

## 74VHC02

### Quad 2-Input NOR Gate

#### General Description

The 74VHC02 is an advanced high-speed CMOS 2-Input NOR Gate fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The internal circuit is composed of 3 stages, including buffer output, which provide high noise immunity and stable output. An input protection circuit insures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back-up. This circuit prevents device destruction due to mismatched supply and input voltages.

#### Features

- Low power dissipation:  
 $I_{CC} = 2 \mu\text{A}$  (max) at  $T_A = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- All inputs are equipped with a power down protection function
- Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- Low noise:  $V_{OLP} = 0.8\text{V}$  (max)
- Pin and function compatible with 74HC02

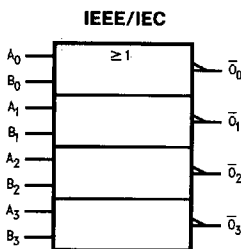
**Ordering Code:** See Section 6

| Commercial | Package Number | Package Description               |
|------------|----------------|-----------------------------------|
| 74VHC02M   | M14A           | 14-Lead Molded JEDEC SOIC         |
| 74VHC02SJ  | M14D           | 14-Lead Molded EIAJ SOIC          |
| 74VHC02MSC | MSC14          | 14-Lead Molded EIAJ Type 1 SSOP   |
| 74VHC02MTC | MTC14          | 14-Lead Molded JEDEC Type 1 TSSOP |
| 74VHC02N   | N14A           | 14-Lead Molded DIP                |

**Note:** Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

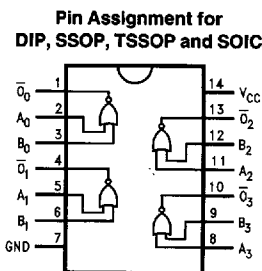
EIAJ Type 1 SSOP available on tape and reel only, order MSCX.

#### Logic Symbol



TL/F/11515-1

#### Connection Diagram



TL/F/11515-2

#### Truth Table

##### Pin Description

| Pin Names  | Description |
|------------|-------------|
| $A_n, B_n$ | Inputs      |
| $O_n$      | Outputs     |

| A | B | O |
|---|---|---|
| L | L | H |
| L | H | L |
| H | L | L |
| H | H | L |

## Absolute Maximum Ratings (Note 1)

|   |                          |
|---|--------------------------|
| Supply Voltage ( $V_{CC}$ )                           | -0.5V to +7.0V           |
| DC Input Voltage ( $V_{IN}$ )                         | -0.5V to +7.0V           |
| DC Output Voltage ( $V_{OUT}$ )                       | -0.5V to $V_{CC} + 0.5V$ |
| Input Diode Current ( $I_{IK}$ )                      | -20 mA                   |
| Output Diode Current ( $I_{OK}$ )                     | $\pm 20$ mA              |
| DC Output Current ( $I_{OUT}$ )                       | $\pm 25$ mA              |
| DC $V_{CC}$ /GND Current ( $I_{CC}$ )                 | $\pm 50$ mA              |
| Storage Temperature ( $T_{STG}$ )                     | -65°C to +150°C          |
| Lead Temperature ( $T_L$ )<br>(Soldering, 10 seconds) | 260°C                    |

Note 1: *Absolute Maximum Ratings* are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation outside databook specifications.

## Recommended Operating Conditions

|   |                |
|---|----------------|
| Supply Voltage ( $V_{CC}$ )             | 2.0V to +5.5V  |
| Input Voltage ( $V_{IN}$ )              | 0V to +5.5V    |
| Output Voltage ( $V_{OUT}$ )            | 0V to $V_{CC}$ |
| Operating Temperature ( $T_{OPR}$ )     | -40°C to +85°C |
| Input Rise and Fall Time ( $t_r, t_f$ ) | 0 ~ 100 ns/V   |
| $V_{CC} = 3.3V \pm 0.3V$                | 0 ~ 20 ns/V    |
| $V_{CC} = 5.0V \pm 0.5V$                |                |

