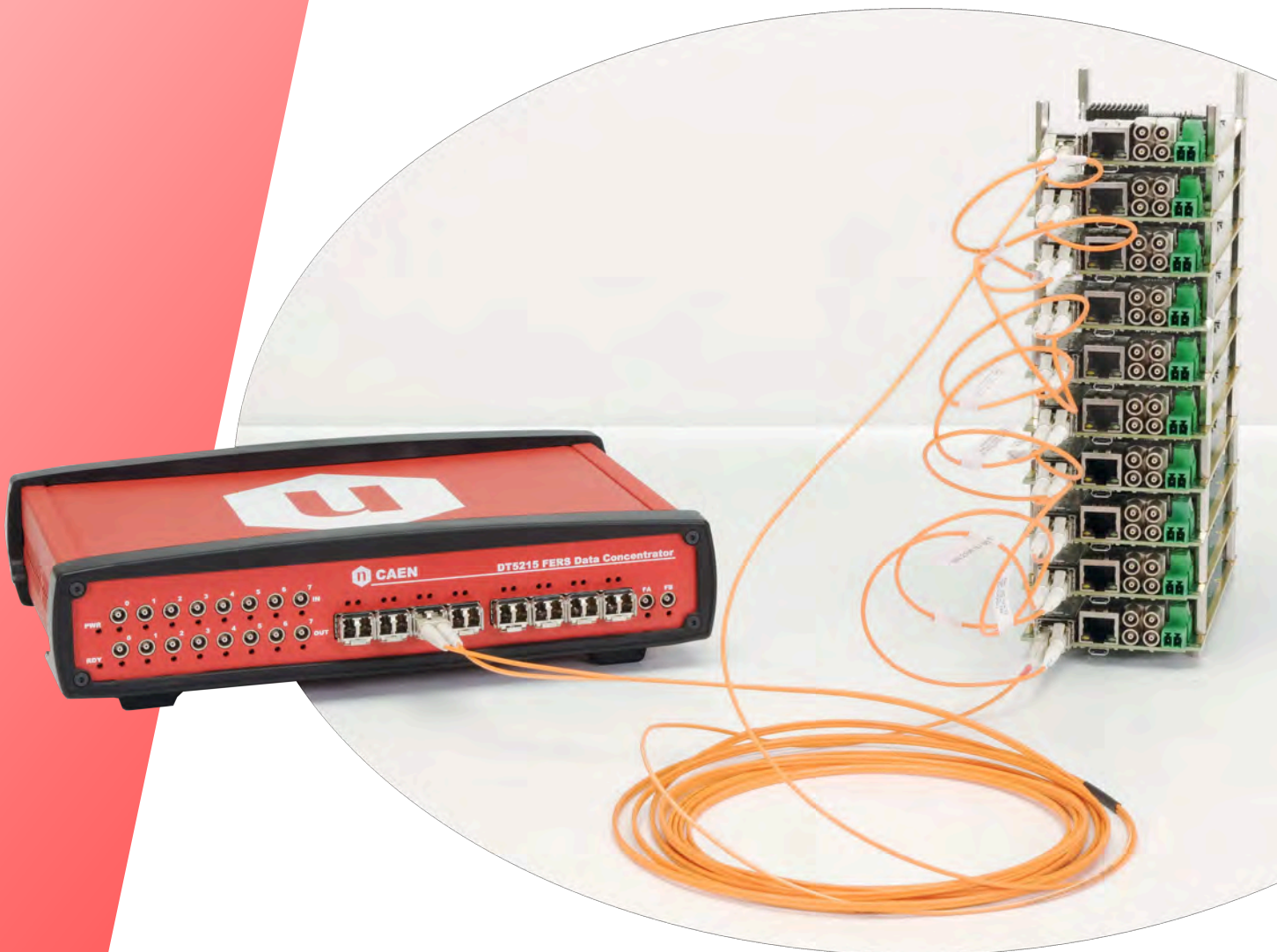


# FERS 5200

## *Front-End Readout System*





# FERS-5200

**Modular, scalable and synchronized set of electronics surrounding your experiment and reading out thousands of detectors!**

