

Department _____

Subject Lab Techniques I

Name Jack Segal

Address _____

National® Brand

Computation Notebook

11 3/4" x 9 1/4", 4 x 4 Quad., 75 Sheets

43-648



Office Products
Chicopee, MA 01022

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7.2AH Battery Charge & Discharge Characteristics 7/20/06

I previously constructed a box to test a solar panel Ed got. It consists of two 6Ω , two 4Ω , and two 2Ω 5% 1/2W wirewound resistors with a $100mV @ 75A$ current shunt. Each is mounted to banana plug sockets in the box, thus allowing for a variety of configurations.

The current shunt is a little big for my applications and I have also used a 1/2W 10Ω wirewound resistor instead of the shunt.

Although I have not used them yet, I have some 0.010Ω and 0.008Ω metal film resistors I could use (1%).

At this point I am attempting to gather loose pieces of information I have accumulated and move on in a more directed manner.

I have 8 batteries from a UPS. 7.2AH They were supposedly bad and replaced. I am using these "old" batteries for learning. Data sheet is on the next page (p. 6 this volume).

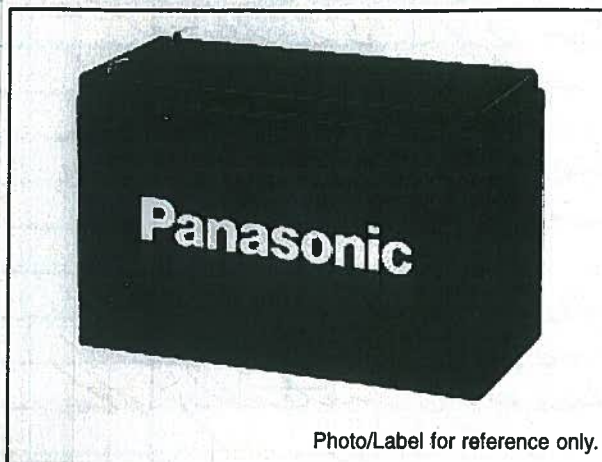
The battery charger is a Battery MINDER 12VDC-1.0A from VDC Electronics, Inc. Model 12112

The data acquisition is done by a PC and a PMD-1208LS from Measurement Computing.

I have used three of the eight batteries. They are numbered 1, 2, 3 in the order in which I first used them.

VALVE-REGULATED LEAD ACID BATTERIES: INDIVIDUAL DATA SHEET

LC-R127R2P



Photo/Label for reference only.

Specifications

Nominal Voltage		12V
Rated Capacity (20 hour rate)		7.2Ah
Dimensions	Length	5.945 inches (151.0 mm)
	Width	2.539 inches (64.5 mm)
	Height	3.702 inches (94.0 mm)
	Total Height*	3.937 inches (100.0 mm)
Approx. mass		5.45 lbs. (2.47 kg)
Standard Terminals and Resin	UL94HB Faston 187	LC-R127R2P
	UL94HB Faston 250	LC-R127R2P1

* The total height with #250 terminal is 101.5mm.

Characteristics

Capacity ^(note) 77°F (25°C)		20 hour rate (360mA)	7.2Ah
		10 hour rate (680mA)	6.8Ah
		5 hour rate (1260mA)	6.3Ah
		1 hour rate (4900mA)	4.9Ah
		1.5 hour rate discharge Cut-off voltage 10.5 V	3.5A
Internal Resistance		Fully charged battery 77°F (25°C)	Approx. 40mΩ
Temperature dependency of capacity (20 hour rate)		104°F (40°C)	102%
		77°F (25°C)	100%
		32°F (0°C)	85%
		5°F (-15°C)	65%
Self discharge 77°F (25°C)		Residual capacity after standing 3 months	91%
		Residual capacity after standing 6 months	82%
		Residual capacity after standing 12 months	64%
Charge Method (Constant Voltage)	Cycle use (Repeating use)	Initial current	2.88 A or smaller
		Control voltage	14.5V to 14.9V (per 12V cell 25°C)
	Trickle use	Initial current	1.08 A or smaller
		Control voltage	13.6V to 13.8V (per 12V cell 25°C)

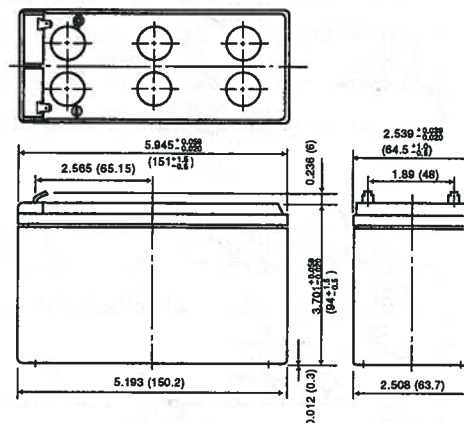
(Note) The above characteristics data are average values obtained within three charge/discharge. Cycles not the minimum values.

For main and standby power supplies.

Expected trickle life: 3-5 years at 25°C, Approx. 5 years at 20°C.

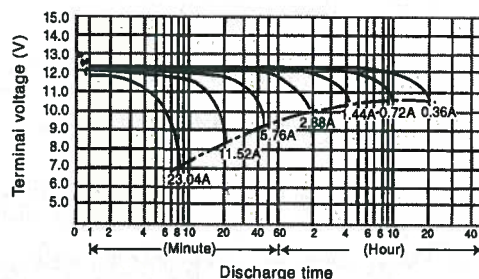
Dimensions (mm)

Terminal type: Faston 187 or Faston 250

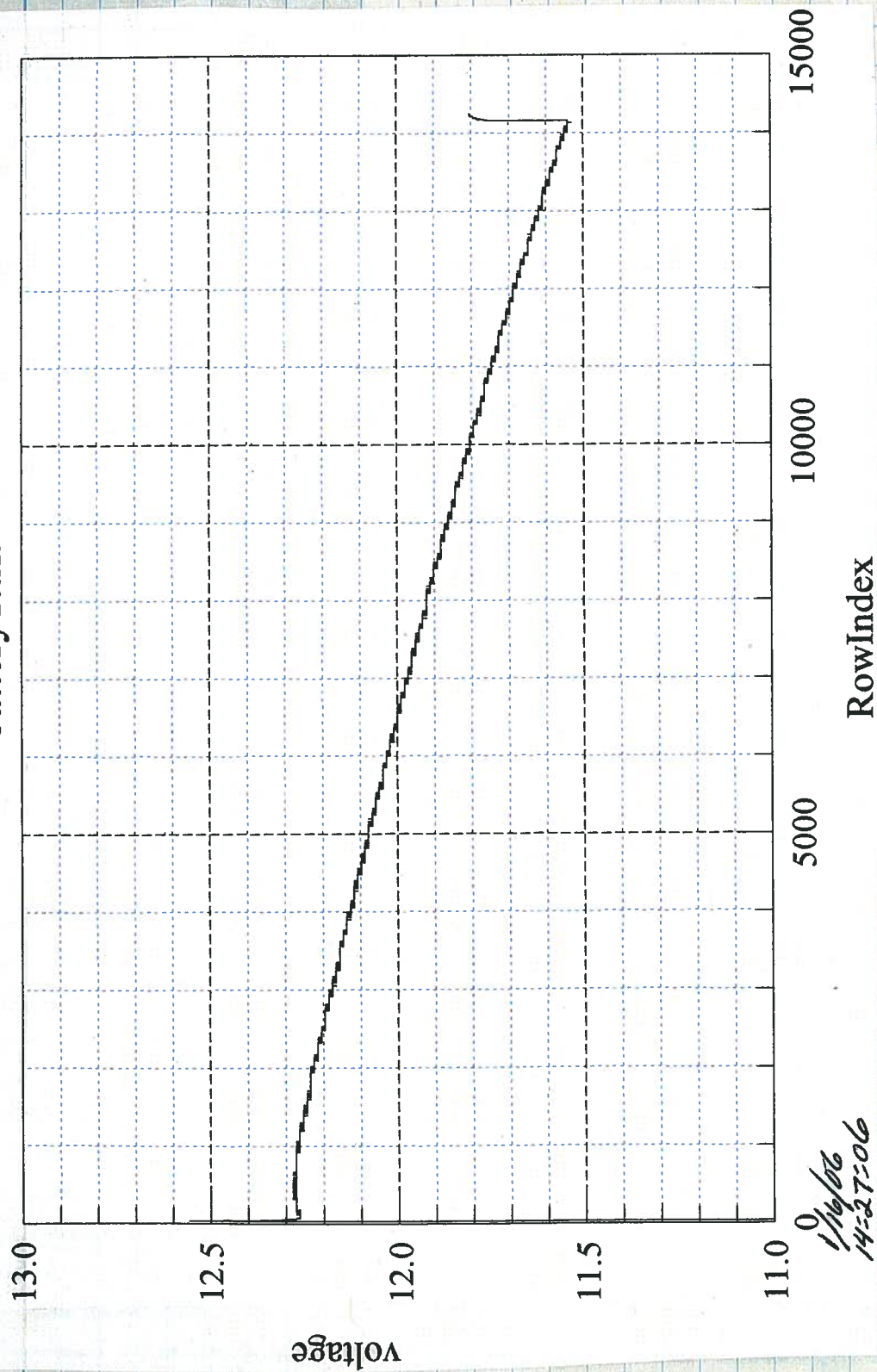


Battery case resin: Standard (UL94HB) Color is black.

Discharge characteristics 77°F (25°C) (Note)

