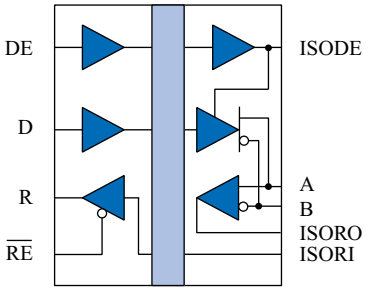
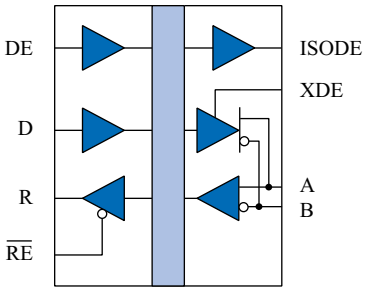
PROFIBUS-Compatible Isolated RS-485 Transceivers

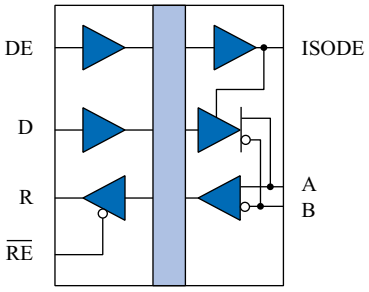
Functional Diagrams



IL3685-1
(QSOP)

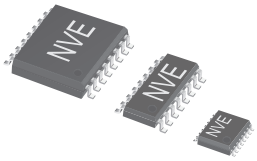


IL3685-3
(narrow-body)



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
- 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
- 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
- 6 kV_{RMS} Reinforced Isolation/ 12.8 kV surge / 1 kV_{RMS} WV (V-Series)
- VDE V 0884-10 certified; UL 1577 recognized
- QSOP, 0.15", or 0.3" 16-pin packages

Applications

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

Description

IL3685-Series galvanically isolated, high-speed differential bus transceivers are designed for bidirectional data communication on balanced transmission lines. The devices use NVE's patented* IsoLoop spintronic Giant Magnetoresistance (GMR) technology.

The wide-body version provides true 8 mm creepage. Narrow-body and QSOP packages offer unprecedented miniaturization.

IL3685-Series transceivers are 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.

PROFI® PROCESS FIELD BUS

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

REV. X

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	Data Rate = 40 Mbps; R_L = 54 Ω
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)	IL3685-1E IL3685-3E IL3685E		3.2 4.0 8.03	 8.3		mm	 Per IEC 60601
Total Barrier Thickness (internal)			0.013	0.016		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	≥600			V_{RMS}	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
Surge Immunity (“V” Version)		V_{IOSM}	12.8			kV_{PK}	Per IEC 61000-4-5
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	QSOP 0.15" SOIC 0.3" SOIC	θ_{JA}		63 38 31		°C/W	Soldered to double-sided board; free air
Junction–Case (Top) Thermal Resistance	QSOP 0.15" SOIC 0.3" SOIC	θ_{JT}		35 21 17		°C/W	
Power Dissipation	QSOP 0.15" SOIC 0.3" SOIC	P_D			675 700 800	mW	

Safety and Approvals

VDE V 0884-10 (VDE V 0884-11 pending)

V-Series (Reinforced Isolation; VDE File Number 5016933-4880-0002)

- Working Voltage (V_{IORM}) 1000 V_{RMS} (1415 V_{PK}); reinforced insulation; pollution degree 2
- Isolation voltage (V_{ISO}) 6000 V_{RMS}
- Surge immunity (V_{IOSM}) 12.8 kV_{PK}
- Surge rating 8 kV
- Transient overvoltage (V_{IOTM}) 6000 V_{PK}
- Each part tested at 2387 V_{PK} for 1 second, 5 pC partial discharge limit
- Samples tested at 6000 V_{PK} for 60 sec.; then 2122 V_{PK} for 10 sec. with 5 pC partial discharge limit

Standard versions (Basic Isolation; VDE File Number 5016933-4880-0001)

