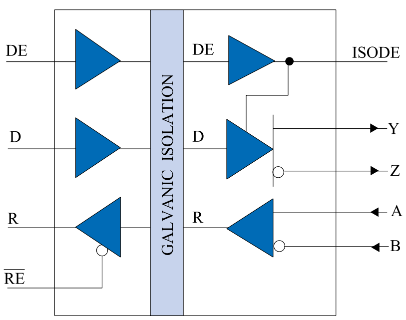
Isolated 3Volt RS422/RS485 Interface with 12 kV Bus ESD Protection

Functional Diagram



Features

- 3.3 V Input Supply Compatible
- 2500 V_{RMS} Isolation (1 min)
- 25 ns Propagation Delay
- 30 MBaud Data Rate
- 1 ns Pulse Skew (typ)
- ±60 mA Driver Output Capability
- Thermal Shutdown Protection
- Bus Pin ESD Protection Exceeds 12kV HBM
- Meets or Exceeds EIA 422-B, EIA 485-A and ITU Recommendation V11
- -40°C to +85°C Temperature Range
- 16 Pin SOIC Package
- UL 1577 Approval Pending
- IEC 61010-1 Approval Pending

Function Table

V_{ID1} (Y-Z)	V_{ID2} (A-B)	DE	$\overline{RE}$	ISODE	R	D	MODE
X	≥ 0.2V	X	L	X	H	X	Receive
X	≤ –0.2V	X	L	X	L	X	Receive
$-7<V_{ID1}<12$	$-7<V_{ID2}<12$	X	H	X	Z	X	Receive/Drive
≥ 1.5	X	H	L	H	H	H	Drive
≤–1.5	X	H	L	H	L	L	Drive
	Open	L	L	L	H	X	Receive

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

Applications

Multi-point or Multi-drop Transmission on Long Bus Lines in Noisy Environments

Description

The IL4422-3V is a galvanically isolated, high speed differential driver and receiver pair, designed for bidirectional data communication on balanced transmission lines. Isolation is achieved through patented* Isoloop® technology. The IL4422-3V meets the ANSI Standards EIA/TIA-422-B and RS485.

The IL4422-3V has current limiting and thermal shutdown features to protect against output short circuits and bus contention situations where these may cause excessive power dissipation.

Input power supply, V_{DD1} may be set to either 3.3V or 5V for direct connection to most microcontrollers.

Isoloop® is a registered trademark of NVE Corporation

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

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Units
Storage Temperature	T_S	-65	150	°C
Ambient Operating Temperature	T_A	-40	85	°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}+ 0.1	V
Continuous Total Power Dissipation (V_{DD1}=V_{DD2}=5V)			520 300	mW (25°C) mW (85°C)
Maximum Output Current	I_O		95	mA
Thermal Resistance	θ_{JC}		28	°C/W
Lead Solder Temperature (10s)			260	°C
ESD	12kV Human Body Model			

Insulation Specifications

Parameter	Condition	Min.	Typ.	Max.	Units
Creepage Distance (External)		8.077			mm
Barrier Impedance			$>10^{14}\|\|7$		Ω || pF
Leakage Current	240 V_{RMS} 60Hz		0.2		μA

Recommended Operating Conditions

Parameters	Symbol	Min.	Max.	Units
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 (VDD1=3.3 V) (VDD1=5.0 V)	V_{IH}	2.4 3.0		V
Low-Level Digital Input Voltage	V_{IL}		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
Operating Free Air Temperature	T_A	-40	85	°C
Digital Input Signal Rise and Fall Times	t_{IR},t_{IF}		DC Stable	

IEC61010-1

TUV Certificate Numbers: *Pending*
Classification as Table 1.

Model	Pollution Degree	Material Group	Max Working Voltage	Package Type *16–SOIC (0.3")*
IL4422	II	III	400 V_{RMS}	✓

