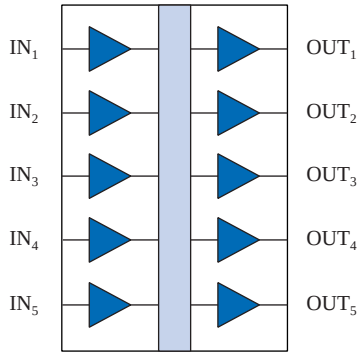
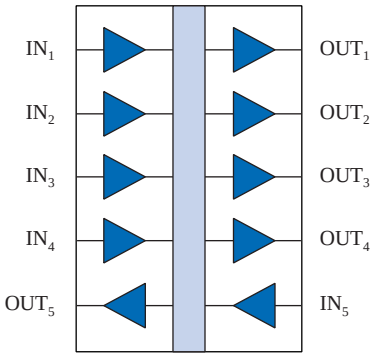
High Speed Five-Channel Digital Isolators

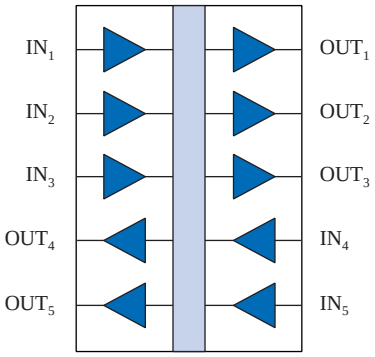
Functional Diagrams



IL260



IL261



IL262

Features

- +5 V / +3.3 V CMOS/TTL Compatible
- High Speed: 110 Mbps
- Extended Temperature Range (−40°C to +85°C)
- 2500 V_{RMS} Isolation (1 min.)
- 2 ns Typical Pulse Width Distortion
- 100 ps Typical Pulse Jitter
- 4 ns Typical Propagation Delay Skew
- 10 ns Typical Propagation Delay
- 30 kV/µs Typical Common Mode Rejection
- Low EMC Footprint
- 2 ns Channel-to-Channel Skew
- 0.3" and 0.15" 16-pin SOIC Packages
- UL1577 and IEC 61010-2001 Approved

Applications

- ADCs and DACs
- Multiplexed Data Transmission
- Data Interfaces
- Board-to-Board Communication
- Digital Noise Reduction
- Operator Interface
- Ground Loop Elimination
- Peripheral Interfaces
- Parallel Bus
- Logic Level Shifting
- Plasma Displays

Description

NVE's IL260-Series five-channel high-speed digital isolators are CMOS devices manufactured with NVE's patented* IsoLoop® spintronic Giant Magnetoresistive (GMR) technology.

All transmit and receive channels operate at 110 Mbps over the full temperature and supply voltage range. The symmetric magnetic coupling barrier provides a typical propagation delay of only 10 ns and a pulse width distortion of 2 ns, achieving the best specifications of any isolator. The unique fifth channel can be is used to distribute isolated clocks or handshake signals to multiple delta-sigma A/D converters. High channel density makes these devices ideal for isolating ADCs and DACs, parallel buses and peripheral interfaces.

Typical transient immunity of 30 kV/µs is unsurpassed. Performance is specified over the temperature range of −40°C to +85°C without derating.

IL260-Series Isolators are available in 0.3" and 0.15" 16-pin SOIC packages. In the 0.15" packages, the five-channel devices provide the highest channel density available.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 Fax: (952) 829-9189 www.IsoLoop.com

Absolute Maximum Ratings

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	−55		150	°C	
Ambient Operating Temperature [1]	T_A	−55		125	°C	
Supply Voltage	V_{DD1} ,V_{DD2}	−0.5		7	V	
Input Voltage	V_I	−0.5		V_{DD} + 0.5	V	
Output Voltage	V_O	−0.5		V_{DD} + 0.5	V	
Output Current Drive	I_O	−10		10	mA	
Lead Solder Temperature				260	°C	10 sec.
ESD			2		kV	HBM

Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Ambient Operating Temperature	T_A	−40		85	°C	
Supply Voltage	V_{DD1} ,V_{DD2}	3.0		5.5	V	3.3/5.0 V Operation
Logic High Input Voltage	V_{IH}	2.4		V_{DD}	V	
Logic Low Input Voltage	V_{IL}	0		0.8	V	
Input Signal Rise and Fall Times	t_{IR}, t_{IF}			1	µs	

Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (external)						
0.15" SOIC		4.03			mm	
0.3" SOIC		8.08			mm	
Leakage Current[5]			0.2		μA_{RMS}	240 V_{RMS}
Barrier Impedance[5]			$>10^{14} \| 7$		Ω || pF	
Capacitance (Input–Output)[5]	C_{I-O}		5		pF	f = 1 MHz

Safety and Approvals

IEC61010-2001

TUV Certificate Numbers: N1502812, N1502812-101

Classification as Reinforced Insulation

Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL260, IL261, IL262	0.3" 16-pin SOIC	II	III	300 V_{RMS}
IL260-3, IL261-3, IL262-3	0.15" 16-pin SOIC	II	III	150 V_{RMS}

UL 1577

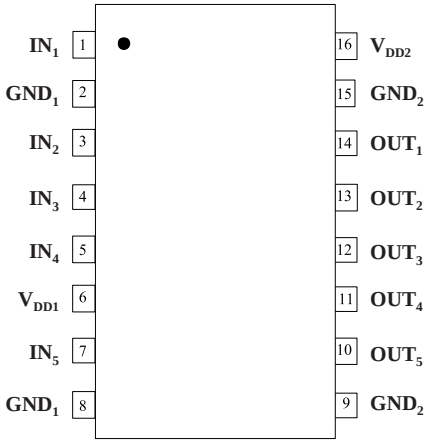
Component Recognition Program File Number: E207481
Rated 2500 V_{RMS} for 1 minute (SOIC, PDIP)

Soldering Profile

Per JEDEC J-STD-020C, MSL=2

IL260 Pin Connections

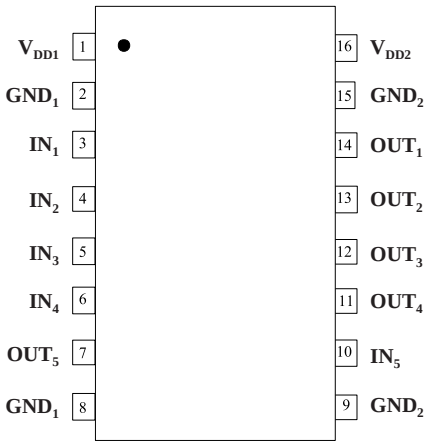
1	**IN_1**	Input 1
2	**GND_1**	Ground
3	**IN_2**	Input 2
4	**IN_3**	Input 3
5	**IN_4**	Input 4
6	**V_{DD1}**	Supply Voltage 1
7	**IN_5**	Input 5
8	**GND_1**	Ground
9	**GND_2**	Ground
10	**OUT_5**	Output 5
11	**OUT_4**	Output 4
12	**OUT_3**	Output 3
13	**OUT_2**	Output 2
14	**OUT_1**	Output 1
15	**GND_2**	Ground
16	**V_{DD2}**	Supply Voltage 2



