

# HD14022B

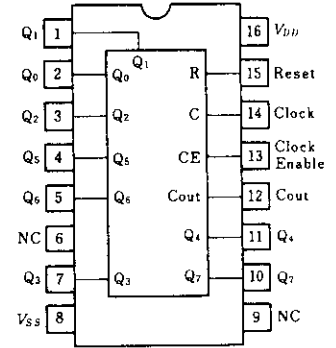
## Octal Counter/Divider

The HD14022B is a four-stage Johnson octal counter with built-in code converter. High speed operation and spike-free outputs are obtained by use of a Johnson octal counter design. The eight decoded outputs are normally low, and go high only at their appropriate octal time period. The output changes occur on the positive-going edge of the clock pulse. This part can be used in frequency division applications as well as octal counter or octal decode display applications.

### FEATURES

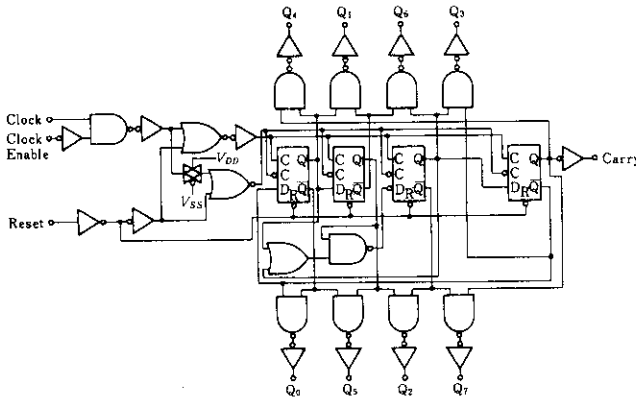
- Quiescent Current = 5nA/pkg typ. @5V
- Supply Voltage Range = 3 to 18V
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4022B and HD14022B

### PIN ARRANGEMENT



(Top View)

### LOGIC DIAGRAM

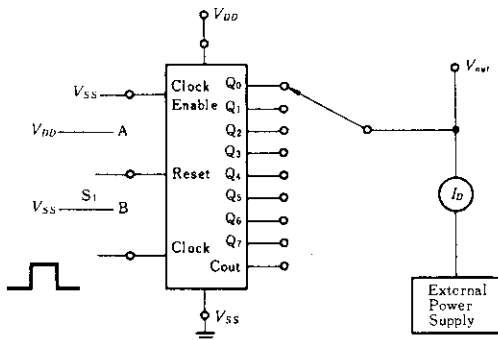


### TRUTH TABLE

| Clock | Clock Enable | Reset | Output n       |
|-------|--------------|-------|----------------|
| L     | x            | L     | n              |
| x     | H            | L     | n              |
| ↗     | L            | L     | n + 1          |
| ↘     | x            | L     | n              |
| H     | ↗            | L     | n + 1          |
| x     | ↘            | L     | n              |
| x     | x            | H     | Q <sub>0</sub> |

x : Don't Care  
 n < 4... Carry = H  
 n ≥ 4... Carry = L

### Typical Output Source and Output Sink Characteristics Test Circuit



|                 | $I_{OL}$  | $I_{OH}$                                      |
|-----------------|---|---|
| Outputs         | (S <sub>1</sub> → A)  | Clock to desired Output (S <sub>1</sub> to B) |
| Carry           | Clock to Q <sub>5</sub> thru Q <sub>7</sub> (S <sub>1</sub> to B) | S <sub>1</sub> → A                            |
| V <sub>CS</sub> | V <sub>DD</sub>   | -V <sub>DD</sub>                              |
| V <sub>DS</sub> | V <sub>ext</sub>  | V <sub>ext</sub> - V <sub>DD</sub>            |

