

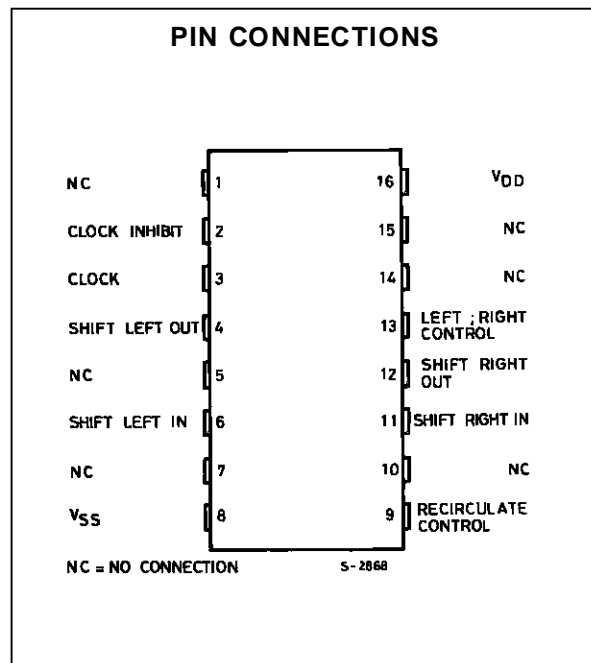
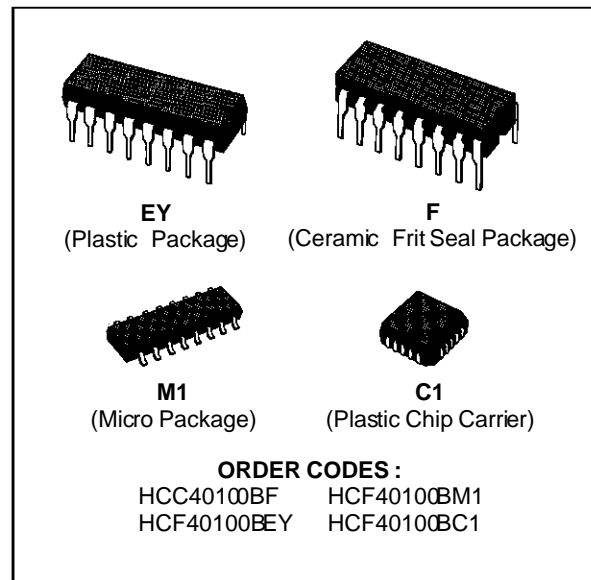
**32-STAGE STATIC LEFT/RIGHT SHIFT REGISTER**

- FULLY STATIC OPERATION
- SHIFT LEFT/SHIFT RIGHT CAPABILITY
- MULTIPLE PACKAGE CASCADING
- RECIRCULATE CAPABILITY
- LIFO OR FIFO CAPABILITY
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED AT 20V FOR HCC DEVICE
- 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 N<sup>o</sup>. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

data in the 32nd stage is shifted into the first stage when the LEFT/RIGHT CONTROL is low and from the 1st stage to the 32nd stage when the LEFT/RIGHT CONTROL is high.

