

SN74LVC74A-Q1 Automotive Dual Positive-Edge-Triggered D-Type Flip-Flop With Clear and Preset

1 Features

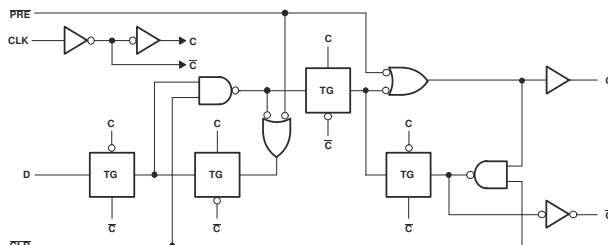
- Qualified for automotive applications
- ESD protection exceeds 2000V per MIL-STD-883, Method 3015
- Operates from 2V to 3.6V
- Inputs accept voltages to 5.5V
- Max t_{pd} of 5.2ns at 3.3V
- Typical V_{OLP} (output ground bounce) $<0.8V$ at $V_{CC} = 3.3V$, $T_A = 25^\circ C$
- Typical V_{OHV} (output V_{OH} undershoot) $>2V$ at $V_{CC} = 3.3V$, $T_A = 25^\circ C$

2 Description

The SN74LVC74A-Q1 dual positive-edge-triggered D-type flip-flop is designed for 2.7V to 3.6V V_{CC} operation.

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾	BODY SIZE ⁽³⁾
SN74LVC74A-Q1	BQA (WQFN, 14)	3mm × 2.5mm	3mm × 2.5mm
	D (SOIC, 14)	8.65mm × 6mm	8.65mm × 3.91mm
	PW (TSSOP, 14)	5mm × 6.4mm	5.00mm × 4.40mm

- (1) For more information, see [Mechanical, Packaging, and Orderable Information](#).
- (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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3 Pin Configuration and Functions

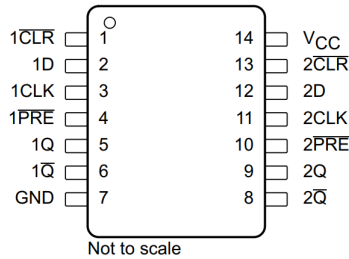


Figure 3-1. D or PW Package, 14-Pin SOIC or TSSOP (Top View)

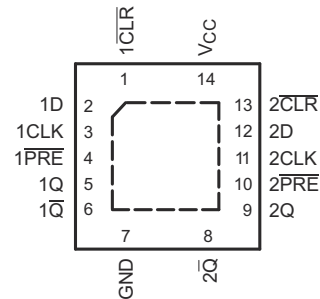


Figure 3-2. BQA Package 14-Pin WQFN With Exposed Thermal Pad (Top View)

Table 3-1. Pin Functions

PIN		I/O ⁽¹⁾	DESCRIPTION
NAME	SOIC, TSSOP, VQFN		
1CLK	3	I	Channel 1 clock input
1 CLR	1	I	Channel 1 clear input. Pull low to set Q output low.
1D	2	I	Channel 1 data input
1 PRE	4	I	Channel 1 preset input. Pull low to set Q output high.
1Q	5	O	Channel 1 output
1 Q-bar	6	O	Channel 1 inverted output
2CLK	11	I	Channel 2 clock input
2 CLR	13	I	Channel 2 clear input. Pull low to set Q output low.
2D	12	I	Channel 2 data input
2 PRE	10	I	Channel 2 preset input. Pull low to set Q output high.
2Q	9	O	Channel 2 output
2 Q-bar	8	O	Channel 2 Inverted output
GND	7	—	Ground
NC	—	—	No connect
V _{CC}	14	—	Supply
Thermal pad		—	Connect the GND pin to the exposed thermal pad for correct operation. Connect the thermal pad to any internal PCB ground plane using multiple vias for good thermal performance.

(1) I = input, O = output, P = power, FB = feedback, GND = ground, N/A = not applicable

4 Specifications

4.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	-0.5	6.5	V
V _I	Input voltage range ⁽¹⁾	-0.5	6.5	V
V _O	Output voltage range ^{(1) (2)}	-0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	V _I < 0		-50 mA
I _{OK}	Output clamp current	V _O < 0		-50 mA
I _O	Continuous output current			±50 mA
	Continuous current through V _{CC} or GND			±100 mA
T _{stg}	Storage temperature range	-65	150	°C

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

(2) The value of V_{CC} is provided in the recommended operating conditions table.

