

SN74AC74-Q1 Automotive Dual D-Type Flip-Flop with Preset and Clear

1 Features

- AEC-Q100 qualified for automotive applications:
 - Device temperature grade 1: -40°C to +125°C
 - Device HBM ESD classification level 2
 - Device CDM ESD classification level C4B
- Available in wettable flank QFN package
- Wide operating range of 1.5V to 6V
- Inputs accept voltages up to 6V
- Continuous ±24mA output drive at 5V
- Supports up to ±75mA output drive at 5V in short bursts
- Drives 50Ω transmission lines
- Maximum t_{pd} of 11.5ns at 5V, 50pF load

2 Applications

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

3 Description

The SN74AC74-Q1 contains two independent D-type flip-flops with preset and clear.

Device Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾	BODY SIZE(3)
SN74AC74-Q1	BQA (WQFN, 14)	3mm x 2.5mm	3mm x 2.5mm
3N/4AC/4-Q1	PW (TSSOP, 14)	5mm x 6.4mm	5mm x 4.4mm

- For more information, see Section 11.
- The package size (length × width) is a nominal value and includes pins, where applicable.
- The body size (length × width) is a nominal value and does not include pins.

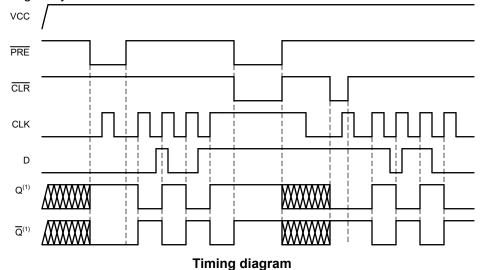


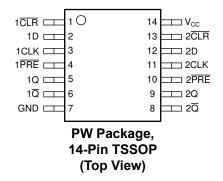


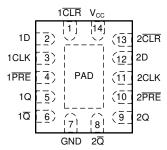
Table of Contents

1 Features	1	7.3 Feature Description	12
2 Applications	1	8 Application and Implementation	
3 Description	1	8.1 Application Information	15
4 Pin Configuration and Functions	3	8.2 Typical Application	
5 Specifications	4	8.3 Power Supply Recommendations	
5.1 Absolute Maximum Ratings		8.4 Layout	19
5.2 ESD Ratings	4	9 Device and Documentation Support	2
5.3 Recommended Operating Conditions	4	9.1 Documentation Support	2
5.4 Thermal Information	5	9.2 Receiving Notification of Documentation Update	tes2
5.5 Electrical Characteristics	5	9.3 Support Resources	2
5.6 Timing Characteristics	6	9.4 Trademarks	2
5.7 Switching Characteristics	7	9.5 Electrostatic Discharge Caution	2
5.8 Typical Characteristics	8	9.6 Glossary	2
6 Parameter Measurement Information		10 Revision History	2
7 Detailed Description	12	11 Mechanical, Packaging, and Orderable	
7.1 Overview	12	Information	2
7.2 Functional Block Diagram	12		



4 Pin Configuration and Functions





BQA Package, 14-Pin WQFN (Transparent Top View)

P	IN	I/O ⁽¹⁾	DESCRIPTION		
NAME	NO.	1/0(-/	DESCRIPTION		
1 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 PRE	4	I	Channel 1, Preset Input, Active Low		
1Q	5	0	Channel 1, Output		
1 Q	6	0	Channel 1, Inverted Output		
GND	7	G	Ground		
2 Q	8	0	Channel 2, Inverted Output		
2Q	9	0	Channel 2, Output		
2 PRE	10	Input	Channel 2, Preset Input, Active Low		
2CLK	11	Input	Channel 2, Positive edge triggered clock input		
2D	12	I	Channel 2, Data Input		
2 CLR	13	I	Channel 2, Clear Input, Active Low		
V _{CC}	14	Р	Positive Supply		
Thermal Pad ⁽²⁾		_	The thermal pad can be connected to GND or left floating. Do not connect to any other signal or supply		

- (1) Signal Types: I = input, O = output, G = ground, P = power.
- (2) 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	7	V
VI	Input voltage range ⁽²⁾		-0.5	V _{CC} + 0.5	V
Vo	Output voltage range ⁽²⁾		-0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	$V_1 < -0.5V \text{ or } V_1 > V_{CC} + 0.5V$		±20	mA
I _{OK}	Output clamp current	V _O < -0.5V or V _O > V _{CC} + 0.5V		±50	mA
Io	Continuous output current	$V_O = 0$ to V_{CC}		±50	mA
	Continuous current through V _{CC} or GND			±200	mA
TJ	Junction temperature			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.

