Low Voltage, Single-Channel Level Translator

ADG3231*

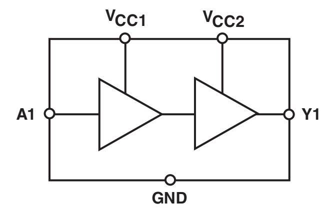
FEATURES

Operates from 1.65 V to 3.6 V Supply Rails
Unidirectional Signal Path, Bidirectional Level Translation
Tiny 6-Lead SOT-23 Package
Short Circuit Protection
LVTTL/CMOS Compatible Inputs

APPLICATIONS

Level Translation
Low Voltage ASIC Translation
Serial Interface Translation

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADG3231 is a level translator designed on a submicron process that operates from supplies as low as 1.65 V. The device is guaranteed for operation over the supply range 1.65 V to 3.6 V. It operates from two supply voltages, allowing bidirectional level translation, i.e., it translates low voltages to higher voltages and vice versa. The signal path is unidirectional, meaning data may flow only from A1 to Y1.

This type of device may be used in applications requiring communication between devices operating from different supply levels.

The level translator is packaged in one of the smallest footprints available for its pin count. The 6-lead SOT-23 package requires only a maximum of 5.28 mm × 5.28 mm board space.

PRODUCT HIGHLIGHTS

1. Bidirectional level translation matches any voltage level from 1.65 V to 3.6 V.
2. The device offers high performance and is fully guaranteed across the supply range.
3. Short circuit protection.
4. Tiny SOT-23 package.

*Patent Pending

REV. 0

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ADG3231–SPECIFICATIONS[1] (V_{CC1} = V_{CC2} = 1.65 V to 3.6 V, GND = 0 V. All specifications T_{MIN} to T_{MAX}, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ[2]	Max	Unit
LOGIC INPUTS/OUTPUTS[3]						
Input High Voltage[4]	V_{IH}	V_{CC1} = 3.0 V to 3.6 V	1.35			V
	V_{IH}	V_{CC1} = 2.3 V to 2.7 V	1.35			V
	V_{IH}	V_{CC1} = 1.65 V to 1.95 V	0.65 V_{CC}			V
Input Low Voltage[4]	V_{IL}	V_{CC1} = 3.0 V to 3.6 V			0.8	V
	V_{IL}	V_{CC1} = 2.3 V to 2.7 V			0.7	V
	V_{IL}	V_{CC1} = 1.65 V to 1.95 V			0.35 V_{CC}	V
Output High Voltage	V_{OH}	I_{OH} = –100 µA, V_{CC2} = 3.0 V to 3.6 V	2.4			V
		V_{CC2} = 2.3 V to 2.7 V	2.0			V
		V_{CC2} = 1.65 V to 1.95 V	V_{CC} – 0.45			V
		I_{OH} = –4 mA, V_{CC2} = 2.3 V to 2.7 V	2.0			V
		V_{CC2} = 1.65 V to 1.95 V	V_{CC} – 0.45			V
		I_{OH} = –8 mA, V_{CC2} = 3.0 V to 3.6 V	2.4			V
Output Low Voltage	V_{OL}	I_{OH} = +100 µA, V_{CC2} = 3.0 V to 3.6 V			0.4	V
		V_{CC2} = 2.3 V to 2.7 V			0.4	V
		V_{CC2} = 1.65 V to 1.95 V			0.45	V
		I_{OH} = +4 mA, V_{CC2} = 2.3 V to 2.7 V			0.4	V
		V_{CC2} = 1.65 V to 1.95 V			0.45	V
		I_{OH} = +8 mA, V_{CC2} = 3.0 V to 3.6 V			0.4	V
SWITCHING CHARACTERISTICS[4, 5]						
Propagation Delay, t_{PD} A1 to Y1	t_{PHL}, t_{PLH}	3.3 V ± 0.3 V, C_L = 30 pF, V_T = $V_{CC}/2$		4	6.5	ns
Propagation Delay, t_{PD} A1 to Y1	t_{PHL}, t_{PLH}	2.5 V ± 0.2 V, C_L = 30 pF, V_T = $V_{CC}/2$		4.5	6.5	ns
Propagation Delay, t_{PD} A1 to Y1	t_{PHL}, t_{PLH}	1.8 V ± 0.15 V, C_L = 30 pF, V_T = $V_{CC}/2$		6.5	10.25	ns
Input Leakage Current	I_I	$0 \leq V_{IN} \leq 3.6$ V			±1	µA
Output Leakage Current	I_O	$0 \leq V_{IN} \leq 3.6$ V			±1	µA
POWER REQUIREMENTS						
Power Supply Voltages	V_{CC1}		1.65		3.6	V
	V_{CC2}		1.65		3.6	V
Quiescent Power Supply Current	I_{CC1}	Digital Inputs = 0 V or V_{CC}			2	µA
	I_{CC2}	Digital Inputs = 0 V or V_{CC}			2	µA

