SN74HC595B 采用三态输出寄存器的 8 位移位寄存器

1 特性

- 8 位串行输入/并行输出移位寄存器
- 采用超小型逻辑四方扁平无引线 (QFN) 封装（最大高度为 0.5mm）
- 独立于 V_{cc} 的输入过压容差
- 2V 至 6V 的宽运行电压范围
- 高电流三态输出最多可驱动 15 个低功耗肖特基晶体管-晶体管逻辑器件 (LSTTL) 负载
- 低功耗：I_{CC} 为 80μA（最大值）
- t_{pd} = 13ns（典型值）
- ±6mA 输出驱动（电压为 5V 时）
- 低输入电流：1μA（最大值）
- 移位寄存器具有直接清零功能
- 运行温度为 -55°C 至 125°C

2 应用

- 网络交换机
- 工厂自动化
- 移动可穿戴设备
- 工业楼宇自动化
- 电力基础设施
- 发光二极管 (LED) 显示屏
- 服务器

3 说明

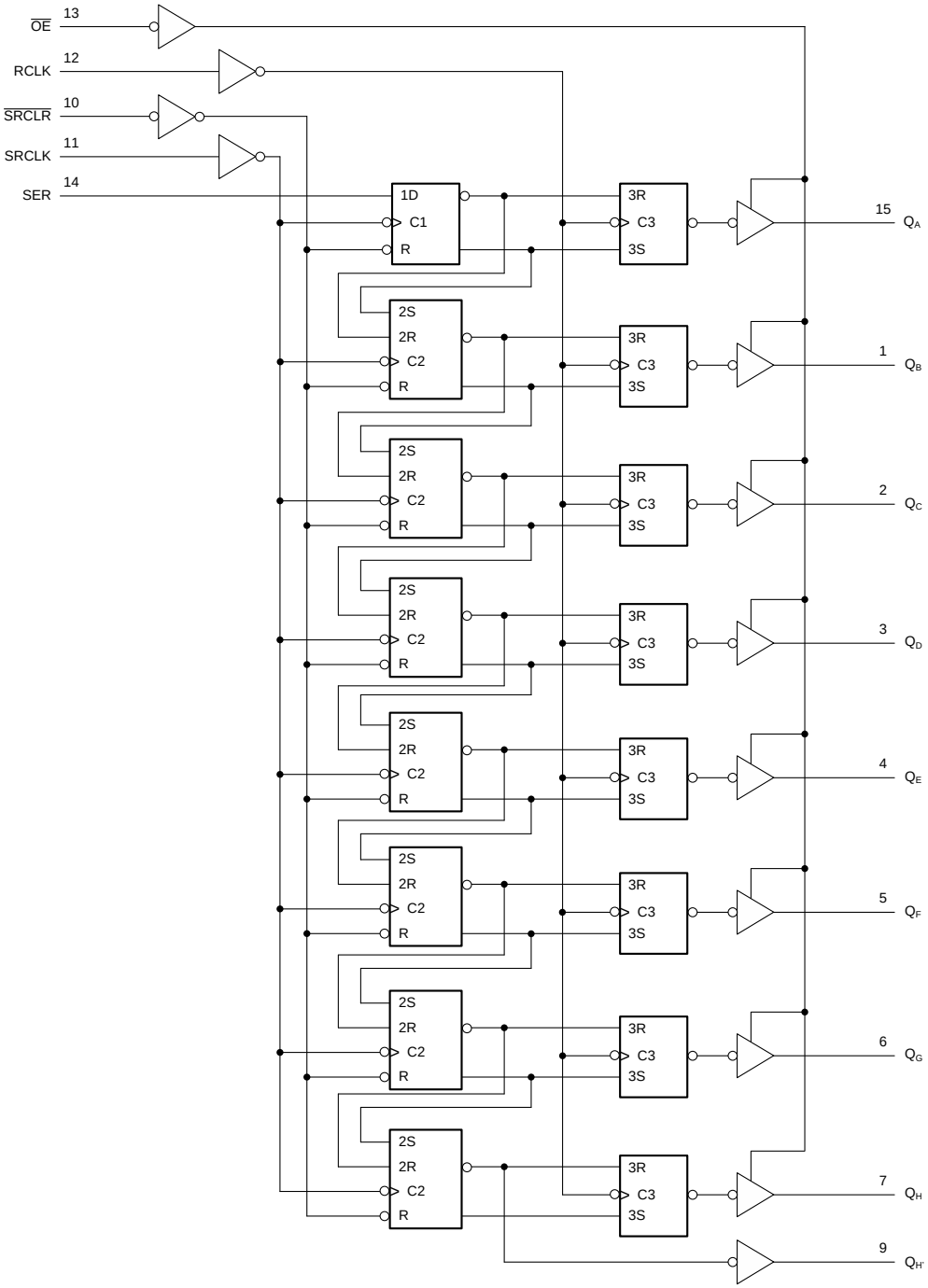
SN74HC595B 器件包含一个 8 位串行输入/并行输出移位寄存器，可将数据馈入 8 位 D 类存储寄存器。存储寄存器具有并行三态输出。移位寄存器和存储寄存器均具有独立时钟。移位寄存器具有一个直接覆盖清零 (SRCLR) 输入以及用于级联结构的串行 (SER) 输入和串行输出。当输出使能 (OE) 输入置为高电平时，除 $Q_{H'}$ 之外的所有输出均将置于高阻抗状态。

