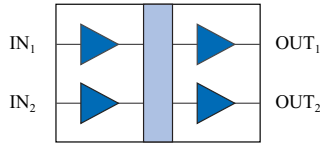
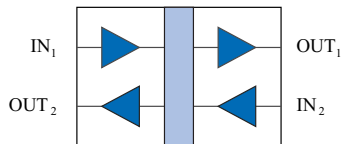


Low-Power Digital Isolators

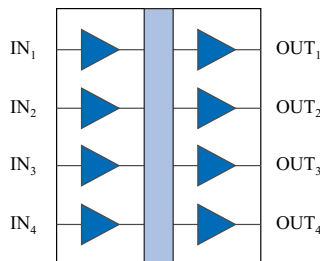
Functional Diagrams



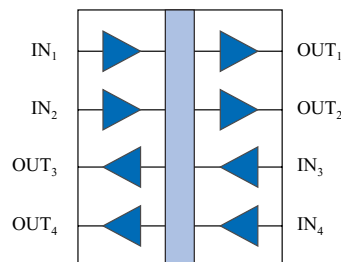
IL011



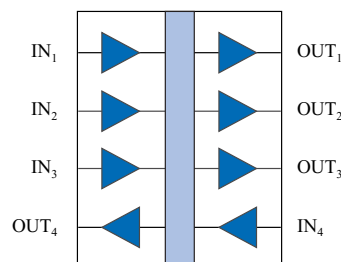
IL012



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
- VDE V 0884-11 / IEC 60747-17 certified; UL 1577 listed
- 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.

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

VDE V 0884-11 / IEC 60747-17 (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	400 V_{RMS}
Wide-body SOIC16/ True 8™	None	500 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 (pending under Component Recognition Program File Number E207481)

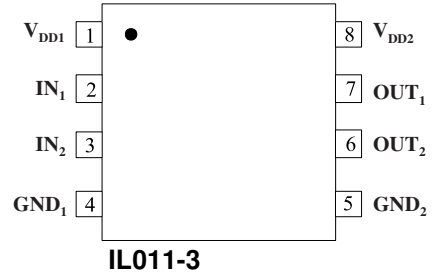
Tested at 3000 V_{RMS} (4240 V_{PK}) for 1 second; each lot sample tested at 2500 V_{RMS} (3530 V_{PK}) for 1 minute

