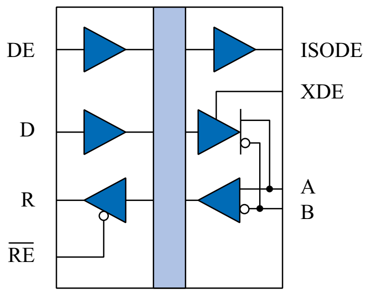
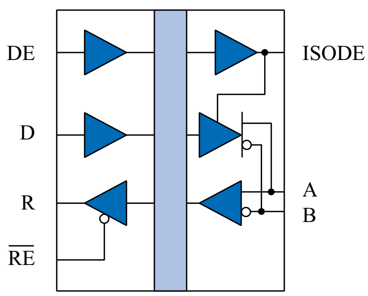
PROFIBUS-Compatible Isolated RS-485 Transceivers

Functional Diagram



IL3685-3
(narrow-body)



IL3685
(wide-body)

V_{ID} (A-B)	DE	$\overline{RE}$	R	D	Mode
≥ 200 mV	L	L	H	X	Receive
≤−200 mV	L	L	L	X	Receive
≥ 1.5 V	H	L	H	H	Drive
≤−1.5 V	H	L	L	L	Drive
X	X	H	Z	X	Hi-Z R
Open	L	L	H	X	Receive

Features

- 40 Mbps data rate
- 0.15", 0.3", or True 8™ mm 16-pin SOIC packages
- 3 V to 5 V power supplies
- 20 ns propagation delay
- 5 ns pulse skew
- 50 kV/µs typ.; 30 kV/µs min. common mode transient immunity
- Low quiescent supply current
- 1000 V_{RMS}/1500 V_{DC} high voltage endurance
- 44000 year barrier life
- 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; IEC 60747-5-5 (VDE 0884) certified

Applications

- PROFIBUS, PROFIBUS DP, and FMS networks
- Factory automation
- Industrial control networks
- Building environmental controls
- Equipment covered under IEC 61010-1 Edition 3

Description

The IL3685 is a galvanically isolated, high-speed differential bus transceiver, designed for bidirectional data communication on balanced transmission lines. The device uses NVE's patented* IsoLoop spintronic Giant Magnetoresistance (GMR) technology.

The part is available in an ultraminiature 0.15" 16-pin SOIC package, a JEDEC-standard 0.3"-wide package, or NVE's exclusive True 8™ 16-pin SOIC package for true 8 millimeter creepage.

The IL3685 is fully PROFIBUS compliant, including the rigorous PROFIBUS differential output voltage specifications.

A unique ceramic/polymer composite barrier provides excellent isolation and virtually unlimited barrier life.

The device is compatible with 3 V as well as 5 V input supplies, allowing interface to standard microcontrollers without additional level shifting.

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.

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

REV. M

Absolute Maximum Ratings[11]

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	−55		150	°C	
Junction Temperature	T_J	−55		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	
ESD (all bus nodes)		15			kV	HBM

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Supply Voltage	V_{DD1} V_{DD2}	3.0 4.5		5.5 5.5	V	
Junction Temperature	T_J	−40		110	°C	
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	
Ambient Operating Temperature	T_A	−40		85	°C	
Digital Input Signal Rise and Fall Times	t_{IR}, t_{IF}	DC Stable				

Insulation Specifications

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (external)	IL3685-3E IL3685E		4.0 8.03	 8.3		mm	Per IEC 60601
Total Barrier Thickness (internal)			0.012	0.013		mm	
Barrier Resistance		R_{IO}		$>10^{14}$		Ω	500 V
Barrier Capacitance		C_{IO}		7		pF	f = 1 MHz
Leakage Current				0.2		μA_{RMS}	240 V_{RMS}, 60 Hz
Comparative Tracking Index		CTI	≥175			V	Per IEC 60112
High Voltage Endurance (Maximum Barrier Voltage for Indefinite Life)	AC DC	V_{IO}	1000 1500			V_{RMS} V_{DC}	At maximum operating temperature
Barrier Life				44000		Years	100°C, 1000 V_{RMS}, 60% CL activation energy

