

Application Bulletin AB-20

NVE's IL600 Series: The True Optocoupler Alternative

The optocoupler has been around for decades and is still a common choice in signal isolation circuits because of its versatility and low cost. While there are alternative isolation schemes with better performance than optos, none have been able to match the opto's versatility, until the introduction of NVE's IL600-Series Isolators.

Smaller and More Reliable

NVE's IL600-Series Isolators combine a hardware-programmable input with a linear GMR sensor and a digital comparator. The input is a coil that can be interfaced to any voltage source with enough power to supply the 5 mA required to drive the logic low state across the isolation barrier. Because they use a true monolithic technology, IL600-Series Isolators are smaller than optocouplers, with up to two channels in an 8-pin MSOP or three channels in a narrow-body 16-pin SOIC. There are even die available for chip-on-board assembly.

Unlike Optos, there is no wearout mechanism in a GMR isolator. Based on life tests, IL600-Series Isolators have FITs of 0.2, which is 100 times more reliable than the best optocouplers.

Wide Input Voltage Range

The design of the IL600-Series means normal logic signals as well as those from 24 V, 48 V or 110 V systems can be monitored or shifted down to the normal 5 V and 3 V logic levels for the next stage of processing. It also means logic signals from 1.6 V, or 200 mV differential lines can be shifted up using the same devices. The IL600 series is the only alternative to optocouplers that allows coupling to voltages higher than 5 V or direct coupling with differential voltages. Figure 1 shows the strikingly similar structures of the IL610A with open drain outputs and a typical open-collector optocoupler:

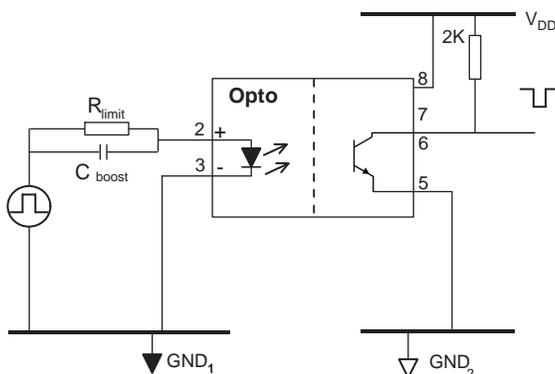


Fig. 1a. Typical Optocoupler

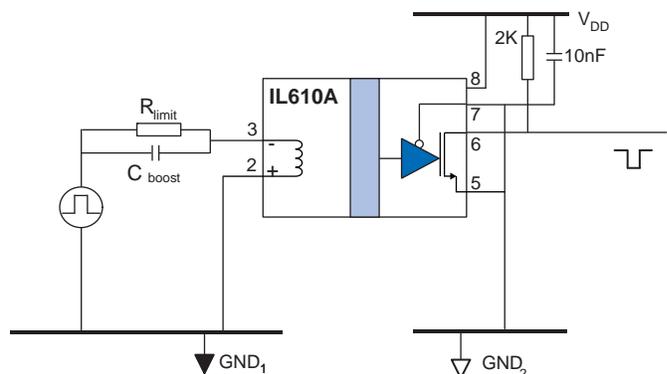


Fig. 1b. IL610 Isolator

No Input-Side Power Supply

The similarities to the opto are obvious and this structure provides many unique advantages when compared to other optocoupler replacements. First and foremost, the input signal provides all of the power required to drive the node. No power supply is required on the input side of the IL610. That's a huge advantage in any application that carries signals from one circuit board to another. The passive input structure does not need a dc/dc converter to power the isolating electronics. Figure 2 shows a typical example of a "heart beat" sync line connected to every board in a system, but galvanically isolated from the source:

