

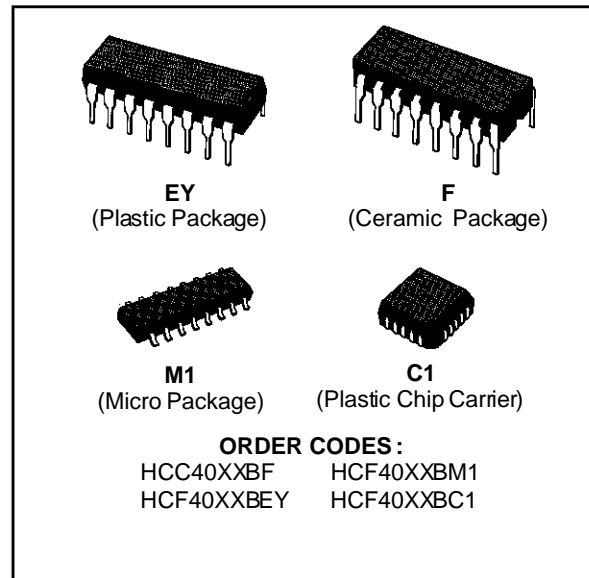
**RIPPLE-CARRY BINARY COUNTER/DIVIDERS**

**4020B - 14 STAGE**

**4024B - 7 STAGE**

**4040B - 12 STAGE**

- MEDIUM-SPEED OPERATION
- FULLY STATIC OPERATION
- COMMON RESET
- BUFFERED INPUTS AND OUTPUTS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

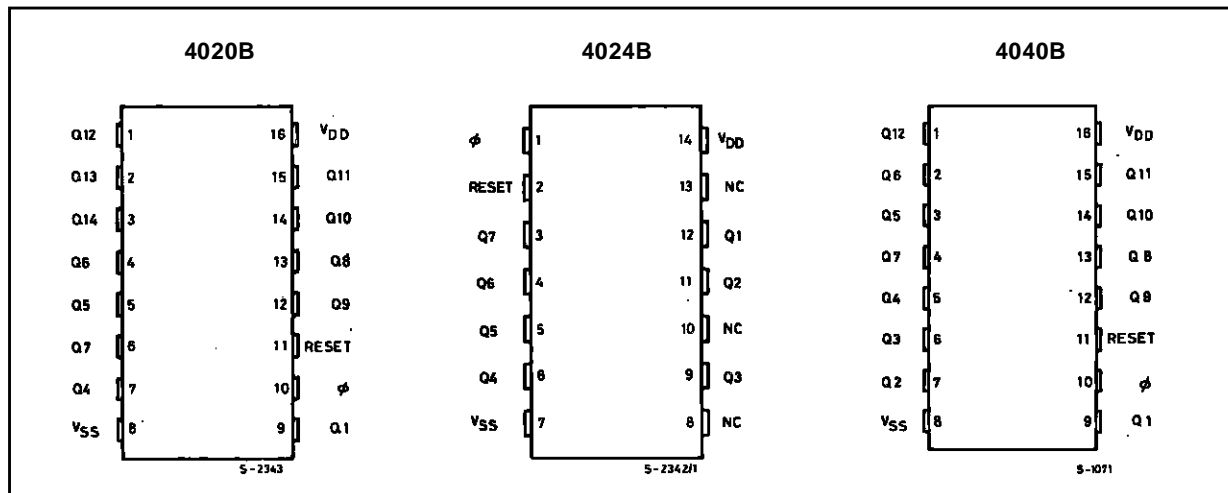


**DESCRIPTION**

The **HCC4XXXB** (extended temperature range) and **HCF4XXXB** (intermediate temperature range) are monolithic integrated circuits, available in 14-lead dual in-line for **4024B** and 16-lead dual in-line for **4020B**, **4040B** plastic or ceramic package and plastic micropackage.

