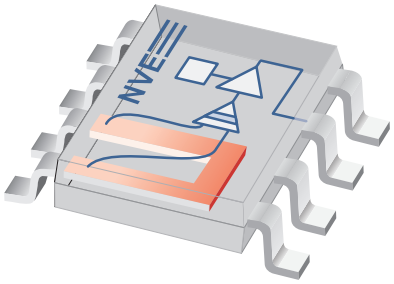
NVE CORPORATION

IL004 Current-Mode Isolators

Features

- −5 A to +5 A Input Current
- 0 V to 5 V Voltage Output
- Total Error <0.5%
- 12-bit Resolution
- AC or DC Input
- Factory Calibrated
- Temperature Compensated −25°C to +85°C
- 2.5 kV_{RMS} (SOIC8 Version) or 6 kV_{RMS} (SOIC16 Version) Isolation
- VDE V 0884-10 and UL 1577 pending



Description

The IL004 is a current-in, voltage-out linear isolator using a linear bipolar GMR bridge sensor and on-chip signal processing to amplify, normalize, and temperature compensate the output. The output is an analog, rail-to-rail voltage signal proportional to the input current and ratiometric with the supply voltage. An on-chip EEPROM stores temperature and linearity factory calibration data.

Isolation up to 6 kV is provided by a unique ceramic/polymer composite barrier with an estimated life of a remarkable 44000 years.

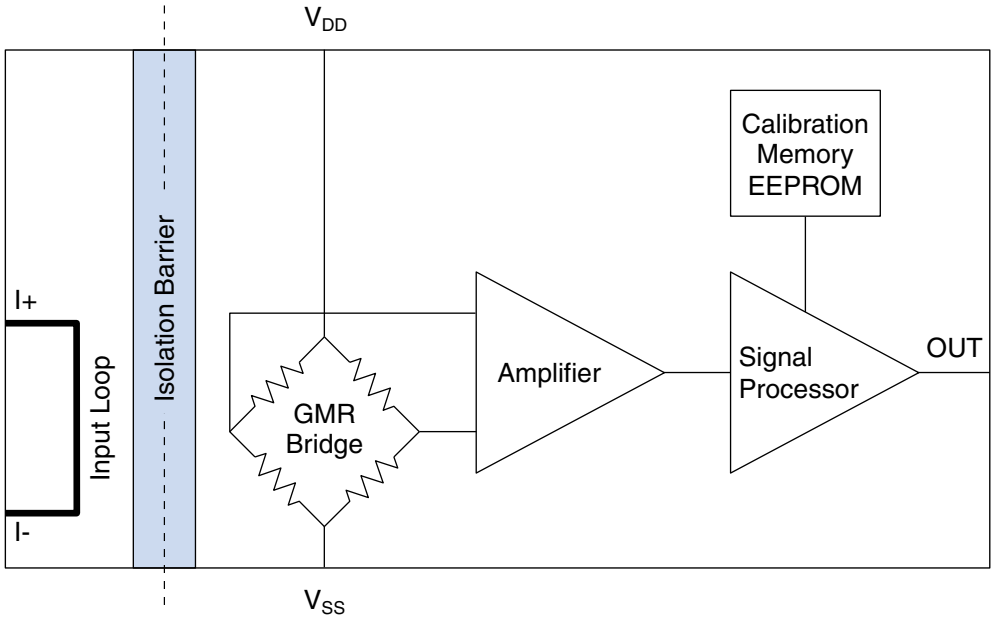


Figure 1. IL004 Block Diagram

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Recalibration and Reconfiguration

Devices are factory configured and calibrated. Reconfiguration is possible, although recommended only for advanced users.

The IL004 uses the ZMDI ZACwire™ digital one-wire interface. The device can be put in a Command Mode by providing a command on the output pin within 3 milliseconds of power up. Calibration data is typically written from a PC, and data is transferred using Manchester bit encoding at speeds from 8 kbps to 32 kbps.

The following major functions are available:

- Reading the ADC digital output
- Calibration commands
- Reading the entire EEPROM
- Writing to the EEPROM

Recalibration and reconfiguration details are available in the ZMDI ZSC31015 datasheet.

