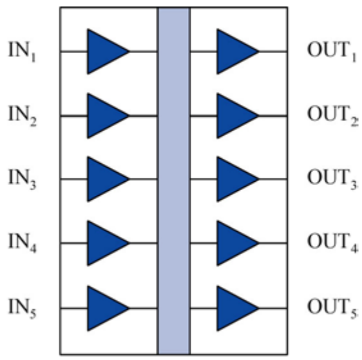
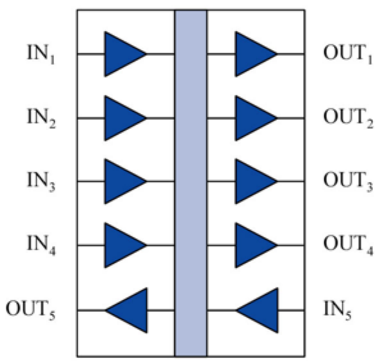
High Speed Five Channel Digital Couplers

Functional Diagram



IL260



IL261

Features

- 3.3 V or 5 V CMOS/TTL Compatible
- 110 Mbps Data Rate
- 2500 V_{RMS} Isolation (1 min)
- 2 ns Typical Pulse Width Distortion
- 4 ns Typical Propagation Delay Skew
- 10 ns Typical Propagation Delay
- 30 kV/ms Typical Transient Immunity
- 2 ns Channel to Channel Skew
- 0.3" and 0.15" 16–Pin SOIC Packages
- Extended Temperature Range (-40°C to +85°C)
- UL1577 Approval Pending
- IEC 61010-1 Approval Pending

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 family of high-speed digital isolators are CMOS devices created by integrating active circuitry and our GMR-based and patented* IsoLoop® technology. The IL260 and IL261 are five channel versions of the world's fastest digital isolator with a 110 Mbps data rate. This device provides the designer with the most compact isolated logic devices yet available. 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 device. Typical transient immunity of 30 kV/µs is unsurpassed. High channel density make them ideally suited to isolating multiple ADCs and DACs, parallel buses and peripheral interfaces.

Performance is specified over the temperature range of -40°C to +85°C without any derating. .

NVE Corp., 11409 Valley View Road, Eden Prairie, MN 55344-3617, U.S.A.
Telephone: 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		175	°C	
Ambient Operating Temperature	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	I_O	-10		10	mA	Drive Channel
Lead Solder Temperature				280	°C	10 s
ESD		2 kV Human Body Model				

Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Ambient Operating Temperature(1)	T_A	-40		85	°C	
Supply Voltage	V_{DD1} ,V_{DD2}	3.0		5.5	V	3.3/5.0 V Operation
Supply Voltage	V_{DD1} ,V_{DD2}	4.5		5.5	V	5 V Operation
Logic High Input Voltage	V_{IH}	2.4		V_{DD}	mA	
Logic Low Input Voltage	V_{IL}	0		0.8	V	
Minimum Input Signal Rise and Fall Times	t_{IR}, t_{IF}			1	μsec	

Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (external)						
0.15" SOIC		4.026			mm	
0.30" SOIC		8.077			mm	
Leakage Current(5)			0.2		μA_{RMS}	240 V_{RMS}
Barrier Impedance (5)			$>10^{14}\|\|7$		Ω || pC	

Safety & Approvals

IEC61010-1

TUV Certificate Numbers: *Approval Pending*

Classification

Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL260, IL261	.30" 16-pin SOIC	II	III	300 V_{RMS}
IL260-3, IL261-3	.15" 16-pin SOIC	II	III	150 V_{RMS}

UL 1577

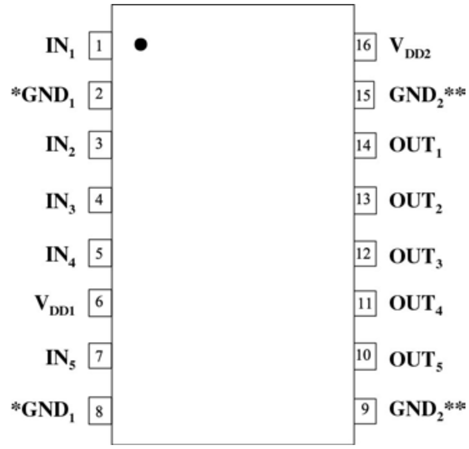
Component Recognition program. File #: *Approval Pending*
Rated 2500V_{RMS} for 1 minute (SOIC, PDIP), 1000V_{RMS} for 1 minute (MSOP)

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.

