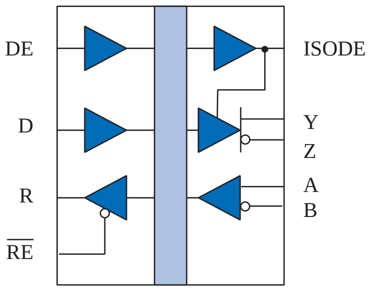
IL422

Isolated RS422/RS485 Interface

Functional Diagram



IL422

IL422 Receiver

$\overline{RE}$	R	$V_{(A-B)}$
H	Z	X
L	H	≥ 200 mV
L	L	≤−200 mV
L	I	Open

IL422 Driver

DE	D	$V_{(Y-Z)}$
L	X	Z
H	H	≥ 200 mV
H	L	≤−200 mV

H = High Level, L = Low Level
I = Indeterminate, X = Irrelevant, Z = High Impedance

Features

- 3.3 V Input Supply Compatible
- 2500 V_{rms} Isolation (1 min.)
- 25 ns Maximum Propagation Delay
- 25 Mbps Data Rate
- 1 ns Pulse Skew (typ.)
- ±60 mA Driver Output Capability
- Thermal Shutdown Protection
- Meets or Exceeds ANSI 422-B, EIA 485-A and ITU Recommended V11
- Low EMC Footprint
- −40°C to +85°C Temperature Range
- PROFIBUS International Component Recognition
- 16-pin SOIC Package
- UL1577 and IEC 61010-2001 Approved

Applications

Multi-point or multi-drop transmission on long bus lines in noisy environments.

Description

The IL422 is a galvanically isolated, high-speed differential bus transceiver, designed for bidirectional data communication on balanced transmission lines. The devices use NVE’s patented* IsoLoop spintronic Giant Magnetoresistance (GMR) technology. The IL422 is the first isolated RS-422 interface in a standard 16-pin SOIC package that meets the ANSI Standards EIA/TIA-422-B and RS-485 and is compatible with 3.3V input supplies.

The IL422 has current limiting and thermal shutdown features to protect against output short circuits and bus contention situations that could cause excessive power dissipation.

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

REV. O

Absolute Maximum Ratings(11)

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	−65		150	°C	
Ambient Operating Temperature	T_A	−40		100	°C	
Voltage Range at A or B Bus Pins		−7		12	V	
Supply Voltage(1)	V_{DD1}, V_{DD2}	−0.5		7	V	
Digital Input Voltage		−0.5		5.5	V	
Digital Output Voltage		−0.5		$V_{DD} + 1$	V	
Continuous Total Power Dissipation				725 377	mW	25°C 85°C
Maximum Output Current	I_O			95	mA	
Lead Solder Temperature				260	°C	10 sec.
ESD			2		kV	HBM

Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Supply Voltage	V_{DD1} V_{DD2}	3.0 4.5		5.5 5.5	V	
Input Voltage at any Bus Terminal (separately or common mode)	V_I V_{IC}			12 −7	V	
High-Level Digital Input Voltage	V_{IH}	2.4 3.0		V_{DD1}	V	$V_{DD1} = 3.3$ V $V_{DD1} = 5.0$ V
Low-Level Digital Input Voltage	V_{IL}	0		0.8	V	
Differential Input Voltage(2)	V_{ID}			±12	V	
High-Level Output Current (Driver)	I_{OH}			60	mA	
High-Level Digital Output Current (Receiver)	I_{OH}			8	mA	
Low-Level Output Current (Driver)	I_{OL}	−60			mA	
Low-Level Digital Output Current (Receiver)	I_{OL}	−8			mA	
Ambient Operating Temperature	T_A	−40		85	°C	
Transient Immunity		20			kV/µs	
Digital Input Signal Rise and Fall Times	t_{IR},t_{IF}	DC Stable				

Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance		8.08				mm
Barrier Impedance			$>10^{14}\|\|7$			Ω || pF
Leakage Current			0.2		µA	240 V_{RMS}, 60 Hz

