Department

Subject Lab Techniques III

Name Jack Segal

Address

National® Brand

Computation Notebook

11 3/4" x 9 1/4", 4 x 4 Quad., 75 Sheets **43-648**

0 73333 43648 8

AVERY DENNISON

Office Products
Chicopee, MA 01022

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Photodiode Leakage Currents

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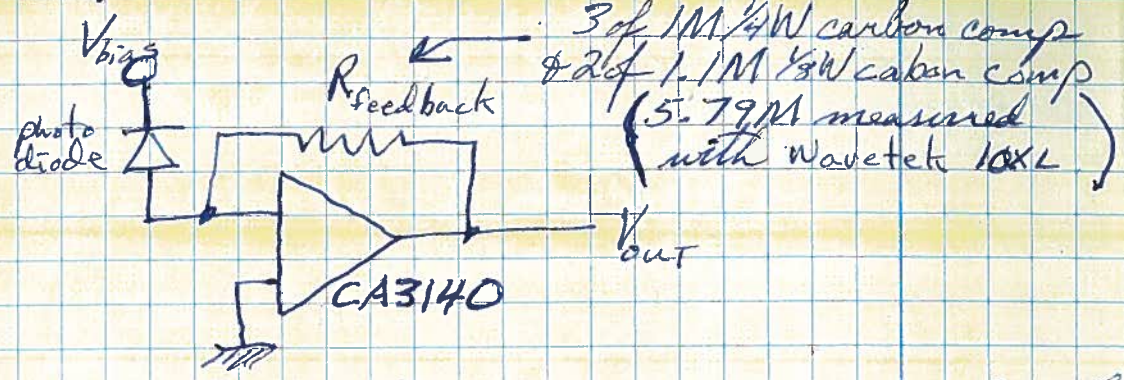
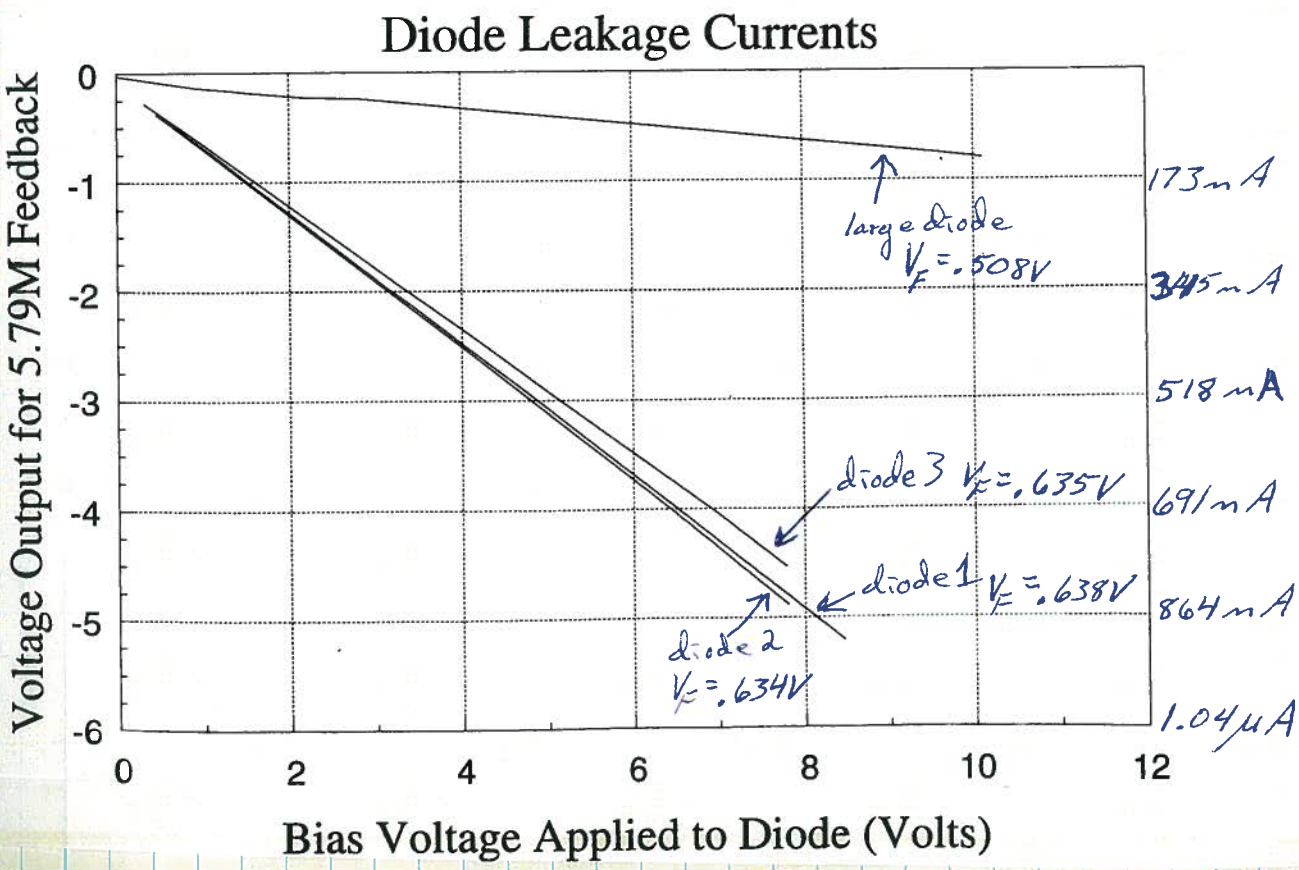
Leakage current measured with an I→V arrangement



I had originally tried a LF356 but was confused by the output. I had not anticipated the amount of leakage current.



I noted the shift in current if I warmed the PD with my hand. Any current monitoring will need for accurate measurement of temperature.

A 1N5401 diode's leakage current was also checked. A much smaller value.
.503V for V_F was measured.

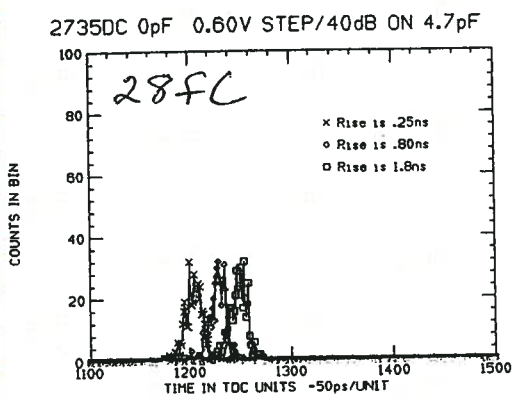
LeCroy 2735DC Timewalk + jitter 6/21/98

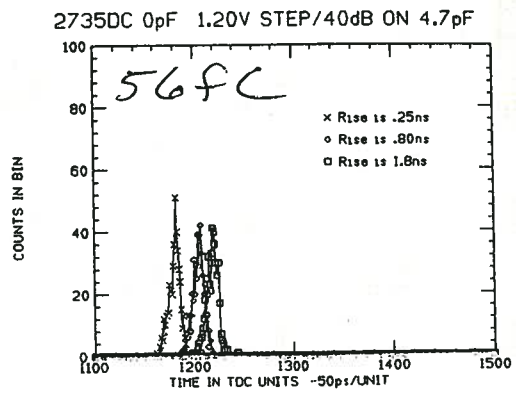
I found these pages stuck in Lab Techniques I. Apparently I did not tape them in anywhere.

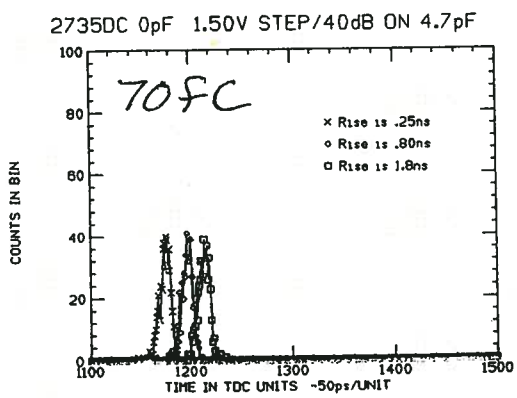
Setup would have been same as on p. 8 of Lab Techniques II.

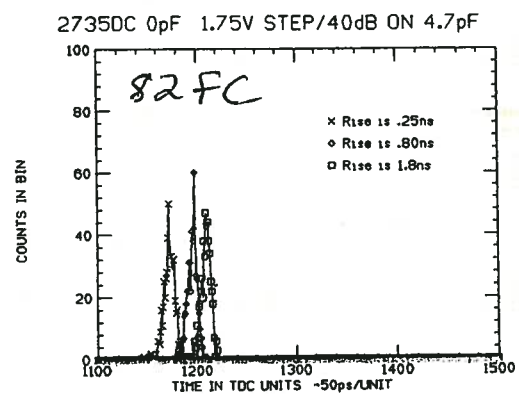
Threshold, risetime and charge injected are varied

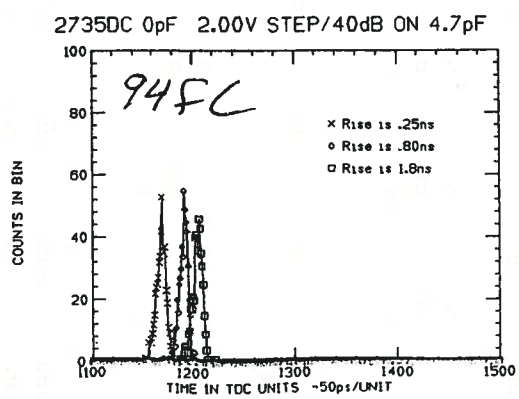
DAC=20 .78V 6/29/95

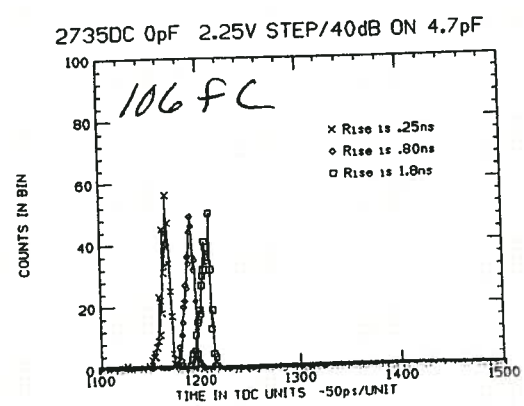






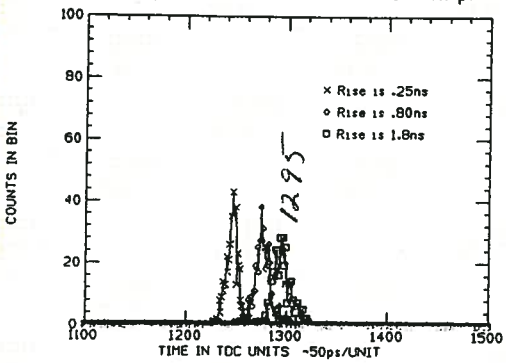




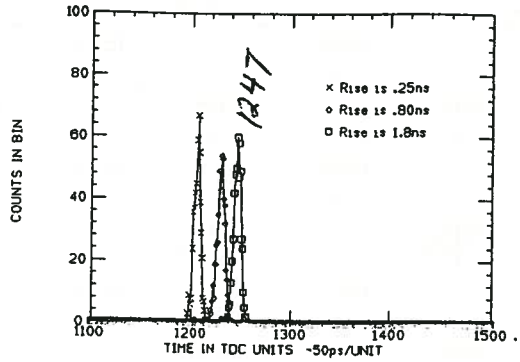


DAC=40 1.57V 6/29/95

2735DC 0pF 0.60V STEP/40dB ON 4.7pF



2735DC 0pF 1.20V STEP/40dB ON 4.7pF



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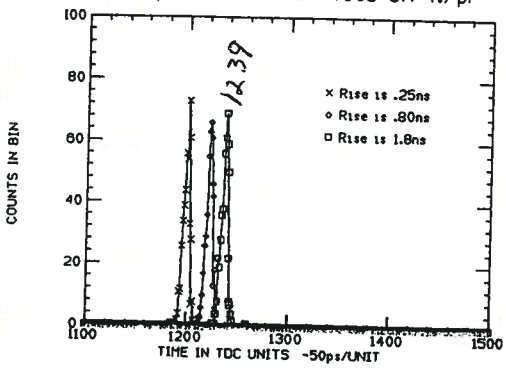

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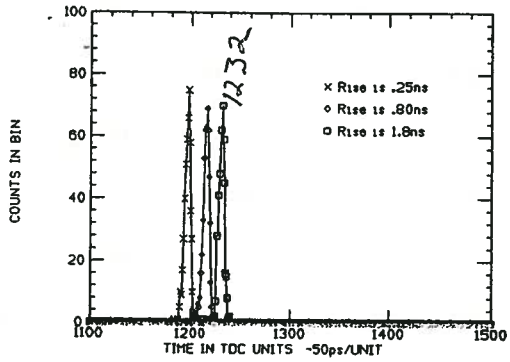
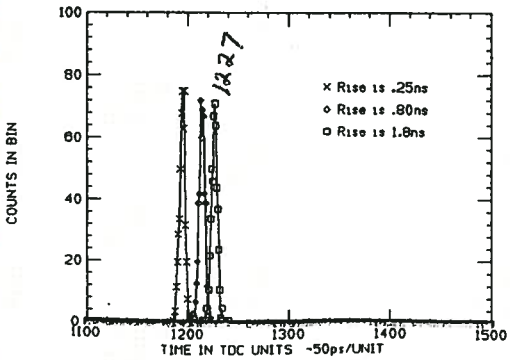


2735DC 0pF 2.00V STEP/40dB ON 4.7pF



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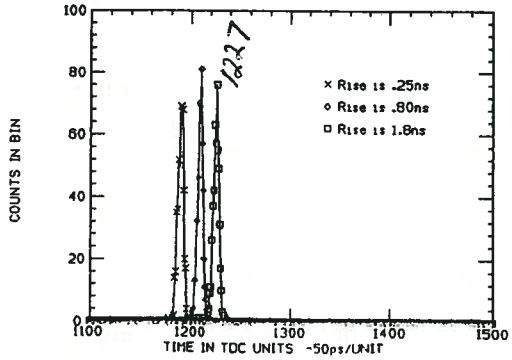
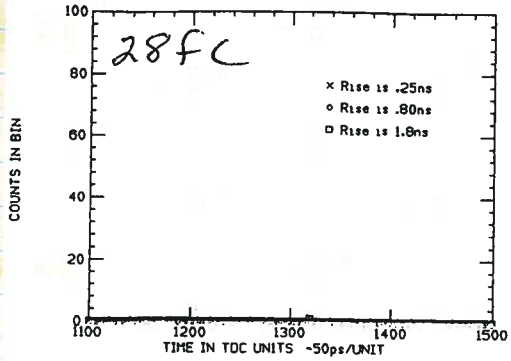


DAC=60 2.35V 6/29/95

2735DC 0pF 0.60V STEP/40dB ON 4.7pF



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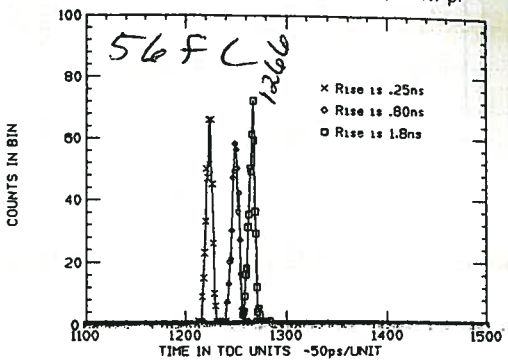

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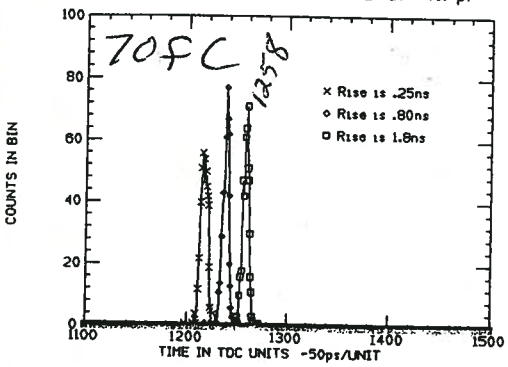

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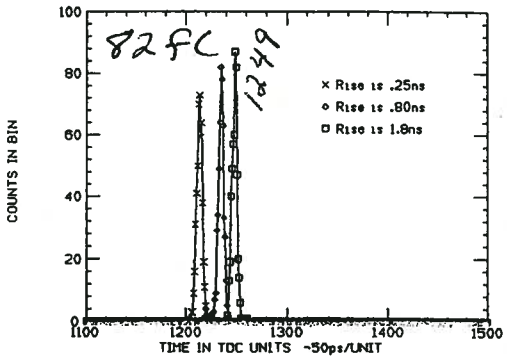

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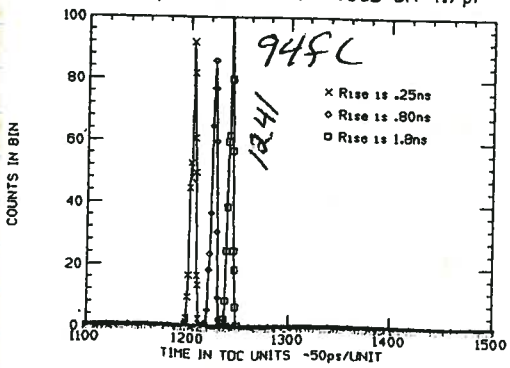
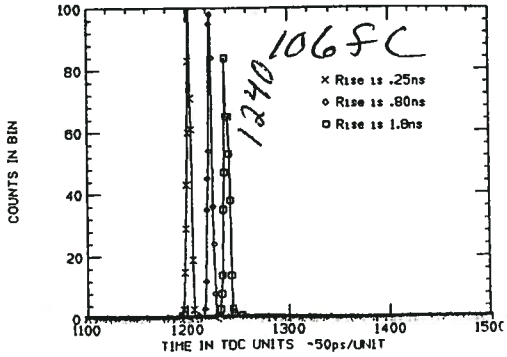
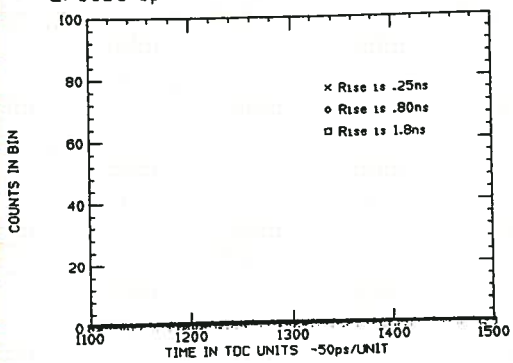


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

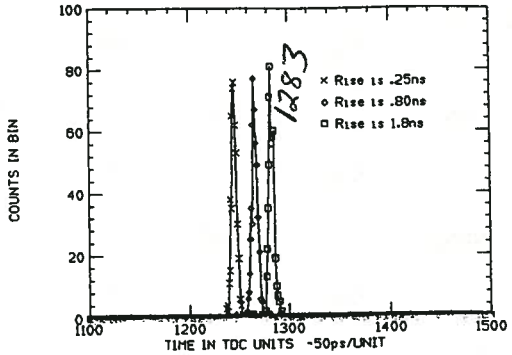


DAC=80 3.14V 6/29/95

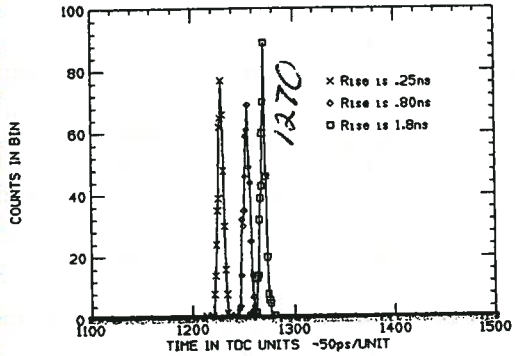
2735DC 0pF 0.60V STEP/40dB ON 4.7pF



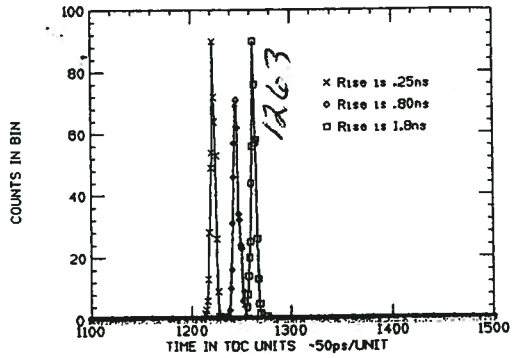
2735DC 0pF 1.20V STEP/40dB ON 4.7pF



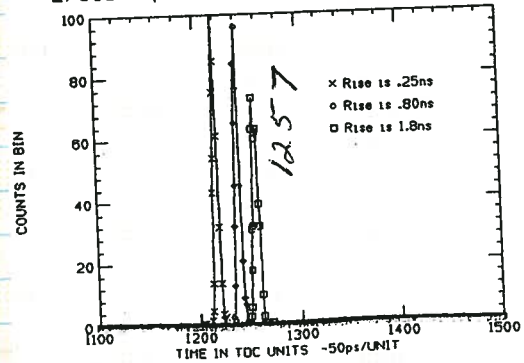
2735DC 0pF 1.50V STEP/40dB ON 4.7pF



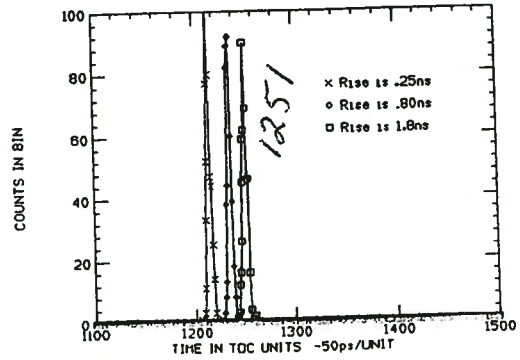
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

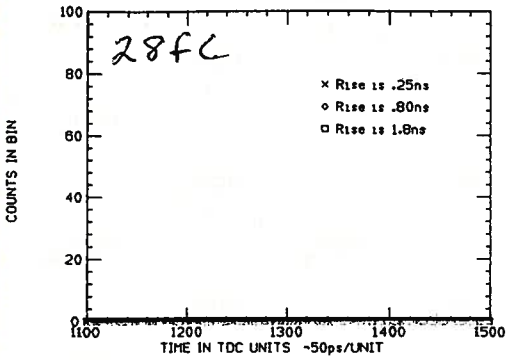


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

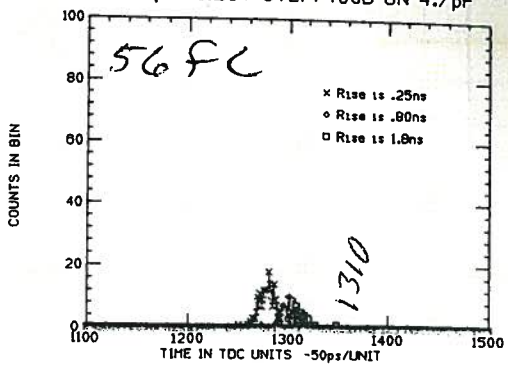


DAC=100 3.92V 6/29/95

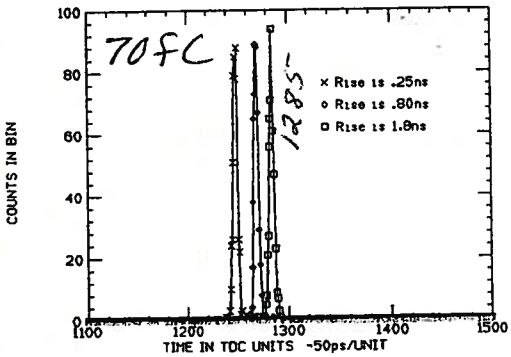
2735DC 0pF 0.60V STEP/40dB ON 4.7pF



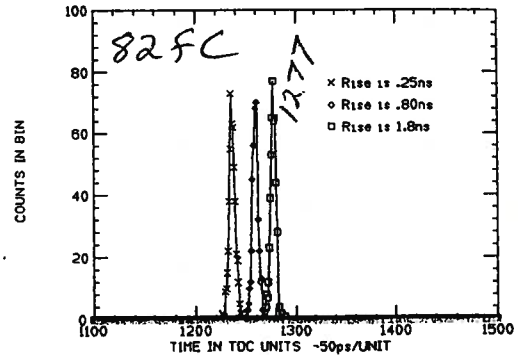
2735DC 0pF 1.20V STEP/40dB ON 4.7pF



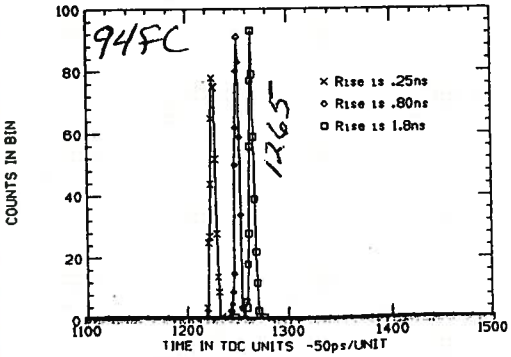
2735DC 0pF 1.50V STEP/40dB ON 4.7pF



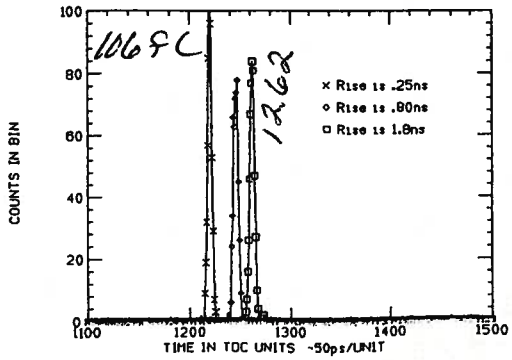
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

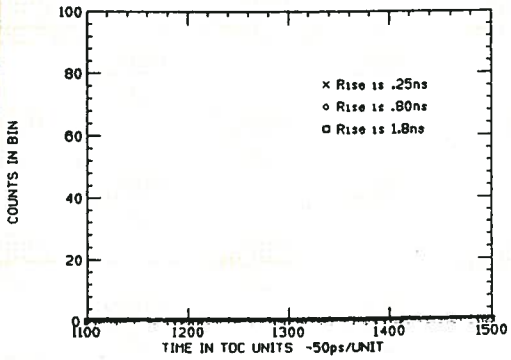


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

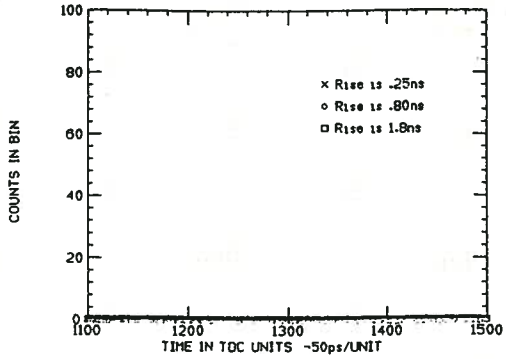


DAC=120 4.71V 6/29/95

2735DC 0pF 0.60V STEP/40dB ON 4.7pF



2735DC 0pF 1.20V STEP/40dB ON 4.7pF



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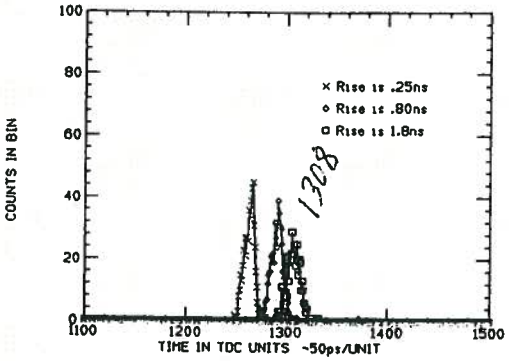
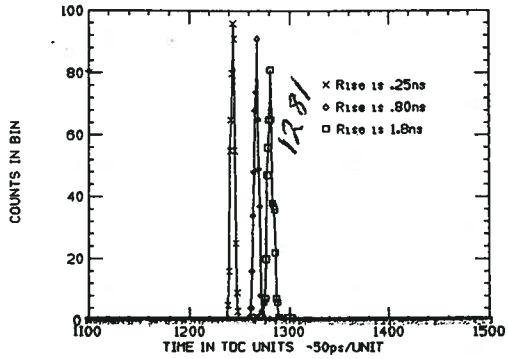
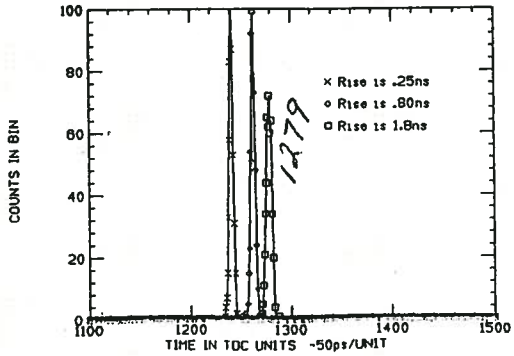


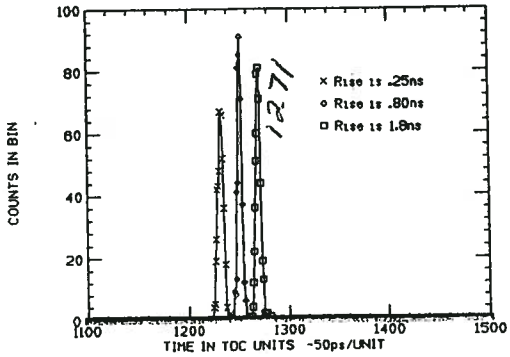
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

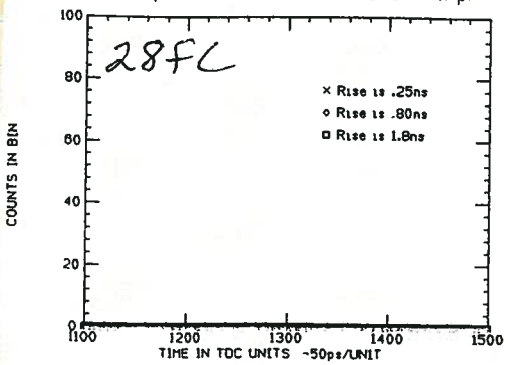


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

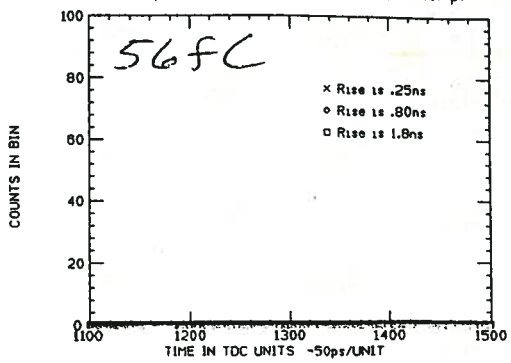


DAC=140 5.49V 6/29/95

2735DC 0pF 0.60V STEP/40dB ON 4.7pF



2735DC 0pF 1.20V STEP/40dB ON 4.7pF



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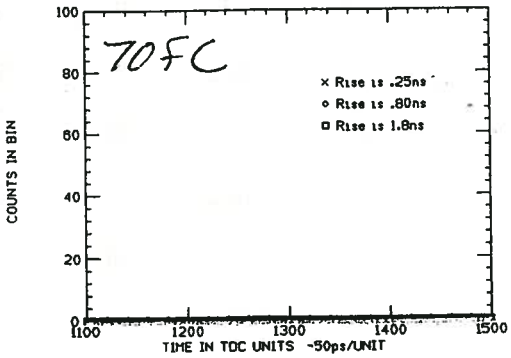
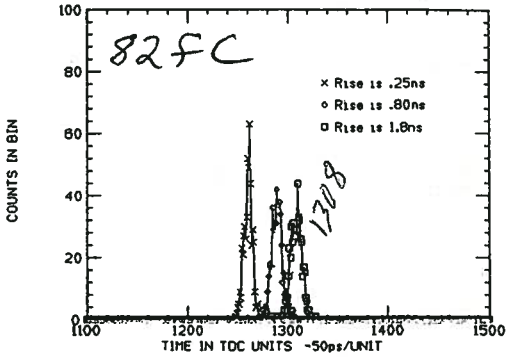
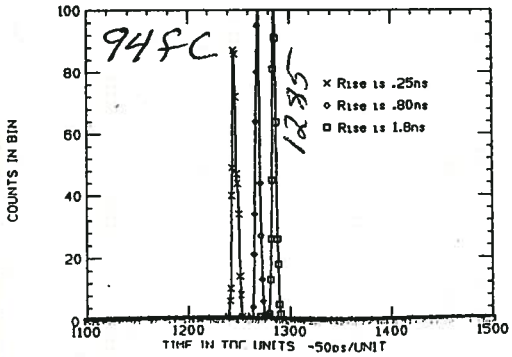


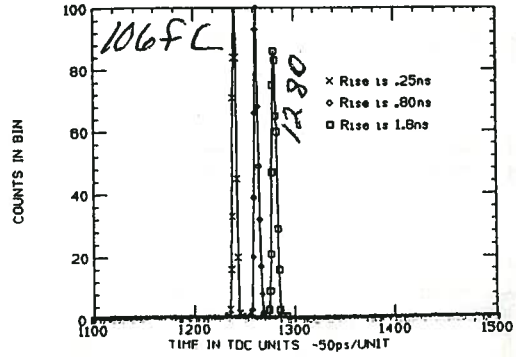
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

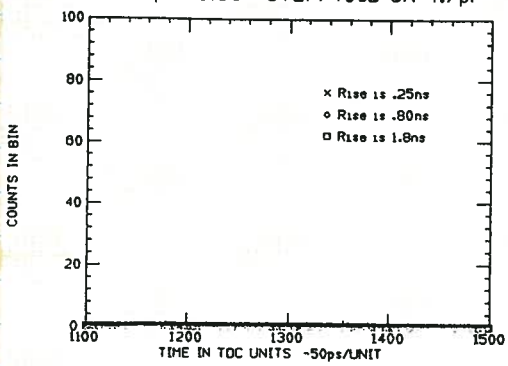


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

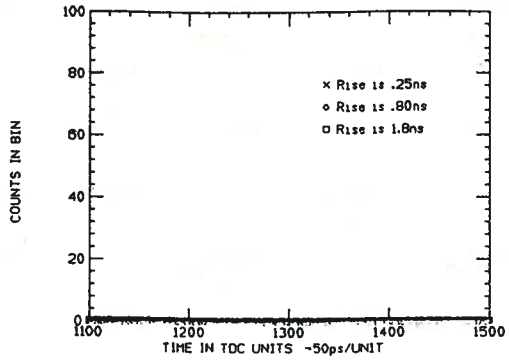


DAC=160 6.27V 6/29/95

2735DC 0pF 0.60V STEP/40dB ON 4.7pF



2735DC 0pF 1.20V STEP/40dB ON 4.7pF



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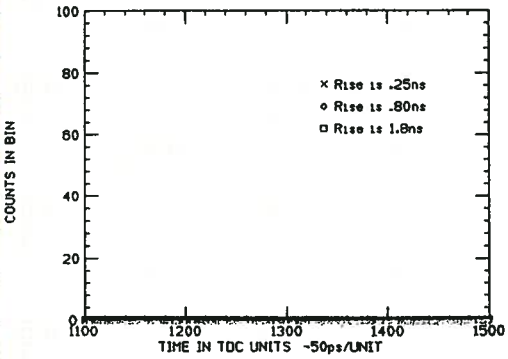
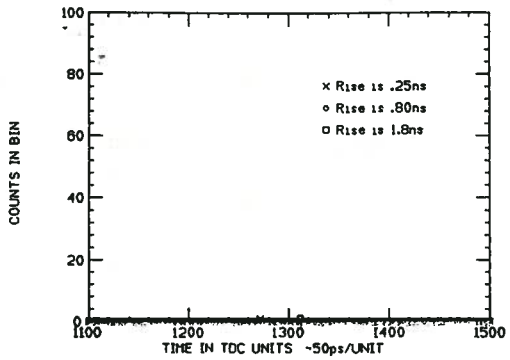
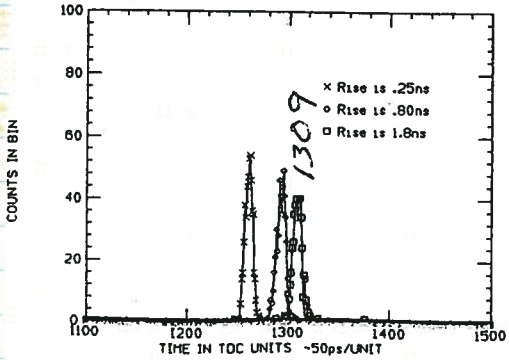


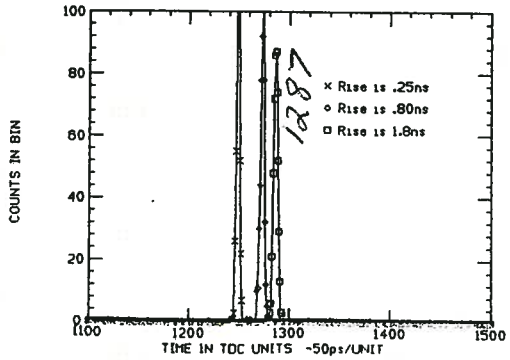
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

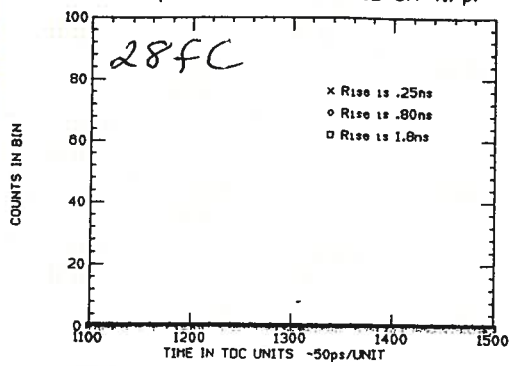


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

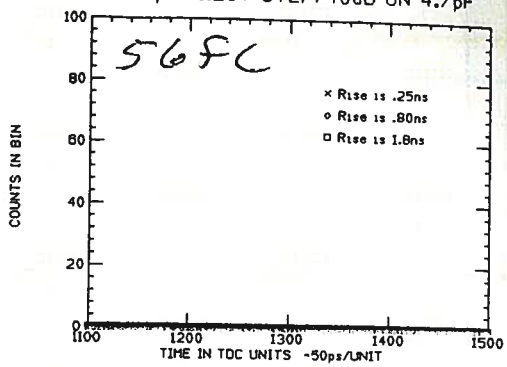


DAC = 180 7.06V 6/29/95

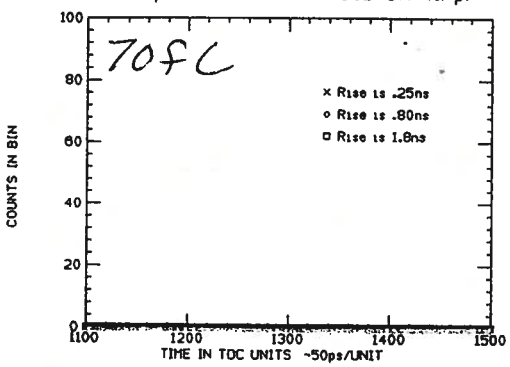
2735DC 0pF 0.60V STEP/40dB ON 4.7pF



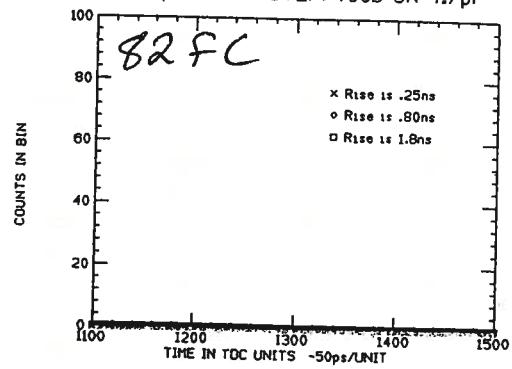
2735DC 0pF 1.20V STEP/40dB ON 4.7pF



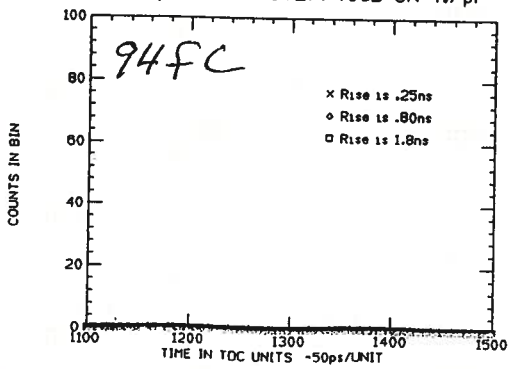
2735DC 0pF 1.50V STEP/40dB ON 4.7pF



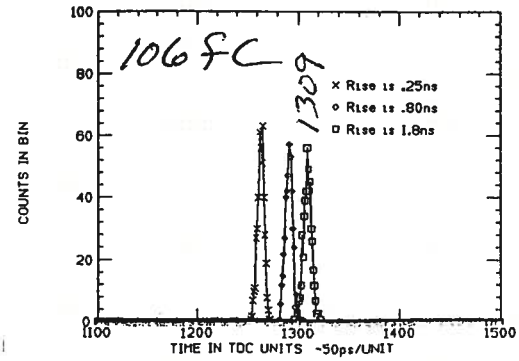
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF

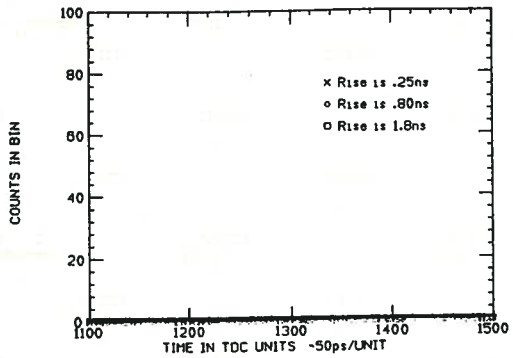


2735DC 0pF 2.25V STEP/40dB ON 4.7pF

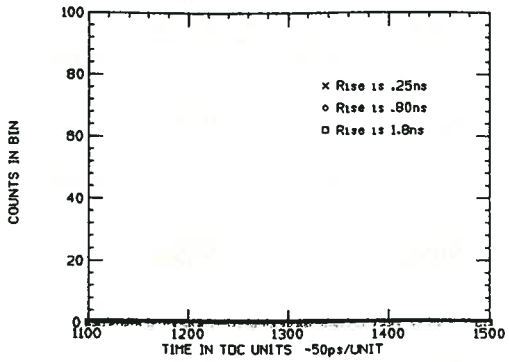


DAC=200 7.84V 6/29/95

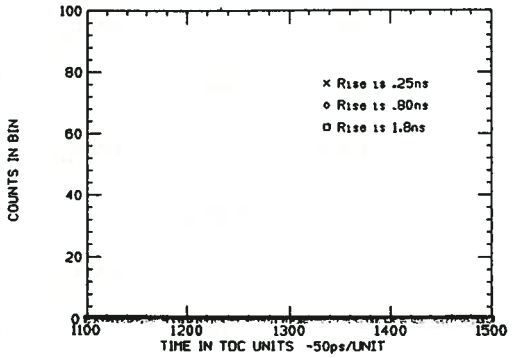
2735DC 0pF 0.60V STEP/40dB ON 4.7pF



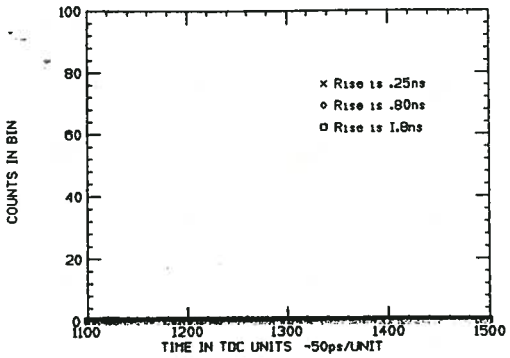
2735DC 0pF 1.20V STEP/40dB ON 4.7pF



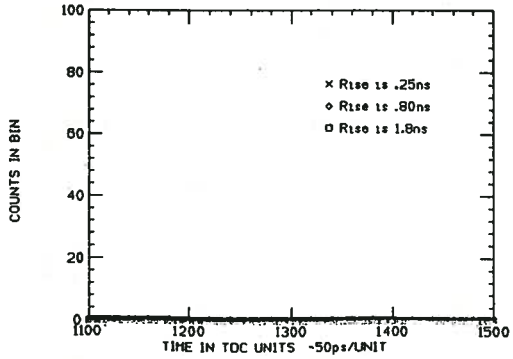
2735DC 0pF 1.50V STEP/40dB ON 4.7pF



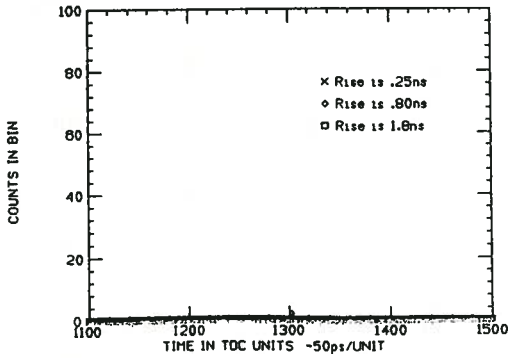
2735DC 0pF 1.75V STEP/40dB ON 4.7pF



2735DC 0pF 2.00V STEP/40dB ON 4.7pF



2735DC 0pF 2.25V STEP/40dB ON 4.7pF



First Try At Pulse Shaping for PSD 9/3/98

Using some of the miscellaneous op-amps I have on hand.

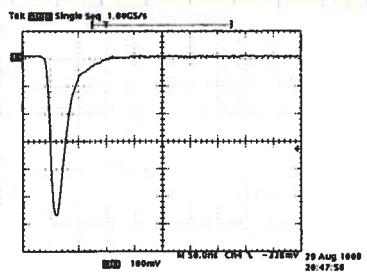
To do some pulse shape discrimination with Sparky using a Bicron BC501A liquid scint and a Hamamatsu R3036 3" PMT. The same PMT we use for the preshower detectors.

This work was done on 8/29.

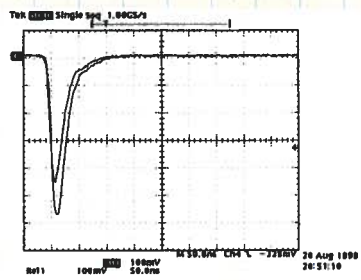
The PMT has a passive base with the resistors scaled in the ratio Hammamatsu uses for optimized linearity, with R = 67k

The idea is to try integrating the pulse then differentiating it twice. A zero crossing discriminator will then give a pulse whose timing is compared to a prompt pulse generated off the leading edge of the PMT pulse.

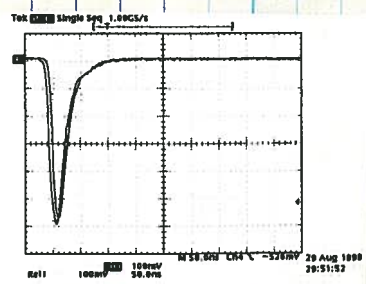
PMT signals going straight into the scope. I don't remember what the voltage was for these 3 pictures.



Response to a β source Sr^{90}



Ref is β from 1st picture γ response Cs^{137}

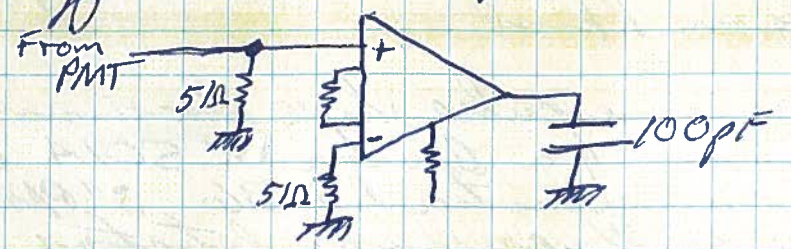


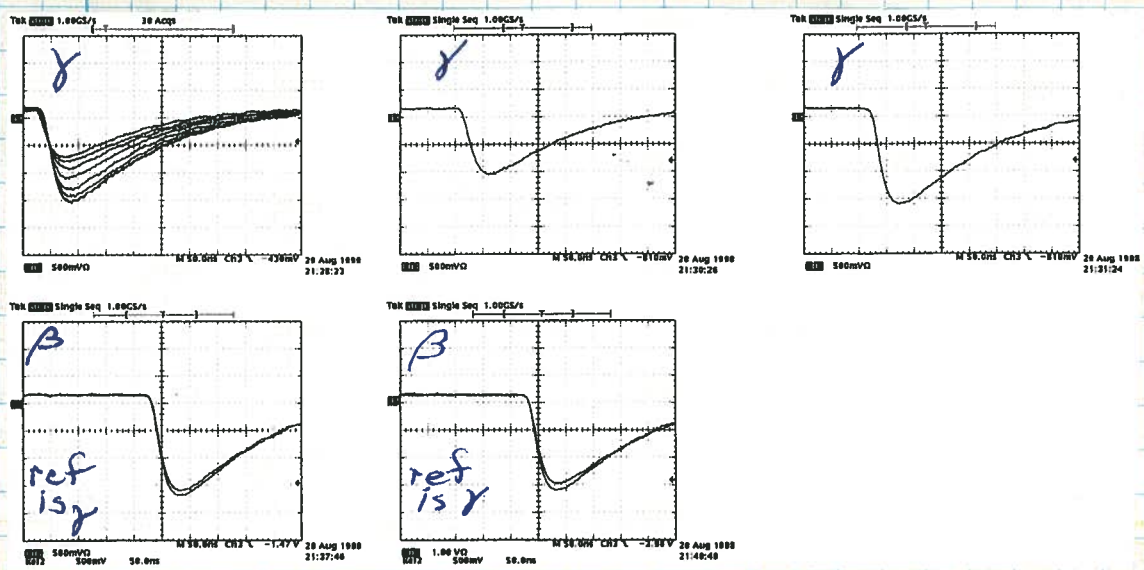
ref is β from 1st another γ from Cs^{137}

β source is Sr^{90} γ source is Cs^{137}

HV was 1000V for the rest of the photos.

Looking at the output of the max436 while bar 100pF to ground.

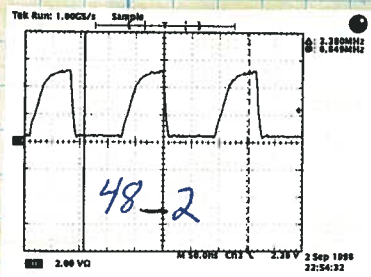


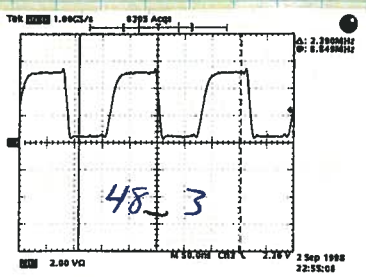


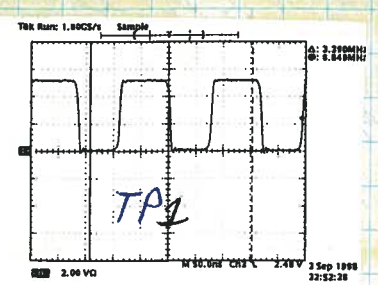
Crane RC Box Waveforms 11/18/98

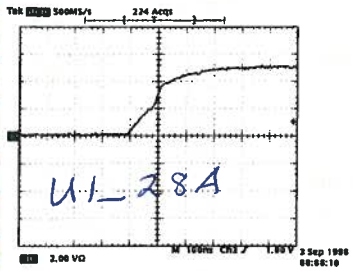
I had previously looked at the signals on the boards of the control chief radio control box for the crane in Hall A. I got a service manual with the schematics in it. I got snapshots of the waveforms at the indicated chips and pins. These are signals off one of the control boards from the receiver on the crane gantry.

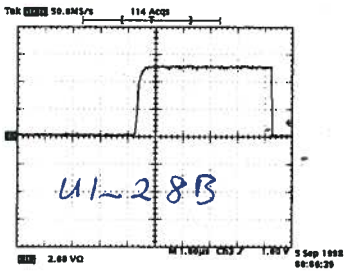
The board had been removed and I could only look at a few signals, since most of the required circuitry was not available.

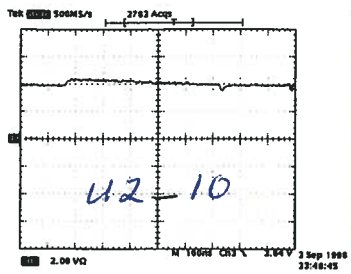

48_2

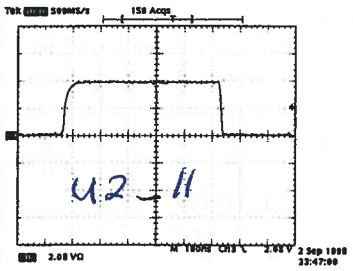

48_3

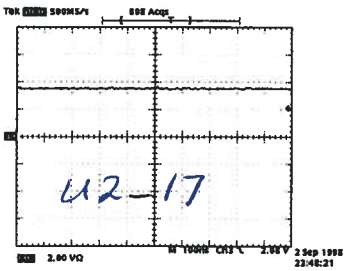

TP1

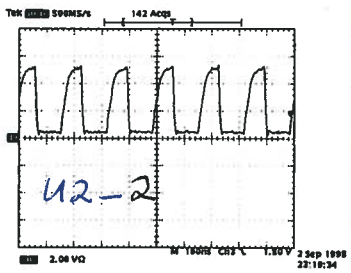

U1_28A

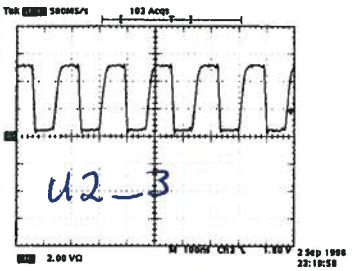

U1_28B

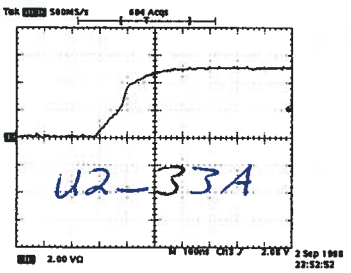

U2_10

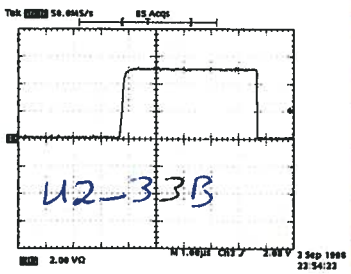

U2_11

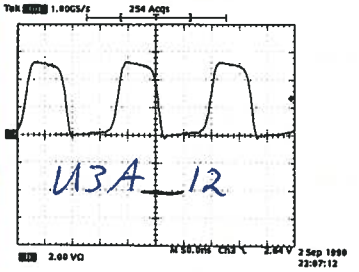

U2_17

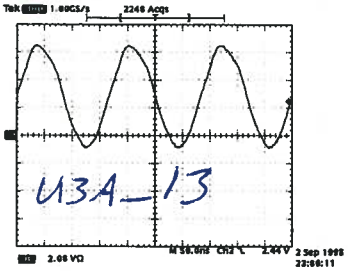

U2_2


U2_3

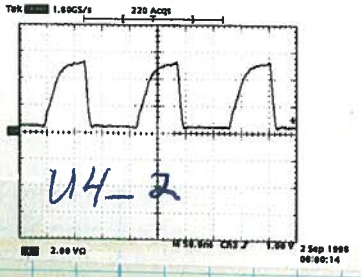

U2_33A

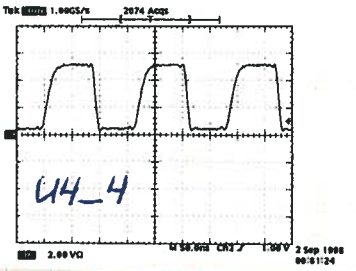

U2_33B

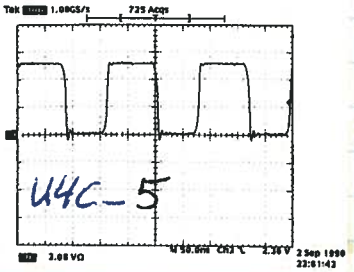

U3A_12

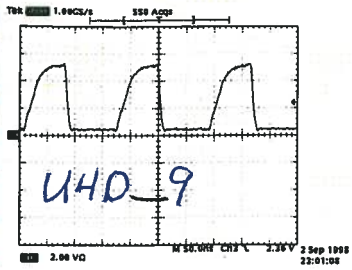

U3A_13

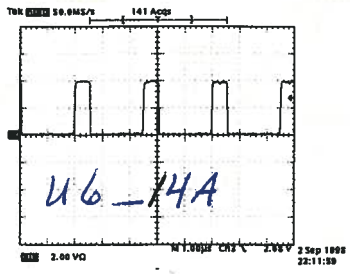

U4_1

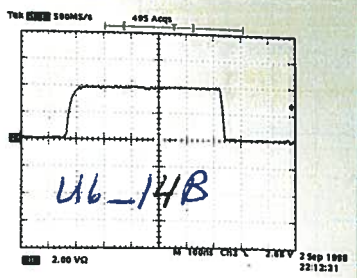

U4_2

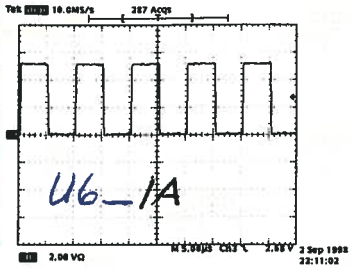

U4_4

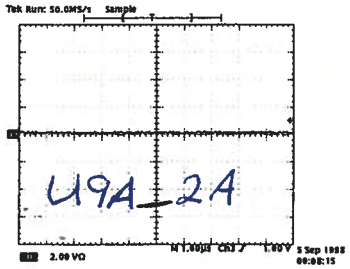

U4C_5

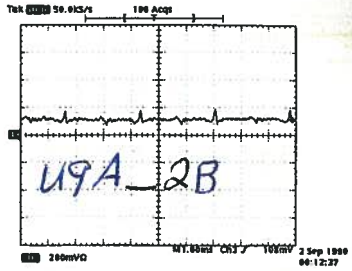

U4D_9

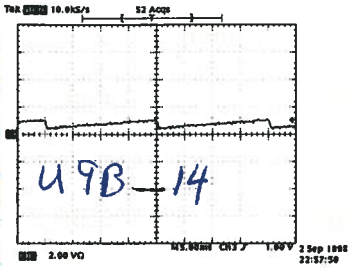

U6_14A


U6_14B


U6_1A


U9A_2A

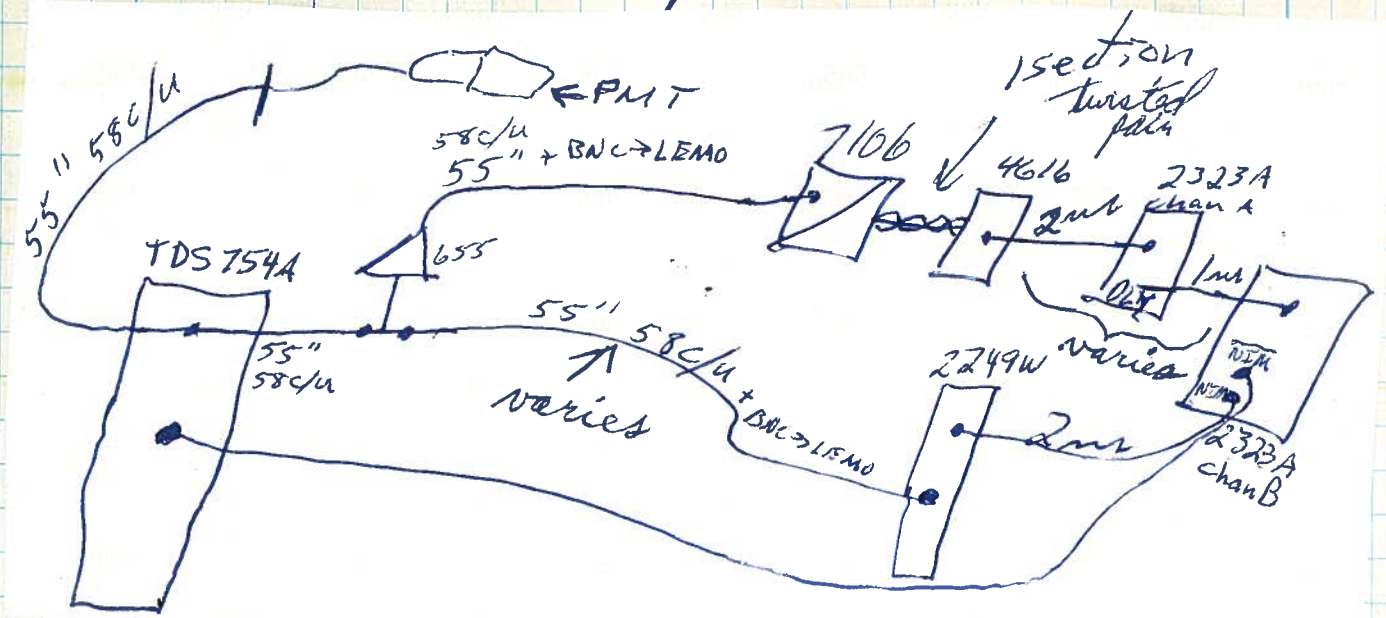

U9A_2B


U9B_14

11/18/98 Delay Cable Comparison

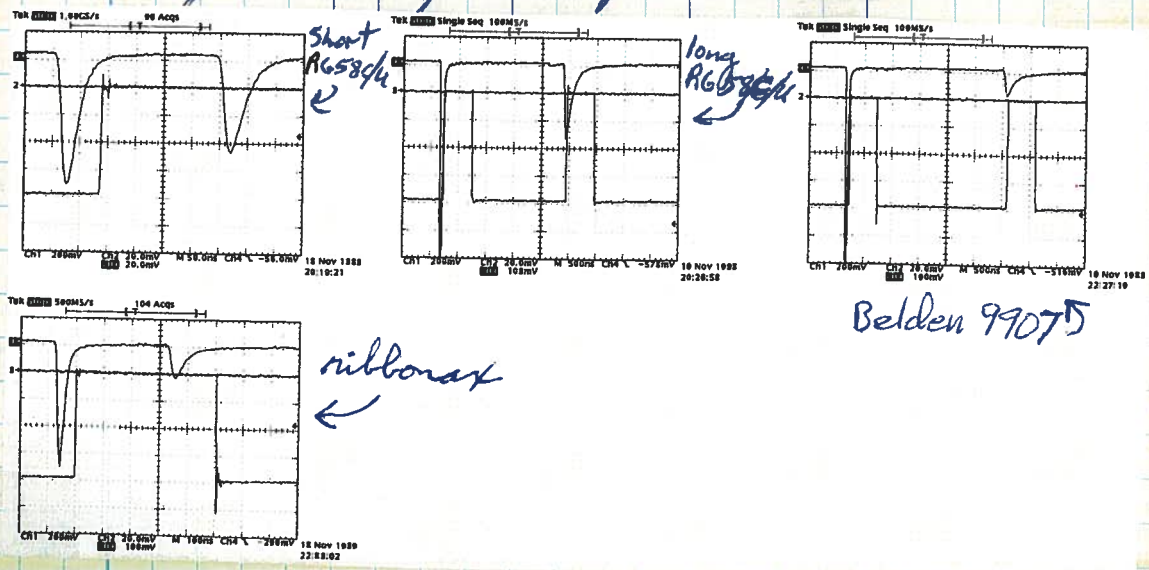
Looking at the performance of ribbonax cable for use as a short delay line before ADCs for the photon calorimeter in Hall A.

The basic setup is

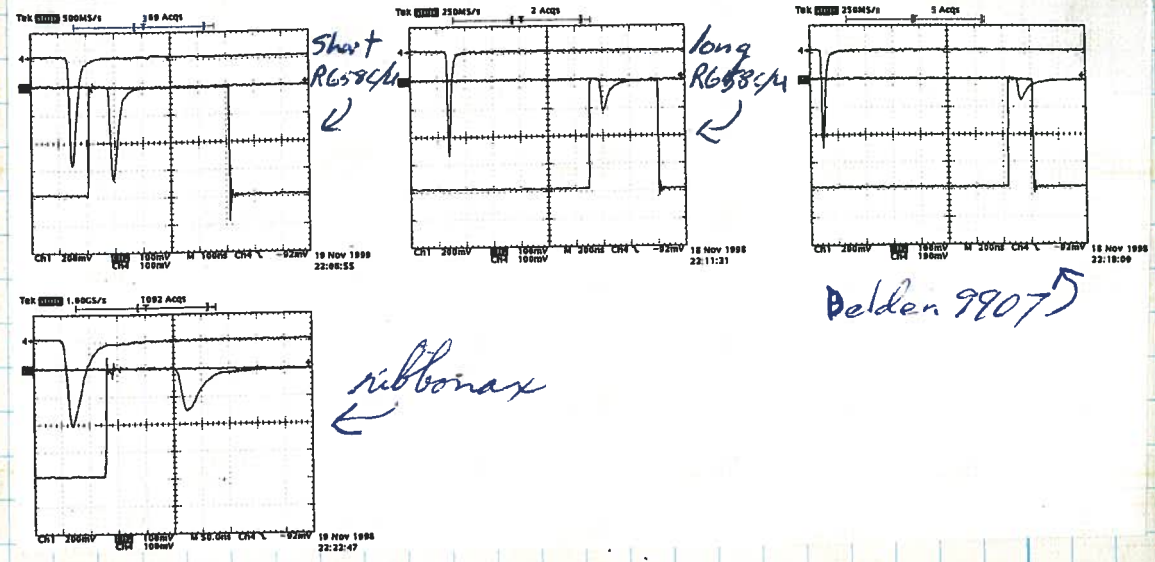


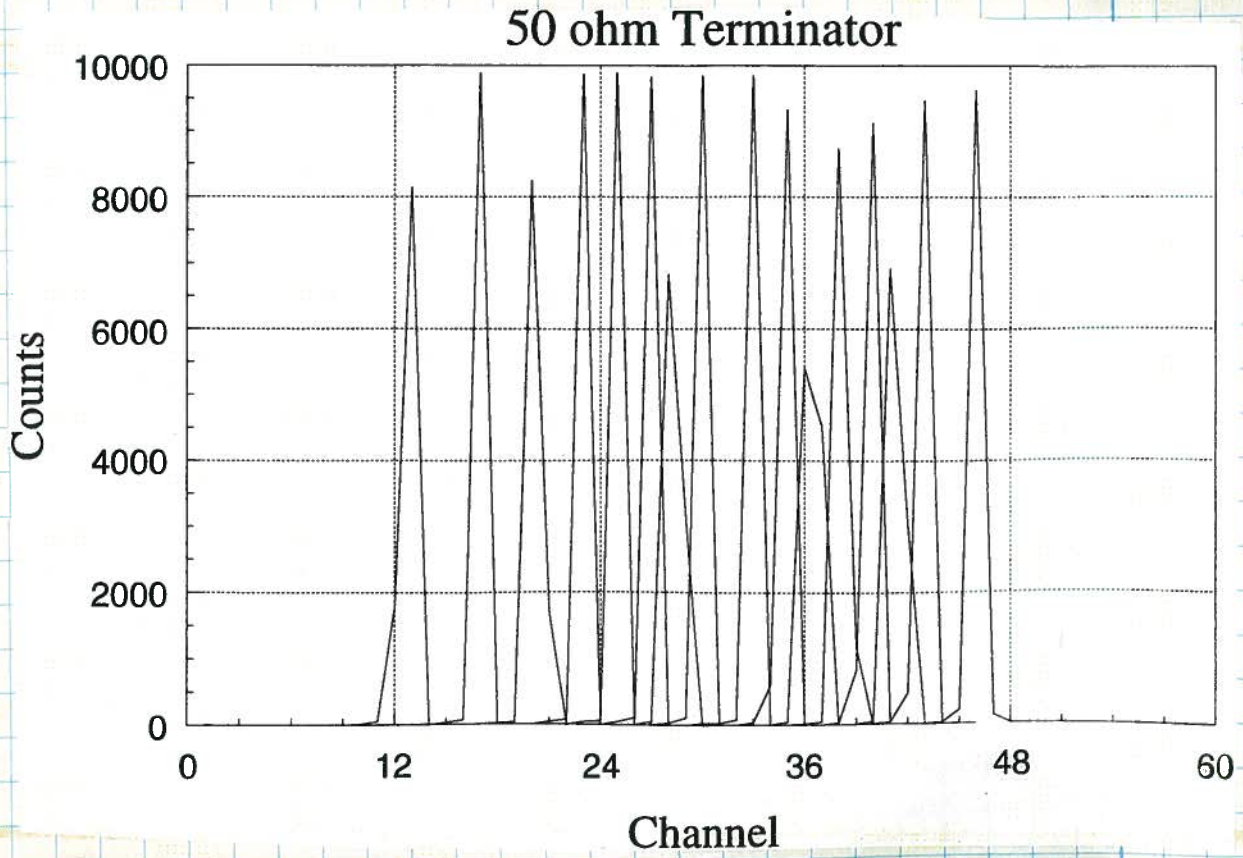
PMT is R3036 (Hamamatsu) with BC501 in front of it. Cs source on the BC501.

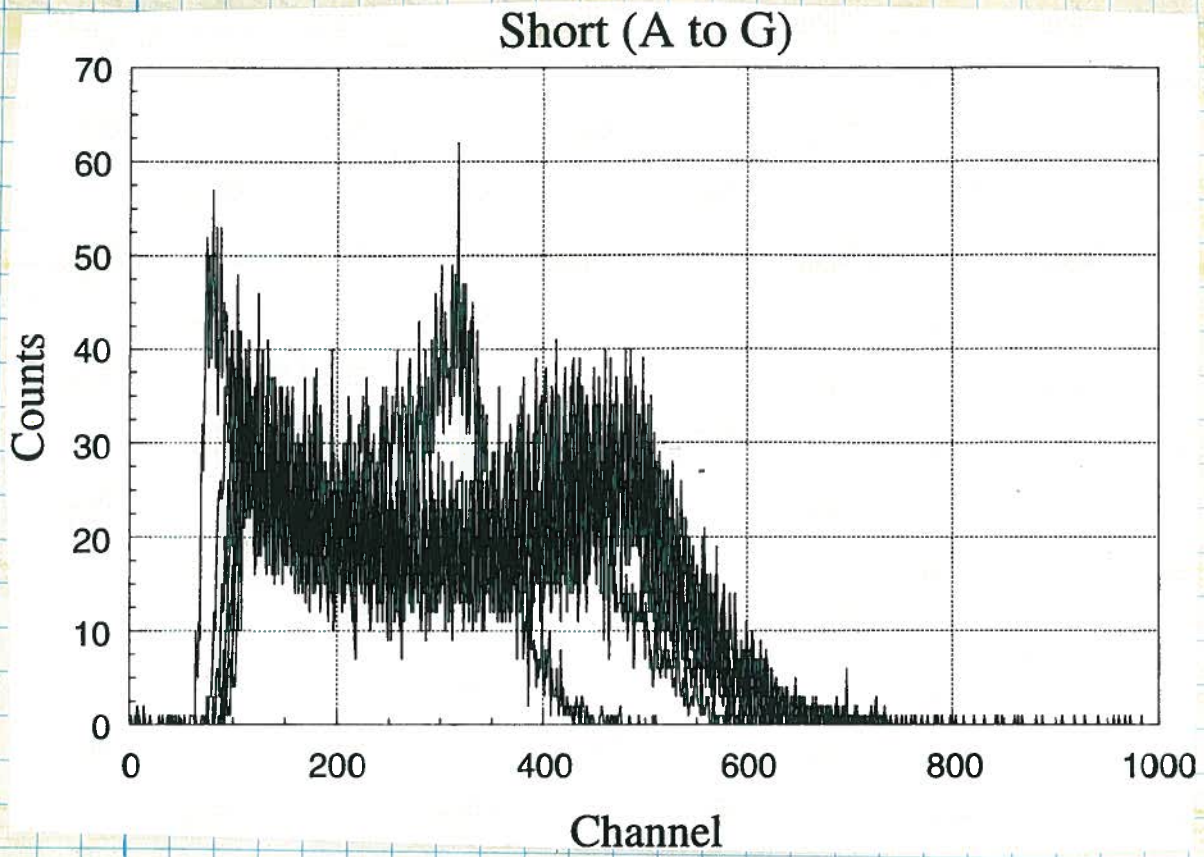
Relative lengths of cable tested. Cable connected to OPA655 and left open ended. Length determined from reflection from open end.

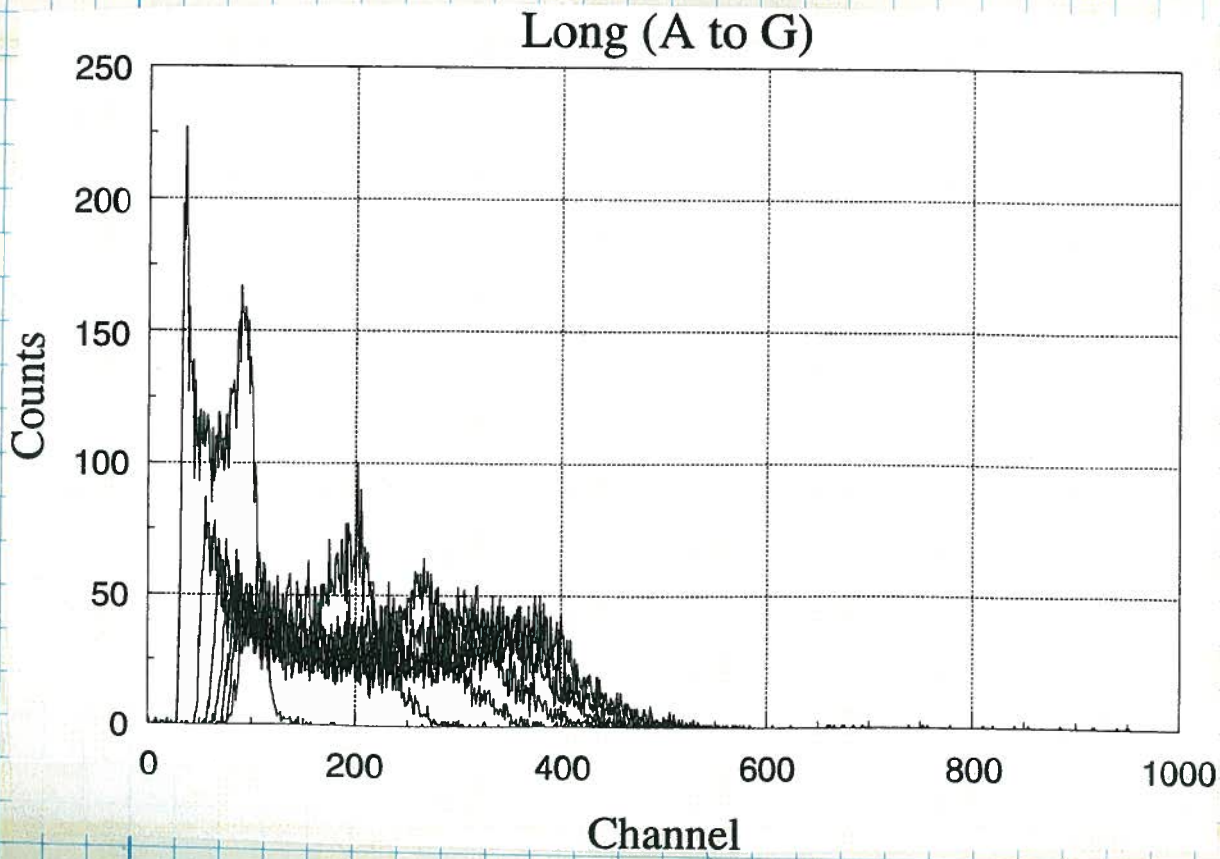


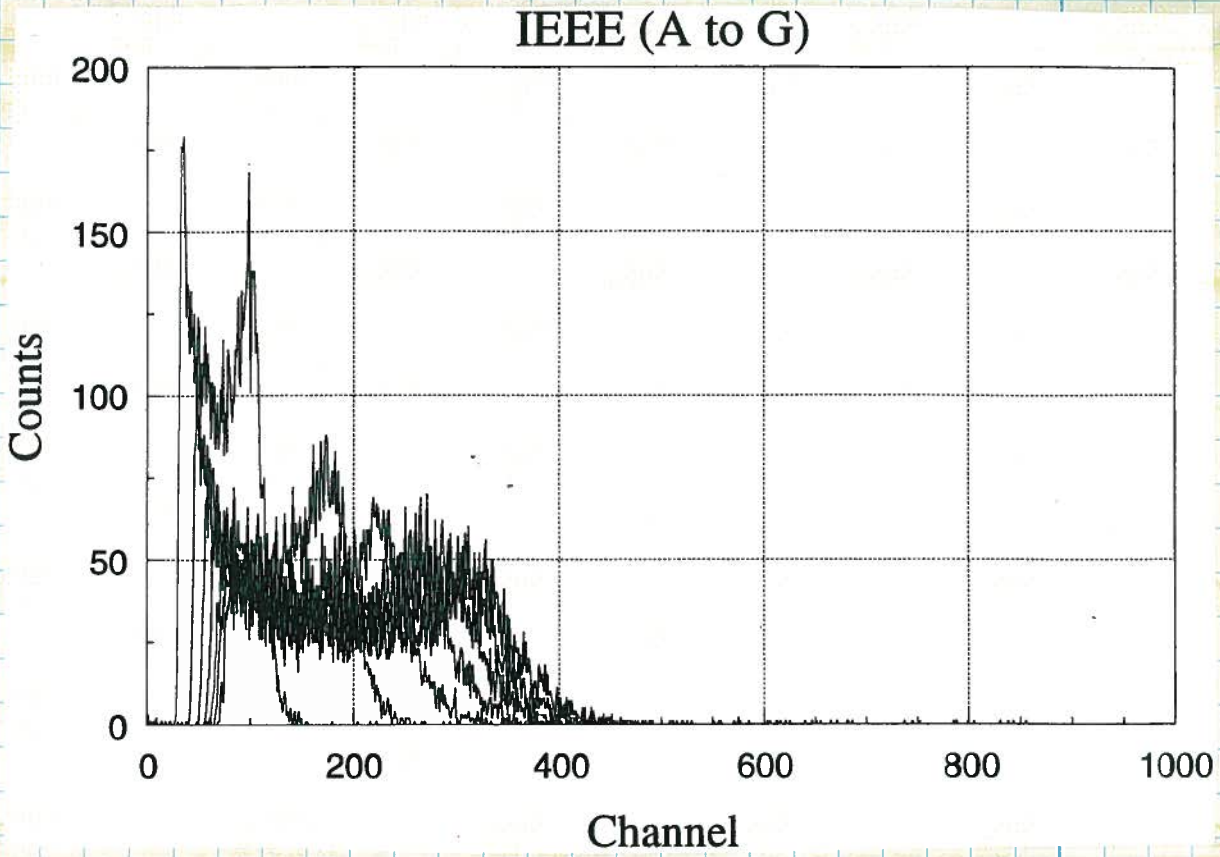
Placement of the leading edge of the gates. Gate is varied from 100ns to 500ns wide by 25ns steps. Leading edge remains in same position. Data sets are labeled A thru Q.

