

SN74AUP1T34-Q1 1-Bit Unidirectional Voltage-Level Translator

1 Features

- Qualified for Automotive Applications
 - AEC-Q100 Qualified
 - Device Temperature Grade 1: -40°C to 125°C Ambient Operating Temperature
 - Device HBM ESD Classification Level 3A
 - Device CDM ESD Classification Level C5
- Wide Operating VCC Range of 0.9 V to 3.6 V
- Balanced Propagation Delays: $t_{\text{PLH}} = t_{\text{PHL}}$ (1.8-V to 3.3-V Translation Typical)
- Low Static-Power Consumption: Maximum of 5- μA ICC
- $\pm 6\text{-mA}$ Output Drive at 3 V
- I_{off} Supports Partial Power-Down-Mode Operation
- VCC Isolation Feature – If V_{CCA} Input Is at GND, B Port Is in the High-Impedance state
- Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at Input
- ESD Protection Exceeds JESD 22
- 5000-V Human-Body Model (AEC-Q100-002-E)
- Latch-Up Performance Meets 100 mA Per Q100-004-D

2 Applications

- Automotive
- Enterprise
- Industrial
- Personal Electronics
- Telecommunications

3 Description

The SN74AUP1T34-Q1 device is a 1-bit noninverting translator that uses two separate configurable power-supply rails. It is a unidirectional translator from A to B. The A port is designed to track V_{CCA} . V_{CCA} accepts supply voltages from 0.9 V to 3.6 V. The B port is designed to track V_{CCB} . V_{CCB} accepts supply voltages from 0.9 V to 3.6 V. This allows for low-voltage translation between 1-V, 1.2-V, 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes. The SN74AUP1T34-Q1 is also 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.

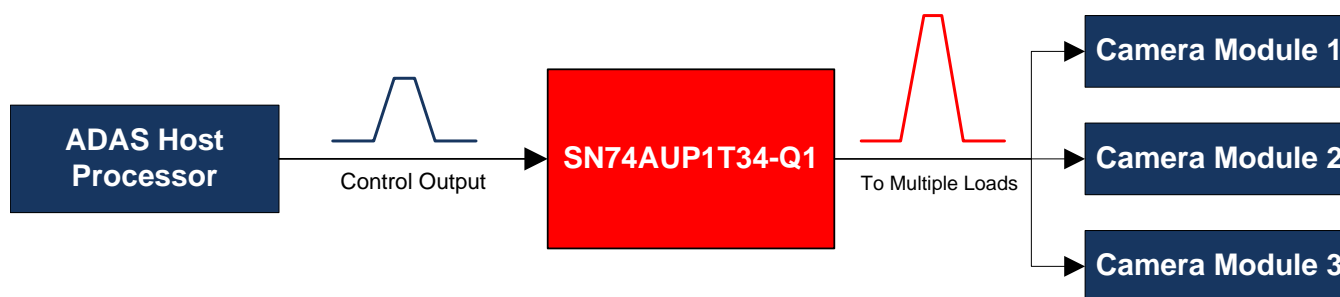
The VCC isolation feature ensures that if V_{CCA} input is at GND, the B port is in the high-impedance state. If V_{CCB} input is at GND, any input to the A side does not cause the leakage current even floating.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN74AUP1T34-Q1	SC70 (5)	2.00 mm x 1.25 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Example Application Diagram



Copyright © 2016, Texas Instruments Incorporated



Table of Contents

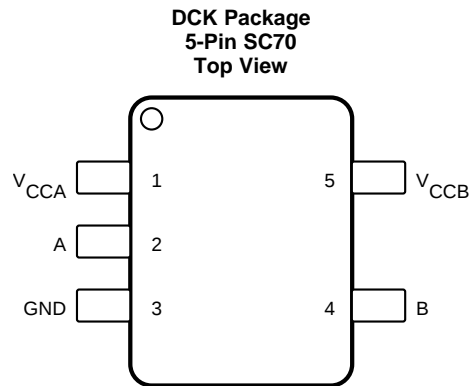
1 Features	1	8.3 Feature Description.....	7
2 Applications	1	8.4 Device Functional Modes.....	7
3 Description	1	9 Application and Implementation	8
4 Revision History	2	9.1 Application Information.....	8
5 Pin Configuration and Functions	3	9.2 Typical Application	8
6 Specifications	3	10 Power Supply Recommendations	9
6.1 Absolute Maximum Ratings	3	11 Layout	10
6.2 ESD Ratings.....	3	11.1 Layout Guidelines	10
6.3 Recommended Operating Conditions	4	11.2 Layout Example	10
6.4 Thermal Information	4	12 Device and Documentation Support	11
6.5 AC Electrical Characteristics.....	5	12.1 Community Resources.....	11
6.6 Typical Characteristics.....	6	12.2 Trademarks	11
7 Parameter Measurement Information	6	12.3 Electrostatic Discharge Caution.....	11
8 Detailed Description	7	12.4 Glossary	11
8.1 Overview	7	13 Mechanical, Packaging, and Orderable	
8.2 Functional Block Diagram	7	Information	11

