Real Time Control/Monitoring & Data acquisition system for nuclear polarization with implanted radioactive ions experiments.

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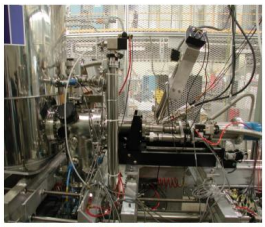
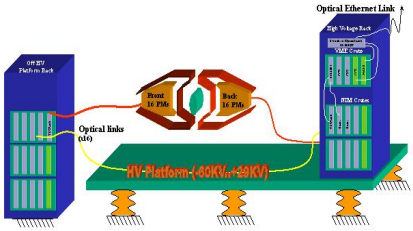
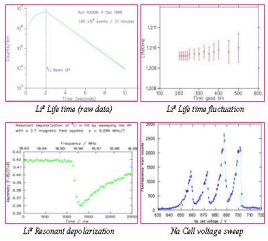


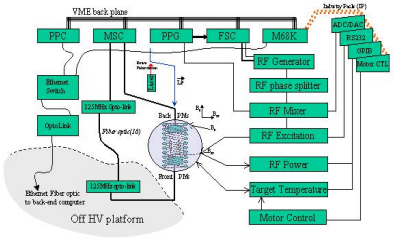
With the availability of the world's most intense source of low-energy radioactive ion beams at the Triumf ISAC facility, the experimenters require state-of-the-art techniques for beam control, polarization monitoring as well as fast data collection.

One of these novel types of experiment focuses on the time evolution of spin polarization, following the implantation of spin polarized isotopes in a sample. To respond to these new challenges, specific hardware has been designed and assembled, which addresses electrical constraints as well as maintaining a highly flexible experimental control. Real-time control and monitoring of these parameters is essential.

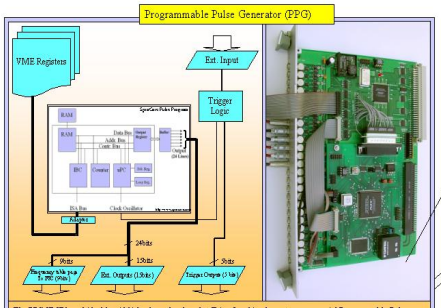
In order to use the ISAC facility to its full potential, experimental designs such as ion implantation depth variation require a high voltage platform (-60KV to +29KV) on which the sample is placed. This setup forces electrical isolation for all connections to the platform.



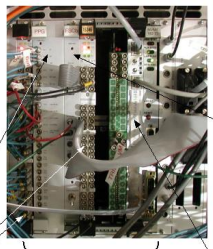




Programmable Pulse Generator (PPG)

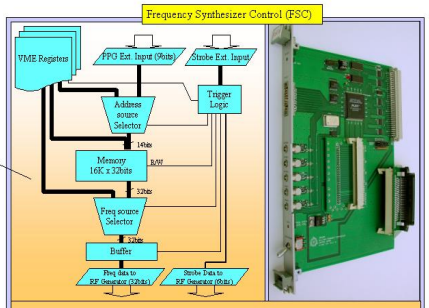


The PPG VME board (double width) has been developed at Triumf, and implements a commercial Programmable Pulse Generator "Pulse Blaster" from SpinCore (www.spincore.com).
This ISA card has its own microprocessor and memory which allows the downloading of sequences for bit pattern output on a 24 bit line, with 0.1 us time resolution. The code generation is based on C and Perl and it is prepared by the back-end computer based on the experimental requirements. This VME PPG has dedicated 9 bit lines to the FSC in order to provide a means of changing the frequency synthesizer "on the fly". The rest of the outputs are used for control and/or monitoring the auxiliary devices involved in the experimental setup.



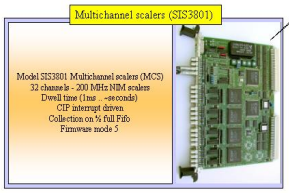
DAQ

Frequency Synthesizer Control (FSC)



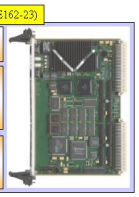
The Frequency Synthesizer Control (FSC) VME board (designed and built at Triumf) acts as a frequency table memory for the FTS160 Frequency Synthesizer. The RF table is loaded through the VME Backplane into the 16Kx32bits RAM. The lookup table is accessed by "stroking" the auto-incremented memory address, either through VME commands or by external input. The content is presented to the Frequency Data output bus connected to the RF synthesizer. With the additional 9 bits of the PPG as input, it is possible to perform sophisticated RF sequences in synchronization with other controllable parameters of the experiment, and with the data acquisition.

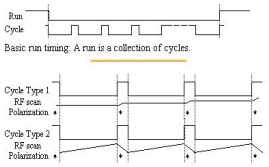
Multichannel scalers (SIS3801)



DAQ MIDAS:
The overall software package coordinating the experimental runs is handled by MIDAS, which provides an easily tailored integrated system to the user for experimental monitoring and data collection.
The experiment requires multiple front-ends in order to collect all the run information.
The beam control is performed through the standard "Experimental Physics and Industrial Control System" (EPICS). Some of the EPICS variables are available to the DAQ through a dedicated Midas front-end.
The target instrumentation is controlled via a second VME processor which run "Control And Monitoring of Peripherals" (CAMP) software which is also accessed by Midas through "mdarc".
The data collection is handled by two "Multichannel scalers" (MCS) which collect the "front" & "back" PM rates. These counts are accumulated and histogrammed directly in the front-end processor and transferred to the back-end computer after each cycle.

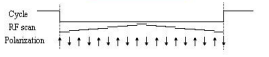
VME Processor (MVME2306, MVME162-23)





Basic run timing: A run is a collection of cycles.

Each cycle is sliced into N bins (MCS dwell time).
For each cycle, external parameters are adjusted depending on the type of experiment.
Type 1: The RF excitation is kept constant within a cycle and/or the beam polarization is flipped every cycle.
Type 2: The RF excitation is ramped up with or without change of the beam polarization



Sophisticated configurations can be performed within a cycle where RF excitation and beam polarization can be varied.