

**COS/MOS  
INTEGRATED  
CIRCUITS**

7929225 S G S SEMICONDUCTOR CORP



**NOR GATES:** DUAL 3 INPUT PLUS INVERTER HCC/HCF 4000B  
 QUAD 2 INPUT HCC/HCF 4001B  
 DUAL 4 INPUT HCC/HCF 4002B  
 TRIPLE 3 INPUT HCC/HCF 4025B

- PROPAGATION DELAY TIME = 60 ns (TYP.) AT  $C_L = 50$  pF,  $V_{DD} = 10$  V
- BUFFERED INPUTS AND OUTPUTS
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 6V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100 nA 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"

The HCC 4000B, HCC 4001B, HCC 4002B and HCC 4025B (extended temperature range) and HCF 4000B, HCF 4001B, HCF 4002B and HCF 4025B (intermediate temperature range) are monolithic integrated circuit, available in 14-lead dual in-line plastic or ceramic package, ceramic flat package and plastic micropackage.

The HCC/HCF 4000B, HCC/HCF 4001B, HCC/HCF 4002B and HCC/HCF 4025B NOR gates provide the system designer with direct implementation of the NOR function and supplement the existing family of CMOS/MOS gates. All inputs and outputs are buffered.

**ABSOLUTE MAXIMUM RATINGS**

|            |                                                                                    |                          |          |
|------------|------------------------------------------------------------------------------------|--------------------------|----------|
| $V_{DD}^*$ | Supply voltage: HCC types<br>HCF types                                             | -0.5 to 20<br>-0.5 to 18 | V<br>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)                                              | 200                      | mW       |
|            | Dissipation per output transistor<br>for $T_{op} =$ full package-temperature range | 100                      | mW       |
| $T_{op}$   | Operating temperature: HCC types<br>HCF types                                      | -55 to 125<br>-40 to 85  | °C<br>°C |
| $T_{stg}$  | Storage temperature                                                                | -65 to 150               | °C       |

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

**ORDERING NUMBERS:**

HCC 4XXX BD for dual in-line ceramic package  
 HCC 4XXX BF for dual in-line ceramic package, frit seal  
 HCC 4XXX BK for ceramic flat package  
 HCF 4XXX BE for dual in-line plastic package  
 HCF 4XXX BF for dual in-line ceramic package, frit seal  
 HCF 4XXX BM for plastic micropackage

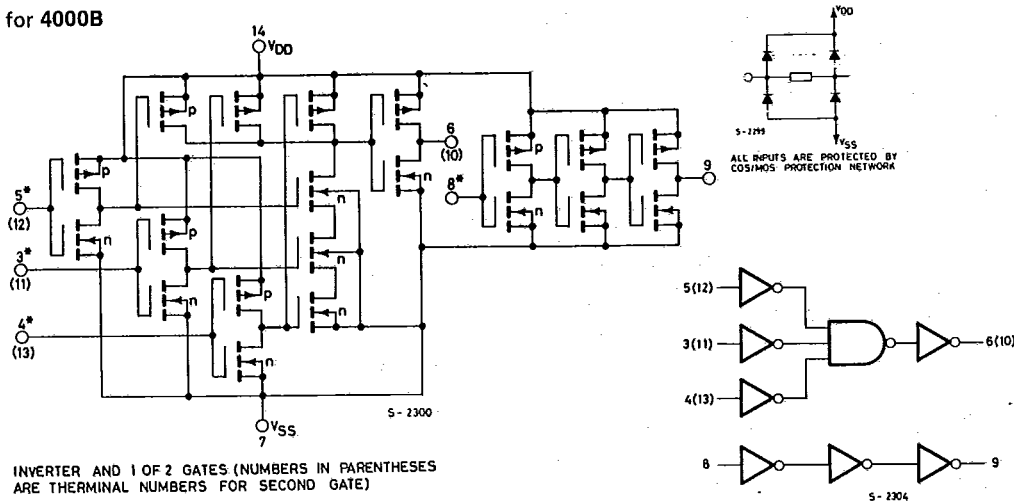




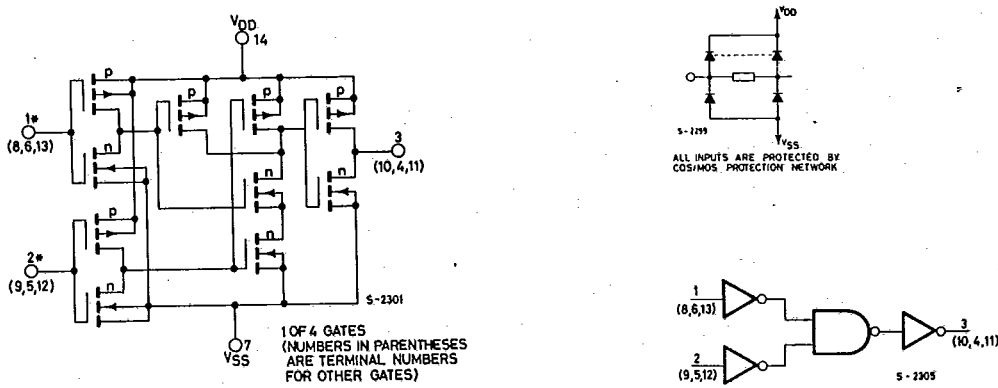
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# SCHEMATIC AND LOGIC DIAGRAMS

