

SN74LVC7002A-Q1 具有施密特触发输入的汽车级四通道双输入或非门

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
 - 器件温度等级 1：-40°C 至 +125°C
 - 器件 HBM ESD 分类等级 2
 - 器件 CDM ESD 分类等级 C4B
- 采用具有可湿性侧面的 QFN (WBQA) 封装
- 工作电压范围为 1.1V 至 3.6V
- 5.5V 容限输入引脚
- 支持标准引脚排列
- 闩锁性能超过 250mA，符合 JESD 17 规范
- ESD 保护性能超过 JESD 22 规范要求
 - 2000V 人体放电模型 (A114-A)
 - 1000V 充电器件模型 (C101)

2 应用

- 将电源正常信号进行组合
- 启用数字信号

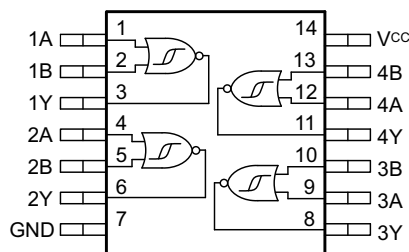
3 说明

SN74LVC7002A-Q1 包含四个具有施密特触发输入的四通道双输入或非门。每个逻辑门以正逻辑执行布尔函数 $Y = \overline{A + B}$ 。

封装信息

器件型号	封装 ⁽¹⁾	封装尺寸 ⁽²⁾	封装尺寸 (标称值) ⁽³⁾
SN74LVC7002A-Q1	BQA (WQFN, 14)	3mm × 2.5mm	3mm × 2.5mm
	PW (TSSOP, 14)	5mm × 6.4mm	5mm × 4.4mm

- (1) 有关更多信息，请参阅节 11。
 (2) 封装尺寸 (长 × 宽) 为标称值，并包括引脚 (如适用)。
 (3) 本体尺寸 (长 × 宽) 为标称值，不包括引脚。



逻辑图



Table of Contents

1 特性	1	7.3 Feature Description.....	10
2 应用	1	7.4 Device Functional Modes.....	11
3 说明	1	8 Application and Implementation	12
4 Pin Configuration and Functions	3	8.1 Application Information.....	12
5 Specifications	4	8.2 Typical Application.....	12
5.1 Absolute Maximum Ratings.....	4	8.3 Power Supply Recommendations.....	14
5.2 ESD Ratings.....	4	8.4 Layout.....	14
5.3 Recommended Operating Conditions.....	4	9 Device and Documentation Support	15
5.4 Thermal Information.....	5	9.1 Documentation Support.....	15
5.5 Electrical Characteristics.....	5	9.2 接收文档更新通知.....	15
5.6 Switching Characteristics.....	6	9.3 支持资源.....	15
5.7 Noise Characteristics.....	6	9.4 Trademarks.....	15
5.8 Typical Characteristics.....	7	9.5 静电放电警告.....	15
6 Parameter Measurement Information	9	9.6 术语表.....	15
7 Detailed Description	10	10 Revision History	15
7.1 Overview.....	10	11 Mechanical, Packaging, and Orderable Information	15
7.2 Functional Block Diagram.....	10		

4 Pin Configuration and Functions

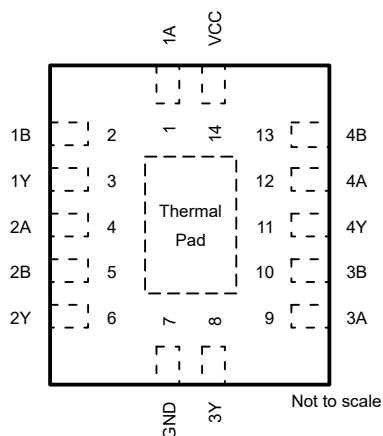


图 4-1. BQA Package, 14 Pin WQFN (Top View)

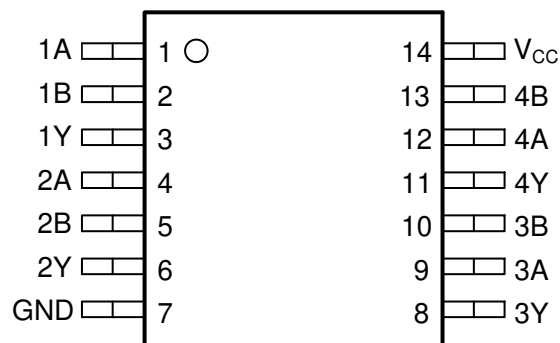


图 4-2. PW Package, 14 Pin TSSOP (Top View)

表 4-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
1A	1	I	Channel 1, Input A
1B	2	I	Channel 1, Input B
1Y	3	O	Channel 1, Output Y
2A	4	I	Channel 2, Input A
2B	5	I	Channel 2, Input B
2Y	6	O	Channel 2, Output Y
GND	7	—	Ground
3Y	8	O	Channel 3, Output Y
3A	9	I	Channel 3, Input A
3B	10	I	Channel 3, Input B
4Y	11	O	Channel 4, Output Y
4A	12	I	Channel 4, Input A
4B	13	I	Channel 4, Input B
V _{CC}	14	—	Positive Supply
Thermal Information ⁽²⁾		—	The thermal pad can be connected to GND or left floating. Do not connect to any other signal or supply.