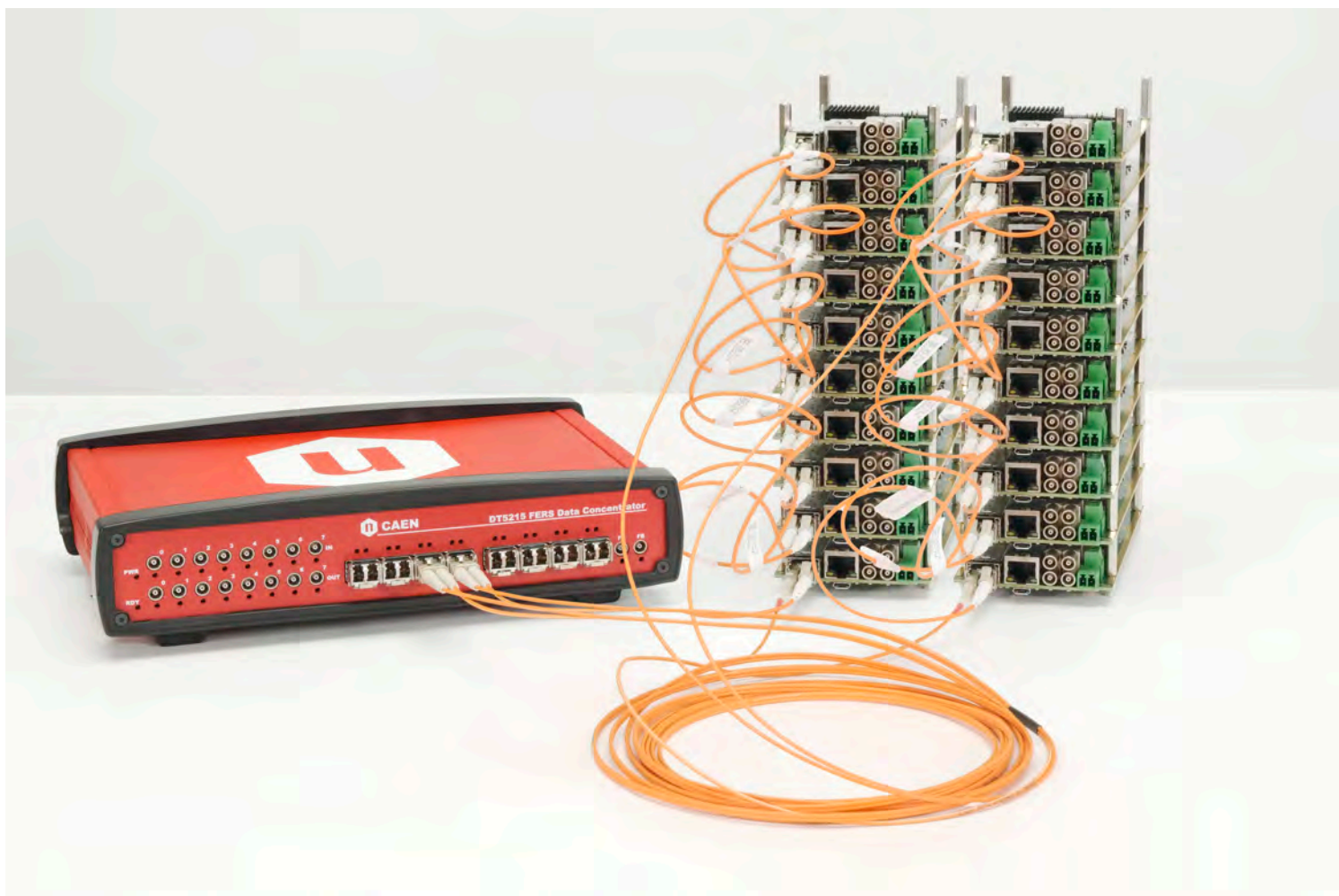
FERS-5200 is a Front-End Readout System designed to read out large arrays of detectors, such as SiPMs, multi-anode PMTs, Silicon Strip detectors, Wire Chambers, GEM, Gas Tubes and others.

FERS is a distributed and easy-scalable platform, where each unit is a small card that houses 64 or 128 channels with Front End electronics (in most cases based on ASIC chips), synchronization, local memory and readout interface.

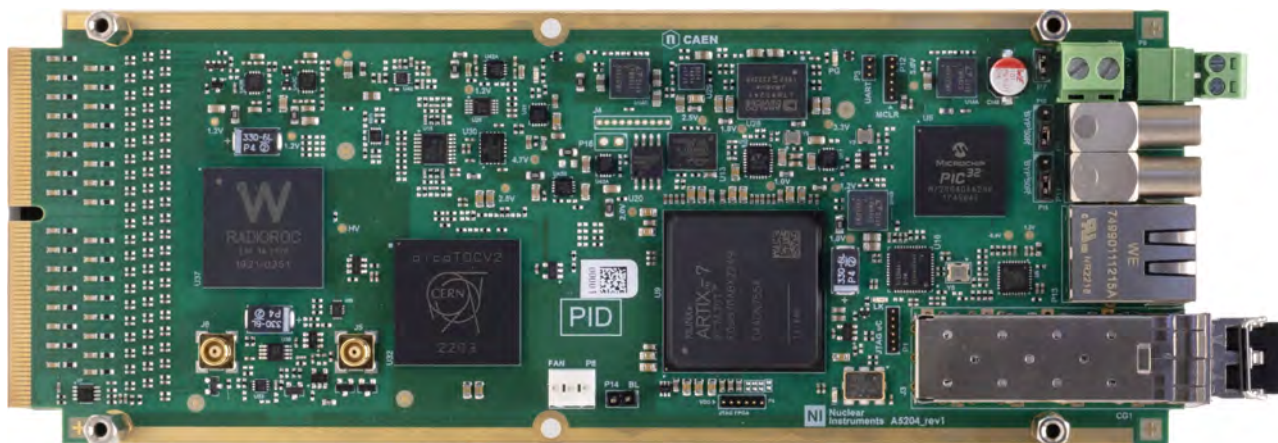
Multiple FERS units can be connected in a tree network thanks to the DT5215 Concentrator Board, that exploits

