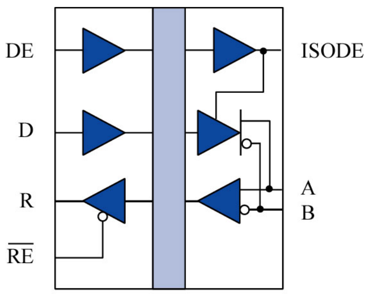
Isolated RS485 Interface

Functional Diagram



IL485

V_{ID} (A-B)	DE	RE	ISODE	R	D	Mode
≥ 200 mV	L	L	L	H	X	Receive
≤ -200 mV	L	L	L	L	X	Receive
$-7<V_{ID}<12$	X	H	X	Z	X	Receive/Drive
≥1.5 V	H	L	H	H	H	Drive
≤ -1.5 V	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

- +3.3 V Input Supply Compatible
- 2500 V_{RMS} Isolation (1 min.)
- 25 ns Maximum Propagation Delay
- 35 Mbps 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 Systems
- Multiple Data Point Transmission

Description

The IL485 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 is the first isolated RS485 interface in a standard 16-pin SOIC package that meets the ANSI Standards EIA/TIA-422-B and RS485 and is compatible with 3.3V input supplies.

The IL485 has current limiting and thermal shutdown features to protect against output short circuits and bus contention situations that could cause excessive power dissipation.

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

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

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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		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} + 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	V_{DD1} = 3.3 V V_{DD1} = 5.0 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	
Ambient Operating Temperature	T_A	-40		85	°C	
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		8.077				mm
Barrier Impedance			$>10^{14}\|\|7$			Ω || pF
Leakage Current			0.2		µA	240 V_{RMS}, 60 Hz

Safety & Approvals

IEC61010-1

TUV Certificate Numbers: *Approval Pending*

Classification: Reinforced Insulation

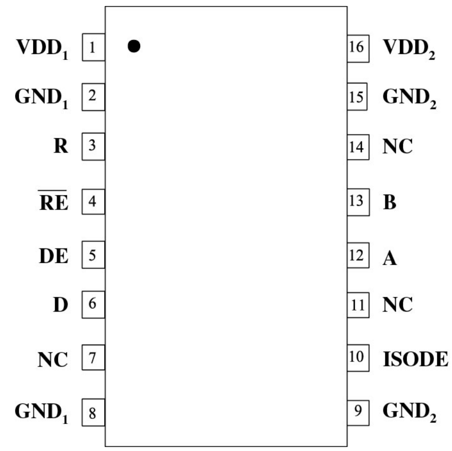
Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL485	0.3" SOIC	II	III	300 V_{RMS}

UL 1577

Component Recognition program. File #: Approval Pending
Rated 2500V_{RMS} for 1 minute (SOIC)

IL485 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	NC	No Internal Connection
12	A	Non-inverting Bus Line
13	B	Inverting Bus Line
14	NC	No Internal Connection
15	GND_2	Output Power Supply Ground Return.
16	V_{DD2}	Output Power Supply



Driver Section

Electrical specifications are T_{min} to T_{max} 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 Ω, V_{DD} = 5 V
Differential Output Voltage(2)(6)	V_{OD3}	1.5		5	V	R_L = 54 Ω, V_{DD} = 4.5 V
Change in Magnitude of Differential Output Voltage(7)	$\Delta\|V_{OD}\|$			±0.2	V	R_L = 54 Ω or 100 Ω
Common Mode Output Voltage	V_{OC}			3 -1	V	R_L = 54 Ω or 100 Ω
Change in Magnitude of Common Mode Output Voltage(7)	$\Delta\|V_{OC}\|$			±0.2	V	R_L = 54 Ω or 100 Ω
Output Current(4) *Output Disabled*	I_O			1 -0.8	mA	V_O = 12V V_O = -7V
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}	60		250 -150 -250	mA	V_O = -6 V V_O = 0 V V_O = 8 V
Supply Current (V_{DD2} = +5 V) (V_{DD1} = +5 V) (V_{DD1} = +3.3 V)	I_{DD2} I_{DD1} I_{DD1}		27 5 3.2	34 10 7	mA	No Load (Outputs Enabled)
Switching Specifications						
Parameters	**Symbol**	**Min.**	**Typ.(5)**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		35			Mbps	R_L = 54 Ω, C_L = 50 pF
Differential Output Prop Delay	t_D(OD)		16	25	ns	R_L = 54 Ω, C_L = 50 pF
Pulse Skew(10)	t_S(P)		1	6	ns	R_L = 54 Ω, C_L = 50 pF
Differential Output Rise & Fall Time	t_T(OD)		8	10	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To High Level	t_{PZH}		31	65	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To Low Level	t_{PZL}		22	35	ns	R_L = 54 Ω, C_L = 50 pF
Output Disable Time From High Level	t_{PHZ}		28	50	ns	R_L = 54 Ω, C_L = 50 pF
Output Disable Time From Low Level	t_{PLZ}		16	32	ns	R_L = 54 Ω, C_L = 50 pF
Skew Limit(3)	t_{SK}(LIM)		2	12	ns	R_L = 54 Ω, C_L = 50 pF