4 Revision History

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

Changes from Original (December 2013) to Revision A	Page
• Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section.	1
• Removed <i>Ordering Information</i> table	1

5 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
A	2	I	Input Port. Referenced to V_{CCA} .
B	4	O	Output Port. Referenced to V_{CCB} .
GND	3	—	Ground.
V_{CCA}	1	—	Input Port DC Power Supply.
V_{CCB}	5	—	Output Port DC Power Supply.

6 Specifications

6.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CCA} , V_{CCB}	Supply voltage		-0.3	4	V
V_I	Input voltage		-0.5	4.6	V
V_O	Voltage applied to any output in the high-impedance or power-off state		-0.5	4.6	V
	Voltage applied to any output in the high or low state		-0.5	4.6	
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_{CCA} or GND			±100	mA
T_{stg}	Storage temperature		-65	150	°C

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ , Classification 3A	5000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ , Classification C5	750	

(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)

PARAMETER	TEST CONDITIONS	VCCA	VCCB	MIN	MAX	UNIT
V_{CCA}, V_{CCB} Supply voltage				0.9	3.6	V
V_{IH} High-level input voltage		0.9 V to 1.95 V	0.9 V to 1.95 V	$0.65 \times V_{CCA}$	1.6	V
		2.3 V to 2.7 V	0.9 V to 3.6 V			
		3 V to 3.6 V	0.9 V to 3.6 V	2		
V_{IL} Low-level input voltage		0.9 V	0.9 V to 1.95 V	$0.3 \times V_{CCA}$	0.7	V
		1 V to 1.95 V	0.9 V to 1.95 V	$0.35 \times V_{CCA}$		
		2.3 V to 2.7 V	0.9 V to 3.6 V			
		3 V to 3.6 V	0.9 V to 3.6 V	0.9		
$\Delta t/\Delta v$ Input transition rise or fall rate		3 V to 3.6 V	0.9 V to 3.6 V		200	ns/V
T_A Operating free-air temperature				-40	125	°C
V_{OH}	$I_{OH} = -100 \mu A$ $I_{OH} = -0.25 \text{ mA}$ $I_{OH} = -1.5 \text{ mA}$ $I_{OH} = -2 \text{ mA}$ $I_{OH} = -3 \text{ mA}$ $I_{OH} = -6 \text{ mA}$	$V_I = V_{IH}$	0.9 V to 3.6 V	0.9 V to 3.6 V	$V_{CCB} - 0.2$	V
			0.9 V to 1 V	0.9 V to 1 V	$0.75 \times V_{CCB}$	
			1.2 V	1.2 V	1	
			1.65 V	1.65 V	1.32	
			2.3 V	2.3 V	1.9	
			3 V	3 V	2.72	
V_{OL}	$I_{OL} = 100 \mu A$ $I_{OL} = 0.25 \text{ mA}$ $I_{OL} = 1.5 \text{ mA}$ $I_{OL} = 2 \text{ mA}$ $I_{OL} = 3 \text{ mA}$ $I_{OL} = 6 \text{ mA}$	$V_I = V_{IL}$	0.9 V to 3.6 V	0.9 V to 3.6 V	0.1	V
			0.9 V to 1 V	0.9 V to 1 V	0.1	
			1.2 V	1.2 V	$0.3 \times V_{CCB}$	
			1.65 V	1.65 V	0.31	
			2.3 V	2.3 V	0.31	
			3 V	3 V	0.31	
I_i Control inputs	$V_i = V_{CCA}$ or GND	0.9 V to 3.6 V	0.9 V to 3.6 V		± 1	μA
I_{off} A or B port	V_I or $V_O = 0$ to 3.6 V	0 V	0 V to 3.6 V		± 5	μA
		0 V to 3.6 V	0 V		± 5	
I_{CCA}	$V_I = V_{CCI}$ or GND, $I_O = 0 \text{ mA}$	0.9 V to 3.6 V	0.9 V to 3.6 V		2.7	μA
		0.9 V to 3.6 V	VCCA		2	
		0 V	0 V to 3.6 V		1	
		0 V to 3.6 V	0 V		1	
I_{CCB}	$V_I = V_{CCI}$ or GND, $I_O = 0 \text{ mA}$	0.9 V to 3.6 V	0.9 V to 3.6 V		2.7	μA
		0.9 V to 3.6 V	VCCA		2	
		0 V	0 V to 3.6 V		1	
		0 V to 3.6 V	0 V		1	
$I_{CCA} + I_{CCB}$	$V_I = V_{CCI}$ or GND, $I_O = 0 \text{ mA}$	0.9 V to 3.6 V	0.9 V to 3.6 V		5.4	μA
C_{io} A or B port		3.3 V	3.3 V		4	pF