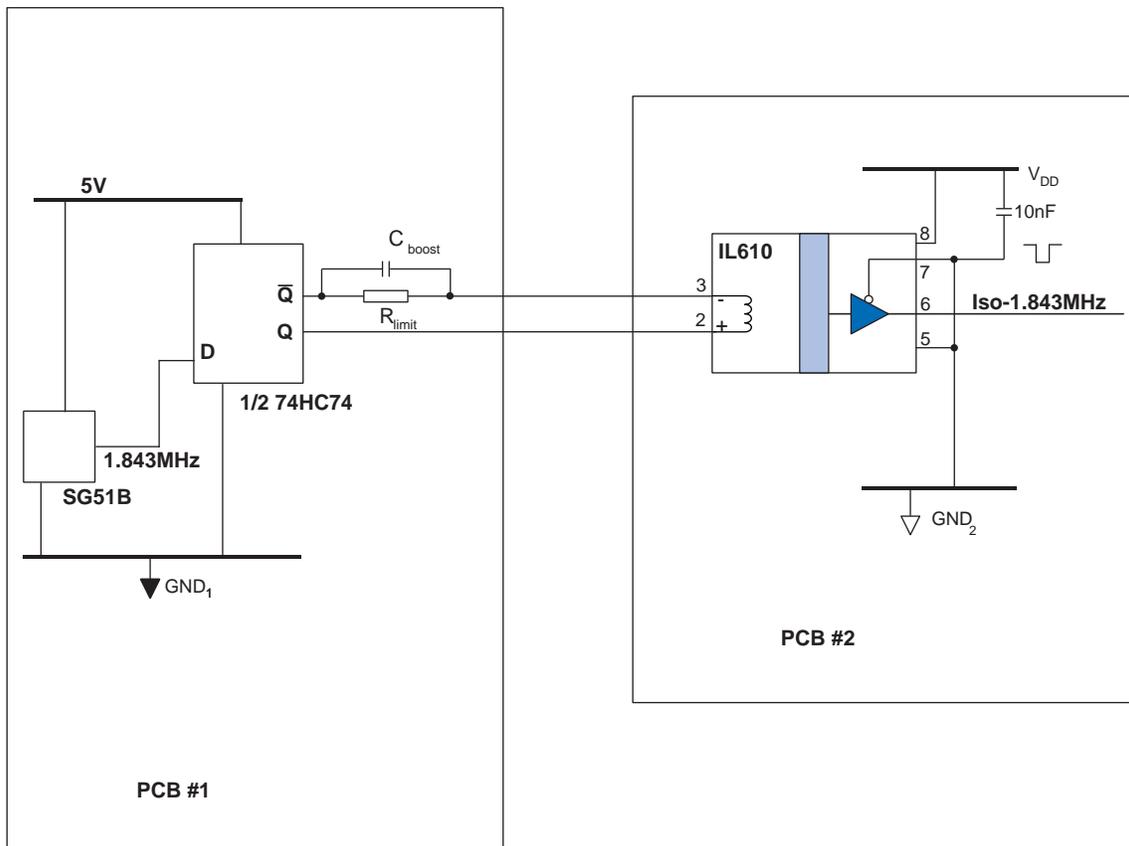


Fig. 2. Board-to-Board Isolation With No Input Power Supply

Differential Inputs

Another unique feature of the IL600 Series is the differential nature of the input. A very simple, low cost, isolated RS-422 or RS-485 receiver node can be created with a single IL610 connected to the bus driver. Once again, no input power is required for this interface, so the receiving board does not need

isolated dc/dc power. Optocouplers can't be used in this "line receiver" mode without reverse polarity protection for the input photodiode. The passive input of the IL610 eliminates that problem and provides up to 50 MHz of bandwidth to boot, allowing the IL610 to be interfaced to almost any form of industrial differential signal. Figure 3 shows a typical isolated receiver node using an RS-485 transceiver.

The same concept can be used to translate differential logic signals to single ended signals at 3.3 V or 5 V. These applications may or may not require isolation, but even in non-isolated cases, the tiny form factor of the IL610 and its competitive cost make it a good choice for simple logic level scaling.

