



Instruments That Advance The Art

FalconX1/X4/X8

Quick Start Guide

Version 0.6

August 23, 2019

ProSpect Software

Software Revision: 1.0.39

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1 Introduction

This manual provides the information required to get up and running with a FalconX1/FalconX4/FalconX8 system from XIA LLC quickly. This family of highly advanced processors incorporates the cutting edge SITORO® algorithm, developed and licensed to XIA by Southern Innovation of Melbourne Australia.

The FalconXn family is designed to work with the full range of available X-ray detectors, including SDD detectors as well as HPGe detectors, offering an unprecedented combination of high throughput, excellent energy resolution and advanced data acquisition features such as fast mapping and list mode output.

1.1 Hardware Setup

The FalconX1/X4/X8 processors are packaged in an a compact aluminum chassis, which can easily be located close to the target detector in the laboratory:



Power is provided to the FalconXn by an external, medical-grade 12V, 5A power supply. Communication is through a high-speed gigabit Ethernet connection. SMA connectors are used for the analog inputs. Several MCX connectors are used for digital control inputs; finally, a high-density connector is used to provide 32 digital I/O lines.

To set up the FalconXn, perform the following steps; note that all connections are on the back panel:

- Connect the power supply to AC power (100-240 VAC, 50-60 Hz) using a standard power cord
- Plug the power supply output (lower left of the rear panel)

- Connect an Ethernet cable (capable of supporting 1 Gbps) to the standard RJ45 connector. See below for more detail on the network setup.
- Connect the detector preamplifier outputs to the input SMA connectors. Short SMA to BNC cables (provided) can be used if conversion is necessary.
- To turn on the box, press the button on the front panel, which will turn blue to indicate that power is on. If the button turns red, it indicates a power fault.
- To turn the unit off, press and hold the power button for more than three seconds.

1.2 Network Setup

We strongly recommend using a gigabit Ethernet network to connect the FalconXn to the host computer systems. For best results with fast mapping applications (which involve very high data transfer loads), it is best to use a dedicated network connection, so that the full data bandwidth is available to carry the high data load.

The FalconXn can be setup to use either DHCP to obtain its IP address, or with a static address for situations where a DHCP server is not available. The network settings can be modified either through the web server (see below) or through a service port on the instrument (which is beyond the scope of this document).

Please note that units are shipped with a static ip address set to 192.168.0.2. To make the initial connection to the FalconXn, it is typically easiest to make a direct connection to the host computer; in this setup, the host computer will also need to be set to a fixed ip address on the same subnet as the FalconXn (such as 192.168.0.1).

1.3 Web Server

To get started, it is best to make the initial connection through the built-in web server on the FalconXn. To access the web server, just type the ip address of the box into the browser address on a computer that is connected to the same Ethernet subnetwork as the box. Upon first connection, you will be prompted for login credentials: username: *user*, password *password*. The web server has several panels, described below, which are selected using the tabs along the top of the page.

1.3.1 Status

Status

Alarm State: CLEAR User Alarm: 0 Network Alarm: 0

Board

Part Number: FALCON-X1	Serial Number: 016348001-0001	Revision: 1.0
Executable: 9edd785	FSBL: 093b7493	SSBL: 09edd785
Factory Mode: No	Boot Mode: QSPI	Boot Path: /9edd785
Host Name: FALCON-X1-016348001-0001	IP Address: 192.168.200.199	MAC Address: 00:0C:79:01:1C:07
Digital EI: S/N: 016348001-0001 (1.0)	Analog EI: S/N: 016615000-0002 (2.1)	Uptime: 1 day, 12:11:02

SiToro

Version: 56aeb828	File: 56AE8828.fw	Sampling Freq: 250 MHz
VDD PLL: LOCKED	SiToro PLL: LOCKED	200MHz PLL: LOCKED

Health

Temperature: 37.6 C	Vcc INT: 0.992 V	Vcc AUX: 1.83 V	Vcc BRAM: 0.994 V
Vcc PINT: 0.991 V	Vcc PAUX: 1.83 V	Vcc ODDR: 1.53 V	RAM: 35.81% used (0 bytes/sec)

Analogue Front End

Channel	Termination	Input Select	Coupling	Decay Time	Gain DAC	Offset DAC
1	1kohm	0dB	ac	short	1710	1550

The status tab shows a wide range of information, including serial numbers, firmware versions, onboard voltages and temperature, and analog settings. The general state of the board is indicated by the color of the tab at the top (where red or orange will indicate an alarm or error state).

