

VXI 4.0: How can I benefit?

How your application can profit from this new specification

By Dr. Fred Blönnigen, CEO of Bustec

With so many new and successful bus structures like LXI and PXIe, the question “What value does VXI rev. 4.0 present?” is a valid one. We will take this opportunity to show the user the benefits of the new specification VXI 4.0. First of all, we should mention that VXI 4.0 is fully backward compatible. System developers who have adopted the VXIbus platform can preserve initial development efforts and more importantly can keep all previous investments, while integrating emerging technology into their test systems. Longevity is the main interest for system integrators who have to support their systems with long lifecycles like in military test systems. Systems designed in the early days of VXI are still fully supported today and can be extended without changing any of the existing infrastructures.

One may wonder, “What did VXI 4.0 add to the specification and how can I benefit from this?” We want to highlight some of the most striking features that the new revision adds, and their applications. VXI 4.0 added significant throughput capability with the adoption of the 2eSST protocol, and the subsequent 320 MB/s transfer rates it enables. The 2eSST protocol also allows for broadcast data transfers, allowing the master to transfer the same data to multiple slaves with a single transfer instead of having to repeat the transfer over and over again to each slave. Bustec’s PCI Express VXIbus Slot-0 Interface, the ProDAQ 3030, was the first to take advantage of this new throughput capability to satisfy large channel count, high-speed data acquisition application requirements. This slot 0 device connects to the host controller via a 4-lane, low-latency (400 nsec) PCI Express serial communications link. While the ProDAQ 3030 was designed with larger multi-crate applications in mind, the newly designed ProDAQ 3026 (see picture 1) is limited to a maximum of two mainframes per PCIe card. Both slot-0s offer the hot-plug capability. Up to now test systems with PCIe bridges would crash if the VXIbus systems lost power. Subsequently, all important data would be lost. Bustec overcame this hurdle with a special PC interface card, which allows the user to boot their PC without having the VXIbus system present and to connect or disconnect at will.

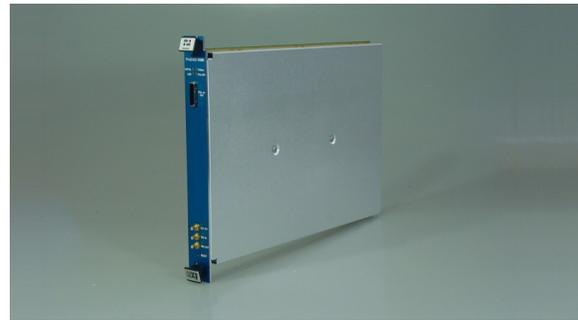


Figure 1 - Bustec’s ProDAQ 3026 PCIe slot-0

In test and measurement and data acquisition, systems throughput speed as well as first-word latencies are very important factors. Both features are addressed in the new Bustec VXI 4.0 slot-0 controllers and the revised ProDAQ 3180 ultra-performance motherboard module. This revised ProDAQ 3180 supports, like the ProDAQ 3030, the 2eSST protocol, which is the most essential part of the new VXI 4.0 specification.

Bustec’s ProDAQ 3030 slot-0, interfacing to a PCIe host can achieve a throughput speed of up to 320 MB/s. The ProDAQ 3030 is the fastest slot-0 on the market, as it is the only slot-0 supporting the new 2eSST transfer protocol. It comes with a standard copper connection. Bustec also offers a fiber-optic cable, which connects to the same connectors as the copper

cable, and with this option, mainframes can be over 300 m apart from each other and from your PC. For the combination of ProDAQ 3030 with our ProDAQ 3180, we measured a throughput speed of over 200 MB/s sustained. This included all software overhead in a typical data acquisition application.

The following example is a typical data acquisition application where the throughput speed of VXI 4.0 and the DSP calculating power of the ProDAQ 3180 motherboard module solved a problem that could not be solved with any other bus structure. The system acquires 344 channels of synchronized analog inputs (ProDAQ 3424-BB) with bridge signal conditioning (ProDAQ 5716) and 8 channels of frequency inputs (ProDAQ 3808) for the rotor test of a helicopter. The user required time domain and frequency domain data, including power spectra. The customer required an analog bandwidth of 60 kHz, which translated into a digitizing speed of roughly 120 kHz. The DSP, a 500 MHz TigerSHARC, was sufficient to calculate in real-time, the frequency domain data and the power spectra. The original time domain data and the derived frequency and power spectra data could now be monitored in real-time by the user, while still having throughput headroom. The combination of DSP power and sustained throughput speed solved this problem. It is important to mention that this application required only one mainframe, due to the high density of channels Bustec could provide using the VXI platform.

