

## SNx4LV594A 8-Bit Shift Registers With Output Registers

### 1 Features

- 2-V to 5.5-V  $V_{CC}$  Operation
- Maximum  $t_{pd}$  of 6.5 ns at 5 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- 8-Bit Serial-In, Parallel-Out Shift Registers With Storage
- Independent Direct Overriding Clears on Shift and Storage Registers
- Independent Clocks for Shift and Storage Registers
- Latch-up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

### 2 Applications

- ECG Electrocardiograms
- Storage Servers
- EPOS, ECR, and Cash Drawers
- Servers and High-Performance Computing

### 3 Description

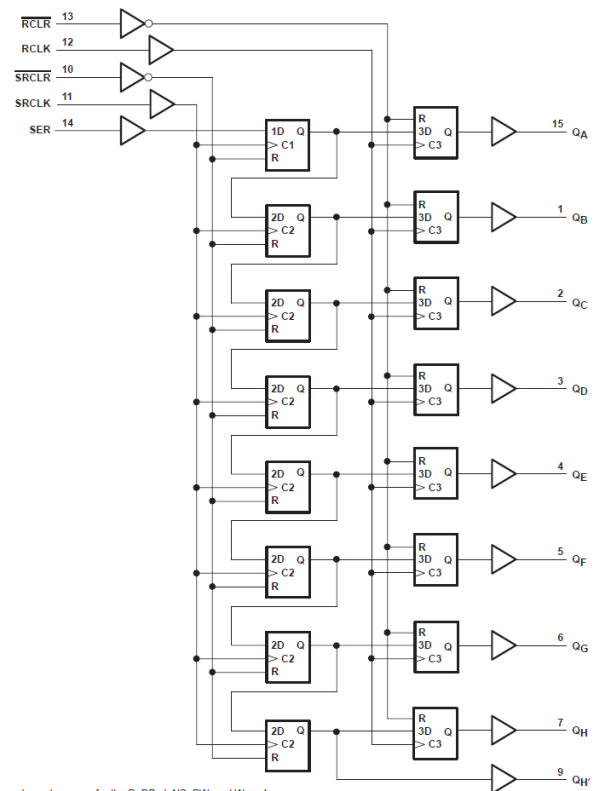
The SN74LV594A devices are 8-bit shift registers designed for 2-V to 5.5-V  $V_{CC}$  operation.

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

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN74LV594A	SSOP (16)	6.20 mm x 5.30 mm
	SOIC (16)	9.90 mm x 3.91 mm
	TSSOP (16)	5.00 mm x 4.40 mm

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

#### Logic Diagram (Positive Logic)



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## 4 Revision History

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

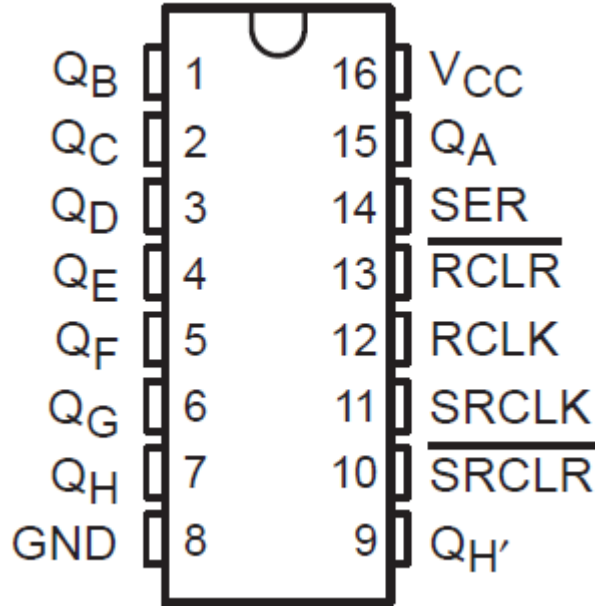
### Changes from Revision I (April 2005) to Revision J

Page

- Added *Pin Configuration and Functions* section, *ESD Ratings* 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**

## 5 Pin Configuration and Functions

D, DB, or PW Package  
16-Pin SOIC, SSOP, or TSSOP  
Top View



**Pin Functions**

PIN		I/O	DESCRIPTION
NO.	NAME		
1	Q <sub>B</sub>	O	Output B
2	Q <sub>C</sub>	O	Output C
3	Q <sub>D</sub>	O	Output D
4	Q <sub>E</sub>	O	Output E
5	Q <sub>F</sub>	O	Output F
6	Q <sub>G</sub>	O	Output G
7	Q <sub>H</sub>	O	Output H
8	GND	–	Ground pin
9	Q <sub>H</sub> '	O	Q <sub>H</sub> inverted
10	$\overline{\text{SRCLR}}$	I	Serial clear
11	SRCLK	I	Serial clock
12	RCLK	I	Storage clock
13	$\overline{\text{RCLR}}$	I	Storage clear
14	SER	I	Serial input
15	Q <sub>A</sub>	O	Output A
16	V <sub>cc</sub>	–	Power pin

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	-0.5	7	V
V <sub>I</sub>	Input voltage <sup>(2)</sup>	-0.5	7	V
V <sub>O</sub>	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	-0.5	7	V
V <sub>O</sub>	Output voltage <sup>(2)(3)</sup>	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0		mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		mA
I <sub>O</sub>	Continuous output current	V <sub>O</sub> = 0 to V <sub>CC</sub>		mA
T <sub>stg</sub>	Storage temperature	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value is limited to 5.5 V maximum.

