



## SNx4HC595 8-Bit Shift Registers With 3-State Output Registers

### 1 Features

- 8-Bit Serial-In, Parallel-Out Shift
- Wide Operating Voltage Range of 2 V to 6 V
- High-Current 3-State Outputs Can Drive Up to 15 LSTTL Loads
- Low Power Consumption: 80- $\mu$ A (Maximum)  $I_{CC}$
- $t_{pd} = 13$  ns (Typical)
- $\pm 6$ -mA Output Drive at 5 V
- Low Input Current: 1  $\mu$ A (Maximum)
- Shift Register Has Direct Clear
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

### 2 Applications

- Network Switches
- Power Infrastructure
- LED Displays
- Servers

### 3 Description

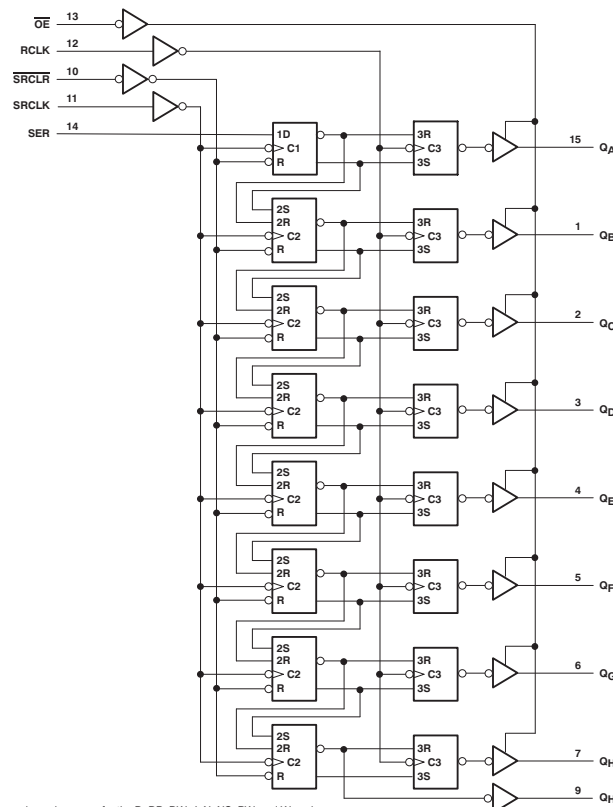
The SNx4HC595 devices contain an 8-bit, serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift and storage register. The shift register has a direct overriding clear (SRCLR) input, serial (SER) input, and serial outputs for cascading. When the output-enable ( $\overline{OE}$ ) input is high, the outputs are in the high-impedance state.

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

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN54HC595	LCCC (20)	8.89 mm x 8.89 mm
	CDIP (16)	21.34 mm x 6.92 mm
SN74HC595	PDIP (16)	19.31 mm x 6.35 mm
	SOIC (16)	9.90 mm x 3.90 mm
	SOIC (16)	10.30 mm x 7.50 mm
	SSOP (16)	6.20 mm x 5.30 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)



Pin numbers shown are for the D, DB, DW, J, N, NS, PW, and W packages.



## Table of Contents

<b>1 Features</b> .....	<b>1</b>	9.2 Functional Block Diagram .....	<b>12</b>
<b>2 Applications</b> .....	<b>1</b>	9.3 Feature Description .....	<b>13</b>
<b>3 Description</b> .....	<b>1</b>	9.4 Device Functional Modes .....	<b>13</b>
<b>4 Revision History</b> .....	<b>2</b>	<b>10 Application and Implementation</b> .....	<b>14</b>
<b>5 Device Comparison Table</b> .....	<b>3</b>	10.1 Application Information .....	<b>14</b>
<b>6 Pin Configuration and Functions</b> .....	<b>4</b>	10.2 Typical Application .....	<b>14</b>
<b>7 Specifications</b> .....	<b>5</b>	<b>11 Power Supply Recommendations</b> .....	<b>16</b>
7.1 Absolute Maximum Ratings .....	<b>5</b>	<b>12 Layout</b> .....	<b>16</b>
7.2 ESD Ratings .....	<b>5</b>	12.1 Layout Guidelines .....	<b>16</b>
7.3 Recommended Operating Conditions .....	<b>5</b>	12.2 Layout Example .....	<b>16</b>
7.4 Thermal Information .....	<b>6</b>	<b>13 Device and Documentation Support</b> .....	<b>17</b>
7.5 Electrical Characteristics .....	<b>6</b>	13.1 Documentation Support .....	<b>17</b>
7.6 Timing Requirements .....	<b>7</b>	13.2 Related Links .....	<b>17</b>
7.7 Switching Characteristics .....	<b>9</b>	13.3 Community Resources .....	<b>17</b>
7.8 Operating Characteristics .....	<b>9</b>	13.4 Trademarks .....	<b>17</b>
7.9 Typical Characteristics .....	<b>10</b>	13.5 Electrostatic Discharge Caution .....	<b>17</b>
<b>8 Parameter Measurement Information</b> .....	<b>11</b>	13.6 Glossary .....	<b>17</b>
<b>9 Detailed Description</b> .....	<b>12</b>	<b>14 Mechanical, Packaging, and Orderable Information</b> .....	<b>17</b>
9.1 Overview .....	<b>12</b>		

## 4 Revision History

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

Changes from Revision H (November 2009) to Revision I	Page
• Added <i>Applications</i> section, <i>Device Information</i> table, <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section .....	<b>1</b>
• Deleted <i>Ordering Information</i> table. ....	<b>1</b>
• Added Military Disclaimer to <i>Features</i> list. ....	<b>1</b>

## 5 Device Comparison Table

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN54HC595FK	LCCC (20)	8.89 mm x 8.89 mm
SN54HC595J	CDIP (16)	21.34 mm x 6.92 mm
SN74HC595N	PDIP (16)	19.31 mm x 6.35 mm
SN74HC595D	SOIC (16)	9.90 mm x 3.90 mm
SN74HC595DW	SOIC (16)	10.30 mm x 7.50 mm
SN74HC595DB	SSOP (16)	6.20 mm x 5.30 mm
SN74HC595PW	TSSOP (16)	5.00 mm x 4.40 mm