Application Information

Current Polarity

Current entering the chip via terminals I+ and leaving the chip via terminals I- results in a voltage output greater than $V_{DD}/2$; current entering the chip via terminal I- and leaving the chip via terminal I+ produces an output less than $V_{DD}/2$.

Power Supply Decoupling

A 0.1 µF decoupling capacitor is recommended between V_{DD} and V_{SS}.

Maintaining Creepage

Creepage distances are often critical in isolated circuits. Standard pad libraries often extend under the package, compromising creepage and clearance. Package drawings and recommended pad layouts are included in this datasheet.

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An example output versus input signal is shown in the diagram below:

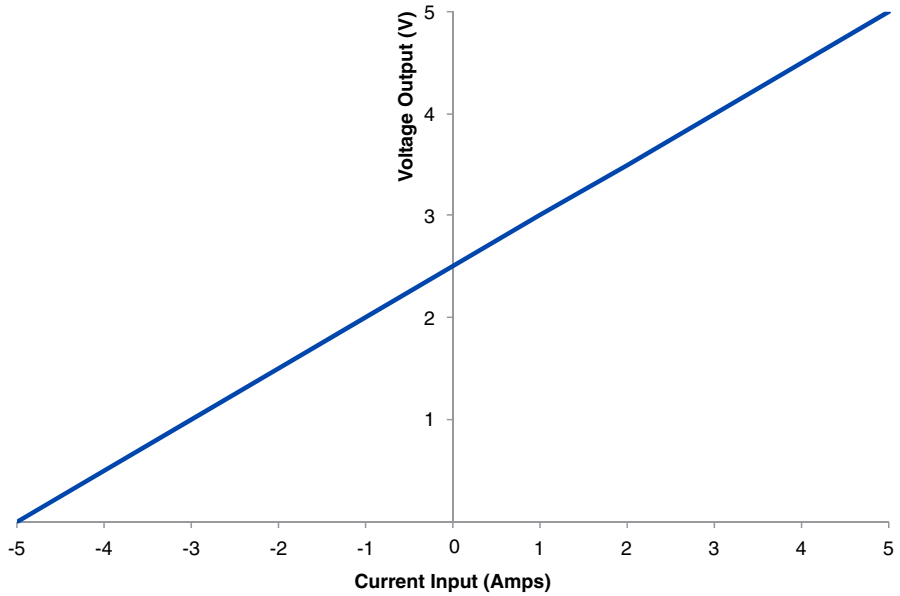

Figure 2. Signal output versus input (5V supply)

The diagram below shows the sensor output error band:

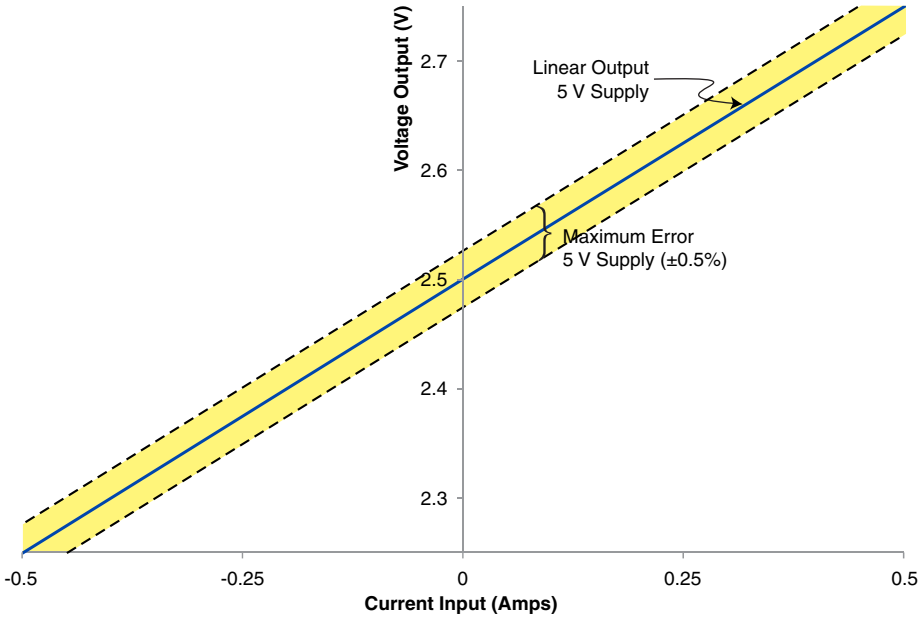

Figure 3. Signal output error tolerance (5V supply)