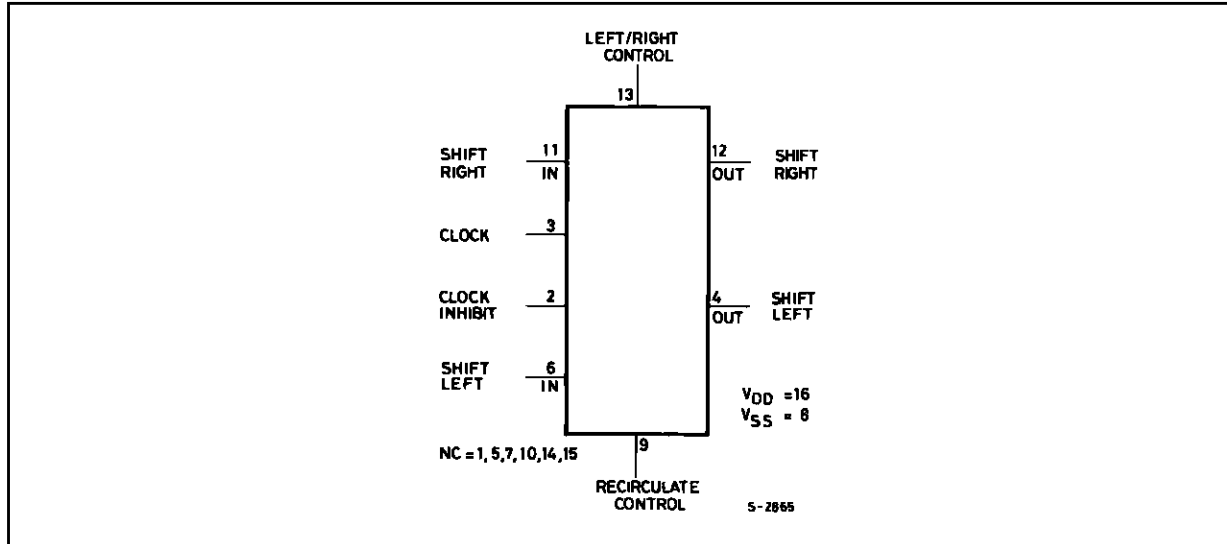
**DESCRIPTION**

The **HCC40100B** (extended temperature range) and **HCF40100B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF40100B** is a 32-stage shift register containing 32 D-type master-slave flip-flops. The data present at the SHIFT-RIGHT INPUT is transferred into the first register stage synchronously with the positive CLOCK edge, provided the LEFT/RIGHT CONTROL is at a low level, the RECIRCULATE CONTROL is at a high level, and the CLOCK INHIBIT is low. If the LEFT/RIGHT CONTROL is at a high level and the RECIRCULATE CONTROL is also high, data at the SHIFT-LEFT INPUT is transferred into the 32nd register stage synchronously with the positive CLOCK transition, provided the CLOCK INHIBIT is low. The state of the LEFT/RIGHT CONTROL, RECIRCULATE CONTROL, and CLOCK INHIBIT should not be changed when the CLOCK is high. Data is shifted one stage left or one stage right depending on the state of the LEFT/RIGHT CONTROL, synchronously with the positive CLOCK edge. Data clocked into the first or 32nd register states is available at the SHIFT-LEFT or SHIFT-RIGHT OUTPUT respectively, on the next negative CLOCK transition (see Data Transfer Table). No shifting occurs on the positive CLOCK edge if the CLOCK INHIBIT line is at a high level. With the RECIRCULATE CONTROL low,



