SNx4AC74 Dual Positive-Edge-Triggered D-Type Flip-Flops with Clear and Preset

1 Features

- 2V to 6V V_{CC} operation
- Inputs accept voltages to 6V
- Maximum t_{pd} of 10ns at 5V

2 Applications

- Convert a momentary switch to a toggle switch
- Divide a clock signal by 2 or 4

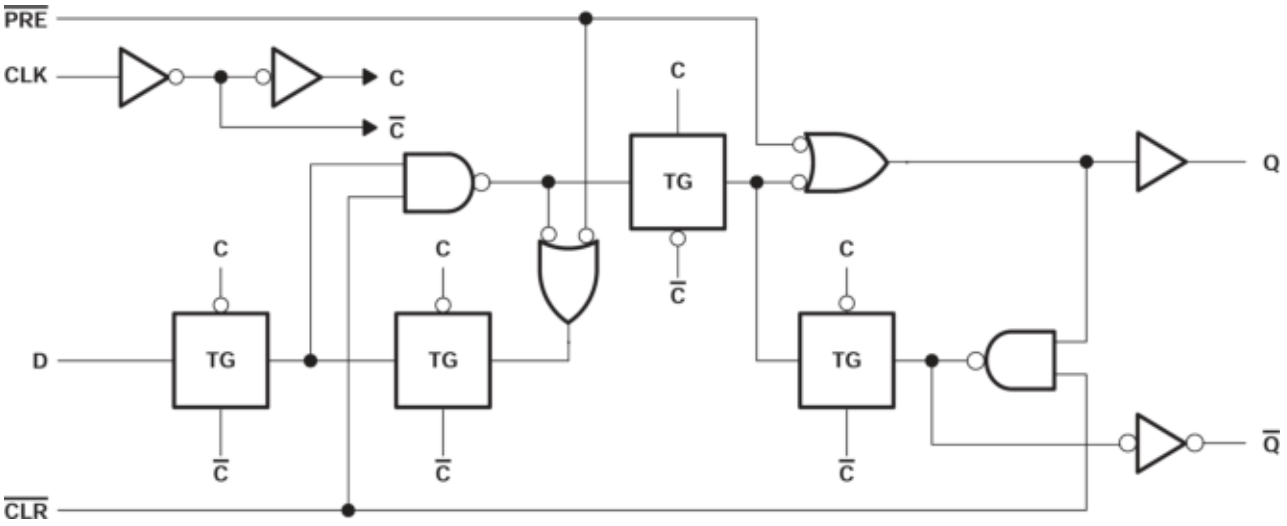
3 Description

The ’AC74 devices are dual positive-edge-triggered D-type flip-flops.

Device Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE (2)	BODY SIZE(3)
SNx4AC74	PW (TSSOP, 14)	5mm × 6.4mm	5mm × 4.40mm
	D (SOIC, 14)	8.65mm × 6mm	8.65mm × 3.9mm
	DB (SSOP, 14)	6.2mm × 7.8mm	6.2mm × 5.3mm
	N (PDIP, 14)	19.3mm × 9.4mm	19.3mm × 6.35mm
	NS (SOP, 14)	10.2mm × 7.8mm	10.3mm × 5.3mm
	BQA (WQFN, 14)	3mm × 2.5mm	3mm × 2.5mm

(1) For more information, see Section 10.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.
(3) The body size (length × width) is a nominal value and does not include pins.



Logic Diagram, Each Flip-flop (Positive Logic)

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4 Pin Configuration and Functions

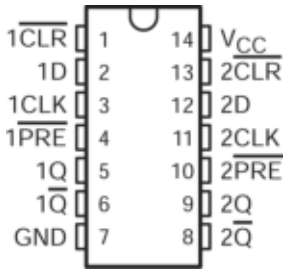
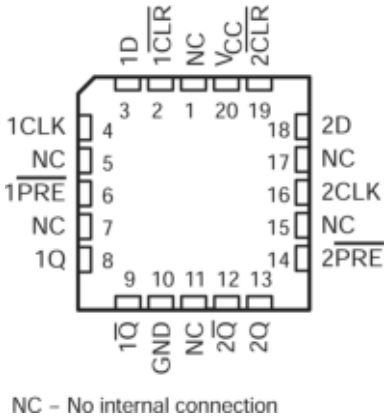


Figure 4-1. SN54AC74 J or W Package; SN74AC74 D, DB, N, NS, or PW Package (Top View)



NC – No internal connection

Figure 4-2. SN54AC74 FK Package (Top View)

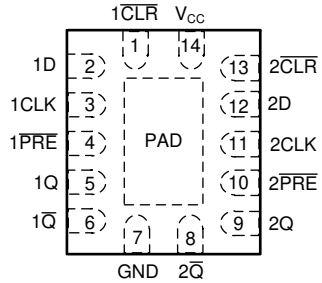


Figure 4-3. BQA Package, 14-Pin WQFN With Exposed Thermal Pad (Top View)

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
1 $\overline{CLR}$	1	I	Channel 1, Clear Input, Active Low
1D	2	I	Channel 1, Data Input
1CLK	3	I	Channel 1, Positive edge triggered clock input
1 $\overline{PRE}$	4	I	Channel 1, Preset Input, Active Low
1Q	5	O	Channel 1, Output
1 $\overline{Q}$	6	O	Channel 1, Inverted Output
GND	7	G	Ground
2 $\overline{Q}$	8	O	Channel 2, Inverted Output
2Q	9	O	Channel 2, Output
2 $\overline{PRE}$	10	I	Channel 2, Preset Input, Active Low
2CLK	11	I	Channel 2, Positive edge triggered clock input
2D	12	I	Channel 2, Data Input
2 $\overline{CLR}$	13	I	Channel 2, Clear Input, Active Low
V_{CC}	14	P	Positive Supply
Thermal Pad[2]		—	Thermal Pad

(1) I = Input, O = Output, I/O = Input or Output, G = Ground, P = Power
(2) BQA package only

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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	7	V
V_I (2)	Input voltage range		−0.5	V_{CC} + 0.5	V
V_O (2)	Output voltage range		−0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	(V_I < 0 or V_I > V_{CC})		±20	mA
I_{OK}	Output clamp current	(V_O < 0 or V_O > V_{CC})		±20	mA
I_O	Continuous output current	(V_O = 0 to V_{CC})		±50	mA
	Continuous current through V_{CC} or GND			±200	mA
T_{stg}	Storage temperature range		−65	150	°C

(1) Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. 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.

5.2 Recommended Operating Conditions

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

			SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2	6	2	6	V
V_{IH}	High-level input voltage	V_{CC} = 3 V	2.1		2.1		V
		V_{CC} = 4.5 V	3.15		3.15		
		V_{CC} = 5.5 V	3.85		3.85		
V_{IL}	Low-level input voltage	V_{CC} = 3 V		0.9		0.9	V
		V_{CC} = 4.5 V		1.35		1.35	
		V_{CC} = 5.5 V		1.65		1.65	
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 3 V		−12		−12	mA
		V_{CC} = 4.5 V		−24		−24	
		V_{CC} = 5.5 V		−24		−24	
I_{OL}	Low-level output current	VCC = 3 V		12		12	mA
		V_{CC} = 4.5 V		24		24	
		V_{CC} = 5.5 V		24		24	
$\Delta t/\Delta v$	Input transition rise or fall rate			8		8	ns/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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5.3 Thermal Information

THERMAL METRIC[1]		SNx4AC74						UNIT
		D (SOIC)	DB (SSOP)	N (PDIP)	NS (SO)	PW (TSSOP)	BQA (WQFN)	
		14 PINS	14 PINS	14 PINS	14 PINS	14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	119.9	96	80	76	145.7	91.3	°C/W

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

5.4 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS		V_{CC}	T_A = 25°C			SN54AC74		SN74AC74		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}		I_{OH} = −50 µA		3 V	2.9	4.49		2.9		2.9		V
				4.5 V	4.4	5.49		4.4		4.4		
				5.5 V	5.4	5.49		5.4		5.4		
		I_{OH} = −12 mA		3 V	2.56			2.4		2.46		
		I_{OH} = −24 mA		4.5 V	3.86			3.7		3.76		
				5.5 V	4.86			4.7		4.76		
		I_{OH} = −50 mA[1]		5.5 V				3.85				
		I_{OH} = −75 mA[1]		5.5 V						3.85		
V_{OL}		I_{OL} = 50 µA		3 V		0.002	0.1		0.1		0.1	V
				4.5 V		0.001	0.1		0.1		0.1	
				5.5 V		0.001	0.1		0.1		0.1	
		I_{OL} = 12 mA		3 V			0.36		0.5		0.44	
		I_{OL} = 24 mA		4.5 V			0.36		0.5		0.44	
				5.5 V			0.36		0.5		0.44	
		I_{OL} = 50 mA[1]		5.5 V					1.65			
		I_{OL} = 75 mA[1]		5.5 V							1.65	
I_I	Data pins	V_I = V_{CC} or GND		5.5 V			±0.1		±1		±1	µA
	Control pins						±0.1		±1		±1	
I_{CC}		V_I = V_{CC} or GND,	I_O = 0	5.5 V			2		40		20	µA
C_i		V_I = V_{CC} or GND		5 V		3						pF

(1) Not more than one output should be tested at a time, and the duration of the test should not exceed 2 ms.

5.5 Timing Requirements, V_{CC} = 3.3 V ± 0.3 V

over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Load Circuit and Voltage Waveforms)

			T_A = 25°C		SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			100		70		95	MHz
t_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ low	5.5		8		7		ns
		CLK	5.5		8		7		
t_{su}	Setup time, data before CLK↑	Data	4		5		4.5		ns
		$\overline{PRE}$ or $\overline{CLR}$ inactive	0		0.5		0		

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over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Load Circuit and Voltage Waveforms)

		T_A = 25°C		SN54AC74		SN74AC74		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t_h	Hold time, data after CLK↑	0.5		0.5		0.5		ns

5.6 Timing Requirements, V_{CC} = 5 V ± 0.5 V

over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Load Circuit and Voltage Waveforms)

			T_A = 25°C		SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			140		95		125	MHz
t_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ low	4.5		5.5		5		ns
		CLK	4.5		5.5		5		
t_{su}	Setup time, data before CLK↑	Data	3		4		3		ns
		$\overline{PRE}$ or $\overline{CLR}$ inactive	0		0.5		0		
t_h	Hold time, data after CLK↑		0.5		0.5		0.5		ns

5.7 Switching Characteristics, V_{CC} = 3.3 V ± 0.3 V

over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Load Circuit and Voltage Waveforms)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			SN54AC74		SN74AC74		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			100	125		70		95		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$	3.5	8	12	1	13	2.5	13	ns
t_{PHL}			4	10.5	12	1	14	3.5	13.5	
t_{PLH}	CLK	Q or $\overline{Q}$	4.5	8	13.5	1	17.5	4	16	ns
t_{PHL}			3.5	8	14	1	13.5	3.5	14.5	

5.8 Switching Characteristics, V_{CC} = 5 V ± 0.5 V

over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Load Circuit and Voltage Waveforms)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			SN54AC74		SN74AC74		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			140	160		95		125		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$	2.5	6	9	1	9.5	2	10	ns
t_{PHL}			3	8	9.5	1	10.5	2.5	10.5	
t_{PLH}	CLK	Q or $\overline{Q}$	3.5	6	10	1	12	3	10.5	ns
t_{PHL}			2.5	6	10	1	10	2.5	10.5	