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Absolute Maximum Ratings[1]

Parameter	Min.	Max.	Units	Test Condition
Absolute Maximum Supply Voltage	−0.3	6.0	V	Operating, All Temperature Conditions
Absolute Maximum Voltage on Output	−0.3	V_{DD} + 0.3	V	Operating, All Temperature Conditions
Absolute Maximum Detection Current	−6	6	A	Operating, Full Temperature Range
Absolute Maximum Ext. Magnetic Field[2]		∞		
Storage Temperature	−40	150	°C	

Operating Specifications

Parameter	Min.	Typ.	Max.	Units	Test Condition
Supply Voltage (V_{DD})	2.7		5.5	Volts	Operating, Full Temp Range
Output Voltage (ratiometric with supply)	2.7		5.5	Volts	Operating, Full Temp Range
Supply Current			4.0	mA	Operating, Full Temp Range
Power-On Rise Time			100	Ms	Operating, Full Temp Range
Sensitivity		500		mV/A	Operating, 5V Supply
Linear Input Range	−5		5	A	Operating, Full Temp Range
Output Load Resistance to V_{SS} or V_{DD}	5			kΩ	Operating, Full Temp Range
Output Load Capacitance		10	15	nF	Operating, Full Temp Range
Linearity of Output Signal	99.5%			% full scale	Operating, Full Temp Range
Offset Variation of Output Signal			1.5%	% full scale	Operating, Full Temp Range
Frequency Response		1000		Hz	Operating, Full Temp Range
Input Resistance			0.005	Ω	25°C; pin 2 to pin 3
Input Resistance TCR		0.39		%/°C	%/◦C
Operating Temperature	−25		85	°C	Operating

Insulation Specifications

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (external)	SOIC8 SOIC16		4.03 8.03	 8.3		mm	Per IEC 60601
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 MHz
Comparative Tracking Index	SOIC8 SOIC16	CTI	≥175 ≥600			V_{RMS}	Per IEC 60112
High Voltage Endurance (Max. Barrier Voltage for Indefinite Life)	AC DC	V_{IO}	1000 1500			V_{RMS} V_{DC}	At maximum operating temperature
Surge Immunity (SOIC16)		V_{IOSM}	12.8			kV_{PK}	Per IEC 61000-4-5
Barrier Life				44000		Years	100°C, 1000 V_{RMS}, 60% CL act. energy

Thermal Specifications

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	SOIC8 SOIC16	θ_{JA}		60 60		°C/W	Soldered to double-sided board; free air
Junction–Case (Top) Thermal Resistance	SOIC8 SOIC16	Ψ_{JT}		10 20		°C/W	
Power Dissipation	SOIC8 SOIC16	P_D			700 800	mW	

Notes:

1. Exceeding Absolute Maximum Ratings may cause permanent damage.
2. Large magnetic fields will not damage NVE Isolators.

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Safety and Approvals

VDE V 0884-10 (File Number 5016933-4880-0001; certification pending)

2.5 kV-rated parts (SOIC8; -3 Suffix;)

- Working Voltage (V_{IORM}) 600 V_{RMS} (848 V_{PK}); basic insulation; pollution degree 2
- 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

6 kV-rated parts (SOIC16; V-Suffix)

