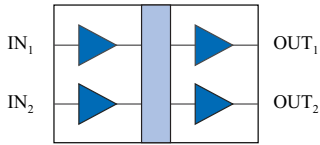
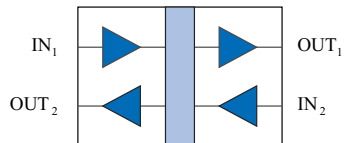


Low-Power Digital Isolators

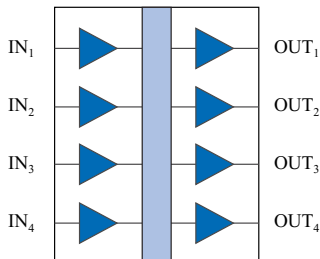
Functional Diagrams



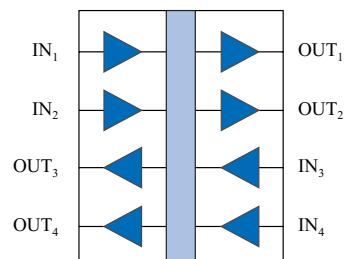
IL011



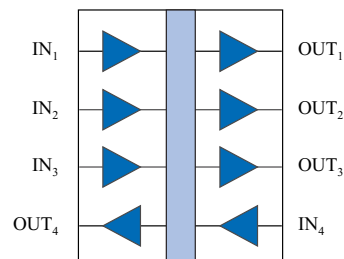
IL012



IL015



IL016



IL017

Features

- 0.3 mA/channel total typical quiescent current
- 10 Mbps guaranteed maximum data rate
- Extended 2.5 to 5.5 volt supply range
- -40 °C to +100 °C
- No carriers or clocks for low EMI emissions
- 44000 year barrier life
- 50 kV/μs typical common mode transient immunity
- Excellent magnetic immunity
- IEC 60747-17 (VDE 0884-17):2021-10 certified; UL 1577 recognized
- ATEX / IEC 60079 certified for IS-to-IS intrinsically safe applications
- SOIC8 and wide-body 16-pin SOIC packages

Applications

- 4-to-20 mA loop-powered controls
- Battery-powered instruments
- SPI
- Multiplexed data transmission
- Ground loop elimination
- Logic level shifting

Description

NVE's IL01x low-power digital isolators use NVE's patented* spintronic Tunneling Magnetoresistance (TMR) technology for a remarkable combination of power efficiency and speed.

A unique ceramic/polymer composite barrier provides excellent isolation and virtually unlimited barrier life.

Their unique design sensitive has no carriers or clocks, providing virtually undetectable EMI emissions.

Parts are available in various two-channel and four-channel configurations.



A STELIAU COMPANY

Singel 3 | B-2550 Kontich | Belgium | Tel.+32(0)3 458 30 33
info@alcom.be | www.alcom.be

Rivium 1e straat 52 | 2909 LE Capelle aan den IJssel | The Netherlands

Tel.+31(0)10 288 25 00 | info@alcom.nl | www.alcom.nl

IsoLoop is a registered trademark of NVE Corporation.

*U.S. Patent numbers 5,831,426; 6,300,617 and others.

REV. C

Absolute Maximum Ratings

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	-55		150	°C	
Junction Temperature	T_J	-55		150	°C	
Ambient Operating Temperature ⁽¹⁾	T_A	-40		100	°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_A	-40		100	°C	
Junction Temperature	T_J	-40		110	°C	
Supply Voltage	V_{DD1}, V_{DD2}	2.5		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	

Safety and Approvals

IEC 60747-17 (VDE 0884-17):2021-10 (Basic Isolation; VDE File Number 5016933-4880-0001):

- Isolation voltage (V_{ISO}): 2500 V_{RMS}
- Transient overvoltage (V_{IOTM}): 4000 V_{PK}
- Surge rating 4000 V
- Each part tested at 1590 V_{PK} for 1 second, 5 pC partial discharge limit
- Samples tested at 4000 V_{PK} for 60 sec.; then 1358 V_{PK} for 10 sec. with 5 pC partial discharge limit
- Working Voltage (V_{IORM} ; pollution degree 2):

Package	Part No. Suffix	Working Voltage
SOIC8	-3	700 V_{RMS}
Wide-body SOIC16/True 8™	None	600 V_{RMS}

