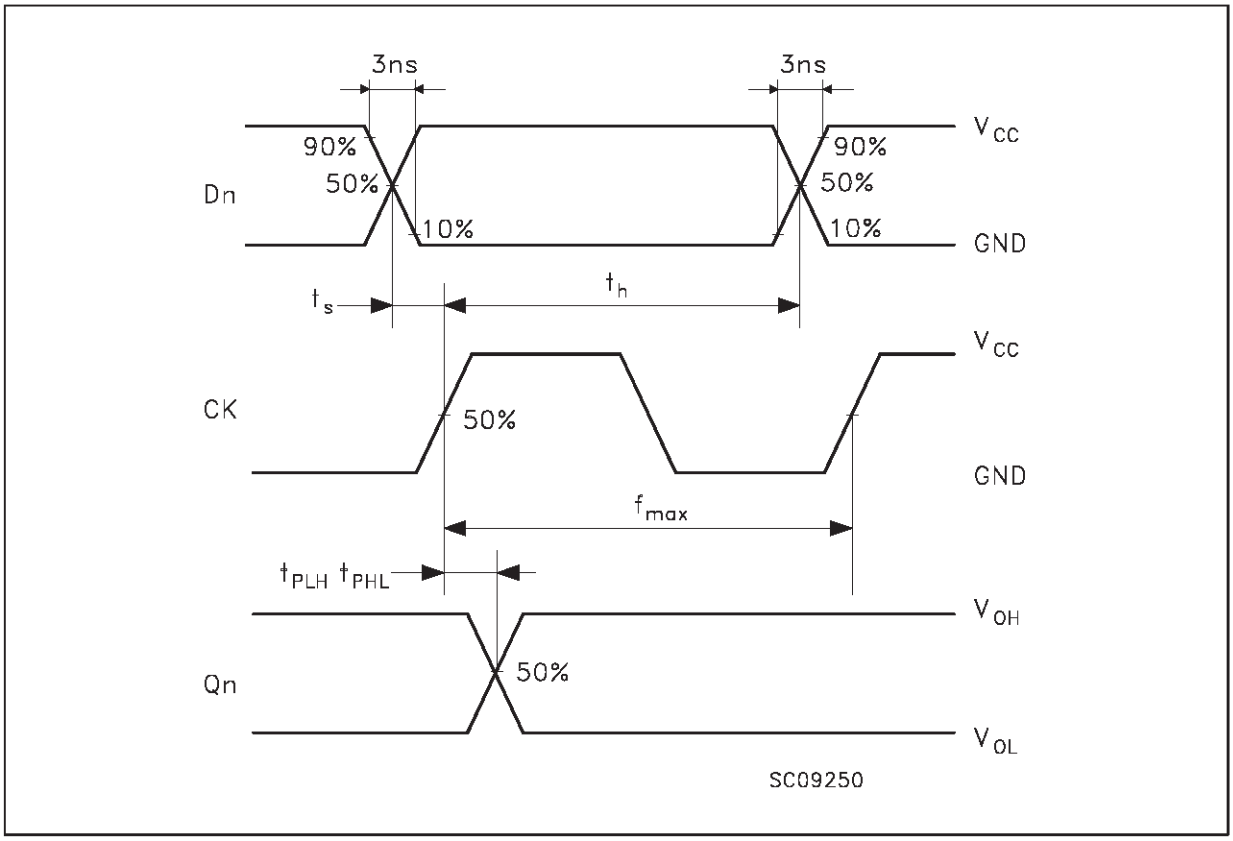
## TEST CIRCUIT



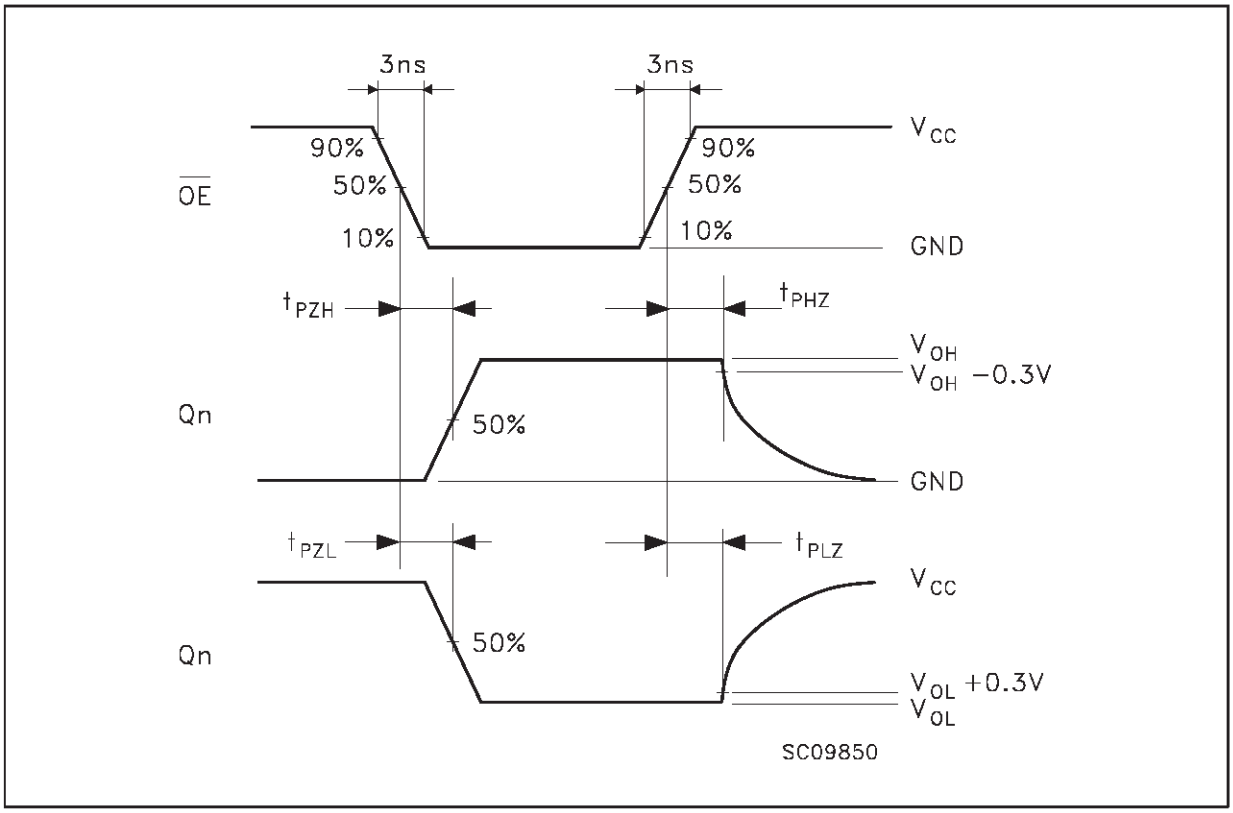

| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}$, $t_{PHZ}$ | GND |

$C_L$ = 15/50 pF or equivalent (includes jig and probe capacitance)
$R_L$ = $R_1$ = 1KΩ or equivalent
$R_T$ = $Z_{OUT}$ of pulse generator (typically 50Ω)