### 6.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	2000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	1000

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

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

		SN54LV594A <sup>(2)</sup>		SN74LV594A		UNIT
		MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage	2	5.5	2	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V	1.5	1.5		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	V <sub>CC</sub> × 0.7	V <sub>CC</sub> × 0.7		
		V <sub>CC</sub> = 3 V to 3.6 V	V <sub>CC</sub> × 0.7	V <sub>CC</sub> × 0.7		
		V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> × 0.7	V <sub>CC</sub> × 0.7		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0.5	0.5	V
		V <sub>CC</sub> = 2.3 V to 2.7 V		V <sub>CC</sub> × 0.3	V <sub>CC</sub> × 0.3	
		V <sub>CC</sub> = 3 V to 3.6 V		V <sub>CC</sub> × 0.3	V <sub>CC</sub> × 0.3	
		V <sub>CC</sub> = 4.5 V to 5.5 V		V <sub>CC</sub> × 0.3	V <sub>CC</sub> × 0.3	
V <sub>I</sub>	Input voltage	0	5.5	0	5.5	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level input current	V <sub>CC</sub> = 2 V		–50	–50	μA
		V <sub>CC</sub> = 2.3 V to 2.7 V		–2	–2	mA
		V <sub>CC</sub> = 3 V to 3.6 V		6	6	
		V <sub>CC</sub> = 4.5 V to 5.5 V		–12	–12	
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 2 V		50	50	μA
		V <sub>CC</sub> = 2.3 V to 2.7 V		2	2	mA
		V <sub>CC</sub> = 3 V to 3.6 V		6	6	
		V <sub>CC</sub> = 4.5 V to 5.5 V		12	12	
Δt/Δv	Input transition rise or fall rate V <sub>CC</sub> = 2.3 V to 2.7 V V <sub>CC</sub> = 3 V to 3.6 V V <sub>CC</sub> = 4.5 V to 5.5 V		200	200	ns/V	
			100	100		
			20	20		
T <sub>A</sub>	Operating free-air temperature	–55	125	–40	125	°C

(1) 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](#).

(2) Product Preview

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		SN74LV594A			UNIT
		D (SOIC)	DB (SSOP)	PW (TSSOP)	
		16 PINS	16 PINS	16 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	80.2	97.8	106.1	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	40.3	48.1	40.8	
R <sub>θJB</sub>	Junction-to-board thermal resistance	38	48.5	51.1	
ψ <sub>JT</sub>	Junction-to-top characterization parameter	9	10	3.8	
ψ <sub>JB</sub>	Junction-to-board characterization parameter	37.7	47.9	50.6	

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

## 6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	VCC	SN54LV594A			SN74LV594A –40°C TO 85°C			SN74LV594A –40°C TO 125°C			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = –50 μA	2 V to 5.5 V	V <sub>CC</sub> – 0.1			V <sub>CC</sub> – 0.1			V <sub>CC</sub> – 0.1			V
	I <sub>OH</sub> = –2 μA	2.3 V	2			2			2			
	I <sub>OH</sub> = –6 μA	3 V	2.48			2.48			2.48			
	I <sub>OH</sub> = –12 μA	4.5 V	3.8			3.8			3.8			
V <sub>OL</sub>	I <sub>OH</sub> = –50 μA	2 V to 5.5 V	0.1			0.1			0.1			V
	I <sub>OH</sub> = –2 μA	2.3 V	0.4			0.4			0.4			
	I <sub>OH</sub> = –6 μA	3 V	0.44			0.44			0.44			
	I <sub>OH</sub> = –12 μA	4.5 V	0.55			0.55			0.55			
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±1			±1			±1			μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> of GND, I <sub>O</sub> = 0	5.5 V	20			20			20			μA
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V	0	5			5			5			μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	3.5			3.5						pF

## 6.6 Switching Characteristics: V<sub>CC</sub> = 2.5 V ± 0.2 V

 over recommended operating free-air temperature range, V<sub>CC</sub> = 2.5 V ± 0.2 V (unless otherwise noted). See Figure 1.

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T <sub>A</sub> = 25°C			SN54lv594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT		
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
f <sub>max</sub>			C <sub>L</sub> = 15 pF	65 <sup>(1)</sup>	80 <sup>(1)</sup>		45 <sup>(1)</sup>		45		35	MHz			
			C <sub>L</sub> = 50 pF	60	70		40		40		30				
t <sub>PLH</sub>	SRCLK	Q <sub>A</sub> – Q <sub>H</sub>	C <sub>L</sub> = 15 pF	6.4 <sup>(1)</sup>	10.6 <sup>(1)</sup>		1 <sup>(1)</sup>	11.1 <sup>(1)</sup>	1	11.1	1	12.5	ns		
t <sub>PHL</sub>				6.3 <sup>(1)</sup>	10.4 <sup>(1)</sup>		1 <sup>(1)</sup>	11.1 <sup>(1)</sup>	1	11.1	1	12.5			
t <sub>PLH</sub>		Q <sub>H'</sub>		7.4 <sup>(1)</sup>	12.1 <sup>(1)</sup>		1 <sup>(1)</sup>	12.8 <sup>(1)</sup>	1	12.8	1	15			
t <sub>PHL</sub>				7.2 <sup>(1)</sup>	11.6 <sup>(1)</sup>		1 <sup>(1)</sup>	12.8 <sup>(1)</sup>	1	12.8	1	15			
t <sub>PHL</sub>	RCLK	Q <sub>A</sub> – Q <sub>H</sub>		7.9 <sup>(1)</sup>	12.7 <sup>(1)</sup>		1 <sup>(1)</sup>	13.6 <sup>(1)</sup>	1	13.6	1	15.5			
		Q <sub>H'</sub>		7.4 <sup>(1)</sup>	11.9 <sup>(1)</sup>		1 <sup>(1)</sup>	13.1 <sup>(1)</sup>	1	13.1	1	15.5			
t <sub>PLH</sub>	SRCLR	Q <sub>A</sub> – Q <sub>H</sub>		C <sub>L</sub> = 50 pF	9.5	14.1		1	14.6	1	14.6	1		17	ns
t <sub>PHL</sub>					10.8	15.5		1	17.2	1	17.2	1		19.5	
t <sub>PLH</sub>		Q <sub>H'</sub>	10.6		15.7		1	16.5	1	16.5	1	18.5			
t <sub>PHL</sub>			11.3		16.1		1	18.6	1	18.6	1	20.5			
t <sub>PHL</sub>		RCLR	Q <sub>A</sub> – Q <sub>H</sub>		12.1	17.4		1	19	1	19	1	21		
			Q <sub>H'</sub>		11.6	16.5		1	18.6	1	18.6	1	20.6		