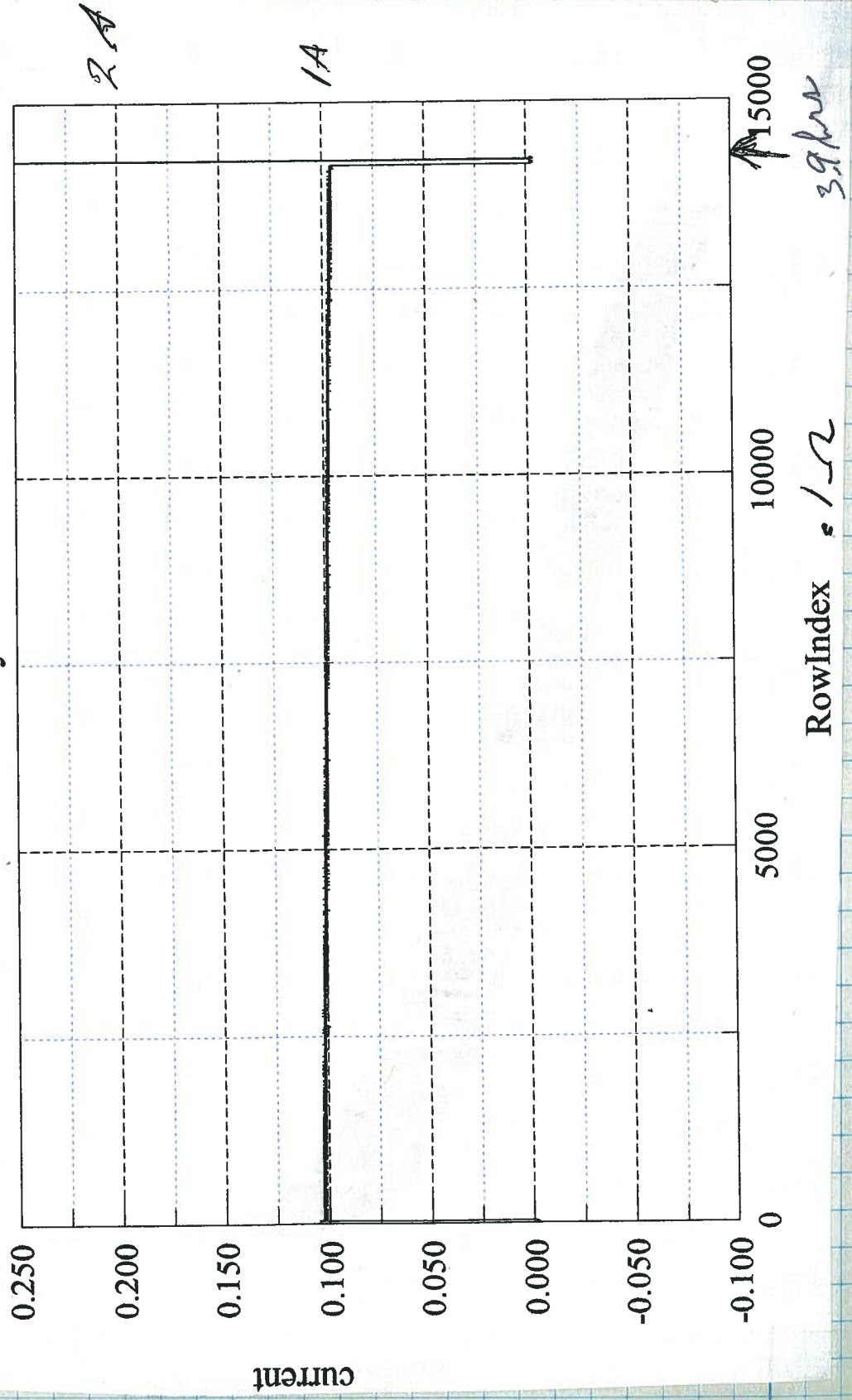


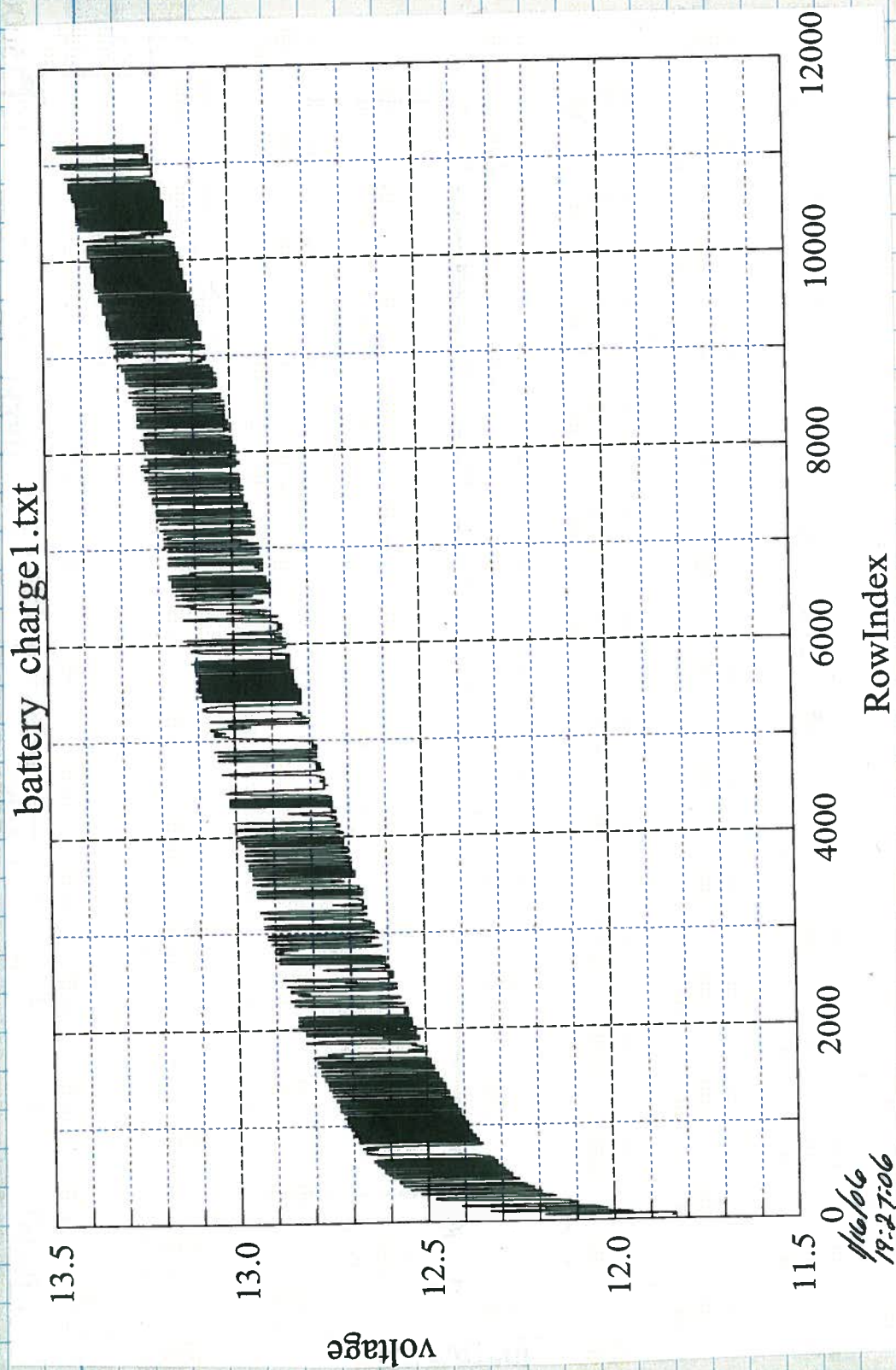
battery1.txt

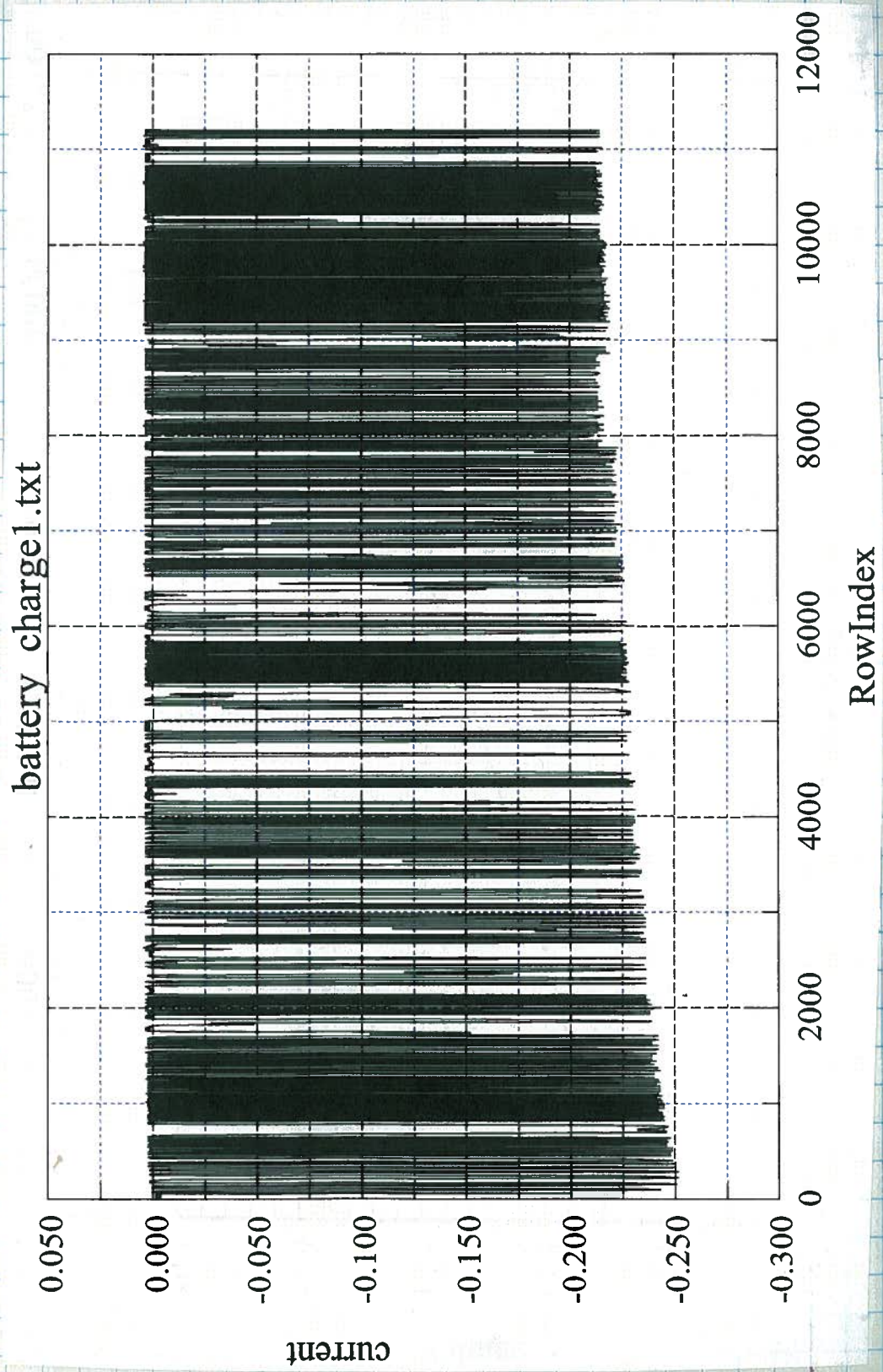


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14:27:06

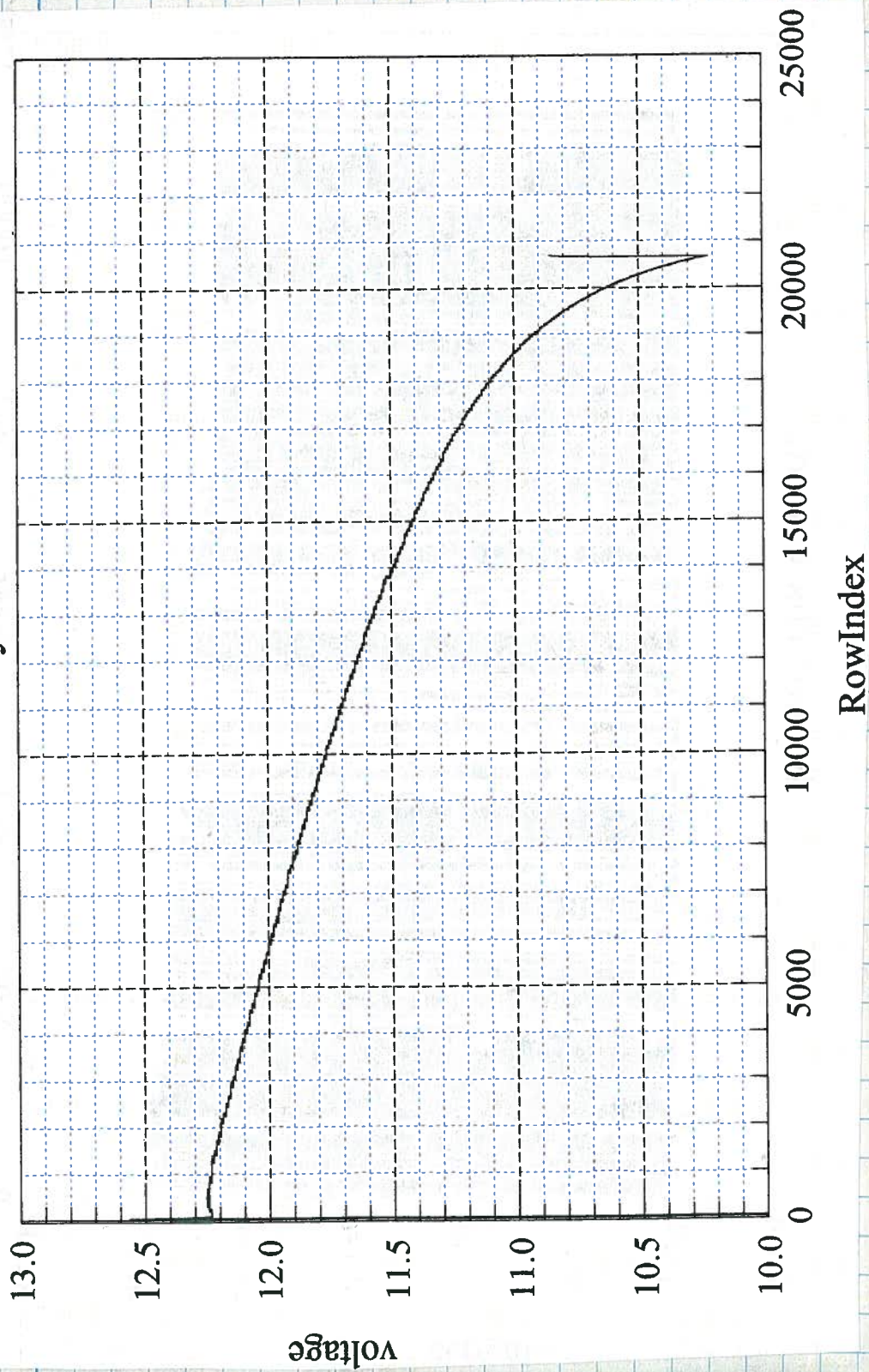
battery1.txt

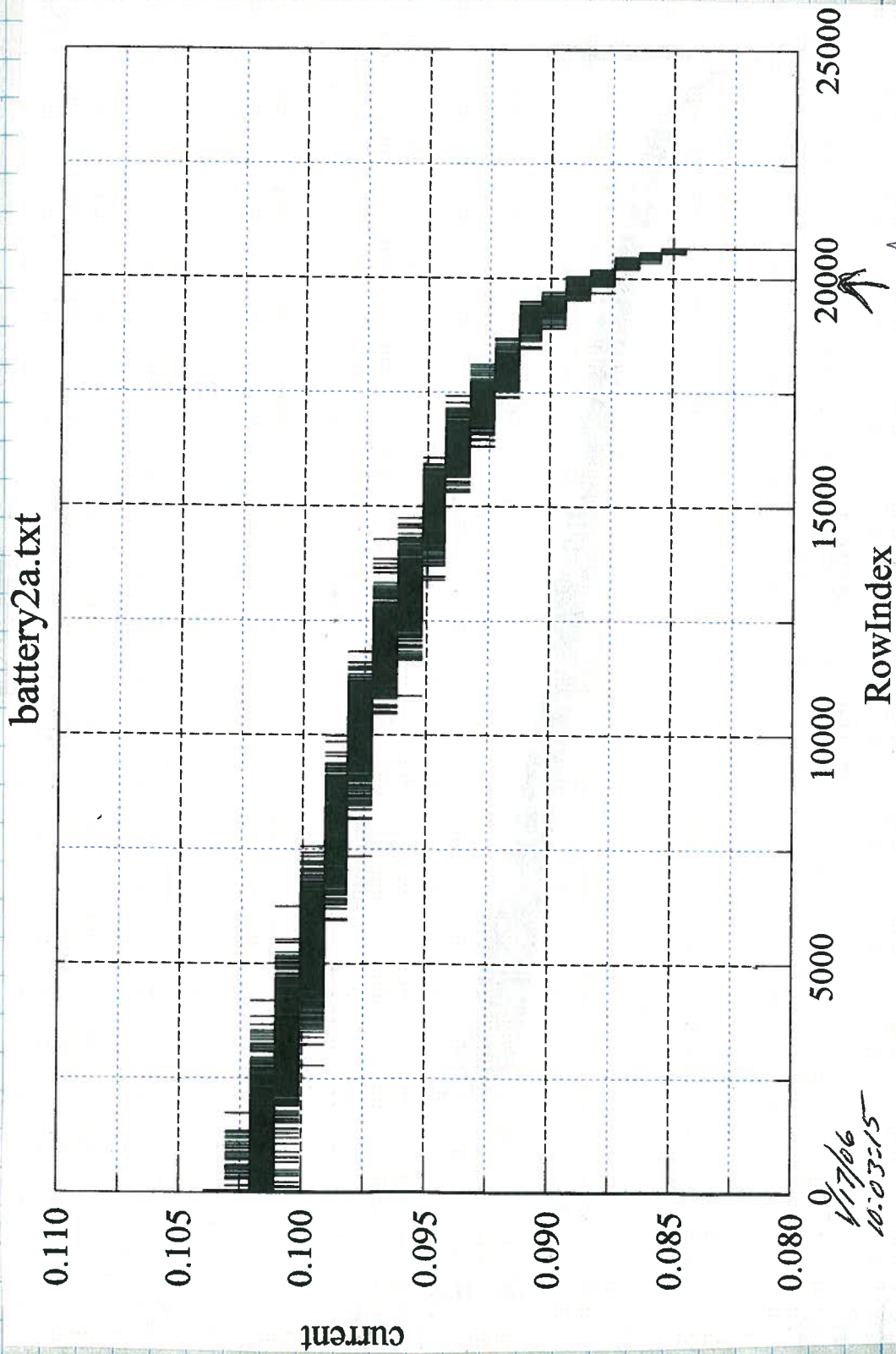


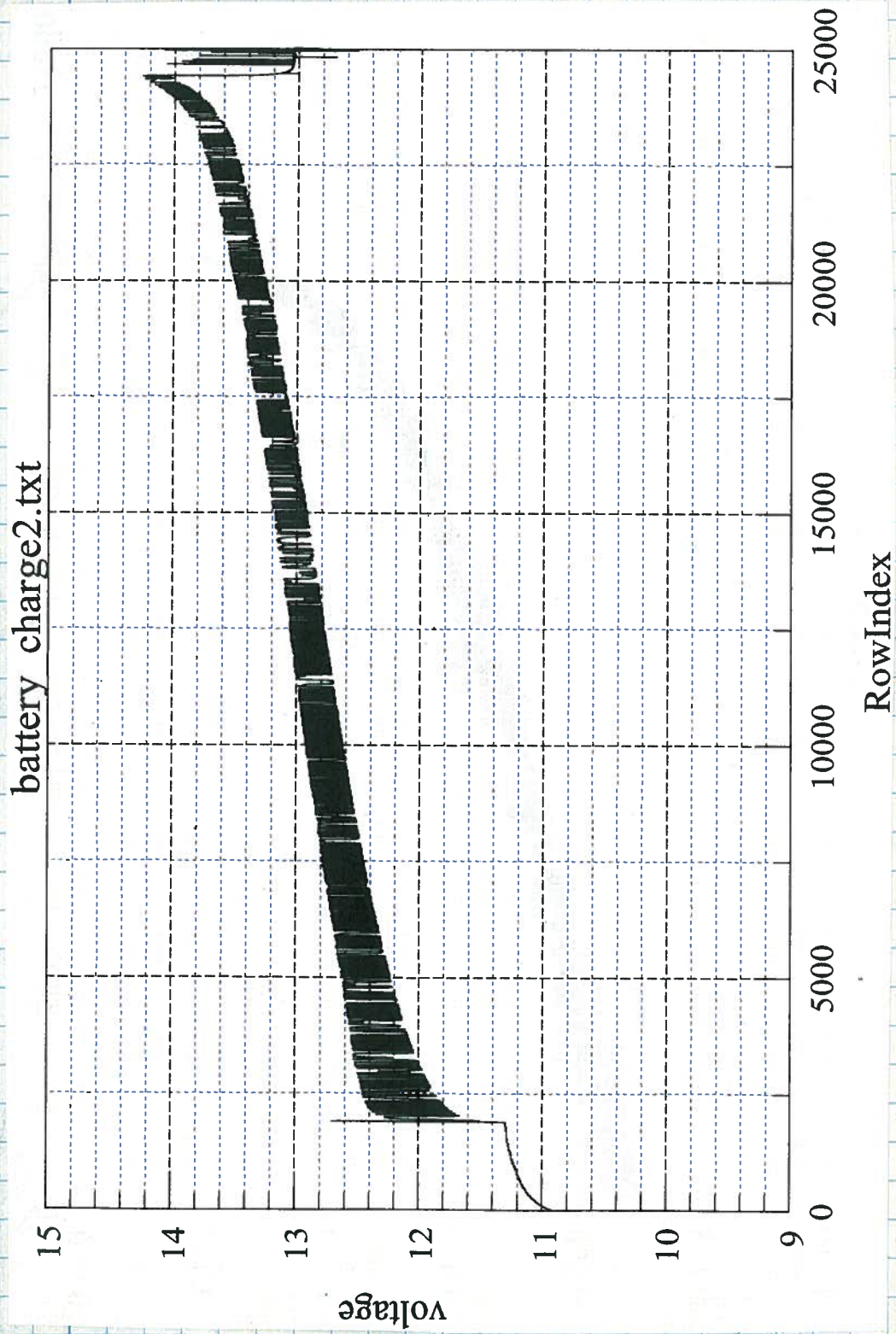


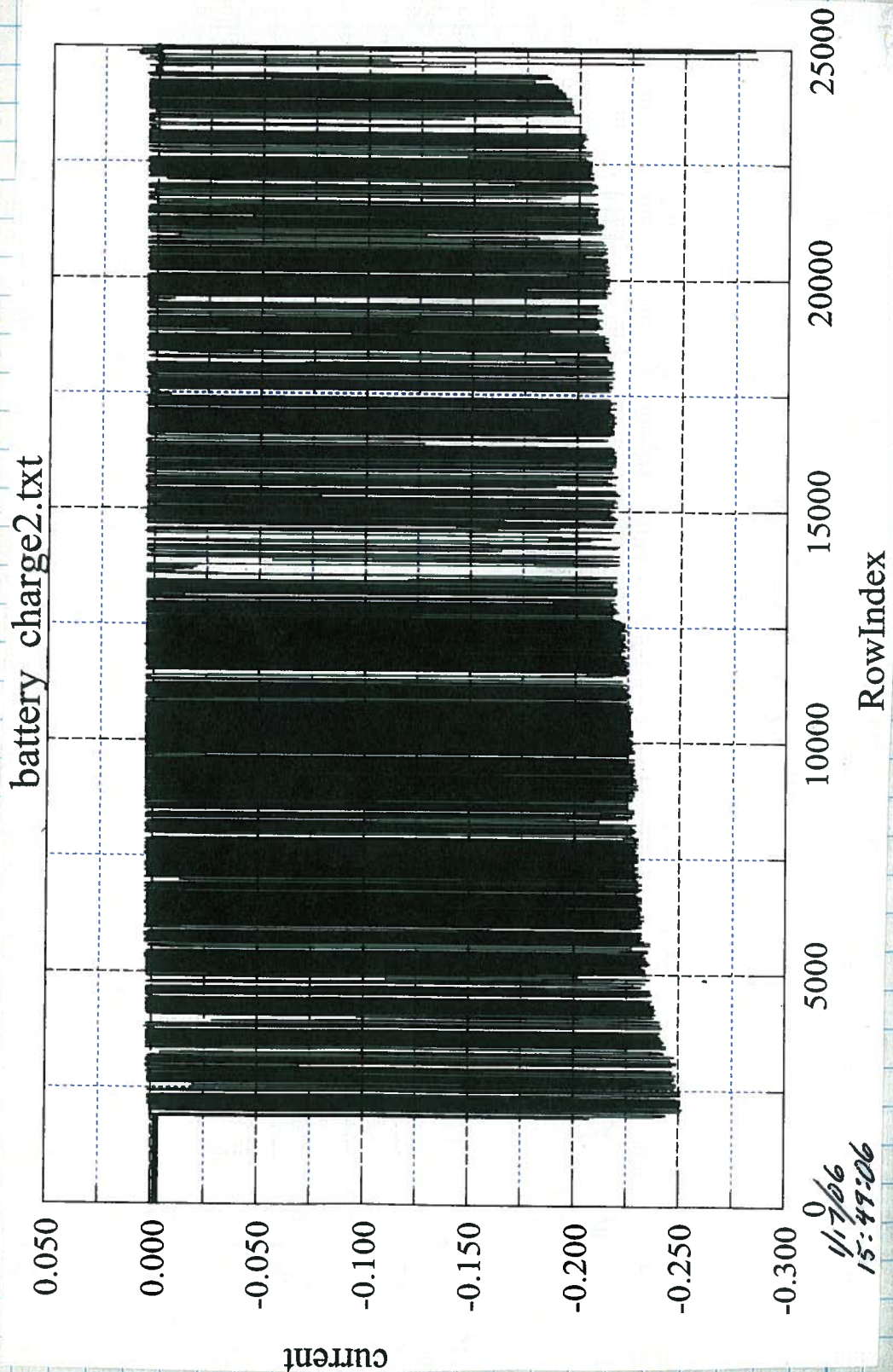


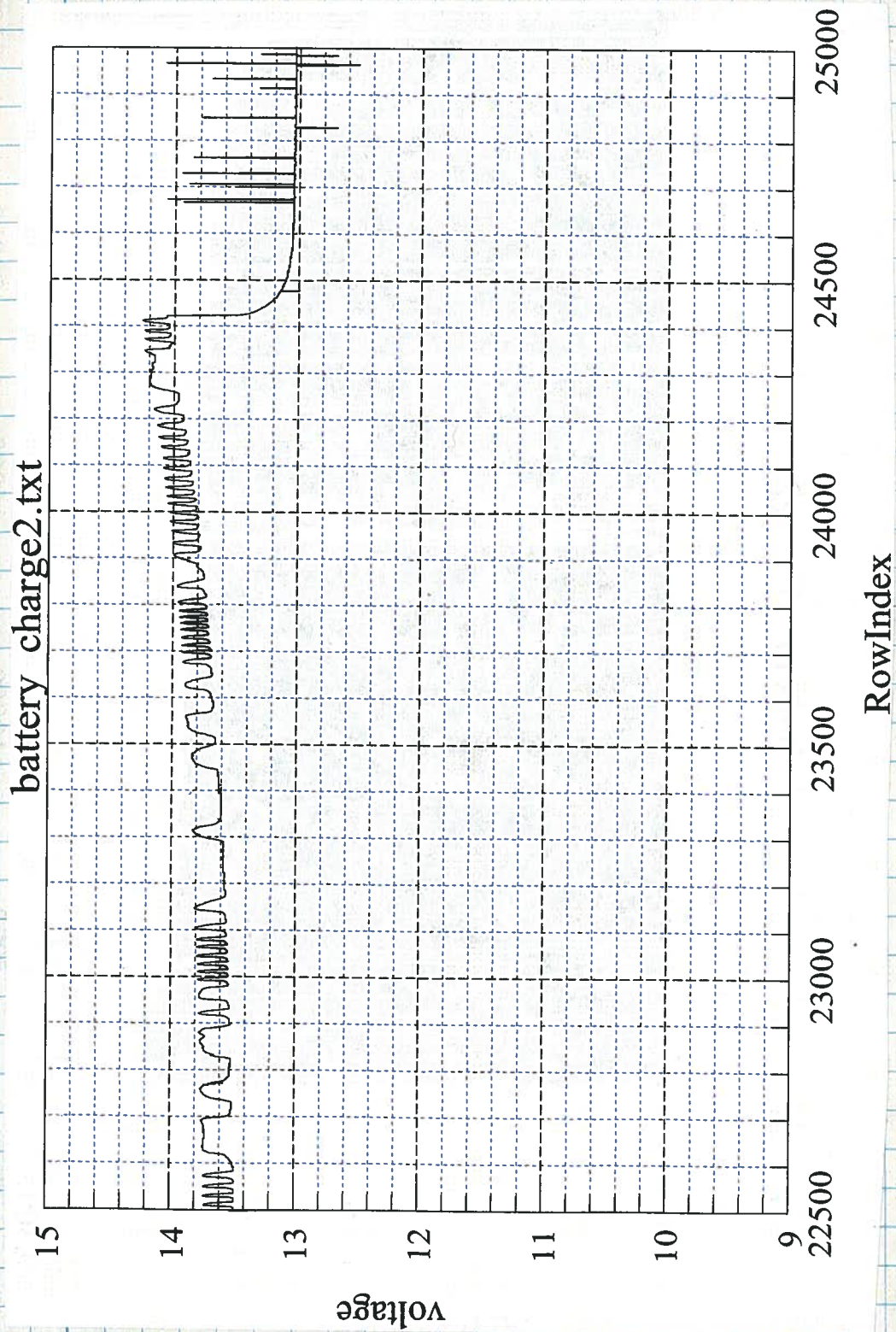
battery2a.txt



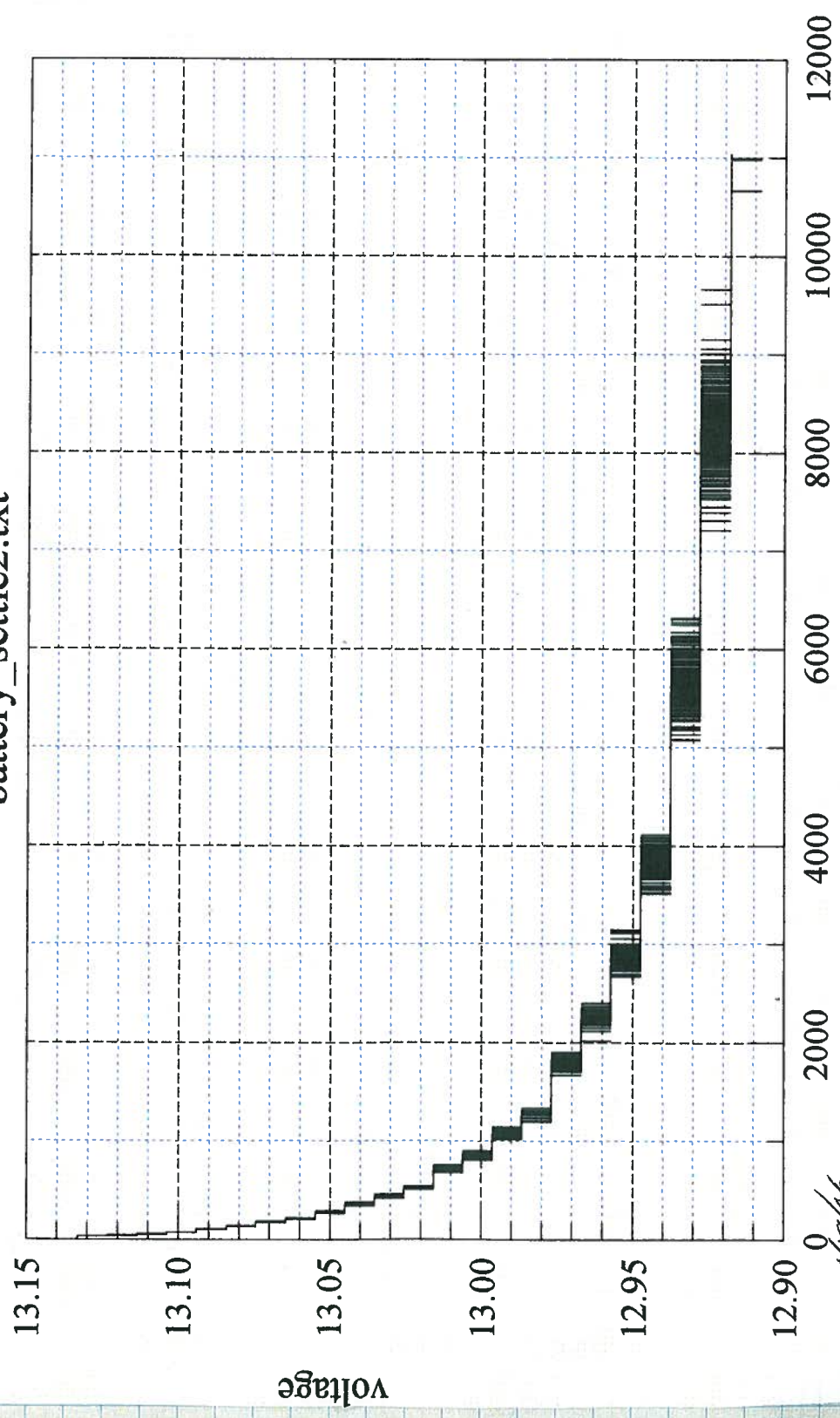








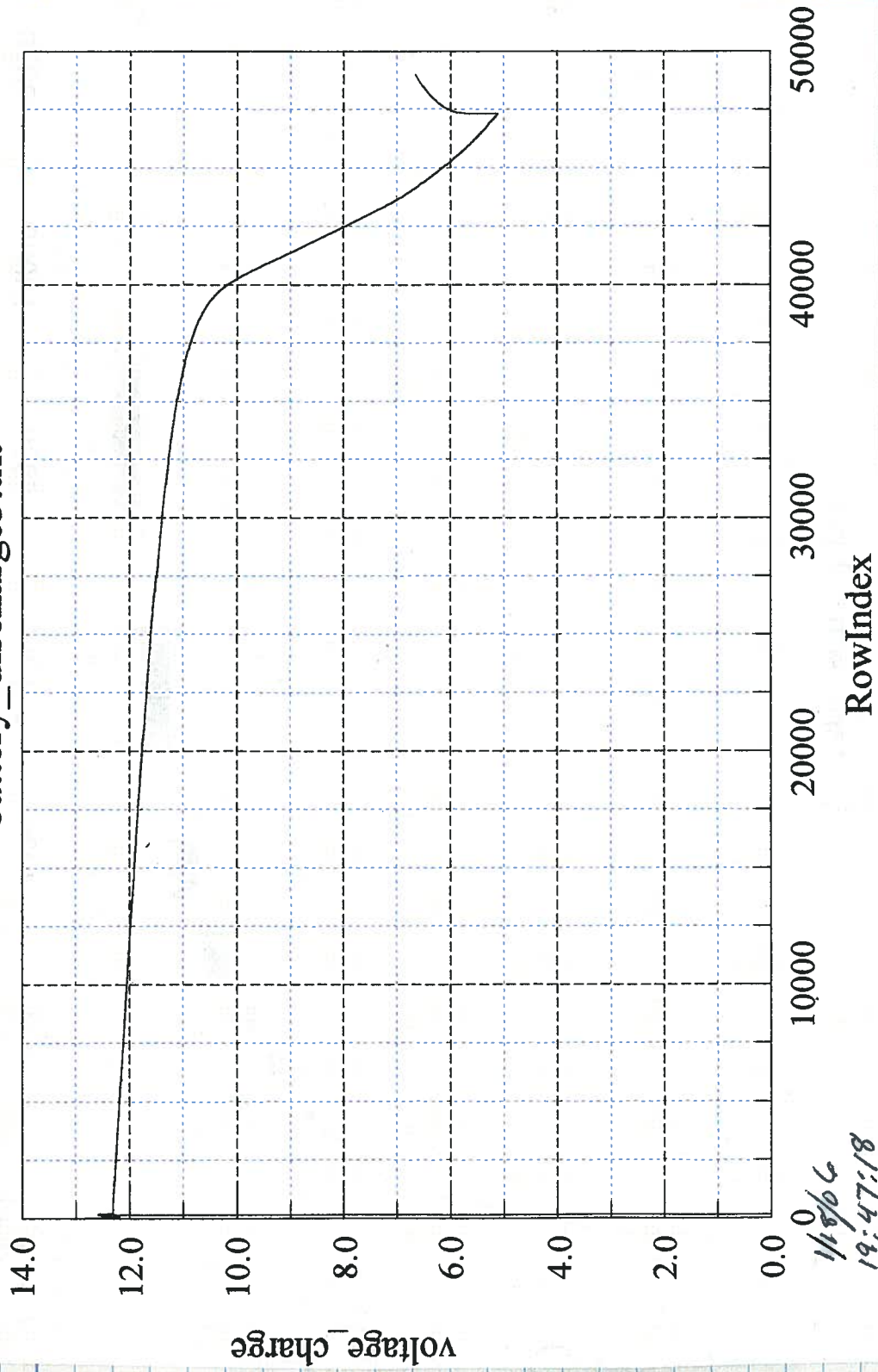
battery_settle2.txt



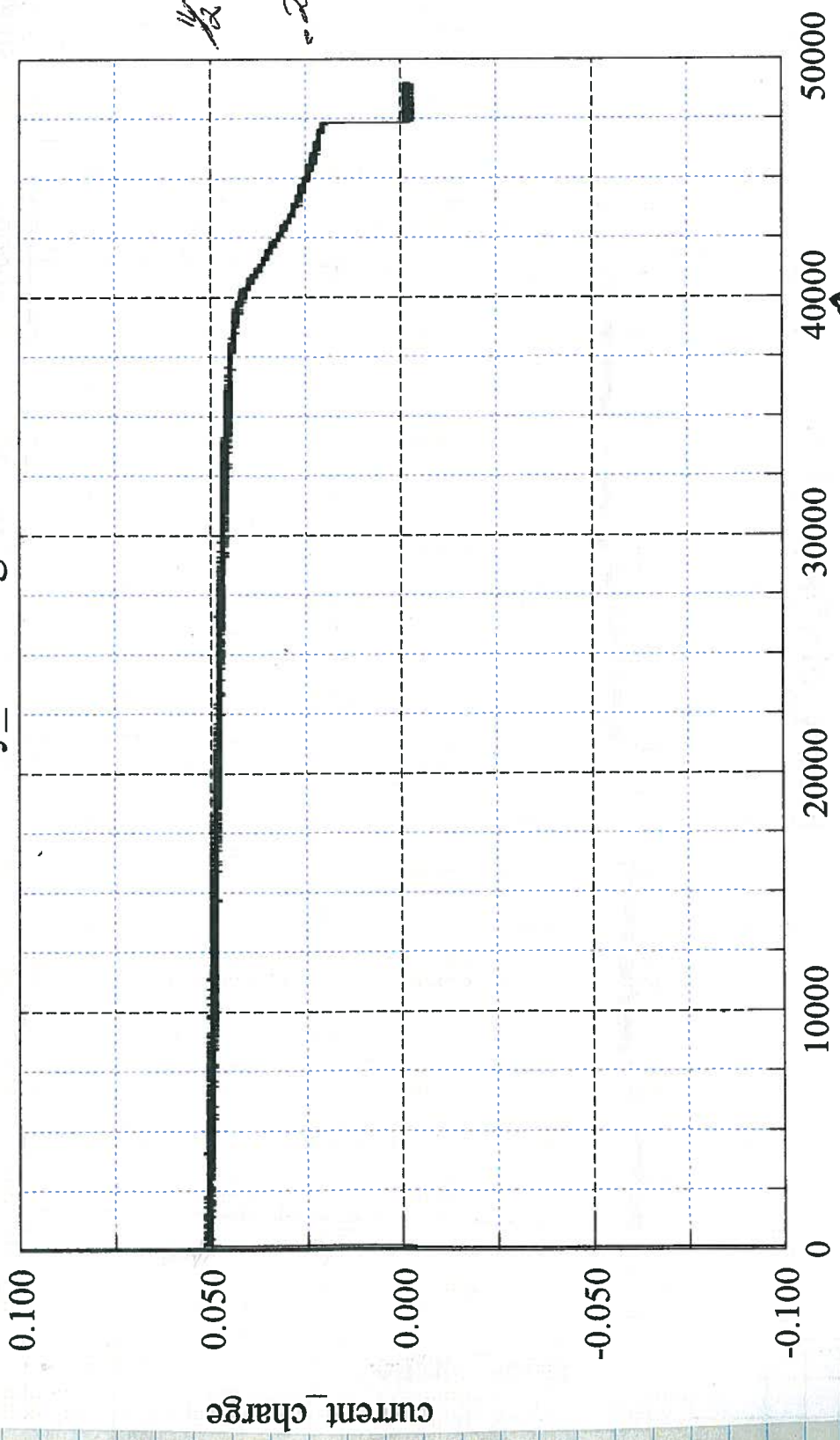
11000 $\approx$ 36hrs

1/18/06
15:15:29

battery_discharge3.txt

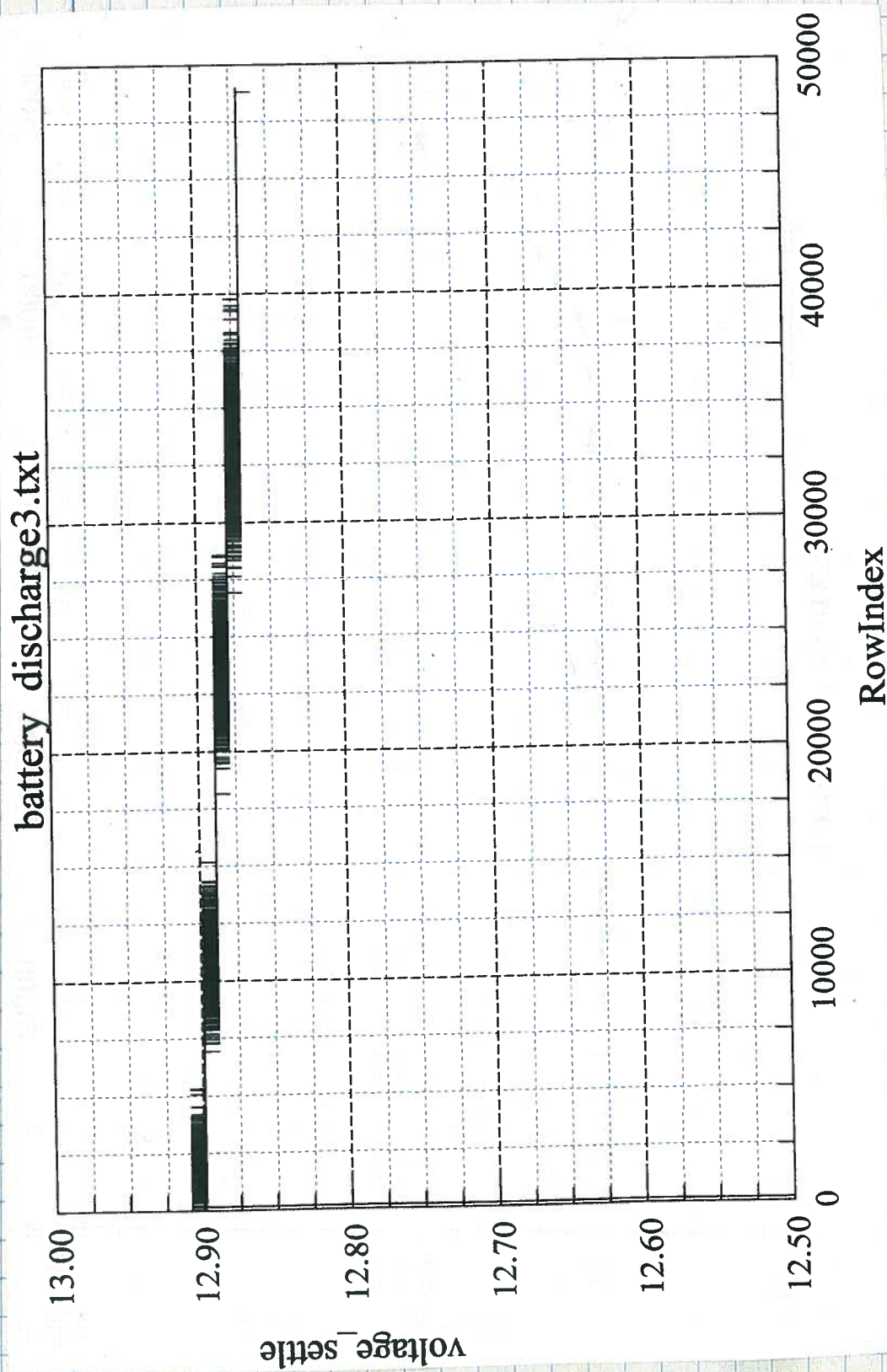


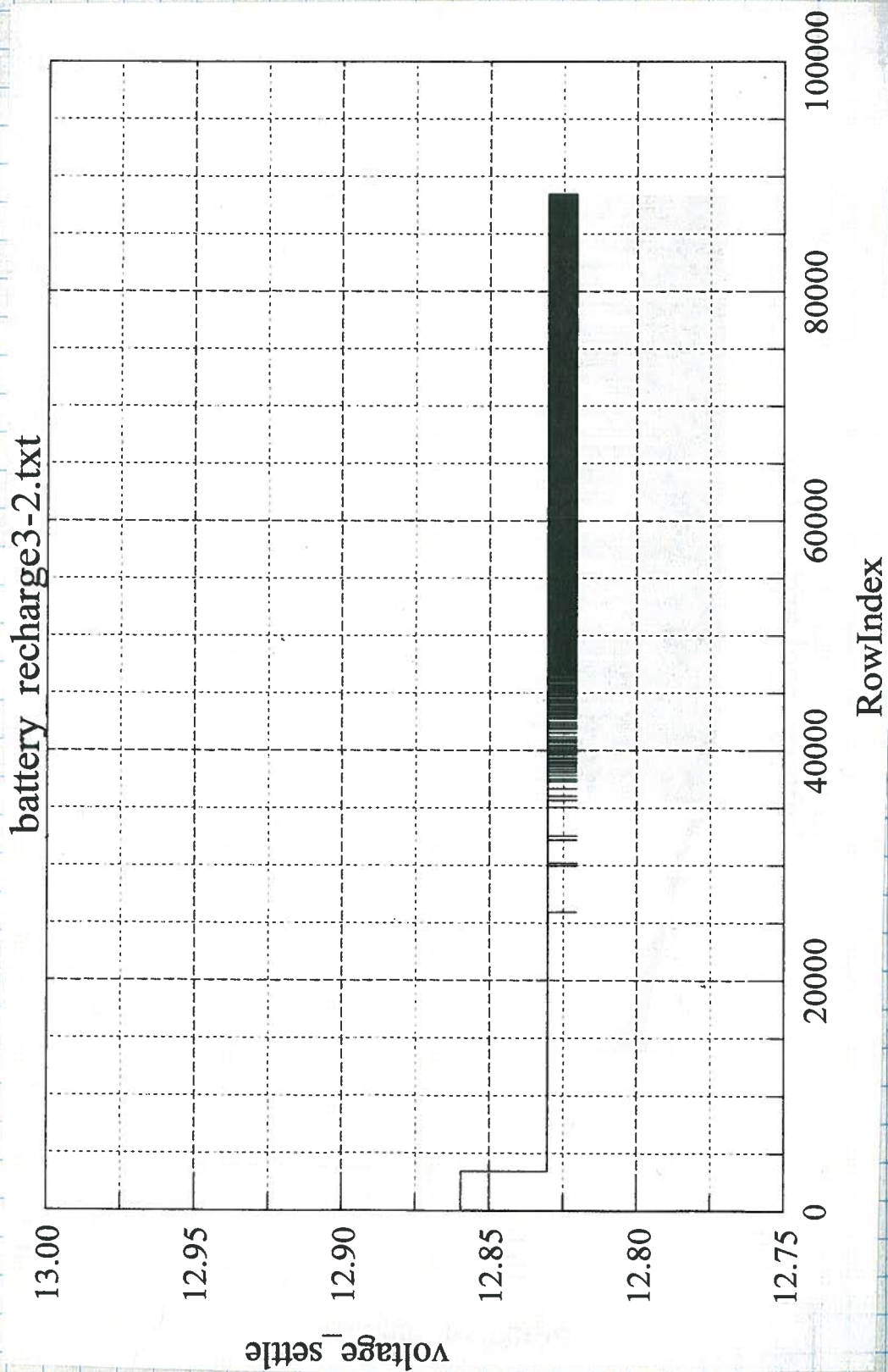
battery_discharge3.txt



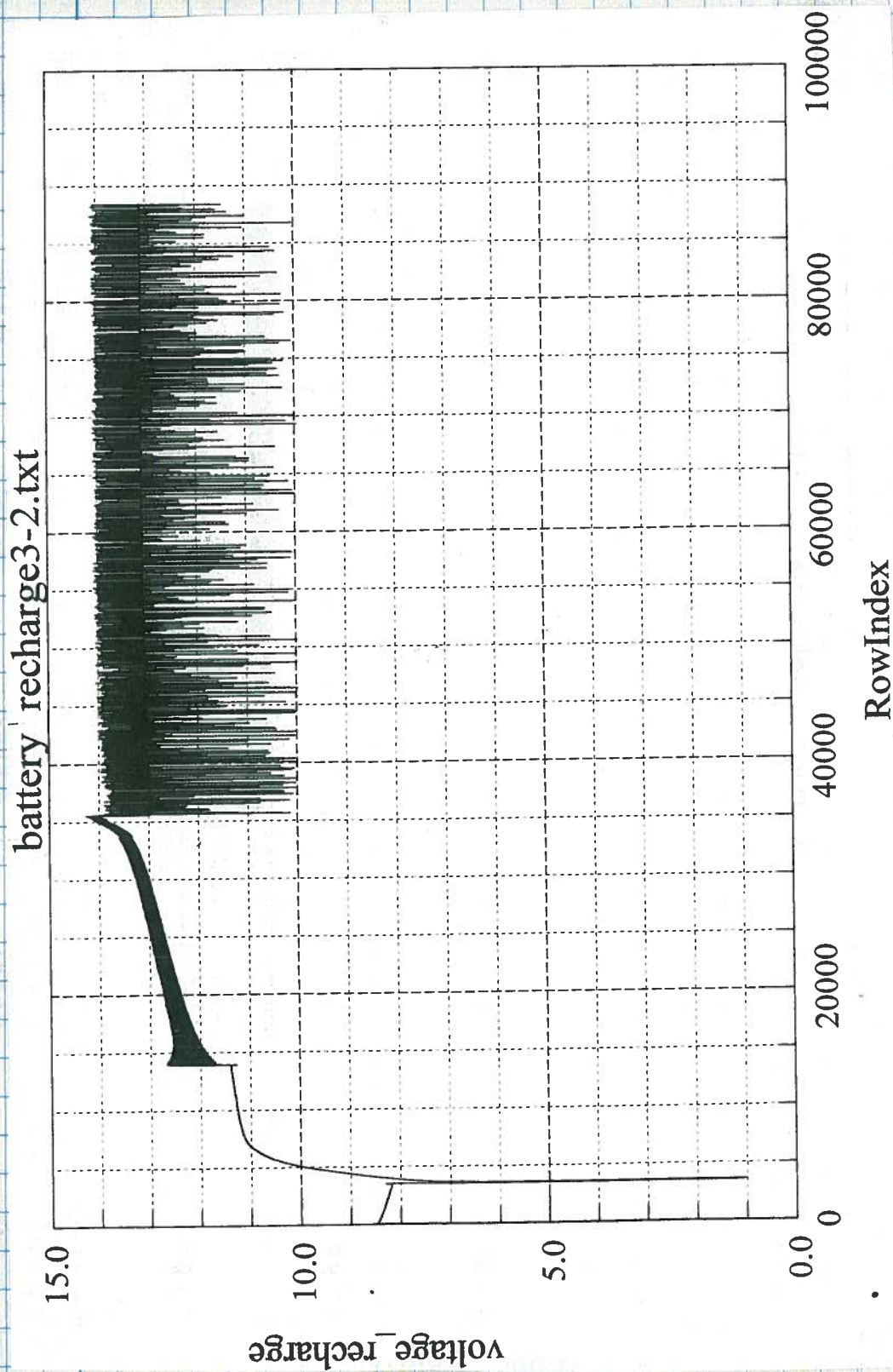
2A -5A
-25A

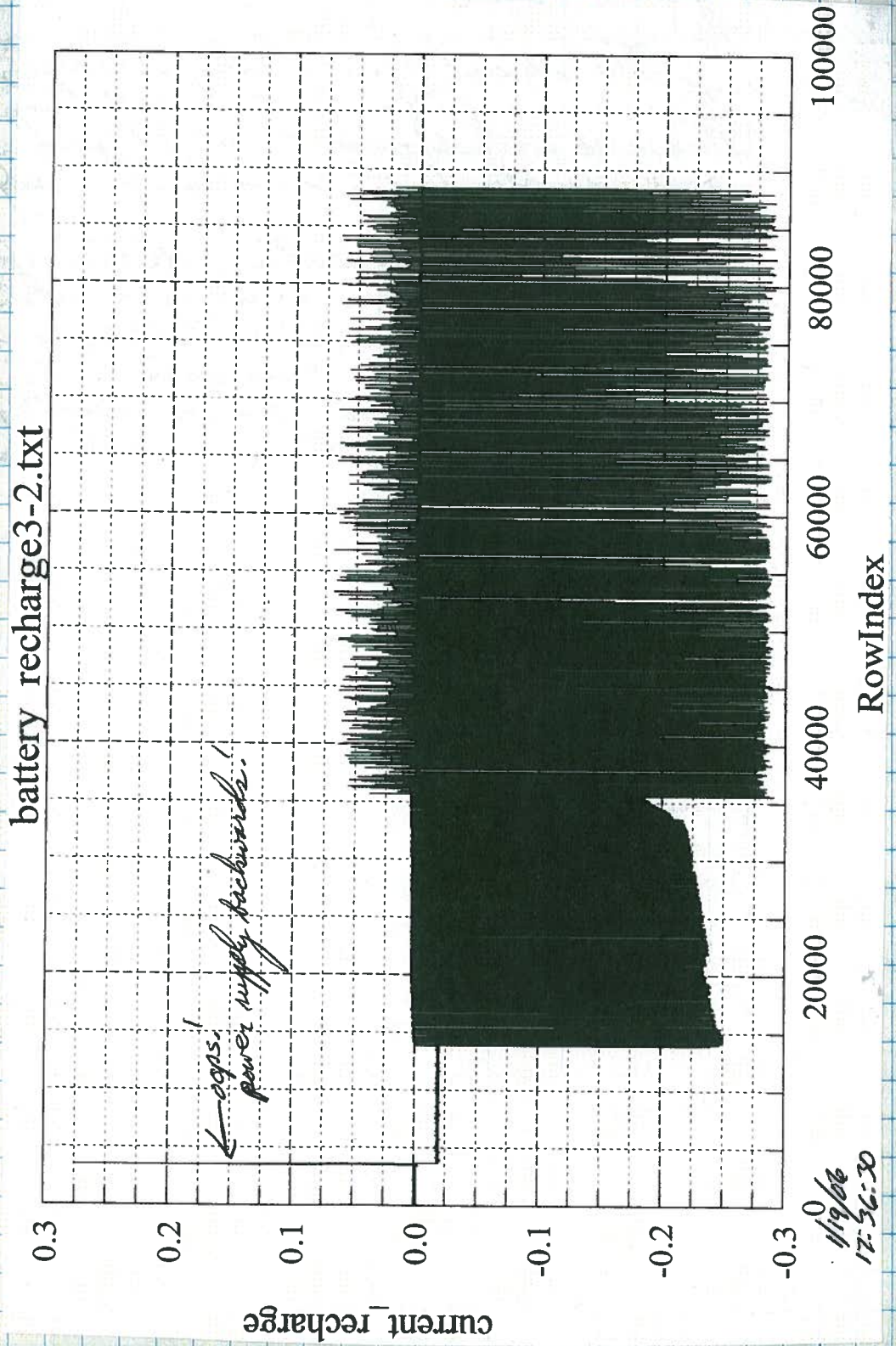
16.1 hrs.





Battery voltage was too low for the MINDer to kick in. It drained some charge off. I hooked up a benchtop supply to charge it, but hooked it up backwards! Reversed it & charged the battery some, then put the MINDer on it.





2/26/66 Current Draws of Clippard Valve, dropod, Q-card

JS

Checking current draw of a Clippard EC-2-12VDC valve. With 12V on a benchtop pwr supply and looking at an Omega HHM290 DMM I see 55mA - 57mA drawn by the valve.

2/28
JS

The current draw of the dropod from Jw Micro is 198mA when first turned on. Measured with Omega HHM290 and using the power supply that came with dropod.

The Mosaic Industries Qcard controller draws 85mA when first turned on. The setup included Qcard controller, carrier board and Compact Flash card with 16 MB flash card. Current measured with Omega HHM290 DMM and using the supply that came with the controller.
Jamesco PDU 08 11 00 8VDC 1A

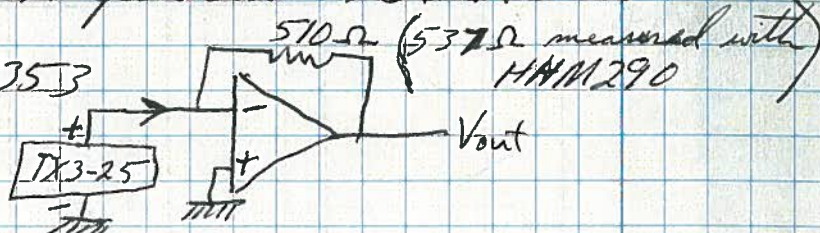
Quick Performance Check of LED Worklight

3/1

Looking at the Coolite 30 LED rechargeable worklight.

I have taped an clone Thin Film Technologies type TX3-25 solar cell to the face of the worklight. It seems to put out 45 mA when the light is on.

I set up an LF353



I am leaving the worklight to charge overnight.

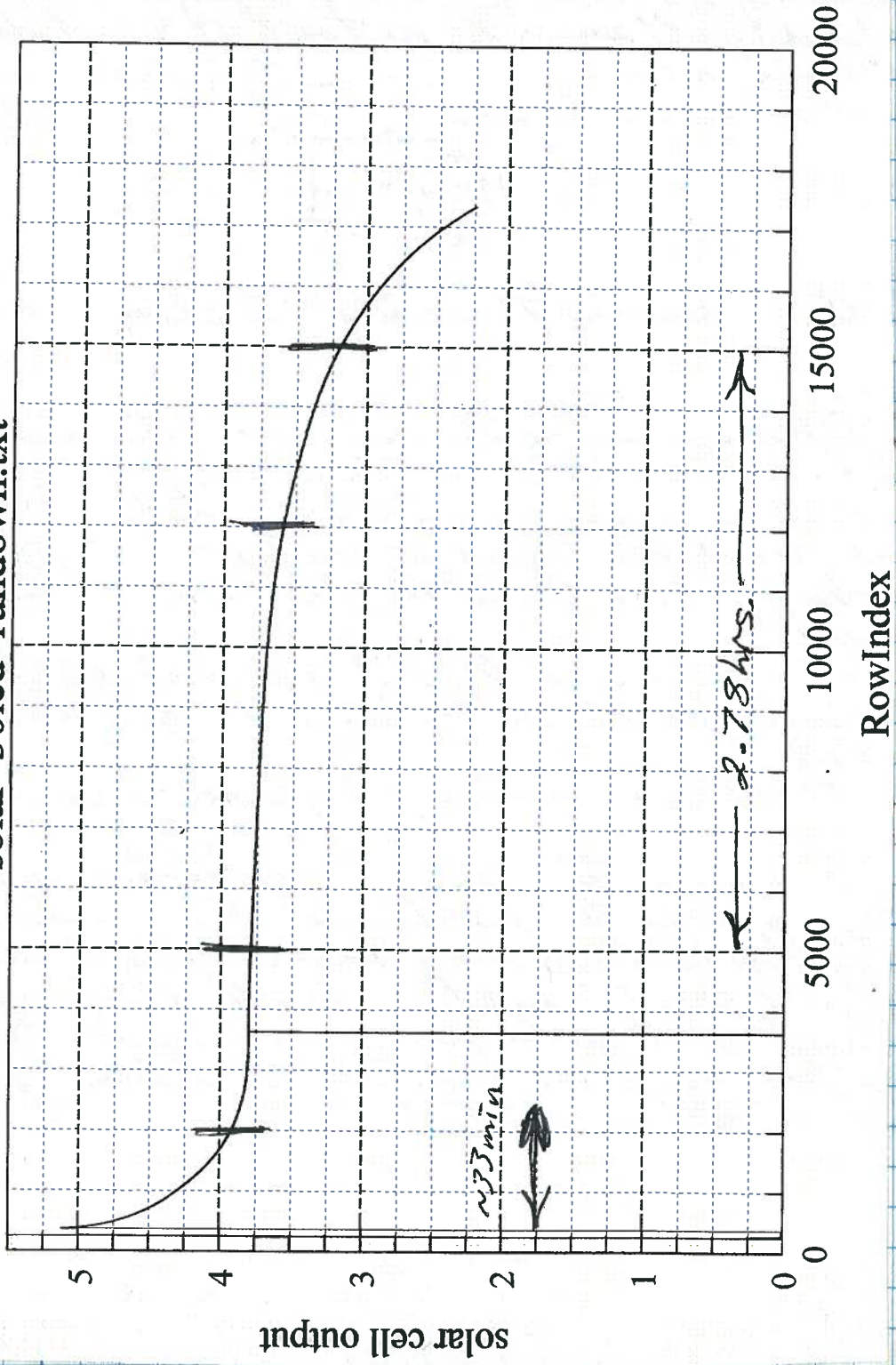
After unplugging the charger I started the PMD-1208 DAQ. Then turned the worklight on and wrapped it in black cloth. At some point the DAQ lost contact with the PMD-1208. I restarted the DAQ and it finished alright.

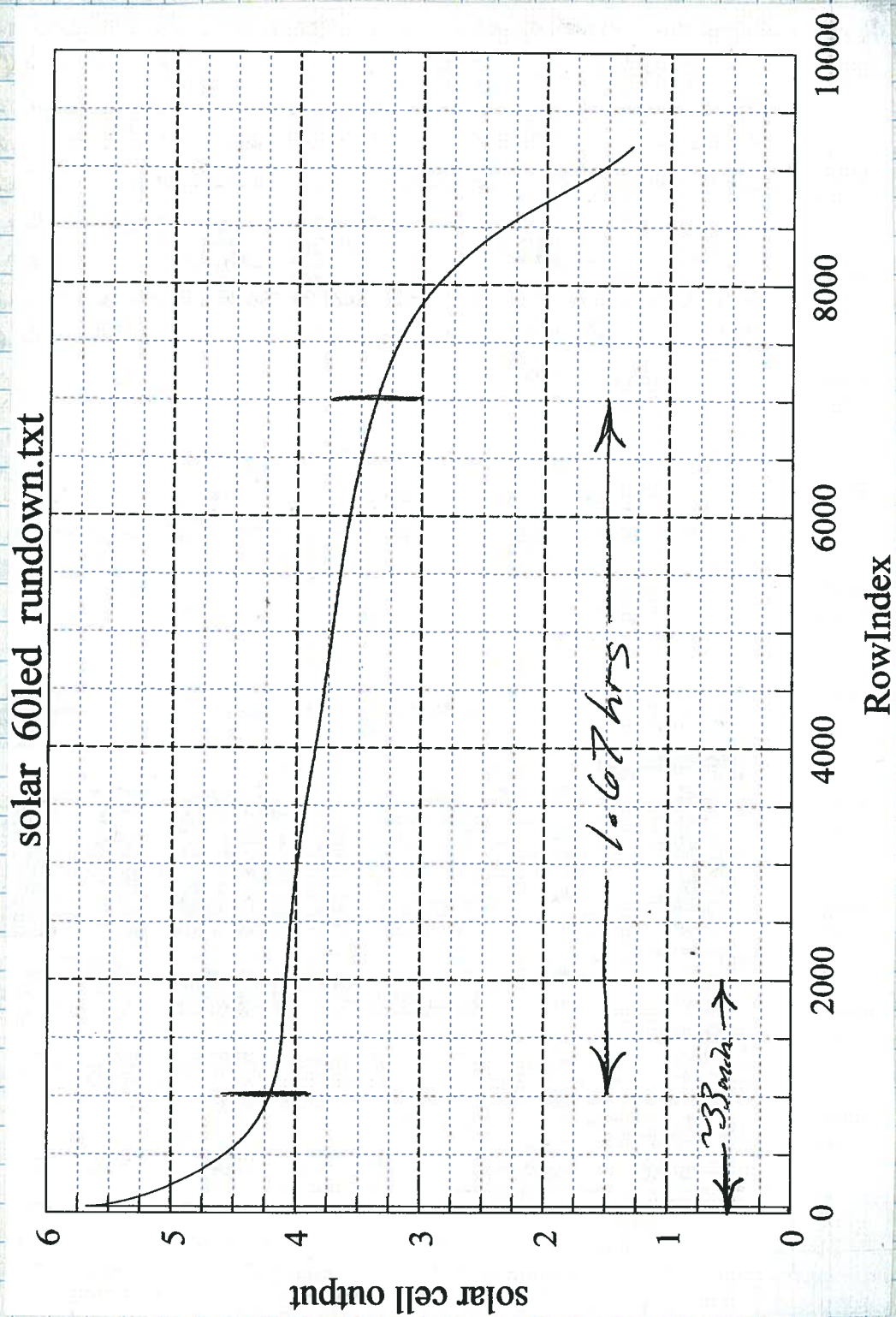
I recharged the 60 LED worklight. Then I did the same thing as with the 30 LED light.

TRACER DAQ was set to sample 1/sec

One important thing I overlooked is that after wrapping the light and cell in black cloth they both get very warm. After the run with the 30 LED light I took the black cloth off and did a short run while the light was cooling. The cell output kept dropping while the cell was cooling.

solar 30led rundown.txt





3/4
A

Check of Backside Efficiency of Thin Film Solar Cell

Checking whether the TX3-25 cell is sensitive to light on its backside. Connecting the cell used for worklight check to the H4/P1290.

I will cover one side of the solar cell with black cloth (the side away from the sun). Today is sunny and right now ~35°F. 9:34 AM

A quick check shows ~39 mA with the active face towards the sun and the black cloth on the backside. ~0.05 mA with the backside towards the sun and the active face covered by the black cloth.

Holding the cell up inside the storage building I can't see the overhead lights through the cell. The lights are a very dim yellow seen through the perforations between the cell sections of the film. So, the cells are essentially opaque.

No gain in efficiency if light is directed onto the back side of the film.



Standard Product List

March 21, 2003

2337 230th Street
Boone, IA 50038 USA
Tel: (515) 292-7906
Fax: (515) 292-1922
sales@iowathinfilm.com

PowerFilm Ultra Flexible Thin Film on Plastic Solar Modules

Product	Operating Voltage	Operating Current	Typ Voc	Typ Isc	Total Size	Aperture Size	Total Thickness	Weight
PowerFilm MP2-37	8 V	22 mA	6.1 V	30 mA	84mm x 97mm (3.3 x 3.8 inches)	80mm x 87mm (3.1 x 3.4 inches)	0.2mm (8mil)	0.7g (0.025oz)
PowerFilm MP2-38	3 V	25 mA	6.1 V	40 mA	114mm x 88 mm (4.5 x 3.5 inches)	100mm x 88mm (3.9 x 3.5 inches)	0.2mm (8mil)	0.9g (0.032oz)
PowerFilm MP2-37	3 V	80 mA	4.1 V	90 mA	114mm x 97mm (4.5 x 3.8 inches)	100mm x 88mm (3.9 x 3.5 inches)	0.2mm (8mil)	1.2g (0.043oz)
PowerFilm MP3-5-75	3.6 V	80 mA	4.8 V	90 mA	74 mm x 75mm (2.9 x 3.0 inches)	69mm x 70mm (2.7 x 2.8 inches)	0.2mm (8mil)	1.8g (0.063oz)
PowerFilm MP3-5-150	3.6 V	100 mA	4.8 V	120 mA	74mm x 150mm (2.9 x 5.9 inches)	69mm x 140mm (2.7 x 5.5 inches)	0.2mm (8mil)	3.1g (0.11oz)
PowerFilm MP4-6-37	4.2 V	22 mA	5.8 V	30 mA	84 mm x 87mm (3.3 x 3.4 inches)	70mm x 87mm (2.8 x 3.4 inches)	0.2mm (8mil)	0.5g (0.020oz)
PowerFilm MP4-6-75	4.8 V	80 mA	6.4 V	90 mA	84mm x 75mm (3.3 x 3.0 inches)	69mm x 70mm (2.7 x 2.8 inches)	0.2mm (8mil)	1.8g (0.063oz)
PowerFilm MP4-6-150	4.8 V	100 mA	6.4 V	120 mA	84mm x 150mm (3.3 x 5.9 inches)	69mm x 140mm (2.7 x 5.5 inches)	0.2mm (8mil)	3.2g (0.11oz)
PowerFilm MP7-8-75	6 V	30 mA	8.0 V	30 mA	114 mm x 75mm (4.5 x 3.0 inches)	100mm x 70mm (3.9 x 2.8 inches)	0.2mm (8mil)	2.5g (0.09oz)
PowerFilm MP7-8-150	6 V	100 mA	8.0 V	120 mA	114 mm x 150mm (4.5 x 5.9 inches)	100mm x 140mm (3.9 x 5.5 inches)	0.2mm (8mil)	4.8g (0.17oz)
PowerFilm MP7-8-75	7.2 V	100 mA	10.5 V	120 mA	80mm x 75mm (3.1 x 3.0 inches)	69mm x 70mm (2.7 x 2.8 inches)	0.2mm (8mil)	1.8g (0.063oz)
PowerFilm MP7-8-150	7.2 V	300 mA	10.5 V	120 mA	80mm x 150mm (3.1 x 5.9 inches)	69mm x 140mm (2.7 x 5.5 inches)	0.2mm (8mil)	25.0g (0.88oz)
PowerFilm MP11-150	18.4 V	80 mA	19 V	80 mA	80mm x 75mm (3.1 x 3.0 inches)	69mm x 70mm (2.7 x 2.8 inches)	0.2mm (8mil)	13.0g (0.46oz)
PowerFilm MP11-150	18.4 V	100 mA	19 V	120 mA	80mm x 150mm (3.1 x 5.9 inches)	69mm x 140mm (2.7 x 5.5 inches)	0.2mm (8mil)	25.0g (0.88oz)

PowerFilm MC Aligned Series

Product	Operating Voltage	Operating Current	Typ Voc	Typ Isc	Total Size	Aperture Size	Total Thickness	Weight
PowerFilm MC2-8-97	7.2 V	80 mA	10.5 V	80 mA	270mm x 97mm (10.6 x 3.8 inches)	240mm x 87mm (9.4 x 3.4 inches)	0.2mm (8mil)	3.5g (0.12oz)
PowerFilm MC2-8-97 PAA*	7.2 V	80 mA	10.5 V	80 mA	270mm x 97mm (10.6 x 3.8 inches)	240mm x 87mm (9.4 x 3.4 inches)	0.2mm (8mil)	4.4g (0.16oz)
PowerFilm MC2-8-150	7.2 V	100 mA	10.5 V	120 mA	270mm x 150mm (10.6 x 5.9 inches)	240mm x 140mm (9.4 x 5.5 inches)	0.2mm (8mil)	5.9g (0.21oz)
PowerFilm MC2-8-150 PAA*	7.2 V	100 mA	10.5 V	120 mA	270mm x 150mm (10.6 x 5.9 inches)	240mm x 140mm (9.4 x 5.5 inches)	0.2mm (8mil)	7.8g (0.28oz)

PowerFilm WeatherPro Series

Product	Operating Voltage	Operating Current	Typ Voc	Typ Isc	Total Size	Aperture Size	Total Thickness	Weight
PowerFilm P7-2-75	7.2 V	100 mA	10.5 V	120 mA	270mm x 100mm (10.6 x 3.9 inches)	240mm x 87mm (9.4 x 3.4 inches)	1.1mm (44 mil)	31.5g (1.11oz)
PowerFilm P7-2-150	7.2 V	300 mA	10.5 V	300 mA	270mm x 175mm (10.6 x 6.9 inches)	240mm x 150mm (9.4 x 5.9 inches)	1.1mm (44 mil)	84.8g (3.00oz)
PowerFilm P7-11-75	18.4 V	80 mA	19 V	80 mA	270mm x 100mm (10.6 x 3.9 inches)	240mm x 87mm (9.4 x 3.4 inches)	1.1mm (44 mil)	31.5g (1.11oz)
PowerFilm P7-11-150	18.4 V	100 mA	19 V	120 mA	270mm x 175mm (10.6 x 6.9 inches)	240mm x 150mm (9.4 x 5.9 inches)	1.1mm (44 mil)	56.4g (2.00oz)
PowerFilm P7-11-200	18.4 V	200 mA	19 V	200 mA	270mm x 225mm (10.6 x 8.9 inches)	240mm x 200mm (9.4 x 7.9 inches)	1.1mm (44 mil)	84.5g (3.00oz)

Solar-Recharged Consumer Electronics - Eliminate Replacement Batteries

Product	Description	Color	Batteries Included	Key Features
SolarFilm MP-1 BLUE	FM Stereo/AM Headphone Radio	BLUE	1 - AAA NiMH	Choi headband, internal antenna, and extended base
SolarFilm MP-10NAV	FM Stereo/AM Headphone Radio	NAVY	1 - AAA NiMH	

* Ultra Thin 1.0 mm ** Powersensitive Adhesive
Operating Voltage and Operating Current at AM1.5. Power performance may vary at 10% due to temperature variation, spectral variation, and related effects.
Iowa Thin Film, PowerFilm and SolarFilm are trademarks of Iowa Thin Film Technologies, Inc.

For more information, visit our website at www.iowathinfilm.com or call 1-800-451-1922

0000021

Quick Check of Drain of Ni-MH AA Batteries

Quick check of some Ni-MH AA batteries. Looking at the time required to drain the batteries.

I put together a Bud box with resistors mounted on banana plug sockets. For this test I'm using a $5 \times 20 \Omega$ resistor in parallel a 5Ω resistor, a $10 \times 20 \Omega$ resistor in parallel, and a $10 \times 5 \Omega$ resistor in series.

The traces on the DMM are labeled 4, 5, 7, & 15 ohms. The DMM is started and then the load connected to each battery.

The battery with the 5Ω load seems to be having a problem. I labeled the batteries 1, 2, 3 & 4. 2 is having the problem. I labeled four more batteries 5, 6, 7, & 8 and put them into the charger.

After putting the label on 2 it seems to have improved. Perhaps a bad connection?

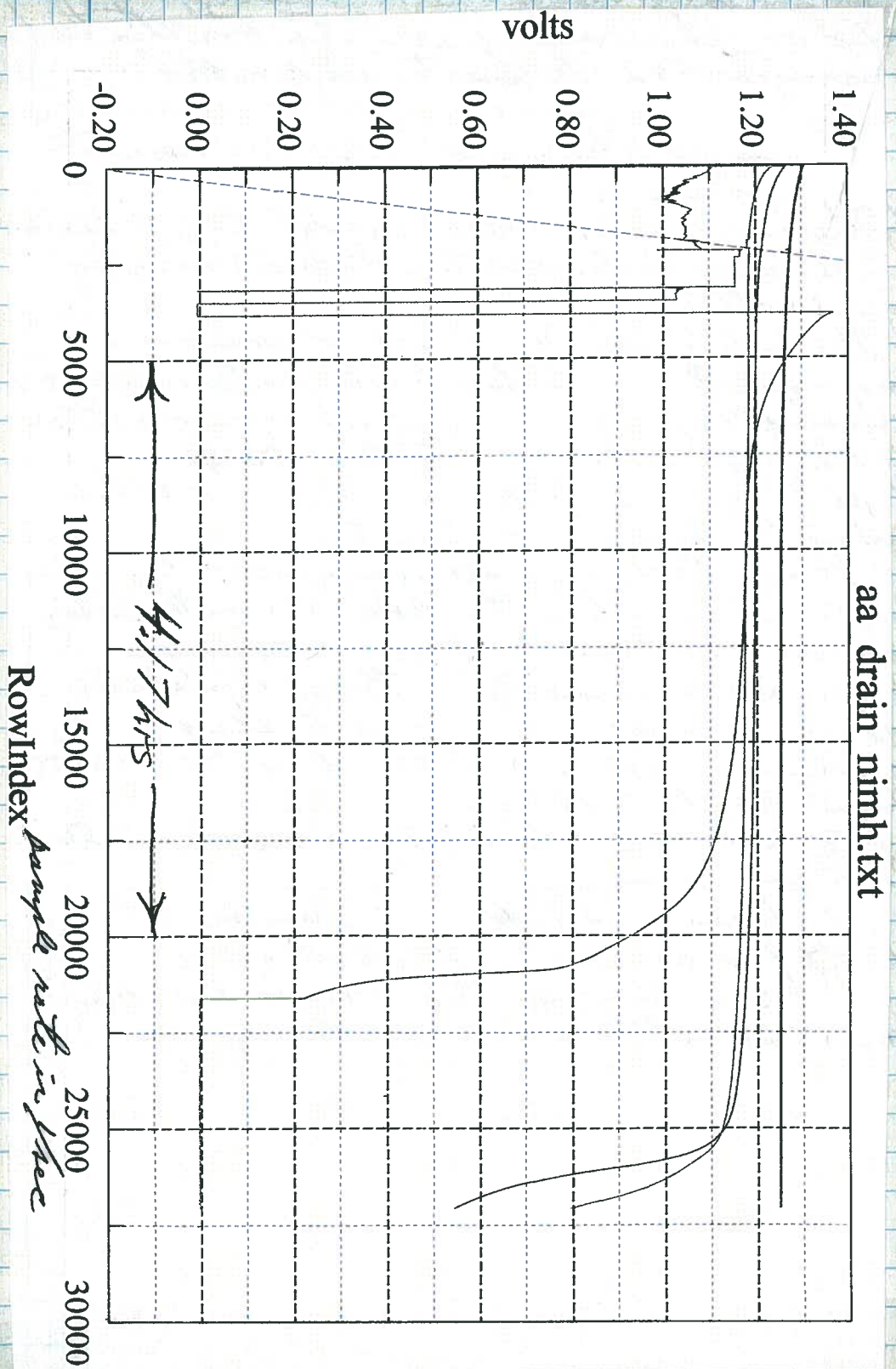
It looks like 2 is holding at some voltage value. I have tried reseating the rubber cable on the battery holder. It comes back around 1 volt.

I have disconnected battery 2. I put it in the charger. I removed battery 8 from the charger, it was finished charging, and I'm letting it cool before putting it on the 5Ω load.

I have connected battery 8 to the 5Ω load. Things seem ok.

I removed battery 1 from the 4Ω load. It had run down to about .1V!

9 PM. I stopped the DMM, removed all the batteries and put them in the charger.



Check of Drain of AA Ni-MH and Alkaline Batteries 3/5

I put batteries 4, 6, 7, 8 in the charger to top them off. I put 4 on the 4Ω load, 6 on the 5Ω load, 7 on the 7Ω load, and 8 on the 15Ω load. I started the DAQ and then made the final connections.

I rotated battery 4 in the holder shortly after I finished connecting everything. Plot of the run is on p. 32.

after the NiMH batteries were finished I put in some Energizer Industrial alkaline batteries.

The run was interrupted twice, the DAQ that is. Once when Heidi logged me out of the PC to print something (the PC was in screen saver at the time). That was for 46 minutes. One other time for 10 minutes because I had to reboot the PC because it was running slow & seemed to have problems with the video. Plot of the run is on p. 33.

PRODUCT DATASHEET

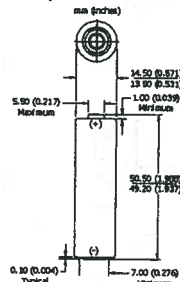
Energizer

 1-800-253-7323 USA/CAN
www.energizer.com

ENERGIZER EN91



Industry Standard Dimensions

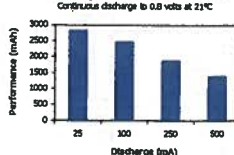


Specifications

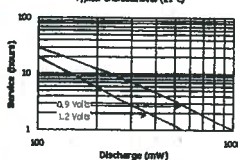
NOT INTENDED FOR RETAIL TRADE
Alkaline
Zinc-Manganese Dioxide (Zn/MnO₂)
No added mercury or cadmium
Designation: ANSI-15A, IEC-LR6
Nominal Voltage: 1.5 volts
Nominal IZ: 150 to 300 mA-hours (first 90%)
Operating Temp: -18°C to 55°C (0°F to 130°F)
Typical Weight: 23.0 grams (0.8 oz.)
Typical Volume: 8.1 cubic centimeters (0.5 cubic inch)
Jackets: Plastic Label
Shelf Life: 7 years at 21°C (80% of initial capacity)
Terminals: Flat Contact

* For additional information, please reference the IZ technical white paper.

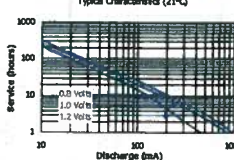
Milliamp-Hours Performance



Constant Power Performance



Constant Current Performance



Important Notice

This data sheet contains typical information specific to products manufactured at the time of its publication.
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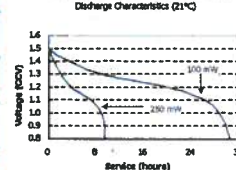
PRODUCT DATASHEET

Energizer

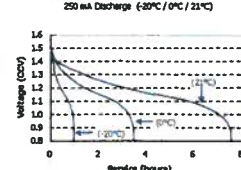
 1-800-253-7323 USA/CAN
www.energizer.com

ENERGIZER EN91

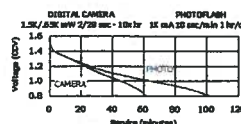
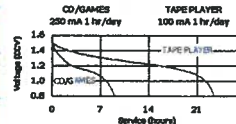
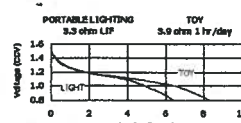
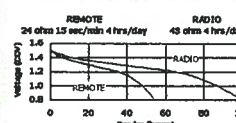
Constant Power Performance



Constant Current Performance

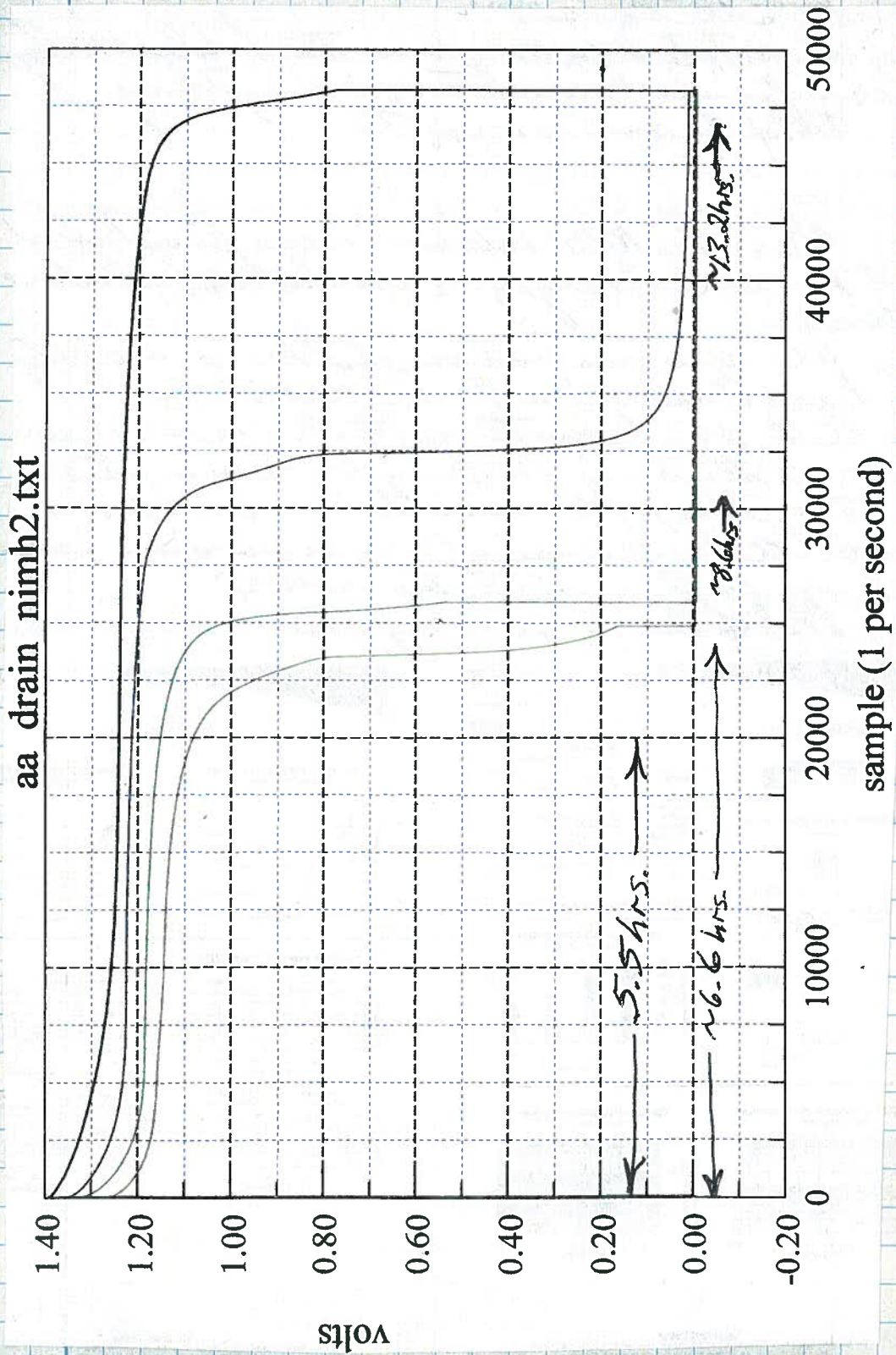


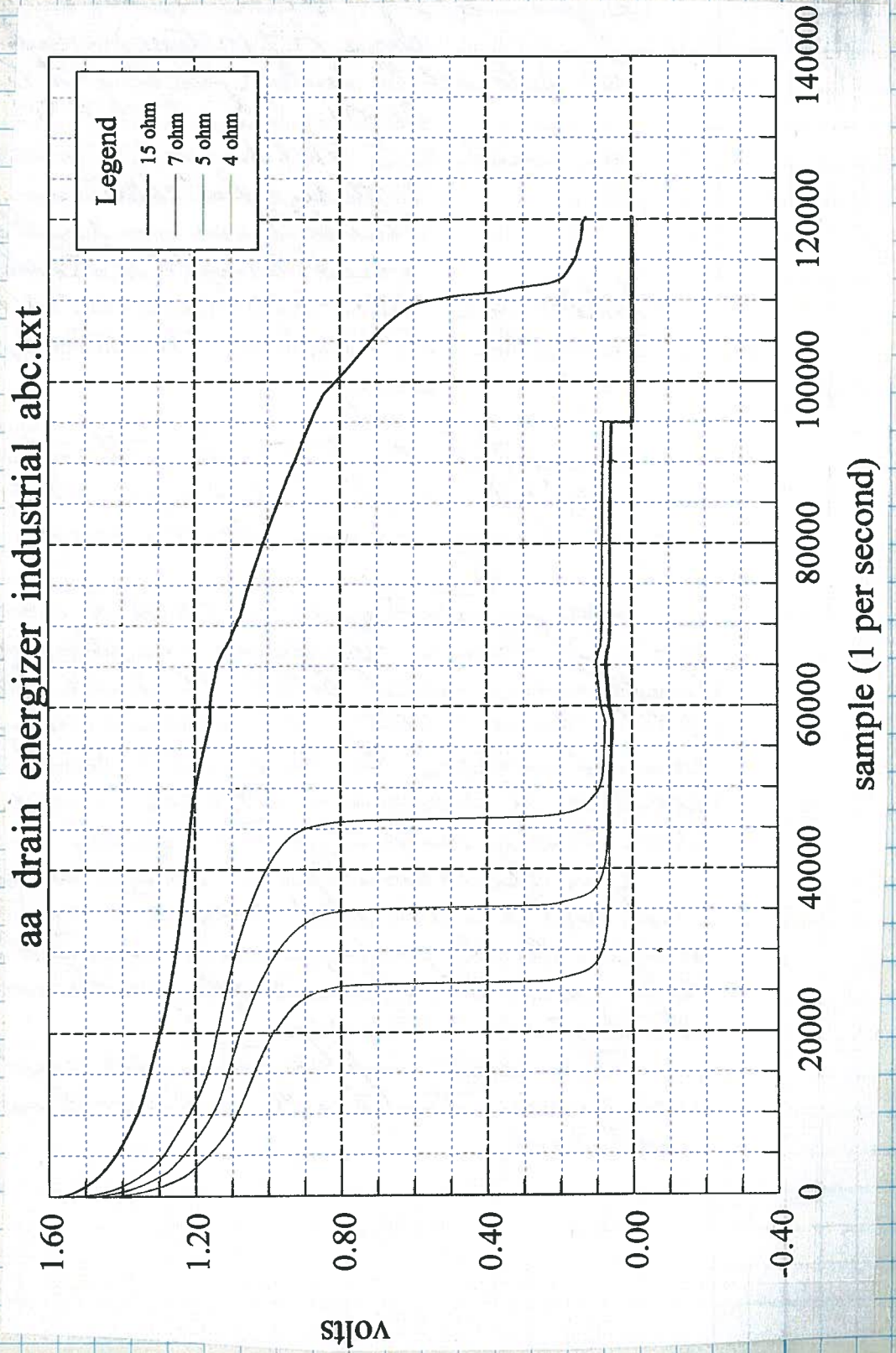
Industry Standard Tests (21°C)



Important Notice

This data sheet contains typical information specific to products manufactured at the time of its publication.
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3/12/06 Initial Current Draw of Various Lightbulbs

Earlier this week I decided to check the initial current draw of lightbulbs. Trying to see how long and how much current it takes for the bulbs to come to equilibrium. Bulbs used were

- Sylvania Soft White 60W, 870 lumens, 1000 hr life
size A19 (or type or whatever)
- GE soft white indoor floodlight 65W, 755 lumens, 2000 hr life, type R30
- GE small white 4W, has a "T1" also on the base, it is the size of a "christmas tree" bulb. This bulb was in a small desk lamp & wired straight to the plug. No filter.
- Ledtronics DEC-R20-OCW-02M LED bulb
- Energetic FE13G/5G 5W, 85mA, self-ballasted lamp

Except for the 4W bulb, the others were tested in a desk lamp that has a small breaker, but no filtering, on its power cord.

Two methods were used to measure the current drawn. The lamp was plugged into a Craftsman model 81060 AC Line Splitter and a Fluke model i200s AC Current Clamp was clamped around either the X1 or X10 section of the line splitter. A Tektronix TH5720 scope was used to look at the output of the i200s.

In the second part I cut an extension cord and put a 1 Ω 10W resistor on the black wire. A x10 probe was connected across the 1 Ω resistor. The ~~probe~~ probe was connected to the TH5720 scope.

The scope information was read out over the serial connection to a PC and saved in a Waveter "notebook".

60W bulb cold turn on.

Both 1, 2 and 3 are using Fluke i200s AC Current Clamp.

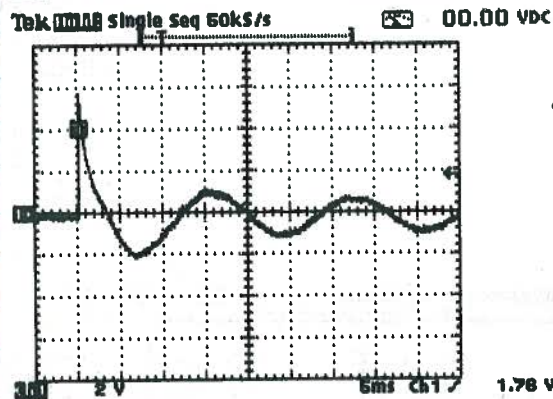
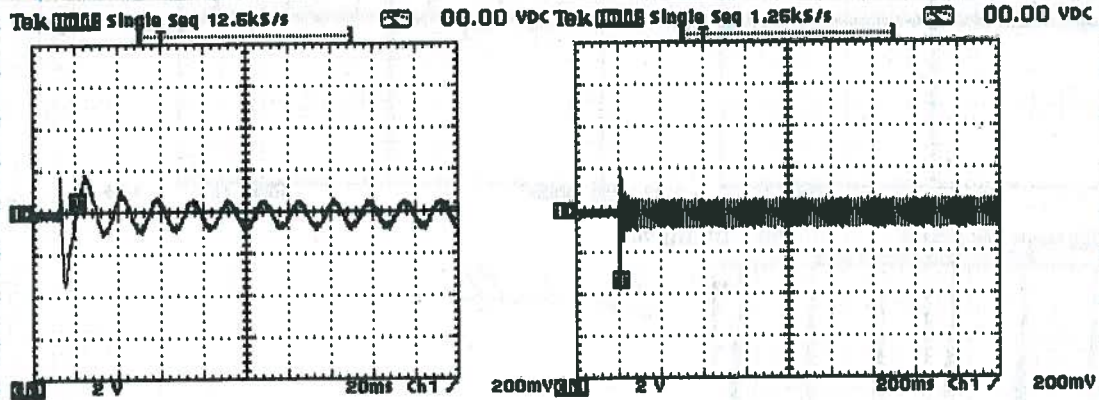
100mV/A. Clamped on X1 of Craftsman AC Line Splitter 81066.

4, 5 and 6 are 120W flood.

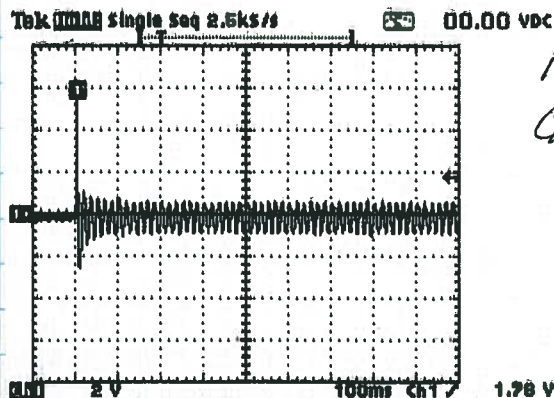
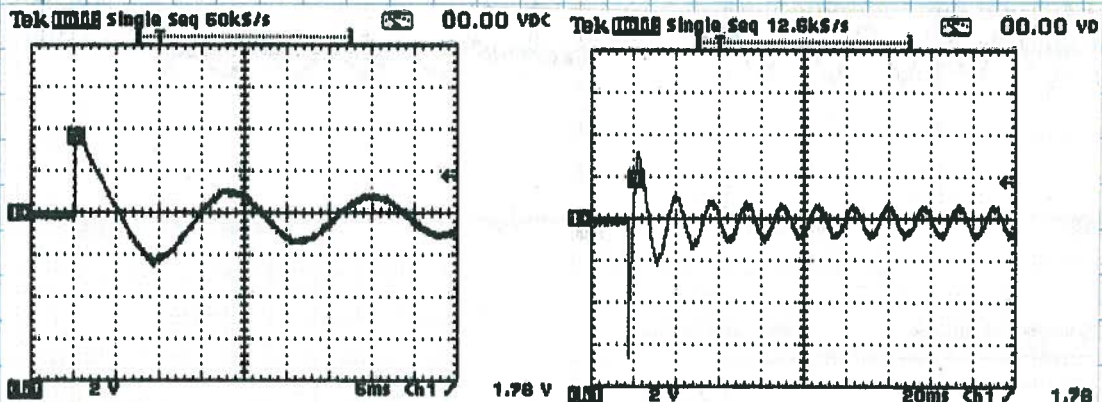
7 and 8 are 5W florecent. 9 is 5W on X10 of splitter.

10 and 11 are desk lamp on X10.

12 is LED bulb on X10.



