



Low Voltage, 1.15 V to 5.5 V, 4-Channel, Bidirectional Logic Level Translator

Enhanced Product

ADG3304-EP

FEATURES

- Bidirectional level translation
- Operates from 1.15 V to 5.5 V
- Low quiescent current $<5 \mu\text{A}$
- No direction pin
- Supports defense and aerospace applications (AQEC standard)
- Military temperature range: -55°C to $+125^{\circ}\text{C}$
- Controlled manufacturing baseline
- One assembly and test site
- One fabrication site
- Product change notification
- Qualification data available on request

APPLICATIONS

- SPI and MICROWIRE level translation
- Low voltage ASIC level translation
- Smart card readers
- Cell phones and cell phone cradles
- Portable communications devices
- Telecommunications equipment
- Network switches and routers
- Storage systems (SAN/NAS)

GENERAL DESCRIPTIONS

The ADG3304-EP is a bidirectional logic level translator that contains four bidirectional channels. It can be used in multivoltage digital system applications, such as data transfer between a low voltage digital signal processing controller and a higher voltage device using SPI® and MICROWIRE™ interfaces. The internal architecture allows the device to perform bidirectional logic level translation without an additional signal to set the direction in which the translation takes place.

The voltage applied to V_{CCA} sets the logic levels on the A side of the device, while V_{CCY} sets the levels on the Y side. For proper operation, V_{CCA} must always be less than V_{CCY} . The V_{CCA} -compatible logic signals applied to the A side of the device appear as V_{CCY} -compatible levels on the Y side. Similarly, V_{CCY} -

FUNCTIONAL BLOCK DIAGRAM

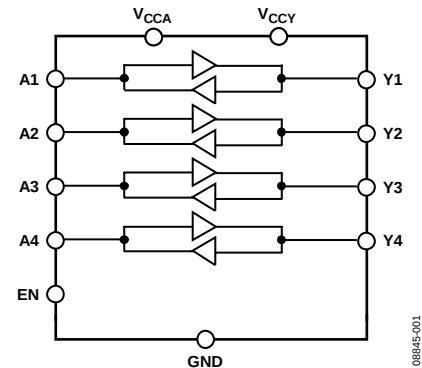


Figure 1.

compatible logic levels applied to the Y side of the device appear as V_{CCA} -compatible logic levels on the A side.

The enable pin (EN) provides three-state operation on both the A side and the Y side pins. When the EN pin is pulled low, the terminals on both sides of the device are in the high impedance state. The EN pin is referred to the V_{CCA} supply voltage and driven high for normal operation.

The ADG3304-EP is available in compact 14-lead TSSOP package.

Full details about this enhanced product are available in the [ADG3304](#) data sheet, which should be consulted in conjunction with this data sheet.

Rev. A

[Document Feedback](#)

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 ©2010–2018 Analog Devices, Inc. All rights reserved.
[Technical Support](#) www.analog.com

TABLE OF CONTENTS

Features	1	Absolute Maximum Ratings	6
Applications.....	1	ESD Caution.....	6
Functional Block Diagram	1	Pin Configurations and Function Descriptions	7
General Descriptions	1	Outline Dimensions	8
Revision History	2	Ordering Guide	8
Specifications.....	3		

REVISION HISTORY

2/2018—Rev. 0 to Rev. A	
Change to Features Section	1
Changes to Ordering Guide	8