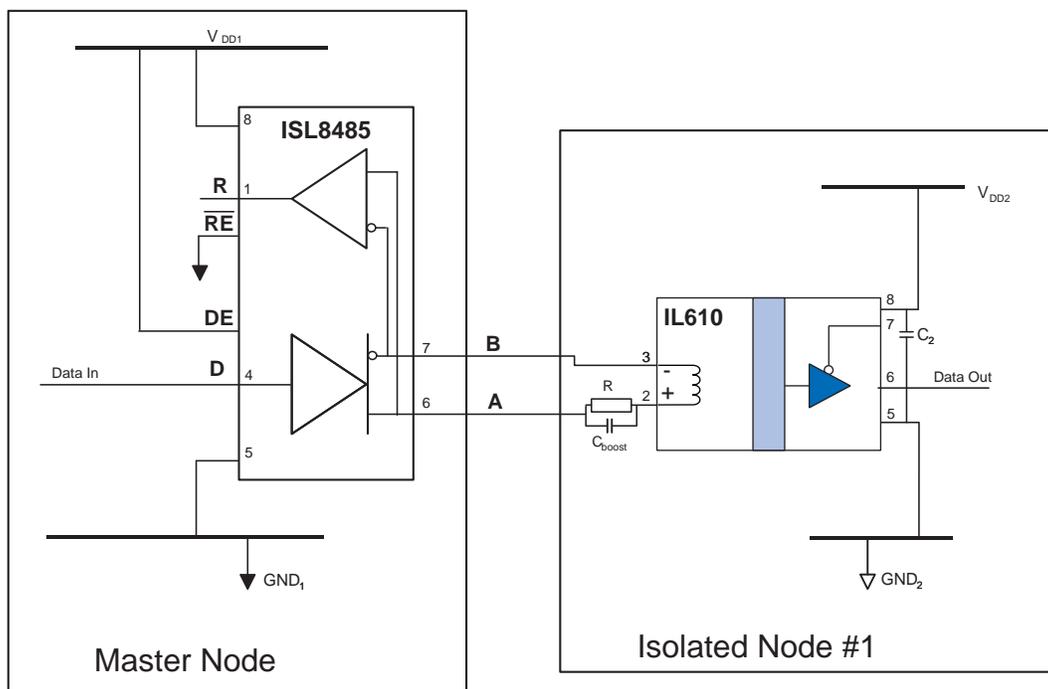


Fig. 3. Isolated RS485 Receiver Node

Channel-to-Channel Isolation

Multi-channel devices such as the two-channel IL611 and three-channel IL613 have all the advantages of the single-channel IL610, plus the input channels are isolated from each other by as much as 800 Vrms. It is often very important in industrial process control applications to have multiple inputs to a processor such as a PLC isolated from each other. The aim is to allow signals on different ground lines to be interfaced directly to a single controller without the need for complex signal-to-signal isolation.

The IL611 and IL613 provide 800 V of isolation between channels in addition to the 2500 V across the isolation barrier. The input coil structure allows optocouplers to be replaced in many process control applications, including PLC inputs and provides all of the advantages of GMR couplers over optocouplers in what has traditionally been an opto world. No other optocoupler replacement family can duplicate the opto function in this application.

