



Triple-Channel Digital Isolators

ADuM1300/ADuM1301

FEATURES

Low power operation

5 V operation

1.2 mA per channel max @ 0 Mbps to 2 Mbps

3.5 mA per channel max @ 10 Mbps

32 mA per channel max @ 90 Mbps

3 V operation

0.8 mA per channel max @ 0 Mbps to 2 Mbps

2.2 mA per channel max @ 10 Mbps

20 mA per channel max @ 90 Mbps

Bidirectional communication

3 V/5 V level translation

High temperature operation: 105°C

High data rate: dc to 90 Mbps (NRZ)

Precise timing characteristics

2 ns max pulse-width distortion

2 ns max channel-to-channel matching

High common-mode transient immunity: >25 kV/μs

Output enable function

Wide body 16-lead SOIC package, Pb-free models available

Safety and regulatory approvals

UL recognition: 2500 V rms for 1 minute per UL 1577

CSA component acceptance notice #5A

VDE certificate of conformity

DIN EN 60747-5-2 (VDE 0884 Part 2): 2003-01

DIN EN 60950 (VDE 0805): 2001-12; EN 60950:2000

$V_{ORM} = 560$ V peak

APPLICATIONS

General-purpose multichannel isolation

SPI® interface/data converter isolation

RS-232/RS-422/RS-485 transceiver

Industrial field bus isolation

GENERAL DESCRIPTION

The ADuM130x are 3-channel digital isolators based on Analog Devices' iCoupler® technology. Combining high speed CMOS and monolithic transformer technology, these isolation components provide outstanding performance characteristics superior to alternatives such as optocoupler devices.

By avoiding the use of LEDs and photodiodes, iCoupler devices remove the design difficulties commonly associated with optocouplers. The typical optocoupler concerns regarding uncertain current transfer ratios, nonlinear transfer functions, and temperature and lifetime effects are eliminated with the simple iCoupler digital interfaces and stable performance characteristics. The need for external drivers and other discretes is eliminated with these iCoupler products. Furthermore, iCoupler devices consume one-tenth to one-sixth the power of optocouplers at comparable signal data rates.

The ADuM130x isolators provide three independent isolation channels in a variety of channel configurations and data rates (see the Ordering Guide). Both models operate with the supply voltage on either side ranging from 2.7 V to 5.5 V, providing compatibility with lower voltage systems as well as enabling a voltage translation functionality across the isolation barrier. In addition, the ADuM130x provides low pulse-width distortion (<2 ns for CRW grade) and tight channel-to-channel matching (<2 ns for CRW grade). Unlike other optocoupler alternatives, the ADuM130x isolators have a patented refresh feature that ensures dc correctness in the absence of input logic transitions and during power-up/power-down conditions.

FUNCTIONAL BLOCK DIAGRAMS

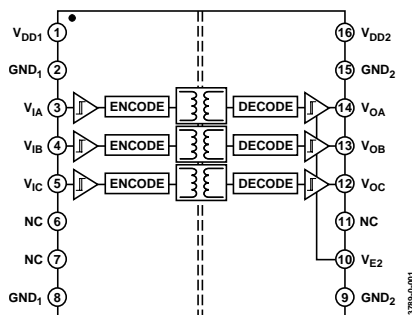


Figure 1. ADuM1300 Functional Block Diagram

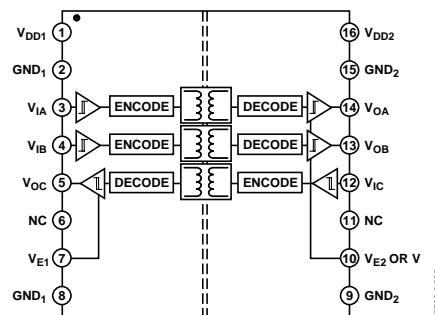


Figure 2. ADuM1301 Functional Block Diagram

Rev. C

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REVISION HISTORY

6/04—Data Sheet Changed from Rev. B to Rev. C.

| | |
|---|-----------|
| Changes to Format | Universal |
| Changes to Features..... | 1 |
| Changes to Electrical Characteristics—5 V Operation | 3 |
| Changes to Electrical Characteristics—3 V Operation | 5 |
| Changes to Electrical Characteristics—Mixed 5 V/3 V or 3 V/5 V Operation | 7 |
| Changes to Ordering Guide | 18 |

5/04—Data Sheet Changed from Rev. A to Rev. B.

| | |
|---|-----------|
| Changes to the Format..... | Universal |
| Changes to the Features | 1 |
| Changes to Table 7 and Table 8..... | 14 |
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| Changes to the DC Correctness and Magnetic Field Immunity Section..... | 19 |
| Changes to the Power Consumption Section | 20 |
| Changes to the Ordering Guide..... | 21 |

9/03—Data Sheet Changed from Rev. 0 to Rev. A.

| | |
|---|----|
| Edits to Regulatory Information..... | 13 |
| Edits to Absolute Maximum Ratings | 15 |
| Deleted the Package Branding Information..... | 16 |

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—5 V OPERATION¹

4.5 V \leq V_{DD1} \leq 5.5 V, 4.5 V \leq V_{DD2} \leq 5.5 V; all min/max specifications apply over the entire recommended operation range, unless otherwise noted; all typical specifications are at T_A = 25°C, V_{DD1} = V_{DD2} = 5 V.

Table 1.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|--|--|--------------------|-------------------|------|--|
| DC SPECIFICATIONS | | | | | | |
| Input Supply Current, per Channel, Quiescent | I _{DD1 (Q)} | | 0.50 | 0.53 | mA | |
| Output Supply Current, per Channel, Quiescent | I _{DDO (Q)} | | 0.19 | 0.21 | mA | |
| ADuM1300, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (Q)} | | 1.6 | 2.5 | mA | DC to 1 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (Q)} | | 0.7 | 1.0 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (10)} | | 6.5 | 8.1 | mA | 5 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (10)} | | 1.9 | 2.5 | mA | 5 MHz logic signal freq. |
| 90 Mbps (CRW Grade Only) | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (90)} | | 57 | 77 | mA | 45 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (90)} | | 16 | 18 | mA | 45 MHz logic signal freq. |
| ADuM1301, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (Q)} | | 1.3 | 2.1 | mA | DC to 1 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (Q)} | | 1.0 | 1.4 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (10)} | | 5.0 | 6.2 | mA | 5 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (10)} | | 3.4 | 4.2 | mA | 5 MHz logic signal freq. |
| 90 Mbps (CRW Grade Only) | | | | | | |
| V _{DD1} Supply Current | I _{DD1 (90)} | | 43 | 57 | mA | 45 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2 (90)} | | 29 | 37 | mA | 45 MHz logic signal freq. |
| For All Models | | | | | | |
| Input Currents | I _{IA} , I _{IB} , I _{IC} , I _{E1} , I _{E2} | −10 | +0.01 | +10 | μA | 0 \leq V _{IA} , V _{IB} , V _{IC} \leq V _{DD1} or V _{DD2} , 0 \leq V _{E1} , V _{E2} \leq V _{DD1} or V _{DD2} |
| Logic High Input Threshold | V _{IH} , V _{EH} | 2.0 | | | V | |
| Logic Low Input Threshold | V _{IL} , V _{EL} | | | 0.8 | V | |
| Logic High Output Voltages | V _{OAH} , V _{OBH} , V _{OCH} | V _{DD1} , V _{DD2} − 0.1 V _{DD1} , V _{DD2} − 0.4 | 5.0 4.8 | | V | I _{OX} = −20 μA, V _{IX} = V _{IXH} I _{OX} = −4 mA, V _{IX} = V _{IXH} |
| Logic Low Output Voltages | V _{OAL} , V _{OBL} , V _{OCL} | | 0.0 0.04 0.2 | 0.1 0.1 0.4 | V | I _{OX} = 20 μA, V _{IX} = V _{IXL} I _{OX} = 400 μA, V _{IX} = V _{IXL} I _{OX} = 4 mA, V _{IX} = V _{IXL} |
| SWITCHING SPECIFICATIONS | | | | | | |
| ADuM130xARW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 1000 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 1 | | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 50 | 65 | 100 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} − t _{PHL} ⁵ | PWD | | | 40 | ns | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 50 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching ⁷ | t _{PSKCD/OD} | | | 50 | ns | C _L = 15 pF, CMOS signal levels |

