

# SN54HC4024, SN74HC4024 ASYNCHRONOUS 7-BIT BINARY COUNTERS

D2804, MARCH 1984—REVISED JUNE 1989

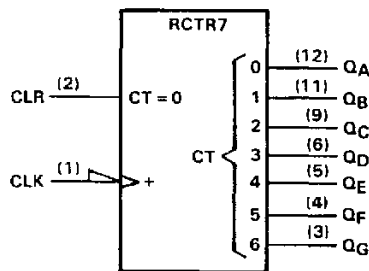
- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs
- Dependable Texas Instruments Quality and Reliability

### description

The 'HC4024 is an asynchronous 7-stage binary counter designed with an input pulse-shaping circuit. The outputs of all stages are available externally. A high clear signal asynchronously clears the counter and resets all outputs low. The count is advanced on the high-to-low transition of the clock pulse. Applications include time-delay circuits, counter controls, and frequency-dividing circuits.

The SN54HC4024 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC4024 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

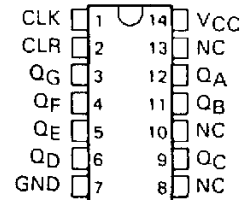
### logic symbol†



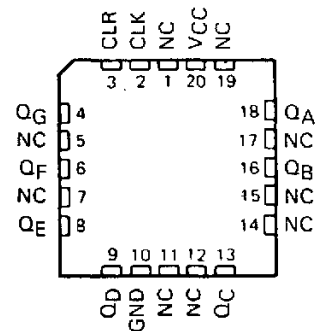
†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

SN54HC4024 . . . J PACKAGE  
SN74HC4024 . . . D OR N PACKAGE  
(TOP VIEW)



SN54HC4024 . . . FK PACKAGE  
(TOP VIEW)



NC—No internal connection

PRODUCTION DATA documents contain information 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.

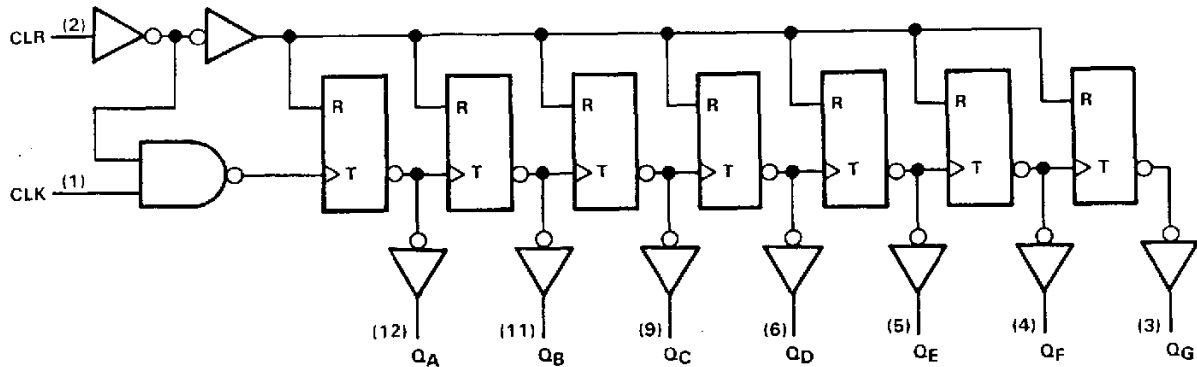
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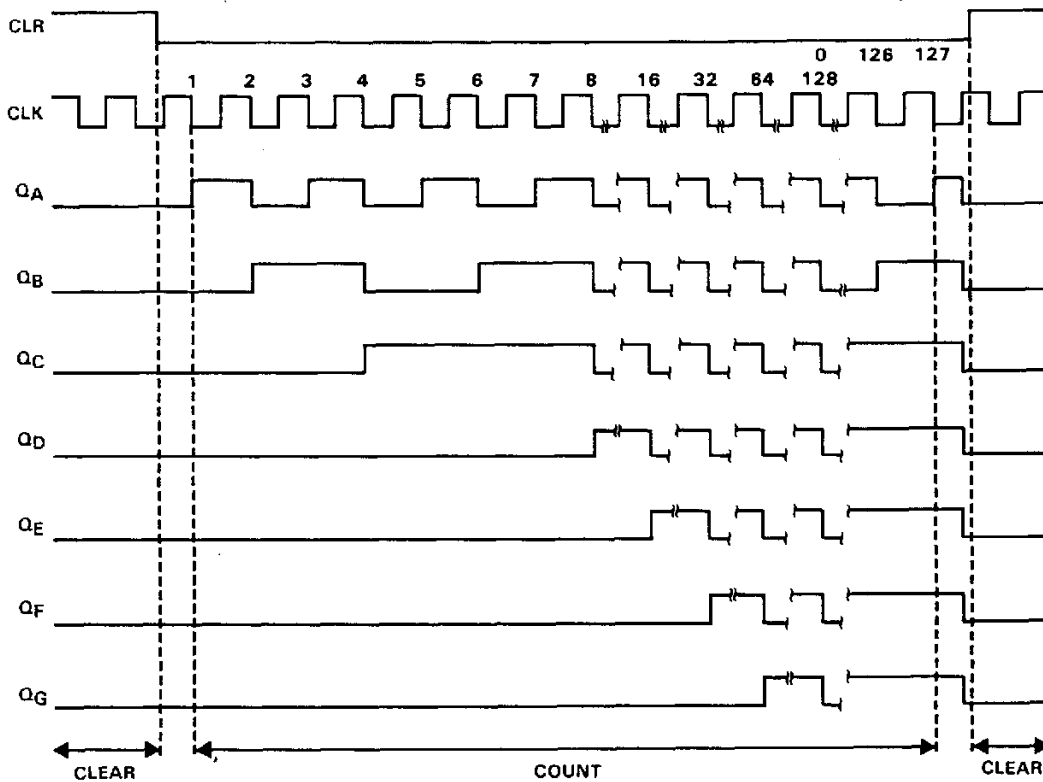
**SN54HC4024, SN74HC4024  
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logic diagram (positive logic)