# HCC/HCF40100B

## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

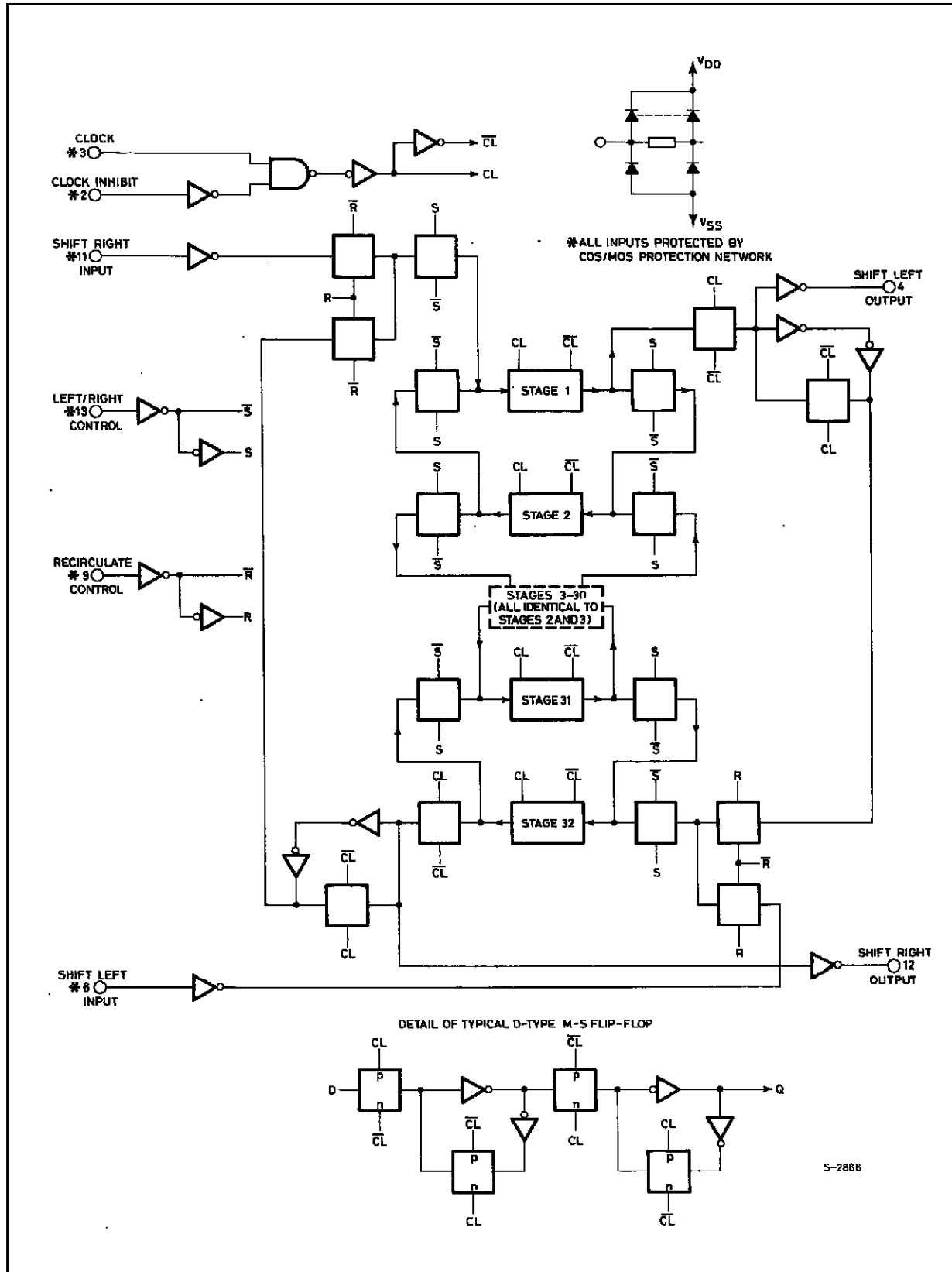
| Symbol     | Parameter   | Value                          | Unit        |
|------------|---|--------------------------------|-------------|
| $V_{DD}^*$ | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> Types   | - 0.5 to + 20<br>- 0.5 to + 18 | V           |
| $V_i$      | Input Voltage   | - 0.5 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.

## 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



# HCC/HCF40100B

## TRUTH TABLES

### CONTROL

| Left/Right Control | Clock Inhibit | Recirculate Control | Action      | Input Bit Origin  |
|--------------------|---------------|---------------------|-------------|-------------------|
| 1                  | 0             | 1                   | Shift Left  | Shift Left Input  |
| 1                  | 0             | 0                   | Shift Left  | Stage 1           |
| 0                  | 0             | 1                   | Shift Right | Shift Right Input |
| 0                  | 0             | 0                   | Shift Right | Stage 32          |
| X                  | 1             | X                   | No Shift    | –                 |

### DATA TRANSFER

| Initial State |               |                | Clock        | Resulting State  |        |
|---------------|---------------|----------------|--------------|------------------|--------|
| Data Input    | Clock Inhibit | Internal Stage | Level Change | Internal Stage Q | Output |
| 0             | 0             | X              |              | 0                | NC     |
| X             | 0             | 0              |              | NC               | 0      |
| 1             | 0             | X              |              | 1                | NC     |
| X             | 0             | 1              |              | NC               | 1      |
| X             | 1             | 1              | X            | NC               | NC     |

0 = Low level

1 = High level

X= Don't Care.

NC = No change.

\* For Shift-Right Mode

For Shift-left Mode

Data Input = SHIFT-RIGHT INPUT (Pin 11)

Data input = SHIFT LEFT INPUT (Pin 6)

Internal Stage = Stage 1 (Q1)

Internal Stage = Stage 32 (Q32)

Output = SHIFT-LEFT OUTPUT (Pin 4).

