

### FEATURES

**Bidirectional I<sup>2</sup>C communication**  
**Open-drain interfaces**  
**Suitable for hot swap applications**  
**30 mA current sink capability**  
**1000 kHz operation**  
**3.0 V to 5.5 V supply/logic levels**  
**8-lead SOIC lead-free package**  
**High temperature operation: 105°C**  
**Safety and regulatory approvals**

#### UL recognition

2500 V rms for 1 minute per UL 1577

CSA Component Acceptance Notice #5A (pending)

VDE Certificate of Conformity (pending)

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

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

V<sub>IORM</sub> = 560 V peak

### APPLICATIONS

**Isolated I<sup>2</sup>C, SMBus, or PMBus interfaces**  
**Multilevel I<sup>2</sup>C interfaces**  
**Power supplies**  
**Networking**  
**Power-over-Ethernet**

### GENERAL DESCRIPTION

The ADuM1250/ADuM1251<sup>1</sup> are hot swappable digital isolators with non latching bidirectional communication channels compatible with I<sup>2</sup>C interfaces. This eliminates the need for splitting I<sup>2</sup>C signals into separate transmit and receive signals for use with standalone optocouplers.

The ADuM1250 provides two bidirectional channels supporting a complete isolated I<sup>2</sup>C interface. The ADuM1251 provides one bidirectional channel and one unidirectional channel for those applications where a bidirectional clock is not required.

### FUNCTIONAL BLOCK DIAGRAMS

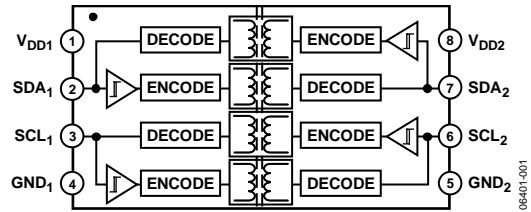


Figure 1. ADuM1250 Functional Block Diagram

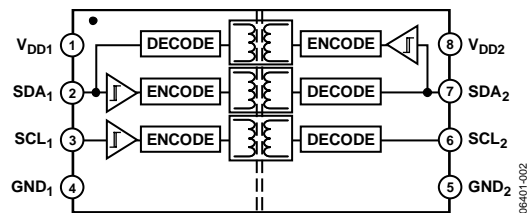


Figure 2. ADuM1251 Functional Block Diagram

Both the ADuM1250 and ADuM1251 contain hot swap circuitry to prevent glitching data when an unpowered card is inserted onto an active bus.

These isolators are based on *iCoupler*<sup>®</sup> chip scale transformer technology from Analog Devices, Inc. *iCoupler* is a magnetic isolation technology with functional, performance, size, and power consumption advantages as compared to optocouplers. With the ADuM1250/ADuM1251, *iCoupler* channels can be integrated with semiconductor circuitry, which enables a complete isolated I<sup>2</sup>C interface to be provided in a small form factor.

<sup>1</sup> Protected by U.S. Patents 5,952,849 and 6,873,065. Other patents pending.

