Data Sheet

ADuM2280/ADuM2281/ADuM2285/ADuM2286

5 kV RMS Dual Channel Digital Isolators

FEATURES

- High isolation voltage: 5000 V_{RMS}
- Up to 100 Mbps data rate
- Low propagation delay: 24 ns maximum
- Low dynamic power consumption
- Bidirectional communication
- 3 V to 5 V level translation
- High temperature operation: 125°C
- High common-mode transient immunity: >25 kV/µs
- Default high output: ADuM2280/ADuM2281
- Default low output: ADuM2285/ADuM2286
- 16-lead SOIC wide body enhanced creepage package
- Safety and regulatory approvals
  - UL 1577
    - V_{ISO} = 5000 V_{RMS} for 1 minute
  - IEC / CSA 62368-1
  - IEC / CSA 60601-1
  - IEC / CSA 61010-1
  - CQC GB 4943.1
  - DIN EN IEC 60747-17 (VDE 0884-17)
    - V_{IORM} = 645 V_{PEAK}
- Pin-compatible with ADuM220x and ADuM221x families

APPLICATIONS

- General-purpose, high voltage, multichannel isolation
- Medical equipment
- Power supplies
- RS-232/RS-422/RS-485 transceiver isolation

GENERAL DESCRIPTION

The ADuM2280/ADuM2281/ADuM2285/ADuM2286[1] (also referred to as ADuM228x in this data sheet) are 5 kV_{RMS} dual-channel digital isolators based on Analog Devices, Inc., *i*Coupler® 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 24 ns maximum, pulse width distortion is less than 2 ns for C grade. Channel-to-channel matching is tight at 5 ns for C grade. The ADuM228x are available in two channel configurations with three different data rates up to 100 Mbps (see the Ordering Guide). All models operate with the supply voltage on either side ranging from 3.0 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 ADuM228x 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 ADuM2280 and ADuM2281 have a default high output and the ADuM2285 and ADuM2286 have a default low output.

FUNCTIONAL BLOCK DIAGRAMS

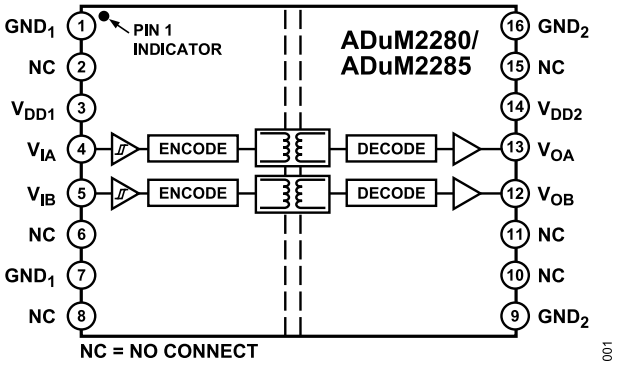


Figure 1. ADuM2280/ADuM2285 Pin-Compatible with ADuM2200/ADuM2210

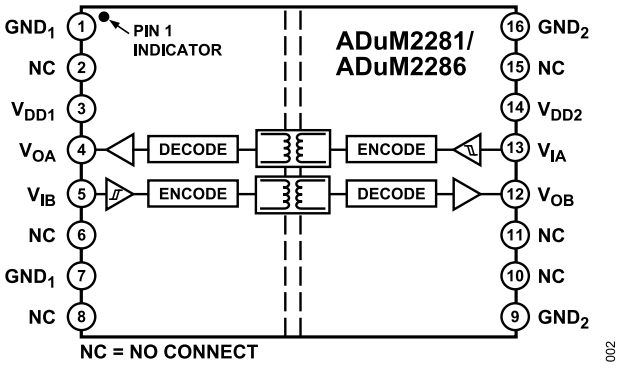


Figure 2. ADuM2281/ADuM2286 Pin-Compatible with ADuM2201/ADuM2211

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

TABLE OF CONTENTS

REVISION HISTORY

3/2025—Rev. C to Rev. D

Changes to Features Section ... 1
Changes to Regulatory Information Section and Table 14 ... 8
Changes to Table 15 ... 8
Changed DIN V VDE V 0884-10 (VDE V 0884-10) Insulation Characteristics Section to DIN EN IEC 60747-17 (VDE 0884-17) Insulation Characteristics Section ... 8
Changes to DIN EN IEC 60747-17 (VDE 0884-17) Insulation Characteristics Section and Table 16 ... 8
Changes to Table 19 ... 10
Changes to Insulation Lifetime Section ... 16
Deleted Figure 16 to Figure 18; Renumbered Sequentially ... 16

