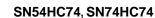


Sample &

Buy





SCLS094E – DECEMBER 1982–REVISED DECEMBER 2015

# SNx4HC74 Dual D-Type Positive-Edge-Triggered Flip-Flops With Clear and Preset

Technical

Documents

# 1 Features

- Wide Operating Voltage Range: 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 40-µA Maximum I<sub>CC</sub>
- Typical t<sub>pd</sub> = 15 ns
- ±4-mA Output Drive at 5 V
- Very Low Input Current of 1 µA

# 2 Applications

- Ultrasound System
- Fans
- Lab Instrumentation
- Vacuum Cleaners
- Video Communications System
- IP Phone: Wired

# 3 Description

Tools &

Software

The SNx4HC74 devices contain two independent Dtype positiv<u>e-edg</u>e-triggered flip-flops. A low level at the preset (PRE) or clear (CLR) inputs sets or resets the outputs, regardless of the levels of the other inputs. When PRE and CLR are inactive (high), data at the data (D) input meeting the setup time requirements are transferred to the outputs on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of CLK. Following the holdtime interval, data at the D input can be changed without affecting the levels at the outputs.

Support &

Community

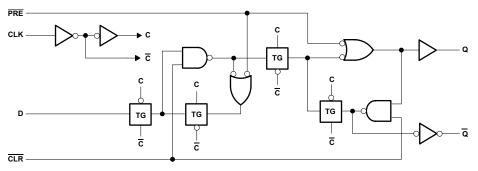
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#### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN74HC74N	PDIP (14)	19.30 mm x 6.40 mm
SN74HC74NS	SO (14)	10.20 mm x 5.30 mm
SN74HC74D	SOIC (14)	8.70 mm x 3.90 mm
SN74HC74DB	SSOP (14)	6.50 mm x 5.30 mm
SN74HC74PW	TSSOP (14)	5.00 mm x 4.40 mm
SNJ54HC74J	CDIP (14)	21.30 mm x 7.60 mm
SNJ54HC74W	CFP (14)	9.20 mm x 6.29 mm
SNJ54HC74FK	LCCC (20)	8.90 mm x 8.90 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

#### Logic Diagram (Positive Logic)



2

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# 4 Revision History

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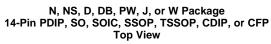
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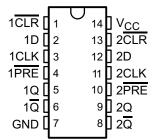


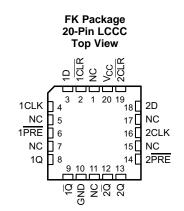
Page



# 5 Pin Configuration and Functions







NC - No internal connection

#### Pin Functions

	PIN						
NAME	LCCC	SOIC, SSOP, CDIP, PDIP, SO, TSSOP, CFP NO.	I/O	DESCRIPTION			
1CLK	4	3	I	Clock input			
1CLR	2	1	I	Clear input - Pull low to set 1Q output low			
1D	3	2	I	Input			
1PRE	6	4	I	Preset input			
1Q	8	5	0	Output			
1Q	9	6	0	Inverted output			
2CLK	16	11	I	Clock input			
2CLR	19	13	I	Clear input - Pull low to set 1Q output low			
2D	18	12	I	Input			
2PRE	14	10	I	Preset input			
2Q	13	9	0	Output			
2Q	12	8	0	Inverted output			
GND	10	7		Ground			
	1						
	5						
NC	7			No connect (no internal connection)			
	11		_	No connect (no internal connection)			
	15						
	17						
V <sub>CC</sub>	20	14	—	Supply			

# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

			MIN	MAX	UNIT
$V_{CC}$	Supply voltage range		-0.5	7	V
I <sub>IK</sub>	Input clamp current <sup>(2)</sup>	$V_{I} < 0 \text{ or } V_{I} > V_{CC}$		±20	mA
I <sub>OK</sub>	Output clamp current <sup>(2)</sup>	$V_O < 0$ or $V_O > V_{CC}$		±20	mA
Ιo	Continuous output current	$V_{O} = 0$ to $V_{CC}$		±25	mA
	Continuous current through $V_{CC} \text{ or } GND$			±50	mA
Tj	Junction temperature range			150	°C
T <sub>stg</sub>	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.