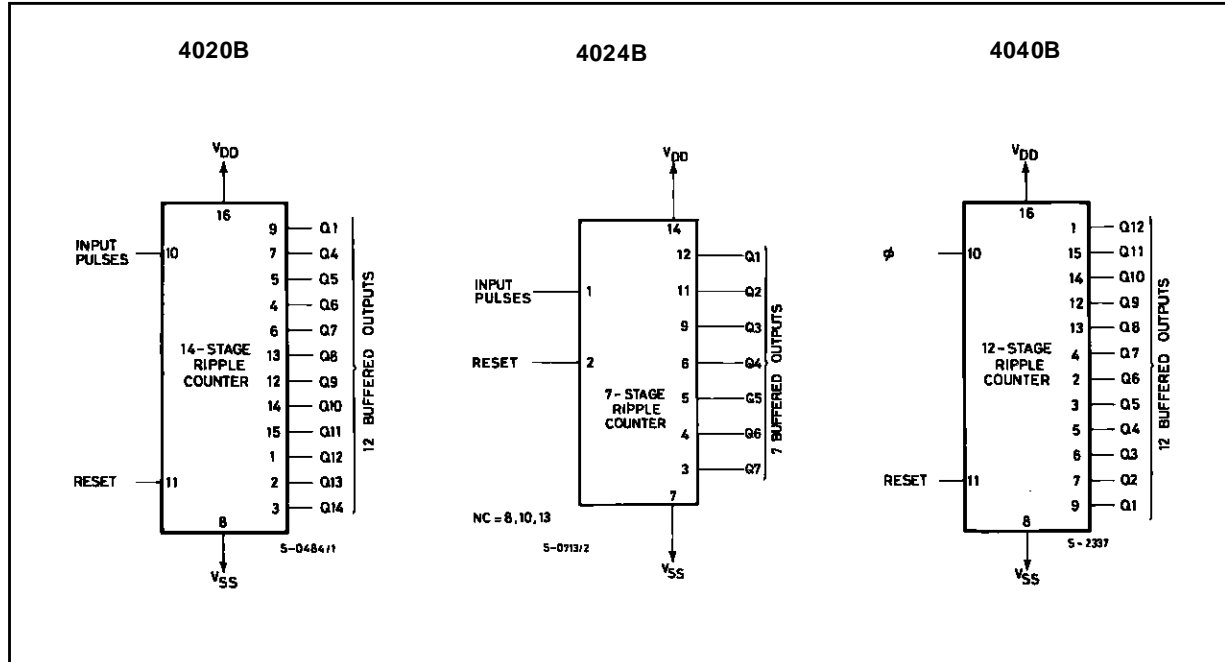
The **HCC/HCF4020B**, **4024B**, and **4040B** are ripple-carry binary counters. All counter stages are master-slave flip-flops. The state of a counter advances one count on the negative transition of each input pulse ; a high level on the RESET line resets the counter to its all zeros stage. Schmitt trigger action on the input-pulse line permits unlimited clock rise and fall times. All inputs and outputs are buffered.

**PIN CONNECTIONS**



# HCC/HFC4020B/24B/40B

## FUNCTIONAL DIAGRAMS



## ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter   | Value                          | Unit        |
|------------|---|--------------------------------|-------------|
| $V_{DD}^*$ | Supply Voltage : HCC Types<br>HCF Types   | - 0.5 to + 20<br>- 0.5 to + 18 | V           |
| $V_I$      | Input Voltage   | - 0.5 to $V_{DD} + 0.5$        | V           |
| $I_I$      | DC Input Current (any one input)  | $\pm 10$                       | mA          |
| $P_{tot}$  | Total Power Dissipation (per package)<br>Dissipation per Output Transistor<br>for $T_{op} =$ Full Package-temperature Range | 200<br>100                     | mW          |
| $T_{op}$   | Operating Temperature : HCC Types<br>HCF Types  | - 55 to + 125<br>- 40 to + 85  | $^{\circ}C$ |
| $T_{stg}$  | Storage Temperature   | - 65 to + 150                  | $^{\circ}C$ |

