1.65 V to 3.6 V, Single-Channel Level Translator in SOT-66 Package

ADG3231

FEATURES

Operates from 1.65 V to 3.6 V supply rails
Unidirectional signal path
Up/down level translation
Ultracompact 6-lead SOT-66 and SOT-23 packages
Output short-circuit protection
LVTTL/CMOS-compatible inputs

APPLICATIONS

Level translation in:
- **PDAs**
- **Handsets**
- **MP3 players**

FUNCTIONAL BLOCK DIAGRAM

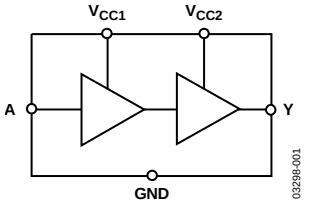

Figure 1.

GENERAL DESCRIPTION

The ADG3231[1] is a single-channel level translator designed on a submicron process that is guaranteed to operate over the 1.65 V to 3.6 V supply range. The device may be used in applications requiring communication between digital devices operating from multiple supply voltages. The logic levels on each side of the device are set by the two supply voltages, V_{CC1} for A and V_{CC2} for Y. The signal path is unidirectional, meaning data may flow only from A to Y.

The ADG3231 can operate with any combination of V_{CC1} and V_{CC2} supply voltages within the 1.65 V to 3.6 V range, allowing the part to perform either up ($V_{CC1} < V_{CC2}$) or down ($V_{CC1} > V_{CC2}$) level translation. The output stage is protected against current overload, which may occur when the Y pin is accidentally shorted to the V_{CC2} or GND rails.

The ADG3231 is available in ultracompact packages, the SOT-66 (1.65 mm × 1.66 mm × 0.57 mm) and the SOT-23 (2.8 mm × 2.9 mm × 1.3 mm), making the part ideal for applications where space is critical.

[1] Patent pending.

PRODUCT HIGHLIGHTS

1. Up/down level translation.
2. Guaranteed to operate with any supply combination within the 1.65 V to 3.6 V range.
3. Output short-circuit protection.
4. Available in ultracompact SOT-66 and SOT-23 packages.

Rev. A

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REVISION HISTORY

12/04—Rev. 0 to Rev. A

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5/03—Revision 0: Initial Version

SPECIFICATIONS

V_{CC1} = V_{CC2} = 1.65 V to 3.6 V, GND = 0 V. All specifications T_{MIN} to T_{MAX}, unless otherwise noted. Temperature range for the B version is −40°C to +85°C.

Table 1.

Parameter	Symbol	Conditions	Min	Typ[1]	Max	Unit
LOGIC INPUTS/OUTPUTS						
Input High Voltage[2]	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_{CC1}			V
Input Low Voltage[2]	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_{CC1}	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_{CC2} − 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_{CC2} − 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[2]						
Propagation Delay, t_{PD} A to Y	t_{PHL}, t_{PLH}	3.3 V ± 0.3 V, C_L = 30 pF, Figure 2		4	6.5	ns
Propagation Delay, t_{PD} A to Y	t_{PHL}, t_{PLH}	2.5 V ± 0.2 V, C_L = 30 pF, Figure 2		4.5	6.5	ns
Propagation Delay, t_{PD} A to Y	t_{PHL}, t_{PLH}	1.8 V ± 0.15 V, C_L = 30 pF, Figure 2		6.5	10.25	ns
Input Leakage Current	I_I	0 ≤ V_{IN} ≤ 3.6 V			±1	µA
Output Leakage Current	I_O	0 ≤ V_{IN} ≤ 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_{CC1}			2	µA
	I_{CC2}	Digital inputs = 0 V or V_{CC2}			2	µA

[1] All typical values are at V_{CC1} = V_{CC2}, T_A = 25°C, unless otherwise stated.
[2] Guaranteed by design, not subject to production test.

