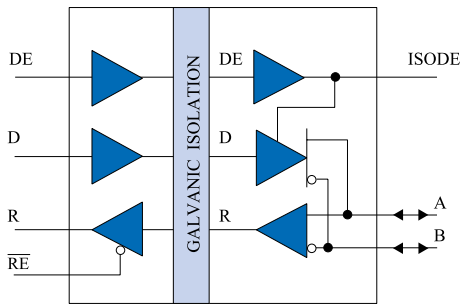


Isolated RS485-3V Interface

Functional Diagram



Function Table

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

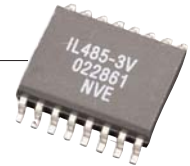
H= High Level, L= Low Level,
X= Irrelevant, Z= High Impedance

Ordering Information

Order as IL485-3V. If requesting tape and reel, please specify as IL485-3VTR.

Features

- 3.3 V Input Supply Compatible
- 2500 V_{RMS} Isolation (1 min)
- 25 ns Maximum Propagation Delay
- 35 MBaud Data Rate
- 1 ns Pulse Skew (typ.)
- Designed for Multi-point Transmission on Long Bus Lines in Noisy Environments
- ± 60 mA Driver Output Capability
- Thermal Shutdown Protection
- Meets or Exceeds ANSI RS-485 and ISO 8482:1987 (E)
- -40°C to +85°C Temperature Range
- PROFIBUS International Component Recognition
- 16 Pin SOIC Package
- UL1577 Approval Pending
- IEC 61010-1 Approval Pending



Applications

- PROFIBUS/RS485
- RS-485 Systems
- Multiple Data Point Transmission

Description

The IL485-3V is a galvanically isolated, high speed differential bus transceiver, designed for bidirectional data communication on balanced transmission lines. Isolation is achieved through patented* IsoLoop® technology. The IL485-3V is the first isolated RS-485 interface available in a standard 16 pin SOIC package, which meets the ANSI Standards EIA/TIA-422-B and RS485 and is compatible with 3.3V input supplies.

The IL485-3V has current limiting and thermal shutdown features to protect against output short circuits and bus contention situations where these may cause excessive power dissipation.

With 1 nsec pulse skew and 16 nsec propagation delay, the IL485 is ideal for PROFIBUS applications.

IsoLoop® is a registered trademark of NVE Corporation

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

IL485-3V^{isoLoop®}

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 | $V_{DD} + 0.5$ | V |
| Digital Output Voltage | | -0.5 | $V_{DD} + 0.1$ | V |
| Continuous Total Power Dissipation | | | 725 377 | mW (25°C) mW (85°C) |
| Maximum Output Current | I_O | | 95 | mA |
| Lead Solder Temperature (10s) | | | 260 | °C |
| ESD | 2kV Human Body Model | | | |

Insulation Specifications

| Parameter | Condition | Min. | Typ. | Max. | Units |
|------------------------------|------------------------------|-------|------------------------|------|------------------------------|
| Creepage Distance (External) | | 8.077 | | | mm |
| Barrier Impedance | | | $>10^{14} \parallel 7$ | | $\Omega \parallel \text{pF}$ |
| 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 ($V_{DD1}=3.3\text{ V}$) ($V_{DD1}=5.0\text{ V}$) | V_{IH} | 2.4 3.0 | | V |
| Low-Level Digital Input Voltage | V_{IL} | | 0.8 | V |
| Differential Input Voltage ⁽²⁾ | V_{ID} | | +12/-7 | 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: Approval Pending
Classification as Table 1.

| Model | Pollution Degree | Material Group | Max Working Voltage | Package Type |
|----------|------------------|----------------|----------------------|---------------------|
| IL485-3V | II | III | 300 V _{RMS} | 16-SOIC (0.3") ✓ |

