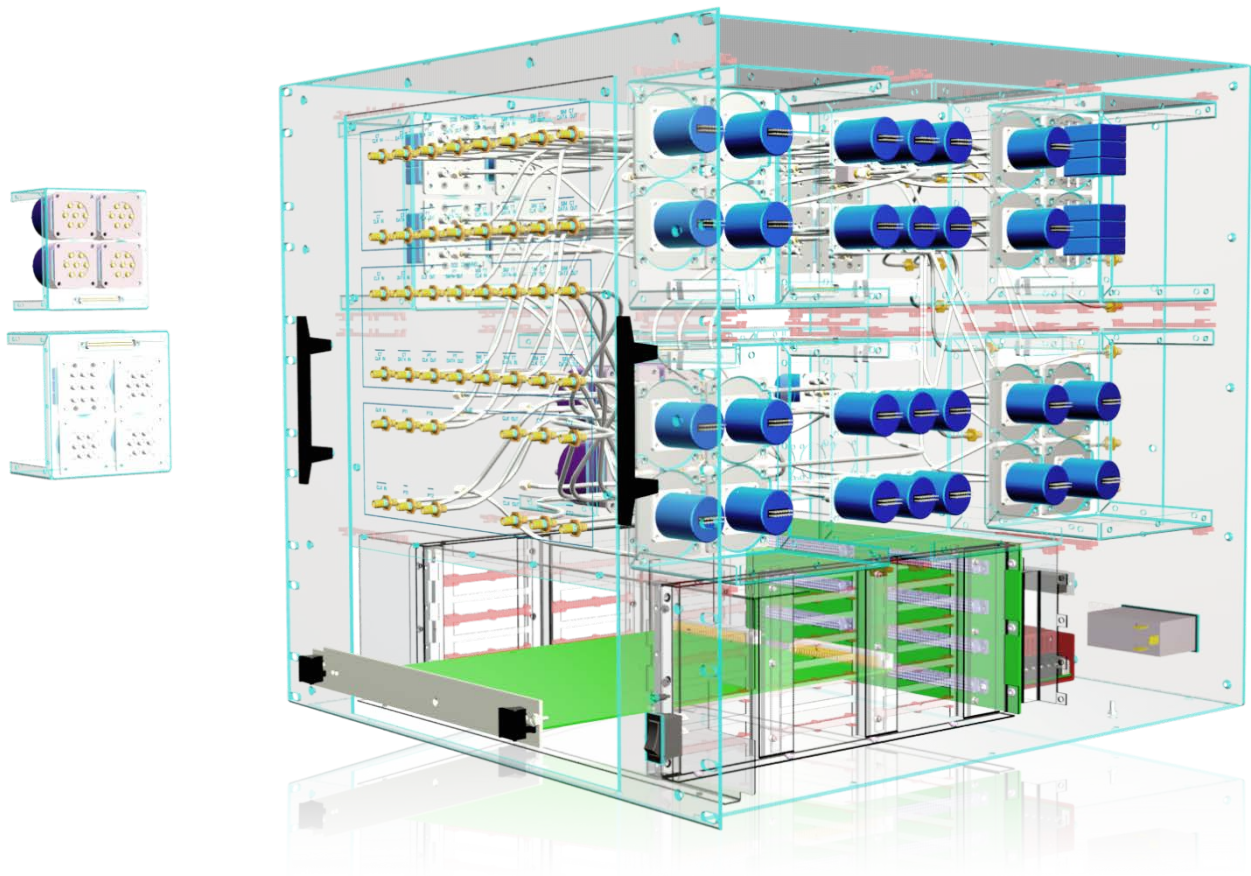


Modular Switching Solutions

Application Note

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Giga-tronics provides a high performance, modular “COTS” architecture to help you create optimum solutions.