Safety-Limiting Values	Symbol	Value	Units
Safety rating ambient temperature	T_s	180	°C
Safety rating power (180°C)	P_s	270	mW
Supply current safety rating (total of supplies)	I_s	54	mA

UL 1577 (Component Recognition Program File Number E207481)

Tested at 3000 V_{RMS} (4240 V_{PK}) for 1 second; each lot sample tested at 2500 V_{RMS} (3530 V_{PK}) for 1 minute

Intrinsically Safe Certification

- ATEX / IEC 60079-0 / 60079-11 Intrinsically Safe (IS) certification under ATEX and IECEx for use in IS-to-IS applications.
- 500 V_{RMS} IS-to-IS isolation rating.
- IS entity parameters and temperature ratings are as follows:

Entity Parameter	Description	Package	
		SOIC-8	0.3" SOIC-16
U_i	Maximum voltage that can be connected to device	60 V	60 V
I_i	Maximum current that can be connected to device	300 mA	300 mA
P_i	Maximum power that can be connected to device	0.8 W	1.3 W
L_i	Maximum internal capacitance of the device	0	0
C_i	Maximum internal inductance of the device	4 pF	4 pF
	Maximum ambient temperature	85 °C	
	Maximum component surface temperature	200 °C*	

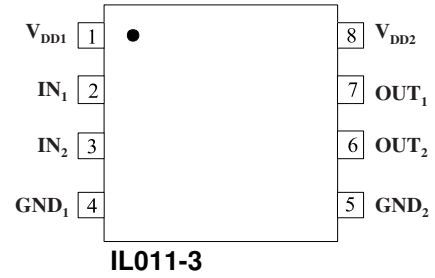
*"T3" maximum surface temperature classification for Group II electrical equipment.

Soldering Profile

Per JEDEC J-STD-020C, MSL 1

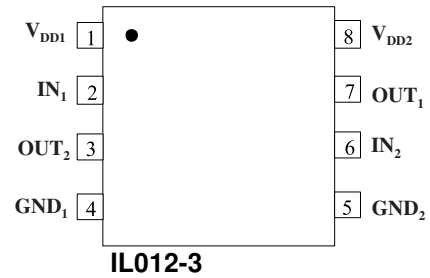
IL011-3 Pin Connections

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



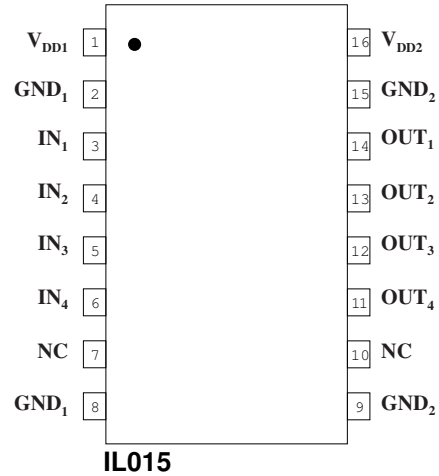
IL012-3 Pin Connections

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



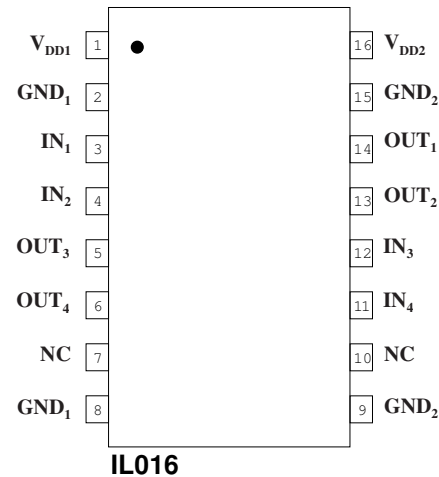
IL015 Pin Connections

1	V _{DD1}	Supply voltage
2	GND ₁	Ground return for V _{DD1} *
3	IN ₁	Data in, channel 1
4	IN ₂	Data in, channel 2
5	IN ₃	Data in, channel 3
6	IN ₄	Data in, channel 4
7	NC	No connection
8	GND ₁	Ground return for V _{DD1} *
9	GND ₂	Ground return for V _{DD2} *
10	NC	No connection
11	OUT ₄	Data out, channel 4
12	OUT ₃	Data out, channel 3
13	OUT ₂	Data out, channel 2
14	OUT ₁	Data out, channel 1
15	GND ₂	Ground return for V _{DD2} *
16	V _{DD2}	Supply voltage