Output = SHIFT-RIGHT OUTPUT (Pin 12).

## 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                |      | V    |         |     |
|                 |                     | 0/10                  |                       | < 1                            | 10                     |                    | 9.95  |      |      |      | 9.95                |      |      |         |     |
|                 |                     | 0/15                  |                       | < 1                            | 15                     |                    | 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                |      |      |         |     |
|                 |                     | 15/0                  |                       | < 1                            | 15                     |                    |       | 0.05 |      |      | 0.05                |      |      |         |     |

\* 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.

## STATIC ELECTRICAL CHARACTERISTICS (continued)

| 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. |
| 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                     |                    | $\pm 0.1$ |        | $\pm 10^{-5}$ | $\pm 0.1$ |                     | $\pm 1$ |      |
|                                   |                       | HCF Types             | 0/15                  |                                | 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, 2.5 V min. with V<sub>DD</sub> = 15V.DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25°C, C<sub>L</sub> = 50pF, R<sub>L</sub> = 200k $\Omega$ , typical temperature coefficient for all V<sub>DD</sub> values is 0.3%/°C, all input rise and fall time = 20ns)

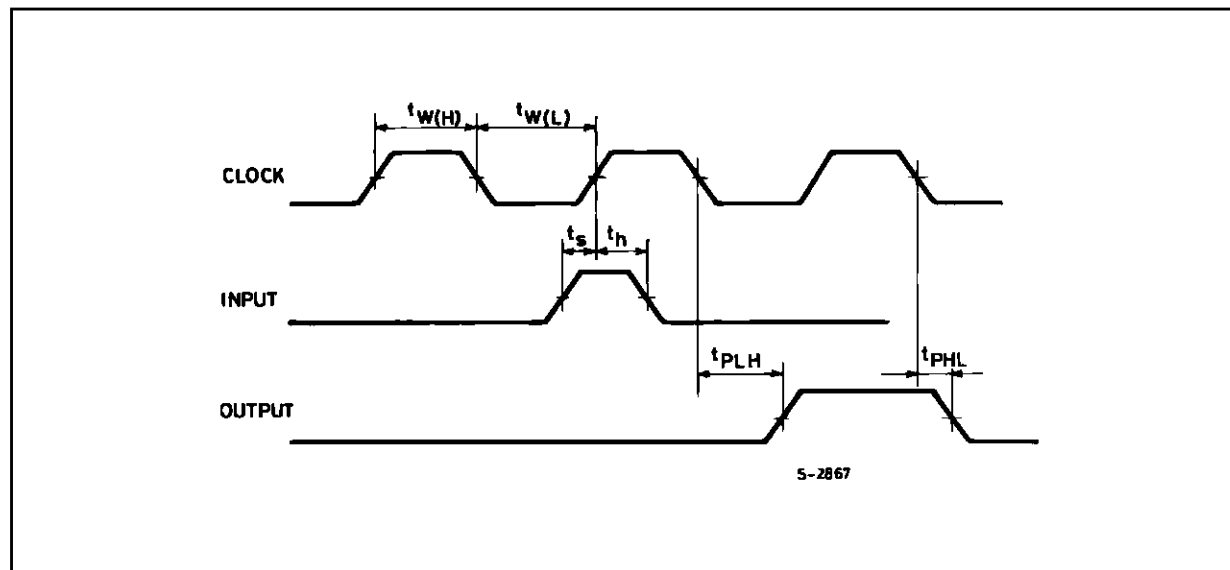
| Symbol                                 | Parameter  | Test Conditions |                     | Value |      |      | Unit |
|--|--|-----------------|---------------------|-------|------|------|------|
|  |  |                 | V <sub>DD</sub> (V) | Min.  | Typ. | Max. |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Propagation Delay Time<br>Clock to Shift Left/Right Output |                 | 5                   |       | 360  | 720  | ns   |
|  |  |                 | 10                  |       | 165  | 330  |      |
|  |  |                 | 15                  |       | 115  | 230  |      |
| t <sub>THL</sub> ,<br>t <sub>TLH</sub> | Transition Time  |                 | 5                   |       | 100  | 200  | ns   |
|  |  |                 | 10                  |       | 50   | 100  |      |
|  |  |                 | 15                  |       | 40   | 80   |      |

