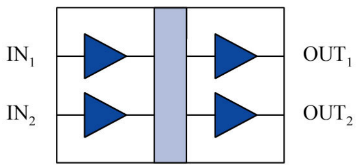
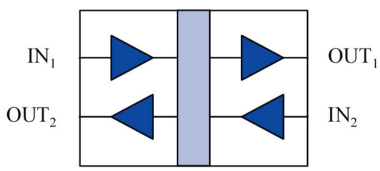
IL711 IL712

High Speed Dual Digital Isolator

Functional Diagram



IL711



IL712

Features

- +5 V/+3.3 V CMOS / TTL Compatible
- High Speed: 110 Mbps
- 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/µs Typical Common Mode Transient Immunity
- 2 ns Channel-to-Channel Skew
- 8-pin PDIP and 8-pin SOIC Packages
- UL1577 Approved (File # E207481)
- IEC 61010-1 Approved (Report # 607057)

Applications

- ADCs and DACs
- Digital Fieldbus
- RS485 and RS422
- Multiplexed Data Transmission
- Data Interfaces
- Board-to-Board Communication
- Digital Noise Reduction
- Operator Interface
- Ground Loop Elimination
- Peripheral Interfaces
- Serial Communication
- Logic Level Shifting

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 IL711 and IL712 are two-channel versions of the world's fastest digital isolator with a 110 Mbps data rate. These devices offer true isolated logic integration not previously 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. The IL711 has two transmit channels; the IL712 has one transmit channel and one receive channel. The IL712 operates in full duplex mode making it ideal for many field bus applications including PROFIBUS.

The IL711 and IL712 are available in 8-pin PDIP and 8-pin SOIC packages and performance is specified over the temperature range of -40°C to +100°C without derating. The T-Series parts (-40°C to +125°C) offer the user the widest temperature range digital couplers available.

IsoLoop is a registered trademark of NVE Corporation.
*U.S. Patent numbers 5,831,426; 6,300,617 and others.

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Absolute Maximum Ratings[1]

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	-55		150	°C	
Ambient Operating Temperature T-Series	T_A	-55		125 135	°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	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-Series	T_A	-40		100 125	°C	
Supply Voltage	V_{DD1}, V_{DD2}	3.0		5.5	V	
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						
SOIC		4.026			mm	
PDIP		7.036			mm	
Leakage Current			0.2		µA	240 V_{RMS}, 60 Hz
Barrier Impedance			$>10^{14}\|\|3$		Ω || pF	

Package Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Capacitance (Input-Output)[5]	C_{I-O}		2		pF	f = 1 MHz
Thermal Resistance						
SOIC	θ_{JCT}		240		°C/W	Thermocouple at center underside of package
PDIP	θ_{JCT}		150		°C/W	
Package Power Dissipation	P_{PD}			150	mW	f = 1 MHz, V_{DD} = 5 V

Safety & Approvals

IEC61010-1

TUV Certificate Numbers: SOIC B 01 07 44230 002
PDIP B 01 07 44230 001

Classification: Reinforced Insulation

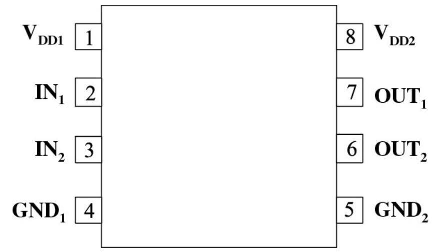
Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL711-2, IL712-2	PDIP	II	III	300 V_{RMS}
IL711-3, IL712-3	SOIC	II	III	150 V_{RMS}

UL 1577

Component Recognition program File #: E207481
Rated 2500V_{RMS} for 1 minute

IL711 Pin Connections

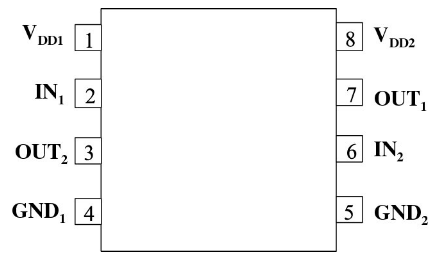
1	V_{DD1}	Supply voltage
2	IN_1	Data in, channel 1
3	IN_2	Data in, channel 2
4	GND_1	Ground return for V_{DD1}
5	GND_2	Ground return for V_{DD2}
6	OUT_2	Data out, channel 2
7	OUT_1	Data out, channel 1
8	V_{DD2}	Supply voltage



