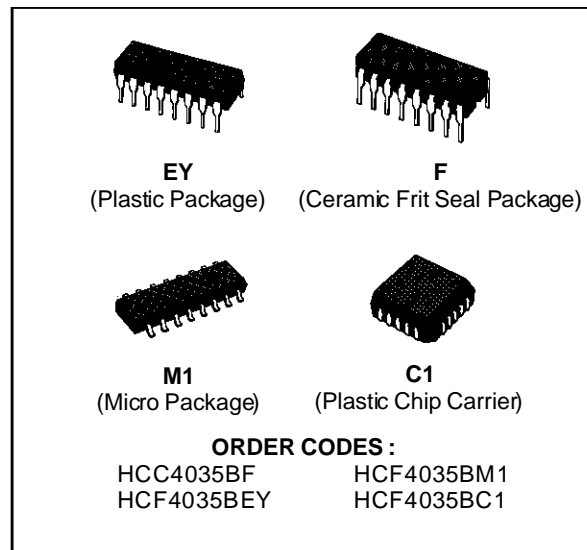


## 4-STAGE PARALLEL IN/PARALLEL OUT SHIFT REGISTER

- 4-STAGE CLOCKED SHIFT OPERATION
- SYNCHRONOUS PARALLEL ENTRY ON ALL 4 STAGES
- JK INPUTS ON FIRST STAGE
- ASYNCHRONOUS TRUE/COMPLEMENT CONTROL ON ALL OUTPUTS
- STATIC FLIP-FLOP OPERATION ; MASTER-SLAVE CONFIGURATION
- BUFFERED INPUTS AND OUTPUTS
- HIGH SPEED 12MHz (typ.) AT  $V_{DD} = 10V$
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURR 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N°. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

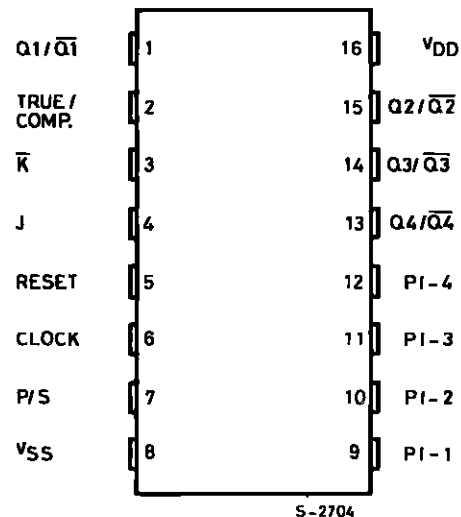
When JK inputs connected together, the first stage becomes a D flip-flop. An asynchronous common RESET is also provided.



### DESCRIPTION

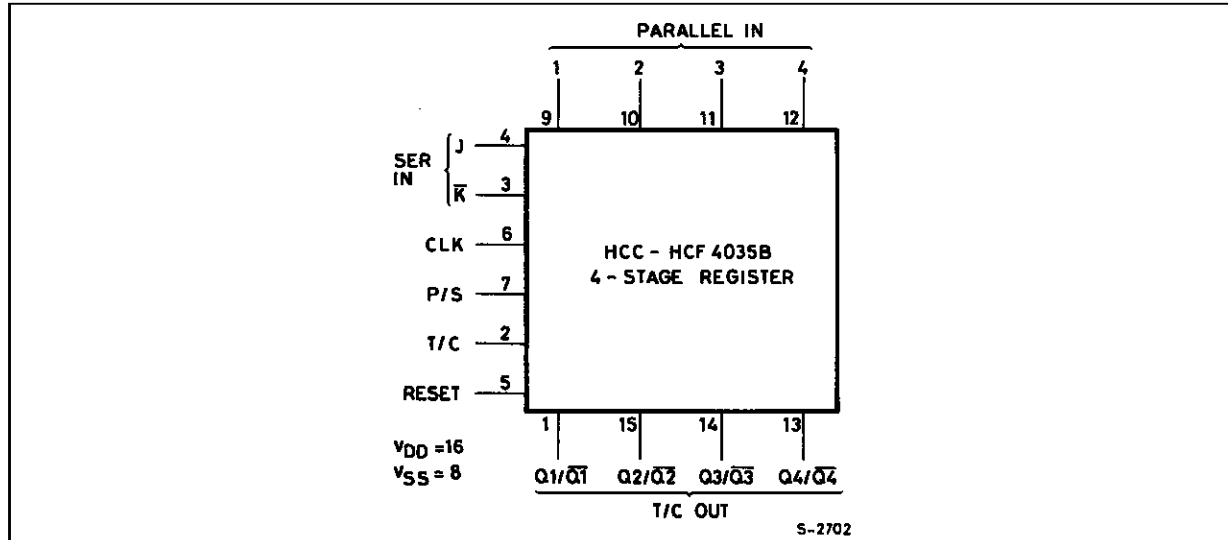
The **HCC4035B** (extended temperature range) and **HCF4035B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4035B** is a four-stage clocked signal serial register with provision for synchronous PARALLEL inputs to each stage and SERIAL inputs to the first stage via JK logic. Register stages 2, 3, and 4 are coupled in a serial D flip-flop configuration when the register is in the serial mode (PARALLEL/SERIAL control low). Parallel entry into each register stage is permitted when the PARALLEL/SERIAL control is high. In the parallel or serial mode information is transferred on positive clock transitions. When the TRUE/COMPLEMENT control is high, the true contents of the register are available at the output terminals. When the TRUE/COMPLEMENT control is low, the outputs are the complements of the data in the register. The TRUE/COMPLEMENT control functions asynchronously with respect to the CLOCK signal. JK input logic is provided on the first stage SERIAL input to minimize logic requirements particularly in counting and sequence-generation applications.

