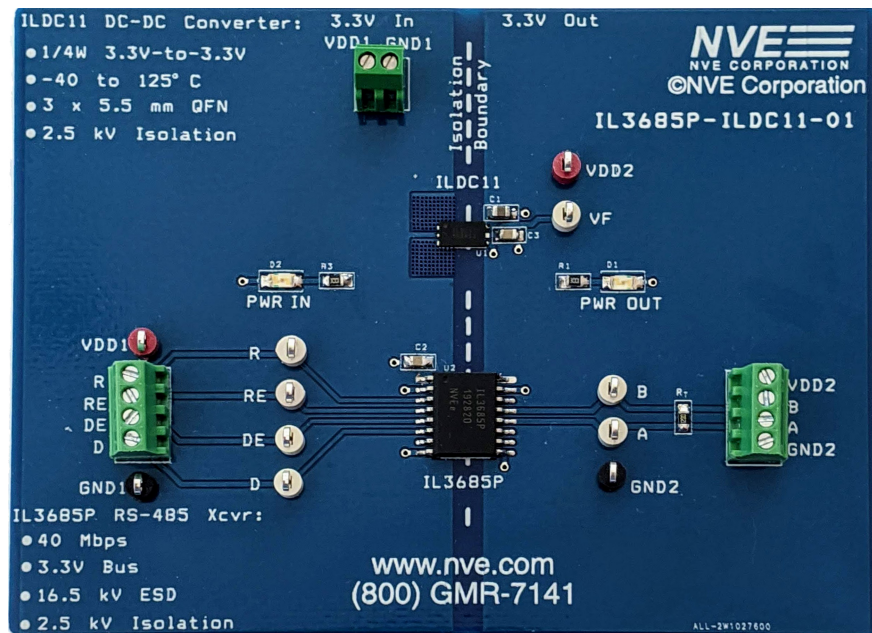


IL3685P-ILDC11-01 Isolated RS-485 Transceiver / DC-DC Converter Evaluation Board



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Board No.: IL3685P-ILDC11-01

About This Evaluation Board

This Evaluation Board provides a complete isolated 3.3-volt RS-485 node using an IL3685PE isolated transceiver and an ILDC11-15E ultraminiature isolated DC-DC convertor. The 4 by 3 inch (100 by 75 mm) board provides screw terminal and RJ45 connections. There are also test points for checking voltages and waveforms.

The IL3685PE is a high-speed, fully-isolated, differential 3.3-volt bus transceiver. The ILDC11-15E 3.3-to-3.3 volt DC-DC convertor provides a fully-isolated 3.3-volt bus supply using the controller supply.

The RS-485 transceiver has current limiting and thermal shutdown features protect against RS-485 short circuits and bus contention that may cause excessive power dissipation. RS-485 inputs feature a “fail-safe if open” design, ensuring a logic high R-output if A/B are floating. The DC-DC convertor has frequency hopping and shielding to minimize EMI.

Both devices use NVE’s unique ceramic/polymer composite barrier to provide full isolation and virtually unlimited barrier life.

IL3685PE Specification Highlights

- 3.3 V Bus
- 40 Mbps
- 1/5 Unit Load
- 2500 V_{RMS} isolation voltage
- 16.5 kV bus ESD protection
- Thermal shutdown protection
- ANSI RS-485, ISO 8482:1987(E), and PROFIBUS compliant
- -40 °C to +85 °C temperature range