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

### 6.7 Switching Characteristics: $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted). See [Figure 1](#).

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT	
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
$f_{\text{max}}$			$C_L = 15\text{ pF}$	80 <sup>(1)</sup>	120 <sup>(1)</sup>		70 <sup>(1)</sup>		70		60	MHz		
			$C_L = 50\text{ pF}$	55	105		50		50		40			
$t_{\text{PLH}}$	SRCLK	$Q_A - Q_H$	$C_L = 15\text{ pF}$	4.6 <sup>(1)</sup>	8 <sup>(1)</sup>	1 <sup>(1)</sup>	8.5 <sup>(1)</sup>	1	8.5	1	10.5	ns		
$t_{\text{PHL}}$				4.9 <sup>(1)</sup>	8.2 <sup>(1)</sup>	1 <sup>(1)</sup>	8.8 <sup>(1)</sup>	1	8.8	1	10.5			
$t_{\text{PLH}}$		$Q_{H'}$		5.4 <sup>(1)</sup>	9.1 <sup>(1)</sup>	1 <sup>(1)</sup>	9.7 <sup>(1)</sup>	1	9.7	1	11.5			
$t_{\text{PHL}}$				5.5 <sup>(1)</sup>	9.2 <sup>(1)</sup>	1 <sup>(1)</sup>	9.9 <sup>(1)</sup>	1	9.9	1	11.6			
$t_{\text{PHL}}$	RCLK	$Q_A - Q_H$		6 <sup>(1)</sup>	9.8 <sup>(1)</sup>	1 <sup>(1)</sup>	10.6 <sup>(1)</sup>	1	10.6	1	12.1			
		$Q_{H'}$		5.6 <sup>(1)</sup>	9.2 <sup>(1)</sup>	1 <sup>(1)</sup>	10 <sup>(1)</sup>	1	10	1	12			
$t_{\text{PLH}}$	$\overline{\text{SRCLR}}$	$Q_A - Q_H$		$C_L = 50\text{ pF}$			1	11.1	1	11.1	1		12.5	ns
$t_{\text{PHL}}$							1	13.1	1	13.1	1		15	
$t_{\text{PLH}}$		$Q_{H'}$				1	12.4	1	12.4	1	14			
$t_{\text{PHL}}$						1	13.9	1	13.9	1	15.5			
$t_{\text{PHL}}$	$\overline{\text{RCLR}}$	$Q_A - Q_H$				1	14.4	1	14.4	1	16.1			
		$Q_{H'}$				1	14	1	14	1	16			

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

### 6.8 Switching Characteristics: $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted). See [Figure 1](#).

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT	
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
$f_{\text{max}}$			$C_L = 15\text{ pF}$	135 <sup>(1)</sup>	170 <sup>(1)</sup>		115 <sup>(1)</sup>		115		105	MHz		
			$C_L = 50\text{ pF}$	120	140		95		95		85			
$t_{\text{PLH}}$	SRCLK	$Q_A - Q_H$	$C_L = 15\text{ pF}$	3.3 <sup>(1)</sup>	6.2 <sup>(1)</sup>	1 <sup>(1)</sup>	6.5 <sup>(1)</sup>	1	6.5	1	8	ns		
$t_{\text{PHL}}$				3.7 <sup>(1)</sup>	6.5 <sup>(1)</sup>	1 <sup>(1)</sup>	6.9 <sup>(1)</sup>	1	6.9	1	8.5			
$t_{\text{PLH}}$		$Q_{H'}$		3.7 <sup>(1)</sup>	6.8 <sup>(1)</sup>	1 <sup>(1)</sup>	7.2 <sup>(1)</sup>	1	7.2	1	8.5			
$t_{\text{PHL}}$				4.1 <sup>(1)</sup>	7.2 <sup>(1)</sup>	1 <sup>(1)</sup>	7.6 <sup>(1)</sup>	1	7.6	1	9			
$t_{\text{PHL}}$	RCLK	$Q_A - Q_H$		4.5 <sup>(1)</sup>	7.6 <sup>(1)</sup>	1 <sup>(1)</sup>	8.2 <sup>(1)</sup>	1	8.2	1	9.5			
		$Q_{H'}$		4.1 <sup>(1)</sup>	7.1 <sup>(1)</sup>	1 <sup>(1)</sup>	7.6 <sup>(1)</sup>	1	7.6	1	9			
$t_{\text{PLH}}$	$\overline{\text{SRCLR}}$	$Q_A - Q_H$		$C_L = 50\text{ pF}$	4.9	7.8	1	8.3	1	8.3	1		9.6	ns
$t_{\text{PHL}}$							5.8	8.9	1	9.7	1		9.7	
$t_{\text{PLH}}$		$Q_{H'}$				5.5	8.6	1	9.1	1	9.1	1	10.5	
$t_{\text{PHL}}$						6	9.2	1	10.1	1	10.1	1	11.5	
$t_{\text{PHL}}$	$\overline{\text{RCLR}}$	$Q_A - Q_H$				6.6	10	1	10.7	1	10.7	1	12	
		$Q_{H'}$				6	9.2	1	10.1	1	10.1	1	11.5	