Modularity in signal switching systems offers many advantages. This application note reviews the advantages and disadvantages of modular switching systems and the ways that Giga-tronics overcomes or minimizes the disadvantages, including introducing our newest ATE switching system. The new system, composed of switch cards (single ended or differential) and IO cards, eliminates the problem of inadvertently wiring a single ended versus differential switch pins to the incorrect switch path, as each of the systems IO channels are three wire channels to support either a single ended or a differential signal, and both types of signals can be mixed on the same switch card.

Benefits of modularity -

Inherent in ATE design is the difficulty in getting the design right the first time. As most experienced ATE engineers know, it is difficult to anticipate what the test requirements for the next product or class of products will be. Modularity brings an inherent scalability, useful in situations with a high product mix. With a modular test platform such as VXI or PXI, cards can be added to or removed from the test system as requirements change. The switching system needs to be modular in order to have the ability to

shrink or grow, depending on the application. Many test managers are choosing to design their next generation test platforms using a "core system" approach. By building the system design around a core of modular instruments, the system can be scaled to the application. The core instruments which are part of most of the system configurations, allow the re-use of software modules, simplifying the sparing requirements. Modular solutions are what make this approach possible.

Consequences of modularity -

like everything in life, modularity comes with a price. When considering modular systems such as VXI and PXI, one must consider the cost of the instrument cards, and the overhead cost of the technology itself. Systems like PXI and VXI require the purchase of both a chassis and a slot 0 controller. The cost of any instrument is a sum of the cost of the instrument itself, plus a fractional share of the cost of the host chassis and controller. Engineers become so enamored of a particular technology, they implement it with blind disregard for the overall cost effectiveness.

Consider performance costs, this is particularly true in the area of switching. Smaller switching cards/modules are convenient and scalable, but the smaller modules are often connected together to make larger switching fabrics. The cables interconnecting the smaller modules carry a variety of penalties which are frequently overlooked:

- *Cost* - The high density connector types used on small switching modules are typically inexpensive to purchase, and can be mounted on the switching card. This makes them a great choice for the card manufacturer. The problem is that building cables for these 5-row connectors precludes the use of insulation displacement connectors, forcing the customer to use crimp and poke technology which is labor intensive, error prone, and expensive.
- *Performance* – Building larger switching fabrics across small cards adds additional connections which reduces bandwidth by increasing the length of stubs left in the signal path. These stubs cause reflections, which rob performance. There are often additional switches in the path which add insertion loss in the signal path.
- *Maintainability* – the inter connectivity between the modules results is called "mega-harness". We have seen examples of systems where there is a single multi-headed cable connecting the switching and the instruments in one large rats-nest harness. While it may function, it makes the system difficult to maintain as the modules are difficult to remove.
- *Reliability* – a second consequence of “mega-harness” is the higher probability of breakage, particularly during service. When a card fails and

needs to be replaced, the mega-harness typically requires multiple connectors to be removed increasing the likelihood that something will be unintentionally damaged.

We recently worked with a customer enamored with the latest PXI technology. He had decided to build his system exclusively using this technology. He had a single chassis of instruments, along with three chassis of switching cards. This resulted in a large and difficult to manage harness. We offered a simpler modular switching system based on our 4000 series switches which fit in a single 3U chassis, and eliminated the overhead cost of three PXI chassis and controllers. The cards were more appropriately sized to the application. Small cards are for small systems, and large cards are for large systems.

Product level modularity -

one of Giga-tronics design goals is to promote modularity wherever possible, either at the system level, the product level or at the design level. The switching cards themselves are modular in the sense that they are composed of small modular elements interconnected in different ways. These well designed elements can be reused on new designs, allowing Giga-tronics to reduce both the cost, and the technical risk of new designs.

Modular solutions for small to medium solutions -



GT-8400A - Scalable 4000 Series Switching Solutions with Analog Backplane

Earlier I mentioned "large cards for large systems, small cards for small systems". There is no bias in this statement, Giga-tronics makes both large and small card products, and is happy to provide either to the customer. The issue is mainly one of performance. Smaller cards such as PXI or fractional VXI systems made by others are limited in real estate, and are IO bound by small front panels which cannot support large high density and high bandwidth connectors.

