

# SN74HCS09-Q1 Automotive Quadruple 2-Input AND Gates with Open-Drain Outputs and Schmitt-Trigger Inputs

## 1 Features

- AEC-Q100 Qualified for automotive applications:
  - Device temperature grade 1:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $T_A$
  - Device HBM ESD Classification Level 2
  - Device CDM ESD Classification Level C6
- Wide operating voltage range: 2 V to 6 V
- Schmitt-trigger inputs allow for slow or noisy input signals
- Low power consumption
  - Typical  $I_{CC}$  of 100 nA
  - Typical input leakage current of  $\pm 100$  nA
- $\pm 7.8$ -mA output drive at 5 V

## 2 Applications

- [Combining power good signals](#)
- [Enable digital signals](#)

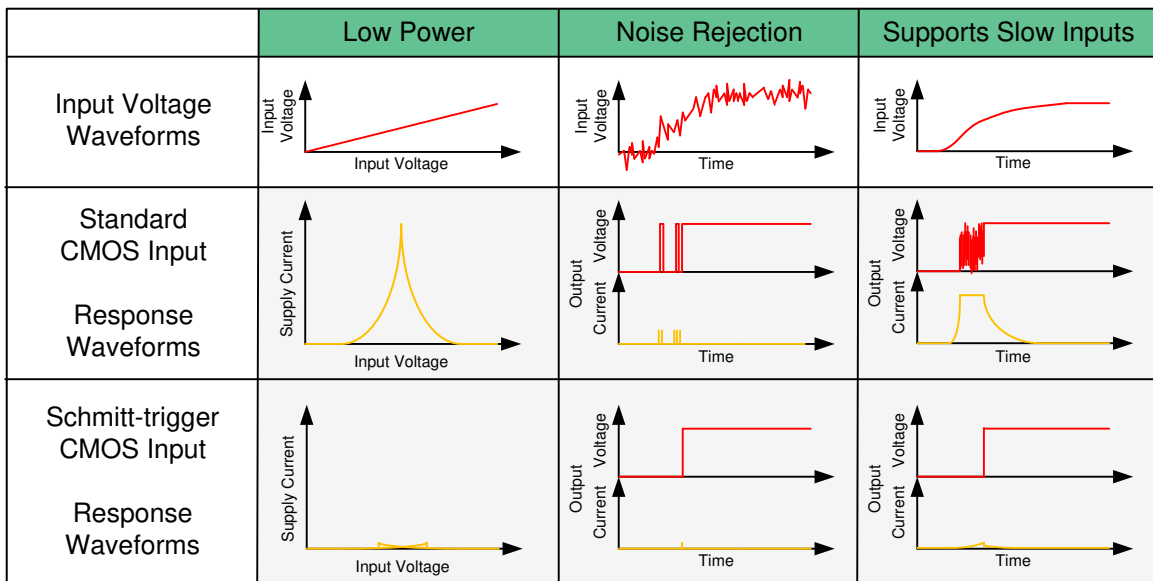
## 3 Description

This device contains four independent 2-input AND gates with open-drain outputs and Schmitt-trigger inputs. Each gate performs the Boolean function  $Y = A \bullet B$  in positive logic.

### Device Information (1)

| PART NUMBER     | PACKAGE    | BODY SIZE (NOM)   |
|-----------------|------------|-------------------|
| SN74HCS09QPWRQ1 | TSSOP (14) | 5.00 mm × 4.40 mm |
| SN74HCS09QDRQ1  | SOIC (14)  | 8.70 mm × 3.90 mm |

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



**Benefits of Schmitt-trigger Inputs**



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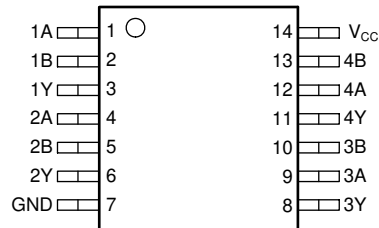
## 4 Revision History

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

### Changes from April 20, 2020 to October 22, 2020 (from Revision \* (April 2020) to Revision A (October 2020))

|  | Page |
|--|------|
| • Updated the numbering format for tables, figures and cross-references throughout the document..... | 1    |
| • Improved clarity of functionality for the device.....  | 8    |