- (1) I = input, O = output
(2) For BQA package only.

5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	-0.5	6.5	V
V _I	Input voltage range ⁽²⁾	-0.5	6.5	V
V _O	Output voltage range ⁽²⁾	-0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	V _I < 0V		-50 mA
I _{OK}	Output clamp current	V _O < 0V		-50 mA
I _O	Continuous output current		±50	mA
I _O	Continuous output current through V _{CC} or GND		±100	mA
T _J	Junction temperature	-65	150	°C
T _{stg}	Storage temperature	-65	150	°C

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If briefly operating outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

5.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 HBM ESD Classification Level 2 ⁽¹⁾	±2000	V
		Charged device model (CDM), per AEC Q100-011 CDM ESD Classification Level C4B	±1000	

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

5.3 Recommended Operating Conditions

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

Specifications	Description	Condition	MIN	MAX	UNIT
V _{CC}	Supply voltage		1.1	3.6	V
V _I	Input voltage			5.5	V
V _O	Output voltage	(High or low state)		V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 1.8V		-4	mA
		V _{CC} = 2.3V		-8	
		V _{CC} = 2.7V		-12	
		V _{CC} = 3V		-24	
I _{OL}	Low-level output current	V _{CC} = 1.8V		4	mA
		V _{CC} = 2.3V		8	
		V _{CC} = 2.7V		12	
		V _{CC} = 3V		24	
Δt/Δv	Input transition rise or fall rate			10	ns/V
T _A	Operating free-air temperature		-40	125	°C

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		Package Options		UNIT
		PW (TSSOP)	BQA (WQFN)	
		14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	150.8	102.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	78.3	96.8	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	93.8	70.9	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	24.7	16.6	°C/W
Y_{JB}	Junction-to-board characterization parameter	93.2	70.9	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	-	50.1	°C/W

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

5.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V_{CC}	-40°C to 125°C			UNIT
			MIN	TYP	MAX	
V_{T+}	Positive-going input threshold voltage	1.1V	0.5		0.8	V
V_{T+}	Positive-going input threshold voltage	1.5V	0.7		1.11	V
V_{T+}	Positive-going input threshold voltage	1.65V	0.4		1.3	V
V_{T+}	Positive-going input threshold voltage	1.95V	0.6		1.5	V
V_{T+}	Positive-going input threshold voltage	2.3V	0.8		1.7	V
V_{T+}	Positive-going input threshold voltage	2.5V	0.8		1.7	V
V_{T+}	Positive-going input threshold voltage	2.7V	0.8		2	V
V_{T+}	Positive-going input threshold voltage	3V	0.9		2	V
V_{T+}	Positive-going input threshold voltage	3.6V	1.1		2	V
V_{T-}	Negative-going input threshold voltage	1.1V	0.2		0.6	V
V_{T-}	Negative-going input threshold voltage	1.5V	0.34		0.75	V
V_{T-}	Negative-going input threshold voltage	1.65V	0.2		0.9	V
V_{T-}	Negative-going input threshold voltage	1.95V	0.3		1	V
V_{T-}	Negative-going input threshold voltage	2.3V	0.4		1.2	V
V_{T-}	Negative-going input threshold voltage	2.5V	0.4		1.2	V
V_{T-}	Negative-going input threshold voltage	2.7V	0.4		1.4	V
V_{T-}	Negative-going input threshold voltage	3V	0.6		1.5	V
V_{T-}	Negative-going input threshold voltage	3.6V	0.8		1.7	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	1.1V	0.07		0.53	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	1.5V	0.18		0.60	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	1.65V	0.1		1.2	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	1.95V	0.2		1.3	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	2.3V	0.3		1.3	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	2.5V	0.3		1.3	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	2.7V	0.3		1.1	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	3V	0.3		1.2	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	3.6V	0.3		1.2	V
V_{OH}	$I_{OH} = -100\mu A$	1.1V to 3.6V	$V_{CC} - 0.2$			V
V_{OH}	$I_{OH} = -4mA$	1.65V	1.2			V

