Dual-Channel Digital Isolators

Preliminary Technical Data

ADuM1200/ADuM1201

FEATURES

- Narrow body SOIC 8-lead package
- Low power operation
  - 5 V operation:
    - 1.1 mA per channel max. @ 0–2 Mbps
    - 3.7 mA per channel max. @ 10 Mbps
    - 10 mA per channel max @ 30 Mbps
  - 3 V operation:
    - 0.8 mA per channel max. @ 0–2 Mbps
    - 2.2 mA per channel max. @ 10 Mbps
    - 6.3 mA per channel max. @ 30 Mbps
- Bidirectional communication
- 3 V/5 V level translation
- High temperature operation: 105°C
- High data rate: DC–30 Mbps (NRZ)
- Precise timing characteristics:
  - 3 ns max. pulsewidth distortion
  - 3 ns max. channel-to-channel matching
- High common-mode transient immunity: > 25 kV/µs
- Safety and regulatory approvals (pending)
  - 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_{IORM} = 560 V peak

APPLICATIONS

- Size-critical multichannel isolation
- SPI® interface/data converter isolation
- RS-232/422/485 transceiver isolation
- Digital fieldbus isolation

DESCRIPTION

The ADuM120x are two-channel digital isolators based on Analog Devices' *i*Coupler® 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, *i*Coupler 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, *i*Coupler digital interfaces and stable performance characteristics. The need for external drivers and other discretes is eliminated with these *i*Coupler products. Furthermore, *i*Coupler devices run at one-tenth to one-sixth the power consumption 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 Ordering Guide). Both ADuM120x models operate with the supply voltage of 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 provides low pulsewidth distortion (<3 ns for CRW grade), and tight channel-to-channel matching (<3 ns for CRW 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.

FUNCTIONAL BLOCK DIAGRAMS

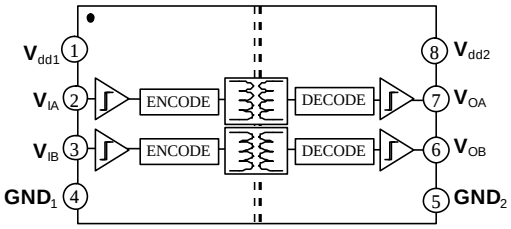

Figure 1. ADuM1200 Functional Block Diagram

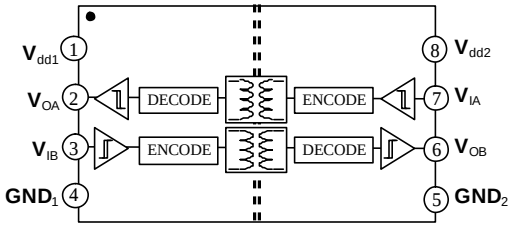

Figure 2. ADuM1201 Functional Block Diagram

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REVISION HISTORY

Revision 0: Initial Version

ELECTRICAL CHARACTERISTICS— 5 V OPERATION[1]

4.5 V = V_{DD1} = 5.5 V, 4.5 V = V_{DD2} = 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	$I_{DDI(Q)}$		0.50	0.6	mA	
Output Supply Current, per Channel, Quiescent	$I_{DDO(Q)}$		0.19	0.25	mA	
ADuM1200, Total Supply Current, Two Channels[2]						
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	0.7	mA	DC to 1 MHz logic signal freq.
10 Mbps (BRW and CRW 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	1.8	mA	5 MHz logic signal freq.
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$		12	16	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$		3.3	4.0	mA	15 MHz logic signal freq.
ADuM1201, Total Supply Current, Two Channels[2]						
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 (BRW and CRW 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.
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$		7.5	9.5	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$		7.5	9.5	mA	15 MHz logic signal freq.
For All Models						
Input Currents	I_{IA}, I_{IB}	–10	0.01	10	µA	0 = V_{IA}, V_{IB} = V_{DD1} or V_{DD2}
Logic High Input Threshold	V_{IH}	0.7V_{DD}			V	
Logic Low Input Threshold	V_{IL}			0.3V_{DD}	V	
Logic High Output Voltages	V_{OAH}, V_{OBH}	$V_{DD1,2}$–0.1	5.0		V	I_{Ox} = –20 µA, V_{Ix} = V_{IxH}
		$V_{DD1,2}$–0.4	4.8		V	I_{Ox} = –4 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OAL}, V_{OBL}		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}