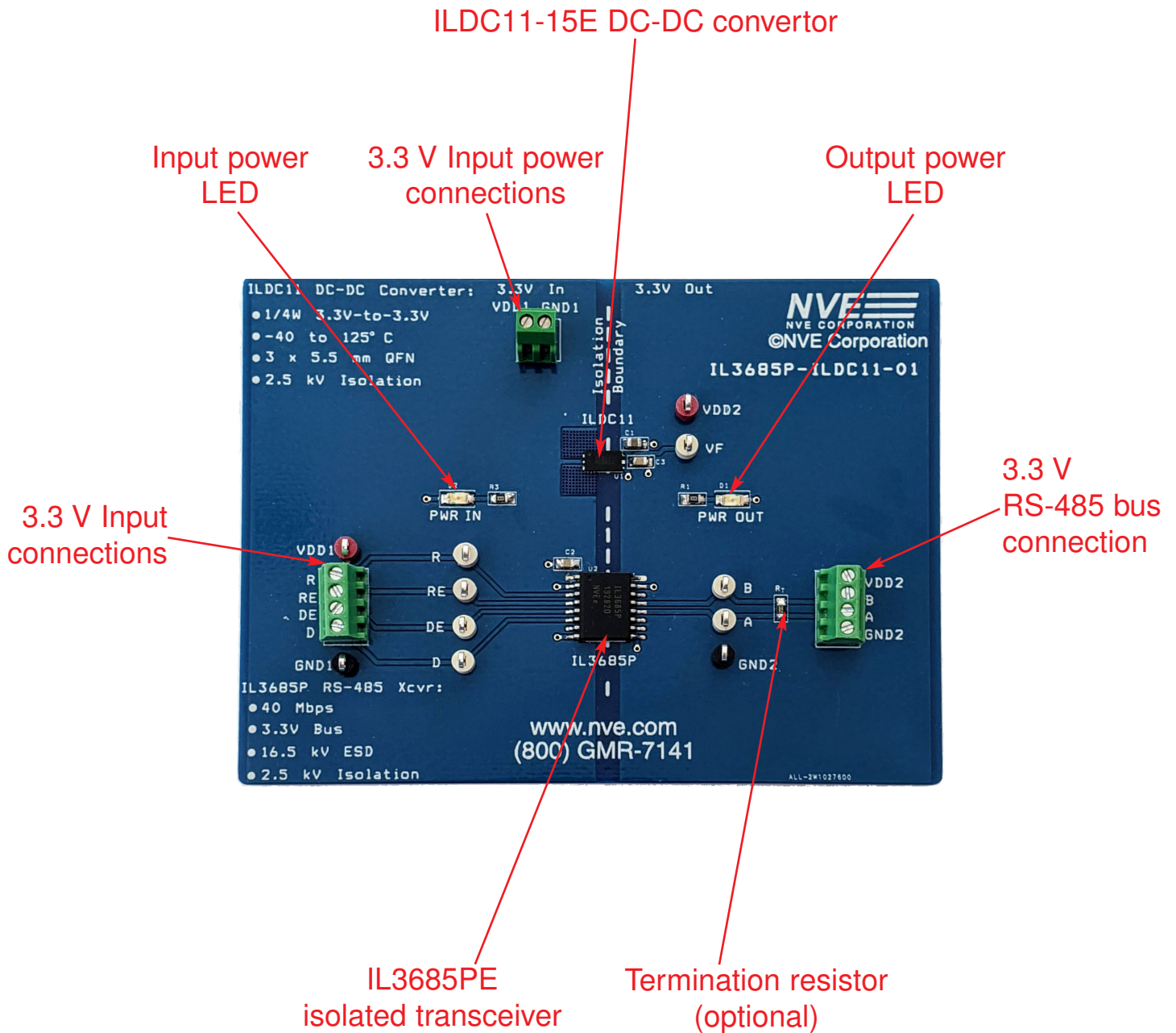
ILDC11-15E Specification Highlights

- Ultraminiature 3 mm x 5.5 mm DFN package
- 3.3 V input to 3.3 V output
- Quarter watt output power
- Fully-regulated output
- Short-circuit protection
- No minimum load
- 2500 V_{RMS} isolation voltage
- Low EMI without ferrite beads
- -40 °C to 125 °C temperature range