11/2023—Rev. B to Rev. C

Changes to Features Section ... 1
Changes to Regulatory Information Section ... 8
Changes to Table 14 ... 8

6/2023—Rev. A to Rev. B

Change to General Description Section ... 1
Changes to Electrical Characteristics—3 V Operation Section ... 4
Change to Electrical Characteristics—Mixed 5 V/3 V Operation Section ... 5
Change to Electrical Characteristics—Mixed 3 V/5 V Operation Section ... 6
Change to Table 17 ... 9
Added Maximum Continuous Working Voltage Section ... 10
Changes to Table 20 and Table 21 ... 11
Updated Outline Dimensions ... 18
Changes to Ordering Guide ... 18

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.

		A Grade			B Grade			C Grade				
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			39	13	20	24	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												
Codirectional	t_{PSKCD}			5			3			2	ns	
Opposing Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

Table 2.

		1 Mbps—A, B, C Grades			25 Mbps—B, C Grades			100 Mbps—C Grade				
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
SUPPLY CURRENT												No load
ADuM2280/ADuM2285	I_{DD1}		1.3	1.6		6.2	7.0		20	25	mA	
	I_{DD2}		2.7	4.5		4.8	7.0		9.5	15	mA	
ADuM2281/ADuM2286	I_{DD1}		2.3	2.6		5.8	6.5		16	19	mA	
	I_{DD2}		2.3	2.9		5.8	6.5		16.5	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} = −4 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} = 4 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	
Undervoltage Lockout						
Positive V_{DDx} Threshold	V_{DDxUV+}		2.6		V	
Negative V_{DDx} Threshold	V_{DDxUV-}		2.4		V	
V_{DDx} Hysteresis	V_{DDxUVH}		0.2		V	

SPECIFICATIONS

Table 3. For All Models (Continued)

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.

ELECTRICAL CHARACTERISTICS—3 V OPERATION

All typical specifications are at T_A = 25°C, $V_{DD1} = V_{DD2}$ = 3.0 V. Minimum/maximum specifications apply over the entire recommended operation range: 3.0 V ≤ V_{DD1} ≤ 3.6 V, 3.0 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 Grade			B Grade			C Grade				
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			39	20	28	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												
Codirectional	t_{PSKCD}			5			3			2.5	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

Table 5.

		1 Mbps—A, B, C Grades			25 Mbps—B, C Grades			100 Mbps—C Grade				
Parameter	Symbol	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit	Test Conditions
SUPPLY CURRENT												No load
ADuM2280/ADuM2285	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	
ADuM2281/ADuM2286	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} = −4 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} = 4 mA, $V_{Ix} = V_{IxL}$
Input Current per Channel	I_I	−10	+0.01	+10	µA	0 V ≤ V_{Ix} ≤ V_{DDx}

SPECIFICATIONS

Table 6. For All Models (Continued)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
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+}		2.6		V	
Negative V_{DDx} Threshold	V_{DDxUV-}		2.4		V	
V_{DDx} Hysteresis	V_{DDxUVH}		0.2		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 V OPERATION

All typical specifications are at T_A = 25°C, V_{DD1} = 5 V, V_{DD2} = 3.0 V. Minimum/maximum specifications apply over the entire recommended operation range: 4.5 V ≤ V_{DD1} ≤ 5.5 V, 3.0 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 Grade			B Grade			C Grade				
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			39	13	20	26	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												
Codirectional	t_{PSKCD}			5			3			2	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

Table 8.

		1 Mbps—A, B, C Grades			25 Mbps—B, C Grades			100 Mbps—C Grades				
Parameter	Symbol	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit	Test Conditions
SUPPLY CURRENT												No load
ADuM2280/ADuM2285	I_{DD1}		1.3	1.6		6.2	7.0		20	25	mA	
	I_{DD2}		2.0	3.5		2.7	4.6		4.8	9.0	mA	
ADuM2281/ADuM2286	I_{DD1}		2.3	2.6		5.8	6.5		16	19	mA	
	I_{DD2}		1.7	2.3		3.9	6.2		11	15	mA	

SPECIFICATIONS

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} = −4 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} = 4 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+}		2.6		V	
Negative V_{DDx} Threshold	V_{DDxUV-}		2.4		V	
V_{DDx} Hysteresis	V_{DDxUVH}		0.2		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 V/5 V OPERATION

All typical specifications are at T_A = 25°C, V_{DD1} = 3.0 V, V_{DD2} = 5 V. Minimum/maximum specifications apply over the entire recommended operation range: 3.0 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.

