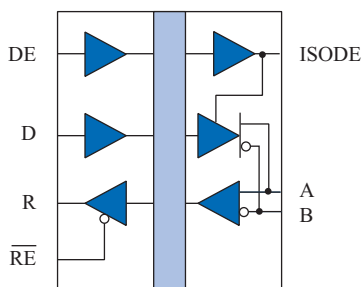


Isolated RS485 Interface

Functional Diagram



IL485

$V_{ID} (A-B)$	DE	\overline{RE}	ISODE	R	D	Mode
$\geq 200 \text{ mV}$	L	L	L	H	X	Receive
$\leq -200 \text{ mV}$	L	L	L	L	X	Receive
$-7 < V_{ID} < 12$	X	H	X	Z	X	Receive/Drive
$\geq 1.5 \text{ V}$	H	L	H	H	H	Drive
$\leq -1.5 \text{ V}$	H	L	H	L	L	Drive
Open	L	L	L	H	X	Indeterminate

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

Features

- 3.3 V Input Supply Compatible
- 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
- $\pm 60 \text{ mA}$ Driver Output Capability
- Thermal Shutdown Protection
- Meets or Exceeds ANSI RS-485 and ISO 8482:1987(E)
- Low EMC Footprint
- -40°C to $+85^\circ\text{C}$ Operating Temperature
- PROFIBUS Compliant
- 2500 V_{RMS} Isolation
- IEC 60747-17 (VDE 0884-17):2021-10 certified; UL 1577 recognized
- 16-Pin Wide-Body SOIC Package

Applications

- RS-485 Systems
- PROFIBUS
- 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. The devices use NVE's patented* spintronic Giant Magnetoresistance (GMR) technology. The IL485 was the first isolated RS-485 interface in a standard 16-pin SOIC package to meet the ANSI Standards EIA/TIA-422-B and RS-485.

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.

Absolute Maximum Ratings⁽¹¹⁾

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T _s	-65		150	°C	
Junction Temperature	T _j	-65		150	°C	Junction Temperature
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	
Ambient Operating Temperature	T _A	-40		85	°C	
Junction Temperature	T _j	-40		100	°C	
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 _{DD1}	V	V _{DD1} = 3.3 V V _{DD1} = 5.0 V
Low-Level Digital Input Voltage	V _{IL}	0		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	
Transient Immunity		20			kV/μs	
Digital Input Signal Rise and Fall Times	t _{IR} , t _{IF}	DC Stable				

Safety and Approvals

IEC 60747-17 (VDE 0884-17):2021-10 (Basic Isolation; VDE File Number 5016933-4880-0001)

- Isolation voltage (V_{ISO}): 2500 V_{RMS}
- Transient overvoltage (V_{IOTM}): 4000 V_{PK}
- Surge rating: 4000 V
- Each part tested at 1590 V_{PK} for 1 second, 5 pC partial discharge limit.
- Samples tested at 4000 V_{PK} for 60 sec.; then 1358 V_{PK} for 10 sec. with 5 pC partial discharge limit.
- Working Voltage (V_{IORM} ; pollution degree 2): 600 V_{RMS}

Safety-Limiting Values	Symbol	Value	Units
Safety rating ambient temperature	T_S	180	°C
Safety rating power (180 °C)	P_S	270	mW
Supply current safety rating (total of supplies)	I_S	54	mA

UL 1577 (Component Recognition Program File Number E207481)

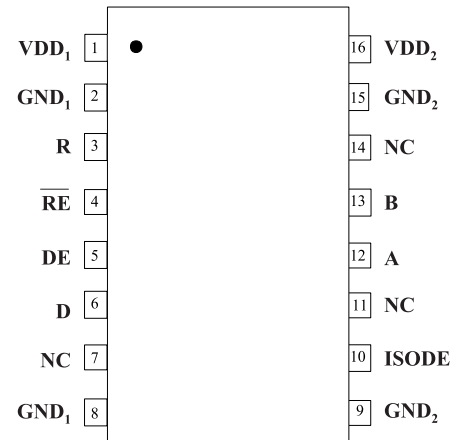
- 2500 V rating.
- Each part tested at 3000 V_{RMS} (4243 V_{PK}) for 1 second.
- Each lot sample tested at 2500 V_{RMS} (3536 V_{PK}) for 1 minute.

