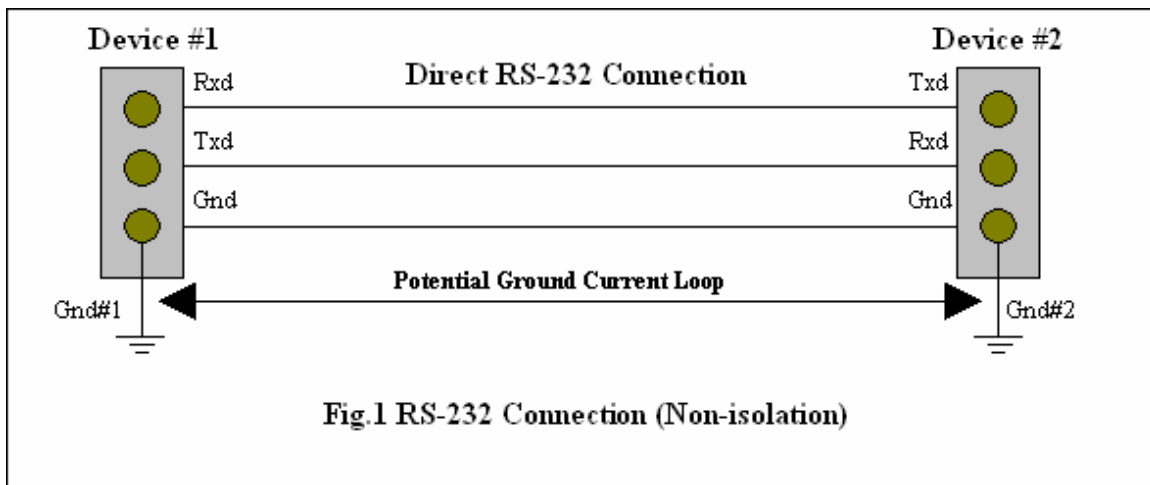




Why Optically Isolate Your Data Communication Lines?

• A RS-232 Connection

Look at the direct RS-232 connection at the figure.1. Do notice the direct ground connection through the RS-232? Being trained to avoid multiple ground paths, many engineers will be shocked by the drawing. If you doubt it is true, take your multi-meter and measure your own computer. For example, there are three computers in this office, the highest resistance to be found between the RS-232 signal ground and chassis ground is only 0.9 ohms (signal ground is pin 7 for a 25-pin and pin 5 for a 9-pin RS-232 DB connector). And don't expect "Industrial PCs" to be any different. Suppose due to a system fault one chassis ground momentarily jumps to 230v until the fuse or circuit breaker opens. Where the current flow? What will be destroyed? What will survive? Many people say, "Oh, no problem ... the RS-232 port will be damaged." But experience proves otherwise -- hard disks and main CPU boards of-ten prove more sensitive and die sooner. Yes, this is an extreme example, but it is not unusual in industrial systems to have minor ground potential differences at various locations within the system. With large UPS and large machinery, different potentials can exist less than a meter apart. Even if not always damaging, different ground potentials make communications unreliable. It may work today and not tomorrow - a real maintenance nightmare.



• Isolate?

Long time ago, industrial data communications was used only in "closed system" - meaning you installed all the equipment and you made it talk together. You controlled the whole design, including the quality and nature of the grounding. But increasingly, you are installing only part of an "open system". You may be installing only the pumping management system, or the fire & gas detection system. You install your own equipment, and then are expected to use common data communications like RS-232, RS-422, or RS-485 to talk to another part of the system; a system supplied by a different vendor with a different understanding of ground. Your data communications line will likely create a



ground loop - a situation shown quite clearly as fig.1. You are exposing your equipment to many variables.