6.4 Thermal Information

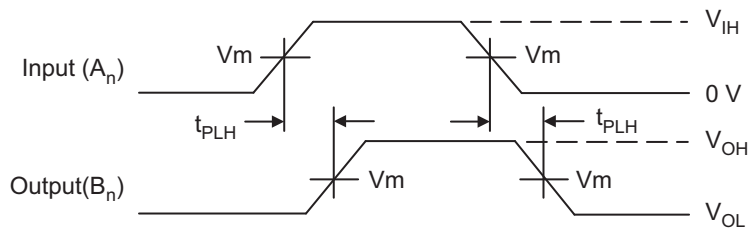
THERMAL METRIC ⁽¹⁾	SN74AUP1T34-Q1		UNIT
	DCK (SC70)		
	5 PINS		
$R_{\theta JA}$ Junction-to-ambient thermal resistance	301.9		°C/W
$R_{\theta JC(top)}$ Junction-to-case (top) thermal resistance	113		°C/W
$R_{\theta JB}$ Junction-to-board thermal resistance	79.1		°C/W
ψ_{JT} Junction-to-top characterization parameter	3.9		°C/W
ψ_{JB} Junction-to-board characterization parameter	78.3		°C/W

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

6.5 AC Electrical Characteristics

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

PARAMETER	C _L	VCCA	VCCB = 0.9 V		VCCB = 1.2 V		VCCB = 1.65 V		VCCB = 2.3 V		VCCB = 3 V		UNIT
			TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	
t _{PLH} /t _{PHL}	5 pF	0.9 V	25		18		16.2		16.3		16.8		ns
	5 pF	1.2 V		42.5		24.9		23.2		22.6		22.5	
	5 pF	1.65 V		40		10.7		8.84		8.08		7.88	
	5 pF	2.3 V		41.3		8.02		5.73		4.92		4.2	
	5 pF	3 V		42.5		7.61		4.5		3.65		3.39	
t _{PLH} /t _{PHL}	10 pF	0.9 V	28.9		19.8		17.9		18		18.5		ns
	10 pF	1.2 V		43.22		12.33		9.57		8.81		8.61	
	10 pF	1.65 V		40.44		9.21		6.57		5.6		4.73	
	10 pF	2.3 V		41.56		8.3		5.54		4.42		4.07	
	10 pF	3 V		42.81		7.87		4.8		3.8		3.36	
t _{PLH} /t _{PHL}	15 pF	0.9 V	30.6		21.6		19.6		19.7		20.3		ns
	15 pF	1.2 V		43.87		16.2		11.8		11		11	
	15 pF	1.65 V		40.78		14.7		8.8		7.1		6.4	
	15 pF	2.3 V		41.79		14.9		7.6		5.88		5.27	
	15 pF	3 V		43.09		16.2		6.98		5.4		4.7	
t _{PLH} /t _{PHL}	30 pF	0.9 V	32.1		21.3		18.7		18		18.3		ns
	30 pF	1.2 V		45.65		15.1		12.37		11.61		11.41	
	30 pF	1.65 V		41.72		12.18		8.15		6.94		6.1	
	30 pF	2.3 V		42.44		12.35		7.25		5.55		4.97	
	30 pF	3 V		43.69		11.6		6.92		4.95		4.35	



$$V_{MI} = V_{IH}/2; V_{MO} = V_{CCB}/2$$

$$t_R = t_F = 2.0 \text{ ns, } 10\% \text{ to } 90\%; f = 1 \text{ MHz; } t_W = 500 \text{ ns}$$