the optical TDlink (a CAEN proprietary protocol that can perform synchronization and exchange data at the same time) as the unique physical connection that guarantees high throughput data readout, slow control and accurate timing synchronization.

FERS has been created keeping flexibility in mind: a single user-interface and readout infrastructure has been designed to support and perform a wide range of front-end tasks suitable for a large variety of detector types.



DT5215 Concentrator Board connected to 16 FERS boards



A5204/DT5204  
64 CHANNEL RADIOROC UNIT FOR FERS-5200



## MAIN FEATURES

- Platform for the readout of large arrays of detectors (SiPM, MA-PMTs, Gas Tubes, Si detectors, ...)
- Versatility: a family of Front-End cards (FERS units) tailored for different detectors
- Scalability: from a single standalone FERS unit for prototyping to many thousands of channels, with simple tree network structure
- Modularity: multiple FERS units can be distributed on a large detector volume and managed by a single Concentrator board
- Flexibility: possibility to fit different front-end in the same architecture
- Compactness: front-end cards with high channel density ASICs and effective connection to the detector backplane
- Easy-synch: optical link (TDlink) daisy-chain for data readout, slow control and boards synchronization
- Concentrator Board with 8 TDlink
- Boxed FERS unit for desktop use or naked for customizable mechanical frames



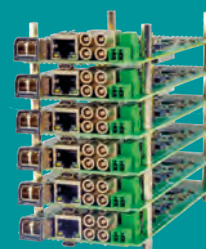
### JANUS

Software for FERS 5200 units control and data acquisition:

- x5202 version
- x5203 version

# FERS-5200

Flexible and scalable network



### A5202/DT5202

Front end readout unit:

- preamplifier
- slow shaper with pulse height detectors
- fast shaper and discriminator

### DT5215

Concentrator board for FERS 5200 units synchronization and alignment with external systems.

**TDlink protocol (CAEN proprietary)**

### A5203(B)/DT5203

CERN picoTDC timing unit:

- Time Of Arrival
- Time Over Threshold





# A5202/DT5202

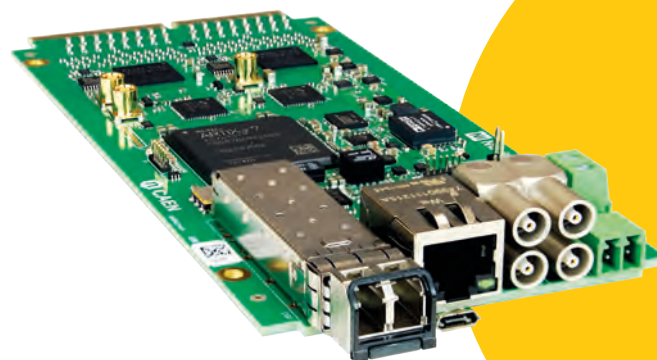
## 64 CH READOUT AND BIAS FOR SILICON PHOTOMULTIPLIERS



A5202



DT5202



**Ideal to read out large arrays of SiPM.  
Full compatibility with 64-pixel matrices**

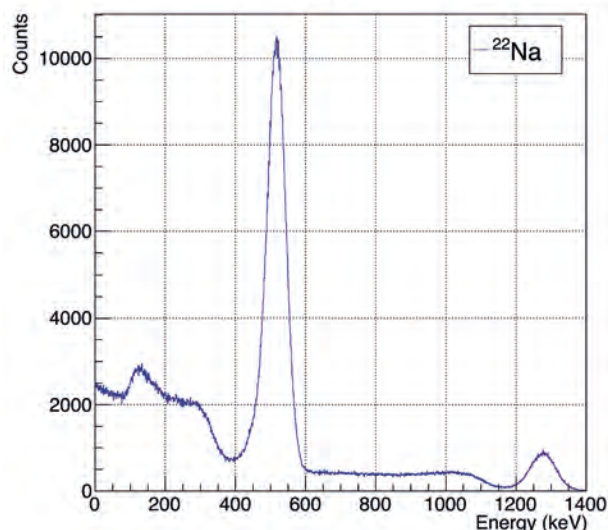
The A5202 is a small board (~ 7 cm x 17 cm) housing two Citiroc-1A chips (64 readout channels). Each readout channel is composed of a Preamplifier, a Slow Shaper with pulse height detector, and a Fast Shaper followed by a discriminator. Pulse height values from each Citiroc-1A are converted sequentially by a 13-bit ADC to perform energy measurements. The 64 channel self-triggers (discriminator outputs) can be used for counting, time stamping, to determine the Time over Threshold (ToT) information, and also to generate the board bunch trigger that starts the ADC conversion. The A5202/DT5202

board also integrates the A7585D power supply module necessary for biasing the SiPMs, and the interfaces for readout, synchronization, and control.