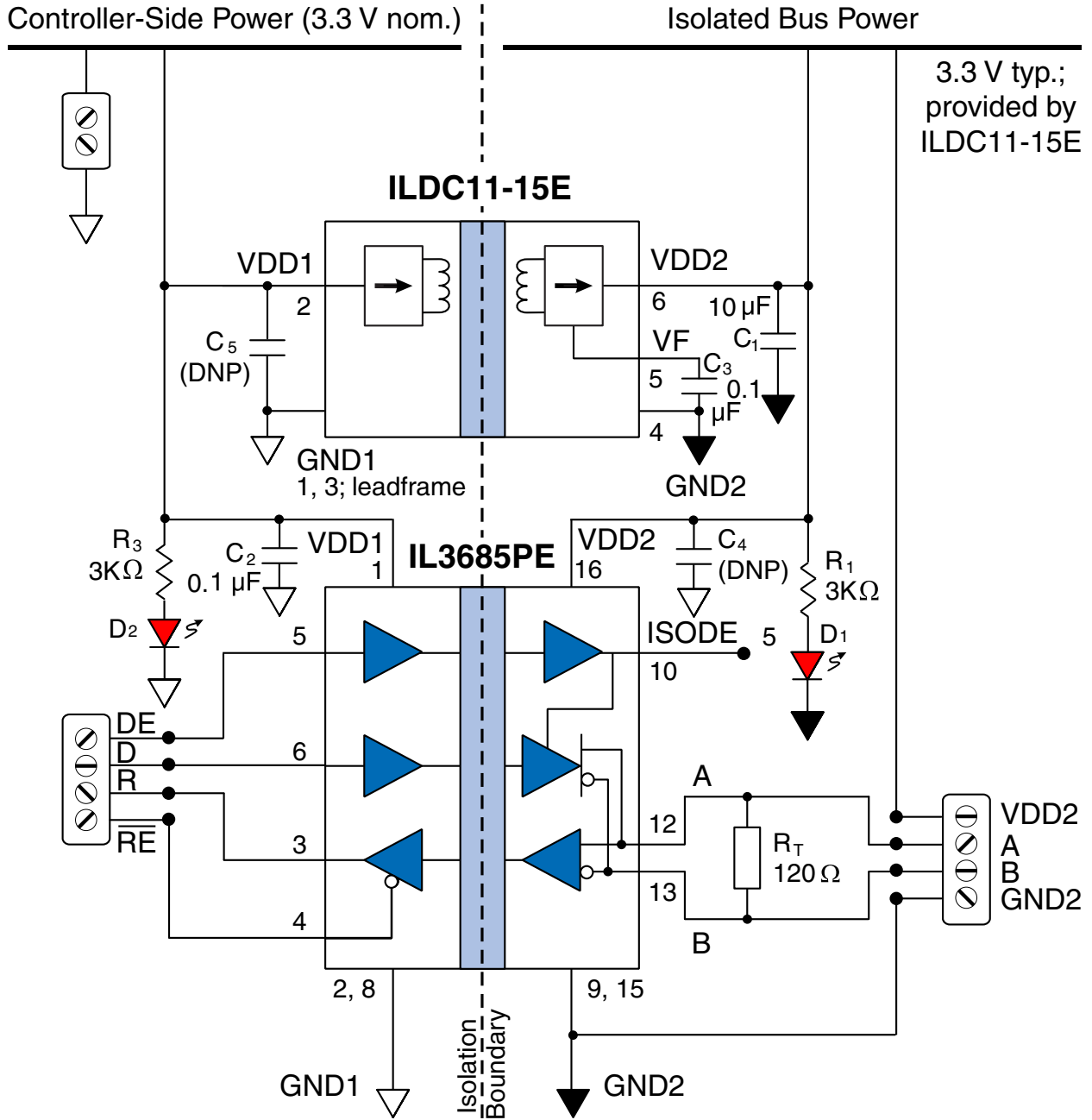
Quick Start

- Connect V_{DD1} to a 3.3 V power supply.
- The two LEDs should indicate input power and output power from the DC-DC convertor.
- Connect a square-wave signal to the “D” input with an amplitude of 2.4 to 3.3 V.
- Look for the complementary “A” and “B” outputs on an oscilloscope.