表 1. 器件信息

部件号	封装（引脚）	封装尺寸（标称值）
SN74HC595BRWN	X1QFN (16)	2.50mm x 2.50mm

(1) 要了解所有可用封装，请参见数据表末尾的可订购产品附录。

图 1. 逻辑图（正逻辑）



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4 Pin Configuration and Functions

RWN Package
16-Pin XQFN
Bottom View

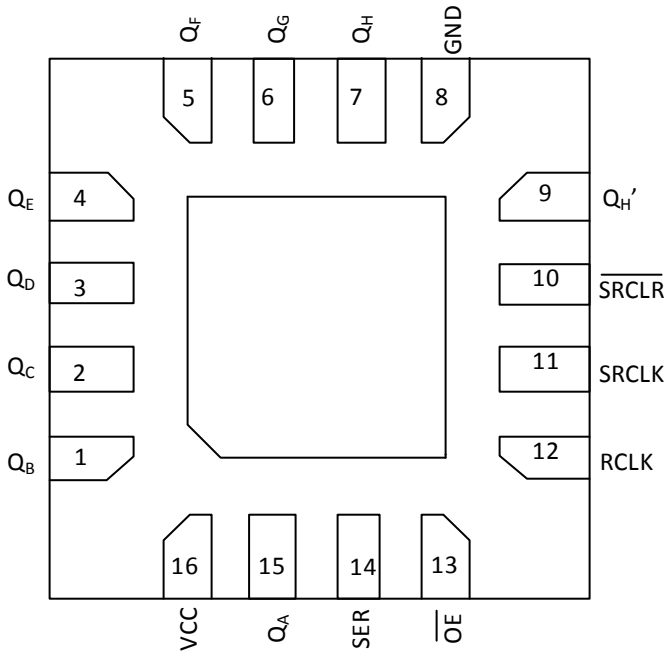


Table 2. Pin Functions

PIN		I/O	DESCRIPTION
NAME	RWN		
GND	8	—	Ground Pin
$\overline{OE}$	13	I	Output Enable; does not control $Q_{H'}$
Q_A	15	O	Q_A Output
Q_B	1	O	Q_B Output
Q_C	2	O	Q_C Output
Q_D	3	O	Q_D Output
Q_E	4	O	Q_E Output
Q_F	5	O	Q_F Output
Q_G	6	O	Q_G Output
Q_H	7	O	Q_H Output
$Q_{H'}$	9	O	$Q_{H'}$ Output
RCLK	12	I	RCLK Input
SER	14	I	SER Input
SRCLK	11	I	SRCLK Input
$\overline{SRCLR}$	10	I	$\overline{SRCLR}$ Input
V_{CC}	16	—	Power Pin

5 Specifications

5.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage		–0.5	7	V
V_I	Input voltage		-0.5	7	V
I_{IK}	Input clamp current(1)	$V_I < 0$		-20	mA
I_{OK}	Output clamp current (2)	$V_O < 0$ or $V_O > V_{CC}$		±20	mA
I_O	Continuous output current	$V_O = 0$ to V_{CC}		±35	mA
	Continuous current through V_{CC} or GND			±70	mA
T_J	Junction temperature			150	°C
T_{stg}	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.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	±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.

5.3 Recommended Operating Conditions

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

			SN74HC595B			UNIT
			MIN	NOM	MAX	
V_{CC}	Supply voltage		2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			V
		V_{CC} = 4.5 V	3.15			
		V_{CC} = 6 V	4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V			0.5	V
		V_{CC} = 4.5 V			1.35	
		V_{CC} = 6 V			1.8	
V_I	Input voltage		0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	V
Δt/Δv	Input transition rise or fall time(2)	V_{CC} = 2 V			1000	ns
		V_{CC} = 4.5 V			500	
		V_{CC} = 6 V			400	
T_A	Operating free-air temperature		–55		125	°C

(1) All unused inputs of the device must be held at V_{CC} 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_{IL}max = 0.5 V to V_{IH} 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_t = 1000 ns and V_{CC} = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

5.4 Thermal Information

THERMAL METRIC(1)		SN74HC595B RWN (X1QFN) 16 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	112	°C/W
$R_{\theta JCtop}$	Junction-to-case (top) thermal resistance	47.9	
$R_{\theta JB}$	Junction-to-board thermal resistance	72.4	
ψ_{JT}	Junction-to-top characterization parameter	0.6	
ψ_{JB}	Junction-to-board characterization parameter	72.4	
$R_{\theta JCbot}$	Junction-to-case (bottom) thermal resistance	32.2	

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

5.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		V_{CC}	T_A = 25°C			T_A = -55°C to 125°C		T_A = -40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	V_I = V_{IH} or V_{IL}	I_{OH} = –20 µA	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		
		$Q_{H'}$, I_{OH} = –4 mA	4.5 V	3.98	4.3		3.7		3.84		
		Q_A – Q_H, I_{OH} = –6 mA		3.98	4.3		3.7		3.84		
		$Q_{H'}$, I_{OH} = −5.2 mA	6 V	5.48	5.8		5.2		5.34		
		Q_A – Q_H, I_{OH} = –7.8 mA		5.48	5.8		5.2		5.34		
V_{OL}	V_I = V_{IH} or V_{IL}	I_{OL} = 20 µA	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	
		$Q_{H'}$, I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
		Q_A – Q_H, I_{OL} = 6 mA			0.17	0.26		0.4		0.33	
		$Q_{H'}$, I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4		0.33	
		Q_A – Q_H, I_{OL} = 7.8 mA			0.15	0.26		0.4		0.33	
I_I	V_I = V_{CC} or 0		6 V		±0.1	±100		±1000		±1000	nA
I_{OZ}	V_O = V_{CC} or 0, Q_A – Q_H		6 V		±0.01	±0.5		±10		±5	µA
I_{CC}	V_I = V_{CC} or 0, I_O = 0		6 V			8		160		80	µA
C_i			2 V to 6 V		3	10		10		10	pF