5.2 ESD Ratings

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

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

5.3 Recommended Operating Conditions

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

Spec	Description	Condition	MIN	MAX	UNIT
V _{CC}	Supply voltage	·	1.5	6	V
		V _{CC} = 1.5V	1.2		
		V _{CC} = 1.8V	1.26		
\ <u>\</u>	High level input voltage	V _{CC} = 2.5V	1.75		V
V _{IH}	High-level input voltage	V _{CC} = 3V	2.1		v
		V _{CC} = 4.5V	3.15		
		V _{CC} = 5.5V	3.85		
		V _{CC} = 1.5V		0.3	
		V _{CC} = 1.8V		0.54	
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Low Lovel input voltage	V _{CC} = 2.5V		0.75	V
V _{IL}	Low-Level input voltage	V _{CC} = 3V		0.9	V
		V _{CC} = 4.5V		1.35	
		V _{CC} = 5.5V		1.65	
VI	Input Voltage	·	0	V _{CC}	V
V _O	Output Voltage		0	V _{CC}	V

Product Folder Links: SN74AC74-Q1

⁽²⁾ The input and output voltage ratings may be exceeded if the input and output current ratings are observed.



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

Spec	Description	Condition	MIN	MAX	UNIT
		V _{CC} = 1.8V		-1	
I _{OH}	High lovel output ourrent	V _{CC} = 2.5V		-2	mA
	High-level output current	V _{CC} = 3V		-12	IIIA
		V _{CC} = 4.5V to 5.5V		-24	
	Low-level output current	V _{CC} = 1.8V		1	
		V _{CC} = 2.5V		2	m ^
I _{OL}		V _{CC} = 3 V		12	mA
		V _{CC} = 4.5V to 5.5V		24	
Δt/Δν	Input transition rise or fall rate	V _{CC} = 1.5V to 3V		50	ns/V
ΔυΔν	Input transition rise or fall rate	V _{CC} = 3.6V to 5.5V		20	115/ V
T _A	Operating free-air temperature		-40	125	°C

5.4 Thermal Information

PACKAGE	PINS	THERMAL METRIC ⁽¹⁾						UNIT
PACKAGE	FINS	R _{0JA}	R _{0JC(top)}	R _{0JB}	Ψ_{JT}	Ψ_{JB}	R _{0JC(bot)}	ONII
PW (TSSOP)	14	145.7	76.5	102.0	18.8	100.7	N/A	°C/W
BQA (WQFN)	14	91.3	99.4	61.0	14.5	60.8	37.0	°C/W

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

5.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V	-40°C	to 125°C		UNIT
FANAMETER		TEST CONDITIONS V _{CC}	MIN	TYP	MAX	UNII
		1.5V	1.4	1.499		
		1.8V	1.7	1.799		
	- FOA	2.5V	2.4	2.499		
	I _{OH} = -50μA	3V	2.9	2.999		
		4.5V	4.4	4.499		
		5.5V	5.4	5.499		
\ <u>\</u>	I _{OH} = -1mA	1.8V	1.44	1.77		V
V _{OH}	I _{OH} = -2mA	2.5V	2	2.4		V
	I _{OH} = -4mA	3V	2.4	2.9		
	I _{OH} = -12mA	3V	2.4	2.8		
	I _{OH} = -24mA	4.5V	3.7	4.2		
	I _{OH} = -24mA	5.5V	4.7	5.2		
	I _{OH} = -75mA 5.5V		3.85	4.6		
	I _{OH} = -50mA	5.5V	3.85	4.9		



