

SN74AHC1G86-Q1 汽车类单通道双输入异或门

1 特性

- 符合汽车应用要求
- 具有符合 AEC-Q100 标准的下列特性：
 - ±4000V 人体放电模型 (HBM) ESD 分类等级 3A
 - ±1000V 充电器件模型 (CDM) ESD 分级等级 C5
- 工作电压范围为 2V 至 5.5V
- 5V 时， t_{pd} 最大值为 10ns
- 低功耗， I_{CC} 最大值为 10 μ A
- 5V 时，输出驱动为 ±8mA
- 所有输入端均采用施密特触发器，使得电路能够承受较慢的输入上升和下降时间

2 应用

- 无线耳机
- 电机驱动与控制
- 电视
- 机顶盒
- 音频

3 说明

SN74AHC1G86-Q1 是一款单通道双输入异或门。该器件执行布尔函数 $Y = A \oplus B$ 或 $Y = \overline{AB} + A\overline{B}$ 。

常用作真/补元件。如果一个输入为低电平，则可在输出时重新生成真实形态的其他输入。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。

封装信息

器件型号	封装 ⁽¹⁾	封装尺寸 ⁽²⁾	封装尺寸 ⁽³⁾
SN74AHC1G86-Q1	DBV (SOT-23, 5)	2.90mm × 2.8mm	2.90mm × 1.60mm

(1) 有关更多信息，请参阅第 11 节。

(2) 封装尺寸 (长 × 宽) 为标称值，并包括引脚 (如适用)。

(3) 封装尺寸 (长 × 宽) 为标称值，不包括引脚。



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功能方框图



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4 Pin Configuration and Functions

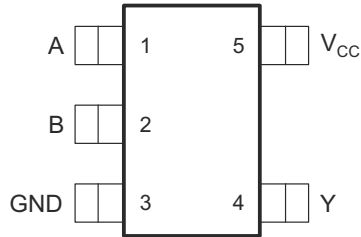


图 4-1. DBV Package 5-Pin SOT-23 Top View

表 4-1. Pin Functions

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

5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage range	- 0.5	7	V
V _I	Input voltage range ⁽²⁾	- 0.5	7	V
V _O	Output voltage range applied in the high- or low-state ⁽²⁾	- 0.5	V _{CC} + 0.5	V
I _{IK}	Input clamp current	(V _I < 0V)	- 20	V
I _{OK}	Output clamp current	(V _O < 0V or V _O > V _{CC})	±20	mA
I _O	Continuous output current	(V _O = 0V to V _{CC})	±25	mA
	Continuous current through V _{CC} or GND		±50	mA
T _J	Junction temperature		150	°C
T _{stg}	Storage temperature range	- 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 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.

5.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage	2	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 2V	1.5	V
		V _{CC} = 3V	2.1	
		V _{CC} = 5.5V	3.85	
V _{IL}	Low-level input voltage	V _{CC} = 2V	0.5	V
		V _{CC} = 3V	0.9	
		V _{CC} = 5.5V	1.65	
V _I	Input voltage	0	5.5	V
V _O	Output voltage	0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 2V	- 50	μA
		V _{CC} = 3.3V ±0.3V	- 4	mA
		V _{CC} = 5V ±0.5V	- 8	
I _{OL}	Low-level output current	V _{CC} = 2V	50	μA
		V _{CC} = 3.3V ±0.3V	4	mA
		V _{CC} = 5V ±0.5V	8	
Δt/ΔV	Input transition rise or fall rate	V _{CC} = 3.3V ±0.3V	100	ns/V
		V _{CC} = 5V ±0.5V	20	
T _A	Operating free-air temperature	- 40	125	°C

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		SN74AHC1G86-Q1	UNIT
		DBV (SOT-23)	
		5 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	278	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	180.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	184.4	°C/W
ψ_{JT}	Junction-to-top characterization parameter	115.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	183.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

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

5.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	V_{CC}	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
			MIN	TYP	MAX			
V_{OH}	$I_{OH} = -50 \mu\text{A}$	2V	1.9	2		1.9	V	
		3V	2.9	3		2.9		
		4.5V	4.4	4.5		4.4		
	$I_{OH} = -4\text{mA}$	3V	2.58			2.48		
	$I_{OH} = -8\text{mA}$	4.5V	3.94			3.8		
V_{OL}	$I_{OL} = 50 \mu\text{A}$	2V			0.1	0.1	V	
		3V			0.1	0.1		
		4.5V			0.1	0.1		
	$I_{OL} = 4\text{mA}$	3V			0.36	0.44		
	$I_{OL} = 8\text{mA}$	4.5V			0.36	0.44		
I_I	$V_I = 5.5\text{V}$ or GND	0V to 5.5V			± 0.1	± 1	μA	
I_{CC}	$V_I = V_{CC}$ or GND, $I_O = 0\text{A}$	5.5V			1	10	μA	
C_I	$V_I = V_{CC}$ or GND	5V			4	10	pF	