5.6 Timing Requirements

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

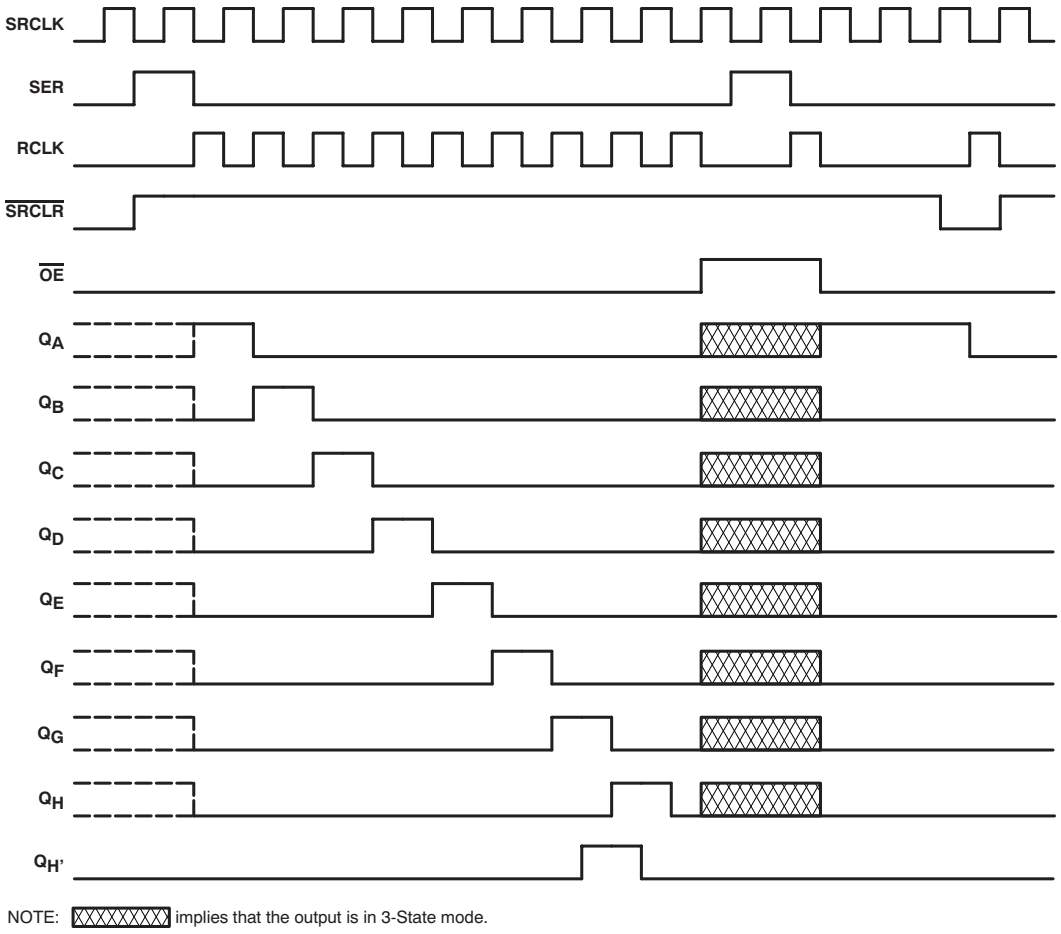
			V_{CC}	T_A = 25°C		T_A = -55°C to 125°C		T_A = -40°C to 85°C		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		2 V		6		4.2		5	MHz
			4.5 V		31		21		25	
			6 V		36		25		29	
t_w	Pulse duration	SRCLK or RCLK high or low	2 V	80		120		100		ns
			4.5 V	16		24		20		
			6 V	14		20		17		
		$\overline{SRCLR}$ low	2 V	80		120		100		
			4.5 V	16		24		20		
			6 V	14		20		17		
t_{su}	Set-up time	SER before SRCLK↑	2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
		SRCLK↑ before RCLK↑(1)	2 V	75		113		94		
			4.5 V	15		23		19		
			6 V	13		19		16		
		$\overline{SRCLR}$ low before RCLK↑	2 V	50		75		65		
			4.5 V	10		15		13		
			6 V	9		13		11		
		$\overline{SRCLR}$ high (inactive) before SRCLK↑	2 V	50		75		60		
			4.5 V	10		15		12		
			6 V	9		13		11		
t_h	Hold time, SER after SRCLK↑		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.

5.7 Switching Characteristics

Over recommended operating free-air temperature range.