## SN54HC595, SN74HC595

SCLS041I – DECEMBER 1982 – REVISED SEPTEMBER 2015

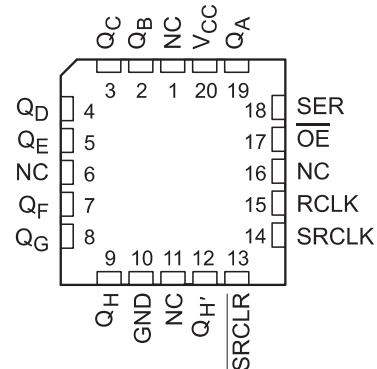
www.ti.com

## 6 Pin Configuration and Functions

**D, N, NS, J, DB, or PW Package**  
16-Pin SOIC, PDIP, SO, CDIP, SSOP, or TSSOP  
Top View



**FK Package**  
20-Pin LCCC  
Top View



### Pin Functions

PIN			I/O	DESCRIPTION
NAME	SOIC, PDIP, SO, CDIP, SSOP, or TSSOP	LCCC		
GND	8	10	—	Ground Pin
$\overline{OE}$	13	17	I	Output Enable
$Q_A$	15	19	O	$Q_A$ Output
$Q_B$	1	2	O	$Q_B$ Output
$Q_C$	2	3	O	$Q_C$ Output
$Q_D$	3	4	O	$Q_D$ Output
$Q_E$	4	5	O	$Q_E$ Output
$Q_F$	5	7	O	$Q_F$ Output
$Q_G$	6	8	O	$Q_G$ Output
$Q_H$	7	9	O	$Q_H$ Output
$Q_{H'}$	9	12	O	$Q_{H'}$ Output
RCLK	12	14	I	RCLK Input
SER	14	18	I	SER Input
SRCLK	11	14	I	SRCLK Input
$\overline{SRCLR}$	10	13	I	$\overline{SRCLR}$ Input
NC	—	1	—	No Connection
		16		
		11		
		16		
$V_{CC}$	—	20	—	Power Pin

## 7 Specifications

### 7.1 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
I <sub>IK</sub>	Input clamp current <sup>(2)</sup>	V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>CC</sub>		±20	mA
I <sub>OK</sub>	Output clamp current <sup>(2)</sup>	V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub>		±20	mA
I <sub>O</sub>	Continuous output current	V <sub>O</sub> = 0 to V <sub>CC</sub>		±35	mA
	Continuous current through V <sub>CC</sub> or GND			±70	mA
T <sub>J</sub>	Junction temperature			150	°C
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, 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.

### 7.2 ESD Ratings

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

### 7.3 Recommended Operating Conditions

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

		SN54HC595			SN74HC595			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	2	5	6	2	5	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V		1.5	1.5			V
		V <sub>CC</sub> = 4.5 V		3.15	3.15			
		V <sub>CC</sub> = 6 V		4.2	4.2			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0.5	0.5			V
		V <sub>CC</sub> = 4.5 V		1.35	1.35			
		V <sub>CC</sub> = 6 V		1.8	1.8			
V <sub>I</sub>	Input voltage	0		V <sub>CC</sub>	0		V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage	0		V <sub>CC</sub>	0		V <sub>CC</sub>	V
Δt/Δv	Input transition rise or fall time <sup>(2)</sup>	V <sub>CC</sub> = 2 V		1000	1000			ns
		V <sub>CC</sub> = 4.5 V		500	500			
		V <sub>CC</sub> = 6 V		400	400			
T <sub>A</sub>	Operating free-air temperature	−55		125	−40		85	°C

- (1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).
- (2) If this device is used in the threshold region (from V<sub>IL</sub> max = 0.5 V to V<sub>IH</sub> min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t<sub>i</sub> = 1000 ns and V<sub>CC</sub> = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

## SN54HC595, SN74HC595

SCLS0411–DECEMBER 1982–REVISED SEPTEMBER 2015

www.ti.com

### 7.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>	SN74AHCT595						UNIT
	D (SOIC)	DB (SSOP)	DW (SOIC)	N (PDIP)	NS (SO)	PW (TSSOP)	
	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	
$R_{\theta JA}$ Junction-to-ambient thermal resistance	73	82	57	67	64	108	°C/W

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

### 7.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\ \mu\text{A}$	2 V	1.9	1.998		1.9		1.9		V
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		$Q_{H1}, I_{OH} = -4\ \text{mA}$	4.5 V	3.98	4.3		3.7		3.84		
				3.98	4.3		3.7		3.84		
				5.48	5.8		5.2		5.34		
		$Q_A - Q_H, I_{OH} = -7.8\ \text{mA}$	6 V	5.48	5.8		5.2		5.34		
				5.48	5.8		5.2		5.34		
$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\ \mu\text{A}$	2 V		0.002	0.1		0.1		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			6 V		0.001	0.1		0.1		0.1	
		$Q_{H1}, I_{OL} = 4\ \text{mA}$	4.5 V		0.17	0.26		0.4		0.33	
					0.17	0.26		0.4		0.33	
					0.15	0.26		0.4		0.33	
		$Q_A - Q_H, I_{OL} = 7.8\ \text{mA}$	6 V		0.15	0.26		0.4		0.33	
					0.15	0.26		0.4		0.33	
$I_I$	$V_I = V_{CC}$ or 0		6 V		$\pm 0.1$	$\pm 100$		$\pm 1000$		$\pm 1000$	nA
$I_{OZ}$	$V_O = V_{CC}$ or 0, $Q_A - Q_H$		6 V		$\pm 0.01$	$\pm 0.5$		$\pm 10$		$\pm 5$	$\mu\text{A}$
$I_{CC}$	$V_I = V_{CC}$ or 0, $I_O = 0$		6 V			8		160		80	$\mu\text{A}$
$C_i$			2 V to 6 V		3	10		10		10	pF

## 7.6 Timing Requirements

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


		$V_{CC}$	$T_A = 25^\circ\text{C}$		SN54HC595		SN74HC595		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{clock}}$	Clock frequency	2 V		6		4.2		5	MHz
		4.5 V		31		21		25	
		6 V		36		25		29	
$t_w$	Pulse duration	2 V	80		120		100		ns
		4.5 V	16		24		20		
		6 V	14		20		17		
	$\overline{\text{SRCLR}}$ low	2 V	80		120		100		
		4.5 V	16		24		20		
		6 V	14		20		17		
$t_{\text{su}}$	Set-up time	SER before SRCLK $\uparrow$	2 V	100		150		125	ns
			4.5 V	20		30		25	
			6 V	17		25		21	
	SRCLK $\uparrow$ before RCLK $\uparrow$ <sup>(1)</sup>	2 V	75		113		94		
		4.5 V	15		23		19		
		6 V	13		19		16		
	$\overline{\text{SRCLR}}$ low before RCLK $\uparrow$	2 V	50		75		65		
		4.5 V	10		15		13		
		6 V	9		13		11		
	$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	2 V	50		75		60		
		4.5 V	10		15		12		
		6 V	9		13		11		
$t_h$	Hold time, SER after SRCLK $\uparrow$	2 V	0		0		0		ns
		4.5 V	0		0		0		
		6 V	0		0		0		

- (1) This set-up 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.