UL 1577

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

Driver Section

All Specifications are T_{min} to T_{max} unless otherwise stated.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Input Clamp Voltage	V_{IK}			-1.5	V	I_L=-18mA
Output Voltage	V_O	0		6	V	I_O=0
Differential Output Voltage	$\|V_{OD1}\|$	1.5		6	V	I_O=0
Differential Output Voltage[6]	$\|V_{OD2}\|$	1.5	2.5	5	V	R_L=54Ω
Differential Output Voltage	V_{OD3}	1.5		5	V	V_{test}=-7 to 12V
Change in Magnitude of [7] Differential Output Voltage	$\Delta\|V_{OD}\|$			±0.2	V	R_L=54 or 100Ω
Common Mode Output Voltage	V_{OC}			3 -1	V	R_L=54 or 100Ω
Change in Magnitude of [7] Common Mode Output Voltage	$\Delta\|V_{OC}\|$			±0.2	V	R_L=54 or 100Ω
Output Current[4]	I_O			1 -0.8	mA mA	Output Disabled V_O=12 V_O=-7
High Level Input Current	I_{IH}			10	µA	V_1=3.5 V
Low Level Input Current	I_{IL}			-10	µA	V_1=0.4 V
Short-Circuit Output Current	I_{OS}			-250 -150 250	mA	V_O= -6 V_O= 0 V_O= 8
Supply Current (V_{DD2}= +5V) (V_{DD1}= +5V) (V_{DD1}= +3.3V)	I_{DD2} I_{DD1} I_{DD1}		12 5 3.2	20 10 7	mA	No Load (Outputs Enabled)

Switching Characteristics

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Maximum Data Rate		30			Mbd	R_L=54Ω, C_L=50pF
Differential Output Delay Time	t_D(OD)		16	25	ns	R_L=54Ω, C_L=50pF
Pulse Skew[10]	$t_{SK(P)}$		1	6	ns	R_L=54Ω, C_L=50pF
Differential Output Transition Time	t_T(OD)		8	11	ns	R_L=54Ω, C_L=50pF
Output Enable Time To High Level	t_{PZH}		22	32	ns	R_L=54Ω, C_L=50pF
Output Enable Time To Low Level	t_{PZL}		22	32	ns	R_L=54Ω, C_L=50pF
Output Disable Time From High Level	t_{PHZ}		22	32	ns	R_L=54Ω, C_L=50pF
Output Disable Time From Low Level	t_{PLZ}		22	32	ns	R_L=54Ω, C_L=50pF
Skew Limit[3]	t_{SK}(LIM)		2	8	ns	R_L=54Ω, C_L=50pF

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Receiver Section

All Specifications are T_{min} to T_{max} unless otherwise stated.

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Positive-going Input Threshold Voltage	V_{IT+}			0.2	V	V_O = 2.7V, I_o= - 0.4mA
Negative-going Input Threshold Voltage	V_{IT-}	–0.2			V	V_O = 0.5V, I_o= 8mA
Hysteresis Voltage (V_{IT+} - V_{IT-})	V_{hys}		50		mV	
High Level Digital Output Voltage	V_{OH}	V_{DD} – 0.2			V	V_{ID}= 200mV, I_{OH} = -20µA
Low Level Digital Output Voltage	V_{OL}			0.2	V	V_{ID}= -200mV, I_{OL} = 20µA
High-impedance-state output current	I_{OZ}			±1	µA	V_O = 0.4 to (V_{DD2} - 0.5) V
Line Input Current[8]	I_I			1	mA	Other Input[11] = 0V V_I=12V
				-0.8		V_I= –7V
Input Resistance	r_I		50		kΩ	
Supply Current (V_{DD2}= +5V)	I_{DD2}		10	20	mA	No Load (Outputs Enabled)
(V_{DD1}= +5V)	I_{DD1}		5	10		
(V_{DD1}= +3.3V)	I_{DD1}		3.2	7		

Switching Characteristics @ 5V

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Maximum Data Rate		30			Mbd	R_L=54Ω, C_L=50pF
Propagation Time[9]	t_{PD}		20	35	ns	V_O=-1.5 to 1.5V, C_L=15pF
Pulse Skew[10]	$t_{SK(P)}$		1.5	6	ns	V_O=-1.5 to 1.5V, C_L=15pF
Skew Limit[3]	$t_{SK(lim)}$		2	8	ns	R_L=54Ω, C_L=50pF
Output Enable Time To High Level	t_{PZH}		10	20	ns	C_L=15pF
Output Enable Time To Low Level	t_{PZL}		10	20	ns	C_L=15pF
Output Disable Time From High Level	t_{PHZ}		10	20	ns	C_L=15pF
Output Disable Time From Low Level	t_{PLZ}		10	20	ns	C_L=15pF

Switching Characteristics @ 3.3V

Parameter	Symbol	Min.	Typ.[5]	Max.	Units	Test Conditions
Maximum Data Rate		30			Mbd	R_L=54Ω, C_L=50pF
Propagation Time[9]	t_{PD}		28	40	ns	V_O=-1.5 to 1.5V, C_L=15pF
Pulse Skew[10]	$t_{SK(P)}$		2	6	ns	V_O=-1.5 to 1.5V, C_L=15pF
Skew Limit[3]	$t_{SK(lim)}$		4	8	ns	R_L=54Ω, C_L=50pF
Output Enable Time To High Level	t_{PZH}		15	25	ns	C_L=15pF
Output Enable Time To Low Level	t_{PZL}		15	25	ns	C_L=15pF
Output Disable Time From High Level	t_{PHZ}		15	25	ns	C_L=15pF
Output Disable Time From Low Level	t_{PLZ}		15	25	ns	C_L=15pF

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.