1.3.2 Firmware

Uploaded files:

Drop files here or click to upload

Configuration

Current Release: fxn_afw_rel_0.7.2 (9edd785)
Active Release: fxn_afw_rel_0.7.2 (9edd785)

Management

Uploaded firmware:

No firmware has been uploaded.

Resident firmware:

- ☒ fxn_afw_rel_0.7.2 (9edd785)
- ☐ XIA_FALCON_X8_0.7.0 (f722525)
- ☐ XIA_FALCON_X8_0.7.1 (5860679)

Instructions:

Upload a file by dropping onto or clicking into the upload box. The uploaded firmware details are displayed in the 'Uploaded firmware' box and the Install button is enabled. Press Install to install.

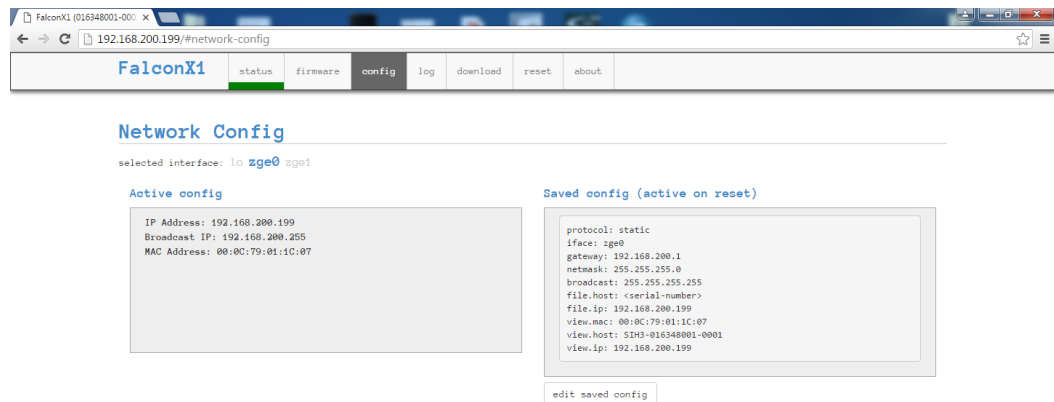
Installed firmware is automatically activated and it runs once you Reset the board.

To activate firmware resident on the board check the firmware in the Resident list and then press the Activate button. The firmware

Session Log:

The firmware tab shows what firmware versions are installed, and allows for loading new firmware, as well as choosing to revert back to any previous version that is loaded in flash memory. Up to three versions can be stored in flash memory; the system automatically retains the most recent versions.

