

Tuesday, April 16, 2002

H. P. Mumm

Attention Ben Kennedy

Ben.Kennedy@ortec-online.com

1-800-251-9750 Ext. 144

Note on Surface Barrier Behavior

The following note outlines some of the problems we have been experiencing with our surface barrier detectors. It pertains to model AB-020-300-300 S detectors (where S indicates use of cryogenic epoxy). I can supply a list of all serial numbers if required, however for this purpose I'll just note that the serial numbers of the detectors referred to below are 41-014E, 40-003J, and 41-071B exhibiting low noise, bursts, and low frequency 'breakdown' respectively.

We have observed two types of problems. The first is a lack of response to applied bias. I.e. these detectors show no decrease in noise as bias is applied. On the bench these detectors show a small voltage drop of 1-1.5 volts when a small current is applied in the forward direction (From a DVM in the diode test mode). The reverse direction is over scale. Normal detectors do not show exhibit this behavior. The resistance in both directions is large enough so as to be unmeasurable with our basic DVM.

The second problem is a large increase in low frequency noise as the bias voltage is increased. Most of this is below 10 kHz, see plot below. This noise has been seen to develop in a detector that had run normally for at least 24 hours.

First it makes sense to verify the use of cryogenic epoxy as we regularly run the detectors at -50 to -100 C. Second, to the degree that it's possible, I'd like you to review our mounting procedure. Hopefully you will be able to uncover any flaws and suggest alternatives. I should also note that we typically run the detectors in vacuums better than 10^{-4} torr and they are never in a vacuum for more than ten minutes without a bias of at least 10 volts being applied.

The following photo shows how the detectors are currently mounted (NOTE the detector is actually in upside down). Each detector is sandwiched between the stainless faceplate and the circuit board holding the preamps. Electrical contact between the detector and both the faceplate and the circuit board is made with conductive elastomer (not shown). Bias is applied to a pad on the backside of the circuit board. Electrical contact between the circuit board ground (preamp ground) and the stainless faceplate

(detector ground) is made through the bolts pictured. There are two posts, visible in the upper left, on each side of the detector. The post height is chosen so that the elastomer is compressed by approximately 15%.