Figure 1. Waveform 1 - Propagation Delays

6.6 Typical Characteristics

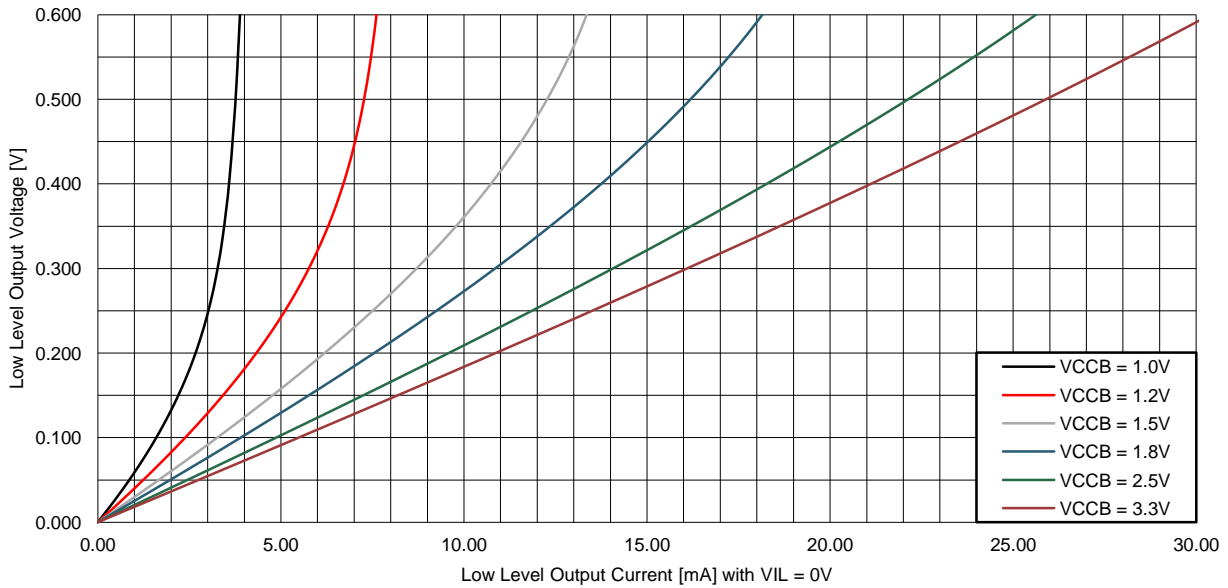
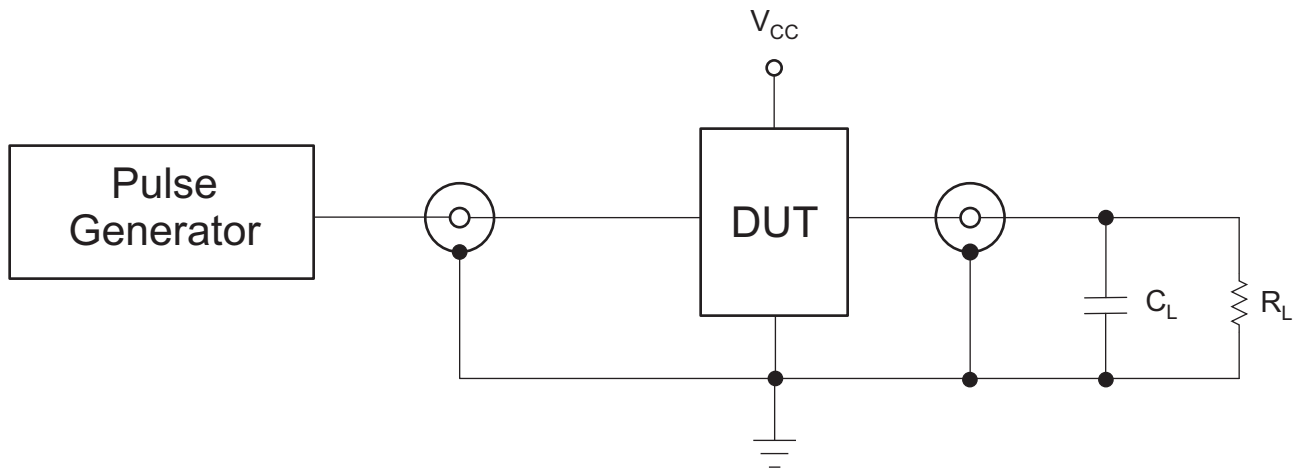


Figure 2. Low Level Output Voltage vs Low Level Output Current

7 Parameter Measurement Information



TEST

t_{PLH} , t_{PHL}

C_L = 5 pF, 10 pF, 15 pF, 30 pF or equivalent (includes probe and jig capacitance)