1.3.3 Config



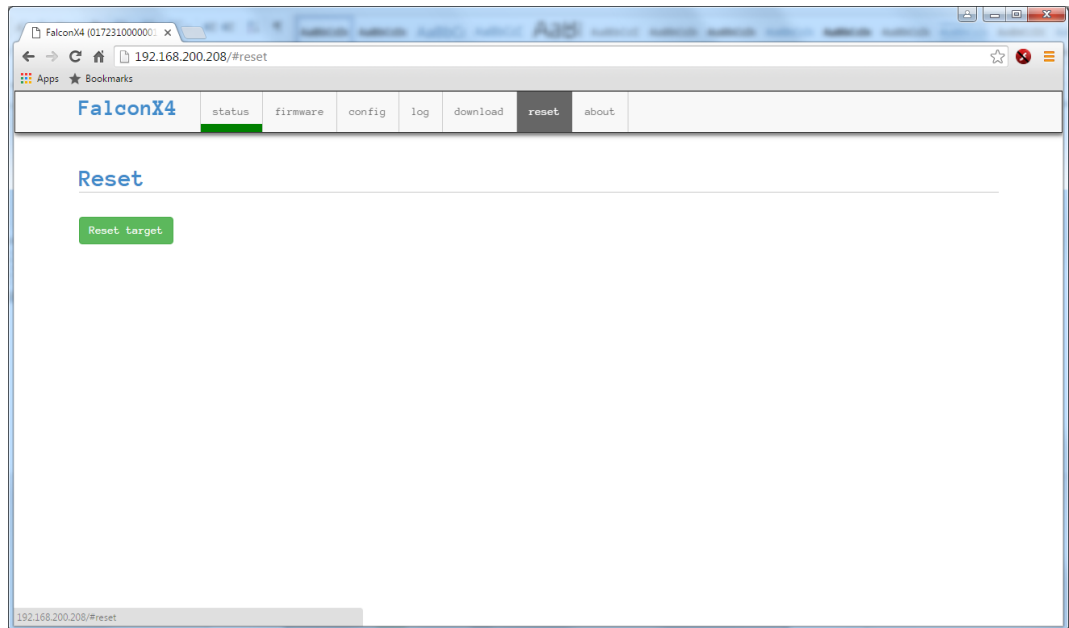
The config tab shows the current network configuration settings. Pressing the ‘edit saved config’ button allows the user to change the network settings (from dhcp to static ip, for example).

1.3.4 Log



The log tab shows basic information from the initial startup as well as subsequent host connections. If there is an error or alarm state, the log page will give the associated details.

1.3.5 Reset



The Reset tab allows the user to reboot the FalconXn unit, in order to restore to initial conditions.

2 ProSpect Control of the FalconXn

We support the FalconXn processors with our standard high-level Handel driver library, which allows us to offer GUI control through ProSpect, our standard setup and control program, which we use to support our full range of X-ray spectrometers. As the FalconXn operates somewhat differently than our conventional spectrometers, a detailed procedure for using ProSpect with the FalconXn is presented here.

2.1 Configuration File

Like all devices under the Handel driver library, a configuration file eg, falconx4.ini) is used to store all of the necessary settings, including the network settings (target ip address and port numbers) as well as spectrometer settings and configuration data. Sample configuration files are included with the ProSpect release; it is typically necessary to edit the sample file with the target ip address to connect to the target system. It may also be necessary to edit the template configuration file included in the ProSpect release to have a file with the correct number of channels; the template file is set up to support an eight-channel system. To set up for fewer channels, just delete the unneeded channels from each section, and change the number of channels specified for the module. Note that it is possible to make a setup for a number of channels that differs from the number of channels of the target unit, if you only want to use a subset of the channels – for example, you can make a six-channel setup that works with a FalconX8.