Thermal Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	IL3685-3E IL3685E	θ_{JA}		100 60		°C/W	Soldered to double-sided board; free air
Junction–Case Thermal Resistance	IL3685-3E IL3685E	Ψ_{JT}		25 12		°C/W	
Power Dissipation	IL3685-3E IL3685E	P_D			625 800	mW	

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Safety and Approvals

IEC 60747-5-5 (VDE 0884) (File Number 5016933-4880-0001)

- Working Voltage (V_{IORM}) 600 V_{RMS} (848 V_{PK}); basic insulation; pollution degree 2
- Transient overvoltage (V_{IOTM}) and surge voltage (V_{IOSM}) 4000 V_{PK}
- 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

IEC 61010-1 (Edition 2; TUV Certificate Numbers N1502812; N1502812-101)
Reinforced Insulation; Pollution Degree II; Material Group III

Part No. Suffix	Package	Working Voltage
-3	SOIC	150 V_{RMS}
None	Wide-body SOIC/True 8™	300 V_{RMS}

UL 1577 (Component Recognition Program File Number E207481)
Each part tested at 3000 V_{RMS} (4240 V_{PK}) for 1 second; each lot sample tested at 2500 V_{RMS} (3530 V_{PK}) for 1 minute

Soldering Profile

Per JEDEC J-STD-020C, MSL 1

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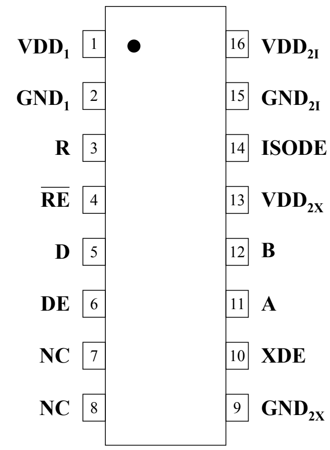
IL3685-3 (0.15" SOIC Package) Pin Connections

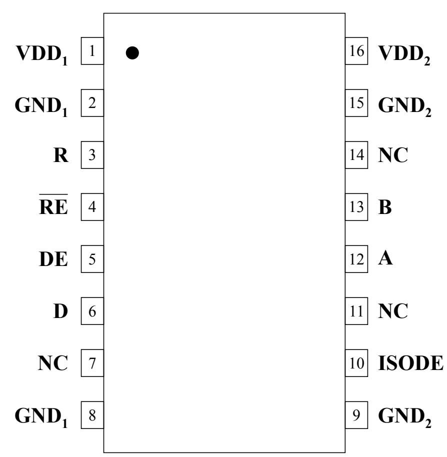
1	V_{DD1}	Input power supply
2	GND_1	Input power supply ground return
3	R	Output data from bus
4	$\overline{RE}$	Read data enable (if $\overline{RE}$ is high, R= high impedance)
5	D	Data input to bus
6	DE	Drive enable
7, 8	NC	No internal connection
9	GND_{2X}	Output transceiver ground return. (normally connected to pin 15)
10	XDE	Transceiver Device Enable input enables the transceiver from the bus side, or is connected to ISODE to enable the trans-ceiver from the controller-side DE input. (this input should not be left unterminated)
11	A	Non-inverting bus line
12	B	Inverting bus line
13	V_{DD2X}	Output transceiver power supply (normally connected to pin 16)
14	ISODE	Isolated DE output (normally connected to pin 10)
15	GND_{2I}	Output isolation power supply ground return. (normally connected to pin 9)
16	V_{DD2I}	Output isolation power supply (normally connected to pin 13)



IL3685-3

IL3685 (0.3" SOIC Package) Pin Connections

1	V_{DD1}	Input power supply
2	GND_1	Input power supply ground return (pin 2 is internally connected to pin 8)
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 (pin 8 is internally connected to pin 2)
9	GND_2	Output power supply ground return (pin 9 is internally connected to pin 15)
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 (pin 15 is internally connected to pin 9)
16	V_{DD2}	Output power supply



