

SN74LVC1G86-Q1 单路 2 输入异或门

1 特性

- 符合汽车应用 要求
- 具有符合 AEC-Q100 标准的下列结果：
 - ±4000 V 人体放电模型 (HBM) ESD 分类等级 3A
 - ±1000 V 带电器件模型 (CDM) ESD 分类等级 C5
- 支持 5V V_{CC} 运行
- 输入为高达 5.5V 过电压差
- 支持下行转换到 V_{CC}
- 低功耗， I_{CC} 最大值为 15 μ A
- 3.3V 和 50pF 负载条件下 t_{pd} 最大值为 6ns
- 电压为 3.3V 时，输出驱动为 ±24mA
- I_{off} 支持部分断电模式和后驱动保护
- 锁断性能超过 100mA，符合 JESD 78 II 类规范的要求

2 应用

- 混合动力汽车/电动汽车 (HEV/EV) 和动力总成
- 汽车信息娱乐系统与组合仪表
- 汽车高级驾驶员辅助系统
- 汽车车身电子设备

3 说明

SN74LVC1G86-Q1 是一款符合汽车要求的器件，并以正逻辑执行布尔函数 $Y = \overline{AB} + A\overline{B}$ 。该单路 2 输入异或门适用于 1.65V 至 5.5V V_{CC} 运行环境。

如果一个输入为低电平，另一个输入则可在输出时重新生成真实形态。如果一个输入为高电平，另一个输入的信号则可在输出时重新生成反向信号。该器件功耗低，3.3V 和 50pF 电容性负载条件下 t_{pd} 最大值为 6ns。最大输出驱动为 ±32mA/4.5V 和 ±24mA/3.3V。

该器件完全适用于使用 I_{off} 的局部掉电应用。 I_{off} 电路可禁用输出，以防在器件断电时电流回流对器件造成损坏。

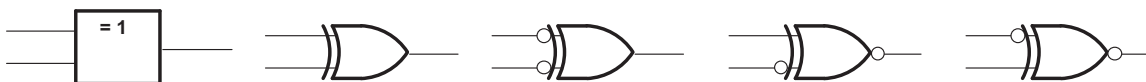
器件信息(1)

器件型号	封装	封装尺寸 (标称值)
SN74LVC1G86QDCKRQ1	SC70 (5)	2.00mm x 1.25mm

(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。

功能框图

EXCLUSIVE OR



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异或门具有多种应用，并可用其他逻辑符号更好地表示其中部分应用。

共有五种等效异或门符号适用于采用正逻辑的 SN74LVC1G86-Q1 门；任意两个端口可能显示否定逻辑。



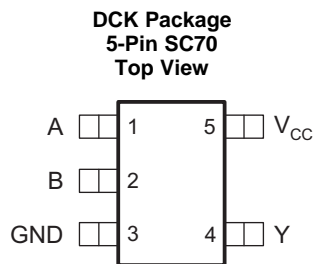
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4 修订历史记录

日期	修订版本	注释
2017 年 3 月	*	初始发行版。

5 Pin Configuration and Functions



Pin Functions⁽¹⁾

PIN		I/O	DESCRIPTION
NO.	NAME		
1	A	I	Input A
2	B	I	Input B
3	GND	—	Ground
4	Y	O	Output Y
5	V _{CC}	—	Positive Supply

(1) See mechanical drawings for dimensions.

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	6.5	V
V _I	Input voltage ⁽²⁾	-0.5	6.5	V
V _O	Voltage applied to any output in the high-impedance or power-off state ⁽²⁾	-0.5	6.5	V
V _O	Voltage applied to any output in the high or low state ⁽²⁾⁽³⁾	-0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	V _I < 0	-50	mA
I _{OK}	Output clamp current	V _O < 0	-50	mA
I _O	Continuous output current		±50	mA
	Continuous current through V _{CC} or GND		±100	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 negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (3) The value of V_{CC} is provided in the *Recommended Operating Conditions* table.

