

# SN74HC86-Q1 Automotive Quadruple 2-Input XOR Gates

## 1 Features

- AEC-Q100 Qualified for automotive applications:
  - Device temperature grade 1:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $T_A$
- Buffered inputs
- Positive and negative input clamp diodes
- Wide operating voltage range: 2 V to 6 V
- Supports fanout up to 10 LSTTL loads
- Significant power reduction compared to LSTTL logic ICs

## 2 Applications

- Detect phase differences in input signals
- Create a selectable inverter / buffer

## 3 Description

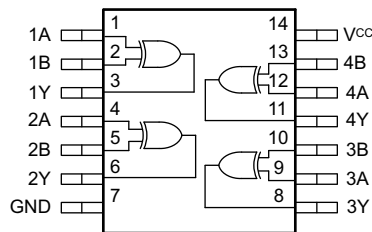
This device contains four independent 2-input XOR gates. Each gate performs the Boolean function  $Y = A \oplus B$  in positive logic.

### Device Information<sup>(1)</sup>

| PART NUMBER     | PACKAGE    | BODY SIZE (NOM)   |
|-----------------|------------|-------------------|
| SN74HC86QDRG4Q1 | SOIC (14)  | 8.70 mm × 3.90 mm |
| SN74HC86QPWRQ1  | TSSOP (14) | 5.00 mm × 4.40 mm |

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

### Functional pinout of the SN74HC86-Q1



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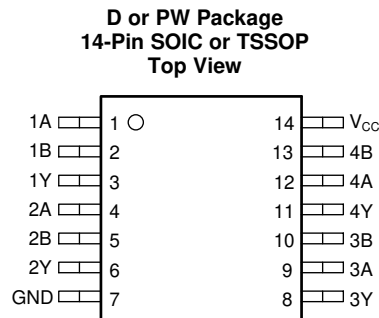
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## 4 Revision History

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

| Changes from Revision C (April 2008) to Revision D                         | Page     |
|----------------------------------------------------------------------------|----------|
| • Updated to new data sheet standards .....                                | <b>1</b> |
| • Changed $R_{\theta JA}$ for PW package from 113 °C/W to 151.7 °C/W ..... | <b>4</b> |
| • Changed $R_{\theta JA}$ for D package from 86 °C/W to 133.6 °C/W .....   | <b>4</b> |

## 5 Pin Configuration and Functions



### 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 or V <sub>I</sub> > V <sub>CC</sub> |      | ±20 | mA   |
| I <sub>OK</sub>  | Output clamp current <sup>(2)</sup>               | V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub> |      | ±20 | mA   |
| I <sub>O</sub>   | Continuous output current                         | V <sub>O</sub> = 0 to V <sub>CC</sub>                  |      | ±25 | mA   |
|                  | Continuous current through V <sub>CC</sub> or GND |                                                        |      | ±50 | 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 |
|-------------|-------------------------|-------------------------------------------------------------------------------------------|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per AEC Q100-002 <sup>(1)</sup><br>HBM ESD Classification Level 2 | ±2000 | V    |
|             |                         | Charged device model (CDM), per AEC Q100-011<br>CDM ESD Classification Level C6           | ±1000 |      |

(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 |
|---------------------|-------------------------------------|-------------------------|------|-----|----------|------|
| $V_{CC}$            | Supply voltage                      |                         | 2    | 5   | 6        | V    |
| $V_{IH}$            | High-level input voltage            | $V_{CC} = 2\text{ V}$   | 1.5  |     |          | V    |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | 3.15 |     |          |      |
|                     |                                     | $V_{CC} = 6\text{ V}$   | 4.2  |     |          |      |
| $V_{IL}$            | Low-level input voltage             | $V_{CC} = 2\text{ V}$   |      |     | 0.5      | V    |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ |      |     | 1.35     |      |
|                     |                                     | $V_{CC} = 6\text{ V}$   |      |     | 1.8      |      |
| $V_I$               | Input voltage                       |                         | 0    |     | $V_{CC}$ | V    |
| $V_O$               | Output voltage                      |                         | 0    |     | $V_{CC}$ | V    |
| $\Delta t/\Delta v$ | Input transition rise and fall rate | $V_{CC} = 2\text{ V}$   |      |     | 1000     | ns   |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ |      |     | 500      |      |
|                     |                                     | $V_{CC} = 6\text{ V}$   |      |     | 400      |      |
| $T_A$               | Operating free-air temperature      | SN74HC00-Q1             | –40  |     | 125      | °C   |

## 6.4 Thermal Information

| THERMAL METRIC       |                                              | SN74HC86-Q1 |          | UNIT |
|----------------------|----------------------------------------------|-------------|----------|------|
|                      |                                              | PW (TSSOP)  | D (SOIC) |      |
|                      |                                              | 14 PINS     | 14 PINS  |      |
| $R_{\theta JA}$      | Junction-to-ambient thermal resistance       | 151.7       | 133.6    | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance    | 79.4        | 89.0     | °C/W |
| $R_{\theta JB}$      | Junction-to-board thermal resistance         | 94.7        | 89.5     | °C/W |
| $\Psi_{JT}$          | Junction-to-top characterization parameter   | 25.2        | 45.5     | °C/W |
| $\Psi_{JB}$          | Junction-to-board characterization parameter | 94.1        | 89.1     | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | N/A         | N/A      | °C/W |