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

typical clear and count sequence



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## SN54HC4024, SN74HC4024 ASYNCHRONOUS 7-BIT BINARY COUNTERS

### absolute maximum ratings over operating free-air temperature range†

|   |                  |
|---|------------------|
| Supply voltage, $V_{CC}$ .....  | -0.5 V to 7 V    |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....         | $\pm 20$ mA      |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....        | $\pm 20$ mA      |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....            | $\pm 25$ mA      |
| Continuous current through $V_{CC}$ or GND pins .....                       | $\pm 50$ mA      |
| Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or J package ..... | 300 °C           |
| Lead temperature 1,6 mm (1/16 in) from case for 10 s: D or N package .....  | 260 °C           |
| Storage temperature range .....   | -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.

### recommended operating conditions

|          |  | SN54HC4024       |     |      | SN74HC4024       |     |      | 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  | $V_{CC} = 2$ V   |     | 1.5  | V    |    |    |
|          |  | $V_{CC} = 4.5$ V |     | 3.15 | $V_{CC} = 4.5$ V |     | 3.15 |      |    |    |
|          |  | $V_{CC} = 6$ V   |     | 4.2  | $V_{CC} = 6$ V   |     | 4.2  |      |    |    |
| $V_{IL}$ | Low-level input voltage                | $V_{CC} = 2$ V   |     | 0    | $V_{CC} = 2$ V   |     | 0    | V    |    |    |
|          |  | $V_{CC} = 4.5$ V |     | 0    | $V_{CC} = 4.5$ V |     | 0    |      |    |    |
|          |  | $V_{CC} = 6$ V   |     | 0    | $V_{CC} = 6$ V   |     | 0    |      |    |    |
| $V_I$    | Input voltage                          | 0                |     |      | $V_{CC}$         |     |      | V    |    |    |
| $V_O$    | Output voltage                         | 0                |     |      | $V_{CC}$         |     |      | V    |    |    |
| $t_t$    | Input transition (rise and fall) times | $V_{CC} = 2$ V   |     | 0    | $V_{CC} = 2$ V   |     | 1000 | ns   |    |    |
|          |  | $V_{CC} = 4.5$ V |     | 0    | $V_{CC} = 4.5$ V |     | 500  |      |    |    |
|          |  | $V_{CC} = 6$ V   |     | 0    | $V_{CC} = 6$ V   |     | 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 |           |           | SN54HC4024 |            | SN74HC4024 |            | UNIT    |
|-----------|---|----------|---------------|-----------|-----------|------------|------------|------------|------------|---------|
|           |   |          | MIN           | TYP       | MAX       | MIN        | MAX        | MIN        | MAX        |         |
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$ , $I_{OH} = -20$ $\mu$ A | 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        |            |         |
|           | 4.5 V   | 3.98     | 4.30          |           | 3.7       |            | 3.84       |            |            |         |
|           | $V_I = V_{IH}$ or $V_{IL}$ , $I_{OH} = -5.2$ mA     | 6 V      | 5.48          | 5.80      |           | 5.2        |            | 5.34       |            |         |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$ , $I_{OL} = 20$ $\mu$ A  | 2 V      |               | 0.002     | 0.1       |            | 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        |         |
|           | 4.5 V   |          | 0.17          | 0.26      |           | 0.4        |            | 0.33       |            |         |
|           | $V_I = V_{IH}$ or $V_{IL}$ , $I_{OL} = 5.2$ mA      | 6 V      |               | 0.15      | 0.26      |            | 0.4        |            | 0.33       |         |
| $I_i$     | $V_I = V_{CC}$ or 0                                 | 6 V      |               | $\pm 0.1$ | $\pm 100$ |            | $\pm 1000$ |            | $\pm 1000$ | nA      |
| $I_{CC}$  | $V_I = V_{CC}$ or 0, $I_O = 0$                      | 6 V      |               |           | 8         |            | 160        |            | 80         | $\mu$ A |
| $C_i$     |   | 2 to 6 V |               | 3         | 10        |            | 10         |            | 10         | pF      |

