

## COUNTERS/DIVIDERS

### 4017B DECADE COUNTER WITH 10 DECODED OUTPUTS

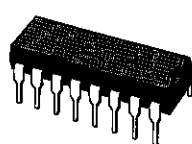
### 4022B OCTAL COUNTER WITH 8 DECODED OUTPUTS

- FULLY STATIC OPERATION
- MEDIUM SPEED OPERATION-12MHz (typ.) AT  $V_{DD} = 10V$
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

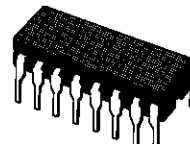
### DESCRIPTION

The **HCC4017B/4022B** (extended temperature range) and **HCF4017B/4022B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micro package.

The **HCC/HCF4017B** and **HCC/HCF4022B** are 5-stage and 4-stage Johnson counters having 10 and 8 decoded outputs, respectively. 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. These counters are advanced one count at the positive clock signal transition if the CLOCK INHIBIT signal is low. Counter advancement 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



**EY**  
(Plastic Package)



**F**  
(Ceramic Frit Seal Package)



**M1**  
(Micro Package)

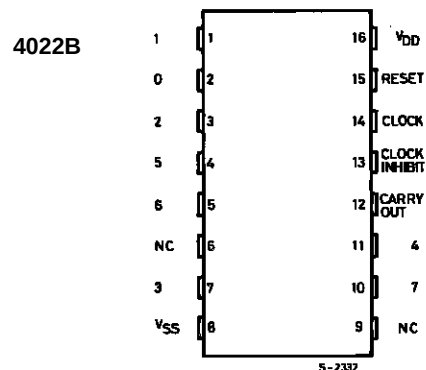
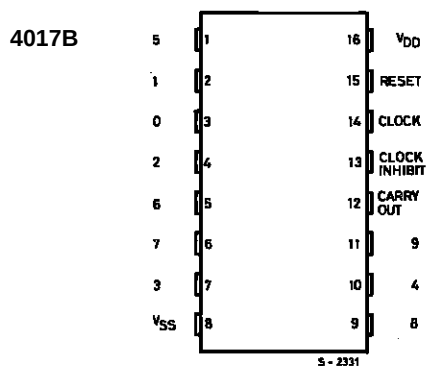


**C1**  
(Plastic Chip Carrier)

#### ORDER CODES :

|            |            |
|------------|------------|
| HCC40XXBF  | HCF40XXBM1 |
| HCF40XXBEY | HCF40XXBC1 |

### PIN CONNECTIONS

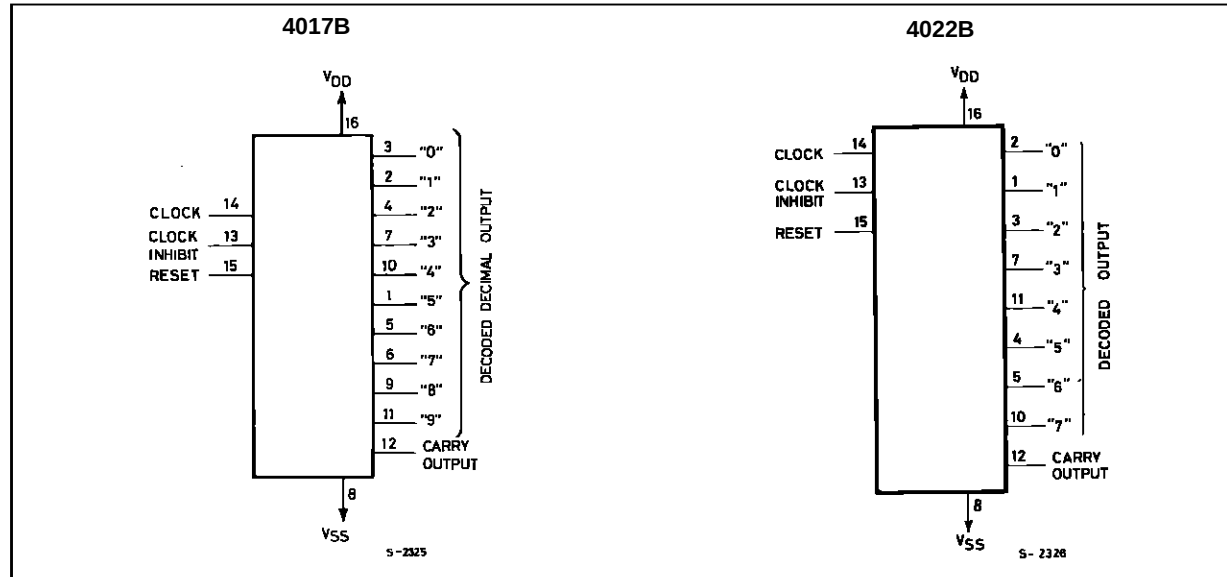


## HCC/HCF4017B/4022B

cycle every 10 clock input cycles in the **HCC/HCF4017B** or every 8 clock input cycles in the