The Janus software, allowing to completely manage the A5202/DT5202 module and the data acquisition, is also provided for free by CAEN.

The offer is completed by a useful set of cables and adapters to connect different kind of SiPMs and possibly remote them, to enable easy fitting into any real setup.

### LYSO



Landau distribution of cosmic rays measured with the A5202 using coincidence trigger logic.

**REMOTIZATION KITS  
AND ADAPTERS  
available for maximum  
flexibility!**



A5260

### ACCESSORIES

#### Input adapters:

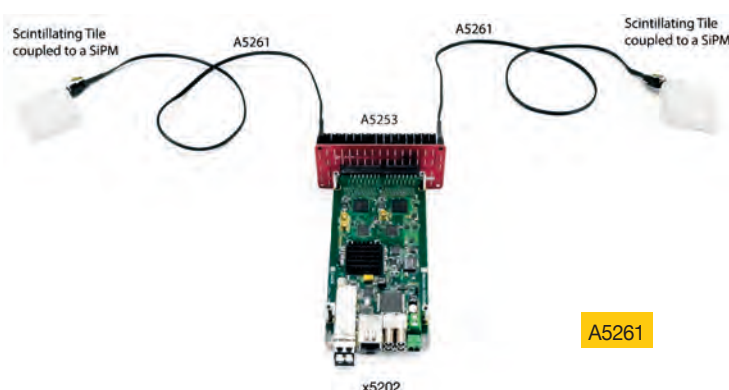
- A5250 - 2.54 mm pin header adapter (included with DT5202 model)
- A5251 - Hamamatsu MPPC adapter
- A5253 - 3-pin adapter for single-pixel SiPMs
- A5254 - SensL ArrayJ adapter

#### Cables:

- A5260 - Remotization cable for FERS-5200 boards - 50 cm
- A5260B - Remotization cable for FERS-5200 boards - 100 cm
- A5261 - SiPM remotization cable (70 cm) for A5253

#### FAN

- A5270 - FERS cooling fan



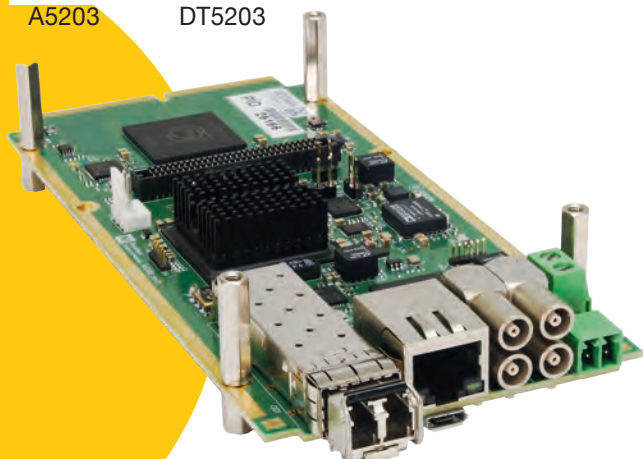
A5261



A5203



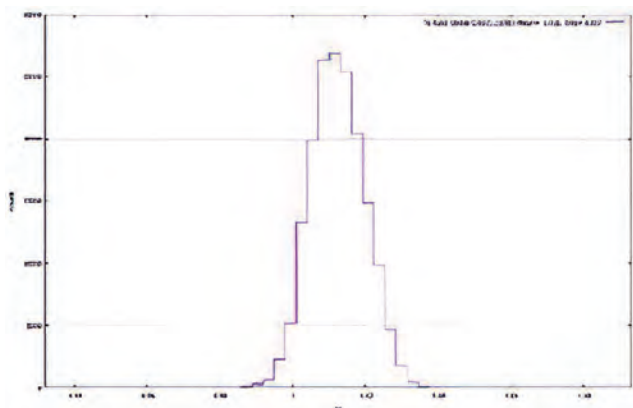
DT5203



**The best achievable timing resolution in a compact form factor and optional dual-threshold discriminators**

The A5203 is a small board (~ 7 cm x 17 cm) housing a CERN picoTDC ASIC, featuring 64/128 digital inputs for time measurements. Each readout channel can accept LVDS signals and measure their rising/falling edge timestamps. In this way, the unit is able to reconstruct Time of Arrival of signals as an absolute timestamp or as a deltaT with respect to a common Tref pulse, as well as the Time over Threshold that allows for amplitude estimation or walk correction.