Our largest PXI matrix card has a 4x16 matrix on it. Assuming your DUT has less than 16 IO pins, and you only have four instruments, it's a great solution. If your DUT has 32 pins or you have a few extra instruments, then it makes good sense to use a pair of cards and interconnect them as needed to create a slightly larger matrix. This is known as scalability. The problem is that small cards don't scale up to large systems well. Take the example of the customer that has 100 or more DUT pins. At this point we are bridging so many of these small modules together, it compromises the bandwidth to a point where the system becomes unusable. It's time to separate the switching from the instruments, and use a larger, yet still modular approach.

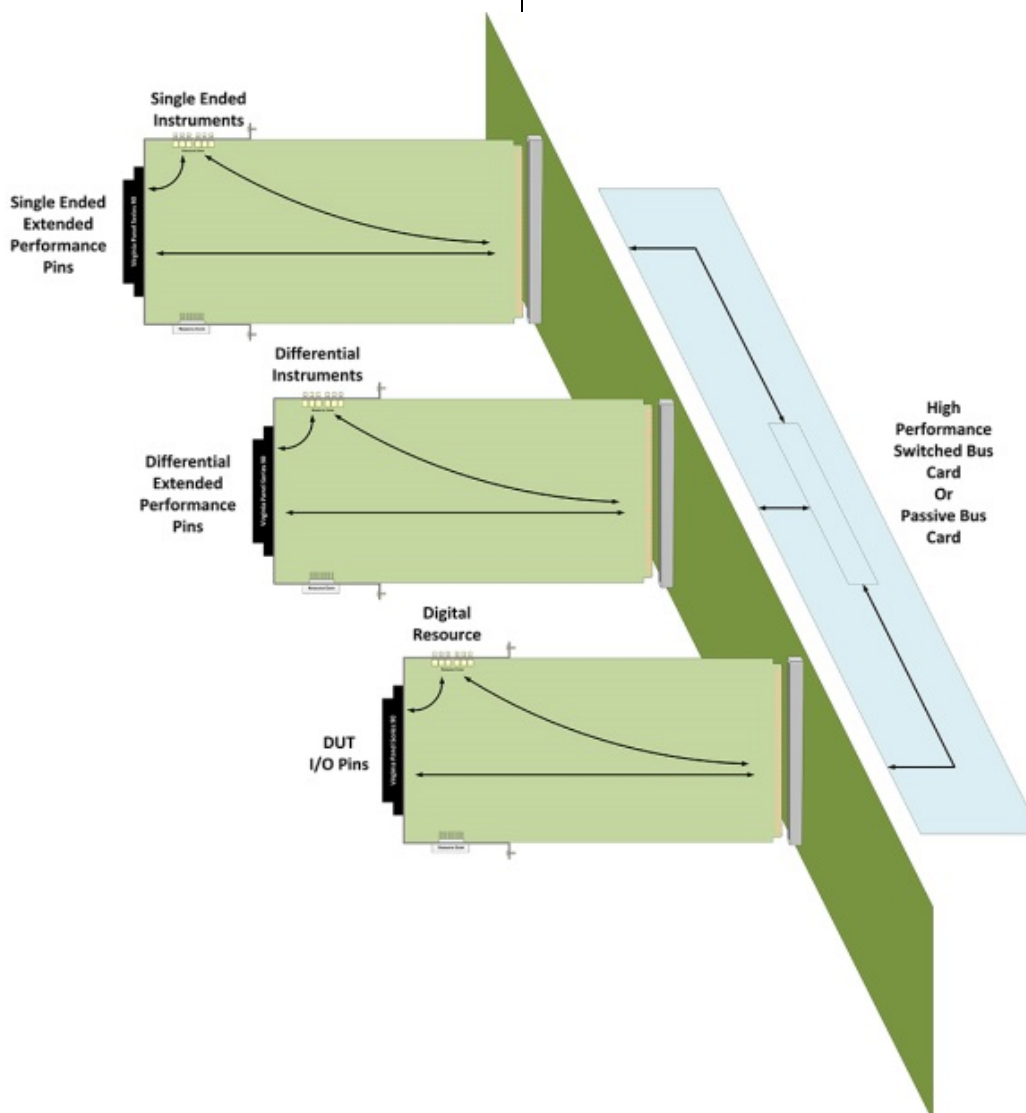
The 8400 chassis shown below can house up to eight switching cards which are nearly the size of VXI cards, and has an analog backplane with 16 differential channels. This allows the larger cards to be connected together using the internal backplane which maximizes performance and simplifies system cabling.

