



OCTAL COUNTER WITH 8 DECODED OUTPUTS

- MEDIUM SPEED OPERATION :
10 MHz (Typ.) at $V_{DD} = 10V$
- FULLY STATIC OPERATION
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT
 $I_l = 100nA$ (MAX) AT $V_{DD} = 18V$ $T_A = 25^\circ C$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



ORDER CODES

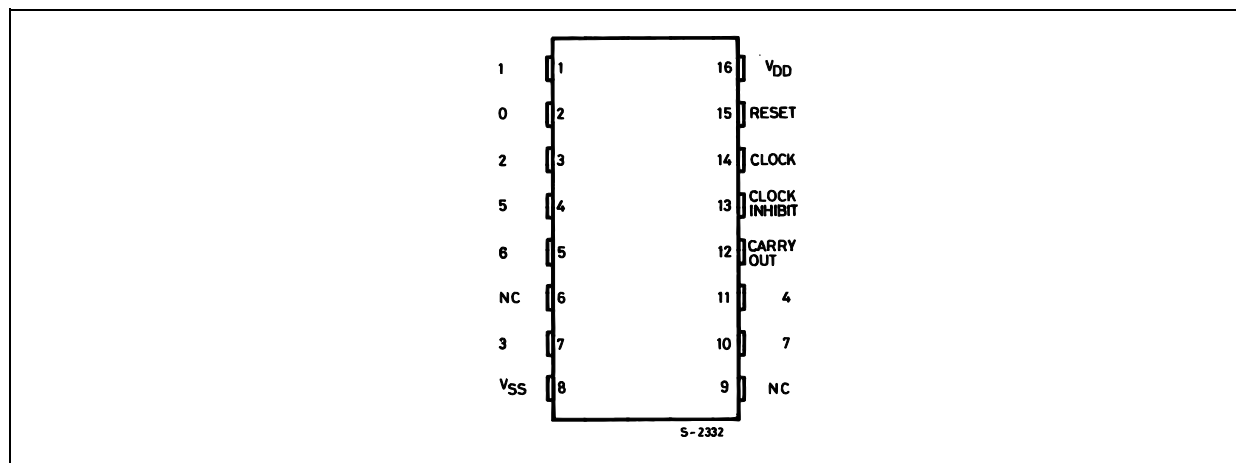
| PACKAGE | TUBE | T & R |
|---------|------------|---------------|
| DIP | HCF4022BEY | |
| SOP | HCF4022BM1 | HCF4022M013TR |

DESCRIPTION

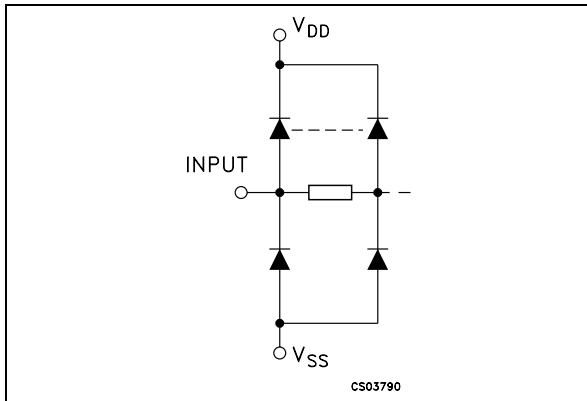
The HCF4022B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. The HCF4022B is 4-stage Johnson counter having 8 decoded outputs. Inputs include a CLOCK, a RESET, and a CLOCK INHIBIT signal. Schmitt trigger action in the clock input circuit provides pulse shaping that allows unlimited clock input pulse rise and fall times. This counter is advanced one count at the positive clock signal transition if the CLOCK INHIBIT signal is low. Counter advanced via the clock line is inhibited

when the CLOCK INHIBIT signal is high. A high RESET signal clears the counter to its zero count. Use of the Johnson decade-counter configuration permits high speed operation, 2-input decimal decode gating and spike-free decoded outputs. Anti-lock gating is provided, thus assuring proper counting sequence. The decoded outputs are normally low and go high only at their respective decoded time slot. Each decoded output remains high for one full clock cycle. A CARRY - OUT signal completes one cycle every 8 clock input cycles and is used to ripple-clock the succeeding device in a multi-device counting chain.