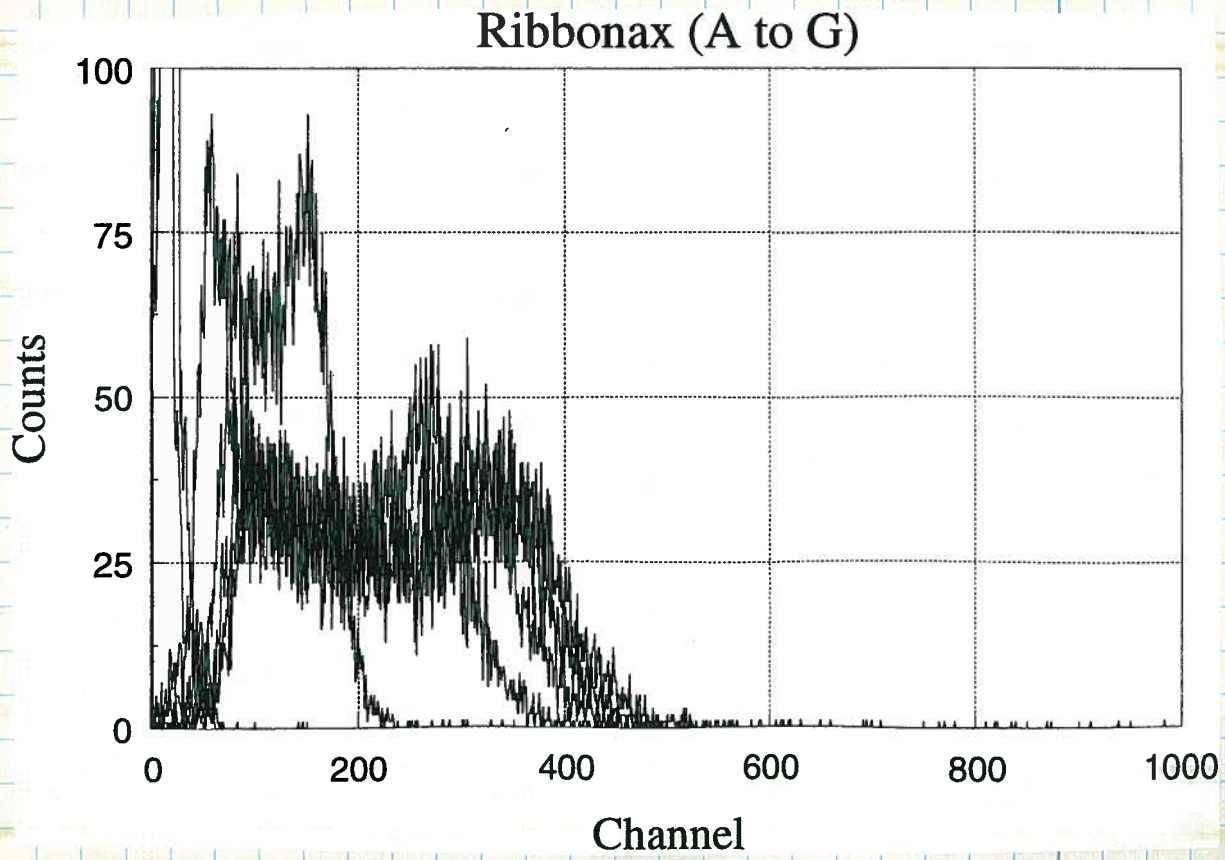


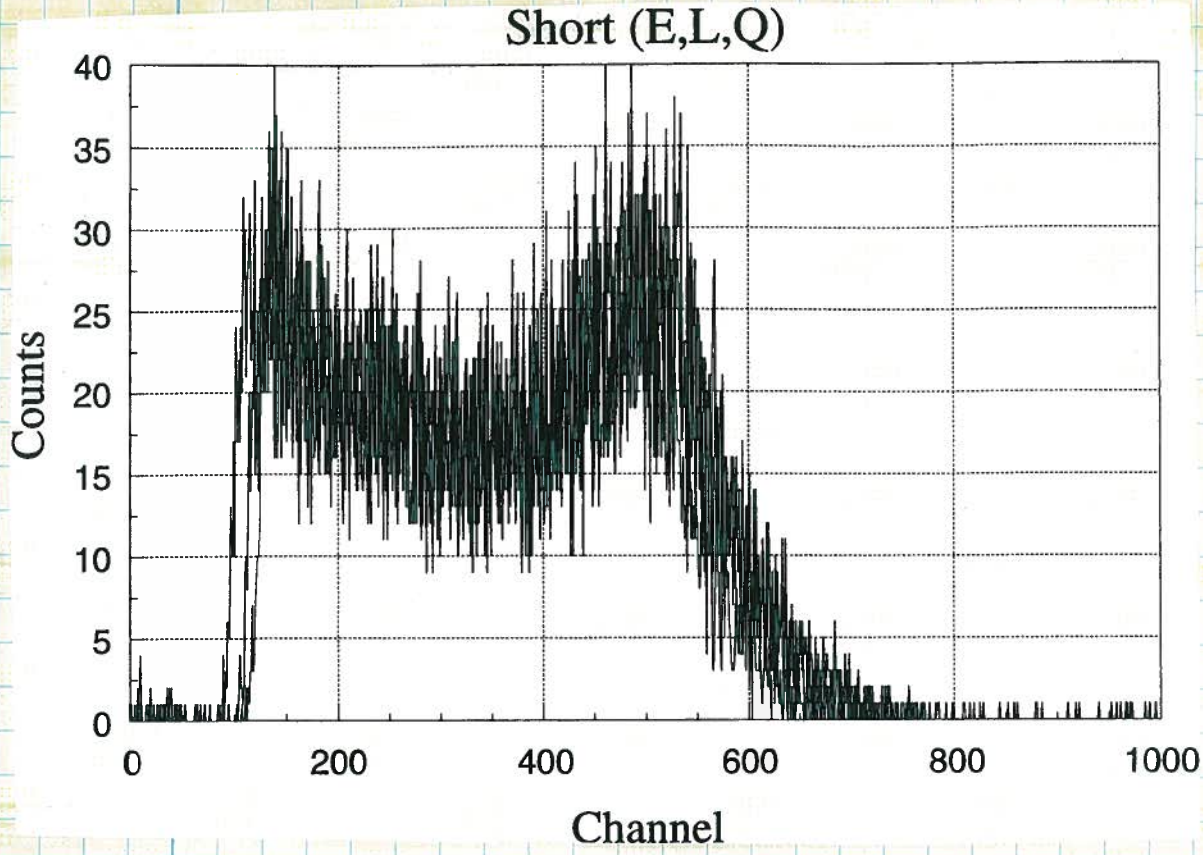


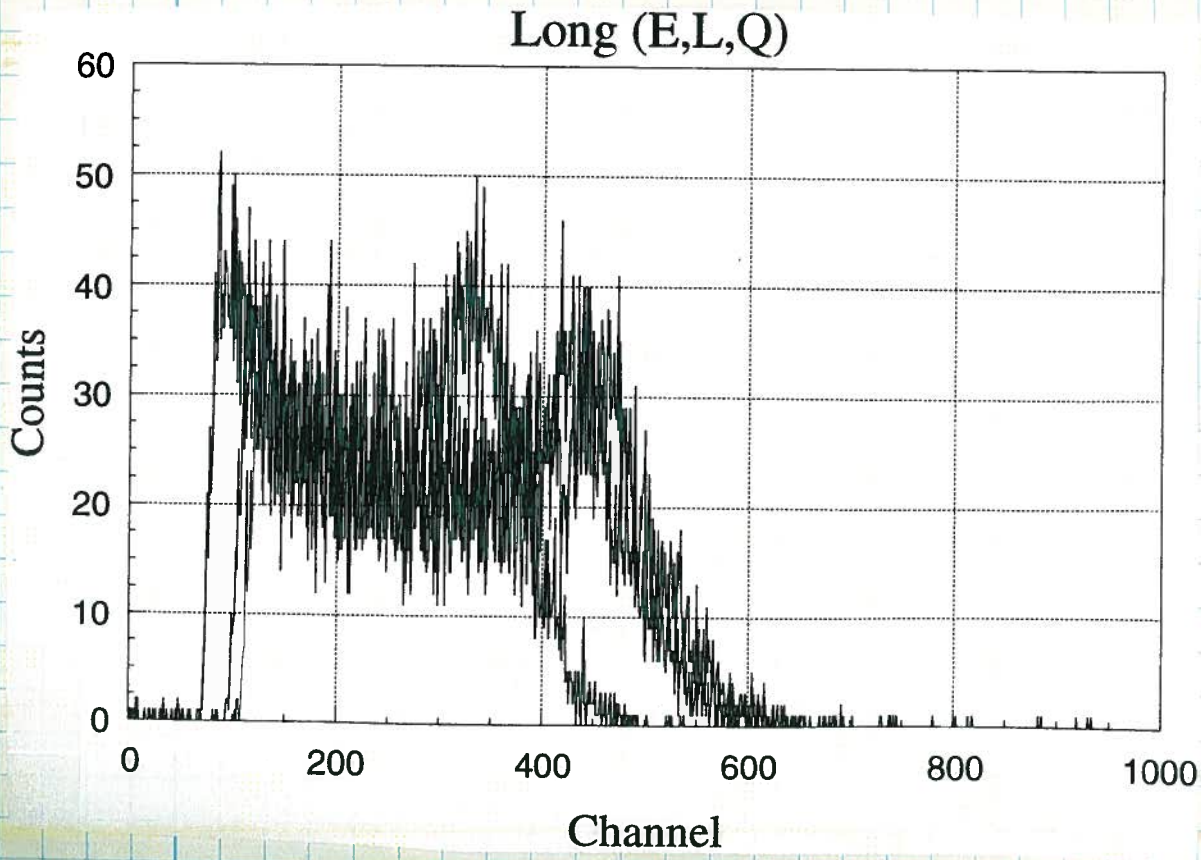

Short (A to G)
Counts
Channel
0
10
20
30
40
50
60
70
0
200
400
600
800
1000

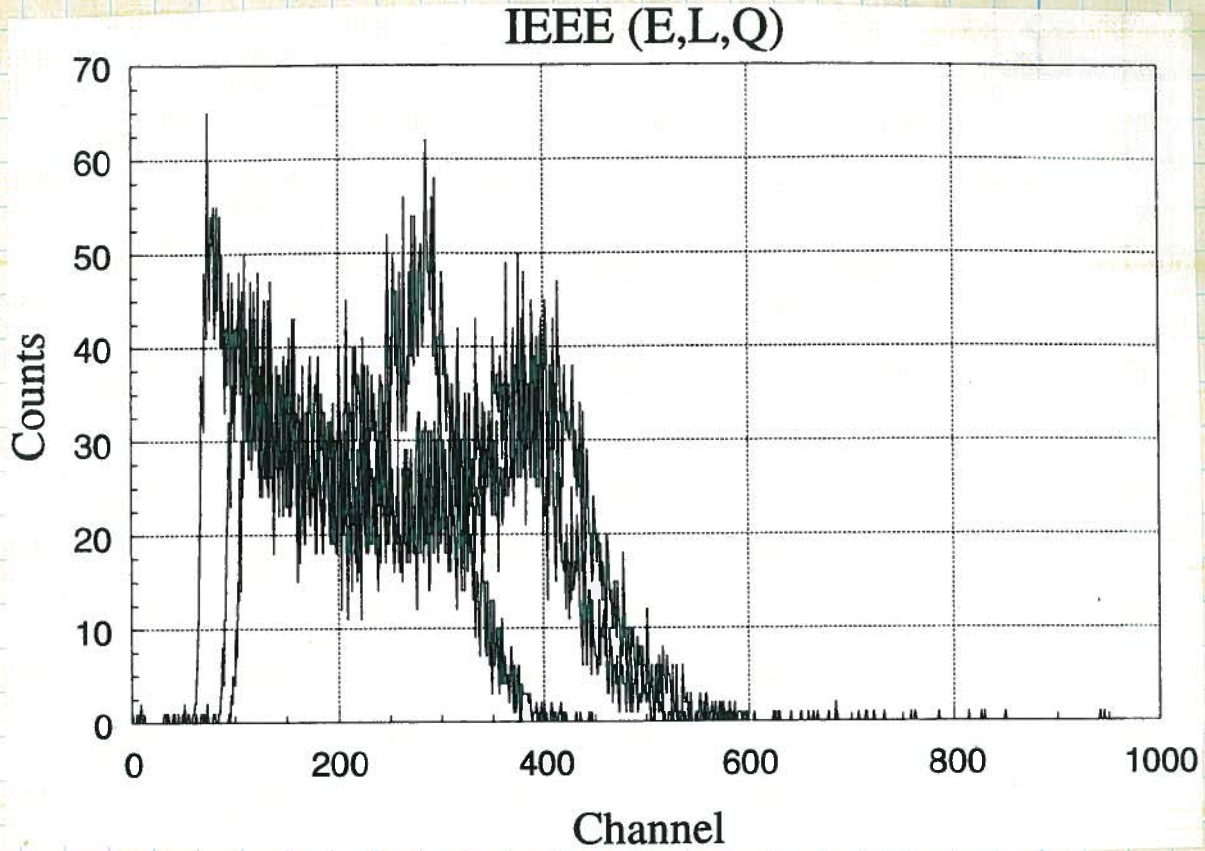

Long (A to G)
Counts
Channel
0
50
100
150
200
250
0
200
400
600
800
1000

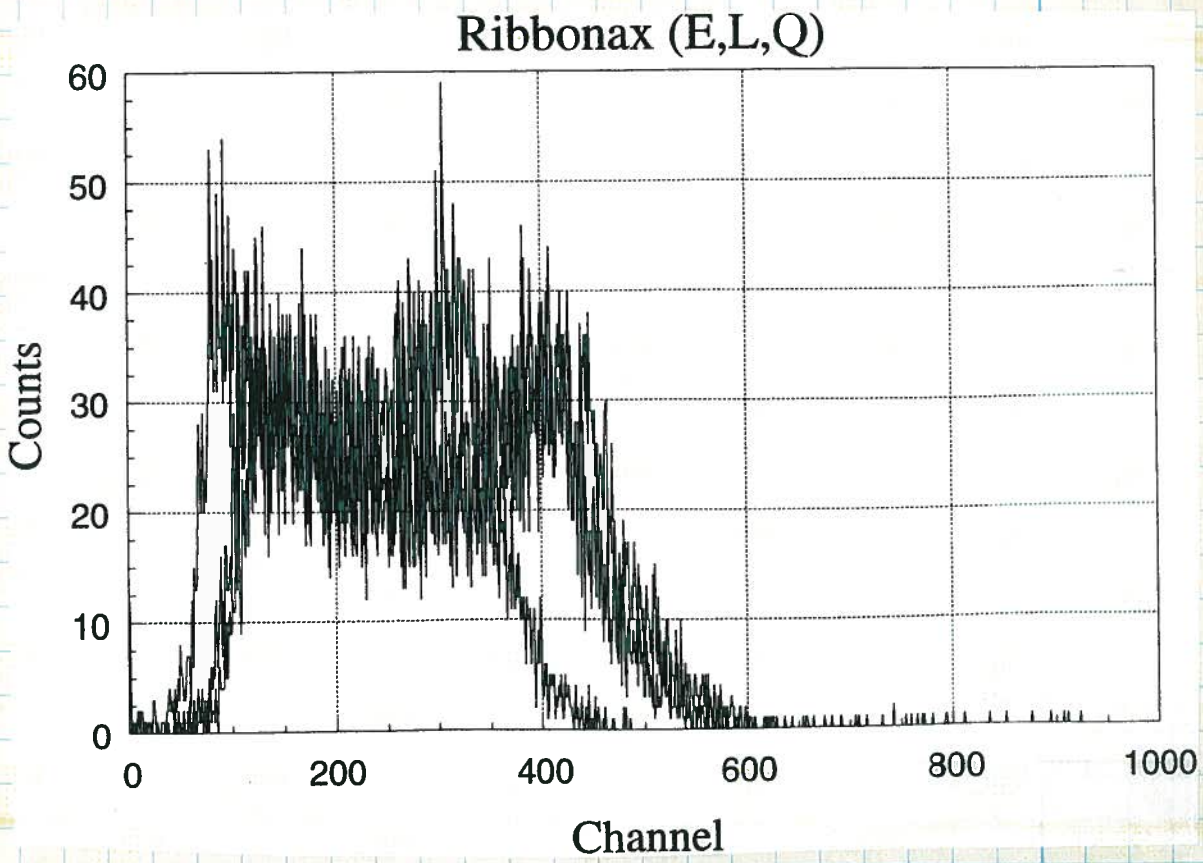

IEEE (A to G)
Counts
200
150
100
50
0
0
200
400
600
800
1000
Channel


Ribbonax (A to G)
Counts
100
75
50
25
0
0
200
400
600
800
1000
Channel


Short (E,L,Q)
Counts
Channel
0
5
10
15
20
25
30
35
40
0
200
400
600
800
1000


Long (E,L,Q)
Counts
Channel
0
10
20
30
40
50
60
0
200
400
600
800
1000

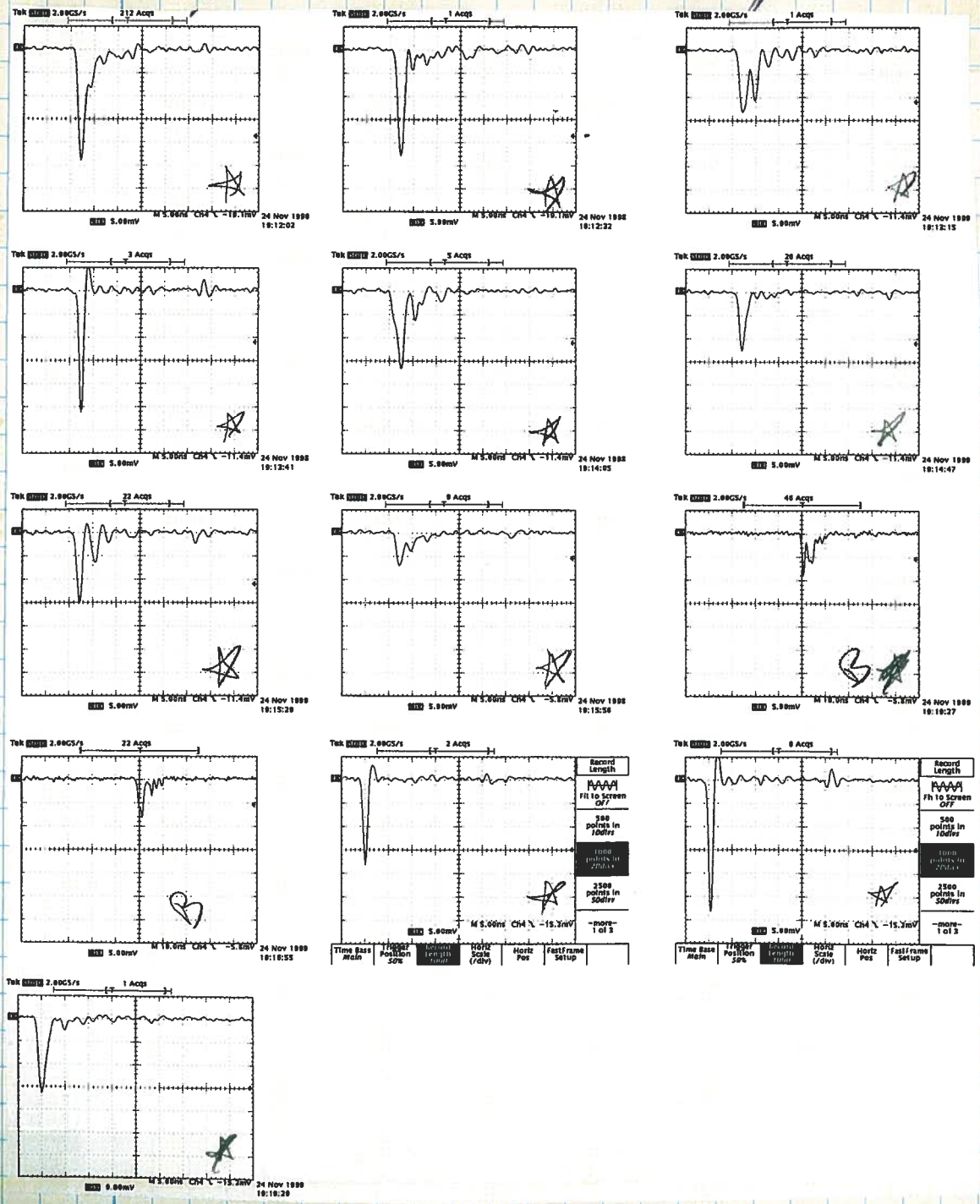

IEEE (E,L,Q)
Counts
Channel
0
10
20
30
40
50
60
70
0
200
400
600
800
1000


Ribbonax (E,L,Q)
Counts
Channel
0
10
20
30
40
50
60
0
200
400
600
800
1000

12/10/98 First Look At A Hamamatsu 5600-U

Put together a positive base using the ratios the tube was special at.

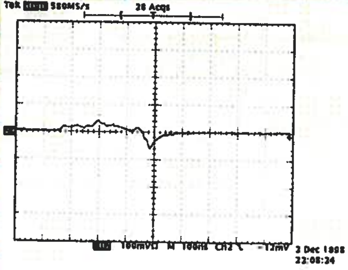
Pictures from a Cs^{137} source on a scrap scintillator sitting on top of the PMT assembly.

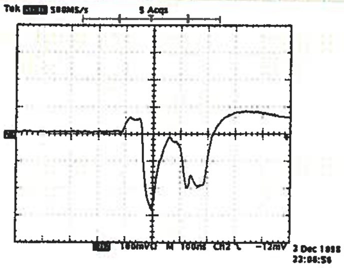


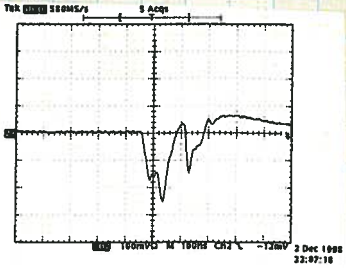
VDC Pulses During Beam 12/10

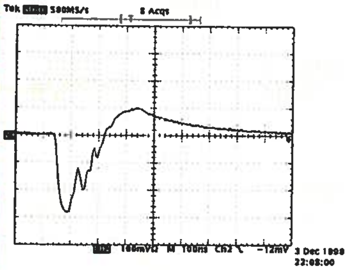
I installed a modified LeCroy 2735DC card on the VDC (Hadron Arm). It is in the "lowest momentum" slot of the upper plane in the bottom chamber.

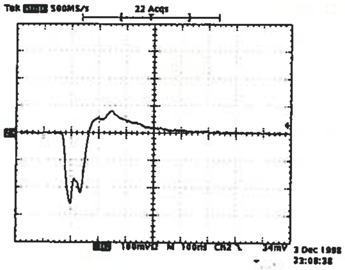
The outputs of the MAX435's run to the analog multiplexer I built in a VME module. The output is run to a patch cable coming up to the counting house.

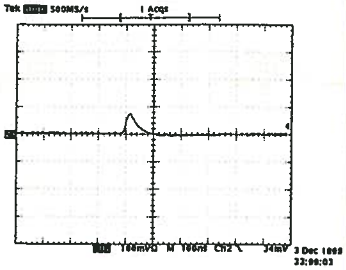

Tek 500MS/s 28 Acqs
100mV Ω M 100ns Ch2 ↘ −12mV
3 Dec 1998
22:06:24

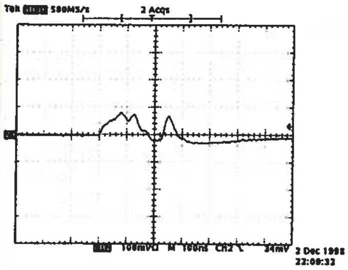

Tek 500MS/s 5 Acqs
100mV Ω M 100ns Ch2 ↘ −12mV
3 Dec 1998
22:06:56

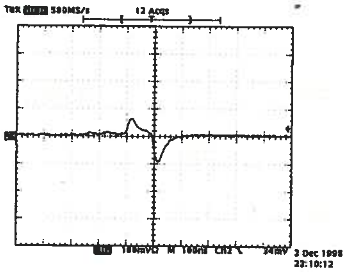

Tek 500MS/s 5 Acqs
100mV Ω M 100ns Ch2 ↘ −12mV
3 Dec 1998
22:07:18

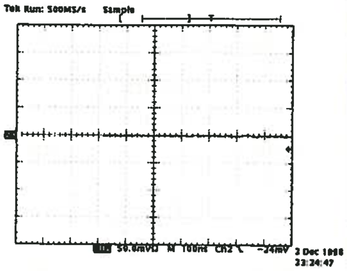

Tek 500MS/s 8 Acqs
100mV Ω M 100ns Ch2 ↘ −12mV
3 Dec 1998
22:08:00

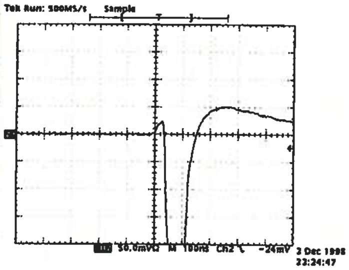

Tek 500MS/s 22 Acqs
100mV Ω M 100ns Ch2 ↘ 34mV
3 Dec 1998
22:08:38

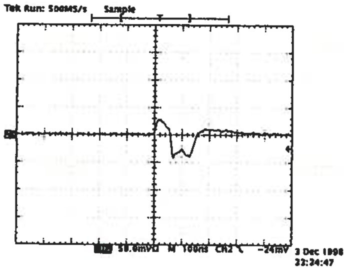

Tek 500MS/s 1 Acqs
100mV Ω M 100ns Ch2 ↘ 34mV
3 Dec 1998
22:09:03

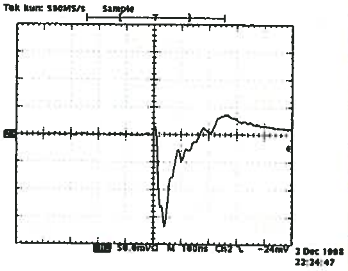

Tek 500MS/s 2 Acqs
100mV Ω M 100ns Ch2 ↘ 34mV
3 Dec 1998
22:09:32

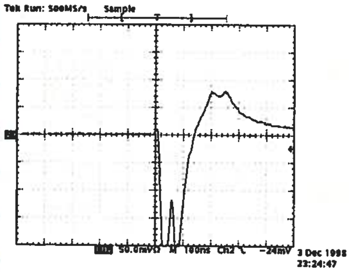

Tek 500MS/s 12 Acqs
100mV Ω M 100ns Ch2 ↘ 34mV
3 Dec 1998
22:10:12

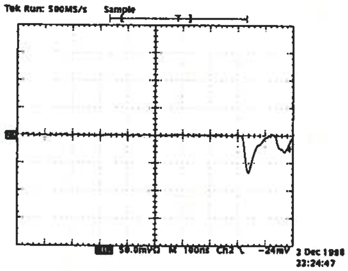

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47

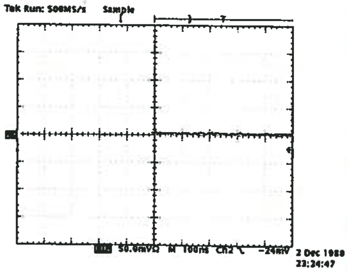

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47

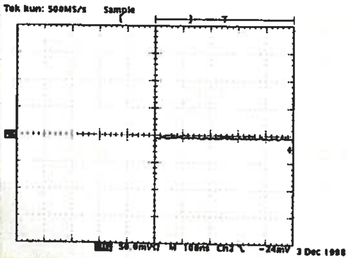

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47

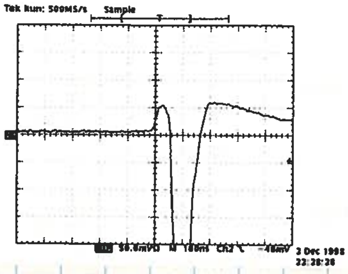

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47

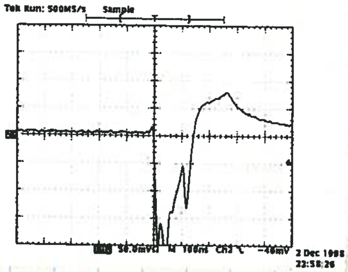

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47

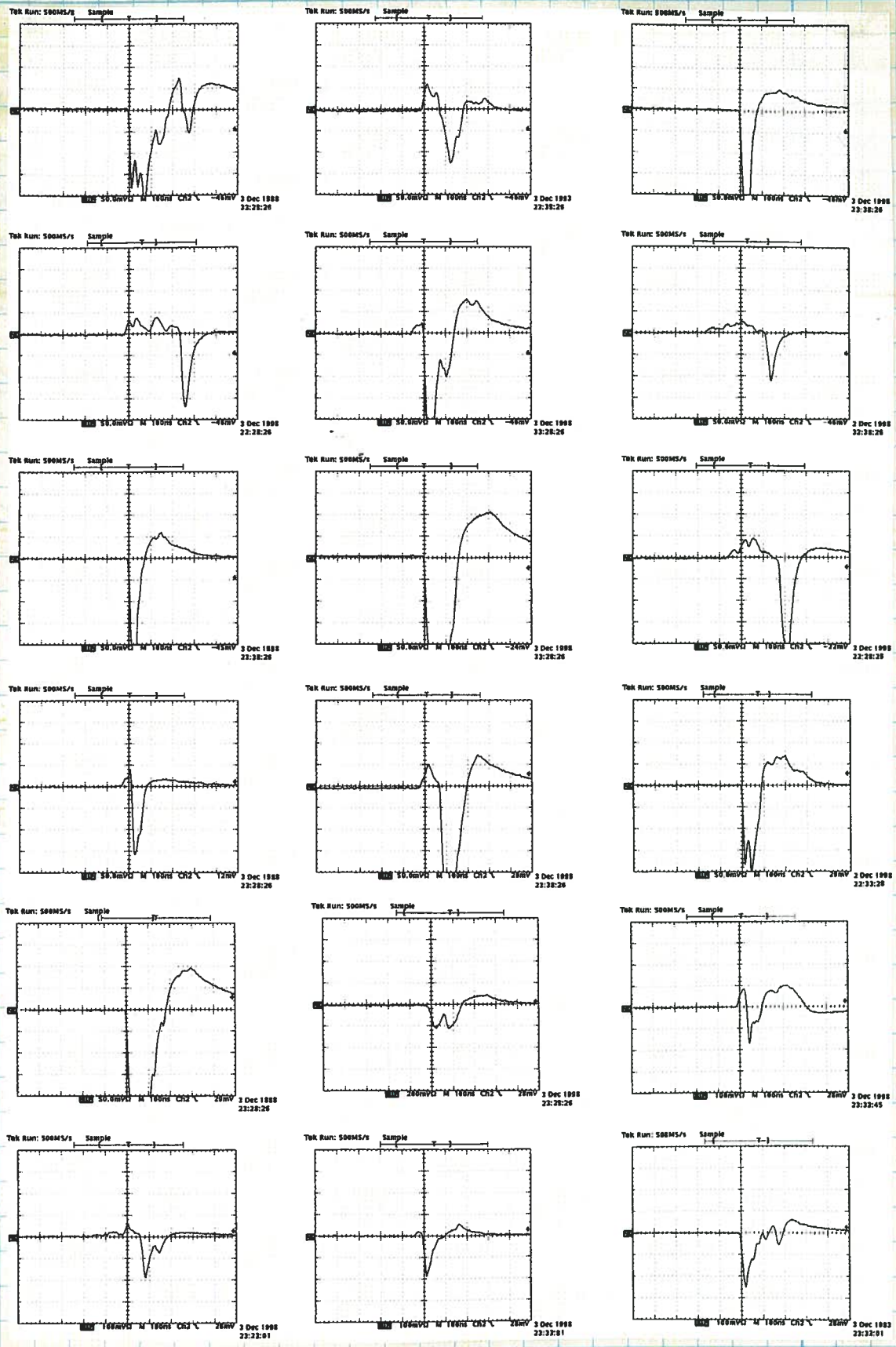

Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47


Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
2 Dec 1998
22:34:47


Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −24mV
3 Dec 1998
22:24:47


Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −48mV
3 Dec 1998
22:28:28


Tek Run: 500MS/s Sample
50.0mV Ω M 100ns Ch2 ↘ −48mV
2 Dec 1998
22:58:26


Tek Run: 500MS/s Sample
3 Dec 1998

(all this was done a little while ago)

12/10 JS

Setting Up For Single Photoelectron PMT Tests

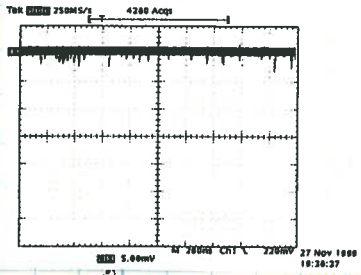
I want to test some of the PMTs and need a setup to give me single photoelectron pulses.

My dark box on wheels was pulled out of storage. I got an 8854 and some old 8575s removed from the spectrometers. Got a new 8575 and a base from S1 on the hadron arm

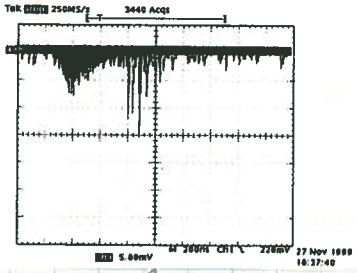
I'm using a green LED I assembled a long time ago. The led is in a small copper tube, has 51Ω across it, has a Lemo connector sealing one side of it and has an optical fiber passing through a copper cap on the other side of it. The fiber is about three feet long or so.

I set up an HP 8013B pulse generator to drive the LED.

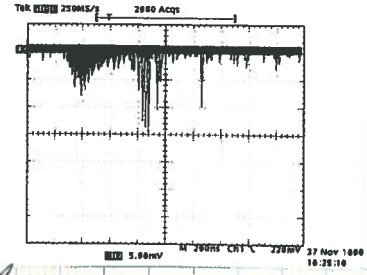
Looking at the new 8575 with the base from the hadron arm. Triggered the scope on channel 1 which was the driving pulse for the led, using a "T" on Ch1. Used a "T" and 50Ω terminator on Ch4 for the PMT output.



led just barely firing



note afterpulses on new tube. Led being driven a little harder.

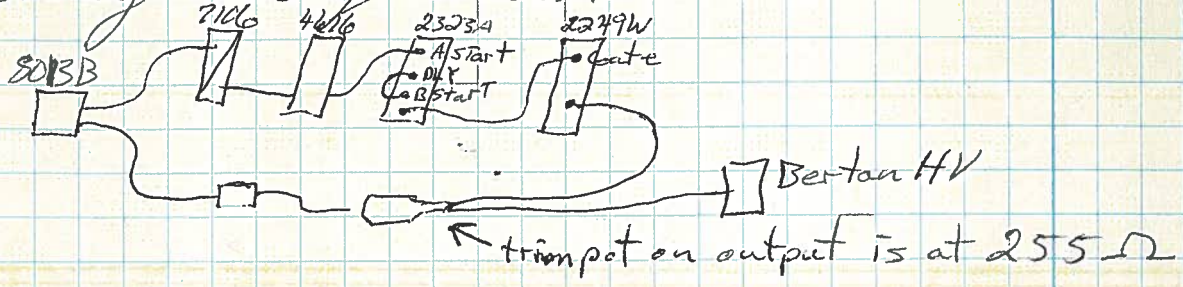


Base and 8575 had to go back to the hadron arm & be installed

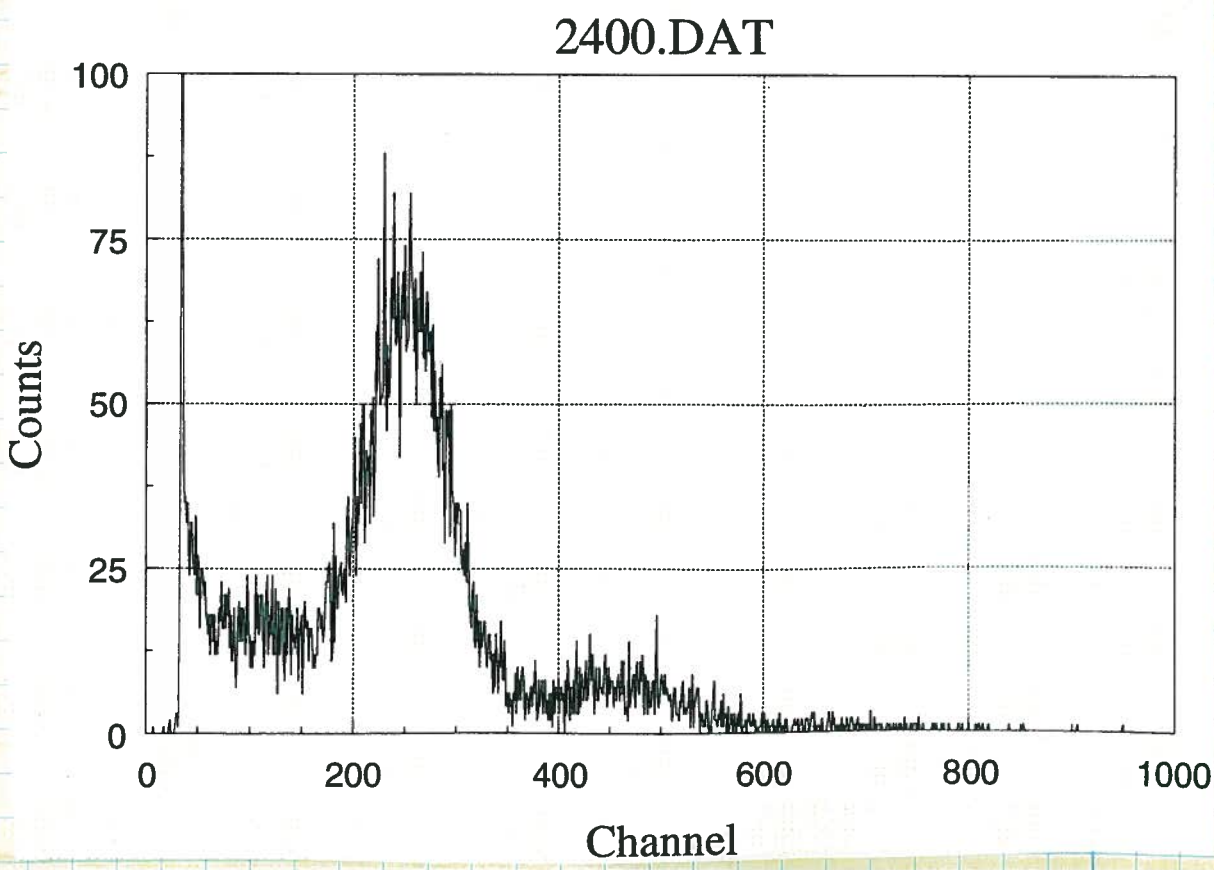
Burle 8854 Single P.E. Response 12/10/98

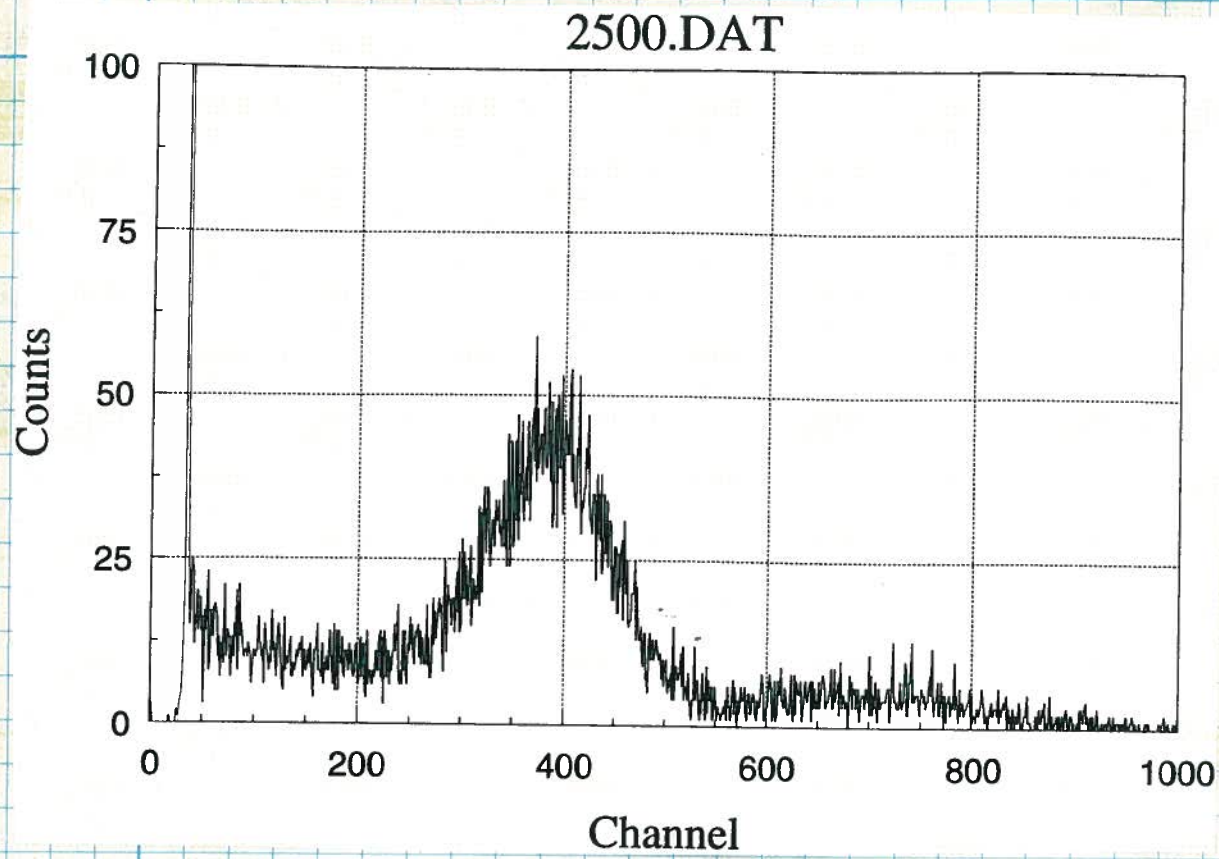
Used the 8854 to replace the 8575 installed on the hadron arm. Used a base off the INFN aerogel counter. Base has a serial number 5A-94-0027G.

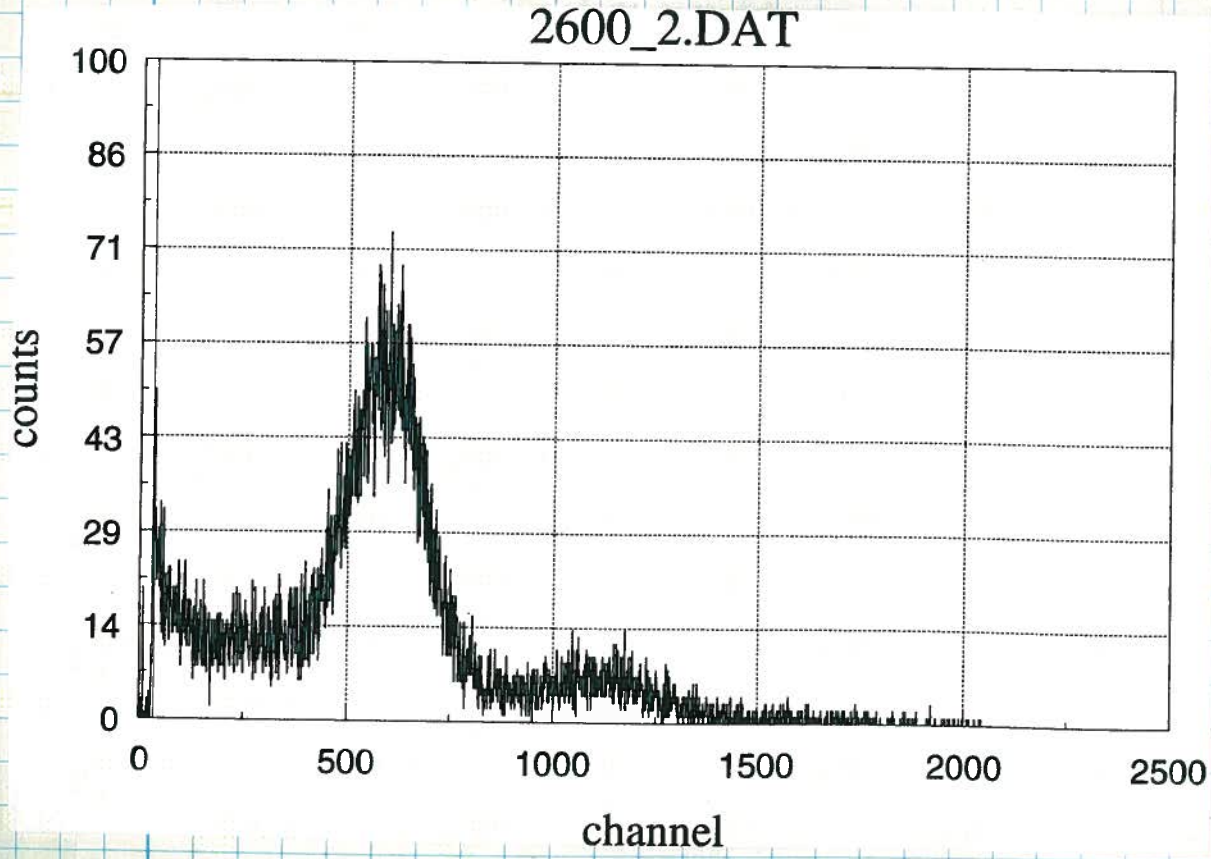
Trigger output of 8013 was run through an inverting transformer and into a Phillips 7106 discriminator to get a start for the ADC gate. Gate was formed with a LeCroy 2323 generator.

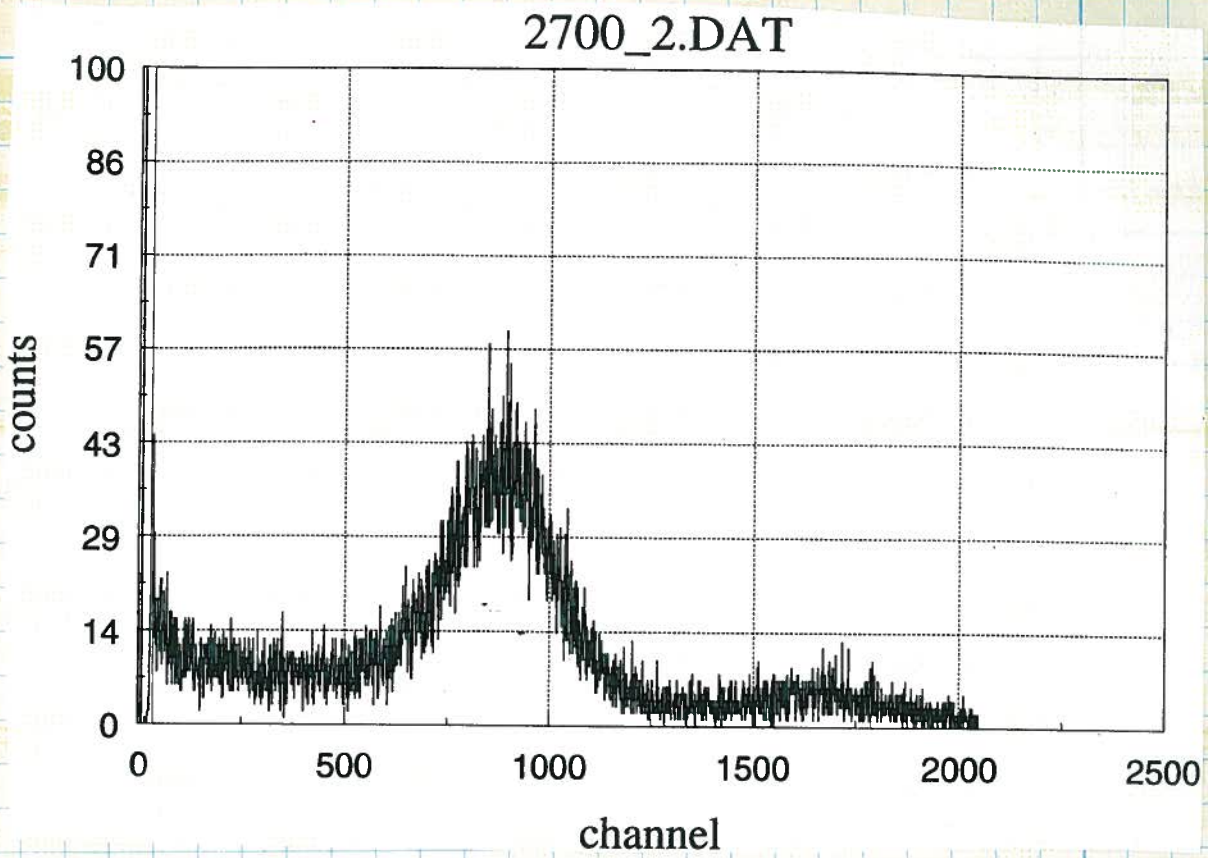


Single P.E. response of 8854

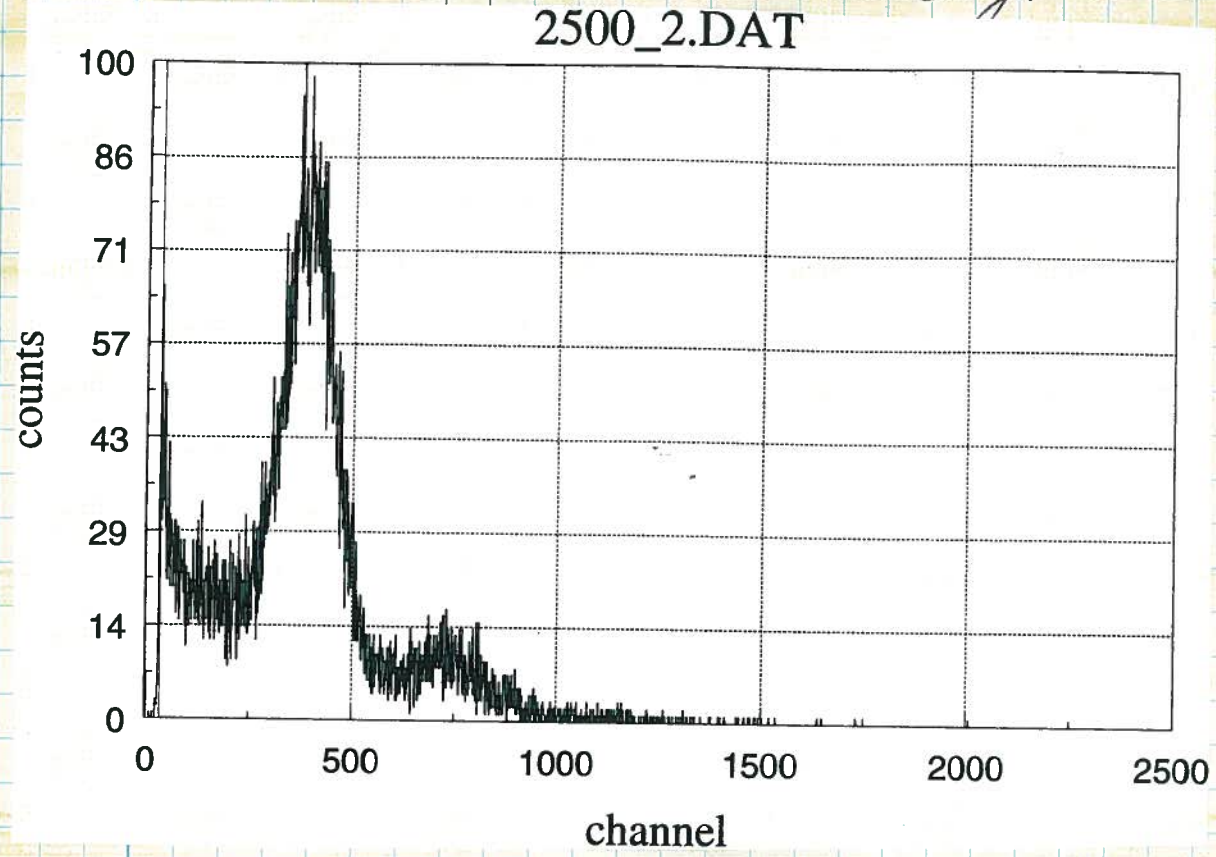


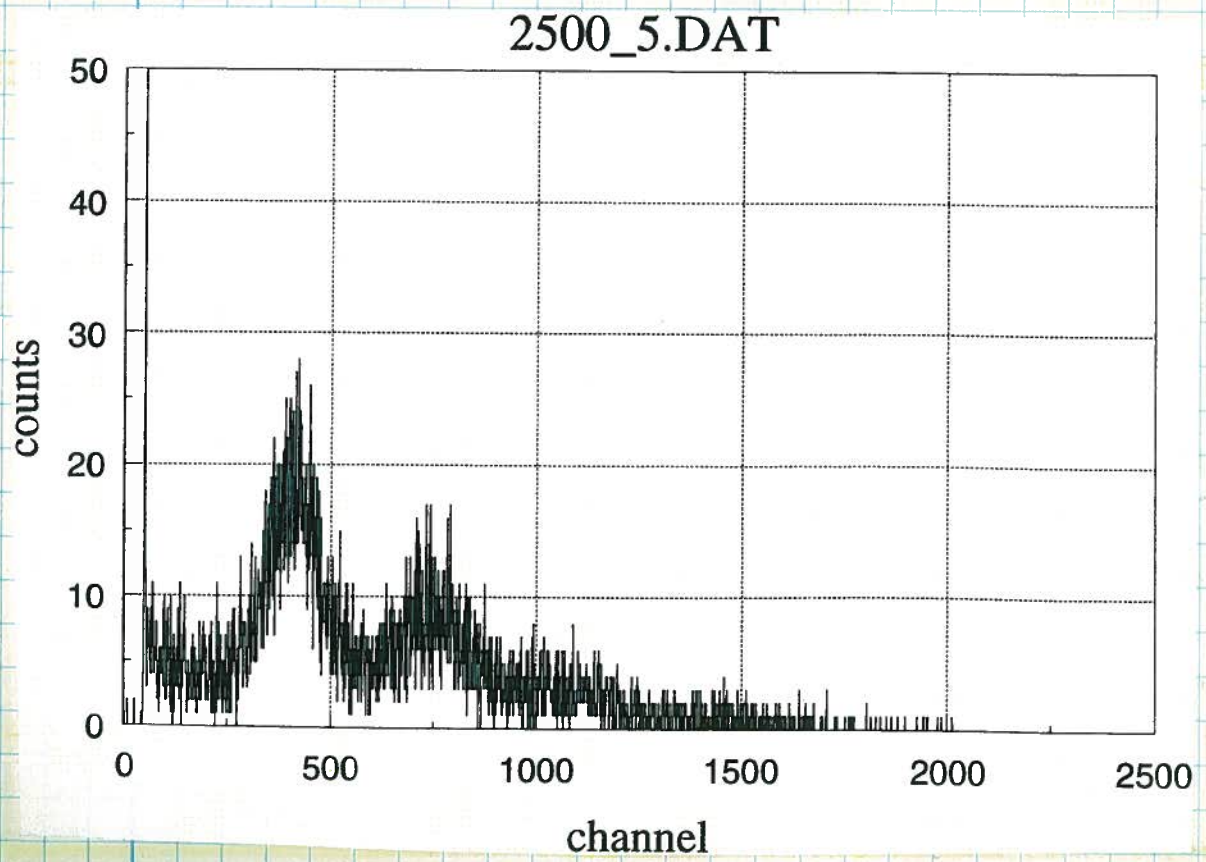

2500.DAT
Counts
100
75
50
25
0
0
200
400
600
800
1000
Channel


2600_2.DAT
counts
100
86
71
57
43
29
14
0
0
500
1000
1500
2000
2500
channel


2700_2.DAT
100
86
71
57
43
29
14
0
counts
0
500
1000
1500
2000
2500
channel

Adjusted 8013B output to get multiple P.E.'s from 8854 PMT. Gate width increased by 200ns.

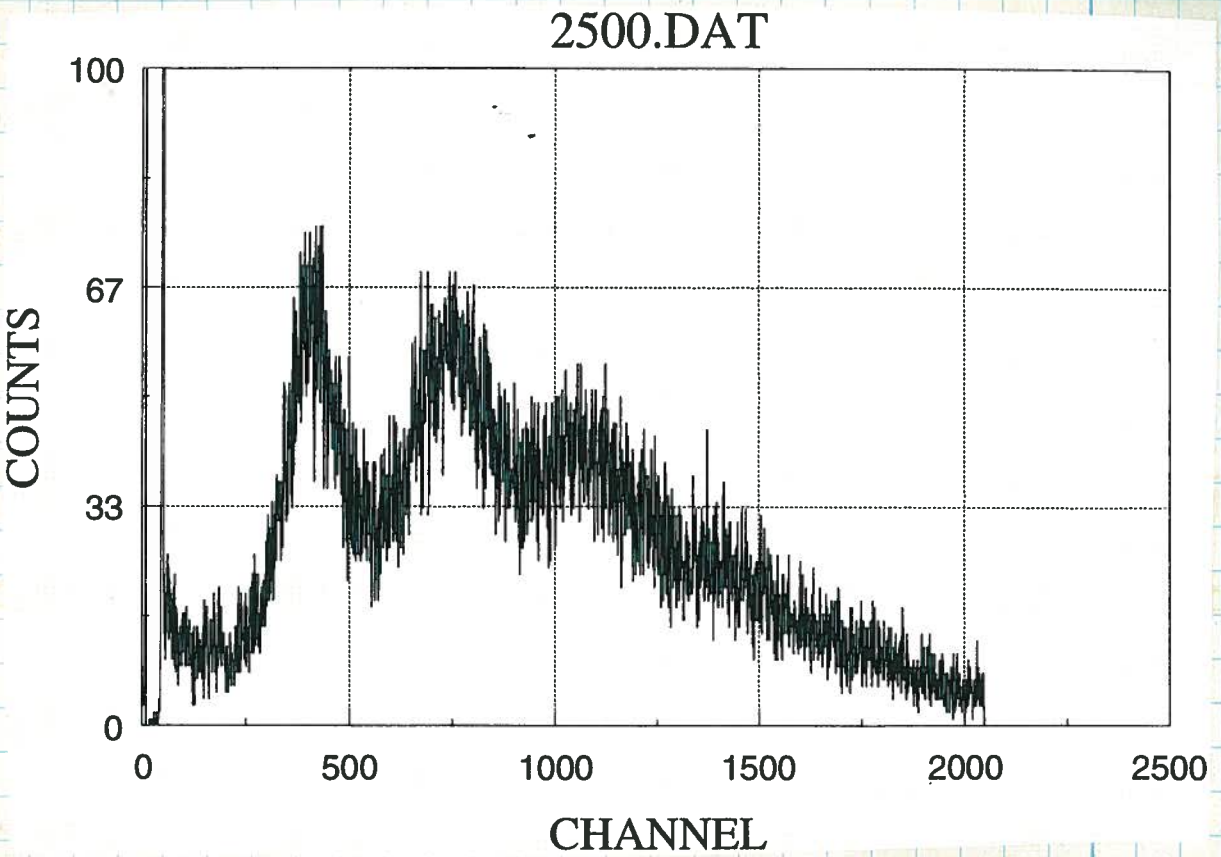


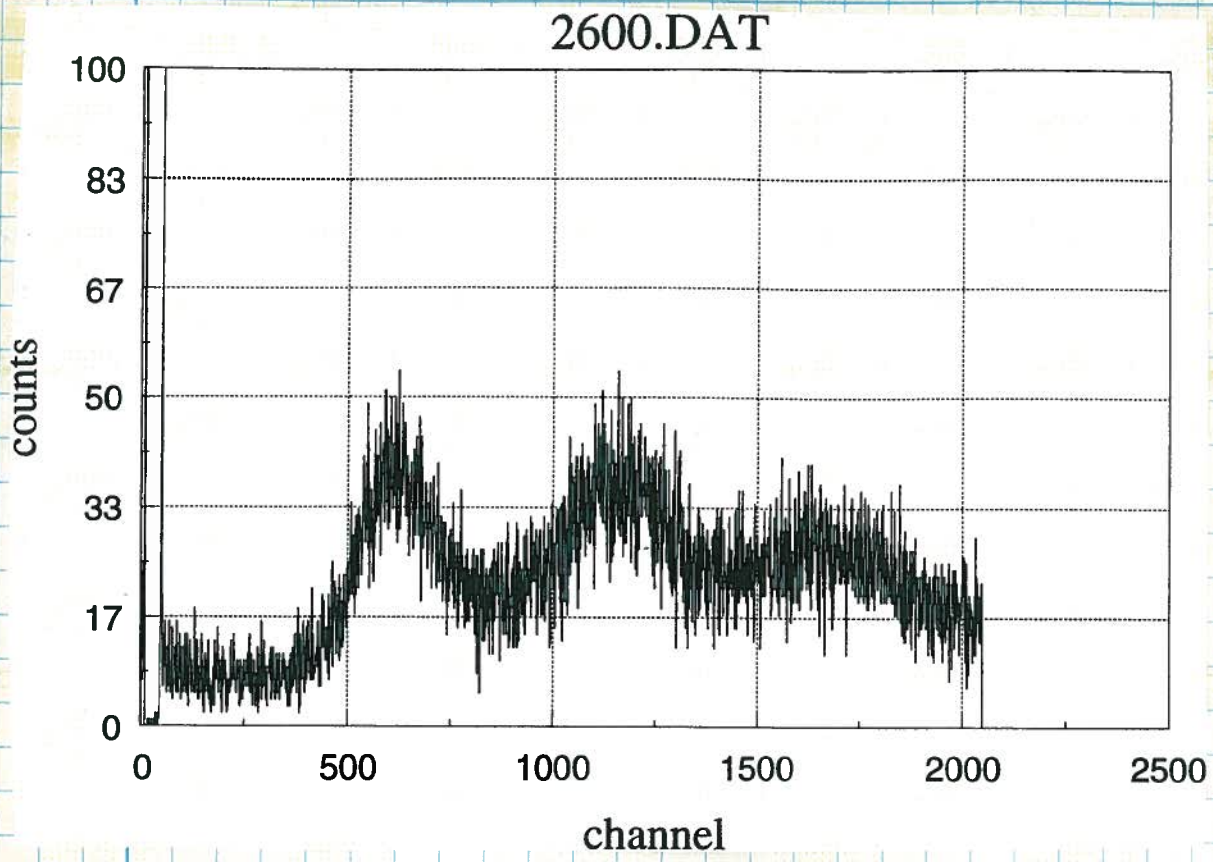


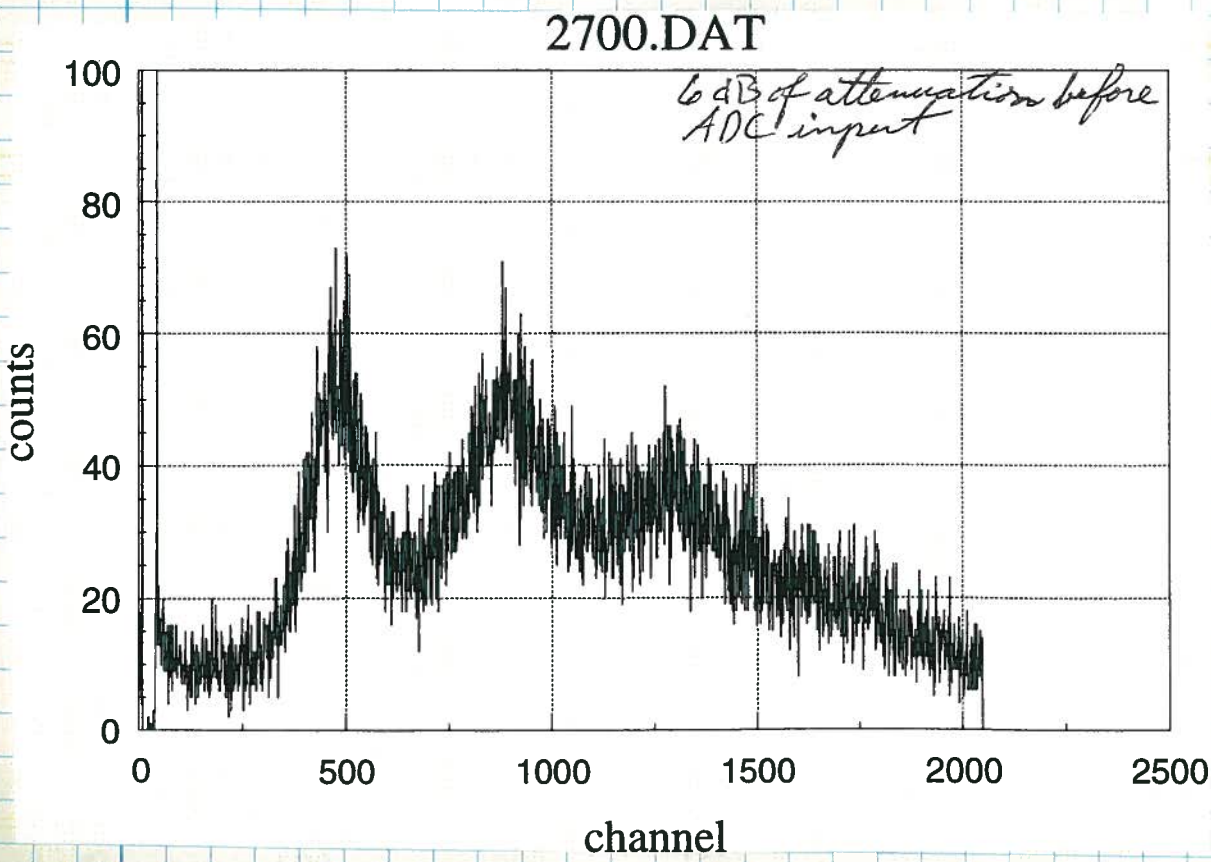
Linearity of 8854 Spectrum

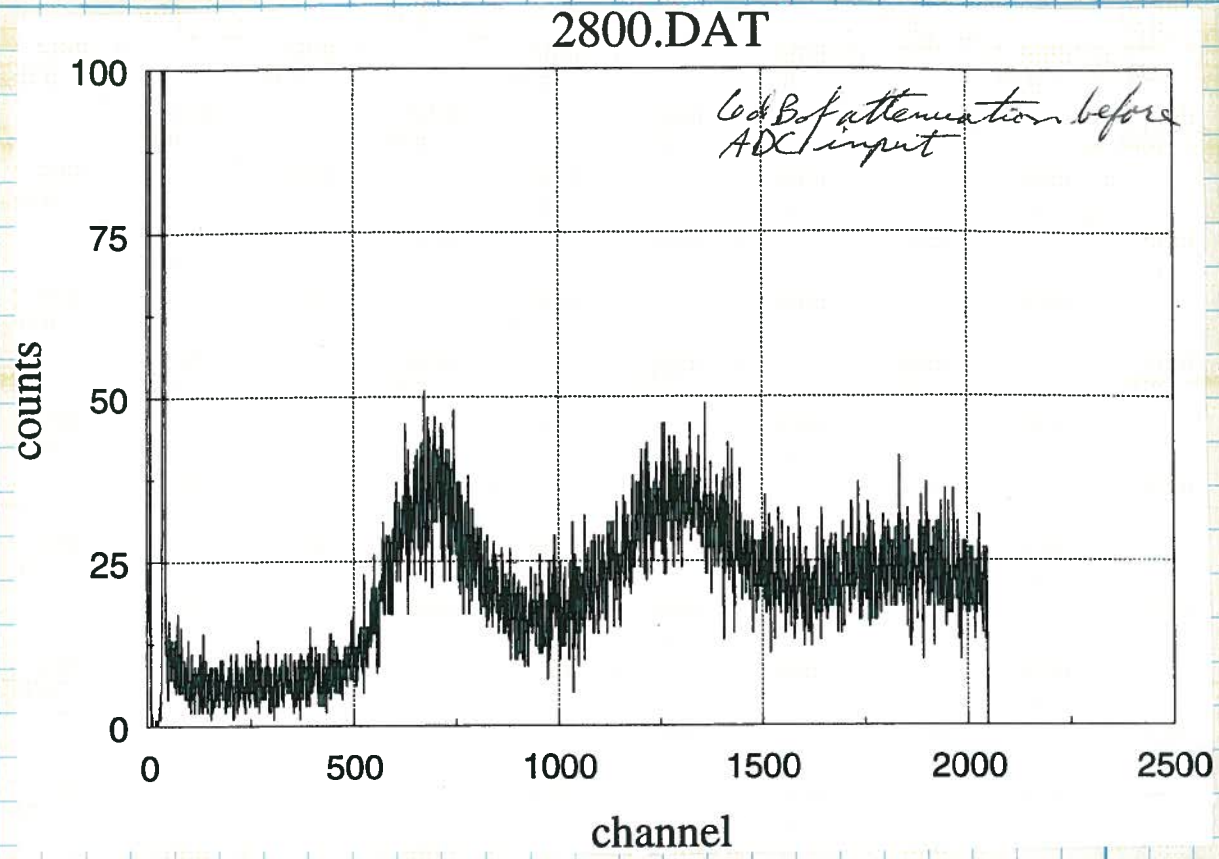
12/11/98

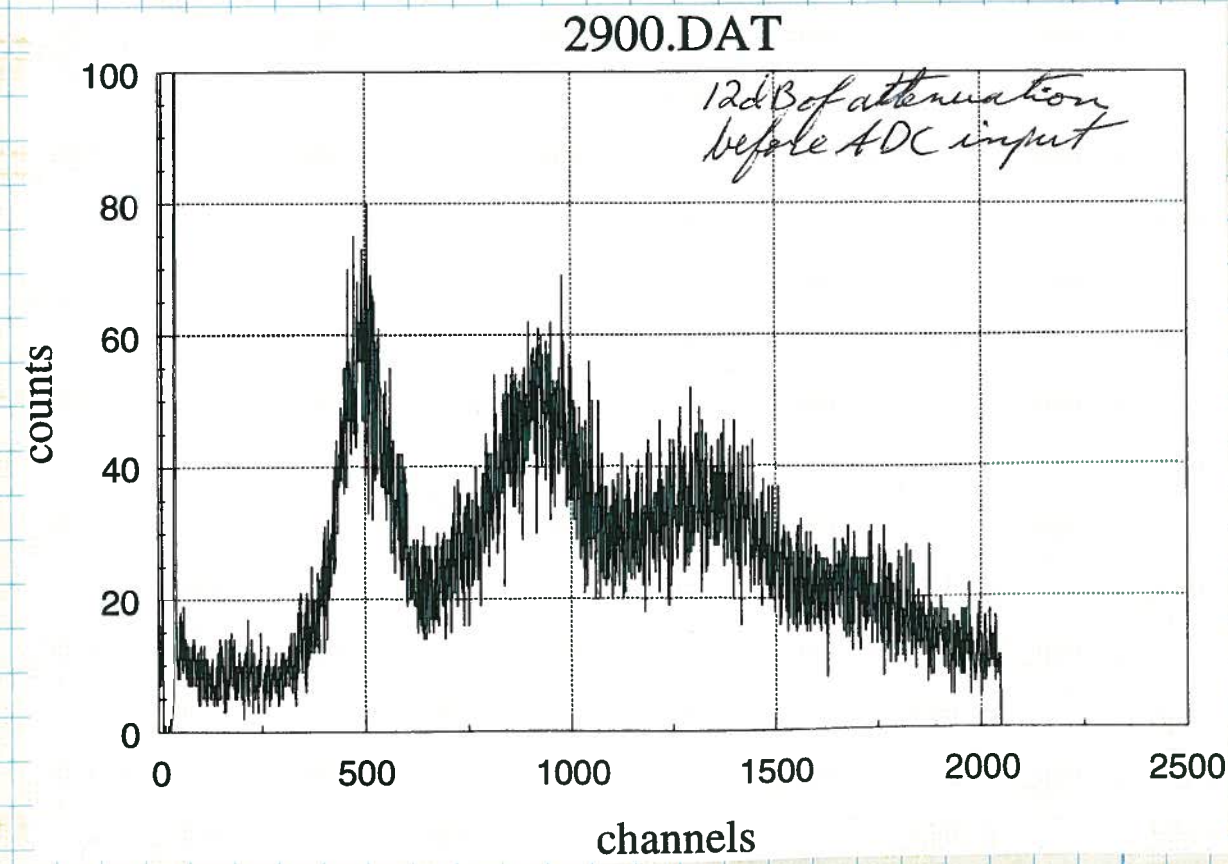
Over this past weekend I took some multiple P.E. spectrums of the 8854 tube and INFN base.
Used same setup from single P.E. (p. 33) and extended gate from p. 36.
Rob van der Meer sees a nonlinear spectrum from the aerogelon the e^- arm. Trying a different ADC to check if it might be the 1881 which is nonlinear.

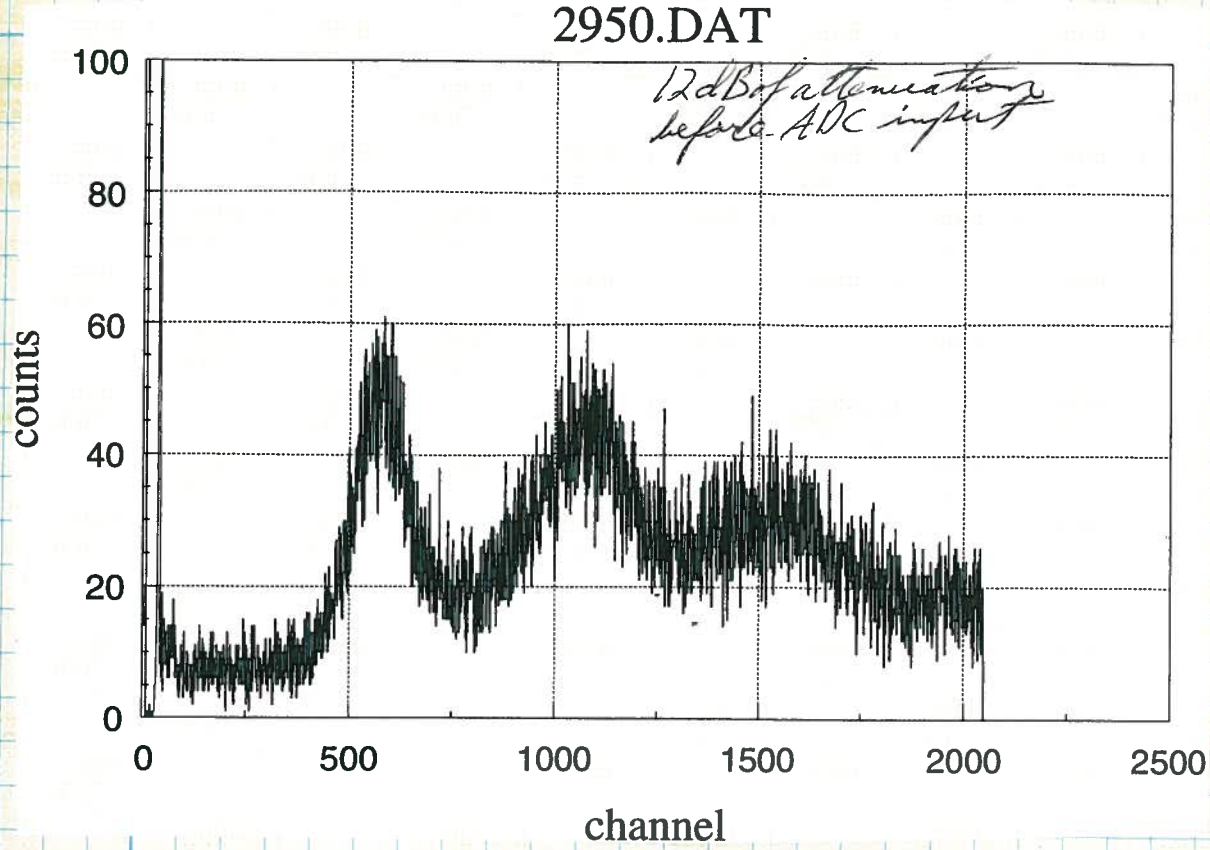



2600.DAT
counts
channel
100
83
67
50
33
17
0
0
500
1000
1500
2000
2500


2700.DAT
6 dB of attenuation before ADC input
counts
channel
100
80
60
40
20
0
0
500
1000
1500
2000
2500


2800.DAT
6dB of attenuation before ADC input
counts
channel
0
25
50
75
100
0
500
1000
1500
2000
2500


2900.DAT
12dB of attenuation before ADC input
counts
channels
0
20
40
60
80
100
0
500
1000
1500
2000
2500



Looking at the gain for a single P.E.

