

SN54HC4020, SN74HC4020 14-BIT ASYNCHRONOUS BINARY COUNTERS

SCLS158B – DECEMBER 1982 – REVISED MAY 1997

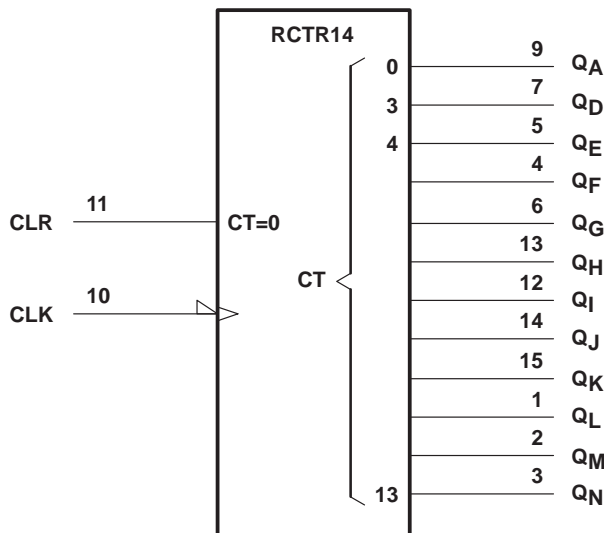
- Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

description

These devices are 14-stage binary ripple-carry counters that advance on the negative-going edge of the clock pulse. The counters are reset to zero (all outputs low) independently of the clock (CLK) input when the clear (CLR) input goes high.

The SN54HC4020 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74HC4020 is characterized for operation from -40°C to 85°C .

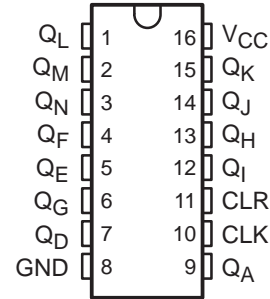
logic symbol†



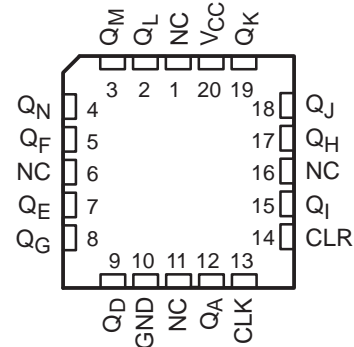
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for the D, J, N, and W packages.

SN54HC4020 . . . J OR W PACKAGE
SN74HC4020 . . . D OR N PACKAGE
(TOP VIEW)



SN54HC4020 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

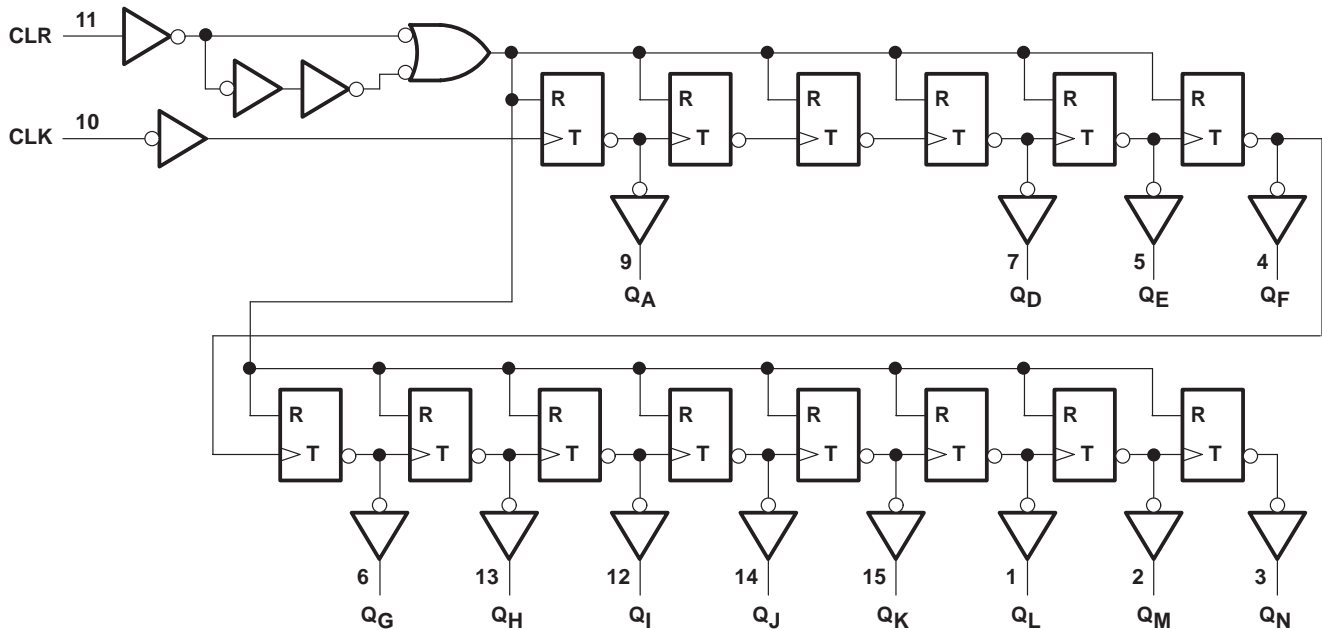
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logic diagram (positive logic)



