SpectTDC Position System

1. Field of application

The SpectTDC Position System is applicable for any neutron scattering measurement with two dimensional position sensitive wire detectors (2D or area detectors) having delay line outputs. The system is able to generate 2D position intensity spectrum. In addition, the SpectTDC Position System has a full **monitor counter** capability also.

2. System description

Operation of a SpectTDC Position System needs 3 main hardware components:

a) **SpectTDC Position Unit**

b) **Position Processor Unit**

c) **Spectrometer PC**

The system firmware / software components have also 3 main components according to the 3 hardware parts:

a) **Firmware of SpectTDC Position Unit**

It does not need any installation or setting.

b) **Position Processor Driver software** running in Position Processor Unit

This server program performs the necessary signal processing by accepting and responding to requests coming from an external PC (called Spectrometer PC).

c) **Spectrometer Application software** running in Spectrometer PC

This is an application for controlling the data acquisition, displaying the spectrum and interactively saving the spectrum.

An **Installation and Reference Guide documentation** is part of the delivery containing also the communication protocol and description of commands and data structures. All the software components are preinstalled in the delivered hardware units and also delivered on a pendrive.

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3. Description of hardware

3.1.   SpectTDC Position Unit

Housing: 2 unit width NIM module

Power connection: +6 V and GROUND of the NIM crate

Signal inputs:

> 5 front end detector signal inputs:
>> Start, StopX1, StopX2, StopY1, StopY2
>> LEMO connectors with NIM signal level
>
> 1 dedicated front end event input:
>> Monitor Counts (Mon) for monitor unit capability
>> LEMO connector with TTL signal level

Time to Digital Conversion:

> Finest internal time bin: 165 ps
>
> Time (position) resolution used: separately configurable in X and Y direction
>
> Typical resolution: 1000*1000 pixels with time resolution 330 ps for both X and Y
>
> Maximal delay between Start and StopX1, StopX2, StopY1, StopY2: 5 microseconds
>
> Maximal count rate: 500 000 neutron events/sec

Signal output communication: through Gigabit Ethernet connection

The unit sends the primary signal data to the Position Processor Unit (see below) through a dedicated Ethernet point-to-point connection.
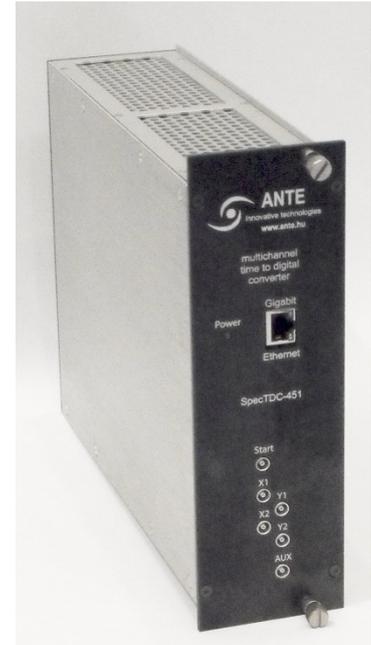
3.2.   Position Processor Unit

The Position Processor Unit receives the incoming 2D PSD neutron elementary events from the SpectTDC Position Unit through a dedicated Gigabit Ethernet connection. It calculates the X-Y position of a single neutron event from the five (Start, StopX1, StopX2, StopY1, StopY2) elementary neutron events. This Unit stores the neutron events into a 2D X-Y intensity spectrum. As the SpectTDC Position Unit electronics can gather also each monitor signal impulse, both the 2D spectrum and the monitor counts are calculated and stored in this Position Processor Unit. However, both data – 2D spectrum and monitor signals - are summed up continuously after an external "Start" command only. If any of the following state occurs

- the elapsed collection times exceeds the preset time limit (time value), or
- the number of monitor counts exceeds the preset monitor limit (monitor value)

the Position Processor Unit stops counting and storing any further incoming signals.

Please use this Position Processor Unit "as is" and never install any computer program to this unit. Any software installation here will terminate the supplier's warranty obligation.

3.3. Spectrometer PC

Such a computer is always necessary to make measurements. It controls the data collection process and it can read out the instant spectrum and monitor value from the Position Processor Unit. sending several commands from the Spectrometer Application software you can

- start a spectrum collection
- stop the spectrum collection
- interactively read out the 2D spectrum
- interactively plot the 2D spectrum
- interactively sum up data in X or Y direction
- interactively store the spectrum

You can use your own PC as Spectrometer PC. Of course, in this case you do not have the preinstalled application in your PC.