IL3685

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Driver Section

Electrical Specifications (T_{min} to T_{max} and V_{DD} = 4.5 V to 5.5 V unless otherwise stated)						
Parameter	**Symbol**	**Min.**	**Typ.**[5]	**Max.**	**Units**	**Test Conditions**
Output voltage	V_O			V_{DD}	V	$I_O = 0$
Differential Output Voltage[2]	$\lvert V_{OD1}\rvert$			V_{DD}	V	$I_O = 0$
Differential Output Voltage[2]	$\lvert V_{OD2}\rvert$	2.1	3	3.5	V	R_L = 54 Ω
Differential Output Voltage[2][6]	V_{OD3}	1.9		3.5	V	R_L = 60 Ω
Change in Magnitude of Differential Output Voltage[7]	$\Delta\lvert V_{OD}\rvert$			±0.2	V	R_L = 54 Ω or 100 Ω
Common Mode Output Voltage	V_{OC}			3	V	R_L = 54 Ω or 100 Ω
Change in Magnitude of Common Mode Output Voltage[7]	$\Delta\lvert V_{OC}\rvert$			±0.2	V	R_L = 54 Ω or 100 Ω
Output Current[4]	I_O			1 −0.8	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
Absolute |Short-circuit Output Current|	I_{OS}			250	mA	−7 V < V_O < 12 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)

Notes (apply to both driver and receiver sections):

1. All voltages 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. −7 V < V_{CM} < 12 V; 4.5 V < V_{DD} < 5.5 V.
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 10 ns read enable time. Maximum propagation delay is 25 ns after read assertion.
10. Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel.
11. Absolute Maximum specifications mean the device will not be damaged if operated under these conditions. It does not guarantee performance.
12. The relevant test and measurement methods are given in the Electromagnetic Compatibility section on p. 6.
13. External magnetic field immunity is improved by this factor if the field direction is "end-to-end" rather than to "pin-to-pin" (see diagram on p. 6).

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Receiver Section

Electrical Specifications (T_{min} to T_{max} and V_{DD} = 4.5 V to 5.5 V unless otherwise stated)						
Parameter	**Symbol**	**Min.**	**Typ.**(5)	**Max.**	**Units**	**Test Conditions**
Positive-going Input Threshold Voltage	V_{IT+}			0.2	V	−7 V < V_{CM} < 12 V
Negative-going Input Threshold Voltage	V_{IT-}	−0.2			V	−7 V < V_{CM} < 12 V
Hysteresis Voltage ($V_{IT+} - V_{IT-}$)	V_{HYS}		28		mV	V_{CM} = 0 V, T = 25°C
High Level Digital Output Voltage	V_{OH}	V_{DD} − 0.2	V_{DD}		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}			±1	μA	V_O = 0.4 to (V_{DD2}−0.5) V
Line Input Current(8)	I_I			1	mA	V_I = 12 V
				−0.8	mA	V_I = −7 V
Input Resistance	R_I	20			kΩ	
Supply Current	I_{DD2}		5	16	mA	No load; Outputs Enabled; V_{DD2X} connected to V_{DD2I} if applicable

