

SNx4HC02 Quadruple 2-Input Positive-NOR Gates

1 Features

- Buffered inputs
- Wide operating voltage range: 2 V to 6 V
- Wide operating temperature range: -40°C to $+85^{\circ}\text{C}$
- Supports fanout up to 10 LSTTL loads
- Significant power reduction compared to LSTTL logic ICs

2 Applications

- [Alarm / tamper detect circuit](#)
- S-R latch

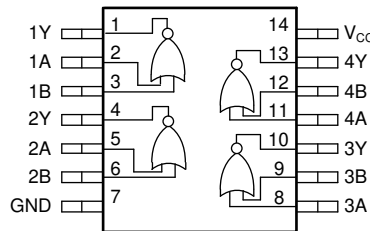
3 Description

This device contains four independent 2-input NOR gates. Each gate performs the Boolean function $Y = \overline{A + B}$ in positive logic.

Device Information

| PART NUMBER | PACKAGE ⁽¹⁾ | BODY SIZE (NOM) |
|-------------|------------------------|--------------------|
| SN74HC02D | SOIC (14) | 8.65 mm × 3.90 mm |
| SN74HC02DB | SSOP (14) | 6.20 mm × 5.30 mm |
| SN74HC02N | PDIP (14) | 19.30 mm × 6.40 mm |
| SN74HC02NS | SO (14) | 10.20 mm × 5.30 mm |
| SN74HC02PW | TSSOP (14) | 5.00 mm × 4.40 mm |
| SN54HC02J | CDIP (14) | 19.94 mm × 7.62 mm |
| SN54HC02W | CDIP (14) | 9.20 mm × 6.29 mm |
| SN54HC02FK | LCCC (20) | 8.89 mm × 8.89 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.



Device functional pinout



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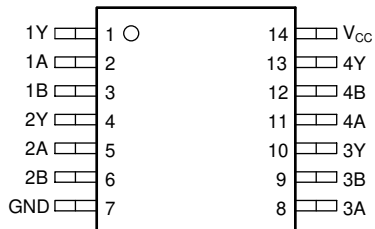
4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

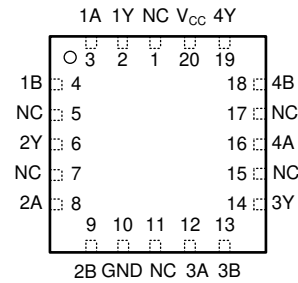
| Changes from Revision F (April 2015) to Revision G (December 2020) | Page |
|---|-------------|
| • Updated to new data sheet template..... | 1 |
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |

| Changes from Revision E (August 2003) to Revision F (April 2015) | Page |
|---|-------------|
| • Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | 1 |
| • Removed ordering information..... | 1 |

5 Pin Configuration and Functions



**Figure 5-1. D, DB, N, NS, PW, J, or W Package
14-Pin SOIC, SSOP, PDIP, SO, TSSOP, CDIP, or CFP
Top View**



**Figure 5-2. FK Package
20-Pin LCCC
Top View**

Pin Functions

| NAME | PIN | | I/O | DESCRIPTION |
|-----------------|---------------------------|---------------------|--------|--------------------------|
| | D, DB, N, NS, PW, J, or W | FK | | |
| 1Y | 1 | 2 | Output | Channel 1, Output Y |
| 1A | 2 | 3 | Input | Channel 1, Input A |
| 1B | 3 | 4 | Input | Channel 1, Input B |
| 2Y | 4 | 6 | Output | Channel 2, Output Y |
| 2A | 5 | 8 | Input | Channel 2, Input A |
| 2B | 6 | 9 | Input | Channel 2, Input B |
| GND | 7 | 10 | — | Ground |
| 3A | 8 | 12 | Input | Channel 3, Input A |
| 3B | 9 | 13 | Input | Channel 3, Input B |
| 3Y | 10 | 14 | Output | Channel 3, Output Y |
| 4A | 11 | 16 | Input | Channel 4, Input A |
| 4B | 12 | 18 | Input | Channel 4, Input B |
| 4Y | 13 | 19 | Output | Channel 4, Output Y |
| V _{CC} | 14 | 20 | — | Positive Supply |
| NC | | 1, 5, 7, 11, 15, 17 | — | Not internally connected |