Modular solutions for large ATE systems -

Large ATE systems have unique requirements. There are typically large numbers of DUT pins to be dealt with, anywhere from hundreds to thousands of pins. In addition, the DUTs often have a mix of both single ended signals as well as differential signals. Giga-tronics may be the only manufacturer who has developed switching cards with DUT IO channels which can support either single ended or differential signals. Large systems also have large numbers of instruments which need to connect to any or all of the DUT channels with higher bandwidth requirements. Giga-tronics has developed a proprietary technology for maximizing backplane bandwidth, allowing us to overcome the problem of reduced bandwidth caused by adding more and more cards to the chassis.

The example below illustrates our newest ATE switching system. The system is composed of Instrument cards (single ended or differential) and DUT IO cards. The process of designing an ITA becomes a trivial matter since all of the DUTs IO pins are simply connected to the systems IO channels in the ITA.

instrument cards. Giga-tronics uses a proprietary design which allows the transmission line on the pc board to provide either a 50 ohm matched line for single ended signals, or a 90 ohm line match for differential signals. In cases where the internal path to the instrument causes insufficient bandwidth or



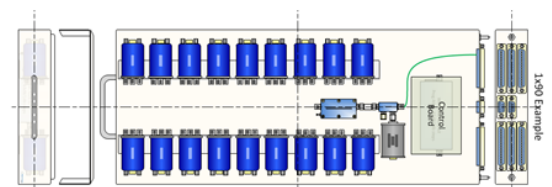
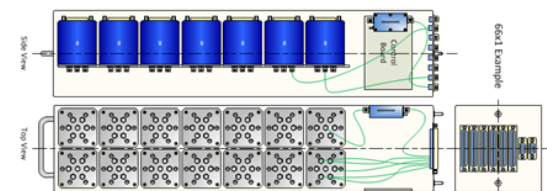
The problem of inadvertently wiring a DUT pin to the incorrect instrument or switch is eliminated. Each of the systems IO channels are three wire channels to support either a single ended or a differential signal, and both types of signals can be mixed on the same card. The backplane bus uses the same 3-wire system to connect the IO pins to the

insertion loss limitations, each of the instrument cards has extended performance IO pins which allow the instrument to be connected directly to the test interface via a high bandwidth path (approx. 1 GHz). The backplane of this system can either be of the straight bussed configuration for lower bandwidth applications, or can use Giga-

tonics' proprietary switched backplane which allows any pair of boards to be connected together without stubbing for maximum performance. Lastly, to provide maximum performance, the cards are all extended out to the test interface, creating a completely cable-less system. The true benefit of this system is its modular approach which allows additional instrument cards or DUT IO cards to be added or removed to scale the system to the application. This system is easily useable for systems requiring 64 IO channels or more. Giga-tronics would be pleased to provide additional information on this exciting new technology.

Modular solutions for RF -

Giga-tronics has also taken its modular design philosophy to the RF and microwave realm. There are some examples of high bandwidth microwave systems, some of which use blind Mateable connections to interconnect the modules. These are typically designs which are tailored to customer requirements, but as mentioned previously, the continual use of the modular approach allows Giga-tronics to provide custom solutions at off-the-shelf prices.



For additional information, please see our other whitepapers on switching:

- [Improved Switching Architectures for ATE Systems](#)
- [Microwave Switch Selection for ATE Systems](#)
- [Switching Solutions for Multi-Channel BERT Testing](#)
- [A Practical Guide to Microwave Switch Selection for ATE Systems](#)

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