3 kV RMS Dual Channel Digital Isolators

Data Sheet

ADuM1280/ADuM1281/ADuM1285/ADuM1286

FEATURES

Up to 100 Mbps data rate (NRZ)
Low propagation delay: 23 ns typical
Low dynamic power consumption
Bidirectional communication
3.3 V to 5 V level translation
High temperature operation: 125°C
High common-mode transient immunity: >25 kV/µs
Default high output: ADuM1280/ADuM1281
Default low output: ADuM1285/ADuM1286
Narrow body, RoHS-compliant, 8-lead SOIC
Safety and regulatory approvals
- **UL recognition: 3000 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
Qualified for automotive applications

APPLICATIONS

General-purpose multichannel isolation
Data converter isolation
Industrial field bus isolation
Hybrid electric vehicles, battery monitor, and motor drive

FUNCTIONAL BLOCK DIAGRAMS

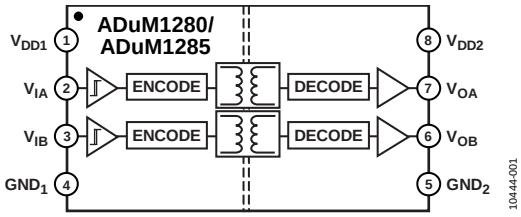

Figure 1. ADuM1280/ADuM1285

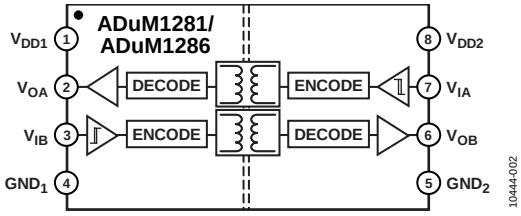

Figure 2. ADuM1281/ADuM1286

GENERAL DESCRIPTION

The ADuM1280/ADuM1281/ADuM1285/ADuM1286[1] are dual-channel digital isolators based on the Analog Devices, Inc., iCoupler® technology. Combining high speed CMOS and monolithic air core transformer technology, these isolation components provide outstanding performance characteristics superior to alternatives, such as optocoupler devices and other integrated couplers.

With propagation delay at 23 ns, pulse width distortion is less than 2 ns for C grade. Channel-to-channel matching is tight at 5 ns for C grade. The two channels of the ADuM1280/ADuM1281/ADuM1285/ADuM1286 are independent isolation channels and are available in two channel configurations with three different data rates up to 100 Mbps (see the Ordering Guide). Industrial grade models operate with the supply voltage on either side ranging from 3.135 V to 5.5 V and the automotive grades operate from 3.135 V to 5.5 V, providing compatibility with lower voltage systems as well as enabling a voltage translation functionality across the isolation barrier. Unlike other optocoupler alternatives, the ADuM1280/ADuM1281/ADuM1285/ADuM1286 isolators have a patented refresh feature that ensures dc correctness in the absence of input logic transitions. When power is first applied or is not yet applied to the input side, the ADuM1280 and ADuM1281 have a default high output, and the ADuM1285 and ADuM1286 have a default low output.

For more information on safety and regulatory approvals, go to www.analog.com/icouplersafety.

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

Rev. D
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REVISION HISTORY

2/2017—Rev. C to Rev. D

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7/2015—Rev. B to Rev. C

Change to General Description Section ... 1
Changed 2.7 V ≤ V_{DDX} ≤ 3.6 V to 3.0 V ≤ V_{DDX} ≤ 3.6 V ... 4
Changed 2.7 V ≤ V_{DD2} ≤ 3.6 V to 3.0 V ≤ V_{DD2} ≤ 3.6 V ... 5
Changed 2.7 V ≤ V_{DD1} ≤ 3.6 V to 3.0 V ≤ V_{DD1} ≤ 3.6 V ... 7
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3/2014—Rev. A to Rev. B

Change to Features ... 1
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3/2013—Rev. 0 to Rev. A

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Added Table 13 to Table 21; Renumbered Sequentially ... 7
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Added Automotive Products Section ... 19

5/2012—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—5 V OPERATION

All typical specifications are at T_A = 25°C, V_{DD1} = V_{DD2} = 5 V. Minimum/maximum specifications apply over the entire recommended operation range: 4.5 V ≤ V_{DD1} ≤ 5.5 V, 4.5 V ≤ V_{DD2} ≤ 5.5 V, −40°C ≤ T_A ≤ 125°C, unless otherwise noted. Switching specifications are tested with C_L = 15 pF and CMOS signal levels, unless otherwise noted.

Table 1.

Parameter	Symbol	A, WA Grades			B, WB Grades			C, WC Grades			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
SWITCHING SPECIFICATIONS												
Pulse Width	PW	1000			40			10			ns	Within PWD limit
Data Rate				1			25			100	Mbps	Within PWD limit
Propagation Delay	t_{PHL}, t_{PLH}			50			35	20	23	29	ns	50% input to 50% output
Pulse Width Distortion	PWD			10			3			2	ns	$\lvert t_{PLH} - t_{PHL} \rvert$
Change vs. Temperature			7			3			1.5		ps/°C	
Propagation Delay Skew	t_{PSK}			38			12			9	ns	Between any two units at same operating conditions
Channel Matching[1]												
Codirectional	t_{PSKCD}			5			3			2	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

[1] Codirectional 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-direction 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.

Table 2.