Soldering Profile

Per JEDEC J-STD-020C, MSL 1

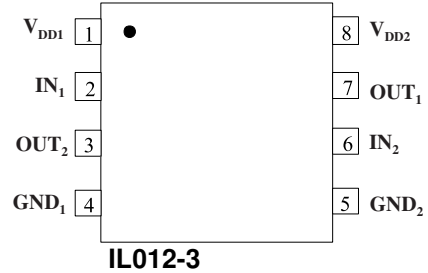
IL011-3 Pin Connections

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



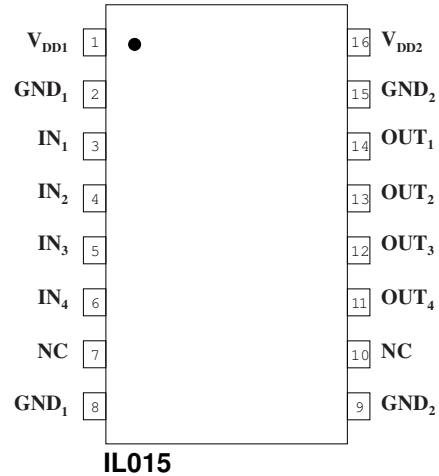
IL012-3 Pin Connections

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



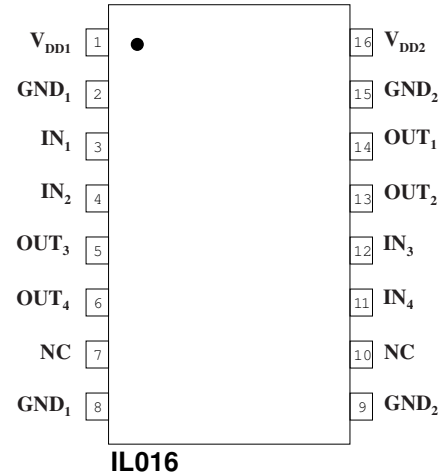
IL015 Pin Connections

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



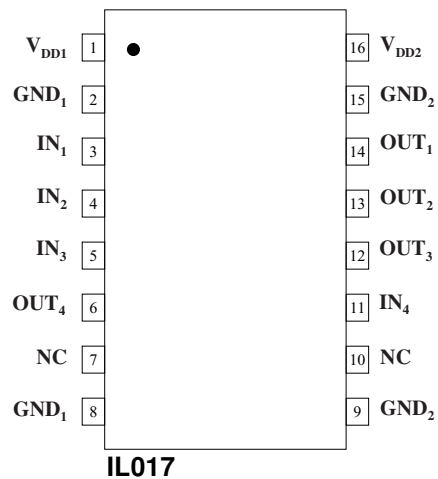
IL016 Pin Connections

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



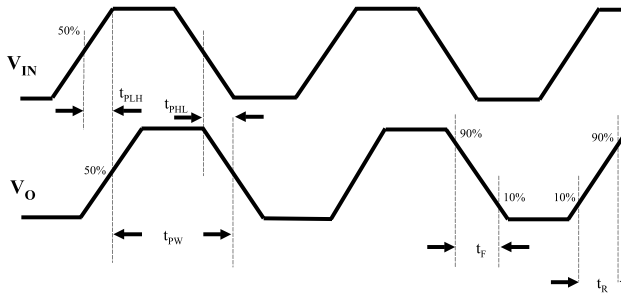
IL017 Pin Connections

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	$I_O = -20 \mu\text{A}, V_I = V_{IH}$
		$0.8 \times V_{DD}$	$0.9 \times V_{DD}$			$I_O = -4 \text{mA}, V_I = V_{IH}$
Logic Low Output Voltage	V_{OL}		0	0.1	V	$I_O = 20 \mu\text{A}, V_I = V_{IL}$
				0.5		0.8

Magnetic Field Immunity ⁽⁸⁾ ($V_{DD1} = V_{DD2} = 3.3\text{V}$)						
Power Frequency Magnetic Immunity	H_{PF}		1500		A/m	50 Hz / 60 Hz
Pulse Magnetic Field Immunity	H_{PM}		2000		A/m	$t_p = 8 \mu\text{s}$
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	$I_O = -20 \mu\text{A}, V_I = V_{IH}$
		$0.8 \times V_{DD}$	$0.9 \times V_{DD}$			$I_O = -4 \text{mA}, V_I = V_{IH}$
Logic Low Output Voltage	V_{OL}		0	0.1	V	$I_O = 20 \mu\text{A}, V_I = V_{IL}$
				0.5		0.8

Magnetic Field Immunity ⁽⁸⁾ ($V_{DD1} = V_{DD2} = 5\text{V}$)						
Power Frequency Magnetic Immunity	H_{PF}		3500		A/m	50 Hz / 60 Hz
Pulse Magnetic Field Immunity	H_{PM}		4500		A/m	$t_p = 8 \mu\text{s}$
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 ($3\text{ V} \leq V_{DD} \leq 5.5\text{ V}$)						
Maximum Data Rate		10			Mbps	$C_L = 15\text{ pF}$
Pulse Width ⁽⁷⁾	PW	50			ns	50% Points, V_O
Propagation Delay Input to Output (High to Low)	t_{PHL}		50	100	ns	$C_L = 15\text{ pF}$
Propagation Delay Input to Output (Low to High)	t_{PLH}		50	100	ns	$C_L = 15\text{ pF}$
Pulse Width Distortion ⁽²⁾	PWD		25	50	ns	$C_L = 15\text{ pF}$
Propagation Delay Skew ⁽³⁾	t_{PSK}		25	50	ns	$C_L = 15\text{ pF}$
Output Rise Time (10%–90%)	t_R		2	4	ns	$C_L = 15\text{ pF}$
Output Fall Time (10%–90%)	t_F		2	4	ns	$C_L = 15\text{ pF}$
Common Mode Transient Immunity (Output Logic High or Logic Low) ⁽⁴⁾	$ CM_H , CM_L $	30	50		kV/ μs	$V_{CM} = 1500\text{ V}_{DC}$ $t_{TRANSIENT} = 25\text{ ns}$
Channel-to-Channel Skew	t_{CSK}		10	15	ns	$C_L = 15\text{ pF}$
Dynamic Power Consumption ⁽⁶⁾			200	340	$\mu\text{A}/\text{Mbps}$	per channel