#### Rev. 0

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## REVISION HISTORY

10/06—Revision 0: Initial Version 0

## SPECIFICATIONS

### ELECTRICAL CHARACTERISTICS

#### DC Specifications

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

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
ADuM1250						
Input Supply Current, Side 1, 5 V	$I_{DD1}$		2.8	5.0	mA	$V_{DD1} = 5\text{ V}$
Input Supply Current, Side 2, 5 V	$I_{DD2}$		2.7	5.0	mA	$V_{DD2} = 5\text{ V}$
Input Supply Current, Side 1, 3.3 V	$I_{DD1}$		1.9	3.0	mA	$V_{DD1} = 3.3\text{ V}$
Input Supply Current, Side 2, 3.3 V	$I_{DD2}$		1.7	3.0	mA	$V_{DD2} = 3.3\text{ V}$
ADuM1251						
Input Supply Current, Side 1, 5 V	$I_{DD1}$		2.8	6.0	mA	$V_{DD1} = 5\text{ V}$
Input Supply Current, Side 2, 5 V	$I_{DD2}$		2.5	4.7	mA	$V_{DD2} = 5\text{ V}$
Input Supply Current, Side 1, 3.3 V	$I_{DD1}$		1.8	3.0	mA	$V_{DD1} = 3.3\text{ V}$
Input Supply Current, Side 2, 3.3 V	$I_{DD2}$		1.6	2.8	mA	$V_{DD2} = 3.3\text{ V}$
LEAKAGE CURRENTS	$I_{SDA1}, I_{SDA2}, I_{SCL1}, I_{SCL2}$		0.01	10	$\mu\text{A}$	$V_{SDA1} = V_{DD1}, V_{SDA2} = V_{DD2}, V_{SCL1} = V_{DD1}, V_{SCL2} = V_{DD2}$
SIDE 1 LOGIC LEVELS						
Logic Input Threshold <sup>1</sup>	$V_{SDA1T}, V_{SCL1T}$	500		700	mV	
Logic Low Output Voltages	$V_{SDA1OL}, V_{SCL1OL}$	600		900	mV	$I_{SDA1} = I_{SCL1} = 3.0\text{ mA}$
		600		850	mV	$I_{SDA1} = I_{SCL1} = 0.5\text{ mA}$
Input/Output Logic Low Level Difference <sup>2</sup>	$\Delta V_{SDA1}, \Delta V_{SCL1}$	50			mV	
SIDE 2 LOGIC LEVELS						
Logic Low Input Voltage	$V_{SDA2IL}, V_{SCL2IL}$			$0.3 V_{DD2}$	V	
Logic High Input Voltage	$V_{SDA2IH}, V_{SCL2IH}$	$0.7 V_{DD2}$			V	
Logic Low Output Voltage	$V_{SDA2OL}, V_{SCL2OL}$			400	mV	$I_{SDA2} = I_{SCL2} = 30\text{ mA}$

<sup>1</sup>  $V_{IL} < 0.5\text{ V}$ ,  $V_{IH} > 0.7\text{ V}$ .

<sup>2</sup>  $\Delta V_{S1} = V_{S1OL} - V_{S1T}$ . This is the minimum difference between the output logic low level and the input logic threshold within a given component. This ensures that there is no possibility of the part latching up the bus to which it is connected.

# ADuM1250/ADuM1251

## AC Specifications

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

Table 2.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
MAXIMUM FREQUENCY		1000			kHz	
OUTPUT FALL TIME						
5 V Operation						$4.5\text{ V} \leq V_{DD1}, V_{DD2} \leq 5.5\text{ V}$ , $C_{L1} = 40\text{ pF}$ , $R_1 = 1.6\text{ k}\Omega$ , $C_{L2} = 400\text{ pF}$ , $R_2 = 180\text{ }\Omega$
Side 1 Output (0.9 $V_{DD1}$ to 0.9 V)	$t_{f1}$	13	26	120	ns	
Side 2 Output (0.9 $V_{DD2}$ to 0.1 $V_{DD2}$ )	$t_{f2}$	32	52	120	ns	
3 V Operation						$3.0\text{ V} \leq V_{DD1}, V_{DD2} \leq 3.6\text{ V}$ , $C_{L1} = 40\text{ pF}$ , $R_1 = 1.0\text{ k}\Omega$ , $C_{L2} = 400\text{ pF}$ , $R_2 = 120\text{ }\Omega$
Side 1 Output (0.9 $V_{DD1}$ to 0.9 V)	$t_{f1}$	13	32	120	ns	
Side 2 Output (0.9 $V_{DD2}$ to 0.1 $V_{DD2}$ )	$t_{f2}$	32	61	120	ns	
PROPAGATION DELAY						
5 V Operation						$4.5 \leq V_{DD1}, V_{DD2} \leq 5.5\text{ V}$ , $C_{L1} = C_{L2} = 0$ , $R_1 = 1.6\text{ k}\Omega$ , $R_2 = 180\text{ }\Omega$
Side 1-to-Side 2, Rising Edge <sup>1</sup>	$t_{PLH12}$		95	130	ns	
Side 1-to-Side 2, Falling Edge <sup>2</sup>	$t_{PHL12}$		162	275	ns	
Side 2-to-Side 1, Rising Edge <sup>3</sup>	$t_{PLH21}$		31	70	ns	
Side 2-to-Side 1, Falling Edge <sup>4</sup>	$t_{PHL21}$		85	155	ns	
3 V Operation						$3.0\text{ V} \leq V_{DD1}, V_{DD2} \leq 3.6\text{ V}$ , $C_{L1} = C_{L2} = 0$ , $R_1 = 1.0\text{ k}\Omega$ , $R_2 = 120\text{ }\Omega$
Side 1-to-Side 2, Rising Edge <sup>1</sup>	$t_{PLH12}$		82	125	ns	
Side 1-to-Side 2, Falling Edge <sup>2</sup>	$t_{PHL12}$		196	340	ns	
Side 2-to-Side 1, Rising Edge <sup>3</sup>	$t_{PLH21}$		32	75	ns	
Side 2-to-Side 1, Falling Edge <sup>4</sup>	$t_{PHL21}$		110	210	ns	
PULSE WIDTH DISTORTION						
5 V Operation						$4.5\text{ V} \leq V_{DD1}, V_{DD2} \leq 5.5\text{ V}$ , $C_{L1} = C_{L2} = 0$ , $R_1 = 1.6\text{ k}\Omega$ , $R_2 = 180\text{ }\Omega$
Side 1-to-Side 2, $ t_{PLH12} - t_{PHL12} $	$PWD_{12}$		67	145	ns	
Side 2-to-Side 1, $ t_{PLH21} - t_{PHL21} $	$PWD_{21}$		54	85	ns	
3 V Operation						$3.0\text{ V} \leq V_{DD1}, V_{DD2} \leq 3.6\text{ V}$ , $C_{L1} = C_{L2} = 0$ , $R_1 = 1.0\text{ k}\Omega$ , $R_2 = 120\text{ }\Omega$
Side 1-to-Side 2, $ t_{PLH12} - t_{PHL12} $	$PWD_{12}$		114	215	ns	
Side 2-to-Side 1, $ t_{PLH21} - t_{PHL21} $	$PWD_{21}$		77	135	ns	
COMMON-MODE TRANSIENT IMMUNITY <sup>5</sup>	$ CM_H $ , $ CM_L $	25	35		kV/ $\mu$ s	

