

 **National® Brand**

COMPUTATION NOTEBOOK

Department _____

Subject Misc Hardware IV

Name Segal

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48-648

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



Rediform Inc. • C

TX 75019

Made in China

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5

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Check of Current Draw of Fastbus Modules
Radiation Tolerance Check of Lead Flow Monitor

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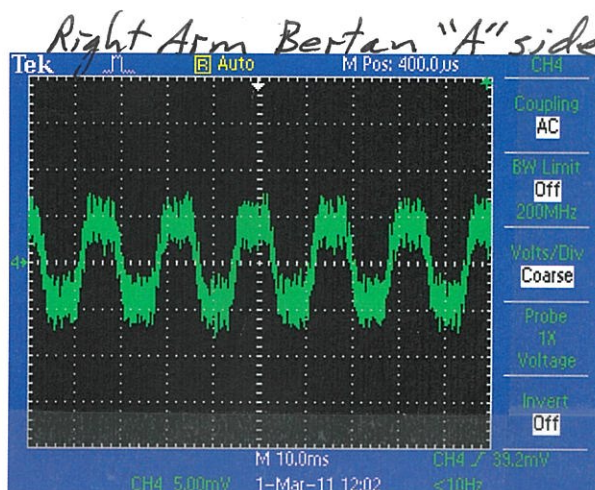
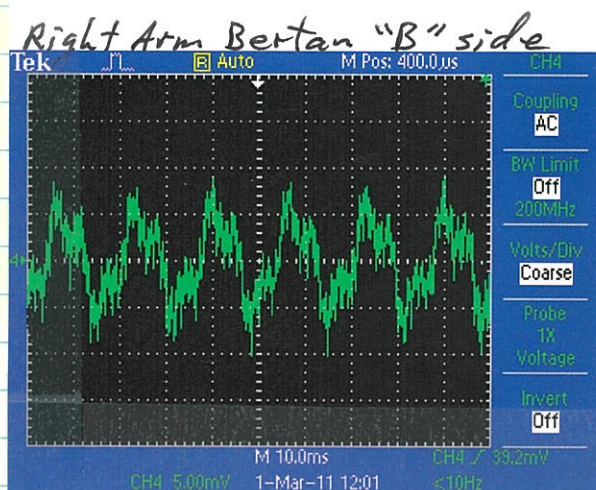
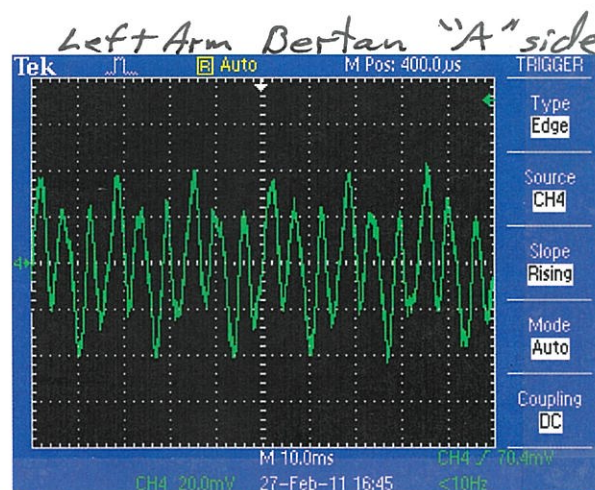
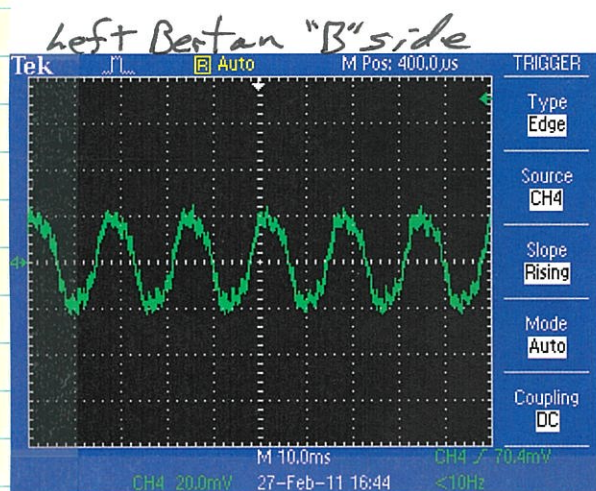
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3/1/11
JS

The Left VDCs readback of the HV monitor from the Bertan power supply has been erratic.

Looking at the voltage monitor outputs with the TPS2024 scope. Ch4 is plugged directly into the Bertan monitor output using an ~8ms RG-174 cable.

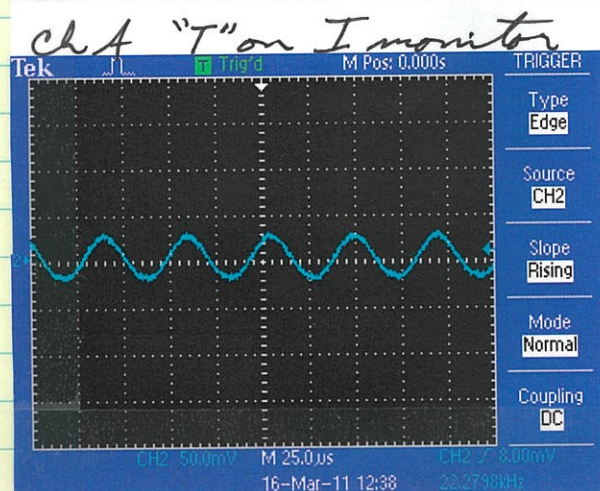
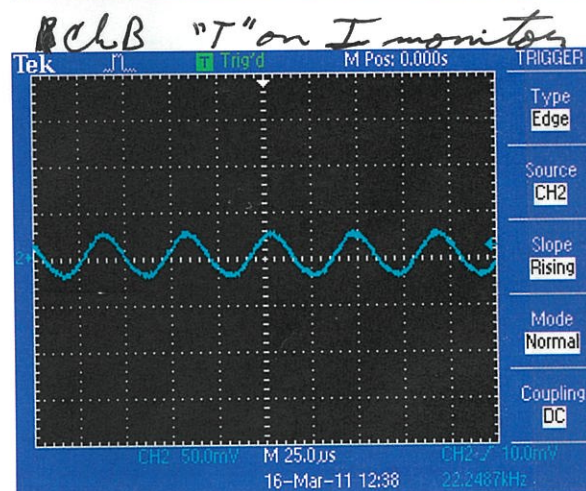
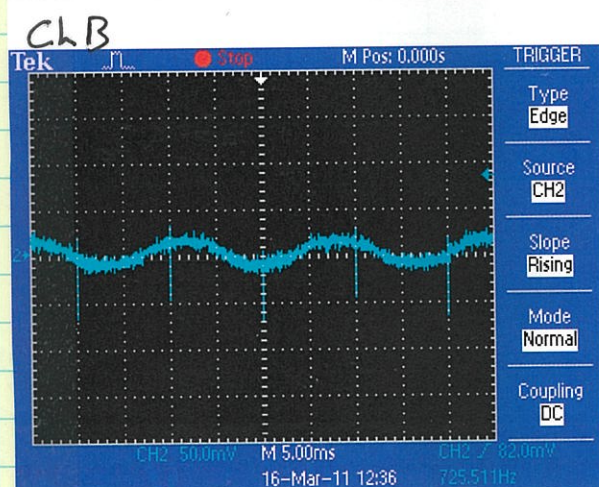
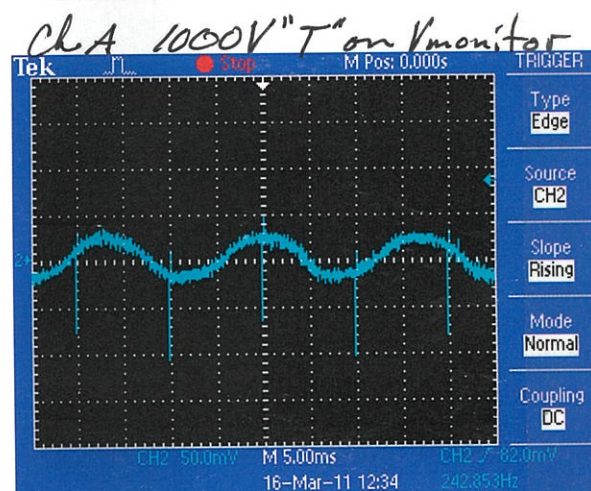
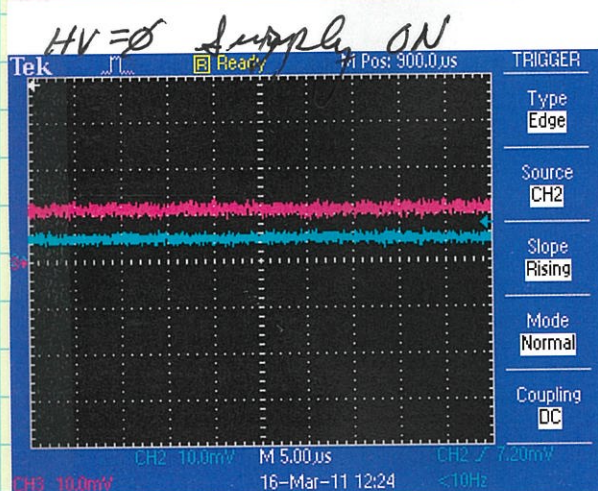
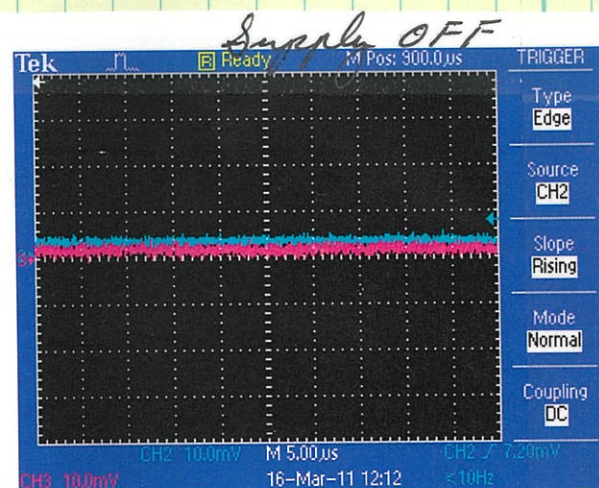
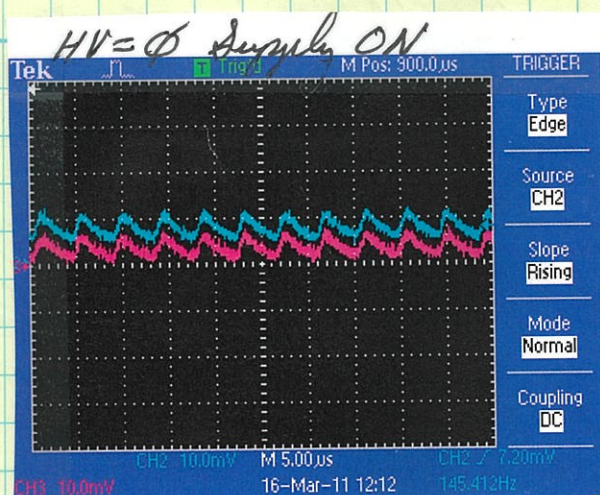


3/16/11 Replace Left VDC Bertan HV Supply

JA

The HV readback for the Left VDCs had a bit of noise and was generating a lot of nuisance alarms in EPICS.

Looking at the voltage monitor outputs
Ch 1 is the A side of the supply
Ch 2 is the B side of the supply



5/10/11 Solenoid Check for NMR Probes

A We found a couple of solenoids while cleaning out the Physics storage building. They are wound on an aluminum bobbin and have a 4-position terminal block on top. It would seem to be two separate windings. Arbitrarily calling one end, left end, of the terminal block "1".

1-2	7.44 Ω	measured using a Fluke 189
1-3	11.88 Ω	
1-4	2.75 Ω	
2-3	4.94 Ω	
2-4	5.15 Ω	
3-4	9.61 Ω	

Re-installed the jumper from 3-4

1-2	5.00 Ω
1-3	2.72 Ω
2-3	2.75 Ω

With the jumper removed from 3-4 I got about 10G at the end of the solenoid with 350mA at ~4V from terminal 1-3.

With the jumper installed at 3-4 and the power supply clipped from 1-2. Voltage is 3.94V and 855mA. The field is about 27G.

To get 1000G will require 148V and 32A.

Terminals 2 and 4 both have 2 wires tied to them. The two top wires on 2 and 4 have ring lugs on them. I will call those 5 and 6.

1-4	2.71 Ω
2-6	5.14 Ω
3-5	4.92 Ω

Check of Current Draw of Fastbus Modules 2/12/12

Check of the current drawn by 1877 Fastbus modules and 1881M modules. I have 4 of 1877 and 3 of 1881M.

There are three Fastbus crates using one power supply on the right arm.

We had a mis-wiring and about half of the cards have blown fuses. The modules now using are from the bottom crate and do not have blown fuses. The +5 & -5.2 connections had been reversed on the top crate.

The current from each supply will be read using an Extech 380741 clamp on multimeter. The cards will be inserted in the middle crate and the currents read at a convenient point along the respective cable.

I will start with an empty crate (all 3 are empty and no cards in the rear slots) and insert modules one at a time. Hot insertions.

cards	-2V	+5V	-5.2V	+15V	-15V	1877 module slot
0	0A	0A	0A	0A	0A	
1	-1.5A	4.7A	-4.8A	0A	-.1A	B34451 16
2	-3.3A	9.3A	-9.8A	0A	-.1A	B34915 15
3	-5.0A	13.8A	-15.3A	0A	-.2A	B37801 14
4	-6.7A	18.7A	-20.4A	0A	-.2A	B34519 13
	2A	5A	4.5A	.1A	.1A	printed on front panel

						1881M module
0	0A	0A	0A	0A	0A	
1	-1.1A	4.0A	-4.3A	.2A	-.1A	B35602 20
2	-2.4A	8.0A	-8.9A	.3A	-.1A	B35377 19
3	-3.7A	11.9A	-13.4A	.5A	-.2A	B34990 18
	2A	5A	6A	.7A	.1A	printed on front panel

4 cards in rear | -7.7A | 0 | -1.5A | — | —

-2.007V 5.04V 5.27V 15.06V 75.14V measured using
Extech DM220

4/25/12 Radiation Tolerance Check of Lead Flow Monitor

In order to get an idea of how radiation tolerant, or intolerant, the 4-20mA displays are I will put one somewhere by the pivot in Hall A.

I got 6 of CNY17-4 optocouplers and measured their CTR using the usual method. The ICs are labeled A thru F and their scope pictures are Tek 4 thru Tek 5.

Setting up a display unit.

Set for 0-10V input. Threshold set to 40.0
input voltage is set to ~75.0 on the display.

On the scope, Ch 4 is pin 5 of 555

Ch 3 is input voltage

Ch 1 is pin 3 of 555

The input voltage is through a 20K resistor to the "in+" input and ground at the "ct" input.

The "in+" is grounded to generate a trigger.

Tek 6 is the "in+" grounded for quite a bit.

Tek 7 is "in+" grounded till the red LED is lit and then the input is released from ground.

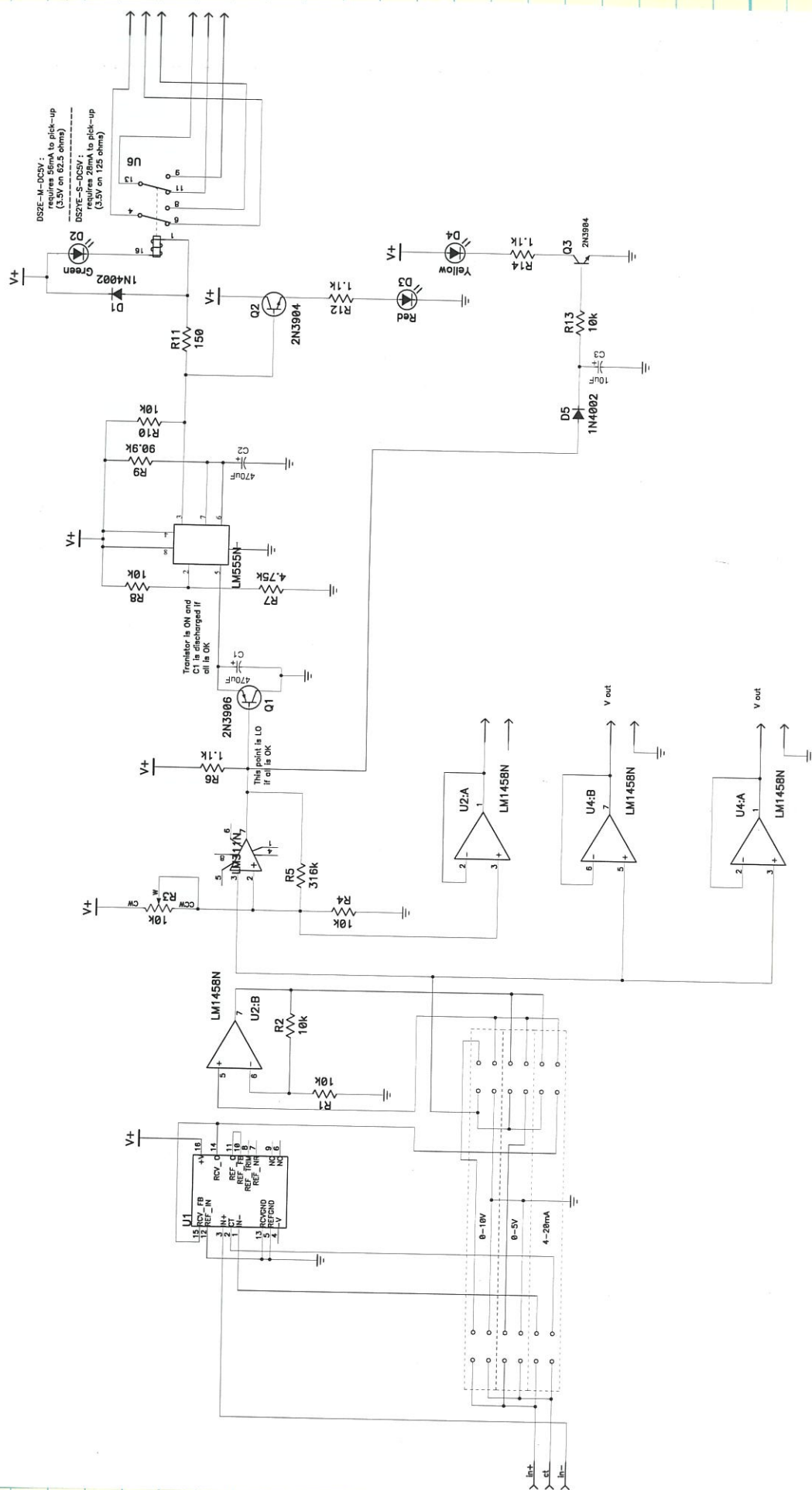
This was the circuit on the left side of the module (while looking at the front).

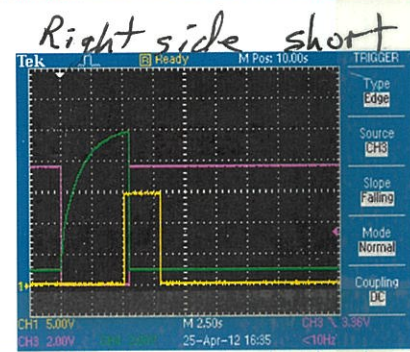
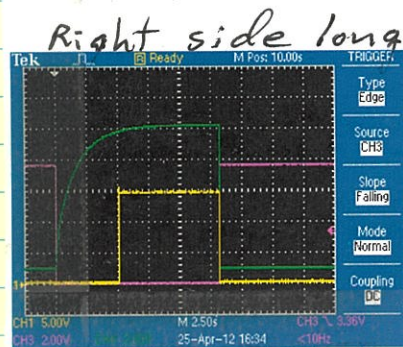
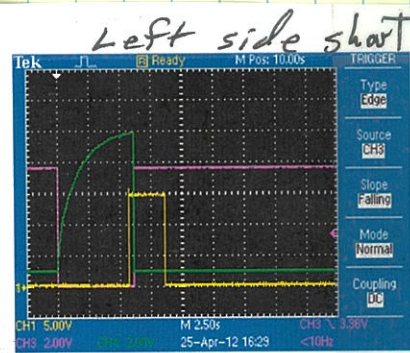
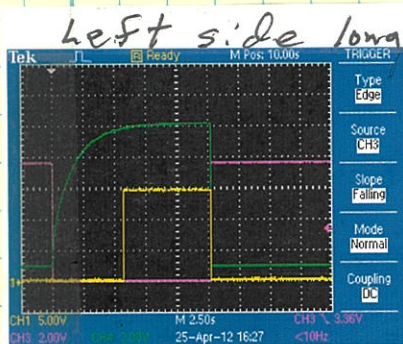
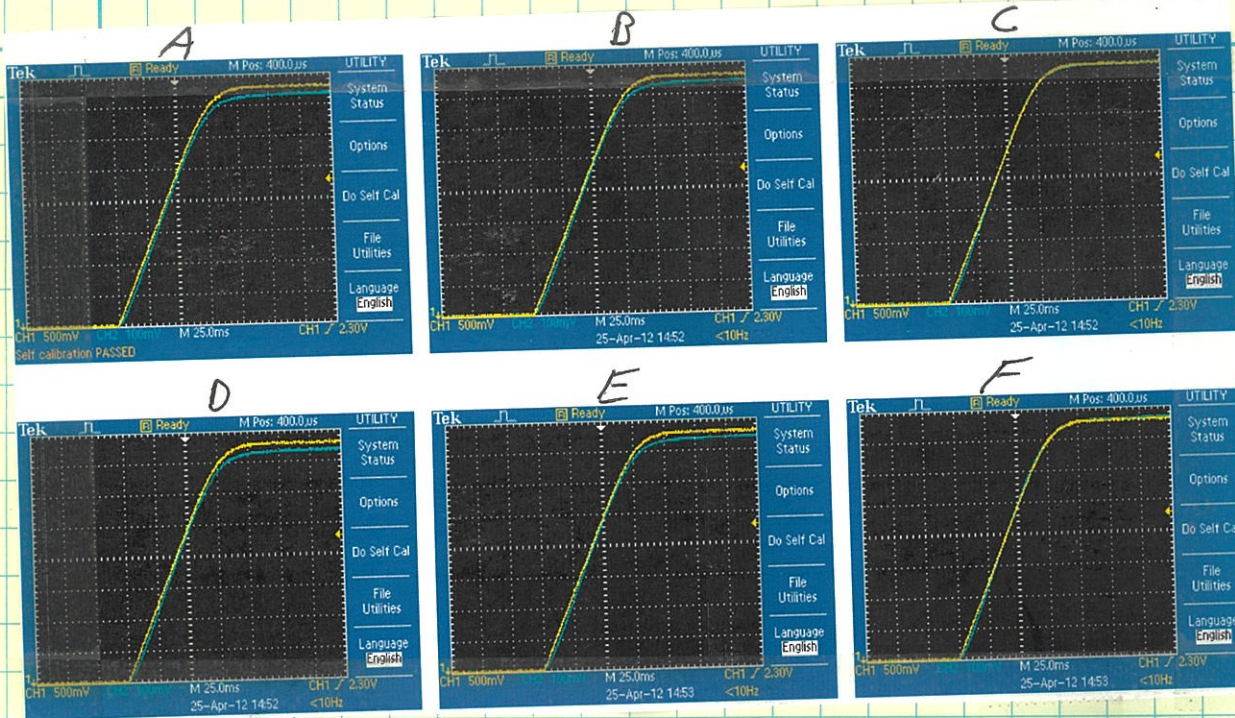
Move over to the right side circuit.

Tek 8 is the "in+" grounded for quite a bit

Tek 9 is "in+" grounded till the red LED is lit and then released.

Scope pictures are on p. 12





After 4 days

Same setup as on p.10.

Tek 0 is left side long

Tek 1 is left side short

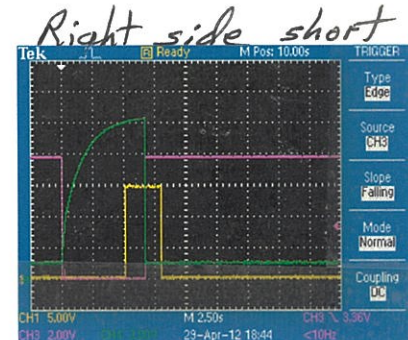
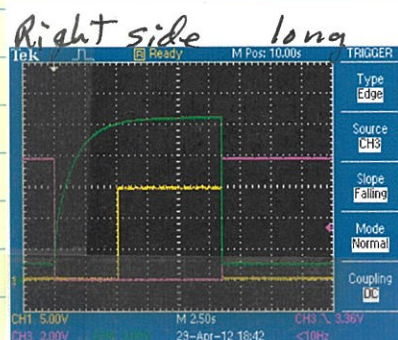
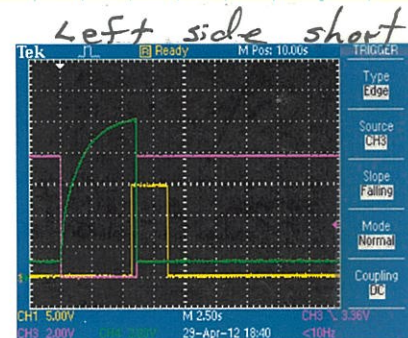
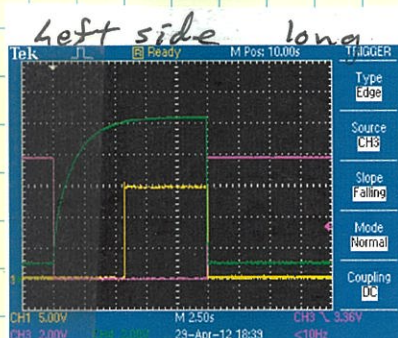
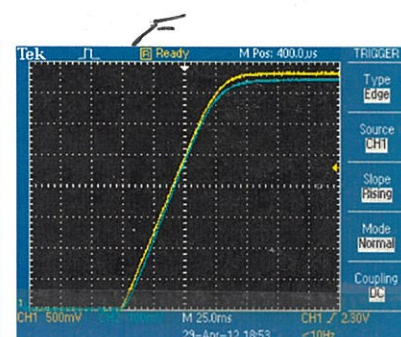
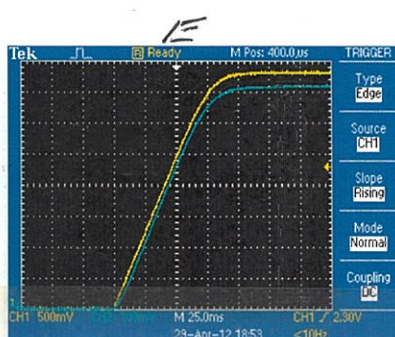
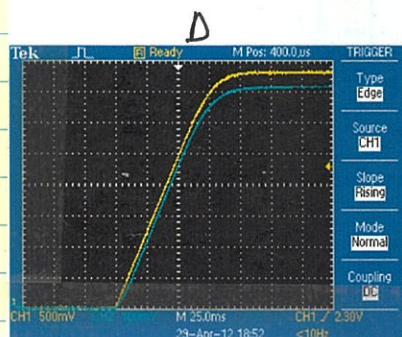
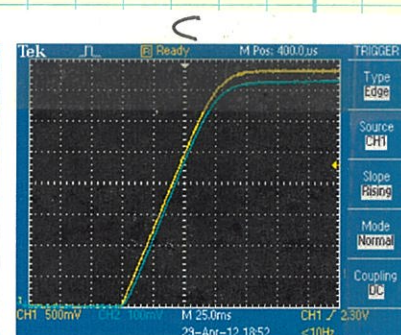
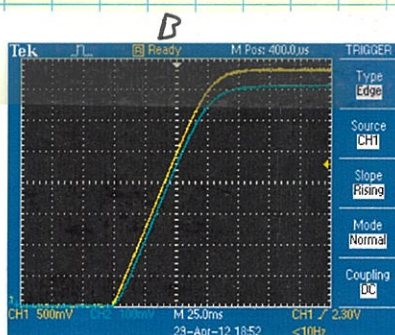
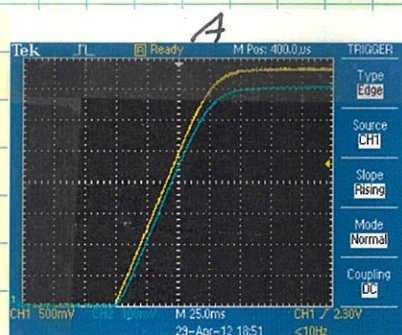
Tek 2 is right side long

Tek 3 is right side short

Optocouplers are usual method: A-F

ICs Pictures

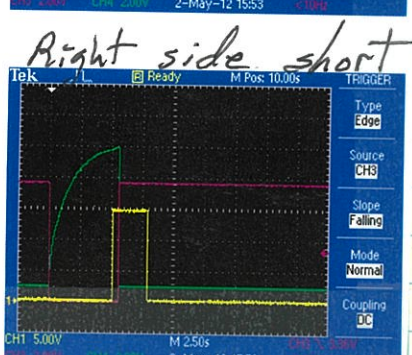
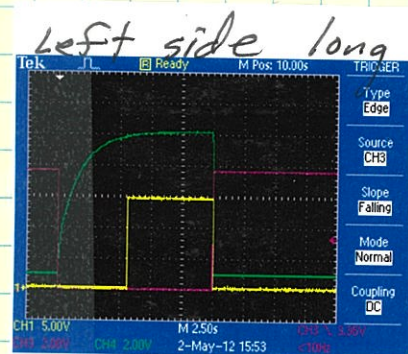
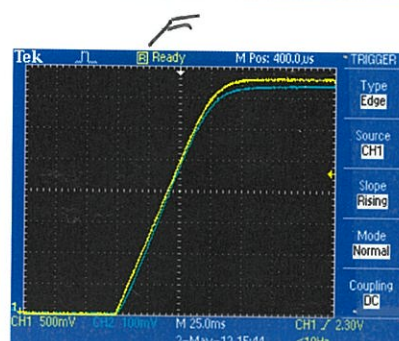
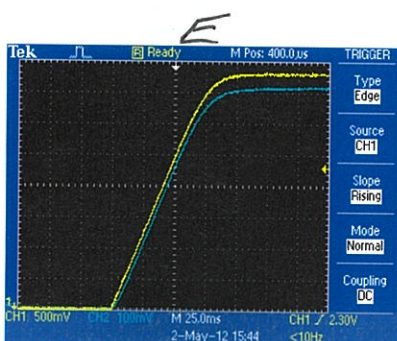
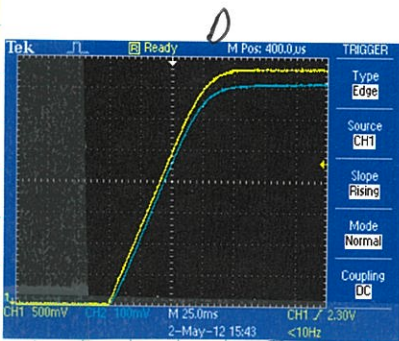
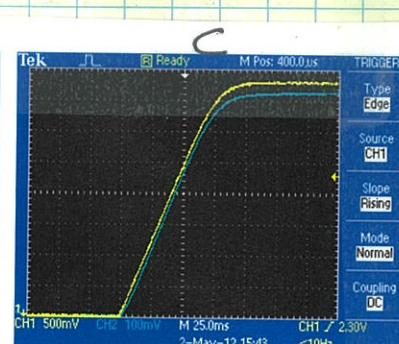
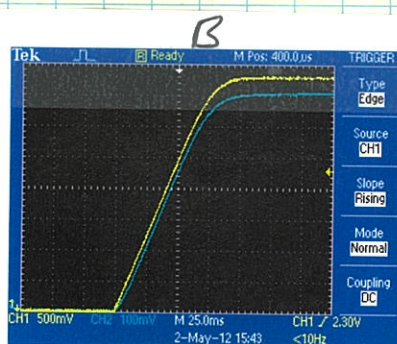
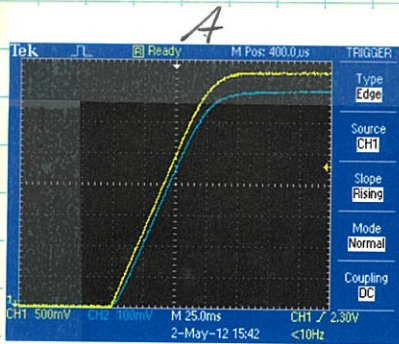
Tek 4-



5/2/12
A

After 7 Days

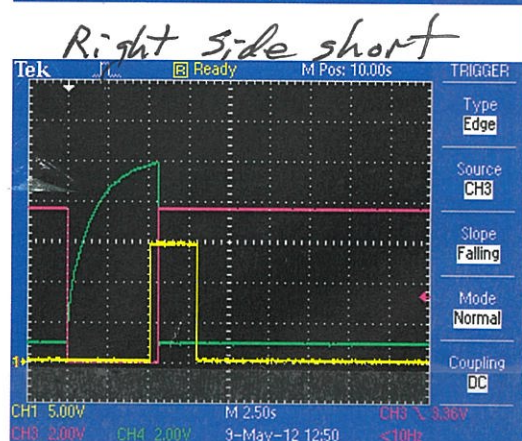
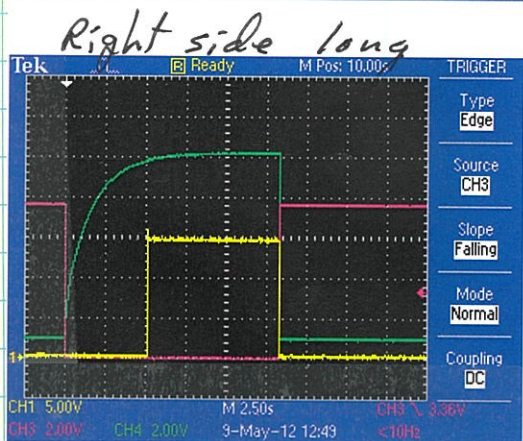
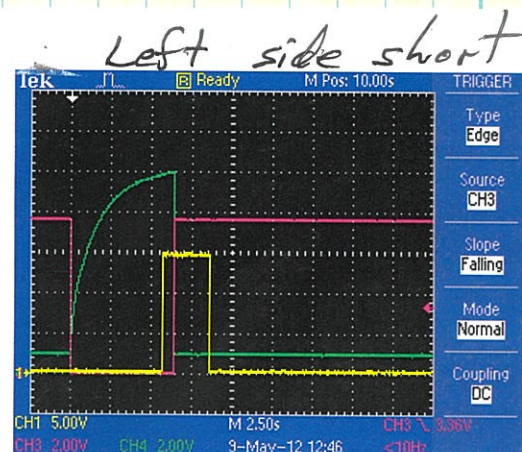
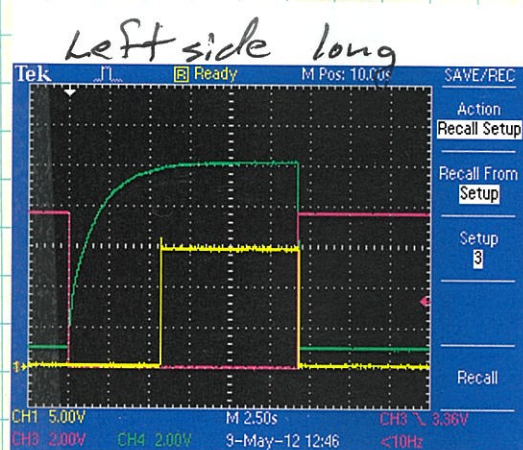
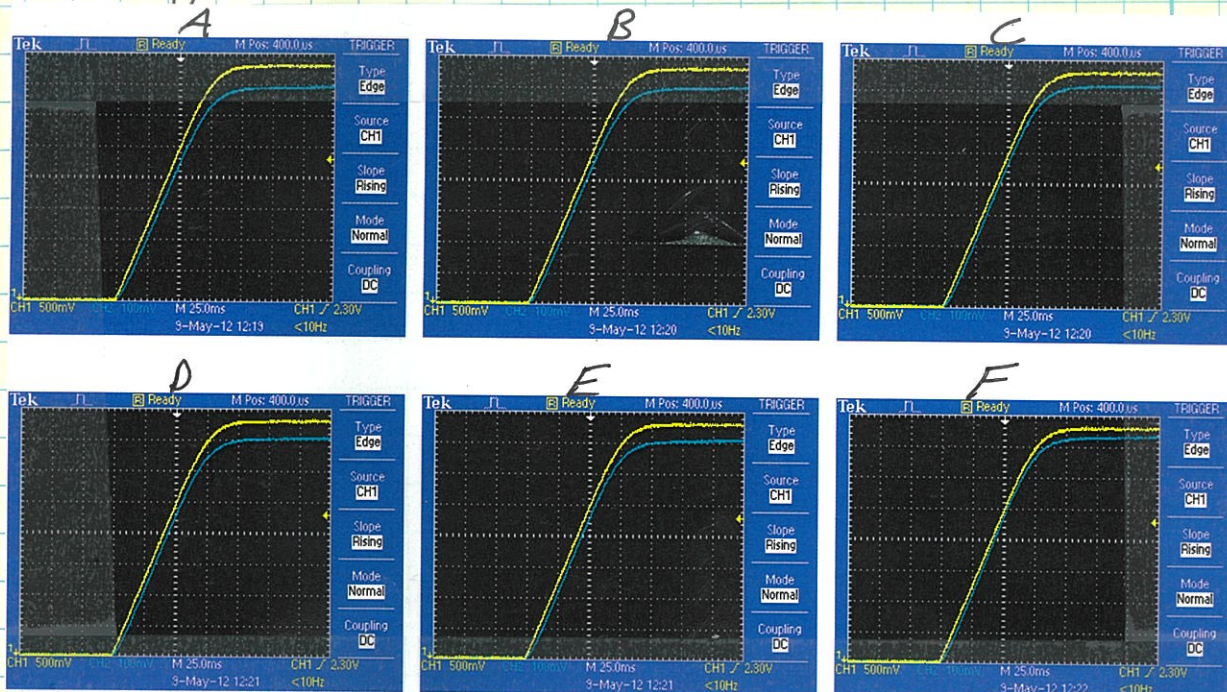
Same setup as on p. 10
Optocouplers are the usual method.



After 8 Days

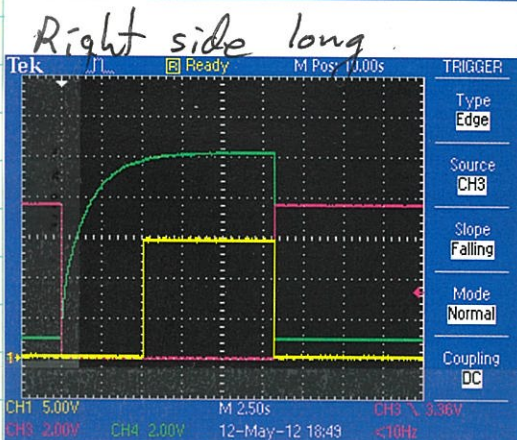
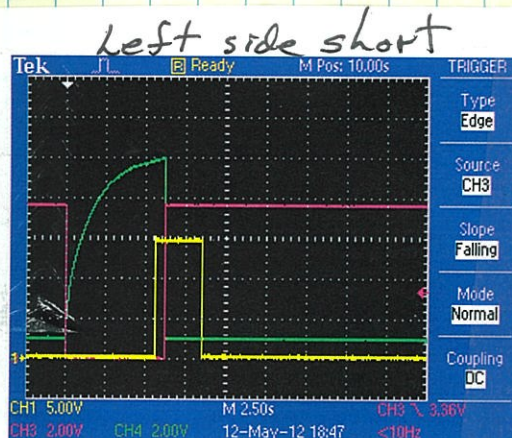
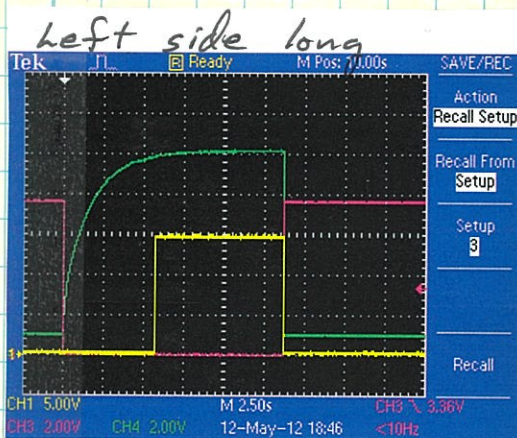
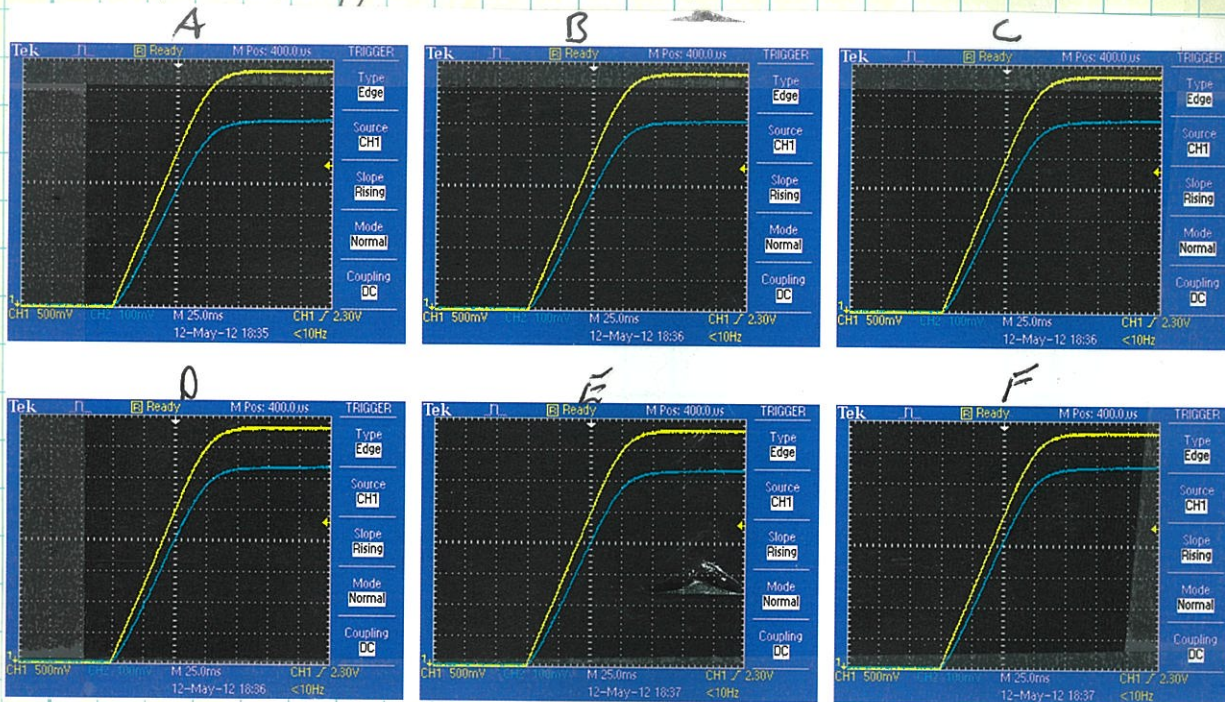
5/9/12
JK

Same setup as on p. 10
Optocouplers are usual setup. ICs A-F are Tek 40-45
Left display reads 74.3. Trip is 39.2.
Right display reads 74.5. Trip is 39.1.



5/12/12 After 17 days

Same setup as on p. 10.
 Optocouplers are the usual method. A-F Tek Ø-Tek 5
 Left display reads 74.4. Trip is 59.2. Tek 6-7
 Right display read 74.6. Trip is 39.1. Tek 8-9



After 14 Days

5/14/12
AS

Same setup as on p. 10

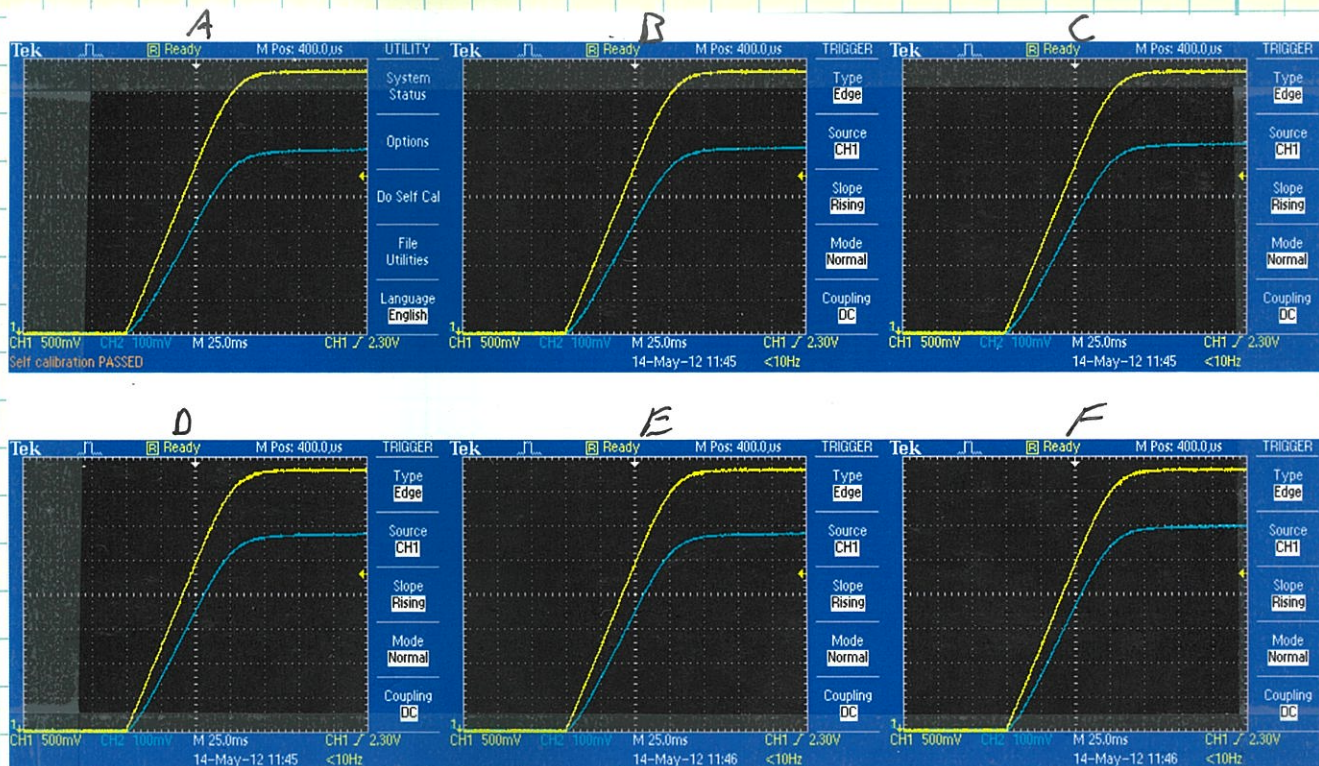
Left display reads 76.0. 7.71V using OM220.

Trip is 39.3

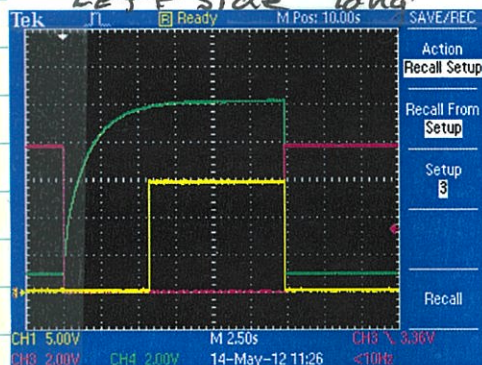
Tek 0 - Tek 1

Right display reads 76.2. Trip is 39.2. Tek 2-3

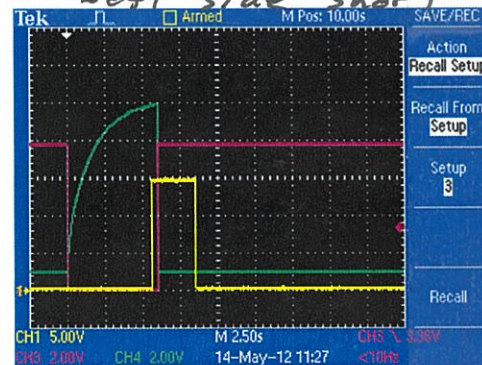
Optocouplers are the usual method. A-F Tek 4 - Tek 9



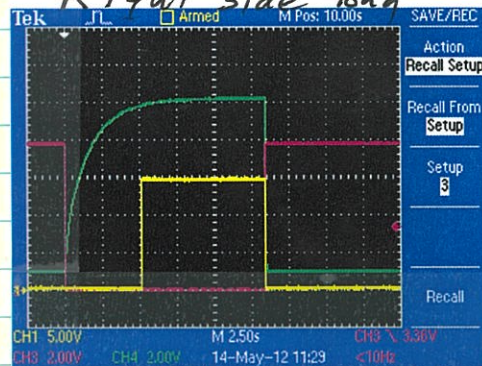
Left side long



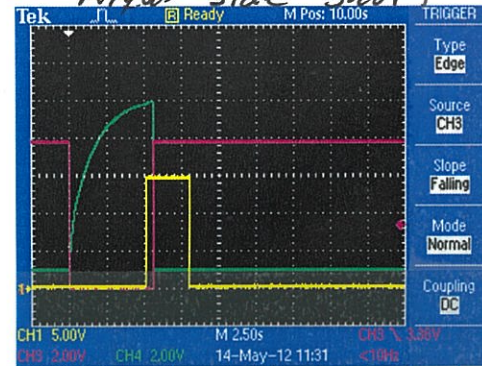
Left side short



Right side long



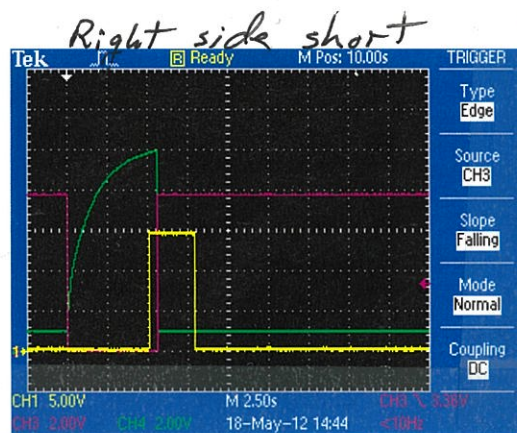
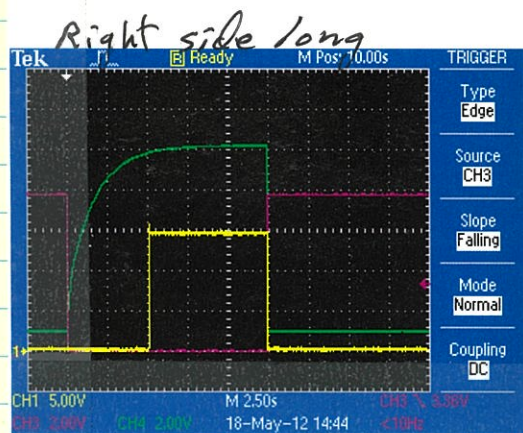
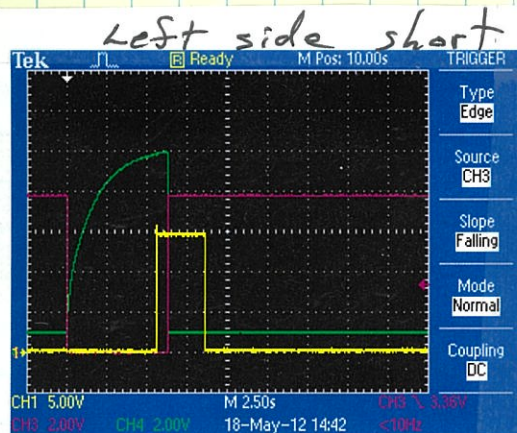
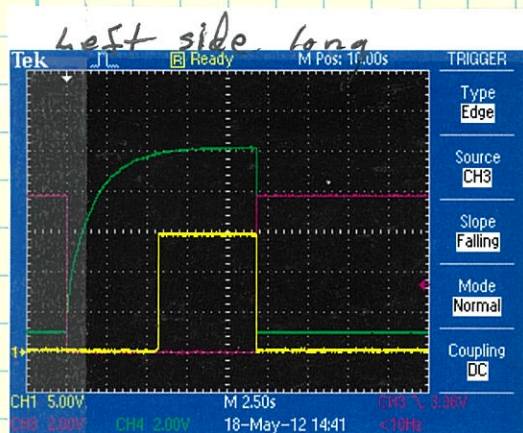
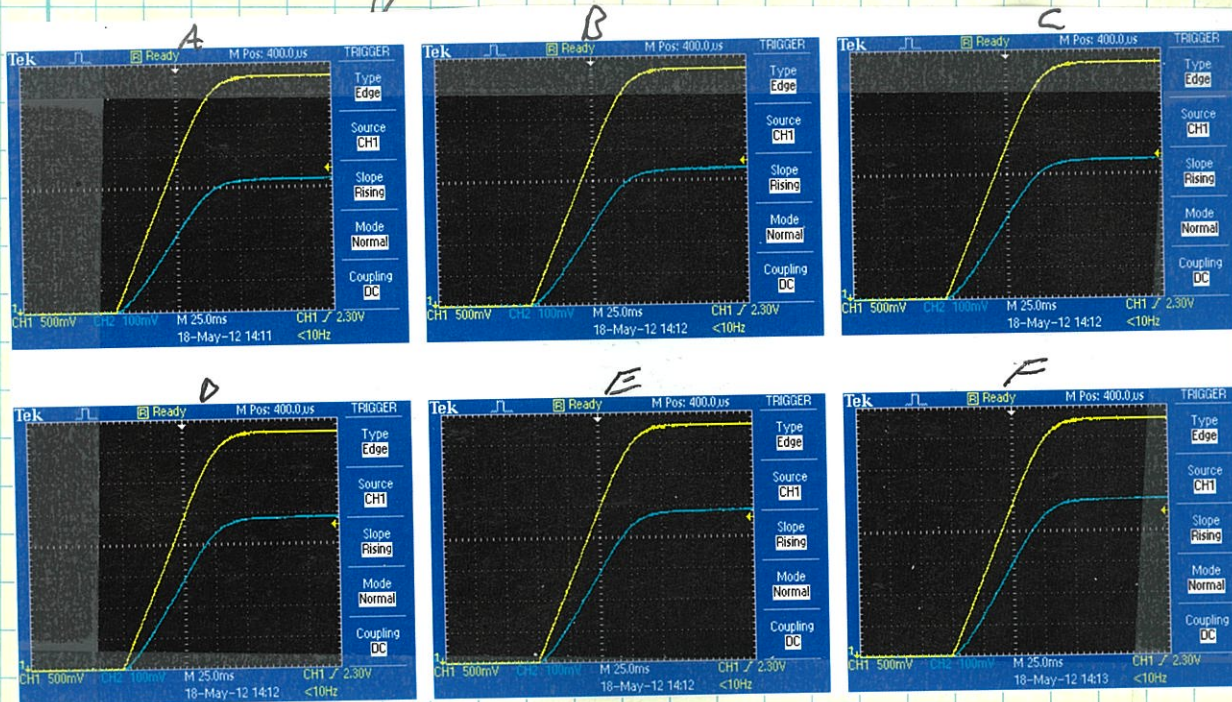
Right side short



5/18/12 After 23 Days

Same setup as on p. 10.

Optocouplers are the usual method. A-F Tek 40-45
 Left display reads 76.4 7.73V input Trip is 39.3 Tek 46-47
 Right display reads 76.5 Trip is 39.2 Tek 48-49



Testing Bogie Motors and Drive Modules 11/8/12

Looking at a test stand for the Bogie driver and motors.

I have one of the old inner bogie drive enclosures and an old mount for two motors.

The first few drive modules and motors have problems. Checking the index pulse they seem to be off the mark.

I have tried to adjust the encoder in S/N H000505. There seems to be an improvement in torque.

As a load I have a 12VDC 1.4HP motor with ~~2.2~~ across the connections.

With a drive voltage of 3.047V I get a CCW rotation and -2.7V out of the motor.

The index pulse does not seem to have the correct phase with $\pm A$. This encoder is one of the original style encoders.

I re-connected the motor I started this whole mess with. S/N H000504. Date code 5200.