		A Grade			B Grade			C Grade				
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			39	16	24	30	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												
Codirectional	t_{PSKCD}			5			3			2.5	ns	
Opposing-Direction	t_{PSKOD}			10			6			5	ns	
Jitter			2			2			1		ns	

SPECIFICATIONS

Table 11.

		1 Mbps—A, B, C Grades			25 Mbps—B, C Grades			100 Mbps—C Grade				
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
SUPPLY CURRENT												No load
ADuM2280/ADuM2285	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	
ADuM2281/ADuM2286	I_{DD1}		1.6	2.1		3.8	5.0		11	15	mA	
	I_{DD2}		1.7	2.3		5.8	6.5		16.5	19	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} = −4 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} = 4 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+}		2.6		V	
Negative V_{DDx} Threshold	V_{DDxUV-}		2.4		V	
V_{DDx} Hysteresis	V_{DDxUVH}		0.2		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.

PACKAGE CHARACTERISTICS

Table 13.

Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
RESISTANCE AND CAPACITANCE						
Resistance (Input-to-Output)[1]	R_{I-O}		10^{13}		Ω	
Capacitance (Input-to-Output)[1]	C_{I-O}		2.2		pF	f = 1 MHz
Input Capacitance[2]	C_I		4.0		pF	
IC Junction to Ambient Thermal Resistance	θ_{JA}		45		°C/W	Thermocouple located at the center of the package underside; test conducted on a 4-layer board with thin traces

[1] This device is considered a 2-terminal device; Pin 1 through Pin 8 are shorted together and Pin 9 through Pin 16 are shorted together.

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

SPECIFICATIONS

REGULATORY INFORMATION

The ADuM2280/ADuM2281/ADuM2285/ADuM2286 certification approvals are listed in Table 14. See Table 19 and the Absolute Maximum Ratings section for recommended maximum working voltages for specific cross-isolation waveforms and insulation levels.

Table 14.

UL	CSA	CQC	VDE
UL 1577[1] Single Protection, 5000 V_{RMS}	IEC / CSA 62368-1 Basic insulation, 870 V_{RMS} Reinforced insulation, 435 V_{RMS} IEC / CSA 61010-1 Basic insulation, 600 V_{RMS} Reinforced insulation, 300 V_{RMS} IEC / CSA 60601-1 Basic insulation (1 MOPP), 500 V_{RMS} Reinforced insulation (2 MOPP), 50 V_{RMS}	CQC GB 4943.1 Basic insulation, 800 V_{RMS} Reinforced insulation, 400 V_{RMS}	DIN EN IEC 60747-17 (VDE 0884-17)[2] Reinforced insulation, 645 V_{PEAK}
File E214100	File No. 205078	Certificate No. CQC15001129425	Certificate No. 40011599

[1] In accordance with UL 1577, each ADuM2280/ADuM2281/ADuM2285/ADuM2286 is proof tested by applying an insulation test voltage ≥ 6000 V_{RMS} for 1 second (current leakage detection limit = 10 µA).

[2] In accordance with DIN EN IEC 60747-17 (VDE 0884-17), each ADuM2280/ADuM2281/ADuM2285/ADuM2286 is proof tested by applying an insulation test voltage ≥ 1209 V_{PEAK} for 1 second (partial discharge detection limit = 5 pC). The asterisk (*) marked on the component designates DIN EN IEC 60747-17 (VDE 0884-17) approval.

INSULATION AND SAFETY-RELATED SPECIFICATIONS

Table 15.

Parameter	Symbol	Value	Unit	Test Conditions
Rated Dielectric Insulation Voltage		5000	V_{RMS}	1-minute duration
Minimum External Air Gap (Clearance)[1,2]	L(I01)	8.7	mm	Distance measured from input terminals to output terminals, shortest distance through air along the PCB mounting plane, as an aid to PC board layout
Minimum External Tracking (Creepage)[1]	L(I02)	8.7	mm	Measured from input terminals to output terminals, shortest distance path along body
Minimum Internal Gap (Internal Clearance)		18	µm	Insulation distance through insulation
Tracking Resistance (Comparative Tracking Index)[3]	CTI	>400	V	DIN IEC 112/VDE 0303 Part 1
Material Group		II		Material Group (DIN VDE 0110, 1/89, Table 1)

[1] In accordance with IEC 62368-1 / IEC 60601-1 guidelines for the measurement of creepage and clearance distances for a pollution degree of 2 and altitudes ≤2000 m.