<sup>1</sup>  $t_{PLH12}$  propagation delay is measured from the Side 1 input logic threshold to an output value of 0.7  $V_{DD2}$ .

<sup>2</sup>  $t_{PHL12}$  propagation delay is measured from the Side 1 input logic threshold to an output value of 0.4 V.

<sup>3</sup>  $t_{PLH21}$  propagation delay is measured from the Side 2 input logic threshold to an output value of 0.7  $V_{DD1}$ .

<sup>4</sup>  $t_{PHL21}$  propagation delay is measured from the Side 2 input logic threshold to an output value of 0.9 V.

<sup>5</sup>  $CM_H$  is the maximum common-mode voltage slew rate that can be sustained while maintaining  $V_o > 0.8 V_{DD2}$ .  $CM_L$  is the maximum common-mode voltage slew rate that can be sustained while maintaining  $V_o < 0.8\text{ V}$ . 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.

**PACKAGE CHARACTERISTICS**

Table 3.

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

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

**REGULATORY INFORMATION**

The ADuM1250/ADuM1251 has been approved by the following organizations:

Table 4.

UL	CSA (Pending)	VDE (Pending)
Recognized under 1577 Component Recognition Program <sup>1</sup> Basic insulation, 2500 V rms isolation rating  File E214100	Approved under CSA Component Acceptance Notice #5A Basic insulation per CSA 60950-1-03 and IEC 60950-1, 400 V rms (560 V peak) maximum working voltage  File 205078	Certified according to DIN EN 60747-5-2 (VDE 0884 Part 2):2003-01 <sup>2</sup> Basic insulation, 400 V rms (560 V peak) maximum working voltage  File 2471900-4880-0001

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

<sup>2</sup> In accordance with DIN EN 60747-5-2, each device 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 5.

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)

# ADuM1250/ADuM1251

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

This isolator is suitable for basic isolation only within the safety limit data. Maintenance of the safety data is ensured by protective circuits. The \* marking on the package denotes DIN EN 60747-5-2 approval for a 560 V peak working voltage.