### PIN CONNECTIONS



# HCC/HCF4035B

## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter   | Value                          | Unit        |
|------------|---|--------------------------------|-------------|
| $V_{DD}^*$ | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> 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 : <b>HCC</b> Types<br><b>HCF</b> Types  | - 55 to + 125<br>- 40 to + 85  | $^{\circ}C$ |
| $T_{stg}$  | Storage Temperature   | - 65 to + 150                  | $^{\circ}C$ |

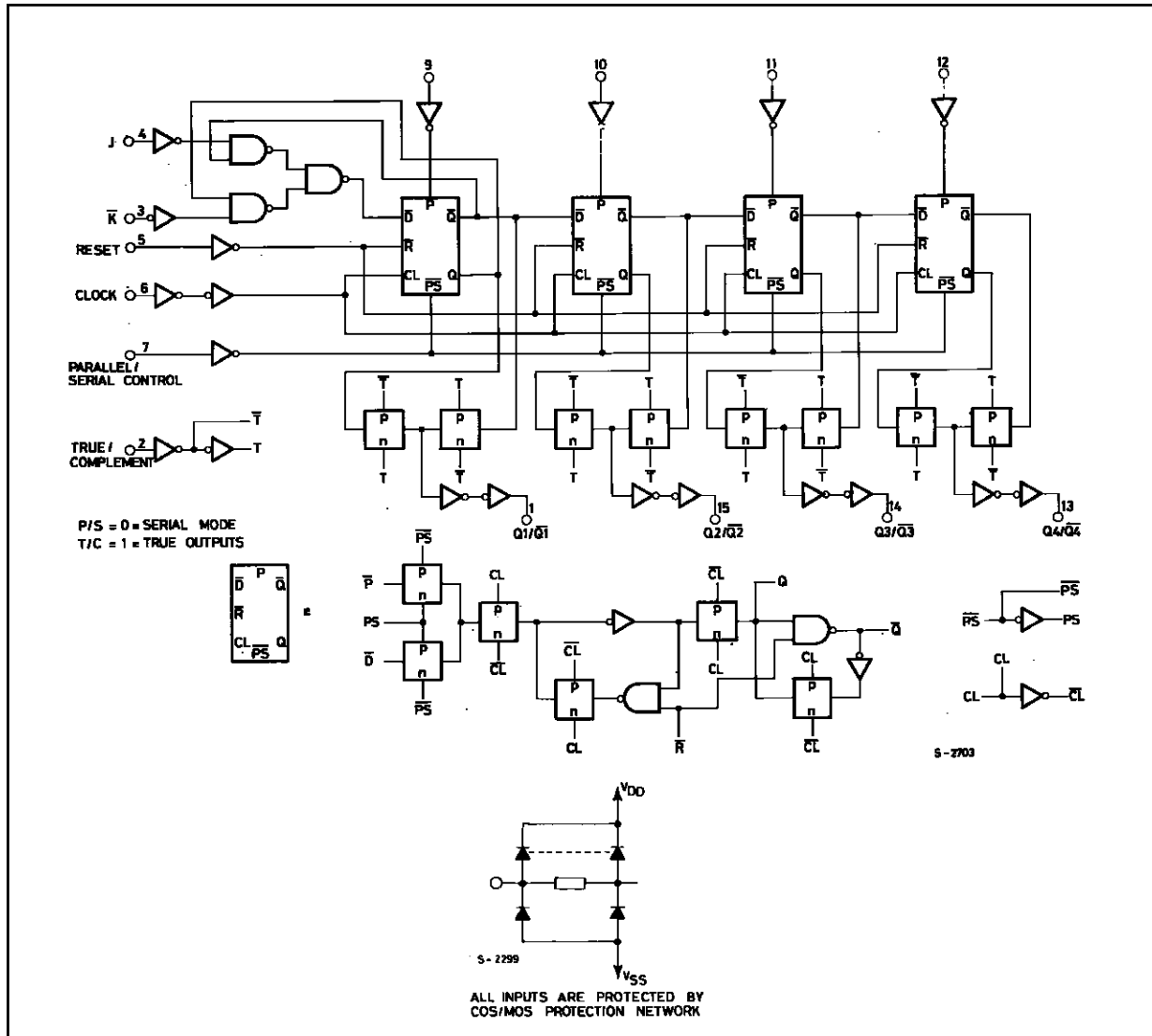
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure 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: <b>HCC</b> Types<br><b>HCF</b> Types        | 3 to 18<br>3 to 15        | V           |
| $V_i$    | Input Voltage   | 0 to $V_{DD}$             | V           |
| $T_{op}$ | Operating Temperature: <b>HCC</b> Types<br><b>HCF</b> Types | -55 to +125<br>-40 to +85 | $^{\circ}C$ |

LOGIC DIAGRAM



TRUTH TABLE  
FIRST STAGE

| Clock<br>( $\phi$ ) | $t_{n-1}$ (inputs) |           |   |           | $t_n$ (outputs)                  |
|---------------------|--------------------|-----------|---|-----------|----------------------------------|
|                     | J                  | $\bar{K}$ | R | $Q_{n-1}$ | $Q_n$                            |
|                     | 0                  | X         | 0 | 0         | 0                                |
|                     | 1                  | X         | 0 | 0         | 1                                |
|                     | X                  | 0         | 0 | 1         | 0                                |
|                     | 1                  | 0         | 0 | $Q_{n-1}$ | $\overline{Q_{n-1}}$ Toggle Mode |
|                     | X                  | 1         | 0 | 1         | 1                                |
|                     | X                  | X         | 0 | $Q_{n-1}$ | $Q_{n-1}$                        |
| X                   | X                  | X         | 1 | X         | 0                                |

**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     |         |
| 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      |                     | 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       |                     | 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 |        | $\pm 10^{-5}$ | $\pm$ 0.1 |                     | $\pm$ 1 | $\mu$ A |
|                                   |                       | HCF Types | 0/15                  | Any Input             |                                | 15                     |                    | $\pm$ 0.3 |        | $\pm 10^{-5}$ | $\pm$ 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.