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V_{CC}	T_A = 25°C			T_A = -55°C to 125°C		T_A = -40°C to 85°C		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			50 pF	2 V	6	26		4.2		5		MHz
				4.5 V	31	38		21		25		
				6 V	36	42		25		29		
t_{pd}	SRCLK	$Q_{H'}$	50 pF	2 V		50	160		240		200	ns
				4.5 V		17	32		48		40	
				6 V		14	27		41		34	
	RCLK	Q_A – Q_H	50 pF	2 V		50	150		225		187	
				4.5 V		17	30		45		37	
				6 V		14	26		38		32	
t_{PHL}	$\overline{SRCLR}$	$Q_{H'}$	50 pF	2 V		51	175		261		219	ns
				4.5 V		18	35		52		44	
				6 V		15	30		44		37	
t_{en}	$\overline{OE}$	Q_A – Q_H	50 pF	2 V		40	150		255		187	ns
				4.5 V		15	30		45		37	
				6 V		13	26		38		32	
t_{dis}	$\overline{OE}$	Q_A – Q_H	50 pF	2 V		42	200		300		250	ns
				4.5 V		23	40		60		50	
				6 V		20	34		51		43	
t_t		Q_A – Q_H	50 pF	2 V		28	60		90		75	ns
				4.5 V		8	12		18		15	
				6 V		6	10		15		13	
		$Q_{H'}$	50 pF	2 V		28	75		110		95	
				4.5 V		8	15		22		19	
				6 V		6	13		19		16	
t_{pd}	RCLK	Q_A – Q_H	150 pf	2 V		60	200		300		250	ns
				4.5 V		22	40		60		50	
				6 V		19	34		51		43	
t_{en}	$\overline{OE}$	Q_A – Q_H	150 pf	2 V		70	200		298		250	ns
				4.5 V		23	40		60		50	
				6 V		19	34		51		43	
t_t		Q_A – Q_H	150 pf	2 V		45	210		315		265	ns
				4.5 V		17	42		63		53	
				6 V		13	36		53		45	



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

Figure 2. Timing Diagram

5.8 Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	400	pF

5.9 Typical Characteristics

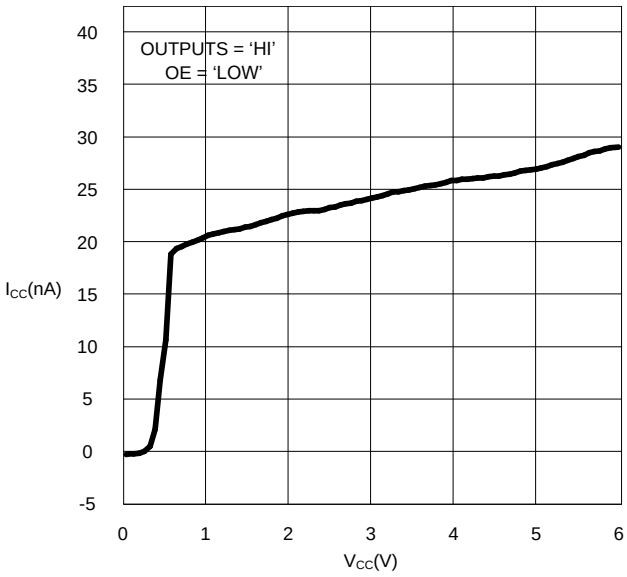
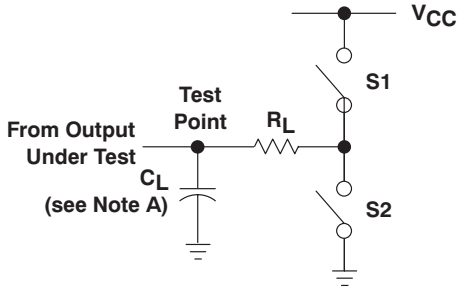


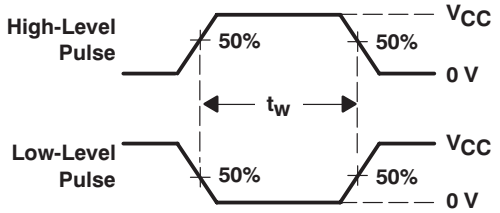
Figure 3. SN74HC595B I_{CC} vs. V_{CC}

6 Parameter Measurement Information

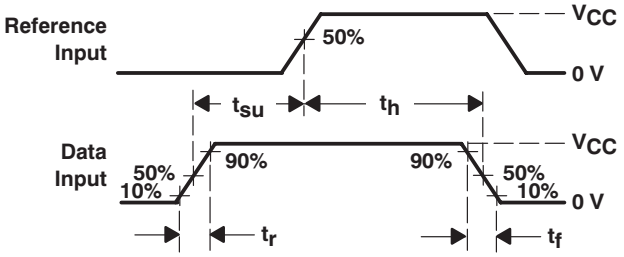


LOAD CIRCUIT

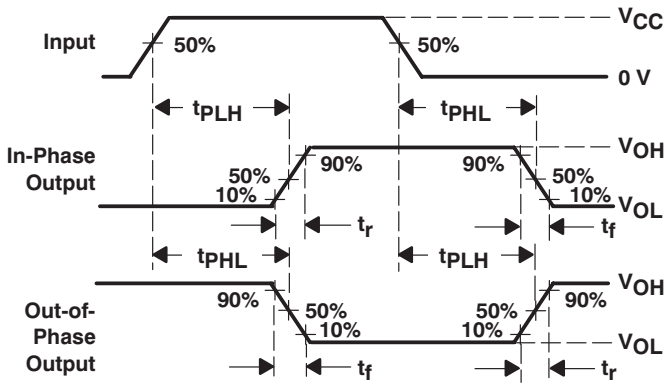
PARAMETER		R_L	C_L	S1	S2
t_{en}	t_{PZH}	1 kΩ	50 pF or 150 pF	Open	Closed
	t_{PZL}			Closed	Open
t_{dis}	t_{PHZ}	1 kΩ	50 pF	Open	Closed
	t_{PLZ}			Closed	Open
t_{pd} or t_t			50 pF or 150 pF	Open	Open



