

### FEATURES

**Narrow body, RoHS-compliant, SOIC 8-lead package**

**Low power operation**

**5 V operation**

**1.1 mA per channel maximum @ 0 Mbps to 2 Mbps**

**3.7 mA per channel maximum @ 10 Mbps**

**8.2 mA per channel maximum @ 25 Mbps**

**3 V operation**

**0.8 mA per channel maximum @ 0 Mbps to 2 Mbps**

**2.2 mA per channel maximum @ 10 Mbps**

**4.8 mA per channel maximum @ 25 Mbps**

**Bidirectional communication**

**3 V/5 V level translation**

**High temperature operation: 105°C**

**High data rate: dc to 25 Mbps (NRZ)**

**Precise timing characteristics**

**3 ns maximum pulse width distortion**

**3 ns maximum channel-to-channel matching**

**High common-mode transient immunity: >25 kV/ $\mu$ s**

**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 V VDE V 0884-10 (VDE V 0884-10):2006-12**

**$V_{IORM} = 560$  V peak**

### APPLICATIONS

**Size-critical multichannel isolation**

**SPI® interface/data converter isolation**

**RS-232/RS-422/RS-485 transceiver isolation**

**Digital field bus isolation**

### GENERAL DESCRIPTION

The ADuM120x<sup>1</sup> are dual-channel, digital isolators based on the Analog Devices, Inc. *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 discrete components 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 ADuM120x isolators provide two independent isolation channels in a variety of channel configurations and data rates (see the Ordering Guide). Both parts 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 ADuM120x provide low pulse width distortion (<3 ns for CR grade) and tight channel-to-channel matching (<3 ns for CR grade). Unlike other optocoupler alternatives, the ADuM120x isolators have a patented refresh feature that ensures dc correctness in the absence of input logic transitions and during power-up/power-down conditions.

<sup>1</sup> Protected by U.S. Patents 5,952,849; 6,873,065; 6,903,578; and 7,075,329. Other patents are pending.

### FUNCTIONAL BLOCK DIAGRAMS

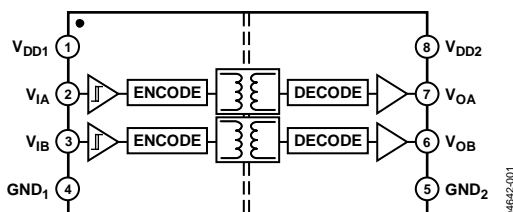


Figure 1. ADuM1200 Functional Block Diagram

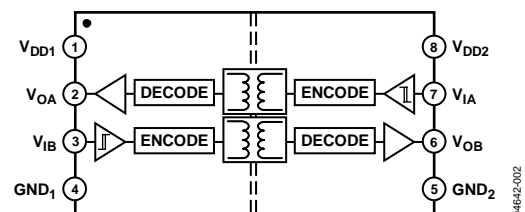


Figure 2. ADuM1201 Functional Block Diagram

### Rev. E

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## REVISION HISTORY

### 11/07—Rev. D to Rev. E

Changes to Note 1.....	1
Added ADuM120xAR Change vs. Temperature Parameter.....	3
Added ADuM120xAR Change vs. Temperature Parameter.....	5
Added ADuM120xAR Change vs. Temperature Parameter.....	8

### 8/07—Rev. C to Rev. D

Updated VDE Certification Throughout .....	1
Changes to Features, Note 1, Figure 1, and Figure 2.....	1
Changes to Table 3.....	7
Changes to Regulatory Information Section .....	10
Added Table 10 .....	12
Added Insulation Lifetime Section .....	16
Updated Outline Dimensions .....	18
Changes to Ordering Guide .....	18

### 2/06—Rev. B to Rev. C

Updated Format.....	Universal
Added Note 1 .....	1
Changes to Absolute Maximum Ratings.....	12
Changes to DC Correctness and Magnetic Field	
Immunity Section.....	15

### 9/04—Rev. A to Rev. B

Changes to Table 5.....	10
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### 6/04—Rev. 0 to Rev. A

Changes to Format .....	Universal
Changes to General Description .....	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

### 4/04—Revision 0: Initial Version

# SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS—5 V OPERATION

All voltages are relative to their respective ground.  $4.5\text{ V} \leq V_{DD1} \leq 5.5\text{ V}$ ,  $4.5\text{ V} \leq V_{DD2} \leq 5.5\text{ V}$ . All minimum/maximum specifications apply over the entire recommended operating range, unless otherwise noted. All typical specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{DD1} = V_{DD2} = 5\text{ V}$ .

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
<b>DC SPECIFICATIONS</b>						
Input Supply Current per Channel, Quiescent	$I_{DD1(Q)}$		0.50	0.60	mA	
Output Supply Current per Channel, Quiescent	$I_{DDO(Q)}$		0.19	0.25	mA	
ADuM1200 Total Supply Current, Two Channels <sup>1</sup>						
DC to 2 Mbps						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$		1.1	1.4	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$		0.5	0.8	mA	DC to 1 MHz logic signal freq.
10 Mbps (BR and CR Grades Only)						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$		4.3	5.5	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$		1.3	2.0	mA	5 MHz logic signal freq.
25 Mbps (CR Grade Only)						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$		10	13	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$		2.8	3.4	mA	12.5 MHz logic signal freq.
ADuM1201 Total Supply Current, Two Channels <sup>1</sup>						
DC to 2 Mbps						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$		0.8	1.1	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$		0.8	1.1	mA	DC to 1 MHz logic signal freq.
10 Mbps (BR and CR Grades Only)						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$		2.8	3.5	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$		2.8	3.5	mA	5 MHz logic signal freq.
25 Mbps (CR Grade Only)						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$		6.3	8.0	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$		6.3	8.0	mA	12.5 MHz logic signal freq.
For All Models						
Input Currents	$I_{IA}, I_{IB}$	-10	+0.01	+10	$\mu\text{A}$	$0\text{ V} \leq V_{IA}, V_{IB} \leq V_{DD1}$ or $V_{DD2}$
Logic High Input Threshold	$V_{IH}$	$0.7(V_{DD1}$ or $V_{DD2})$			V	
Logic Low Input Threshold	$V_{IL}$			$0.3(V_{DD1}$ or $V_{DD2})$	V	
Logic High Output Voltages	$V_{OAH}$	$(V_{DD1}$ or $V_{DD2}) - 0.1$	5.0		V	$I_{OX} = -20\ \mu\text{A}$ , $V_{IX} = V_{IXH}$
	$V_{OBH}$	$(V_{DD1}$ or $V_{DD2}) - 0.5$	4.8		V	$I_{OX} = -4\ \text{mA}$ , $V_{IX} = V_{IXH}$
Logic Low Output Voltages	$V_{OAL}$		0.0	0.1	V	$I_{OX} = 20\ \mu\text{A}$ , $V_{IX} = V_{IXL}$
	$V_{OBL}$		0.04	0.1	V	$I_{OX} = 400\ \mu\text{A}$ , $V_{IX} = V_{IXL}$
			0.2	0.4	V	$I_{OX} = 4\ \text{mA}$ , $V_{IX} = V_{IXL}$
<b>SWITCHING SPECIFICATIONS</b>						
ADuM120xAR						
Minimum Pulse Width <sup>2</sup>	PW			1000	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Maximum Data Rate <sup>3</sup>		1			Mbps	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay <sup>4</sup>	$t_{PHL}, t_{PLH}$	50		150	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Pulse Width Distortion, $ t_{PLH} - t_{PHL} $ <sup>4</sup>	PWD			40	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Change vs. Temperature			11		ps/ $^\circ\text{C}$	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay Skew <sup>5</sup>	$t_{PSK}$			100	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching <sup>6</sup>	$t_{PSKCD}/t_{PSKOD}$			50	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Output Rise/Fall Time (10% to 90%)	$t_R/t_F$		10		ns	$C_L = 15\ \text{pF}$ , CMOS signal levels