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
SWITCHING SPECIFICATIONS						
ADuM120xARW						
Minimum Pulsewidth[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		150	ns	C_L = 15 pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH}-t_{PHL}\|$[5]	PWD			40	ns	C_L = 15 pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			100	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
Output Rise/Fall Time (10%–90%)	t_R/t_F		10		ns	C_L = 15 pF, CMOS signal levels
ADuM120xBRW						
Minimum Pulsewidth[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		50	ns	C_L = 15 pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH}-t_{PHL}\|$[5]	PWD			3	ns	C_L = 15 pF, CMOS signal levels
Change Versus 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, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			15	ns	C_L = 15 pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		2.5		ns	C_L = 15 pF, CMOS signal levels
ADuM120xCRW						
Minimum Pulsewidth[3]	PW		20	33	ns	C_L = 15 pF, CMOS signal levels
Maximum Data Rate[4]		30	50		Mbps	C_L = 15 pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	20		45	ns	C_L = 15 pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH}-t_{PHL}\|$[5]	PWD			3	ns	C_L = 15 pF, CMOS signal levels
Change Versus 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, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15 pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			15	ns	C_L = 15 pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		2.5		ns	C_L = 15 pF, CMOS signal levels
For All Models						
Output Disable Propagation Delay (High/Low to High Impedance)	t_{PHZ}, t_{PLH}		3	5	ns	C_L = 15 pF, CMOS signal levels
Output Enable Propagation Delay (High Impedance to High/Low)	t_{PZH}, t_{PZL}		3	5	ns	C_L = 15 pF, CMOS signal levels
Common-Mode Transient Immunity at Logic High Output[8]	$\|CM_H\|$	25	35		kV/µs	$V_{Ix} = V_{DD1/DD2}$, 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	

ELECTRICAL CHARACTERISTICS— 3 V OPERATION[1]

2.7 V = V_{DD1} = 3.6 V, 2.7 V = V_{DD2} = 3.6 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} = 3.0 V.

Table 2.

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Input Supply Current, per Channel, Quiescent	$I_{DDI(Q)}$		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[2]						
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	0.5	mA	DC to 1 MHz logic signal freq.
10 Mbps (BRW and CRW 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	1.0	mA	5 MHz logic signal freq.
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$		6.2	10.0	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$		1.8	2.5	mA	15 MHz logic signal freq.
ADuM1201, Total Supply Current, Two Channels[2]						
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 (BRW and CRW 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.
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$		4.0	6.2	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$		4.0	6.2	mA	15 MHz logic signal freq.
For All Models						
Input Currents	I_{IA}, I_{IB}	–10	0.01	10	µA	0 = V_{IA}, V_{IB}, = V_{DD1} or V_{DD2}
Logic High Input Threshold	V_{IH}	0.7V_{DD}			V	
Logic Low Input Threshold	V_{IL}			0.3V_{DD}		
Logic High Output Voltages	V_{OAH}, V_{OBH}	$V_{DD1,2}$ – 0.1	3.0		V	I_{Ox} = –20 µA, V_{Ix} = V_{IxH}
		$V_{DD1,2}$ – 0.4	2.8		V	I_{Ox} = –4 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OAL}, V_{OBL},		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}

