Libera MONACO 3

The Libera MONACO 3 (Multichannel Neutron Acquisition in Campbell Mode) is a multichannel digital acquisition system **dedicated to fission/ion chamber measurements in research reactors.**

Highlights and main features

- Dedicated to in-core and ex-core gaseous detectors including fission chambers and ionization chambers.

- Four independent input channels.

- Wide range of detector operation: the signal from every single detector can be processed in pulse, campbell, and current operating modes simultaneously, making it possible to characterize the entire reactor power range ($1 \cdot 10^{15}$ n $\cdot$ cm^{-2} $\cdot$ s^{-1}).

- Internal high voltage source up to ±1 kV of polarization and 1 mA output current.

- Real-time data processing.

- User GUI that integrates live charts, pulse charge and amplitude calculation, spectra, automatic detector operating curves, (saturation and discrimination) and online statistics.

Dedicated frontend preamplifier

The frontend preamplifier is compatible with the majority of gaseous detectors for in-core and ex-core use. The optimized bandpass allows retrieving pulses with currents of 1 to 10 uA and duration down to 20 ns with a bandpass of more than 20 MHz. Additional filtering allows full EMC shielding.

Real-time data acquisition

The GUI integrates real-time data visualization and statistics. It allows recording the raw data and preprocessed statistics, oscilloscope mode pulse visualization, and Pulse Height Analysis.

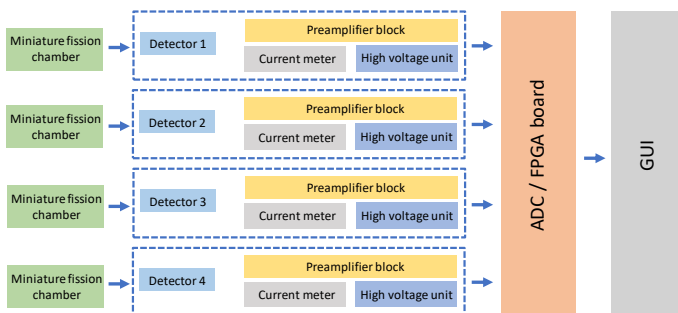The time resolution of the acquired raw data can be set from 1 ms to 100 s.

- GUI screenshot

INSTRUMENTATION TECHNOLOGIES
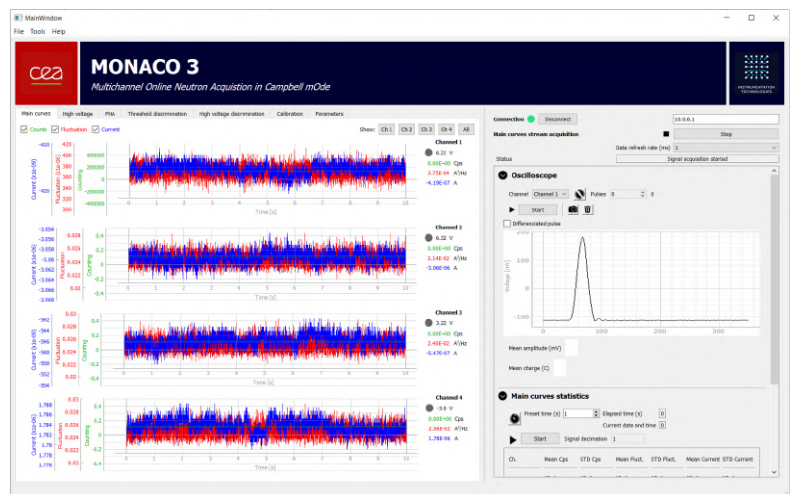
Libera MONACO 3 building blocks

The signal from the detector is collected by the frontend which integrates:

· a specifically developed **transimpedance preamplifier block** that amplifies the current pulses,

· a **high-voltage unit** that polarizes the detector,

· a **current meter unit** that uses two separate measurement ranges: 0 to 1 uA and 0 to 1 mA.
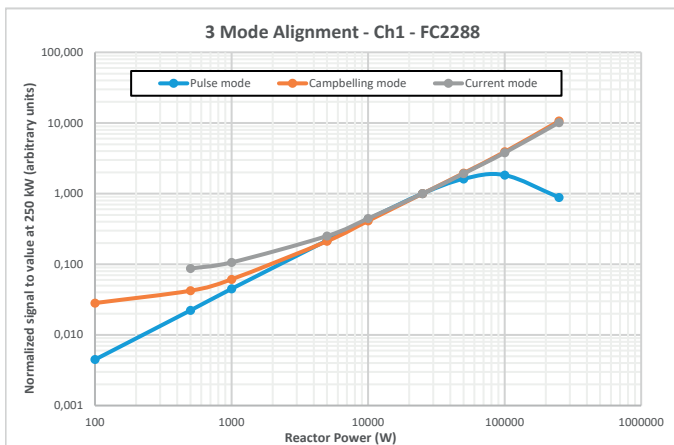
The pulses are then decoupled and digitized by the **ADCs** and processed within the **FPGA**. The digitizer unit is running a Linux-embedded system that is streaming the data on a **GUI** running on a local PC.

Digital Signal Processing

The system allows the user to perform:

· **Fission chamber data acquisition** in parallel in Pulse, Campbell, or Current mode, depending on the fission rate in the detectors. The operator can choose the most relevant mode.

· **Pulse Height Analysis (PHA)**: calculates the charge associated with the pulse population and provides this data in a histogram.

· **Oscilloscope:** in this mode, the instrument works as an oscilloscope and allows to monitor and collect the single pulse signals. It integrates the single pulse charge/amplitude statistics.

· **Automatic generation of saturation and pulse discrimination curves** for determination of optimum detector operating condition.

Technical specifications

Nu. of channels	4	
Acquisition electronics	Sampling rate	500 MS/s
	Resolution	14-bit
	Dynamic range	90 dB
	SoC	Zynq 7035
Bandwidth of the transimpedance amplifier	> 20 MHz which allows retrieving current pulses down to 20 nS with a few uA of amplitude	
High Voltage polarization output	Up to ±1 kV for each independent channel	
Reactor power range	Three measurement modes from zero power to maximum power	
	Counting mode	From a few Cps to 11 M Cps
	Campbelling mode	Intermediate ranges
	Current mode	Up to 1 mA with 1 nA resolution at lower ranges
Neutron flux range	Up to $1 \cdot 10^{15}$ n $\cdot$ cm^{-2} $\cdot$ s^{-1}	
Digital Signal Processing modules	Oscilloscope mode for pulse visualization Pulse Height Analysis Automatic detector operating curves Online statistics and data acquisition	
Dimensions	Rack-mountable: 19" wide, 3U high	
Power	220 V	

Preliminary results of testing at IJS Triga Ljubljana

The preliminary results from the validation campaign at IJS TRIGA MARK II reactor in Ljubljana allowed to cover the entire reactor dynamic range from 0 to 250 kW of power. All the three modes showed consistent linearity with the reactor power over the expected ranges respectively.
The alignment of the three modes, spanning over a decade, holds promise for additional fine-tuning tailored to specific experimental conditions.

· Plot aligning all three measurement modes from a single FC2288 fission chamber detector (manufacturer CEA Cadarache)

Information and sales

The instrument is ready for pre-order.
Testing sessions can be already booked.

Contact us at sales@i-tech.si