## 6.5 Electrical Characteristics

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

| PARAMETER       |                           | TEST CONDITIONS                                     |                           | V <sub>CC</sub> | Operating free-air temperature (T <sub>A</sub> ) |     |     |                |     |     | UNIT |
|-----------------|---------------------------|-----------------------------------------------------|---------------------------|-----------------|--------------------------------------------------|-----|-----|----------------|-----|-----|------|
|                 |                           |                                                     |                           |                 | –40°C to 85°C                                    |     |     | –40°C to 125°C |     |     |      |
|                 |                           |                                                     |                           |                 | MIN                                              | TYP | MAX | MIN            | TYP | MAX |      |
| V <sub>OH</sub> | High-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -20 μA  | 2 V             | 1.9                                              |     |     | 1.9            |     |     | V    |
|                 |                           |                                                     |                           | 4.5 V           | 4.4                                              |     |     | 4.4            |     |     |      |
|                 |                           |                                                     |                           | 6 V             | 5.9                                              |     |     | 5.9            |     |     |      |
|                 |                           |                                                     | I <sub>OH</sub> = -4 mA   | 4.5 V           | 3.84                                             |     |     | 3.7            |     |     |      |
|                 |                           |                                                     | I <sub>OH</sub> = -5.2 mA | 6 V             | 5.34                                             |     |     | 5.2            |     |     |      |
| 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             | 0.1                                              |     |     | 0.1            |     |     | V    |
|                 |                           |                                                     |                           | 4.5 V           | 0.1                                              |     |     | 0.1            |     |     |      |
|                 |                           |                                                     |                           | 6 V             | 0.1                                              |     |     | 0.1            |     |     |      |
|                 |                           |                                                     | I <sub>OL</sub> = 4 mA    | 4.5 V           | 0.33                                             |     |     | 0.4            |     |     |      |
|                 |                           |                                                     | I <sub>OL</sub> = 5.2 mA  | 6 V             | 0.33                                             |     |     | 0.4            |     |     |      |
| I <sub>I</sub>  | Input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or 0               |                           | 6 V             | ±1000                                            |     |     | ±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             | 20                                               |     |     | 40             |     |     | μA   |
| C <sub>i</sub>  | Input capacitance         |                                                     |                           | 2 V to 6 V      | 10                                               |     |     | 10             |     |     | pF   |

## 6.6 Switching Characteristics

over operating free-air temperature range (unless otherwise noted),  $C_L = 50\ \text{pF}$

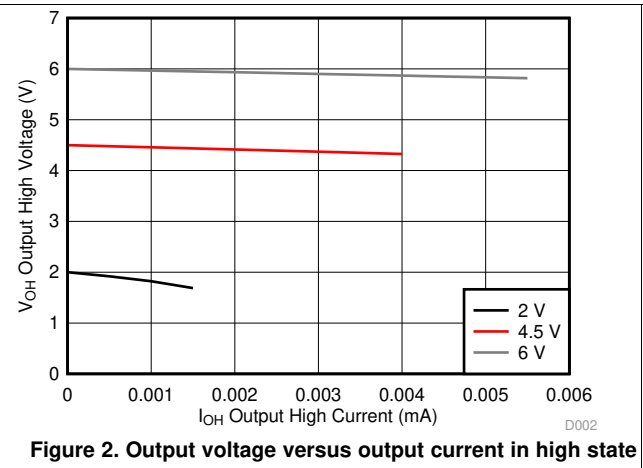
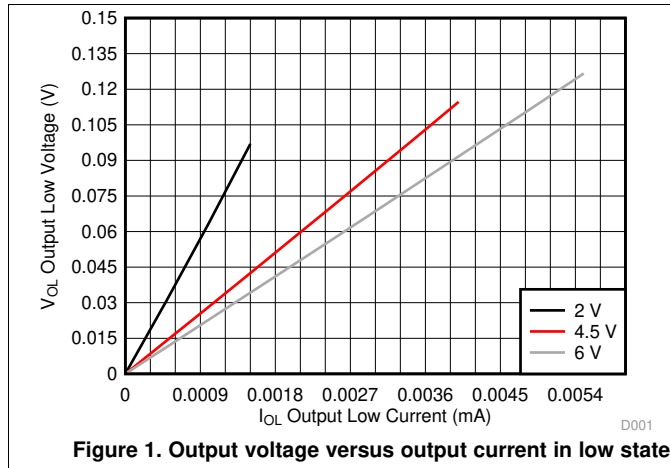
| PARAMETER       |                   | FROM   | TO | V <sub>CC</sub> | Operating free-air temperature (T <sub>A</sub> ) |     |     |                |     |     | UNIT |
|-----------------|-------------------|--------|----|-----------------|--------------------------------------------------|-----|-----|----------------|-----|-----|------|
|                 |                   |        |    |                 | –40°C to 85°C                                    |     |     | –40°C to 125°C |     |     |      |
|                 |                   |        |    |                 | MIN                                              | TYP | MAX | MIN            | TYP | MAX |      |
| t <sub>pd</sub> | Propagation delay | A or B | Y  | 2 V             | 125                                              |     |     | 150            |     |     | ns   |
|                 |                   |        |    | 4.5 V           | 25                                               |     |     | 30             |     |     |      |
|                 |                   |        |    | 6 V             | 21                                               |     |     | 25             |     |     |      |
| t <sub>t</sub>  | Transition-time   |        | Y  | 2 V             | 95                                               |     |     | 110            |     |     | ns   |
|                 |                   |        |    | 4.5 V           | 19                                               |     |     | 22             |     |     |      |
|                 |                   |        |    | 6 V             | 16                                               |     |     | 19             |     |     |      |