# ADuM1200/ADuM1201

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
ADuM120xBR						
Minimum Pulse Width <sup>2</sup>	PW			100	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Maximum Data Rate <sup>3</sup>		10			Mbps	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay <sup>4</sup>	t <sub>PHL</sub> , t <sub>PLH</sub>	20		50	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Pulse Width Distortion,  t <sub>PLH</sub> – t <sub>PHL</sub>    <sup>4</sup>	PWD			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Change vs. Temperature			5		ps/°C	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay Skew <sup>5</sup>	t <sub>PSK</sub>			15	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	t <sub>PSKCD</sub>			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	t <sub>PSKOD</sub>			15	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Output Rise/Fall Time (10% to 90%)	t <sub>R</sub> /t <sub>F</sub>		2.5		ns	C <sub>L</sub> = 15 pF, CMOS signal levels
ADuM120xCR						
Minimum Pulse Width <sup>2</sup>	PW		20	40	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Maximum Data Rate <sup>3</sup>		25	50		Mbps	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay <sup>4</sup>	t <sub>PHL</sub> , t <sub>PLH</sub>	20		45	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Pulse Width Distortion,  t <sub>PLH</sub> – t <sub>PHL</sub>    <sup>4</sup>	PWD			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Change vs. Temperature			5		ps/°C	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay Skew <sup>5</sup>	t <sub>PSK</sub>			15	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	t <sub>PSKCD</sub>			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	t <sub>PSKOD</sub>			15	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Output Rise/Fall Time (10% to 90%)	t <sub>R</sub> /t <sub>F</sub>		2.5		ns	C <sub>L</sub> = 15 pF, CMOS signal levels
For All Models						
Common-Mode Transient Immunity at Logic High Output <sup>7</sup>	CM <sub>H</sub>	25	35		kV/μs	V <sub>ix</sub> = V <sub>DD1</sub> or V <sub>DD2</sub> , V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Common-Mode Transient Immunity at Logic Low Output <sup>7</sup>	CM <sub>L</sub>	25	35		kV/μs	V <sub>ix</sub> = 0 V, V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Refresh Rate	f <sub>r</sub>		1.2		Mbps	
Input Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDI (D)</sub>		0.19		mA/Mbps	
Output Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDO (D)</sub>		0.05		mA/Mbps	

<sup>1</sup> The supply current values are for both channels 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. 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 11 for total V<sub>DD1</sub> and V<sub>DD2</sub> supply currents as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

<sup>2</sup> The minimum pulse width is the shortest pulse width at which the specified pulse width distortion is guaranteed.

<sup>3</sup> The maximum data rate is the fastest data rate at which the specified pulse width distortion is guaranteed.

<sup>4</sup> t<sub>PHL</sub> propagation delay is measured from the 50% level of the falling edge of the V<sub>ix</sub> signal to the 50% level of the falling edge of the V<sub>ox</sub> signal. t<sub>PLH</sub> propagation delay is measured from the 50% level of the rising edge of the V<sub>ix</sub> signal to the 50% level of the rising edge of the V<sub>ox</sub> signal.

<sup>5</sup> t<sub>PSK</sub> is the magnitude of the worst-case difference in t<sub>PHL</sub> and/or t<sub>PLH</sub> that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

<sup>6</sup> 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.

<sup>7</sup> CM<sub>H</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>o</sub> > 0.8 V<sub>DD2</sub>. CM<sub>L</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>o</sub> < 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.

<sup>8</sup> Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in the signal data rate. 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 the Power Consumption section for guidance on calculating per-channel supply current for a given data rate.

**ELECTRICAL CHARACTERISTICS—3 V OPERATION**

All voltages are relative to their respective ground.  $2.7\text{ V} \leq V_{DD1} \leq 3.6\text{ V}$ ,  $2.7\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$ . All minimum/maximum specifications apply over the entire recommended operating 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
<b>DC SPECIFICATIONS</b>						
Input Supply Current per Channel, Quiescent	$I_{DD1(Q)}$		0.26	0.35	mA	
Output Supply Current per Channel, Quiescent	$I_{DDO(Q)}$		0.11	0.20	mA	
ADuM1200 Total Supply Current, Two Channels <sup>1</sup>						
DC to 2 Mbps						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$		0.6	1.0	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$		0.2	0.6	mA	DC to 1 MHz logic signal freq.
10 Mbps (BR and CR Grades Only)						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$		2.2	3.4	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$		0.7	1.1	mA	5 MHz logic signal freq.
25 Mbps (CR Grade Only)						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$		5.2	7.7	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$		1.5	2.0	mA	12.5 MHz logic signal freq.
ADuM1201 Total Supply Current, Two Channels <sup>1</sup>						
DC to 2 Mbps						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$		0.4	0.8	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$		0.4	0.8	mA	DC to 1 MHz logic signal freq.
10 Mbps (BR and CR Grades Only)						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$		1.5	2.2	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$		1.5	2.2	mA	5 MHz logic signal freq.
25 Mbps (CR Grade Only)						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$		3.4	4.8	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$		3.4	4.8	mA	12.5 MHz logic signal freq.
For All Models						
Input Currents	$I_{IA}, I_{IB}$	-10	+0.01	+10	$\mu\text{A}$	$0\text{ V} \leq V_{IA}, V_{IB} \leq V_{DD1}$ or $V_{DD2}$
Logic High Input Threshold	$V_{IH}$	0.7 ( $V_{DD1}$ or $V_{DD2}$ )			V	
Logic Low Input Threshold	$V_{IL}$			0.3 ( $V_{DD1}$ or $V_{DD2}$ )		
Logic High Output Voltages						
	$V_{OAH}$	$(V_{DD1}$ or $V_{DD2}) - 0.1$	3.0		V	$I_{Ox} = -20\ \mu\text{A}$ , $V_{Ix} = V_{IxH}$
	$V_{OBH}$	$(V_{DD1}$ or $V_{DD2}) - 0.5$	2.8		V	$I_{Ox} = -4\ \text{mA}$ , $V_{Ix} = V_{IxH}$
Logic Low Output Voltages						
	$V_{OAL}$		0.0	0.1	V	$I_{Ox} = 20\ \mu\text{A}$ , $V_{Ix} = V_{IxL}$
	$V_{OBL}$		0.04	0.1	V	$I_{Ox} = 400\ \mu\text{A}$ , $V_{Ix} = V_{IxL}$
			0.2	0.4	V	$I_{Ox} = 4\ \text{mA}$ , $V_{Ix} = V_{IxL}$
<b>SWITCHING SPECIFICATIONS</b>						
ADuM120xAR						
Minimum Pulse Width <sup>2</sup>	PW			1000	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Maximum Data Rate <sup>3</sup>		1			Mbps	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay <sup>4</sup>	$t_{PHL}, t_{PLH}$	50		150	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Pulse Width Distortion, $ t_{PLH} - t_{PHL} $ <sup>4</sup>	PWD			40	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Change vs. Temperature			11		ps/ $^\circ\text{C}$	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay Skew <sup>5</sup>	$t_{PSK}$			100	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching <sup>6</sup>	$t_{PSKCD}/t_{PSKOD}$			50	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Output Rise/Fall Time (10% to 90%)	$t_R/t_F$		10		ns	$C_L = 15\ \text{pF}$ , CMOS signal levels

