

具有清零和预设功能且通过汽车认证的 **SN74HCS74** 施密特触发输入双路 D 型正缘触发触发器

1 特性

- 宽工作电压范围：2V 至 6V
- 施密特触发输入可实现慢速或高噪声输入信号
- 低功耗
 - I_{CC} 典型值为 100nA
 - 输入泄漏电流典型值为 ± 100 nA
- 电压为 5V 时，输出驱动为 ± 7.8 mA
- 工作环境温度范围： -40°C 至 $+125^{\circ}\text{C}$, T_A

2 应用

- 将瞬时开关转换为拨动开关
- 在控制器复位期间保持信号
- 输入慢速边沿速率信号
- 可在高噪声环境中运行
- 将时钟信号一分为二

3 说明

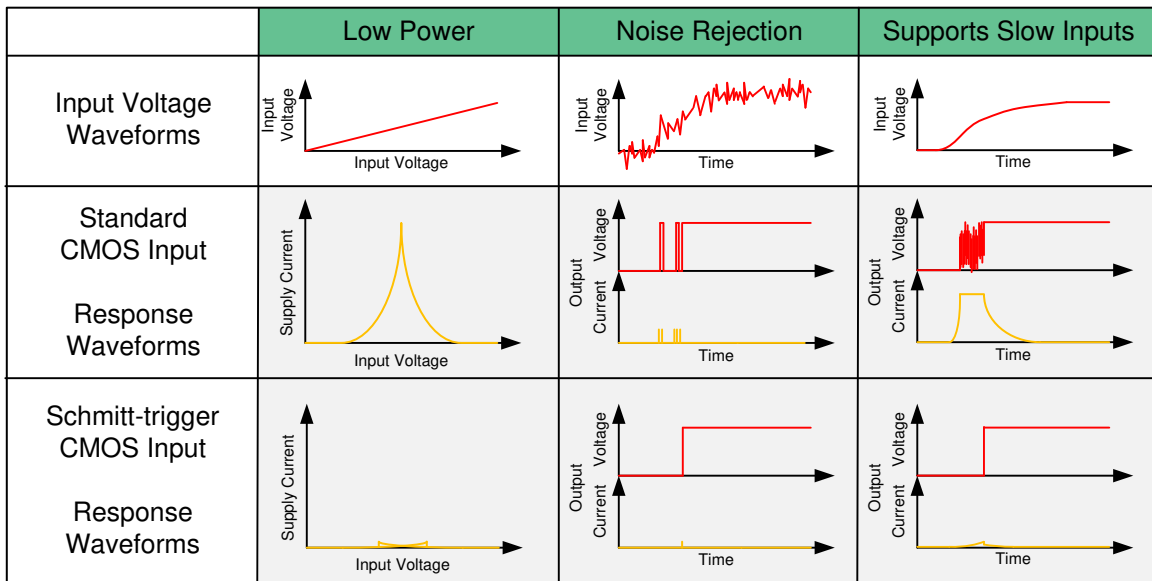
该器件包含两个独立的 D 型正缘触发触发器。所有输入均包括施密特触发，可实现慢速或高噪声输入信号。将预设 ($\overline{\text{PRE}}$) 输入设为低电平，会输出高电平。将清零 ($\overline{\text{CLR}}$) 输入设为低电平，会重新输出低电平。预设和清零功能是异步的，并且不依赖于其他输入的电平。当 $\overline{\text{PRE}}$ 和 $\overline{\text{CLR}}$ 处于非活动状态（高电平）时，数据 (D) 输入处满足设置时间要求的数据将传输到时钟 (CLK) 脉冲正向缘上的输出 (Q , \overline{Q}) 处。时钟触发在一定电压电平下发生，并且不与输入 (CLK) 信号的上升时间直接相关。经过保持时间间隔后，可以更改数据 (D) 输入处的数据而不影响输出 (Q , \overline{Q}) 处的电平。

器件信息(1)

器件型号	封装	封装尺寸 (标称值)
SN74HCS74PWR	TSSOP (14)	5.00mm x 4.40mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

施密特触发输入的优势



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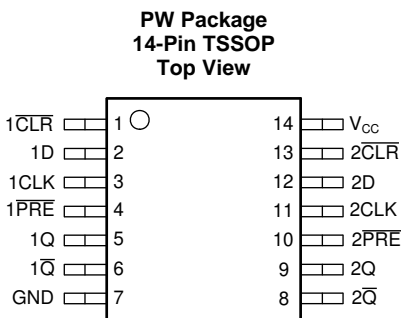
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4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