ADuM1300/ADuM1301

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|-------------------------------------|-----|------|------|---------|--|
| ADuM130xBRW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 100 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 10 | | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 20 | 32 | 50 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} – t _{PHL} ⁵ | PWD | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 5 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 15 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 6 | ns | C _L = 15 pF, CMOS signal levels |
| ADuM130xCRW | | | | | | |
| Minimum Pulse Width ³ | PW | | 8.3 | 11.1 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 90 | 120 | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 18 | 27 | 32 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} – t _{PHL} ⁵ | PWD | | 0.5 | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 3 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 10 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 5 | ns | C _L = 15 pF, CMOS signal levels |
| For All Models | | | | | | |
| Output Disable Propagation Delay (High/Low-to-High Impedance) | t _{PHZ} , t _{PLH} | | 6 | 8 | ns | C _L = 15 pF, CMOS signal levels |
| Output Enable Propagation Delay (High Impedance to High/Low) | t _{PZH} , t _{PZL} | | 6 | 8 | ns | C _L = 15 pF, CMOS signal levels |
| Output Rise/Fall Time (10% to 90%) | t _R /t _F | | 2.5 | | ns | C _L = 15 pF, CMOS signal levels |
| Common-Mode Transient Immunity at Logic High Output ⁸ | CM _H | 25 | 35 | | kV/μs | V _{IX} = V _{DD1} /V _{DD2} , V _{CM} = 1000 V, transient magnitude = 800 V |
| Common-Mode Transient Immunity at Logic Low Output ⁸ | CM _L | 25 | 35 | | kV/μs | V _{IX} = 0 V, V _{CM} = 1000 V, transient magnitude = 800 V |
| Refresh Rate | f _r | | 1.2 | | Mbps | |
| Input Dynamic Supply Current, per Channel ⁹ | I _{DDI} (D) | | 0.19 | | mA/Mbps | |
| Output Dynamic Supply Current, per Channel ⁹ | I _{DDO} (D) | | 0.05 | | mA/Mbps | |

¹ All voltages are relative to their respective ground.

² The supply current values for all three channels are combined when running at identical data rates. Output supply current values are specified with no output load present. The supply current associated with an individual channel operating at a given data rate may be calculated as described in the Power Consumption section on Page 17. See Figure 6 through Figure 8 for information on per-channel supply current as a function of data rate for unloaded and loaded conditions. See Figure 9 through Figure 12 for total I_{DD1} and I_{DD2} supply currents as a function of data rate for ADuM1300/ADuM1301 channel configurations.

³ The minimum pulse width is the shortest pulse width at which the specified pulse-width distortion is guaranteed.

⁴ The maximum data rate is the fastest data rate at which the specified pulse-width distortion is guaranteed.

⁵ t_{PHL} propagation delay is measured from the 50% level of the falling edge of the V_{ix} signal to the 50% level of the falling edge of the V_{ox} signal. t_{PLH} propagation delay is measured from the 50% level of the rising edge of the V_{ix} signal to the 50% level of the rising edge of the V_{ox} signal.

⁶ t_{PSK} is the magnitude of the worst-case difference in t_{PHL} or t_{PLH} that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

⁷ Codirectional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on the same side of the isolation barrier. Opposing-directional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on opposing sides of the isolation barrier.

⁸ CM_H is the maximum common-mode voltage slew rate that can be sustained while maintaining V_O > 0.8 V_{DD2}. CM_L is the maximum common-mode voltage slew rate that can be sustained while maintaining V_O < 0.8 V. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges. The transient magnitude is the range over which the common mode is slewed.

⁹ Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in signal data rate. See Figure 6 through Figure 8 for information on per-channel supply current for unloaded and loaded conditions. See the Power Consumption section on Page 17 for guidance on calculating the per-channel supply current for a given data rate.

ELECTRICAL CHARACTERISTICS—3 V OPERATION¹

$2.7\text{ V} \leq V_{DD1} \leq 3.6\text{ V}$, $2.7\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$; all min/max specifications apply over the entire recommended operation range, unless otherwise noted; all typical specifications are at $T_A = 25^\circ\text{C}$, $V_{DD1} = V_{DD2} = 3.0\text{ V}$.

Table 2.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|--|--------------------------|-------|------|---------------|--|
| DC SPECIFICATIONS | | | | | | |
| Input Supply Current, per Channel, Quiescent | $I_{DD1(Q)}$ | | 0.26 | 0.31 | mA | |
| Output Supply Current, per Channel, Quiescent | $I_{DDO(Q)}$ | | 0.11 | 0.14 | mA | |
| ADuM1300, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(Q)}$ | | 0.9 | 1.7 | mA | DC to 1 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(Q)}$ | | 0.4 | 0.7 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(10)}$ | | 3.4 | 4.9 | mA | 5 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(10)}$ | | 1.1 | 1.6 | mA | 5 MHz logic signal freq. |
| 90 Mbps (CRW Grade Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(90)}$ | | 31 | 48 | mA | 45 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(90)}$ | | 8 | 13 | mA | 45 MHz logic signal freq. |
| ADuM1301, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(Q)}$ | | 0.7 | 1.4 | mA | DC to 1 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(Q)}$ | | 0.6 | 0.9 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(10)}$ | | 2.6 | 3.7 | mA | 5 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(10)}$ | | 1.8 | 2.5 | mA | 5 MHz logic signal freq. |
| 90 Mbps (CRW Grade Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(90)}$ | | 24 | 36 | mA | 45 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(90)}$ | | 16 | 23 | mA | 45 MHz logic signal freq. |
| For All Models | | | | | | |
| Input Currents | $I_{IA}, I_{IB}, I_{IC}, I_{E1}, I_{E2}$ | -10 | +0.01 | +10 | μA | $0 \leq V_{IA}, V_{IB}, V_{IC} \leq V_{DD1}$ or V_{DD2} , $0 \leq V_{E1}, V_{E2} \leq V_{DD1}$ or V_{DD2} |
| Logic High Input Threshold | V_{IH}, V_{EH} | 1.6 | | | V | |
| Logic Low Input Threshold | V_{IL}, V_{EL} | | | 0.4 | V | |
| Logic High Output Voltages | $V_{OAH}, V_{OBH}, V_{OCH}$ | $V_{DD1}, V_{DD2} - 0.1$ | 3.0 | | V | $I_{OX} = -20\text{ }\mu\text{A}, V_{IX} = V_{IXH}$ |
| | | $V_{DD1}, V_{DD2} - 0.4$ | 2.8 | | V | $I_{OX} = -4\text{ mA}, V_{IX} = V_{IXH}$ |
| Logic Low Output Voltages | $V_{OAL}, V_{OBL}, V_{OCL}$ | | 0.0 | 0.1 | V | $I_{OX} = 20\text{ }\mu\text{A}, V_{IX} = V_{IXL}$ |
| | | | 0.04 | 0.1 | V | $I_{OX} = 400\text{ }\mu\text{A}, V_{IX} = V_{IXL}$ |
| | | | 0.2 | 0.4 | V | $I_{OX} = 4\text{ mA}, V_{IX} = V_{IXL}$ |
| SWITCHING SPECIFICATIONS | | | | | | |
| ADuM130xARW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 1000 | ns | $C_L = 15\text{ pF}$, CMOS signal levels |
| Maximum Data Rate ⁴ | | 1 | | | Mbps | $C_L = 15\text{ pF}$, CMOS signal levels |
| Propagation Delay ⁵ | t_{PHL}, t_{PLH} | 50 | 75 | 100 | ns | $C_L = 15\text{ pF}$, CMOS signal levels |
| Pulse-Width Distortion, $ t_{PLH} - t_{PHL} $ ⁵ | PWD | | | 40 | ns | $C_L = 15\text{ pF}$, CMOS signal levels |
| Propagation Delay Skew ⁶ | t_{PSK} | | | 50 | ns | $C_L = 15\text{ pF}$, CMOS signal levels |
| Channel-to-Channel Matching ⁷ | $t_{PSKCD/OD}$ | | | 50 | ns | $C_L = 15\text{ pF}$, CMOS signal levels |

