SN74LVC7002A-Q1 車載対応、クワッド 2 入力 NOR ゲート、シュミットトリガ入力採用

1 特長

- 車載アプリケーション用に AEC-Q100 認定済み：
  - デバイス温度グレード 1：-40℃～+125℃
  - デバイス HBM ESD 分類レベル 2
  - デバイス CDM ESD 分類レベル C4B
- ウェッタブル フランク QFN (WBQA) パッケージで供給されます
- 1.1V～3.6V の動作範囲
- 5.5V 耐圧入力ピン
- 標準ピン配置をサポート
- JESD 17 準拠で 250mA 超のラッチアップ性能
- JESD 22 を上回る ESD 保護
  - 2000V、人体モデル (A114-A)
  - 1000V、デバイス帯電モデル (C101)

2 アプリケーション

- パワー グッド信号の結合
- デジタル信号のイネーブル

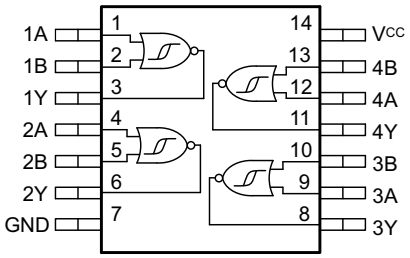
3 概要

SN74LVC7002A-Q1 には、シュミット トリガ入力を搭載した 4 つの独立した 2 入力 NOR ゲートが内蔵されています。各ゲートはブール関数 $Y = \overline{A + B}$ を正論理で実行します。

パッケージ情報

部品番号	パッケージ (1)	パッケージ サイズ(2)	本体サイズ (公称)(3)
SN74LVC7002A-Q1	BQA (WQFN、14)	3mm × 2.5mm	3mm × 2.5mm
	PW (TSSOP、14)	5mm × 6.4mm	5mm × 4.4mm

(1) 詳細については、セクション 11 を参照してください。
(2) パッケージ サイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。
(3) 本体サイズ (長さ×幅) は公称値であり、ピンは含まれません。



ロジック図

このリソースの元の言語は英語です。 翻訳は概要を便宜的に提供するもので、自動化ツール (機械翻訳) を使用していることがあり、TI では翻訳の正確性および妥当性につきましては一切保証いたしません。 実際の設計などの前には、ti.com で必ず最新の英語版をご参照くださいますようお願いいたします。

Table of Contents

1 特長.....1
2 アプリケーション.....1
3 概要.....1
4 Pin Configuration and Functions.....3
5 Specifications.....4
5.1 Absolute Maximum Ratings.....4
5.2 ESD Ratings.....4
5.3 Recommended Operating Conditions.....4
5.4 Thermal Information.....5
5.5 Electrical Characteristics.....5
5.6 Switching Characteristics.....6
5.7 Noise Characteristics.....6
5.8 Typical Characteristics.....7
6 Parameter Measurement Information.....9
7 Detailed Description.....10
7.1 Overview.....10
7.2 Functional Block Diagram.....10
7.3 Feature Description.....10
7.4 Device Functional Modes.....11
8 Application and Implementation.....12
8.1 Application Information.....12
8.2 Typical Application.....12
8.3 Power Supply Recommendations.....14
8.4 Layout.....14
9 Device and Documentation Support.....15
9.1 Documentation Support.....15
9.2 ドキュメントの更新通知を受け取る方法.....15
9.3 サポート・リソース.....15
9.4 Trademarks.....15
9.5 静電気放電に関する注意事項.....15
9.6 用語集.....15
10 Revision History.....15
11 Mechanical, Packaging, and Orderable Information.....15

Copyright © 2024 Texas Instruments Incorporated

4 Pin Configuration and Functions

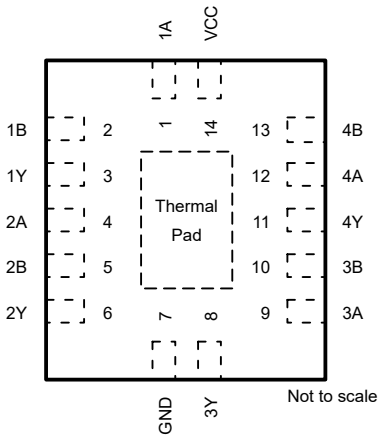


図 4-1. BQA Package, 14 Pin WQFN (Top View)

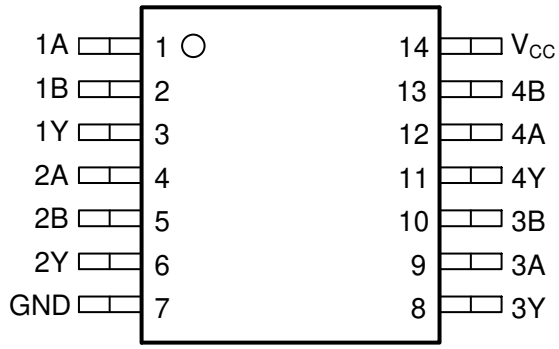


図 4-2. PW Package, 14 Pin TSSOP (Top View)

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

Copyright © 2024 Texas Instruments Incorporated

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}= –100µA	1.1V to 3.6V	V_{CC} - 0.2			V
V_{OH}	I_{OH}= –4mA	1.65V	1.2			V

Copyright © 2024 Texas Instruments Incorporated

5.5 Electrical Characteristics (続き)

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}		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

VCC = 3.3V, CL = 50pF, TA = 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

Copyright © 2024 Texas Instruments Incorporated

5.8 Typical Characteristics

T_A = 25°C (unless otherwise noted)

