

14 STAGE BINARY COUNTER/OSCILLATOR

KK74HC4060A

The KK74HC4060A is an high speed CMOS 14-STAGE BINARY COUNTER/OSCILLATOR fabricated with silicon gate C²MOS 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 ($\overline{\text{QI}}$) 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

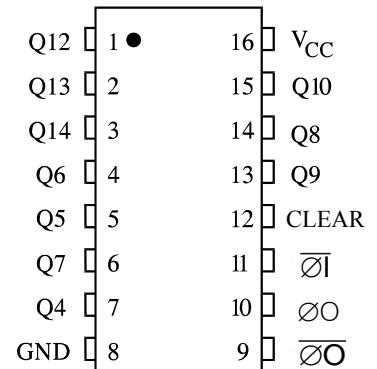
DW SUFFIX SOIC

ORDERING INFORMATION
 KK74HC4060AN Plastic
 KK74HC4060ADW SOIC
 $T_A = -55^\circ \text{ to } 125^\circ \text{ C}$ for all packages

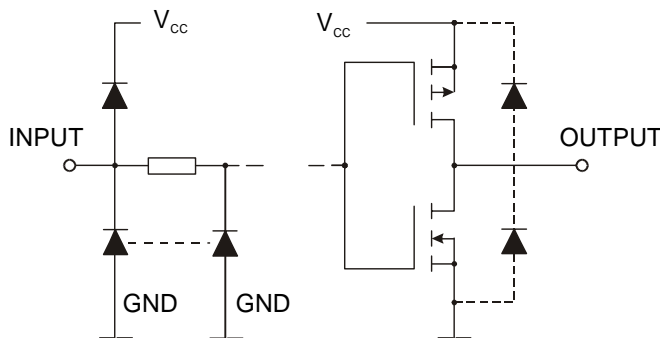
PIN DESCRIPTION

| 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 | RO | External Resistor Connection |
| 11 | $\overline{\text{QI}}$ | Clock Input / Oscillator |
| 12 | CLEAR | Master Reset |
| 08 | GND | Ground (0V) |
| 16 | V _{CC} | Positive Supply Voltage |