5.5 Electrical Characteristics (续)

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

PARAMETER	TEST CONDITIONS	V _{CC}	-40°C to 125°C			UNIT
			MIN	TYP	MAX	
V _{OH}	I _{OH} = -8mA	2.3V	1.75			V
V _{OH}	I _{OH} = -12mA	2.7V	2.2			V
V _{OH}	I _{OH} = -24mA	3V	2.4			V
V _{OH}	I _{OH} = -24mA	3V	2.2			V
V _{OL}	I _{OH} = 100μA	1.1V to 3.6V			0.15	V
V _{OL}	I _{OH} = 4mA	1.65V			0.45	V
V _{OL}	I _{OH} = 8mA	2.3V			0.7	V
V _{OL}	I _{OH} = 12mA	2.7V			0.4	V
V _{OL}	I _{OH} = 24mA	3V			0.55	V
I _I	V _I = V _{CC} or GND	3.6V			±5	μA
I _{off}	V _I or V _O = V _{CC}	0V			±10	μA
I _{CC}	V _I = V _{CC} or GND, I _O = 0	3.6V			40	μA
ΔI _{CC}	One input at V _{CC} - 0.6V, other inputs at V _{CC} or GND	2.7V to 3.6V			500	μA
C _I	V _I = V _{CC} or GND	3.3V				pF
C _O	V _O = V _{CC} or GND	3.3V				pF
C _{PD}	f = 10MHz	1.8V		31		pF
C _{PD}	f = 10MHz	2.5V		31		pF
C _{PD}	f = 10MHz	3.3V		32		pF

5.6 Switching Characteristics

over operating free-air temperature range; typical values measured at T_A = 25°C (unless otherwise noted). See *Parameter Measurement Information*

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V _{CC}	-40°C to 125°C			UNIT
					MIN	TYP	MAX	
t _{pd}	A or B	Y	C _L = 15pF	1.2V ± 0.1V		12	44	ns
t _{pd}	A or B	Y	C _L = 15pF	1.5V ± 0.12V		9	15	ns
t _{pd}	A or B	Y	C _L = 30pF	1.8V ± 0.15V			10.2	ns
t _{pd}	A or B	Y	C _L = 30pF	2.5V ± 0.2V			6.9	ns
t _{pd}	A or B	Y	C _L = 50pF	2.7V			6.4	ns
t _{pd}	A or B	Y	C _L = 50pF	3.3V ± 0.3V			5.6	ns
t _{sk(o)}				3.3V ± 0.3V			1.5	ns

5.7 Noise Characteristics

V_{CC} = 3.3V, C_L = 50pF, T_A = 25°C

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
V _{OL(P)}	Quiet output, maximum dynamic V _{OL}		0.9	0.8	V
V _{OL(V)}	Quiet output, minimum dynamic V _{OL}	-0.8	-0.3		V
V _{OH(V)}	Quiet output, minimum dynamic V _{OH}	2.2	3.3		V
V _{IH(D)}	High-level dynamic input voltage	2.0			V
V _{IL(D)}	Low-level dynamic input voltage			0.8	V

5.8 Typical Characteristics

$T_A = 25^\circ\text{C}$ (unless otherwise noted)