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
SWITCHING SPECIFICATIONS						
ADuM120xARW						
Minimum Pulsewidth[3]	PW			1000	ns	C_L = 15pF, CMOS signal levels
Maximum Data Rate[4]		1			Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	50		150	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			40	ns	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			100	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching[7]	$t_{PSKCD/OD}$			50	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		10		ns	C_L = 15 pF, CMOS signal levels
ADuM120xBRW						
Minimum Pulsewidth[3]	PW			100	ns	C_L = 15pF, CMOS signal levels
Maximum Data Rate[4]		10			Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	20		60	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			3	ns	C_L = 15pF, CMOS signal levels
Change Versus Temperature			5		ps/°C	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			22	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			22	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		3.0		ns	C_L = 15 pF, CMOS signal levels
ADuM120xCRW						
Minimum Pulsewidth[3]	PW		20	33	ns	C_L = 15pF, CMOS signal levels
Maximum Data Rate[4]		30	50		Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	20		55	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			3	ns	C_L = 15pF, CMOS signal levels
Change Versus Temperature			5		ps/°C	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			16	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			16	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		3.0		ns	C_L = 15 pF, CMOS signal levels
For All Models						
Output Disable Propagation Delay (High/Low to High Impedance)	t_{PHZ}, t_{PLH}		3	5	ns	C_L = 15pF, CMOS signal levels
Output Enable Propagation Delay (High Impedance to High/Low)	t_{PZH}, t_{PZL}		3	5	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		3		ns	C_L = 15pF, CMOS signal levels
Common Mode Transient Immunity at Logic High Output[8]	$\|CM_H\|$	25	35		kV/µs	$V_{Ix} = V_{DD1/DD2}$, 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	

ELECTRICAL CHARACTERISTICS— MIXED 5 V/3 V OR 3 V/5 V OPERATION[1]

5 V/3 V operation: 4.5 V = V_{DD1} = 5.5 V, 2.7 V = V_{DD2} = 3.6 V. 3 V/5 V operation: 2.7 V = V_{DD1} = 3.6 V, 4.5 V = V_{DD2} = 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} = 3.0 V, V_{DD2} = 5 V; or V_{DD1} = 5 V, V_{DD2} = 3.0 V.

Table 3.

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Input Supply Current, per Channel, Quiescent	$I_{DDI(Q)}$				mA	
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	$I_{DDO(Q)}$				mA	
5 V/3 V Operation			0.11	0.20	mA	
3 V/5 V Operation			0.19	0.25	mA	
ADuM1200, Total Supply Current, Two Channels[2]						
DC to 2 Mbps						
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	0.5	mA	DC to 1 MHz logic signal freq.
3 V/5 V Operation			0.5	0.7	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			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	1.0	mA	5 MHz logic signal freq.
3 V/5 V Operation			1.3	1.8	mA	5 MHz logic signal freq.
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$					
5 V/3 V Operation			12	16	mA	15 MHz logic signal freq.
3 V/5 V Operation			6.2	10.0	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$					
5 V/3 V Operation			1.8	2.5	mA	15 MHz logic signal freq.
3 V/5 V Operation			3.3	4.0	mA	15 MHz logic signal freq.
ADuM1201, Total Supply Current, Two Channels[2]						
DC to 2 Mbps						
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.
10 Mbps (BRW and CRW Grades Only)						
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.

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
30 Mbps (CRW Grade Only)						
V_{DD1} Supply Current	$I_{DD1(30)}$					
5 V/3 V Operation			7.5	9.5	mA	15 MHz logic signal freq.
3 V/5 V Operation			4.0	6.2	mA	15 MHz logic signal freq.
V_{DD2} Supply Current	$I_{DD2(30)}$					
5 V/3 V Operation			4.0	6.2	mA	15 MHz logic signal freq.
3 V/5 V Operation			7.5	9.5	mA	15 MHz logic signal freq.
For All Models						
Input Currents	I_{IA}, I_{IB}	–10	0.01	10	µA	0 = V_{IA}, V_{IB} = V_{DD1} or V_{DD2}
Logic High Input Threshold	V_{IH}	$0.7V_{DD}$			V	
Logic Low Input Threshold	V_{IL}			$0.3V_{DD}$	V	
5 V/3 V Operation		0.8			V	
3 V/5 V Operation		0.4			V	
Logic High Output Voltages	V_{OAH}, V_{OBH}	$V_{DD1/2} - 0.1$	$V_{DD1/2}$		V	I_{Ox} = –20 µA, V_{Ix} = V_{IxH}
		$V_{DD1/2} - 0.4$	$V_{DD1/2}$–0.2		V	I_{Ox} = –4 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OAL}, V_{OBL}		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						
ADuM120xARW						
Minimum Pulsewidth[3]	PW			1000	ns	C_L = 15pF, CMOS signal levels
Maximum Data Rate[4]		1			Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	50		100	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			40	ns	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			50	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching[7]	$t_{PSKCD/OD}$			50	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10%–90%)	t_R/t_F		10		ns	C_L = 15 pF, CMOS signal levels
ADuM120xBRW						
Minimum Pulsewidth[3]	PW			100	ns	C_L = 15pF,CMOS signal levels
Maximum Data Rate[4]		10			Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	15		55	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			3	ns	C_L = 15pF, CMOS signal levels
Change Versus Temperature			5		ps/°C	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			22	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			22	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10-90%)	t_R/t_f					C_L = 15pF, CMOS signal levels
5 V/3 V Operation			3.0		ns	
3 V/5 V Operation			2.5		ns	
ADuM120xCRW						
Minimum Pulsewidth[3]	PW		20	33	ns	C_L = 15pF, CMOS signal levels
Maximum Data Rate[4]		30	50		Mbps	C_L = 15pF, CMOS signal levels
Propagation Delay[5]	t_{PHL}, t_{PLH}	20		50	ns	C_L = 15pF, CMOS signal levels
Pulsewidth Distortion, $\|t_{PLH} - t_{PHL}\|$[5]	PWD			3	ns	C_L = 15pF, CMOS signal levels
Change Versus Temperature			5		ps/°C	C_L = 15pF, CMOS signal levels
Propagation Delay Skew[6]	t_{PSK}			15	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Co-Directional Channels[7]	t_{PSKCD}			3	ns	C_L = 15pF, CMOS signal levels
Channel-to-Channel Matching, Opposing-Directional Channels[7]	t_{PSKOD}			15	ns	C_L = 15pF, CMOS signal levels
Output Rise/Fall Time (10-90%)	t_R/t_f					C_L = 15pF, CMOS signal levels