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|------------------|---|--|-----|--------|
| V _{CC} | Supply voltage | -0.5 | 7 | V |
| I _{IK} | Input clamp current ⁽²⁾ | V _I < 0 V or V _I > V _{CC} | | ±20 mA |
| I _{OK} | Output clamp current ⁽²⁾ | V _O < 0 V or V _O > V _{CC} | | ±20 mA |
| I _O | Continuous output current | V _O = 0 to V _{CC} | | ±25 mA |
| | Continuous current through V _{CC} or GND | | | ±50 mA |
| T _J | Junction temperature ⁽³⁾ | | | 150 °C |
| T _{stg} | Storage temperature | -65 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) Guaranteed by design.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|
| V _(ESD) | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/ JEDEC JS-001 ⁽¹⁾ | ±1500 |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±2000 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|-----------------|-------------------------------------|-------------------------|------|-----------------|------|
| V _{CC} | Supply voltage | 2 | 5 | 6 | V |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | 1.5 | | V |
| | | V _{CC} = 4.5 V | 3.15 | | |
| | | V _{CC} = 6 V | 4.2 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | | 0.5 | V |
| | | V _{CC} = 4.5 V | | 1.35 | |
| | | V _{CC} = 6 V | | 1.8 | |
| V _I | Input voltage | 0 | | V _{CC} | V |
| V _O | Output voltage | 0 | | V _{CC} | V |
| t _t | Input transition rise and fall time | V _{CC} = 2 V | | 1000 | ns |
| | | V _{CC} = 4.5 V | | 500 | |
| | | V _{CC} = 6 V | | 400 | |
| T _A | Operating free-air temperature | SN54HC00 | -55 | 125 | °C |
| | | SN74HC00 | -40 | 85 | |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | SN74H02 | | | | | SN54H02 | | | UNIT |
|-------------------------------|--|----------|-----------|----------|---------|------------|----------|---------|-----------|------|
| | | D (SOIC) | DB (SSOP) | N (PDIP) | NS (SO) | PW (TSSOP) | J (CDIP) | W (CFP) | FK (LCCC) | |
| | | 14 PINS | 14 PINS | 14 PINS | 14 PINS | 14 PINS | 14 PINS | 14 PINS | 14 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 94 | 105.4 | 54.9 | 88.8 | 119.6 | N/A | N/A | N/A | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 53.2 | 57.3 | 42.5 | 46.5 | 48.4 | 53.8 | 89.6 | 61.1 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 48.7 | 52.7 | 34.7 | 47.6 | 61.3 | 73.1 | 164.1 | 59.8 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 15.6 | 22.6 | 27.9 | 16.8 | 5.6 | N/A | N/A | N/A | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 48.4 | 52.2 | 34.6 | 47.2 | 60.7 | N/A | N/A | N/A | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | N/A | N/A | N/A | N/A | N/A | 26.7 | 15.5 | 11.7 | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics - Commercial (74xx)

over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | | V_{CC} | Operating free-air temperature (T_A) | | | | | | UNIT |
|-----------|---------------------------|----------------------------|----------------------------|----------|--|-------|------|---------------|------|-----|------|
| | | | | | 25°C | | | -40°C to 85°C | | | |
| | | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OH} | High-level output voltage | $V_I = V_{IH}$ or V_{IL} | $I_{OH} = -20 \mu\text{A}$ | 2 V | 1.9 | 1.998 | | 1.9 | | V | |
| | | | | 4.5 V | 4.4 | 4.499 | | 4.4 | | | |
| | | | 6 V | 5.9 | 5.999 | | 5.9 | | | | |
| | | | $I_{OH} = -4 \text{ mA}$ | 4.5 V | 3.98 | 4.3 | | 3.84 | | | |
| | | | | 6 V | 5.48 | 5.8 | | 5.34 | | | |
| V_{OL} | Low-level output voltage | $V_I = V_{IH}$ or V_{IL} | $I_{OL} = 20 \mu\text{A}$ | 2 V | | 0.002 | 0.1 | | 0.1 | V | |
| | | | | 4.5 V | | 0.001 | 0.1 | | 0.1 | | |
| | | | $I_{OL} = 20 \mu\text{A}$ | 6 V | | 0.001 | 0.1 | | 0.1 | | |
| | | | $I_{OL} = 4 \text{ mA}$ | 4.5 V | | 0.17 | 0.26 | | 0.33 | | |
| | | | | 6 V | | 0.15 | 0.26 | | 0.33 | | |
| I_I | Input leakage current | $V_I = V_{CC}$ or 0 | 6 V | | ±0.1 | ±100 | | ±1000 | nA | | |
| I_{CC} | Supply current | $V_I = V_{CC}$ or 0 | $V_I = V_{CC}$ or 0 | 6 V | | | 2 | | 20 | μA | |
| C_i | Input capacitance | | 2 V to 6 V | | | 3 | 10 | | 10 | pF | |