## 5 Pin Configuration and Functions



**Figure 5-1. PW or D Package 14-Pin TSSOP or SOIC Top View**

## Pin Functions

| PIN             |     | I/O    | DESCRIPTION         |
|-----------------|-----|--------|---------------------|
| NAME            | NO. |        |                     |
| 1A              | 1   | Input  | Channel 1, Input A  |
| 1B              | 2   | Input  | Channel 1, Input B  |
| 1Y              | 3   | Output | Channel 1, Output Y |
| 2A              | 4   | Input  | Channel 2, Input A  |
| 2B              | 5   | Input  | Channel 2, Input B  |
| 2Y              | 6   | Output | Channel 2, Output Y |
| GND             | 7   | —      | Ground              |
| 3Y              | 8   | Output | Channel 3, Output Y |
| 3A              | 9   | Input  | Channel 3, Input A  |
| 3B              | 10  | Input  | Channel 3, Input B  |
| 4Y              | 11  | Output | Channel 4, Output Y |
| 4A              | 12  | Input  | Channel 4, Input A  |
| 4B              | 13  | Input  | Channel 4, Input B  |
| V <sub>CC</sub> | 14  | —      | Positive Supply     |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |   | MIN   | MAX | UNIT |
|------------------|---|---|-----|------|
| V <sub>CC</sub>  | Supply voltage                                    | -0.5  | 7   | V    |
| I <sub>IK</sub>  | Input clamp current <sup>(2)</sup>                | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | ±20 | mA   |
| I <sub>OK</sub>  | Output clamp current <sup>(2)</sup>               | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | ±20 | mA   |
| I <sub>O</sub>   | Continuous output current                         | V <sub>O</sub> = 0 to V <sub>CC</sub>                               | ±35 | mA   |
| I <sub>CC</sub>  | Continuous current through V <sub>CC</sub> or GND |   | ±70 | mA   |
| T <sub>J</sub>   | Junction temperature <sup>(3)</sup>               |   | 150 | °C   |
| T <sub>stg</sub> | 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 <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per AEC Q100-002 <sup>(1)</sup><br>HBM ESD Classification Level 2 | ±4000 |
|                    |                         | Charged device model (CDM), per AEC<br>Q100-011 CDM ESD Classification Level C6           | ±1500 |

(1) AEC Q100-002 indicate that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 6.3 Recommended Operating Conditions

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

|                 |                     | MIN | NOM | MAX             | UNIT |
|-----------------|---------------------|-----|-----|-----------------|------|
| V <sub>CC</sub> | Supply voltage      | 2   | 5   | 6               | V    |
| V <sub>I</sub>  | Input voltage       | 0   |     | V <sub>CC</sub> | V    |
| V <sub>O</sub>  | Output voltage      | 0   |     | V <sub>CC</sub> | V    |
| T <sub>A</sub>  | Ambient temperature | -40 |     | 125             | °C   |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | SN74HCS09-Q1 |          | UNIT |
|-------------------------------|--|--------------|----------|------|
|                               |  | PW (TSSOP)   | D (SOIC) |      |
|                               |  | 14 PINS      | 14 PINS  |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 151.7        | 133.6    | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 79.4         | 89       | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 94.7         | 89.5     | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 25.2         | 45.5     | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 94.1         | 89.1     | °C/W |

| THERMAL METRIC <sup>(1)</sup> |  | SN74HCS09-Q1 |          | UNIT |
|-------------------------------|--|--------------|----------|------|
|                               |  | PW (TSSOP)   | D (SOIC) |      |
|                               |  | 14 PINS      | 14 PINS  |      |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | N/A          | N/A      | °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

over operating free-air temperature range; typical values measured at T<sub>A</sub> = 25°C (unless otherwise noted).