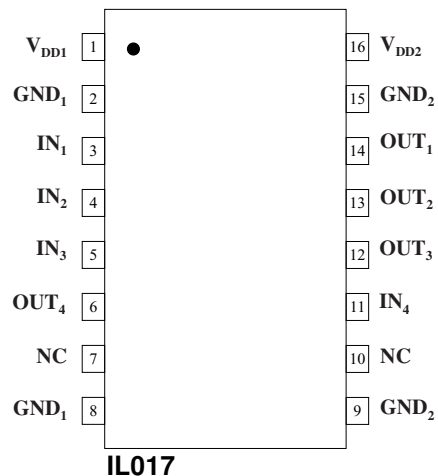
IL016 Pin Connections

1	V _{DD1}	Supply voltage
2	GND ₁	Ground Return for V _{DD1} *
3	IN ₁	Data in, channel 1
4	IN ₂	Data in, channel 2
5	OUT ₃	Data out, channel 3
6	OUT ₄	Data out, channel 4
7	NC	No connection
8	GND ₁	Ground Return for V _{DD1} *
9	GND ₂	Ground Return for V _{DD2} *
10	NC	No connection
11	IN ₄	Data in, channel 4
12	IN ₃	Data in, channel 3
13	OUT ₂	Data out, channel 2
14	OUT ₁	Data out, channel 1
15	GND ₂	Ground Return for V _{DD2} *
16	V _{DD2}	Supply voltage



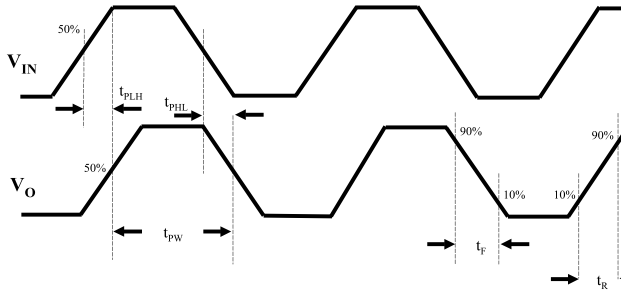
IL017 Pin Connections

1	V _{DD1}	Supply voltage
2	GND ₁	Ground return for V _{DD1} *
3	IN ₁	Data in, channel 1
4	IN ₂	Data in, channel 2
5	IN ₃	Data in, channel 3
6	OUT ₄	Data out, channel 4
7	NC	No connection
8	GND ₁	Ground return for V _{DD1} *
9	GND ₂	Ground return for V _{DD2} *
10	NC	No connection
11	IN ₄	Data in, channel 4
12	OUT ₃	Data out, channel 3
13	OUT ₂	Data out, channel 2
14	OUT ₁	Data out, channel 1
15	GND ₂	Ground return for V _{DD2} *
16	V _{DD2}	Supply voltage



*NOTE: Pins 2 and 8 are internally connected, as are pins 9 and 15.

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

3.3 Volt Electrical Specifications (T _{min} to T _{max} unless otherwise stated)						
Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
V _{DD1} Quiescent Supply Current						
IL011	I _{DD1}		8	15	μA	
IL012			0.3	0.5	mA	
IL015			10	15	μA	
IL016			0.4	1.0	mA	
IL017			0.3	0.5	mA	
V _{DD2} Quiescent Supply Current						
IL011	I _{DD2}		0.6	1.0	mA	
IL012			0.3	0.5	mA	
IL015			1.2	2.0	mA	
IL016			0.4	1.0	mA	
IL017			0.9	1.5	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

Magnetic Field Immunity ⁽⁸⁾ (V _{DD1} = V _{DD2} = 3.3V)						
Power Frequency Magnetic Immunity	H _{PF}		1500		A/m	50 Hz / 60 Hz
Pulse Magnetic Field Immunity	H _{PM}		2000		A/m	t _p = 8 μs
Damped Oscillatory Magnetic Field	H _{OSC}		2000		A/m	0.1 Hz - 1 MHz
Cross-axis Immunity Multiplier ⁽⁹⁾	K _X		2.5			