IL711

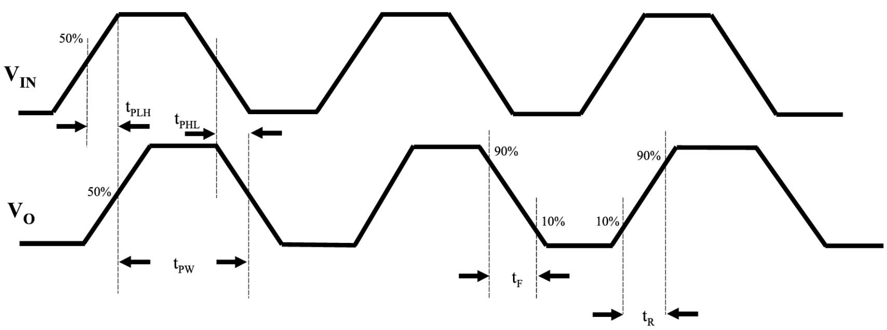
IL712 Pin Connections

1	V_{DD1}	Supply voltage
2	IN_1	Data in, channel 1
3	OUT_2	Data out, channel 2
4	GND_1	Ground return for V_{DD1}
5	GND_2	Ground return for V_{DD2}
6	IN_2	Data in, channel 2
7	OUT_1	Data out, channel 1
8	V_{DD2}	Supply voltage



IL712

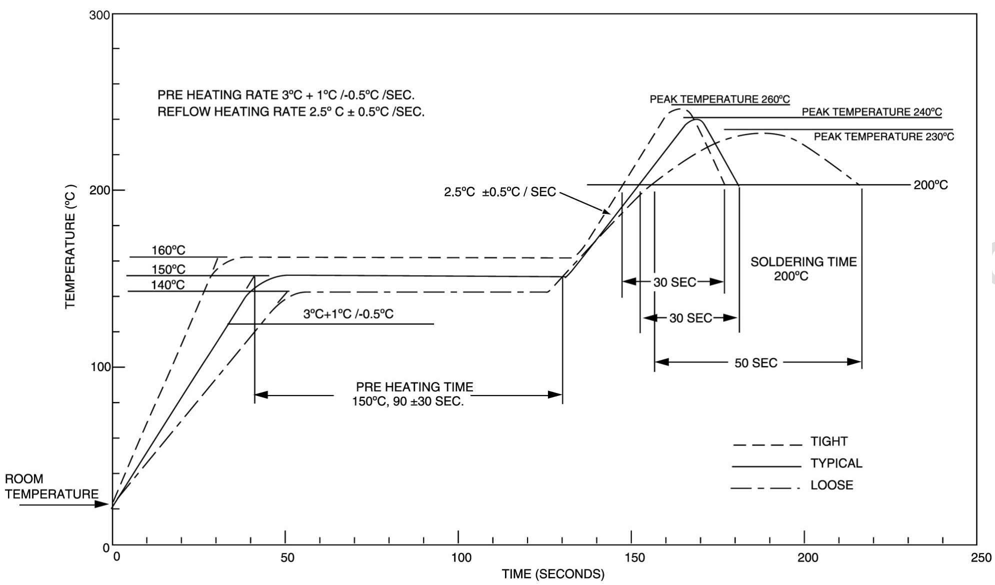
Timing Diagram



Legend

t_{PLH}	Propagation Delay, Low to High
t_{PHL}	Propagation Delay, High to Low
t_{PW}	Minimum Pulse Width
t_R	Rise Time
t_F	Fall Time

IR Soldering Profile



3.3 Volt Electrical Specifications

Electrical specifications are T_{min} to T_{max} unless otherwise stated.

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
DC Specifications						
Input Quiescent Supply Voltage						
IL711	I_{DD1}		8	10	µA	
IL712			1.5	2	mA	
Output Quiescent Supply Voltage						
IL711	I_{DD2}		3.3	4	mA	
IL712			1.5	2	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
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 (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 or Logic Low) (4)	$\|CM_H\|,\|CM_L\|$	20	30		kV/µs	V_{CM} = 300 V
Channel-to-Channel Skew	t_{CSK}		2	3	ns	C_L = 15 pF
Dynamic Power Consumption (6) T-Series			170 500	200 640	µA/MHz	per channel

5 Volt Electrical Specifications

Electrical specifications are T_{min} to T_{max} unless otherwise stated.