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

### 6.9 Timing Requirements: $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ . See [Figure 1](#).

		$T_A = 25^\circ\text{C}$		SN54LV594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_w$	Pulse duration	RCLK or SRCLK high or low	7		7.5		7.5		8.5	ns
		$\overline{\text{RCKR}}$ or $\overline{\text{SCRCLR}}$ low	6		6.5		6.5		7.5	
$t_{su}$	Setup time	SER before SRCLK $\uparrow$	5.5		5.5		5.5		6	ns
		SRCLK $\uparrow$ before RCLK $\uparrow$	8		9		9		10	
		$\overline{\text{SCRCLR}}$ low before RCLK $\uparrow$ <sup>(1)</sup>	8.5		9.5		9.5		10.5	
		$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	6		6.8		6.8		7.5	
		$\overline{\text{RCLK}}$ high (inactive) before RCLK $\uparrow$	6.7		7.6		7.6		8.5	
$t_h$	Hold time	SER after SRCLK $\uparrow$	1.5		1.5		1.5		2	ns

(1) This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

### 6.10 Timing Requirements: $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ . See [Figure 1](#).

		$T_A = 25^\circ\text{C}$		SN54LV594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_w$	Pulse duration	RCLK or SRCLK high or low	5.5		5.5		5.5		6.5	ns
		$\overline{\text{RCKR}}$ or $\overline{\text{SCRCLR}}$ low	5		5		5		6	
$t_{su}$	Setup time	SER before SRCLK $\uparrow$	3.5		3.5		3.5		4	ns
		SRCLK $\uparrow$ before RCLK $\uparrow$	8		8.5		8.5		9.5	
		$\overline{\text{SCRCLR}}$ low before RCLK $\uparrow$ <sup>(1)</sup>	8		9		9		10	
		$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	4.2		4.8		4.8		5.5	
		$\overline{\text{RCLK}}$ high (inactive) before RCLK $\uparrow$	4.6		5.3		5.3		6	
$t_h$	Hold time	SER after SRCLK $\uparrow$	1.5		1.5		1.5		2	ns

(1) This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.



## 6.11 Timing Requirements: $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$

over recommended operating free-air temperature range,  $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ . See [Figure 1](#).

		$T_A = 25^\circ\text{C}$		SN54LV594A		SN74LV594A –40°C TO 85°C		SN74LV594A –40°C TO 125°C		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_w$	Pulse duration	RCLK or SRCLK high or low	5		5		5		6	ns
		$\overline{\text{RCKR}}$ or $\overline{\text{SCRCLR}}$ low	5.2		5.2		5.2		6.2	
$t_{su}$	Setup time	SER before SRCLK $\uparrow$	3		3		3		3.5	ns
		SRCLK $\uparrow$ before RCLK $\uparrow$	5		5		5		6	
		$\overline{\text{SCRCLR}}$ low before RCLK $\uparrow$ <sup>(1)</sup>	5		5		5		5.5	
		$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	2.9		3.3		3.3		4	
		RCLK high (inactive) before RCLK $\uparrow$	3.2		3.7		3.7		4.5	
$t_h$	Hold time	SER after SRCLK $\uparrow$	2		2		2		2.5	ns

(1) This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

## 6.12 Noise Characteristics<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted),  $V_{CC} = 3.3\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$

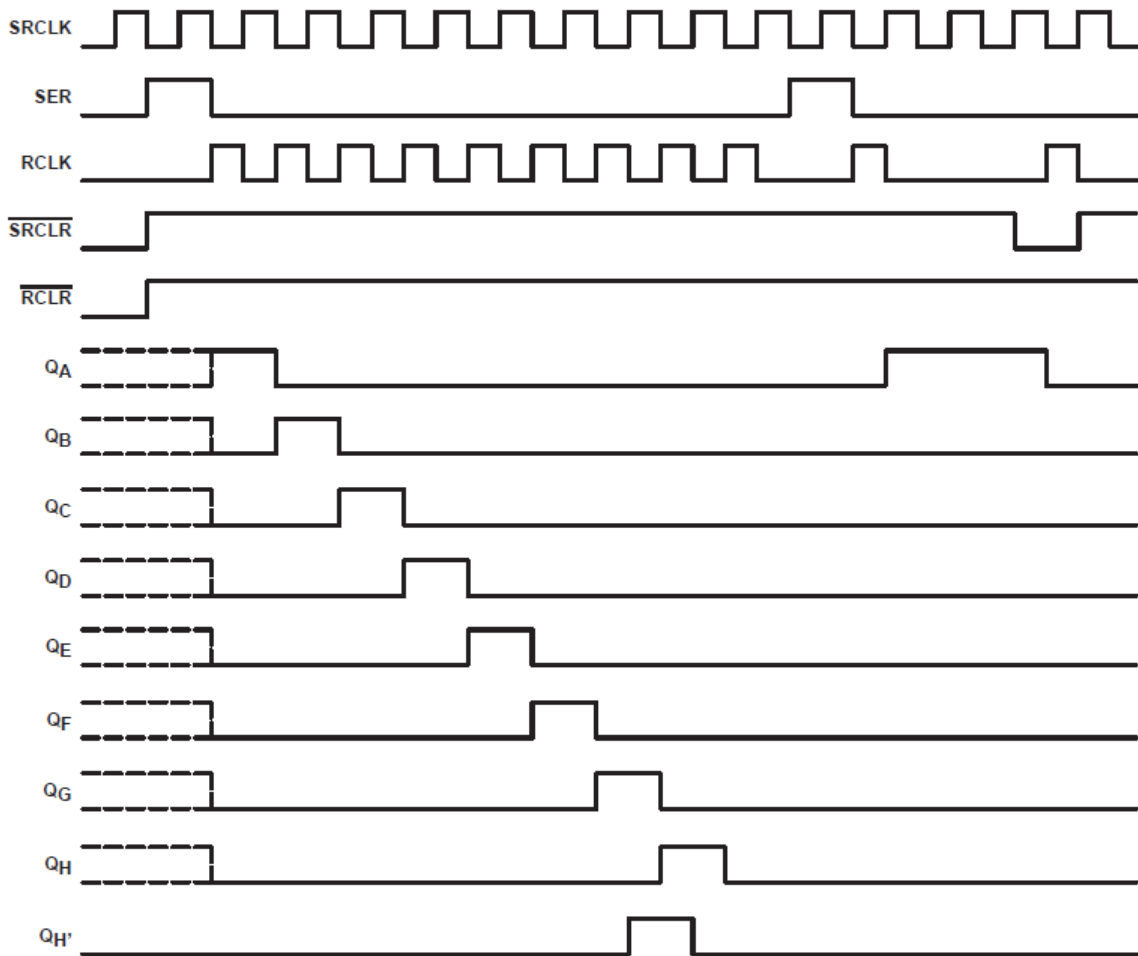
PARAMETER		MIN	TYP	MAX	UNIT
$V_{OL(P)}$	Quiet output, maximum dynamic $V_{OL}$		0.5	0.8	V
$V_{OL(V)}$	Quiet output, minimum dynamic $V_{OL}$		–0.1	–0.8	V
$V_{OH(V)}$	Quiet output, minimum dynamic $V_{OH}$		2.8		V
$V_{IH(V)}$	High-level dynamic input voltage	2.31			V
$V_{IL(V)}$	Low-level dynamic input voltage			0.99	V