Soldering Profile

Per JEDEC J-STD-020C, MSL-1

IL485 Pin Connections

1	V _{DD1}	Input Power Supply
2	GND ₁	Input Power Supply Ground*
3	R	Output Data from Bus
4	$\overline{\text{RE}}$	Read Data Enable (if 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*
9	GND ₂	Output Power Supply Ground*
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*
16	V _{DD2}	Output Power Supply



***NOTE:** Pins 2 and 8 are internally connected, as are pins 9 and 15.

Driver Section

Electrical Specifications are T_{min} to T_{max} and $V_{DD} = 4.5\text{ V}$ to 5.5 V , 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⁾	Δ 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⁾	Δ V _{OC}			±0.2	V	R _L = 54 Ω or 100 Ω
Output Current ⁽⁴⁾ <i>Output Disabled</i>	I _O			1 -0.8	mA	V _O = 12 V V _O = -7 V
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 V _O = 0 V V _O = 8 V
Supply Current	V _{DD1} = +5 V V _{DD1} = +3.3 V	I _{DD1} I _{DD1}	4 3	6 4	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

Receiver Section

Electrical Specifications are T_{min} to T_{max} and $V_{DD} = 4.5\text{ V}$ to 5.5 V , unless otherwise stated.

Parameters	Symbol	Min.	Typ. ⁽⁵⁾	Max.	Units	Test Conditions
Positive-going Input Threshold Voltage	V_{IT+}			0.2	V	$V_O = 2.7\text{ V}$, $I_O = -0.4\text{ mA}$
Negative-going Input Threshold Voltage	V_{IT-}	-0.2			V	$V_O = 0.5\text{ V}$, $I_O = 8\text{ mA}$
Hysteresis Voltage ($V_{IT+} - V_{IT-}$)	V_{HYS}		60		mV	
High Level Digital Output Voltage	V_{OH}	$V_{DD} - 0.2$			V	$V_{ID} = 200\text{ mV}$ $I_{OH} = -20\text{ }\mu\text{A}$
Low Level Digital Output Voltage	V_{OL}			0.2	V	$V_{ID} = -200\text{ mV}$ $I_{OH} = 20\text{ }\mu\text{A}$
High-impedance-state output current	I_{OZ}			± 20	μA	$V_O = 0.4$ to $(V_{DD2} - 0.5)\text{ V}$
Line Input Current ⁽⁸⁾	I_I			1 -0.8	mA	$V_I = 12\text{ V}$ $V_I = -7\text{ V}$ Other Input ⁽¹¹⁾ = 0 V
Input Resistance	r_I	12	20		k Ω	
Supply Current	I_{DD2}		27	34	mA	No load Outputs Enabled

Switching Characteristics at 5 V

Parameters	Symbol	Min.	Typ. ⁽⁵⁾	Max.	Units	Test Conditions
Maximum Data Rate		35			Mbps	$R_L = 54\text{ }\Omega$, $C_L = 50\text{ pF}$
Propagation Delay ^(2, 9)	t_{PD}		24	32	ns	$V_O = -1.5\text{ V}$ to 1.5 V , $C_L = 15\text{ pF}$
Pulse Skew ^(2, 10)	$t_{SK(P)}$		1	6	ns	$V_O = -1.5\text{ V}$ to 1.5 V , $C_L = 15\text{ pF}$
Skew Limit ⁽³⁾	$t_{SK(LIM)}$		2	8	ns	$R_L = 54\text{ }\Omega$, $C_L = 50\text{ pF}$
Output Enable Time To High Level	t_{PZH}		17	24	ns	$C_L = 15\text{ pF}$
Output Enable Time To Low Level	t_{PZL}		30	45	ns	$C_L = 15\text{ pF}$
Output Disable Time From High Level	t_{PHZ}		30	45	ns	$C_L = 15\text{ pF}$
Output Disable Time From Low Level	t_{PLZ}		18	27	ns	$C_L = 15\text{ pF}$