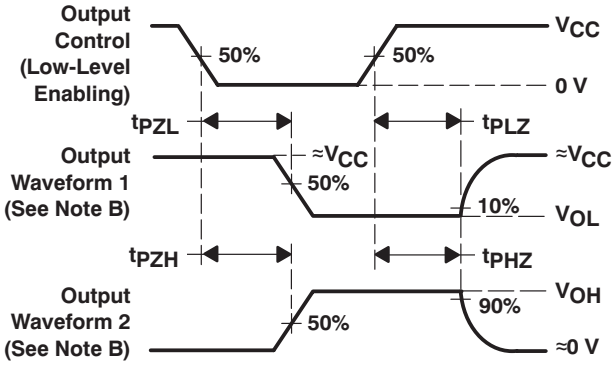
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES FOR 3-STATE OUTPUTS

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 ≤ 1 MHz, Z_O = 50 Ω, 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 4. Load Circuit and Voltage Waveforms

7 Detailed Description

7.1 Overview

The SN74HC595B is part of the HC family of logic devices intended for CMOS applications. The SN74HC595B device 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 is always one clock pulse ahead of the storage register. The $Q_{H'}$ may be used for daisy chaining the device and will not go into high impedance when $\overline{OE}$ is asserted.

7.2 Functional Block Diagram

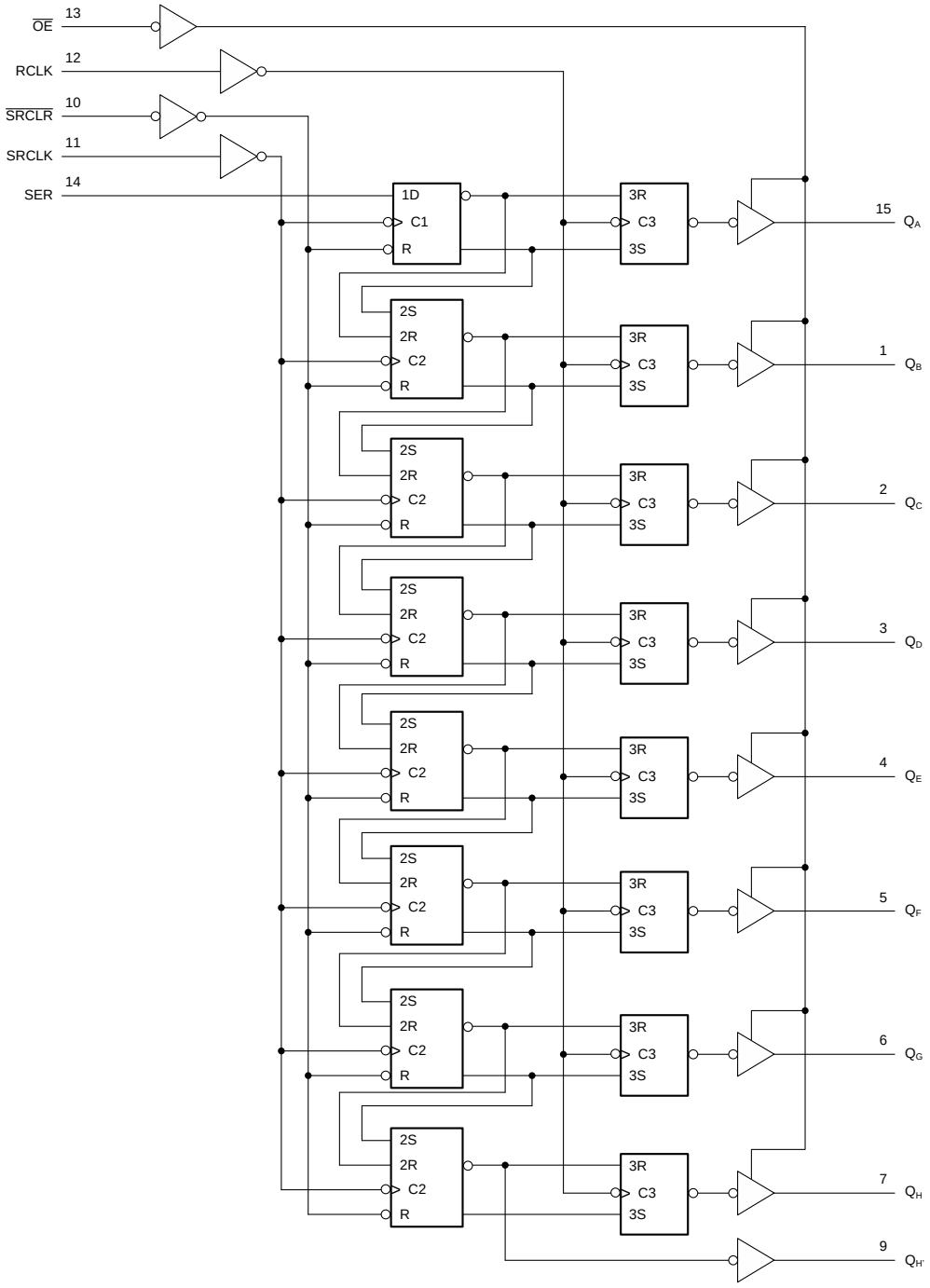


Figure 5. Logic Diagram (Positive Logic)

7.3 Feature Description

The SN74HC595B device is an 8-bit Serial-In, Parallel-Out shift register. It has a wide operating voltage of 2 V to 6 V, and the high-current 3-state outputs can drive up to 15 LSTTL Loads. The device has a low power consumption of 80-µA (Maximum) I_{CC}. Additionally, this device has a low input current of 1 µA (Maximum) and a ±6-mA output drive at 5 V. The device is available currently in the smallest logic QFN package at 0.5 mm max height with 0.4 mm pitch. The inputs are over voltage tolerant independent of V_{cc}.