IL260 Pin Connections

1	**IN_1**	Input 1
2	**GND_1**	Ground *Pins 2 and 8 connected internally*
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 *Pins 2 and 8 connected internally*
9	**GND_2**	Ground *Pins 9 and 15 connected internally*
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 *Pins 9 and 15 connected internally*
16	**V_{DD2}**	Supply Voltage 2



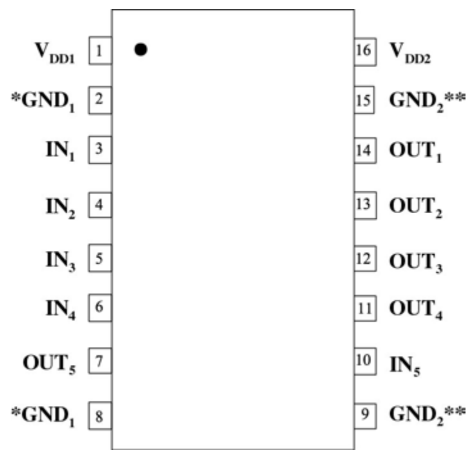
IL260

* Pins 2 and 8 internally connected

** Pins 9 and 15 internally connected

IL260 Pin Connections

1	**V_{DD1}**	Supply Voltage 1
2	**GND_1**	Ground *Pins 2 and 8 connected internally*
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 *Pins 2 and 8 connected internally*
9	**GND_2**	Ground *Pins 9 and 15 connected internally*
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 *Pins 9 and 15 connected internally*
16	**V_{DD2}**	Supply Voltage 2



IL261

* Pins 2 and 8 internally connected

** Pins 9 and 15 internally connected

3.3 Volt Electrical Specifications

Electrical Specifications are T_{min} to T_{max}

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Quiescent Current	IL260	I_{DD1}		30	50	µA	
	IL261			1.5	2.0	mA	
Output Quiescent Current	IL260	I_{DD2}		6.5	10	mA	
	IL261			5.5	8	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*V_{DD}	V_{DD}-0.5			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		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 $\|t_{PHL}-t_{PLH}\|$ (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)		$\|CM_H\|,\|CM_L\|$	20	30		kV/µs	V_{CN} = 300 V
Channel to Channel Skew				2	3	ns	C_L = 15 pF
Dynamic Power Consumption(6)				200	240	µA/MHz	per channel

5 Volt Electrical Specifications

Electrical Specifications are T_{min} to T_{max}

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Quiescent Current	IL260	I_{DD1}		30	50	µA	
	IL261			2.5	3.0	mA	
Output Quiescent Current	IL260	I_{DD2}		10	15	mA	
	IL261			8	12	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*V_{DD}	V_{DD}-0.5			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		PW	10			ns	50% Points, V_O
Propagations Delay Input to Output (High to Low)		t_{PHL}		10	15	ns	C_L = 15 pF,
Propagations Delay Input to Output (Low to High)		t_{PLH}		10	15	ns	C_L = 15 pF,
Pulse Width Distortion $\|t_{PHL}-t_{PLH}\|$ (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		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)		$\|CM_H\|,\|CM_L\|$	20	30		kV/µs	V_{CN} = 300 V
Channel to Channel Skew				2	3	ns	C_L = 15 pF
Dynamic Power Consumption(6)				280	340	µA/MHz	per channel

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 | t_{PHL}– t_{PLH} |. %PWD is equal to the PWD divided by the pulse width.
3. t_{PSK} is equal to the magnitude of the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units 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_{DD}. 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.

Application Notes

Dynamic Power Consumption

Isoloop® devices achieve their low power consumption from the manner by which 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 2.5ns wide, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers whose power consumption is heavily dependent on its on-state and frequency.

The approximate power supply current per channel for

Isoloop® is: $I(\text{input}) = 40\left(\frac{f}{f\text{max}}\right)\left(\frac{1}{4}\right)$ mA

where f = operating frequency
fmax = 50 MHz

Power Supply Decoupling

Both power supplies to these devices must be decoupled with low ESR 100 nF ceramic capacitors. For data rates in excess of 10MBd, use of ground planes for both GND1 and GND2 is highly recommended. Capacitors should be located as close as possible to the device.

Signal Status on Start-up and Shut Down

To minimize power dissipation, the 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 the inclusion of an initialization signal in his start-up circuit. Initialization consists of toggling each channel either high then low or low then high, depending on the desired state.

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 ns. It may also be expressed as a percentage:

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

For example: For data rates of 12.5 Mb

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

This figure is almost three times better than for any available optocoupler with the same temperature range, and two times better than any optocoupler regardless of published temperature range. The IsoLoop® range of isolators will run at almost 35 Mb before reaching the 10% limit.

