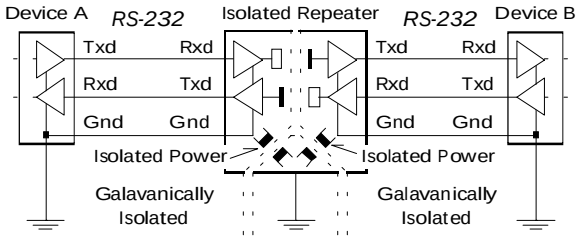
Robust Data Comm
Making Industrial Data Flow Like Water ... Safely, Silently, & Sanely

Isolation Testing at RobustDC

RobustDC Application Note #15

Overview of Isolation & Terms



3-of-3 Port Galvanic Isolation (Full)

As more and more intelligent devices interconnect to exchange information, careful placement of electrical isolation is becoming one of the most critical new steps in the engineering design process. The goal is to allow data to flow, without any electrical flow between systems. The benefits of isolation include: 1) reduction in data noise, 2) protection of equipment, 3) increase in system robustness, and 4) clear separation of vendor/departmental scope. Some of the terms you will see:

3-port (or 2-port) Isolation - These terms tend to mislead people not familiar with isolation jargon. For example, how can an RS-232 isolator with only two RS-232 ports have "3-port isolation"? The answer is you are forgetting the "power port". Therefore the more correct term is "3-of-3 port isolation" - or you may be happier if we say 3-of-3 grounds are isolated. In the diagram above: device A has its own ground reference isolated from device B and the power supply, device B has its own ground reference isolated from device A and the power supply, and the power supply has its ground reference isolated from device A and device B. With full 3-of-3 ground isolation there is no current leakage or unwanted galvanic current flow between device A, device B, or the power supply.

Galvanic Isolation - This is a more appropriate term than "optical isolation". A galvanic current is generally thought of as the small current flow inherent within any distributed system due to various physical properties of the materials involved. For example, when 2 device communicate we expect current flow related to the movement of our data, but we do not expect current to flow just because we have connected two devices together. Yet assuming both devices are powered externally, there must also be some current flows between the two devices due merely to differences in the power system design. We adding galvanic isolation to prevent this undesired current flow - we want only are data to move between the devices and no current to flow.

Optical Isolation - This is a common phrase in the market these days. It declares that the isolation of the data signals is accomplished by opto-isolators (or photo-couplers) and not by transformer isolation. An opto-isolator is a light-emitting diode (LED) separated by clear plastic from a light detector. The light moves the data across the component; the plastic provides the electrical isolation.

Intrinsic Isolation Design

The isolation of any powered isolator is determined by is three factors:

1) The isolation rating of the opto-isolator used for data signal isolation.
2) The isolation rating of the DC/DC converter (or AC/AC transformer) used for power isolation.

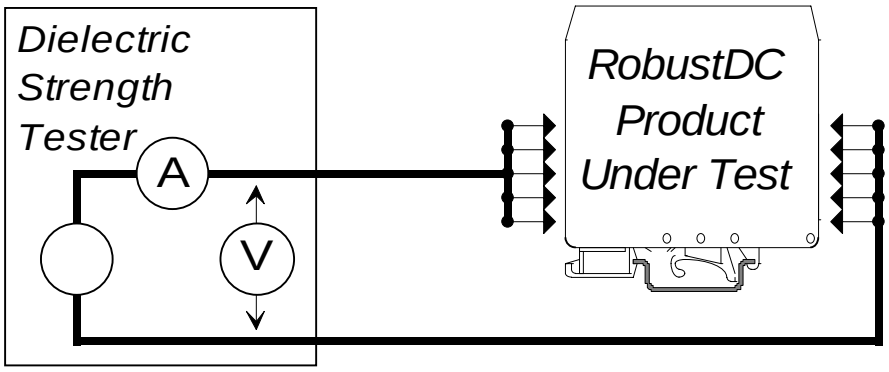
3) The physical layout of the circuit board, spacing of the components and wires. The "air gap" between metal surfaces determines the voltage potential difference before sparks jump across between two traces or components. This value degrades with rising humidity or dust in the air.

The overall isolation rating of the unit is determined by the lowest isolation rating of these three factors. RobustDC assures all of these three factors meet the rated isolation voltage (usually 2500v) in our products. Depending on the circuit design, our opto-isolators are UL rated at 3500v or 5000v. Our DC/DC converters are rated at 3000v - and 100% tested to this level by the manufacturer. Our circuit board layout provides an air-gap of at least 240mil (a ¼ inch) which isolates normally to at least 2500v. The isolation of our products can be further enhanced by full "tropicalization" - which includes epoxy encapsulation rated at 14,000v per 1mm of epoxy.

However many low-cost devices avoid this topic and use misleading phrases like "up to 2000v isolation" even if their DC/DC converter is rated only at 500v and their air-gaps only allow a few hundred volts of isolation. They rely on ignorance for their sales. The phrase "up to" means there exists somewhere a user lucky enough to have 2000v isolation from the product - but you may get only 1v isolation from your unit and it still meets the written specification***! Are you buying 1v isolation or 2000v isolation? You cannot know.*** It always makes us at RobustDC sad to see this deception, but there is little we can do other than to educate our customers to be smarter than this.

● Dielectric Strength Test

RobustDC routinely takes new product designs to a third-party test lab for isolation strength testing. We follow the method in IEC 940 for dielectric strength testing. The test is quite simple. A special dielectric test device is used. One side of the RobustDC product is grounded, and a high voltage potential is applied to the other side (usually 2500v). It then measures the leakage current across the product for a period of time (usually 1 minute) and "passes" the test if the leakage current is below the threshold set by the test (usually less than 0.5mA). Both before and after the dielectric strength test RobustDC does a loop-back data communication test of at least 1000 characters just to verify the product still functions normally.



Example Dielectric Strength Test Connection

Note that all signal pins on each side of the device under test are tied together during this test.