

# Behavior of the SOL\_TOT, Analog Discriminator and the TDC\_Q Output Signals on the Milagro FEBs.

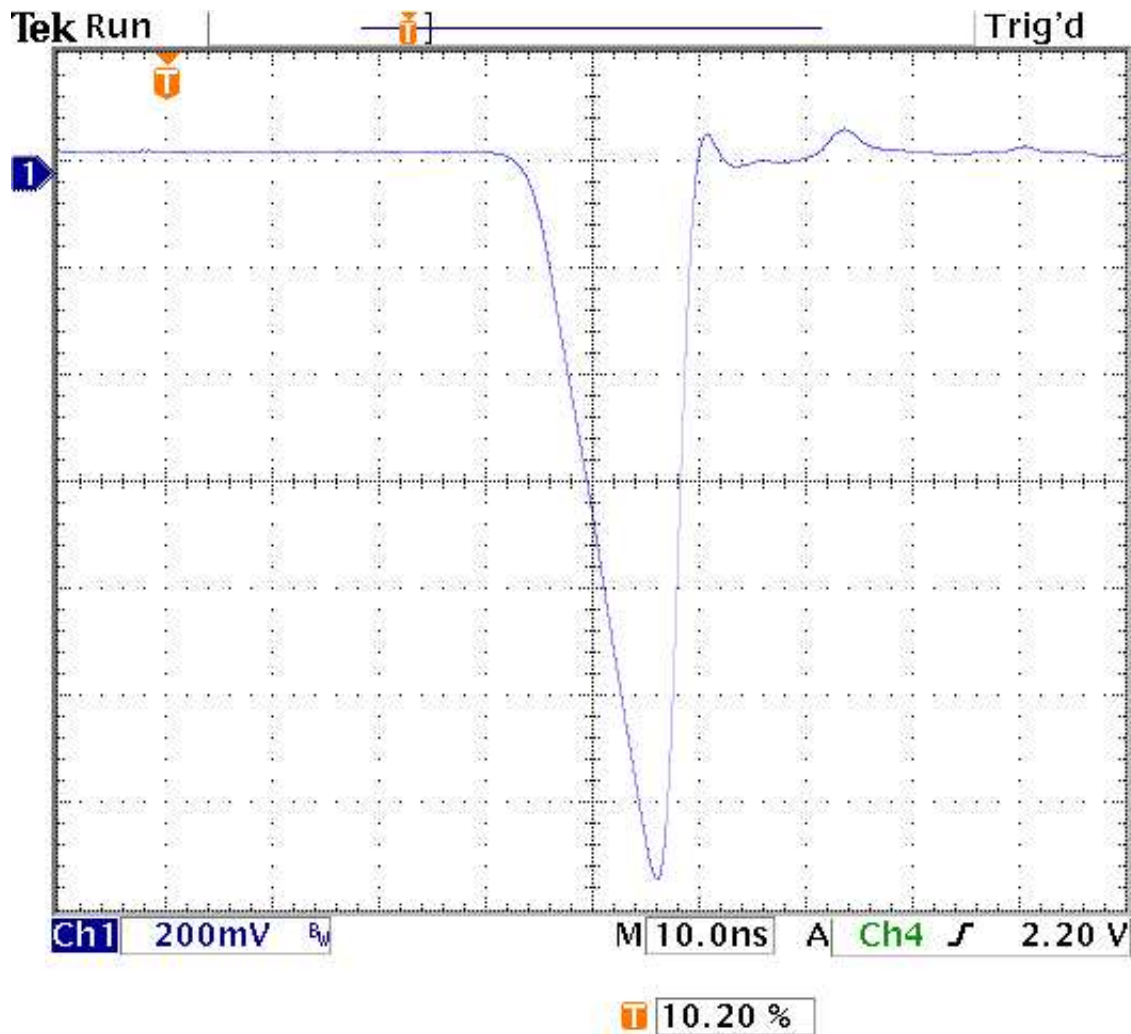
Udara Abeysekera  
Department of Physics and Astronomy  
Michigan State University