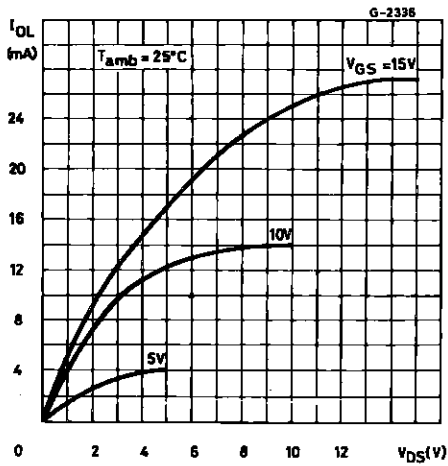
\* T<sub>High</sub> = + 125°C for HCC device : + 85°C for HCF device.

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, 2.5V min. with V<sub>DD</sub> = 15V.

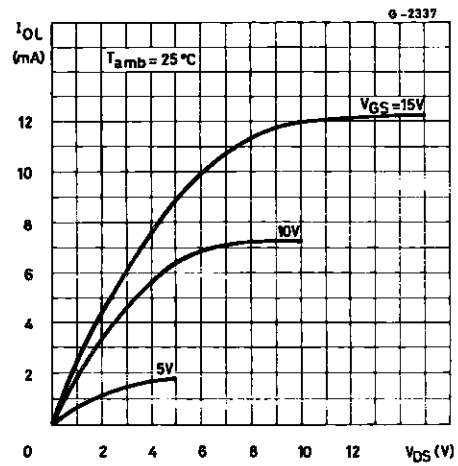
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD} = 0.3\%/^{\circ}\text{C}$ , all input rise and fall time = 20ns)

| Symbol                   | Parameter                         | Test Conditions |              | Value |      |      | Unit          |
|--------------------------|-----------------------------------|-----------------|--------------|-------|------|------|---------------|
|                          |                                   |                 | $V_{DD}$ (V) | Min.  | Typ. | Max. |               |
| <b>CLOCKED OPERATION</b> |                                   |                 |              |       |      |      |               |
| $t_{PLH}$ , $t_{PHL}$    | Propagation Delay Time            |                 | 5            |       | 250  | 500  | ns            |
|                          |                                   |                 | 10           |       | 100  | 200  |               |
|                          |                                   |                 | 15           |       | 75   | 150  |               |
| $t_{THL}$ , $t_{TLH}$    | Transition Time                   |                 | 5            |       | 100  | 200  | ns            |
|                          |                                   |                 | 10           |       | 50   | 100  |               |
|                          |                                   |                 | 15           |       | 40   | 80   |               |
| $f_{CL}$                 | Maximum Clock Input Frequency     |                 | 5            | 2     | 4    |      | MHz           |
|                          |                                   |                 | 10           | 6     | 12   |      |               |
|                          |                                   |                 | 15           | 8     | 16   |      |               |
| $t_w$                    | Clock Pulse Width                 |                 | 5            |       | 100  | 200  | ns            |
|                          |                                   |                 | 10           |       | 45   | 90   |               |
|                          |                                   |                 | 15           |       | 30   | 60   |               |
| $t_r$ , $t_f$            | Clock Input Rise or Fall Time     |                 | 5            |       | 15   |      | $\mu\text{s}$ |
|                          |                                   |                 | 10           |       | 15   |      |               |
|                          |                                   |                 | 15           |       | 15   |      |               |
| $t_{setup}$              | Data Setup Time J/K Lines         |                 | 5            |       | 110  | 220  | ns            |
|                          |                                   |                 | 10           |       | 40   | 80   |               |
|                          |                                   |                 | 15           |       | 30   | 60   |               |
| $t_{setup}$              | Data Setup Time Parallel-In-Lines |                 | 5            |       | 70   | 140  | ns            |
|                          |                                   |                 | 10           |       | 25   | 50   |               |
|                          |                                   |                 | 15           |       | 20   | 40   |               |
| <b>RESET OPERATION</b>   |                                   |                 |              |       |      |      |               |
| $t_{PLH}$ , $t_{PHL}$    | Propagation Delay Time            |                 | 5            |       | 230  | 460  | ns            |
|                          |                                   |                 | 10           |       | 100  | 200  |               |
|                          |                                   |                 | 15           |       | 80   | 160  |               |
| $t_w$                    | Reset Pulse Width                 |                 | 5            |       | 125  | 250  | ns            |
|                          |                                   |                 | 10           |       | 55   | 110  |               |
|                          |                                   |                 | 15           |       | 40   | 40   |               |

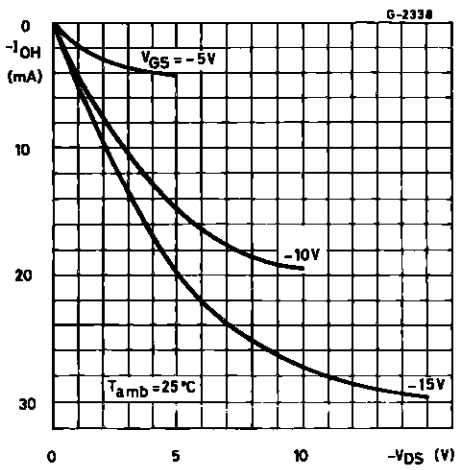
Typical Output Low (sink) Current Characteristics.



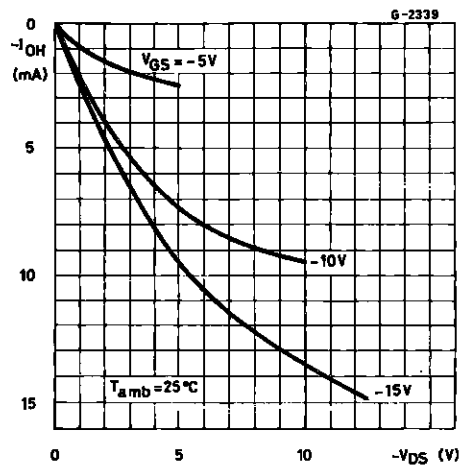
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.