- Working Voltage (V_{IORM}) 600 V_{RMS} (848 V_{PK}); basic insulation; pollution degree 2
- 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

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

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
-1	QSOP	150 V_{RMS}
-3	SOIC	150 V_{RMS}
None	True 8™ Wide-body SOIC	300 V_{RMS}

UL 1577 (Component Recognition Program File Number E207481)

V-Series isolation grade

6 kV rating; tested at 7.2 kV_{RMS} (10.2 kV_{PK}) for 1 second; each lot sample tested at 6 kV_{RMS} (8485 V_{PK}) for 1 minute

Standard isolation grade

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

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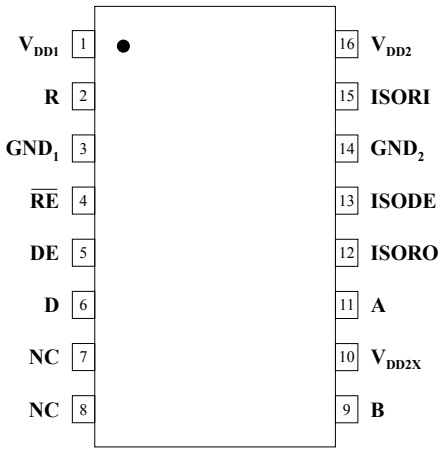
IL3685-1 (QSOP Package) Pin Connections

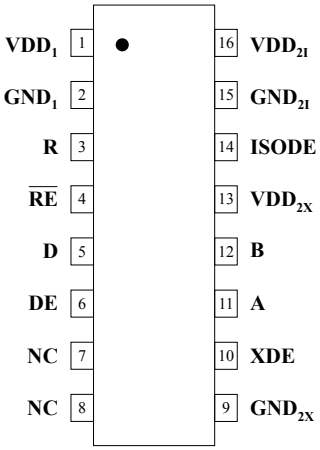
1	V_{DD1}	Input power supply.
2	R	Output data from bus.
3	GND_1	Input power supply ground return.
4	$\overline{RE}$	Read data enable (if $\overline{RE}$ is high, R= high impedance).
5	DE	Drive enable.
6	D	Data input to bus.
7, 8	NC	No internal connection.
9	B	Inverting bus line.
10	V_{DD2X}	Output transceiver power supply (normally connected to pin 16).
11	A	Non-inverting bus line.
12	ISORO	Isolated R output (should be externally connected to pin 15; no other connection should be made).
13	ISODE	Isolated DE output.
14	GND_2	Output power supply ground return.
15	ISORI	Isolated R input (should be connected to pin 12; no other connection should be made).
16	V_{DD2I}	Output isolation power supply (normally connected to pin 10).



IL3685-1

IL3685-3 (0.15" Narrow-Body SOIC) Pin Connections

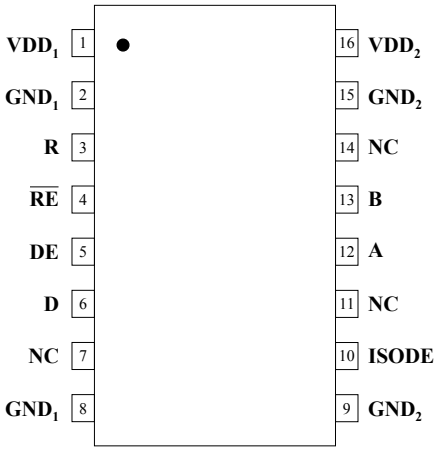
1	V_{DD1}	Input power supply.
2	GND_1	Input power supply ground return.
3	R	Output data from bus.
4	$\overline{RE}$	Read data enable (if $\overline{RE}$ is high, R= high impedance).
5	D	Data input to bus.
6	DE	Drive enable.
7, 8	NC	No internal connection.
9	GND_{2X}	Output transceiver ground return. (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 Wide-Body SOIC) 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

