From: **Stefan Diehl** <Stefan.Diehl@exp2.physik.uni-giessen.de>
Date: Thu, Oct 13, 2016 at 5:14 AM
Subject: Re: Pre-Amplifier Information
To: Andres Vargas <vargasa@cua.edu>
Cc: Valery.Dormenev@exp2.physik.uni-giessen.de, "Horn, Tanja" <HORNT@cua.edu>, Marco Carmignotto <43pannunzioc@cua.edu>, Rishabh uniyal <uniyalrishabh@gmail.com>, Richard Trotta <trotta@cua.edu>, Greg Kalicy <gkalicy@jlab.org>, Stefan Diehl <Stefan.Diehl@exp2.physik.uni-giessen.de>

Dear Andreas,

If you want to attach APDs this should be the correct amplifier. The values I sent you last time (70 V for Ubias) were for SiPMs, since according to your mail I thought you want to do measurements with these.

Concerning the APD amplifiers I have attached a documentation to this Mail.
In addition you can find a typical gain-volatge curve of our PANDA APDs, which shows that you have to apply something between 360 and 380 V (for quadratic ones even up to 410 V). However this value strongly depends on the individual APD and the APD series and may not be correct for your APDs.

The output of the amplifiers shows a quite long decay tail which has to be shaped to achive a good rate capability. I have attached a picture of a typical output signal of the APD amplifiers.

For your measurements I think the light from the LED is too strong and causes some saturation (try to play with the intensity or place it further away). The fact that you see the same signal for 0V and 70 V is normal, since the APD gain is very small for 70 V and what you see are just some "dark counts" since charge is induced in the APD by the light whith practicaly no avalanche taking place. If you apply a volatge > 350 V you should see real signals.

I hope the information helps you.
Please feel free to write again if you have any problems.

From: **Novotny, Rainer** <Rainer.Novotny@exp2.physik.uni-giessen.de>
Date: Thu, Oct 13, 2016 at 7:53 AM
Subject: PA Test
To: "V.Dormenev@exp2.physik.uni-giessen.de" <Valery.Dormenev@exp2.physik.uni-giessen.de>, "HORNT@cua.edu" <HORNT@cua.edu>, "43pannunzioc@cua.edu" <43pannunzioc@cua.edu>, "uniyalrishabh@gmail.com" <uniyalrishabh@gmail.com>, "trotta@cua.edu" <trotta@cua.edu>, "gkalicy@jlab.org" <gkalicy@jlab.org>, "Stefan.Diehl@exp2.physik.uni-giessen.de" <Stefan.Diehl@exp2.physik.uni-giessen.de>

Dear All,

I just have seen this morning the mail from Andreas and I would like to add a few comments. Are the figures of the set-up, as they are shown, just to illustrate the components or reperesents it the used arrangement for measuring the response. In the latter case, it would not work, since one has to implement the APD as well as the connections to the PA in a shielded container. The cables connecting the PA are not shielded and serve as a perfect antenna. Even without applying any HV for the APD you would already receive tremendous pick-up from your environment. It is true that the operating bias, depending

on temperature will be at least above 350V and will provide a typical gain of 50, as Stefan`s figure shows. For the voltage you applied your are still in the mode of a diode with a gain of 1. However, since you exposed the APD to the bright light of an LED you have at least 10**16 photons per second and will immediately saturate the output of the PA. If attached to a scintillator you will collect thousands of photons only. The shape of the PA output is determined by the integrating and shaping parameters of the PA and are optimized for count rates up to a few hundreds of kHz and to optimize the signal to noise ratio. The de-charging of PA is set to a time constant of µs. I am a bit wondering about the 15 Volts you measured since I had in mind that the output range of the PA was <10V.

In order to check for any pick-up, put the set-up shielded in the dark and verify that you have only low noise level without any incoming light. This way you can verify your shielding. In order to get a fast signal and the information on the collected charge in the PA use as a next stage a main amplifier with differentiation and integration times below 1µs. You remember, one of the requested parameters of the PWO is a fast decay time which should allow to collect at least 90% within 100ns and most of the light yield within 1µs.

I hope these additional comments will help you,

With best regards,

Rainer

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