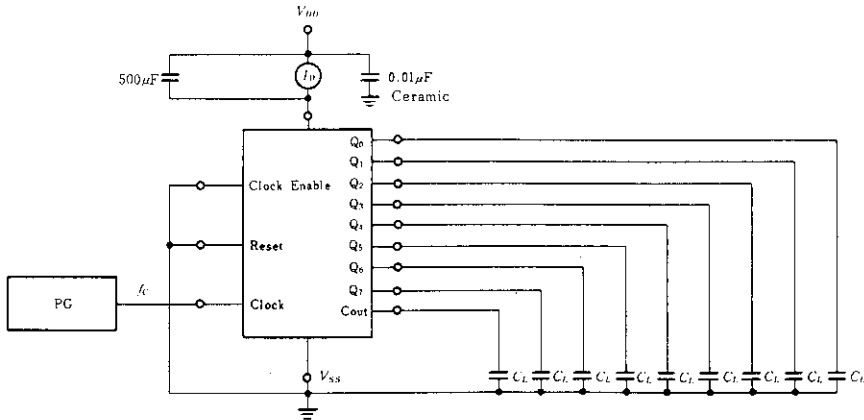
**ELECTRICAL CHARACTERISTICS**

| Characteristic        | Symbol          | V <sub>DD</sub> (V)    | Test Conditions  | -40°C |      | 25°C  |          |      | 85°C  |      | Unit |
|-----------------------|-----------------|------------------------|--|-------|------|-------|----------|------|-------|------|------|
|                       |                 |                        |  | min   | max  | min   | typ      | max  | min   | max  |      |
| Output Voltage        | V <sub>OL</sub> | 5.0                    | V <sub>in</sub> = V <sub>DD</sub> or 0                                 | —     | 0.05 | —     | 0        | 0.05 | —     | 0.05 | V    |
|                       |                 | 10                     |  | —     | 0.05 | —     | 0        | 0.05 | —     | 0.05 |      |
|                       |                 | 15                     |  | —     | 0.05 | —     | 0        | 0.05 | —     | 0.05 |      |
|                       | V <sub>OH</sub> | 5.0                    | V <sub>in</sub> = 0 or V <sub>DD</sub>                                 | 4.95  | —    | 4.95  | 5.0      | —    | 4.95  | —    | V    |
|                       |                 | 10                     |  | 9.95  | —    | 9.95  | 10       | —    | 9.95  | —    |      |
|                       |                 | 15                     |  | 14.95 | —    | 14.95 | 15       | —    | 14.95 | —    |      |
| Input Voltage         | V <sub>IL</sub> | 5.0                    | V <sub>out</sub> = 4.5 or 0.5V   | —     | 1.5  | —     | 2.25     | 1.5  | —     | 1.5  | V    |
|                       |                 | 10                     | V <sub>out</sub> = 9.0 or 1.0V   | —     | 3.0  | —     | 4.50     | 3.0  | —     | 3.0  |      |
|                       |                 | 15                     | V <sub>out</sub> = 13.5 or 1.5V  | —     | 4.0  | —     | 6.75     | 4.0  | —     | 4.0  |      |
|                       | V <sub>IH</sub> | 5.0                    | V <sub>out</sub> = 0.5 or 4.5V   | 3.5   | —    | 3.5   | 2.75     | —    | 3.5   | —    | V    |
|                       |                 | 10                     | V <sub>out</sub> = 1.0 or 9.0V   | 7.0   | —    | 7.0   | 5.50     | —    | 7.0   | —    |      |
|                       |                 | 15                     | V <sub>out</sub> = 1.5 or 13.5V  | 11.0  | —    | 11.0  | 8.25     | —    | 11.0  | —    |      |