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]	$\|V_{OD1}\|$			V_{DD}	V	I_O = 0
Differential Output Voltage[2]	$\|V_{OD2}\|$	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]	$\Delta\|V_{OD}\|$			±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]	$\Delta\|V_{OC}\|$			±0.2	V	R_L = 54 Ω or 100 Ω
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. All typical values are at V_{DD1},V_{DD2} = 5 V or V_{DD1}= 3.3 V and T_A = 25°C.
5. −7 V < V_{CM} < 12 V; 4.5 V < V_{DD} < 5.5 V.
6. $\Delta|V_{OD}|$ 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.
7. 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.
8. Includes 10 ns read enable time. Maximum propagation delay is 25 ns after read assertion.
9. Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel.
10. Absolute Maximum specifications mean the device will not be damaged if operated under these conditions. It does not guarantee performance.
11. The relevant test and measurement methods are given in the Electromagnetic Compatibility section on p. 6.
12. 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
Differential Bus Input Capacitance	C_D		9	12	pF	
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			220	µA	V_I = 12 V
				−160	µA	V_I = −7 V
Input Resistance	R_I	54			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

Magnetic Field Immunity[12]

V_{DD1} = 5 V, V_{DD2} = 5 V						
Power Frequency Magnetic Immunity	H_{PF}		3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}		4500		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}		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}		1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}		2000		A/m	t_p = 8µs
Damped Oscillatory Magnetic Field	H_{OSC}		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.

Pinout Differences Between Packages

The QSOP (IL3685-1E) and narrow-body (IL3685-3E) versions are designed for minimum board area in densely-populated PCAs. Both have pin sets that should be connected externally for normal operation, but that can be used for testing, trouble-shooting, or special purposes. 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 QSOP and narrow-body versions also provide separate bus-side power supply pins—V_{DD2X} for the transceiver module and V_{DD2I} for the isolation module. These should be externally connected for normal operation, but can be used separately for testing or troubleshooting. The QSOP version also has an "ISORI" input that can be used to test the controller-side "R" from the bus side. ISORI should be connected externally to "ISORO" for normal operation. ISORI and ISORO can be used for testing.

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.

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.

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.

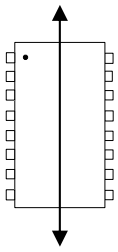
Maintaining Creepage

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.

Electromagnetic Compatibility

IL3685-Series Transceivers are 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, 1b, and 1c show typical connections to a bus and microcontroller for the three package versions, including external connections required for normal operation. Typical termination resistors, fail-safe resistors, and power supply decoupling capacitors are also included:

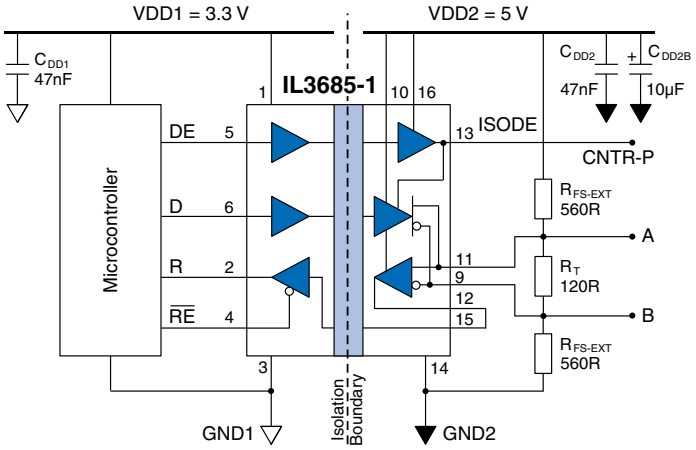


Figure 1a. Typical QSOP transceiver connections.