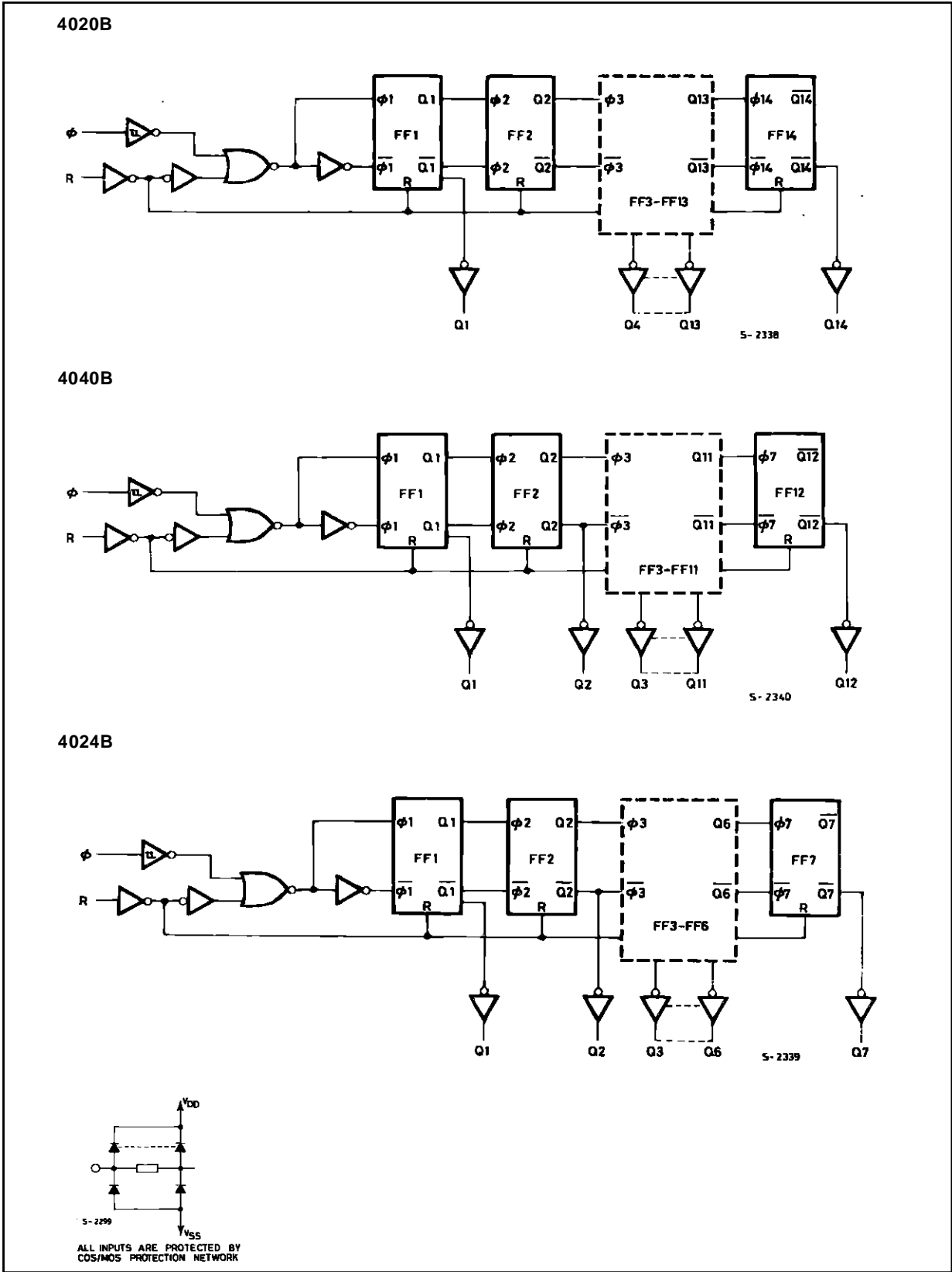
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure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