Parameter	Symbol	1 Mbps—A, B, C, WA, WB, WC Grades			25 Mbps—B, C, WB, WC Grades			100 Mbps—C, WC Grades			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
SUPPLY CURRENT												No load
ADuM1280/ADuM1285	I_{DD1}		1.1	1.6		6.2	7.0		20	25	mA	
	I_{DD2}		2.7	4.5		4.8	7.0		9.5	15	mA	
ADuM1281/ADuM1286	I_{DD1}		2.1	2.6		4.9	6.0		15	19	mA	
	I_{DD2}		2.3	2.9		4.7	6.4		15.6	19	mA	

Table 3. For All Models

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Logic High Input Threshold	V_{IH}	0.7 V_{DDx}			V	
Logic Low Input Threshold	V_{IL}			0.3 V_{DDx}	V	
Logic High Output Voltages	V_{OH}	V_{DDx} − 0.1	5.0		V	I_{Ox} = −20 µA, V_{Ix} = V_{IxH}
		V_{DDx} − 0.4	4.8		V	I_{Ox} = −3.2 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OL}		0.0	0.1	V	I_{Ox} = 20 µA, V_{Ix} = V_{IxL}
			0.2	0.4	V	I_{Ox} = 3.2 mA, V_{Ix} = V_{IxL}
Input Current per Channel	I_I	−10	+0.01	+10	µA	0 V ≤ V_{Ix} ≤ V_{DDx}
Supply Current per Channel						
Quiescent Input Supply Current	$I_{DDI(Q)}$		0.54	0.8	mA	
Quiescent Output Supply Current	$I_{DDO(Q)}$		1.6	2.0	mA	
Dynamic Input Supply Current	$I_{DDI(D)}$		0.09		mA/Mbps	
Dynamic Output Supply Current	$I_{DDO(D)}$		0.04		mA/Mbps	

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Undervoltage Lockout						
Positive V_{DDx} Threshold	V_{DDXUV+}		2.75		V	
Negative V_{DDx} Threshold	V_{DDXUV-}		2.65		V	
V_{DDx} Hysteresis	V_{DDXUVH}		0.1		V	
AC SPECIFICATIONS						
Output Rise/Fall Time	t_R/t_F		2.5		ns	10% to 90%
Common-Mode Transient Immunity[1]	|CM|	25	35		kV/µs	$V_{Ix} = V_{DDx}$, V_{CM} = 1000 V, transient magnitude = 800 V
Refresh Period	t_r		1.6		µs	

[1] |CM| is the maximum common-mode voltage slew rate that can be sustained while maintaining $V_o > 0.8\ V_{DDx}$. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.

ELECTRICAL CHARACTERISTICS—3.3 V OPERATION

All typical specifications are at T_A = 25°C, $V_{DD1} = V_{DD2}$ = 3.3 V. Minimum/maximum specifications apply over the entire recommended operation range: 3.135 V ≤ V_{DD1} ≤ 3.6 V, 3.135 V ≤ V_{DD2} ≤ 3.6 V, −40°C ≤ T_A ≤ 125°C, unless otherwise noted. Switching specifications are tested with C_L = 15 pF and CMOS signal levels, unless otherwise noted.

Table 4.

		A, WA Grades			B, WB Grades			C, WC Grades				
Parameter	Symbol	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit	Test Conditions
SWITCHING SPECIFICATIONS												
Pulse Width	PW	1000			40			10			ns	Within PWD limit
Data Rate				1			25			100	Mbps	Within PWD limit
Propagation Delay	t_{PHL}, t_{PLH}			50			35	22	27	35	ns	50% input to 50% output
Pulse Width Distortion	PWD			10			3			2.5	ns	$\|t_{PLH} - t_{PHL}\|$
Change vs. Temperature			7			3			1.5		ps/°C	
Propagation Delay Skew	t_{PSK}			38			16			12	ns	Between any two units at same operating conditions
Channel Matching[1]												
Codirectional	t_{PSKCD}			5			3			2.5	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

[1] Codirectional 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-direction 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.

Table 5.

		1 Mbps—A, B, C, WA, WB, WC Grades			25 Mbps—B, C, WB, WC Grades			100 Mbps—C, WC Grades				
Parameter	Symbol	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit	Test Conditions
SUPPLY CURRENT												No load
ADuM1280/ADuM1285	I_{DD1}		0.75	1.4		5.1	9.0		17	23	mA	
	I_{DD2}		2.0	3.5		2.7	4.6		4.8	9	mA	
ADuM1281/ADuM1286	I_{DD1}		1.6	2.1		3.8	5.0		11	15	mA	
	I_{DD2}		1.7	2.3		3.9	6.2		11	15	mA	

Table 6. For All Models

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Logic High Input Threshold	V_{IH}	0.7 V_{DDx}			V	
Logic Low Input Threshold	V_{IL}			0.3 V_{DDx}	V	
Logic High Output Voltages	V_{OH}	V_{DDx} − 0.1	3.0		V	I_{Ox} = −20 µA, V_{Ix} = V_{IxH}
		V_{DDx} − 0.4	2.8		V	I_{Ox} = −3.2 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OL}		0.0	0.1	V	I_{Ox} = 20 µA, V_{Ix} = V_{IxL}
			0.2	0.4	V	I_{Ox} = 3.2 mA, V_{Ix} = V_{IxL}
Input Current per Channel	I_I	−10	+0.01	+10	µA	0 V ≤ V_{Ix} ≤ V_{DDx}
Supply Current per Channel						
Quiescent Input Supply Current	$I_{DDI(Q)}$		0.4	0.6	mA	
Quiescent Output Supply Current	$I_{DDO(Q)}$		1.2	1.7	mA	
Dynamic Input Supply Current	$I_{DDI(D)}$		0.08		mA/Mbps	
Dynamic Output Supply Current	$I_{DDO(D)}$		0.015		mA/Mbps	
Undervoltage Lockout						
Positive V_{DDx} Threshold	V_{DDxUV+}		2.75		V	
Negative V_{DDx} Threshold	V_{DDxUV-}		2.65		V	
V_{DDX} Hysteresis	V_{DDxUVH}		0.1		V	
AC SPECIFICATIONS						
Output Rise/Fall Time	t_R/t_F		3		ns	10% to 90%
Common-Mode Transient Immunity[1]	|CM|	25	35		kV/µs	V_{Ix} = V_{DDx}, V_{CM} = 1000 V, transient magnitude = 800 V
Refresh Period	t_r		1.6		µs	

[1] |CM| is the maximum common-mode voltage slew rate that can be sustained while maintaining V_o > 0.8 V_{DDX}. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.

