

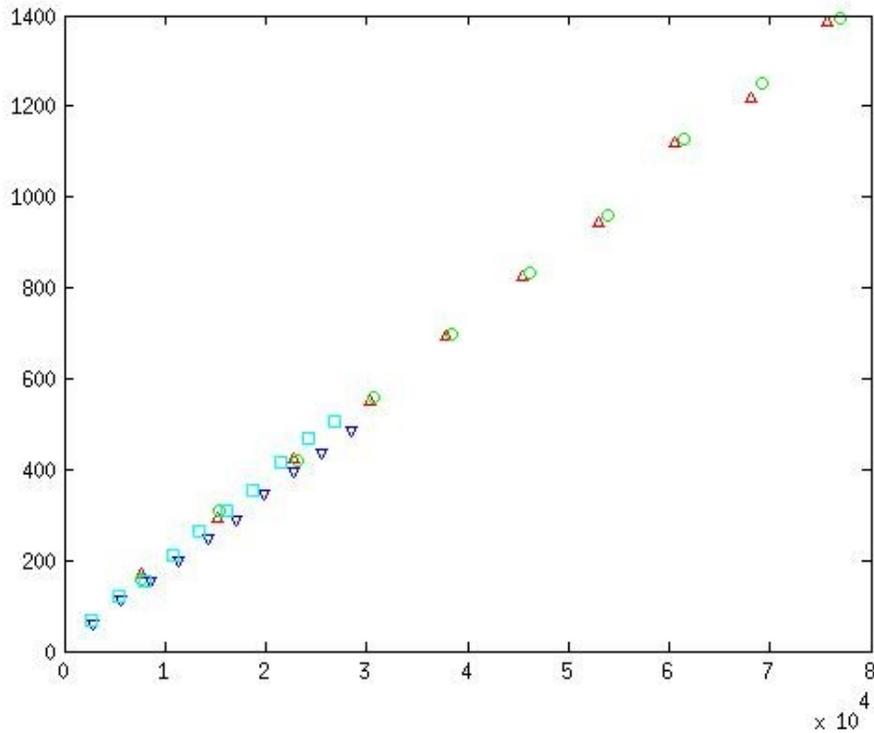
FEB 5.x Preproduction Evaluation

Nathan Felt John Oliver

2013, May 21

Calibration

Many of the FEB characteristics will be based on the system gain from APD connector to ADC value output. The gain will be measured in $e^- / \text{ADC count}$. To measure the gain, a charge injection board was built containing 4 charge injection capacitors that are able to inject charge simultaneously into 4 fixed ASIC channels. These caps were measured to be 1.72pF, 1.82pF, 4.93pF and 4.83pF. Using the FEB external trigger output and pulse generator, a 2.5V pulse was sent through three 20dB attenuators and one adjustable attenuator. This setup allowed charge to be injected into four channels using 10 attenuator settings. The following plot shows the four channels in ADC count vs charge.

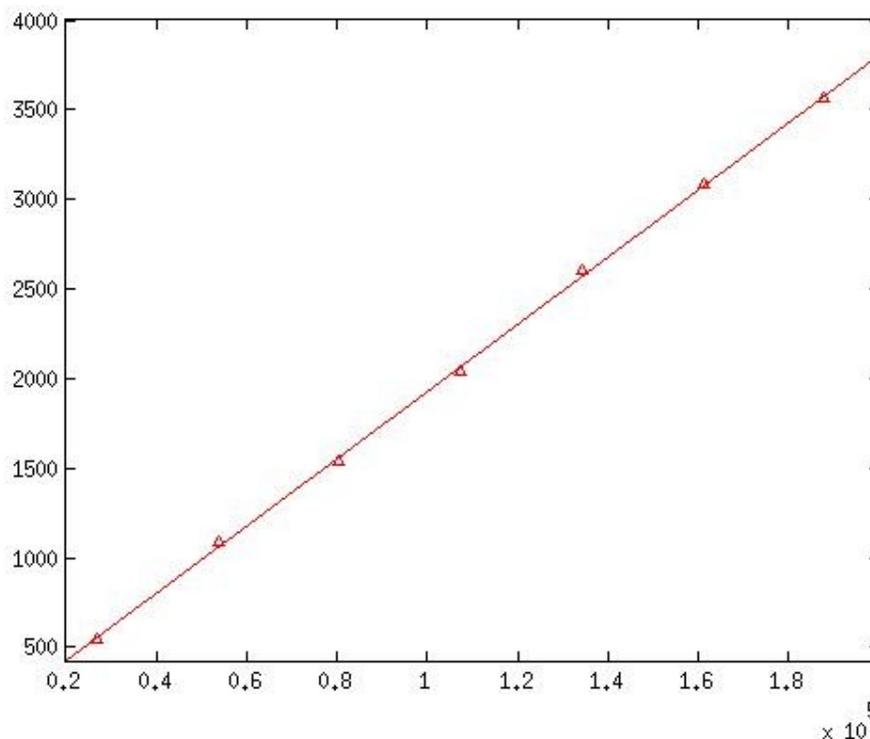


The measurement was averaged over 30 charge injections / attenuator setting. The ADC value was taken using the max value of DCS filtered data using samples separated by ??us. The ASIC was set as follows.

defaultAsic.refsel = + 100mV differential output amplifier reference voltage,
defaultAsic.isel = 0.50mA integrator input transistor bias current
defaultAsic.bwsel = 380 ns shaper risetime
defaultAsic.gsel = 33.3 mV/fC ASIC voltage gain
defaultAsic.tfsel = 7us shaper falltime
defaultAsic.mux2to1 = '0001';
defaultAsic.mux8to1 = '0000'; 2 to 1 analog mux
defaultAsic.off = +120mV pedestal shift (all channels)
defaultAsic.mask = Odd channels masked but internal charge injection not used for this calibration

The gain for each measured channel was 49 50 52 46 (e-/ADC Count). Based on this measurement the value of 50 e-/ADC Count will be used as the gain for this board.