6.6 Electrical Characteristics - Military (54xx)

 over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted).

| PARAMETER | TEST CONDITIONS | V_{CC} | Operating free-air temperature (T_A) | | | | | | UNIT | | |
|-----------|---------------------------|----------------------------|--|-------|-----------|----------------|------|------------|-------|---------------|----|
| | | | 25°C | | | -55°C to 125°C | | | | | |
| | | | MIN | TYP | MAX | MIN | TYP | MAX | | | |
| V_{OH} | High-level output voltage | $V_I = V_{IH}$ or V_{IL} | $I_{OH} = -20 \mu\text{A}$ | 2 V | 1.9 | 1.998 | | 1.9 | 1.998 | V | |
| | | | | 4.5 V | 4.4 | 4.499 | | 4.4 | 4.499 | | |
| | | | | 6 V | 5.9 | 5.999 | | 5.9 | 5.999 | | |
| | | | $I_{OH} = -6 \text{ mA}$ | 4.5 V | 3.98 | 4.3 | | 3.7 | | | |
| | | | | 6 V | 5.48 | 5.8 | | 5.2 | | | |
| V_{OL} | Low-level output voltage | $V_I = V_{IH}$ or V_{IL} | $I_{OL} = 20 \mu\text{A}$ | 2 V | | 0.002 | 0.1 | | 0.002 | 0.1 | V |
| | | | | 4.5 V | | 0.001 | 0.1 | | 0.001 | 0.1 | |
| | | | $I_{OL} = 6 \text{ mA}$ | 6 V | | 0.001 | 0.1 | | 0.001 | 0.1 | |
| | | | | 4.5 V | | 0.17 | 0.26 | | | 0.4 | |
| | | | | 6 V | | 0.15 | 0.26 | | | 0.4 | |
| I_I | Input leakage current | $V_I = V_{CC}$ or 0 | 6 V | | ± 0.1 | ± 100 | | ± 1000 | nA | | |
| I_{CC} | Supply current | $V_I = V_{CC}$ or 0 | $V_I = V_{CC}$ or 0 | 6 V | | | 2 | | 40 | μA | |
| C_i | Input capacitance | | 2 V to 6 V | | | 3 | 10 | | 3 | 10 | pF |

6.7 Switching Characteristics - Commercial (74xx)

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | FROM | TO | V_{CC} | Operating free-air temperature (T_A) | | | | | | UNIT | |
|-----------|-------------------|--------|----------|--|-----|-----|---------------|-----|-----|------|----|
| | | | | 25°C | | | -40°C to 85°C | | | | |
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| t_{pd} | Propagation delay | A or B | Y | 2 V | | 45 | 90 | | | 115 | ns |
| | | | | 4.5 V | | 9 | 18 | | | 23 | |
| | | | | 6 V | | 8 | 15 | | | 20 | |
| t_t | Transition-time | | Y | 2 V | | 38 | 75 | | | 95 | ns |
| | | | | 4.5 V | | 8 | 15 | | | 19 | |
| | | | | 6 V | | 6 | 13 | | | 16 | |

6.8 Switching Characteristics - Military (54xx)

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | FROM | TO | V_{CC} | Operating free-air temperature (T_A) | | | | | | UNIT | |
|-----------|-------------------|--------|----------|--|-----|-----|----------------|-----|-----|------|----|
| | | | | 25°C | | | -55°C to 125°C | | | | |
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| t_{pd} | Propagation delay | A or B | Y | 2 V | | 45 | 90 | | | 135 | ns |
| | | | | 4.5 V | | 9 | 18 | | | 27 | |
| | | | | 6 V | | 8 | 15 | | | 23 | |
| t_t | Transition-time | | Y | 2 V | | 38 | 75 | | | 110 | ns |
| | | | | 4.5 V | | 8 | 15 | | | 22 | |
| | | | | 6 V | | 6 | 13 | | | 19 | |