图 5-1. Supply Current Across Input Voltage 1.8V and 2.5V Supply

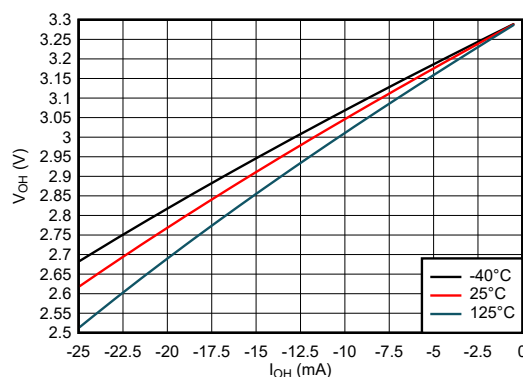


图 5-2. Output Voltage vs Current in HIGH State; 3.3V Supply

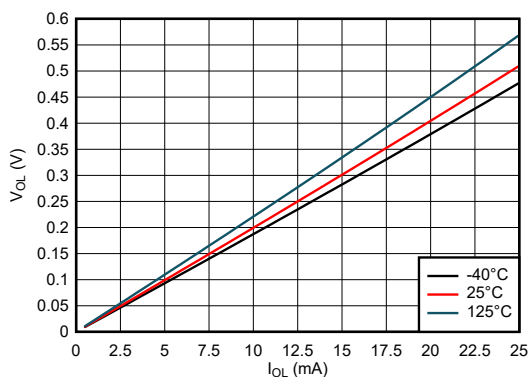


图 5-3. Output Voltage vs Current in LOW State; 3.3V Supply

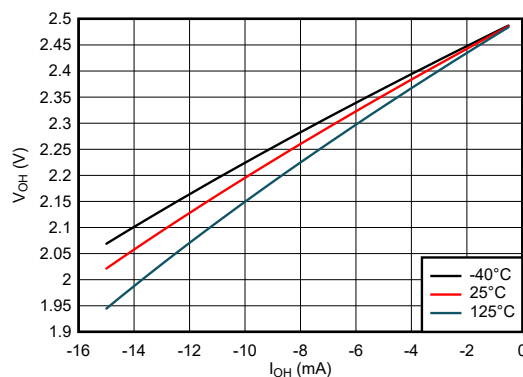


图 5-4. Output Voltage vs Current in HIGH State; 2.5V Supply

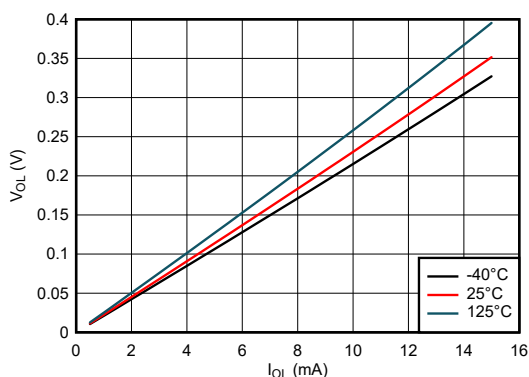


图 5-5. Output Voltage vs Current in LOW State; 2.5V Supply

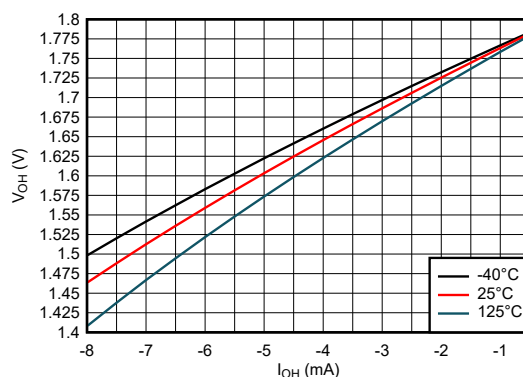


图 5-6. Output Voltage vs Current in HIGH State; 1.8V Supply

5.8 Typical Characteristics (continued)

$T_A = 25^\circ\text{C}$ (unless otherwise noted)

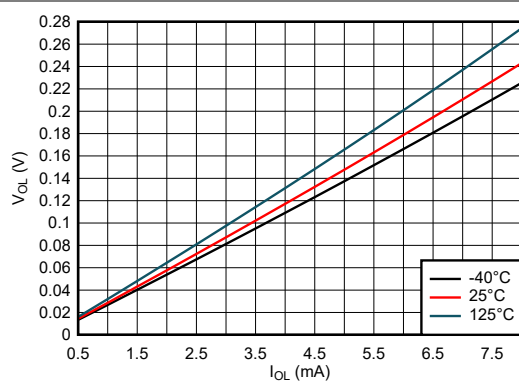


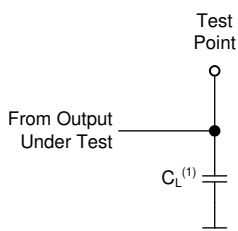
图 5-7. Output Voltage vs Current in LOW State; 1.8V Supply

6 Parameter Measurement Information

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

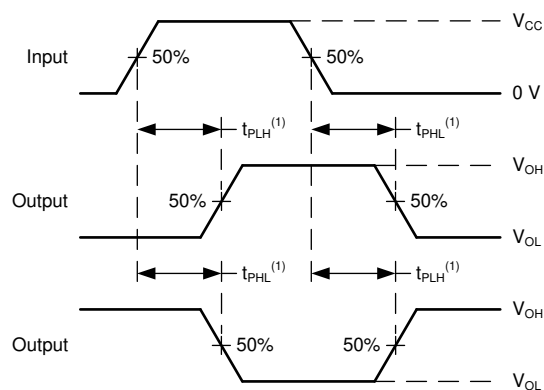
For clock inputs, f_{max} is measured when the input duty cycle is 50%.

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



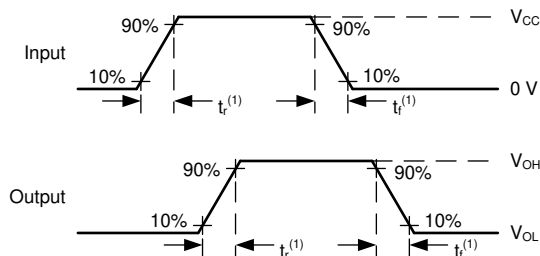
(1) C_L includes probe and test-fixture capacitance.