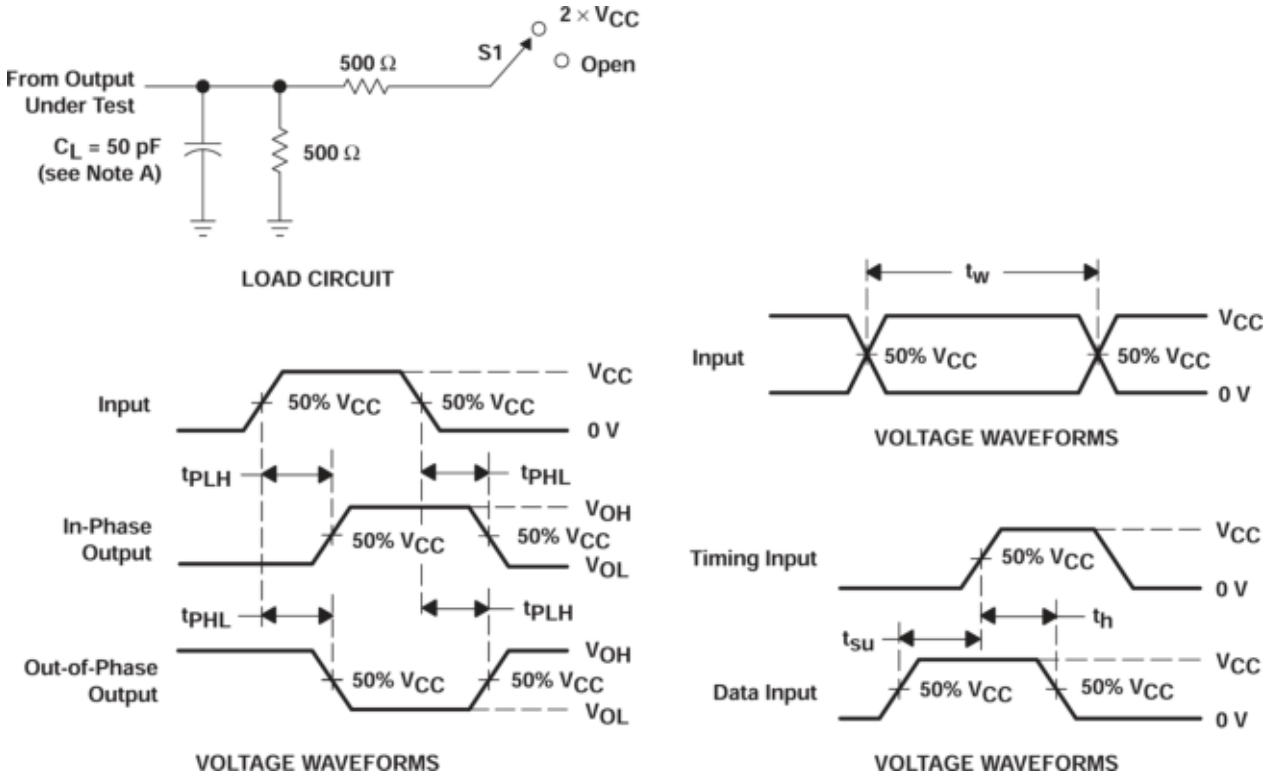
5.9 Operating Characteristics

V_{CC} = 3.3 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance	C_L = 50 pF,	f = 1 MHz	45	pF

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6 Parameter Measurement Information



A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r v 2.5 ns, t_f v 2.5 ns.
C. The outputs are measured one at a time with one input transition per measurement.

Figure 6-1. Load Circuit and Voltage Waveforms

TEST	S1
t_{PLH}/t_{PHL}	Open

7 Detailed Description

7.1 Overview

The SNx4AC74 includes two independent D-type flip-flops. Each channel has independent asynchronous preset ($\overline{PRE}$) and clear ($\overline{CLR}$) inputs. Each channel has inverted ($\overline{Q}$) and non-inverted (Q) outputs.

7.2 Functional Block Diagram

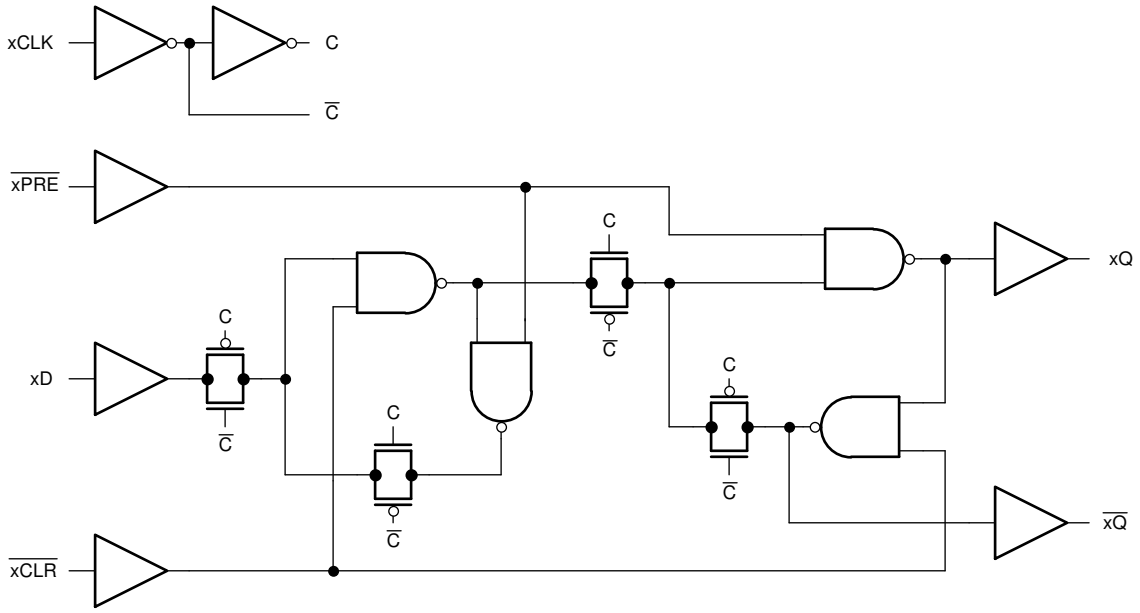


Figure 7-1. Logic Diagram (Positive Logic) for one channel of SNx4AC74

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7.3 Feature Description

7.3.1 Balanced CMOS Push-Pull Outputs

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

Unused push-pull CMOS outputs must be left disconnected.

7.3.2 Latching Logic

This device includes latching logic circuitry. Latching circuits commonly include D-type latches and D-type flip-flops, but include all logic circuits that act as volatile memory.

When the device is powered on, the state of each latch is unknown. There is no default state for each latch at start-up.

The output state of each latching logic circuit only remains stable as long as power is applied to the device within the supply voltage range specified in the *Recommended Operating Conditions* table.

7.3.3 Standard CMOS Inputs

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

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

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

7.3.4 Clamp Diode Structure

As shown in Figure 7-2, the inputs and outputs to this device have both positive and negative clamping diodes.

CAUTION

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

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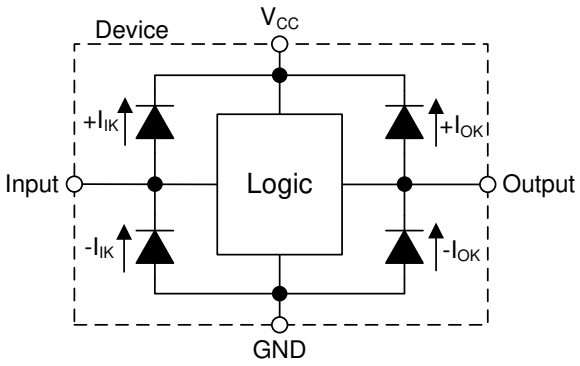


Figure 7-2. Electrical Placement of Clamping Diodes for Each Input and Output

7.4 Device Functional Modes

Table 7-1. Function Table

INPUTS(1)				OUTPUTS	
$\overline{PRE}$	$\overline{CLR}$	CLK	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H(2)	H(2)
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q_0	$\overline{Q}_0$

(1) H = High Voltage Level, L = Low Voltage Level, X = Don't Care
(2) This configuration is unstable; does not persist when either $\overline{PRE}$ or $\overline{CLR}$ returns to it's inactive (high) level.

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8 Application and Implementation

Note

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

8.1 Application Information

Toggle switches are typically large, mechanically complex and relatively expensive. It is desirable to use a momentary switch instead because they are small, mechanically simple and low cost. Some systems require a toggle switch's functionality but are space or cost constrained and must use a momentary switch instead.

If the data input (D) of the D-type flip-flop is tied to the inverted output ($\overline{Q}$), then each clock pulse will cause the value at the output (Q) to toggle. The momentary switch can be debounced and connected through a Schmitt-trigger buffer to the clock input (CLK) to toggle the output.

This application also utilizes a power-on reset circuit so that the output always starts in the LOW state when power is applied.

8.2 Typical Application

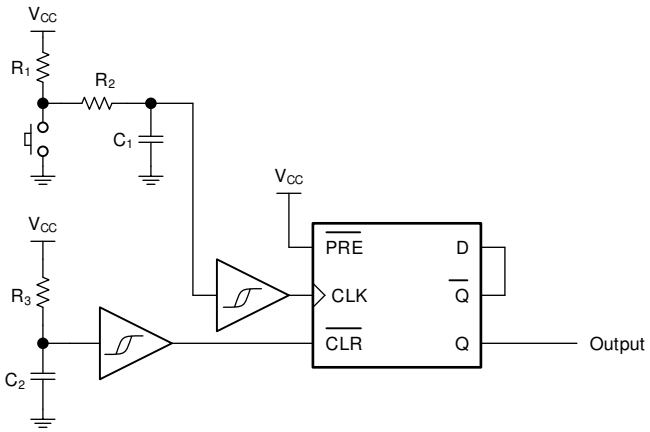


Figure 8-1. Typical Application Schematic

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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 of the device as described in the *Electrical Characteristics* section.

The positive voltage supply must be capable of sourcing current equal to the total current to be sourced by all outputs of the SNx4AC74 plus the maximum static supply current, I_{CC}, listed in the *Electrical Characteristics*, and any transient current required for switching. The logic device can only source as much current that is provided by the positive supply source. Ensure the maximum total current through V_{CC} listed in the *Absolute Maximum Ratings* is not exceeded.

The ground must be capable of sinking current equal to the total current to be sunk by all outputs of the SNx4AC74 plus the maximum supply current, I_{CC}, listed in the *Electrical Characteristics*, and any transient current required for switching. The logic device can only sink as much current that can be sunk into its ground connection. Ensure the maximum total current through GND listed in the *Absolute Maximum Ratings* is not exceeded.

The SNx4AC74 can drive a load with a total capacitance less than or equal to 50pF while still meeting all of the data sheet specifications. Larger capacitive loads can be applied; however, it is not recommended to exceed 50pF.

The SNx4AC74 can drive a load with total resistance described by $R_L \geq V_O / I_O$, with the output voltage and current defined in the *Electrical Characteristics* table with V_{OH} and V_{OL}. When outputting in the HIGH state, the output voltage in the equation is defined as the difference between the measured output voltage and the supply voltage at the V_{CC} pin.

Total power consumption can be calculated using the information provided in *CMOS Power Consumption and Cpd Calculation*.

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

CAUTION

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

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8.2.1.2 Input Considerations

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

Unused inputs must be terminated to either V_{CC} or ground. The unused inputs 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 will 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 drive current of the controller, leakage current into the SNx4AC74 (as specified in the *Electrical Characteristics*), and the desired input transition rate limits the resistor size. A 10kΩ resistor value is often used due to these factors.

The SNx4AC74 has CMOS inputs and thus requires fast input transitions to operate correctly, as defined in the *Recommended Operating Conditions* table. Slow input transitions can cause oscillations, additional power consumption, and reduction in device reliability.

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

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

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

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

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

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

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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 *Layout* section.
2. Ensure the capacitive load at the output is ≤ 50pF. This is not a hard limit; by design, however, it will optimize performance. This can be accomplished by providing short, appropriately sized traces from the SNx4AC74 to one or more of the receiving devices.
3. Ensure the resistive load at the output is larger than (V_{CC} / $I_{O(max)}$)Ω. Doing this will prevent the maximum output current from the *Absolute Maximum Ratings* from being violated. Most CMOS inputs have a resistive load measured in MΩ; much larger than the minimum calculated previously.
4. Thermal issues are rarely a concern for logic gates; the power consumption and thermal increase, however, can be calculated using the steps provided in the application report, *CMOS Power Consumption and Cpd Calculation*.