日期	修订版本	说明
2019 年 11 月	*	初始发行版。

5 Pin Configuration and Functions



Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
1CLR	1	Input	Clear for channel 1, active low
1D	2	Input	Data for channel 1
1CLK	3	Input	Clock for channel 1, rising edge triggered
1PRE	4	Input	Preset for channel 1, active low
1Q	5	Output	Output for channel 1
1Q \bar{Q}	6	Output	Inverted output for channel 1
GND	7	—	Ground
2Q \bar{Q}	8	Output	Inverted output for channel 2
2Q	9	Output	Output for channel 2
2PRE	10	Input	Preset for channel 2, active low
2CLK	11	Input	Clock for channel 2, rising edge triggered
2D	12	Input	Data for channel 2
2CLR \bar{Q}	13	Input	Clear for channel 2, active low
V _{CC}	14	—	Positive supply

6 Specifications

6.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V _{CC}	Supply voltage		−0.5	7	V
I _{IK}	Input clamp current ⁽²⁾	V _I < −0.5 V or V _I > V _{CC} + 0.5 V		±20	mA
I _{OK}	Output clamp current ⁽²⁾	V _I < −0.5 V or V _I > V _{CC} + 0.5 V		±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 ⁽³⁾			150	°C
T _{stg}	Storage temperature		−65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Rating* 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 Condition*. 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.
- (3) Guaranteed by design.

6.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±4000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1500	

- (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)

		MIN	NOM	MAX	UNIT
V _{CC}	Supply voltage	2	5	6	V
V _I	Input voltage	0		V _{CC}	V
V _O	Output voltage	0		V _{CC}	V
T _A	Ambient temperature	−40		125	°C

6.4 Thermal Information

THERMAL METRIC		SN74HCS74	UNIT
		PW (TSSOP)	
		14 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	151.7	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	79.4	°C/W
R _{θJB}	Junction-to-board thermal resistance	94.7	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	25.2	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	94.1	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	°C/W

6.5 Electrical Characteristics

over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted).

PARAMETER		TEST CONDITIONS		V_{CC}	MIN	TYP	MAX	UNIT
V_{T+}	Positive switching threshold			2 V	0.7		1.5	V
				4.5 V	1.7		3.15	
				6 V	2.1		4.2	
V_{T-}	Negative switching threshold			2 V	0.3		1.0	V
				4.5 V	0.9		2.2	
				6 V	1.2		3.0	
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$) ⁽¹⁾			2 V	0.2		1.0	V
				4.5 V	0.4		1.4	
				6 V	0.6		1.6	
V_{OH}	High-level output voltage	$V_I = V_{IH}$ or V_{IL}	$I_{OH} = -20\ \mu\text{A}$	2 V to 6 V	$V_{CC} - 0.1$	$V_{CC} - 0.002$		V
			$I_{OH} = -6\ \text{mA}$	4.5 V	4.0	4.3		
			$I_{OH} = -7.8\ \text{mA}$	6 V	5.4	5.75		
V_{OL}	Low-level output voltage	$V_I = V_{IH}$ or V_{IL}	$I_{OL} = 20\ \mu\text{A}$	2 V to 6 V		0.002	0.1	V
			$I_{OL} = 6\ \text{mA}$	4.5 V		0.18	0.30	
			$I_{OL} = 7.8\ \text{mA}$	6 V		0.22	0.33	
I_I	Input leakage current	$V_I = V_{CC}$ or 0		6 V		± 100	± 1000	nA
I_{CC}	Supply current	$V_I = V_{CC}$ or 0, $I_O = 0$		6 V		0.1	2	μA
C_i	Input capacitance			2 V to 6 V			5	pF
C_{pd}	Power dissipation capacitance per gate	No load		2 V to 6 V		10		pF

(1) Guaranteed by design.

6.6 Switching Characteristics

$C_L = 50\ \text{pF}$; over operating free-air temperature range; typical values measured at $T_A = 25^\circ\text{C}$ (unless otherwise noted). See [Parameter Measurement Information](#).

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CC}	MIN	TYP	MAX	UNIT
f_{max}	Max switching frequency			2 V	18	31		MHz
				4.5 V	45	95		
				6 V	65	105		
t_{pd}	Propagation delay	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or \overline{Q}	2 V		19	42	ns
				4.5 V		8	19	
				6 V		7	15	
		CLK	Q or \overline{Q}	2 V		19	42	ns
				4.5 V		8	19	
				6 V		7	15	
t_t	Transition-time		Q or \overline{Q}	2 V		9	16	ns
				4.5 V		5	9	
				6 V		4	8	

6.7 Timing Characteristics

$C_L = 50\ \text{pF}$; over operating free-air temperature range (unless otherwise noted). See [Parameter Measurement Information](#).