7.4 Device Functional Modes

Table 3 lists the functional modes of the SN74HC595B devices.

Table 3. Function Table

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

8 Application and Implementation

8.1 Application Information

The SN74HC595B is a low-drive CMOS device that is 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. $Q_{H'}$ pin of the first register should be connected to the serial (SER) pin of the second register for daisy chaining.

8.2 Typical Application

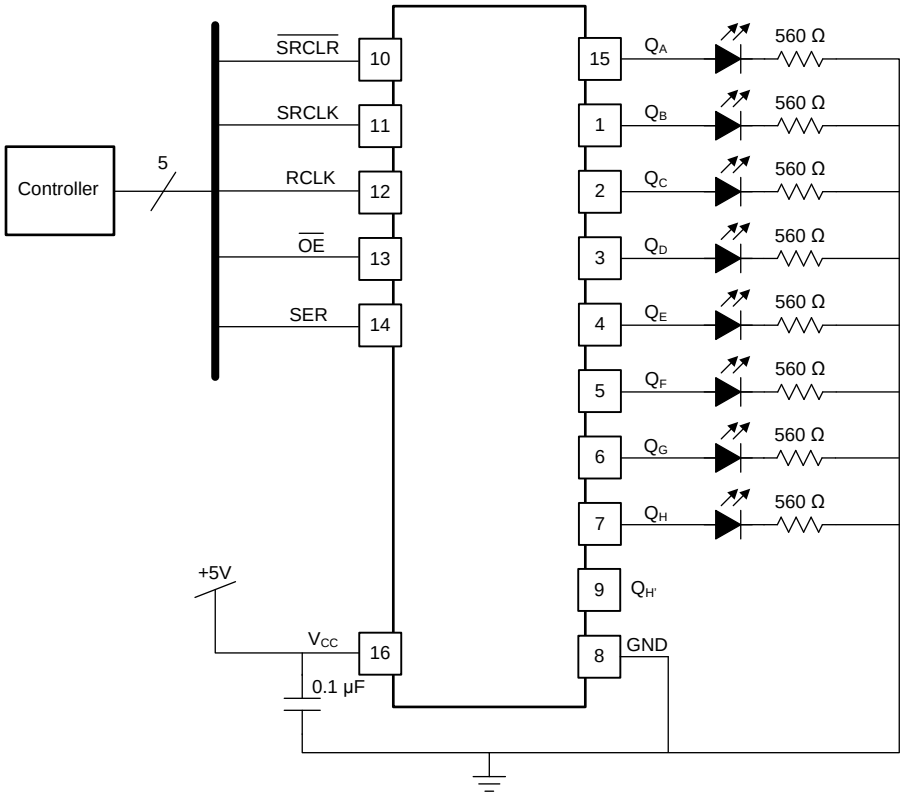


Figure 6. Typical Application Schematic

8.2.1 Design Requirements

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

8.2.2 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 over-voltage tolerant allowing them to go as high as 5.5 V at any valid V_{CC}
- Recommended output conditions
  - Load currents should not exceed 35 mA per output as per the *Absolute Maximum Ratings* table.
  - Outputs should not be pulled below Ground or above V_{CC}

Typical Application (continued)

8.2.3 Application Curves

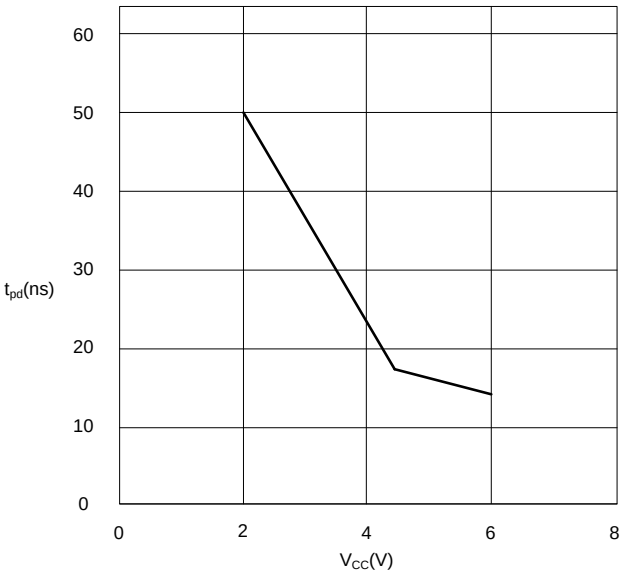


Figure 7. SN75HC595B t_{pd} vs. V_{CC}

9 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. The total current through Ground or Vcc should not exceed 70 mA as per *Absolute Maximum Ratings* table.

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

10 Layout

10.1 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 the 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 8 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 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.