# 6.2 ESD Ratings

			VALUE	UNIT
		Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±2000	
V <sub>(ESD)</sub>	Electrostatic discharge	Charged-device model (CDM), per JEDEC specification JESD22-C101 $^{\left( 2\right) }$	±1500	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible with the necessary precautions.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250-V CDM is possible with the necessary precautions.

# 6.3 Recommended Operating Conditions

See (1)

			S	N54HC74		SI	SN74HC74		
			MIN	NOM	MAX	MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage		2	5	6	2	5	6	V
	High-level input voltage	$V_{CC} = 2 V$	1.5			1.5			
VIH		$V_{CC} = 4.5 V$	3.15			3.15			V
		$V_{CC} = 6 V$	4.2			4.2			
V <sub>IL</sub>	Low-level input voltage	$V_{CC} = 2 V$			0.5			0.5	V
		$V_{CC} = 4.5 V$			1.35			1.35	
		$V_{CC} = 6 V$			1.8			1.8	
VI	Input voltage		0		V <sub>CC</sub>	0		$V_{CC}$	V
Vo	Output voltage		0		V <sub>CC</sub>	0		$V_{CC}$	V
		$V_{CC} = 2 V$			1000			1000	
$\Delta t / \Delta v$	Input transition rise and fall time	$V_{CC} = 4.5 V$			500			500	ns
		$V_{CC} = 6 V$			400			400	l
T <sub>A</sub>	Operating free-air temperature		-55		125	-40		85	°C

 All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, SCBA004.

## 6.4 Thermal Information

		SN74HC74					SN54HC74			
THERMAL METRIC <sup>(1)</sup>		D DB N NS PW (SOIC) (SSOP) (PDIP) (SO) (TSSOP)				J (CDIP)	W (CFP)	FK (LCCC)	UNIT	
	14 PINS				14 PINS 20 PINS					
$R_{\theta JA}$	Junction-to-ambient thermal resistance	86	96	80	76	113		—	—	°C/W
R <sub>0JC(top)</sub>			—	—	—	—	15.05	14.65	5.61	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report, SPRA953.

# 6.5 Electrical Characteristics

over recommended operating free-air temperature range,  $T_A = 25^{\circ}C$  (unless otherwise noted)

PARAMETER	2	TEST CONDITIO	NS	V <sub>cc</sub>	MIN	TYP	MAX	UNIT
				2 V	1.9	1.998		
		I <sub>OH</sub> = -20 μA		4.5 V	4.4	4.499		
				6 V	5.9	5.999		
			T <sub>A</sub> = 25°C		3.98	4.3		
V <sub>OH</sub>	$V_I = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -4 \text{ mA}$	SN54HC74	4.5 V	3.7			V
			SN74HC74		3.84			
			$T_A = 25^{\circ}C$		5.48	5.8		
		I <sub>OH</sub> = -5.2 mA	SN54HC74	6 V	5.2			
		-	SN74HC74		5.34			
			и	2 V		0.002	0.1	V
		I <sub>OL</sub> = 20 μA		4.5 V		0.001	0.1	
				6 V		0.001	0.1	
			T <sub>A</sub> = 25°C			0.17	0.26	
V <sub>OL</sub>	$V_I = V_{IH} \text{ or } V_{IL}$	I <sub>OL</sub> = 4 mA	SN54HC74	4.5 V			0.4	
			SN74HC74				0.33	
			$T_A = 25^{\circ}C$			0.15	0.26	
		I <sub>OL</sub> = 5.2 mA	SN54HC74	6 V			0.4	
			SN74HC74				0.33	
	$V_{I} = V_{CC} \text{ or } 0$	Ш	$T_A = 25^{\circ}C$			±0.1	±100	
l <sub>i</sub>			SN54HC74, SN74HC74	6 V			±1000	nA
	$V_I = V_{CC} \text{ or } 0,$	I <sub>O</sub> = 0	$T_A = 25^{\circ}C$				4	
I <sub>CC</sub>			SN54HC74	6 V			80	μA
			SN74HC74				40	
Ci		· · · · · · · · · · · · · · · · · · ·		2 V to 6 V		3	10	pF
C <sub>pd</sub>	No load			2 V to 6 V		35		pF