**HCC/HCF4022B** and is used to ripple-clock the succeeding device in a multi-device counting chain.

### FUNCTIONAL DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter                                                                                                                          | Value                          | Unit     |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------|
| V <sub>DD</sub> * | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> Types                                                                              | – 0.5 to + 20<br>– 0.5 to + 18 | V<br>V   |
| V <sub>I</sub>    | Input Voltage                                                                                                                      | – 0.5 to V <sub>DD</sub> + 0.5 | V        |
| I <sub>I</sub>    | DC Input Current (any one input)                                                                                                   | ± 10                           | mA       |
| P <sub>tot</sub>  | Total Power Dissipation (per package)<br>Dissipation per Output Transistor<br>for T <sub>op</sub> = Full Package-temperature Range | 200<br>100                     | mW<br>mW |
| T <sub>op</sub>   | Operating Temperature : <b>HCC</b> Types<br><b>HCF</b> Types                                                                       | – 55 to + 125<br>– 40 to + 85  | °C<br>°C |
| T <sub>stg</sub>  | Storage Temperature                                                                                                                | – 65 to + 150                  | °C       |

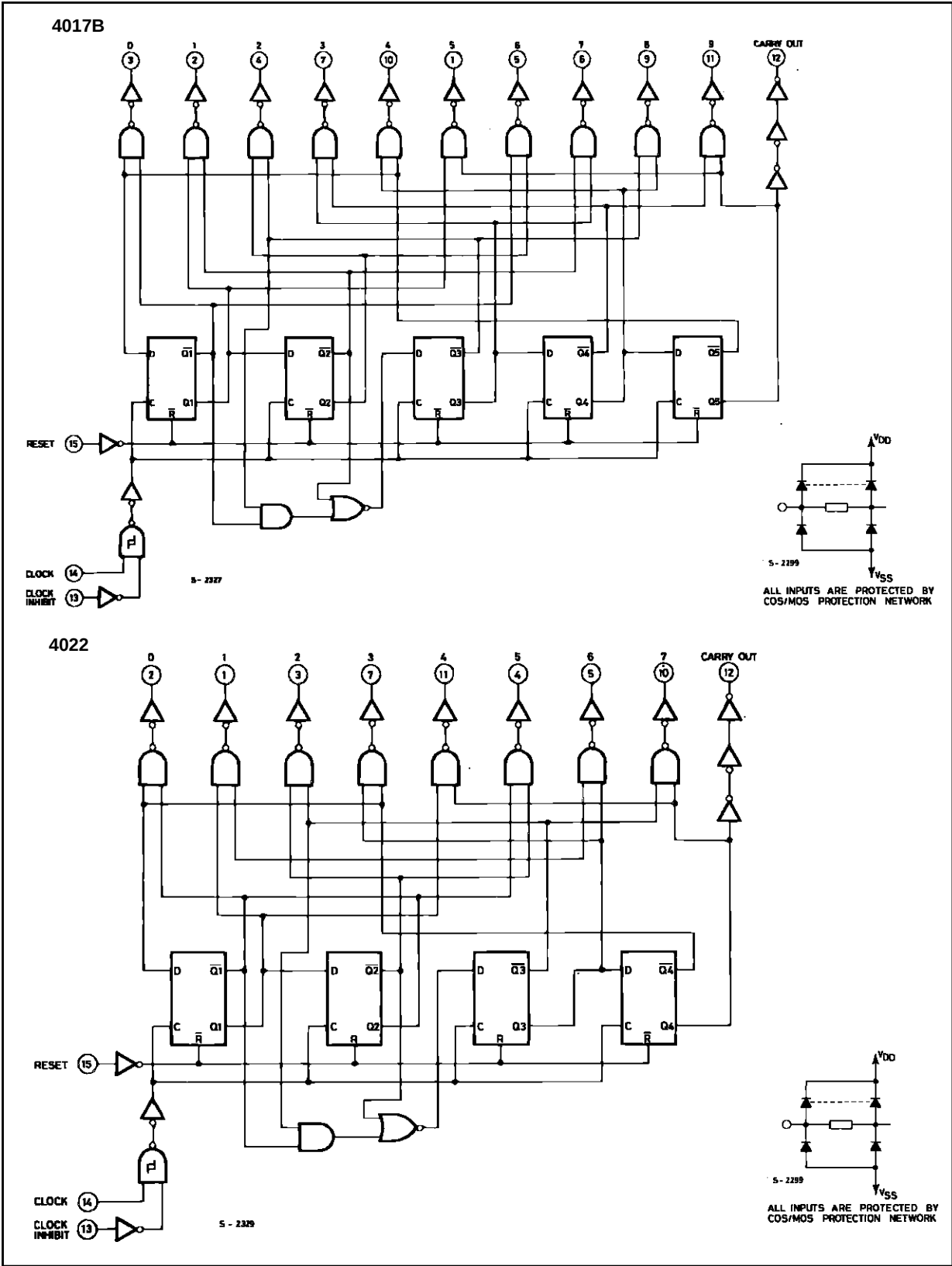
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

\* All voltages values are referred to V<sub>SS</sub> pin voltage.