# ADuM1200/ADuM1201

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
ADuM120xBR						
Minimum Pulse Width <sup>2</sup>	PW			100	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Maximum Data Rate <sup>3</sup>		10			Mbps	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay <sup>4</sup>	t <sub>PHL</sub> , t <sub>PLH</sub>	20		60	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Pulse Width Distortion,  t <sub>PLH</sub> - t <sub>PHL</sub>   <sup>4</sup>	PWD			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Change vs. Temperature			5		ps/°C	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay Skew <sup>5</sup>	t <sub>PSK</sub>			22	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	t <sub>PSKCD</sub>			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	t <sub>PSKOD</sub>			22	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Output Rise/Fall Time (10% to 90%)	t <sub>R</sub> /t <sub>F</sub>		3.0		ns	C <sub>L</sub> = 15 pF, CMOS signal levels
ADuM120xCR						
Minimum Pulse Width <sup>2</sup>	PW		20	40	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Maximum Data Rate <sup>3</sup>		25	50		Mbps	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay <sup>4</sup>	t <sub>PHL</sub> , t <sub>PLH</sub>	20		55	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Pulse Width Distortion,  t <sub>PLH</sub> - t <sub>PHL</sub>   <sup>4</sup>	PWD			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Change vs. Temperature			5		ps/°C	C <sub>L</sub> = 15 pF, CMOS signal levels
Propagation Delay Skew <sup>5</sup>	t <sub>PSK</sub>			16	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	t <sub>PSKCD</sub>			3	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	t <sub>PSKOD</sub>			16	ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Output Rise/Fall Time (10% to 90%)	t <sub>R</sub> /t <sub>F</sub>		3.0		ns	C <sub>L</sub> = 15 pF, CMOS signal levels
For All Models						
Common-Mode Transient Immunity at Logic High Output <sup>7</sup>	CM <sub>H</sub>	25	35		kV/μs	V <sub>IX</sub> = V <sub>DD1</sub> or V <sub>DD2</sub> , V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Common-Mode Transient Immunity at Logic Low Output <sup>7</sup>	CM <sub>L</sub>	25	35		kV/μs	V <sub>IX</sub> = 0 V, V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Refresh Rate	f <sub>r</sub>		1.1		Mbps	
Input Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDI (D)</sub>		0.10		mA/Mbps	
Output Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDO (D)</sub>		0.03		mA/Mbps	

<sup>1</sup> The supply current values are for both channels 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. 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 11 for total V<sub>DD1</sub> and V<sub>DD2</sub> supply currents as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

<sup>2</sup> The minimum pulse width is the shortest pulse width at which the specified pulse width distortion is guaranteed.

<sup>3</sup> The maximum data rate is the fastest data rate at which the specified pulse width distortion is guaranteed.

<sup>4</sup> t<sub>PHL</sub> propagation delay is measured from the 50% level of the falling edge of the V<sub>ix</sub> signal to the 50% level of the falling edge of the V<sub>ox</sub> signal. t<sub>PLH</sub> propagation delay is measured from the 50% level of the rising edge of the V<sub>ix</sub> signal to the 50% level of the rising edge of the V<sub>ox</sub> signal.

<sup>5</sup> t<sub>PSK</sub> is the magnitude of the worst-case difference in t<sub>PHL</sub> and/or t<sub>PLH</sub> that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

<sup>6</sup> 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.

<sup>7</sup> CM<sub>H</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>O</sub> > 0.8 V<sub>DD2</sub>. CM<sub>L</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>O</sub> < 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.

<sup>8</sup> Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in the signal data rate. 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 the Power Consumption section for guidance on calculating per-channel supply current for a given data rate.

**ELECTRICAL CHARACTERISTICS—MIXED 5 V/3 V OR 3 V/5 V OPERATION**

All voltages are relative to their respective ground. 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 minimum/maximum specifications apply over the entire recommended operating range, unless otherwise noted. All typical specifications are at  $T_A = 25^\circ\text{C}$ ;  $V_{DD1} = 3.0\text{ V}$ ,  $V_{DD2} = 5.0\text{ V}$ ; or  $V_{DD1} = 5.0\text{ V}$ ,  $V_{DD2} = 3.0\text{ V}$ .