PARAMETER			V_{CC}	MIN	MAX	UNIT
f_{clock}	Clock frequency		2 V		18	MHz
			4.5 V		45	
			6 V		65	

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Timing Characteristics (continued)
 $C_L = 50 \text{ pF}$; over operating free-air temperature range (unless otherwise noted). See [Parameter Measurement Information](#).

PARAMETER			V_{CC}	MIN	MAX	UNIT
t_w	Pulse duration	\overline{PRE} or \overline{CLR} low	2 V	11		ns
			4.5 V	11		
			6 V	11		
		CLK high or low	2 V	14		ns
			4.5 V	12		
			6 V	11		
t_{su}	Setup time before CLK high	Data	2 V	24		ns
			4.5 V	9		
			6 V	6		
		\overline{PRE} or \overline{CLR} inactive	2 V	7		ns
			4.5 V	5		
			6 V	5		
t_h	Hold time	Data after CLK \uparrow	2 V	0		ns
			4.5 V	0		
			6 V	0		

6.8 Typical Characteristics

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

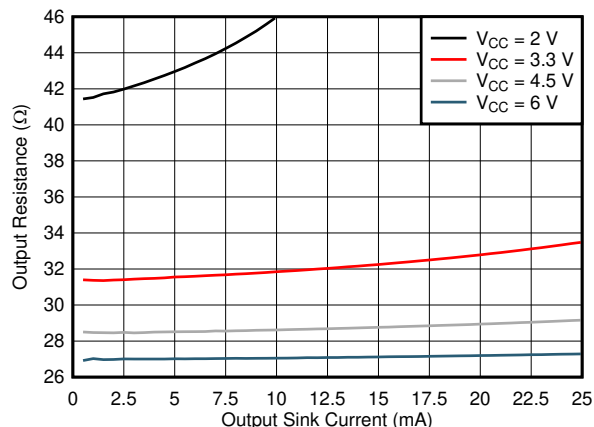


图 1. Output driver resistance in LOW state.

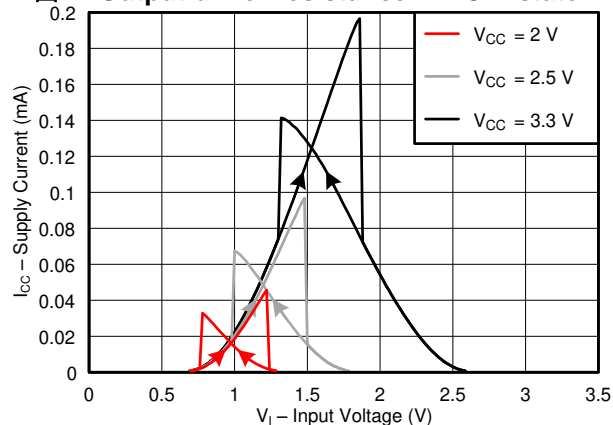


图 3. Supply current across input voltage, 2-, 2.5-, and 3.3-V supply

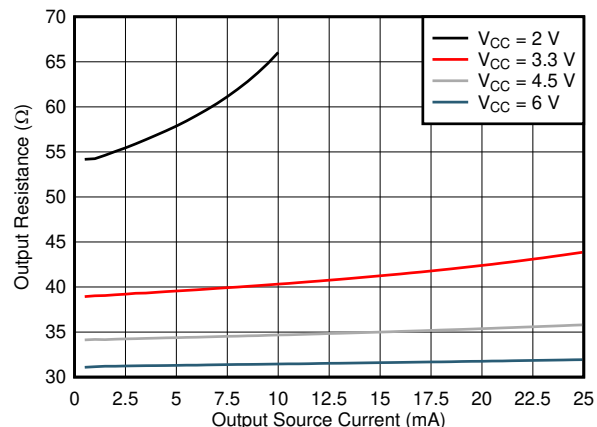


图 2. Output driver resistance in HIGH state.