10/2010—Revision 0: Initial Version

SPECIFICATIONS

$V_{CCY} = 1.65\text{ V to }5.5\text{ V}$, $V_{CCA} = 1.15\text{ V to }V_{CCY}$, $GND = 0\text{ V}$, $T_A = -55^\circ\text{C to }+125^\circ\text{C}$ unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ ¹	Max	Unit
LOGIC INPUTS/OUTPUTS						
A Side						
Input High Voltage ²	V_{IHA}	$V_{CCA} = 1.2\text{ V} + 0.1\text{ V}/-0.05\text{ V}$	$V_{CCA} \times 0.88$			V
		$V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$	$V_{CCA} \times 0.72$			V
		$V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$	1.7			V
		$V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$	2.2			V
		$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$	$V_{CCA} \times 0.7$			V
Input Low Voltage ²	V_{ILA}	$V_{CCA} = 1.2\text{ V} + 0.1\text{ V}/-0.05\text{ V}$			$V_{CCA} \times 0.35$	V
		$V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$			$V_{CCA} \times 0.35$	V
		$V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$			0.7	V
		$V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$			0.8	V
		$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$			$V_{CCA} \times 0.3$	V
Output High Voltage	V_{OHA}	$V_Y = V_{CCY}$, $I_{OH} = 20\text{ }\mu\text{A}$	$V_{CCA} - 0.4$			V
Output Low Voltage	V_{OLA}	$V_Y = 0\text{ V}$, $I_{OL} = 20\text{ }\mu\text{A}$			0.4	V
Capacitance ²	C_A	$f = 1\text{ MHz}$, $EN = 0$		9		pF
Leakage Current	$I_{LA, HI-Z}$	$V_A = 0\text{ V}/V_{CCA}$, $EN = 0$			± 1	μA
Y Side						
Input High Voltage ²	V_{IHY}	$V_{CCY} = 1.8\text{ V} \pm 0.15\text{ V}$	$V_{CCY} \times 0.67$			V
		$V_{CCY} = 2.5\text{ V} \pm 0.2\text{ V}$	1.7			V
		$V_{CCY} = 3.3\text{ V} \pm 0.3\text{ V}$	2			V
		$V_{CCY} = 5\text{ V} \pm 0.5\text{ V}$	$V_{CCY} \times 0.7$			V
						V
Input Low Voltage ²	V_{ILY}	$V_{CCY} = 1.8\text{ V} \pm 0.15\text{ V}$			$V_{CCY} \times 0.35$	V
		$V_{CCY} = 2.5\text{ V} \pm 0.2\text{ V}$			0.7	V
		$V_{CCY} = 3.3\text{ V} \pm 0.3\text{ V}$			0.8	V
		$V_{CCY} = 5\text{ V} \pm 0.5\text{ V}$			$V_{CCY} \times 0.25$	V
						V
Output High Voltage	V_{OHY}	$V_A = V_{CCA}$, $I_{OH} = 20\text{ }\mu\text{A}$	$V_{CCY} - 0.4$			V
Output Low Voltage	V_{OLY}	$V_A = 0\text{ V}$, $I_{OL} = 20\text{ }\mu\text{A}$			0.4	V
Capacitance ²	C_Y	$f = 1\text{ MHz}$, $EN = 0$		6		pF
Leakage Current	$I_{LY, HI-Z}$	$V_Y = 0\text{ V}/V_{CCY}$, $EN = 0$			± 1	μA
Enable (EN)						
Input High Voltage ²	V_{IHEN}	$V_{CCA} = 1.2\text{ V} + 0.1\text{ V}/-0.05\text{ V}$	$V_{CCA} \times 0.88$			V
		$V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$	$V_{CCA} \times 0.72$			V
		$V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$	1.7			V
		$V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$	2.2			V
		$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$	$V_{CCA} \times 0.7$			V
Input Low Voltage ²	V_{ILEN}	$V_{CCA} = 1.2\text{ V} + 0.1\text{ V}/-0.05\text{ V}$			$V_{CCA} \times 0.35$	V
		$V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$			$V_{CCA} \times 0.35$	V
		$V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$			0.7	V
		$V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$			0.8	V
		$V_{CCA} = 5\text{ V} \pm 0.5\text{ V}$			$V_{CCA} \times 0.3$	V
Leakage Current	I_{LEN}	$V_{EN} = 0\text{ V}/V_{CCA}$, $V_A = 0\text{ V}$			± 1	μA
Capacitance ²	C_{EN}			3		pF
Enable Time ²	t_{EN}	$R_S = R_T = 50\text{ }\Omega$ $V_A = 0\text{ V}/V_{CCA}$ (A $\rightarrow$ Y) $V_Y = 0\text{ V}/V_{CCY}$ (Y $\rightarrow$ A)		1	1.8	μs