Another way to view the problem is shown at fig.2. With 2 panels (whether 1 or 2 vendors) you have subtly different electrical characteristics on the ground/earth wire. Here we have inductance (L1), resistance (R1), and capacitance (C1) from panel #1 to site ground. We also have L2/R2/C2 for panel #2 and L3/R3/C3 on the data communication line between the 2 panels. So the question is: “during a surge or ground fault condition, will the combination of L3 and L1 be less than L2? Will the combination of R3 and R1 be less than R2?” If either condition is true, then panel #1 will suffer damage as surge energy moves from panel #2 to site ground the *wrong way through Panel #1!*

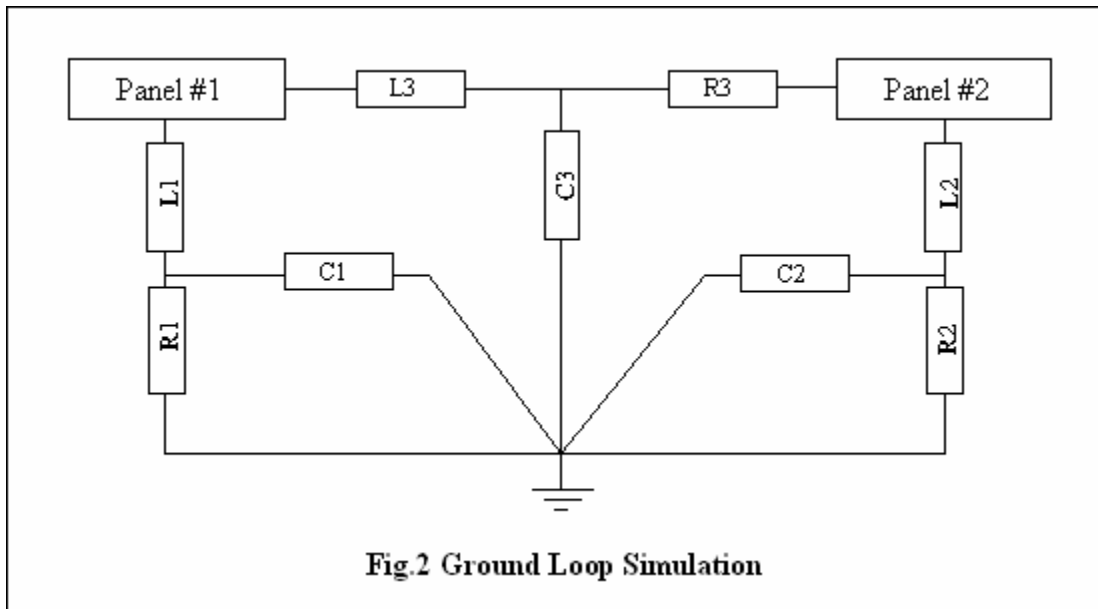


Fig.2 Ground Loop Simulation

You carefully design and install a grounding system with maybe less than 1 ohm of resistance to earth - possibly this measurement was even part of your site-acceptance test. Now you run an RS-232 cable to another company’s computer or DCS gateway. ***What is the quality of their ground?*** Is it 1 ohm? Is it 3 ohm? If it is 1 ohm today, will it still 1 ohm tomorrow? If you cannot even be sure of the quality of that ground today, how can you be sure of it’s quality tomorrow or next month or next year? This ground is out of your scope of design, supply, and maintenance. But you can be sure of one thing - if “their” device is a normal computer, then it has less than 1 ohm of resistance between ***your*** RS-232 signal ground and ***their*** ground system. So that presents a question - who is supplying the better ground path? What may happen if your panel has the better ground path? Will fault or surge energy use the RS-232 data communication cable to enter your panel and dissipate through your ground? Without full galvanic isolation of your data communications line, you can never be sure. So to answer the question of “Why Isolate?” you isolate to be assured that your ground is a closed system. You isolate so that all of the equipment using your ground is within your scope of supply and maintenance. You