R_L = 1 M Ω or equivalent

Z_{OUT} of pulse generator = 50 Ω

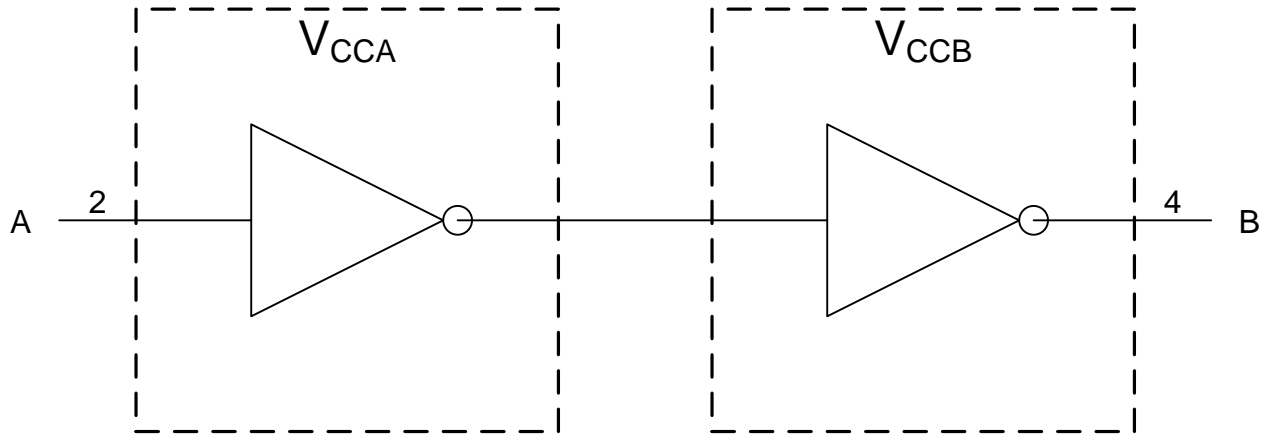
Figure 3. AC (Propagation Delay) Test Circuit

8 Detailed Description

8.1 Overview

The SN74AUP1T34-Q1 is a unidirectional, single-bit, dual-supply, noninverting voltage-level translator. Pin A, which is referenced to V_{CCA} , receives the signal that is to be level translated. Pin B, which is referenced to V_{CCB} , transmits the level translated signal. Both supply pins V_{CCA} and V_{CCB} support a voltage range from 0.9 V to 3.6 V.

8.2 Functional Block Diagram



Copyright © 2016, Texas Instruments Incorporated

8.3 Feature Description

8.3.1 Fully Configurable Dual-Rail Design

Both V_{CCA} and V_{CCB} can be supplied at any voltage from 0.9 V to 3.6 V, making the device suitable for translating between any of the voltage nodes (1 V, 1.2 V, 1.8 V, 2.5 V, and 3.3 V).

8.3.2 Partial-Power-Down Mode Operation

I_{off} circuitry disables the outputs, preventing damaging current backflow through the SN74AUP1T34-Q1 when it is powered down. This can occur in applications where subsections of a system are powered down (partial-power-down) to reduce power consumption.

8.3.3 V_{CC} Isolation

The V_{CC} isolation feature ensures that if either V_{CCA} or V_{CCB} are at GND (or < 0.4 V), both ports A and B are set to a high-impedance state, preventing false logic levels from being presented to either bus.

8.3.4 Input Hysteresis

Input hysteresis allows the input to support slew rates as slow as 200 ns/V, improving switching noise immunity.

8.4 Device Functional Modes

Table 1 lists the functional modes of the SN74AUP1T34-Q1.

Table 1. Function Table

INPUT	OUTPUT
A PORT	B PORT
L	L
H	H

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 SN74AUP1T34-Q1 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another.