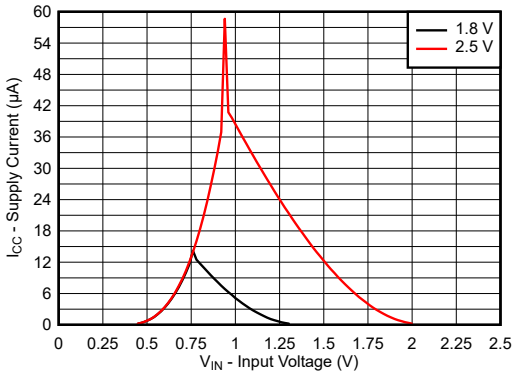


図 5-1. Supply Current Across Input Voltage 1.8V and 2.5V Supply

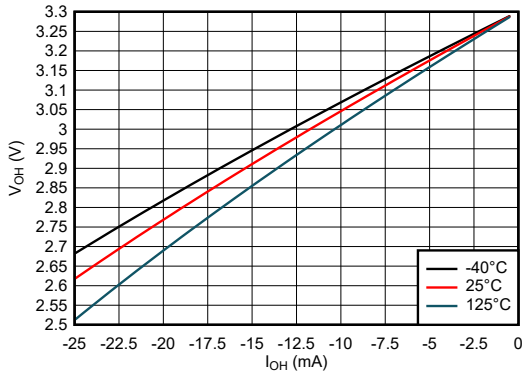


図 5-2. Output Voltage vs Current in HIGH State; 3.3V Supply

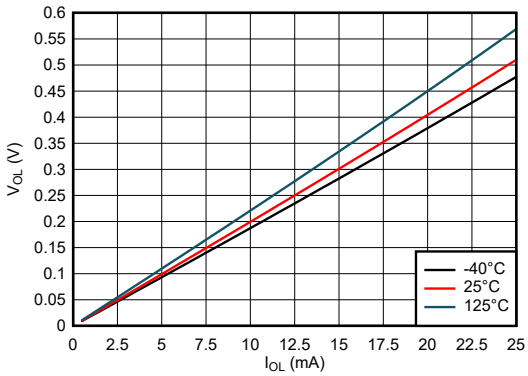


図 5-3. Output Voltage vs Current in LOW State; 3.3V Supply

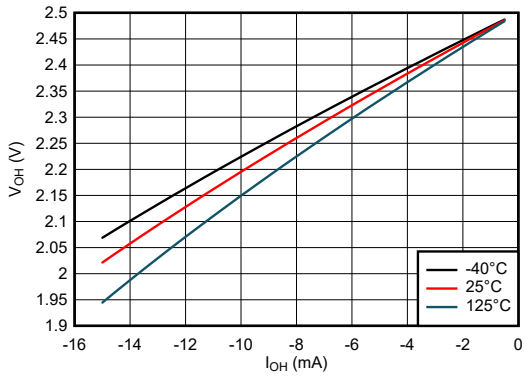


図 5-4. Output Voltage vs Current in HIGH State; 2.5V Supply

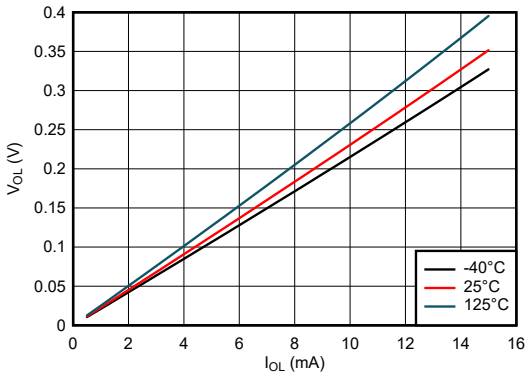


図 5-5. Output Voltage vs Current in LOW State; 2.5V Supply

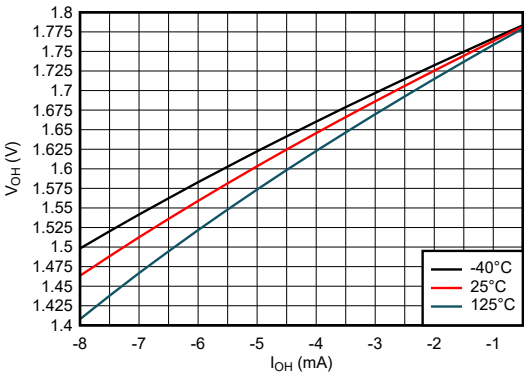


図 5-6. Output Voltage vs Current in HIGH State; 1.8V Supply

Copyright © 2024 Texas Instruments Incorporated

5.8 Typical Characteristics (continued)

T_A = 25°C (unless otherwise noted)

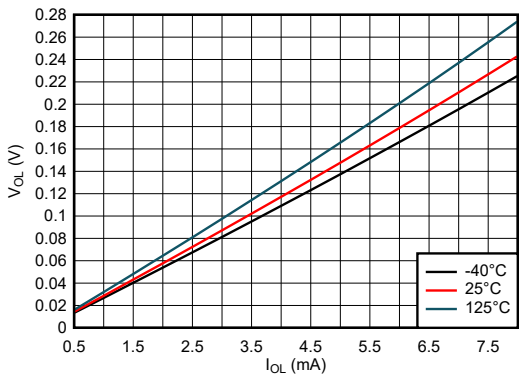


図 5-7. Output Voltage vs Current in LOW State; 1.8V Supply

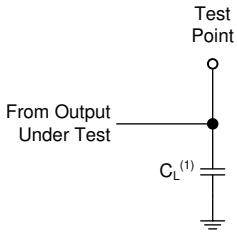
Copyright © 2024 Texas Instruments Incorporated

6 Parameter Measurement Information

Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1MHz, Z_O = 50Ω.