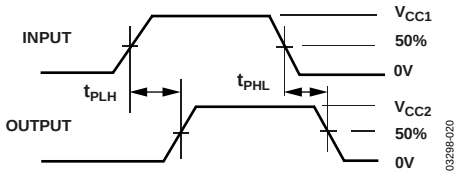

Figure 2. Timing Diagram

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Rating
V_{CC} to GND	−0.3 V to +4.6 V
Input Voltage for A	−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
6-Lead SOT-66	
θ_{JA} Thermal Impedance	191°C/W (4-layer board)
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

ESD 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 this product 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.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

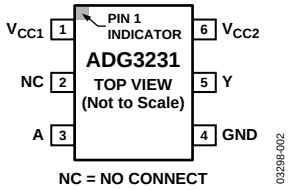

Figure 3. SOT-23

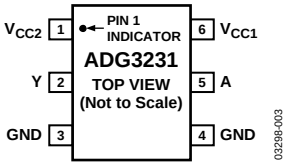

Figure 4. SOT-66

Table 3. Pin Function Descriptions

SOT-66 Pin No.	SOT-23 Pin No.	Mnemonic	Description
6	1	V_{CC1}	Supply Voltage 1. Can be any supply voltage from 1.65 V to 3.6 V.
	2	NC	Not internally connected.
5	3	A	Digital Input Referred to V_{CC1}.
3, 4	4	GND	Device Ground Pin.
2	5	Y	Digital Output Referred to V_{CC2}.
1	6	V_{CC2}	Supply Voltage 2. Can be any supply voltage from 1.65 V to 3.6 V.