PIN ASSIGNMENT



INPUT AND OUTPUT EQUIVALENT CIRCUIT

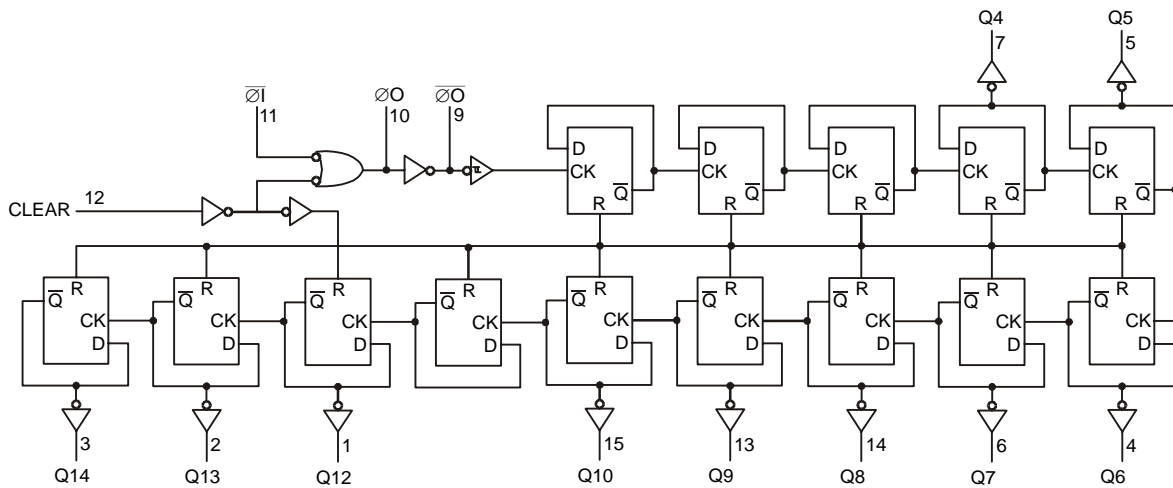


TRUTH TABLE

| $\overline{\text{CI}}$ | CLEAR | FUNCTION |
|------------------------|-------|---|
| X | H | COUNTER IS RESET TO ZERO STATE $\overline{\text{CO}}$ OUTPUT GOES TO HIGH LEVEL $\overline{\text{QO}}$ OUTPUT GOES TO LOW LEVEL |
| \downarrow | L | COUNT UP ONE STEP |
| \uparrow | L | NO CHANGE |

X : Don't Care

LOGIC DIAGRAM



This logic diagram has not be 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 | ± 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 | $^{\circ}C$ |

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 | $^{\circ}C$ | |
| t_r, t_f | Input Rise and Fall Time | $V_{CC} = 2.0\text{ V}$ | 0 to 1000 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 0 to 500 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 0 to 400 | ns |

DC ELECTRICAL CHARACTERISTICS

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

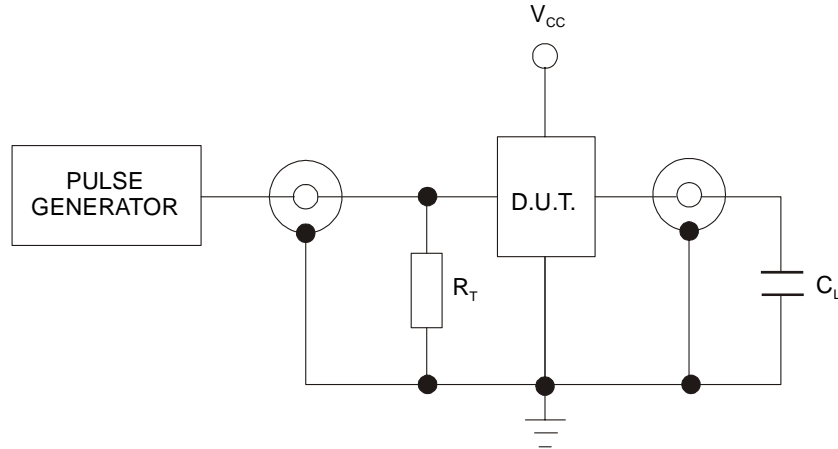
AC ELECTRICAL CHARACTERISTICS ($C_L = 50$ pF, Input $t_r = t_f = 6$ ns)

| Symbol | Parameter | Test Condition | | Value | | | | Unit |
|--|---|------------------------|--|-----------------------|-----|----------------|-----|------|
| | | V _{CC} (V) | | T _A = 25°C | | -55°C to 125°C | | |
| | | | | Min | Max | Min | Max | |
| t _{TLH} , t _{THL} | Output Transition Time | 2.0 | | | 75 | | 110 | ns |
| | | 4.5 | | | 15 | | 22 | |
| | | 6.0 | | | 13 | | 19 | |
| t _{PLH} , t _{PHL} | Propagation Delay Time ($\overline{Q1-Q4}$) | 2.0 | | | 300 | | 450 | ns |
| | | 4.5 | | | 60 | | 90 | |
| | | 6.0 | | | 51 | | 76 | |
| t _{PD} | Propagation Delay Time Difference (Q _n – Q _{n+1}) | 2.0 | | | 75 | | 110 | ns |
| | | 4.5 | | | 15 | | 22 | |
| | | 6.0 | | | 13 | | 19 | |
| t _{PHL} | Propagation Delay Time (CLEAR – Q _n) | 2.0 | | | 195 | | 295 | ns |
| | | 4.5 | | | 39 | | 59 | |
| | | 6.0 | | | 33 | | 50 | |
| f _{MAX} | Maximum Clock Frequency | 2.0 | | 6 | | 4 | | MHz |
| | | 4.5 | | 30 | | 20 | | |
| | | 6.0 | | 35 | | 24 | | |
| t _{W(H)} , t _{W(L)} | Minimum Pulse Width ($\overline{Q1}$) | 2.0 | | | 75 | | 110 | ns |
| | | 4.5 | | | 15 | | 22 | |
| | | 6.0 | | | 13 | | 19 | |
| t _{W(H)} | Minimum Pulse Width (CLEAR) | 2.0 | | | 75 | | 110 | ns |
| | | 4.5 | | | 15 | | 22 | |
| | | 6.0 | | | 13 | | 19 | |
| t _{REM} | Minimum Removal Time | 2.0 | | | 100 | | 150 | ns |
| | | 4.5 | | | 20 | | 30 | |
| | | 6.0 | | | 17 | | 26 | |