| PARAMETER       |  | TEST CONDITIONS   |                          | V <sub>CC</sub> | MIN | TYP   | MAX   | UNIT |
|-----------------|--|---|--------------------------|-----------------|-----|-------|-------|------|
| V <sub>T+</sub> | Positive switching threshold                                   |   |                          | 2 V             | 0.7 |       | 1.5   | V    |
|                 |  |   |                          | 4.5 V           | 1.7 |       | 3.15  |      |
|                 |  |   |                          | 6 V             | 2.1 |       | 4.2   |      |
| V <sub>T-</sub> | Negative switching threshold                                   |   |                          | 2 V             | 0.3 |       | 1.0   | V    |
|                 |  |   |                          | 4.5 V           | 0.9 |       | 2.2   |      |
|                 |  |   |                          | 6 V             | 1.2 |       | 3.0   |      |
| ΔV <sub>T</sub> | Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> ) <sup>(1)</sup> |   |                          | 2 V             | 0.2 |       | 1.0   | V    |
|                 |  |   |                          | 4.5 V           | 0.4 |       | 1.4   |      |
|                 |  |   |                          | 6 V             | 0.6 |       | 1.6   |      |
| V <sub>OL</sub> | Low-level output voltage                                       | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OL</sub> = 20 μA  | 2 V to 6 V      |     | 0.002 | 0.1   | V    |
|                 |  |   | I <sub>OL</sub> = 6 mA   | 4.5 V           |     | 0.18  | 0.30  |      |
|                 |  |   | I <sub>OL</sub> = 7.8 mA | 6 V             |     | 0.22  | 0.33  |      |
| I <sub>I</sub>  | Input leakage current  | V <sub>I</sub> = V <sub>CC</sub> or 0                     |                          | 6 V             |     | ±100  | ±1000 | nA   |
| I <sub>CC</sub> | Supply current   | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 |                          | 6 V             |     | 0.1   | 2     | μA   |
| C <sub>i</sub>  | Input capacitance  |   |                          | 2 V to 6 V      |     |       | 5     | pF   |

(1) Guaranteed by design.

## 6.6 Switching Characteristics

C<sub>L</sub> = 50 pF; over operating free-air temperature range (unless otherwise noted). See [Parameter Measurement Information](#).

| PARAMETER       |                   | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> | MIN | TYP <sup>(1)</sup> | MAX | UNIT |
|-----------------|-------------------|--------------|-------------|-----------------|-----|--------------------|-----|------|
| t <sub>pd</sub> | Propagation delay | A or B       | Y           | 2 V             |     | 15                 | 23  | ns   |
|                 |                   |              |             | 4.5 V           |     | 10                 | 12  |      |
|                 |                   |              |             | 6 V             |     | 9                  | 11  |      |
| t <sub>t</sub>  | Transition-time   |              | Y           | 2 V             |     | 9                  | 16  | ns   |
|                 |                   |              |             | 4.5 V           |     | 5                  | 9   |      |
|                 |                   |              |             | 6 V             |     | 4                  | 8   |      |

(1) T<sub>A</sub> = 25°C

## 6.7 Operating Characteristics

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

| PARAMETER       |  | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------|--|-----------------|-----|-----|-----|------|
| C <sub>pd</sub> | Power dissipation capacitance per gate | No load         |     | 10  |     | pF   |

## 6.8 Typical Characteristics

T<sub>A</sub> = 25°C

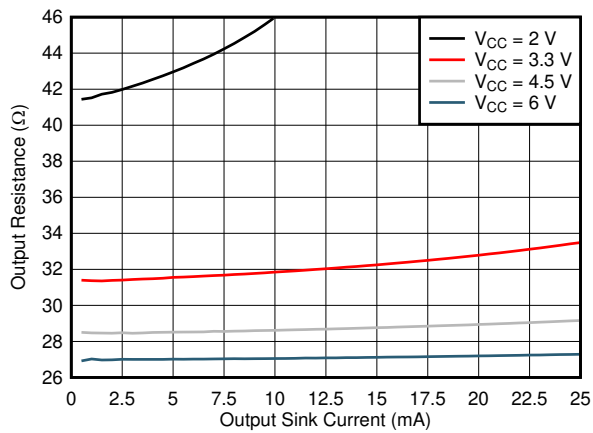


Figure 6-1. Output driver resistance in Low state

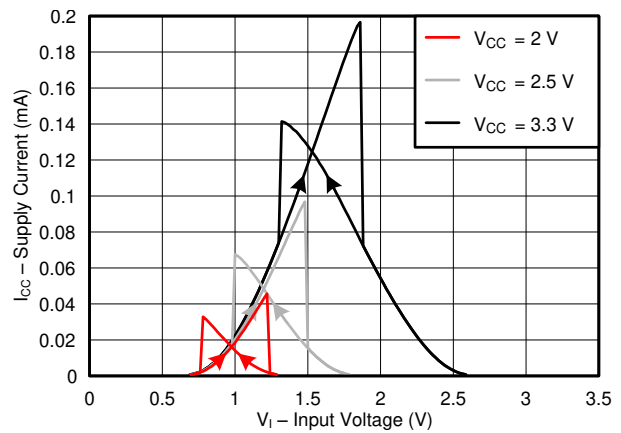


Figure 6-2. Typical supply current versus input voltage across common supply values (2 V to 3.3 V)

