Quantum DETECTORS

Xspress 3

Xspress 3

Technical Datasheet

Many solid-state detectors are not limited by their intrinsic rate capability, but by the readout system connected to them. Xspress 3 was developed to maximize the throughput and resolution of such detectors and remove the bottleneck at the readout stage.

The primary benefit of using Xspress 3 over traditional readout systems is simple: at rates above 100 Kcps (counts per second), for any given resolution the output rate achievable per channel with Xspress 3 is up to 10 times faster than other systems.

This opens up the beamline to much faster data collection. Its extended dynamic range (0 - 3.4 Mcps per channel) can reduce the number of scans required and save large amounts of time with attenuation selection. The higher rate can also lead to less damage to samples, better statistics and ultimately higher beamline throughput and data quality.

In addition to this, because Xspress 3 does not use fixed shaping or peaking times, the system effectively optimizes the output for each sample (or each pixel for mapping applications) without user intervention.

The system can handle up to 9 channels of input per unit and can be synchronized with other Xspress 3 units. Please read on or get in touch for details or answers to your specific questions.

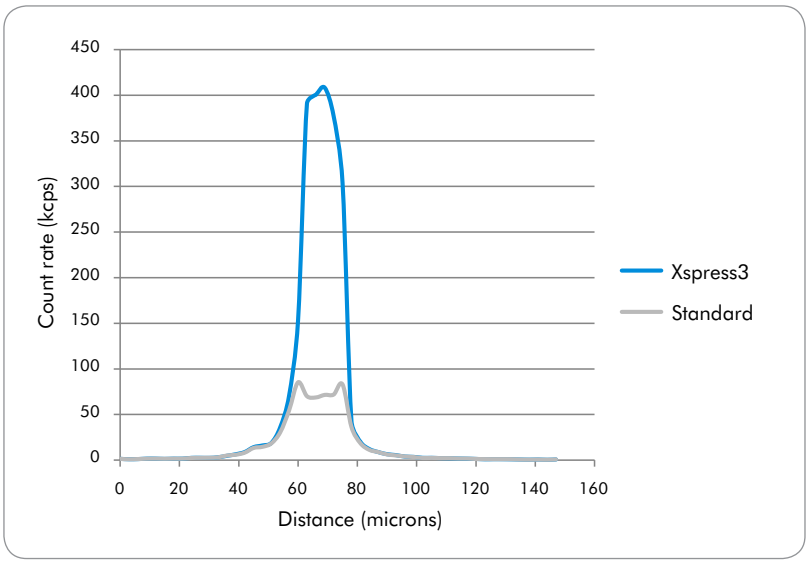
KEY features & benefits

- **Greater than 3.4Mcps output rate**
- **Less than 100ns deadtime per event**
- **Up to 9 channels supported**
- **Out of the box EPICS integration**

Xspress 3

Output Rate

To give some context for the benefits of this increased scanning rate, imagine a readout system that becomes saturated at 100 kcps, beyond which it becomes paralyzed, leading to a lower output rate with increasing input rate and often unusable resolution. Xspress 3 is able to usefully read out events at up to 34 times that rate, 3.4 million counts per second. An example of this difference is shown on the right: data were recorded at the SSRL with both the existing readout and Xspress 3 set up in their standard operating modes.



Copper wire scan, 3 micron pixels

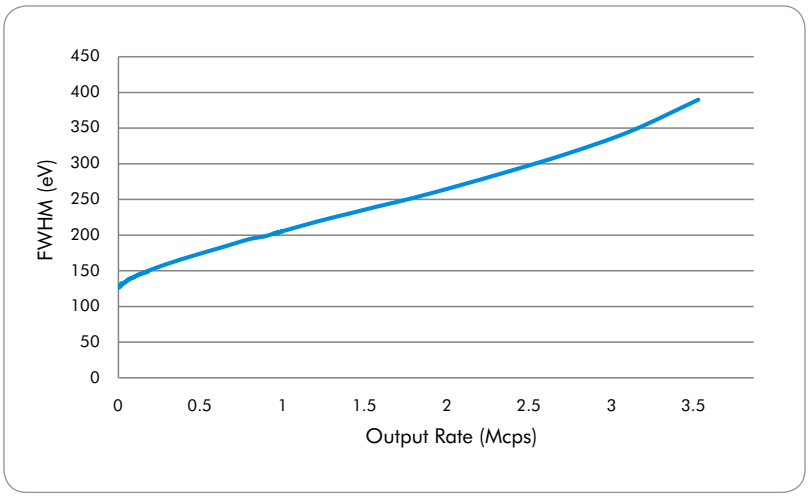
Resolution

While Xspress 3 offers higher resolution than the competition at rates above 100 kcps, it has also been proven to have as good resolution at low rates as other readout systems. Tests at the APS showed that at 35 kcps, the energy resolution of the system was 127 eV, at Mn Kαusing the NIST SRM1832 standard fluorescence spectroscopy sample.