**SN54HC595, SN74HC595**

SCLS0411–DECEMBER 1982–REVISED SEPTEMBER 2015

[www.ti.com](http://www.ti.com)

 NOTE:  implies that the output is in 3-State mode.

**Figure 1. Timing Diagram**



## 7.7 Switching Characteristics

Over recommended operating free-air temperature range.

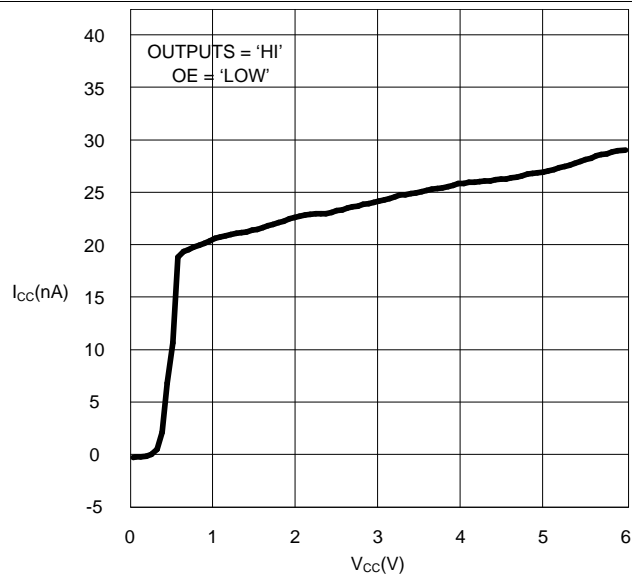
PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC595		SN74HC595		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			50 pF	2 V	6	26		4.2		5		MHz
				4.5 V	31	38		21		25		
				6 V	36	42		25		29		
t <sub>pd</sub>	SRCLK	Q <sub>H'</sub>	50 pF	2 V		50	160	240		200		ns
				4.5 V		17	32	48		40		
				6 V		14	27	41		34		
	RCLK	Q <sub>A</sub> – Q <sub>H</sub>	50 pF	2 V		50	150	225		187		
				4.5 V		17	30	45		37		
				6 V		14	26	38		32		
t <sub>PHL</sub>	$\overline{\text{SRCLR}}$	Q <sub>H'</sub>	50 pF	2 V		51	175	261		219		ns
				4.5 V		18	35	52		44		
				6 V		15	30	44		37		
t <sub>en</sub>	$\overline{\text{OE}}$	Q <sub>A</sub> – Q <sub>H</sub>	50 pF	2 V		40	150	255		187		ns
				4.5 V		15	30	45		37		
				6 V		13	26	38		32		
t <sub>dis</sub>	$\overline{\text{OE}}$	Q <sub>A</sub> – Q <sub>H</sub>	50 pF	2 V		42	200	300		250		ns
				4.5 V		23	40	60		50		
				6 V		20	34	51		43		
t <sub>t</sub>		Q <sub>A</sub> – Q <sub>H</sub>	50 pF	2 V		28	60	90		75		ns
				4.5 V		8	12	18		15		
				6 V		6	10	15		13		
		Q <sub>H'</sub>	50 pF	2 V		28	75	110		95		
				4.5 V		8	15	22		19		
				6 V		6	13	19		16		
t <sub>pd</sub>	RCLK	Q <sub>A</sub> – Q <sub>H</sub>	150 pf	2 V		60	200	300		250		ns
				4.5 V		22	40	60		50		
				6 V		19	34	51		43		
t <sub>en</sub>	$\overline{\text{OE}}$	Q <sub>A</sub> – Q <sub>H</sub>	150 pf	2 V		70	200	298		250		ns
				4.5 V		23	40	60		50		
				6 V		19	34	51		43		
t <sub>t</sub>		Q <sub>A</sub> – Q <sub>H</sub>	150 pf	2 V		45	210	315		265		ns
				4.5 V		17	42	63		53		
				6 V		13	36	53		45		

## 7.8 Operating Characteristics

T<sub>A</sub> = 25°C

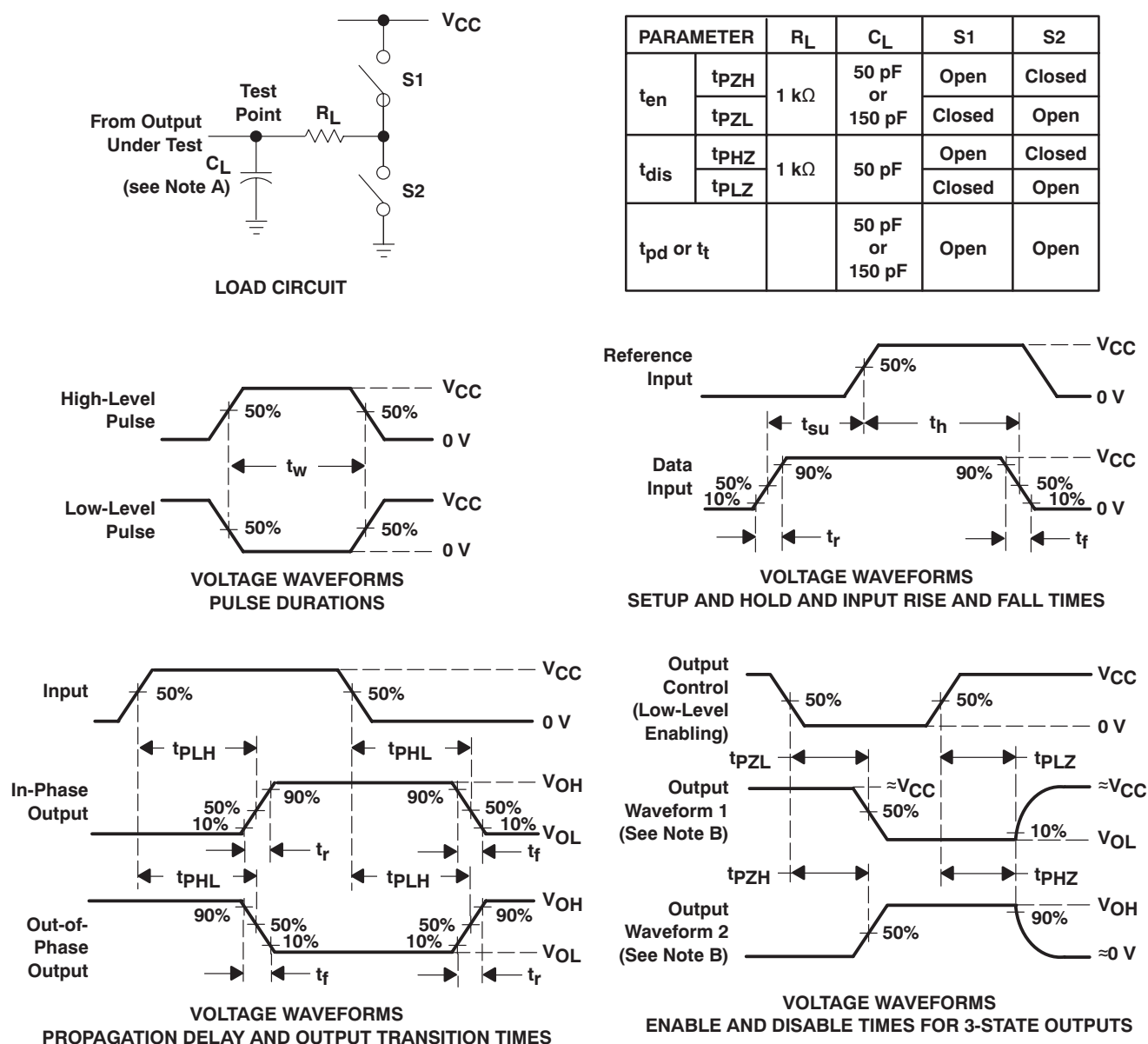
PARAMETER		TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance	No load	400	pF