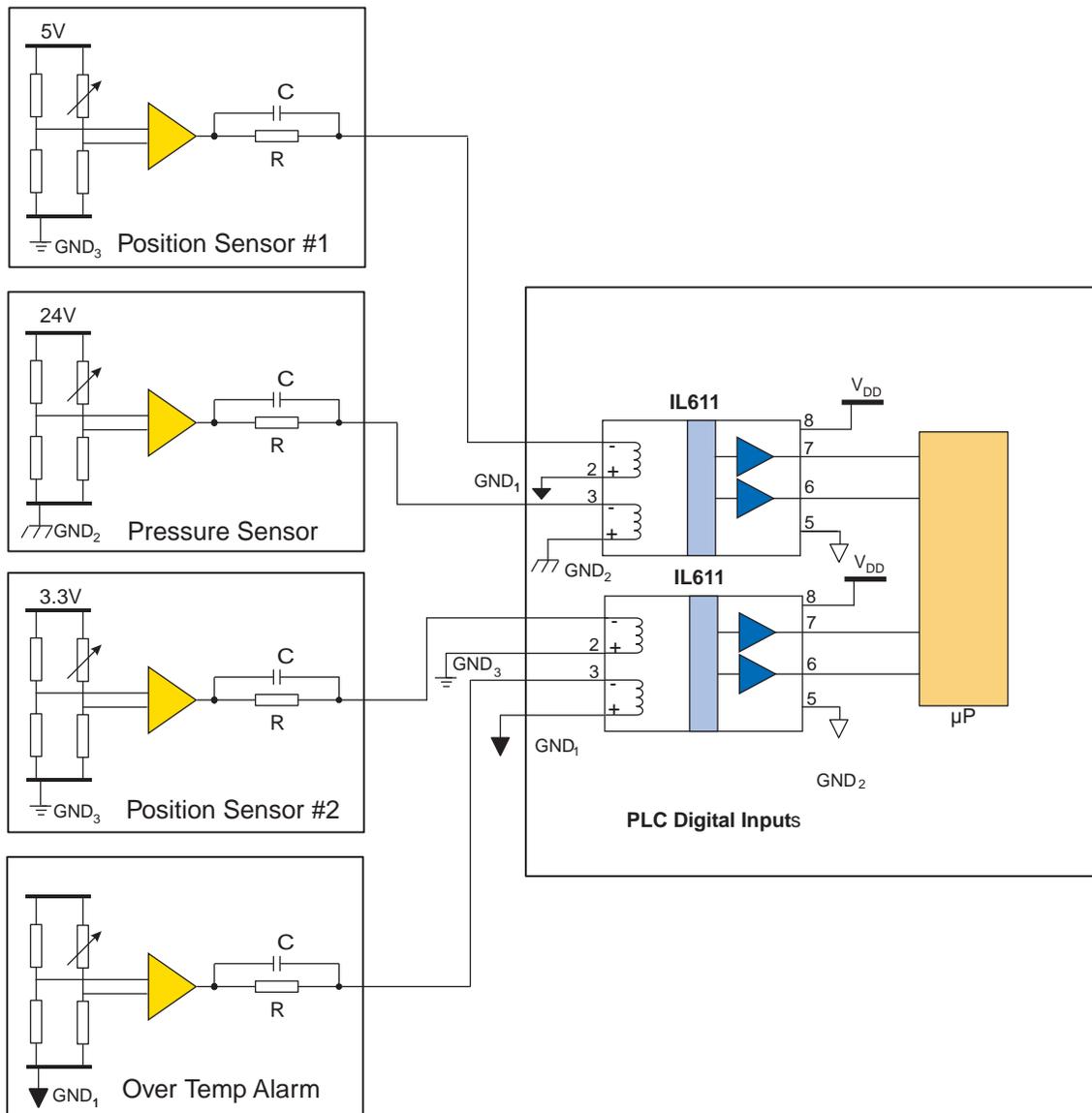


Fig. 4. Isolated PLC Input Channels Using the IL611

CMOS or Open-Drain Outputs

Error or fault detection circuits can easily be handled by the IL610A and IL611A. These devices have open drain outputs, allowing multiple channels to be wire ORed to a single alarm circuit. This is one of the many benefits of channel-to-channel isolation and an input that does not require power, since channels from different earth mats can be connected at the inputs without complicated power supply separation or 3-Port signal isolation.