6.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002 ⁽¹⁾	±4000
		Charged-device model (CDM), per AEC Q100-011	±1000

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

6.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage	Operating	1.65	5.5
		Data retention only	1.5	
V _{IH}	High-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V	1.7	
		V _{CC} = 3 V to 3.6 V	2	
		V _{CC} = 4.5 V to 5.5 V	0.7 × V _{CC}	
V _{IL}	Low-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.35 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V	0.7	
		V _{CC} = 3 V to 3.6 V	0.8	
		V _{CC} = 4.5 V to 5.5 V	0.3 × V _{CC}	
V _I	Input voltage	0	5.5	V
V _O	Output voltage	0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 1.65 V	-4	mA
		V _{CC} = 2.3 V	-8	
		V _{CC} = 3 V	-16	
		V _{CC} = 4.5 V	-24	

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See [Implications of Slow or Floating CMOS Inputs](#), SCBA004.

Recommended Operating Conditions (continued)

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

		MIN	MAX	UNIT	
I _{OL}	Low-level output current	V _{CC} = 1.65 V	4	mA	
		V _{CC} = 2.3 V	8		
		V _{CC} = 3 V	16		
			24		
		V _{CC} = 4.5 V	32		
Δt/Δv	Input transition rise or fall rate	V _{CC} = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V	20	ns/V	
		V _{CC} = 3.3 V ± 0.3 V	10		
		V _{CC} = 5 V ± 0.5 V	5		
T _A	Operating free-air temperature	DCK package	–40	125	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		SN74LVC1G86-Q1	UNIT
		DCK (SC70)	
		5 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	277.6	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	179.5	°C/W
R _{θJB}	Junction-to-board thermal resistance	75.9	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	49.7	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	75.1	°C/W

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

6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OH}	I _{OH} = –100 μA	1.65 V to 5.5 V	V _{CC} – 0.1		V	
	I _{OH} = –4 mA	1.65 V	1.2			
	I _{OH} = –8 mA	2.3 V	1.9			
	I _{OH} = –16 mA	3 V	2.4			
			2.3			
	I _{OH} = –32 mA	4.5 V	3.8			
V _{OL}	I _{OL} = 100 μA	1.65 V to 5.5 V	0.1		V	
	I _{OL} = 4 mA	1.65 V	0.45			
	I _{OL} = 8 mA	2.3 V	0.3			
	I _{OL} = 16 mA	3 V	0.4			
			0.55			
	I _{OL} = 32 mA	4.5 V	0.55			
I _I	A or B input	V _I = 5.5 V or GND	0 to 5.5 V		±5	μA
I _{off}		V _I or V _O = 5.5 V	0		±10	μA
I _{CC}		V _I = V _{CC} or GND, I _O = 0	1.65 V to 5.5 V		15	μA
ΔI _{CC}		One input at V _{CC} – 0.6 V, Other inputs at V _{CC} or GND	3 V to 5.5 V		500	μA
C _i		V _I = V _{CC} or GND	3.3 V		6	pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

6.6 Switching Characteristics, $C_L = 30\text{ pF}$ or 50 pF

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CC} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	-40°C to 125°C temperature range, see Figure 2	3.5	12	1.8	7	1.3	6	1	5	ns

6.7 Operating Characteristics

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

PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	$V_{CC} = 5\text{ V}$	UNIT
		TYP	TYP	TYP	TYP	
C_{pd} Power dissipation capacitance	$f = 10\text{ MHz}$	22	22	22	24	pF

6.8 Typical Characteristics

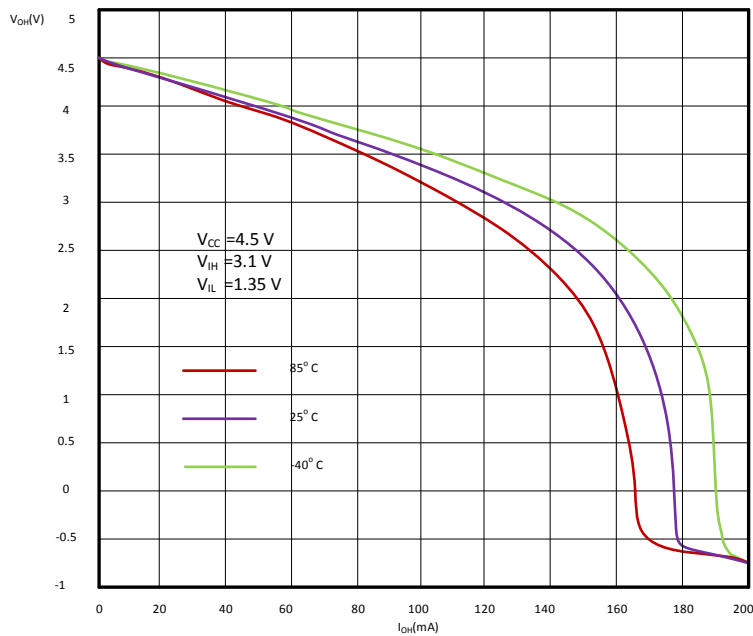
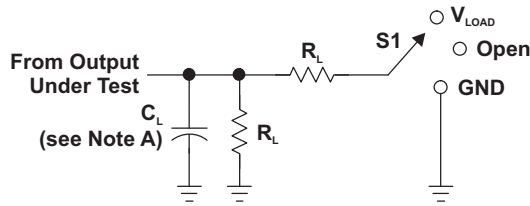