(1) Characteristics are for surface-mount packages only.

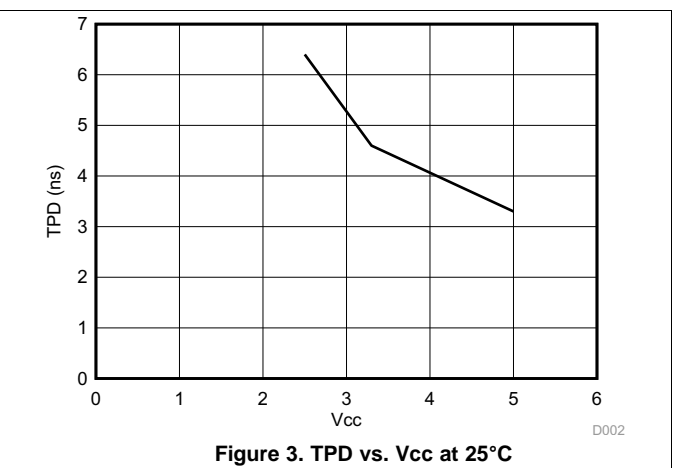
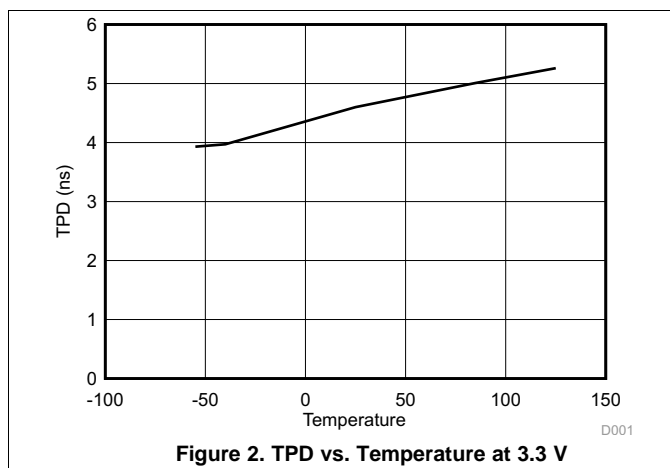
## 6.13 Operating Characteristics