TYPICAL PERFORMANCE CHARACTERISTICS

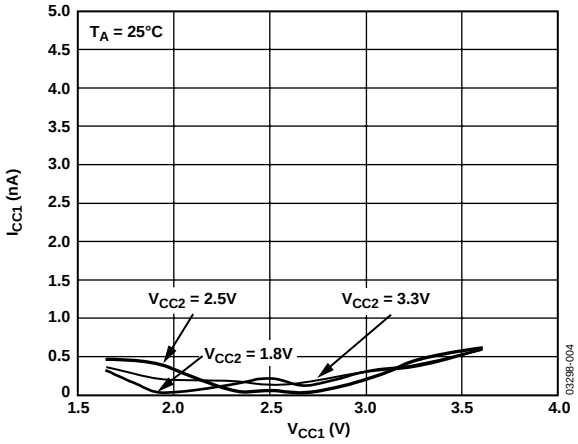

Figure 5. I_{CC1} vs. V_{CC1}

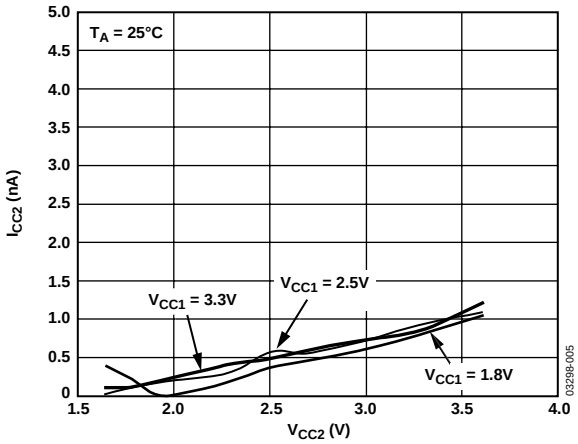

Figure 6. I_{CC2} vs. V_{CC2}

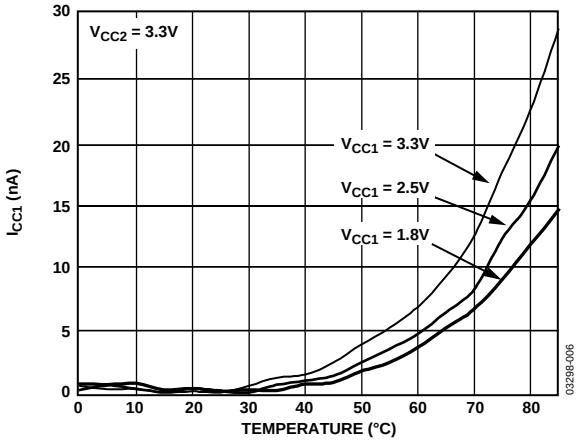

Figure 7. I_{CC1} vs. Temperature

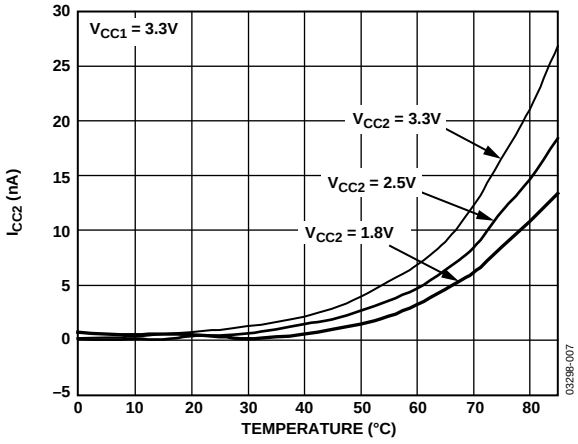

Figure 8. I_{CC2} vs. Temperature

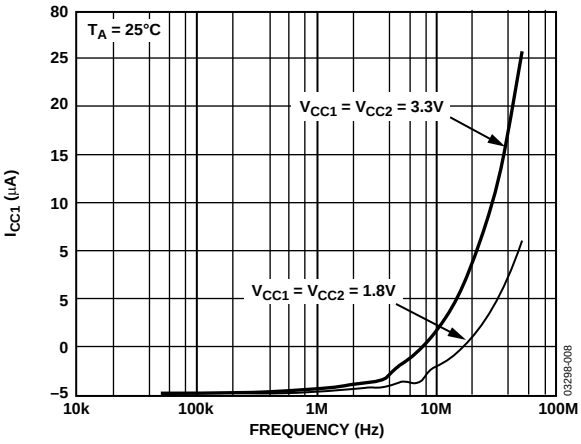

Figure 9. I_{CC1} vs. Frequency

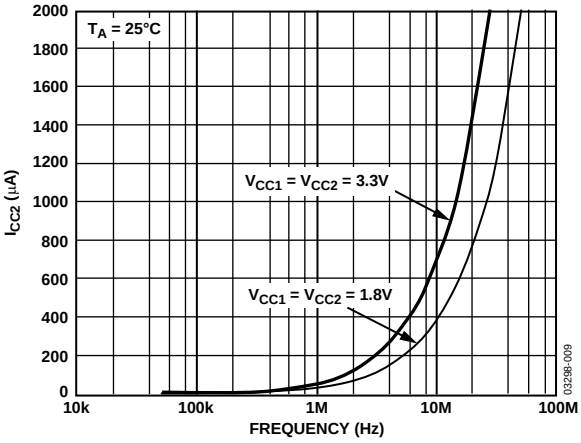

Figure 10. I_{CC2} vs. Frequency

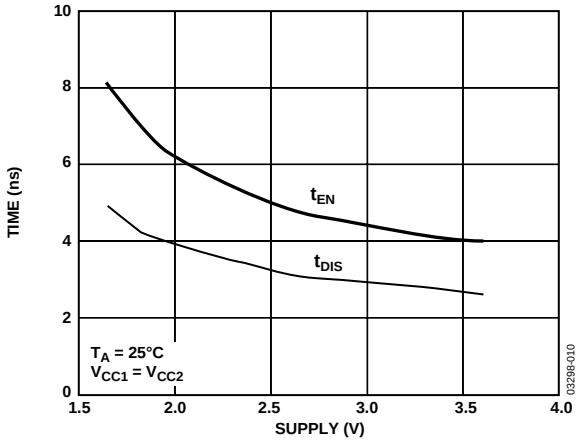

Figure 11. Enable, Disable Time vs. Supply

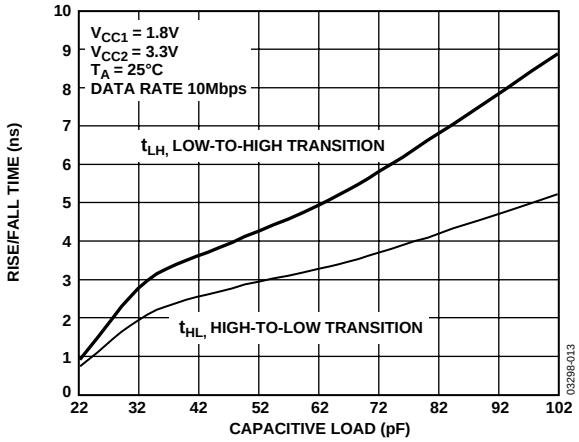

Figure 14. Rise/Fall Time vs. Capacitive Load(1.8 V to 3.3 V Level Translation)