**Table 3.**

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
<b>DC SPECIFICATIONS</b>						
Input Supply Current per Channel, Quiescent	$I_{DD1(Q)}$					
5 V/3 V Operation			0.50	0.6	mA	
3 V/5 V Operation			0.26	0.35	mA	
Output Supply Current per Channel, Quiescent	$I_{DDO(Q)}$					
5 V/3 V Operation			0.11	0.20	mA	
3 V/5 V Operation			0.19	0.25	mA	
<b>ADuM1200 Total Supply Current, Two Channels<sup>1</sup></b>						
<b>DC to 2 Mbps</b>						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$					
5 V/3 V Operation			1.1	1.4	mA	DC to 1 MHz logic signal freq.
3 V/5 V Operation			0.6	1.0	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$					
5 V/3 V Operation			0.2	0.6	mA	DC to 1 MHz logic signal freq.
3 V/5 V Operation			0.5	0.8	mA	DC to 1 MHz logic signal freq.
<b>10 Mbps (BR and CR Grades Only)</b>						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$					
5 V/3 V Operation			4.3	5.5	mA	5 MHz logic signal freq.
3 V/5 V Operation			2.2	3.4	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$					
5 V/3 V Operation			0.7	1.1	mA	5 MHz logic signal freq.
3 V/5 V Operation			1.3	2.0	mA	5 MHz logic signal freq.
<b>25 Mbps (CR Grade Only)</b>						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$					
5 V/3 V Operation			10	13	mA	12.5 MHz logic signal freq.
3 V/5 V Operation			5.2	7.7	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$					
5 V/3 V Operation			1.5	2.0	mA	12.5 MHz logic signal freq.
3 V/5 V Operation			2.8	3.4	mA	12.5 MHz logic signal freq.
<b>ADuM1201 Total Supply Current, Two Channels<sup>1</sup></b>						
<b>DC to 2 Mbps</b>						
$V_{DD1}$ Supply Current	$I_{DD1(Q)}$					
5 V/3 V Operation			0.8	1.1	mA	DC to 1 MHz logic signal freq.
3 V/5 V Operation			0.4	0.8	mA	DC to 1 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(Q)}$					
5 V/3 V Operation			0.4	0.8	mA	DC to 1 MHz logic signal freq.
3 V/5 V Operation			0.8	1.1	mA	DC to 1 MHz logic signal freq.
<b>10 Mbps (BR and CR Grades Only)</b>						
$V_{DD1}$ Supply Current	$I_{DD1(10)}$					
5 V/3 V Operation			2.8	3.5	mA	5 MHz logic signal freq.
3 V/5 V Operation			1.5	2.2	mA	5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(10)}$					
5 V/3 V Operation			1.5	2.2	mA	5 MHz logic signal freq.
3 V/5 V Operation			2.8	3.5	mA	5 MHz logic signal freq.
<b>25 Mbps (CR Grade Only)</b>						
$V_{DD1}$ Supply Current	$I_{DD1(25)}$					
5 V/3 V Operation			6.3	8.0	mA	12.5 MHz logic signal freq.
3 V/5 V Operation			3.4	4.8	mA	12.5 MHz logic signal freq.
$V_{DD2}$ Supply Current	$I_{DD2(25)}$					
5 V/3 V Operation			3.4	4.8	mA	12.5 MHz logic signal freq.
3 V/5 V Operation			6.3	8.0	mA	12.5 MHz logic signal freq.

# ADuM1200/ADuM1201

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
For All Models						
Input Currents	$I_{IA}, I_{IB}$	-10	+0.01	+10	$\mu\text{A}$	$0\text{ V} \leq V_{IA}, V_{IB} \leq V_{DD1}$ or $V_{DD2}$
Logic High Input Threshold	$V_{IH}$	0.7 ( $V_{DD1}$ or $V_{DD2}$ )			V	
Logic Low Input Threshold	$V_{IL}$			0.3 ( $V_{DD1}$ or $V_{DD2}$ )	V	
Logic High Output Voltages	$V_{OAH}, V_{OBH}$	( $V_{DD1}$ or $V_{DD2}$ ) - 0.1	( $V_{DD1}$ or $V_{DD2}$ )		V	$I_{OX} = -20\ \mu\text{A}, V_{IX} = V_{IXH}$
		( $V_{DD1}$ or $V_{DD2}$ ) - 0.5	( $V_{DD1}$ or $V_{DD2}$ ) - 0.2		V	$I_{OX} = -4\ \text{mA}, V_{IX} = V_{IXH}$
Logic Low Output Voltages	$V_{OAL}, V_{OBL}$		0.0	0.1	V	$I_{OX} = 20\ \mu\text{A}, V_{IX} = V_{IXL}$
			0.04	0.1	V	$I_{OX} = 400\ \mu\text{A}, V_{IX} = V_{IXL}$
			0.2	0.4	V	$I_{OX} = 4\ \text{mA}, V_{IX} = V_{IXL}$
<b>SWITCHING SPECIFICATIONS</b>						
ADuM120xAR						
Minimum Pulse Width <sup>2</sup>	PW			1000	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Maximum Data Rate <sup>3</sup>		1			Mbps	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay <sup>4</sup>	$t_{PHL}, t_{PLH}$	50		150	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Pulse Width Distortion, $ t_{PLH} - t_{PHL} ^4$	PWD			40	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Change vs. Temperature			11		ps/°C	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay Skew <sup>5</sup>	$t_{PSK}$			50	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching <sup>6</sup>	$t_{PSKCD}/t_{PSKOD}$			50	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Output Rise/Fall Time (10% to 90%)	$t_R/t_F$		10		ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
ADuM120xBR						
Minimum Pulse Width <sup>2</sup>	PW			100	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Maximum Data Rate <sup>3</sup>		10			Mbps	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay <sup>4</sup>	$t_{PHL}, t_{PLH}$	15		55	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Pulse Width Distortion, $ t_{PLH} - t_{PHL} ^4$	PWD			3	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Change vs. Temperature			5		ps/°C	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay Skew <sup>5</sup>	$t_{PSK}$			22	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	$t_{PSKCD}$			3	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	$t_{PSKOD}$			22	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Output Rise/Fall Time 10% to 90%)	$t_R/t_F$					$C_L = 15\ \text{pF}$ , CMOS signal levels
5 V/3 V Operation			3.0		ns	
3 V/5 V Operation			2.5		ns	
ADuM120xCR						
Minimum Pulse Width <sup>2</sup>	PW		20	40	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Maximum Data Rate <sup>3</sup>		25	50		Mbps	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay <sup>4</sup>	$t_{PHL}, t_{PLH}$	20		50	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Pulse Width Distortion, $ t_{PLH} - t_{PHL} ^4$	PWD			3	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Change vs. Temperature			5		ps/°C	$C_L = 15\ \text{pF}$ , CMOS signal levels
Propagation Delay Skew <sup>5</sup>	$t_{PSK}$			15	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching, Codirectional Channels <sup>6</sup>	$t_{PSKCD}$			3	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Channel-to-Channel Matching, Opposing Directional Channels <sup>6</sup>	$t_{PSKOD}$			15	ns	$C_L = 15\ \text{pF}$ , CMOS signal levels
Output Rise/Fall Time (10% to 90%)	$t_R/t_F$					$C_L = 15\ \text{pF}$ , CMOS signal levels
5 V/3 V Operation			3.0		ns	
3 V/5 V Operation			2.5		ns	



Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
For All Models						
Common-Mode Transient Immunity at Logic High Output <sup>7</sup>	CM <sub>H</sub>	25	35		kV/μs	V <sub>ix</sub> = V <sub>DD1</sub> or V <sub>DD2</sub> , V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Common-Mode Transient Immunity at Logic Low Output <sup>7</sup>	CM <sub>L</sub>	25	35		kV/μs	V <sub>ix</sub> = 0 V, V <sub>CM</sub> = 1000 V, transient magnitude = 800 V
Refresh Rate	f <sub>r</sub>					
5 V/3 V Operation			1.2		Mbps	
3 V/5 V Operation			1.1		Mbps	
Input Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDI (D)</sub>					
5 V/3 V Operation			0.19		mA/Mbps	
3 V/5 V Operation			0.10		mA/Mbps	
Output Dynamic Supply Current per Channel <sup>8</sup>	I <sub>DDO (D)</sub>					
5 V/3 V Operation			0.03		mA/Mbps	
3 V/5 V Operation			0.05		mA/Mbps	

<sup>1</sup> The supply current values are for both channels 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. 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 11 for total V<sub>DD1</sub> and V<sub>DD2</sub> supply currents as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

<sup>2</sup> The minimum pulse width is the shortest pulse width at which the specified pulse width distortion is guaranteed.