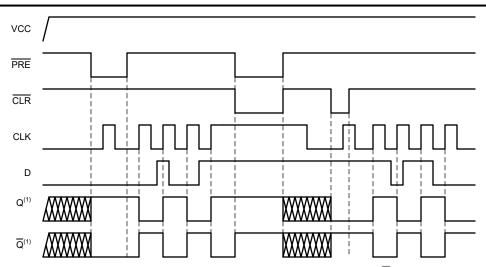
over operating free-air temperature range (unless otherwise noted)

DADAMETED	TEST CONDITIONS	V	-40°C to 125°C		UNIT
PARAMETER	TEST CONDITIONS	V _{cc}	MIN TYP	MAX	UNII
		1.5V	0.001	0.1	
		1.8V	0.001	0.1	
	I - 500A	2.5V	0.001	0.1	
	I _{OL} = 50μA	3V	0.001	0.1	
		4.5V	0.001	0.1	
		5.5V	0.001	0.1	
N/	I _{OL} = 1mA	1.8V	0.01	0.36	v
V _{OL}	I _{OL} = 2mA	2.5V	0.02	0.5	v
	I _{OL} = 4mA	3V	0.03	0.5	
	I _{OL} = 12mA	3V	0.1	0.5	
	I _{OL} = 24mA	4.5V	0.16	0.5	
	I _{OL} = 24mA	5.5V	0.15	0.5	
	I _{OL} = 75mA	5.5V	0.4	1.65	
	I _{OL} = 50mA	5.5V	0.3	1.65	
I _I	V _I = 5.5V or GND	0V to 5.5V	±0.005	±1	μA
I _{cc}	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5V	0.1	20	μA
C _I	V _I = V _{CC} or GND	5V	2		pF
C _{PD}	C _L = 50pF, F = 1MHz	5V	60		pF

5.6 Timing Characteristics

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

PARAMETE	DESCRIPTION CONDITION		.,	-40°C to 12	25°C	
R	DESCRIPTION	CONDITION	V _{cc}	MIN	70	UNIT
f _{CLOCK}	Clock frequency		1.5V		9	MHz
t _W	Pulse duration	PRE or CLR low	1.5V	3.7		ns
t _W	Pulse duration	CLK	1.5V	3.7		ns
t _{SU}	Setup time	Data before CLK edge	1.5V	2.8		ns
t _{SU}	Setup time	PRE or CLR low inactive	1.5V	0		ns
t _H	Hold time	Data after CLK edge	1.5V	0.1		ns
f _{CLOCK}	Clock frequency		3.3V		70	MHz
t _W	Pulse duration	PRE or CLR low	3.3V	3.7		ns
t _W	Pulse duration	CLK	3.3V	3.7		ns
t _{SU}	Setup time	Data before CLK edge	3.3V	0.8		ns
t _{SU}	Setup time	PRE or CLR low inactive	3.3V	0		ns
t _H	Hold time	Data after CLK edge	3.3V	0.1		ns
f _{CLOCK}	Clock frequency		5V		95	MHz
t _W	Pulse duration	PRE or CLR low	5V	3.7		ns
t _W	Pulse duration	CLK	5V	3.7		ns
t _{SU}	Setup time	Data before CLK edge	5V	0.7		ns
t _{SU}	Setup time	PRE or CLR low inactive	5V	0		ns
t _H	Hold time	Data after CLK edge	5V	0.1		ns



 $(1) \ Crosshatch \ indicates \ unknown \ output \ state. \ Unknown \ outputs \ are \ either \ high \ or \ low. \ Q \ and \ \overline{Q} \ are \ in \ opposite \ states \ when \ unknown.$