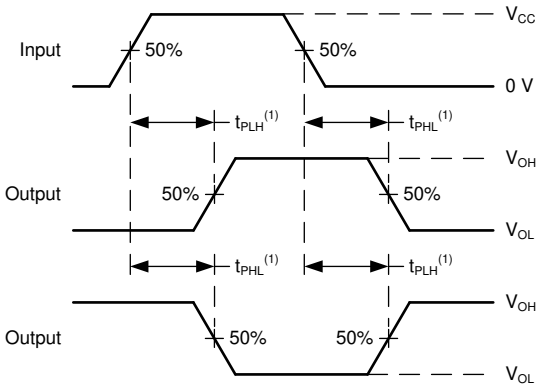
For clock inputs, f_{max} is measured when the input duty cycle is 50%.

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



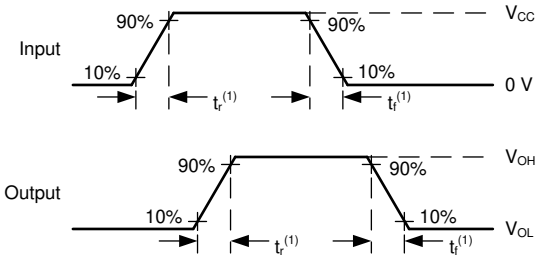
(1) C_L includes probe and test-fixture capacitance.

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



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

図 6-2. Voltage Waveforms Propagation Delays



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

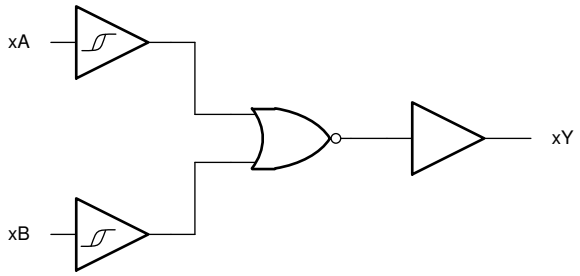
図 6-3. Voltage Waveforms, Input and Output Transition Times

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 ÷ 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

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

注意

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.

Copyright © 2024 Texas Instruments Incorporated

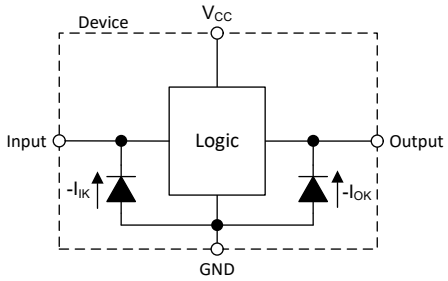


図 7-1. Electrical Placement of Clamping Diodes for Each Input and Output

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.

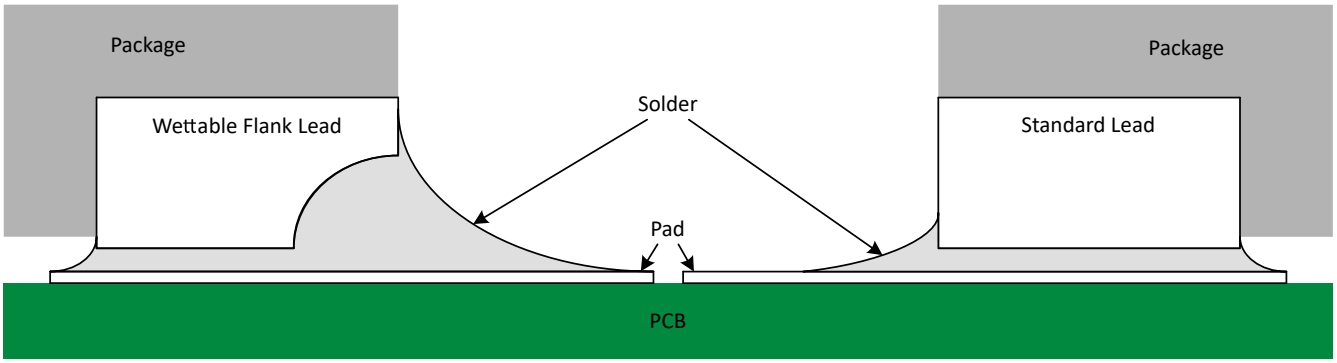


図 7-2. Simplified Cutaway View of Wettable-Flank QFN Package and Standard QFN Package After Soldering

Wettable flanks help improve side wetting after soldering, which makes QFN packages easier to inspect with automatic optical inspection (AOI). As shown in 図 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

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 図 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

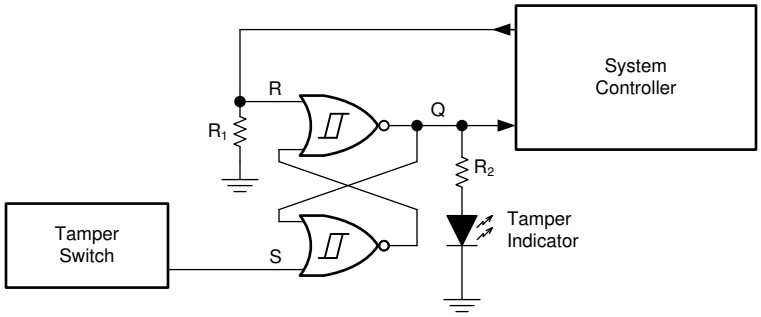


図 8-1. Typical Application Block Diagram

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.

Copyright © 2024 Texas Instruments Incorporated

注意

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.