Figure 1. V_{oh} vs I_{oh} at 4.5 V

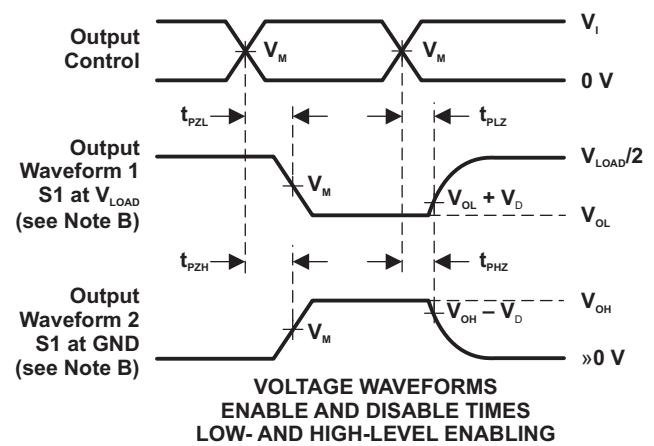
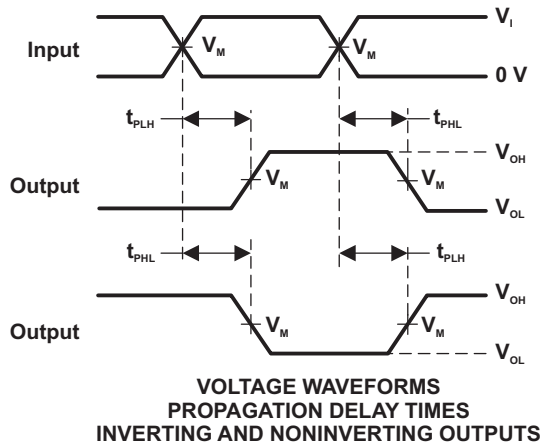
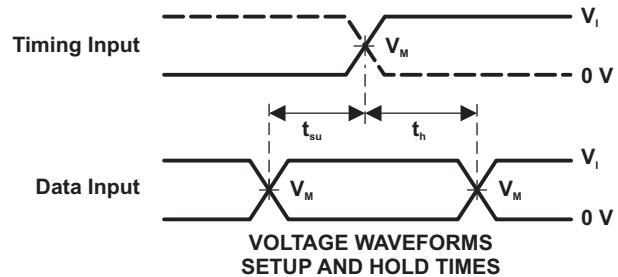
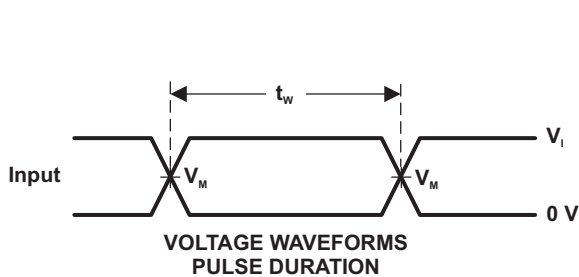
7 Parameter Measurement Information



LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_D
	V_i	t_r/t_f					
$1.8\text{ V} \pm 0.15\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M Ω	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	V_{CC}	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M Ω	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	3 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	15 pF	1 M Ω	0.3 V
$5\text{ V} \pm 0.5\text{ V}$	V_{CC}	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	15 pF	1 M Ω	0.3 V



- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, $Z_o = 50\ \Omega$.
 - D. The outputs are measured one at a time, with one transition per measurement.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PLH} and t_{PHL} are the same as t_{pd} .
 - H. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