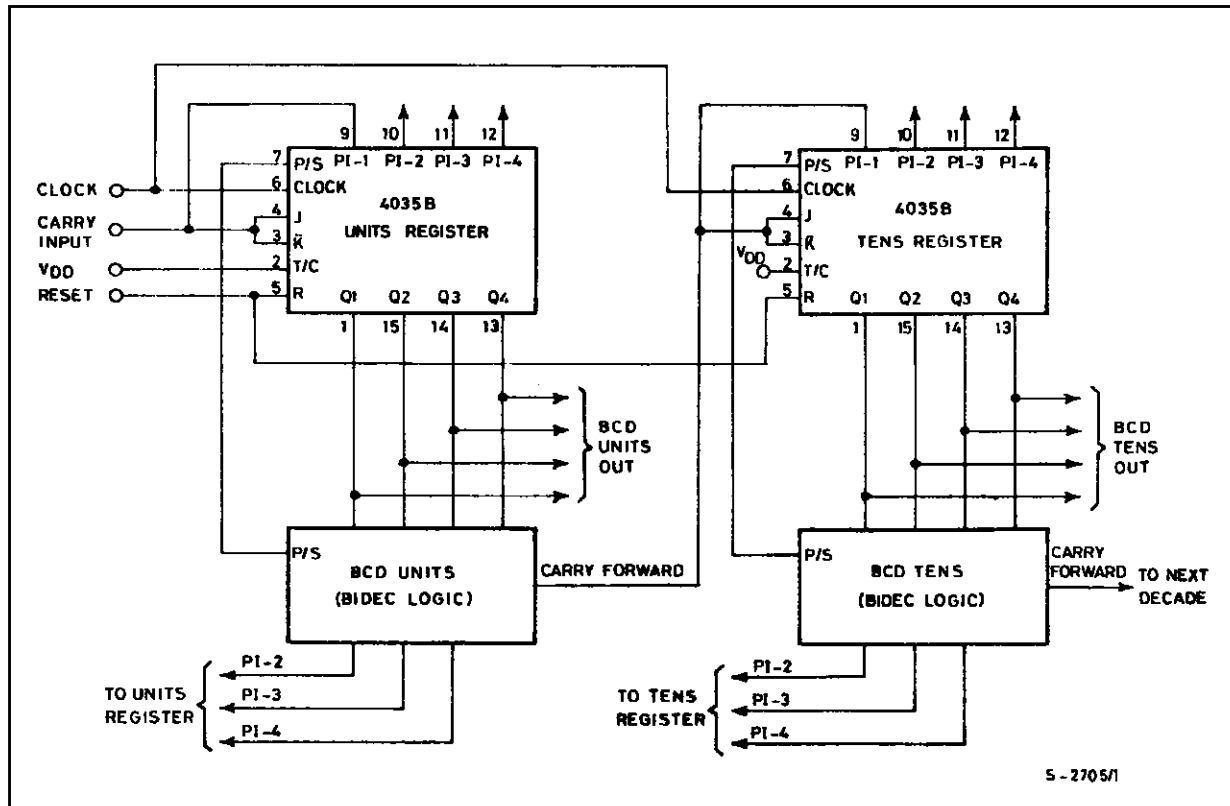


Minimum Output High (source) Current Characteristics.