8.2.1.2 Input Considerations

Input signals must cross V_{t-}(min) to be considered a logic LOW, and V_{t+}(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-kΩ 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 ΔV_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 *セクション 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 *セクション 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 *セクション 8.4*.
2. Ensure the capacitive load at the output is ≤ 70pF. 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(max)) Ω. 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

Copyright © 2024 Texas Instruments Incorporated

8.2.3 Application Curves

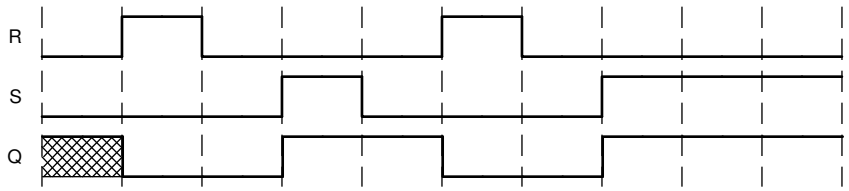


図 8-2. Application Timing Diagram

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 0.1µF capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1µF and 1µF 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 *図 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

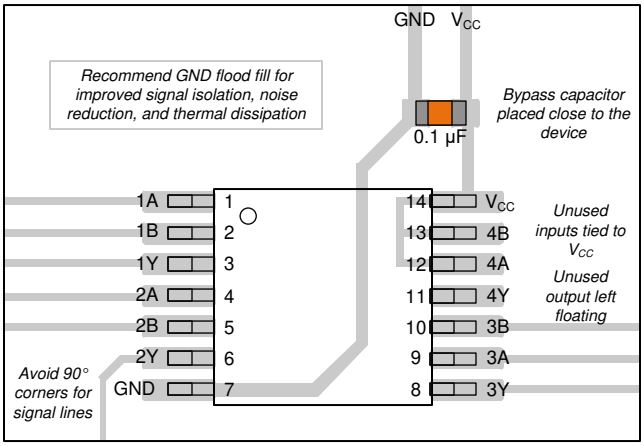


図 8-3. Example Layout for the SN74LVC7002A-Q1

Copyright © 2024 Texas Instruments Incorporated

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 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、www.tij.co.jp のデバイス製品フォルダを開いてください。[通知] をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取ることができます。 変更の詳細については、改訂されたドキュメントに含まれている改訂履歴をご覧ください。

9.3 サポート・リソース

テキサス・インスツルメンツ E2E™ サポート・フォーラムは、エンジニアが検証済みの回答と設計に関するヒントをエキスパートから迅速かつ直接得ることができる場所です。既存の回答を検索したり、独自の質問をしたりすることで、設計で必要な支援を迅速に得ることができます。

リンクされているコンテンツは、各寄稿者により「現状のまま」提供されるものです。これらはテキサス・インスツルメンツの仕様を構成するものではなく、必ずしもテキサス・インスツルメンツの見解を反映したものではありません。テキサス・インスツルメンツの使用条件を参照してください。

9.4 Trademarks

テキサス・インスツルメンツ E2E™ is a trademark of Texas Instruments.
すべての商標は、それぞれの所有者に帰属します。

9.5 静電気放電に関する注意事項



この IC は、ESD によって破損する可能性があります。テキサス・インスツルメンツは、IC を取り扱う際には常に適切な注意を払うことを推奨します。正しい取り扱いおよび設置手順に従わない場合、デバイスを破損するおそれがあります。

ESD による破損は、わずかな性能低下からデバイスの完全な故障まで多岐にわたります。精密な IC の場合、パラメータがわずかに変化するだけで公表されている仕様から外れる可能性があるため、破損が発生しやすくなっています。

9.6 用語集

テキサス・インスツルメンツ用語集　この用語集には、用語や略語の一覧および定義が記載されています。

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 :

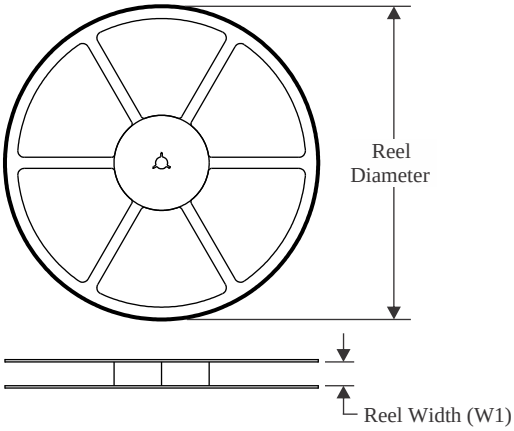
- Catalog : SN74LVC7002A

NOTE: Qualified Version Definitions:

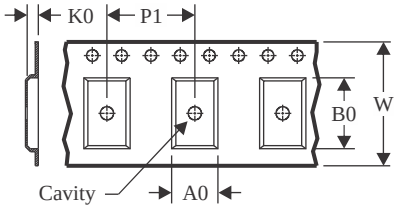
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