5 Volt Electrical Specifications (T _{min} to T _{max} unless otherwise stated)						
Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
V _{DD1} Quiescent Supply Current						
IL011	I _{DD1}		10	20	μA	
IL012			0.5	0.75	mA	
IL015			17	25	μA	
IL016			0.7	1.5	mA	
IL017			0.5	0.75	mA	
V _{DD2} Quiescent Supply Current						
IL011	I _{DD2}		1	1.5	mA	
IL012			0.5	0.75	mA	
IL015			2	3	mA	
IL016			0.7	1.5	mA	
IL017			1.5	2.25	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

Magnetic Field Immunity ⁽⁸⁾ (V _{DD1} = V _{DD2} = 5V)						
Power Frequency Magnetic Immunity	H _{PF}		3500		A/m	50 Hz / 60 Hz
Pulse Magnetic Field Immunity	H _{PM}		4500		A/m	t _p = 8 μs
Damped Oscillatory Magnetic Field	H _{OSC}		4500		A/m	0.1 Hz - 1 MHz
Cross-axis Immunity Multiplier ⁽⁹⁾	K _X		2.5			

Switching Specifications (3 V ≤ V _{DD} ≤ 5.5V)						
Maximum Data Rate		10			Mbps	C _L = 15 pF
Pulse Width ⁽⁷⁾	PW	50			ns	50% Points, V _O
Propagation Delay Input to Output (High to Low)	t _{PHL}		50	100	ns	C _L = 15 pF
Propagation Delay Input to Output (Low to High)	t _{PLH}		50	100	ns	C _L = 15 pF
Pulse Width Distortion ⁽²⁾	PWD		25	50	ns	C _L = 15 pF
Propagation Delay Skew ⁽³⁾	t _{PSK}		25	50	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	30	50		kV/μs	V _{CM} = 1500 V _{DC} t _{TRANSIENT} = 25 ns
Channel-to-Channel Skew	t _{CSK}		10	15	ns	C _L = 15 pF
Dynamic Power Consumption ⁽⁶⁾			200	340	μA/Mbps	per channel

Insulation Specifications						
Creepage Distance (external)						
SOIC8			4.03			mm
SOIC16			8.03			
Per IEC 60601						
Total Barrier Thickness (internal)			0.012	0.016		mm
Leakage Current ⁽⁵⁾				0.2		μA
Barrier Resistance ⁽⁵⁾				>10 ¹⁴		Ω
Barrier Capacitance ⁽⁵⁾				4		pF
Comparative Tracking Index		CTI	≥600			V _{RMS}
Per IEC 60112						
High Voltage Endurance (Maximum Barrier Voltage for Indefinite Life)	AC	V _{IO}	1000			V _{RMS}
	DC		1500			V _{DC}
At maximum operating temperature						
Barrier Life				44000		Years
100°C, 1000 V _{RMS} , 60% CL activation energy						

Thermal Characteristics							
Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	SOIC8	θ _{JA}		134		°C/W	Double-sided PCB in free air
	0.3" SOIC16			67			
Junction–Case (Top) Thermal Resistance	SOIC8	θ _{JC}		10			
	0.3" SOIC16			12			
Junction–Ambient Thermal Resistance	0.3" SOIC	θ _{JA}		46			
				Junction–Case (Top) Thermal Resistance			
Power Dissipation	SOIC8	P _D	675				
	0.3" SOIC16		1500				
mW							

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 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 is calculated per channel and is 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. 9.
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. 9).
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

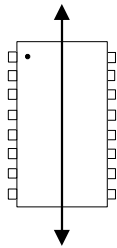
This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to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

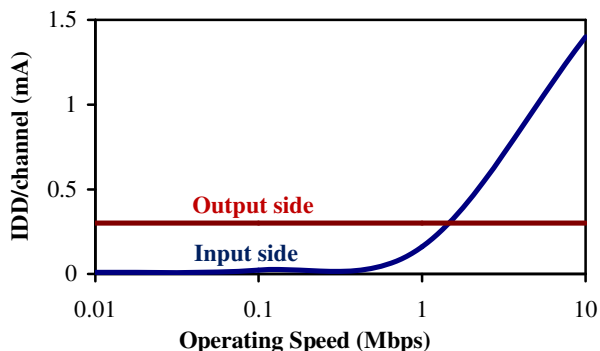
These isolators are fully compliant with generic EMC standards EN50081, EN50082-1 and the umbrella IEC 61000-6-1 and IEC 61000-6-2 standards for immunity, and IEC 61000-6-3, IEC 61000-6-4, CISPR, and FCC Class A standards for emissions.