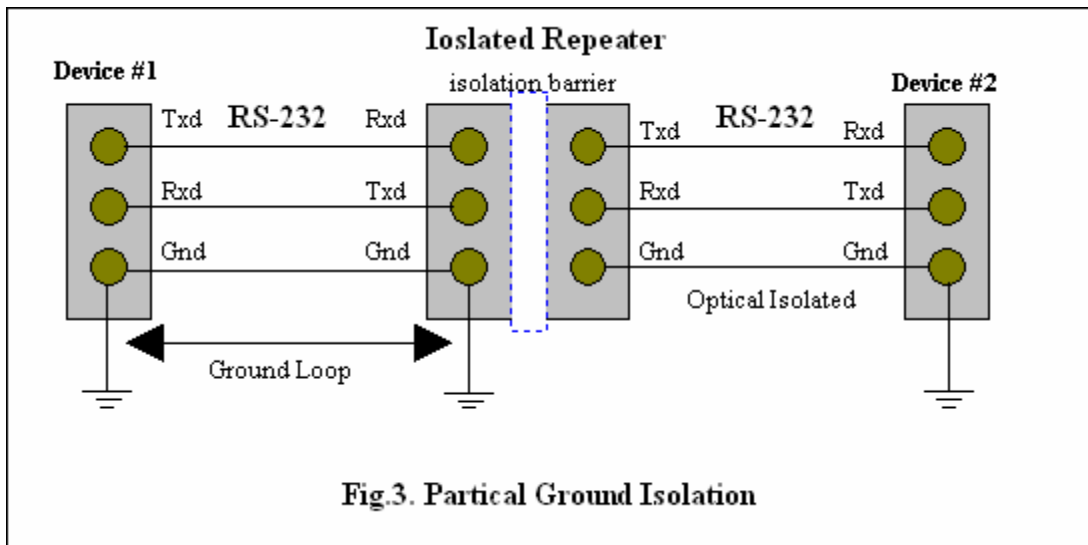
isolate to make sure your equipment doesn't suffer because of their problems. You isolate to keep *their* wiring, power, surge, and/or grounding problems out of *your* system.

• **Adding Optical Isolation**

Adding full optical isolation between the two systems eliminates all grounding plus most surge problems. Before we had two systems *sharing* two grounds with the risk of current flow between them. Now we have two fully closed ground systems without current flow between them. Now the quality of their ground is their problem - just as the quality of your own ground is your own problem. Galvanic isolation breaks the ground path by using air-gaps, transformers, and/or optical devices. Galvanic isolation allows data to flow between systems, but not electrical current. This protects your equipment, your warranty repair budget, and your reputation.

• **Partial Galvanic Isolation**

2-of-3 ground (also called “2-port”) isolation is the most common. The RS-232 data path is completely isolated and one RS-232 circuit has a floating power supply. Although the power supply and circuit to device #1 are not isolated, grounding problems are easily solved by locating both in the same area and insuring both share a common ground path. 2-port isolation does present another problem; if the isolated repeater shares a DC power supply with other devices, then faults creating surges in the common power supply could effects device #1 through the isolated repeater.