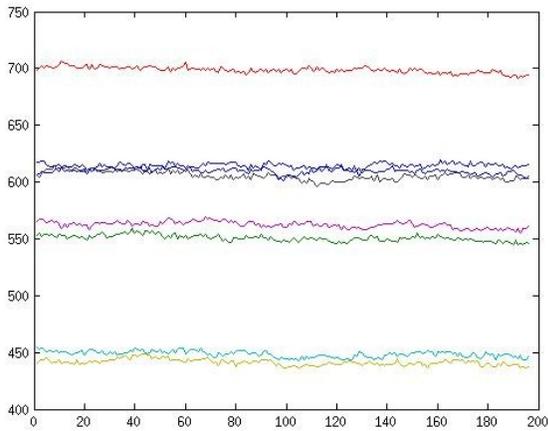
Increasing the amount of charge near the max ADC value of 4095, the following plot shows the linearity of one channel.



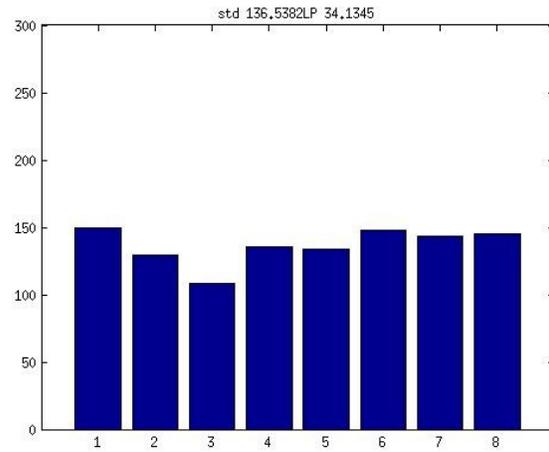
Baseline Noise

During noise measurement, the FEB is connected to a “Dummy Load” board which places a 10pf

capacitor on each input to simulate the capacitance of the APD. Each of the 32 channels is sampled in DSO mode with 2k points at 64 Msps.



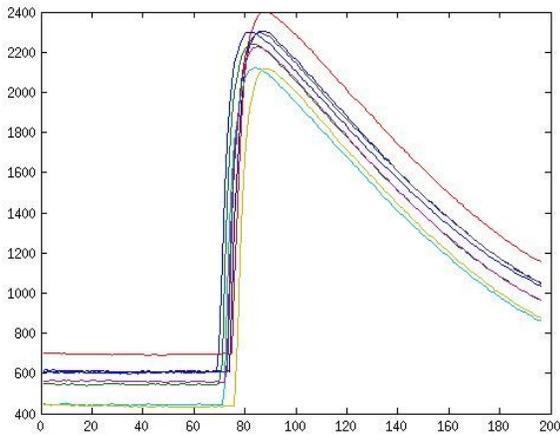
ADC Count vs Sample Number



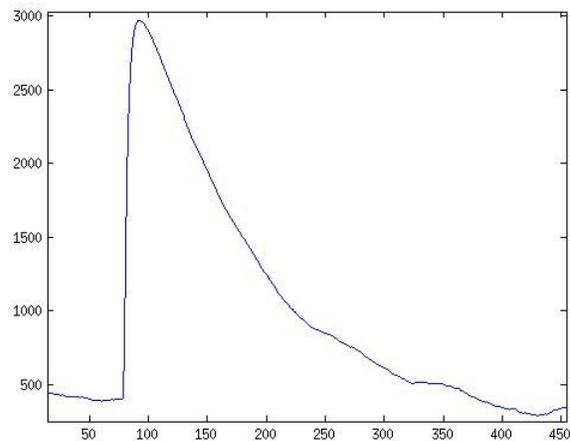
RMS e- vs Channel

Baseline samples for first 8 channels were taken without APD cable. This test will be expanded to include all channels with APD cable and input capacitance. We will also explore different rise and fall time settings. The value of the FEBV4 sensitivity was used for the noise unit conversion and will be verified with the charge injection tests.

Charge Injection and Calibration



Internal ASIC Charge injection in ADC count vs Sample



External Calibration Charge injection

Charge injection for both internal ASIC and external stimulus. The external charge injection uses capacitors that were measured with a precision meter to increase the accuracy of the sensitivity calculation. The charge injection board will allow charge to be injected into 4 of the 32 FEB channels.

Verify correct power and power consumption. - Done

Check the analog voltage is within the specified range.

Temperature - Done

Verify the temperature reading .

TECC - Done

A TECC test circuit is placed on the TECC connector to verify the DACs, ADC, Enable signal and voltages are operational.

Serial Number - Pass

Verify the Serial number is properly written.

High Voltage - Pass

Sweep the high voltage regulator and measure the output at the APD carrier. Calculate the linear fit and the residuals.

Pass thresholds

Slope: 20 to 30 (mV/DAC Count)

Intercept: 275 to 310 V

Max residual -1 to 1 V