PIN CONNECTION



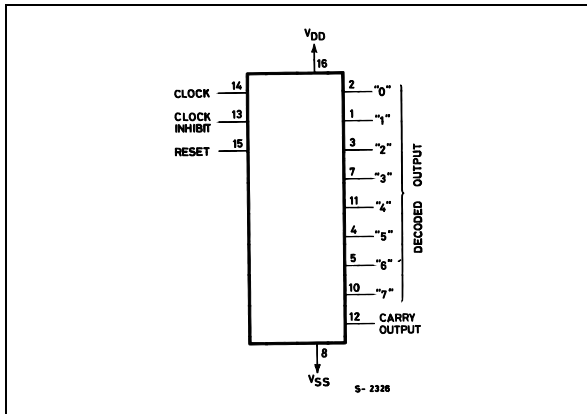
INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------------------------|-----------------|-------------------------|
| 2, 1, 3, 7, 11, 4, 5, 10 | 0 to 7 | Decoded Output |
| 6, 9 | NC | Not Connected |
| 14 | CLOCK | Clock Input |
| 13 | CLOCK INHIBIT | Clock Inhibit Input |
| 15 | RESET | Reset Input |
| 12 | CARRY OUT | Carry Output |
| 8 | V _{SS} | Negative Supply Voltage |

FUNCTIONAL DIAGRAM

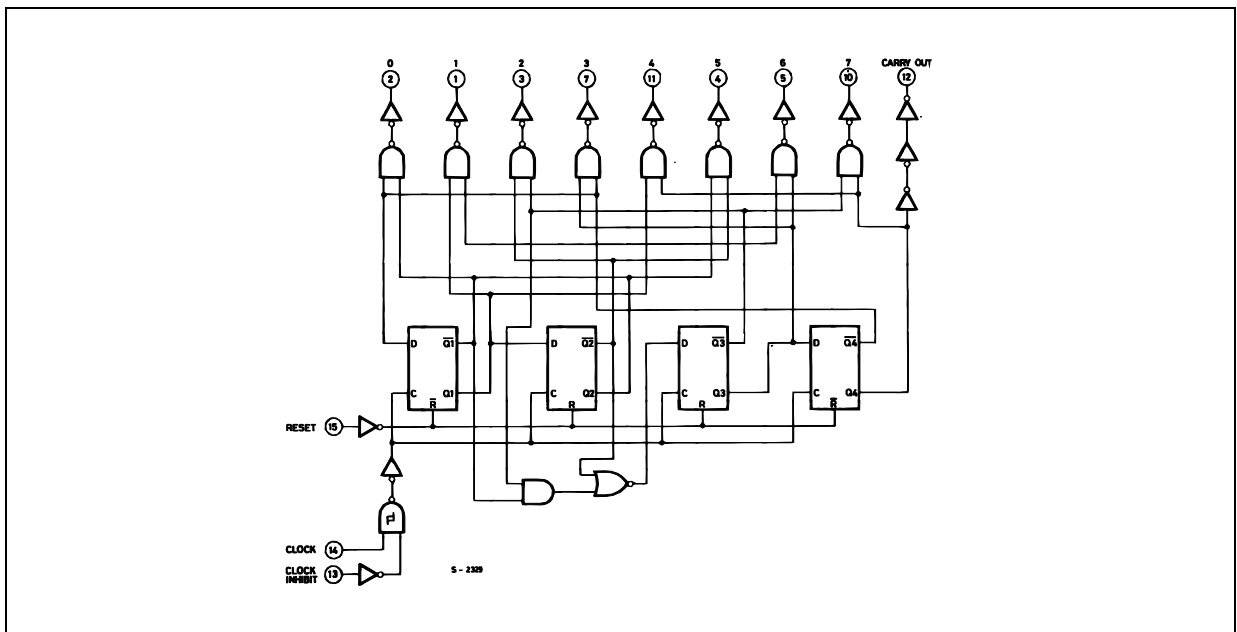


TRUTH TABLE

| CLOCK | CLOCK INHIBIT | RESET | DECODED OUTPUT |
|-------|---------------|-------|------------------|
| X | X | H | Q ₀ |
| L | X | L | Q _n |
| X | H | L | Q _n |
| | L | L | Q _{n+1} |
| | L | L | Q _n |
| H | | L | Q _n |
| H | | L | Q _{n+1} |