Switching Characteristics

V_{DD1} = 5 V, V_{DD2} = 5 V						
Parameter	**Symbol**	**Min.**	**Typ.**(5)	**Max.**	**Units**	**Test Conditions**
Data Rate		40			Mbps	R_L = 54 Ω, C_L = 50 pF
Propagation Delay(2, 9)	t_{PD}		20	30	ns	V_O = −1.5 to 1.5 V, C_L = 15 pF
Pulse Skew(2, 10)	$t_{SK}(P)$		1	5	ns	V_O = −1.5 to 1.5 V, C_L = 15 pF
Skew Limit(3)	$t_{SK}(LIM)$		2	10	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To High Level	t_{PZH}		15	30	ns	C_L = 15 pF
Output Enable Time To Low Level	t_{PZL}		15	30	ns	C_L = 15 pF
Output Disable Time From High Level	t_{PHZ}		15	30	ns	C_L = 15 pF
Output Disable Time From Low Level	t_{PLZ}		15	30	ns	C_L = 15 pF
Common Mode Transient Immunity (Output Logic High to Logic Low)	$\|CM_H\|,\|CM_L\|$	30	50		kV/μs	V_{CM} = 1500 V_{DC} $t_{TRANSIENT}$ = 25 ns
V_{DD1} = 3.3 V, V_{DD2} = 5 V						
Parameter	**Symbol**	**Min.**	**Typ.**(5)	**Max.**	**Units**	**Test Conditions**
Data Rate		40			Mbps	R_L = 54 Ω, C_L = 50 pF
Propagation Delay(2, 9)	t_{PD}		25	35	ns	V_O = −1.5 to 1.5 V, C_L = 15 pF
Pulse Skew(2, 10)	$t_{SK}(P)$		2	5	ns	V_O = −1.5 to 1.5 V, C_L = 15 pF
Skew Limit(3)	$t_{SK}(LIM)$		4	10	ns	R_L = 54 Ω, C_L = 50 pF
Output Enable Time To High Level	t_{PZH}		17	30	ns	C_L = 15 pF
Output Enable Time To Low Level	t_{PZL}		17	30	ns	C_L = 15 pF
Output Disable Time From High Level	t_{PHZ}		17	30	ns	C_L = 15 pF
Output Disable Time From Low Level	t_{PLZ}		17	30	ns	C_L = 15 pF
Common Mode Transient Immunity (Output Logic High to Logic Low)	$\|CM_H\|,\|CM_L\|$	30	50		kV/μs	V_{CM} = 1500 V_{DC} $t_{TRANSIENT}$ = 25 ns

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Magnetic Field Immunity[12]

V_{DD1} = 5 V, V_{DD2} = 5 V						
Power Frequency Magnetic Immunity	H_{PF}	2800	3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}	4000	4500		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}	4000	4500		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier[13]	K_X		2.5			
V_{DD1} = 3.3 V, V_{DD2} = 5 V						
Power Frequency Magnetic Immunity	H_{PF}	1000	1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}	1800	2000		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}	1800	2000		A/m	0.1Hz – 1MHz
Cross-axis Immunity Multiplier[13]	K_X		2.5			

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.

Narrow- and Wide-Body Pinout Differences

The narrow-body version (IL3685-3E) is designed for application flexibility and minimum board area in densely-populated PCAs. The wide-body version (IL3685E) has redundant ground pins for layout flexibility.

The narrow-body version provides a separate isolated DE output (ISODE) and Transceiver Device Enable (XDE) input. ISODE follows the Device Enable input (DE). XDE can be used to enable and disable the transceiver from the bus side, or connected to ISODE to enable and disable the transceiver from the DE controller-side input. The narrow-body version also provides separate bus-side power supply and ground pins—V_{DD2X} and GND_{2X} for the transceiver module and V_{DD2I} and GND_{2I} for the isolation module. The supplies and grounds should be externally connected for normal operation, but they can be used separately for testing or troubleshooting.

The wide-body version has internal connections between the isolated DE output and the Transceiver Device Enable input, and well as between the two bus-side power supplies. The ISODE output can be used in PROFIBUS applications where the state of the isolated drive enable node needs to be monitored, or for testing or troubleshooting.

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.

Data Rate (Mbps)	I_{DD1}	I_{DD2}
1	150 µA	150 µA
10	1.5 mA	1.5 mA
20	3 mA	3 mA
40	6 mA	6 mA

Table 2. Typical Dynamic Supply Currents.

Power Supply Decoupling

Both V_{DD1} and V_{DD2} must be bypassed with 47 nF ceramic capacitors. These should be placed as close as possible to V_{DD} pins for proper operation. Additionally, V_{DD2} should be bypassed with a 10 µF tantalum capacitor.