## 7.9 Typical Characteristics



**Figure 2. SN74HC595 I<sub>CC</sub> vs. V<sub>CC</sub>**

## 8 Parameter Measurement Information



- NOTES: A.  $C_L$  includes probe and test-fixture 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. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
- D. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
- E. The outputs are measured one at a time, with one input transition per measurement.
- F.  $t_{pLZ}$  and  $t_{pHZ}$  are the same as  $t_{dis}$ .
- G.  $t_{pZL}$  and  $t_{pZH}$  are the same as  $t_{en}$ .
- H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 3. Load Circuit and Voltage Waveforms**

## 9 Detailed Description

### 9.1 Overview

The SNx4HC595 is part of the HC family of logic devices intended for CMOS applications. The SNx4HC595 is an 8-bit shift register that feeds an 8-bit D-type storage register.

Both the shift register clock (SRCLK) and storage register clock (RCLK) are positive-edge triggered. If both clocks are connected together, the shift register always is one clock pulse ahead of the storage register.

### 9.2 Functional Block Diagram



**Figure 4. Logic Diagram (Positive Logic)**

### 9.3 Feature Description

The SNx4HC595 devices are 8-bit Serial-In, Parallel-Out Shift Registers. They have a wide operating current of 2 V to 6 V, and the high-current 3-state outputs can drive up to 15 LSTTL Loads. The devices have a low power consumption of 80- $\mu$ A (Maximum)  $I_{CC}$ . Additionally, the devices have a low input current of 1  $\mu$ A (Maximum) and a  $\pm$ 6-mA Output Drive at 5 V.

### 9.4 Device Functional Modes

[Table 1](#) lists the functional modes of the SNx4HC595 devices.

**Table 1. Function Table**

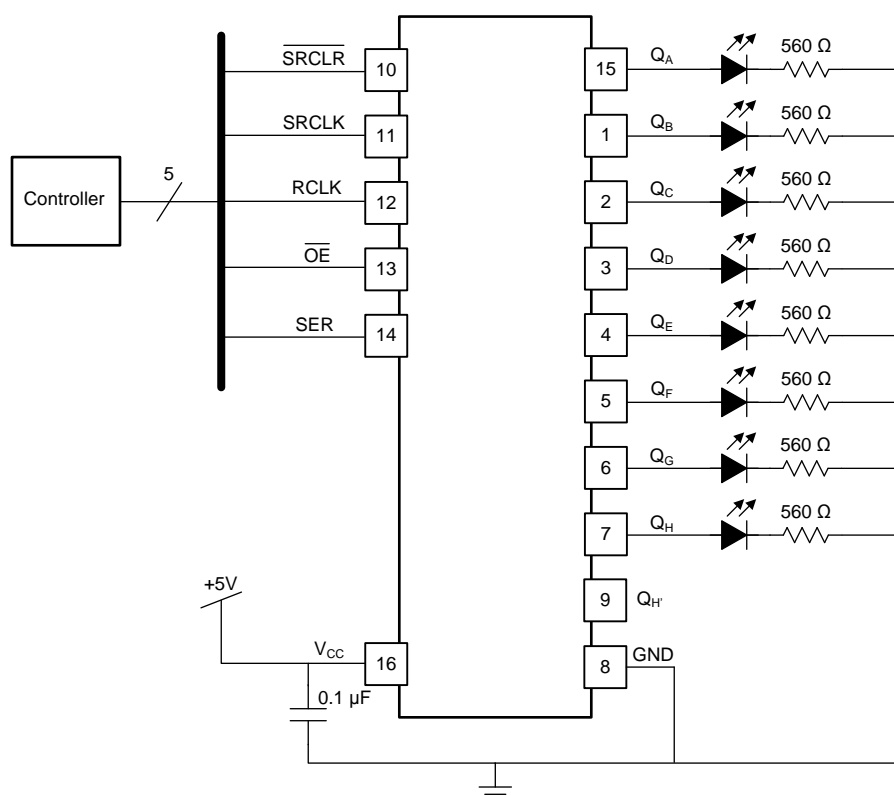
INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	$\overline{OE}$	
X	X	X	X	H	Outputs $Q_A - Q_H$ are disabled.
X	X	X	X	L	Outputs $Q_A - Q_H$ are enabled.
X	X	L	X	X	Shift register is cleared.
L	$\uparrow$	H	X	X	First stage of the shift register goes low. Other stages store the data of previous stage, respectively.
H	$\uparrow$	H	X	X	First stage of the shift register goes high. Other stages store the data of previous stage, respectively.
X	X	X	$\uparrow$	X	Shift-register data is stored in the storage register.