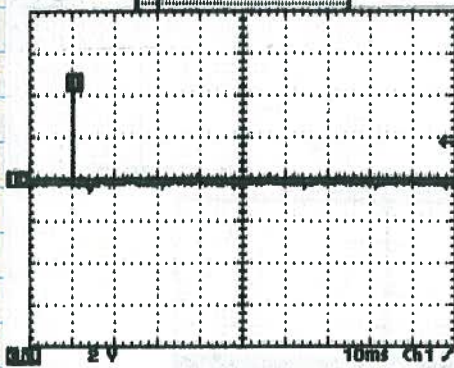
*60W bulb.
Cold when turned on.*



*120W flood.
Cold when turned on.*

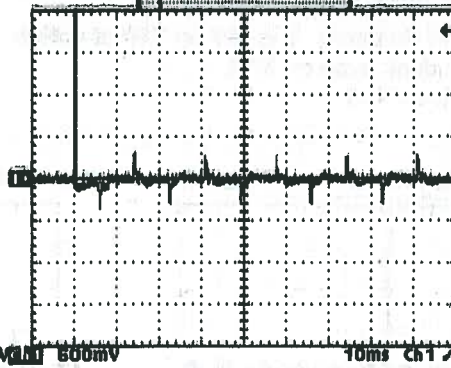
Tek 0000 Single Seq 25kS/s

00.00 VDC



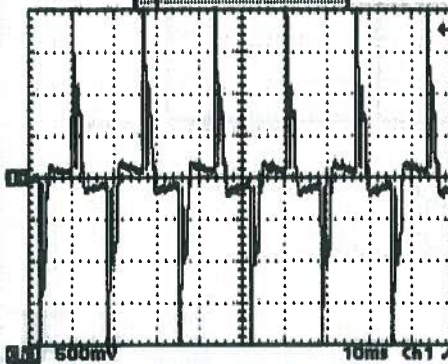
Tek 0000 Single Seq 25kS/s

00.00 VDC



Tek 0000 Single Seq 25kS/s

00.00 VDC

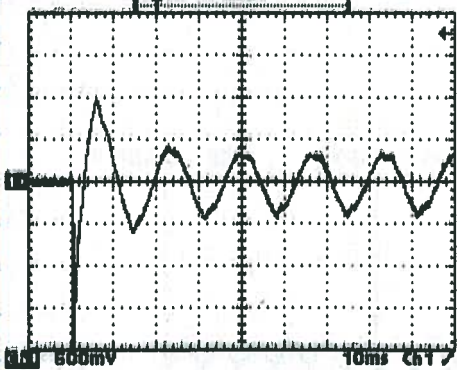


5W bulb

1.76 V

Tek 0000 Single Seq 25kS/s

00.00 VDC

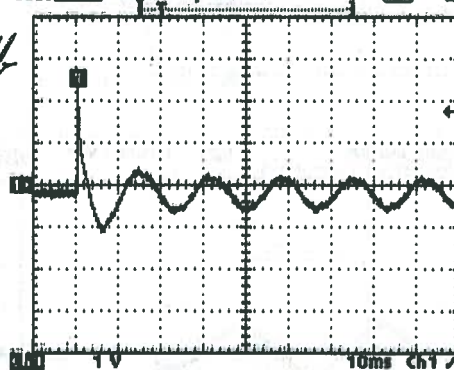


4W bulb

1.76 V

Tek 0000 Single Seq 25kS/s

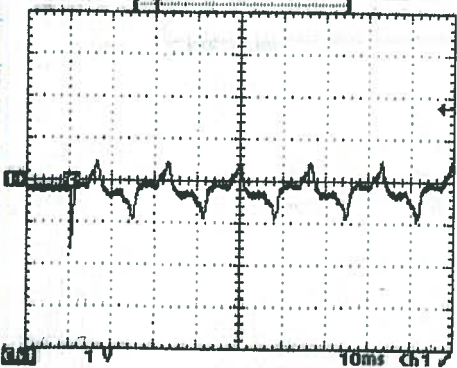
00.00 VDC



1.76 V

Tek 0000 Single Seq 25kS/s

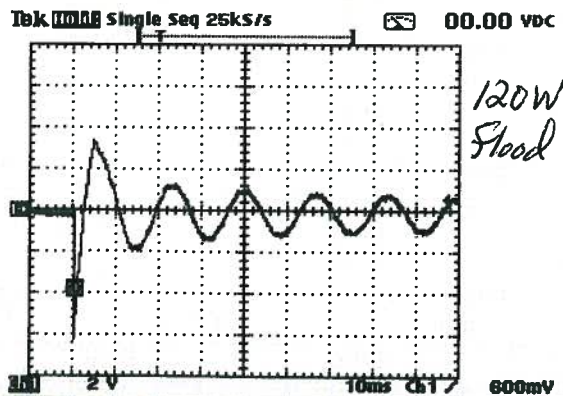
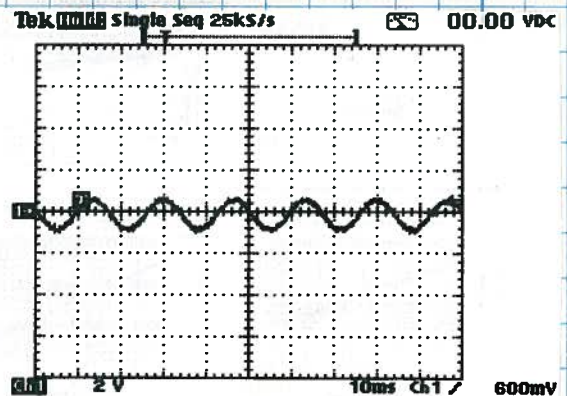
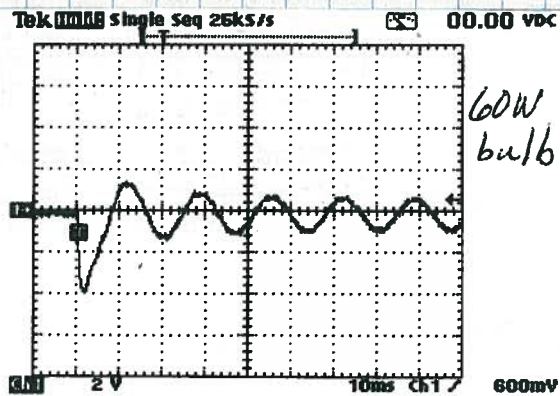
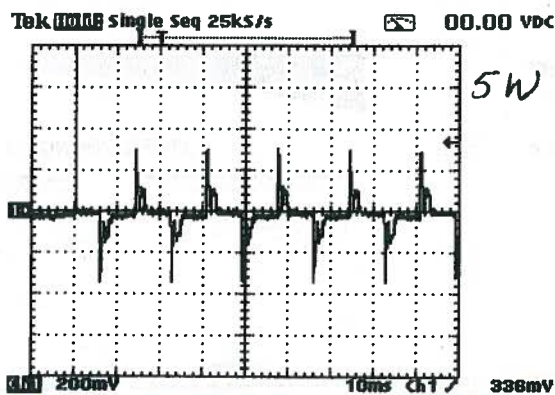
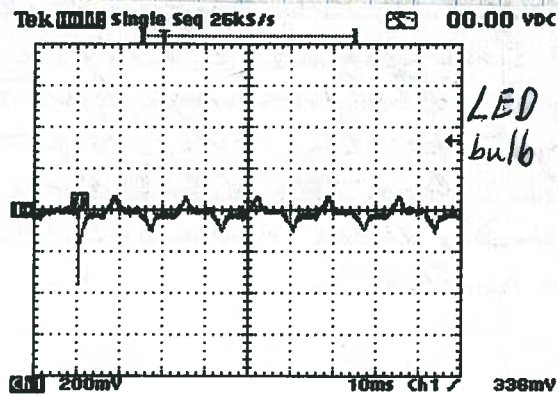
00.00 VDC



LED bulb

1.76 V

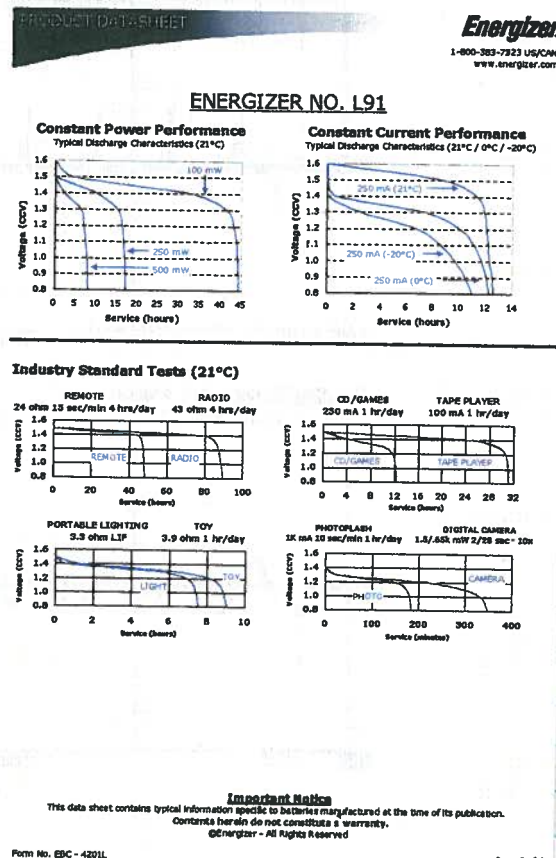
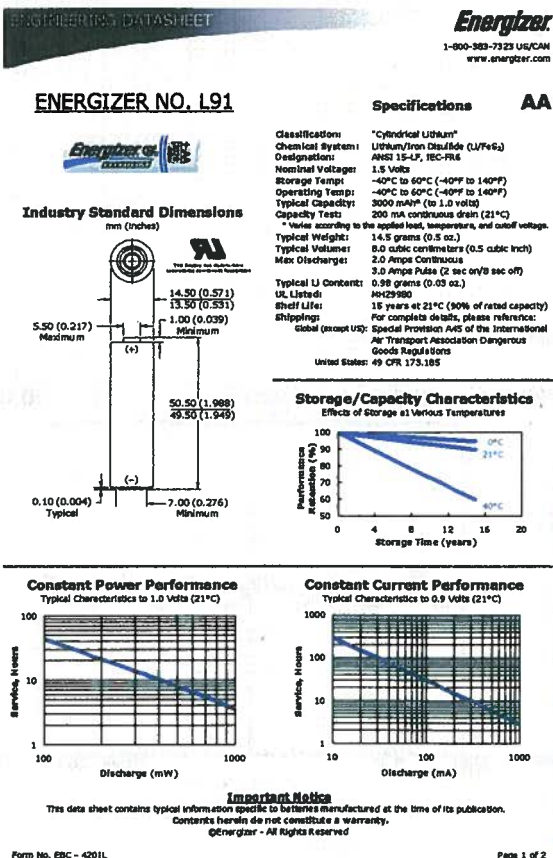
1 is of LED bulb using probe across a 1 ohm resistor.
 I also just realized the scope was already on x10 probe on the vertical menu!
 2 is 5W florescent.
 3 is 60W. 4 is 60W after being on for a few seconds.
 5 is 120W flood.



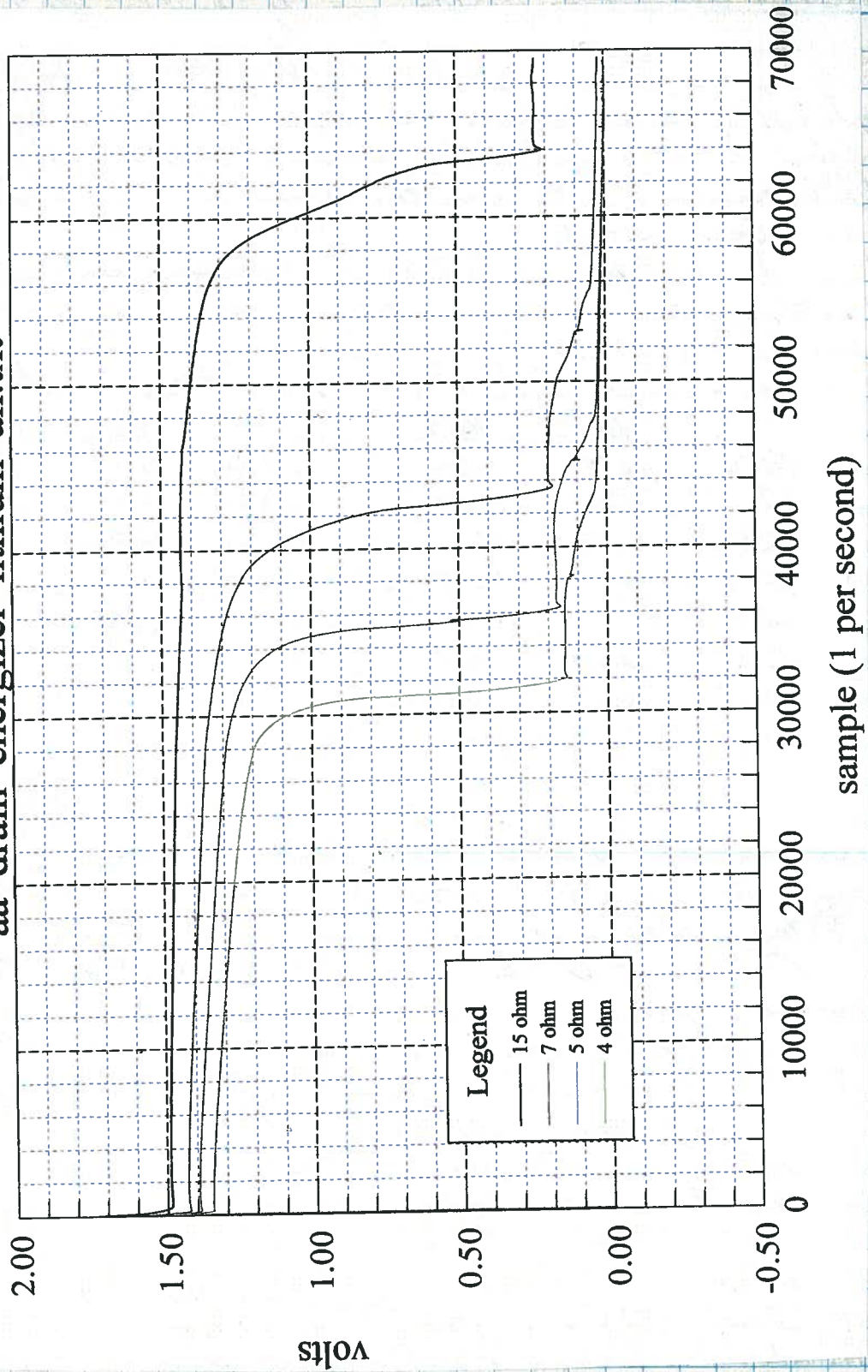
Current Drain of Lithium AA Batteries

3/18

I started a run with some lithium batteries on the 4 Ω , 5 Ω , 7 Ω , and 15 Ω loads. Batteries are Energizer e² Lithium. Number L91BP-2. The package has the bunny on the front. So, they must be good. Batteries were taken from the stockroom shortly after the run on p. 31, about 2 weeks ago. Package says "Use by 2020".



aa drain energizer lithium all.txt



More Observations on Charging Pb-Acid Batteries

3/25

Some time ago we had a UPS go bad and I got 8 more Panasonic LC-R127R2CH1 batteries from it. I painted the numbers 1-16 on all the batteries. 1, 2, & 3 are the same as 1, 2, & 3 of the previous work.

Some of the batteries had a very low resting voltage. I used the "batteryminder" charger on some of them.

Using my Fluke 189 the present resting voltages are

		4/9/06	4/15			4/9/06	4/15
1	12.768	12.750	12.745	9	12.920	12.851	12.833
2	12.694	12.683	12.680	10	12.884	12.753	12.730
3	12.565	12.554	12.553	11	12.726	12.653	12.626
4	12.683	12.673	12.672	12	11.735	} disposed of	
5	12.713	12.700	12.697	13	11.465		
6	12.690	12.681	12.679	14	11.176		
7	12.670	12.681	12.679	15	8.560		
8	12.683	12.673	12.671	16	9.044		

12 has spent the last "week" on the "batteryminder". It also had a very low resting voltage. I used a benchtop supply to try a constant force charge on it. When the voltage was high enough I put the "batteryminder" on it and left it till about 15 minutes before this measurement.

I have 8 more Panasonic LC-R127R2P1 batteries that I got as new. The present resting voltages are

		4/9/06	4/15	4/22
17	12.674	12.725	12.713	12.698
18	12.657	12.670	12.664	12.657
19	12.639	12.628	12.626	12.620
20	12.661	12.651	12.649	12.643
21	12.660	12.650	} these 4 were installed in the UPS we removed 25, 26, 27 + 28 from.	
22	12.653	12.642		
23	12.653	12.643		
24	12.657	12.647		

I put the minder on #13. It immediately started to blink the green LED. I put the minder off #17 and the green LED came on steady. It looks like the minder sees #13 as bad. I'm assuming the minder saw #12 as bad too ... I don't know ... at 12.671 #12 all week.

I put the Forward 6306D benchtop supply on #12.
 Set to a little over 13V and ~0.1A in CC mode.
 When connected, the supply reads 17.3V and 0.1A.
 Checking the minder manual the charger does
 not turn on unless the battery voltage is at least 11V.
 Some excerpts from the minder manual

BatteryMINDER Specifications

The BatteryMINDER is UL Listed and CSA Certified.

Input	105-130 Vac 50/60 Hz
Output	12 volts @ 1.0 Amps
Charge Voltage	14 Vdc
Float Voltage	13.4 Vdc
Desulphation Pulse	1.0A @ 3.26 MHz
Float Current	5 Ma - 200 Ma*
Size/Weight	3-3/4" L x 2-1/2" W x 2-1/4" H / 2.3 lbs

Battery voltage vs. Charge Percentage

Hydrometer Reading on Each Cell	Voltage	Percentage
1.270	12.7 volts	100 %
1.250	12.5 volts	75 %
1.190	12.3 volts	50 %
1.150	12.1 volts	25 %
1.120	11.8 volts	0 %

Testing a Sealed, Maintenance-free, Gelled-type Lead Acid Battery

These batteries have no filler caps or manifold-type covers. If you cannot gain access to the interior of your battery, because it is sealed, you cannot test it with a hydrometer.

1. Test the battery with a voltmeter. If the voltage is less than 11 volts, charge the battery overnight with a regular charger or with the BatteryMINDER.
2. Let the battery rest for minimum of 8 hours, which means that you do not use or charge the battery for 8 hours.
3. Test the battery with a voltmeter. If the voltage is less than 12.2 volts (25% charge), the battery might have too much sulphation in it to reach full charge.
4. Connect the BatteryMINDER to the battery.
5. Lightly touch the Desulphation button to start the maintenance/desulphation mode right away.
6. Let the BatteryMINDER desulphate the battery at least a week.
7. Test the battery again with a voltmeter.

After ~2 hrs I took the power supply off #12.
 The battery was up over 13V. After ~15 minutes I
 checked again and it was down to 12.69V and
 not dropping. I connected the minder and the green
 LED started blinking immediately.

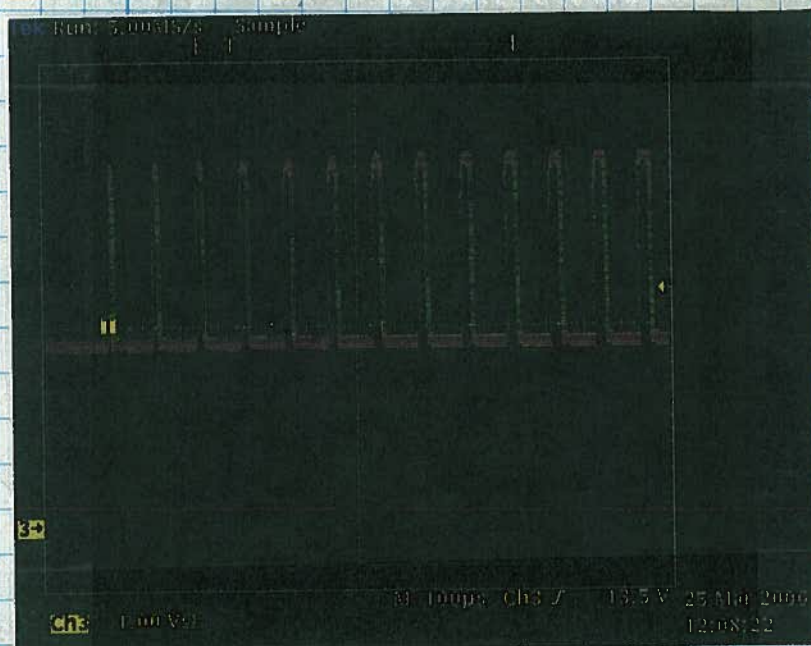
I connected the TDS754A to the
 minder while it was charging the battery 12.
 I took a few pictures and then tried
 batteries 17 and 18 to see how it did on
 a new battery.

I put the minder back on 12 and left
 it till 3/28. When I took it off and checked
 the voltage of the battery it was below
 13V (~12.6V).

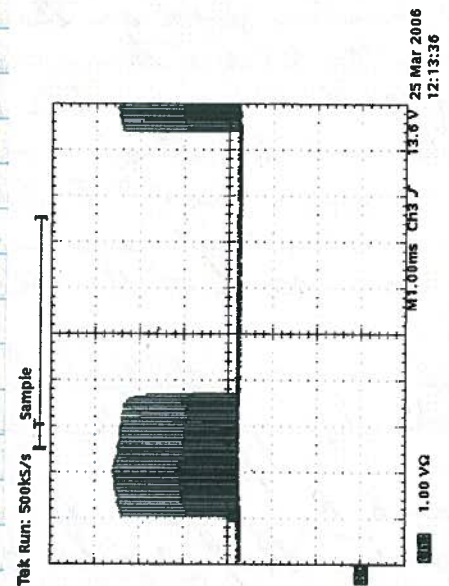
I put the minder on battery 13 (on 3/28).

Comparing the pictures of battery 12 with the pictures of batteries 17 & 18, it looks like the internal resistance of battery 12 is higher and the "minder" is trying to force a set amount of current through the battery on each pulse.

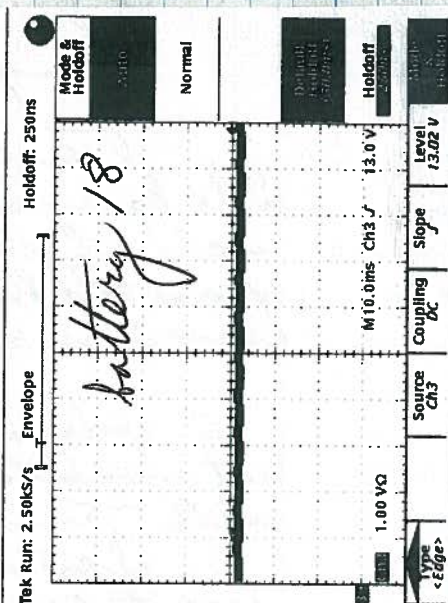
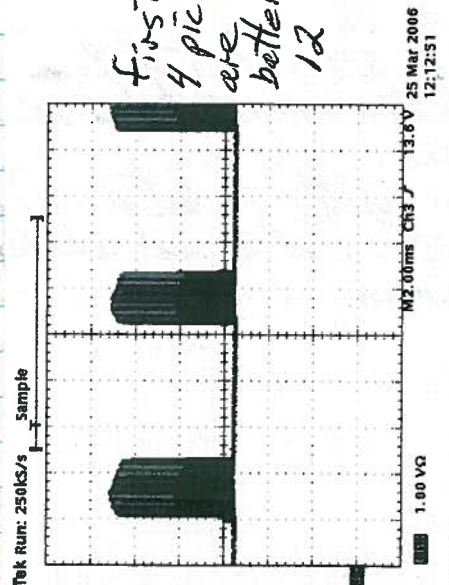
I wonder what this says about the condition of the batteries on p. 14 and p. 22 for example.



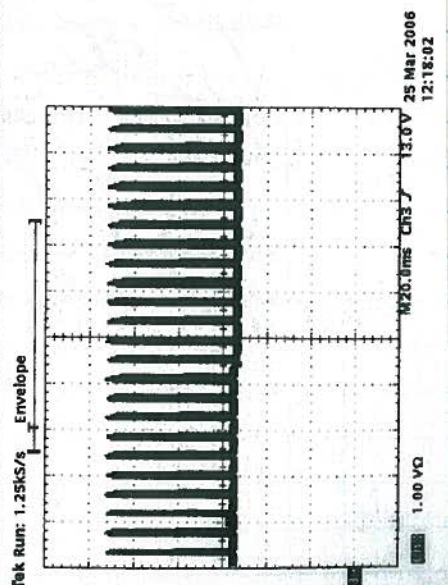
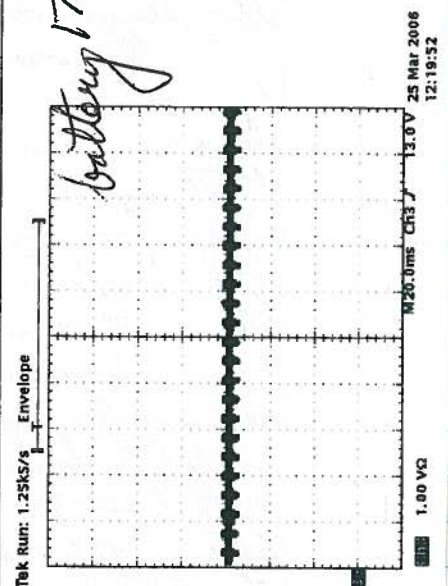
Minder on battery 12



first
4 pics
are
battery
12



battery 17



4/9/06 First Try of PVDF Sensor on Drum Head

Preamplifier for PVDF sensor on drum head.

I started over a week ago using a LF353. The base response seemed good, but the high notes were clipping. Had a lot of hum. Twisting the wires from the PVDF greatly reduced the hum. The files are saved as opamp-LF353_a.wav then d.wav

Today I started with the CLC522 difference amp. It seems to be too fast for the plug board and oscillator with $\sim 5\text{ms}$ period.

I put an INA101 down with a gain of 1 and $100\text{k}\Omega$ to GND on each input. File is saved as diff-ina101_a.wav. The playback is not as good as the opamp.

Removing the $100\text{k}\Omega$ things seem to saturate and be erratic. I put $10\text{k}\Omega$ on the inputs to GND. The bass is weak and the high ends still kind of tinny. Putting 1Meg on each input to GND improves the bass response. The high ends are still clipping. File is 1mc.wav. Some of the old file "b" is left on the end of it.

I put down an AMP04. The first try did not sound too good. I played with varying R_5 & R_6 . There is definitely a region for stability with the amp. I put $R_5 = 4.7\text{k}\Omega$ and $R_6 = 200\text{k}\Omega$. I had to put 1Meg to GND on the inputs. That is file "b". File "c" had 5.6Meg to GND on each input. File "d" is $R_6 = 1.1\text{M}$, 5.6M each input and $R_5 = 4.7\text{k}\Omega$.

There is still a bit of hum. I turned off the two lights next to the board. That didn't seem to help. That is the "e" file.

I played with the setup a bit to find the hum. I think I will need to use shielded cables and clean up the plug board.

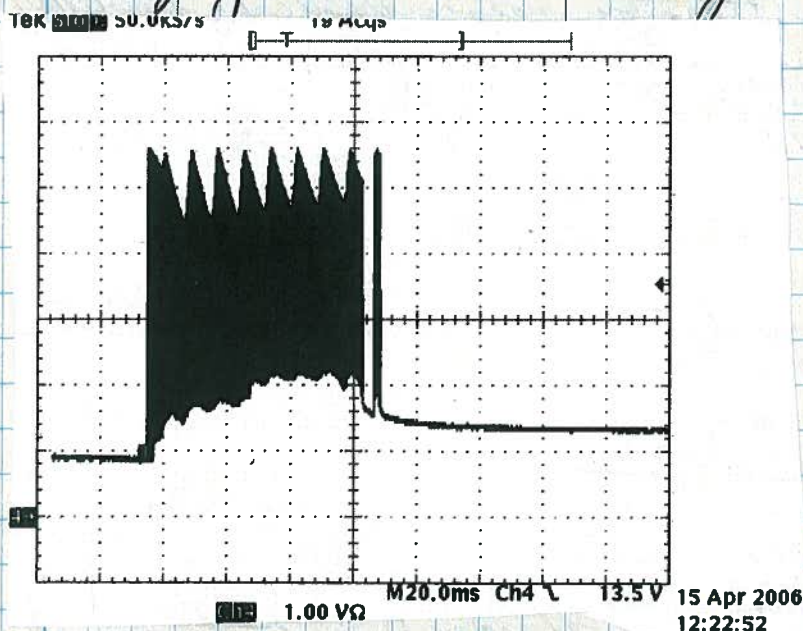
Charging Batteries With the "Battery Winder" 4/15

A few days ago we removed four 12V batteries from a Best UPS. They are Panasonic LC-R120CH1 (12V, 9Ah, 20HR). I have numbered them 25, 26, 27, 28 with yellow paint.

battery voltage

25	11.133
26	11.510
27	9.886
28	9.888

I put the minder on 25 and it started to blink the green LED immediately. I connected the scope, TDS754A, and took a look. The ~~two~~^{one} picture are with a 10V offset on ch4. So, it looks like the minder is trying to recover the battery.



I am leaving the minder connected to 25.

I am numbering the old 6V Trojan batteries from my golf car, thru 6. They are model T-105 Mileage Master.

batt. voltage

1	4.632
2	5.724
3	5.886
4	5.826
5	5.719
6	4.520

I have connected them in series, 1 thru 6.

Connecting the 36V minder the green LED comes on solid. I am leaving it connected.

4/22

Internal Resistances of 9AH Pb-Acid Batteries

Trying to look at the internal resistance of some batteries.

I looked up some of the power resistors. Using the Buck box with resistors I put together for checking the solar panel, I will check the current and voltage output of the battery with 24 Ω , 12 Ω and 6 Ω loads on the battery. I put the Fluke 77 III to measure the voltage. I put a 0.1 Ω resistor on the negative connection with a Fluke 189 to measure the voltage drop across this resistor.

The first battery to check is #1. Upon connecting the load to the battery I can see the voltage of the battery drooping slightly. On 12 Ω it drops faster and on 6 Ω the drop is very fast. So the voltages measured can be a little out of "sync" with each other.

ohms	voltage	current volts $\Rightarrow$	Amps	using 0.32 Ω
24	12.52	.077	.77	.24
12	12.30	.160	1.60	.50
6	12.08	.303	3.03	.95

$$R_I = .85 \Omega$$

Measuring the 0.10 Ω 1% resistor with the Fluke 189 I get 0.32 Ω .

Trying again

ohms	voltage	current volts $\Rightarrow$	Amps
24	12.42	.057	.18
12	12.28	.112	.35
6	12.07	.220	.69

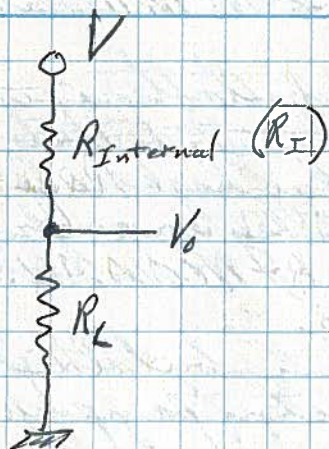
$$R_I = .82 \Omega$$

Checking again, the 0.10 Ω resistor is not a 1%. Oh, well. The 6 Ω is measured at 6.26 Ω (using Fluke 189) 12 Ω 12.34 Ω 24 Ω 24.56 Ω

I recorded resting voltages of #17 $\rightarrow$ #20 on p. 40.

ohms	voltage	current volts $\Rightarrow$	Amps
24	12.56	.053	.17
12	12.43	.104	.33
6	12.24	.203	.63

$$R_I = .81 \Omega$$



Assume V is constant. Internal resistance of battery is constant R_I . V_o is V_1 and V_2 corresponding to loads R_1 and R_2 respectively. I_1 and I_2 are currents through R_1 and R_2 .

$$I_1 R_1 \left(\frac{R_1 + R_I}{R_1} \right) = V = I_2 R_2 \left(\frac{R_2 + R_I}{R_2} \right)$$

$$I_1 (R_1 + R_I) = I_2 (R_2 + R_I)$$

$$I_1 R_1 + I_1 R_I = I_2 R_2 + I_2 R_I$$

$$I_1 R_1 - I_2 R_2 = (I_2 - I_1) R_I$$

$$\frac{I_1 R_1 - I_2 R_2}{I_2 - I_1} = R_I$$

$$\frac{V_1 - V_2}{I_2 - I_1} = R_I$$

Looking at battery #25. Resting voltage is 11.65 V

ohms	voltage	Current Volts	amps
24	6.76	.028	.088
12	5.11	.043	.134
6	2.7	.044	.138

$$R_I = 35.9 \Omega$$

6/4/06 Current Drain of AA Ni-Cd and Ni-MH Batteries

I got some Ni-Cd AA batteries. I got them through Merchandise Distributors. Sorry, I looked at the wrong Purchase Recp. I got them through Allright. They are from Dantona Industries, type KRF1100AAU. I numbered them 1 thru 8.

I got a charger with them, but I did not like the way the instruction pamphlet said it operated. I brought in my Panasonic charger from home.

I charged 1 thru 4 and did a discharge run using the same setup of resistors as noted on p. 29 of this book. A computer problem during the overnight run terminated the Tracer DR2 program early in the run. No useful data was collected.

I then charged 5-8 and ran those. 5/29/06-ended on

I charged 1-4 and ran those, again. 5/29/06

The 1-4 "b" run was significantly poorer than the 5-8 "a" run.

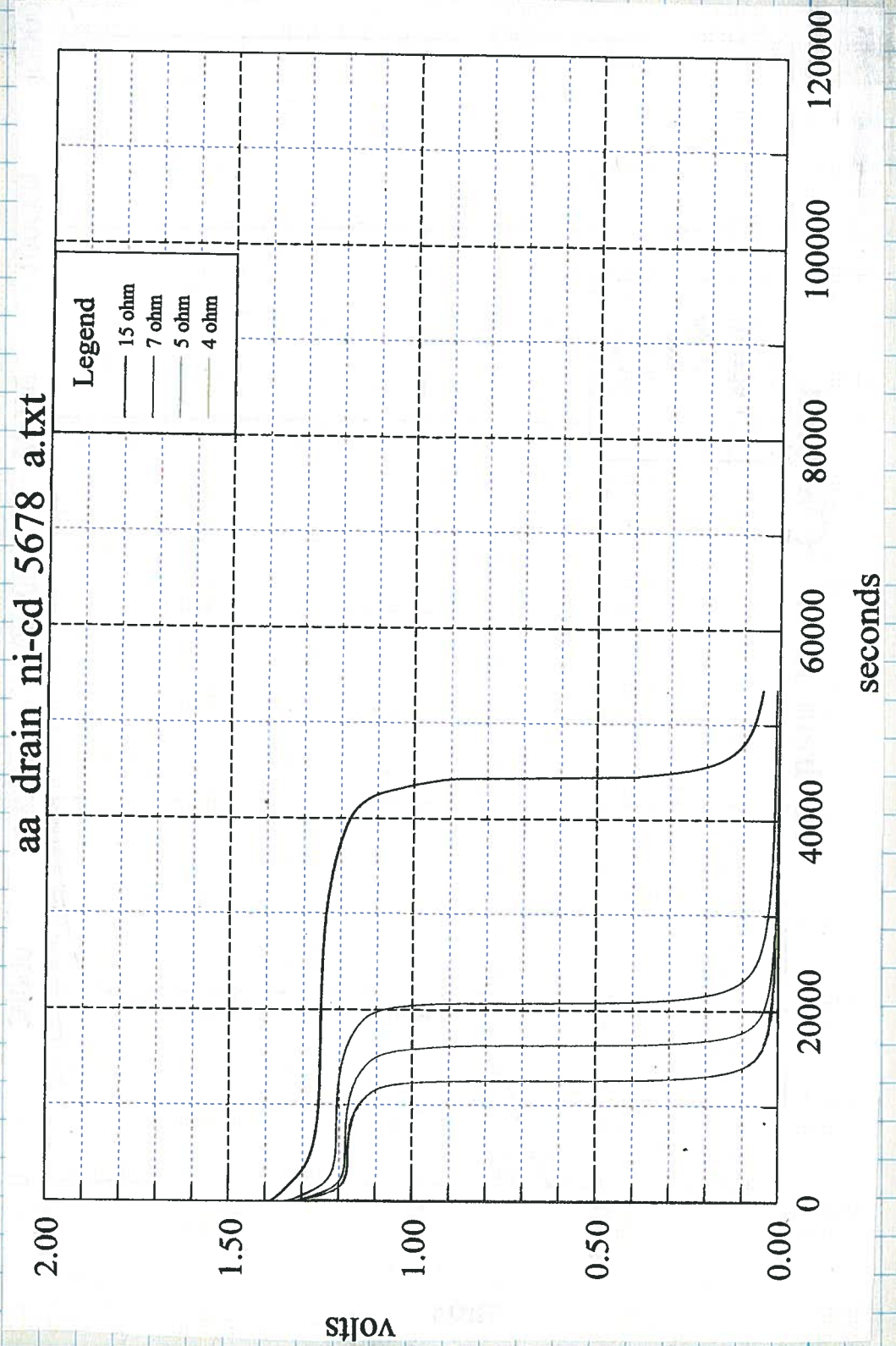
I charged 5-8 and ran them again. 5/30/06 or 5/31/06
The 5-8 "b" run was also significantly poorer than the "a" run.

I charged 5-8 and ran them again. 6/1/06
The 5-8 "c" run was now similar to the "a" run.

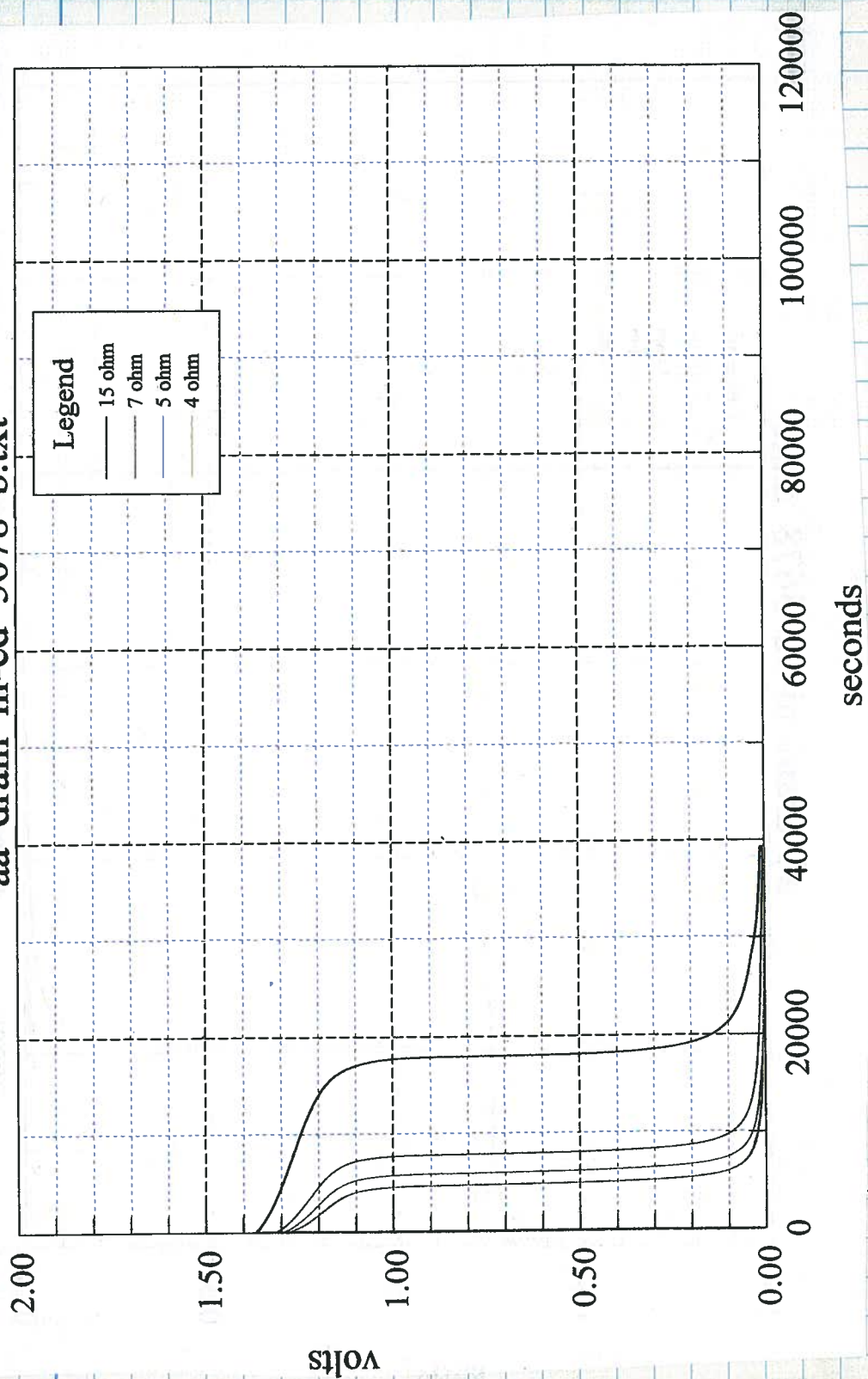
I had been charging the Ni-MH batteries 4, 5, 6 and 7. I ran those. I wanted some run of the Ni-MH at a similar ambient temperature as the Ni-Cd runs. 6/2/06-ended on

I charged 1-4 and ran them again 6/3/06
The performance was similar to the 5-8 "a" run.

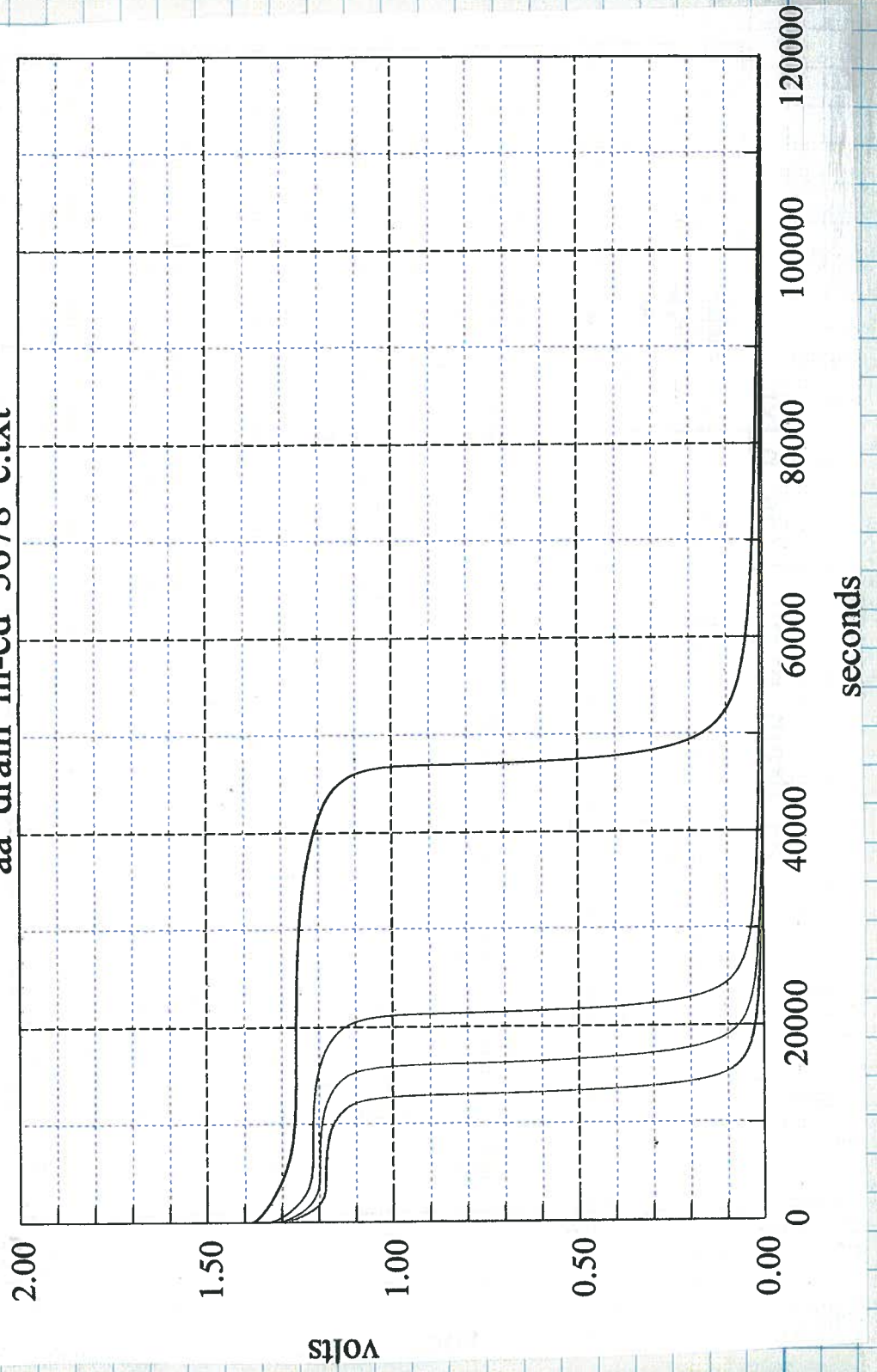
I group the following plots by the battery groups. They are not in chronological order.



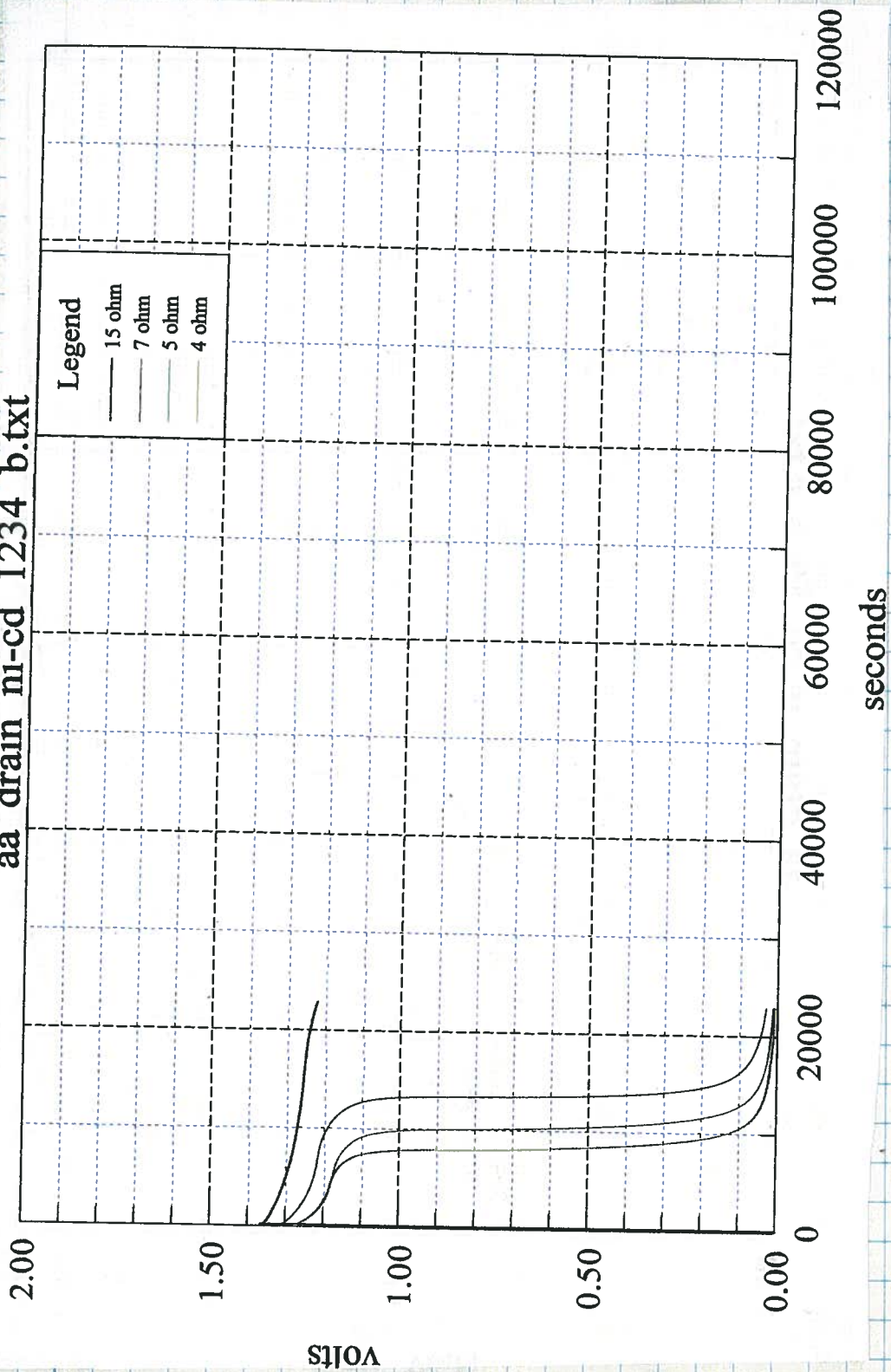
aa drain ni-cd 5678 b.txt

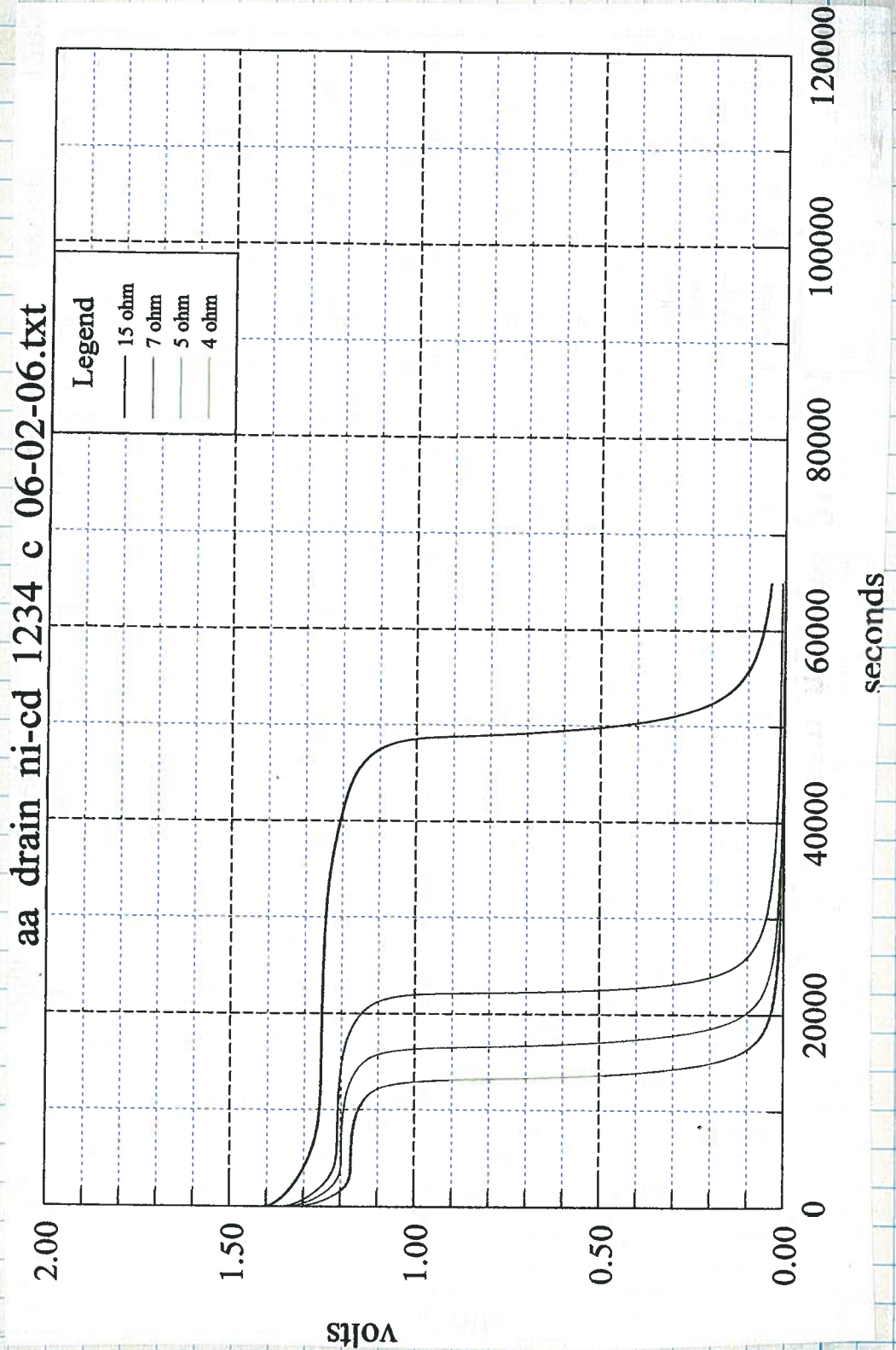


aa drain ni-cd 5678 c.txt



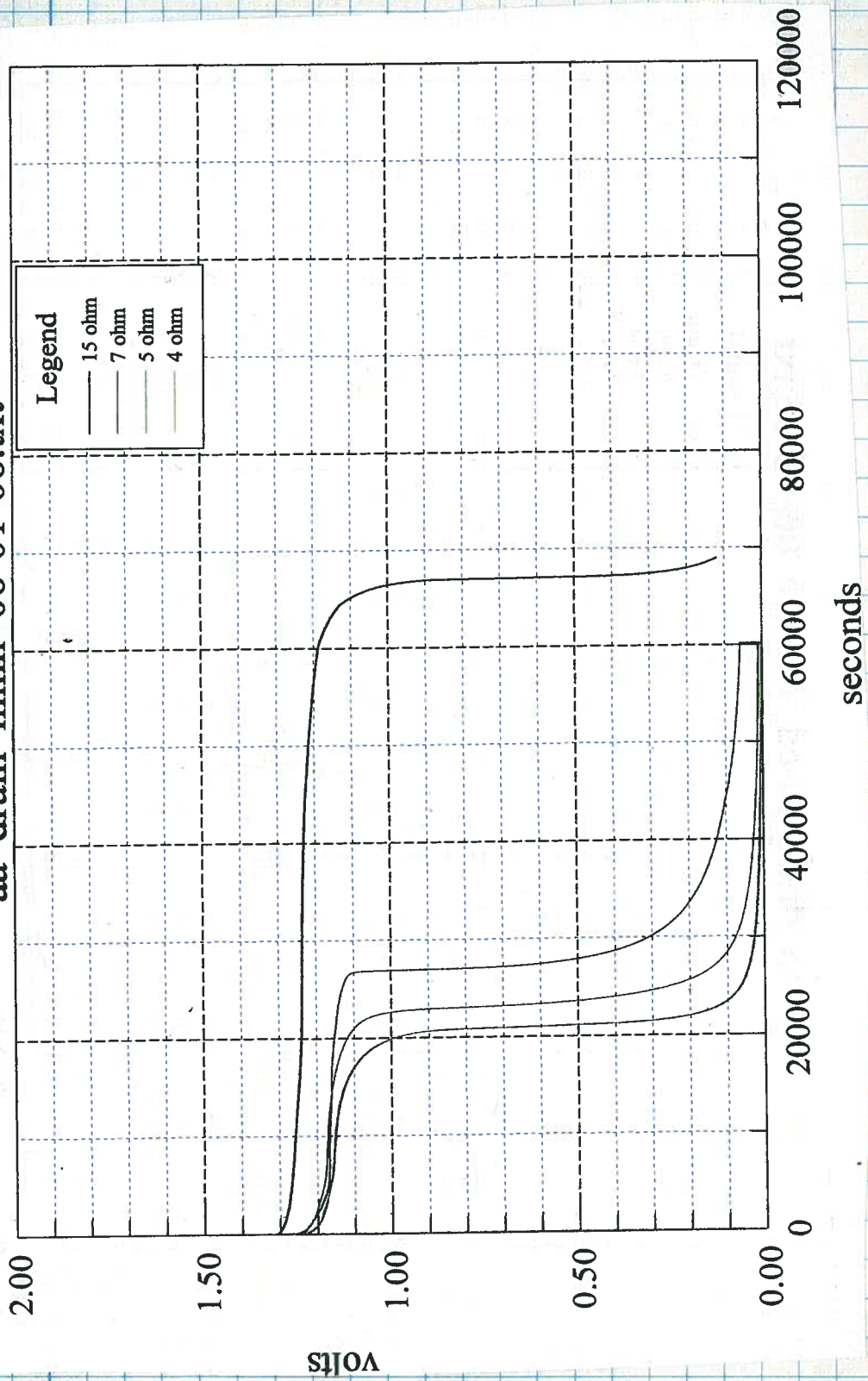
aa drain ni-cd 1234 b.txt





Unfortunately, I did not keep a record of which charger I used for each Ni-Cd run. I was having problems with contacts and used both chargers at some point.

aa drain nimh 06-01-06.txt



Checking Some Gas Cylinders 2/6/07

Yesterday Alexandre Camsoere mentioned
he had very low efficiency in the VDC's.
After a lot of work I believe I finally
have something put together to get a check
of the gas quality in the cylinders

I have hooked up a straw tube for an FPP prototype. I am using the "Little Duke" preamp. The output is being displayed and saved on a Tek TDS 5054B.