NOTES
[1] Temperature range is as follows: B Version: –40°C to +85°C.
[2] All typical values are at V_{CC1} = V_{CC2}, T_A = 25°C, unless otherwise stated.
[3] V_{IL} and V_{IH} levels are specified with respect to V_{CC1}; V_{OH} and V_{OL} levels are with respect to V_{CC2}.
[4] Guaranteed by design, not subject to production test.
[5] See Test Circuit and Waveforms.

Specifications subject to change without notice.

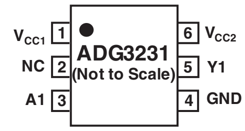
ABSOLUTE MAXIMUM RATINGS*

(T_A = 25°C, unless otherwise noted.)

V_{CC} to GND . . . . –0.3 V to +4.6 V
A1 Input Voltage . . . . –0.3 V to V_{CC1} +0.3 V
DC Output Current . . . . 25 mA
Operating Temperature Range
  Industrial (B Version) . . . . –40°C to +85°C
Storage Temperature Range . . . . –65°C to +150°C
Junction Temperature . . . . .150°C
6-Lead SOT-23,
  θ_{JA} Thermal Impedance . . . . 229°C/W
Lead Temperature, Soldering (10 seconds) . . . . 300°C
IR Reflow, Peak Temperature (<20 seconds) . . . . 235°C

*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Only one absolute maximum rating may be applied at any one time.

PIN CONFIGURATION



ORDERING GUIDE

Model	Temperature Range	Package Description	Branding	Package Option
ADG3231BRJ-REEL	–40°C to +85°C	SOT-23	W2B	RJ-6
ADG3231BRJ-REEL7	–40°C to +85°C	SOT-23	W2B	RJ-6

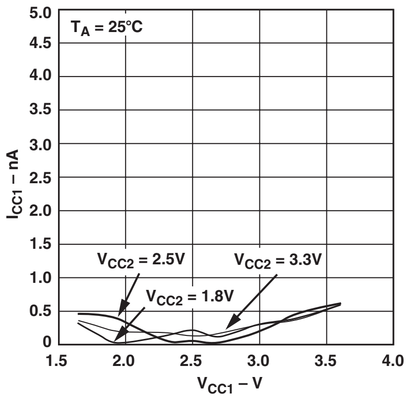
PIN FUNCTION DESCRIPTIONS

Pin	Mnemonic	Description
1	V_{CC1}	Supply Voltage 1, can be any supply voltage from 1.65 V to 3.6 V.
2	NC	Not Internally Connected.
3	A1	Digital Input Referred to V_{CC1}.
4	GND	Device Ground Pin.
5	Y1	Digital Output Referred to V_{CC2}.
6	V_{CC2}	Supply Voltage 2, can be any supply voltage from 1.65 V to 3.6 V.

