

Features



- Neutron Coincidence Analyzer and Multiplicity module combining the Shift Register and Pulse Train Recorder functions
- Neutron counting capability on multiple detectors
- Dedicated to Nuclear Safeguards and nuclear material process monitoring in its life cycle
- Up to 512-channel histogram of multiplicity data (Real+Accidentals and Accidentals)
- Time-stamped lists saved to PTR-32 compatible file format
- Unattended operation with data logging capability (two removable SD cards and USB stick)
- Redundant storing mechanism implemented for higher reliability in unattended operation
- Minimum pulse width detection of 10 ns
- Pulse pair resolution: 10 ns + pulse width
- 8 inputs on LEMO connectors (TTL, 50 Ω) with independent counting capability
- Special video output (HDMI) to externally monitor the state-of-health of the device
- Single high-power high-voltage supply output (+2000 V @ 500 μ A)
- Two high-power low-voltage outputs (+5V / +12V @ 1 A)
- 1 GbE and USB-2.0 interfaces
- Fully controlled by CAEN Shift Register readout software
- Compliant to INCC software package
- Fully remotely controllable by Web Interface
- 19" rack mount capability

Description

The CAEN **Mod.R7780** manages the acquisition and analysis over up to 8 neutron detectors that can work in unattended mode. Mechanics are compliant to 19" racks, and it can be operated also as stand-alone.

This is a Neutron Coincidence Analyzer and Multiplicity module combining the functions of a Shift Register and a Pulse Train Recorder. The eight single-ended TTL inputs (LEMO) feature independent counting capability. Moreover, adjustable input thresholds give the possibility to compensate TTL signal voltage drops in case of long-distance use.

The internal 100MHz sampling clock fits for high count-rate applications and the on-board intelligence synergy of a FPGA and a Single Board Computer (an ARM CPU running Linux) makes it possible to provide time-stamped lists and the overall neutron counting information (coincidence timing, multiplicity distributions of coincident events, etc.) required for the analysis in Nuclear Safeguards and nuclear material process monitoring.

After the start-up sequence based on a programmable configuration file, the device can collect data without external control on a local non-volatile memory. Two SD cards, externally accessible for insertion/extraction, store all measurement results and log information in two identical copies for redundancy reasons. The presence of a OTG USB port allows the automatic data retrieval by a USB stick.

The device can also operate in attended mode controlled by an external host computer using the USB port as virtual point-to-point serial connection (reserved for INCC software⁽¹⁾) and a remote network connection through the ethernet port.

The R7780 is equipped with a video output (HDMI) to connect an external display for monitoring the state of the device and acquisition information.

High power outputs are available as well: one high-voltage channel for the detector biasing and two different low-voltage channels (+5V and +12V) to power the front-end electronics such as preamplifiers and discriminators.

The R7780 is fully supported by CAEN ShiftRegister control software which configures the device and handles the data acquisition. In attended mode, the raw data can be saved to binary files on the host computer for offline analysis (supported PTR-32 format compatible with the INCC software). Complete device control, including firmware upgrade, is also possible by Web Interface.

(1) INCC Software Users Manual: <http://lib-www.lanl.gov/la-pubs/00326587.pdf>

Technical Specifications

Mechanical

Form Factor: 1U width, 265mm depth compatible with 19" rack
Weight: 2400 g

Connectors

Inputs

- 8 signal inputs
- Single-ended TTL ($Z_{in} = 50 \Omega$)
- LEMO 00 female socket
- Internal fast comparator with a software-programmable TTL threshold (from 0.1 V to 4.3 V with a resolution of 0.01 V) common to each group of 4 channels to compensate for cable length signal attenuation

HV

High Voltage output
SHV plug

+5V, +12V

Low voltage outputs
BNC jack
receptacle

SD1, SD2

Memory slot for
SD card

EXT

OTG USB2.0
port for USB
stick
Type-A socket

HDMI

Video monitoring
output
Type-A HDMI
socket

USB

USB-2.0 port
Type-B socket

ETHERNET

GbE port
RJ45 shielded
jack

Power In

9-36V DC rack
power input

Minimum Pulse Width

10 ns

Pulse Pair Resolution

Pulse width + 10 ns

Hvps Output

Single channel for the detector power supply:

- **Output Bias Voltage (V_{set}) = 0 to + 2000 V**
- **V_{set} Resolution = 1 V**
- **V_{mon} Resolution = 1 V**
- **V_{out}/V_{set} ($V_{out} > 200 V$) Accuracy = 1.5%**
- **V_{out}/V_{mon} ($V_{out} > 200 V$) Accuracy = 1.5%**
- **Ramp-Up/Ramp-Down = 1 to 500 V/s in steps of 1V**
- **Maximum Output Bias Current (I_{set}) = 500 μ A**
- **I_{mon} Resolution = 1 μ A**
- **I_{max_out}/I_{set} ($V_{out} > 500 V$) Accuracy = 3%**
- **I_{out}/I_{mon} ($V_{out} > 500 V$) Accuracy = 3%**

Low Voltage Outputs

Two channels for the preamplifier power supply:

- +5 V @ 1 A
- +12 V @ 1 A

On-board CPU

SBC: ARM Cortex-A9 quad core @ 1 GHz running Linux®

FPGA: Cyclone V GX

Operating Modes

- UNATTENDED: After the start-up sequence, all data are logged on-board without external intervention
- ATTENDED: The device works under full control of an external PC (INCC software compliance) transmitting raw data for further analysis; time-stamped lists are saved to binary files compatible with PTR-32 format
- LIST: Like the attended mode, but raw data are saved on the SD cards to PTR-32 files under the user external control

Data Logging On SD Card

- Local storage on non-volatile memory of log files and analysis results (Coincidence and Multiplicity data) in an unattended mode, while log files and raw data (time-stamped pulses) in list mode.
- Two removable 32GB SD cards replicate same folder structure and contains same data for redundancy reasons to prevent from non-volatile memory device failures
- LED indicators inform on the SD card state.
- Attaching a USB stick to the OTG USB port activates the fully automatic copy of all data from non-volatile memory; a LED indicator shows the state of the process.

Programmable Parameters

- Gate width from 10 ns to 1.3 ms in steps of 10 ns
- Pre-delay: from 0 to 100 μ s in steps of 10 ns
- Long delay (the delay between the Reals+Accidentals gate and the Accidentals gate) from 0 to 5 ms in steps of 1 μ s
- Measurement time between 0.1 s and 43600 s (12 h)
- Reals+Accidentals and Accidentals on 64-bit counters
- Number of multiplicity bins for Accidentals and Reals+Accidentals up to 512 (32 bits per each bin)

System Performances

- Internal clock = 100 MHz
- Timestamp resolution = 10 ns
- Pulse pair resolution = pulse width + 10 ns
- Maximum rate in coincidence/multiplicity mode = 7 Mcps (measured at constant rate)
- Maximum rate in counting mode = 16.6 Mcps (measured at constant rate)

Communication Interfaces

Ethernet

- 1 Gbit Ethernet,
- 1000Base-T
- Configuration, operation, and data taking in attended mode

USB

- USB 2.0 version
- Virtual COM port reserved for local communication through the INCC software protocol with a Windows-based computer
- Configuration, operation and data taking in attended mode

Software

- Windows® and Linux® support
- CAEN Shift Register control software
- Compatibility with INCC software
- Web Interface (Board information retrieval and configuration, files management, data readout, firmware upgrade)

Environmental

- Operating temperature: -10°C to +55°C
- Storage temperature: -10°C to +85°C
- Operating humidity: up to 93%
- Storage humidity: up to 93%
- Operating Humidity: up to 93% RH non condensing
- Storage Humidity: up to 93% RH non condensing
- Altitude: < 2000m
- Pollution Degree: 2
- Overvoltage Category: II
- EMC Environment: Commercial and Light Industrial
- IP Degree: IPX= Enclosure, not for wet location

Regulatory Compliance

EMC: CE 2014/30/EU Electromagnetic compatibility Directive
Safety: CE 2014/35/EU Low Voltage Directive

Power Requirements

Integrated primary power supply unit 9-36V DC:

- 1 A @ 28 V
- 1.17 A @ 24 V
- 2.4 A @ 12 V
- 3.22 A @ 9 V

Measured in full load conditions (12V and 5V preamplifier outputs on 1A, HVPS output on 2kV @500 µA, SBC on, fan on, USB stick in, 2 SD cards in, Ethernet link active)

Ordering Options

Code	Description	
WR7780AXAAAA	R7780A - CAEN Shift Register Multiplicity and Time Recorder	RoHS
WR7780XAAAAA	R7780 - CAEN Shift Register Multiplicity and Time Recorder (UDL1)	RoHS
WR7780XXAAAA	R7780X - CAEN Shift Register Multiplicity and Time Recorder (Discontinued)	RoHS

Related Products

DT7790



Unattended Dual Current Monitor

A1421



Preamplifier and Discriminator for 3He tubes

Gallery



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