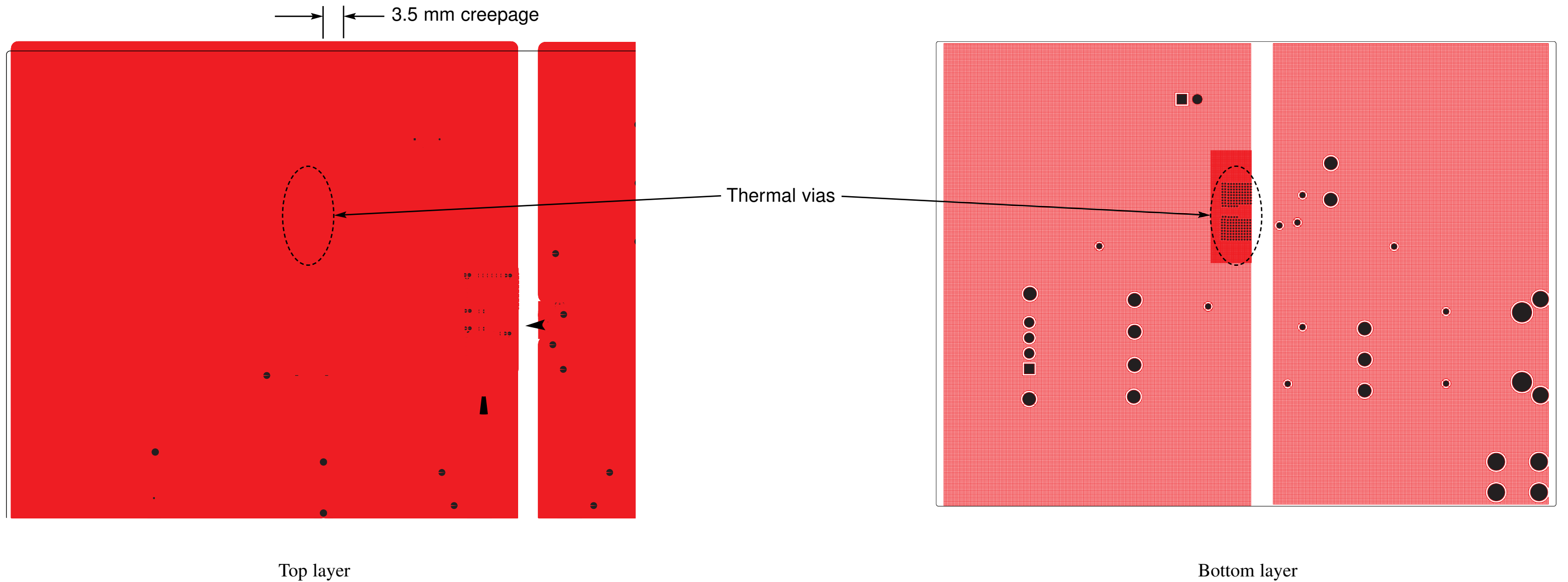
Evaluation Board Layout



Circuit Diagram



Evaluation Board Layers



Bill of Materials

Reference	Manufacturer	Part Number	Description
U1	NVE Corporation	ILDC11-15E	3.3V-to-3.3V Ultramini DC-DC Conv
U2	NVE Corporation	IL3685PE	3.3V RS-485 Isolated Transceiver
D1, D2	Kingbright	APT3216LSECK	LED CLR CHIP 2SMD
R1, R2	TE Connectivity Passive	CRG0805F3K0	RES SMD 3K OHM 1% 1/8W 0805
RT	TE Connectivity Passive	CRG0805F120R	RES SMD 120 OHM 1% 1/8W 0805
C1	Taiyo Yuden	LMK212AB7106MG-T	CAP CER 10UF 10V X7R 0805
C2, C3	Samsung Electro-Mech	CL21B104MBCNNNC	CAP CER 0.1UF 50V X7R 0805
C4, C5		DNP	Alternate capacitor locations
	Keystone Electronics	500x	PC TEST POINT COMPACT
2x	TE Connectivity	282834-4	TERM BLK 4P SIDE ENT 2.54MM P
	TE Connectivity	282834-2	TERM BLK 2P SIDE ENT 2.54MM P

Board Layout

Bypass Capacitors

The input power bypass capacitor should be placed as close as possible to the transceiver VDD1 supply pin, and the 10 μ F output-side bypass capacitor should be close to the DC-DC convertor VDD2 pin.

Maintaining Creepage

The ILDC11 has 3.5 mm clearance between isolated pads. Creepage distances are often critical in isolated circuits. Therefore power planes should be spaced to avoid compromising creepage, and board pads should not extend past the part pads to avoid compromising creepage.