Eventually I found a cylinder of Ar/CO_2 80/20. The label says 20.4% CO_2 actual. I took a picture of that at +1803V (on the Bertan 375P monitor output).

I switched flow to a cylinder of Ar/Eth 50/50 (50.0% actual argon, on label). Picture 2 (3rd picture)

Putting the argon & ethane cylinders that were online yesterday when the VDCs were of low efficiency. The set voltages for the MFCs on the mixing tanks are
argons - 2.60V ethane - 4.60

Looking at the EPICS archives I see the VPC system has argon-2.6V and ethane-4.6V so, things should be ok. The cylinders are labeled Ar 1 and Eth 1. See pic 3 (4th picture).

Changing the argon cylinder to the one I labeled 4 of 2. See p. 4. The signal is really down in the noise.

Change the argon cylinder to the one I labeled A-4. The signal is still small. No picture taken. It will come back to this tomorrow.

After turning everything back on this morning
I got out the Extra of 52 flammable gas detector.
Checking the purge valve on the mixing tank
I did not read any flammable gas. I unscrewed
the ethane cylinder I labeled E.H. I. I read
flammable gas. I unscrewed the swageless fitting
on the output of the regulator on the cylinder labeled
E.H. I. I read 15. I read 15. I read 15. I read 15.

the regulator on the cylinder labeled Eth 2. I have flowed for a while and opened the purge valve on the tank twice. I see a very small signal from the Fe^{55} . See pic tck00005.eps.

I checked the set and readback voltages on the mix controller for the ethane. Both were 4.59V. The argon was 2.59V for both, also.

Apparently, I was pointing the wrong end of the flammable gas detector at the cylinders... If I point the correct end at the fittings it reads flammable gas. The two ethane cylinders, Eth 1 & Eth 2, both smell strange.

I brought two of the ethane cylinders I recently got. They do not have a significant odor to the gas. I labeled them Eth 3 & Eth 4. I put the regulator on Eth 3 and turned the mixer on. Within a couple of minutes I could see the pulse height increasing on the scope. I have cracked the tank purge valve 3 times to clean out the gas in it. The gain is now substantial. See pic 00006.eps.

I switched to the cylinder Eth 4. After cracking the purge valve 3 times see pic 00007.

I changed the argon cylinder from the one I labeled Ar 4 to the one I labeled Ar 3. Ar 3 has red tape on it that has "Poss. Contaminated #1" written on it. This cylinder was from when I went to WI and the system went bad just before I got on the plane. I have opened ("cracked") the purge valve twice, now. See pic 00008.

I switched to the cylinder I labeled Ar 1. This was the cylinder online the 02/05 when Alexandre found the VDC efficiency low (zero). See pic 00009. It looks good.

I switched to the cylinder I labeled Ar 2. I put a new cartridge in my pen. I have opened the purge valve twice. See pic 00010.

I switched off the mix controller before it had fully filled the tank the second time. I changed the ethane cylinder to the one I labeled Eth 2 (bad gas). I turned on the mix controller. I see about 100 counts. The gain is 100 counts.

about half of what it was. After ~30 seconds see pic 00011.

I switched back to the cylinder I labeled Eth 4. I will leave the system run while I put cylinders back in the racks.

The cylinder I labeled Eth 2 has red tape on it which has written on it "Poss. Contaminated #1".

The cylinders I labeled Eth 1 and Eth 2 both have 2 stickers on their valve stems. The stickers are the same on both cylinders. One says

3010

the other one says

EEO

LOT #

LOT NUMBER

031805 06

031105 3

Both of the cylinders are labeled CP grade ethane.

I have left the argon cyl. Ar 2 and the ethane cyl. Eth 4 running over lunch + some time. See pic 00012 for current gain.

I switched to the ethane cylinder with a red tape on which is written "Suspect bottle #12 (Javier installed)". This is also from when I went home for Christmas. The MFCs cycled once and I see no significant change in the pulse height on the scope. I opened the purge valve. Still no big change. See pic 00000 on the second floppy disk.

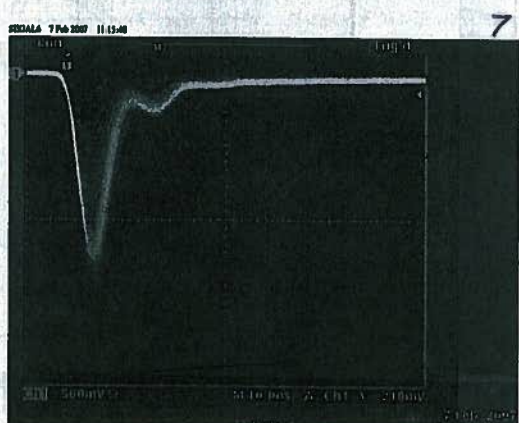
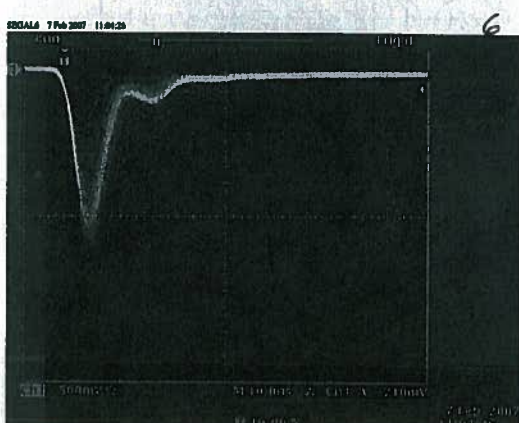
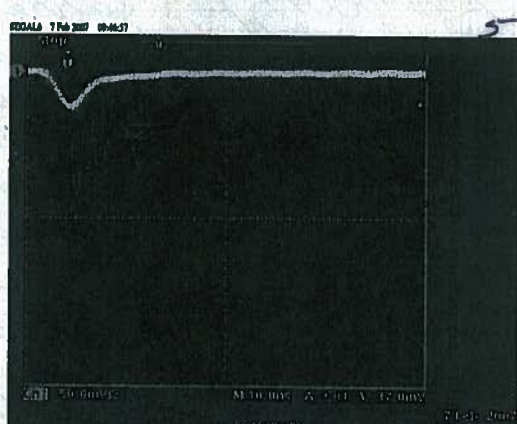
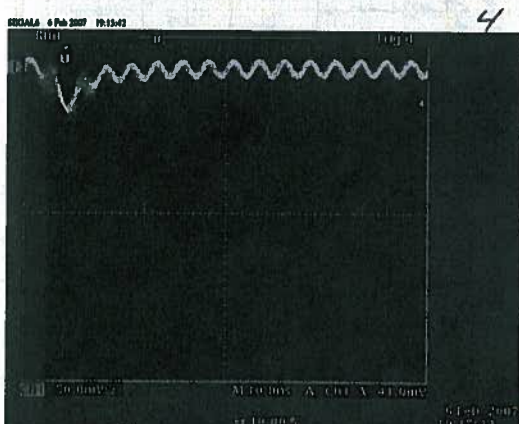
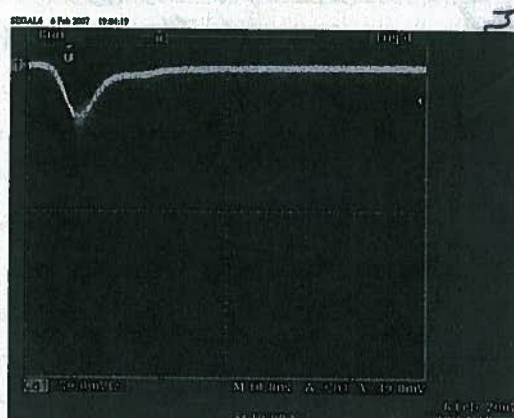
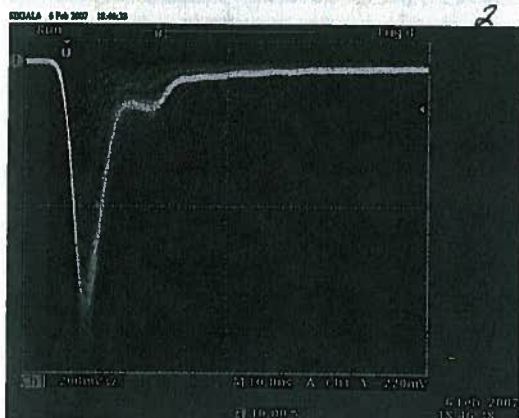
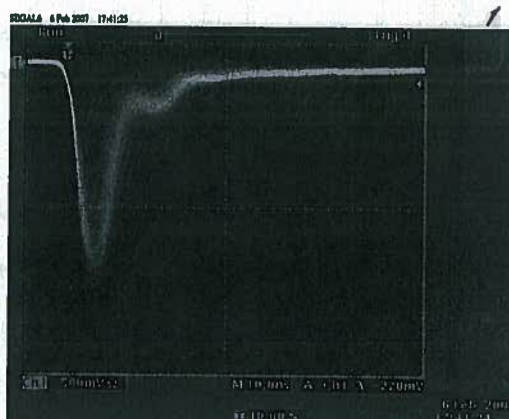
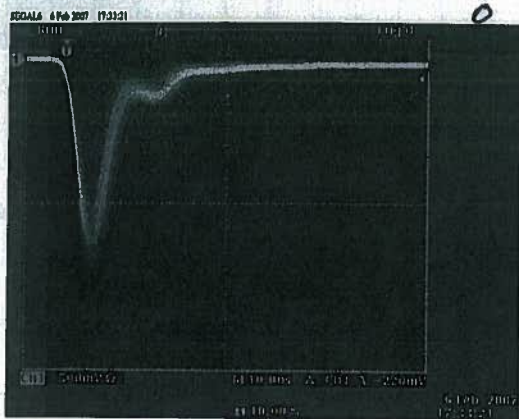
I switched to the ethane cylinder with red tape on which is written "Original Bottle (Before ~6:30 PM 12/18) IN USE 1". This cylinder, the previous cylinder, and the cylinder I labeled Eth 4 all have the same stickers on their valve stems. They say

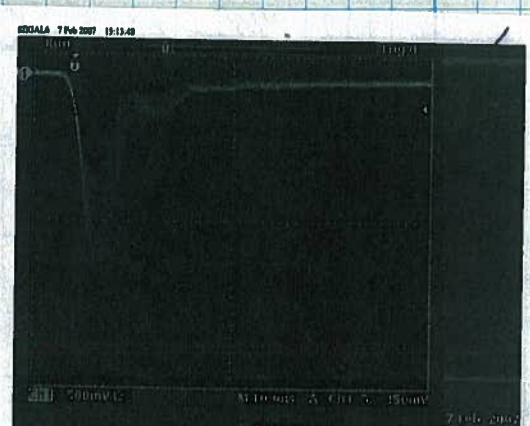
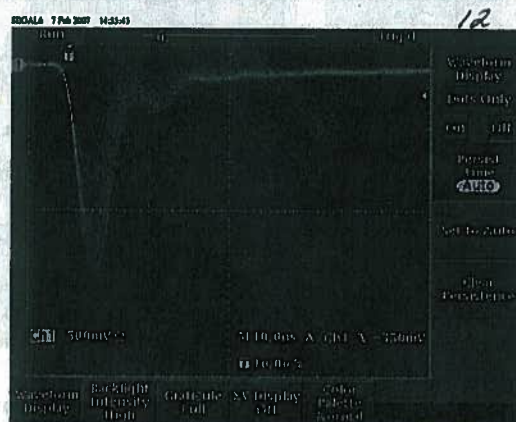
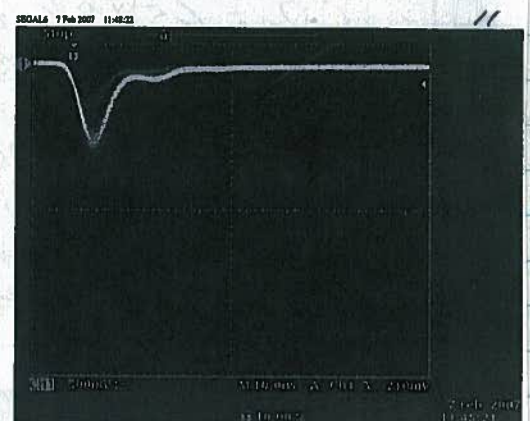
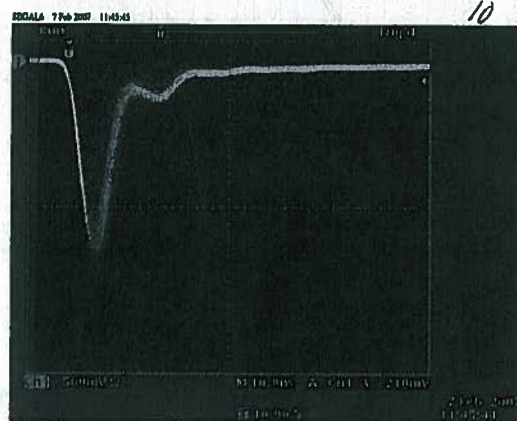
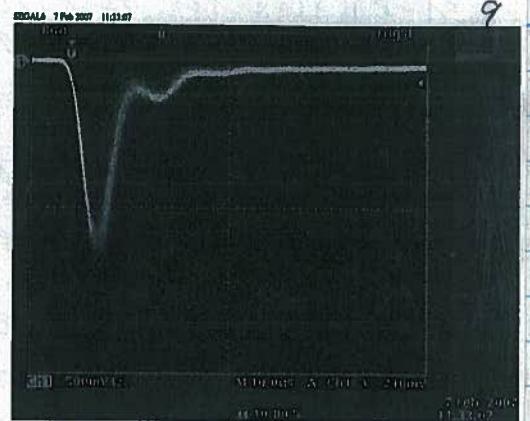
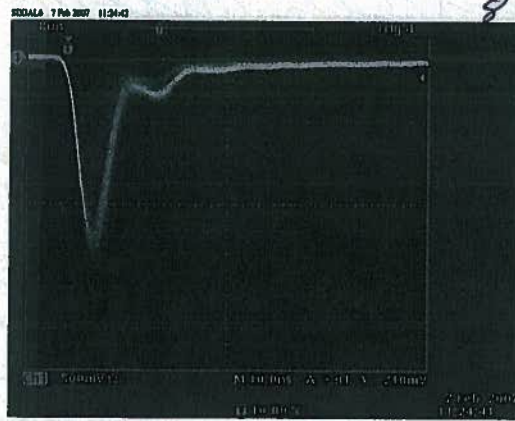
3000 24

LOT #

132 6 02

The MFCs cycled once. I opened the purge valve. See pic 00001.





2/7/07 Check of Argon/CO₂ Mixtures.

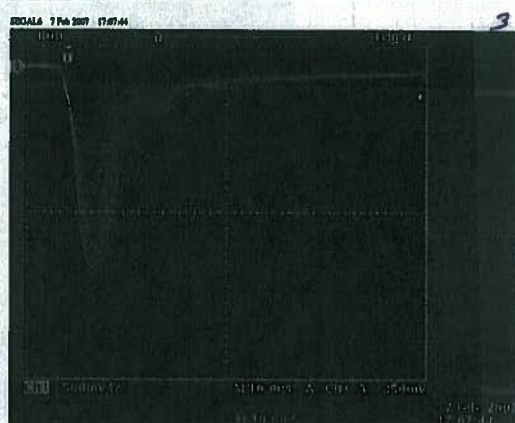
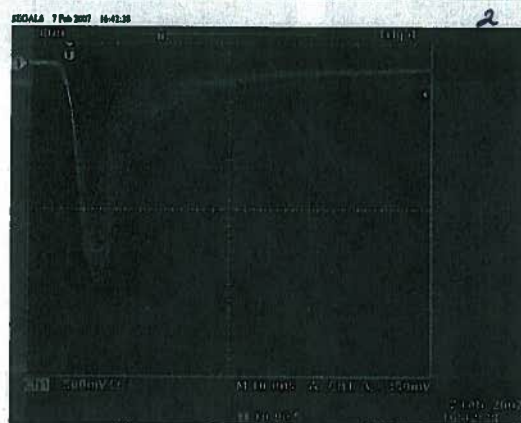
JS

In a previous (earlier) experiment I had to use a "welding" grade of CO₂ for the CO₂ supply. The FPP seemed to have a problem with efficiency.

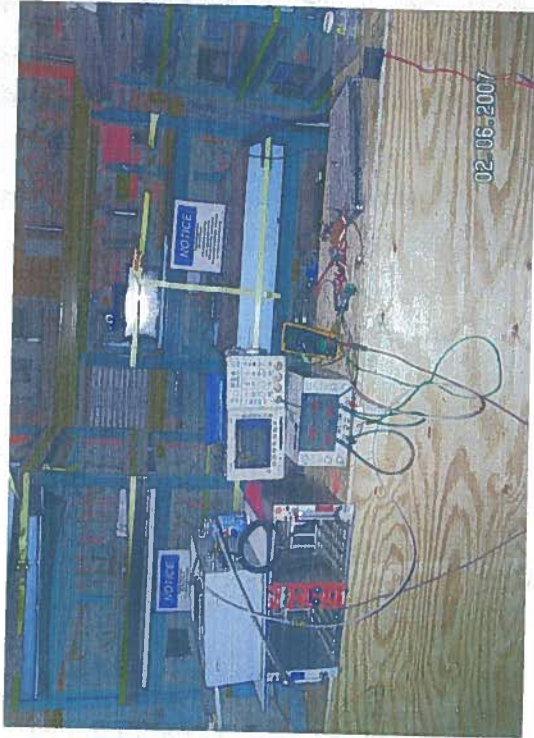
Using the same setup as on p. 55 of this book, I have connected a UHP argon cylinder and a Coleman grade CO₂ cylinder. I have set the MFCs to argon - 3.056 Volts and CO₂ - 1.510 Volts.

I have opened the tank purge valve 4 times. The HV monitor shows 1.802 Volts (+1802V). See pic 00002.

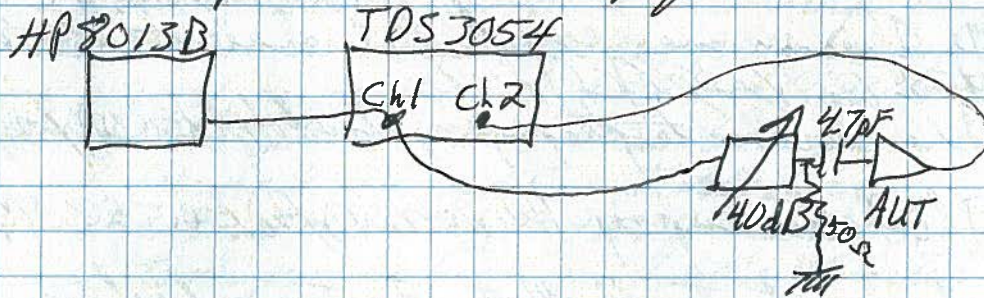
I switched to the cylinder of "welding" grade CO₂. See pic 00003.



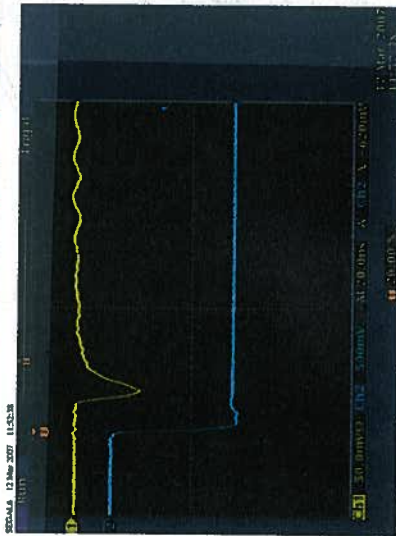
No significant difference between the two grades. FPP efficiency loss probably due to something else.



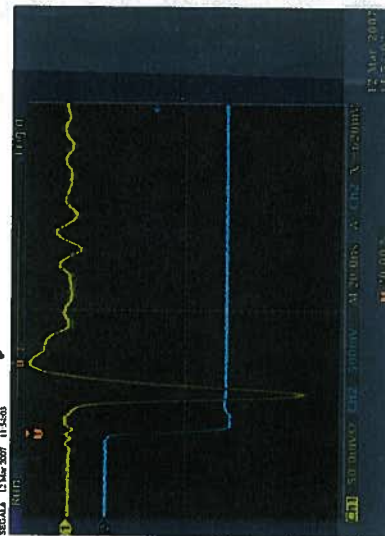
I set up to test the amplifier



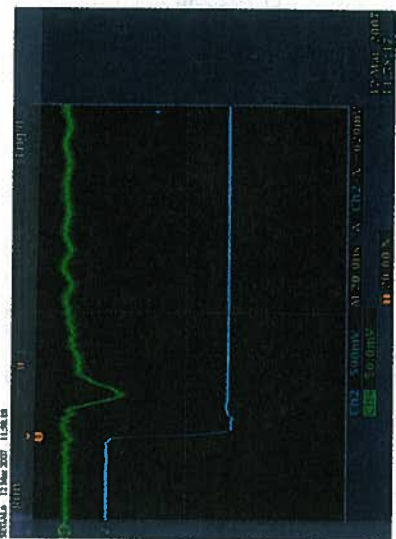
I also checked one of the 3227 preamps and one of the ETT Fujitsu preamps.



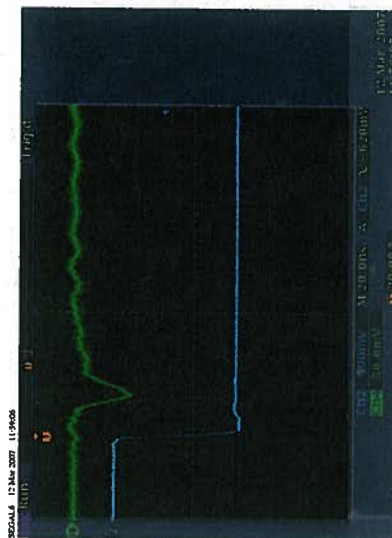
discrete



3227



Fujitsu



for the Fujitsu amp I used a passive probe on Ch. 4 looking at the signal to the transformer (after the capacitor) and before the transformer.

$$(1500\text{mV} \div 100) \times 4.7\text{pF} = 70.5\text{fC}$$

For the 3227 amp I see about $4.1 \text{ mV/}\mu\text{C}$
 $(290 \text{ mV}/70.5 \text{ fC})$

This seems very high. I seem to recall
 about $1.8 \text{ mV/}\mu\text{C}$

The discrete preamp is about $(1.6 \times 50 \text{ mV})/70.5 \text{ fC} = 1.1 \text{ mV/}\mu\text{C}$

The Fujitsu amp is $(1.4 \times 50 \text{ mV})/70.5 \text{ fC} = 0.99 \text{ mV/}\mu\text{C}$

I seem to recall the Fujitsu amp being $\sim 2.25 \text{ mV/}\mu\text{C}$.

Something seems a little odd.

But, the discrete has about the same gain
 as the E711 amp. That is with the pole-zero
 installed on the discrete. The amplifier looks
 usable.

Checking New Ethane Cylinders

3/23/0

I have re-assembled the setup on p. 61 of this volume. For the preamp I am using the 3227 amp that I had put together for this setup, the canary chamber.

I flushed the system thoroughly.

The amp has ± 12 VDC output.

I took a picture with the Bertan 606-30P supplying the HV.

The MFCs are set to ^{argon} 2.60V and ^{ethane} 4.60V.

I took a picture of the Fe55 signal.

I switched to the Bertan 375P for HV.

I set the HV to 1.698V on the monitor output.

I took a picture of the Fe55 signal. It is about the same as the one using the 606-30P.

I set the HV to 1.600V on the monitor output and took a picture of the Fe55 signal.

The ethane cylinder has a ~~two~~ stickers on the valve. The upper one says 3000 24

LOT #

036 7 01

There is an identical sticker on the cylinder body by the "Chemically Pure" sticker. The second sticker on the valve stem is faded and says

EA

LOT NUMBER

012907 2

I switched the ethane cylinder. This new cylinder has stickers identical to the stickers on the first one.

I purged the buffer tank twice and increased the flow through the canary chamber. I turned the flow back down for the canary chamber. The Bertan 375P still shows 1.600V on the monitor output.

I took a picture of the Fe55 signal. It looks the same as for the first cylinder.

I increased the HV to ~~1.600V~~ 1.701V on the monitor output. I took a picture.

I consider these two cylinders to be good. I put them in the gas rack by the Gas Shed.

I got two more cylinders (new) of ethane. I hooked one up and started the

Each of these cylinders has two identical stickers on each one. One on the valve stem and one on the cylinder body. All four stickers say the same thing 3000 24

LOT #

132 6 02

I have purged the buffer tank twice. The flow through the canary chamber was also increased. It is instructive to plug the canary chamber exhaust with my finger and observe the Fe55 signal decrease in amplitude as the pressure in the canary chamber increases.

I decreased the flow through the canary chamber.

The Bertan 375P has 1.701V on the monitor.

I took a picture of the Fe55 signal. It looks the same as for the first two cylinders.

I set the HV to 1.599V on the monitor and took a picture of the Fe55 signal.

I switched to the fourth and final ethane cylinder. I increased the flow rate through the canary chamber and purged the buffer tank twice.

The HV shows 1.599V on the monitor. I turned the flow through the canary chamber and took a picture of the Fe55 signal. It looks about the same as the previous cylinder.

I turned the HV up to 1.701 on the monitor and took a picture.

These two cylinders also seem to be good.

The argon cylinder was the one labeled Ar 2" from the previous tests on p. 55 of this logbook.

I removed the 3227 amp and installed a discrete preamp, see p. 62 & 63 of this volume.

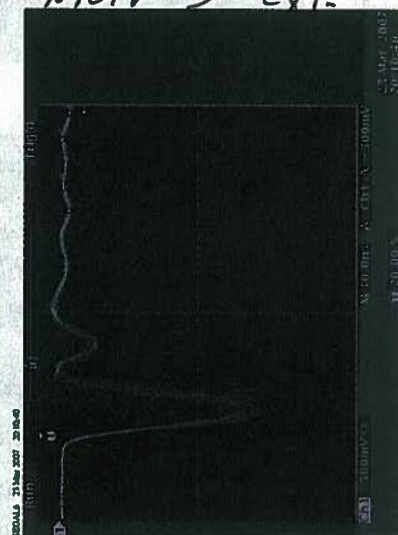
I set the HV to 1.604V on the monitor and took a picture.

I set the HV to 1.702 on the monitor and took a picture.

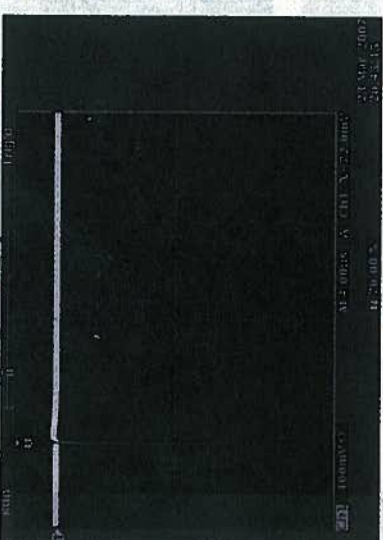
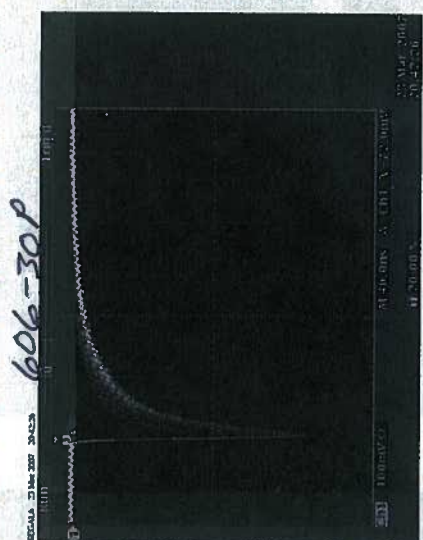
I disconnected the Bertan 375P and connected the Bertan 606-30P and took a picture.

I changed the timescale and took another picture.

I changed the time scale again and took another picture just to show the overshoot.

3227 & 60630P 1st cvl.375P 1.698V 1st cvl.1.600V 1st cvl.2nd cvl. 1.600V2nd cvl. 1.701V1.701V 3rd cvl.1.599V 3rd cvl.1.599V 4th cvl.1.701V 4th cvl.

Pictures of the discrete preamp signals.



↑ ripple was some pickup
from somewhere. Not
sure from where. It
would come & go.

Checking Ethane Cylinders With Gas Gain Tube 5/56

I set up the Gas Gain Tube to check four new ethane cylinders.

I'm using the same mixing system from page 61 of this logbook. The argon MFC is set to 2.60V and the ethane is set to 4.60V.

The preamp is the discrete amp from p. 62 of this logbook. The HV is the Burton 606-30P.

The first ethane cylinder has 2 labels on its valve stem.

EA	3000 24
LOT NUMBER	LOT #
012907 2	036 701

The Fe^{55} spectrum is the first picture. The scope is set to 1.75 sec persistence on the display.

The second picture is of the Fe^{55} spectrum from the second cylinder, after purging the ~~last~~ mixing buffer tank twice. The two stickers on the valve stem are the same as the two stickers on the first cylinder.

The third cylinder has the same two stickers on its valve stem as the first cylinder. The mixing buffer tank is purged twice.

The third picture is the Fe^{55} spectrum from the third ethane cylinder.

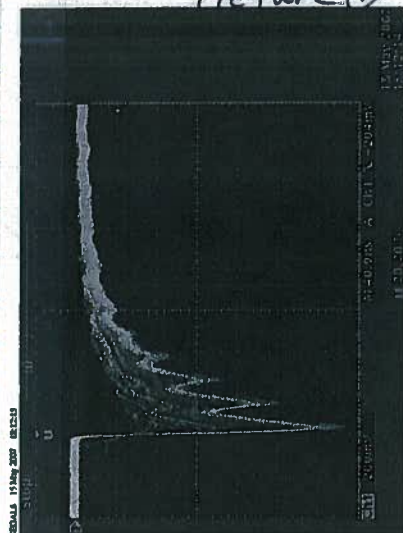
The fourth cylinder has the same two stickers on its valve stem as the first cylinder.

The buffer tank has been purged twice.

The fourth picture is the Fe^{55} spectrum from the fourth cylinder.

It looks like all 4 cylinders are ok to use and it seems they are all from the same batch.

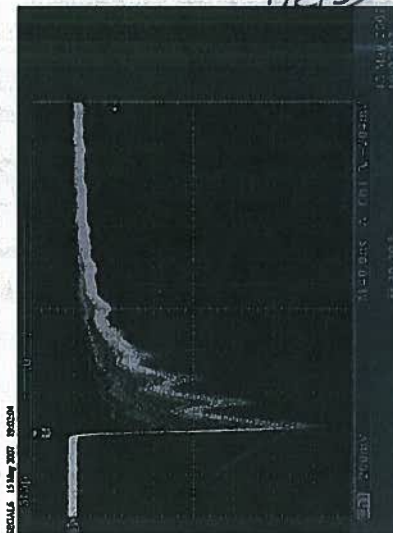
Picture ①



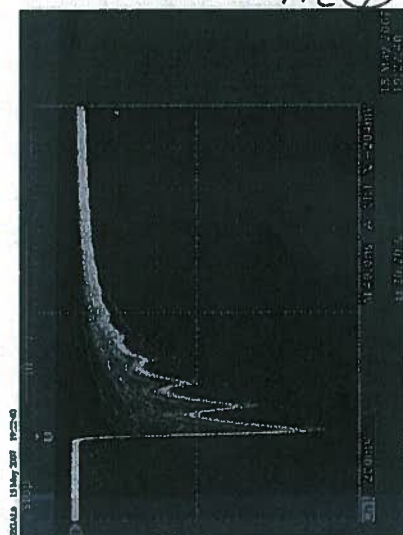
Pic ②



Pic ③



Pic ④



Optocoupler Test Circuit

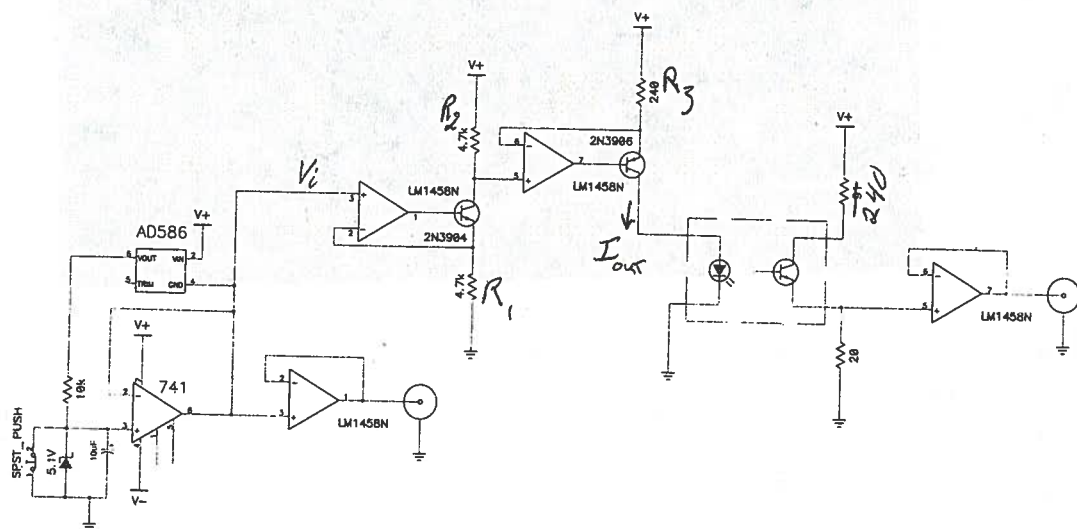
1/12/08

Looking to check the current transfer ratio (CTR) of optocouplers used in the hall.

This will hopefully give us a good diagnostic tool for managing the functionality of the controls electronics that are exposed to radiation damage.

AN3655

As a basis I have used an application note from Maxim for the ramp generator and a current source from The Art of Electronics.



$$I_1 = \frac{V_1}{R_1}$$

$$V_2 = I_1 R_2$$

$$= V_1 \frac{R_2}{R_1}$$

$$I_{out} = \frac{V_{cc} - (V_{cc} - V_2)}{R_3}$$

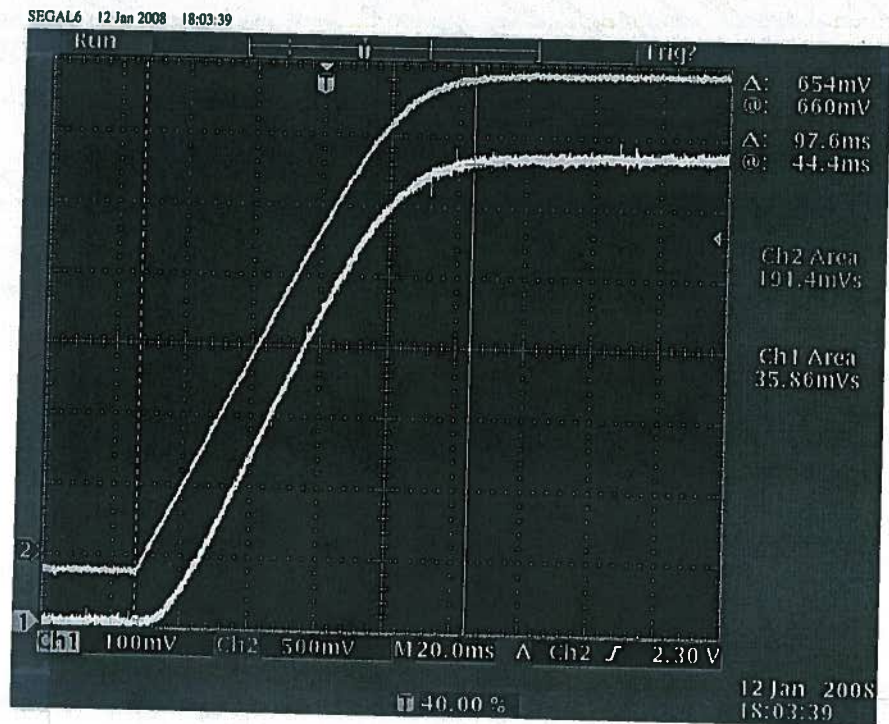
$$= \frac{V_2}{R_3}$$

$$= V_1 \frac{R_2}{R_1 R_3}$$

$$R_1 = R_2$$

$$I_{out} = \frac{V_1}{R_3}$$

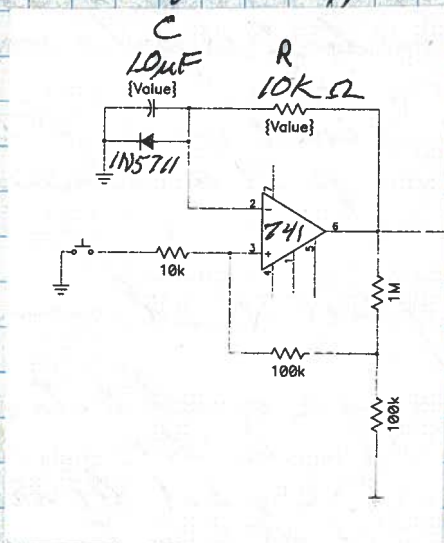
Using a Sharp PC 817 optocoupler that was removed from a board in the hall gives the following response.



Switch Debounce Using 741 Opamp 1/27/08

Following a suggested circuit from Gravity & Hill. ~~Looking to~~ Looking to debounce a SPST switch.

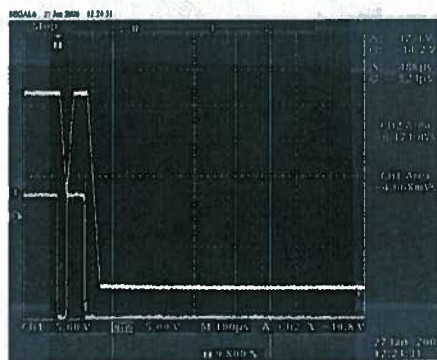
I set the following up on the PB-503 "Proto-Board."



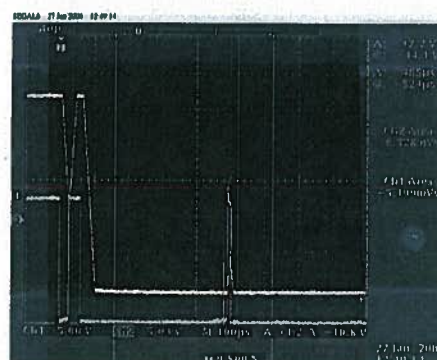
$\pm 15V$ supplies

If I close the switch the circuit oscillates. Works correctly if switch goes to $-15V$.

The circuit does not perform well as it is. This is using a SPDT switch connected to $+15V$ $-15V$ to the input.



The fall time is less than calculated. It does not debounce the switch. Ch 2 is switch, Ch 1 is amp output. Trig is set low to catch transition from switch middle position (no contact) to contact with $-15V$. Opamp output does not change going from $+15V$ to (no contact) middle position.



R changed to $100k\Omega$. I would have expected a change in the fall time.

4/12/08 Temperature Effect on a CNY17-3 Optocoupler

Because of an unexpected result while checking some CNY17-4 optocouplers in the hall, I want to see the temperature effect on a similar optocoupler.

I am using a board I had made for this, "Optocoupler Monitor." I put a wall mount $\pm 15V$ power supply on it.

It is the same circuit as on p. 71, except the 240Ω resistors on p. 71 are 200Ω on the circuit board.

I took a picture of the CTR at room temperature. Tek 0.

I applied heat using a small butane tool with a head to heat shrink tubing (Weller Portasol). The chip got very hot to the touch. I took a pic of the CTR at high temperature. Tek 1.

I took a pic of the CTR after the chip had cooled to room temperature.

The increase in CTR was not as dramatic as what I see in the results from the hall. The hall results must be due to a difference in the driving circuits, not a temperature effect.

Stepper Motor Driver Check

4/12
JH

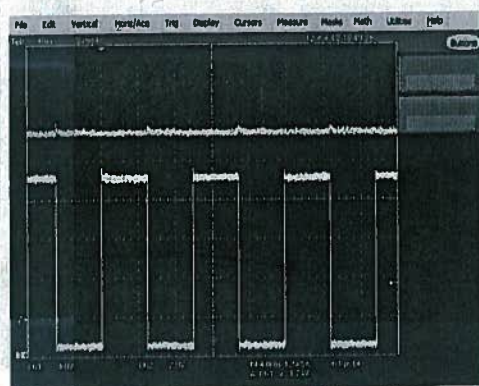
Looking at the Stepper Motor Driver that I made.

It uses all bipolar components and takes a step + direction input. It has two limit switch inputs that are required to inhibit the driver. It does not have an idle mode. Current is always flowing through the motor.

The power supply was set to $\sim +9V$. After taking some pictures I put it to 10V. The supply front meter shows $\sim 4A$. Supply is a BK Precision 1686.

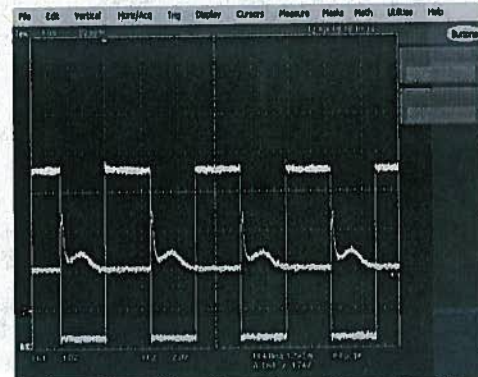
Pictures are triggered on the clock pulse from a Proto-Board PB-503 pulse generator (ITT) (Ch. 2 is the channel of interest).

The first two pictures are of the voltage on either side of the 2Ω resistor in series with the motor.



Power supply side
↙

Motor side
↘

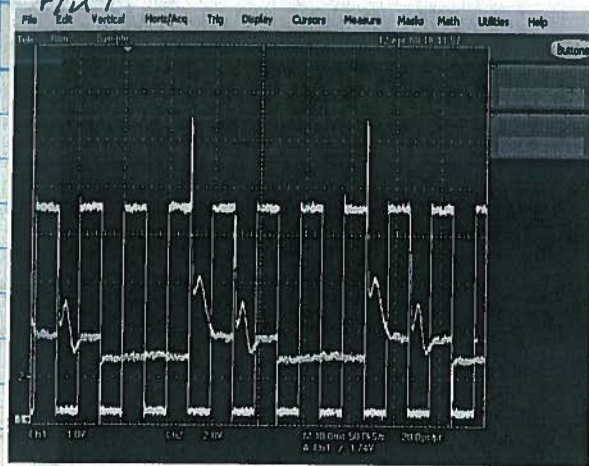


The next 4 pictures are of the collectors of the low-side drive transistors. The voltages were probed at terminals 1, 2, 3 & 4 of the screw terminals.

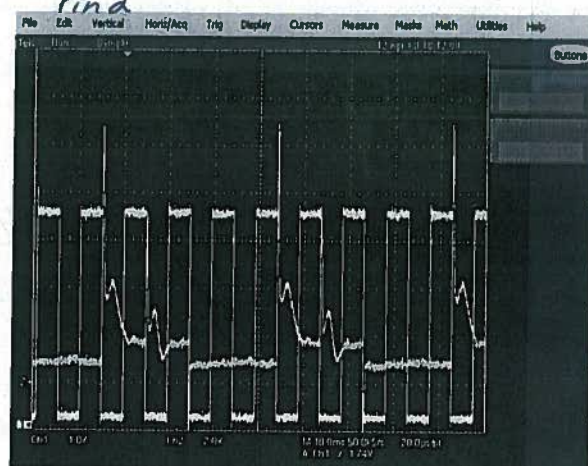
The next 4 pictures are of the bases of the drive transistors. They are in reverse order of the collector's pictures.

76

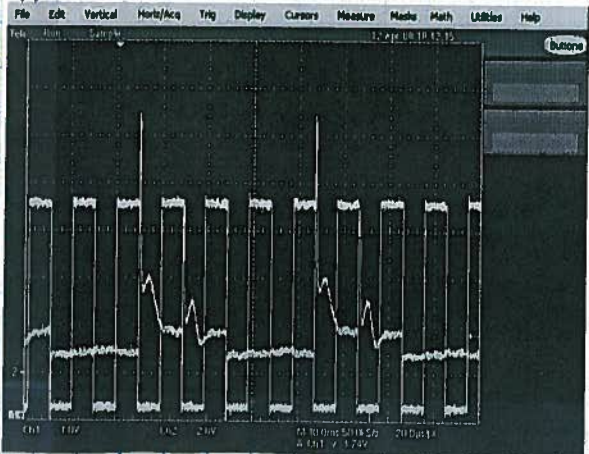
Pin 1



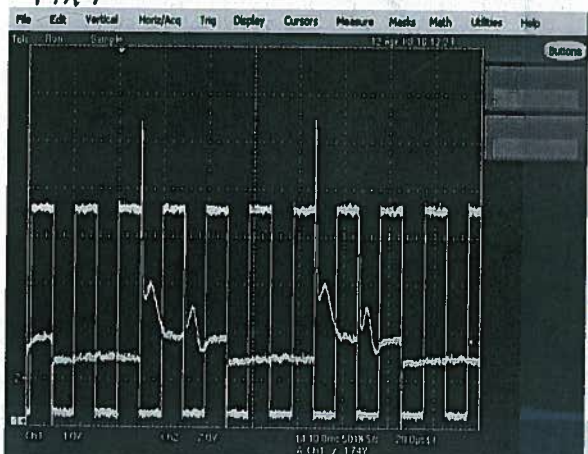
Pin 2



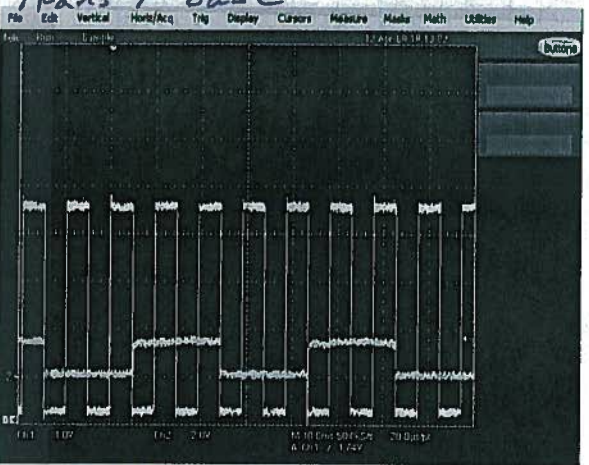
Pin 3



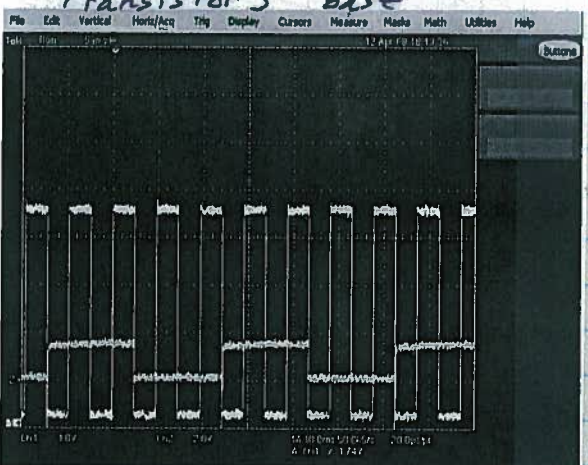
Pin 4



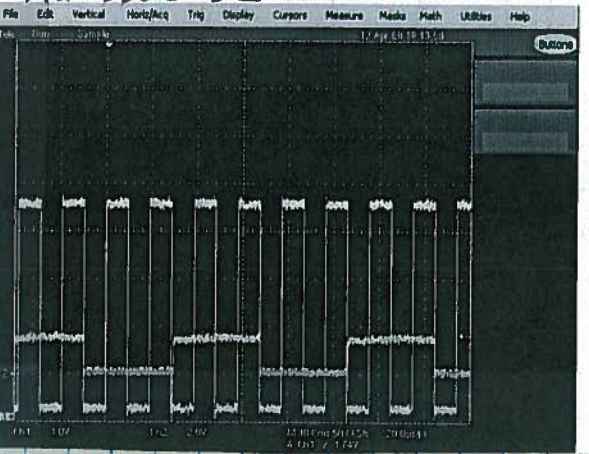
Trans 4 base



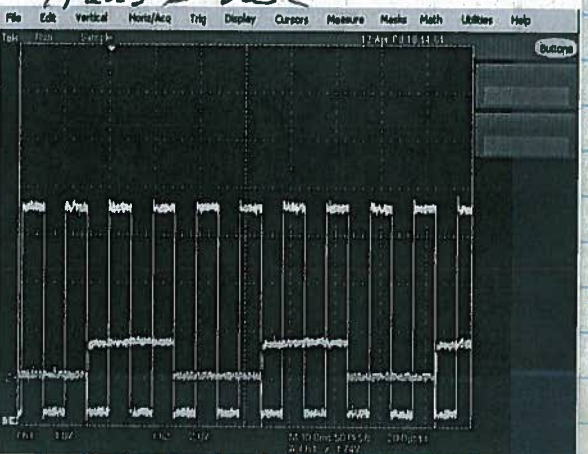
Transistor 3 base

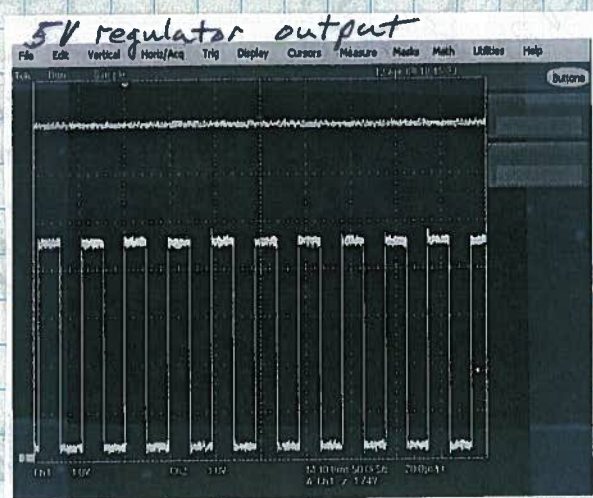


Trans 2 base



Trans 1 base





The +5V regulator was found to be putting out a stable 5V.

I replaced the regulator. The new one put out a stable $+5V$.

The waveforms were all similar to the ones with the bad regulator, so I did not take more pictures.

The trigger is "random", so relative ~~pos~~ horizontal positions between similar pictures can be meaningless. Do not compare pictures to try and get phase information.

The cable to connect to the motor was wired as

red wire to	1 of terminal block
orange	2
green	3
blue	4
black & white	5

red wire	1 of terminal block
orange	2
green	3
blue	4
black & white	5

orange 2

april 3

Blue 4

black & white	5
---------------	---

This is a cable with a mating Molex connector on one end.