Parameter	Symbol	Min.	Typ	Max	Unit	Test Conditions
5 V/3 V Operation			3.0		ns	
3 V/5 V Operation			2.5		ns	
For All Models						
Output Disable Propagation Delay (High/Low to High Impedance)	t_{PHZ}, t_{PLH}		3	5	ns	C_L = 15pF, CMOS signal levels
Output Enable Propagation Delay (High Impedance to High/Low)	t_{PZH}, t_{PZL}		3	5	ns	C_L = 15pF, CMOS signal levels
Common-Mode Transient Immunity at Logic High Output[8]	$\|CM_H\|$	25	35		kV/µs	$V_{Ix} = V_{DD1/DD2}$, 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					
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	

NOTES

1 All voltages are relative to their respective ground.

2 Supply current values are for both channels combined 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 11 for total I_{DD1} and I_{DD2} supply currents as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

3 The minimum pulsewidth is the shortest pulsewidth at which the specified pulsewidth distortion is guaranteed.

4 The maximum data rate is the fastest data rate at which the specified pulsewidth 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} and/or t_{PLH} that will be 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 $V_O > 0.8V_{DD2}$. CM_L is the maximum common-mode voltage slew rate than 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 Power Consumption section on page 17 for guidance on calculating per-channel supply current for a given data rate.

PACKAGE CHARACTERISTICS

Table 4.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Resistance (Input-Output)[1]	R_{I-O}		10^{12}		?	
Capacitance (Input-Output)[1]	C_{I-O}		1.0		pF	f = 1 MHz
Input Capacitance	C_I		4.0		pF	
IC Junction-to-Case Thermal Resistance, Side 1	$?_{jci}$		46		°C/W	Thermocouple located at center of package underside
IC Junction-to-Case Thermal Resistance, Side 2	$?_{jco}$		41		°C/W	

NOTE

[1] Device considered a two-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.

[1] Input capacitance is from any input data pin to ground.

REGULATORY INFORMATION

The ADuM120x will be approved by the following organizations upon product release:

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

NOTES

[1] In accordance with UL1577, each ADuM120x 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 ADuM120x is proof tested by applying an insulation test voltage = 1050 V peak for 1 second (partial discharge detection limit = 5 pC).

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

Table 7.