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

## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter                                      | Value                         | Unit        |
|----------|--|-------------------------------|-------------|
| $V_{DD}$ | Supply Voltage : HCC Types<br>HCF Types        | 3 to 18<br>3 to 15            | V           |
| $V_I$    | Input Voltage                                  | 0 to $V_{DD}$                 | V           |
| $T_{op}$ | Operating Temperature : HCC Types<br>HCF Types | - 55 to + 125<br>- 40 to + 85 | $^{\circ}C$ |

LOGIC DIAGRAMS



# HCC/HFC4020B/24B/40B

## 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>( $\mu$ A) | 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     | $\mu$ A |
|                                   |                       |           | 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                     |                    | $\pm$ 0.1 |        | $\pm$ 10 <sup>-5</sup> | $\pm$ 0.1 |                     | $\pm$ 1 | $\mu$ A |
|                                   |                       | HCF Types | 0/15                  | Any Input             |                                | 15                     |                    | $\pm$ 0.3 |        | $\pm$ 10 <sup>-5</sup> | $\pm$ 0.3 |                     | $\pm$ 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.

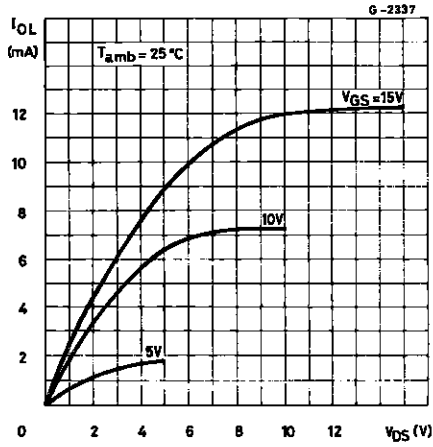
The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5 V min. with V<sub>DD</sub> = 15V.

**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).

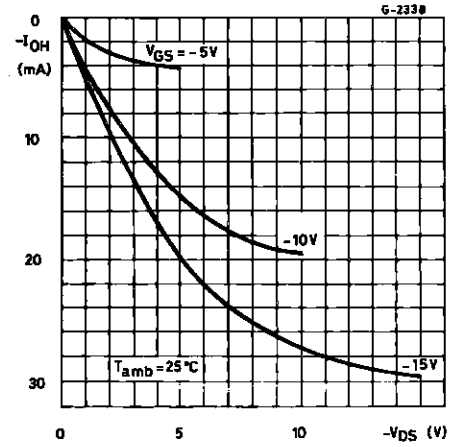
| Symbol                       | Parameter  | Test Conditions |              | Value     |      |      | Unit          |
|------------------------------|--|-----------------|--------------|-----------|------|------|---------------|
|                              |  |                 | $V_{DD}$ (V) | Min.      | Typ. | Max. |               |
| <b>INPUT-PULSE OPERATION</b> |  |                 |              |           |      |      |               |
| $t_{PLH}, t_{PHL}$           | Propagation Delay Time<br>( $\emptyset$ to Q1 Out) |                 | 5            |           | 180  | 360  | ns            |
|                              |  |                 | 10           |           | 80   | 160  |               |
|                              |  |                 | 15           |           | 65   | 130  |               |
| $t_{PLH}, t_{PHL}$           | Propagation Delay Time<br>$Q_n$ to $Q_{n+1}$       |                 | 5            |           | 100  | 200  | ns            |
|                              |  |                 | 10           |           | 40   | 80   |               |
|                              |  |                 | 15           |           | 30   | 60   |               |
| $t_{TLH}, t_{THL}$           | Transition Time                                    |                 | 5            |           | 100  | 200  | ns            |
|                              |  |                 | 10           |           | 50   | 100  |               |
|                              |  |                 | 15           |           | 40   | 80   |               |
| $t_w$                        | Minimum Input Pulse Width                          |                 | 5            |           | 70   | 140  | ns            |
|                              |  |                 | 10           |           | 30   | 60   |               |
|                              |  |                 | 15           |           | 20   | 40   |               |
| $t_r, t_f$                   | Input Pulse Rise and Fall Time                     |                 | 5            | Unlimited |      |      | $\mu\text{s}$ |
|                              |  |                 | 10           |           |      |      |               |
|                              |  |                 | 15           |           |      |      |               |
| $f_{max}$                    | Maximum Clock Input Frequency                      |                 | 5            | 3.5       | 7    |      | MHz           |
|                              |  |                 | 10           | 8         | 16   |      |               |
|                              |  |                 | 15           | 12        | 24   |      |               |
| <b>RESET OPERATION</b>       |  |                 |              |           |      |      |               |
| $t_{PHL}$                    | Propagation Delay Time                             |                 | 5            |           | 140  | 280  | ns            |
|                              |  |                 | 10           |           | 60   | 120  |               |
|                              |  |                 | 15           |           | 50   | 100  |               |
| $t_w$                        | Minimum Reset Pulse Width                          |                 | 5            |           | 100  | 200  | ns            |
|                              |  |                 | 10           |           | 40   | 80   |               |
|                              |  |                 | 15           |           | 30   | 60   |               |
| $t_{rem}$                    | Reset Removal Time                                 |                 | 5            |           | 175  | 350  | ns            |
|                              |  |                 | 10           |           | 75   | 150  |               |
|                              |  |                 | 15           |           | 50   | 100  |               |