Pin numbers shown are for the D, J, N, and W packages.

absolute maximum ratings over operating free-air temperature†

| | |
|---|----------------|
| Supply voltage range, V_{CC} | -0.5 V to 7 V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1) | ± 20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) | ± 20 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ± 25 mA |
| Continuous current through V_{CC} or GND | ± 50 mA |
| Package thermal impedance, θ_{JA} (see Note 2): D package | 113°C/W |
| N package | 78°C/W |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

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recommended operating conditions

| | | SN54HC4020 | | | SN74HC4020 | | | UNIT |
|-----------------|---------------------------------------|-------------------------|-----------------|------|------------|-----------------|-----|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} | Supply voltage | 2 | 5 | 6 | 2 | 5 | 6 | V |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | 1.5 | | 1.5 | | V | |
| | | V _{CC} = 4.5 V | 3.15 | | 3.15 | | | |
| | | V _{CC} = 6 V | 4.2 | | 4.2 | | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | 0 | 0.5 | 0 | 0.5 | V | |
| | | V _{CC} = 4.5 V | 0 | 1.35 | 0 | 1.35 | | |
| | | V _{CC} = 6 V | 0 | 1.8 | 0 | 1.8 | | |
| V _I | Input voltage | 0 | V _{CC} | | 0 | V _{CC} | | V |
| V _O | Output voltage | 0 | V _{CC} | | 0 | V _{CC} | | V |
| t _t | Input transition (rise and fall) time | V _{CC} = 2 V | 0 | 1000 | 0 | 1000 | ns | |
| | | V _{CC} = 4.5 V | 0 | 500 | 0 | 500 | | |
| | | V _{CC} = 6 V | 0 | 400 | 0 | 400 | | |
| T _A | Operating free-air temperature | -55 | | 125 | -40 | | 85 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V _{CC} | T _A = 25°C | | | SN54HC4020 | | SN74HC4020 | | UNIT |
|-----------------|---|---------------------------|-----------------|-----------------------|-------|------|------------|-----|------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -20 μA | 2 V | 1.9 | 1.998 | | 1.9 | | 1.9 | V | |
| | | | 4.5 V | 4.4 | 4.499 | | 4.4 | | 4.4 | | |
| | | | 6 V | 5.9 | 5.999 | | 5.9 | | 5.9 | | |
| | | I _{OH} = -4 mA | 4.5 V | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | | I _{OH} = -5.2 mA | 6 V | 5.48 | 5.8 | | 5.2 | | 5.34 | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2 V | | 0.002 | 0.1 | | 0.1 | | V | |
| | | | 4.5 V | | 0.001 | 0.1 | | 0.1 | | | 0.1 |
| | | | 6 V | | 0.001 | 0.1 | | 0.1 | | | 0.1 |
| | | I _{OL} = 4 mA | 4.5 V | | 0.17 | 0.26 | | 0.4 | | | 0.33 |
| | | I _{OL} = 5.2 mA | 6 V | | 0.15 | 0.26 | | 0.4 | | | 0.33 |
| I _I | V _I = V _{CC} or 0 | 6 V | | ±0.1 | ±100 | | ±1000 | | ±1000 | nA | |
| I _{CC} | V _I = V _{CC} or 0, I _O = 0 | 6 V | | | 8 | | 160 | | 80 | μA | |
| C _i | | 2 V to 6 V | | 3 | 10 | | 10 | | 10 | pF | |



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timing requirements over recommended operating free-air temperature range (unless otherwise noted)

| | | V _{CC} | T _A = 25°C | | SN54HC4020 | | SN74HC4020 | | UNIT |
|--------------------|--------------------------------------|-----------------|-----------------------|-----|------------|-----|------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| f _{clock} | Clock frequency | 2 V | 0 | 5.5 | 0 | 3.7 | 0 | 4.3 | MHz |
| | | 4.5 V | 0 | 28 | 0 | 19 | 0 | 22 | |
| | | 6 V | 0 | 33 | 0 | 22 | 0 | 25 | |
| t _w | Pulse duration | CLK high or low | 2 V | 90 | | 135 | | 115 | ns |
| | | | 4.5 V | 18 | | 27 | | 23 | |
| | | | 6 V | 15 | | 23 | | 20 | |
| | CLR high | 2 V | 70 | | 105 | | 90 | | |
| | | 4.5 V | 14 | | 21 | | 18 | | |
| | | 6 V | 12 | | 18 | | 25 | | |
| t _{su} | Setup time, CLR inactive before CLK↓ | 2 V | 60 | | 90 | | 75 | ns | |
| | | 4.5 V | 12 | | 18 | | 15 | | |
| | | 6 V | 10 | | 15 | | 13 | | |

switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

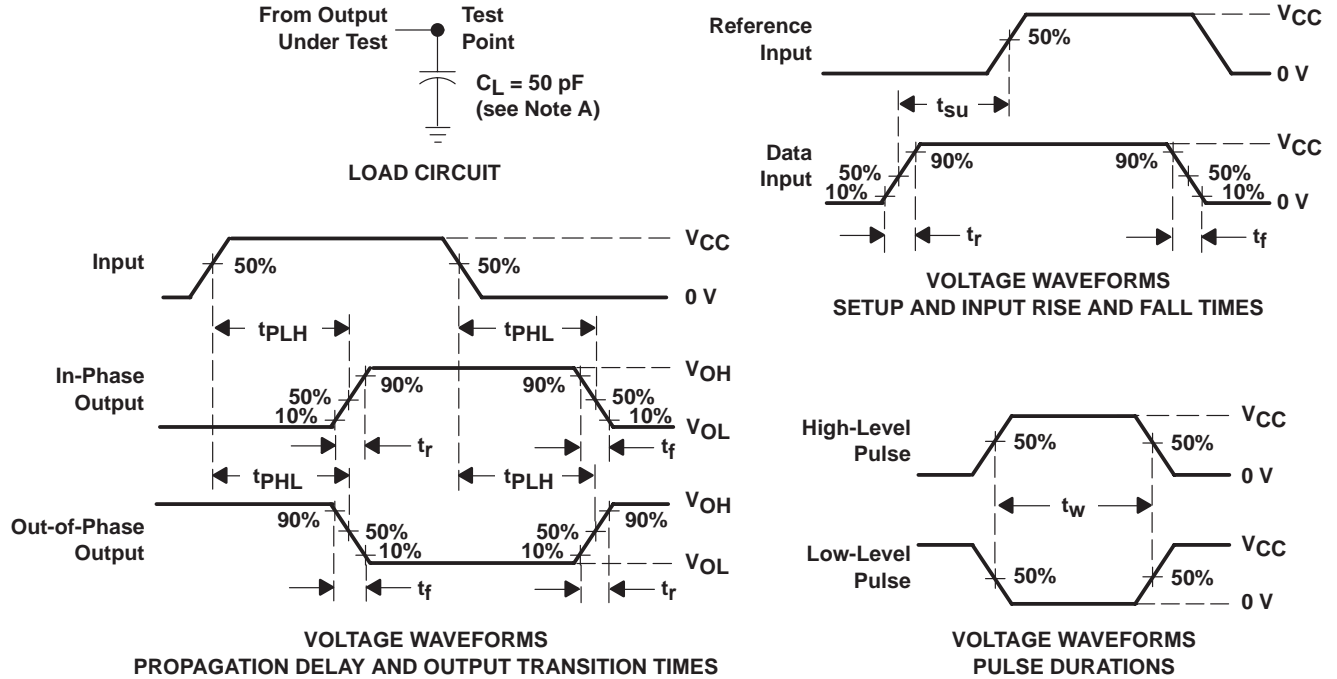
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} | T _A = 25°C | | | SN54HC4020 | | SN74HC4020 | | UNIT |
|------------------|--------------|----------------|-----------------|-----------------------|-----|-----|------------|-----|------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f _{max} | | | 2 V | 5.5 | 10 | | 3.7 | | 4.3 | MHz | |
| | | | 4.5 V | 28 | 45 | | 19 | | 22 | | |
| | | | 6 V | 33 | 53 | | 22 | | 25 | | |
| t _{pd} | CLK | Q _A | 2 V | | 62 | 150 | | 225 | | 190 | ns |
| | | | 4.5 V | | 16 | 30 | | 45 | | 38 | |
| | | | 6 V | | 12 | 26 | | 38 | | 32 | |
| t _{PHL} | CLR | Any | 2 V | | 63 | 140 | | 210 | | 175 | ns |
| | | | 4.5 V | | 17 | 28 | | 42 | | 35 | |
| | | | 6 V | | 13 | 24 | | 36 | | 30 | |
| t _t | | Any | 2 V | | 28 | 75 | | 110 | | 95 | ns |
| | | | 4.5 V | | 8 | 15 | | 22 | | 19 | |
| | | | 6 V | | 6 | 13 | | 19 | | 16 | |

operating characteristics, T_A = 25°C

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|-----------------|-------------------------------|-----------------|-----|------|
| C _{pd} | Power dissipation capacitance | No load | 88 | pF |



PARAMETER MEASUREMENT INFORMATION



- NOTES: A. C_L includes probe and test-fixture capacitance.
 B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
 C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 D. The outputs are measured one at a time with one input transition per measurement.
 E. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

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