8 Detailed Description

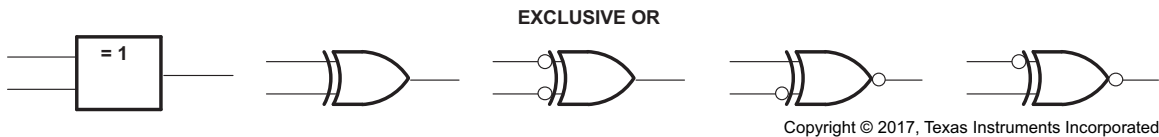
8.1 Overview

The SN74LVC1G86-Q1 is an automotive qualified device that performs the Boolean function $Y = \bar{A}B + A\bar{B}$ in positive logic. This single 2-input exclusive-OR gate is designed for 1.65-V to 5.5-V V_{CC} operation.

A common application is as a true and complement element. If the input is low, the other input is reproduced in true form at the output. If the input is high, the signal on the other input is reproduced inverted at the output.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

8.2 Functional Block Diagram



These are five equivalent exclusive-OR symbols valid for an SN74LVC1G86-Q1 gate in positive logic; negation may be shown at any two ports.

8.3 Feature Description

8.3.1 Balanced High-Drive CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The high drive capability of this device creates 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 power output of the device to be limited to avoid thermal runaway and 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 Standard CMOS 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 [Recommended Operating Conditions](#), and the maximum input leakage current, given in the [Electrical Characteristics](#), using ohm's law ($R = V \div I$).

Signals applied to the inputs need to have fast edge rates, as defined by $\Delta t/\Delta v$ in [Recommended Operating Conditions](#) to avoid excessive currents and oscillations. If tolerance to a slow or noisy input signal is required, a device with a Schmitt-trigger input should be utilized to condition the input signal prior to the standard CMOS input.

Feature Description (continued)

8.3.3 Clamp Diodes

The inputs and outputs to this device have negative clamping diodes.

CAUTION

Avoid any voltage below or above the input or output voltage specified in the [Absolute Maximum Ratings](#). In this event, the current must be limited to the maximum input or output clamp current value indicated in the [Absolute Maximum Ratings](#) to avoid damage to the device.

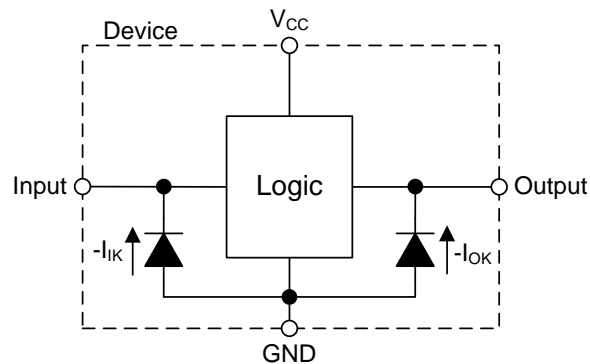


Figure 3. Electrical Placement of Clamping Diodes for Each Input and Output

8.3.4 Partial Power Down (I_{off})

The inputs and outputs for this device enter a high impedance state when the supply voltage is 0 V. The maximum leakage into or out of any input or output pin on the device is specified by I_{off} in the [Electrical Characteristics](#).

8.3.5 Over-voltage Tolerant Inputs

Input signals to this device can be driven above the supply voltage so long as they remain below the maximum input voltage value specified in the [Recommended Operating Conditions](#).

8.4 Function Table

Table 1 lists the functional modes of the SN74LVC1G86-Q1 device.

Table 1. Function Table

INPUTS		OUTPUT Y
A	B	
L	L	L
L	H	H
H	L	H
H	H	L

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The SN74LVC1G86-Q1 device can accept input voltages up to 5.5 V at any valid V_{CC} which makes the device suitable for down translation. This feature of the SN74LVC1G86-Q1 makes it ideal for various bus interface applications.

9.2 Typical Application

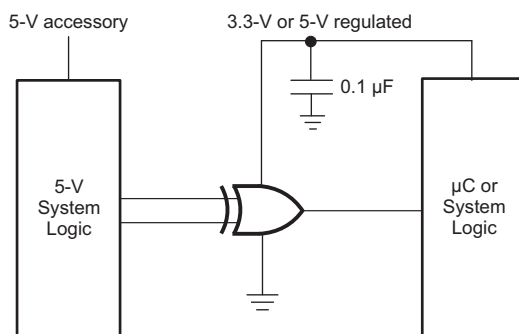


Figure 4. Typical Application Schematic

9.2.1 Design Requirements

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

9.2.2 Detailed Design Procedure

1. Recommended Input Conditions
 - For rise time and fall time specifications, see $\Delta t/\Delta V$ in the [Recommended Operating Conditions](#) table.
 - For 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} .
2. Recommended Output Conditions
 - Load currents should not exceed 32 mA per output and 50 mA total for the part.
 - Outputs should not be pulled above V_{CC} .

