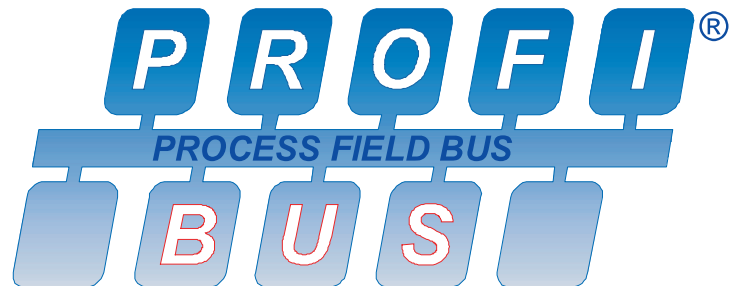


**IsoLoop<sup>®</sup>**  
**Isolated PROFIBUS**  
**Evaluation Board**



Board No.: IL3685-3-01

# About This Evaluation Board

Isolation reduces noise, eliminates ground loops, and improves safety.

The PROFIBUS Evaluation Board provides a complete isolated PROFIBUS node using the ultraminiature IL3685-3E narrow-body isolated transceiver.

The evaluation board provides screw terminal and DB9 connections, and demonstrates best layout practices including separate ground planes. Termination, pull-up, and pull-down resistors can be changed to accommodate different configurations.

The IL3685 is a galvanically isolated transceiver using NVE's patented IsoLoop spintronic Giant Magnetoresistance (GMR) technology.

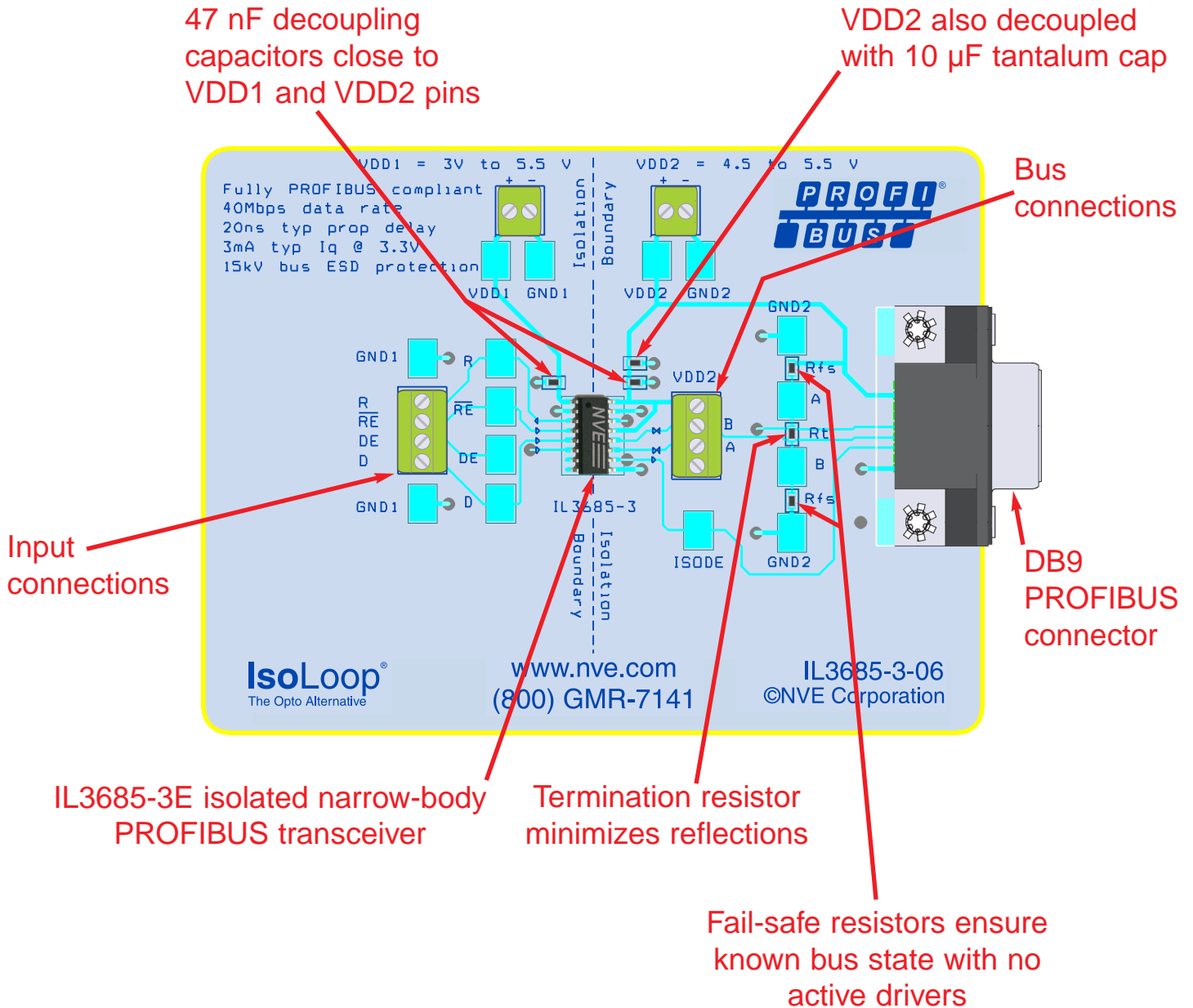
Full PROFIBUS compliance includes the rigorous PROFIBUS differential output voltage specifications. Current limiting and thermal shutdown features protect against output short circuits and bus contention that may cause excessive power dissipation. Receiver inputs feature a "fail-safe if open" design, ensuring a logic high R-output if A/B are floating.