Safety and Approvals

IEC61010-1

TUV Certificate Numbers: **N1502812, N1502812-101**

Classification: Reinforced Insulation

Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL422	0.3" SOIC	II	III	300 V_{RMS}

UL 1577

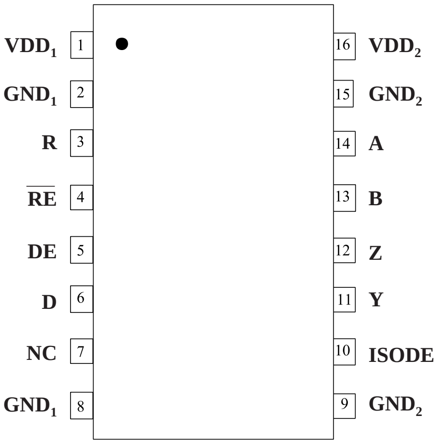
Component Recognition Pprogram File Number: E207481
Rated 2500V_{RMS} for 1 minute

Soldering Profile

Per JEDEC J-STD-020C, MSL=2

IL422 Pin Connections

1	V_{DD1}	Input Power Supply
2	GND_1	Input Power Supply Ground Return
3	R	Output Data from Bus
4	$\overline{RE}$	Read Data Enable (if $\overline{RE}$ is high, R = high impedance)
5	DE	Drive Enable
6	D	Data Input to Bus
7	NC	No Internal Connection
8	GND_1	Input Power Supply Ground Return
9	GND_2	Output Power Supply Ground Return
10	ISODE	Isolated DE Output for use in Profibus applications where the state of the isolated drive enable node needs to be monitored
11	Y	Y Bus (Drive – True)
12	Z	Z Bus (Drive – Inverse)
13	B	B Bus (Receive – Inverse)
14	A	A Bus (Receive – True)
15	GND_2	Output Power Supply Ground Return
16	V_{DD2}	Output Power Supply



IL422

Driver Section

Electrical specifications are T_{min} to T_{max} and V_{DD} = 4.5 V to 5.5 V unless otherwise stated.

Parameters	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Input Clamp Voltage	V_{IK}			−1.5	V	$I_L = -18$ mA
Output voltage	V_O	0		6	V	$I_O = 0$
Differential Output Voltage[2]	$\|V_{OD1}\|$	1.5		6	V	$I_O = 0$
Differential Output Voltage[2]	$\|V_{OD2}\|$	1.5	2.5	5	V	$R_L = 54\ \Omega$, $V_{DD} = 5$ V
Differential Output Voltage[2][6]	V_{OD3}	1.5		5	V	$R_L = 54\ \Omega$, $V_{DD} = 4.5$ V
Change in Magnitude of Differential Output Voltage[7]	$\Delta\|V_{OD}\|$			±0.2	V	$R_L = 54\ \Omega$ or $100\ \Omega$
Common Mode Output Voltage	V_{OC}			3 −1	V	$R_L = 54\ \Omega$ or $100\ \Omega$
Change in Magnitude of Common Mode Output Voltage[7]	$\Delta\|V_{OC}\|$			±0.2	V	$R_L = 54\ \Omega$ or $100\ \Omega$
Output Current[4] *Output Disabled*	I_O			1 −0.8	mA	$V_O = 12$ V $V_O = -7$ V
High Level Input Current	I_{IH}			10	µA	$V_I = 3.5$ V
Low Level Input Current	I_{IL}			−10	µA	$V_I = 0.4$ V
Short-circuit Output Current	I_{OS}			250 −150 −250	mA	$V_O = -6$ V $V_O = 0$ V $V_O = 8$ V
Supply Current $V_{DD1} = +5$ V $V_{DD1} = +3.3$ V	I_{DD1} I_{DD1}		4 3	6 3	mA	No Load (Outputs Enabled)
Switching Specifications						
Parameters	**Symbol**	**Min.**	**Typ.[5]**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		25			Mbps	$R_L = 54\ \Omega$, $C_L = 50$ pF
Differential Output Prop Delay	t_D(OD)		16	25	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Pulse Skew[10]	t_S(P)		1	6	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Differential Output Rise & Fall Time	t_T(OD)		8	10	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Output Enable Time to High Level	t_{PZH}		31	65	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Output Enable Time to Low Level	t_{PZL}		22	35	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Output Disable Time from High Level	t_{PHZ}		28	50	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Output Disable Time from Low Level	t_{PLZ}		16	32	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF
Skew Limit[3]	t_{SK}(LIM)		2	8	ns	$R_L = 54\ \Omega$, $C_L = 50$ pF