Propagation delay skew is the difference in time taken for two or more channels to propagate their signals. This becomes significant when clocking is involved since it is undesirable for the clock pulse to arrive before the data has settled. A short propagation delay skew is therefore critical, especially in high data rate parallel systems, to establish and maintain accuracy and repeatability. The IsoLoop® range of isolators all have a maximum propagation delay skew of 6 ns, which is five times better than any optocoupler. The maximum channel-to-channel skew in the IsoLoop® coupler is only 3 ns which is ten times better than any optocoupler.

Application Diagrams

Figure 1 Single Channel ΔΣ

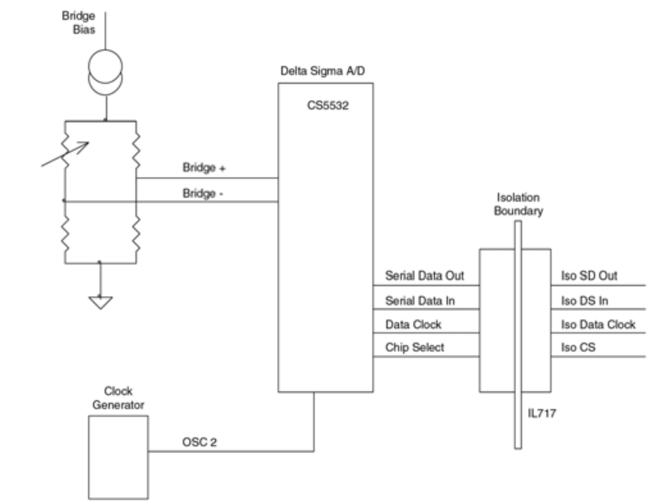
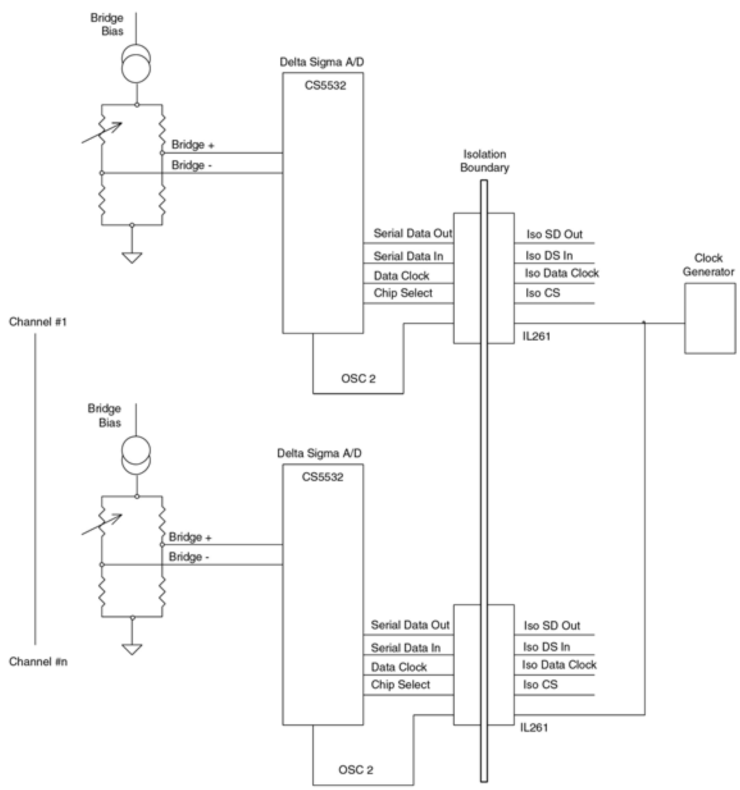


Figure 1 shows a typical single channel ΔΣ ADC application. The A/D is located on the bridge with no signal conditioning electronics between the bridge sensor and the ADC. In this application, the IL717 is the best choice for isolation. It isolates the control bus from the microcontroller. The system clock is located on the isolated side of the system.