## IL3685-3E Specification Highlights

- 40 Mbps data rate
- 16-pin narrow-body (0.15-inch) SOIC package
- 3 V to 5.5 V power supplies
- 20 ns propagation delay
- 5 ns pulse skew
- 100 ps jitter
- Low quiescent supply current
- 2,500 V<sub>RMS</sub> isolation (1 minute)
- 20 kV/ $\mu$ s transient immunity
- 15 kV bus ESD protection
- Low EMC footprint
- Thermal shutdown protection
- -40°C to +85°C temperature range
- Meets or exceeds ANSI RS-485 and ISO 8482:1987(E)
- PROFIBUS compliant
- UL 1577 recognized and IEC 61010-2001 approved

Visit [www.IsoLoop.com](http://www.IsoLoop.com) for datasheets and illustrative applications.

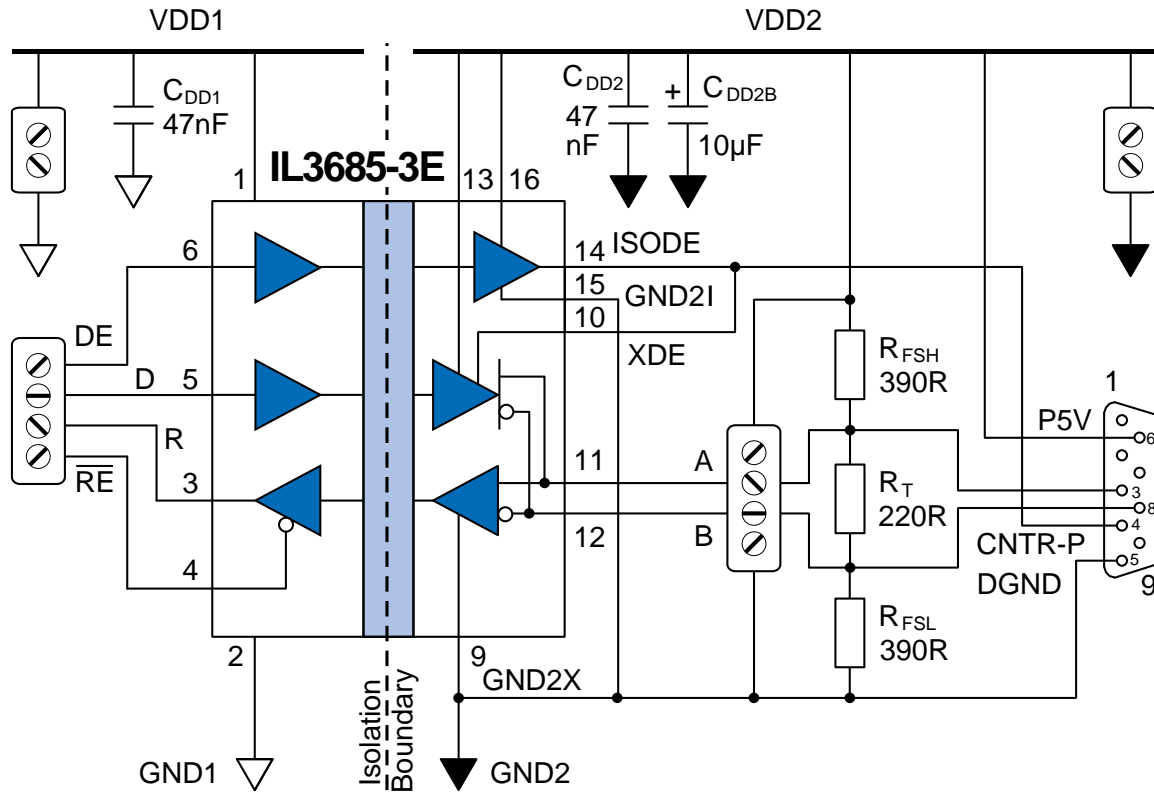
# Evaluation Board Layout



## Quick Start

- Connect  $V_{DD1}$  to a 3.3 V power supply and  $V_{DD2}$  to a 5 V supply.
- Tie “DE” high and “ $\overline{RE}$ ” low to enable the input and output data.
- Connect a signal generator to the “D” input.
- Look for the complementary “A” and “B” outputs on an oscilloscope.

# Circuit Diagram



Device pin	Symbol	Description
1	VDD1	Input power supply
2	GND1	Input power supply ground return
3	R	Output data from bus
4	$\overline{RE}$	Read data enable (R=high impedance if $\overline{RE}$ is high)
5	D	Data input to bus
6	DE	Drive enable
7	NC	No internal connection
8	NC	No internal connection
9	GND2X	Output transceiver ground return (normally connected to pin 15)
10	XDE	Transceiver Device Enable (normally connected to pin 14)
11	A	Non-inverting bus line
12	B	Inverting bus line