29th January 2010

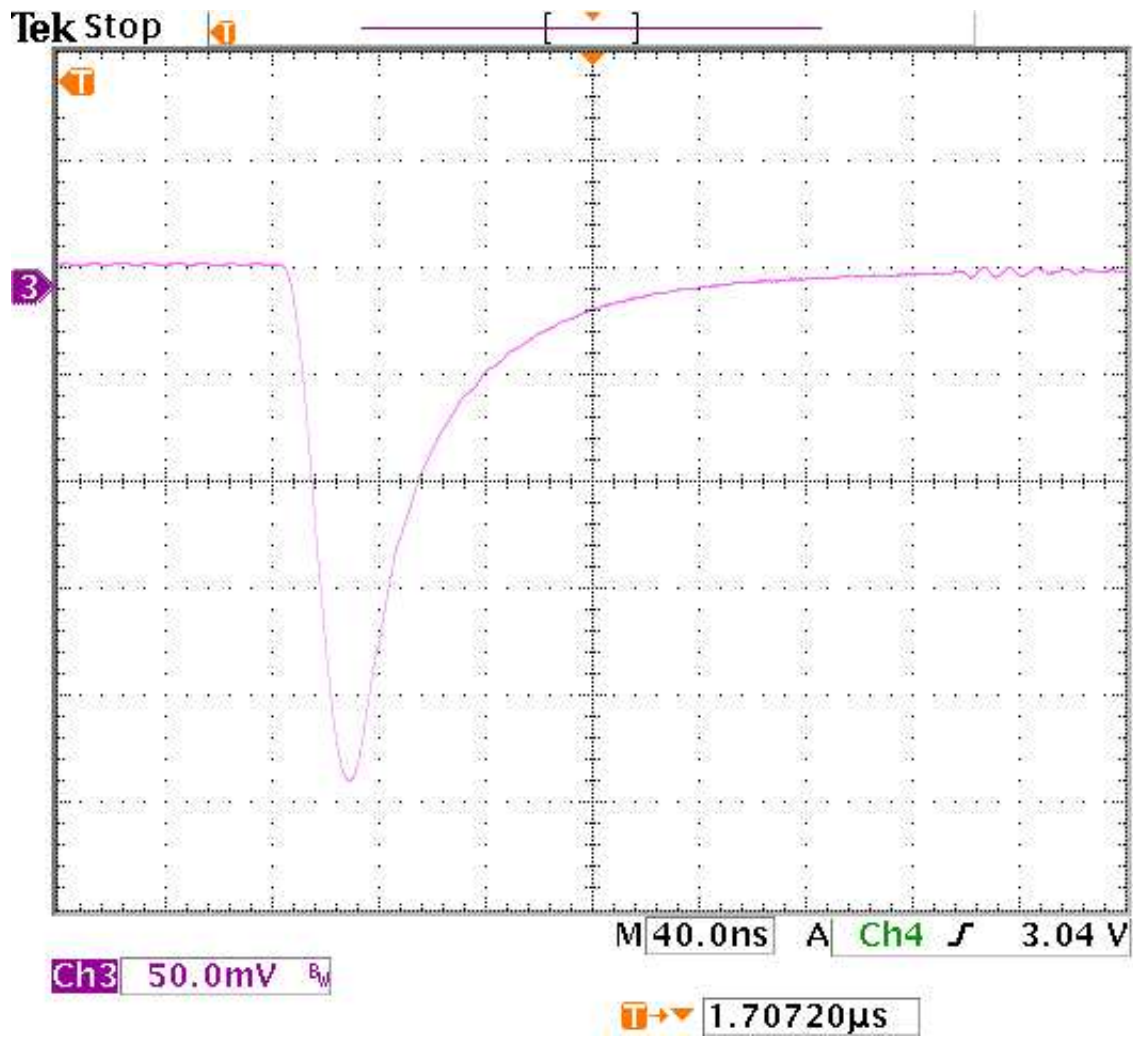
## Introduction

Following oscilloscope traces have been made to characterize the SOL\_TOT output signal of the Milagro FEBs. The SOL\_TOT signal has been traced with respect to the high and low threshold discriminator outputs and with respect to the TDC\_Q output. The signal names used here match the names used in the FEB schematic drawings. The places where the oscilloscope was connected to these signals is summarized in the following table.

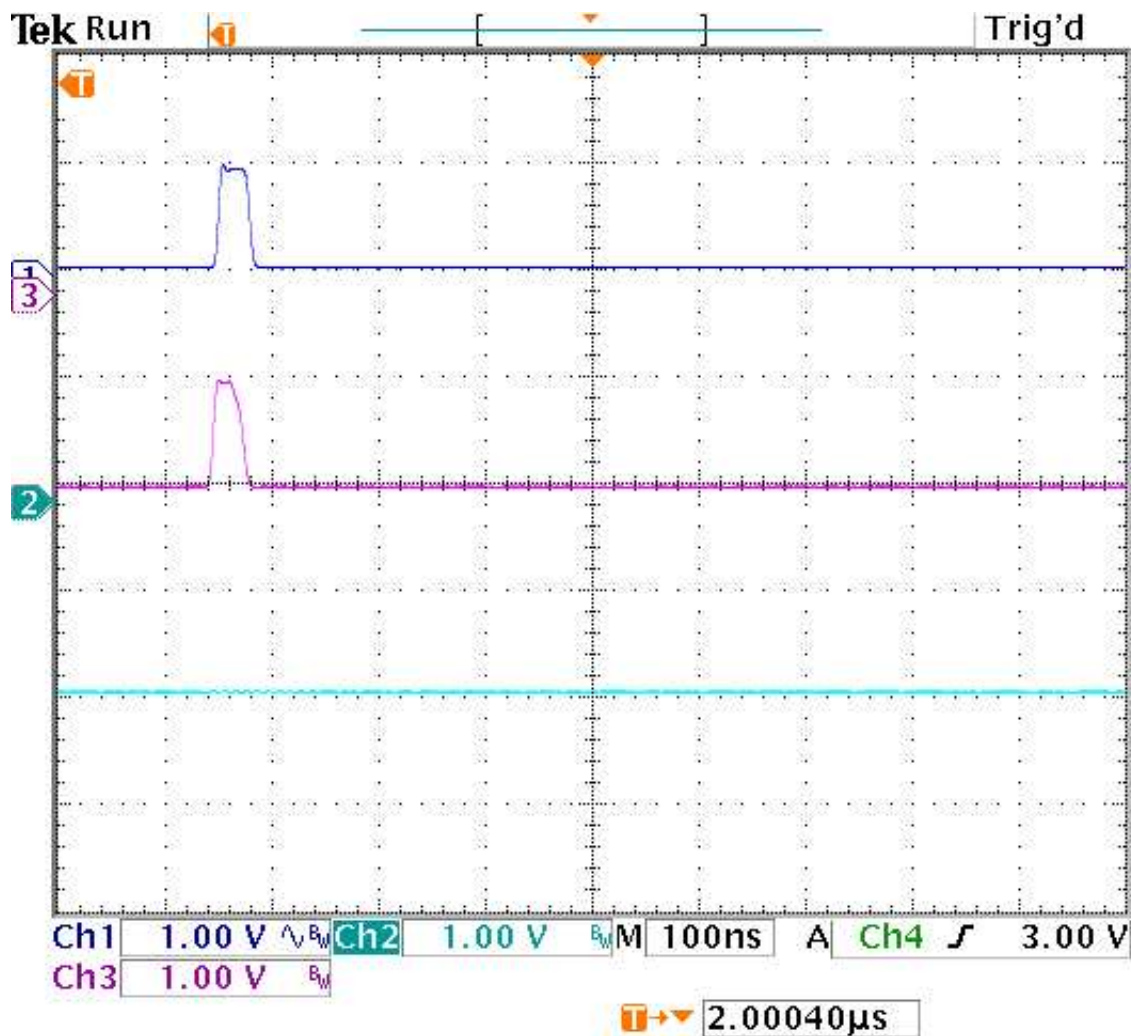
Signal name	Picked at the
SOL_TOT output signal	Solar header of the digital card front panel.
TDC_Q output signal	TDC header of the digital card front end panel.
High threshold discriminator output	pin number 2 of the corresponding MC 10115 IC.
Low threshold discriminator output	pin number 3 of the corresponding MC 10115 IC.