Typical RMS resolution is 7 ps<sup>(\*)</sup>.



(\*) Spectrum of  $\Delta T$  between ch1 and ch0 in Common Start Mode, measured with a pulse generator, 1 V single-ended pulse, 0.8 ns rising edge using the A5255 adapter. The RMS resolution is nearly 7 ps.

A5256

**16+1 channel single threshold, or 8+1 channel dual threshold, leading edge discriminator for analog signals available!**

## A5203/DT5203

**64/128 CH TDC WITH 3.125 ps LSB RESOLUTION**



The Janus software, allowing to completely manage the A5203/DT5203 module and the data acquisition, is also provided for free by CAEN.

The offer is completed by a useful set of adapters to easily connect signals with flat cables to the high-density input edge-connector of the A5203. Moreover, the A5256 adapter allows to use 16+1 analog/digital single-ended signals on LEMO connectors and discriminate them thanks to the embedded fast voltage comparators with programmable threshold.

### ACCESSORIES

#### Input adapters:

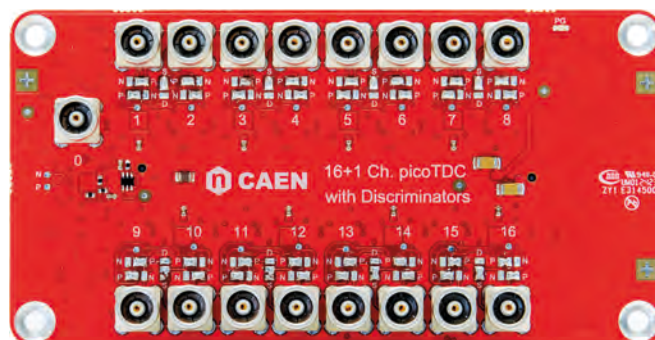
- A5255 - Quad 17x4 Header Adapter (included with DT5203 model)
- A5256 - 16+1 ch. Pos/Neg Discriminator for A5203

#### Cables:

- A5260 - Remotization cable for FERS-5200 boards - 50 cm
- A5260B - Remotization cable for FERS-5200 boards - 100 cm

#### FAN

- A5270 - FERS cooling fan



# A5204/DT5204

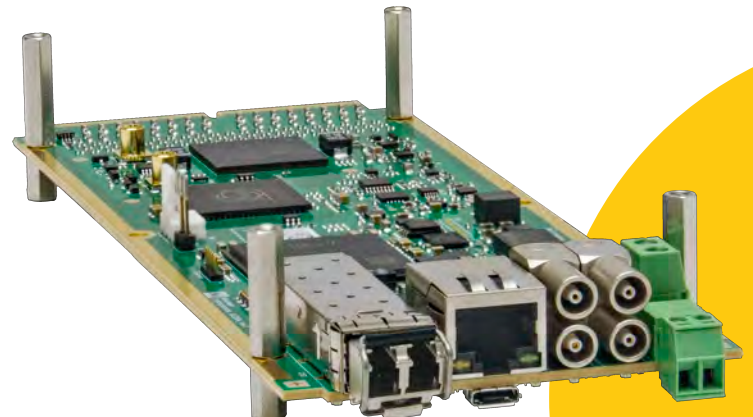
## 64 CHANNEL RADIOROC UNIT FOR FERS-5200



A5204



DT5204



**SiPM, 10/100 MbE, TDlink,  
USB 2.0, Web Interface**

The A5204 is a small board ( $\sim 7 \times 20 \text{ cm}^2$ ) housing one Weeroc Radioroc ASIC and one CERN picoTDC chip, featuring 64 analog inputs.

Besides a slow shaper with a pulse height detector for the data acquisition, the Radioroc ASIC includes configurable fast pre-amplifiers followed by fast shapers and discriminators that can output 64 individual channel triggers with jitter as low as 55 ps FWHM on a single p.e. The individual channel triggers are connected to the FPGA, for photo-counting up to 200 MHz as well as for the implementation of coincidences, majority and topological acquisition triggers. The individual triggers are also connected to the picoTDC chip, that allows for very precise timing measurements thanks to the 3.125 ps LSB. Time Over Threshold (ToT) can also be used to estimate the pulse height, making it possible to acquire time stamp and PHA with very low dead time and extremely high rate, without the need of the multiplexed A/D conversion.

The A5204/DT5204 integrates the A7585D power supply module for the SiPM biasing, and the interfaces for readout, synchronization and control.

Janus 5204 Open Source software on Windows® and Linux® is provided for free by CAEN for an easy management of the board configuration and data acquisition.

