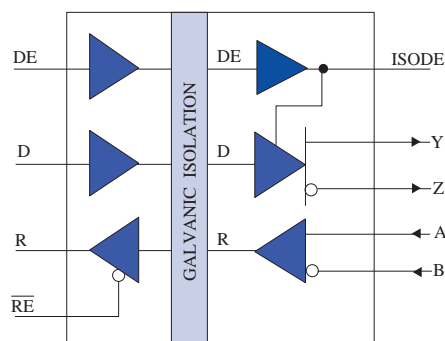


Isolated RS422/RS485 Interface

Functional Diagram



Function Table

| V_{ID1} (Y-Z) | V_{ID2} (A-B) | DE | \overline{RE} | ISODE | R | D | MODE |
|---------------------|---------------------|----|-----------------|-------|---|---|---------------|
| X | $\geq 0.2V$ | X | L | X | H | X | Receive |
| X | $\leq -0.2V$ | 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

Features

- 2500 V_{RMS} Isolation (1 min)
- 25 ns Propagation Delay
- 25 Mbaud Data Rate
- 1 ns Skew
- ± 60 mA Driver Output Capability
- Thermal Shutdown Protection
- Meets or Exceeds EIA 422-B, EIA 485-A and ITU Recommendation V11
- $-40^{\circ}C$ to $+85^{\circ}C$ Temperature Range
- 16 Pin SOIC Package
- UL 1577 Approval (pending)



Applications

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

Description

The IL422 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 IL422 is the first isolated RS-422 interface available in a standard 16 pin SOIC package, which meets the ANSI Standards EIA/TIA-422-B and RS485.

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

IsoLoop® is a registered trademark of NVE, Inc.

* US Patent number 5,831,426 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,B,Y or Z Bus Pins ⁽¹⁾ | | -7 | 12 | Volts |
| Supply Voltage ⁽²⁾ | V_{DD1}, V_{DD2} | -0.5 | 7 | Volts |
| Digital Input Voltage | | -0.5 | 5.5 | Volts |
| Digital Output Voltage | | -0.5 | $V_{DD} + 0.1$ | Volts |
| Continuous Total Power Dissipation | | | 725 377 | mWatts (25°C) mWatts (85°C) |
| Maximum Output Current | I_O | | 95 | mAmps |
| Lead Solder Temperature (10s) | | | 260 | °C |
| ESD | 2kV Human Body Model | | | |

Insulation Specifications

| Parameter | Condition | Min. | Typ. | Max. | Units |
|---|-----------------------|-------|-----------------|------|----------------|
| Rated Voltage, 1 min | | 2500 | | | V_{RMS} |
| Partial Discharge, 100% Tested ⁽³⁾ | 1s, 5pC | 2000 | | | V_{RMS} |
| Creepage Distance (External) | | 8.077 | | | mm |
| Barrier Impedance | | | $>10^{14} 7$ | | ΩpF |
| Leakage Current | 240 V_{RMS} 60Hz | | 0.1 | | μ Amps |

Recommended Operating Conditions

| Parameters | Symbol | Min. | Max. | Units |
|--|--------------------|-----------|----------|-------|
| Supply Voltage | V_{DD1}, V_{DD2} | 4.5 | 5.5 | Volts |
| Input Voltage at any bus terminal (separately or common mode) | V_I V_{IC} | | 12 -7 | Volts |
| High-level Digital Input Voltage | V_{IH} | 3 | | Volts |
| Low-Level Digital Input Voltage | V_{IL} | | 0.8 | Volts |
| Differential Input/ Output Voltage ⁽¹²⁾ | V_{ID} | | ± 12 | Volts |
| 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 |
| Input Signal Rise and Fall Times | t_{IR}, t_{IF} | DC Stable | | |

