



# THE DATASHEET OF 74AC374B





# 74AC374

## OCTAL D-TYPE FLIP-FLOP WITH 3 STATE OUTPUTS (NON INVERTED)

- HIGH SPEED:  
 $f_{MAX} = 270\text{MHz}$  (TYP.) at  $V_{CC} = 5\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4\mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- 50Ω TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 374
- IMPROVED LATCH-UP IMMUNITY



### ORDER CODES

| PACKAGE | TUBE     | T & R      |
|---------|----------|------------|
| DIP     | 74AC374B |            |
| SOP     | 74AC374M | 74AC374MTR |
| TSSOP   |          | 74AC374TTR |

### DESCRIPTION

The 74AC374 is an advanced high-speed CMOS OCTAL D-TYPE FLIP-FLOP with 3 STATE OUTPUT NON INVERTING fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

These 8 bit D-Type Flip-Flop are 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 that were setup at

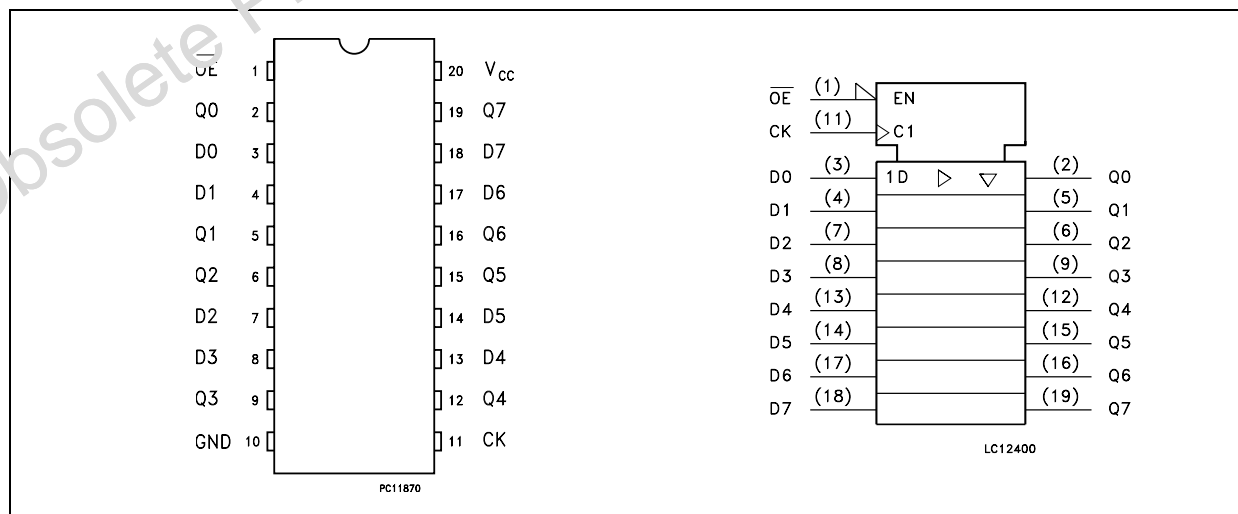
the D inputs.

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

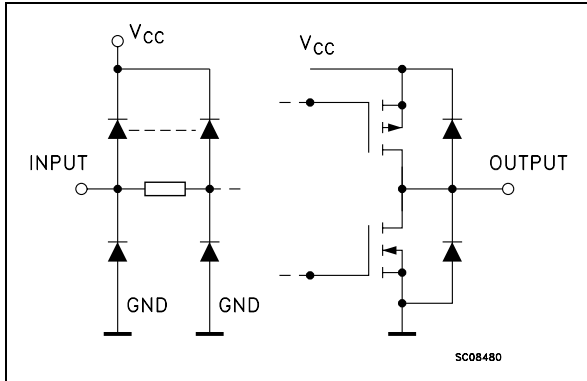
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