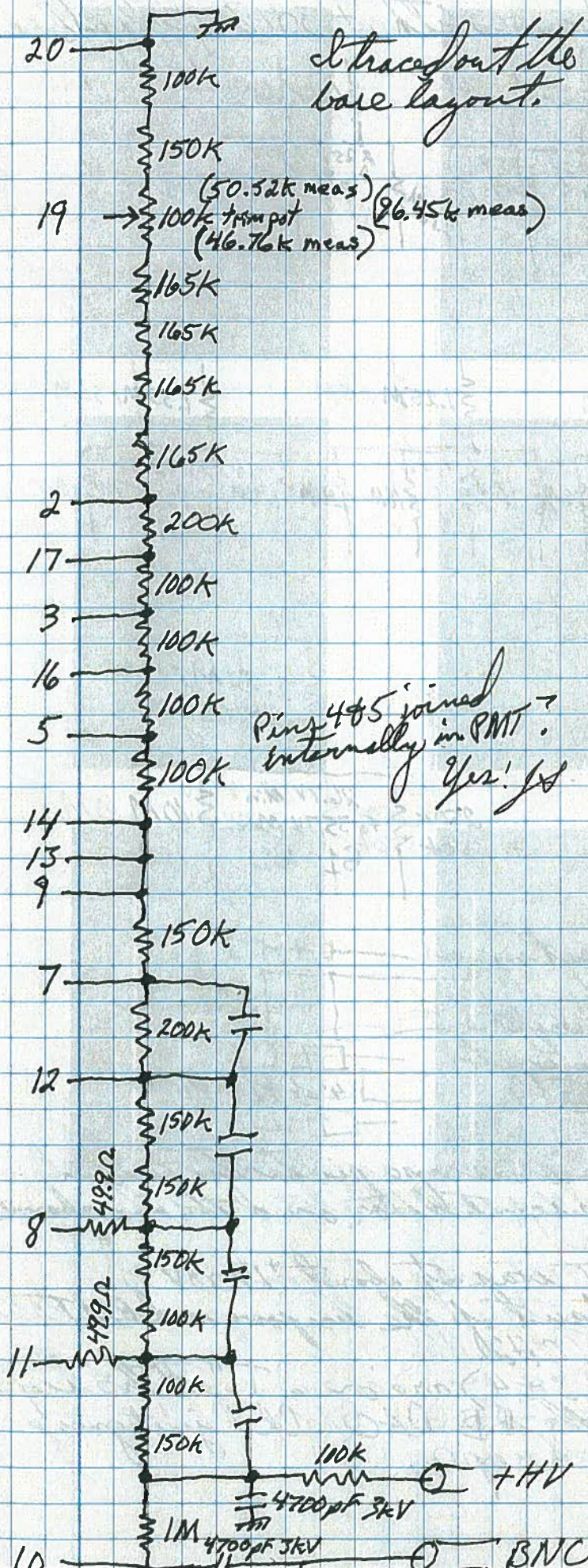
7/26/68 A Look at PMTs for the Freon Far Cherenkov
H

There was no luck seeing signals from the Freon Cherenkov in the Big Bite setup. We are trying to understand why this is.

The phototubes are Photonic XP4508/B. If I understand this correctly the bases are Photonic VD305.

Dough. had set up 3 scintillators to use for a "hard cosmic" trigger. Using those PMTs and a scope I saw some strange behaviour from the XP4508/B.

I brought the XP4508/B up to my darkbox. I set up with an 8575, so the 4508 should see the light. I set the XP4508 to ~ 1706 V. I see pulses due to the LED, but they seem small. The tube also seems to be noisy.



Datasheet says pins 1, 6, 15 & 18 are not connected (NC)

I put +30V on the base.

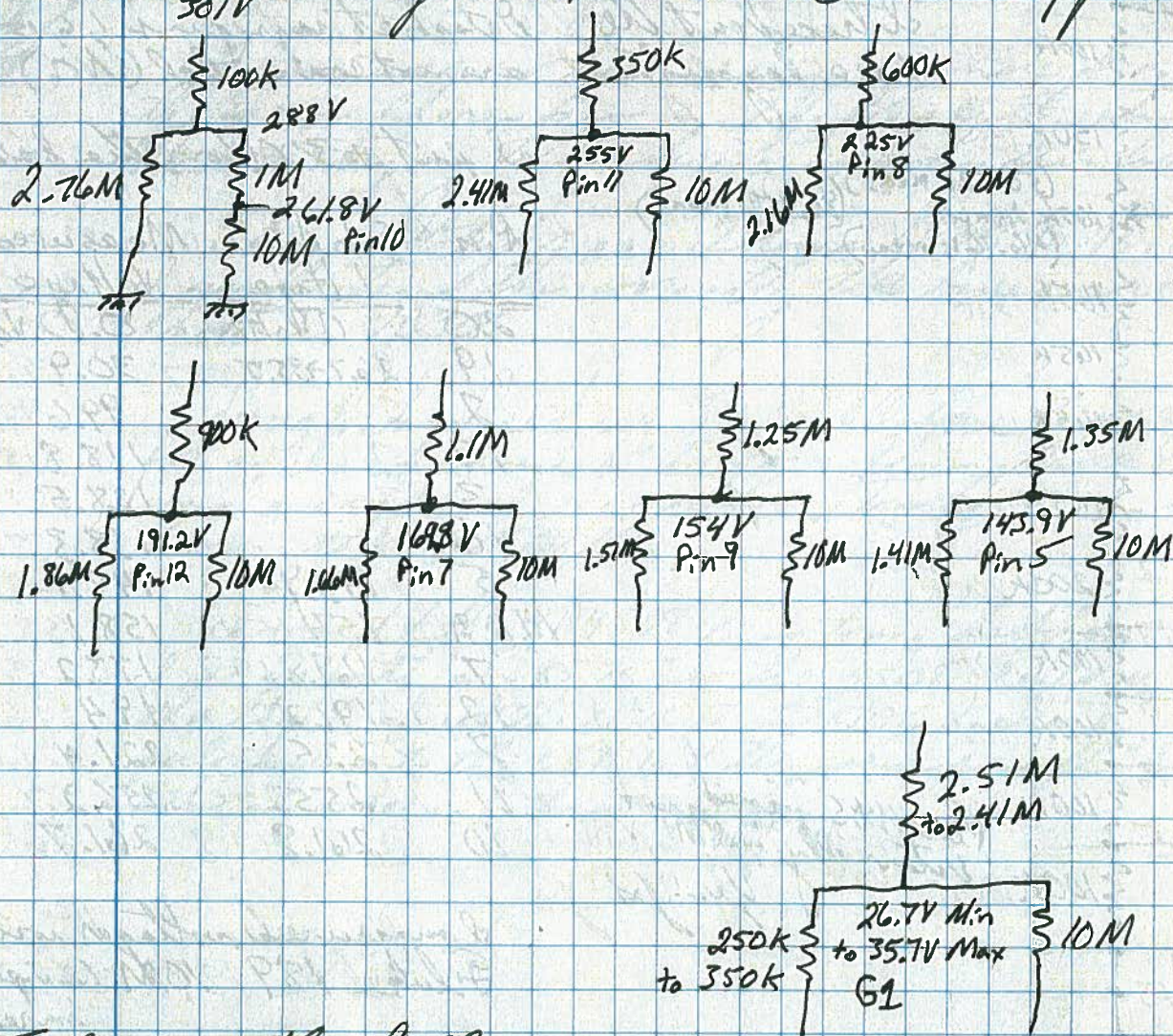
Pin	Calculated Voltage	Measured Voltage
20	0 Volts	0.0 Volts
19	26.7 → 35.7	30.9
2		99.6
17		118.8
3		128.5
16		158.3
5	143.9	148.1
14, 13, 9	154	158.1
7	169.8	173.2
12	191.2	194
8	225	221.4
11	255	256.2
10	261.8	261.7

I measured voltages with a
Fluke 189 10M Ω input
impedance

This is the same base as in
L.T. III p. 99. I seem to
have drawn the anode correct
in the wrong place in L.T. III

Pin 485 joined
internally in PMT.
Yes! *JS*

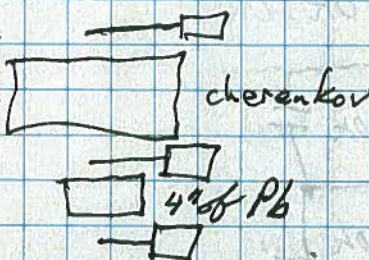
Calculated voltages on base with +30V applied



Setup down in the hall.

Scintillators are set up as

I checked the rough alignment using a laser line generator. It seemed acceptable.

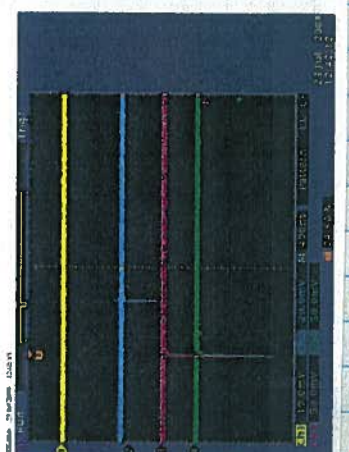
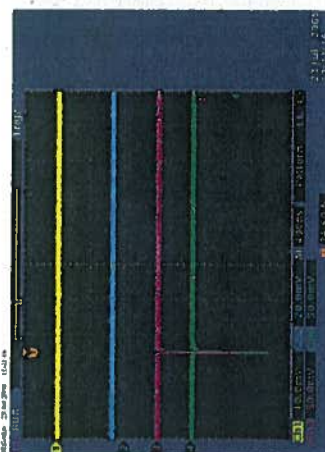
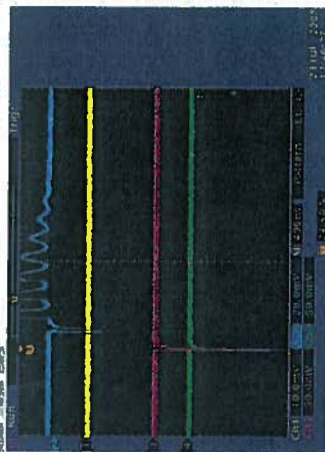
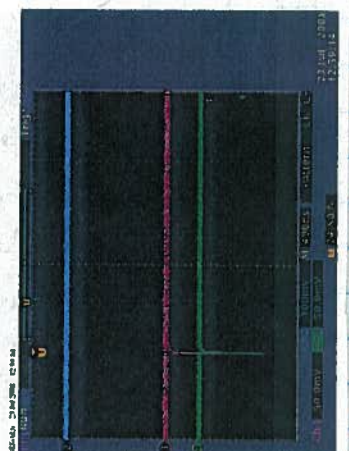
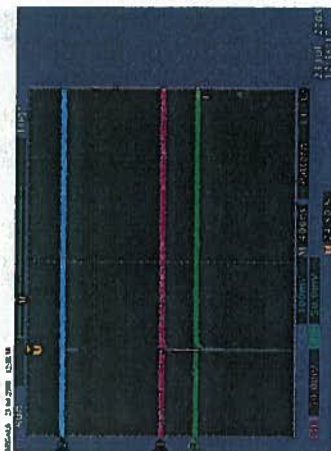
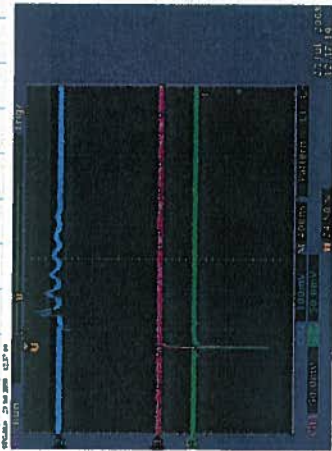
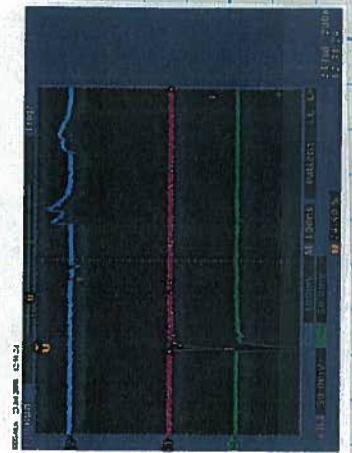
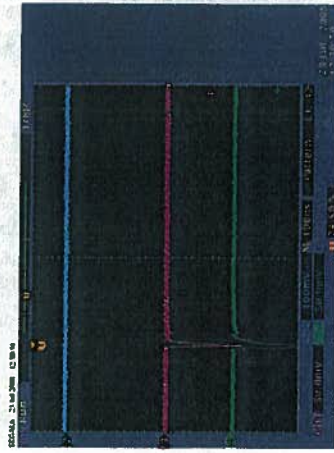
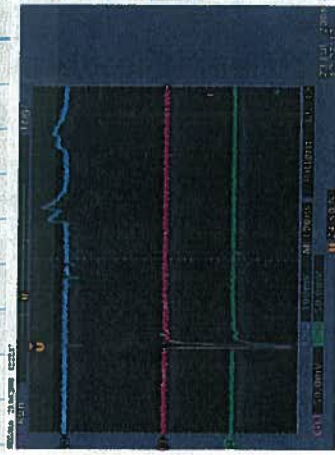


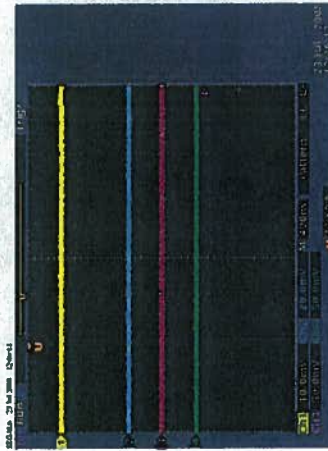
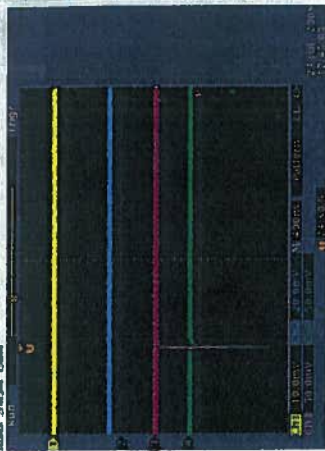
The next 2 pages are scope pictures taken triggering off the top scintillator and the one above the lead bricks.

Cherenkov PMT was at about +1700V

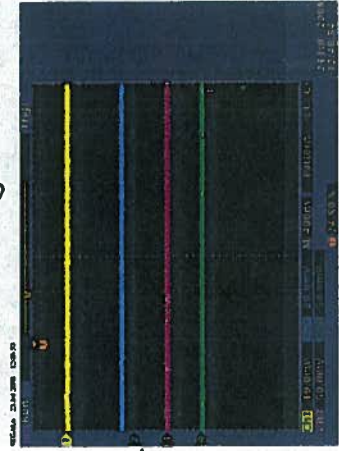
Ch 1 is the output of the unpowered PMT next to the PMT in CH2.

All channels (Ch 2, 3 & 4) are on "T" at the scope and continue to the BB DAQ. Ch 1 just goes straight into the scope.

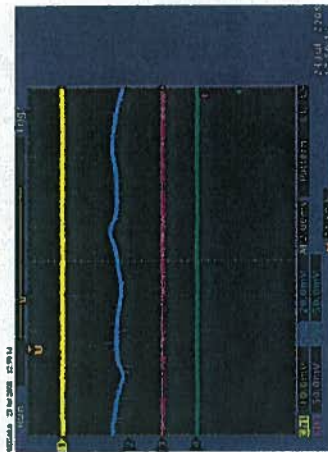
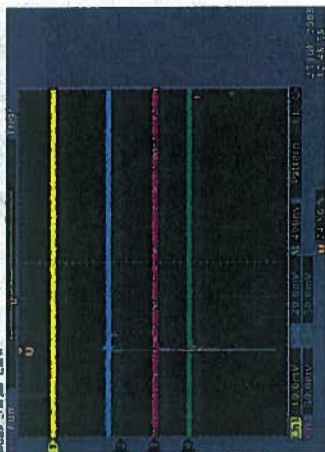




Ch2
unplugged



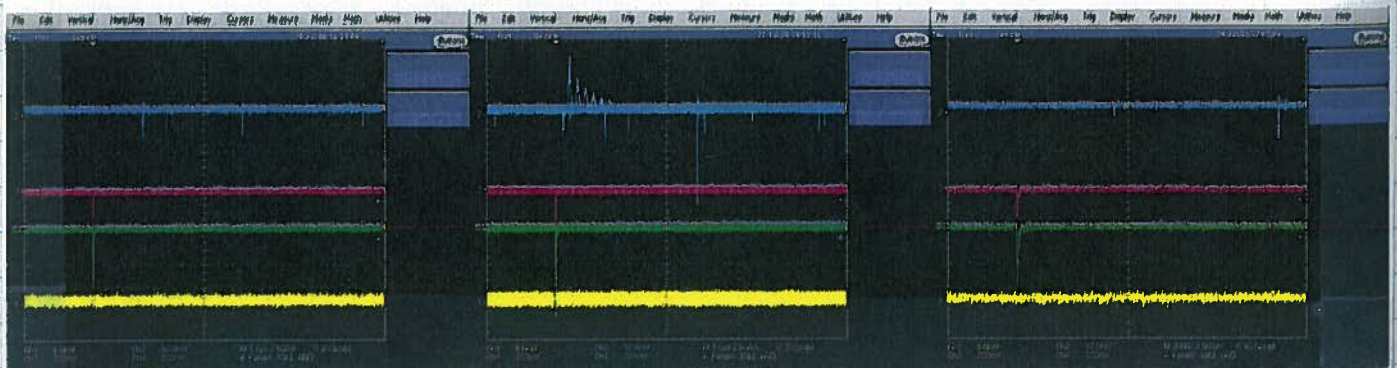
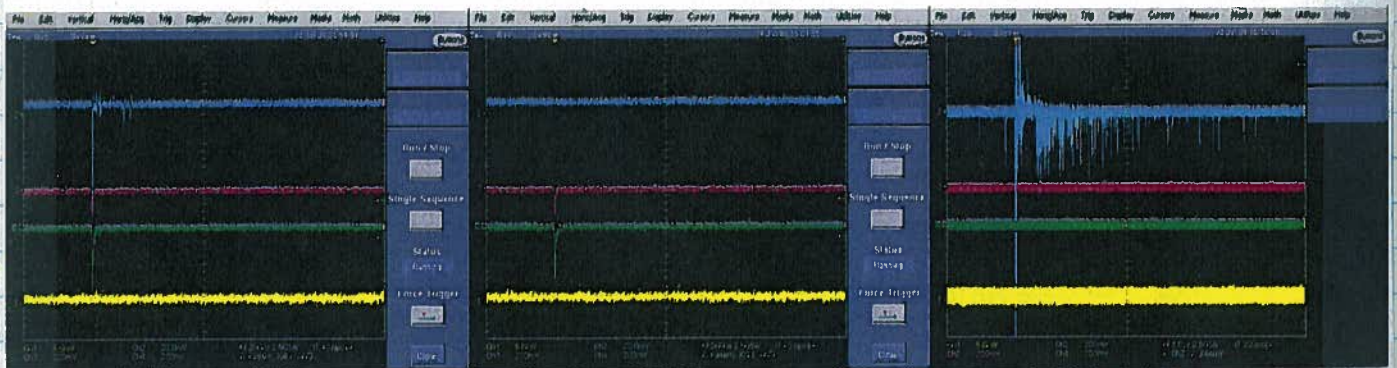
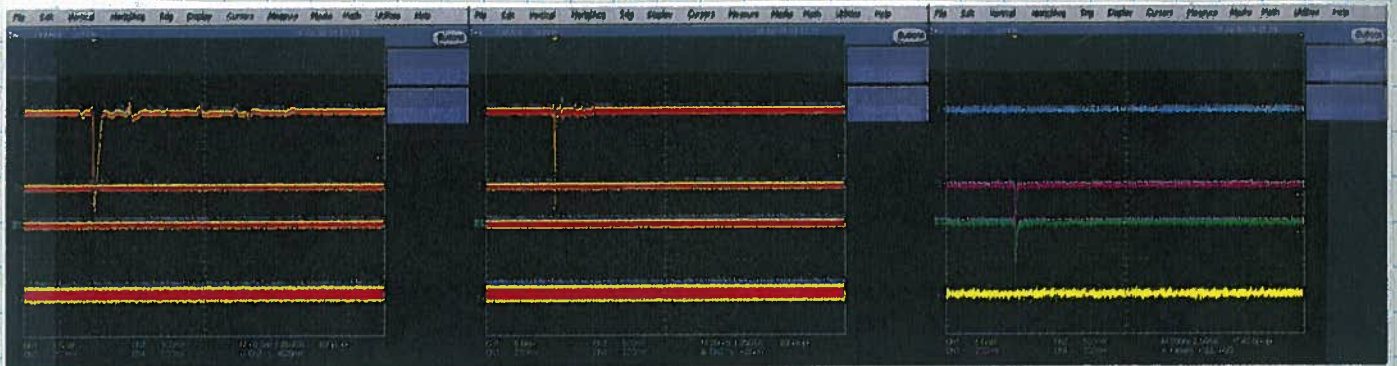
Effect on Ch2?

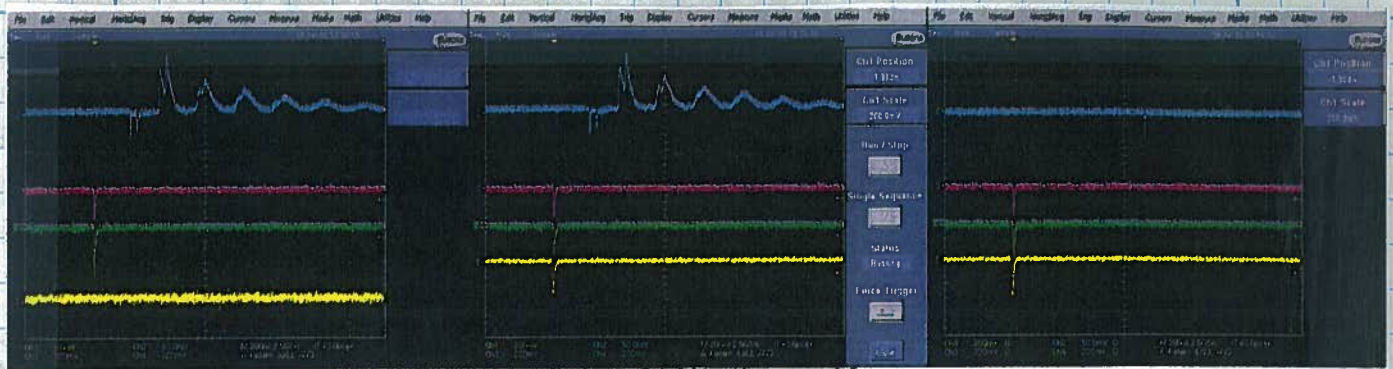


60Hz
from
somewhere?

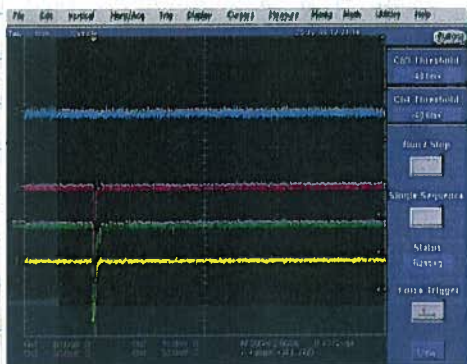
The pictures on the next page used the scintillators above and below the Pb for the trigger.
Again, Ch1 is the unpowered PMT next to the powered PMT.

I brought the 7104 scope to the hall to see
 what I could do with it.
 Ch. 1 is unpowered tube. Ch. 2 is powered tube,
 Ch. 3 & 4 are PMTs above and below the Pb.





Ch1 in PMT above &
Use all 3 for trigger

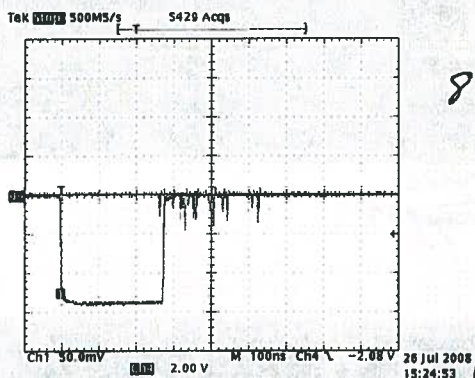


Things look like only noise. I triggered all the "T's" and just ran the signals into the scope at some point. I believe for the last 5 pictures. It would be good to continue looking at this to see if the positive polarity "ringing" is something coming back from the DAC. Very strange.

4508 PMT and LED in the Darkbox

These pictures are from the darkbox using the TP5754.

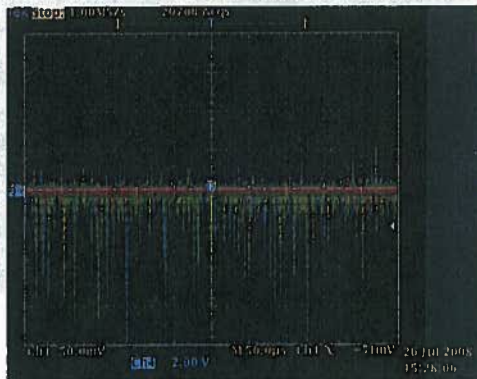
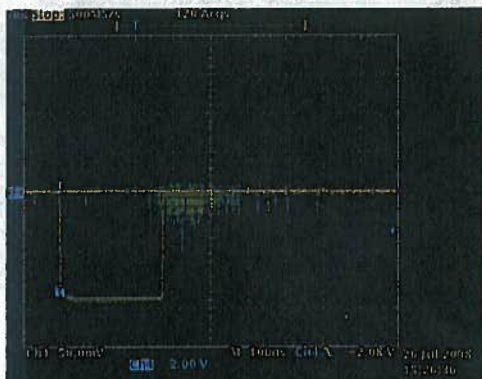
Ch 1 is PMT under test. Ch 4 is LED driving pulse.



8854
~1800V?

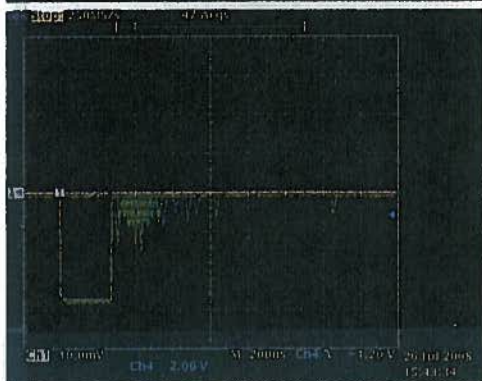
8854

Same HV
supply as in
the lab.



I'm not sure if this
was 8854 or 4508. But,
it shows a lot of "noise"
when triggering on PMT
alone.

← 4508
+1700V

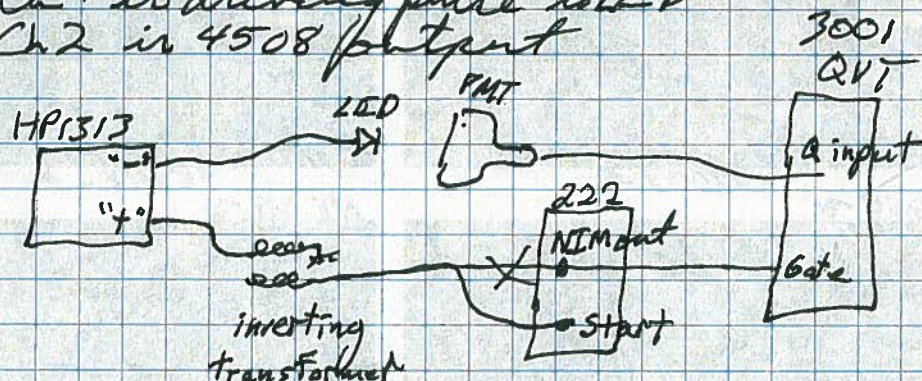


I think this shows a couple of things. My darkbox
is not so dark. It needs to be refurbished.
The gain of the 4508 at 1700V is way too low
to get a good single photoelectron response. I think
we need to look at the 4508 operating point a bit
more.

4508 PMT Check - QVT Charge Injection 7/29

I took the 4508 to the EEL (9/9/22) to look at it in a different setup. Same PMT and LED. Different ^{different} ~~lightbox~~ pulse generator (HP1313A), HV supply was the same CAEN, a different QVT.

Ch 1 is driving pulse to LED
Ch 2 is 4508 output



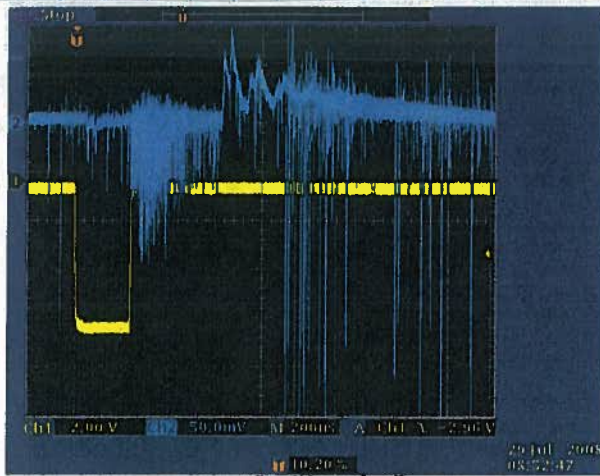
The pulse "-" output was put through an inverting transformer and used to start a LeCroy 222 gate generator. The gate was used to gate the QVT.

Starting things running I saw the positive pulses and ringing after the LED pulses.

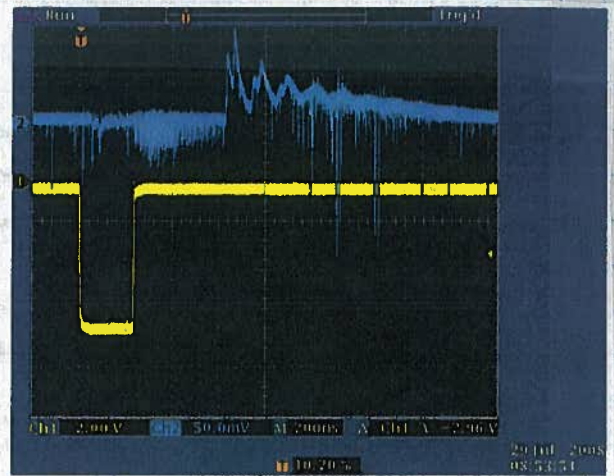
This stayed even after reducing the HV to 0V. Eventually, I found this to be due to charge injection and removal by the QVT ~~gate~~ when the gate was started and stopped. Not shown in the pictures is that the two pulses as seen in the upper right picture on p. 89, went away when the QVT was "STOP"ed and came back when the QVT was "START"ed.

Rediscovering an old problem.

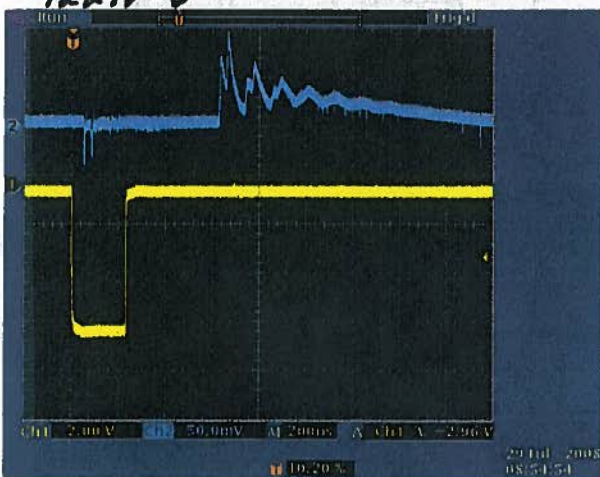
The positive pulsing was evident ~~and~~ in only some of the earlier pictures from the hall because Doug H. had the QVT gate triggered by a coincidence with all 3 PMTs (scintillators) and I had the scopes triggering off a coincidence of only 2 PMTs.



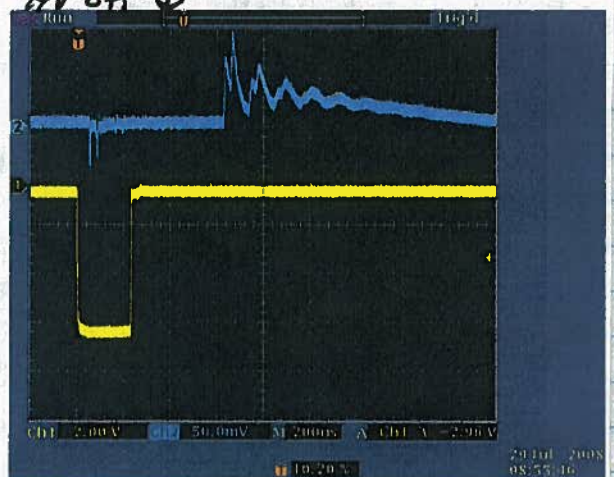
+1800V



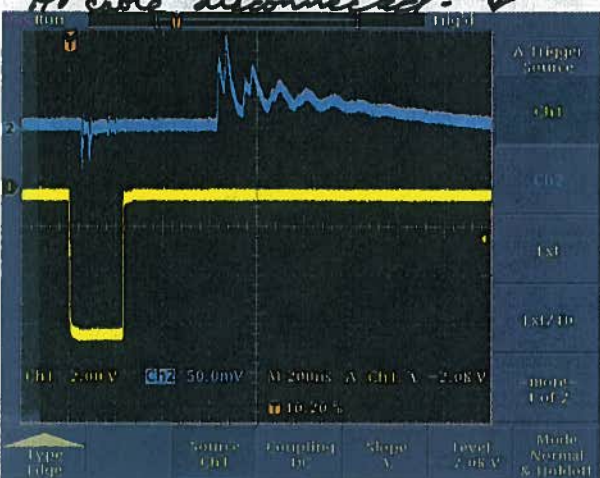
1569V



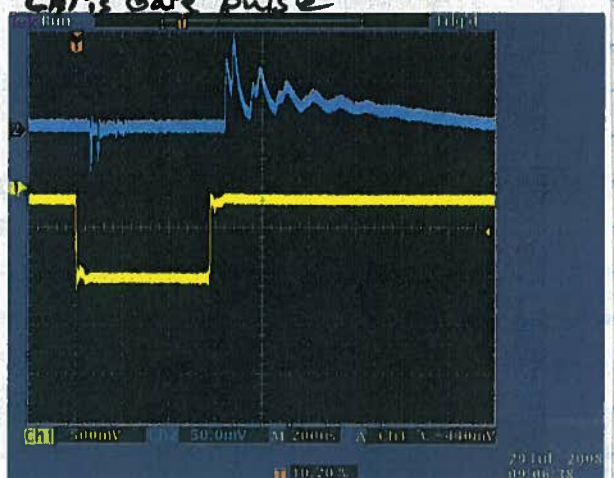
1224V



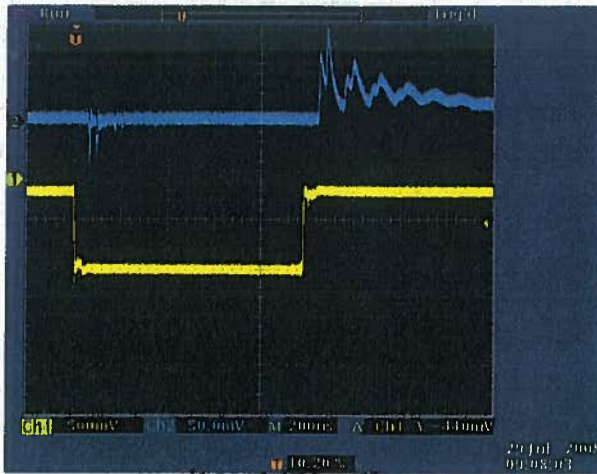
HV OFF



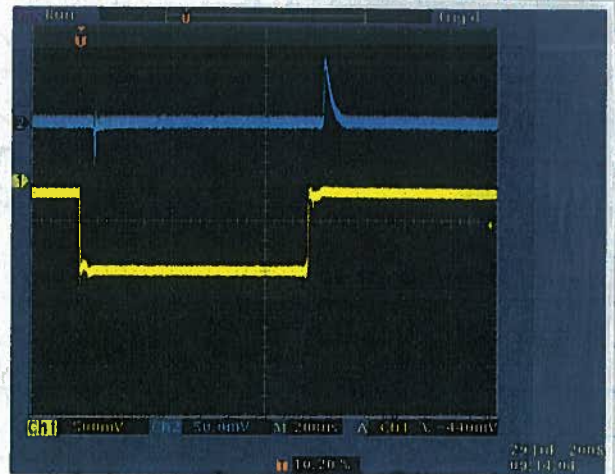
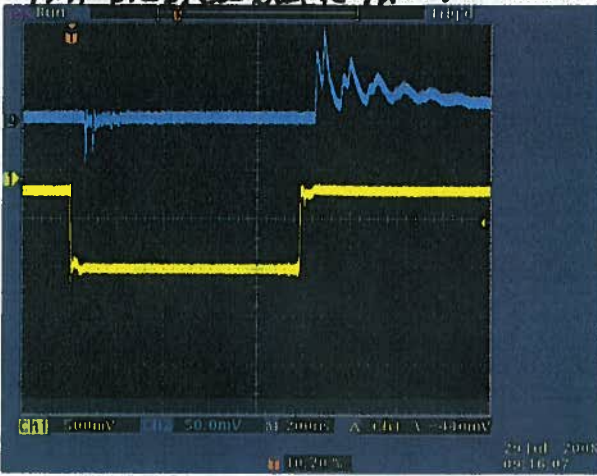
HV cable disconnected!



CH1 is Gate pulse



Change gate width &
PMT plugged back in ↘



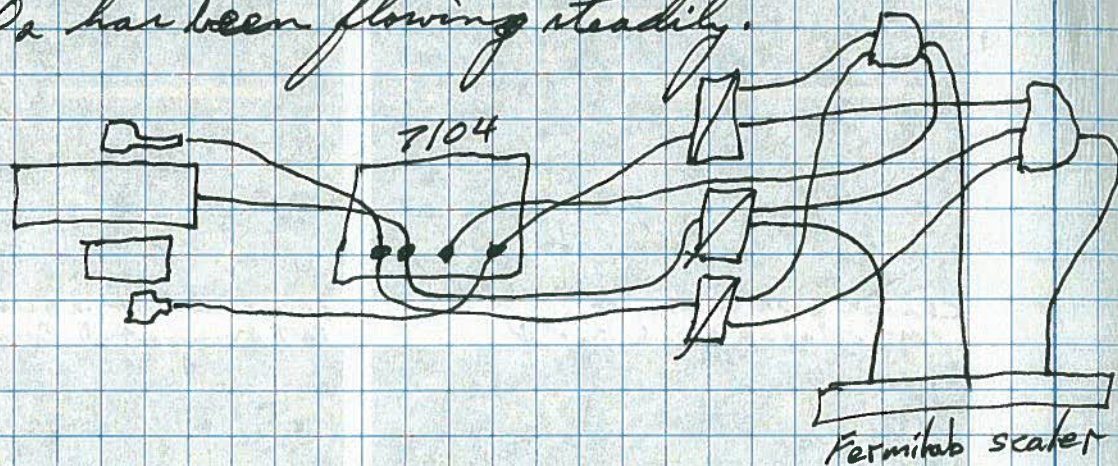
50Ω terminator in place & PMT
PMT disconnected. Open cable ↘



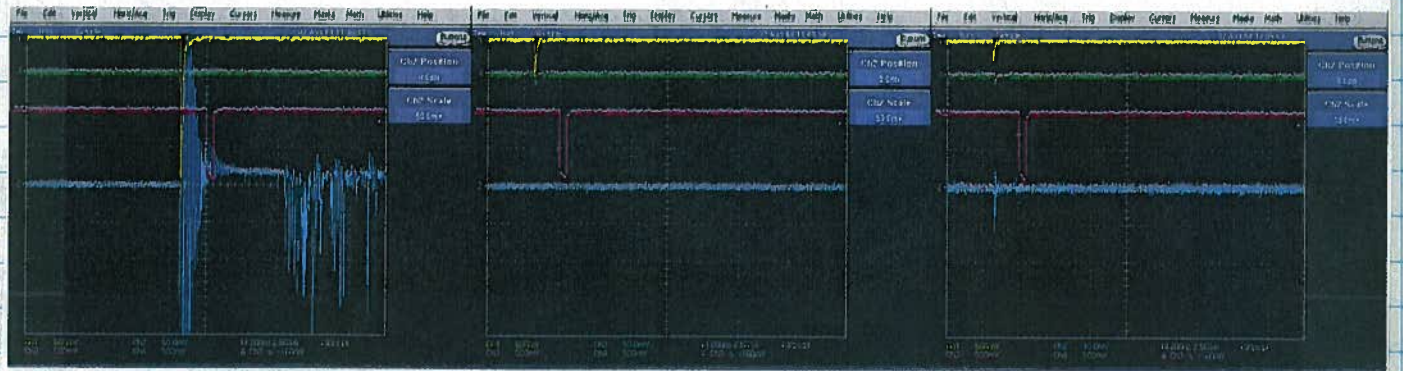
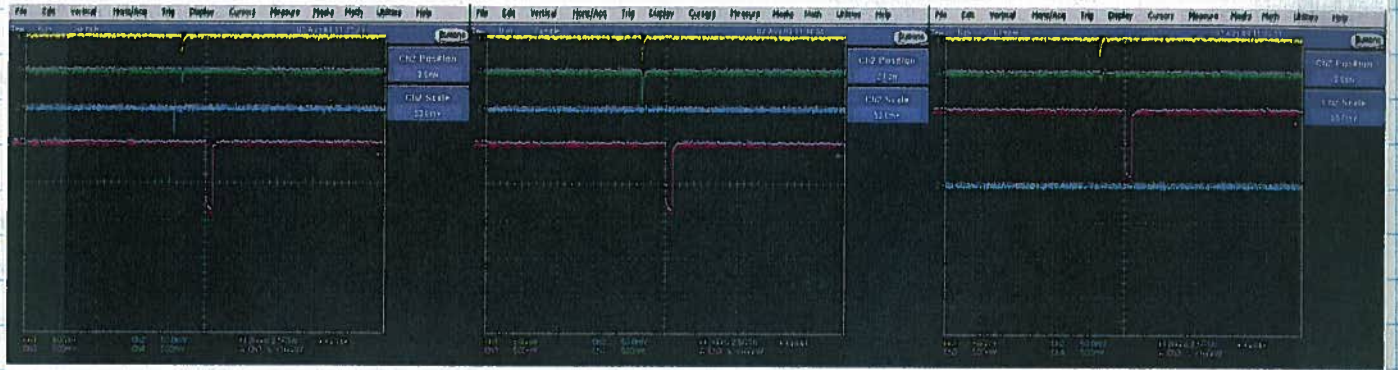
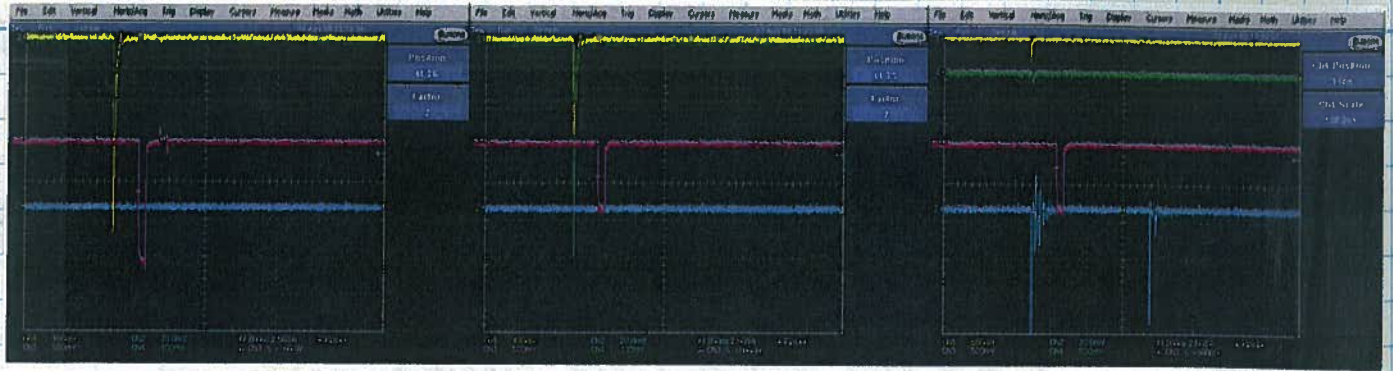
8/28/5 Attempt to See Cosmics With Freon C¹

PS

Using one of Doug's scintillators on top of the cherenkov and one of my XP2020 scintillator under the Pb trigger beneath the cherenkov. CO₂ has been flowing steadily.



I had done this basic setup on 8/2. I did not have the triple coincidence setup nor the scalars. I was just trying to see if I could see anything in time with the scintillators. I ran for a while and got some screen captures. See opposite page.



Handwritten notes on graph paper:

2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
10.5
11.5
12.5
13.5
14.5
15.5
16.5
17.5
18.5
19.5
20.5
21.5
22.5
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36.5
37.5
38.5
39.5
40.5
41.5
42.5
43.5
44.5
45.5
46.5
47.5
48.5
49.5
50.5
51.5
52.5
53.5
54.5
55.5
56.5
57.5
58.5
59.5
60.5
61.5
62.5
63.5
64.5
65.5
66.5
67.5
68.5
69.5
70.5
71.5
72.5
73.5
74.5
75.5
76.5
77.5
78.5
79.5
80.5
81.5
82.5
83.5
84.5
85.5
86.5
87.5
88.5
89.5
90.5
91.5
92.5
93.5
94.5
95.5
96.5
97.5
98.5
99.5
100.5

I set up the triple coincidence on 8/4
at 6:23 PM.
1st scaler is raw 5" PMT counts
2nd is coine. of 2 scint.
3rd is triple coine. both scint. + 5" PMT

I left it run over night.
Doug left me a note Tuesday morning
"@ 8:30 1% EFF?! too
Changed Scope To Triple
Trigger"

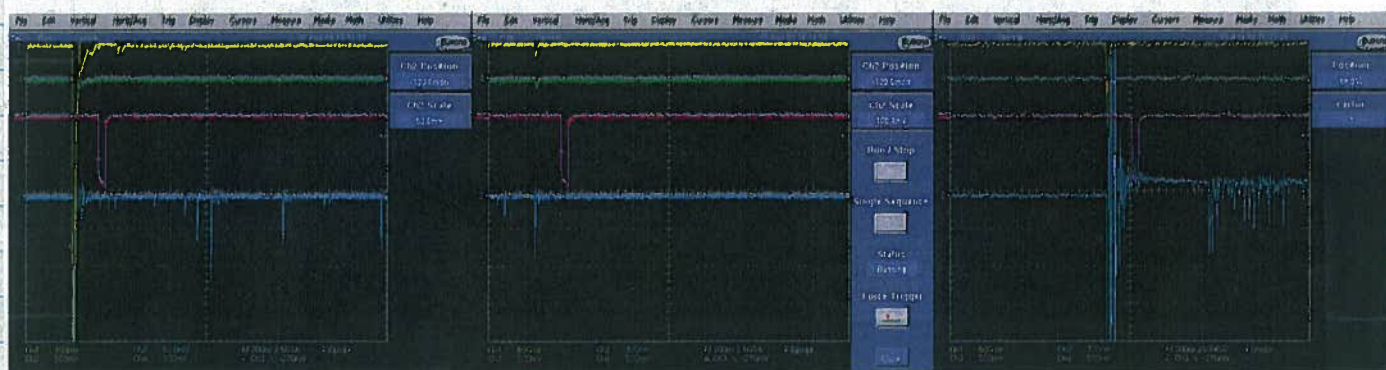
So Ch 3 was now the output of the triple AND.
I found the scalers as
 $\sim 89 \times 10^6$ 1201 11

~~Later in the day~~

I reset the scalers
& increased 5" PMT from
+1600V to +1700V

Later in the day I found the scalers as
 34×10^6 1225 3

Below are the few screens we bothered to
save.



First Look at the MCA-2

9/20/08

Checking the sensitivity of the MCA-2 to varying gas mixtures.

I have refilled the portable mixing system with argon and ethane. The output goes to the proportional tube for the gas mix monitoring.

The flow through the tube is set to ~ 3 ft³/hr (air) on the rotameter. The tube exhausts through 48 in. of $\frac{1}{4}$ " polyflo to air.

The voltages on the mix controller are set to the desired values and then the mixing tank is filled and emptied 3 times using the purge valve on the output. The $\frac{1}{5}$ of $\frac{1}{4}$ ply to the tube should take the gas about 15 sec. to pass through. After the fill and empty routine I will let things settle for $\frac{1}{2}$ min. before trying to take a histogram.

The HV is read back as 2200. Threshold is 10.
Gain is 30.

Argon set is 2.599 V ~60 records for each histogram
Ethane set is 4.6711 V

Ethane ref is 4.6711 V

1st histogram saved as or-eth-09-20-08-a1.dat
2nd -a2.dat
3rd -a3.dat

- a2.plat

a3.dat

Argon ref is 2.5891 V

Ethane ref is 4.6607 V

1st histogram saved as ar-eth_09-20-08_b1.dat
2nd _b2.dat
3rd _b3.dat

-b2.dat

-b2.dat

Argon ref is 2.5981

Ethane ref is 4.6512

1st *peritogram savadad*
2nd
3rd

- G2 dat.

- c3.dat

Argon set is 2.5991

Ethanol is 4.6809

1st histogram saved as ar-eth_09-20-08_d1.dat
2nd d2.dat
3rd d3.dat

—d2.dat

13 Det

Argon set is 2.5991 V

Ethane set is 4.6707 V

1st histogram saved as

2nd

3rd

ar-eth_09-20-08_c1.dat

-c2.dat

-c3.dat

Argon set is 2.5905 V

Ethane set is 4.6707 V

1st histogram

2nd

3rd

-f1.dat

-f2.dat

-f3.dat

Argon set is 2.5703

Ethane set is 4.6708

1st histogram

2nd

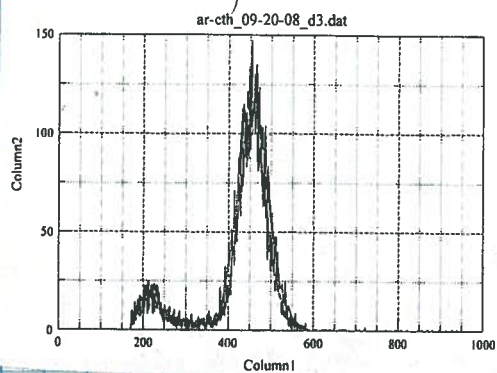
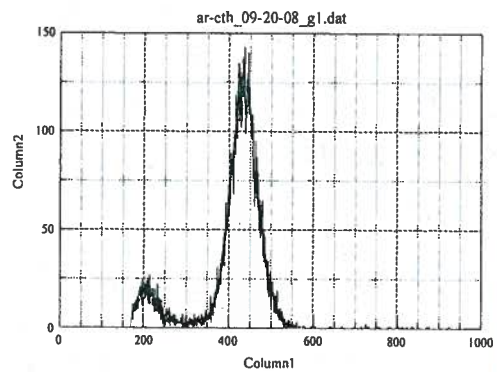
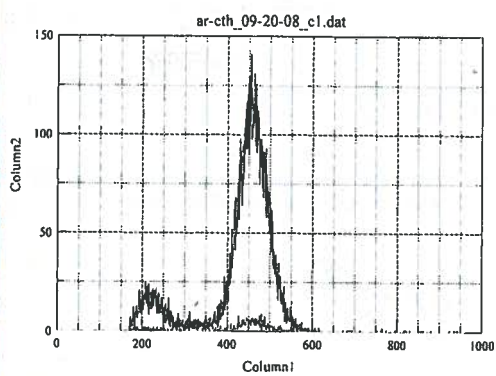
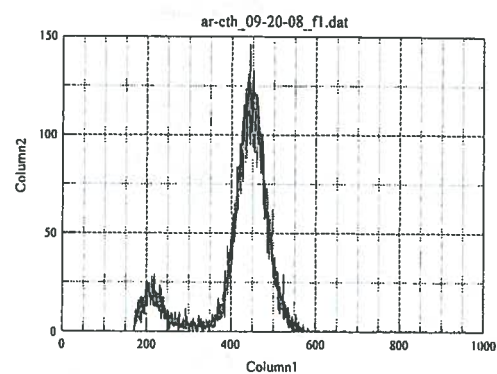
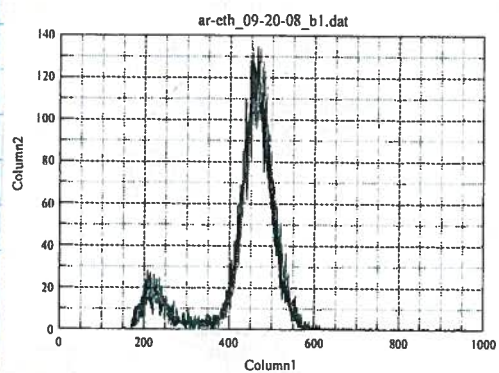
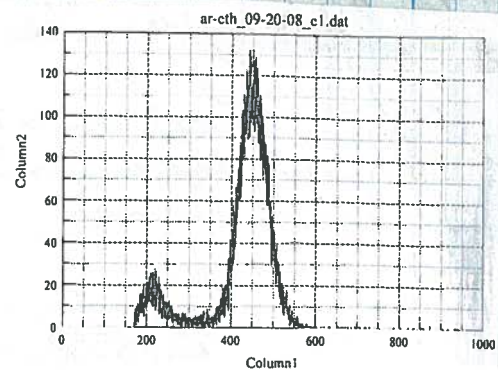
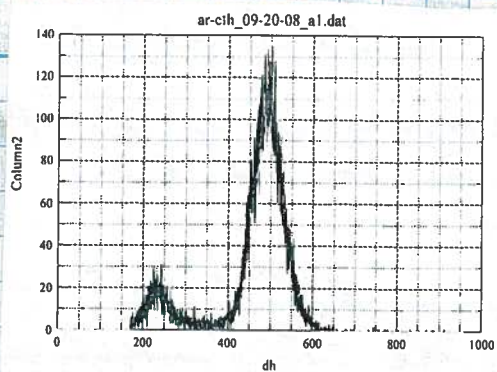
3rd

-g1.dat

-g2.dat

-g3.dat

It can be seen in the plots on the facing page that the peak shifted slightly down irrespective of any changes in the gas mix.
H, more careful work is required.