for 4000B



for 4001B

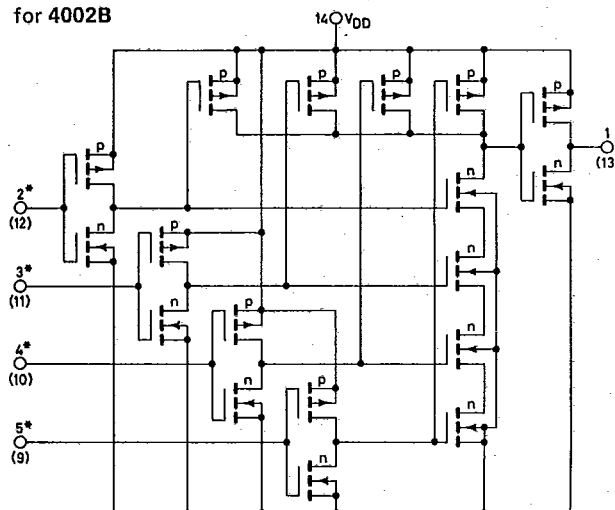


HCC/HCF 4000 B  
HCC/HCF 4001 B  
HCC/HCF 4002 B  
HCC/HCF 4025 B

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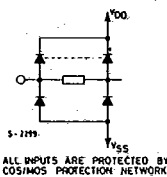
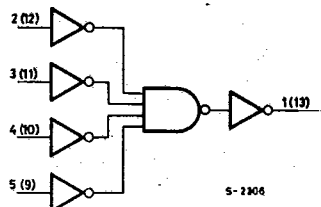
SCHEMATIC AND LOGIC DIAGRAMS (continued)

for 4002B



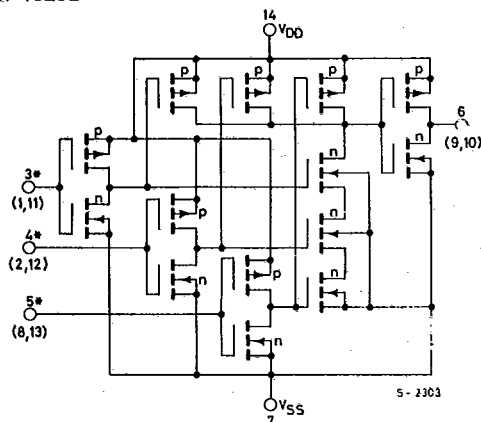
1 OF 2 GATES (NUMBERS IN PARENTHESES ARE TERMINAL NUMBERS FOR SECOND GATE)

S-2302



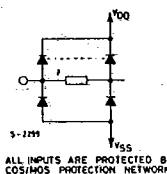
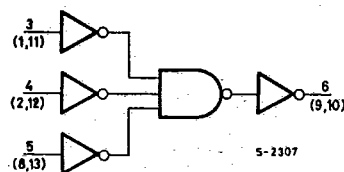
ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

for 4025B



INVERTER AND 1 OF 3 GATES (NUMBERS IN PARENTHESES ARE THERMINAL NUMBERS FOR SECOND GATE)

S-2303



ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK



7929225 S G S SEMICONDUCTOR CORP

## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Parameter                                               |           |      | Test conditions       |                       |                          |                        | Values             |       |                   |      |       |                     | 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                        |                        | 0.25               |       | 0.01              | 0.25 |       | 7.5                 | μA   |      |
|                                                         |           | 0/10 |                       |                       | 10                       |                        | 0.5                |       | 0.01              | 0.5  |       | 15                  |      |      |
|                                                         |           | 0/15 |                       |                       | 15                       |                        | 1                  |       | 0.01              | 1    |       | 30                  |      |      |
|                                                         |           | 0/20 |                       |                       | 20                       |                        | 5                  |       | 0.02              | 5    |       | 150                 |      |      |
|                                                         | HCF types | 0/ 5 |                       |                       | 5                        |                        | 1                  |       | 0.01              | 1    |       | 7.5                 |      |      |
|                                                         |           | 0/10 |                       |                       | 10                       |                        | 2                  |       | 0.01              | 2    |       | 15                  |      |      |
|                                                         |           | 0/15 |                       |                       | 15                       |                        | 4                  |       | 0.01              | 4    |       | 30                  |      |      |
| 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  |                     |      |      |
| 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. with V<sub>DD</sub> = 5V  
2V min. with V<sub>DD</sub> = 10V  
2.5V min. with V<sub>DD</sub> = 15V