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
DC Specifications						
Input Quiescent Supply Voltage						
IL711	I_{DD1}		10	15	µA	
IL712			2.5	3	mA	
Output Quiescent Supply Voltage						
IL711	I_{DD2}		5	6	mA	
IL712			2.5	3	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
Pulse Width	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 (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 or Logic Low)(4)	$\lvert CM_H \rvert, \lvert CM_L \rvert$	20	30		kV/µs	V_{cm} = 300 V
Channel-to-Channel Skew	t_{CSK}		2	3	ns	C_L = 15 pF
Dynamic Power Consumption(6) T-Series			170 500	200 640	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 $\lvert t_{PHL} - t_{PLH} \rvert$. %PWD is equal to PWD divided by 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 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 1-4 shorted and pins 5-8 shorted.
6. Dynamic power consumption numbers are calculated per channel and are supplied by the channel's input side power supply.

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.

Application Information

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 2.5 ns 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 is:

$$I_{IN} = 40 \times \frac{f}{f_{MAX}} \times \frac{1}{4} \text{ mA}$$

Where f = operating frequency

f_{MAX} = 50 MHz

Power Supply Decoupling

Both power supplies to these devices should be decoupled with low ESR 47 nF ceramic capacitors. For data rates in excess of 10 Mbps, use of ground planes for both GND_1 and GND_2 is highly recommended. 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, 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 the input 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 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: For data rates of 12.5 Mbps

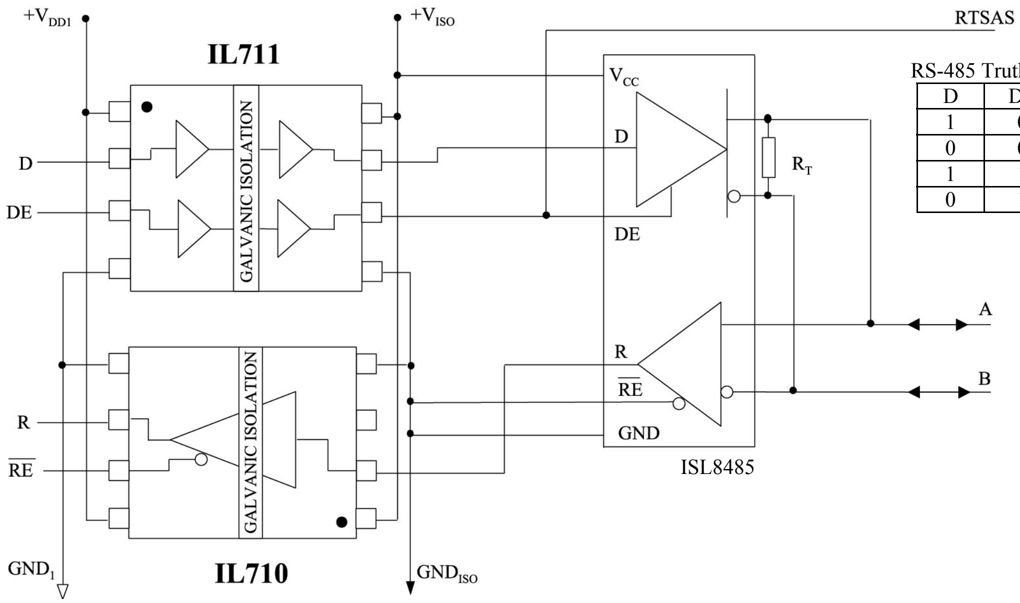
$$PWD\% = \frac{3 \text{ ns}}{80 \text{ ns}} \times 100\% = 3.75\%$$

This figure is almost **three times** better than 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 surpasses the 10% maximum PWD recommended by PROFIBUS, and 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 3ns, which is ten times better than any optocoupler.