Scope trace of the signal generator output, which is connected to a 1000 FT long BELDEN 8241 RG-59U 75 ohms cable and 20x attenuator. We selected this signal generator output signal because it produces a FEB input signal, which has the same characteristics as real Milagro FEB input signals from PMT tubes. You can find examples for real Milagro FEB inputs at the [http://mildb.umd.edu/wiki/images/7/71/Plot\\_cable.pdf](http://mildb.umd.edu/wiki/images/7/71/Plot_cable.pdf).

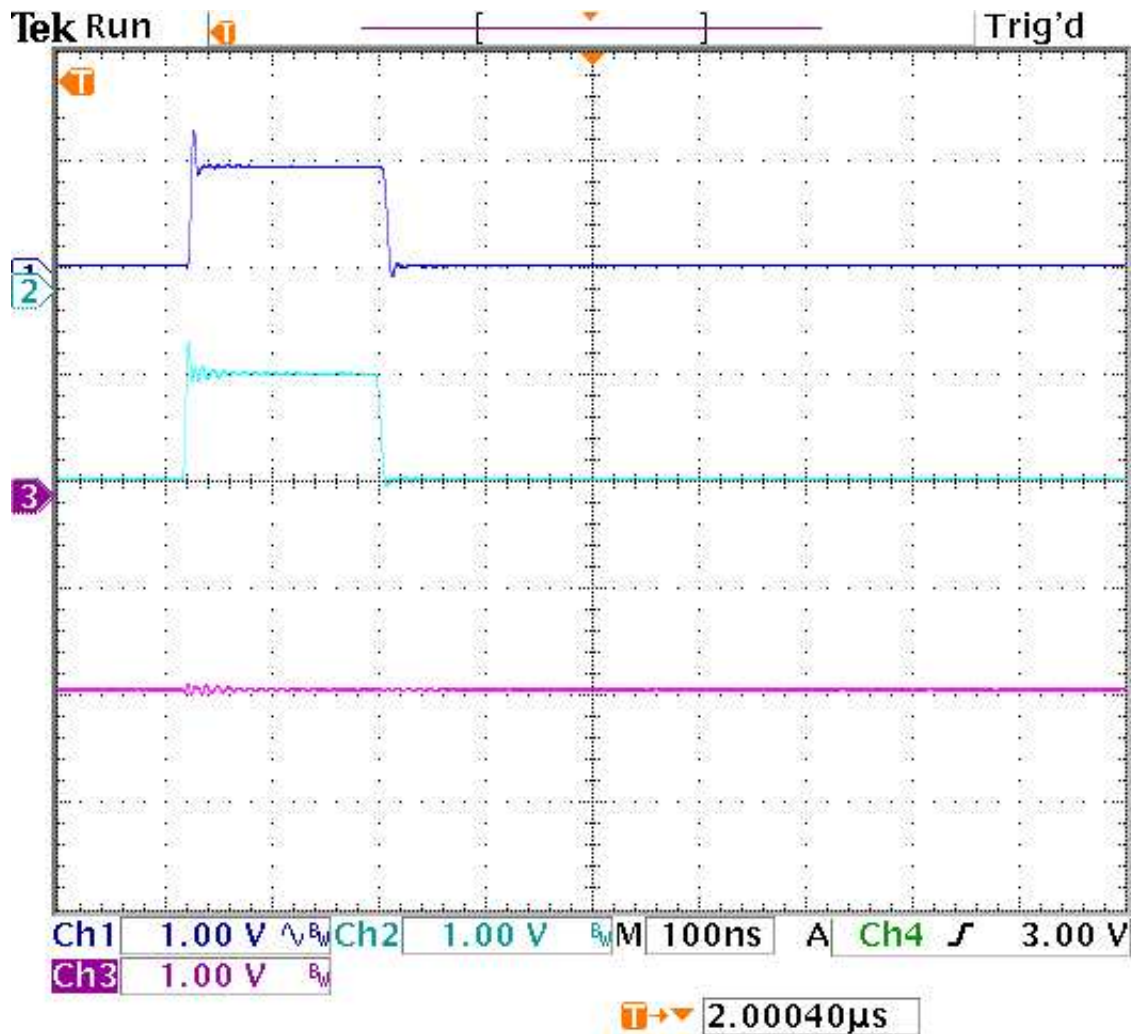