5.6 Switching Characteristics, $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$

over recommended operating free-air temperature range, $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$, $T_A = -40^\circ\text{C}$ to 125°C , see [Load Circuit and Voltage Waveforms](#)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{PLH}	A or B	Y	$C_L = 50\text{pF}$		9.5	14.5	1	16.5	ns
t_{PHL}					9.5	14.5	1	16.5	

5.7 Switching Characteristics, $V_{CC} = 5\text{V} \pm 0.5\text{V}$

over recommended operating free-air temperature range, $V_{CC} = 5\text{V} \pm 0.5\text{V}$, $T_A = -40^\circ\text{C}$ to 125°C , see [Load Circuit and Voltage Waveforms](#)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{PLH}	A or B	Y	$C_L = 50\text{pF}$		6.3	8.8	1	10	ns
t_{PHL}					6.3	8.8	1	10	

5.8 Operating Characteristics

$V_{CC} = 5V, T_A = 25^{\circ}C$

PARAMETER	TEST CONDITIONS	TYP	UNIT
C_{pd} Power dissipation capacitance	No load, $f = 1MHz$	18	pF

5.9 Typical Characteristics

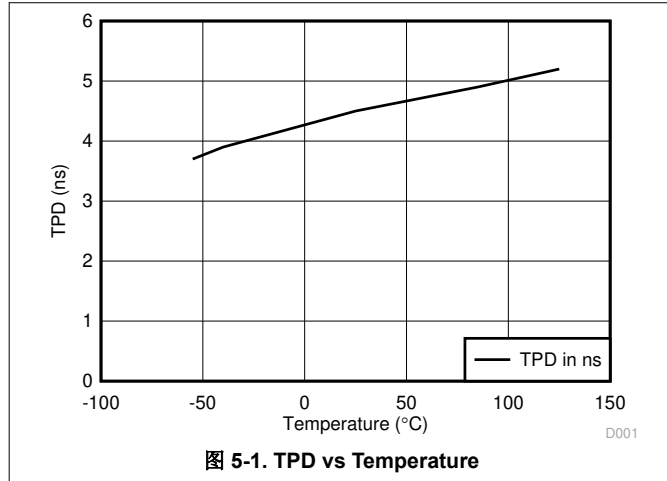


图 5-1. TPD vs Temperature

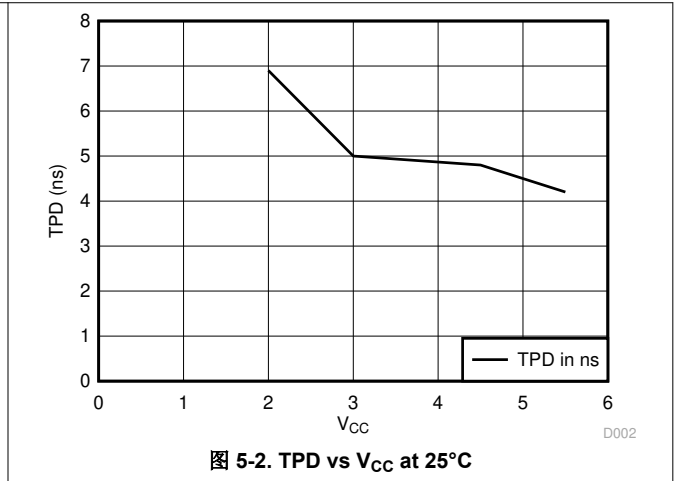
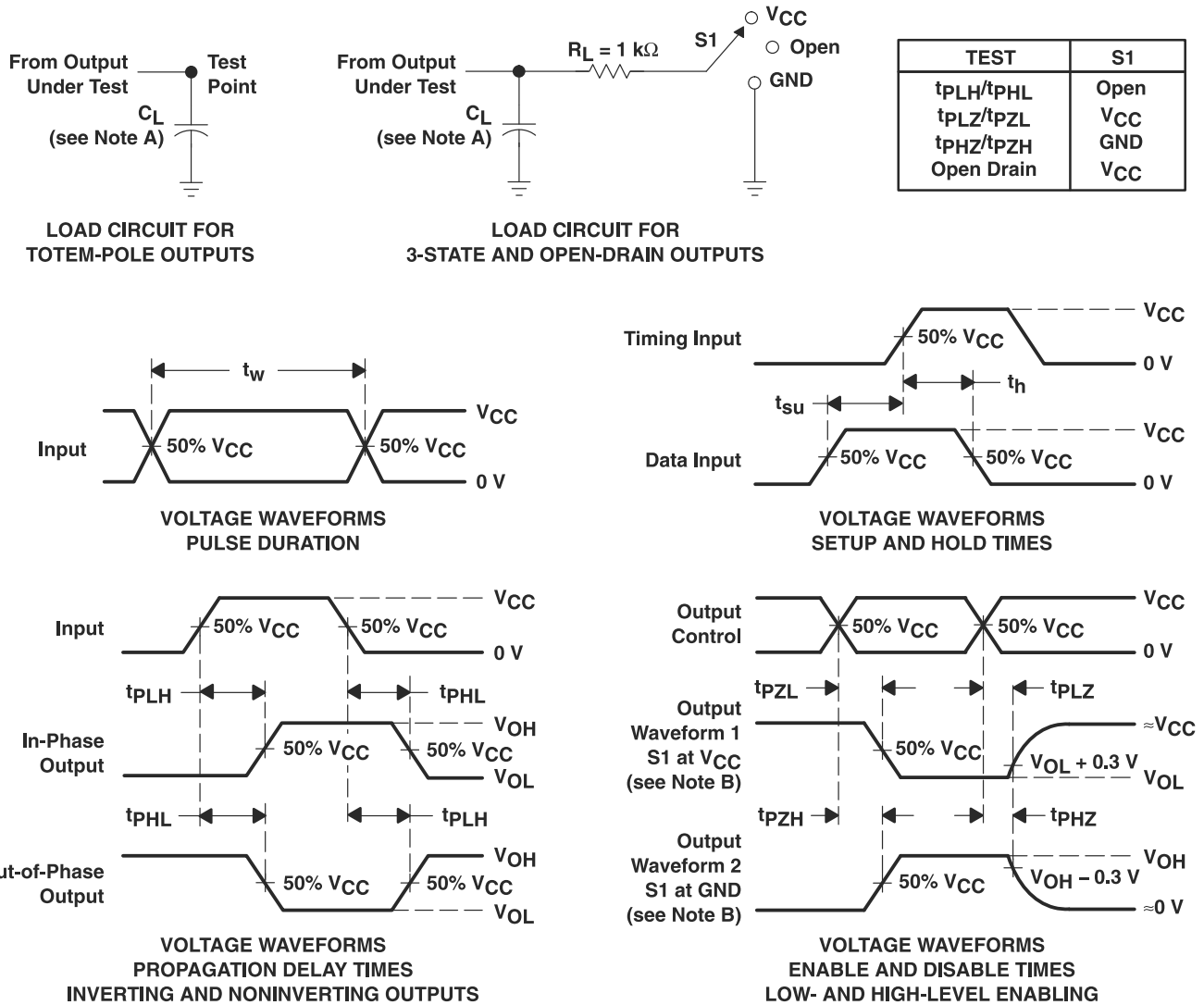


图 5-2. TPD vs V_{CC} at 25°C

6 Parameter Measurement Information



- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O = 50 \Omega$, $t_r \leq 3$ ns, $t_f \leq 3$ ns.
 D. The outputs are measured one at a time, with one input transition per measurement.

图 6-1. Load Circuit and Voltage Waveforms

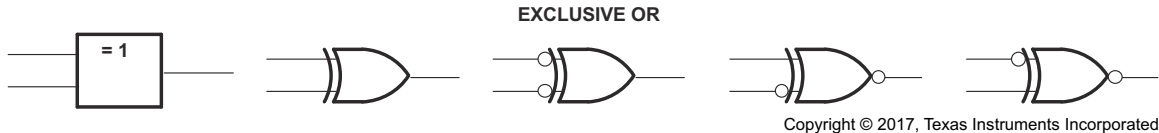
7 Detailed Description

7.1 Overview

The SN74AHC1G86-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 2V to 5.5V V_{CC} operation.

