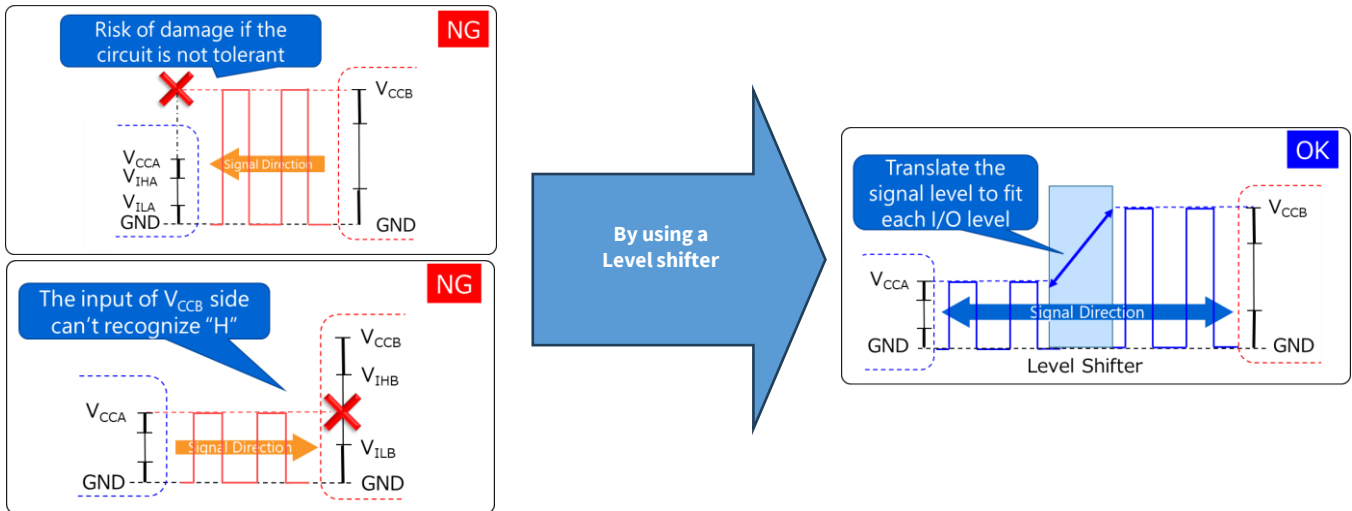


## Introduction to Level Shifters (Voltage-Conversion Logic ICs)

A level shifter is an IC that converts voltage. It helps achieve communication between different power supply systems.

### Why is a Level Shifter Necessary?

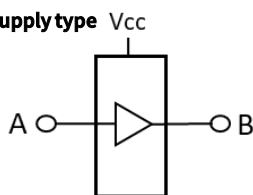
In electronic equipment, System on Chip (SoC) processing is improving because of higher speeds, increased functionality, smaller size, and lower current consumption. As a result, operating voltages are continuously lowering. In contrast, peripheral devices may use existing power supply systems and the signal voltage level at the time of data communication may not match. A level shifter is used as a product to bridge the potential voltage mismatch during this communication.



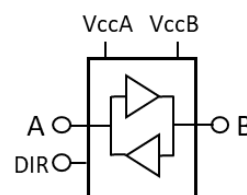
### Types of Power Supply for Level Shifters

Level shifters are available in single power supply and dual power supply types. A single power supply type has a simple power circuit, but a narrow voltage conversion range. Dual-power supply types support the power supply voltage on each side and convert the voltage depending on the selected direction. However, the power supply management for IC logical confirmation may be complicated.

Single power supply type products



Dual power supply type product



### New products considering power supply management for dual-power supply products

We offer products (74AVC series) that solve power management problems using a dual power supply system. It is characterized by the large-small relationship between the dual-power supplies and the fact that there is no rule in the order of power-on, which facilitates power management.

### 74AVC Series

- 0.7V $\leftrightarrow$ 3.6V (Note) level shift transceiver
- The order of ON/OFF of the power supply can be set freely.
- $V_{CCA}$ ,  $V_{CCB}$  size can be set freely
- Wide operating temp.: Topr= -40 to 125 °C

Here is the link to 74AVC series. [Click](#)

(Note):74AVC1T45FU, 74AVCH1T45FU, 74AVC2T45FK, 74AVCH2T45FK : support 0.8 $\leftrightarrow$ 3.6V translate

### Level conversion method and bit expansion

For the level-conversion method, we have developed a bus switch type that enables open-drain communication compatible with I2C communication from a simplified buffer type, and more. Bit expansion is also expanded from 1-bit to 8-bit, and the lineup includes products that can control communication direction control in units of 2bit, compatible with UART communication and products that can control direction with 3bit and 1bit compatible with SPI communication.