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

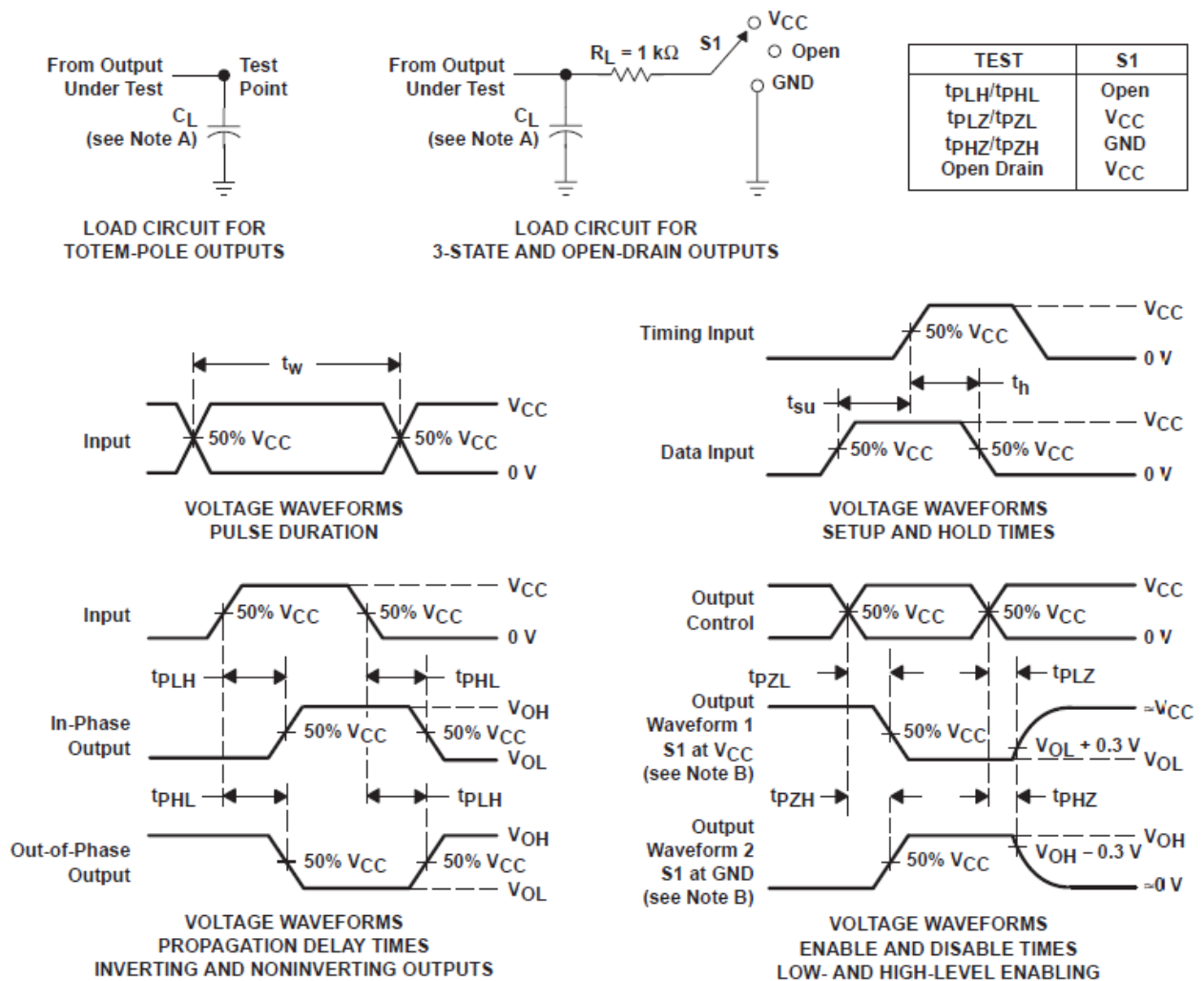
PARAMETER		TEST CONDITIONS	$V_{CC}$	TYP	UNIT
$C_{pd}$	Power dissipation capacitance	f = 10 MHz	3.3 V	93	pF
			5 V	112	


**Figure 1. Timing Diagram**

## 6.14 Typical Characteristics



## 7 Parameter Measurement Information



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
 C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1 MHz,  $Z_O = 50\ \Omega$ ,  $t_r \leq 3\text{ ns}$ ,  $t_f \leq 3\text{ ns}$ .  
 D. The outputs are measured one at a time, with one input transition per measurement.  
 E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
 G.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .  
 H. All parameters and waveforms are not applicable to all devices.

Figure 4. Load Circuit and Voltage Waveforms

## 8 Detailed Description

### 8.1 Overview

The SN74LV594A devices are 8-bit shift registers designed for 2-V to 5.5-V  $V_{CC}$  operation.

These devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks (RCLK, SRCLK) and direct overriding clear ( $\overline{RCLR}$ ,  $\overline{SRCLR}$ ) inputs are provided on the shift and storage registers. A serial output ( $Q_H$ ) is provided for cascading purposes. The shift-register (SRCLK) and storage-register (RCLK) clocks are positive-edge triggered. If the clocks are tied together, the shift register always is one clock pulse ahead of the storage register.