### RECOMMENDED OPERATING CONDITIONS

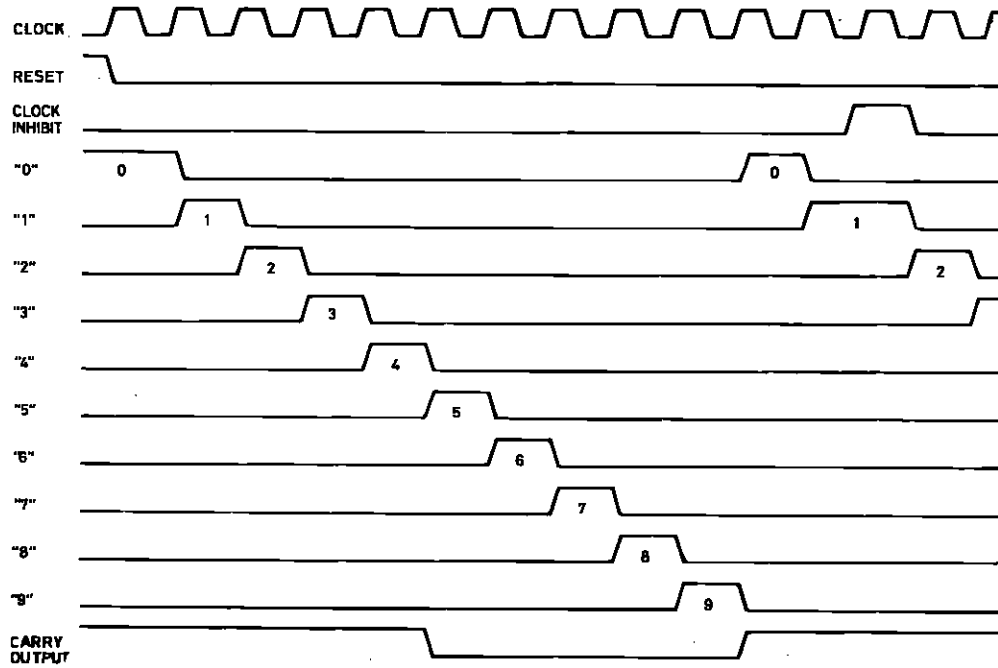
| Symbol          | Parameter                                                    | Value                         | Unit     |
|-----------------|--------------------------------------------------------------|-------------------------------|----------|
| V <sub>DD</sub> | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> Types        | 3 to 18<br>3 to 15            | V<br>V   |
| V <sub>I</sub>  | Input Voltage                                                | 0 to V <sub>DD</sub>          | V        |
| T <sub>op</sub> | Operating Temperature : <b>HCC</b> Types<br><b>HCF</b> Types | – 55 to + 125<br>– 40 to + 85 | °C<br>°C |