8.2.3 Application Curves

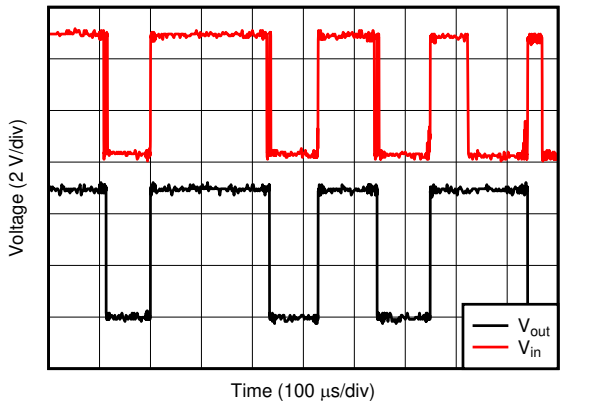


Figure 8-2. Waveform for Non-Debounced Switch

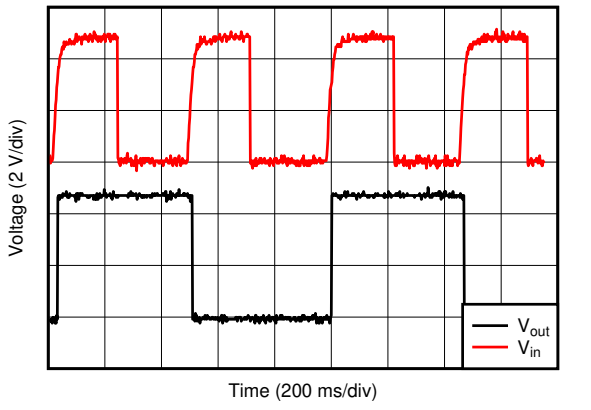


Figure 8-3. Waveform for Debounced Switch

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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 good bypass capacitor to prevent power disturbance. A 0.1µF capacitor is recommended for this device. It is acceptable to parallel multiple bypass capacitors 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.

8.4 Layout

8.4.1 Layout Guidelines

- Bypass capacitor placement
  - Place near the positive supply terminal of the device
  - Provide an electrically short ground return path
  - Use wide traces to minimize impedance
  - Keep the device, capacitors, and traces on the same side of the board whenever possible
- Signal trace geometry
  - 8mil to 12mil trace width
  - Lengths less than 12cm to minimize transmission line effects
  - Avoid 90° corners for signal traces
  - Use an unbroken ground plane below signal traces
  - Flood fill areas around signal traces with ground
  - Parallel traces must be separated by at least 3x dielectric thickness
  - For traces longer than 12cm
    - Use impedance controlled traces
    - Source-terminate using a series damping resistor near the output
    - Avoid branches; buffer each signal that must branch separately

8.4.2 Layout Example

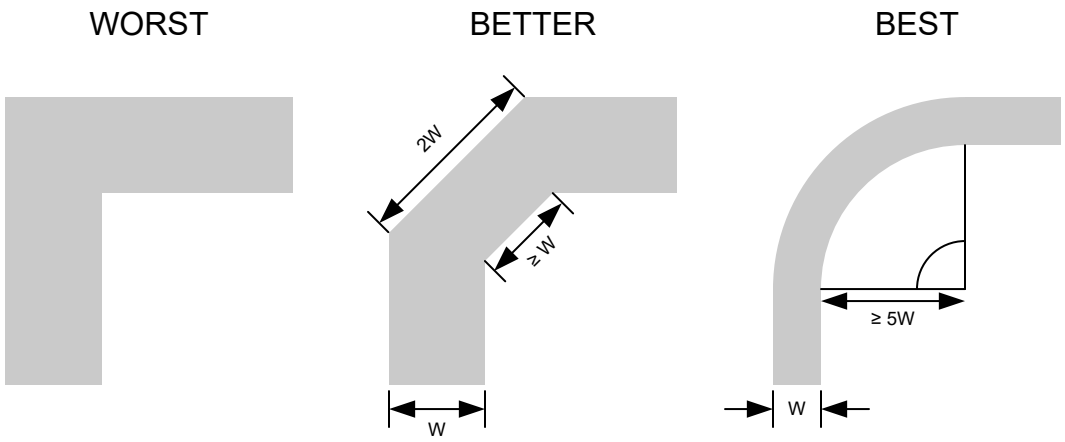


Figure 8-4. Example Trace Corners for Improved Signal Integrity

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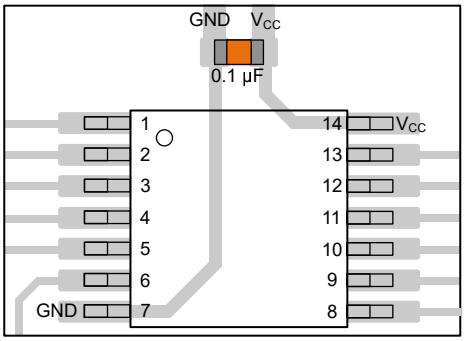


Figure 8-5. Example Bypass Capacitor Placement for TSSOP and Similar Packages

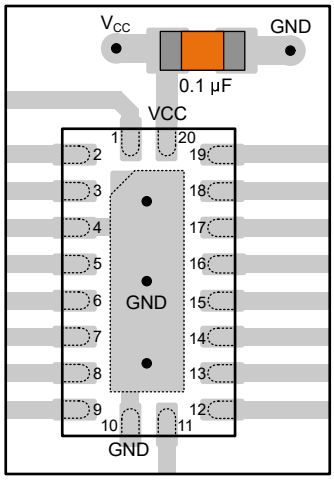


Figure 8-6. Example Bypass Capacitor Placement for WQFN and Similar Packages

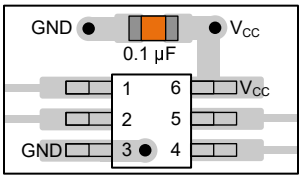


Figure 8-7. Example Bypass Capacitor Placement for SOT, SC70 and Similar Packages

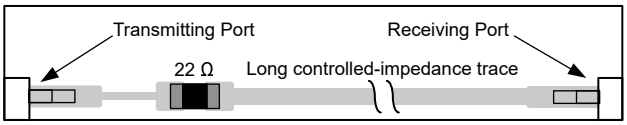


Figure 8-8. Example Damping Resistor Placement for Improved Signal Integrity

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9 Device and Documentation Support

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

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, *CMOS Power Consumption and C_{pd} Calculation* application report
- Texas Instruments, *Designing With Logic* application report
- Texas Instruments, *Thermal Characteristics of Standard Linear and Logic (SLL) Packages and Devices* application report

9.2 Receiving Notification of Documentation Updates

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

9.3 Support Resources

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

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

9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

9.5 Electrostatic Discharge Caution



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

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

9.6 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

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

Changes from Revision G (July 2024) to Revision H (June 2025)	Page
• Added BQA package to *Device Information*	1
• Added BQA package to *Pin Configuration and Functions*	3
• Added BQA package to *Thermal Information*	5

Changes from Revision F (October 2003) to Revision G (July 2024)	Page
• Added *Device Information* table, *Pin Functions* table, *Thermal Information* table, *Device Functional Modes, Application and Implementation* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section	1

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• Updated RθJA values: D = 86 to 119.9, PW = 113 to 145.7, all values in °C/W..... 5

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.

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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)
5962-88520012A	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-88520012A SNJ54AC 74FK
5962-8852001CA	Active	Production	CDIP (J) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001CA SNJ54AC74J
5962-8852001DA	Active	Production	CFP (W) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001DA SNJ54AC74W
5962-8852001VDA	Active	Production	CFP (W) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001VDA SNV54AC74W
5962-8852001VDA.A	Active	Production	CFP (W) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001VDA SNV54AC74W
SN74AC74BQAR	Active	Production	WQFN (BQA) | 14	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74D	Obsolete	Production	SOIC (D) | 14	-	-	Call TI	Call TI	-40 to 85	AC74
SN74AC74DBR	Active	Production	SSOP (DB) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74DBR.A	Active	Production	SSOP (DB) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74DR	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74DR.A	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74N	NRND	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	SN74AC74N
SN74AC74N.A	NRND	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	SN74AC74N
SN74AC74NE4	NRND	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	SN74AC74N
SN74AC74NSR	Active	Production	SOP (NS) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74NSR.A	Active	Production	SOP (NS) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74PW	Obsolete	Production	TSSOP (PW) | 14	-	-	Call TI	Call TI	-40 to 85	AC74
SN74AC74PWR	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74PWR.A	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74PWRG4	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74
SN74AC74PWRG4.A	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AC74

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)
SNJ54AC74FK	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-88520012A SNJ54AC 74FK
SNJ54AC74FK.A	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-88520012A SNJ54AC 74FK
SNJ54AC74J	Active	Production	CDIP (J) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001CA SNJ54AC74J
SNJ54AC74J.A	Active	Production	CDIP (J) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001CA SNJ54AC74J
SNJ54AC74W	Active	Production	CFP (W) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001DA SNJ54AC74W
SNJ54AC74W.A	Active	Production	CFP (W) | 14	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8852001DA SNJ54AC74W

(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 SN54AC74, SN54AC74-SP, SN74AC74 :

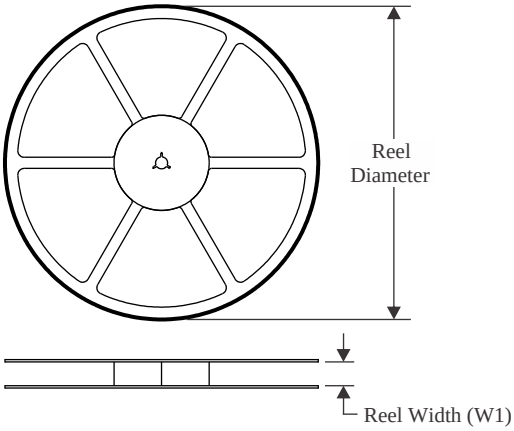
- Catalog : SN74AC74, SN54AC74
- Automotive : SN74AC74-Q1, SN74AC74-Q1
- Enhanced Product : SN74AC74-EP, SN74AC74-EP
- Military : SN54AC74
- Space : SN54AC74-SP

NOTE: Qualified Version Definitions:

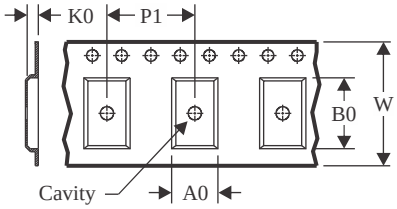
- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION

REEL DIMENSIONS

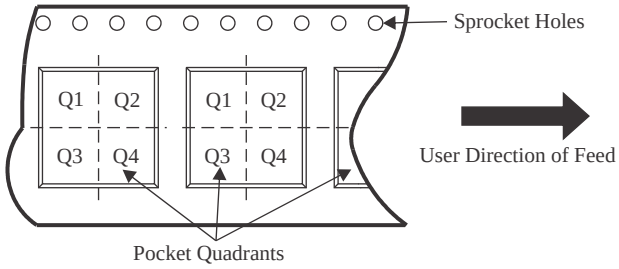


TAPE DIMENSIONS



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

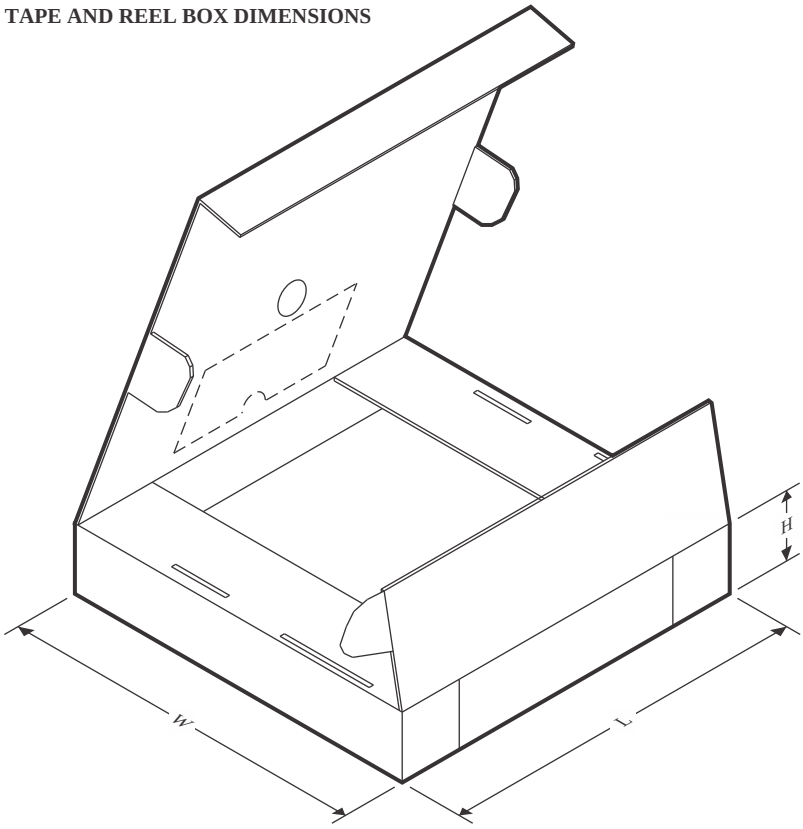
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74AC74BQAR	WQFN	BQA	14	3000	180.0	12.4	2.8	3.3	1.1	4.0	12.0	Q1
SN74AC74DBR	SSOP	DB	14	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1
SN74AC74DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74AC74NSR	SOP	NS	14	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
SN74AC74PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AC74PWRG4	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

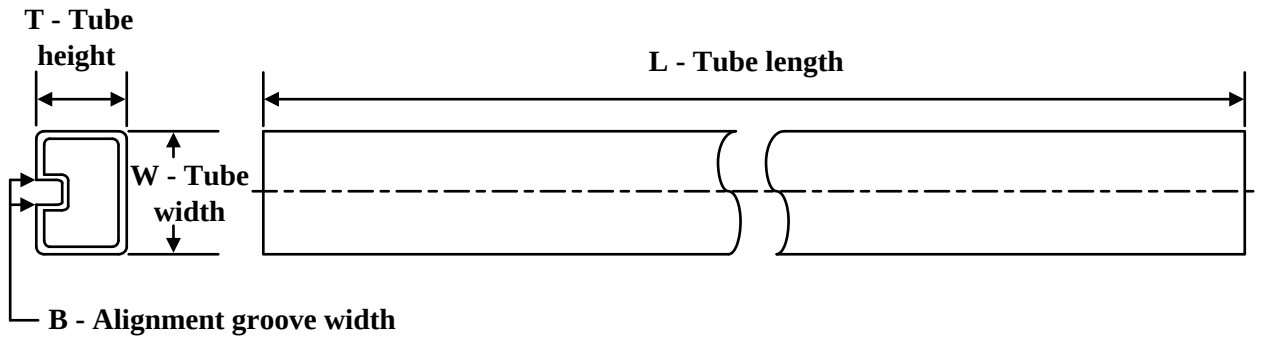
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AC74BQAR	WQFN	BQA	14	3000	210.0	185.0	35.0
SN74AC74DBR	SSOP	DB	14	2000	353.0	353.0	32.0
SN74AC74DR	SOIC	D	14	2500	353.0	353.0	32.0
SN74AC74NSR	SOP	NS	14	2000	353.0	353.0	32.0
SN74AC74PWR	TSSOP	PW	14	2000	353.0	353.0	32.0
SN74AC74PWRG4	TSSOP	PW	14	2000	353.0	353.0	32.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-88520012A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-8852001DA	W	CFP	14	25	506.98	26.16	6220	NA
5962-8852001VDA	W	CFP	14	25	506.98	26.16	6220	NA
5962-8852001VDA.A	W	CFP	14	25	506.98	26.16	6220	NA
SN74AC74N	N	PDIP	14	25	506	13.97	11230	4.32
SN74AC74N	N	PDIP	14	25	506	13.97	11230	4.32
SN74AC74N.A	N	PDIP	14	25	506	13.97	11230	4.32
SN74AC74N.A	N	PDIP	14	25	506	13.97	11230	4.32
SN74AC74NE4	N	PDIP	14	25	506	13.97	11230	4.32
SN74AC74NE4	N	PDIP	14	25	506	13.97	11230	4.32
SNJ54AC74FK	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54AC74FK.A	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54AC74W	W	CFP	14	25	506.98	26.16	6220	NA
SNJ54AC74W.A	W	CFP	14	25	506.98	26.16	6220	NA

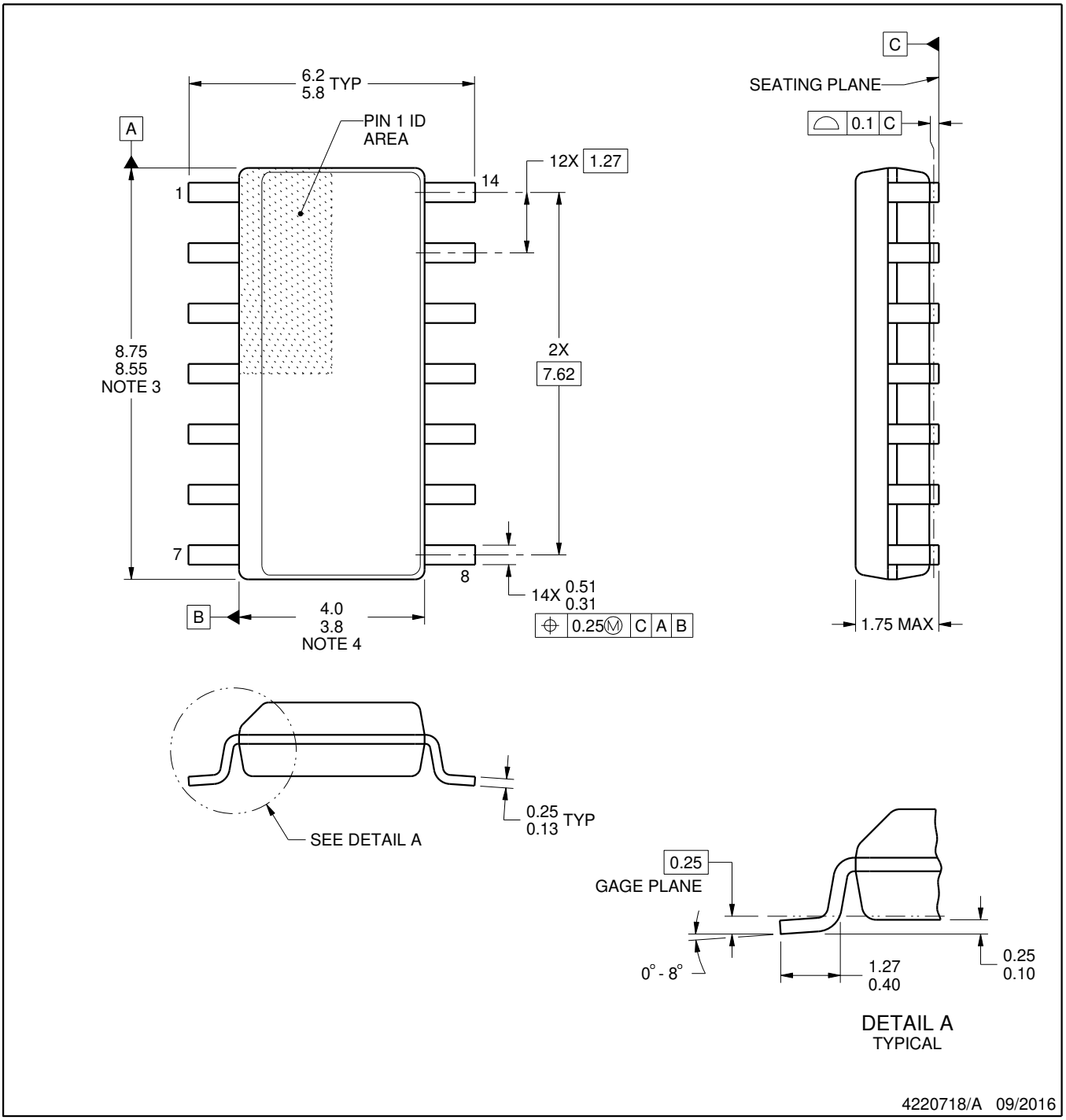


PACKAGE OUTLINE

D0014A

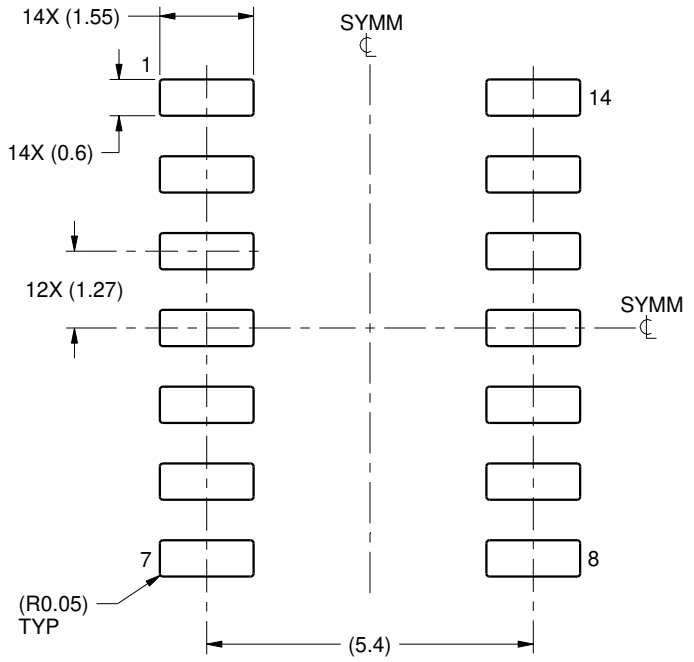
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

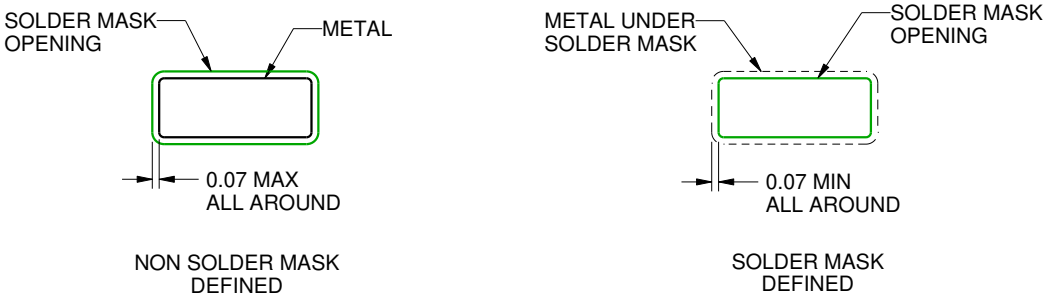


NOTES:

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.



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

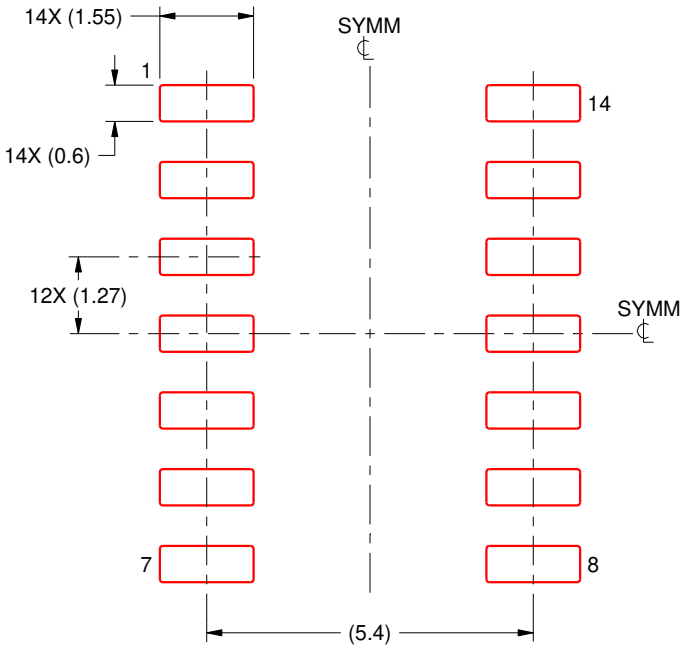
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.