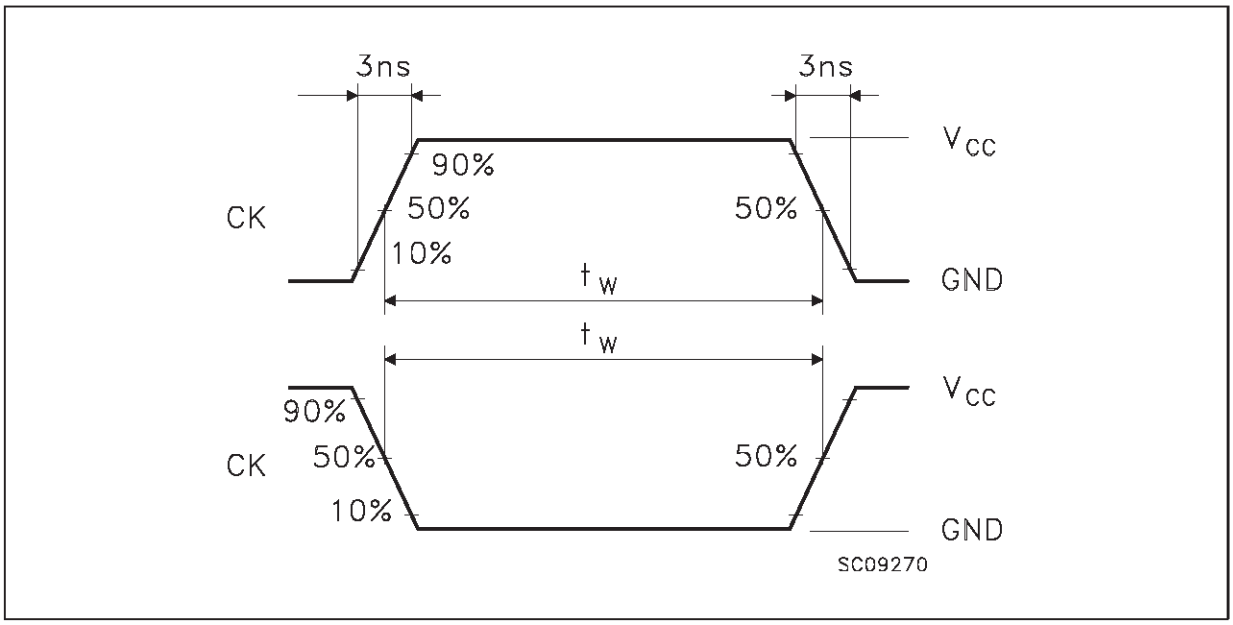
**WAVEFORM 1: PROPAGATION DELAYS, SETUP AND HOLD TIMES** (f=1MHz; 50% duty cicle)



**WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIMES** (f=1MHz; 50% duty cicle)

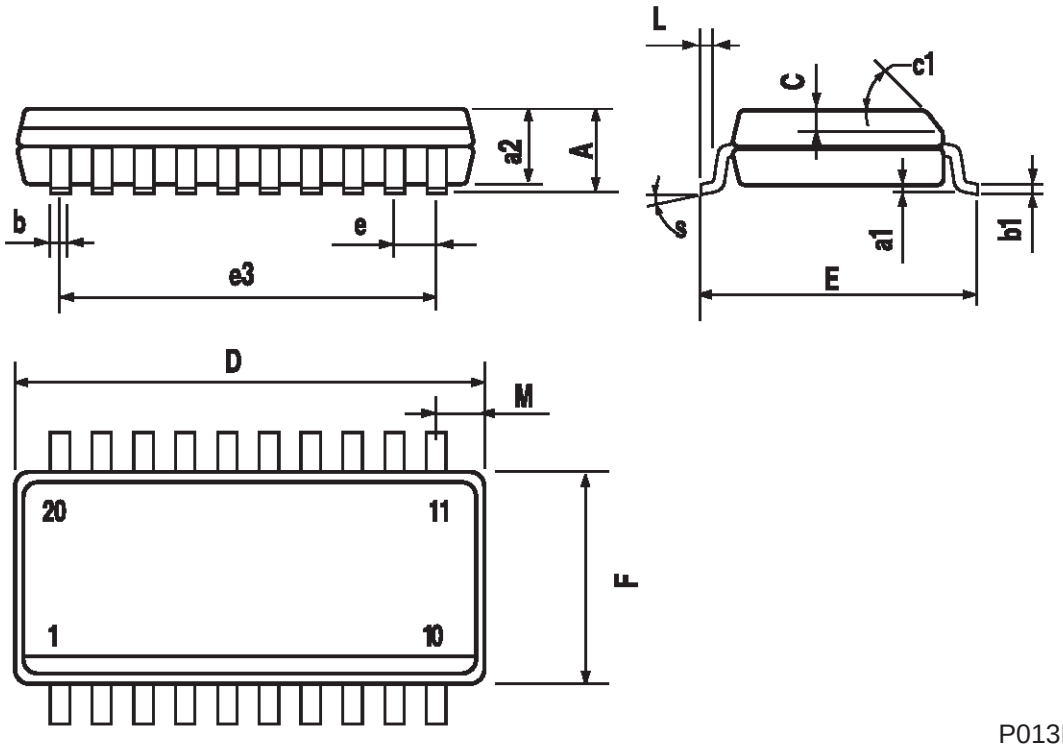



**WAVEFORM 3: PULSE WIDTH**



## 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 | $0^o$ | $4^o$ | $8^o$ | $0^o$ | $4^o$ | $8^o$ |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |