

# 14 STAGE BINARY COUNTER/OSCILLATOR

**IN74HC4060A**

The IN74HC4060A is an high speed CMOS 14-STAGE BINARY COUNTER/OSCILLATOR fabricated with silicon gate C<sup>2</sup>MOS technology. The oscillator configuration allows design of either RC or crystal oscillator circuits. A high level on the CLEAR accomplishes the reset function, i.e. all counter outputs are made low and the oscillator is disabled.

A negative transition on the clock input increments the counter. Ten kinds of divided output are provided; 4 to 10 and 12 to 14 stage inclusive. The maximum division available at Q12 is 1/16384 f oscillator.

The Clock Input ( $\overline{\text{CI}}$ ) and the CLEAR input are equipped with protection circuits against static discharge and transient excess voltage.

- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu\text{A}(\text{MAX.})$  at  $T_A = 25^\circ\text{C}$
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 4 \text{ mA}(\text{MIN})$
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:  
 $V_{CC}(\text{OPR}) = 2 \text{ V to } 6 \text{ V}$

N SUFFIX PLASTIC

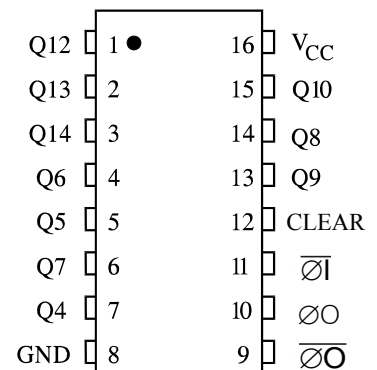
DW SUFFIX SOIC

**ORDERING INFORMATION**  
 IN74HC4060AN Plastic  
 IN74HC4060ADW SOIC  
 $T_A = -55^\circ \text{ to } 125^\circ \text{ C}$  for all packages

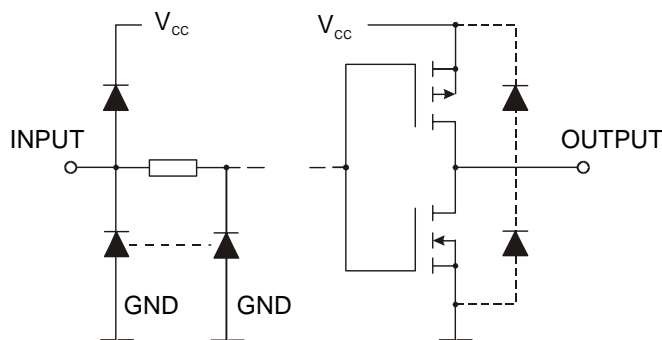
## PIN DESCRIPTION

| PIN No                     | SYMBOL                 | NAME AND FUNCTION             |
|----------------------------|------------------------|-------------------------------|
| 01, 02, 03                 | Q12 to Q14             | Counter Outputs               |
| 07, 05, 04, 06, 14, 13, 15 | Q4 to Q10              | Counter Outputs               |
| 09                         | $\overline{\text{CO}}$ | External Capacitor Connection |
| 10                         | $\text{RO}$            | External Resistor Connection  |
| 11                         | $\overline{\text{CI}}$ | Clock Input / Oscillator      |
| 12                         | CLEAR                  | Master Reset                  |
| 08                         | GND                    | Ground (0V)                   |
| 16                         | V <sub>CC</sub>        | Positive Supply Voltage       |

## PIN ASSIGNMENT



## INPUT AND OUTPUT EQUIVALENT CIRCUIT





**ABSOLUTE MAXIMUM RATINGS**

| 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                    | ± 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   |

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           | 2 to 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    | -55 to +125             | °C        |    |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time | V <sub>CC</sub> = 2.0 V | 0 to 1000 | ns |
|                                 |                          | V <sub>CC</sub> = 4.5 V | 0 to 500  | ns |
|                                 |                          | V <sub>CC</sub> = 6.0 V | 0 to 400  | ns |

DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter   | Test Condition         |   | Value                 |      |                |      | Unit |
|-----------------|---|------------------------|---|-----------------------|------|----------------|------|------|
|                 |   | V <sub>CC</sub><br>(V) |   | T <sub>A</sub> = 25°C |      | -55°C to 125°C |      |      |
|                 |   |                        |   | Min                   | Max  | Min            | Max  |      |
| V <sub>IH</sub> | High Level Input Voltage  | 2.0                    |   | 1.5                   |      | 1.5            |      | V    |
|                 |   | 4.5                    |   | 3.15                  |      | 3.15           |      |      |
|                 |   | 6.0                    |   | 4.2                   |      | 4.2            |      |      |
| V <sub>IL</sub> | Low Level Input Voltage   | 2.0                    |   |                       | 0.5  |                | 0.5  | V    |
|                 |   | 4.5                    |   |                       | 1.35 |                | 1.35 |      |
|                 |   | 6.0                    |   |                       | 1.8  |                | 1.8  |      |
| V <sub>OH</sub> | High Level Output Voltage<br>(Q Output)   | 2.0                    | I <sub>O</sub> = -20 μA                 | 1.9                   |      | 1.9            |      | V    |
|                 |   | 4.5                    | I <sub>O</sub> = -20 μA                 | 4.4                   |      | 4.4            |      |      |
|                 |   | 6.0                    | I <sub>O</sub> = -20 μA                 | 5.9                   |      | 5.9            |      |      |
|                 |   | 4.5                    | I <sub>O</sub> = -4.0 μA                | 4.18                  |      | 4.10           |      |      |
|                 |   | 6.0                    | I <sub>O</sub> = -5.2 μA                | 5.68                  |      | 5.60           |      |      |
| V <sub>OL</sub> | Low Level Output Voltage<br>(Q Output)  | 2.0                    | I <sub>O</sub> = 20 μA                  |                       | 0.1  |                | 0.1  | V    |
|                 |   | 4.5                    | I <sub>O</sub> = 20 μA                  |                       | 0.1  |                | 0.1  |      |
|                 |   | 6.0                    | I <sub>O</sub> = 20 μA                  |                       | 0.1  |                | 0.1  |      |
|                 |   | 4.5                    | I <sub>O</sub> = 4.0 μA                 |                       | 0.26 |                | 0.40 |      |
|                 |   | 6.0                    | I <sub>O</sub> = 5.2 μA                 |                       | 0.26 |                | 0.40 |      |
| V <sub>OH</sub> | High Level Output Voltage<br>( $\overline{Q}$ , $\overline{\overline{Q}}$ Output) | 2.0                    | I <sub>O</sub> = -20 μA                 | 1.8                   |      | 1.8            |      | V    |
|                 |   | 4.5                    | I <sub>O</sub> = -20 μA                 | 4.4                   |      | 4.0            |      |      |
|                 |   | 6.0                    | I <sub>O</sub> = -20 μA                 | 5.5                   |      | 5.5            |      |      |
| V <sub>OL</sub> | Low Level Output Voltage<br>( $\overline{Q}$ , $\overline{\overline{Q}}$ Output)  | 2.0                    | I <sub>O</sub> = 20 μA                  |                       | 0.2  |                | 0.2  | V    |
|                 |   | 4.5                    | I <sub>O</sub> = 20 μA                  |                       | 0.5  |                | 0.5  |      |
|                 |   | 6.0                    | I <sub>O</sub> = 20 μA                  |                       | 0.5  |                | 0.5  |      |
| I <sub>I</sub>  | Input Leakage Current   | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND |                       | ±0.1 |                | ±1   | μA   |
| I <sub>CC</sub> | Quiescent Supply Current  | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND |                       | 4    |                | 80   | μA   |

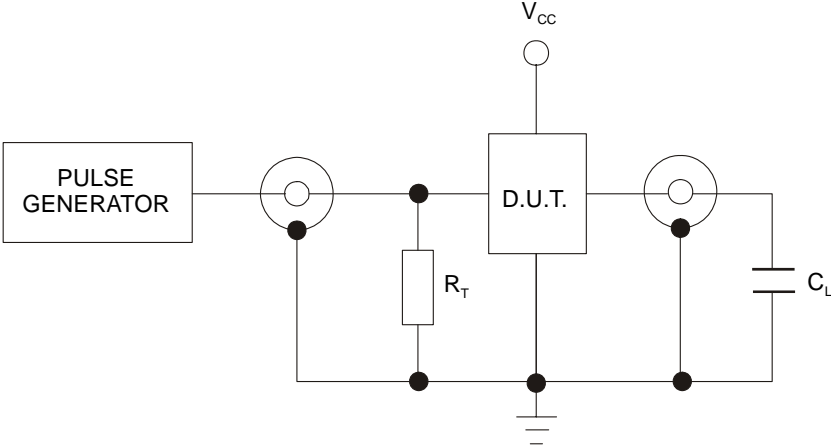
**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50$  pF, Input  $t_r = t_f = 6$  ns)

| Symbol                                   | Parameter   | Test Condition         |  | Value                 |     |                |     | Unit |
|--|---|------------------------|--|-----------------------|-----|----------------|-----|------|
|  |   | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |     | -55°C to 125°C |     |      |
|  |   |                        |  | Min                   | Max | Min            | Max |      |
| t <sub>TLH</sub> , t <sub>THL</sub>      | Output Transition Time  | 2.0                    |  |                       | 75  |                | 110 | ns   |
|  |   | 4.5                    |  |                       | 15  |                | 22  |      |
|  |   | 6.0                    |  |                       | 13  |                | 19  |      |
| t <sub>PLH</sub> , t <sub>PHL</sub>      | Propagation Delay Time<br>( $\overline{01-Q4}$ )                          | 2.0                    |  |                       | 300 |                | 450 | ns   |
|  |   | 4.5                    |  |                       | 60  |                | 90  |      |
|  |   | 6.0                    |  |                       | 51  |                | 76  |      |
| t <sub>PD</sub>                          | Propagation Delay Time Difference<br>(Q <sub>n</sub> – Q <sub>n+1</sub> ) | 2.0                    |  |                       | 75  |                | 110 | ns   |
|  |   | 4.5                    |  |                       | 15  |                | 22  |      |
|  |   | 6.0                    |  |                       | 13  |                | 19  |      |
| t <sub>PHL</sub>                         | Propagation Delay Time<br>(CLEAR – Q <sub>n</sub> )                       | 2.0                    |  |                       | 195 |                | 295 | ns   |
|  |   | 4.5                    |  |                       | 39  |                | 59  |      |
|  |   | 6.0                    |  |                       | 33  |                | 50  |      |
| f <sub>MAX</sub>                         | Maximum Clock Frequency   | 2.0                    |  | 6                     |     | 4              |     | MHz  |
|  |   | 4.5                    |  | 30                    |     | 20             |     |      |
|  |   | 6.0                    |  | 35                    |     | 24             |     |      |
| t <sub>W(H)</sub> ,<br>t <sub>W(L)</sub> | Minimum Pulse Width<br>( $\overline{01}$ )                                | 2.0                    |  |                       | 75  |                | 110 | ns   |
|  |   | 4.5                    |  |                       | 15  |                | 22  |      |
|  |   | 6.0                    |  |                       | 13  |                | 19  |      |
| t <sub>W(H)</sub>                        | Minimum Pulse Width<br>(CLEAR)  | 2.0                    |  |                       | 75  |                | 110 | ns   |
|  |   | 4.5                    |  |                       | 15  |                | 22  |      |
|  |   | 6.0                    |  |                       | 13  |                | 19  |      |
| t <sub>REM</sub>                         | Minimum Removal Time  | 2.0                    |  |                       | 100 |                | 150 | ns   |
|  |   | 4.5                    |  |                       | 20  |                | 30  |      |
|  |   | 6.0                    |  |                       | 17  |                | 26  |      |

**CAPACITIVE CHARACTERISTICS**

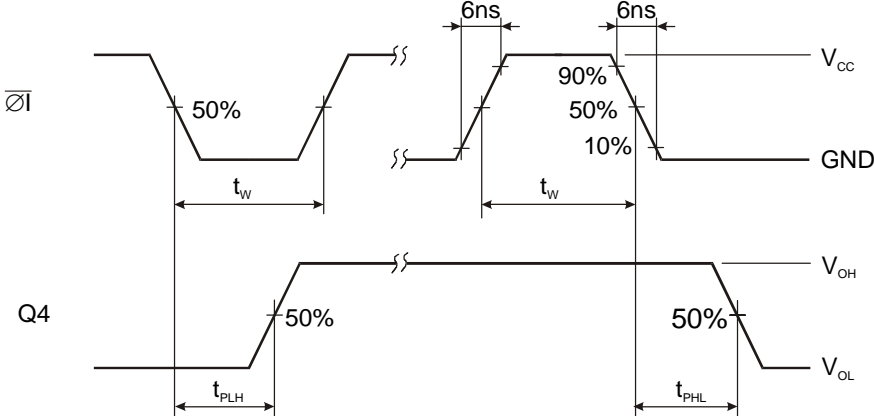
| Symbol          | Parameter         | Test Condition         |  | Value                 |     |                |     | Unit |
|-----------------|-------------------|------------------------|--|-----------------------|-----|----------------|-----|------|
|                 |                   | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |     | -55°C to 125°C |     |      |
|                 |                   |                        |  | Min                   | Max | Min            | Max |      |
| C <sub>IN</sub> | Input Capacitance | 5.0                    |  |                       | 10  |                | 10  | pF   |

TEST CIRCUIT

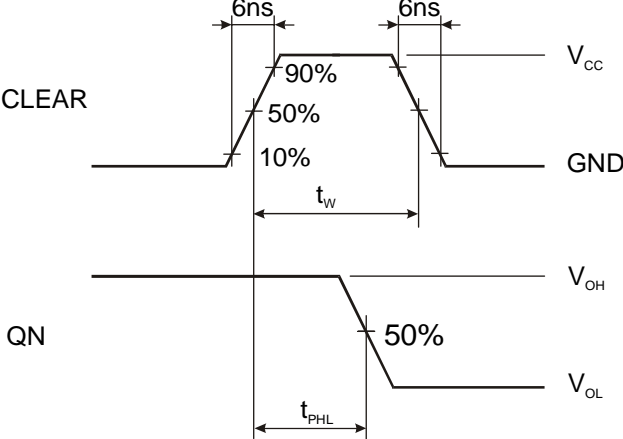


$C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

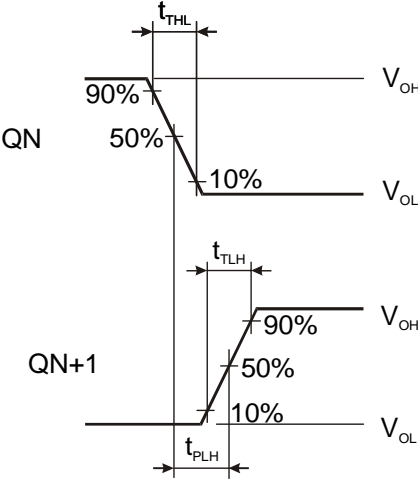
WAVEFORM 1: PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH ( $\overline{Q1}$ ) ( $f=1\text{MHz}$ ; 50% duty cycle)



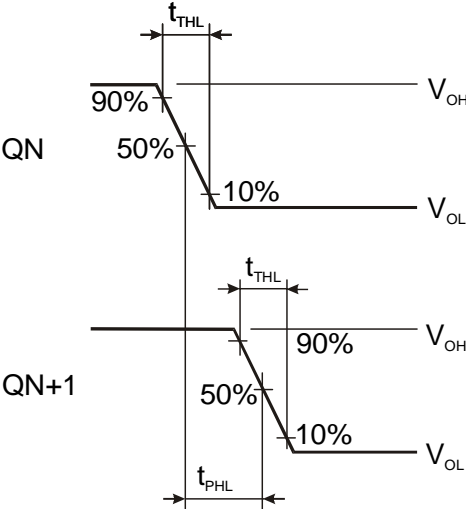
WAVEFORM 2 : PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CLEAR) ( $f=1\text{MHz}$ ; 50% duty cycle)