## 6.7 Operating Characteristics

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

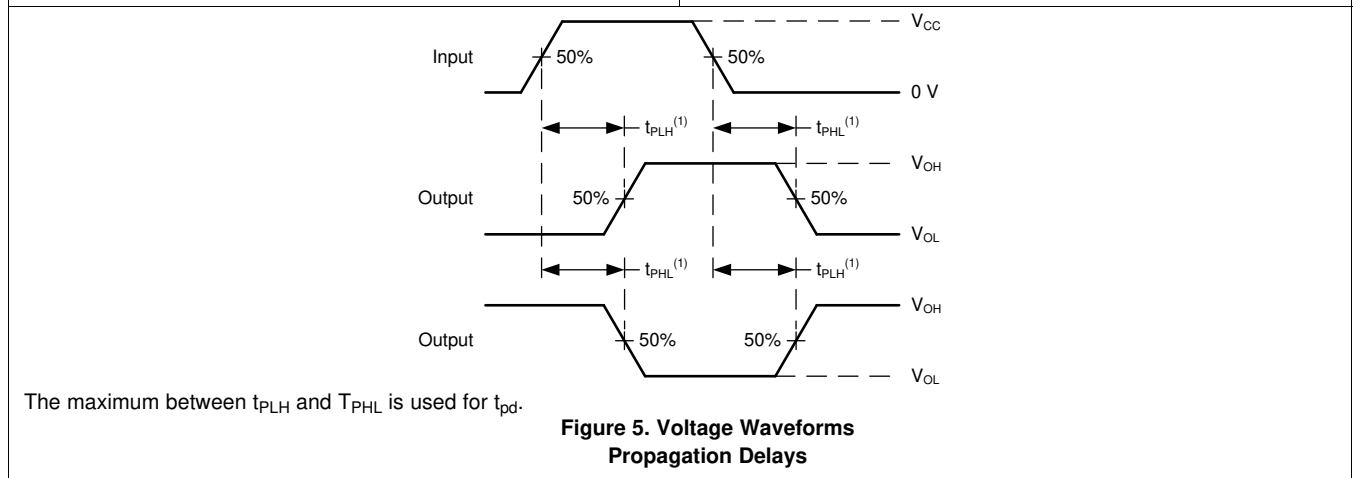
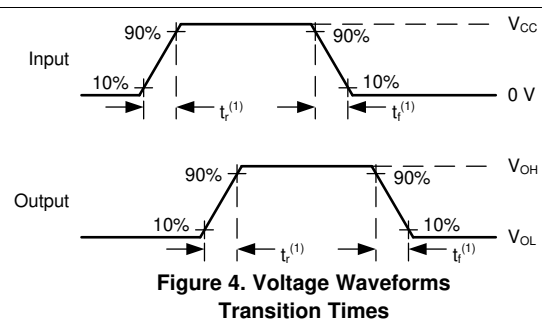
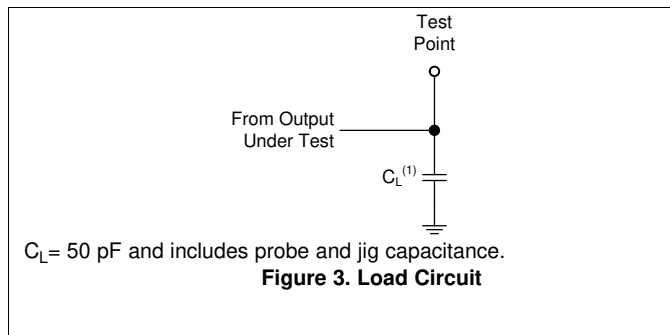
| PARAMETER |                                        | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|----------------------------------------|-----------------|-----|-----|-----|------|
| $C_{pd}$  | Power dissipation capacitance per gate | No load         |     | 35  |     | pF   |

## 6.8 Typical Characteristics

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


## 7 Parameter Measurement Information

- Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $\text{PRR} \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_f < 6 \text{ ns}$ .
- The outputs are measured one at a time, with one input transition per measurement.

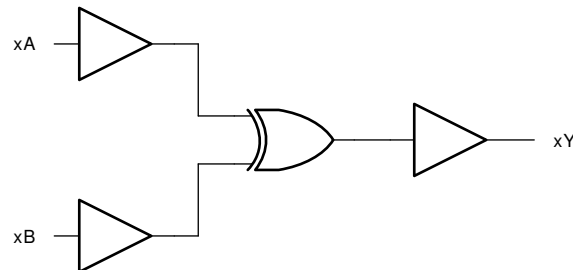


## 8 Detailed Description

### 8.1 Overview

This device contains four independent 2-input XOR gates. Each gate performs the Boolean function  $Y = A \oplus B$  in positive logic.

### 8.2 Functional Block Diagram



### 8.3 Feature Description

#### 8.3.1 Balanced CMOS Push-Pull Outputs

A balanced output allows the device to 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 over-current. The electrical and thermal limits defined in the [Absolute Maximum Ratings](#) must be followed at all times.

The SN74HC86-Q1 can drive a load with a total capacitance less than or equal to 50 pF connected to a high-impedance CMOS input while still meeting all of the datasheet specifications. Larger capacitive loads can be applied, however it is not recommended to exceed 70 pF. If larger capacitive loads are required, it is recommended to add a series resistor between the output and the capacitor to limit output current to the values given in the [Absolute Maximum Ratings](#).