10.2 Layout Example

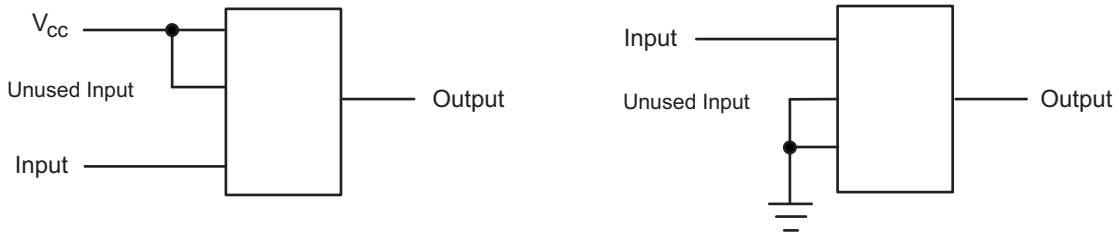


Figure 8. Layout Diagram

11 器件和文档支持

11.1 文档支持

11.1.1 相关文档

相关文档如下：

《*CMOS 输入缓慢变化或悬空的影响*》，SCBA004

11.2 社区资源

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.

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

11.3 Trademarks

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11.4 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.

11.5 Glossary

SLYZ022 — *TI Glossary*.

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

12 机械、封装和可订购信息

以下页中包括机械封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。要获得这份数据表的浏览器版本，请查阅左侧导航栏。

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DLP® 产品	www.dlp.com	能源	www.ti.com/energy
DSP - 数字信号处理器	www.ti.com.cn/dsp	工业应用	www.ti.com.cn/industrial
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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74HC595BRWNR	ACTIVE	X1QFN	RWN	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	13YI	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

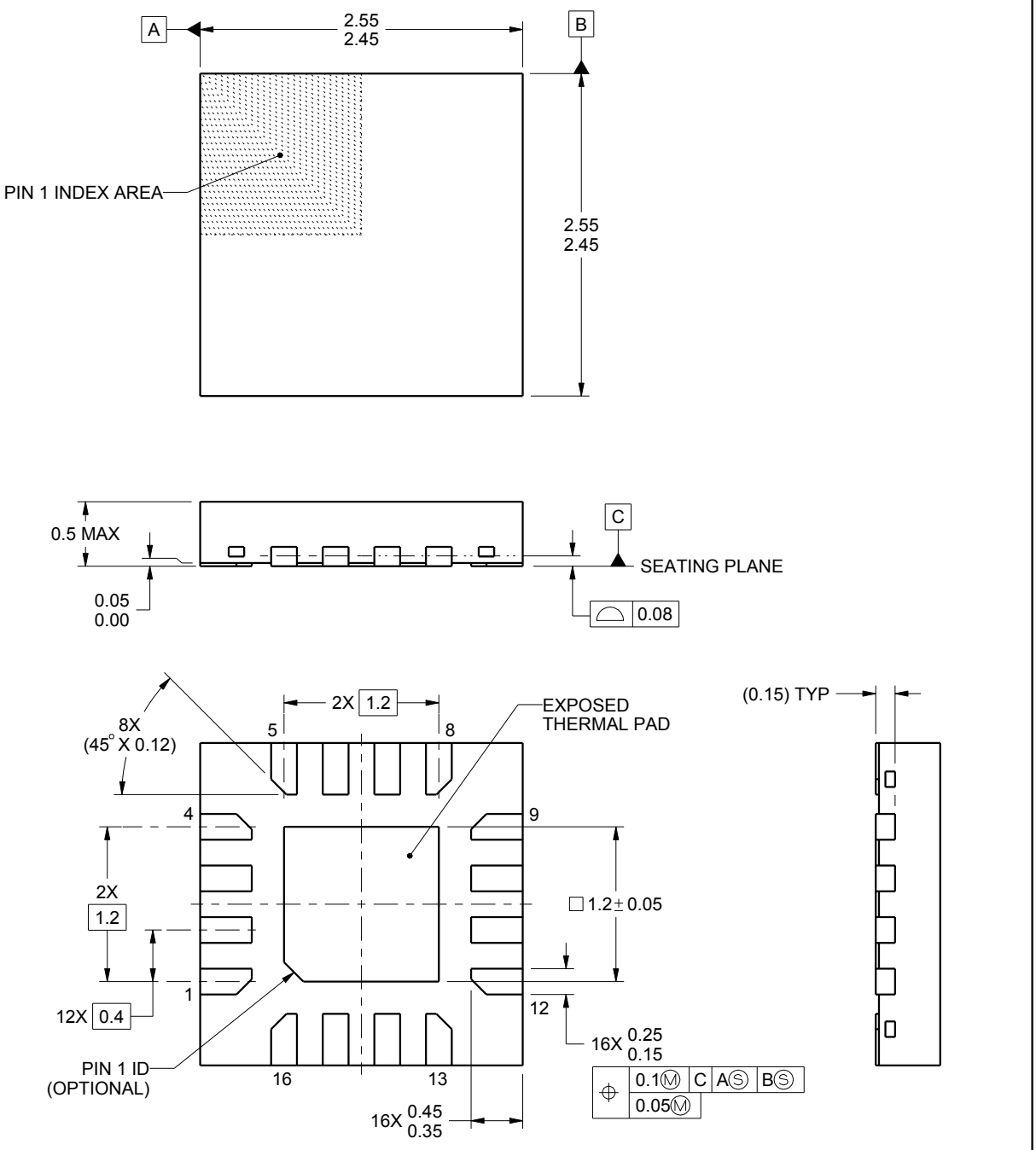
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