GENERIC PACKAGE VIEW

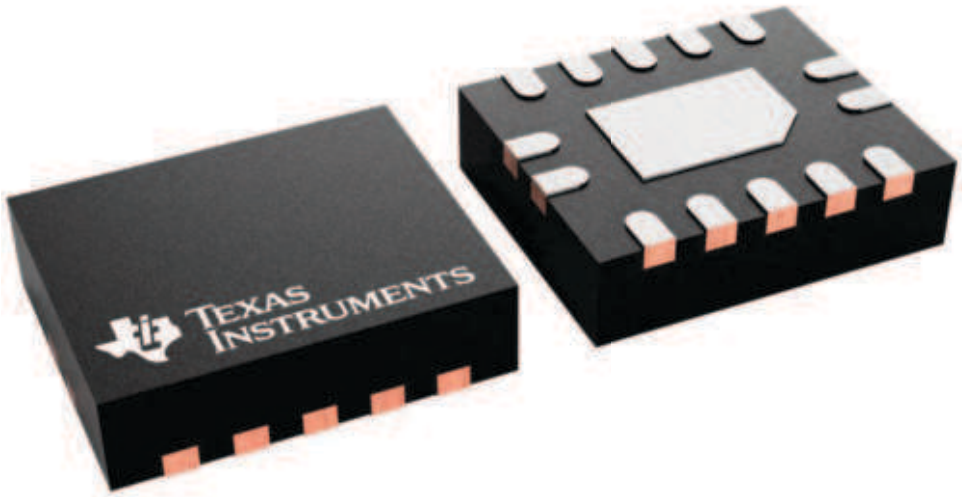
BQA 14

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.



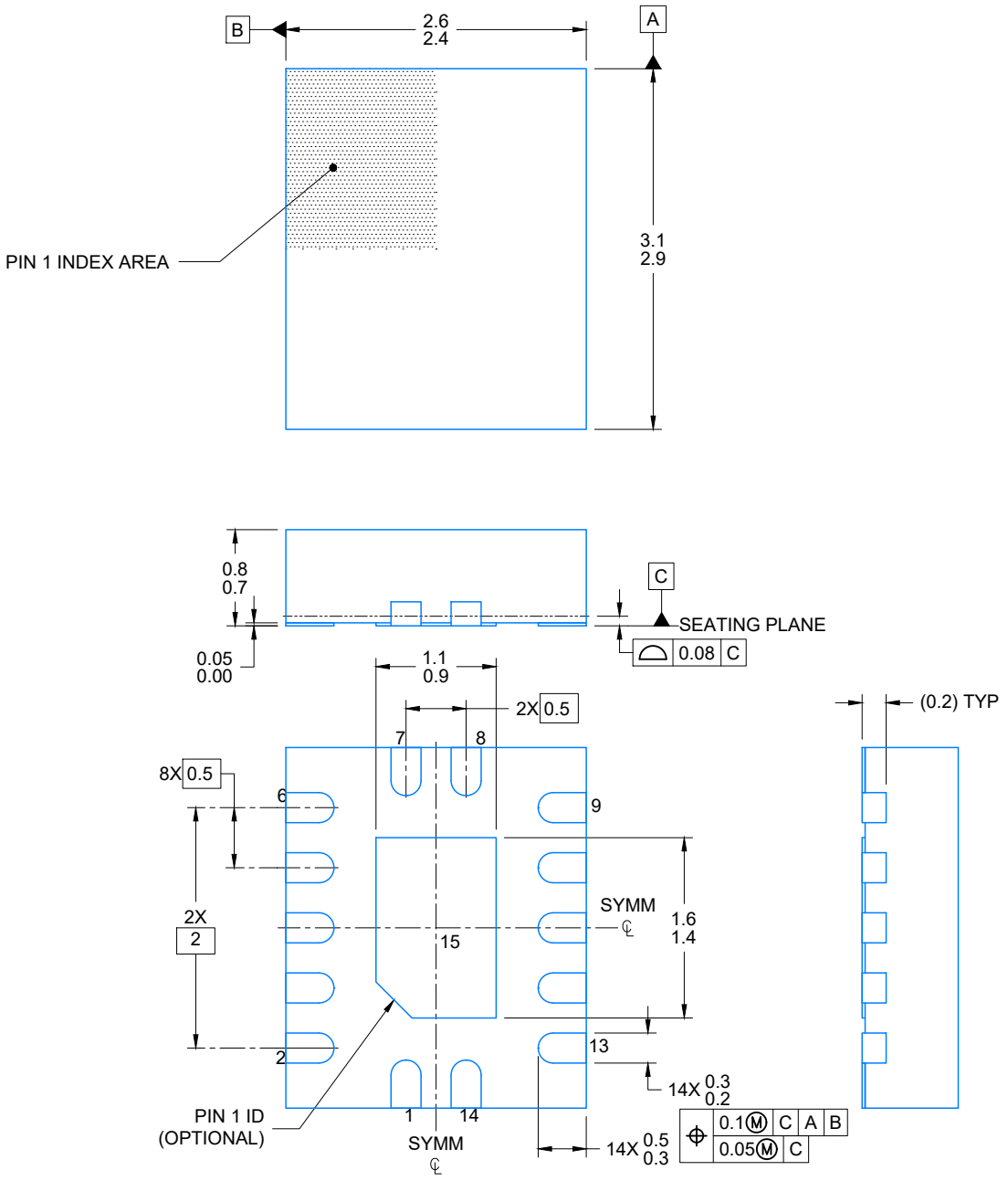
4227145/A

PACKAGE OUTLINE

BQA0014A

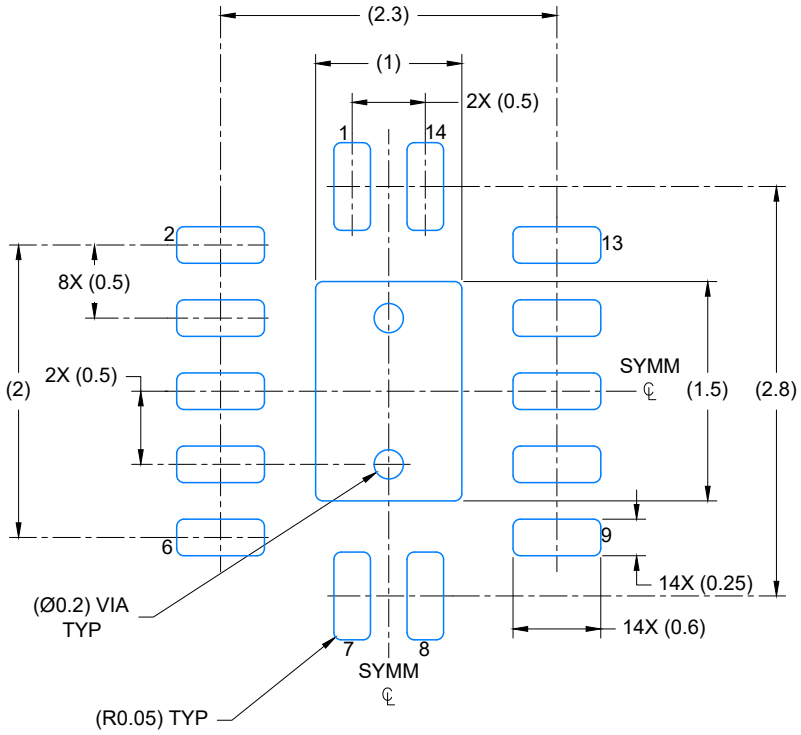
WQFN - 0.8 mm max height

PLASTIC QUAD FLAT PACK-NO LEAD

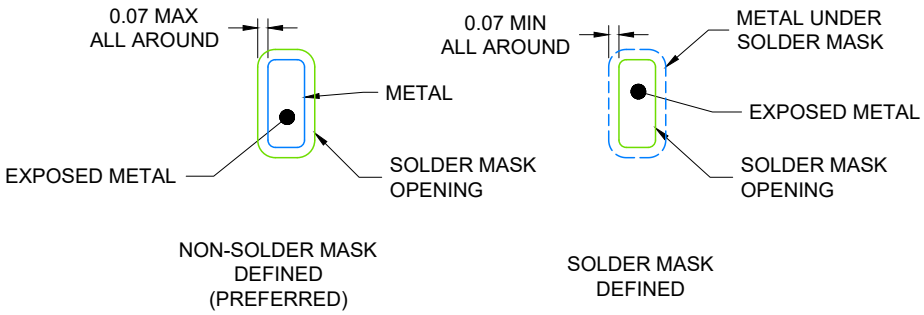


NOTES:

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 optimal thermal and mechanical performance.



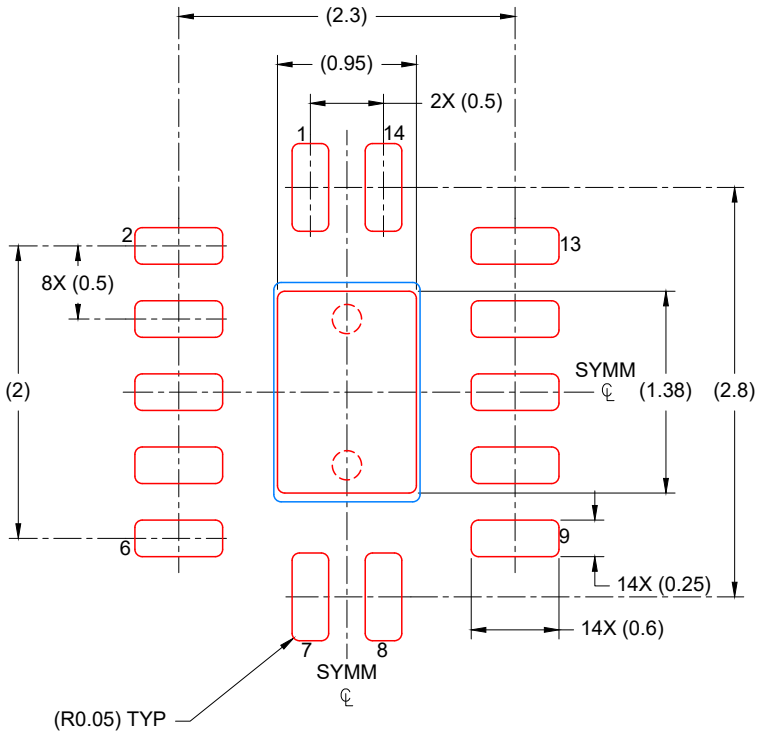
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224636/A 11/2018