#### 8.3.2 Standard CMOS 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 ( $R = V \div I$ ).

Signals applied to the inputs need to have fast edge rates, as defined by  $\Delta t/\Delta v$  in the [Recommended Operating Conditions](#) to avoid excessive current consumption and oscillations. If a slow or noisy input signal is required, a device with a Schmitt-trigger input should be used to condition the input signal prior to the standard CMOS input.

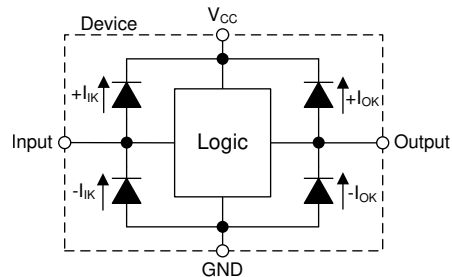
## Feature Description (continued)

### 8.3.3 Clamp Diode Structure

The inputs and outputs to this device have both positive and negative clamping diodes as depicted in [Figure 6](#).

#### 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 6. Electrical Placement of Clamping Diodes for Each Input and Output**

## 8.4 Device Functional Modes

**Table 1. Function Table**

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

## 9 Application and Implementation

### NOTE

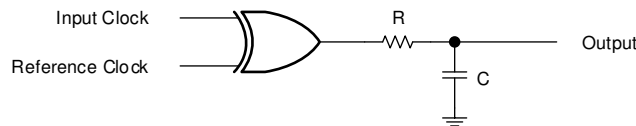
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

### 9.1 Application Information

In this application, a 2-input XOR gate is used as a phase difference detector as shown in [Figure 7](#). The remaining three gates can be used for other applications in the system, or the inputs can be grounded and the channels left unused.

The SN74HC86-Q1 is used to identify phase difference between a reference clock and another input clock. Whenever the clock states are different, the XOR output will pulse HIGH until the clocks return to the same state. The output is fed into a low-pass filter to obtain a DC representation of the phase difference.

### 9.2 Typical Application



**Figure 7. Typical application block 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 supply must be capable of sourcing current equal to the total current to be sourced by all outputs of the SN74HC86-Q1 plus the maximum supply current,  $I_{CC}$ , listed in the [Electrical Characteristics](#). The logic device can only source or sink as much current as it is provided at the supply and ground pins, respectively. Be sure not to exceed the maximum total current through GND or  $V_{CC}$  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,  $T_J(\text{max})$  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

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 SN74HC86-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.

## Typical Application (continued)

The SN74HC86-Q1 has standard CMOS inputs, so input signal edge rates cannot be slow. Slow input edge rates can cause oscillations and damaging shoot-through current. The recommended rates are defined in the [Recommended Operating Conditions](#).

Refer to the [Feature Description](#) 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](#). Similarly, 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](#).

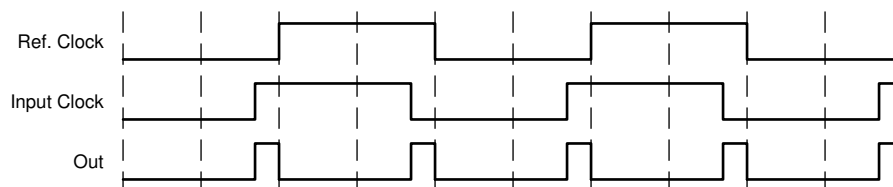
Unused outputs can be left floating. Do not connect outputs directly to  $V_{CC}$  or ground.

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 SN74HC86-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 8. Application timing diagram**

## 10 Power Supply Recommendations

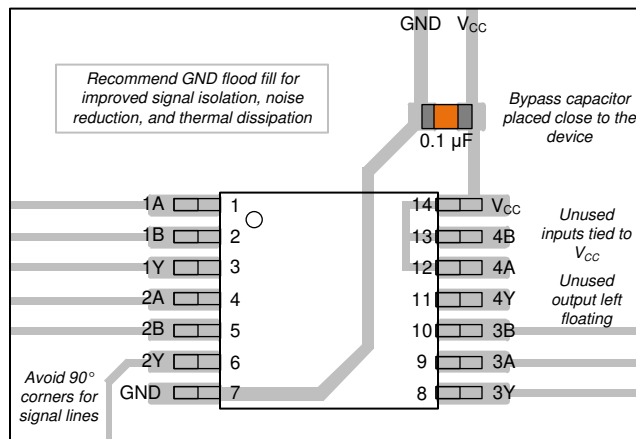
The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#). Each  $V_{CC}$  terminal should have a bypass capacitor to prevent power disturbance. A 0.1- $\mu$ F capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1- $\mu$ F and 1- $\mu$ 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 9](#).