A common application is as a true or complementary element. If one of the inputs is low, the other input is reproduced in true form at the output. If one of the inputs is high, the signal on the other input is reproduced inverted at the output.

7.2 Functional Block Diagram



These are five equivalent exclusive-OR symbols valid for an SN74AHC1G86-Q1 gate in positive logic; negation may be shown at any two ports.

7.3 Feature Description

7.3.1 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 must be followed at all times.

7.3.2 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 . The worst case resistance is calculated with the maximum input voltage, given in the , and the maximum input leakage current, given in the , 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 to avoid excessive current consumption and oscillations. If a slow or noisy input signal is required, a device with a Schmitt-trigger input should be used to condition the input signal prior to the standard CMOS input.

7.3.3 Clamping Diodes

The inputs have negative clamping diodes, and the outputs have positive and negative clamping diodes as depicted in [图 7-1](#).

小心

Voltages beyond the values specified in the 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.

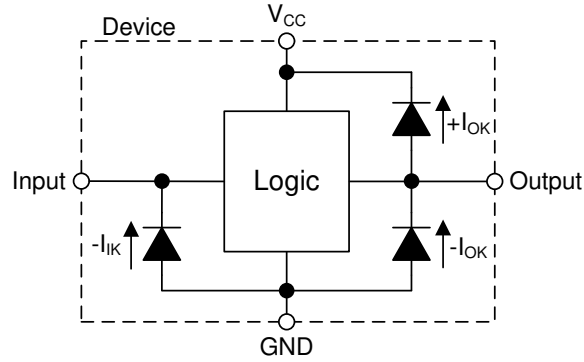


图 7-1. Electrical Placement of Clamping Diodes for Each Input and Output

7.3.4 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 .

7.4 Device Functional Modes

表 7-1 lists the functional modes of the SN74AHC1G86-Q1 device.

表 7-1. Function Table

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

8 Application and Implementation

备注

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

8.1 Application Information

The SN74AHC1G86-Q1 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. The inputs can accept voltages to 5.5V at any valid V_{CC} making it ideal for down translation.

8.2 Typical Application

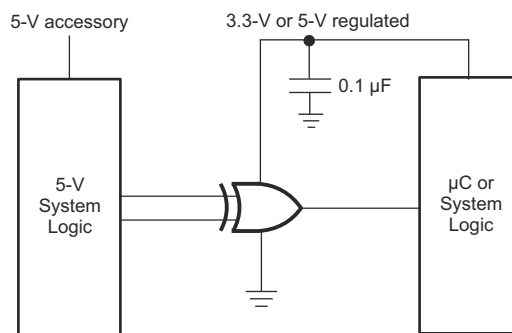


图 8-1. Typical Application Schematic

8.2.1 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.

8.2.2 Detailed Design Procedure

- Recommended Input Conditions
 - For rise time and fall time specifications, see $\Delta t / \Delta V$ in the table.
 - For specified High and low levels, see V_{IH} and V_{IL} in the table.
 - Inputs are overvoltage tolerant allowing them to go as high as 5.5V at any valid V_{CC} .
- Recommended Output Conditions
 - Load currents should not exceed 8mA per output.
 - Outputs should not be pulled above V_{CC} .