This scope trace shows the FEB input signal resulting from the signal generator setup as shown in the previous scope trace. This is the wave form that was used for all the subsequent measurements shown in this report.



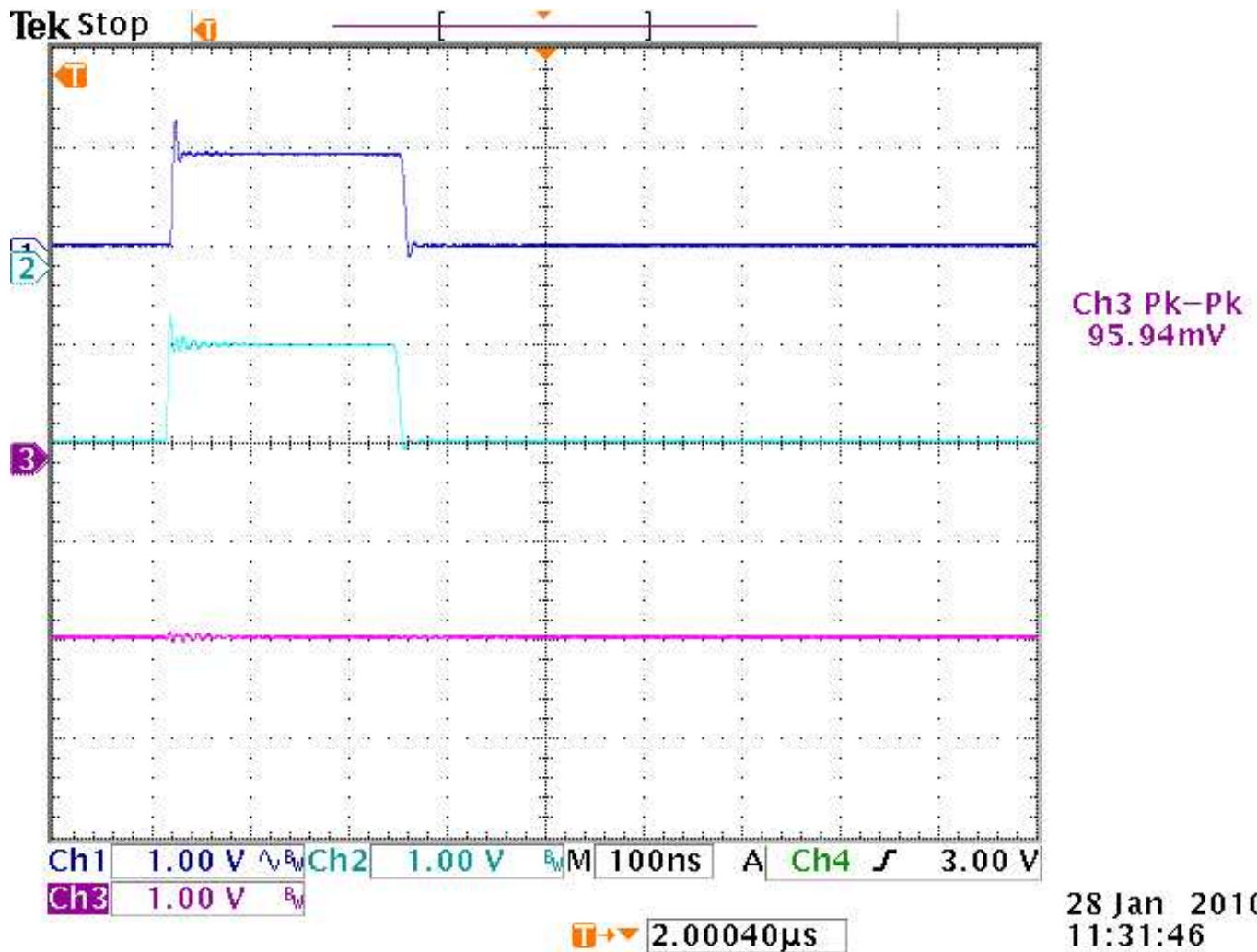
- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

Amplitude of the FEB input signal is 2.38 mV. This is the minimum amplitude required to make a stable signal at the output of the low threshold discriminator. Relative amplitude is 5.3% (100% is equal to the minimum amplitude required to make a stable high threshold signal)



- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

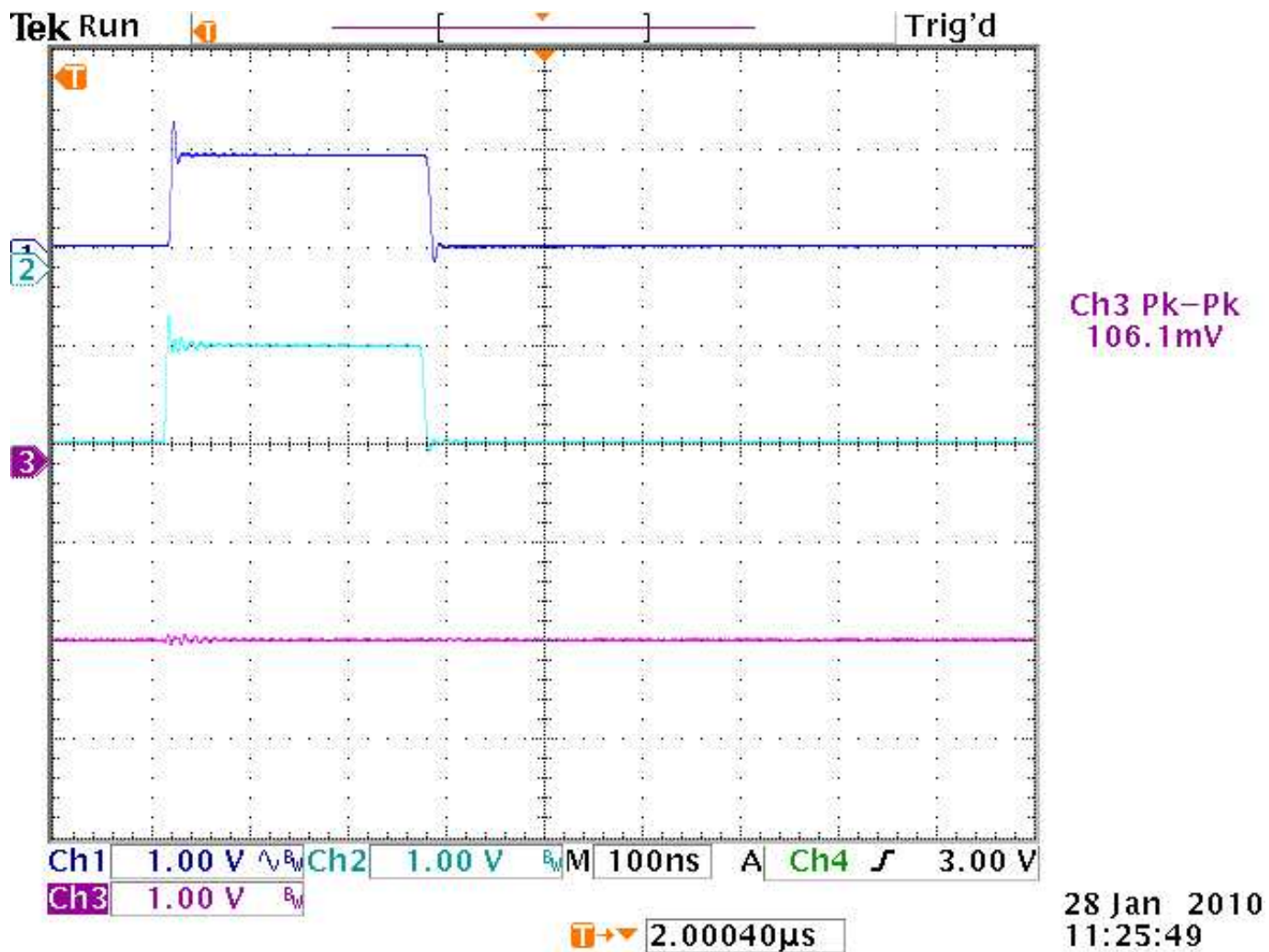
Amplitude of the FEB input signal is 11.2 mV. Relative amplitude is 25% (100% is equal to the minimum amplitude required to make a stable highthreshold signal).



- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

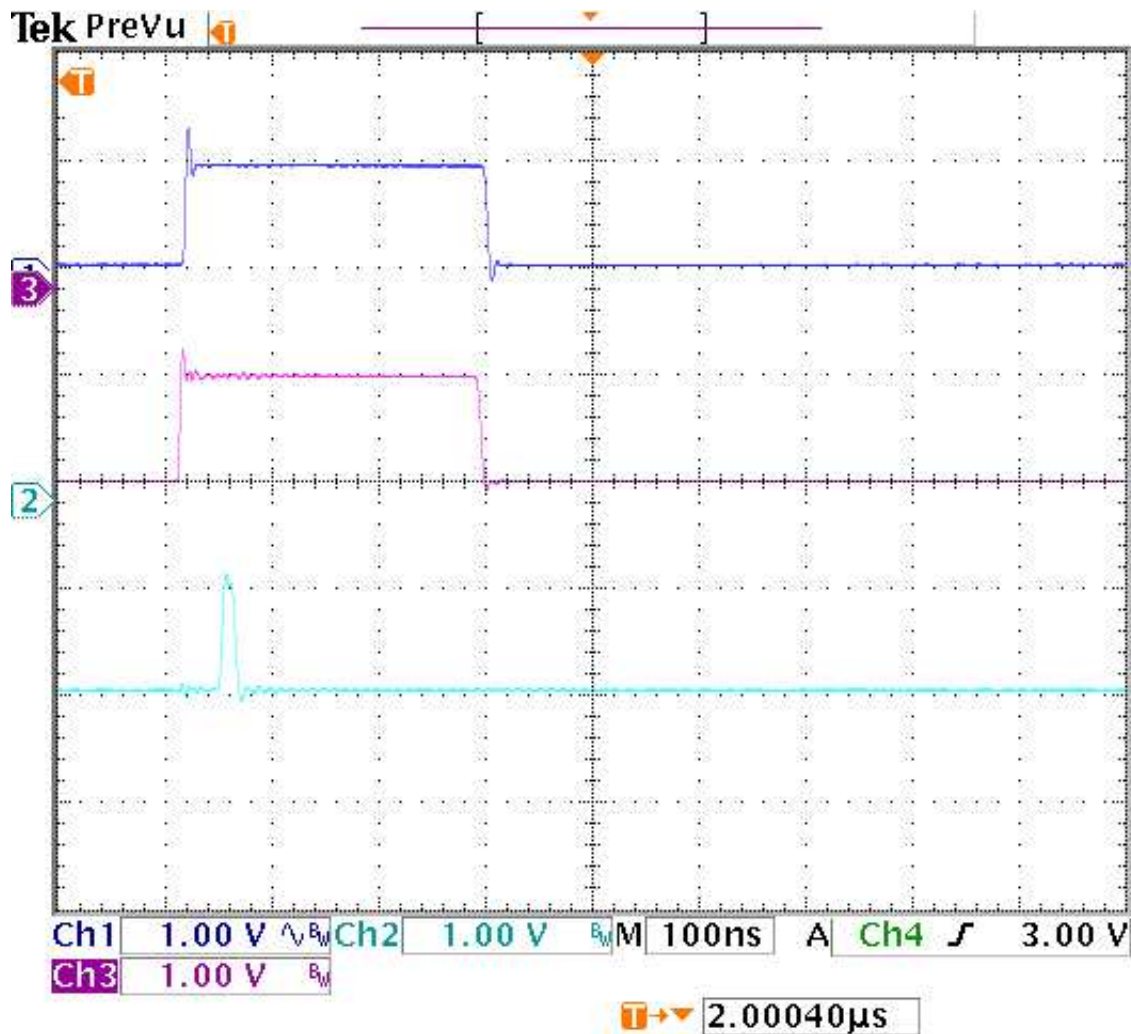
Amplitude of the FEB input signal is 22.4 mV. Relative amplitude is 50% (100% is equal to the minimum amplitude required to make a stable highthreshold signal).





- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

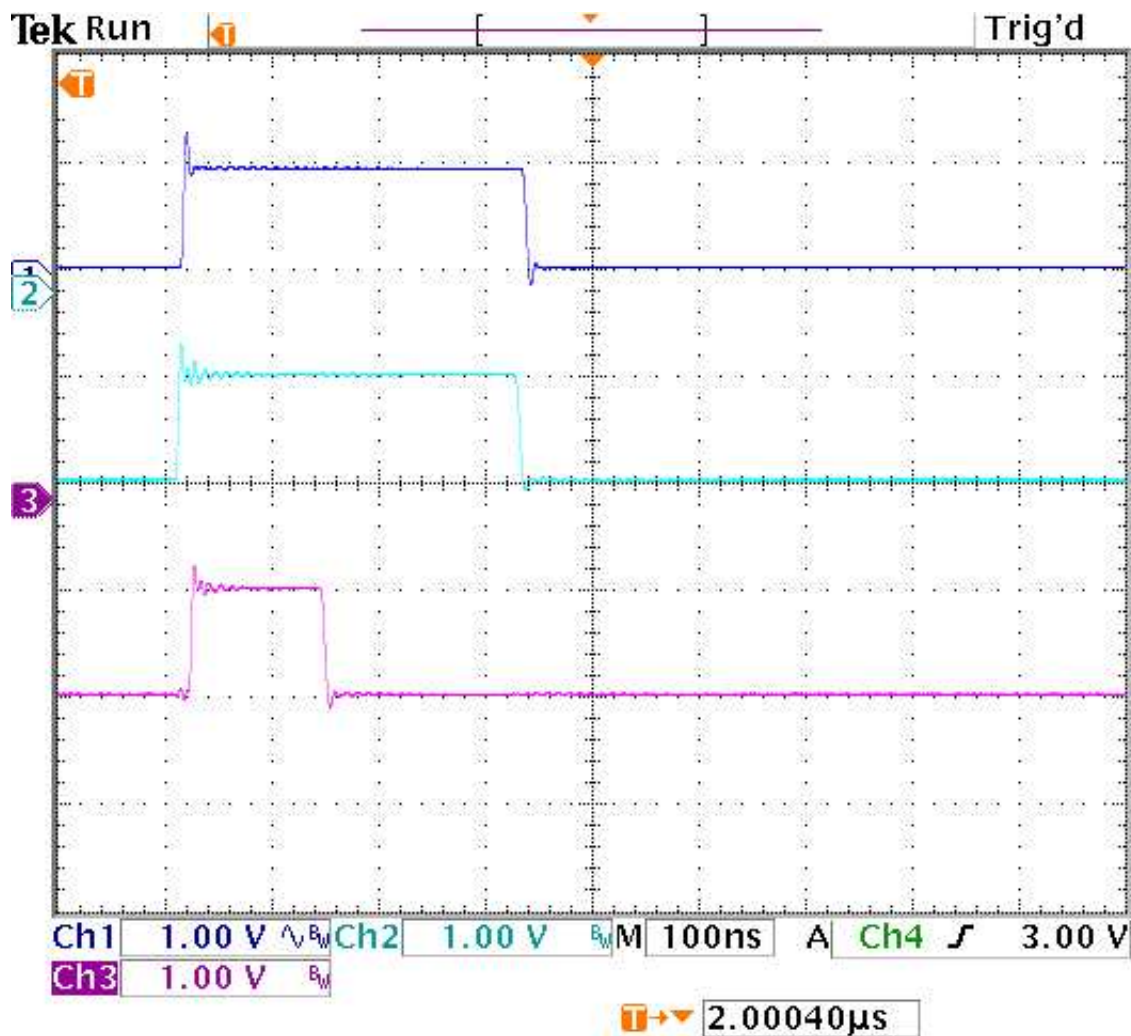
Amplitude of the FEB input signal is 33.6 mV. Relative amplitude is 75% (100% is equal to the minimum amplitude required to make a stable highthreshold signal).



- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

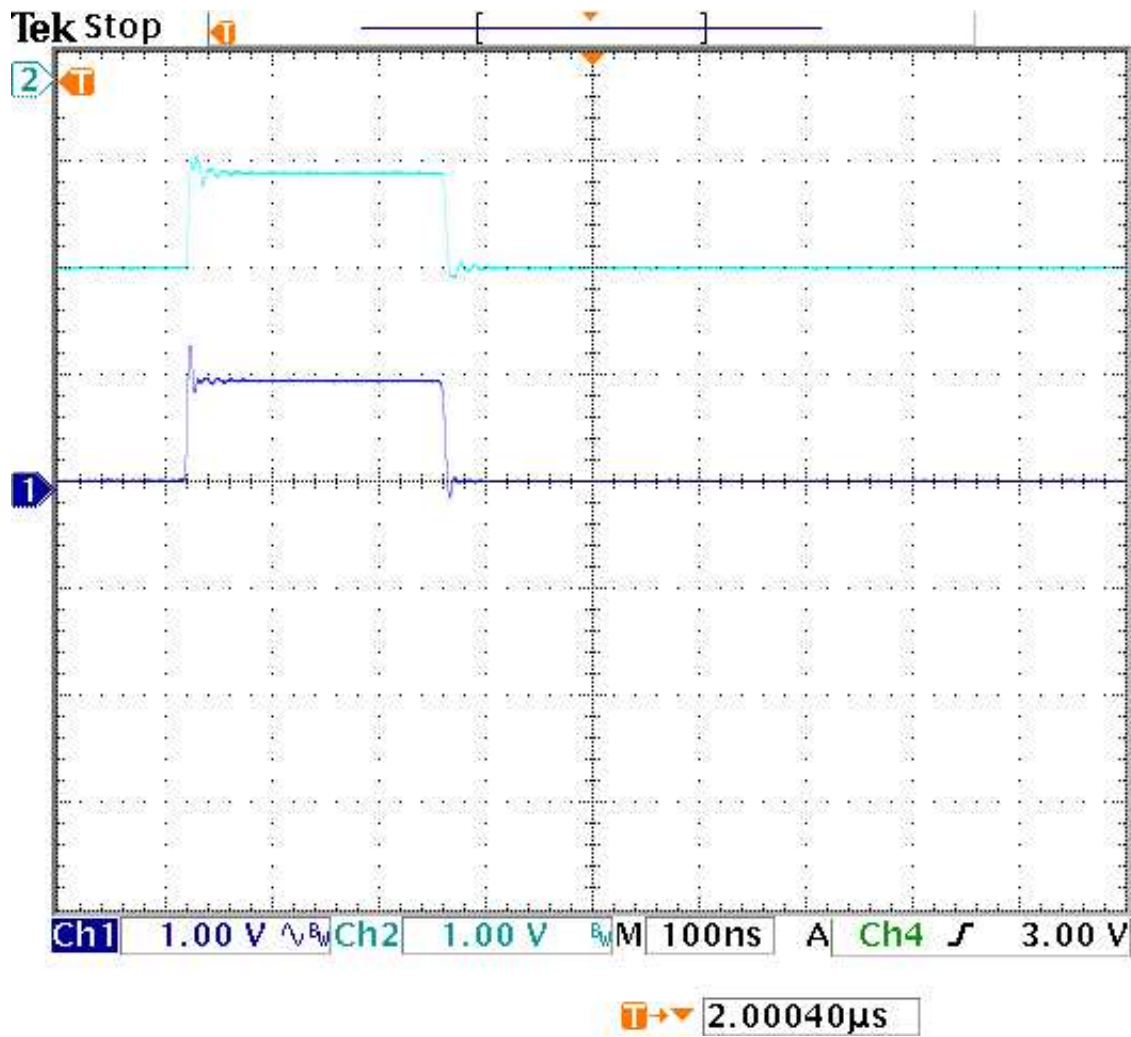
Amplitude of the FEB input signal is 44.8 mV. This is the minimum amplitude required to make a stable signal at the output of the high threshold discriminator. Relative amplitude is 100% (100% is equal to the minimum amplitude required to make a stable highthreshold signal).