5.7 Switching Characteristics

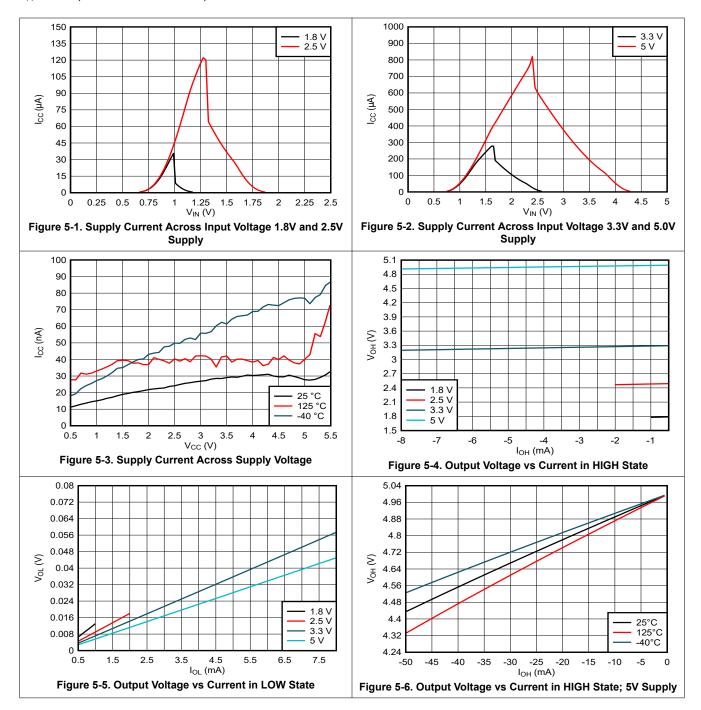
 C_L = 50pF; over operating free-air temperature range; typical values measured at T_A = 25°C (unless otherwise noted). See *Parameter Measurement Information*

PARAMETE	EDOM (MIDUE)	TO (OUTPUT)	-40°C to	-40°C to 125°C			
R	FROM (INPUT)	TO (OUTPUT)	V _{CC}	MIN	TYP	MAX	UNIT
f _{max}			1.5V	9	68.8		MHz
t _{PLH}	PRE or CLR	Q or $\overline{\mathbb{Q}}$	1.5V	14.5	17.3	125	ns
t _{PHL}	PRE OF CLR	QorQ	1.5V	15.9	18.3	125	ns
t _{PLH}	CLK	Q or Q	1.5V	11.6	19.2	132	ns
t _{PHL}	CLK	QuiQ	1.5V	11.2	18.4	144	ns
f _{max}			3.3V	79	275.5		MHz
t _{PLH}	PRE or CLR	Q or $\overline{\mathbb{Q}}$	3.3V	3.5	5.9	14	ns
t _{PHL}	PRE OF CLR	QuiQ	3.3V	3.5	6.3	14	ns
t _{PLH}	- CLK	Q or Q	3.3V	3.7	6.2	14.7	ns
t _{PHL}	OLK	QuiQ	3.3V	4	6.4	16.1	ns
f _{max}			5V	110	300		MHz
t _{PLH}	PRE or CLR	Q or $\overline{\mathbb{Q}}$	5V	2.5	4.7	10	ns
t _{PHL}	PRE OF CLR	QuiQ	5V	2.5	4.9	10	ns
t _{PLH}	CLK	Q or Q	5V	2.6	4.7	10.5	ns
t _{PHL}	OLK	QuiQ	5V	2.9	4.8	11.5	ns
t _r		Υ	1.5V	4.8	9.8	14.2	ns
t _f		1	1.5V	4.6	9.5	13.8	ns
t _r		Υ	3.3V	2.5	4.4	6.5	ns
t _f		I I	3.3V	2.5	4.2	5.9	ns
t _r		Υ	5V	1.9	3.4	4.8	ns
t _f			5V	2.1	3.3	4.5	ns