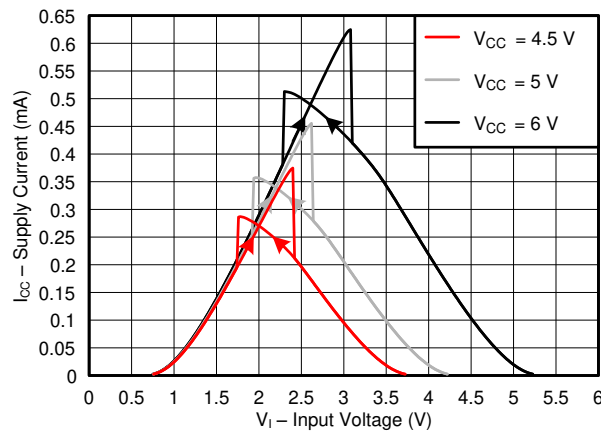
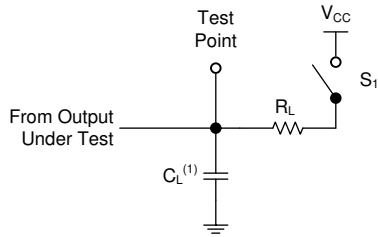


Figure 6-3. Typical supply current versus input voltage across common supply values (4.5 V to 6 V)

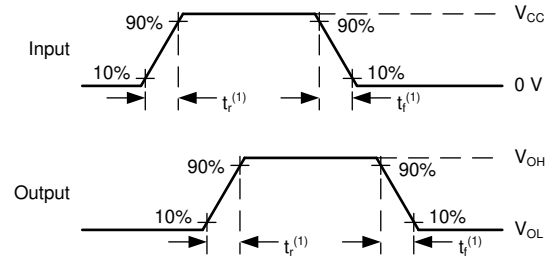
## 7 Parameter Measurement Information

- Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_t < 2.5 \text{ ns}$ .
- The outputs are measured one at a time, with one input transition per measurement.

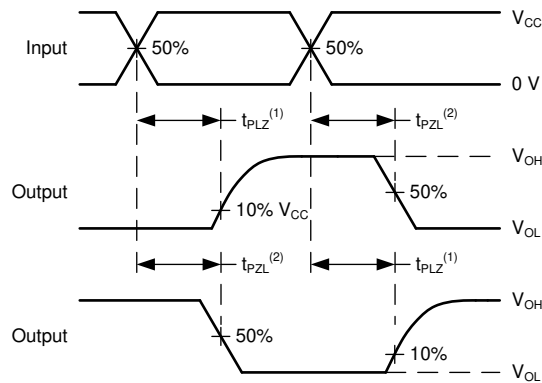


A.  $C_L = 50 \text{ pF}$  and includes probe and jig capacitance.

**Figure 7-1. Load Circuit**



**Figure 7-2. Voltage Waveforms Transition Times**



A. The maximum between  $t_{PLH}$  and  $t_{PHL}$  is used for  $t_{pd}$ .

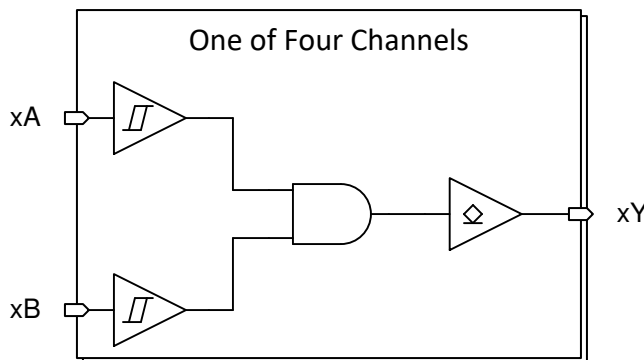
**Figure 7-3. Voltage Waveforms Propagation Delays**

## 8 Detailed Description

### 8.1 Overview

This device contains four independent 2-input AND gates with open-drain outputs and Schmitt-trigger inputs. Each gate performs the Boolean function  $Y = A \bullet B$  in positive logic.