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

EXPOSED PAD
88% PRINTED COVERAGE BY AREA
SCALE: 20X

4224636/A 11/2018

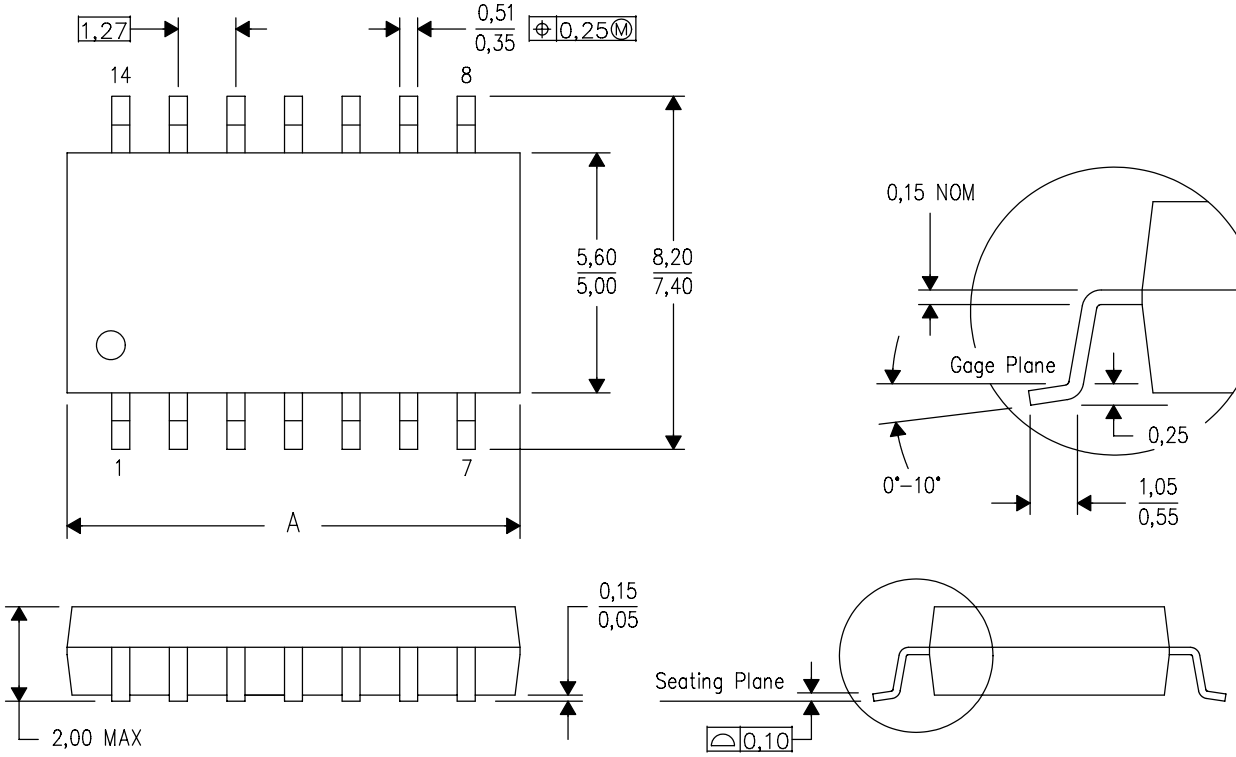
NOTES: (continued)

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

MECHANICAL DATA

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14-PINS SHOWN

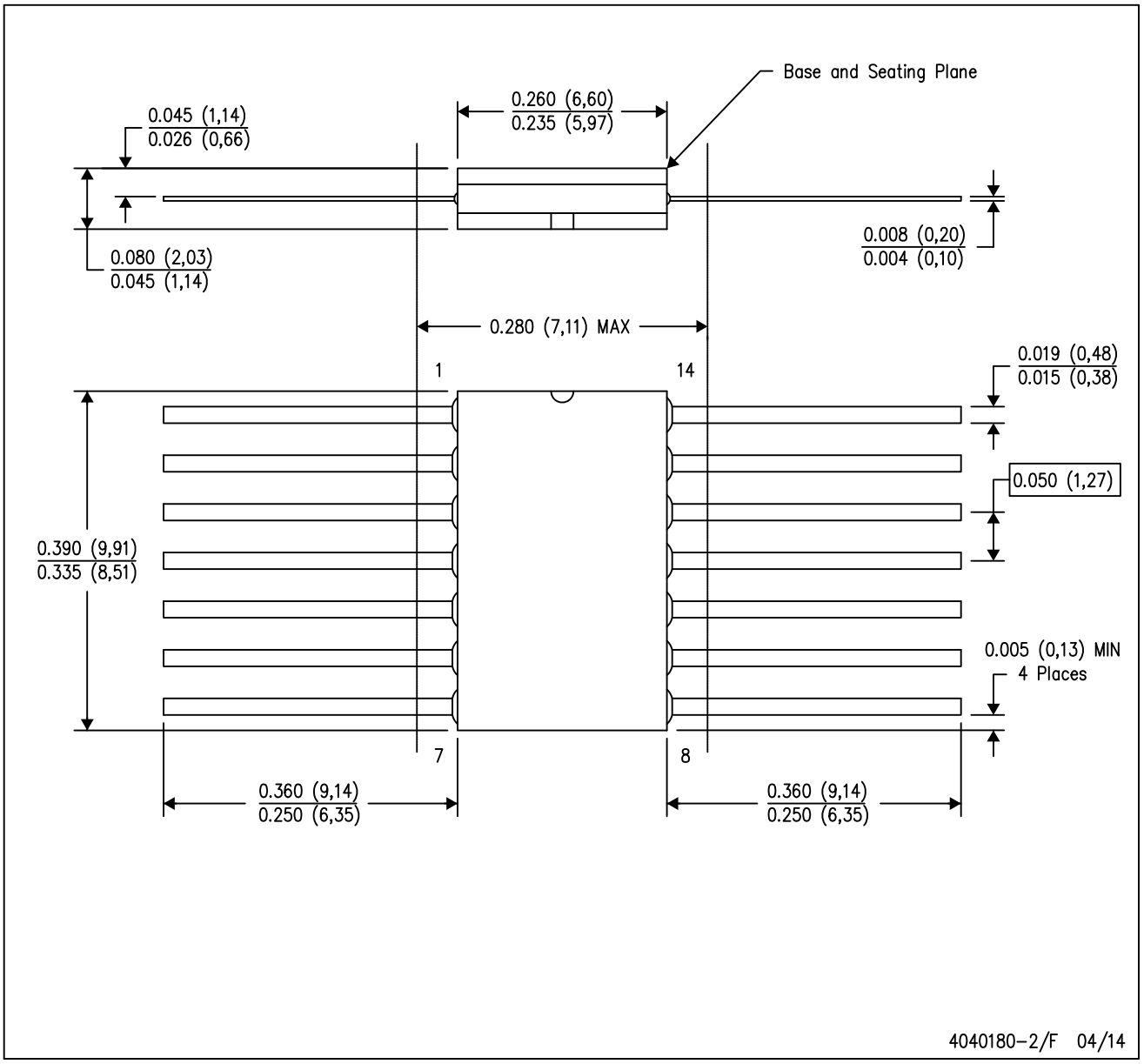


DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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

W (R–GDFP–F14) CERAMIC DUAL FLATPACK



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

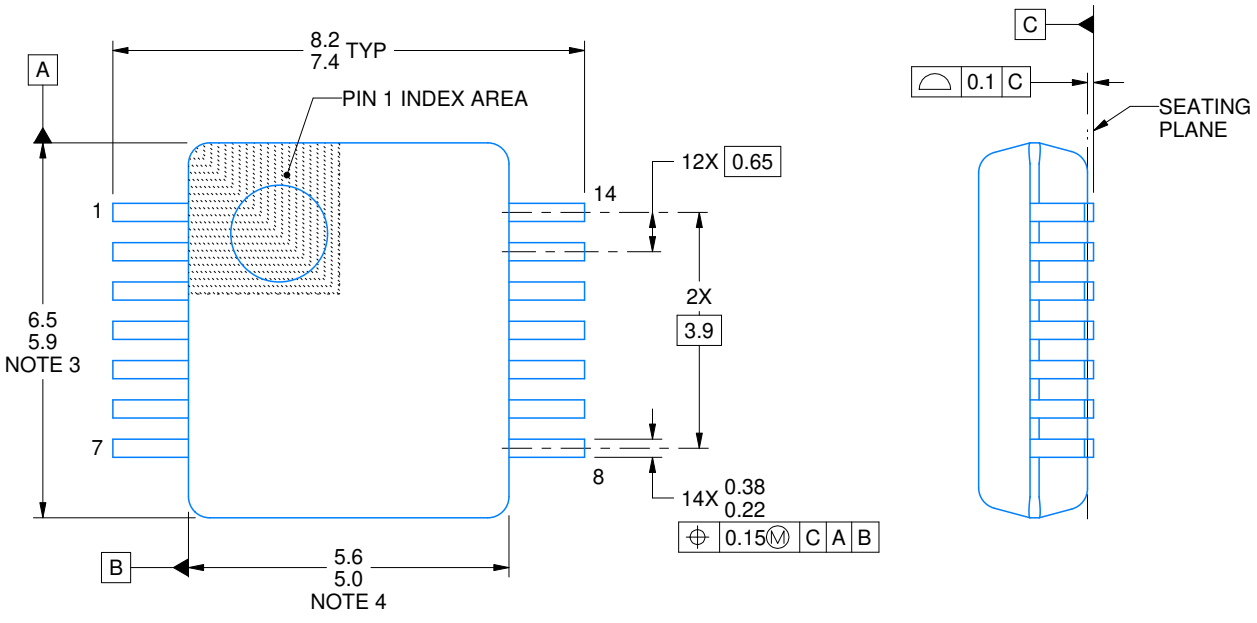
DB0014A

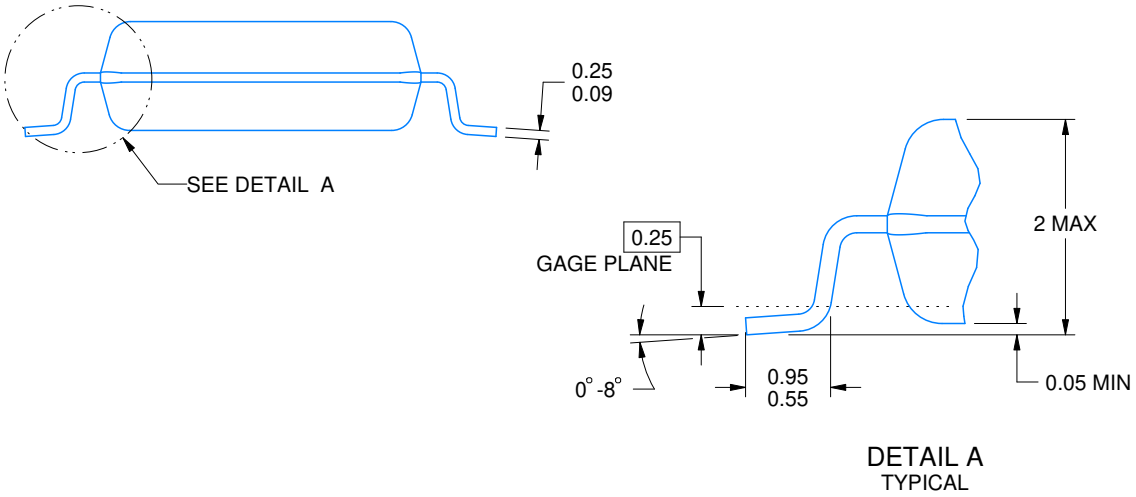


PACKAGE OUTLINE

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



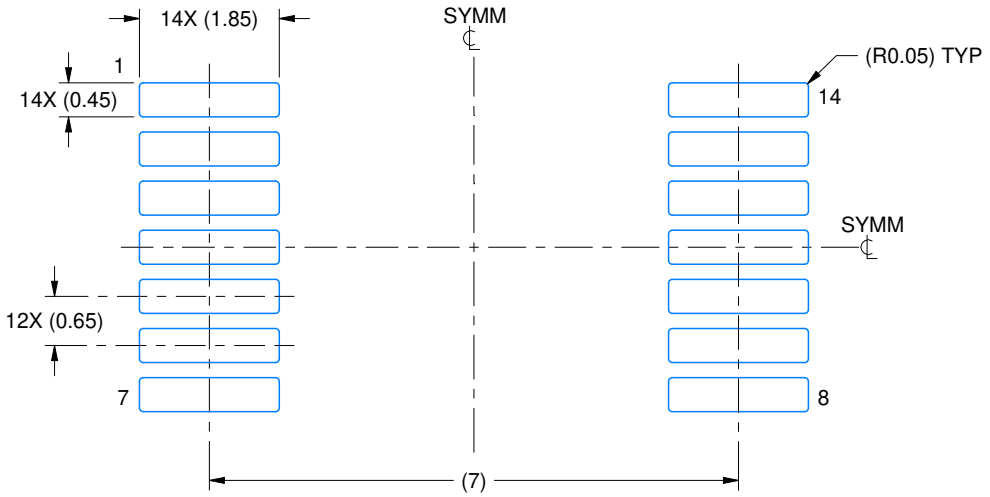


DETAIL A
TYPICAL

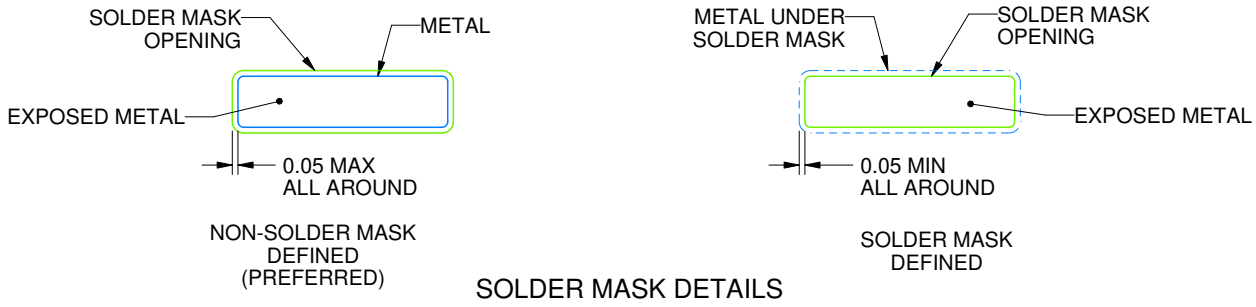
4220762/A 05/2024

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. Reference JEDEC registration MO-150.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220762/A 05/2024