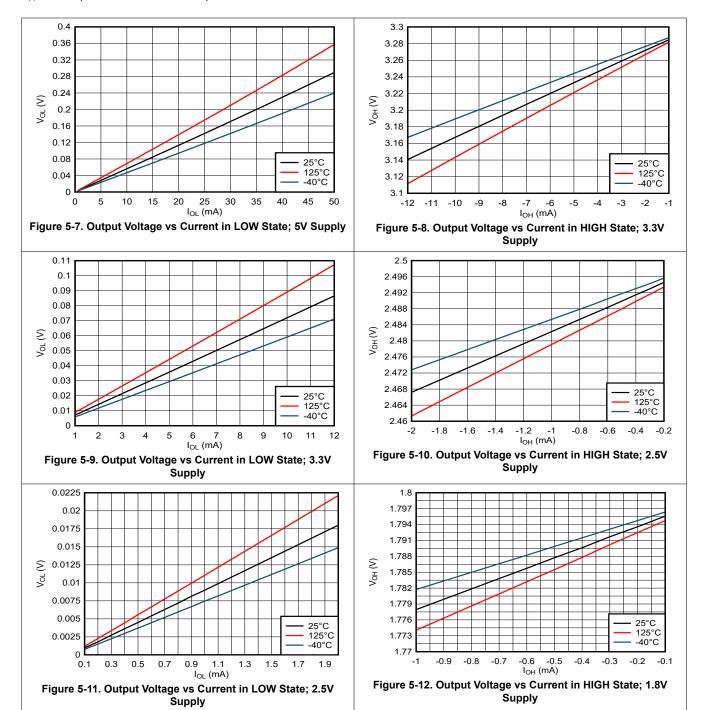
5.8 Typical Characteristics

T_A = 25°C (unless otherwise noted)



5.8 Typical Characteristics (continued)

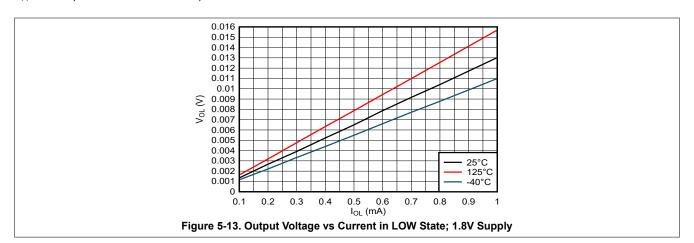
T_A = 25°C (unless otherwise noted)





5.8 Typical Characteristics (continued)

T_A = 25°C (unless otherwise noted)

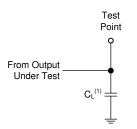


6 Parameter Measurement Information

Phase relationships between waveforms were chosen arbitrarily for the examples listed in the following table. All input pulses are supplied by generators having the following characteristics: PRR \leq 1MHz, $Z_O = 50\Omega$, $t_t < 2.5$ ns.

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

The outputs are measured individually with one input transition per measurement.



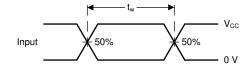


Figure 6-2. Voltage Waveforms, Pulse Duration

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

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

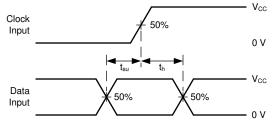
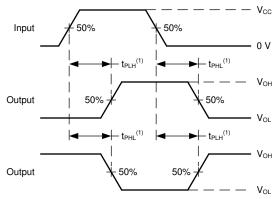
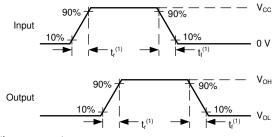


Figure 6-3. Voltage Waveforms, Setup and Hold Times



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

Figure 6-4. Voltage Waveforms Propagation Delays



(1) The greater between t_{r} and t_{f} is the same as $t_{\text{t}}.$

Figure 6-5. Voltage Waveforms, Input and Output Transition Times



7 Detailed Description

7.1 Overview

The SN74AC74-Q1 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 (\overline{Q}) outputs.

7.2 Functional Block Diagram

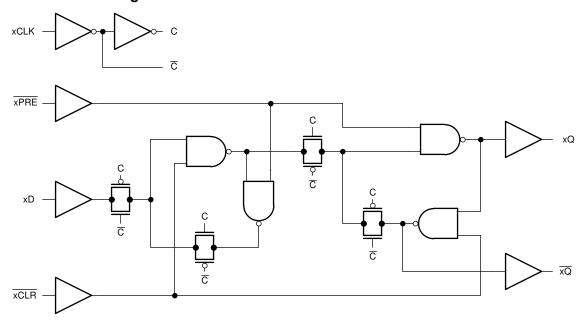


Figure 7-1. Logic Diagram (Positive Logic) for one channel of SN74AC74-Q1

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 $(R = V \div I)$.

