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Electronics and DAQ Requirements for E160

P. Bosted

Abstract

In this note, a preliminary list is given of all data sources in E160, along with channel counts, location, and requirements for H.V., movers, slow readouts, etc.

1 Introduction

While a few items are not quite finalized, the E160 design is far enough along that a preliminary list of data sources and associated electronics can be given. It is anticipated that the requirements for E161 will be very similar, if not identical. The major difference for E159 will be the addition of many ADC channels for the calorimeter channels, but this is not addressed in this document. Items are listed in anticipated order along the beam line. Requirements for HV, movers, etc. are given if applicable.

2 Electron/Photon Beam

2.1 Goniometer Control

The goniometer will be located about 7 m down-beam of Q28 in the BSY. It is anticipated that this will have its own Lab-view control program to control the three stepping motors and read out position monitors and limit switches. Networking to DAQCNTRL would periodically (once every several seconds) read out the information and send requests for changes in conditions. This is a slow controls data source.

2.2 Goniometer SEM

Controls are needed to select between an SEM with large hole, and SEM with small hole, and no SEM position. These SEMS are located just up-beam of the goniometer. The output signals from the SEM need to be read out to an ADC on each beam pulse and put into the ESA DAQ system. The signals should also need to go to MCC into the SCP system for a) steering the beam initially; and b) position feedback loop.

2.3 Goniometer UV Lamp

Controls are needed at MCC to turn on/off the UV lamp shining on the diamonds. A sensor is needed to make sure the lamp is working.

2.4 Electron detectors

Located between the first and second electron beam dump magnets. About 50 to 100 channels will be read out. Amplifiers may be needed for some of the signals (to b determined). The signals should each go to a standard ADC (integrating signal over beam spill). Cables will be needed going to ADC's, probably located in ESA counting house (can't be in beam switchyard due to radiation damage). The ADC's are read out once per beam spill.

2.5 Electron Beam Dump Toroid

Located just in front of the electron dump, just up-beam of the Alcove. This is an analog pulse signal that should go into a circuit similar to those used for other End Station A toroids. The signal should be read out for every beam pulse to a single channel of ADC.

2.6 C24, C37, Quads, A-line-Bend

The settings of the C24 and C37 collimaters, and the field settings for all A-line magnets, and the flip-coil beam energy, should all be requested about once per minute from the MCC computer, to be displayed and logged by DAQCNTRL.

2.7 C37 SEQ

The singles of the four SEQ monitors on the C37 collimator should be read into ADC channels once per beam pulse. C37 is located just up-beam of the Alcove, in BSY. Control of the C37 jaw positions is done through MCC SCP panel.

2.8 Wire Array

The wire array will remain in approximately the same location as for E158. The E158 mover system and readout are needed. The signals from the 96 wires should each go to an ADC channel.

2.9 Roller Screen, PR screens

The same controls and TV monitors as for E158 are needed for the roller screen (in the alcove), and the PR2, PR3, and PR4 screens.

2.10 Compton Polarimeter Target

This is the same as the E158 Fe target and Helmholtz coil assembly, but the z location will likely be near the E158 Q3 position, rather than in the alcove. The aluminum foil should be changed for a Be foil. Two thicknesses of Fe should be provided (to be determined). Slow readout of the encoder position is needed, as well as Helmholtz coil current and direction. Computer control of position is not needed, only readout.

2.11 Compton Polarimeter Magnet

The current in the magnet should be read about once/minute from the magnet control program. There is currently no plan to read out NMR values.

2.12 Compton Polarimeter Detectors

These have not been finalized, but it is clear that there will approximately 100 lead glass blocks. Each output should go to an ADC and 3 levels of discriminator, each going to a multi-hit TDC with leading/trailing edge capability and 1 ns or better time resolution (like 2.75 deg. lead glass electronics in E155). The anticipated hit rate is an average of 1 TDC hits/level. Therefore we need about 100 channels of ADC, 300 channels of TDC delivering 300 leading and 300 trailing edge signals per beam spill.

Still under study is the option of having about 100 scintillator hodoscopes. Each output would go to a single channel of leading edge TDC.

It is anticipated that the Compton Polarimeter data would not be recorded at the same time as the normal spectrometer data: these would be separate data runs. This is because when the spectrometer target is in, a large background would be created in the CP in E160 (since it is down-beam). In E161, the CP is up-beam of the polarized target, and would cause too much background in that spectrometer when the Fe foil is in.

2.13 Beam Flux, Intensity Monitors

Located near 3PC3 (and E158 Lumi location) will be a Cherenkov, Ion Chamber, and Quantameter. A few channels of HV are needed to power these. The signals of each monitor are read out to a single ADC channel every beam spill. Provision for reading the vacuum level in the Quantameter should be made (readout in CHA).

3 E160 Target, Spectrometer

3.1 Target

This is similar to the E158 Fe target assembly, but there is no Helmholtz coil. The location is at the entrance of E158 D3 magnet. The mover needs slow controls to select between at least five different target positions by computer control. The encoder should be read back to the computer every few seconds. Some electricity is needed to power the mover.

3.2 Spectrometer Magnet

The current in the D3 magnet should be read about once/minute from the magnet control program. There is currently no plan to read out NMR values.

3.3 Spectrometer Detectors

Located a few meters down-beam of the E158 D3 magnet will be an array of about 1000 scintillator hodoscopes. Each PMT requires HV, which will be built into the bases of the 500 new hodoscopes, but is external for the 500 existing ones (can use CEAN supplies with two-way splitters). The output of each PMT will go to a discriminator and to a leading edge, multi-hit TDC with bin width of 0.5 nsec or better. A study is needed to determine if trailing edge times are useful, but they probably are not, because the pulses are anticipated to be very short (5 nsec approximately). The anticipated average hit rates is 3/pulse/finger, or 3000 TDC hits/spill. It would be prudent to design a DAQ system that can handle up to 4 hits /pulse/finger. Beyond that, studies indicate that the tracking code will become unacceptably inefficient and find too many false tracks. With an average of 3 hits/spill, a TDC with 16 hit capability should be sufficient to accommodate Poisson fluctuations. The TDCs are read out once every beam spill.

The requirements for E161 are essentially the same as for E160. It requirements for E159 should be re-evaluated when it is determined exactly what detectors will be used (possibility of switching to lead glass block array from Fermilab).