ADuM1300/ADuM1301

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|-------------------------------------|-----|------|------|---------|--|
| ADuM130xBRW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 100 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 10 | | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 20 | 38 | 50 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} – t _{PHL} ⁵ | PWD | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 5 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 26 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 6 | ns | C _L = 15 pF, CMOS signal levels |
| ADuM130xCRW | | | | | | |
| Minimum Pulse Width ³ | PW | | 8.3 | 11.1 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 90 | 120 | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 20 | 34 | 45 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} – t _{PHL} ⁵ | PWD | | 0.5 | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 3 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 16 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 5 | ns | C _L = 15 pF, CMOS signal levels |
| For All Models | | | | | | |
| Output Disable Propagation Delay (High/Low-to-High Impedance) | t _{PHZ} , t _{PLH} | | 6 | 8 | ns | C _L = 15 pF, CMOS signal levels |
| Output Enable Propagation Delay (High Impedance to High/Low) | t _{PZH} , t _{PZL} | | 6 | 8 | ns | C _L = 15 pF, CMOS signal levels |
| Output Rise/Fall Time (10% to 90%) | t _R /t _F | | 3 | | ns | C _L = 15 pF, CMOS signal levels |
| Common-Mode Transient Immunity at Logic High Output ⁸ | CM _H | 25 | 35 | | kV/μs | V _{ix} = V _{DD1} /V _{DD2} , V _{CM} = 1000 V, transient magnitude = 800 V |
| Common-Mode Transient Immunity at Logic Low Output ⁸ | CM _L | 25 | 35 | | kV/μs | V _{ix} = 0 V, V _{CM} = 1000 V, transient magnitude = 800 V |
| Refresh Rate | f _r | | 1.1 | | Mbps | |
| Input Dynamic Supply Current, per Channel ⁹ | I _{DDI} (D) | | 0.10 | | mA/Mbps | |
| Output Dynamic Supply Current, per Channel ⁹ | I _{DDO} (D) | | 0.03 | | mA/Mbps | |

¹ All voltages are relative to their respective ground.

² The supply current values for all three channels are combined when running at identical data rates. Output supply current values are specified with no output load present. The supply current associated with an individual channel operating at a given data rate may be calculated as described in the Power Consumption section on Page 17. See Figure 6 through Figure 8 for information on per-channel supply current as a function of data rate for unloaded and loaded conditions. See Figure 9 through Figure 12 for total I_{DD1} and I_{DD2} supply currents as a function of data rate for ADuM1300/ADuM1301 channel configurations.

³ The minimum pulse width is the shortest pulse width at which the specified pulse-width distortion is guaranteed.

⁴ The maximum data rate is the fastest data rate at which the specified pulse-width distortion is guaranteed.

⁵ t_{PHL} propagation delay is measured from the 50% level of the falling edge of the V_{ix} signal to the 50% level of the falling edge of the V_{ox} signal. t_{PLH} propagation delay is measured from the 50% level of the rising edge of the V_{ix} signal to the 50% level of the rising edge of the V_{ox} signal.

⁶ t_{PSK} is the magnitude of the worst-case difference in t_{PHL} or t_{PLH} that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

⁷ Codirectional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on the same side of the isolation barrier. Opposing-directional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on opposing sides of the isolation barrier.

⁸ CM_H is the maximum common-mode voltage slew rate that can be sustained while maintaining V_o > 0.8 V_{DD2}. CM_L is the maximum common-mode voltage slew rate that can be sustained while maintaining V_o < 0.8 V. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges. The transient magnitude is the range over which the common mode is slewed.

⁹ Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in signal data rate. See Figure 6 through Figure 8 for information on per-channel supply current for unloaded and loaded conditions. See the Power Consumption section on Page 17 for guidance on calculating the per-channel supply current for a given data rate.

ELECTRICAL CHARACTERISTICS—MIXED 5 V/3 V OR 3 V/5 V OPERATION¹

5 V/3 V operation: $4.5\text{ V} \leq V_{DD1} \leq 5.5\text{ V}$, $2.7\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$; 3 V/5 V operation: $2.7\text{ V} \leq V_{DD1} \leq 3.6\text{ V}$, $4.5\text{ V} \leq V_{DD2} \leq 5.5\text{ V}$; all min/max specifications apply over the entire recommended operation range, unless otherwise noted; all typical specifications are at $T_A = 25^\circ\text{C}$; $V_{DD1} = 3.0\text{ V}$, $V_{DD2} = 5\text{ V}$; or $V_{DD1} = 5\text{ V}$, $V_{DD2} = 3.0\text{ V}$.

Table 3.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---------------|-----|------|------|------|--------------------------------|
| DC SPECIFICATIONS | | | | | | |
| Input Supply Current, per Channel, Quiescent | $I_{DD1(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 0.50 | 0.53 | mA | |
| 3 V/5 V Operation | | | 0.26 | 0.31 | mA | |
| Output Supply Current, per Channel, Quiescent | $I_{DDO(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 0.11 | 0.14 | mA | |
| 3 V/5 V Operation | | | 0.19 | 0.21 | mA | |
| ADuM1300, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 1.6 | 2.5 | mA | DC to 1 MHz logic signal freq. |
| 3 V/5 V Operation | | | 0.9 | 1.7 | mA | DC to 1 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 0.4 | 0.7 | mA | DC to 1 MHz logic signal freq. |
| 3 V/5 V Operation | | | 0.7 | 1.0 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(10)}$ | | | | | |
| 5 V/3 V Operation | | | 6.5 | 8.1 | mA | 5 MHz logic signal freq. |
| 3 V/5 V Operation | | | 3.4 | 4.9 | mA | 5 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(10)}$ | | | | | |
| 5 V/3 V Operation | | | 1.1 | 1.6 | mA | 5 MHz logic signal freq. |
| 3 V/5 V Operation | | | 1.9 | 2.5 | mA | 5 MHz logic signal freq. |
| 90 Mbps (CRW Grade Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(90)}$ | | | | | |
| 5 V/3 V Operation | | | 57 | 77 | mA | 45 MHz logic signal freq. |
| 3 V/5 V Operation | | | 31 | 48 | mA | 45 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(90)}$ | | | | | |
| 5 V/3 V Operation | | | 8 | 13 | mA | 45 MHz logic signal freq. |
| 3 V/5 V Operation | | | 16 | 18 | mA | 45 MHz logic signal freq. |
| ADuM1301, Total Supply Current, Three Channels ² | | | | | | |
| DC to 2 Mbps | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 1.3 | 2.1 | mA | DC to 1 MHz logic signal freq. |
| 3 V/5 V Operation | | | 0.7 | 1.4 | mA | DC to 1 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(Q)}$ | | | | | |
| 5 V/3 V Operation | | | 0.6 | 0.9 | mA | DC to 1 MHz logic signal freq. |
| 3 V/5 V Operation | | | 1.0 | 1.4 | mA | DC to 1 MHz logic signal freq. |
| 10 Mbps (BRW and CRW Grades Only) | | | | | | |
| V_{DD1} Supply Current | $I_{DD1(10)}$ | | | | | |
| 5 V/3 V Operation | | | 5.0 | 6.2 | mA | 5 MHz logic signal freq. |
| 3 V/5 V Operation | | | 2.6 | 3.7 | mA | 5 MHz logic signal freq. |
| V_{DD2} Supply Current | $I_{DD2(10)}$ | | | | | |
| 5 V/3 V Operation | | | 1.8 | 2.5 | mA | 5 MHz logic signal freq. |
| 3 V/5 V Operation | | | 3.4 | 4.2 | mA | 5 MHz logic signal freq. |