## 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 9. Example layout for the SN74HC86-Q1**

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

- [HCMOS Design Considerations](#)
- [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 Community 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

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 12.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.6 Glossary

[SLYZ022](#) — *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 part number            | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|----------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">SN74HC86IDRG4Q1</a>  | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC86I               |
| SN74HC86IDRG4Q1.A                | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC86I               |
| <a href="#">SN74HC86IPWRG4Q1</a> | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC86I               |
| SN74HC86IPWRG4Q1.A               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC86I               |
| <a href="#">SN74HC86QDRG4Q1</a>  | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |
| SN74HC86QDRG4Q1.A                | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |
| <a href="#">SN74HC86QPWRG4Q1</a> | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |
| SN74HC86QPWRG4Q1.A               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |
| <a href="#">SN74HC86QPWRQ1</a>   | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |
| SN74HC86QPWRQ1.A                 | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | HC86Q               |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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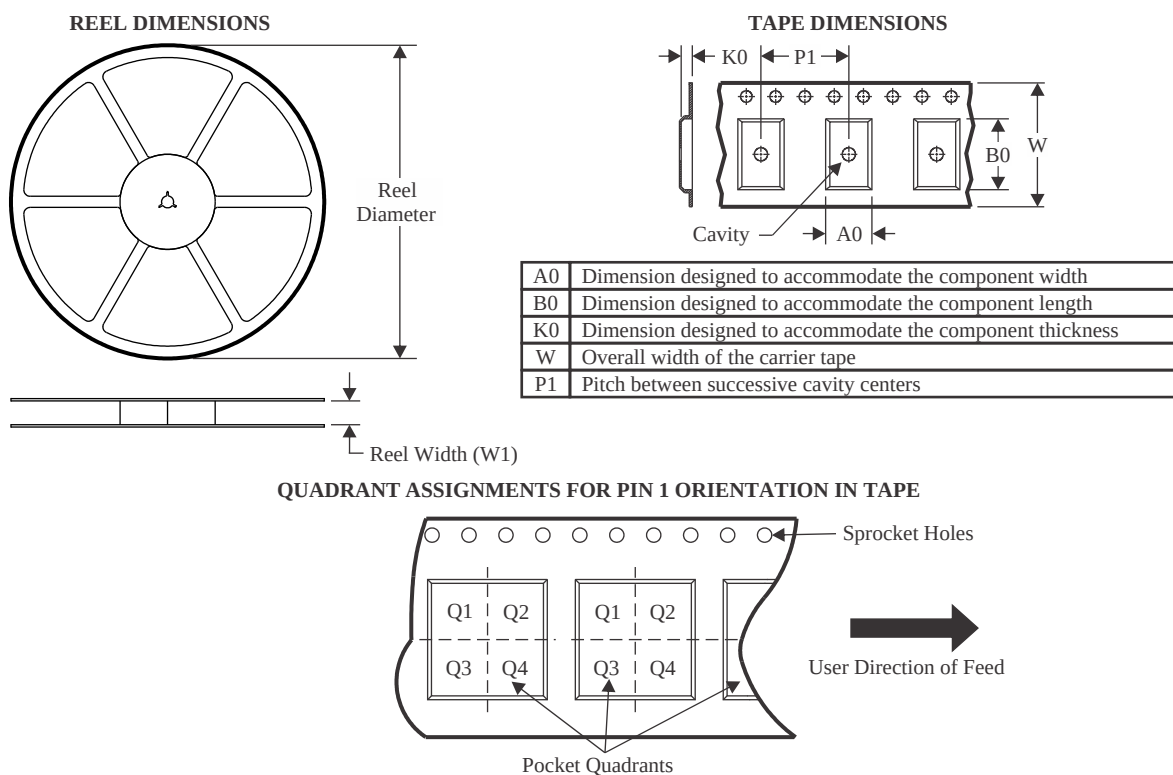
**OTHER QUALIFIED VERSIONS OF SN74HC86-Q1 :**

- Catalog : [SN74HC86](#)
- Military : [SN54HC86](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

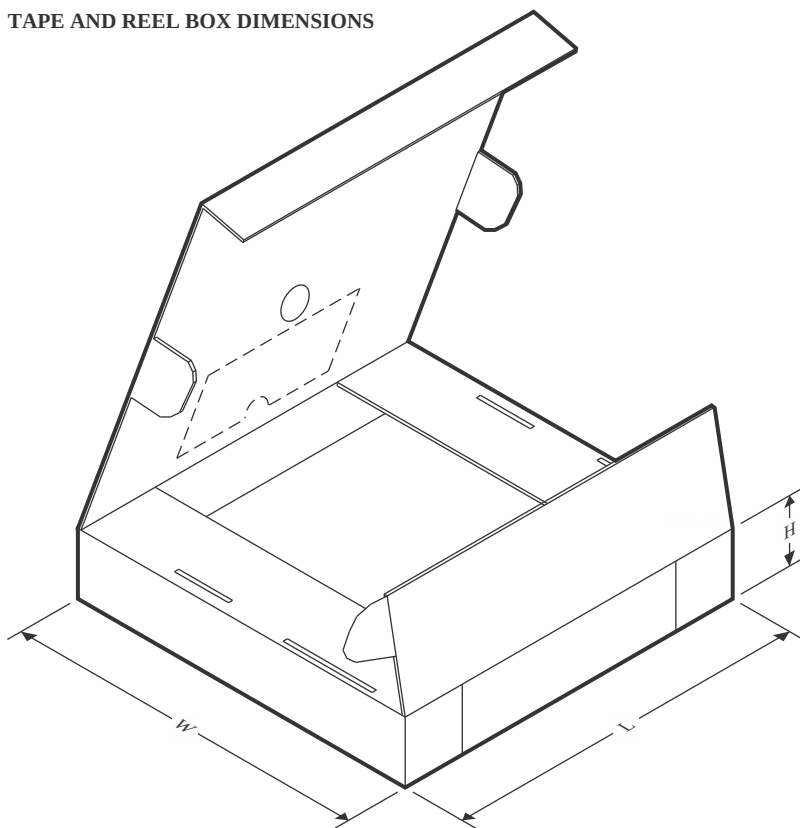
## TAPE AND REEL INFORMATION



\*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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC86IDRG4Q1  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC86IPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC86QDRG4Q1  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC86QPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC86QPWRQ1   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