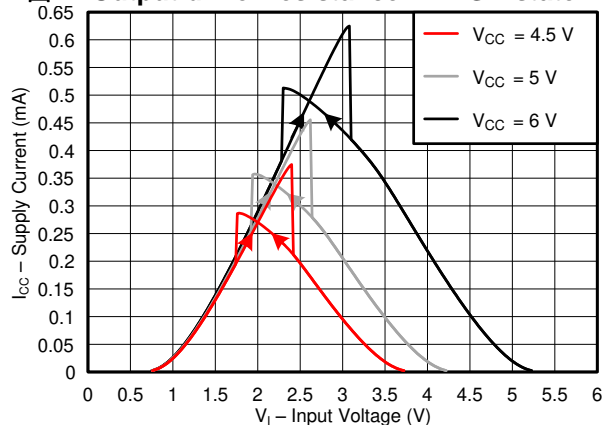


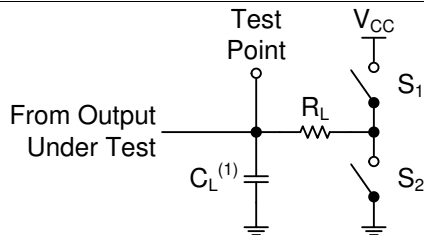
图 4. Supply current across input voltage, 4.5-, 5-, and 6-V supply

7 Parameter Measurement Information

Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $\text{PRR} \leq 1 \text{ MHz}$, $Z_O = 50 \, \Omega$, $t_f < 2.5 \text{ ns}$.

For clock inputs, f_{max} is measured when the input duty cycle is 50%.

The outputs are measured one at a time with one input transition per measurement.



C_L includes probe and test-fixture capacitance.

图 5. Load Circuit

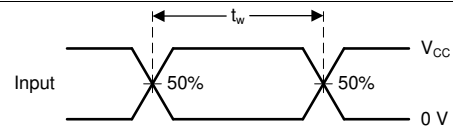


图 6. Voltage Waveforms, Pulse Duration

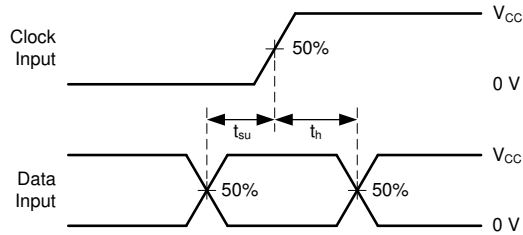
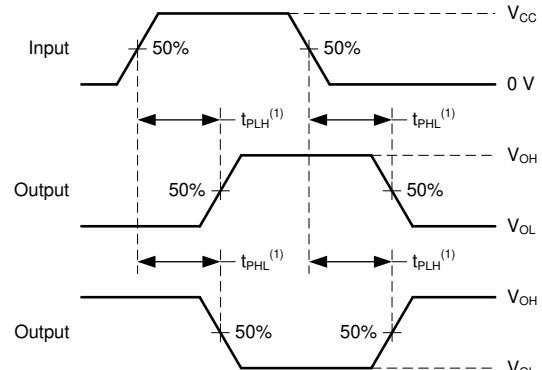


图 7. Voltage Waveforms, Setup and Hold Times



Voltage Waveforms, Propagation Delay specifications t_{PLH} and t_{PHL} are the same as t_{pd} .

图 8.

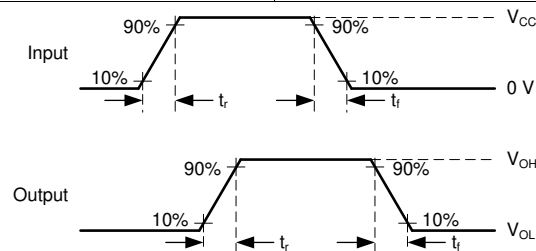


图 9. Voltage Waveforms, Input and Output Transition Times

8 Detailed Description

8.1 Overview

图 10 describes the SN74HCS74. As the SN74HCS74 is a dual D-Type positive-edge-triggered flip-flop with clear and preset, the diagram below describes one of the two device flip-flops.