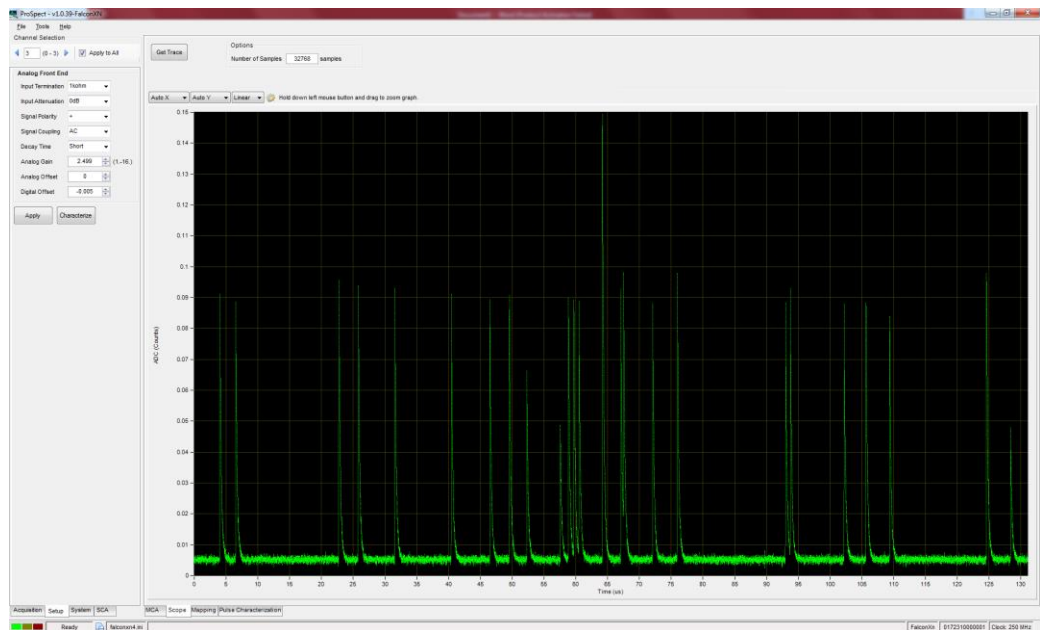
2.2 Analog Setup and Oscilloscope Mode

The first step to setting up a system is to adjust the analog settings appropriately for the target detector and application. All analog front-end settings are under computer control, so that the FalconXn can easily be used with a wide range of detectors with no special modifications or special setup necessary. The settings can be grouped into three categories: input control, coupling, and gain/offset.

- Input control:
 - Signal termination: 1 kohm or 50 ohm. Typically set to 1 kohm, except when using long cables with a preamplifier output that can drive a 50 ohm load.
 - Signal attenuation: 0 dB (no attenuation) or -6 dB (50%). Typically set to 0 dB, except when the preamplifier output range extends outside +/- 8V, or if the gain is extremely high.
 - Signal Polarity: set so that the X-ray steps are positive-going.
- Signal Coupling
 - DC coupling: for use with resistive feedback preamplifier outputs or the direct output from a PMT connected to a scintillator
 - AC coupling: for use with reset preamplifier outputs to turn the step-pulse into a tail pulse (you will use this setting for all SDD and X-ray HPGe detectors). For the tail pulse, four decay times are available, ranging from

‘very-short’ (around 300 nanoseconds) to ‘long’ (around 2 microseconds). The shorter decay times are meant to support the highest counting rate operation. SDD detectors will use wither the ‘short’ or ‘very-short’ settings; HPGe detectors, which have higher noise, can benefit from the longer decay times.

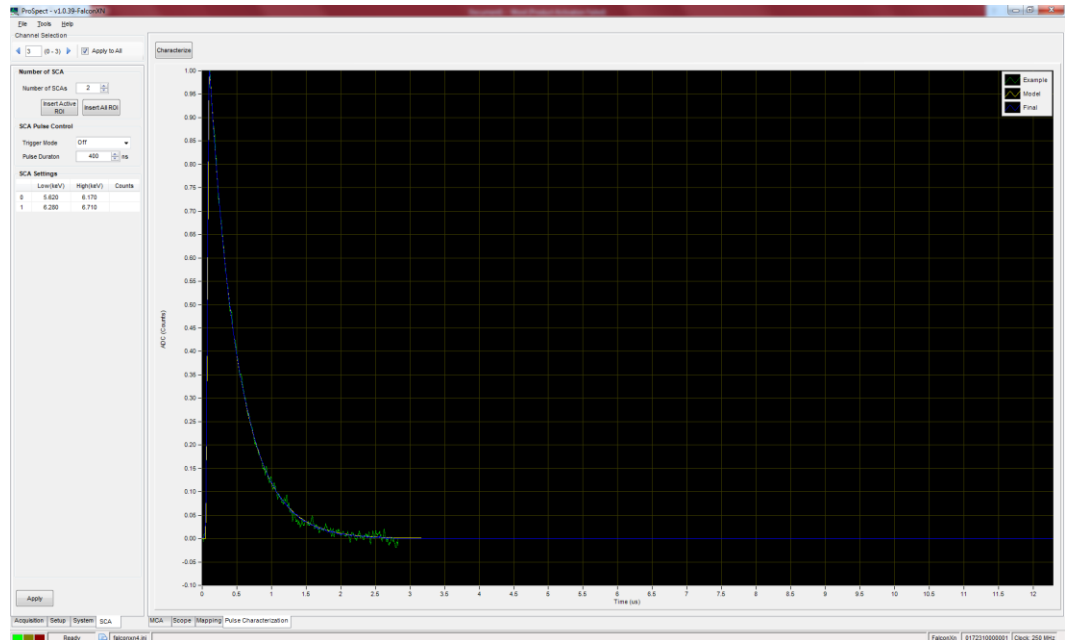
- Gain and offset control
 - The signal gain can be adjusted over a range of x1 to x16 in fine steps (as 12-bit DAC is used)
 - The signal offset can be adjusted so that the baseline value can be placed anywhere in the ADC range. By default, it is in the center of the range.