<sup>3</sup> The maximum data rate is the fastest data rate at which the specified pulse width distortion is guaranteed.

<sup>4</sup> t<sub>PHL</sub> propagation delay is measured from the 50% level of the falling edge of the V<sub>ix</sub> signal to the 50% level of the falling edge of the V<sub>Ox</sub> signal. t<sub>PLH</sub> propagation delay is measured from the 50% level of the rising edge of the V<sub>ix</sub> signal to the 50% level of the rising edge of the V<sub>Ox</sub> signal.

<sup>5</sup> t<sub>PSK</sub> is the magnitude of the worst-case difference in t<sub>PHL</sub> and/or t<sub>PLH</sub> that is measured between units at the same operating temperature, supply voltages, and output load within the recommended operating conditions.

<sup>6</sup> 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.

<sup>7</sup> CM<sub>H</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>O</sub> > 0.8 V<sub>DD2</sub>. CM<sub>L</sub> is the maximum common-mode voltage slew rate that can be sustained while maintaining V<sub>O</sub> < 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.

<sup>8</sup> Dynamic supply current is the incremental amount of supply current required for a 1 Mbps increase in the signal data rate. 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 the Power Consumption section for guidance on calculating per-channel supply current for a given data rate.

# ADuM1200/ADuM1201

## PACKAGE CHARACTERISTICS

Table 4.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Resistance (Input-to-Output) <sup>1</sup>	R <sub>I-O</sub>		10 <sup>12</sup>		Ω	f = 1 MHz
Capacitance (Input-to-Output) <sup>1</sup>	C <sub>I-O</sub>		1.0		pF	
Input Capacitance	C <sub>I</sub>		4.0		pF	Thermocouple located at center of package underside
IC Junction-to-Case Thermal Resistance, Side 1	θ <sub>JCI</sub>		46		°C/W	
IC Junction-to-Case Thermal Resistance, Side 2	θ <sub>JCO</sub>		41		°C/W	

<sup>1</sup> The device is considered a 2-terminal device; Pin 1, Pin 2, Pin 3, and Pin 4 are shorted together, and Pin 5, Pin 6, Pin 7, and Pin 8 are shorted together.

## REGULATORY INFORMATION

The ADuM1200/ADuM1201 are approved by the organizations listed in Table 5. Refer to Table 10 and the Insulation Lifetime section for details regarding recommended maximum working voltages for specific cross-isolation waveforms and insulation levels.

Table 5.

UL	CSA	VDE
Recognized Under 1577 Component Recognition Program <sup>1</sup> Single/Basic 2500 V rms Isolation Voltage	Approved under CSA Component Acceptance Notice #5A Basic insulation per CSA 60950-1-03 and IEC 60950-1, 400 V rms (566 peak) maximum working voltage Functional insulation per CSA 60950-1-03 and IEC 60950-1, 800 V rms (1131 V peak) maximum working voltage	Certified according to DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 <sup>2</sup> Reinforced insulation, 560 V peak
File E214100	File 205078	File 2471900-4880-0001

<sup>1</sup> In accordance with UL 1577, each ADuM120x is proof tested by applying an insulation test voltage ≥ 3000 V rms for 1 second (current leakage detection limit = 5 μA).

<sup>2</sup> In accordance with DIN V VDE V 0884-10, each ADuM120x is proof tested by applying an insulation test voltage ≥ 1050 V peak for 1 sec (partial discharge detection limit = 5 pC). The \* marking branded on the component designates DIN V VDE V 0884-10 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)	4.90 min	mm	Measured from input terminals to output terminals, shortest distance through air
Minimum External Tracking (Creepage)	L(I02)	4.01 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 V VDE V 0884-10 (VDE V 0884-10):2006-12 INSULATION CHARACTERISTICS**

This isolator is suitable for reinforced isolation, only within the safety limit data. Maintenance of the safety data is ensured by protective circuits. Note that the \* marking on the package denotes DIN V VDE V 0884-10 approval for a 560 V peak working voltage.

**Table 7.**

Description	Conditions	Symbol	Characteristic	Unit
Installation Classification per DIN VDE 0110 For Rated Mains Voltage ≤ 150 V rms For Rated Mains Voltage ≤ 300 V rms For Rated Mains Voltage ≤ 400 V rms			I to IV I to III I to II	
Climatic Classification			40/105/21	
Pollution Degree per DIN VDE 0110, Table 1			2	
Maximum Working Insulation Voltage		$V_{IORM}$	560	V peak
Input-to-Output Test Voltage, Method B1	$V_{IORM} \times 1.875 = V_{PR}$ , 100% production test, $t_m = 1$ sec, partial discharge < 5 pC	$V_{PR}$	1050	V peak
Input-to-Output Test Voltage, Method A	$V_{IORM} \times 1.6 = V_{PR}$ , $t_m = 60$ sec, partial discharge < 5 pC	$V_{PR}$		
After Environmental Tests Subgroup 1			896	V peak
After Input and/or Safety Test Subgroup 2 and Subgroup 3	$V_{IORM} \times 1.2 = V_{PR}$ , $t_m = 60$ sec, partial discharge < 5 pC		672	V peak
Highest Allowable Overvoltage	Transient overvoltage, $t_{TR} = 10$ seconds	$V_{TR}$	4000	V peak
Safety-Limiting Values	Maximum value allowed in the event of a failure (see Figure 3)			
Case Temperature		$T_S$	150	°C
Side 1 Current		$I_{S1}$	160	mA
Side 2 Current		$I_{S2}$	170	mA
Insulation Resistance at $T_S$	$V_{IO} = 500$ V	$R_S$	>10 <sup>9</sup>	Ω

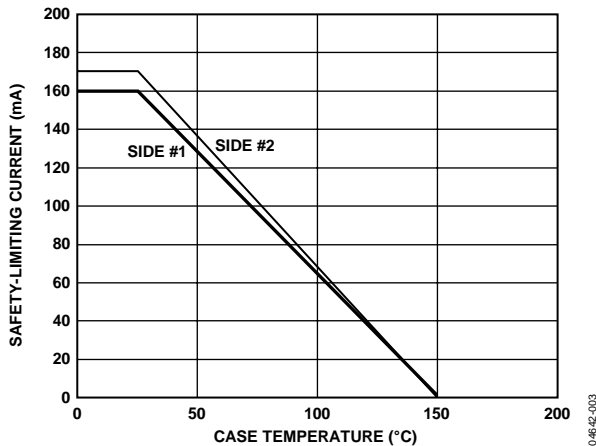


Figure 3. Thermal Derating Curve, Dependence of Safety-Limiting Values on Case Temperature per DIN V VDE V 0884-10

**RECOMMENDED OPERATING CONDITIONS**

**Table 8.**

Parameter	Rating
Operating Temperature ( $T_A$ )	-40°C to +105°C
Supply Voltages ( $V_{DD1}$ , $V_{DD2}$ ) <sup>1</sup>	2.7 V to 5.5 V
Input Signal Rise and Fall Times	1.0 ms

<sup>1</sup> All voltages are relative to their respective ground. See the DC Correctness and Magnetic Field Immunity section for information on immunity to external magnetic fields.