IL485-3V^{ISOLOOP®}

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 | Δ 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 | Δ 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) | I _{DD2} | | 27 | 34 | mA | No Load (Outputs Enabled) |
| (V _{DD1} = +5V) | I _{DD1} | | 5 | 10 | | |
| (V _{DD1} = +3.3V) | I _{DD1} | | 3.2 | 7 | | |
| Switching Characteristics | | | | | | |
| Parameter | Symbol | Min. | Typ. ⁽⁵⁾ | Max. | Units | Test Conditions |
| Maximum Data Rate | | 35 | | | 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 | 10 | ns | R _L =54Ω, C _L =50pF |
| Output Enable Time To High Level | t _{PZH} | | 31 | 65 | ns | R _L =54Ω, C _L =50pF |
| Output Enable Time To Low Level | t _{PZL} | | 22 | 35 | ns | R _L =54Ω, C _L =50pF |
| Output Disable Time From High Level | t _{PHZ} | | 28 | 50 | ns | R _L =54Ω, C _L =50pF |
| Output Disable Time From Low Level | t _{PLZ} | | 16 | 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. ⁽⁶⁾ | 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} - 0.2 | | | 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} | | | ±20 | μA | V _O = 0.4 to (V _{DD2} - 0.5) V |
| Line Input Current ⁽⁸⁾ | I _I | | | 1 -0.8 | mA | Other Input ⁽¹¹⁾ = 0V V _I = 12V V _I = -7V |
| Input Resistance | r _I | | 50 | | kΩ | |
| SuSupply Current (V _{DD2} = +5V) | I _{DD2} | | 27 | 34 | 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. ⁽⁶⁾ | Max. | Units | Test Conditions |
| Maximum Data Rate | | 35 | | | Mbd | R _L = 54Ω, 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)} | | 1 | 6 | ns | V _O = -1.5 to 1.5V, C _L = 15pF |
| Skew Limit ⁽⁵⁾ | t _{SK(lim)} | | 2 | 8 | ns | R _L = 54Ω, 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 |
| Switching Characteristics @ 3.3V | | | | | | |
| Parameter | Symbol | Min. | Typ. ⁽⁶⁾ | Max. | Units | Test Conditions |
| Maximum Data Rate | | 35 | | | Mbd | R _L = 54Ω, C _L = 50pF |
| Propagation Time ⁽⁹⁾ | t _{PD} | | 27 | 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 ⁽⁵⁾ | t _{SK(lim)} | | 4 | 8 | ns | R _L = 54Ω, C _L = 50pF |
| Output Enable Time To High Level | t _{PZH} | | 20 | 24 | ns | C _L = 15pF |
| Output Enable Time To Low Level | t _{PZL} | | 33 | 45 | ns | C _L = 15pF |
| Output Disable Time From High Level | t _{PHZ} | | 33 | 45 | ns | C _L = 15pF |
| Output Disable Time From Low Level | t _{PLZ} | | 20 | 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.

IL485-3V^{ISOLOOP®}

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 with respect to the inverting terminal B.
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 $V_{DD1}, V_{DD2} = 5V$ or $V_{DD1} = 3.3 V$ and $T_A = 25^\circ C$.
6. The minimum V_{OD2} with a 100Ω load is either $\frac{1}{2} V_{OD1}$ 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.

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

$$\text{Isoloop}^\circ \text{ is: } I(\text{input}) = 40 \left(\frac{f}{f_{\text{max}}} \right) \left(\frac{1}{4} \right) \text{ mA}$$

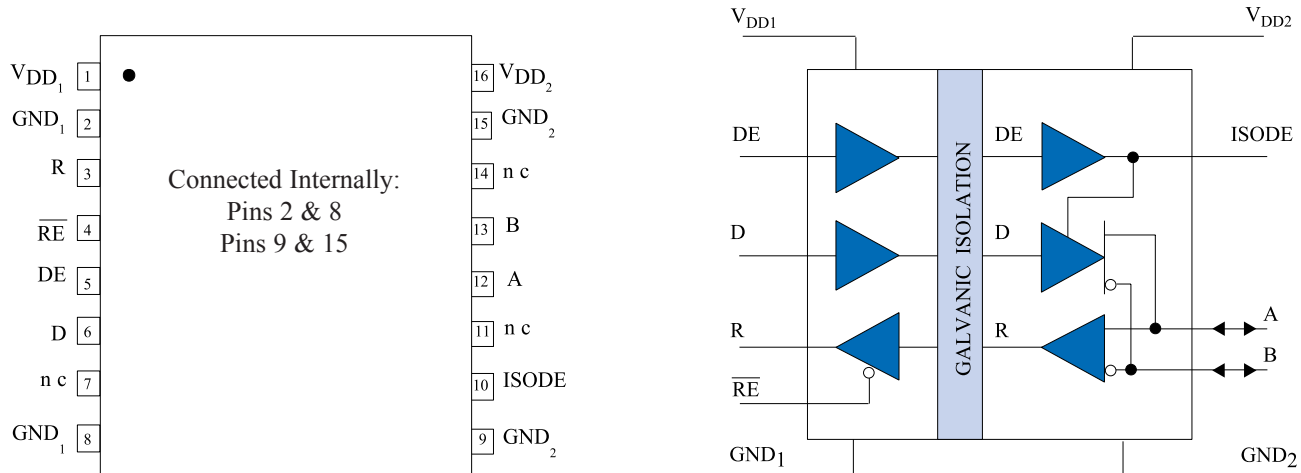
where f = operating frequency
 $f_{\text{max}} = 50 \text{ MHz}$

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.