9.2 Typical Application

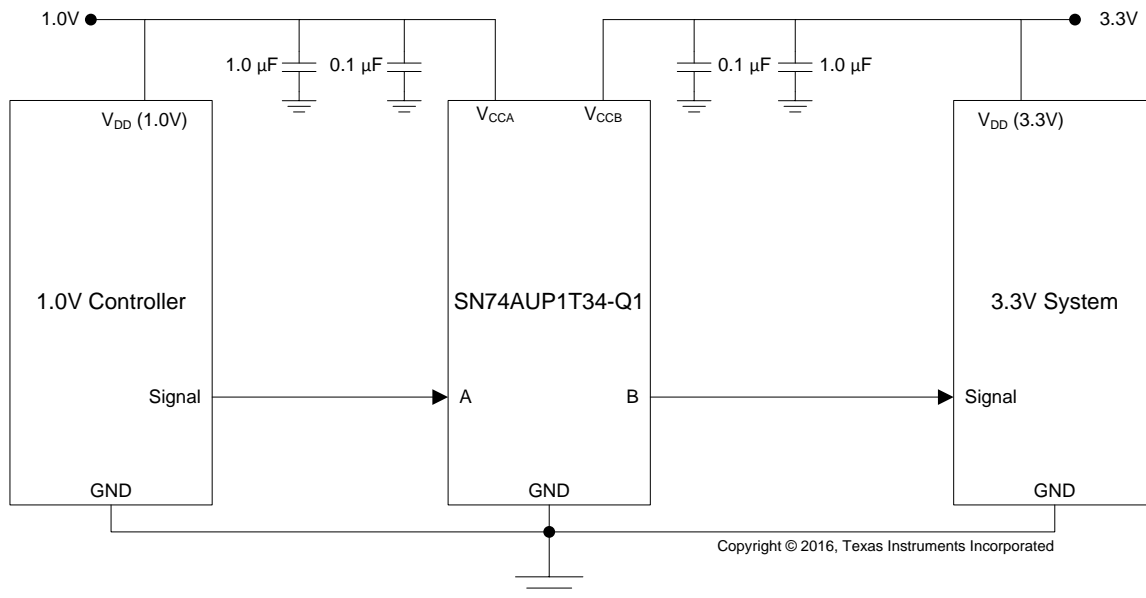


Figure 4. Typical Application Example

9.2.1 Design Requirements

Table 2 lists the design requirements of the SN74AUP1T34-Q1.

Table 2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input Voltage Range	0.9 V to 3.6 V
Output Voltage Range	0.9 V to 3.6 V

9.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
 - Use the supply voltage of the device that is driving the SN74AUP1T34-Q1 device to determine the input voltage range. For a valid logic-high, the value must exceed the V_{IH} of the input port. For a valid logic low the value must be less than the V_{IL} of the input port.
- Output voltage range
 - Use the supply voltage of the device that the SN74AUP1T34-Q1 device is driving to determine the output voltage range.

9.2.3 Application Curve

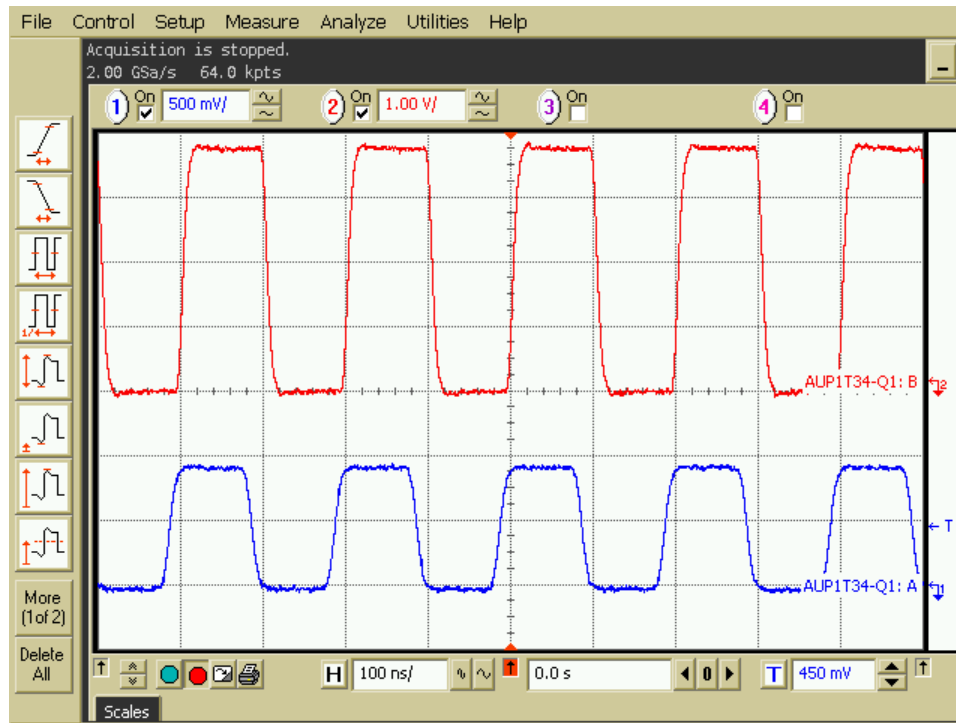


Figure 5. 10 MHz Up Translation (0.9 V to 3.6 V)

10 Power Supply Recommendations

Connect ground before applying either V_{CCA} or V_{CCB} . There is no specific power sequence requirement for the SN74AUP1T34. V_{CCA} or V_{CCB} may be powered up first, and V_{CCA} or V_{CCB} may be powered down first.