Notes:

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/Y with respect to the inverting terminal B/Z.
3. Skew limit is the maximum difference in any two channels in one device.
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} = 5V and T_A = 25°C unless otherwise stated.
6. The minimum V_{OD2} with a 100Ω load is either ½V_{OD1} or 2V, 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 the $|t_{PLH} - t_{PHL}|$ of each channel.

Ordering Information: use the following format to order these devices

IL4422 -3V TR13

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

Input Supply Voltage
Blank = 5 V only
-3V = 3.3V or 5V Volt

Base Part Number

Application Notes:

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.

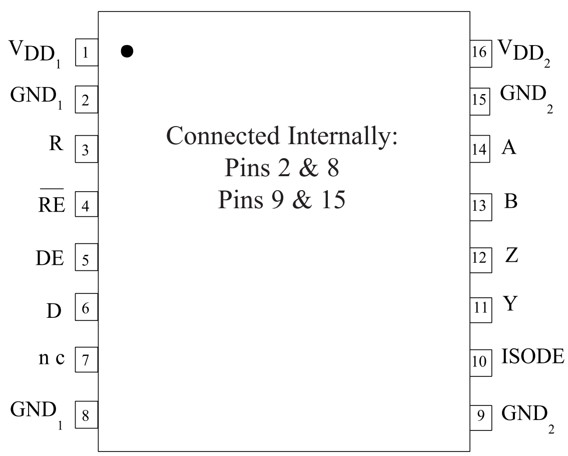
The approximate power supply current per channel for Isoloop® is: $I(input) = 40\left(\frac{f}{fmax}\right)\left(\frac{1}{4}\right)$ mA

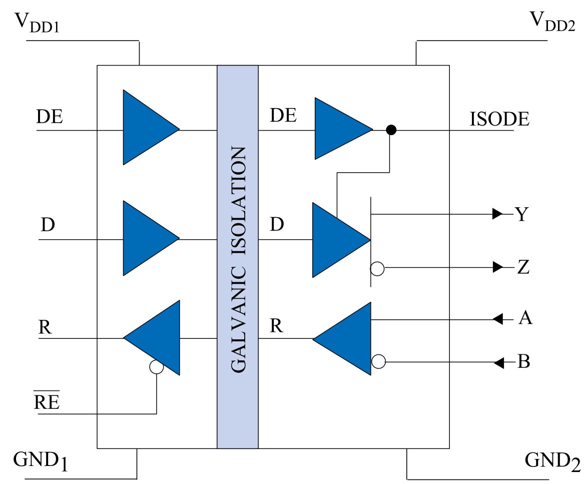
where f = operating frequency
fmax = 50 MHz

Power Supplies

It is recommended that low ESR ceramic capacitors be used to decouple the supplies. Both V_{DD1} and V_{DD2} should be bypassed with 47 nF capacitors. These should be placed no further than 1 cm from the device pins for proper operation. In addition, V_{DD2} should have a 10 µF tantalum capacitor connected in parallel with the 47 nF capacitor. The '-3V' option allows 3.3V or 5V supply levels on the input supply, V_{DD1}. V_{DD2} is always 5Volts.

Pin Configuration





Pin Description

Pin	Mnemonic	Description
1	V_{DD1}	Input Power Supply
2	GND_1	Input Power Supply Ground Return
3	R	Output Data from AB Bus
4	$\overline{RE}$	Read Data Enable (If $\overline{RE}$ is high, R is High Impedance)
5	DE	Drive Enable
6	D	Data Input to YZ 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 applications where the state of the 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 Return
16	V_{DD2}	Output Power Supply