With a drive signal of 3.034V I get a CW rotation and 2.7V across the DC motor. It is not hard for me to hold the pulley and run the drive up to 6V.

After adjusting the encoder. 3.065V drive signal. CW rotation and -2.8V across the ^{DC} motor.

It has some torque at a dead stop when I hold the pulley.

The phase of the index and $\pm A$ seems correct.

The personality IC on the DM-25 is labeled INNER #1.

I powered it down and replaced the personality chip with the one labeled OUTER #4.

3.066V drive signal. CCW. -2.9V across the DC motor. The $\pm$ Index to $\pm A$ phase is the same.

Looking at motor S/N H000509. 3.051V drive. CCW rotation. -3.2V across the DC motor. Tek 8. This motor did not require adjustment.

Looking at motor S/N H000503. This motor ^{new style encoder} appears to have been in the water when the hall flooded. 3.054V drive. CW. +1.6V on DC motor. After adjusting the encoder. 3.047V drive. CCW. -3.1V across DC motor. Tek 10.

Looking at motor H000521. This has an old style encoder. 3.035V drive. CCW. -2.8V across the DC motor. This encoder is out of adjustment. Tek 11. After adjustment. 3.096V drive. CCW. -3.1V across the DC motor. Tek 12. Phasing looks wrong. Perhaps the encoder is radiation damaged.

Looking at motor S/N H000511. This motor has the original style encoder. This one has real problems rotating at all. After adjustment. Still has problems. Encoder signals have problems. Tek 13. Probably radiation damage.

Looking at motor S/N H000510. This one has the original style encoder. 3.070V drive. CW. +3.1V across DC motor. Tek 14. The phase of the index looks correct, but it is rotated. After adjustment. 3.034V drive. CCW. -3.1V across the DC motor. Tek 15. Phase is not right. But, it still seems to run correctly.

11/9/12

Looking at motor S/N H000506. 3.052V drive. CW and slow. 0.7V across the DC motor. Index is off of adjustment. Tek 16. This encoder is the new style, 2-row 2mm connector. After adjustment. 3.050V drive. CW. -3.1V across the DC motor. Tek 17.

Looking at motor S/N H000504. We already have a 504! The date code on this one is 2783. The previous one has a date code of 5200. This one has an older style encoder, but not the original style. 3.051V drive. CCW. -2.9V across the DC motor. Phasing is a bit off. Tek 18. The encoder might be slightly out of adjustment, but seems to be within the stated tolerance of $\pm 10^\circ$. After slight adjustment.

3.048V drive. CCW. -3.2V across the DC motor. Tek 19.

Looking at motor S/N H000502. 3.084V drive. CW. +1.3V on DC motor. Tek 20. After adjustment. 3.048V drive. CCW. -2.8V across the DC motor. Tek 21. This is an older style encoder, but not the original style.

Looking at motor S/N H000514. This one has one of the original style encoders. 3.066V drive. CW. +2.7V across the DC motor. Tek 22. After adjustment. 3.064V drive. CCW. -3.2V across the DC motor. Tek 23.

Looking at motor S/N H000507. This one has an original style encoder. 3.031V drive. CCW. -3.1V on the DC motor. Encoder phasing looks correct. Tek 24.

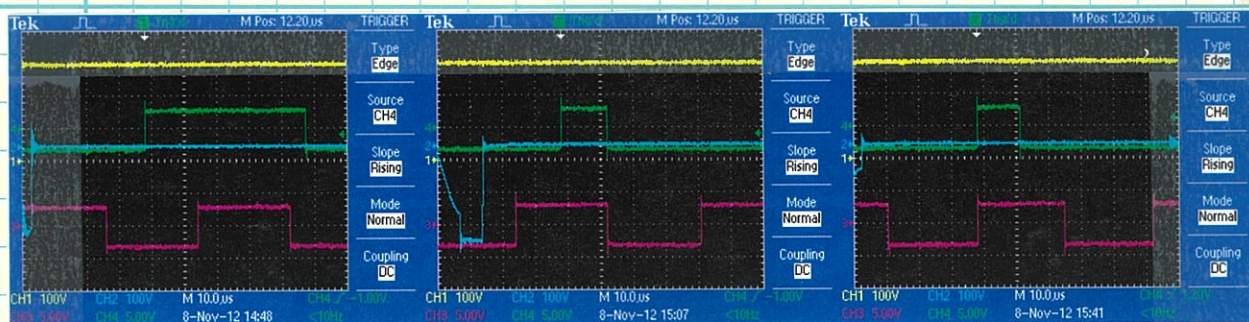
Looking at motor S/N H000532. 3.068V drive. CCW. -1.0V on DC motor. Tek 0. The encoder is one of the original style. After adjustment. 3.049V drive. CCW. -3.3V on the DC motor. Tek 1.

Looking at motor S/N H000522. 3.050V drive. CCW. -2.9V on DC motor. Tek 2. After adjustment. 3.071V drive. CCW. -3.2V on DC motor. Tek 3.

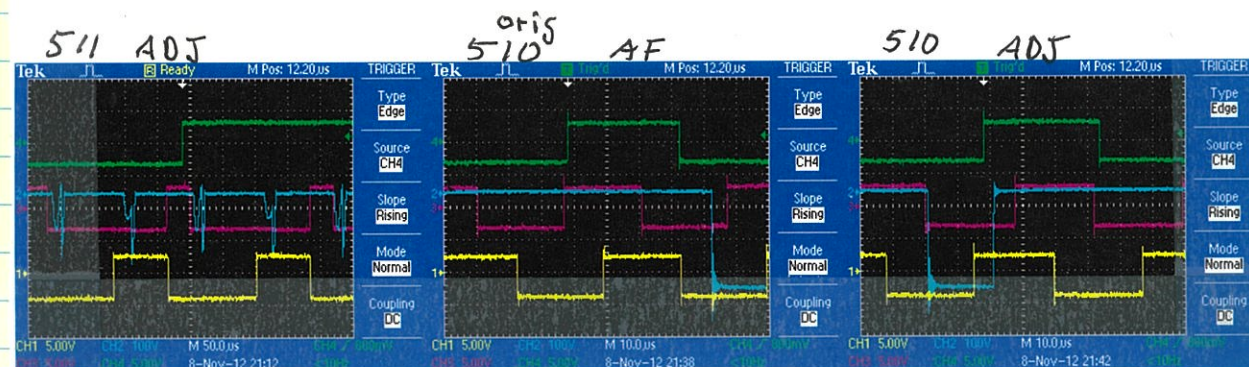
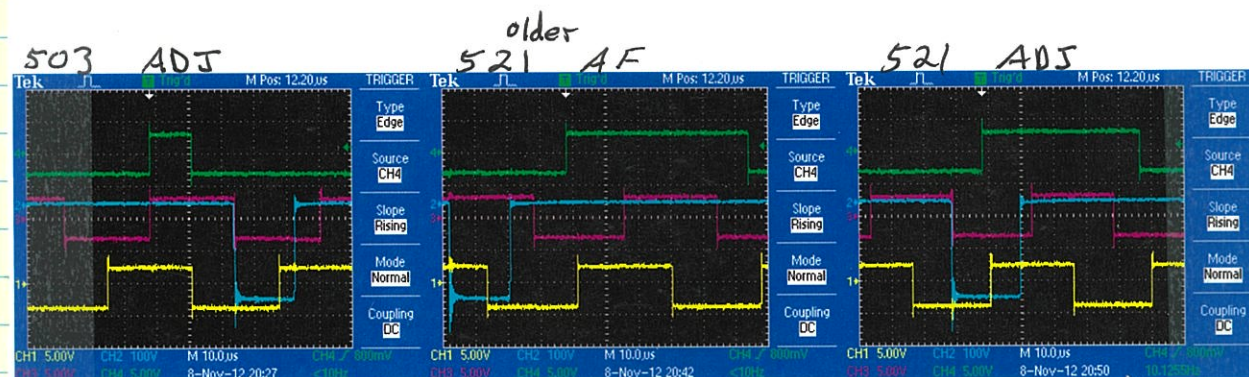
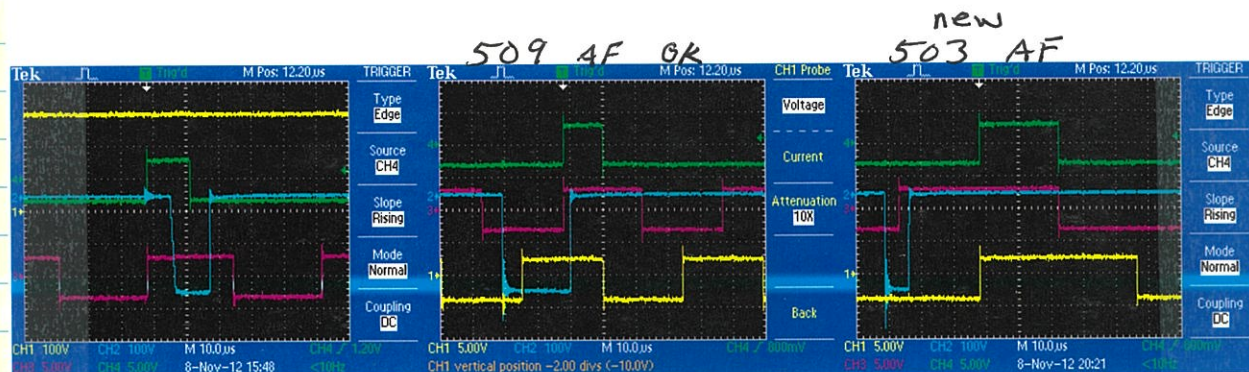
Looking at motor H000517. The encoder is one of the older style. 3.047V drive. Not moving. 4.013V drive. CCW. -0.7V on the DC motor. Tek 4. 3.046V drive. CCW. -3.1V across the DC motor. Tek 5.

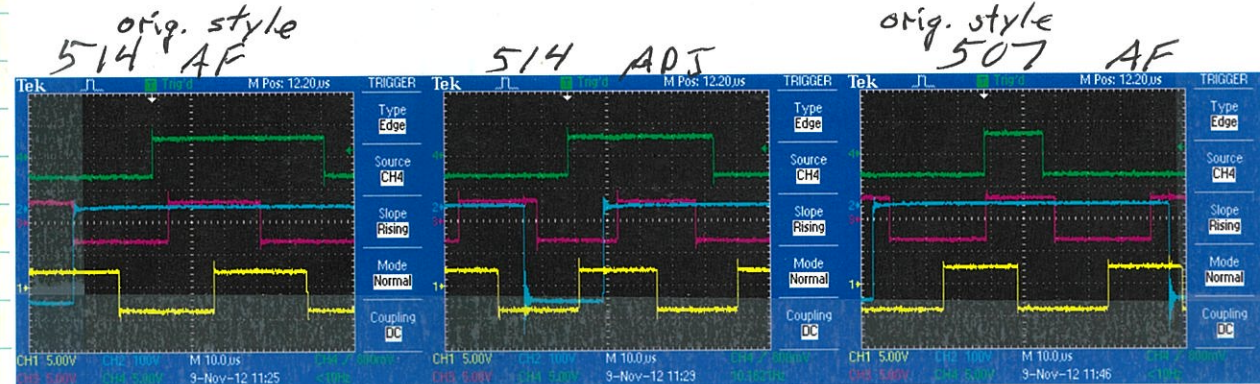
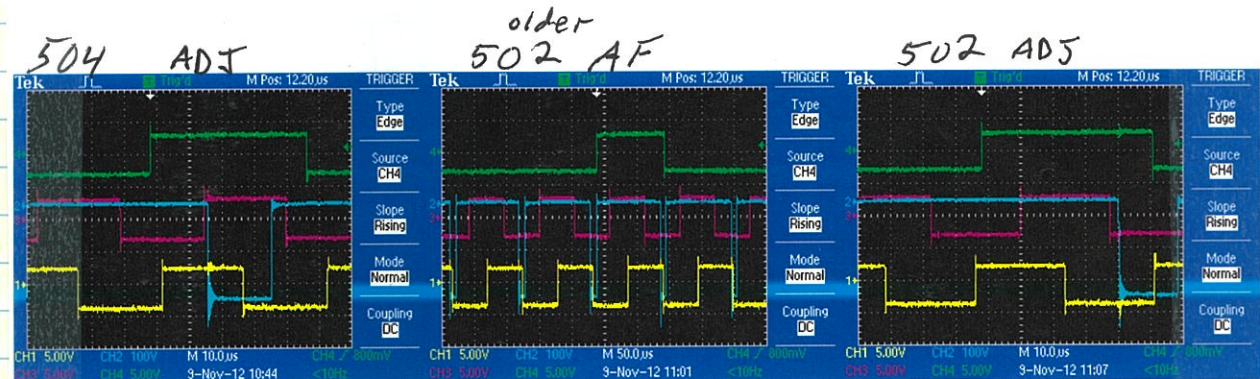
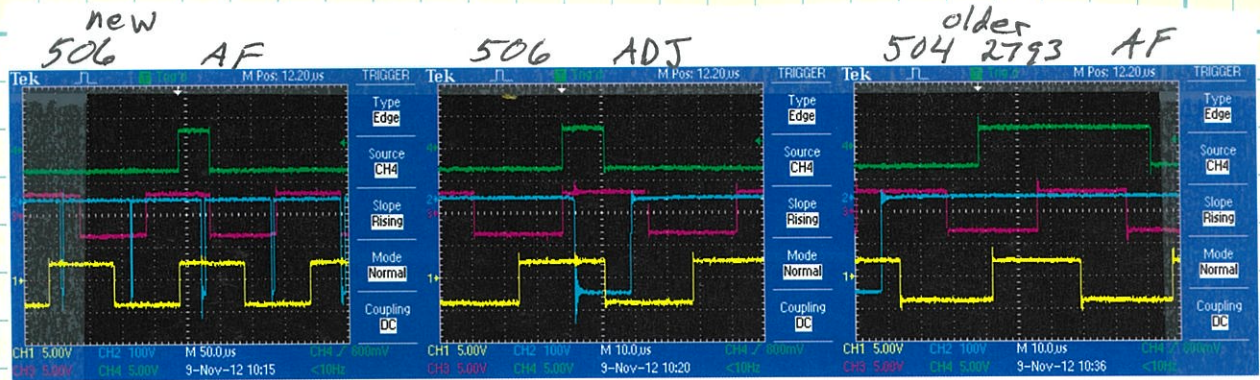
Looking at motor S/N H000513. 3.095V drive. CCW. -2.4V on the DC motor. Tek 6. This motor has an older style encoder. After adjustment. 3.049V drive. CCW. -3.0V across the DC motor. Tek 7. Phasing of the encoder is off.

11/12/12
JH

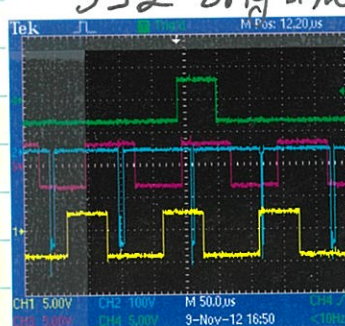


AF = As Found

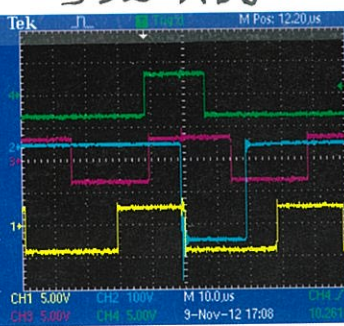




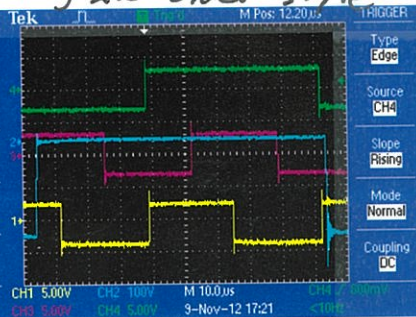
532 orig style



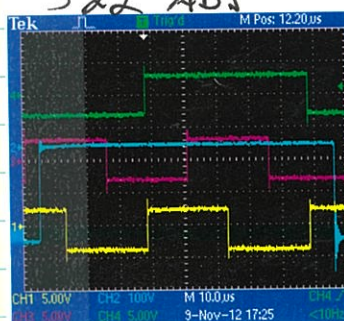
532 ADJ



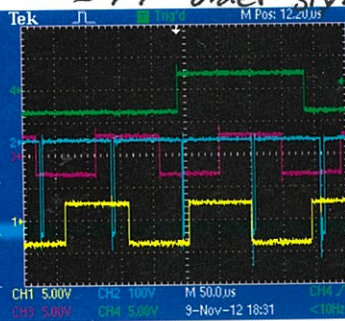
522 older style



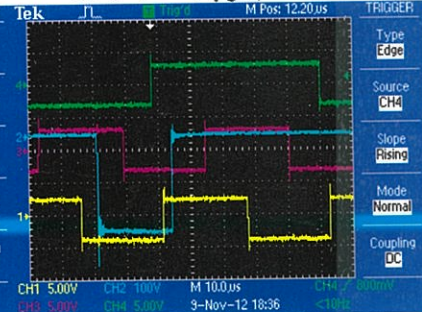
522 ADJ



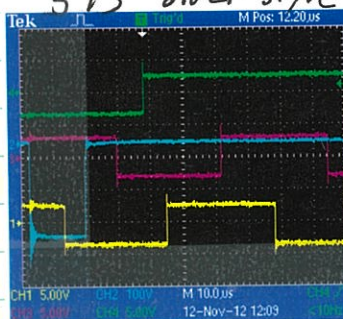
517 older style



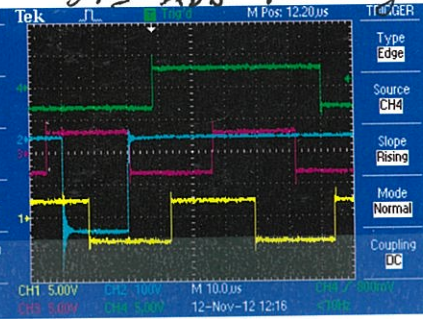
517 ADJ



513 older style



513 ADJ phasing?



12/5/12

Looking at motor S/N H000519. +3.094V drive. CCW. -3.21V on DC motor. Tek ϕ . Looks ok.

Connecting to the serial port of the DM-25 with a laptop and Hyperterm. The personality chip has a label with "OUTER #4" " ADDR = 10

Hitting a "p" the screen shows

Scale	1.00 AMP/V	Mode(2): Torque Monitor-Tach
Offset	0.0000 V	
Peak I	9.9 AMP	
Overspeed	2002 RPM	
Filter BW	OFF HZ	

For scope channels Ch 4 is tip +I ref -I
Ch 3 +A -A
Ch 1 +B -B

I'm pretty sure this is what I had for the previous stages, too.

Swap out the DM with a DM-25 with a personality chip that says "OUTER #2". I had to move a ADDR = 8
few jumpers to be the same as the previous DM.

A little hard to get started, but 3.048V drive. CCW. -3.3V across the DC motor. Tek 1.

When I press "p" I get the same info as on the previous DM.

Replace DM with a DM-50 with a personality IC that says "MIDDLE #4".
ADDR = 6

3.048V drive. CCW. -3.4V across DC motor.

Pressing "p" the screen shows

Scale	0.99 AMP/V	Mode(2): Torque Monitor-Tach
Offset	0.0000 V	
Peak I	10.1 AMP	
Overspeed	2002 RPM	
Filter BW	300 HZ	

Scope looked the same as the others.

Swap out the DM with a DM-25 that also has a personality IC that says "OUTER #4"
ADDR = 10

3.085V drive. CCW. -3.2V on DC motor. Tek 2.
Pressing "p" the screen shows the same info as the first DM-25 I tried.

Swap out the DM with a DM-25 with a personality IC that says "OUTER #3"
ADDR = 9

3.032V drive. CCW. -3.0V on the DC motor. Tek 3.
Pressing "p" the screen shows the same info as the first DM-25 I tried.

12/6/12
JS

Swap out the DM with a DM-50 that has a personality IC that says "MIDDLE #3"
ADDR = 5

3.664V drive. CCW. -4.07V on DC motor.

Pressing "p" the screen shows

Scale 0.99 AMP/V

Offset 0.0000 V

Peak I 10.1 AMP

Overspeed 2002 RPM

Filter BW 300 Hz

Mode (2) - Torque

Monitor - Tach

Swap out the DM with a DM-50 with personality chip "MIDDLE #2".
ADDR = 4

3.045V drive. CCW. -3.5V on DC motor.

Pressing "p" the screen shows the same as the previous DM.

Swap out the DM with a DM-50 with personality chip "MIDDLE #4"
ADDR = 6

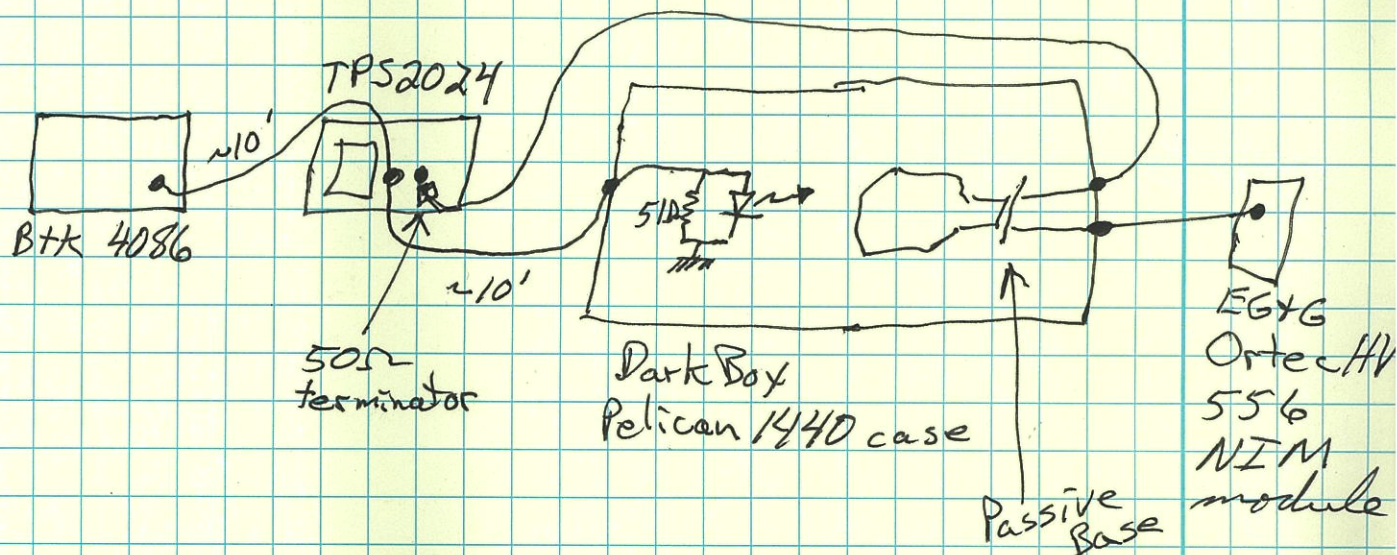
3.042V drive. CCW. -3.6V on DC motor. Tek 4.

Pressing "p" the screen shows the same as the previous DM.

Checking Gas Contamination of 5" PMTs

3/8/13

We previously found the transcontainer that had all the 5" tubes we were storing. I brought them down to the hall to check with an LED.



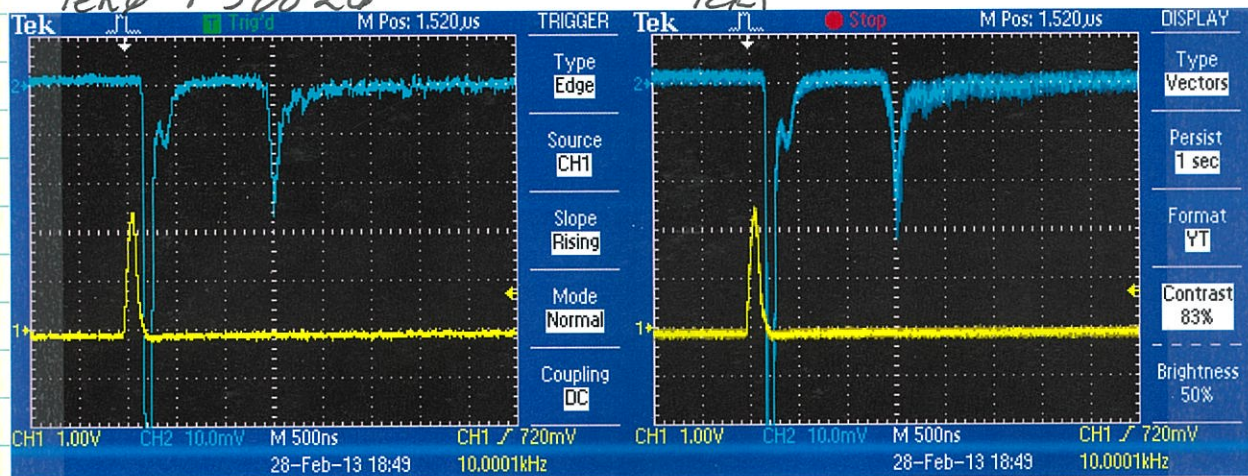
I had some trouble understanding what the function generator was doing. I tried a number of settings until I found one which seems to work for what I am doing. From the pre-configured Arb List I am using 8, which seems to be a positive pulse. I left the frequency to 70 kHz and the amplitude to 15 V_{p-p}. I am up with a ~2.5 V output pulse ~200 ns wide. This seems to work, so I quit fooling with the function generator.

For the HV I used 7500V.

5V_{pp} 10kHz?

Tek0 T50026

Tek1

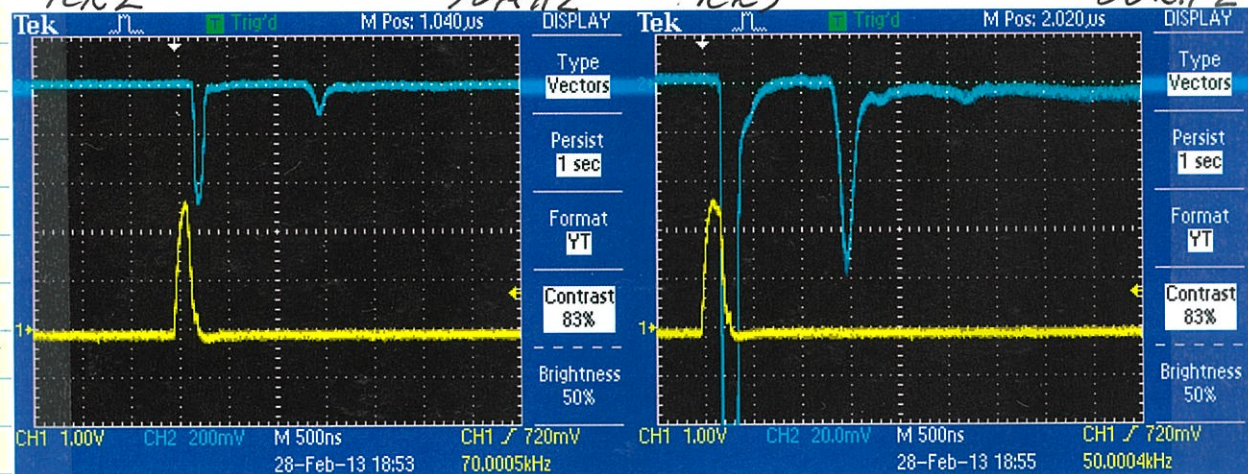


Tek2

70kHz

Tek3

50kHz

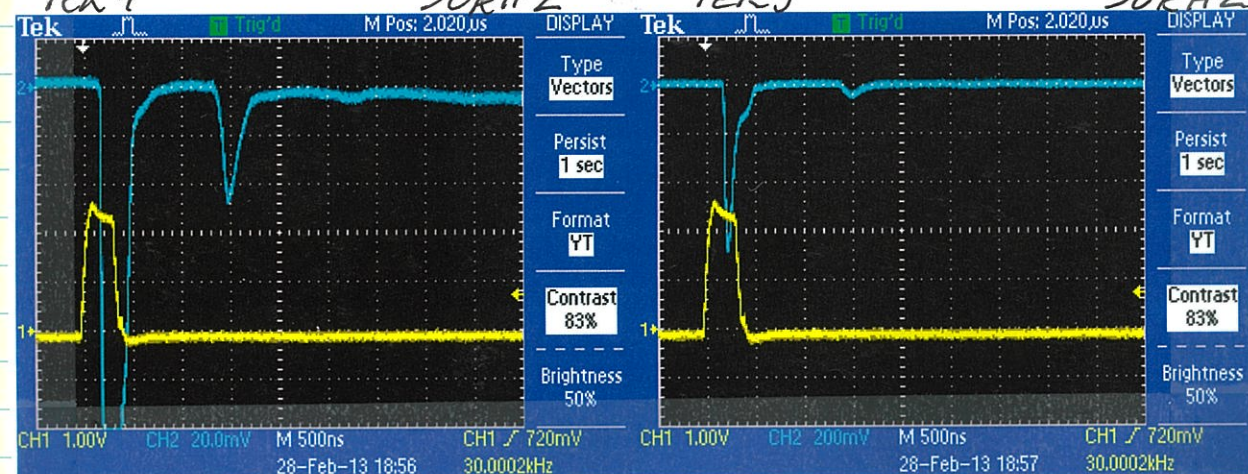


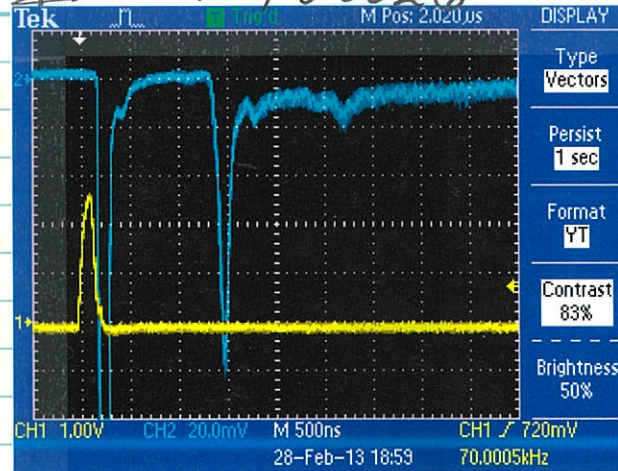
Tek4

30kHz

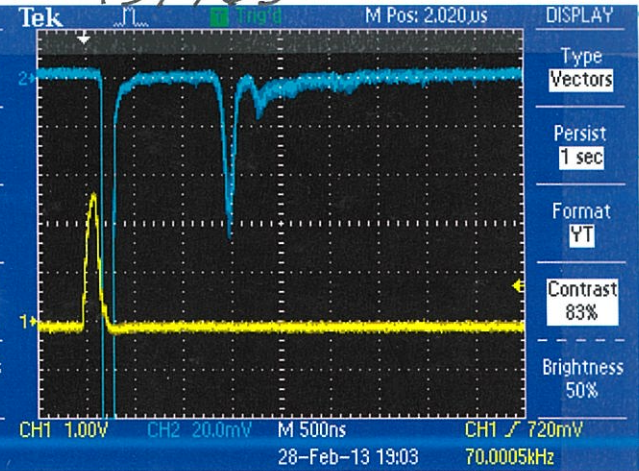
Tek5

30kHz

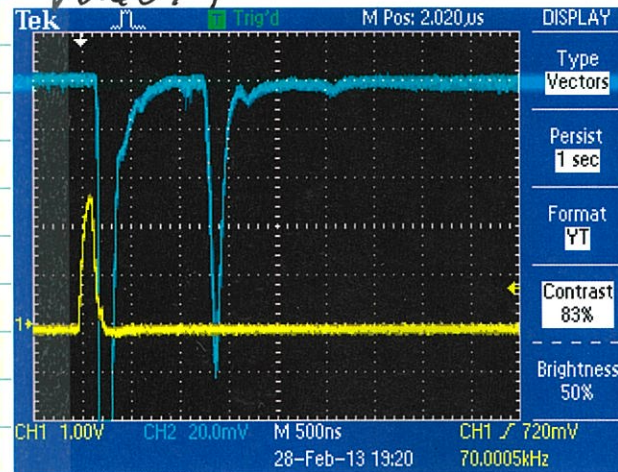


~~Y21463~~ T50026

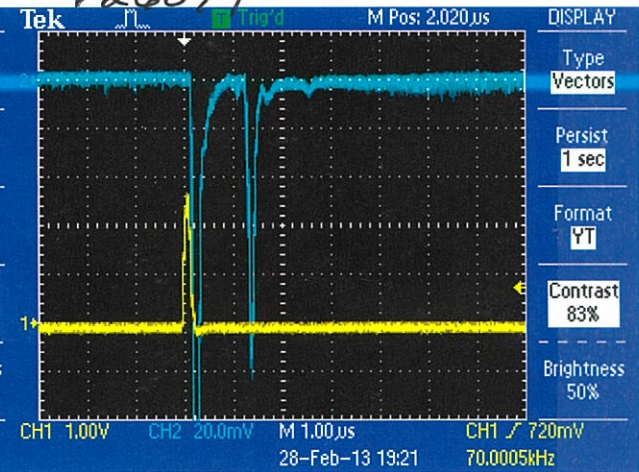
Y31463



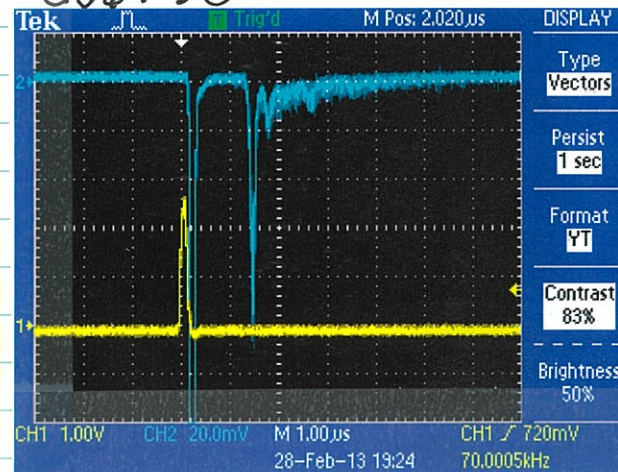
V26079



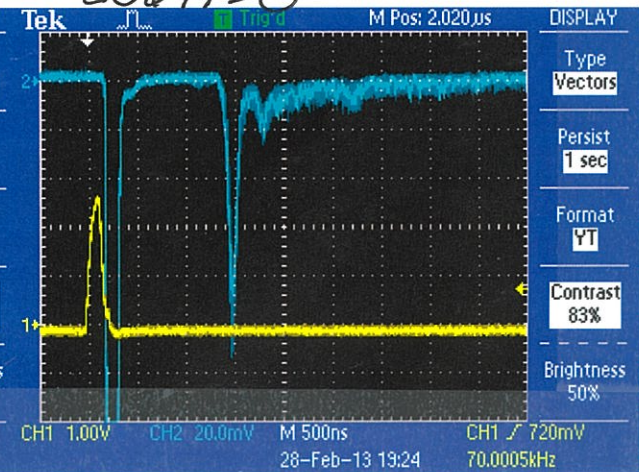
V26079



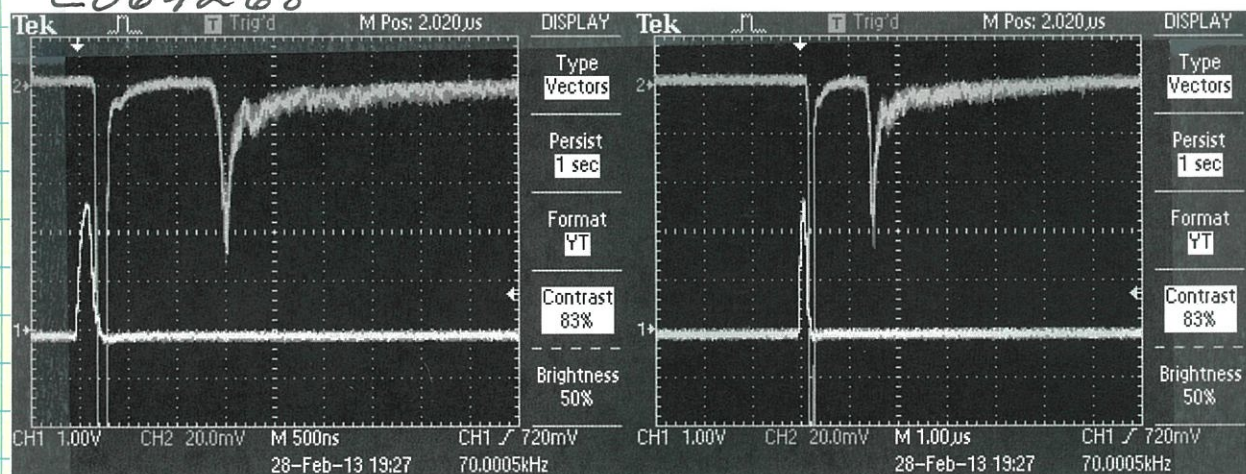
C069130



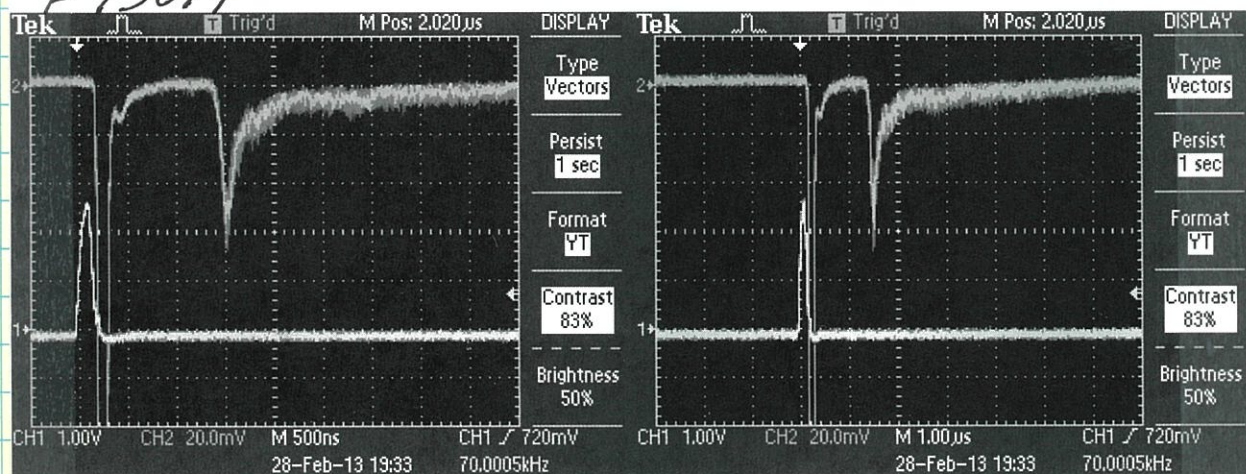
C069130



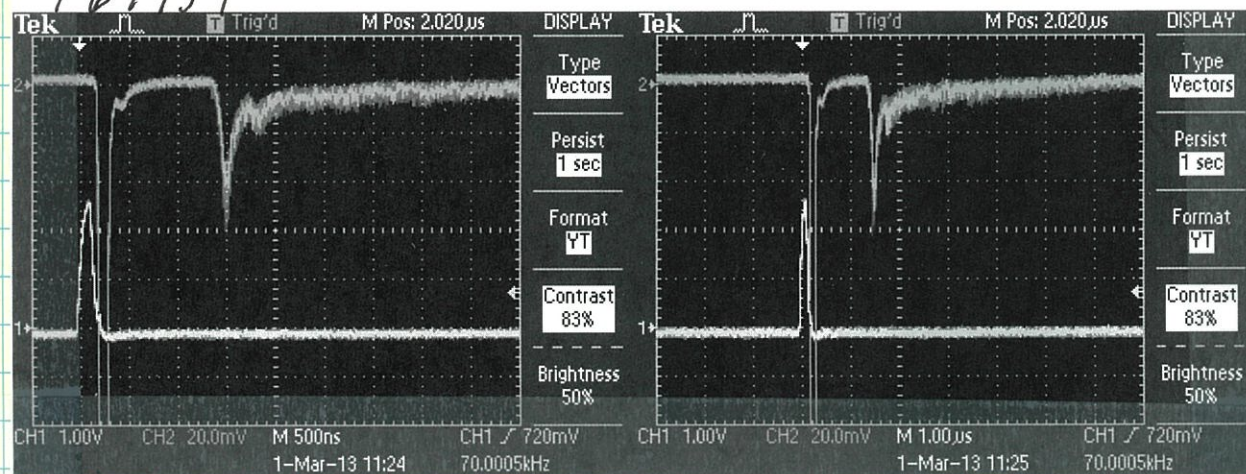
C064268



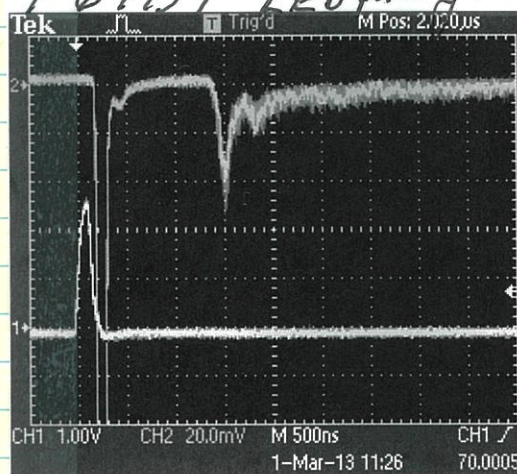
F73014



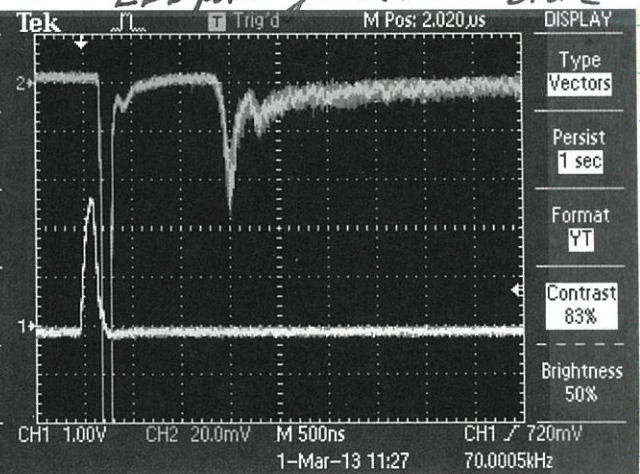
F67934



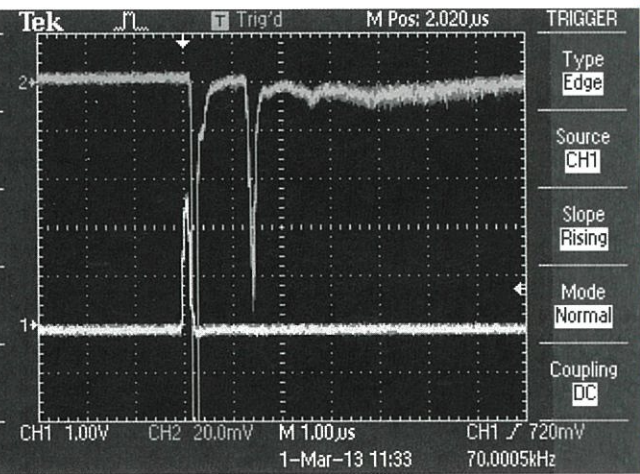
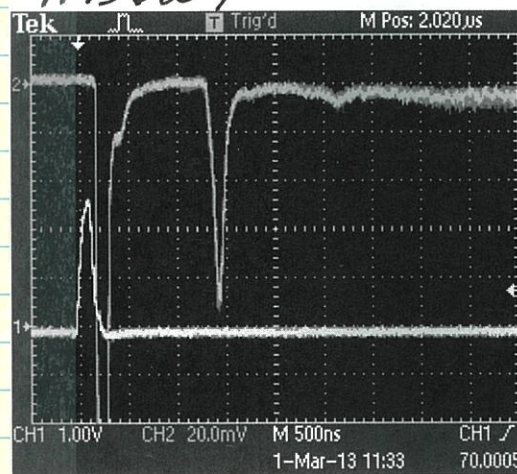
F67834 LED pointing to one side