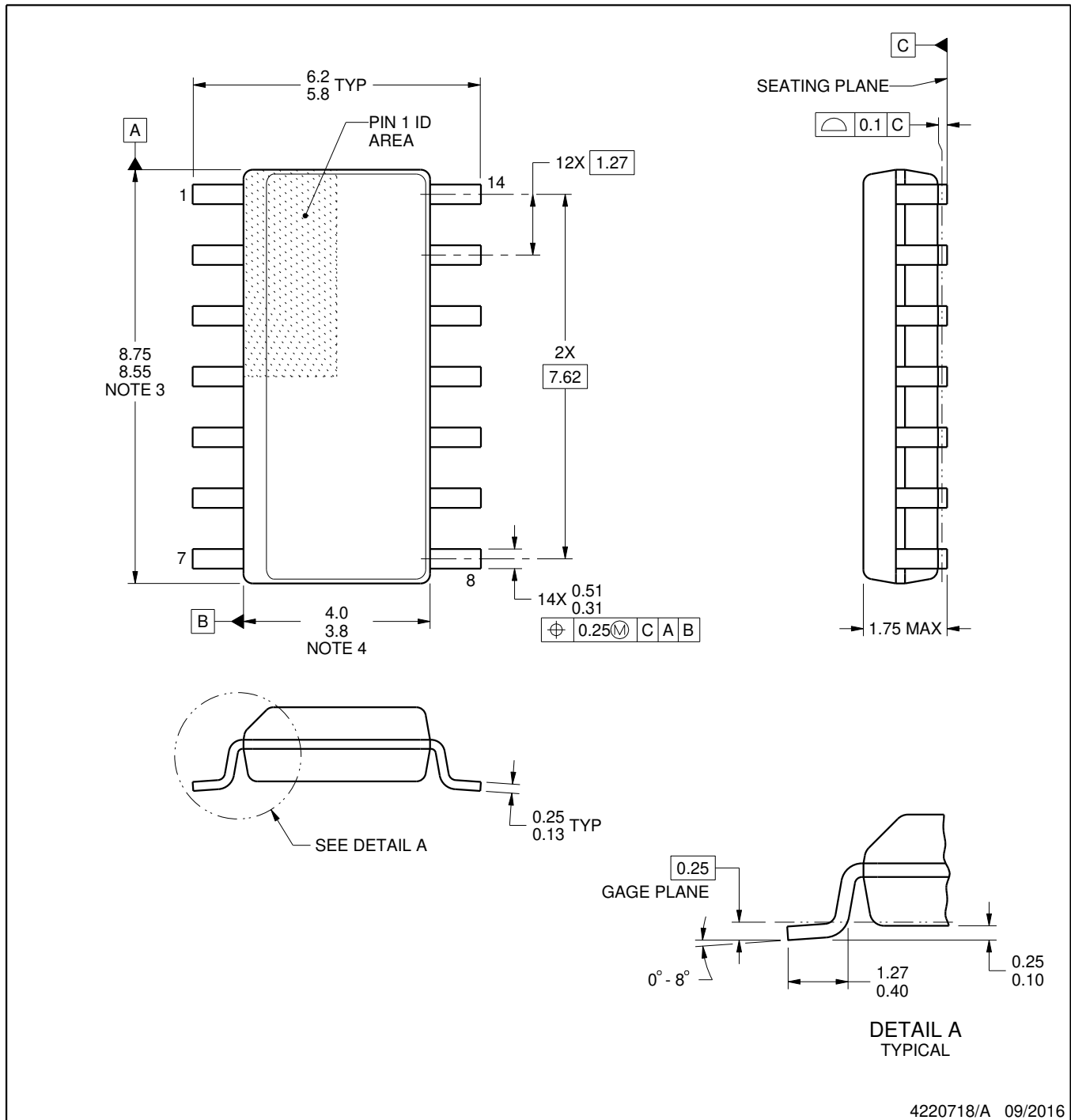


\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC86IDRG4Q1  | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| SN74HC86IPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |
| SN74HC86QDRG4Q1  | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| SN74HC86QPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |
| SN74HC86QPWRQ1   | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

**NOTES:**

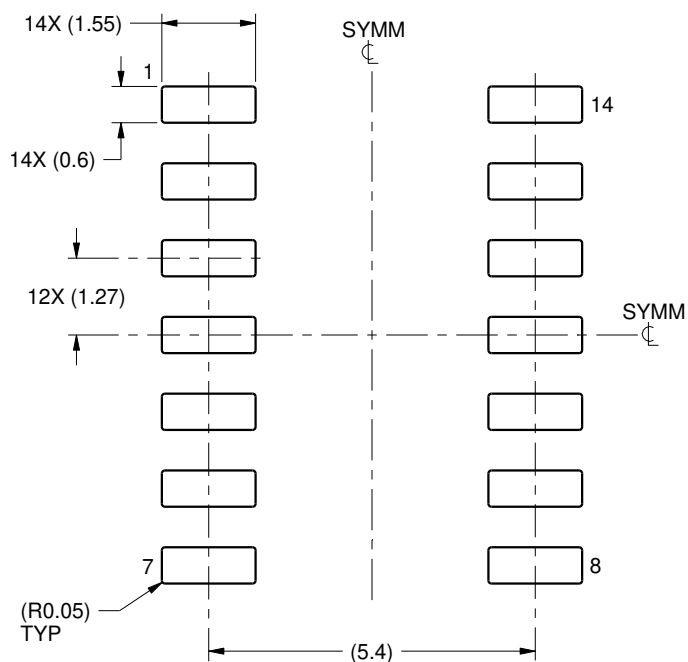
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