1 channel = 250 fC

1 fC = 6250 e^-

6dB = X2

12dB = X4

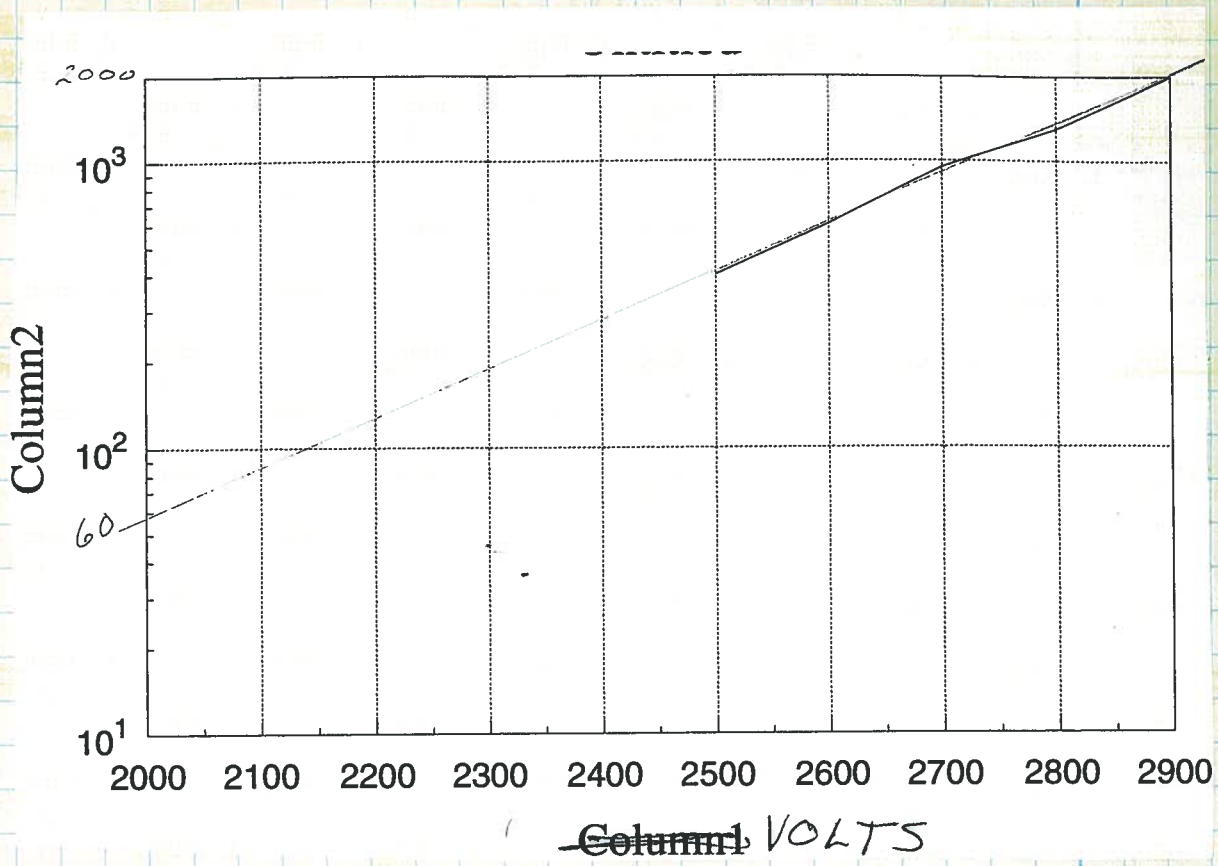
at 2900V and ~500 channels

500 X 4 = 2000

2000 X 250 fC X 6250 e^-/fC = 3.1×10^9

the tube gain is <u>very</u> large

plotting the single P.E. peak and extrapolating back to 2000V we can compare with the gain given by burle.

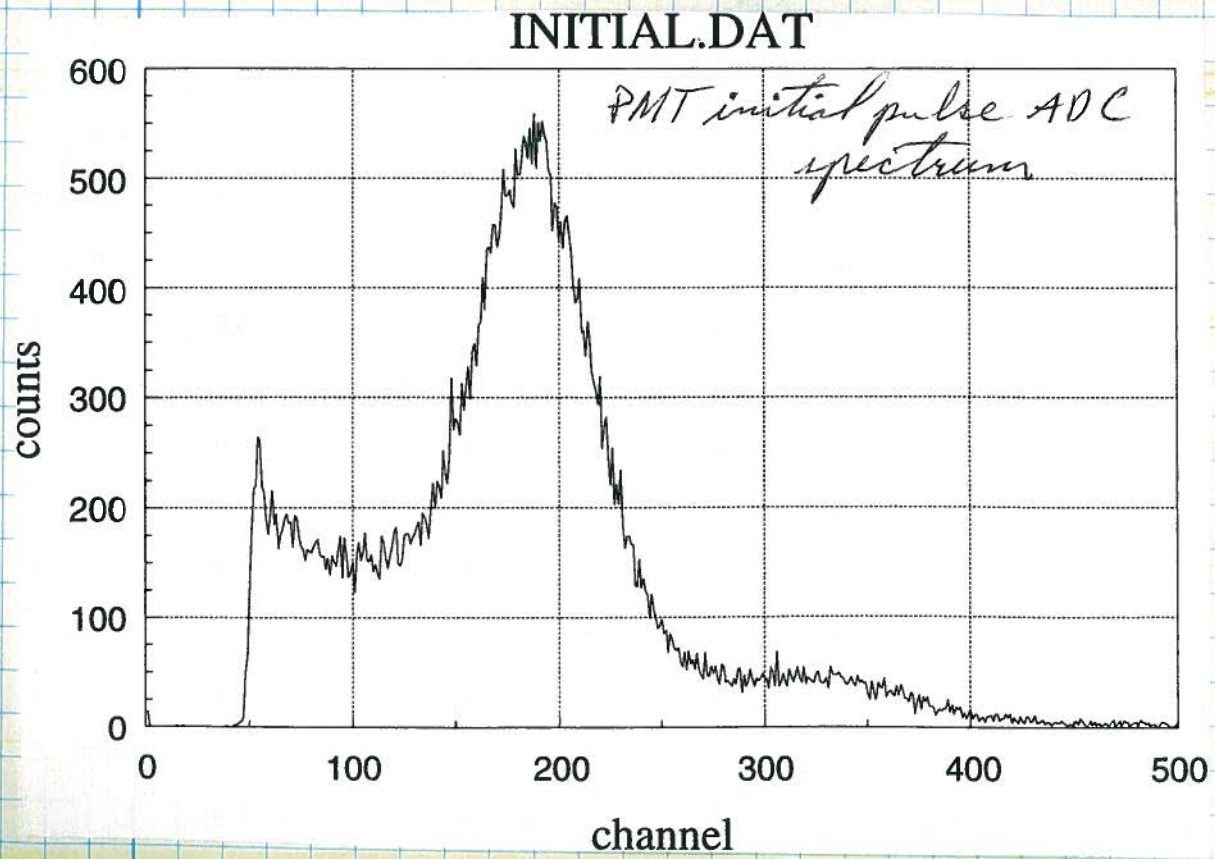


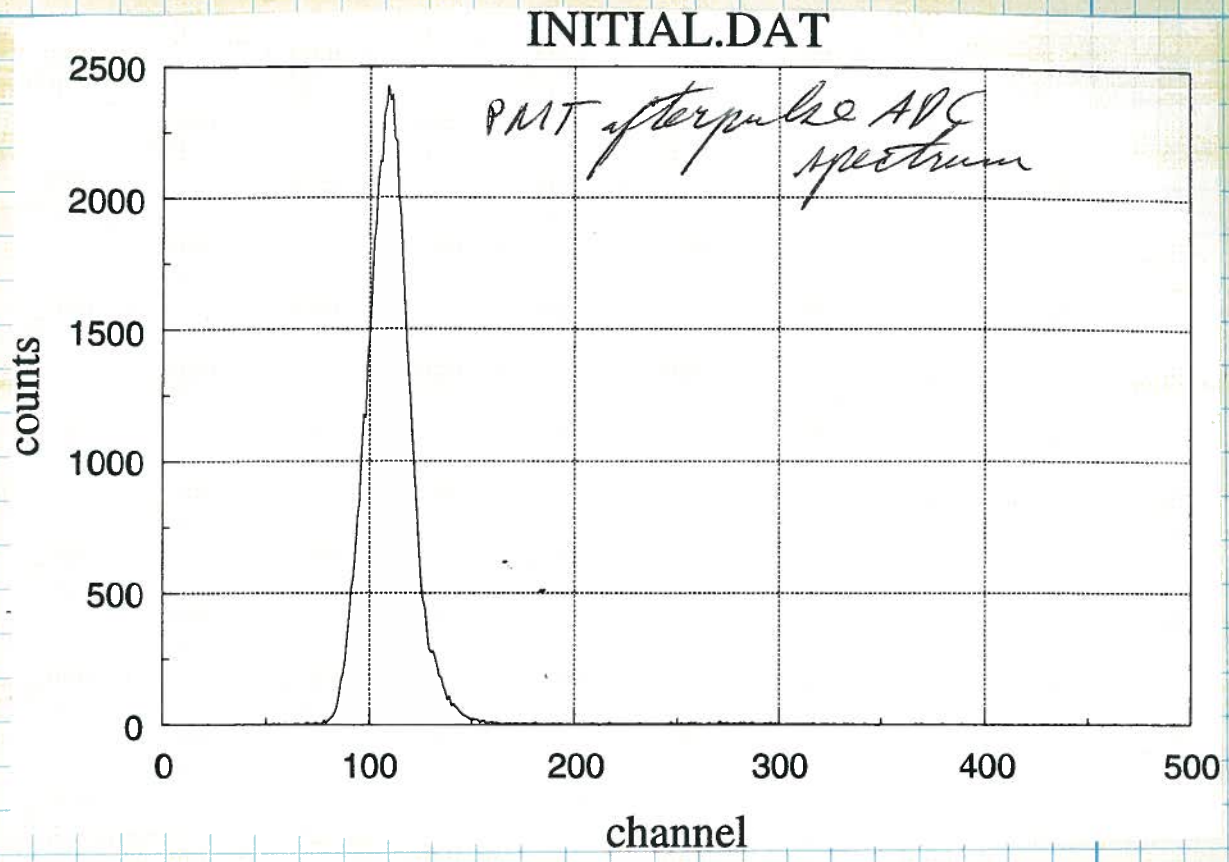
$60 \times 6250\,e^-/fc \times 250\,fc = 9.4 \times 10^7$

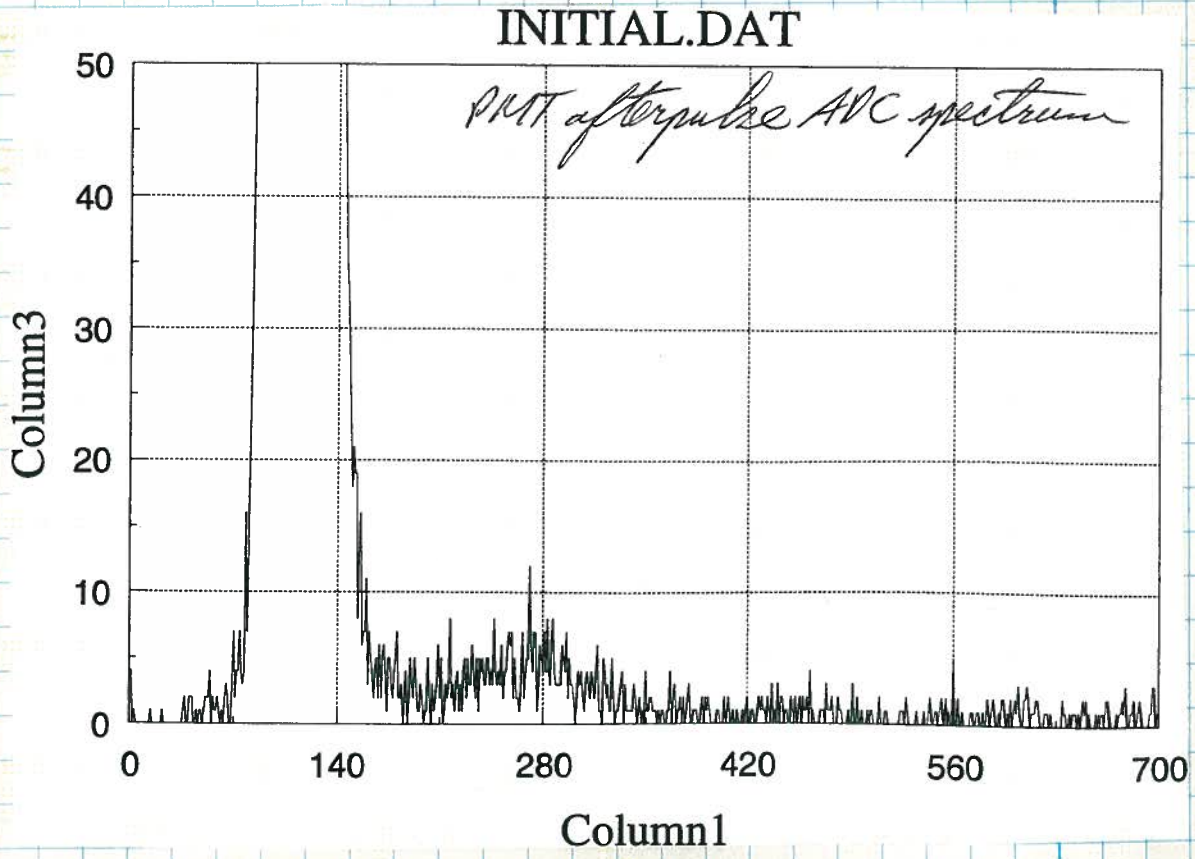
Burle specs 5.2×10^7 with their recommended base.

12/11/98 Afterpulsing Charge Spectrum of 8854
RS

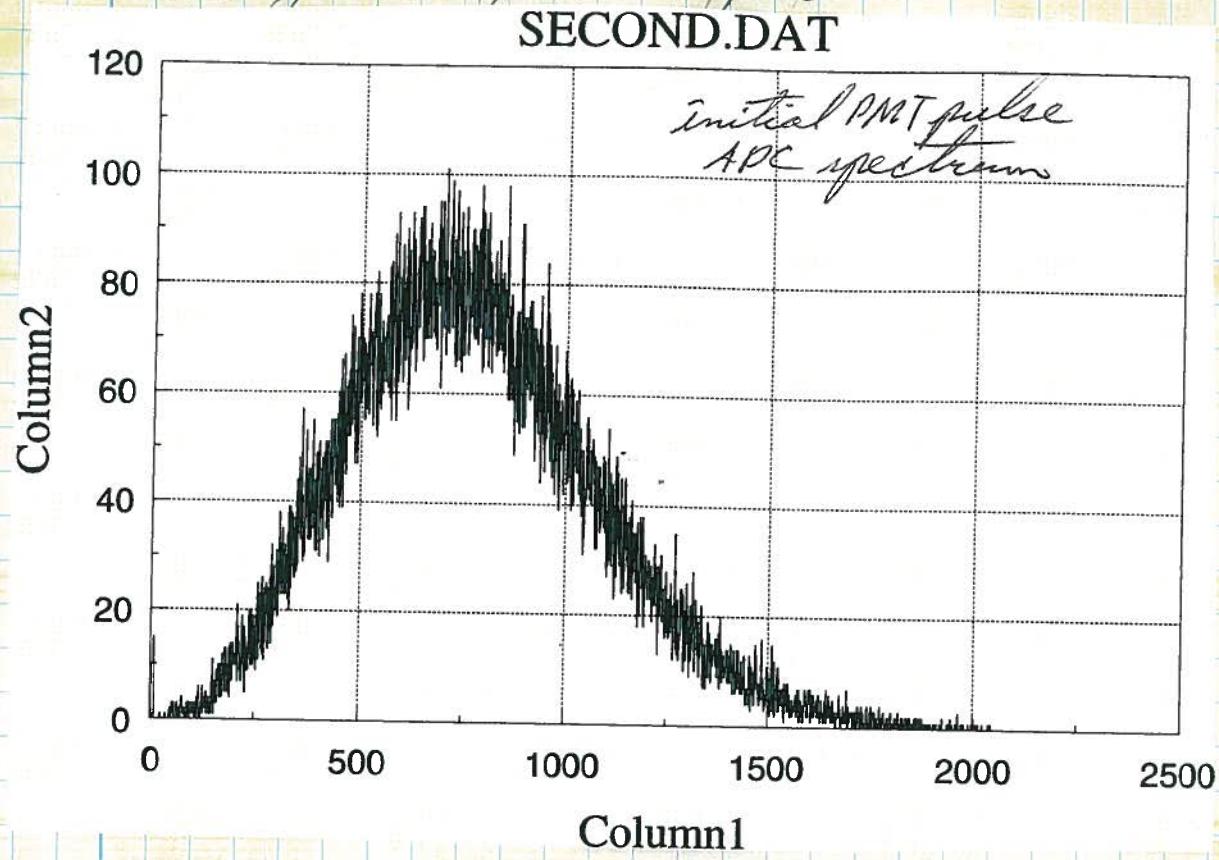
Trying to look at the afterpulsing in the 8854.
Switched to a spare SB base. Pimpotomoutput is 100 Ω

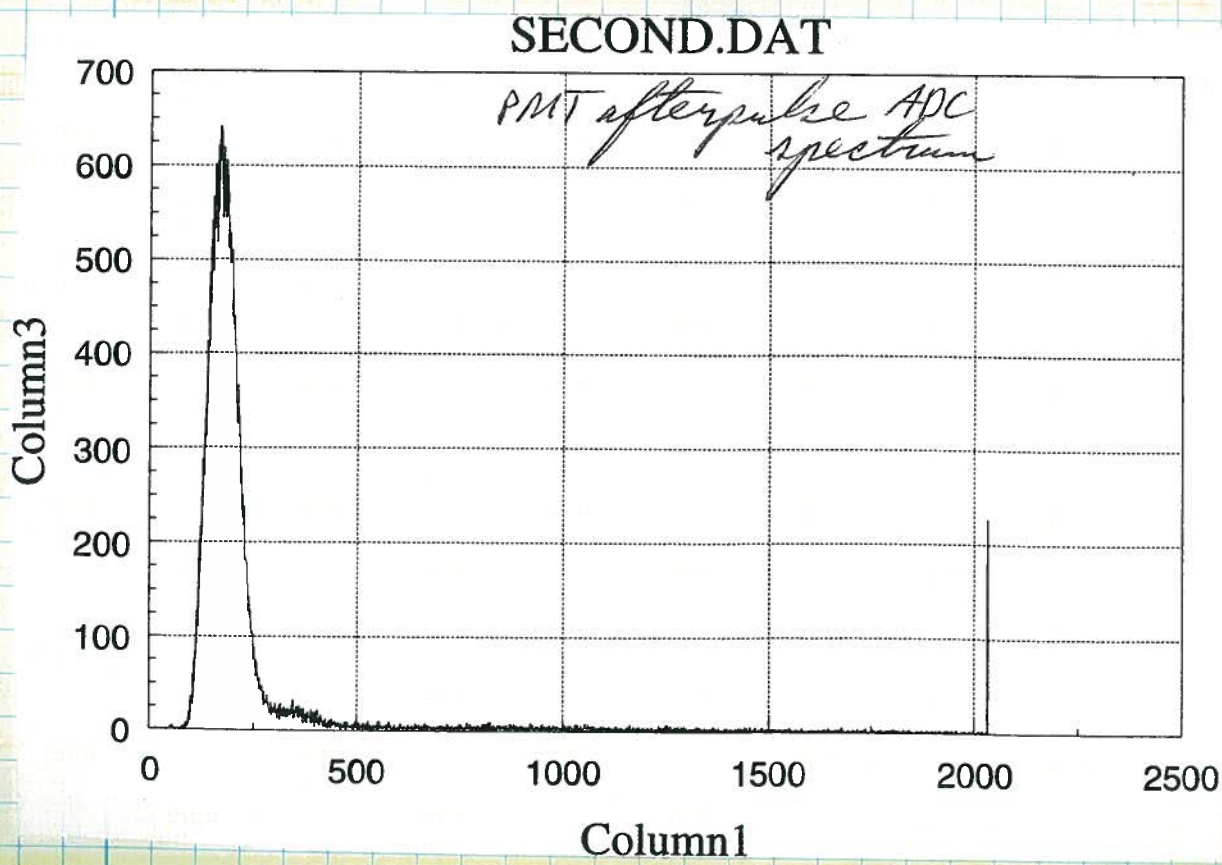


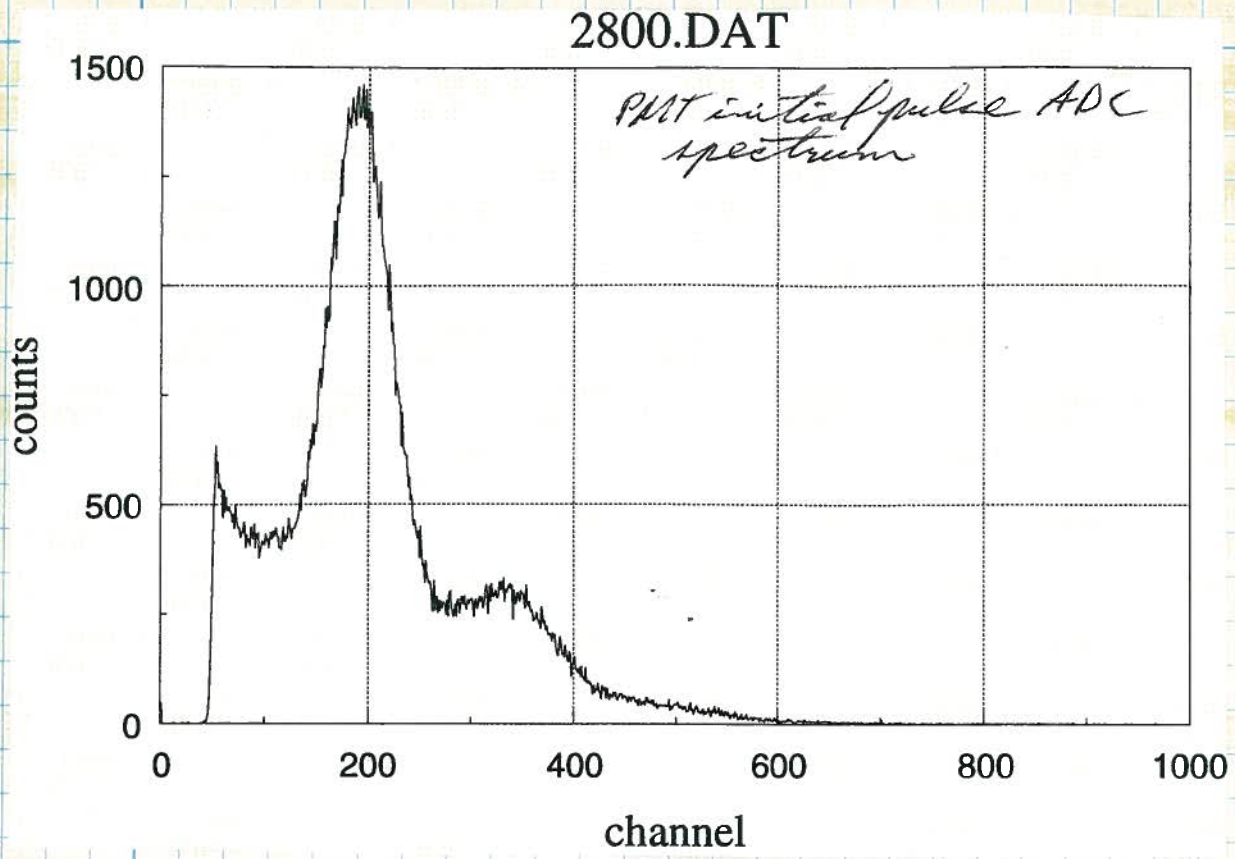

INITIAL.DAT
PMT afterpulse ADC spectrum
counts
channel
0
500
1000
1500
2000
2500
0
100
200
300
400
500

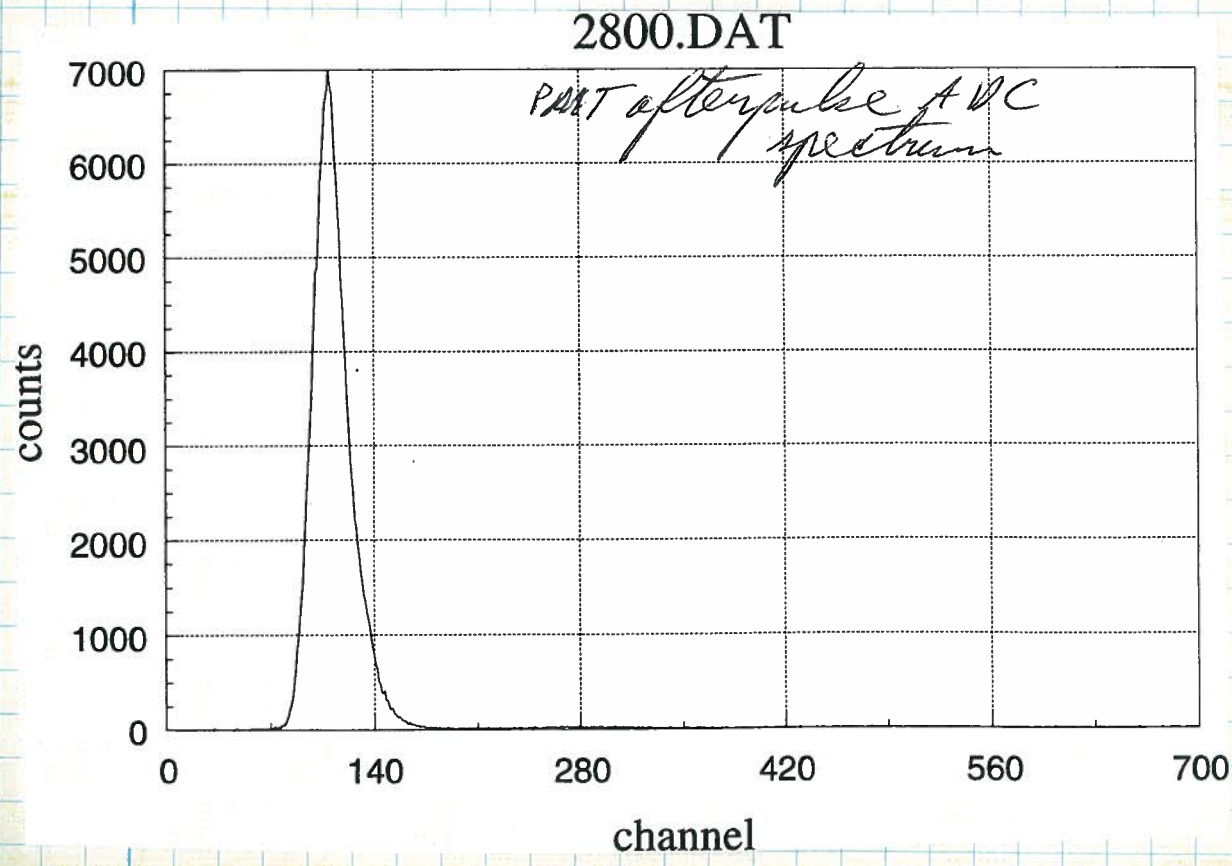

INITIAL.DAT
PMT afterpulse ADC spectrum
Column3
Column1
0
10
20
30
40
50
0
140
280
420
560
700

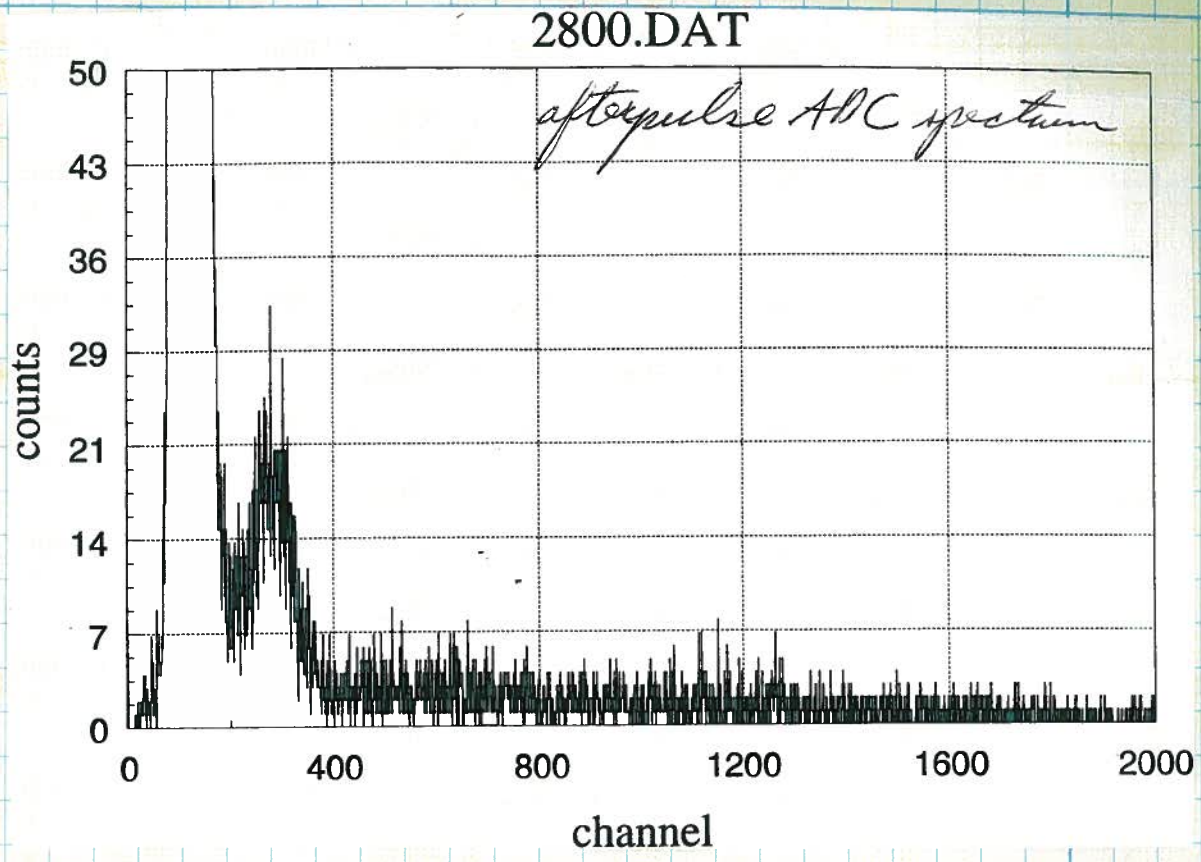
My second try at setting the 8013B resulted in driving the left too hard.

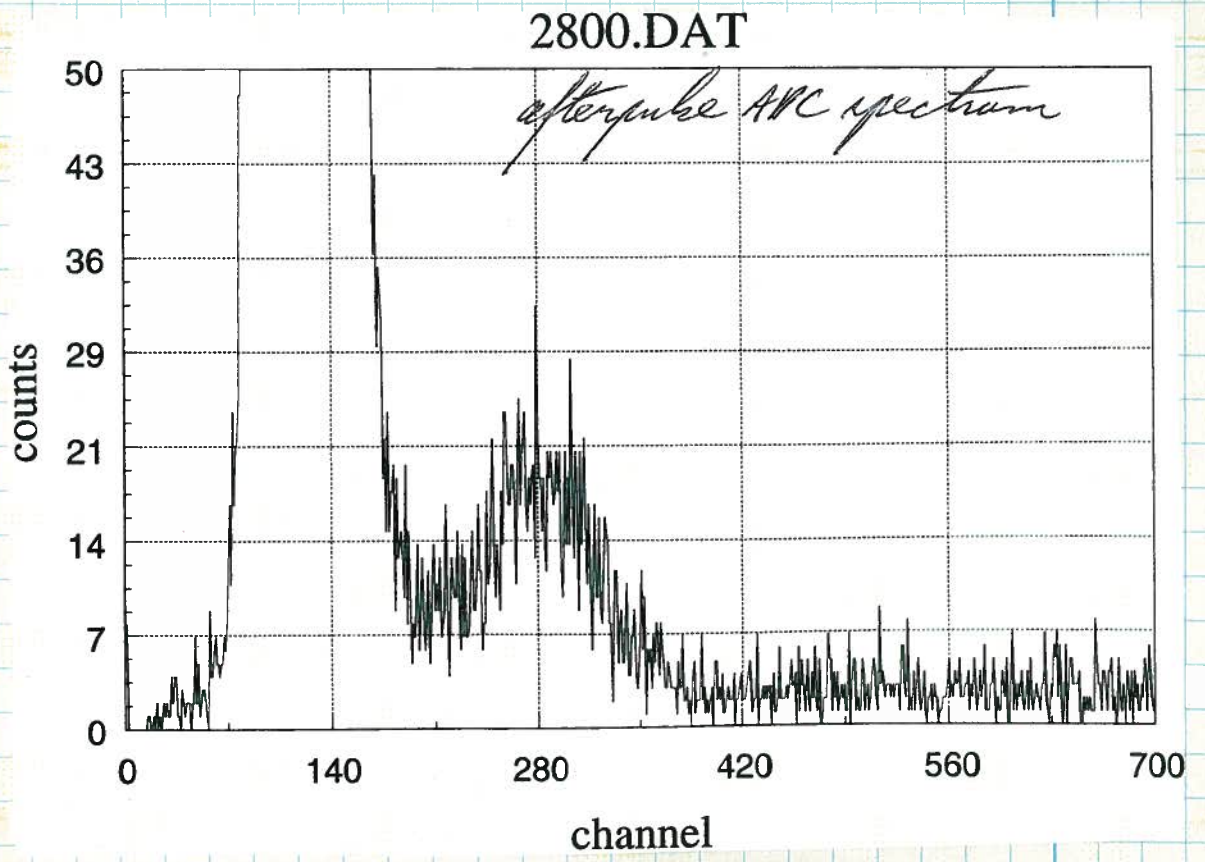


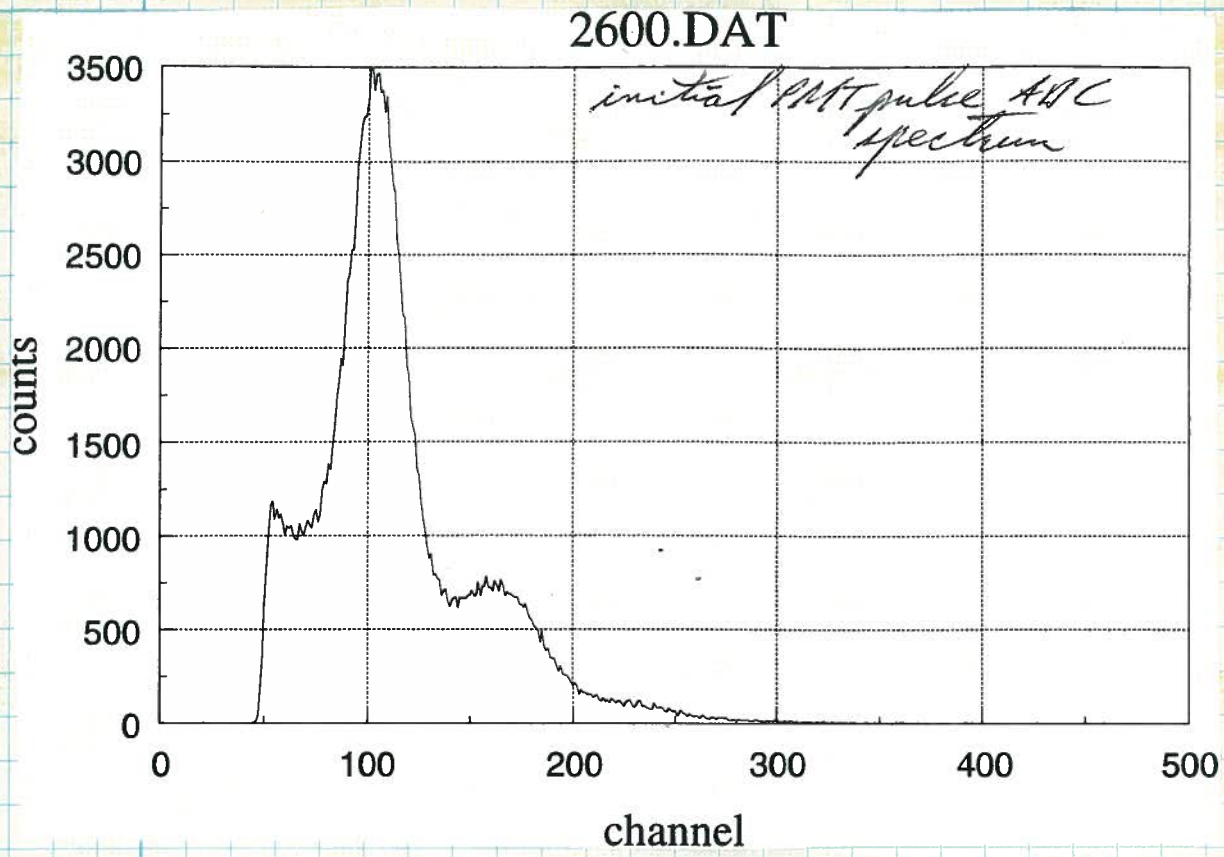


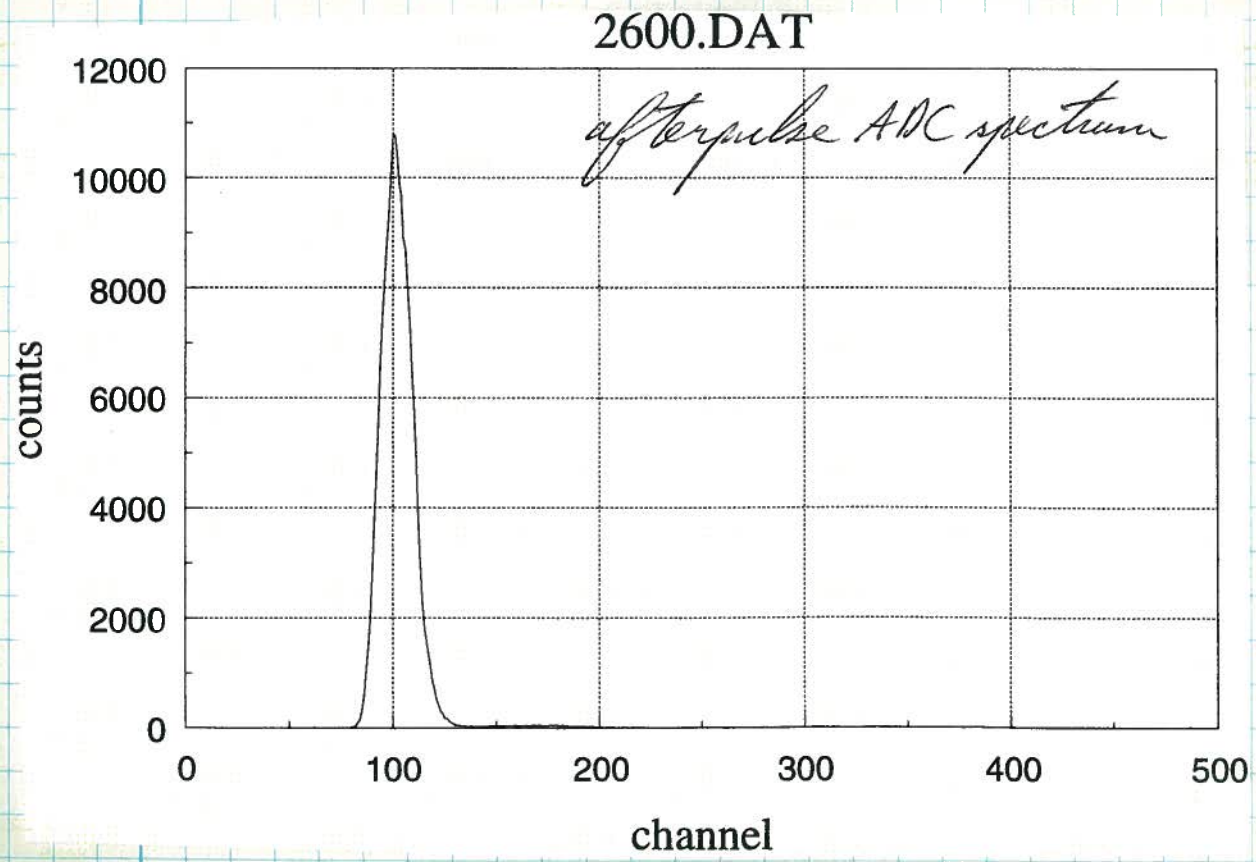

2800.DAT
PMT initial pulse ADC spectrum
counts
channel
0
500
1000
1500
0
200
400
600
800
1000

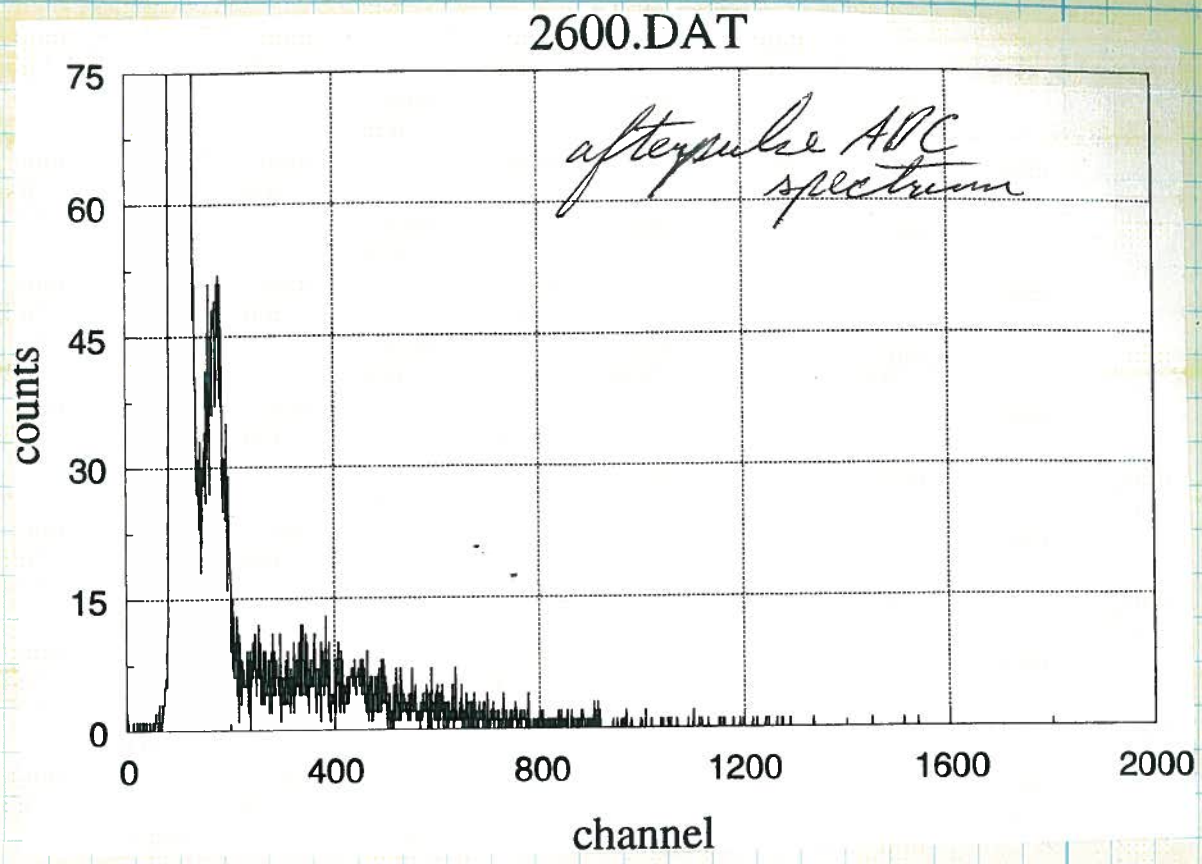

2800.DAT
PMT afterpulse ADC spectrum
counts
channel
0
1000
2000
3000
4000
5000
6000
7000
0
140
280
420
560
700

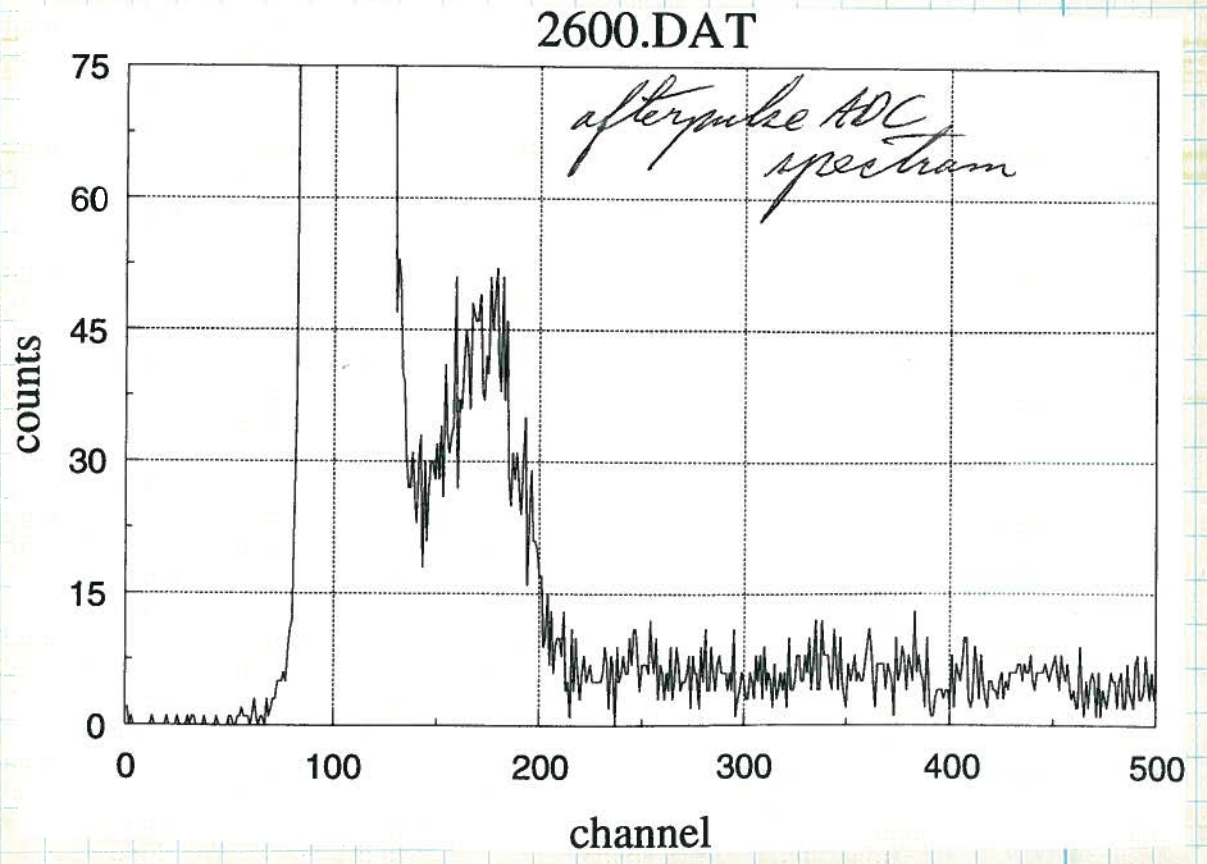

2800.DAT
afterpulse ADC spectrum
counts
50
43
36
29
21
14
7
0
0
400
800
1200
1600
2000
channel

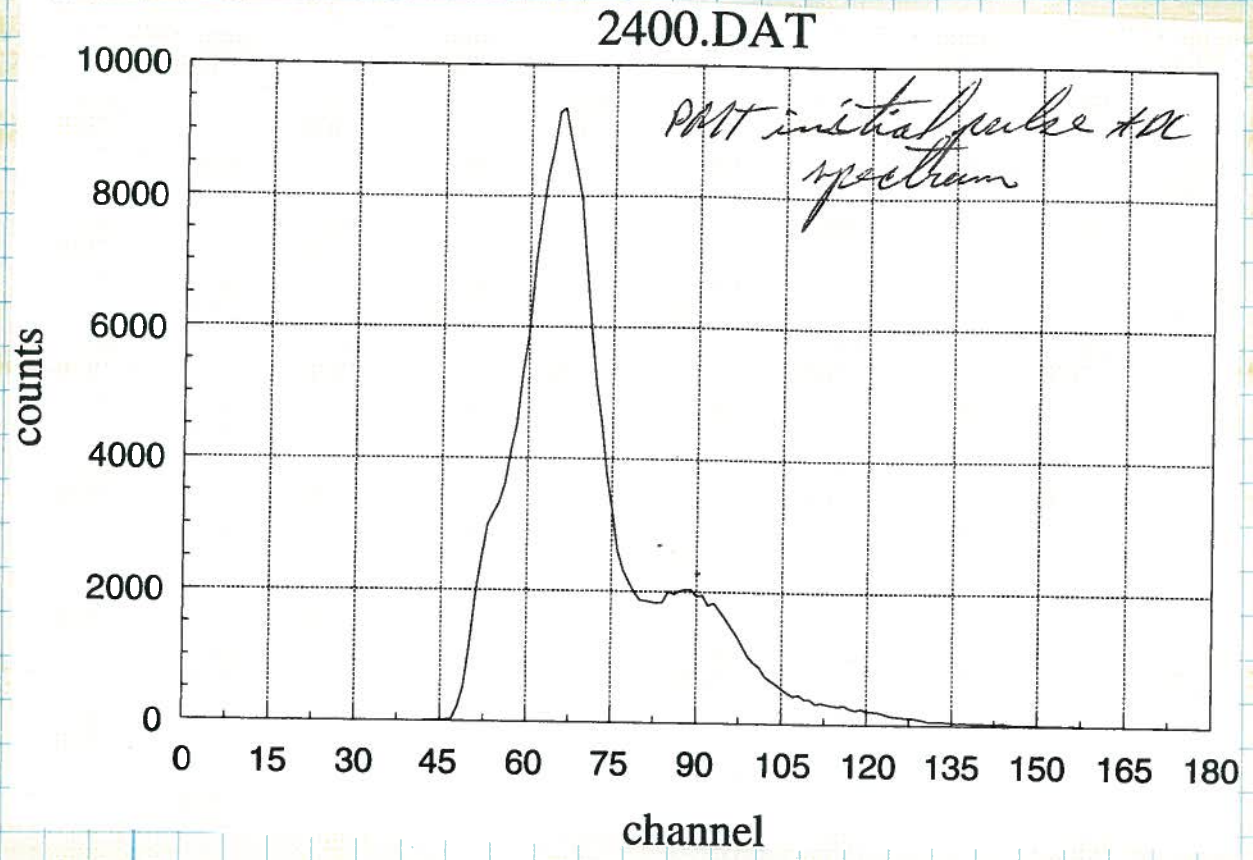

2800.DAT
afterpulse ADC spectrum
counts
50
43
36
29
21
14
7
0
0
140
280
420
560
700
channel

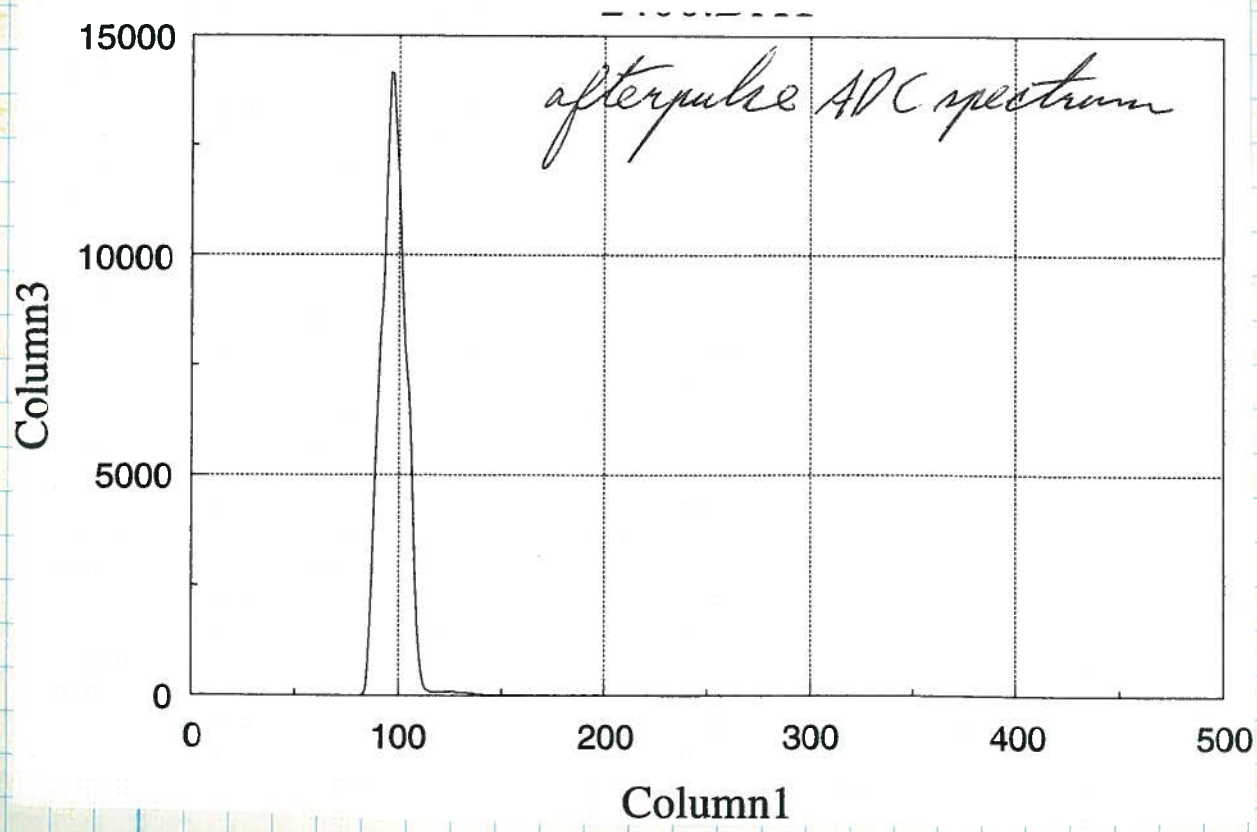

2600.DAT
initial PMT pulse ADC spectrum
counts
channel
0
500
1000
1500
2000
2500
3000
3500
0
100
200
300
400
500

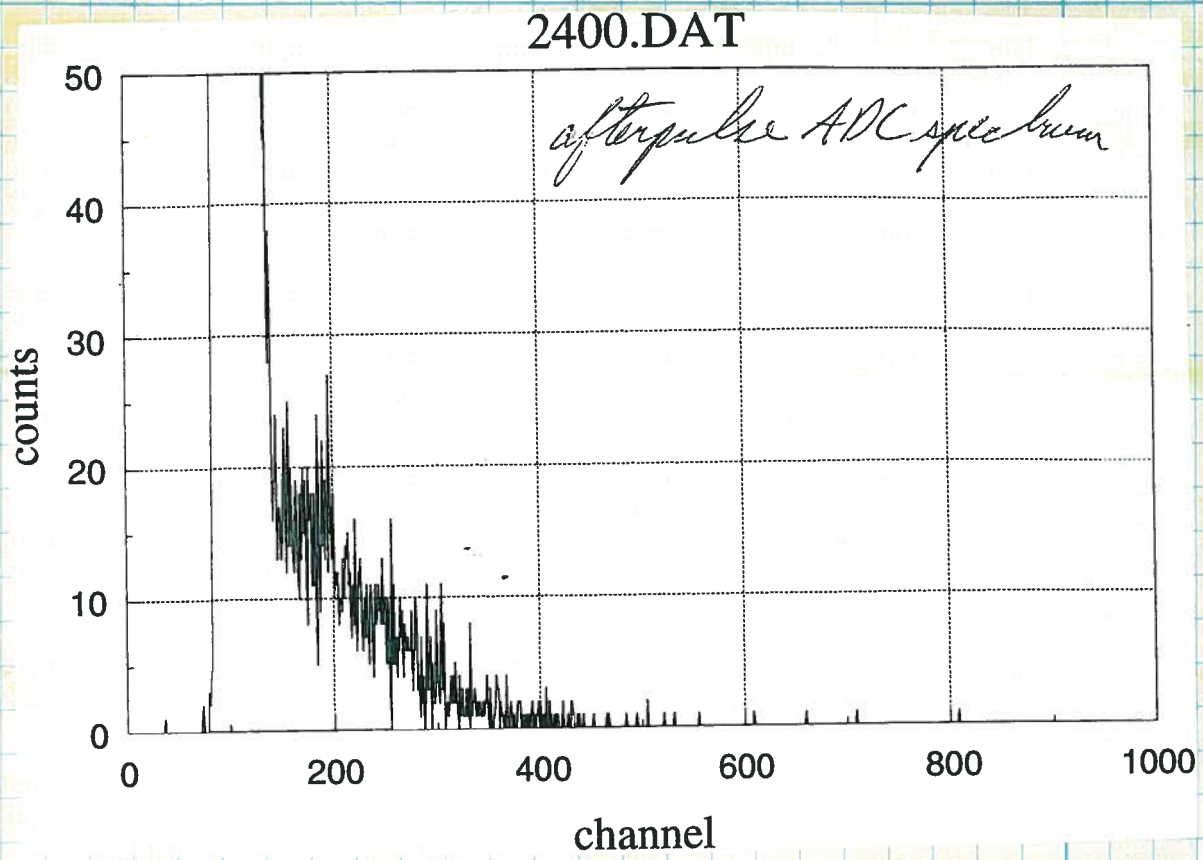

2600.DAT
afterpulse ADC spectrum
counts
channel
0
2000
4000
6000
8000
10000
12000
0
100
200
300
400
500


2600.DAT
afterpulse ADC spectrum
counts
75
60
45
30
15
0
0
400
800
1200
1600
2000
channel

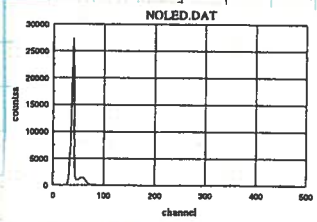

2600.DAT
afterpulse ADC spectrum
counts
75
60
45
30
15
0
0
100
200
300
400
500
channel

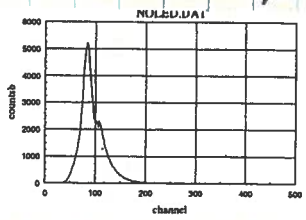

2400.DAT
PMT initial pulse ADC spectrum
counts
channel
10000
8000
6000
4000
2000
0
0
15
30
45
60
75
90
105
120
135
150
165
180


afterpulse ADC spectrum
Column3
Column1
15000
10000
5000
0
0
100
200
300
400
500



ADC spectrum with LED disconnected from pulser.
2400V. Taken on 12/12/98. JS



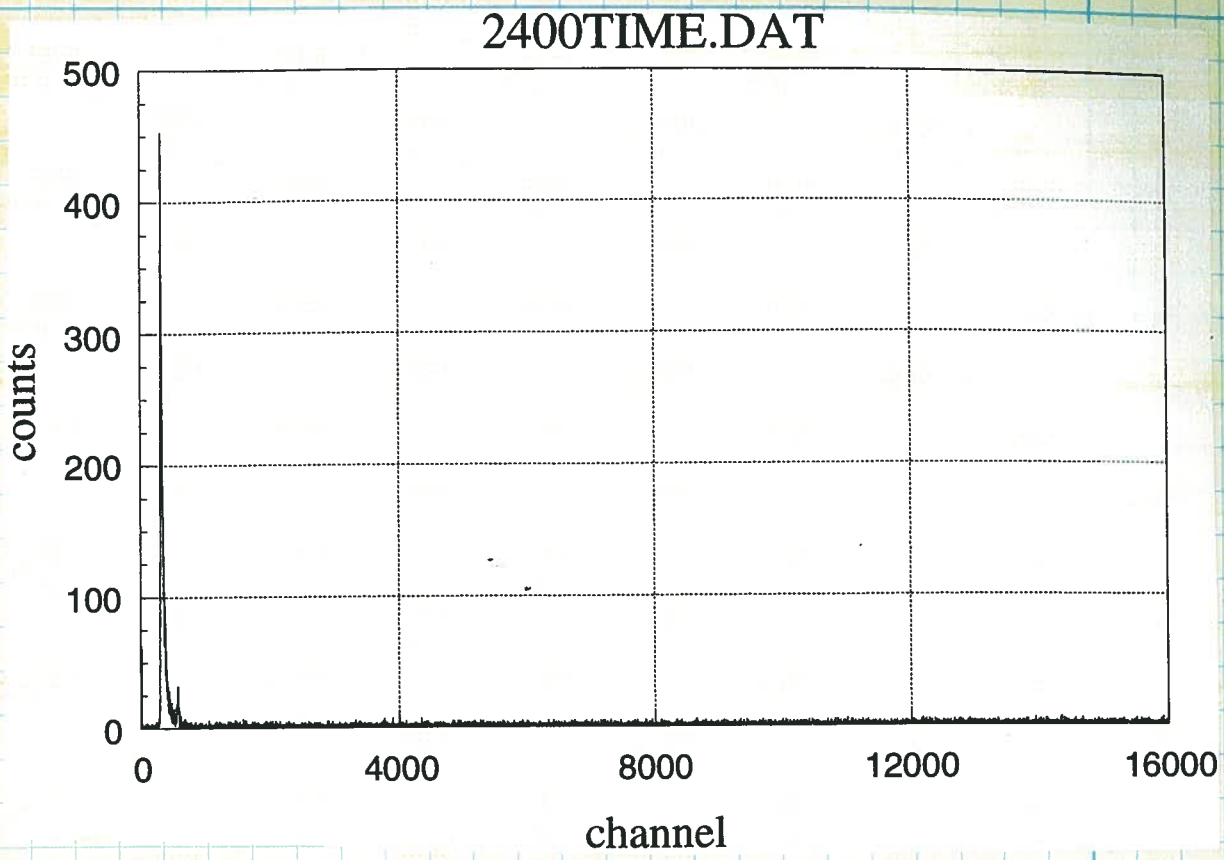


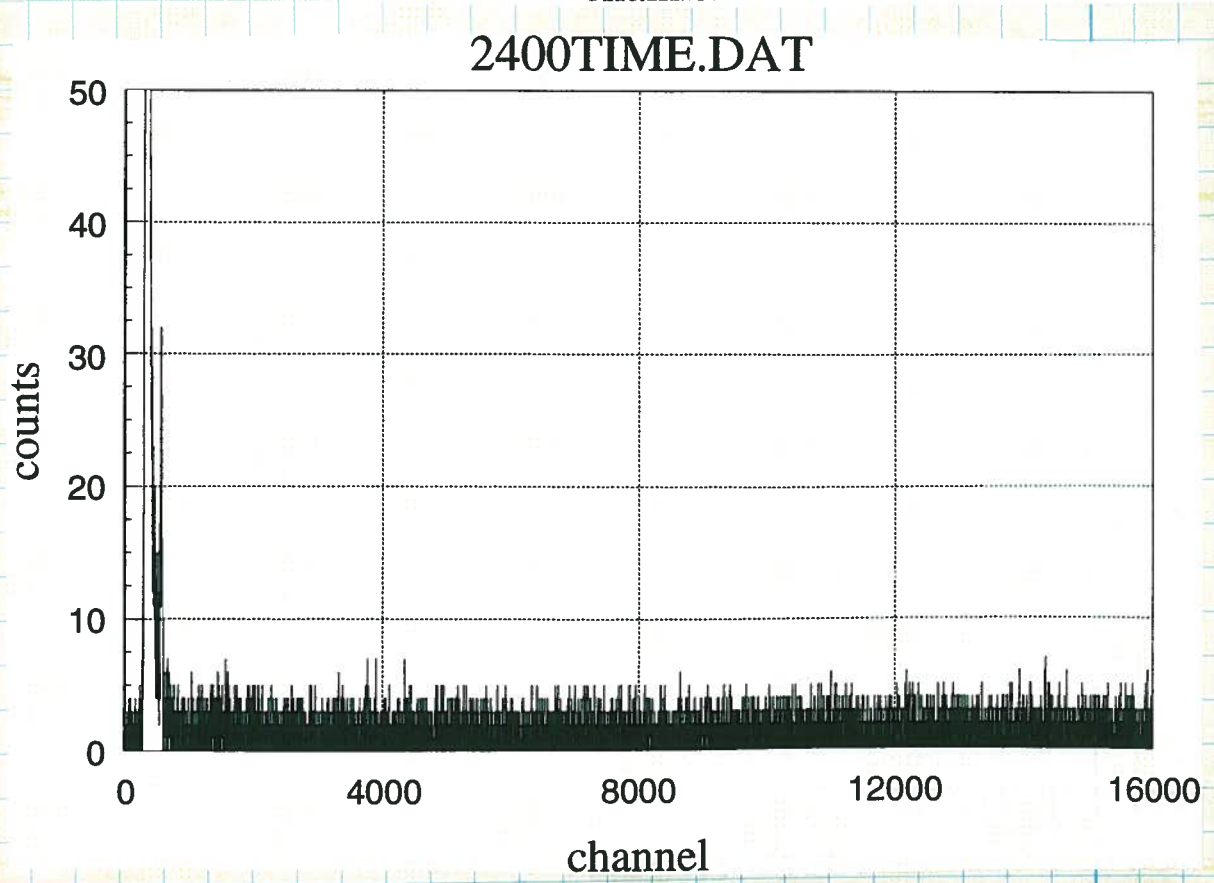
initial

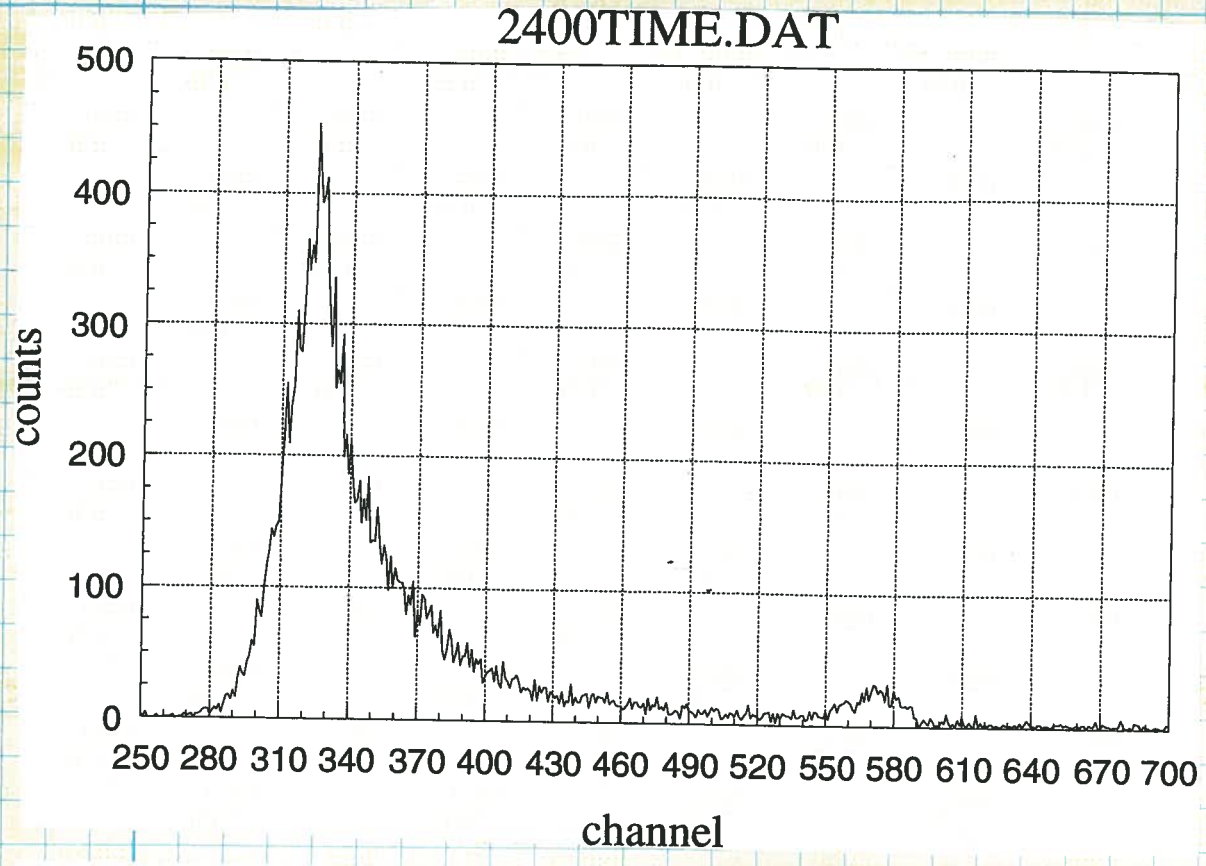
afterpulse

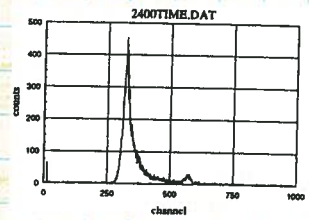
12/14 TDC Spectrum of Afterpulsing in an 8854

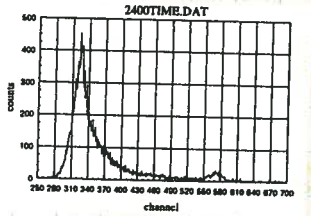
GS This weekend I finally got the TDC readout included in the program. Wiring scheme and readout can be found in ATPULSE2.FOR