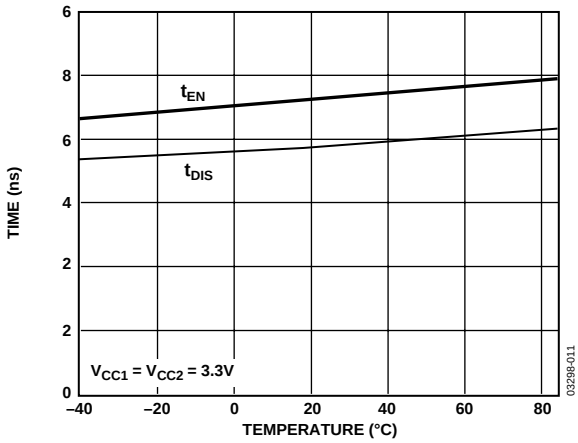

Figure 12. Enable, Disable Time vs. Temperature

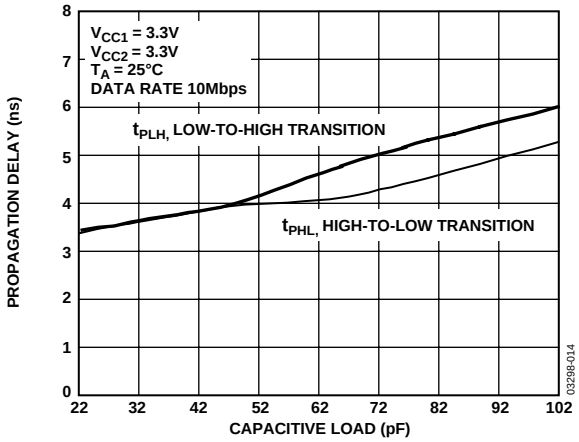

Figure 15. Propagation Delay vs. Capacitive Load

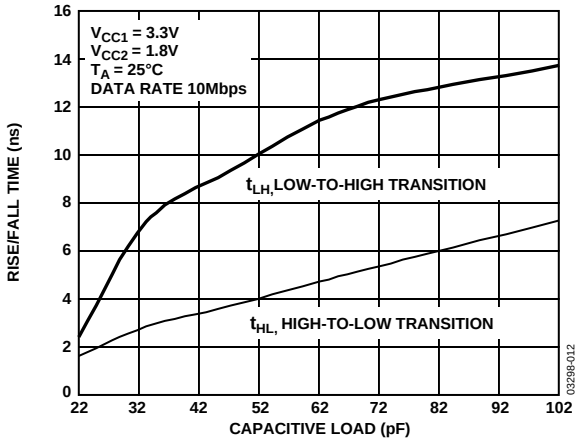

Figure 13. Rise/Fall Time vs. Capacitive Load (3.3 V to 1.8 V Level Translation)