LOGIC DIAGRAMS

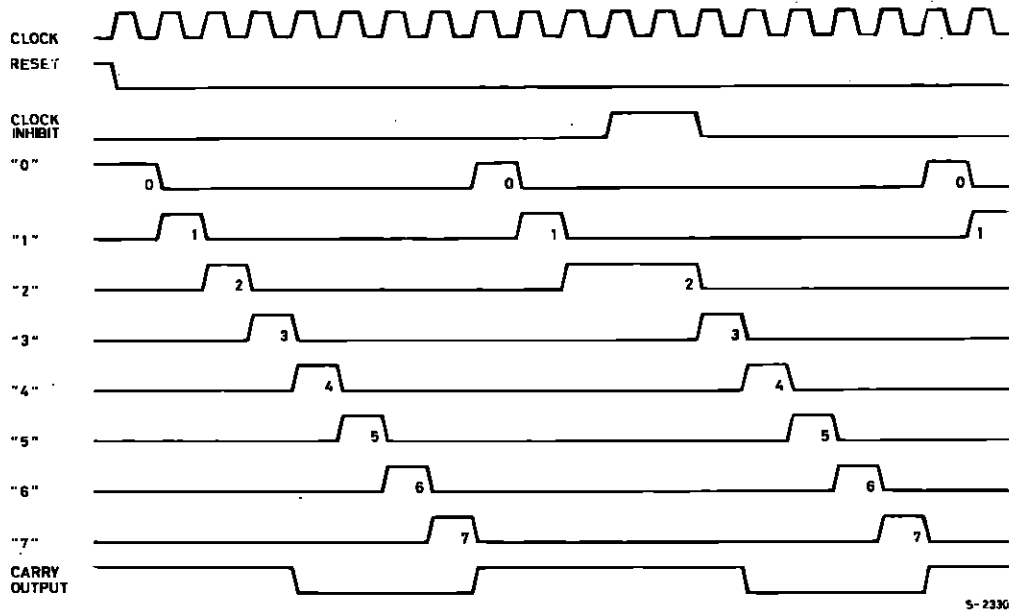


## TIMING DIAGRAMS

4017B



4022B



## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Symbol                          | Parameter             |           | Test Conditions       |                       |                          |                        | Value              |       |        |                   |       |                     |      | Unit |
|---------------------------------|-----------------------|-----------|-----------------------|-----------------------|--------------------------|------------------------|--------------------|-------|--------|-------------------|-------|---------------------|------|------|
|                                 |                       |           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>O</sub>  <br>(μA) | V <sub>DD</sub><br>(V) | T <sub>Low</sub> * |       | 25°C   |                   |       | T <sub>High</sub> * |      |      |
|                                 |                       |           |                       |                       |                          |                        | Min.               | Max.  | Min.   | Typ.              | Max.  | Min.                | Max. |      |
| I <sub>L</sub>                  | Quiescent Current     | HCC Types | 0/ 5                  |                       |                          | 5                      |                    | 5     |        | 0.04              | 5     |                     | 150  | μA   |
|                                 |                       |           | 0/10                  |                       |                          | 10                     |                    | 10    |        | 0.04              | 10    |                     | 300  |      |
|                                 |                       |           | 0/15                  |                       |                          | 15                     |                    | 20    |        | 0.04              | 20    |                     | 600  |      |
|                                 |                       |           | 0/20                  |                       |                          | 20                     |                    | 100   |        | 0.08              | 100   |                     | 3000 |      |
|                                 |                       | HCF Types | 0/ 5                  |                       |                          | 5                      |                    | 20    |        | 0.04              | 20    |                     | 150  |      |
|                                 |                       |           | 0/10                  |                       |                          | 10                     |                    | 40    |        | 0.04              | 40    |                     | 300  |      |
|                                 |                       |           | 0/15                  |                       |                          | 15                     |                    | 80    |        | 0.04              | 80    |                     | 600  |      |
| V <sub>OH</sub>                 | Output High 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 <sub>OL</sub>                 | Output Low 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 <sub>IH</sub>                 | Input High 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 <sub>IL</sub>                 | Input Low 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 <sub>OH</sub>                 | Output Drive Current  | HCC Types | 0/ 5                  | 2.5                   |                          | 5                      | – 2                |       | – 1.6  | – 3.2             |       | – 1.15              |      | mA   |
|                                 |                       |           | 0/ 5                  | 4.6                   |                          | 5                      | – 0.64             |       | – 0.51 | – 1               |       | – 0.36              |      |      |
|                                 |                       |           | 0/10                  | 9.5                   |                          | 10                     | – 1.6              |       | – 1.3  | – 2.6             |       | – 0.9               |      |      |
|                                 |                       |           | 0/15                  | 13.5                  |                          | 15                     | – 4.2              |       | – 3.4  | – 6.8             |       | – 2.4               |      |      |
|                                 |                       | HCF Types | 0/ 5                  | 2.5                   |                          | 5                      | – 1.53             |       | – 1.36 | – 3.2             |       | – 1.1               |      |      |
|                                 |                       |           | 0/ 5                  | 4.6                   |                          | 5                      | – 0.52             |       | – 0.44 | – 1               |       | – 0.36              |      |      |
|                                 |                       |           | 0/10                  | 9.5                   |                          | 10                     | – 1.3              |       | – 1.1  | – 2.6             |       | – 0.9               |      |      |
|                                 |                       |           | 0/15                  | 13.5                  |                          | 15                     | – 3.6              |       | – 3.0  | – 6.8             |       | – 2.4               |      |      |
| I <sub>OL</sub>                 | Output Sink Current   | HCC Types | 0/ 5                  | 0.4                   |                          | 5                      | 0.64               |       | 0.51   | 1                 |       | 0.36                |      | mA   |
|                                 |                       |           | 0/10                  | 0.5                   |                          | 10                     | 1.6                |       | 1.3    | 2.6               |       | 0.9                 |      |      |
|                                 |                       |           | 0/15                  | 1.5                   |                          | 15                     | 4.2                |       | 3.4    | 6.8               |       | 2.4                 |      |      |
|                                 |                       | HCF Types | 0/ 5                  | 0.4                   |                          | 5                      | 0.52               |       | 0.44   | 1                 |       | 0.36                |      |      |
|                                 |                       |           | 0/10                  | 0.5                   |                          | 10                     | 1.3                |       | 1.1    | 2.6               |       | 0.9                 |      |      |
|                                 |                       |           | 0/15                  | 1.5                   |                          | 15                     | 3.6                |       | 3.0    | 6.8               |       | 2.4                 |      |      |
| I <sub>IH</sub> I <sub>IL</sub> | Input Leakage Current | HCC Types | 0/18                  | Any Input             |                          | 18                     |                    | ± 0.1 |        | ±10 <sup>–5</sup> | ± 0.1 |                     | ± 1  | μA   |
|                                 |                       | HCF Types | 0/15                  |                       |                          | 15                     |                    | ± 0.3 |        | ±10 <sup>–5</sup> | ± 0.3 |                     | ± 1  |      |
| C <sub>I</sub>                  | Input Capacitance     |           |                       | Any Input             |                          |                        |                    |       |        | 5                 | 7.5   |                     |      | pF   |

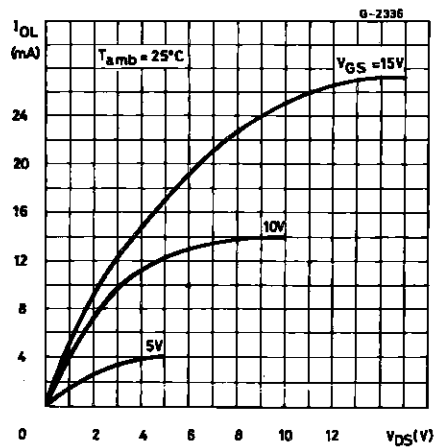
\* T<sub>Low</sub> = - 55°C for **HCC** device : - 40°C for **HCF** device.\* T<sub>High</sub> = + 125°C for **HCC** device : + 85°C for **HCF** device.The Noise Margin for both "1" and "0" level is : 1V min. width V<sub>DD</sub> = 5V, 2V min. width V<sub>DD</sub> = 10V, 2.5V min. width V<sub>DD</sub> = 15V.