NOTES: (continued)

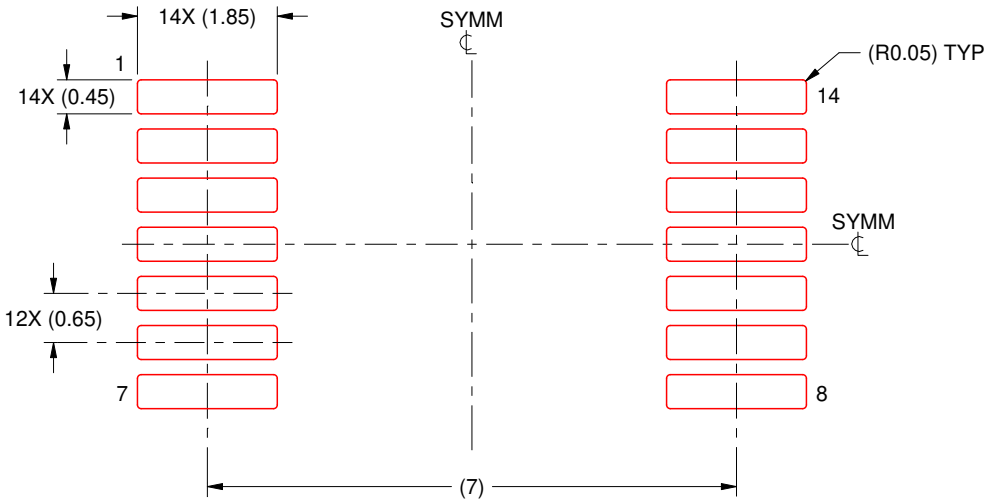
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0014A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



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

4220762/A 05/2024

NOTES: (continued)

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

GENERIC PACKAGE VIEW

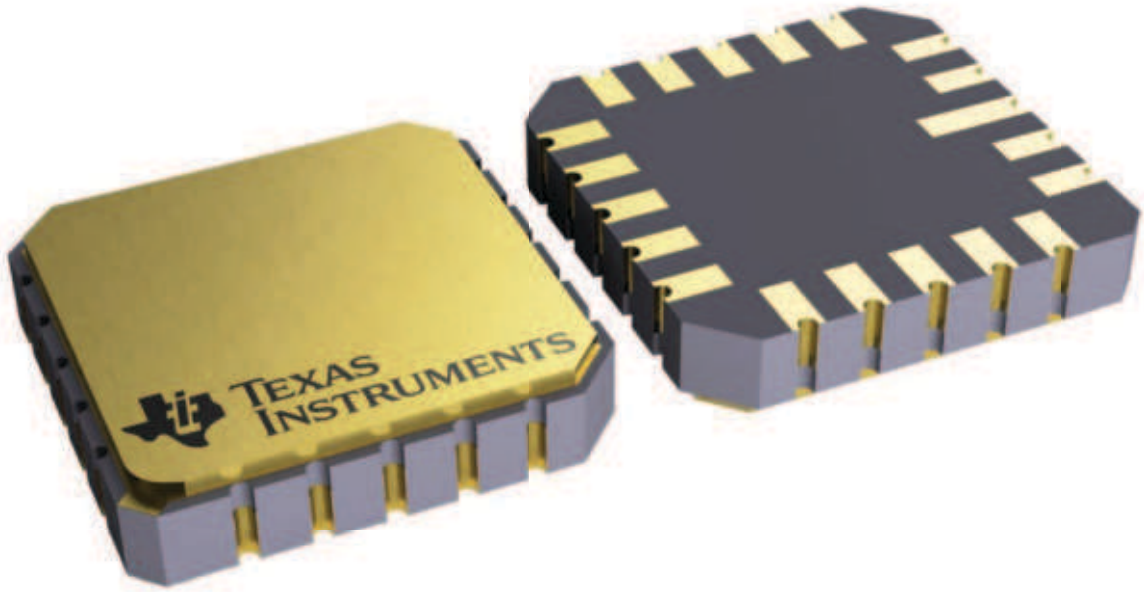
FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

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



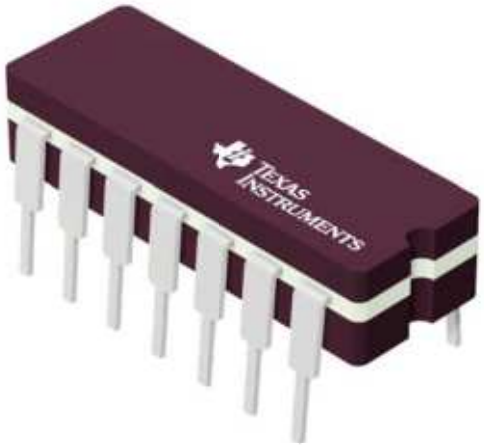
4229370\VA\

GENERIC PACKAGE VIEW

J 14

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



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

4040083-5/G

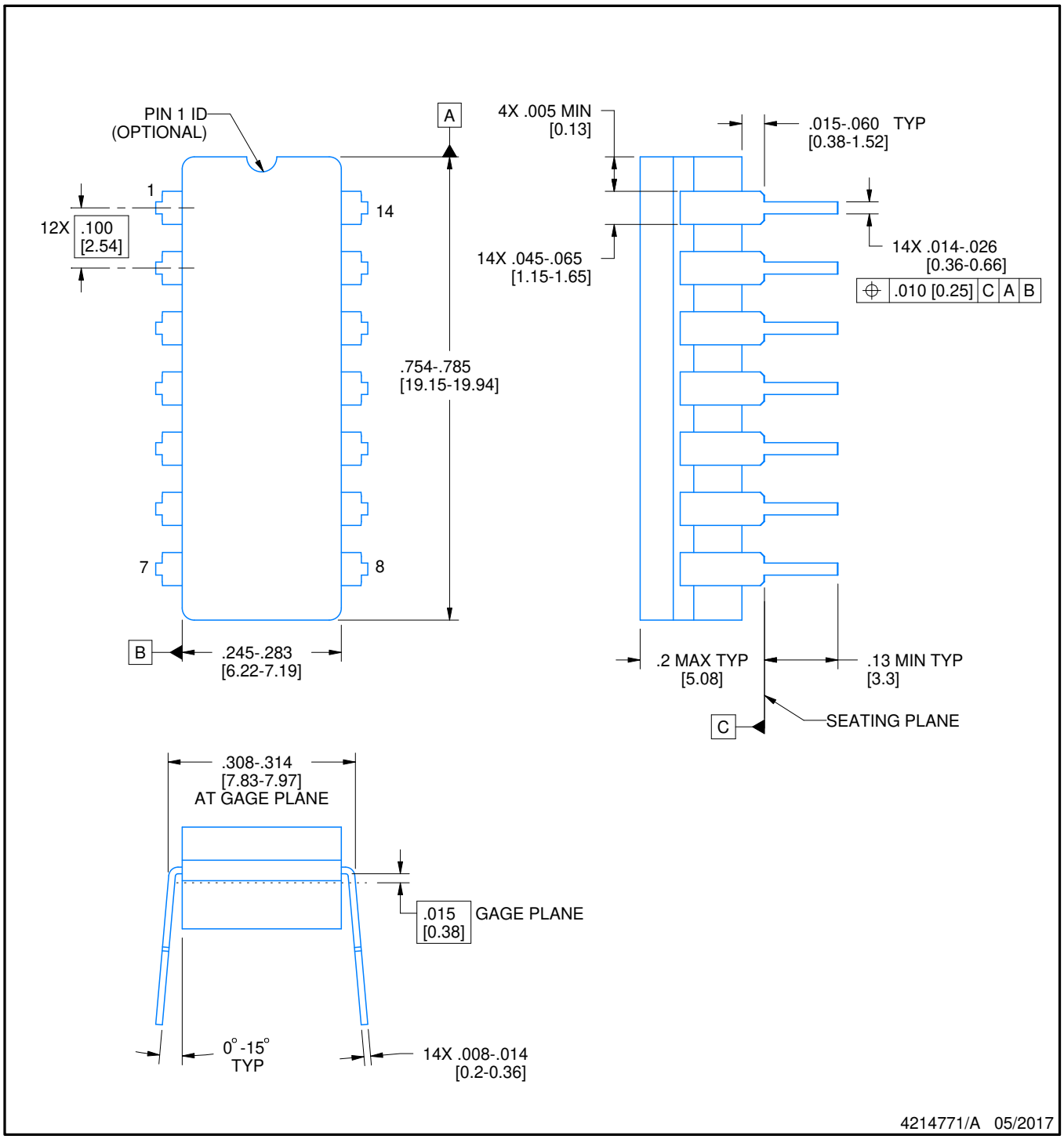


PACKAGE OUTLINE

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



NOTES:

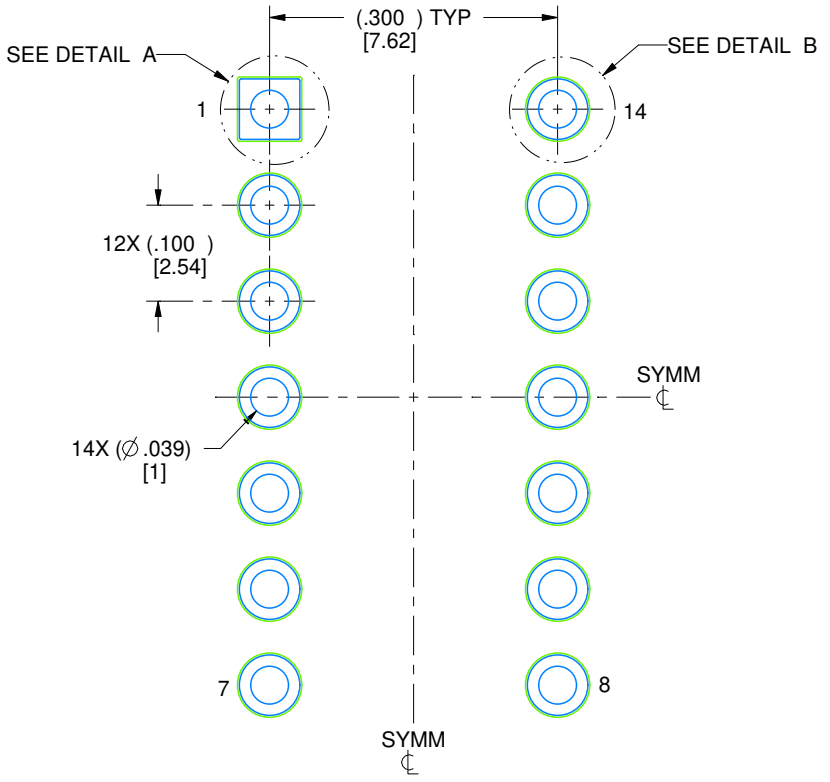
1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermitically sealed with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