Description	Symbol	Characteristic	Unit
Installation classification per DIN VDE 0110			
For Rated Mains Voltage = 150 V rms		I–IV	
For Rated Mains Voltage = 300 V rms		I–III	
For Rated Mains Voltage = 400 V rms		I–II	
Climatic Classification		40/105/21	
Pollution Degree (DIN VDE 0110, Table 1)		2	
Maximum Working Insulation Voltage	V_{IORM}	560	V peak
Input to Output Test Voltage, Method b1	V_{PR}	1050	V peak
V_{IORM} × 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)			
V_{IORM} x 1.6 = V_{PR}, t_m = 60 sec, Partial Discharge < 5p C		896	V peak
After Input and/or Safety Test Subgroup 2/3)			
V_{IORM} × 1.2 = V_{PR}, t_m = 60 sec, Partial Discharge < 5p C		672	V peak
Highest Allowable Overvoltage	V_{TR}	4000	V peak
(Transient Overvoltage, t_{TR} = 10 sec)			
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	$>10^9$	?

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

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

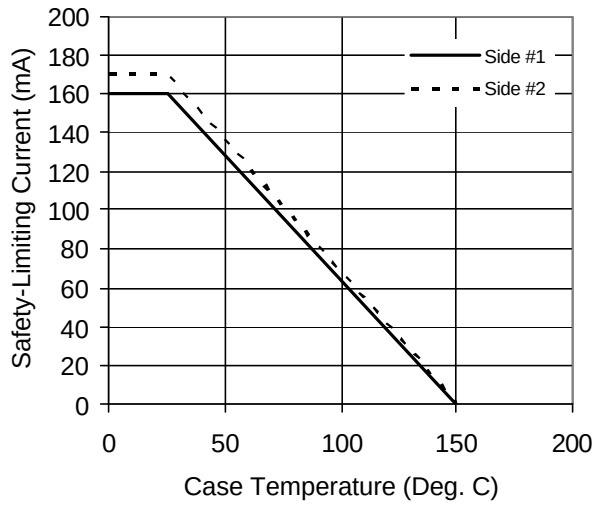

Figure 3. Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-2

RECOMMENDED OPERATION CONDITIONS

Parameter	Symbol	Min.	Max.	Unit
Operating Temperature	T_A	–40	+105	°C
Supply Voltages[1]	$V_{DD1,2}$	2.7	5.5	V
Input Signal Rise and Fall Times			1.0	ms

NOTES

[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

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_{ST}	–55	150	°C
Ambient Operating Temperature	T_A	–40	100	°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_{DDI} + 0.5	V
Output Voltage[1, 2]	V_{OA}, V_{OB}, V_{OC}	–0.5	V_{DDO} + 0.5	V
Average Output Current, Per Pin[3]	I_O	-35	35	mA
Common-Mode Transients[4]		-100	+100	kV/µs

NOTES
1 All voltages are relative to their respective ground.
2 V_{DDI} and V_{DDO} refer to the supply voltages on the input and output sides of a given channel, respectively.
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 for extended periods may affect device reliability. Ambient temperature = 25°C unless otherwise noted.

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 8. ADuM1200 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} Output	Note
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 returns to input state within 1 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	Indeterminate	Indeterminate	Outputs returns to input state within 1 µs of V_{DDO} power restoration.

Table 9. ADuM1201 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} Output	Note
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 returns to input state within 1 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	H	Indeterminate	Outputs returns to input state within 1 µs of V_{DDO} power restoration.

PIN CONFIGURATIONS AND PIN FUNCTION DESCRIPTIONS

PIN CONFIGURATIONS

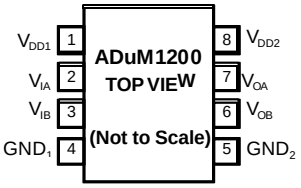

Figure 4. DuM1200 Pin Configuration

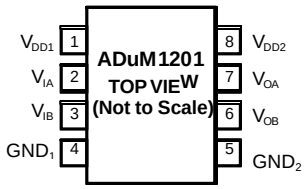

Figure 5. ADuM1201 Pin Configuration

PIN FUNCTION DESCRIPTIONS

Table 9. ADuM1200 Pin Function Descriptions

Pin No.	Mnemonic	Function
1	V_{DD1}	Supply voltage for isolator Side 1, 2.7 V to 5.5 V.
2	V_{IA}	Logic input A.
3	V_{IB}	Logic input B.
4	GND_1	Ground 1. Ground reference for isolator Side 1.
5	GND_2	Ground 2. Ground reference for isolator Side 2.
6	V_{OB}	Logic output B.
7	V_{OA}	Logic output A.
8	V_{DD2}	Supply voltage for isolator Side 2, 2.7 V to 5.5 V.