CAPACITIVE CHARACTERISTICS

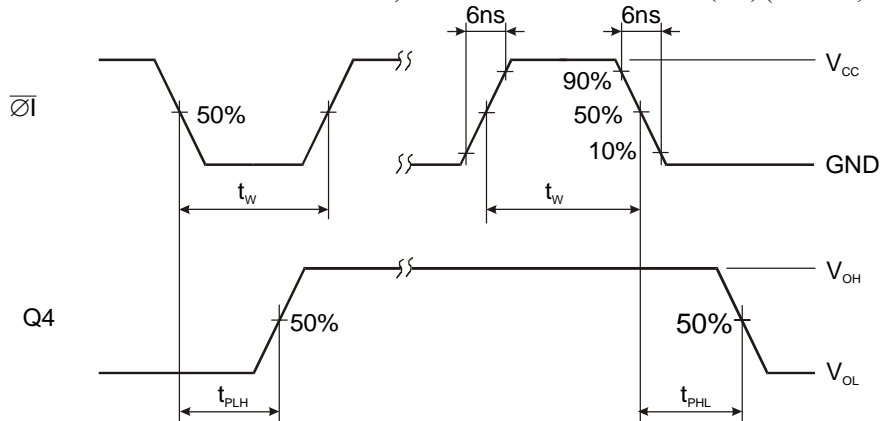
| Symbol | Parameter | Test Condition | | Value | | | | Unit |
|-----------------|-------------------|------------------------|--|-----------------------|-----|----------------|-----|------|
| | | V _{CC} (V) | | T _A = 25°C | | -55°C to 125°C | | |
| | | | | Min | Max | Min | Max | |
| C _{IN} | Input Capacitance | 5.0 | | | 10 | | 10 | pF |

TEST CIRCUIT

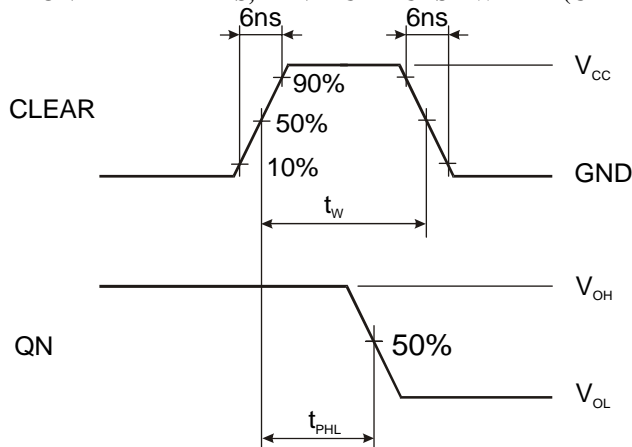


$C_L = 50 \text{ pF}$ or equivalent (includes jig and probe capacitance)
 $R_L = Z_{OUT}$ of pulse generator (typically 50Ω)