6.9 Operating Characteristics

over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted).

| PARAMETER | | TEST CONDITIONS | V_{CC} | MIN | TYP | MAX | UNIT |
|-----------|--|-----------------|------------|-----|-----|-----|------|
| C_{pd} | Power dissipation capacitance per gate | No load | 2 V to 6 V | | 4.5 | | pF |

6.10 Typical Characteristics

$T_A = 25^\circ\text{C}$

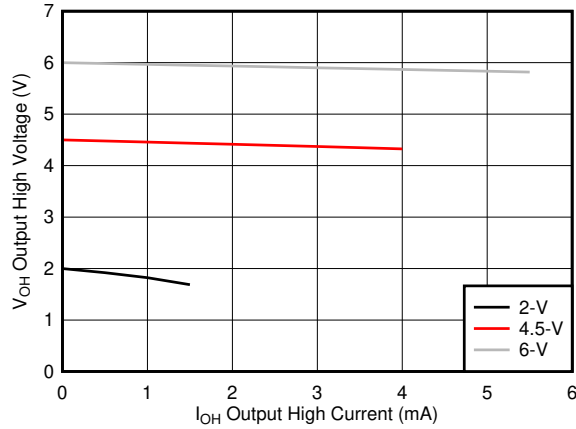


Figure 6-1. Typical output voltage in the high state (V_{OH})

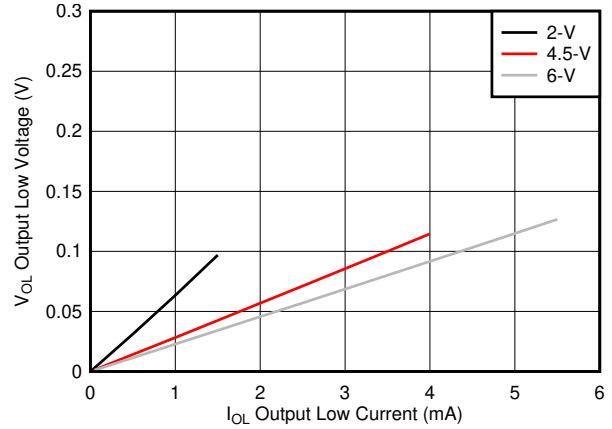


Figure 6-2. Typical output voltage in the low state (V_{OL})

7 Parameter Measurement Information

Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_f < 6 \text{ ns}$.

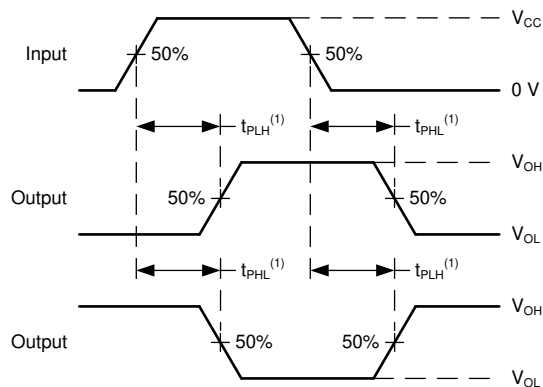
For clock inputs, f_{max} is measured when the input duty cycle is 50%.

The outputs are measured one at a time with one input transition per measurement.



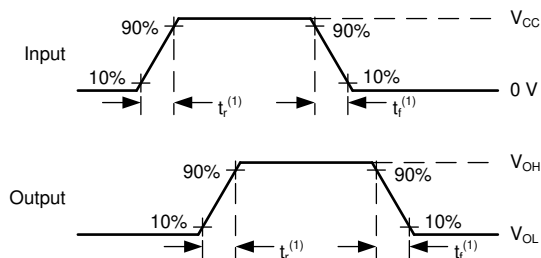
(1) C_L includes probe and test-fixture capacitance.

Figure 7-1. Load Circuit for Push-Pull Outputs



(1) The greater between t_{PLH} and t_{PHL} is the same as t_{pd} .