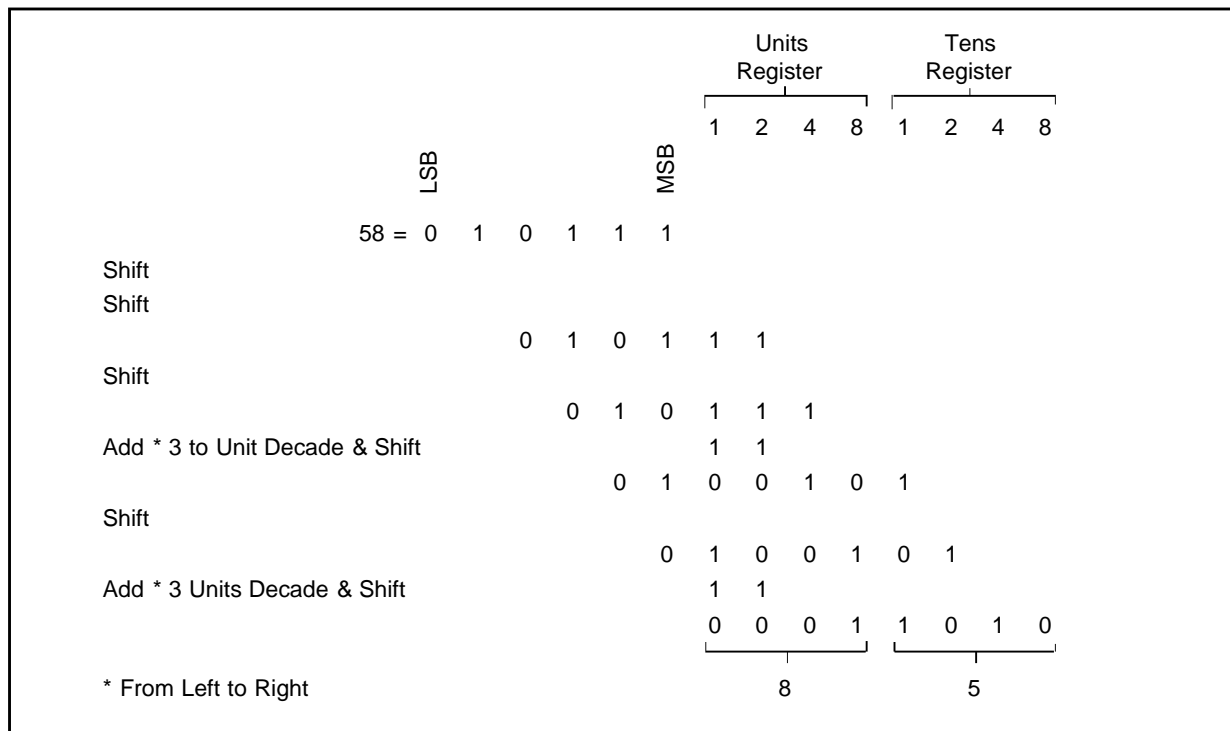


TYPICAL APPLICATIONS

BINARY-TO-BCD CONVERTER

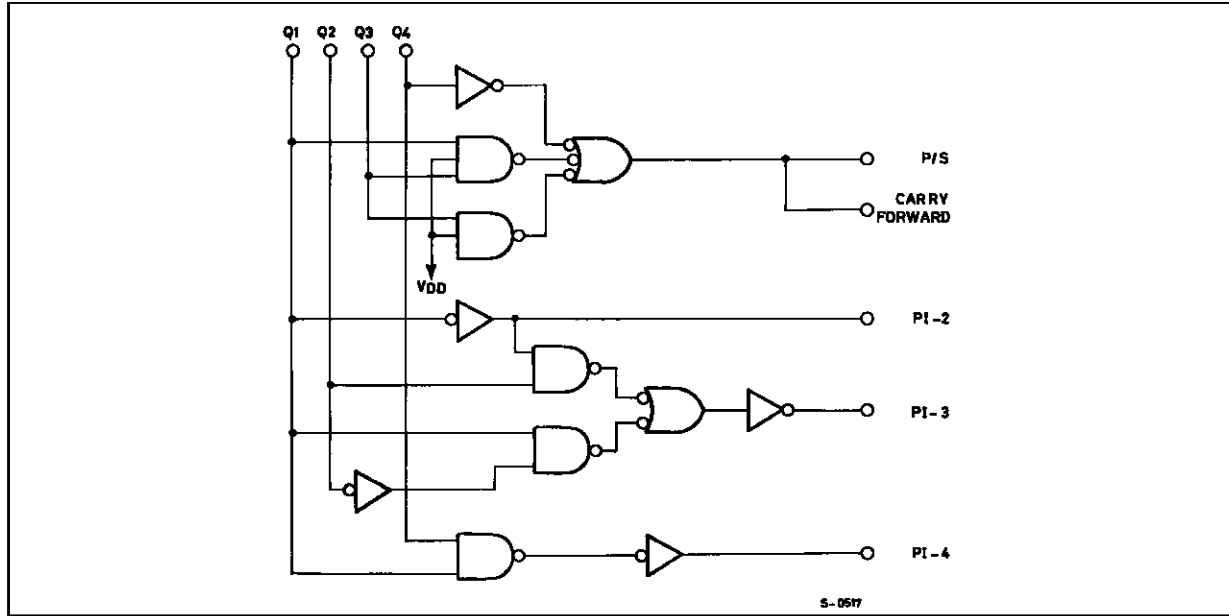


EXAMPLE OF BINARY-TO-BCD CONVERSION

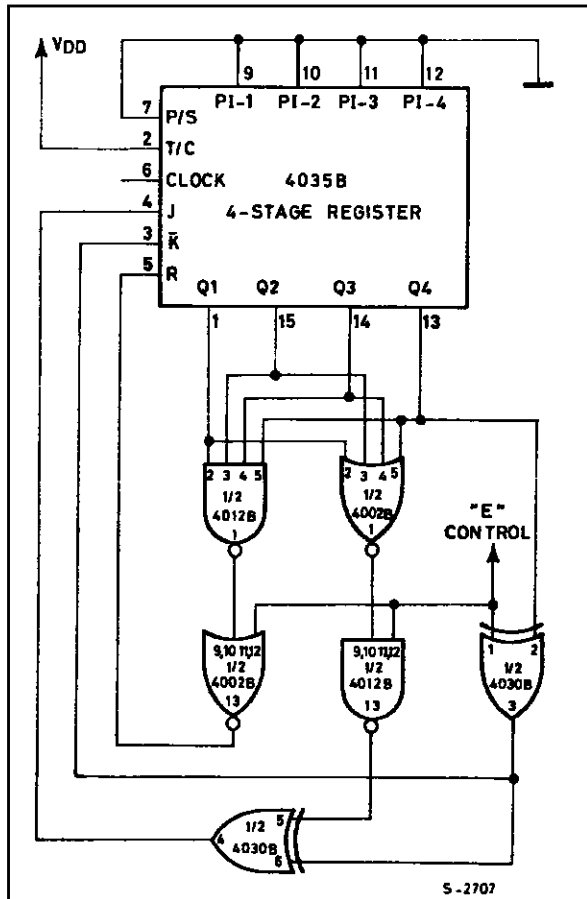


TYPICAL APPLICATIONS

BIDEC LOGIC



DOUBLE SEQUENCE GENERATOR



STATE SEQUENCES

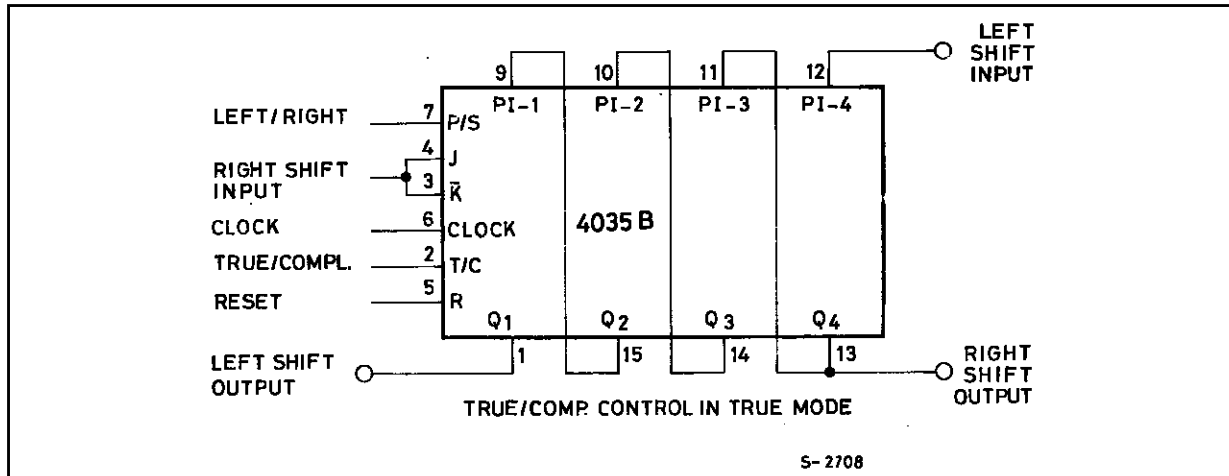
Using a control line (E) two different state sequences can be generated. For example, suppose the following two sequences are desired on command (control line E).