ELECTRICAL CHARACTERISTICS—MIXED 5 V/3.3 V OPERATION

All typical specifications are at T_A = 25°C, V_{DD1} = 5 V, V_{DD2} = 3.3 V. Minimum/maximum specifications apply over the entire recommended operation range: 4.5 V ≤ V_{DD1} ≤ 5.5 V, 3.135 V ≤ V_{DD2} ≤ 3.6 V; and −40°C ≤ T_A ≤ 125°C, unless otherwise noted. Switching specifications are tested with C_L = 15 pF and CMOS signal levels unless otherwise noted.

Table 7.

		A, WA Grades			B, WB Grades			C, WC Grades				
Parameter	Symbol	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit	Test Conditions
SWITCHING SPECIFICATIONS												
Pulse Width	PW	1000			40			10			ns	Within PWD limit
Data Rate				1			25			100	Mbps	Within PWD limit
Propagation Delay	t_{PHL}, t_{PLH}			50			35	20	25	31	ns	50% input to 50% output
Pulse Width Distortion	PWD			10			3			2	ns	|t_{PLH} − t_{PHL}|
Change vs. Temperature			7			3			1.5		ps/°C	
Propagation Delay Skew	t_{PSK}			38			16			12	ns	Between any two units at same operating conditions
Channel Matching[1]												
Codirectional	t_{PSKCD}			5			3			2	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

[1] Codirectional 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-direction 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.

Table 8.

Parameter	Symbol	1 Mbps—A, B, C, WA, WB, WC Grades			25 Mbps—B, C, WB, WC Grades			100 Mbps—C, WC Grades			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
SUPPLY CURRENT												No load
ADuM1280/ADuM1285	I_{DD1}		1.1	1.6		6.2	7.0		20	25	mA	
	I_{DD2}		2.0	3.5		2.7	4.6		4.8	9.0	mA	
ADuM1281/ADuM1286	I_{DD1}		2.1	2.6		4.9	6.0		15	19	mA	
	I_{DD2}		1.7	2.3		3.9	6.2		11	15	mA	

Table 9. For All Models

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Logic High Input Threshold	V_{IH}	0.7 V_{DDx}			V	
Logic Low Input Threshold	V_{IL}			0.3 V_{DDx}	V	
Logic High Output Voltages	V_{OH}	V_{DDx} − 0.1	V_{DDx}		V	I_{Ox} = −20 µA, V_{Ix} = V_{IxH}
		V_{DDx} − 0.4	V_{DDx} − 0.2		V	I_{Ox} = −3.2 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OL}		0.0	0.1	V	I_{Ox} = 20 µA, V_{Ix} = V_{IxL}
			0.2	0.4	V	I_{Ox} = 3.2 mA, V_{Ix} = V_{IxL}
Input Current per Channel	I_I	−10	+0.01	+10	µA	0 V ≤ V_{Ix} ≤ V_{DDx}
Supply Current per Channel						
Quiescent Input Supply Current	$I_{DDI(Q)}$		0.54	0.75	mA	
Quiescent Output Supply Current	$I_{DDO(Q)}$		1.2	2.0	mA	
Dynamic Input Supply Current	$I_{DDI(D)}$		0.09		mA/Mbps	
Dynamic Output Supply Current	$I_{DDO(D)}$		0.02		mA/Mbps	
Undervoltage Lockout						
Positive V_{DDX} Threshold	V_{DDxUV+}		2.75		V	
Negative V_{DDX} Threshold	V_{DDxUV-}		2.65		V	
V_{DDX} Hysteresis	V_{DDxUVH}		0.1		V	
AC SPECIFICATIONS						
Output Rise/Fall Time	t_R/t_F		2.5		ns	10% to 90%
Common-Mode Transient Immunity[1]	|CM|	25	35		kV/µs	V_{Ix} = V_{DDx}, V_{CM} = 1000 V, transient magnitude = 800 V
Refresh Period	t_r		1.6		µs	

[1] |CM| is the maximum common-mode voltage slew rate that can be sustained while maintaining V_o > 0.8 V_{DDx}. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.

ELECTRICAL CHARACTERISTICS—MIXED 3.3 V/5 V OPERATION

All typical specifications are at T_A = 25°C, V_{DD1} = 3.3 V, V_{DD2} = 5 V. Minimum/maximum specifications apply over the entire recommended operation range: 3.135 V ≤ V_{DD1} ≤ 3.6 V, 4.5 V ≤ V_{DD2} ≤ 5.5 V; and −40°C ≤ T_A ≤ 125°C; unless otherwise noted. Switching specifications are tested with C_L = 15 pF and CMOS signal levels, unless otherwise noted.

Table 10.

Parameter	Symbol	A, WA Grades			B, WB Grades			C, WC Grades			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
SWITCHING SPECIFICATIONS												
Pulse Width	PW	1000			40			10			ns	Within PWD limit
Data Rate				1			25			100	Mbps	Within PWD limit
Propagation Delay	t_{PHL}, t_{PLH}			50			35	20	27	33	ns	50% input to 50% output
Pulse Width Distortion	PWD			10			3			2.5	ns	$\lvert t_{PLH} - t_{PHL} \rvert$
Change vs. Temperature			7			3			1.5		ps/°C	
Propagation Delay Skew	t_{PSK}			38			16			12	ns	Between any two units at same operating conditions
Channel Matching[1]												
Codirectional	t_{PSKCD}			5			3			2.5	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

[1] Codirectional 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-direction 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.

Table 11.