Figure 7-2. Voltage Waveforms Propagation Delays



(1) The greater between t_r and t_f is the same as t_t .

Figure 7-3. Voltage Waveforms, Input and Output Transition Times

8 Detailed Description

8.1 Overview

This device contains four independent 2-input NOR gates. Each gate performs the Boolean function $Y = \overline{A + B}$ in positive logic.

8.2 Functional Block Diagram

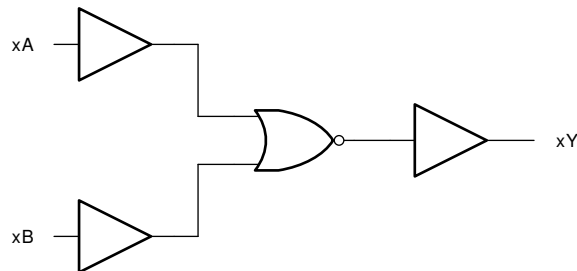


Figure 8-1. Logic Diagram (Positive Logic) for the SN74HC02

8.3 Balanced CMOS Push-Pull Outputs

This device includes balanced CMOS push-pull outputs. The term "balanced" indicates that the device can sink and source similar currents. The drive capability of this device may create fast edges into light loads so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. It is important for the output power of the device to be limited to avoid damage due to overcurrent. The electrical and thermal limits defined in the *Absolute Maximum Ratings* must be followed at all times.

Unused push-pull CMOS outputs should be left disconnected.

8.4 Standard CMOS Inputs

This device includes standard CMOS inputs. Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the *Electrical Characteristics*. The worst case resistance is calculated with the maximum input voltage, given in the *Absolute Maximum Ratings*, and the maximum input leakage current, given in the *Electrical Characteristics*, using Ohm's law ($R = V \div I$).

Standard CMOS inputs require that input signals transition between valid logic states quickly, as defined by the input transition time or rate in the *Recommended Operating Conditions* table. Failing to meet this specification will result in excessive power consumption and could cause oscillations. More details can be found in [Implications of Slow or Floating CMOS Inputs](#).

Do not leave standard CMOS inputs floating at any time during operation. Unused inputs must be terminated at V_{CC} or GND. If a system will not be actively driving an input at all times, a pull-up or pull-down resistor can be added to provide a valid input voltage during these times. The resistor value will depend on multiple factors, however a 10-k Ω resistor is recommended and will typically meet all requirements.

8.5 Clamp Diode Structure

The inputs and outputs to this device have both positive and negative clamping diodes as depicted in [Electrical Placement of Clamping Diodes for Each Input and Output](#).

CAUTION

Voltages beyond the values specified in the *Absolute Maximum Ratings* table can cause damage to the device. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

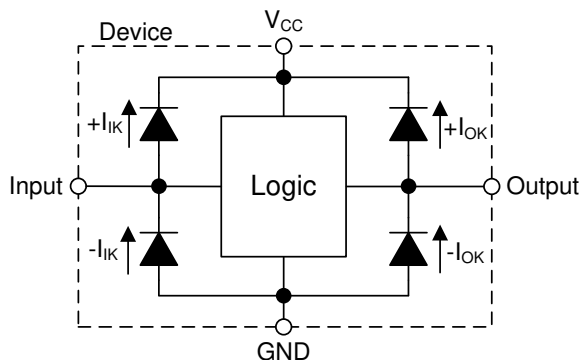


Figure 8-2. Electrical Placement of Clamping Diodes for Each Input and Output

8.6 Device Functional Modes

Table 8-1. Function Table

| INPUTS | | OUTPUT |
|--------|---|--------|
| A | B | Y |
| L | L | H |
| H | X | L |
| X | H | L |

9 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

In this application, the SN74HC02 is used to create an active-low SR latch. The two additional gates can be used for a second active-low SR latch, individually used for their logic function, or the inputs can be grounded and both channels left unused. This device is used to drive the tamper indicator LED and provide one bit of data to the system controller. When the tamper switch outputs LOW, the output Q becomes HIGH. This output remains HIGH until the system controller addresses the event and sends a LOW signal to the R input which returns the Q output back to LOW.