# 74AC374

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

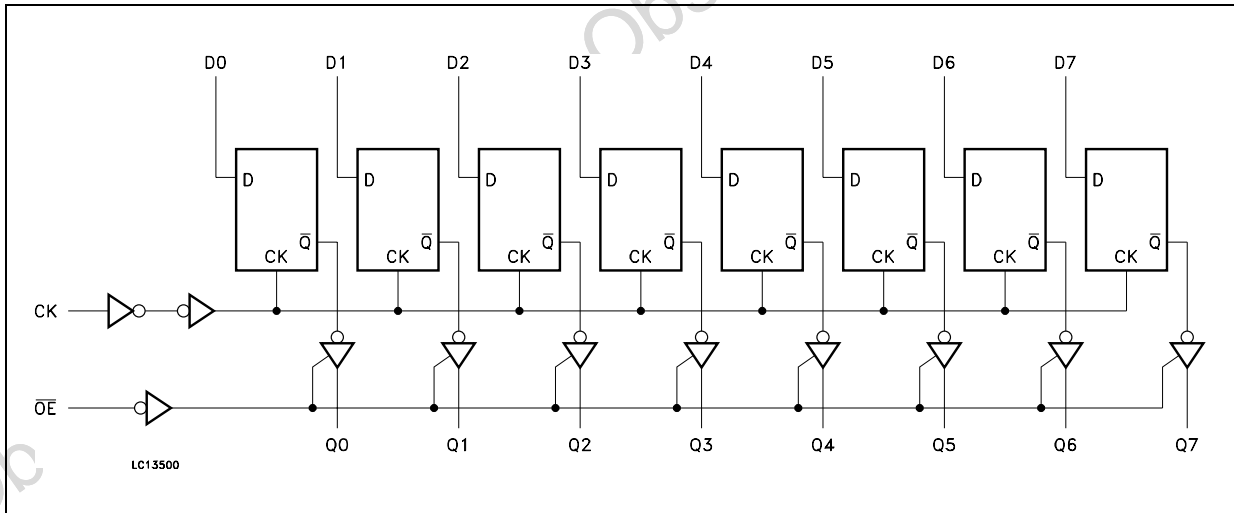
| PIN No                     | SYMBOL          | NAME AND FUNCTION                      |
|----------------------------|-----------------|--|
| 1                          | $\overline{OE}$ | 3-State Output Enable (Active LOW)     |
| 2, 5, 6, 9, 12, 15, 16, 19 | Q0 to Q7        | 3-State Outputs    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

## TRUTH TABLE

| INPUTS          |    |   | OUTPUT    |
|-----------------|----|---|-----------|
| $\overline{OE}$ | 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



This logic diagram has not been used to estimate propagation delays

**ABSOLUTE MAXIMUM RATINGS**

| Symbol                | Parameter                     | Value                  | Unit |
|-----------------------|-------------------------------|------------------------|------|
| $V_{CC}$              | Supply Voltage                | -0.5 to +7             | V    |
| $V_I$                 | DC Input Voltage              | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC Output Voltage             | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current        | $\pm 20$               | mA   |
| $I_{OK}$              | DC Output Diode Current       | $\pm 20$               | mA   |
| $I_O$                 | DC Output Current             | $\pm 50$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 400$              | 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  | 2 to 6        | V    |
| $V_I$    | Input Voltage   | 0 to $V_{CC}$ | 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 $V_{CC} = 3.0, 4.5$ or $5.5V$ (note 1) | 8             | ns/V |

1)  $V_{IN}$  from 30% to 70% of  $V_{CC}$

## 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              | 3.0                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> -0.1V   | 2.1                   | 1.5   |       | 2.1         |      | 2.1          |      | V    |
|                  |                                       | 4.5                    |  | 3.15                  | 2.25  |       | 3.15        |      | 3.15         |      |      |
|                  |                                       | 5.5                    |  | 3.85                  | 2.75  |       | 3.85        |      | 3.85         |      |      |
| V <sub>IL</sub>  | Low Level Input Voltage               | 3.0                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> -0.1V   |                       | 1.5   | 0.9   |             | 0.9  |              | 0.9  | V    |
|                  |                                       | 4.5                    |  |                       | 2.25  | 1.35  |             | 1.35 |              | 1.35 |      |
|                  |                                       | 5.5                    |  |                       | 2.75  | 1.65  |             | 1.65 |              | 1.65 |      |
| V <sub>OH</sub>  | High Level Output Voltage             | 3.0                    | I <sub>O</sub> =-50 μA   | 2.9                   | 2.99  |       | 2.9         |      | 2.9          |      | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =-50 μA   | 4.4                   | 4.49  |       | 4.4         |      | 4.4          |      |      |
|                  |                                       | 5.5                    | I <sub>O</sub> =-50 μA   | 5.4                   | 5.49  |       | 5.4         |      | 5.4          |      |      |
|                  |                                       | 3.0                    | I <sub>O</sub> =-12 mA   | 2.56                  |       |       | 2.46        |      | 2.4          |      |      |
|                  |                                       | 4.5                    | I <sub>O</sub> =-24 mA   | 3.86                  |       |       | 3.76        |      | 3.7          |      |      |
|                  |                                       | 5.5                    | I <sub>O</sub> =-24 mA   | 4.86                  |       |       | 4.76        |      | 4.7          |      |      |
| V <sub>OL</sub>  | Low Level Output Voltage              | 3.0                    | I <sub>O</sub> =50 μA  |                       | 0.002 | 0.1   |             | 0.1  |              | 0.1  | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =50 μA  |                       | 0.001 | 0.1   |             | 0.1  |              | 0.1  |      |
|                  |                                       | 5.5                    | I <sub>O</sub> =50 μA  |                       | 0.001 | 0.1   |             | 0.1  |              | 0.1  |      |
|                  |                                       | 3.0                    | I <sub>O</sub> =12 mA  |                       |       | 0.36  |             | 0.44 |              | 0.5  |      |
|                  |                                       | 4.5                    | I <sub>O</sub> =24 mA  |                       |       | 0.36  |             | 0.44 |              | 0.5  |      |
|                  |                                       | 5.5                    | I <sub>O</sub> =24 mA  |                       |       | 0.36  |             | 0.44 |              | 0.5  |      |
| I <sub>I</sub>   | Input Leakage Current                 | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND  |                       |       | ± 0.1 |             | ± 1  |              | ± 1  | μA   |
| I <sub>oz</sub>  | High Impedance Output Leakage Current | 5.5                    | 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  |              | ± 10 | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current              | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND  |                       |       | 4     |             | 40   |              | 80   | μA   |
| I <sub>OLD</sub> | Dynamic Output Current (note 1, 2)    | 5.5                    | V <sub>OLD</sub> = 1.65 V max  |                       |       |       |             | 75   |              | 50   | mA   |
| I <sub>OHD</sub> |                                       |                        | V <sub>OHD</sub> = 3.85 V min  |                       |       |       |             | -75  |              | -50  | mA   |