Typical Application (continued)

9.2.3 Application Curve

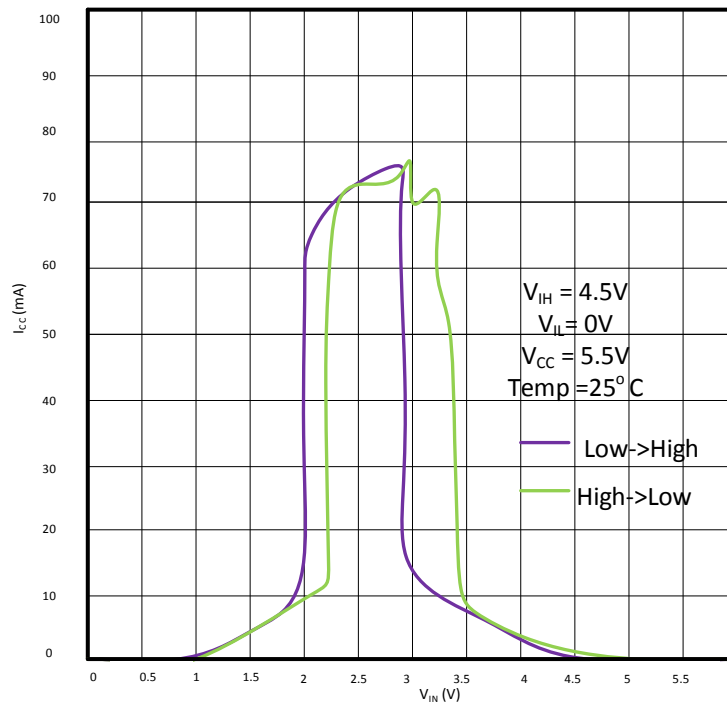


Figure 5. I_{CC} vs. V_{IN}

10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#) table.

Each V_{CC} pin must 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, 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 1- μF are commonly used in parallel. The bypass capacitor must be installed as close to the power pin as possible for best results.

11 Layout

11.1 Layout Guidelines

Even low data rate digital signals can have high frequency signal components due to fast edge rates. When a PCB trace turns a corner at a 90° angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self-inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must turn corners. Figure 6 shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

11.2 Layout Example

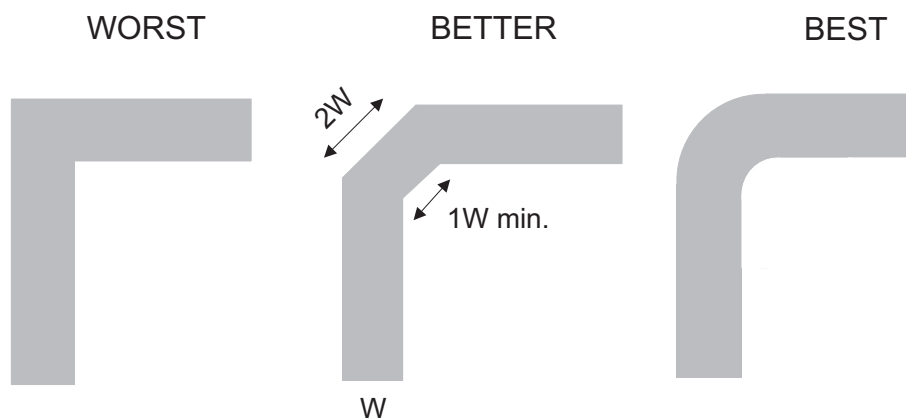


Figure 6. Trace Example

12 器件和文档支持

12.1 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。请单击右上角的通知我进行注册，即可收到任意产品信息更改每周摘要。有关更改的详细信息，请查看任意已修订文档中包含的修订历史记录。

12.2 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](#).

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.