4.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000 V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

4.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT		
V _{CC}	Supply voltage	Operating	2	3.6	V	
		Data retention only	1.5			
V _{IH}	High-level input voltage	V _{CC} = 2.7 V to 3.6 V		2	V	
V _{IL}	Low-level input voltage	V _{CC} = 2.7 V to 3.6 V		0.8	V	
V _I	Input voltage	0	5.5	V		
V _O	Output voltage	0	V _{CC}	V		
I _{OH}	High-level output current	V _{CC} = 2.7 V		-12	mA	
		V _{CC} = 3 V		-24		
I _{OL}	Low-level output current	V _{CC} = 2.7 V		12	mA	
		V _{CC} = 3 V		24		
Δt/Δv	Input transition rise or fall rate			10	ns/V	
T _A	Operating free-air temperature	Q suffix		-40	125	°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.

4.4 Thermal Information

THERMAL METRIC ⁽¹⁾	SN74LVC74A-Q1			UNIT	
	BQA (WQFN)	D (SOIC)	PW (TSSOP)		
	14 PINS	14 PINS	14 PINS		
R _{θJA}	Junction-to-ambient thermal resistance	102.3	127.8	150.8	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	96.8	81.9	78.3	°C/W
R _{θJB}	Junction-to-board thermal resistance	70.9	84.4	93.8	°C/W
ψ _{JT}	Junction-to-top characterization parameter	16.6	39.6	24.7	°C/W

THERMAL METRIC ⁽¹⁾	SN74LVC74A-Q1			UNIT
	BQA (WQFN)	D (SOIC)	PW (TSSOP)	
	14 PINS	14 PINS	14 PINS	
Ψ_{JB} Junction-to-board characterization parameter	70.9	83.9	93.2	°C/W
$R_{\theta JC(bot)}$ Junction-to-case (bottom) thermal resistance	50.1	N/A	N/A	°C/W

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

4.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V_{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V_{OH}	$I_{OH} = -100 \mu A$	2.7 V to 3.6 V	$V_{CC} - 0.2$		V	
	$I_{OH} = -12 \text{ mA}$	2.7 V	2.2			
		3 V	2.4			
	$I_{OH} = -24 \text{ mA}$	3 V	2.2			
V_{OL}	$I_{OL} = 100 \mu A$	2.7 V to 3.6 V	0.2		V	
	$I_{OL} = 12 \text{ mA}$	2.7 V	0.4			
		$I_{OL} = 24 \text{ mA}$	3 V	0.55		
I_I	$V_I = 5.5 \text{ V or GND}$	3.6 V	± 5		μA	
I_{CC}	$V_I = V_{CC} \text{ or GND, } I_O = 0$	3.6 V	10		μA	
ΔI_{CC}	One input at $V_{CC} - 0.6 \text{ V}$, Other inputs at $V_{CC} \text{ or GND}$	2.7 V to 3.6 V	500		μA	
C_i	$V_I = V_{CC} \text{ or GND}$	3.3 V	5		pF	

(1) All typical values are at $V_{CC} = 3.3 \text{ V}$, $T_A = 25^\circ\text{C}$.

4.6 Timing Requirements

over recommended operating free-air temperature range (unless otherwise noted) (see [Load Circuit and Voltage Waveforms](#))

		$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	83		100		MHz
t_w	Pulse duration	PRE or \overline{CLR} low		3.3		ns
		CLK high or low		3.3		
t_{su}	Setup time before CLK \uparrow	Data		3		ns
		PRE or \overline{CLR} inactive		2.2		
t_h	Hold time, data after CLK \uparrow	1		1		ns

4.7 Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see [Load Circuit and Voltage Waveforms](#))

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			83		100		MHz
t_{pd}	CLK	Q or \overline{Q}	6		1	5.2	ns
	\overline{PRE} or \overline{CLR}		6.4		1	5.4	

4.8 Operating Characteristics

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

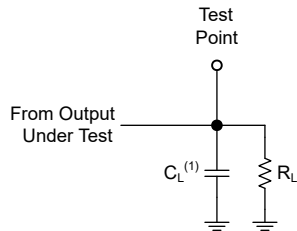
PARAMETER		TEST CONDITIONS	V _{CC} = 2.5 V	V _{CC} = 3.3 V	UNIT
			TYP	TYP	
C _{pd}	Power dissipation capacitance per flip-flop	f = 10 MHz	47	51	pF

5 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 ≤ 1MHz, Z_O = 50Ω, t_f ≤ 2.5ns.