8.2.3 Application Curve

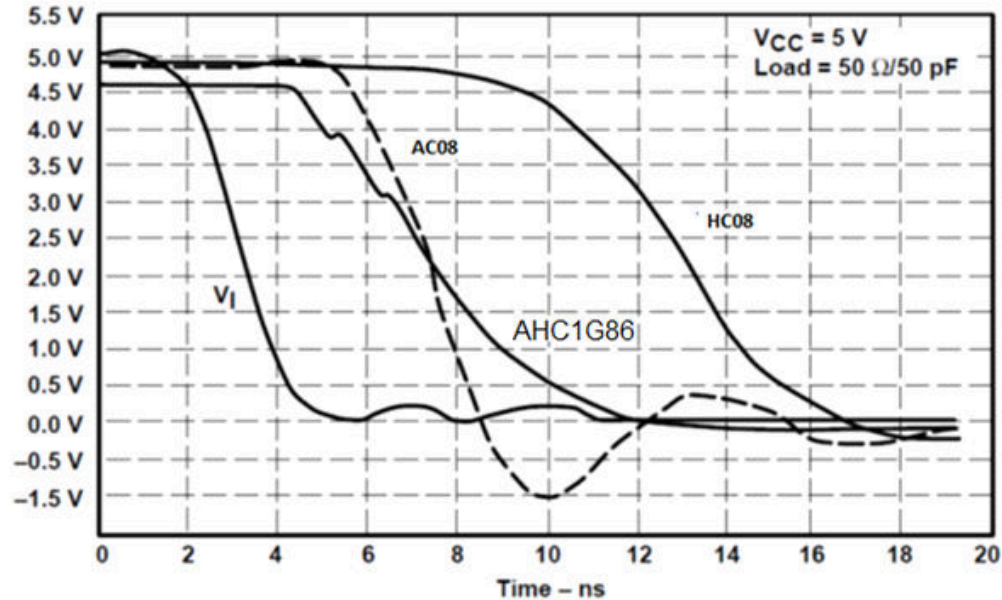


图 8-2. Switching Characteristics Comparison

8.3 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the table.

Each V_{CC} pin must 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, $0.01\ \mu\text{F}$ 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 $1\ \mu\text{F}$ are commonly used in parallel. The bypass capacitor must be installed as close to the power pin as possible for best results.

8.4 Layout

8.4.1 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. shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

8.4.2 Layout Example

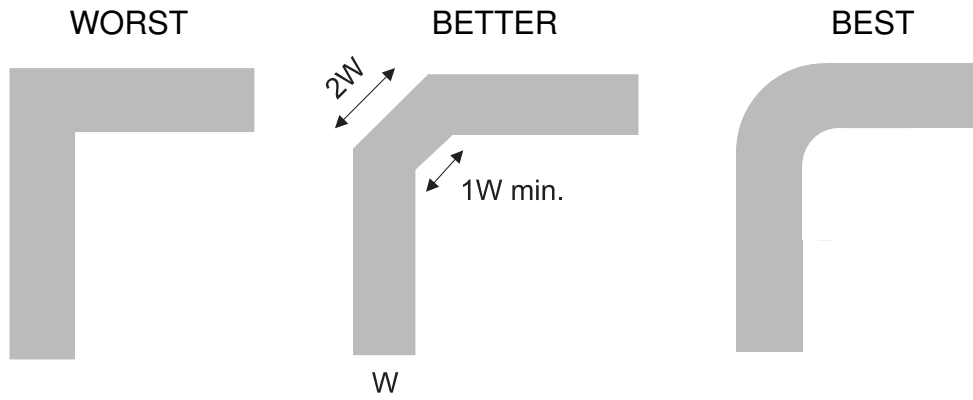


图 8-3. Trace Example

9 Device and Documentation Support

9.1 Community Resources

9.2 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。点击 [通知](#) 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。

9.3 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [使用条款](#)。

9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

9.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

9.6 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

10 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision A (May 2019) to Revision B (February 2024)	Page
• 更新了整个文档中的表格、图和交叉参考的编号格式.....	1
• Updated thermal values for DBV package from $R_{\theta JA} = 224.1$ to 278, $R_{\theta JC(top)} = 152.8$ to 180.5, $R_{\theta JB} = 131.8$ to 184.4, $\Psi_{JT} = 65.7$ to 115.4, $\Psi_{JB} = 131.0$ to 183.4, $R_{\theta JC(bot)} = N/A$, all values in $^{\circ}C/W$	5

Changes from Revision * (April 2011) to Revision A (May 2019)	Page
• 更改了“特性”部分.....	1
• 添加了“应用”部分.....	1
• 更改了“说明”部分.....	1
• Changed Pin Configuration and Functions section.....	3
• Added T_J spec to Absolute Maximum Ratings table.....	4
• Changed T_{stg} to -65° (min) and $150^{\circ}C$ (max) from $-40^{\circ}C$ (min) and $125^{\circ}C$ (max).....	4
• Added ESD Ratings table.....	4
• Added Thermal Information table.....	5
• Added Typical Characteristics section.....	6
• Added Application and Implementation section	10
• Added Power Supply Recommendations section	11

11 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 finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74AHC1G86QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	(39KH, ACYU)	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.

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 SN74AHC1G86-Q1 :

- Catalog : [SN74AHC1G86](#)
- Enhanced Product : [SN74AHC1G86-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AHC1G86QDBVRQ1	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
SN74AHC1G86QDBVRQ1	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AHC1G86QDBVRQ1	SOT-23	DBV	5	3000	210.0	185.0	35.0
SN74AHC1G86QDBVRQ1	SOT-23	DBV	5	3000	200.0	183.0	25.0

EXAMPLE BOARD LAYOUT

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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