9.2 Typical Application

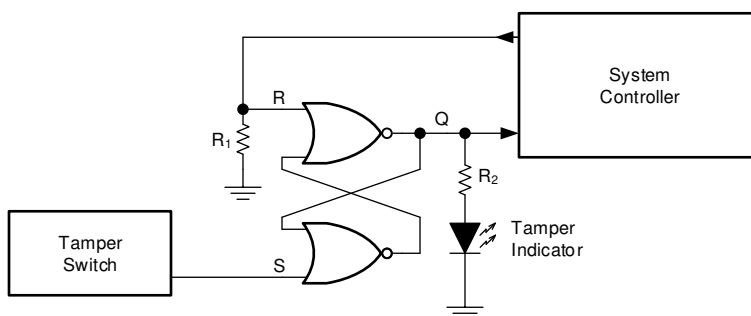


Figure 9-1. Typical application diagram

9.2.1 Design Requirements

9.2.1.1 Power Considerations

Ensure the desired supply voltage is within the range specified in the *Recommended Operating Conditions*. The supply voltage sets the device's electrical characteristics as described in the *Electrical Characteristics*.

The positive voltage supply must be capable of sourcing current equal to the total current to be sourced by all outputs of the SN74HC02 plus the maximum static supply current, I_{CC} , listed in *Electrical Characteristics* and any transient current required for switching. The logic device can only source as much current as is provided by the positive supply source. Be sure not to exceed the maximum total current through V_{CC} listed in the *Absolute Maximum Ratings*.

The ground must be capable of sinking current equal to the total current to be sunk by all outputs of the SN74HC02 plus the maximum supply current, I_{CC} , listed in *Electrical Characteristics*, and any transient current required for switching. The logic device can only sink as much current as can be sunk into its ground connection. Be sure not to exceed the maximum total current through GND listed in the *Absolute Maximum Ratings*.

The SN74HC02 can drive a load with a total capacitance less than or equal to 50 pF while still meeting all of the datasheet specifications. Larger capacitive loads can be applied, however it is not recommended to exceed 50 pF.

The SN74HC02 can drive a load with total resistance described by $R_L \geq V_O / I_O$, with the output voltage and current defined in the *Electrical Characteristics* table with V_{OH} and V_{OL} . When outputting in the high state, the output voltage in the equation is defined as the difference between the measured output voltage and the supply voltage at the V_{CC} pin.

Total power consumption can be calculated using the information provided in [CMOS Power Consumption and Cpd Calculation](#).

Thermal increase can be calculated using the information provided in [Thermal Characteristics of Standard Linear and Logic \(SLL\) Packages and Devices](#).

CAUTION

The maximum junction temperature, $T_{J(max)}$ listed in the *Absolute Maximum Ratings*, is an additional limitation to prevent damage to the device. Do not violate any values listed in the *Absolute Maximum Ratings*. These limits are provided to prevent damage to the device.

9.2.1.2 Input Considerations

Input signals must cross $V_{IL(max)}$ to be considered a logic LOW, and $V_{IH(min)}$ to be considered a logic HIGH. Do not exceed the maximum input voltage range found in the *Absolute Maximum Ratings*.

Unused inputs must be terminated to either V_{CC} or ground. These can be directly terminated if the input is completely unused, or they can be connected with a pull-up or pull-down resistor if the input is to be used sometimes, but not always. A pull-up resistor is used for a default state of HIGH, and a pull-down resistor is used for a default state of LOW. The resistor size is limited by drive current of the controller, leakage current into the SN74HC02, as specified in the *Electrical Characteristics*, and the desired input transition rate. A 10-k Ω resistor value is often used due to these factors.

The SN74HC02 has CMOS inputs and thus requires fast input transitions to operate correctly, as defined in the *Recommended Operating Conditions* table. Slow input transitions can cause oscillations, additional power consumption, and reduction in device reliability.

Refer to the *Feature Description* section for additional information regarding the inputs for this device.

9.2.1.3 Output Considerations

The positive supply voltage is used to produce the output HIGH voltage. Drawing current from the output will decrease the output voltage as specified by the V_{OH} specification in the *Electrical Characteristics*. The ground voltage is used to produce the output LOW voltage. Sinking current into the output will increase the output voltage as specified by the V_{OL} specification in the *Electrical Characteristics*.

Push-pull outputs that could be in opposite states, even for a very short time period, should never be connected directly together. This can cause excessive current and damage to the device.