### 8.2 Functional Block Diagram



### 8.3 Feature Description

#### 8.3.1 Open-Drain CMOS Outputs

This device includes open-drain CMOS outputs. Open-drain outputs can only drive the output low. When in the high logical state, open-drain outputs will be in a high-impedance state. 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.

When placed into the high-impedance state, the output will neither source nor sink current, with the exception of minor leakage current as defined in the *Electrical Characteristics* table. In the high-impedance state, the output voltage is not controlled by the device and is dependent on external factors. If no other drivers are connected to the node, then this is known as a floating node and the voltage is unknown. A pull-up resistor can be connected to the output to provide a known voltage at the output while it is in the high-impedance state. The value of the resistor will depend on multiple factors, including parasitic capacitance and power consumption limitations. Typically, a 10 k $\Omega$  resistor can be used to meet these requirements.

Unused open-drain CMOS outputs should be left disconnected.

#### 8.3.2 CMOS Schmitt-Trigger Inputs

Standard CMOS inputs are high impedance and are typically modeled as a resistor from the input to ground 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 ( $R = V \div I$ ).

The Schmitt-trigger input architecture provides hysteresis as defined by  $\Delta V_T$  in the *Electrical Characteristics*, which makes this device extremely tolerant to slow or noisy inputs. While the inputs can be driven much slower than standard CMOS inputs, it is still recommended to properly terminate unused inputs. Driving the inputs slowly will also increase dynamic current consumption of the device. For additional information regarding Schmitt-trigger inputs, please see [Understanding Schmitt Triggers](#).

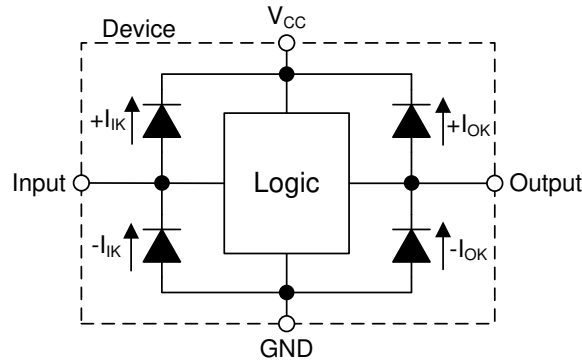


### 8.3.3 Clamp Diode Structure

The inputs and outputs to this device have both positive and negative clamping diodes as depicted in [Figure 8-1](#).

**CAUTION**

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



**Figure 8-1. Electrical Placement of Clamping Diodes for Each Input and Output**

### 8.4 Device Functional Modes

**Table 8-1. Function Table**

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

## 9 Application and Implementation

### Note

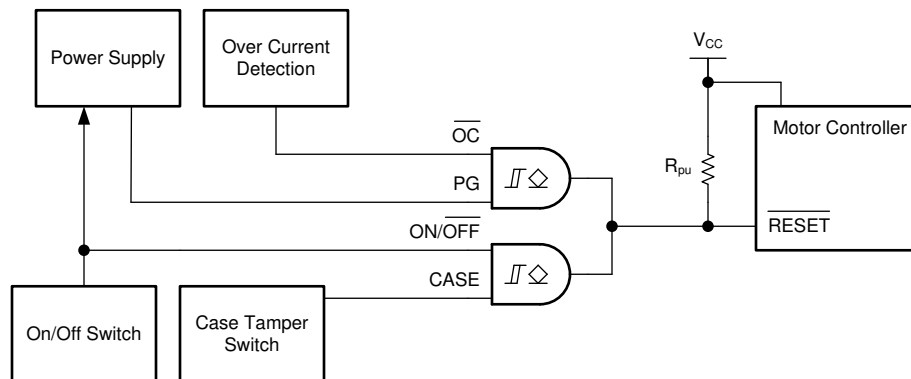
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

### 9.1 Application Information

In this application, two 2-input AND gates with open-drain outputs are combined to produce a 4-input AND gate function as shown in [Figure 9-1](#). The remaining two gates can be used for another application in the system, or the inputs can be grounded and the channels left unused.

The SN74HCS09-Q1 is used to directly control the  $\overline{\text{RESET}}$  pin of a motor controller. The controller requires four input signals to all be HIGH before being enabled, and should be disabled in the event that any one signal goes LOW. The 4-input AND gate function combines the four individual reset signals into a single active-low reset signal.