**Table 6.**

Description	Symbol	Characteristic	Unit
Installation Classification per DIN VDE 0110		I to IV	
For Rated Mains Voltage ≤ 150 V rms		I to III	
For Rated Mains Voltage ≤ 300 V rms		I to II	
For Rated Mains Voltage ≤ 400 V rms		40/105/21	
Climatic Classification		2	
Pollution Degree (DIN VDE 0110, Table 1)			
Maximum Working Insulation Voltage	$V_{IORM}$	560	$V_{PEAK}$
Input-to-Output Test Voltage, Method b1	$V_{PR}$	1050	$V_{PEAK}$
$V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test, $t_m = 1$ sec, Partial Discharge < 5 pC			
Input-to-Output Test Voltage, Method a	$V_{PR}$		
After Environmental Tests Subgroup 1		896	$V_{PEAK}$
$V_{IORM} \times 1.6 = V_{PR}$ , $t_m = 60$ sec, Partial Discharge < 5 pC			
After Input and/or Safety Test Subgroup 2/3		672	
$V_{IORM} \times 1.2 = V_{PR}$ , $t_m = 60$ sec, Partial Discharge < 5 pC			
Highest Allowable Overvoltage (Transient Overvoltage, $t_{TR} = 10$ sec)	$V_{TR}$	4000	$V_{PEAK}$
Safety-Limiting Values (Maximum Value Allowed in the Event of a Failure (See also Figure 3)			
Case Temperature	$T_S$	150	°C
Side 1 Current	$I_{S1}$	160	mA
Side 2 Current	$I_{S2}$	170	mA
Insulation Resistance at $T_S$ , $V_{IO} = 500$ V	$R_S$	>10 <sup>9</sup>	Ω

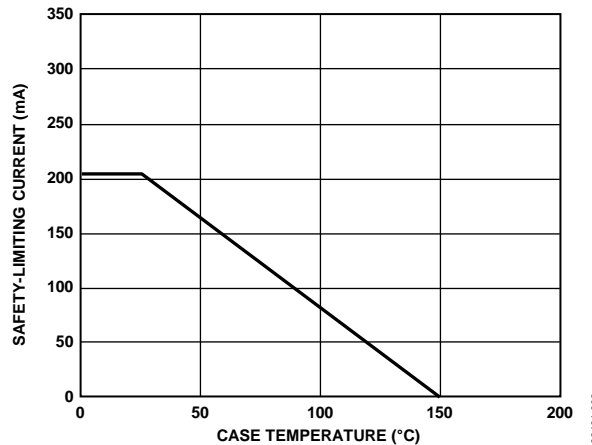


Figure 3. Thermal Derating Curve, Dependence of Safety Limiting Values on Case Temperature, per DIN EN 60747-5-2

## RECOMMENDED OPERATING CONDITIONS

**Table 7.**

Parameter	Symbol	Min	Max	Unit
Operating Temperature	$T_A$	-40	+105	°C
Supply Voltages <sup>1</sup>	$V_{DD1}$ , $V_{DD2}$	3.0	5.5	V
Input/Output Signal Voltage	$V_{SDA1}$ , $V_{SCL1}$ , $V_{SDA2}$ , $V_{SCL2}$		5.5	V
Capacitive Load, Side 1	$C_{L1}$		40	pF
Capacitive Load, Side 2	$C_{L2}$		400	pF
Static Output Loading, Side 1	$I_{SDA1}$ , $I_{SCL1}$	0.5	3	mA
Static Output Loading, Side 2	$I_{SDA2}$ , $I_{SCL2}$	0.5	30	mA

<sup>1</sup> All voltages are relative to their respective ground. See the Application Notes section for data on immunity to external magnetic fields.

## ABSOLUTE MAXIMUM RATINGS

Ambient temperature = 25°C, unless otherwise noted.

Table 8.

Parameter	Symbol	Min	Max	Unit
Storage Temperature	$T_{ST}$	-55	+150	°C
Ambient Operating Temperature	$T_A$	-40	+105	°C
Supply Voltages <sup>1</sup>	$V_{DD1}$ , $V_{DD2}$	-0.5	+7.0	V
Input/Output Voltage <sup>1</sup> , Side 1	$V_{SDA1}$ , $V_{SCL1}$	-0.5	$V_{DD1} + 0.5$	V
Input/Output Voltage <sup>1</sup> , Side 2	$V_{SDA2}$ , $V_{SCL2}$	-0.5	$V_{DD2} + 0.5$	V
Average Output Current, per Pin2	$I_O$			mA
Common-Mode Transients <sup>3</sup>		-100	+100	kV/ $\mu$ s

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

<sup>2</sup> See Figure 3 for maximum rated current values for various temperatures.