IL485-3V^{isoLoop®}

Pin Configuration

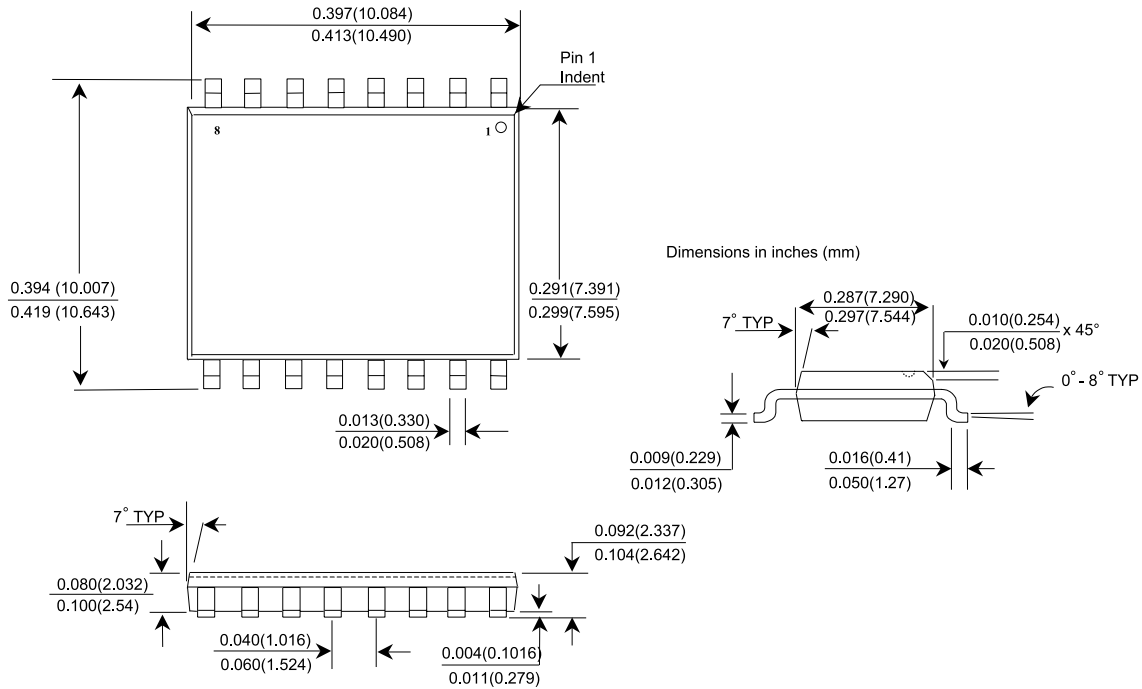


Pin Description

| Pin | Mnemonic | Description |
|-----|------------------|--|
| 1 | V _{DD1} | Input Power Supply |
| 2 | GND ₁ | Input Power Supply Ground Return |
| 3 | R | Output Data from 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 drive enable node needs to be monitored |
| 11 | nc | No Internal Connection |
| 12 | A | 'A' Bus Connection to RS485 (True) |
| 13 | B | 'B' Bus Connection to RS485 (Inverse) |
| 14 | nc | No Internal Connection |
| 15 | GND ₂ | Output Power Supply Return |
| 16 | V _{DD2} | Output Power Supply |

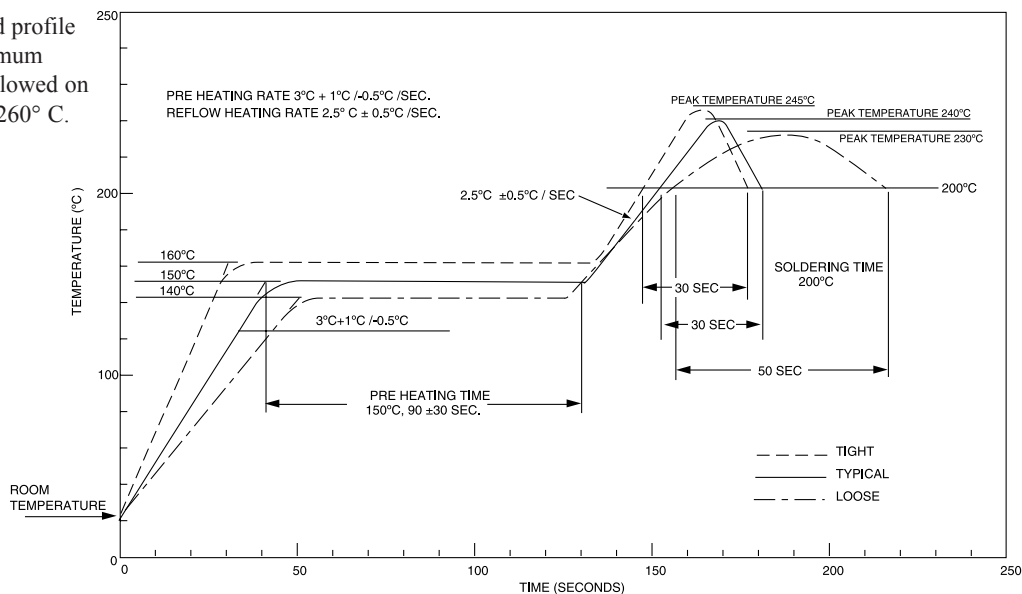
IL485-3V^{ISOLOOP®}

IL485-3V (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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Specifications shown are subject to change without notice.

ISB-DS-001-IL485-3V-A
December 2002