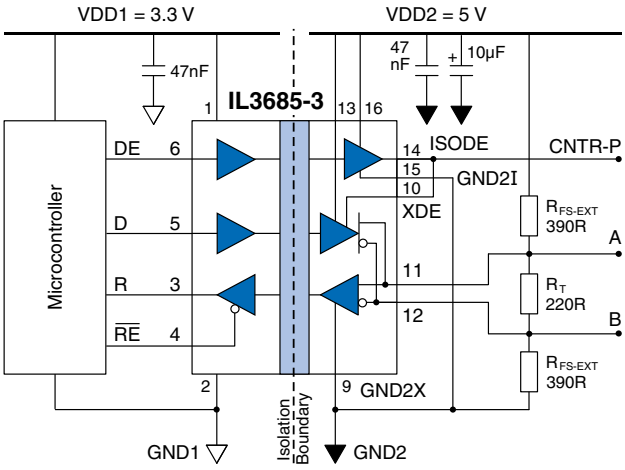


Figure 1b. Typical narrow-body transceiver connections.

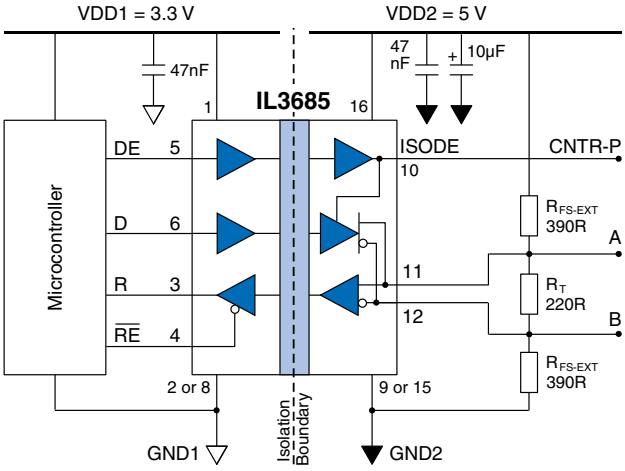


Figure 1c. Typical wide-body transceiver connections.

Receiver Features
The receiver output "R" has tri-state capability via the active low $\overline{RE}$ 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, IL3685-Series transceivers meet 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-Series 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.

The ISODE Output
The unique 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.

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):

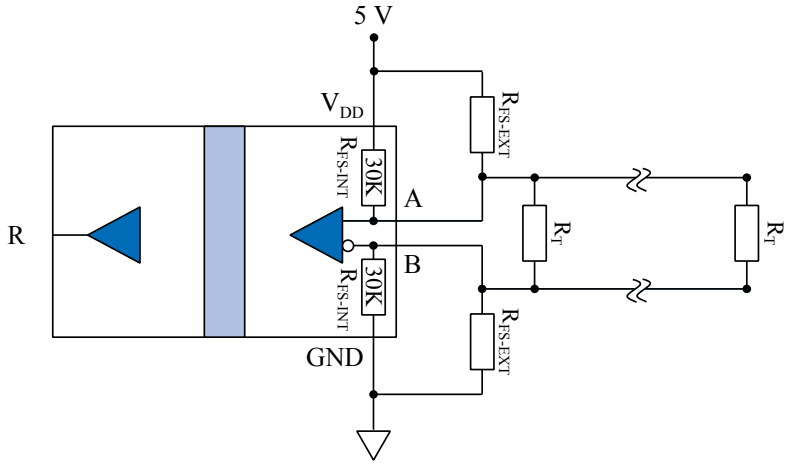


Figure 2. Termination and internal and external fail-safe biasing resistors.

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.