ADuM1300/ADuM1301

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|--|--|--|------|-------|--|
| 90 Mbps (CRW Grade Only) | | | | | | |
| V _{DD1} Supply Current | I _{DD1} (90) | | | | | |
| 5 V/3 V Operation | | | 43 | 57 | mA | 45 MHz logic signal freq. |
| 3 V/5 V Operation | | | 24 | 36 | mA | 45 MHz logic signal freq. |
| V _{DD2} Supply Current | I _{DD2} (90) | | | | | |
| 5 V/3 V Operation | | | 16 | 23 | mA | 45 MHz logic signal freq. |
| 3 V/5 V Operation | | | 29 | 37 | mA | 45 MHz logic signal freq. |
| For All Models | | | | | | |
| Input Currents | I _{IA} , I _{IB} , I _{IC} , I _{E1} , I _{E2} | -10 | +0.01 | +10 | μA | 0 ≤ V _{IA} , V _{IB} , V _{IC} ≤ V _{DD1} or V _{DD2} , 0 ≤ V _{E1} , V _{E2} ≤ V _{DD1} or V _{DD2} |
| Logic High Input Threshold | V _{IH} , V _{EH} | | | | | |
| 5 V/3 V Operation | | 2.0 | | | V | |
| 3 V/5 V Operation | | 1.6 | | | V | |
| Logic Low Input Threshold | V _{IL} , V _{EL} | | | | | |
| 5 V/3 V Operation | | | | 0.8 | V | |
| 3 V/5 V Operation | | | | 0.4 | V | |
| Logic High Output Voltages | V _{OA} H, V _{OB} H, V _{OC} H | V _{DD1} , V _{DD2} - 0.1 | V _{DD1} /V _{DD2} | | V | I _{OX} = -20 μA, V _{IX} = V _{IXH} |
| | | V _{DD1} , V _{DD2} - 0.4 | V _{DD1} / V _{DD2} - 0.2 | | V | I _{OX} = -4 mA, V _{IX} = V _{IXH} |
| Logic Low Output Voltages | V _{OA} L, V _{OB} L, V _{OC} L | | 0.0 | 0.1 | V | I _{OX} = 20 μA, V _{IX} = V _{IXL} |
| | | | 0.04 | 0.1 | V | I _{OX} = 400 μA, V _{IX} = V _{IXL} |
| | | | 0.2 | 0.4 | V | I _{OX} = 4 mA, V _{IX} = V _{IXL} |
| SWITCHING SPECIFICATIONS | | | | | | |
| ADuM130xARW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 1000 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 1 | | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 50 | 70 | 100 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} - t _{PHL} ⁵ | PWD | | | 40 | ns | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 50 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching ⁷ | t _{PSKCD} /OD | | | 50 | ns | C _L = 15 pF, CMOS signal levels |
| ADuM130xBRW | | | | | | |
| Minimum Pulse Width ³ | PW | | | 100 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 10 | | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 15 | 35 | 50 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} - t _{PHL} ⁵ | PWD | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 5 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 6 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 3 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 22 | ns | C _L = 15 pF, CMOS signal levels |
| ADuM130xCRW | | | | | | |
| Minimum Pulse Width ³ | PW | | 8.3 | 11.1 | ns | C _L = 15 pF, CMOS signal levels |
| Maximum Data Rate ⁴ | | 90 | 120 | | Mbps | C _L = 15 pF, CMOS signal levels |
| Propagation Delay ⁵ | t _{PHL} , t _{PLH} | 20 | 30 | 40 | ns | C _L = 15 pF, CMOS signal levels |
| Pulse-Width Distortion, t _{PLH} - t _{PHL} ⁵ | PWD | | 0.5 | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Change vs. Temperature | | | 3 | | ps/°C | C _L = 15 pF, CMOS signal levels |
| Propagation Delay Skew ⁶ | t _{PSK} | | | 14 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Codirectional Channels ⁷ | t _{PSKCD} | | | 2 | ns | C _L = 15 pF, CMOS signal levels |
| Channel-to-Channel Matching, Opposing-Directional Channels ⁷ | t _{PSKOD} | | | 5 | ns | C _L = 15 pF, CMOS signal levels |

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|--|--------------------|-----|------|-----|-------------|---|
| For All Models | | | | | | |
| Output Disable Propagation Delay (High/Low-to-High Impedance) | t_{PHZ}, t_{PLH} | | 6 | 8 | ns | $C_L = 15$ pF, CMOS signal levels |
| Output Enable Propagation Delay (High Impedance to High/Low) | t_{PZH}, t_{PZL} | | 6 | 8 | ns | $C_L = 15$ pF, CMOS signal levels |
| Output Rise/Fall Time (10% to 90%) | t_R/t_F | | | | | $C_L = 15$ pF, CMOS signal levels |
| 5 V/3 V Operation | | | 3.0 | | ns | |
| 3 V/5 V Operation | | | 2.5 | | ns | |
| Common-Mode Transient Immunity at Logic High Output ⁸ | $ CM_H $ | 25 | 35 | | kV/ μ s | $V_{IX} = V_{DD1}/V_{DD2}$, $V_{CM} = 1000$ V, transient magnitude = 800 V |
| Common-Mode Transient Immunity at Logic Low Output ⁸ | $ CM_L $ | 25 | 35 | | kV/ μ s | $V_{IX} = 0$ V, $V_{CM} = 1000$ V, transient magnitude = 800 V |
| Refresh Rate | f_R | | | | | |
| 5 V/3 V Operation | | | 1.2 | | Mbps | |
| 3 V/5 V Operation | | | 1.1 | | Mbps | |
| Input Dynamic Supply Current, per Channel ⁹ | $I_{DDI(D)}$ | | | | | |
| 5 V/3 V Operation | | | 0.19 | | mA/Mbps | |
| 3 V/5 V Operation | | | 0.10 | | mA/Mbps | |
| Output Dynamic Supply Current, per Channel ⁹ | $I_{DDI(D)}$ | | | | | |
| 5 V/3 V Operation | | | 0.03 | | mA/Mbps | |
| 3 V/5 V Operation | | | 0.05 | | mA/Mbps | |

¹ All voltages are relative to their respective ground.

² Supply current values for all three channels are combined when running at identical data rates. Output supply current values are specified with no output load present. The supply current associated with an individual channel operating at a given data rate may be calculated as described in the Power Consumption section on Page 17. See Figure 6 through Figure 8 for information on per-channel supply current as a function of data rate for unloaded and loaded conditions. See Figure 9 through Figure 12 for total I_{DD1} and I_{DD2} supply currents as a function of data rate for ADuM1300/ADuM1301 channel configurations.

³ The minimum pulse width is the shortest pulse width at which the specified pulse-width distortion is guaranteed.

⁴ The maximum data rate is the fastest data rate at which the specified pulse-width distortion is guaranteed.

⁵ t_{PHL} propagation delay is measured from the 50% level of the falling edge of the V_{IX} signal to the 50% level of the falling edge of the V_{OX} signal. t_{PLH} propagation delay is measured from the 50% level of the rising edge of the V_{IX} signal to the 50% level of the rising edge of the V_{OX} signal.

⁶ t_{PSK} is the magnitude of the worst-case difference in t_{PHL} or t_{PLH} that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

⁷ Co-directional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on the same side of the isolation barrier. Opposing-directional channel-to-channel matching is the absolute value of the difference in propagation delays between any two channels with inputs on opposing sides of the isolation barrier.

⁸ CM_H is the maximum common-mode voltage slew rate that can be sustained while maintaining $V_O > 0.8 V_{DD2}$. CM_L is the maximum common-mode voltage slew rate that can be sustained while maintaining $V_O < 0.8$ V. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges. The transient magnitude is the range over which the common mode is slewed.

⁹ Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in signal data rate. See Figure 6 through Figure 8 for information on per-channel supply current for unloaded and loaded conditions. See the Power Consumption section on Page 17 for guidance on calculating the per-channel supply current for a given data rate.

ADuM1300/ADuM1301

PACKAGE CHARACTERISTICS

Table 4.

| Parameter | Symbol | Min | Typ | Max | Unit | Test Conditions |
|--|------------------|-----|------------------|-----|------|---|
| Resistance (Input-Output) ¹ | R _{I-O} | | 10 ¹² | | Ω | f = 1 MHz |
| Capacitance (Input-Output) ¹ | C _{I-O} | | 1.7 | | pF | |
| Input Capacitance ² | C _I | | 4.0 | | pF | |
| IC Junction-to-Case Thermal Resistance, Side 1 | θ _{JCI} | | 33 | | °C/W | Thermocouple located at center of package underside |
| IC Junction-to-Case Thermal Resistance, Side 2 | θ _{JCO} | | 28 | | °C/W | |

¹ Device considered a 2-terminal device; Pins 1, 2, 3, 4, 5, 6, 7, and 8 shorted together and Pins 9, 10, 11, 12, 13, 14, 15, and 16 shorted together.