Notes: (These 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 the $|t_{PLH} - t_{PHL}|$ of each channel.

Receiver Section

Electrical specifications are T_{min} to T_{max} 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}			±20	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		50		kΩ	
Supply Current (V_{DD2} = +5V) (V_{DD1} = +5V) (V_{DD1} = +3.3V)	I_{DD2} I_{DD1} I_{DD1}		27 5 3.2	34 10 7	mA	No load Outputs Enabled
Switching Characteristics @ 5 V						
Parameters	**Symbol**	**Min.**	**Typ.[5]**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		35			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 @ 3.3 V						
Parameters	**Symbol**	**Min.**	**Typ.[5]**	**Max.**	**Units**	**Test Conditions**
Maximum Data Rate		35			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

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.

Application Information

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 2.5 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 onstate and frequency.

The approximate power supply current per channel is:

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

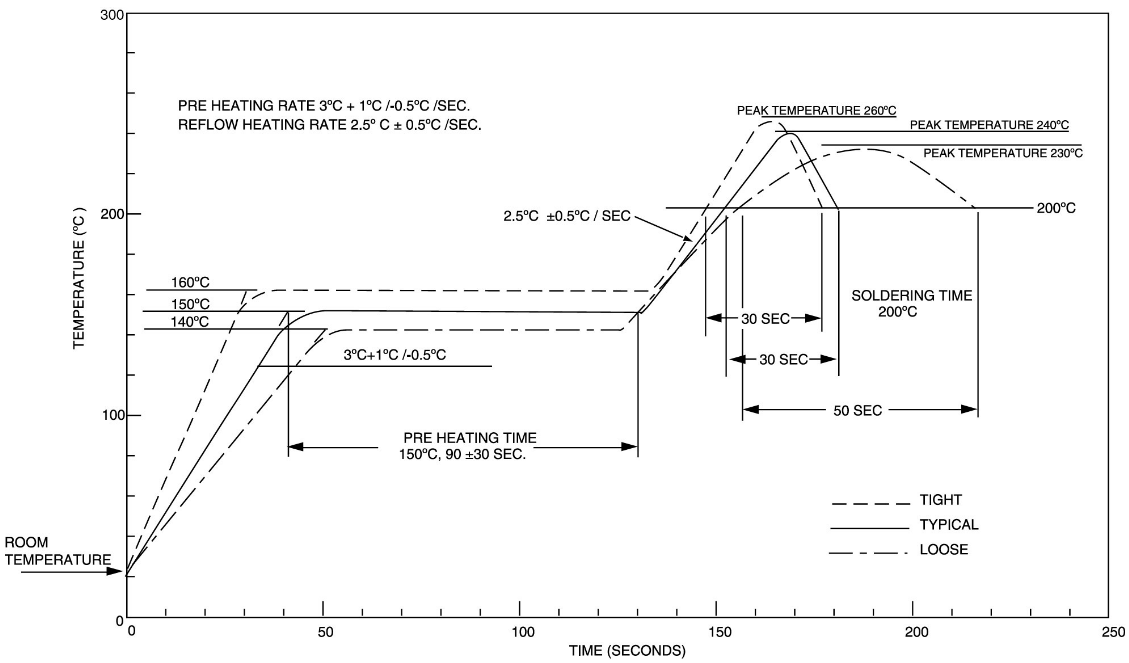