Two channels within the same device with the same input signals can be connected in parallel for additional output drive strength.

Unused outputs can be left floating. Do not connect outputs directly to V_{CC} or ground.

Refer to *Feature Description* section for additional information regarding the outputs for this device.

9.2.2 Detailed Design Procedure

1. Add a decoupling capacitor from V_{CC} to GND. The capacitor needs to be placed physically close to the device and electrically close to both the V_{CC} and GND pins. An example layout is shown in the *Layout* section.
2. Ensure the capacitive load at the output is ≤ 50 pF. This is not a hard limit, however it will ensure optimal performance. This can be accomplished by providing short, appropriately sized traces from the SN74HC02 to the receiving device(s).
3. Ensure the resistive load at the output is larger than $(V_{CC} / I_{O(max)}) \Omega$. This will ensure that the maximum output current from the *Absolute Maximum Ratings* is not violated. Most CMOS inputs have a resistive load measured in megaohms; much larger than the minimum calculated above.
4. Thermal issues are rarely a concern for logic gates, however the power consumption and thermal increase can be calculated using the steps provided in the application report, [CMOS Power Consumption and Cpd Calculation](#).

9.2.3 Application Curve

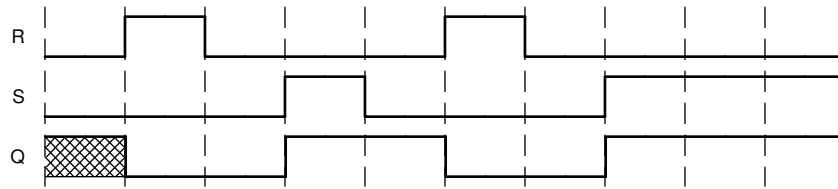


Figure 9-2. Application timing diagram

10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*. Each V_{CC} terminal should have a good bypass capacitor to prevent power disturbance. A 0.1- μF capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1- μF and 1- μF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results, as shown in given example layout image.

11 Layout

11.1 Layout Guidelines

When using multiple-input and multiple-channel logic devices inputs must not ever be left floating. In many cases, functions or parts of functions of digital logic devices are unused; for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such unused input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. All unused inputs of digital logic devices must be connected to a logic high or logic low voltage, as defined by the input voltage specifications, to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally, the inputs are tied to GND or V_{CC} , whichever makes more sense for the logic function or is more convenient.

11.2 Layout Example

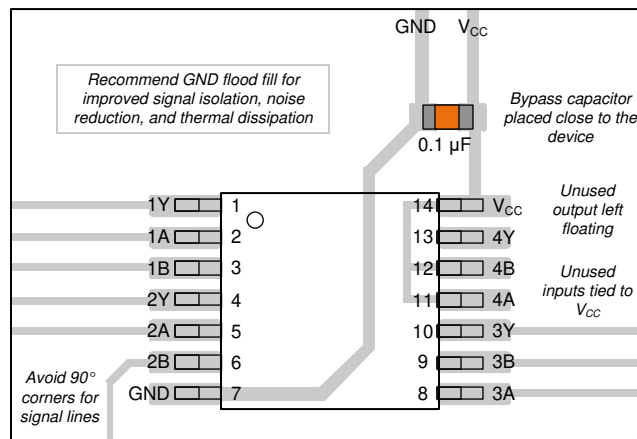


Figure 11-1. Example layout for the SN74HC02.