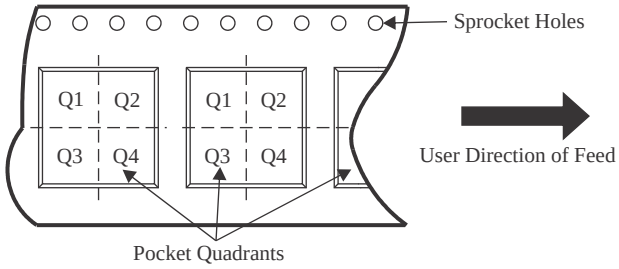


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

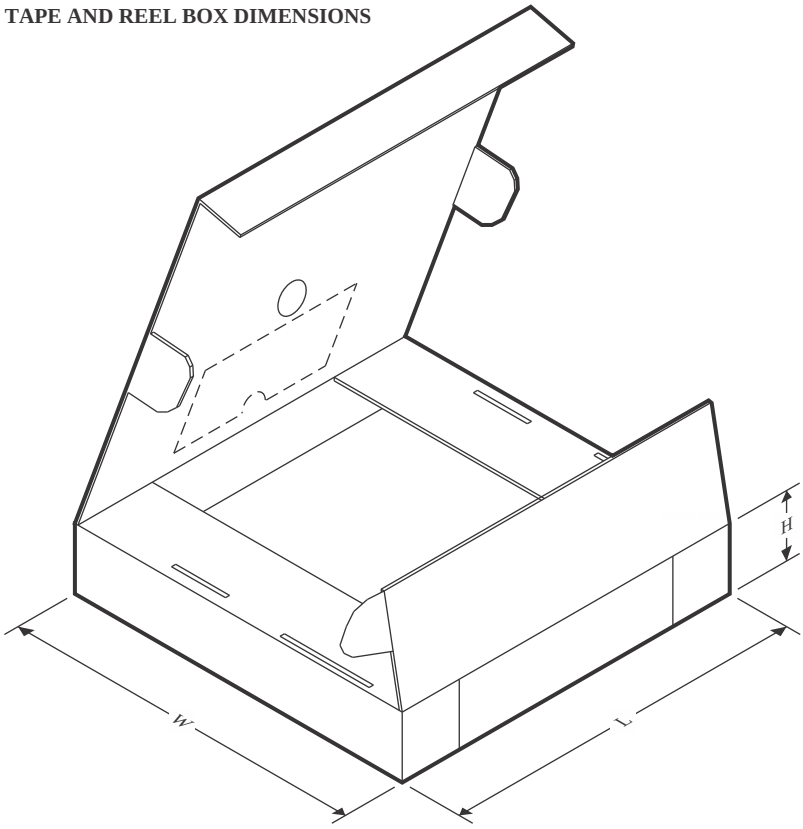
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
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	353.0	353.0	32.0

GENERIC PACKAGE VIEW

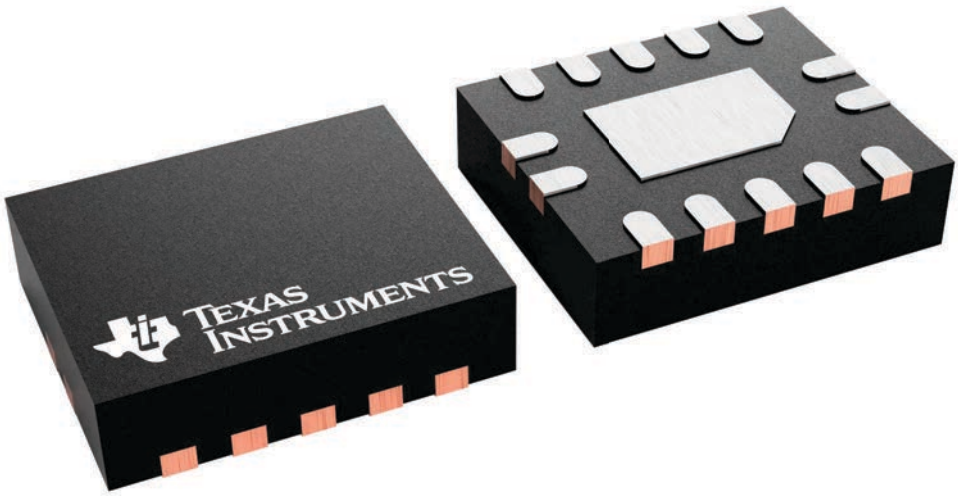
BQA 14

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.