Parameter	Symbol	1 Mbps—A, B, C, WA, WB, WC Grades			25 Mbps—B, C, WB, WC Grades			100 Mbps—C, WC Grades			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
SUPPLY CURRENT												No load
ADuM1280/ADuM1285	I_{DD1}		0.75	1.4		5.1	9.0		17	23	mA	
	I_{DD2}		2.7	4.5		4.8	7.0		9.5	15	mA	
ADuM1281/ADuM1286	I_{DD1}		1.6	2.1		3.8	5.0		11	15	mA	
	I_{DD2}		1.7	2.3		3.9	6.2		11	15	mA	

Table 12. For All Models

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
DC SPECIFICATIONS						
Logic High Input Threshold	V_{IH}	0.7 V_{DDx}			V	
Logic Low Input Threshold	V_{IL}			0.3 V_{DDx}	V	
Logic High Output Voltages	V_{OH}	V_{DDx} − 0.1	V_{DDx}		V	I_{Ox} = −20 µA, V_{Ix} = V_{IxH}
		V_{DDx} − 0.4	V_{DDx} − 0.2		V	I_{Ox} = −3.2 mA, V_{Ix} = V_{IxH}
Logic Low Output Voltages	V_{OL}		0.0	0.1	V	I_{Ox} = 20 µA, V_{Ix} = V_{IxL}
			0.2	0.4	V	I_{Ox} = 3.2 mA, V_{Ix} = V_{IxL}
Input Current per Channel	I_I	−10	+0.01	+10	µA	0 V ≤ V_{Ix} ≤ V_{DDx}
Supply Current per Channel						
Quiescent Input Supply Current	$I_{DDI(Q)}$		0.4	0.75	mA	
Quiescent Output Supply Current	$I_{DDO(Q)}$		1.6	2.0	mA	
Dynamic Input Supply Current	$I_{DDI(D)}$		0.08		mA/Mbps	
Dynamic Output Supply Current	$I_{DDO(D)}$		0.03		mA/Mbps	
Undervoltage Lockout						
Positive V_{DDX} Threshold	V_{DDxUV+}		2.75		V	
Negative V_{DDX} Threshold	V_{DDxUV-}		2.65		V	
V_{DDX} Hysteresis	V_{DDxUVH}		0.1		V	

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
AC SPECIFICATIONS						
Output Rise/Fall Time	t_R/t_F		2.5		ns	10% to 90%
Common-Mode Transient Immunity[1]	|CM|	25	35		kV/µs	$V_{Ix} = V_{DDx}$, V_{CM} = 1000 V, transient magnitude = 800 V
Refresh Period	t_r		1.6		µs	

[1] |CM| is the maximum common-mode voltage slew rate that can be sustained while maintaining V_o > 0.8 V_{DDx}. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.

PACKAGE CHARACTERISTICS

Table 13.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
Resistance (Input-to-Output)[1]	R_{I-O}		10^{13}		Ω	
Capacitance (Input-to-Output)[1]	C_{I-O}		2		pF	f = 1 MHz
Input Capacitance[2]	C_I		4.0		pF	
IC Junction-to-Ambient Thermal Resistance	θ_{JA}		85		°C/W	Thermocouple located at center of package underside

[1] The device is considered a 2-terminal device; Pin 1 through Pin 4 are shorted together and Pin 5 through Pin 8 are shorted together.
[2] Input capacitance is from any input data pin to ground.

REGULATORY INFORMATION

The ADuM1280/ADuM1281/ADuM1285/ADuM1286 are approved by the organizations listed in Table 14. See Table 18 and Table 19 for recommended maximum working voltages for specific cross-isolation waveforms and insulation levels.

Table 14.

UL	CSA	VDE
Recognized Under UL 1577 Component Recognition Program[1]	Approved under CSA Component Acceptance Notice 5A	Certified according to DIN V VDE V 0884-10 (VDE V 0884-10): 2006-12[2]
Single Protection, 3000 V rms Isolation Voltage	Basic insulation per CSA 60950-1-03 and IEC 60950-1, 390 V rms (550 V peak) maximum working voltage	Reinforced insulation, 560 V peak
File E214100	File 205078	File 2471900-4880-0001

[1] In accordance with UL 1577, each ADuM1280/ADuM1281/ADuM1285/ADuM1286 is proof tested by applying an insulation test voltage ≥ 3600 V rms for 1 second (current leakage detection limit = 6 µA).
[2] In accordance with DIN V VDE V 0884-10, each ADuM1280/ADuM1281/ADuM1285/ADuM1286 is proof tested by applying an insulation test voltage ≥ 1050 V peak for 1 second (partial discharge detection limit = 5 pC). The asterisk (*) marked on the component designates DIN V VDE V 0884-10 approval.

INSULATION AND SAFETY-RELATED SPECIFICATIONS

Table 15.

Parameter	Symbol	Value	Unit	Test Conditions/Comments
Rated Dielectric Insulation Voltage		3000	V rms	1-minute duration
Clearance in the Plane of the PCB	CL_{PCB}	4.5	mm min	Measured from input terminals to output terminals, shortest line of sight distance through air in the plane of the PCB
Minimum External Air Gap (Clearance)	L(I01)	4.0	mm min	Measured from input terminals to output terminals, shortest distance through air
Minimum External Tracking (Creepage)	L(I02)	4.0	mm min	Measured from input terminals to output terminals, shortest distance path along body
Minimum Internal Gap (Internal Clearance)		0.017	mm min	Insulation distance through insulation
Tracking Resistance (Comparative Tracking Index)	CTI	>400	V	DIN IEC 112/VDE 0303 Part 1
Isolation Group		II		Material Group (DIN VDE 0110, 1/89, Table 1)

DIN V VDE V 0884-10 (VDE V 0884-10): 2006-12 INSULATION CHARACTERISTICS

These isolators are suitable for reinforced electrical isolation within the safety limit data only. Maintenance of the safety data is ensured by protective circuits. The asterisk (*) marked on packages denotes DIN V VDE V 0884-10 approval.