## DC Characteristics for 'VHC Family Devices

| Symbol   | Parameter                 | $V_{CC}$<br>(V)   | 74VHC                |                   |                      |                                 | Units                            | Conditions               |     |
|----------|---------------------------|-------------------|----------------------|-------------------|----------------------|---------------------------------|----------------------------------|--------------------------|-----|
|          |                           |                   | $T_A = 25^\circ C$   |                   |                      | $T_A = -40^\circ C$<br>to +85°C |                                  |                          |     |
|          |                           |                   | Min                  | Typ               | Max                  | Min                             |                                  |                          | Max |
| $V_{IH}$ | High Level Input Voltage  | 2.0<br>3.0-5.5    | 1.50<br>0.7 $V_{CC}$ |                   | 1.50<br>0.7 $V_{CC}$ |                                 | V                                |                          |     |
| $V_{IL}$ | Low Level Input Voltage   | 2.0<br>3.0-5.5    | 0.50<br>0.3 $V_{CC}$ |                   | 0.50<br>0.3 $V_{CC}$ |                                 | V                                |                          |     |
| $V_{OH}$ | High Level Output Voltage | 2.0<br>3.0<br>4.5 | 1.9<br>2.9<br>4.4    | 2.0<br>3.0<br>4.5 | 1.9<br>2.9<br>4.4    | V                               | $V_{IN} = V_{IH}$<br>or $V_{IL}$ | $I_{OH} = -50 \mu A$     |     |
|          |                           | 3.0<br>4.5        | 2.58<br>3.94         |                   | 2.48<br>3.80         |                                 |                                  |                          | V   |
| $V_{OL}$ | Low Level Output Voltage  | 2.0<br>3.0<br>4.5 | 0.0<br>0.0<br>0.0    | 0.1<br>0.1<br>0.1 | 0.1<br>0.1<br>0.1    | V                               | $V_{IN} = V_{IH}$<br>or $V_{IL}$ | $I_{OL} = 50 \mu A$      |     |
|          |                           | 3.0<br>4.5        |                      | 0.36<br>0.36      | 0.44<br>0.44         |                                 |                                  |                          | V   |
| $I_{IN}$ | Input Leakage Current     | 0-5.5             | $\pm 0.1$            |                   | $\pm 1.0$            |                                 | $\mu A$                          | $V_{IN} = 5.5V$ or GND   |     |
| $I_{CC}$ | Quiescent Supply Current  | 5.5               | 2.0                  |                   | 20.0                 |                                 | $\mu A$                          | $V_{IN} = V_{CC}$ or GND |     |

## DC Characteristics for 'VHC Family Devices: See Section 2 for Waveforms (Continued)

| Symbol             | Parameter                                    | V <sub>CC</sub><br>(V) | 74VHC                 |        | Units | Conditions             | Fig.<br>No. |
|--------------------|--|------------------------|-----------------------|--------|-------|------------------------|-------------|
|                    |  |                        | T <sub>A</sub> = 25°C |        |       |                        |             |
|                    |  |                        | Typ                   | Limits |       |                        |             |
| V <sub>OLP</sub> * | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                    | 0.3                   | 0.8    | V     | C <sub>L</sub> = 50 pF | 2-11, 12    |
| V <sub>OLV</sub> * | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                    | -0.3                  | -0.8   | V     | C <sub>L</sub> = 50 pF | 2-11, 12    |
| V <sub>IHD</sub> * | Minimum High Level Dynamic Input Voltage     | 5.0                    |                       | 3.5    | V     | C <sub>L</sub> = 50 pF | 2-11, 12    |
| V <sub>ILD</sub> * | Maximum Low Level Dynamic Input Voltage      | 5.0                    |                       | 1.5    | V     | C <sub>L</sub> = 50 pF | 2-11, 12    |

\*Parameter guaranteed by design.

## AC Electrical Characteristics: See Section 2 for Waveforms

| Symbol                               | Parameter                     | V <sub>CC</sub><br>(V) | 74VHC                 |      |     |                                    | Units | Conditions             | Fig.<br>No. |     |
|--------------------------------------|-------------------------------|------------------------|-----------------------|------|-----|------------------------------------|-------|------------------------|-------------|-----|
|                                      |                               |                        | T <sub>A</sub> = 25°C |      |     | T <sub>A</sub> = -40°C<br>to +85°C |       |                        |             |     |
|                                      |                               |                        | Min                   | Typ  | Max | Min                                |       |                        |             | Max |
| t <sub>PHL</sub><br>t <sub>PLH</sub> | Propagation Delay             | 3.3 ± 0.3              | 5.6                   | 7.9  | 1.0 | 9.5                                | ns    | C <sub>L</sub> = 15 pF | 2-5         |     |
|                                      |                               |                        | 8.1                   | 11.4 | 1.0 | 13.0                               |       | C <sub>L</sub> = 50 pF |             |     |
|                                      |                               | 5.0 ± 0.5              | 3.6                   | 5.5  | 1.0 | 6.5                                | ns    | C <sub>L</sub> = 15 pF | 2-5         |     |
|                                      |                               |                        | 5.1                   | 7.5  | 1.0 | 8.5                                |       | C <sub>L</sub> = 50 pF |             |     |
| C <sub>IN</sub>                      | Input Capacitance             |                        | 4                     | 10   |     | 10                                 | pF    | V <sub>CC</sub> = Open |             |     |
| C <sub>PD</sub>                      | Power Dissipation Capacitance |                        | 15                    |      |     |                                    | pF    | (Note 1)               |             |     |

**Note 1:** C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I<sub>CC (opr.)</sub> = C<sub>PD</sub> \* V<sub>CC</sub> \* f<sub>IN</sub> + I<sub>CC/4</sub> (per gate).