# Integration test performed on January 19, 2001.

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Integration test between External Targets and ACD electronics were done on January 17 and 18 at Stanford University (room #148 of a HEPL building). This document describes the test results of the second day.

## 1 Test of Preamp and Mid–amp

In yesterday's test, PMT output was terminated by 50 Ω when connected to ACD electronics. On the contrary, PMT output will be directory connected to electronics at Balloon Flight. Therefore I removed the termination and observed waveforms by oscilloscope today.

I set the high voltage at 500 V, 525 V, 550 V, 575 V, 600 V, and 625 V, and monitored PMT output, mid–amp input (preamp output), and mid–amp output. Figure 1 gives observed waveforms at 525 V. The amount of charge injected from PMT is

$$\frac{1}{2} \times 30 \text{ mV}/50 \ \Omega \times 50 \text{ ns} \sim 15 \text{ pC} \quad .$$

This is attenuated to about 10 % (the ratio of R312 to R309) at pre–amp input. Thus, an output of preamp is expected to be

$$15 \text{ pC} \times 0.1 \div 50 \text{ pF} \sim 30 \text{ mV} \quad .$$

This is consistent with the observed pulse height in Figure 1. A time constant of preamp output is expected to be

$$50 \text{ pF} \times 30 \text{ k}\Omega \sim 1.5 \ \mu\text{s} \ ,$$

and is also consistent with the observed waveform (Figure 1).

Since the ratio of preamp output to PMT output is about 1, and the gain of mid–amp output is 10, an effective gain of preamp plus mid–amp is about 10. Therefore, if I set the threshold of External Target at 50 MeV, and operated PMTs at HV=450 V, the level of the mid–amp output will be ∼360 mV (see the calculation at § 3 of "Integration test performed on January 18, 2001").

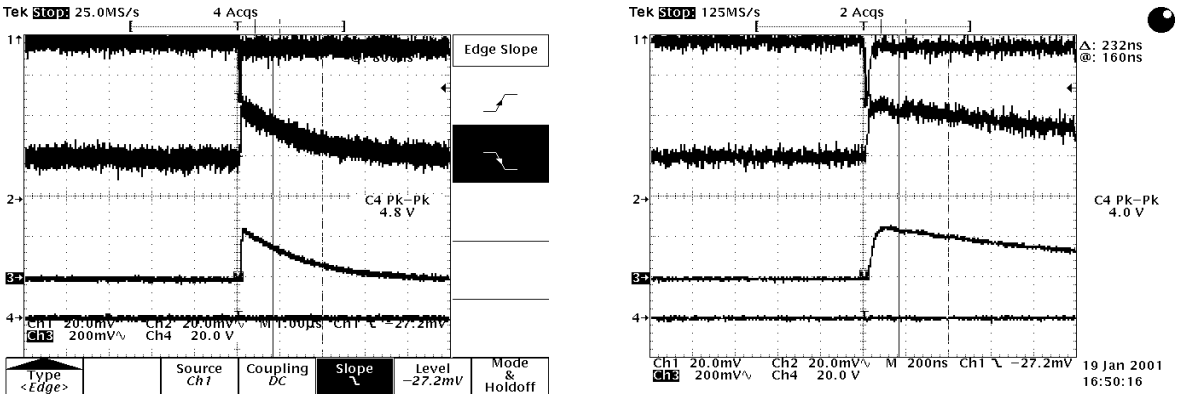


Figure 1: Waveforms of ACD electronics. Channel 1 (top) is PMT output (without termination), Channel 2 (middle) is the preamp output, and Channel 3 (bottom) is the mid–amp output. PMT is operated at 525 V. A scale of horizontal axis of the left figure is 1 $\mu$s/div, and that of the right one is 200 ns/div.