11 Layout

11.1 Layout Guidelines

To ensure reliability of the device, TI recommends following common printed-circuit board layout guidelines.

- Bypass capacitors must be used on power supplies.
- Short trace lengths must be used to avoid excessive loading.
- Placing pads on the signal paths for loading capacitors or pullup resistors helps adjust rise and fall times of signals depending on the system requirements.

11.2 Layout Example

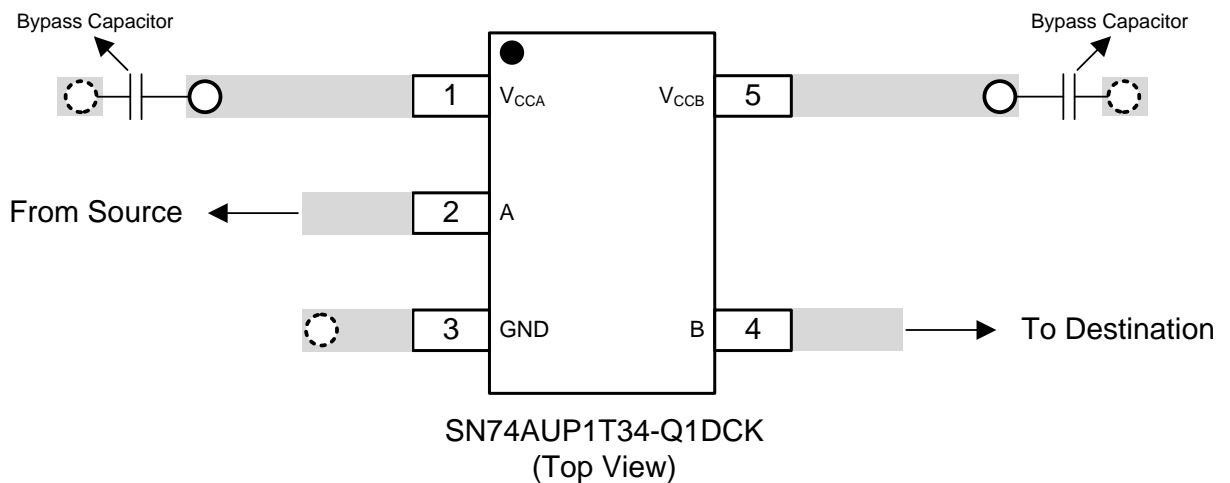
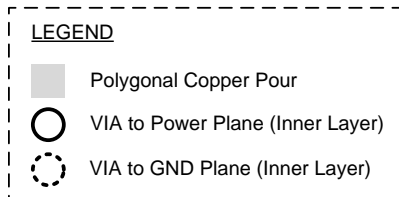


Figure 6. Example Layout

12 Device and Documentation Support

12.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

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

12.2 Trademarks

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

12.3 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.

12.4 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 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
SN74AUP1T34QDCKRQ1	ACTIVE	SC70	DCK	5	3000	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	(U4E, U4J)	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.

OBSELETE: 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 SN74AUP1T34-Q1 :

- Catalog : [SN74AUP1T34](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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
SN74AUP1T34QDCKRQ1	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	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)
SN74AUP1T34QDCKRQ1	SC70	DCK	5	3000	190.0	190.0	30.0