Parameter	Symbol	Test Conditions/Comments	Min	Typ ¹	Max	Unit
SWITCHING CHARACTERISTICS²						
$3.3\text{ V} \pm 0.3\text{ V} \leq V_{CCA} \leq V_{CCY}, V_{CCY} = 5\text{ V} \pm 0.5\text{ V}$						
A→Y Level Translation		$R_S = R_T = 50\ \Omega, C_L = 50\text{ pF}$				
Propagation Delay	$t_{P, A \rightarrow Y}$			6	15	ns
Rise Time	$t_{R, A \rightarrow Y}$			2	5	ns
Fall Time	$t_{F, A \rightarrow Y}$			2	5	ns
Maximum Data Rate	$D_{MAX, A \rightarrow Y}$			50		Mbps
Channel-to-Channel Skew	$t_{SKEW, A \rightarrow Y}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, A \rightarrow Y}$			3		ns
Y→A Level Translation		$R_S = R_T = 50\ \Omega, C_L = 15\text{ pF}$				
Propagation Delay	$t_{P, Y \rightarrow A}$			4	10	ns
Rise Time	$t_{R, Y \rightarrow A}$			1	5	ns
Fall Time	$t_{F, Y \rightarrow A}$			3	10	ns
Maximum Data Rate	$D_{MAX, Y \rightarrow A}$			50		Mbps
Channel-to-Channel Skew	$t_{SKEW, Y \rightarrow A}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, Y \rightarrow A}$			2		ns
$1.8\text{ V} \pm 0.15\text{ V} \leq V_{CCA} \leq V_{CCY}, V_{CCY} = 3.3\text{ V} \pm 0.3\text{ V}$						
A→Y Translation		$R_S = R_T = 50\ \Omega, C_L = 50\text{ pF}$				
Propagation Delay	$t_{P, A \rightarrow Y}$			8	15	ns
Rise Time	$t_{R, A \rightarrow Y}$			2	8	ns
Fall Time	$t_{F, A \rightarrow Y}$			2	8	ns
Maximum Data Rate	$D_{MAX, A \rightarrow Y}$			50		Mbps
Channel-to-Channel Skew	$t_{SKEW, A \rightarrow Y}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, A \rightarrow Y}$			4		ns
Y→A Translation		$R_S = R_T = 50\ \Omega, C_L = 15\text{ pF}$				
Propagation Delay	$t_{P, Y \rightarrow A}$			5	12	ns
Rise Time	$t_{R, Y \rightarrow A}$			2	5	ns
Fall Time	$t_{F, Y \rightarrow A}$			2	5	ns
Maximum Data Rate	$D_{MAX, Y \rightarrow A}$			50		Mbps
Channel-to-Channel Skew	$t_{SKEW, Y \rightarrow A}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, Y \rightarrow A}$			3		ns
$1.15\text{ V to }1.3\text{ V} \leq V_{CCA} \leq V_{CCY}, V_{CCY} = 3.3\text{ V} \pm 0.3\text{ V}$						
A→Y Translation		$R_S = R_T = 50\ \Omega, C_L = 50\text{ pF}$				
Propagation Delay	$t_{P, A \rightarrow Y}$			9	27	ns
Rise Time	$t_{R, A \rightarrow Y}$			3	8	ns
Fall Time	$t_{F, A \rightarrow Y}$			2	8	ns
Maximum Data Rate	$D_{MAX, A \rightarrow Y}$			40		Mbps
Channel-to-Channel Skew	$t_{SKEW, A \rightarrow Y}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, A \rightarrow Y}$			10		ns
Y→A Translation		$R_S = R_T = 50\ \Omega, C_L = 15\text{ pF}$				
Propagation Delay	$t_{P, Y \rightarrow A}$			5	13	ns
Rise Time	$t_{R, Y \rightarrow A}$			2	6	ns
Fall Time	$t_{F, Y \rightarrow A}$			2	6	ns
Maximum Data Rate	$D_{MAX, Y \rightarrow A}$			40		Mbps
Channel-to-Channel Skew	$t_{SKEW, Y \rightarrow A}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, Y \rightarrow A}$			4		ns