图 6-1. Load Circuit for Push-Pull Outputs



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

图 6-2. Voltage Waveforms Propagation Delays



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

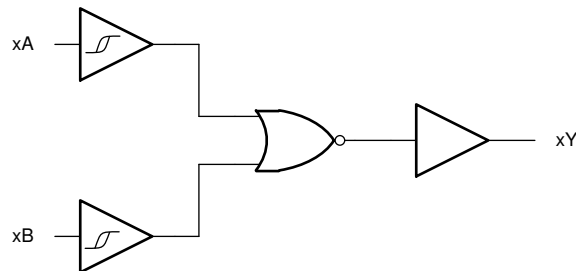
图 6-3. Voltage Waveforms, Input and Output Transition Times

7 Detailed Description

7.1 Overview

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

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 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 SN74LVC7002A-Q1 can drive a load with a total capacitance less than or equal to the maximum load listed in the [Switching Characteristics](#) 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 the provided load value. 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](#).

7.3.2 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 ΔV_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](#).

7.3.3 Clamp Diode Structure

图 7-1 shows the inputs and outputs to this device have negative clamping diodes only.

小心

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.

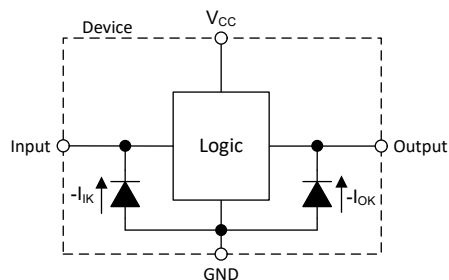


图 7-1. Electrical Placement of Clamping Diodes for Each Input and Output

7.3.4 Wettable Flanks

This device includes wettable flanks for at least one package. See the *Features* section on the front page of the data sheet for which packages include this feature.

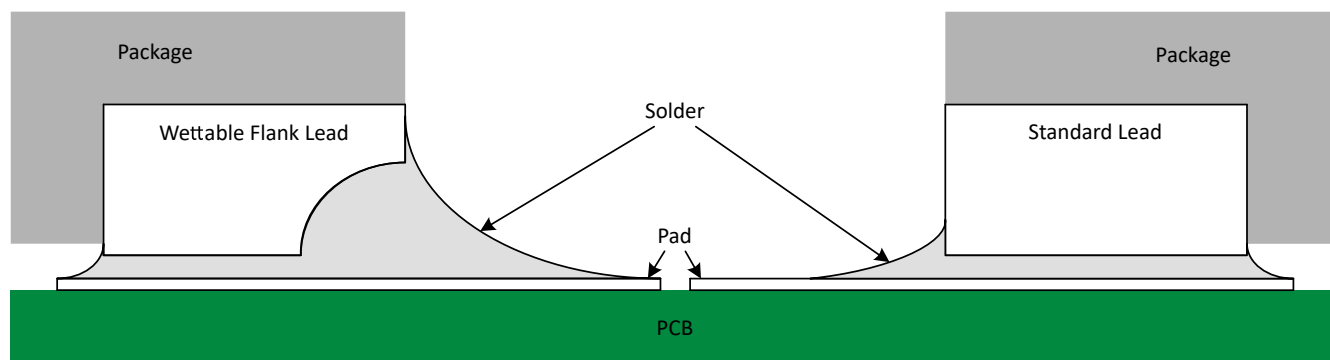


图 7-2. Simplified Cutaway View of Wettable-Flank QFN Package and Standard QFN Package After Soldering

Wettable flanks help improve side wetting after soldering, which makes QFN packages easier to inspect with automatic optical inspection (AOI). As shown in 图 7-2, a wettable flank can be dimpled or step-cut to provide additional surface area for solder adhesion which assists in reliably creating a side fillet. See the mechanical drawing for additional details.

7.4 Device Functional Modes

表 7-1 lists the functional modes of the SN74LVC7002A-Q1.

表 7-1. Function Table

INPUTS ⁽¹⁾		OUTPUT Y
A	B	
L	L	H
H	X	L
X	H	L

(1) H = High Voltage Level, L = Low Voltage Level, X = Don't Care

8 Application and Implementation

备注

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.

8.1 Application Information

In this application, two 2-input NOR gates are used to create an SR latch as shown in [图 8-1](#). The two additional gates can be used for a second SR latch, or the inputs can be grounded and both channels left unused.

The SN74LVC7002A-Q1 is used to drive the tamper indicator LED and provide one bit of data to the system controller. When the tamper switch outputs HIGH, the output Q becomes HIGH. This output remains HIGH until the system controller addresses the event and sends a HIGH signal to the R input which returns the Q output back to LOW.

The user can add a small RC to the feedback path of the NOR gates to default the output to a certain state, which can create slow transition rates. This fact makes the SN74LVC7002A-Q1 an excellent choice for the application because it has Schmitt-trigger inputs that do not have input transition rate requirements.