Driver Section

All Specifications are T_{min} to T_{max} unless otherwise stated. $V_{DD1}=V_{DD2}=5V$

| 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} $ | $1/2 V_{OD}$ or 2 | | | V | $R_L=100\Omega$ |
| | | 1.5 | 2.5 | 5 | V | $R_L=54\Omega$ |
| 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 | $V_I=3.5$ V |
| Low Level Input Current | I_{IL} | | | -10 | μA | $V_I=0.4$ V |
| Short-Circuit Output Current | I_{OS} | | | -250 -150 250 | mA | $V_O=-6$ $V_O=0$ $V_O=8$ |
| Supply Current ($V_{DD2}=+5V$) ($V_{DD1}=+5V$) | I_{DD2} I_{DD1} | | 27 5 | 34 10 | mA mA | No Load (Outputs Enabled) |

Switching Characteristics

| Parameter | Symbol | Min. | Typ. ⁽⁵⁾ | Max. | Units | Test Conditions |
|-------------------------------------|---------------|------|---------------------|------|-------|-----------------------------|
| Data Rate | | 25 | | | Mbd | $R_L=54\Omega$, $C_L=50pF$ |
| Differential Output Delay Time | $t_D(OD)$ | | 16 | 25 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Pulse Skew ⁽¹⁰⁾ | $t_{SK(P)}$ | | 1 | 6 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Differential Output Transition Time | $t_T(OD)$ | | 8 | 10 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Output Enable Time To High Level | t_{PZH} | | 31 | 65 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Output Enable Time To Low Level | t_{PZL} | | 22 | 35 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Output Disable Time From High Level | t_{PHZ} | | 28 | 50 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Output Disable Time From Low Level | t_{PLZ} | | 16 | 32 | ns | $R_L=54\Omega$, $C_L=50pF$ |
| Skew Limit ⁽¹¹⁾ | $t_{SK}(LIM)$ | | 2 | 8 | ns | $R_L=54\Omega$, $C_L=50pF$ |

Receiver Section

All Specifications are T_{min} to T_{max} unless otherwise stated. $V_{DD1}=V_{DD2}=5V$

| 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} | | 60 | | mV | |
| High Level Digital Output Voltage | V_{OH} | $V_{DD} - 0.1$ | | | V | $V_{ID} = 200mV, I_{OH} = -20\mu A$ |
| Low Level Digital Output Voltage | V_{OL} | | | 0.2 | V | $V_{ID} = -200mV, I_{OL} = 20\mu A$ |
| 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 | Other Input ⁽¹⁾ = 0V $V_I = 12V$ $V_I = -7V$ |
| Input Resistance | r_i | | 50 | | k Ω | |
| Supply Current ($V_{DD2} = +5$) ($V_{DD1} = +5$) | I_{DD2} I_{DD1} | | 27 5 | 34 10 | mA mA | No Load (Outputs Enabled) |

Switching Characteristics

| Parameter | Symbol | Min. | Typ. ⁽⁵⁾ | Max. | Units | Test Conditions |
|-------------------------------------|---------------|------|---------------------|------|-------|------------------------------------|
| Data Rate | | 25 | | | Mbd | $R_L = 54\Omega, C_L = 50pF$ |
| Propagation Time ⁽⁹⁾ | t_{PD} | | 24 | 32 | 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 ⁽¹¹⁾ | $t_{SK(lim)}$ | | 2 | 8 | ns | $R_L = 54\Omega, C_L = 50pF$ |
| Output Enable Time To High Level | t_{PZH} | | 17 | 24 | ns | $C_L = 15pF$ |
| Output Enable Time To Low Level | t_{PZL} | | 30 | 45 | ns | $C_L = 15pF$ |
| Output Disable Time From High Level | t_{PHZ} | | 30 | 45 | ns | $C_L = 15pF$ |
| Output Disable Time From Low Level | t_{PLZ} | | 18 | 27 | 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. Absolute maximum voltage quoted with respect to GND2. Note that this voltage may be as high as 2500Vac rms with respect to GND1
2. All Voltage values are with respect to network ground except differential I/O bus voltages.
3. Differential input/output voltage is measured at the noninverting terminal A/Y with respect to the inverting terminal B/Z.
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 $T_A = 25^\circ C$.
6. The minimum V_{OD2} with a 100Ω load is either $1/2V_{OD1}$ 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 from 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.
11. Skew limit is the maximum difference in any two channels in one device.
12. All devices receive a one second test. Failure criteria is ≥ 5 pulses of ≥ 5 pC.