# ADuM1200/ADuM1201

## ABSOLUTE MAXIMUM RATINGS

Ambient temperature = 25°C, unless otherwise noted.

Table 9.

Parameter	Rating
Storage Temperature (T <sub>ST</sub> )	-55°C to +150°C
Ambient Operating Temperature (T <sub>A</sub> )	-40°C to +105°C
Supply Voltages (V <sub>DD1</sub> , V <sub>DD2</sub> ) <sup>1</sup>	-0.5 V to +7.0 V
Input Voltages (V <sub>IA</sub> , V <sub>IB</sub> ) <sup>1, 2</sup>	-0.5 V to V <sub>DD1</sub> + 0.5 V
Output Voltages (V <sub>OA</sub> , V <sub>OB</sub> ) <sup>1, 2</sup>	-0.5 V to V <sub>DDO</sub> + 0.5 V
Average Output Current per Pin (I <sub>O</sub> ) <sup>3</sup>	-35 mA to +35 mA
Common-Mode Transients (CM <sub>L</sub> , CM <sub>H</sub> ) <sup>4</sup>	-100 kV/μs to +100 kV/μs

<sup>1</sup> All voltages are relative to their respective ground.

<sup>2</sup> V<sub>DD1</sub> and V<sub>DDO</sub> refer to the supply voltages on the input and output sides of a given channel, respectively.

<sup>3</sup> See Figure 3 for maximum rated current values for various temperatures.

<sup>4</sup> Refers to common-mode transients across the insulation barrier.

Common-mode transients exceeding the Absolute Maximum Rating can 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 indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### 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.

Table 10. Maximum Continuous Working Voltage<sup>1</sup>

Parameter	Max	Unit	Constraint
AC Voltage, Bipolar Waveform	565	V peak	50-year minimum lifetime
AC Voltage, Unipolar Waveform			
Functional Insulation	1131	V peak	Maximum approved working voltage per IEC 60950-1
Basic Insulation	560	V peak	Maximum approved working voltage per IEC 60950-1 and VDE V 0884-10
DC Voltage			
Functional Insulation	1131	V peak	Maximum approved working voltage per IEC 60950-1
Basic Insulation	560	V peak	Maximum approved working voltage per IEC 60950-1 and VDE V 0884-10

<sup>1</sup> Refers to continuous voltage magnitude imposed across the isolation barrier. See the Insulation Lifetime section for more details.

Table 11. ADuM1200 Truth Table (Positive Logic)

V <sub>IA</sub> Input	V <sub>IB</sub> Input	V <sub>DD1</sub> State	V <sub>DD2</sub> State	V <sub>OA</sub> Output	V <sub>OB</sub> Output	Notes
H	H	Powered	Powered	H	H	
L	L	Powered	Powered	L	L	
H	L	Powered	Powered	H	L	
L	H	Powered	Powered	L	H	
X	X	Unpowered	Powered	H	H	Outputs return to the input state within 1 μs of V <sub>DD1</sub> power restoration.
X	X	Powered	Unpowered	Indeterminate	Indeterminate	Outputs return to the input state within 1 μs of V <sub>DDO</sub> power restoration.

Table 12. ADuM1201 Truth Table (Positive Logic)

V <sub>IA</sub> Input	V <sub>IB</sub> Input	V <sub>DD1</sub> State	V <sub>DD2</sub> State	V <sub>OA</sub> Output	V <sub>OB</sub> Output	Notes
H	H	Powered	Powered	H	H	
L	L	Powered	Powered	L	L	
H	L	Powered	Powered	H	L	
L	H	Powered	Powered	L	H	
X	X	Unpowered	Powered	Indeterminate	H	Outputs return to the input state within 1 μs of V <sub>DD1</sub> power restoration.
X	X	Powered	Unpowered	H	Indeterminate	Outputs return to the input state within 1 μs of V <sub>DDO</sub> power restoration.

## PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

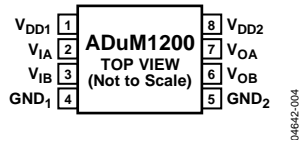


Figure 4. ADuM1200 Pin Configuration

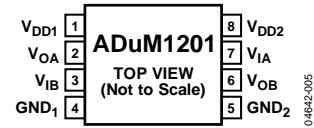


Figure 5. ADuM1201 Pin Configuration

**Table 13. ADuM1200 Pin Function Descriptions**

Pin No.	Mnemonic	Description
1	V <sub>DD1</sub>	Supply Voltage for Isolator Side 1, 2.7 V to 5.5 V.
2	V <sub>IA</sub>	Logic Input A.
3	V <sub>IB</sub>	Logic Input B.
4	GND <sub>1</sub>	Ground 1. Ground Reference for Isolator Side 1.
5	GND <sub>2</sub>	Ground 2. Ground Reference for Isolator Side 2.
6	V <sub>OB</sub>	Logic Output B.
7	V <sub>OA</sub>	Logic Output A.
8	V <sub>DD2</sub>	Supply Voltage for Isolator Side 2, 2.7 V to 5.5 V.

**Table 14. ADuM1201 Pin Function Descriptions**

Pin No.	Mnemonic	Description
1	V <sub>DD1</sub>	Supply Voltage for Isolator Side 1, 2.7 V to 5.5 V.
2	V <sub>OA</sub>	Logic Output A.
3	V <sub>IB</sub>	Logic Input B.
4	GND <sub>1</sub>	Ground 1. Ground Reference for Isolator Side 1.
5	GND <sub>2</sub>	Ground 2. Ground Reference for Isolator Side 2.
6	V <sub>OB</sub>	Logic Output B.
7	V <sub>IA</sub>	Logic Input A.
8	V <sub>DD2</sub>	Supply Voltage for Isolator Side 2, 2.7 V to 5.5 V.