Table 10. ADuM1201 Pin Function Descriptions

Pin No.	Mnemonic	Function
1	V_{DD1}	Supply voltage for isolator Side 1, 2.7 V to 5.5 V.
2	V_{OA}	Logic output A.
3	V_{IB}	Logic input B.
4	GND_1	Ground 1. Ground reference for isolator Side 1.
5	GND_2	Ground 2. Ground reference for isolator Side 2.
6	V_{OB}	Logic output B.
7	V_{IA}	Logic input A.
8	V_{DD2}	Supply voltage for isolator Side 2, 2.7 V to 5.5 V.

TYPICAL PERFORMANCE CHARACTERISTICS

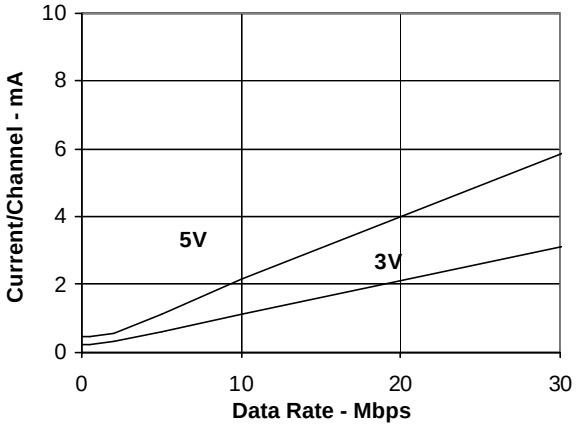

Figure 6. Typical Input Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation.

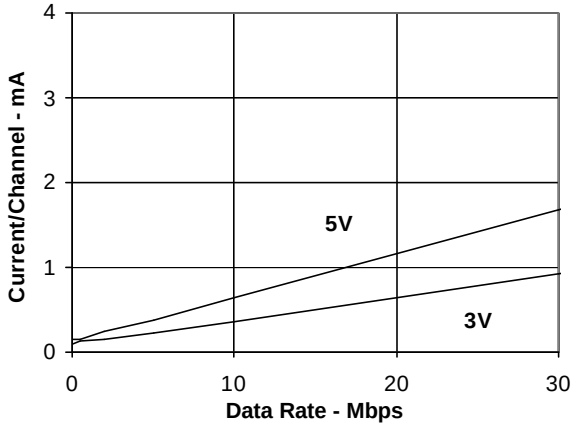

Figure 7. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (No Output Load)

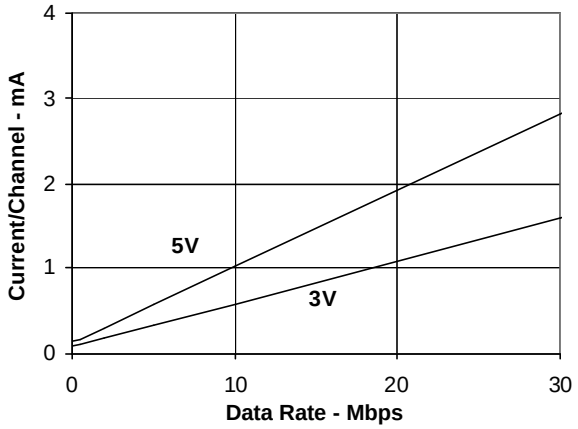

Figure 8. Typical Output Supply Current per Channel vs. Data Rate for 5 V and 3 V Operation (15 pF Output Load)

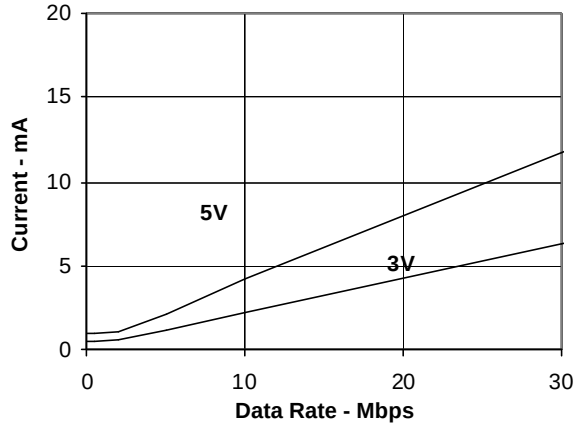

Figure 9. Typical ADuM1200 V_{DD1} Supply Current vs. Data Rate for 5 V and 3 V Operation.