Maintaining Creepage

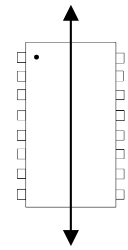
Creepage distances are often critical in isolated circuits. In addition to meeting JEDEC standards, NVE isolator packages have unique creepage specifications. Standard pad libraries often extend under the package, compromising creepage and clearance. Similarly, ground planes, if used, should be spaced to avoid compromising clearance. Package drawings and recommended pad layouts are included in this datasheet.

DC Correctness

The IL3685 incorporates a patented refresh circuit to maintain the correct output state with respect to data input. At power up, the bus outputs will follow the Function Table shown on Page 1. The DE input should be held low during power-up to eliminate false drive data pulses from the bus. An external power supply monitor to minimize glitches caused by slow power-up and power-down transients is not required.

Electromagnetic Compatibility

The IL3585 is fully compliant with generic EMC standards EN50081, EN50082-1 and the umbrella line-voltage standard for Information Technology Equipment (ITE) EN61000. The IsoLoop Isolator's Wheatstone bridge configuration and differential magnetic field signaling ensure excellent EMC performance against all relevant standards. NVE conducted compliance tests in the categories below:



EN50081-1
- Residential, Commercial & Light Industrial
- Methods EN55022, EN55014

EN50082-2: Industrial Environment
- Methods EN61000-4-2 (ESD), EN61000-4-3 (Electromagnetic Field Immunity), EN61000-4-4 (Electrical Transient Immunity), EN61000-4-6 (RFI Immunity), EN61000-4-8 (Power Frequency Magnetic Field Immunity), EN61000-4-9 (Pulsed Magnetic Field), EN61000-4-10 (Damped Oscillatory Magnetic Field)

ENV50204
- Radiated Field from Digital Telephones (Immunity Test)

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 above.

Application Information

Figures 1a and 1b show typical connections to a microcontroller for the narrow-body and wide-body versions. The schematics include typical termination and fail-safe resistors, and power supply decoupling capacitors:

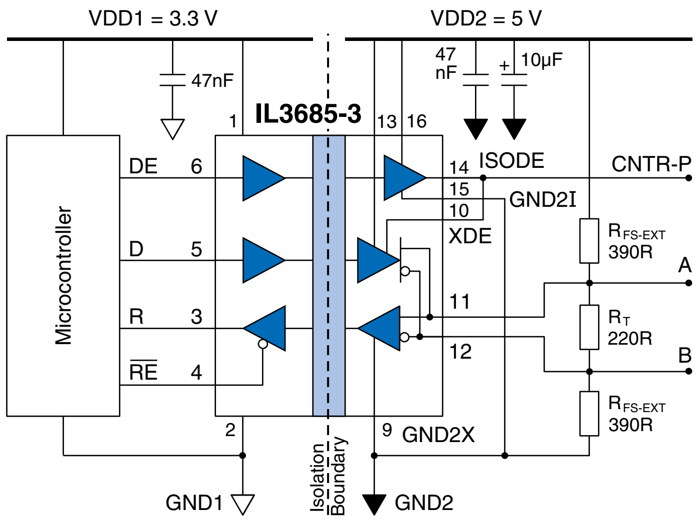


Figure 1a. Typical narrow-body connections.

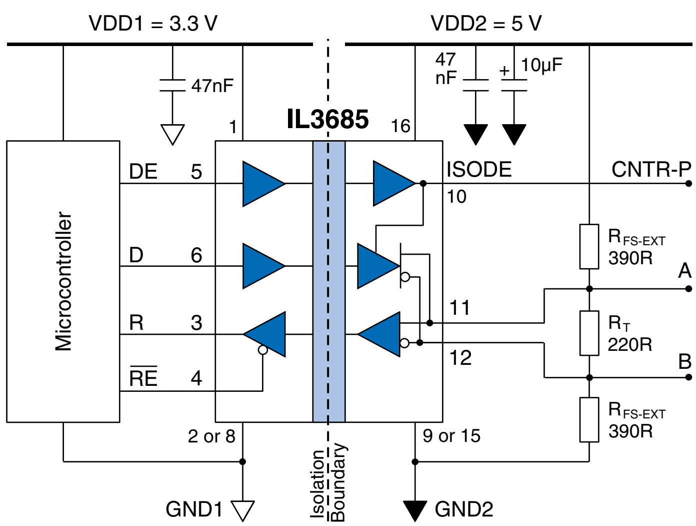


Figure 1b. Typical wide-body connections.