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

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

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

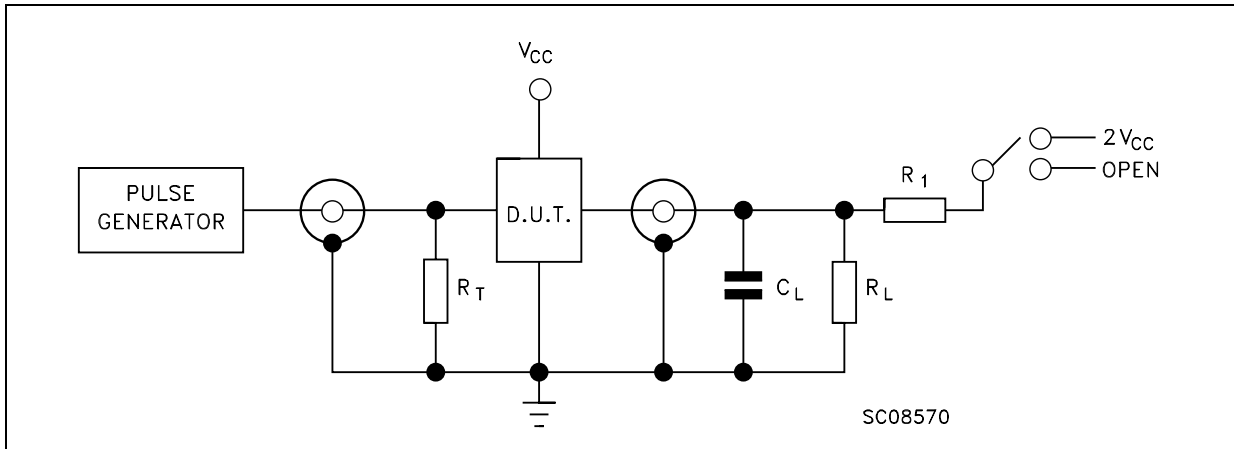
| Symbol              | Parameter                         | Test Condition  |  | Value                    |      |      |                                    |      |                                     | Unit |      |
|---------------------|-----------------------------------|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
|                     |                                   | $V_{CC}$<br>(V) |  | $T_A = 25^\circ\text{C}$ |      |      | $-40 \text{ to } 85^\circ\text{C}$ |      | $-55 \text{ to } 125^\circ\text{C}$ |      |      |
|                     |                                   |                 |  | Min.                     | Typ. | Max. | Min.                               | Max. | Min.                                |      | Max. |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>CK to Q | 3.3(*)          |  |                          | 6.5  | 13.5 |                                    | 15.5 |                                     | 16.5 | ns   |
|                     |                                   | 5.0(**)         |  |                          | 5.0  | 9.5  |                                    | 10.5 |                                     | 12.0 |      |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Time                | 3.3(*)          |  |                          | 7.5  | 12.0 |                                    | 13.0 |                                     | 14.0 | ns   |
|                     |                                   | 5.0(**)         |  |                          | 5.5  | 9.0  |                                    | 9.5  |                                     | 10.5 |      |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable Time               | 3.3(*)          |  |                          | 7.5  | 12.5 |                                    | 14.5 |                                     | 16.0 | ns   |
|                     |                                   | 5.0(**)         |  |                          | 6.0  | 11.0 |                                    | 12.5 |                                     | 12.5 |      |
| $t_W$               | CLOCK Pulse Width HIGH or LOW     | 3.3(*)          |  |                          | 1.5  | 5.0  |                                    | 6.0  |                                     | 6.0  | ns   |
|                     |                                   | 5.0(**)         |  |                          | 1.5  | 4.0  |                                    | 5.0  |                                     | 5.0  |      |
| $t_s$               | Setup Time D to CK, HIGH or LOW   | 3.3(*)          |  |                          | -0.5 | 5.0  |                                    | 5.0  |                                     | 5.0  | ns   |
|                     |                                   | 5.0(**)         |  |                          | -0.5 | 4.0  |                                    | 4.0  |                                     | 4.0  |      |
| $t_h$               | Hold Time D to CK, HIGH or LOW    | 3.3(*)          |  |                          | 0.5  | 2.0  |                                    | 3.0  |                                     | 3.0  | ns   |
|                     |                                   | 5.0(**)         |  |                          | 0.5  | 2.0  |                                    | 3.0  |                                     | 3.0  |      |
| $f_{MAX}$           | Maximum Clock Frequency           | 3.3(*)          |  | 60                       | 250  |      | 60                                 |      | 60                                  |      | MHz  |
|                     |                                   | 5.0(**)         |  | 100                      | 270  |      | 100                                |      | 100                                 |      |      |