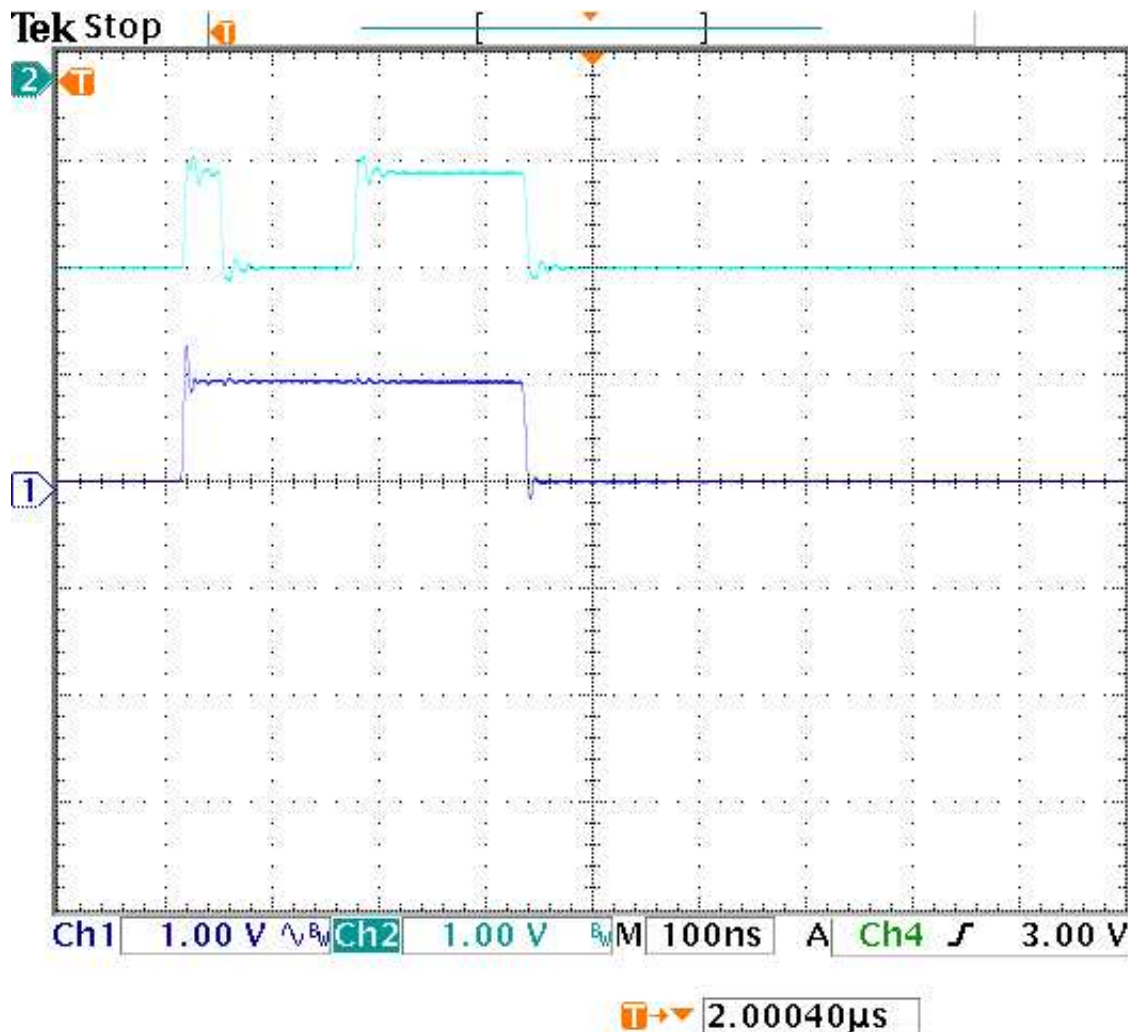
- Top trace is the SOL.TOT output.
- Middle trace is the low threshold discriminator output.
- Lower trace is the high threshold discriminator output.

Amplitude of the FEB input signal is 89.6 mV. Relative amplitude is 200% (100% is equal to the minimum amplitude required to make a stable highthreshold signal)



- Upper trace is the TDC\_Q output
- Lower trace is the SOL\_TOT output.

Amplitude of the FEB input signal is 22.4 mV. Relative amplitude is 50% (100% is equal to the minimum amplitude required to make a stable high threshold signal)



- Upper trace is the TDC\_Q output
- Lower trace is the SOL\_TOT output.

Amplitude of the FEB input signal is 89.6 mV. Relative amplitude is 200% (100% is equal to the minimum amplitude required to make a stable high threshold signal)

**Note:** In the above scope pictures the TDC\_Q output is terminated with a 110 ohms resistor.

### Conclusion

Using an input signal that looks much like a real PMT signal, over the input amplitude range that I tested, the SOL\_TOT signal behaves the same as the output of low threshold discriminator. There is no special behavior of the SOL\_TOT signal either around low threshold or high threshold. The width of the SOL\_TOT output is same as the width of the full TDC\_Q output signal (the width of the full signal is the distance from the first edge to the last edge).