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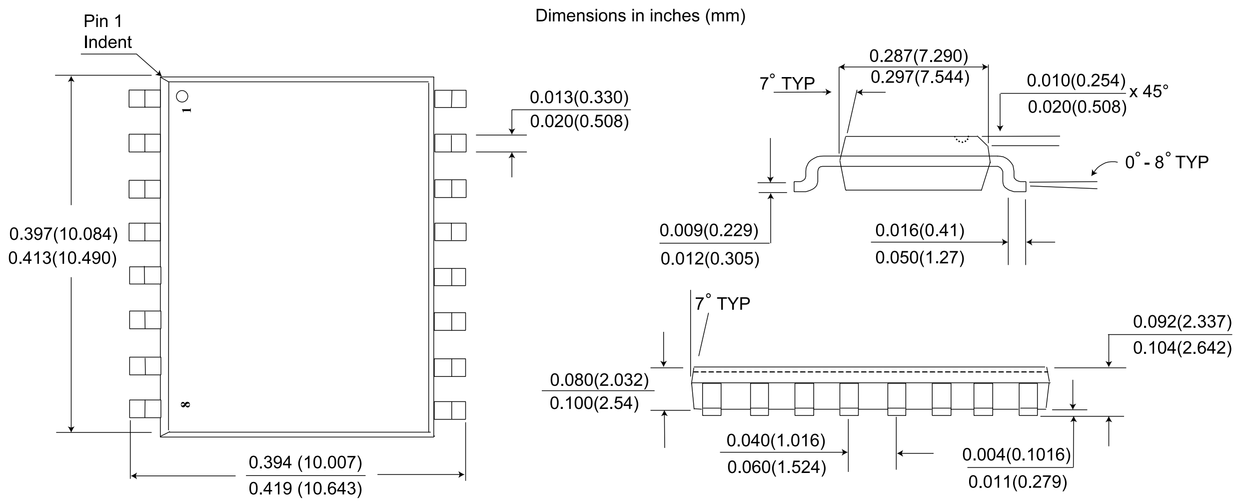
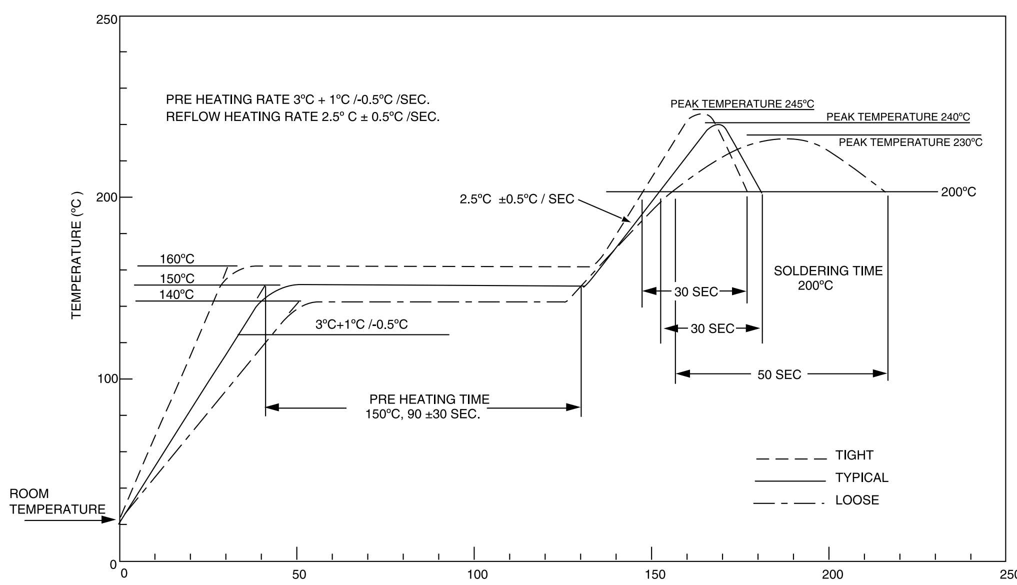
IL4422-3V (0.3" SOIC-16 Package)



IR Soldering Profile

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



About NVE

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine leading edge Giant Magnetoresistive (GMR) materials with integrated circuits to make high performance electronic components. Products include Magnetic Field Sensors, Magnetic Field Gradient Sensors (Gradiometer), Digital Magnetic Field Sensors, Digital Signal Isolators and Isolated Bus Transceivers.

NVE is a leader in GMR research and in 1994 introduced the world's first products using GMR material, a line of GMR magnetic field sensors that can be used for position, magnetic media, wheel speed and current sensing.

NVE is located in Eden Prairie, Minnesota, a suburb of Minneapolis. Please visit our Web site at www.nve.com or call 952-829-9217 for information on products, sales or distribution.

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