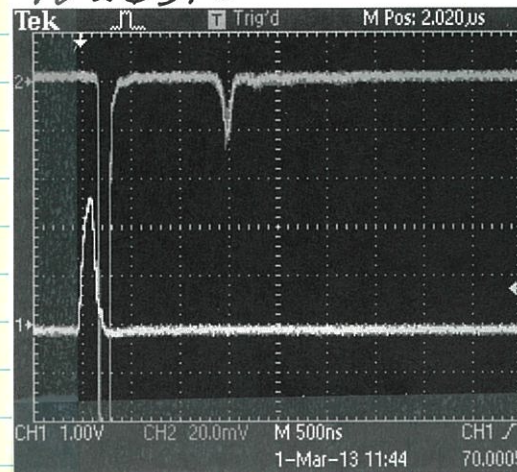
LED pointing even more to one side



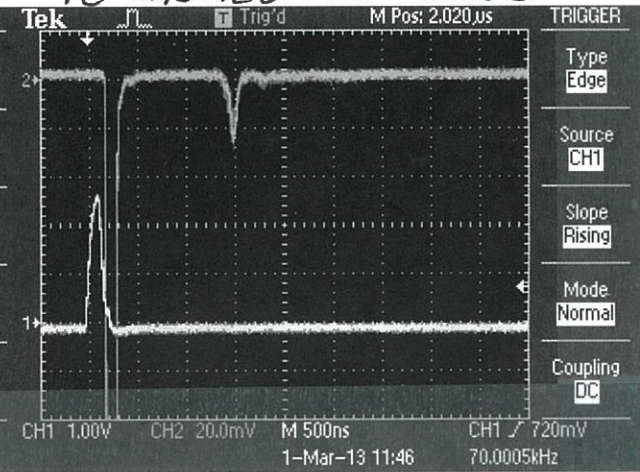
N93627



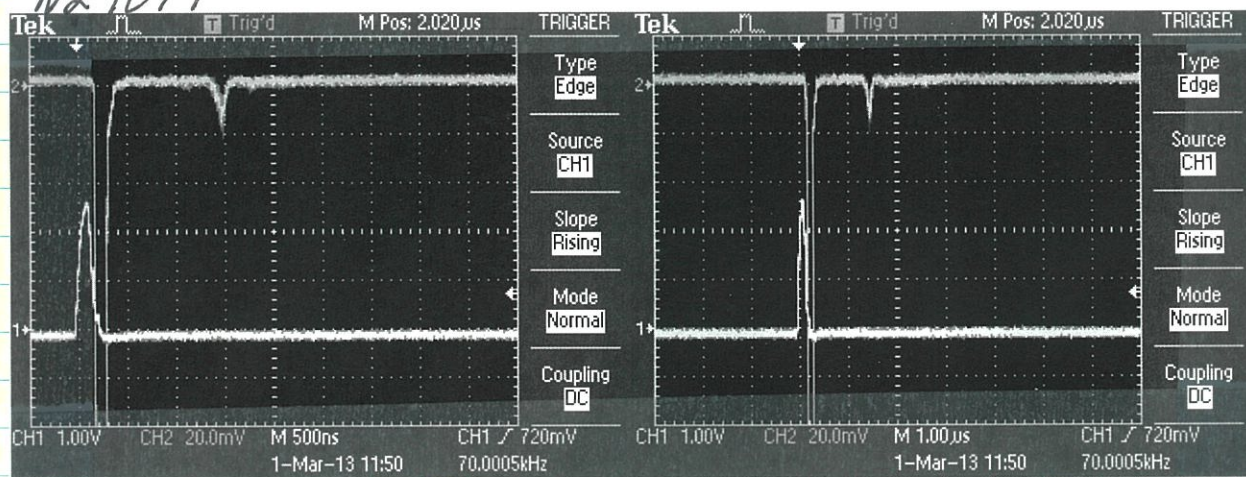
V026395



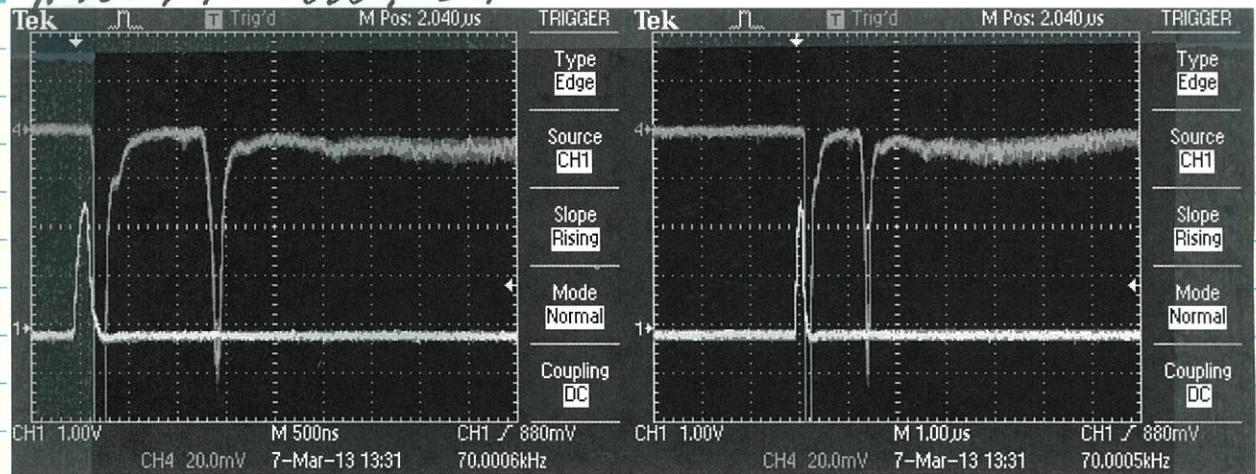
re-oriented LED and slightly closer



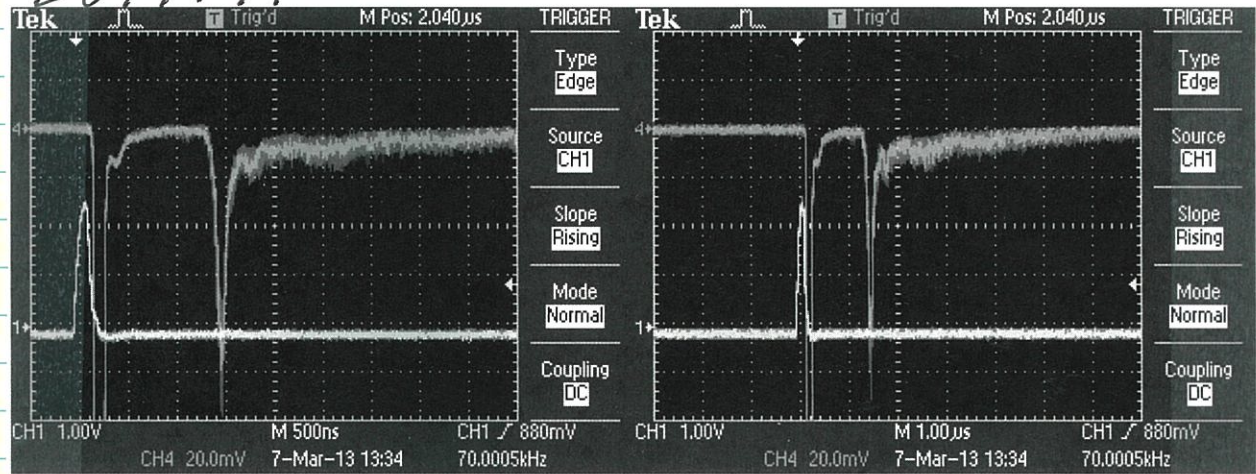
N29019



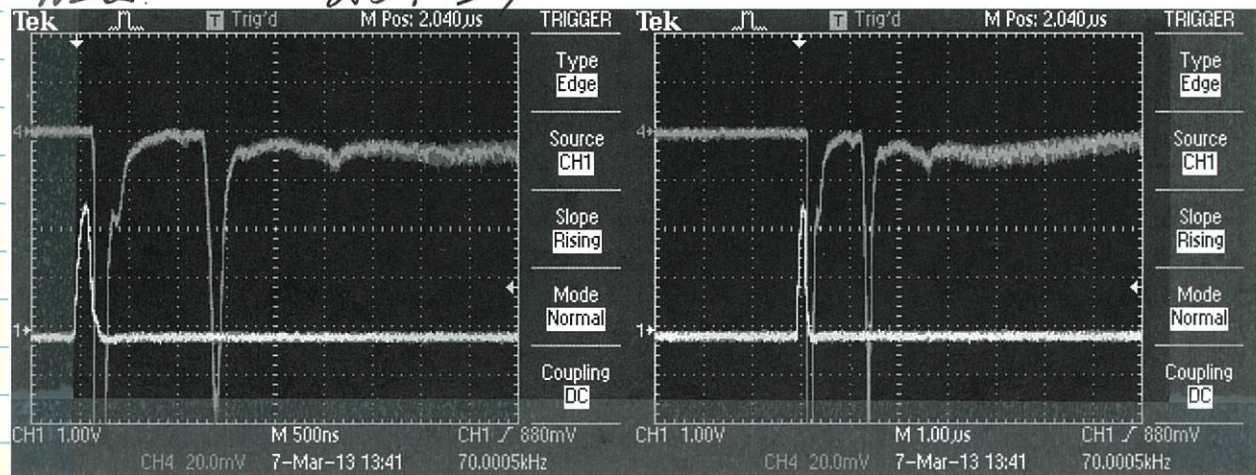
N90047 8854-37



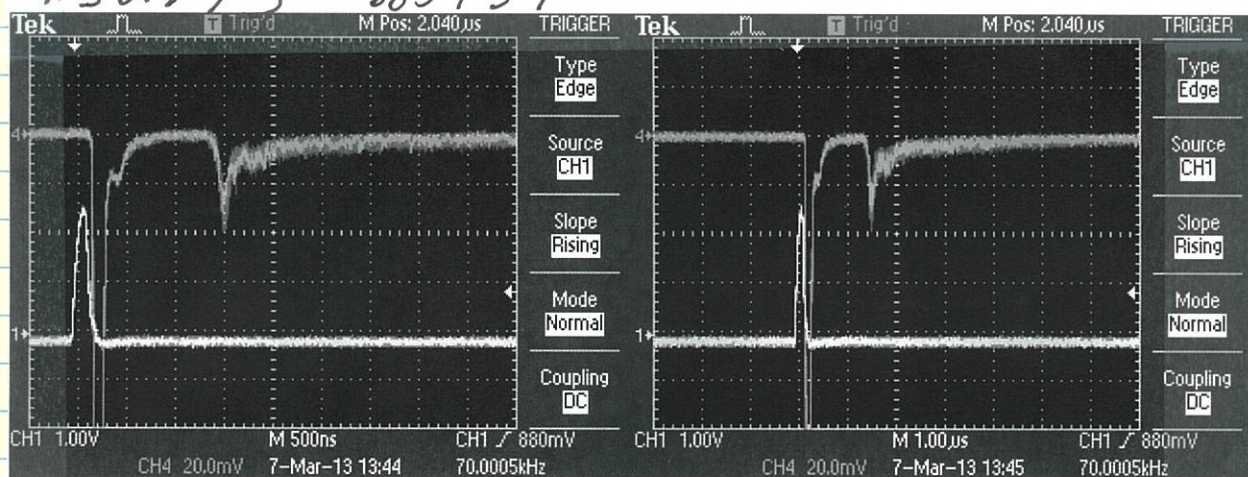
J094791



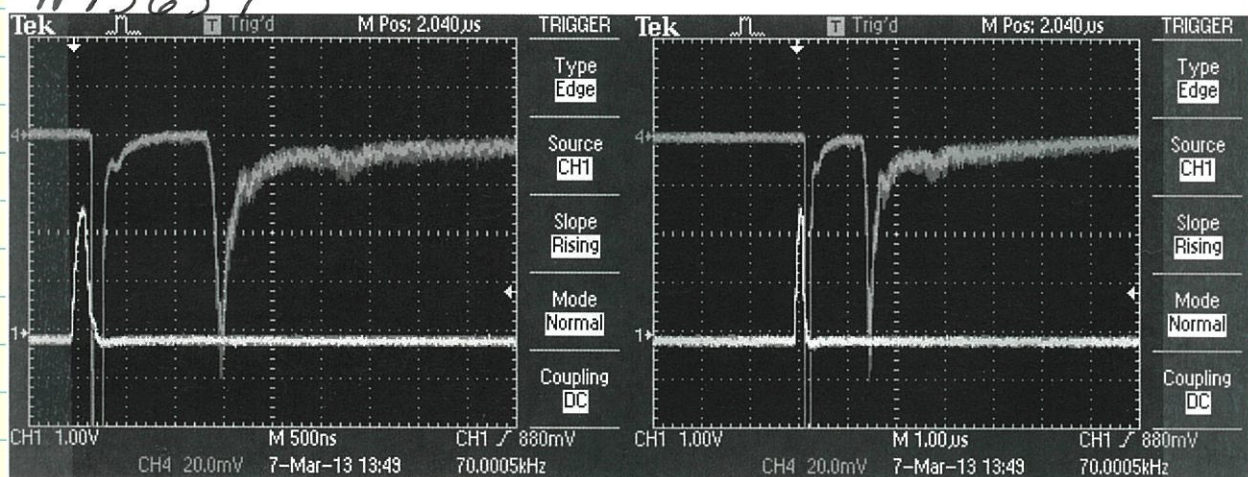
N32- 8854-37



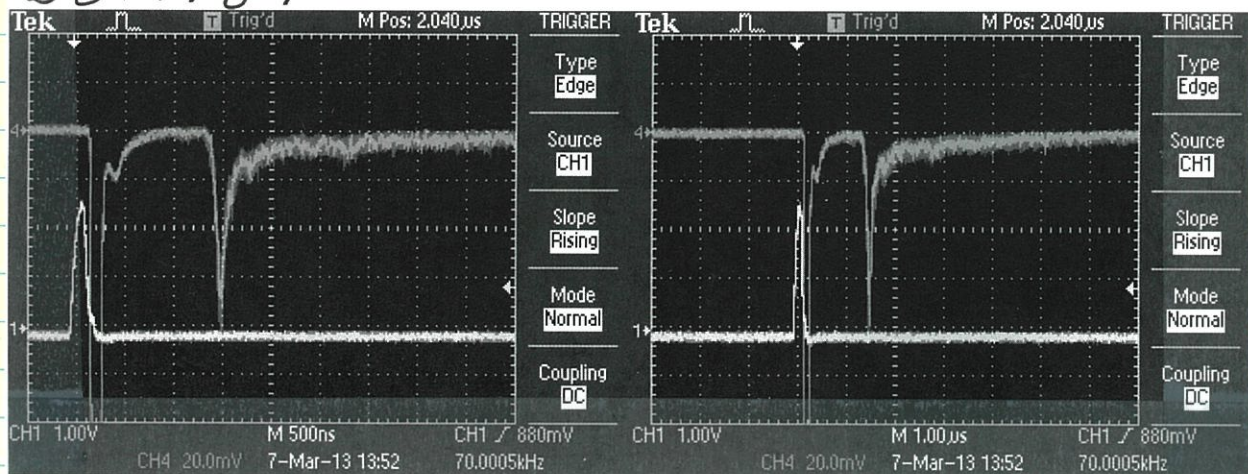
N32743 8854-37



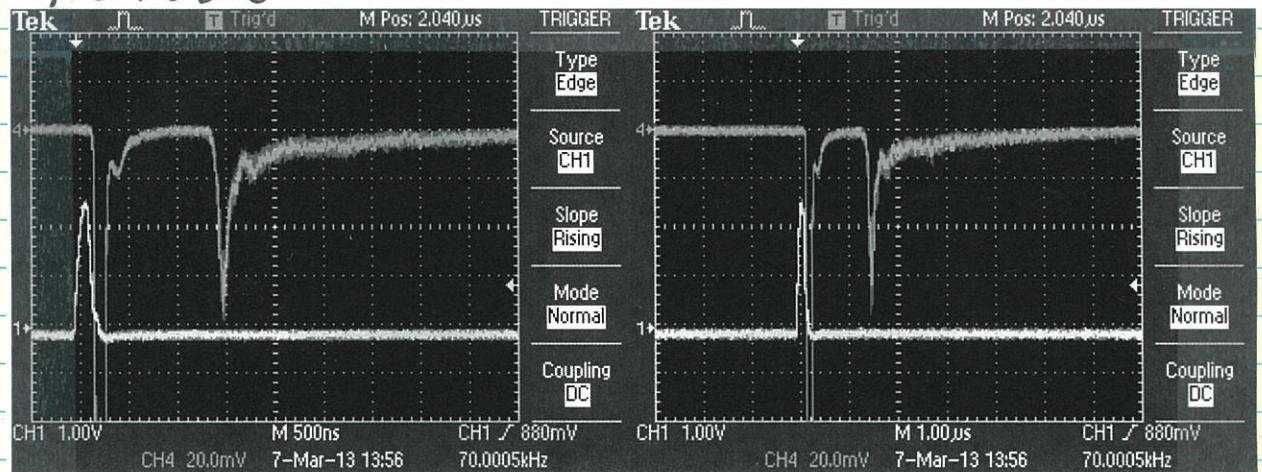
N93634



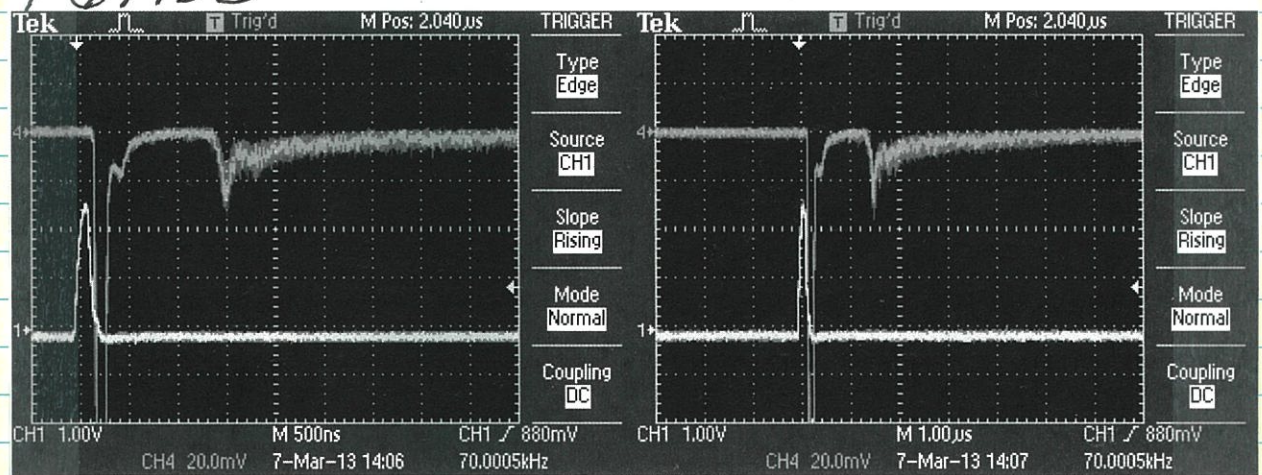
J094787



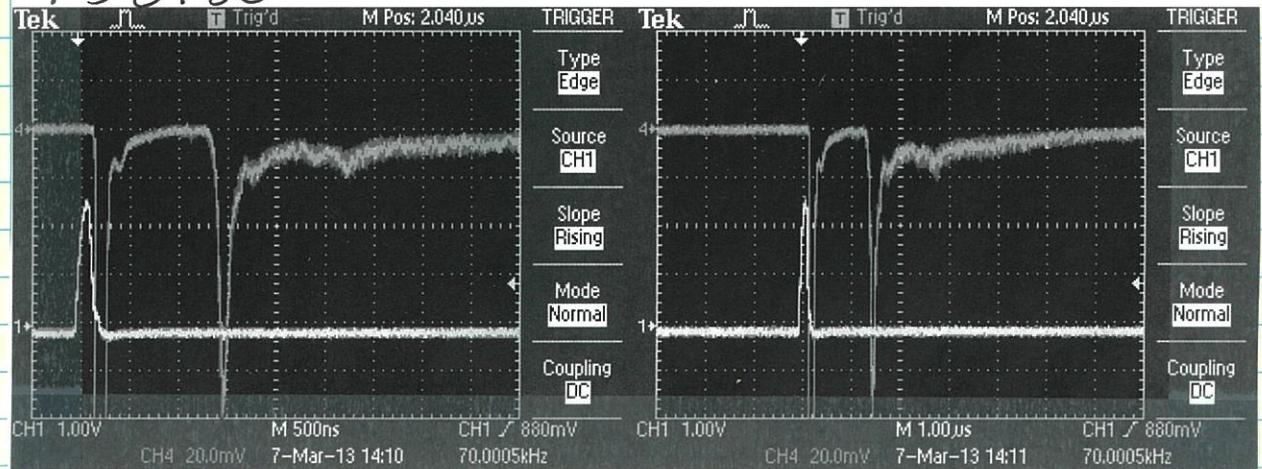
T51825



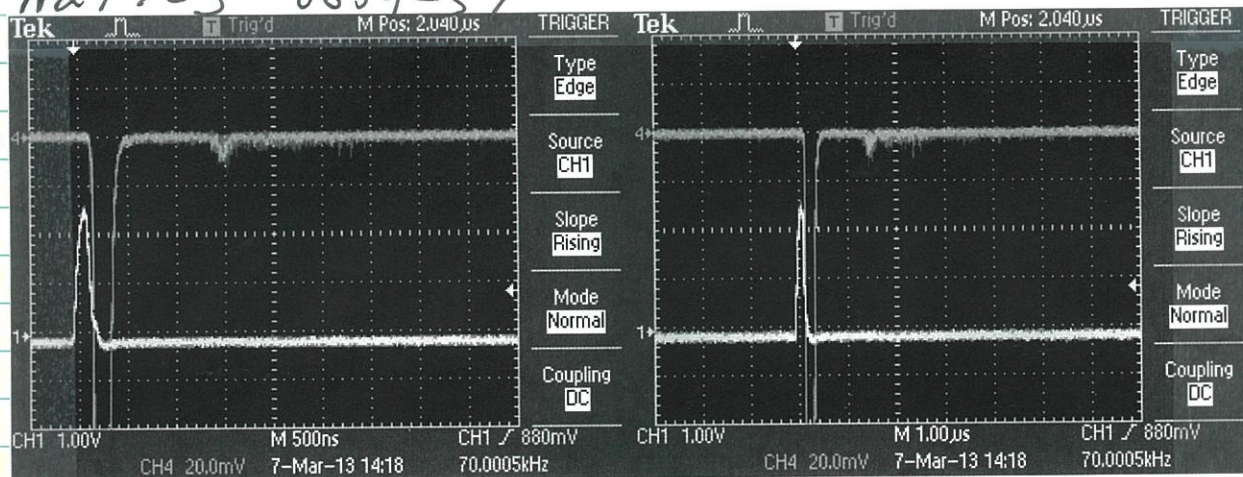
F67933



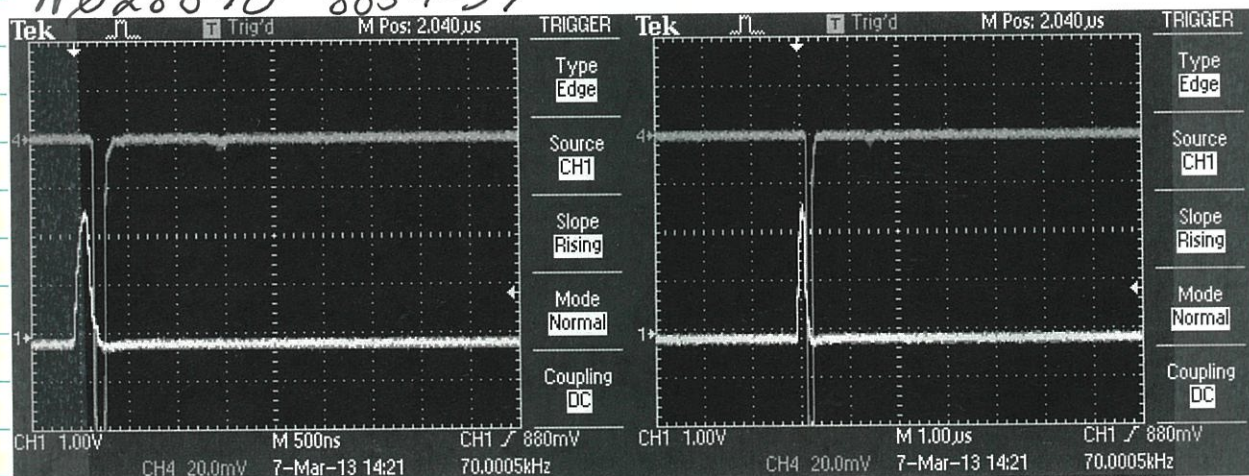
T50980



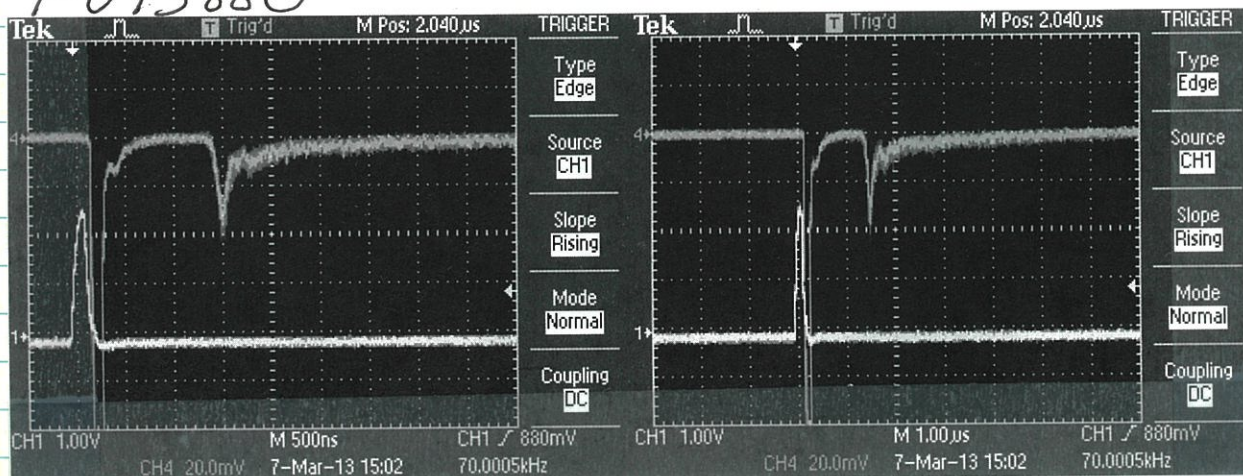
N27703 8854-37



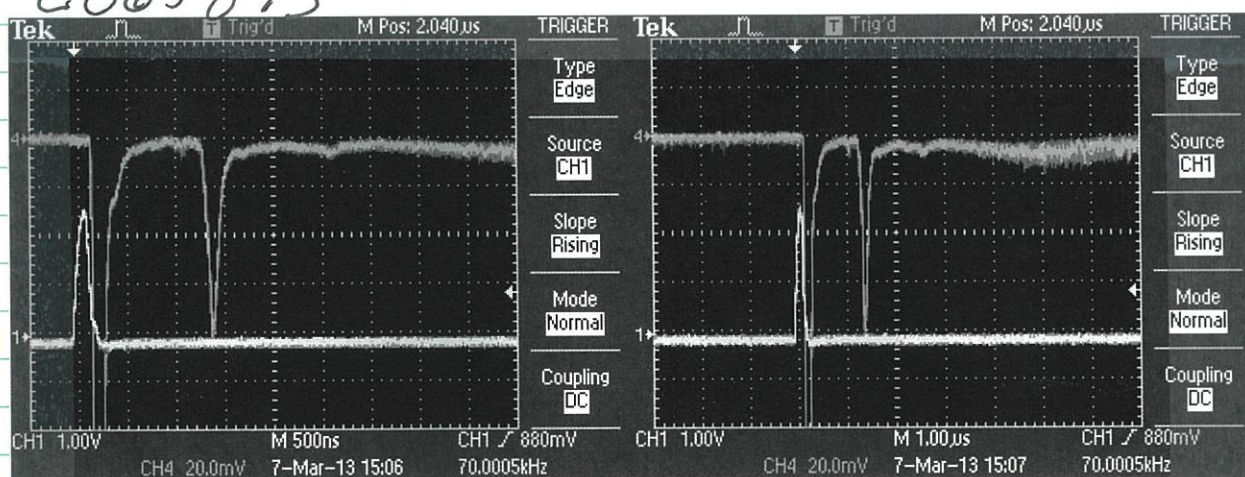
N028840 8854-37



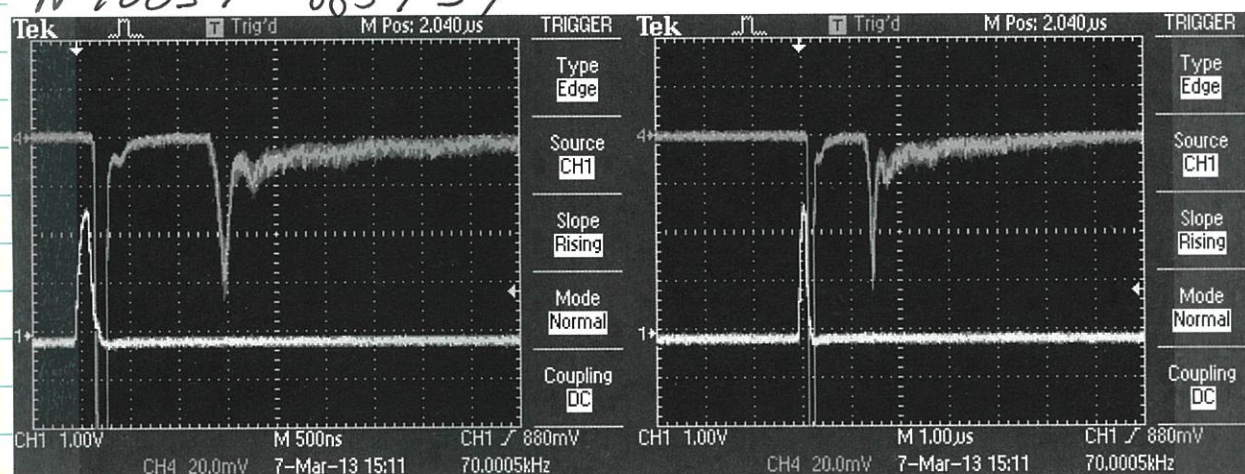
F093880



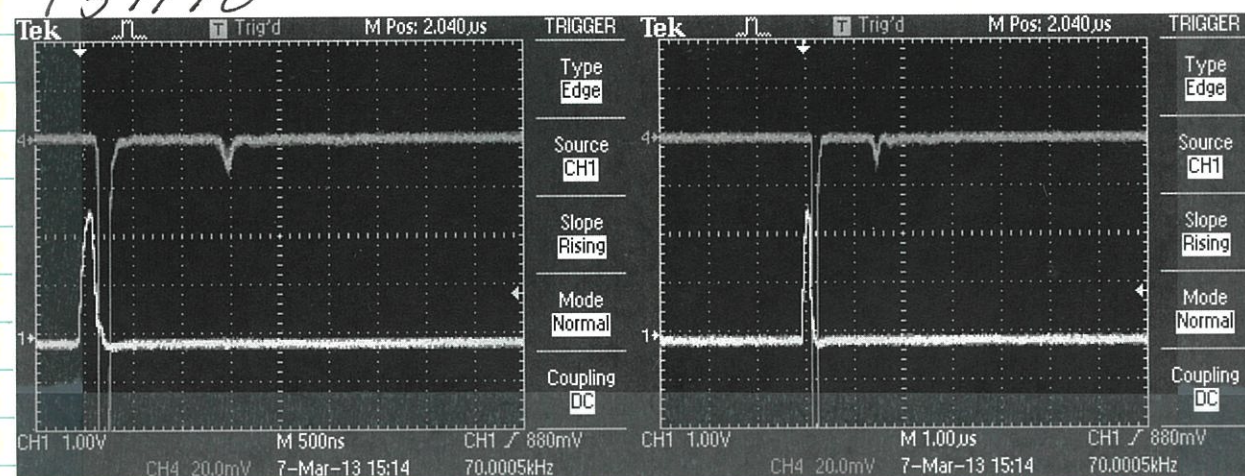
C065093



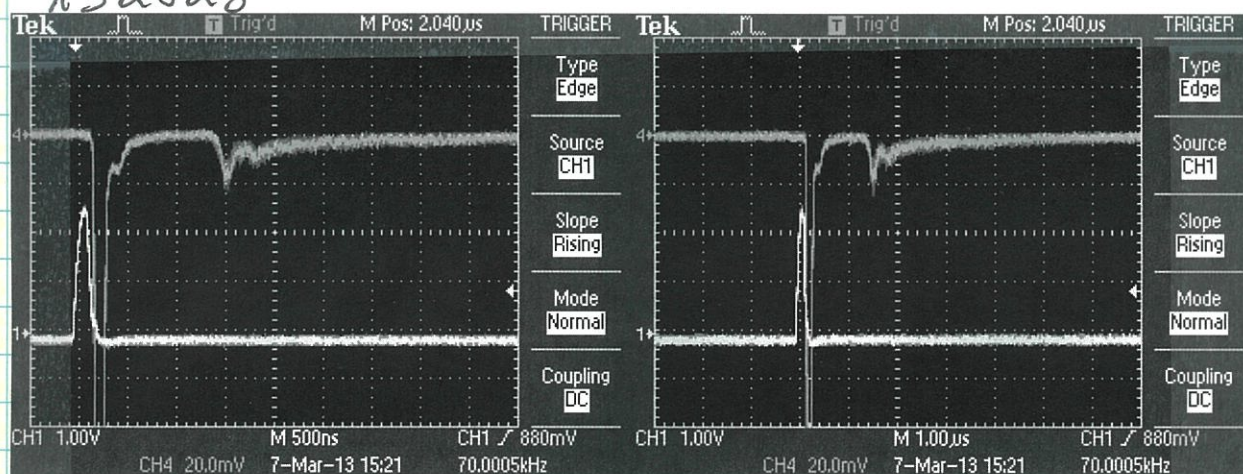
N90037 8854-37



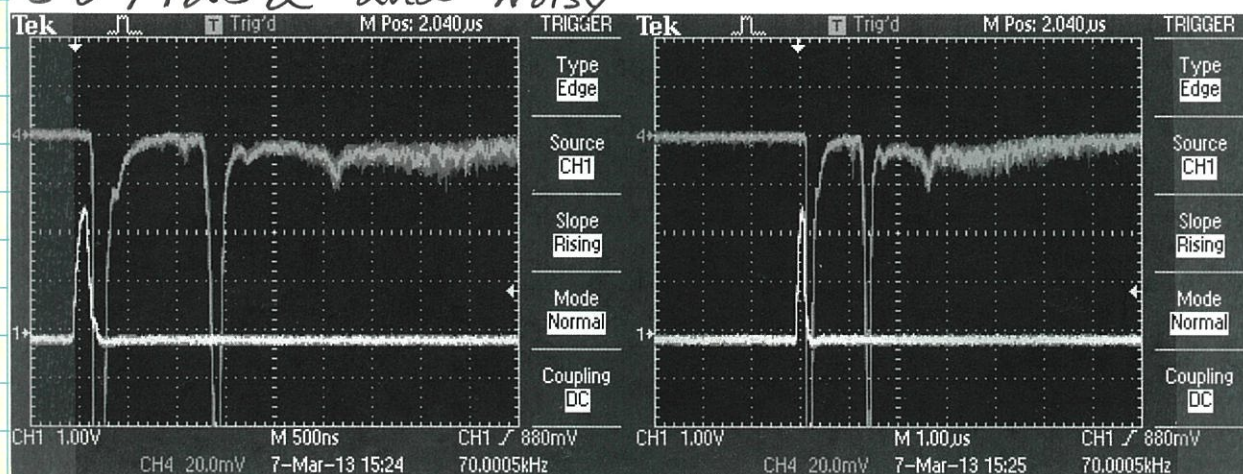
T51990



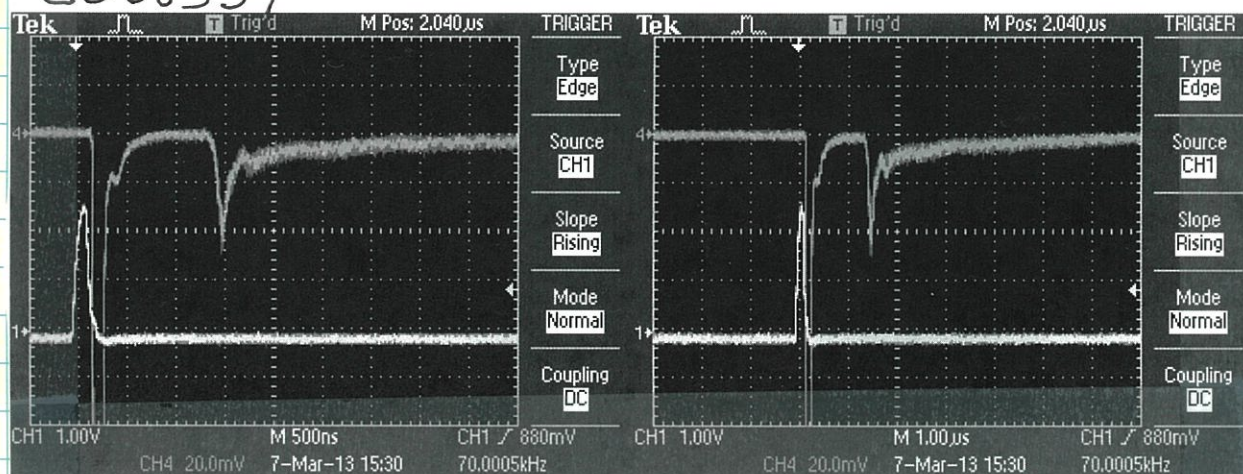
X32828



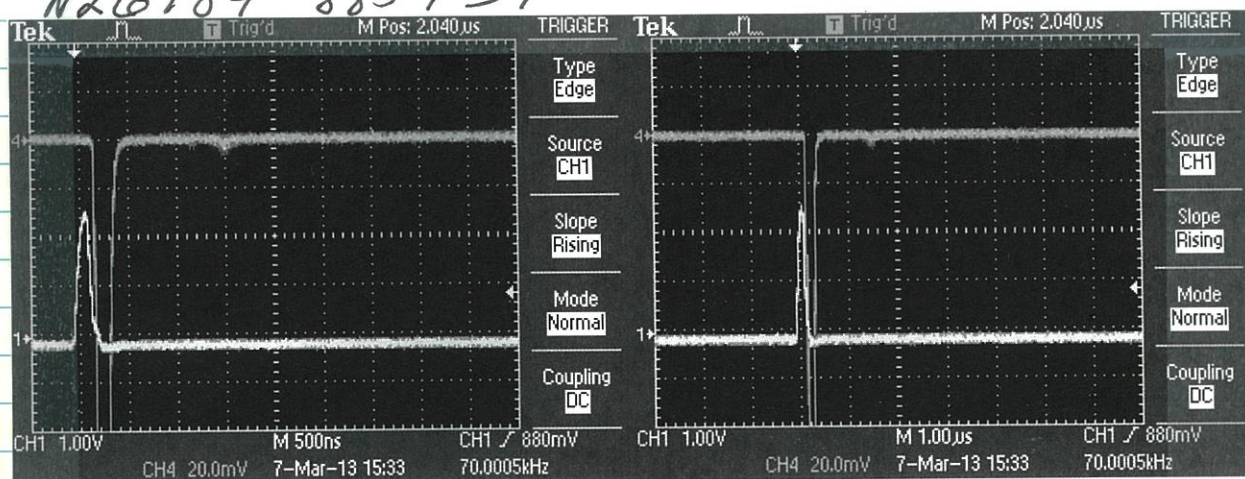
labeled as removed from G.C. 2000
J099252 and "Noisy"



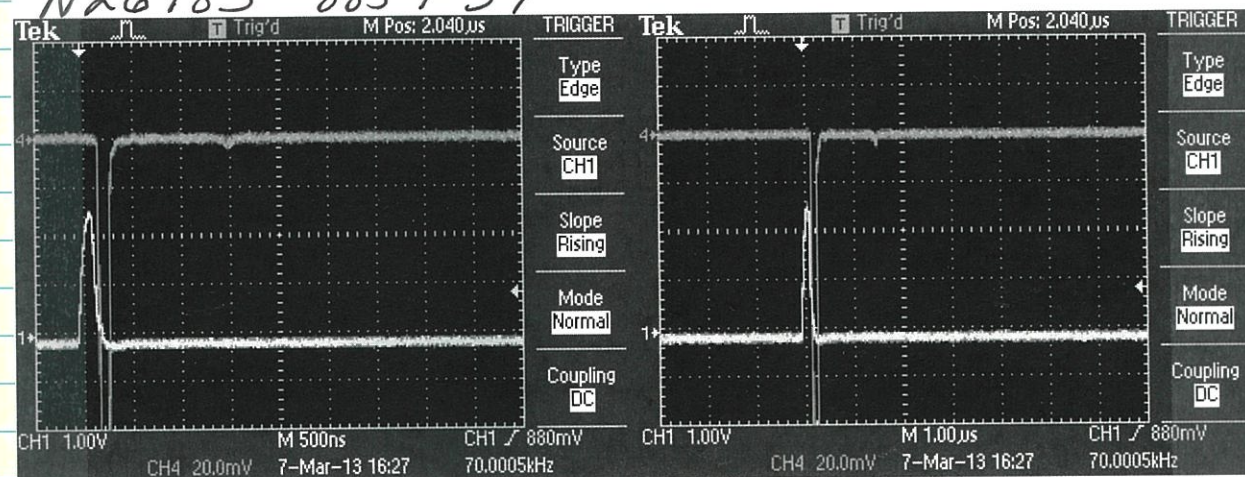
C068339



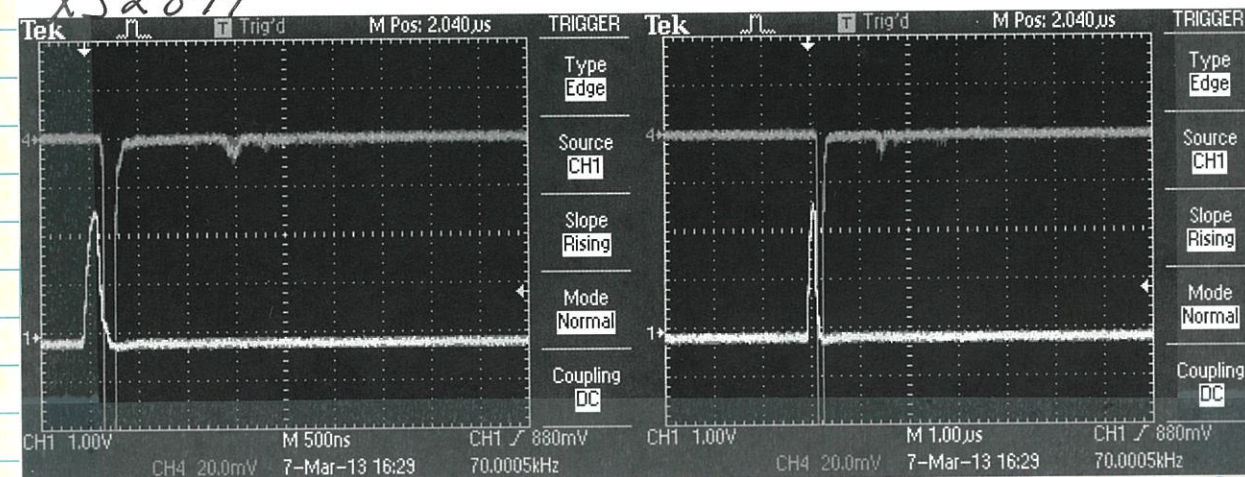
N26984 8854-37



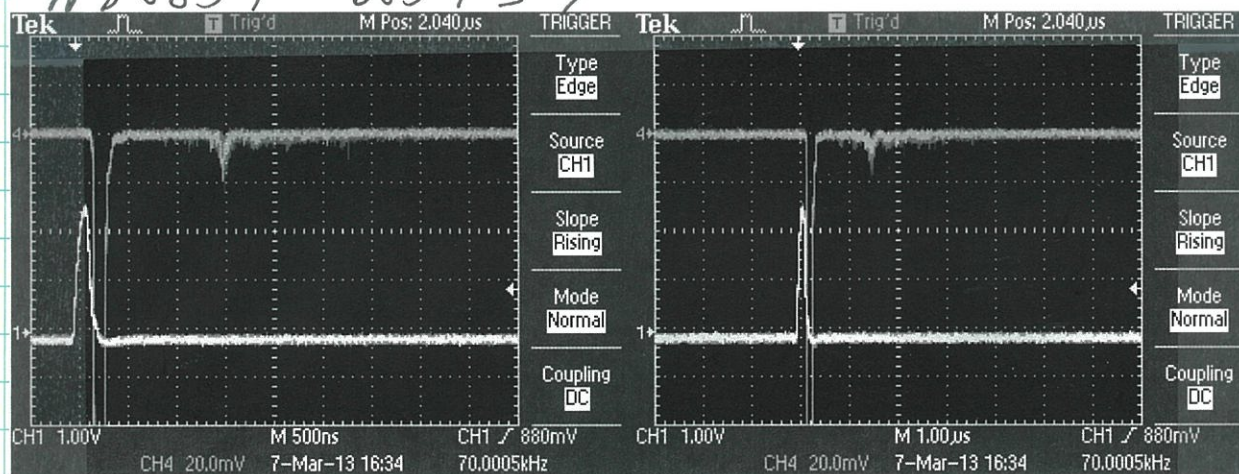
N26983 8854-37



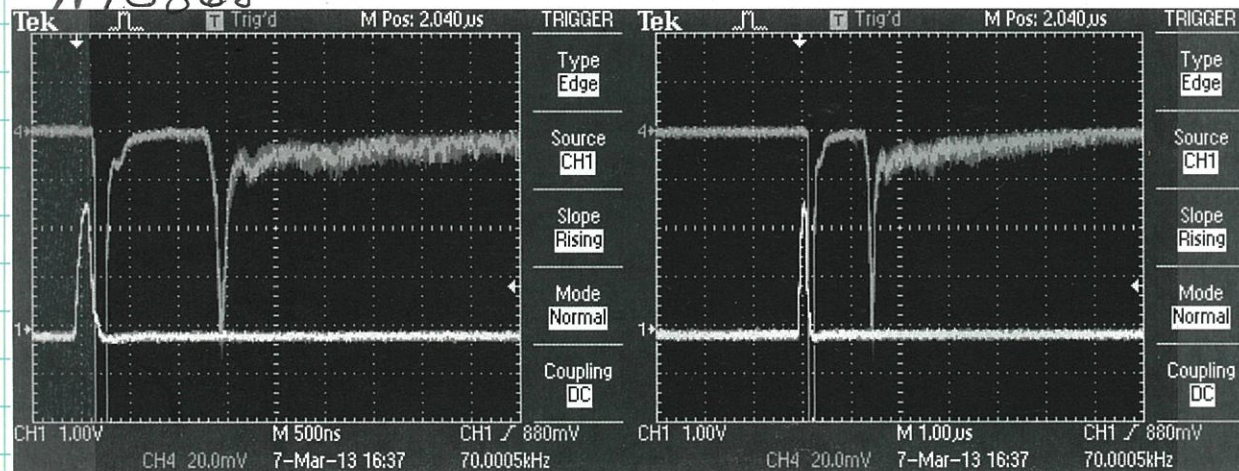
X32841



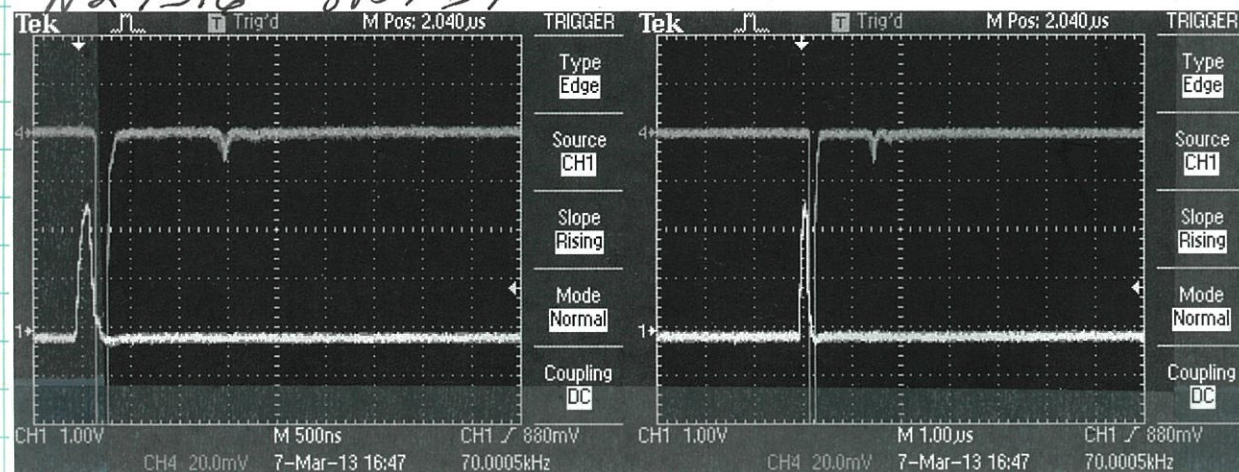
N88854 8854-37

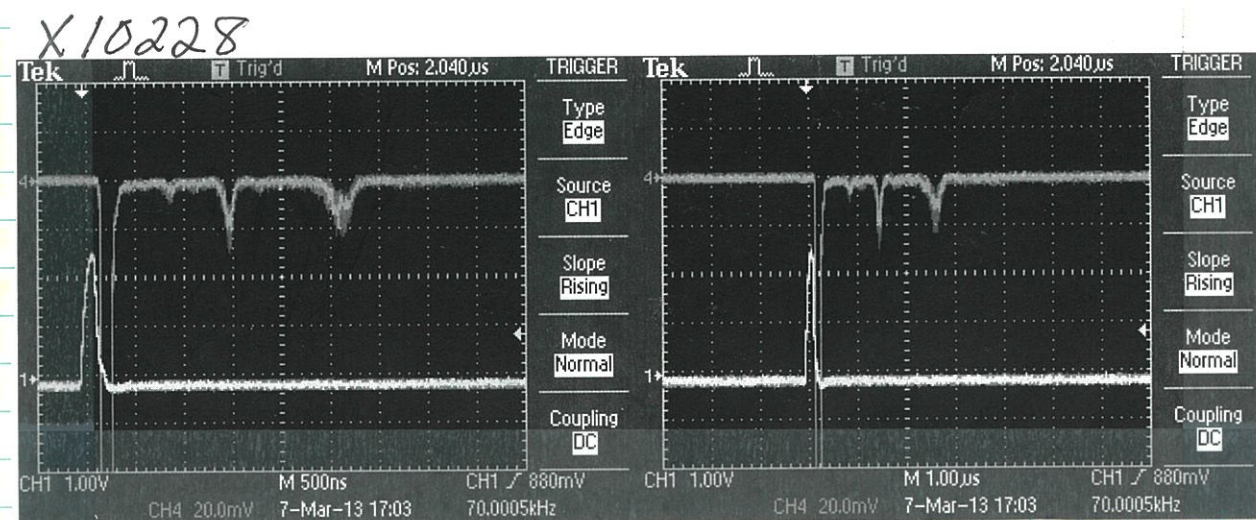
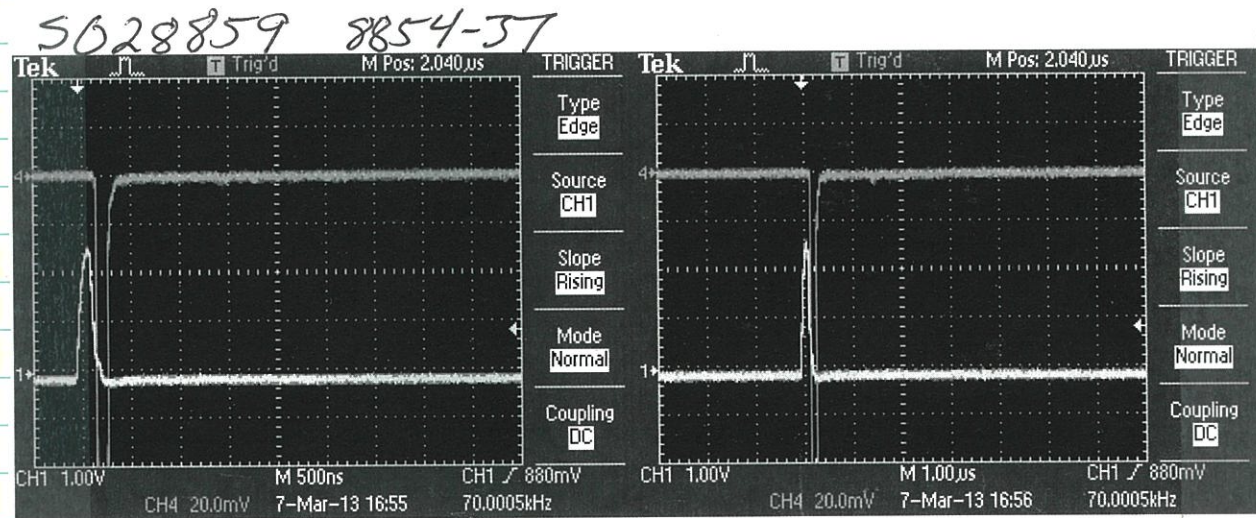
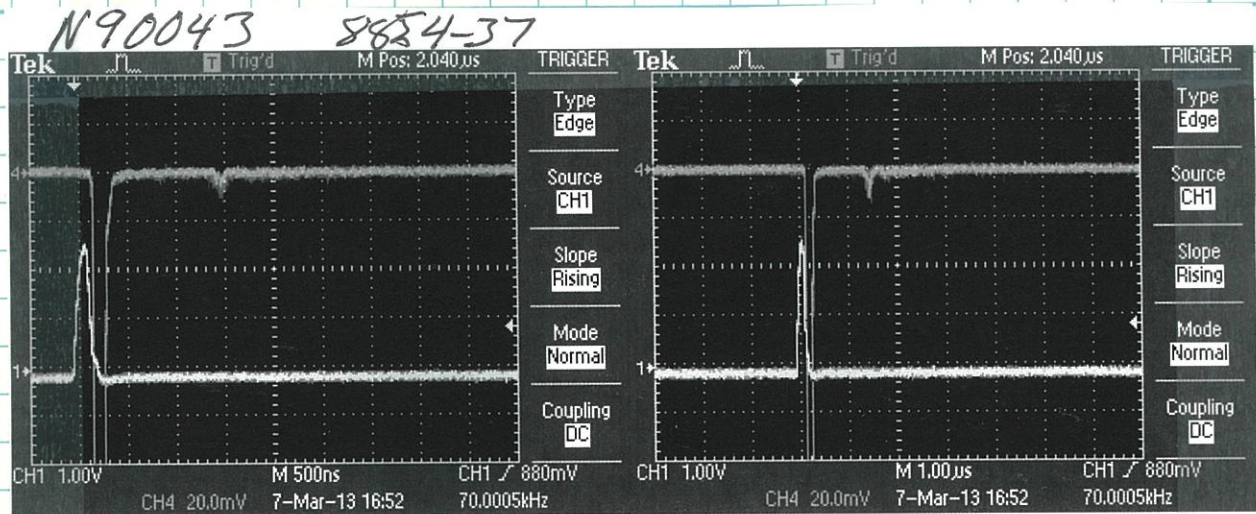


N90868



N27316 8854-37



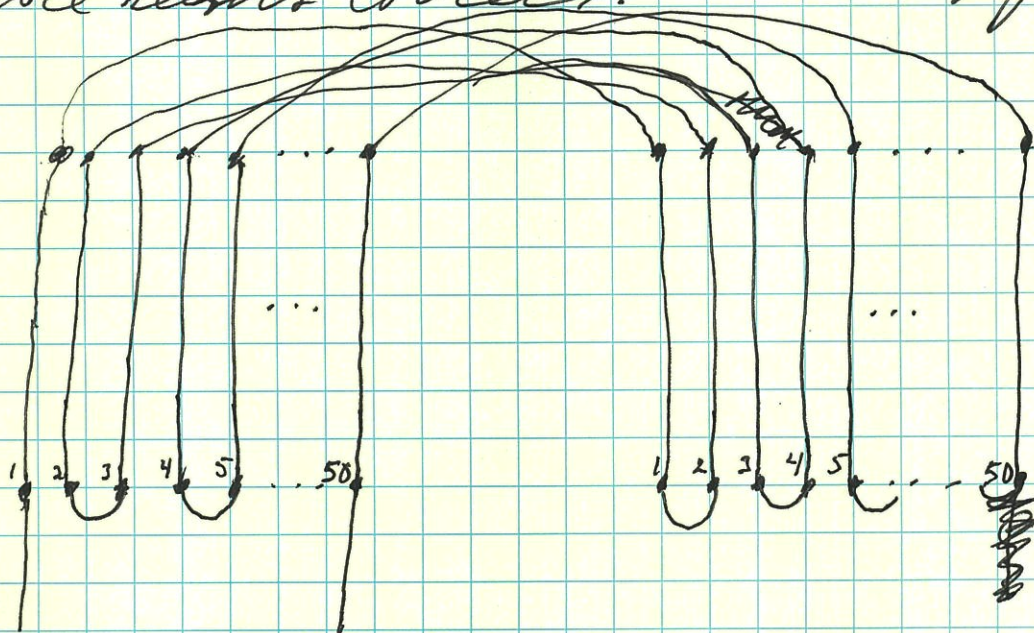


4/15/13 Check of 50 Conductor Cables For VME ADCs

I have configured two 50 pin D-sub terminal blocks and a short jumper to do a quick check of the 50 pin cables for the SNAF scanning ADCs.

Jessie pulled two cables on each arm from the power supply platform to the Slow Controls crate under the boxbeam in the Shield House. He terminated the ends in the Shield House. I am terminating the ends on the P.S. platform.

Since it is a modestly long run I will check impedances, DC, to verify the cable seems correct.



On the Left Arm. Using my Fluke 189 DMM I measure 333.40 ohms from terminal 1 to 50. I measure 320.01 ohms from terminal 1 to 49. The measurement from 1 to 49 skips 4 of the 100 wires.

$$\begin{array}{r}
 333.40 \Omega \\
 - 320.01 \Omega \\
 \hline
 13.39 \times 25 = 334.75 \text{ ohms}
 \end{array}$$

$$13.39 \div 4 = 3.35 \text{ ohms per wire}$$

So, it looks like things might be OK for the Left Arm.

Moving to the Right Arm.
I measure 324.96 ohms from terminal 1 to 50.
I measure 312.03 ohms from terminal 1 to 49.

$$\begin{array}{r} 324.96 \Omega \\ - 312.03 \Omega \\ \hline 12.93 \end{array} \times 25 = 323.25 \text{ ohms}$$

$$12.93 \div 4 = 3.23 \text{ ohms per wire}$$

F

R
D.

4/25/13 Calculated Fire Loads in the Shield Houses

VDC's

From my rigging notes I will estimate about 500 lbs of Styracite per VDC.

$$500 \cdot 2 = 1000 \text{ lbs of epoxy/glass}$$

The active area is $2.88\text{m} \times 2.118\text{m}$

Thickness is $26\text{mm} \cdot 3 = 78\text{mm}$

Volume is 0.0476m^3

$$0.048\text{m}^3 = 1.7\text{ft}^3$$

$$1.7 \cdot 2 = 3.4\text{ft}^3 \text{ of gas}$$

1" Polyethylene Gas Line

$$40' + 20' + 6' \approx 70' \text{ total}$$

1" I.D. $\frac{1}{8}$ " wall $\Rightarrow$ $1\frac{1}{4}$ " O.D.

$$\begin{array}{r} \pi (.625)^2 \\ - \pi (.5)^2 \\ \hline \end{array} \quad \begin{array}{r} 1.227\text{in}^2 \\ - .785\text{in}^2 \\ \hline .442\text{in}^2 \\ .003071\text{ft}^2 \end{array}$$

$$.003071\text{ft}^2 \cdot 70' = 0.215\text{ft}^3 \text{ of P.E.}$$

$$= 0.382\text{ft}^3 \text{ of gas}$$

$\frac{1}{4}$ " Polyethylene Tubing

$\frac{1}{4}$ " O.D. 0.12" I.D.

$$\begin{array}{r} \pi (.125)^2 \\ - \pi (\frac{.12}{2})^2 \\ \hline \end{array} \quad \begin{array}{r} 0.0491\text{in}^2 \\ - 0.0227\text{in}^2 \\ \hline 0.0264\text{in}^2 \end{array}$$

$$0.007\text{ft}^3/37\text{ft}$$

Signal and HV Cable

assume 37' for each cable

$$\begin{array}{rcl}
 \text{VDC} & 46 \times 2 & = 92 \text{ ribbon} \\
 \text{S1} & 12 \times 2 & = 24 \text{ HV \& RG-58} \\
 \text{S2m} & 24 \times 2 & = 48 \\
 \text{Gas } \checkmark & 10 \times 2 & = 20 \\
 & & \underline{184}
 \end{array}$$

$$\begin{array}{rcl}
 \text{Pion Rejector} & 68 \times 2 & = 136 \\
 & + 184 & \\
 & \hline
 & 320
 \end{array}$$

$$\begin{array}{rcl}
 \text{Pre-Shower} & 48 \times 2 & = 96 \\
 \text{Total Absorber} & 80 \times 2 & = 160 \\
 & \hline
 & 256 \\
 & + 184 & \\
 & \hline
 & 440
 \end{array}$$

$\frac{1}{4}$ " cable, assume 0.75 is plastic
 $(\pi(.125)^2 \times 0.75 \div 144) \times 37 = .009 \text{ ft}^3 \text{ per cable}$

Left Arm
 2.9 ft^3

Right Arm
 4.0 ft^3

Dry Air Poly $\frac{1}{4}$ "

Tubing for dry air to S1, S2m, Gas $\checkmark$ PMT housings.
 46 lines per arm. Assume 37' each.
 0.32 ft^3

 $\frac{1}{2}$ " Polyethylene Gas Lines

$\frac{1}{2}$ " O.D. 0.375" I.D.

$$\begin{array}{rcl}
 \pi(.25)^2 & & 0.196 \text{ in}^2 \\
 - \pi\left(\frac{.375}{2}\right)^2 & & - 0.110 \text{ in}^2 \\
 \hline
 & & 0.086 \text{ in}^2
 \end{array}$$

Assume lines are $40' + 20' + 6' \approx 70'$ total

Per line 0.042 ft^3 of P.E.
 0.054 ft^3 of gas

5 lines per arm $\Rightarrow 0.21 \text{ ft}^3$ of P.E.

1 line of Ar/Eth $\Rightarrow 0.06 \text{ ft}^3$ of gas

FPP Carbon Doors

Made of graphite 1.8g/cc

Assume each door half is $234 \times 50 \text{ cm}$

$2.34 \text{ m} \times 0.5 \text{ m}$
 2.34 m^2 per full door

Door thicknesses are

1.90 cm
3.81
7.62
15.24
<u>22.86</u>
51.43 cm

$1.2 \text{ m}^3 = 42.4 \text{ ft}^3$ of graphite

Delay Cables Inside Shield Houses

Left Arm

175 delay spools
 350 of $\frac{1}{4}$ " cables

$$24' + 21' + 6' = 51'$$

Right Arm

215 delay spools
 430 of $\frac{1}{4}$ " cables

0.013 ft^3 per cable

4.6 ft^3 add 37' to each cable from rear of stack to PANTON DAC. $+ 3.3 \text{ ft}^3$ 7.9 ft^3	5.6 ft^3 $+ 4.1 \text{ ft}^3$ 9.7 ft^3
--	--

Left Shield House

42.4 ft³ graphite
 7.9 ft³ delay cable
 0.4 ft³ dry air poly
 2.7 ft³ det. cables
 0.5 ft³ P.E. for 1"
 0.4 ft³ gas for 1"
 0.1 ft³ gas for 1/2"
 0.3 ft³ P.E. for 1/2"
 3.4 ft³ gas for VDCs
 1000 lbs of epoxy/glass

Left

42.4 ft³ graphite
 12 ft³ plastic (PVC, P.E.)
 4 ft³ Ar/Eth gas
 1000 lbs epoxy/glass

Right Shield House

9.7 ft³ delay cable
 0.4 ft³ dry air poly
 4.0 ft³ det. cables
 0.3 ft³ P.E. for 1"
 0.4 ft³ gas for 1"
 0.1 ft³ gas for 1/2"
 0.3 ft³ P.E. for 1/2"
 3.4 ft³ gas for VDCs
 1000 lbs of epoxy/glass

Right

14.7 ft³ plastic (PVC, P.E.)
 4 ft³ Ar/Eth gas
 1000 lbs epoxy/glass

4/25/13 Portable Gas Mixer Notes

These are some random notes on the small portable gas mixing system I put together.

Both gas cylinders should supply the same pressure. I use about 40 psi.

The pressure sensor on the buffer tank is
0-200 psi absolute
0-10 V

$$1V = 20 \text{ psi}$$

The control circuit should keep the pressure in the tank at about 1.5 V.

$$1.5V = 30 \text{ psi}$$

$$\begin{array}{r} -18 \text{ psi for atmosphere} \\ \hline 12 \text{ psi over atmosphere} \end{array}$$

Test Stand for Bogie Motors

6/7/13

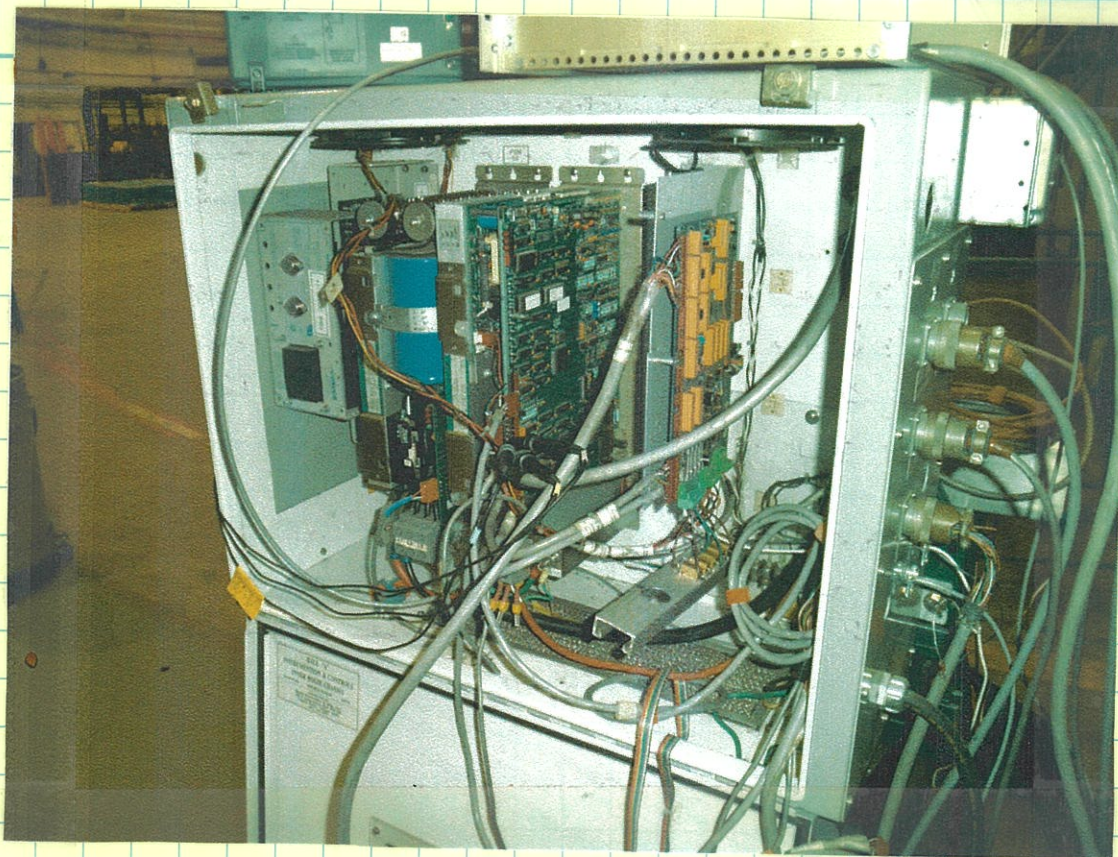
Revisiting the test stand I put together for the bogie drives. This is the same setup used on pages 19-26 of this volume.