8.2 Functional Block Diagram

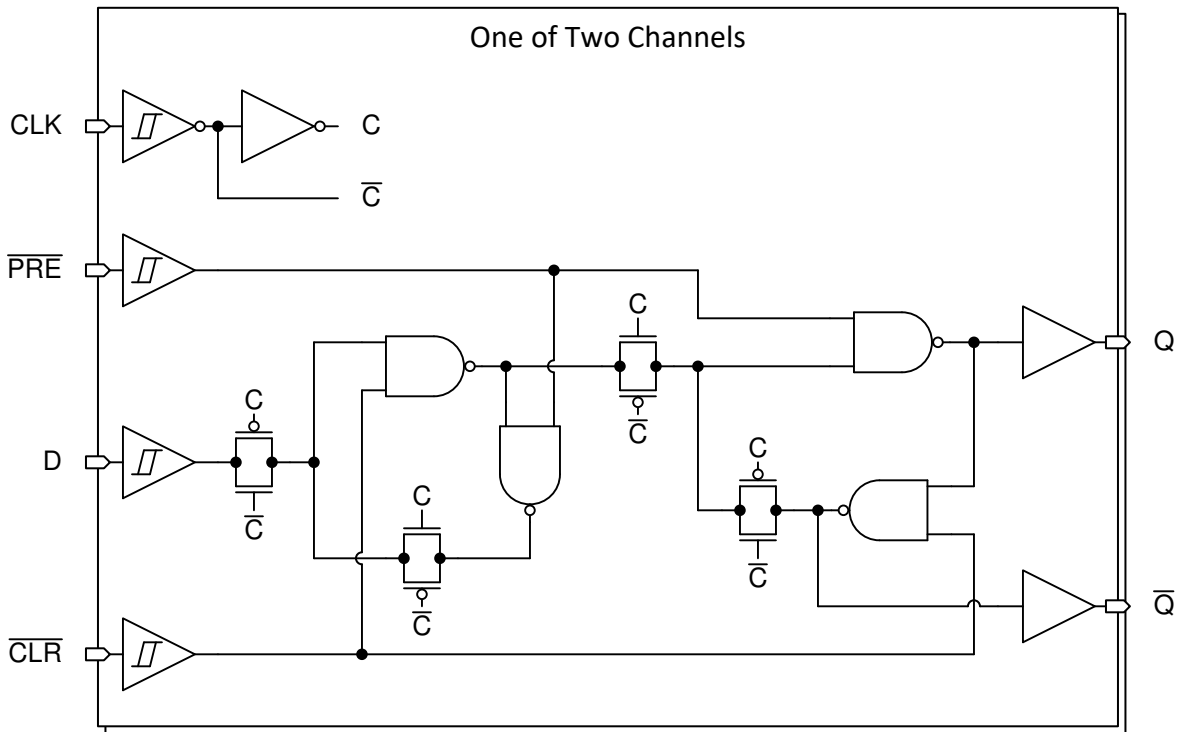


图 10. Logic Diagram (Positive Logic) for one channel of SN74HCS74

8.3 Feature Description

8.3.1 Balanced CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The drive capability of this device may create fast edges into light loads so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. It is important for the output power of the device to be limited to avoid damage due to over-current. The electrical and thermal limits defined in the [Absolute Maximum Ratings](#) must be followed at all times.

8.3.2 CMOS Schmitt-Trigger Inputs

Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the [Electrical Characteristics](#). The worst case resistance is calculated with the maximum input voltage, given in the [Absolute Maximum Ratings](#), and the maximum input leakage current, given in the [Electrical Characteristics](#), using ohm's law ($R = V \div I$).

The Schmitt-trigger input architecture provides hysteresis as defined by ΔV_T in the [Electrical Characteristics](#), which makes this device extremely tolerant to slow or noisy inputs. While the inputs can be driven much slower than standard CMOS inputs, it is still recommended to properly terminate unused inputs. Driving the inputs slowly will also increase dynamic current consumption of the device. For additional information regarding Schmitt-trigger inputs, please see [Understanding Schmitt Triggers](#).

Feature Description (接下页)

8.3.3 Positive and Negative Clamping Diodes

The inputs and outputs to this device have both positive and negative clamping diodes as depicted in 图 11.

CAUTION

Voltages beyond the values specified in the [Absolute Maximum Ratings](#) table can cause damage to the device. The input negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

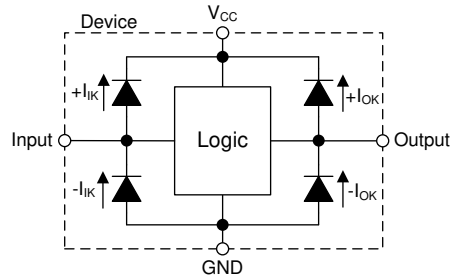


图 11. Electrical Placement of Clamping Diodes for Each Input and Output

8.4 Device Functional Modes

表 1 lists the functional modes of the SN74HCS74.

表 1. Function Table

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

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

9 Application and Implementation

注

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

Toggle switches are typically large, mechanically complex and relatively expensive. It is desirable to use a momentary switch instead because they are small, mechanically simple and low cost. Some systems require a toggle switch's functionality but are space or cost constrained and must use a momentary switch instead. The SN74HCS74 has integrated Schmitt-trigger inputs that eliminate the need for a second IC for signal conditioning, reducing the required board space. This makes the SN74HCS74 an ideal device for converting a momentary switch into a toggle switch.