# HCC/HFC4020B/24B/40B

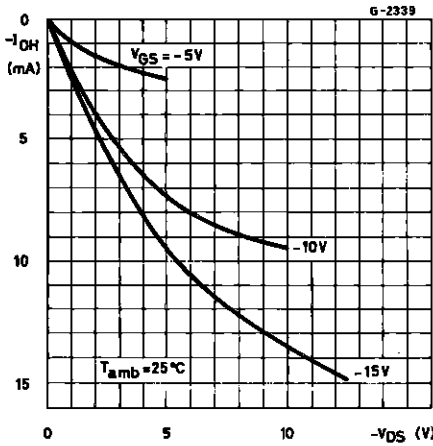
Minimum Output Low (sink) Current Characteristics.



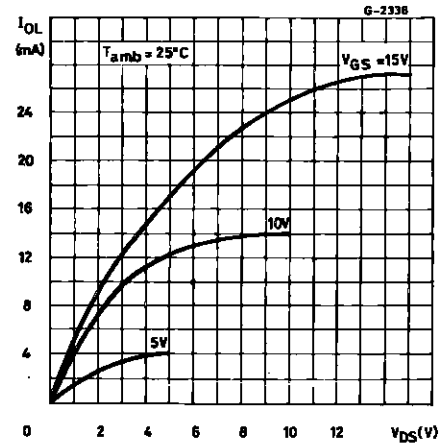
Typical Output Low (source) Current Characteristics.