The following Xspress 3 data were recorded at GSECARS on the ID-13-E beamline at the APS. While this is a more unusual way of visualizing measures of readout performance, it emphasizes the difference between the adaptive filtering technology used in Xspress 3 and standard shaping time systems.

If you imagine where the series for your current readout system would lie on this plot, operated at the shaping time that you use most frequently, it is likely that it would be represented by a straight line (until the readout saturates) from the Y axis at a fixed energy resolution out to the maximum useable rate.

Xspress 3, as shown below, operates at the optimum compromise between rate and resolution at all rates, meaning at lower rates than the maximum you operate at, you would achieve better resolution. Above the rate to which you are currently limited you would see a much improved rate performance.



Xspress 3 output rate Vs energy resolution

Results taken at ID-13-E, with a 4 channel Vortex ME4 used on Xspress 3. Mn Kαpeak fitted from NIST SRM1832 standard fluorescence spectroscopy sample. Comprehensive details available on request.

Quantum DETECTORS

Software

Delivering excellent software as part of experimental systems is a vital to their success. We understand this and as such offer industry standard open source EPICS drivers with Xspress 31. This ensures that our system will integrate seamlessly with most beamlines, offering ease of use and strong support options.

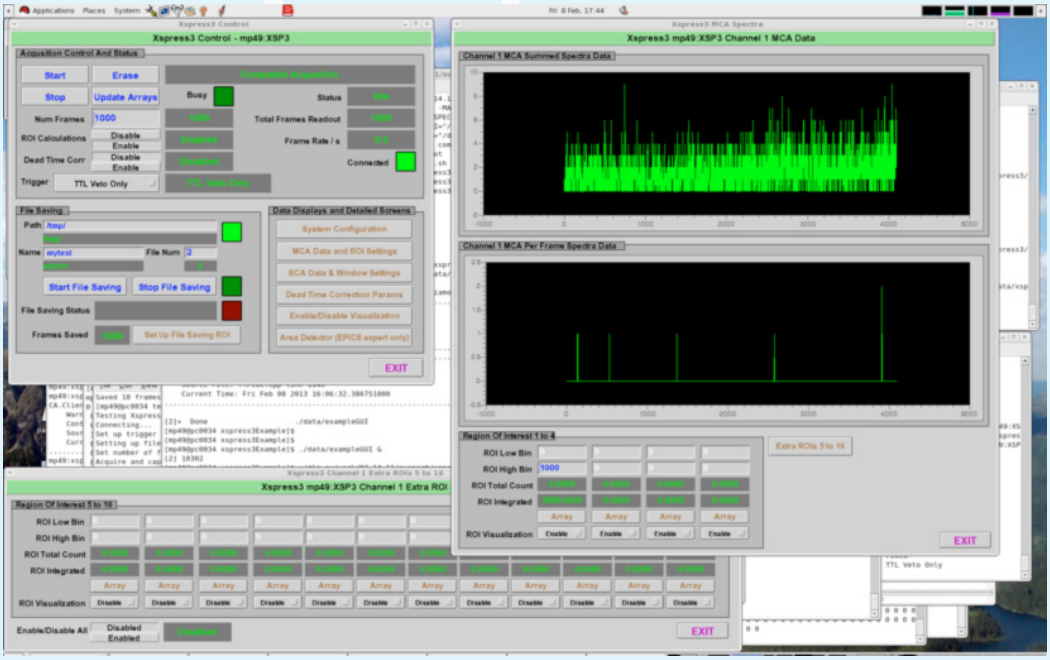
The information that is made available through the server included with any Xspress 3 purchase can be accessed by any remote terminal (Linux, Windows or OSX) and either gathered directly from PVs or the GUI accessed through SSH.