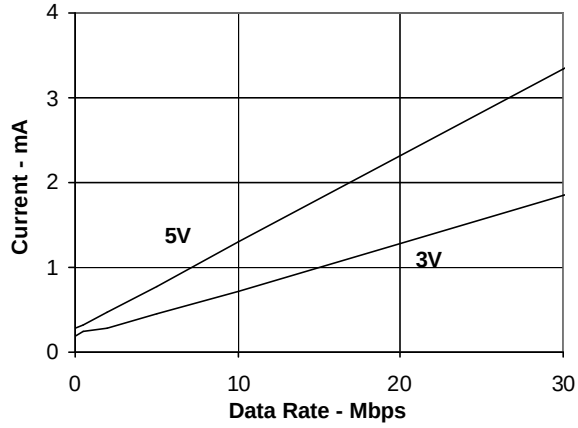

Figure 10. Typical ADuM1200 V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation.

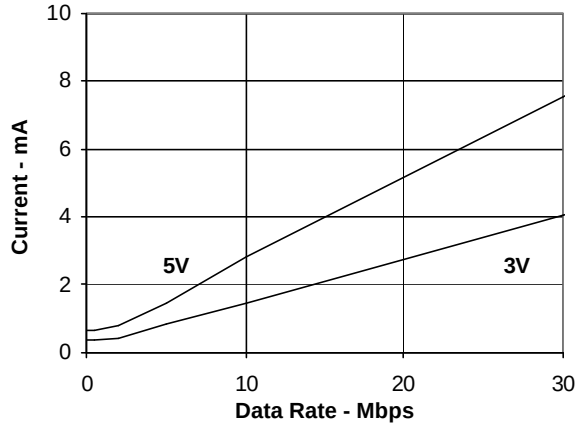

Figure 11. Typical ADuM1201 V_{DD1} V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation.

APPLICATION INFORMATION

PC BOARD LAYOUT

The ADuM120x digital isolator requires 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 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.

PROPAGATION DELAY-RELATED PARAMETERS

Propagation delay is a parameter that describes the length of time it takes for 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.

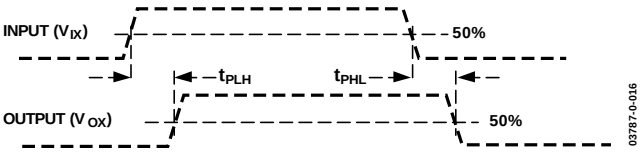

Figure 12. Propagation Delay Parameters

Pulsewidth 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 the propagation delay differs among channels within a single ADuM120x component.

Propagation delay skew refers to the maximum amount the propagation delay differs among multiple ADuM120x components operated 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 via the transformer to the decoder. The decoder is bistable and is therefore either set or reset by the pulses indicating input logic transitions. In the absence of logic transitions at the input for more than 2 µs, 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 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 8) by the watchdog timer circuit.

The ADuM120x is extremely immune to external magnetic fields. The limitation on the ADuM120x'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 analysis below defines the conditions under which this may occur. The 3 V operating condition of the ADuM120x is examined as 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:

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

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 ADuM120x 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 below in Figure 13.

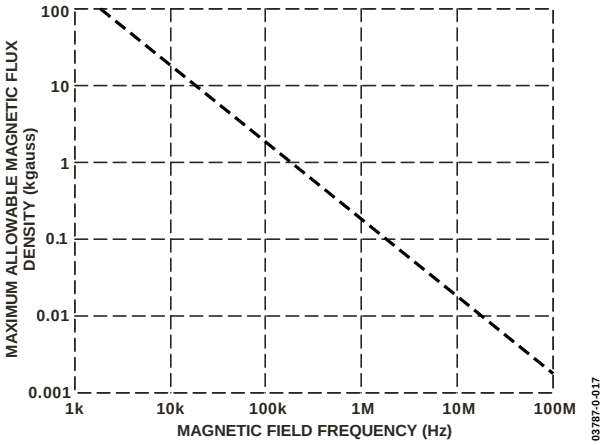

Figure 13. Maximum Allowable External Magnetic Flux Density.