Table 16.

Description	Test Conditions/Comments	Symbol	Characteristic	Unit
Installation Classification per DIN VDE 0110				
For Rated Mains Voltage ≤ 150 V rms			I to IV	
For Rated Mains Voltage ≤ 300 V rms			I to III	
For Rated Mains Voltage ≤ 400 V rms			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	$V_{IORM} \times 1.875 = V_{pd(m)}$, 100% production test, $t_{ini} = t_m = 1$ sec, partial discharge < 5 pC	$V_{pd(m)}$	1050	V_{PEAK}
Input-to-Output Test Voltage, Method A				
After Environmental Tests Subgroup 1	$V_{IORM} \times 1.5 = V_{pd(m)}$, t_{ini}=60 sec, t_m = 10 sec, partial discharge < 5 pC	$V_{pd(m)}$	840	V_{PEAK}
After Input and/or Safety Test Subgroup 2 and Subgroup 3	$V_{IORM} \times 1.2 = V_{pd(m)}$, t_{ini} = 60 sec, t_m = 10 sec, partial discharge < 5 pC	$V_{pd(m)}$	672	V_{PEAK}
Highest Allowable Overvoltage		V_{IOTM}	4000	V_{PEAK}
Withstand Isolation Voltage	1 minute withstand rating	V_{ISO}	3000	V_{RMS}
Surge Isolation Voltage	V_{PEAK} = 10 kV, 1.2 µs rise time, 50 µs, 50% fall time	V_{IOSM}	6000	V_{PEAK}
Safety Limiting Values	Maximum value allowed in the event of a failure (see Figure 3)			
Case Temperature		T_S	150	°C
Total I_{DD1} and I_{DD2} Safety Limiting Current		I_S	290	mA
Insulation Resistance at T_S	V_{IO} = 500 V	R_S	$>10^9$	Ω

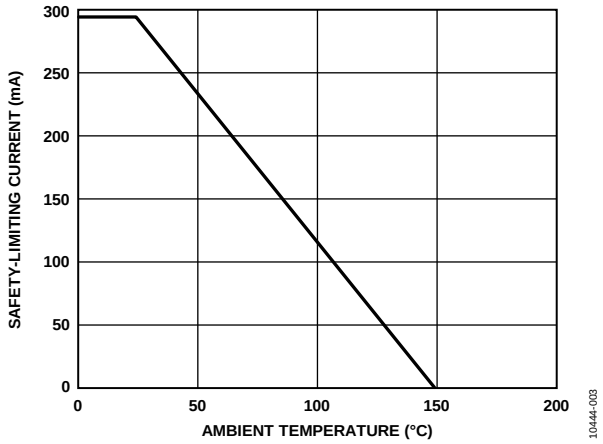


Figure 3. Thermal Derating Curve at V_{DDx} = 5 V, Dependence of Safety-Limiting Values with Case Temperature per DIN V VDE V 0884-10

RECOMMENDED OPERATING CONDITIONS

Table 17.

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	−40	+125	°C
Supply Voltages[1]	V_{DD1}, V_{DD2}			
A, B, and C Grades		3.135	5.5	V
WA, WB, and WC Grades		3.135	5.5	V
Input Signal Rise and Fall Times			1.0	ms

[1] See the DC Correctness and Magnetic Field Immunity section.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 18.

Parameter	Rating
Storage Temperature (T_{ST}) Range	−65°C to +150°C
Ambient Operating Temperature (T_A) Range	−40°C to +125°C
Supply Voltages (V_{DD1}, V_{DD2})	−0.5 V to +7.0 V
Input Voltages (V_{IA}, V_{IB})	−0.5 V to V_{DDI} + 0.5 V
Output Voltages (V_{OA}, V_{OB})	−0.5 V to V_{DD2} + 0.5 V
Average Output Current per Pin[1]	
Side 1 (I_{O1})	−10 mA to +10 mA
Side 2 (I_{O2})	−10 mA to +10 mA
Common-Mode Transients[2]	−100 kV/µs to +100 kV/µs

[1] See Figure 3 for maximum rated current values for various temperatures.
[2] Refers to common-mode transients across the insulation barrier. Common-mode transients exceeding the absolute maximum ratings may cause latch-up or permanent damage.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product 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 19. Maximum Continuous Working Voltage[1]

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

[1] Refers to continuous voltage magnitude imposed across the isolation barrier. See the Insulation Lifetime section for more details.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

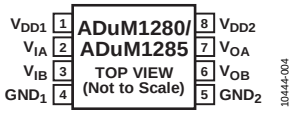


Figure 4. ADuM1280/ADuM1285 Pin Configuration

Table 20. ADuM1280/ADuM1285 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V_{DD1}	Supply Voltage for Isolator Side 1 (3.135 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 (3.135 V to 5.5 V).

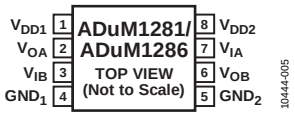


Figure 5. ADuM1281/ADuM1286 Pin Configuration

Table 21. ADuM1281/ADuM1286 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V_{DD1}	Supply Voltage for Isolator Side 1 (3.135 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 (3.135 V to 5.5 V).

For specific layout guidelines, refer to the AN-1109 Application Note, *Recommendations for Control of Radiated Emissions with* iCoupler *Devices*.