[2] Consideration must be given to pad layout to ensure the minimum required distance for clearance is maintained.

[3] CTI rating for the ADuM2280/ADuM2281/ADuM2285/ADuM2286 is >400 V and a Material Group II isolation group.

DIN EN IEC 60747-17 (VDE 0884-17) INSULATION CHARACTERISTICS

These isolators are suitable for reinforced electrical isolation only within the safety limit data. Maintenance of the safety data is ensured by means of protective circuits. Note that the asterisk (*) branded on packages denotes DIN EN IEC 60747-17 (VDE 0884-17) approval.

Table 16.

Description	Test Conditions	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 II	
For Rated Mains Voltage ≤ 400 V_{RMS}			I to II	
Climatic Classification			40/105/21	
Pollution Degree per DIN VDE 0110, Table 1			2	

SPECIFICATIONS

Table 16. (Continued)

Description	Test Conditions	Symbol	Characteristic	Unit
Maximum Repetitive Isolation Voltage		V_{IORM}	645	V_{PEAK}
Maximum Working Insulation Voltage		V_{IOWM}	456	V_{RMS}
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	$V_{pd(m)}$	1209	V_{PEAK}
Input-to-Output Test Voltage, Method A				
After Environmental Tests Subgroup 1	$V_{IORM} \times 1.6 = V_{pd(m)}$, t_{ini} = 60 sec, t_m = 10 sec, partial discharge < 5 pC	$V_{pd(m)}$	1032	V_{PEAK}
After Input and/or Safety Test Subgroup 2and Subgroup 3	$V_{IORM} \times 1.2 = V_{pd(m)}$, t_{ini} = 60 sec, t_m = 10 sec, partial discharge < 5 pC	$V_{pd(m)}$	774	V_{PEAK}
Maximum Transient Isolation Voltage	$V_{TEST} = 1.2 \times V_{IOTM}$, t =1 sec (100% production)	V_{IOTM}	6000	V_{PEAK}
Maximum Impulse Voltage	Surge Voltage in Air, Waveform per IEC 61000-4-5	V_{IMP}	6000	V_{PEAK}
Withstand Isolation Voltage	1 minute withstand rating	V_{ISO}	5000	V_{RMS}
Maximum Surge Isolation Voltage	$V_{TEST} \geq 1.3 \times V_{IMP}$ (sample test), Tested in Oil, Waveform per IEC 61000-4-5	V_{IOSM}	10000	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 I_{DD1} Current		I_{S1}	555	mA
Insulation Resistance at T_S	V_{IO} = 500 V	R_S	$>10^9$	Ω

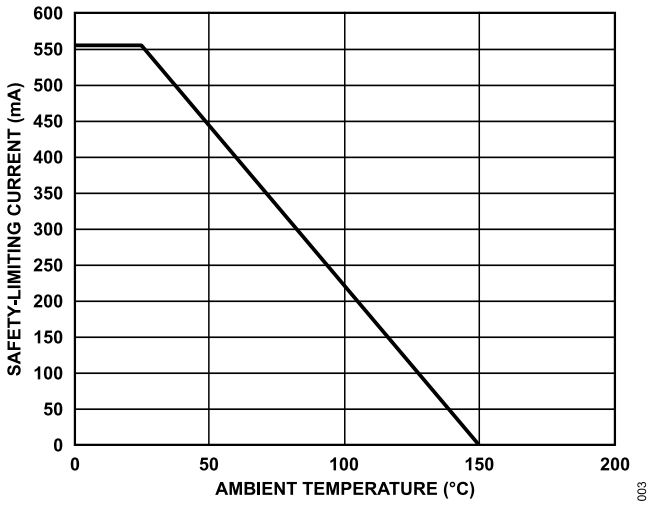


Figure 3. Thermal Derating Curve, Dependence of Safety-Limiting Values with Case Temperature per DIN EN IEC 60747-17 (VDE 0884-17)

RECOMMENDED OPERATING CONDITIONS

Table 17.

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	−40	+125	°C
Supply Voltages[1]	V_{DD1}, V_{DD2}	3.0	5.5	V
Input Signal Rise and Fall Times			1.0	ms

[1] See the DC Correctness and Magnetic Field Immunity section. All voltages are relative to their respective ground.

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.