**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD} = 0.3\%/^{\circ}\text{C}$  values, all input rise and fall time = 20ns)

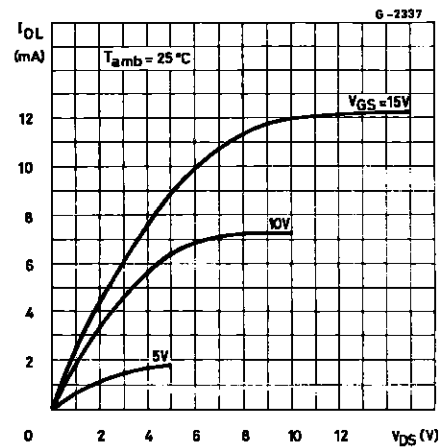
| Symbol                              | Parameter                                               | Test Conditions |                     | Value     |      |      | Unit |
|-------------------------------------|---------------------------------------------------------|-----------------|---------------------|-----------|------|------|------|
|                                     |                                                         |                 | V <sub>DD</sub> (V) | Min.      | Typ. | Max. |      |
| CLOCKED OPERATION                   |                                                         |                 |                     |           |      |      |      |
| t <sub>PLH</sub> , t <sub>PHL</sub> | Propagation Delay Time<br>Decode Out                    |                 | 5                   |           | 325  | 650  | ns   |
|                                     |                                                         |                 | 10                  |           | 135  | 270  |      |
|                                     |                                                         |                 | 15                  |           | 85   | 170  |      |
|                                     | Carry Out                                               |                 | 5                   |           | 300  | 600  | ns   |
|                                     |                                                         |                 | 10                  |           | 125  | 250  |      |
|                                     |                                                         |                 | 15                  |           | 80   | 160  |      |
| t <sub>THL</sub> , t <sub>TLH</sub> | Transition Time<br>Carry Out or Decoded Out Line        |                 | 5                   |           | 100  | 200  | ns   |
|                                     |                                                         |                 | 10                  |           | 50   | 100  |      |
|                                     |                                                         |                 | 15                  |           | 40   | 80   |      |
| f <sub>CL</sub> *                   | Maximum Clock Input Frequency                           |                 | 5                   | 2.5       | 5    | 5    | MHz  |
|                                     |                                                         |                 | 10                  | 5         | 10   |      |      |
|                                     |                                                         |                 | 15                  | 5.5       | 11   |      |      |
| t <sub>W</sub>                      | Minimum Clock Pulse Width                               |                 | 5                   |           | 100  | 200  | ns   |
|                                     |                                                         |                 | 10                  |           | 45   | 90   |      |
|                                     |                                                         |                 | 15                  |           | 30   | 60   |      |
| t <sub>r</sub> , t <sub>f</sub>     | Clock Input Rise or Fall Time                           |                 | 5                   | Unlimited |      |      | μs   |
|                                     |                                                         |                 | 10                  |           |      |      |      |
|                                     |                                                         |                 | 15                  |           |      |      |      |
| t <sub>setup</sub>                  | Data Setup Time<br>Minimum Clock Inhibit                |                 | 5                   |           | 115  | 230  | ns   |
|                                     |                                                         |                 | 10                  |           | 50   | 100  |      |
|                                     |                                                         |                 | 15                  |           | 35   | 7.5  |      |
| RESET OPERATION                     |                                                         |                 |                     |           |      |      |      |
| t <sub>PLH</sub> , t <sub>PHL</sub> | Propagation Delay Time<br>Carry Out or Decode Out Lines |                 | 5                   |           | 265  | 530  | ns   |
|                                     |                                                         |                 | 10                  |           | 115  | 230  |      |
|                                     |                                                         |                 | 15                  |           | 85   | 170  |      |
| t <sub>W</sub>                      | Minimum Reset Pulse Width                               |                 | 5                   |           | 130  | 260  | ns   |
|                                     |                                                         |                 | 10                  |           | 55   | 110  |      |
|                                     |                                                         |                 | 15                  |           | 30   | 60   |      |
| t <sub>rem</sub>                    | Minimum Reset Removal Time                              |                 | 5                   |           | 200  | 400  | ns   |
|                                     |                                                         |                 | 10                  |           | 140  | 280  |      |
|                                     |                                                         |                 | 15                  |           | 75   | 150  |      |

\* Measured with respect to carry output line.