<sup>3</sup> 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 indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

# ADuM1250/ADuM1251

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

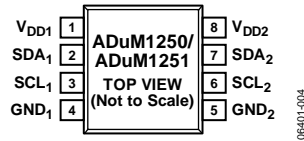


Figure 4. ADuM1250/ADuM1251 Pin Configuration

Table 9. ADuM1250 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V <sub>DD1</sub>	Supply Voltage, 3.0 V to 5.5 V.
2	SDA <sub>1</sub>	Data Input/Output, Side 1.
3	SCL <sub>1</sub>	Clock Input/Output, Side 1.
4	GND <sub>1</sub>	Ground 1. Ground reference for isolator Side 1.
5	GND <sub>2</sub>	Ground 2. Isolated ground reference for isolator Side 2.
6	SCL <sub>2</sub>	Clock Input/Output, Side 2.
7	SDA <sub>2</sub>	Data Input/Output, Side 2.
8	V <sub>DD2</sub>	Supply Voltage, 3.0 V to 5.5 V.

Table 10. ADuM1251 Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V <sub>DD1</sub>	Supply Voltage, 3.0 V to 5.5 V.
2	SDA <sub>1</sub>	Data Input/Output, Side 1.
3	SCL <sub>1</sub>	Clock Input, Side 1.
4	GND <sub>1</sub>	Ground 1. Ground reference for isolator Side 1.
5	GND <sub>2</sub>	Ground 2. Isolated ground reference for isolator Side 2.
6	SCL <sub>2</sub>	Clock Output, Side 2.
7	SDA <sub>2</sub>	Data Input/Output, Side 2.
8	V <sub>DD2</sub>	Supply Voltage, 3.0 V to 5.5 V.



TEST CONDITIONS

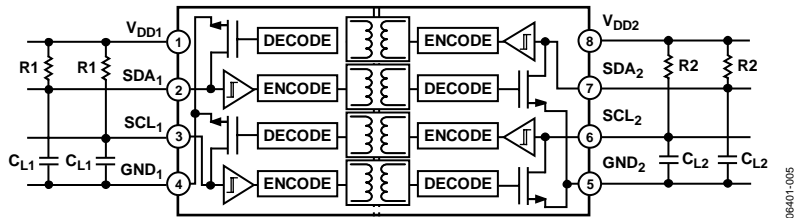


Figure 5. Timing Test Diagram

## APPLICATION NOTES

### FUNCTIONAL DESCRIPTION

The ADuM1250/ADuM1251 interfaces on each side to a bidirectional I<sup>2</sup>C signal. Internally, the I<sup>2</sup>C interface is split into two unidirectional channels communicating in opposing directions via a dedicated iCoupler isolation channel for each. One channel (the bottom channel of each channel pair shown in Figure 6) senses the voltage state of the Side 1 I<sup>2</sup>C pin and transmits its state to its respective Side 2 I<sup>2</sup>C pin.

Both the Side 1 and the Side 2 I<sup>2</sup>C pins are designed to interface to an I<sup>2</sup>C bus operating in the 3.0 V to 5.5 V range. A logic low on either causes the opposite pin to be pulled low enough to comply with the logic low threshold requirements of other I<sup>2</sup>C devices on the bus. Avoidance of I<sup>2</sup>C bus contention is ensured by an input low threshold at SDA<sub>1</sub> or SCL<sub>1</sub> guaranteed to be at least 50 mV less than the output low signal at the same pin. This prevents an output logic low at Side 1 being transmitted back to Side 2 and pulling down the I<sup>2</sup>C bus.

Since the Side 2 logic levels/thresholds are standard I<sup>2</sup>C values, multiple ADuM1250/ADuM1251 devices connected to a bus by their Side 2 pins can communicate with each other and with other devices having I<sup>2</sup>C compatibility<sup>1</sup>.

However, since the Side 1 pin has a modified output level/input threshold, this side of the ADuM1250/ADuM1251 can only communicate with devices conforming to the I<sup>2</sup>C standard. In other words, Side 2 of the ADuM1250/ADuM1251 is I<sup>2</sup>C-compliant while Side 1 is only I<sup>2</sup>C-compatible.

The output logic low levels are independent of the V<sub>DD1</sub> and V<sub>DD2</sub> voltages. The input logic low threshold at Side 1 is also independent of V<sub>DD1</sub>. However, the input logic low threshold at Side 2 is designed to be at 0.3 V<sub>DD2</sub>, consistent with I<sup>2</sup>C requirements. The Side 1 and Side 2 pins have open-collector outputs whose high levels are set via pull-up resistors to their respective supply voltages.

