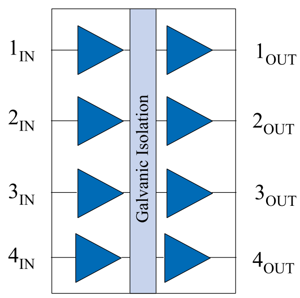
IL715/6/7 IsoLoop®

NVE CORPORATION

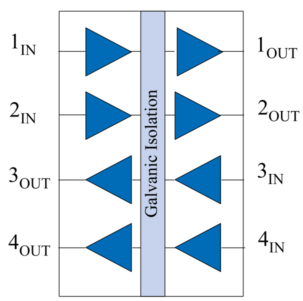
High Speed Four Channel Digital Coupler

Functional Diagram

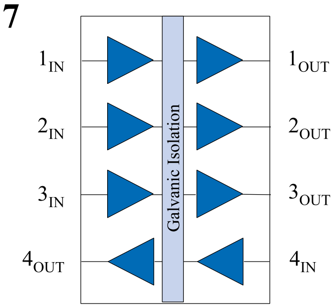
IL715



IL716



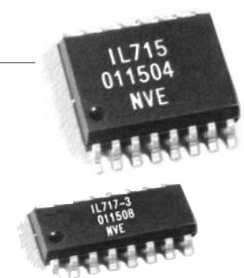
IL717



Isoloop® is a registered trademark of NVE Corporation

* US Patent number 5,831,426; 6,300,617 and others.

Features



- +5/3.3V or 5V CMOS/TTL Compatible
- High Speed: 110 MBaud
- 2500 V_{RMS} Isolation (1 min)
- 2 ns Typical Pulse Width Distortion
- 4 ns Typical Propagation Delay s Skew
- 10 ns Typical Propagation Delay
- 30 kV/µs Typical Transient Immunity
- 2 ns Channel to Channel Skew
- 0.3" and 0.15" 16–Pin SOIC Packages
- UL1577 Approved (File # E207481)
- IEC 61010-1 Approved (Report # 607057)

Isolation 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
- Parallel Bus
- 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 IL715, IL716 and IL717 are four channel versions of the world's fastest digital isolator with a 110 Mbaud data rate. These devices provide the designer with the most compact isolated logic devices yet available. All transmit and receive channels operate at 110 Mbd 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 IL715 has four transmit channels; the IL716 has two transmit channels and two receive channels; the IL717 has three transmit channels and one receive channel. The IL715, IL716 and IL717 high channel density make them ideally suited to isolating ADCs and DACs, parallel buses and peripheral interfaces.

The IL715, IL716 and IL717 are available in 0.3" and 0.15" 16-pin SOIC packages and performance is specified over the temperature range of -40°C to +100°C without any derating.

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Units
Storage Temperature	T_S	-55	175	°C
Ambient Operating Temperature[1]	T_A	-55	125	°C
Supply Voltage	V_{DD1},V_{DD2}	-0.5	7	Volts
Input Voltage	V_I	-0.5	V_{DD}+0.5	Volts
Output Voltage	V_O	-0.5	V_{DD}+0.5	Volts
Output Current Drive Channel	I_O		10	mA
Lead Solder Temperature (10s)			280	°C
ESD	2kV Human Body Model			

Recommended Operating Conditions

Parameters	Symbol	Min.	Max.	Units
Ambient Operating Temperature	T_A	-40	100	°C
Supply Voltage (3.3/5.0 V operation)	V_{DD1},V_{DD2}	3.0	5.5	Volts
Supply Voltage (5.0 V operation)	V_{DD1},V_{DD2}	4.5	5.5	Volts
Logic High Input Voltage	V_{IH}	2.4	V_{DD}	Volts
Logic Low Input Voltage	V_{IL}	0	0.8	Volts
Minimum Signal Rise and Fall Times	t_{IR},t_{IF}		1	µsec

Insulation Specifications

Parameter	Symbol	Min	Typ.	Max.	Units	Test Condition
Barrier Impedance				$>10^{14}\|\|7$		Ω || pF
Creepage Distance (External)		8.077 (0.3" SOIC) 4.026 (0.15" SOIC)			mm	
Leakage Current			0.2		µA	240 V_{RMS}
Capacitance (Input-Output)[5]	C_{I-O}		4.0		pF	f = 1MHz

IEC61010-1

TUV Certificate Numbers: B 01 07 44230 003
Classification as Table 1.