(\*) Voltage range is  $3.3\text{V} \pm 0.3\text{V}$ (\*\*) Voltage range is  $5.0\text{V} \pm 0.5\text{V}$ 
**CAPACITIVE CHARACTERISTICS**

| Symbol    | Parameter                              | Test Condition  |                         | Value                    |      |      |                                    |      |                                     | Unit |      |
|-----------|--|-----------------|-------------------------|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
|           |  | $V_{CC}$<br>(V) |                         | $T_A = 25^\circ\text{C}$ |      |      | $-40 \text{ to } 85^\circ\text{C}$ |      | $-55 \text{ to } 125^\circ\text{C}$ |      |      |
|           |  |                 |                         | Min.                     | Typ. | Max. | Min.                               | Max. | Min.                                |      | Max. |
| $C_{IN}$  | Input Capacitance                      | 5.0             |                         |                          | 4    |      |                                    |      |                                     |      | pF   |
| $C_{OUT}$ | Output Capacitance                     | 5.0             |                         |                          | 8    |      |                                    |      |                                     |      | pF   |
| $C_{PD}$  | Power Dissipation Capacitance (note 1) | 5.0             | $f_{IN} = 10\text{MHz}$ |                          | 18   |      |                                    |      |                                     |      | 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.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/n$  (per circuit)