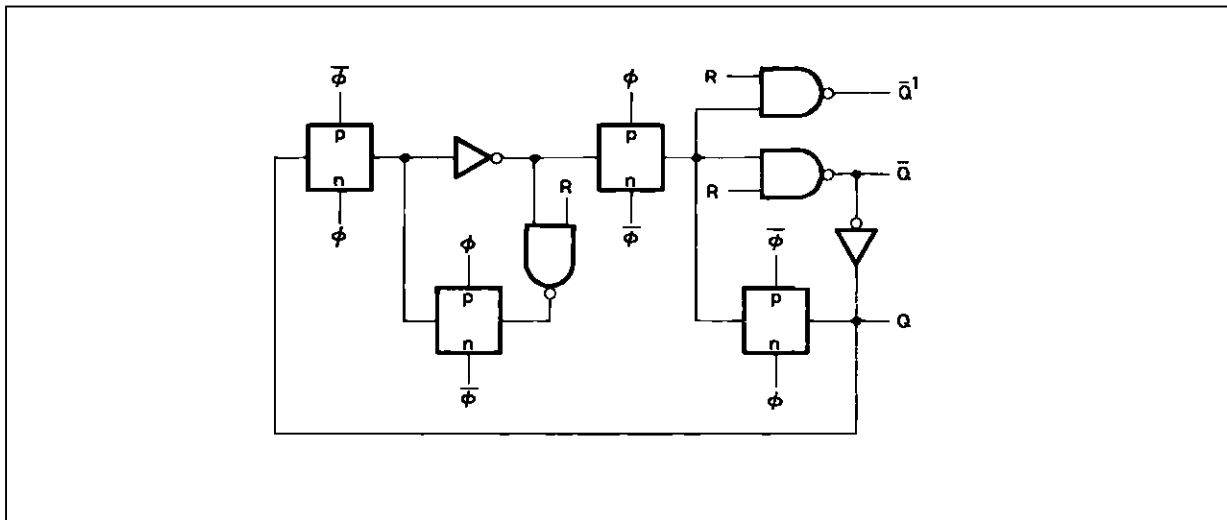
Minimum Output High (source) Current Characteristics.



Typical Output High (sink) Current Characteristics.