### 9.2 Typical Application



**Figure 9-1. Typical application block diagram**

#### 9.2.1 Design Requirements

- All signals in the system operate at the same voltage within the recommended operating range of the device
- The motor controller should be disabled if any of these conditions apply:
  - Power Supply is not ready (PG)
  - Excessive current is detected ( $\overline{\text{OC}}$ )
  - Excessive temperature is detected ( $\overline{\text{OT}}$ )
  - The power switch is in the OFF position ( $\overline{\text{ON/OFF}}$ )

### 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 ground must be capable of sinking current equal to the total current to be sunk by all outputs of the SN74HCS09-Q1 plus the maximum supply current,  $I_{CC}$ , listed in *Electrical Characteristics*. The logic device can only sink as much current as is provided by the external pull-up resistor or other supply source. Be sure not to exceed the maximum total current through GND listed in the *Absolute Maximum Ratings*.

Total power consumption can be calculated using the information provided in [CMOS Power Consumption and  \$C\_{pd}\$  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  $V_{L(min)}$  to be considered a logic LOW, and  $V_{H(max)}$  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 SN74HCS09-Q1, as specified in the *Electrical Characteristics*, and the desired input transition rate. A 10-k $\Omega$  resistor value is often used due to these factors.

The SN74HCS09-Q1 has no input signal transition rate requirements because it has Schmitt-trigger inputs.

Another benefit to having Schmitt-trigger inputs is the ability to reject noise. Noise with a large enough amplitude can still cause issues. To know how much noise is too much, please refer to the  $\Delta V_T(min)$  in the *Electrical Characteristics*. This hysteresis value will provide the peak-to-peak limit.

Unlike what happens with standard CMOS inputs, Schmitt-trigger inputs can be held at any valid value without causing huge increases in power consumption. The typical additional current caused by holding an input at a value other than  $V_{CC}$  or ground is plotted in the *Typical Characteristics*.

Refer to the [Feature Description](#) for additional information regarding the inputs for this device.

### 9.2.1.3 Output Considerations

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*.

Open-drain outputs can be directly connected together to produce a wired-AND. This is possible because the outputs cannot source current, and thus can never be in bus-contention.

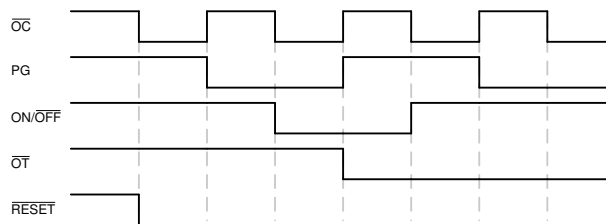
Unused outputs can be left floating. Do not connect outputs directly to  $V_{CC}$  or ground.

Refer to [Feature Description](#) 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](#).
2. Ensure the capacitive load at the output is  $\leq 70$  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 SN74HCS09-Q1 to the receiving device.
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 Curves



**Figure 9-2. Application timing diagram**

## 10 Power Supply Recommendations

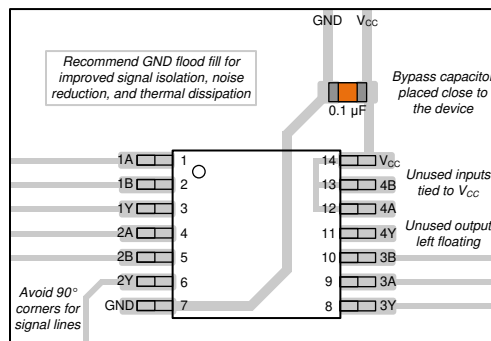
The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*. Each  $V_{CC}$  terminal should have a bypass capacitor to prevent power disturbance. A 0.1- $\mu\text{F}$  capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1- $\mu\text{F}$  and 1- $\mu\text{F}$  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 [Figure 11-1](#).