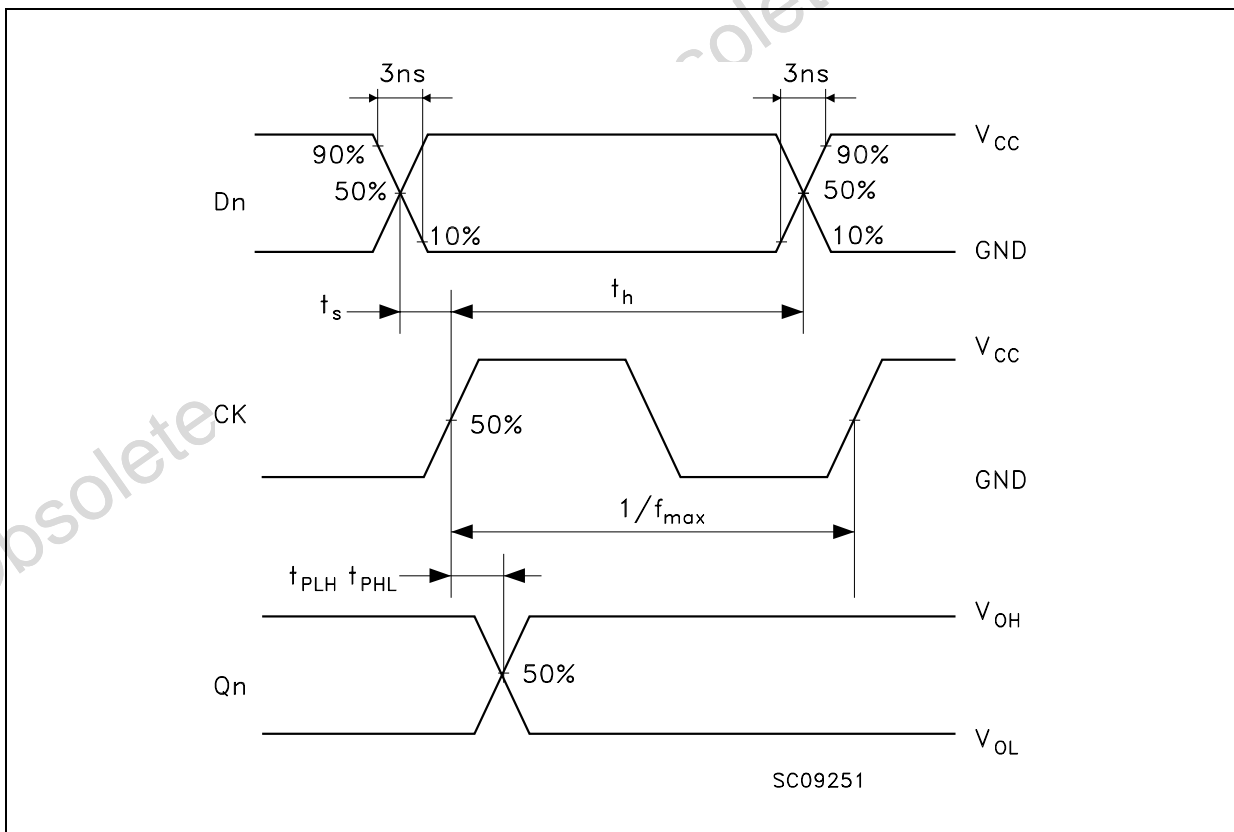
TEST CIRCUIT