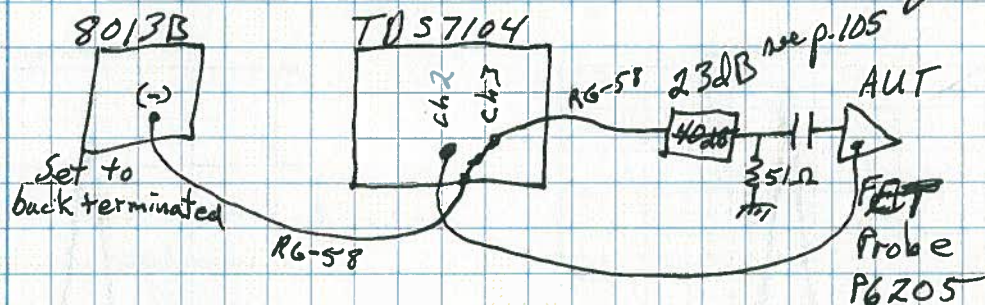


7/2/09 Compton Electron Detector Amplifier PRE48V

Looking at the performance of the PRE48V amplifier/discriminator board from Clermont-Ferrand.

V_{pp} and V_{NN} are connected to $\pm 5.0V$.

0.987A drawn on the $+5.0V$ supply and 1.465A drawn on the $-5.0V$ supply.



8013B output is set to $\sim 1V$. ~~40dB~~ ^{40dB would imply} $\Rightarrow \sim 10mV$ on the capacitor. $1mV$ on $1pF = 6250e^-$.

~~Looking at 120pF. That is $\sim 7.5 \times 10^6 e^-$. Ch47 of card.~~
~~1200FC~~

Ch47 of Motherboard

Pic 193854 is pin 8 of MAX912

194012 is pin 9 of MAX912

194118 is output of daughter board. No threshold is applied

Changed to 4.7pF. $\sim 2.9 \times 10^5 e^-$. 470FC

Pic 194419 is pin 8 of MAX912

194519 is pin 9 of MAX912

no output from daughter board

195554 } pin 8 of MAX912

thru

195902 }

200009 is pin 8 of MAX912

200218 is pin 8, also

200920 is pin 1 of OPA2690

201007 is pin 8 of MAX912

201234 is pin 8 of MAX912 Time scale change

Pin 8 MAX912 120pF

Pin 9

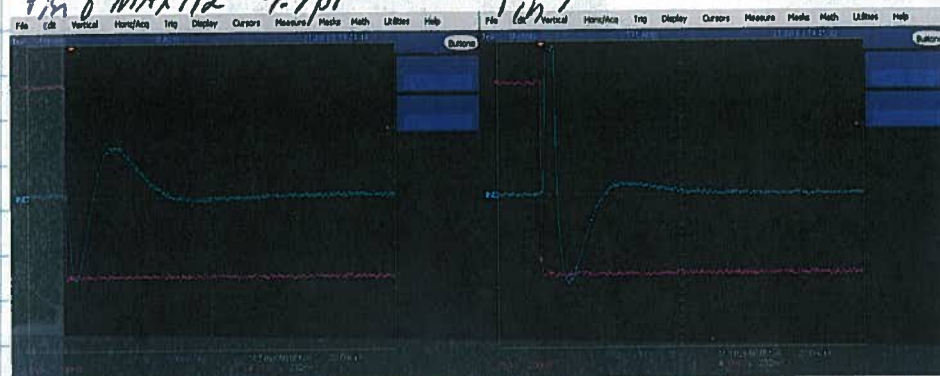
Daughter B1 output



Pin 8 MAX912 4.7pF

Pin 9

Input pulse kept
constant height.
Same voltage applied
to the capacitor.



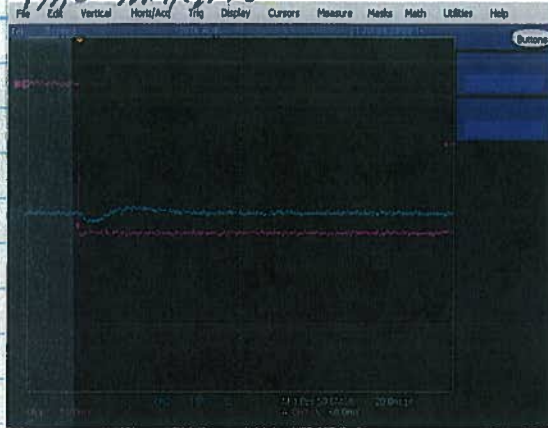
Pin 8 MAX912



Varying the step, pulse height.

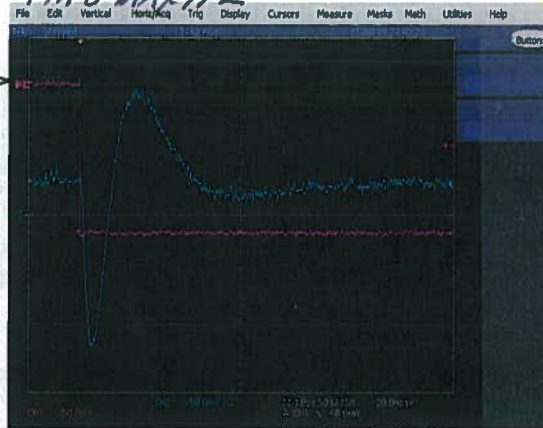


Pin 8 MAX912

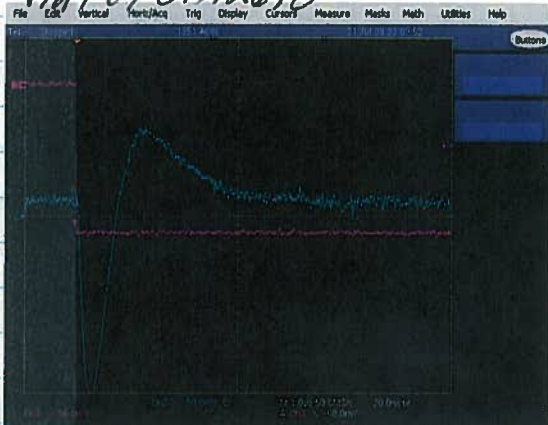


Same.
Different
vertical
scale

Pin 8 MAX912

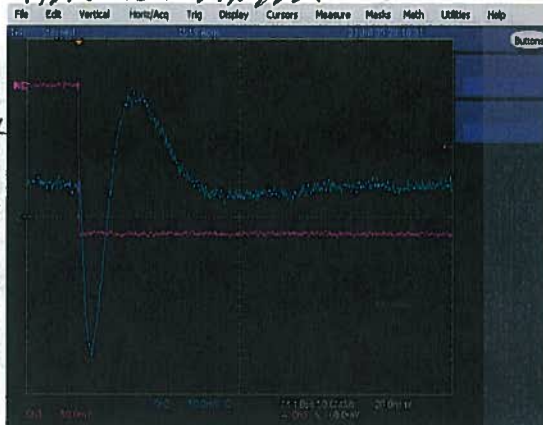


Pin 1 of OPA2690

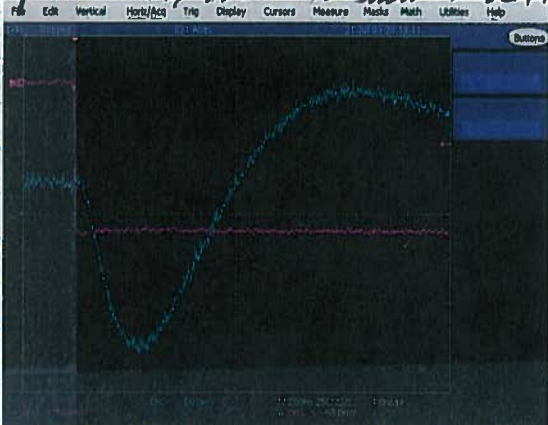


Same input
pulse
height.

Pin 8 S MAX912



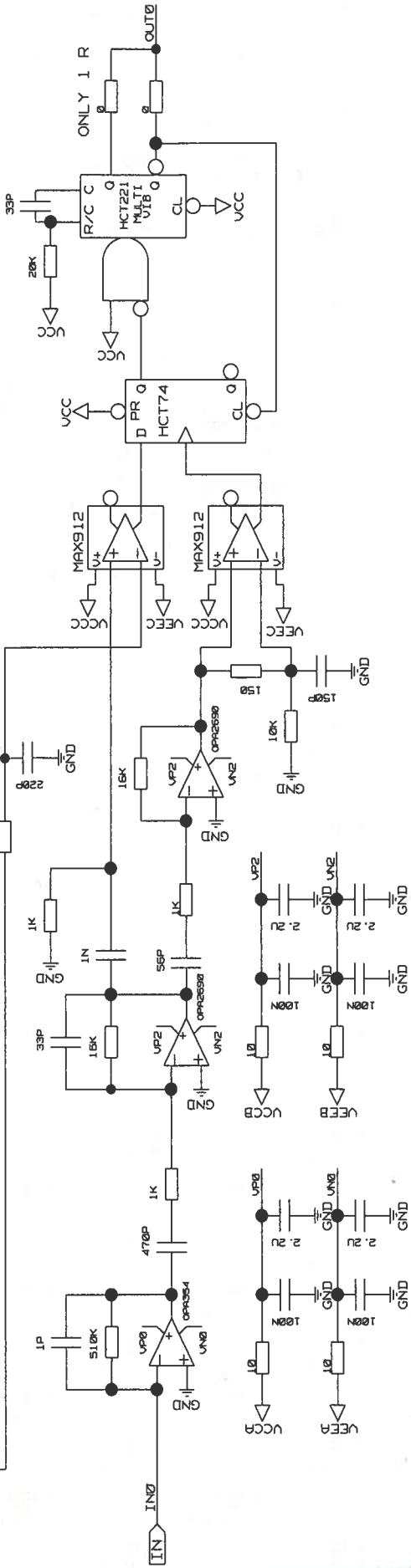
Pin 8 MAX912 to show risetime.



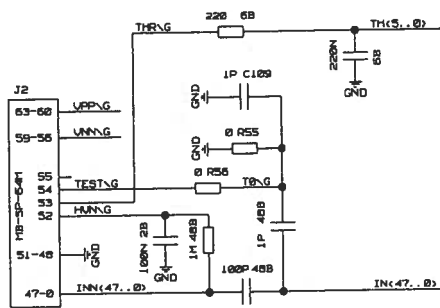
All with 4.7pF on input.

Input Step	Pulse Height	Input Charge	Gain	Input Charge	Gain
650mV	3800mV	31fC	124mV/fC	216fC	17.6mV/fC
520mV	3000mV	25fC	120mV/fC	173	17.3
360mV	2000mV	17fC	118mV/fC	120	16.7
340mV	2000mV	16fC	125mV/fC	113	17.7
260mV	1500mV	12fC	123mV/fC	87	17.3
170mV	1000mV	8fC	125mV/fC	57	17.7

23dB NOT 40dB at Pin 9
assumed 40dB wrong!
at Pin 9



Input on the
Motherboard.



TH(5..0) 17 TH(5..0)
IN(47..0) 18 IN(47..0)
VCC(5..0) 19 VCC(5..0)

7/22

Continuing to look at the Compton Amp.

I put a cable extension on the input side of one of the cards installed on the e-detector. Chipped a F. line DMM to the card's input connector to measure the threshold voltage delivered to the card on pin 53. Card is from the "B" side electronic cage.

Threshold setting in EPICS GUI	DMM mV	Thresh	DMM(V)	Th.	DMM
5	-8.7 mV	5	+1.106 V	129	.023
10	-3.9	10	+2.209 V	130	2.679
15	+1.2	15	.312		
20	+6.0	20	.415		
30	+18.3	110	2.268		
40	+27.9	120	2.473		
50	+37.5	130	.044		
60	+47.1	140	2.885		
70	+56.7	131	2.700		
80	+66.4	132	2.720		
90	+76.1	133	2.741		
100	+85.7	134	2.761		
110	+95.5	130	2.679		
120	+105.2	120	2.473		
130	-11.6	130	.044		
140	+124.7	129	2.658		
150	+134.5	128	2.637		
160	+144.3	120	2.473		
		130	.044		
		120	2.473		
		121	2.494		

Put the card back in.

Connected the RG-174 cable that supplies the threshold voltage for the "B" side to the DMM. Data on the right side, above.

Looking at the RG-174 for the "A" side I see the same behavior going from 120 to 130.

For the HV bias, measuring at the input pins to the Mithras board - 1000

EPICS GUI Setting	Voltage at Input pin
100	-38.1 V
150	-57.3 V
200	-71.9 V

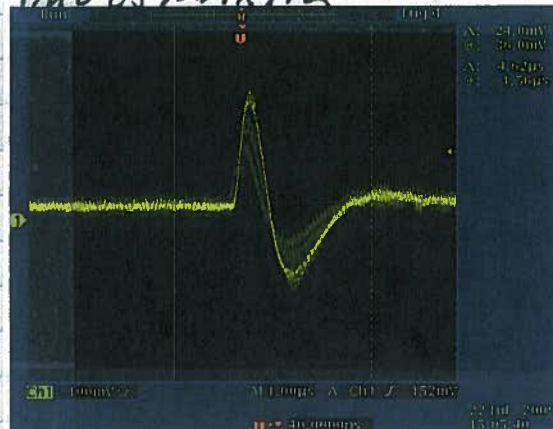
Put the FET probe on the T053054 in the hall.

Put the cable extensor back on the card.

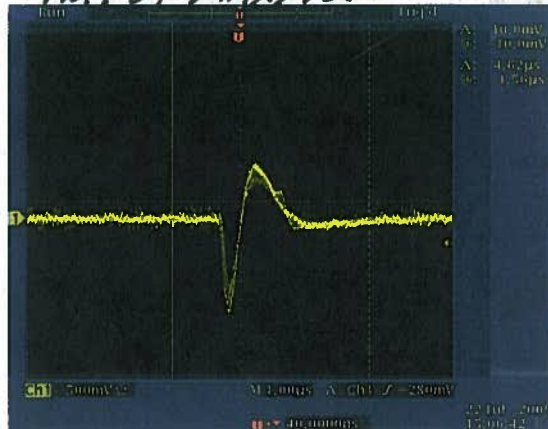
Looked at the signal from an Amerigium source. HV set to 200 on the GUT, which clm told is 100V on the silicon.

Looking at a random channel which seems to have a bit of a rate from the source.

Pin 8 of MAX912



Pin 9 of MAX912



So, this is the opposite of what I was looking at.

Checking the FET with a AAA battery.

Pic 090722-173016. Looks good to me.

The Am seems to be $\sim 250\text{mV}$ in the hall.

With 10dB before the 4.7pF cap

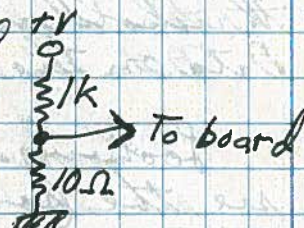
pin 8 is 173453 The input step is $\sim 560\text{mV}$
173701 in same with horiz. scale expanded
173819 is pin 9 of MAX912

29dB

This seems to be what we see in the hall with the Am source.

The threshold is now derived

So, $+V \div 100$

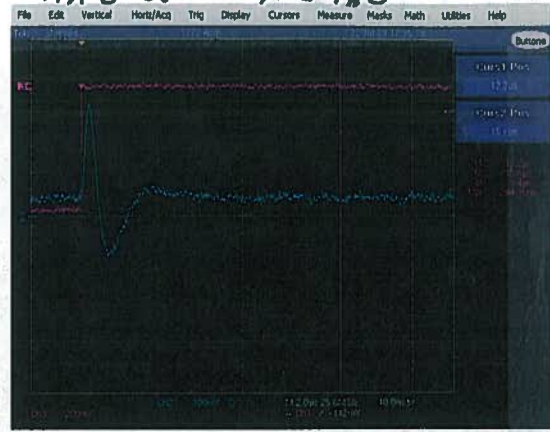


As things are the output of the daughter board goes low when the pulse occurs. & tops firing when the +V is $\sim 19.6\text{V}$
Start to double pulse at $\sim 3.6\text{V}$

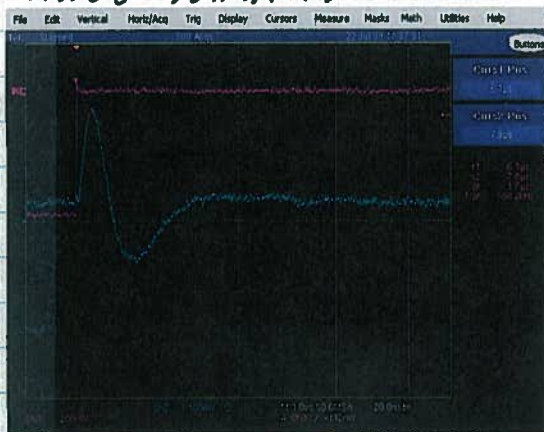
Battery



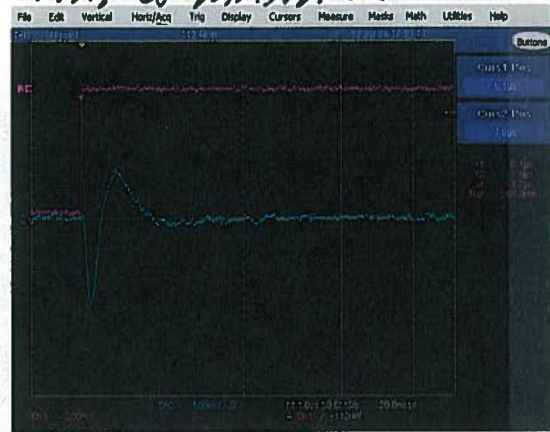
Pin 8 of MAX912



Pin 8 of MAX912



Pin 9 of MAX912



output begins double pulsing
when threshold $\sim 3.6V$
or 36mV on the board

Threshold is at $\sim 3.6V$.

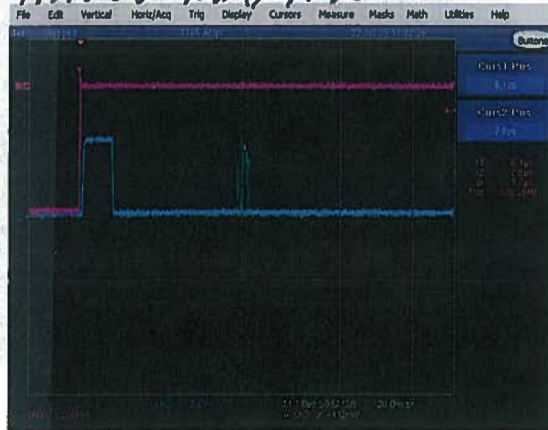
183014 is pin 1 of MAX912

183248 is pin 16 of MAX912

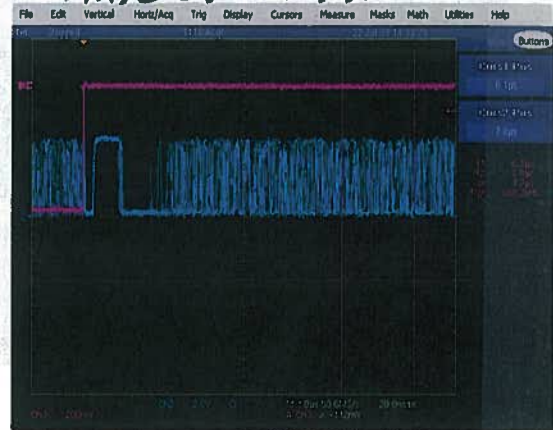
next 3 pins are output, pin 16, and pin 1

183709 is pin 9 of MAX912

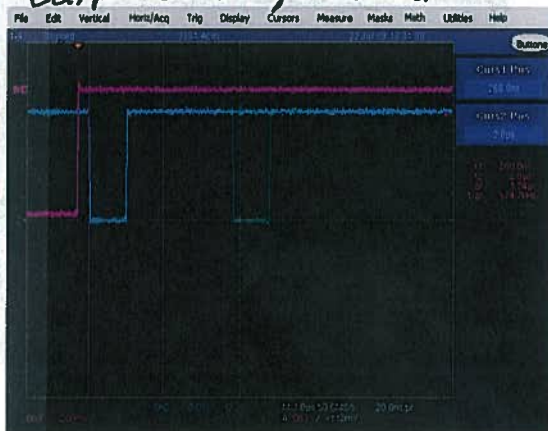
Pin 1 of MAX912



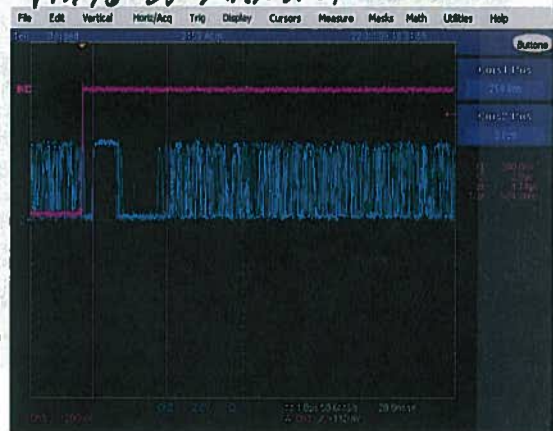
Pin 16 of MAX912



Output of Daughterboard



Pin 16 of MAX912

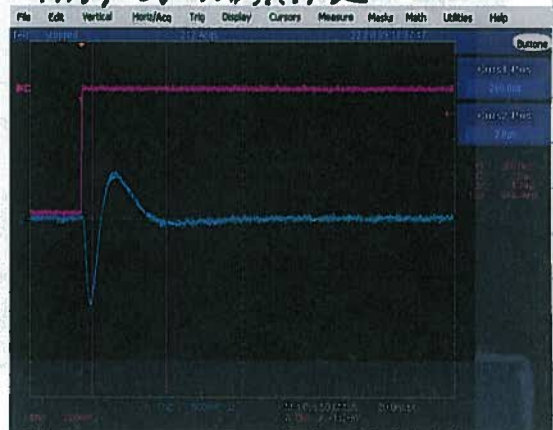


↖ Note
Cursor
positions
↘

Pin 1 of MAX912

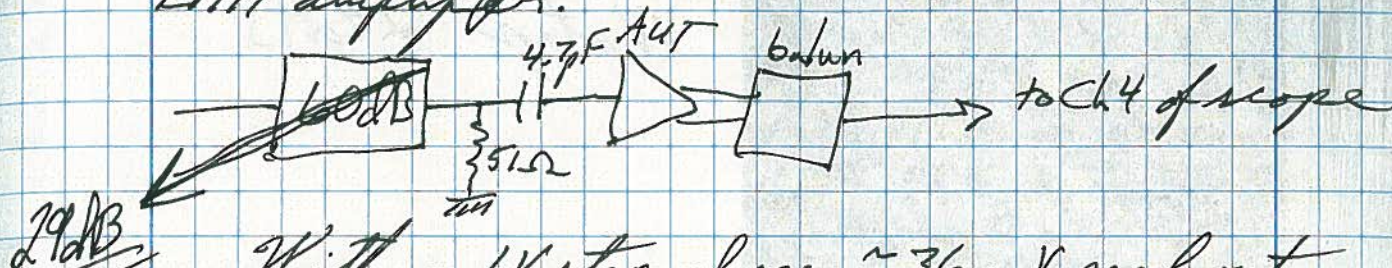


Pin 9 of MAX912



7/23

The gain of this amp seems increasingly high. Checking the ~~test~~ test setup with the ET11 amplifier.



29dB
With a 1V step I see ~36mV peak out of the amplifier. Picture 090723-093339

$$\frac{1V}{1000} = 1mV \text{ on } 4.7pF = 4.7fC \quad \frac{36mV}{4.7fC} = 7.7mV/f$$

Way too large!

Plug the "60dB" directly into Ch4. Pic 093723
~35mV step into Ch4.

Remove 2 of the "20dB's" and use just 1.

Step size is ~480mV. Pic 094051

(I had to take a picture because this is too funny!)

Looking at the "20dB" attenuator I noticed it has 6dB printed on its label! Oh, man!!! The middle attenuator says 20dB and the third attenuator says 3dB.

Well, that explains a lot!

Never assume, always check!!!!

And always keep a pen refill handy.

Repeating the setup on p. 96 of this volume Double check, yes, using 2 of 20dB and 4.7pF
Pic 100311 of pin 8 of MAX912

$$\frac{1V}{100} = 10mV \quad 10mV \cdot 4.7pF = 47pF$$

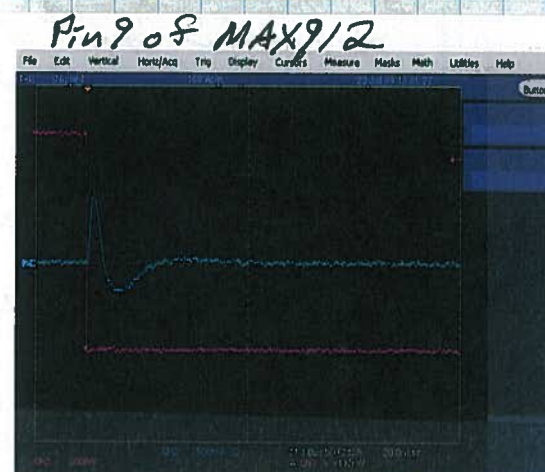
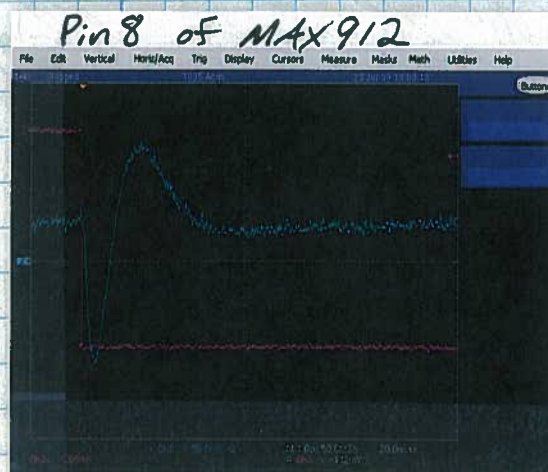
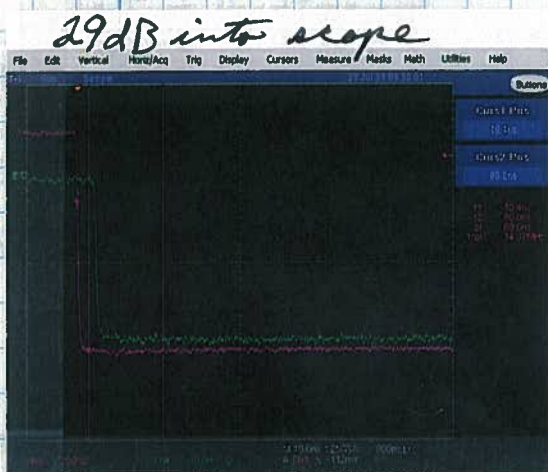
I see ~150mV at pin 8.

~3mV/fC

Pic 100608 is pin 9 of MAX912



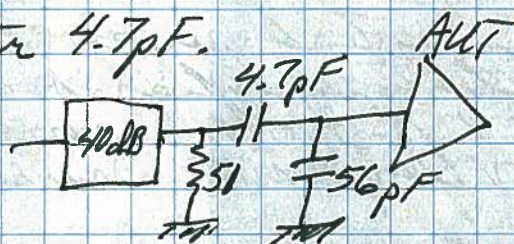
E711 preamp
IV step 29dB



$\sim 3.2 \text{ mV/fC}$

$\sim 17 \text{ mV/fC}$

Put 56pF after 4.7pF.

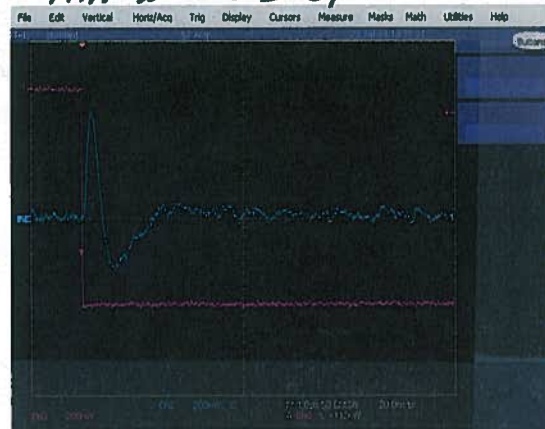


Pic 103219 is pin 8 of MAX912
103309 is pin 9 of MAX912

Pin 8 with 56pF



Pin 9 with 56pF



For pulse height $dB = 20 \log \left(\frac{A_1}{A_2} \right)$

For power $dB = 10 \log \left(\frac{P_1}{P_2} \right)$

7/29 Compton Electron Detector Original Amplifier
 7/30
 Connecting power to the old electron detector amplifier board.

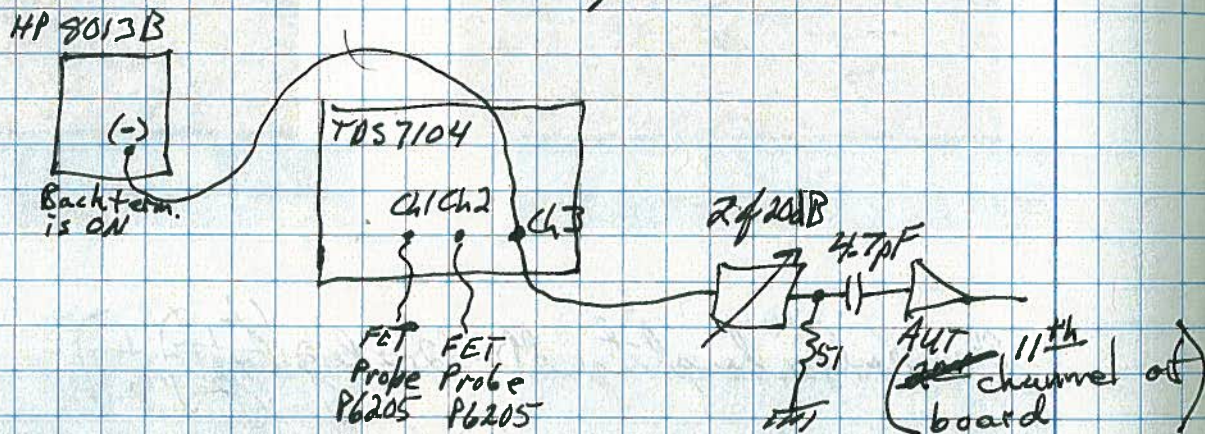
+5V for "VPC" current draw is 0.444 A
 -5V for "VM6" current draw is 0.189 A

Looking with the pulser I see it is similar to the new amplifier.

With 47FC input $\left[(1V \div 100) \cdot 4.7pF \right]$ ^{40dB} I see about 750mV positive going pulse on pin 8 of the MAX912. The negative going pulse on pin 9 is saturated at about -3V.

7/31
 PJ

Fired up the same setup as above.



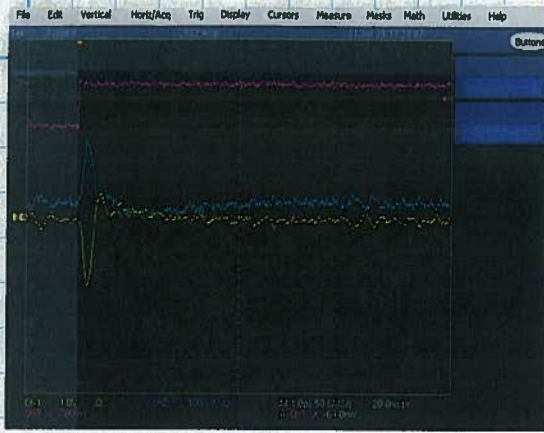
Went through a quick look, just saving pictures.

There is a LOT more gain than the new amp.

The signals at the inputs of the MAX912 are ~~input to~~ compared to the new

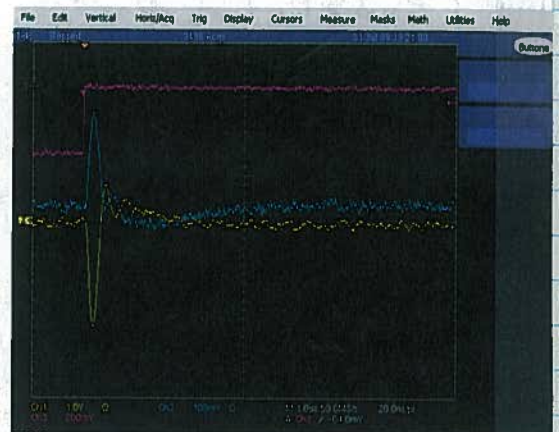
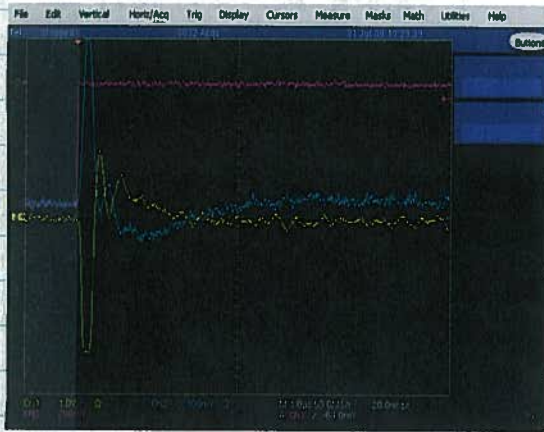
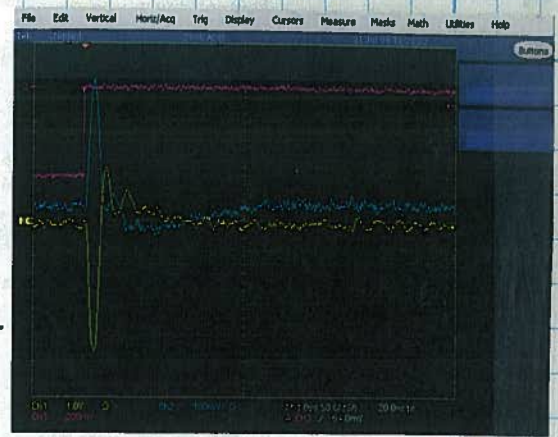
the same sense as the new amplifiers. I am injecting a "+" pulse and need to compare the pictures on the following page (109) with pictures on p. 103 of the new amp. Pictures of new amp on p. 106 & 107 are "-" input pulse.

The pictures on pp. 109 & 110 are from my just poking around.

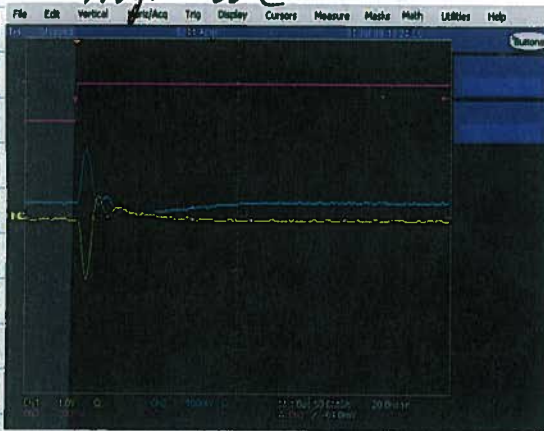


Ch2 is
pin 8

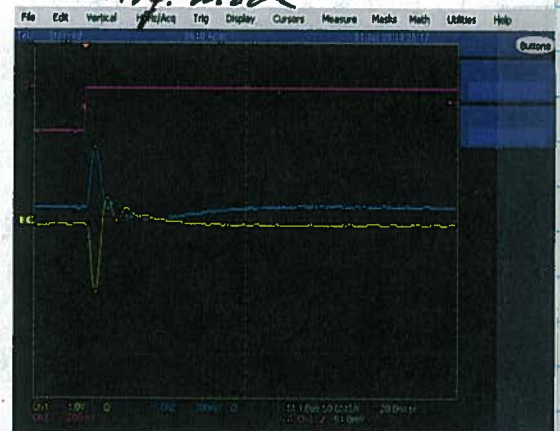
Ch1 is
pin 9
of
MAX912



Avg. mode



Avg. mode



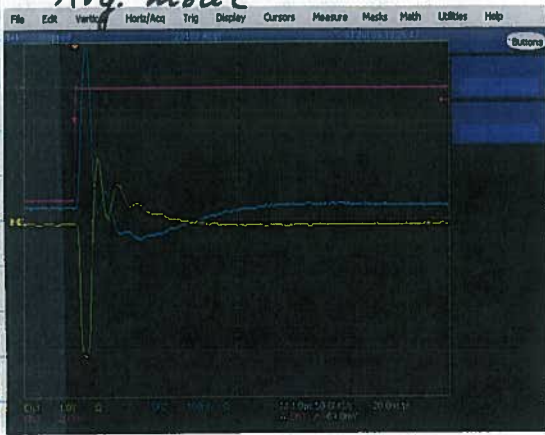
Avg. mode



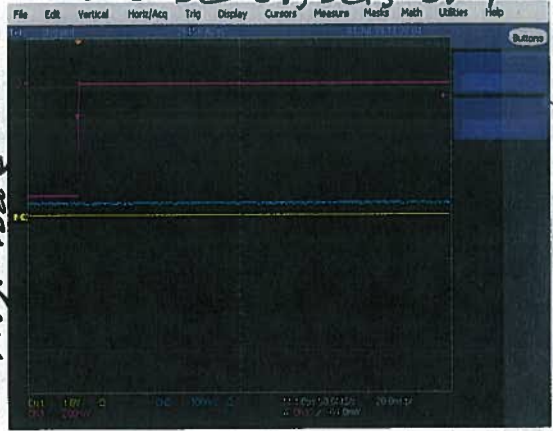
Avg. mode



avg. mode

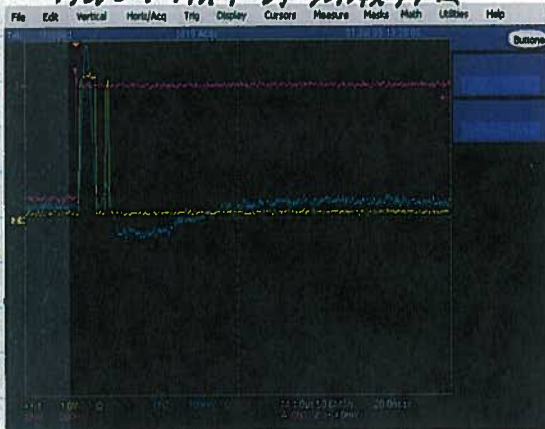


Shows DC offsets of probe

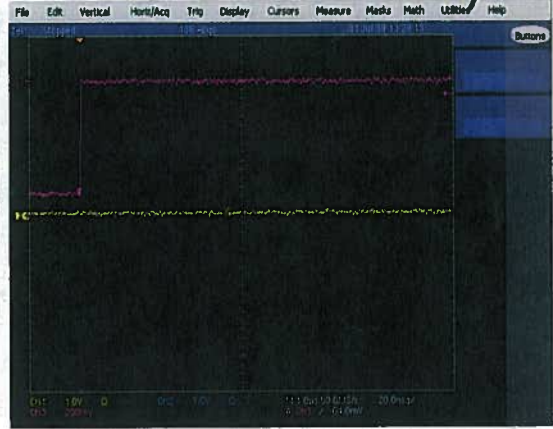


avg. mode

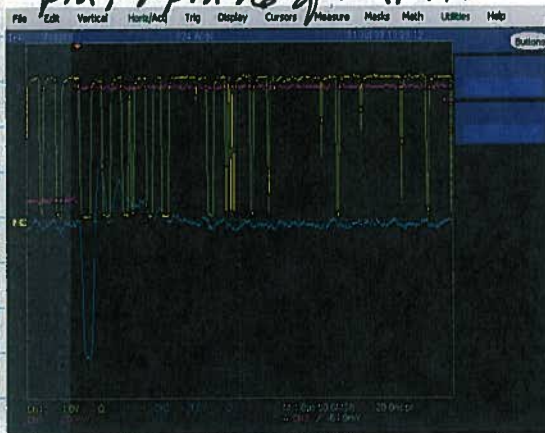
sample mode
Pin 8 & Pin 1 of MAX912



Shows DC offsets of probe

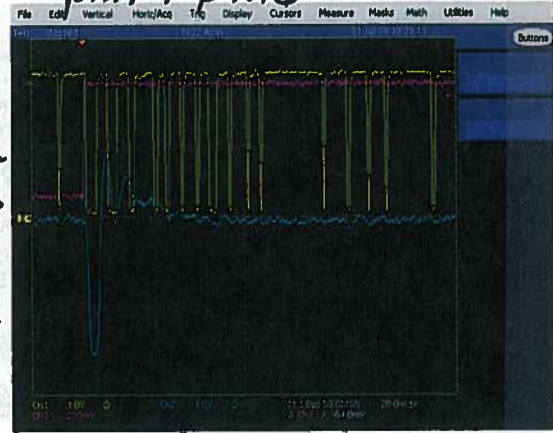


pin 9 & pin 16 of MAX912



Seems to fire on leading edge then on falling edges.

pin 9 & pin 16



pin 9 & pin 16



(Pin 3 of '74)
Pin 16 MAX912 pin 6 of '74



Looking at the amp in a little more methodical fashion.

Pics 123506 + 123544 are pins 2 & 3 of the '74.

Looking at pin 8 of 912 and pins 1 and 16 of 912 we can see the comparators file on the leading edges.
Pics 123827 & 123942

Pic 124525 is pin 2 and pin 6 of '74

124551 is 3 6 '74

631 is avg. mode of 124551

'74 output is determined by the falling edge of the input pulse. Seems odd.

Pic 125428 is pin 1 and pin 4 of first '221

125646 is 1 131 second '221

125844 is pin 13 of '221 and pin 5 of 26LS31

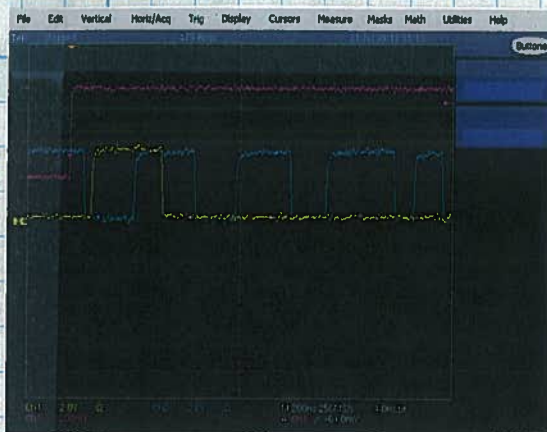
pin 6 of 26LS31 is opposite phase of pin 5

Pic 130822 is pin 1 & 2 of OPA2680

Looking at the board it seems the gain resistors are 1k and 15k for the first OPA2680 amp and 1k and 15k for the second.
(on backside)

Pic 134308 is pin 3 of OP37

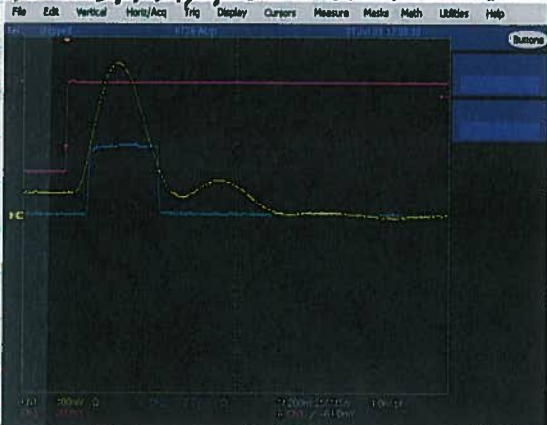
Pic 135413 is set up to do a comparison with the bottom two pictures on p. 106.



Pins 2 & 3
of '74
Sample
Mode
←
Avg.
Mode →

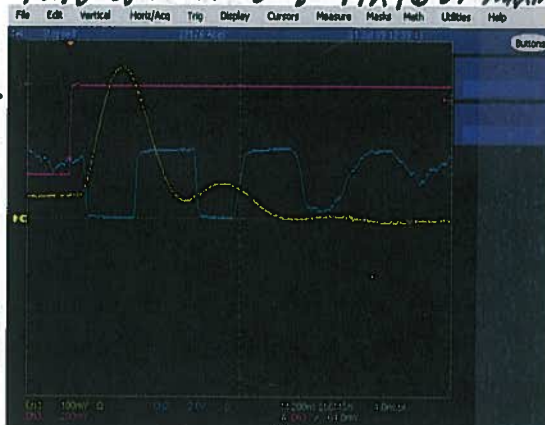


Pin 8 of MAX912 & Pin 1 of MAX912

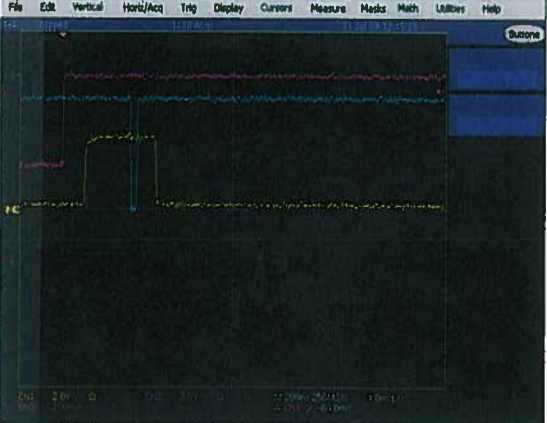


Avg.
Modes
← →

Pin 8 of MAX912 & Pin 16 of MAX912

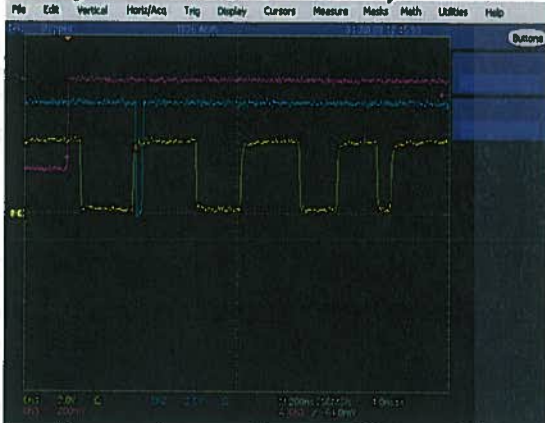


Pin 2 & Pin 6 of '74

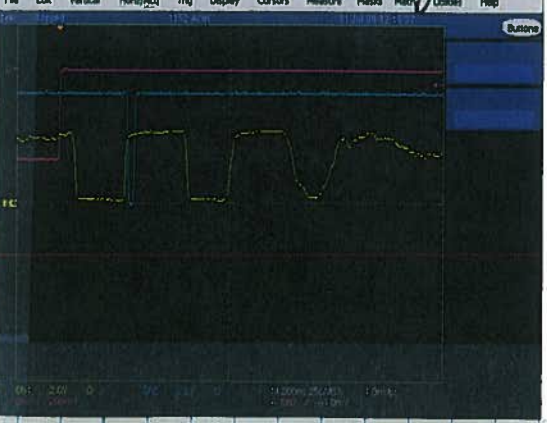


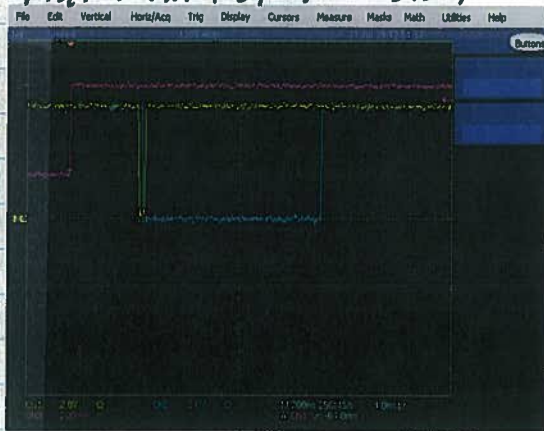
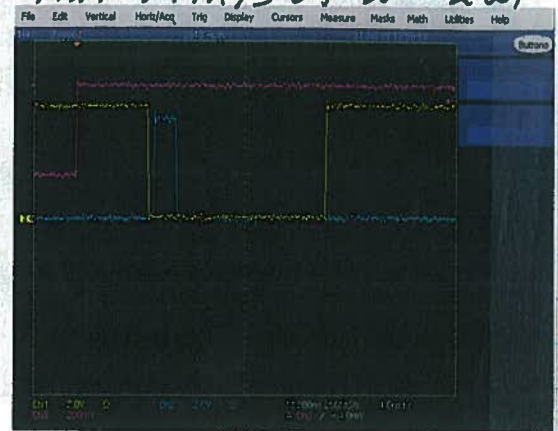
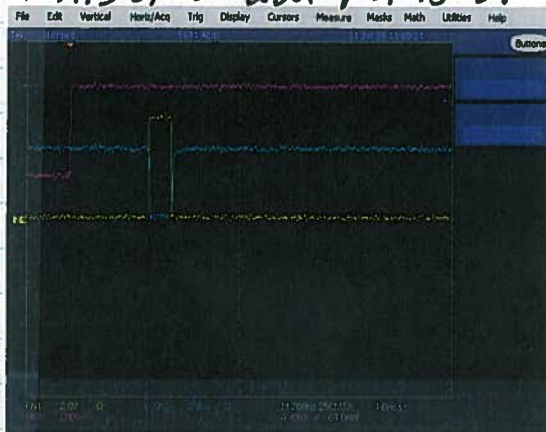
Sample
Mode
← →

Pin 3 & Pin 6 of '74



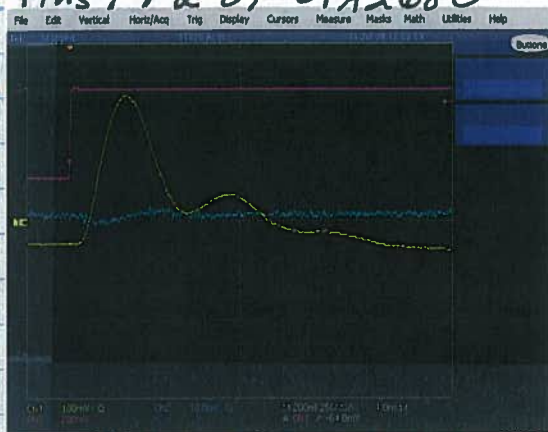
Pin 3 & Pin 6 of '74 Avg. Mode



Pin 1 + Pin 4 of 1st '221Pin 1 & Pin 13 of 2nd '221Pin 13 of 2nd '221 & Pin 15 of 26LS31

I assume the extended pulse length out of the 1st '221 is to prevent double pulsing from ringing/overshoot of the input pulse.