| Output Drive Current  | I <sub>OH</sub> | 5.0                    | V <sub>OH</sub> = 2.5V   | -1.0  | —    | -0.8  | -1.7     | —    | -0.6  | —    | mA   |
|                       |                 | 5.0                    | V <sub>OH</sub> = 4.6V   | -0.2  | —    | -0.16 | -0.36    | —    | -0.12 | —    |      |
|                       |                 | 10                     | V <sub>OH</sub> = 9.5V   | -0.5  | —    | -0.4  | -0.9     | —    | -0.3  | —    |      |
|                       |                 | 15                     | V <sub>OH</sub> = 13.5V  | -1.4  | —    | -1.2  | -3.5     | —    | -1.0  | —    |      |
|                       | I <sub>OL</sub> | 5.0                    | V <sub>OL</sub> = 0.4V   | 0.52  | —    | 0.44  | 0.88     | —    | 0.36  | —    | mA   |
|                       |                 | 10                     | V <sub>OL</sub> = 0.5V   | 1.3   | —    | 1.1   | 2.25     | —    | 0.9   | —    |      |
| 15                    |                 | V <sub>OL</sub> = 1.5V | 3.6  | —     | 3.0  | 8.8   | —        | 2.4  | —     |      |      |
| Input Current         | I <sub>n</sub>  | 15                     |  | —     | ±0.3 | —     | ±0.00001 | ±0.3 | —     | ±1.0 | μA   |
| Input Capacitance     | C <sub>in</sub> |                        | V <sub>in</sub> = 0  | —     | —    | —     | 5.0      | 7.5  | —     | —    | pF   |
| Quiescent Current     | I <sub>DD</sub> | 5.0                    | Zero Signal, per Package   | —     | 20   | —     | 0.005    | 20   | —     | 150  | μA   |
|                       |                 | 10                     |  | —     | 40   | —     | 0.010    | 40   | —     | 300  |      |
|                       |                 | 15                     |  | —     | 80   | —     | 0.015    | 80   | —     | 600  |      |
| Total Supply Current* | I <sub>T</sub>  | 5.0                    | Dynamic + I <sub>DD</sub> , per Gate, C <sub>L</sub> = 50pF, f = 1 kHz | —     | —    | —     | 0.28     | —    | —     | —    | μA   |
|                       |                 | 10                     |  | —     | —    | —     | 0.56     | —    | —     | —    |      |
|                       |                 | 15                     |  | —     | —    | —     | 0.85     | —    | —     | —    |      |