### Line up

Bit configuration	Product Name
2-bit	74AVC2T45FK
	74AVCH2T45FK
1-bit	74AVC1T45FU/NX
	74AVCH1T45FU/NX
2-bit $\times$ 2	74AVC4T245FT
	74AVCH4T245FT
4-bit	74AVC4T774FT
1+3-bit	74AVC4T345FT





## Features of Each Series

Simplified selection guide for Toshiba level shifters

Power supply voltage	Type	Communication direction	V <sub>CCA</sub>	V <sub>CCB</sub>	Bit	Bit configuration	Product name	Package	Purchase
Single		Uni-direction	1.65V to 5.5V	-	4	1bit x 4	<a href="#">74LV4T125FK</a>	US14	
							<a href="#">74LV4T125FT</a>	TSSOP14B	
							<a href="#">74LV4T126FK</a>	US14	
							<a href="#">74LV4T126FT</a>	TSSOP14B	
Dual	Buffer	Uni-direction	1.1V to 2.7V	1.65V to 3.6V	1	1bit	<a href="#">TC7SP3125TU/TC7SPN3125TU</a>	UF6 (SOT-363F)	
					2	2bit	<a href="#">TC7WP3125FK/TC7WPN3125FK</a>	US8 (SOT-765)	
		Bi-direction • With DIR	Configurable power supply 0.8V to 3.6V	Configurable power supply 0.8V to 3.6V	2	2bit	<a href="#">74AVC2T45FK/74AVCH2T45FK</a> (Note)	US8 (SOT-765)	
					1	1bit	<a href="#">74AVC1T45FU/74AVCH1T45FU</a> (Note)	US6 (SOT-363)	
			Configurable power supply 0.7V to 3.6V	Configurable power supply 0.7V to 3.6V	1	1bit	<a href="#">74AVC1T45NX/74AVCH1T45NX</a> (Note)	XSON6	
					4	2bit x 2	<a href="#">74AVC4T245FT/74AVCH4T245FT</a> (Note)	TSSOP16B	
					4	4bit	<a href="#">74AVC4T774FT</a>	TSSOP16B	
			4	3bit 1bit	<a href="#">74AVC4T345FT</a>	TSSOP16B			
		Configurable power supply 1.65V to 5.5V	Configurable power supply 1.65V to 5.5V	2	2bit	<a href="#">74LVC2T45FK</a>	US8 (SOT-765)		
		Bi-direction • With DIR	1.1V to 2.7V	1.65V to 3.6V	4	2bit x 2	<a href="#">TC7MP3125FK/TC7MPN3125FK</a>	US16	
							<a href="#">TC7MP3125FT/TC7MPN3125FT</a>	TSSOP16B	
		Bus Switch	Bi-direction • No DIR	1.65V to 5.0V	2.3 to 5.5V	1	1bit	<a href="#">TC7SPB9306TU/9307TU</a>	UF6 (SOT-363F)
2	2bit					<a href="#">TC7WPB9306FK/9307FK</a>	US8 (SOT-765)		
4	4bit					<a href="#">TC7QPB9306FK/9307FK</a>	US14		
						<a href="#">TC7QPB9306FT/9307FT</a>	TSSOP14B		
8	8bit					<a href="#">TC7MPB9307FK</a>	US20		
						<a href="#">TC7MPB9307FT</a>	TSSOP20B		

(Note): Products with an “H” after “AVC” in the product name are equipped with a bus-hold function.

## Package lineup

XSON6	US6(SOT-363)	UF6(SOT-363F)	US8(SOT-765)
			
W : 1.45 mm L : 1.0 mm H : 0.48 mm	W : 2.0 mm L : 2.1mm H : 0.9 mm	W : 2.0 mm L : 2.1 mm H : 0.7 mm	W : 2.0 mm L : 3.1 mm H : 0.7 mm

TSSOP14B	US14	TSSOP16B
		
W : 5.4 mm L : 6.4 mm H : 1.0 mm	W : 4.0 mm L : 4.0 mm H : 0.8 mm	W : 5.4 mm L : 6.4 mm H : 1.0 mm

US16	TSSOP20B	US20
		
W : 4.0 mm L : 4.0 mm H : 0.8 mm	W : 6.5 mm L : 6.4 mm H : 1.0 mm	W : 5.0 mm L : 4.0 mm H : 0.8 mm

### Related Links

●Parametric searches for the products.

[Click](#)

●Application notes

[Click](#)

●FAQ of general-purpose logic IC

[Click](#)

●Online distributor purchase, inventory search page

[Click](#)

The company name, product name, service name, etc. may be used as trademarks by each company.

## RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA".

Hardware, software and systems described in this document are collectively referred to as "Product".

- TOSHIBA reserves the right to make changes to the information in this document and related Product without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.
- PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE"). Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, Class 3 medical devices, equipment used for automobiles, and military vehicles and munitions. IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT. For details, please contact your TOSHIBA sales representative or contact us via our website.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.

**Toshiba Electronic Devices & Storage Corporation**

<https://toshiba.semicon-storage.com/>