Notes (apply to both driver and receiver sections):

1. All voltage values are with respect to network ground except differential I/O bus voltages.
2. Differential input/output voltage is measured at the noninverting terminal A with respect to the inverting terminal B.
3. Skew limit is the maximum propagation delay difference between any two devices at 25°C.
4. The power-off measurement in ANSI Standard EIA/TIA-422-B applies to disabled outputs only and is not applied to combined inputs and outputs.
5. All typical values are at V_{DD1},V_{DD2} = 5 V or V_{DD1}= 3.3 V and T_A = 25°C.
6. The minimum V_{OD2} with a 100 Ω load is either ½ V_{OD1} or 2 V, whichever is greater.
7. $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed form one logic state to the other.
8. This applies for both power on and power off, refer to ANSI standard RS-485 for exact condition. The EIA/TIA-422-B limit does not apply for a combined driver and receiver terminal.
9. Includes 8 ns read enable time. Maximum propagation delay is 25 ns after read assertion.
10. Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel.
11. The relevant test and measurement methods are given in the Electromagnetic Compatibility section on p. 6.
12. External magnetic field immunity is improved by this factor if the field direction is “end-to-end” rather than “pin-to-pin” (see diagram on p. 6).

Receiver Section

Electrical specifications are T_{min} to T_{max} and V_{DD} = 4.5 V to 5.5 V unless otherwise stated.

Parameters	Symbol	Min.	Typ.(5)	Max.	Units	Test Conditions
Positive-going Input Threshold Voltage	V_{IT+}			0.2	V	V_O = 2.7 V, I_O = −0.4 mA
Negative-going Input Threshold Voltage	V_{IT-}	−0.2			V	V_O = 0.5 V, I_O = 8 mA
Hysteresis Voltage ($V_{IT+} - V_{IT-}$)	V_{HYS}		60		mV	
High Level Digital Output Voltage	V_{OH}	V_{DD} − 0.2			V	V_{ID} = 200 mV I_{OH} = −20 µA
Low Level Digital Output Voltage	V_{OL}			0.2	V	V_{ID} = −200 mV I_{OH} = 20 µA
High-impedance-state output current	I_{OZ}			±10	µA	V_O = 0.4 to (V_{DD2}−0.5) V
Line Input Current(8)	I_I			1 −0.8	mA	V_I = 12 V V_I = −7 V Other Input(11) = 0 V
Input Resistance	r_I	12	20		kΩ	
Supply Current	I_{DD2}		27	34	mA	No load Outputs Enabled
Switching Characteristics at 5 V						
Parameters	**Symbol**	**Min.**	**Typ.(5)**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		25			Mbps	R_L = 54 Ω, C_L = 50 pF
Propagation Delay(9)	t_{PD}		24	32	ns	V_O = −1.5 V to 1.5 V, C_L = 15 pF
Pulse Skew(10)	t_{SK}(P)		1	6	ns	V_O = −1.5 V to 1.5 V, C_L = 15 pF
Skew Limit(3)	t_{SK}(LIM)		2	8	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To High Level	t_{PZH}		17	24	ns	C_L = 15 pF
Output Enable Time To Low Level	t_{PZL}		30	45	ns	C_L = 15 pF
Output Disable Time From High Level	t_{PHZ}		30	45	ns	C_L = 15 pF
Output Disable Time From Low Level	t_{PLZ}		18	27	ns	C_L = 15 pF
Switching Characteristics at 3.3 V						
Parameters	**Symbol**	**Min.**	**Typ.(5)**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		25			Mbps	R_L = 54 Ω, C_L = 50 pF
Propagation Delay(9)	t_{PD}		27	32	ns	V_O = −1.5 V to 1.5 V, C_L = 15 pF
Pulse Skew(10)	t_{SK}(P)		2	6	ns	V_O = −1.5 V to 1.5 V, C_L = 15 pF
Skew Limit(3)	t_{SK}(LIM)		4	8	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To High Level	t_{PZH}		20	24	ns	C_L = 15 pF
Output Enable Time To Low Level	t_{PZL}		33	45	ns	C_L = 15 pF
Output Disable Time From High Level	t_{PHZ}		33	45	ns	C_L = 15 pF
Output Disable Time From Low Level	t_{PLZ}		20	27	ns	C_L = 15 pF