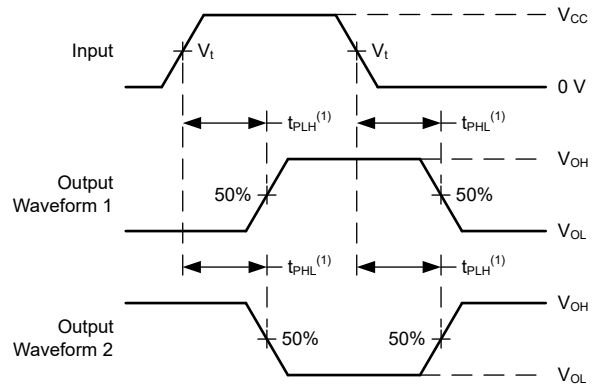
The outputs are measured individually with one input transition per measurement.

V _{CC}	V _t	R _L	C _L	ΔV
1.8V ± 0.15V	V _{CC} /2	1kΩ	30pF	0.15V
2.5V ± 0.2V	V _{CC} /2	500Ω	30pF	0.15V
2.7V	1.5V	500Ω	50pF	0.3V
3.3V ± 0.3V	1.5V	500Ω	50pF	0.3V



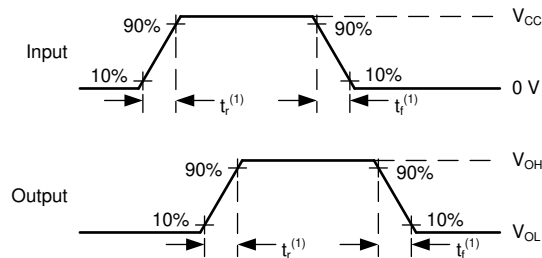
(1) C_L includes probe and test-fixture capacitance.

Figure 5-1. Load Circuit for Push-Pull Outputs



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

Figure 5-2. Voltage Waveforms Propagation Delays



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

Figure 5-3. Voltage Waveforms, Input and Output Transition Times

6 Detailed Description

6.1 Overview

A low level at the preset ($\overline{\text{PRE}}$) or clear ($\overline{\text{CLR}}$) inputs sets or resets the outputs, regardless of the levels of the other inputs. When $\overline{\text{PRE}}$ and $\overline{\text{CLR}}$ are inactive (high), data at the data (D) input meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at the D input can be changed without affecting the levels at the outputs.

Inputs can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V system environment.

6.2 Functional Block Diagram

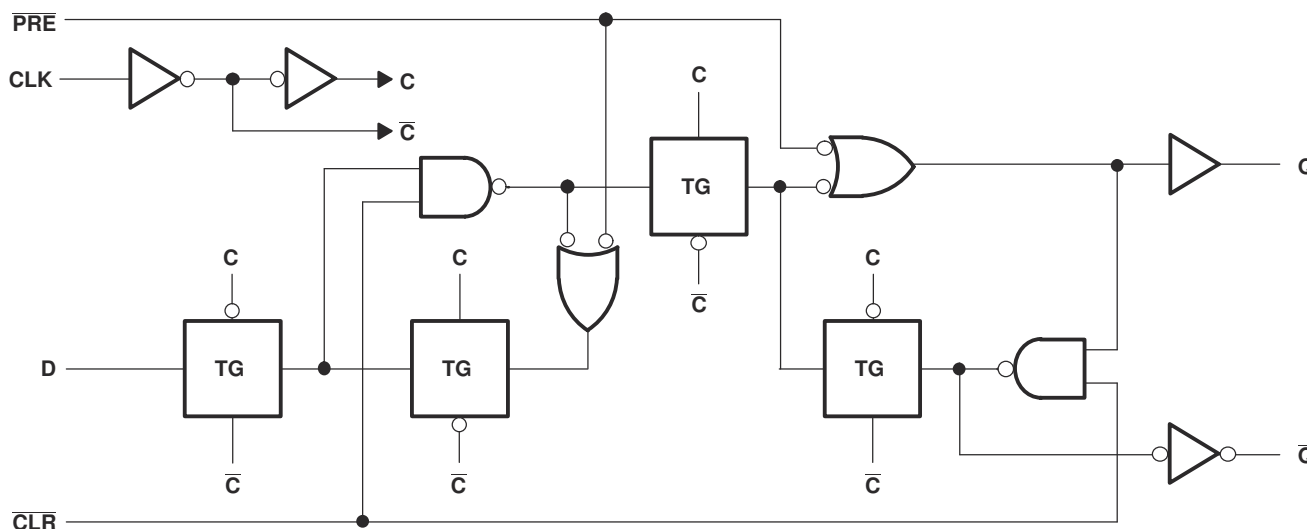


Figure 6-1. Logic Diagram, Each Flip-Flop (Positive Logic)