Table 22. ADuM1280 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} 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	
L	L	Unpowered	Powered	H	H	Outputs return to the input state within 1.6 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	Indeterminate	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

Table 23. ADuM1281 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} 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	L	Unpowered	Powered	Indeterminate	H	Outputs return to the input state within 1.6 µs of V_{DD1} power restoration.
L	X	Powered	Unpowered	H	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

Table 24. ADuM1285 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} 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	
L	L	Unpowered	Powered	L	L	Outputs return to the input state within 1.6 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	Indeterminate	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

Table 25. ADuM1286 Truth Table (Positive Logic)

V_{IA} Input	V_{IB} Input	V_{DD1} State	V_{DD2} State	V_{OA} Output	V_{OB} 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	L	Unpowered	Powered	Indeterminate	L	Outputs return to the input state within 1.6 µs of V_{DD1} power restoration.
L	X	Powered	Unpowered	L	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

TYPICAL PERFORMANCE CHARACTERISTICS

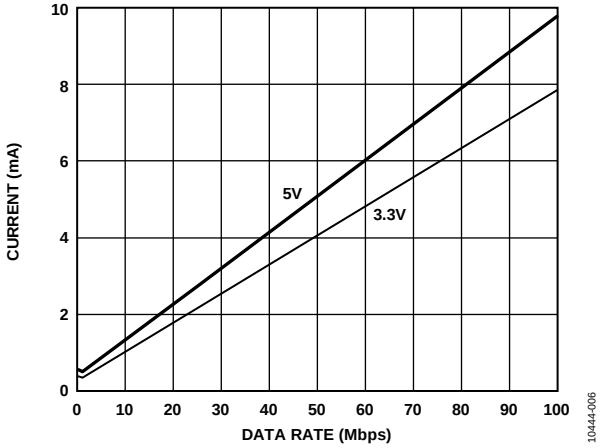


Figure 6. Typical Supply Current per Input Channel vs. Data Rate for 5 V and 3.3 V Operation

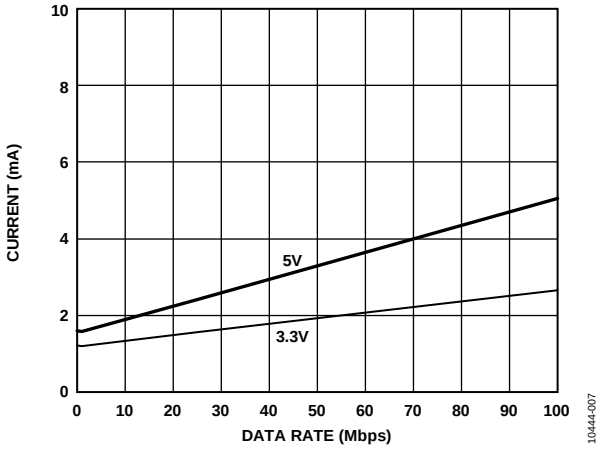


Figure 7. Typical Supply Current per Output Channel vs. Data Rate for 5 V and 3.3 V Operation (No Output Load)

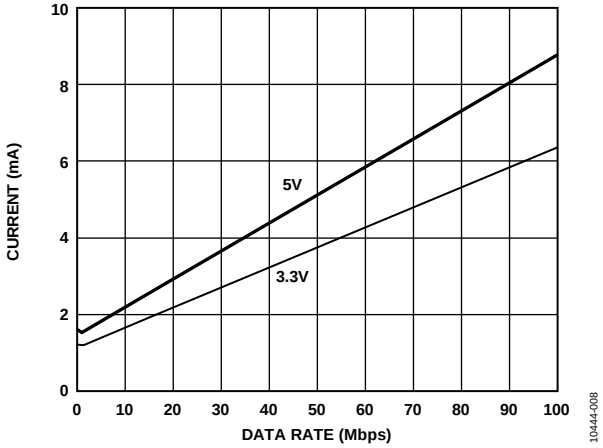


Figure 8. Typical Supply Current per Output Channel vs. Data Rate for 5 V and 3.3 V Operation (15 pF Output Load)

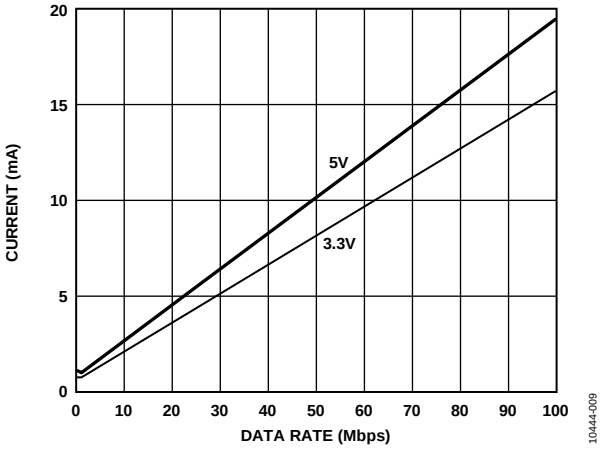


Figure 9. Typical ADuM1280 or ADuM1285 V_{DD1} Supply Current vs. Data Rate for 5 V and 3.3 V Operation

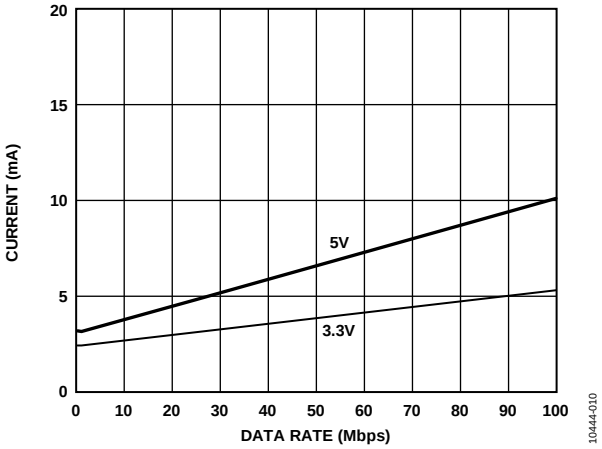


Figure 10. Typical ADuM1280 or ADuM1285 V_{DD2} Supply Current vs. Data Rate for 5 V and 3.3 V Operation