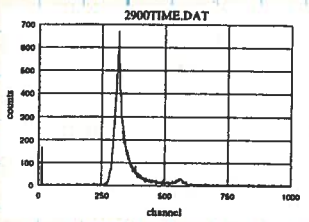

2400TIME.DAT
500
400
300
200
100
0
counts
0
4000
8000
12000
16000
channel

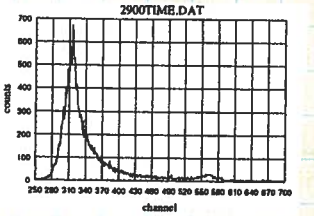

2400TIME.DAT
50
40
30
20
10
0
counts
0
4000
8000
12000
16000
channel

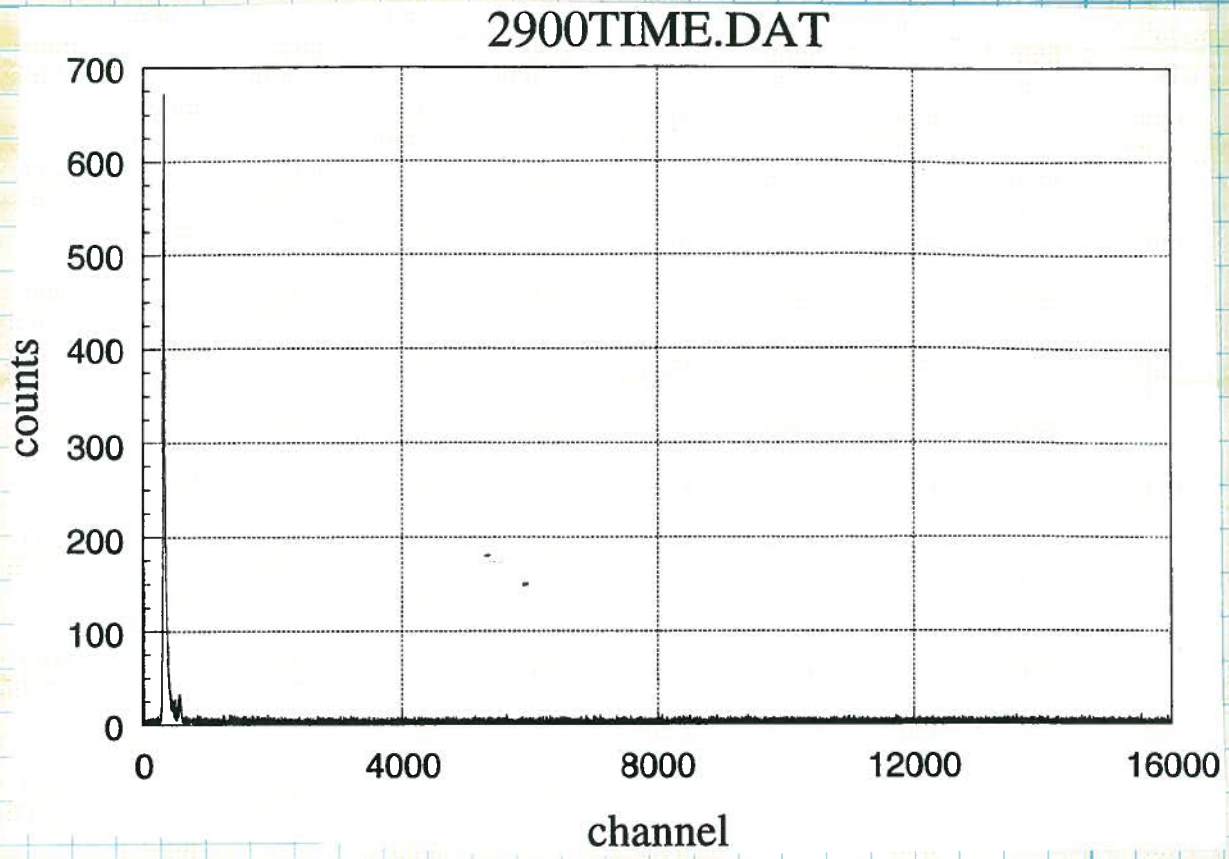

2400TIME.DAT
counts
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

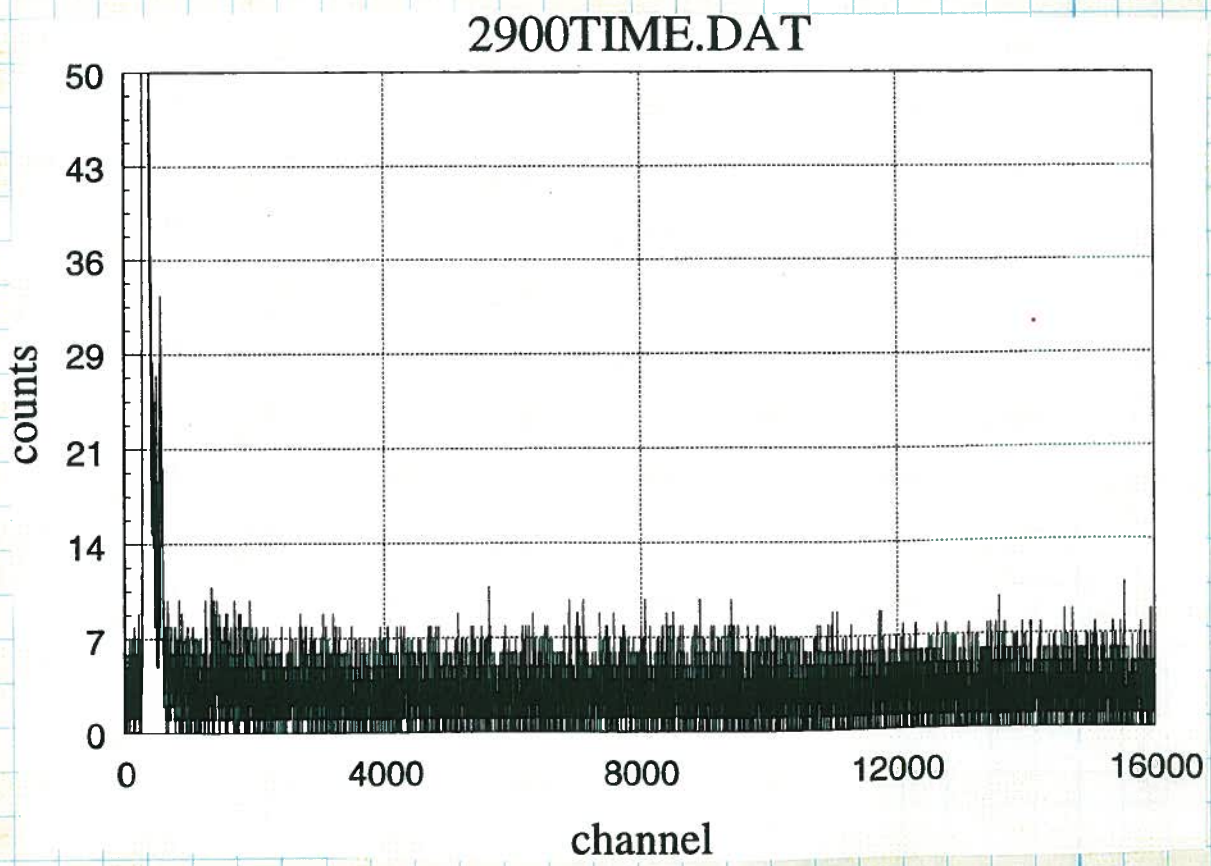

2400TIME.DAT
counts
channel

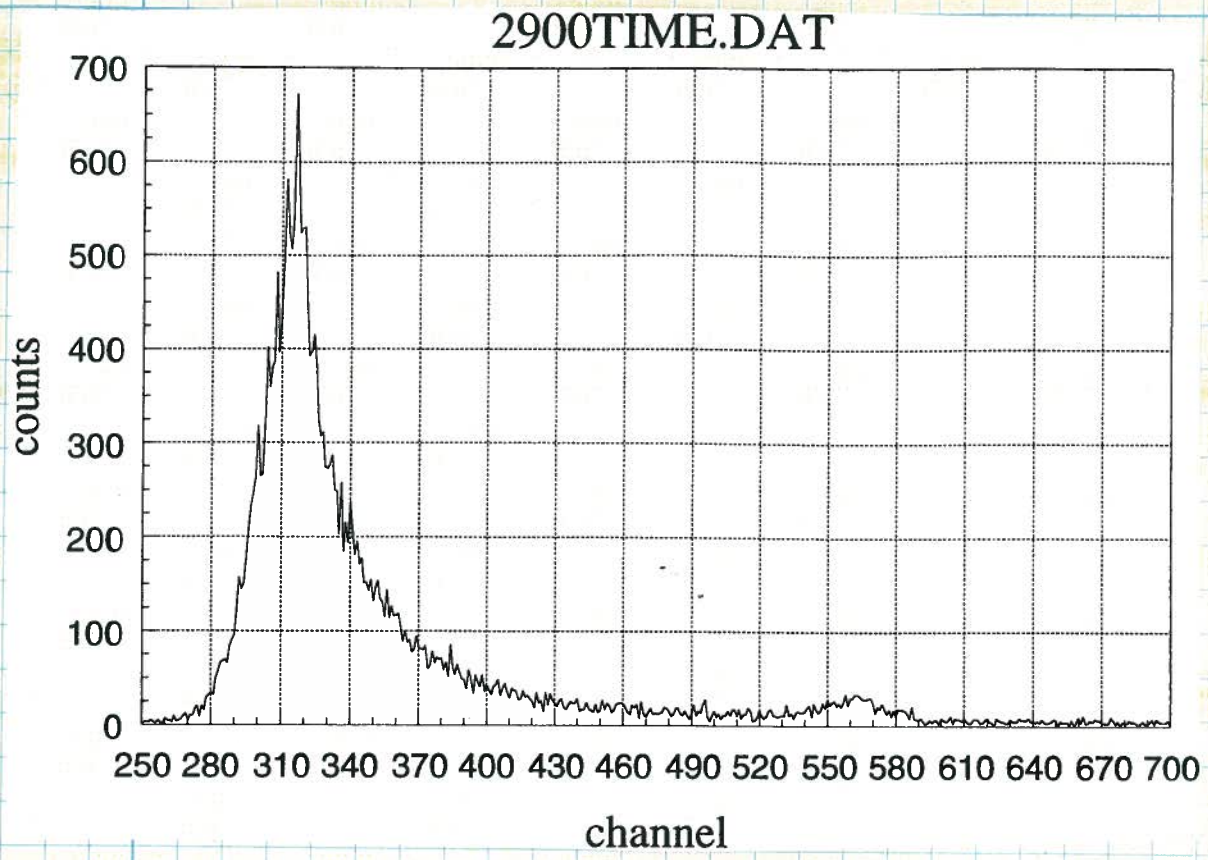

2400TIME.DAT
counts
channel


2900TIME.DAT
counts
channel

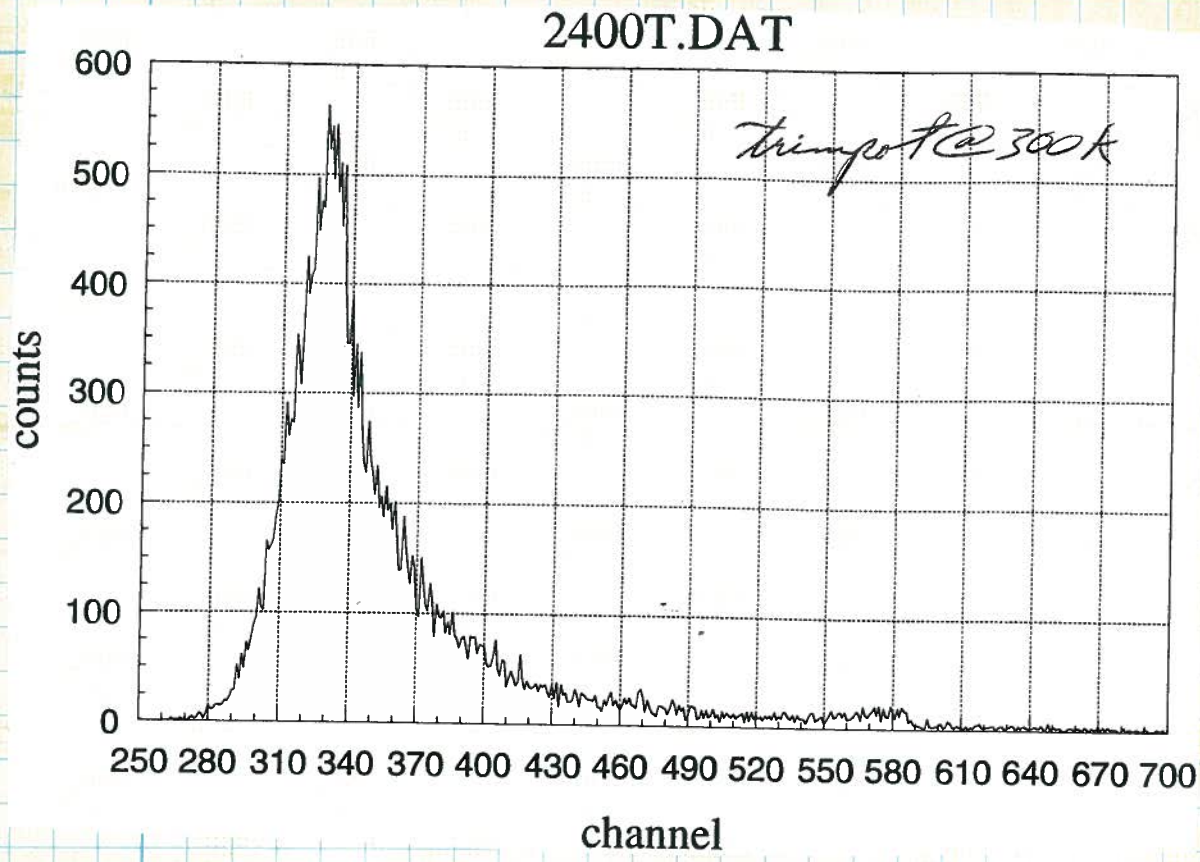

2900TIME.DAT
counts
channel

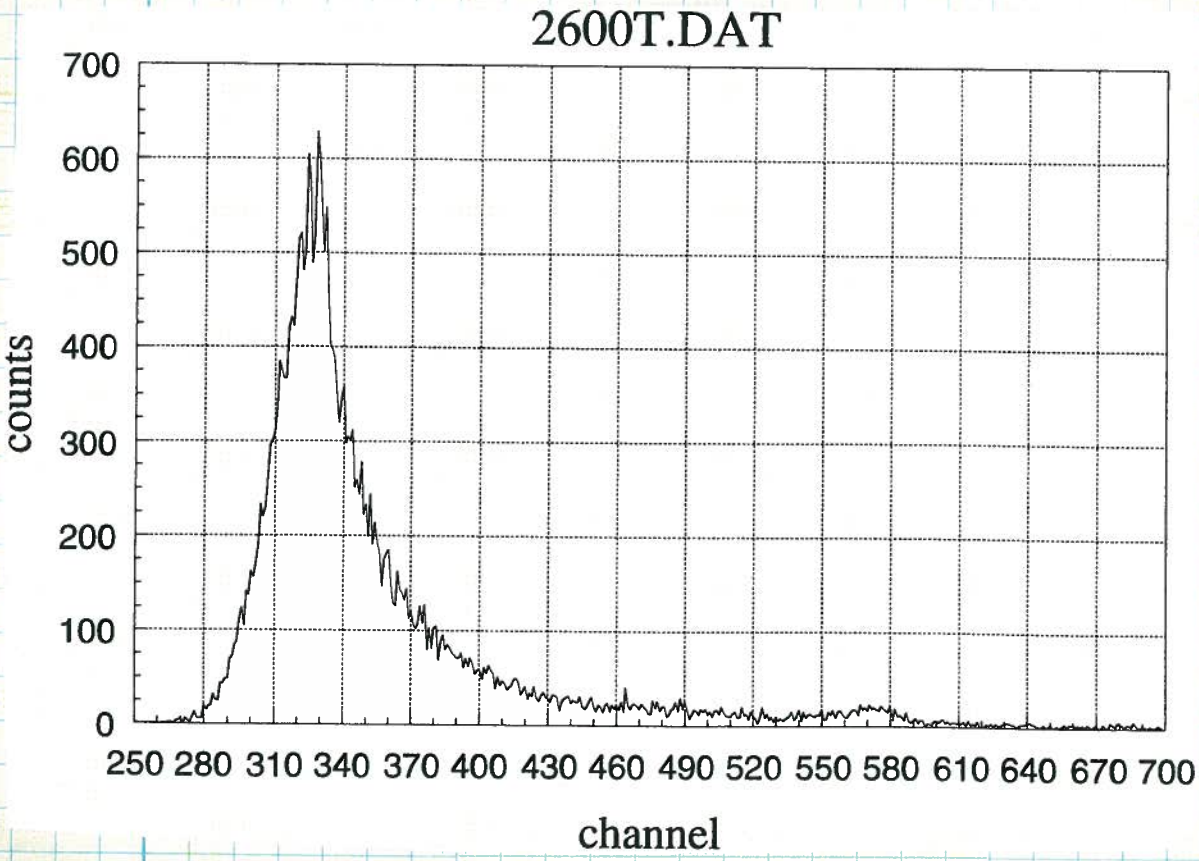

2900TIME.DAT
700
600
500
400
300
200
100
0
counts
0
4000
8000
12000
16000
channel

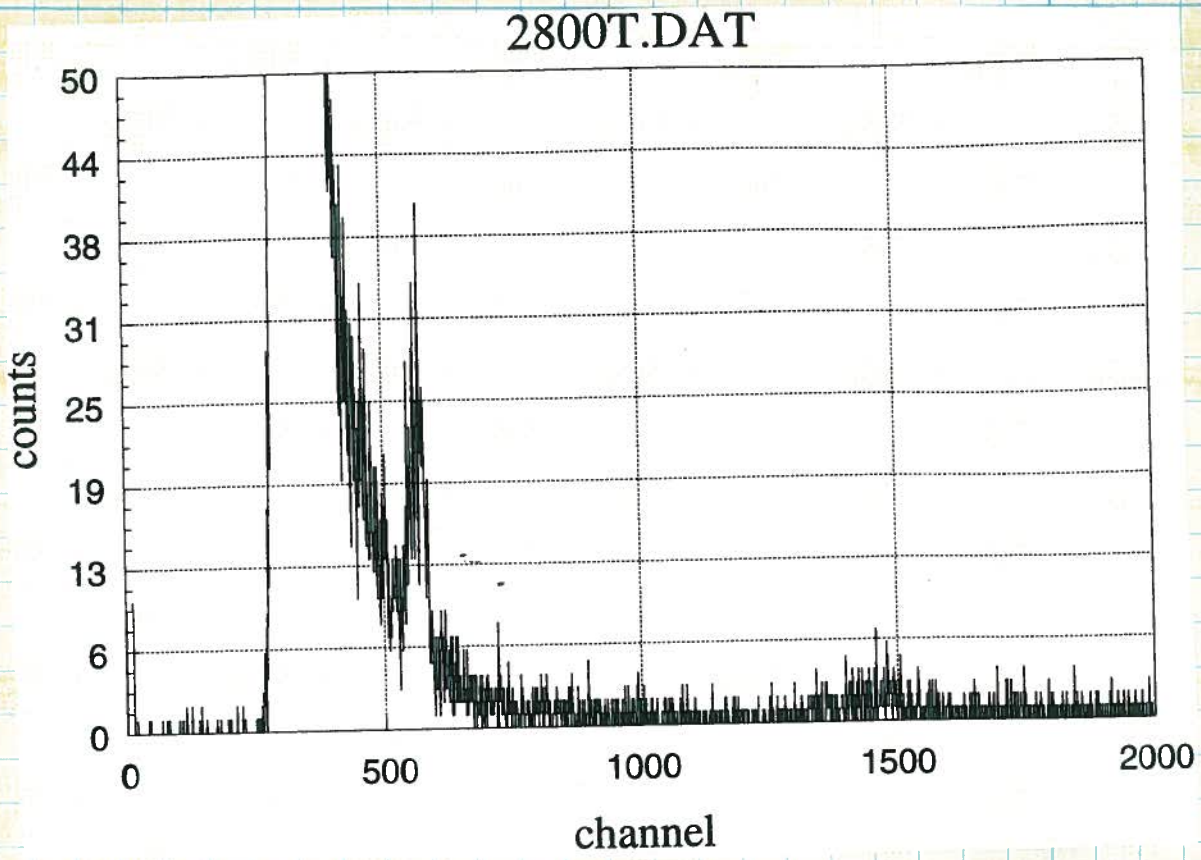

2900TIME.DAT
50
43
36
29
21
14
7
0
counts
0
4000
8000
12000
16000
channel

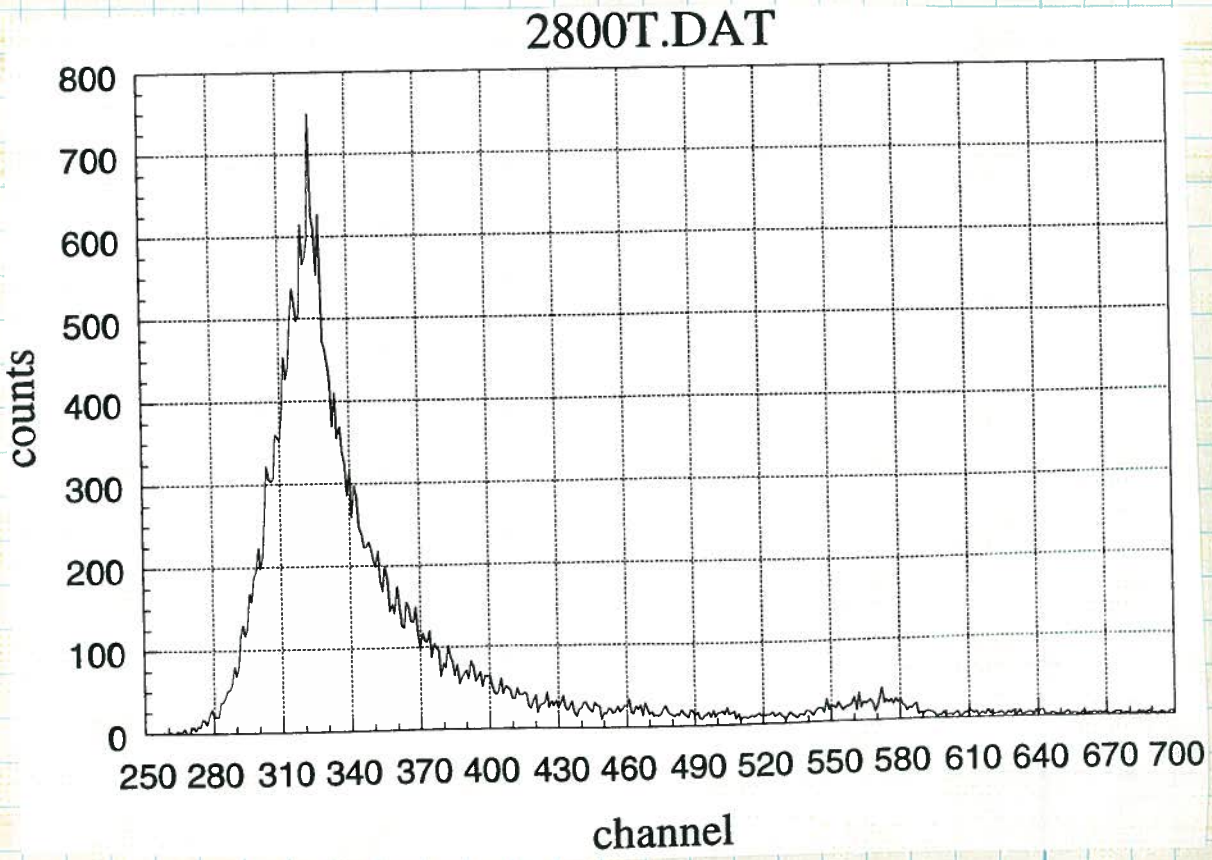

2900TIME.DAT
700
600
500
400
300
200
100
0
counts
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

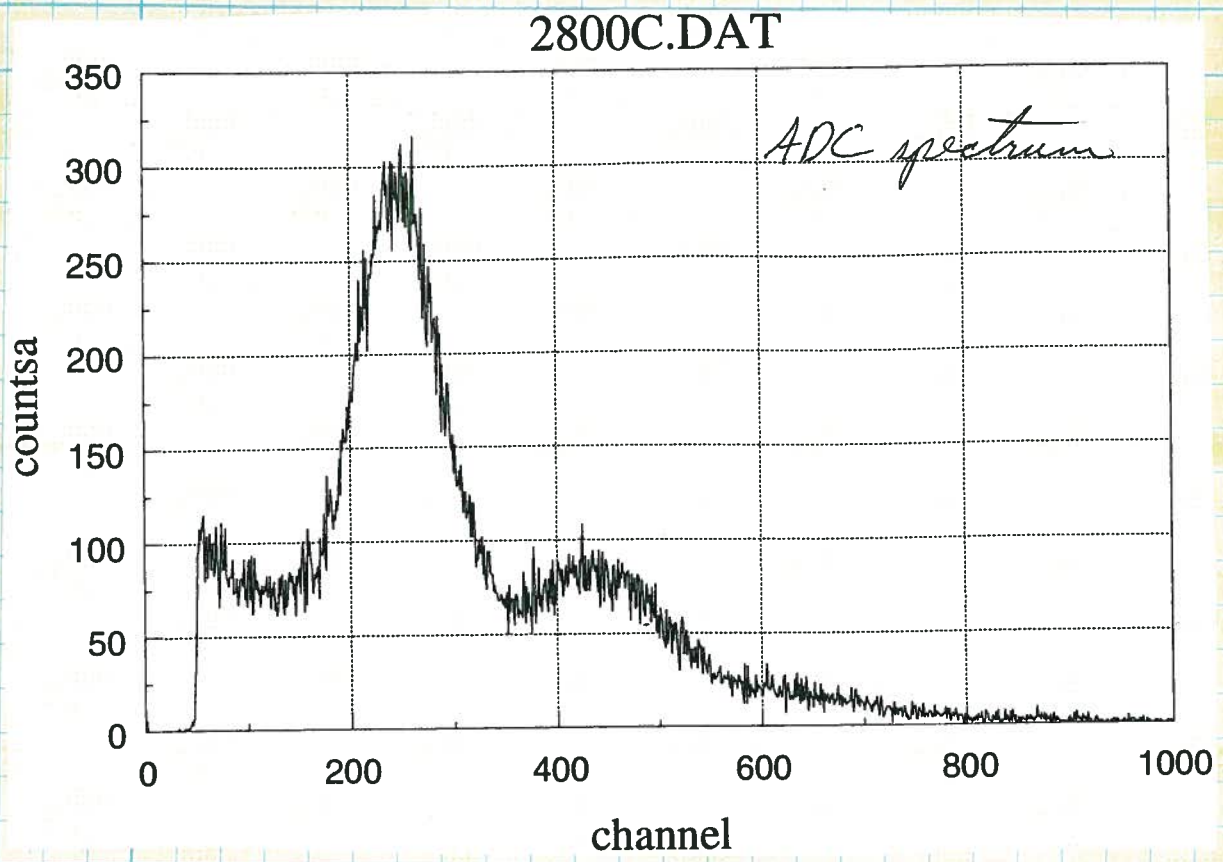
12/14


2400T.DAT
trimpot@300k
counts
channel
0
100
200
300
400
500
600
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700


2600T.DAT
counts
channel
0
100
200
300
400
500
600
700
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700


2800T.DAT
counts
50
44
38
31
25
19
13
6
0
0
500
1000
1500
2000
channel

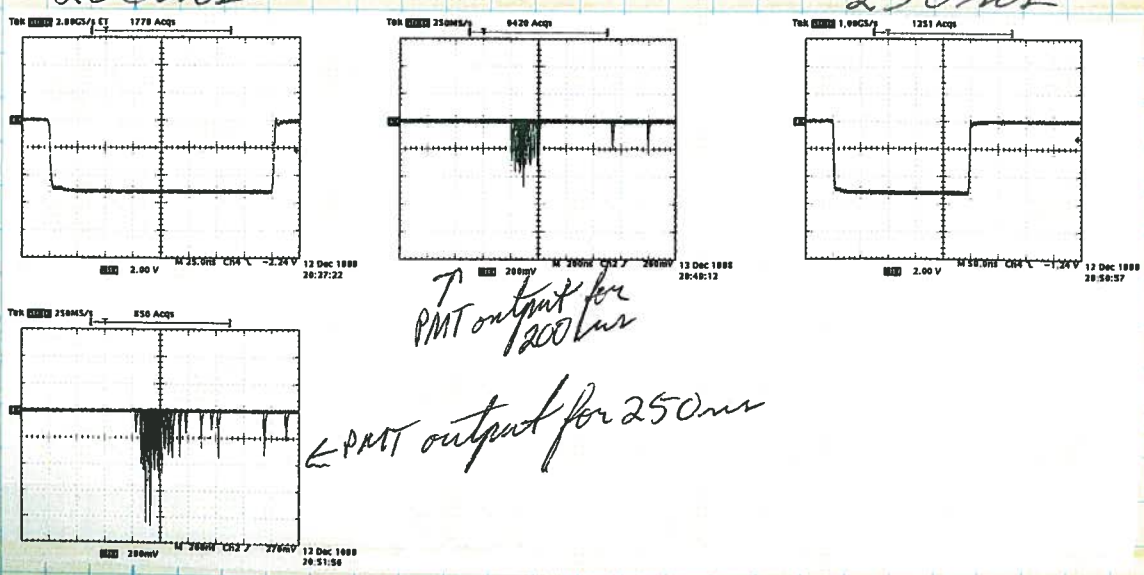

2800T.DAT
counts
800
700
600
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

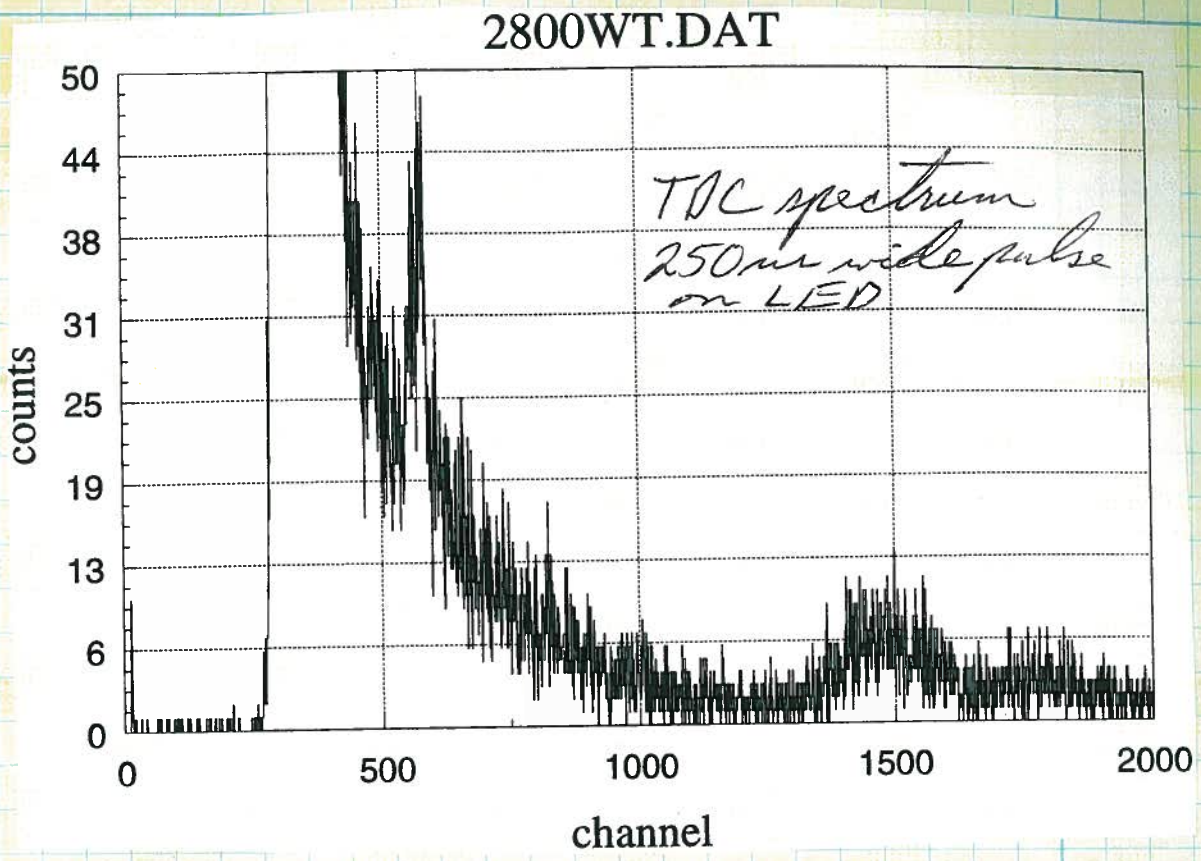


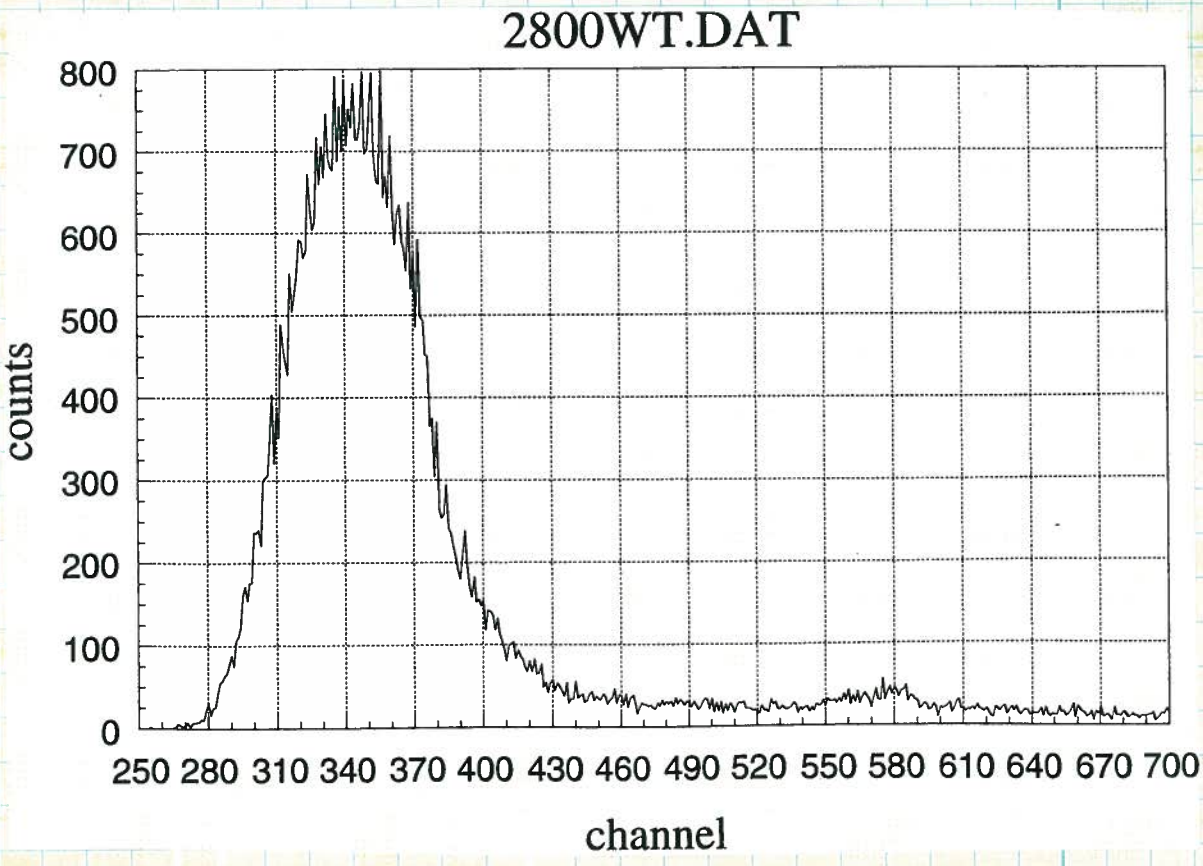
LED driving pulse width, 250ns was used for "WT" & "WC" wide pulse setting

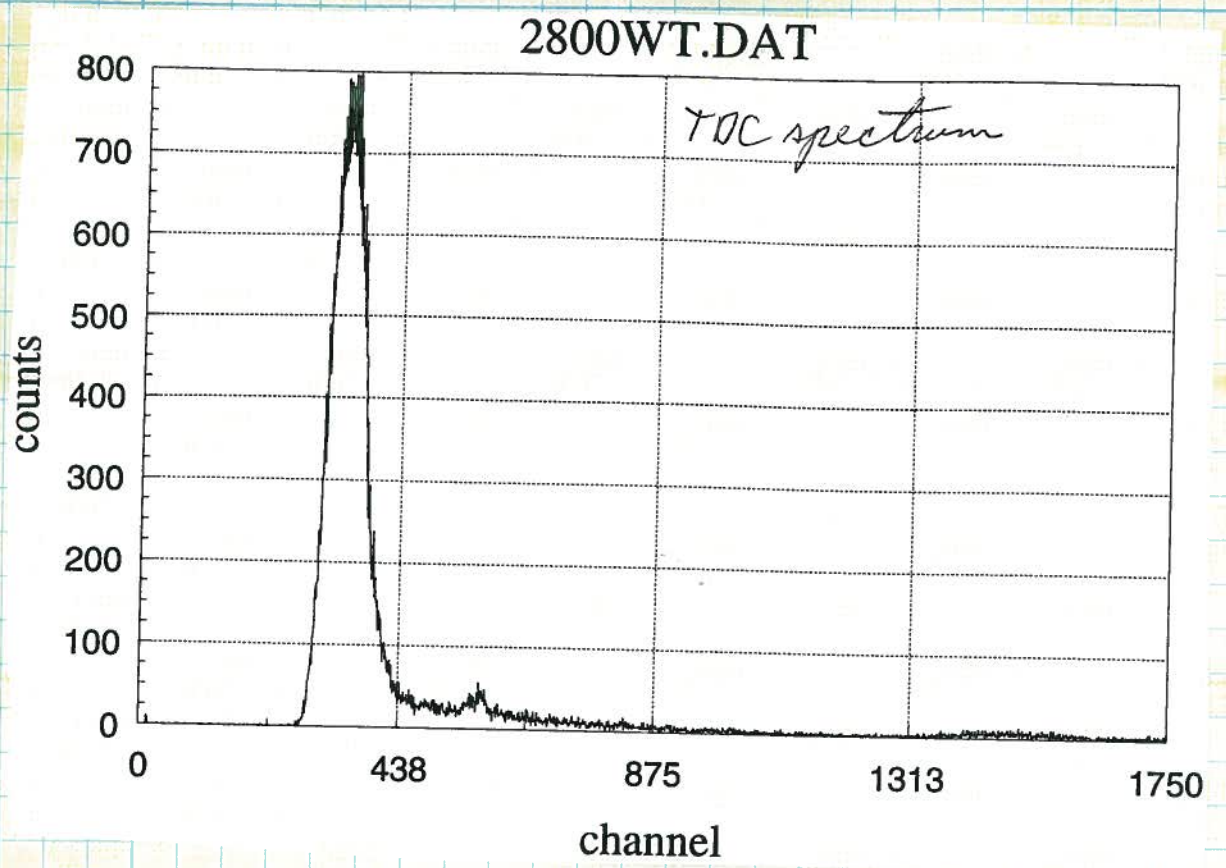
200ns

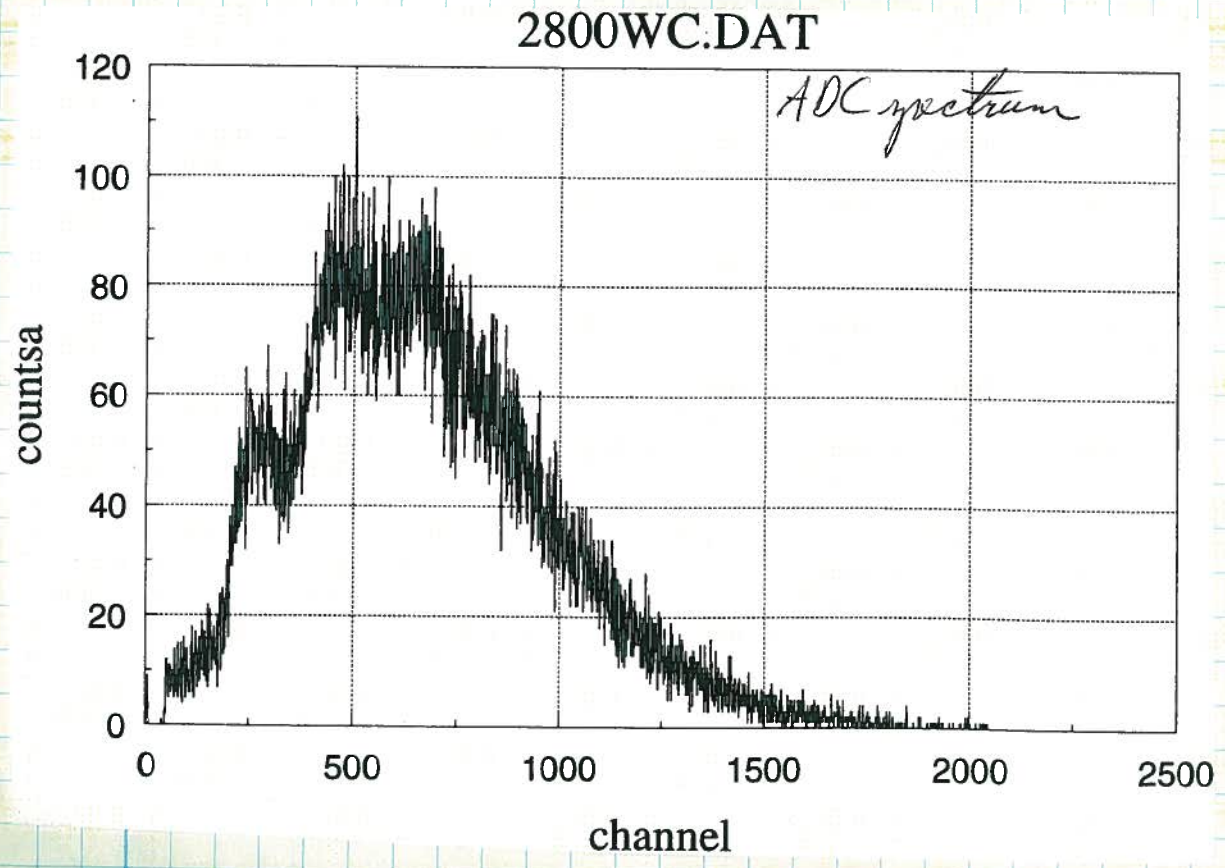
250ns

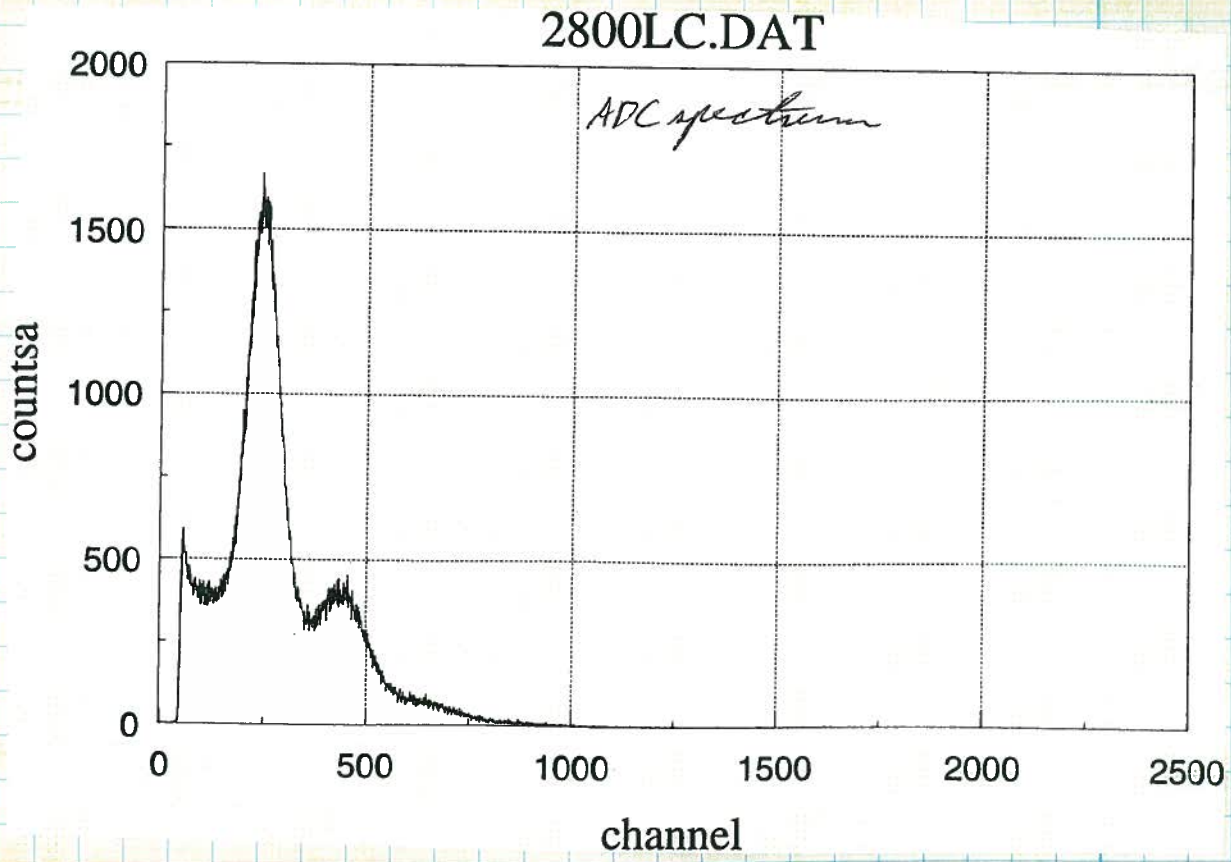


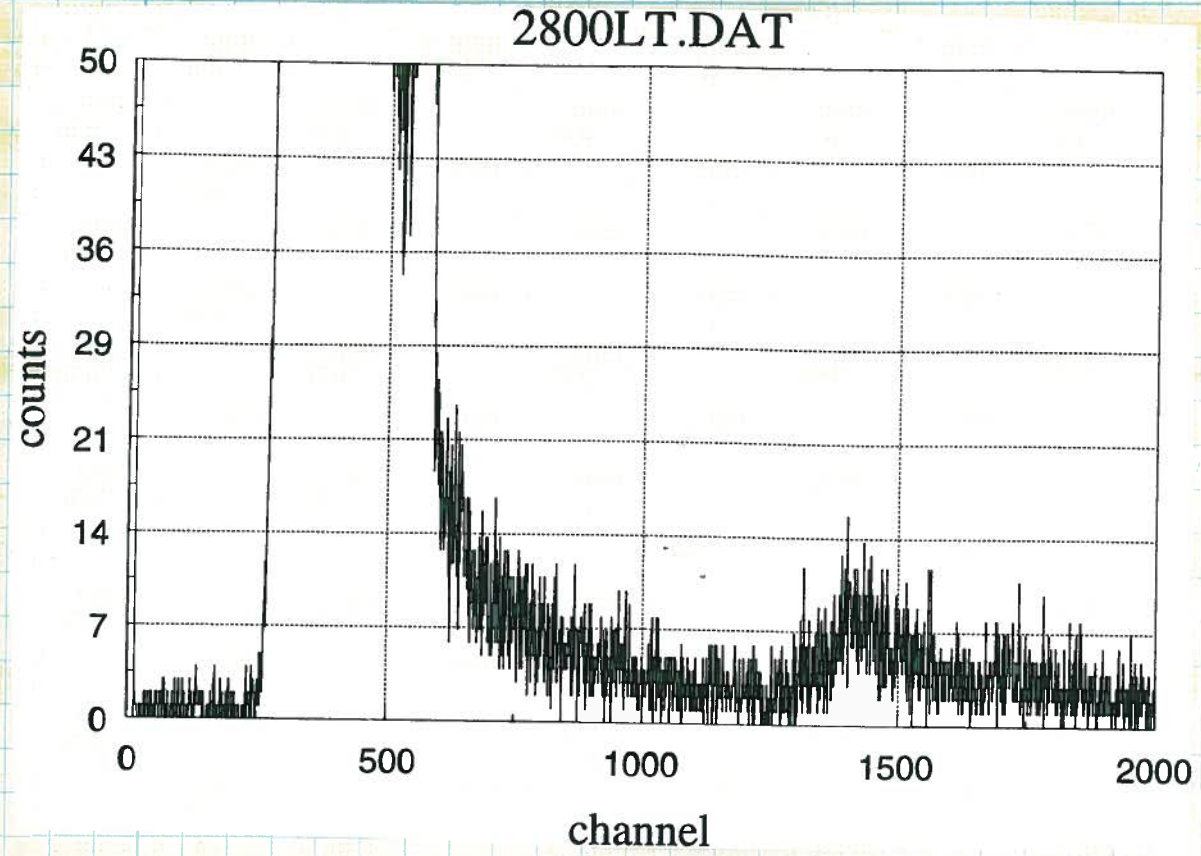

2800WT.DAT
TDC spectrum
250ns wide pulse
on LED
counts
50
44
38
31
25
19
13
6
0
0
500
1000
1500
2000
channel

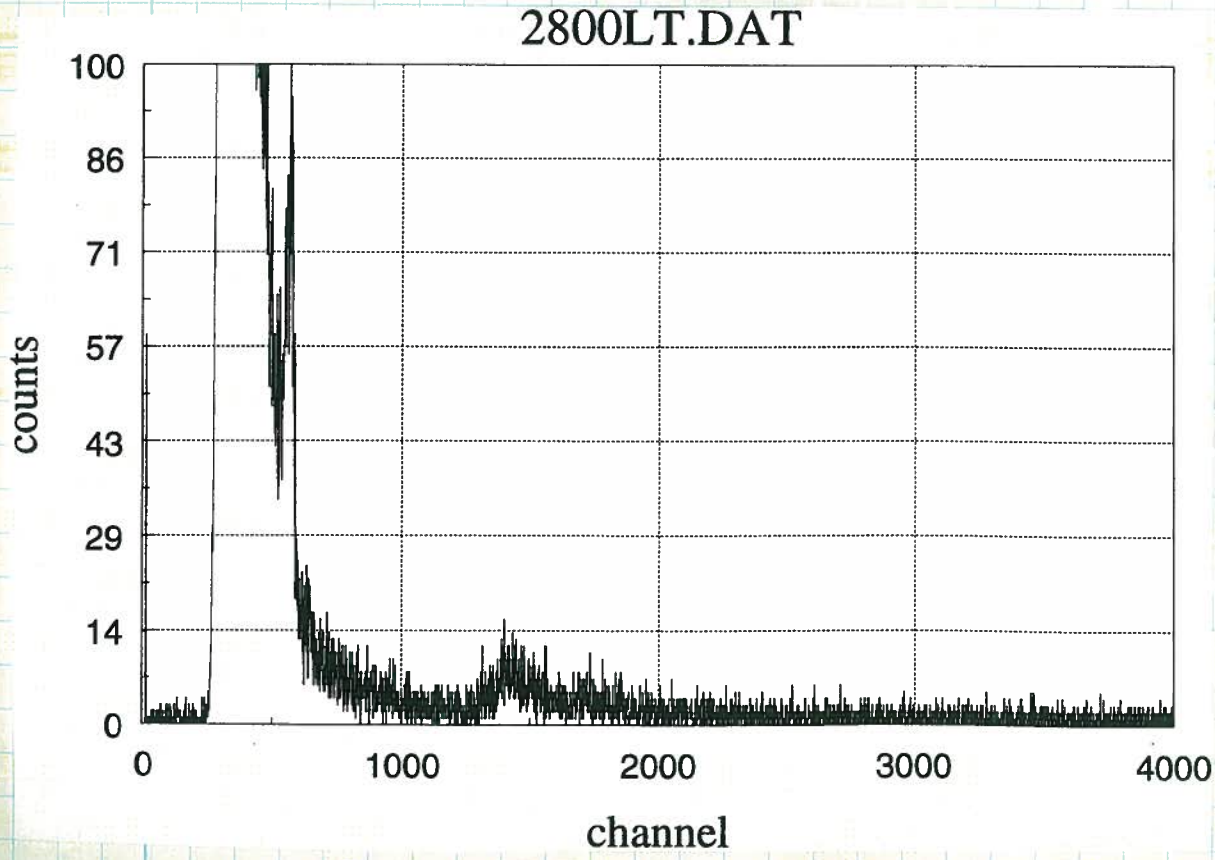

2800WT.DAT
counts
800
700
600
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

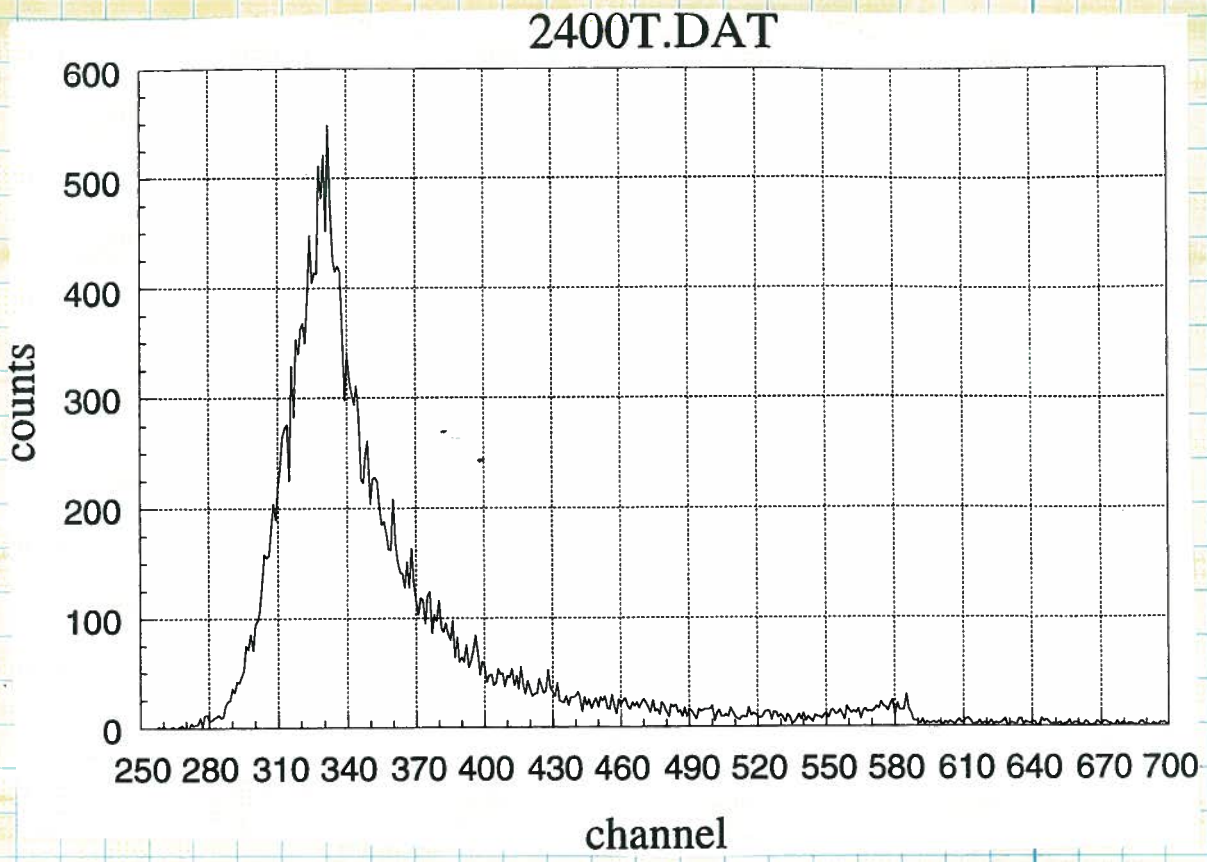

2800WT.DAT
TDC spectrum
counts
800
700
600
500
400
300
200
100
0
0
438
875
1313
1750
channel

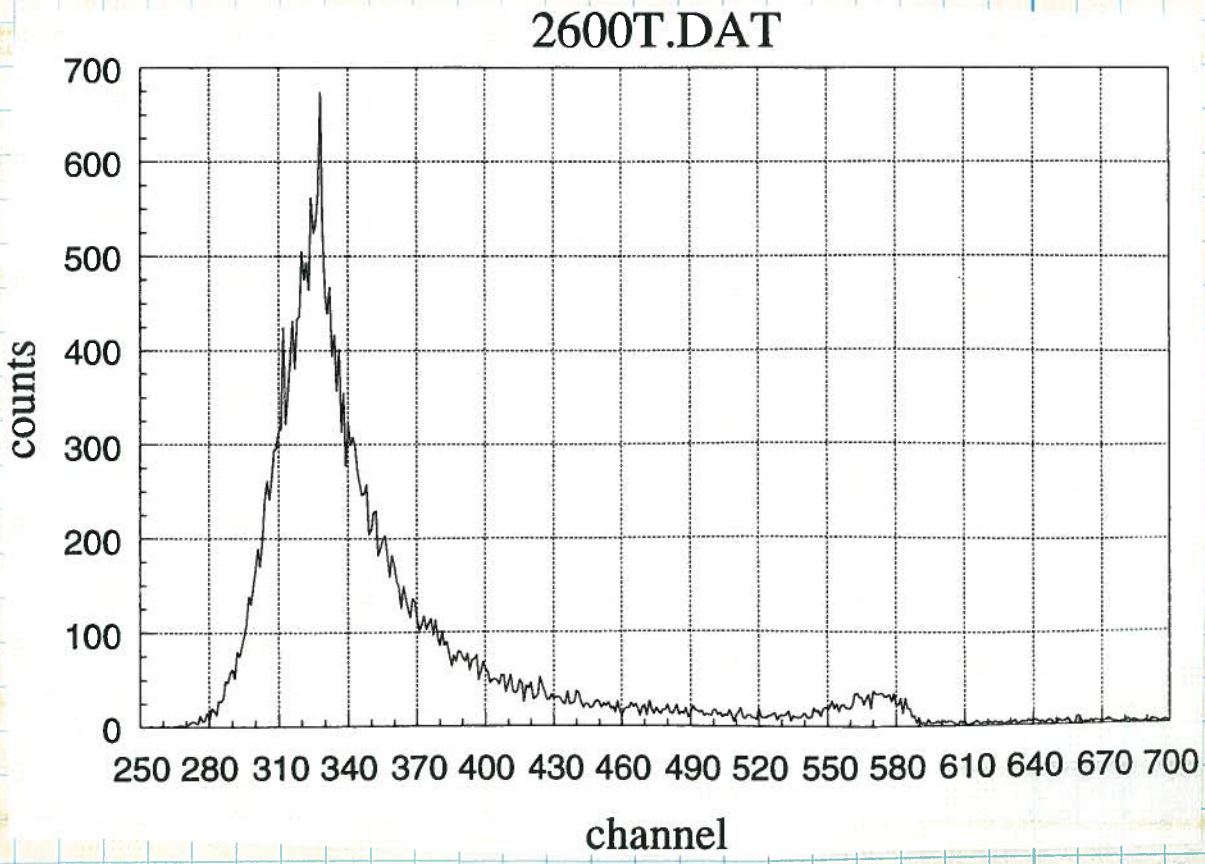

2800WC.DAT
ADC spectrum
countsa
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
channel

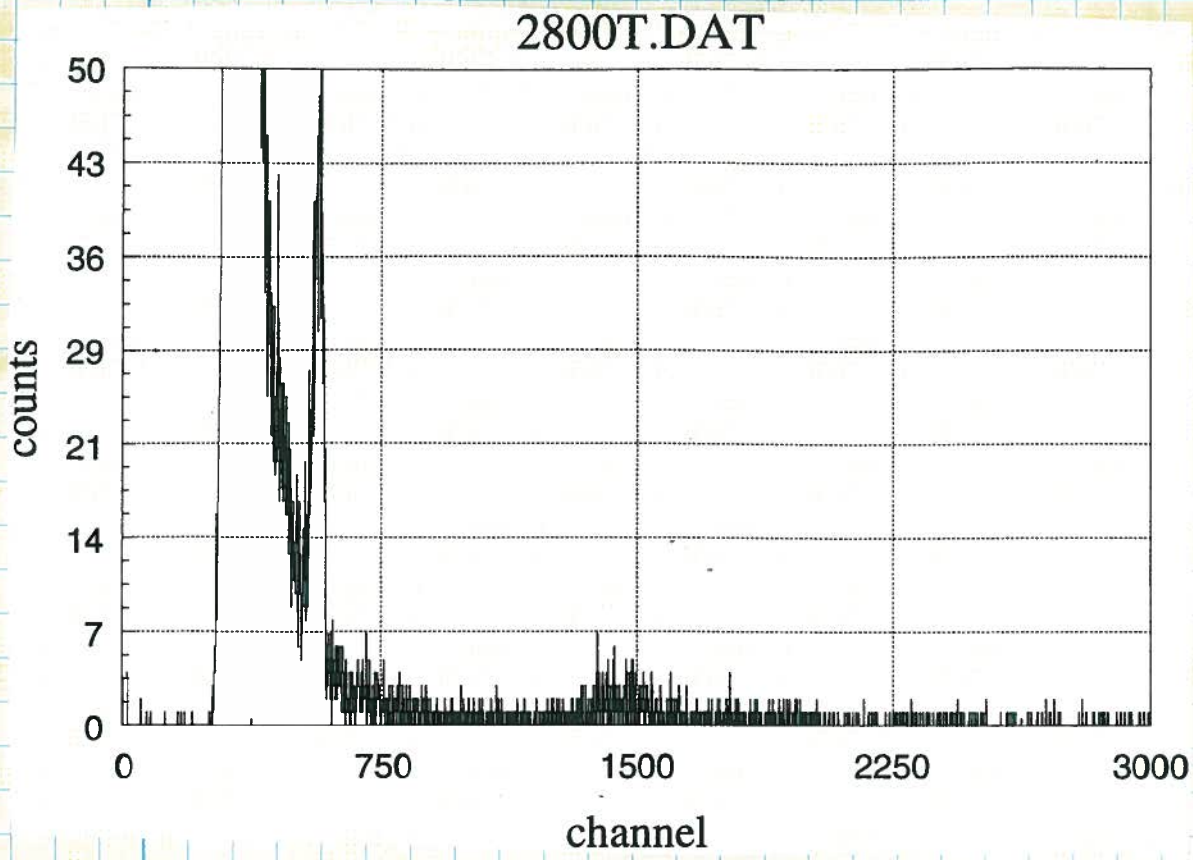

2800LC.DAT
ADC spectrum
countsa
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
channel

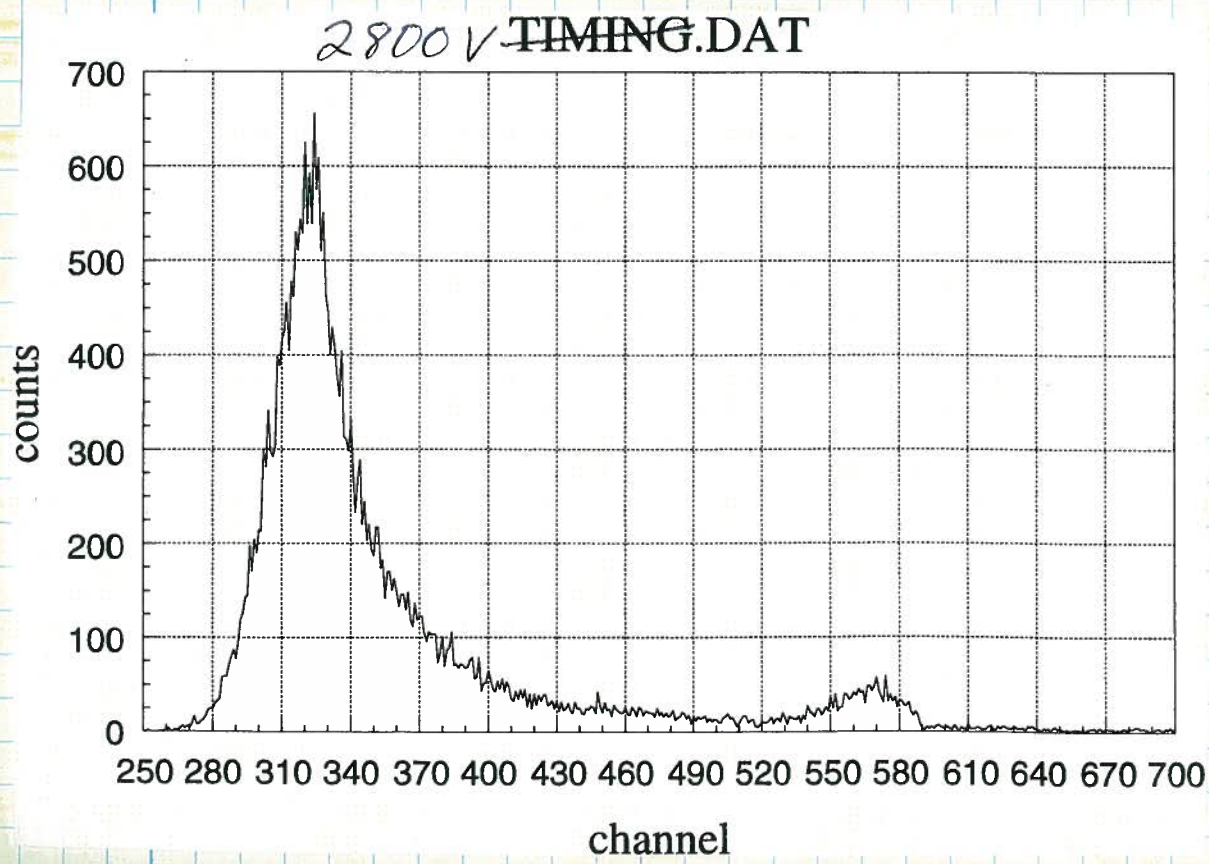

2800LT.DAT
50
43
36
29
21
14
7
0
counts
0
500
1000
1500
2000
channel


2800LT.DAT
100
86
71
57
43
29
14
0
counts
0
1000
2000
3000
4000
channel


2400T.DAT
counts
600
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

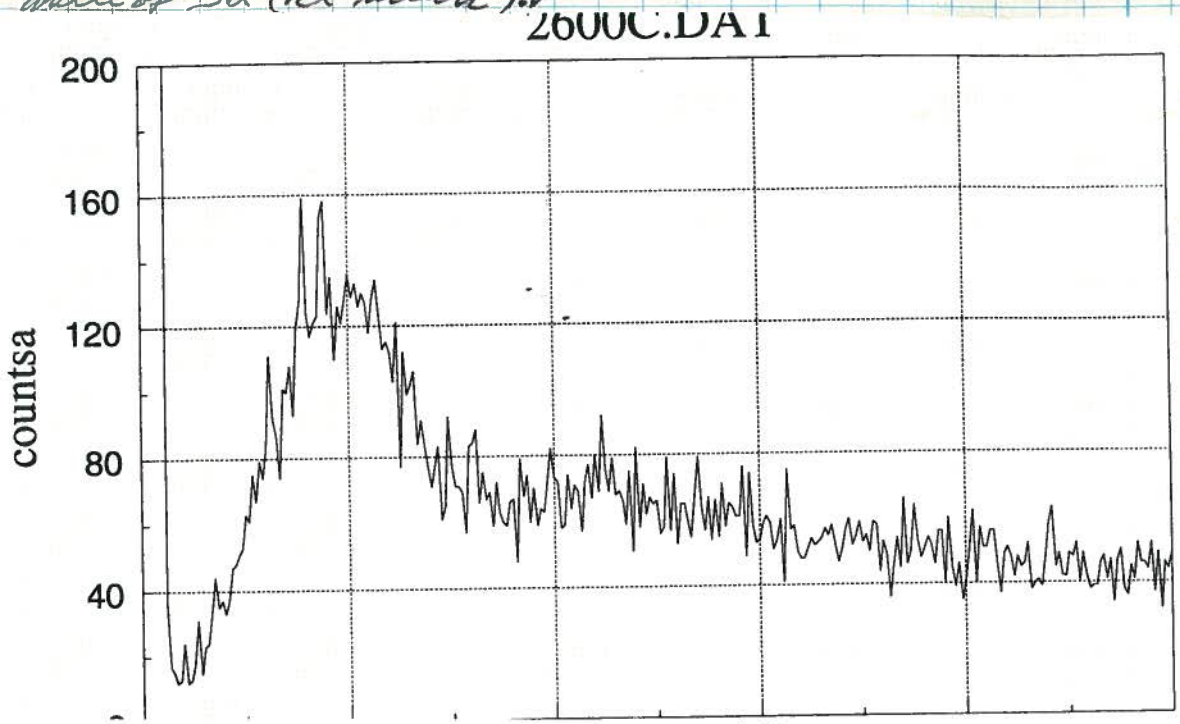

2600T.DAT
counts
700
600
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

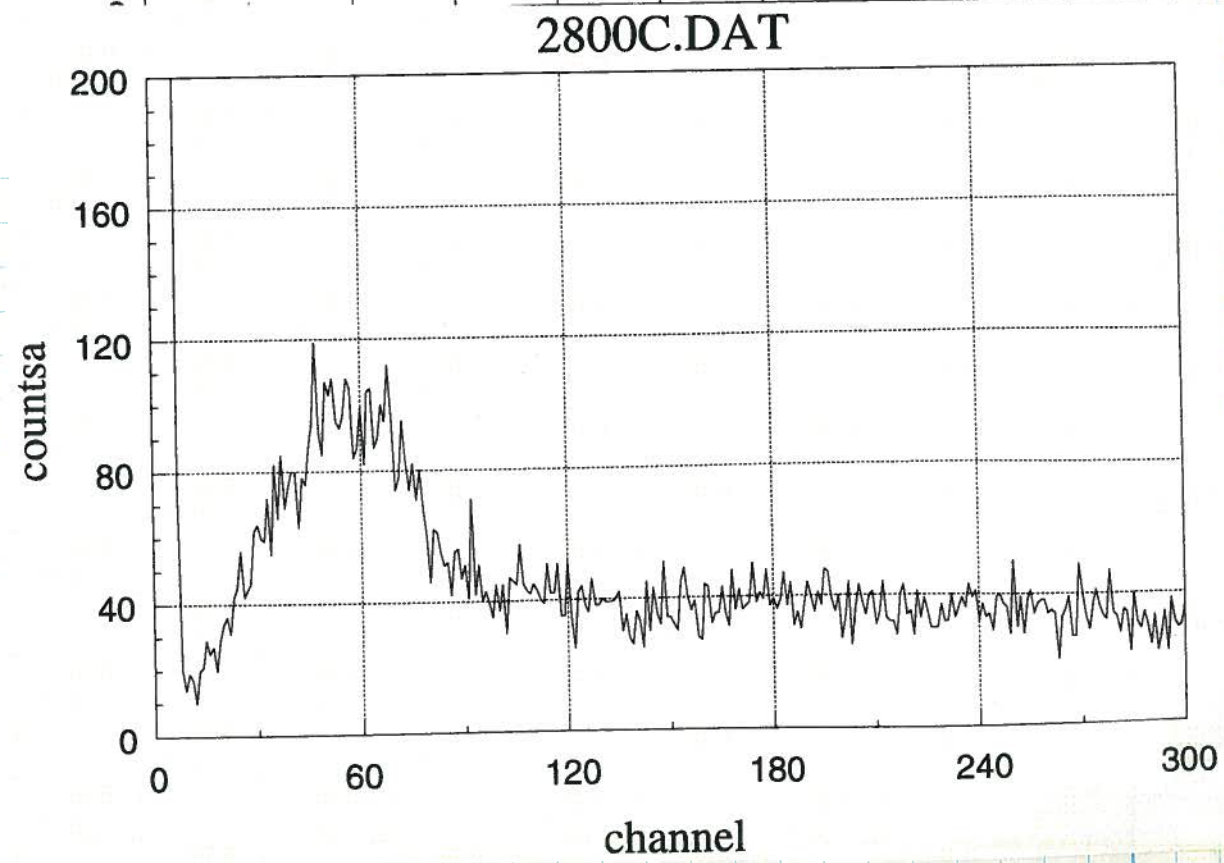

2800T.DAT
counts
50
43
36
29
21
14
7
0
0
750
1500
2250
3000
channel

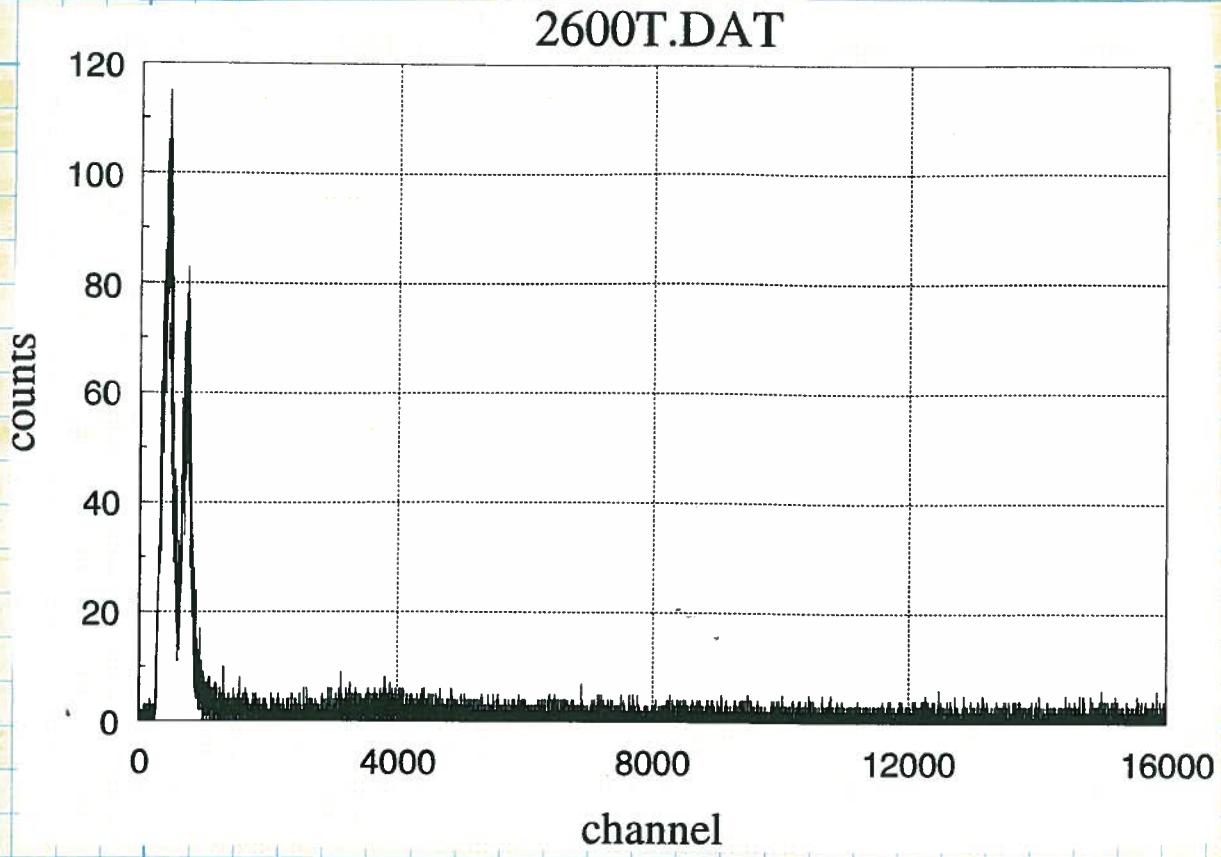

2800 V ~~TIMING~~.DAT
counts
700
600
500
400
300
200
100
0
250 280 310 340 370 400 430 460 490 520 550 580 610 640 670 700
channel

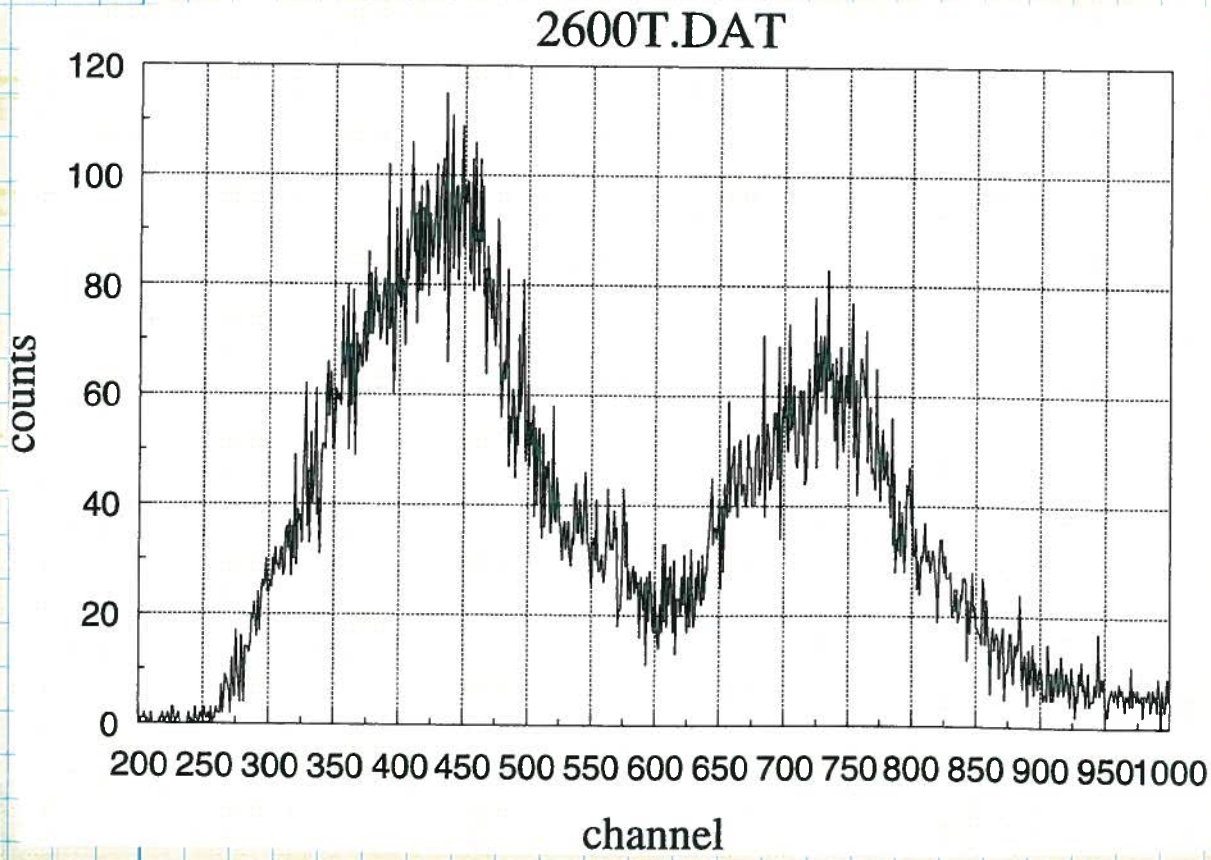
8575 ADC & TDC Spectrum 12/31/88

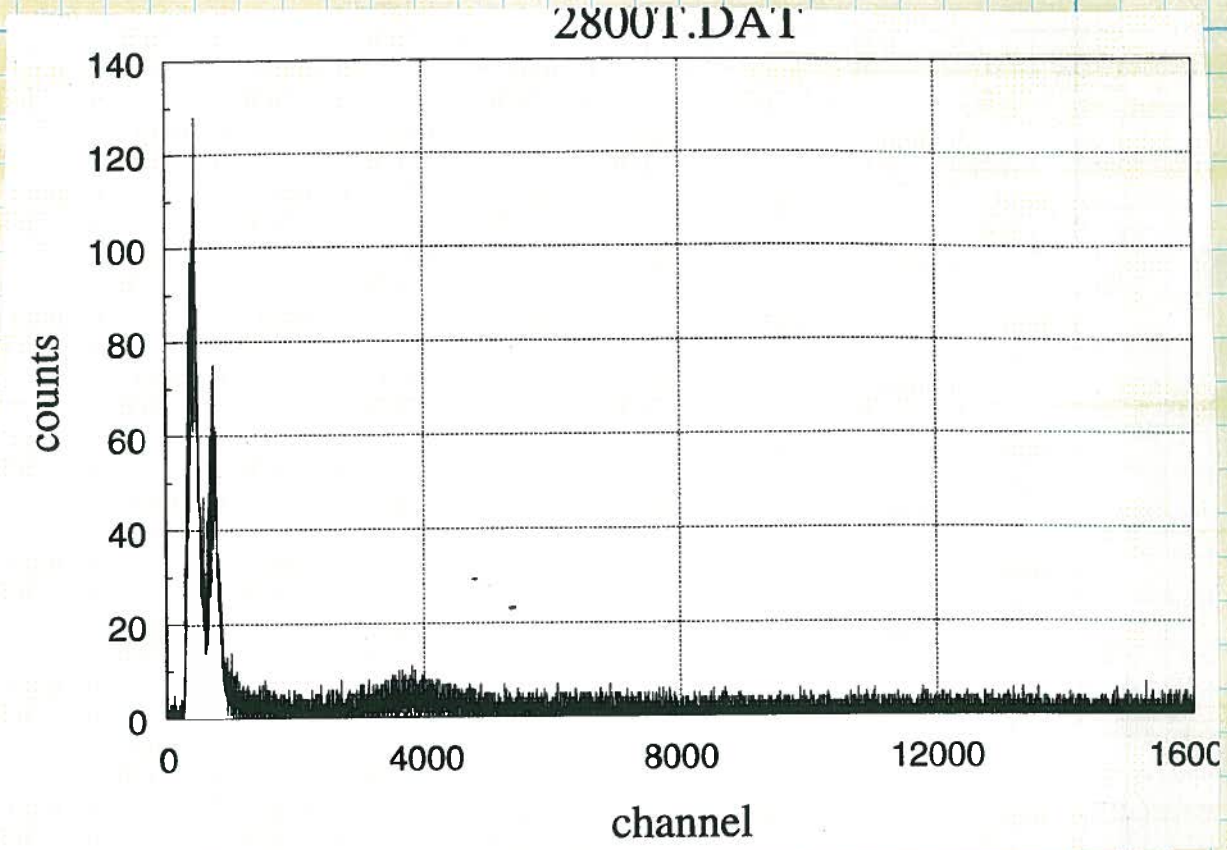
Shortly before leaving for Christmas vacation I ran a good 8575 looking for a single PE peak. I didn't get one. I ran the PMT signal through a Phillips amp to a min of 32 (I think).