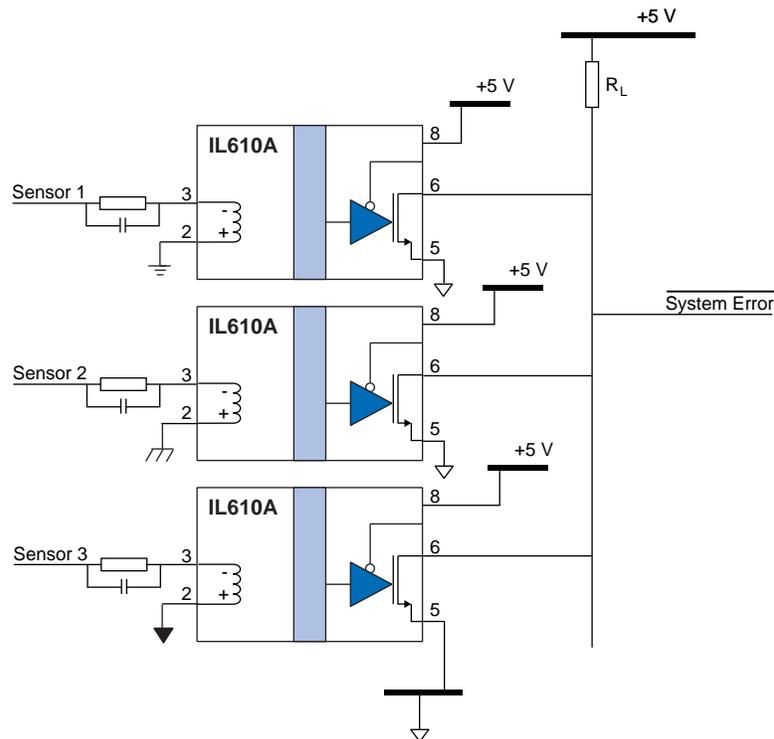


Fig. 5. Isolated Multi-Channel Alarm Using The IL610A

Exceptional Signal Fidelity

The IL600 Series is good for more than “grunt work” like you’d expect from lower-grade optos. These devices also have stellar dynamic response. That’s because the integrated GMR sensor has a bandwidth of close to 2 GHz, and the capacitor used across the input protection resistor allows ultra fast current spikes to be transmitted to the field coil. As a result, jitter is reduced to less than 100 ps, making the IL600-Series perfect for precision audio applications. Figure 6 shows a typical isolated CD transport that provides noticeable sonic improvement without costing the earth. The aim of an isolation component in audio circuits is to eliminate hum and other interference caused by unintended static and

dynamic current routing. If the isolator employed doesn't have enough stability or bandwidth, it will simply add jitter to the I²S data, resulting in degradation to the intended sound from the PCM DAC. Most audiophiles will tell you they can tolerate hum but not jitter in their audio systems, so play to the market and isolate audio signals using the high fidelity IL600 Series.

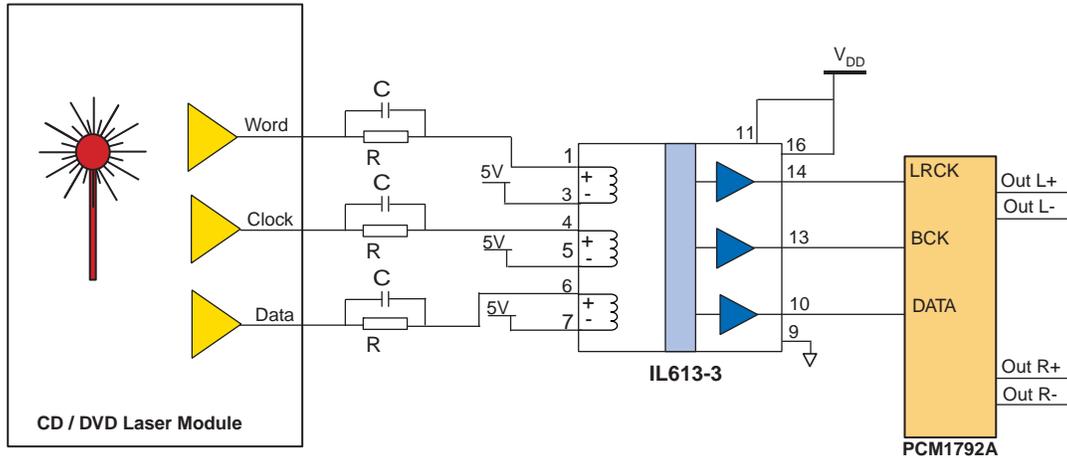


Fig. 6. CD Transport Isolation Using IL610

Isolated Serial Interfaces

If you're looking for the most competitively priced, smallest footprint isolated SPI or RS-485 interface, look no further than the three-channel IL614. This device combines small scale SOIC packaging with functional design for these two common isolation tasks. In the case of isolated RS-485 (or RS-422), optocouplers can be replaced with the usual space savings while keeping the existing bus transceiver. A fully integrated transceiver approach means changing the transceiver protocol. Using the IL614 reduces the qualification pain of changing a major component.