Product Folder Links: SN74AC74-Q1

it Document Feedback



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 $10k\Omega$ resistor, however, is recommended and will typically meet all requirements.

Product Folder Links: SN74AC74-Q1



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 where packages include this feature.

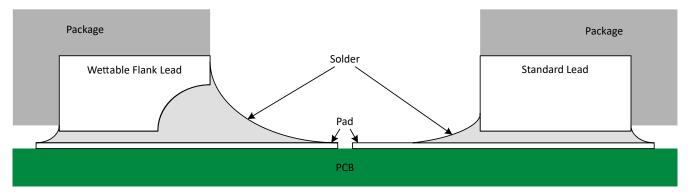


Figure 7-2. Simplified Cutaway View of Wettable-Flank QFN Package and Standard QFN Package After Soldering

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

7.3.5 Clamp Diode Structure

As shown in Figure 7-3, 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.

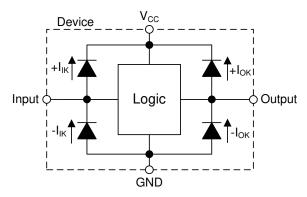


Figure 7-3. Electrical Placement of Clamping Diodes for Each Input and Output

Product Folder Links: SN74AC74-Q1

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

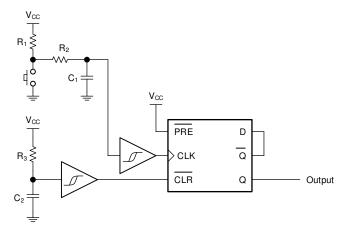


Figure 8-1. Typical Application Schematic



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 SN74AC74-Q1 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 SN74AC74-Q1 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 SN74AC74-Q1 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 SN74AC74-Q1 can drive a load with total resistance described by $R_L \ge V_O / I_O$, 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.

Product Folder Links: SN74AC74-Q1

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 SN74AC74-Q1 (as specified in the *Electrical Characteristics*), and the desired input transition rate limits the resistor size. A $10k\Omega$ resistor value is often used due to these factors.

The SN74AC74-Q1 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.

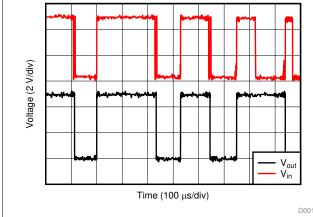
Refer to the Feature Description section for additional information regarding the outputs for this device.



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*
- 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 SN74AC74-Q1 to one or more of the receiving devices.
- 3. Ensure the resistive load at the output is larger than $(V_{CC} / I_{O(max)})\Omega$. 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 $M\Omega$; 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



Voltage (2 V/div) Time (200 ms/div)

Figure 8-2. Waveform for Non-Debounced Switch

Figure 8-3. Waveform for Debounced Switch

Submit Document Feedback

Copyright © 2025 Texas Instruments Incorporated

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 $0.1\mu F$ capacitor is recommended for this device. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. The $0.1\mu F$ and $1\mu F$ capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

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

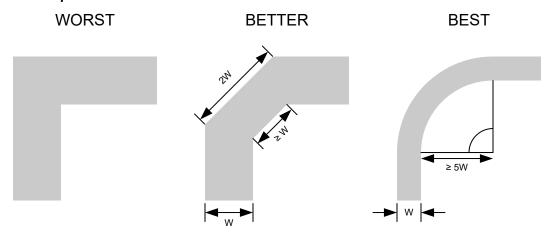


Figure 8-4. Example Trace Corners for Improved Signal Integrity

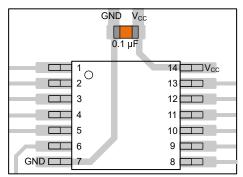


Figure 8-5. Example Bypass Capacitor Placement for TSSOP and Similar Packages

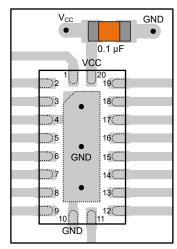


Figure 8-6. Example Bypass Capacitor Placement for WQFN and Similar Packages

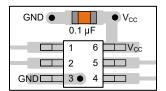


Figure 8-7. Example Bypass Capacitor Placement for SOT, SC70 and Similar Packages

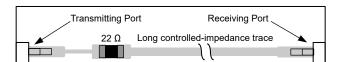


Figure 8-8. Example Damping Resistor Placement for Improved Signal Integrity

Submit Document Feedback

Copyright © 2025 Texas Instruments Incorporated



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 Cpd 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.

