#### Sample ANSEL Report: Tests with analog and digital nuclear electronics

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**Abstract**

The first ANSEL experiment entailed hands-on tests of the functionalities of a digital oscilloscope and of various NIM electronic modules to be used in subsequent experiments. The response of a radiation detector was simulated with precision pulse generators and processed with main amplifiers. Discriminators were used to produce digital signals employed to set up trigger logics for the data acquisition system. The linearity of the analog circuitry, tested with a pulse generator, was found to be good to better than 1%.

# Introduction (Motivation/Purpose)

The tasks given for the first ANSEL experiments are designed to practice basic operations of digital oscilloscopes, as well as analog and digital electronics. The object was to practice spectroscopic applications for the subsequent experiments with gamma and charged-particle radiation detectors. Digital electronics is needed to define acceptance criteria and to produce signals to trigger the data acquisition system. The system was to be tested with a pulser calibration.

# Experimental setup and procedures

For the first task with analog electronic modules, a low-amplitude pulser signal was generated using an ORTEC 419 precision pulse generator. Figure 1 illustrates the typical shape of the direct pulser output signal observed on the oscilloscope. Its amplitude is …V, and it has a decay time constant of 2s. This pulse was obtained with the pulser settings …………**…**

Next, the pulser signal was inserted into an OR-TEC 572 (?) Spectroscopy Amplifier. The amplifier to lowest coarse (x..) and fine gains (x…). Input polarity was set to…. As shown by the screen shot in Fig.2, the amplifier output signal shape was less than ideal …….It also showed a DC base line offset of 45 mV, which was cor-rected to less than 2 mV by activating the base line re-storer (Automatic BLR). ….base line restorer toggle switch (BLR) to automatic ……… The ORTEC 419 pulse generator allows one to adjust the output signal shape by adjusting various front panel controls, including rise and fall time, in addition to pulse amplitude and frequency. Table 1 lists the corresponding parameters read off the scope display and compares them to the control settings. Rise times were varied between …. and …., fall times from …. to……

Figure 1: Output pulse shape of an ORTEC 419 precision pulse generator (Scope screen shot). The scales are ..V/division and …s/division, resp.

Following tests of the behavior of analog electronic modules, the experiment was set up to generate a logical circuitry. First, a digital NIM signal was produced by inserting the …..output signal into a fast leading-edge discriminator. The term “leading edge” implies that …… The discriminator used (Type …) has two modes of operation, an integral, lower level threshold, and a differential window (single-channel) mode. Figure 3, taken from Ref 2 illustrates the two functions……. In the integral mode,…In the differential mode,…...

Table 1: ORTEC 419 Pulse Shape Parameters

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The discriminator output signals were duplicated with a Fan-In/Fan-Out module. One of the latter signals were used to produce a wider “gate” signal, the other was fed into a Delay Generator (Type ) producing a copy of the input signal but delayed by an adjustable time delay. The gate signal had a width of ….., the delayed signal had a width of only …ns. Undelayed gate and delayed NIM signals were put into a Universal Coincidence Module (Type) to test coincidence and anticoincidence modes. The setup is represented by the schematic electronics block diagram shown in Fig. 4, which also includes the analog part of the electronics.

In the tests, the delayed signal……. The resulting coincidence resolution time turned out, as expected, to be equal to …., i.e., equal to .. A similar test was done using the Veto input of the …..

# Data Analysis

***Describe the results of the various phases of the experiments, as far as a data reduction was done. Include a discussion of statistical and systematic uncertainties.***

………..

The approximate pulser signal shape *U*(t)was observed to have an analytical form given by

 $U\left(t\right)=U\_{0}∙t^{a}∙exp⁡\{-β∙t\}$ (1)

Approximate fit parameters are listed in Table 1, together with their estimated uncertainties.

The results of the “pulser fence” measurement described in the previous section are displayed in Fig. 5 where the counts/bin or channel are plotted vs. bin or channel number. The corresponding correlation between input signal amplitude (S) in V and channel number (Ch) is displayed in Fig. 6 as solid dots. The straight line drawn through the data points represents a calibration of the abscissa in volts,

 $ S\left(Ch\right)=S\_{0}+DS∙Ch$ (2)

# Summary of Results and Conclusions

Overall, the first experiments with analog and digital electronics worked out well. All modules used were in working order and functioned as described in the manual. Understanding and using the data acquisition system efficiently will probably require some more practice but the quick start sheet was sufficiently detailed to allow a simple setup and running. ……..

The main lessons taken away from these experiments can be summarized as follows:

1)

2)

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References

1. Glenn F. Knoll, *Radiation Detection and Measurement,* Wiley & Son, 2000, Ch. 16.
2. W. U. Schroeder, ANSEL Lecture Notes, Lect 3, 2012
3. ……
4. ……