As for the other FERS-5200 units, the A5204/DT5204 present a wide range of accessories: adapters and cables specifically designed to provide versatility of choice and the ability to remotely operate the detectors.

### ACCESSORIES

#### Input adapters:

- A5250 - 2.54 mm pin header adapter for A5202/DT5202 & A5204/DT5204
- A5251 - Hamamatsu MPPC header adapter for A5202/DT5202 & A5204/DT5204
- A5253 - 3-pin header adapter for A5202/DT5202 & A5204/DT5204
- A5254 - OnSemi (ex SensL) ARRAY J/C header adapter for A5202/DT5202 & A5204/DT5204

#### Cables:

- A5260 - Remotization cable for FERS-5200 boards
- A5261 - SiPM remotization cable (0.7 m) for A5253

#### FAN

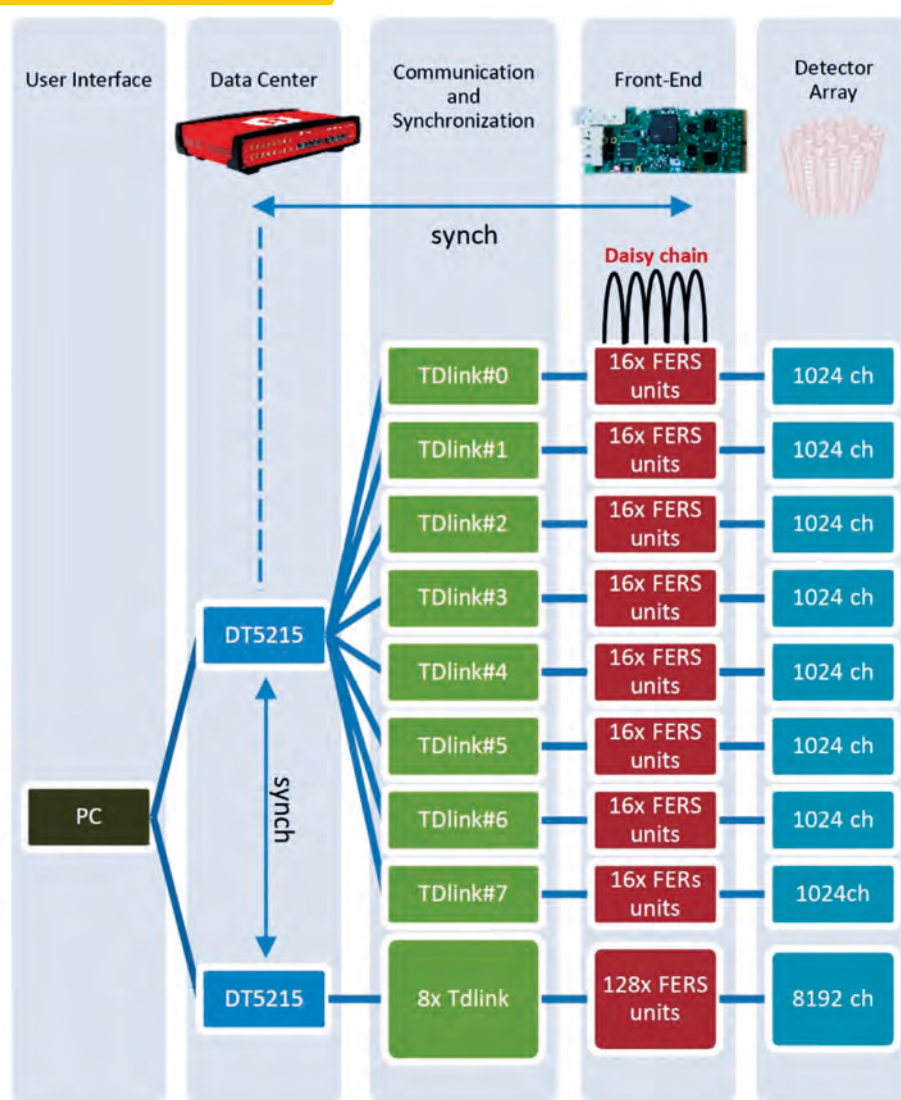
- A5270 - FERS cooling fan





# DT5215

## CONCENTRATOR BOARD FOR FERS-5200

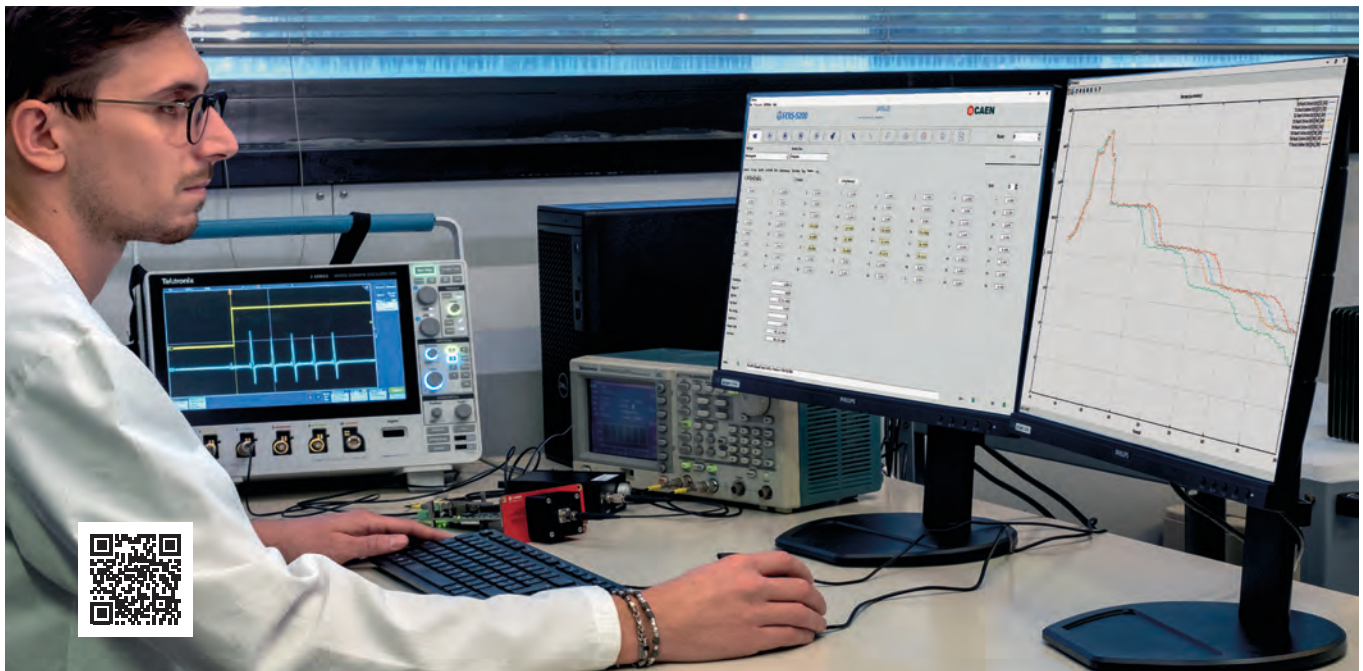


The DT5215 Concentrator Board is responsible for synchronization and data collection from multiple FERS units. It features 8 optical TDLink connectors, each with the possibility of controlling up to 16 FERS units in daisy-chain, for a total of 128 cards per concentrator. Multiple concentrator boards can be synchronized in order to further extend the total number of channels.