Parameter	Symbol	Test Conditions/Comments	Min	Typ ¹	Max	Unit
1.15 V to 1.3 V $\leq V_{CCA} \leq V_{CCY}$, $V_{CCY} = 1.8 \text{ V} \pm 0.3 \text{ V}$						
A $\rightarrow$ Y Translation						
Propagation Delay	$t_{P, A \rightarrow Y}$	$R_S = R_T = 50 \, \Omega$, $C_L = 50 \text{ pF}$		12	35	ns
Rise Time	$t_{R, A \rightarrow Y}$			7	18	ns
Fall Time	$t_{F, A \rightarrow Y}$			3	8	ns
Maximum Data Rate	$D_{MAX, A \rightarrow Y}$			25		Mbps
Channel-to-Channel Skew	$t_{SKEW, A \rightarrow Y}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, A \rightarrow Y}$			15		ns
Y $\rightarrow$ A Translation						
Propagation Delay	$t_{P, Y \rightarrow A}$	$R_S = R_T = 50 \, \Omega$, $C_L = 15 \text{ pF}$		14	40	ns
Rise Time	$t_{R, Y \rightarrow A}$			5	24	ns
Fall Time	$t_{F, Y \rightarrow A}$			2.5	10	ns
Maximum Data Rate	$D_{MAX, Y \rightarrow A}$			25		Mbps
Channel-to-Channel Skew	$t_{SKEW, Y \rightarrow A}$			3		ns
Part-to-Part Skew	$t_{PPSKEW, Y \rightarrow A}$			23.5		ns
2.5 V $\pm 0.2 \text{ V} \leq V_{CCA} \leq V_{CCY}$, $V_{CCY} = 3.3 \text{ V} \pm 0.3 \text{ V}$						
A $\rightarrow$ Y Translation						
Propagation Delay	$t_{P, A \rightarrow Y}$	$R_S = R_T = 50 \, \Omega$, $C_L = 50 \text{ pF}$		7	15	ns
Rise Time	$t_{R, A \rightarrow Y}$			2.5	6	ns
Fall Time	$t_{F, A \rightarrow Y}$			2	8	ns
Maximum Data Rate	$D_{MAX, A \rightarrow Y}$			60		Mbps
Channel-to-Channel Skew	$t_{SKEW, A \rightarrow Y}$			1.5		ns
Part-to-Part Skew	$t_{PPSKEW, A \rightarrow Y}$			4		ns
Y $\rightarrow$ A Translation						
Propagation Delay	$t_{P, Y \rightarrow A}$	$R_S = R_T = 50 \, \Omega$, $C_L = 15 \text{ pF}$		5	12	ns
Rise Time	$t_{R, Y \rightarrow A}$			1	6	ns
Fall Time	$t_{F, Y \rightarrow A}$			3	8	ns
Maximum Data Rate	$D_{MAX, Y \rightarrow A}$			60		Mbps
Channel-to-Channel Skew	$t_{SKEW, Y \rightarrow A}$			2		ns
Part-to-Part Skew	$t_{PPSKEW, Y \rightarrow A}$			3		ns
POWER REQUIREMENTS						
Power Supply Voltages	V_{CCA}	$V_{CCA} \leq V_{CCY}$	1.15		5.5	V
	V_{CCY}		1.65		5.5	V
Quiescent Power Supply Current	I_{CCA}	$V_A = 0 \text{ V}/V_{CCA}$, $V_Y = 0 \text{ V}/V_{CCY}$, $V_{CCA} = V_{CCY} = 5.5 \text{ V}$, $EN = 1$		0.17	5	μA
	I_{CCY}	$V_A = 0 \text{ V}/V_{CCA}$, $V_Y = 0 \text{ V}/V_{CCY}$, $V_{CCA} = V_{CCY} = 5.5 \text{ V}$, $EN = 1$		0.27	5	μA
Three-State Mode Power Supply Current	$I_{HI-Z, A}$	$V_{CCA} = V_{CCY} = 5.5 \text{ V}$, $EN = 0$		0.1	5	μA
	$I_{HI-Z, Y}$	$V_{CCA} = V_{CCY} = 5.5 \text{ V}$, $EN = 0$		0.1	5	μA

¹ T_A for typical specifications is +25°C.² Guaranteed by design, not production tested.

ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 2.