|    | Control = E = 0 |                |                |                |    | 1              |                |                |                |
|----|-----------------|----------------|----------------|----------------|----|----------------|----------------|----------------|----------------|
|    | Q <sub>1</sub>  | Q <sub>2</sub> | Q <sub>3</sub> | Q <sub>4</sub> |    | Q <sub>1</sub> | Q <sub>2</sub> | Q <sub>3</sub> | Q <sub>4</sub> |
| 0  | A               | B              | C              | D              | 15 | A              | B              | C              | D              |
| 1  | 0               | 0              | 0              | 0              | 14 | 0              | 0              | 1              | 1              |
| 2  | 1               | 0              | 0              | 0              | 13 | 1              | 0              | 1              | 1              |
| 5  | 0               | 1              | 0              | 0              | 10 | 0              | 1              | 0              | 1              |
| 10 | 1               | 0              | 1              | 0              | 5  | 1              | 0              | 1              | 0              |
| 4  | 0               | 0              | 1              | 0              | 11 | 1              | 1              | 0              | 1              |
| 9  | 1               | 0              | 0              | 1              | 6  | 0              | 1              | 1              | 0              |
| 3  | 1               | 1              | 0              | 0              | 12 | 0              | 0              | 1              | 1              |
| 6  | 0               | 1              | 1              | 0              | 9  | 1              | 0              | 0              | 1              |
| 13 | 1               | 0              | 1              | 1              | 2  | 0              | 1              | 0              | 0              |
| 11 | 1               | 1              | 0              | 1              | 4  | 0              | 0              | 1              | 0              |
| 7  | 1               | 1              | 1              | 0              | 8  | 0              | 0              | 0              | 1              |
| 14 | 0               | 1              | 1              | 1              | 1  | 1              | 0              | 0              | 0              |
| 12 | 0               | 0              | 1              | 1              | 3  | 1              | 1              | 0              | 0              |
| 8  | 0               | 0              | 0              | 1              | 7  | 1              | 1              | 1              | 0              |



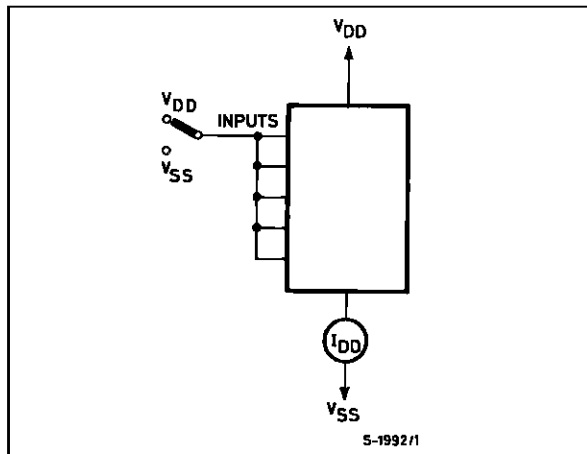
TYPICAL APPLICATIONS

SHIFT LEFT/SHIFT RIGHT REGISTER

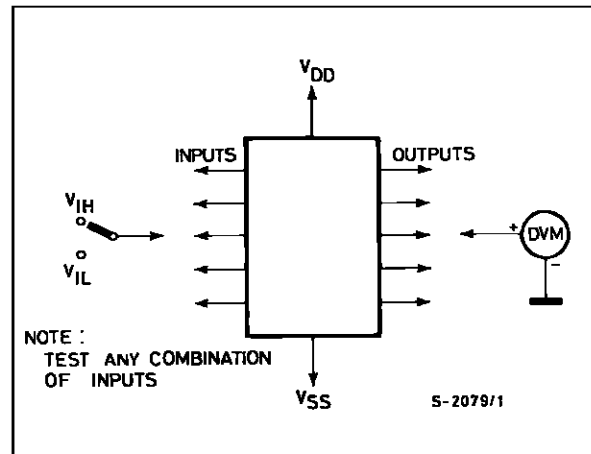


TEST CIRCUITS

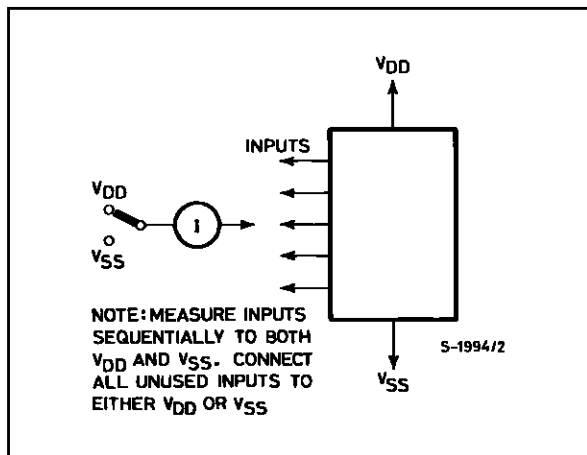
Quiescent Device Current



Input Voltage.