- Working Voltage (V_{IORM}) 1000 V_{RMS} (1415 V_{PK}); reinforced insulation; pollution degree 2
- Isolation voltage (V_{ISO}) 6000 V_{RMS}
- Surge immunity (V_{IOSM}) 12.8 kV
- Surge rating 8 kV
- Transient overvoltage (V_{IOTM}) 6000 V_{PK}
- Each part tested at 2387 V_{PK} for 1 second, 5 pC partial discharge limit
- Samples tested at 6000 V_{PK} for 60 sec.; then 2122 V_{PK} for 10 sec. with 5 pC partial discharge limit

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; approval pending)

- 2.5 kV-rated parts 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

- 6 kV-rated V-Series parts tested at 7.2 kV_{RMS} (10.2 kV_{PK}) for 1 second; each lot sample tested at 6 kV_{RMS} (8485 V_{PK}) for 1 minute

Soldering Profile

Per JEDEC J-STD-020C, MSL 1

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Pinout

The IL004 pinouts are specified below:

Pin		Terminal	Description
SOIC8	SOIC16		
1, 2	1, 2, 3, 6, 7, 8	N/C(1)	No internal connection
3	4	I+	Positive Input(2)
4	5	I-	Negative Input(2)
5	10, 11,12, 13	N/C(1)	No internal connection
6	9, 15	V_{SS}	Ground
7	14	Out	Output
8	16	V_{DD}	Supply Voltage

Notes:

1. "N/C" pins are not to be energized to ensure high-voltage performance and safety.

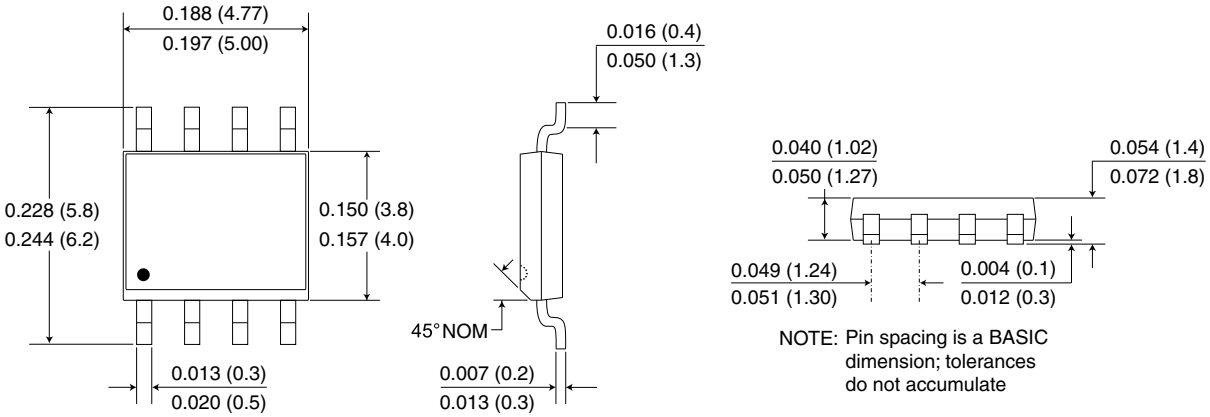
2. Current entering the chip via terminals I+ and leaving the chip via terminals I- will result in a signal voltage output greater than $V_{DD}/2$; current entering the chip via terminal I- and leaving the chip via terminal I+ will result in a signal voltage output less than $V_{DD}/2$.

PREVIEW

Package Drawings

8-pin SOIC Package (-3 suffix)