Model	Pollution Degree	Material Group	Max Working Voltage	Package Type 16–SOIC (0.3")	16–SOIC (0.15")
IL715, IL716, IL717	II	III	300 V_{RMS}	✓	
IL715-3, IL716-6, IL717-3	II	III	150 V_{RMS}		✓

UL 1577

Component Recognition program. File # E207481
Rated 2500Vrms for 1min.

* UL & IEC approval is pending for the 16-SOIC (0.15") parts.

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

Electrical Specifications

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

Parameter	Symbol	3.3 Volt Specifications			5.0 Volt Specifications			Units	Test Conditions
DC Specifications		**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**		
Input Quiescent Supply Current									
IL715	I_{DD1}		16	20		24	30	μA	
IL716	I_{DD1}		3.3	4		5	6	mA	
IL717	I_{DD1}		1.5	2.0		2.5	3.0	mA	
Output Quiescent Supply Current									
IL715	I_{DD2}		5.5	8		8	12	mA	
IL716	I_{DD2}		3.3	4		5	6	mA	
IL717	I_{DD2}		3	6		6	9	mA	
Logic Input Current	I_I	-10		10	-10		10	μA	
Logic High Output Voltage	V_{OH}	V_{DD}-0.1 0.8*V_{DD}	V_{DD} V_{DD}-0.5		V_{DD}-0.1 0.8*V_{DD}	V_{DD} V_{DD}-0.5		V	I_O =-20 μA, V_I =V_{IH} I_O = -4 mA, V_I =V_{IH}
Logic Low Output Voltage	V_{OL}		0 0.5	0.1 0.8		0 0.5	0.1 0.8	V	I_O = 20 μA, V_I =V_{IL} I_O = 4 mA, V_I =V_{IL}
Switching Parameters									
Maximum Data Rate		100	110		100	110		MBd	C_L = 15 pF
Minimum Pulse Width	PW	10			10			ns	50% Points, V_O
Propagation Delay Input to Output (High to Low)	t_{PHL}		12	18		10	15	ns	C_L = 15 pF
Propagation Delay Input to Output (Low to High)	t_{PLH}		12	18		10	15	ns	C_L = 15 pF
Pulse Width Distortion(2) | tPHL- tPLH |	PWD		2	3		2	3	ns	C_L = 15 pF
Propagation Delay Skew(3)	t_{PSK}		4	6		4	6	ns	C_L = 15 pF
Output Rise Time (10-90%)	t_R		2	4		1	3	ns	C_L = 15 pF
Output Fall Time (10-90%)	t_F		2	4		1	3	ns	C_L = 15 pF
Common Mode Transient Immunity (Output Logic High or Logic Low)(4)	|CMH| |CML|	20	30		20	30		kV/μs	Vcm = 300V
Channel to Channel Skew	t_{CSK}		2	3		2	3	ns	C_L = 15 pF

Notes:

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.

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

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:

$$I(\text{input}) = 40 \left(\frac{f}{f_{max}}\right)\left(\frac{1}{4}\right) \text{ mA}$$

where f = operating frequency
fmax = 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 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.

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.

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

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

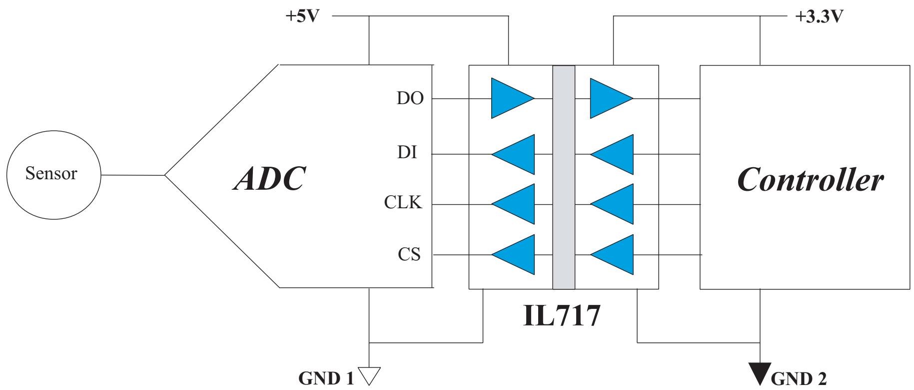
This figure is almost ***three times*** better than for any available optocoupler with the same temperature range, and ***two times*** better than any optocoupler regardless of published temperature range. The *IsoLoop*® range of isolators surpasses the 10% maximum PWD recommended by PROFIBUS, and will 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 3 ns which is ***ten times*** better than any optocoupler.