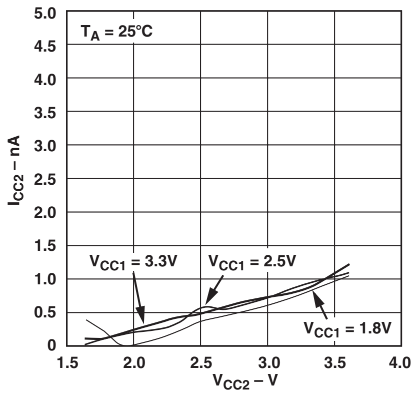
CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG3231 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

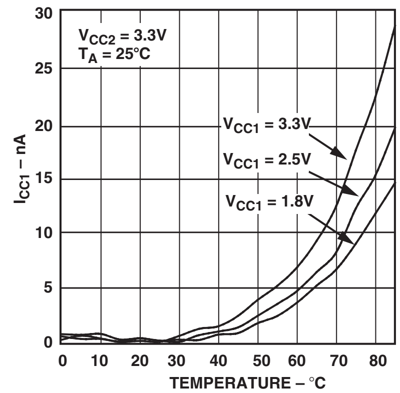
ADG3231–Typical Performance Characteristics



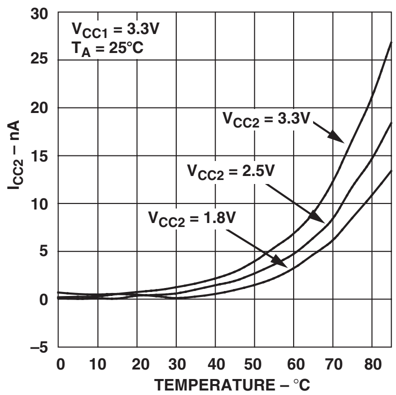
TPC 1. I_{CC1} vs. V_{CC1}



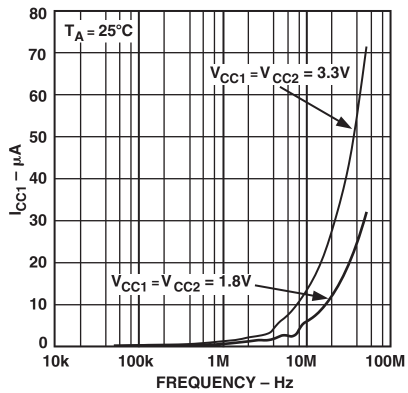
TPC 2. I_{CC2} vs. V_{CC2}



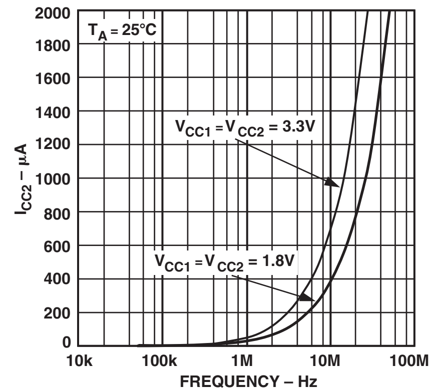
TPC 3. I_{CC1} vs. Temperature



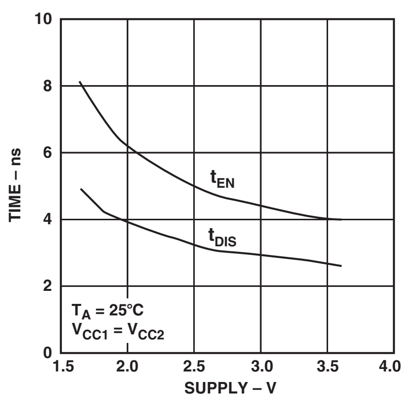
TPC 4. I_{CC2} vs. Temperature



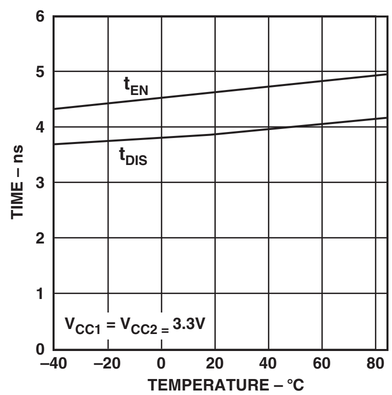
TPC 5. I_{CC1} vs. Frequency