Switching Characteristics at 3.3 V

Parameters	Symbol	Min.	Typ. ⁽⁵⁾	Max.	Units	Test Conditions
Maximum Data Rate		35			Mbps	$R_L = 54\text{ }\Omega$, $C_L = 50\text{ pF}$
Propagation Delay ^(2, 9)	t_{PD}		27	32	ns	$V_O = -1.5\text{ V}$ to 1.5 V , $C_L = 15\text{ pF}$
Pulse Skew ^(2, 10)	$t_{SK(P)}$		2	6	ns	$V_O = -1.5\text{ V}$ to 1.5 V , $C_L = 15\text{ pF}$
Skew Limit ⁽³⁾	$t_{SK(LIM)}$		4	8	ns	$R_L = 54\text{ }\Omega$, $C_L = 50\text{ pF}$
Output Enable Time to High Level	t_{PZH}		20	24	ns	$C_L = 15\text{ pF}$
Output Enable Time to Low Level	t_{PZL}		33	45	ns	$C_L = 15\text{ pF}$
Output Disable Time from High Level	t_{PHZ}		33	45	ns	$C_L = 15\text{ pF}$
Output Disable Time from Low Level	t_{PLZ}		20	27	ns	$C_L = 15\text{ pF}$

Magnetic Field Immunity⁽¹¹⁾

Magnetic Field Immunity at 5 V

Power Frequency Magnetic Immunity	H_{PF}		3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}		4500		A/m	$t_p = 8\text{ }\mu\text{s}$
Damped Oscillatory Magnetic Field	H_{OSC}		4500		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier ⁽¹²⁾	K_X		2.5			

Magnetic Field Immunity at 3.3 V

Power Frequency Magnetic Immunity	H_{PF}		1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}		2000		A/m	$t_p = 8\text{ }\mu\text{s}$
Damped Oscillatory Magnetic Field	H_{OSC}		2000		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier ⁽¹²⁾	K_X		2.5			

Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance		8.08				mm
Barrier Impedance			$>10^{14} \parallel 7$			$\Omega \parallel \text{pF}$
Leakage Current			0.2		μA	240 V _{RMS} , 60 Hz

Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	θ_{JA}		67		$^{\circ}\text{C}/\text{W}$	Double-sided PCB in free air
Junction–Case (Top) Thermal Resistance	θ_{JC}		12			
Junction–Ambient Thermal Resistance	θ_{JA}		46			2s2p PCB in free air per JESD51
Junction–Case (Top) Thermal Resistance	θ_{JC}		9			
Power Dissipation	P_D			1500	mW	

Notes:

- All voltage values are with respect to network ground except differential I/O bus voltages.
- Differential input/output voltage is measured at the noninverting terminal A with respect to the inverting terminal B.
- Skew limit is the maximum propagation delay difference between any two devices at 25°C.
- 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.
- All typical values are at $V_{DD1} = 3.3 \text{ V}$ or 5 V and $V_{DD2} = 5 \text{ V}$, and $T_A = 25^{\circ}\text{C}$.
- The minimum V_{OD2} with a 100Ω load is either $\frac{1}{2} V_{OD1}$ or 2 V , whichever is greater.
- ΔV_{OD} and ΔV_{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.
- 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.
- Includes 8 ns read enable time. Maximum propagation delay is 25 ns after read assertion.
- Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel.
- The relevant test and measurement methods are given in the Electromagnetic Compatibility section.
- External magnetic field immunity is improved by this factor if the field direction is “end-to-end” rather than to “pin-to-pin.”

Application Information

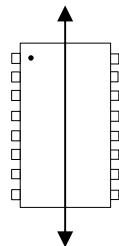
Electrostatic Discharge Sensitivity

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.

Electromagnetic Compatibility

The IL485 is fully compliant with IEC 61000-6-1 and IEC 61000-6-2 standards for immunity, and IEC 61000-6-3, IEC 61000-6-4, CISPR, and FCC Class A standards for emissions.

Immunity to external magnetic fields is even higher if the field direction is “end-to-end” rather than to “pin-to-pin” as shown in the diagram below:



Cross-axis Field Direction

Dynamic Power Consumption

IsoLoop Isolators achieve their low power consumption from the way 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, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers, which have power consumption heavily dependent on frequency and time.