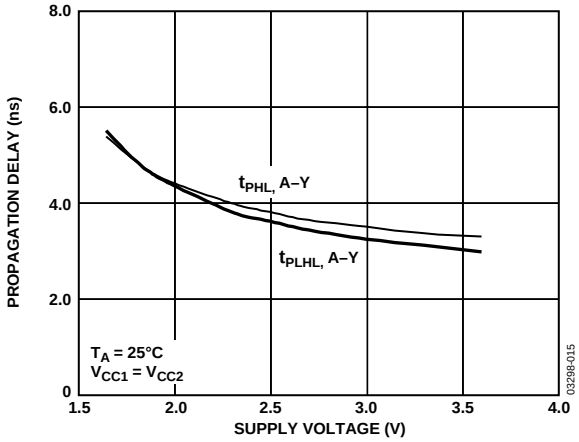

Figure 16. Propagation Delay vs. Supply Voltage

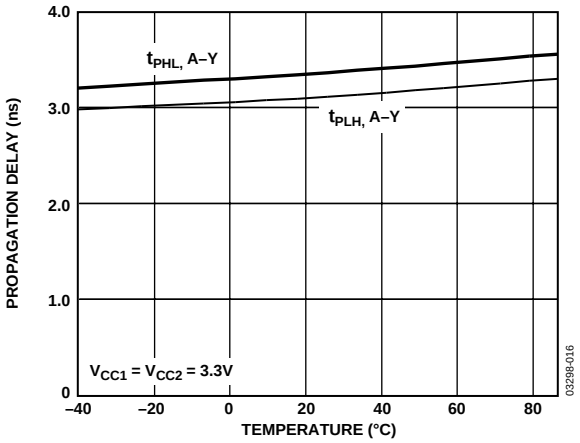

Figure 17. Propagation Delay vs. Temperature

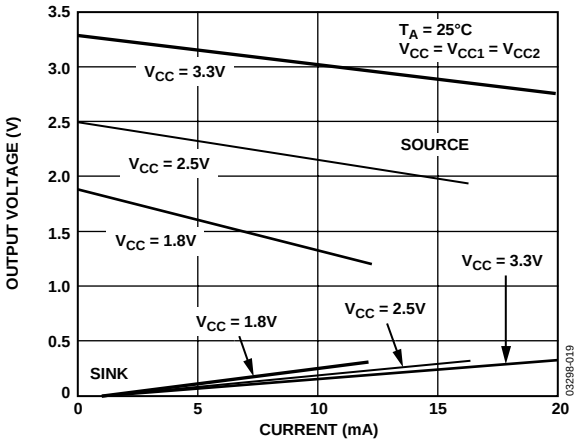

Figure 20. Output Voltage vs. Sink and Source Current

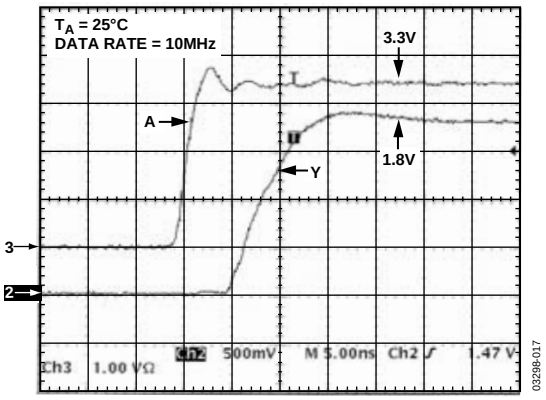

Figure 18. Input/Output V_{CC1} = 3.3 V, V_{CC2} = 1.8 V

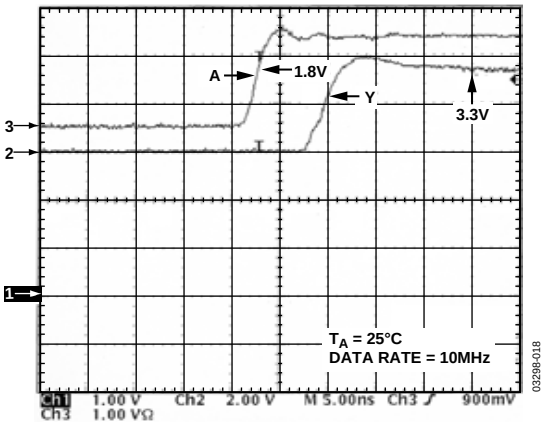

Figure 19. Input/Output V_{CC1} = 1.8 V, V_{CC2} = 3.3 V

THEORY OF OPERATION

The ADG3231 is a single-channel level translator designed on a submicron process that is guaranteed to operate over the 1.65 V to 3.6 V supply range. The device may be used in applications requiring communication between digital devices operating from multiple supply voltages. The logic levels on each side of the device are set by the two supply voltages, V_{CC1} for A and V_{CC2} for Y. The signal path is unidirectional, meaning data may flow only from A to Y.

The ADG3231 can operate with any combination of V_{CC1} and V_{CC2} supply voltages within the 1.65 V to 3.6 V range, allowing the part to perform either up ($V_{CC1} < V_{CC2}$) or down ($V_{CC1} > V_{CC2}$) level translation.