#### SN54HC74, SN74HC74

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#### 6.6 Timing Requirements

over recommended operating free-air temperature range,  $T_A = 25^{\circ}C$  (unless otherwise noted)

			V <sub>cc</sub>	T <sub>A</sub>	MIN	MAX	UNI
				T <sub>A</sub> = 25°C		6	
			2 V	SN54HC74		4.2	
				SN74HC74		5	
			4.5 V	T <sub>A</sub> = 25°C		31	
clock	Clock frequency			SN54HC74		21	MHz
	PRE o			SN74HC74		25	
				T <sub>A</sub> = 25°C	0	36	
			6 V	SN54HC74	0	25	
				SN74HC74	0	29	
				T <sub>A</sub> = 25°C	100		
			2 V	SN54HC74	150		
				SN74HC74	125		
				$T_A = 25^{\circ}C$	20		
		PRE or CLR low	4.5 V	SN54HC74	30		
				SN74HC74	25		
				$T_A = 25^{\circ}C$	14		
			6 V	SN54HC74	25		
				SN74HC74	20		
/	Pulse duration			$T_A = 25^{\circ}C$	80		ns
			2 V	SN54HC74	120		
		2 4	SN74HC74	120		-	
			$T_A = 25^{\circ}C$	100			
	CLK high or low	4.5 V	SN54HC74	24			
		CLK High of low	4.5 V				
				SN74HC74	20		
	CLK high or I		0.14	$T_A = 25^{\circ}C$	14		_
			6 V	SN54HC74	20		
				SN74HC74	17		
				T <sub>A</sub> = 25°C	100		
			2 V	SN54HC74	150		
				SN74HC74	125		
				$T_A = 25^{\circ}C$	20		
		Data	4.5 V	SN54HC74	30		
				SN74HC74	25		
				T <sub>A</sub> = 25°C	17		
			6 V	SN54HC74	25		
	Setup time before			SN74HC74	21		
l	CLK↑			$T_A = 25^{\circ}C$	25		ns
			2 V	SN54HC74	40		
				SN74HC74	30		
				T <sub>A</sub> = 25°C	5		
		PRE or CLR inactive	4.5 V	SN54HC74	8		-
				SN74HC74	6		
				$T_A = 25^{\circ}C$	4		
			6 V	SN54HC74	7		-
	Setup time before ' CLK↑			SN74HC74	5		

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#### **Timing Requirements (continued)**

0.0.	eeen operating nee an temperature range,	· A = • • (******			
		V <sub>cc</sub>	T <sub>A</sub>	MIN MAX	UNIT
		2 V		0	
t <sub>h</sub>	Hold time, data after CLK↑	4.5 V		0	ns
	h Hold time, data after CLK↑	6 V		0	

over recommended operating free-air temperature range,  $T_A = 25^{\circ}C$  (unless otherwise noted)

## 6.7 Switching Characteristics

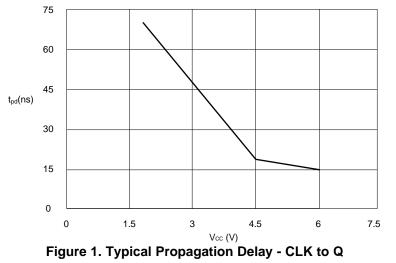
over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>cc</sub>	T <sub>A</sub>	MIN	ТҮР	МАХ	UNIT
				T <sub>A</sub> = 25°C	6	10		
			2 V	SN54HC74	4.2			
				SN74HC74	6			
				T <sub>A</sub> = 25°C	31	50		
f <sub>max</sub>			4.5 V	SN54HC74	21			MHz
				SN74HC74	25			
				$T_A = 25^{\circ}C$	36	60		
			6 V	SN54HC74	25			
				SN74HC74	29			
				T <sub>A</sub> = 25°C		70	230	
			2 V	SN54HC74			345	
				SN74HC74			290	
				T <sub>A</sub> = 25°C		20	46	
	PRE or CLR	Q or $\overline{Q}$	4.5 V	SN54HC74			69	- ns
				SN74HC74			58	
				T <sub>A</sub> = 25°C		15	39	
			6 V	SN54HC74			59	
				SN74HC74			49	
t <sub>pd</sub>		Q or Q	2 V 4.5 V	T <sub>A</sub> = 25°C		70	175	
				SN54HC74			250	
				SN74HC74			220	
				T <sub>A</sub> = 25°C		20	35	
	CLK			SN54HC74			50	
				SN74HC74			44	
				T <sub>A</sub> = 25°C		15	30	
			6 V	SN54HC74			42	
				SN74HC74			37	-
				T <sub>A</sub> = 25°C		28	75	
			2 V	SN54HC74			110	-
				SN74HC74			95	
				T <sub>A</sub> = 25°C		8	15	ns
t <sub>t</sub>		Q or $\overline{Q}$	4.5 V	SN54HC74			22	
				SN74HC74			19	
				T <sub>A</sub> = 25°C		6	13	
			6 V	SN54HC74			19	
				SN74HC74			16	

