Cables, Pins and Connectors - PXI Test System Build Success

Submitted by MAC Panel

Before choosing cables and connectors for your next PXI based system, it's important to clearly understand the real-world worst-case environment the test station will reside. For example, many environments are conducive to electromagnetic interference through radiation or conductivity, which can have an adverse effect on measurement quality. Another example environment could be an off-shore high humidity region where the factory manager tells you they are at room-temperature; but then never cleans filters or conveys that the AC works only one-half the time. In this later example, moister creeps into everything causing debug nightmares. Cables and interconnect often get little attention verses software and instrument selection. This article focuses upon cabling and interconnect and is a reminder that the weakest link in your test system build is often not obvious. Designers need not forget to place emphasis on the paths between their PXI instrumentation and the external world.

Wires verses Cables

You'll often read the terms "cable assembly" and "wire harness" used interchangeably. Many also mistakenly use the terms "cable" and "wire" synonymously. In truth, these components couldn't be more different. While they're both used in electrical and communication fields to route electricity between different locations, that's where the similarities end. Each has a distinct purpose, which means the success of your PXI system depends on selecting the right one based upon the application need.

Wire Harness: Open up a wire harness and you'll find multiple wires, each with its own single layer of exterior covering. Each single conductor, often made of copper or aluminum, are of low resistance, low cost and measured by "gauge". The smaller the gauge, the thicker the wire. The wire covering is typically made from a thermoset or thermoplastic material and serves two primary purposes. First (1) to protect outside stimuli, like environmental materials or technicians, from harm caused by the flow of electricity. Secondly (2), to help with the design and maintenance, while ensuring the PXI system is organized and easy to navigate.

The jacketing material that covers each wire often does little to protect the wire itself, which is why this solution is typically employed in applications where moisture, dust, temperature and friction are not a concern. To add organization and manageability, many custom wire harness builds will include spiral-wraps to allow breakout of single/multiple wires. Another option may include the use of corrugated tubing which often has a slit down its side to allow for simplified bundling.

Cable Assembly: A cable assembly is made up of cables that often include two or more conductors wrapped in a single jacket. Most cables consist of a positive wire that carries the electrical current, a neutral wire that completes the electrical loop and a grounding wire. Like wire harnesses, cable assemblies are groups of cable that also have an exterior covering. However, the entire bundle is encased in an extremely durable sheath made of material like shrink-wrapped thermoplastic, rubber, or vinyl.

Cable assemblies serve three main purposes. First (1) to protect outside stimuli from harm caused by the flow of electricity. Second (2) to ensure test systems are organized and easy for technicians to navigate. Third (3) to protect the cable against wear and tear or other harsh environmental conditions. Cable assemblies are often custom-designed to address logistical challenges such as size constraints, temperature exposure, moisture, dust, friction, flexibility and more.

Electromagnetic Fields

Another area that should be analyzed during any PXI base system design are electromagnetic fields. The natural world, including your body, produces electromagnetic fields. But these fields are low in intensity. Technology produces much more intense electromagnetic fields, and these fields can cause havoc on test and measurement systems. In order to manage the effects of electromagnetic interference and radio frequency interference (EMI/RFI), cables and interconnects should be shielded. EMI/RFI shielding can be thought of as an enclosure for insulated conductors. They may consist of braided strands of copper or a metallic foil tape, or both. The shielding can act as an energy reflector or grounding point to the electrical signal by surrounding the power-carrying conductors. For cables, typical shielding types are foil and braid. Foil shielding provides coverage to the entire conductor it surrounds and is relatively inexpensive. Due to the thin nature of foil, it can be difficult to terminate. Braided shielding is typically tinned copper that has been woven into a mesh that surrounds the conductors. Unlike foil shielding, braided shielding does not offer 100 percent coverage of conductors. Despite the lack of coverage to the entire conductor surface, the higher level of conductivity present in copper as compared to aluminum foil makes braided wire a more effective option for shielding.

Interconnect Contacts

Signals from PXI instrumentation often leads to some form of test-station interconnect. The contact pins used within a selected interconnect ensure measurement quality, repeatability of insertion, and protection. Three areas to consider. First (1) know the pin and interconnect current capacity. The current carrying ability of a signal pin is ultimately determined with respect to probe temperature. Check that your supplier's current carrying design specification tolerances are in excess of rated literature to ensure quality and safety. Second (2), know the interconnect high frequency performance. Resistance of connector pins and receptacles increases rapidly with increasing frequency. A quality interconnect supplier selects the optimum plating to mitigate oxidation, fretting corrosion, and other contact degradation mechanisms. Third (3), and lastly, know the cycle-life of contact pins. Mechanical life and resistance is based on the fatigue life of the pin and the internal sliding contact surfaces. A quality interconnect supplier selects the best compromise for an optimum roughness of the contact components to allow for cleaning of contact debris while not highly affecting wear mechanics.

MAC Panel's contact pins are made of Au (Gold) over other natural materials to provide strength and electrical performance. Gold's resistance to corrosion offers an atomically clean metal surface which has an electrical contact resistance close to zero, while it's high thermal

conductivity ensures rapid dissipation of heat. MAC Panel's gold contact handle not only hostile environments but are also sized to handle high-volume insertion/removal cycle rates.

Summary

MAC Panel Inc. can assist you with any form of cabling and interconnect, as well as offerings minimized cabling solutions between your PXI instrumentation and device-under-test (DUT) interfacing mechanics. Consider the SCOUT and APEX product technologies for your next PXI interconnect. Our commitment to quality begins with our processes and in-house manufacturing. We work to ensure the highest possible quality and accuracy of every component we produce.