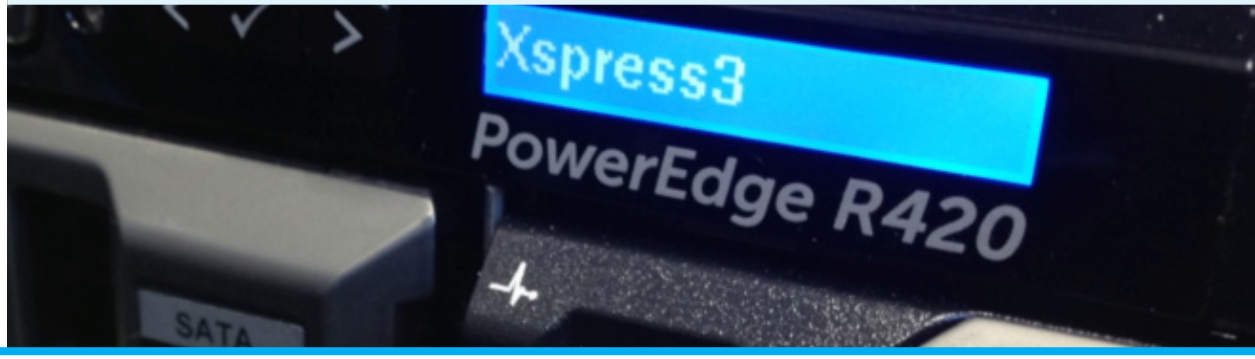
A GDA layer has been built for implementation of the system on Diamond Light Source beamlines and is also available as open source software for other users wishing to take advantage of this.

Future developments include TANGO drivers and further development of the EPICS interface. Users are welcome to use the documentation provided for EPICS, TANGO and GDA and direct support from us to build new interfaces or custom projects around the system.

The 6 core Dell server provided comes with redundant power supplies, hot swappable 1TB RAID 0 drives, a 10GB fibre and gigabit ethernet connections to Xspress 3 and the web.

[1] controls.diamond.ac.uk/downloads/support/xspress3
Open Source EPICS drivers for Xspress 3.
Thanks to Diamond Light Source.





Quantum DETECTORS

Xspress 3

Performance

Maximum Output Rate	>3.4 Mcps
Deadtime / event	≤100ns
Maximum Time Frames	16k expandable
ADC bit depth	16
Sample rate	80Mhz / 12.5ns
TTL Channels	4 In and 4 Out
Time between frames	<1µs
Max number of time frames	>16,000

Set-up

Calibration Routine	1hr by QD Staff with beam/source
Routine Re-Calibration	Unnecessary
Performance Tested	Vortex, Ketek, Canberra HPGe, SGX Sensortech, PN Sensor
Input Range	Factory Set ±2v as standard
Differential Signal	Compatible
Support available over Internet remotely	Yes, QD Staff offer support

Compatibility

Channel Count	1 – 9
Performance Tested	Vortex, Ketek, Canberra HPGe, SGX Sensortech, PN Sensor
Input Range	Factory Set ±2v as standard
Differential Signal	Compatible
Software Infrastructure	EPICS full support, GDA full support, TANGO in development

Data format

Points per MCA	4096
ROIs	16
Windows (sub MCAs)	2
ROIs, Scalars, MCAs available directly in EPICS through	PVs
File Format from EPICS	HDF5, Accessible during frame write

References

While the Xspress 3 development has just been completed, with the first production units being commissioned in May 2013, the concept has some history. The original Xspress system was developed at the SRS Daresbury in the early ‘90s for use on HPGe detectors. Xspress 2 was a rack based system, mainly used for high channel count (9, 36, 64) HPGe detectors at Diamond Light Source. As the success of the Xspress systems became clear and tests were completed with more types of detector it became clear that a compact unit for lower channel count systems with up to date technology would be a key development for many beamlines, with the current system the outcome of this development. Details of the initial program can be found in the following publications:

Initial concept developed at the SRS at Daresbury: XSPRESS — X-ray Signal Processing Electronics for Solid State detectorshttp://dx.doi.org/10.1016/0168-583X(94)00370-X

Initial data from the 30-element ORTEC HPGe detector array and the XSPRESS pulse-processing electronics at the SRS, Daresbury Laboratory http://dx.doi.org/10.1107/S0909049597013125