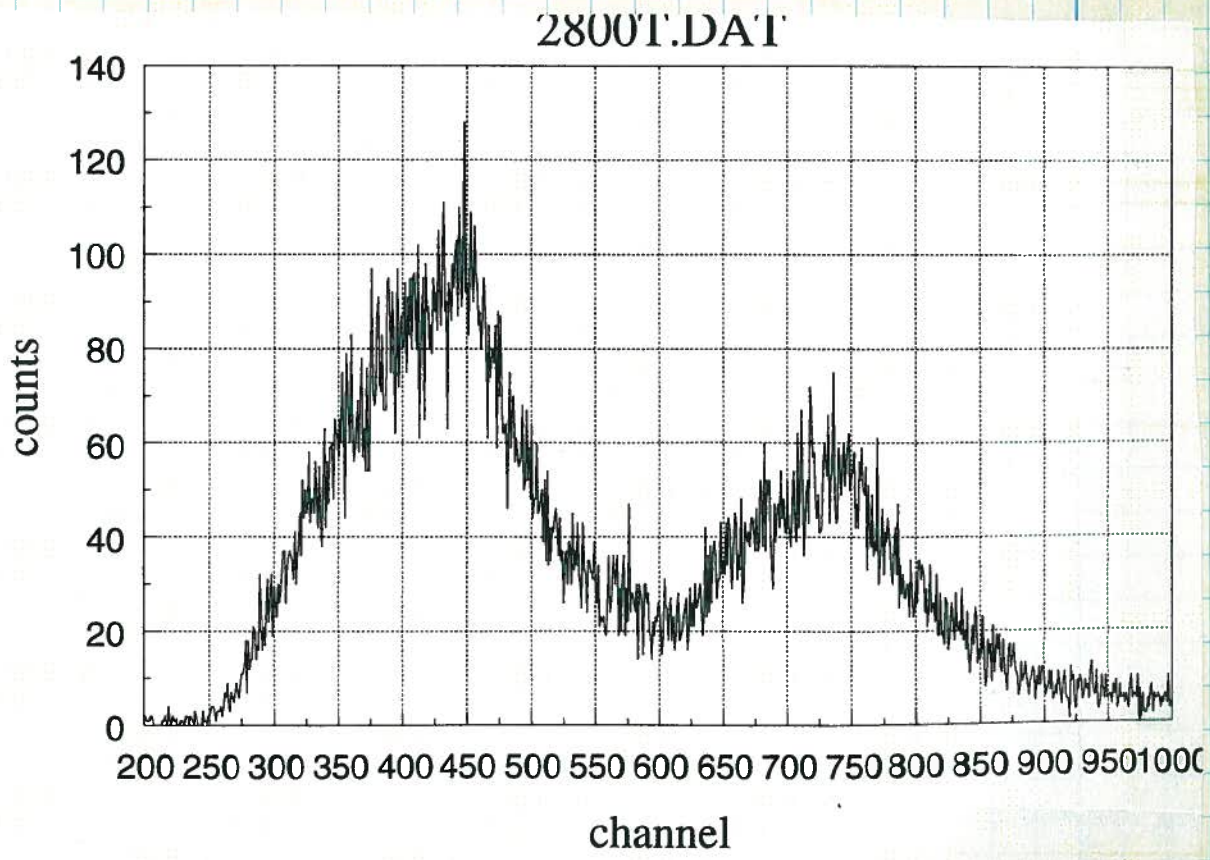





2600T.DAT
counts
channel
0
20
40
60
80
100
120
0
4000
8000
12000
16000

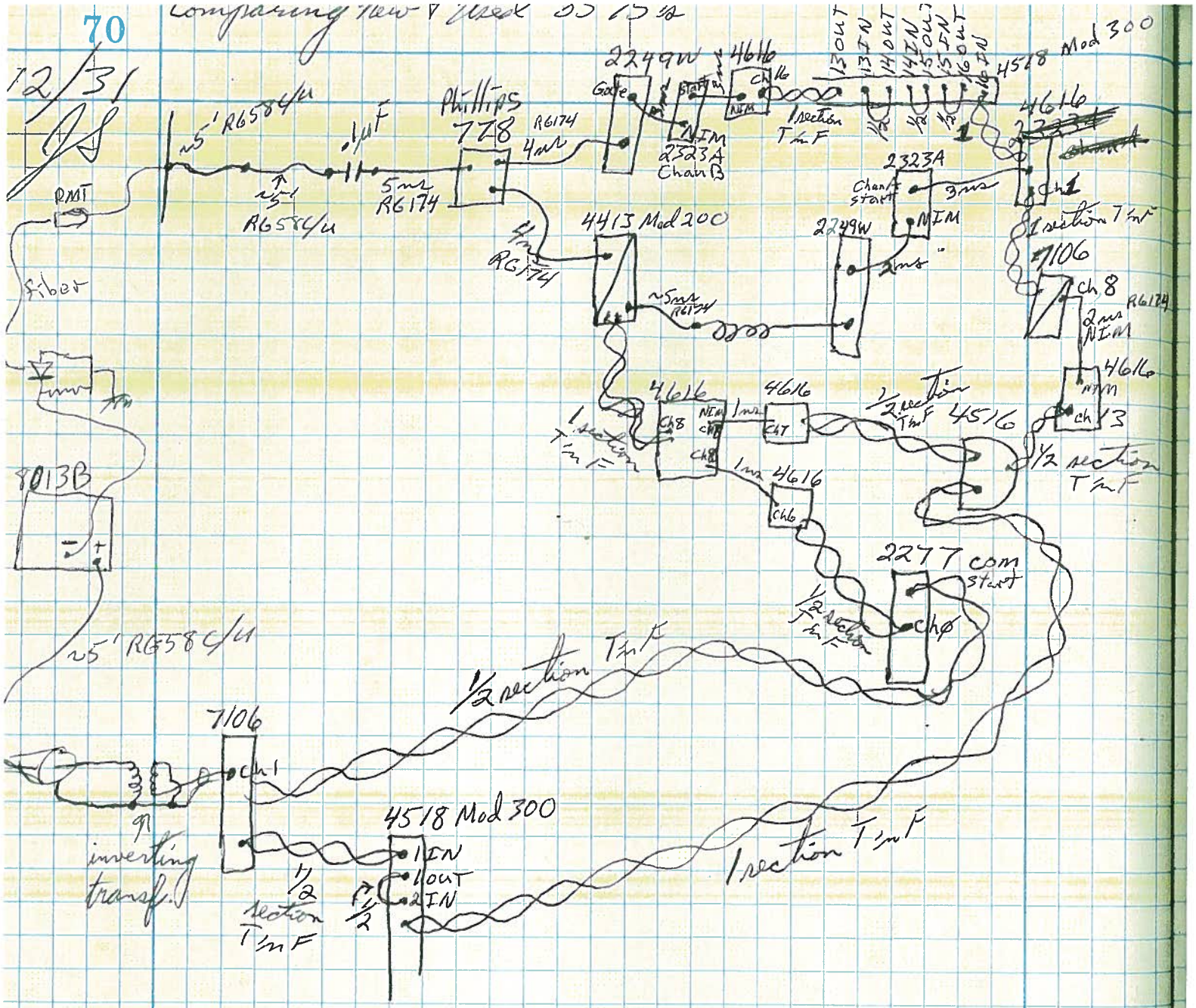

2600T.DAT
counts
channel
0
20
40
60
80
100
120
200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 9501000


2800T.DAT
counts
140
120
100
80
60
40
20
0
0
4000
8000
12000
1600
channel


2800T.DAT
counts
140
120
100
80
60
40
20
0
200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000
channel

12/31

Comparing new & used 8575



This is the way (above) I have the setup done as of today.

The print queue is down in the EEL. No pictures yet. (see p. 76 for scope pics)

I verified the gate timing for the ADCs.

I ran the new 8575 with ~175ns wide LED pulse and ~350ns wide LED pulse. The edge on the TDC spectrum of p. 58, and similar spectrums, at about 580 seems to be from the off edge of the LED pulse. This is a much more noticeable effect on the 8575 than the 8854, or so it appears from the spectrums taken.

Discriminator pulse width!

If this is an inconsequential feature of the setup I'm using move on to the afterpulsing of an older tube.

The two older tubes I was looking at cannot operate at an elevated voltage. Somewhere ~-2000V the anode is outputting a low DC current. Anode is at a small negative potential. I got a few more used tubes from room 122. The one I tested also ceased functioning above ~-1900V. At -1800V the TDC spectrum for "afterpulsing" is basically flat.

There is so much "noise" pulsing from this old tube as to make it completely unusable.

1/1/99 JS

Looking at the old 8575 I stripped all the black tape off of. I taped a Centro Vision BPW-34 photodiode to the glass of the 8575. ~-2000V is where the anode goes to ~-12 mV on 25 Ω (50Ω||50Ω). I can't see any direct current from the PD. Looking with Wavetek 10XL DMM.

Switching to measuring dynode voltages on the lower end of the chain. Voltage is to GND

I didn't record voltages at which "breakdown" occurred, not exact voltages.

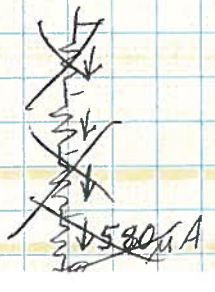
~~Last dynode~~	~-2000V	~-2000V	ΔV	
Last dynode (Dy 12)	115	87	28	⇒ 187 μA
Dy 11	229	195	34	
Dy 10	341	319	22	
Dy 9	450 (442)	449 (439)	1	

Voltage divider used is the type "O" for 12 stages from the Burle catalog. with R = 150K

1.4R = 215k and 4R = 560K

between Dy 2 + Dy 3 — between cathode & Dy 1

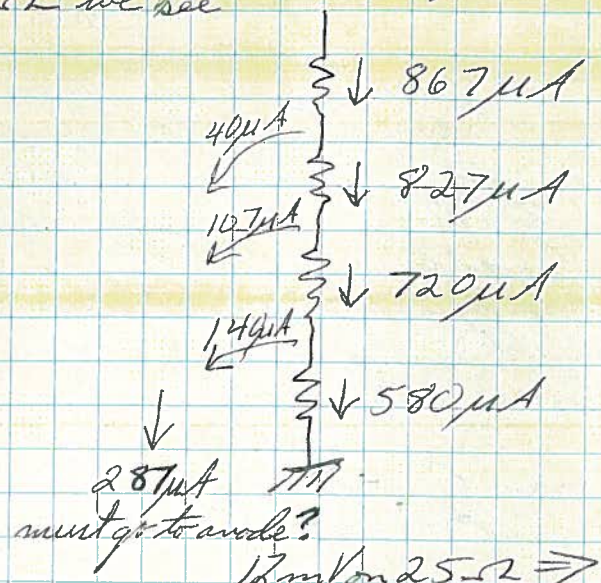
total divider is nominally 2.425 MΩ



12 mV on 25 Ω ⇒ 480 μA

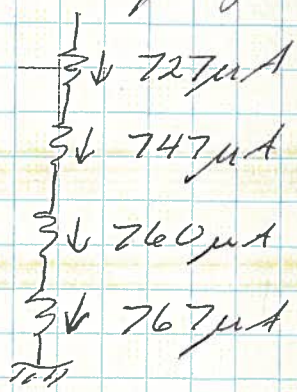
Burle specs are 200 μA max anode current!

From the dynode voltage measurements, when ~12mV on 25Ω we see



12mV on 25Ω ⇒ 480μA ?!?

Looking at voltages just prior to "breakdown"



currents are calculated from the difference in the voltage measurements at each dynode.

As the dynode voltage measurements were being made the PMT may have been becoming more "sensitive" to a "breakdown". Breaking down at a lower voltage each time would lead to the decreasing currents appearing above.

Burle Voltage Divider Configurations 1/2/99

From the Burle catalog

Table 1 - Voltage Divider Configurations From Burle catalog

No. Of Stages	Designation	Voltage Distribution K: Photocathode; FE: Focusing Electrode; Dy: Dynode; P: Anode																
		K	FE	Dy 1	Dy 2	Dy 3	Dy 4	Dy 5	Dy 6	Dy 7	Dy 8	Dy 9	Dy 10	Dy 11	Dy 12	Dy 13	Dy 14	P
6	A	2R	-	R	R	R	R	R	R	-	-	-	-	-	-	-	-	
8	B	R	R	R	R	R	R	R	R	R	R	-	-	-	-	-	-	
9	C	R	-	R	R	R	R	R	R	R	R	R	-	-	-	-	-	
10	D	2R	-	R	R	R	R	R	R	R	R	R	R	-	-	-	-	
	D1	2R	*	R	R	R	R	R	R	R	R	R	R	-	-	-	-	
	E	1.2R	-	1.2R	1.7R	R	R	R	R	R	R	R	R	-	-	-	-	
	F	1.1R	-	1.2R	1.7R	R	R	R	R	R	R	R	R	-	-	-	-	
	G	1.7R	-	1.3R	1.3R	R	R	R	R	R	R	R	R	-	-	-	-	
	H	1.8R	*	1.4R	1.5R	1.2R	R	R	R	R	R	R	R	-	-	-	-	
	I	2R	**	R	R	R	R	R	R	R	R	R	R	-	-	-	-	
	J	0.8R	1.2R	R	R	R	R	R	R	R	R	R	R	-	-	-	-	
	K	3R	-	R	R	R	R	R	R	R	R	R	R	-	-	-	-	
	L	3R	-	R	1.5R	R	R	R	R	R	R	R	R	-	-	-	-	
11	M	R	***	1.4R	R	R	R	R	R	R	R	R	R	R	-	-	-	
	N	R	-	R	R	R	R	R	R	R	R	R	R	R	-	-	-	
12	O	4R	*	R	1.4R	R	R	R	R	R	R	R	R	R	R	-	-	
	P	6R	*	R	1.4R	R	R	R	R	R	R	R	R	R	R	-	-	
14	Q	3R	**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	

* These tubes are designed with a focusing electrode. The resistance (voltage) should be varied to give maximum anode current.

** It is recommended that the focusing electrode be operated at the same potential as Dynode No.1.

*** Aperture Plate is connected to photocathode potential.

1/26
1/25
JA

Re-established the setup.
Looking against tube S/N U34636, the new tube used on previous pages. 8575 from Burle. Tube can go to ~2500V without problems.

S/N N31827
Can get to ~2160V. ~25 mV on anode.
When turn back to 1660V get ~12 mV off the anode

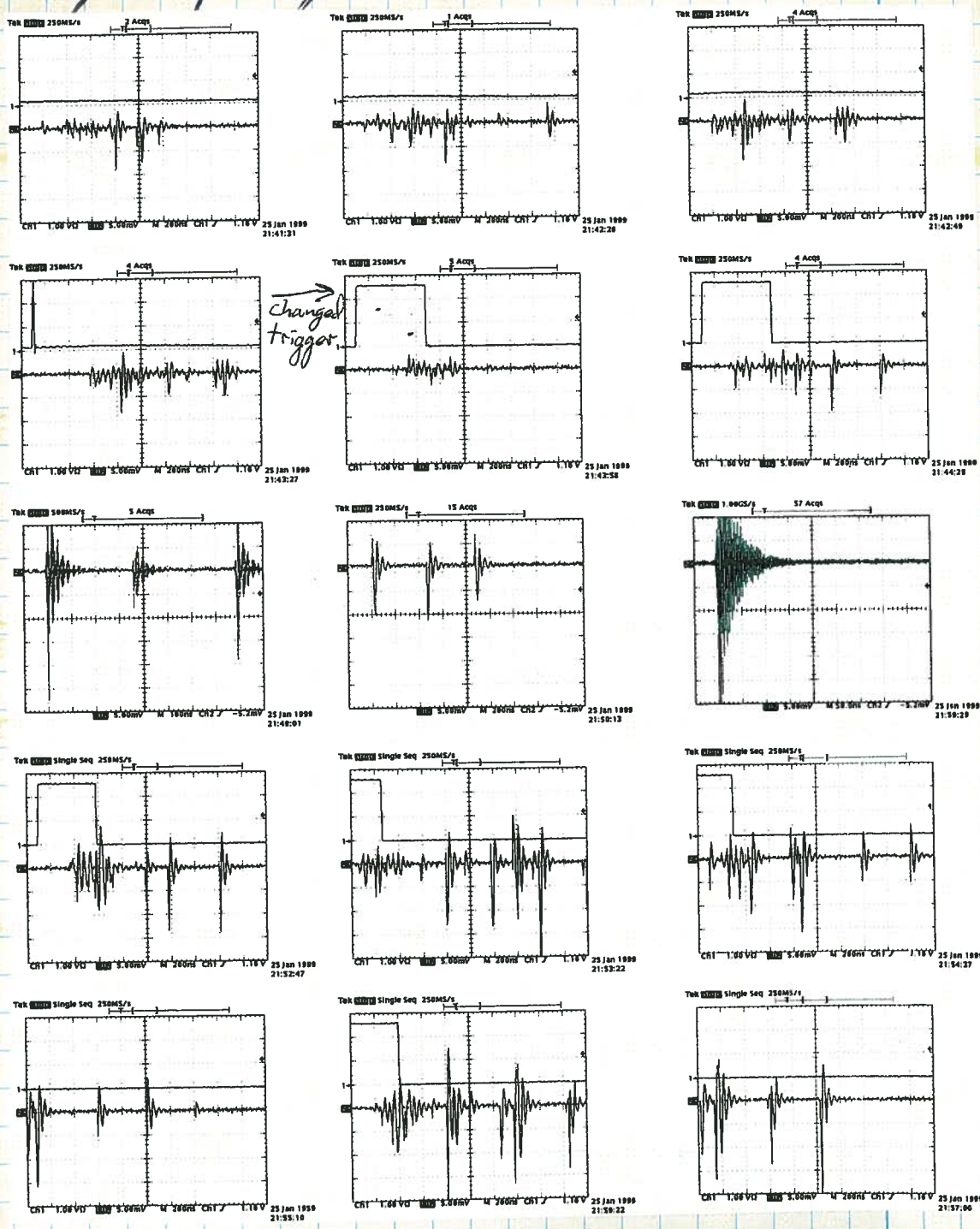
S/N N30429
At 2160V get ~30 mV off the anode. It was unstable. Dropped to ~10 mV. Reduced voltage to 1160 and brought up to 1660. ~10 mV off the anode. Turned HV off. Back up to 1560V. "Stable". At 1630V things were clearly less stable. After a minute the anode voltage dropped to a DC value of ~15 mV. By increasing the ON period of the LED (increase pulse width) I pushed it over the edge. I had turned HV down to 1330V and then back up to 1630V. It was stable for a bit. Dropped to ~15 mV off anode after I increased pulse width. After playing at this a bit more I have demonstrated to my satisfaction that this is true.

S/N 292P5
At ~~[illegible]~~ ~1640V get ~~[illegible]~~ ~3 mV off the anode. Try again. Same. Increasing voltage and anode voltage drops slightly. Off at ~1740 it drops to ~7 mV. Unstable. This tube also shows sensitivity to pulse width & rep rate.

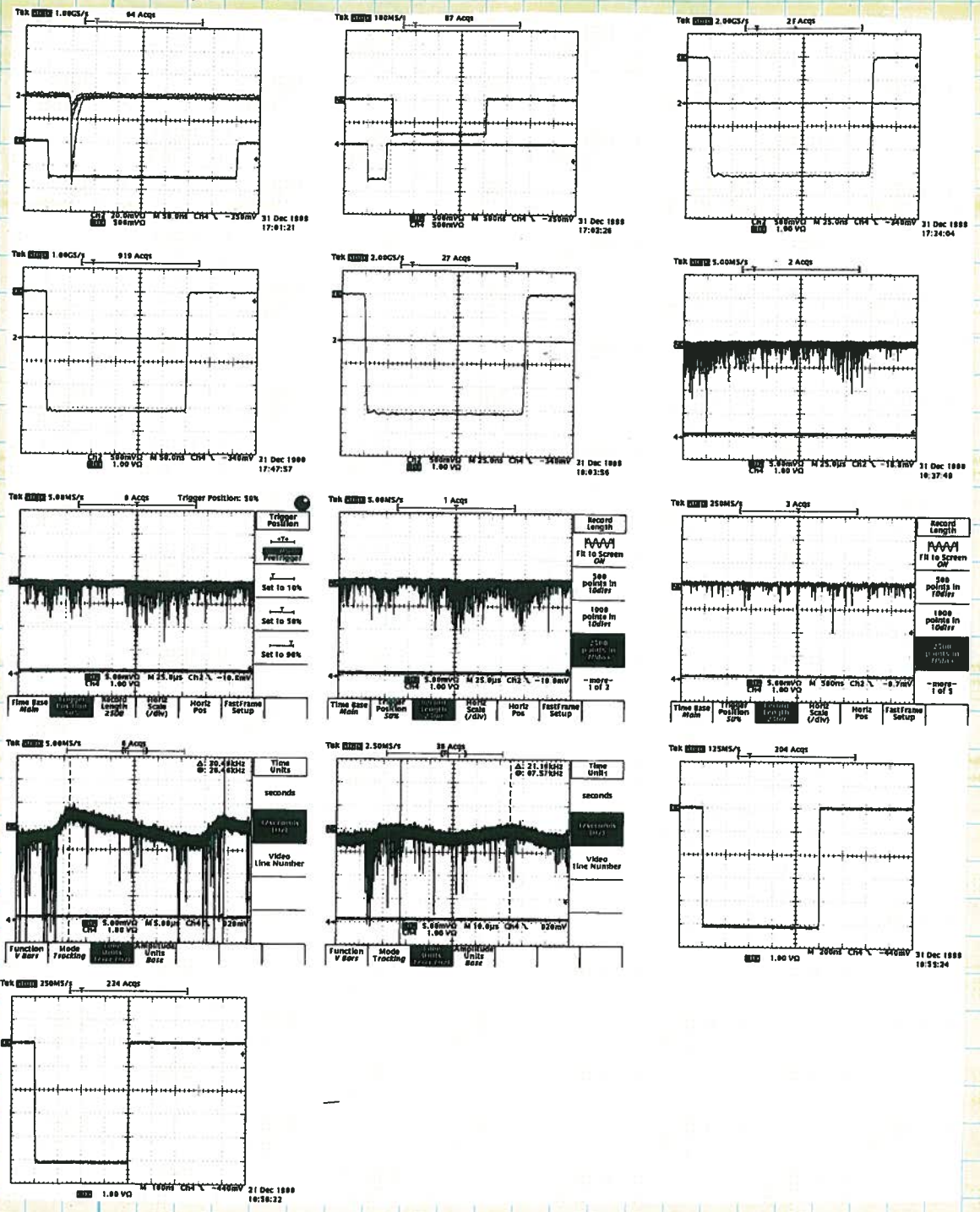
S/N C06343 3
At ~2120 I see signs of what seems to be discharges in the tube. At 2300V have some pretty small, ratty looking pulses. Saved some Tscope pictures at 2600V and pulse width as can be seen on the pics.

S/N C063682
Similar behavior to the above tube. At 2200V I played a bit. I can force constant stream of pulses by varying pulse width & frequency, but the tube anode voltage does not go to a DC value.

These pictures are from tube CQ63433
Pics 1 thru 4 are triggered off the trig out of the HP pulser. Pics 5 and on are triggered off the "+" output of the pulser.



1/26 Pictures From 12/31/98 p. 70
JS Scope pictures all taken.

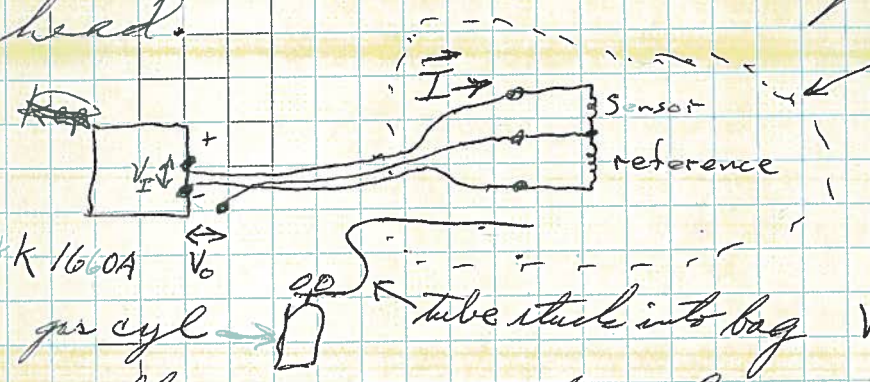


The TDC pictures are not included. It's been long enough time that I don't recall what they were each about.

Crowcon Gas Sensor Sensitivity to He 1/29/99

Crowcon DI 9 sensor
ION Science Gas-Check B4 leak detector

Looking in a copy of the Instruction Manual for Gasmaster Systems I see a note, presumably from Howard, the I ≈ 350 mA through the sensor head.



V_I measured with Wavetek 10XL
V_o measured with Fluke 8060A

With I ≈ .35 A the readings settle to

I	V_I	V_o	ION	
.35	2.73	1.388	0×10^2	
.35	2.73	1.387	9×10^2	
.35	2.73	1.387	1×10^3	
.35	2.49	1.21	off scale	~6:39 30
	2.57	1.26		
	2.62	1.30		6:42 05
	2.64	1.31	took to high bay reset	6:43
	2.66	1.327	still goes off scale	6:46 10 I.
	2.67	1.337	still goes off scale	
	2.71	1.36	still goes off scale	
				flush hole bag out w/ air
.35	2.74	1.388	$0 \times 10^5 + 0 \times 10^2$	
	~~2.73~~	~~1.378~~		← put more He in
	2.73	1.378	goes off scale	
.35	2.73	1.379	still goes off scale (after a couple min wait)	
			← full He flush	
	2.06	.905		7:03
	2.73	1.38		7:25
	2.74	1.387		7:44

V_I	V_o	
2.74	1.385	
2.74	1.388	← N_2 flush till ~100% N_2
2.75	1.391	high point ~1 min later
2.74	1.384	~1.5 min later (2.5 min after flush)

Dot the cylinder of calibration gas from the gas shed.
(2.43% Methane 199PPM CO_2)

2.74	1.384	← just before turn calibration cyl on
2.79	1.375	~ 1/2 min
2.78	1.375	~ 1 min
2.73	1.386	calibration cylinder removed & sensor allowed to settle

More Used 8575's 1/30

Looking at more of the old 8575's

S/N N30947
a very small DC output @ ~2600V ~2mV
seems to switch at ~1600V

S/N N30923
~3mV DC @ ~1560V
at ~1500V increasing LED pulse width
causes output to go to ~5mVDC

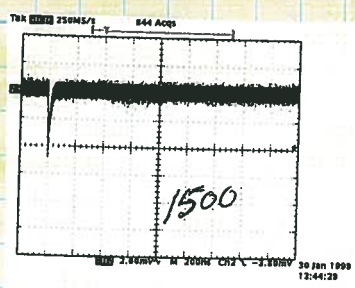
S/N N27496
~4mVDC @ ~1650
at 1500V LED gives pulses ~1mV high when
set to ~200μs width
put Sr90 & spray scint in front of tube. At
1500V get ~4mV (up to) pulse out of tube.
Went to DC output @ ~1700V. On AC
coupling I see no pulses.
pics @ 1500, 1540, 1540, 1540 on 10s persistence

S/N N27488
@ ~1500 get ~8mV from Sr + scint.
@ ~20 more volts get breakdown (pic)
settled down (pic) same HV. Went back & forced
breakdown again. Broke down in "settled"
condition

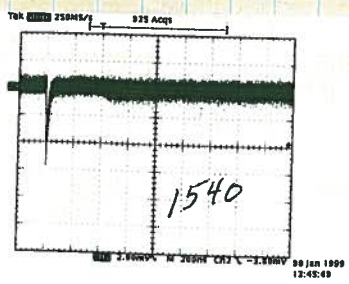
S/N C063682 used on p. 74
@ ~2000V took some pics. Last shows the
ringing on initial pulse
@ 2300V pic of 10s persist. + pic @ 2600V

S/N U34636 ("new" tube 11/10/92)
pics @ 2600V
pics @ 1500V, 1600, 1700, 1800, 1900, 2000, 2500

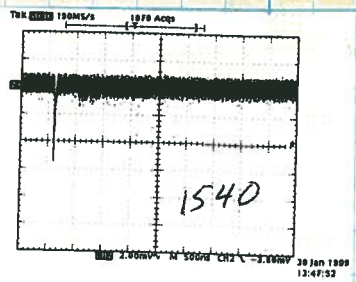
Broke open S/N N27488 to look at the dynodes.
I did not notice anything significant about
the surface appearance of the dynodes.



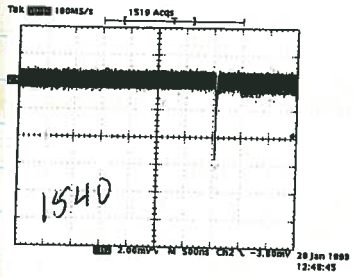
1500



1540



1540



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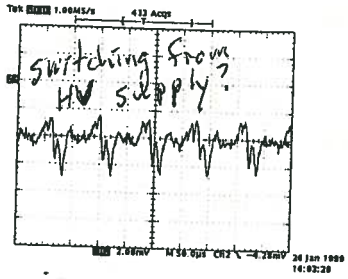
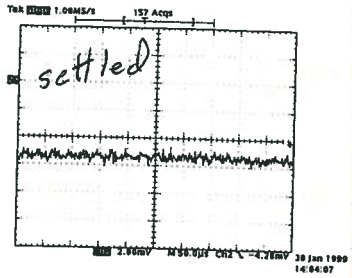
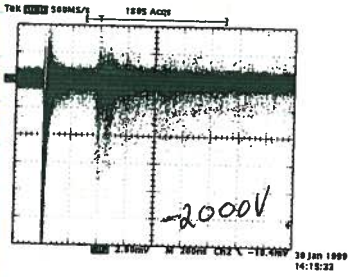


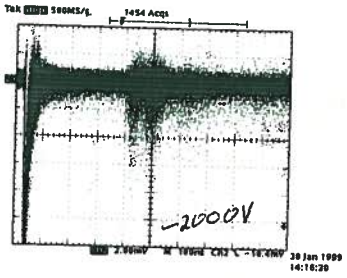
switching from HV supply?



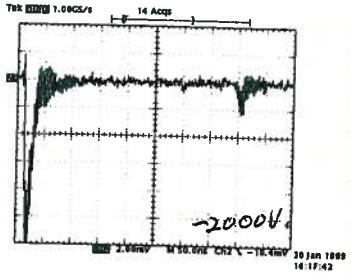
settled



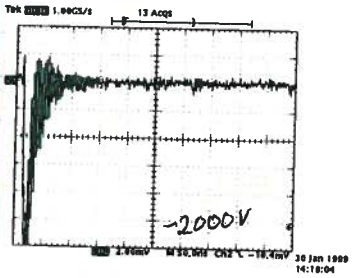
-2000V



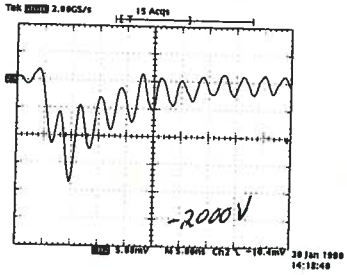
-2000V



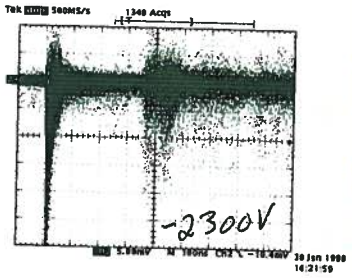
-2000V



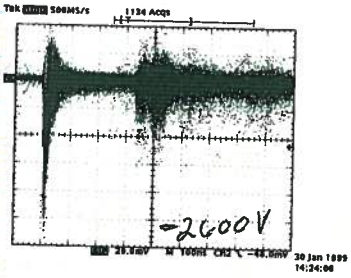
-2000V



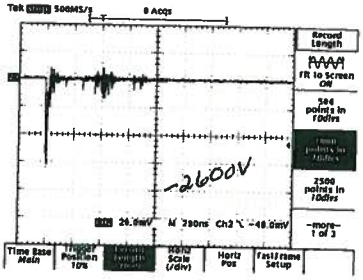
-2000V



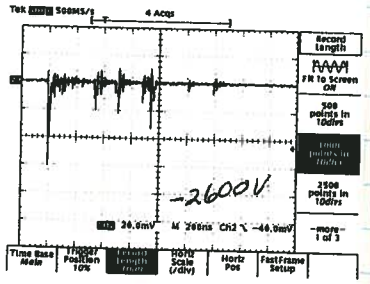
-2300V



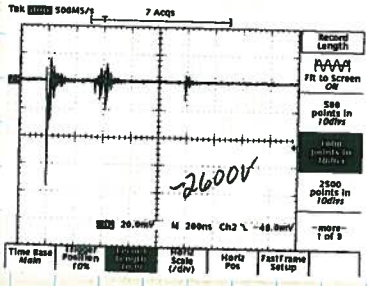
-2600V



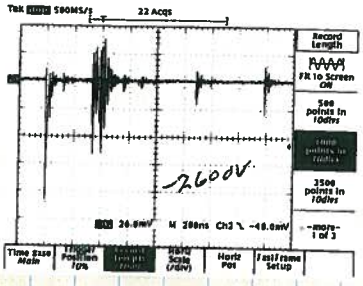
-2600V



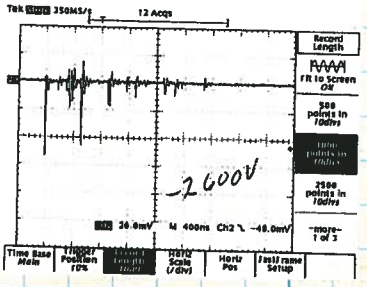
-2600V



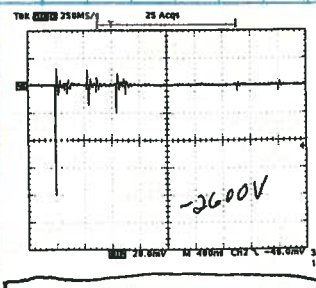
-2600V

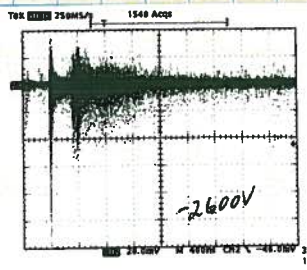


-2600V.

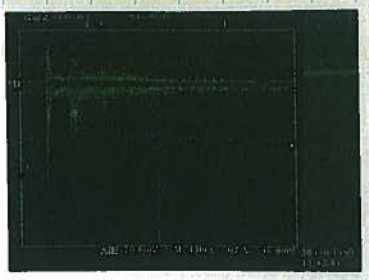


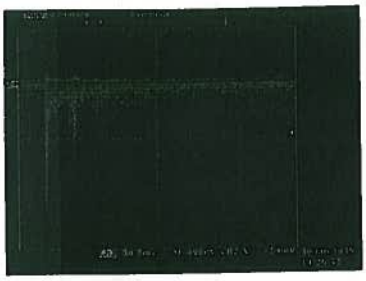
-2600V

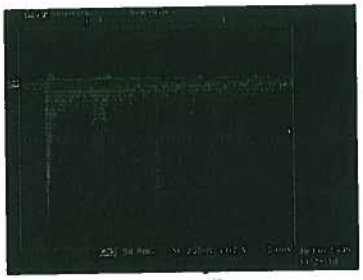


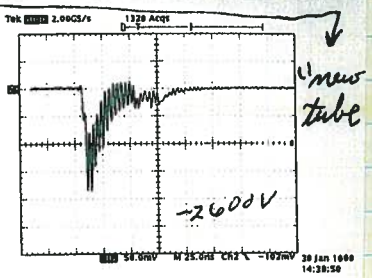


-2600V

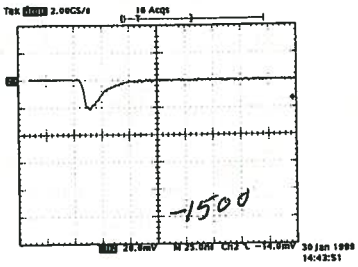


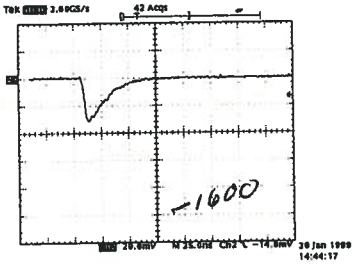


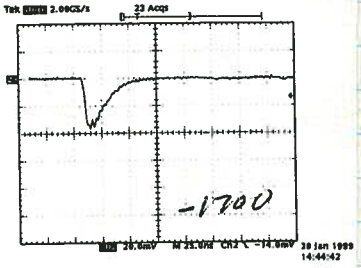


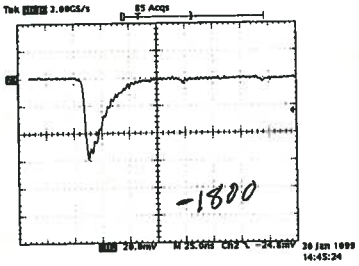


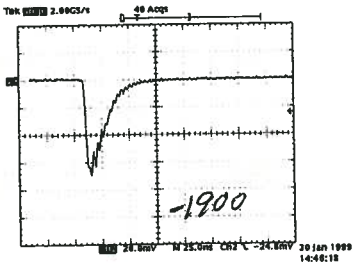
"new tube

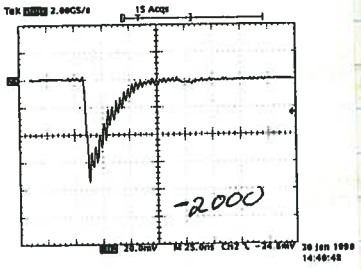


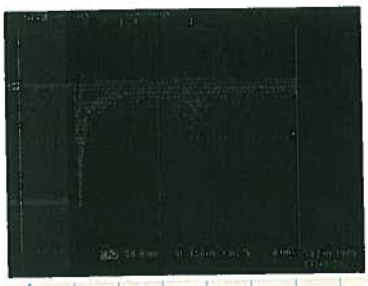












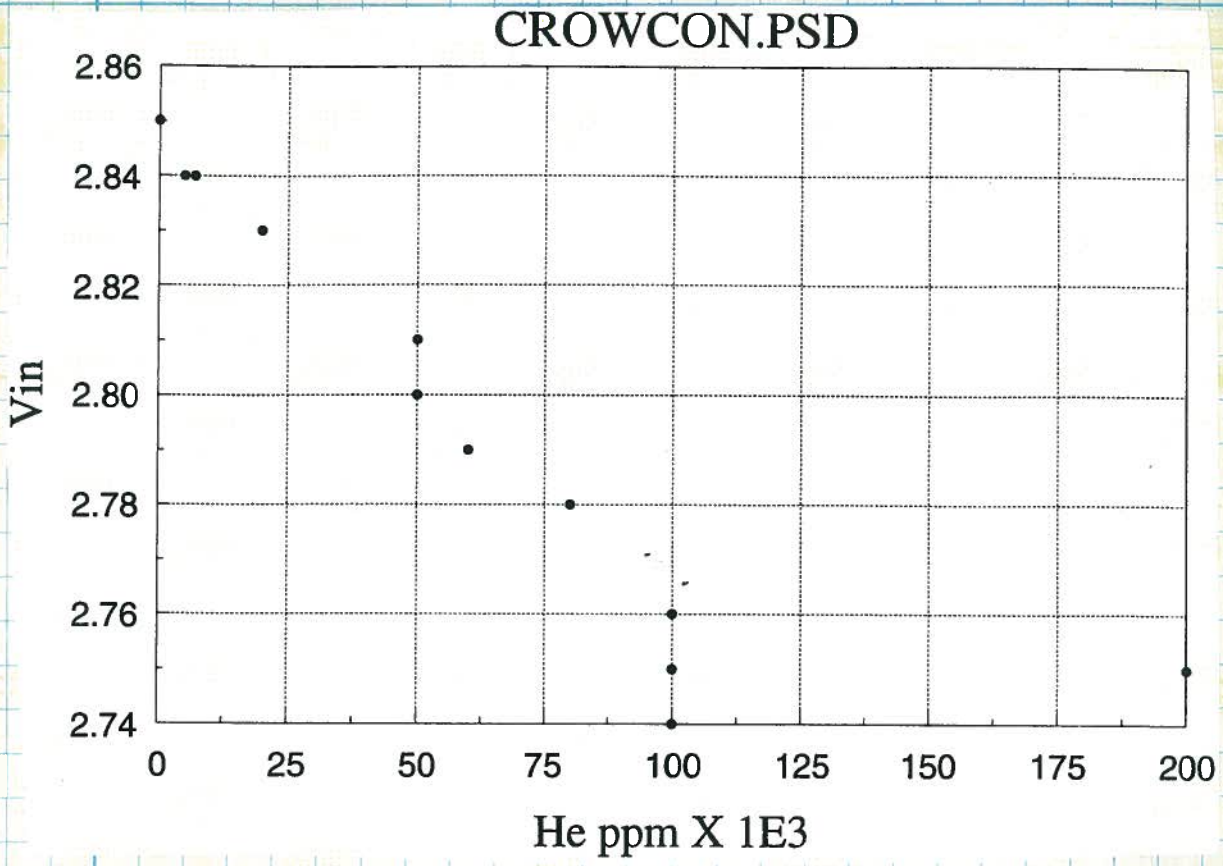
-2500V

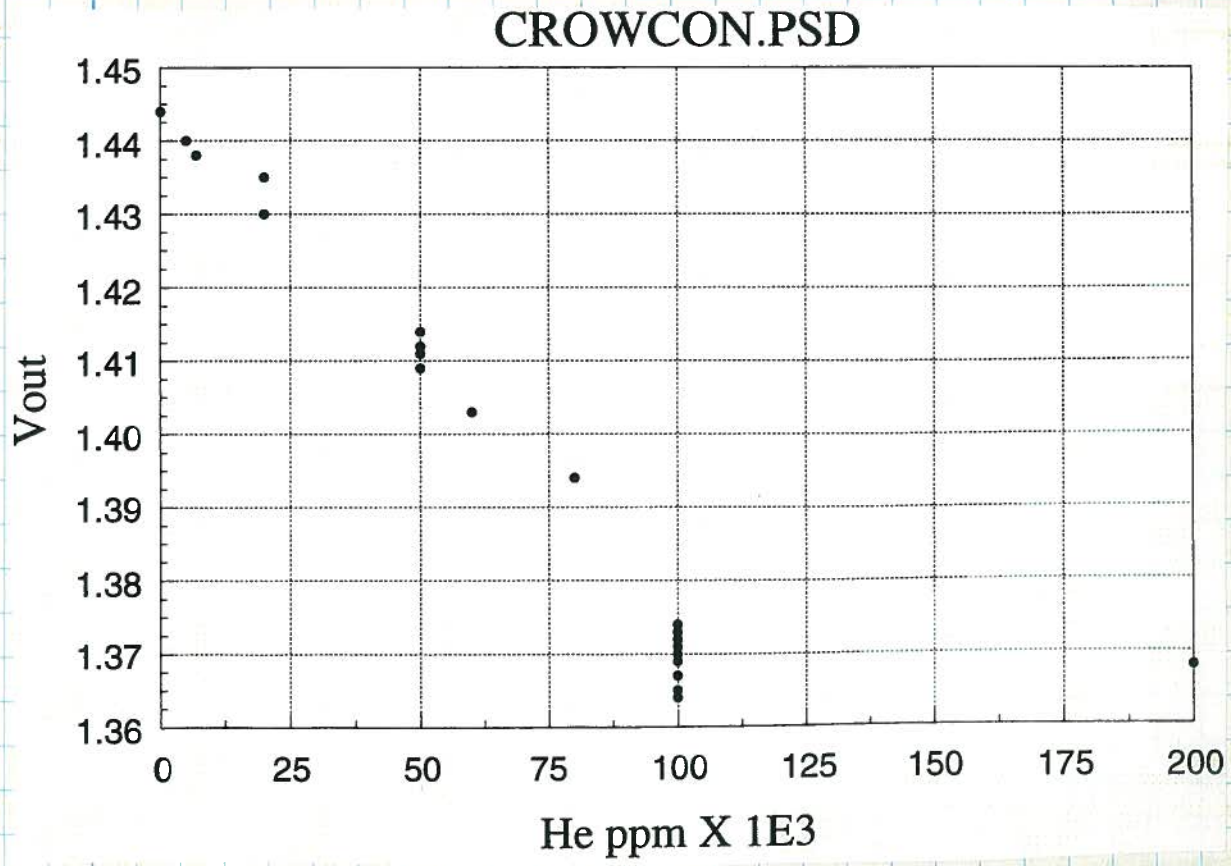
Crowcon Sensitivity to He Again

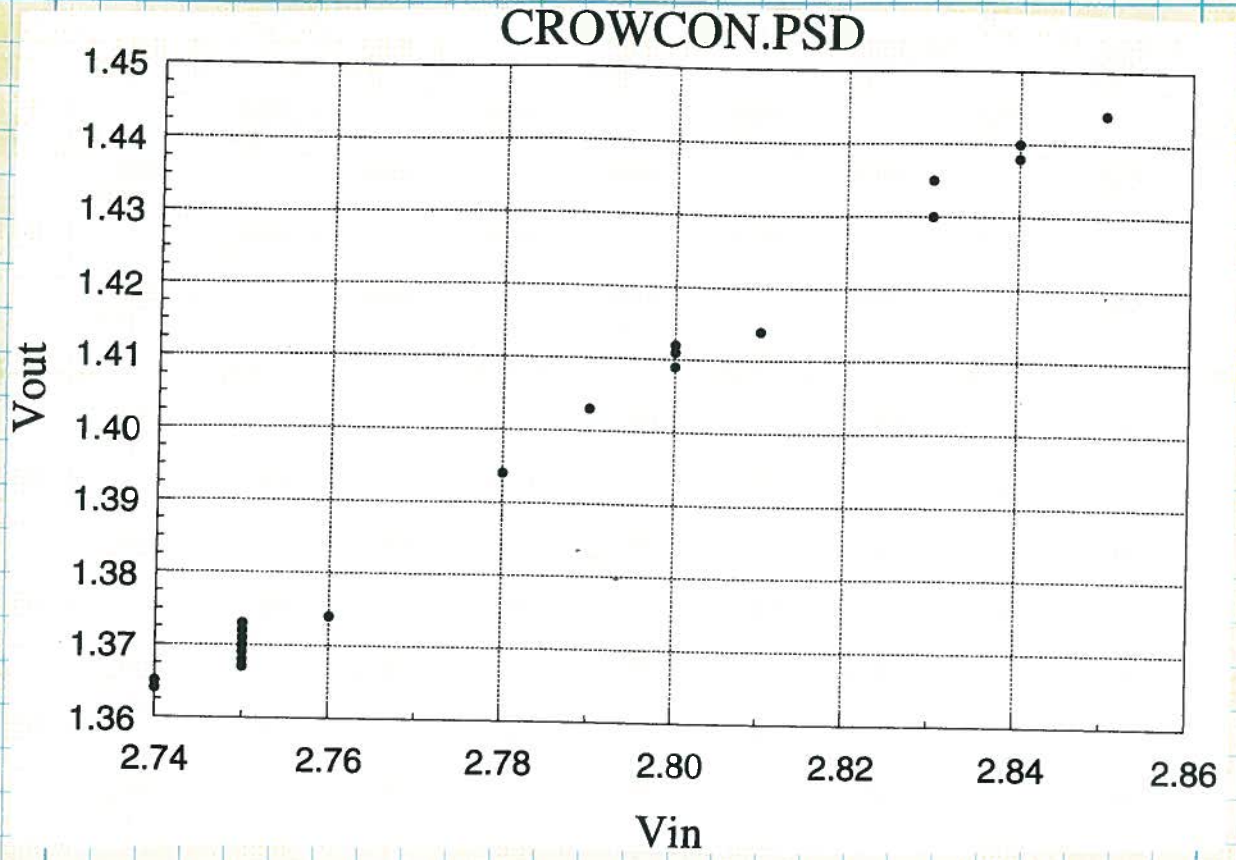
Trying to get the Crowcon sensitivity in a region the ION leak tester seems to work. Instead of sticking a tube end into the plastic bag and blowing in some He, it blew in too much, I will fill a smaller bag with He and place it in the larger bag with the Crowcon.

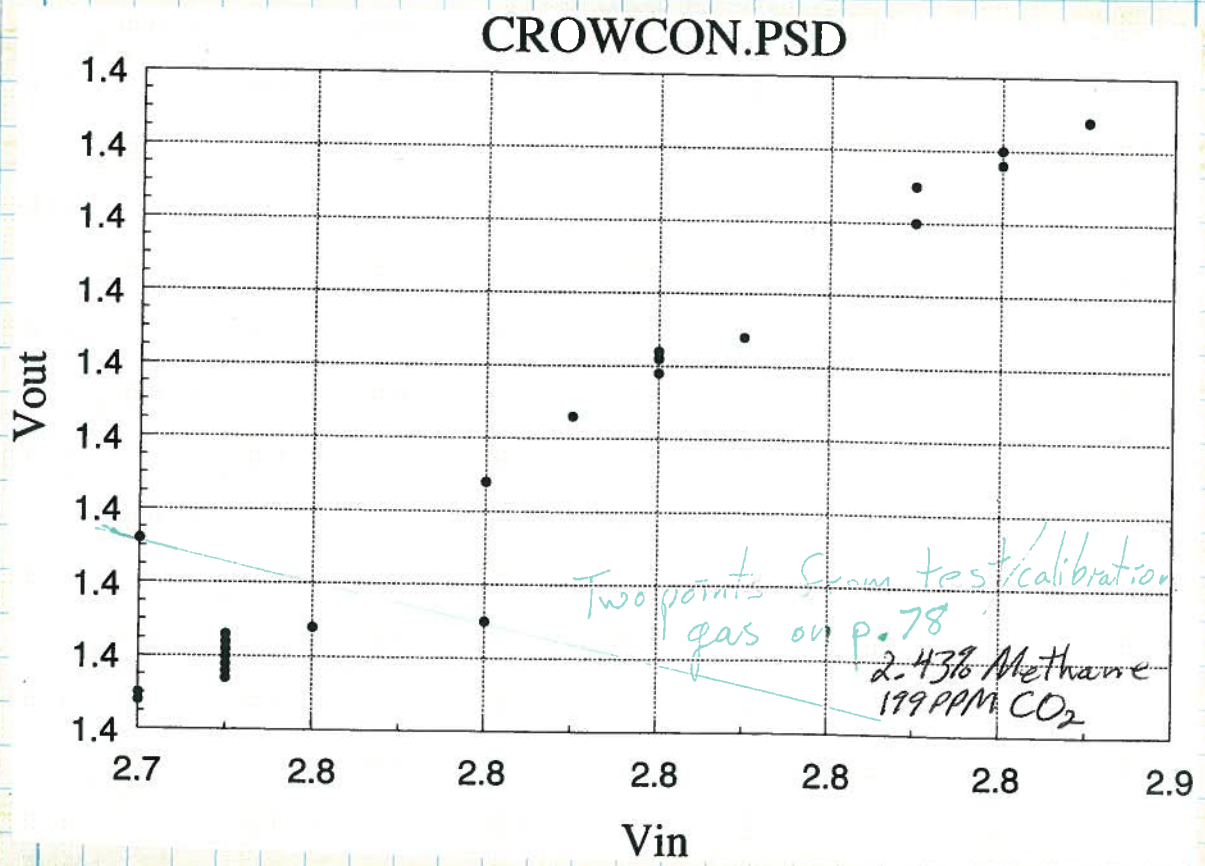
Three Wavetek 10X's are setup to measure the current, V_I & V_o.
After being allowed to settle for a little while

I	V_I	V_o	ION
.35	2.85	1.444	Zeroed
.35	2.83	1.435	2×10^4
.35	2.84	1.438	7×10^3
.35	2.84	1.446	5×10^3
			filled the small bag up a bit more & put in big bag
.35	2.80	1.412	5×10^4
	2.82	1.430	2×10^4
			added more He
	2.78	1.394	8×10^4
	2.79	1.403	6×10^4
	2.80	1.409	5×10^4
	2.81	1.414	5×10^4
			added more He
	2.75	1.368	2×10^5
	2.74	1.365	1×10^5
	2.74	1.364	1×10^5
	2.75	1.367	1×10^5
	2.75	1.369	1×10^5
		1.370	
		1.371	
		1.372	
		1.373	
.35	2.76	1.374	1×10^5
			let some escape
	2.80	1.411	5×10^4


CROWCON.PSD
Vin
2.86
2.84
2.82
2.80
2.78
2.76
2.74
0
25
50
75
100
125
150
175
200
He ppm X 1E3


CROWCON.PSD
Vout
1.45
1.44
1.43
1.42
1.41
1.40
1.39
1.38
1.37
1.36
0
25
50
75
100
125
150
175
200
He ppm X 1E3


CROWCON.PSD
Vout
1.45
1.44
1.43
1.42
1.41
1.40
1.39
1.38
1.37
1.36
2.74
2.76
2.78
2.80
2.82
2.84
2.86
Vin


CROWCON.PSD
Vout
1.4
1.4
1.4
1.4
1.4
1.4
1.4
1.4
1.4
1.4
2.7
2.8
2.8
2.8
2.8
2.8
2.9
Vin
Two points from test/calibration gas on p.78
2.43% Methane
199PPM CO_2

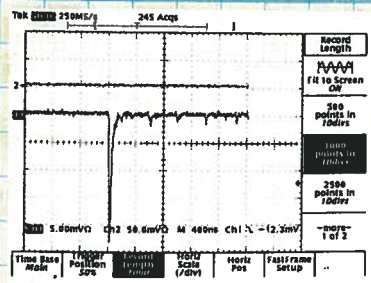
Afterpulsing in Pb-glass of PS & TA 2/5/99

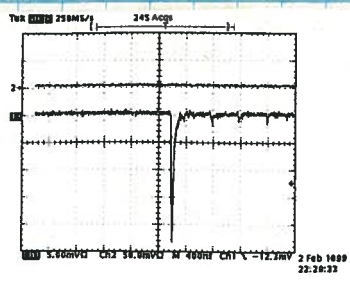
Last night I went up on the ~~electron~~ arm to look for afterpulsing on the ~~electron~~ pres lower leadglass detector. I had gone up on the 1st and looked at 51, 52 and the TA absorber. 1 tube in each.

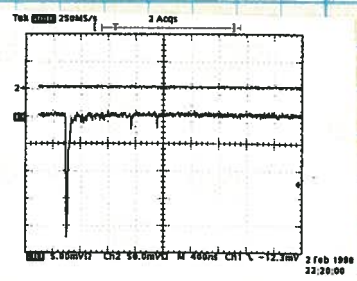
I looked at a few R3036 tubes on the right, high momentum side of the PS.

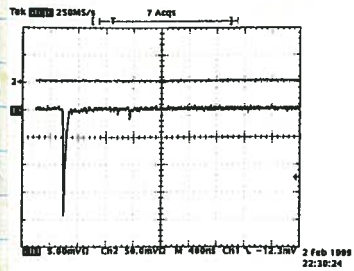
Afterpulsing was evident. Triggering off the cosmic background signals from the tubes.

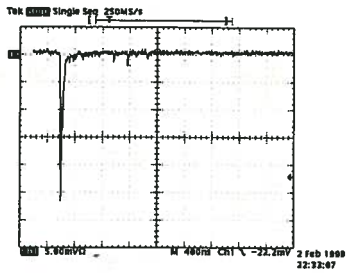
At first I checked about the first 50 or so tubes at their operating (normal) voltages. The afterpulsing is notable at the 1mV/div setting. This is not as high a gain tube as the 8854. It's rated around 1×10^6 or so.

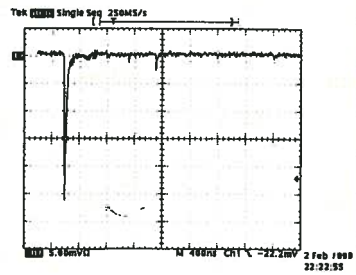

Tek Stop 250MS/s
245 Acqs
Record Length
Fit to Screen Off
500 points in 10div/div
2500 points in 10div/div
more 1 of 2
Ch1 5.00mV
Ch2 50.0mV
M 400ns Ch1 -12.3mV
Time Base Main
Trigger Position 50%
Horiz Scale (/div)
Horiz Pos
Fast/Frame Setup

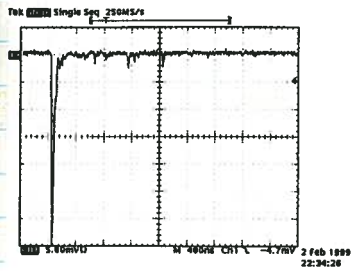

Tek Stop 250MS/s
245 Acqs
Ch1 5.00mV
Ch2 50.0mV
M 400ns Ch1 -12.3mV
2 Feb 1999
22:20:33

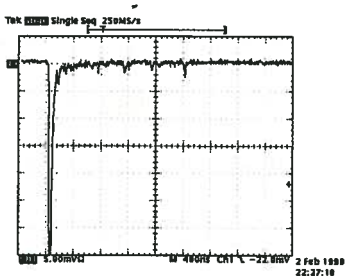

Tek Stop 250MS/s
2 Acqs
Ch1 5.00mV
Ch2 50.0mV
M 400ns Ch1 -12.3mV
2 Feb 1999
22:20:00

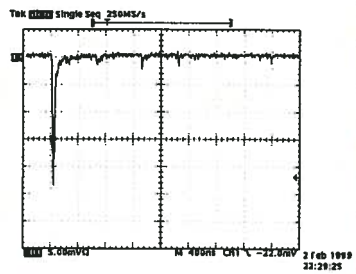

Tek Stop 250MS/s
7 Acqs
Ch1 5.00mV
Ch2 50.0mV
M 400ns Ch1 -12.3mV
2 Feb 1999
22:30:24

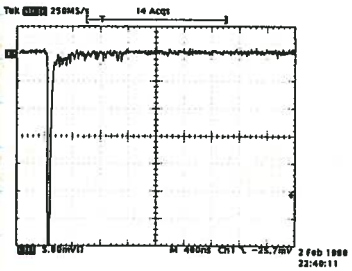

Tek Stop Single Seq 250MS/s
Ch1 5.00mV
M 400ns Ch1 -22.1mV
2 Feb 1999
22:32:07

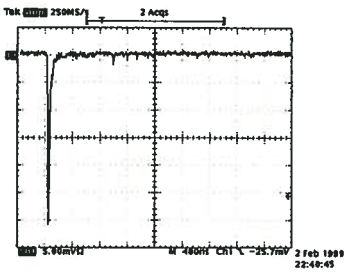

Tek Stop Single Seq 250MS/s
Ch1 5.00mV
M 400ns Ch1 -22.1mV
2 Feb 1999
22:22:55

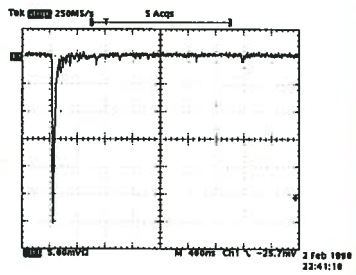

Tek Stop Single Seq 250MS/s
Ch1 5.00mV
M 400ns Ch1 -4.7mV
2 Feb 1999
22:34:26

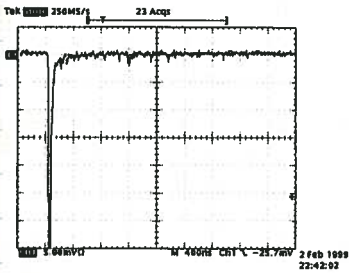

Tek Stop Single Seq 250MS/s
Ch1 5.00mV
M 400ns Ch1 -22.1mV
2 Feb 1999
22:37:10

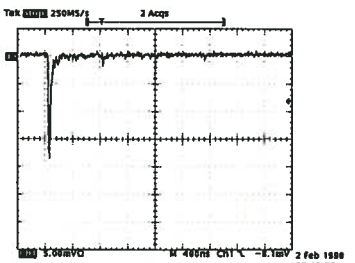

Tek Stop Single Seq 250MS/s
Ch1 5.00mV
M 400ns Ch1 -22.1mV
2 Feb 1999
22:29:25

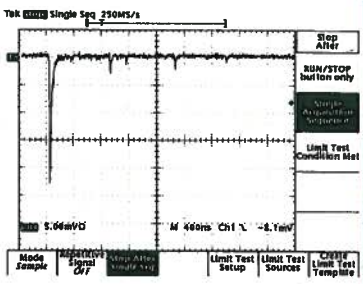

Tek Stop 250MS/s
14 Acqs
Ch1 5.00mV
M 400ns Ch1 -25.7mV
2 Feb 1999
22:40:11

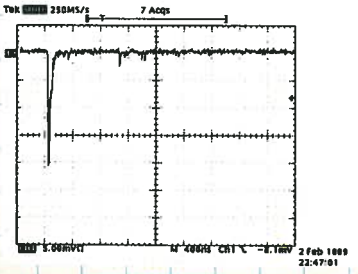

Tek Stop 250MS/s
2 Acqs
Ch1 5.00mV
M 400ns Ch1 -25.7mV
2 Feb 1999
22:40:45


Tek Stop 250MS/s
5 Acqs
Ch1 5.00mV
M 400ns Ch1 -25.7mV
2 Feb 1999
22:41:10

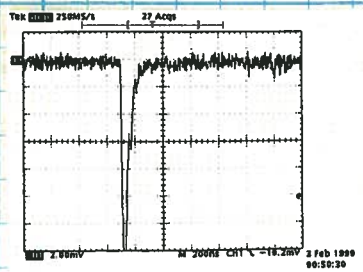

Tek Stop 250MS/s
23 Acqs
Ch1 5.00mV
M 400ns Ch1 -25.7mV
2 Feb 1999
22:42:02

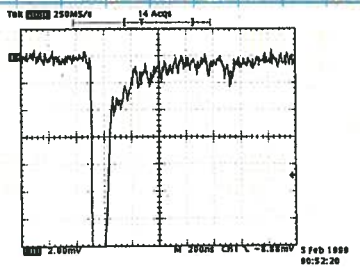

Tek Stop 250MS/s
2 Acqs
Ch1 5.00mV
M 400ns Ch1 -8.1mV
2 Feb 1999
22:42:52

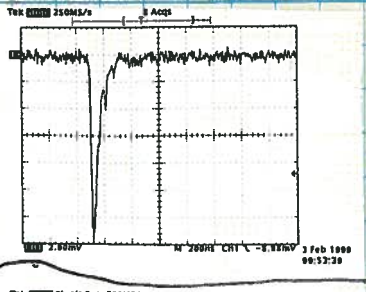

Tek Stop Single Seq 250MS/s
Stop After
RUN/STOP button only
Limit Test Condition Met
Ch1 5.00mV
M 400ns Ch1 -8.1mV
Mode Sample
Acquisition Signal Off
Stop After Single Seq
Limit Test Setup
Limit Test Sources
Create Limit Test Template

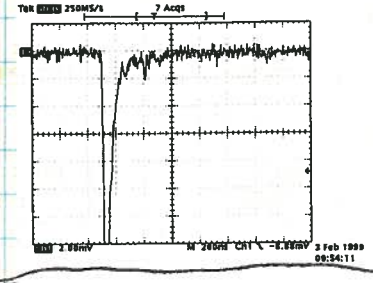

Tek Stop 250MS/s
7 Acqs
Ch1 5.00mV
M 400ns Ch1 -8.1mV
2 Feb 1999
22:47:01

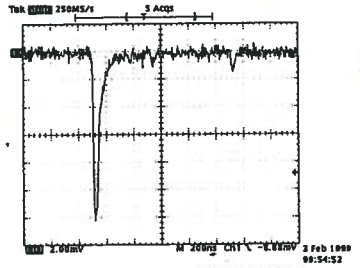
TA91
@1800V

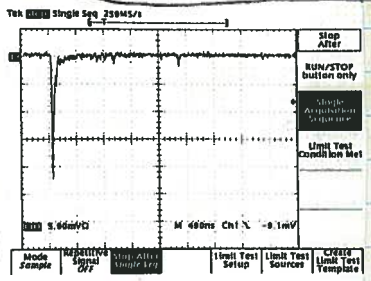

Tek Stop 250MS/s
22 Acqs
Ch1 2.00mV
M 200ns Ch1 ∖ -10.2mV
2 Feb 1999
00:50:30

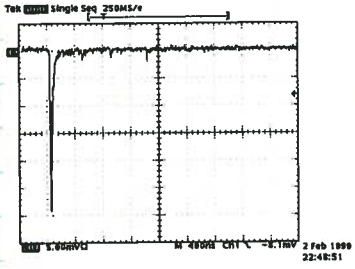

Tek Stop 250MS/s
14 Acqs
Ch1 2.00mV
M 200ns Ch1 ∖ -8.00mV
2 Feb 1999
00:52:20

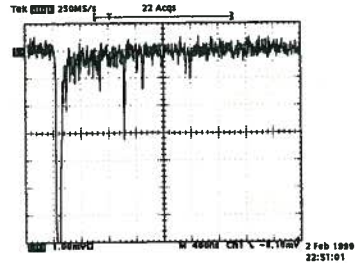

Tek Stop 250MS/s
3 Acqs
Ch1 2.00mV
M 200ns Ch1 ∖ -8.00mV
2 Feb 1999
00:53:39

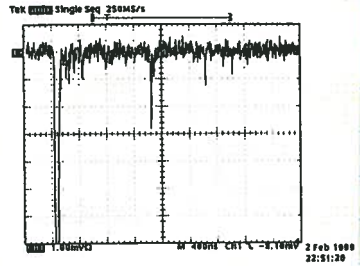

Tek Stop 250MS/s
7 Acqs
Ch1 2.00mV
M 200ns Ch1 ∖ -8.00mV
3 Feb 1999
00:54:11

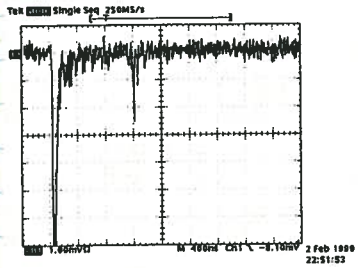

Tek Stop 250MS/s
5 Acqs
Ch1 2.00mV
M 200ns Ch1 ∖ -8.00mV
2 Feb 1999
00:54:52

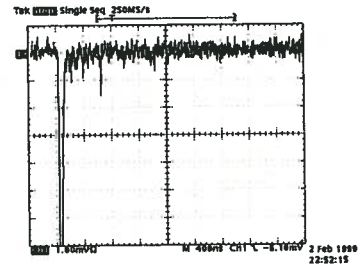

Tek Single Seq 250MS/s
Stop After
RUN/STOP button only
Single Acquisition Sequence
Limit Test Condition Met
Ch1 5.00mV(?)
M 400ns Ch1 ∖ -8.1mV
Mode Sample
Repetitive Signal Off
Stop After Single Seq
Limit Test Setup
Limit Test Sources
Create Limit Test Template

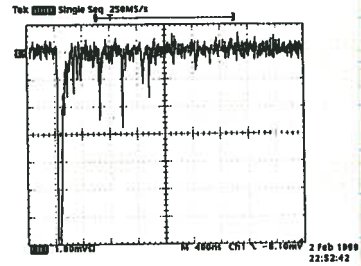

Tek Single Seq 250MS/s
Ch1 5.00mV(?)
M 400ns Ch1 ∖ -8.1mV
2 Feb 1999
22:48:51

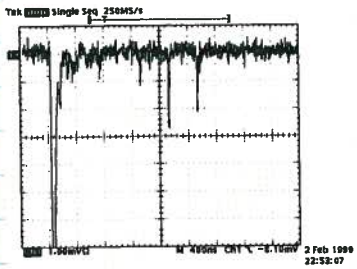

Tek Stop 250MS/s
22 Acqs
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:51:01

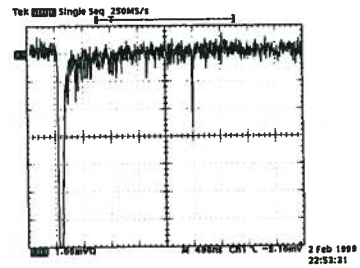

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:51:20

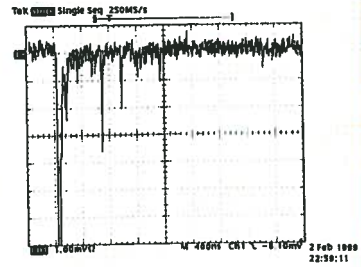

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:51:53

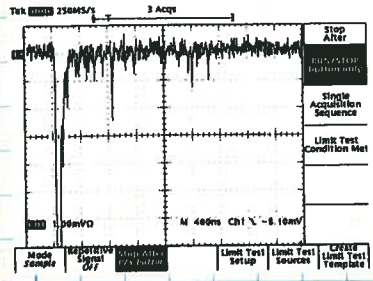

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:52:15

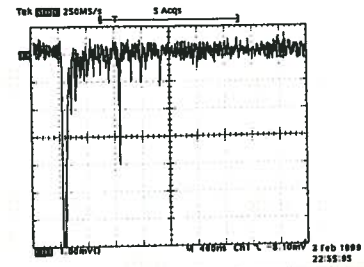

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:52:42

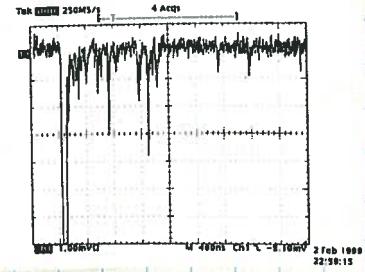

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:52:07


Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:52:31

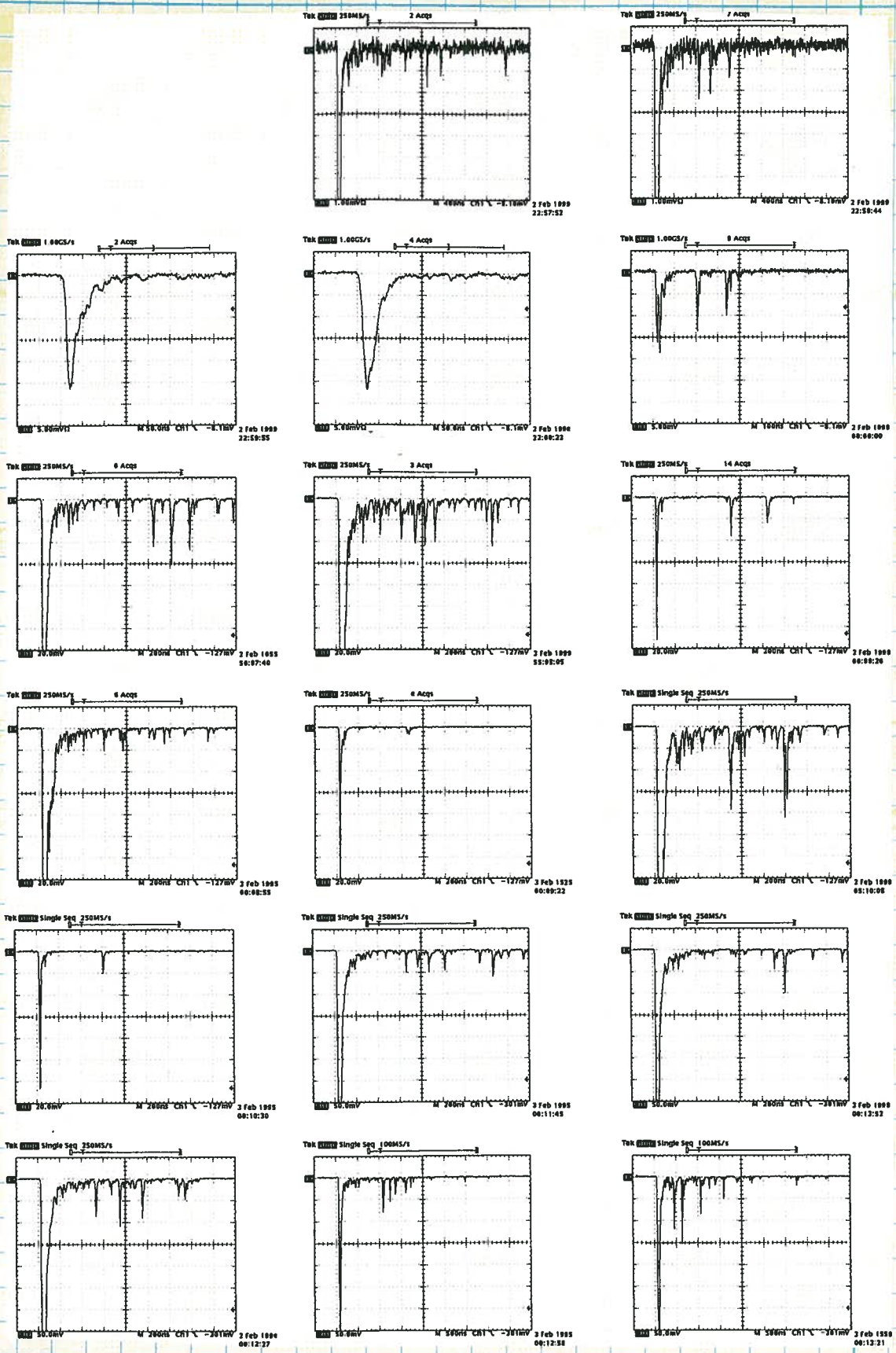

Tek Single Seq 250MS/s
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:50:11

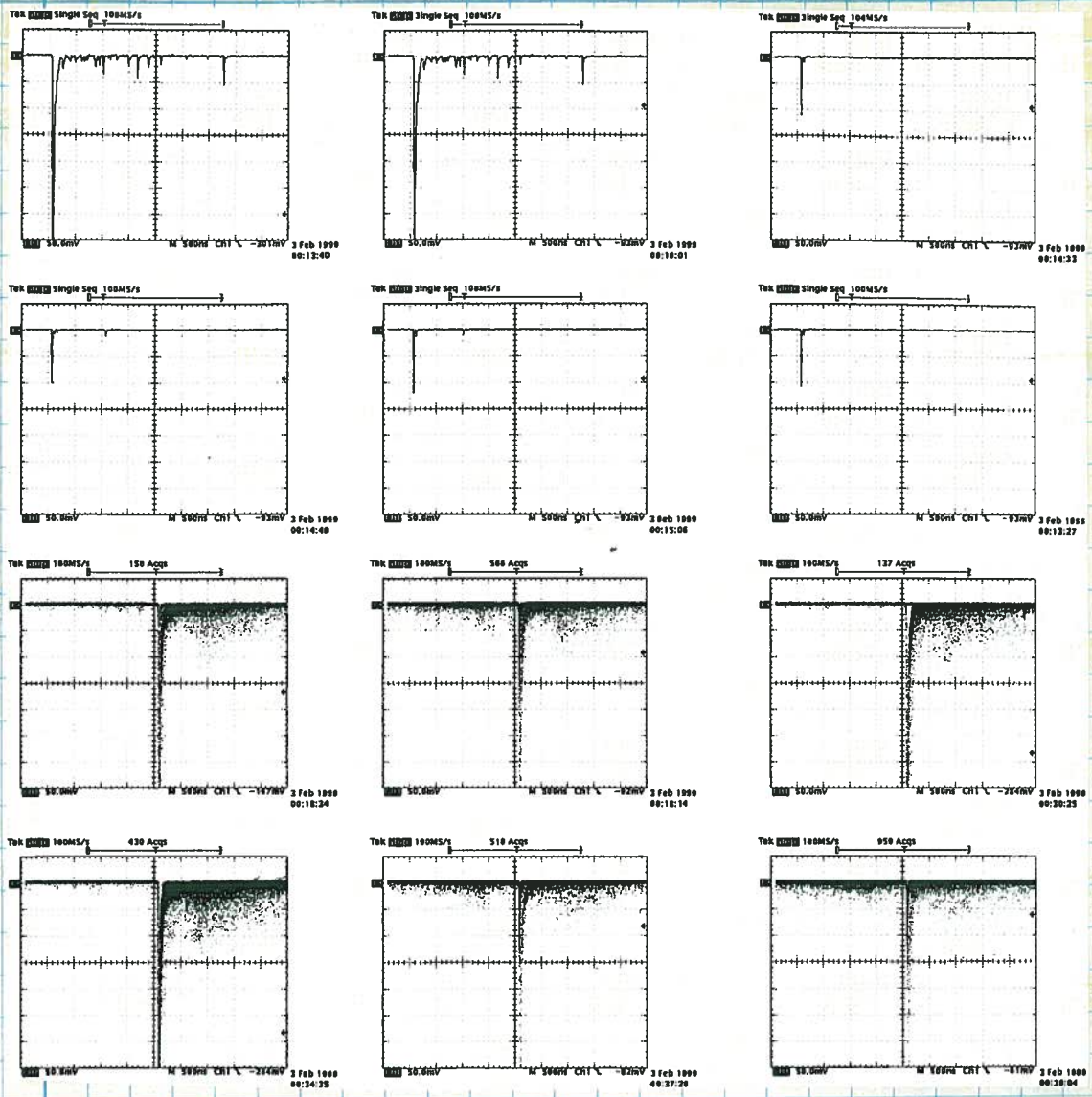

Tek Stop 250MS/s
3 Acqs
Stop After
RUN/STOP button only
Single Acquisition Sequence
Limit Test Condition Met
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
Mode Sample
Repetitive Signal Off
Stop After FA button
Limit Test Setup
Limit Test Sources
Create Limit Test Template


Tek Stop 250MS/s
5 Acqs
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:55:05


Tek Stop 250MS/s
4 Acqs
Ch1 1.00mV(?)
M 400ns Ch1 ∖ -8.10mV
2 Feb 1999
22:50:15

@1800V

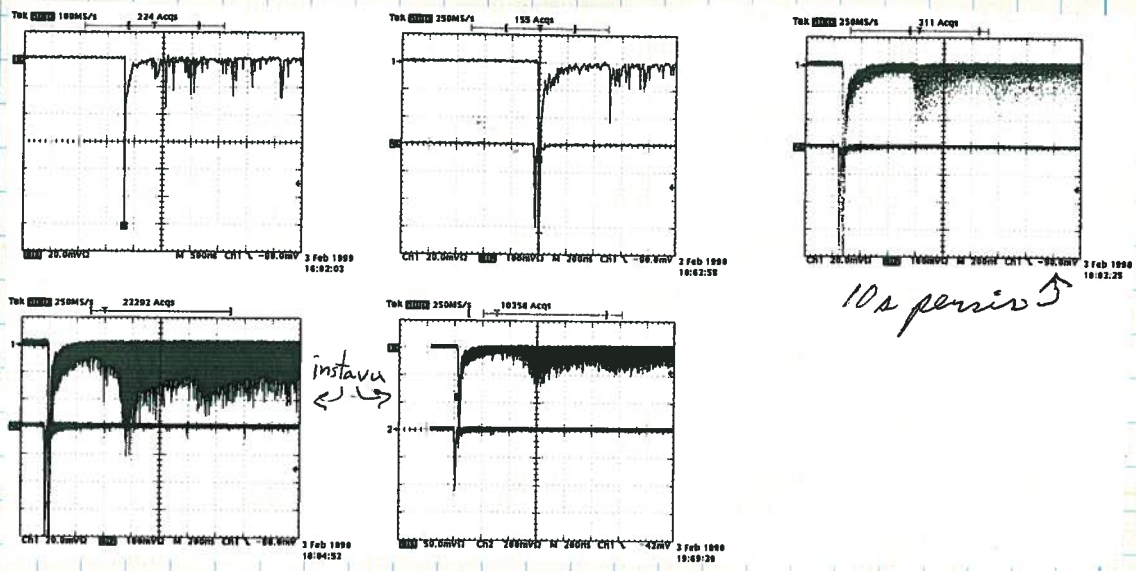

Tek 250MS/s 2 Acqs
2 Feb 1999 22:57:52
Tek 250MS/s 7 Acqs
2 Feb 1999 22:58:44
Tek 1.00GS/s 2 Acqs
2 Feb 1999 22:59:55
Tek 1.00GS/s 4 Acqs
2 Feb 1999 23:00:23
Tek 1.00GS/s 8 Acqs
2 Feb 1999 00:00:00
Tek 250MS/s 6 Acqs
2 Feb 1999 00:07:40
Tek 250MS/s 3 Acqs
2 Feb 1999 00:08:05
Tek 250MS/s 14 Acqs
2 Feb 1999 00:09:26
Tek 250MS/s 6 Acqs
2 Feb 1999 00:08:55
Tek 250MS/s 4 Acqs
3 Feb 1999 00:09:22
Tek Single Seq 250MS/s
2 Feb 1999 00:10:06
Tek Single Seq 250MS/s
3 Feb 1999 00:10:30
Tek Single Seq 250MS/s
3 Feb 1999 00:11:45
Tek Single Seq 250MS/s
2 Feb 1999 00:13:52
Tek Single Seq 250MS/s
2 Feb 1999 00:12:27
Tek Single Seq 100MS/s
3 Feb 1999 00:12:58
Tek Single Seq 100MS/s
3 Feb 1999 00:13:21


Tek Single Seq 100MS/s
3 Feb 1999
00:13:40
Tek Single Seq 100MS/s
3 Feb 1999
00:10:01
Tek Single Seq 100MS/s
3 Feb 1999
00:14:33
Tek Single Seq 100MS/s
3 Feb 1999
00:14:40
Tek Single Seq 100MS/s
3 Feb 1999
00:15:06
Tek Single Seq 100MS/s
3 Feb 1999
00:13:27
Tek 100MS/s 150 Acqs
3 Feb 1999
00:18:34
Tek 100MS/s 500 Acqs
3 Feb 1999
00:18:14
Tek 100MS/s 137 Acqs
3 Feb 1999
00:30:25
Tek 100MS/s 430 Acqs
3 Feb 1999
00:34:35
Tek 100MS/s 510 Acqs
3 Feb 1999
00:37:28
Tek 100MS/s 950 Acqs
3 Feb 1999
00:38:04

2/3
JA

Moller Pb-glass Afterpulsing

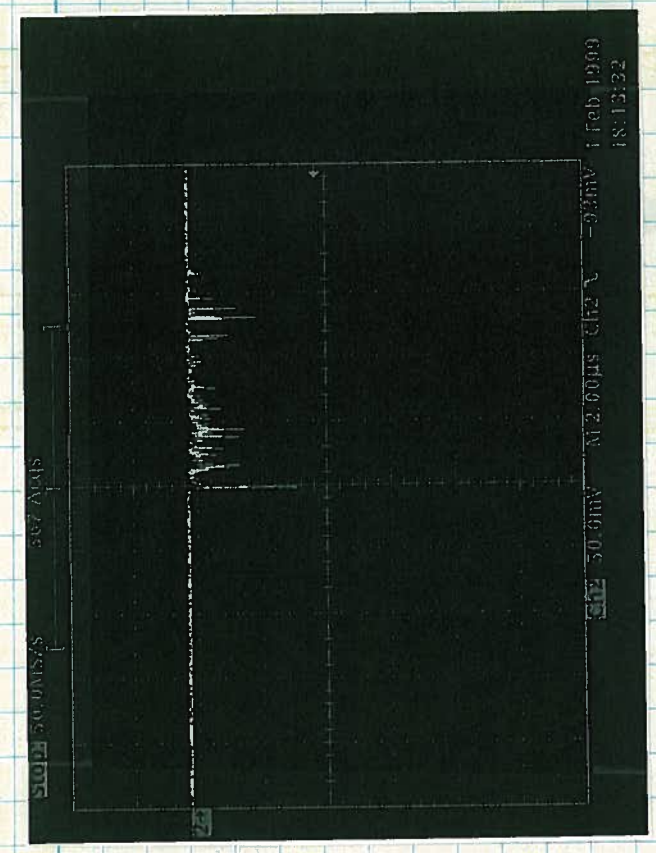
Roman was checking out the Moller Pb-glass when I chanced to walk past. Glancing at the 2445 he was using I noted significant afterpulsing. I went to get the 754 scope. Roman patiently assisted me while I took a few pictures. He said the top row of tubes was bad. He showed me a newer tube. The new tube is included in the last 4 pictures. ~~He Jim~~

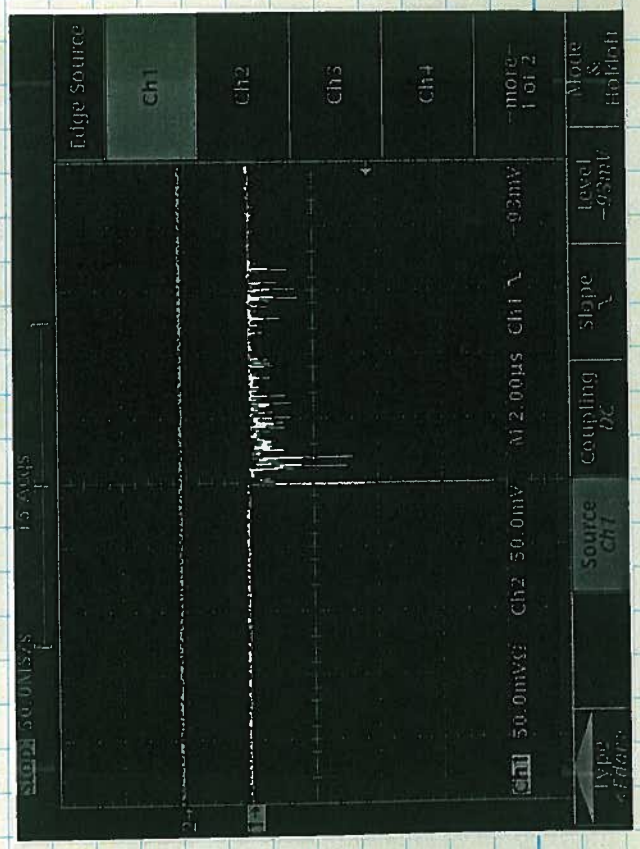


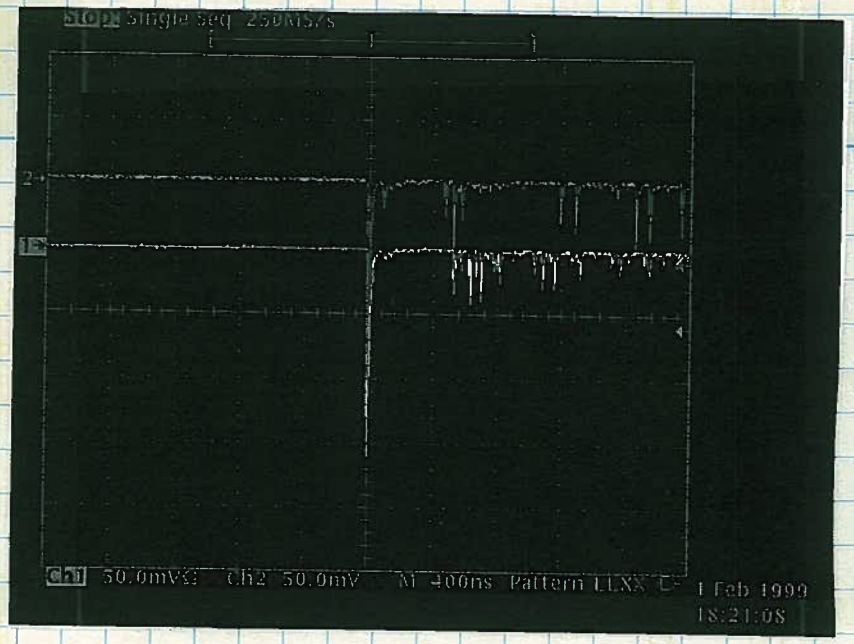
Typical afterpulsing in TOF 85754 2/9/99

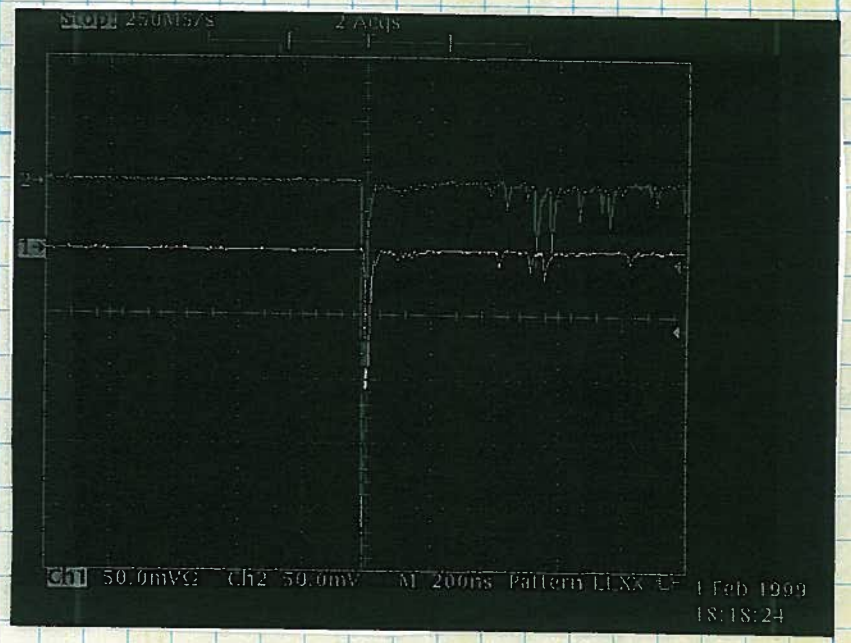
I had previously gone upon the electron arm to check for afterpulsing.