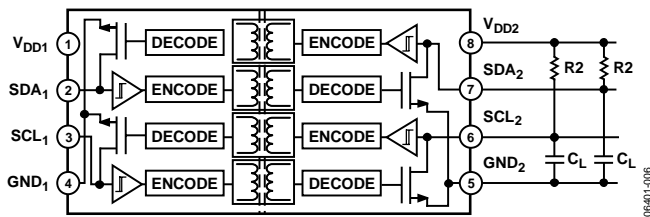


Figure 6. ADuM1250 Block Diagram

<sup>1</sup> Here a distinction is made between I<sup>2</sup>C compatibility and I<sup>2</sup>C compliance. I<sup>2</sup>C compatibility refers to situations in which a component's logic levels do not necessarily meet the requirements of the I<sup>2</sup>C specification but still allow the component to communicate with an I<sup>2</sup>C-compliant device. I<sup>2</sup>C compliance refers to situations in which a component's logic levels meet the requirements of the I<sup>2</sup>C specification.

### STARTUP

Both the V<sub>DD1</sub> and V<sub>DD2</sub> supplies have an under voltage lockout feature to prevent the signal channels from operating unless certain criteria are met. This avoids the possibility of input logic low signals from pulling down the I<sup>2</sup>C bus inadvertently during power-up/power-down.

The two criteria that must be met in order for the signal channels to be enabled are as follows:

- Both supplies must be at least 2.5 V.
- At least 40 μs must elapse after both supplies exceeded the internal startup threshold of 2.0 V.

Until both of these criteria are met for both supplies, the ADuM1250/ADuM1251 outputs are pulled high, ensuring a startup that avoids any disturbances on the bus. Figure 7 and Figure 8 illustrate the supply conditions for fast and slow input supply slew rates.

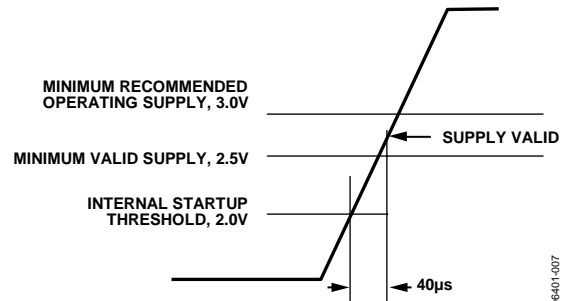


Figure 7. Start-Up Condition, Supply Slew Rate > 12.5 V/ms

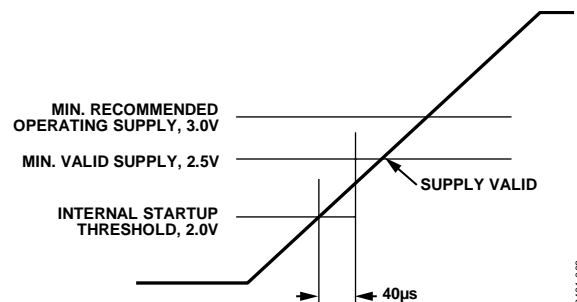


Figure 8. Start-Up Condition, Supply Slew Rate < 12.5 V/ms

**TYPICAL APPLICATION DIAGRAM**

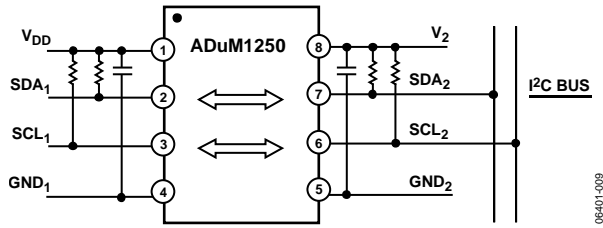


Figure 9. Typical Isolated I<sup>2</sup>C Interface using ADuM1250

**MAGNETIC FIELD IMMUNITY**

The ADuM1250 is extremely immune to external magnetic fields. The limitation on the ADuM1250's magnetic field immunity is set by the condition in which induced voltage in the transformer's receiving coil is sufficiently large to either falsely set or reset the decoder. The following analysis defines the conditions under which this may occur. The 3 V operating condition of the ADuM1250 is examined because it represents the most susceptible mode of operation.

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

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

where:

- $\beta$  is the magnetic flux density (gauss).
- $N$  is the number of turns in the receiving coil.
- $r_n$  is the radius of the nth turn in the receiving coil (cm).

Given the geometry of the receiving coil in the ADuM1250 and an imposed requirement that the induced voltage is at most 50% of the 0.5 V margin at the decoder, a maximum allowable magnetic field is calculated, as shown in Figure 10.