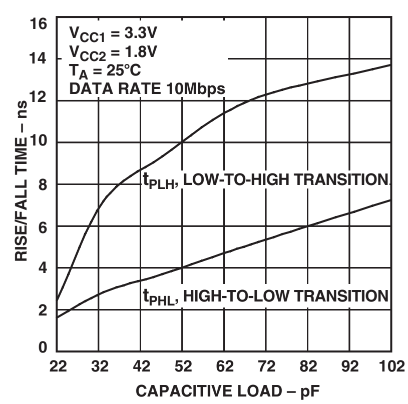
TPC 6. I_{CC2} vs. Frequency



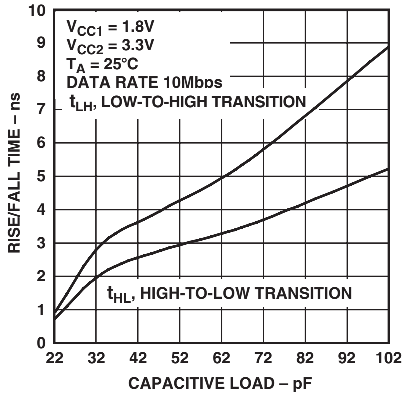
TPC 7. Enable, Disable Time vs. Supply



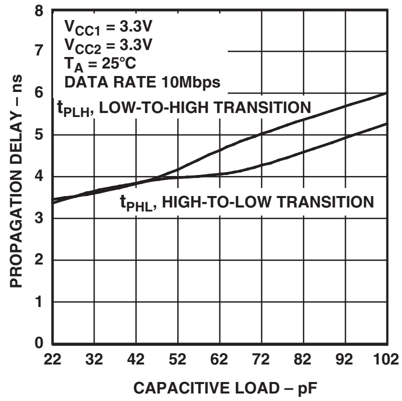
TPC 8. Enable, Disable Time vs. Temperature



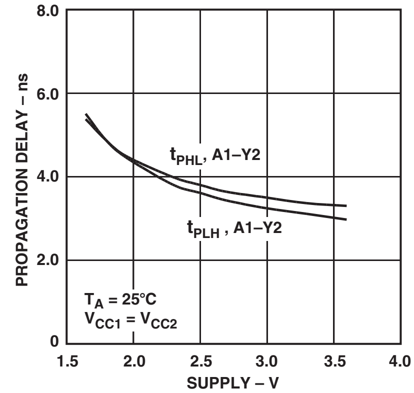
TPC 9. Rise/Fall Time vs. Capacitive Load, A1–Y1



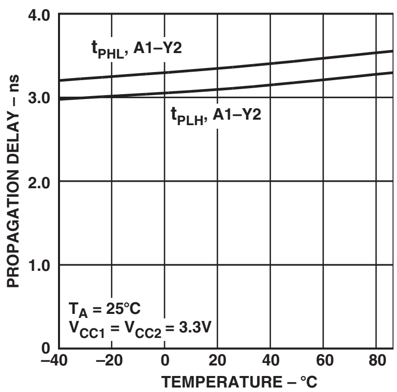
TPC 10. Rise/Fall Time vs. Capacitive Load, A1–Y1



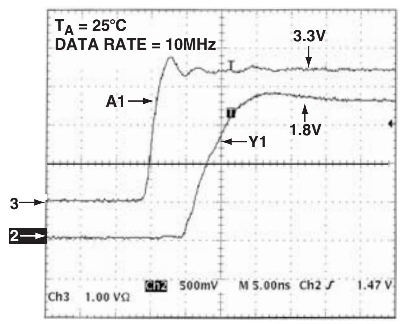
TPC 11. Propagation Delay vs. Capacitive Load, A1–Y1



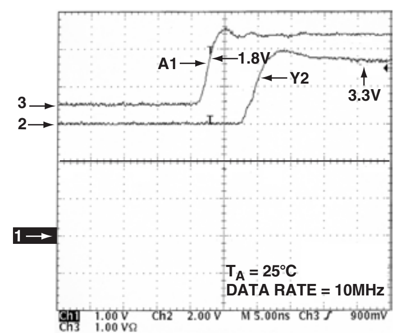
TPC 12. Propagation Delay vs. Supply, Bypass Mode