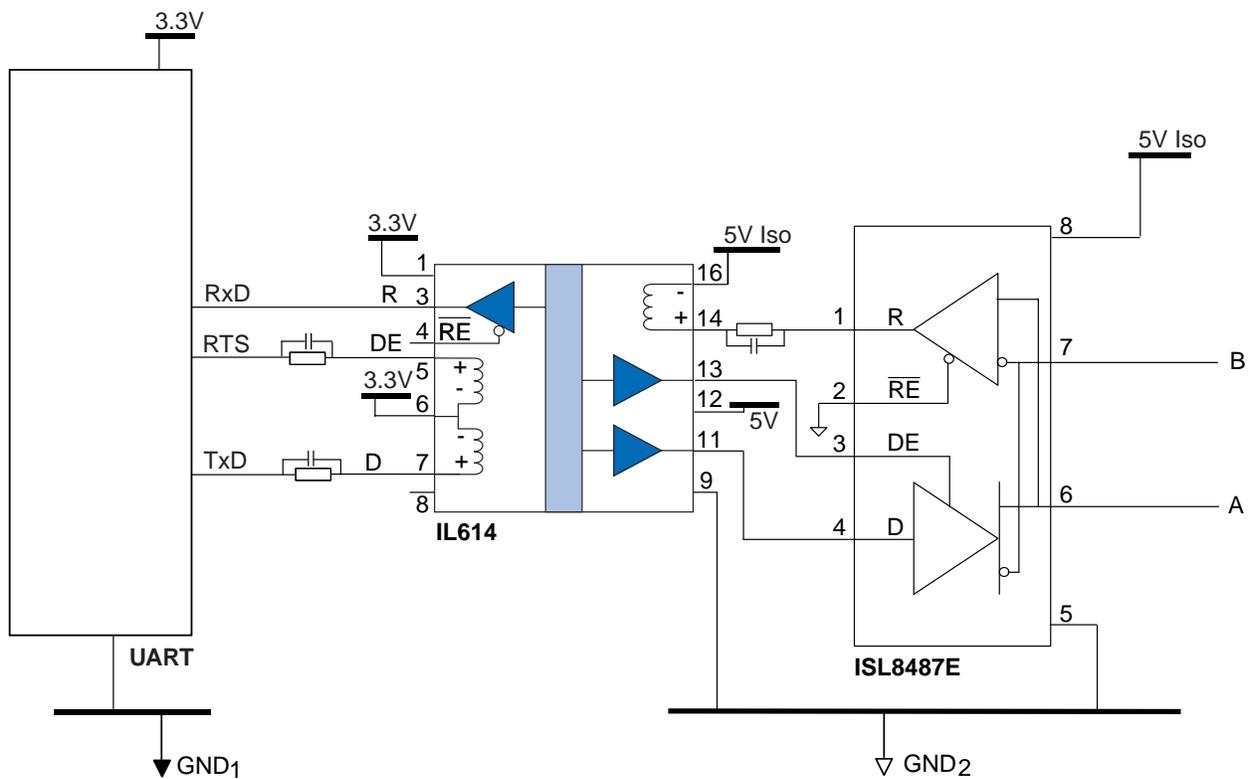


Fig. 6. Isolated RS-485 Using IL614

Conclusion—The True Optocoupler Alternative

NVE's IL600-Series is the only optocoupler replacement family that can be driven in current mode or voltage mode, single ended or differential, with almost any voltage. Outputs are either CMOS or open drain and can be configured as true data or inverse data by connecting coil inputs accordingly.

The IL600 series does everything an opto can but with reliability, signal fidelity, and channel density, making the IL600 an ideal choice for both basic and complex isolation solutions.

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