# HCC/HCF40100B

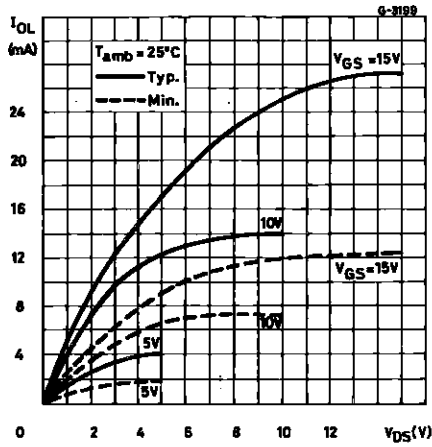
## DYNAMIC ELECTRICAL CHARACTERISTICS (continued)

| Symbol             | Parameter                          | Test Conditions |                     | Value |      |      | Unit |
|--------------------|------------------------------------|-----------------|---------------------|-------|------|------|------|
|                    |                                    |                 | V <sub>DD</sub> (V) | Min.  | Typ. | Max. |      |
| t <sub>setup</sub> | Data Setup Time                    |                 | 5                   | 100   | 50   |      | ns   |
|                    |                                    |                 | 10                  | 20    | 10   |      |      |
|                    |                                    |                 | 15                  | 10    | 5    |      |      |
| t <sub>hold</sub>  | Data Hold Time                     |                 | 5                   | 275   | 170  |      | ns   |
|                    |                                    |                 | 10                  | 100   | 75   |      |      |
|                    |                                    |                 | 15                  | 75    | 50   |      |      |
| t <sub>w</sub>     | Clock Input Pulse Width Low Level  |                 | 5                   | 450   | 225  |      | ns   |
|                    |                                    |                 | 10                  | 230   | 115  |      |      |
|                    |                                    |                 | 15                  | 190   | 95   |      |      |
| t <sub>w</sub>     | Clock Input Pulse Width High Level |                 | 5                   | 280   | 140  |      | ns   |
|                    |                                    |                 | 10                  | 150   | 75   |      |      |
|                    |                                    |                 | 15                  | 140   | 70   |      |      |
| f <sub>CL</sub>    | Maximum Clock Input Frequency      |                 | 5                   | 1     | 2    |      | MHz  |
|                    |                                    |                 | 10                  | 2.5   | 5    |      |      |
|                    |                                    |                 | 15                  | 3     | 6    |      |      |

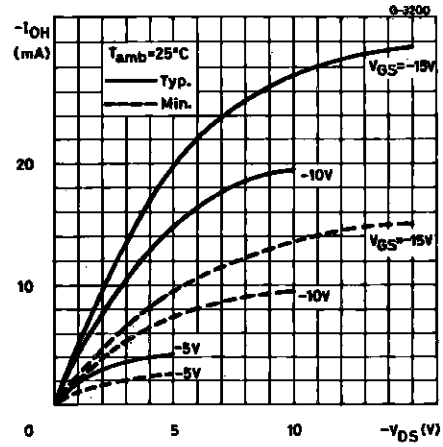
## WAVEFORMS



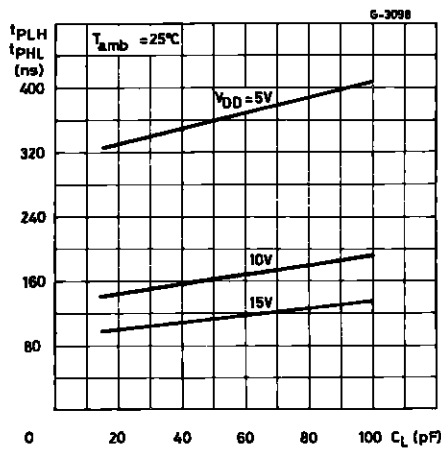
Output Low (sink) Current Characteristics.