Insulation Specifications						
Creepage Distance (external)						
SOIC8		4.03			mm	Per IEC 60601
SOIC16		8.03	8.3			
Total Barrier Thickness (internal)		0.012	0.016		mm	
Leakage Current ⁽⁵⁾			0.2		μA	240 V_{RMS} , 60 Hz
Barrier Resistance ⁽⁵⁾			$>10^{14}$		Ω	500 V
Barrier Capacitance ⁽⁵⁾			4		pF	$f = 1\text{ MHz}$
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}	At maximum operating temperature
	DC		1500		V_{DC}	
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			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				2s2p PCB in free air per JESD51
				θ_{JC}				
Power Dissipation	SOIC8	P_D				675 1500	mW	
	0.3" SOIC16							

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 $V_O < 0.8\text{ V}$. 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

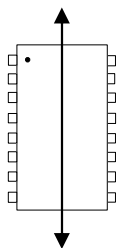
This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to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

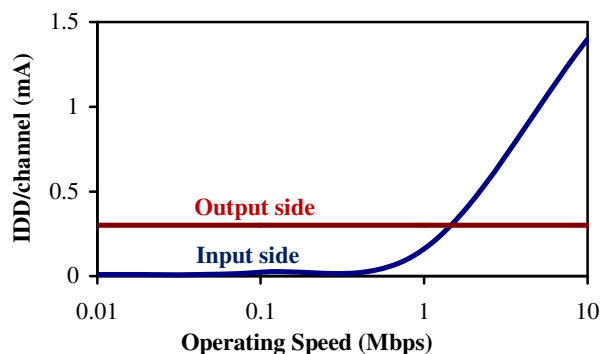
These isolators are fully compliant with generic EMC standards EN50081, EN50082-1 and the umbrella IEC 61000-6-1 and IEC 61000-6-2 standards for immunity, and IEC 61000-6-3, IEC 61000-6-4, CISPR, and FCC Class A standards for emissions.

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 V_{DD} 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.