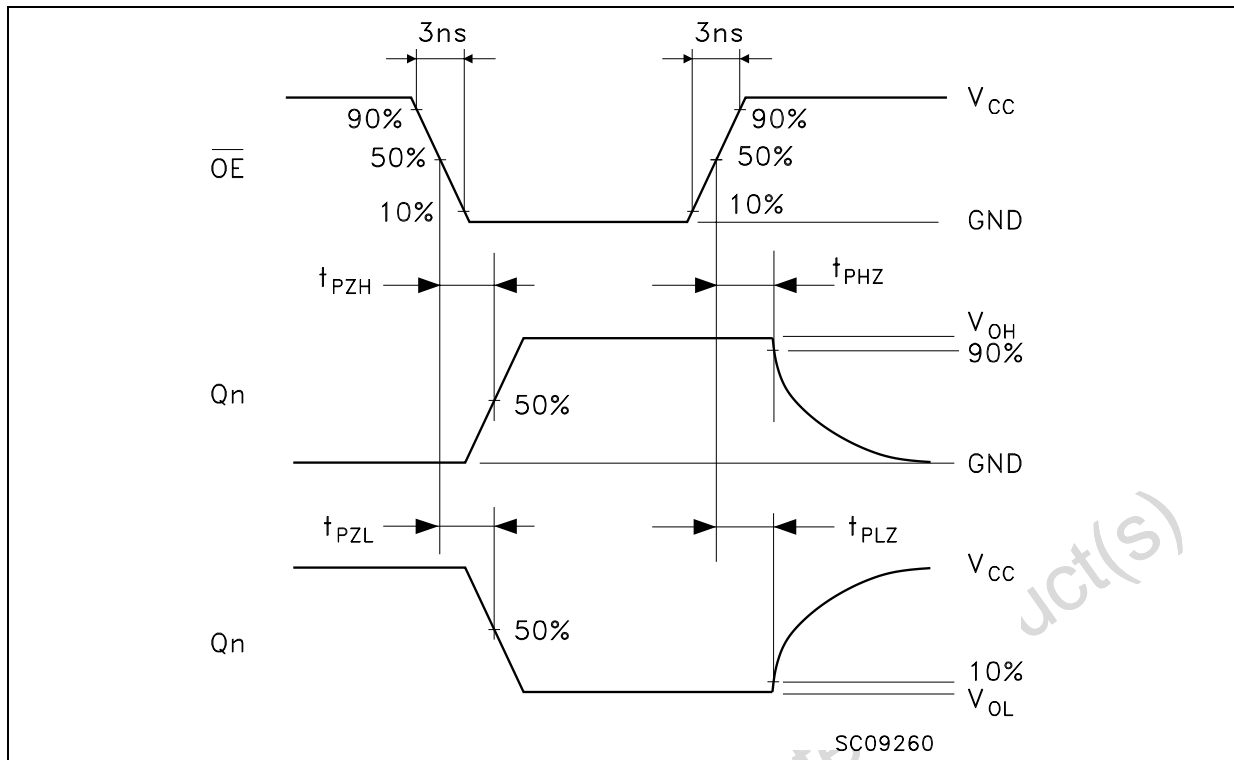
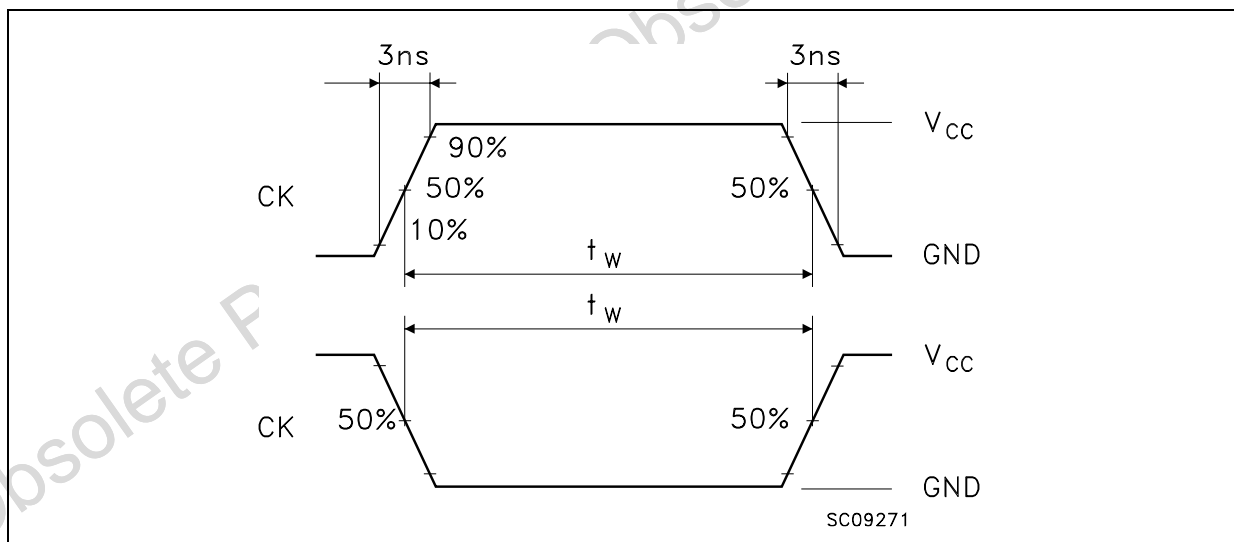