The setup has one bogie motor and a 12VDC motor as a load. The bogie motor is on the left, the 12V on the right. The V-belt has enough slack that the pulley can be slipped off the bogie motor. The 12V motor has a resistive load made of nine 2 ohm resistors in parallel. $\frac{2}{9} \approx 0.22 \Omega$. The resistors are mounted on a heat sink visible on the middle shelf of the cart.

The panel box on the right of the cart was from the controls for the inner bogies. It has the power supplies, drive module, and brake board.

The small box on top of the controls has switches and a potentiometer to mimic the VME controls.



The picture above is the inside of the control box. Below the brake board is an aluminum angle with resistors mounted to mimic the brakes of three motors. Each "brake" is two $100\ \Omega$ resistors in parallel.

The cable from P1 & P2 of the drive module is plugged into the brake board connector for the 4th motor.

Jumpers need to be installed in the connectors for motors 1, 2, and 3. A jumper needs to be installed across pins ~~15 and 16~~ ^{15 and 17}. Also, a jumper needs to be installed across pins 8 and 9.

The jumper across pins 15 and 16 pass the power supply enable along. This is from the power supply itself, not the VME signal.

No { The P5T drive has optocouplers to the power supply module. See p. 20 of the BRU 200/500 instruction manual.

The jumper across pins 15 & 16 substitute for a pair of wires that normally go to $SS0+$ and $SS0-$ of the drive module P1 pins 6 and 7. The $SS0$ is a relay that closes when the DM is ready to run and has no fault.

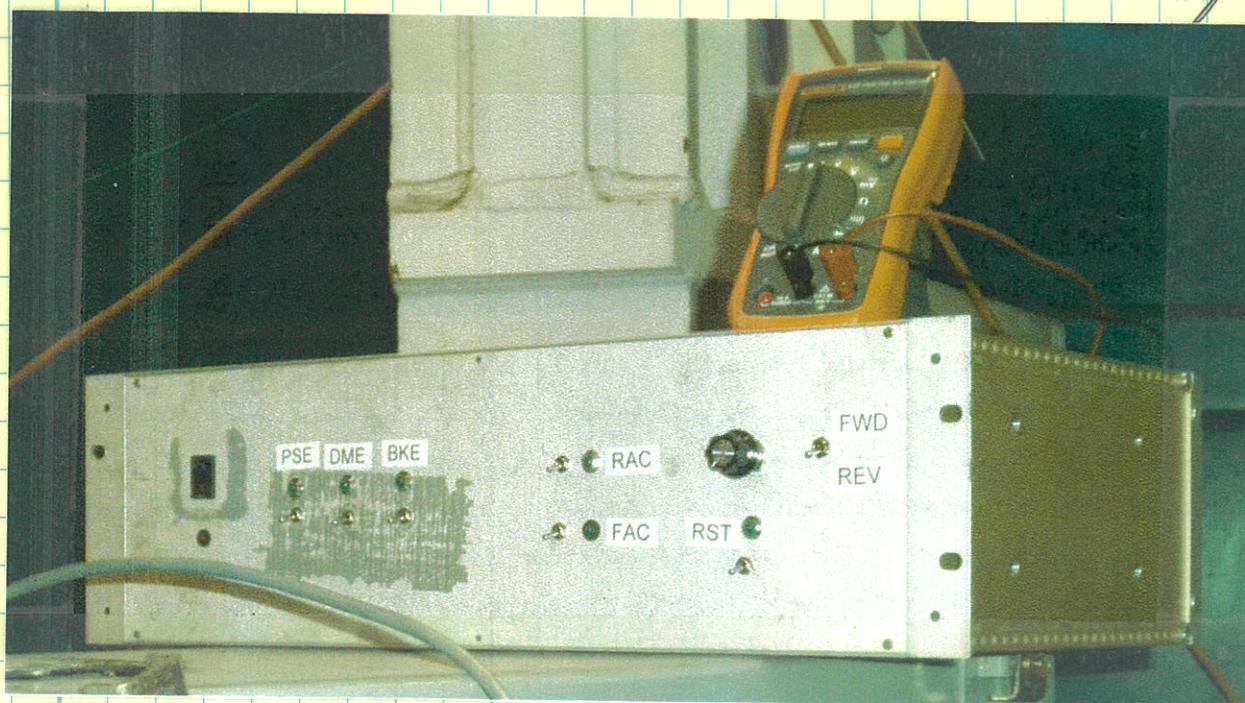
The jumper across pins 8 and 9 substitute for a pair of wires that normally go to $OUT+$

and OUT - of the drive module P2 pins 8 and 9. This is a relay that closes if the DM is enabled by connecting the DM P1 pins 1 and 2 together. The DM P1 pins 1 and 2 go to the brake board P1, P2, P3, P4 pins 13 and 14 which go to K8 contacts on the brake board. K8 is energized if the DME line from the VME PTO card has 24V on it.

What a mess this all is.

On the other side of the brake board, on connector P6, jumpers need to be installed.
 pin 1 and pin 2 need to be jumpered together.
 pin 3 and pin 4
 pin 5 and pin 6
 pin 7 and pin 8
 pin 9 and pin 10
 pin 11 and pin 12

Pin 1 is toward the middle of the board.



This small box is intended to act like the VME crate. It was recycled from something. The rocker switch and red LED on the left side are not connected to anything.

Flipping the toggle switches will put 24V ~~15V~~ ^{24V} on the signal lines indicated.

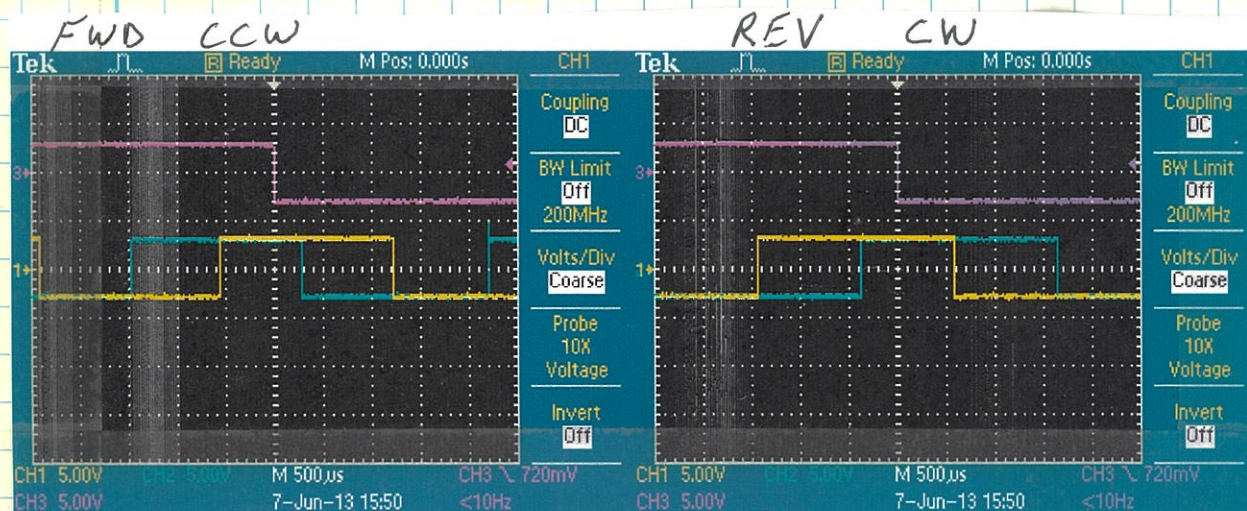
The LED below each switch will light if 24V comes back on the respective "RTN" line. The switches are in series where required.

I have the motor S/N H000517 mounted in the setup. It has a tag on it that says, "Runs OK. But, encoder phase is off." Dated 11-9-12 by me.

See p. 25.
Previous work was opposite of this.

The scope is connected with
 Ch1 DM P4 pin 3 (A+) is ~~connection~~ pin 4 (A-) in tip
 Ch2 DM P4 pin 5 (B+) is ref. pin 6 (B-) is tip
 Ch3 DM P4 pin 7 (I+) is ref. pin 8 (I-) is tip

With PSE DME, and BKE energized. Speed pot set to 0V. I turned the pulleys by hand and triggered on the index signal. I did a CCW and CW rotation.



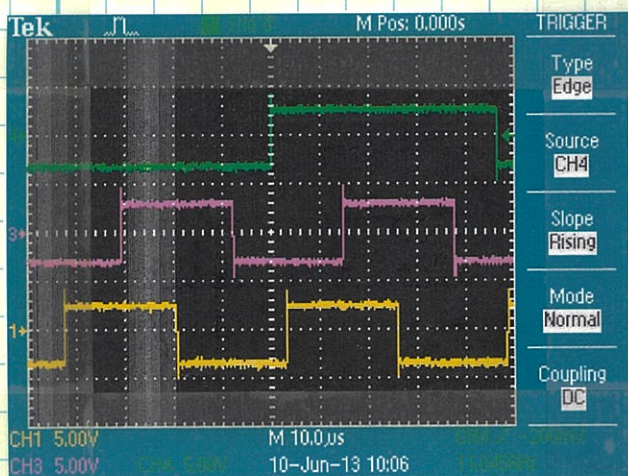
Looking back at page 24 of this volume. This seems consistent with the photos. After looking over some of the prior pictures, I'm not sure why I put on the tag that the phasing is off. It seems consistent with other pictures.

It also looks like the newer motors, 503 and 506, run with A+B 180° off from the rest of the motors.

6/10/13

I have reconnected the scope probes so they are the same as was on p. 25 of this volume. Tek 6 is with the drive voltage 3.162V, -3.65V on the DC motor, CCW rotation, motor direction is "FWD".

After running for a few minutes, the mosfets on the brake board are very warm. The mosfet to the motor brake is HOT!



Tek 6. This is the same as the picture on p. 24 of this volume.

Looking at the motors on the R-Driver outer fogies I see, from the beamline side, S/N H000504, H000505, H000506, H000519.

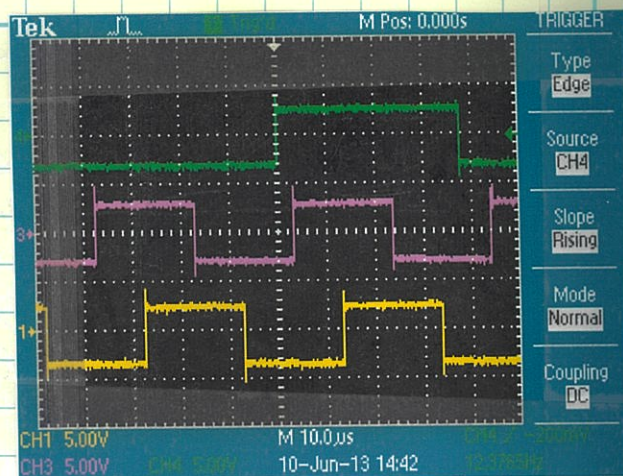
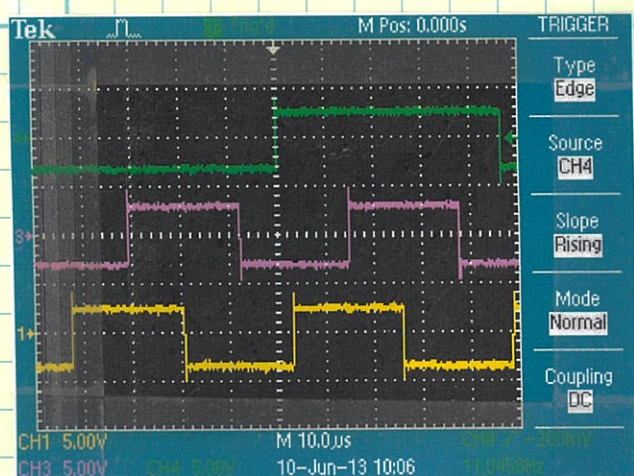
The picture above looks the same as the picture for H000504 on p. 23 of this volume.

I really do not know why I tagged it as having the phase off.

I put the motor S/N H000514 in the stand. I also tagged this one as running correctly but having the wrong phasing. Tek 0. 3.064V drive. -3.53V on motor. CCW. Motor direction is "FWD".

This seems identical to the picture above. Running it in "REV". 3.056V drive. +4.03 on motor. CW rotation. Tek 1.

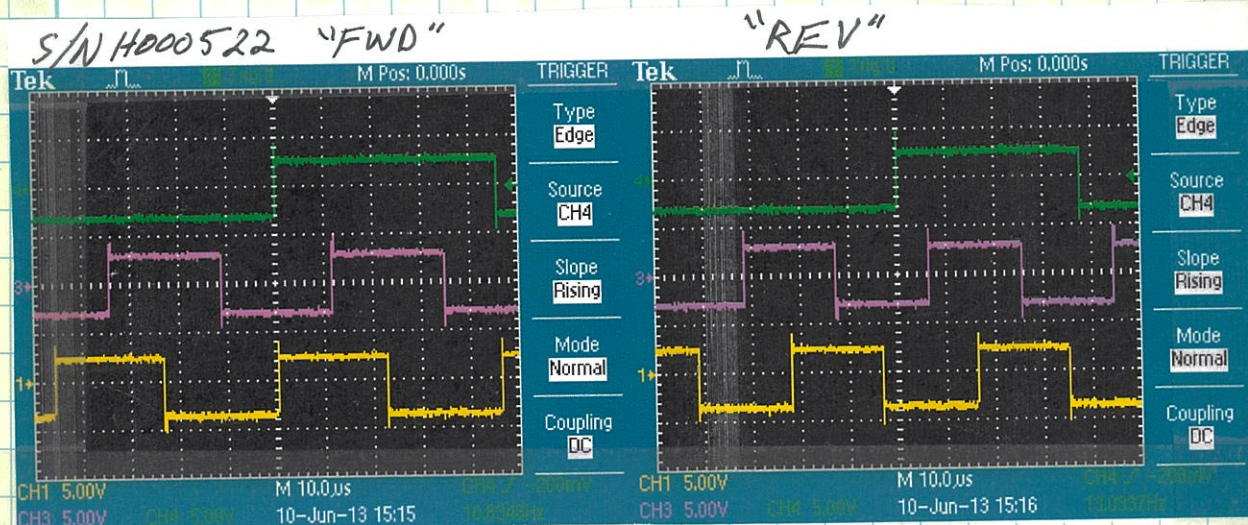
The motor S/N H000522 also had a tag stating it ran fine but the encoder phases were off. I put it on the test stand.



Motor S/N H000522

"FWD". 3.048 drive. -3.30 on DC motor. CLW. Tek 2.

"REV". 3.048 drive. +4.12 on DC motor. CW. Tek 3.



Starting from the beamline side, the motors on the R-Arm middle bogies are S/N H000509, 503, 532, 507.

Looking on p. 24, the phasing for motors 532 and 522 seem to be 180° out.

Also, on pp. 22-24, the motors 509, 503, 532 and 507 all have the same phasing.

For the motors on the outer bogies, S/N 504 is 180° out from the middle bogies and 509 is the same as the middle motors.

506

Continuing To Check Bogie Motors/Drives 6/12/13

While talking to Javien about this phasing difference I remembered that the index pulse has to come $\pm 18^\circ$ of "top dead center", i.e. when the keyway of the spindle is on the top (the side of the motor with the connectors on it).

The A & B pulses are 2000 per rev., far smaller than 18° each. So, the controller cannot care about the phase of A or B relative to the index pulse. It only cares about the phase of A relative to B.

So, while we want to check the index pulse is 18° of "TDC", we also want to check that A & B are stable with respect to each other and their phasing with respect to each other is correct.

Motor brake current draw.

I put a DC current clamp on a wire going to the motor brake connector. A Exlube i1010 on a Exlube 115 DMM.

With the motor S/N 400522 hooked up I see .6A and .8A. It seems to vary a little bit. Assuming .8A at 24V that is 19.2W.

The two 100Ω resistors in parallel to fake the brakes of the other three motors which are not in the setup, will give 50Ω on $24V \Rightarrow .48A$ for 11.52W.

For checking the motors we will do a 3.048V drive (or close to that) and trigger on Ch 1 or Ch 4 for both FWD and REV.

	FWD Ch 1	REV Ch 1	FWD Ch 4	REV Ch 4
S/N H000522	Tek 0	1	2	3
514	4	5	6	7
517	8	9	10	11
Volts across DC motor	-3.26	3.98	4.03	-3.39
S/N H000521	3.29 12	13	14	15
	-3.29	3.71	3.76	-3.45
S/N H000513	16	17	18	19
	-3.34	3.98	4.03	-3.47
S/N H000511	does not run			
S/N H000502	20	21	22	23
	-3.03	3.60	3.62	-3.18
S/N H000537	24	25	26	27
	-2.76	3.78	3.83	-2.86
S/N H000510	Tek 28	29	30	31
	-3.37	3.90	3.94	-3.36

The drive module for the setup for these tests has a "personality" IC that only has black tape on it.

6/14/13 Connecting the laptop "segal2" to the serial port and using hyperterm. 9600, 8, 1, none, XON/XOFF. Sending a "P" and get back

Scale 0.99 AMP/V

Offset 0.0000

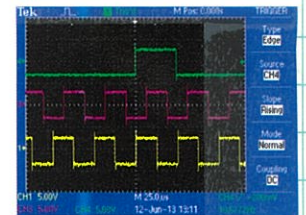
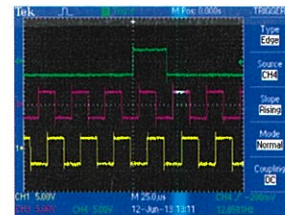
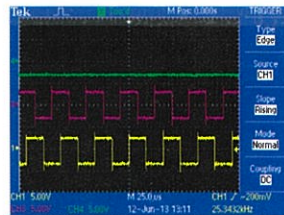
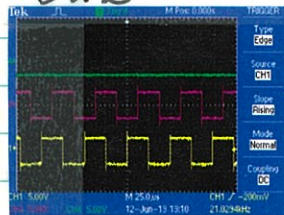
Peak I 10.1 Amp

Overspeed 3495 RPM / Mode (2): Torque

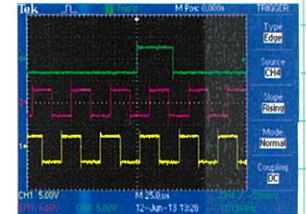
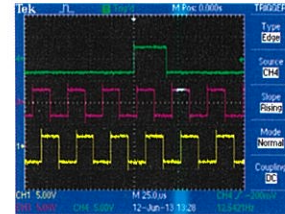
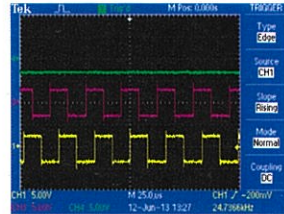
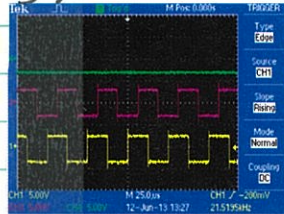
Filter BW OFF Hz / Monitor ~ Tach

Drive module is a DM-50. S/N H000775.

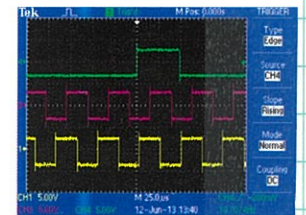
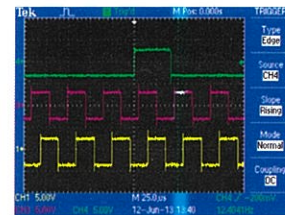
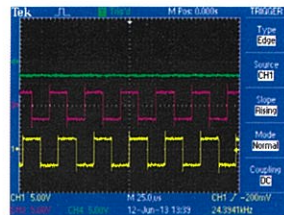
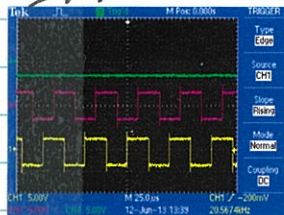
522



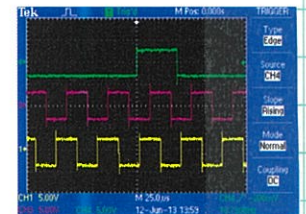
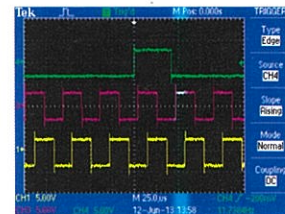
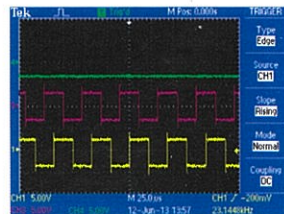
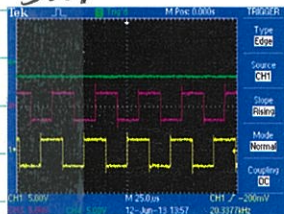
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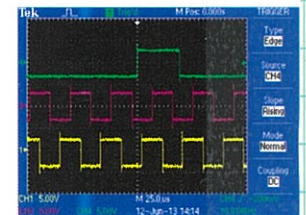
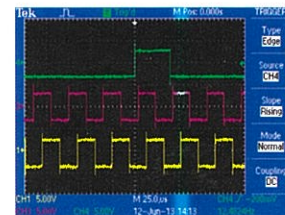
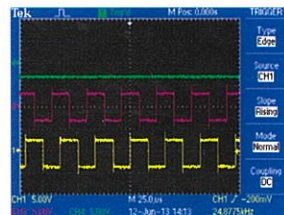
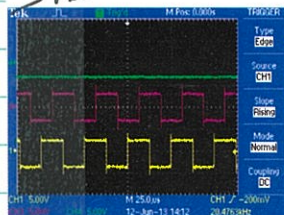
517



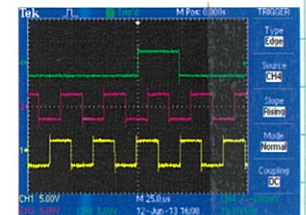
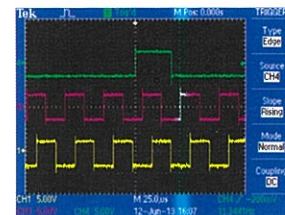
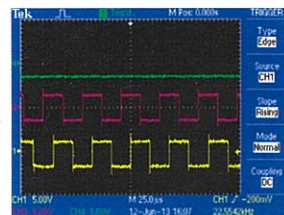
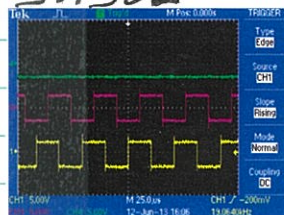
521



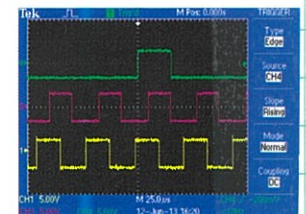
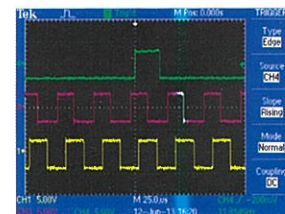
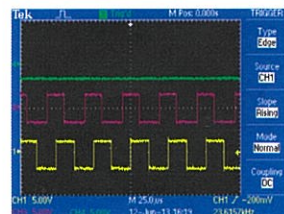
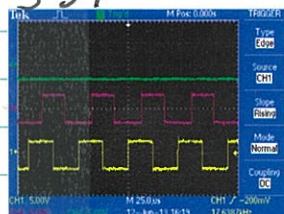
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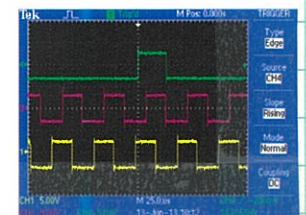
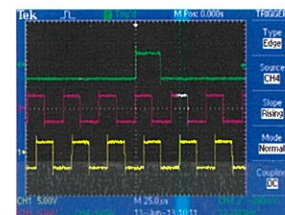
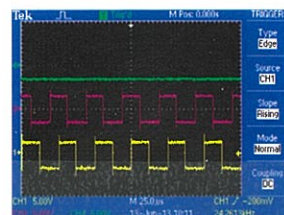
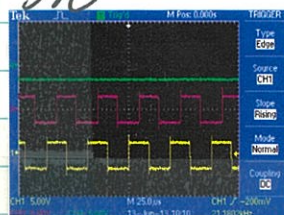
5H502



537



510



6/17/13

J

Looking at the drive module DM-25
 SN H000891.

I configured the jumpers to be the same
 as on the module I used to look at the motors.

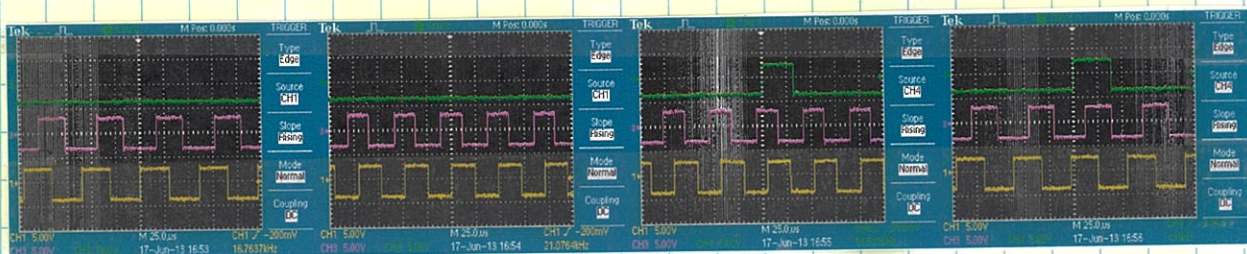
Remove the top circuit board and metal shield.
 A visual inspection does not seem to show any
 heating damage.

The "personality IC" is labeled INNER #2
 ADDR = 2

I reconnected the scope and the laptop.
 After power-up I hit "P" in hyperterm and got:

Scale 1.00 AMP/V
 Offset 0.0000 V
 Peak I 9.9 AMP
 Overspeed 2002 RPM; Mode (2): Torque
 Filter BW OFF Hz; Monitor - Tach

Set 3.041 FWD	-2.6V on motor	Tek 0	-500 RPM on terminals
3.048 REV	3.35	1	630
3.048 REV	3.35	2	630
3.037 FWD	-2.7	3	-520

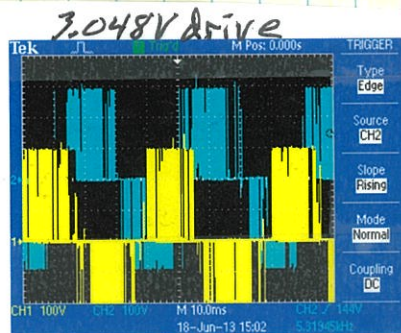
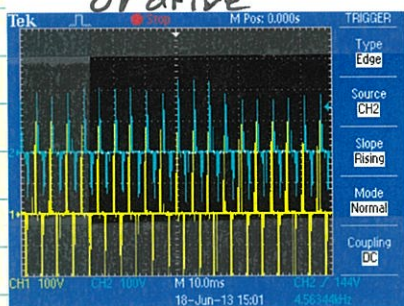


6/18/13

J

I put two HV probes on the scope.
 Ch1 tip is R ref is S
 Ch2 tip is S ref is T

Tek 0 in 0.000V drive. Tek 1 in 3.048V drive FWD
 or drive



Looking at the drive module DM-25 S/N H000601
 It did not have a "personality IC" installed.
 I installed an IC with the label OUTER #1
 ADDR = 7

The top circuit board has all the jumpers
 set the same as S/N H000775.

Remove the top circuit board and the metal
 shield. A visual inspection does not seem to
 show any significant overheating. I took a
 couple of pictures. Reassemble the DM-25.

Hyperterm receives the information

Scale 1.00 AMP/V

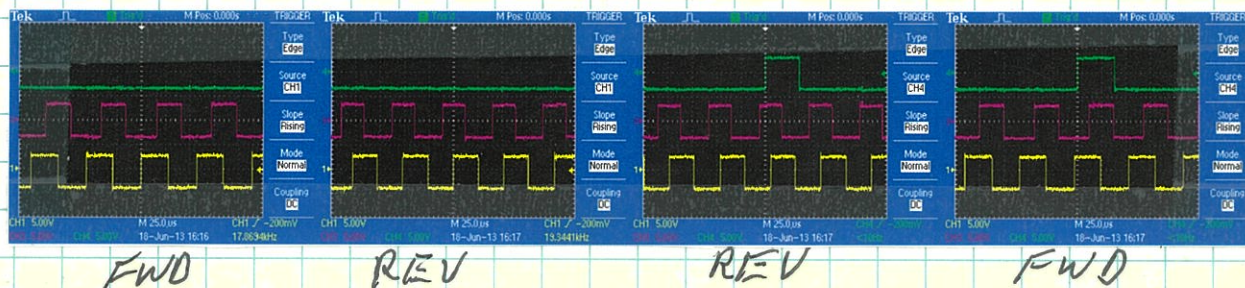
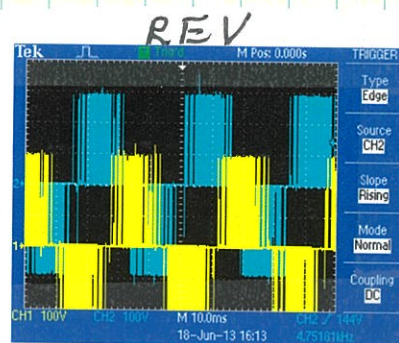
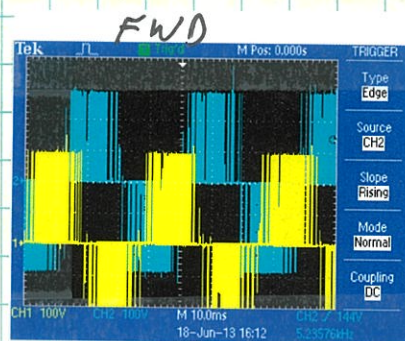
Offset 0.0000 V

Peak I 9.9 AMP

Overspeed 2002 RPM; Mode(2) - Torque

Filter BW OFF Hz; Monitor - Tach

3.041 drive 2.7V motor Tek2 530 RPM on display FWD
 3.044 3.0 Tek3 580 REV



at
 ~3.044V
 drive

Looking at DM-25 S/N H000598
 Made sure the jumpers are set the same
 as the previous modules.
 No "personality IC" installed. Put in a chip
 with the label OUTER #1, same as the one in the
 module above.
 ADDR = 7

Taking the top circuit board off and

6/27/13

doing a visual inspection, I don't see any obvious signs of overheating. I took two pictures.

After connecting the module and powering it up, there is a motor overtemp fault.

Pin 14 of P4 should be pulled to +5V.

Pin 13 of P4 has a pull down to -15V. If the jumper is from pins 2-3 of P4, then pin 14 should be a bit less than +5 and pin 13 should be a bit more than -15V.

Looking at it with the fault present pin 14 is at 5.00V and pin 13 is at 4.997V. This is with P4 jumper from 2-3. A little wiggle of the P4 cable and pin 13 goes to -7.48V. The fault now clears. Pin 14 is also at -7.48V.

I can wiggle the P4 cable and make the fault come and go. Even if the P4 jumper 1-2, wiggling the P4 cable makes the fault come and go! A bad solder joint or broken trace somewhere?

Wiggled the P4 cable till the fault cleared.

Using hyperterm to send a "P" I get back

Scale 1.00 AMP/V

Offset 0.0000 V

Peak I 9.9 AMP

Overspeed 2002 RPM; Mode (2): Torque

Filter BW OFF Hz; Monitor - Tach

3.044V drive	-2.65V on motor	CCW	FWD	Tek 0
3.045	3.08	CW	REV	1
3.045	3.10	CW	REV	2
3.044	-2.77	CCW	FWD	3 & 4
3.048	3.17	CW	REV	5

Looking at the top board of the DM-25 I do not see anything obvious. I re-did the solder joints on P4 pins 13 & 14 and P14 all 3 pins.

It looks like R70 is the pull down to -15V. I re-did the solder joints for that.

Put the DM-25 back in the setup. I can still get the fault to come and go by wiggling the P4 cable.

If the fault is present I can see $-15V$ on one side of $R70$ and $+5V$ on the other side of $R70$.

If the fault is not present I see $-15V$ and about $-7.5V$.

Turn off power when the fault is present. The resistance across $R70$ is about ∞ . Wiggle the P4 cable and it drops to $\sim 3K\Omega$ and is not all too stable.

Remove the DM-25.

Clip a DMM across $R70$. It shows $5.109K\Omega$. The color code shows 5110Ω . I get no variation when I press on the resistor, or when I wiggle the P4 connector.

Re-install the DM-25. Again, I can vary the fault by wiggling the P4 cable. It seems pretty repeatable.

Eventually I have to remove the scope probes from the small pickoff board on the P4 connector. Things are now very stable. No faults.

This has been a frustrating waste of time. But, it does seem the drive module is ok to use.

Looking at DM-50 S/N H000780

The "personality IC" just has a piece of black tape over the window. The label has been removed.

Changed the jumpers to be the same as on the previous DM-25.

Remove the top circuit board and the metal shield. A visual inspection does not show any obvious overheating. I took two pictures.

For the encoder readout with the scope I am using the pickoff card on P4 connector:

Ch 1 tip is pin 3 (A+) ref is pin 4 (A-)
Ch 2 tip is pin 5 (B+) ref is pin 6 (B-)
Ch 3 tip is pin 7 (I+) ref is pin 8 (I-)

For the motor drive signals the HV probe are connected ~~to pins 5 & 8~~ No! Ch 1 tip is 5 ref is 1.
Ch 2 tip is R ref is S.

6/21/13

Looking at hyperterm and sending a "P"

Scale 0.99 AMP/V

Offset 0.0000 V

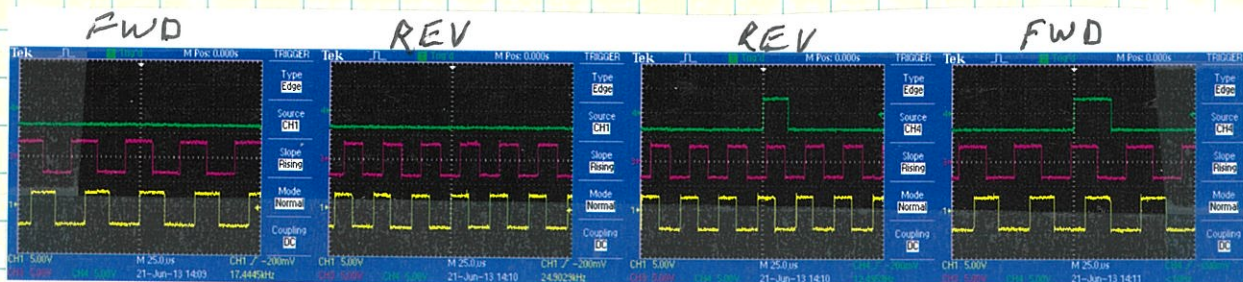
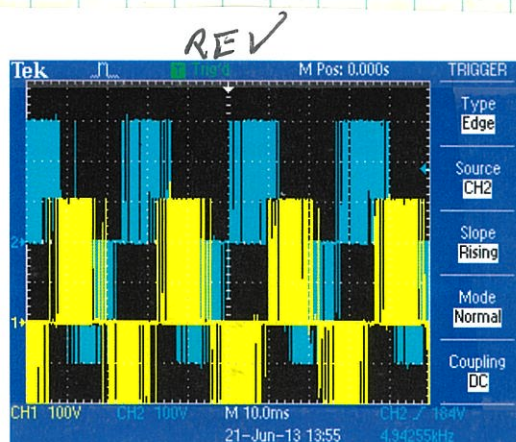
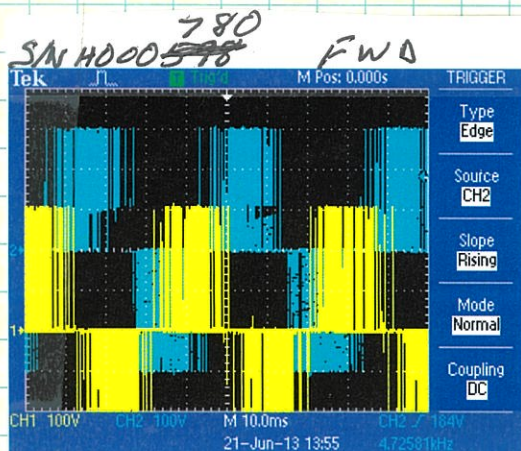
Peak I 10.1 AMP

Overspeed 3495 RPM; Mode (2): Torque

Filter BW OFF Hz; Monitor - Tach

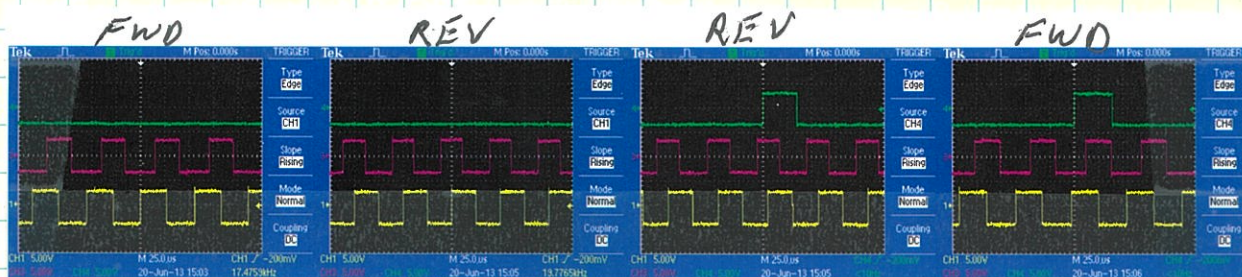
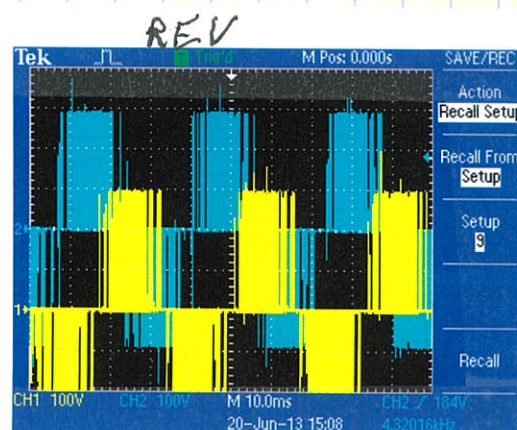
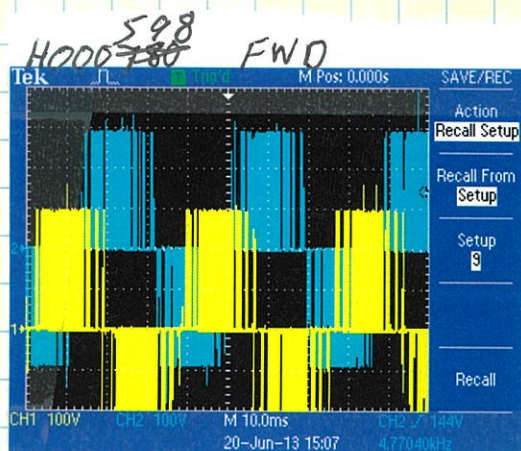
3.033 drive FWD CCW Tek ϕ -2.70V on motor
3.045 REV CW Tek 1 4.00V on motor

3.043 FWD CCW -2.70V on motor Tek 2
3.028 REV CW 4.02 Tek 3
3.008 REV CW 4.02 Tek 4
3.043 FWD CCW -2.79 Tek 5



There are backwards from the ones taken on p. 60. See the pictures on the next page, p. 63.

These pictures are from p. 60 of this volume.



While trying to verify this I ran into a couple of problems and got a bit sidetracked.

I ordered a new USB chip programmer and cloned the chips labeled

MIDDLE #4 and OUTER #1
ADDR = 6 ADDR = 7

So, I will redo these tests using the appropriate IC in the drive modules.

The S/N H000780 is a DM-50. I installed an IC labeled MIDDLE #4 and tried it

again. I verified the scope probe connections are as on p. 61.

Trying the DM again I verified that it still runs as the pictures on p. 62 show.

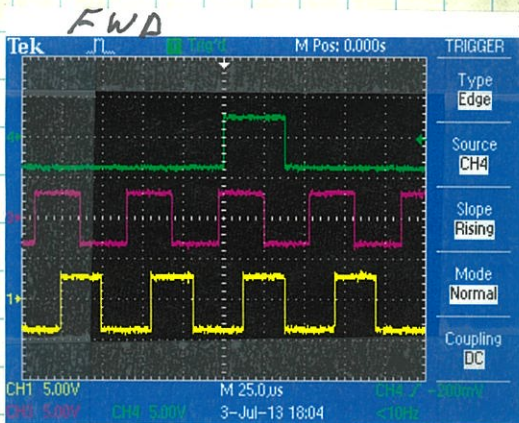
I will install an IC labeled OUTER #1 in the DM-25 S/N H000598.

7/3/13
RS

angled, ~~with~~ with FWD I get CCW
and the scope looks like it does for
S/N H000780. Tek ϕ
I must have had the scope probes
1 & 3 swapped somehow.

Hyperterm shows Scale 1.00 AMP/V
Offset 0.0000 V

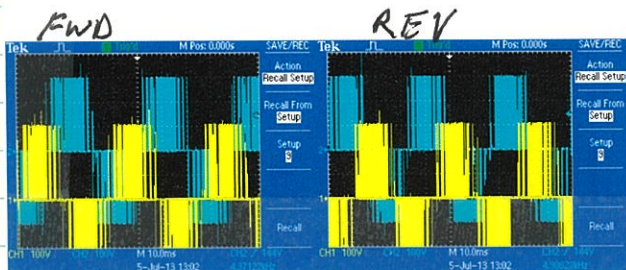
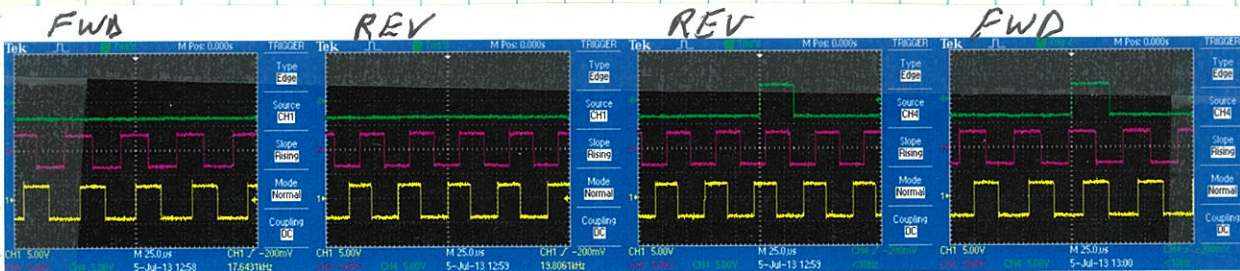
Peak I 9.9 AMP
Overspeed 2002 RPM; Mode(2): Torque
Filter BW OFF Hz; Monitor-Tach



7/5/13
JS

Re-doing S/N H000598

3.047 CCW	-2.71 on motor	Tek ϕ	FWD
3.050 CW	3.13	Tek1	REV
	CW	Tek2	REV
3.046 CCW	2.8	Tek3	FWD
Tek4 in FWD		3.045 drive	
Tek5 in REV		3.049 drive	

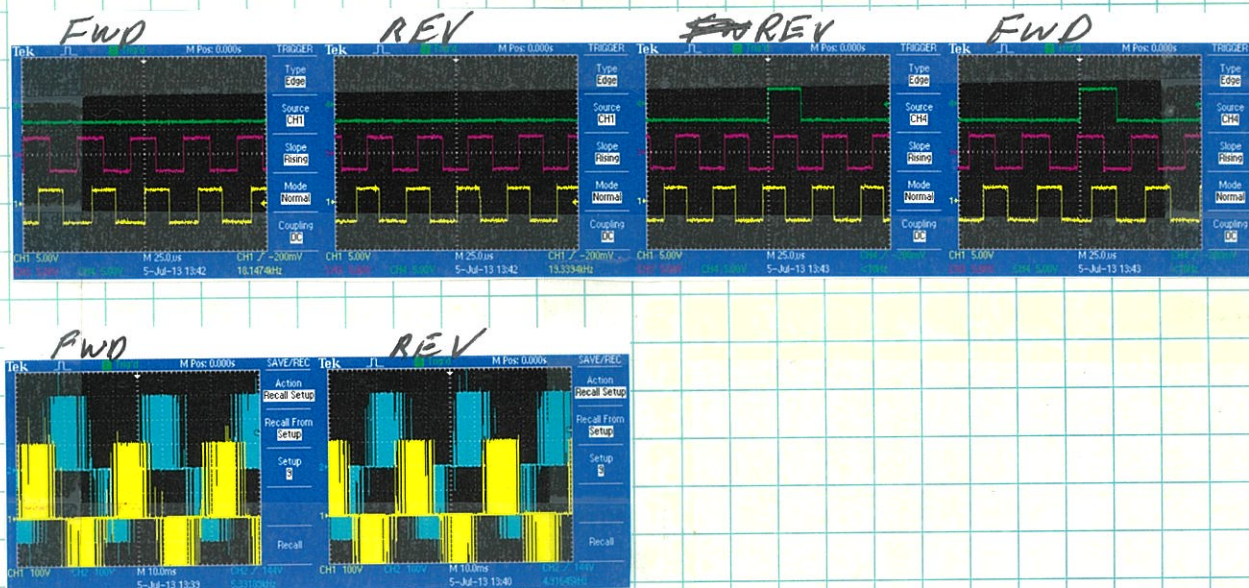


The DM-25 ~~was~~ S/N H000601 was previously checked on p. 59 with a personality IC for the outer bogies. The same IC is still installed. The pictures from p. 59 also look like the encoder probes are inverted. Not inverted... did I have Ch1 and Ch3 swapped? Anyway, re-doing S/N H000601.

After power-up, Hyperterm shows the same info as on p. 64 for S/N H000598.

Tek 6 is FWD	3.045 drive	CLW	
7	REV	3.042	CW 3.04V on motor
3.042 drive	CLW	-2.82 on motor	FWD Tek 8
3.042	CW	3.08	REV Tek 9
3.042	CW		REV Tek 10
3.043	CCW	-2.88	FWD Tek 11

Things look the same as for the previous DM.

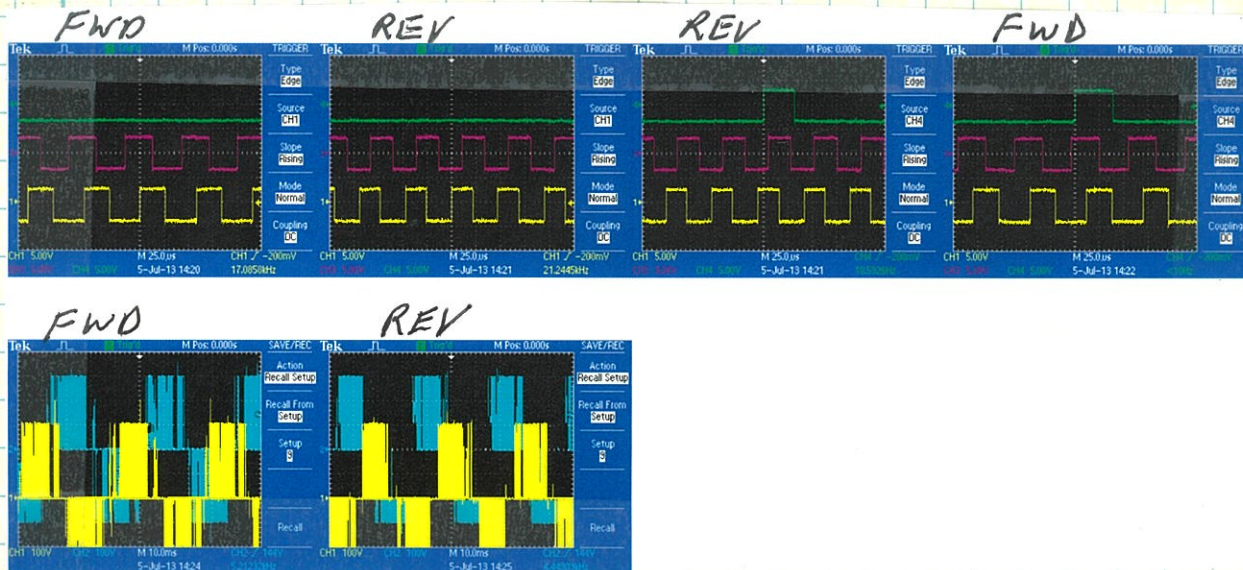


Next up is DM-25 S/N H000591 with a personality IC OUTER #1
ADDR = 7

After power-up, Hyperterm also shows the same as the top of p. 64.

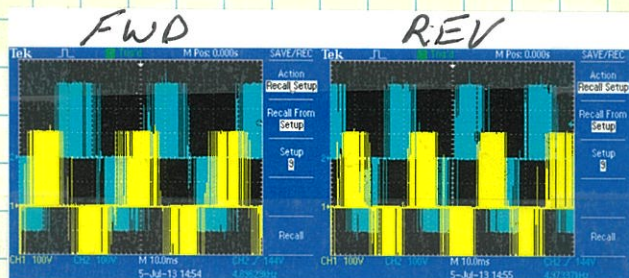
3.046 drive	CLW FWD	-2.64 on motor	Tek 12
3.049	CW REV	3.39	13
3.049	CW REV		14
3.038	CCW FWD	2.71	15

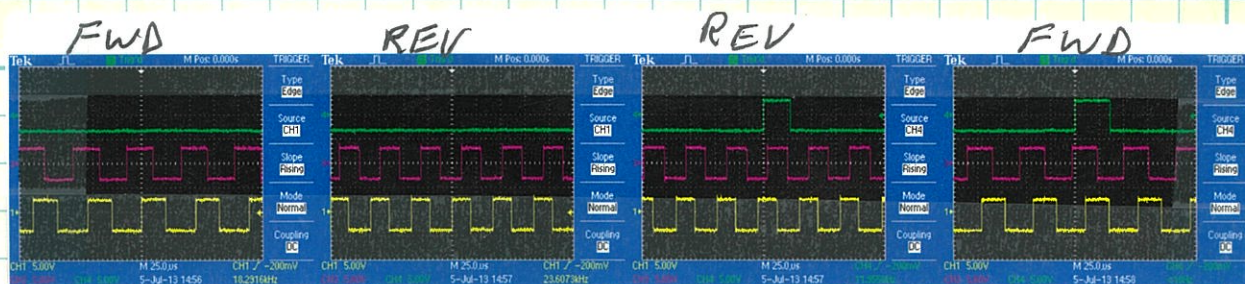
FWD 3.051 2.74 Tek 16
REV 3.049 3.43 Tek 17



Next is the DM-50 S/N H000775. I installed
a personality IC MIDDLE #4
ADDR = 6
Using Hyperterm I see
Scale 0.99 AMP/V
Offset 0.0000 V
Peak I 10.1 AMP
Overspeed 2002 RPM; Mode(2): Torque
Filter BW 300 Hz; Monitor-Tach

3.046 drive	FWD	CCW	-2.78 on motor	Tek 18
3.049	REV	CW	3.80	Tek 19
3.046	FWD	CCW	-2.85	Tek 20
3.049	REV	CW	3.85	Tek 21
3.048	REV	CW	3.88	Tek 22
3.046	FWD	CCW	-2.92	Tek 23

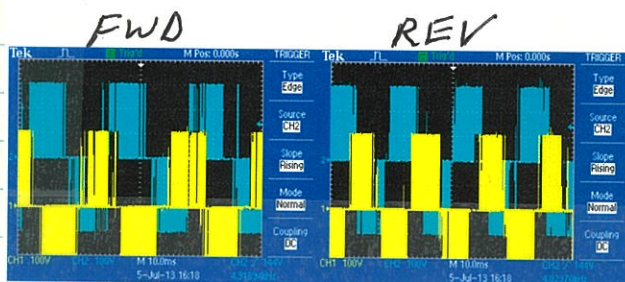
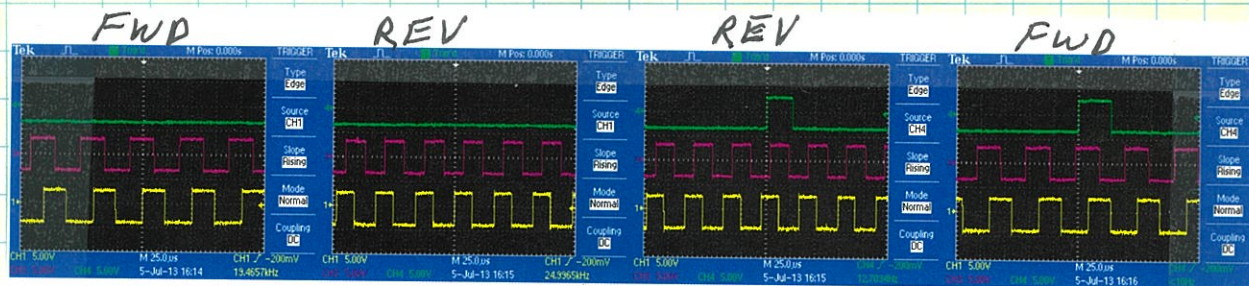




Next is the DM-50 S/N H000770. I installed a personality IC MIDDLE #4
ADDR = 6

Hyperterm shows the same info as on p. 66.

3.048 drive CCW FWD	-3.04 on motor	Tek24
3.047 CW REV	4.08	Tek25
3.047 CW REV	4.11	Tek26
3.030 CCW FWD	-3.12	Tek27
3.022 CCW FWD	-3.10	Tek28
3.047 CW REV	4.14	Tek29



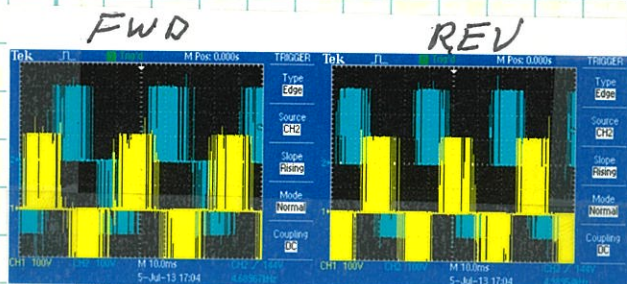
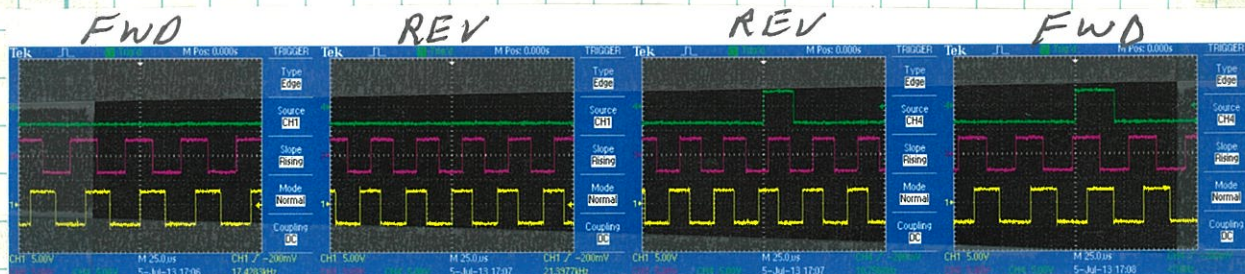
Next is DM-25 S/N H000586. I installed a personality IC OUTER #1
ADDR = 7

The jumpers on the top board are configured to be the same as the rest.

Removing the top board and the metal shield, a visual inspection shows no obvious signs of overheating. I took two pictures.

After power-up, Hyperterm shows the same info as on the top of p. 64 of this volume.