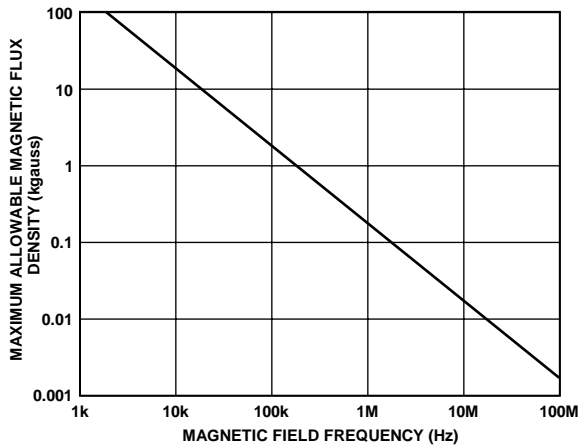


Figure 10. Maximum Allowable External Magnetic Flux Density

For example, at a magnetic field frequency of 1 MHz, the maximum allowable magnetic field of 0.2 kgauss induces a voltage of 0.25 V at the receiving coil. This is about 50% of the sensing threshold and does not cause a faulty output transition. Similarly, if such an event occurs during a transmitted pulse (with the worst-case polarity), it reduces the received pulse from > 1.0 V to 0.75 V. Note that 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 ADuM1250 transformers. Figure 11 expresses these allowable current magnitudes as a function of frequency for selected distances. As shown in Figure 11, the ADuM1250 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, one would have to place a 0.5 kA current 5 mm away from the ADuM1250 to affect the component's operation.

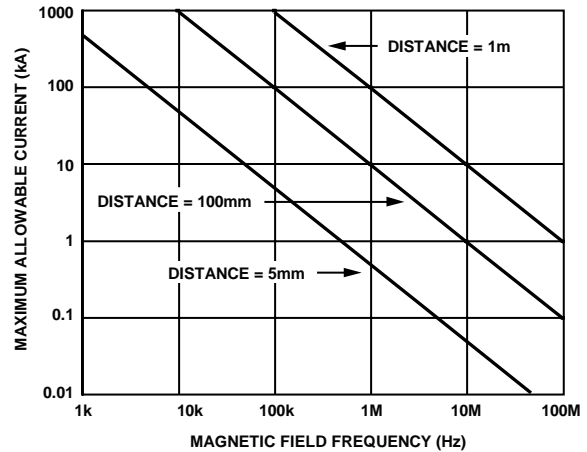
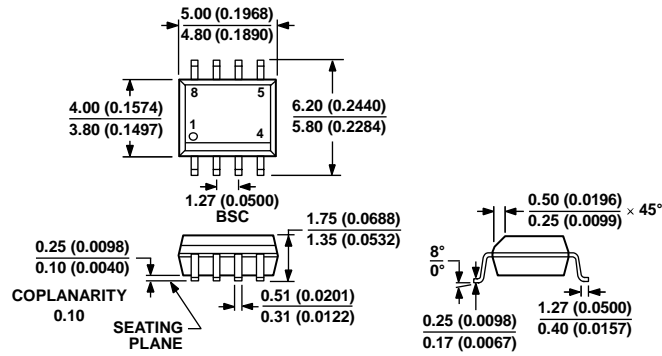


Figure 11. Maximum Allowable Current for Various Current-to-ADuM1250 Spacings

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

# ADuM1250/ADuM1251

## 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.

Figure 12. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-8)

Dimensions shown in millimeters (inches)

060506-A

## ORDERING GUIDE

Model	Number of Inputs, V <sub>DD1</sub> Side	Number of Inputs, V <sub>DD2</sub> Side	Maximum Data Rate (Mbps)	Maximum Propagation Delay (ns)	Temperature Range	Package Description	Package Option
ADuM1250ARZ <sup>1</sup>	2	2	1	150	-40°C to +105°C	8-Lead SOIC_N	R-8
ADuM1250ARZ-RL7 <sup>1</sup>	2	2	1	150	-40°C to +105°C	8-Lead SOIC_N	R-8
ADuM1251ARZ <sup>1</sup>	2	1	1	150	-40°C to +105°C	8-Lead SOIC_N	R-8
ADuM1251ARZ-RL7 <sup>1</sup>	2	1	1	150	-40°C to +105°C	8-Lead SOIC_N	R-8

<sup>1</sup> Z = Pb-free part.