## TYPICAL PERFORMANCE CHARACTERISTICS

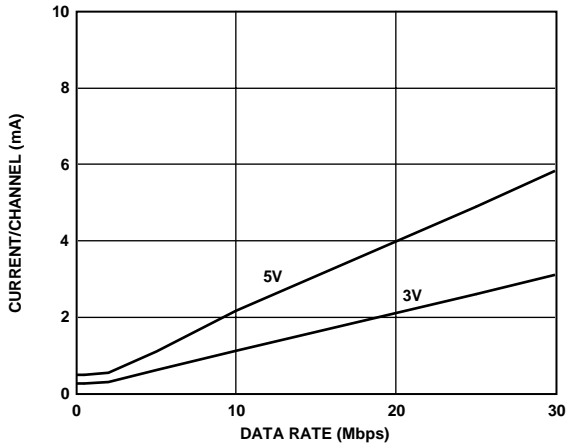


Figure 6. Typical Input Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation

04642-008

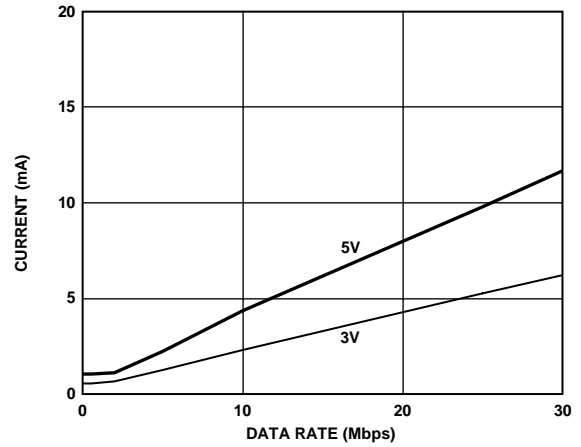


Figure 9. Typical ADuM1200  $V_{DD1}$  Supply Current vs. Data Rate for 5 V and 3 V Operation

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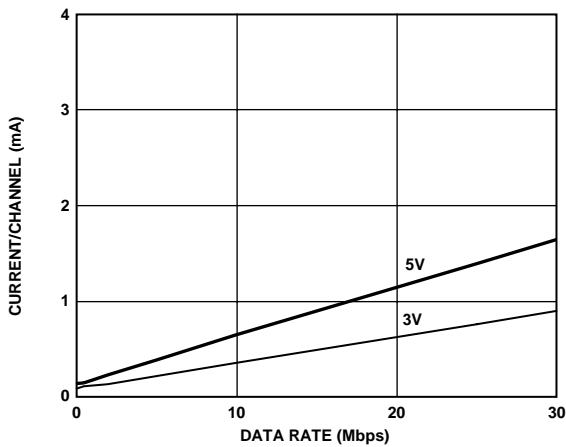


Figure 7. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (No Output Load)

04642-007

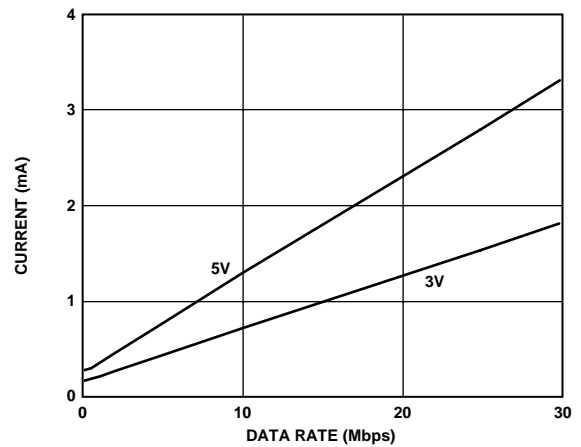


Figure 10. Typical ADuM1200  $V_{DD2}$  Supply Current vs. Data Rate for 5 V and 3 V Operation

04642-010

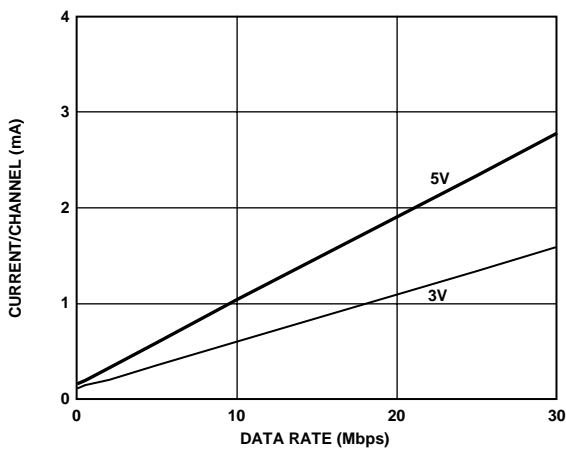


Figure 8. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (15 pF Output Load)

04642-008

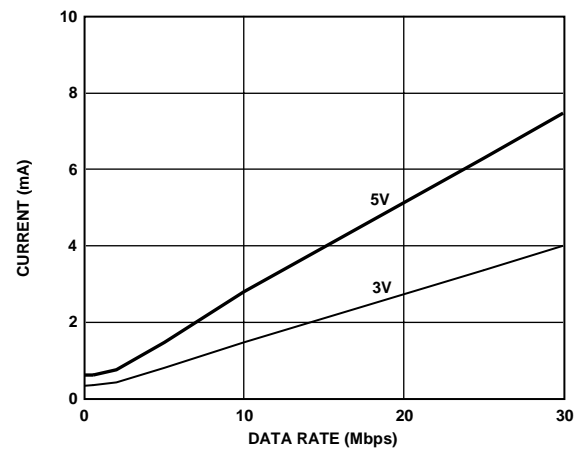


Figure 11. Typical ADuM1201  $V_{DD1}$  or  $V_{DD2}$  Supply Current vs. Data Rate for 5 V and 3 V Operation

04642-011

## APPLICATION INFORMATION

### PC BOARD LAYOUT

The ADuM120x digital isolators require no external interface circuitry for the logic interfaces. Power supply bypassing is strongly recommended at the input and output supply pins. The capacitor value should be between 0.01  $\mu\text{F}$  and 0.1  $\mu\text{F}$ . The total lead length between both ends of the capacitor and the input power supply pin should not exceed 20 mm.

### 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 can differ from the propagation delay to a Logic high output.

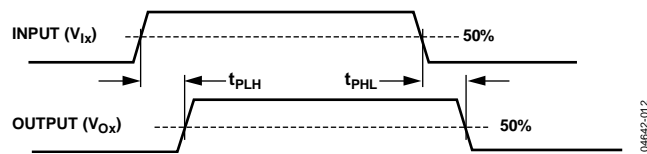


Figure 12. Propagation Delay Parameters

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

Channel-to-channel matching refers to the maximum amount that the propagation delay differs between channels within a single ADuM120x component.

Propagation delay skew refers to the maximum amount that the propagation delay differs between multiple ADuM120x components operating under the same conditions.