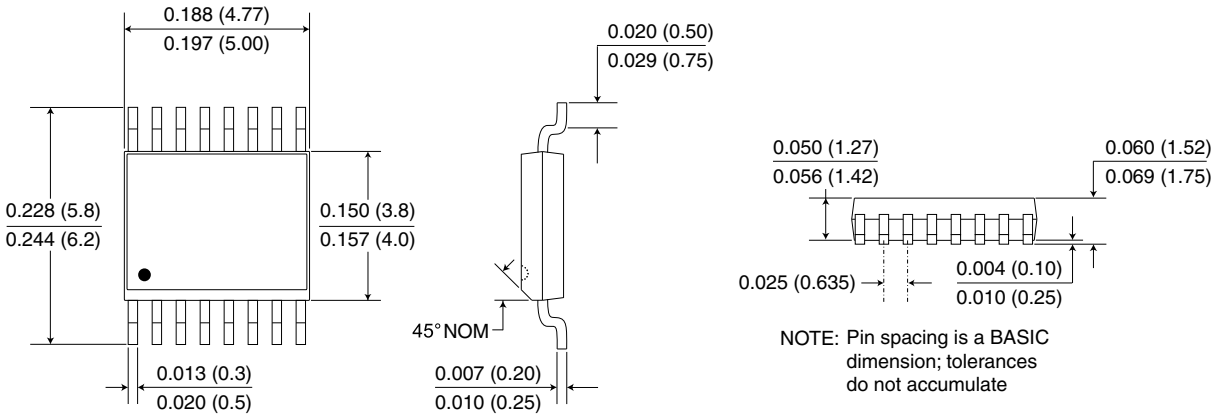
Termination Resistors
Termination resistors should be on both ends of the network to minimize reflections. Values should be selected to match cable impedance; 220 Ω resistors are typical for PROFIBUS.

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.

Package Drawings

Ultraminiature 16-pin QSOP Package (-1 suffix)

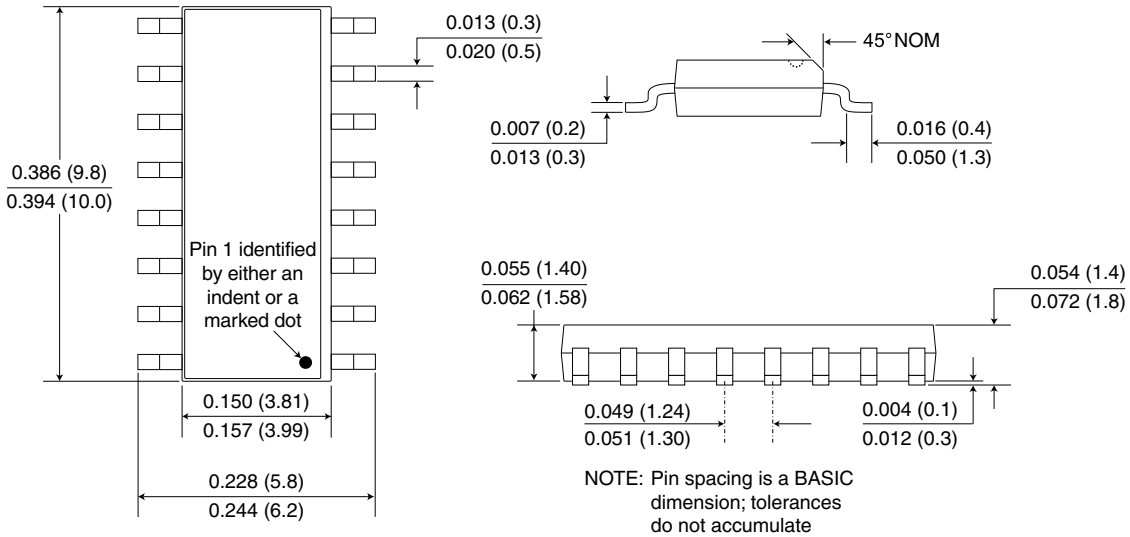
Dimensions in inches (mm); scale = approx. 5X