8.2 Typical Application

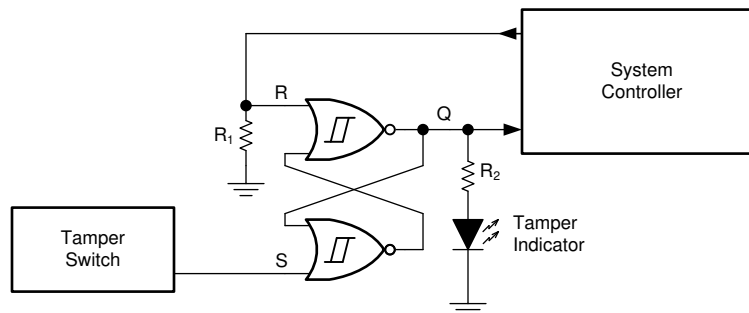


图 8-1. Typical Application Block Diagram

8.2.1 Design Requirements

8.2.1.1 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 SN74LVC7002A-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](#).

小心

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.

8.2.1.2 Input Considerations

Input signals must cross $V_{L(\text{min})}$ to be considered a logic LOW, and $V_{H(\text{max})}$ 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 SN74LVC7002A-Q1, 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 SN74LVC7002A-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 $\Delta V_T(\text{min})$ 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 [§ 7.3](#) for additional information regarding the inputs for this device.

8.2.1.3 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 [§ 7.3](#) for additional information regarding the outputs for this device.

8.2.2 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 [§ 8.4](#).
2. Ensure the capacitive load at the output is $\leq 70\text{pF}$. This is not a hard limit; however, it will optimize performance. This can be accomplished by providing short, appropriately sized traces from the SN74LVC7002A-Q1 to the receiving device.
3. Ensure the resistive load at the output is larger than $(V_{CC} / I_O(\text{max})) \Omega$. This will not violate the maximum output current from the [Absolute Maximum Ratings](#). 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](#)

8.2.3 Application Curves

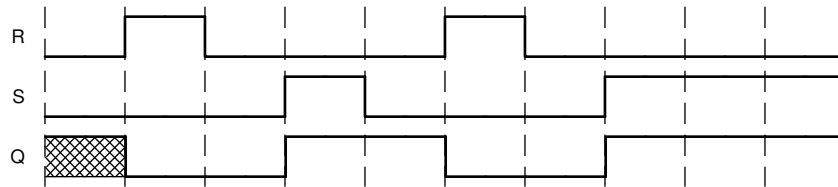


图 8-2. Application Timing Diagram

8.3 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 [图 8-3](#).

8.4 Layout

8.4.1 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.

8.4.2 Layout Example

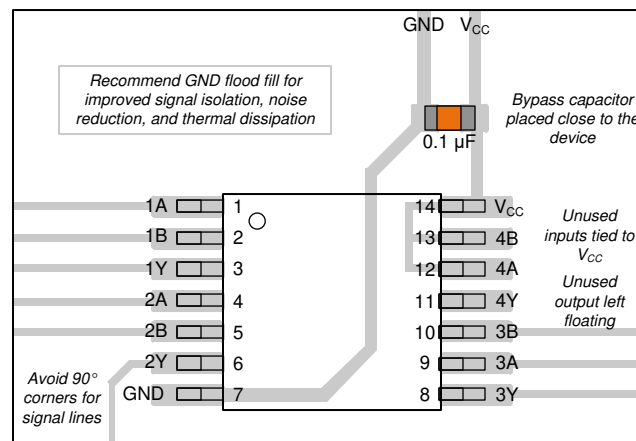


图 8-3. Example Layout for the SN74LVC7002A-Q1

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [Introduction to Logic application report](#)
- Texas Instruments, [Implications of Slow or Floating CMOS Inputs application note](#)

9.2 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击 [通知](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

9.3 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [使用条款](#)。

9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

9.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

9.6 术语表

TI 术语表

本术语表列出并解释了术语、首字母缩略词和定义。

10 Revision History

DATE	REVISION	NOTES
March 2024	*	Initial Release

11 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 (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CLVC7002AWBQARQ1	Active	Production	WQFN (BQA) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LC702Q
CLVC7002AWBQARQ1.A	Active	Production	WQFN (BQA) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LC702Q
SN74LVC7002APWRQ1	Active	Production	TSSOP (PW) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LC7002Q
SN74LVC7002APWRQ1.A	Active	Production	TSSOP (PW) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LC7002Q

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

⁽²⁾ **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.

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

⁽⁴⁾ **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.

⁽⁵⁾ **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.

⁽⁶⁾ **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.