The Concentrator is the core of DAQ, picking up the fragments acquired by each unit and sending them sorted and merged to the host PC. A Linux-based Single Board Computer is embedded in the Concentrator board. It manages the data readout from the network of FERS units and the event data building according to the time stamp and/or trigger ID of the event fragments acquired by each unit. Sorted and merged data packets are then stored in the local memory and finally sent to the host computers through a fast 10 GbE or USB 3.0 link. Custom algorithms for data processing and reduction can be easily uploaded by the user into the embedded CPU.

# JANUS

## FERS-5200 DAQ SOFTWARE



**A single DAQ software to control the FERS-5200 board family. Available in Console and GUI Mode, it allows the user to customize the DAQ, and offers an easy way to approach multi-boards and high-channel density FERS-5200 systems.**

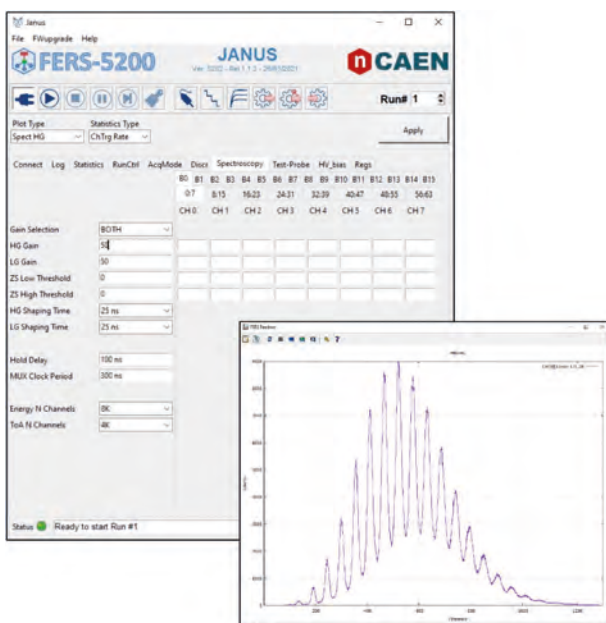
Janus is an open source software for the control and readout of FERS-5200 boards. Available in two versions (Ver. 5202, Ver. 5203), it can be used as a platform for the development of custom DAQ, tailored to the specific application. Indeed, the user can change the data treatment, the acquired statistics and the output file format.