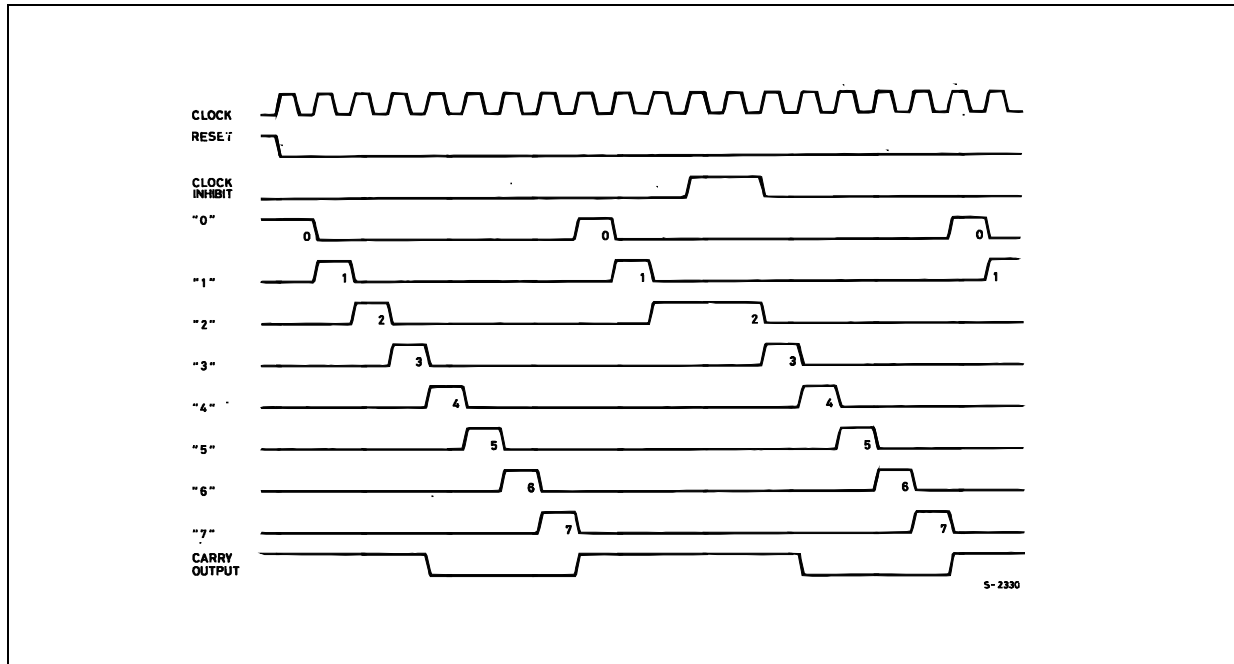
X : Don't Care
Q_n : No Change

LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

TIMING CHART



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------|---|------------------------|--------------------|
| V_{DD} | Supply Voltage | -0.5 to +22 | V |
| V_I | DC Input Voltage | -0.5 to $V_{DD} + 0.5$ | V |
| I_I | DC Input Current | ± 10 | mA |
| P_D | Power Dissipation per Package | 200 | mW |
| | Power Dissipation per Output Transistor | 100 | mW |
| T_{op} | Operating Temperature | -55 to +125 | $^{\circ}\text{C}$ |
| T_{stg} | Storage Temperature | -65 to +150 | $^{\circ}\text{C}$ |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|----------|-----------------------|---------------|--------------------|
| V_{DD} | Supply Voltage | 3 to 20 | V |
| V_I | Input Voltage | 0 to V_{DD} | V |
| T_{op} | Operating Temperature | -55 to 125 | $^{\circ}\text{C}$ |

DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | | | Value | | | | | | Unit | |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------|------------------------|-----------------------|-------------------|------|-------------|------|--------------|------|------|
| | | V _I (V) | V _O (V) | I _{OL} (μA) | V _{DD} (V) | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| I _L | Quiescent Current | 0/5 | | | 5 | | 0.04 | 5 | | 150 | | 150 | μA |
| | | 0/10 | | | 10 | | 0.04 | 10 | | 300 | | 300 | |
| | | 0/15 | | | 15 | | 0.04 | 20 | | 600 | | 600 | |
| | | 0/20 | | | 20 | | 0.08 | 100 | | 3000 | | 3000 | |
| V _{OH} | High Level Output Voltage | 0/5 | | <1 | 5 | 4.95 | | | 4.95 | | 4.95 | | V |
| | | 0/10 | | <1 | 10 | 9.95 | | | 9.95 | | 9.95 | | |
| | | 0/15 | | <1 | 15 | 14.95 | | | 14.95 | | 14.95 | | |
| V _{OL} | Low Level Output Voltage | 5/0 | | <1 | 5 | | 0.05 | | | 0.05 | | 0.05 | V |
| | | 10/0 | | <1 | 10 | | 0.05 | | | 0.05 | | 0.05 | |
| | | 15/0 | | <1 | 15 | | 0.05 | | | 0.05 | | 0.05 | |
| V _{IH} | High Level Input Voltage | | 0.5/4.5 | <1 | 5 | 3.5 | | | 3.5 | | 3.5 | | V |
| | | | 1/9 | <1 | 10 | 7 | | | 7 | | 7 | | |
| | | | 1.5/13.5 | <1 | 15 | 11 | | | 11 | | 11 | | |
| V _{IL} | Low Level Input Voltage | | 4.5/0.5 | <1 | 5 | | | 1.5 | | 1.5 | | 1.5 | V |
| | | | 9/1 | <1 | 10 | | | 3 | | 3 | | 3 | |
| | | | 13.5/1.5 | <1 | 15 | | | 4 | | 4 | | 4 | |
| I _{OH} | Output Drive Current | 0/5 | 2.5 | <1 | 5 | -1.36 | -3.2 | | -1.1 | | -1.1 | | mA |
| | | 0/5 | 4.6 | <1 | 5 | -0.44 | -1 | | -0.36 | | -0.36 | | |
| | | 0/10 | 9.5 | <1 | 10 | -1.1 | -2.6 | | -0.9 | | -0.9 | | |
| | | 0/15 | 13.5 | <1 | 15 | -3.0 | -6.8 | | -2.4 | | -2.4 | | |
| I _{OL} | Output Sink Current | 0/5 | 0.4 | <1 | 5 | 0.44 | 1 | | 0.36 | | 0.36 | | mA |
| | | 0/10 | 0.5 | <1 | 10 | 1.1 | 2.6 | | 0.9 | | 0.9 | | |
| | | 0/15 | 1.5 | <1 | 15 | 3.0 | 6.8 | | 2.4 | | 2.4 | | |
| I _I | Input Leakage Current | 0/18 | Any Input | | 18 | | ±10 ⁻⁵ | ±0.1 | | ±1 | | ±1 | μA |
| C _I | Input Capacitance | | Any Input | | | | 5 | 7.5 | | | | | pF |

The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD}=5V, 2V min. with V_{DD}=10V, 2.5V min. with V_{DD}=15V