## 8.2 Functional Block Diagram

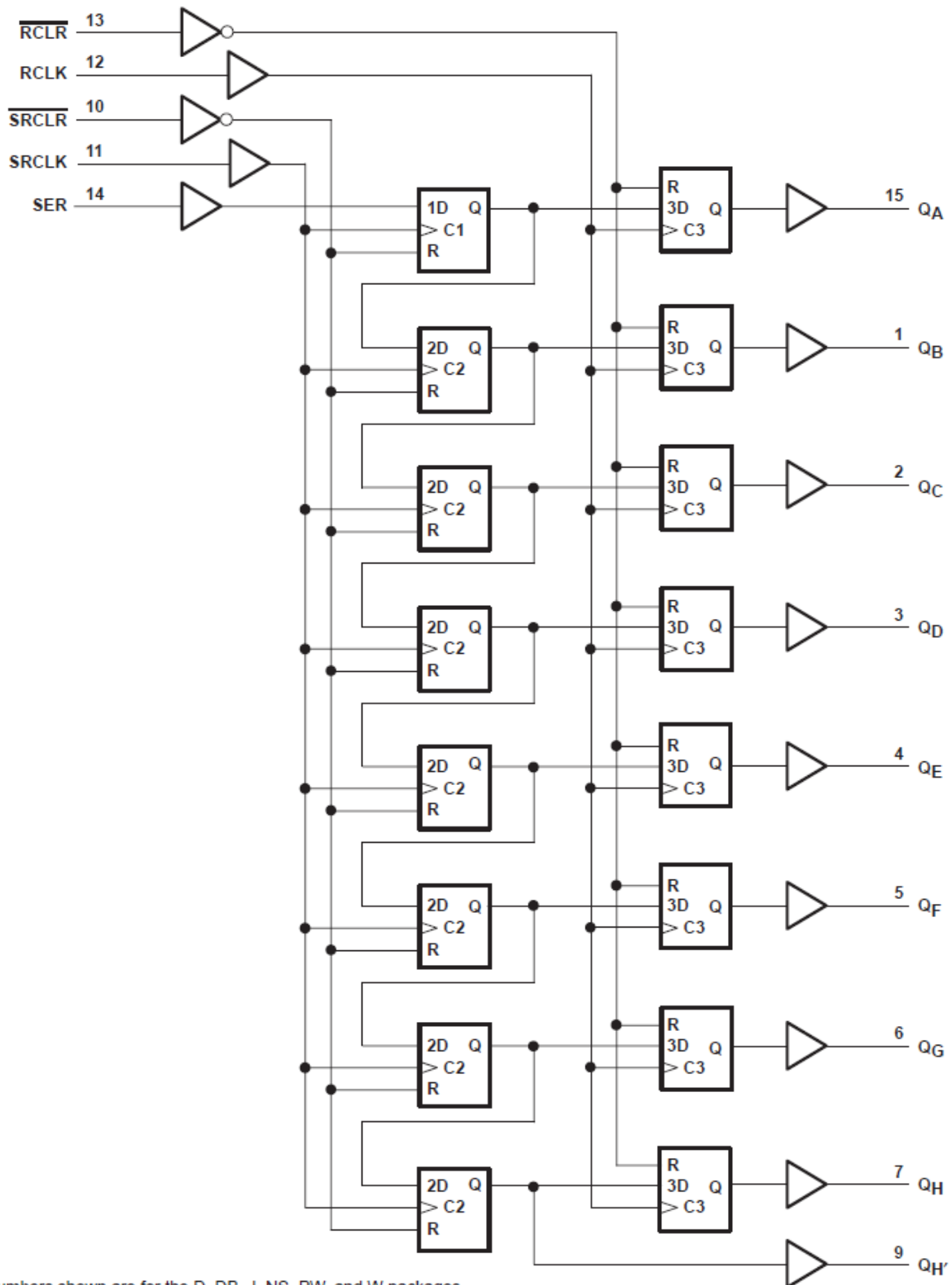


Figure 5. Logic Diagram (Positive Logic)

### 8.3 Feature Description

The device's wide operating range allows it to be used in a variety of systems that use different logic levels. The low propagation delay allows fast switching and higher speeds of operation. In addition, the low ground bounce stabilizes the performance of non-switching outputs while another output is switching.

### 8.4 Device Functional Modes

**Table 1. Function Table**

INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	RCLR	
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of shift register goes low. Other stages store the data of previous stage, respectively.
H	↑	H	X	X	First stage of shift register goes high. Other stages store the data of previous stage, respectively.
L	↓	H	X	X	Shift register state is not changed.
X	X	X	X	L	Storage register is cleared.
X	X	X	↑	H	Shift register data is stored in the storage register.
X	X	X	↓	H	Storage register state is not changed.

## 9 Application and Implementation

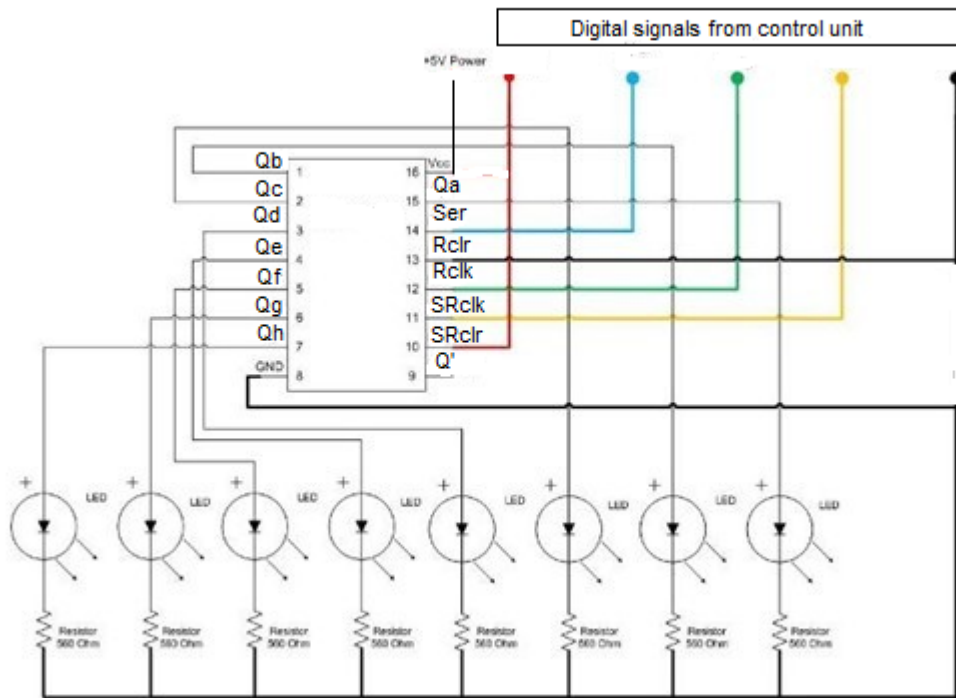
### NOTE

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

The SN74LV594A is a low drive CMOS device that can be used for a multitude of bus interface type applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs.

### 9.2 Typical Application



**Figure 6. Typical Application Schematic**

#### 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. The high drive will also create fast edges into light loads so consider routing and load conditions to prevent ringing.

## Typical Application (continued)

### 9.2.2 Detailed Design Procedure

- Recommended input conditions:
  - Rise time and fall time specs. See  $(\Delta t/\Delta V)$  in [Recommended Operating Conditions](#).
  - Specified high and low levels. See  $(V_{IH}$  and  $V_{IL})$  in [Recommended Operating Conditions](#).
  - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid  $V_{CC}$ .
- Recommended output conditions:
  - Load currents should not exceed 25 mA per output and 50 mA total for the part.
  - Outputs should not be pulled above  $V_{CC}$ .