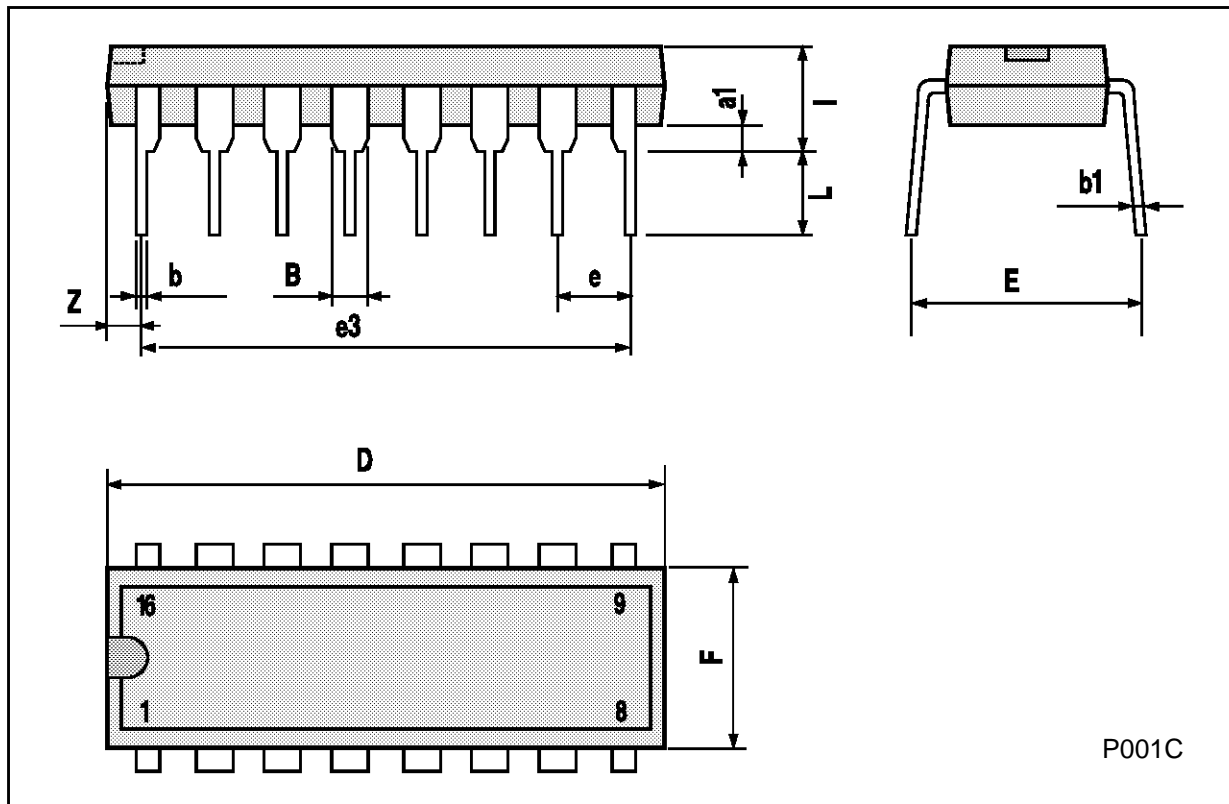
Input Current.



HCC/HCF4035B

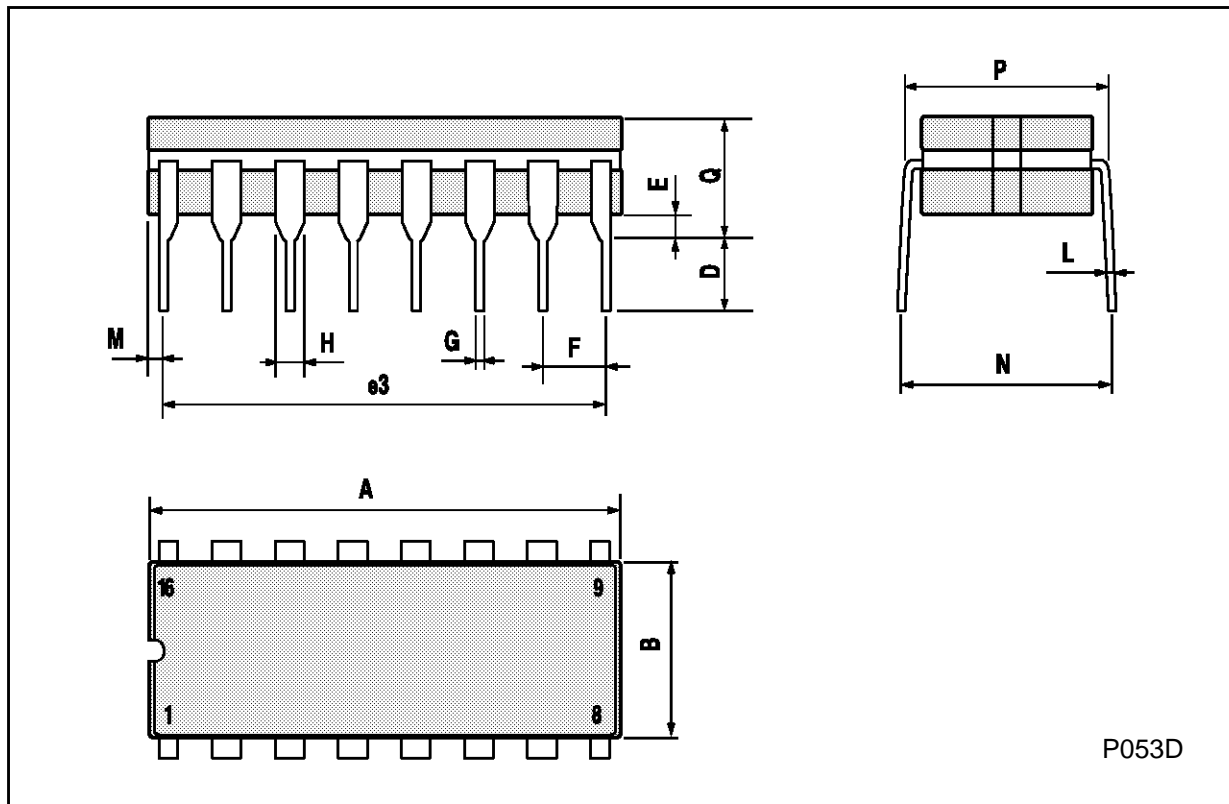
**Plastic DIP16 (0.25) MECHANICAL DATA**