MAXIMUM CONTINUOUS WORKING VOLTAGE

Table 19. Maximum Continuous Working Voltage[1]

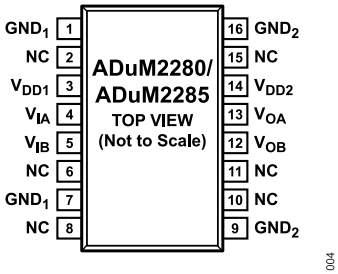
Parameter	Max	Unit	Constraint
AC Voltage			
Bipolar Waveform	645	V_{PEAK}	Reinforced insulation rating per IEC 60747-17 (VDE 0884-17).

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

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.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS



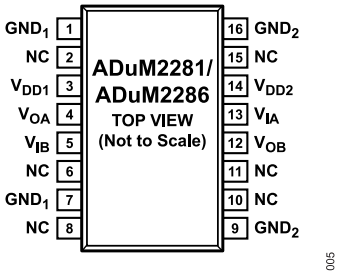
NOTES
1. NC = NO CONNECT.
2. PIN 1 AND PIN 7 ARE INTERNALLY CONNECTED, AND CONNECTING BOTH TO GND_1 IS RECOMMENDED.
3. PIN 9 AND PIN 16 ARE INTERNALLY CONNECTED, AND CONNECTING BOTH TO GND_2 IS RECOMMENDED.

Figure 4. ADuM2280/ADuM2285 Pin Configuration

Table 20. ADuM2280/ADuM2285 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	GND_1	Ground 1. Ground reference for Isolator Side 1.
2	NC	No internal connection.
3	V_{DD1}	Supply Voltage for Isolator Side 1, 3.0 V to 5.5 V.
4	V_{IA}	Logic Input A.
5	V_{IB}	Logic Input B.
6	NC	No internal connection.
7	GND_1	Ground 1. Ground reference for Isolator Side 1.
8	NC	No internal connection.
9	GND_2	Ground 2. Ground reference for Isolator Side 2.
10	NC	No internal connection.
11	NC	No internal connection.
12	V_{OB}	Logic Output B.
13	V_{OA}	Logic Output A.
14	V_{DD2}	Supply Voltage for Isolator Side 2, 3.0 V to 5.5 V.
15	NC	No internal connection.
16	GND_2	Ground 2. Ground reference for Isolator Side 2.

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



NOTES:
1. NC = NO CONNECT.
2. PIN 1 AND PIN 7 ARE INTERNALLY CONNECTED, AND CONNECTING BOTH TO GND_1 IS RECOMMENDED.
3. PIN 9 AND PIN 16 ARE INTERNALLY CONNECTED, AND CONNECTING BOTH TO GND_2 IS RECOMMENDED.

Figure 5. ADuM2281/ADuM2286 Pin Configuration

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

Table 21. ADuM2281/ADuM2286 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	GND_1	Ground 1. Ground reference for Isolator Side 1.
2	NC	No internal connection.
3	V_{DD1}	Supply Voltage for Isolator Side 1, 3.0 V to 5.5 V.
4	V_{OA}	Logic Output A.
5	V_{IB}	Logic Input B.
6	NC	No internal connection.
7	GND_1	Ground 1. Ground reference for Isolator Side 1.
8	NC	No internal connection.
9	GND_2	Ground 2. Ground reference for Isolator Side 2.
10	NC	No internal connection.
11	NC	No internal connection.
12	V_{OB}	Logic Output B.
13	V_{IA}	Logic Input A.
14	V_{DD2}	Supply Voltage for Isolator Side 2, 3.0 V to 5.5 V.
15	NC	No internal connection.
16	GND_2	Ground 2. Ground reference for Isolator Side 2.

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

Table 22. ADuM2280 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	X	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. ADuM2281 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	X	Unpowered	Powered	Indeterminate	H	Outputs return to the input state within 1.6 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	H	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

Table 24. ADuM2285 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	X	Unpowered	Powered	L	L	Outputs return to the input state within 1.6 µs of V_{DDI} power restoration.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

Table 24. ADuM2285 Truth Table (Positive Logic) (Continued)

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

Table 25. ADuM2286 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	X	Unpowered	Powered	Indeterminate	L	Outputs return to the input state within 1.6 µs of V_{DDI} power restoration.
X	X	Powered	Unpowered	L	Indeterminate	Outputs return to the input state within 1.6 µs of V_{DDO} power restoration.