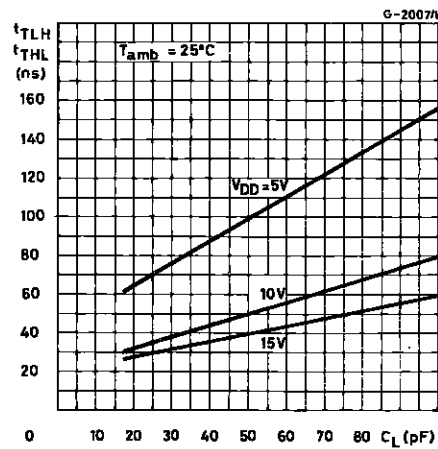
Output High (source) Current Characteristics.



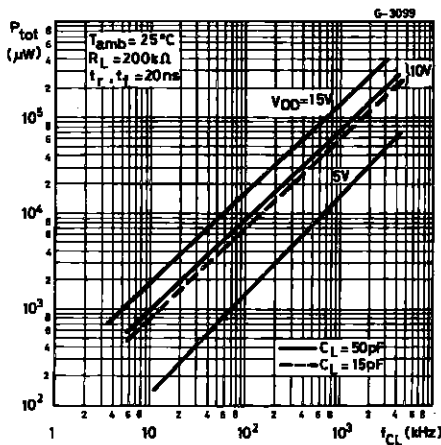
Typical Propagation Delay Time (clock to shift left right) vs. Load Capacitance.



Typical Transition Time vs. Load Capacitance.

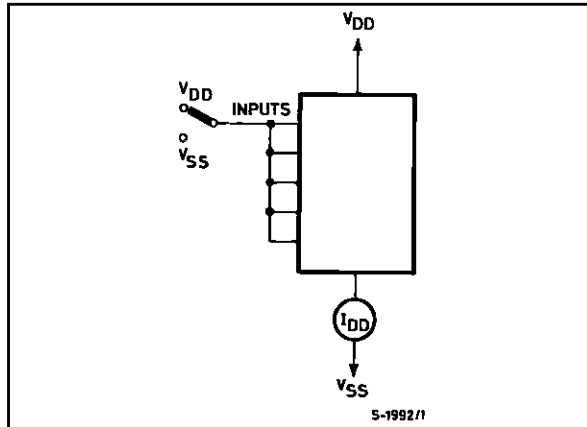


Typical Dynamic Power Dissipation vs. Clock Frequency.

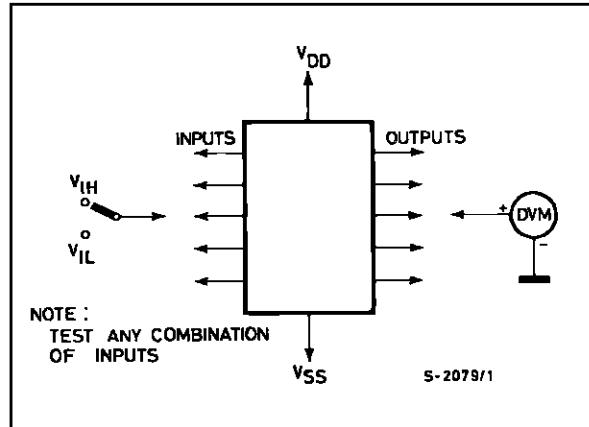


TEST CIRCUITS

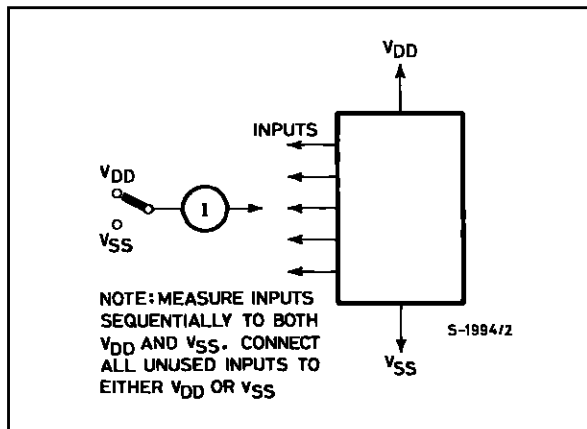
Quiescent Device Current.



Input Voltage.



Input Leakage Current.





**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.)  |      |      |       |       |       |



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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