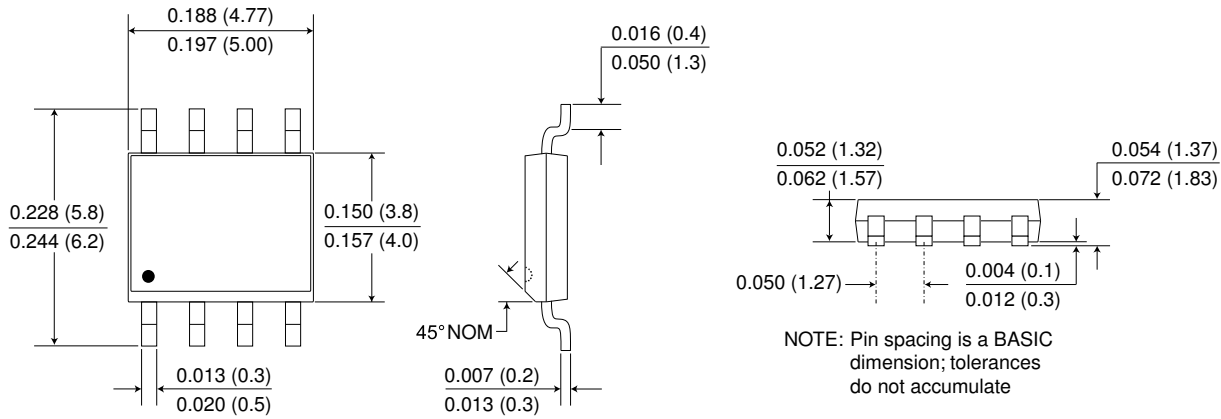
Signal Status on Start-up and Shut Down

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

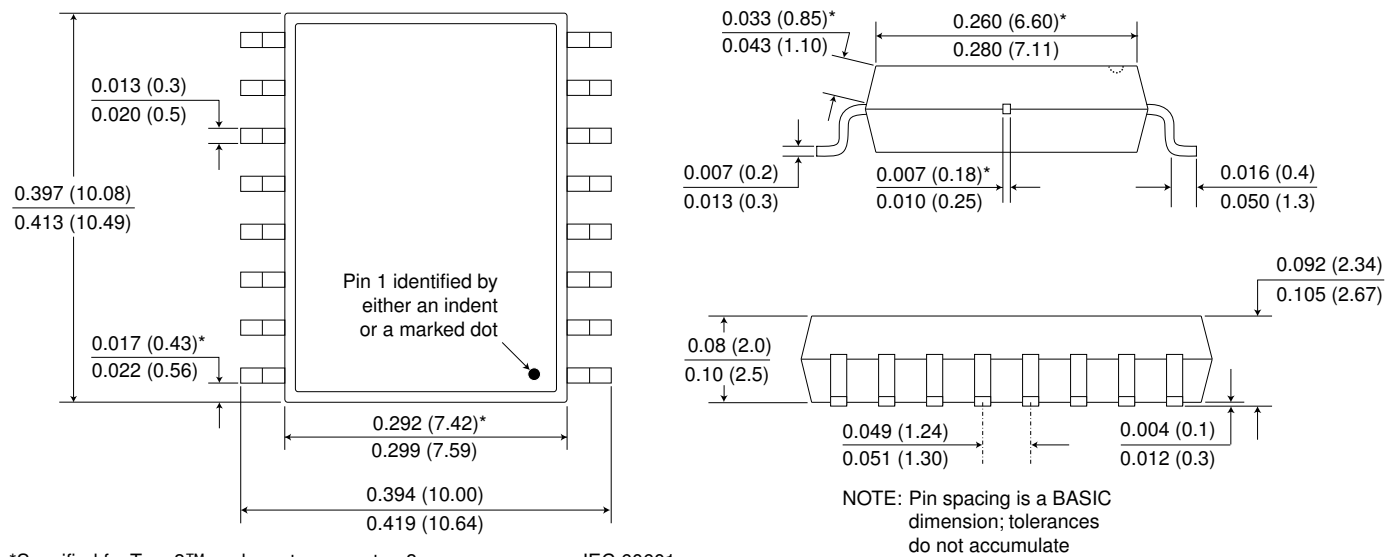
8-pin SOIC8 Package (IL011-3 / IL012-3)

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



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

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



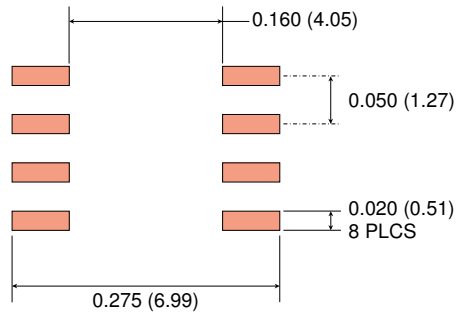
*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.