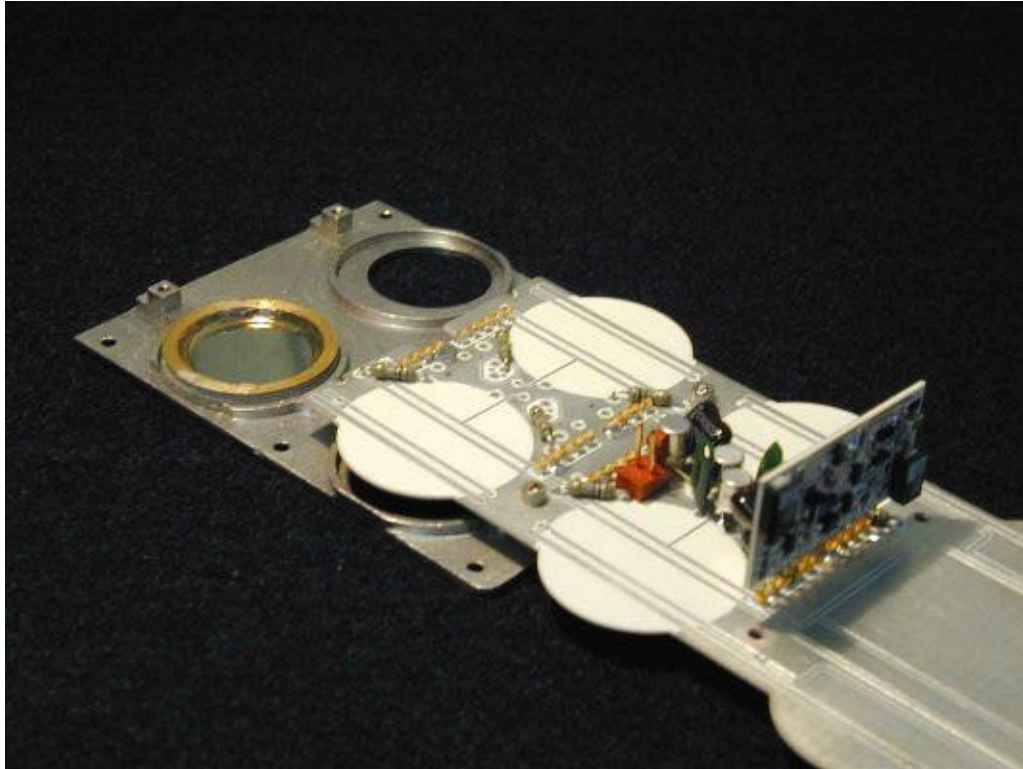
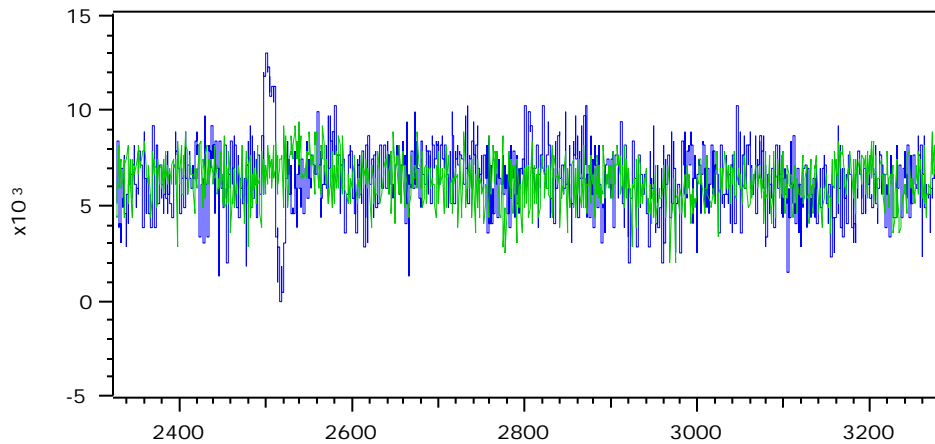
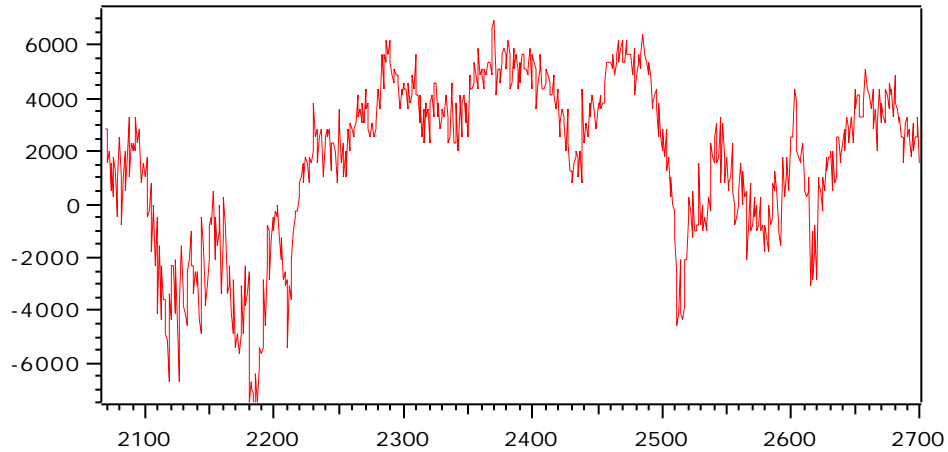


Figure 1. Detector mounting assembly

This following plot shows data from two detectors, green is a detector that looks good under all circumstances. Blue shows a detector that shows an occasional burst (left in plot) The overall noise width is approximately 5 mV. Most of the detectors have shown these bursts from time to time and such behavior does not seem to be correlated with the more serious problem shown below.



The next plot shows data from a detector that may be breaking down. The time scale is roughly $0.1\mu\text{s}$. The overall amplitude of the low frequency noise varies with applied bias voltage in this case being about 50mV. The noise width at higher frequencies is comparable to detectors that are behaving properly.



If you have any questions or need further information feel free to contact me either by phone (206) 669-0298 or at the email below.

Thank you for your help,

Pieter Mumm

Pieter@u.washington.edu

University of Washington

Center for Experimental Physics and Nuclear Astrophysics