- The screenshot above shows the signal from an SDD, with the polarity set to give positive-going pulses and the gain set to give a reasonable step size.

2.3 Pulse Characterization

Once the analog settings have been adjusted, the next step is to characterize the pulse, or measure the shape of the pulse; it is necessary to have this characteristic pulse shape prior to collecting MCA data (the MCA will not operate if there is no measurement of the pulse shape). For this step, it is best to have a signal from a simple spectrum (Fe55 or metal foil target), at a moderate count rate (up to 100 kcps – most pulses should be isolated when looking at a Scope trace). To start the Characterization process, either press the ‘Characterize’ button in the setup panel on the left, or choose the Characterization tab on the right and press the ‘Characterize’ button at the top. In either case, the Characterization tab will be activated, and you will see a progress bar along the top. Once the process ends, the display will be updated with the fitted pulse shape, where you will see three curves: a sample pulse, the initial fitted shape based on a sum of two exponentials, and the final pulse shape which is a refined version of that fit.



Please note that if you are using a weak source, the characterization process may fail due to a timeout in the final verification procedure, which starts at the 60% point of the process. In that case, run the process again, and cancel the process once you get to the 60% point – the best fit to that point will be used.

Once you have completed the characterization process, it is a good idea to save the configuration so you can reload it at a later time. Choose File -> Save as ... to store the configuration file; at this point, it is necessary to store each configuration in a separate directory, so as to avoid overwriting the characterization file, which is stored separately from the ini file (and referenced by the ini file).

2.4 MCA Operation

Once you have successfully characterized the pulse shape, you can take MCA data. To get started, switch to the main MCA panel, and also select the Acquisition tab on the left; see screenshot below.

In the Acquisition tab, you can select the number of bins in the spectrum (up to 4k), as well as the bin width (in eV).

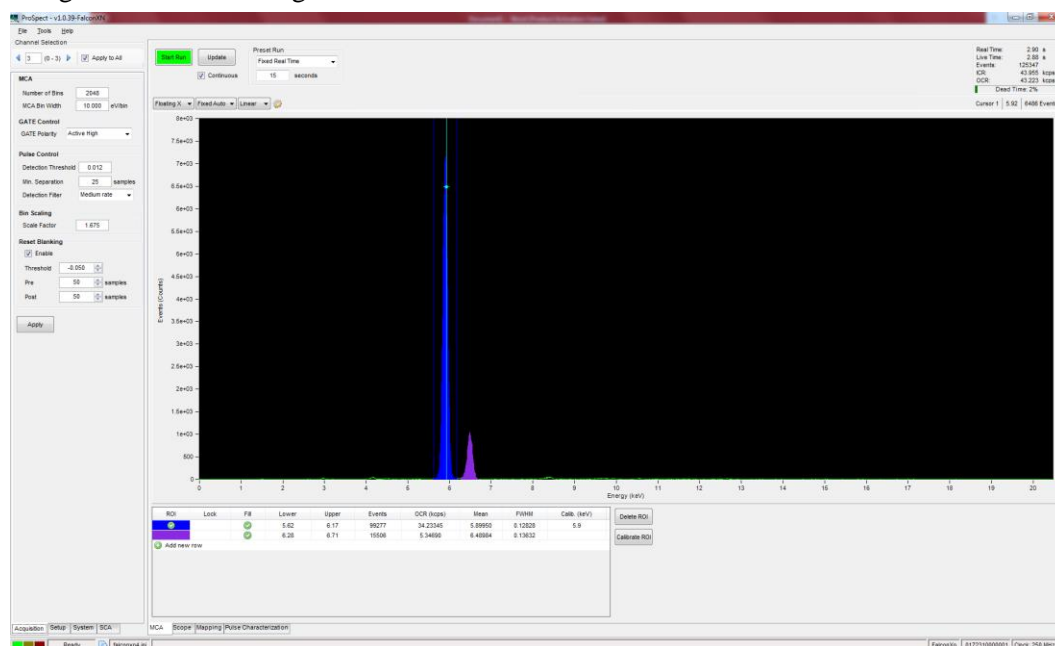
For pulse control, you can set the detection threshold, which is expressed as a fraction of the full ADC range, and is set in the Characterization process – you may not need to adjust the threshold, unless you are working to see the lowest possible energies. The Minimum separation controls how close together two detected pulses can be and be included in the spectrum; a longer separation can give somewhat better resolution at high rates, at the expense of throughput. Finally, you can choose what sort of detection and measurement filter is used to process the pulses:

Low energy: this is the slowest setting, and allows the lowest possible threshold to detect light elements. This setting is also useful to process pulses with very long rise times.

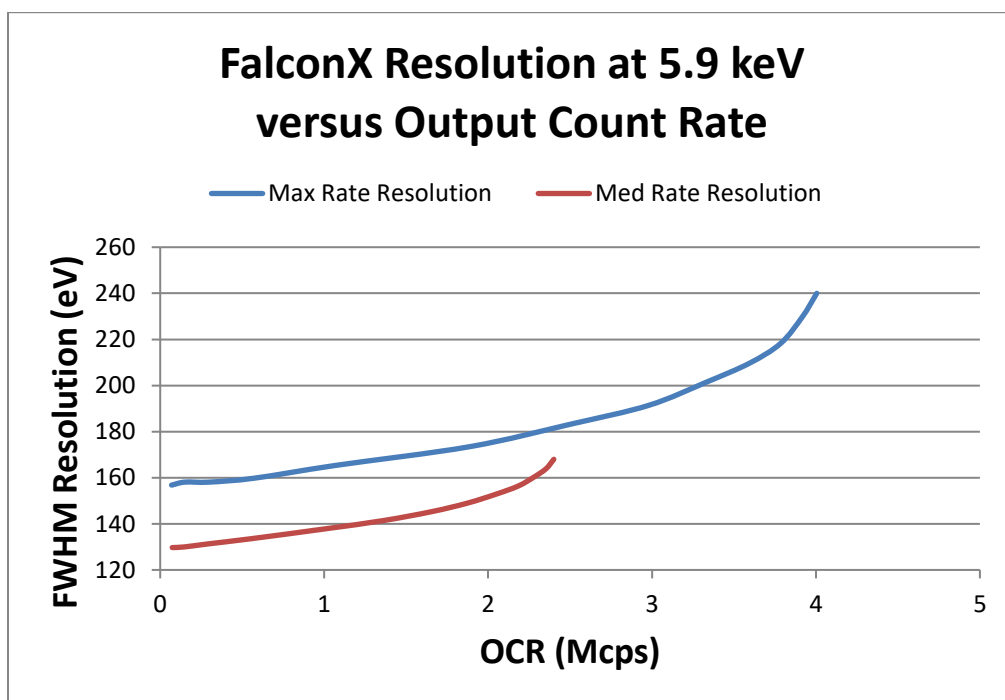
Low rate: Useful for larger area detectors with some pulses with longer rise times.

Medium rate: This is the best all-around setting for most applications, as it combines very high throughput with the best energy resolution for fast detectors.

High rate: this setting works with very fast (typically small area) detectors, and allows for the highest possible throughput and the best pileup inspection, at the expense of some resolution at low rates. Please note that this setting should only be used with very short rise times; resolution performance is significantly degraded using this filter with long rise times.