Magnetic Field Immunity(11)

Magnetic Field Immunity at 5 V						
Power Frequency Magnetic Immunity	H_{PF}	2800	3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}	4000	4500		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}	4000	4500		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier(12)	K_X		2.5			
Magnetic Field Immunity at 3.3 V						
Power Frequency Magnetic Immunity	H_{PF}	1000	1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}	1800	2000		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}	1800	2000		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier(12)	K_X		2.5			

Application Information

Electrostatic Discharge Sensitivity

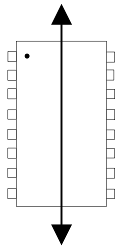
This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to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

Electromagnetic Compatibility

The IL422 is fully compliant with generic EMC standards EN50081, EN50082-1 and the umbrella line-voltage standard for Information Technology Equipment (ITE) EN61000. The IsoLoop Isolator's Wheatstone bridge configuration and differential magnetic field signaling ensure excellent EMC performance against all relevant standards. NVE conducted compliance tests in the categories below:

EN50081-1
    Residential, Commercial & Light Industrial
    Methods EN55022, EN55014
EN50082-2: Industrial Environment
    Methods EN61000-4-2 (ESD), EN61000-4-3 (Electromagnetic Field Immunity), EN61000-4-4 (Electrical Transient Immunity), EN61000-4-6 (RFI Immunity), EN61000-4-8 (Power Frequency Magnetic Field Immunity), EN61000-4-9 (Pulsed Magnetic Field), EN61000-4-10 (Damped Oscillatory Magnetic Field)
ENV50204
    Radiated Field from Digital Telephones (Immunity Test)

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



Cross-axis Field Direction

Dynamic Power Consumption

IsoLoop Isolators achieve their low power consumption from the way 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, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers, which have power consumption heavily dependent on frequency and time.

The approximate power supply current per channel is:

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

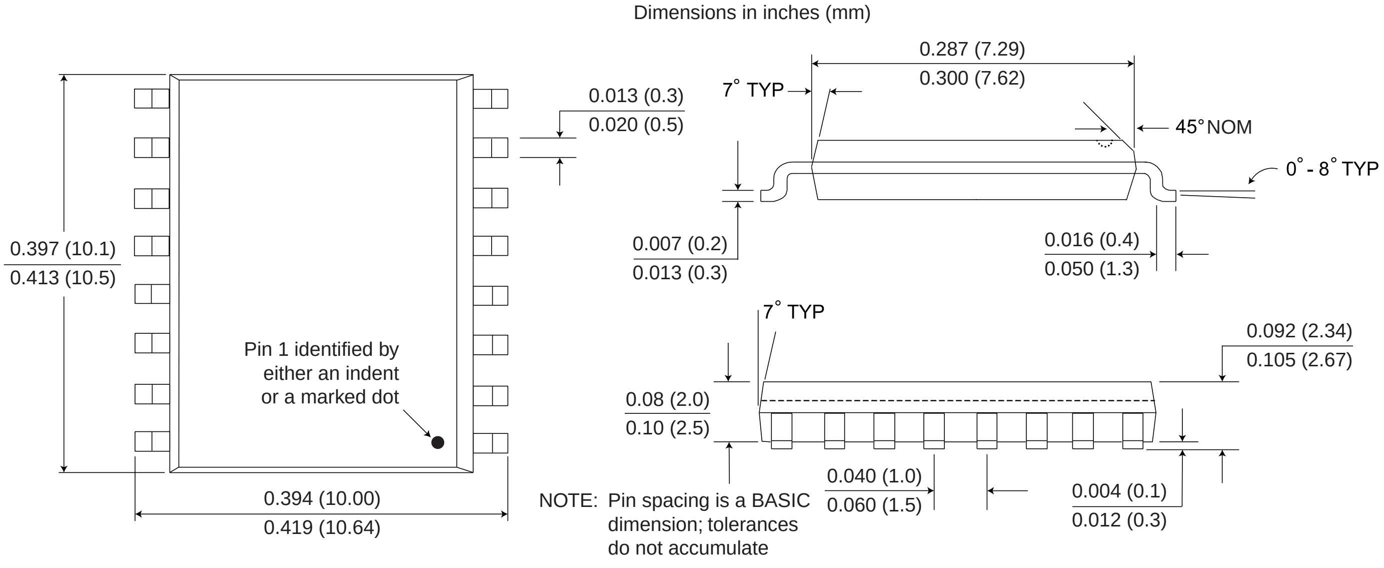
Where f = operating frequency

f_{MAX} = 50 MHz

Power Supply Decoupling

Low ESR capacitors such as ceramic are required to decouple the supplies. Both V_{DD1} and V_{DD2} must be bypassed with 47 nF capacitors. These should be placed as close as possible to V_{DD} pins for proper operation. Additionally, V_{DD2} should have a 10 µF tantalum capacitor connected in parallel with the 47 nF capacitor.

0.3" 16-pin SOIC Package



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

Ordering Information and Valid Part Numbers

IL 422 E TR13

Bulk Packaging
Blank = Tube
TR = 13" Tape and Reel

Package
Blank = 80/20 Tin/Lead Plating
E = RoHS Compliant

Base Part Number
422 = RS-422 Transceiver

Product Family
IL = Isolators

Valid Part Numbers
IL422
IL422E

All IL422 part types are available on tape and reel.

RoHS
COMPLIANT

ISB-DS-001-IL422-O
January 2009

Changes

- Added low EMC footprint.

ISB-DS-001-IL422-N

Changes

- Added magnetic field immunity and electromagnetic compatibility specifications.
- Added note on package drawing that pin-spacing tolerances are non-accumulating.

ISB-DS-001-IL422-M

Changes

- Changed ordering information to reflect that devices are now fully RoHS compliant with no exemptions.

ISB-DS-001-IL422-L

Changes

- Reorganized supply current specifications; misc. minor changes

ISB-DS-001-IL422-K

Changes

- Eliminated soldering profile chart

ISB-DS-001-IL422-J

Changes

- Updated open input state in truth table

ISB-DS-001-IL422-I

Changes

- Updated package drawing; misc.

ISB-DS-001-IL422-H

Changes

- Updated UL and IEC approvals

ISB-DS-001-IL422-G

Changes

- Revision letter added.
- Ordering Information Removed.
- IEC 61010-1 Classification: “Reinforced Insulation” added.
- Notes added.
- IR Soldering Profile added
- Ordering Information added.

About NVE

An ISO 9001 Certified Company

NVE Corporation manufactures innovative products based on unique spintronic Giant Magnetoresistive (GMR) technology. Products include Magnetic Field Sensors, Magnetic Field Gradient Sensors (Gradiometers), Digital Magnetic Field Sensors, Digital Signal Isolators, and Isolated Bus Transceivers.

NVE pioneered spintronics and in 1994 introduced the world's first products using GMR material, a line of ultra-precise magnetic sensors for position, magnetic media, gear speed and current sensing.

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Specifications shown are subject to change without notice.

ISB-DS-001-IL422-O

January 2009