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ASYNCHRONOUS 7-BIT BINARY COUNTERS**

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

|                    |                                 | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC4024 |     | SN74HC4024 |     | UNIT |
|--------------------|---------------------------------|-----------------|-----------------------|-----|-----|------------|-----|------------|-----|------|
|                    |                                 |                 | MIN                   | TYP | MAX | MIN        | MAX | MIN        | MAX |      |
| f <sub>clock</sub> | 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 <sub>w</sub>     | 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             | 80                    |     | 120 |            | 100 | ns         |     |      |
|                    |                                 | 4.5 V           | 16                    |     | 24  |            | 20  |            |     |      |
|                    |                                 | 6 V             | 14                    |     | 20  |            | 17  |            |     |      |
| t <sub>su</sub>    | Setup time, CLR low before CLK↓ | 2 V             | 80                    |     | 120 |            | 100 | ns         |     |      |
|                    |                                 | 4.5 V           | 16                    |     | 24  |            | 20  |            |     |      |
|                    |                                 | 6 V             | 14                    |     | 20  |            | 17  |            |     |      |

switching characteristics over recommended operating free-air temperature range (unless otherwise noted), C<sub>L</sub> = 50 pF (see Note 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT)    | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC4024 |     | SN74HC4024 |     | UNIT |
|------------------|--------------|----------------|-----------------|-----------------------|-----|-----|------------|-----|------------|-----|------|
|                  |              |                |                 | MIN                   | TYP | MAX | MIN        | MAX | MIN        | MAX |      |
| f <sub>max</sub> |              | Q <sub>A</sub> | 2 V             | 5.5                   | 10  |     | 3.7        |     | 4.3        | MHz |      |
|                  |              |                | 4.5 V           | 28                    | 50  |     | 19         |     | 22         |     |      |
|                  |              |                | 6 V             | 33                    | 60  |     | 22         |     | 26         |     |      |
| t <sub>pd</sub>  | CLK          | Q <sub>A</sub> | 2 V             |                       | 56  | 120 |            | 180 |            | 150 | ns   |
|                  |              |                | 4.5 V           |                       | 16  | 24  |            | 36  |            | 30  |      |
|                  |              |                | 6 V             |                       | 12  | 20  |            | 31  |            | 26  |      |
| t <sub>PHL</sub> | CLR          | Any            | 2 V             |                       | 61  | 130 |            | 195 |            | 165 | ns   |
|                  |              |                | 4.5 V           |                       | 17  | 26  |            | 39  |            | 32  |      |
|                  |              |                | 6 V             |                       | 13  | 22  |            | 33  |            | 28  |      |
| t <sub>t</sub>   |              | Q <sub>A</sub> | 2 V             |                       | 28  | 75  |            | 110 |            | 95  | ns   |
|                  |              |                | 4.5 V           |                       | 8   | 15  |            | 22  |            | 19  |      |
|                  |              |                | 6 V             |                       | 6   | 13  |            | 19  |            | 16  |      |

|                 |                               |                                |           |
|-----------------|-------------------------------|--------------------------------|-----------|
| C <sub>pd</sub> | Power dissipation capacitance | No load, T <sub>A</sub> = 25°C | 40 pF typ |
|-----------------|-------------------------------|--------------------------------|-----------|

Note 1: Load circuits and voltage waveforms are shown in Section 1.



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