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

Applications:

Isolated Logic Level Shifters

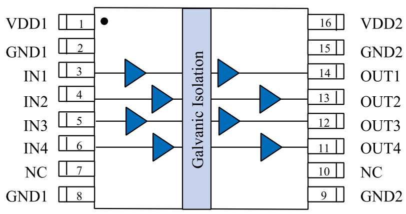


NVE Corporation 11409 Valley View Road Eden Prairie, MN 55344-3617 USA Telephone: (952) 829-9217 Fax: (952) 829-9189 Internet: www.isoloop.com

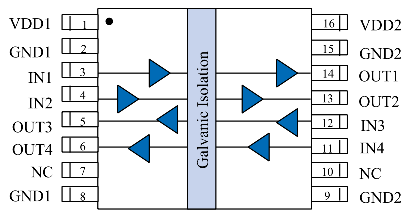
Pin Configurations IL715, IL716, IL717

Note: Connected Internally
Pins 2 & 8
Pins 9 & 15

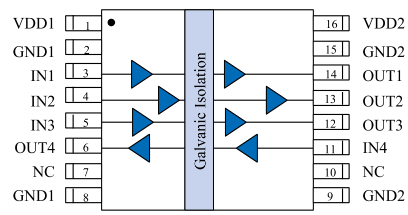
IL715



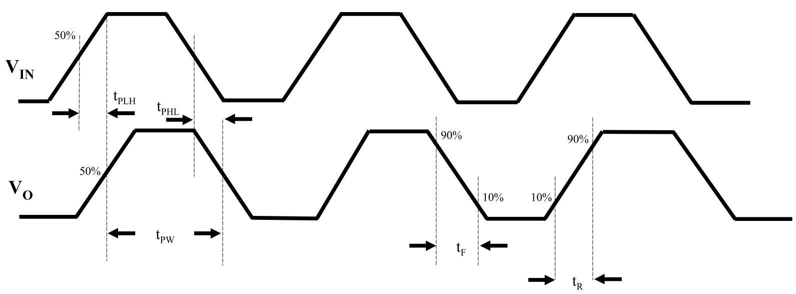
IL716



IL717



Timing Diagram

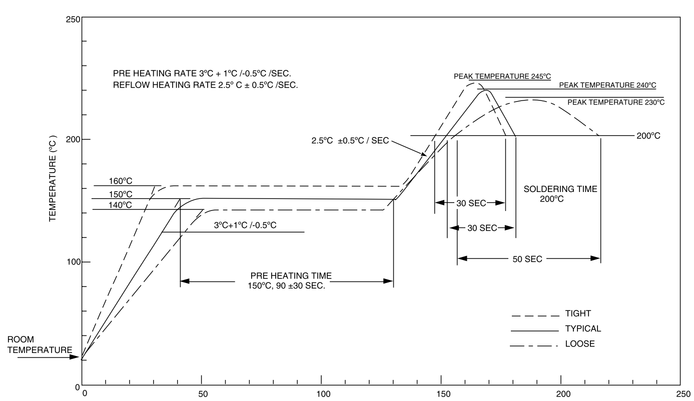


Legend

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

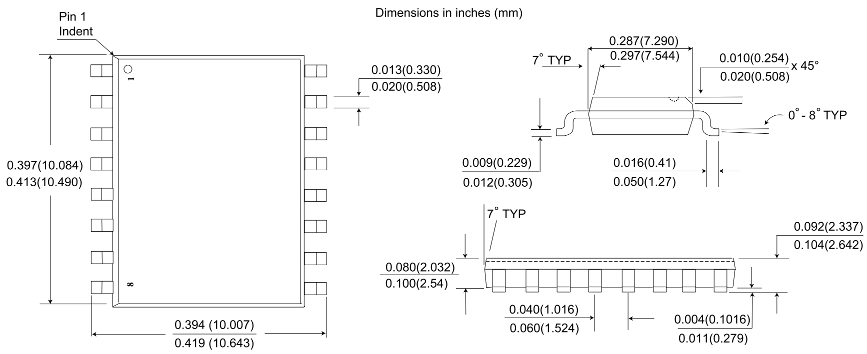
IR Soldering Profile

Recommended profile shown. Maximum temperature allowed on any profile is 260° C.