TYPICAL PERFORMANCE CHARACTERISTICS

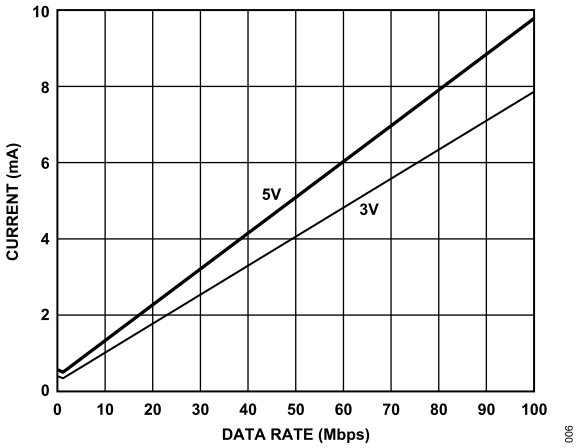


Figure 6. Typical Supply Current per Input Channel vs. Data Rate for 5 V and 3 V Operation

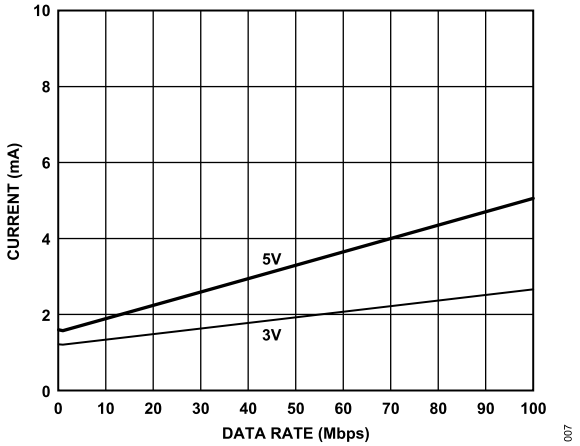


Figure 7. Typical Supply Current per Output Channel vs. Data Rate for 5 V and 3 V Operation (No Output Load)

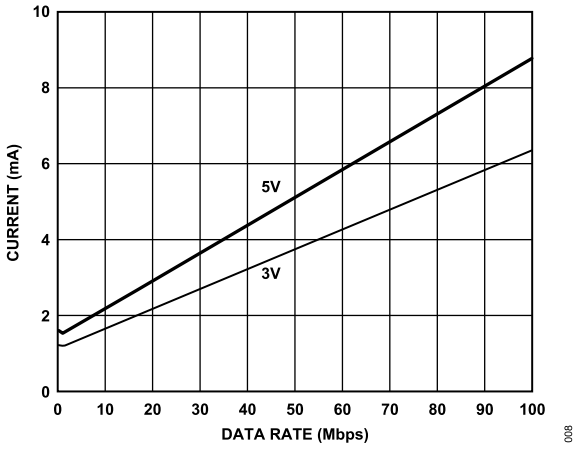


Figure 8. Typical Supply Current per Output Channel vs. Data Rate for 5 V and 3 V Operation (15 pF Output Load)

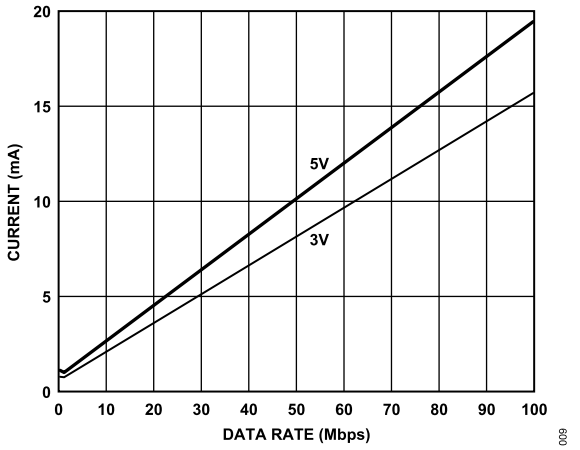


Figure 9. Typical ADuM2280 or ADuM2285 V_{DD1} Supply Current vs. Data Rate for 5 V and 3 V Operation

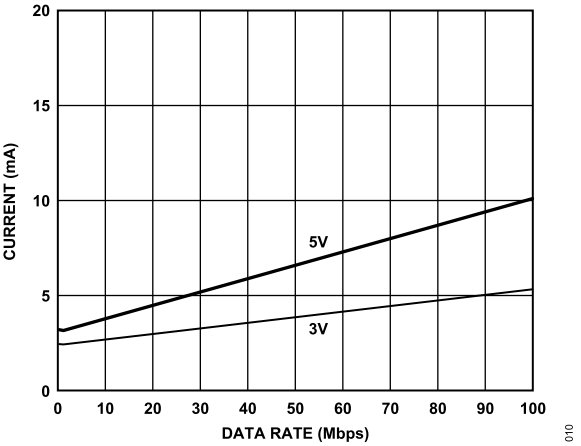


Figure 10. Typical ADuM2280 or ADuM2285 V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation

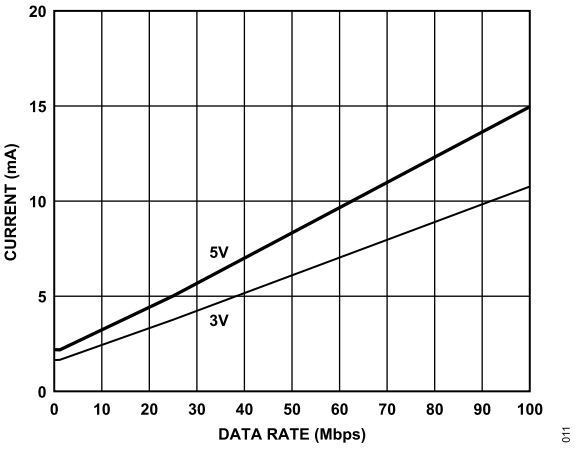


Figure 11. Typical ADuM2281 or ADuM2286 V_{DD1} or V_{DD2} Supply Current vs. Data Rate for 5 V and 3 V Operation

APPLICATIONS INFORMATION

PC BOARD LAYOUT

The ADuM228x digital isolators requires no external interface circuitry for the logic interfaces. Power supply bypassing is strongly recommended at the input and output supply pins (see Figure 12). Bypass capacitors are most conveniently connected between Pin 1 and Pin 3 for V_{DD1} and between Pin 14 and Pin 16 for V_{DD2}. The capacitor value should be between 0.01 µF and 0.1 µF. The total lead length between both ends of the capacitor and the input power supply pin should not exceed 20 mm. Bypassing between Pin 3 and Pin 7 and between Pin 9 and Pin 14 should be considered unless the ground pair on each package side are connected close to the package.

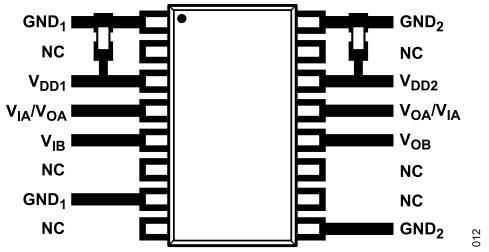


Figure 12. Recommended Printed Circuit Board Layout

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

The ADuM228x 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 Application Note 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.

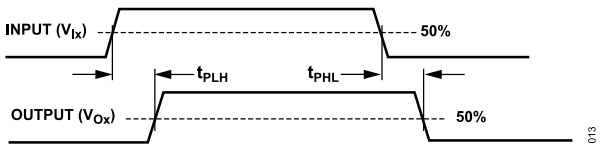


Figure 13. Propagation Delay Parameters

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 ADuM228x component.

Propagation delay skew refers to the maximum amount the propagation delay differs between multiple ADuM228x 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 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 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 ADuM2280 is examined in a 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

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

where:
β is the magnetic flux density.
r_n is the radius of the n^{th} turn in the receiving coil.
N is the number of turns in the receiving coil.

Given the geometry of the receiving coil in the ADuM2280 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 14.

APPLICATIONS INFORMATION

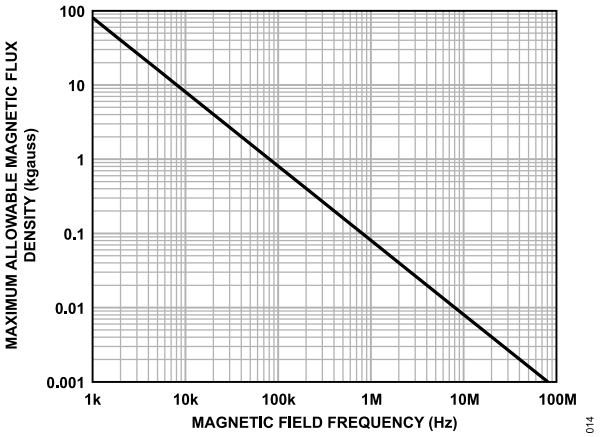


Figure 14. Maximum Allowable External Magnetic Flux Density

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 ADuM2280 transformers. Figure 15 expresses these allowable current magnitudes as a function of frequency for selected distances. The ADuM2280 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, one would have to place a 0.2 kA current 5 mm away from the ADuM2280 to affect component operation.