The output stage is protected against current overload that may occur when the Y pin is accidentally shorted to the V_{CC2} or GND rails by limiting the current delivered into the load; for example, ~1.7 mA with V_{CC2} = 3.6 V.

The short-circuit protection circuitry works by limiting the output current when the output voltage exceeds V_{OL} (A = 0 logic) or is less than V_{OH} (A = 1 logic) threshold values specified for the V_{CC2} supply voltage used.

Figure 21 shows the typical application for the ADG3231 where the device performs level translation from V_{CC1}-compatible levels to V_{CC2}-compatible levels to allow proper communication between the two digital devices, DEVICE 1 and DEVICE 2.

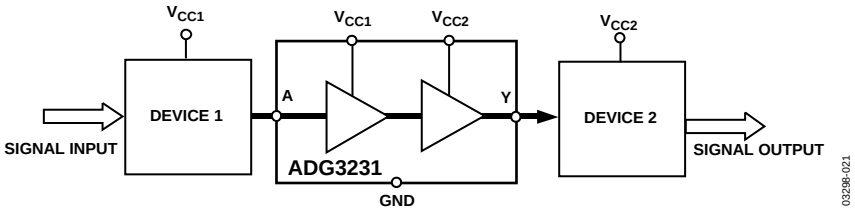

Figure 21. Typical Application of the ADG3231 Level Translator

OUTLINE DIMENSIONS

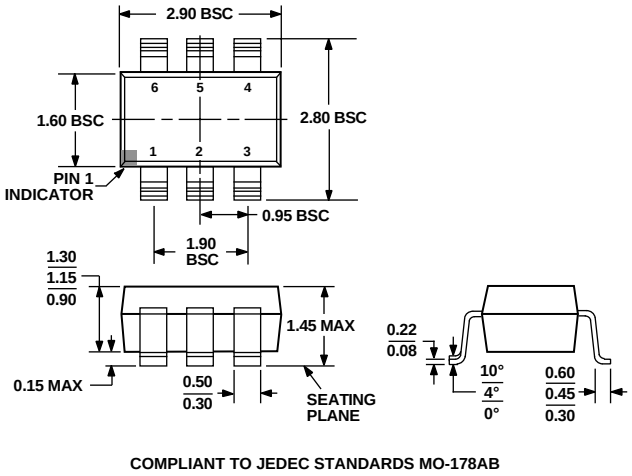

Figure 22. 6-Lead Small Outline Transistor Package [SOT-23]
(RJ-6)
Dimensions shown in millimeters

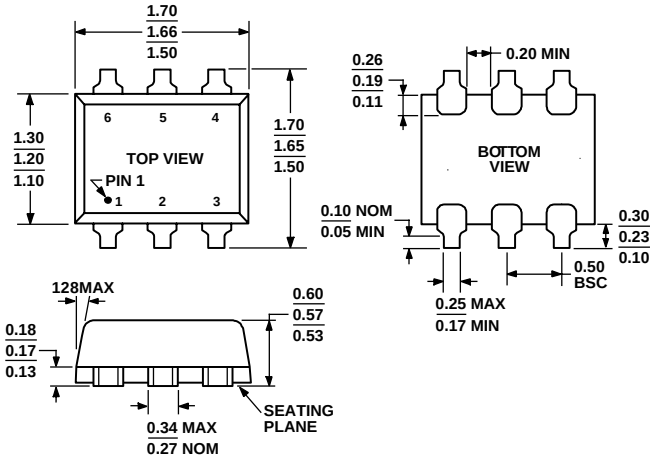

Figure 23. 6-Lead Small Outline Transistor Package [SOT-66]
(RY-6-1)
Dimensions shown in millimeters

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
ADG3231BRJZ-REEL[1]	−40°C to +85°C	SOT-23	SO2	RJ-6
ADG3231BRJZ-REEL7[1]	−40°C to +85°C	SOT-23	SO2	RJ-6
ADG3231BRYZ-REEL[1]	−40°C to +85°C	SOT-66	SO2	RY-6-1
ADG3231BRYZ-REEL7[1]	−40°C to +85°C	SOT-66	SO2	RY-6-1

[1] Z = Pb-free part.

NOTES

NOTES

C03298–0–12/04(A)