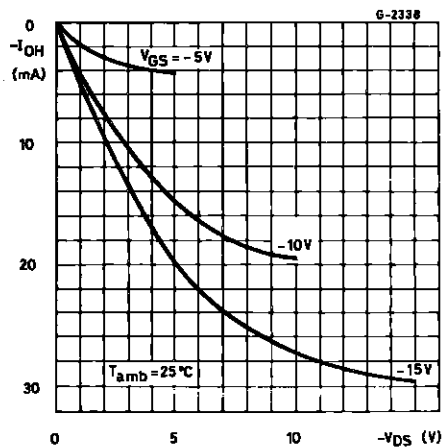
Typical Output Low (sink) Current Characteristics.



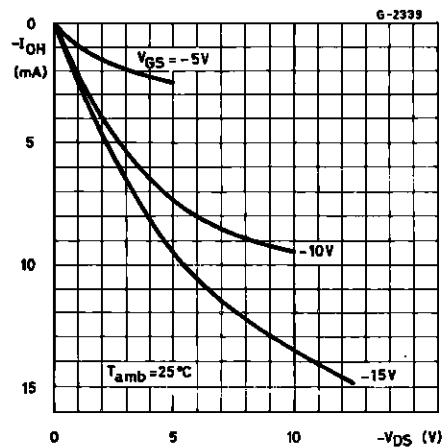
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.

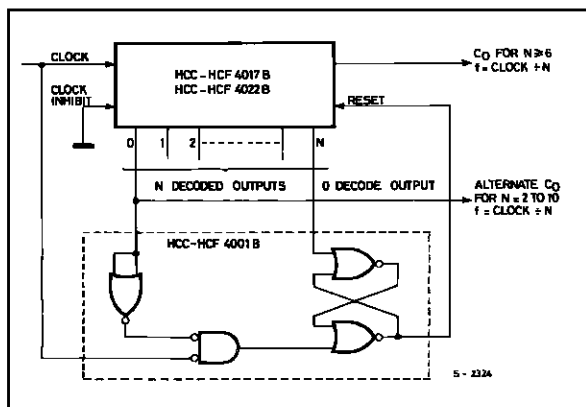


Minimum Output High (source) Current Characteristics.



## TYPICAL APPLICATIONS

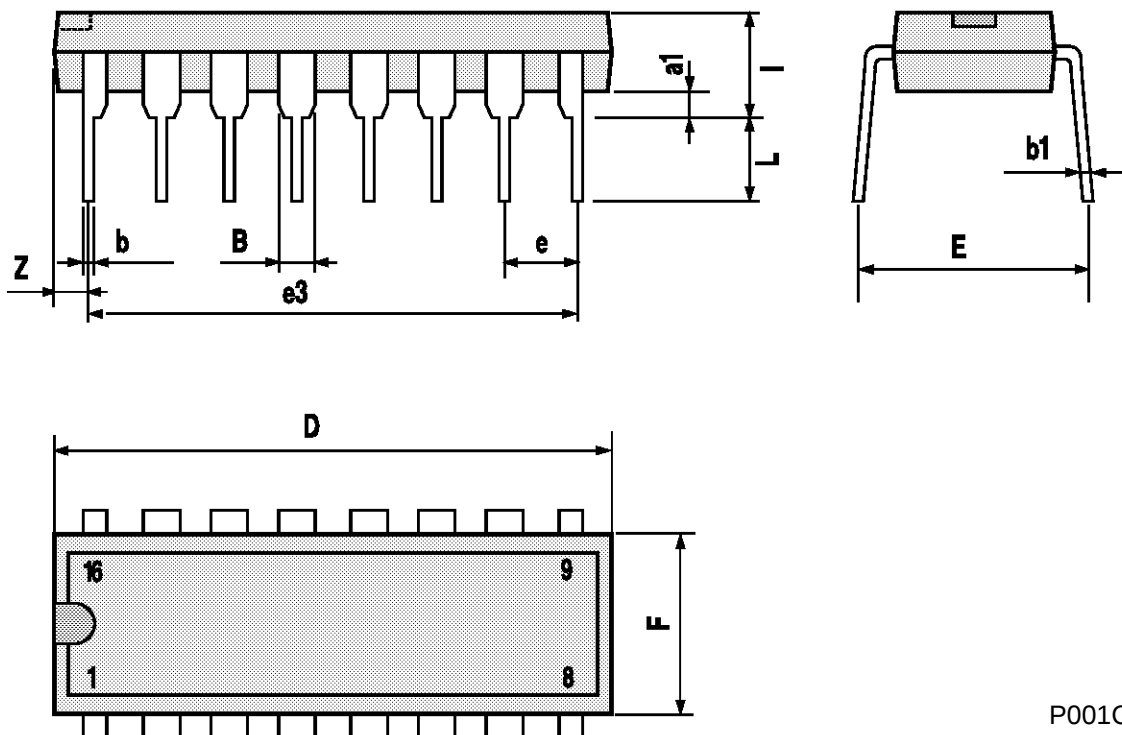
Divide by N Counter ( $N \leq 10$ ) with N Decoded Outputs.