\* To calculate total supply current at frequency other than 1kHz.

@ V<sub>DD</sub> = 5.0V I<sub>T</sub> = (0.28μA/kHz)f + I<sub>DD</sub>, @ V<sub>DD</sub> = 10V I<sub>T</sub> = (0.56μA/kHz)f + I<sub>DD</sub>, @ V<sub>DD</sub> = 15V I<sub>T</sub> = (0.85μA/kHz)f + I<sub>DD</sub>.

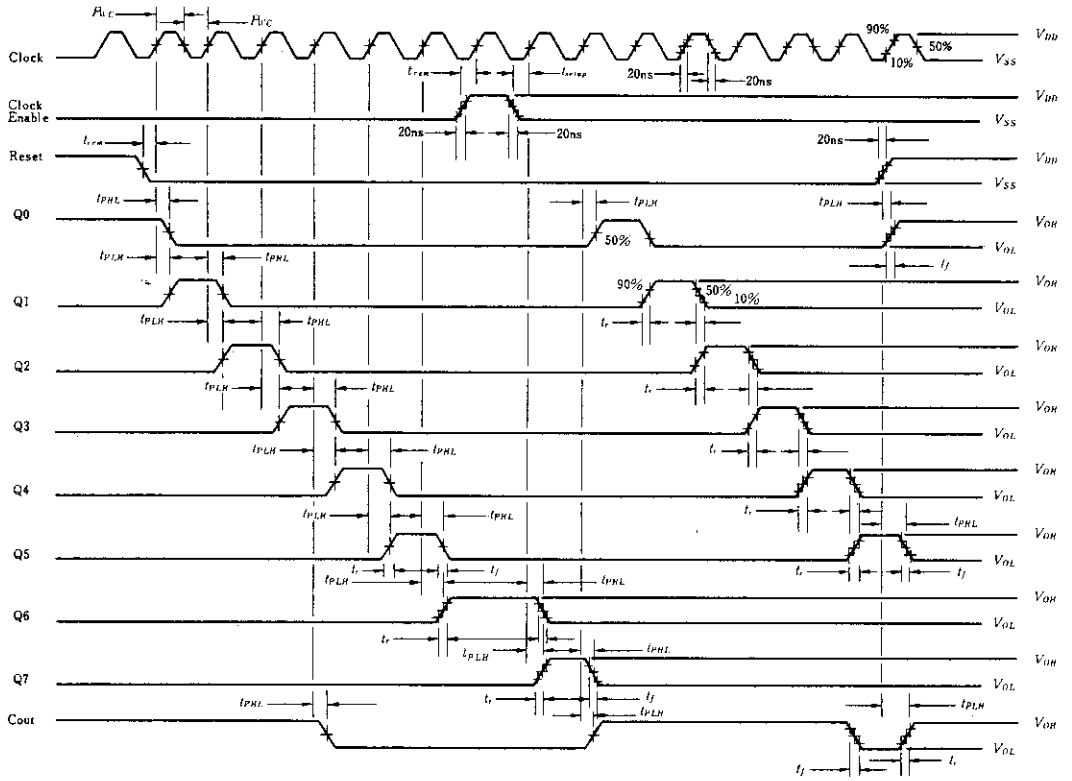
**POWER DISSIPATION TEST CIRCUIT**

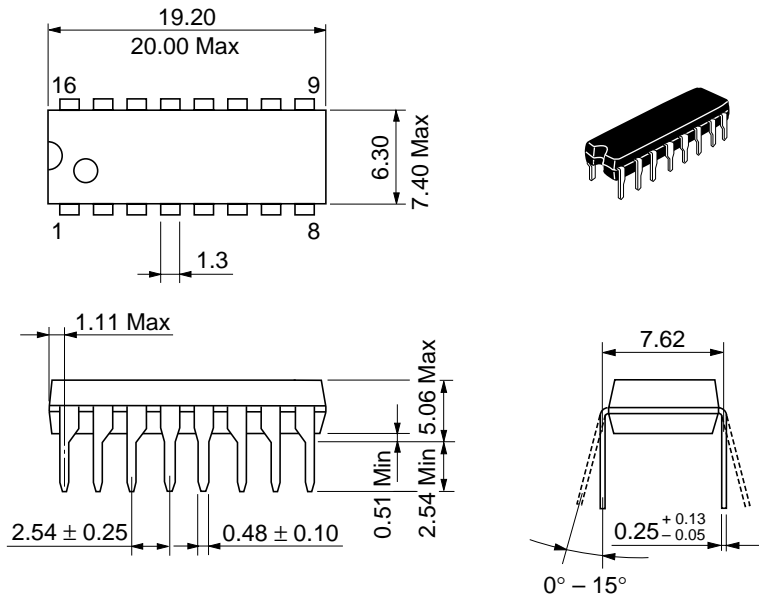


**SWITCHING CHARACTERISTICS** ( $C_L = 50\text{pF}$ ,  $T_a = 25^\circ\text{C}$ )

| Characteristic                 |                     | Symbol                 | $V_{DD}$ (V) | min | typ  | max  | Unit |
|--------------------------------|---------------------|------------------------|--------------|-----|------|------|------|
| Output Rise Time               |                     | $t_r$                  | 5.0          | —   | 180  | 400  | ns   |
|                                |                     |                        | 10           | —   | 90   | 200  |      |
|                                |                     |                        | 15           | —   | 65   | 160  |      |
| Output Fall Time               |                     | $t_f$                  | 5.0          | —   | 100  | 200  | ns   |
|                                |                     |                        | 10           | —   | 50   | 100  |      |
|                                |                     |                        | 15           | —   | 37   | 80   |      |
| Propagation Delay Time         | Reset to Decode Out | $t_{PLH}$<br>$t_{PHL}$ | 5.0          | —   | 500  | 1000 | ns   |
|                                |                     |                        | 10           | —   | 230  | 460  |      |
|                                |                     |                        | 15           | —   | 140  | 350  |      |
|                                | Clock to Cout       |                        | 5.0          | —   | 400  | 800  |      |
|                                |                     |                        | 10           | —   | 150  | 350  |      |
|                                |                     |                        | 15           | —   | 100  | 250  |      |
|                                | Clock to Decode Out | 5.0                    | —            | 500 | 1000 |      |      |
|                                |                     | 10                     | —            | 230 | 460  |      |      |
|                                |                     | 15                     | —            | 140 | 350  |      |      |
|                                | Reset to Cout       | $t_{PLH}$              | 5.0          | —   | 400  | 800  |      |
|                                |                     |                        | 10           | —   | 150  | 350  |      |
|                                |                     |                        | 15           | —   | 100  | 250  |      |
| Clock Pulse Width              | $PW_C$              | 5.0                    | 250          | 100 | —    | ns   |      |
|                                |                     | 10                     | 100          | 42  | —    |      |      |
|                                |                     | 15                     | 75           | 30  | —    |      |      |
| Clock Frequency                | $PRF$               | 5.0                    | —            | 5.0 | 2.0  | MHz  |      |
|                                |                     | 10                     | —            | 12  | 5.0  |      |      |