² Input capacitance is from any input data pin to ground.

REGULATORY INFORMATION

The ADuM130x have been approved by the organizations listed in Table 5.

Table 5.

| UL | CSA | VDE |
|--|---|--|
| Recognized under 1577 component recognition program ¹ | Approved under CSA Component Acceptance Notice #5A | Certified according to DIN EN 60747-5-2 (VDE 0884 Part 2): 2003-01 ² |
| Double insulation, 2500 V rms isolation voltage | Reinforced insulation per CSA 60950-1-03 and IEC 60950-1, 400 V rms maximum working voltage | Basic insulation, 560 V peak Complies with DIN EN 60747-5-2 (VDE 0884 Part 2):2003-01, DIN EN 60950 (VDE 0805): 2001-12; EN 60950:2000 Reinforced insulation, 560 V peak |
| File E214100 | File 205078 | File 2471900-4880-0001 |

¹ In accordance with UL1577, each ADuM130x is proof tested by applying an insulation test voltage ≥ 3000 V rms for 1 second (current leakage detection limit = 5 μA).

² In accordance with DIN EN 60747-5-2, each ADuM130x is proof tested by applying an insulation test voltage ≥ 1050 V peak for 1 second (partial discharge detection limit = 5 pC). A “*” mark branded on the component designates DIN EN 60747-5-2 approval.

INSULATION AND SAFETY-RELATED SPECIFICATIONS

Table 6.

| Parameter | Symbol | Value | Unit | Conditions |
|--|--------|-----------|-------|--|
| Rated Dielectric Insulation Voltage | | 2500 | V rms | 1 minute duration |
| Minimum External Air Gap (Clearance) | L(I01) | 8.40 min | mm | Measured from input terminals to output terminals, shortest distance through air |
| Minimum External Tracking (Creepage) | L(I02) | 8.10 min | mm | Measured from input terminals to output terminals, shortest distance path along body |
| Minimum Internal Gap (Internal Clearance) | | 0.017 min | mm | Insulation distance through insulation |
| Tracking Resistance (Comparative Tracking Index) | CTI | >175 | V | DIN IEC 112/VDE 0303 Part 1 |
| Isolation Group | | IIIa | | Material Group (DIN VDE 0110, 1/89, Table 1) |

DIN EN 60747-5-2 (VDE 0884 PART 2) INSULATION CHARACTERISTICS

Table 7.

| Description | Symbol | Characteristic | Unit |
|---|------------|----------------|----------|
| Installation Classification per DIN VDE 0110 | | I–IV | |
| For Rated Mains Voltage ≤ 150 V rms | | I–III | |
| For Rated Mains Voltage ≤ 300 V rms | | I–II | |
| For Rated Mains Voltage ≤ 400 V rms | | 40/105/21 | |
| Climatic Classification | | 2 | |
| Pollution Degree (DIN VDE 0110, Table 1) | | | |
| Maximum Working Insulation Voltage | V_{IORM} | 560 | V peak |
| Input to Output Test Voltage, Method b1 | V_{PR} | 1050 | V peak |
| $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test, $t_m = 1$ sec, Partial Discharge < 5 pC | | | |
| Input to Output Test Voltage, Method a | V_{PR} | | |
| After Environmental Tests Subgroup 1 | | 896 | V peak |
| $V_{IORM} \times 1.6 = V_{PR}$, $t_m = 60$ sec, Partial Discharge < 5 pC | | | |
| After Input and/or Safety Test Subgroup 2/3 | | 672 | V peak |
| $V_{IORM} \times 1.2 = V_{PR}$, $t_m = 60$ sec, Partial Discharge < 5 pC | | | |
| Highest Allowable Overvoltage (Transient Overvoltage, $t_{TR} = 10$ sec) | V_{TR} | 4000 | V peak |
| Safety-Limiting Values (Maximum value allowed in the event of a failure; also see Thermal Derating Curve, Figure 3) | | | |
| Case Temperature | T_S | 150 | °C |
| Side 1 Current | I_{S1} | 265 | mA |
| Side 2 Current | I_{S2} | 335 | mA |
| Insulation Resistance at T_S , $V_{IO} = 500$ V | R_S | $>10^9$ | Ω |

This isolator is suitable for basic isolation only within the safety limit data. Maintenance of the safety data is ensured by protective circuits.

The * marking on packages denotes DIN EN 60747-5-2 approval for 560 V peak working voltage.

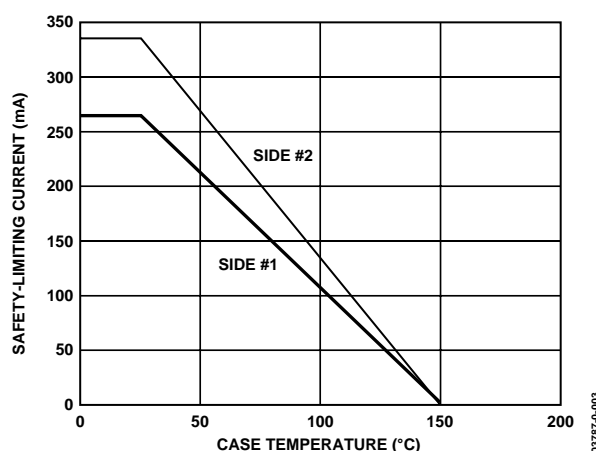


Figure 3. Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-2

RECOMMENDED OPERATION CONDITIONS

Table 8.

| Parameter | Symbol | Min | Max | Unit |
|----------------------------------|-----------------------|-----|------|------|
| Operating Temperature | T_A | -40 | +105 | °C |
| Supply Voltages ¹ | V_{DD1} , V_{DD2} | 2.7 | 5.5 | V |
| Input Signal Rise and Fall Times | | | 1.0 | ms |

¹ All voltages are relative to their respective ground.

See the DC Correctness and Magnetic Field Immunity section on Page 16 for information on immunity to external magnetic fields.

ABSOLUTE MAXIMUM RATINGS

Ambient temperature = 25°C, unless otherwise noted.

Table 9.

| Parameter | Symbol | Min | Max | Unit |
|--|--|------|-----------------|-------|
| Storage Temperature | T_{ST} | -65 | +150 | °C |
| Ambient Operating Temperature | T_A | -40 | +105 | °C |
| Supply Voltages ¹ | V_{DD1}, V_{DD2} | -0.5 | +7.0 | V |
| Input Voltage ^{1,2} | $V_{IA}, V_{IB}, V_{IC}, V_{E1}, V_{E2}$ | -0.5 | $V_{DD1} + 0.5$ | V |
| Output Voltage ^{1,2} | V_{OA}, V_{OB}, V_{OC} | -0.5 | $V_{DD0} + 0.5$ | V |
| Average Output Current, Per Pin ³ | | | | |
| Side 1 | I_{O1} | -23 | +23 | mA |
| Side 2 | I_{O2} | -30 | +30 | mA |
| Common-Mode Transients ⁴ | | -100 | +100 | kV/μs |

¹ All voltages are relative to their respective ground.

² V_{DD1} and V_{DD0} refer to the supply voltages on the input and output sides of a given channel, respectively. See PC Board Layout section.

³ See Figure 3 for maximum rated current values for various temperatures.

⁴ Refers to common-mode transients across the insulation barrier. Common-mode transients exceeding the Absolute Maximum Rating may cause latch-up or permanent damage.

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 may affect device reliability.

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.



Table 10. Truth Table (Positive Logic)

| V_{IX} Input ¹ | V_{EX} Input ² | V_{DD1} State ¹ | V_{DD0} State ¹ | V_{OX} Output ¹ | Notes |
|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|---|
| H | H or NC | Powered | Powered | H | Outputs return to the input state within 1 μs of V_{DD1} power restoration. |
| L | H or NC | Powered | Powered | L | |
| X | L | Powered | Powered | Z | |
| X | H or NC | Unpowered | Powered | H | |
| X | L | Unpowered | Powered | Z | Outputs return to the input state within 1 μs of V_{DD0} power restoration, if V_{EX} state is H or NC. Outputs returns to high impedance state within 8 ns of V_{DD0} power restoration, if V_{EX} state is L. |
| X | X | Powered | Unpowered | Indeterminate | |

¹ V_{IX} and V_{OX} refer to the input and output signals of a given channel (A, B, or C). V_{EX} refers to the output enable signal on the same side as the V_{OX} outputs. V_{DD1} and V_{DD0} refer to the supply voltages on the input and output sides of the given channel, respectively.