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50\text{pF}$, $R_L = 200\text{K}\Omega$, $t_r = t_f = 20\text{ ns}$)

| Symbol | Parameter | Test Condition | | Value (*) | | | Unit |
|--------------------------|---|----------------|--|-----------|------|------|---------------|
| | | V_{DD} (V) | | Min. | Typ. | Max. | |
| CLOCKED OPERATION | | | | | | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (decode out) | 5 | | | 325 | 650 | ns |
| | | 10 | | | 135 | 270 | |
| | | 15 | | | 85 | 170 | |
| | Propagation Delay Time (carry out) | 5 | | | 300 | 600 | ns |
| | | 10 | | | 125 | 250 | |
| | | 15 | | | 80 | 160 | |
| t_{THL} t_{TLH} | Transition Time (carry out or decoded out lines) | 5 | | | 100 | 200 | ns |
| | | 10 | | | 50 | 100 | |
| | | 15 | | | 40 | 80 | |
| $f_{CL}^{(1)}$ | Maximum Clock Input Frequency | 5 | | 2.5 | 5 | 5 | MHz |
| | | 10 | | 5 | 10 | | |
| | | 15 | | 5.5 | 11 | | |
| t_W | Minimum Clock Pulse Width | 5 | | | 100 | 200 | ns |
| | | 10 | | | 45 | 90 | |
| | | 15 | | | 30 | 60 | |
| t_r , t_f | Clock Input Rise or Fall Time | 5 | | unlimited | | | μs |
| | | 10 | | | | | |
| | | 15 | | | | | |
| t_{setup} | Data Setup Time Minimum Clock Inhibit | 5 | | | 115 | 230 | ns |
| | | 10 | | | 50 | 100 | |
| | | 15 | | | 35 | 75 | |
| RESET OPERATION | | | | | | | |
| t_{PLH} , t_{PHL} | Propagation Delay Time (carry out or decoded out lines) | 5 | | | 265 | 530 | ns |
| | | 10 | | | 115 | 230 | |
| | | 15 | | | 85 | 170 | |
| t_W | Minimum Reset Pulse Width | 5 | | | 130 | 260 | ns |
| | | 10 | | | 55 | 110 | |
| | | 15 | | | 30 | 60 | |
| t_{REM} | Minimum Reset Removal Time | 5 | | | 200 | 400 | ns |
| | | 10 | | | 140 | 280 | |
| | | 15 | | | 75 | 150 | |

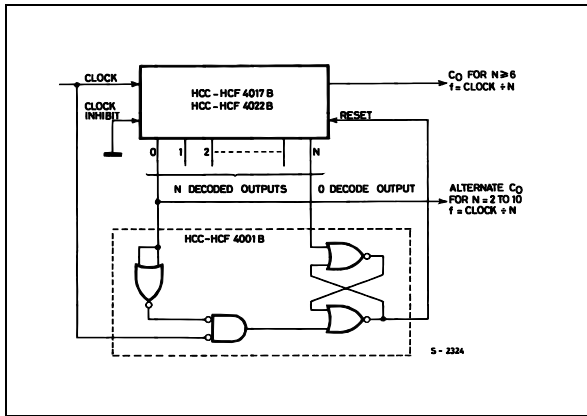
(*) Typical temperature coefficient for all V_{DD} value is 0.3 %/°C.

(1) Measured with respect to carry out line.