## 10 Application and Implementation

### 10.1 Application Information

The SNx4HC595 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.

### 10.2 Typical Application



**Figure 5. Typical Application Schematic**

#### 10.2.1 Design Requirements

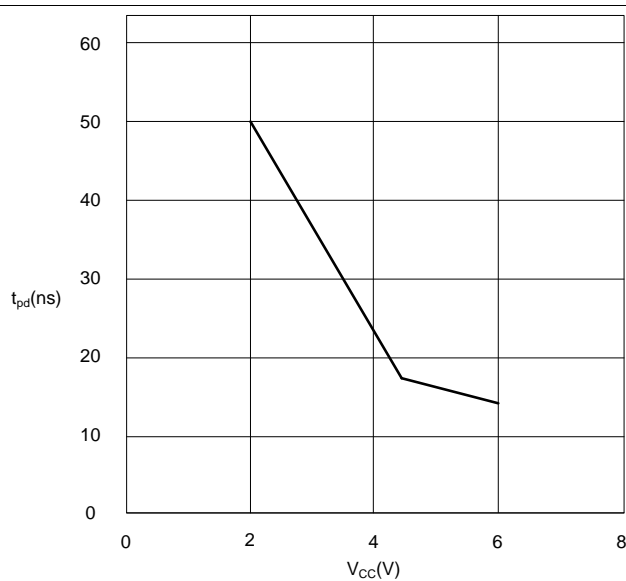
This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads so routing and load conditions should be considered to prevent ringing.

#### 10.2.2 Detailed Design Procedure

- Recommended input conditions
  - Specified high and low levels. See ( $V_{IH}$  and  $V_{IL}$ ) in the [Recommended Operating Conditions](#) table.
  - Specified high and low levels. See ( $V_{IH}$  and  $V_{IL}$ ) in the [Recommended Operating Conditions](#) table.
  - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid  $V_{CC}$
- Recommend output conditions
  - Load currents should not exceed 35 mA per output and 70 mA total for the part
  - Outputs should not be pulled above  $V_{CC}$

## Typical Application (continued)

### 10.2.3 Application Curves



**Figure 6. SN75HC595  $t_{pd}$  vs.  $V_{CC}$**

## 11 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  $V_{CC}$  pin should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, 0.1  $\mu\text{f}$  is recommended; if there are multiple  $V_{CC}$  pins, then 0.01  $\mu\text{f}$  or 0.022  $\mu\text{f}$  is recommended for each power pin. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. A 0.1  $\mu\text{f}$  and a 1  $\mu\text{f}$  are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

## 12 Layout

### 12.1 Layout Guidelines

When using multiple-bit logic devices, inputs should never 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 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. [Figure 7](#) specifies 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 makes more sense or is more convenient. It is generally acceptable to float outputs, unless the part is a transceiver. If the transceiver has an output enable pin, it will disable the output section of the part when asserted. This will not disable the input section of the I/Os, so they cannot float when disabled.

### 12.2 Layout Example



**Figure 7. Layout Diagram**



## 13 Device and Documentation Support

### 13.1 Documentation Support

#### 13.1.1 Related Documentation

For related documentation, see the following:

*Implications of Slow or Floating CMOS Inputs*, [SCBA004](#)

### 13.2 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.

**Table 2. Related Links**

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
SN54HC595	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>
SN74HC595	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

### 13.3 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™ 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.

### 13.4 Trademarks

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 13.5 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.

### 13.6 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 14 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
5962-86816012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 86816012A SNJ54HC 595FK	<a href="#">Samples</a>
5962-8681601EA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8681601EA SNJ54HC595J	<a href="#">Samples</a>
5962-8681601VEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8681601VE A SNV54HC595J	<a href="#">Samples</a>
5962-8681601VFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8681601VF A SNV54HC595W	<a href="#">Samples</a>
SN54HC595J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	SN54HC595J	<a href="#">Samples</a>
SN74HC595D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DBRE4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DRG3	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>

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
SN74HC595DT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DWRE4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595DWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU   CU SN	N / A for Pkg Type	-40 to 85	SN74HC595N	<a href="#">Samples</a>
SN74HC595NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SN74HC595N	<a href="#">Samples</a>
SN74HC595NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595PWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SN74HC595PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC595	<a href="#">Samples</a>
SNJ54HC595FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 86816012A SNJ54HC 595FK	<a href="#">Samples</a>
SNJ54HC595J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8681601EA SNJ54HC595J	<a href="#">Samples</a>

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
SNJ54HC595W	OBSOLETE			16		TBD	Call TI	Call TI	-55 to 125		

(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.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

**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 SN54HC595, SN54HC595-SP, SN74HC595 :**

- Catalog: [SN74HC595](#), [SN54HC595](#)
- Enhanced Product: [SN74HC595-EP](#), [SN74HC595-EP](#)
- Military: [SN54HC595](#)
- Space: [SN54HC595-SP](#)

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
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

**TAPE AND REEL INFORMATION**


\*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
SN74HC595DBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74HC595DR	SOIC	D	16	2500	330.0	16.8	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DRG3	SOIC	D	16	2500	330.0	16.8	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN74HC595DWRG4	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN74HC595PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC595DBR	SSOP	DB	16	2000	367.0	367.0	38.0
SN74HC595DR	SOIC	D	16	2500	364.0	364.0	27.0
SN74HC595DRG3	SOIC	D	16	2500	364.0	364.0	27.0
SN74HC595DRG4	SOIC	D	16	2500	367.0	367.0	38.0
SN74HC595DRG4	SOIC	D	16	2500	333.2	345.9	28.6
SN74HC595DWR	SOIC	DW	16	2000	367.0	367.0	38.0
SN74HC595DWRG4	SOIC	DW	16	2000	367.0	367.0	38.0
SN74HC595PWR	TSSOP	PW	16	2000	367.0	367.0	35.0

J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only.
  - Falls within MIL STD 1835 GDFP2-F16