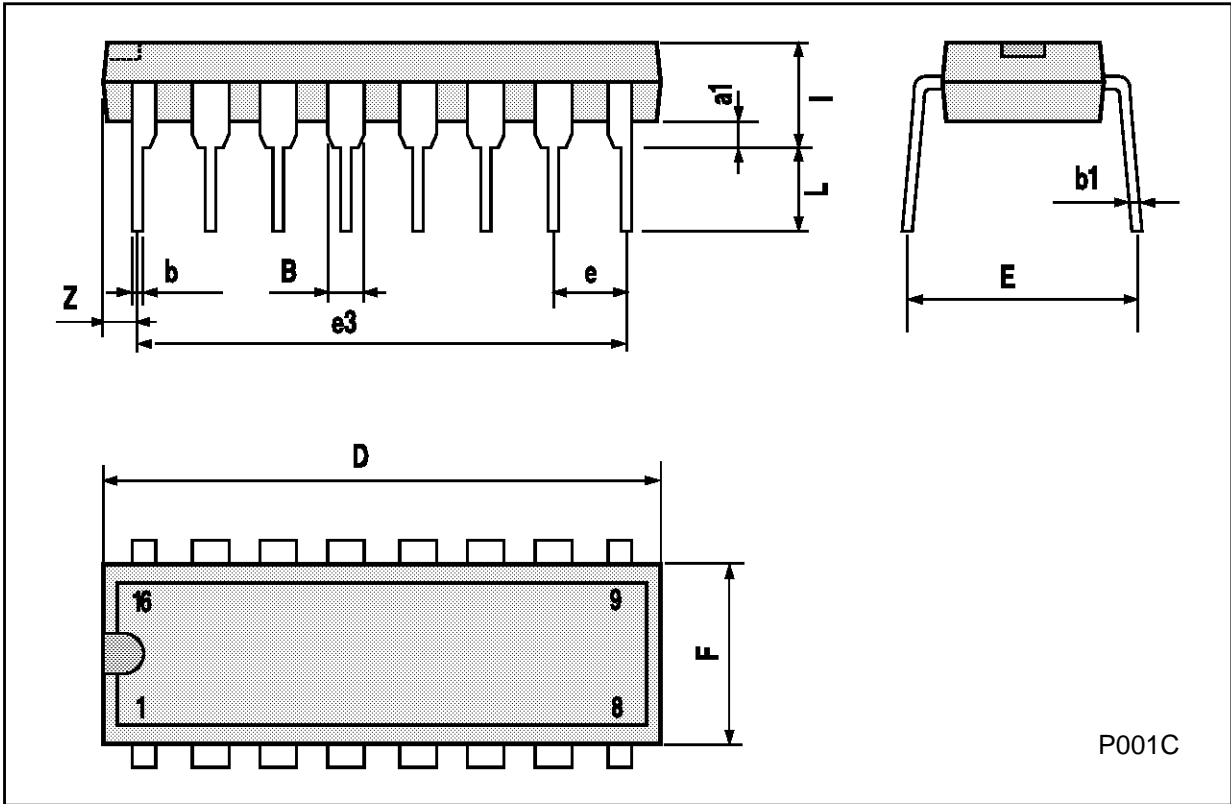


Details of Typical Flip-flop Stage.



**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**

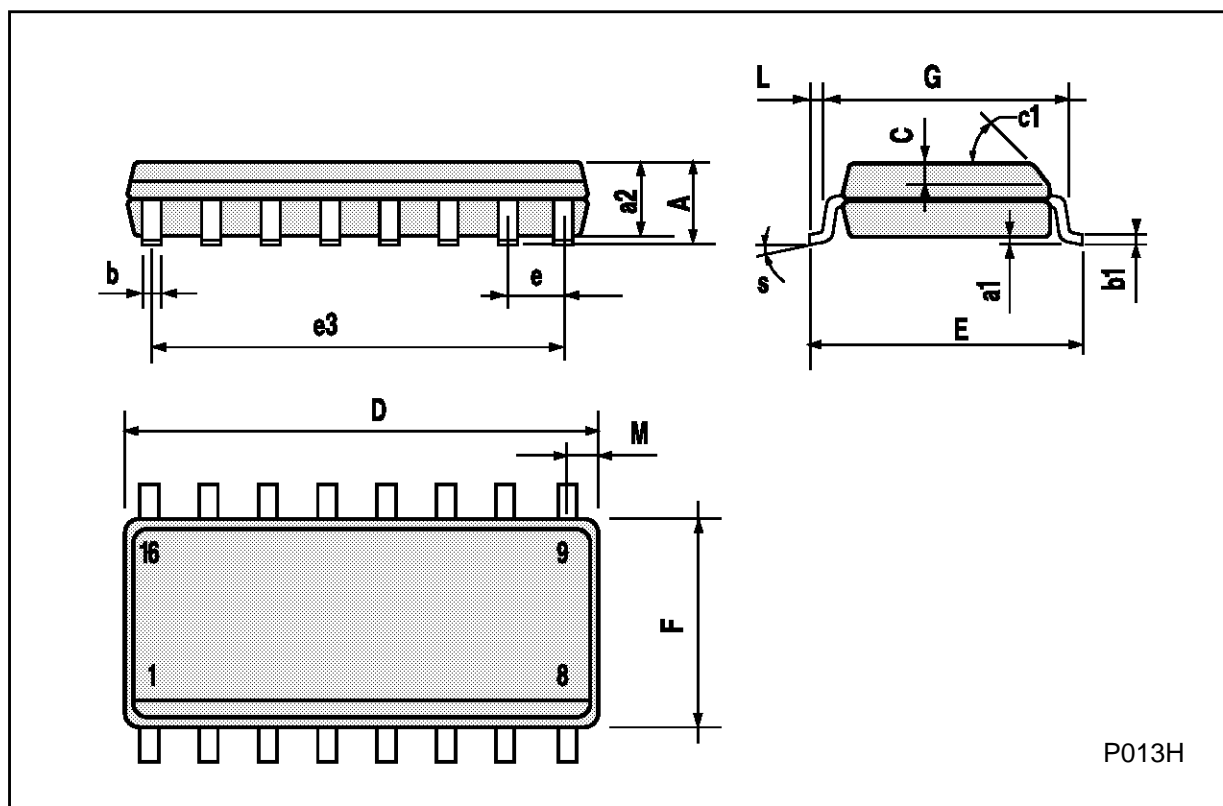
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 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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