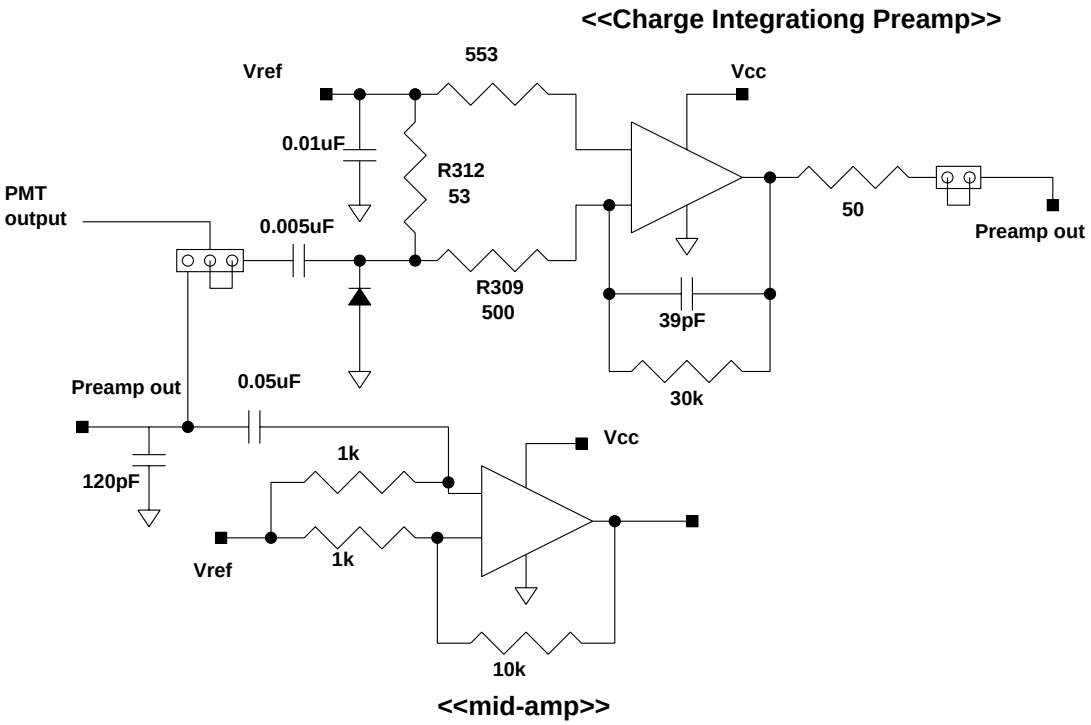


Figure 2: Circuit diagram of preamp and mid–amp of ACD electronics board.

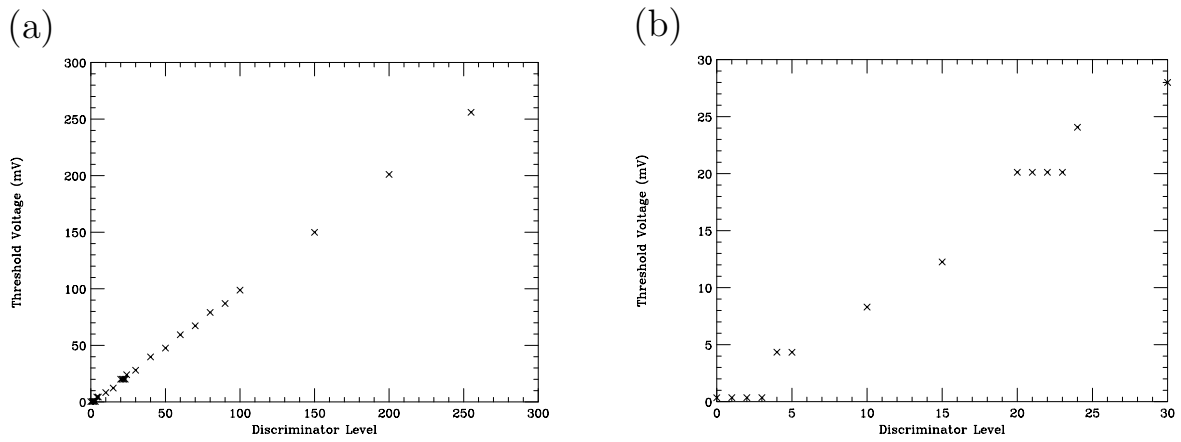


Figure 3: Relation between the low-level discriminator threshold and the level set by command. In the right panel, I expanded the figure to examine the relation in detail.

# 2 DAQ test

Following the observation of analog circuit (§ 2), we performed a test using DAQ, that controlls ACD electronics and obtains histogram. The DAQ was set up by Dave Lauben, and the test was done with help of Scott Williams and Jim Wallace. We first studied a low-level disrciminator threshold. We changed discriminator level by command (from 0 to 255–8 bit), and monitored a differential voltage between $V_{\rm ref}$ and $V_{\rm threshold}$ by Digital Multimeter. As shown in Figure 3a, the threshold voltage is proportional to the level set by command, and the relation is $\frac{V_{\rm threshold}({\rm mV})}{\rm level} \sim 1$. Scott found that an lower 2 bit is neglected, as shown in Figure 3b.

We finally tested ADC input and output. Figure 4 is observed waveforms of PMT output, preamp-output, mid–amp output, and ADC input (peak–follower output). Thus, a gain of peak–follower is 700 mV/500 mV $\sim$ 1.4. We then examined the relation between an ACD channel and ADC input pulse height. Here, we used an HP pulser as an input to the electronics board, and set the pulse width quite narrow ($\sim$5 ns), in order to avoid a saturation at mid–amp output. We adjusted a pulse height of the pulser, and set the voltage at ACD input at 200 mV, 300 mV, and 400 mV. Since the base-line voltage is about 100 mV, a differential voltage was about 100 mV, 200 mV, and 300 mV. Observed waveforms and obtained histograms are given in Figure 5. Thus, the ADC peak channel seems to be propotional not to the voltage at ACD input, but to the differential voltage (ACD input - base line).