Receiver Features

The receiver output "R" has tri-state capability via the active low $\overline{\text{RE}}$ input.

Driver Features

The RS-485 driver has a differential output and delivers at least 2.1 V across a 54 Ω load. In addition, unlike most other transceivers, the IL3685 also meets stringent PROFIBUS standards for maximum differential output voltage.

Drivers feature low propagation delay skew to maximize bit width and minimize EMI. Drivers have tri-state capability via the active-high DE input.

Receiver Data Rate, Cables and Terminations

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. 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.

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Termination and Fail-Safe Biasing

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 kΩ in the receiver section (RFS-INT in Figure 2 below):

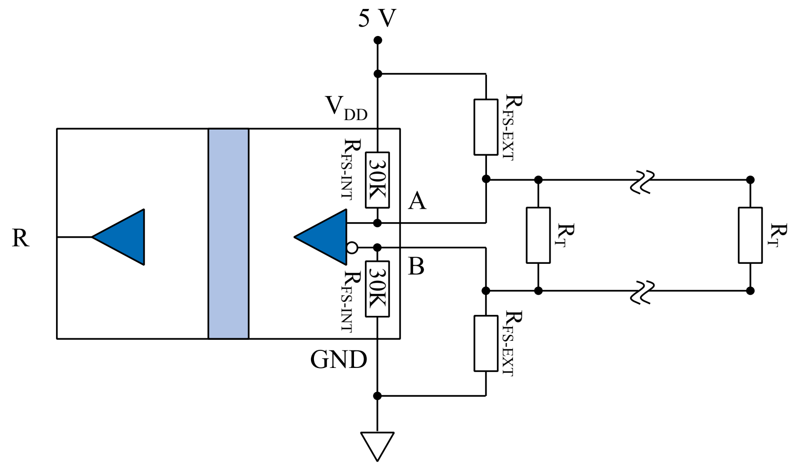

Figure 2. Termination and internal and external fail-safe biasing resistors.

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 kΩ.

Termination Resistors

Termination resistors should be on both ends of the network to minimize reflections. Values should be selected to match cable impedance; 220 Ω resistors are typical for PROFIBUS.

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 (labeled RFS-EXT in Figure 2) 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. Fail-safe resistors of 390 Ω are common for PROFIBUS. They should be on only one node of the network. Using the same value for pull-up and pull-down biasing resistors maintains balance for positive- and negative going transitions.