HCF4022B

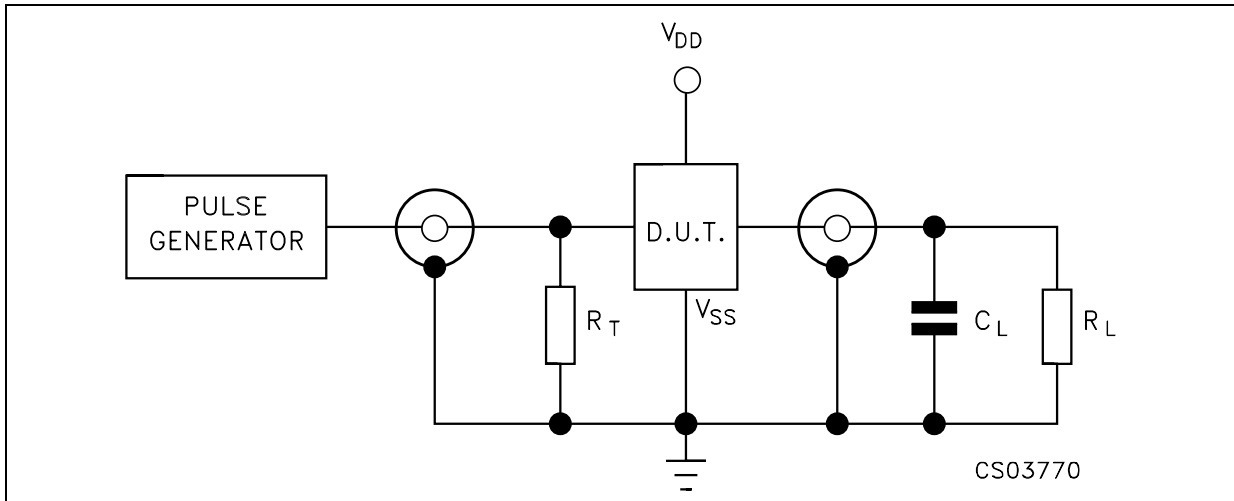
TYPICAL APPLICATIONS

DIVIDE BY N COUNTER ($N \leq 10$) WITH DECODED OUTPUTS



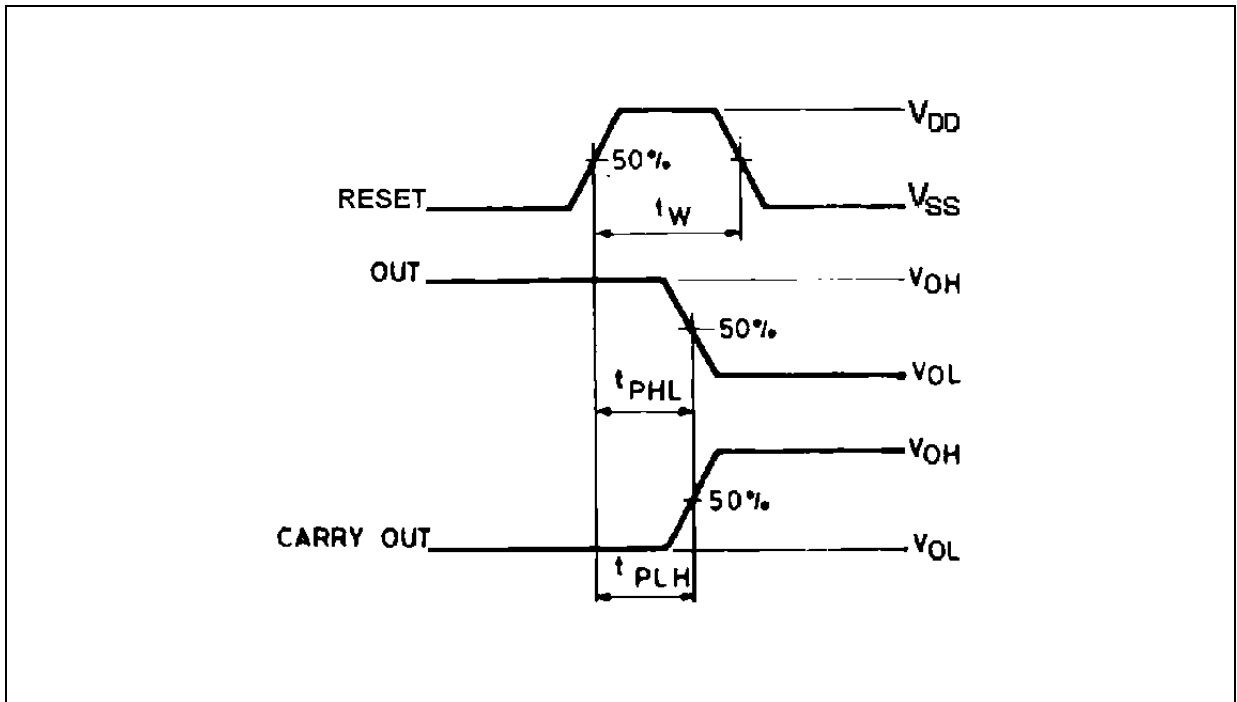
When the N^{th} decoded output is reached (N^{th} clock pulse) the S-R flip-flop (constructed from two NOR gates of the HCF4001B) generates a reset pulse which clears the HCF4022B to its zero count. At this time, if the N^{th} decoded output is greater than or equal to 6, the C_{OUT} line goes high to clock the next HCF4022B counter section. The "0" decoded output also goes high at this time. Coincidence of the clock low and decoded "0" output high resets the S-R flip-flop to enable the HCF4022B. If the N^{th} decoded output is less than 6, the C_{OUT} line will not go high and, therefore, cannot be used. In this case "0" decoded output may be used to perform the clocking function for the next counter.