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.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN74LVC7002A-Q1 :

- Catalog : [SN74LVC7002A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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
CLVC7002AWBQARQ1	WQFN	BQA	14	3000	180.0	12.4	2.8	3.3	1.1	4.0	12.0	Q1
SN74LVC7002APWRQ1	TSSOP	PW	14	3000	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)
CLVC7002AWBQARQ1	WQFN	BQA	14	3000	210.0	185.0	35.0
SN74LVC7002APWRQ1	TSSOP	PW	14	3000	356.0	356.0	35.0

GENERIC PACKAGE VIEW

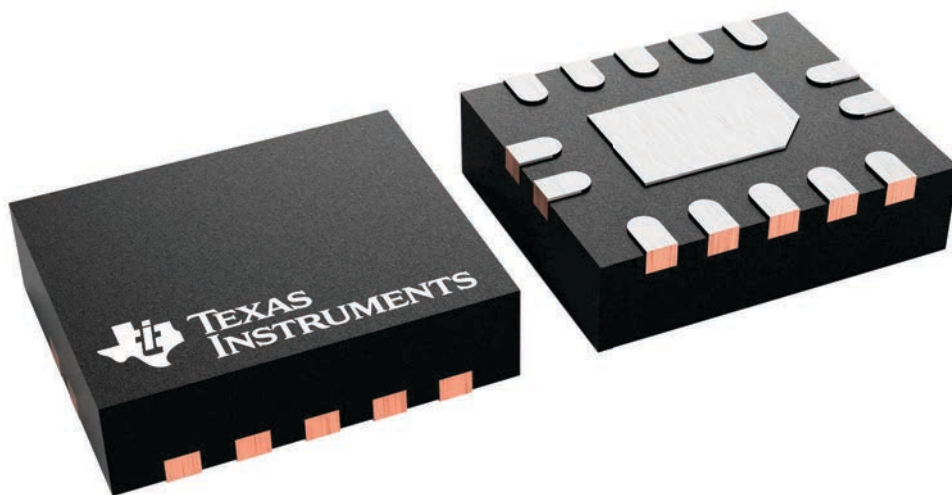
BQA 14

WQFN - 0.8 mm max height

2.5 x 3, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



WQFN - 0.8 mm max height

Technical drawing of a microelectronic package showing top, side, and cross-sectional views with dimensions and callouts.

Top View:

- Overall width: 2.6
- Overall height: 3.1
- PIN 1 INDEX AREA (hatched square)
- Section line A-A

Side View:

- Overall height: 2.9
- Seating Plane
- Dimension 0.08 C

Cross-Section A-A (TYPICAL):

- Dimension 0.1 MIN
- Dimension (0.13)

Bottom View:

- Exposed Thermal Pad
- PIN 1 ID
- Dimensions: 1.5 ± 0.1, 1.4 ± 0.1, 0.5, 0.3, 0.16 TYP, 0.2 TYP
- Callouts: 2X [2], 8X [0.5], 14X [0.3], 14X [0.1 M] C A B, 0.05 M

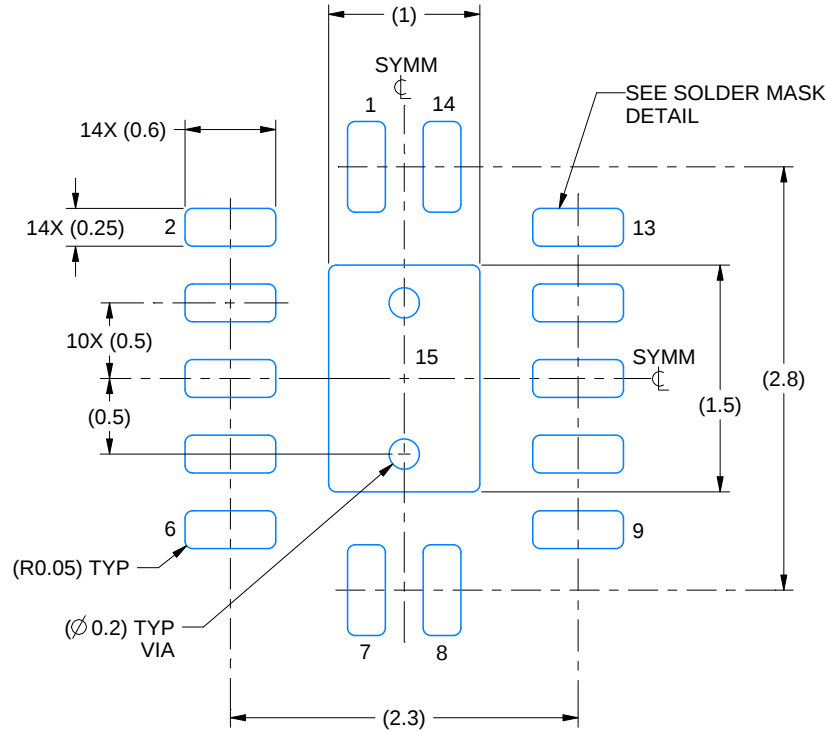
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