Janus can manage up to 16 FERS units connected via Ethernet or USB directly as well as the readout of the DT5215 Concentrator Board, so that a single user interface is available for the whole system.

Janus is composed of two parts, one written in C, which is the real heart of the application, one written in Python which manages the user interface. The plots are executed through Gnuplot. All the configuration parameters are written in a textual configuration file.

It is possible to launch and use Janus in 2 different modes:

- **Console Mode.** In this case, the Python part of the software is not used. The user can edit the configuration file with any text editor and save the proper values for the desired parameters. Then, the user can launch a purely textual console window. The application writes a series of messages (which are also saved in a log file) and, during the run, prints statistics on the screen. The only graphical part is the plot, which is managed by Gnuplot.
- **GUI Mode:** In this case, the user only have to run the Python program which calls the C program and connects to it via a socket to send commands and receive messages which are then displayed in the Python GUI.



### Features

- Model-dependent GUI for a quick and easy start
- Open-Source for user customization
- Management of the acquisition parameters of all connected boards
- Multi parametric Jobs and Runs with time or counts preset
- Data saving of lists in .bin, .txt format
- Statistics and Plots visualization



## ORDERING OPTION

### FERS

#### A5202/DT5202+Adapters&Cables

Code	Description
WA5202XAAAA	A5202 - 64 Channel Citiroc unit for FERS-5200
WDT5202XAAAA	DT5202 - Desktop 64 Channel Citiroc unit for FERS-5200
WA5250FHAXAA	A5250 - 2.54 mm pin header adapter for FERS-5200
WA5251FMAXAA	A5251 - MPPC header adapter for A5202/DT5202
WA5253F3AXAA	A5253 - 3-pin header adapter for FERS-5200
WKA5253X64AA	A5253 Kit - A5253 adapter and 64 SiPM remotization CABLES
WA5254FSAXAA	A5254 - SensL ArrayJ Adapter for A5202/DT5202
WA5260XAAAA	A5260 - Remotization cable for FERS-5200 boards - 50 cm
WA5260BXAAAA	A5260B - Remotization cable for FERS-5200 boards - 100 cm
WA5261XAAAA	A5261 - SiPM remotization cable (0.7 m) for A5253
WA5270FANXAA	A5270 - FERS cooling fan



A5251 - MPPC header adapter (SiPM matrix not included)



A5253 - 3-pin header adapter for FERS-5200



A5254 - SensL ArrayJ Adapter for A5202/DT5202



A5250 - 2.54 mm pin header adapter for FERS-5200

#### A5203/DT5203+Adapters&Cables

Code	Description
WA5203XAAAA	A5203 - 64 Channel pico-TDC unit for FERS-5200
WA5203BXAAAA	A5203B - 128 Channel pico-TDC unit for FERS-5200
WDT5203XAAAA	DT5203 - Desktop 64 Channel pico-TDC unit for FERS-5200
WA5255XAAAA	A5255 - Quad 17x4 Header Adapter
WA5256XAAAA	A5256 - 16+1 ch pos/neg Discriminator for A5203
WA5260XAAAA	A5260 - Remotization cable for FERS-5200 boards - 50 cm
WA5260BXAAAA	A5260B - Remotization cable for FERS-5200 boards - 100 cm
WA5270FANXAA	A5270 - FERS cooling fan



A5255 - 17x2 pin 2.54 mm pitch Quad Connector for A5203/DT5203



A5256 - 16+1 ch pos/neg Discriminator for A5203

#### A5204/DT5204

Code	Description
WDT5204BXAAA	DT5204B - Desktop 64 channel Radioroc unit for FERS
WDT5204XAAAA	DT5204 - Desktop 64 channel Radioroc unit for FERS-5200 with picoTDC

#### DT5215

Code	Description	Form Factor
WDT5215XAAAA	DT5215 - Collector Board for FERS-5200	Desktop



A5260 - Remotization cable for FERS-5200 boards



A5261 - SiPM remotization cable for A5253

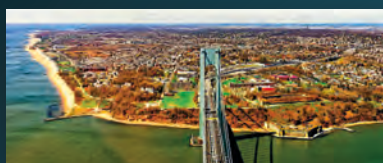
# CAEN global presence

**CAEN**



Worldwide presence

**CAENsys**



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Staten Island, NY • USA

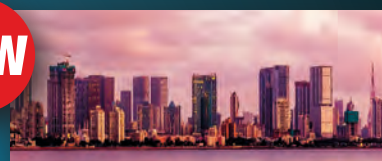


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### Front-End Readout System



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