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 will 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 away from the ADuM120x transformers. Figure 14 expresses these allowable current magnitudes as a function of frequency for selected distances. As can be seen, the ADuM120x is 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 noted, one would have to place a 0.5 kA current 5 mm away from the ADuM120x to affect the component's operation.

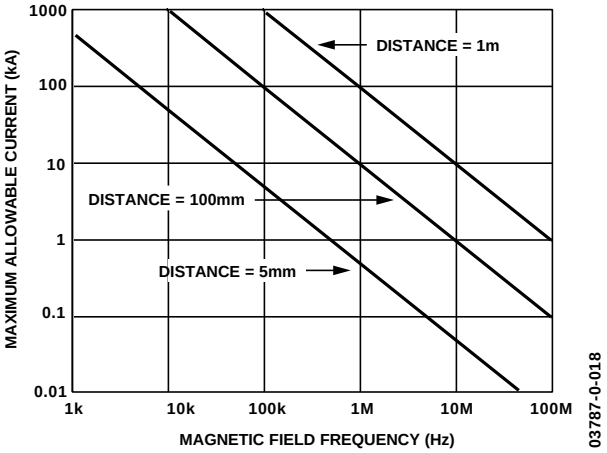

Figure 14. Maximum Allowable Current for Various Current-to-ADuM120x Spacings

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 ADuM120x 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:

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

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

For each output channel, the supply current is given by:

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

$$I_{DDO} = (I_{DDO(D)} + 10^6 \times C_L V_{DDO}) \times (2f - f_r) + I_{DDO(Q)} \qquad f > 0.5f_r$$

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 11 provide total I_{DD1} and I_{DD2} supply current as a function of data rate for ADuM1200 and ADuM1201 channel configurations.

OUTLINE DIMENSIONS

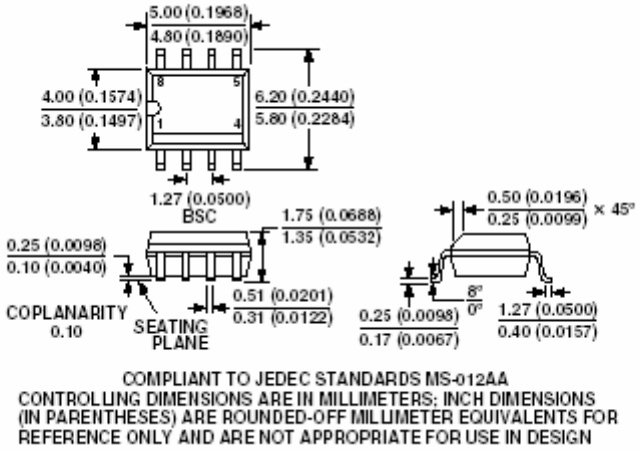

Figure 15. 8-Lead Standard Small Outline Package [SOIC]— Narrow Body (R-8)

ORDERING GUIDE

Table 11. Ordering Guide

Model	Number of Inputs, V_{DD1} Side	Number of Inputs, V_{DD2} Side	Max. Data Rate (Mbps)	Max. Propagation Delay, 5 V (ns)	Max. Pulsewidth Distortion (ns)	Channel-to-Channel Matching, Co-Directional Channels (ns)	Package Description
ADuM1200AR*	2	0	1	100	40	40	8-Lead Narrow Body SOIC
ADuM1200BR*	2	0	10	50	3	3	8-Lead Narrow Body SOIC
ADuM1200CR*	2	0	30	45	3	3	8-Lead Narrow Body SOIC
ADuM1201AR*	1	1	1	100	40	40	8-Lead Narrow Body SOIC
ADuM1201BR*	1	1	10	50	3	3	8-Lead Narrow Body SOIC
ADuM1201CR*	1	1	30	45	3	3	8-Lead Narrow Body SOIC

NOTE
* Tape and Reel is available. The addition of an "-RL7" suffix designates a 7" (1000 units) tape and reel option

PR04642-0-1/04(PrE)

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