12.3 商标

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

12.4 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。

12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 机械、封装和可订购信息

以下页面包括机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据发生变化时，我们可能不会另行通知或修订此文档。如欲获取此产品说明书的浏览器版本，请参见左侧的导航栏。

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
SN74LVC1G86QDCKRQ1	ACTIVE	SC70	DCK	5	3000	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	16T	Samples
SN74LVC1G86QDCKTQ1	ACTIVE	SC70	DCK	5	250	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	16T	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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DCK (R-PDSO-G5)

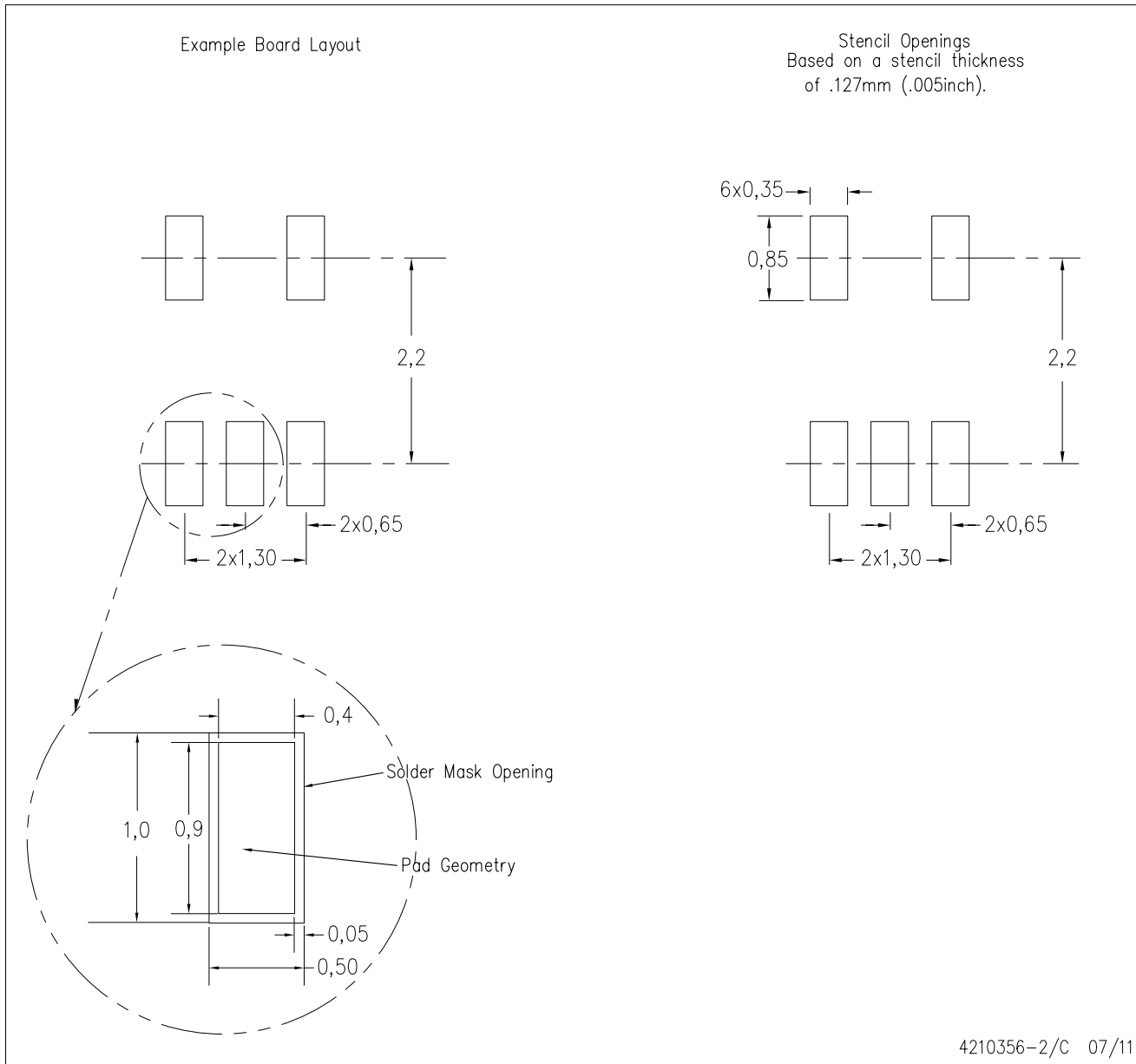
PLASTIC SMALL-OUTLINE PACKAGE



- 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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AA.

DCK (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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