While most vendors have a dedicated function per slot, i.e. a high-speed ADC or a DAC or



Figure 2 – Bustec's ProDAQ 3180

digital I/O, counter or serial card, Bustec provides a standard motherboard module, the ProDAQ 3180 that can be configured with up to 8 plug-in modules (please see Figure 2). These modules cover the complete spectrum of the different measurement or control applications, as described above.. The motherboard has different options, i.e. different memory sizes, onboard, programmable on-the-fly voltage references and a powerful TigerSHARC DSP. These options come in addition to the 8 Function cards. By implementing the 2eSST protocol into the ProDAQ 3180, Bustec now

offers the complete spectrum of different functions under the new VXI 4.0 specification.

The VXIbus incorporates well-defined power and cooling specifications that have resulted in it being the platform of choice for performance-driven applications. As more demanding applications emerged, one primary focus of the VXI Technical Committee was to increase the power capacity on the backplane. To do this, the 96-pin J1/J2 connectors were expanded to 160 pins. Two outer rows were added to these connectors and this was accomplished in a manner that achieved complete backward compatibility with legacy VXI instruments. The additional pins increased the traditional power rail capacities by 418 Watts, while adding 3.3 V and user logic rails. This has proven particularly useful in multi-channel high-speed digital applications that operate at various digital and current levels in which each channel can be dissipating up to 5 Watts. With the additional power that VXI 4.0 offers, EADS Test & Services have been able to introduce a 50 MHz digital test instrument that has avoided limitations or tradeoffs existing with digital test products on other platforms. All power required to source 80 mA of user current per digital channel and high slew rates is derived directly from the VXI backplane; no external power source is required. Figure 3 shows the new Talon Instruments

T940 Digital Instrument which can utilize the new 5-row VXI connector to add power and speed.

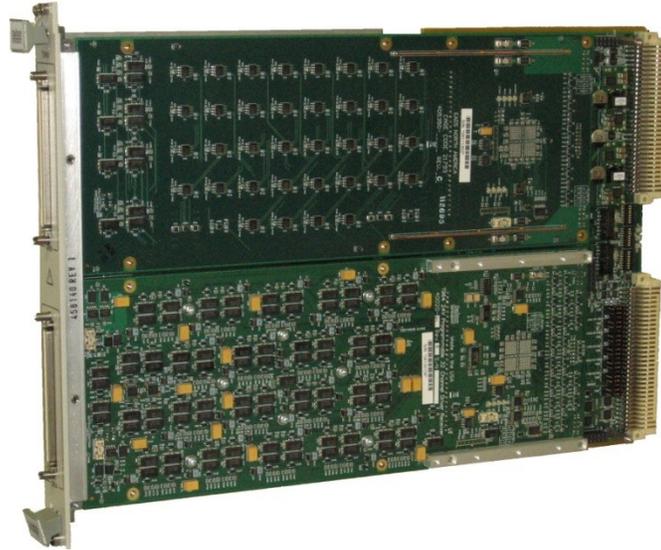


Figure 3 - Talon Instruments T940 50 MHz Digital Instrument from EADS North America Test and Services

To best utilize the features of VXI 4.0 discussed here, a suitable VXI mainframe is required. The new 1263 series from EADS North America Test and Services provides 13-slot VXI 4.0 compatible mainframes for medium to high system power needs and for front or rear maintainability. Medium power mainframes like the new 1263MPf have nearly 1.8 kW of power available to the VXI 4.0 slots while providing a pluggable power/fan tray which is serviceable from the front of the unit (only optional VXS switch card is maintained from the rear). Likewise, the new 1263HPf (Figure 4) supplies > 3.8 kW of power from a rear-accessible plug-in power module and cools > 300 Watts of dissipated power per VXI slot from its rear-maintainable 1280 cfm fan tray. Mainframes such as these and the > 4 kW 1263HPf are backward-compatible with all previous VXI revisions yet support new features that will enable a new generation of VXI 4.0 compatible modules to solve the toughest problems in test for years to come.



Figure 4 – The new 1263HPf High-Power Rear-Maintainable VXI 4.0 Mainframe

To summarize, VXI 4.0 can provide the user with enough bandwidth to transfer data in large high-speed systems. In addition, the ProDAQ 3030 VXI 4.0 slot-0 from Bustec solves the issue of a system crash, in the event of a loss of power to the VXIbus mainframe. Finally, the addition of higher cooling and power delivery in the VXI 4.0 backplane supports the trend of higher performing, higher density systems. Come and view these new modules and the implementation of VXI 4.0 at AUTOTESTCON in Bustec's booth 141 and in EADS North America Test and Services' booth 525.

About the author: Dr. Fred Blönnigen has a Ph.D. in physics. After he completed his Ph.D. in France, he worked in the University of Berkeley in California as Nuclear and Elementary particle Physicist. Back in Europe, he worked for a large American data acquisition and test company for several years. In 1998 he founded Bustec in Ireland and opened a branch in 2000 in the USA. He is still working as CEO of Bustec.