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



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



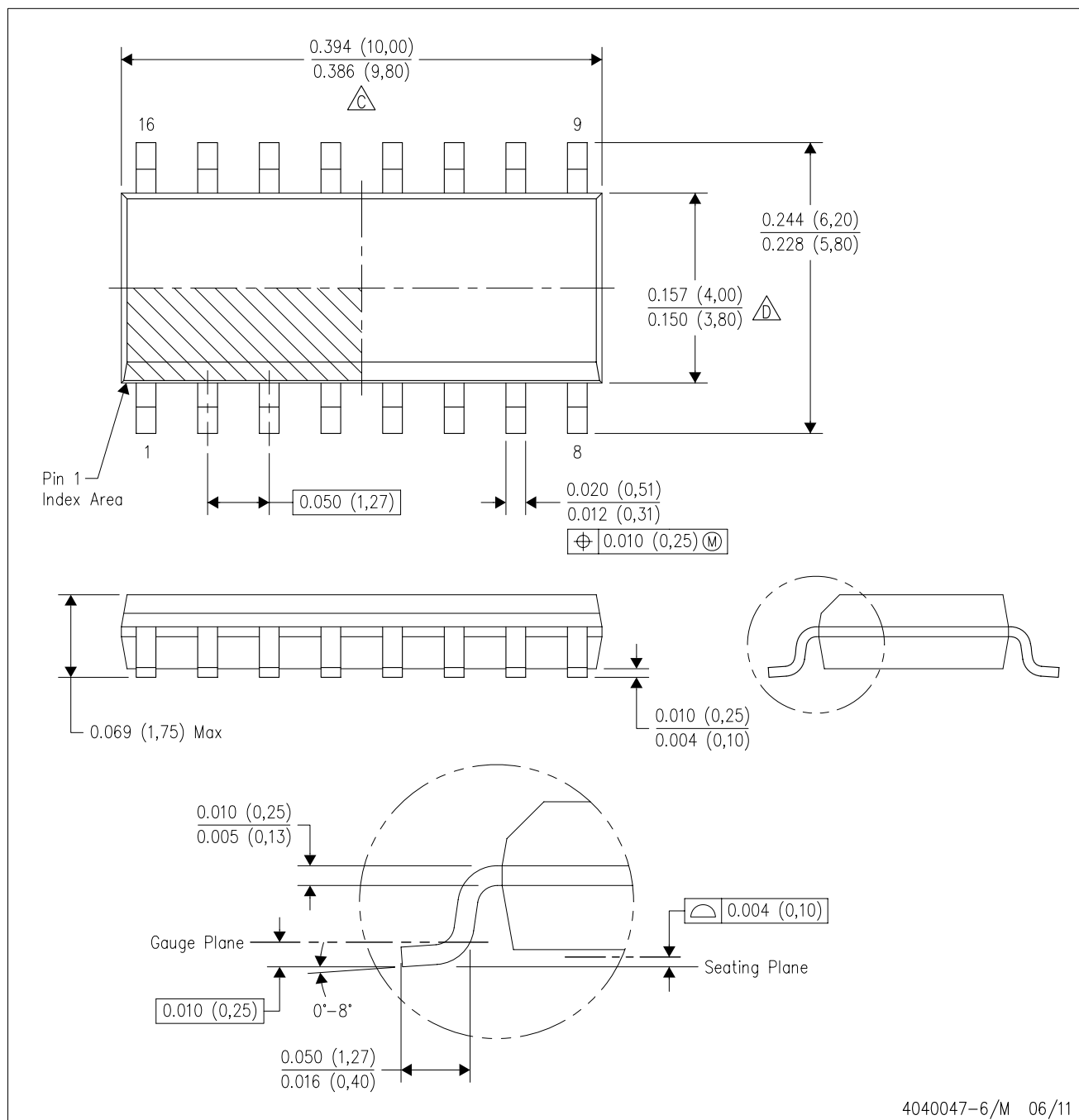
14/18 Pin Only  
20 Pin vendor option

4040049/E 12/2002

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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