12 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

12.1 Documentation Support

12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

12.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

12.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

12.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|-----------------------------------|-------------------------|
| 5962-8404101VCA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-8404101VC A SNV54HC02J | Samples |
| 84041012A | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 84041012A SNJ54HC 02FK | Samples |
| 8404101CA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8404101CA SNJ54HC02J | Samples |
| 8404101DA | ACTIVE | CFP | W | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8404101DA SNJ54HC02W | Samples |
| JM38510/65101B2A | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101B2A | Samples |
| JM38510/65101BCA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101BCA | Samples |
| JM38510/65101BDA | ACTIVE | CFP | W | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101BDA | Samples |
| M38510/65101B2A | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101B2A | Samples |
| M38510/65101BCA | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101BCA | Samples |
| M38510/65101BDA | ACTIVE | CFP | W | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | JM38510/ 65101BDA | Samples |
| SN54HC02J | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | SN54HC02J | Samples |
| SN74HC02D | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02DBR | ACTIVE | SSOP | DB | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02DE4 | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02DR | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02DRG4 | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02DT | ACTIVE | SOIC | D | 14 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|------------------------------|-------------------------|
| SN74HC02N | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU SN | N / A for Pkg Type | -40 to 85 | SN74HC02N | Samples |
| SN74HC02NE4 | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | -40 to 85 | SN74HC02N | Samples |
| SN74HC02NSR | ACTIVE | SO | NS | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02NSRG4 | ACTIVE | SO | NS | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02PW | ACTIVE | TSSOP | PW | 14 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02PWG4 | ACTIVE | TSSOP | PW | 14 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02PWR | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02PWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SN74HC02PWT | ACTIVE | TSSOP | PW | 14 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC02 | Samples |
| SNJ54HC02FK | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 84041012A SNJ54HC 02FK | Samples |
| SNJ54HC02J | ACTIVE | CDIP | J | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8404101CA SNJ54HC02J | Samples |
| SNJ54HC02W | ACTIVE | CFP | W | 14 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8404101DA SNJ54HC02W | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN54HC02, SN54HC02-SP, SN74HC02 :

- Catalog : [SN74HC02](#), [SN54HC02](#)
- Automotive : [SN74HC02-Q1](#), [SN74HC02-Q1](#)
- Enhanced Product : [SN74HC02-EP](#), [SN74HC02-EP](#)
- Military : [SN54HC02](#)
- Space : [SN54HC02-SP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC02DBR | SSOP | DB | 14 | 2000 | 330.0 | 16.4 | 8.35 | 6.6 | 2.4 | 12.0 | 16.0 | Q1 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.6 | 9.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 330.0 | 16.8 | 6.5 | 9.5 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02DT | SOIC | D | 14 | 250 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC02NSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.45 | 10.55 | 2.5 | 12.0 | 16.2 | Q1 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.85 | 5.45 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC02PWRG4 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC02PWT | TSSOP | PW | 14 | 250 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC02DBR | SSOP | DB | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 366.0 | 364.0 | 50.0 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 367.0 | 367.0 | 38.0 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74HC02DR | SOIC | D | 14 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74HC02DRG4 | SOIC | D | 14 | 2500 | 356.0 | 356.0 | 35.0 |
| SN74HC02DRG4 | SOIC | D | 14 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74HC02DT | SOIC | D | 14 | 250 | 210.0 | 185.0 | 35.0 |
| SN74HC02NSR | SO | NS | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74HC02PWR | TSSOP | PW | 14 | 2000 | 366.0 | 364.0 | 50.0 |
| SN74HC02PWRG4 | TSSOP | PW | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74HC02PWT | TSSOP | PW | 14 | 250 | 356.0 | 356.0 | 35.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 84041012A | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |
| 8404101DA | W | CFP | 14 | 1 | 506.98 | 26.16 | 6220 | NA |
| JM38510/65101B2A | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |
| JM38510/65101BDA | W | CFP | 14 | 1 | 506.98 | 26.16 | 6220 | NA |
| M38510/65101B2A | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |
| M38510/65101BDA | W | CFP | 14 | 1 | 506.98 | 26.16 | 6220 | NA |
| SN74HC02D | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |
| SN74HC02DE4 | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |
| SN74HC02N | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC02N | N | PDIP | 14 | 25 | 506.1 | 9 | 600 | 5.4 |
| SN74HC02N | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC02NE4 | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC02NE4 | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC02NE4 | N | PDIP | 14 | 25 | 506.1 | 9 | 600 | 5.4 |
| SN74HC02PW | PW | TSSOP | 14 | 90 | 530 | 10.2 | 3600 | 3.5 |
| SN74HC02PWG4 | PW | TSSOP | 14 | 90 | 530 | 10.2 | 3600 | 3.5 |
| SNJ54HC02FK | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |
| SNJ54HC02W | W | CFP | 14 | 1 | 506.98 | 26.16 | 6220 | NA |

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP1-F14

J 14

GENERIC PACKAGE VIEW
CDIP - 5.08 mm max height
CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040083-5/G

J0014A



PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

NOTES:

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

EXAMPLE BOARD LAYOUT

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 5X



4214771/A 05/2017

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 -  Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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