² In noisy environments, connecting V_{EX} to an external logic high or low is recommended.

PIN CONFIGURATIONS AND PIN FUNCTION DESCRIPTIONS

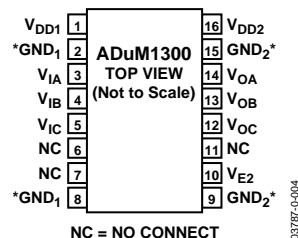


Figure 4. ADuM1300 Pin Configuration

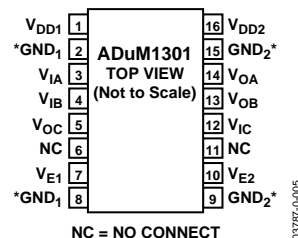


Figure 5. ADuM1301 Pin Configuration

* Pins 2 and 8 are internally connected. Connecting both to GND₁ is recommended. Pins 9 and 15 are internally connected. Connecting both to GND₂ is recommended. Output enable Pin 10 on the ADuM1300 may be left disconnected if outputs are to be always enabled. Output enable Pins 7 and 10 on the ADuM1301 may be left disconnected if outputs are to be always enabled. In noisy environments, connecting Pin 7 (for ADuM1301) and Pin 10 (for both models) to an external logic high or low is recommended.

Table 11. ADuM1300 Pin Function Descriptions

| Pin No. | Mnemonic | Function |
|---------|------------------|--|
| 1 | V _{DD1} | Supply Voltage for Isolator Side 1, 2.7 V to 5.5 V. |
| 2 | GND ₁ | Ground 1. Ground reference for isolator Side 1. |
| 3 | V _{IA} | Logic Input A. |
| 4 | V _{IB} | Logic Input B. |
| 5 | V _{IC} | Logic Input C. |
| 6 | NC | No Connect. |
| 7 | NC | No Connect. |
| 8 | GND ₁ | Ground 1. Ground Reference for Isolator Side 1. |
| 9 | GND ₂ | Ground 2. Ground Reference for Isolator Side 2. |
| 10 | V _{E2} | Output Enable 2. Active high logic input. V _{OA} , V _{OB} , and V _{OC} outputs are enabled when V _{E2} is high or disconnected. V _{OA} , V _{OB} , and V _{OC} outputs are disabled when V _{E2} is low. In noisy environments, connecting V _{E2} to an external logic high or low is recommended. |
| 11 | NC | No Connect. |
| 12 | V _{OC} | Logic Output C. |
| 13 | V _{OB} | Logic Output B. |
| 14 | V _{OA} | Logic Output A. |
| 15 | GND ₂ | Ground 2. Ground Reference for Isolator Side 2. |
| 16 | V _{DD2} | Supply Voltage for Isolator Side 2, 2.7 V to 5.5 V. |

Table 12. ADuM1301 Pin Function Descriptions

| Pin No. | Mnemonic | Function |
|---------|------------------|--|
| 1 | V _{DD1} | Supply Voltage for Isolator Side 1, 2.7 V to 5.5 V. |
| 2 | GND ₁ | Ground 1. Ground Reference for Isolator Side 1. |
| 3 | V _{IA} | Logic Input A. |
| 4 | V _{IB} | Logic Input B. |
| 5 | V _{OC} | Logic Output C. |
| 6 | NC | No Connect. |
| 7 | V _{E1} | Output Enable 1. Active high logic input. V _{OC} output is enabled when V _{E1} is high or disconnected. V _{OC} is disabled when V _{E1} is low. In noisy environments, connecting to V _{E1} to an external logic high or low is recommended. |
| 8 | GND ₁ | Ground 1. Ground Reference for Isolator Side 1. |
| 9 | GND ₂ | Ground 2. Ground Reference for Isolator Side 2. |
| 10 | V _{E2} | Output Enable 2. Active high logic input. V _{OA} and V _{OB} outputs are enabled when V _{E2} is high or disconnected. V _{OA} and V _{OB} outputs are disabled when V _{E2} is low. In noisy environments, connecting V _{E2} to an external logic high or low is recommended. |
| 11 | NC | No Connect. |
| 12 | V _{IC} | Logic Input C. |
| 13 | V _{OB} | Logic Output B. |
| 14 | V _{OA} | Logic Output A. |
| 15 | GND ₂ | Ground 2. Ground Reference for Isolator Side 2. |
| 16 | V _{DD2} | Supply Voltage for Isolator Side 2, 2.7 V to 5.5 V. |

TYPICAL PERFORMANCE CHARACTERISTICS

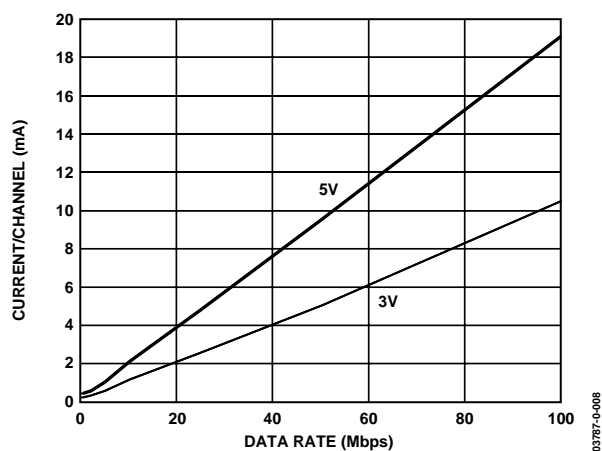


Figure 6. Typical Input Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation

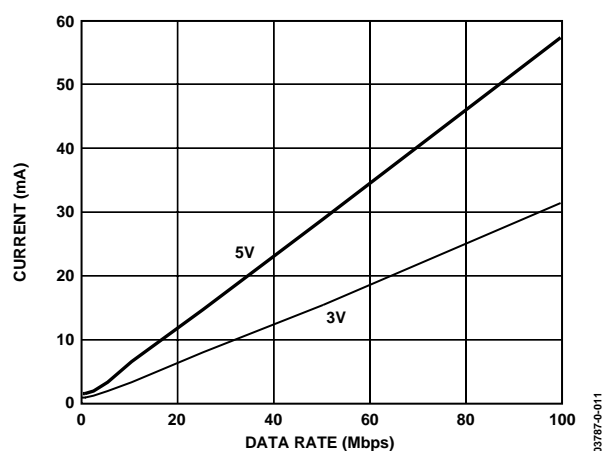


Figure 9. Typical ADuM1300 V_{DD1} Supply Current vs. Data Rate for 5 V and 3 V Operation

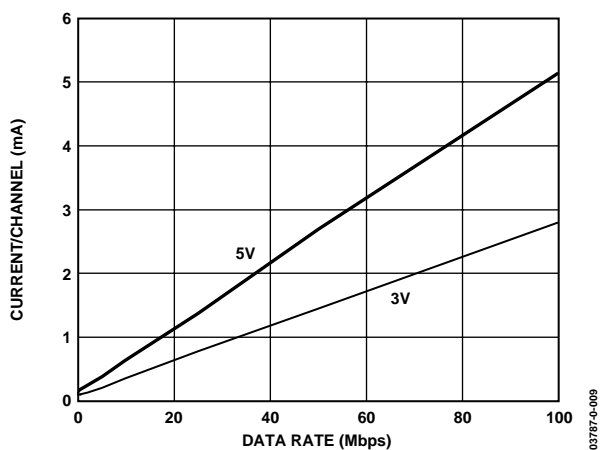


Figure 7. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (No Output Load)

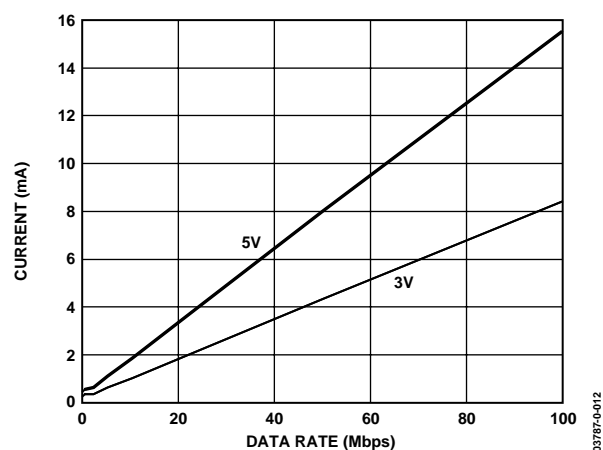


Figure 10. Typical ADuM1300 V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation

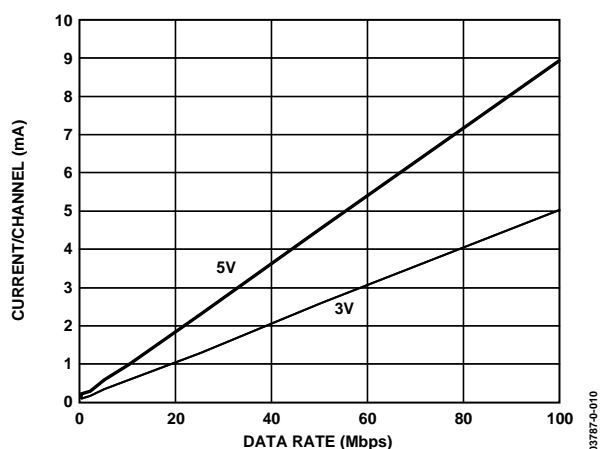


Figure 8. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (15 pF Output Load)

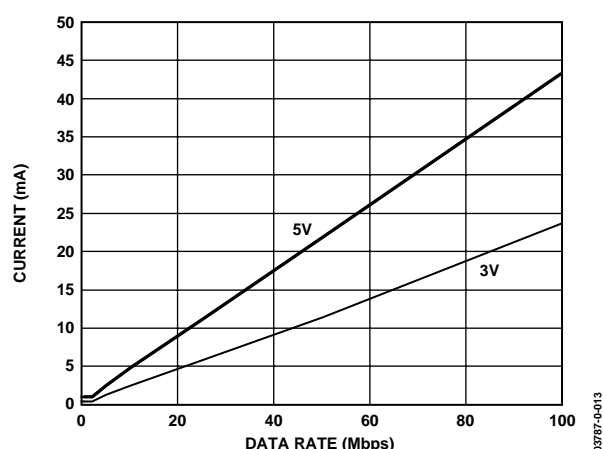


Figure 11. Typical ADuM1301 V_{DD1} Supply Current vs. Data Rate for 5 V and 3 V Operation

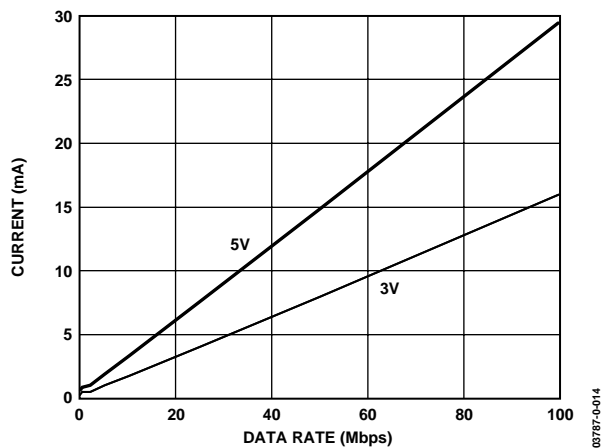


Figure 12. Typical ADuM1301 V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation

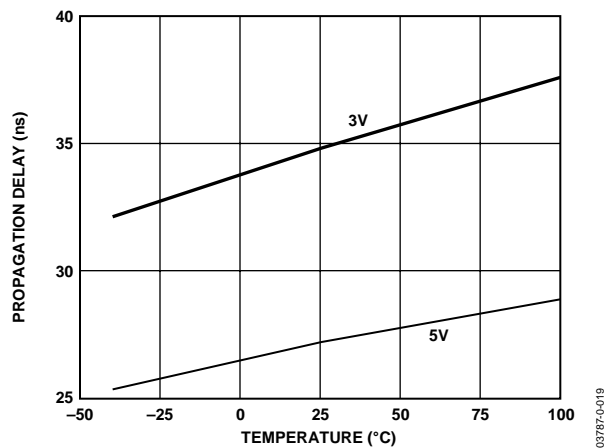


Figure 13. Propagation Delay vs. Temperature, C Grade

APPLICATION INFORMATION

PC BOARD LAYOUT

The ADuM130x digital isolator requires no external interface circuitry for the logic interfaces. Power supply bypassing is strongly recommended at the input and output supply pins (Figure 14). Bypass capacitors are most conveniently connected between Pins 1 and 2 for V_{DD1} and between Pins 15 and 16 for V_{DD2} . The capacitor value should be between 0.01 μF and 0.1 μF . The total lead length between both ends of the capacitor and the input power supply pin should not exceed 20 mm. Bypassing between Pins 1 and 8 and between Pins 9 and 16 should also be considered unless the ground pair on each package side is connected close to the package.

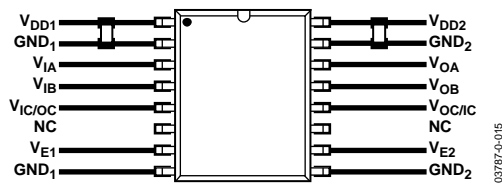


Figure 14. Recommended Printed Circuit Board Layout

In applications involving high common-mode transients, care should be taken to ensure that board coupling across the isolation barrier is minimized. Furthermore, the board layout should be designed such that any coupling that does occur equally affects all pins on a given component side. Failure to ensure this could cause voltage differentials between pins exceeding the device's Absolute Maximum Ratings, thereby leading to latch-up or permanent damage.

PROPAGATION DELAY-RELATED PARAMETERS

Propagation delay is a parameter that describes the time it takes a logic signal to propagate through a component. The propagation delay to a logic low output may differ from the propagation delay to a logic high.

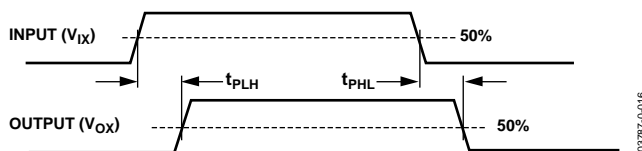


Figure 15. Propagation Delay Parameters

Pulse-width distortion is the maximum difference between these two propagation delay values and is an indication of how accurately the input signal's timing is preserved.

Channel-to-channel matching refers to the maximum amount that the propagation delay differs between channels within a single ADuM130x component.

Propagation delay skew refers to the maximum amount that the propagation delay differs between multiple ADuM130x components operating under the same conditions.

DC CORRECTNESS AND MAGNETIC FIELD IMMUNITY

Positive and negative logic transitions at the isolator input cause narrow (~ 1 ns) pulses to be sent to the decoder via the transformer. The decoder is bistable and is therefore either set or reset by the pulses, indicating input logic transitions. In the absence of logic transitions of more than 2 μs at the input, a periodic set of refresh pulses indicative of the correct input state are sent to ensure dc correctness at the output. If the decoder receives no internal pulses for more than about 5 μs , the input side is assumed to be unpowered or nonfunctional, in which case the isolator output is forced to a default state (see Table 10) by the watchdog timer circuit.

The ADuM130x is extremely immune to external magnetic fields. The limitation on the ADuM130x's magnetic field immunity is set by the condition in which induced voltage in the transformer's receiving coil is sufficiently large to either falsely set or reset the decoder. The following analysis defines the conditions under which this may occur. The 3 V operating condition of the ADuM130x is examined because it represents the most susceptible mode of operation.

The pulses at the transformer output have an amplitude greater than 1.0 V. The decoder has a sensing threshold at about 0.5 V, therefore establishing a 0.5 V margin in which induced voltages can be tolerated. The voltage induced across the receiving coil is given by

$$V = (-d\beta/dt) \sum \pi r_n^2; n = 1, 2, \dots, N$$

where:

β is magnetic flux density (gauss).

N is the number of turns in the receiving coil.

r_n is the radius of the n^{th} turn in the receiving coil (cm).