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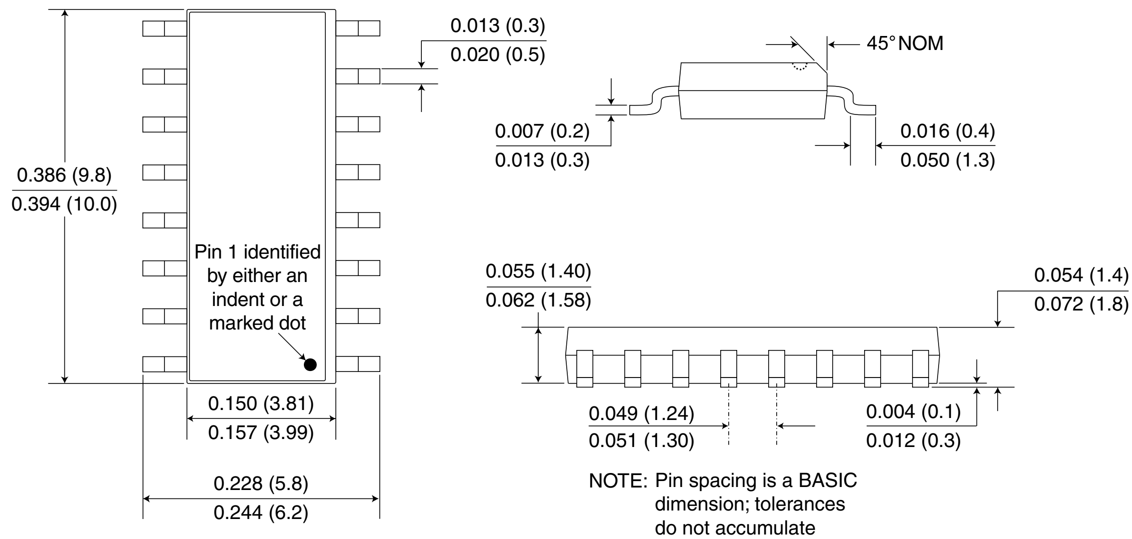
Package Drawings

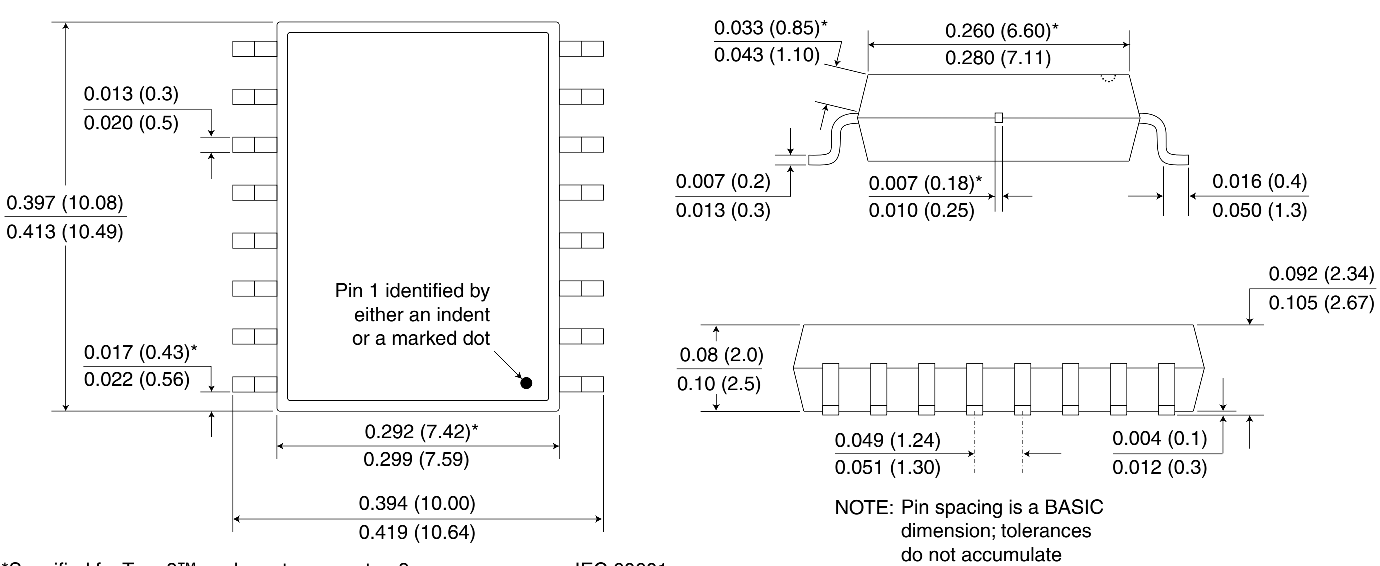
0.15" 16-pin SOIC Package (-3 suffix)

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



0.3" 16-pin SOIC Package (no suffix)