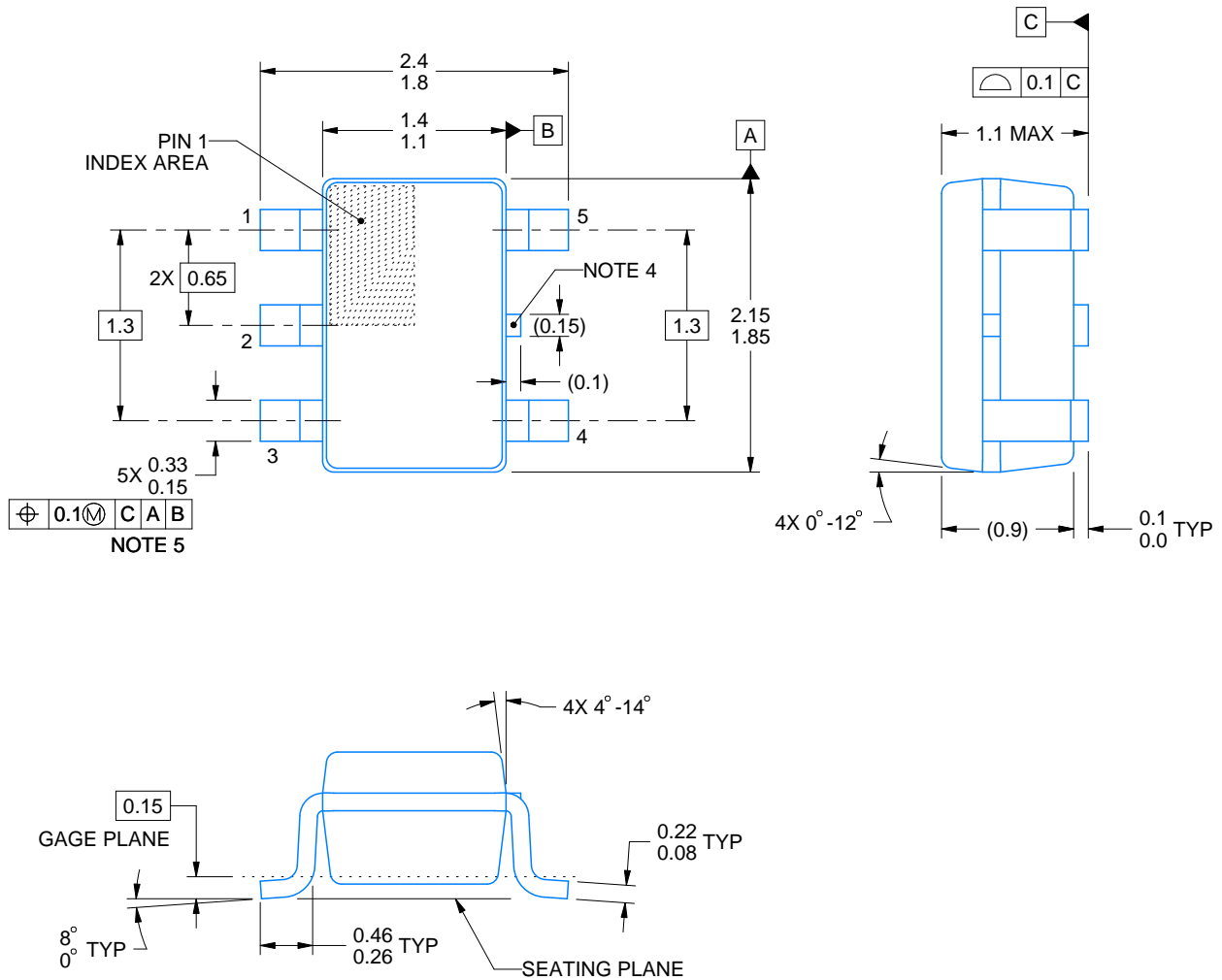
DCK0005A



PACKAGE OUTLINE

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



4214834/F 08/2024

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. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

EXAMPLE BOARD LAYOUT

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X



SOLDER MASK DETAILS

4214834/F 08/2024

NOTES: (continued)

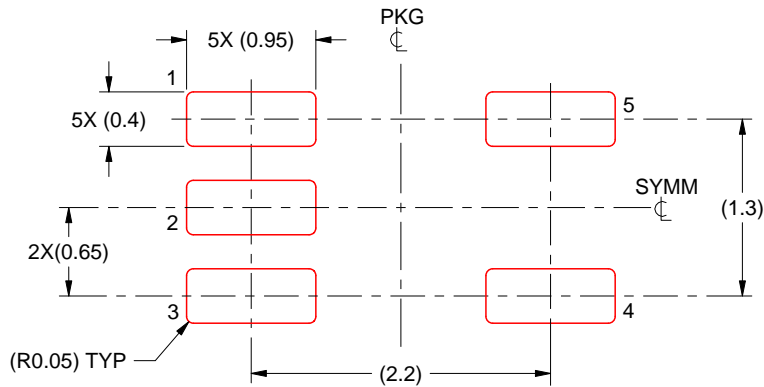
- 7. Publication IPC-7351 may have alternate designs.
- 8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE: 18X

4214834/F 08/2024

NOTES: (continued)

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

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2024, Texas Instruments Incorporated