If the data input (D) of the SN74HCS74 is tied to the inverted output (\bar{Q}), then each clock pulse will cause the value at the output (Q) to toggle. The momentary switch can be debounced and directly connected to the clock input (CLK) to toggle the output.

9.2 Typical Application

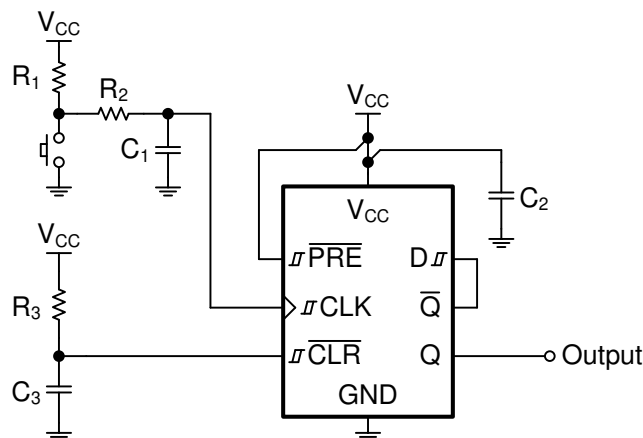


图 12. Device Power Button Circuit

9.2.1 Design Requirements

The supply voltage of the D-Type flip-flop must be chosen to meet the supply voltage specification from the [Recommended Operating Conditions](#). The same supply must be used for the pushbutton and power on reset circuit allowing for the high and low level input voltage conditions, V_{T+} and V_{T-} , to meet the requirements in [Electrical Characteristics](#).

When the flip-flop is first powered on, it will start in an unknown state if both the (\overline{PRE}) and (\overline{CLR}) pins are directly tied high. However, if either the (\overline{PRE}) or (\overline{CLR}) pin is held low, then the flip-flop will be in a known state.

With the SN74HCS74, a power on reset circuit only requires a resistor (R) and capacitor (C) to create a delay. The R and C values create a delay that is approximately $2.2 \times RC$. An additional Schmitt-trigger input device would be required to allow this slow rise if the flip-flop did not have Schmitt-trigger inputs. In this application, it is desired to have the output (Q) in the LOW state at startup, so R_3 and C_3 are connected directly to the \overline{CLR} pin, as shown in 图 12.

Typical Application (接下页)

9.2.1.1 Designing with Momentary Switches

Push buttons are the most common type of momentary switch. This application uses a normally open push-button switch. The mechanical linkages inside a switch can bounce, causing multiple outputs for each button press. It is important to eliminate these multiple outputs when working with a device fast enough to trigger from each bounce, such as the SN74HCS74.

To eliminate this bouncing, a debounce circuit can be used. The debounce circuit is a delay circuit, consisting of a resistor and a capacitor, that smooths out the bouncing enough to produce a single transition. Similar to the power on reset circuit, the resistor and capacitor values create a delay that is approximately 2.2 times the RC time constant. ($t_{\text{delay}} \approx 2.2RC$). To prevent a false trigger during power on, the debounce delay needs to be much smaller than the power on reset circuit's delay ($R_3 \times C_3 \gg R_2 \times C_1$).

The D-Type flip-flop reads in the input (D) when there is a positive edge on the clock. The circuitry described above is called a 'trigger on release' system, producing a positive clock edge only when the button is released. The 'trigger on press' circuit can be achieved by simply swapping the R_1 and button positions in the schematic.

9.2.1.2 Output Considerations

In general, the load needs to be considered in the design to determine if the device will have the capability to drive it. For this application, we assume that the button output is transmitting over a relatively short trace (under 10 cm) to a CMOS input on a microcontroller.

Primary load factors to consider:

- Load Capacitance: approximately 15 pF
 - See the [Switching Characteristics](#) section for the capacitive loads tested with this device.
 - Increasing capacitance will proportionally increase output transition times.
 - Decreasing capacitance will proportionally decrease output transition times, and can produce ringing due to very fast transition rates. A 25-Ω resistor can be added in series with the output if ringing needs to be dampened.
- Load Current: expected maximum of 10 μA
 - Leakage current into connected devices.
 - Parasitic current from other components.
 - Resistive load current.
- Output Voltage: see [Electrical Characteristics](#) for output voltage ratings at a given current.
 - Output HIGH (V_{OH}) and output LOW (V_{OL}) voltage levels affect the input voltage, V_{IH} and V_{IL} , respectively, to subsequent devices.