| TEST                  | SWITCH    |
|-----------------------|-----------|
| $t_{PLH}$ , $t_{PHL}$ | Open      |
| $t_{PZL}$ , $t_{PLZ}$ | $2V_{CC}$ |
| $t_{PZH}$ , $t_{PHZ}$ | Open      |

$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = R_1 = 500\Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

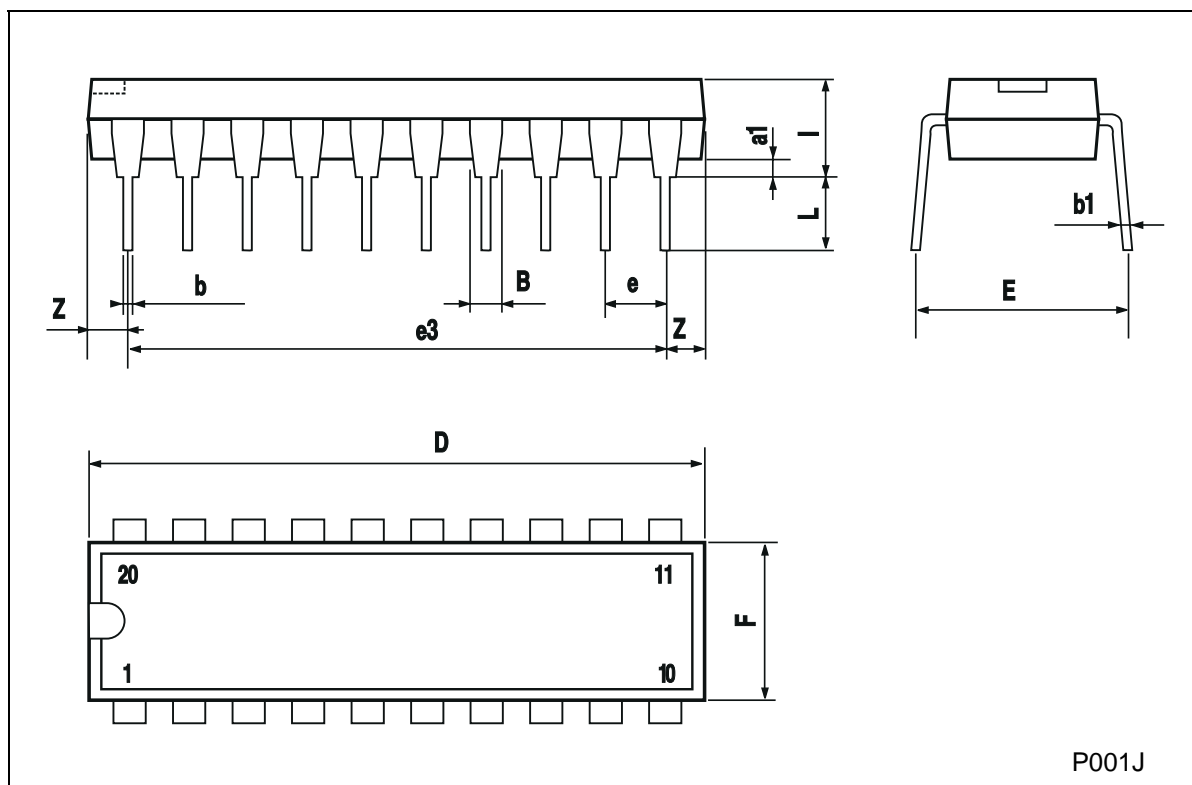
WAVEFORM 1: PROPAGATION DELAYS, SETUP AND HOLD TIMES ( $f=1\text{MHz}$ ; 50% duty cycle)



**WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIMES** ( $f=1\text{MHz}$ ; 50% duty cycle)**WAVEFORM 3: PULSE WIDTH** ( $f=1\text{MHz}$ ; 50% duty cycle)

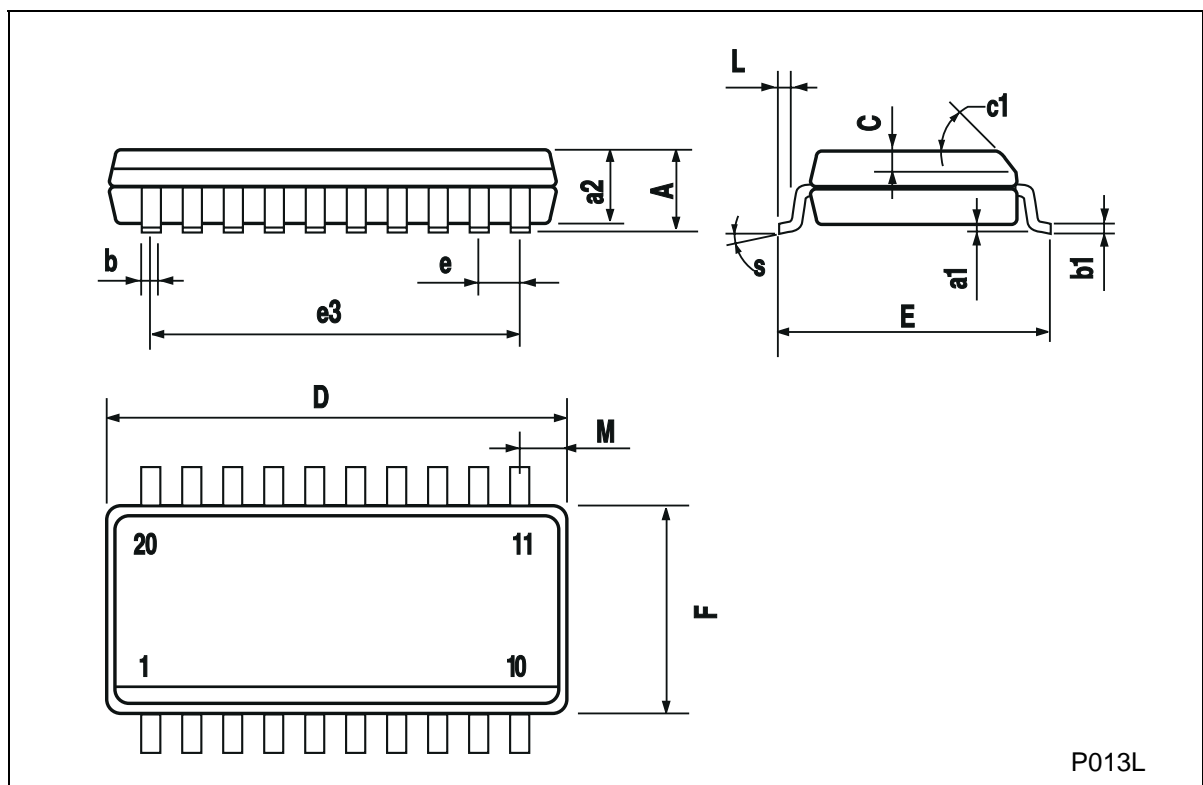
### Plastic DIP-20 (0.25) MECHANICAL DATA