Pins 1 & 2 of OPA2680



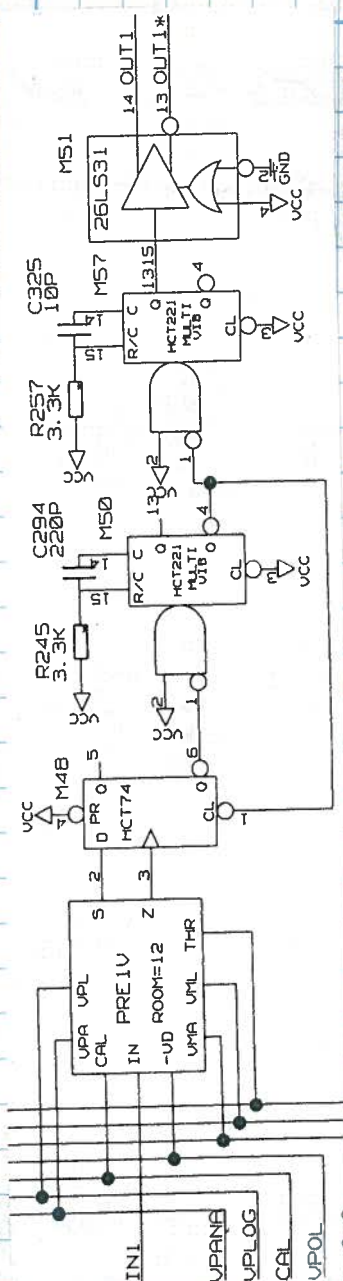
Pin 3 of OP37 Ch1 just hanging



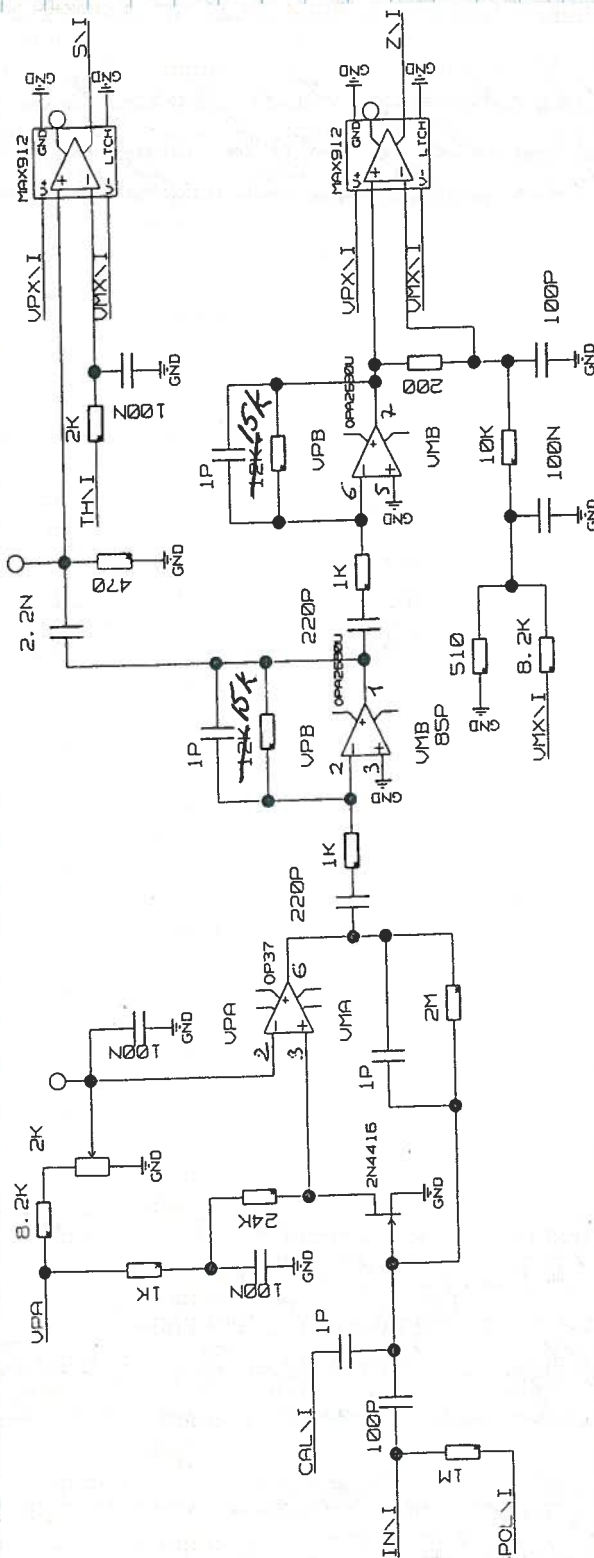
Pin 8 and Pin 9 of MAX912



This picture can be compared to the bottom two pictures on p-106. Note the differences in vertical scale.



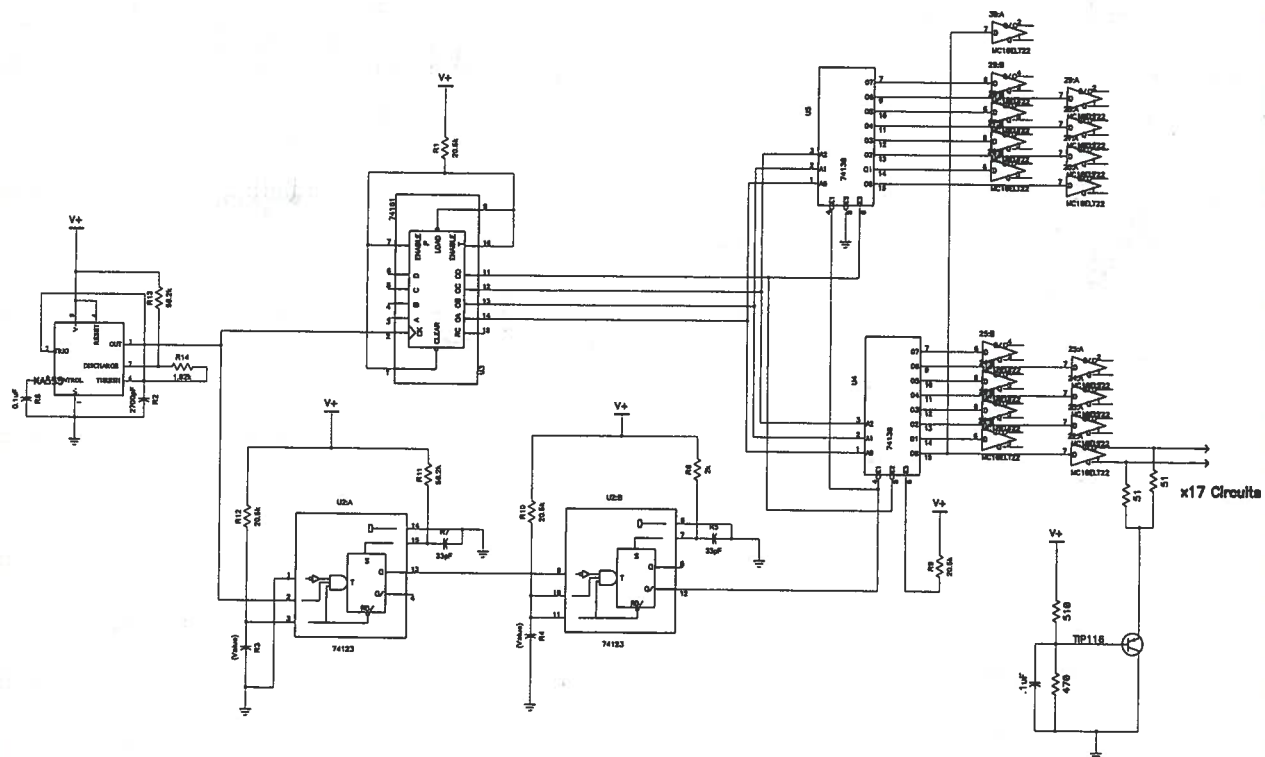
cl found this
to be the connections
for the 11th channel.
so, cl cut this one out
instead.



Amplifier/Comparator
of old electron
detector.

9/7/69 PECL Cable Pulser Check

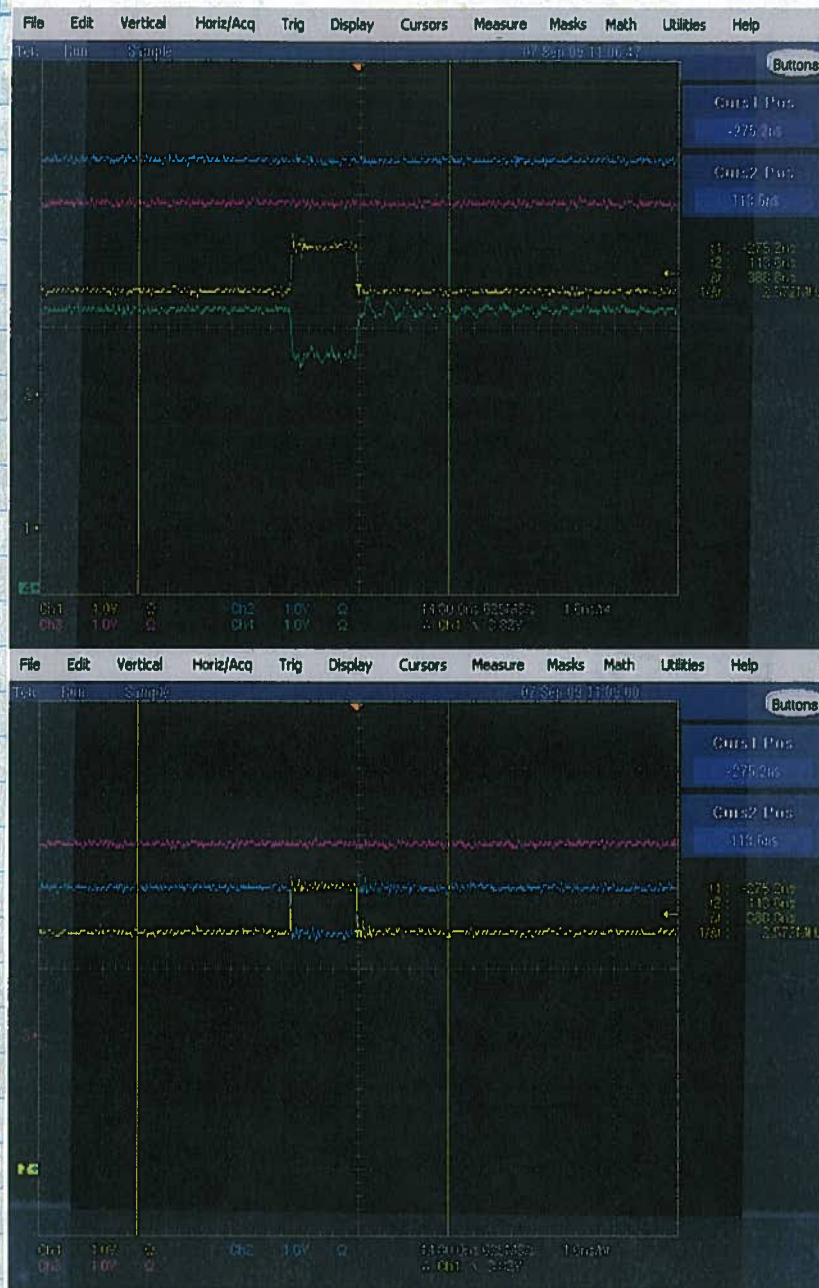
Checking the function of the PECL cable pulser I made a LONG time ago.
The schematic that was lying around.



Looking with the TDS7104 and P6205 probes.
Ch 1 is output pin
Ch 4 is opposite output pin (no ground clip)
Ch 2 is transistor emitter
Ch 3 is transistor base.

I found the transistor was dead. Replaced with a TIP30. All seems ok.

Data sheet for 10ELT22 has output ~~not~~ terminated to +V - 2V. This is terminated to 3.5V rather than 3.0V.



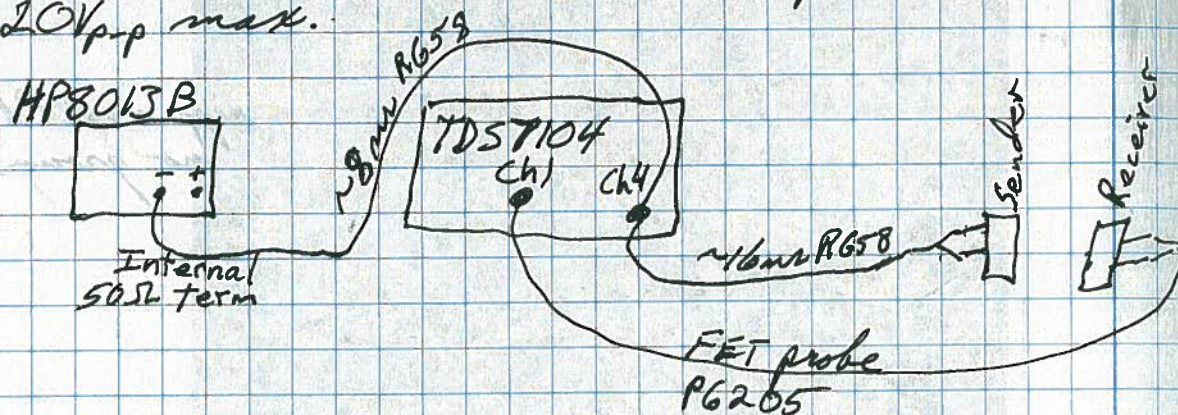
ripple on Ch 4 due to
no ground clips.

Put Ch 2 probe on
output to verify ripple
was due to no
ground clip.
Also, 1 & 2 have 0V in
same vertical position

All of the channels seem to have similar
pulses.
Looks like it is ready to be used.

2/6/10 Ultrasonic Transmitter & Receiver

Looking at a set of Murata ultrasonic sender/receivers. Part numbers MA40S4S and MA40S4R. 40kHz. 2550pF $\pm 20\%$. 20V_{p-p} max.

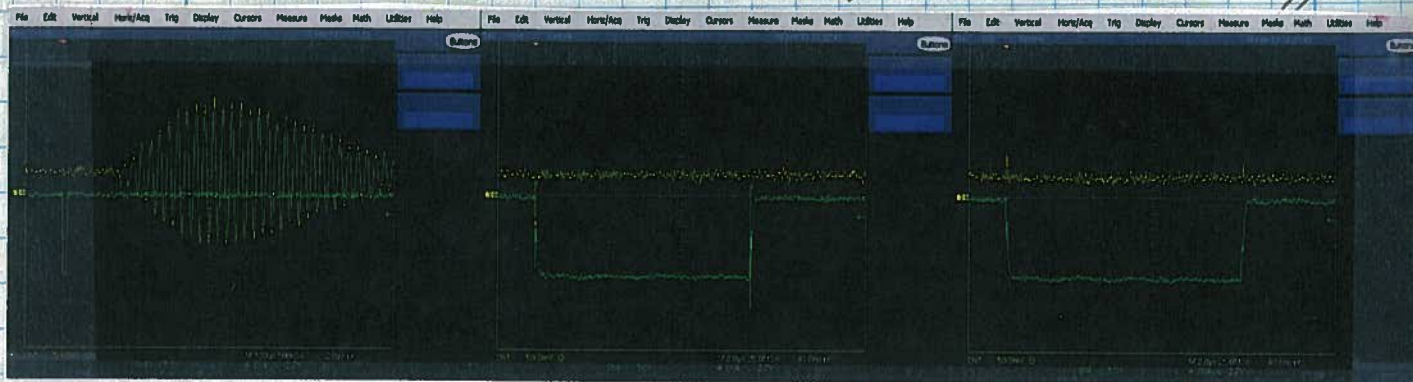


$$40\text{kHz} \Rightarrow 25\mu\text{s}$$

Varying the pulse width I find the minimum width that generates a sizable response.

I did not verify what was happening, but the response seemed to increase whenever the pulse width was an integer multiple of the minimum pulse.

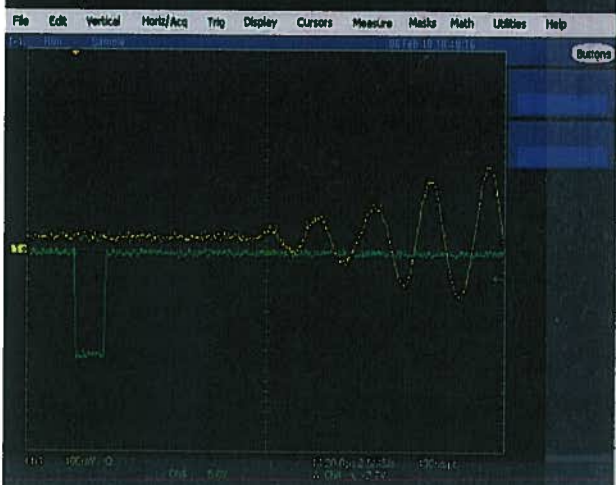
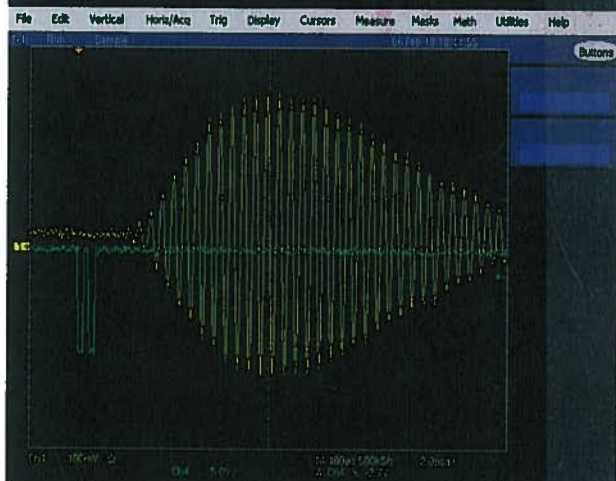
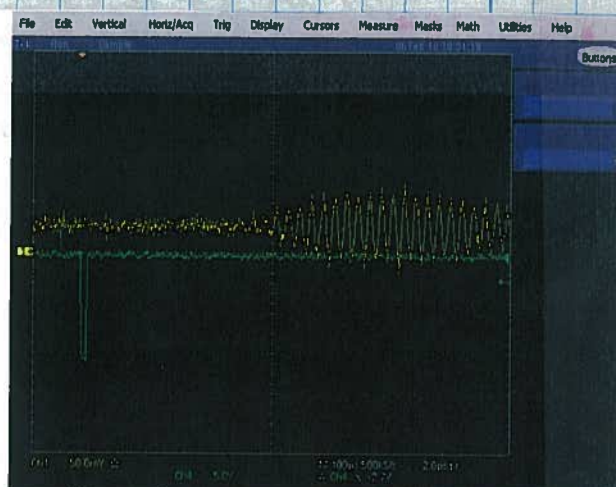
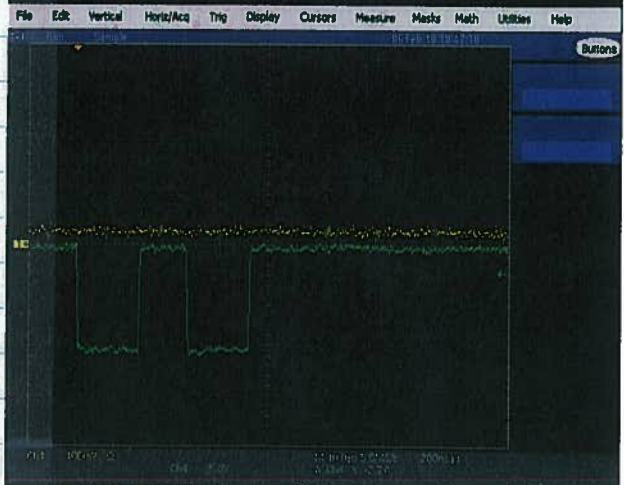
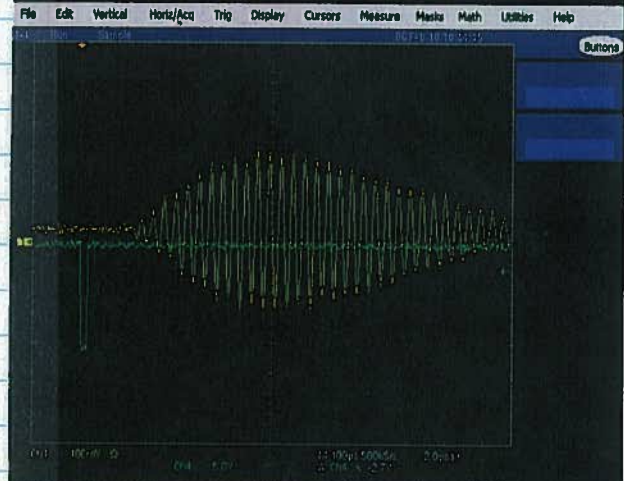
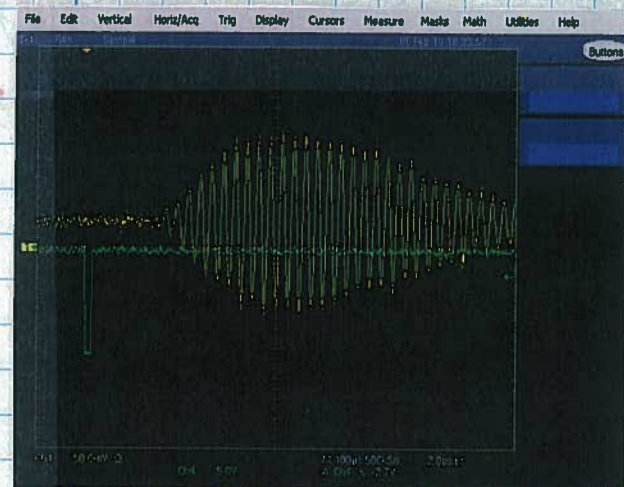
After adjusting to the minimum width that gave the largest response, I increased the time scale to see the pulse width. $\sim 12\mu\text{s}$. Increasing the pulse width just a bit did seem to increase the amplitude of the response slightly.



So, some optimization of the driving pulse would need to be done.

I moved the receiver from close to the sender to about twice as far from the sender (close was $\sim 2''$).

Then I tried a double pulse vs. single & varied the timing till I got maximum response. The double pulse with max. response is shown in picture 5 below. Picture 6 below is just to show the frequency of response of the receiver.



I took a $1\frac{3}{8}$ " I.D. thick walled aluminum tube, $\frac{1}{4}$ " long and held the sender at one end and the receiver at the other. The response was

sizeable. It varied with the orientation in the tube of the sender and receiver. I did not get pictures since both hands were busy. The signal varied a lot if either unit was moved away from the central axis.

I tried a PVC tube 3" I.D. and $\sim 1/6$ " long. This also had promising results.

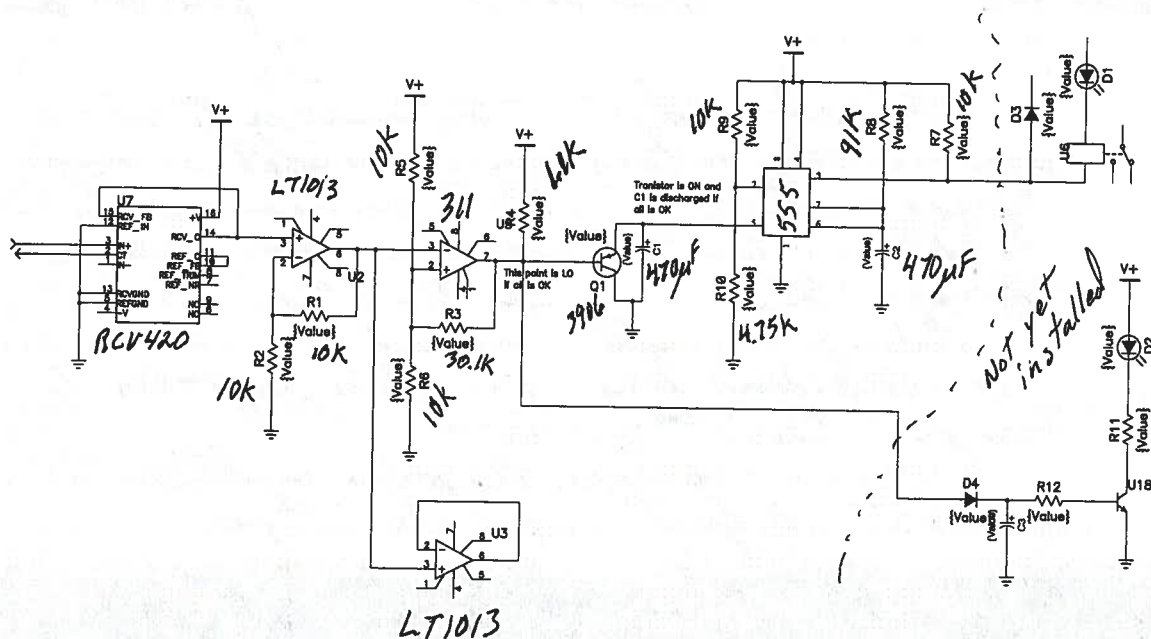
It will be worth investing some more time on this.

Delayed Output Panel Meter

2/14/10

The panel meter must take a 4-20mA current loop input, buffer the input as a 0-10V output, trip a relay when the input is below threshold for some time (to avoid "nursance" trips), and have a local display.

A possible circuit is shown below. I previously tried the 555 configuration and it seems to behave in a manner we would like.



This circuit, with the values shown, has been assembled on a prototyping plugboard. $\pm 12V$ supplies set.

The $+12V$ and a $1k$ pot were used to vary the input current. But, it was not trivial to set the timing of the various signals.

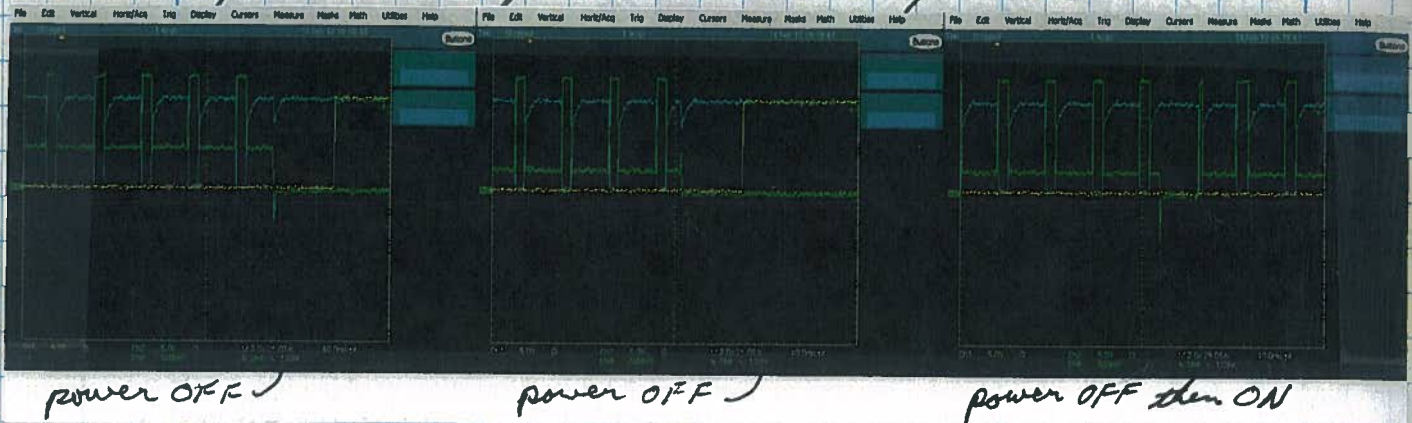
I connected a HP8013B as the driver for the current input. Unfortunately it does not seem to have a slow enough repetition rate to allow the 555 to trigger.

That the 555 would trigger was verified by turning the 8013 off.

The ~~off~~ low current level was adjusted to give about 4mA. This did not change the behavior.

As a third check I turned the 8013 power off and then back on. The 555 output did

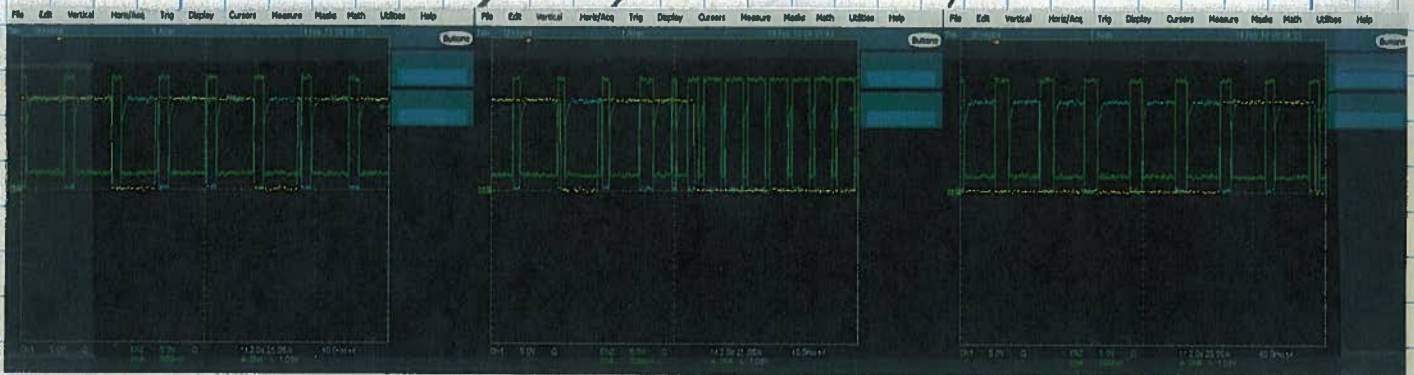
not change, thus showing that the 555 reset before its output could change.



I reduced C_1 to $220\mu F$. I can now reduce the output pulse width enough to trigger the 555. Well, increase the pulse width. Whatever, the 8013 now has enough range to trigger the 555. See the 1st pic below.

The pulse width is varied and we can see the rep rate gets high enough to suppress the 555 output. See 2nd pic below.

I can increase the pulse width until eventually the 555 output fires. See 3rd pic.



This is still a bit hard to interpret. The pulse width needs to be increased beyond the pulse interval.

Ch 4 is 8013B output. BNC "T" on scope.
 Ch 2 is output of 311. FET probe
 Ch 1 is output of 555. FET probe.
 These are the settings for all the pictures.

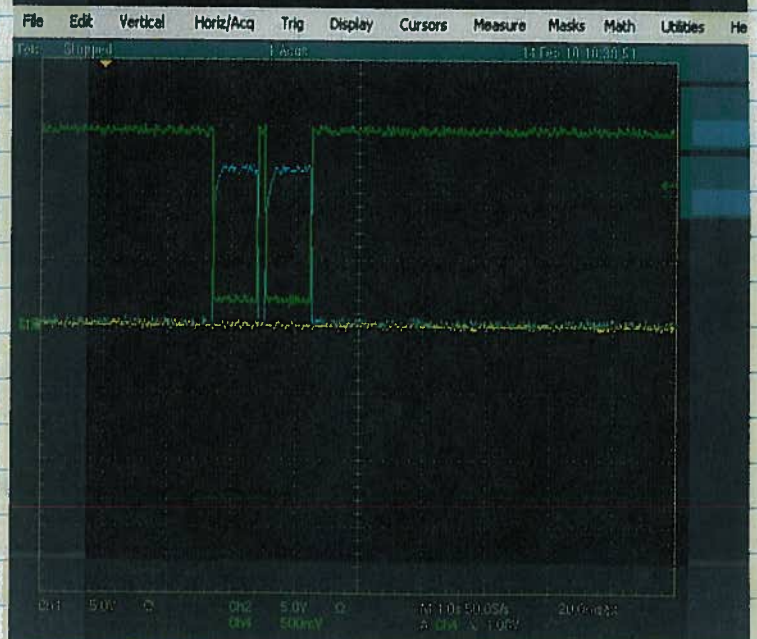
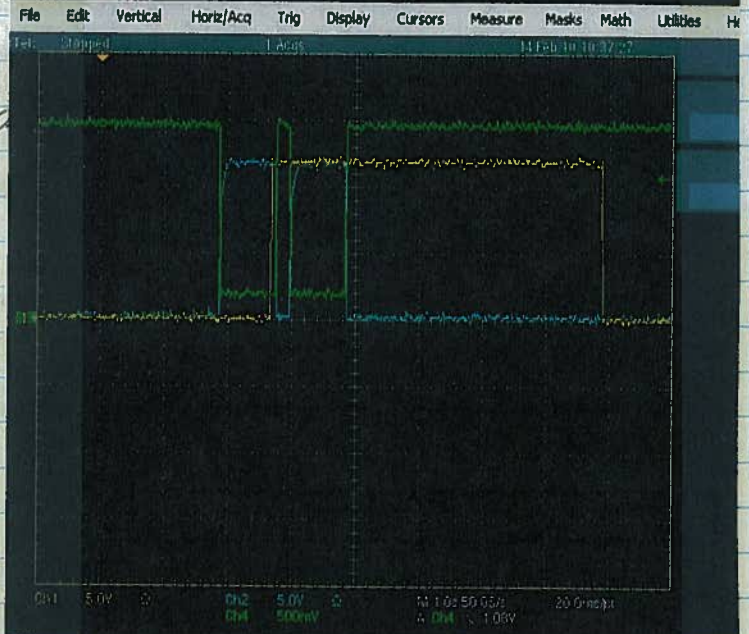
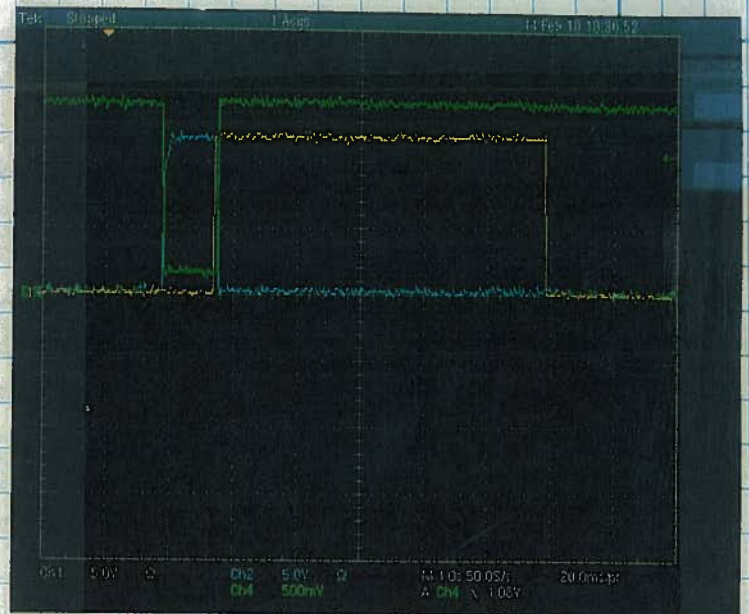
I reduced C_1 to $100\mu F$.

This is about the minimum pulse width required to trigger the 555.

Turning on the double pulse feature, it can be seen that once the 555 is triggered a second pulse does not mess with the triggering.

If the input returns high before triggering the 555, a second pulse will not trigger the 555.

The input must drop below threshold at least about 1 sec.

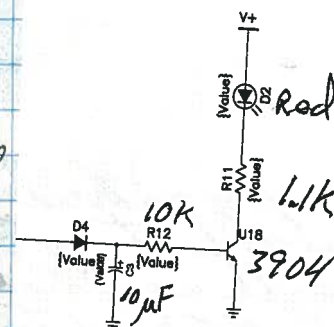
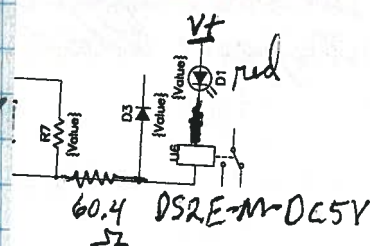


2/14

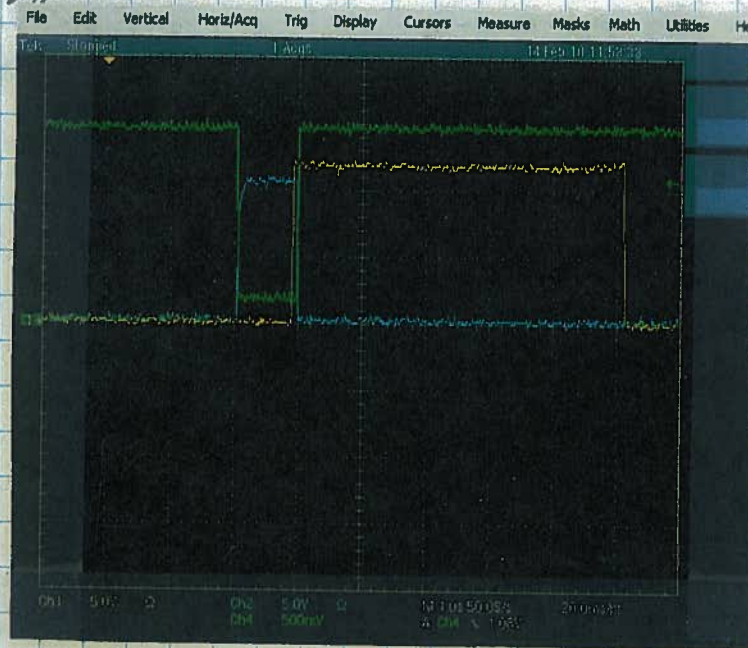
Continuing with the meter.

The circuit is finished off as shown on the right. First the 3904 was installed and the effect on the circuit checked. The picture below shows the same performance as before. I wasn't sure how it would affect the 311 output. Things look OK.

The relay was then added. I only had 5V and 24V relays. Added a resistor for the 5V. Everything seems to work as required. The relay is energized till the 555 is triggered.



No notable change in the circuit's behaviour



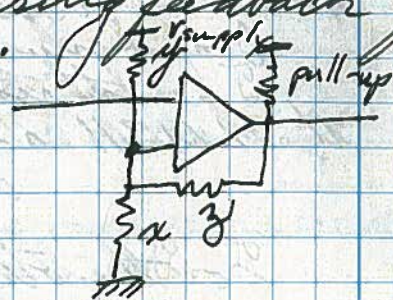
I connected the Lascar EM32-1B-LED panel meter. Everything behaves as expected.

Some adjustment to R & C values may be desired to change timing and hysteresis, but the circuit layout seems workable.

Comparator Hysteresis Calculation

2/18/10

This is for a comparator using feedback to generate some hysteresis.

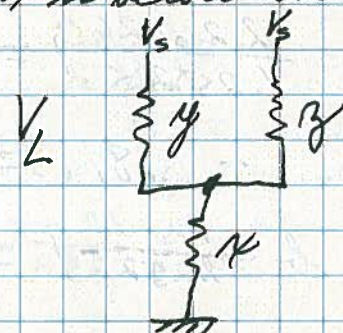
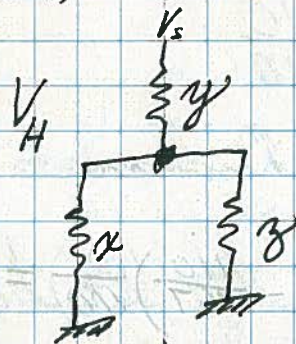


V_s = supply voltage

V_H = threshold when the input is above threshold

V_L = threshold when the input is below threshold

$$V_H \leq V_L$$



ignoring the pull-up resistor

$$\text{Let } a = \frac{V_s}{V_L} - 1 \quad \text{and} \quad b = \frac{V_s}{V_H} - 1$$

$$\frac{V_L}{V_H} - 1 = \frac{xy}{z}$$

$$a \left(\frac{1}{y} + \frac{1}{z} \right) = \frac{1}{x}$$

$$\left(b - \frac{xy}{z} \right) \frac{1}{xy} = \frac{1}{x}$$

My derivation of this was done on the tablet PC and is in a Windows journal file. The result only is presented here for brevity.

Looking at the comparator boards for the
Matheron 8590 controllers.

Board number 4.

The thresholds measured at pin 2 of
the LM311 are 2.260V $R5$ is measured as 2315 Ω
and 1.252V

For the other LM311 on the board I measure
1.726V
and 1.231V and $R5$ is 2816 Ω

Looking at the equations on p. 125 and
the schematic

$$\frac{2.260}{1.252} - 1 = \frac{110}{270}$$

$$.81 = .41 \text{ hmmm...}$$

$$b = \frac{12}{1.252} - 1 = 9 \quad \left(9 - \frac{110}{267}\right) \frac{1}{110} = \frac{1}{12.3}$$

$$.078 = .081$$

If $V_H = 1.2$ and $V_L = 3$ and $y = 220k$

$$\frac{3}{1.2} - 1 = \frac{220}{y}$$

$$y = 146.7$$

$$\left(\frac{12}{3} - 1\right) \left(\frac{1}{220} + \frac{1}{147}\right) = \frac{1}{x}$$

$$x = 29.4$$

$$y = 220k$$

$$y_2 = 147k$$

$$x = 29.4k$$

Replacing 110k with 221k
267k 150k

and adjusting potentiometer to 19.4k ($x = 29.4k$)
Threshold voltages are now 1.202V
and 2.915V

Replaced the resistors on the second channel and adjusted the potentiometer.

Threshold voltages are 1.268 and 3.077

Checking the first channel the threshold voltages are 1.202 and 2.915 the same as before.

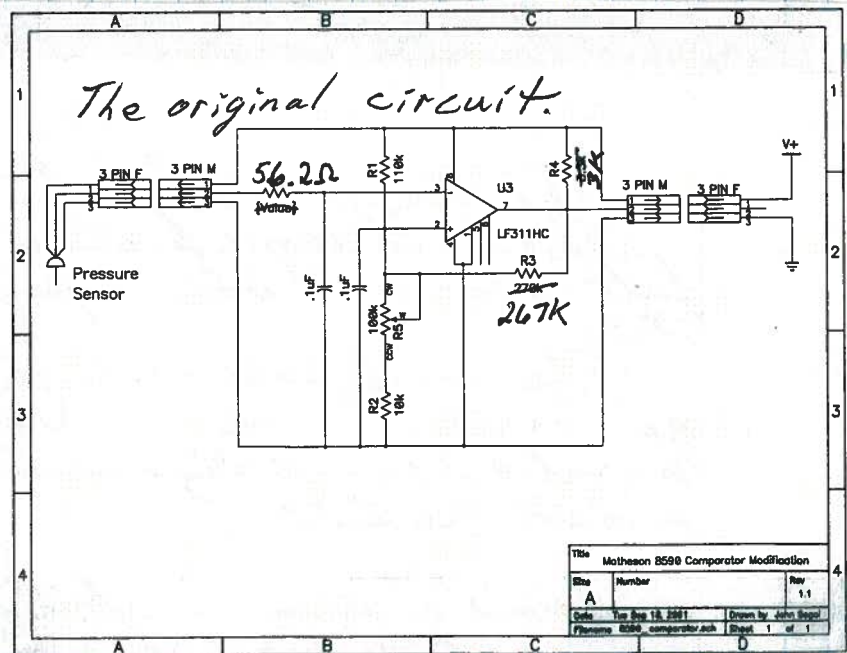
Adjust the pot on the second channel till the threshold voltages are 1.202 and 2.917

Measuring across the pot of the second channel I see 17.6K. Across the pot of the first channel I see 17.6K.

I was going to replace "X" with a 27.4K resistor before it dawned on me that I could just adjust the pot. So, I actually tried to set the pot to 17.4K to have $R_X = 27.4K$.

Ok, I understand.

I will leave the pots on board 4 at this value.



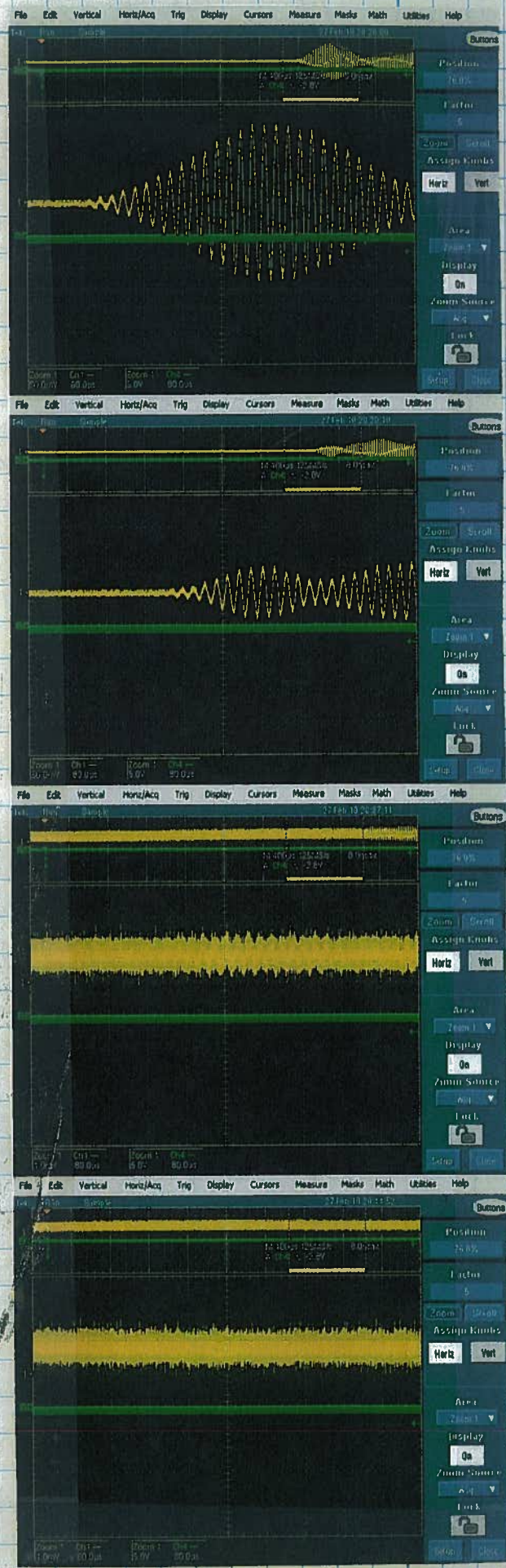
2/27/10 Ultrasonic Signal Attenuation

✓ The ultrasonic sender (S) and receiver (R) have been mounted on BNC panel jacks on ~~the~~ caps on a copper tube. 2" diameter copper tube. The tube has an inlet and outlet swage lock fitting, so the gas can be flushed out. The tube is not constructed to be "gas tight", but should suffice for investigating what is required to use this technique.



The 8013B is adjusted as on p. 118.
 The first scope picture is with the tube full of air and both caps fully seated on the tube.
 The second picture is with the caps backed off, barely on. This is how they will need to be mounted when I try a plastic foil over the ends of the tube.

A piece of aluminum foil inserted under each cap, as a gas barrier, seriously attenuates the signal. See the third picture.

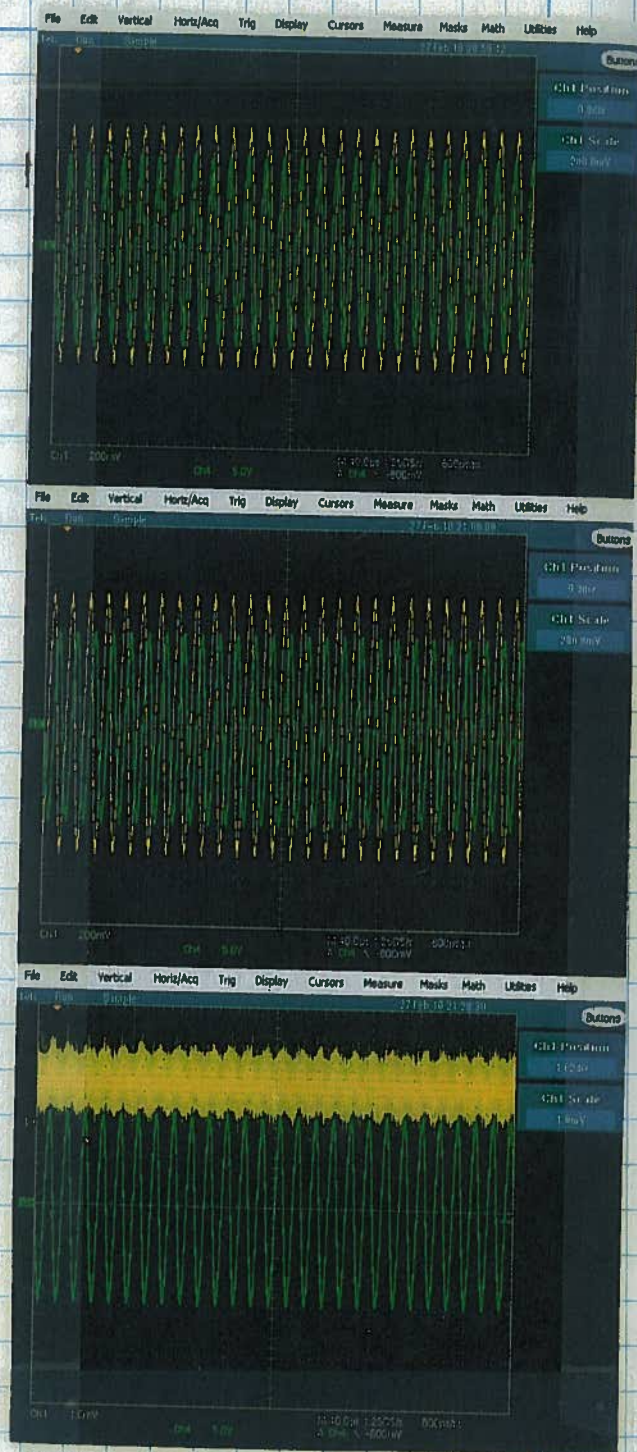


The addition of CO_2 seems to degrade the transmission, too!

Changed to a Tektronix
 CFC 253 function generator.
 CW sine wave.
 Tube flushed with air.
 Both caps are fully seated.
 No gas flow

Flushed the mixing tank
 out with pure N_2 .

N_2 MFC is at 3.95V
 CO_2 MFC is at 3.05V
 Tank allowed to fill to full
 pressure and then vent
 twice. Then filled to full
 pressure & flowed through
 copper tube.
 Almost immediately the
 signal drops to about zero.



Ultrasonic Attenuation in N_2/CO_2 Mixtures 2/28

There is a sizable gap in the information between p.118 and p.128.

I played a bit with Ar and CO_2 gases.

The Argon and CO_2 do not seem to allow the generation/transmission of the 40kHz waves.

For the mix controller the N_2 MFC is set to 4.00V.

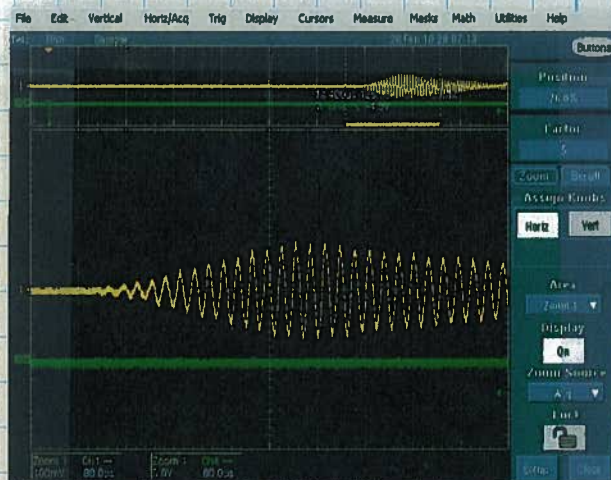
Looking up the "k" value for CO_2 I find 0.94 for gas adjustment to the flow of a meter calibrated to N_2 .

$$\frac{CO_2 \text{ set V} \cdot (CO_2 \text{ set V}) \cdot (0.94)}{[(CO_2 \text{ set V}) \cdot (0.94)] + (N_2 \text{ set V})} \times 100 = \% CO_2$$

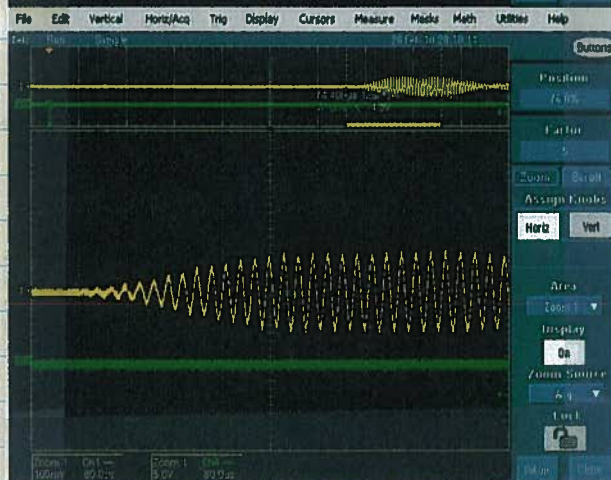
$$\frac{CO_2 \text{ set V}}{CO_2 \text{ set V} + \frac{N_2 \text{ set V}}{0.94}} \times 100 = \% CO_2$$

CO_2 set voltage is at 0.109V $\Rightarrow \% CO_2$ is 2.5%.

First we look at the transmission in air.
No gas flow.



Flush with N_2 and record with no gas flow.



Allow 2 ~~press~~ fill-empty
cycles of the mixing tank.
Then fill, then flush out
the copper tube.

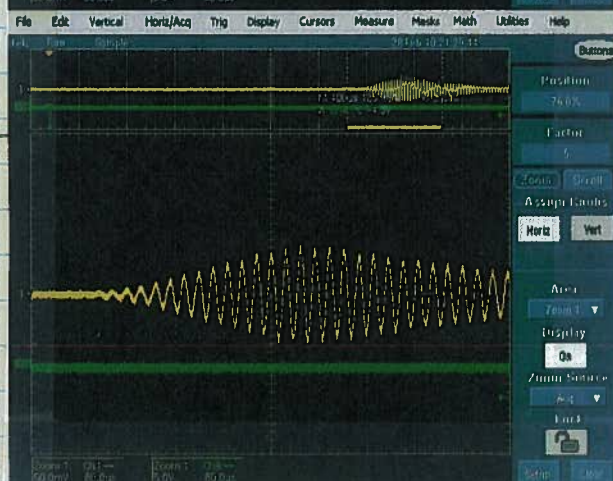
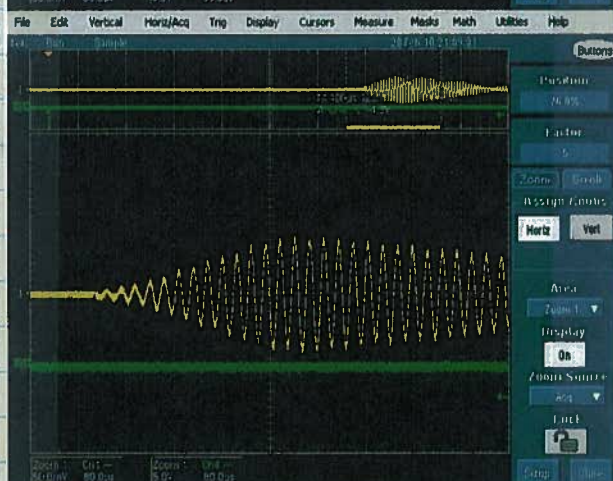
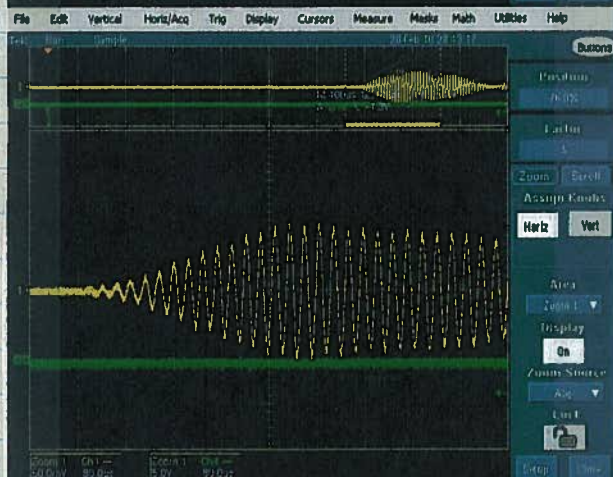
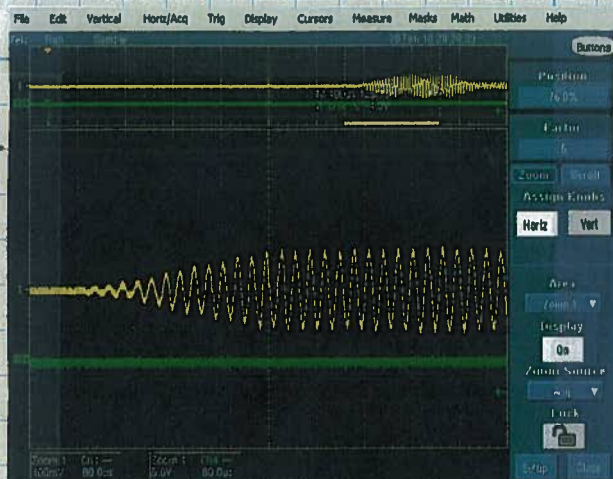
2.5% CO_2

CO_2 set value increased to
.199V. $\Rightarrow$ 4.47% CO_2

A slight, but noticeable
reduction in pulse height.