9.2.1.3 Input Considerations

The SN74HCS74 has Schmitt-trigger inputs. Schmitt-trigger inputs have no limitation on transition rate, however the input voltage must be larger than $V_{T+(max)}$ to be guaranteed to be read as a logic high, and below $V_{T-(min)}$ to be guaranteed to be read as a logic low, as defined in the [Electrical Characteristics](#). Do not exceed the values specified in the [Absolute Maximum Ratings](#) or the device could be damaged.

9.2.1.4 Timing Considerations

The SN74HCS74 is a clocked device. As such, it requires special timing considerations to ensure normal operation.

Primary timing factors to consider:

- Maximum clock frequency: the maximum operating clock frequency defined in [Timing Characteristics](#) is the maximum frequency at which the device is guaranteed to function. This value refers specifically to the triggering waveform, measuring from one trigger level to the next.
- Pulse duration: ensure that the triggering event duration is larger than the minimum pulse duration, as defined in the [Timing Characteristics](#).
- Setup time: ensure that the data has changed at least one setup time prior to the triggering event, as defined in the [Timing Characteristics](#).
- Hold time: ensure that the data remains in the desired state at least one hold time after the triggering event,

Typical Application (接下页)

as defined in the [Timing Characteristics](#).

9.2.2 Detailed Design Procedure

1. Recommended Input Conditions:

- Input signals to Schmitt-trigger inputs, like those found on the HCS family of devices, can support unlimited edge rates.
- Input thresholds are listed in the [Electrical Characteristics](#).
- Inputs include positive clamp diodes. Input voltages can exceed the device's supply so long as the clamp current ratings are observed from the [Absolute Maximum Ratings](#). Do not exceed the absolute maximum voltage rating of the device or it could be damaged.

2. Recommended Output Conditions:

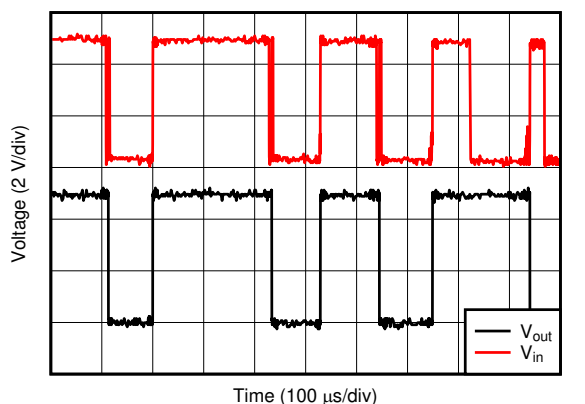
- Load currents should not exceed the value listed in the [Absolute Maximum Ratings](#).
- Series resistors on the output may be used if the user desires to slow the output edge signal or limit the output current.

3. Recommended Circuit Design Procedure:

- For proper startup, the debounce circuit should have a much smaller delay than the power on reset circuit, $10R_2C_1 < R_3C_3$.
- To perform a trigger on press instead of trigger on release, the button can be connected from V_{CC} to the input and R_1 can be connected from the input to the GND.

9.2.3 Application Curve

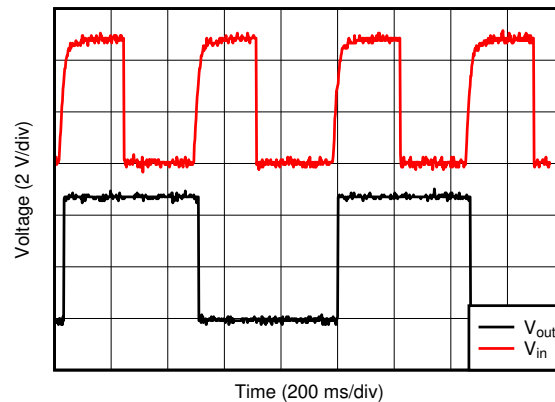
图 13 illustrates an example of a single button press bouncing and causing the output to toggle multiple times. This will cause issues in the desired application. 图 14 illustrates 4 button presses with an added debounce circuit, fixing the unwanted toggling and allowing for proper toggle switch operation.



D001

图 13. Circuit response without RC debounce
 $V_{in} := \text{CLK input}$, $V_{out} := \text{Q output}$

Typical Application (接下页)



D002

图 14. Circuit response with RC debounce
 $V_{in} := \text{CLK input}$, $V_{out} := \text{Q output}$

10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Absolute Maximum Ratings](#) table. Each V_{CC} terminal should have a bypass capacitor to prevent power disturbance. For this device, a 0.1- μF capacitor is recommended. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1- μF and 1- μF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminals as possible for best results.