Grounding, Cables, and Connectors

Twisted pair cable helps cancel common mode noise. In noisy environments, use Shielded Twisted Pair (STP) CAT5 or CAT6 cables and shielded connectors. With shielded cables, one of the connectors should be tied to earth ground (not digital ground). For demanding applications, the other connector shield should be connected via an R-C network (typically 47 nF in parallel with 150 k Ω as in this board) to earth ground to damp AC noise induced in the shield.

Design for Speed

The IL3685P operates at up to 40 Mbps. The following best practices can be used to allow fast data transfer:

- Provide ground planes for both power supplies.
- The connector, termination resistor, and transceiver should be as close together as possible.
- Two wires from the same differential pair should be adjacent on the connector.
- A differential microstrip on the board reduces reflections if long traces are necessary.

Thermal Management

The ILDC11 is rated to 125 °C operating temperature with a 175 °C maximum junction temperature. Since this evaluation board is limited to the IL3685P's 85 °C maximum operating temperature, a simple, double sided PCB can be used. Thermal vias were added to improve thermal performance as shown on the "Evaluation Board Layers" page.

For high-temperature applications a double-sided, double buried power plane ("2s2p") board with thermal vias maximizes thermal performance. Even if not necessary to avoid the maximum junction temperature, a 2s2p board will reduce temperature rise and therefore improve thermal stability of the DC-DC convertor output voltage in critical applications.

Application Information

Simple Capacitive Decoupling

The only external parts required are a 0.1 μF ceramic capacitor placed as close as possible to the transceiver VDD1 supply pin, a 10 μF ceramic capacitor for the DC-DC convertor VDD2 pin, and a 0.1 μF filter capacitor for the DC-DC convertor.

Inherently Low EMI

The ILDC11 DC-DC convertor oscillator operates above 88 MHz, where emission limits are higher since there is less risk of interference with common commercial radio and television broadcasting. Frequency-hopping technology dramatically reduces peak EMI, and synchronous rectification and PWM control are avoided, resulting in inherently low EMI. Ferrite beads are generally not required for EMI mitigation.

High Magnetic Immunity

The IL3685PE's Wheatstone bridge configuration and differential magnetic field signaling ensure excellent EMC performance against all relevant standards.

Power Management

Here are some tips to avoid overtaxing the DC-DC convertor:

Consider eliminating termination resistors

Termination resistors minimize reflections, which can be important for long cable lengths. However, these resistors increase output drive current and may be unnecessary for short cables and low speeds. If termination resistors are used, power can be reduced by using 150-ohm termination resistors rather than 120-ohm with 150-ohm impedance cable (Molex 1554111004, Belden 3079A, Siemens 6XV1830-0EH10, or similar).

Avoid "fail-safe" resistors

Because the IL3685P has internal "fail-safe" resistors, external "fail-safe" pull-up and pull-down bias resistors may be unnecessary, especially if there are no termination resistors, and they use power.

Minimize data rate

The IL3685P and most nodes draw more power at higher frequency, so the data rate should not be higher than necessary to minimize power requirements.

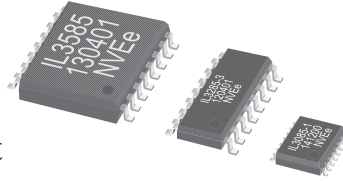
Use low-power, fractional-load transceivers

Transceivers such as the NVE IL3685P use less bus power than other transceivers and are fractional load to minimize the drive current required by transmitting nodes.

Isolated RS485 / RS422 Transceivers

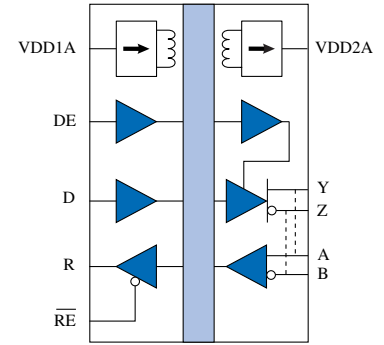
NVE offers a wide choice of isolated RS-485 and RS-422 network transceivers.

Versions are available in 0.15-inch and 0.3-inch SOIC packages, as well as ultraminiature QSOP packages. QSOP and 0.15-inch SOIC package are the most compact solutions in the world.