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

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

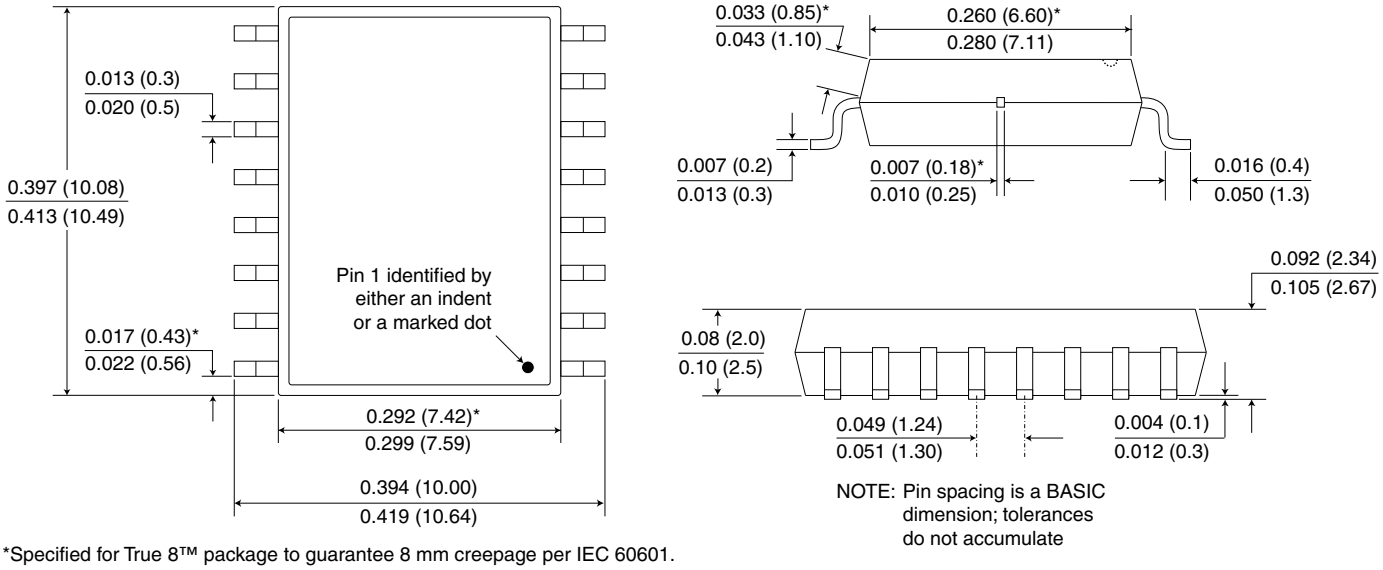
Dimensions in inches (mm); scale = approx. 5X



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

0.3" 16-pin Wide-Body SOIC Package (no suffix)

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



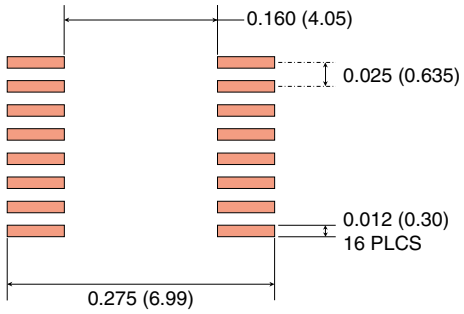
NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