11 Layout

11.1 Layout Guidelines

In many cases, functions or parts of functions of digital logic devices are unused. Some examples are when only two inputs of a triple-input AND gate are used, or when only 3 of the 4 channels are used. Such input pins should not be left completely unconnected because the unknown voltages result in undefined operational states.

Specified in [图 15](#) are rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally they are tied to GND or V_{CC} , whichever makes more sense or is more convenient. It is recommended to float outputs unless the part is a transceiver. If the transceiver has an output enable pin, it disables the output section of the part when asserted. This pin keeps the input section of the I/Os from being disabled and floated.

11.2 Layout Example

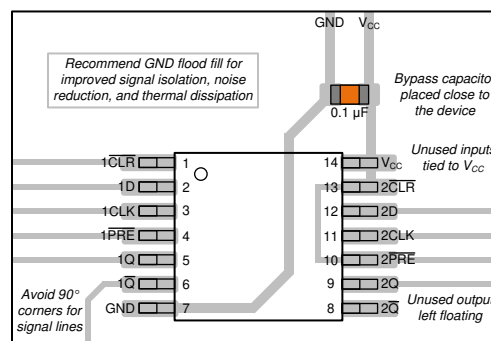


图 15. Layout Example

12 器件和文档支持

12.1 文档支持

12.1.1 文档支持

12.1.1.1 相关文档

请参阅如下相关文档：

- 德州仪器 (TI), 《慢速或浮点 CMOS 输入的影响》应用报告
- 德州仪器 (TI), 《使用全新 HCS 逻辑系列降低噪声并节省电力》应用报告
- 德州仪器 (TI), 《了解施密特触发》应用报告

12.2 相关链接

下表列出了快速访问链接。类别包括技术文档、支持与社区资源、工具和软件，以及申请样片或购买产品的快速链接。

12.3 接收文档更新通知

要接收文档更新通知，请导航至 ti.com.cn 上的器件产品文件夹。单击右上角的通知我进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

12.4 社区资源

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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](#).

12.5 商标

E2E is a trademark of Texas Instruments.

12.6 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

12.7 Glossary

SLYZ022 — *TI Glossary*.

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

13 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

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
SN74HCS74BQAR	ACTIVE	WQFN	BQA	14	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCS74	Samples
SN74HCS74DR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	HCS74	Samples
SN74HCS74PWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	HCS74	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.

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D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040047-5/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 AB.

D (R-PDSO-G14)

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.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040064-3/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-G14)

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.



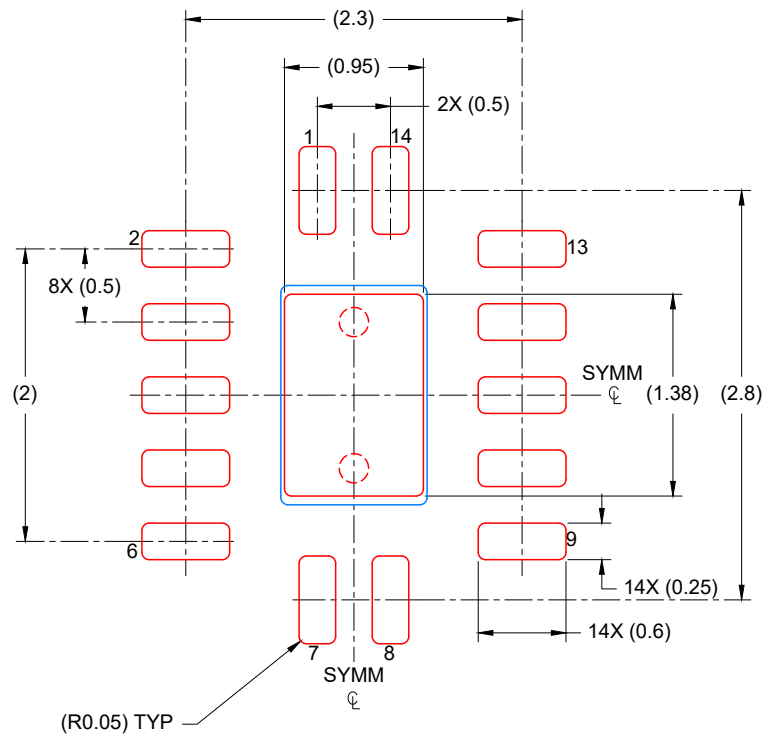
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224636/A 11/2018

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/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
 88% PRINTED COVERAGE BY AREA
 SCALE: 20X

4224636/A 11/2018

NOTES: (continued)

6. 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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