Given the geometry of the receiving coil in the ADuM130x and an imposed requirement that the induced voltage be at most 50% of the 0.5 V margin at the decoder, a maximum allowable magnetic field is calculated as shown in Figure 16.

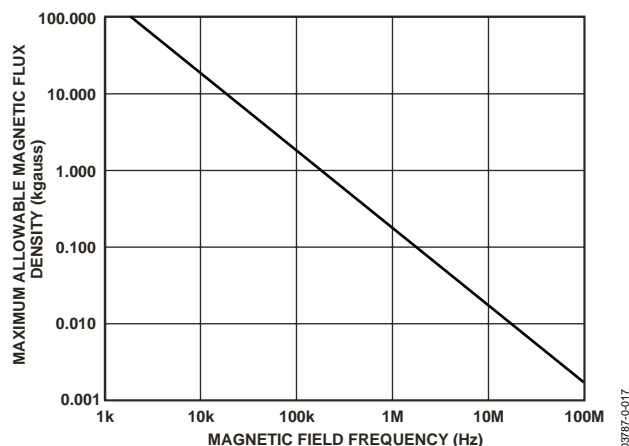


Figure 16. Maximum Allowable External Magnetic Flux Density

For example, at a magnetic field frequency of 1 MHz, the maximum allowable magnetic field of 0.2 kgauss induces a voltage of 0.25 V at the receiving coil. This is about 50% of the sensing threshold and does not cause a faulty output transition. Similarly, if such an event were to occur during a transmitted pulse (and was of the worst-case polarity), it would reduce the received pulse from > 1.0 V to 0.75 V—still well above the 0.5 V sensing threshold of the decoder.

The preceding magnetic flux density values correspond to specific current magnitudes at given distances from the ADuM130x transformers. Figure 17 expresses these allowable current magnitudes as a function of frequency for selected distances. As seen, the ADuM130x is extremely immune and can be affected only by extremely large currents operated at high frequency, very close to the component. For the 1 MHz example, one would have to place a 0.5 kA current 5 mm away from the ADuM130x to affect the component's operation.

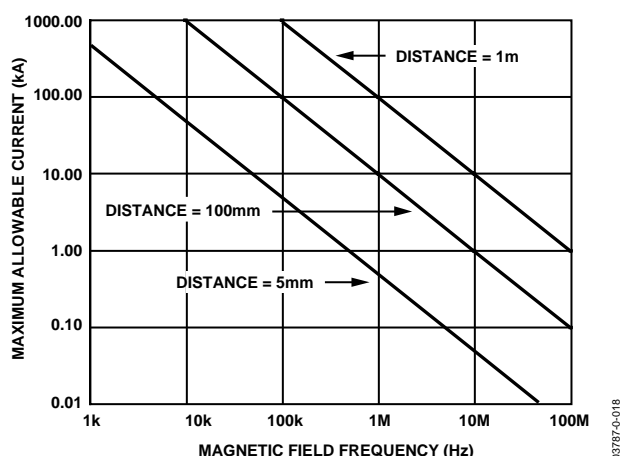


Figure 17. Maximum Allowable Current for Various Current-to-ADuM130x Spacings

Note that at combinations of strong magnetic field and high frequency, any loops formed by printed circuit board traces could induce sufficiently large error voltages to trigger the thresholds of succeeding circuitry. Care should be taken in the layout of such traces to avoid this possibility.

POWER CONSUMPTION

The supply current at a given channel of the ADuM130x isolator is a function of the supply voltage, the channel's data rate, and the channel's output load.

For each input channel, the supply current is given by

$$I_{DDI} = I_{DDI(Q)} \quad f \leq 0.5f_r$$

$$I_{DDI} = I_{DDI(D)} \times (2f - f_r) + I_{DDI(Q)} \quad f > 0.5f_r$$

For each output channel, the supply current is given by

$$I_{DDO} = I_{DDO(Q)} \quad f \leq 0.5f_r$$

$$I_{DDO} = (I_{DDO(D)} + (0.5 \times 10^{-3}) \times C_L V_{DDO}) \times (2f - f_r) + I_{DDO(Q)} \quad f > 0.5f_r$$

where:

$I_{DDI(D)}$, $I_{DDO(D)}$ are the input and output dynamic supply currents per channel (mA/Mbps).

C_L is output load capacitance (pF).

V_{DDO} is the output supply voltage (V).

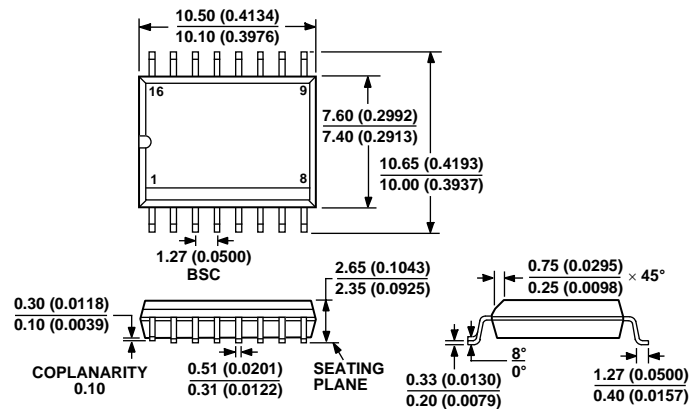
f is the input logic signal frequency (MHz, half of the input data rate, NRZ signaling).

f_r is the input stage refresh rate (Mbps).

$I_{DDI(Q)}$, $I_{DDO(Q)}$ are the specified input and output quiescent supply currents (mA).

To calculate the total I_{DD1} and I_{DD2} supply current, the supply currents for each input and output channel corresponding to I_{DD1} and I_{DD2} are calculated and totaled. Figure 6 and Figure 7 provide per-channel supply currents as a function of data rate for an unloaded output condition. Figure 8 provides per-channel supply current as a function of data rate for a 15 pF output condition. Figure 9 through Figure 12 provide total I_{DD1} and I_{DD2} supply current as a function of data rate for ADuM1300/ADuM1301 channel configurations.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-013AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 18. 16-Lead Standard Small Outline Package [SOIC]
Wide Body (RW-16)
Dimensions shown in millimeters (inches)

ORDERING GUIDE

| Model | Number of Inputs, V _{DD1} Side | Number of Inputs, V _{DD2} Side | Maximum Data Rate (Mbps) | Maximum Propagation Delay, 5 V (ns) | Maximum Pulse-Width Distortion (ns) | Temperature Range (°C) | Package Option ¹ |
|-----------------------------|---|---|--------------------------|-------------------------------------|-------------------------------------|------------------------|-----------------------------|
| ADuM1300ARW ² | 3 | 0 | 1 | 100 | 40 | –40 to +105 | RW-16 |
| ADuM1300BRW ² | 3 | 0 | 10 | 50 | 3 | –40 to +105 | RW-16 |
| ADuM1300CRW ² | 3 | 0 | 90 | 32 | 2 | –40 to +105 | RW-16 |
| ADuM1300ARWZ ^{2,3} | 3 | 0 | 1 | 100 | 40 | –40 to +105 | RW-16 |
| ADuM1300BRWZ ^{2,3} | 3 | 0 | 10 | 50 | 3 | –40 to +105 | RW-16 |
| ADuM1300CRWZ ^{2,3} | 3 | 0 | 90 | 32 | 2 | –40 to +105 | RW-16 |
| ADuM1301ARW ² | 2 | 1 | 1 | 100 | 40 | –40 to +105 | RW-16 |
| ADuM1301BRW ² | 2 | 1 | 10 | 50 | 3 | –40 to +105 | RW-16 |
| ADuM1301CRW ² | 2 | 1 | 90 | 32 | 2 | –40 to +105 | RW-16 |
| ADuM1301ARWZ ^{2,3} | 3 | 0 | 1 | 100 | 40 | –40 to +105 | RW-16 |
| ADuM1301BRWZ ^{2,3} | 3 | 0 | 10 | 50 | 3 | –40 to +105 | RW-16 |
| ADuM1301CRWZ ^{2,3} | 3 | 0 | 90 | 32 | 2 | –40 to +105 | RW-16 |

¹ RW-16 = 16-lead wide body SOIC.

² Tape and reel are available. The addition of an “-RL” suffix designates a 13” (1,000 units) tape and reel option.

³ Z = Pb-free part.

NOTES

NOTES