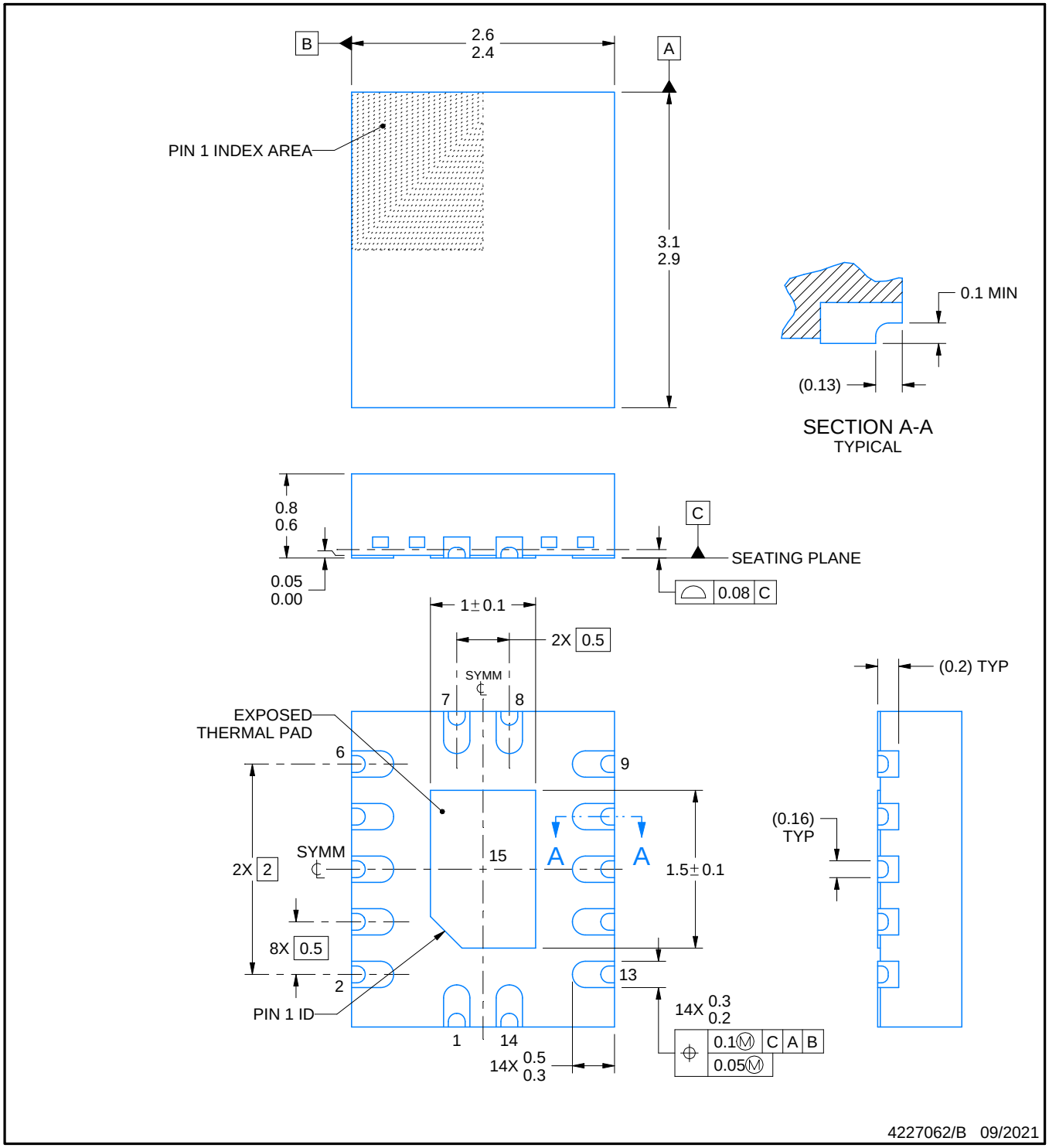


BQA0014B

PACKAGE OUTLINE

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

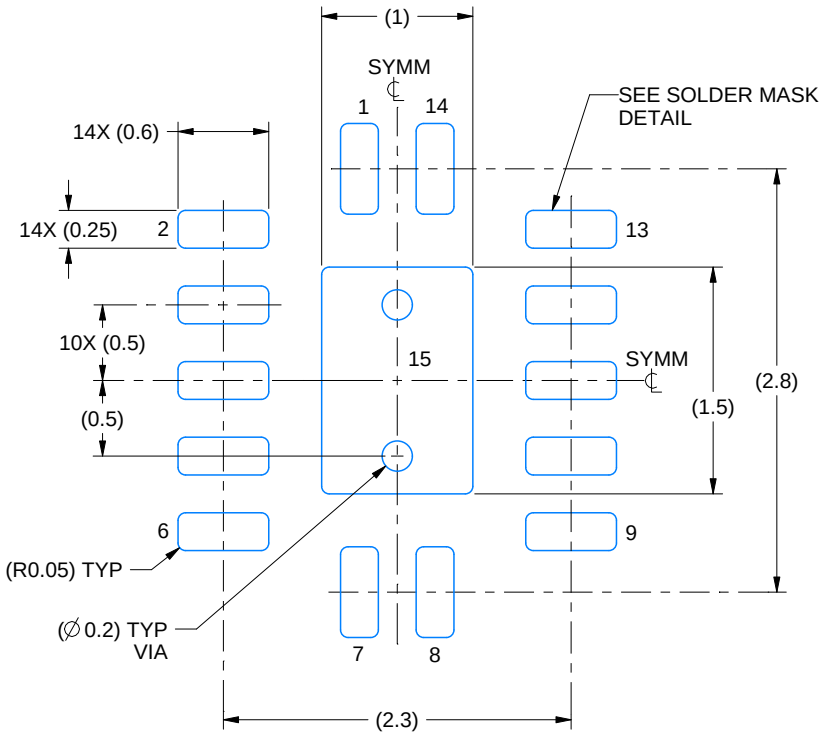
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