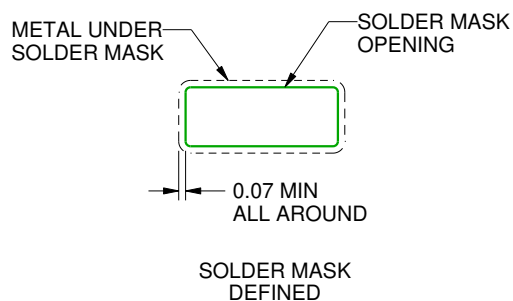
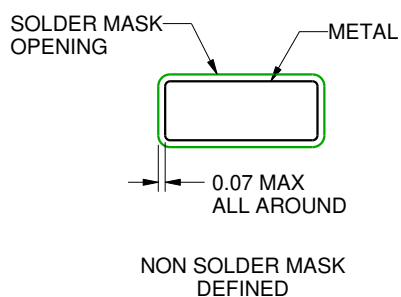
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

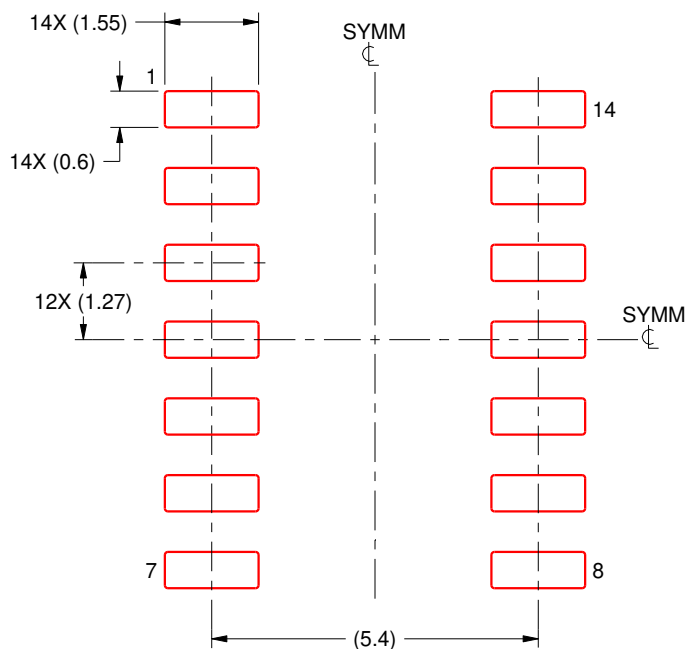
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