3.044 drive	CCW FWD	-2.65 on motor	Tek30
3.048	CW REV	3.980	Tek31
3.043	CCW FWD	-2.73	Tek32
3.047	CW REV	3.45	Tek33
3.047	CW REV	3.46	Tek34
3.046	CCW FWD	-2.81	Tek35

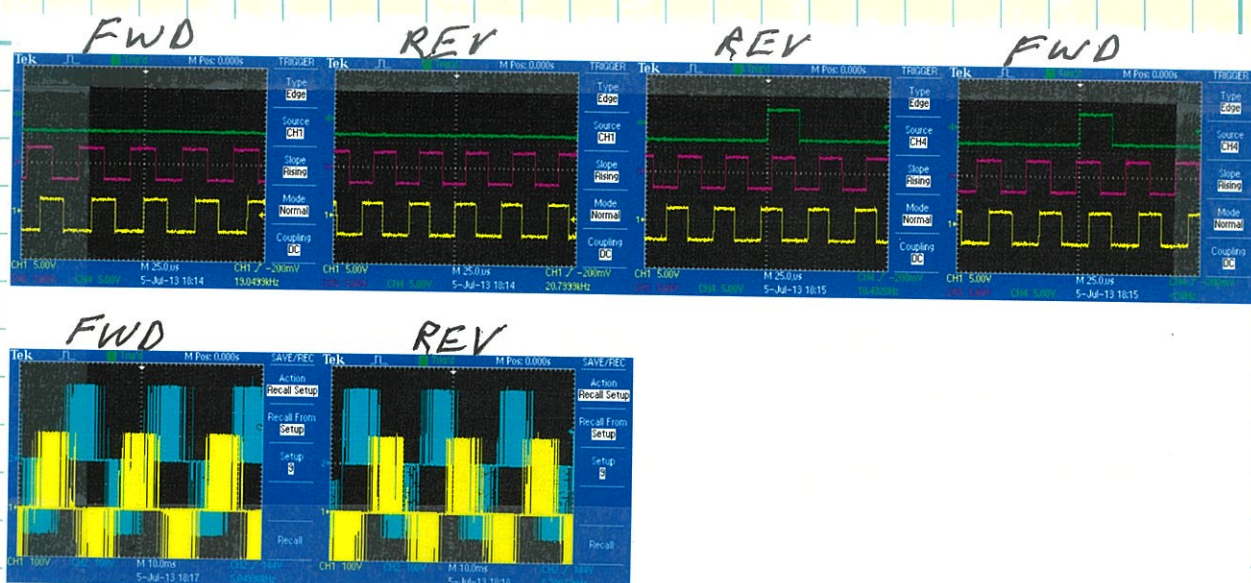


Next in DM-50 S/N H00D779. I installed a personality IC MIDDLE #4 ADDR=6

The jumpers on the top board were checked and found to be already the same as the others. ~~Power~~ Removing the top board and metal shield, a visual inspection did not find any obvious signs of over heating. I took two pictures.

After power-up, Hyperterm shows the same info as on p.66 of this volume.

3.047 drive	CCW FWD	-2.97 on motor	Tek36
3.034	CW REV	3.32	Tek37
3.034	CW REV	3.33	Tek38
3.046	CCW FWD	-3.06	Tek39
3.046	CCW FWD	-3.05	Tek40
3.036	CW REV	3.38	Tek41



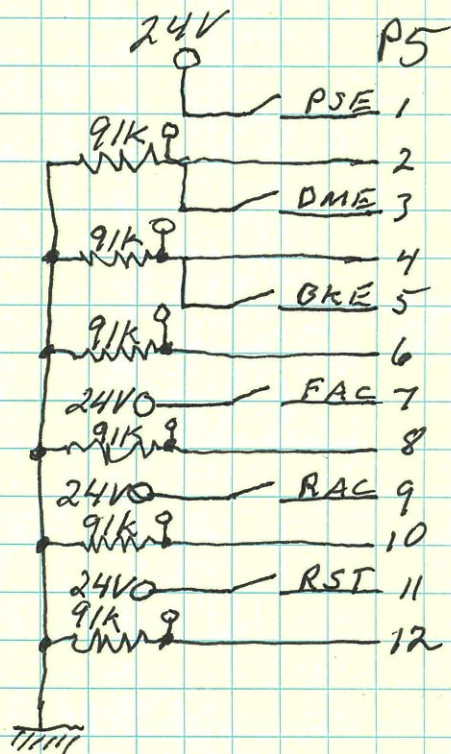
7/9/13 Developing a Bogie Brake Board Bench Test

Trying to reliably bench test the Bogie Brake Board.

I have some small cards to mimic the drive modules. Two jumpers on each board. Pins 15 & 16 of each connector and pins 8 & 9.

A small card with jumpers for one half of the P6 connector. Pins 1-12. Pins 1 & 2, 3 & 4, 5 & 6, 7 & 8, 9 & 10, 11 & 12 jumpered.

From the P5 connector I made two small cards to plug in. One for pins 1-12 has six switches to mimic the VME card. The ~~card~~ for pins 13-24 jumper pins 13 & 24 to connect VME COM to GND on the board. I also pick 24V (on pin 21) and GND to use on the small card with the switches. For the small card with the switches



I have two 100Ω resistors in parallel (50Ω) to act as motor brake.

A jumper on P9 1 & 2 and a 1.5kΩ resistor on P9 pins 3 & 4 act as the power supply module.

When power is first turned ON, ~~the~~
 $+24V$ and $\pm 15V$, L8 & L9 should turn ON.
 There should be $0V$ across the resistor on P9.

If I close the PSE switch.
 $24V$ across the resistor on P9 (pin 4 to 3)
 $24V$ on PSE RTN test point (pin 2 of P5)
 L1 should be ON

If I now close the DME switch
 L2 should be ON
 $24V$ on DMERTN (pin 4 of P5)
 pins 13 & 14 shorted on each DM connector

If I now close the BKE switch
 L3 should be ON
 chip U6 pin 7 should be at $15V$ ($0V$ in no BKE)
 $24V$ on BKERTN
 L4, L5, L6, L7 should all be ON
 $24V$ on each brake resistor (50Ω)
 P5 pins 7 & 8 shorted (FAC) and
 pins 9 & 10 shorted (RAC)

If I close the FAC switch
 $24V$ on FAC and FACRTN
 pins 1 & 2 of DM connectors shorted together

If I close the RAC switch
 $24V$ on RAC and RACRTN
 pins 3 & 4 of DM connectors shorted together

If I close the RST switch
 $24V$ on RST and RSTRTN
 pins 5 & 6 of DM connectors shorted together

I have had a problem with a couple of brake boards. After I close the PSE, DME, and then the BKE switch, on the motor test setup, the BKE LED briefly lights and then goes out. The current is still going to the motor brake. After some time the BKE LED comes ON and I can get the FAC and RAK LEDs to light up.

I labeled some of the boards I threw. 1 & 2 are on the Right Arm.

Looking at board 3. Power on. L8 & L9 are lit.

If I close PSE, DME, and BKE switches all the LEDs are lit.

When this brake board was on the test stand I put a scope on U11 pin 7 and U12 pin 6. It looked like the comparator was switching on and off.

Looking with the brake board test setup.

V R26	R33	R40	R47
0.0459	0.0460	0.0462	0.0461

U7	U9	U10	U12
2 3	2 3	2 3	2 3
.0722 .0722	.0610 .0610	.0654 .0654	.0621 .0620

U18	U8	U11	U11
2 3	5 6	2 3	5 6
.7237 .9603	.9290 .7181	.7189 .9397	.8000 .7158

R31	R38	R45	R45 R52
14.405	14.413	14.410	14.413

On U8 and U11 the inputs on the board are flipped from what they are on the schematic. Isn't that special.

R26	R33	R40	R47
.0287 .0746	.0172 .0633	.0677 .0215	.0178 .0639
		.0462	.0461

How is it that TP10 is about 100mV less than TP4, TP6, and TP8? The voltage drop on the 0.1 Ω resistors are about the same. Well, to make a long story short, the ground is run as a meandering trace, not a ground plane. 24V on 50 Ω is almost 0.5A. That is almost 2A on a trace! Think of the voltage drops.

The voltage from P8 ground pin to the ground side of R47 is 0.0171V. From P8 to the ground side of R49 is 0.0242V.

I soldered a brown jumper wire from the ground side of R47 to the ground side of R49. TP10 is now 0.9260V.

The same trace routing is also used for R33 and R35.

All this work was done on "Board 3".

I put jumpers on boards 3, 4, 5, and 6

I put board 6 in the Left Arm outer bogie and board 4 in the Left Arm middle bogies.

We moved the Left Arm a little ways in each direction. It seemed to run smoothly.

While trying to get things going I found out a couple of things.

I have been working with the wrong schematic. The board we use was designed in 1995. I was using the schematic for the 1994 board. Small but significant differences.

Since the "FWS" and "RVS" and "GND" lines of the P5 + P6 connector are connected between the middle and outer bogies, but the +24V is not, there is an interesting

problem that results. The $10k\Omega$ pull-up on the ~~FS~~ WS and RVS lines are the key. When both bogie controls are off, if you turn one on the $10k\Omega$ pull-up on the unpowered board will try to pull-up the 24V on the unpowered board. The 24V of the unpowered board will get pulled up to 1.6, 1.7, or 1.8V, about. This is near the turn-on voltage of the MOSFETs used. Q15 of the unpowered board ~~can~~ can be turned on. This will prevent K13 and K14 relays from being energized when the "unpowered" board is actually powered up.

The "SRST", Sensor Reset line is not ~~used~~ used by the VME crate. The software has no way to correct this.

I put a switch on a piece of prototyping board and put it on the 13-24 pins of the P5 connector of the left arm outer bogies.

Pushing the switch will energize the K16 relay on both boards and clear the fault. K13 and K14 should be energized and the L8 and L9 LEDs should light up.

It is kind of a cheery fix, but it works.

Starting To Check The NMR Meters 7/18/13

Trying to develop some understanding of the kinds of problems we have with the Metrolab NMR meters.

I have a meter with cards of unknown condition. The cards & rack have no tags on them.

The analog card is a type 2201B with no serial number. I will label it ~~"AN SN 01"~~ "AN Hall A-01".

The RF card is a type 2202B. On the back side is penned "3535". I will label it ~~"RF SN 01"~~ "RF Hall A-01".
~~"RF SN 3535"~~

The CT card is a type 2203C with no serial number. I will label it "CT Hall A-01".

The IO card is a type 2204D. I will label it "IO Hall A-01".

The PS card is a type 2205B. On the circuit board is penned "28.5.98". I will label it "PS Hall A-01". The circuit board under the heatsink and around the TO-220 packs shows signs of overheating.

Playing with the setup and poking around with the oscilloscope I did not see anything that looked like an obvious problem.

I removed the AN board and inserted one that I labeled "AN Hall A-02". It has an Out of Service tag that notes "L Arm" and "NMR would not lock". I mounted the AN board on an extender. I first noted that SW2 was in the OFF position. I switched it ON.

I should note that the amp/mux is a type 2031, SN 3989, Rev B. The probe is a number 3, type 1060/3/7m, SN 61891. P.

I started on the servicing and adjustment procedure.

I kind of did the first step of adjusting the PO1 pot to change the amplitude of TP1 signal to about 140mV p-p.

7/19/13 Re-Start Of Checking the NMR

JS

I sort of jumped the gun on the methodology. I will start back at the beginning of the adjustment procedure.

I am leaving the AN HallA-02 card on the extender.

Using a very small phillips head screwdriver I set the amplitude modulation fully clockwise, frequency modulation fully CCW, gain fully CW.

These three were already set that way. But, I backed them off a bit and made sure they ended up where they should be.

Connected the NMR signal and field modulation to Ch1 and Ch2 (respectively) of the scope.

Connect RF out from the rear to Ch3 of the scope.

The field modulation signal is about 200 mVp.p. and about 30 Hz. This is with 1 M Ω input.

The RF signal is about 800 mVp.p. and varying around 50 MHz. Maybe 45 MHz. 50 Ω input.

MPX is set to "C" and the probe is plugged into "C" of the multiplexer.

The NMR signal is a DC level of about 12V. This is with 1 M Ω input. With 50 Ω input it is about 60 mV DC.

Scope Pictures From Metrolab NMR

77
8/12/13

I fooled around with the Metrolab chassis for a little bit and got to the point I would need to add a probe to see if it would lock.

Using the magnet from way back when we first were checking the operation of the NMR probe. It is a blue magnet from Techni-Tek Corporation. It has a plaque on it that states: 30 DEG. ANALYZING MAGNET
1300 LBS. 0.39 OHM/MAG.
100 AMPS. 1.6 GPM/60 PSI
NBS-AD1591 TT1068-4/80

I connected one of the Lakeshore model 622 power supplies. There are $\pm 30V$ and $\pm 12.5A$ power supplies.

I connected a number 3 probe and the new multiplexer to the chassis.

At 45 A the system locked in at about 0.21007 Tesla.

The probe is sideways and field on the chassis is set to "-". The labels on the probe are facing the coils connected to the "out -" side of the power supply.

Starting out looking at the MUX SN 3908 Rev 3. The first picture is of pin 2 on the 8 pin Lemo connector. The "Automatic Tuning". Ch1 is the signal when there is no lock. DA in the magnet. Tip of probe is pin 2, ref is GND of the MUX. This is after ~1 hr warm up. The signal is a triangle wave from about -1.5V to about -0.5V. Tek 2

The NMR signal seems to have about a +.4V offset. Tek 3

The modulation input, from pin 1 to pin 6, is a triangle wave. Tek 4 & Tek 5.

The identification seems to be about +1.0V. Tek 6.

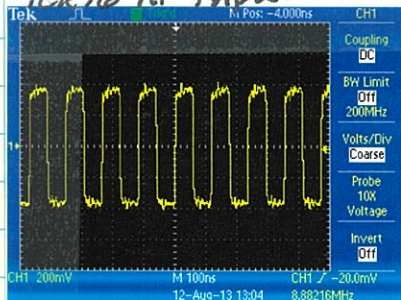
RF input at C17 and R52 seems to be a square wave. Tek 7. The V varies a bit as the system searches.

The signal at pin 2 of IC 21. Tek 8

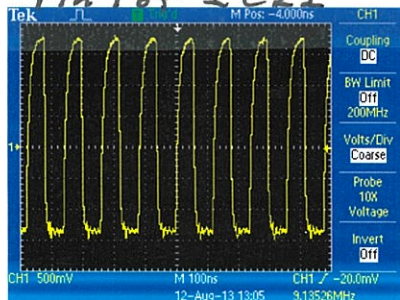
The signal at pin 6 of IC22. Tek 9 & 10
 The signal at the collector of T9. Tek 11
 The signal at the T10 & T11 side of C30. Tek 12
 The RF out signal on the C channel. Tek 13 & 14
 The RF signal at R50 & C41. Tek 15

Looking at the MUX S/N 3927 Rev. B
 This MUX was removed from the Right Dipole.
 RF in at C17 & R52. Tek 16
 The signal at pin 1 of IC22. Tek 17
 The signal at pin 6 of IC22. Tek 18 & 19
 The signal at the collector of T9. Tek 20 & 21
 The signal at the T10 & T11 side of C30. Tek 22
 The RF out signal on the C channel. Tek 23
 The RF signal at R50 & C41. Tek 24

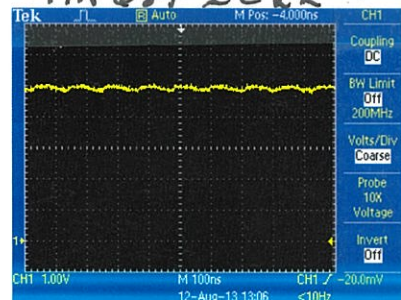
Tek 16 RF input



Pin 1 of IC22

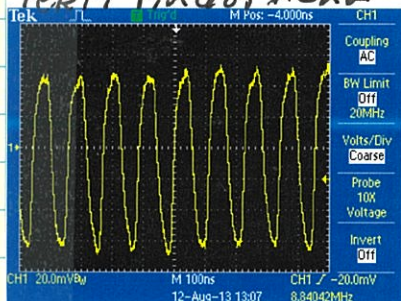


Pin 6 of IC22

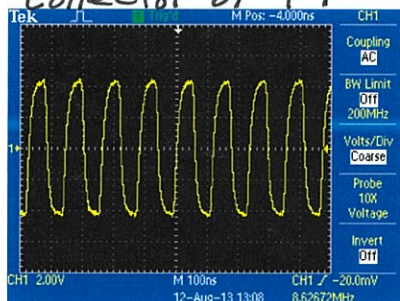


S/N 3927
 from
 R-dipole

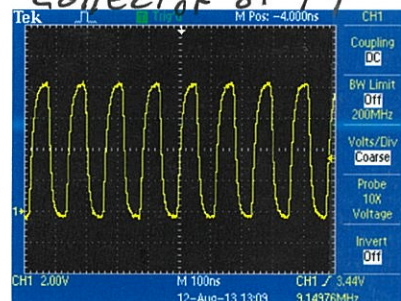
Tek 19 Pin 6 of IC22



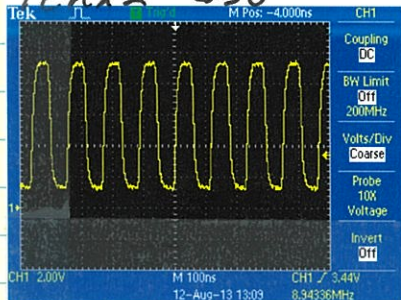
collector of T9



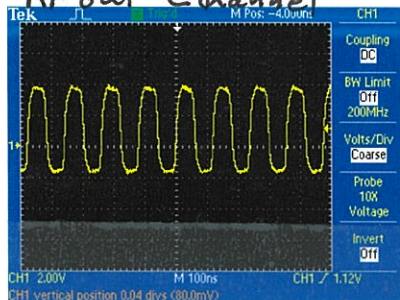
collector of T9



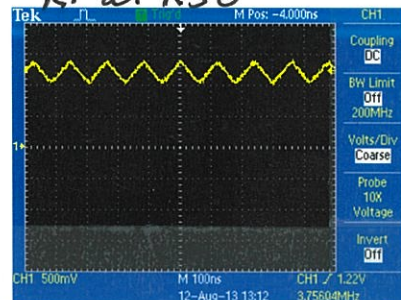
Tek 22 C30



RF out C channel



RF at R50

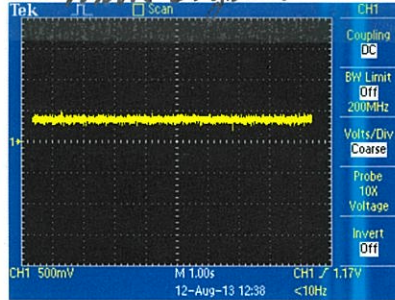


S/N 3908

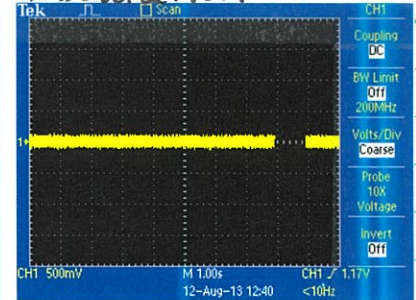
Tek 2 Automatic Tuning



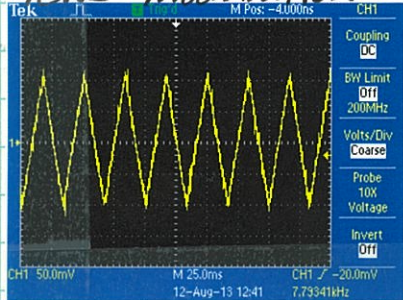
NMR Signal



Modulation



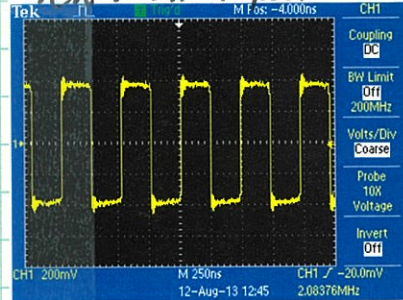
Tek 5 Modulation



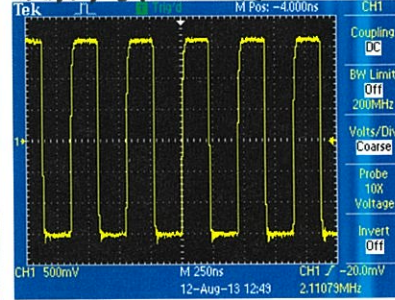
Identification



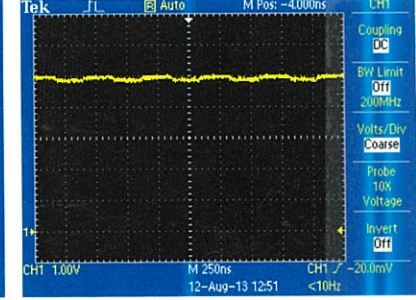
Tek 7 RF input



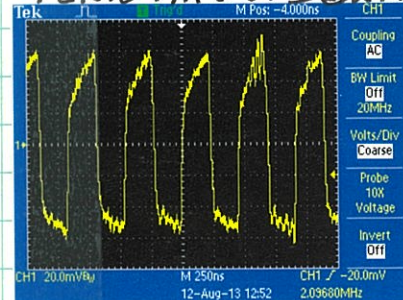
Pin 1 of IC22



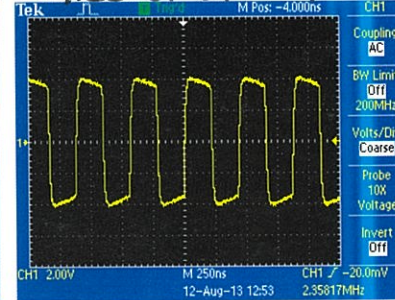
Pin 6 of IC22



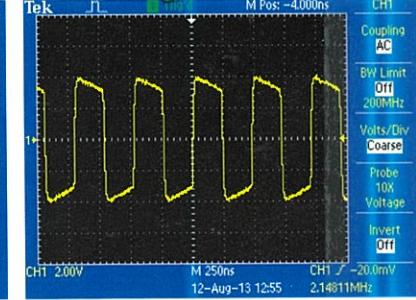
Tek 10 Pin 6 of IC22



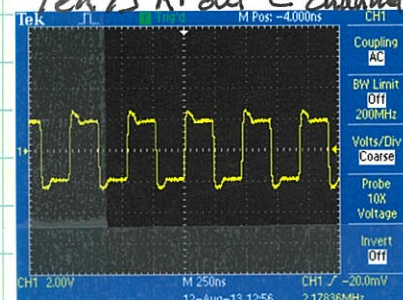
collector of T9



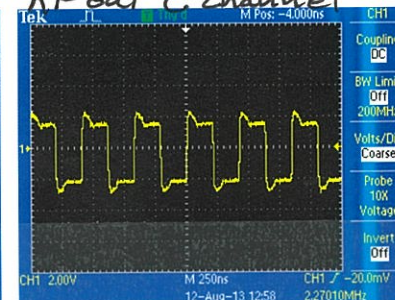
C30



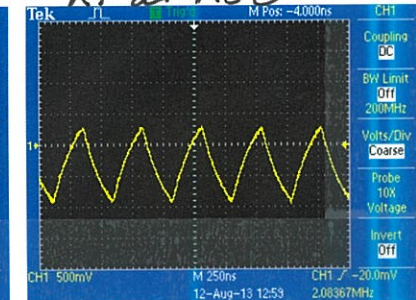
Tek 13 RF out C channel



RF out C channel



RF at R50



Why is there a freq. difference?
Looking at Identification of S/N 3927. Tek 25 2.5x larger

Interesting. I disconnected all cables except the 8 pin & then reconnected them to take the measurement of identification. The RF now looks like Tek 26 and the chassis is showing probe 1 selected, NMR lock at 0.048967 T.

Disconnect probe power connector. Re-insert. RF input is about back to where it was. Tek 27 identification on pin 8 is lower. Tek 28

Switch back to S/N 3908. Everything plugged in. Front panel shows probe 3 is selected.

RF input is now Tek 29.

Pin 1 of IC22 is now Tek 30.

Pin 14 in Tek 31 & 32

collector of T9 is now Tek 33

C30 is now Tek 34

RF out is now Tek ~~35~~ ³⁶

RF at R50 is now Tek 35

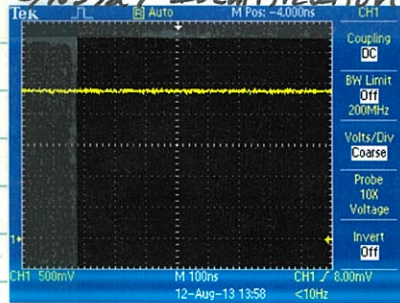
I cannot duplicate what I had on p. 79.

8/13/13

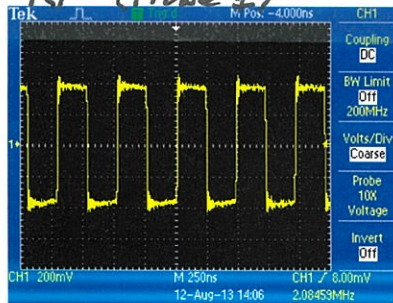
I was following the RF path and just poking around. I noticed on the S/N 3908 MUX that the LO levels on the outputs of IC7 and 10 did not all go to 0V.

I replaced the chips for IC7 & 10. All the LO levels are now about 0V.

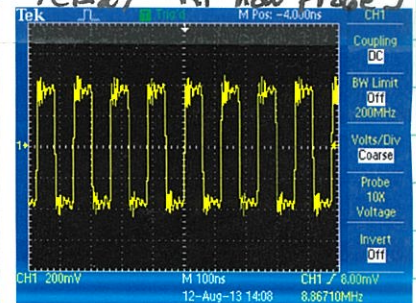
S/N3927 Identification



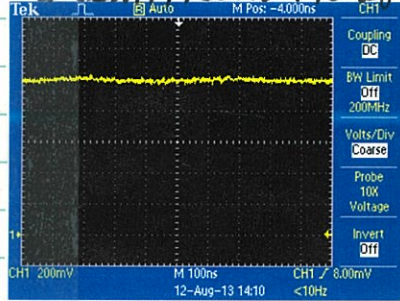
RF (Probe 1)



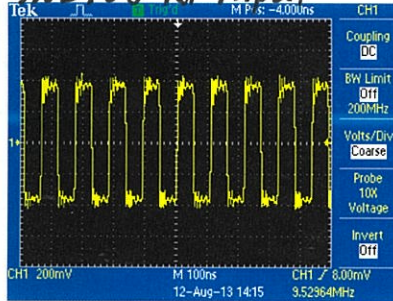
Tek27 RF now Probe 3



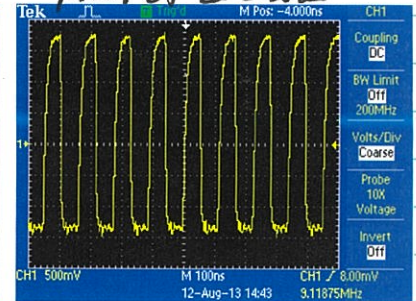
Identification Tek28



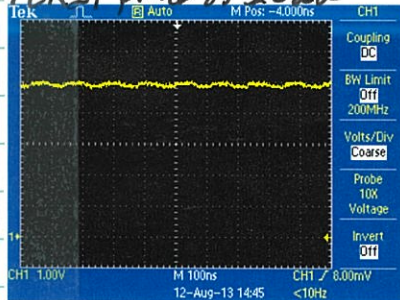
S/N3908 RF input



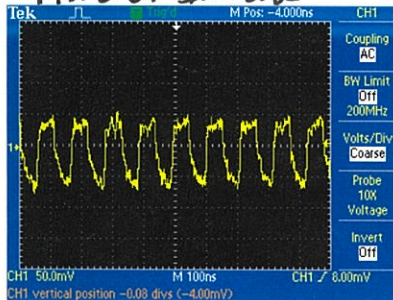
Pin1 of IC12



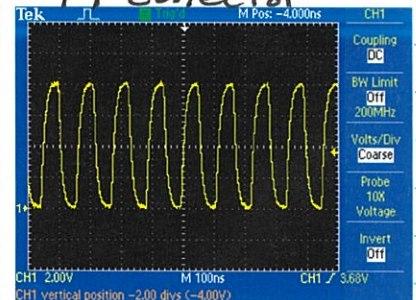
Tek31 pin6 of IC22



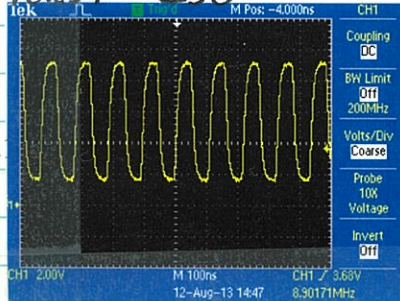
Pin6 of IC22



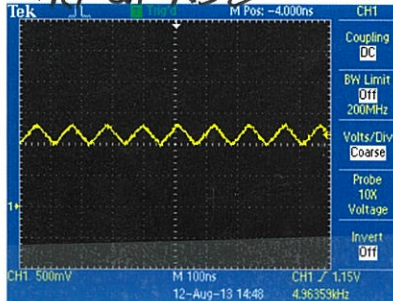
T9 collector



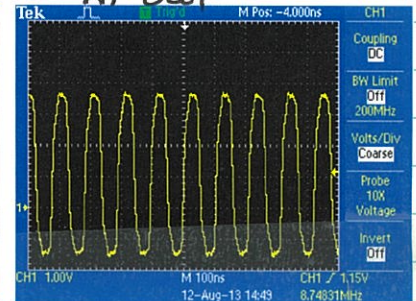
Tek34 C-30



RF at R50



RF out



8/22/13 Probe Identification on a Metrolab NMR

I have had some problems with the NMR chassis not recognizing the probe as a number 3. This is with the MUX S/N 3927 which came out of the Right Dipole.

The "Ident" seems to be two parallel resistors to +15V on the RF board in series with a resistor to gnd in the probe.

$30K // 15K + \text{probe}$.

This voltage is fed to the voltage input of a LM3914 LED display driver.

For probe 3 the resistance is 1.8K

Looking at the resistance for some other probes see:

probe #	Ω (pin 5 to shield)
3	1.77K
6	3.89K
7	4.73K
4	2.25K
6	3.90K
7	4.74K

$$30K // 15K = 10K$$

Scope Pictures From Metrolab NMR₂ 9/19/13

I have a few scope pictures from earlier, when I was looking at the fact the unit from inside the dipole does not lock when first turned ON. But, if I unplug the 8 cord. cable and then reconnect it the unit locks.

After first turning ON, 45 A in magnet, the unit recognizes it is a #3 probe. Using channel 0 of the MUX. Not locked. The NMR signal on pin 7 of the 8 pin, Tek 0 & Tek 1. RF signal at pin 4 of IC 8, Tek 2. Modulation signal at pin 1 of 8 pin, Tek 3, Tek 4. I unplug the 8 pin and plug it back in. Locks at 0.21014 T. Modulation at pin 1 of 8 pin, Tek 5, Tek 6. RF at pin 4 of IC 8, Tek 7. NMR on pin 7 of the 8 pin, Tek 8. If I changed the polarity button it loses lock. NMR on pin 7 of the 8 pin, Tek 9. RF at pin 4 of IC 8, Tek 10. Modulation signal at pin 1 of 8 pin, Tek 11, Tek 12, Tek 13. Tek 14.

Looking at S/N 3789 ("NEW")

It locks in right away at 0.210128 T

NMR signal at pin 7 of 8 pin, Tek 15

RF at pin 4 of IC 8, Tek 16

Modulation signal at pin 1 of 8, Tek 17, Tek 18, Tek 19

Change polarity button, lose lock.

Modul. signal, Tek 20, 21, 22

RF at pin 4 of IC 8, Tek 23

NMR on pin 7 of 8 pin, Tek 24

Looking at S/N 3994, a new one I borrowed from Doug H.

The setup thinks the probe is a #1 probe.

Disconnect & re-connect the 8 pin connector.

Still thinks it is a #1 probe.

Disconnect probe power connector & reconnect.

It sees it as a #3 probe and locks at 0.210117 T.

NMR on pin 7 of 8 pin, Tek 25

RF on pin 4 of IC 8, Tek 26

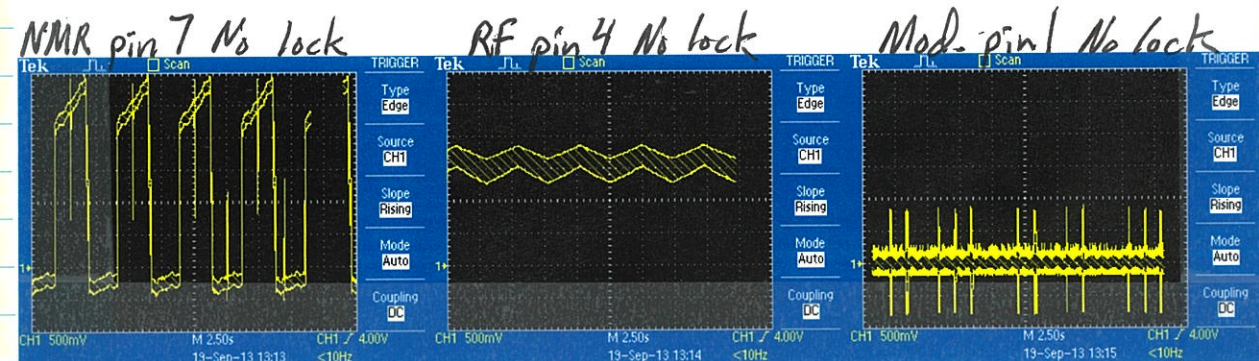
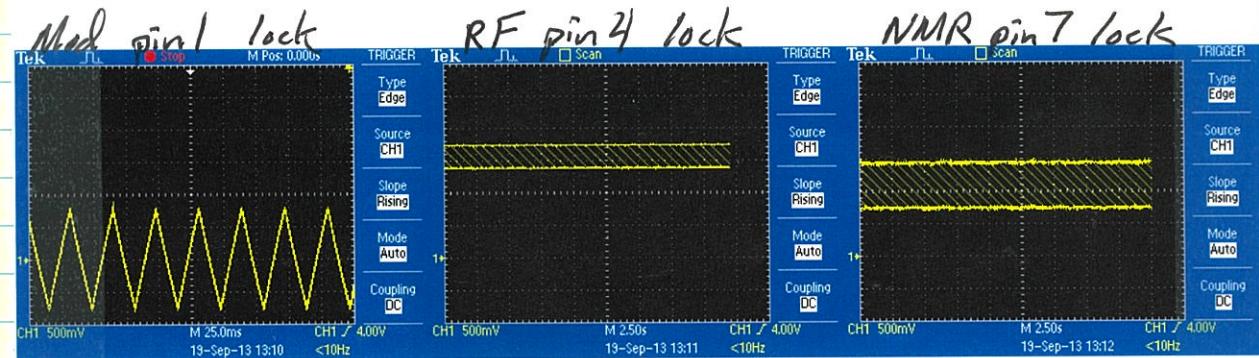
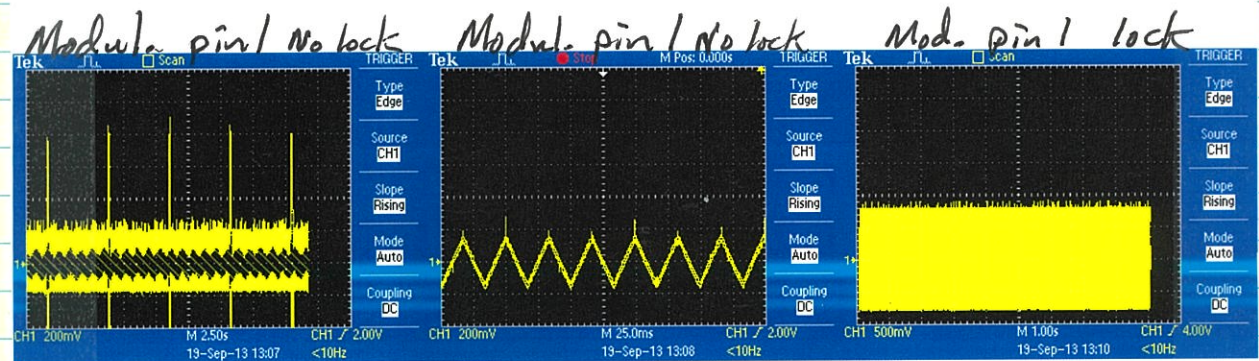
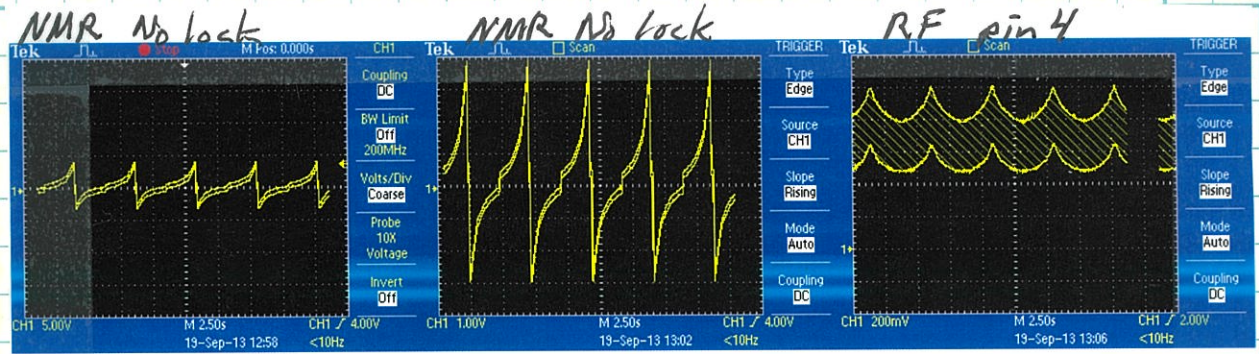
Modulation on pin 1 of 8 pin, Tek 27, 28

Charge polarity button, lose lock

Modulation on pin 1 of 8 pin, Tek 29, 30, 31

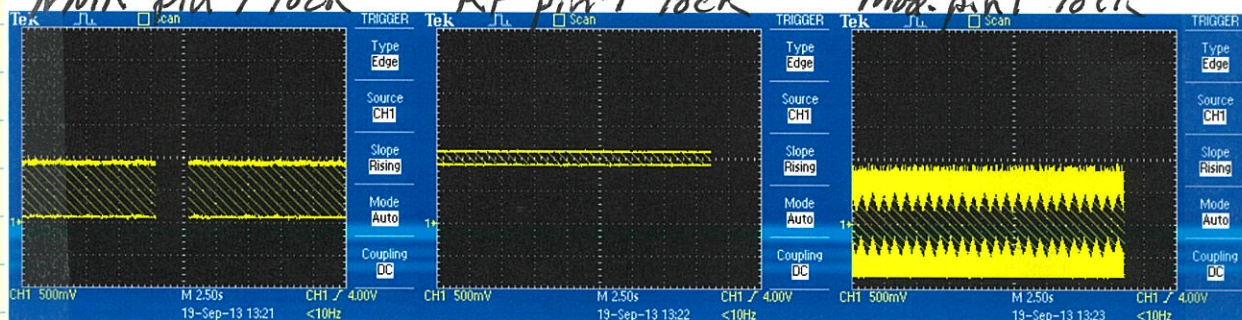
RF on pin 4 of IC 8, Tek 32

NMR on pins 7 of 8 pin, Tek 33

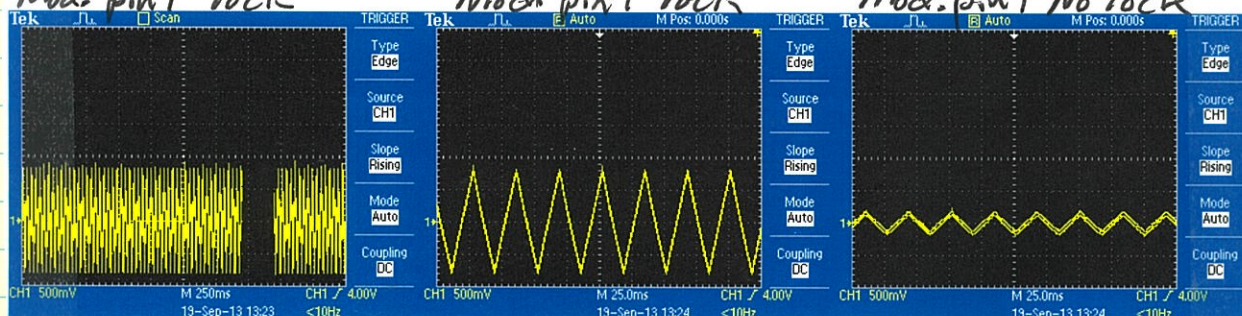




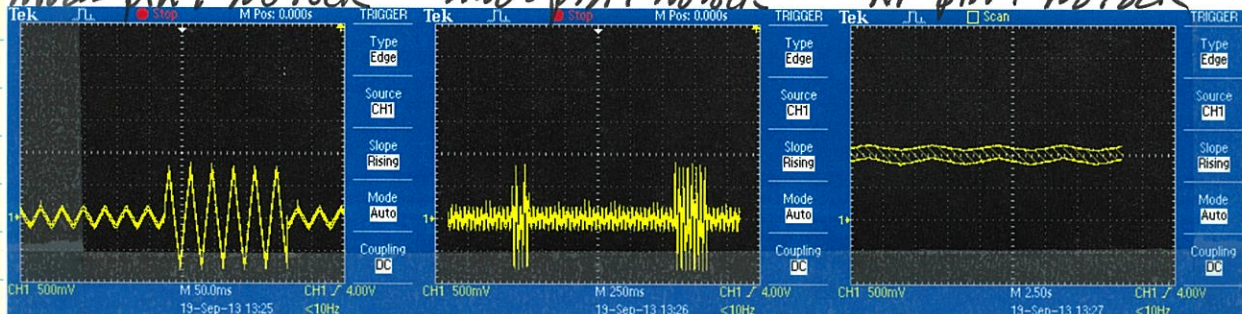
S/N 3989 ("NEW")
NMR pin 7 lock

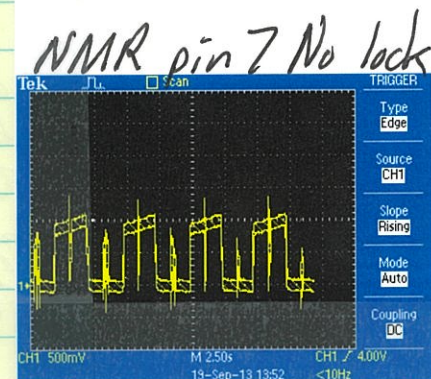
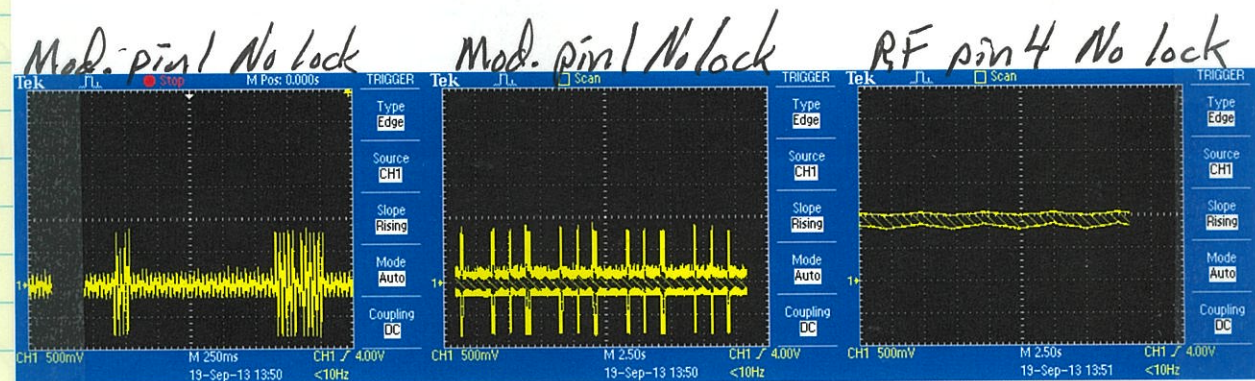
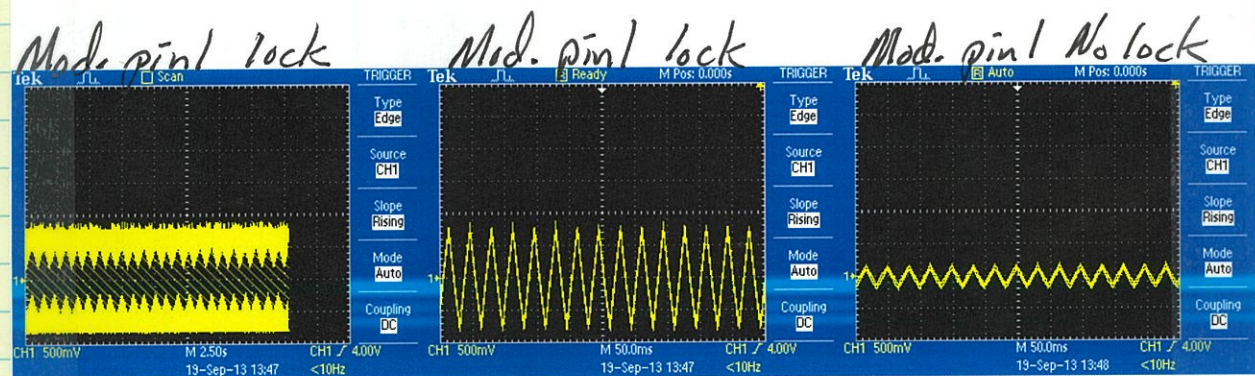
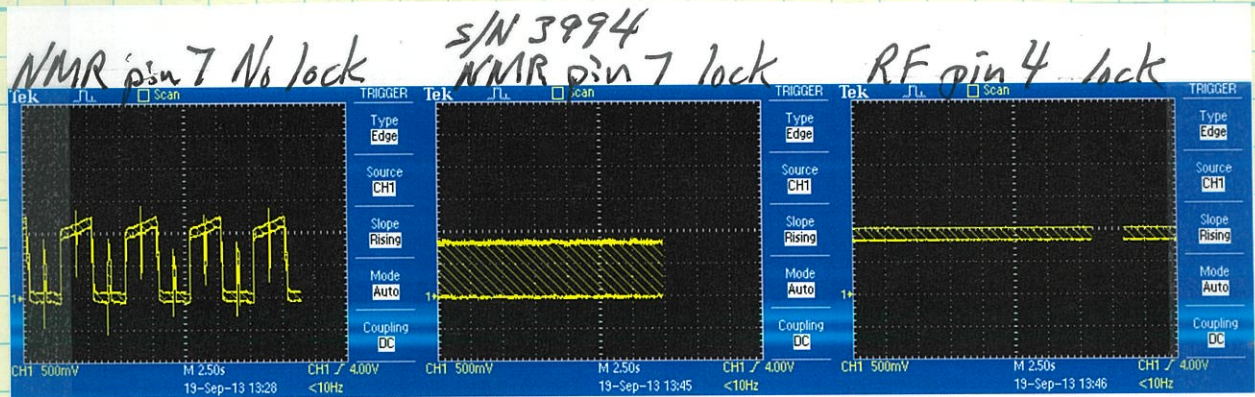


Mod. pin 1 lock



Mod. pin 1 No lock





12/18/13 Current On Detector Stack Safety Ground

I took a look at measuring the currents on the 208VAC safety ground cable. This was motivated by work I had done previously in 1997 in the logbook, Miscellaneous Hardware I p. 110 - 112. The DC Power Supply group had also recently found large current on a setup in the Test Lab.

I used a Fluke 36 clamp meter to make these measurements.

What was the Hadron Stack in 1997 is now on the Left Arm.

Looking at the Right Detector Stack. On the 208VAC 3-phase safety ground cable at the rear of the stack, in the tray after the junction box, I get ~ 0 A DC and ~ 0 A AC.

I see 13.0 A on the yellow cable (AC)
 29.0 A blue
 22.8 A red
 10.9 A neutral

Going over to the Left Detector Stack.

I see ~ 0 A AC on the safety wire coming from the breaker panel to the junction box at the rear of the detector stack. I see 2.5 A on the safety wire cable in the tray. I see about 1 A on the safety wire for one of the black 50 cables coming from the junction box.

I see 38.7 A AC on the black wire of the junction box
 26.2 A red
 12.0 A blue
 18.4 A white

after the Left Detector Stack was pulled out of the Shield House I put the Telluric current clamp on the orange safety ground cable in the cable tray.

The clamp read 2.1 A

Turn the bottom FB crate off it reads 0.8 A

Turn off the whole rack (FB) it reads 0.9 A

Turn on the rack 0.8 A

Turn stuff off on the upper platform 0.3 A

Turn off the main breaker on the

panels on the lower platform 0.1 A

Turn main breaker back on 0.3 A

Turn on lower platform lights 0.3 A

I checked the Right Detector Stack.

The orange safety cable read 0.5 A

The meter zero was 0.2 A

90

Looking at the loading of the power supply.

8 of 1881M modules and three of the ~~SI~~ ^{SI S} 4100 NGF modules with an IOC and a couple of CAEN VME cards between them. ^{1 of V560E}
^{(2 of 1151E}
 1877S 5V 5A x 20 = 10A

Totals	5V	140A
	-5V	128A
	2V	76A

There must have been a problem with the connection at the terminal strip.

Church and I replaced the supply. Church went through all the supplies and checked the connections. We still need to check the Left Arm Satchels crate.

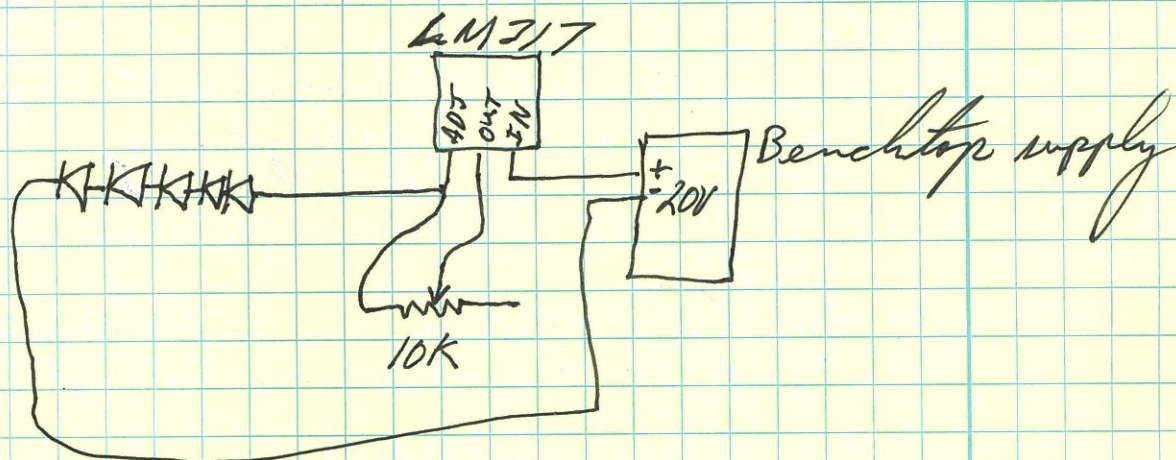
This work was done earlier in July.

Short LED String For RQ1 Inspection 8/5/14

I assembled an LED light to try and get more illumination inside the RQ1 magnet.

I removed some bright white LEDs from a 3M lighting strip.

The LEDs were soldered in series. A voltage regulator (LM317) and a 10K dial potentiometer from Freestock were used to vary the current through the LEDs.



The dial on the pot goes from 000 to 999.
With this setup:

	Dial Reading	Current through the LEDs
$\sim 140\Omega$	14	10mA
$\sim 100\Omega$	10	14mA
$\sim 70\Omega$	7	20mA
$\sim 260\Omega$	26	5mA

Current was measured with a Fluke 117 in series with the "-" of the supply.

The assembly was attached to a thin twisted pair cable and clear heatsink put over the LEDs and solder joints.

Care needs to be taken in its use. There is no heat sink and the solder joints are not flexible.

2/26/15 First Look At PCA9698 40-bit I/O Chips

Taking a look at the NXP PCA9698 chip. This is a 40-bit I/O chip. 5 eight bit ports.
I got an evaluation board for it. OM6281.

I got a USB interface board for it, also. That was not so useful. So, I made a connection to a Raspberry Pi.

It became apparent there are some wiring errors on the eval board. I made some plugs with red LEDs to try and identify the errors.

I wrote a short program to turn off the LED on each pin in sequence.

It looks like ports 0 and 1 are wired correctly. It also looks like port 4 is wired correctly.

Bit 7 of port 2 is connected to pin 1 of header 3.

Bit 0 of port 3 is connected to pin 7 of header 2.

OK, let's say port bits are 0-7 and header pins are also 0-7.

Bit 1 of port 3 is connected to pin 0 of port 3 header. What is kind of amusing is that the LED for port 3 is connected to pin 0 of port header 3. So, the LED turns off and on with bit 1 of port 3, not bit 0. The rest of header 3 seems correct.

Looking at the PCA9698 data sheet.

Bit 7 of port 2 is on pin 35 of the IC. On the board it seems that pin is tied to pin 1 of header 3. OK.

Bit 0 of port 3 is on pin 36 of the IC. On the board it seems that pin is tied to pin 7 of header 2. OK.

Bit 1 of port 3 is on pin 37 of the IC. On the board it seems that pin is tied to LED 3 and pin 0 of header 3. OK.

Sol
log

Damage Extension Cord

6/25/15

We found a damaged extension cord in use in the laser lab in the EEL. The ends showed definite signs of having been overheated.

There is a tag on it that has a UL mark and shows 13A 125V 1625W. It is 10' long.

The male and female plugs show serious charring at the crimpers for the L & N wires.

Jessie and I measured the current draw of the heaters for the He-3 target. Both of the heaters draw about 10A each.

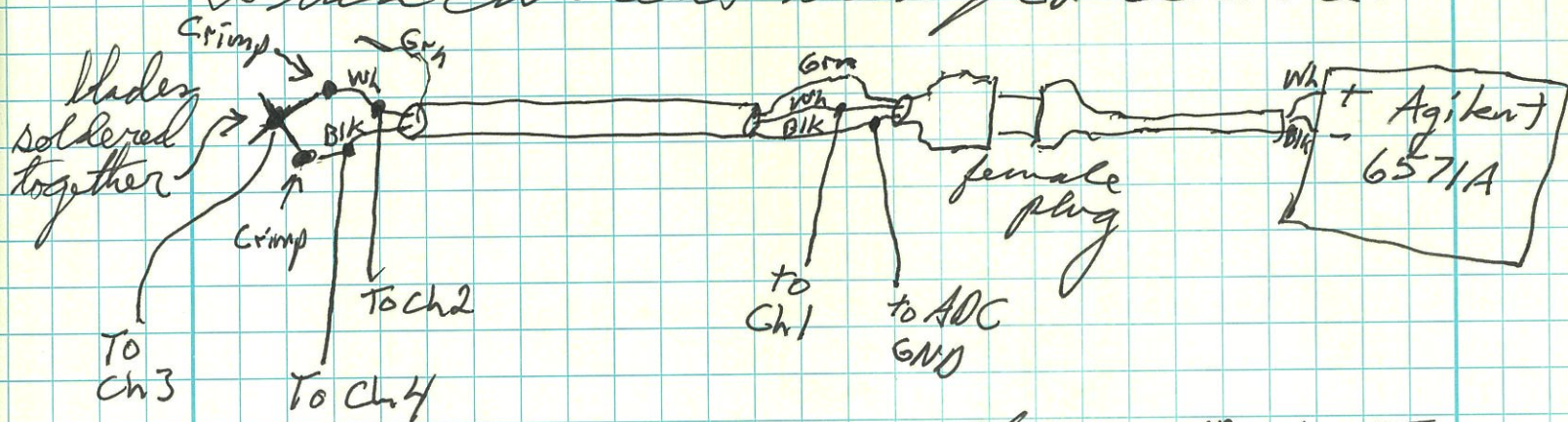
I cut open the male plug. The crimpers did not look bad.

I soldered the L & N blades together of the male plug. I cut off insulation on the other side of the crimpers to expose the wires.

I cut back insulation at the female plug end to expose the L & N wires.

The cable is 10' long and marked AWG16x3C SJTW JFT 2.

I soldered wires to the exposed wires to be able to measure the voltage drops as I run current through the cable.