Recommended Pad Layouts

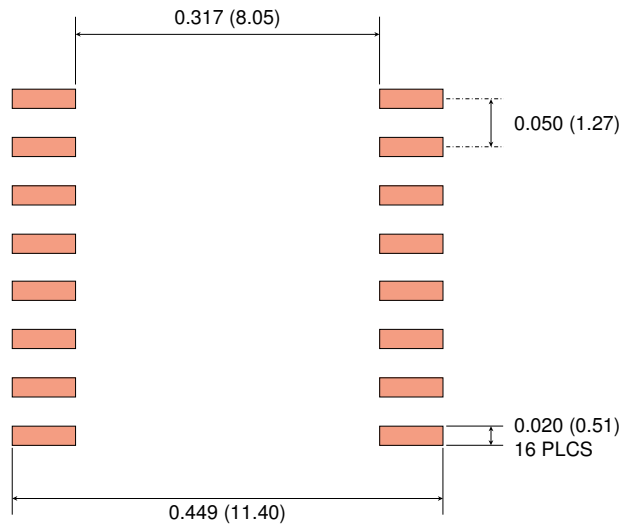
SOIC8 Pad Layout

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



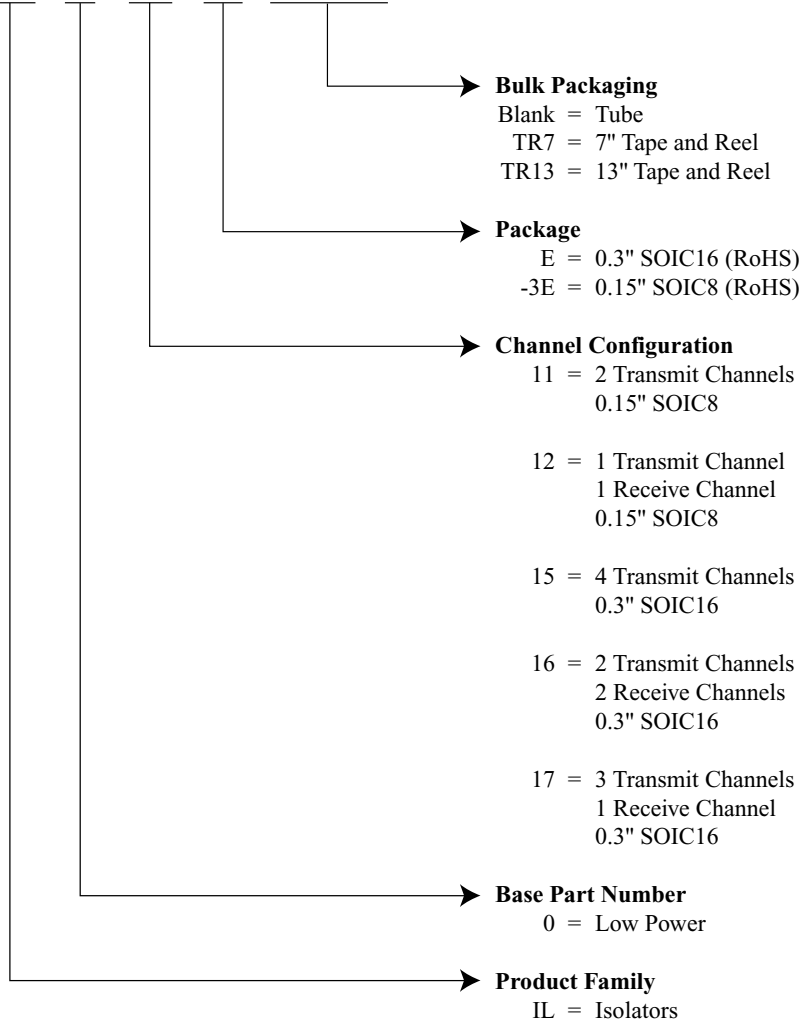
SOIC16 Pad Layout

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



Ordering Information

IL 0 17 E TR13



ISB-DS-001-IL01x-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.

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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.

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