Immunity to external magnetic fields is even higher if the field direction is "end-to-end" rather than to "pin-to-pin" as shown below:



Dynamic Power Consumption

IsoLoop Isolators achieve their low EMI emissions and low power consumption from a unique edge-triggered architecture. Most of the power is consumed on the output side, which is not dependant on operating frequency. Input side power consumption is generally lower, but has some dependence on operating frequency. Typical power consumption is shown in the following graph:



Typical supply current per channel, VDD = 3.3 V; 25°C.

Power Supply Decoupling

Both power supplies should be decoupled with 0.1 μ F typical (0.047 μ F minimum) capacitors as close as possible to the VDD pins.

Maintaining Creepage

Creepage distances are often critical in isolated circuits. In addition to meeting JEDEC standards, NVE isolator packages have unique creepage specifications. Standard pad libraries often extend under the package, compromising creepage and clearance. Similarly, ground planes, if used, should be spaced to avoid compromising clearance. Package drawings and recommended pad layouts are included in this datasheet.

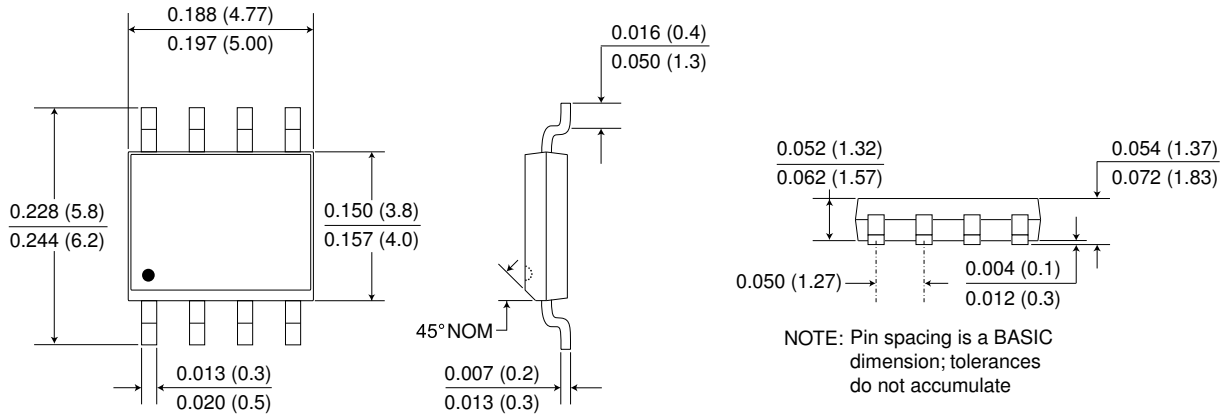
Signal Status on Start-up and Shut Down

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.

Package Drawings

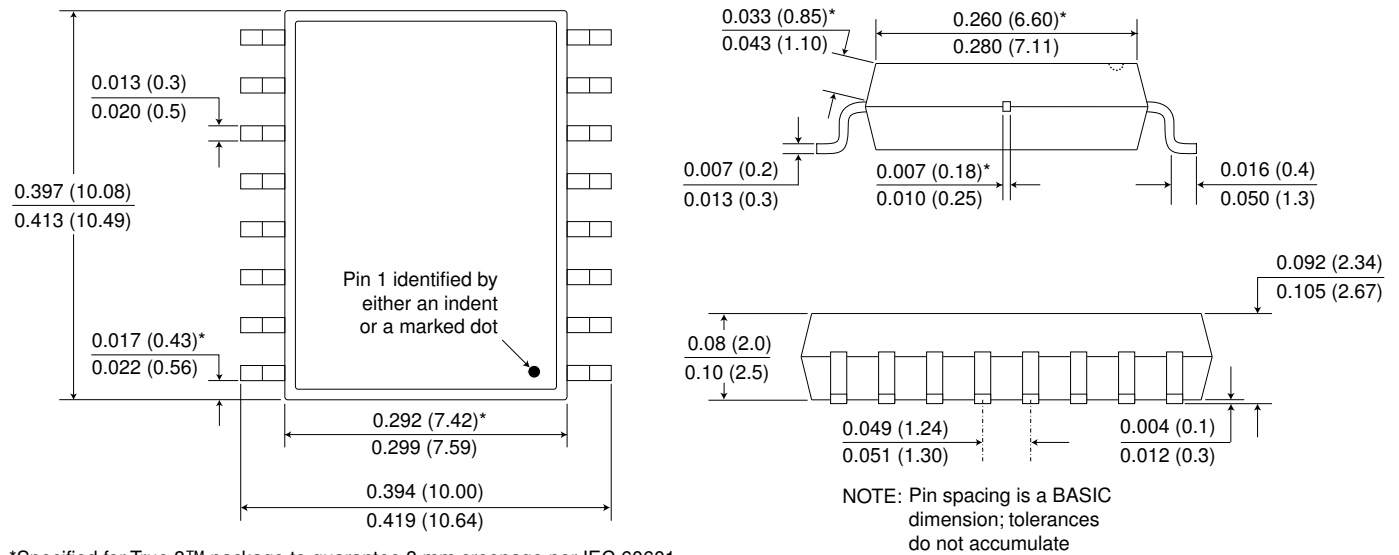
8-pin SOIC8 Package (IL011-3 / IL012-3)