Where f = operating frequency

f_{MAX} = 50 MHz

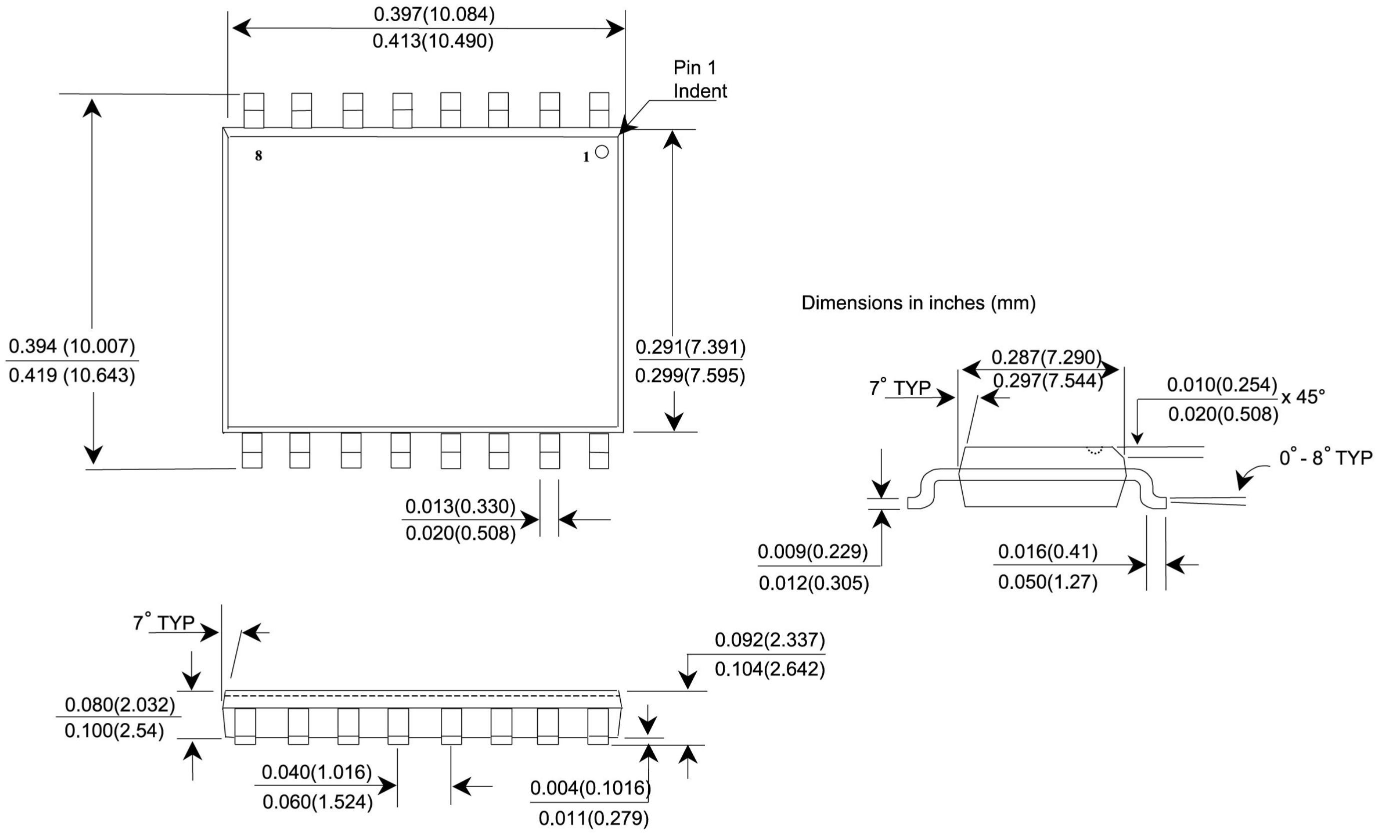
Power Supplies

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. In addition, V_{DD2} should have a 10 µF tantalum capacitor connected in parallel with the 47 nF capacitor.

IR Soldering Profile



0.3" 16-pin SOIC Package



Ordering Information and Valid Part Numbers

IL 485 E TR13

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

Lead Frame Material
Blank = Tin-Lead Plating
E = 100% Tin (Lead Free)

Base Part Number
485 = RS485 Transceiver

Product Family
IL = Isolators

Valid Part Numbers

IL485
IL485E
IL485TR13
IL485E TR13

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ISB-DS-001-IL485-J

Changes

1. Page 1: Revision letter added.
2. Page 1: Ordering Information Removed.
3. Page 2: IEC 61010-1 “Reinforced Insulation” added.
4. Page 4: Notes added.
5. Page 6: IR Soldering Profile added
6. Page 7: Ordering Information added.

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About NVE

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine spintronic 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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