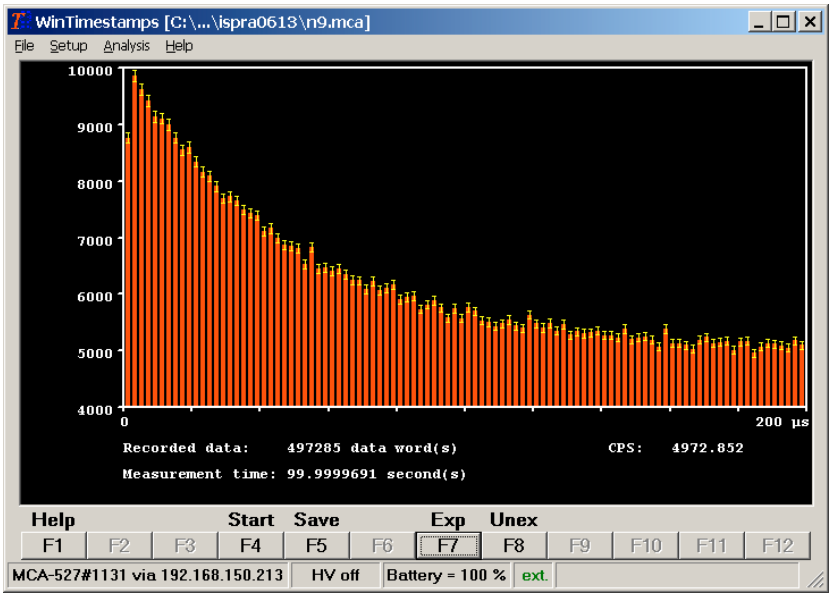
MCA527 for Neutrons

Neutron counting with the MCA527 in multiplicity or coincidence mode

The MCA527 is a battery powered high performance 16K Multi-Channel Analyzer/Multi-Channel Scaler module for gamma spectroscopy (see original data sheet of MCA527). But with upgraded firmware and neutron counting software the same hardware can be used as multiplicity or coincidence counter for neutron counting which picks time intervals between pulses instead of performing pulse height analysis for spectrometry.

The MCA527 works here in list mode as pulse train recorder. In the raw data files the time difference between two subsequent pulses is stored in multiples of 100ns.

Evaluation is done as post processing by the application software which allows to adjust settings (gate width, predelay, delay) even after the measurement. Evaluation includes coincidence analysis, multiplicity analysis and the Rossi-alpha distribution, the latter being a valuable diagnostic tool to monitor the health state of a measurement station.



Rossi-alpha distribution measured with MCA527

In the AHRC counting mode dead times significantly below the duration of the TTL neutron pulses can be achieved, which is better than any normal digital counter.

As with its use for gamma radiation detectors, the MCA527 provides the HV for the neutron detector, i.e. it can be controlled remotely; an optionally available supply delivers the 5V preamplifier voltage for the neutron counter.

The software used for neutron counting is WinTimeStamps. Beyond the above mentioned list mode files it also generates output fully compatible with the widely used INCC software.

The MCA527 has the multiple capability a) to perform gamma spectrometric measurements (i.e. pulse height analysis and gamma scanning) for all types of gamma radiation detectors, b) to do time step analysis for neutron counting, and c) to do all this with the nowadays routinely used informatics environment. This makes it fit perfectly in the suite of instruments for nuclear safeguards and nuclear security.

Specification of MCA527 for neutron coincidence counting

Input

Analog input (BNC), 1kOhm impedance, designed to process signals in the range –2V...+10V, bandwidth (-3dB) 1.3 MHz, ADC14bit, 10 MSps.

Input modes

Level triggered counting

This mode works for fast and slow input signals, as well as for digital and analog ones. An event is assumed if the input signal crosses a threshold which is adjustable. Dead time depends on pulse width and settings, but is typical >0.5µs.

Edge (rise) triggered counting (default)

Similar to level triggered, but the threshold is on the differentiated input signal. Requires fast rise signals (e.g. TTL), but allows dead times down to 200-300ns.

Analog high rate counting

The integral of the input signal over a pulse burst is analyzed for the amount of pulses in it.

Requires pulses which are stable during a measurement in terms of width and amplitude. Pulse width should be in the range 20...200ns. Principally, dead times down to 1ns are possible. Adjustment is done automatically.

Measurement time, memory, count rates

Measurement duration can be defined by preset time (up to 60h) or number of counts (up to 32M). Typically rather the memory will be the limit which corresponds to 320s measurement time at 100 kcps.

More than 300 kcps is not recommended for serious measurement.

If for better statistics more than 32M events are required, repeat mode (multiple cycle) operation is recommended. For multiple cycle operation also data transfer and data evaluation time may become critical. USB may not transfer more than 75 kcps, and depending on computer real time evaluation may be limited to 200 kcps. Exceeding this will cause the measurement to pause between cycles and extend total measurement time.

Data evaluation modes

Coincidence counting

This mode delivers classical shift register evaluation giving totals (T), reals+accidentals (R+A) and accidentals (A). It is possible to adjust predelay (0-10ms, default 4.5µs), gate width (0.1µs..10ms, default 64µs) and delay (0-10ms, default 1ms).

Multiplicity counting

Will give R+A and A for multiplicities from 0 to 128. Very similar to coincidence counting, with the same adjustment possibilities.

Rossi-Alpha Distribution

Shows the time distribution of events after each event. Max. range 0-2ms, min. channel resolution 100ns. This is a valuable tool to evaluate detector time constants and dead times and may be used for quality supervision

Data formats

The raw data is stored as 16 bit numbers in a *.mca binary file which also contains the settings for the individual measurement, so all measurement parameters are traceable.

In repeat mode, a file with the multiplicity evaluation results and the ending *.cnn can be generated. This file can be read by INCC software.

Preamplifier power supply, high voltage

± 12 V, 60mA, ± 24V, 60mA by D9 connector, if needed.

Detector HV up to ±3.6kV (SHV), as default for this application a negative HV module is inserted.

+5V supply for neutron detector preamplifiers: externally, 1A max., stabilized, wall plug in 90-250VAC, low coupling capacitance, rated also for medical applications. Output connector BNC plug.

Computer Interface

Ethernet (recommended), USB and RS232 (not recommended for high count rates).

Software

WinTimestamps together with firmware version 13.07 and higher.

Mechanical, power supply

Housing 164 mm x 111 mm x 45 mm without connectors; weight 820g.

Li-Ion batteries, operation time up to 25h.

Plugs for power supply, interface, LED for status and miniature switch for ON/OFF.

Environmental

operational: at least 0 - 50 °C, eventual larger range.

humidity up to 90%, non condensing, IP42.

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