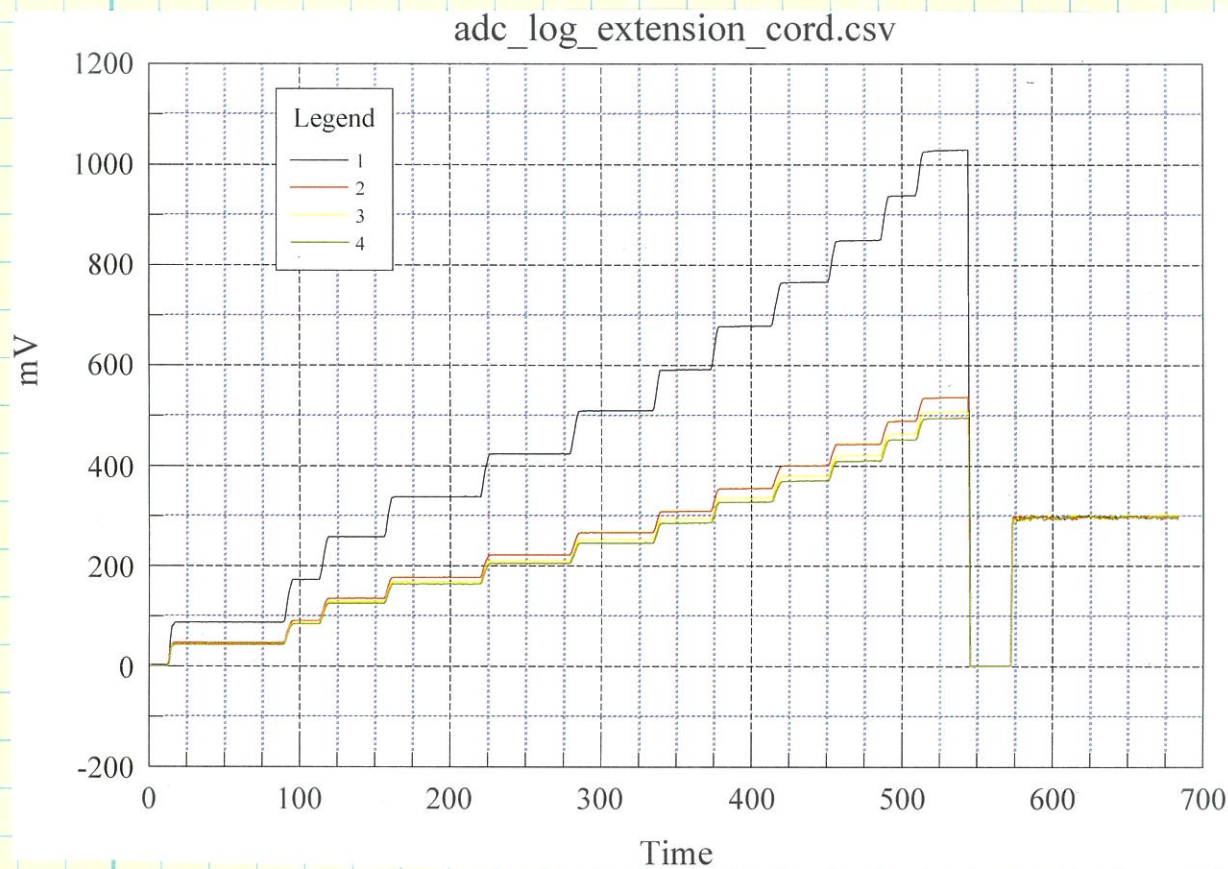


The ADCs are a RPi with 2 of ADS1015 I²C 10bit ADCs.

The power supply was run in current mode, and ramped up manually, pausing at each setting to allow the ADCs to run for a bit.

The current settings during the pauses are:

0.00 A
 2.04
 3.05
 4.01
 5.03
 6.05
 7.00
 8.02
 9.04
 10.00
 11.01
 12.03



After turning the supply off none of the parts were shot.

Most likely the extension cable was damaged in a previous setup and was re-used, rather than being disposed of as it should have been.

First Look At How The APC PDU Works 7/27/15

Looking at the wiring of the APC Switched Rack PDU.

The relays seem to be driven by a couple of 74AC02 chips driven by a PCF8574 chip. That is an I2C eight bit port expander. I measured 3.38V on the V_{DD} pin of the 8574. The three address lines have A0 0V on them.

A1 3.3V
A2 3.3V
26 hex = A2 3.3V

On the 10 conductor ribbon cable that goes to the header by the 8574 chip. Pins 1 & 2 are tied together and to ground.

It seems SCL is tied to pin 8 of the 10 pin header. Pins 5 & 6 of the header are tied together and 24V.

Pin 3 of the header is connected to 3.3V

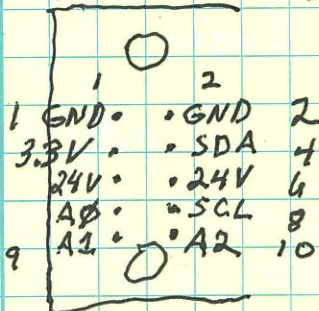
SDA is tied to pin 4 of the header.

It looks like pin 7 of the header is connected to pin 1 of the 8574.

Pin 2 of the 8574 looks like it is tied to pin 9 of the header.

Pin 3 of the 8574 looks like it is tied to pin 10 of the header.

Header on the end of the relay board.



Header on the 24V power supply board. There seem to be two 24V power supplies.

middle sensor 1 2 } secondary common

furthest sensor 3 4 }

22V 5 6 22V (supply by the AC current monitors)

closest sensor 7 8 GND

GND 9 10 24V (supply on the end)

There are three current sensors at one end of the power supply board. Only one of the sensors is connected to the AC line. It seems the board can be used in a 2 or 3 phase switch, also.

On the dead PDU the sensor is a SHILCHAR SPTL 0414 460-1001A/6. This gets no results on a web search. A working PDU has FALCO 460-1002-Z-04 1429. After a web search I find a similar part, a FALCO T75010 which is a 1000:1 turn ratio, 0.10V/A, DCR 46.2 Ω .

The sensor has a 16.9 Ω resistor across the secondary. $16.9 // 46.2 = 12.4 \Omega$

I measure 12.1 Ω across the secondary with a Fluke 189.

The secondary has one end grounded. No, not ground. Pins 2 & 4 of the header?

Pin 3 of header to the sensor furthest away.

Pin 1 of header to the middle sensor.

Pin 7 of header to the closest sensor, the one being used for the single phase.

Pin 7 goes to Y1 input of the 74HC451 analog multiplexer.

I'm not sure how the current is read out. The sensor outputs from the secondary go to the first three inputs of an 8 ch analog mux. A 74HC4051.

The mux output goes to a LTC1966 RMS-to-DC converter.

The converter output goes to one of the input pins on a LMC6062 amp, through a 200K resistor (it looks like).

I can't seem to find if the sensor signals eventually end up at an input on the AD7417 10bit ADC.

But, I think I now have enough information to use.

8/15/15

Starting To Develop Heater Control

Putting together some heat control. To be used for soldering the RQ1 leads.

I put together four of the temperature sticks using the TMP100 chip from TI.

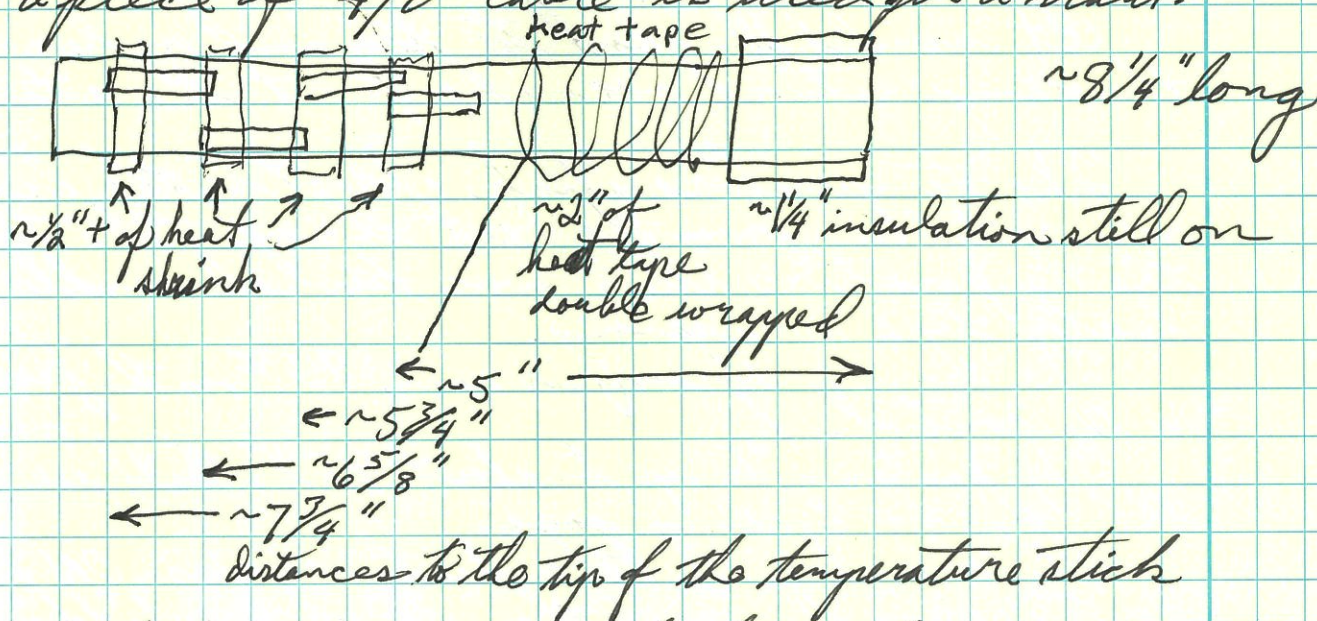
I'm using one of the I2K multiplexers I put together for the brewery (MUX4).

I made phone jumper cables to connect to the boards in the APC PDU. These are 2mm headers, using 1mm pitch 10 conductor cable.

I put together a prototyping board for the RPi. It is pretty messy, but functional. The 24V from the power supply board is led to a 5V DC-DC converter (for the RPi) and to the relay board. The 3.3V for the relay board is now from the RPi.

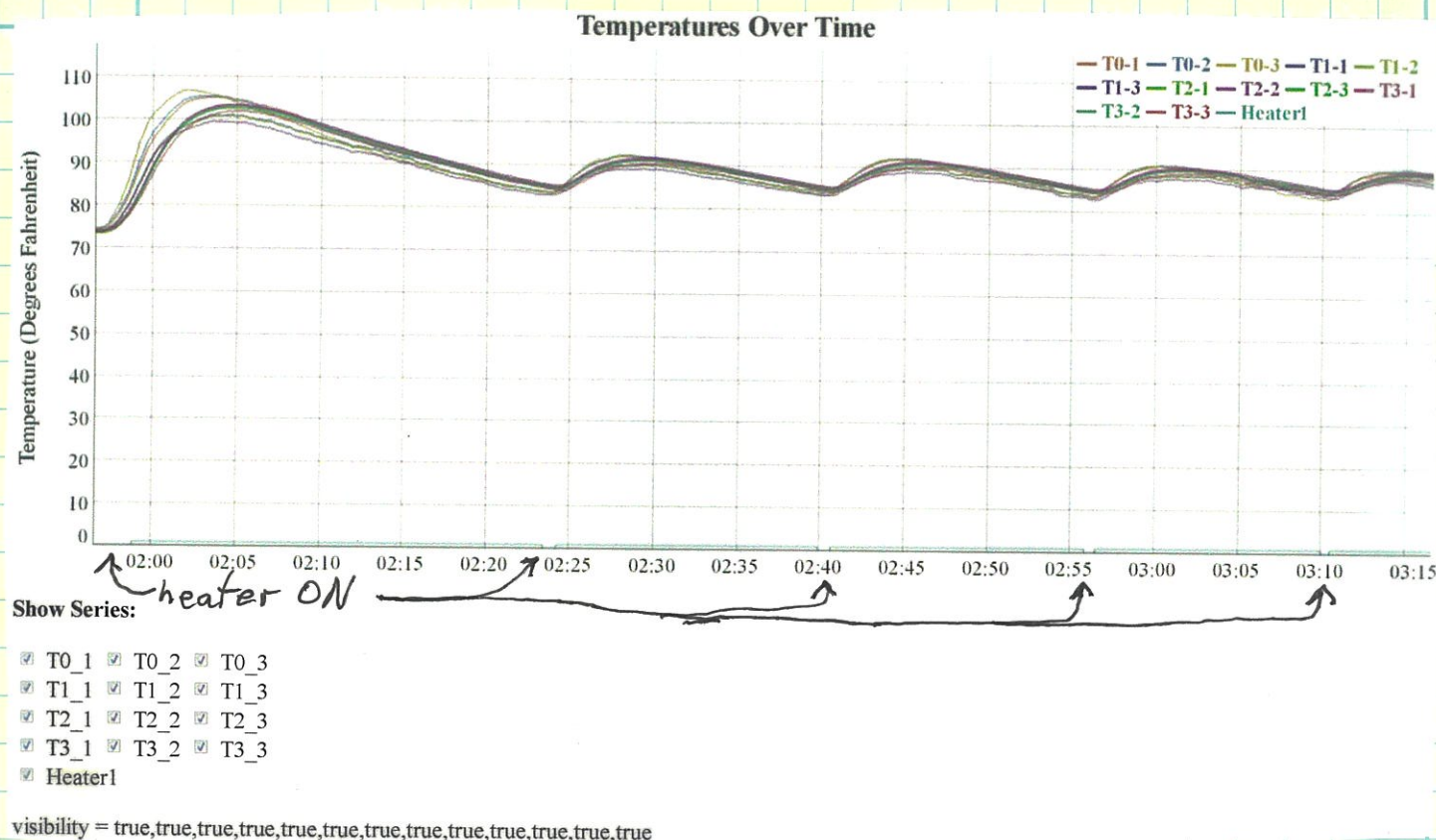
The RPi I2C is connected to the relay board in the PDU and to the MUX4. The four temperature sticks are connected to the MUX4 channels.

A piece of 4/0 cable is used for a stant.



Each temperature stick has three TMP100 chips installed on the three positions at the tip of the stick. They are read out in the order of the addresses 4F, 4A, 49. Looking at the schematic this is the first, second, and then third from the tip of the stick.

For the first run I had the heater plugged into outlet 8 and set to turn off when the first chip of the stick closest to the heater was $\geq 85^\circ\text{F}$. The plot is on the following page.



It seems to take about 45 minutes to sort of stabilize.

It would be good to try and reduce the temperature overshoot at the start.

The temperature stick closest to the heater was cut free, from the heat shrink. The tip of the temperature stick was tucked under the heater tape wrapping.

The same program is run, 85°F on the first chip is the control.

The heater gets up to about 95°F. We'll see how the ON/OFF cycling goes.

It looks like the heater cycles ON for 4 or 5 seconds and then off for a while. The end of the cable looks stuck at about 80°F.

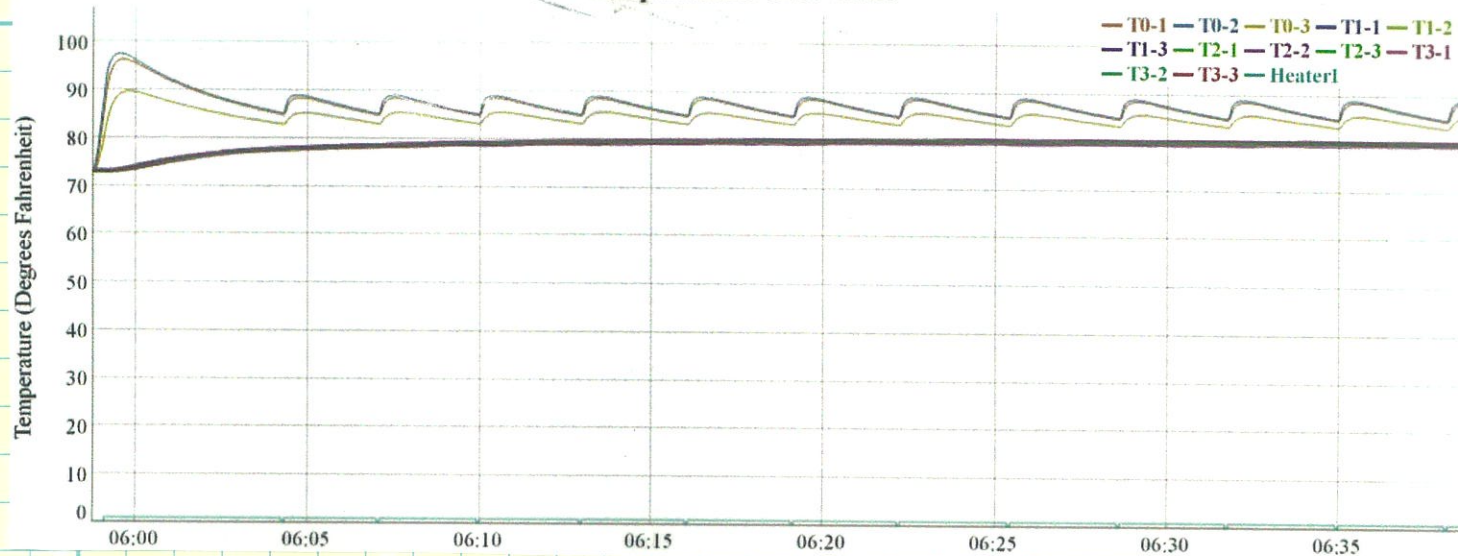
Stop the program. Save the files.

Change the set temperature from 85°F to 95°F.

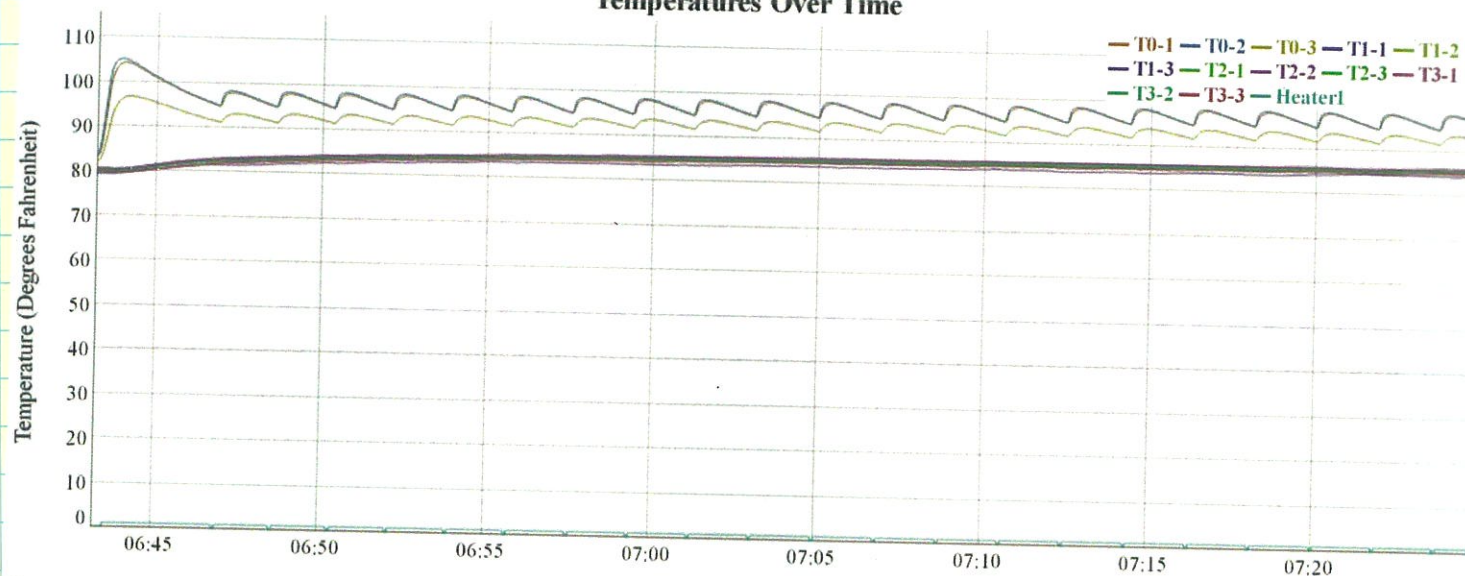
See the plots on p. 99 (opposite).

The TMP10 is specified to run up to 125°C, or 257°F.

Temperatures Over Time



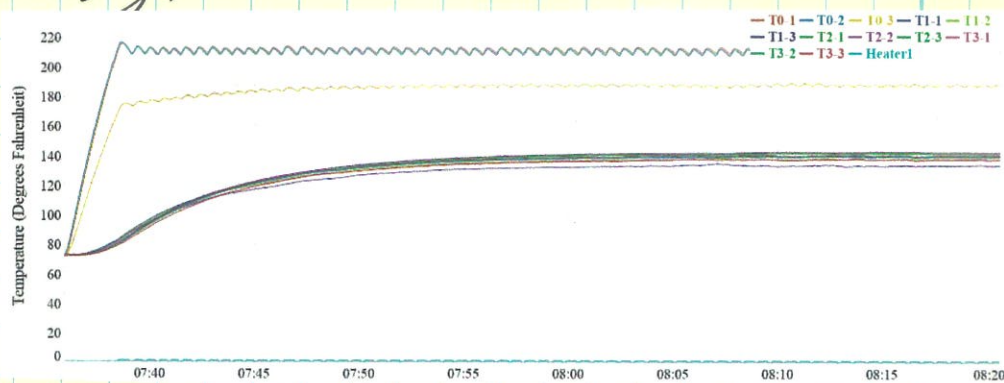
Temperatures Over Time



Show Series:

- ☒ T0_1 ☒ T0_2 ☒ T0_3
☒ T1_1 ☒ T1_2 ☒ T1_3
☒ T2_1 ☒ T2_2 ☒ T2_3
☒ T3_1 ☒ T3_2 ☒ T3_3
☒ Heater1

I changed the set temperature in the program to 210°F. Probably need to be a bit more clever.



8/18/15 First Try With Citric Acid

Trying a slightly different heater control.

I moved the "T₂" stick back to the point just down from the heater, on the bare copper cable. Except I installed it backwards. So, T₂-1 is closest to the heater.

An Omega temperature controller is plugged into outlet 8 of the PDU. The temperature controller has the heater plugged into it and a K type thermocouple is inserted between the two layers of wrap of the heat tape. The controller is set for 300°F.

Also, trying citric acid as a flux. The RPi is set for T₂-1 to be at 170°F.

At about 17:10 on the plot I applied some flux on the end of the cable. It seemed to clean off the copper. It looked a bit more shiny.

At about 17:18 I applied a bit of flux over one side of the end and then turned the Omega controller OFF.

The end of the cable was manually inserted into the cup of liquid solder. Solder cup has a heater wrapped around it and controlled by another Omega controller set to 170°F. A K type thermocouple is inserted in the liquid solder.

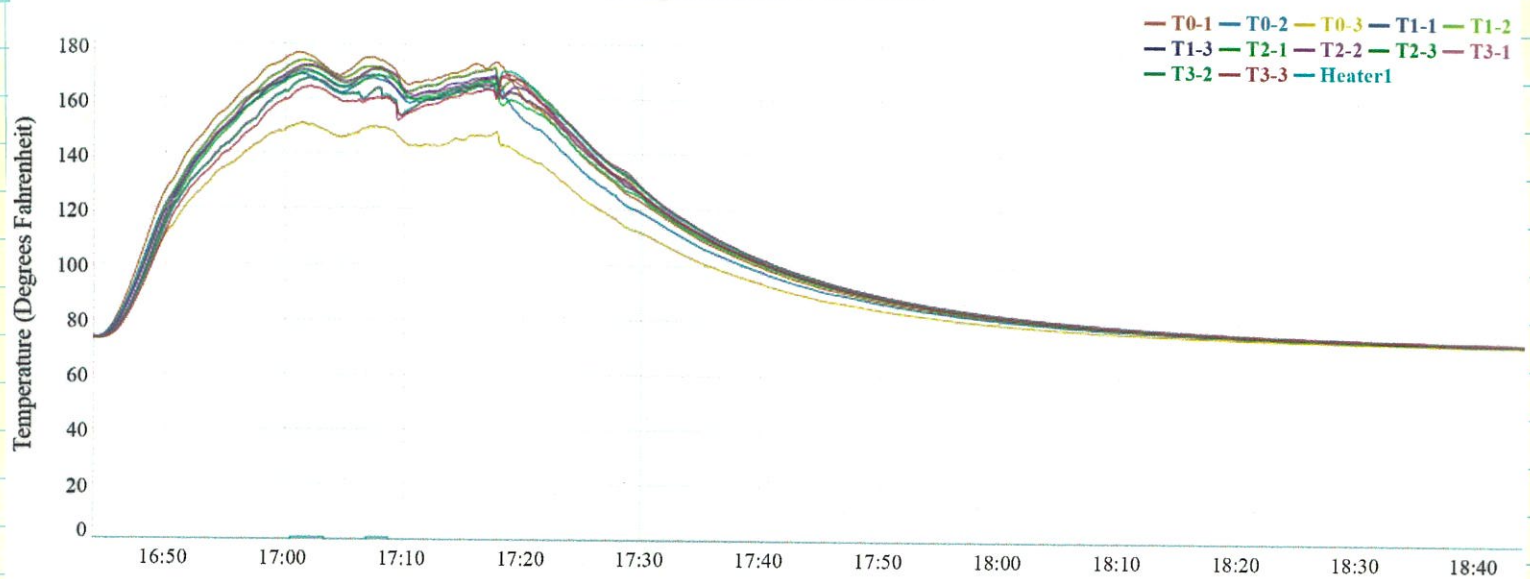
In general, the heating seemed to work ok.

The citric acid seemed to work as a flux.

It looks like where there was no flux there was no wetting of the copper.

It looks like the solder may have wicked a bit further up the cable than I would like to see. Perhaps this is due to putting some flux on well before dipping the end into the solder.

Temperatures Over Time



Show Series:

- ☒ T0_1 ☒ T0_2 ☒ T0_3
- ☒ T1_1 ☒ T1_2 ☒ T1_3
- ☒ T2_1 ☒ T2_2 ☒ T2_3
- ☒ T3_1 ☒ T3_2 ☒ T3_3
- ☒ Heater1

After removing the heat tape it seems the copper under it oxidized in places. It looks to me to be between the wraps on the inner layer. Not under the heat tape itself.

8/12/15 Attempt to Bridge A Cable

Heat tape is wrapped around an ~8" piece of cable, 4/8".
 ~6" of insulation removed from one end.
 Heat tape wrapped around the exposed 6" in one layer.

K type ~~thermocouple~~ thermocouple is wrapped under the heat tape. Omega C5C32 controller is set to 300°F.

After the cable reached 300°F I let it run there for ~30 minutes. Then I switched off the controller and left things to cool on their own.

After unwrapping the heat tape I could see signs of discoloration under the heat tape.

This is a 24" 52W 1/2" wide 450°F silicone heat tape.

Trying a 900°F 12" 105W 1" wide heat tape.

This started smoking in a short bit.

The thermocouple reads about 250°F. It is set for 300°F.

If I put my hand above the heat tape it seems to be very hot. I would think much more than 300°F.

I turned the controller off and let things cool down.

Removing the heat tape and looking at the cable. Some hint of discoloration, but I did not leave it run very long. Maybe 5 minutes.

I have cut some more pieces of 4/8 welding cable of a length better suited to the heat tapes. The pieces are about 12" long.

8/20/15

Trying the 12" long x 1" wide heat tape again.

I wrapped it in a single wrap on one of the 12" long 4/0 cables.

On initial warm-up the heater was smoking slightly. ~~The~~ The CSC32 controller cycles from $\sim 220^{\circ}\text{F}$ to $\sim 370^{\circ}\text{F}$. It is set to 300°F .

The controller was turned off when the I2C stick reached 170°F . When the controller was turned back ON (I2C stick back down to 170°F) it read 202°F .

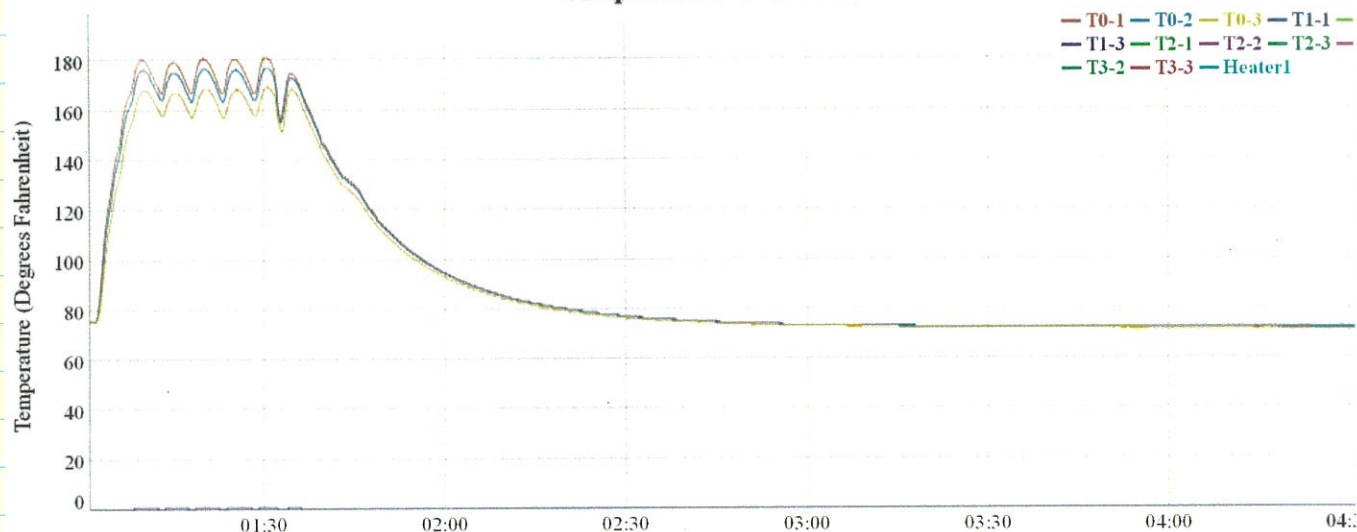
After the heat tape had cycled a few times I picked the cable assembly up and dipped the end into a citric acid solution.

Then the end was dipped into the molten solder which was at about 180°F .

After 5-10 seconds I pulled the cable out.

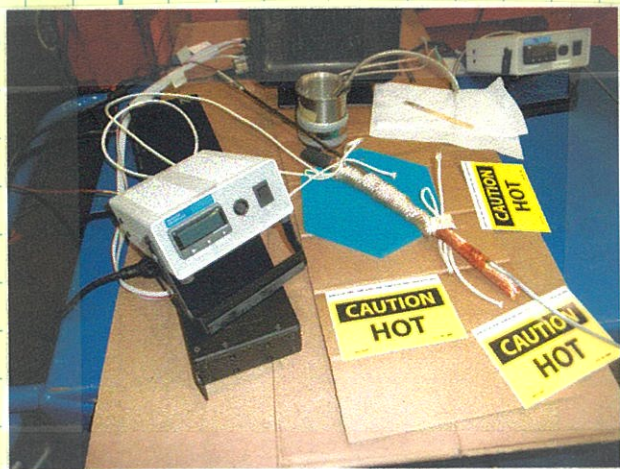
When initially inserting the cable into the solder, I turned the heat tape controller OFF. I was starting to feel the heat tape through the oven mitt I had on.

Temperatures Over Time



Show Series:

- ☒ T0_1 ☒ T0_2 ☒ T0_3
- ☒ T1_1 ☒ T1_2 ☒ T1_3
- ☒ T2_1 ☒ T2_2 ☒ T2_3
- ☒ T3_1 ☒ T3_2 ☒ T3_3
- ☒ Heater1



This is the setup for this run. Only one temperature stick was used. It is taped to the cable "upside down". The tip points toward the heater. The control was set so T_{D-1} is 170°F . This controls the AC to the Omega controller.

After everything had cooled, I cut $\sim 1"$ off the end of the cable. Looking to see how far up the cable the solder had wicked.

The solder appears to have wicked up the centers of the strands. I can see solder around the wires at the centers of the strands, but not around the wires on the outer edges of the strands.

I cut an additional $\sim 1\frac{3}{4}"$ off the end of the cable.

I was able to easily separate all the strands. Most of the outer wires of each strand came off. Well, really all of the outer wires. The sections of the centers are of varying sizes. The sections that are soldered together at the end which was closest to the tip.

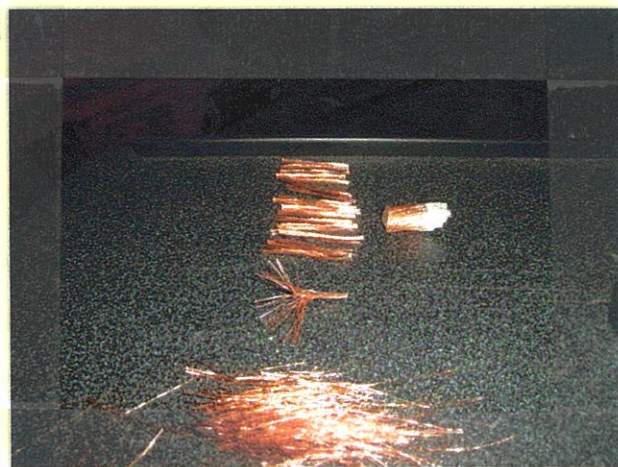
Before separating all the strands, I did not see any ~~to~~ solder at the end farthest from the tip. That end could be moved easily and it seemed all the wires moved freely.

I took the center of one strand and pried the wires apart till I got to the point the wires were soldered together. That point is about $\sim 1"$ up from the tip end.

So, the solder wicked as much as $\sim 2"$ up the cable.

Looking at previous infrared pictures of one of the earlier cables, I thought maybe the center wires of a strand at the tip were hotter than the outer wires. But, looking at the pictures again, it is not conclusive and looks to be the opposite.

The solder wicked about 2" up the cable.



This time I will take the remaining cable, $\sim 9\frac{3}{4}$ " long, and dip the end of the room temperature cable into the solder.

8/21/15

JA

I dipped the end of the cable into $\sim \frac{1}{4}$ " of citric acid.

I dipped the end of the cable into $\sim 180^\circ\text{F}$ solder for ~ 15 seconds.

After cooling, I cut off $\sim 1\frac{1}{8}$ " from the end of the cable.



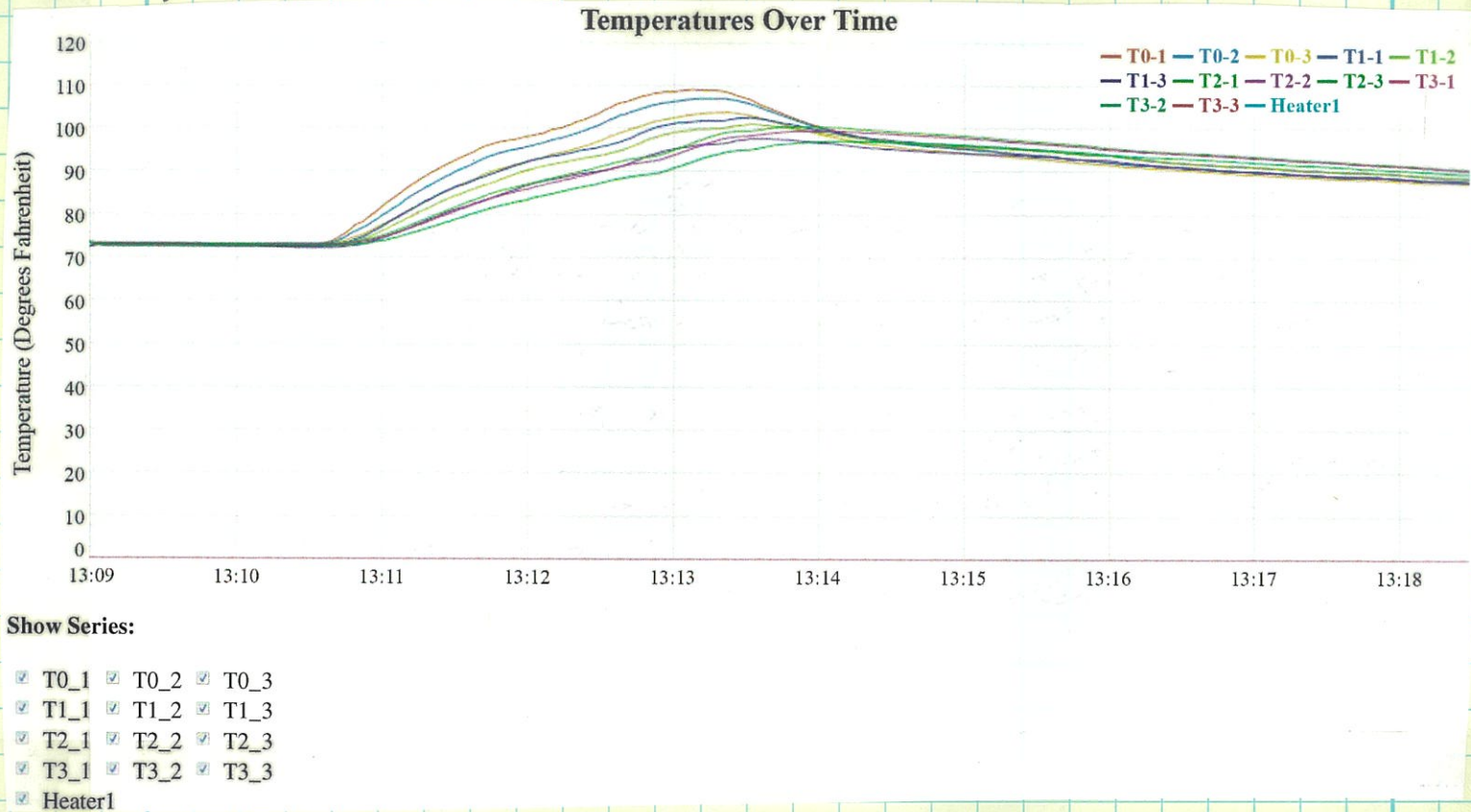
All the wires at the cut seem to move freely. It does not seem that the solder wicked that far up the cable.

Bending the wires back on the piece of the tip I see a bit of greenish residue on the wires. It looks like the flux wicked up that far.

None of the wires in the center of the tip are wet by the solder. They can all be pulled out of the tip.

I am going to try this with temperature sensors on it.

I put three temperature sticks on the cable and repeated this.
 I held the cable in the solder for a bit over 20 seconds.
 The solder formed a ball at the end of the cable. It definitely did not form a joint on the end.



Essentially none of the wires were wet.

8/22/15

I have set things up so I can hold the cable tip in the solder cup for an extended period of time.

After the solder is liquid I will lower the cable till the tip is immersed $\sim 1/4"$ into the liquid solder.

If the cable is warming up satisfactorily, I will wait to apply flux until some temperature. The set point for the solder is 170°F .

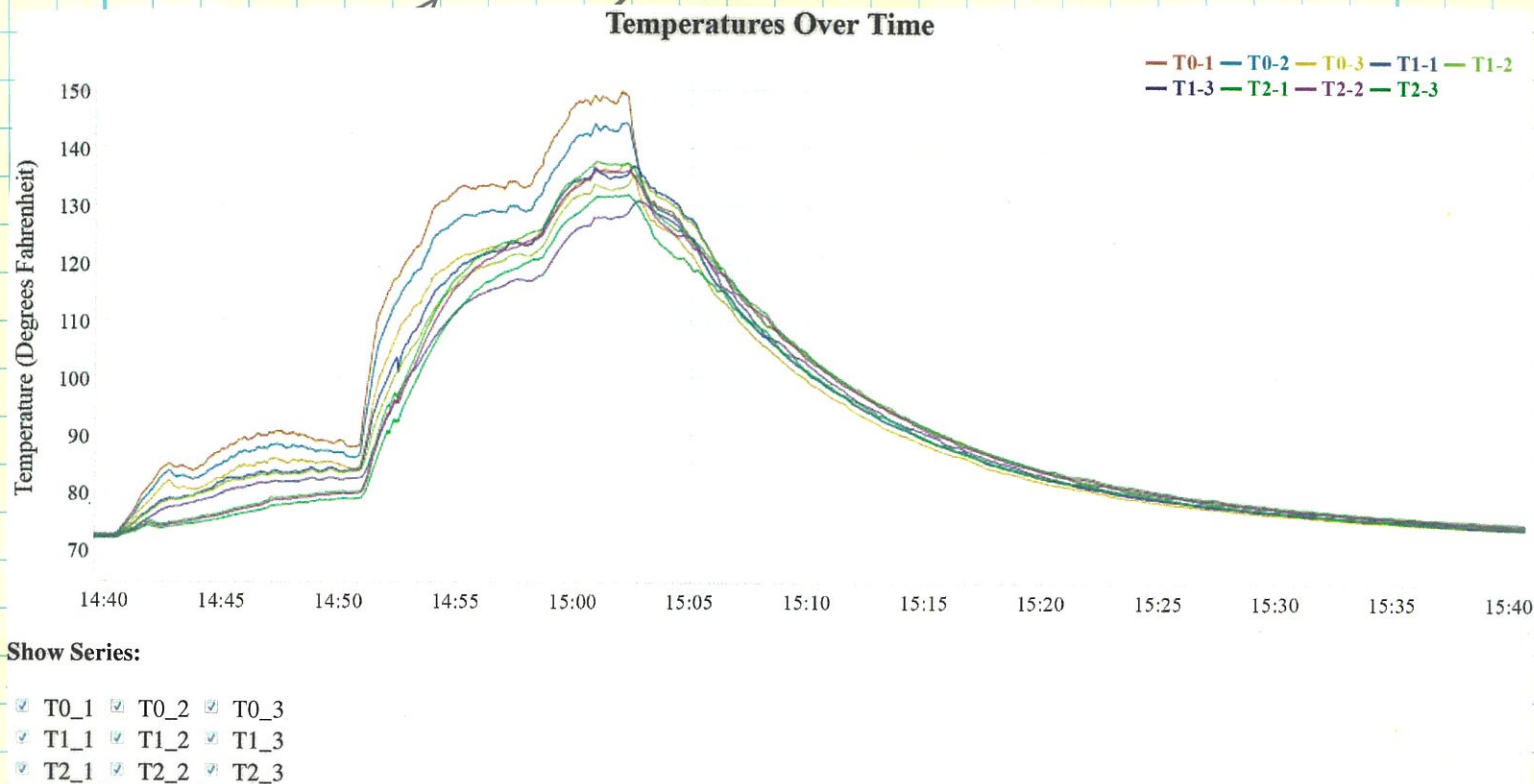
When the T1-0 seemed to settle at $134-135^{\circ}\text{F}$ I changed the solder set point to 175°F .

Shortly after that I squirted some citric acid solution on the surface of the solder all around the cable.

After a brief time the acid was wicked up into the cable.

After ~ 20 seconds I lifted the cable up out of the solder and turned off the heater for the solder cup.

Leaving things to cool.



The solder did wick up into the cable. It feels like up to $\sim 1/2"$ up the cable.

I cut the tip of the cable off about $1\frac{3}{8}$ " up.
It is clear the solder reached that far
and more.

I cut $\sim 1\frac{1}{4}$ " more off. Most of the wires
fell as loose pieces.

Most of the joined wires has solder just
at the tip. The worst piece had solder $\sim \frac{1}{8}$ "
up.

So, $\sim 1\frac{1}{2}$ " wicking up the cable.

8/23/15

JS

I tried another piece of cable.

For the flux, I only put a little water
in the citric acid. The mix had a bit of
viscosity to it. More than water.

Just the end of the cable was dipped into
the solution. The cable was at room temperature.

The cable end was inserted $\sim \frac{1}{4}$ " into
the liquid mix.

The cable was left in the solder for about
7 minutes.

After cooling the cable was inspected.

The solder had wicked up into the
cable.

8/24/15
A

Determining the heating parameters for the copper lug to be soldered to the end of the lead removed from RQ1.

The lower watt, silicone heat tape is wrapped around the lug.

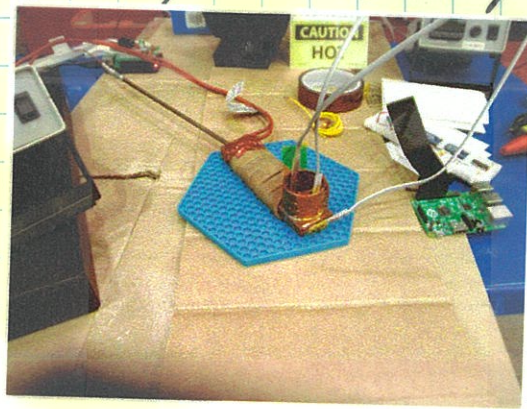
Control is from the temperature stick inside the cup along the end. 170°F .

The Omega controller is set to 300°F and the K thermocouple is under the heat tape wrap.

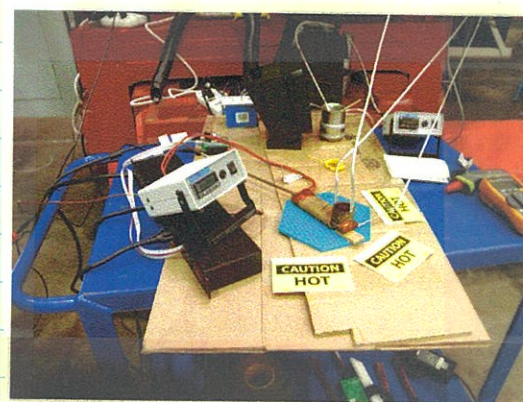
The kapton tape did not hold the temperature sticks very well. I ended the run early.

The two sticks on the cup are moved to the outside of the cup and now held in place by a piece of heat shrink.

The third stick is now under the end of the copper lug, under the cup. It is pressed to the copper by resting on a piece of cardboard that props up the end of the copper lug.

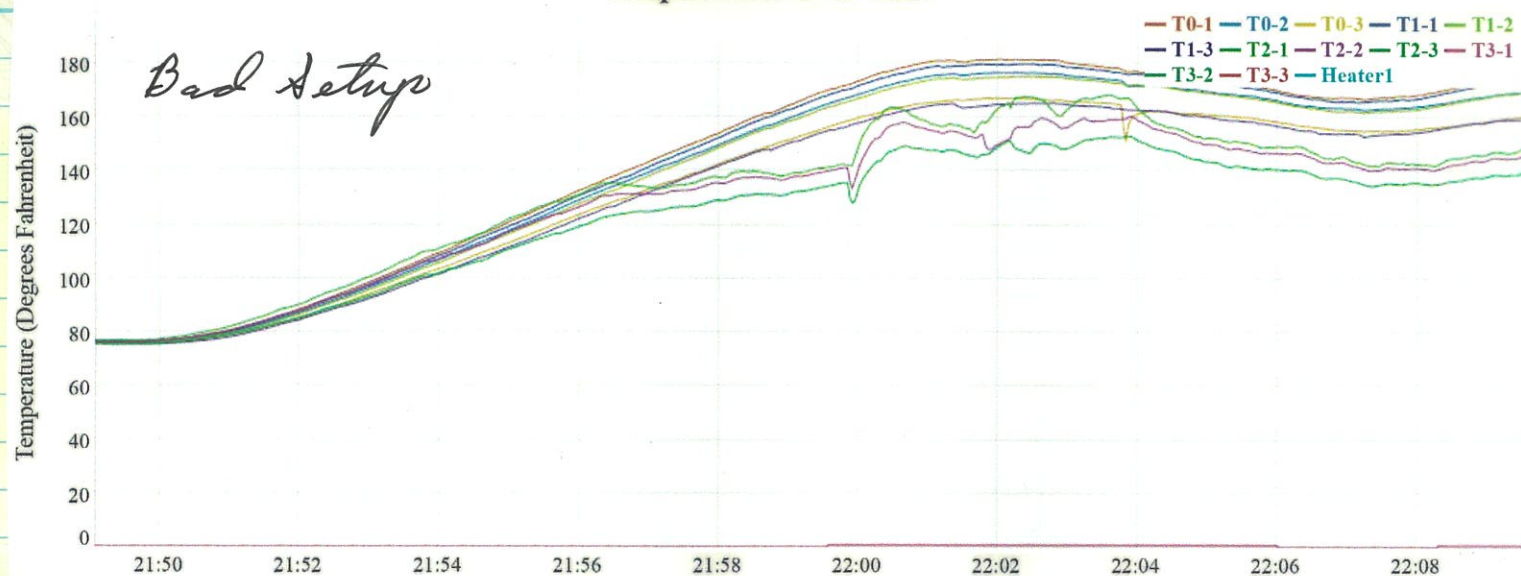


bad setup

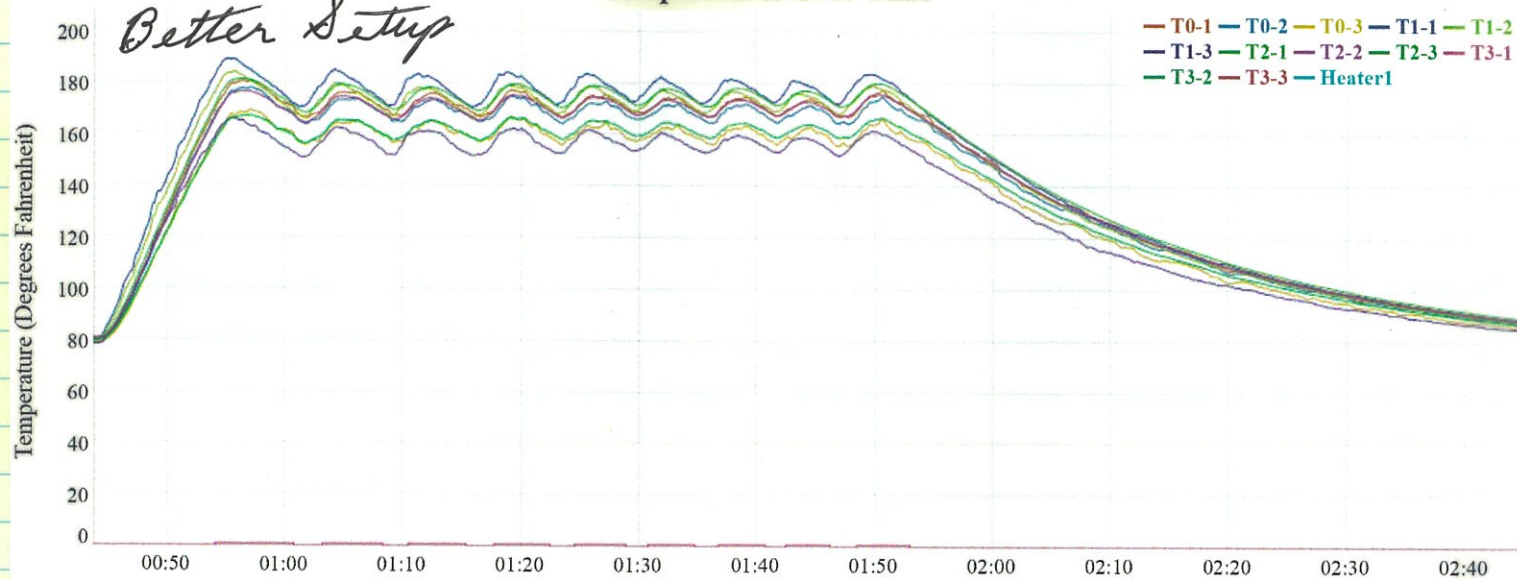


better

Temperatures Over Time

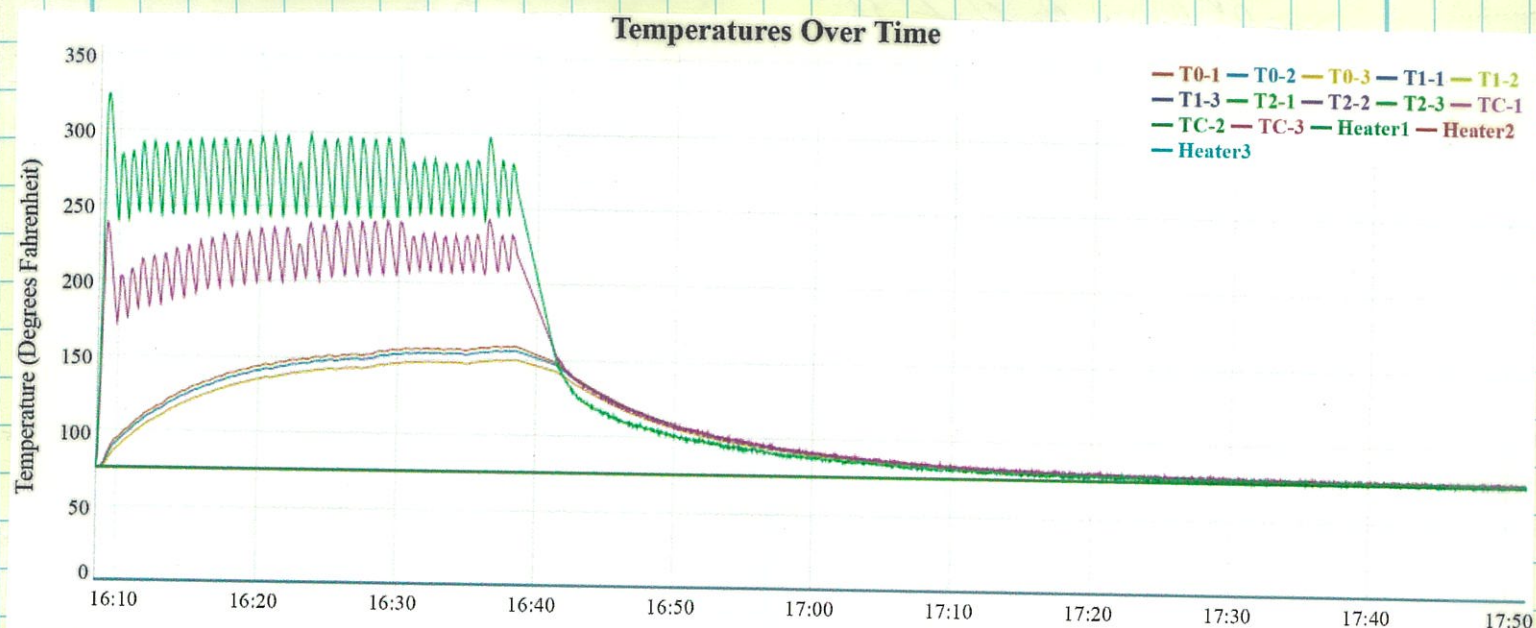


Temperatures Over Time



Show Series:

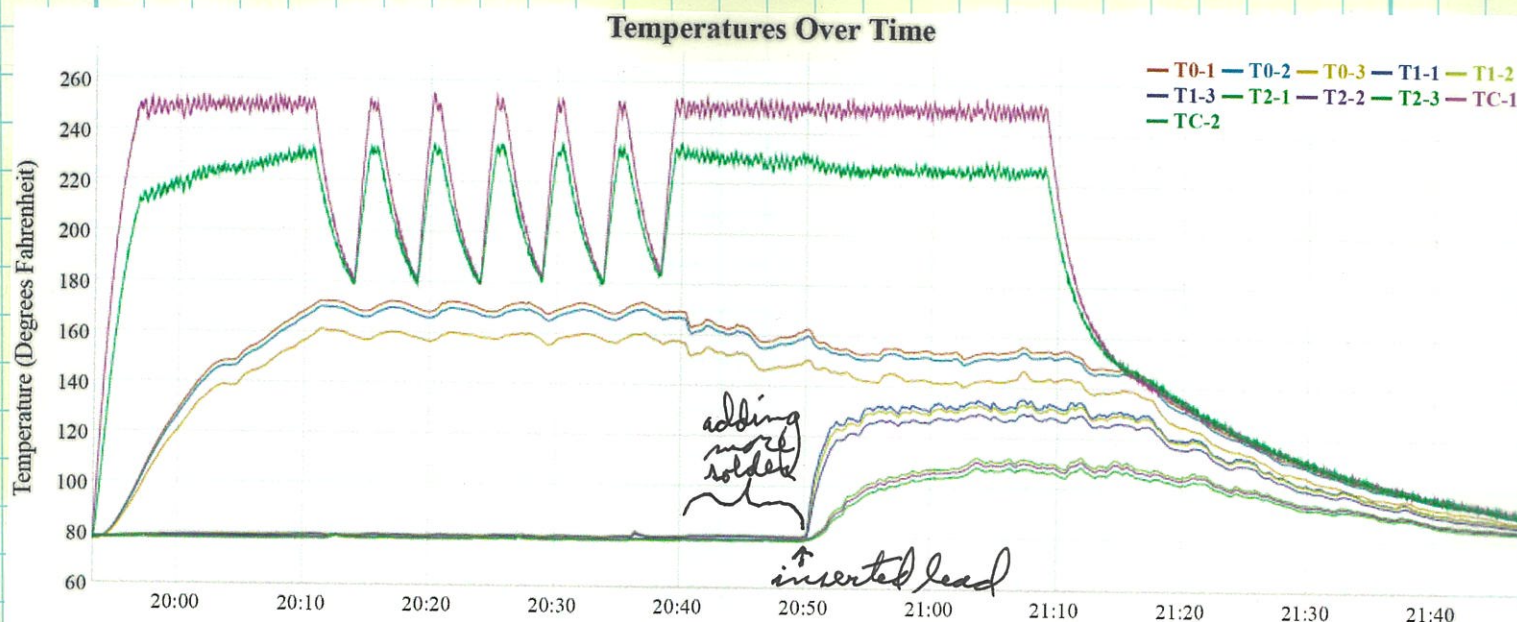
- ☒ T0_1 ☒ T0_2 ☒ T0_3
- ☒ T1_1 ☒ T1_2 ☒ T1_3
- ☒ T2_1 ☒ T2_2 ☒ T2_3
- ☒ T3_1 ☒ T3_2 ☒ T3_3
- ☒ Heater1

9/7/15
AS

Show Series:

- ☒ T0_1 ☒ T0_2 ☒ T0_3
☒ T1_1 ☒ T1_2 ☒ T1_3
☒ T2_1 ☒ T2_2 ☒ T2_3
☒ TC_1 ☒ TC_2 ☒ TC_3
☒ Heater1 ☒ Heater2 ☒ Heater3

Trilling the copper cup on the foot.