Application Notes:

Power Consumption

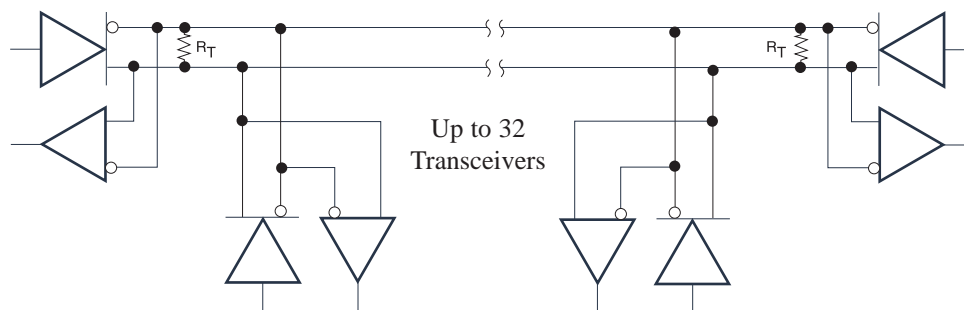
The IL422 achieves its low power consumption from the manner by which it transmits data across its isolation barrier. By detecting the edge transitions of the input logic signal and converting this to a narrow current pulse which drives the isolation barrier, the isolator then latches the input logic state in the output latch. Since the current pulses are narrow, about 2.5 ns 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.

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.

Application Notes:

IL422

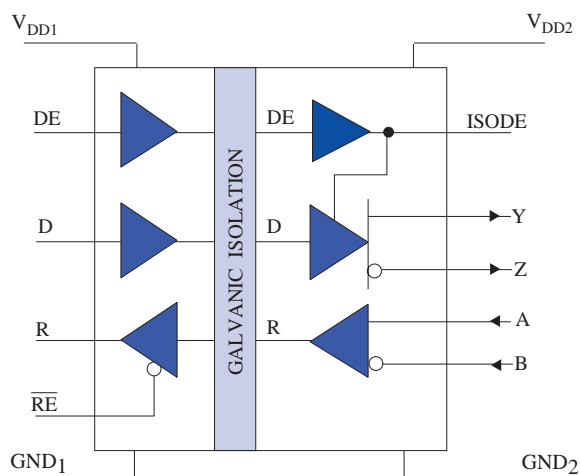
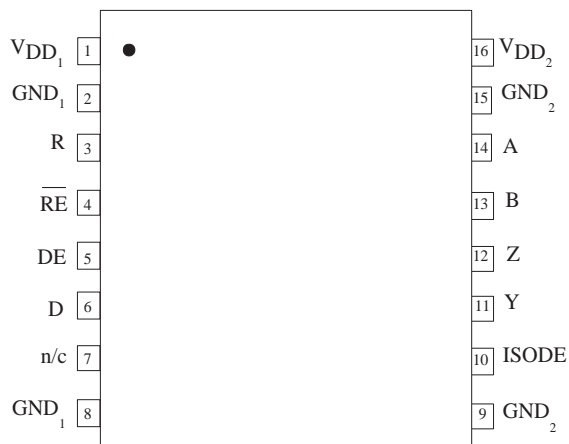


IL422

This line should be at both ends in its characteristic impedance ($R_T = Z_0$). Sub lengths off the main line should be kept as short as possible.