DATE	REVISION	NOTES				
May 2025	*	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.

Submit Document Feedback

Copyright © 2025 Texas Instruments Incorporated

www.ti.com 29-May-2025

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type	Package Pins	Package qty Carrier	RoHS	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
SN74AC74PWRQ1	Active	Production	TSSOP (PW) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	AC74Q
SN74AC74WBQARQ1	Active	Production	WQFN (BQA) 14	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	AC74Q

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

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 SN74AC74-Q1:

Catalog: SN74AC74

⁽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.

PACKAGE OPTION ADDENDUM

www.ti.com 29-May-2025

• Enhanced Product : SN74AC74-EP

Military: SN54AC74

NOTE: Qualified Version Definitions:

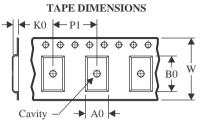
- Catalog TI's standard catalog product
- Enhanced Product Supports Defense, Aerospace and Medical Applications
- Military QML certified for Military and Defense Applications

PACKAGE MATERIALS INFORMATION

www.ti.com 30-May-2025

TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	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		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AC74PWRQ1	TSSOP	PW	14	3000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AC74WBQARQ1	WQFN	BQA	14	3000	180.0	12.4	2.8	3.3	1.1	4.0	12.0	Q1

www.ti.com 30-May-2025



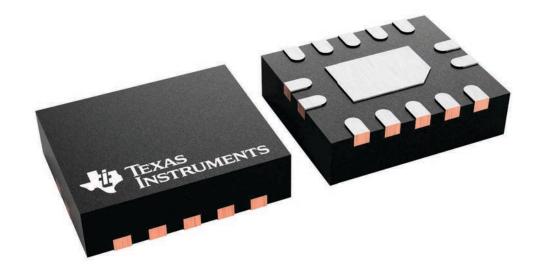
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AC74PWRQ1	TSSOP	PW	14	3000	353.0	353.0	32.0
SN74AC74WBQARQ1	WQFN	BQA	14	3000	210.0	185.0	35.0

2.5 x 3, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

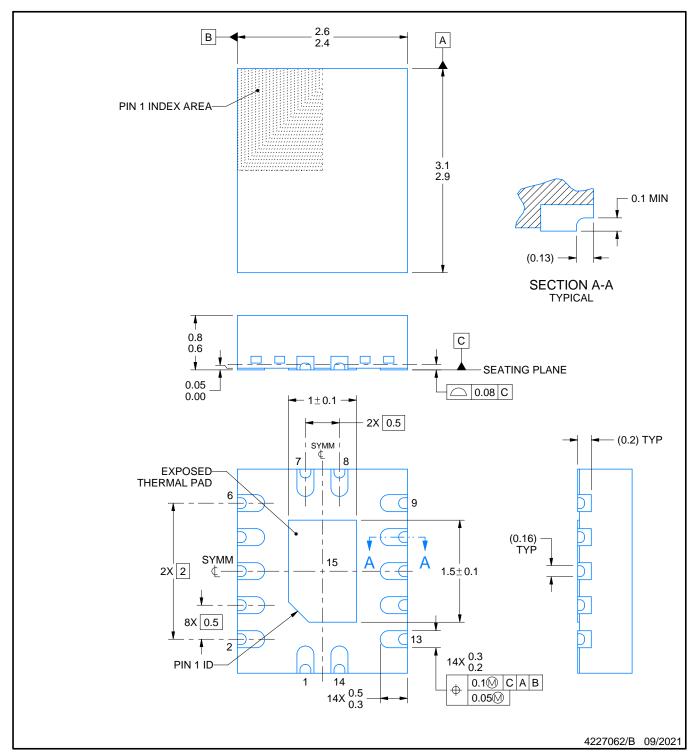
This image is a representation of the package family, actual package may vary. Refer to the product data sheet for package details.