3.4. Hardware system build up

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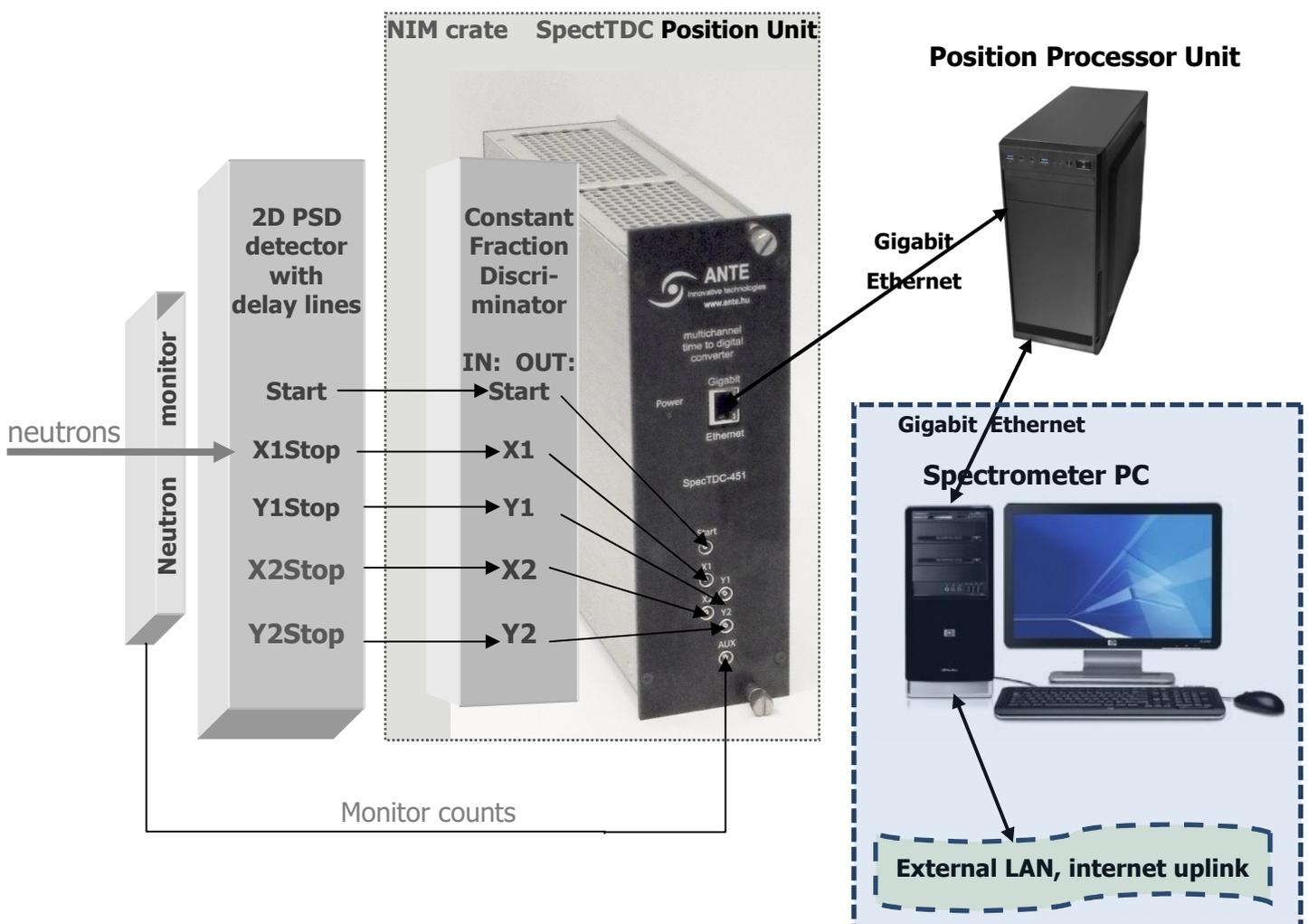
4. Description of software components

4.1. Firmware of SpectTDC Position Unit

This software sends the data packets to the Position Processor Driver software through a dedicated Gigabit Ethernet cable. As being firmware it is built into the hardware and not stored in the software pendrive.

4.2. Position Processor Driver software

This server program runs in the Position Processor Unit under MS Windows 10 as a driver. This program performs the necessary signal processing steps:

- o It calculates a single neutron event and X - Y detector position from the five (Start, StopX1, StopX2, StopY1, StopY2) elementary events.
- o It calculates the actual monitor counts
- o It stores and continuously updates the 2D X-Y intensity spectrum

It works as a TCP/IP server program which accepts, performs and responds to commands and requests from an external computer, e. g. Spectrometer PC. The main accepted commands and requests have ASCII format as follows:

`StartDAQ`   Start measurement

- o Start N, M (start event acquisition until N millisec time or M monitor count value)

- o Example: `StartDAQ, Time=10000, Monitor=15000;`

- o Response: `DAQStart;`

`StopDAQ;`   Stop measurement (immediate stop)

- o Response: `DAQStop;`

`GetStatus;`   Status request

- o Response: `Status: Running;`

`Get2DHistogram;`   2D spectrum request

- o Response example: `Get2DHistogram, seq=20000000, dimx=600, dimy=600, sum=8, shiftx=-10, shifty=50, time=9000, monitor=14567, bytelength=123456789, Histogram=`(binary data)`...;`

This server program does not display any data, so Position Processor Unit does not require any peripheral device element like monitor, keyboard or mouse.

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4.3. Spectrometer Application software

This application software runs under Microsoft Windows 10 in a Spectrometer PC.

DAQ Control Application

This application program component sends control commands to the Position Processor Driver program running in the Position Processor Unit. This example application program is delivered in both binary and source code form. By delivering the source code we would like to support you in preparing your own application for your special purposes, if necessary. If you order also a Spectrometer PC you can develop your own application using this Spectrometer PC. This means that - unlike in the Position Processor Unit - you can install your own or third party software also in this Spectrometer PC.

This DAQ Control Application software uses the communication protocol elements, commands as they were described in the previous point. It is suitable for:

- starting and stopping the signal processing
- reading out the status of signal processing

Detector Display Application

This software part is delivered in compiled binary form. This graphical application software contains a complex program for

- reading out the 2D spectrum
- displaying the 2D spectrum
- storing the spectrum

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You can start your data acquisition by using the DAQ Control Application program and you can display the collected X-Y spectrum by using the Detector Display Application program at the same time. Detailed documentation of the communication protocol, description of commands is to be delivered together with the software.