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

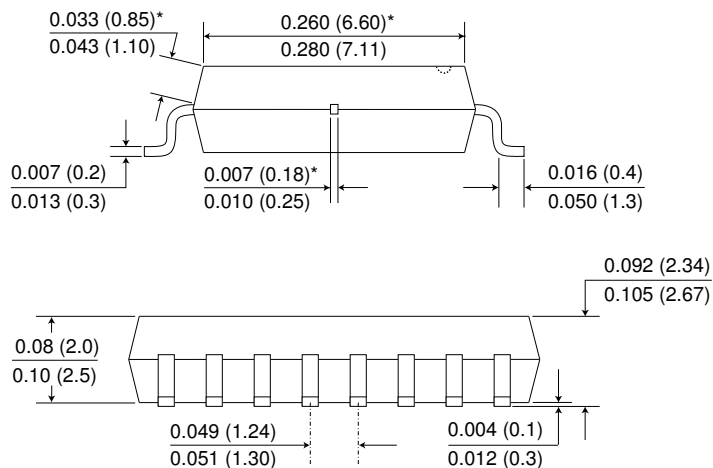
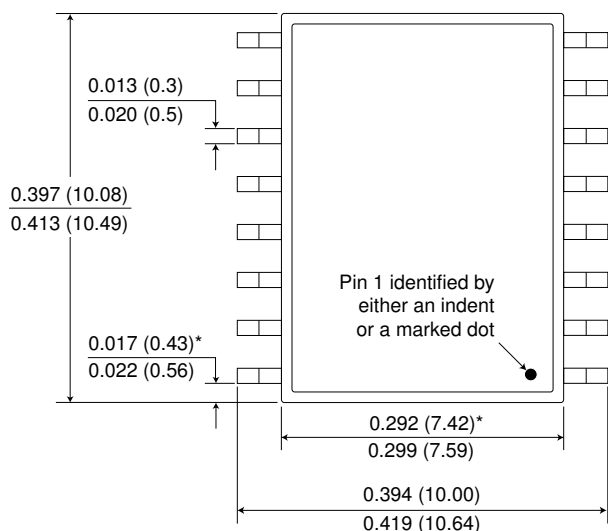
$$f_{MAX} = 50 \text{ MHz}$$

Power Supply Decoupling

V_{DD1} and V_{DD2} should be bypassed with 0.1 μF typical (0.047 μF minimum) capacitors as close as possible to the V_{DD} pins.

0.3" 16-pin SOIC Package

Dimensions in inches (mm); scale = approx. 5X



NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.

Ordering Information and Valid Part Numbers

IL 485 E TR13

Bulk Packaging

Blank = Tube
TR = 13" Tape and Reel

Package

Blank = 80/20 Tin/Lead Plating
E = RoHS Compliant

Base Part Number

485 = RS-485 Transceiver

Product Family

IL = Isolators

Valid Part Numbers

IL485
IL485E

All IL485
part types are
available on
tape and reel.

RoHS
COMPLIANT

ISB-DS-001-IL485-V
October 2022

Changes

- Upgrade to VDE 0884-17 (p. 3).
- Increased Working Voltage from 400 V to 600 V based on latest VDE testing (p. 3).
- Updated EMC standards.
- Added thermal specifications (p. 7).

ISB-DS-001-IL485-U

Change

- Updated MSL, agency approvals, magnetic immunity, and misc. wording.

ISB-DS-001-IL485-T

Change

- Update terms and conditions.

ISB-DS-001-IL485-S

Change

- Added clarification of internal ground connections (p. 3),

ISB-DS-001-IL485-R

Change

- Added low EMC footprint.

ISB-DS-001-IL485-Q

Changes

- Added magnetic field immunity and electromagnetic compatibility specifications.
- Added note on package drawing that pin-spacing tolerances are non-accumulating.

ISB-DS-001-IL485-P

Change

- Changed ordering information to reflect that devices are now fully RoHS compliant with no exemptions.

ISB-DS-001-IL485-O

Change

- Reorganized supply current specifications; misc. minor changes

ISB-DS-001-IL485-N

Change

- Eliminated soldering profile chart

ISB-DS-001-IL485-M

Change

- Updated open input state in truth table

ISB-DS-001-IL485-L

Change

- Updated package drawing; misc. changes

ISB-DS-001-IL485-K

Change

- Update UL and IEC approvals

ISB-DS-001-IL485-J

Changes

- Revision letter added.
- Ordering Information Removed.
- IEC 61010-1 “Reinforced Insulation” added.
- Notes added.
- IR Soldering Profile added
- Ordering Information added.

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ISB-DS-001-IL485-V

October 2022