13	VDD2X	Output transceiver power supply (normally connected to pin 16)
14	ISODE	Isolated DE output (normally connected to pin 10)
15	GND2I	Output isolation power supply ground return (normally connected to pin 9)
16	VDD2I	Output power supply (normally connected to pin 13)

# Board Layout and Cabling

## Board Layout Best Practices

Although not always necessary, the following connector layout precautions are best practices:

- The connector, termination resistor, and transceiver should be as close together as possible.
- Use 47 nF decoupling capacitors as close as possible to transceiver  $V_{DD}$  pins, plus 10  $\mu$ F on  $V_{DD2}$ .
- Provide ground planes for both power supplies.

## Cable Specifications

PROFIBUS Type A bus cable is recommended for high transmission speeds (more than 500 Kbps). Type B should only be used at low baud rates and low requirements on the network distances.

## Cable Length

IL3685 transceivers are intended for networks up to 4,000 feet (1,200 m) with Type A bus cable and proper termination. The maximum data rate decreases as cable length increases.

## Differential Bus Output Voltage

Unlike many other PROFIBUS transceivers, the IL3685 meets stringent PROFIBUS standards for transceiver differential output voltage. Some transceivers manufacturers erroneously believe maximizing differential output voltage is a good thing.

The PROFIBUS specification requires:

“The differential voltage between A- and B-line shall be a minimum of 4 V and a maximum of 7 V.”