### DC CORRECTNESS AND MAGNETIC FIELD IMMUNITY

Positive and negative logic transitions at the isolator input cause narrow ( $\sim 1$  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  $\sim 1$   $\mu\text{s}$  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  $\mu\text{s}$ , the input side is assumed to be unpowered or nonfunctional, in which case the isolator output is forced to a default state (see Table 11 and Table 12) by the watchdog timer circuit.

The ADuM120x are extremely immune to external magnetic fields. The limitation on the magnetic field immunity of the ADuM120x is set by the condition in which induced voltage in the receiving coil of the transformer is sufficiently large enough to either falsely set or reset the decoder. The following analysis defines the conditions under which this can occur. The 3 V operating condition of the ADuM120x 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:

$\beta$  is the 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 ADuM120x and an imposed requirement that the induced voltage be 50% at most of the 0.5 V margin at the decoder, a maximum allowable magnetic field is calculated, as shown in Figure 13.

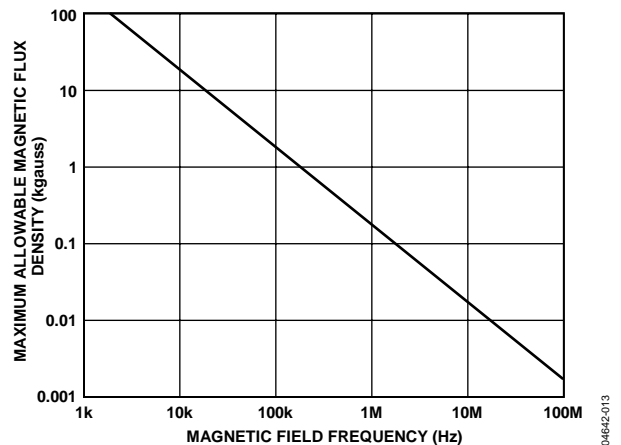


Figure 13. Maximum Allowable External Magnetic Flux Density

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 occurs during a transmitted pulse (and has the worst-case polarity), it reduces the received pulse from  $>1.0$  V to 0.75 V—still well above the 0.5 V sensing threshold of the decoder.

# ADuM1200/ADuM1201

The preceding magnetic flux density values correspond to specific current magnitudes at given distances away from the ADuM120x transformers. Figure 14 expresses these allowable current magnitudes as a function of frequency for selected distances. As seen, the ADuM120x are extremely immune and can be affected only by extremely large currents operated at high frequency and 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 ADuM120x to affect the operation of the component.

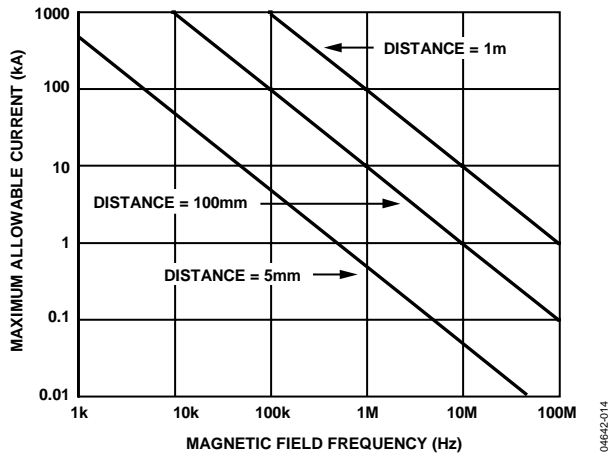


Figure 14. Maximum Allowable Current for Various Current-to-ADuM120x Spacings

Note that at combinations of strong magnetic fields and high frequencies, any loops formed by printed circuit board traces could induce sufficiently large error voltages to trigger the threshold 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 ADuM120x isolator is a function of the supply voltage, the data rate of the channel, and the output load of the channel.

For each input channel, the supply current is given by

$$I_{DD1} = I_{DD1(Q)} \quad f \leq 0.5f_r$$

$$I_{DD1} = I_{DD1(D)} \times (2f - f_r) + I_{DD1(Q)} \quad f > 0.5f_r$$

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:

$I_{DD1(D)}$ ,  $I_{DDO(D)}$  are the input and output dynamic supply currents per channel (mA/Mbps).

$C_L$  is the 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).

$I_{DD1(Q)}$ ,  $I_{DDO(Q)}$  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 11 provide total  $V_{DD1}$  and  $V_{DD2}$  supply current as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

## INSULATION LIFETIME

All insulation structures eventually break down when subjected to voltage stress over a sufficiently long period. The rate of insulation degradation is dependent on the characteristics of the voltage waveform applied across the insulation. In addition to the testing performed by the regulatory agencies, Analog Devices carries out an extensive set of evaluations to determine the lifetime of the insulation structure within the ADuM120x.

Analog Devices performs accelerated life testing using voltage levels higher than the rated continuous working voltage. Acceleration factors for several operating conditions are determined. These factors allow calculation of the time to failure at the actual working voltage. The values shown in Table 10 summarize the peak voltage for 50 years of service life for a bipolar ac operating condition and the maximum CSA/VDE approved working voltages. In many cases, the approved working voltage is higher than the 50-year service life voltage. Operation at these high working voltages can lead to shortened insulation life in some cases.

The insulation lifetime of the ADuM120x depends on the voltage waveform type imposed across the isolation barrier. The iCoupler insulation structure degrades at different rates depending on whether the waveform is bipolar ac, unipolar ac, or dc. Figure 15, Figure 16, and Figure 17 illustrate these different isolation voltage waveforms, respectively.

Bipolar ac voltage is the most stringent environment. The goal of a 50-year operating lifetime under the ac bipolar condition determines the Analog Devices recommended maximum working voltage.



In the case of unipolar ac or dc voltage, the stress on the insulation is significantly lower, which allows operation at higher working voltages while still achieving a 50-year service life. The working voltages listed in Table 10 can be applied while maintaining the 50-year minimum lifetime provided the voltage conforms to either the unipolar ac or dc voltage cases. Any cross insulation voltage waveform that does not conform to Figure 16 or Figure 17 should be treated as a bipolar ac waveform and its peak voltage should be limited to the 50-year lifetime voltage value listed in Table 10.

Note that the voltage presented in Figure 16 is shown as sinusoidal for illustration purposes only. It is meant to represent any voltage waveform varying between 0 V and some limiting value. The limiting value can be positive or negative, but the voltage cannot cross 0 V.

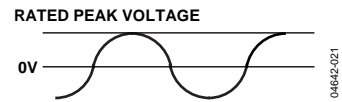


Figure 15. Bipolar AC Waveform

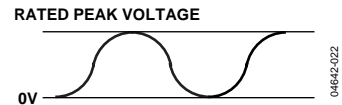


Figure 16. Unipolar AC Waveform

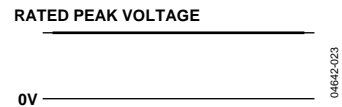


Figure 17. DC Waveform



**NOTES**

**NOTES**