| DIM. | mm    |       |      | inch  |       |       |
|------|-------|-------|------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.254 |       |      | 0.010 |       |       |
| B    | 1.39  |       | 1.65 | 0.055 |       | 0.065 |
| b    |       | 0.45  |      |       | 0.018 |       |
| b1   |       | 0.25  |      |       | 0.010 |       |
| D    |       |       | 25.4 |       |       | 1.000 |
| E    |       | 8.5   |      |       | 0.335 |       |
| e    |       | 2.54  |      |       | 0.100 |       |
| e3   |       | 22.86 |      |       | 0.900 |       |
| F    |       |       | 7.1  |       |       | 0.280 |
| I    |       |       | 3.93 |       |       | 0.155 |
| L    |       | 3.3   |      |       | 0.130 |       |
| Z    |       |       | 1.34 |       |       | 0.053 |



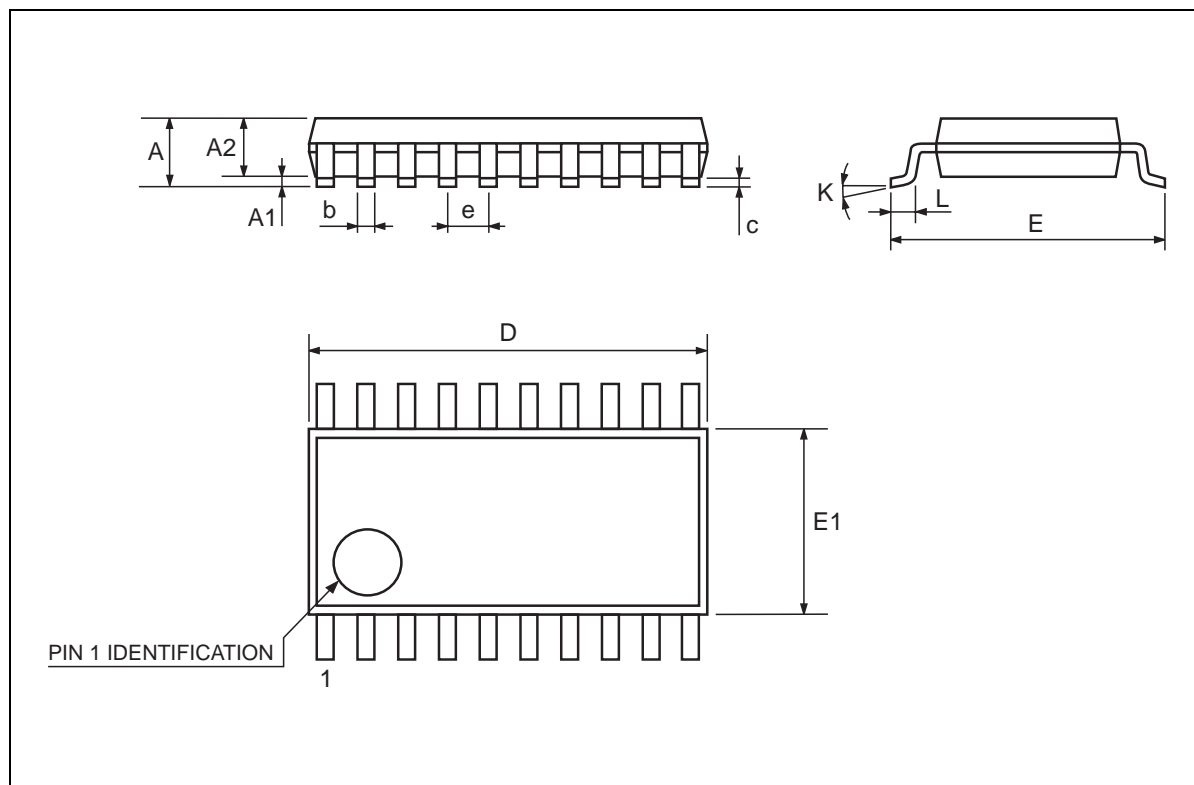
## SO-20 MECHANICAL DATA

| 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.)  |       |       |       |       |       |



## 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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