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

Recommended Pad Layouts

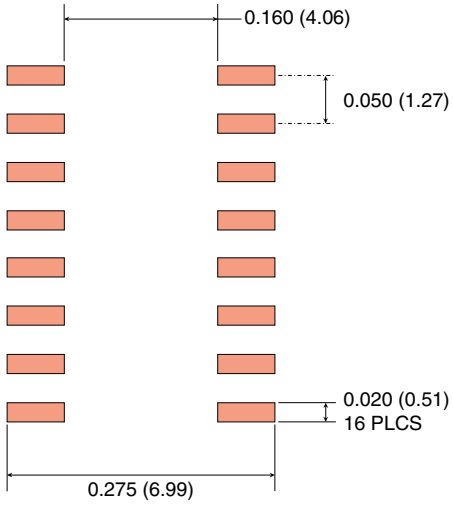
4 mm x 5 mm 16-pin QSOP Pad Layout

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



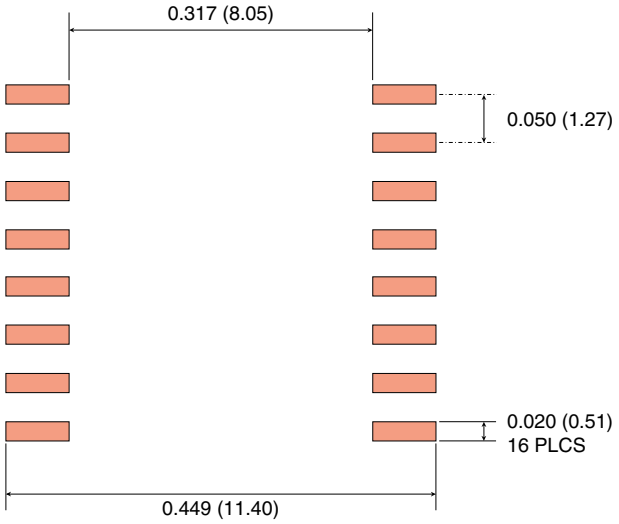
0.15" Narrow-Body 16-pin SOIC Pad Layout

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



0.3" 16-pin Wide-Body SOIC Pad Layout

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



Ordering Information and Valid Part Numbers

IL 36 85 -3 V E TR13

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

Package
E = RoHS Compliant

Isolation Grade
Blank = 2.5 kV Basic Isolation
V = 6 kV Reinforced Isolation

Package Type
Blank = 0.3" SOIC
-3 = 0.15" SOIC
-1 = 0.15" QSOP

Channel Configuration
85 = RS-485

Base Part Number
36 = 40 Mbps, PROFIBUS compliant

Product Family
IL = Isolators

Valid Part Numbers

IL3685E
IL3685E TR13
IL3685-3E
IL3685-3E TR13
IL3685-1E TR7
IL3685-1E TR13

IL3685VE
IL3685VE TR13

RoHS COMPLIANT

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 (952) 829-9217 www.nve.com YouTube.com/NveCorporation

Revision History

ISB-DS-001-IL3685-X
December 2017

Change

- Improved thermal specifications based on new test data (p. 2).

ISB-DS-001-IL3685-W

Change

- Dropped 10 µF tantalum decoupling capacitor recommendation (p. 8).

ISB-DS-001-IL3685-V

Change

- Added IL3685VE to the list of available parts (p. 16).

ISB-DS-001-IL3685-U

Change

- Refined thermal resistance specifications based on additional test data (p. 2).
- Added worst-case operating conditions to max. ambient operating temperature spec.
- Deleted minimum magnetic field immunity specifications (p. 8) since it is not 100% tested.

ISB-DS-001-IL3685-T

Change

- Added QSOP version (IL3685-1E).
- VDE certification and UL approval for V-Series version (6 kV reinforced isolation).

ISB-DS-001-IL3685-S

Change

- Eliminated inconsistent Driver Section output current specification.
- Improved Receiver Section Line Input Current and Input Resistance specifications.

ISB-DS-001-IL3685-R

Change

- Updated VDE certification standard to VDE V 0884-10.
- Upgraded “V” Version Surge Immunity specification to 12.8 kV.
- Upgraded “V” Version VDE 0884-10 rating to reinforced insulation.

ISB-DS-001-IL3685-Q

Change

- Increased V-Series isolation voltage to 6 kVrms.
- Increased typ. Total Barrier Thickness specification to 0.016 mm.
- Increased CTI min. specification to ≥600 V_{RMS}.

ISB-DS-001-IL3685-P

Change

- Increase V-Series surge voltage specification to 10 kV.
- Upgraded V-Series safety and approval from IEC 60747-5-5 (VDE 0884) to VDE 0884-10.

ISB-DS-001-IL3685-O

Change

- Added V-Series versions (5 kVrms isolation / 1000 Vrms working voltage)

ISB-DS-001-IL3685-N

Change

- Added Differential Bus Input Capacitance specification (p. 6).

ISB-DS-001-IL3685-M

Change

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

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ISB-DS-001-IL3685-X

December 2017

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