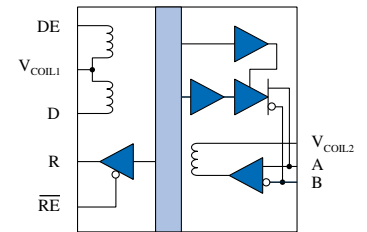


Standard isolation voltage is 2.5 kV_{RMS}, and ultrahigh-voltage V-Series versions have 6 kV_{RMS} isolation voltage.

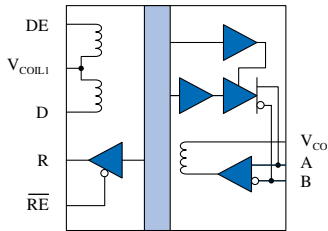
The IL4685 and IL4622 combine isolated transceivers with integrated DC-DC convertors.



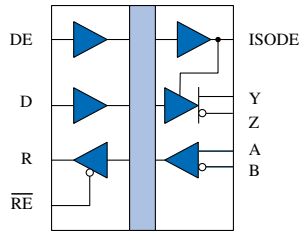
IL4685 / IL4622



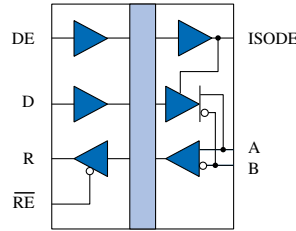
IL3185 / IL3285 / IL3485



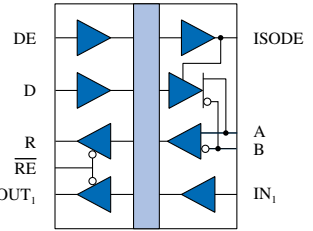
IL3122 / IL3222 / IL3422



IL422 / IL3022 / IL3522



IL485 / IL3085 /
IL3585 / IL3685 / IL3685P



IL485W

Model	Bus	Inputs	Mbps	Nodes	Bus ESD	Key Features	Available Packages
IL3122	RS-422	Passive	5	32	15 kV	Low Cost	0.15" SOIC16; 0.3" SOIC16
IL3185	RS-485	Passive	5	32	15 kV	Low Cost	0.15" SOIC16; 0.3" SOIC16
IL3222	RS-422	Passive	5	256	15 kV	1/8 Unit Load	0.15" SOIC16; 0.3" SOIC16
IL3285	RS-485	Passive	5	256	15 kV	1/8 Unit Load	0.15" SOIC16; 0.3" SOIC16
IL3422	RS-422	Passive	20	32	15 kV	High Speed	0.15" SOIC16; 0.3" SOIC16
IL3485	RS-485	Passive	20	32	15 kV	High Speed	0.15" SOIC16; 0.3" SOIC16
IL422	RS-422	Digital	25	32	15 kV	Legacy Standard	0.3" SOIC16
IL485	RS-485	Digital	35	32	2 kV	Legacy Standard	0.3" SOIC16
IL485W	RS-485	Digital	35	32	2 kV	Handshake Line	0.3" SOIC16
IL3022	RS-422	Digital	4	32	7.5 kV	Low Cost	0.3" SOIC16
IL2985	RS-485	Digital	4	32	15 kV	Low Power	0.3" SOIC16
IL3085	RS-485	Digital	4	32	15 kV	Low Cost	QSOP16; 0.15" SOIC16; 0.3" SOIC16
IL3522	RS-422	Digital	40	50	15 kV	Very High Speed	0.3" SOIC16
IL3585	RS-485	Digital	40	50	15 kV	Very High Speed	0.15" SOIC16; 0.3" SOIC16
IL3685	RS-485	Digital	40	50	15 kV	PROFIBUS	QSOP16; 0.15" SOIC16; 0.3" SOIC16
IL3685P	RS-485	Digital	40	160	16.5 kV	3.3 V bus; 1/5 U.L.	QSOP16; 0.3" SOIC16
IL4622	RS-422	Digital	40	160	12 kV	DC-DC Convertor	0.3" SOIC16
IL4685	RS-485	Digital	40	160	16.5 kV	DC-DC Convertor	0.3" SOIC16

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