NSTRUMENTS

EXAS

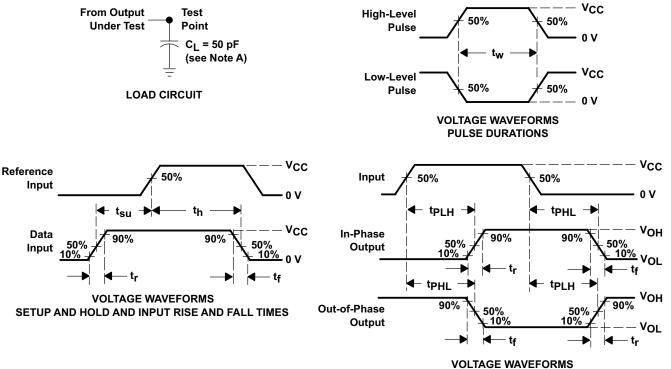
# 6.8 Typical Characteristics



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# 7 Parameter Measurement Information



#### PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

- A. C<sub>L</sub> includes probe and test-fixture capacitance.
- B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1 MHz, Z<sub>0</sub> = 50  $\Omega$ , t<sub>r</sub> = 6 ns, t<sub>f</sub> = 6 ns.
- C. For clock inputs,  $f_{\text{max}}$  is measured when the input duty cycle is 50%.
- D. The outputs are measured one at a time with one input transition per measurement.
- E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

#### Figure 2. Load Circuit and Voltage Waveforms

SN54HC74, SN74HC74 SCLS094E – DECEMBER 1982–REVISED DECEMBER 2015



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## 8 Detailed Description

#### 8.1 Overview

Figure 3 describes the SNx4HC74 devices. As the SNx4HC74 is a dual D-Type positive-edge-triggered flip-flop with clear and preset, the diagram below describes one of the two device flip-flops.

## 8.2 Functional Block Diagram

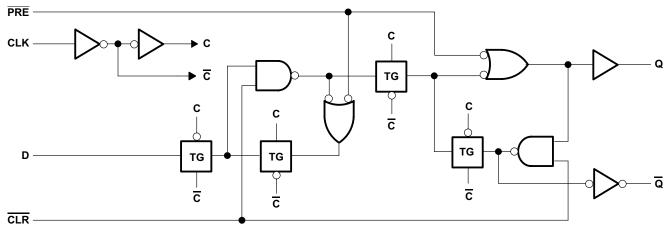


Figure 3. Logic Diagram (Positive Logic)

## 8.3 Feature Description

The SNx4HC74 inputs accept voltage levels up to 5.5 V. Refer to the *Recommended Operating Conditions* for appropriate input high and low logic levels.

## 8.4 Device Functional Modes

Table 1 lists the functional modes of the SNx4HC74.

INPUTS				OUTPUTS				
PRE	CLR	CLK	D	Q	Q			
L	Н	Х	Х	Н	L			
Н	L	х	Х	L	Н			
L	L	х	Х	H <sup>(1)</sup>	H <sup>(1)</sup>			
Н	Н	↑	Н	Н	L			
Н	Н	↑	L	L	Н			
Н	Н	L	Х	Q <sub>0</sub>	$\overline{Q}_0$			

Table 1. Function Table

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



# 9 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.

#### 9.1 Application Information

A low level at the preset (PRE) or clear (CLR) input sets or resets the outputs, regardless of the levels of the other inputs. When PRE and 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 related directly 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.