| 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 |



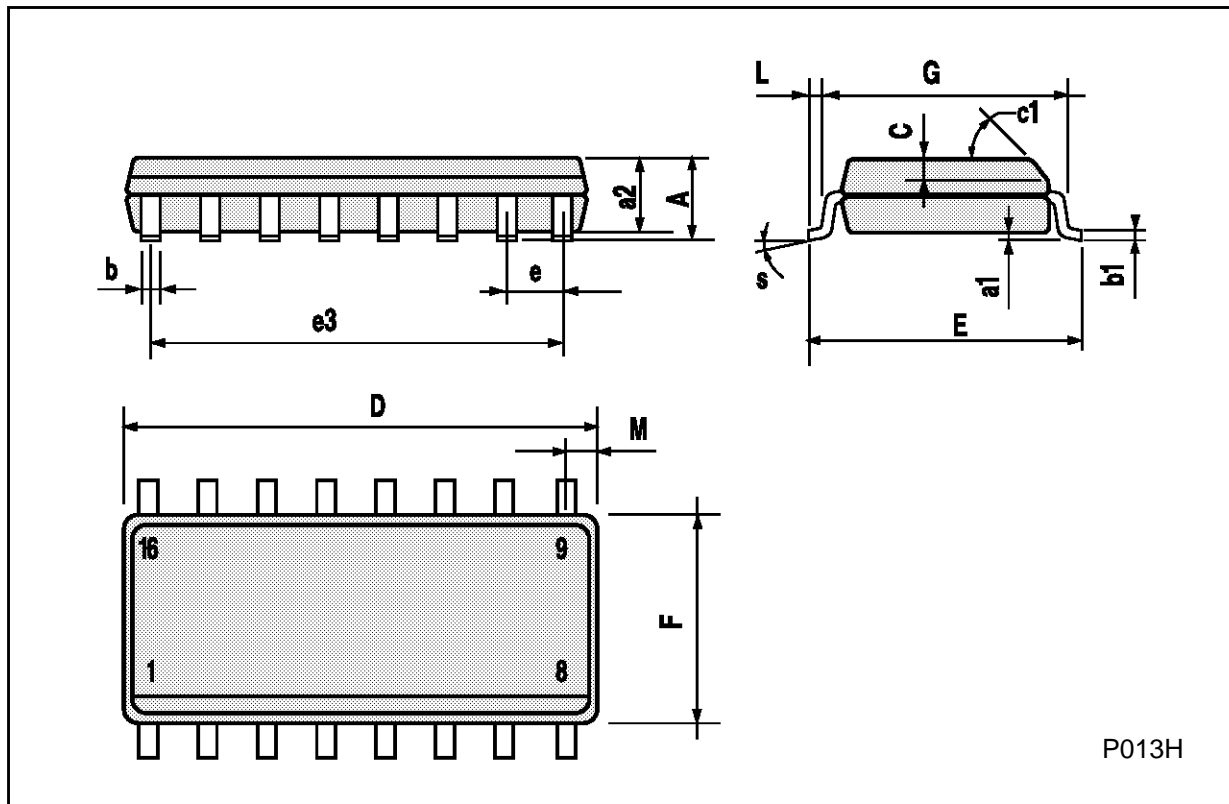
**Ceramic DIP16/1 MECHANICAL DATA**

| 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 |



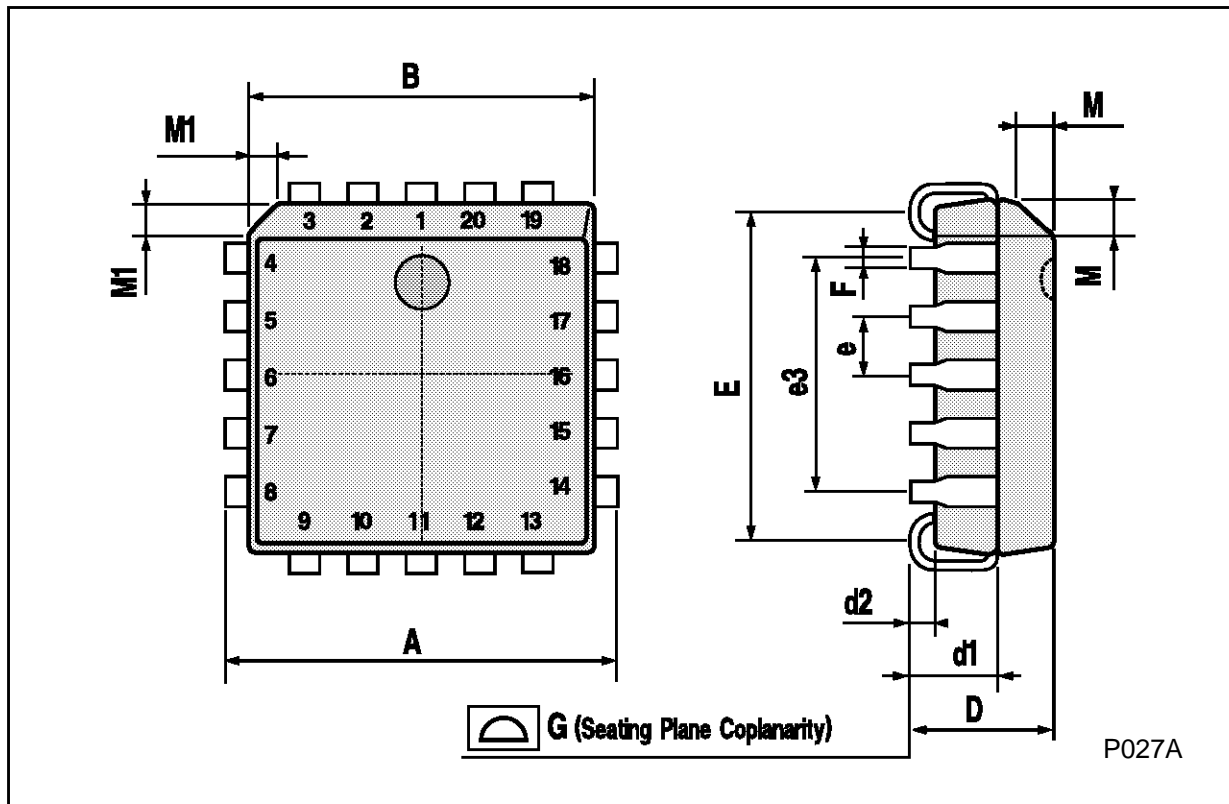
**SO16 (Narrow) MECHANICAL DATA**

| 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.)  |      |      |       |       |       |



**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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