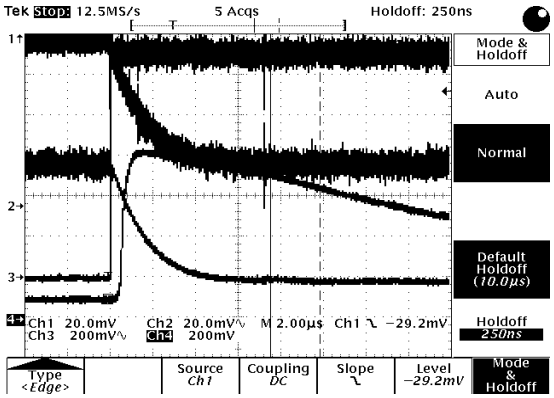


Figure 4: PMT output (Channel 1), preamp output (Channel 2), mid–amp output (Channel 3), and ADC input (Channel 4). The PMT is operated at 575 V.

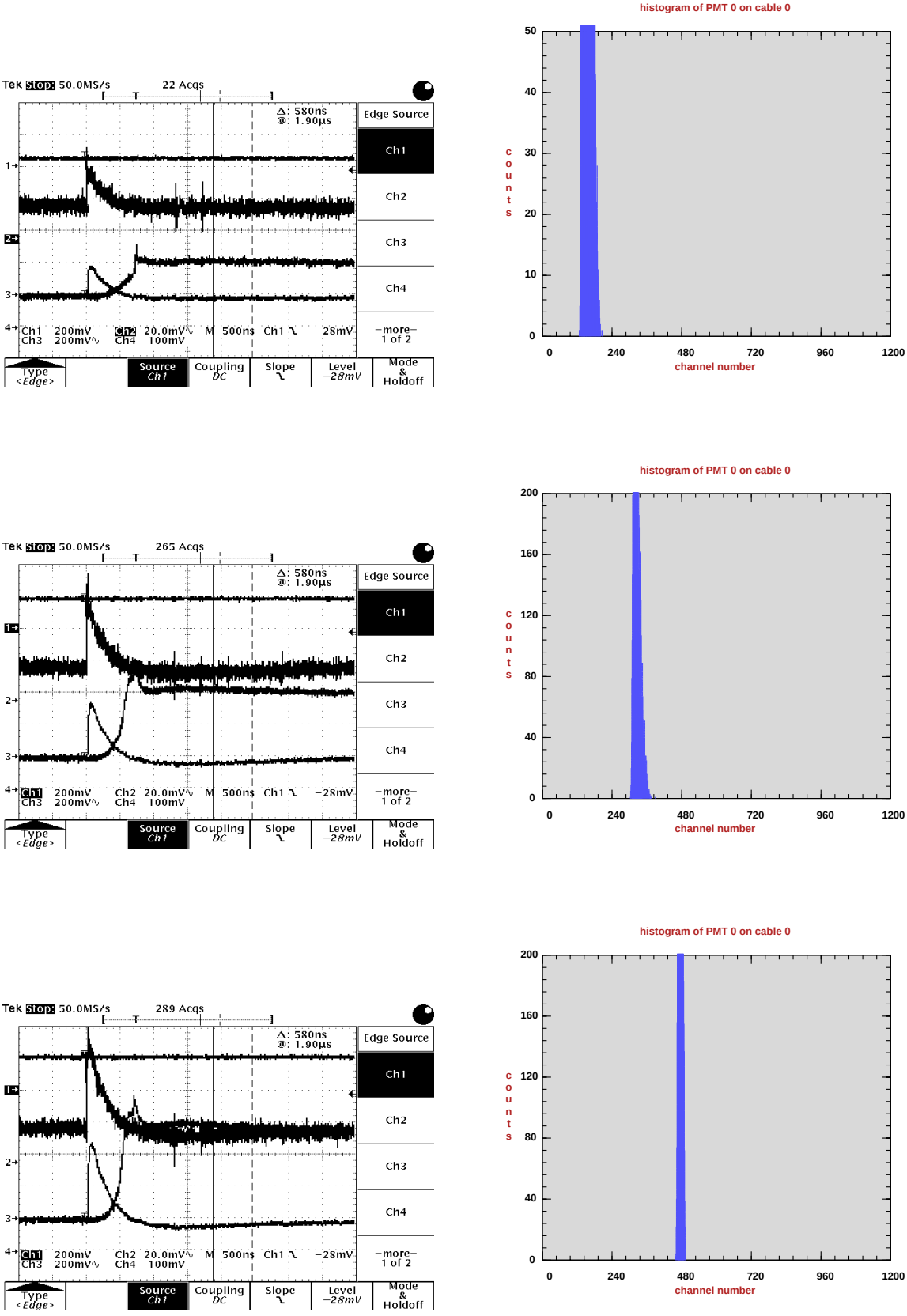


Figure 5: Waveforms and histograms obtained at ADC test. The left panels show observed waveforms of the PMT output (Channel 1), the preamp output (Channel 2), the mid–amp output (Channel 3), and the ADC input (Channel 4). The right ones are obtained histograms.