EXAMPLE BOARD LAYOUT

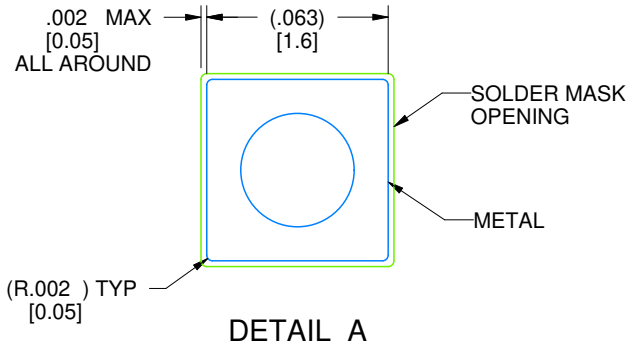
J0014A

CDIP - 5.08 mm max height

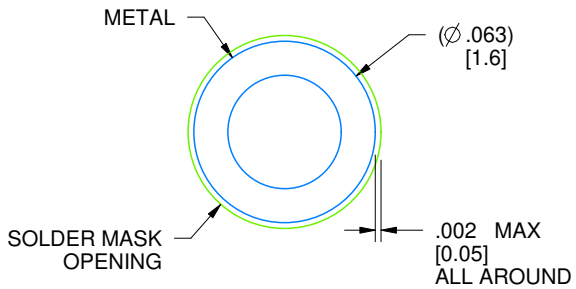
CERAMIC DUAL IN LINE PACKAGE



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



DETAIL A
SCALE: 15X



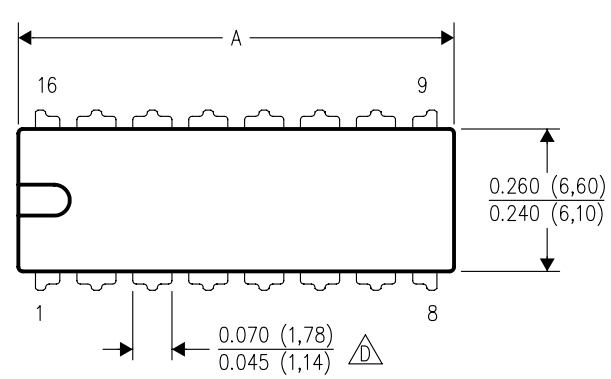
DETAIL B
13X, SCALE: 15X

4214771/A 05/2017

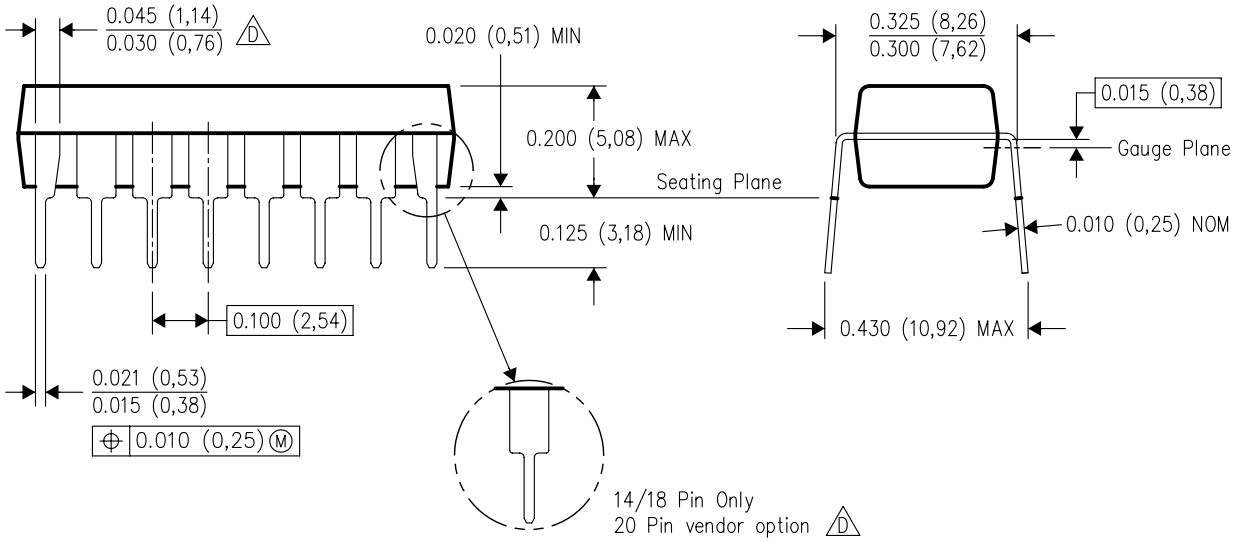
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

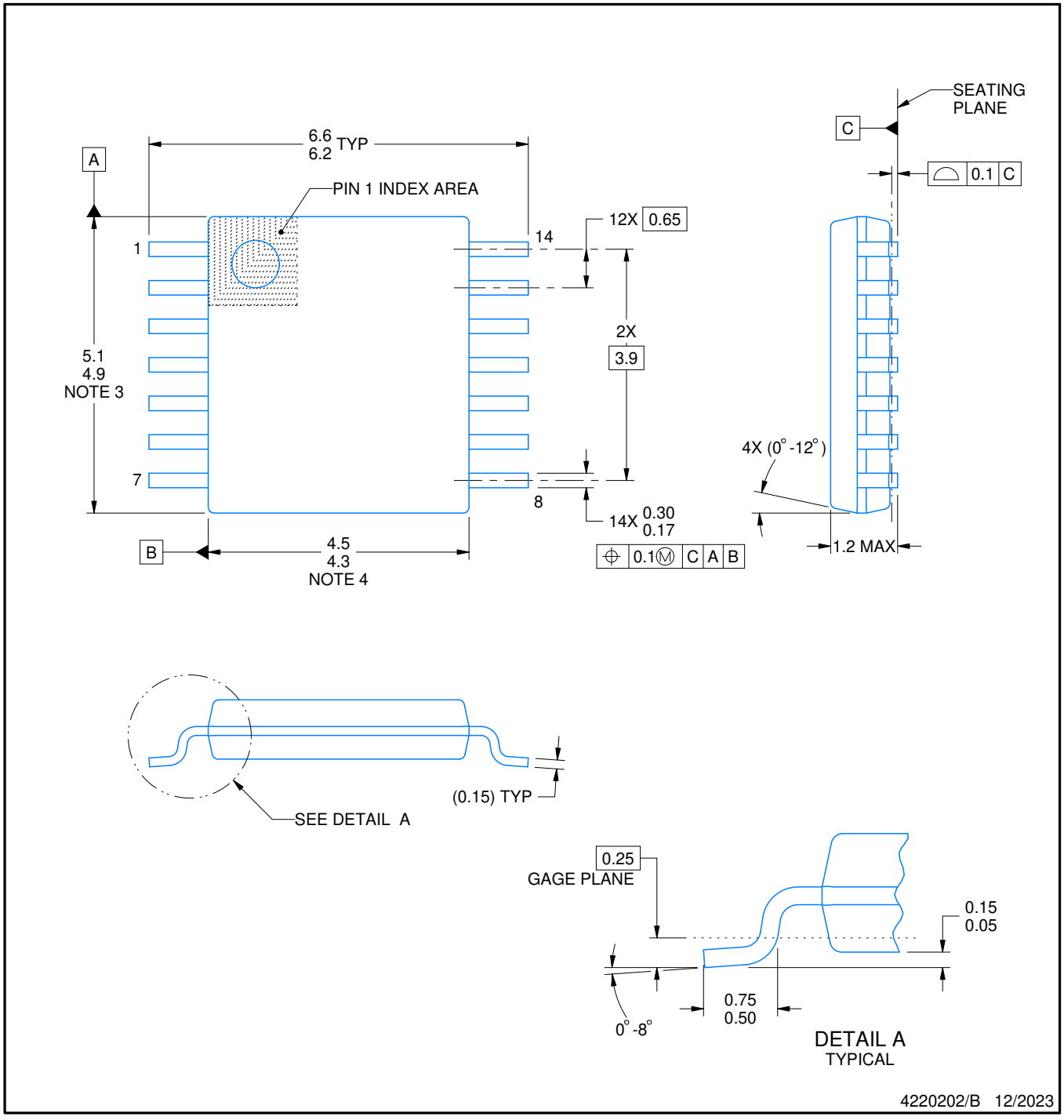
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

PACKAGE OUTLINE

PW0014A

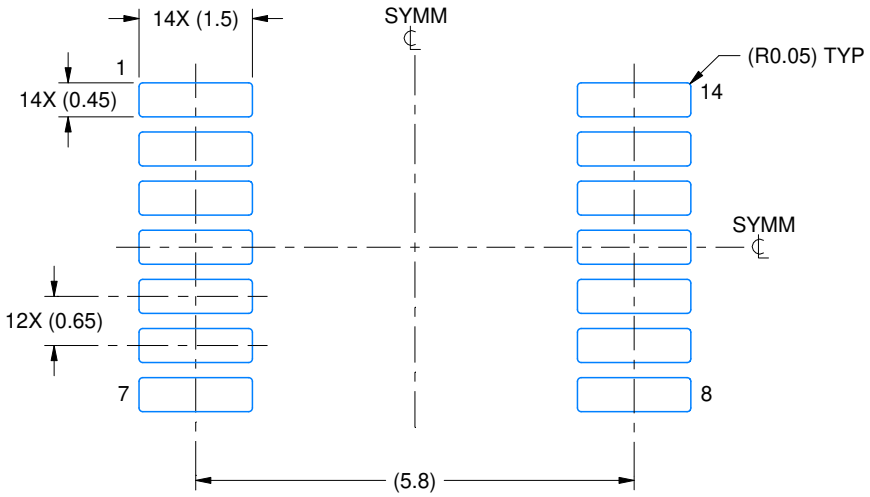
TSSOP - 1.2 mm max height

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



NON-SOLDER MASK DEFINED (PREFERRED)

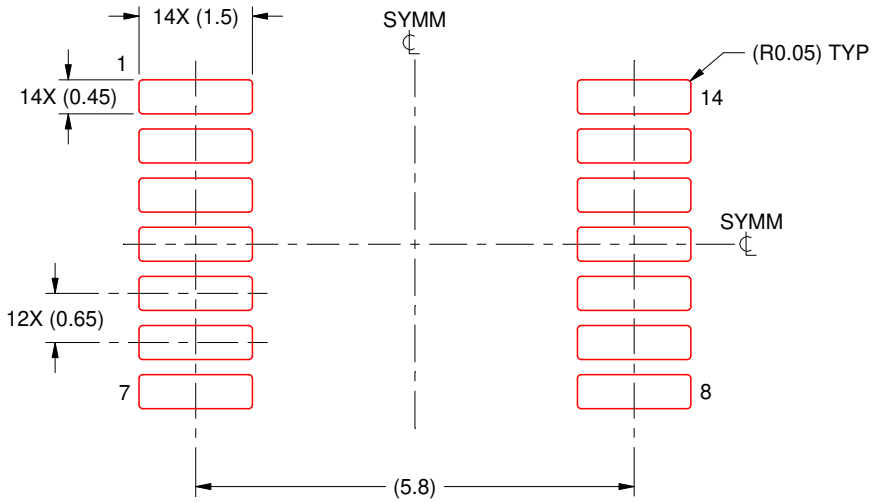
SOLDER MASK DETAILS

SOLDER MASK DEFINED

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.

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