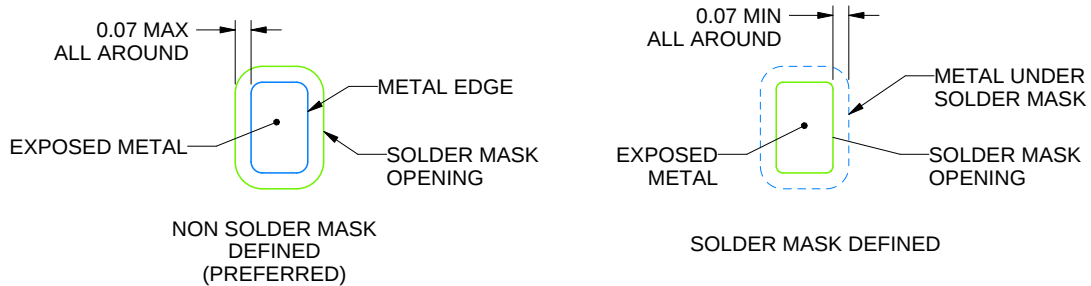
BQA0014B

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



SOLDER MASK DETAILS

4227062/B 09/2021

NOTES: (continued)

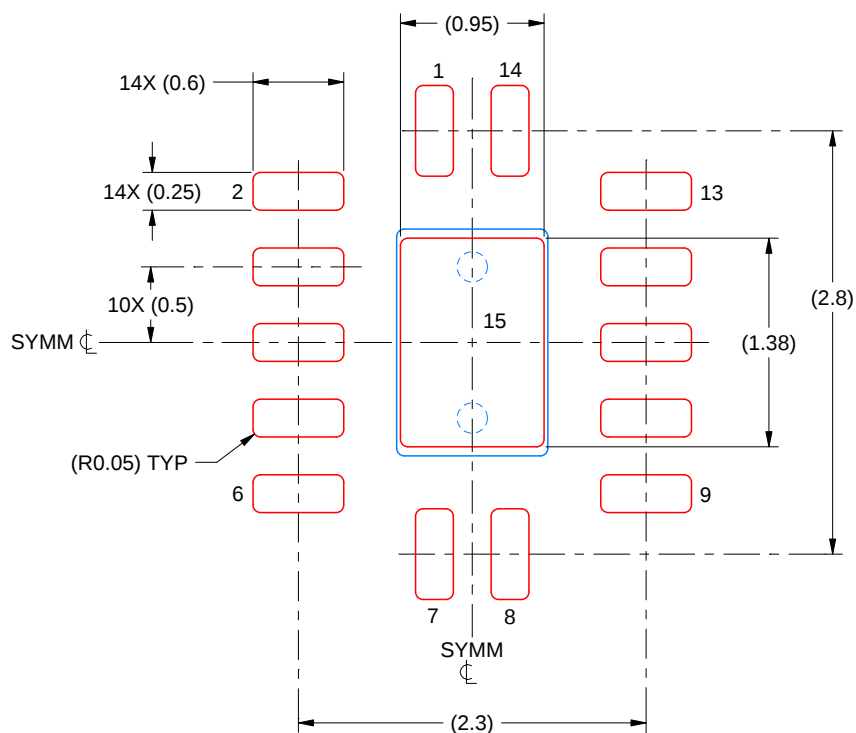
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

BQA0014B

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 20X

EXPOSED PAD 15
87% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4227062/B 09/2021

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PW0014A

PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

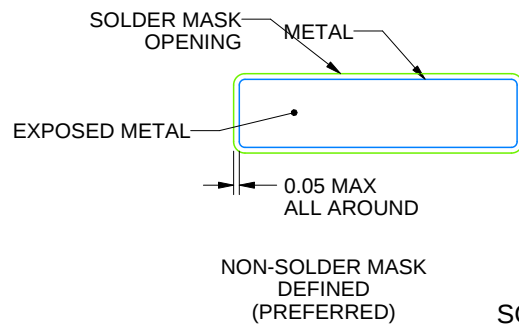
PW0014A

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

4220202/B 12/2023

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.

重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、某特定用途方面的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他功能安全、信息安全、监管或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。您应全额赔偿因在这些资源的使用中对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，TI 对此概不负责。

TI 提供的产品受 [TI 的销售条款](#) 或 [ti.com](#) 上其他适用条款/TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

邮寄地址：Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
版权所有 © 2025，德州仪器 (TI) 公司