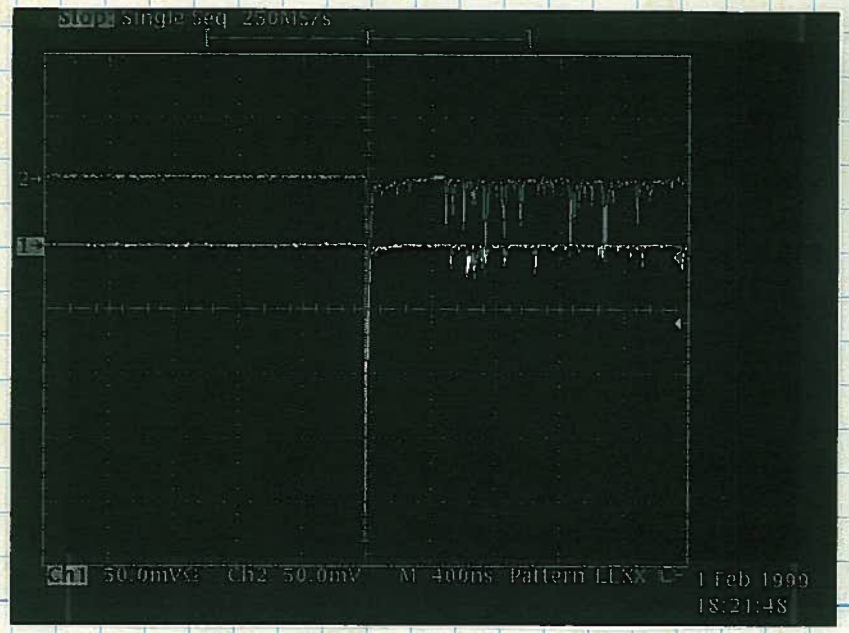
Channel 2 of the 7544 is the high momentum, right side PMT of S1.
Channel 1 is the high momentum, right side PMT of S2.
The last 3 pictures are from one of the total absorber PMTs. I don't remember which tube, somewhere in the high momentum, right corner.

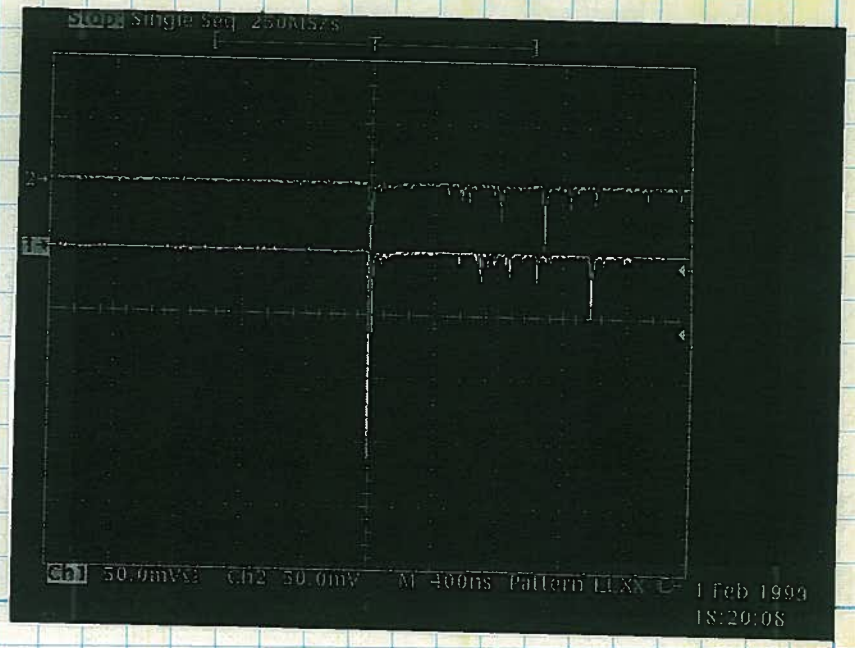


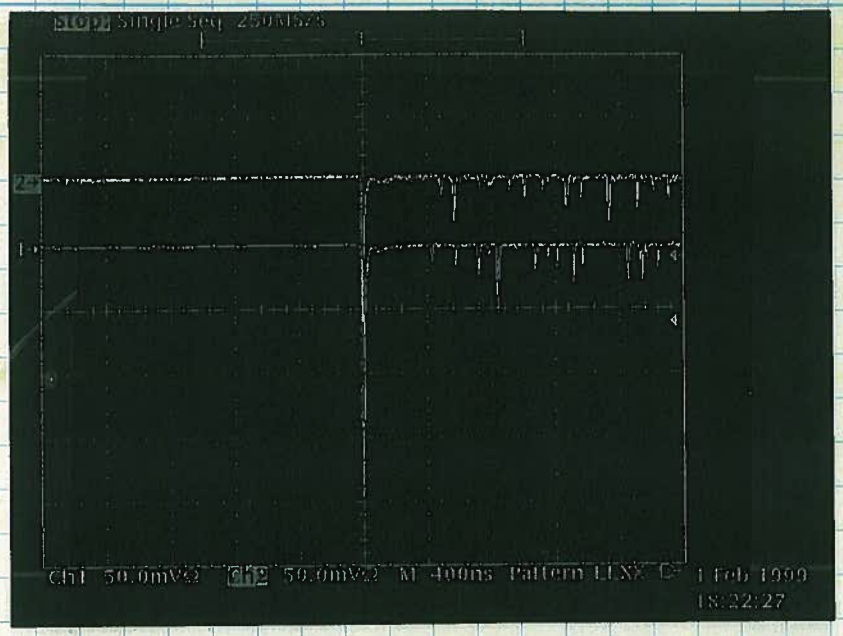


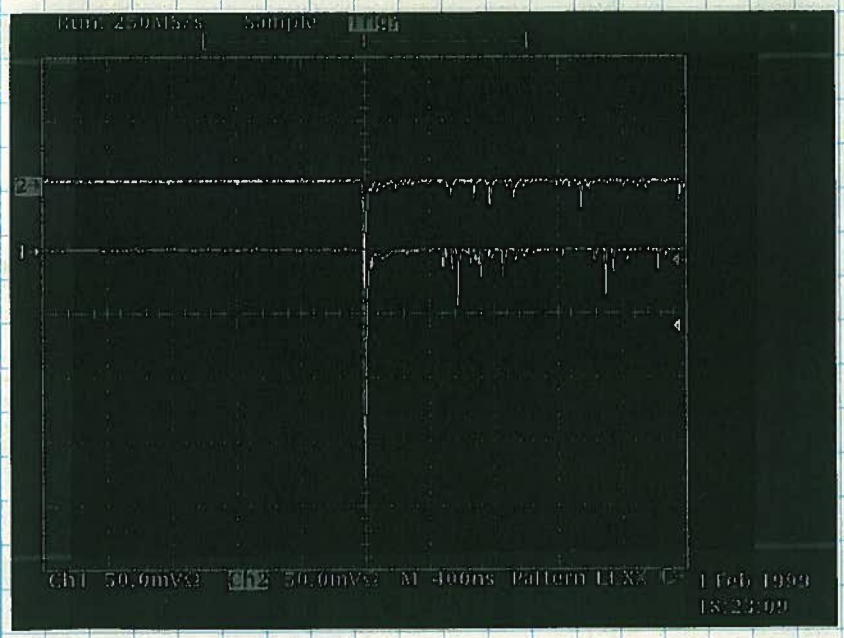

Stop Single Seq 250MS/s
Ch1 50.0mV Ch2 50.0mV M 400ns Pattern LLXX
1 Feb 1999
18:21:08

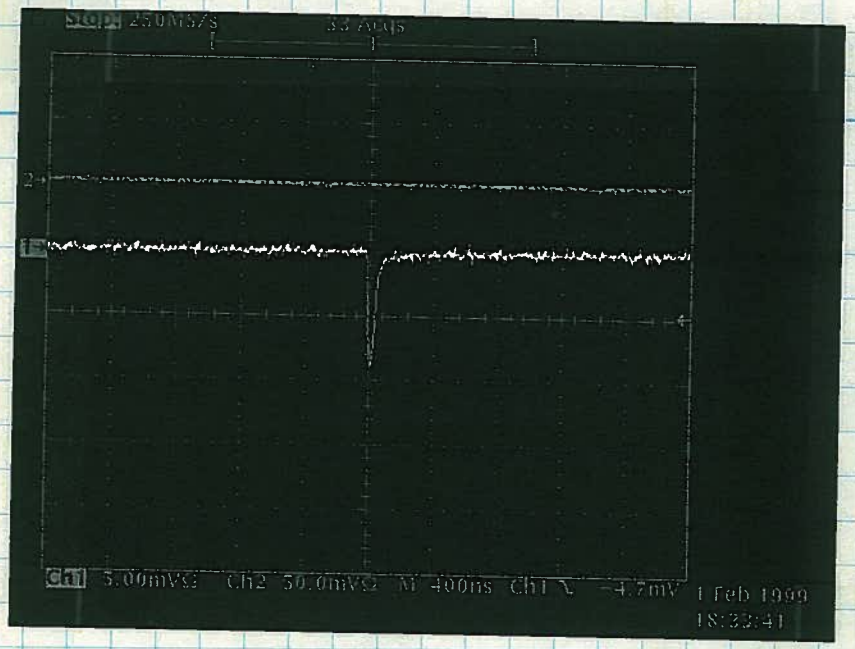

Stop 250MS/s 2 Acqs
Ch1 50.0mV Ch2 50.0mV M 200ns Pattern LLXX
1 Feb 1999
18:18:24

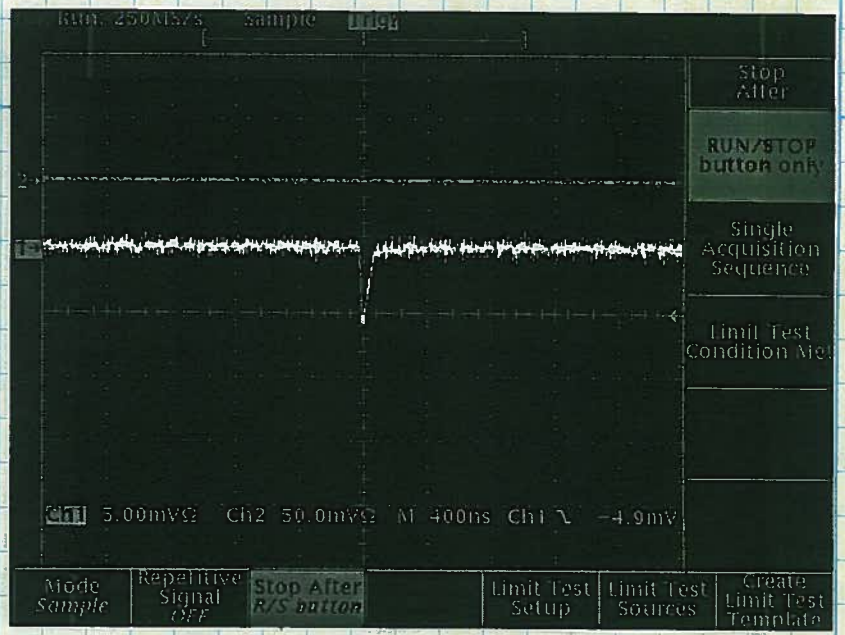

Stop Single Seq 250MS/s
Ch1 50.0mV Ch2 50.0mV M 400ns Pattern LLXX
1 Feb 1999
18:21:48

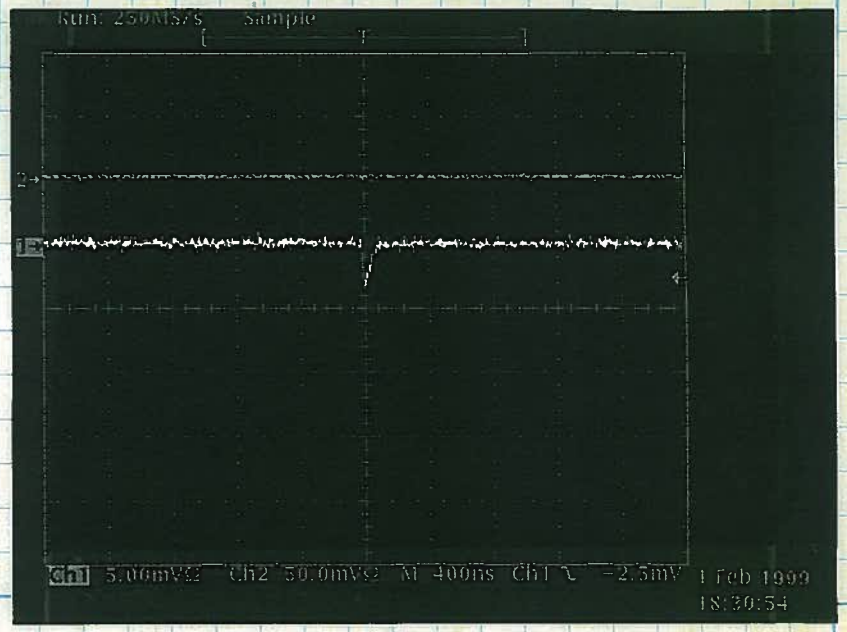

Stop Single Seq 250MS/s
Ch1 50.0mV Ch2 50.0mV M 400ns Pattern LLXX
1 Feb 1999
18:20:08


Stop Single Seq 250MS/s
Ch1 50.0mV/2 Ch2 50.0mV/2 M 400ns Pattern LLXX
1 Feb 1999
18:22:27


Run: 250MS/s Sample
Ch1 50.0mV/2 Ch2 50.0mV/2 M 400ns Pattern LLXX
1 Feb 1999
18:23:09


Stop 250MS/s 33 acqs
Ch1 5.00mV Ω Ch2 50.0mV Ω M 400ns Ch1 ∿ -4.7mV
1 Feb 1999
18:33:41


Run: 250MS/s Sample Trig
Stop After
RUN/STOP button only
Single Acquisition Sequence
Limit Test Condition Met
Ch1 5.00mV Ω Ch2 50.0mV Ω M 400ns Ch1 ∿ -4.9mV
Mode Sample
Repetitive Signal OFF
Stop After R/S button
Limit Test Setup
Limit Test Sources
Create Limit Test Template

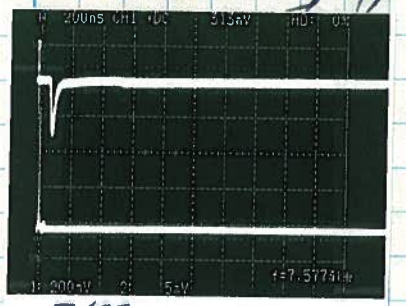

Run: 250MS/s Sample
Ch1 5.00mV Ω Ch2 50.0mV Ω M 400ns Ch1 ∿ -2.5mV
1 Feb 1999
18:30:54

8575 Afterpulsing – LED on Cable 2/9

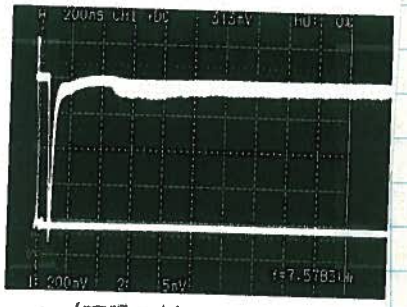
Yesterday I put a green LED on the end of a LEMO receptacle. This was placed ~2" from the face of an 8575, in the dark box. The HP pulser was set to minimum pulse width. (+) output used to trigger the Lecroy scope on CH1. CH2 is PMT output. HP (−) output drove the LED. With this setup it is possible to get a large enough pulse to see at low gains. The (−) output amplitude was adjusted till a satisfactory pulse was obtained from the "new" tube.

The "new" (11/97) tube showed some small amount of afterpulsing ~400ns after the initial pulse. It appeared to be two closely spaced peaks.

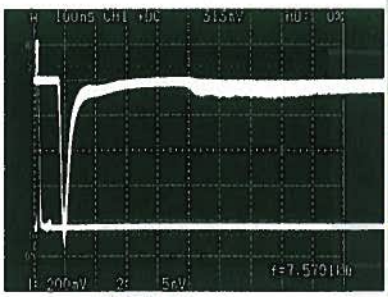
After looking at the "new" tube and another one off the spectrometer, I chose one of the tubes that would go into regenerative feedback. I wanted to see if I could tell anything more about when it breakdown from the analog scope. The following are scope pics taken from the video out using Snappy video capture for the PC.



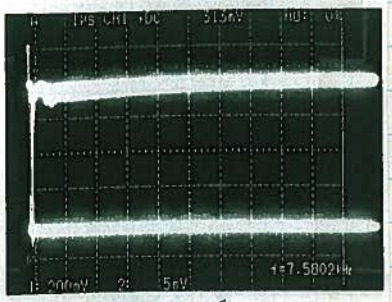
−1500V



−1730V

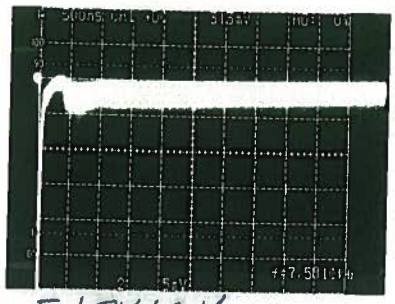


−1730V

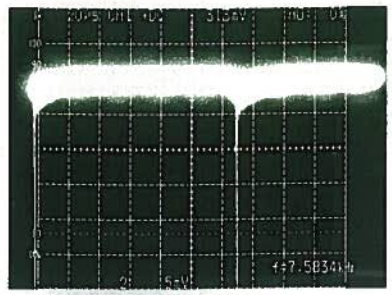


−1730V

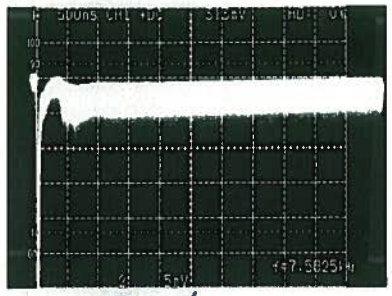
PMT signal is into 50Ω on BNC "T" at the scope. Scope at 1MΩ.



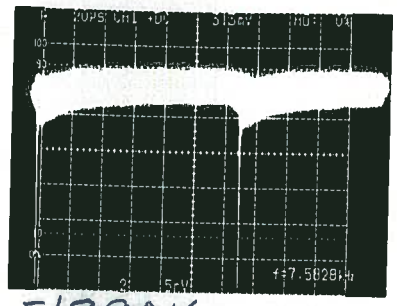
-1840V



-1840V



-1890V



-1890V

At -1890V I could increase the pulse repetition rate and drive the tube into regenerative feedback. The anode current put something like 10mV on the scope display (a flat DC signal).

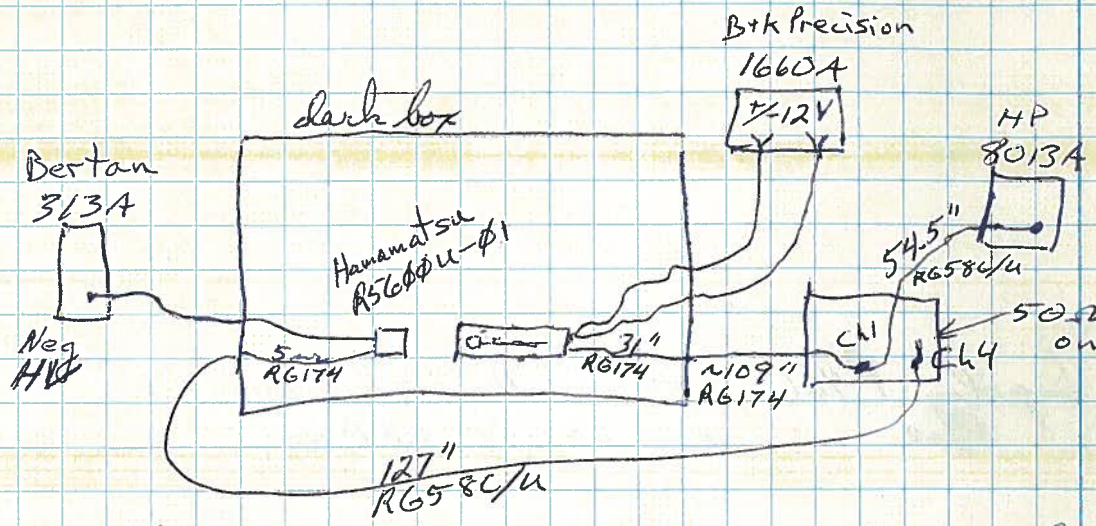
I could switch the HV supply down 500V (one step on the control knob) and see the DC output drop quickly to 0V and the PMT pulse come back.

Stepping back up immediately 500V would drive the tube back into feedback. Waiting about 5 seconds at -1390V and then stepping the voltage up 500V would allow the tube to function as in the last two pictures.

Bogdan W. noted the (e,p) setup had a similar problem with their PMT. As the HV was increased the signal would disappear. This was during running so the analog signal was not accessible but the current drawn from the HV supply was noted to increase when this happened.

LED Comparison - Avalanche Pulser 3/19

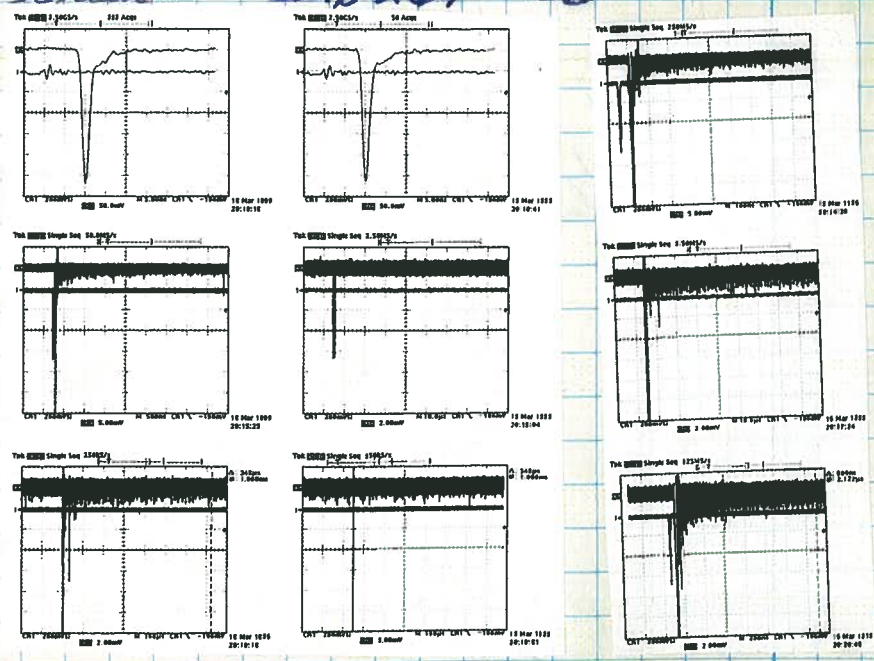
Yesterday and today I looked at some LEDs I had bought. Looking for best to use, and just to characterize stuff.



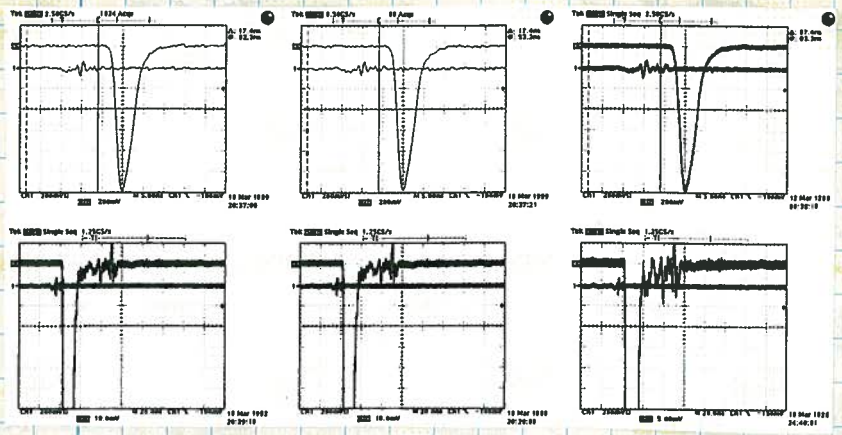
LED characteristics measured using sample mode, envelope mode (500) and average mode (32).

Digi Key L14006-ND 250mCD 3mm clear blue bar
blue 430nm CMD264-UBD

-750V

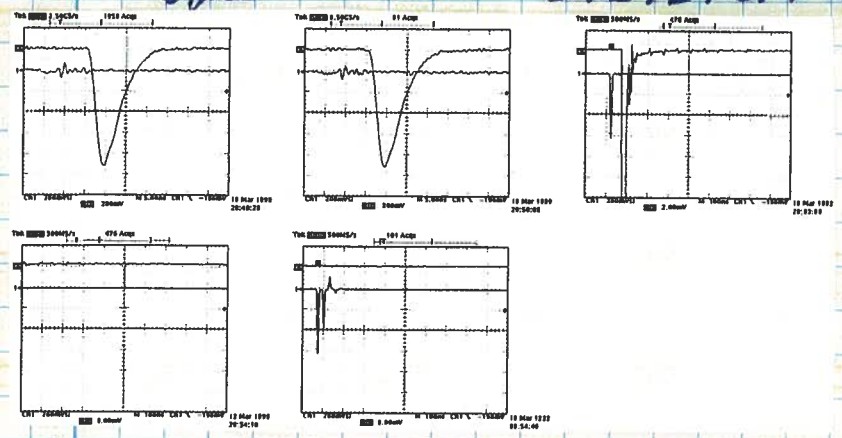


P467 (Digi-Key) 350mCD T1-3/4 clear lens
blue LNG921CFBW



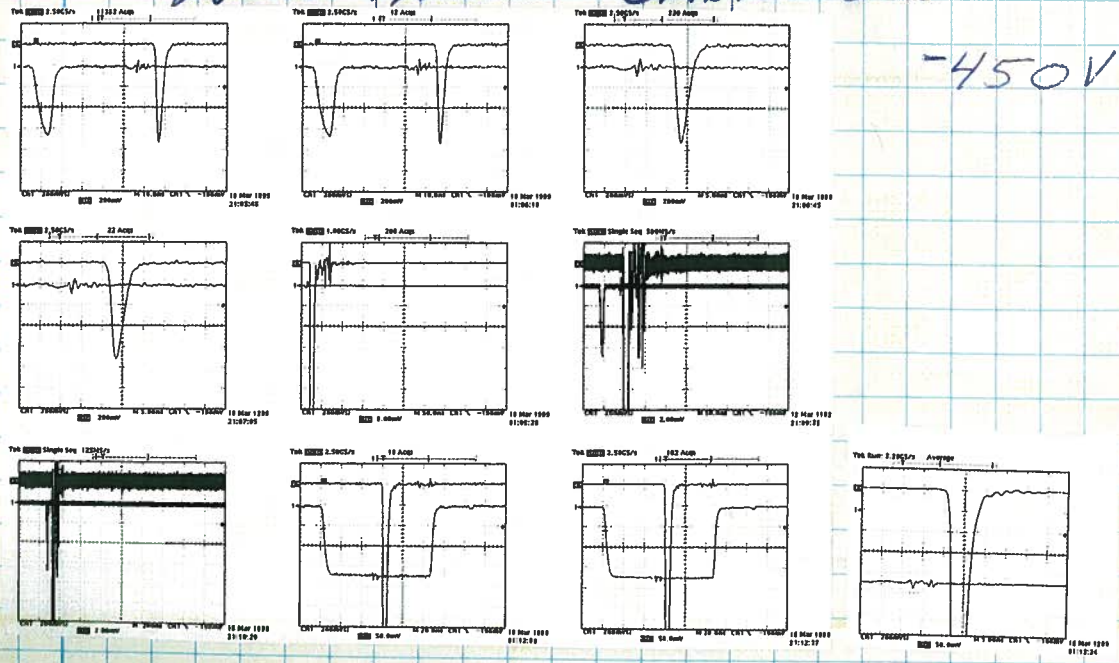
-450V

Digi-Key P466 650mCD T1-3/4 clear lens
blue LNG901CFBW



-400V

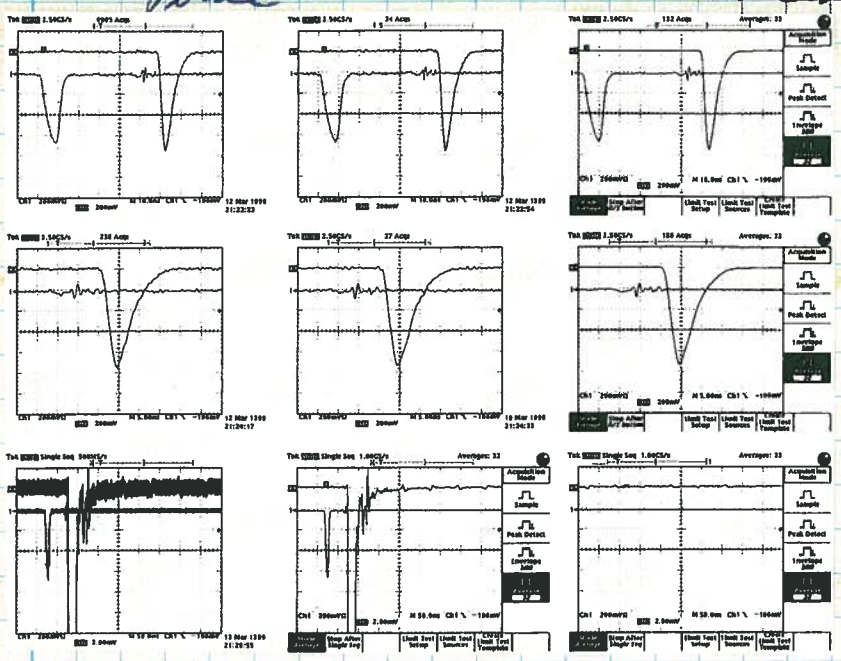
Digi-Key L13006ND 1000mCD 3mm clear lens
blue 470nm CMD1224BCN



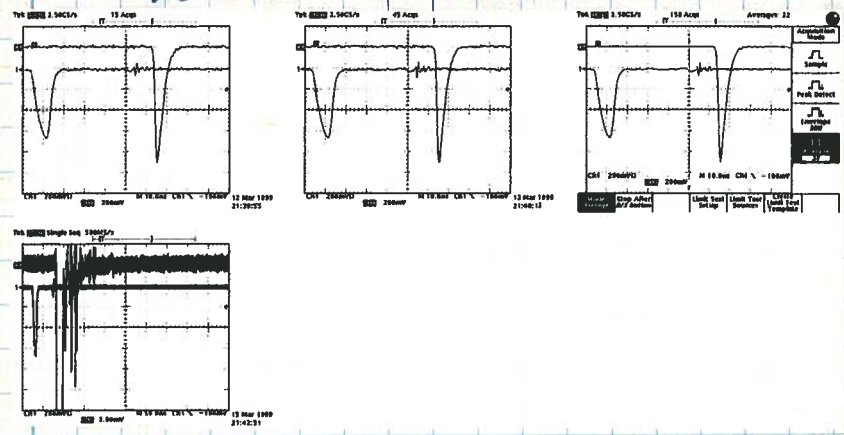
-450V

Digikey P465 1500mCD T1-3/4 clear lens
Blue LNG992CFBW

-400V

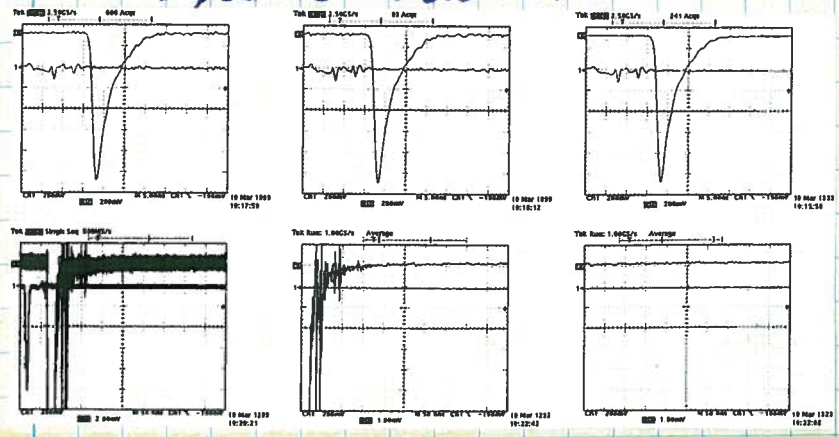


Digikey L12006-ND 2000mCD 5mm clear lens
Blue 470nm

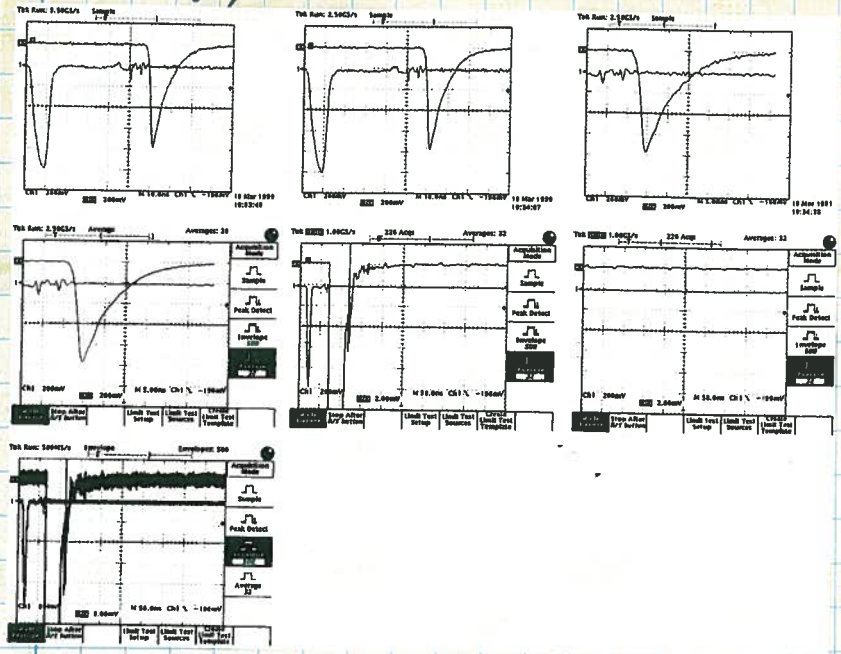


Digikey L13005 3400mCD 3mm clear lens
green 525nm

-500V

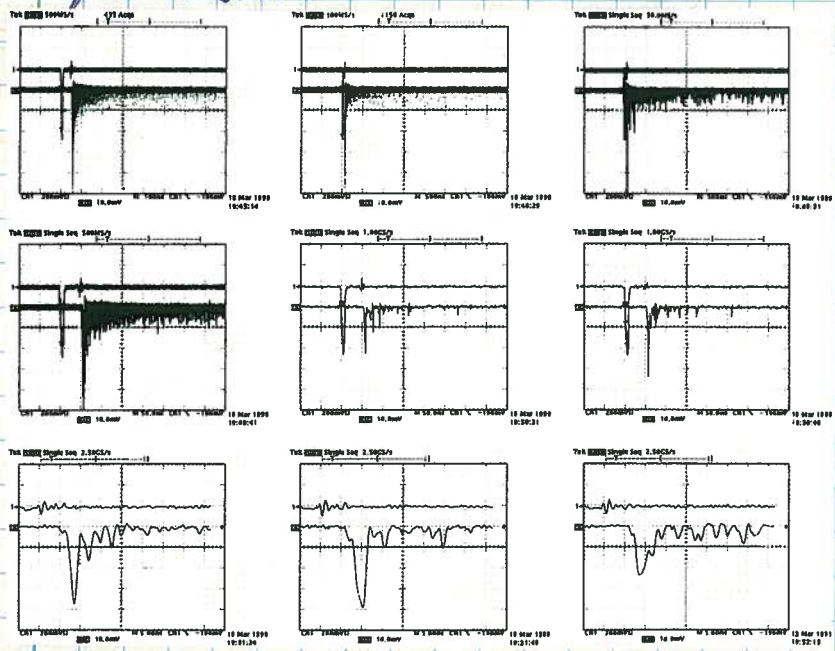


DigiKey L12005 6000mCD 5mm clear lens
green 525nm



-400V

Small green LED ?? mCD green diffuse lens ~~yellow~~
from Star



-950V

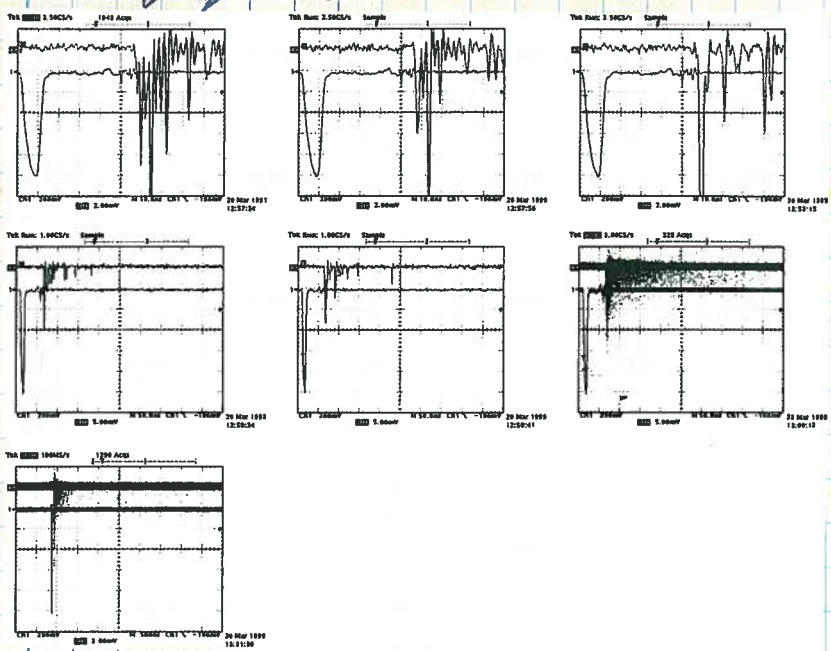
3/20/99

Continuing from yesterday.

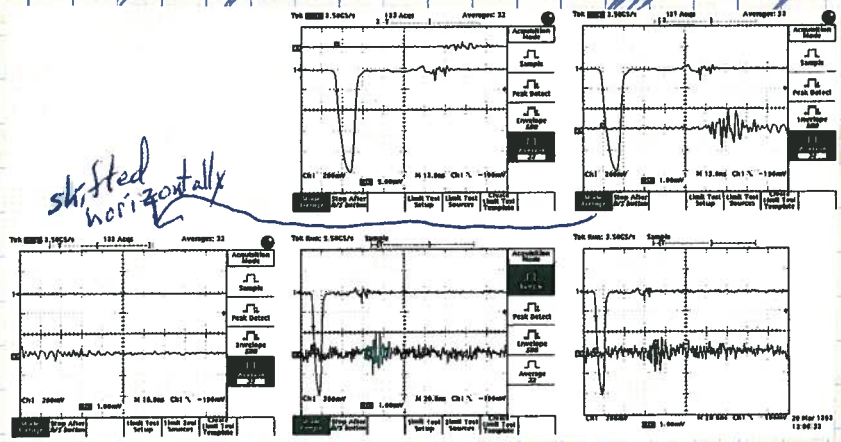
Digi Key 67-1198 green

2mm clear green lens

-950V

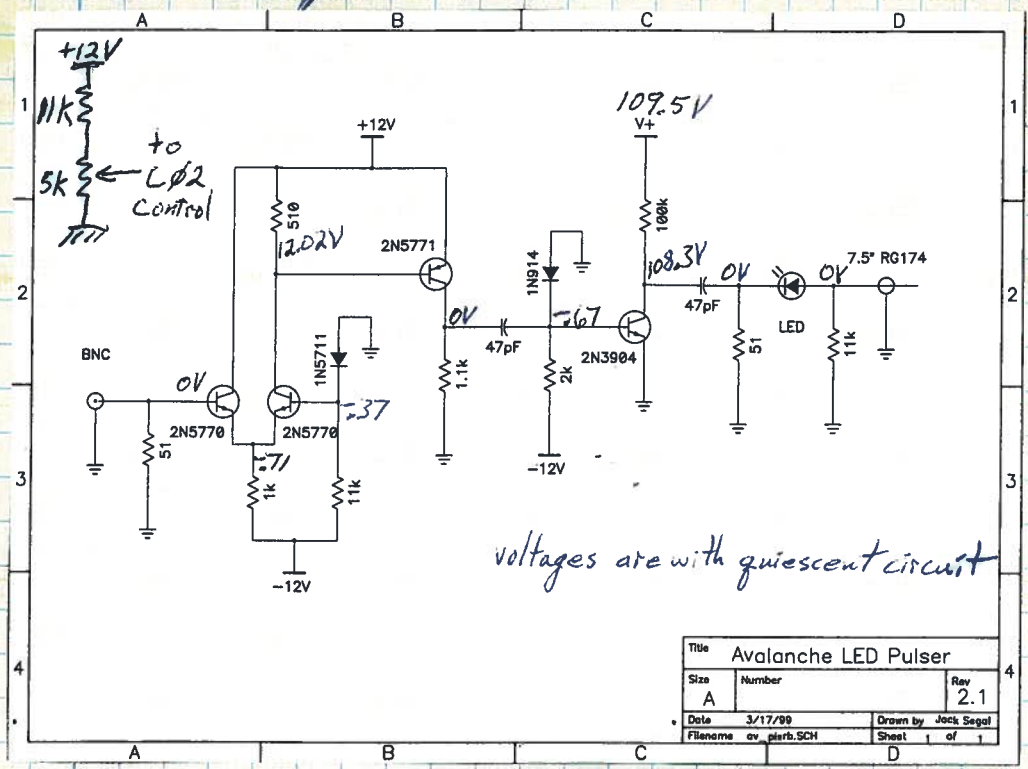


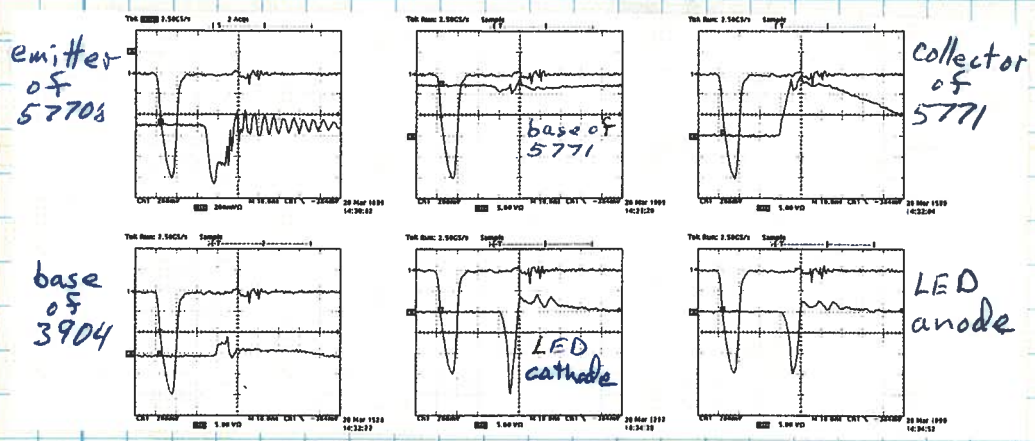
Output of PMT with HV off & pulser on



Avalanche Pulser Circuit

This is the avalanche pulser used for the LED comparison.





Tek P6205 probe used for 1st four

P6137 probe used for the last 2 pics

LED was L13005-ND (green, 525nm, 3400mCD)

R5600 PMT Looking at Gassy 8575

I hooked up a gassy 8575 to a Bertan high voltage MWPC supply. The HV is connected to two pins on the base of the 8575.

With sufficient HV applied the tube has a faint glow around the inside of the base and along the glass envelope. It glows in particular near of the inside of the walls. Perhaps there is some residual contamination at those parts of the walls? I was using the tube to see if I could hold up optical filters and get some confirmation that it was He in the tube which was the source of the glow.

The filters are bandpass ones from Edmund Sci.

Holding the filters up (alternately) I can see the glowing spots on the PMT through each filter.

I had looked at this PMT, with the filters, some time ago. The HV setup and tube were in the darkbox next to the LED test arrangement. I turned the R5600U-01A PMT towards the gassy 8575. ~4" away. I directed the R5600 face in the general direction of the base, pointed from ~½ way up the tube.

With the HV of the MWPC supply adjusted the 8575 will glow very faintly and periodically there will be a flash inside the tube. When there is a flash the MWPC supply trips off & the faint glow is gone. The faint glow gradually builds back up. Eventually there is another flash and the process repeats.

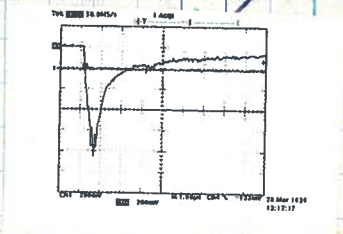
With the R5600 tube in place & looking at its output I see a lot of random pulses. Eventually there is a large pulse out of the R5600 and the MWPC trips at the same time (visually determined). The MWPC supply is set to AUTORESET. After a large R5600 output the R5600 output is quiet for a short time. The random pulses begin to occur and their "frequency" of occurance quickly increases. Eventually there is a large flash and the process repeats.

I turned the R5600 HV off, left the Bertan MWPC HV on and opened the darkbox to see the intensity of the glow I could see with the R5600. It was difficult, but not impossible, to see some glow with the low level of illumination in the area I was working in. It would have been easily seen in complete darkness, I think.

The flashes are easily noticed in the low level illumination. But, I think they might be more difficult to notice in a brightly lit room.

Below is the R5600U-01A response to a flash.

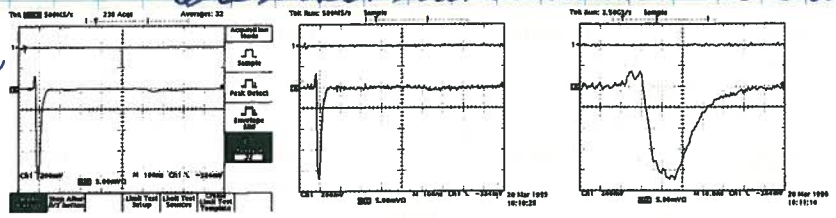
-550V on R5600 base



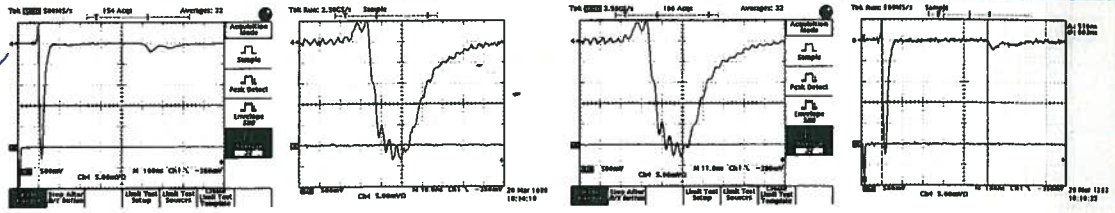
Comparison of a New & 2 Used 8575's
Using surface mount base I'd made
Checking out a few of the 8575's lying around.

Serial number C063433
It was in a box of tubes removed from the spectrometers
The box it was in was marked "old PMT low gain"

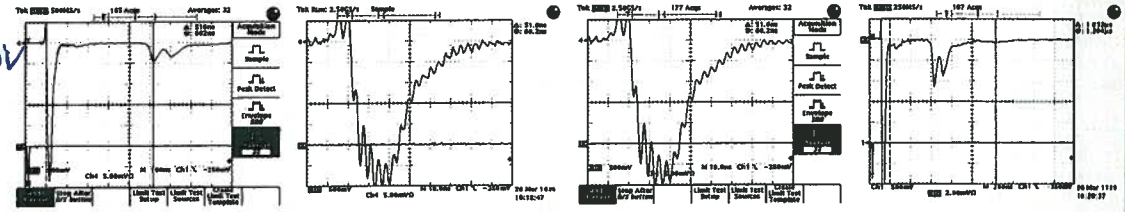
1000V



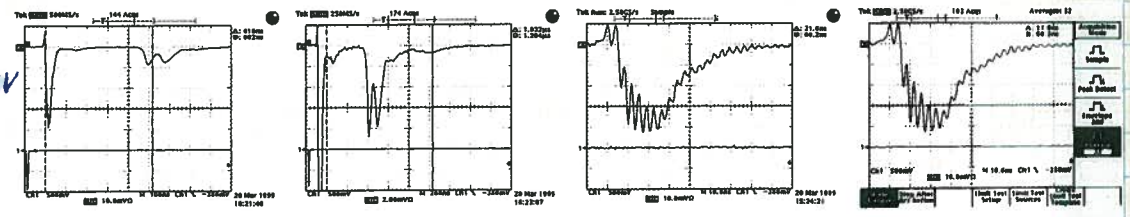
1100V



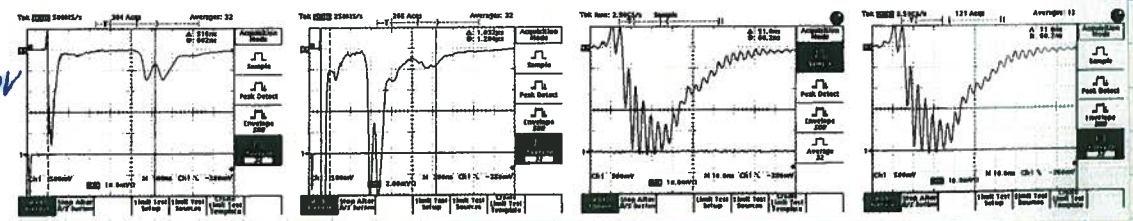
1200V



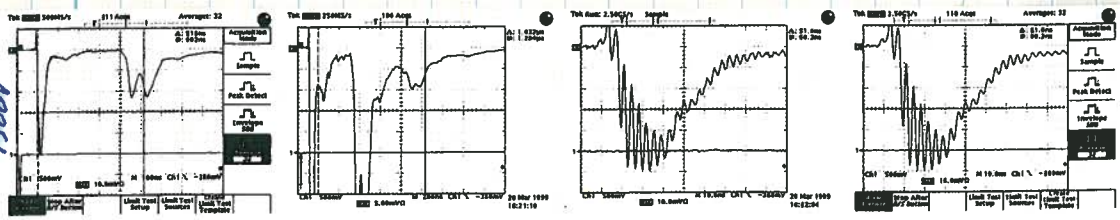
1300V



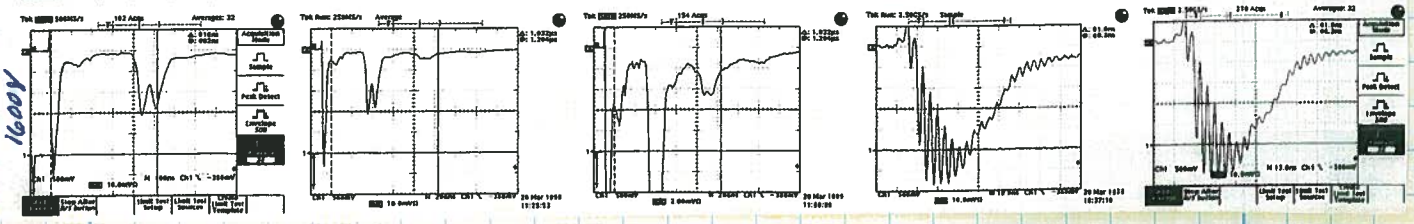
1400V



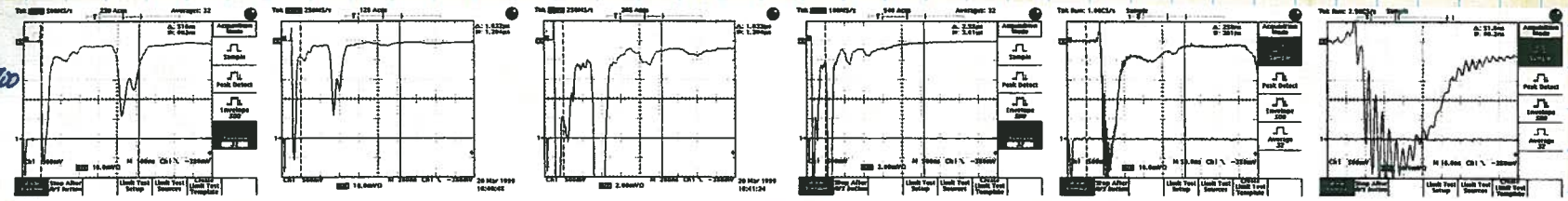
1500V

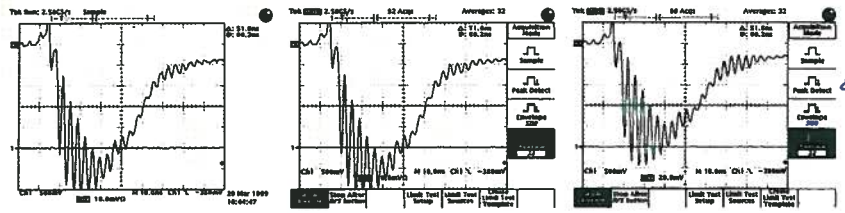


1600V



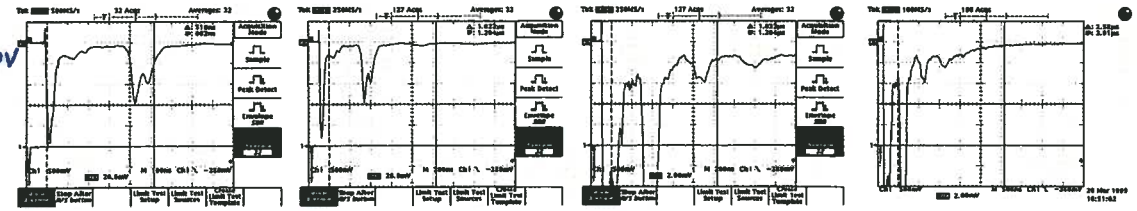
1700



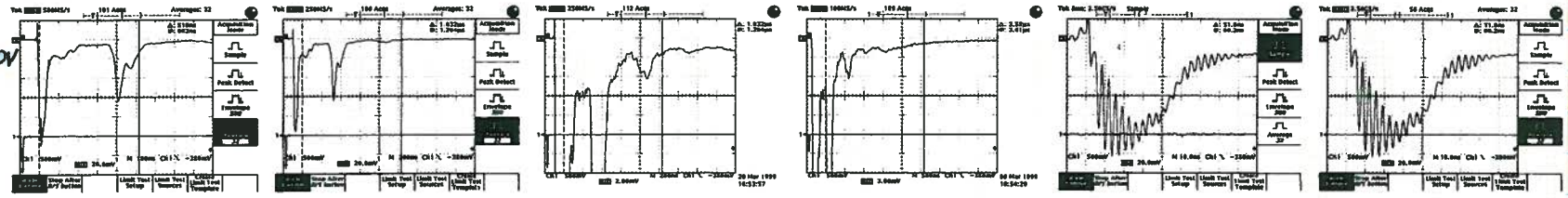


← previously Ch4 was on 50Ω. There is a 50Ω on a BNC "T", also, set Ch4 to high impedance and re-did 1700V

1700V



1800V



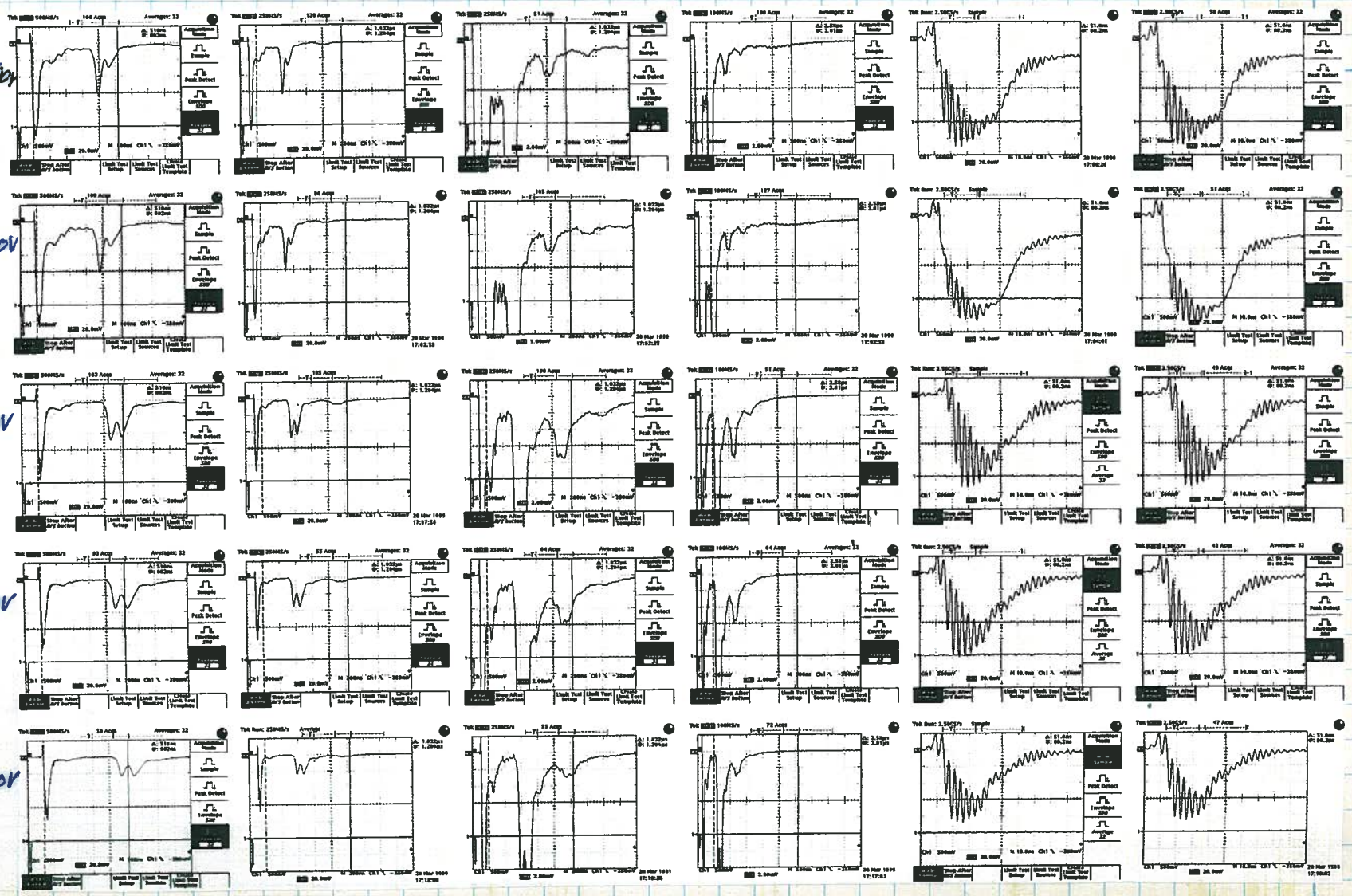
1700V

2000V

1600V

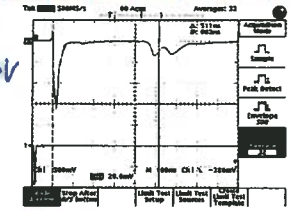
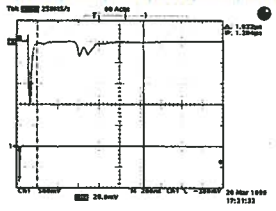
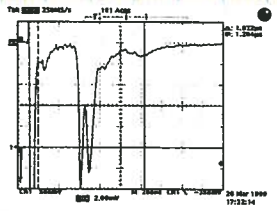
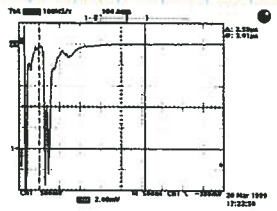
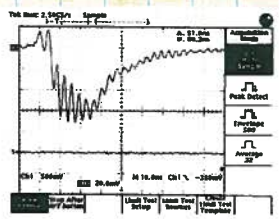
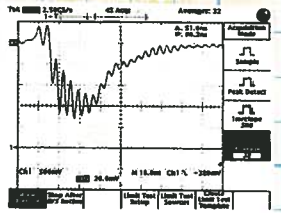
1500V

1400V

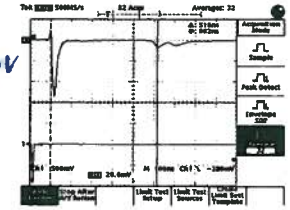
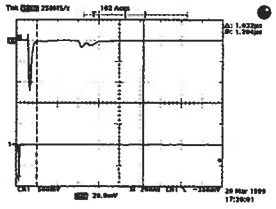
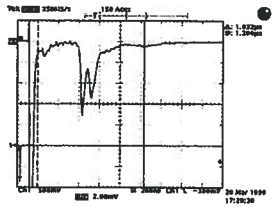
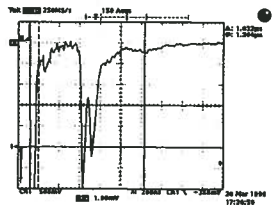
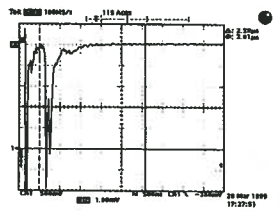
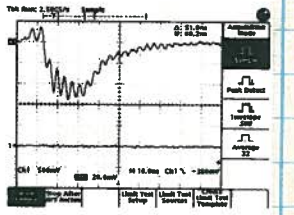
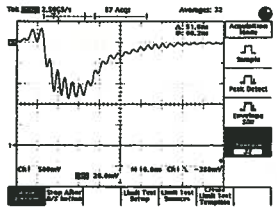


At 2000V I reached the limit on the "fine" adjustment knob. Since I needed to turn it back to 0 and switch the 500V/div knob, I re-did the lower voltages on my way down.