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

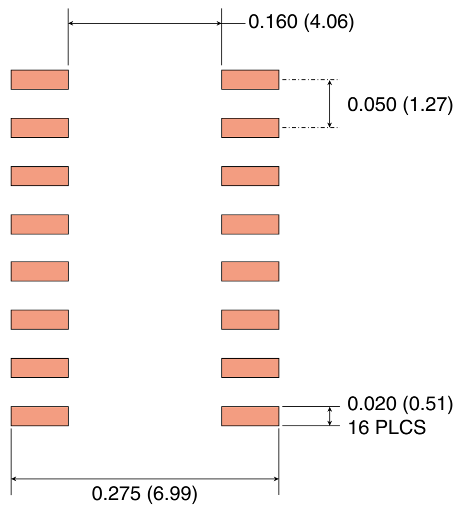


*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.

Recommended Pad Layouts

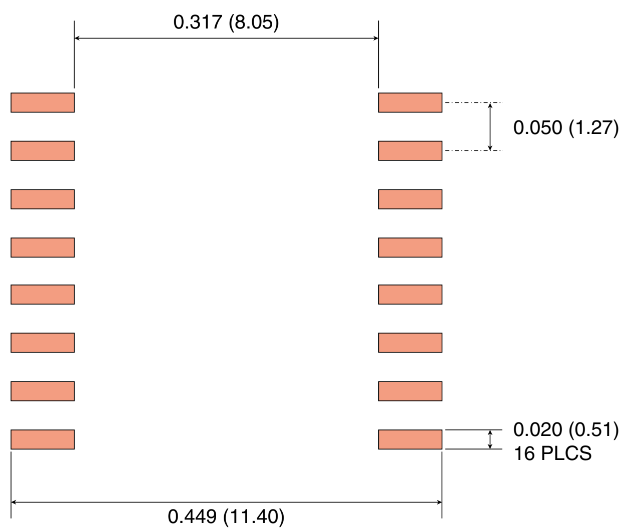
0.15" 16-pin SOIC Pad Layout

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



0.3" 16-pin SOIC Pad Layout

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



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Ordering Information and Valid Part Numbers

IL 36 85 -3 E TR13

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

Package
E = RoHS Compliant

Package Type
Blank = 0.3" SOIC
-3 = 0.15" SOIC

Channel Configuration
85 = RS-485

Base Part Number
36 = 40 Mbps PROFIBUS

Product Family
IL = Isolators

Valid Part Numbers
IL3685E
IL3685E TR13
IL3685-3E
IL3685-3E TR13

RoHS COMPLIANT

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Revision History

ISB-DS-001-IL3685-M
November 2013

Change

- IEC 60747-5-5 (VDE 0884) certification.
- Upgraded from MSL 2 to MSL 1.

ISB-DS-001-IL3685-L

Change

- Increased transient immunity specifications based on additional data.
- Added VDE 0884 pending.
- Added transient immunity specifications.
- Added high voltage endurance specification.
- Increased magnetic immunity specifications.
- Updated package drawings.
- Added recommended solder pad layouts.

ISB-DS-001-IL3685-K

Change

- Added thermal characteristics (p. 2).
- Cosmetic changes.

ISB-DS-001-IL3685-J

Change

- Added narrow-body version (IL3685-3E).
- UL 1577 recognition and IEC 61010-1 approval.
- Added application schematics (p. 7).
- Revised biasing and termination section (p. 8).

ISB-DS-001-IL3685-I

Change

- Update terms and conditions.

ISB-DS-001-IL3685-H

Change

- Revised maximum Receiver Section Supply Current to 16 mA.

ISB-DS-001-IL3685-G

Change

- Added fail-safe resistor values for PROFIBUS to table on p. 7.

ISB-DS-001-IL3685-F

Change

- Clarified pending UL 1577 approval.

ISB-DS-001-IL3685-E

Change

- Added low EMC footprint.

ISB-DS-001-IL3685-D

Change

- Added bus-protection ESD specification (15 kV).

ISB-DS-001-IL3685-C

Change

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

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ISB-DS-001-IL3685-M

November 2013