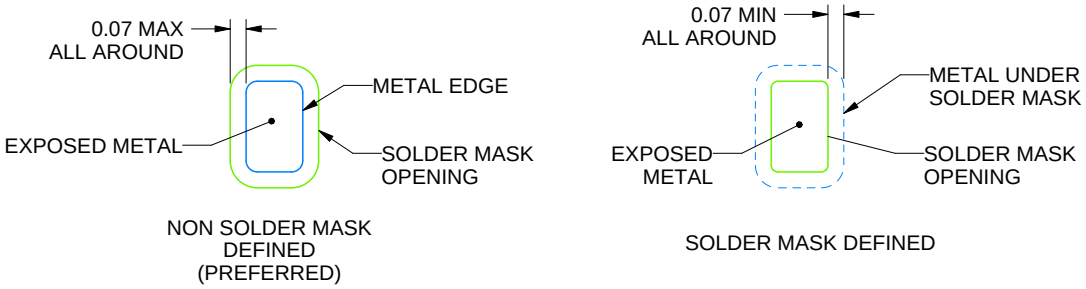
BQA0014B

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X

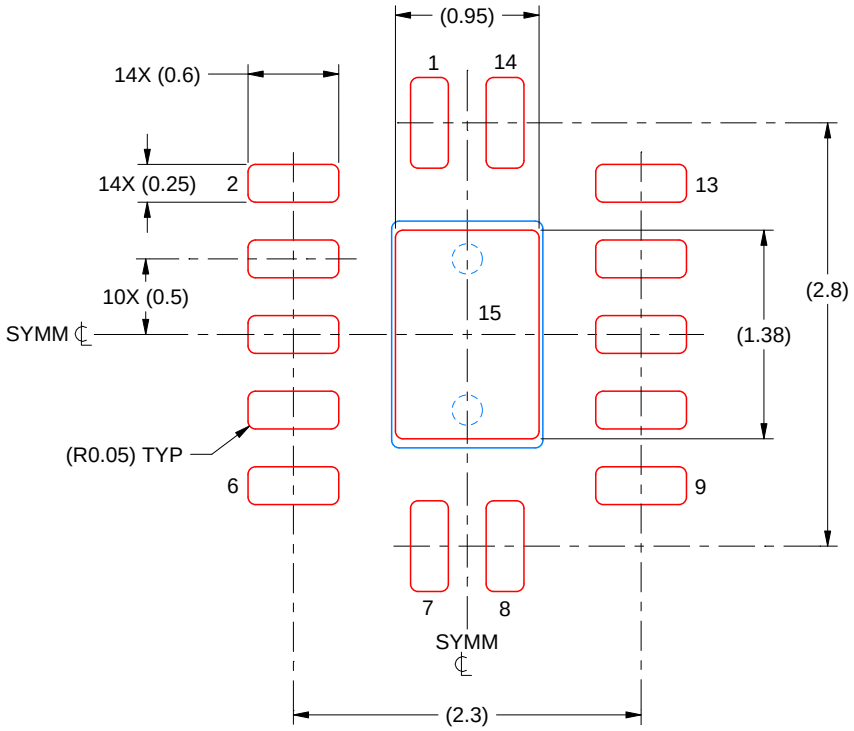


SOLDER MASK DETAILS

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/slua271).
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.



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)

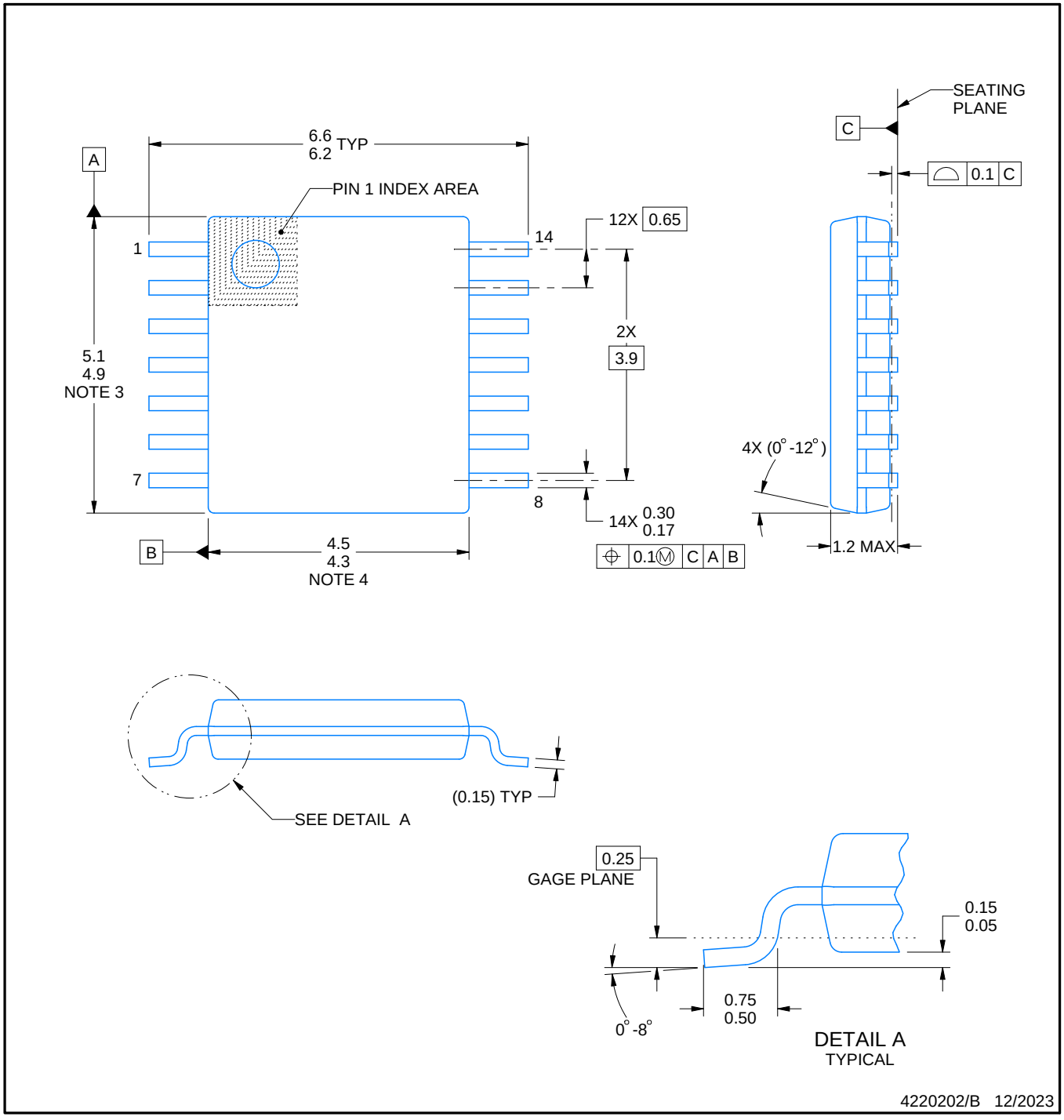
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGE OUTLINE