Dimensions in inches (mm); scale = approx. 5X



16-pin 0.3" SOIC16 Package (IL015 / IL016 / IL017)

Dimensions in inches (mm); scale = approx. 5X



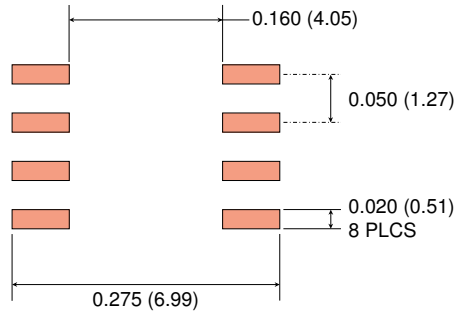
*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.



Recommended Pad Layouts

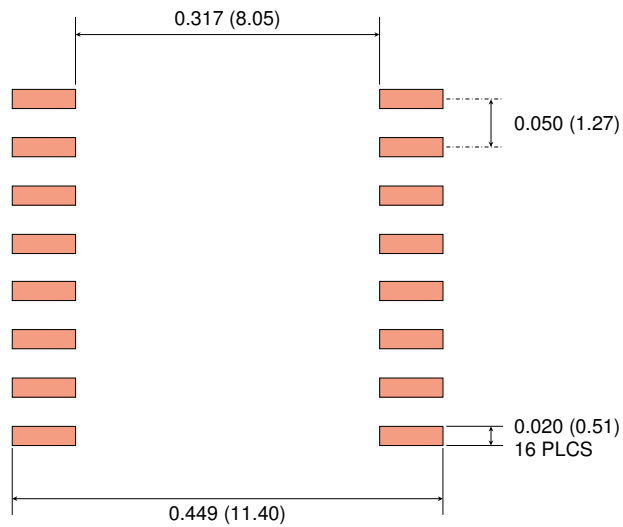
SOIC8 Pad Layout

Dimensions in inches (mm); scale = approx. 5X



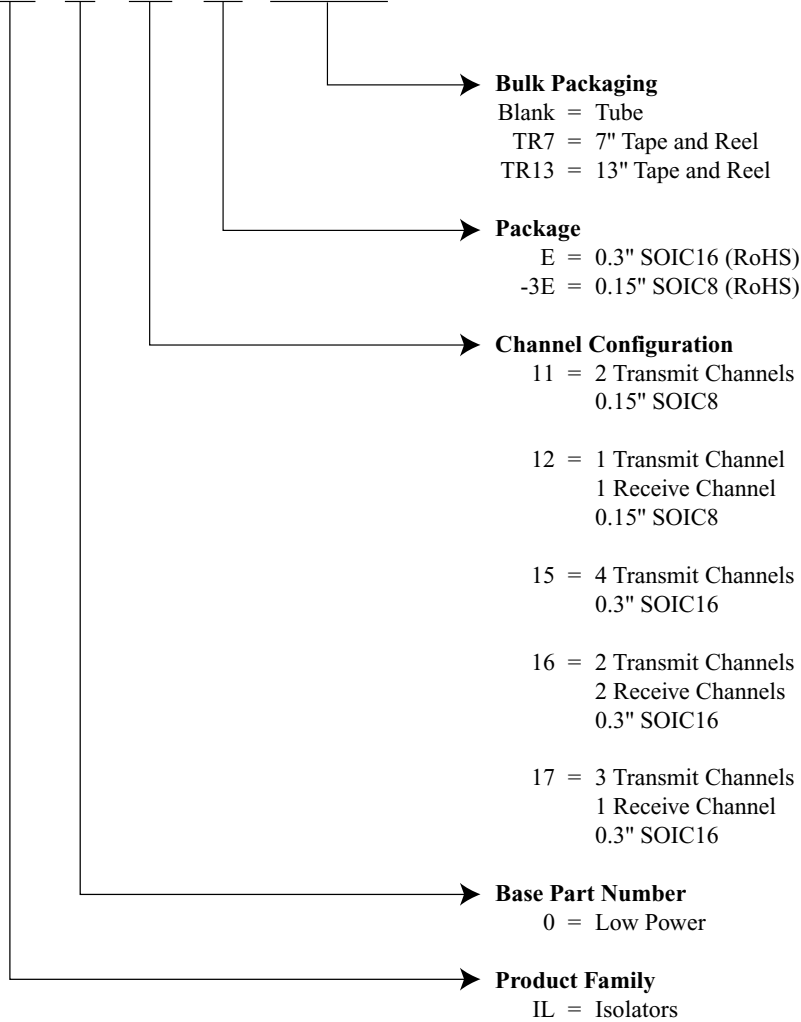
SOIC16 Pad Layout

Dimensions in inches (mm); scale = approx. 5X



Ordering Information

IL 0 17 E TR13



ISB-DS-001-IL01x-RevC
October 2022

Change

- Upgrade to VDE 0884-17 (p. 3).
- Increased Working Voltage ratings based on latest VDE testing (p. 3).
- ATEX / IEC 60079 certified for IS-to-IS intrinsically safe applications.

ISB-DS-001-IL01x-RevB
January 2020

Changes

- Revised thermal characteristics (p. 2).
- Extended power supply range to as low as 2.5 volts.
- Merged 3.3 V and 5 V switching speed specifications and revised specifications (p. 8).
- Upgrade from VDE V 0884-10 to VDE V 0884-11 / IEC 60747-17.
- Updated EMC standards.

ISB-DS-001-IL01x-RevA
June 2018

Changes

- Added IL011 configuration.
- Decrease typ. Pulse Width Distortion Propagation Delay Skew specs.
- Increase worst-case Propagation Delay specs.
- Product launch.

ISB-DS-001-IL01x-PRELIM
December 2017

Change

- Preliminary Release.

Datasheet Limitations

The information and data provided in datasheets shall define the specification of the product as agreed between NVE and its customer, unless NVE and customer have explicitly agreed otherwise in writing. All specifications are based on NVE test protocols. In no event however, shall an agreement be valid in which the NVE product is deemed to offer functions and qualities beyond those described in the datasheet.

Limited Warranty and Liability

Information in this document is believed to be accurate and reliable. However, NVE does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NVE be liable for any indirect, incidental, punitive, special or consequential damages (including, without limitation, lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Right to Make Changes

NVE reserves the right to make changes to information published in this document including, without limitation, specifications and product descriptions at any time and without notice. This document supersedes and replaces all information supplied prior to its publication.

Use in Life-Critical or Safety-Critical Applications

Unless NVE and a customer explicitly agree otherwise in writing, NVE products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical devices or equipment. NVE accepts no liability for inclusion or use of NVE products in such applications and such inclusion or use is at the customer's own risk. Should the customer use NVE products for such application whether authorized by NVE or not, the customer shall indemnify and hold NVE harmless against all claims and damages.

Applications

Applications described in this datasheet are illustrative only. NVE makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NVE products, and NVE accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NVE product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customers. Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NVE does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customers. The customer is responsible for all necessary testing for the customer's applications and products using NVE products in order to avoid a default of the applications and the products or of the application or use by customer's third party customers. NVE accepts no liability in this respect.

Limiting Values

Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the recommended operating conditions of the datasheet is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and Conditions of Sale

In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NVE hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NVE products by customer.

No Offer to Sell or License

Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export Control

This document as well as the items described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Automotive Qualified Products

Unless the datasheet expressly states that a specific NVE product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NVE accepts no liability for inclusion or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NVE's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NVE's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NVE for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NVE's standard warranty and NVE's product specifications.



An ISO 9001 Certified Company

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

©NVE Corporation
All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

ISB-DS-001-IL01x-RevC

October 2022