Show Series:

- ☒ T0_1 ☒ T0_2 ☒ T0_3
☒ T1_1 ☒ T1_2 ☒ T1_3
☒ T2_1 ☒ T2_2 ☒ T2_3
☒ TC_1 ☒ TC_2 ☒ TC_3
☒ Heater1 ☒ Heater2 ☒ Heater3

*adding more wood's metal to the cup
on the foot and then inserting the
old lead into the cup.*

The solder joint resulting from the efforts on the preceding page did not really look very good. It looked doubtful that the solder had wet the braid.

I decided to press on and measure voltage drops on the leads.

I got three ADS1015 12 bit ADCs on a small board (each) from Adafruit. The ADCs are set as 4 inputs, 11 bits, 0.256V full scale.

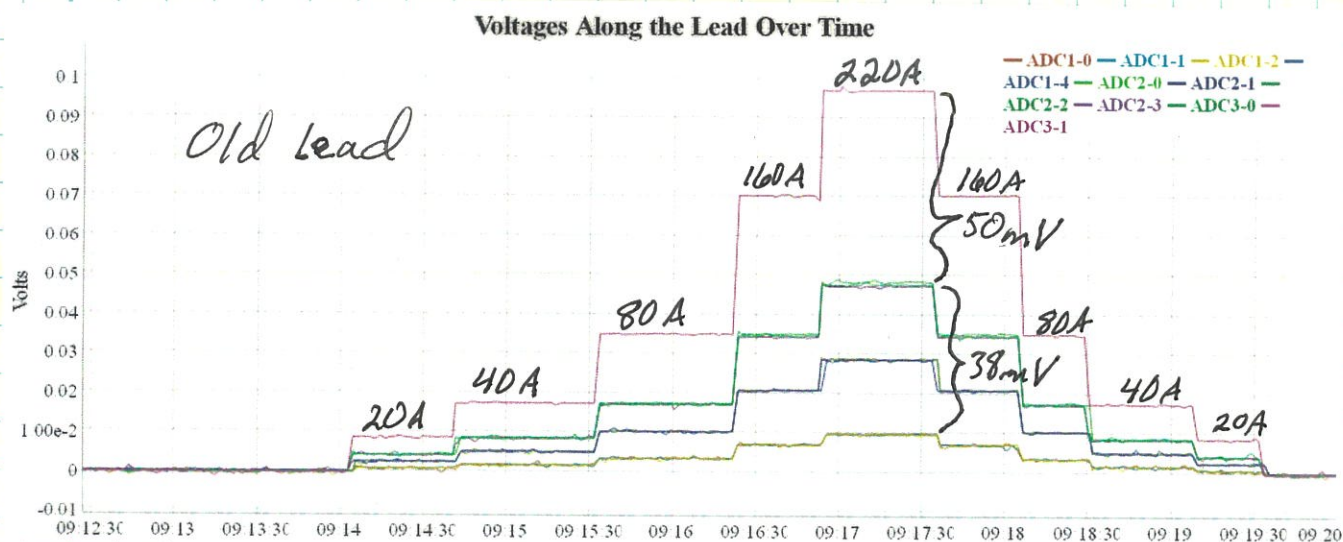
The boards are mounted on a plug board.

The GND of the RPi on the plug board is tied to the flag on the foot of the lead.

At three points up the braid I soldered three wires (at each point) to go to ADC inputs.

One wire from the top flag goes to an ADC input. The wire is pinned against the top crownpost by the flag.

The current through the lead was varied using an Agilent power supply.



The first point is about 1" above the copper cup solder joint.

The second point is about the middle of the braid.

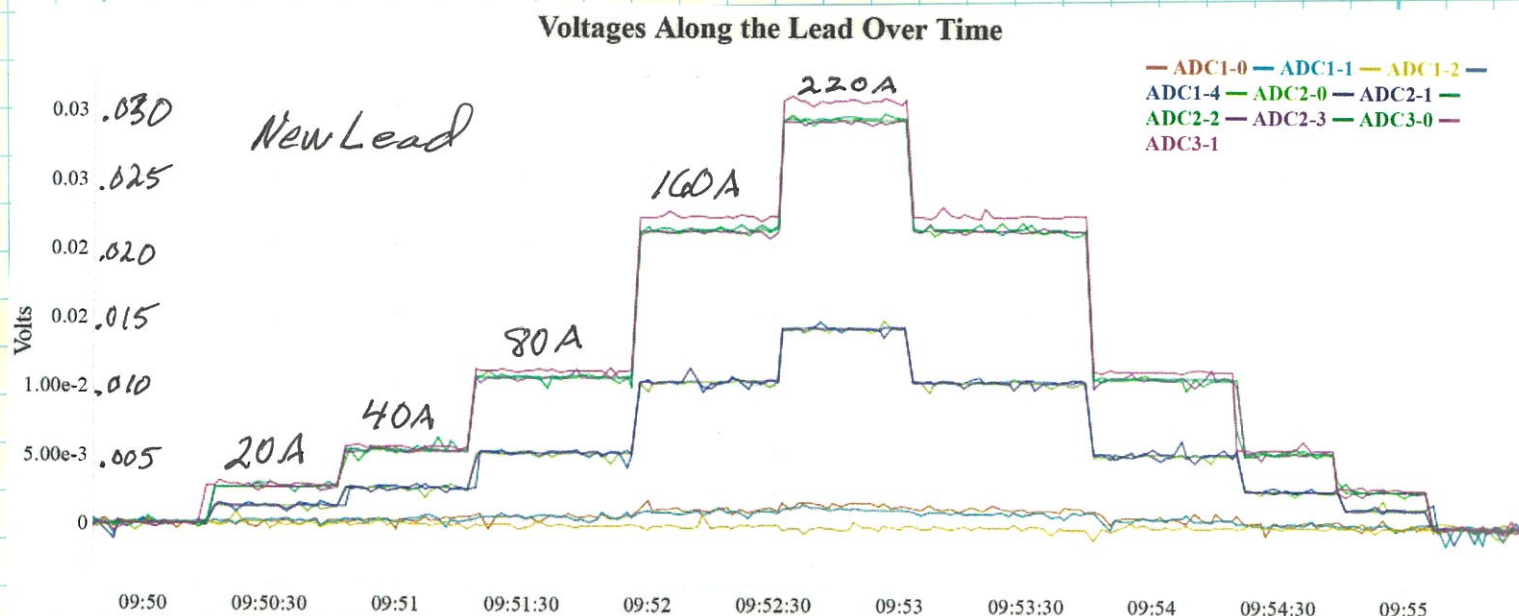
The third point is about 1/2" below the crimp at the top.

The drop across the crimp seems to be very high.

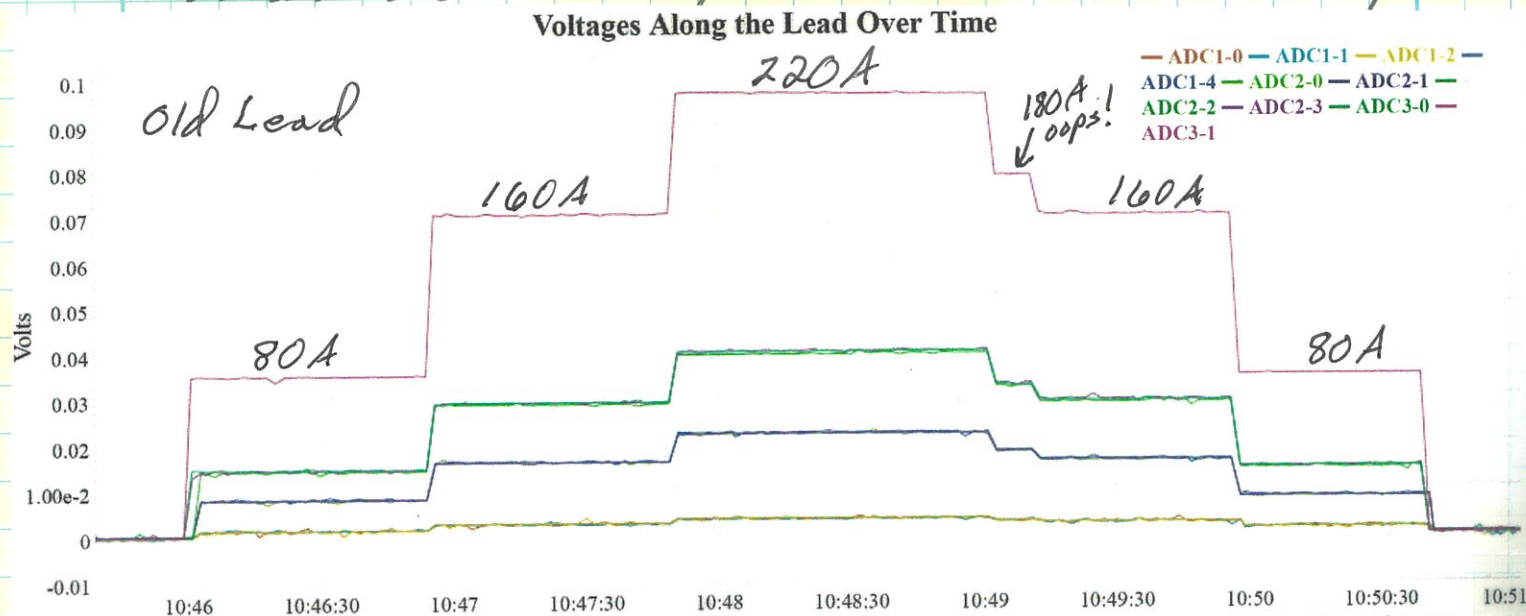
Comparing this to one of the new leads.
I used all the same wires and the same
flag at the top.

I clamped a 1 AWG cable at about the same
distance down the braid from the top as the
foot on the old lead.

I unsoldered the wires from the old braid and
stuck them under the same points on the
new braid.



I put all the connections back on the old lead.
I cleaned the copper at the top end connection and
moved and cleaned the hot connection closer to the cup.



The voltage drop by the foot is much better. It was previously from the lug on the cable from the legible at the end of the foot flag. I think it included the drop along the copper flag.

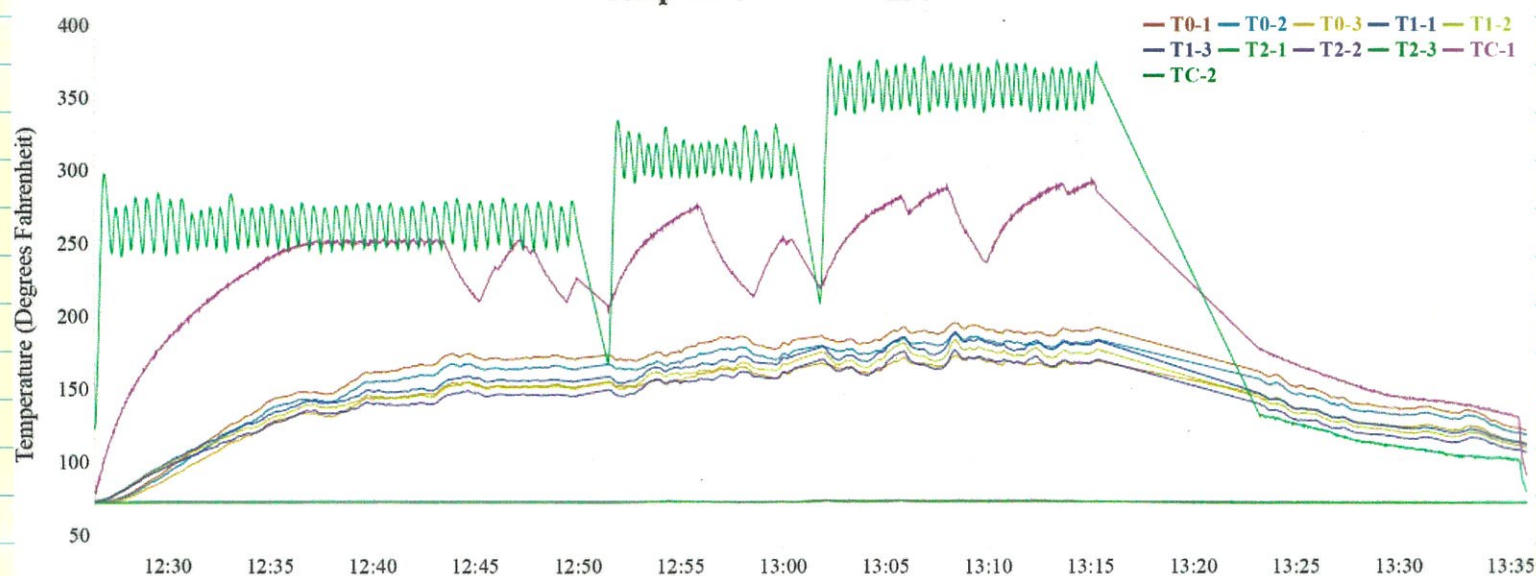
I set up the temperature controls for two heat tapes.

One uses a temperature stick on the copper cup, on the far side from the flag. The low wattage heat tape is wrapped around the flag and the first thermocouple is wedged under it.

The second uses the second temperature stick a few inches above the solder joint. Taped to the braid. The higher wattage heat tape is a few inches above the temperature stick. The second thermocouple is wedged under the heat tape.

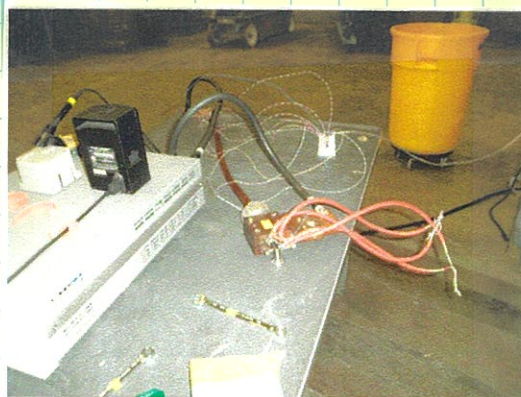
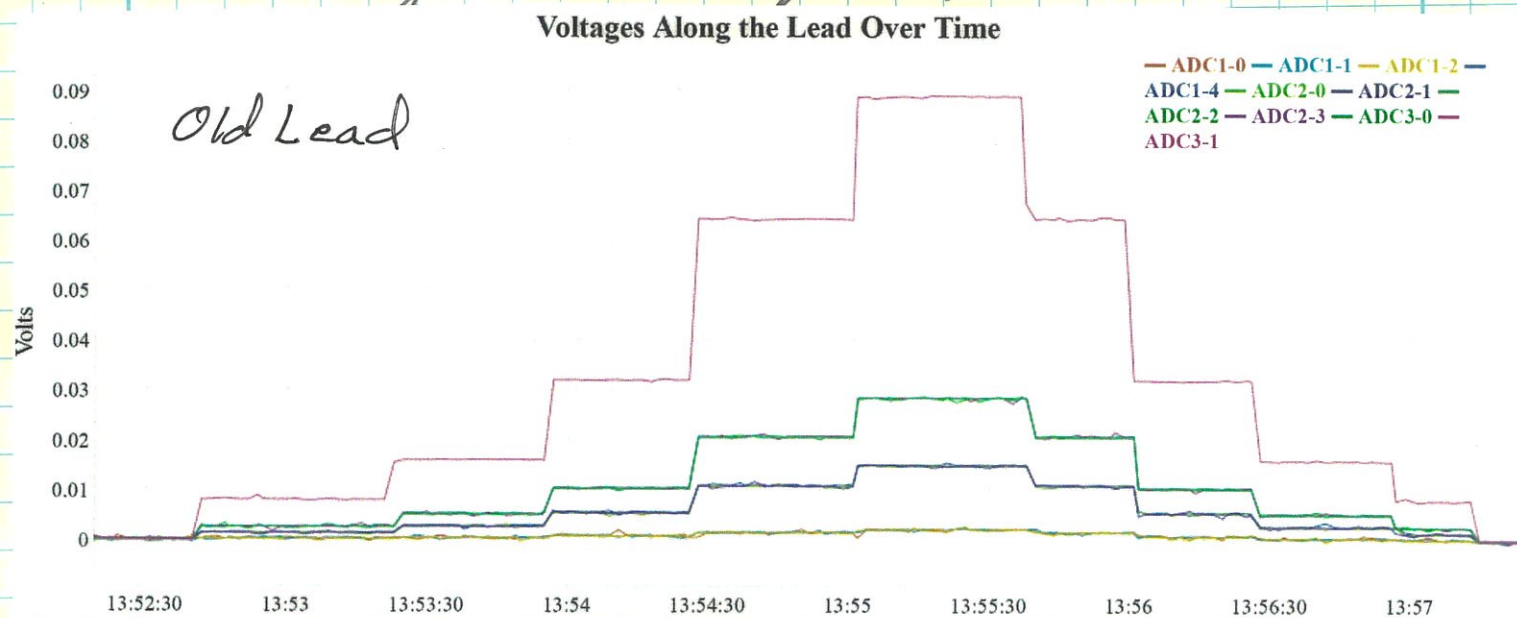
The third temperature stick was just dangling in air. I adjusted the temperature limits a couple of times. It didn't seem to be wetting the copper any more than it already had. Chosen had the citric acid bubbling. Still did not seem to be wetting the copper.

Temperatures Over Time

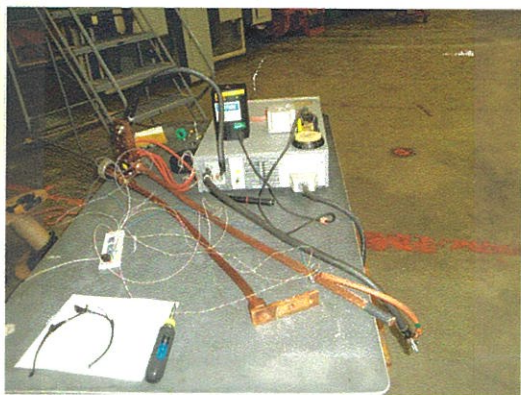


Next time I would put the higher wattage heater on the lug of the foot.

Looking at the voltage drops, again.



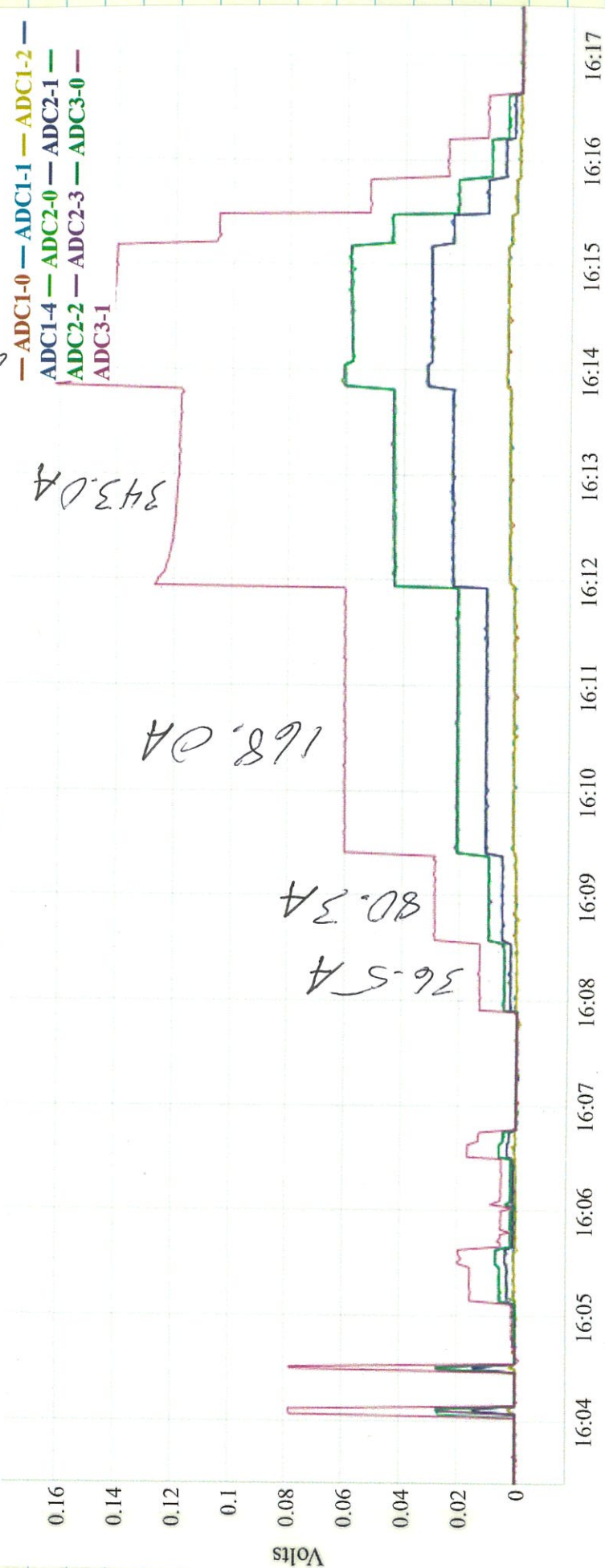
Setup for measuring the voltage drops on the Q1 lead.



I eventually added another power supply in parallel to increase the current through the lead. I only did a run with the old lead.

Click the check boxes to toggle data visibility

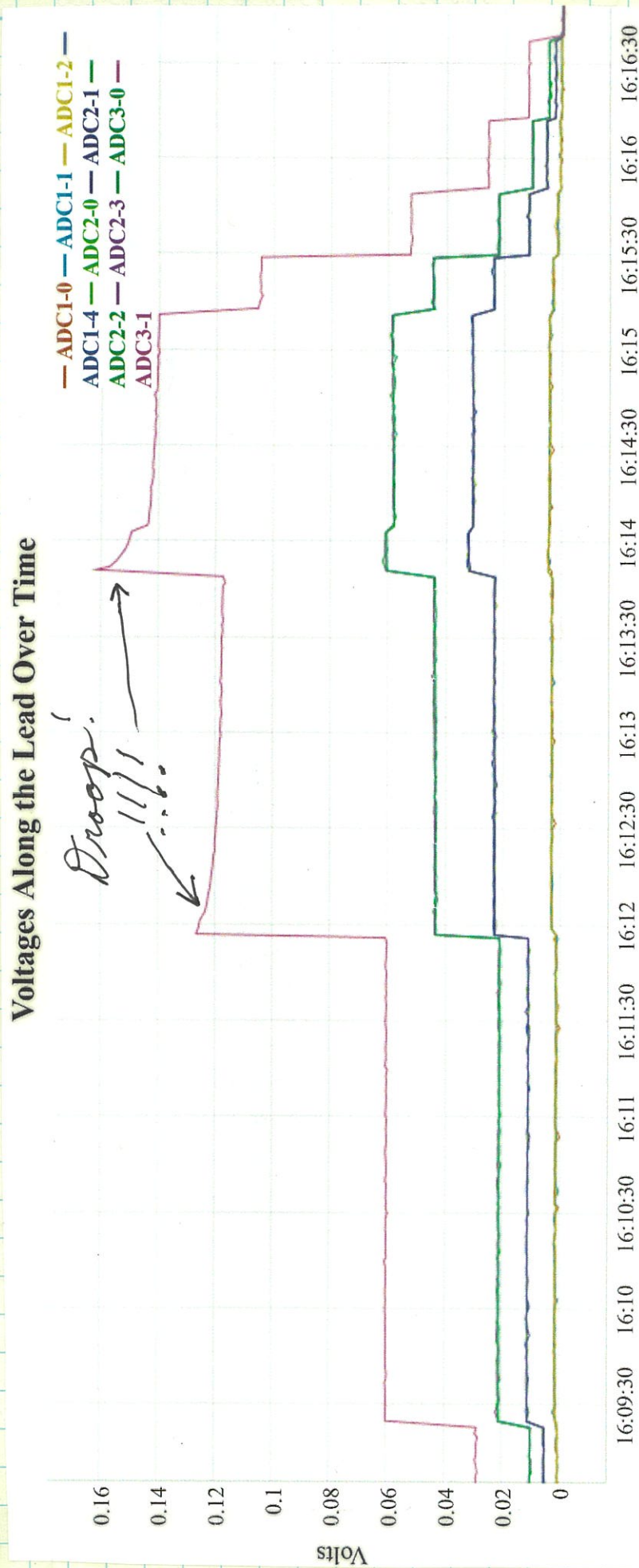
Voltages Along the Lead Over Time



Show Series:

- ☒ ADC1-0 ☒ ADC1-1 ☒ ADC1-2
- ☒ ADC1-3 ☒ ADC2-0 ☒ ADC2-1
- ☒ ADC2-2 ☒ ADC2-3 ☒ ADC3-0
- ☒ ADC3-1 ☒ ADC3-2 ☒ ADC3-3

Expanded the time scale. I wanted to get the voltage droop out from behind the legend.
 Compare the character of the droop to what we were seeing on the RQ1 when we were first investigating this.



Show Series:

- ☒ ADC1-0
- ☒ ADC1-1
- ☒ ADC1-2
- ☒ ADC1-3
- ☒ ADC2-0
- ☒ ADC2-1
- ☒ ADC2-2
- ☒ ADC2-3
- ☒ ADC3-0
- ☒ ADC3-1
- ☒ ADC3-2
- ☒ ADC3-3

1/17/16 Hall C SHMS "Magnet On" Signs

Chuck had replaced all the burnt out LEDs on the Hall C "Magnet On" signs. The signs were installed on the SHMS. The LEDs began burning out shortly after the signs were turned on.

Chuck removed one of the signs so I could take a look at it.

The signs were laid out by Bill Dunning in ~2001. They are composed of strings of three serially connected LEDs, all in parallel. There are no current limiting resistors.

Letter	# of LEDs
M	21
A	12
G	15
N	15
E	15
T	9
O	18
N	15

3 LEDs per chain

40 chains
 $3.0 \overline{) 120}$

120 leds total

If we want 10mA flowing through the chains

10mA/chain $\Rightarrow$ 400mA total

For a red LED the voltage drop is $\sim 1.8V \cdot 3 = 5.4V$

The signs have a 12V supply. $12V - 5.4V = 6.6V$

To determine a limiting resistor $R = \frac{6.6V}{0.4A}$

$R = 16.5 \text{ ohms}$

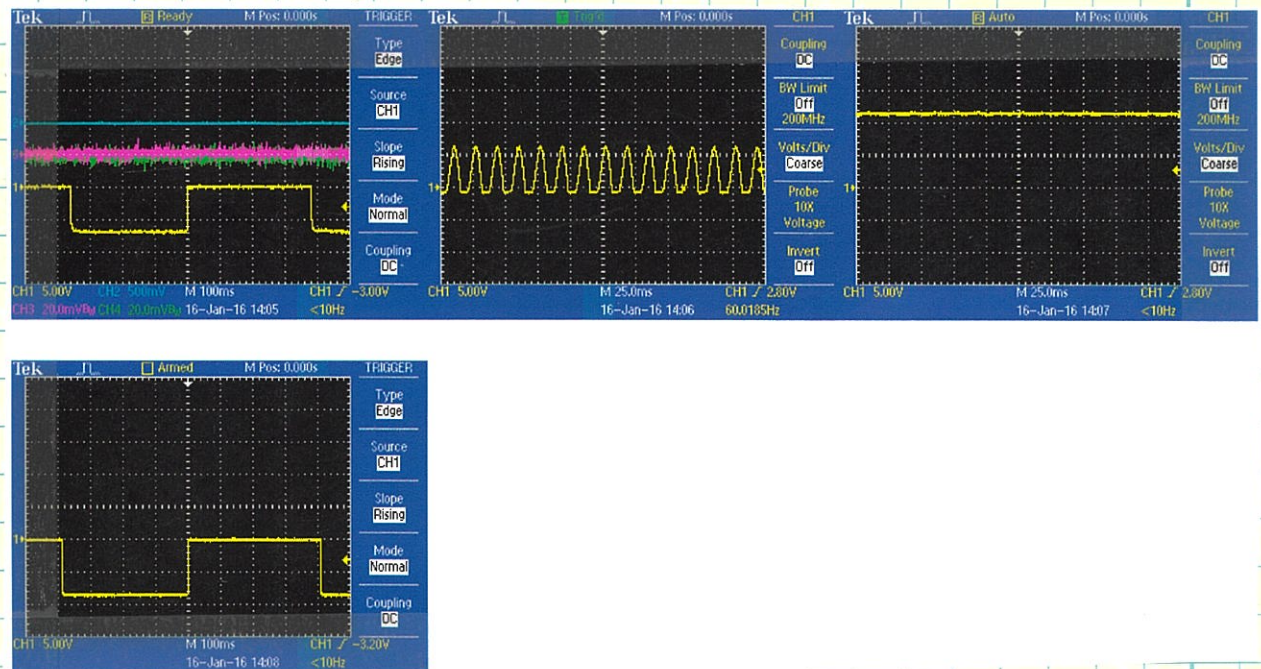
Power = $I \cdot V$ $6.6V \cdot 0.4A = 2.64W$

The setup is a 12V supply feeding some automotive flashers in parallel. One flasher for one sign. All in a box. Wires out to the signs.

Using a TP52024 scope I looked across the three flashers and at the power supply.

The supply does not seem to be having a problem with the demand on it. It is warm, though.

The voltage drops across the flashers are the other three pictures. No particular attention was paid to the polarity of connecting the probe and its reference.



✓ Chuck will replace all the LEDs, again. He will put a suitable resistor in series with each sign. Resistors will be mounted in the box with the supply and flashers.

3/15/16

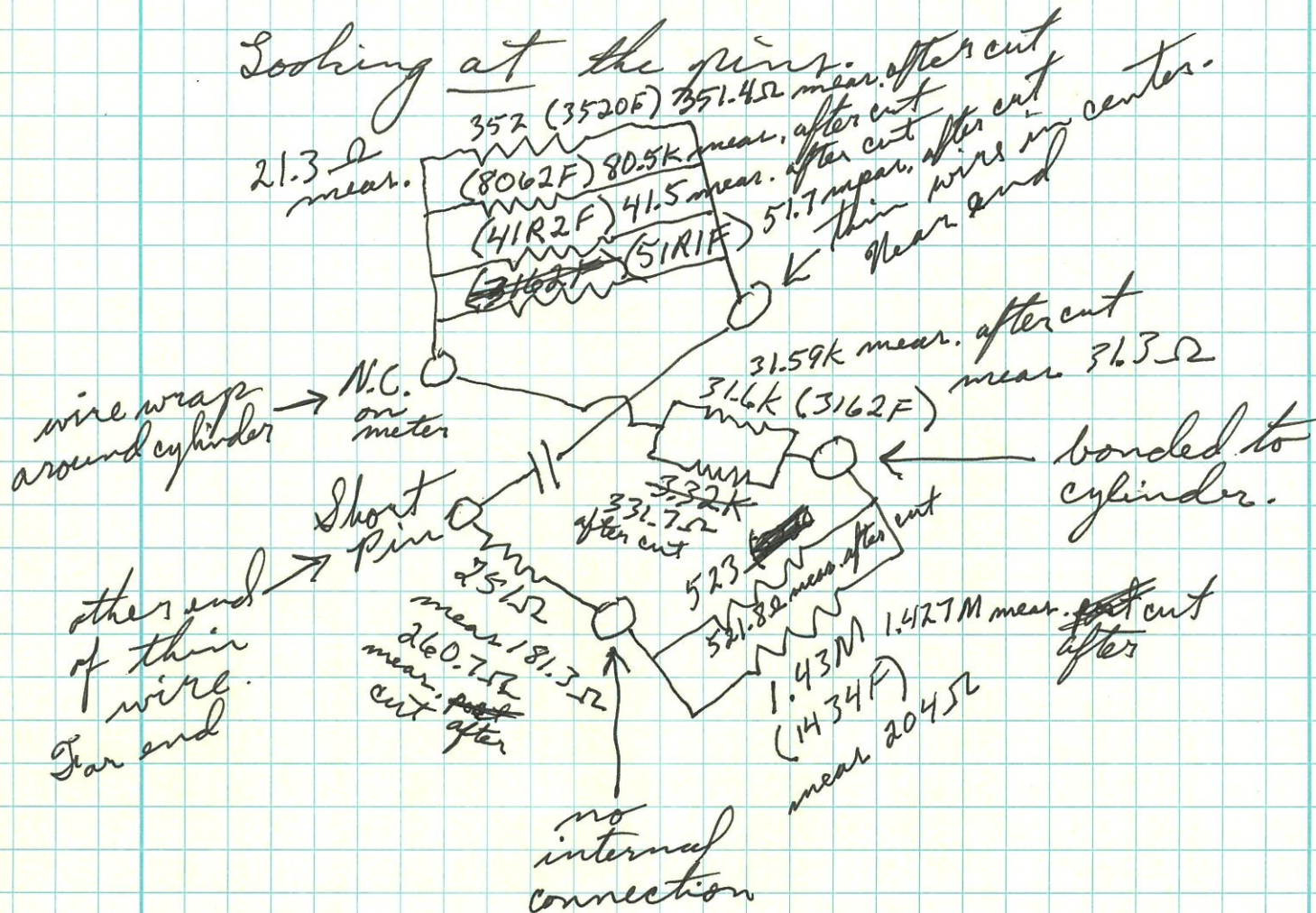
/H

Looking at the Granville-Phillips Convection Gauges we are using in Hall 4.

They are installed in the model 275 Mini Convection units.

G-P is now under MKS Instruments.

Looking at the pins after cut



On a whole gauge: Thin wire is $\sim 20 \Omega$.
Heater is $\sim 30 \Omega$.

7/2/16

At one point we had a grounding problem on a base for the Hall C SHMS scintillator planes.

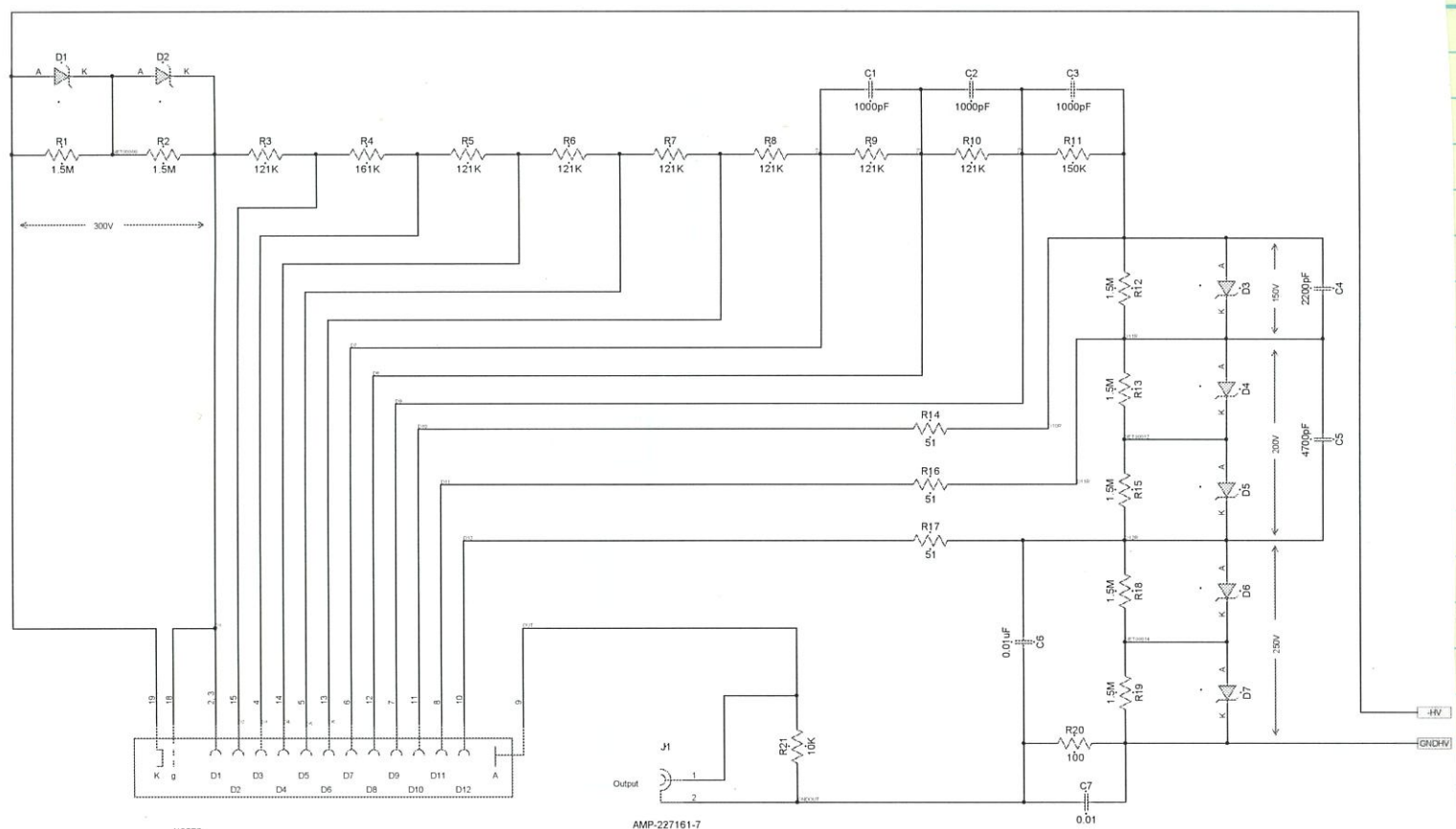
The base was designed by the FEC. The grounding scheme is not very robust. The BNC & SHV holes in the end aluminum plate are round holes, not "D" holes. An aluminum block makes the ground connection from the end aluminum plate to the circuit board. Two screws hold it to the plate (1 screw) and the circuit board (1 screw). The BNC jack is an isolated one. That ground is a direct solder to the circuit board with $100\ \Omega$ to the HV ground.

So, if the BNC cable is connected and terminated in a piece of equipment that has the BNC shield grounded, there should be little chance of a shock.

Looking at the voltage divider it seems to be what I found on the Hall C webpages. See the next page.

It looks like there is not nearly enough current draw through the generators to make a stable base.

This is worth looking into. Yesterday Signora showed me an oscilloscope display that had abrupt changes in gain of one of the PMTs. She was looking at the "single photon" signals. There seemed to be abrupt, random changes of $\sim \times 2$ in gain.



NOTES

- 1 Design based on CERN/S type 4244
- 2 All resistors are SMT, size 1206 - 4W except as noted
- 3 Resistors R14, R16, R17, R20 and R21 are SMT, size 0805
- 4 All capacitors are SMT, X7R ceramic, 500 V, size 1206, except as noted
- 5 Capacitor C7 is SMT ceramic, size 0805
- 6 BNC connector has ground isolated from ground on SHV connector

AMP-227161-7

Title		XP2262 PMT BASE	
Size	Number		
B		HALL C	
Date		20 Sep 2004	
Filename		XP2262.SCH	

7/2/16

Yesterday Simona also came to me with a grounding problem on the bases from the Hall A RCS experiment. She and another person received a small shock when they disconnected the BNC cable from the picometer they were using. They found the 2 wire HV cable for the base was broken in the Hypertronics connector.

The hypertronics connector was assembled without the cable clamp installed under the back shell. The wires in the HV cable are not very robust and really need that cable clamp installed.

I looked at the bases I could find and they all seemed to have the cable clamps installed.

The connector without the cable clamp was on a cable from an SHV to Hypertronics adapter box that Church made. The rest of the adapter boxes I could find have the cable clamp installed on them.

I traced out the base and found it in agreement with the schematic I found on one of the RCS webpages.

The 3.9k Ω resistor for isolating the HV and signal ground is really installed on the wrong side of the end of the voltage divider.

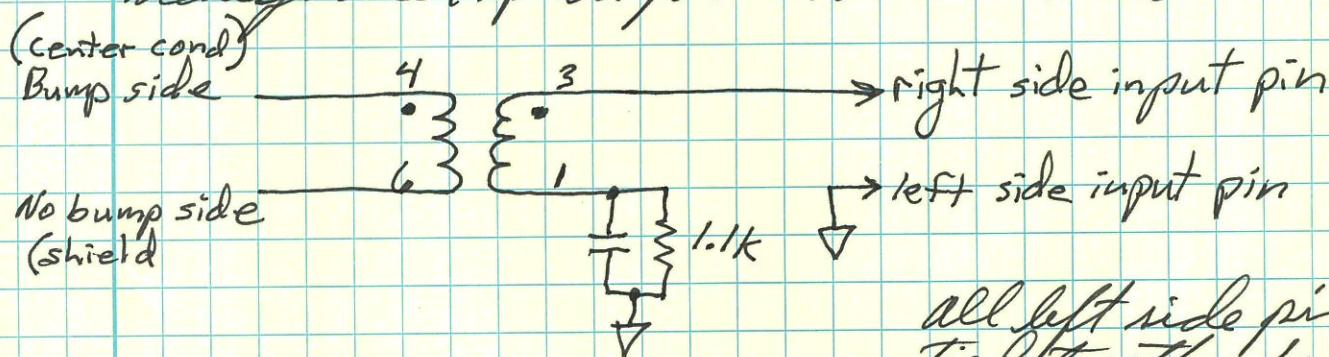
Midgets!!

7/2/16

While looking at the delay cable on the Left Arm I thought I might take a look at the card people had plugged into the 1881M inputs.

The card has printed at the bottom...
"1881-ADC-XFORMER - 2015 Sept 14"

It is populated with 32 Mini Circuits transformers. Model ADT1-1. This is a 50Ω transformer spec'd for 0.15-400MHz. It is 1:1.



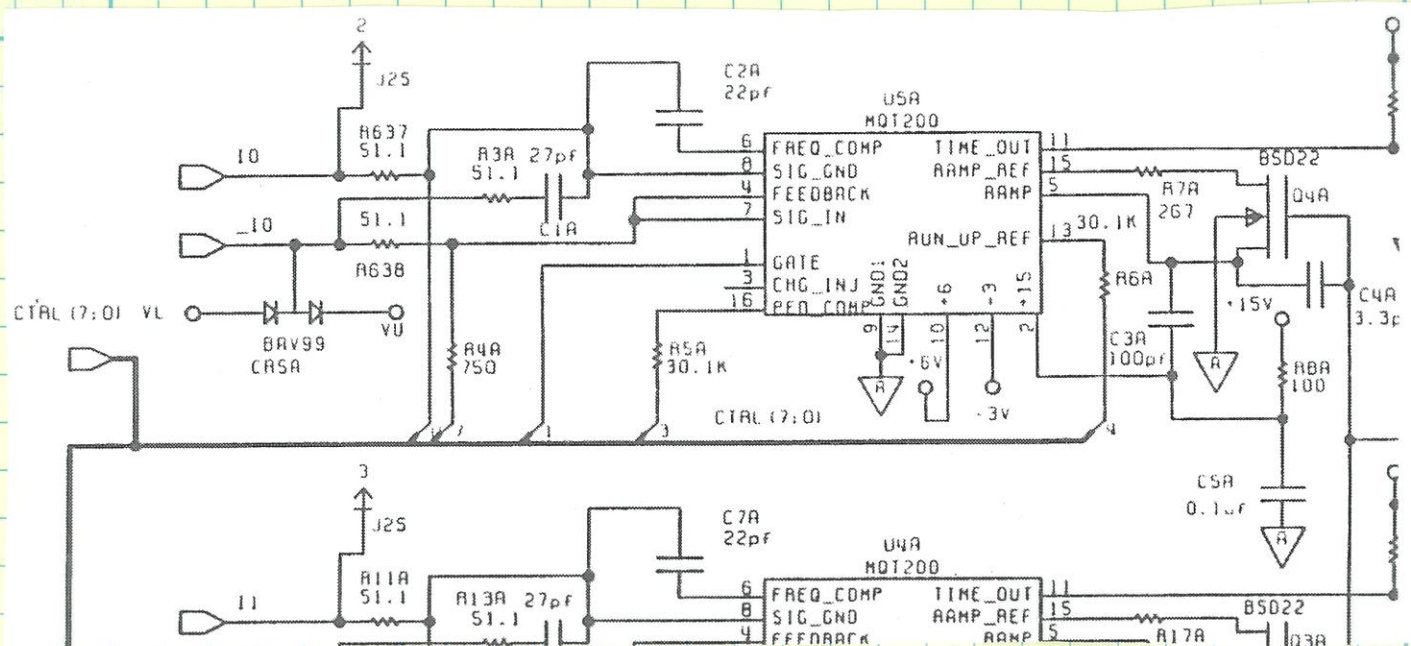
It is worth going back to the LeCroy 1881M manual and looking at the input specs again.

2.4.2 Inputs

All analog inputs are received via four 34 pin connectors. A 3M connector type 3414-6034 or a LeCroy connector part number 403 220 034 with pull tab part number 403 910 034 will mate with the ADC header and provide strain relief. The bottom two pins of each of the four headers are connected to the clean analog ground within the module. The analog inputs are numbered from top to bottom in ascending order.

- IN: 64 inputs are used to receive individual channel signals. It is recommended that the source's output DC impedance exceed $1\text{ K}\Omega$ for each of these signals to avoid excessive pedestal spread and degraded temperature performance. The inputs may be configured in several different modes. These include 50Ω single ended, 100Ω differential, and 100Ω pseudo-differential. It is important to verify the jumper links are correctly configured. See Section 3.1.2 for Input options

It would be good to go through and check the jumper settings on the 1881Ms.



flowing out of the board may be added (using a very large resistor to a negative supply) to cure the non-linearity problem, but this will simply move the pedestals and will not affect the magnitude of the rate shift. Experiments with a distinct time structure to their spill (in the tens of milli-second domain) should consider this more seriously as they may get a pedestal shift during each spill. To calculate this effect simply calculate the mean current during the spill. The pedestal could be expected to ramp down during the spill if the rate is high enough. It should be noted that the guarantee of 8192 codes above intrinsic pedestal does not mean that that an arbitrary user pedestal can be accommodated without loss of dynamic range.

Permanently installed jumpers:

- JL - (upper right hand corner) should be positioned between pins 2, 3 (upper two pins)
- JU - (upper right hand corner) should be positioned between pins 1, 2 (right two pins)
- J5 - (middle) should be positioned between pins 2, 3 (left two pins)

Options:

- J26, J27 - (Lower right hand corner) when inserted CLR input is terminated in 102 Ω . To bus CLR remove links from all but the last board on the cable.
- J24, J25 - (Lower right hand corner) When inserted GATE input is terminated in 102 Ω s. To bus GATE remove links from all but the last board on the cable.
- J5S, J5T, J5V, J5W - (along right edge) When inserted termination is to ground. When removed termination is allowed to float with 20 μ F to ground in parallel with 1K. The termination is shared for entire groups of 16 channels.
- J2/4S, J2/4T, J2/4V, J2/4W - (along right edge) When 18 pin jumper links are inserted positive input termination resistors are shorted giving a single ended 51 Ω input.
- J1/6S, J1/6T, J1/6V, J1/6W - (along right edge) Storage location for 18 pin links. Links should be stored here when 102 Ω differential inputs are desired.

The following list indicates the normal link combinations:

- 51 Ω single ended (coax) fixed ground (default) - J5 (S,T,V,W) and J2/4 (S,T,V,W) inserted (J1/6 (S,T,V,W) removed)
- 51 Ω floating ground - J2/4 (S,T,V,W) inserted (J1/6 (S,T,V,W) and J5 (S,T,V,W) removed)
- 102 Ω quasi-differential (twisted pair)- J1/6 (S,T,V,W) and J5 (S,T,V,W) inserted (J2/4 (S,T,V,W) removed)

3.1.2 Input options

The 1881M has a number of different input configuration options. These allow both 100 Ω twisted pair and 50 Ω coaxial cables to be correctly terminated. The options can be selected in the field using pluggable links. The options available are:

- Single ended signals on 50 Ω cables, negative polarity, fixed or floating ground.
- Differential signals on symmetrically terminated twisted-pair cables with nominally 100 Ω line impedance.

Unlike the 1882/5 units the 1881M cannot be configured for positive inputs. The units are normally shipped (except for special order) with the links configured for 50 Ω cables and a fixed ground.

If it is desired to use 100 Ω differential cabling, it should be noted the 1881M when operated in this mode does not have a true balanced input. Common mode noise should be minimized by reducing ground noise and using shielded twisted pairs. Figure 3-1 illustrates the options available. To select the different options see the end of this section. The recommended operating mode, and the only one tested during production testing is 50 Ω single ended.

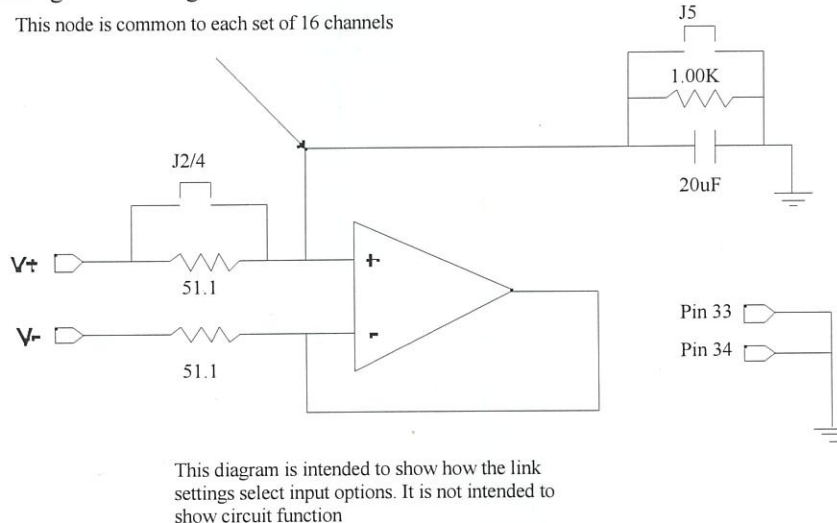
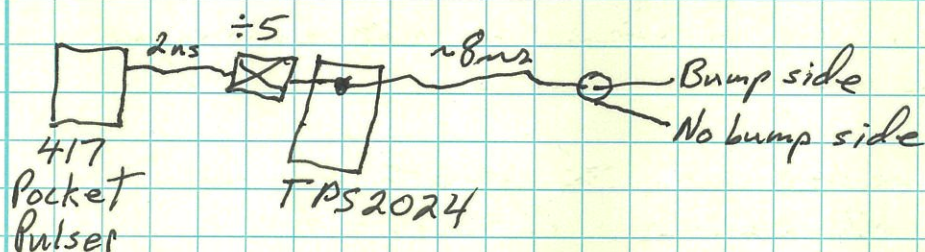


Figure 3-1 Input Circuit

To operate in a truly balanced configuration pulse transformers should be used on the input. In this mode the 1881M should be configured for single ended 50 Ω operation. In this case however, that the AC coupling thus introduced can cause pedestal shift problems at high input rates. In order to estimate this effect, it is simply necessary to know the amount of charge flowing into each channel per second. This figure should be calculated independently of the gate as the transformer is before the gate switch. A transformer will not couple a DC current so this mean pulse current will be balanced by a DC offset current in the opposite direction.

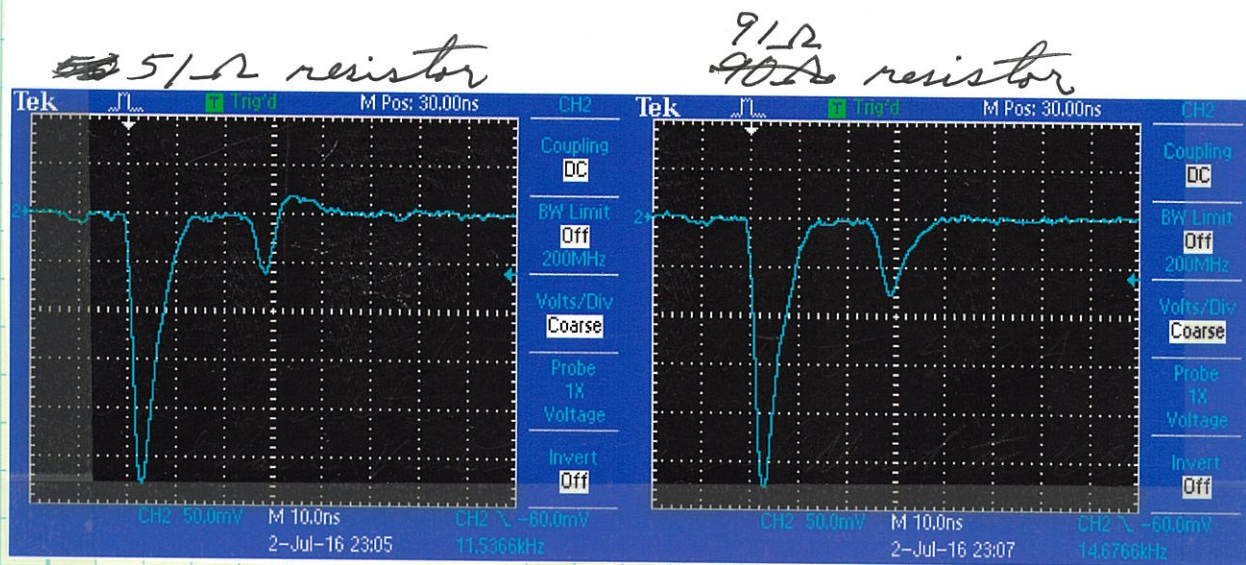
For example, consider an experiment with a 10KHz mean rate of pulses of -100pC magnitude (2000 codes) and a gate width of 500ns. The mean input current is -1 μ A, hence there will be a DC offset of +1 μ A added to the input current. With a 500ns gate this would correspond to 500fC. This implies that a pedestal shift of 10 codes will occur between a very low rate and the 10KHz rate calculated. This maybe acceptable, especially considering the considerable gain in noise immunity. Consider an experiment making extensive use of the fast clear with a mean rate of 200KHz and again a 500ns gate. The shift then becomes 200 codes, a considerably greater problem. In addition, the offset current should be kept as small as possible (certainly less than +50 μ A) to avoid deterioration of the integral non-linearity. If necessary a balancing current

I set up a scope to take a look at this input board.



The 34 pin that plugs into the 1881M has a 34 pin 50Ω terminator we had made for an amplifier. It is 50Ω across each pair of pins.

I then tried nothing on the 1881M side. A 51Ω 1/8W carbon comp. and a 91Ω 1/8W carbon comp. resistor.



11/5/17

While looking at a RPi to control the new Hollmopgen drives for the Left Arm Bogies, we noticed some timing concerns in the program.

Just for reference, the motors are Hollmopgen GoldLine B-404-A

I wrote some code for one motor and drive on the Bogie test stand. The test stand has one motor and a DC motor coupled by a ~~V~~ V-belt and a couple of sheaves. The DC motor has a resistor across its terminals. The resistor is made of nine two ohm resistors in parallel mounted on a heat sink. $\frac{2 \text{ ohm}}{9} = 0.222 \text{ ohms}$.

When running my original "paramate_test.c" code I was able to get about 24 lines written to a file in one second. Each line constituted six separate reads from the drive, two time requests and calculations, and one write to a file.

Each read is a call to a function which has a number of string manipulation functions in it. Also, a write to the display.

Just to get some ideas, Javier suggested bringing the reads out of the function and minimizing the string manipulations to two. We got 96 reads of lines in about seven seconds. Also, no write to display.

Going back to the original program, I change one sprintf to using six constants and redefining $\text{tmp} = \text{Txbuf}[\text{x}]$. Each read has a separate "x" constant. I pulled each read out of the function, too.

I get 24 lines of reads per second. 48 seconds for the whole program to run.