IL260

IL261 Pin Connections

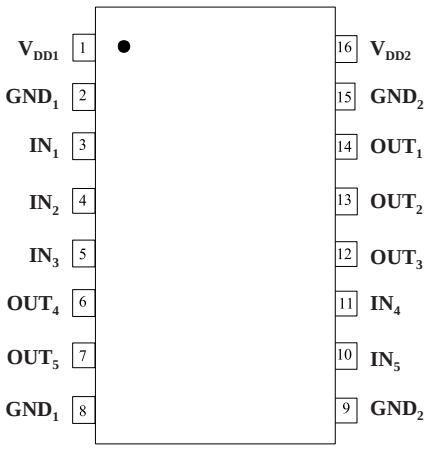
1	**V_{DD1}**	Supply Voltage 1
2	**GND_1**	Ground
3	**IN_1**	Input 1
4	**IN_2**	Input 2
5	**IN_3**	Input 3
6	**IN_4**	Input 4
7	**OUT_5**	Output 5
8	**GND_1**	Ground
9	**GND_2**	Ground
10	**IN_5**	Input 5
11	**OUT_4**	Output 4
12	**OUT_3**	Output 3
13	**OUT_2**	Output 2
14	**OUT_1**	Output 1
15	**GND_2**	Ground
16	**V_{DD2}**	Supply Voltage 2



IL261

IL262 Pin Connections

1	**V_{DD1}**	Supply Voltage 1
2	**GND_1**	Ground
3	**IN_1**	Input 1
4	**IN_2**	Input 2
5	**IN_3**	Input 3
6	**OUT_4**	Output 4
7	**OUT_5**	Output 5
8	**GND_1**	Ground
9	**GND_2**	Ground
10	**IN_5**	Input 5
11	**IN_4**	Input 4
12	**OUT_3**	Output 3
13	**OUT_2**	Output 2
14	**OUT_1**	Output 1
15	**GND_2**	Ground
16	**V_{DD2}**	Supply Voltage 2



IL262

3.3 Volt Electrical Specifications (T_{min} to T_{max})

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Quiescent Current	IL260	I_{DD1}		300	400	µA	
	IL261			1.5	2	mA	
	IL262			3	4	mA	
Output Quiescent Current	IL260	I_{DD2}		6.5	10	mA	
	IL261			5	8	mA	
	IL262			3.5	6	mA	
Logic Input Current		I_i	−10		10	µA	
Logic High Output Voltage		V_{OH}	V_{DD}−0.1	V_{DD}		V	I_O = −20 µA, V_I=V_{IH}
			0.8 x V_{DD}	0.9 x V_{DD}			I_O = −4 mA, V_I=V_{IH}
Logic Low Output Voltage		V_{OL}		0	0.1	V	I_O = 20 µA, V_I=V_{IL}
				0.5	0.8		I_O = 4 mA, V_I=V_{IL}
Switching Specifications							
Maximum Data Rate			100	110		Mbps	C_L = 15 pF
Minimum Pulse Width[7]		PW	10			ns	50% Points, V_O
Propagation Delay Input to Output (High to Low)		t_{PHL}		12	18	ns	C_L = 15 pF
Propagation Delay Input to Output (Low to High)		t_{PLH}		12	18	ns	C_L = 15 pF
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH} \rvert$[2]		PWD		2	3	ns	C_L = 15 pF
Propagation Delay Skew[3]		t_{PSK}		4	6	ns	C_L = 15 pF
Output Rise Time (10%–90%)		t_R		2	4	ns	C_L = 15 pF
Output Fall Time (10%–90%)		t_F		2	4	ns	C_L = 15 pF
Common Mode Transient Immunity (Output Logic High to Logic Low)[4]		$\lvert CM_H \rvert$,$\lvert CM_L \rvert$	20	30		kV/µs	V_{CN} = 300 V
Channel-to-Channel Skew				2	3	ns	C_L = 15 pF
Dynamic Power Consumption[6]				140	240	µA/MHz	per channel
Magnetic Field Immunity[8] (V_{DD2}= 3V, 3V<V_{DD1}<5.5V)							
Power Frequency Magnetic Immunity		H_{PF}	1000	1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity		H_{PM}	1800	2000		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field		H_{OSC}	1800	2000		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier[9]		K_X		2.5			