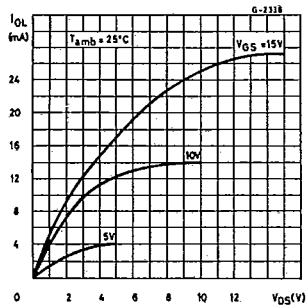
HCC/HCF 4000 B  
HCC/HCF 4001 B  
HCC/HCF 4002 B  
HCC/HCF 4025 B

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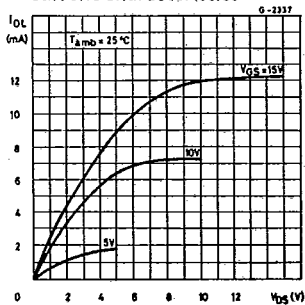
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$ , typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^\circ\text{C}$ , all input rise and fall times =  $20\text{ ns}$ )

| Parameter                                    | Test conditions | Values       |      |      | Unit |
|----------------------------------------------|-----------------|--------------|------|------|------|
|                                              |                 | $V_{DD}$ (V) | Min. | Typ. | Max. |
| $t_{PHL}$ , $t_{PLH}$ Propagation delay time |                 | 5            |      | 125  | 250  |
|                                              |                 | 10           |      | 60   | 120  |
|                                              |                 | 15           |      | 45   | 90   |
| $t_{THL}$ , $t_{TLH}$ Transition time        |                 | 5            |      | 100  | 200  |
|                                              |                 | 10           |      | 50   | 100  |
|                                              |                 | 15           |      | 40   | 80   |

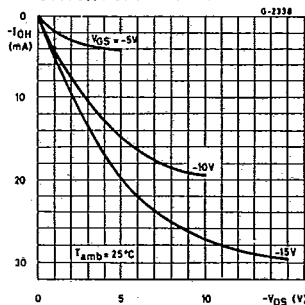
Typical output low (sink) current characteristics



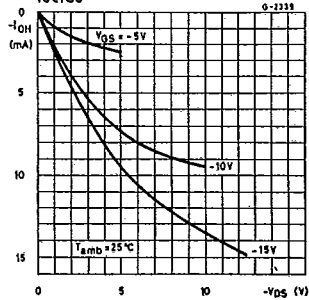
Minimum output low (sink) current characteristics



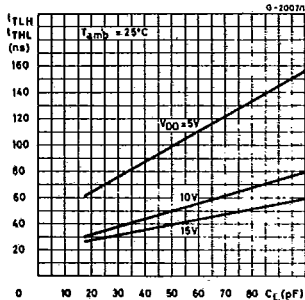
Typical output high (source) current characteristics



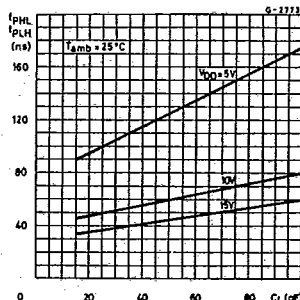
Minimum output high (source) current characteristics



Typical transition time vs. load capacitance



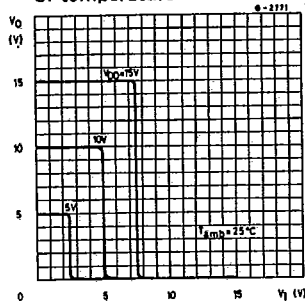
Typical propagation delay time vs. load capacitance



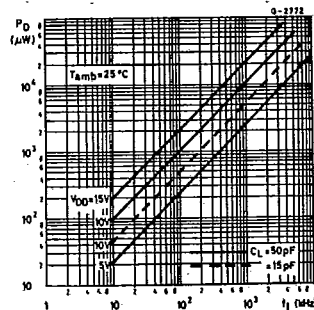


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Typical voltage transfer characteristics as a function of temperature

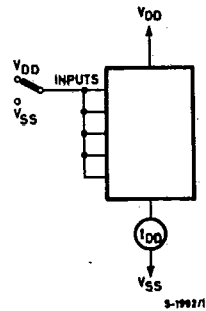


Typical power dissipation per gate vs. frequency

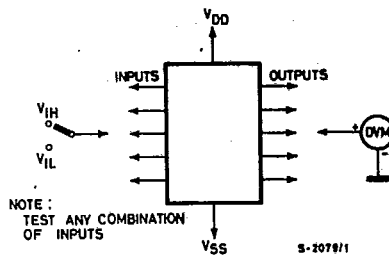


## TEST CIRCUITS

Quiescent device current



Input voltage



Input leakage current