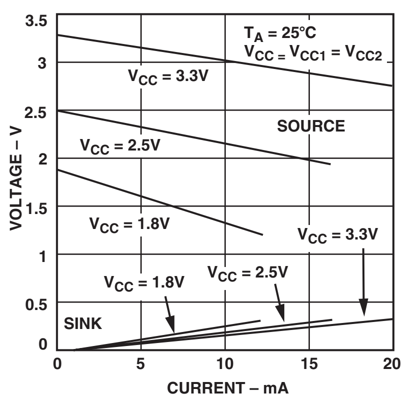
TPC 13 Propagation Delay vs. Temperature



TPC 14. Input/Output $V_{CC1} = 3.3\ V$, $V_{CC2} = 1.8\ V$



TPC 15. Input/Output $V_{CC1} = 1.8\ V$, $V_{CC2} = 3.3\ V$



TPC 16. Y1 Sink and Source Current

TEST CIRCUIT

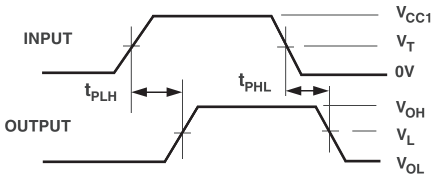


Figure 1. Propagation Delay

DESCRIPTION

The ADG3231 is a level translating device designed on a submicron process that operates from supplies as low as 1.65 V. The device is guaranteed for operation over the supply range 1.65 V to 3.6 V. It operates from two supply voltages, allowing bidirectional level translation, i.e., it translates low voltages to high voltages and vice versa. The signal path is unidirectional, meaning data may only flow from A to Z.

A1 Input

The A1 input is capable of accepting inputs outside the V_{CC1} supply range. For example, the V_{CC1} supply applied to the device could be 1.8 V while the preceding device could be supplied from a 2.5 V or 3.3 V supply rail. There are no internal diodes to the supply rails, so the ADG3231 can handle inputs above the supply but inside the absolute maximum ratings stated.

Normal Operation

The signal path is from A1 to Y1. The device will level translate the signal applied to A1 to a V_{CC1} logic level (this level translation can be to either a higher or a lower supply) and route the signal to the Y1 output, which will have standard V_{OL}/V_{OH} levels for V_{CC2} supplies.

The supplies in Figure 2 may be any combination of supplies, e.g., V_{CC1} and V_{CC2} may be anywhere in the range of 1.65 V to 3.6 V.

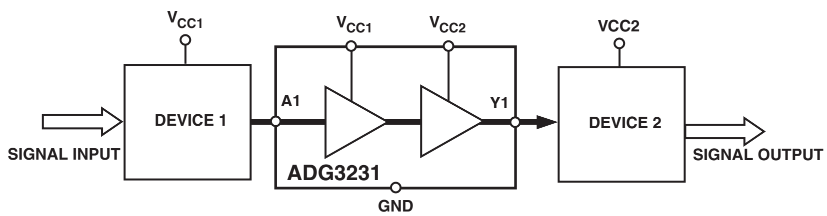
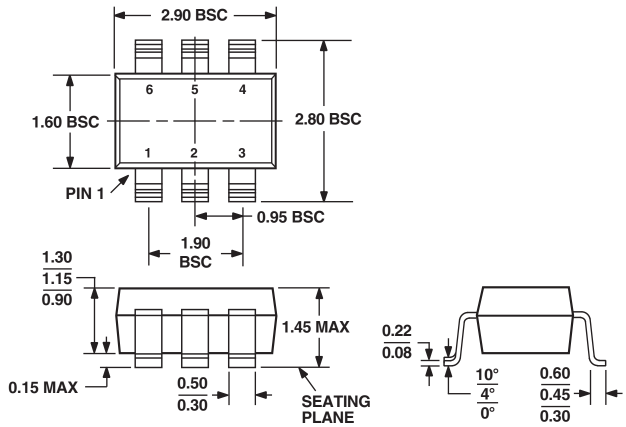


Figure 2. Typical Operation of the ADG3231 Level Translating Switch

OUTLINE DIMENSIONS

6-Lead Small Outline Transistor Package [SOT-23] (RJ-6)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-178AB

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