5 Volt Electrical Specifications (T_{min} to T_{max})

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Quiescent Current	IL260	I_{DD1}		350	500	µA	
	IL261			2.5	3	mA	
	IL262			5	6	mA	
Output Quiescent Current	IL260	I_{DD2}		10	15	mA	
	IL261			7.5	12	mA	
	IL262			5	9	mA	
Logic Input Current		I_i	−10		10	µA	
Logic High Output Voltage		V_{OH}	V_{DD}−0.1	V_{DD}		V	I_O = −20 µA, V_I = V_{IH}
			0.8 x V_{DD}	0.9 x V_{DD}			I_O = −4 mA, V_I = V_{IH}
Logic Low Output Voltage		V_{OL}		0	0.1	V	I_O = 20 µA, V_I = V_{IL}
				0.5	0.8		I_O = 4 mA, V_I = V_{IL}
Switching Specifications							
Maximum Data Rate			100	110		Mbps	C_L = 15 pF
Minimum Pulse Width[7]		PW	10			ns	50% Points, V_O
Propagation Delay Input to Output (High to Low)		t_{PHL}		10	15	ns	C_L = 15 pF
Propagation Delay Input to Output (Low to High)		t_{PLH}		10	15	ns	C_L = 15 pF
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH} \rvert$[2]		PWD		2	3	ns	C_L = 15 pF
Pulse Jitter[10]		t_J		100		ps	C_L = 15 pF
Propagation Delay Skew[3]		t_{PSK}		4	6	ns	C_L = 15 pF
Output Rise Time (10%–90%)		t_R		1	3	ns	C_L = 15 pF
Output Fall Time (10%–90%)		t_F		1	3	ns	C_L = 15 pF
Common Mode Transient Immunity (Output Logic High to Logic Low)[4]		$\lvert CM_H \rvert$,$\lvert CM_L \rvert$	20	30		kV/µs	V_{CN} = 300 V
Channel-to-Channel Skew				2	3	ns	C_L = 15 pF
Dynamic Power Consumption[6]				200	340	µA/MHz	per channel
Magnetic Field Immunity[8] (V_{DD2}= 5V, 3V<V_{DD1}<5.5V)							
Power Frequency Magnetic Immunity		H_{PF}	2800	3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity		H_{PM}	4000	4500		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field		H_{OSC}	4000	4500		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier[9]		K_X		2.5			

Notes (apply to both 3.3 V and 5 V specifications):

1. Absolute maximum ambient operating temperature means the device will not be damaged if operated under these conditions. It does not guarantee performance.
2. PWD is defined as $\lvert t_{PHL} - t_{PLH} \rvert$. %PWD is equal to PWD divided by pulse width.
3. t_{PSK} is the magnitude of the worst-case difference in t_{PHL} and/or t_{PLH} between devices at 25°C.
4. 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 input voltage that can be sustained while maintaining V_O < 0.8 V. The common mode voltage slew rates apply to both rising and falling common mode voltage edges.
5. Device is considered a two terminal device: pins 1–8 shorted and pins 9–16 shorted.
6. Dynamic power consumption numbers are calculated per channel and are supplied by the channel's input side power supply.
7. Minimum pulse width is the minimum value at which specified PWD is guaranteed.
8. The relevant test and measurement methods are given in the Electromagnetic Compatibility section on p. 6.
9. External magnetic field immunity is improved by this factor if the field direction is "end-to-end" rather than to "pin-to-pin" (see diagram on p. 6).
10. 66,535-bit pseudo-random binary signal (PRBS) NRZ bit pattern with no more than five consecutive 1s or 0s; 800 ps transition time.

Application Information

Electrostatic Discharge Sensitivity

This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to complete failure.

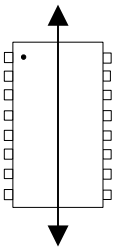
Electromagnetic Compatibility

IsoLoop Isolators have the lowest EMC footprint of any isolation technology. IsoLoop Isolators' Wheatstone bridge configuration and differential magnetic field signaling ensure excellent EMC performance against all relevant standards.