Application Diagrams

Isolated PROFIBUS / RS-485

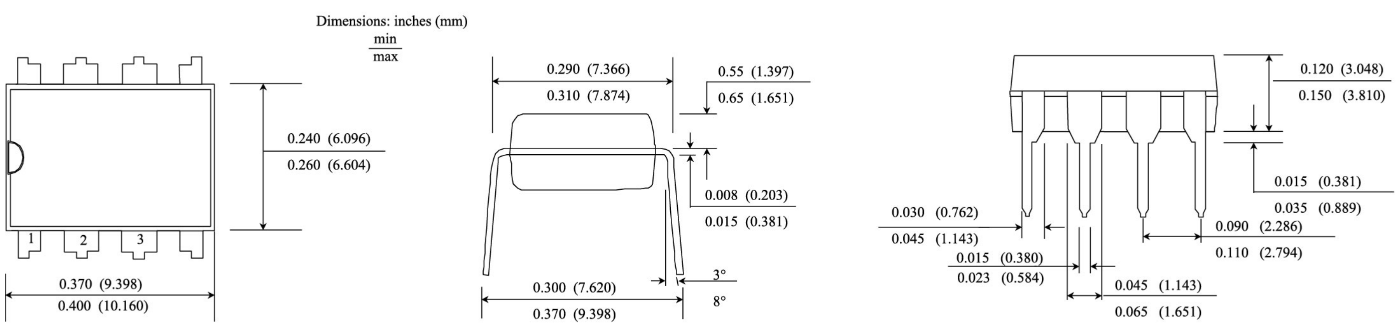


RS-485 Truth Table

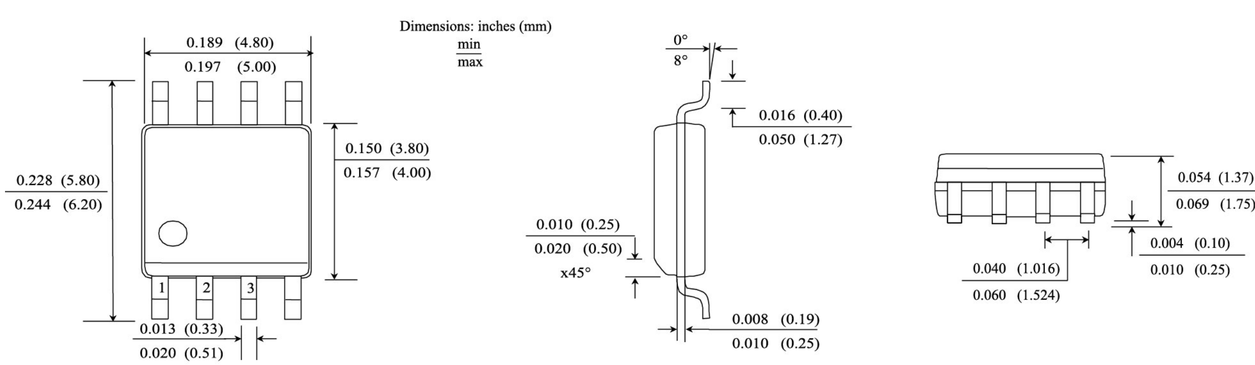
D	DE	A	B	R
1	0	Z	Z	X
0	0	Z	Z	X
1	1	1	0	1
0	1	0	1	0

Package Drawings, Dimensions and Specifications

8-pin PDIP Package



8-pin SOIC Package



Ordering Information and Valid Part Numbers

IL 711 T -3 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 (Lead Free)

Package Type
-2 = PDIP
-3 = 0.15" 8-pin SOIC

Temperature Range
Blank = -40°C to +100°C
T = -40°C to +125°C

Base Part Number
711 = 2 Drive Channels
712 = 1 Drive Channel
1 Receive Channel

Product Family
IL = Isolators

Valid Part Numbers

IL711-2	IL712-2
IL711-2E	IL712-2E
IL711T-2	IL712T-2
IL711T-2E	IL712T-2E
IL711-3	IL712-3
IL711T-3	IL712T-3
IL711-3E	IL712-3E
IIL711T-3E	IL712T-3E
All IL711-3 parts are available on tape and reel.	All IL711-3 parts are available on tape and reel.

ISB-DS-001-IL711/12-H

Changes

1. Page 1: Revision letter added.
2. Page 1: T-Series parts temperature information added.
3. Page 2: T-Series parts temperature information added to Absolute Maximum Ratings.
4. Page 2: T-Series parts temperature information added to Recommending Operating Conditions.
5. Page 2: Storage temperature changed from 175°C max. to 150°C max.
6. Page 2: Lead soldering temperature changed from 180°C max. to 260°C max.
7. Page 2: Package Power Dissipation: Test Condition added f = 1MHz, V_{DD} = 5V.
8. Page 2: IEC 61010-1 Classification: "Reinforced Insulation" added.
9. Page 4: 3.3 Volt and 5 Volt Electrical Specifications split into separate tables.
10. Page 5: 3.3 Volt Electrical Specifications: Dynamic Power Consumption added.
11. Page 6: 5 Volt Electrical Specifications: Dynamic Power Consumption added.
12. Page 9: Ordering Information: Temperature Range Option added
13. Page 9: Ordering Information: 5 Volt only option removed.
    Valid Part Numbers IL711-2B, IL711-3B, IL711-2BE,
    IL711-3BE, IL712-2B, IL712-3B,
    IL712-2BE, and IL712-3BE removed.

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.

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Specifications shown are subject to change without notice.

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