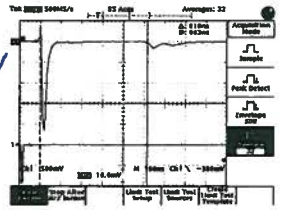
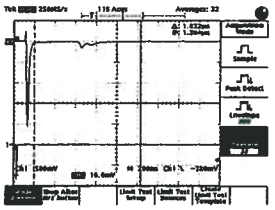
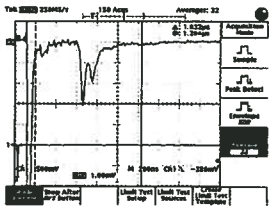
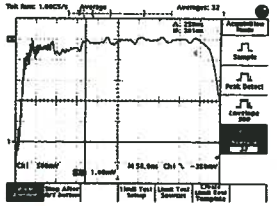
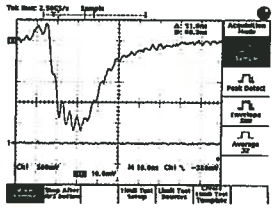
1300V

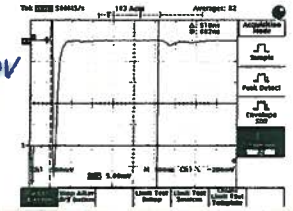
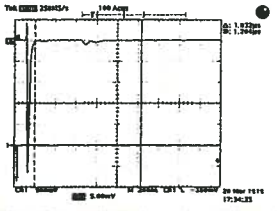
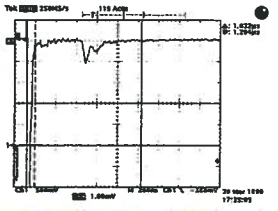
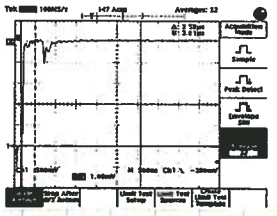
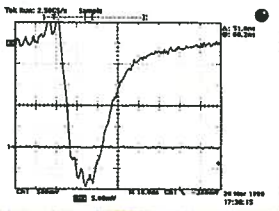
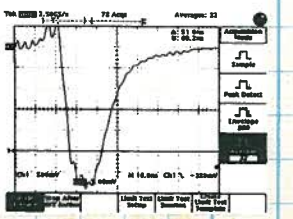
1200V

1100V

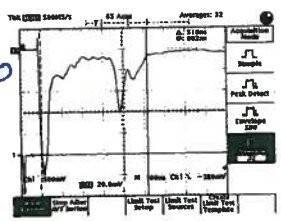






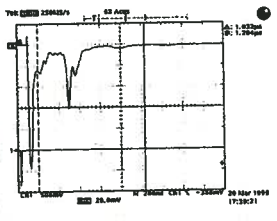
1000V

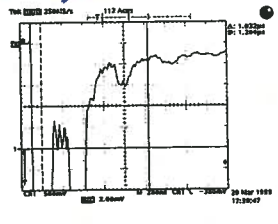







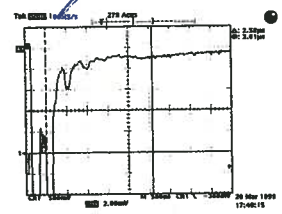
Set to 2000V on the "coarse" adjustment dial of the Bertan 313A

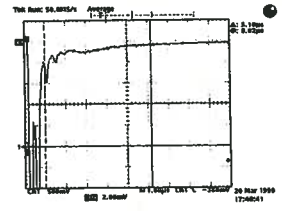
2000

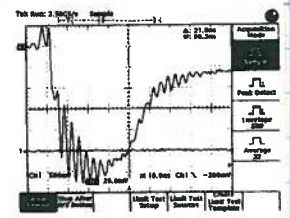


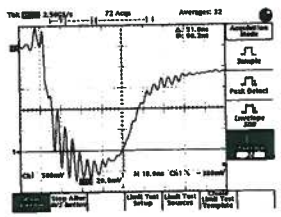


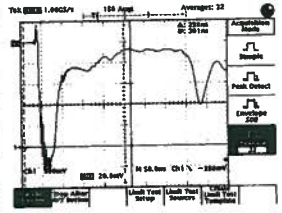




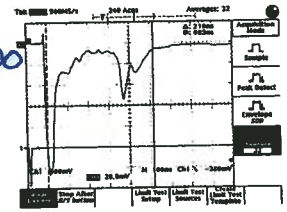


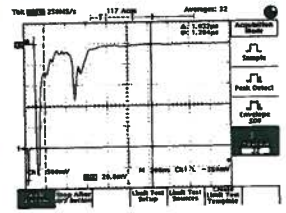


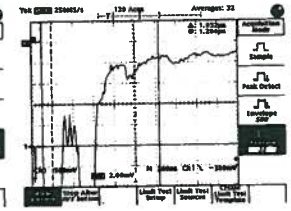


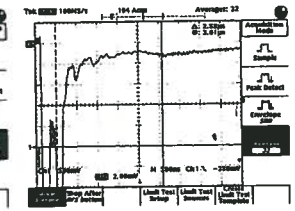


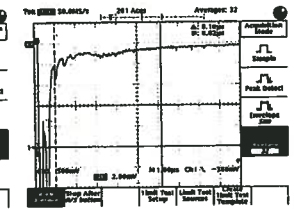
2100

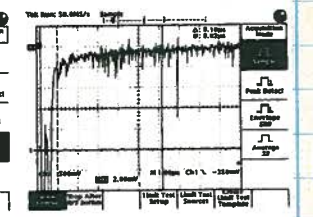


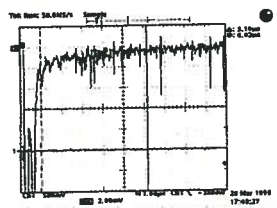


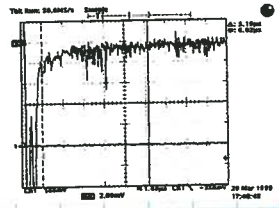




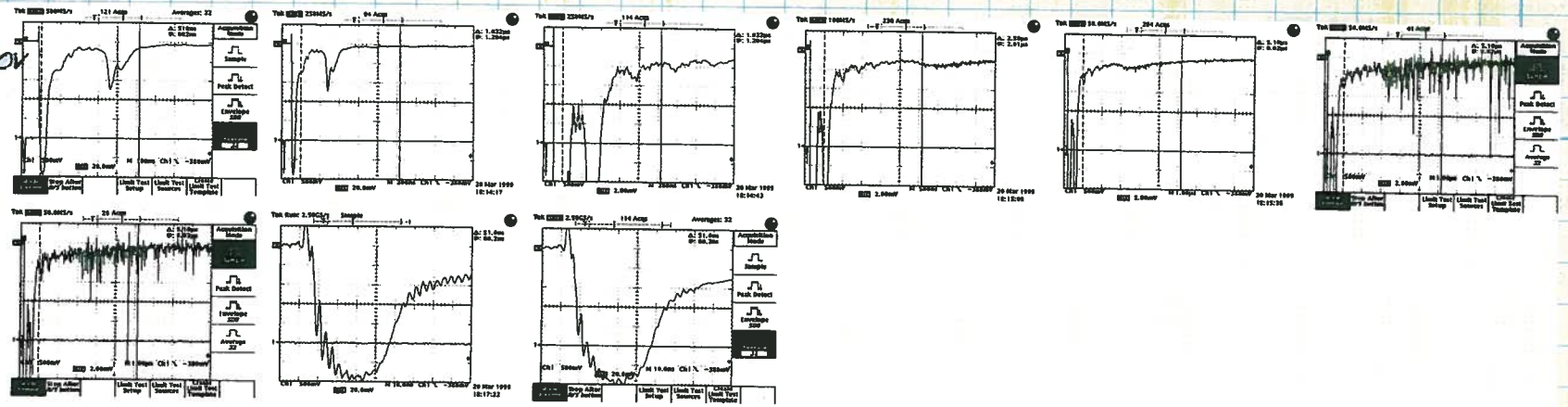




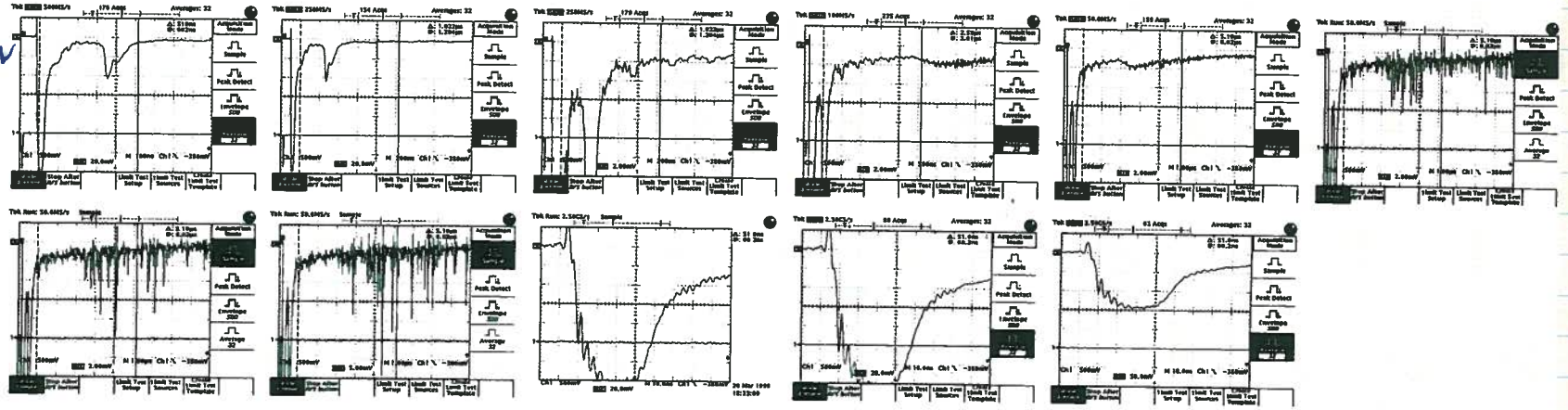




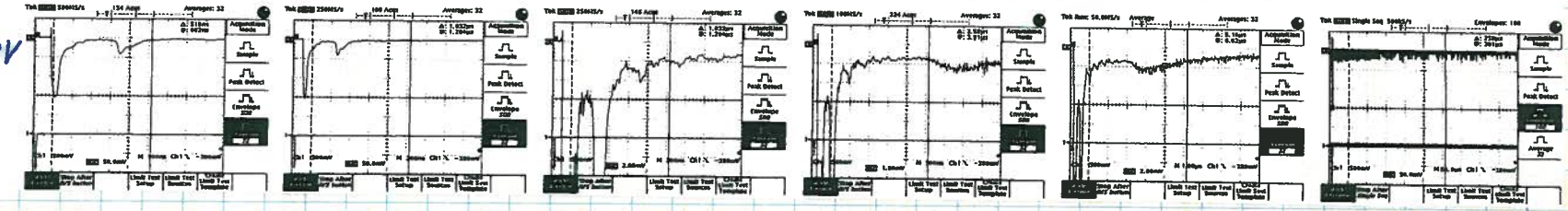
2200V



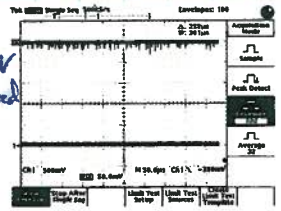
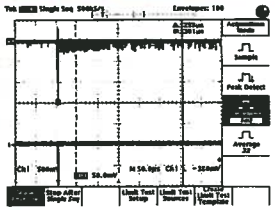
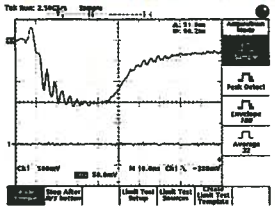
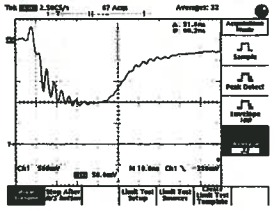
2300V



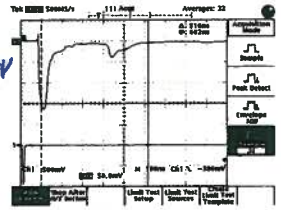
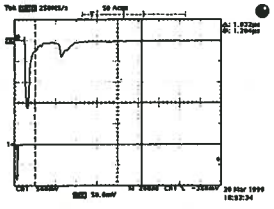
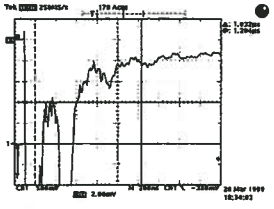
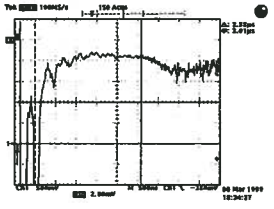
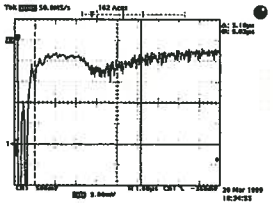
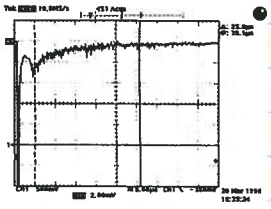
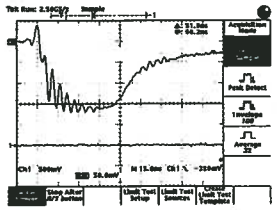
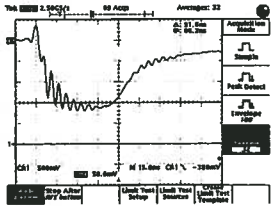
2400V



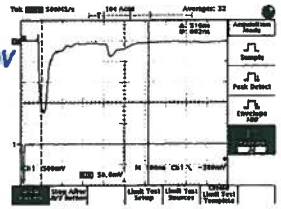
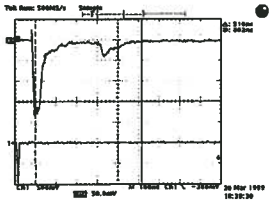
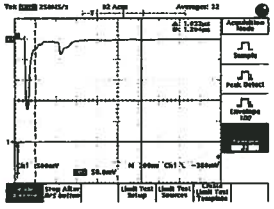
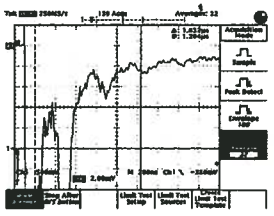
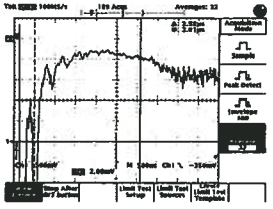
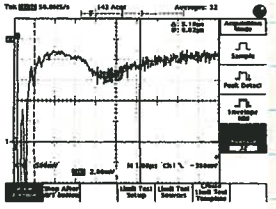
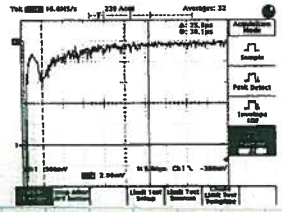
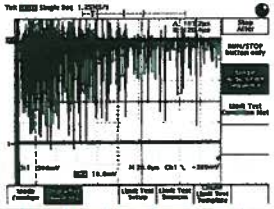
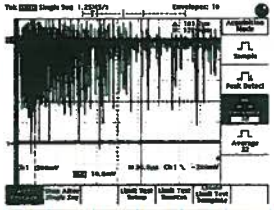
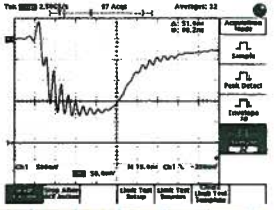
2400V
Continued

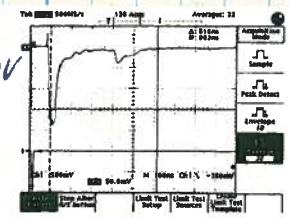
2500V

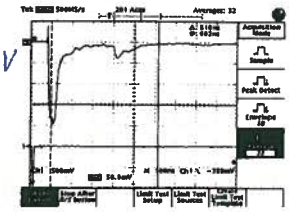
2600V

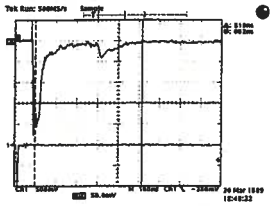











2700V

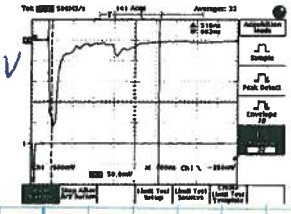


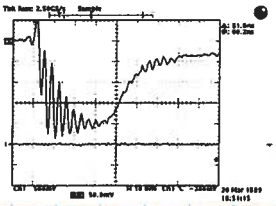
2800V

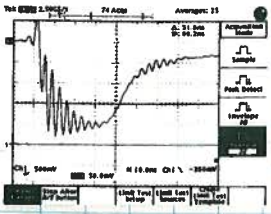




2900V

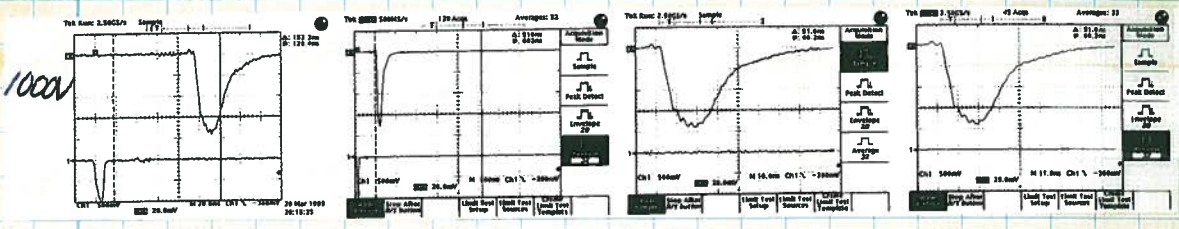




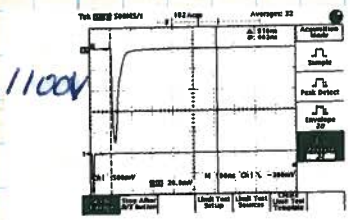


I got a new 8575 from a recent shipment.
Serial number T5Ø992.

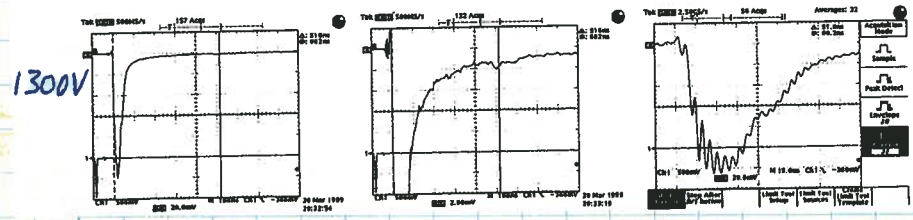
1000V



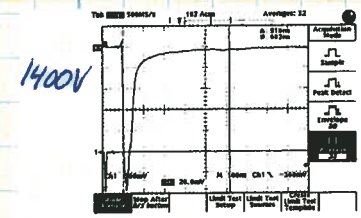
1100V



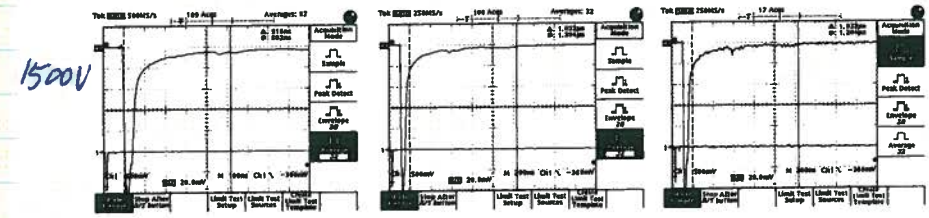
1300V



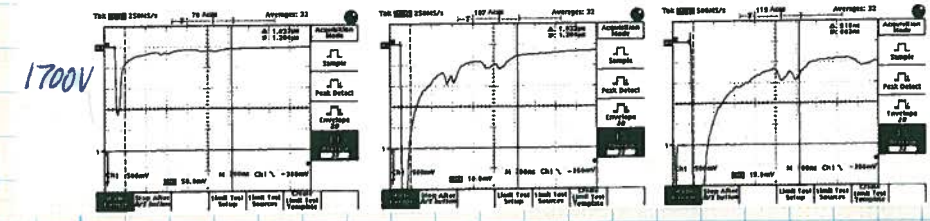
1400V



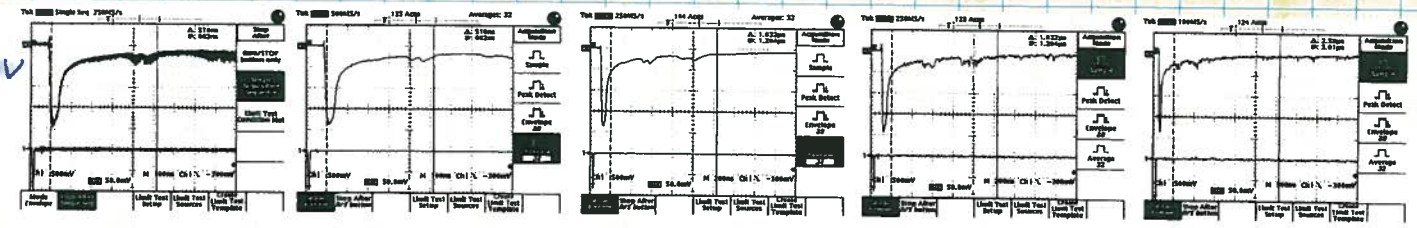
1500V



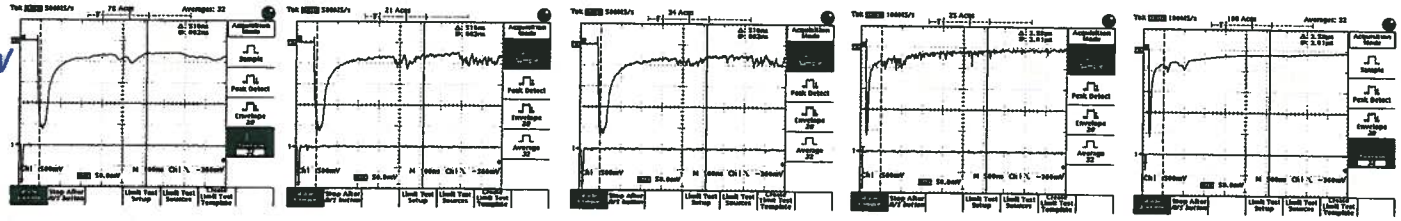
1700V



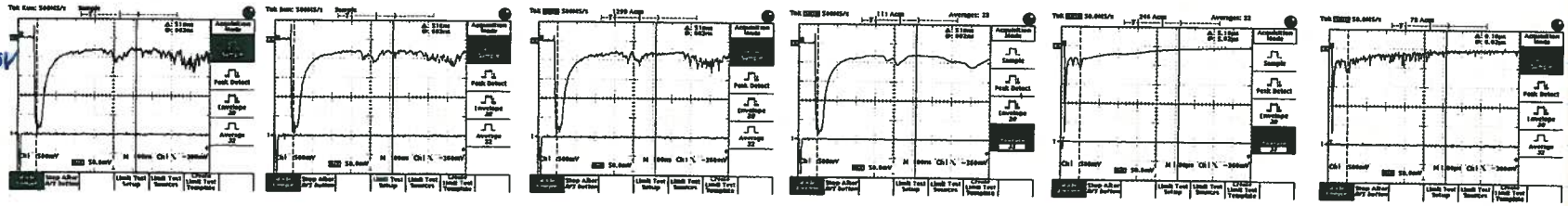
1900V

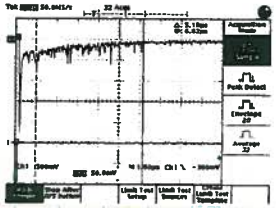


2100V

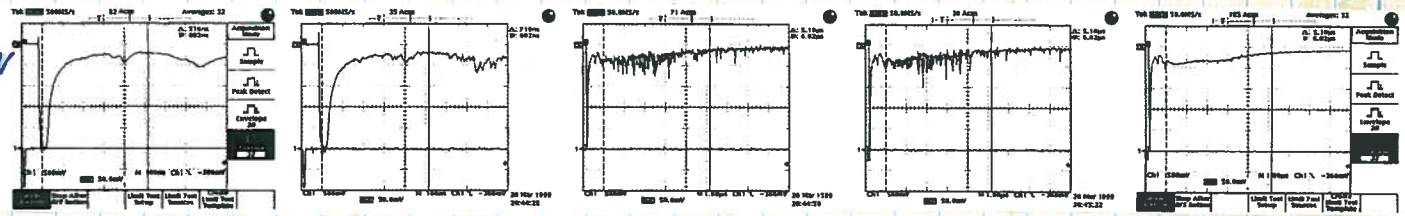


2300V

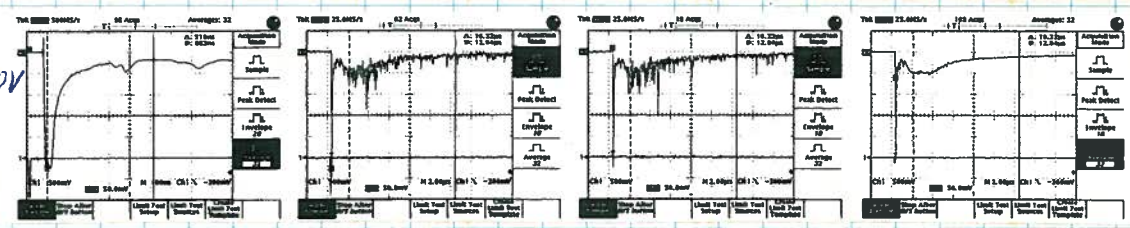




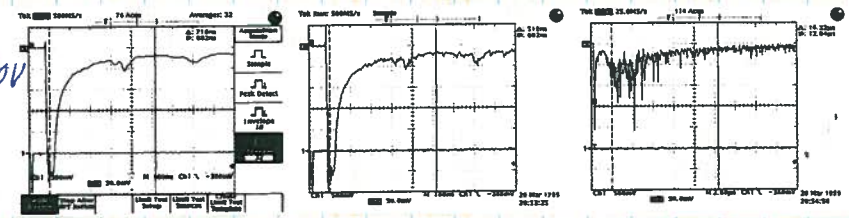
2500V



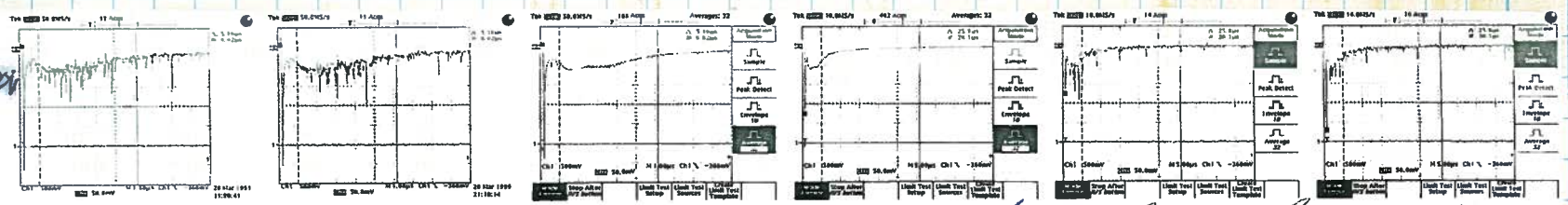
2700V

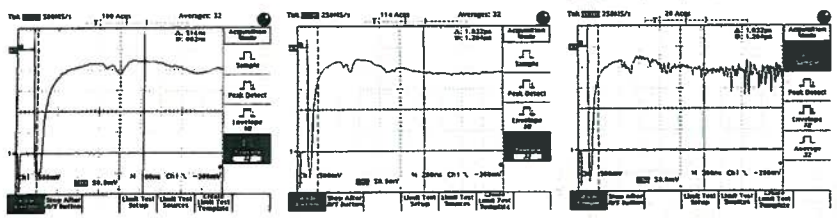


2900V



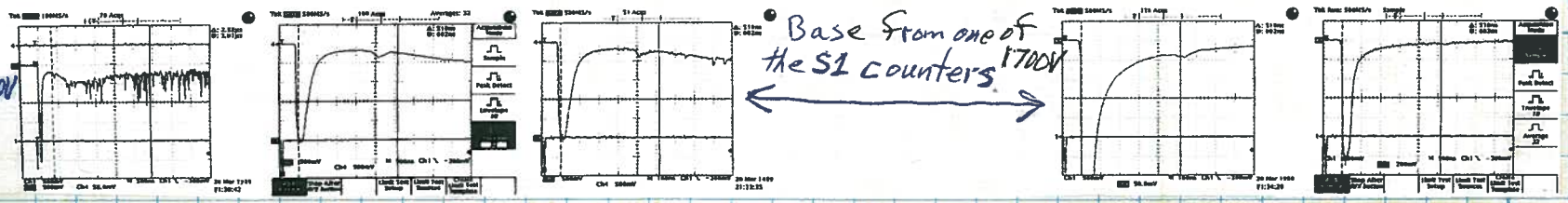
2700V





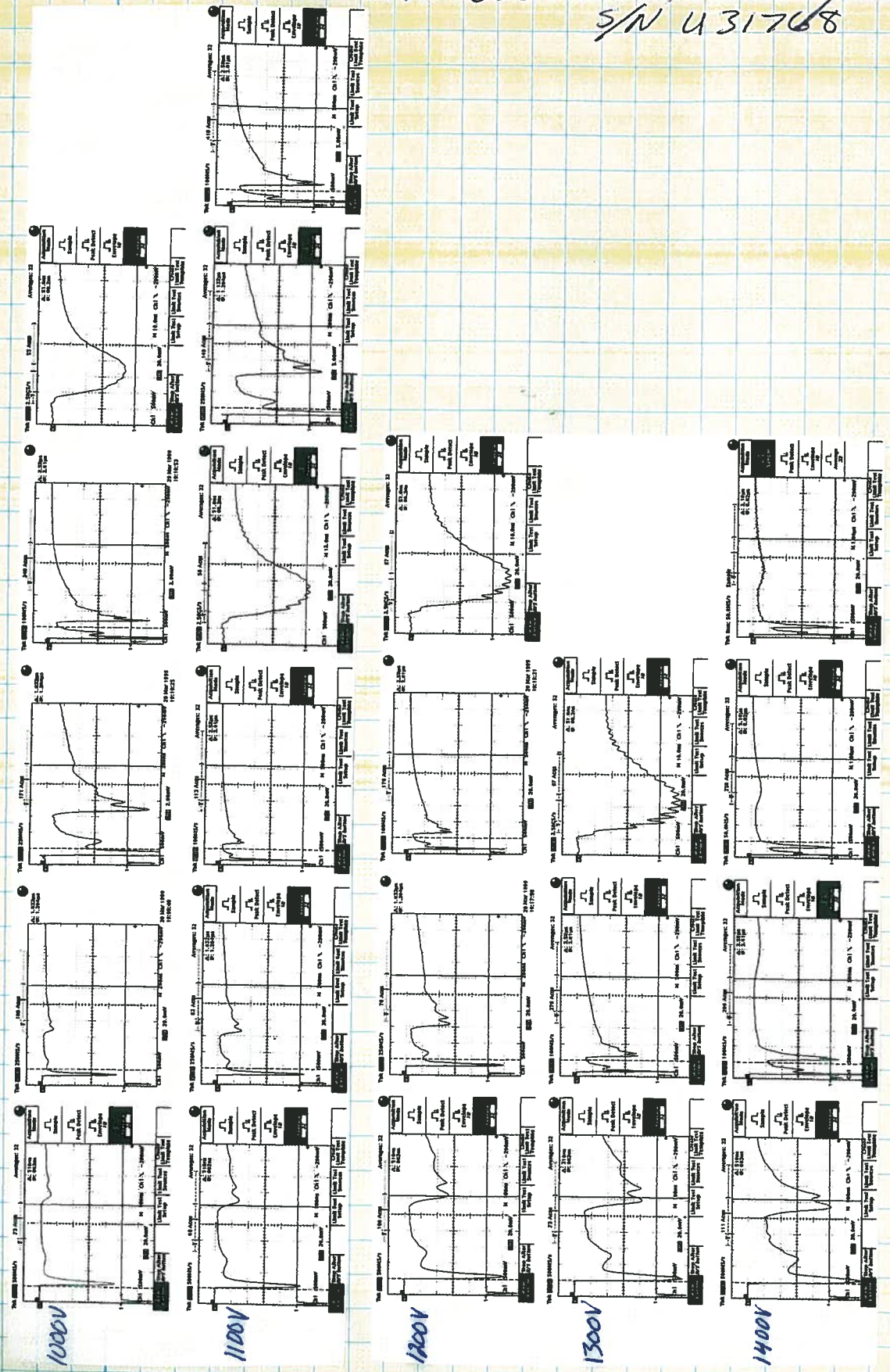
Among the other problems with my 8575 base, the dynode shield was floating. These last 2 rows are with the shield (pin 10) connected to dynode 5 (pin 3).

2700V

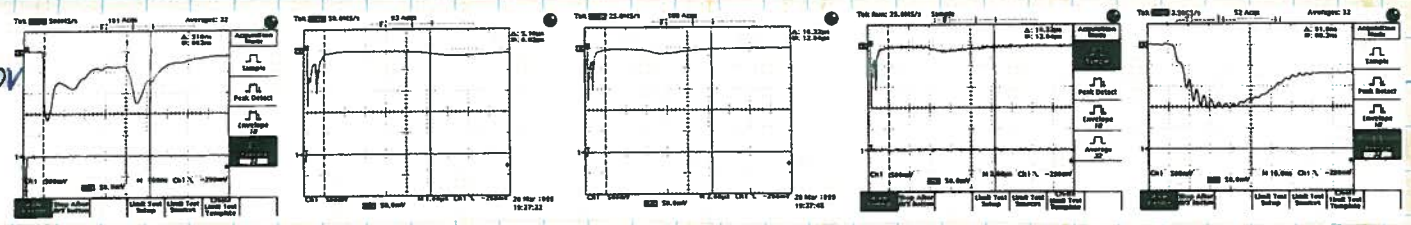


Base from one of the S1 counters 1700V

I also looked at the 8575 I'd removed from ES2/5R.
S/N U31768

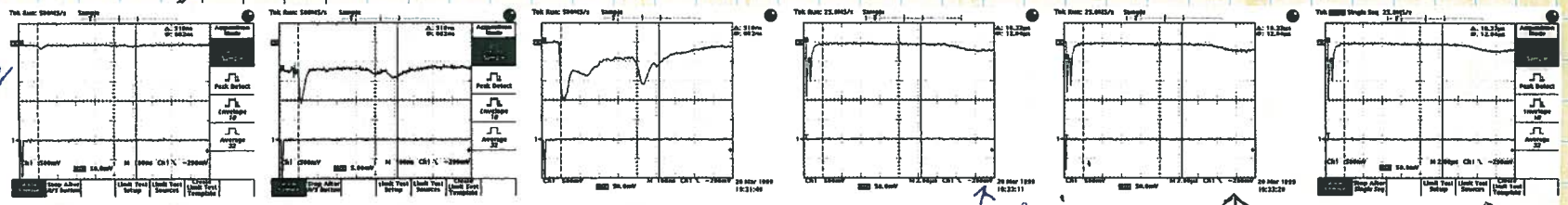


1500V

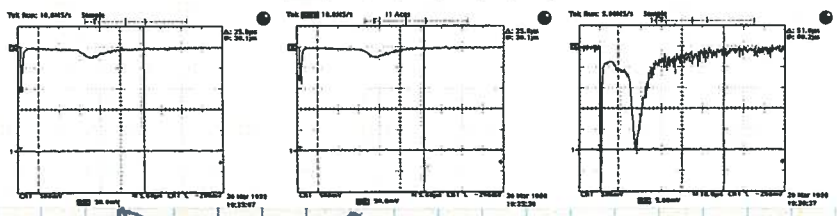


At almost 1600V the output from the anode became a small DC level. The second picture below shows that the PMT is still able to respond to the LED pulse. I switched the HV down 500V. I turned it back up and was able to take the next 7 pictures.

1596V



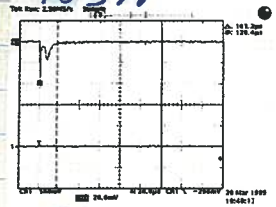
late bump had a fair amount of jitter to it



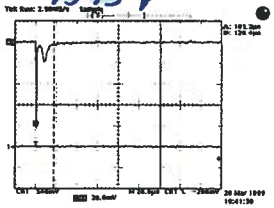
again, trying to show the extent of the jitter

While playing around at ~1600V I noted the late bump would move further away from the LED pulse as the voltage was increased. Just prior to a DC anode level output the bump would shift outward quickly. I tried to demonstrate this in the pictures below.

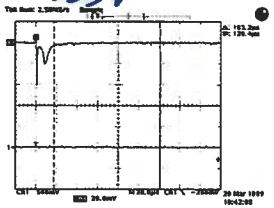
1537V



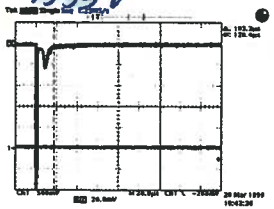
1545V



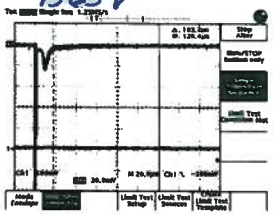
1555V



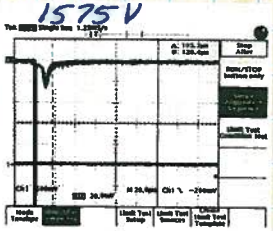
1555V



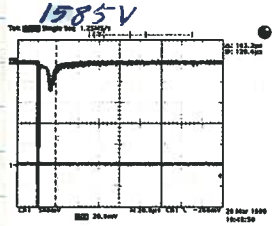
1565V



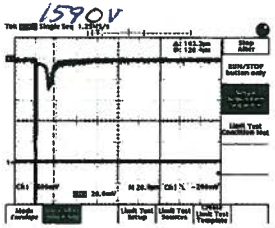
1575V



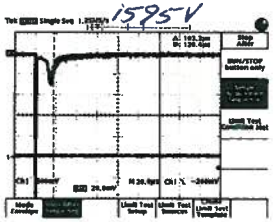
1585V



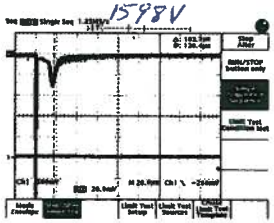
1590V



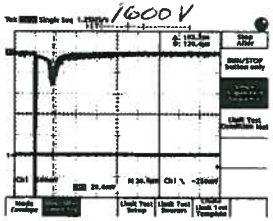
1595V



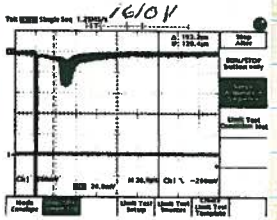
1598V



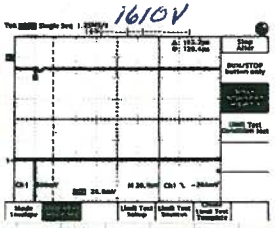
1600V



1610V



1610V

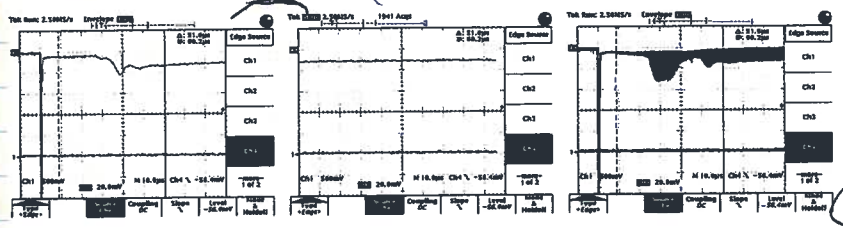


(envelope set to 10)

Triggering on Ch4. trigger is in "normal" mode. A DC output will not trigger it unless very close to the trigger level

Scope quit triggering after this trace. Assumed DC out on Anode.

same trace

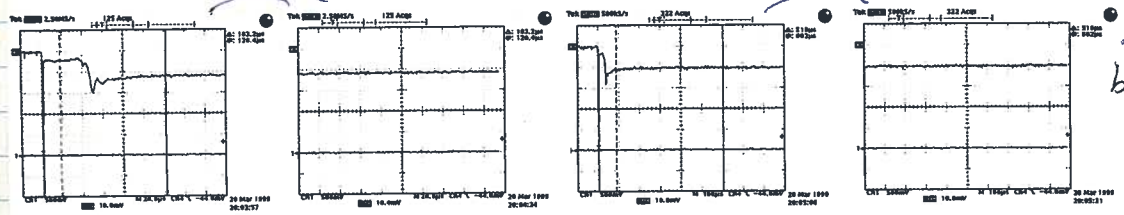


Just before scope quits triggering the late bump moves out ~35 μs and then the scope quickly stops triggering.

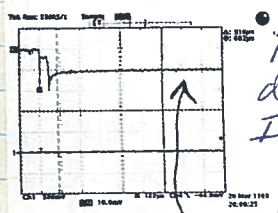
(envelope set to 10)

same trace

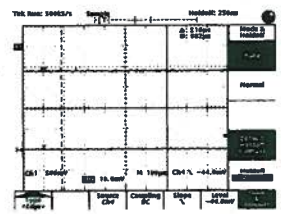
same trace

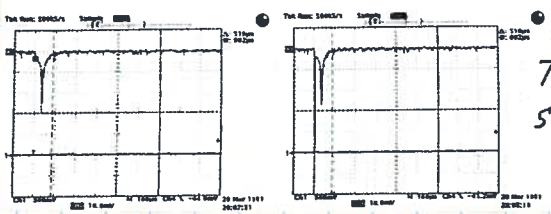


A couple more of the last trace before the scope stopped triggering.



This was the last trace displayed on the scope.
I switched to "Auto" trigger mode in order to confirm the anode DC output is the same as the "tail" of the trace





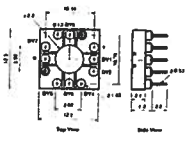
These were also common last traces.
Tube probably slipped into DC anode output before the scope could rearm after this trace.

The above pics were acquired by setting the HV to 1675. It would switch from -1175V to -1675V. As the voltage ramped up the tube would eventually develop a DC anode output.

HAMAMATSU

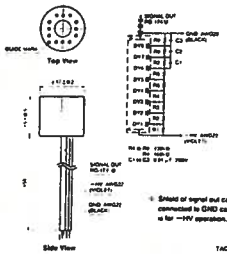
ACCESSORIES OPTION

● Socket E678-12M (Unit: mm)

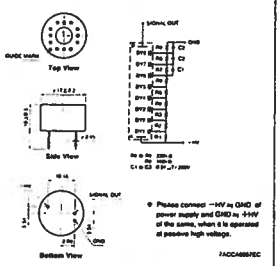


● D Type Socket Assemblies (Unit: mm)
The D type socket assemblies have a built-in voltage divider in a plastic container.

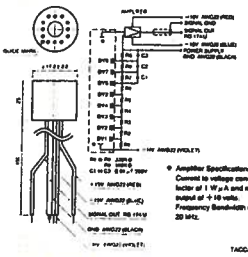
CABLE TYPE E5780



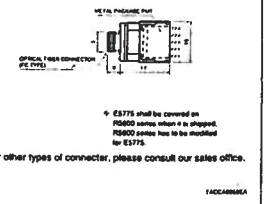
ON-BOARD TYPE E5770



● DA Type Socket Assemblies C5781 (Unit: mm)
The DA type socket assemblies feature a built-in voltage driver and amplifier.



● Optical Fiber Adaptor (FC Type) with Insulation Cover E5775 (Unit: mm)



For other types of connector, please consult our sales office.

SEGAL
HAMAMATSU

METAL PACKAGE PHOTOMULTIPLIER TUBE R5600 SERIES

Ultra Compact
TO-8 Metal Can Type 10mm Length, 15mm Diameter, Head-On Type

FEATURES

- "METAL PACKAGE PMT" the world smallest photomultiplier tube in a TO-8 metal can (1/7 size volume compared to Hamamatsu R647) New generation of optical detector having the photomultiplier tube performance in a TO-8 size metal can.
- Newly developed "Metal Channel Dynode". Applying a thin layer, "Metal Channel Dynode" developed to make timing characteristics and linearity better.
- Enable to use for a photon counting detection. (R5600P Type)

▲Left: R5600, Right: R5600U

GENERAL

Parameter		R5600/R5600U/R5600P	-01	-03	-04	-06	Unit
Spectral Response		300 to 650	300 to 820	185 to 650	185 to 820	160 to 650	nm
Photocathode	Material	Bialkali	Multialkali	Bialkali	Multialkali	Bialkali	—
	Minimum Effective Area	8					mm ϕ
Window Material		Borosilicate		UV glass		Synthetic Silica	—
Dynode	Structure	Metal channel dynode					—
	Number of Stages	8					—
Case		TO-8 Metal can					—
Weight		R5600 Series: Approx. 4.1		R5600U/P Series: Approx. 4.2			g

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1000	Vdc
Average Anode Current		100	μA

METAL PACKAGE PHOTOMULTIPLIER TUBE R5600 SERIES

R5600/R5600U Series TYPICAL CHARACTERISTICS (at 25℃)

Parameter		R5600/R5600U	-01	-03	-04	-06	Unit
Cathode Sensitivity	Luminous (2856K)	70	100	70	100	70	μA/lm
	Blue	8	—	8	—	8	μA/lm-b
	Red/White Ratio	—	0.1	—	0.1	—	—
Current Amplification		3×10^5					—
Anode Sensitivity	Luminous (2856K)	21	30	21	30	21	A/lm
Anode Dark Current		0.5	1	0.5	1	0.5	nA
Time Response	Rise Time	0.65					ns
Pulse Linearity (at 5% deviation)		30					mA

* After 30min storage in darkness.
※ Anode characteristics are measured with a voltage distribution ratio shown below.

R5600P Series TYPICAL CHARACTERISTICS (at 25℃)

Parameter		R5600P	-01	-03	-04	-06	Unit
Cathode Sensitivity	Luminous (2856K)	70	100	70	100	70	μA/lm
	Blue	8	—	8	—	8	μA/lm-b
	Red/White Ratio	—	0.1	—	0.1	—	—
Current Amplification		5×10^4 (MIN.) / 7×10^4 (TYP.)					—
Anode Sensitivity	Luminous (2856K)	49	70	49	70	49	A/lm
Dark Count (R5600P Series) **		80	500	80	500	80	cps
Time Response	Rise Time	0.65					ns
Pulse Linearity (at 5% deviation)		30					mA

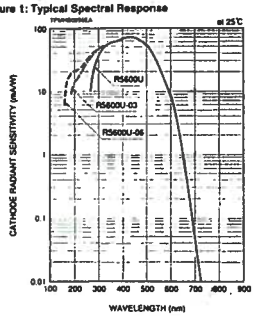
** After 30min storage in darkness and at 10^6 current amplificaiton.
※ Anode characteristics are measured with a voltage distribution ratio shown below.

VOLTAGE DISTRIBUTION RATIO AND SUPPLY VOLTAGE

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	P
Ratio	1	1	1	1	1	1	1	1	1	0.5

Supply Voltage: 800Vdc, K: Cathode, Dy: Dynode, P: Anode

Figure 1: Typical Spectral Response



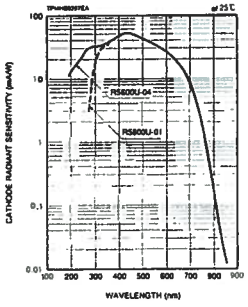


Figure 2: Typical Current Amplification

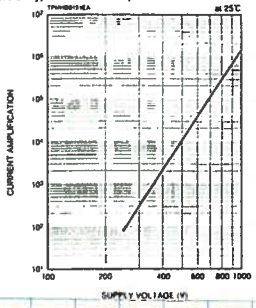
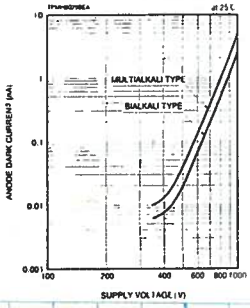


Figure 3: Anode Dark Current Characteristics

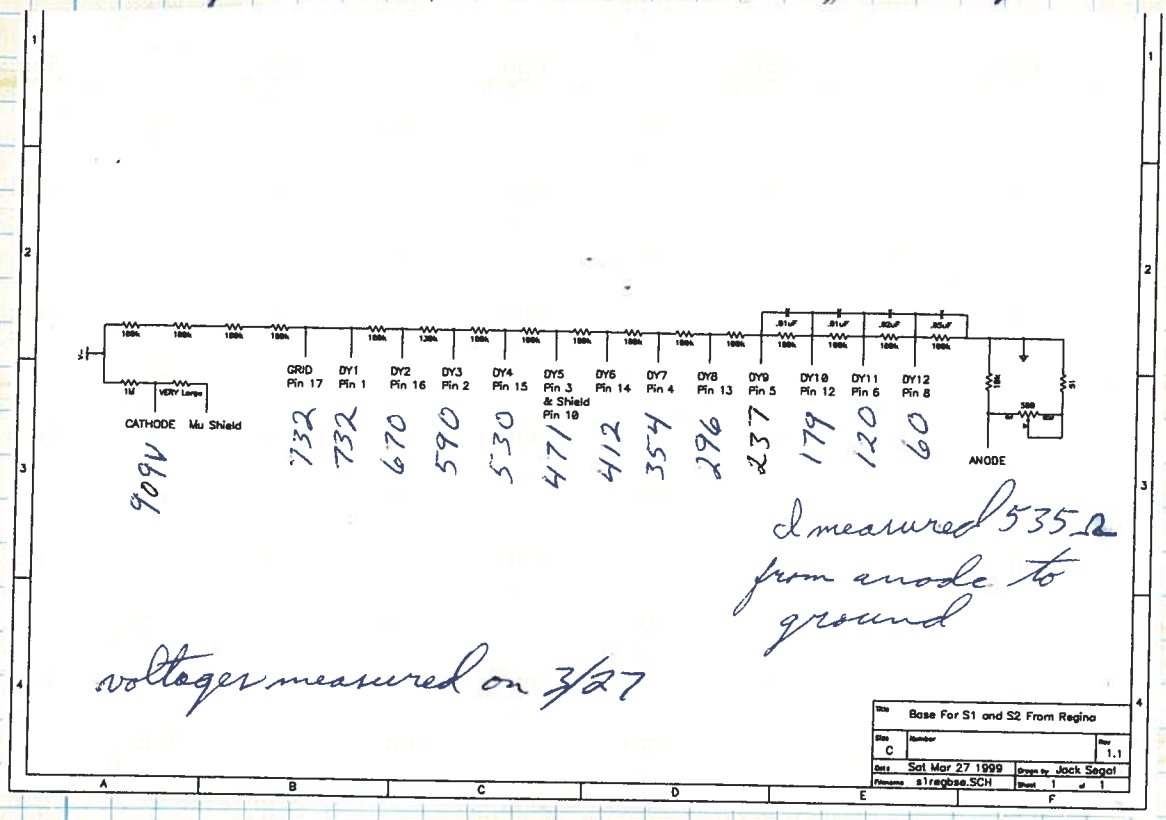


Base for R5600 has 69.8k on each stage with 2 of the 69.8k in parallel from the last dynode to ground. 51.1 is from the anode to ground for back termination. There are 5 capacitors, 2 of them are on the last dynode.

3/27 8575 PMT's w/ Regina Base and Av. Pulser LED
JS

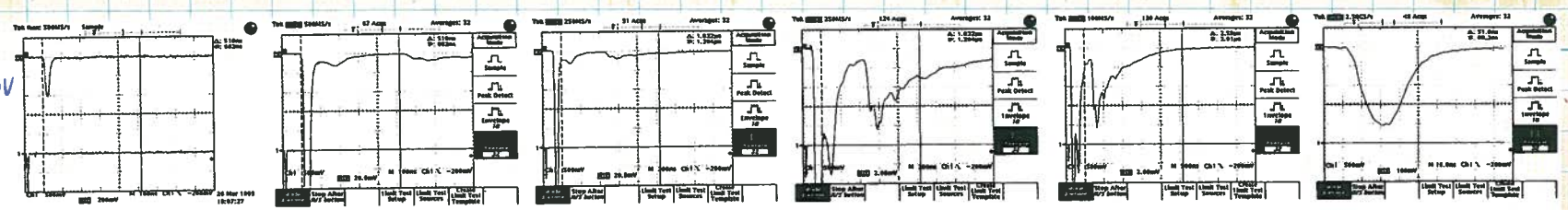
This was done yesterday (3/26)
Used the same setup from pp 105 to 119.
Substituted the base from HS1/6R to power the 8575's

As far as I can tell the base from Regina is

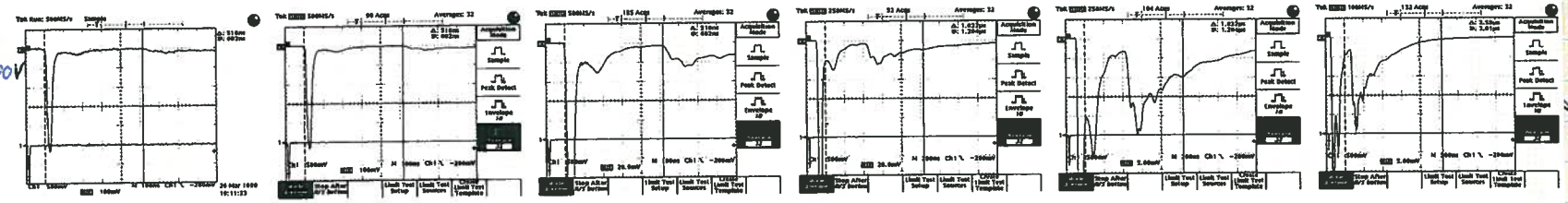


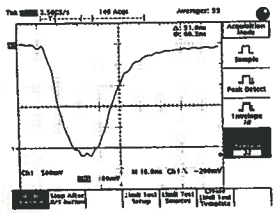
Startup by looking at S/N 131768 from ESA/SR

1000V

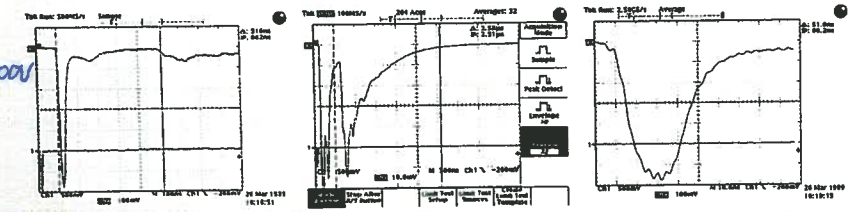


1100V

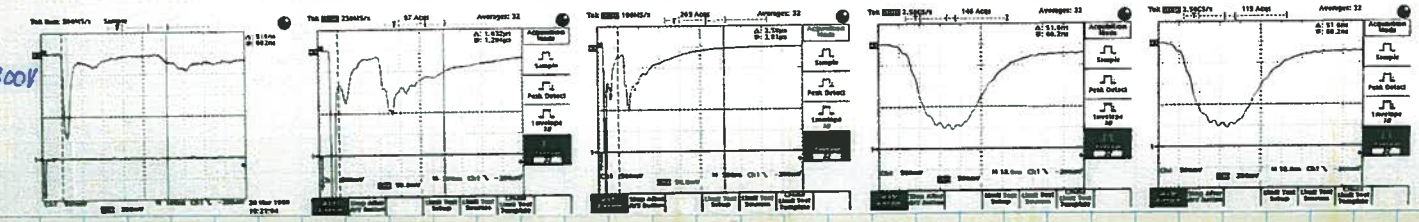




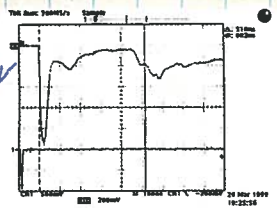
1200V

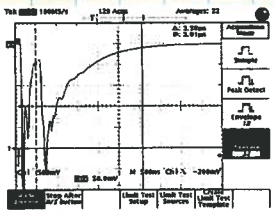


1300V

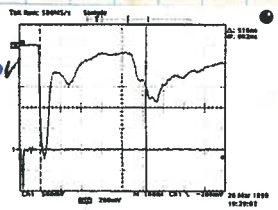


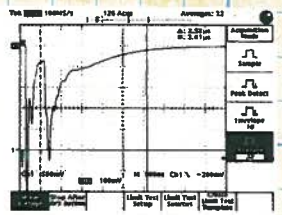
1400V



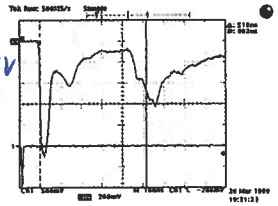


1500V

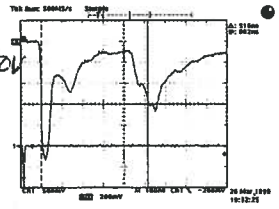


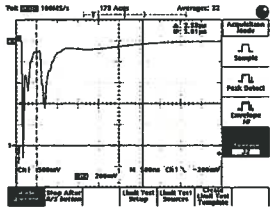


1525V

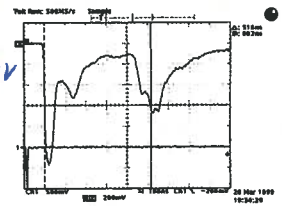


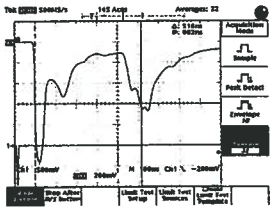
1550V

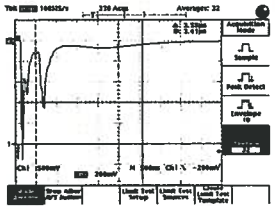




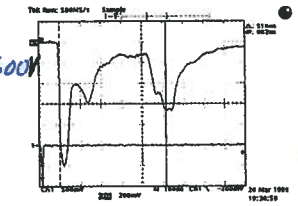
1575V

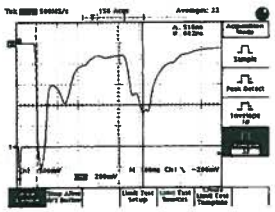


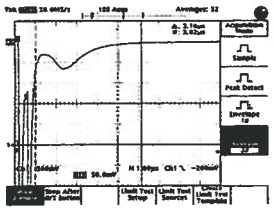


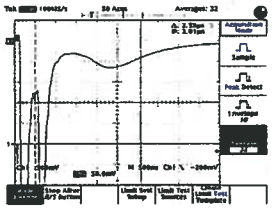


1600V

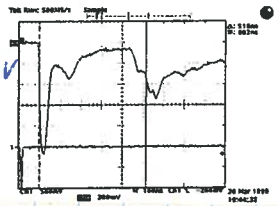


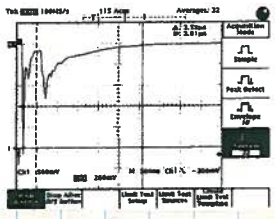


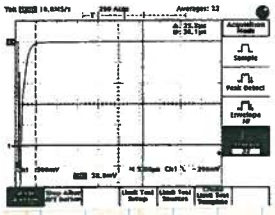


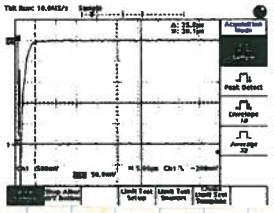


1500V



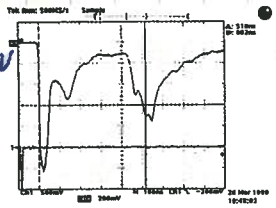
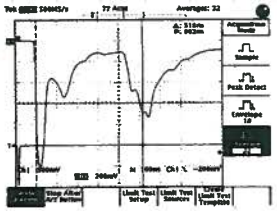
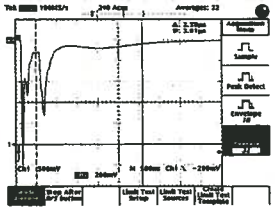
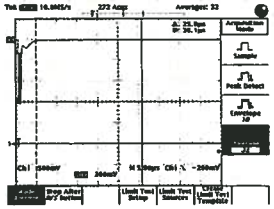




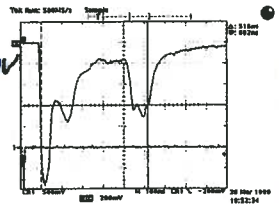
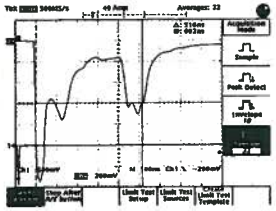
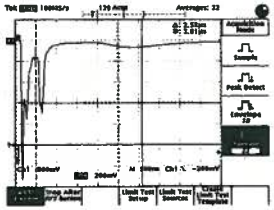
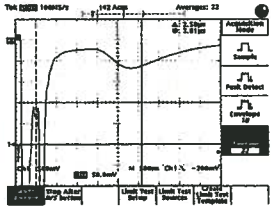
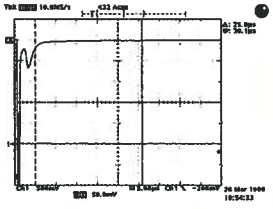
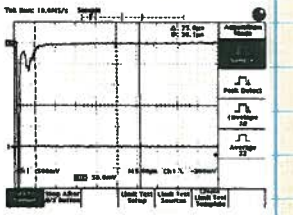


at this point I cranked the HV up to see where the tube goes DC out on the anode. Still had plenty of room to go. Note the after pulsing amplitude decrease from 1575 to 1600. Started over at 1500V.

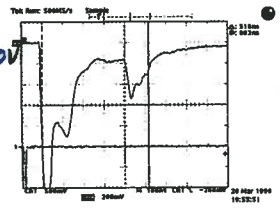
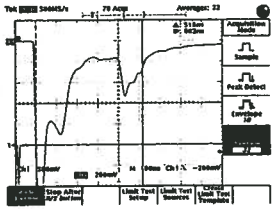
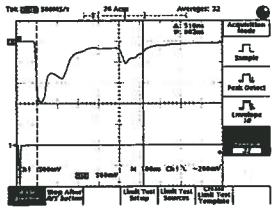
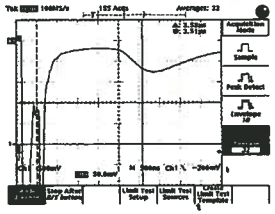
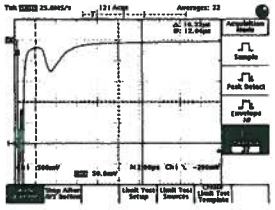
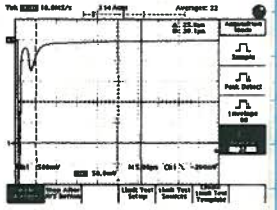
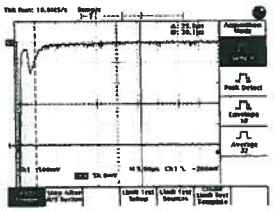
1600V

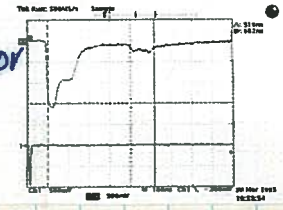
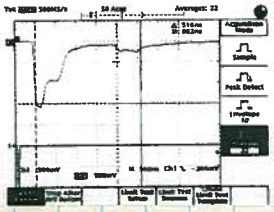
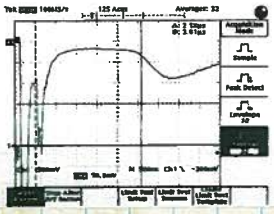
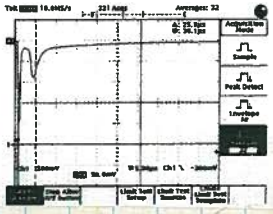
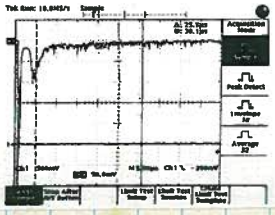
1700V

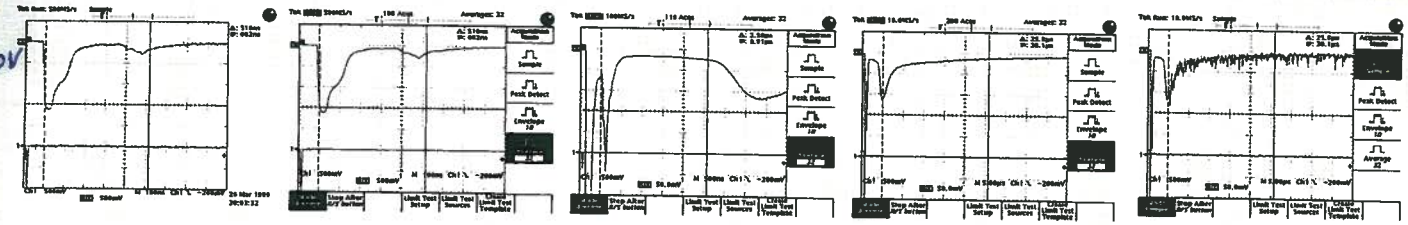
1800V

1900V

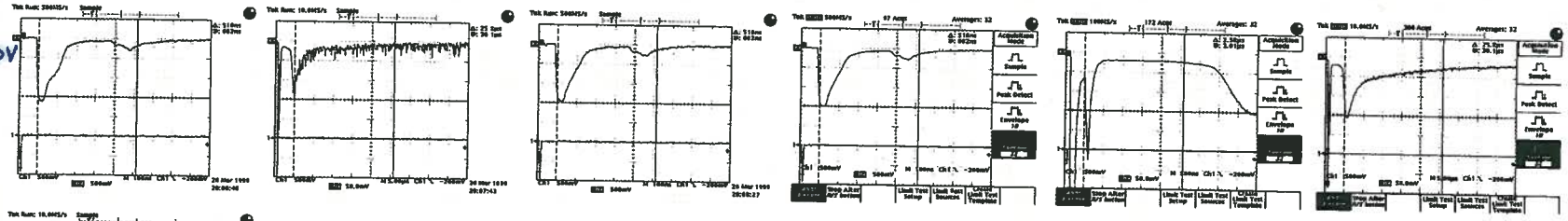






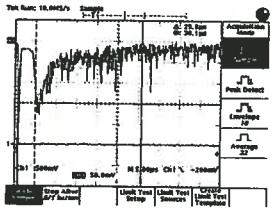
2000V



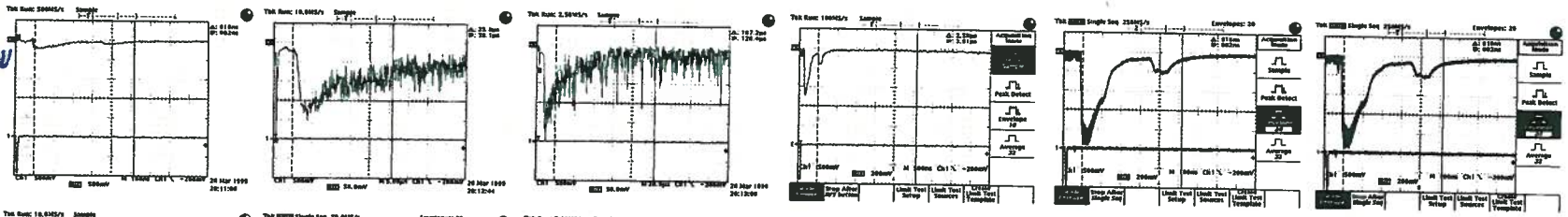
turned "fine" adjust to 0 and "coarse" to 2000V
run 2000V again

2000V

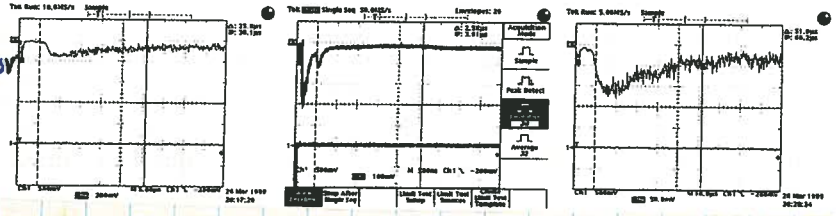




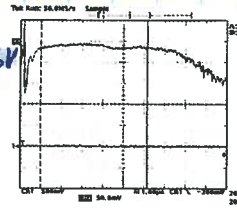
2200V

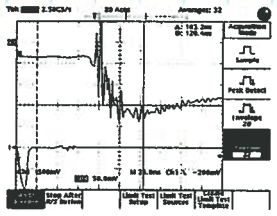


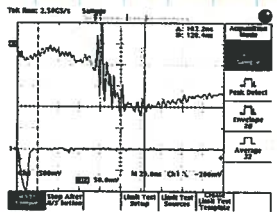
2230V



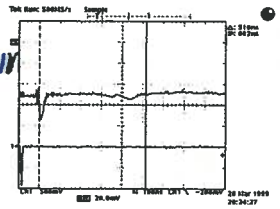
2286V

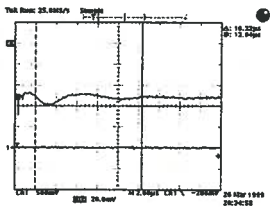


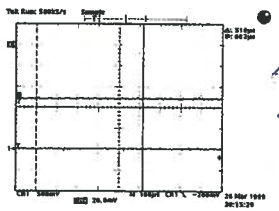




2301V

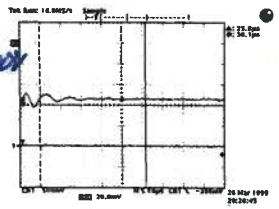




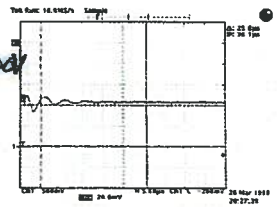


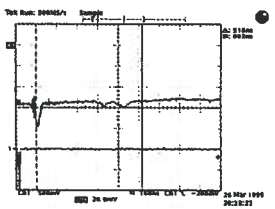
went to DC output on anode at 2301V

2400V

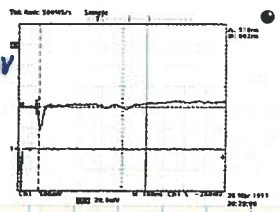


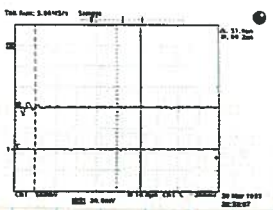
2500V



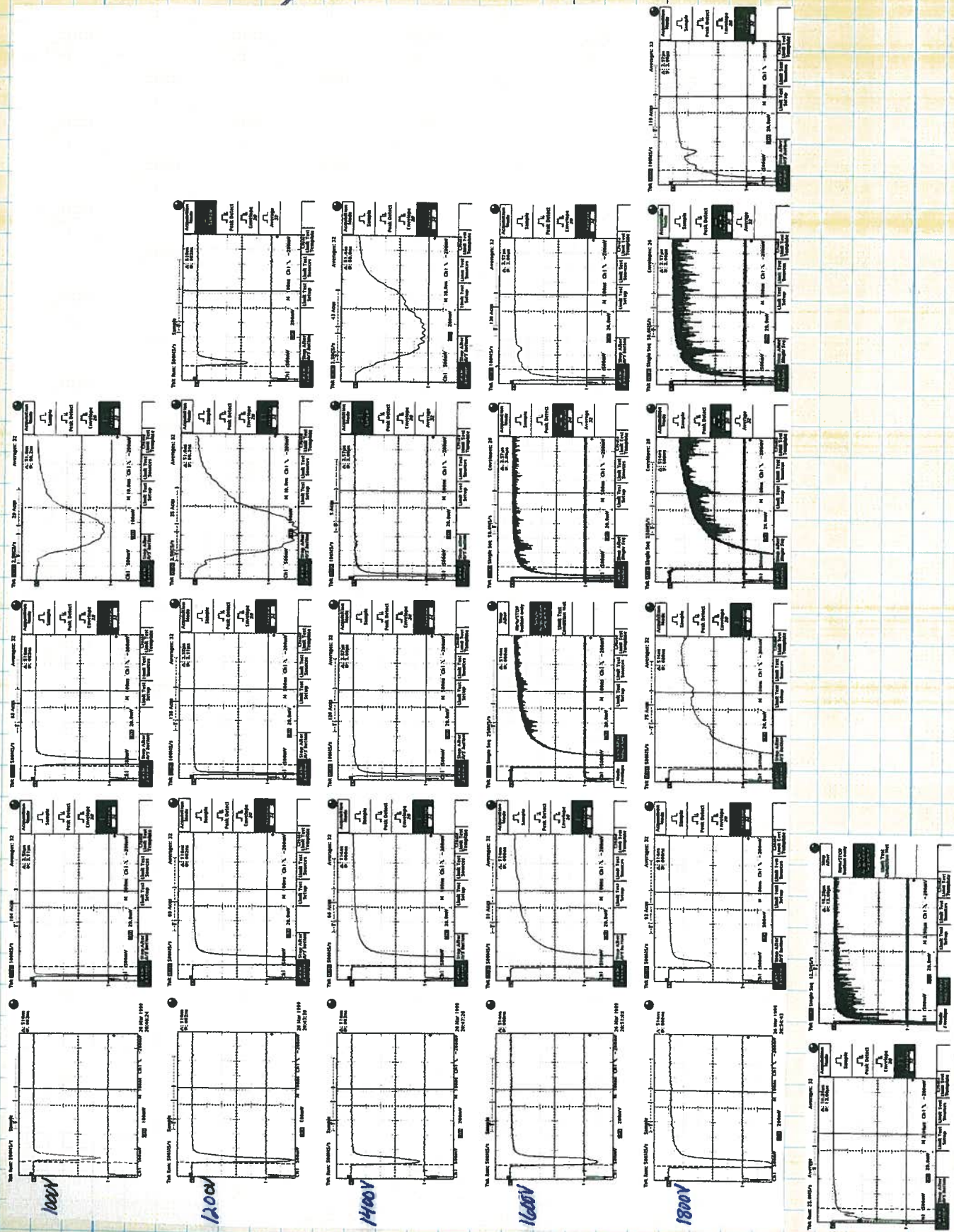


2600V

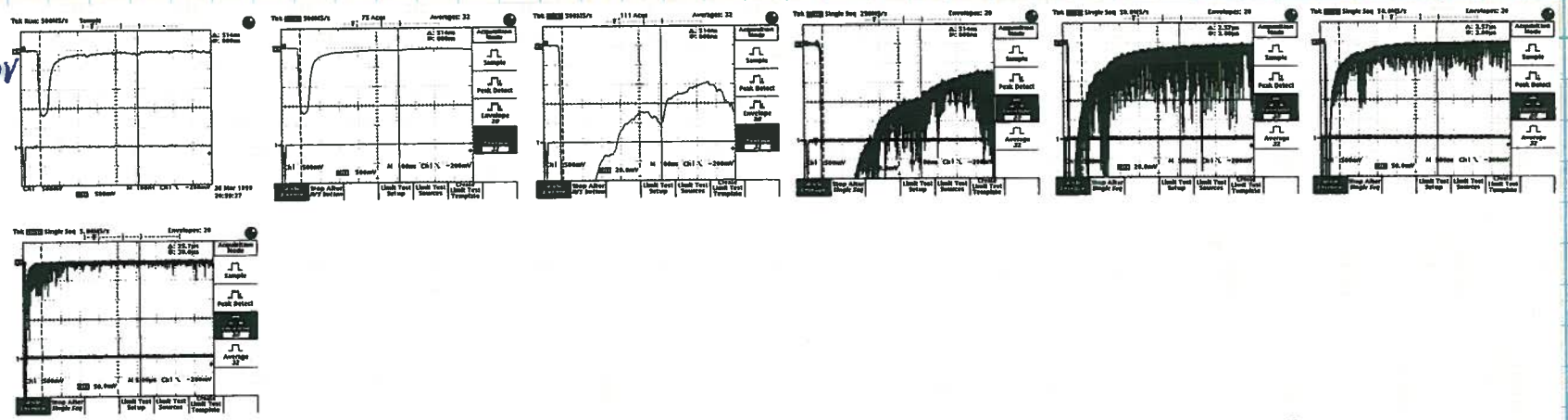




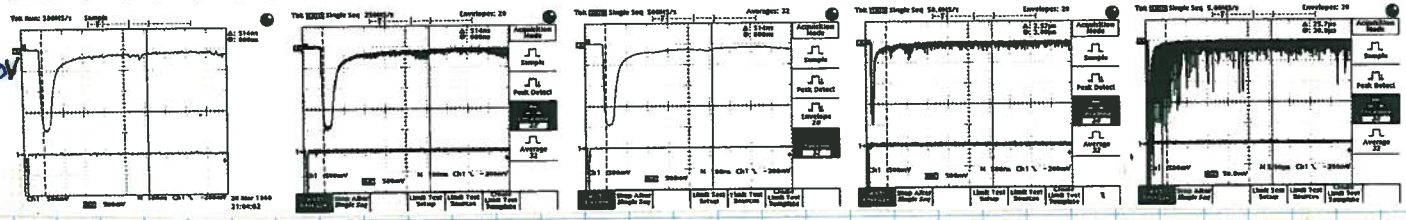
Next I got one of the brand new tubes that just arrived from Burle. S/N T51842



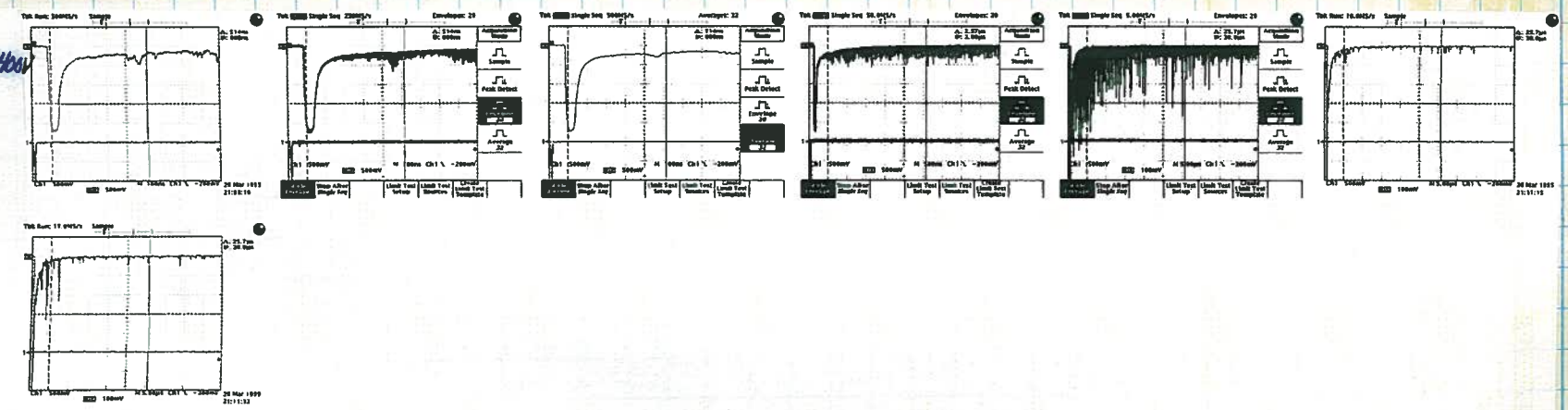
2000V



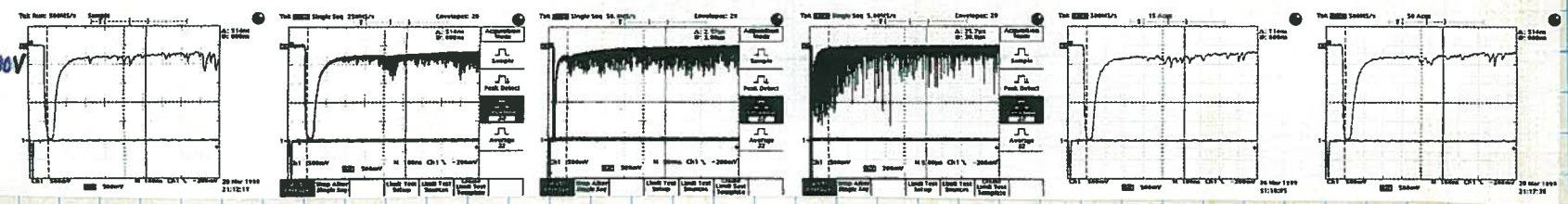
2200V



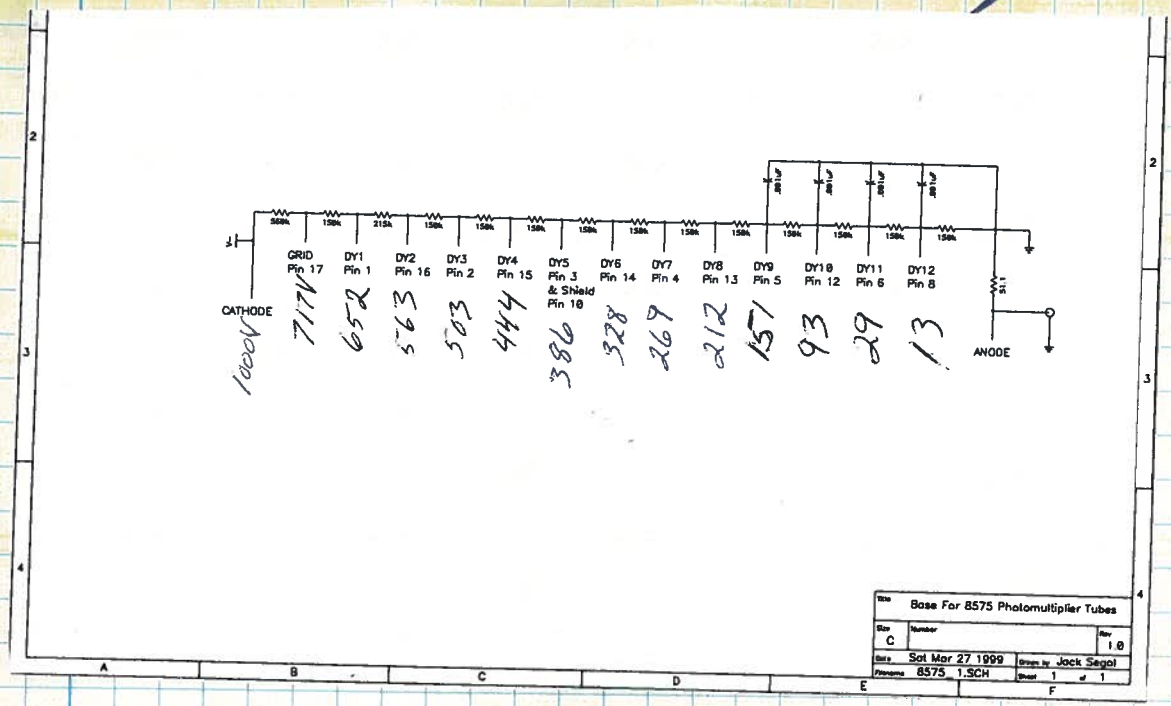
2400V



2600V



Attempting to find why my base has so much less gain compared to the Regina base.
I re-examined the base and find



Looks like I did not make what I had intended. (see p. 73 and bottom of p. 71) Oh, well.

I set the Bertan supply to 1000V on the "coarse" dial and checked voltages on the two bases using a Wavetek
Voltages are noted on the two schematics.
(this page & p. 122)

PMT's & Bases From HS1/6 & ES1/6 3/27

HS1/6 & ES1/6 counters have been removed for HARPEX. They are in storage in room 122.
I will test them because they are convenient.

ES1/6R base housing had a tag saying S/N N30432 for tube inside the tube was S/N U31776, actually

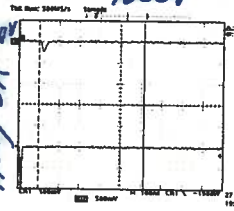
ES1/6L base housing had a tag saying S/N N31828 for tube inside the tube was S/N T20204, actually

Below is a screen capture of the present settings on HAL 5. The Hadron Arm 1458 crate.