Taking out the write to file. It still takes 48 seconds for the program to execute.

Looking at parameter test2.c again. There was only one read per line, rather than 6. The times in the log file were 2, 4, 7 seconds. I upped the for loop from 300 to 1800 to get the same total number of reads. The log file now shows 13, 26, 40 seconds. I comment out the one sscanf() statement. The log file now shows 13, 26, 40 seconds.

The SLEEPTIME constant is 100 usec. If I set it to 1 usec the log file now has 13, 26, 40 seconds.

Well, if the network is limiting all this,
 $24 \text{ per second} \Rightarrow 0.042 \text{ seconds per line read}$
 $24 \cdot 6 = 144 \Rightarrow 0.007 \text{ seconds per individual read}$

I added the readout of IL.FB to the program parameter test3.c.

The execution time is about 44 seconds. I added another loop to the "for" loop. The motor should go to 1200 rpm. I set MOTOR.ICONT to 2.00 A.

The motor went to ~1000 rpm. Execution time was about 59 sec. I turned on the voltmeter across the DC motor leads.

RPM	Volts
300	1.6
600	3.2
900	4.9
"1200"	5.5

I upped MOTOR.ICONT to 4.00 A. About the same results.

I have VL.LIMITP and N set to 1000.00.

Set them to 1400.00

Now the voltages are 1.5, 3.2, 4.9, 6.6.

11/6/17
JA

I changed a few parameters on the AKD drive.

I configured the analog output to be 1V per 1A of drive current to the motor.

I changed I.L.KP from 600-something to the default of 50.009.

Those are the most significant things I did.

I changed parameter test3.c to take 900 lines of data at each rpm.

I put a voltmeter on the DC motor and the analog output.

RPM	Volts DC Motor	Volts AOUT
300	1.5	1.2
600	3.2	1.8
900	4.9	2.3
1200	6.6	2.6

Both of the voltmeters have a lot of noise on them.

The program executed in 178 seconds, with the additional reads

11/7/17
JS

Looking for the correct parameter to use to limit the current supplied to the motor.

I set MOTOR.ICONT to 1.0 and ran parameter_test3.c.

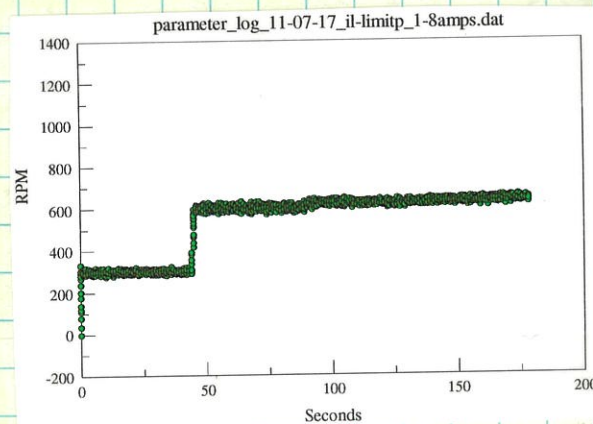
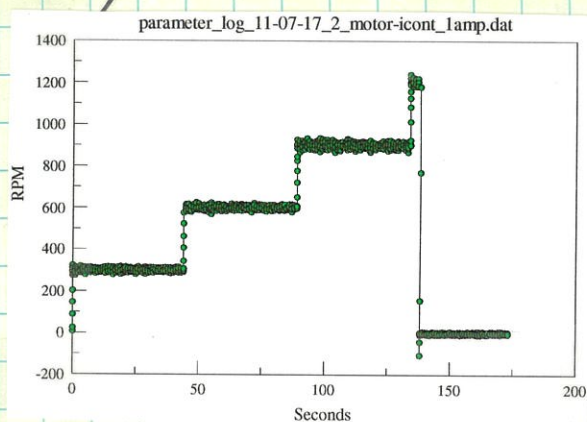
The motor actually reached 1200 rpm before the foldback kicked in. The current drive went to zero and the drive faulted, requiring that I clear the fault before it would run again.

While we can change the foldback parameters, this is not what we want.

I set MOTOR.ICONT back to where it was.

I set IL.LIMITP to 1.8 and ran parameter_test3.c.

This did limit the current to 1.8 amps, which is just a tiny bit over 600 rpm in this setup.



Next is to see if IL.LIMITP can be changed on the fly.

I use Javier's short program which I renamed T1.c.

I set IL.LIMITP to 4.0. I then set it to 600 rpm.

I set limitps to 1.0 and the rpm dropped. I set it to 1.5 and the rpm increased a little. I set it to 4.0 and the rpm went back up. I played with it for a little bit more. This is the correct parameter to use.

I brought down a TPS2024 and put a probe on the analog output.

At 300 rpm the analog signal is not steady, but I can believe a large part of that is due to the loose belt between the motor and load.

$300 \text{ rpm} \Rightarrow 5 \text{ rps} \Rightarrow 1 \text{ rev} / 200 \text{ ms}$

600 rpm might be a little more steady.

Went to 900 rpm.

Back to 600 rpm to get a picture of the current draw as the rpm increases. Tek 15

To 1200 rpm. Tek 16. At 1200 rpm. Tek 17 & 18

To 900 and steady Tek 19.

Steady at 600 rpm. Tek 20

Steady at 300 rpm. Tek 21

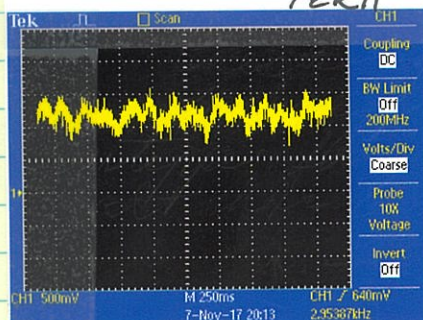
VL.LIMITP behaves similarly to the IL.LIMITP. It also may be changed on the fly.

The drive seems to be limited by whichever of the two limits is lower. i.e. both limits are active at any time.

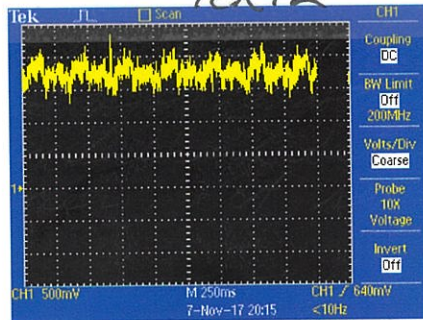
Also of note is that the checksum for NV.CHECK changes when one of the limits is changed. But, it does not seem to change when VL.CMDU is changed.

Perhaps the checksum should be updated whenever the rpm is changed.

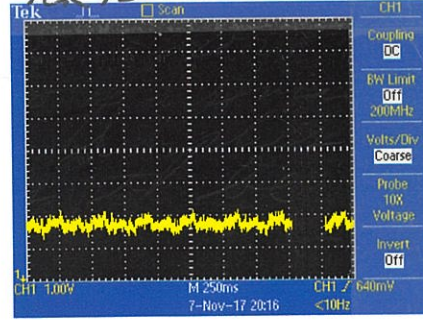
Tek11



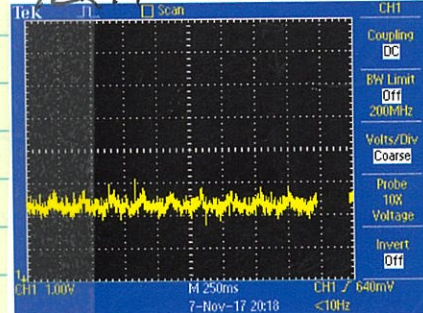
Tek12



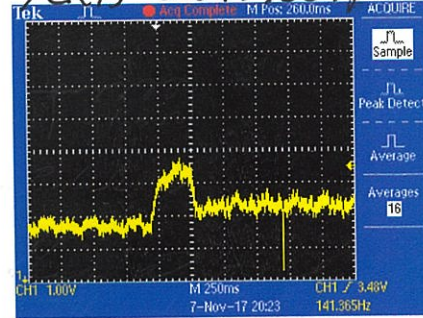
Tek13



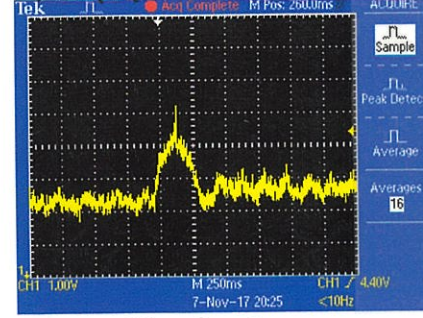
Tek14



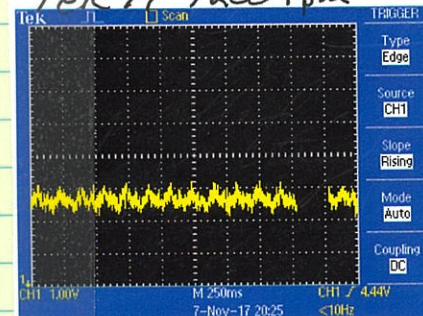
Tek15 600 to 900 rpm



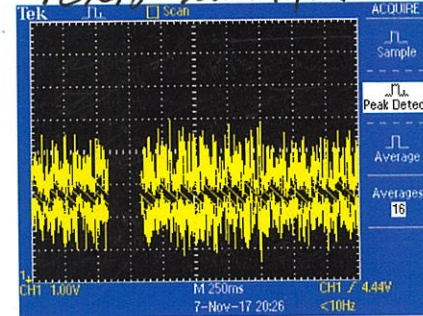
Tek16 to 1200 rpm



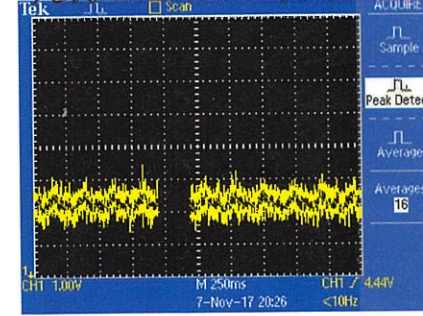
Tek17 1200 rpm



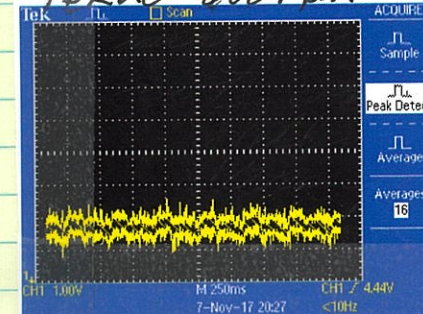
Tek18 1200 rpm



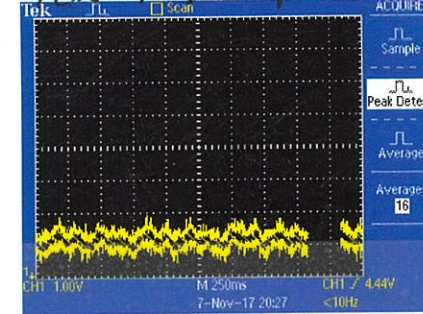
Tek19 900 rpm



Tek20 600 rpm



Tek21 300 rpm



12/10/17
JS

Trying to check out some pressure sensors that Tom Slachetkowski wants to use in a manifold. It is a SMT S_C package.

Silicon Microstructures SM5420E absolute pressure sensor 0-60 psi.

It is a bridge sensor. $\sim 6 \text{ k}\Omega$ for the bridge resistance.

It is uncompensated.

I cobbled together a RPi, ADS1115, and a 4.096V reference (to drive the bridge).

Using 5V on the I2C bus.

At room pressure the three sensors output

8.38 mV

5.75 mV

7.62 mV

The span has a fairly large spread of 65 mV min to 135 mV max. These will require calibration and temperature adjustments.

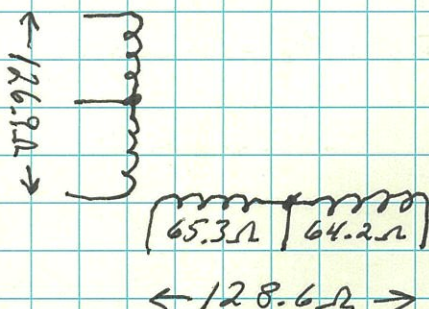
If span is 100 mV for 0-60 psi $\Rightarrow 1.67 \text{ mV/psi}$

$$15 \text{ psi} \cdot 1.67 \frac{\text{mV}}{\text{psi}} = 25 \text{ mV for atmospheric}$$

Using a syringe placed over the hole in the top of the IC I was able to get one of the sensors to put out $\sim 10 \text{ mV}$.

12/29/17

Checking out a small stepper motor.
 A long time ago I got two of a small
 stepper from American Science Surplus.
 It has 6 wires. It seems to be



I drove this at one point with the
 Pololu DRV8824 breakout board. This is
 a TI chip.

The SLEEP and RESET should not be
 pulled up to the motor power supply.
 A voltage divider or something should
 be used to bring it down to a logic level.
 If the pins are pulled too HI the driver
 will not drive.

I got the drive and motor to work
 with the two green wires (center tap)
 not connected.

Yellow	connected to A2
Orange	A1
Brown	B2
Black	B1

Swapping the A1 and A2 wires reverses the
 rotation of the motor.

Swapping the B1 and B2 wires also reverses the
 rotation of the motor.

Swapping both the A1/A2 wires and the B1/B2
 wires gives the same rotation of the motor.

The motor seems to make one revolution
 when driven 47 steps.

Actually, it seems to vary slightly. I will
 need some limit switches for scanning the
 TOF sensor back and forth.

The field of view (FOV) of the VL53L0X TOF distance sensor is given as 25° . This is determined by the aperture for the photon detector. The light source is supposed to emit in a cone of 35° .

$$\frac{25}{360} = \frac{\alpha}{2\pi} \quad \alpha = 0.4363 \text{ Radians}$$

$$@200 \text{ cm} \Rightarrow 87 \text{ cm width} \\ 34.4''$$

For 47 steps for 360°

$$\frac{25^\circ}{360^\circ} = \frac{x \text{ steps}}{47 \text{ steps}} \quad x = 3.26 \text{ steps}$$

We can try 4 steps in each direction.

As for how fast things need to process...

$$5280' / \text{mile}$$

$$3 \text{ mph} = 15840' / \text{hr}$$

$$\div 60 = 264' / \text{min}$$

$$\div 60 = 4.4' / \text{sec}$$

$$1 \text{ mph} = 1.47' / \text{sec}$$

1/9/88
JS

I got three pressure sensors from Tom Slacktonski in Cryo.

They are automotive sensors, basically, and we would like to get a better idea of their operating parameters.

Bob Tucker put together a small chamber so we could pull a vacuum or apply pressure.

The sensors are a resistive bridge.

The power and gnd lines are tied in common and the bridge signal lines are individually wired to a DB-9 connector.

The DB-9 connector is plugged into a vacuum fitting with a DB-9 feedthru. This gives a pin number inversion since the feedthru is basically a gender changer.

If the sensors are "1", "2" and "3", the connections are

inside the vacuum can	signal	outside the vacuum can
1	GND	5
2	1+	4
3	1-	3
4	2-	2
5	Vcc	1
6	2+	9
7	3+	8
8	3-	7
9	NC	6

1/15/18

The stepper motors on the vacuum cleaner cart are Pacific Scientific model N32HREK-LDK-NS-00. 200 steps per revolution. 1500 RPM max.

The wheels have an outside diameter of 6".
 $6 \cdot \pi = 18.85$ inches circumference.

from p. 137 $1 \text{ mph} = 1.47' / \text{sec}$
 so, 1 rps should be fine

$1 \text{ rev} / 5 \Rightarrow 200 \text{ pulses per sec} \Rightarrow 5 \text{ ms/step}$

I tried using a 555 as a VCO. The range is limited and it doesn't like to go to 0 Hz.

I connected a CD4046 PLL and looked at the VCO on that.

I left pin 12 open

pin 11 has $36.5 \text{ k}\Omega$ to GND

$.01 \mu\text{F}$ from pin 6 to pin 7

Looking at the data sheet and the results I got, it would be better served with a larger resistor on pin 11.

I put a $30 \text{ k}\Omega$ resistor on pin 11.

Driving the VCO with a MCP4725 DAC output.

DAC setting	VCO time output
1EFO	$\sim 11.75 \mu\text{s}$
23FO	$2.5 \mu\text{s}$
28FO	550 ns
32FO	62.5 ns
4BFO	11 ns
69FO	5 ns
C8FO	2 ns
FFFO	1.75 ns

That seems like a good configuration.

3/17/18 Correcting Meter Connections For LVDT Testing

While trying to understand some of the valve problems we have been having in Ball C I have been trying to better understand the LVDTs we use and how we calibrate the valve assemblies.

Hall A uses a Schaevitz PML-1000 LVDT readout unit.

The wiring is a pigtail from the rear of the readout unit to a ~~extra~~ panel jack on the end of the cable.

A jumper cable with a cable plug on each end connects to another panel jack to which the LVDT is wired.

I checked the wire colors and things seem to be connected as the manual instructs.

6 pin MS style connector	Term block on rear	Plugs on jumper	LVDT connector
A	red	red	red
B	blue	blue	blue
C	green	green	green
D	black	black	black
E	white	yellow	yellow
F	brown	brown	brown

At the terminal block on the rear of the readout the blue and green wires are tied together, the black wire is in terminal 19, the red wire is in terminal 18, the brown wire is in terminal 3, and the white wire is in terminal 2.

The LVDT is a MHR 250.

Using a Fluke DMM the DC resistance across the primary is 79.9Ω , the resistance from the black to the green wire is 123.0Ω , and the resistance from the blue to the red wire is 123.0Ω .

Using a TPS 2024. Ch1 tip is on terminal 2 and reference is on terminal 3. Ch2 tip is on terminal 19 and reference is on terminal 18.

Using some nylon screws with jam nuts on them adjusted to get the correct placement of the core.

With the core at the end away from the connecting wires, Tek 0 & Tek 1.

With the core at the center "zero" position, Tek 2.

With the core at the limit position at the end with the wires, Tek 3.

For completeness I put the longer screw in from the end with the wires to also get the "zero", Tek 4.

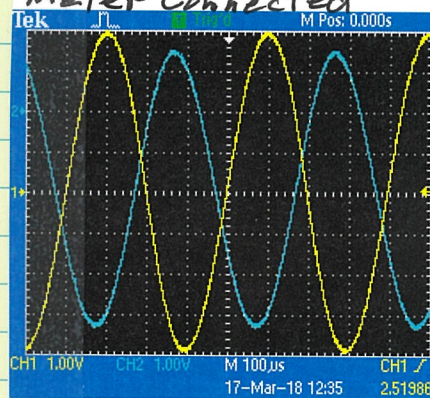
I remove the red & black wires from the terminal block. 499k Ω resistor clipped between them with Ch 2 tip on the black wire & reference on the red wire.

Repeating the pictures above.

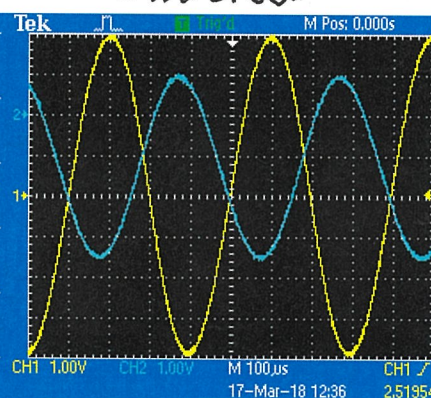
Tek 5, 6, 7 and 8.

I changed the display to X-Y and repeated. Tek 9, 10, 11, and 12.

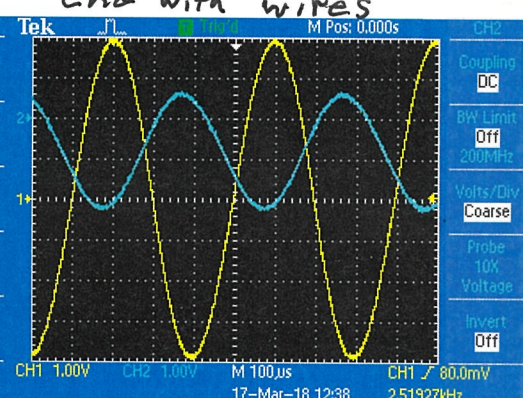
end without wires
Meter Connected



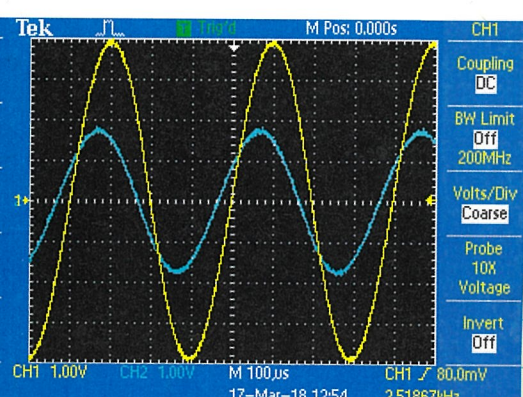
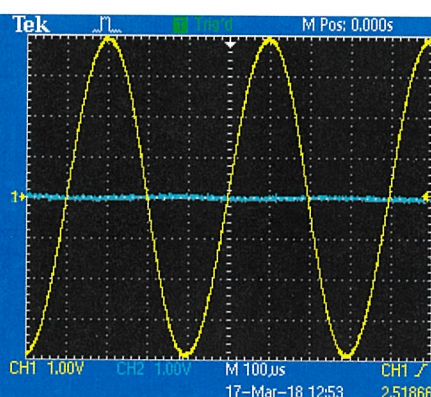
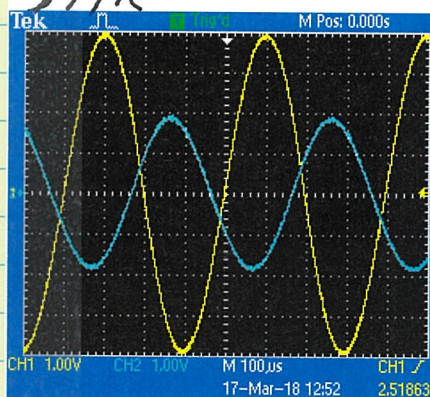
centered



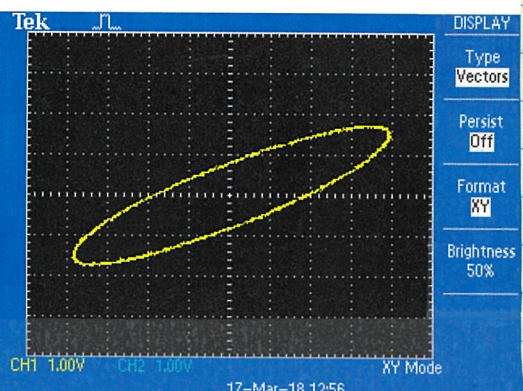
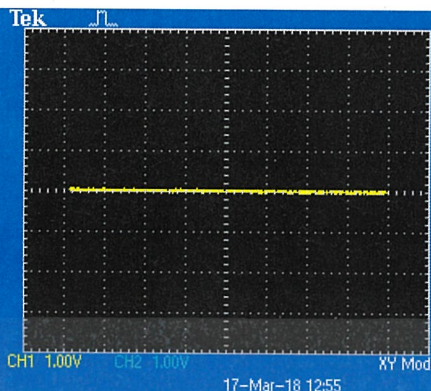
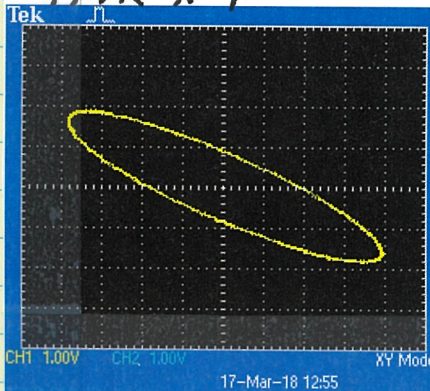
end with wires



499k



499k X-Y



Understanding LVDT Meter Connections

3/18/18

Repeating the setup with the LVDT meter. Adding two more scope probes.

Ch 1 and Ch 2 are as before.

Ch 3 tip is on Terminal 19 and reference is terminal 1

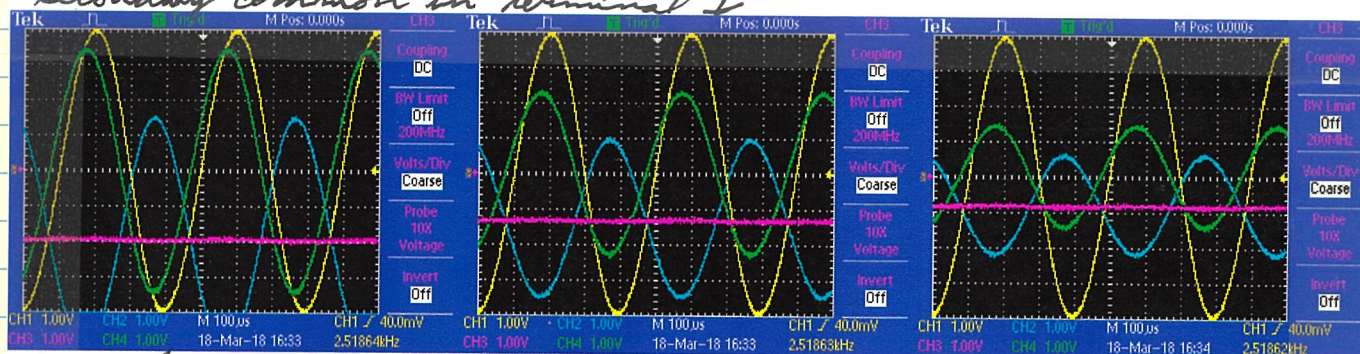
Ch 4 tip is on terminal 18 and reference is Terminal 1

After fooling around a bit I removed the common wires of the secondaries (blue & green wires) from Terminal 1. They are still tied together.

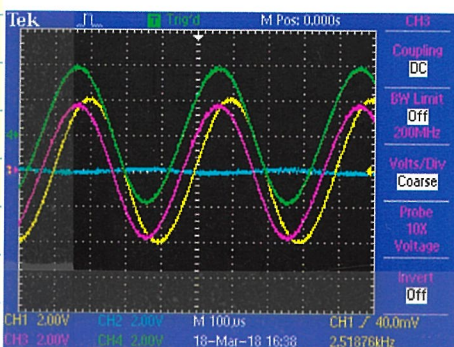
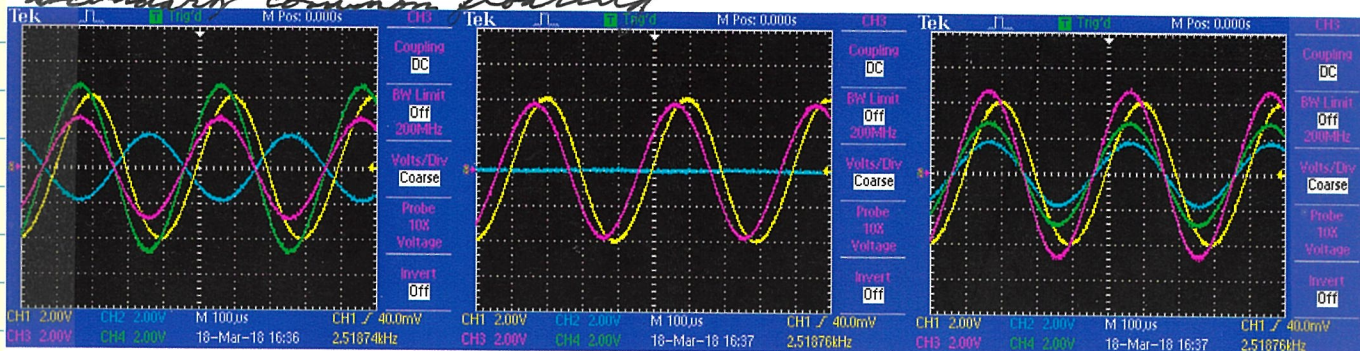
Now, what I see on the scope looks correct.

In the manual, terminal 1 is listed as NC. Apparently it is connected to something!

secondary common in Terminal 1



secondary common floating



Ch 4 shifted to show Ch 3 & 4 are the same magnitude and in phase.

11/15/88 Comparison of a Few Optocouplers

Three different optocouplers are being compared.

Five of each type are mounted on a piece of conductive foam. All on the same piece of foam.

Each chip has a sticker with a number on it.

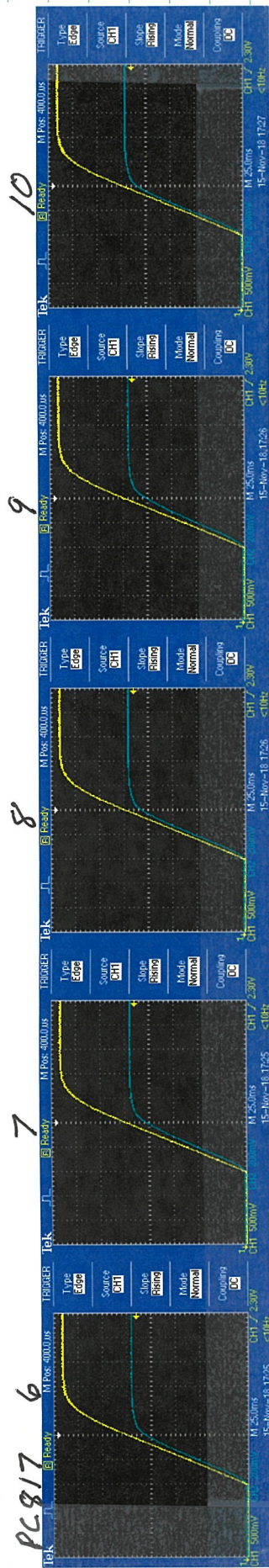
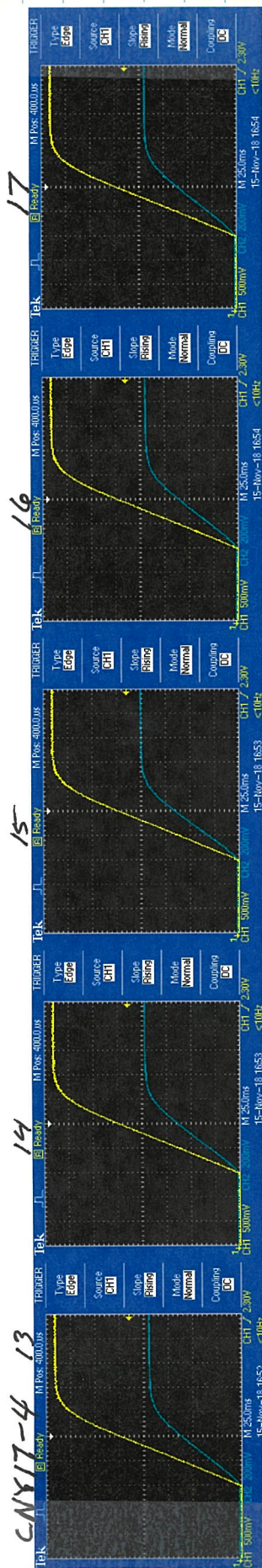
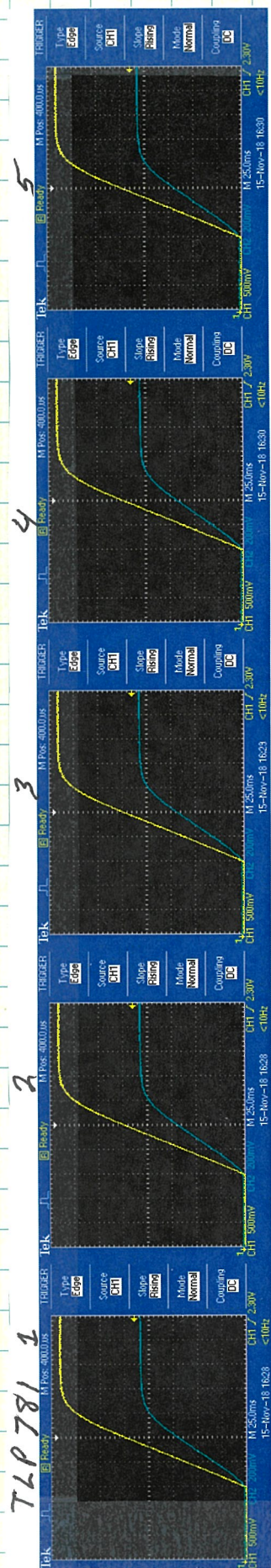
The Toshiba TLP781 are numbered 1 thru 5.

The Vishay CNY17-4 are numbered 13 thru 17.

The PC8PT Sharp are numbered 6 thru 10.

The CTRs are measured in the usual fashion.

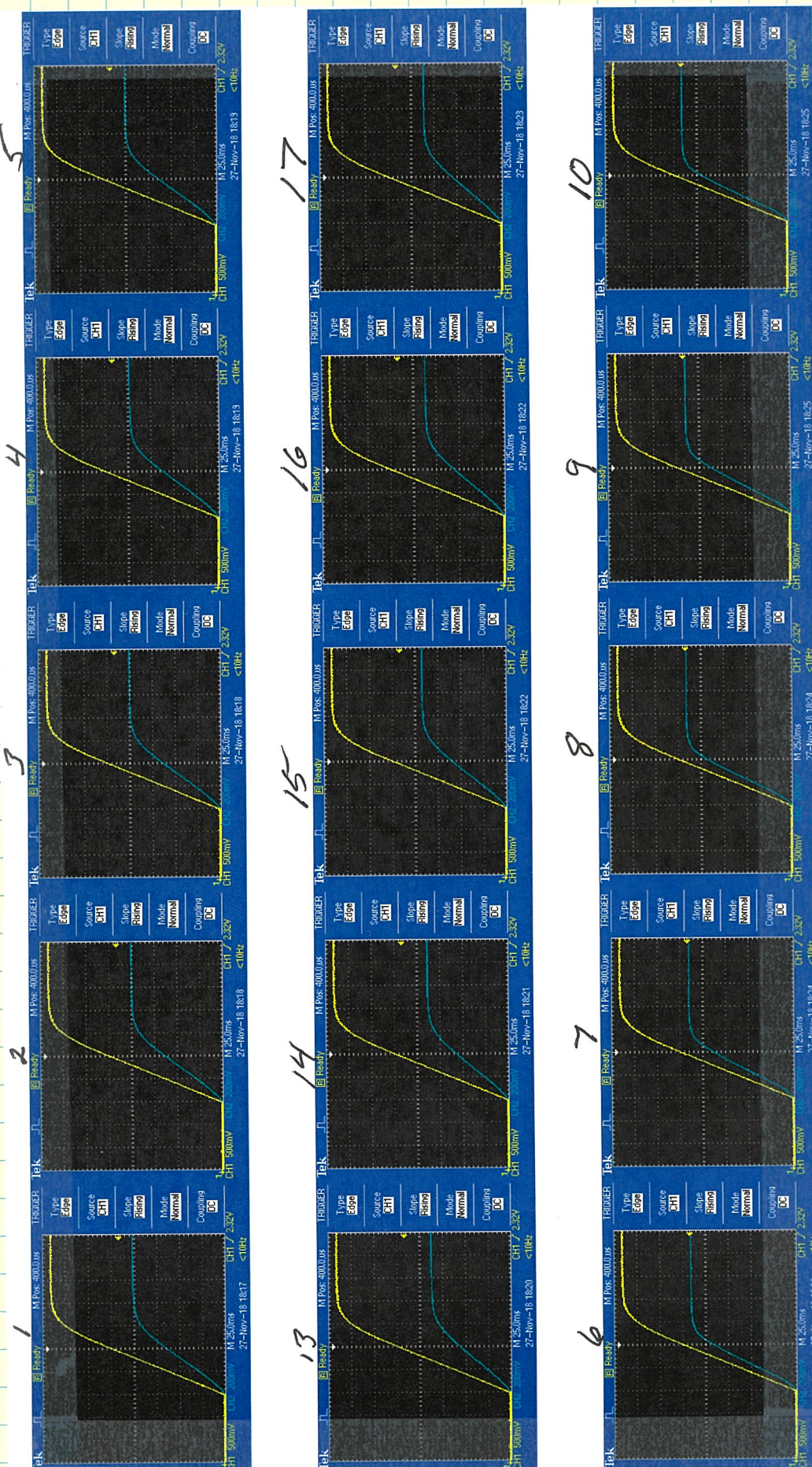
IC#	Picture
1	Tek 0
2	1
3	2
4	3
5	4
13	5
14	6
15	7
16	8
17	9
6	10
7	11
8	12
9	13
10	14



11/27/8 A Few Optocouplers After Irradiation

CTR check of the optocouplers from p. 144-145.
usual method.

IC#	Picture
1	Tek Ø
2	1
3	2
4	3
5	4
13	5
14	6
15	7
16	8
17	9
6	10
7	11
8	12
9	13
10	14



5/24/19 Hall A Gar Shed Air Compressor
 JS The compressor in the Gar Shed keeps blowing fuses.

a lot of work was done on the system this spring. New parts, new breaker, and such. The motor was replaced.

I put a Fluke i200 current probe on each phase of the 208 3 ϕ going to the compressor.

The pictures Tek 0, 1, and 2 are of the initial turn on. Tek 3 and 4 are after it has been running for a bit. Tek 5 and 6 I was trying to see how long the large current draw lasted. The end of Tek 6 is where one of the fuses on the input phases blew.

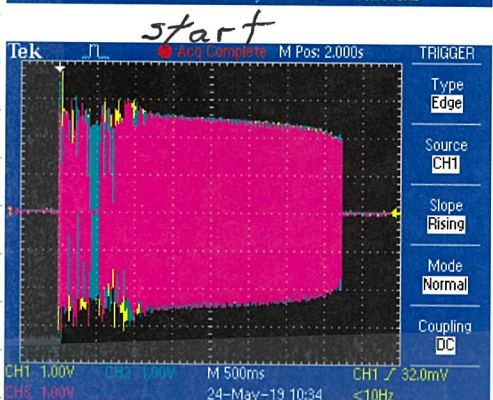
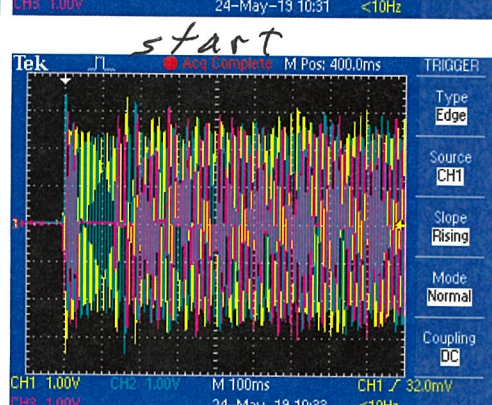
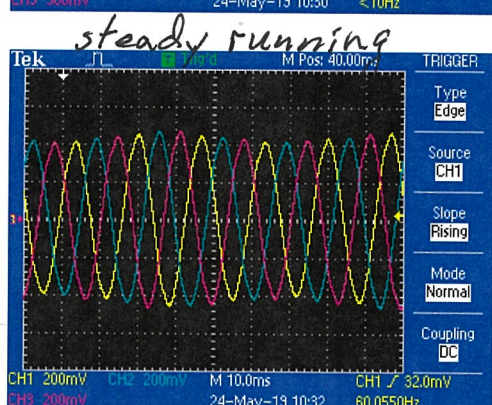
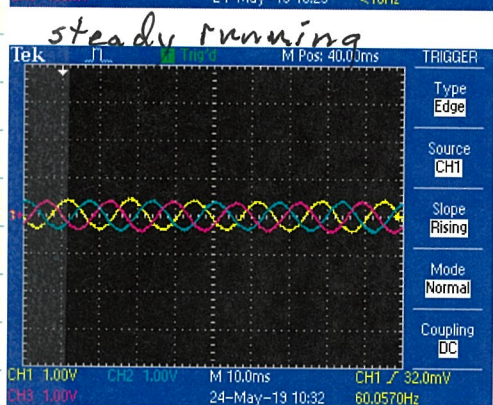
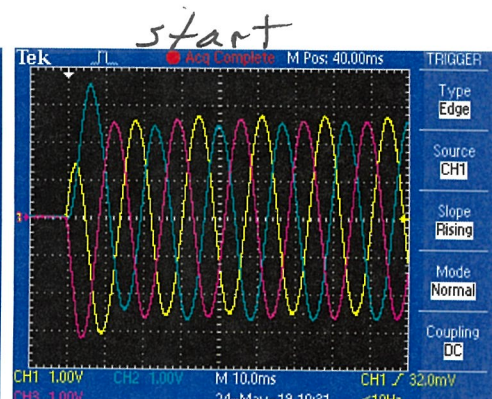
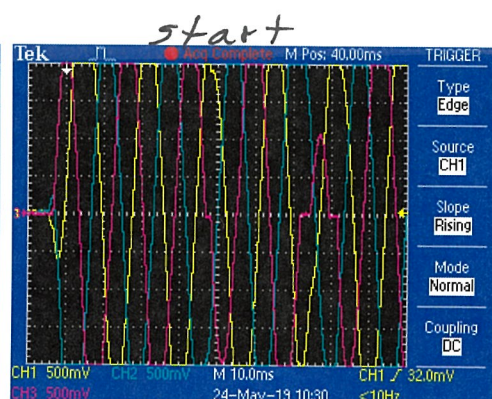
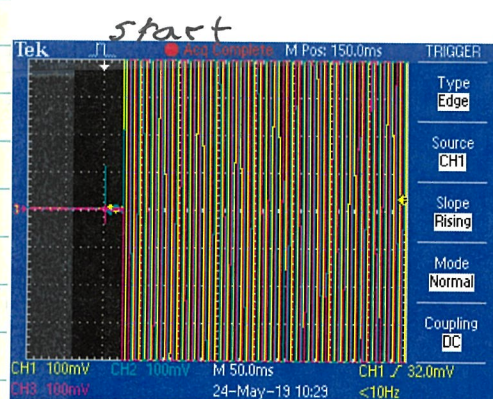
The current probes were set for 10mV/1A

The initial current peaks at about 2.6V.
 RMS makes that about 1.84V.

This implies an insanely large current.

During normal running it looks like the peak voltage is about ~~220mV~~ 440mV.
 RMS makes that about 311mV.

This implies about 31A for steady running.

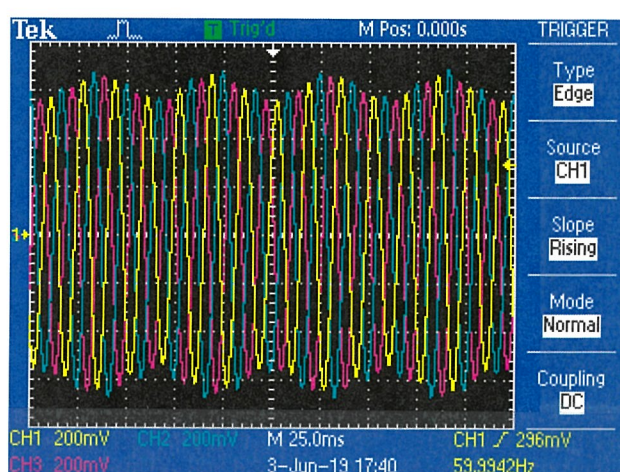
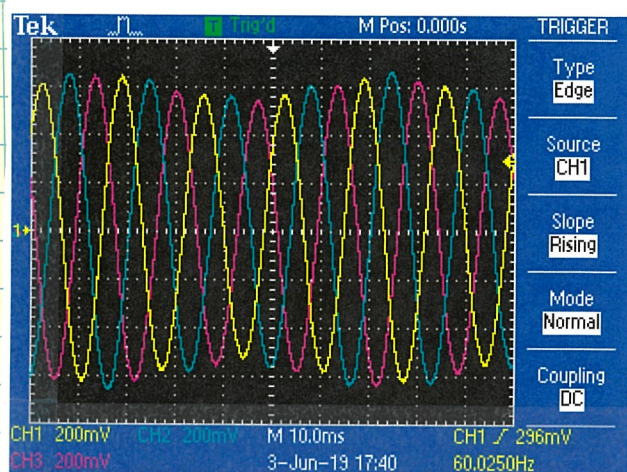
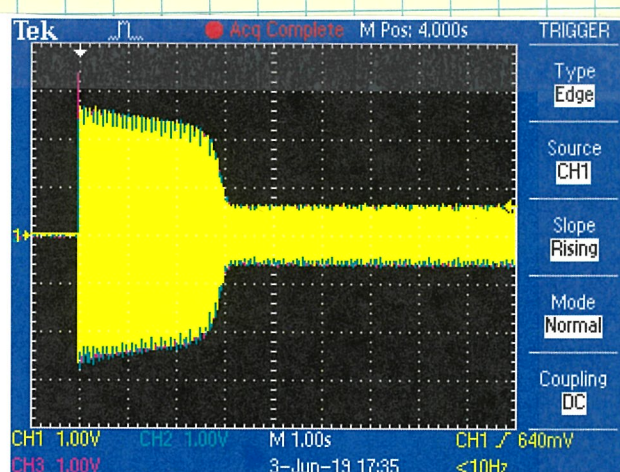
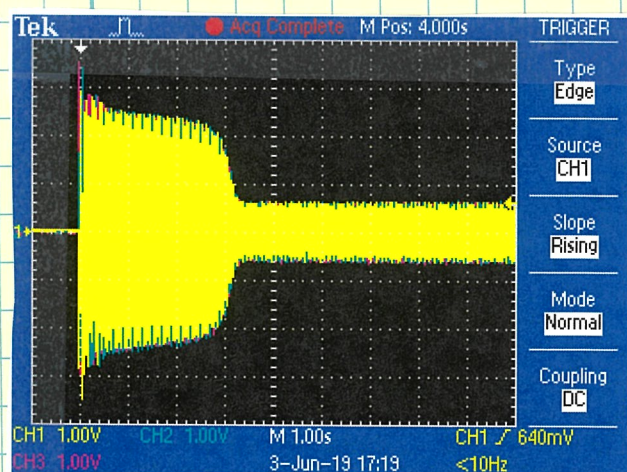


6/3/19 More On The Gas Shed Compressor

The compressor saga continues. Facilities checked on it and replaced the blown fuse. It has been running without a problem for a few days.

I put the current probe back on it and took a couple of scope pictures of when the compressor starts and a couple of after it had gotten running.

Again, 10mV/1A



Eventually it was clear the compressor was worn out. It has been turned off. We are looking at options.

Jack 10/10/19

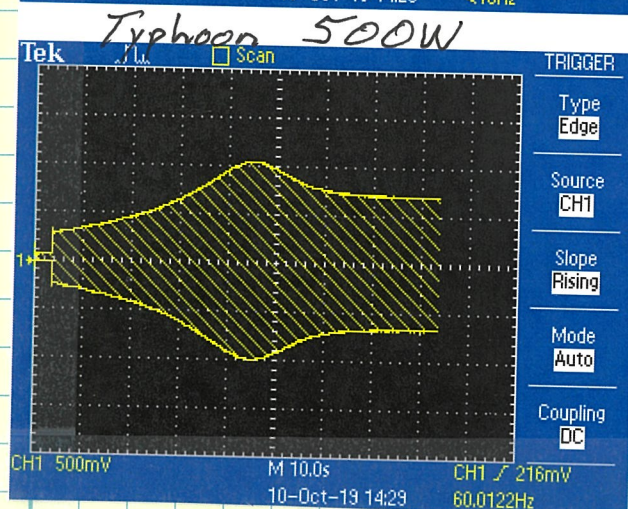
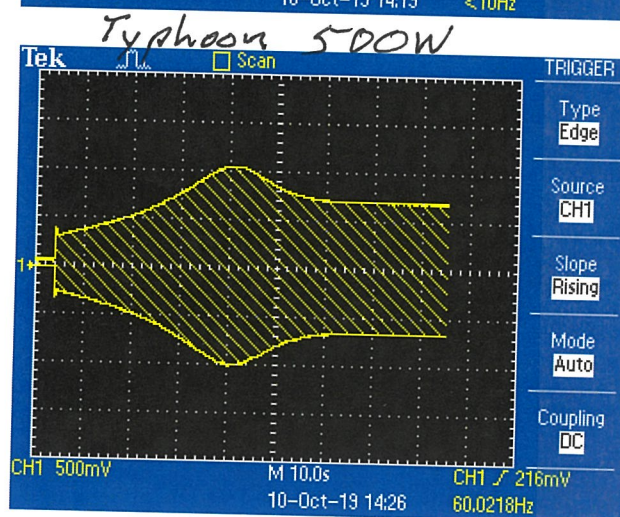
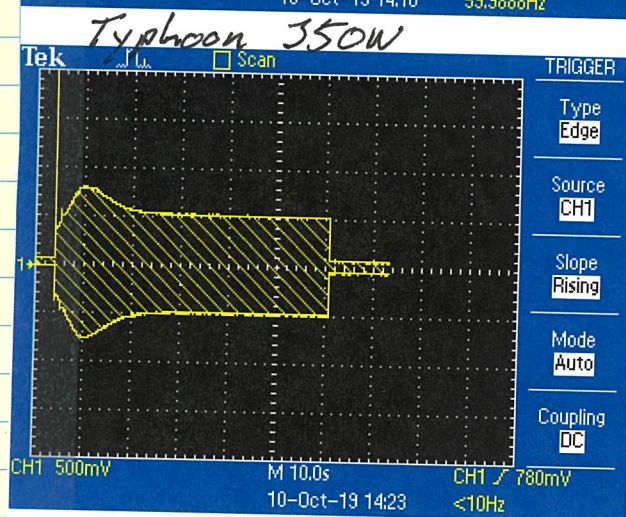
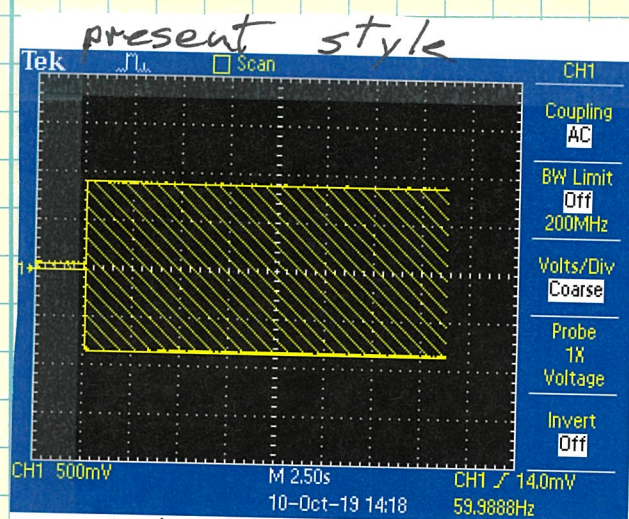
Initial Current Draw Of DBK Heaters

10/10/19

We bought a few models of heater from DBK. There are intended for use on the leads of the superconducting magnets.

JS
J
J.S.

We plugged them into a power strip and used the switch to turn them on. We want to see the initial current draw.



The scope had a current clamp on Ch 1.
 a Tektronic i200s set to 100mV/A.
 The scope was set to peak detect.

The present style heater has about
 850mV peak AC draw. For an RMS of 6 amps.

The Typhoon 350W draws up to 800mV peak
 on warmup and has a continuous draw of
 500mV peak. The RMS values are 5.7amps
 on start up and 3.5A steady running.

The Typhoon 500W draws up to 1050mV peak
 on warmup and 700mV for continuous running.
 The RMS values are 7.43A for warm up and
 5A for continuous running.

The current clamp was around the X1
 position of an Extech AC Line Splitter 480172.

Type	Max on Start	Running
present	6	6
350W	5.7	3.5
500W	7.5	5

~20 second warm up
 ~60 second warm up

Effect of 10 SLM Gas Flow into Hall A 6/29/20

Looking at ODH concerns in the hall. I'm just curious what 10 SLM of Ar/CO₂ would do in the hall if it is not vented back outside.

JS

Hall A is, nominally, 174' in diameter
53'6" high to Spring Height

$$\frac{174' \times 53'6" \approx 93}{\pi \left(\frac{174'}{2}\right)^2 \cdot 53'6" = 1,272,161 \text{ ft}^3} \cdot 28.3168 \text{ g/ft}^3$$

$$= 36,023,535 \text{ L}$$

$$10 \text{ slm} = 600 \text{ slh} \cdot 24 = 14,400 \text{ slh}$$

$$= 508.5 \text{ ft}^3$$

$$\frac{508.5 \text{ ft}^3}{1,272,161 \text{ ft}^3} = 0.04\%$$

O₂ is 21% of air $\Rightarrow .21 \cdot .0004 = .000084$
O₂ concentration would fall by about $\frac{.000084}{.0004} = 0.01\%$
after one day of flow.

The gas mix for the GEM is Ar/CO₂ 70%/30%

$$0.3 \cdot 508.5 \text{ ft}^3 = \frac{152.55 \text{ ft}^3}{1,272,161 \text{ ft}^3} = 0.00012$$

CO₂ concentration would rise from 0.04%
to 0.052%
= 520 ppm

7/10/21 Distances & Voltage Drops of BB I2C Cables
 Measuring distances/lengths of I2C cables for BB.

Using a Fluke MicroScanner Pro F2-13425

From BB bunker to JUNCTION BOX 1 1H75B23 at the pivot: 93 ft. With Wiremap Adapter: 84 ft.

Short ethernet cable: 5 ft. With adapter: 5 ft. Physically the cable is 61" long.

Cable from BB bunker plugged into RJ-45 port 2 at the pivot: 282 ft. With 5' cable & adapter: 263 ft.

The cable is Conduflex Bravotwist code 664455-22 CAT5e Type CMR 4PR 24 AWG (solid). 24 AWG. From BB bunker to pivot. 8860 ft at bunker. 8768 ft. at pivot. Cable has each foot numbered. 8860

$\frac{-8768}{92 \text{ feet} + \sim 1 \text{ ft. for the ends}}$

The cable from pivot to rack is labeled CAT6, solid. It is marked each meter. 240m at pivot. 183m at rack.

$\frac{240}{-183}$

57m + $\sim 1 \text{ m}$ for the ends $\Rightarrow 190 \text{ feet}$

I put a terminal block RJ-45 adapter at each end of the cable. On the rack end I put a 24V wall wart with V+ on pins 1 & 3 and V- on pins 5 & 7. With the lines unloaded I measure 24.119V from 1-3 to 5-7.

At the BB bunker I measure 24.119V.

With 91 Ω from 1-3 to 5-7 at BB bunker 22.369V $\Rightarrow 0.246 \text{ A}$

~~100 Ω~~ 100 Ω

~~510 Ω~~ 510 Ω

~~510 Ω~~ 510 Ω

510 510

22.510V

23.786

23.463

Resistance verified. Meter is a Fluke 289.

With $1k\Omega$ from 1-3 to 5-7 $23.948V$
 $2k$ ~~24.043~~ $24.033V$
 $4.7k$ (5.192 measured) $24.086V$ carbon comp.
 $10k$ $24.102V$

The Tripp-Lite webpage notes that CAT6 is typically 23 AWG.

From the HyperPhysics website 24 AWG is $25.67\Omega/1000'$
 (for Cu at $20^\circ C$) 23 AWG $20.36\Omega/1000'$

Using the cable markings we have 93 ft of 24 AWG and 190 ft of 23 AWG

We have two lines in parallel and out and back. So, that is equivalent to one line.

$$\frac{93ft}{100ft} \cdot 25.67\Omega = 2.387\Omega$$

$$\frac{190ft}{100ft} \cdot 20.36\Omega = 3.868\Omega$$

$$\frac{6.255\Omega}{2} \cdot 0.246A = 1.538V$$

from $9/\Omega$

$$\begin{array}{r} 24.119 \\ - 1.538 \\ \hline 22.581V \end{array}$$

$$\begin{array}{r} 24.119 \\ - 22.369 \\ \hline 1.750V \end{array}$$

So, the voltage drop is a little higher than expected. But, in the ballpark.

$$1.750V \cdot 0.246A = 0.43W$$

8/30/21 HMS Shield House Door Maglock

AS

A couple of comments about what happened when trying to reconnect the wires for the maglock on the HMS Shield House door.

I checked for voltage on the two wires in the box on the platform. I saw $\sim 19VDC$.

I flipped off the breaker for the door drive. Power was off on the drive. Still $\sim 19VDC$ on the wires in the box on the platform.

I unplugged the 12VDC wall wart supply with the label "MAG LOCK". Still $\sim 19VDC$ on the wires.

I pulled the relay with the labels for the shutter and the mag lock. No more voltage on the mag lock wires.

I'm guessing someone tied the mag lock to the 24VDC supply for the exit window shutter drive.