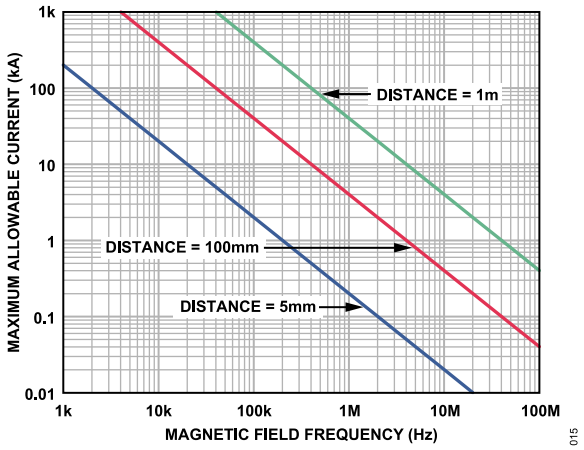


Figure 15. Maximum Allowable Current for Various Current to ADuM2280 Spacings

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 ADuM228x isolators 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

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

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

For each output channel, the supply current is given by

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

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

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 the ADuM2280/ADuM2285 and ADuM2281/ADuM2286 channel configurations.

INSULATION LIFETIME

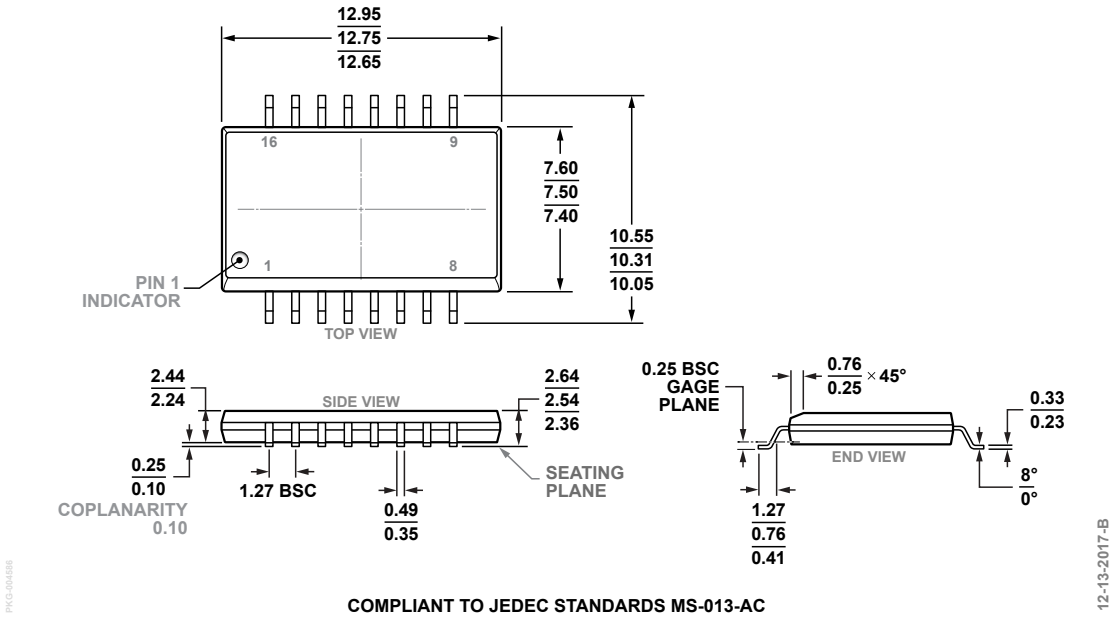
All insulation structures eventually break down when subjected to voltage stress over a sufficiently long period. The rate of insulation degradation is dependent on the characteristics of the voltage waveform applied across the insulation. In addition to the testing performed by the regulatory agencies, Analog Devices carries out an extensive set of evaluations to determine the lifetime of the insulation structure within the ADuM228x.

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 maximum continuous working voltages as per IEC 60747-17. Operation at

APPLICATIONS INFORMATION

these high working voltages can lead to shortened insulation life in some cases.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-013-AC

Figure 16. 16-Lead Standard Small Outline Package, with Increased Creepage [SOIC_IC]
Wide Body
(RI-16-2)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Packing Quantity	Package Option
ADUM2280ARIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2280ARIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2280BRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2280BRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2280CRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2280CRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2281ARIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2281ARIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2281BRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2281BRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2281CRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2281CRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2285ARIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2285ARIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2285BRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2285CRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2285CRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2286ARIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2286ARIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2286BRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2286BRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2
ADUM2286CRIZ	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Tube, 37	RI-16-2
ADUM2286CRIZ-RL	-40°C to +125°C	16-Lead SOIC (Increased Creepage)	Reel, 1000	RI-16-2

[1] Z = RoHS Compliant Part.