## 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. 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 SN74HCS09-Q1**

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

- [Reduce Noise and Save Power with the New HCS Logic Family](#)
- [CMOS Power Consumption and CPD Calculation](#)
- [Designing with Logic](#)

#### 12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

#### 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.

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#### 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<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74HCS09QDRQ1   | ACTIVE        | SOIC         | D               | 14   | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HCS09Q1                 | <a href="#">Samples</a> |
| SN74HCS09QPWRQ1  | ACTIVE        | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HCS09Q1                 | <a href="#">Samples</a> |

(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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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**OTHER QUALIFIED VERSIONS OF SN74HCS09-Q1 :**

- Catalog: [SN74HCS09](#)

## NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product



D (R-PDSO-G14)

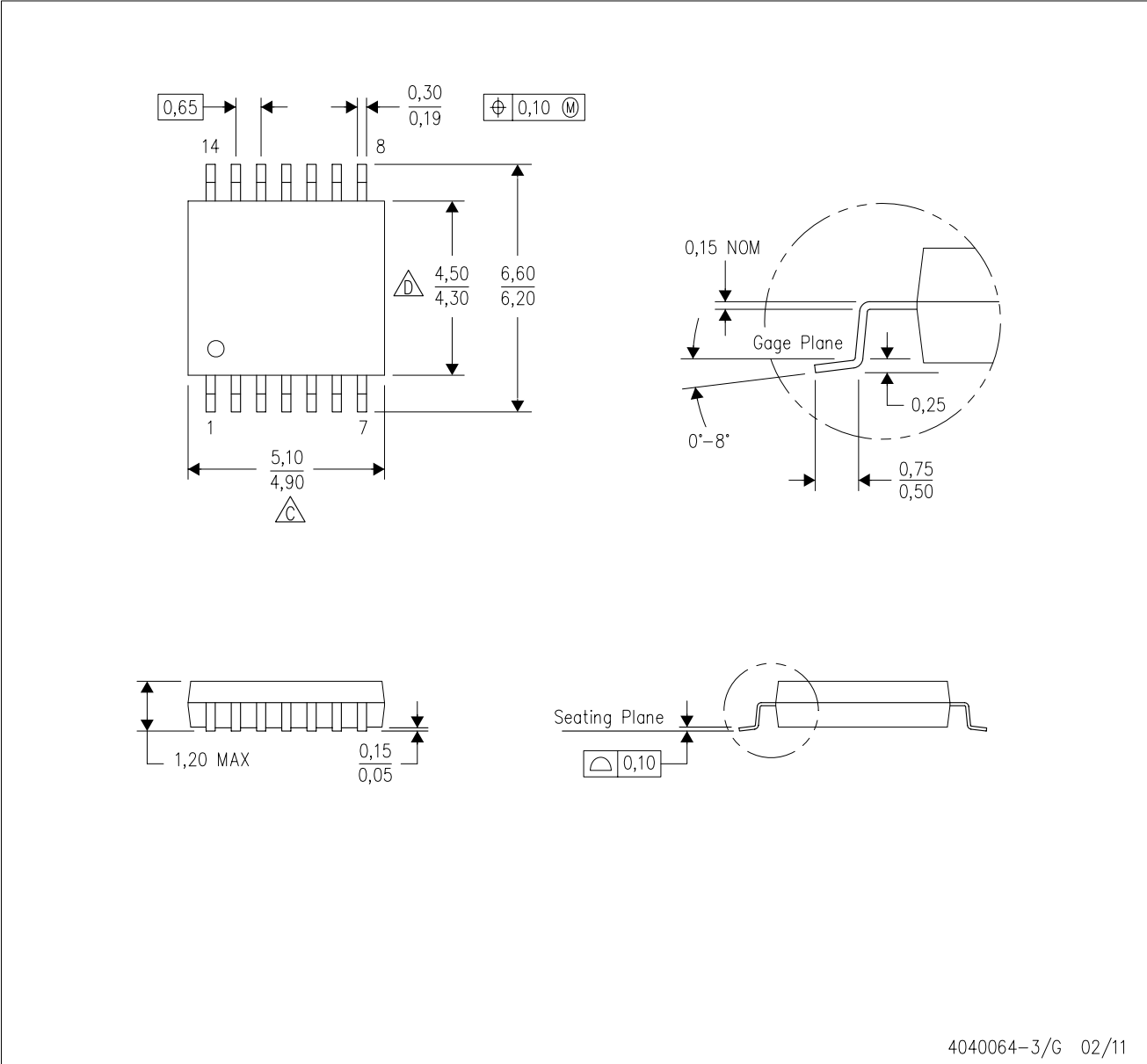
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - 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.
  - 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.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040064-3/G 02/11

- 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.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. 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:
- 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.

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