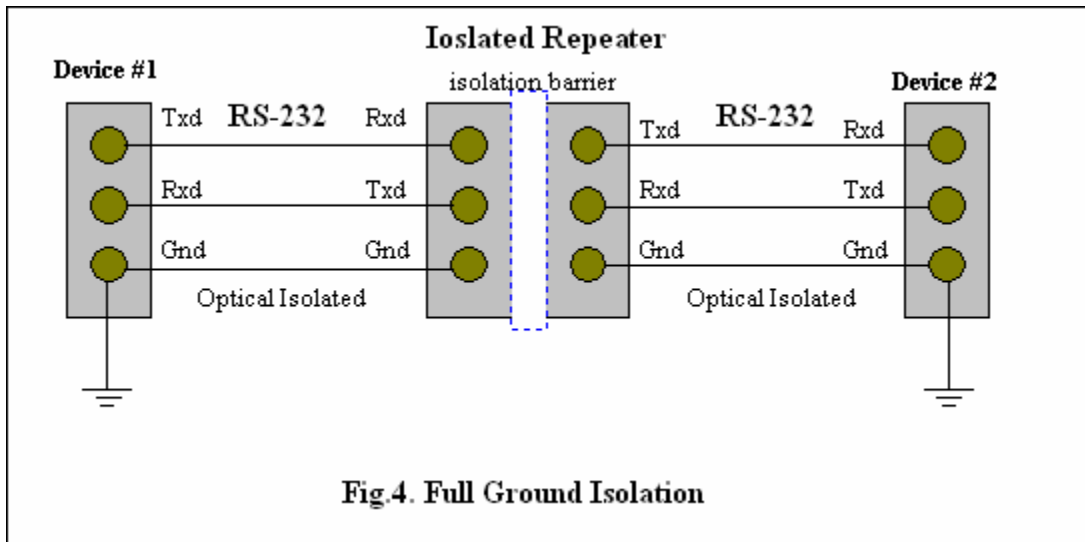


• **Full Galvanic Isolation**

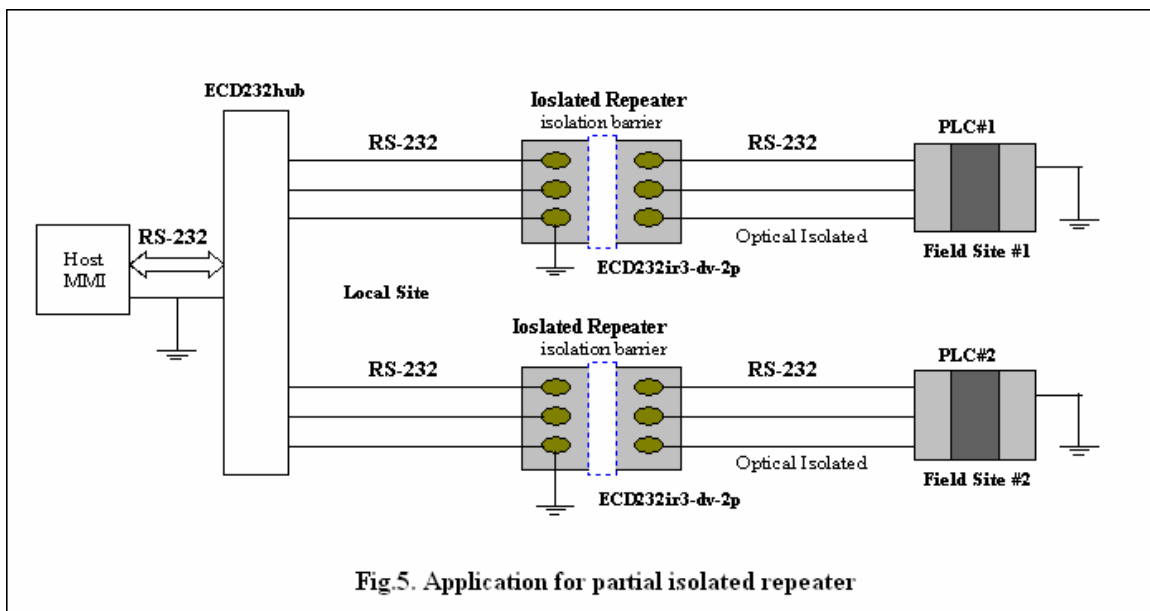
Another option is **full 3-of-3 ground (3-port) isolation** as shown at figure.4.. It adds another isolation barrier so both sides of the data communication path have floating power supplies. Since isolating power is more expensive than digital signals, 3-port galvanic isolation costs more than 2-port. Choosing between 2 or 3-port isolation depends



on the physical layout of your system. 3-port isolation allows a natural physical arrangement where a computer (device #1) is located in the control room, the isolated repeater is located in marshaling panels, and the controller (device #2) is out in the field. However, 2-port isolation is perfectly acceptable if one device and the isolated repeaters are located with identical ground paths.



• *A Common Application of 2-port Galvanic Isolation*



Here is a common installation of the ECD232ir3 with 2-port optical isolation. A small power supply with 2.5Kv isolation powers the two ECD232ir3 units. Since all two host RS-232 circuits share a common ground within the computer, any concern about devices



damaging each other through the power supply is not applicable. But notice something else: **galvanic isolation is a good way to both reduce system complexity and increase overall system reliability.** In this example we now have 3 smaller independent "ground" systems to design and maintain. Without galvanic isolation you have a much larger, more difficult grounding system to design and maintain. All it takes is one misplaced wire to invalidate even the most carefully designed and installed grounding system and destroy attached equipment. The three smaller grounding systems are an order of magnitude safer than the single, larger system. Of course all 3 will connect to a single site ground, but the quality of this connection no longer impacts our data comms! **With the size and complexity of today's systems, galvanic isolation is a good insurance policy to counter not only acts of nature and hardware faults, but also mistakes by well-intentioned technicians and operators.** To not optically isolate industrial data communications is to gamble tens of thousands of repair dollars just to save a few hundred dollars during installation. Do it right the first time – fully isolate your data communications! Protect yourself and prevent problems before they happen.