These isolators are fully compliant with generic EMC standards EN50081, EN50082-1 and the umbrella line-voltage standard for Information Technology Equipment (ITE) EN61000. NVE has completed compliance tests in the categories below:

EN50081-1
Residential, Commercial & Light Industrial
Methods EN55022, EN55014
EN50082-2: Industrial Environment
Methods EN61000-4-2 (ESD), EN61000-4-3 (Electromagnetic Field Immunity), EN61000-4-4 (Electrical Transient Immunity), EN61000-4-6 (RFI Immunity), EN61000-4-8 (Power Frequency Magnetic Field Immunity), EN61000-4-9 (Pulsed Magnetic Field), EN61000-4-10 (Damped Oscillatory Magnetic Field)
ENV50204
Radiated Field from Digital Telephones (Immunity Test)

Immunity to external magnetic fields is even higher if the field



direction is "end-to-end" rather than to "pin-to-pin" as shown in the diagram below:

Cross-axis Field Direction

Dynamic Power Consumption

IsoLoop Isolators achieve their low power consumption from the way they transmit data across the isolation barrier. By detecting the edge transitions of the input logic signal and converting these to narrow current pulses, a magnetic field is created around the GMR Wheatstone bridge. Depending on the direction of the magnetic field, the bridge causes the output comparator to switch following the input logic signal. Since the current pulses are narrow, about 2.5 ns, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers, which have power consumption heavily dependent on mark-to-space ratio.

Power Supply Decoupling

Both power supplies to these devices should be decoupled with low ESR 47 nF ceramic capacitors. Ground planes for both GND_1 and GND_2 are highly recommended for data rates above 10 Mbps. Capacitors must be located as close as possible to the V_{DD} pins.

Signal Status on Start-up and Shut Down

To minimize power dissipation, input signals are differentiated and then latched on the output side of the isolation barrier to reconstruct the signal. This could result in an ambiguous output state depending on power up, shutdown and power loss sequencing. Therefore, the designer should consider including an initialization signal in the start-up circuit. Initialization consists of toggling the input either high then low, or low then high.

Data Transmission Rates

The reliability of a transmission system is directly related to the accuracy and quality of the transmitted digital information. For a digital system, those parameters which determine the limits of the data transmission are pulse width distortion and propagation delay skew.

Propagation delay is the time taken for the signal to travel through the device. This is usually different when sending a low-to-high than when sending a high-to-low signal. This difference, or error, is called pulse width distortion (PWD) and is usually in nanoseconds. It may also be expressed as a percentage:

$$PWD\% = \frac{\text{Maximum Pulse Width Distortion (ns)}}{\text{Signal Pulse Width (ns)}} \times 100\%$$

For example, with data rates of 12.5 Mbps:

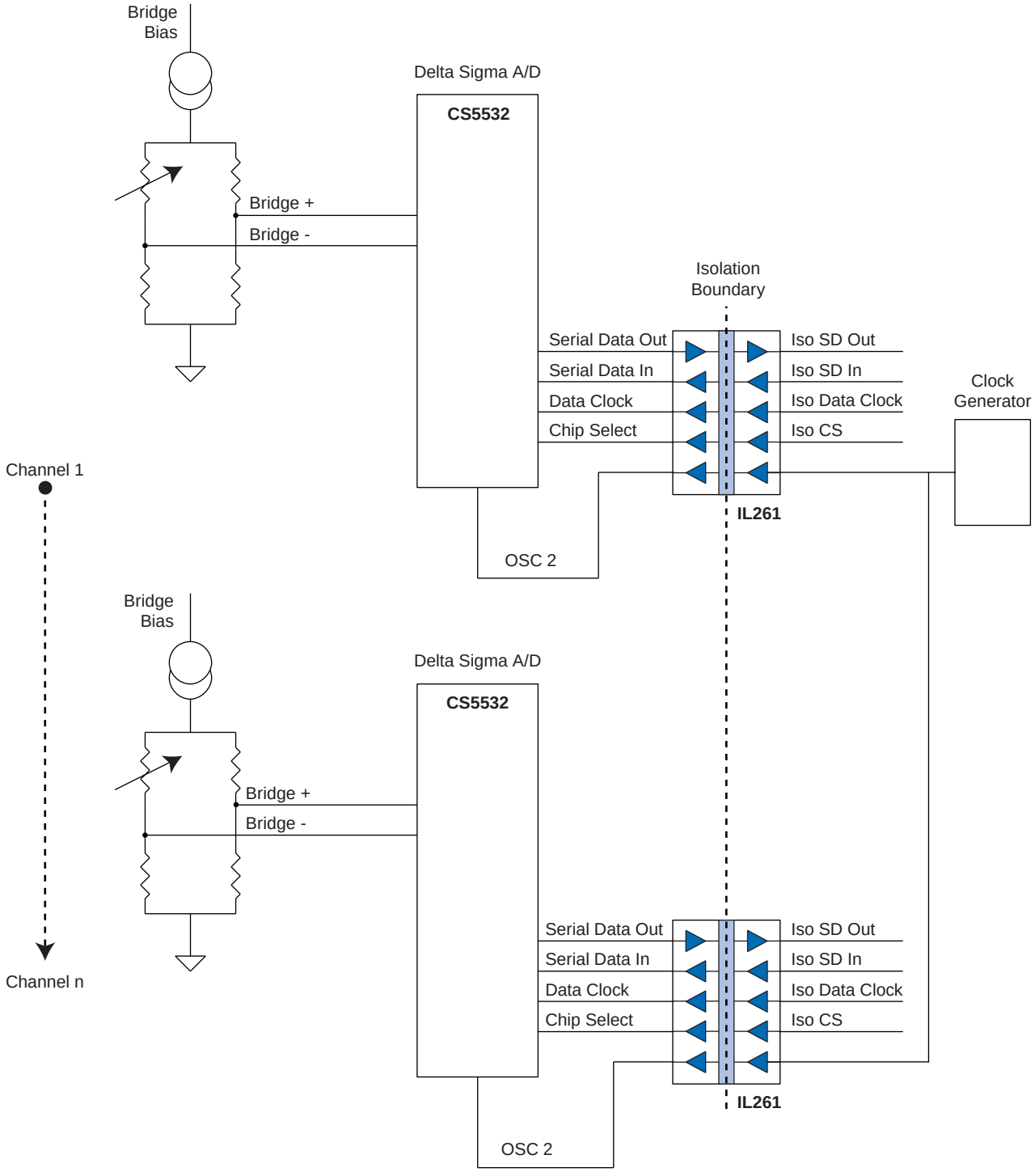
$$PWD\% = \frac{3\text{ ns}}{80\text{ ns}} \times 100\% = 3.75\%$$

This figure is almost **three times** better than any available optocoupler with the same temperature range, and **two times** better than any optocoupler regardless of published temperature range. IsoLoop isolators exceed the 10% maximum PWD recommended by PROFIBUS, and will run to nearly 35 Mb within the 10% limit.

Propagation delay skew is the signal propagation difference between two or more channels. This becomes significant in clocked systems because it is undesirable for the clock pulse to arrive before the data has settled. Short propagation delay skew is therefore especially critical in high data rate parallel systems for establishing and maintaining accuracy and repeatability. Worst-case channel-to-channel skew in IL260-Series Isolators is only 3 ns, which is **ten times** better than any optocoupler. IL260-Series Isolators have a maximum propagation delay skew of 6 ns, which is **five times** better than any optocoupler.

