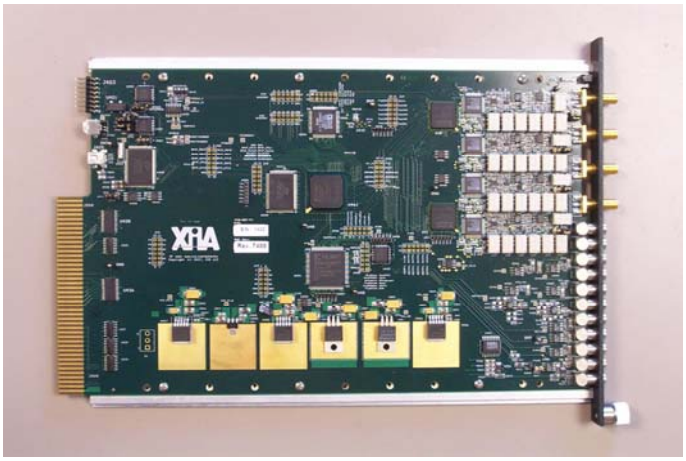
DGF-4C USB

4-Channel 80 MHz CAMAC/USB Digital Spectrometer



OVERVIEW

The DGF-4C USB is a 4-channel all digital spectrometer card in CAMAC form factor, but with a high speed USB 2.0 interface. This latest addition to the DGF series of digital spectrometers is backwards compatible with older DGF-4C models (Revision D and E), but offers a higher digitization rate, better energy resolution, and much faster data readout.

The DGF-4C USB directly accepts signals from HPGe detectors, PMT/scintillator combinations, and most other radiation detectors with RC-type (exponential decay) signals. Decay times can range from <100ns to several milliseconds. After a digitally controlled gain and offset stage, detector signals are digitized by a 14-bit ADC at a rate of 80 MHz. Triggering, pile-up inspection and filtering of the data stream is performed in real time and waveforms up to 12.8 µs (1024 samples) per channel are captured in a FIFO. For each validated pulse, coincidence tests are applied, pulse heights are computed and binned in an MCA spectrum in on-board memory. A second block of on-board memory can store up to 256KB of list mode data - energies, timestamps, waveforms, and results of pulse shape analysis for each event. The memory is read out in a fast block transfer through the USB interface. Several DGF-4C modules sharing clocks and triggers can be combined into a larger acquisition system, with parallel USB readout.

FEATURES

- Complete spectrometer with digital trigger, filter, pileup rejection, MCA and waveform capture at 80 MHz
- Designed for high precision γ-ray coincidence spectroscopy with HPGe detectors
- Directly compatible with scintillator/PMT combinations: NaI, CsI, $LaBr_3$, and many others
- Synchronous waveform acquisition across channels and modules
- Acquisition conditional to on-board coincidence tests between channels
- Addback spectrum for clover detectors
- CAMAC and USB 2.0 data I/O
- Fast block reads from on-board list mode memory
- Front panel I/O for external vetoing (global or channel specific) and for trigger and multiplicity information
- Clock and trigger distribution between modules via auxiliary connector on rear
- User programmable DSP for pulse shape analysis
- Igor Pro graphical user interface and C driver libraries
- Compatible with earlier 40 MHz models (Revision D and E)

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SPECIFICATIONS

Analog I/O:

4x signal inputs, 50Ω or 5 kΩ
Daisy-chained multiplicity sum

Digital front panel I/O (NIM) includes:

In: Global First Level Trigger (Veto)
4x Channel Gate
Global Second Level Trigger (Spare)
Out: DSP Trigger (processing event data)

Host I/O:

Fast CAMAC (<= 5MByte/s)
USB 2.0 (~20MByte/s)

Output data:

MCA:	32K bins for each channel, 2^{32} counts per bin
Waveforms:	1024 samples per channel at 12.5 ns intervals (total 12.8 µs)
Run statistics:	Live time, real time, input/output count rates
List mode data:	Pulse height, time stamp, waveforms, PSA data; up to 256KB/spill

Digital Settings include

Gain:	10:1 in 2^6 steps ±10% digital adjustment for gain matching
Filter:	Filter rise time/flat top from 0.025-100 µs
Control:	Coincidence window and hit pattern, GFLT and GATE polarity, trigger distribution

PERFORMANCE AND APPLICATIONS

Resolutions for a multi-source spectrum are shown in Fig.1. Note the clear separation of lines at 70-90 keV for an overall dynamic range of ~3.2MeV. Resolutions at 1.3 MeV remain below 1.8 keV for up to 40,000 cps (results are detector specific)

The core of the DGF-4C USB is identical to the DGF Pixie-4. Both modules can be used in a variety of applications, including clovers or individual HPGe detectors, multiple detector setups with coincidence requirements, and scintillator applications using pulse shape analysis e.g. to identify particles.

SOFTWARE

The **DGF Viewer** is a graphical user interface for the DGF-4C, based on Wavemetrics' Igor Pro. It calls functions from a C driver library to carry out the communications between the DGF-4C modules and the interface. All parameters can be saved to disk for easy switching between applications. Tools like oscilloscope mode and FFT noise analysis assist in system setup.

The **DGF-4C driver library** is a set of functions written in ANSI C. This library source code is free to users that plan to integrate the DGF-4C into an acquisition system with a custom interface or operating system (e.g. Linux).

SAMPLE PERFORMANCE

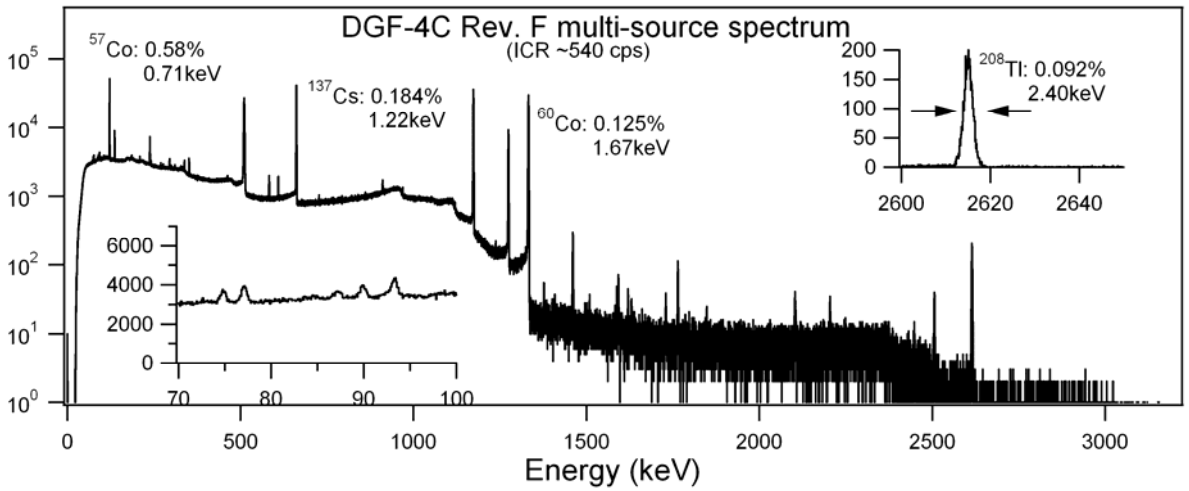

Figure 1: *Multi-source spectrum acquired with DGF-4C USB and a 40% Aptec HPGe detector*