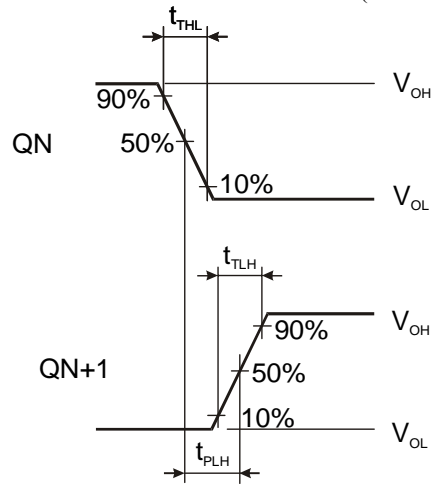
WAVEFORM 1: PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH ($\overline{Q1}$) ($f=1\text{MHz}$; 50% duty cycle)



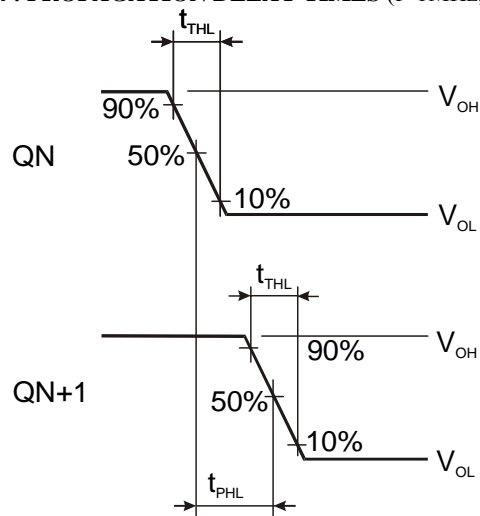
WAVEFORM 2 : PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CLEAR) ($f=1\text{MHz}$; 50% duty cycle)



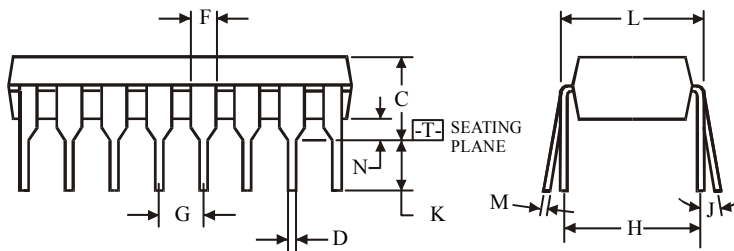
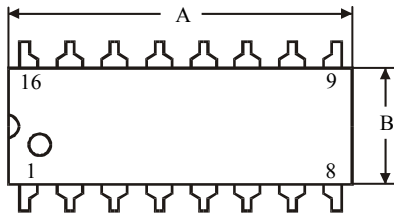
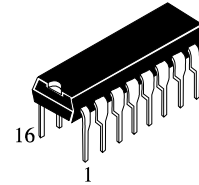
WAVEFORM 3 : PROPAGATION DELAY TIMES (f=1MHz; 50% duty cycle)



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



N SUFFIX PLASTIC DIP (MS - 001BB)



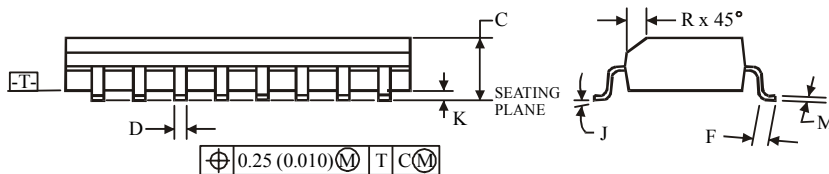
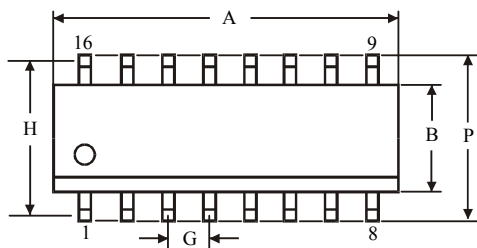
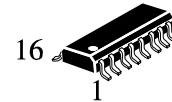
$\oplus 0.25 (0.010) \text{ (M) T}$

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 |