|                                |                     | 15                     | —            | 16  | 6.7  |      |      |
| Reset Pulse Width              | $PW_R$              | 5.0                    | 500          | 200 | —    | ns   |      |
|                                |                     | 10                     | 250          | 100 | —    |      |      |
|                                |                     | 15                     | 190          | 75  | —    |      |      |
| Reset Removal Time             | $t_{rem}$           | 5.0                    | 750          | 300 | —    | ns   |      |
|                                |                     | 10                     | 275          | 100 | —    |      |      |
|                                |                     | 15                     | 210          | 80  | —    |      |      |
| Clock Pulse Rise and Fall Time | $t_r, t_f$          | 5.0                    | No Limit     |     |      |      |      |
|                                |                     | 10                     |              |     |      |      |      |
|                                |                     | 15                     |              |     |      |      |      |
| Clock Enable Setup Time        | $t_{setup}$         | 5.0                    | 700          | 175 | —    | ns   |      |
|                                |                     | 10                     | 300          | 75  | —    |      |      |
|                                |                     | 15                     | 225          | 52  | —    |      |      |
| Clock Enable Removal Time      | $t_{rem}$           | 5.0                    | 700          | 260 | —    | ns   |      |
|                                |                     | 10                     | 300          | 100 | —    |      |      |
|                                |                     | 15                     | 225          | 70  | —    |      |      |

■ DYNAMIC SIGNAL WAVEFORMS





|                          |          |
|--------------------------|----------|
| Hitachi Code             | DP-16    |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 1.07 g   |

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# HITACHI

## Hitachi, Ltd.

Semiconductor & Integrated Circuits.  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan  
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL      North America      : <http://semiconductor.hitachi.com/>  
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## For further information write to:

Hitachi Semiconductor  
(America) Inc.  
179 East Tasman Drive,  
San Jose, CA 95134  
Tel: <1> (408) 433-1990  
Fax: <1>(408) 433-0223

Hitachi Europe GmbH  
Electronic components Group  
Dornacher Straße 3  
D-85622 Feldkirchen, Munich  
Germany  
Tel: <49> (89) 9 9180-0  
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.  
Electronic Components Group.  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA, United Kingdom  
Tel: <44> (1628) 585000  
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.  
16 Collyer Quay #20-00  
Hitachi Tower  
Singapore 049318  
Tel: 535-2100  
Fax: 535-1533

Hitachi Asia Ltd.  
Taipei Branch Office  
3F, Hung Kuo Building, No.167,  
Tun-Hwa North Road, Taipei (105)  
Tel: <886> (2) 2718-3666  
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.  
Group III (Electronic Components)  
7/F., North Tower, World Finance Centre,  
Harbour City, Canton Road, Tsim Sha Tsui,  
Kowloon, Hong Kong  
Tel: <852> (2) 735 9218  
Fax: <852> (2) 730 0281  
Telex: 40815 HITEC HX

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