PW0014A

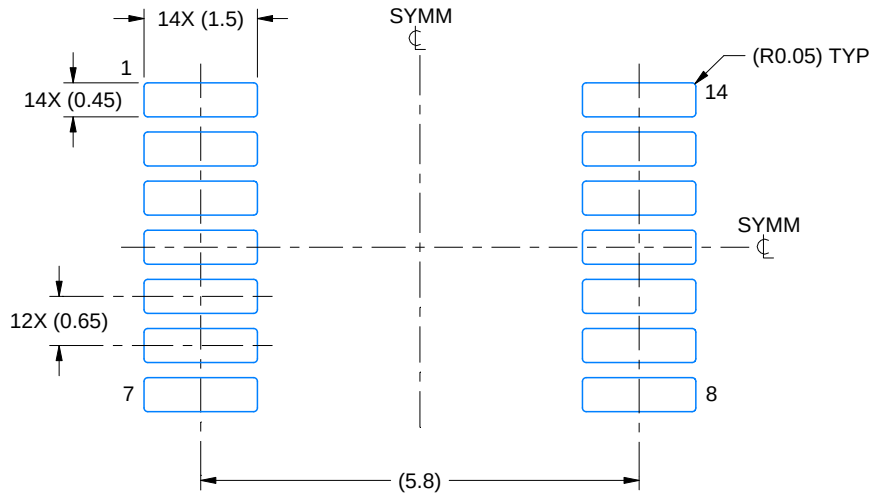
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

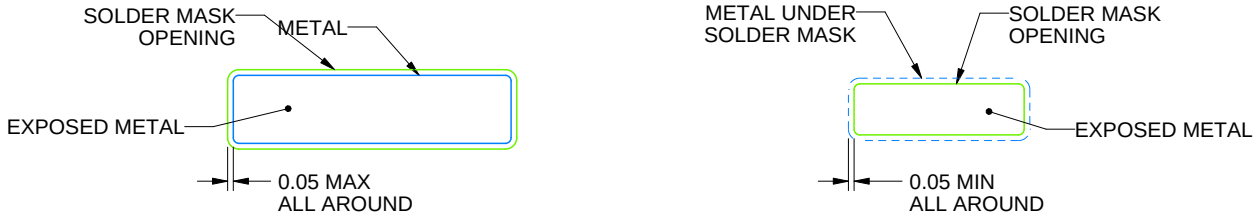


NOTES:

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

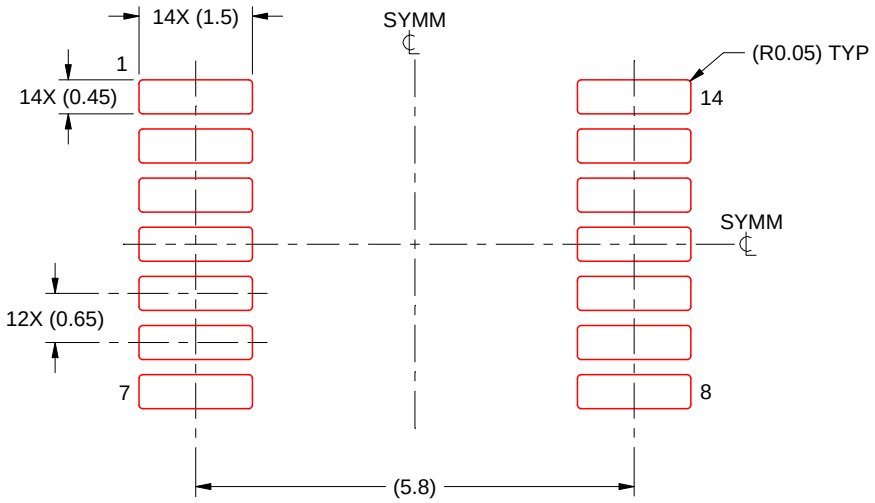


SOLDER MASK DETAILS

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.



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.

重要なお知らせと免責事項

TI は、技術データと信頼性データ (データシートを含みます)、設計リソース (リファレンス デザインを含みます)、アプリケーションや設計に関する各種アドバイス、Web ツール、安全性情報、その他のリソースを、欠陥が存在する可能性のある「現状のまま」提供しており、商品性および特定目的に対する適合性の黙示保証、第三者の知的財産権の非侵害保証を含むいかなる保証も、明示的または黙示的にかかわらず拒否します。

これらのリソースは、TI 製品を使用する設計の経験を積んだ開発者への提供を意図したものです。(1) お客様のアプリケーションに適した TI 製品の選定、(2) お客様のアプリケーションの設計、検証、試験、(3) お客様のアプリケーションに該当する各種規格や、その他のあらゆる安全性、セキュリティ、規制、または他の要件への確実な適合に関する責任を、お客様のみが単独で負うものとします。

上記の各種リソースは、予告なく変更される可能性があります。これらのリソースは、リソースで説明されている TI 製品を使用するアプリケーションの開発の目的でのみ、TI はその使用をお客様に許諾します。これらのリソースに関して、他の目的で複製することや掲載することは禁止されています。TI や第三者の知的財産権のライセンスが付与されている訳ではありません。お客様は、これらのリソースを自身で使用した結果発生するあらゆる申し立て、損害、費用、損失、責任について、TI およびその代理人を完全に補償するものとし、TI は一切の責任を拒否します。

TI の製品は、TI の販売条件 、 TI の総合的な品質ガイドライン 、 ti.com または TI 製品などに関連して提供される他の適用条件に従い提供されます。TI がこれらのリソースを提供することは、適用される TI の保証または他の保証の放棄の拡大や変更を意味するものではありません。 TI がカスタム、またはカスタマー仕様として明示的に指定していない限り、TI の製品は標準的なカタログに掲載される汎用機器です。

お客様がいかなる追加条項または代替条項を提案する場合も、TI はそれらに異議を唱え、拒否します。

Copyright © 2025, Texas Instruments Incorporated

最終更新日：2025 年 10 月