TEST CIRCUIT

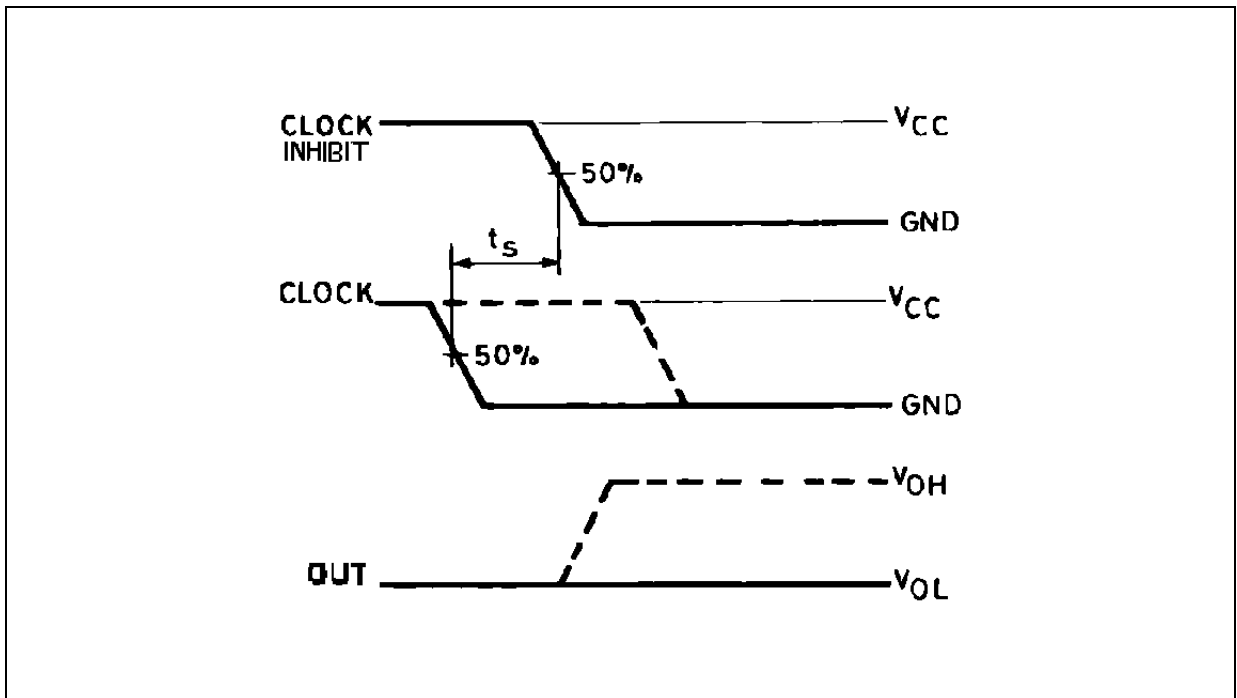


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_L = 200\text{K}\Omega$
 $R_T = Z_{\text{OUT}}$ of pulse generator (typically 50Ω)

WAVEFORM 3 : PROPAGATION DELAY TIMES, MINIMUM RESET PULSE WIDTH (f=1MHz; 50% duty cycle)



WAVEFORM 4 : MINIMUM SETUP TIME (CLOCK TO CLOCK INHIBIT) (f=1MHz; 50% duty cycle)



Plastic DIP-16 (0.25) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 17.78 | | | 0.700 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |



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

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