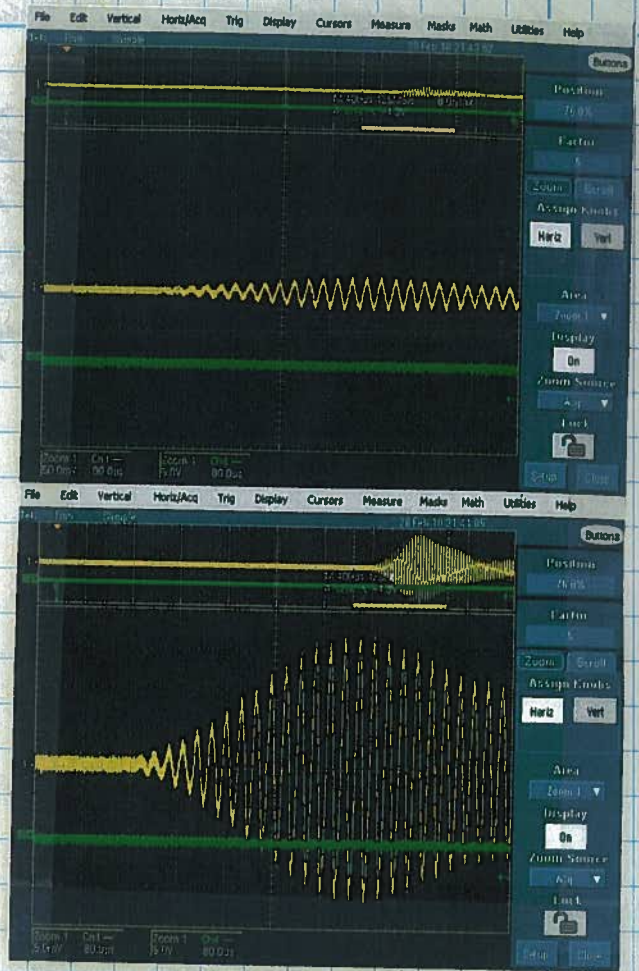
CO_2 set value is increased to
.256V. $\Rightarrow$ 5.67%

CO_2 set value is increased to
.352V $\Rightarrow$ 7.64%



CO_2 ref value increased to
2.937V $\Rightarrow$ 18.05%

Same configuration.
Different vertical scale.



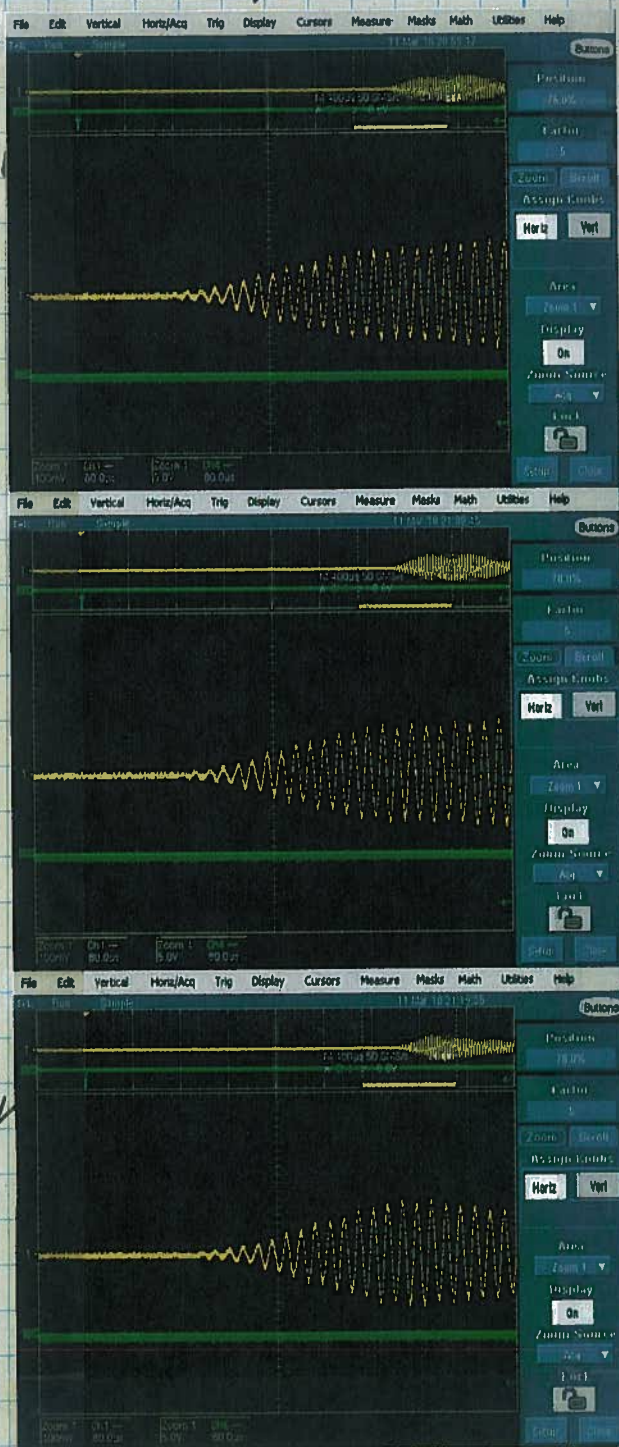
3/11 Ultrasonic Attenuation in N_2/Ar Mixtures
 AS Same setup as on pgs. 131-133, except
 Ar has been substituted for CO_2 .
 N_2 MFC set to 4.60V.

Looking up the "K" value for Ar I find
 1.42 for an adjustment to the flow of a meter
 calibrated to N_2 .

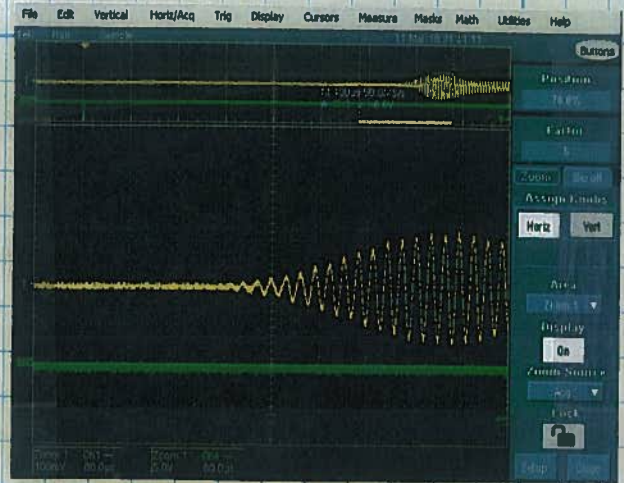
Only N_2 flowing.

Ar set to 0.095V

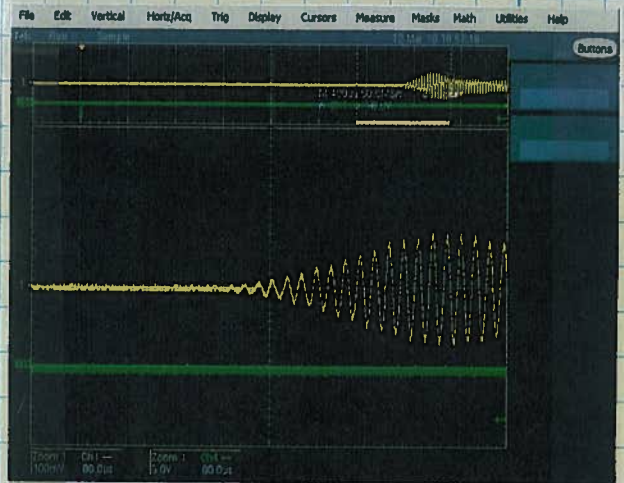
Ar set increased to 0.304V



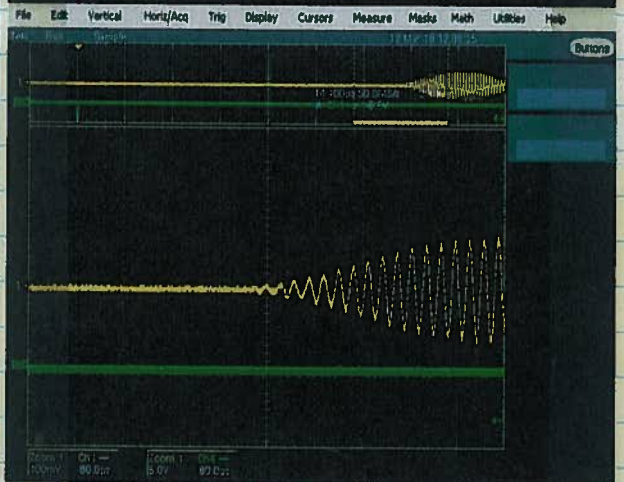
Ar set increased to 1.006V



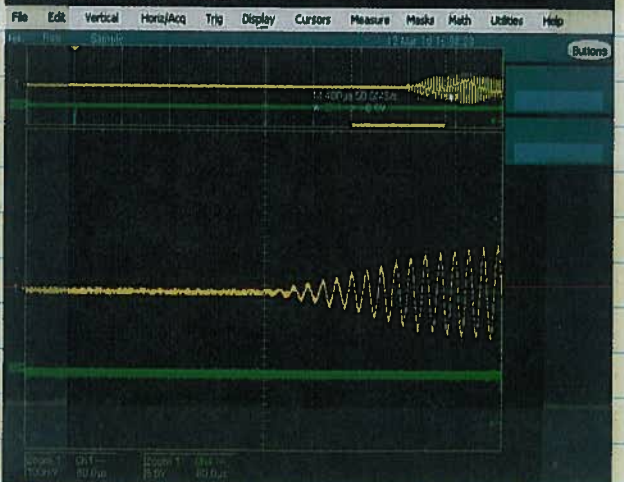
3/12
Ar set to 1.006V



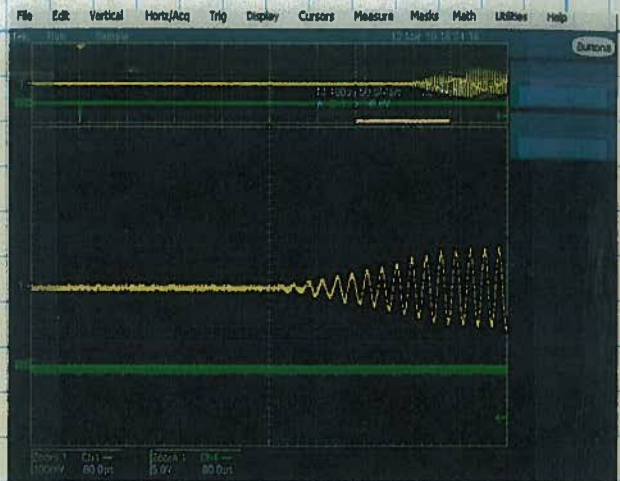
Ar set increased to 2.006



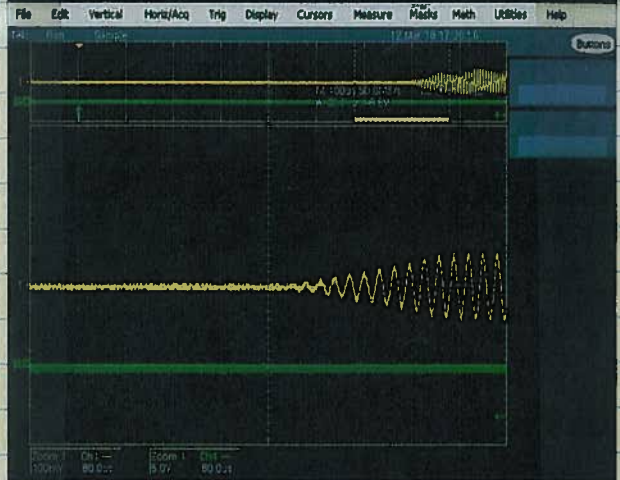
Ar set increased to 2.999



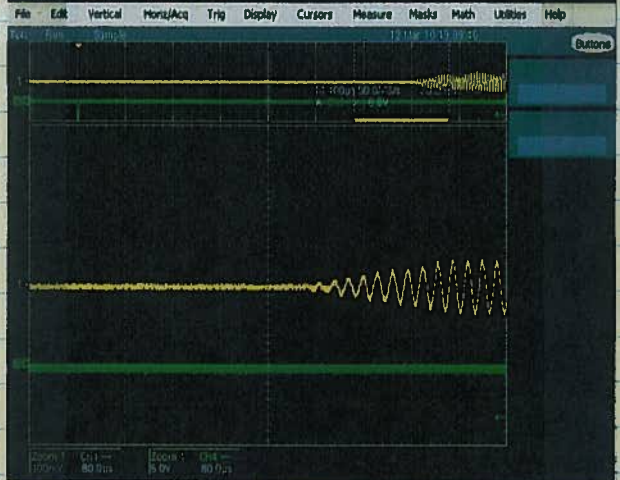
A_1 set is 2.999
 N_2 set is changed to 3.02V



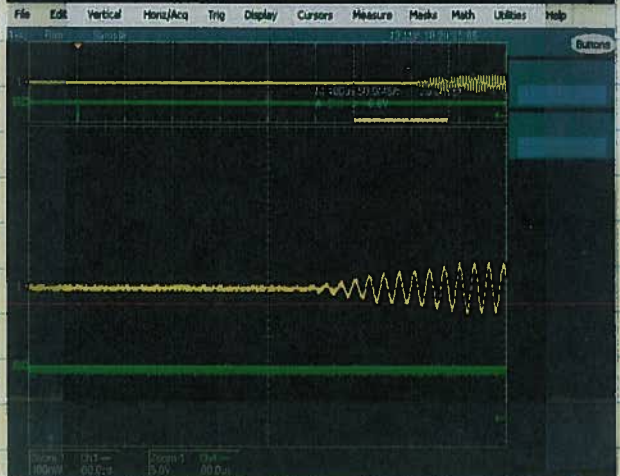
N_2 set changed to 1.998V

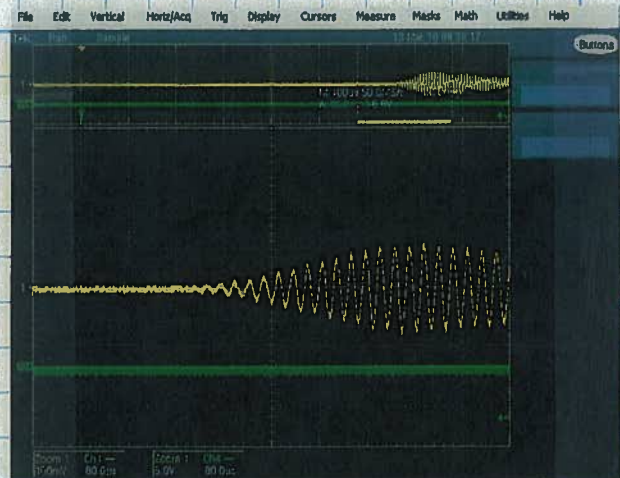


N_2 set changed to 1.007V

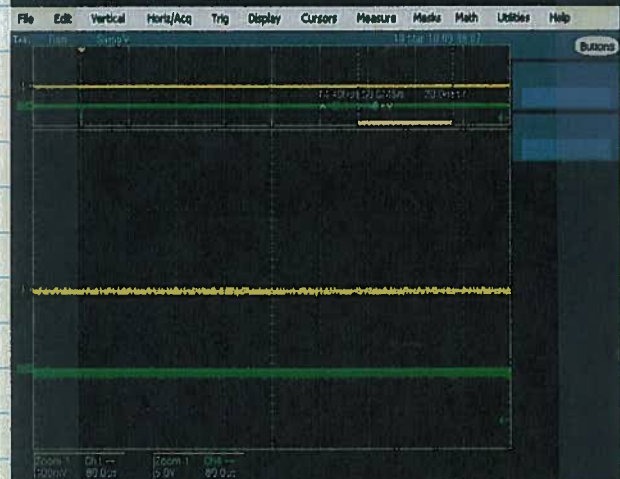


N_2 set to 0.501V

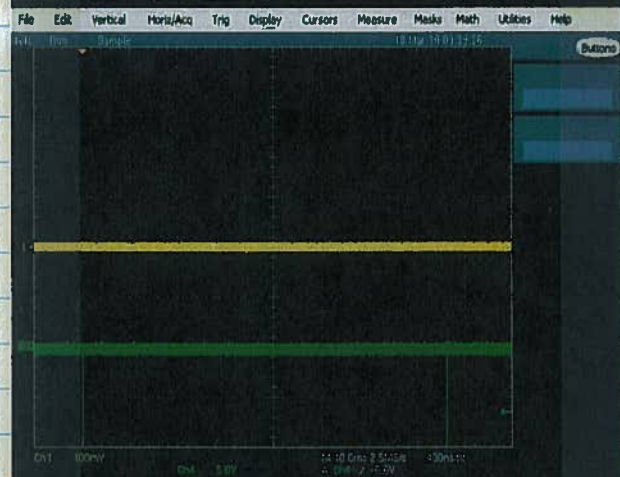


3/13
ASAir ~~only~~

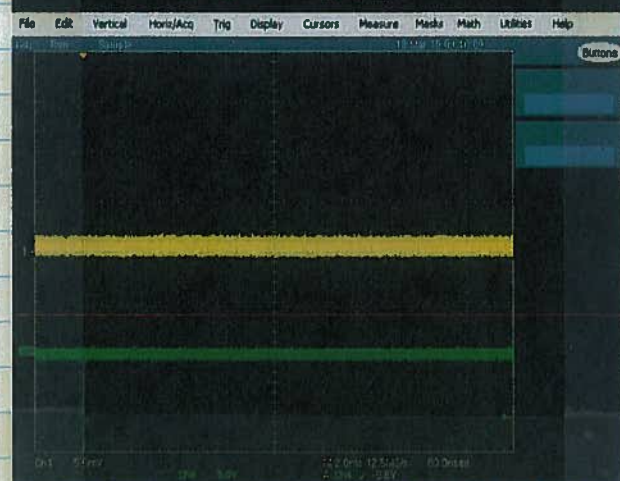
He only



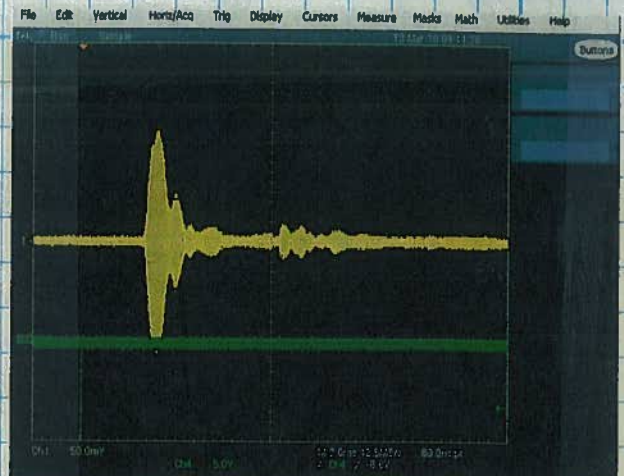
He only



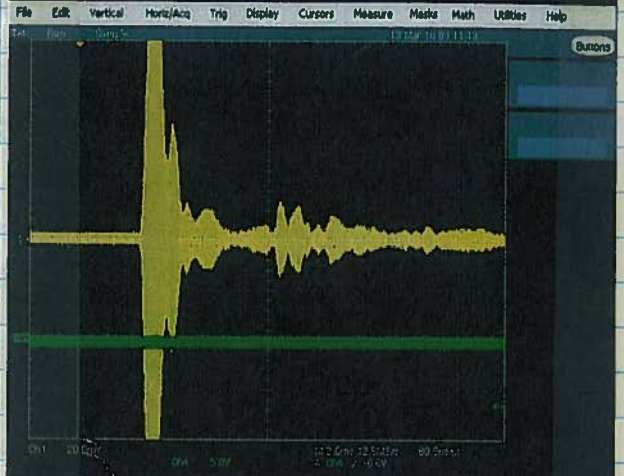
He only



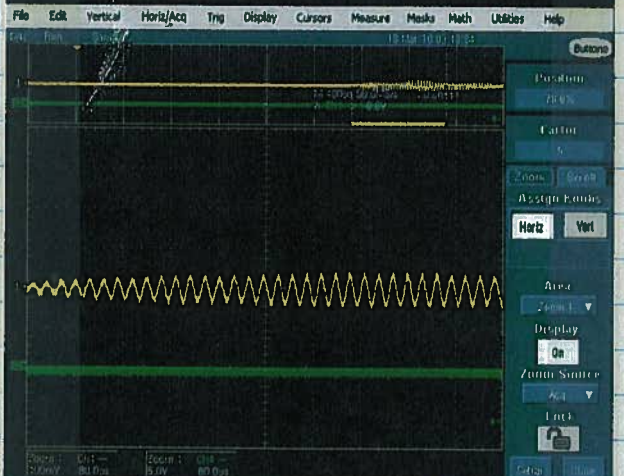
Air $\frac{1}{2}$ only
Looking at the overall
response. Long time scale.



Air $\frac{1}{2}$ only
Changed vertical scale

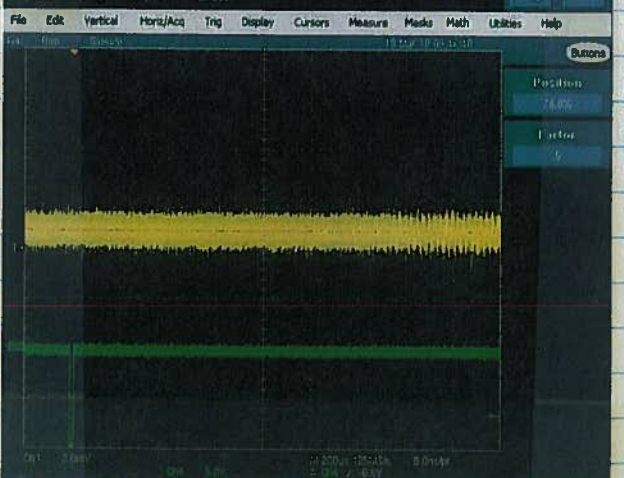


Air + just enough
He to illustrate
the effect of He



He + a slight bit
of air

The signal is just barely
discernable at the right
side of the trace.



4/8/11 Ramp Generator Revisited

I had previously copied a ramp generator based on an application note from Maxim. I did the original work on p. 71 of this volume. I used alternate components because the Maxim chips are surface mount. I had no convenient way to work with them at the time. I then laid out a PCB using what I had put together.

The first prototype was used in the hall on p. 152 of Magnet Power Supplies I.

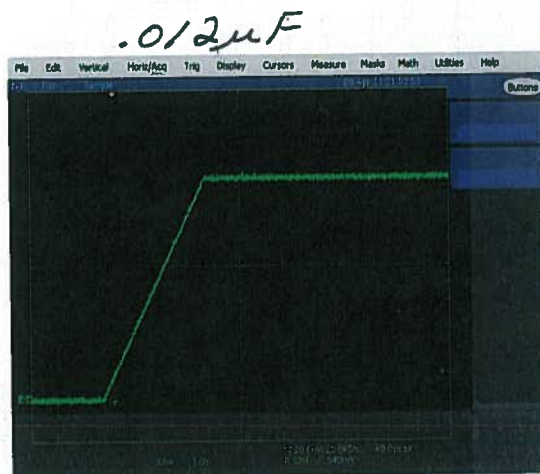
The PCB was first used on p. 57 of Magnet Power Supplies II. The drive circuit used was similar to that of the prototype.

Eventually I got some small ϕ boards to put SMT chips on and be able to plug them into through-holes or plug boards.

I put together the circuit from the application note. Part values are the same. Done on the PB-503 plug board prototyping kit. Rather than an FET I used the debounced switch on PB-503 and the diode is a 1N4002.

The output is very close to that in the application note.

Changing Cramp to $.012 \mu F$ the ramp still looks good. I do, this may be useful for chipping the optocoupler.



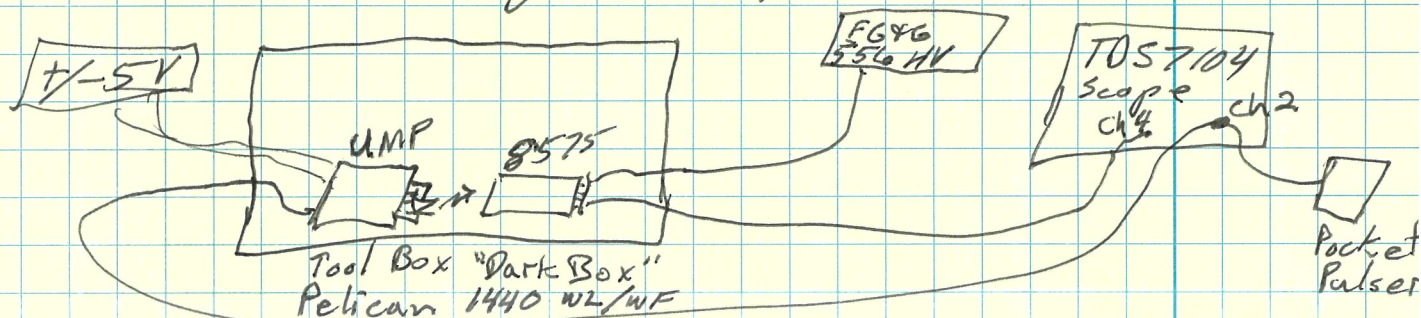
Use-Me Pulser New Circuit Board.

1/15/12

I laid out a circuit board for the USE-ME pulser and put one together. It uses a small EMCO DC-DC converter that seems to have a couple of quirks. After fooling around for a while I finally got things to run somewhat reproducibly.

I first tried a large green LED that was just lying around. I have no spec on it. It is in a T-3/4 package.

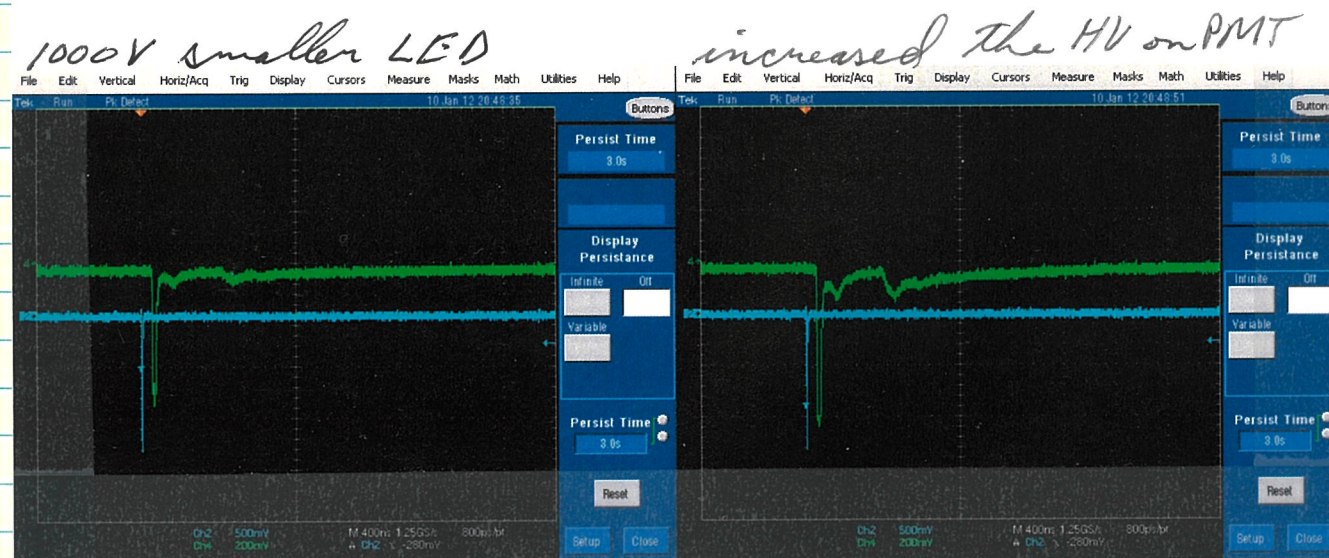
I set up an 8575 PMT with a passive base I made a long time ago.



This did not seem to be as large a PMT response as I was expecting.

My old Use-Me Pulser was not working. I took the smaller green LED off of that and put it on the new circuit.

The response was more along the lines of what I was expecting.



I increased the PMT HV for the last picture, but I don't remember what to. I'm guessing it was to 1100V, but I'm not positive.

Voltage on PMT are -HV.

This work was done a few days ago.

I have reconnected everything. It looks like the last picture ~~was~~ indeed 1100V on the PMT.

Testing LEDs For Use In Pulsar

1/21/12
JH

Trying to select a good performance LED for use in the USE ME PULSER.

I ordered a variety of small green LEDs.

The ones that are 0402 size, or of a similar size, are too small to be able to make them work. Perhaps at a later time when I have more patience and non-magnetic multimeter leads.

Most of the LEDs I tried today did about the same, or worse, as the small LED on p. 142 (the facing page). The LED from p. 142 was also a Bourn LED.

I had some hope that the smaller LEDs, with their smaller capacitance, would give a faster and shorter response in their light output. The 0402 size LEDs were too small for me to handle. Mainly because they were light enough that they would be attracted to, and stick to, the lead tips of the DMM I was using to verify the polarity. I elected to postpone further work with them.

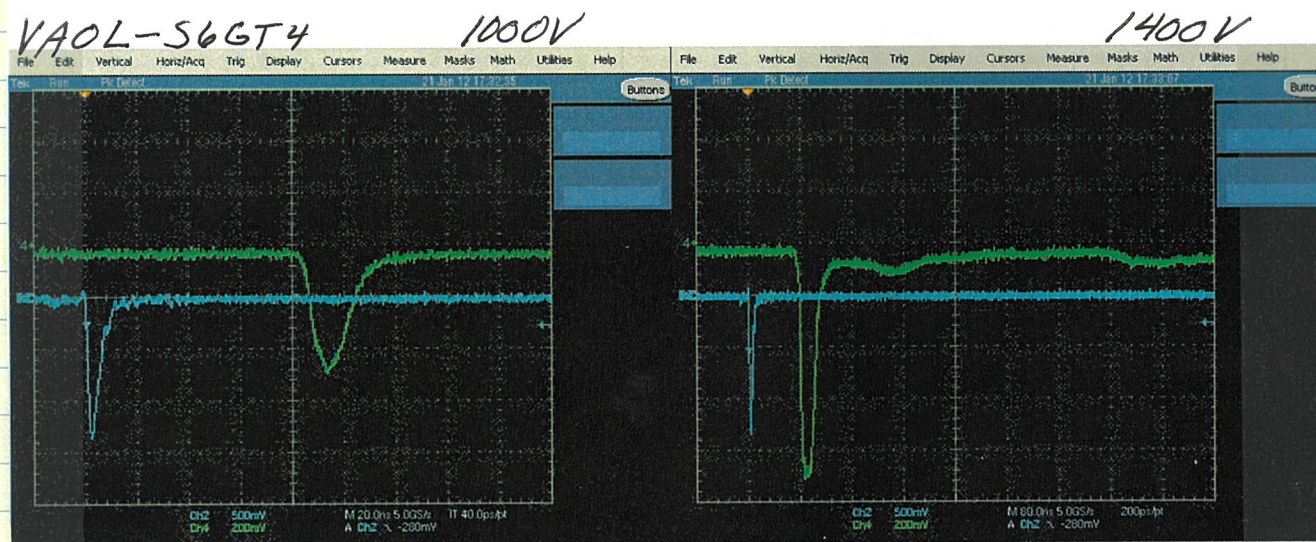
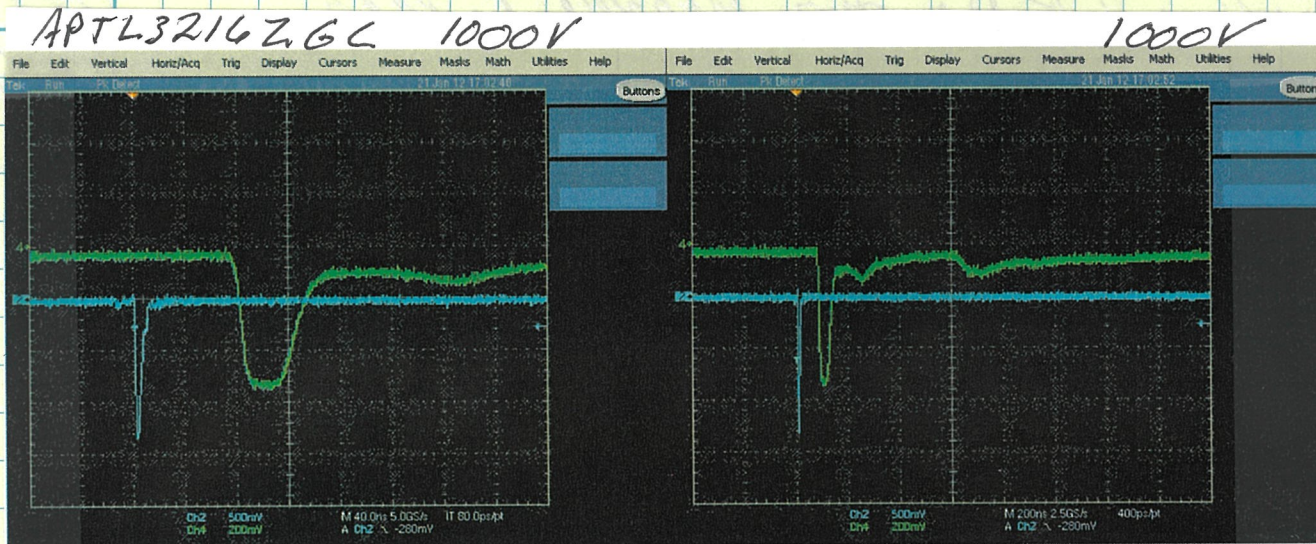
Of the 4 which seemed to work well, the "APT" part numbers are $3.2 \times 1.6 \text{ mm}$ and do not do any better than the LED on p. 142.

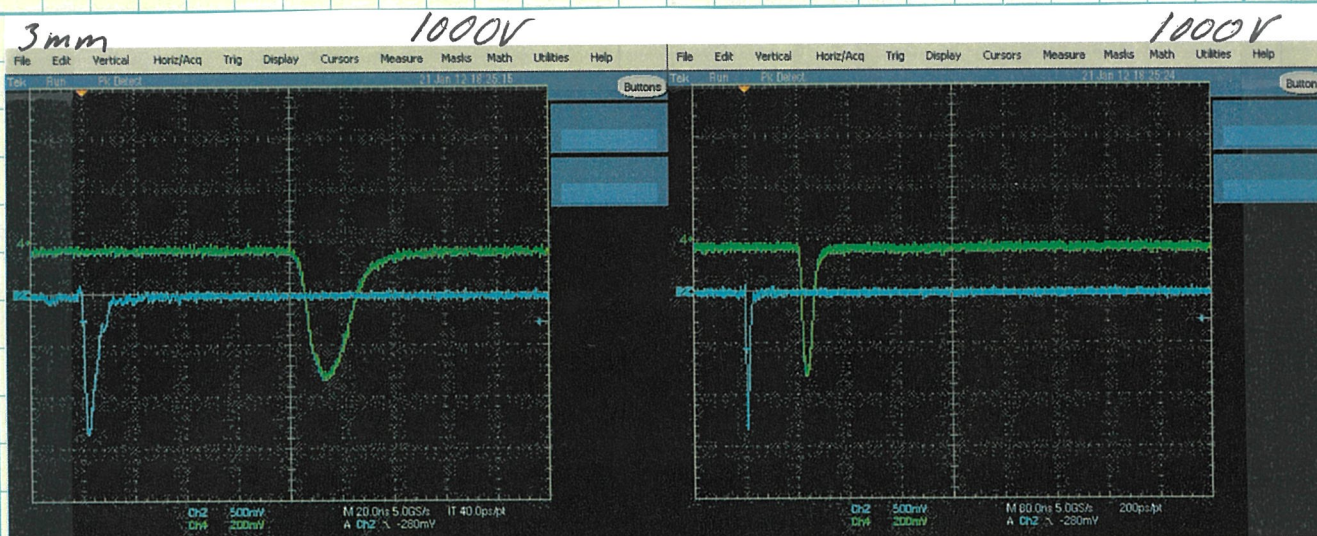
The second LED, VAOL-S6GT4 is a 0603 size and gave a quick response.

The 3mm LED gave a quick response, very similar to the 0603 size LED.

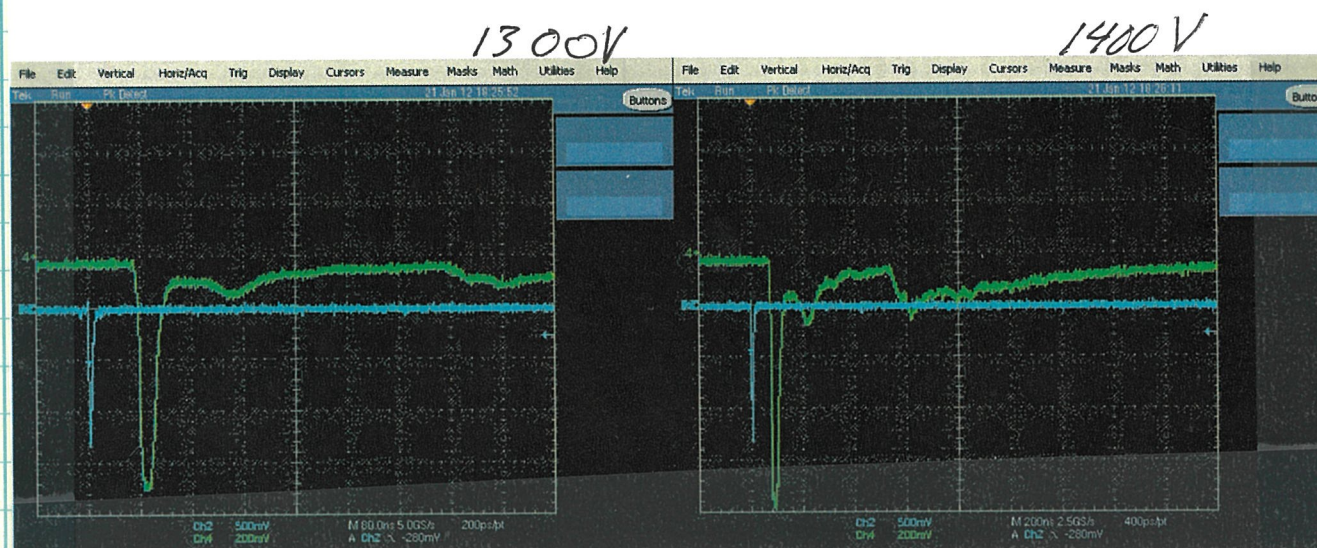
SL9036CE

The 0603 and the 3mm LEDs seem to be the best choice for any further testing/evaluation.



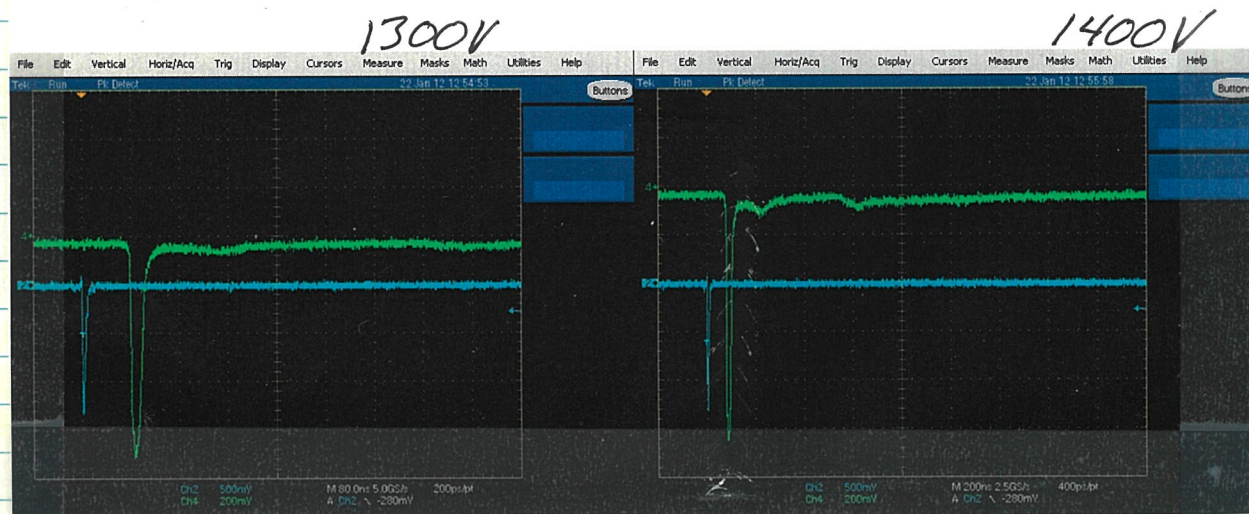
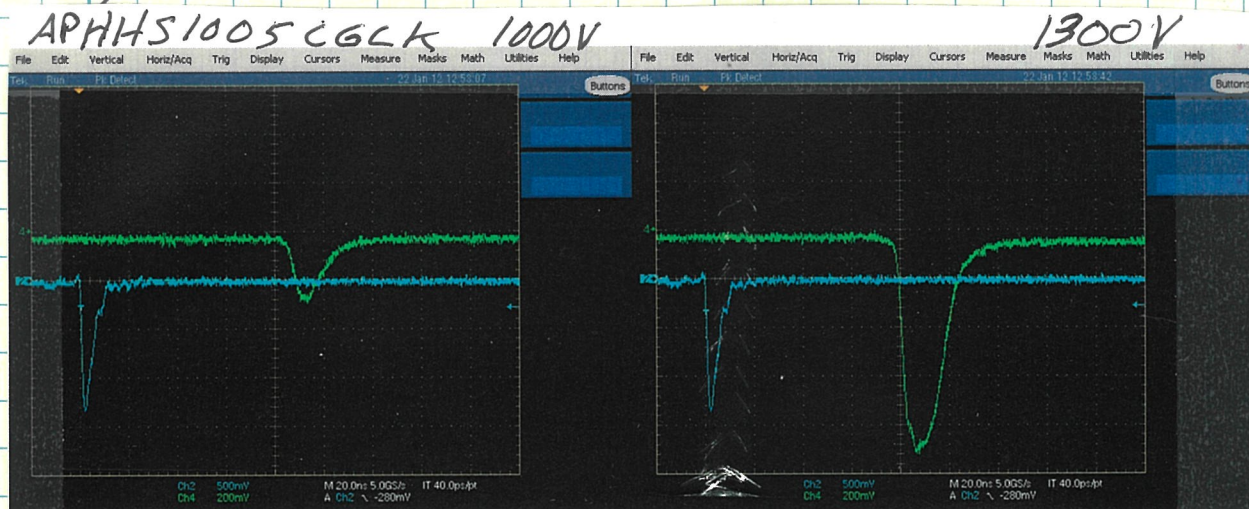


SL9036CE



1/22/12 One More LED Test

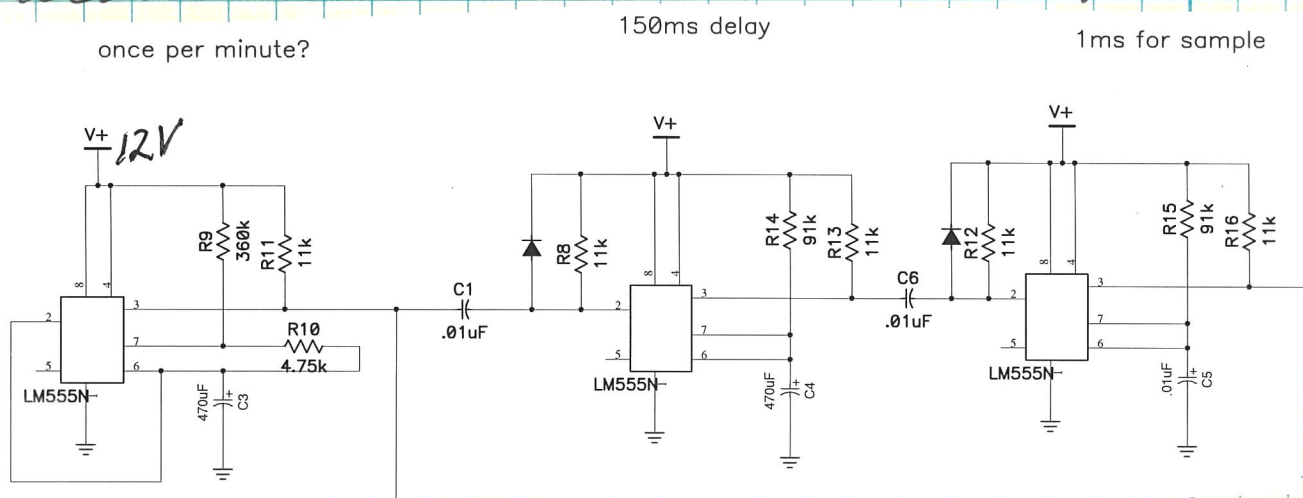
I managed to solder one of the small LEDs to two small pieces of copper tape. Using this arrangement I was able to get it soldered onto the circuit board for evaluation.



555 Timer Chain For Background Monitor 6/19/12

Looking at 555 timers to trigger a ramp and sample & hold for a radiation damage monitor.

I put this circuit together on a plug board.



The times for these parts did not match what I had noted on the circuit. I fired up the TDS7104.

On the first picture Ch2 & 3 are not connected. Ch1 is pin 3 of the first 555

For the second pic Ch1 is 1st 555 output
Ch2 is pin 2 of 2nd 555
Ch3 is pin 6 of 1st 555



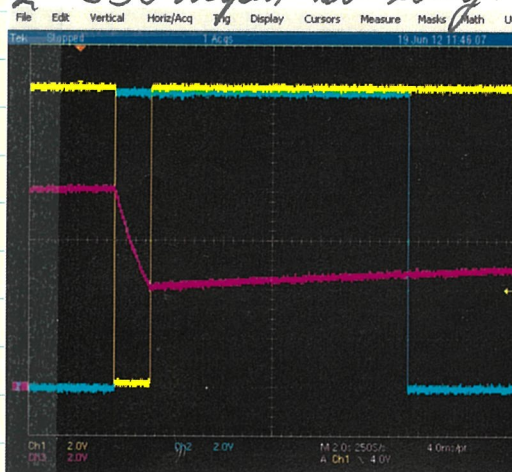
~110sec

It turned out the timing of the second 555 was wrong. It went low long after the ramp and plateau was gone. The plateau is about 1.5 seconds long.

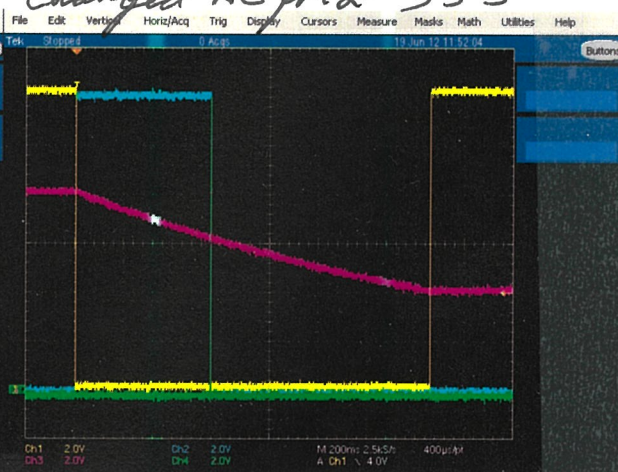
I changed C4 to 100 μ F and R14 to 4.75k. The trigger for the third 555 now comes about 400ms after the ramp reaches the plateau.

The third 555 output is about 1ms wide. Things look OK.

2nd 555 output too long!

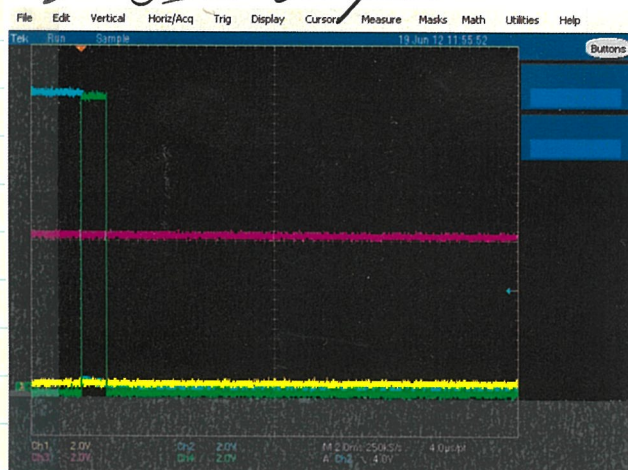


changed RC for 2nd 555



Ch1 is 1st 555 output
Ch2 is 2nd 555 output
Ch4 is 3rd 555 output
Ch3 is pin 6 of 1st 555

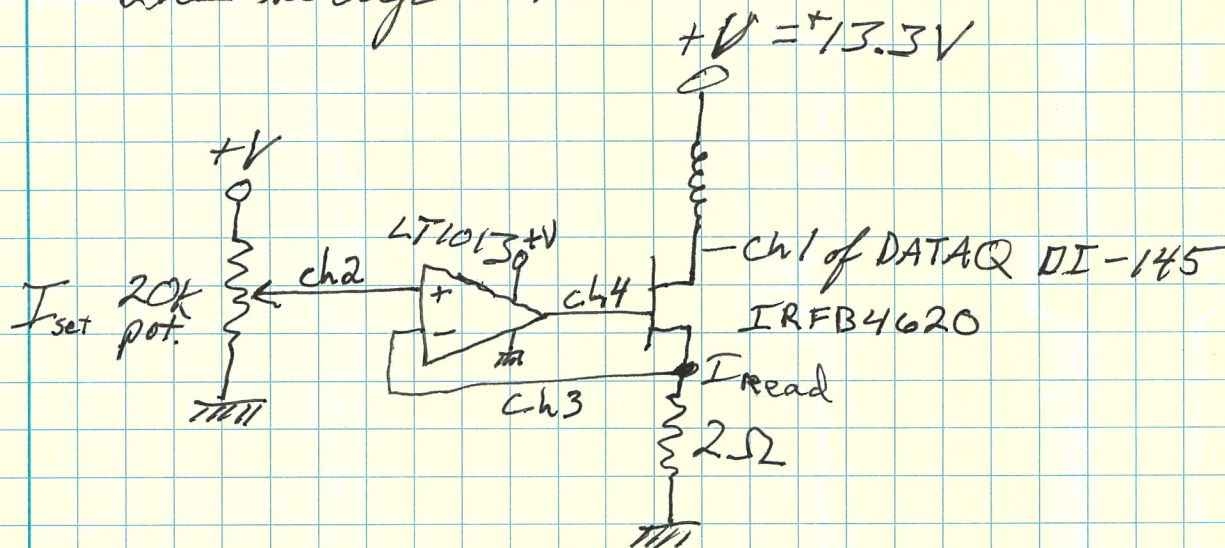
3rd 555 output



12V Brushed DC Motor Control Experiment 3/14/13

Trying to develop a better understanding of the behavior of brushed DC motor behavior. The goal is to develop a usable control for the logic drives.

The setup is



First run of the DAQ was just to see how the setup performed. File saved as motor1.WDQ.

For the second run I used the "event markers" to try and help me remember when I changed something.

- 1- turn power on
- 2- I_{set} increase
- 3- motor begins to run
- 4- applied load - pressed my finger against the sprocket
- 5- load until stall - release & let run
- 6- decrease I_{set} till stop and ϕ

For the third run

- 1- power applied
- 2- increase I_{set} till motor runs - decrease till stops
- 3- increase I_{set} till motor runs
- 4- load the motor down
- 5- load till motor stops - release load - repeat
- 6- end of loading
- 7- increase I_{set}
- 8- load and release load
- 9- load till stop - release - repeat

- 10 - decrease I_{set} to ϕ - motor stops before
 $I_{set} = \phi$
11 - ~~motor is stopped - I_{set} is ϕ~~
12 - power is off - this marker is a little
early before power turned off