### 9.2.3 Application Curves

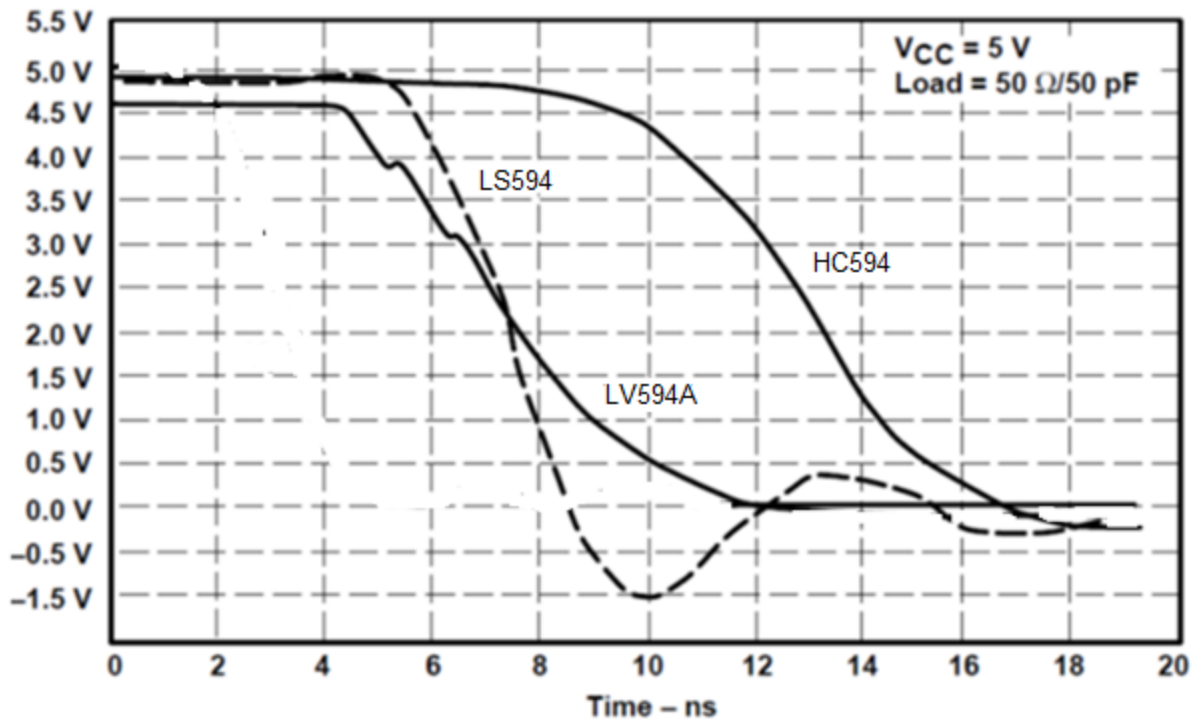


Figure 7. Switching Characteristics Comparison



## 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](#). Each  $V_{CC}$  terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, TI recommends a 0.1- $\mu\text{F}$  capacitor and if there are multiple  $V_{CC}$  terminals then TI recommends a 0.01- $\mu\text{F}$  or 0.022- $\mu\text{F}$  capacitor for each power terminal. Multiple bypass capacitors can be paralleled to reject different frequencies of noise. Frequencies of 0.1  $\mu\text{F}$  and 1  $\mu\text{F}$  are commonly used in parallel. The bypass capacitor should be installed as close as possible to the power terminal for best results.

## 11 Layout

### 11.1 Layout Guidelines

When using multiple bit logic devices inputs should not ever float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only three of the four 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 below are the 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 should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or  $V_{CC}$  whichever make more sense or is more convenient. Floating outputs is generally acceptable, unless the part is a transceiver. If the transceiver has an output enable pin it will disable the outputs section of the part when asserted. This will not disable the input section of the I.O's so they also cannot float when disabled.

### 11.2 Layout Example

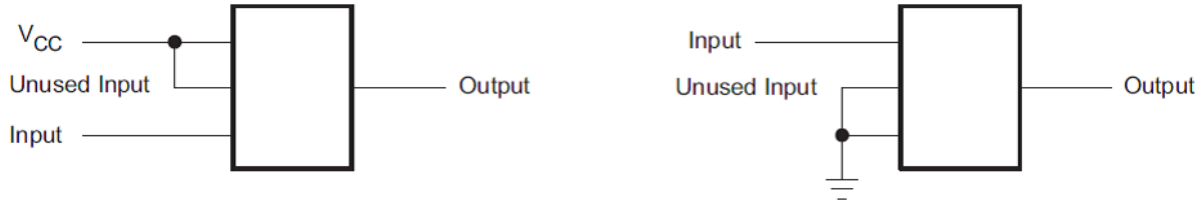


Figure 8. Layout Example

## 12 Device and Documentation Support

### 12.1 Trademarks

All trademarks are the property of their respective owners.

### 12.2 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.

### 12.3 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.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LV594AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594ADBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWT	ACTIVE	TSSOP	PW	16	250	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>
SN74LV594APWTG4	ACTIVE	TSSOP	PW	16	250	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LV594A	<a href="#">Samples</a>

(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.

**OBSOLETE:** TI has discontinued the production of the device.

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(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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm 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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION



### 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
SN74LV594ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74LV594APWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV594APWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV594APWRG4	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74LV594APWT	TSSOP	PW	16	250	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)
SN74LV594ADR	SOIC	D	16	2500	333.2	345.9	28.6
SN74LV594APWR	TSSOP	PW	16	2000	364.0	364.0	27.0
SN74LV594APWR	TSSOP	PW	16	2000	367.0	367.0	35.0
SN74LV594APWRG4	TSSOP	PW	16	2000	367.0	367.0	35.0
SN74LV594APWT	TSSOP	PW	16	250	367.0	367.0	35.0

DB (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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.  
 D. Falls within JEDEC MO-150





D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- 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.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/A 02/2017

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

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/A 02/2017

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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