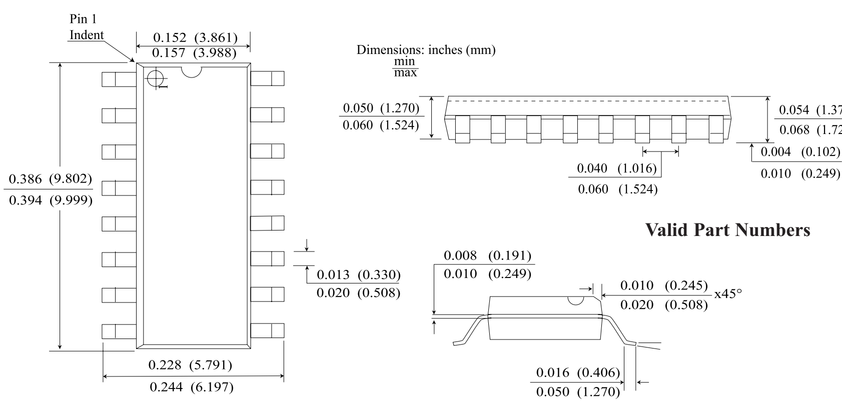


NVE Corporation 11409 Valley View Road Eden Prairie, MN 55344-3617 USA Telephone: (952) 829-9217 Fax: (952) 829-9189 Internet: www.isoloop.com

0.3'' SOIC-16 Package



0.15'' SOIC-16 Package



Ordering Information: use the following format to order these devices

IL 715 -3 B TR13

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

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

Package
Blank = SOIC (0.3")
-3 = SOIC (0.15")

Base Part Number
715 = 4 drive channels
716 = 2 drive and 2 receive channels
717 = 3 drive and 1 receive channels

Product Family
IL = Isolators

Valid Part Numbers

IL 715	IL 716	IL 717
IL 715-3	IL 716-3	IL 717-3
IL 715-3B	IL 716-3B	IL 717-3B
IL 715-3BTR13	IL 716-3BTR13	IL 717-3BTR13
IL 715-3BTR7	IL 716-3BTR7	IL 717-3BTR7
IL 715-3TR13	IL 716-3TR13	IL 717-3TR13
IL 715-3TR7	IL 716-3TR7	IL 717-3TR7
IL 715B	IL 716B	IL 717B
IL 715BTR13	IL 716BTR13	IL 717BTR13
IL 715TR13	IL 716TR13	IL 717TR13

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

About NVE

NVE Corporation is a world leader in the practical commercialization of "spintronics," which many experts believe represents the next generation of microelectronics — the successor to the transistor. Unlike conventional electronics, which rely on electron charge, spintronics uses electron spin to store and transmit information. Spintronics devices are smaller, faster, and more accurate, compared to charge-based microelectronics.

It is the spin of electrons that causes magnetism. NVE's products use proprietary spintronic materials called Giant Magnetoresistors (GMR). These materials are made of exotic alloys a few atoms thick, and provide very large signals (the "Giant" in "Giant Magnetoresistor"). NVE has the unique capability to combine leading edge GMR materials with integrated circuits to make high performance electronic components.

We are pioneers in creating practical products using this revolutionary technology and introduced the world's first GMR products in 1994. We also license spintronics/Magnetic Random Access Memory (MRAM) designs to world-class memory manufacturers.

Our products include:
- Digital Signal Isolators
- Isolated Bus Transceivers
- Magnetic Field Sensors
- Magnetic Field Gradient Sensors (Gradiometer)
- Digital Magnetic Field Sensors.

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-IL715/6/7-F
July 2002