The performance of the medium and high rate filters with a small area CUBE SDD detector (Ketek H7) is shown below. The high rate setting achieves 240 eV FWHM at an output rate of 4 Mcps, while the medium rate setting achieves better than 170 eV resolution at an output rate of 2.4 Mcps (and better than 140 eV at an output rate of 1 Mcps).



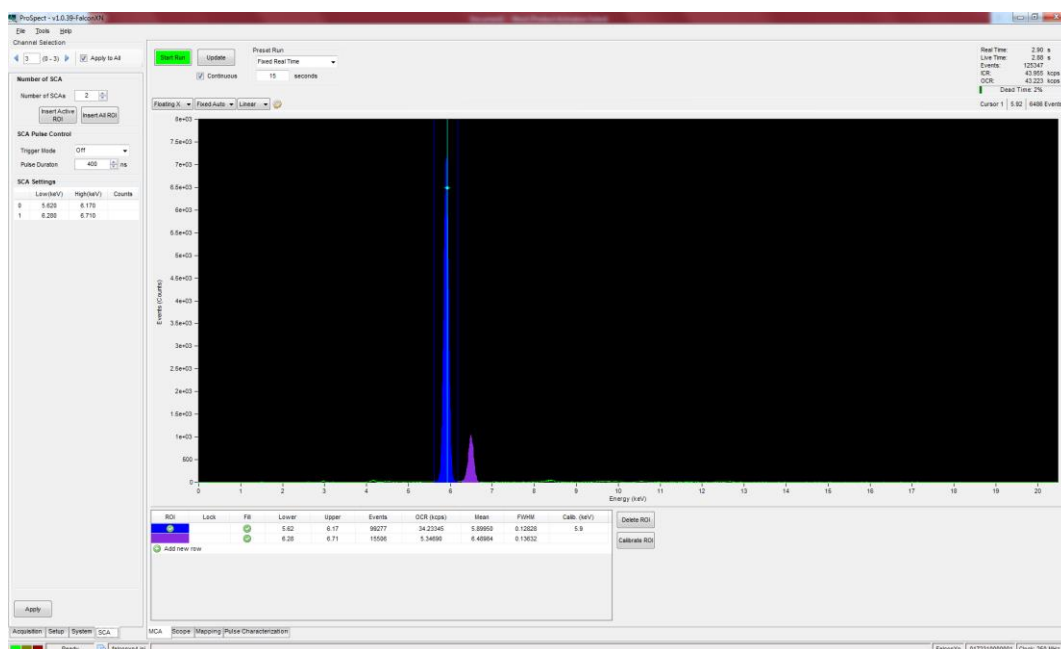
2.5 SCA Outputs

The FalconXn has 32 digital lines available on the high density connector that can support either inputs or outputs. By default, the unit can be set up to have either 16 or 24 digital output lines used to support hardware SCA outputs, where the remaining lines are set up as inputs to support reading in encoder positions or counter outputs. Running under ProSpect/Handel, the default setup uses 24 outputs used for SCA outputs, where the outputs are split evenly per channel (24/channel for FalconX1, 6/channel for the FalconX4 and 3/channel for the falconX8).

Use the SCA tab on the left to set up and control the SCA outputs. The easiest way to set the SCA regions is to define an ROI in the MCA window around the target energy range, then transfer that ROI definition to the FalconXn unit using the appropriate buttons on the SCA panel.

You can control the width of the pulses using the SCA panel; the default pulse length is 400 ns, but can be adjusted in 4 ns steps. Note that the minimum off time for the digital outputs is set to the pulse width (but can be longer, depending on counting rate). Note that a high pulse indicates that a pulse was detected in the corresponding SCA region.

The SCA outputs for the FalconXn are not affected by the run state – you do not need to start a run to get the outputs. The SCA outputs are enabled or disabled using the drop-down box in the SCA panel – they can either be always on or always off, or controlled by the GATE pulse.



2.6 ProSpect

For more details concerning the use of ProSpect, please consult the User Manual for the DXP-Mercury, as the common features of the ProSpect interface are described there and are outside the scope of this short manual.