IL422 ^{IsoLoop®}

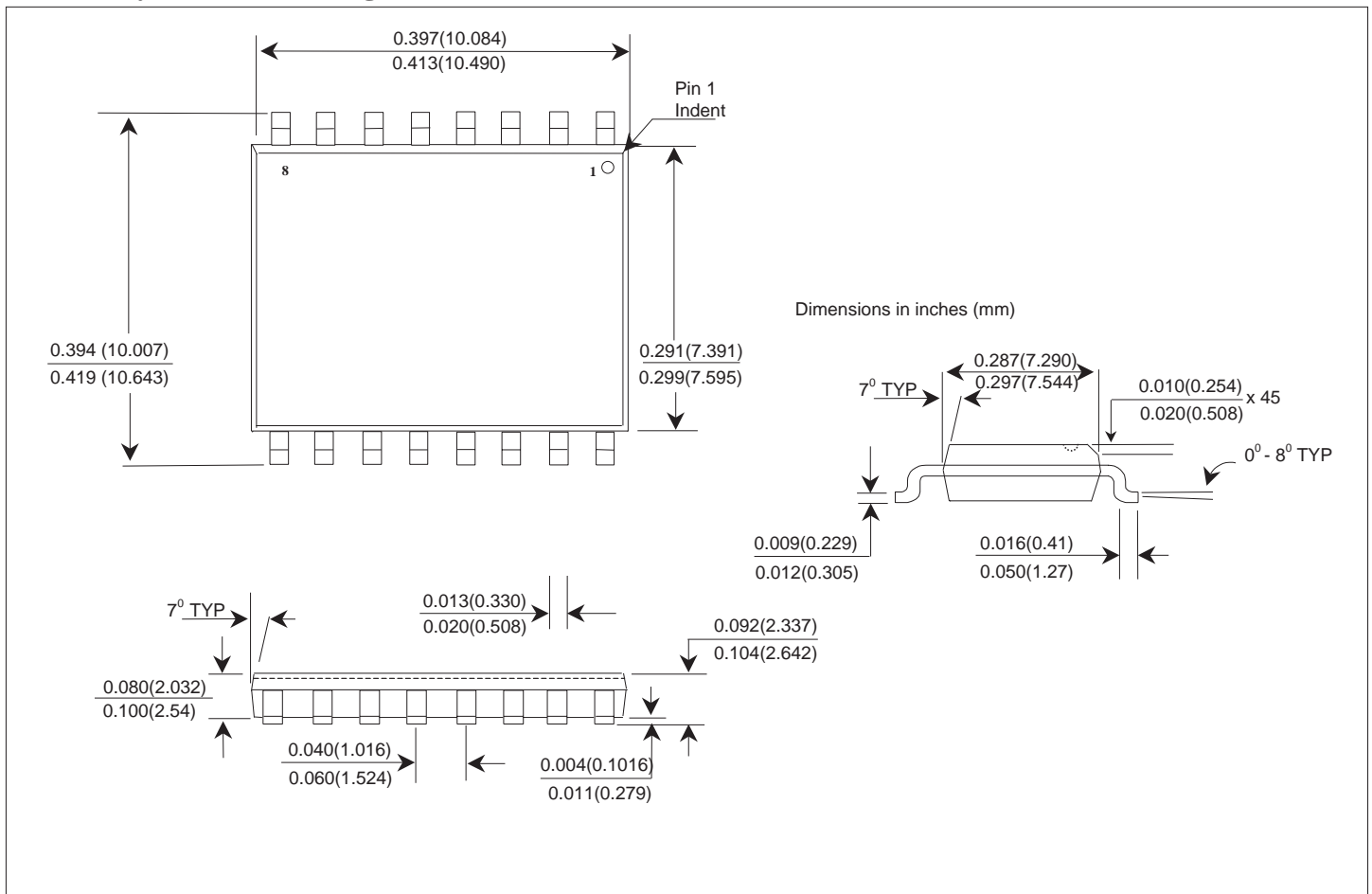
Pin Configuration



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 |
| 5 | DE | Drive Enable |
| 6 | D | Data Input to YZ Bus |
| 7 | n\c | 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 |

Wide Body SOIC-16 Package





About NVE

An ISO 9001 Certified Company

NVE is a high technology components manufacturer having the unique capability to combine leading edge Giant Magnetoresistive (GMR) materials with integrated circuits to make novel 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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ISB-DS-001-IL422-A