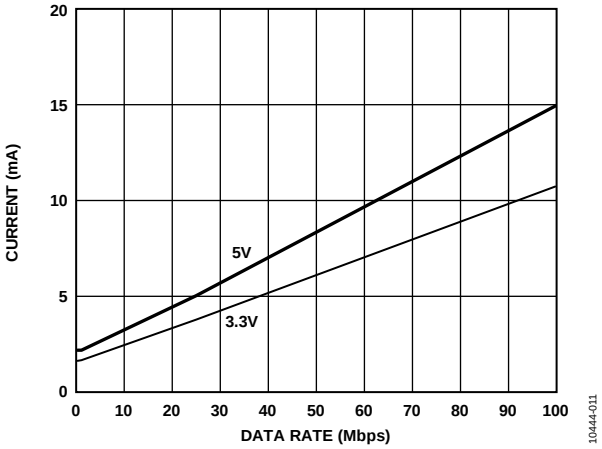


Figure 11. Typical ADuM1281 or ADuM1286 V_{DD1} or V_{DD2} Supply Current vs. Data Rate for 5 V and 3.3 V Operation

APPLICATIONS INFORMATION

PRINTED CIRCUIT BOARD LAYOUT

The ADuM1280/ADuM1281/ADuM1285/ADuM1286 digital isolator requires no external interface circuitry for the logic interfaces. Power supply bypassing is strongly recommended at both input and output supply pins V_{DD1} and V_{DD2} (see Figure 12). 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.

The ADuM1280/ADuM1281/ADuM1285/ADuM1286 can readily meet CISPR 22 Class A (and FCC Class A) emissions standards, as well as the more stringent CISPR 22 Class B (and FCC Class B) standards in an unshielded environment, with proper PCB design choices. Refer to the AN-1109 Applicaton Note, *Recommendations for Control of Radiated Emissions with iCoupler Devices* for PCB-related EMI mitigation techniques, including board layout and stack-up issues.

PROPAGATION DELAY-RELATED PARAMETERS

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

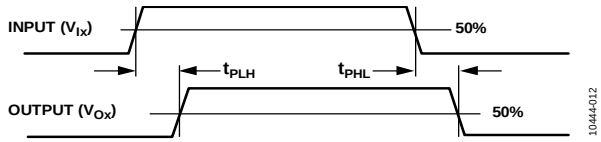


Figure 12. Propagation Delay Parameters

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

Channel-to-channel matching refers to the maximum amount the propagation delay differs between channels within a single ADuM1280/ADuM1281/ADuM1285/ADuM1286 component.

Propagation delay skew refers to the maximum amount the propagation delay differs between multiple ADuM1280/ADuM1281/ADuM1285/ADuM1286 components operating under the same conditions.

DC CORRECTNESS AND MAGNETIC FIELD IMMUNITY

Positive and negative logic transitions at the isolator input cause narrow (~1 ns) pulses to be sent 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 ~1.6 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 6.4 µs, the input side is assumed to be unpowered or nonfunctional, in which case, the isolator output is forced to a default low state by the watchdog timer circuit.

The limitation on the device's magnetic field immunity is set by the condition in which induced voltage in the transformer receiving coil is sufficiently large to either falsely set or reset the decoder. The following analysis defines such conditions. The ADuM1280 is examined in a 3.3 V operating condition because it represents the most susceptible mode of operation of this product.

The pulses at the transformer output have an amplitude greater than 1.5 V. The decoder has a sensing threshold of about 1.0 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

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

where:

β is the magnetic flux density.
r_n is the radius of the nth turn in the receiving coil.
N is the number of turns in the receiving coil.

Given the geometry of the receiving coil in the ADuM1280 and an imposed requirement that the induced voltage be, at most, 50% of the 0.5 V margin at the decoder, a maximum allowable magnetic field is calculated, as shown in Figure 13.

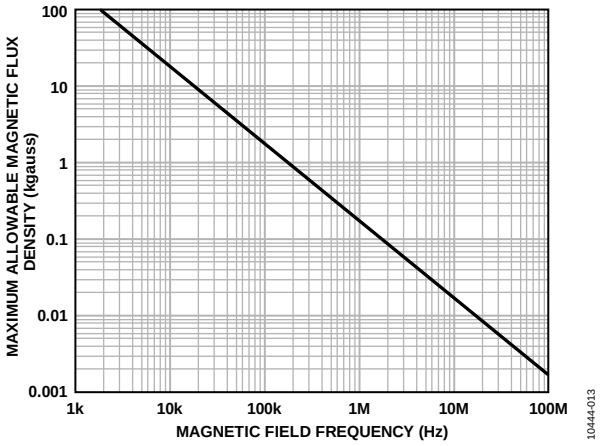


Figure 13. Maximum Allowable External Magnetic Flux Density

For example, at a magnetic field frequency of 1 MHz, the maximum allowable magnetic field of 0.08 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. If such an event occurs, with the worst-case polarity, during a transmitted pulse, it would reduce the received pulse from >1.0 V to 0.75 V. This is 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 ADuM1280 transformers. Figure 14 expresses these allowable current magnitudes as a function of frequency for selected distances. The ADuM1280 is very insensitive to external fields. Only extremely large, high frequency currents, very close to the component could potentially be a concern. For the 1 MHz example noted, place a 0.2 kA current 5 mm away from the ADuM1280 to affect component operation.