PACKAGE OUTLINE

RWN0016A

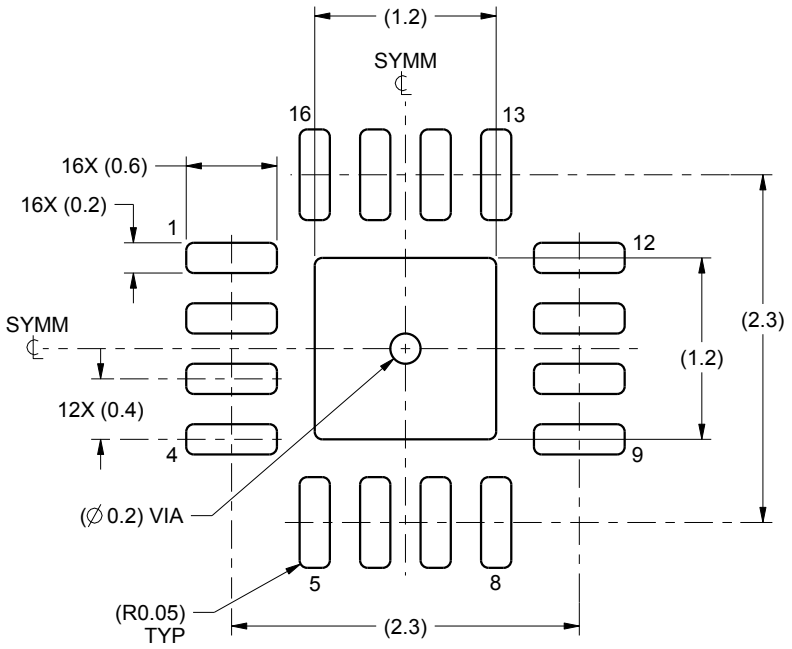
X1QFN - 0.5 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

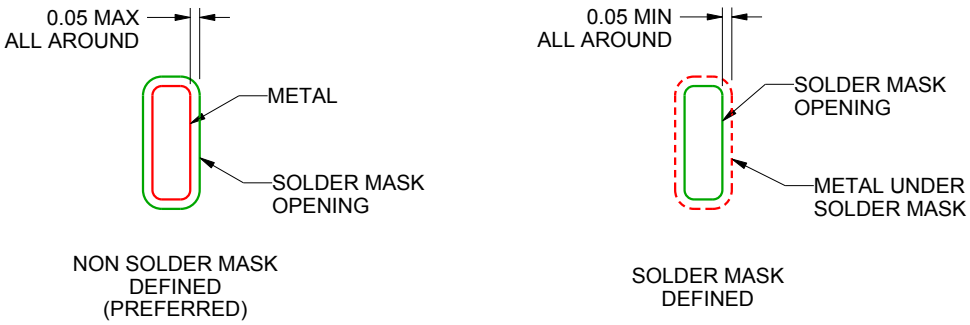


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
SCALE:20X

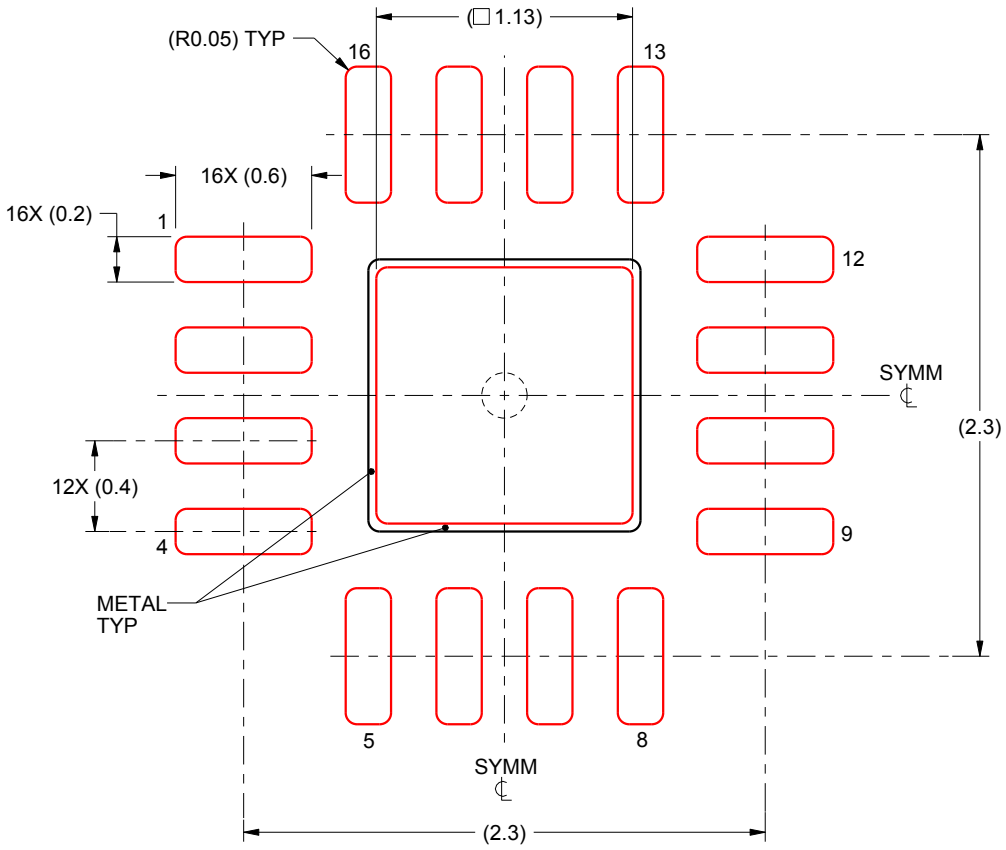


SOLDER MASK DETAILS

4221911/A 05/2015

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL

EXPOSED PAD
88% PRINTED SOLDER COVERAGE BY AREA
SCALE:30X

4221911/A 05/2015

NOTES: (continued)

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

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