Parameter	Rating
V_{CCA} to GND	$-0.3\text{ V to }+7\text{ V}$
V_{CCY} to GND	V_{CCA} to $+7\text{ V}$
Digital Inputs (A)	$-0.3\text{ V to } (V_{CCA} + 0.3\text{ V})$
Digital Inputs (Y)	$-0.3\text{ V to } (V_{CCY} + 0.3\text{ V})$
EN to GND	$-0.3\text{ V to }+7\text{ V}$
Operating Temperature Range	$-55^\circ\text{C to }+125^\circ\text{C}$
Storage Temperature Range	$-65^\circ\text{C to }+150^\circ\text{C}$
Junction Temperature	150°C
θ_{JA} Thermal Impedance (4-Layer Board) 14-Lead TSSOP	112.6°C/W
Lead Temperature, Soldering	215°C
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

Only one absolute maximum rating can be applied at any one time.

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

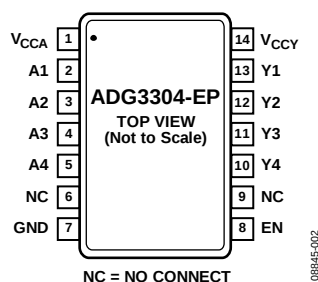


Figure 2. 14-Lead TSSOP
Pin Configuration

Table 3. 14-Lead TSSOP Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V _{CCA}	Power Supply Voltage Input for the A1 to A4 Input/Output (I/O) Pins ($1.15\text{ V} \leq V_{CCA} \leq V_{CCY}$).
2	A1	Input/Output A1. Referenced to V _{CCA} .
3	A2	Input/Output A2. Referenced to V _{CCA} .
4	A3	Input/Output A3. Referenced to V _{CCA} .
5	A4	Input/Output A4. Referenced to V _{CCA} .
6, 9	NC	No Connect.
7	GND	Ground.
8	EN	Active High Enable Input.
10	Y4	Input/Output Y4. Referenced to V _{CCY} .
11	Y3	Input/Output Y3. Referenced to V _{CCY} .
12	Y2	Input/Output Y2. Referenced to V _{CCY} .
13	Y1	Input/Output Y1. Referenced to V _{CCY} .
14	V _{CCY}	Power Supply Voltage Input for the Y1 to Y4 I/O Pins ($1.65\text{ V} \leq V_{CC} \leq 5.5\text{ V}$).

Table 4. Truth Table

EN	Y I/O Pins	A I/O Pins
0	Hi-Z ¹	Hi-Z ¹
1	Normal operation ²	Normal operation ²

¹ High impedance state.

² In normal operation, the ADG3304-EP performs level translation.

OUTLINE DIMENSIONS

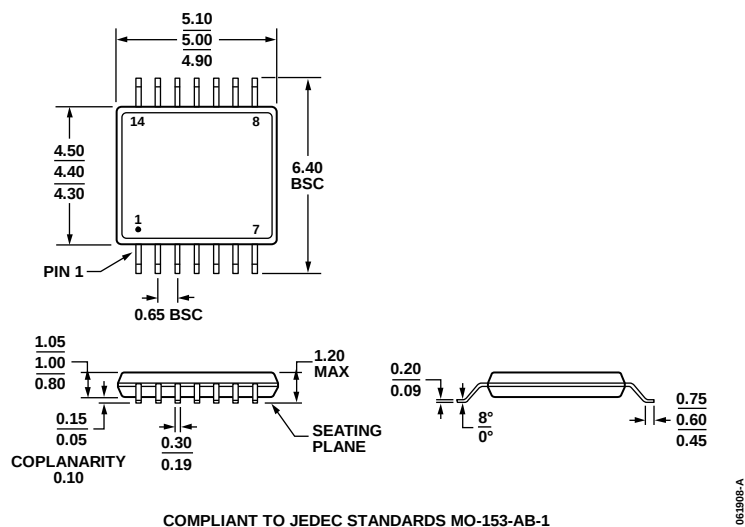


Figure 3. 14-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-14)
Dimensions shown in millimeters

ORDERING GUIDE

Model ¹	Temperature Range	Package Description	Package Option
ADG3304SRU-EP-RL7	–55°C to +125°C	14-Lead Thin Shrink Small Outline Package [TSSOP]	RU-14
ADG3304SRUZ-EP-RL7	–55°C to +125°C	14-Lead Thin Shrink Small Outline Package [TSSOP]	RU-14

¹ Z= RoHS Compliant Part.