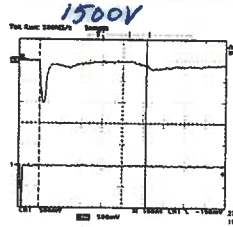
Channel	S	Meas uA	Meas V	Target V			Meas uA	Meas V	Target V
1.0	II	-1214.0	-1981.1	-1980.0	2.0	II	-1167.0	-1900.1	-1900.0
1.1	II	-1196.4	-1950.0	-1950.0	2.1	II	-1198.8	-1951.2	-1950.0
1.2	II	-1277.1	-2080.7	-2080.0	2.2	II	-1099.8	-1793.0	-1792.0
1.3	II	-1228.7	-2001.2	-2000.0	2.3	II	-1272.0	-2075.3	-2075.0
1.4	II	-1156.9	-1885.9	-1885.0	2.4	II	-1183.7	-1932.6	-1930.0
1.5		.7	-28.2	-1960.0	2.5		-.9	-30.7	-1820.0
1.6	II	-1314.5	-2140.8	-2140.0	2.6	II	-1216.0	-1981.2	-1980.0
1.7	II	-1184.7	-1926.4	-1925.0	2.7	II	-1326.0	-2162.0	-2160.0
1.8	II	-1338.1	-2181.4	-2180.0	2.8	II	-1228.7	-2001.9	-2000.0
1.9	II	-1287.4	-2100.9	-2100.0	2.9	II	-1208.1	-1976.5	-1975.0
1.10	II	-1227.7	-2001.3	-2000.0	2.10	II	-1225.4	-2001.3	-2000.0
1.11	II	-1120.7	-1826.1	-1825.0	2.11	II	-1178.1	-1922.6	-1920.0

HS1/6A

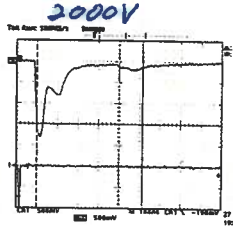
1000V



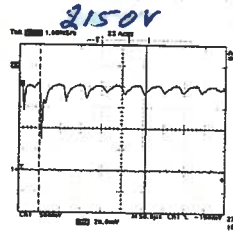
1000V



1500V



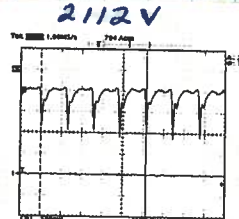
2000V



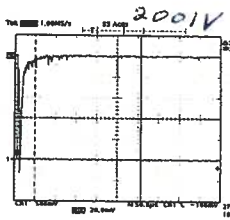
2150V

2150V

HP pulser unplugged from LED pulser

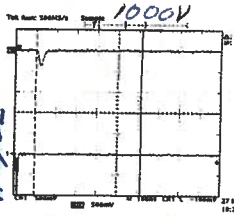


2112V

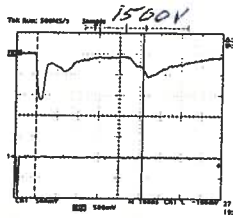


2001V

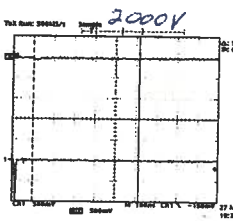
HS1/6L



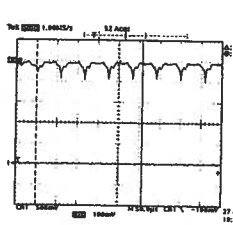
1000V

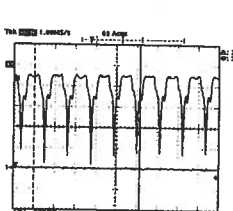


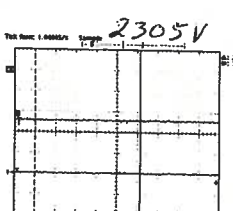
1500V



2000V

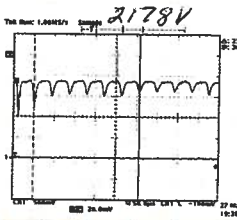




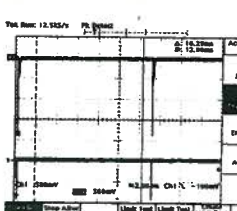


2305V

from 2305V I reduced to 2107V & the pulsing came back

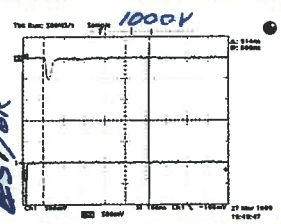


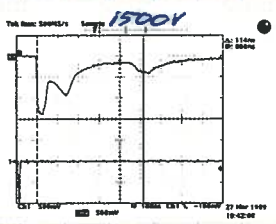
2178V

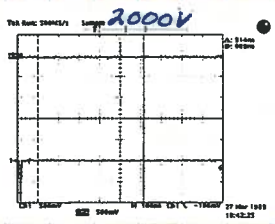


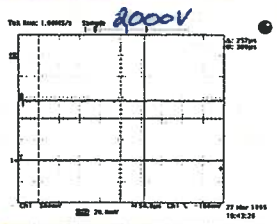
← just to show triggering freq.

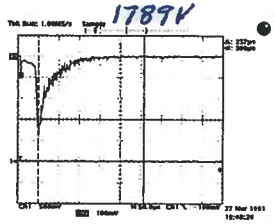
E51/6R

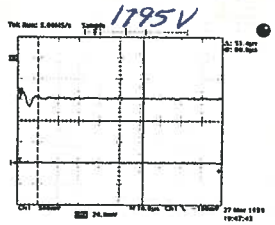

1000V

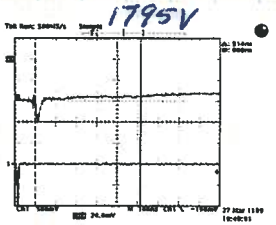

1500V

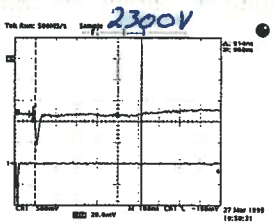

2000V


2000V


1789V

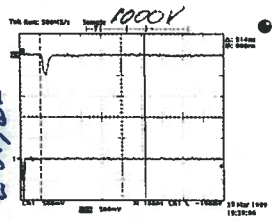

1795V

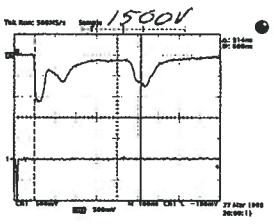

1795V

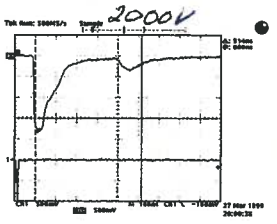

2300V

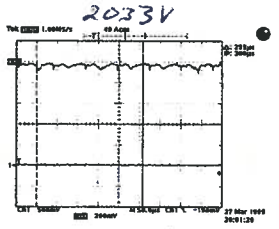
per bad ~1800V
never saw the "pulsing" on the 5 μs/div

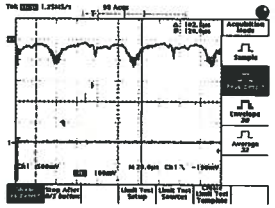
E51/6L

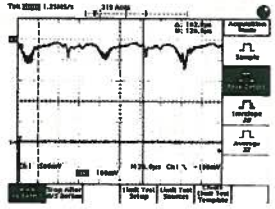

1000V


1500V

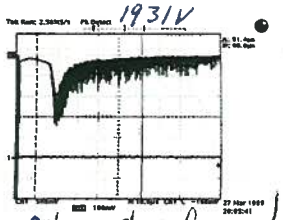

2000V


2033V

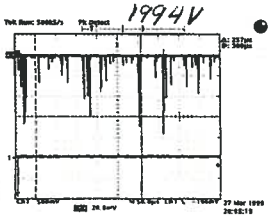


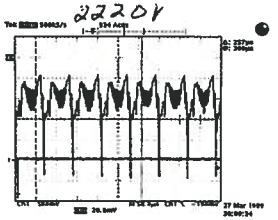


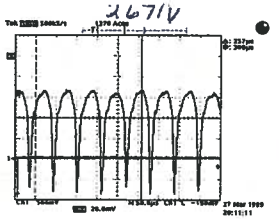
pulser unplugged from LED pulser

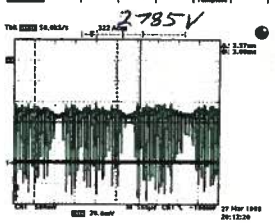

1931V

pulser plugged in


1994V


2220V


2671V

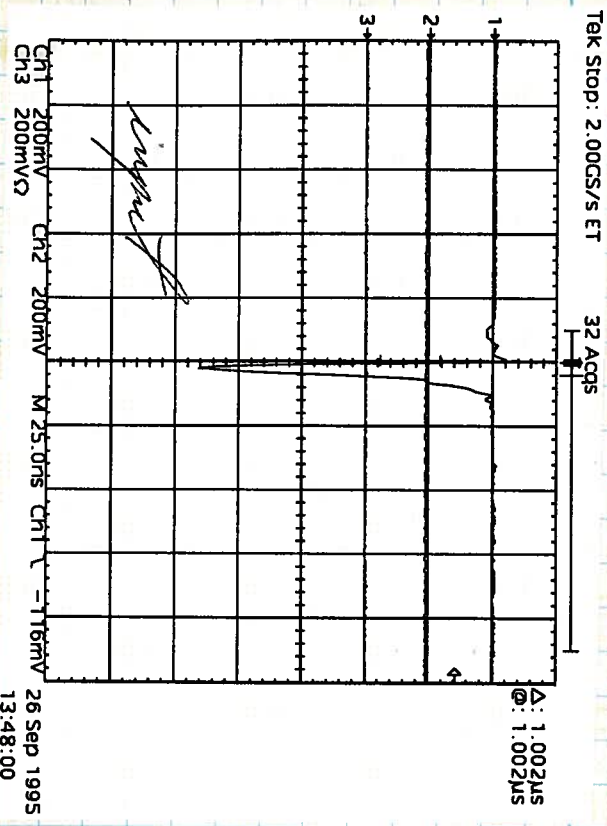

2785V

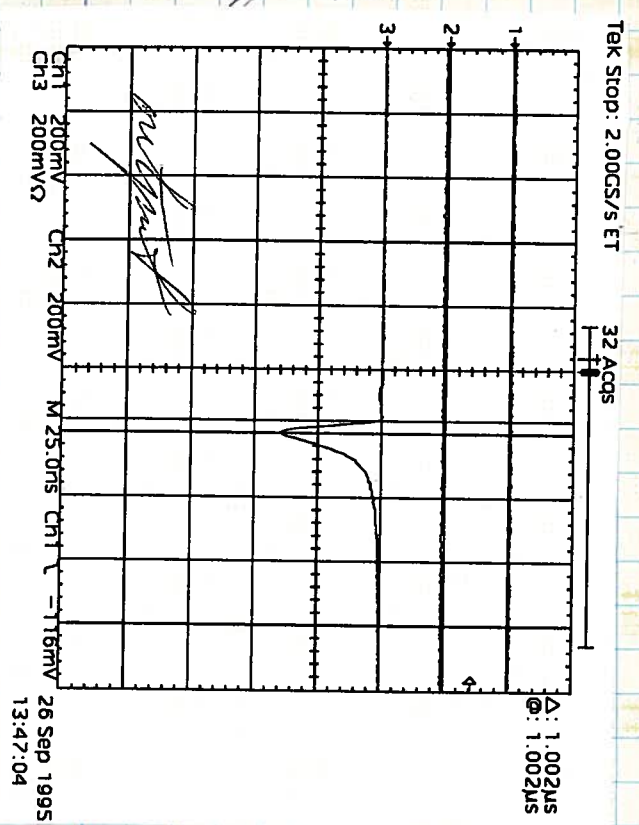
pulser disconnected for these last 4 pictures

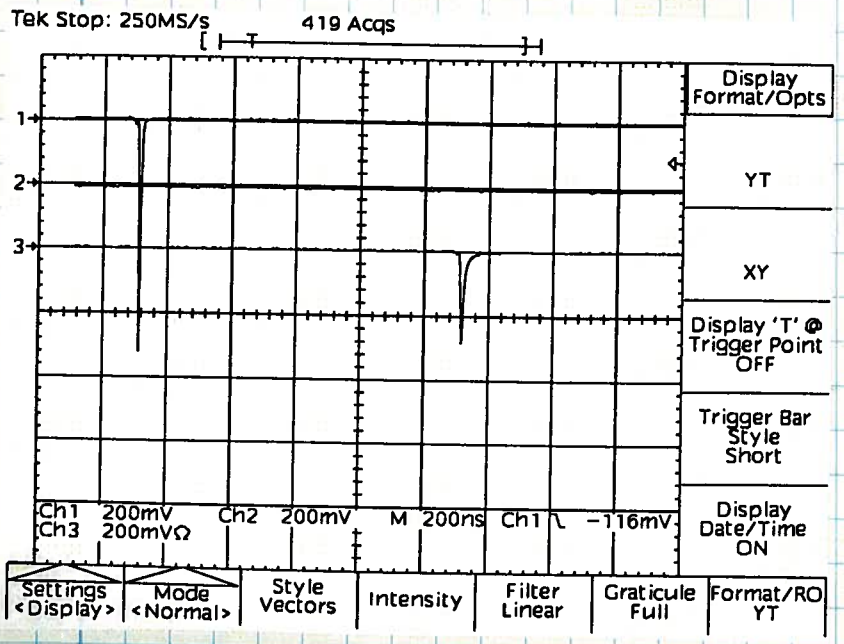
4/9/99 Attenuation in a Delay Spool

Way back in the dark recesses of time I looked at the attenuation in the delay spools for Hall A.

Input pulse and output for a spool of RG-213 used for Hall A.

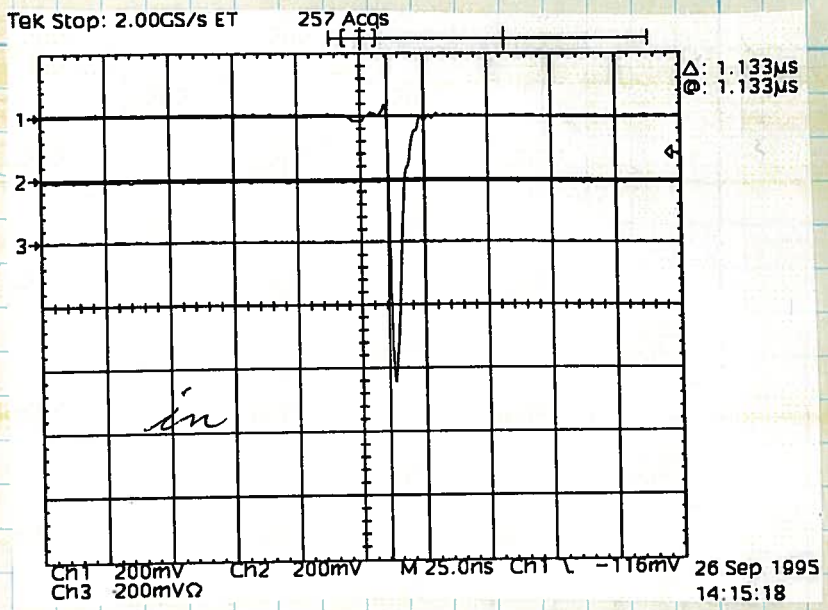


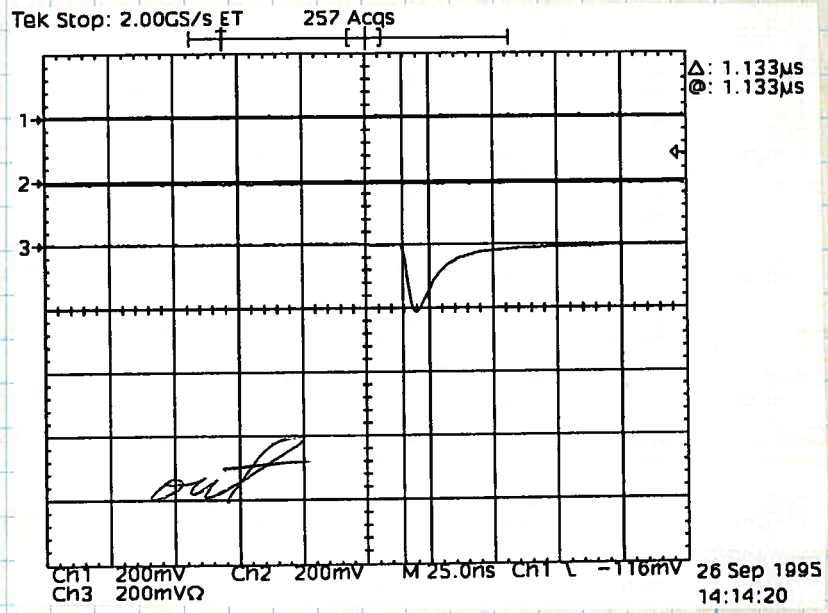


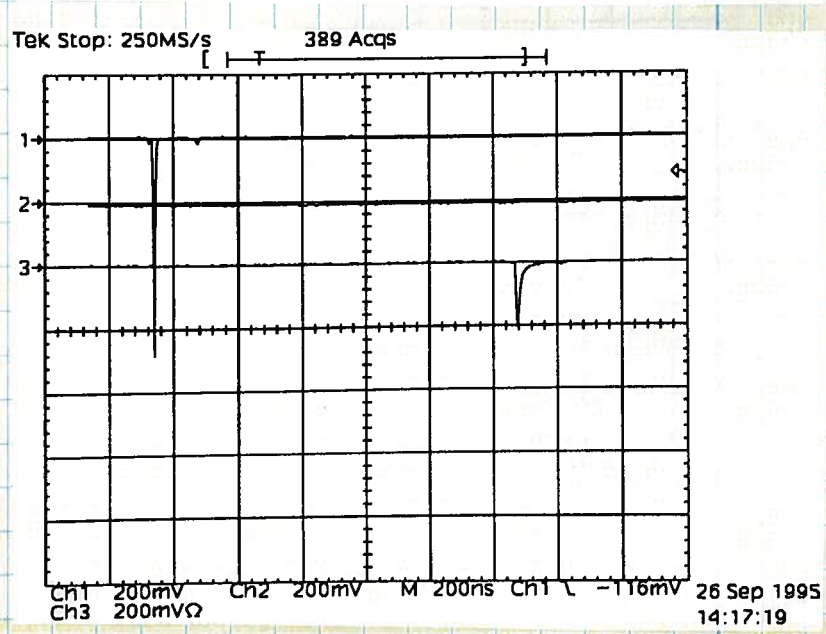


both in and out in one picture.

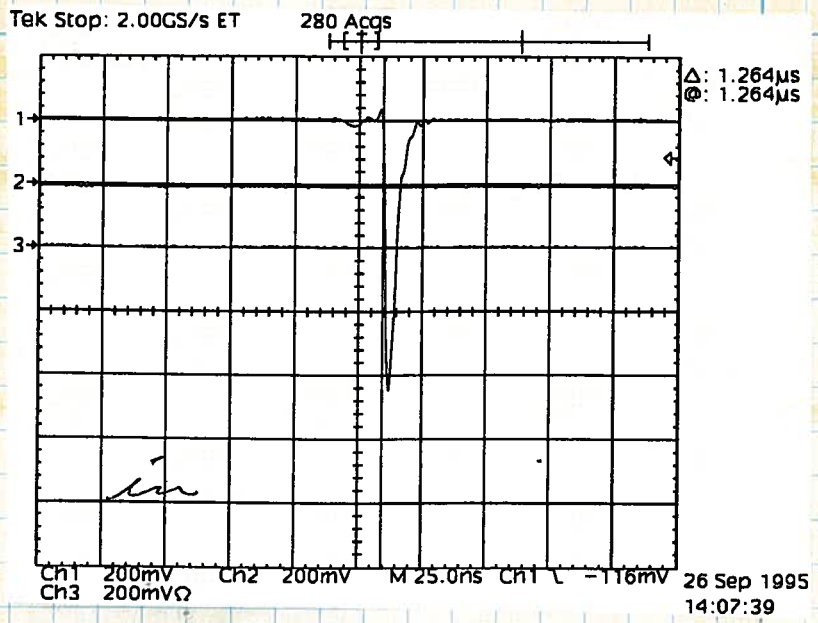
These were of a spool of RG-21B with 50' of IEEE 802-3 coax on each end.

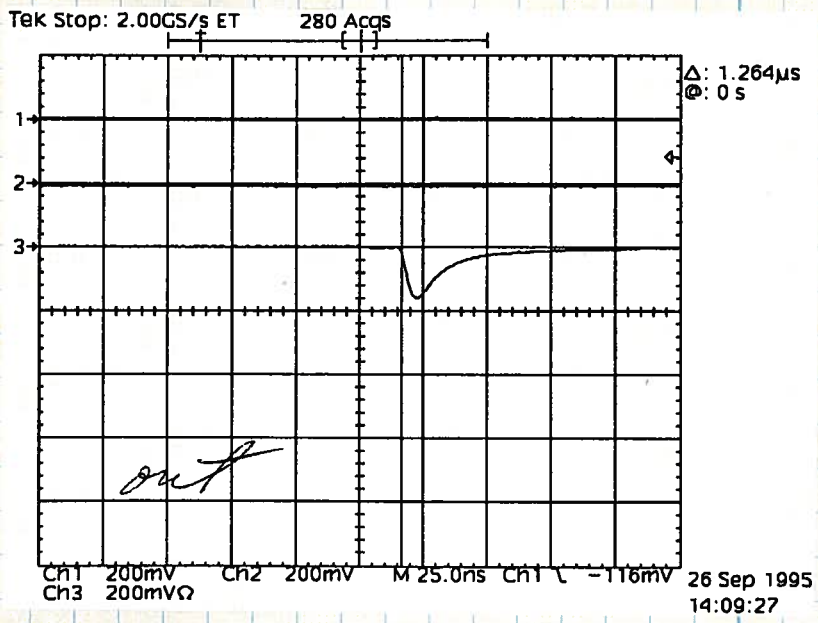


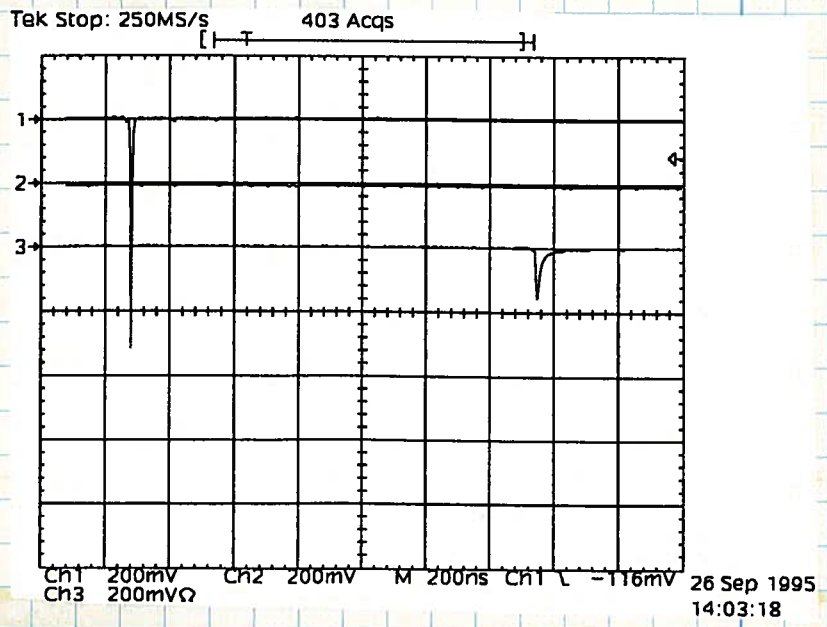




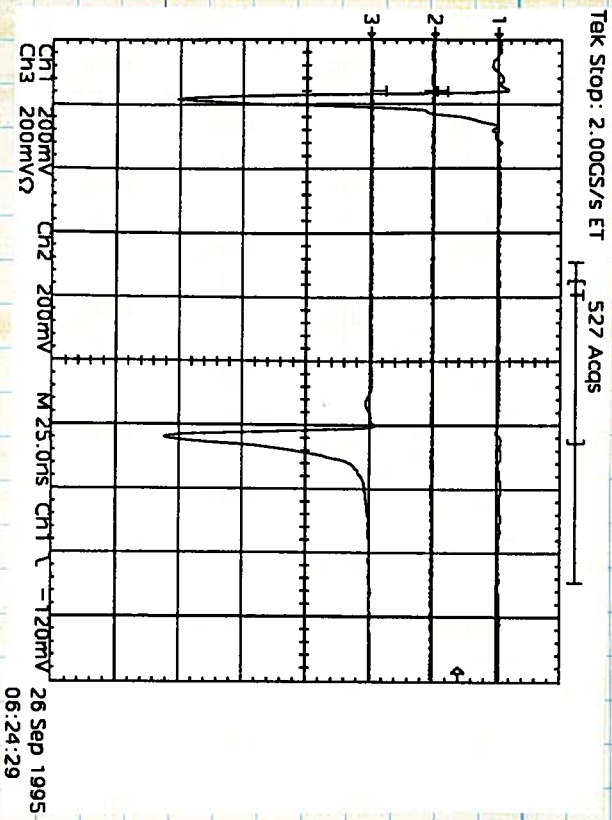
These were of a spool of RG-213 with 100' of IEEE 802.3 on each end of the spool.

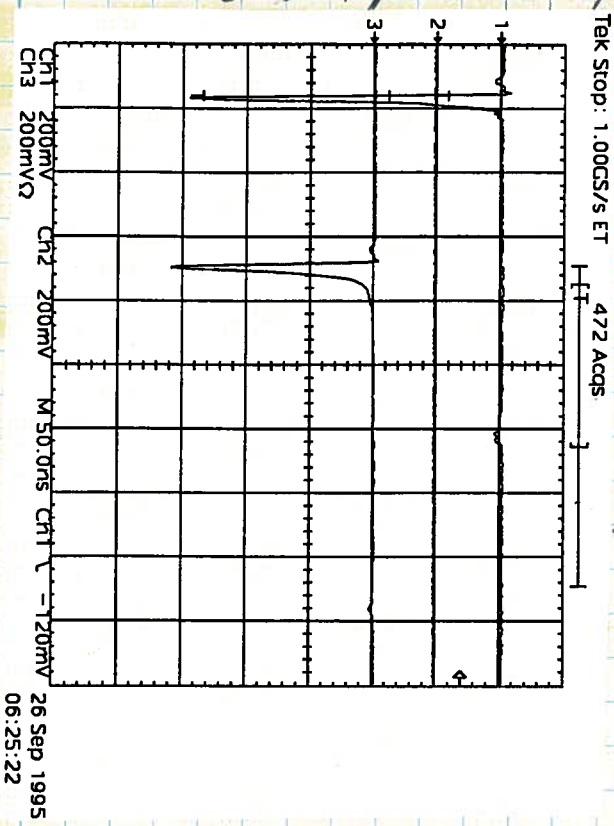




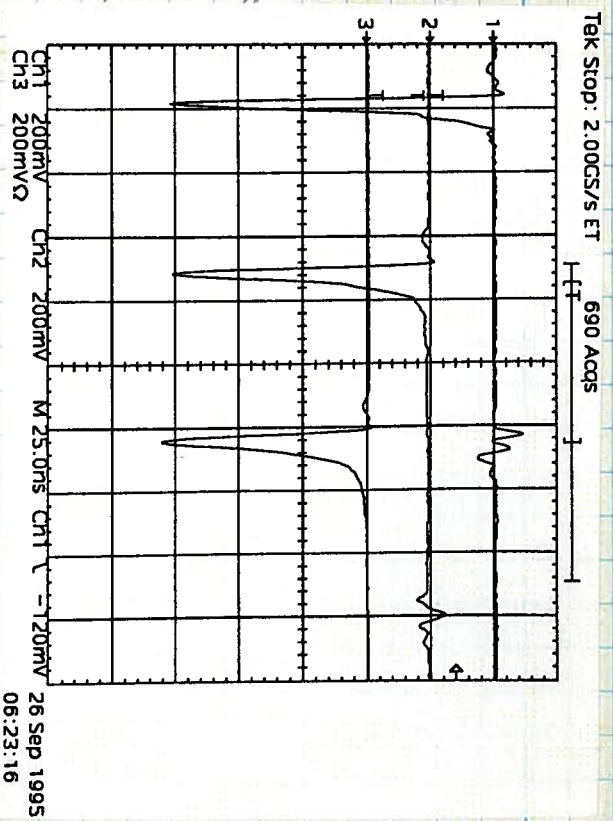


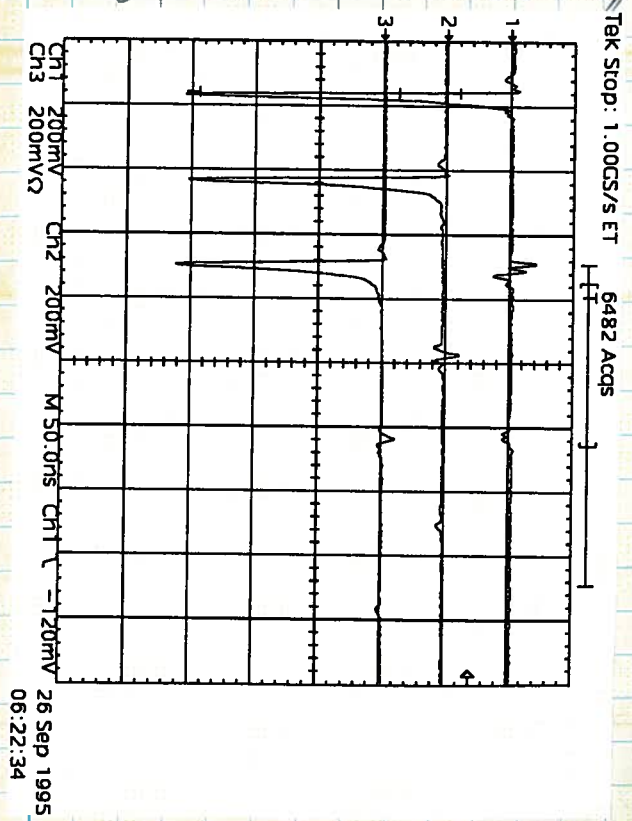
In and out for 100' of IEEE 802.3





In and out & middle for 2 of 50' of IEEE 802.3

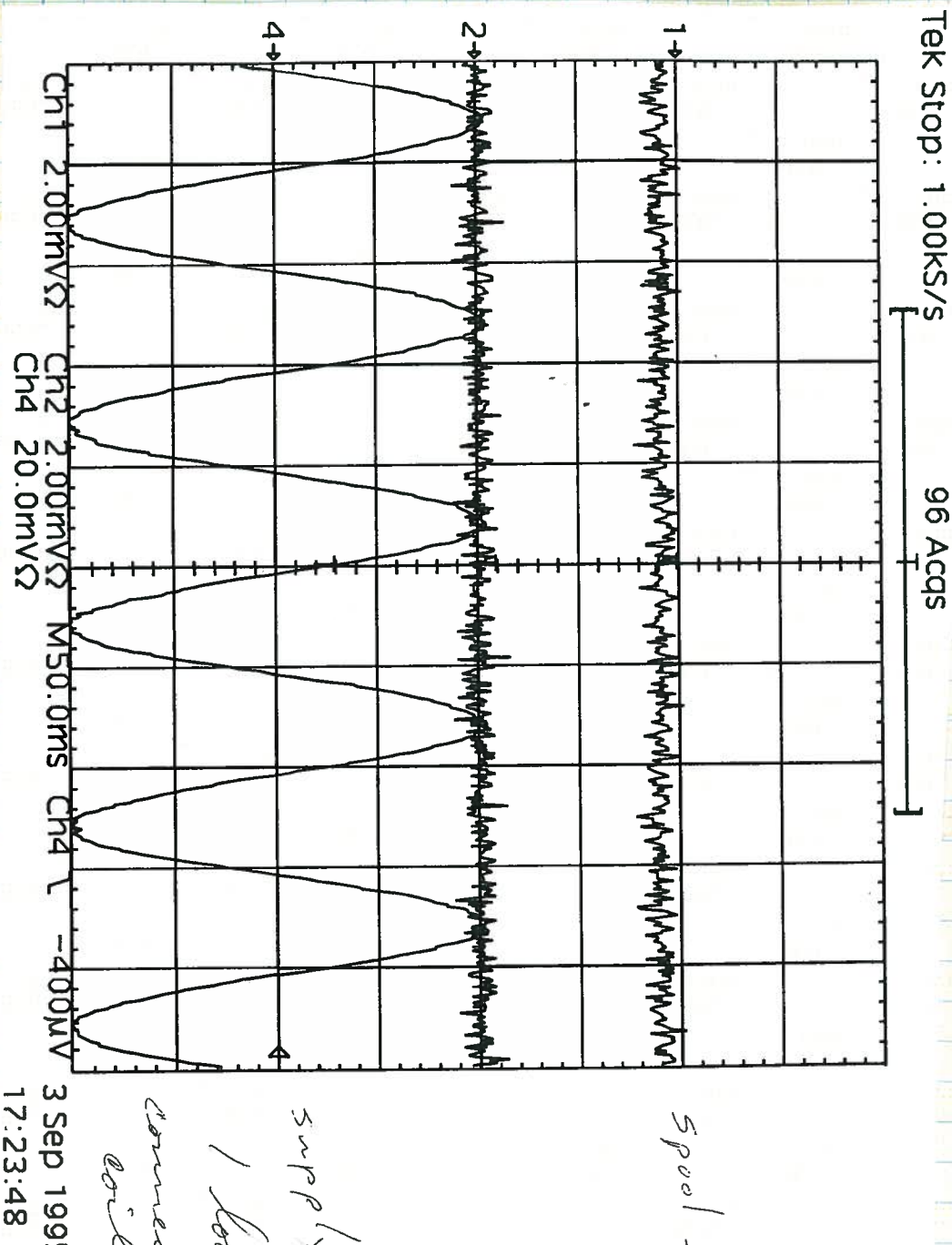




Induced Signal in a Delay Spool

At some point I also took one of the delay spools and set it up with the larger Helmholtz coils from Hall B and a Repco 1004 supply from the VDCx. The idea was to use the voltage control input of the Repco to vary the current frequency in the coils. By hooking the spool up to the scope input I wanted to find the induced current in the delay spool.

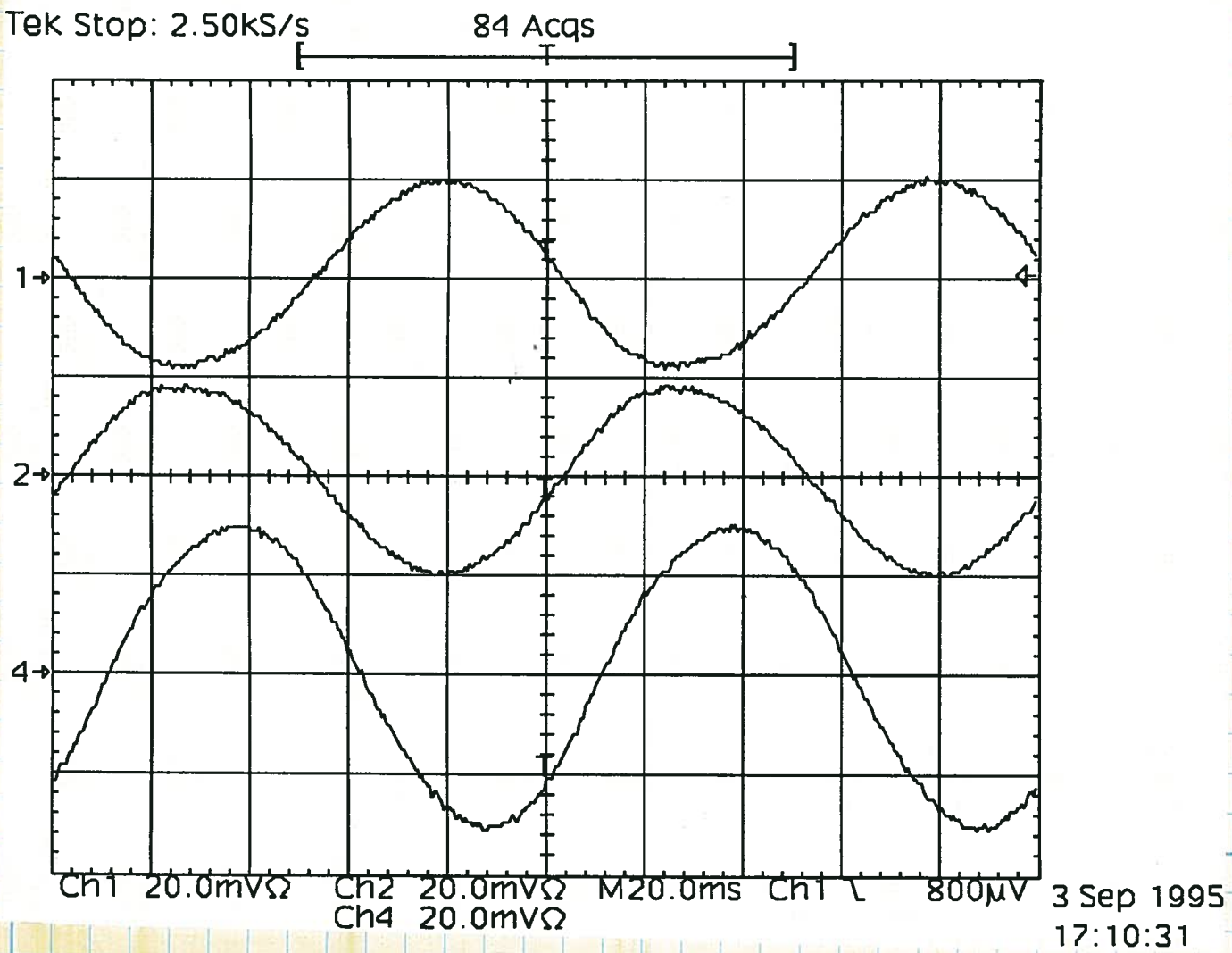
The pickup in the spool from just the power supply is negligible



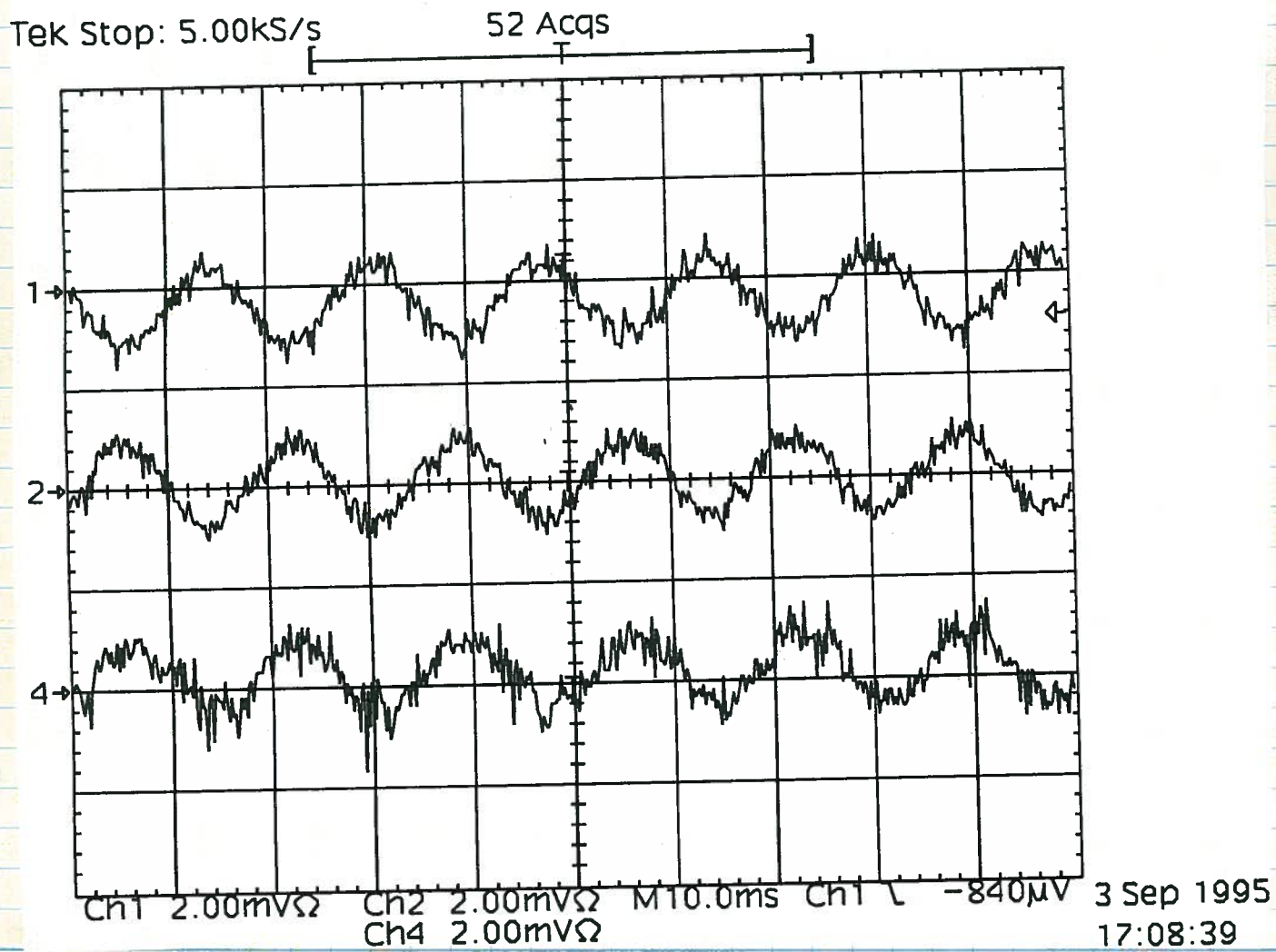
Spool 1 coils

supply only
1 loop. Not
connected to
coils.

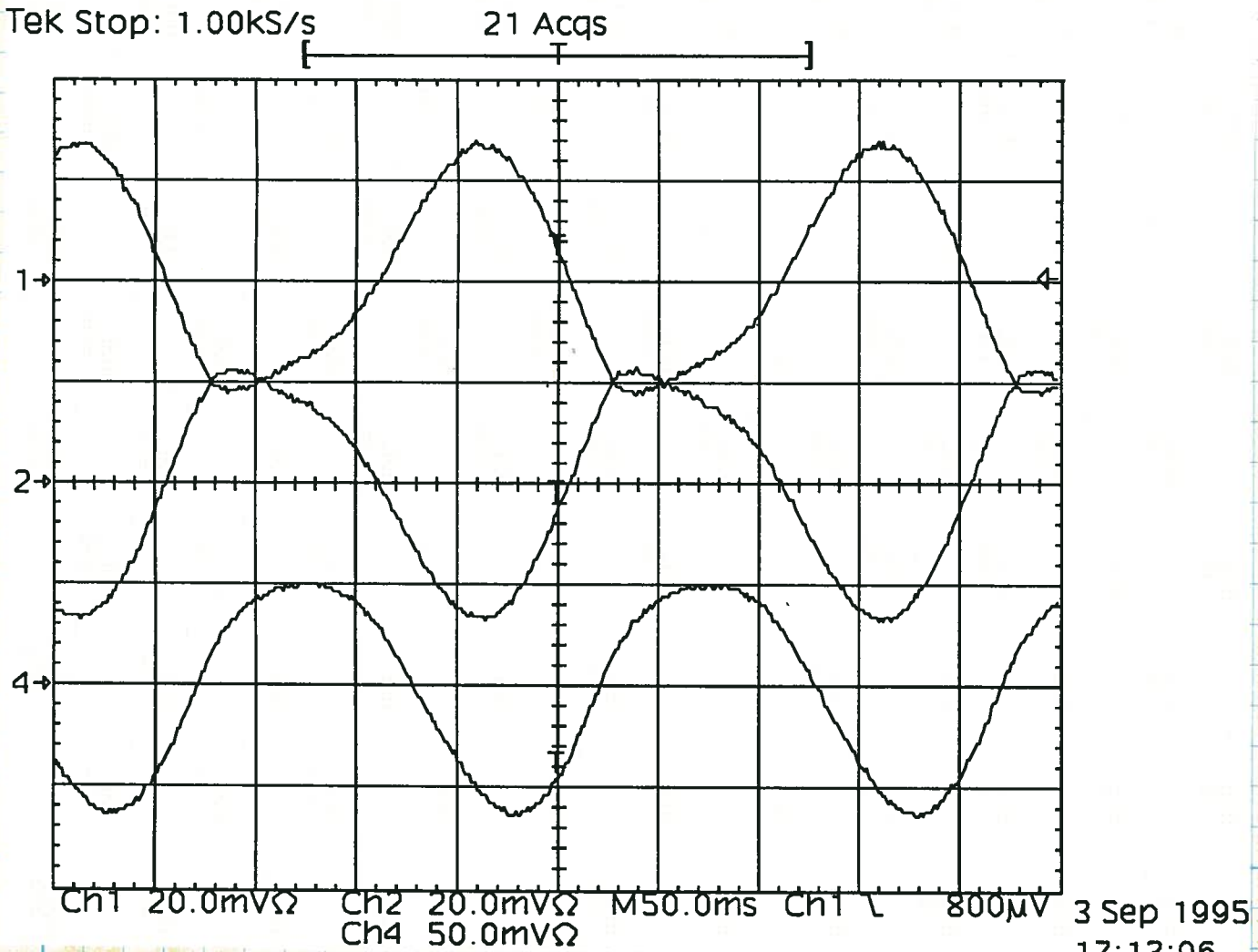
$\frac{1}{T_2} = 10\,Hz$



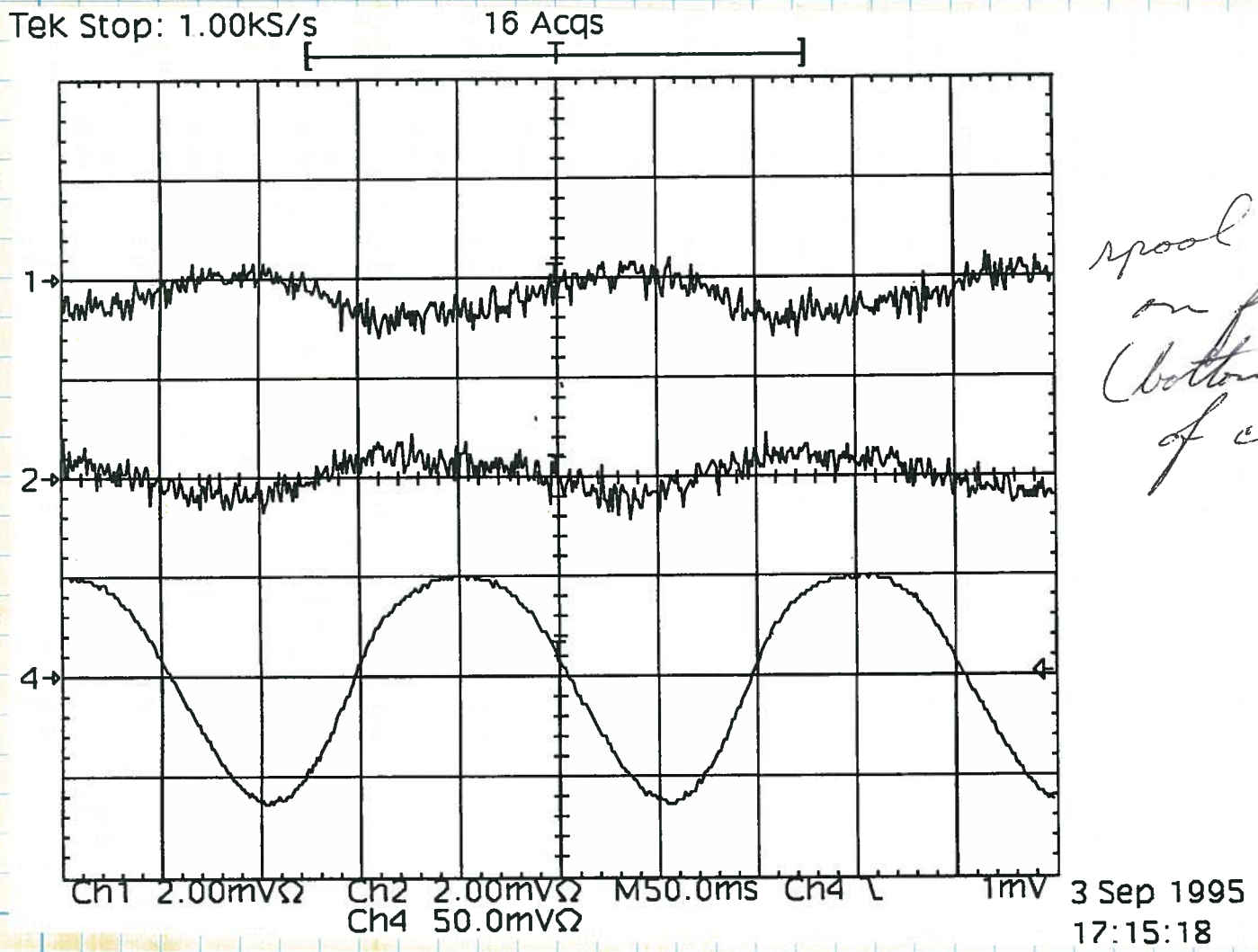
$\frac{1}{.015\,\Omega} \cong 60\,Hz$



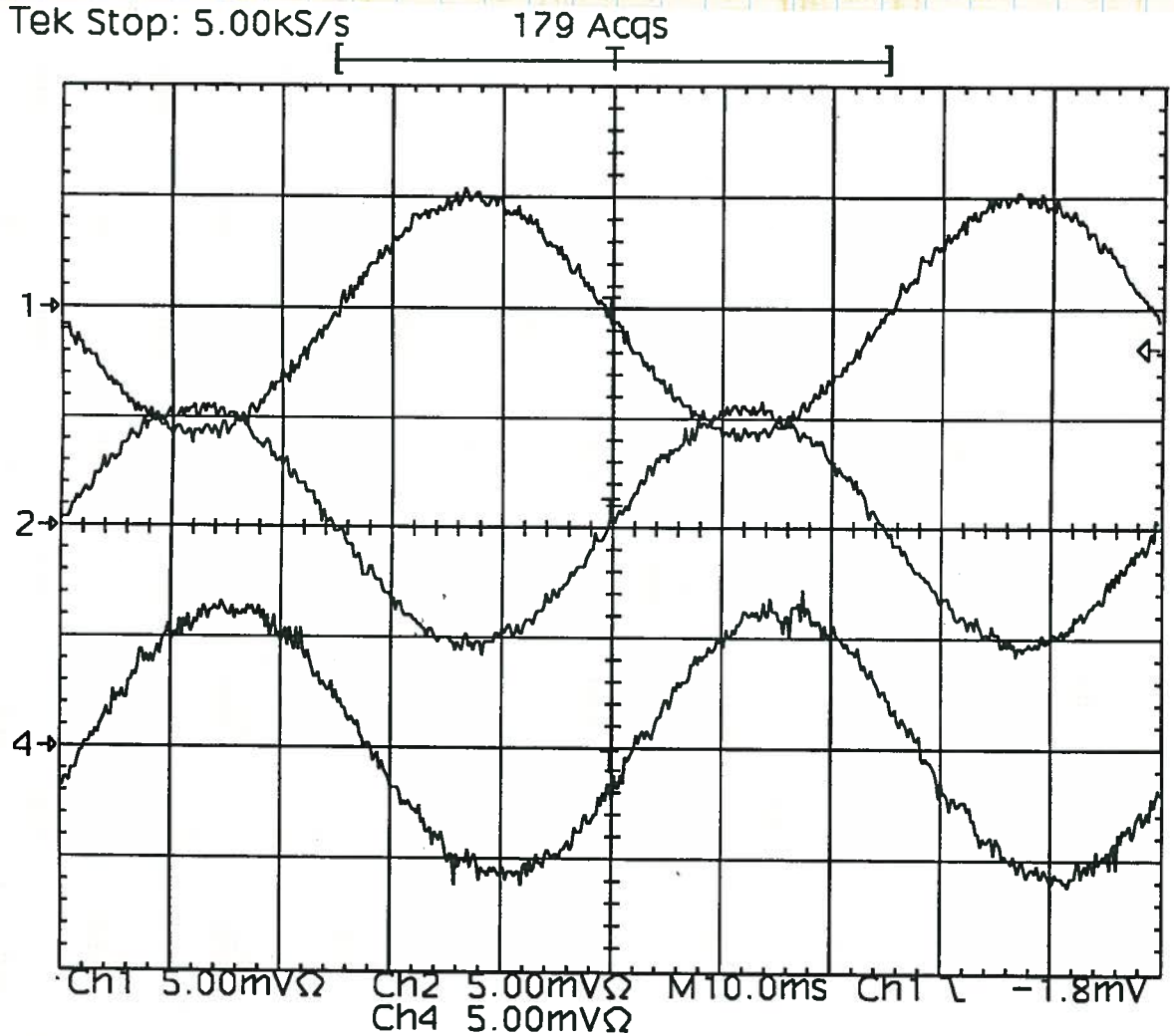
$\frac{1}{.2} = 5\ Hz$



3 Sep 1995
17:13:06



spool ⊥ $\vec{B}$
on floor
(bottom edge
of coils)



3 Sep 1995
17:06:50

10mV ⇒ 2mA

10mV ⇒ 2mA

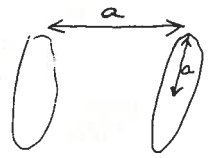
2mA ⇒ 2A

2A ⇒ 1.3 Gauss

notes from the other side of the sheet on p. 144

$$B = \frac{32\pi N}{5^{3/2}\, a} \frac{I}{10}$$

A
cm
Gauss
N turns/coil



100A gives 64 Gauss

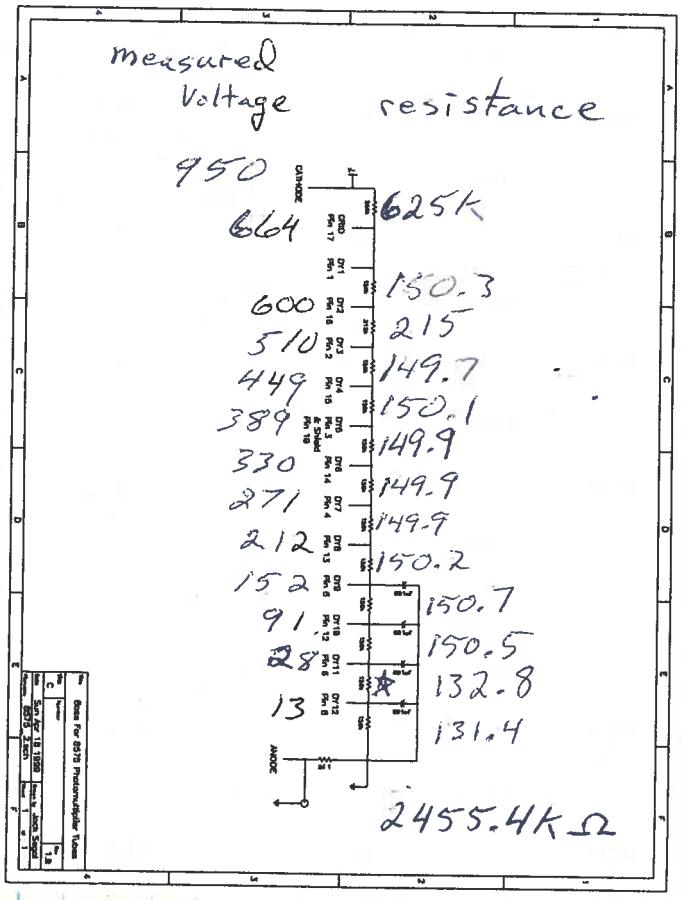
approx 64 windings = N

.64 Gauss/A

4/18/99

JS

Tried to fix the base old made, page 130.



I pulled off the resistor marked with a ☆. I found ~3MΩ to ground from pin 6. I pulled off the capacitor on pin 6 and got ≈∞ Ω from pin 6 to GND. I replaced the last 3 of .01μF with .022μF 500VDC and the cap on pin 5 was changed to a .01μF 1000VDC

Using the repaired base & 8575 S/N U31768 at ~1500V on the Bertan I saw an output almost identical to that on p. 124 of this volume.

4C Oxygen Sensor

4/18

I bought some oxygen sensors from City Technology.

Oxygen CiTiceL® Specification

4C - Oxygen

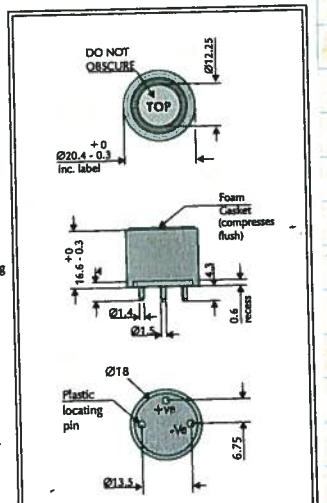
Performance Characteristics

Nominal Range	0-25% Oxygen
Max Overload	30% Oxygen
Expected Operating Life	One year in Air
Output Signal	0.225 ± 0.025mA in Air
T_{90} Response Time	≤15 seconds
Temperature Range	-20°C to +50°C
Temperature Coefficient	0.2% signal/°C
Pressure Range	Atmospheric ± 10%
Pressure Coefficient	<0.02% signal/mBar (typ. 0.01%)
Operating Humidity	0 to 99% RH non-condensing
Long Term Output Drift	<2% signal/month (typically <5% over Operating Life)
Recommended Load Resistor	100Ω

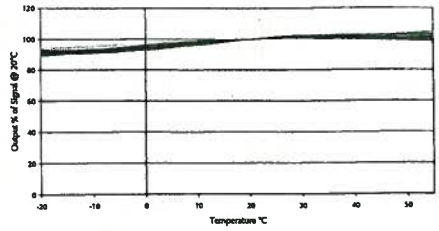
Physical Characteristics

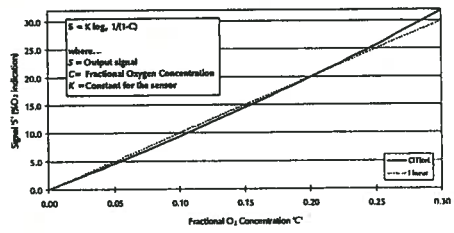
Weight	17g (approx.)
Position Sensitivity	None
Storage Life	Six months in CTL container
Recommended Storage Temperature	0-20°C

IMPORTANT NOTE: Connection should be made via PCB sockets only. Soldering to the pins will seriously damage your sensor.



All dimensions in mm
All tolerances ±0.15mm unless otherwise stated





Doc. Ref. 4C.p65
Issue 4.3 May 15, 1998

City Technology Ltd, City Technology Centre, Walton Rd, Portsmouth PO6 1SZ, UK
Tel:+44 1705 325511, Fax:+44 1705 386611, Email:sensors@citytech.co.uk

Assuming it acts as a current source I hooked up 100Ω from +Ve to −Ve. I did this a couple days ago. It took a little while (as in minutes) for the voltage across the 100Ω to drop & stabilize.

Today it is reading 22.3mV

I take a 12"x15" zip lock plastic bag. Blowing a small jet of Ar/CO_2 80/20 directly on the sensor face I can get the sensor output down to ~6mV. Removing the jet it comes back up to 21.7. Slowly working its way back up. It's at 22.1mV. Trying the jet again it goes down to ~0.7mV. Jet off & it comes back up to 21.6mV. At 22.0mV one minute after the jet is off. At 22.1mV after 1½ min.

I put the sensor in the plastic bag. I insert the hose for Ar/CO_2 and zip it up so only a small spot is open where the wire leads and the hose poke into the bag.

The sensor reads 22.2 mV. Gas on. Dropping quickly. Reaches ~3 mV after ~30 sec. Below 1 mV after ~1 min. ~.1 after ~90 sec.

I increased the gas flow and it went to 0.0 mV.

Gas off ~~& sensor removed from the bag.~~ Sensor left in bag & bag not touched. Still 0.0 mV after 60 sec. 0.0 mV after 120 sec.

Unzip bag. Slowly increasing output. ~3 mV after ~15 seconds. .35 mV after ~60 sec.

Sensor removed from bag. 20.5 mV after ~20 sec. 20.7 mV after ~30 sec. 20.9 mV after ~40 sec. 21.0 mV @ ~60 sec 21.1 mV @ ~70 sec. 21.3 @ ~90 sec. 21.3 @ ~100 sec. 21.4 mV @ ~120 sec

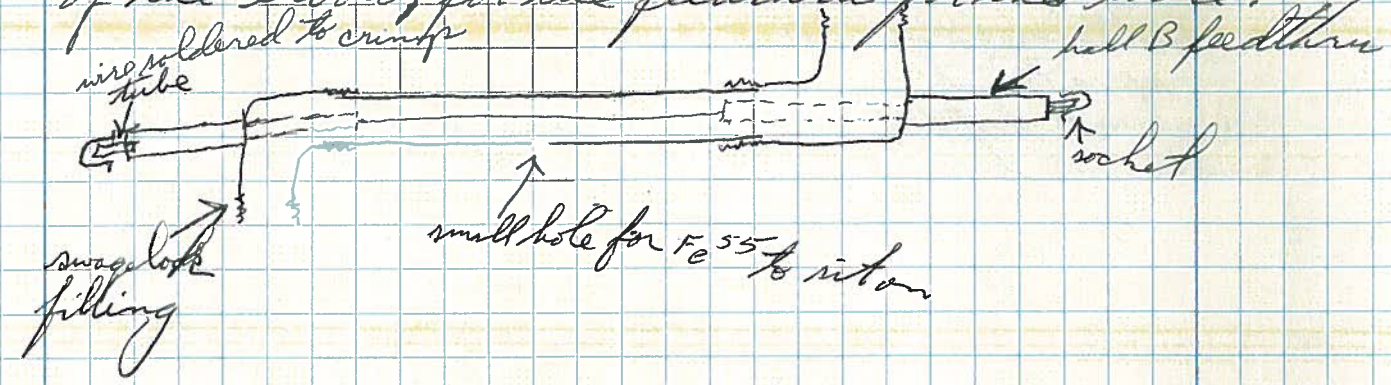
After ~15 more minutes sensor is at 22.2 mV.

A later e-mail to the manufacturer verified that the sensor is intended to be used as a current source.

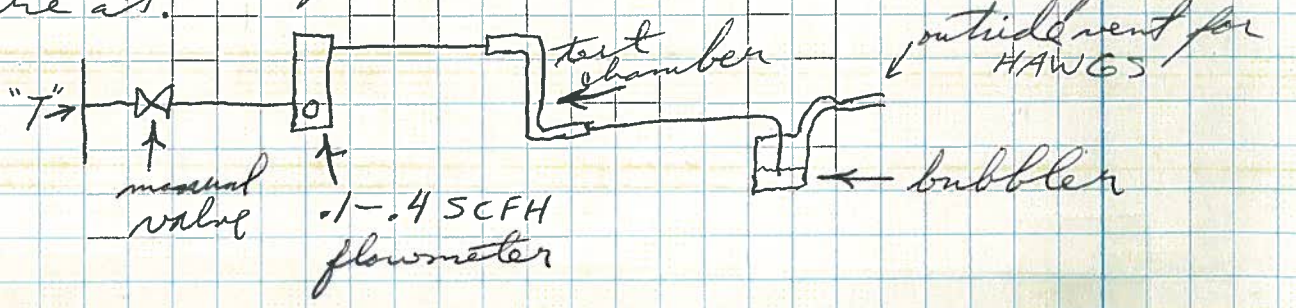
Gas Test Chamber For HAWGS 10/22/99

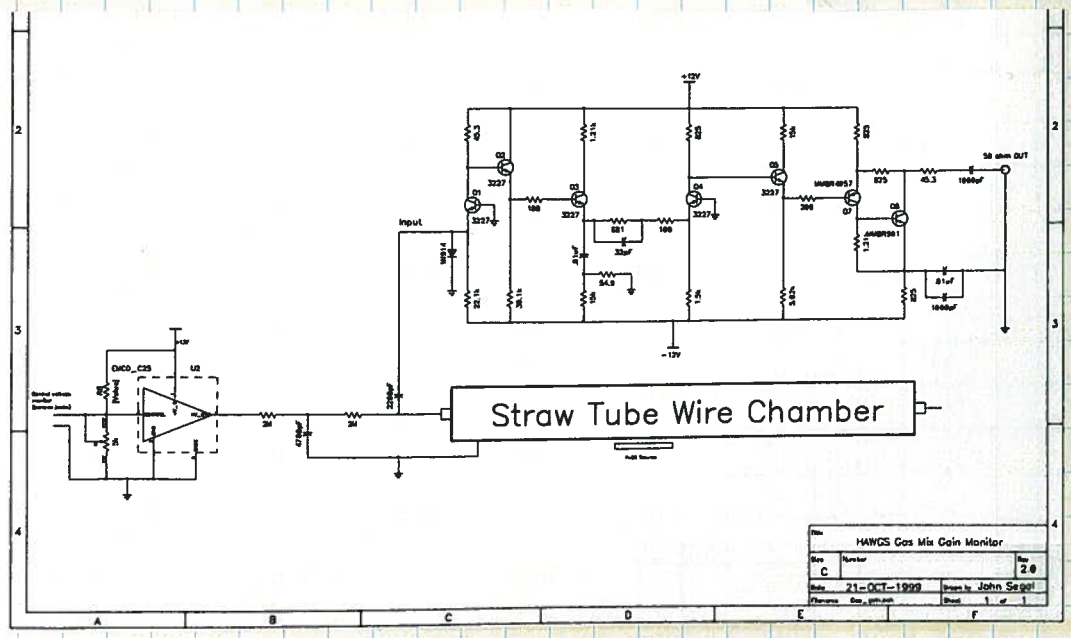
I finally got a small ~~clear~~ cylindrical chamber working to monitor the gas gain in the HAWGS.

It is a brass tube ~1/2" OD with Swagelok right angle fittings on each end. The shop drilled a hole down the center of one end of the elbow, for the feedthru for the wire.



Gas supply is "T"'d off the ~~bottle~~ output at the same point the NDC & FPP valves & flowmeters are at.

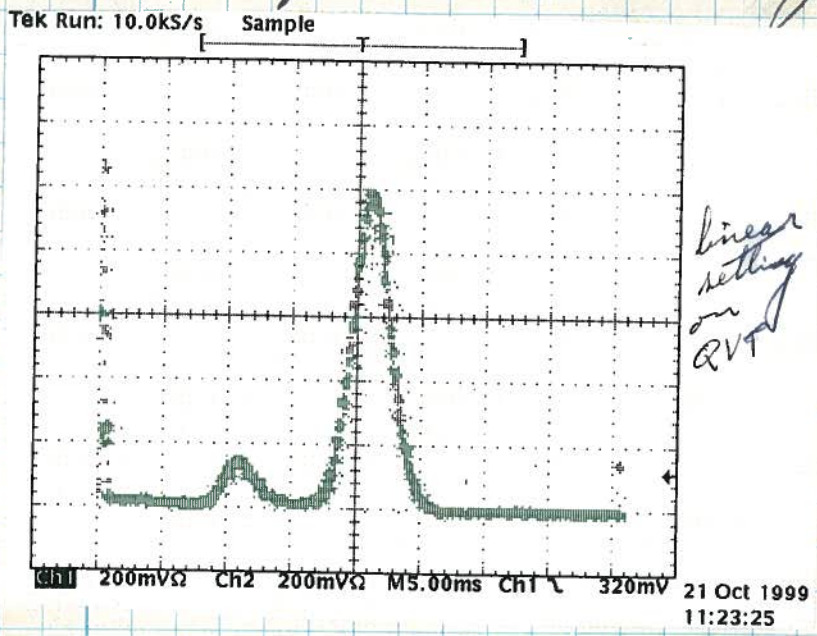




I had some trouble getting a LeCroy 3001 QVT to readout the preamp. Buff, Howard & Fenker demonstrated that a little patience could go a LONG way!

We got everything setup using premix and running on the 20 ±½. I adjusted the Q trim on the QVT with a 50Ω on the input and the threshold as low as it would go. So, zero is on the left edge of the spectrum.

I left the QVT running overnight.



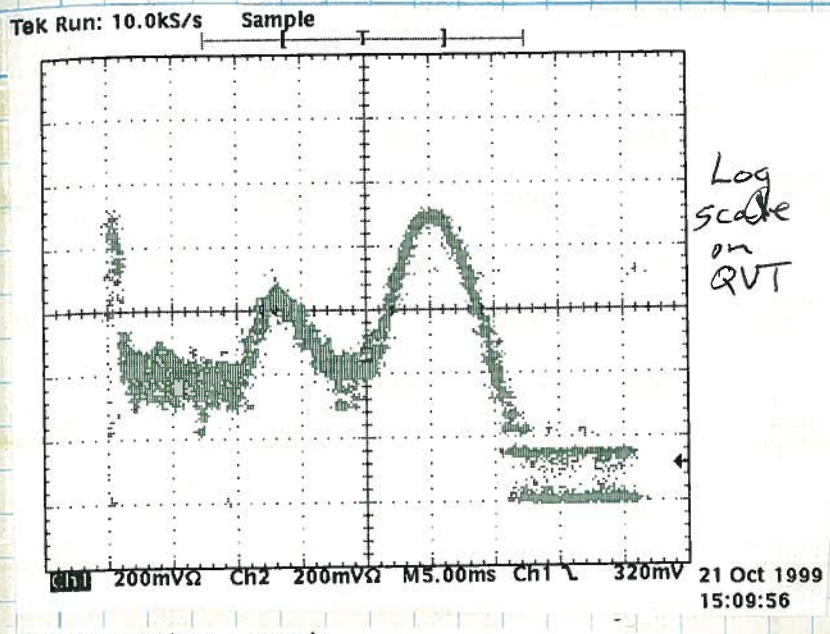
linear setting on QVT

This is what I had in the morning.
Premix bottle.

$V_{control}$ on HV = 3.185 V

I fitted the chassis for the test chamber into the rack with the flowmeter & pressure gauges to the VDCs & FPP.

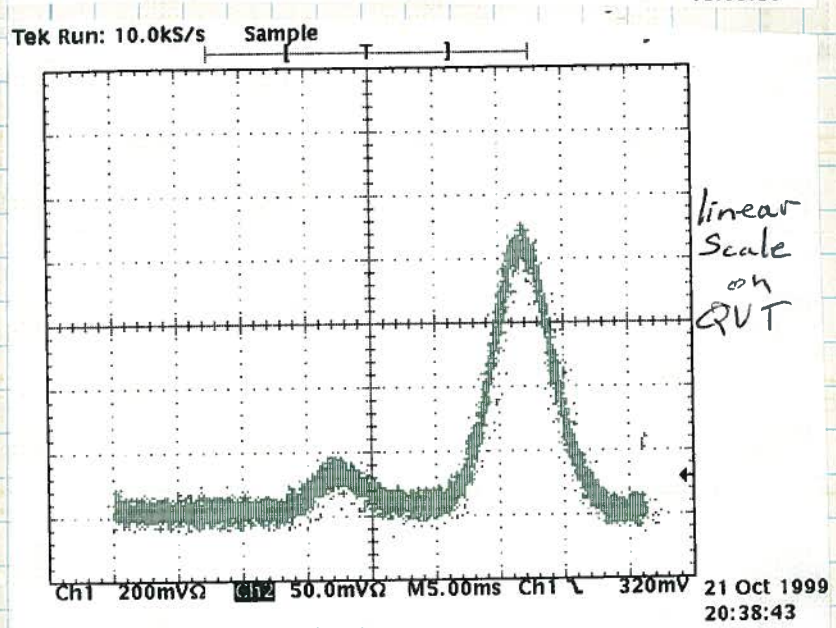
Running system gas through the test chamber I then got the spectrum on the next page.



Log scale on QVT

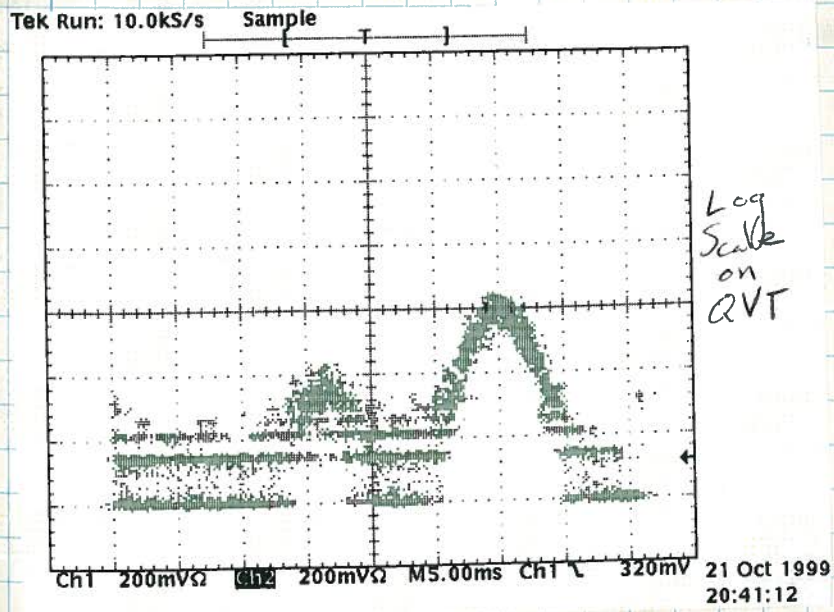
$V_{control}$ on HV = 3.185 V

After this top picture I cleared the QVT and left it running. Later I came back and found the ethane manifold had switched over to a new bottle at some point. This is what I saw from the QVT



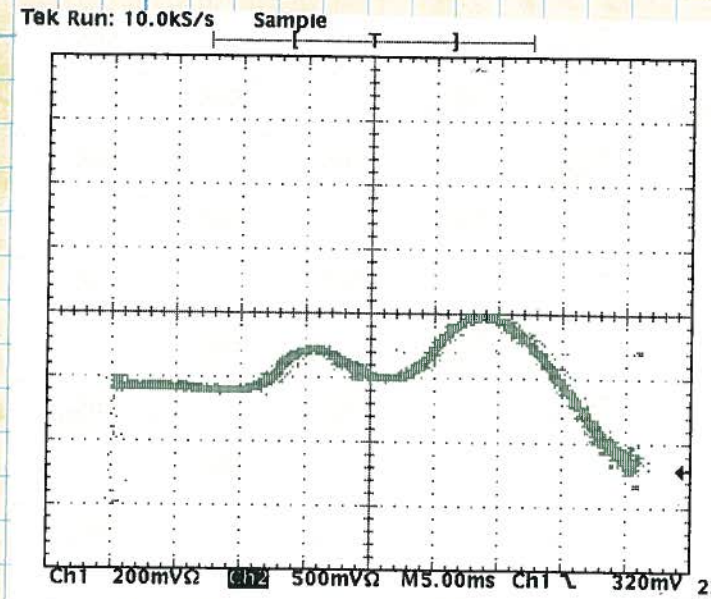
linear Scale on QVT

I cleared the QVT and did a short run to see what it looked like now. This is what I got from the QVT



Log Scale on QVT

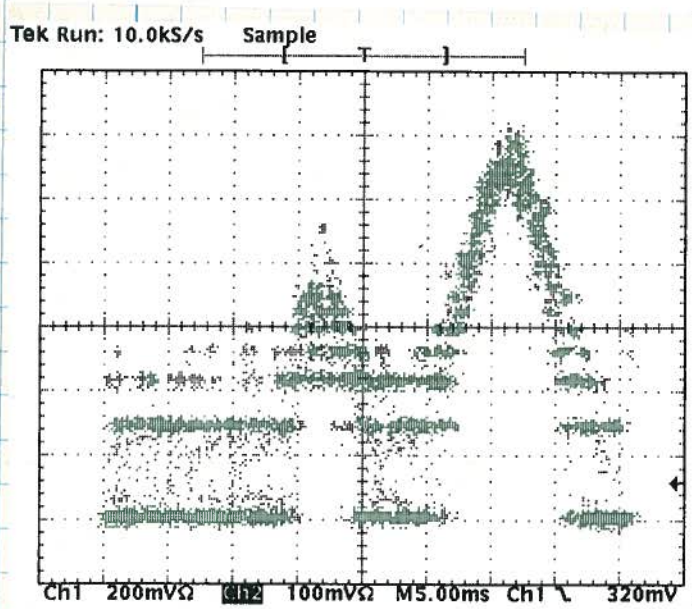
I left the QVT running overnight.



22 Oct 1999
10:41:25

This is what I found on the QVT in the morning. The ball in the flowmeter ~~still and~~ was all the way at the bottom.

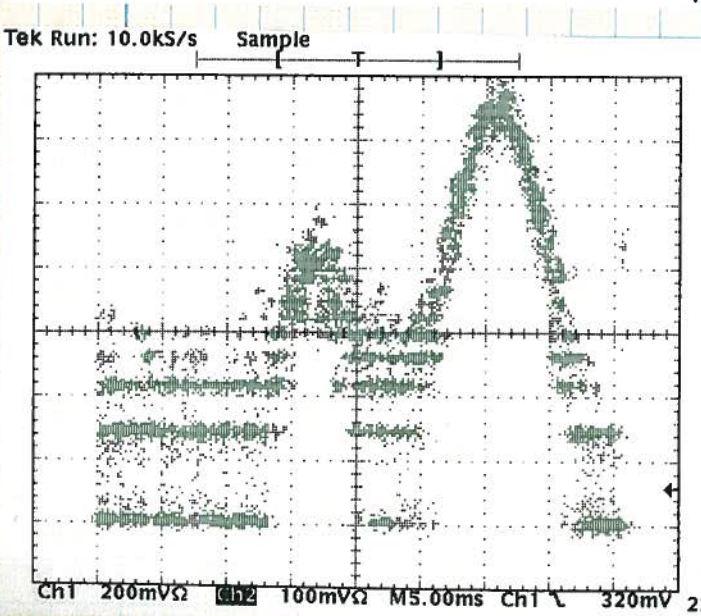
$V_{control}$ on HV = 3.186 V



22 Oct 1999
10:43:33

I cleared the QVT and adjusted flow rate to ~.15 SCFH (air).

After a short while this is the QVT output



22 Oct 1999
10:44:53

I left the QVT run a little longer and got this

I left the QVT running.