Unfortunately, most RS-485 transceiver don't specify bus voltages that way. They specify a maximum and a minimum differential voltage between A and B. Differential maximum and minimum is almost always quoted with a single output state under low and high loads respectively.

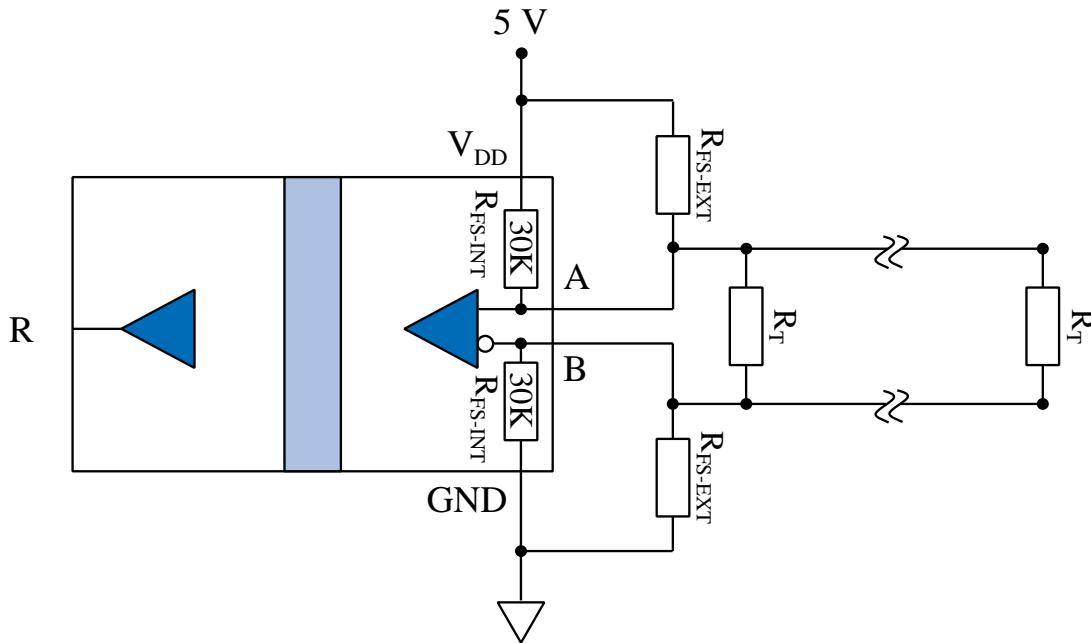
The PROFIBUS specification is with respect to terminal A of the bus, however. When A is greater than B, a negative voltage is measured with respect to A.

With no load, the voltage measured will be approximately  $-3.2$  V for compatible transceivers. When the opposite logic state is driven from TxD, the B node will become positive with respect to A.

# Biasing and Termination

## Internal Biasing Resistors

“Fail-safe biasing” forces a logic high state on “R” in response to an open-circuit condition between the bus “A” and “B” lines, or when no drivers are active on the bus. IL3000-Series Isolated Transceivers include internal pull-up and pull-down resistors of approximately 30 k $\Omega$  in the receiver section ( $R_{FS-INT}$  in the figure below):



These internal resistors ensure fail-safe operation if there are no termination resistors and up to four RS-485 worst-case Unit Loads of 12 k $\Omega$ .

## Termination Resistor

The evaluation board has a 220  $\Omega$  termination resistor, which is standard for PROFIBUS. The resistor should be removed if the board is connected to a bus already terminated at both ends.

## External Fail-Safe Biasing Resistors

Termination resistors bring the differential voltage across the conductor pair close to zero with no active drivers. In this case, the idle bus is indeterminate and susceptible to noise. External fail-safe biasing resistors ( $R_{FS-EXT}$ ) at one end of the bus ensure fail-safe operation with a terminated bus. Biasing should provide at least 200 mV across the conductor pair to meet the RS-485 input sensitivity specification.