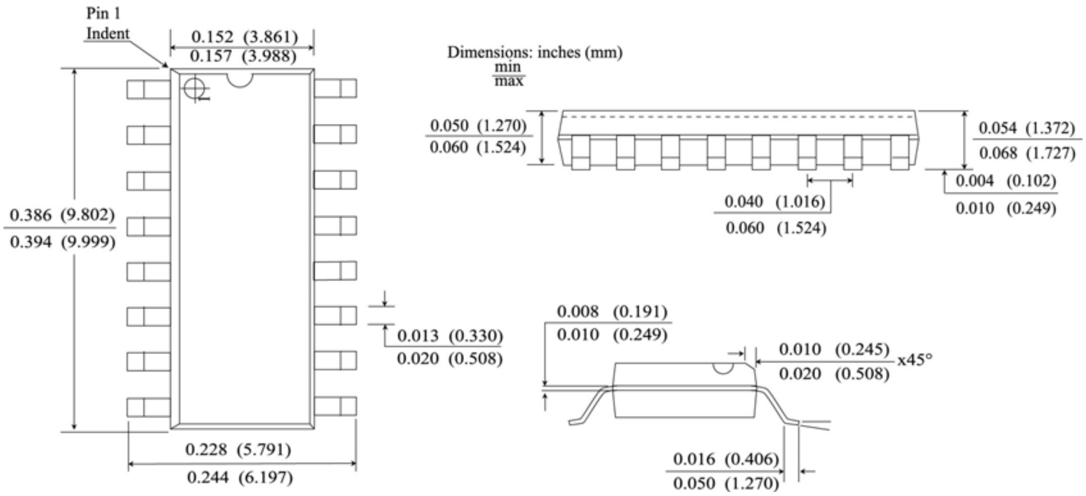
Figure 2 Multi Channel ΔΣ



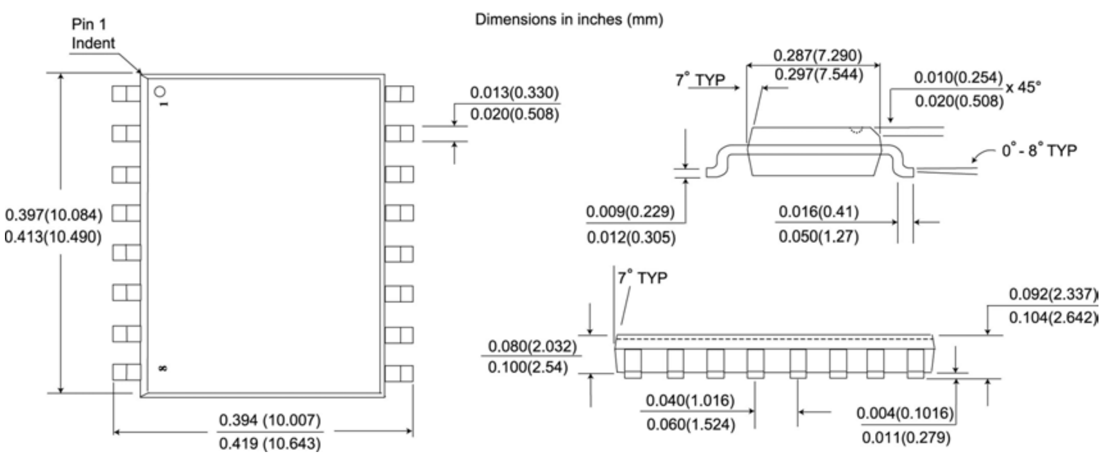
The second ΔΣ application is where multiple ADC's are configured in a channel-to-channel isolation configuration. The problem for designers is how to control clock jitter and edge placement accuracy of the system clock for each ADC. The best solution is to use a single clock on the system side and distribute this to each ADC. The IL261 adds a 5th channel to the IL717. This 5th channel is used to distribute a single, isolated clock to multiple ADC's as shown in Figure 2.

Package drawings, dimensions and specifications

0.15'' 16-pin SOIC



0.3'' 16-pin SOIC



Ordering information and valid part numbers.

IL 260 -3 B E TR13

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

Lead Frame Material
Blank = Tin-Lead Plating
E = 100% Tin (Pb Free)

Supply Voltage
Blank = 3.3/5.0 VDC
B = 5.0 VDC

Package Type
Blank = 0.3" 16-pin SOIC
-3 = 0.15" 8-pin SOIC

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

Product Family
IL = Isolators

IL260 Valid Part Numbers	IL261 Valid Part Numbers
IL260	IL261
IL260B	IL261B
IL260E	IL261E
IL260BE	IL261BE
IL260ETR13	IL261ETR13
IL260BETR13	IL261BETR13
IL260TR13	IL261TR13
IL260BTR13	IL261BTR13
IL260-3	IL261-3
IL260-3B	IL261-3B
IL260-3E	IL261-3E
IL260-3BE	IL261-3BE
IL260-3TR7	IL261-3TR7
IL260-3BTR7	IL261-3BTR7
IL260-3TR13	IL261-3TR13
IL260-3BTR13	IL261-3BTR13
IL260-3BETR7	IL261-3BETR7
IL260-3ETR7	IL261-3ETR7
IL260-3BETR13	IL261-3BETR13
IL260-3ETR13	IL261-3ETR13

About NVE

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine leading edge 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

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