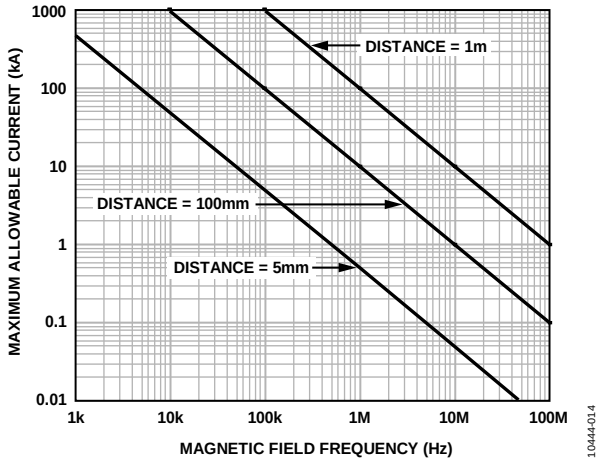


Figure 14. Maximum Allowable Current for Various Current to ADuM1280 Spacings

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. Take care to avoid PCB structures that form loops.

POWER CONSUMPTION

The supply current at a given channel of the ADuM1280/ADuM1281/ADuM1285/ADuM1286 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

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

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

For each output channel, the supply current is given by

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

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

where:
$I_{DDI(D)}$, $I_{DDO(D)}$ 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); it is half the input data rate, expressed in units of Mbps.
f_r is the input stage refresh rate (Mbps) = $1/t_r$ (µs).
$I_{DDI(Q)}$, $I_{DDO(Q)}$ are the specified input and output quiescent supply currents (mA).

To calculate the total V_{DD1} and V_{DD2} supply current, the supply currents for each input and output channel corresponding to V_{DD1} and V_{DD2} are calculated and totaled. Figure 6 and Figure 7 show per-channel supply currents as a function of data rate for an unloaded output condition. Figure 8 shows the per-channel supply current as a function of data rate for a 15 pF output condition. Figure 9 through Figure 11 show the total V_{DD1} and V_{DD2} supply current as a function of data rate for ADuM1280/ADuM1281 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 ADuM1280/ADuM1281/ADuM1285/ADuM1286.

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 19 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 ADuM1280/ADuM1281/ADuM1285/ADuM1286 depends on the voltage waveform type imposed across the isolation barrier. The *i*Coupler 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.

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. This allows operation at higher working voltages while still achieving a 50-year service life. The working voltages listed in Table 19 can be applied while maintaining the 50-year minimum lifetime provided the voltage conforms to either the unipolar ac or dc voltage case. 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 19.

Note that the voltage presented in Figure 17 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.

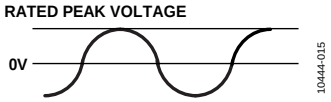


Figure 15. Bipolar AC Waveform

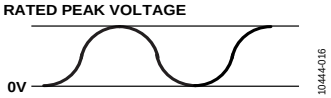


Figure 16. Unipolar AC Waveform

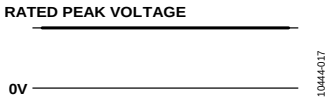
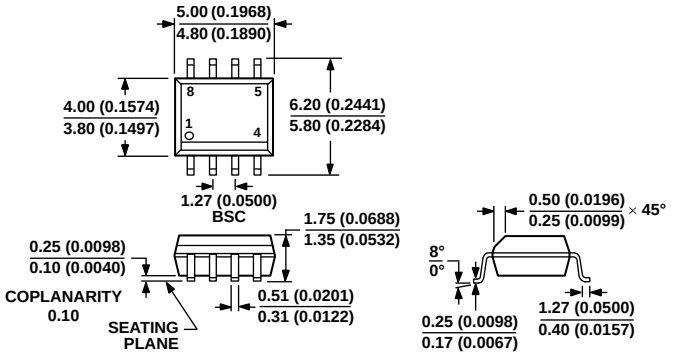


Figure 17. DC Waveform

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

012407-A

Figure 18. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-8)
Dimensions shown in millimeters (inches)

ORDERING GUIDE

Model[1, 2, 3]	No. of Inputs, V_{DD1} Side	No. of Inputs, V_{DD2} Side	Max Data Rate	Max Prop Delay, 5 V	Output Default State	Temperature Range	Package Description	Package Option
ADuM1280ARZ	2	0	1 Mbps	50	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1280WARZ	2	0	1 Mbps	50	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1280BRZ	2	0	25 Mbps	35	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1280WBRZ	2	0	25 Mbps	35	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1280CRZ	2	0	100 Mbps	24	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1280WCRZ	2	0	100 Mbps	24	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281ARZ	1	1	1 Mbps	50	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281WARZ	1	1	1 Mbps	50	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281BRZ	1	1	25 Mbps	35	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281WBRZ	1	1	25 Mbps	35	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281CRZ	1	1	100 Mbps	24	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1281WCRZ	1	1	100 Mbps	24	High	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285ARZ	2	0	1 Mbps	50	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285WARZ	2	0	1 Mbps	50	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285BRZ	2	0	25 Mbps	35	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285WBRZ	2	0	25 Mbps	35	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285CRZ	2	0	100 Mbps	24	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1285WCRZ	2	0	100 Mbps	24	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286ARZ	1	1	1 Mbps	50	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286WARZ	1	1	1 Mbps	50	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286BRZ	1	1	25 Mbps	35	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286WBRZ	1	1	25 Mbps	35	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286CRZ	1	1	100 Mbps	24	Low	−40°C to +125°C	8-Lead SOIC_N	R-8
ADuM1286WCRZ	1	1	100 Mbps	24	Low	−40°C to +125°C	8-Lead SOIC_N	R-8

[1] Z = RoHS Compliant Part.
[2] Tape and reel are available. The addition of an "-RL7" suffix designates a 7" (1,000 units) tape and reel option.
[3] W = Qualified for Automotive Applications.

AUTOMOTIVE PRODUCTS

The ADuM1280W, ADuM1281W, ADuM1285W, and ADuM1286W models are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models; therefore, designers should review the Specifications section of this data sheet carefully. Only the automotive grade products shown are available for use in automotive applications. Contact your local Analog Devices account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.

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D10444-0-2/17(D)

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