6.3 Device Functional Modes

Function Table

INPUTS				OUTPUTS	
PRE	CLR	CLK	D	Q	$\overline{\text{Q}}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H ⁽¹⁾	H ⁽¹⁾
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q ₀	$\overline{\text{Q}}_0$

(1) This configuration is nonstable; that is, it does not persist when PRE or CLR returns to its inactive (high) level.

7 Application and Implementation

Note

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

7.1 Power Supply Recommendations

The power supply may be any voltage between the minimum and maximum supply voltage rating located in [Recommended Operating Conditions](#).

Each V_{CC} terminal must have a good bypass capacitor to prevent power disturbance. A 0.1- μF capacitor is recommended for devices with a single supply. If there are multiple V_{CC} terminals, then 0.01- μF or 0.022- μF capacitors are recommended for each power terminal. It is permissible to parallel multiple bypass capacitors to reject different frequencies of noise. Multiple bypass capacitors may be paralleled to reject different frequencies of noise. The bypass capacitor must be installed as close to the power terminal as possible for the best results.

7.2 Layout

7.2.1 Layout Guidelines

Inputs must not float when using multiple bit logic devices. In many cases, functions or parts of functions of digital logic devices are unused. Some examples include situations when only two inputs of a triple-input AND gate are used, or when only 3 of the 4-buffer gates are used. Such input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states.

Specified in [Layout Diagram](#) are rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally, they are tied to GND or V_{CC} , whichever makes more sense or is more convenient.

7.2.2 Layout Example

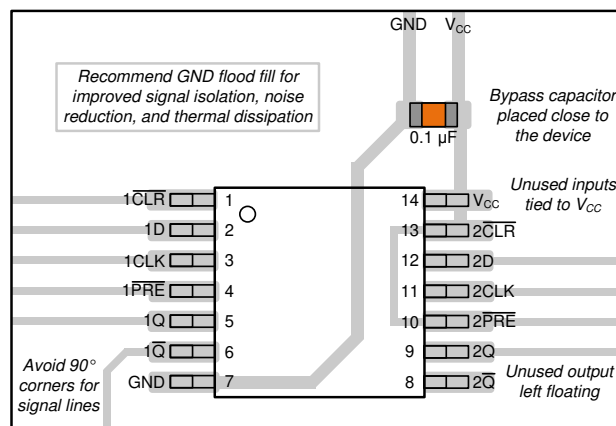


Figure 7-1. Layout Diagram

8 Device and Documentation Support

8.1 Documentation Support (Analog)

8.1.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to order now.

Table 8-1. Related Links

PARTS	PRODUCT FOLDER	ORDER NOW	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
SN74LVC74A-Q1	Click here	Click here	Click here	Click here	Click here

8.2 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.

8.3 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.

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8.4 Trademarks

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8.5 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.

8.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

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

Changes from Revision D (May 2024) to Revision E (August 2024) Page

- Updated thermal values for PW package from RθJA = 113 to 150.8, RθJC(top) = 50.3 to 78.3, RθJB = 63.4 to 93.8, ΨJT = 6.2 to 24.7, ΨJB = 62.8 to 93.2, all values in °C/W4

Changes from Revision C (August 2003) to Revision D (May 2024) Page

- Added BQA package to *Package Information* table, *Pin Configuration and Functions* section, and *Thermal Information* table..... 1
- Added *Applications* section, *ESD Ratings* table, *Thermal Information* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section..... 1

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- Deleted references to machine model in *Features* section..... 1
 - Updated R θ JA values: D = 86 to 127.8, all values in °C/W4
-

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVC74AQDRG4Q1	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC74AQ	Samples
SN74LVC74AQPWRG4Q1	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC74AQ	Samples
SN74LVC74AQPWRQ1	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC74AQ	Samples
SN74LVC74AWBQARQ1	ACTIVE	WQFN	BQA	14	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVC74Q	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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OTHER QUALIFIED VERSIONS OF SN74LVC74A-Q1 :

- Catalog : [SN74LVC74A](#)
- Enhanced Product : [SN74LVC74A-EP](#)
- Military : [SN54LVC74A](#)

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

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