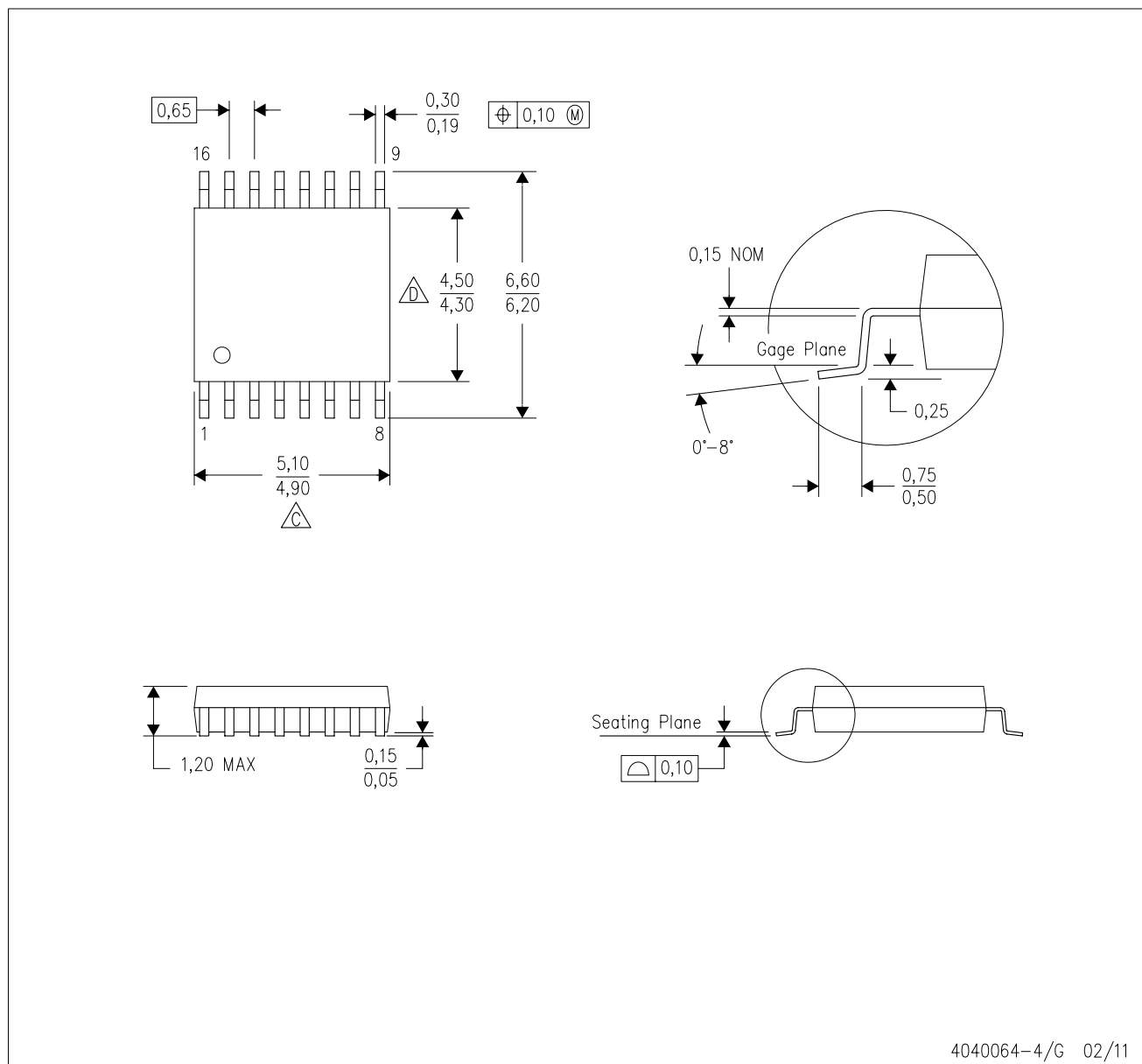
PLASTIC SMALL OUTLINE



- 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.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

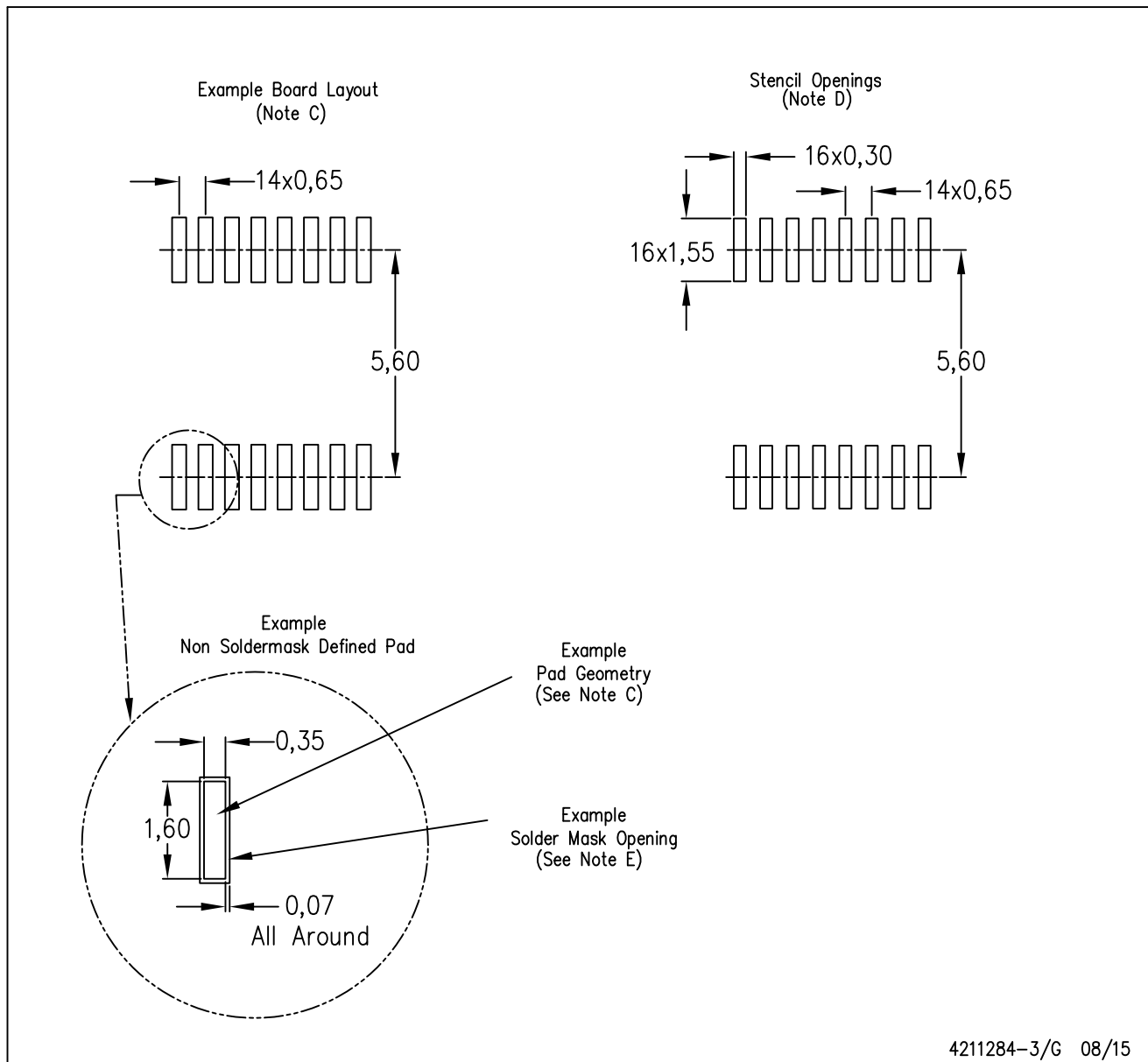


4040064-4/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. 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.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN

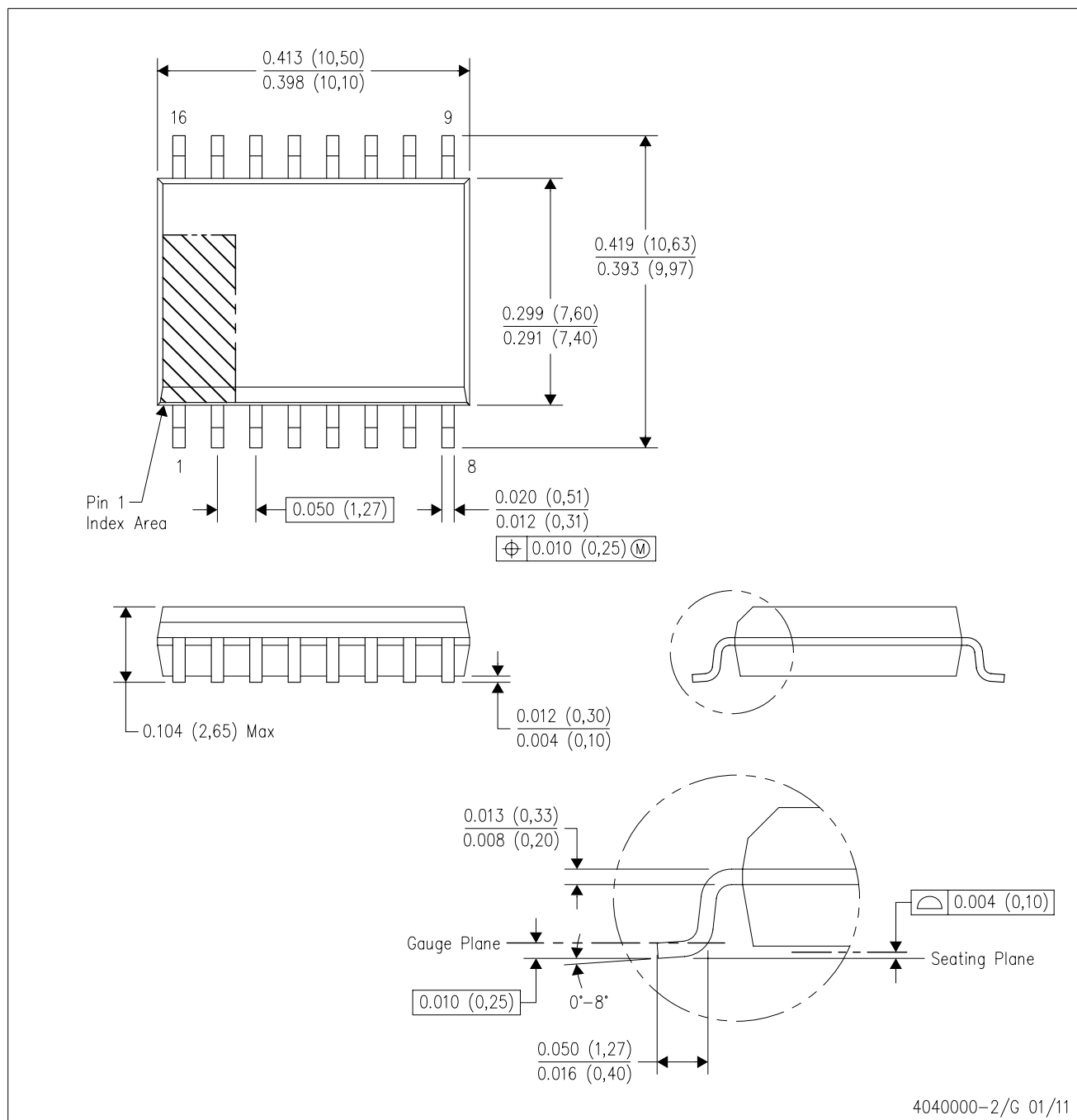


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150



DW (R-PDSO-G16)

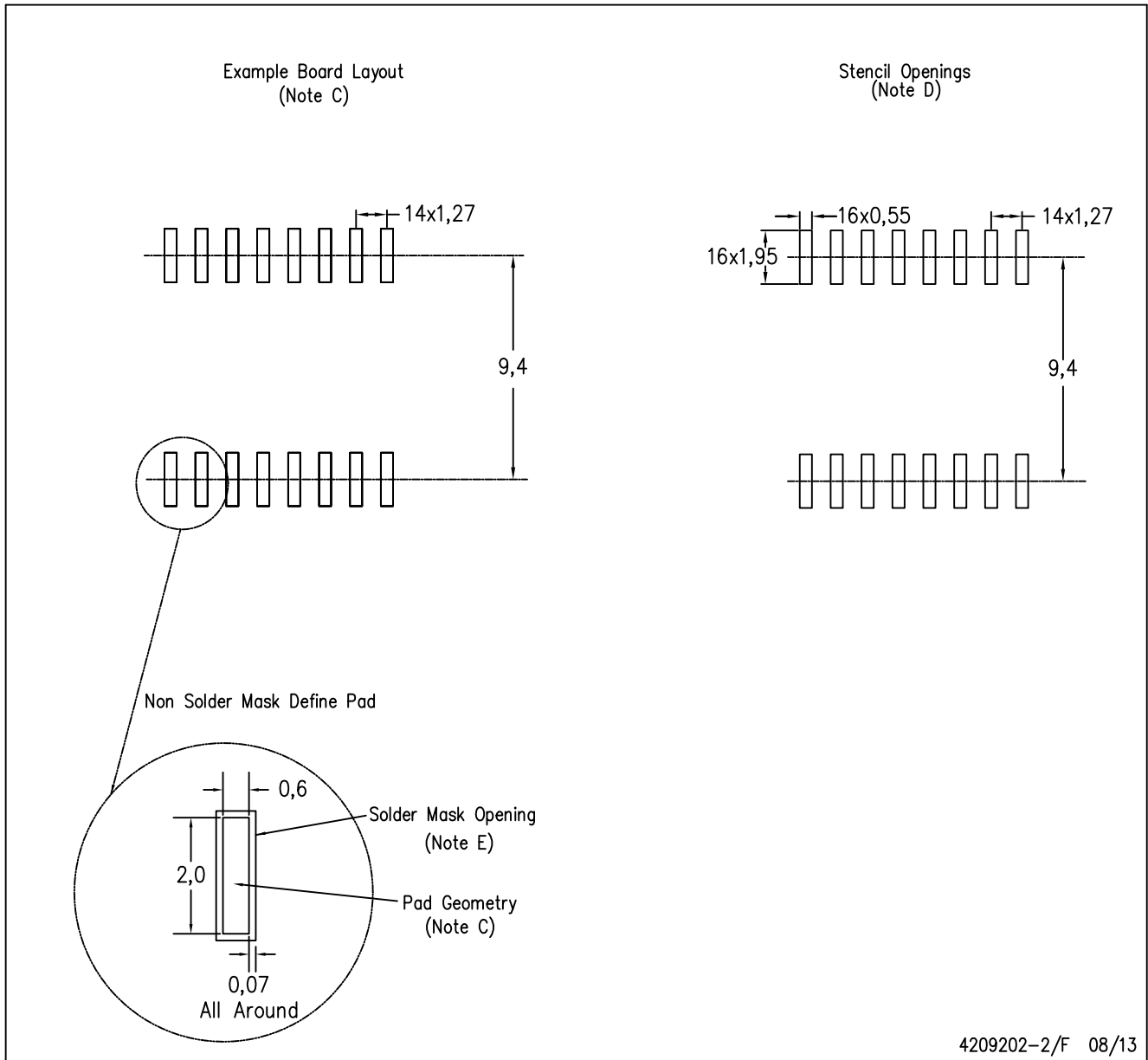
## PLASTIC SMALL OUTLINE



- NOTES: A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
D. Falls within JEDEC MS-013 variation AA.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. 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
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-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.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)