www.ti.com



PLASTIC QUAD FLATPACK - NO LEAD

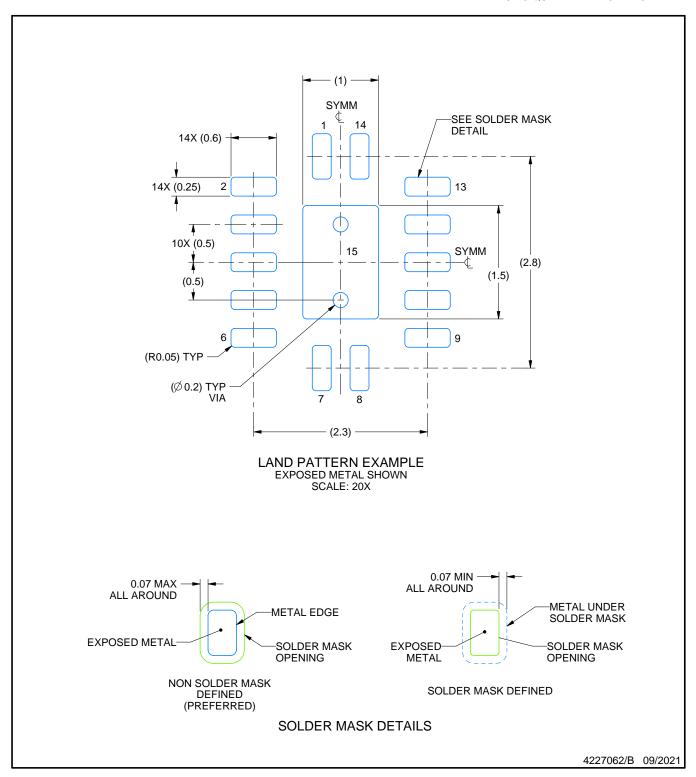


NOTES:

- 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.



PLASTIC QUAD FLATPACK - NO LEAD

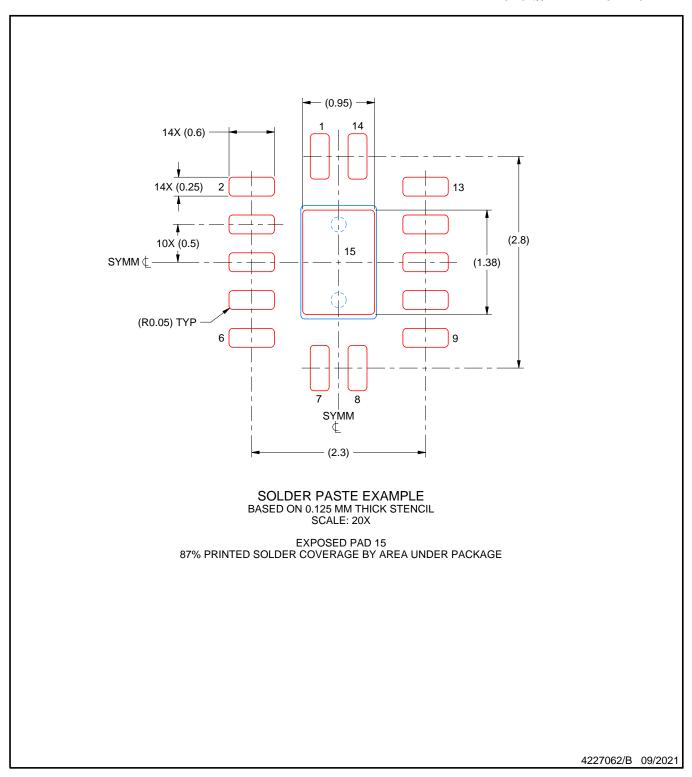


NOTES: (continued)

- 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.



PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

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





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.



SMALL OUTLINE PACKAGE



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.



SMALL OUTLINE PACKAGE



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.



IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265 Copyright © 2025. Texas Instruments Incorporated