When the  $N^{\text{th}}$  decoded output is reached ( $N^{\text{th}}$  clock pulse) the S-R flip-flop (constructed from two NOR gates of the **HCC/HCF4001B**) generates a reset pulse which clears the **HCC/HCF4017B** to its zero count. At this time, if the  $N^{\text{th}}$  decoded output is greater than or equal to 6, the  $C_{OUT}$  line goes high to clock the next **HCC/HCF4017B** 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 **HCC/HCF4017B**. If the  $N^{\text{th}}$  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.

## Plastic DIP16 (0.25) MECHANICAL DATA

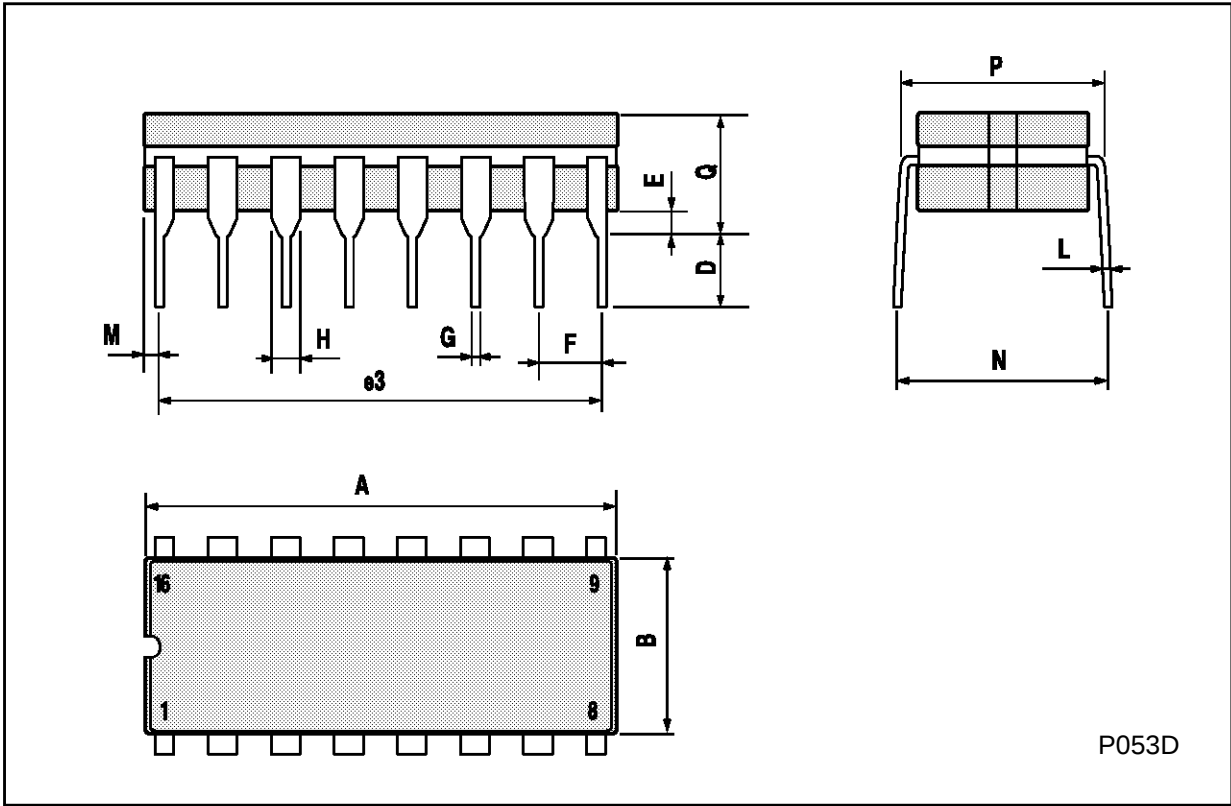
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 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 |