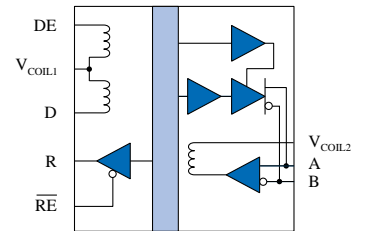
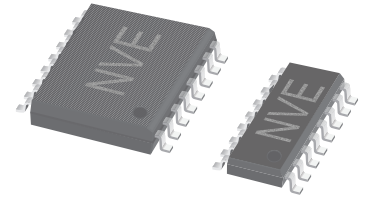
PROFIBUS-standard 390  $\Omega$  fail-safe resistors are included on the evaluation board. If two or more evaluation boards are connected, remove the resistors from all but one board.

# Isolated Network Transceivers

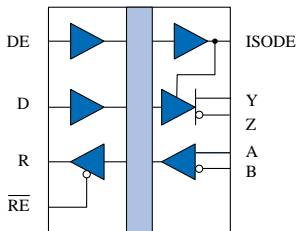
NVE offers a wide choice of isolated RS-422, RS-485, and CAN network transceivers. Models provide high speed, 15 kV ESD protection, handshake channels, and fractional loads.

Versions are available in 0.15-inch and 0.3-inch SOIC packages, making these the most compact solutions in the world while still meeting safety standard creepage and clearance requirements.

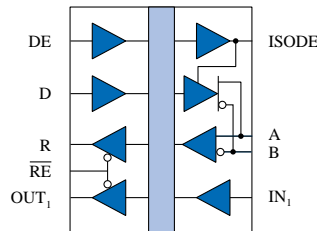
All transceivers have an isolation rating of 2,500 V<sub>RMS</sub> (one minute), and are supplied RoHS compliant as standard. All are UL1577 and IEC61010 approved; the IL3685 is PROFIBUS compliant.



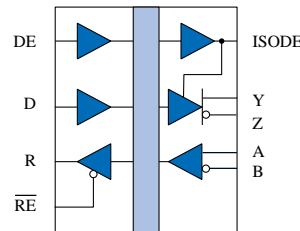
**IL3122/IL3185/  
IL3222/IL3285/  
IL3422/IL3485**



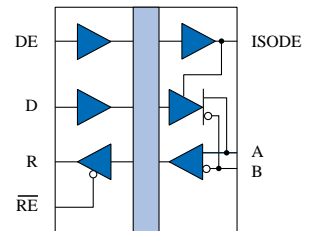
**IL422/IL485**



**IL485W**



**IL3522/IL3585**



**IL3685**

Model	Bus	Inputs	Mbps	Nodes	Bus ESD (kV)	Key Features	Packages
IL3122	RS-422	Passive	5	32	15	Low Cost	0.15" SOIC-16; 0.3" SOIC-16
IL3185	RS-485	Passive	5	32	15	Low Cost	0.15" SOIC-16; 0.3" SOIC-16
IL3222	RS-422	Passive	5	256	15	Fractional Load	0.15" SOIC-16; 0.3" SOIC-16
IL3285	RS-485	Passive	5	256	15	Fractional Load	0.15" SOIC-16; 0.3" SOIC-16
IL3422	RS-422	Passive	20	32	15	High Speed	0.15" SOIC-16; 0.3" SOIC-16
IL3485	RS-485	Passive	20	32	15	High Speed	0.15" SOIC-16; 0.3" SOIC-16
IL422	RS-422	Digital	25	32	15	Industry Standard	0.3" SOIC-16
IL485	RS-485	Digital	35	32	2	Industry Standard	0.3" SOIC-16
IL485W	RS-485	Digital	35	32	2	RS-485 + Handshake	0.3" SOIC-16
IL3522	RS-422	Digital	40	50	15	Very High Speed	0.3" SOIC-16
IL3585	RS-485	Digital	40	50	15	Very High Speed	0.15" SOIC-16; 0.3" SOIC-16
IL3685	RS-485	Digital	40	50	15	PROFIBUS Compliant	0.15" SOIC-16; 0.3" SOIC-16

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