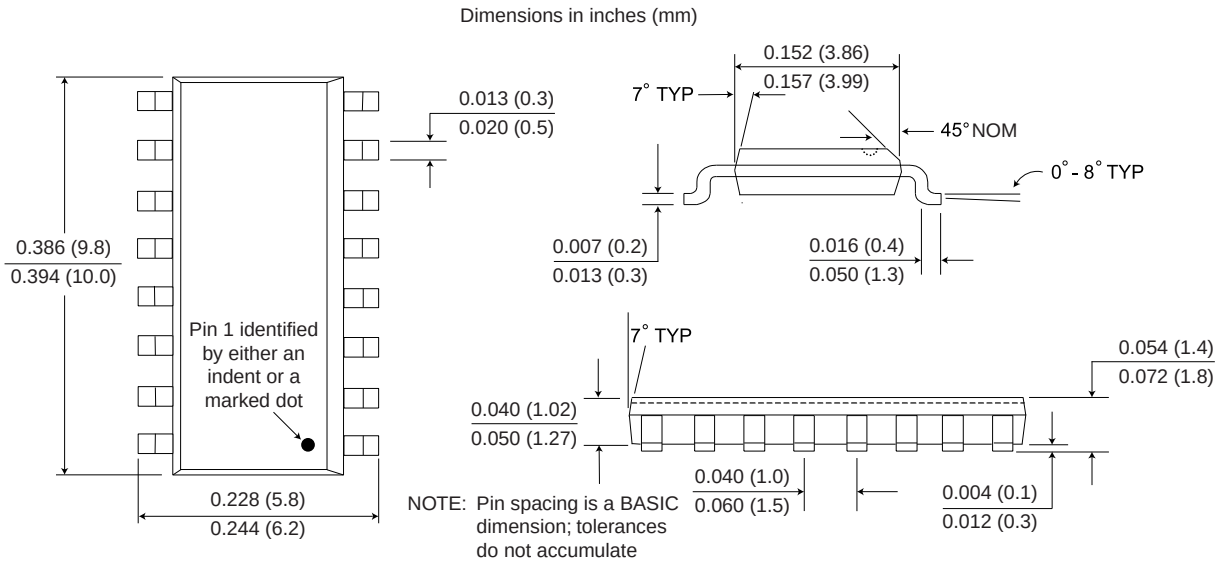
Application Diagram—Multi-Channel Delta-Sigma A/D Converter

In a typical single-channel delta-sigma ADC, the system clock is located on the isolated side of the system and only four channels of isolation are required. With multiple ADCs configured in a channel-to-channel isolation configuration, however, clock jitter and edge placement accuracy of the system clock must be matched between ADCs. The best solution is to use a single clock on the system side and distribute the clock to each ADC. The five-channel IL261 is ideal, with the fifth channel used to distribute a single, isolated clock to multiple ADCs as shown below:

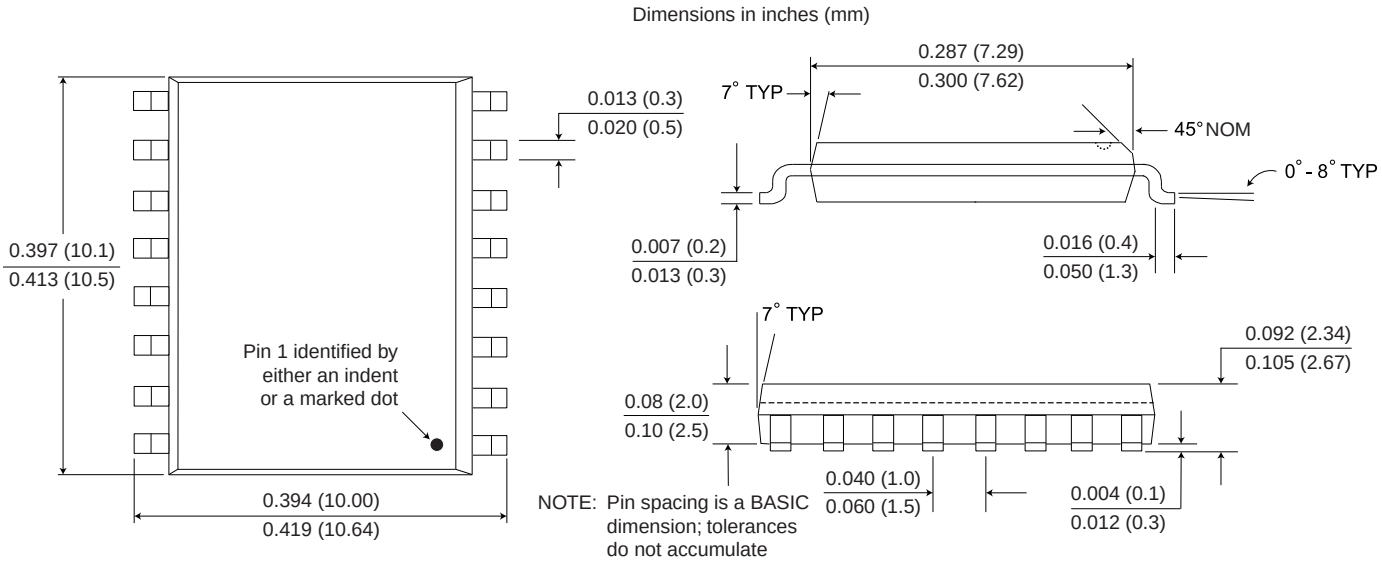


Package Drawings, Dimensions and Specifications

0.15" 16-pin SOIC Package



0.3" 16-pin SOIC Package



Ordering Information and Valid Part Numbers

IL 260 - 3 E TR13

Bulk Package
Blank = Tube
TR7 = 7" Tape and Reel
TR13 = 13" Tape and Reel

Package
Blank = 80/20 Tin/Lead Plating
E = RoHS Compliant

Package Type
Blank = 0.3" 16-pin SOIC
-3 = 0.15" 16-pin SOIC

Base Part Number
260 = 5 Drive Channels
261 = 4 Drive Channels, 1 Receive Channel
262 = 3 Drive Channels, 2 Receive Channel

Product Family
IL = Isolators

Valid Part Numbers

IL260
IL260E
IL260-3
IL260-3E
IL261
IL261E
IL261-3
IL261-3E
IL262
IL262E
IL262-3
IL262-3E

All IL260-Series part types are available on tape and reel.

RoHS COMPLIANT

Revision History

ISB-DS-001-IL260/1/2-J
December 2009

Change

- Relaxed Vdd1 quiescent current specification to 500µA.

ISB-DS-001-IL260/1/2-I

Change

- Added typical jitter specification at 5V.

ISB-DS-001-IL260/1/2-H

Change

- Added EMC details.

ISB-DS-001-IL260/1/2-G

Change

- Added magnetic field immunity and electromagnetic compatibility specifications.

ISB-DS-001-IL260/1/2-F

Change

- Added IL262 configuration
- Added note on package drawings that pin-spacing tolerances are non-accumulating.
- Changed ordering information to reflect that devices are fully RoHS compliant with no exemptions.

ISB-DS-001-IL260/1-E

Change

- Eliminated soldering profile chart

ISB-DS-001-IL260/1-D

Change

- Revised application drawing
- Revised package drawings
- Misc. syntax changes

ISB-DS-001-IL260/1-C

Change

Page 2: UL File Number and TUV Certificate Numbers added

Page 9: Soldering Profile added.

About NVE

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine spintronic Giant Magnetoresistive (GMR) materials with integrated circuits to make high performance electronic components. Products include Magnetic Field Sensors, Magnetic Field Gradient Sensors (Gradiometer), Digital Magnetic Field Sensors, Digital Signal Isolators and Isolated Bus Transceivers.

NVE is a leader in GMR research and in 1994 introduced the world's first products using GMR material, a line of GMR magnetic field sensors that can be used for position, magnetic media, wheel speed and current sensing.

NVE is located in Eden Prairie, Minnesota, a suburb of Minneapolis. Please visit our Web site at www.nve.com or call (952) 829-9217 for information on products, sales or distribution.

NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617 USA
Telephone: (952) 829-9217
Fax: (952) 829-9189
Internet: www.nve.com
e-mail: isoinfo@nve.com

ISB-DS-001-IL260/1/2-J

December 2009