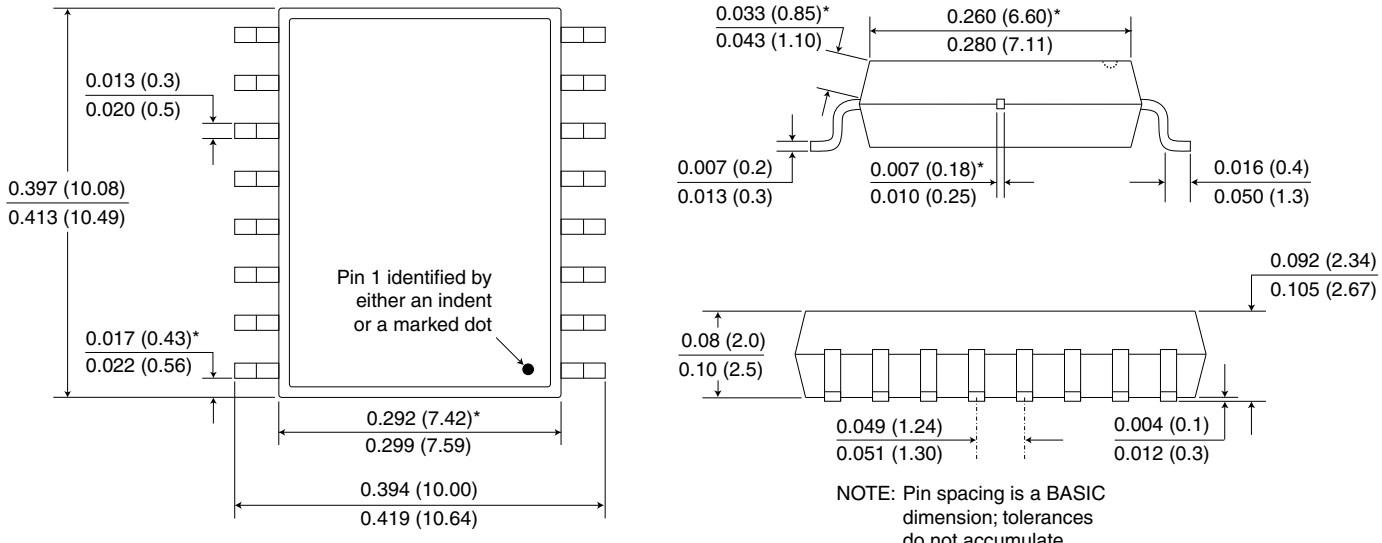
Dimensions in inches (mm); scale = approx. 5X



NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

True 8™ (8 mm creepage) 16-pin SOIC Package (no suffix)

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



NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

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

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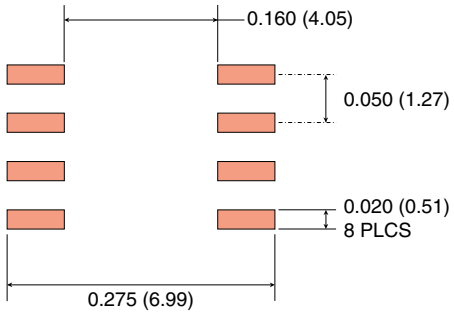
Recommended Pad Layouts

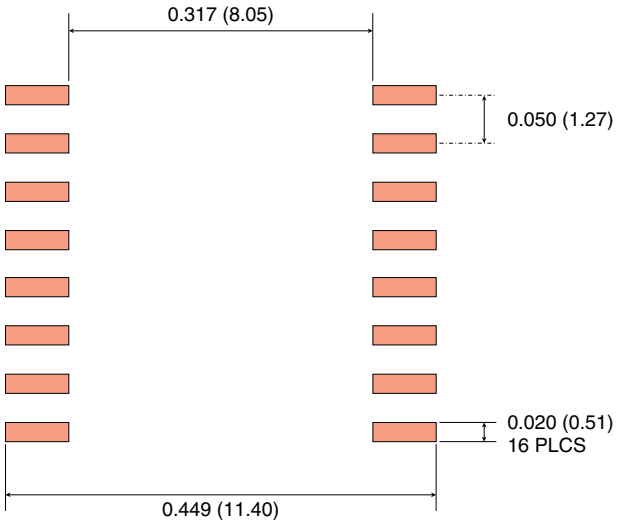
8-pin SOIC Pad Layout

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



True 8™ 16-pin SOIC Pad Layout

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



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Ordering Information

IL 004 -3 E TR13

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

Package
E = RoHS Compliant

Package Type
-3 = 2.5 kV Isolation SOIC8
V = 6 kV Isolation 0.3" SOIC16

Base Part Number
004 = Current In / Voltage Out

Product Family
IL = Isolators

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Revision History

ISB-DS-001-IL004-A November 2015	**Changes** • Initial release.

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