The resistor and capacitor at the  $\overline{\text{CLR}}$  pin are optional. If they are not used, the  $\overline{\text{CLR}}$  pin should be connected directly to V<sub>CC</sub> to be inactive.

## 9.2 Typical Application

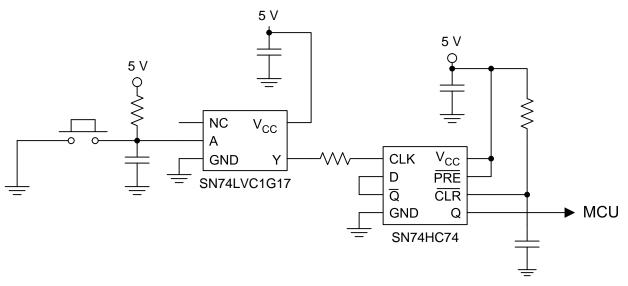


Figure 4. Device Power Button Circuit

#### 9.2.1 Design Requirements

This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. Outputs may be combined to produce higher drive, but the high drive will also create faster edges into light loads. Because of this, routing and load conditions should be considered to prevent ringing.

## 9.2.2 Detailed Design Procedure

- 1. Recommended Input Conditions:
  - For rise time and fall time specifications, see ( $\Delta t/\Delta V$ ) in *Recommended Operating Conditions* table.
  - For specified high and low levels, see (V<sub>IH</sub> and V<sub>IL</sub>) in *Recommended Operating Conditions* table.
  - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid V<sub>CC</sub>.
- 2. Recommended Output Conditions:
  - Load currents should not exceed 25 mA per output and 50 mA total for the part.
  - Series resistors on the output may be used if the user desires to slow the output edge signal or limit the output current.

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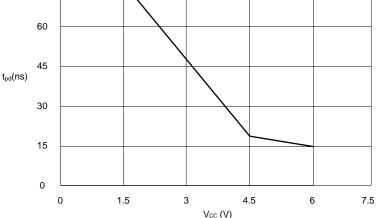


Figure 5. Typical Propagation Delay - CLR to Q

# **10** Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the Recommended Operating Conditions table. Each V<sub>CC</sub> terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1-µF capacitor is recommended and if there are multiple V<sub>CC</sub> terminals then .01-µF or .022-µF capacitors are recommended for each power terminal. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1-µF and 1-µF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

**Typical Application (continued)** 

9.2.3 Application Curve

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# 11 Layout

## 11.1 Layout Guidelines

When using multiple bit logic devices, inputs should not float. In many cases, functions or parts of functions of digital logic devices are unused. Some examples are 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 should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states.

Specified in Figure 6 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. It is acceptable to float outputs unless the part is a transceiver. If the transceiver has an output enable pin, it disables the output section of the part when asserted. This pin keeps the input section of the I/Os from being disabled and floated.

## 11.2 Layout Example

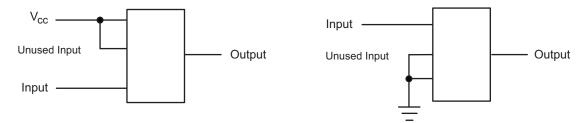


Figure 6. Layout Diagram

TEXAS INSTRUMENTS

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# **12 Device and Documentation Support**

#### **12.1** Documentation Support

#### 12.1.1 Related Documentation

For related documentation, see the following: Implications of Slow or Floating CMOS Inputs, SCBA004

#### 12.2 Related Links

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

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY		
SN54HC74	Click here	Click here	Click here	Click here	Click here		
SN74HC74	Click here	Click here	Click here	Click here	Click here		

#### Table 2. Related Links

## 12.3 Community Resources

The following links connect to TI community resources. Linked contents are 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.

TI E2E<sup>™</sup> Online Community *TI's Engineer-to-Engineer (E2E) Community.* Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support TI's Design Support** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

#### 12.4 Trademarks

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

#### 12.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## 12.6 Glossary

SLYZ022 — TI Glossary.

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

# 13 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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