P001C

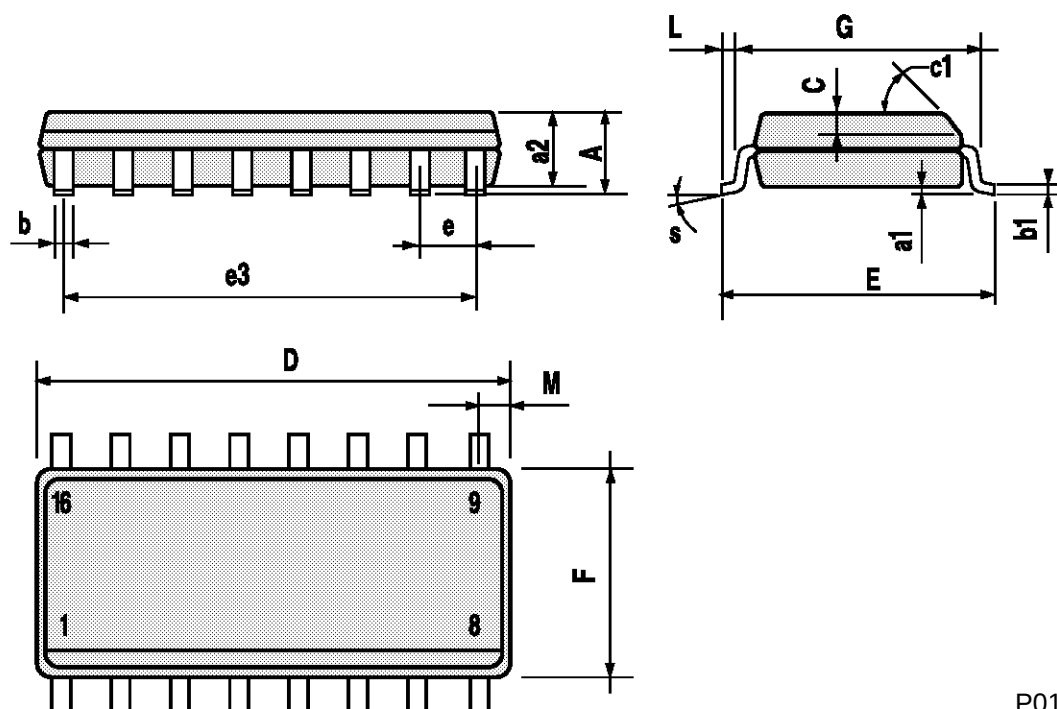
Ceramic DIP16/1 MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    | 2.29 |       | 2.79 | 0.090 |       | 0.110 |
| G    | 0.4  |       | 0.55 | 0.016 |       | 0.022 |
| H    | 1.17 |       | 1.52 | 0.046 |       | 0.060 |
| L    | 0.22 |       | 0.31 | 0.009 |       | 0.012 |
| M    | 0.51 |       | 1.27 | 0.020 |       | 0.050 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



## SO16 (Narrow) MECHANICAL DATA

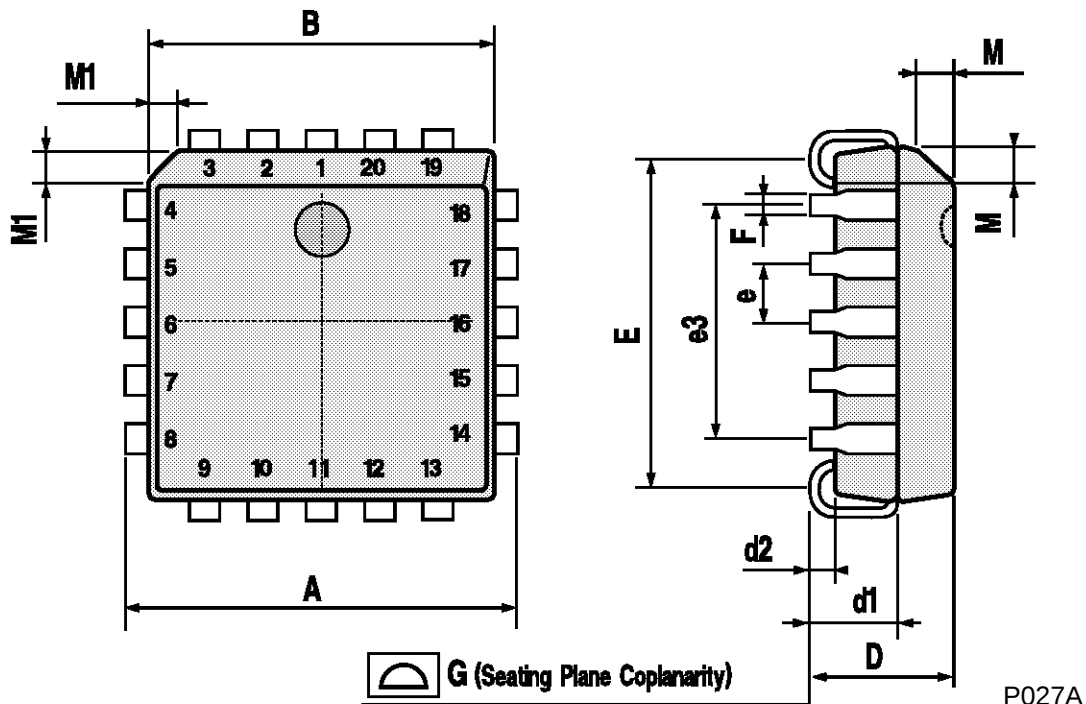
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
| 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.)  |      |      |       |       |       |



P013H

## PLCC20 MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 9.78 |      | 10.03 | 0.385 |       | 0.395 |
| B    | 8.89 |      | 9.04  | 0.350 |       | 0.356 |
| D    | 4.2  |      | 4.57  | 0.165 |       | 0.180 |
| d1   |      | 2.54 |       |       | 0.100 |       |
| d2   |      | 0.56 |       |       | 0.022 |       |
| E    | 7.37 |      | 8.38  | 0.290 |       | 0.330 |
| e    |      | 1.27 |       |       | 0.050 |       |
| e3   |      | 5.08 |       |       | 0.200 |       |
| F    |      | 0.38 |       |       | 0.015 |       |
| G    |      |      | 0.101 |       |       | 0.004 |
| M    |      | 1.27 |       |       | 0.050 |       |
| M1   |      | 1.14 |       |       | 0.045 |       |



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