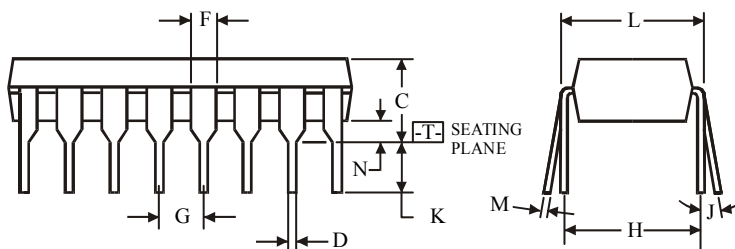
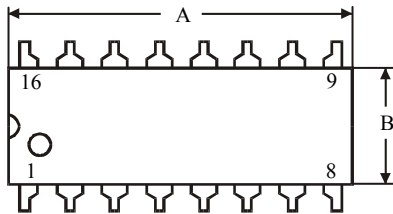
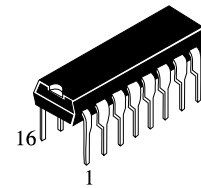
WAVEFORM 3 : PROPAGATION DELAY TIMES (f=1MHz; 50% duty cycle)



WAVEFORM 4 : PROPAGATION DELAY TIMES (f=1MHz; 50% duty cycle)



**N SUFFIX PLASTIC DIP  
(MS - 001BB)**



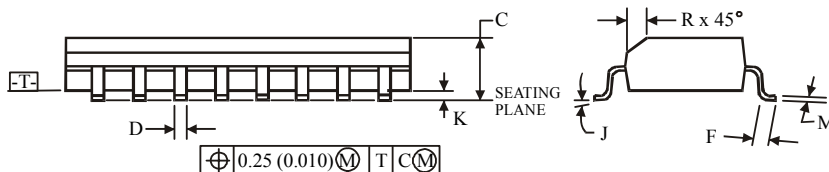
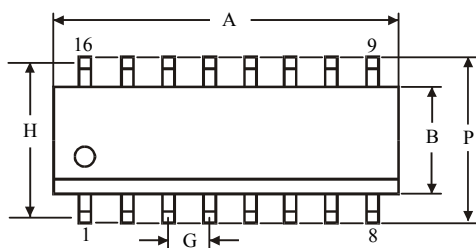
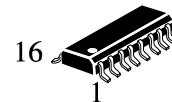
$\oplus 0.25 (0.010) \text{ (M) T}$

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

| Symbol | Dimension, mm |       |
|--------|---------------|-------|
|        | MIN           | MAX   |
| A      | 18.67         | 19.69 |
| B      | 6.1           | 7.11  |
| C      |               | 5.33  |
| D      | 0.36          | 0.56  |
| F      | 1.14          | 1.78  |
| G      | 2.54          |       |
| H      | 7.62          |       |
| J      | 0°            | 10°   |
| K      | 2.92          | 3.81  |
| L      | 7.62          | 8.26  |
| M      | 0.2           | 0.36  |
| N      | 0.38          |       |

**D SUFFIX SOIC  
(MS - 012AC)**



$\oplus 0.25 (0.010) \text{ (M) T C (M)}$

**NOTES:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.

| Symbol | Dimension, mm |      |
|--------|---------------|------|
|        | MIN           | MAX  |
| A      | 9.8           | 10   |
| B      | 3.8           | 4    |
| C      | 1.35          | 1.75 |
| D      | 0.33          | 0.51 |
| F      | 0.4           | 1.27 |
| G      | 1.27          |      |
| H      | 5.72          |      |
| J      | 0°            | 8°   |
| K      | 0.1           | 0.25 |
| M      | 0.19          | 0.25 |
| P      | 5.8           | 6.2  |
| R      | 0.25          | 0.5  |