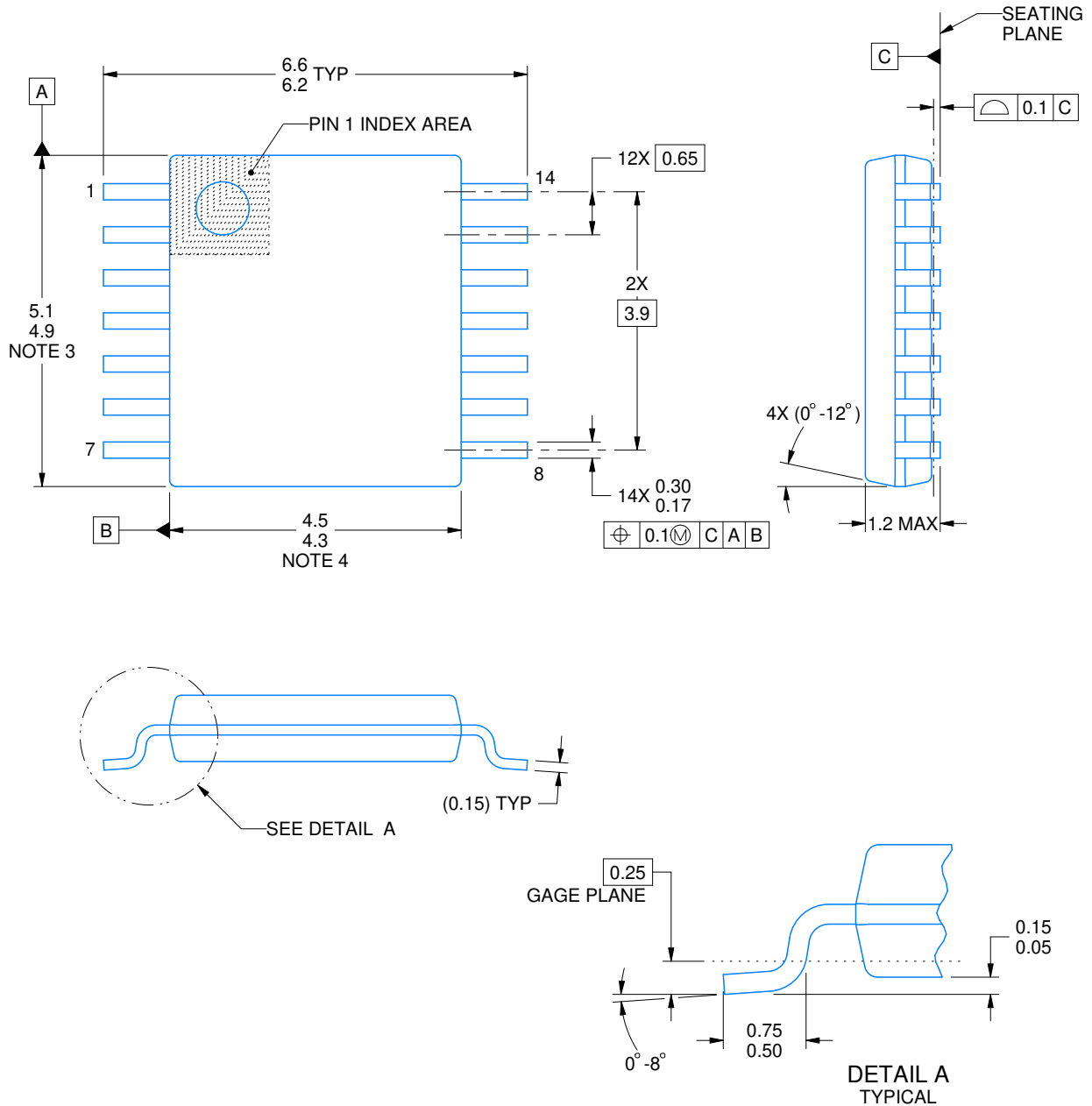


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



4220202/B 12/2023

## NOTES:

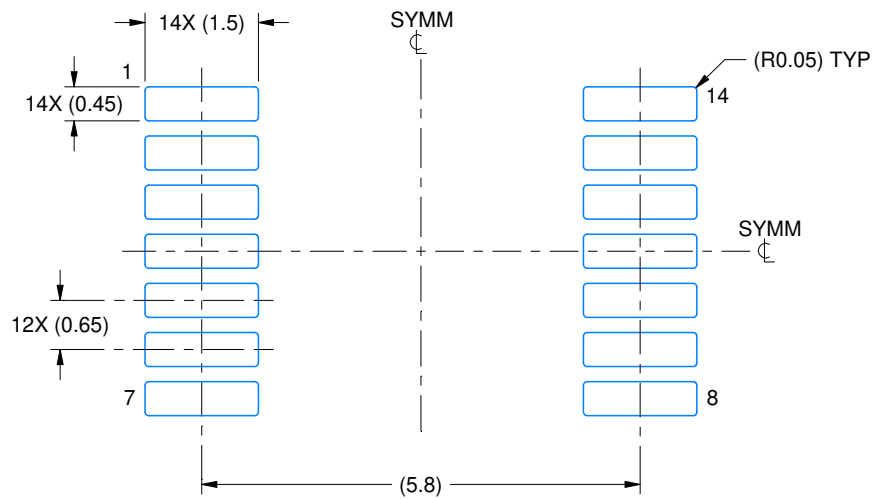
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

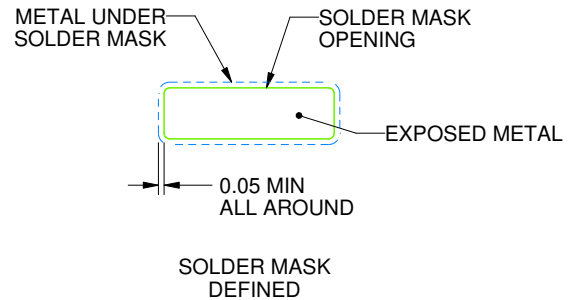
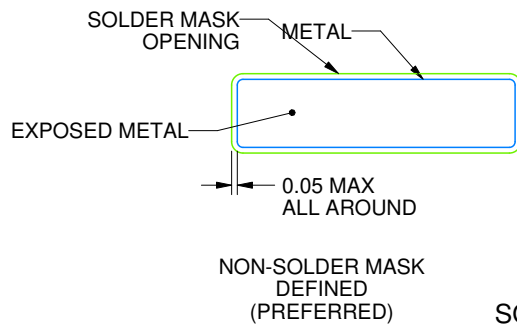
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

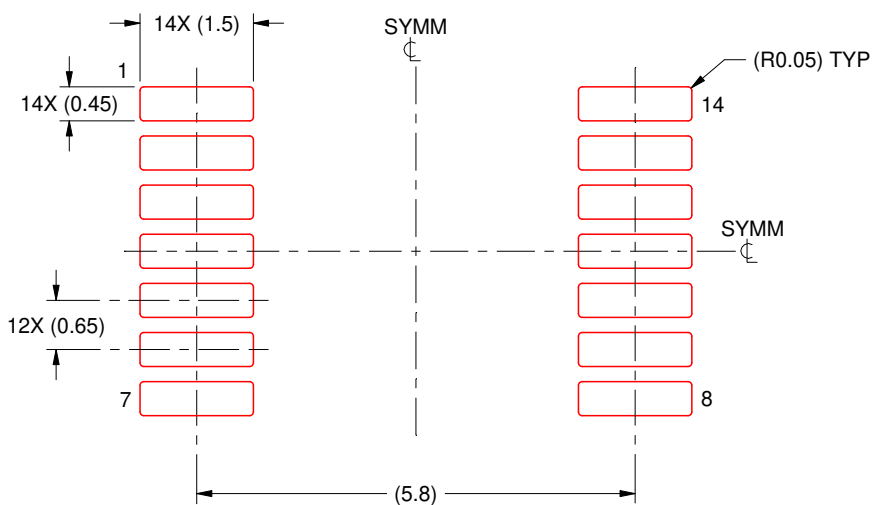
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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