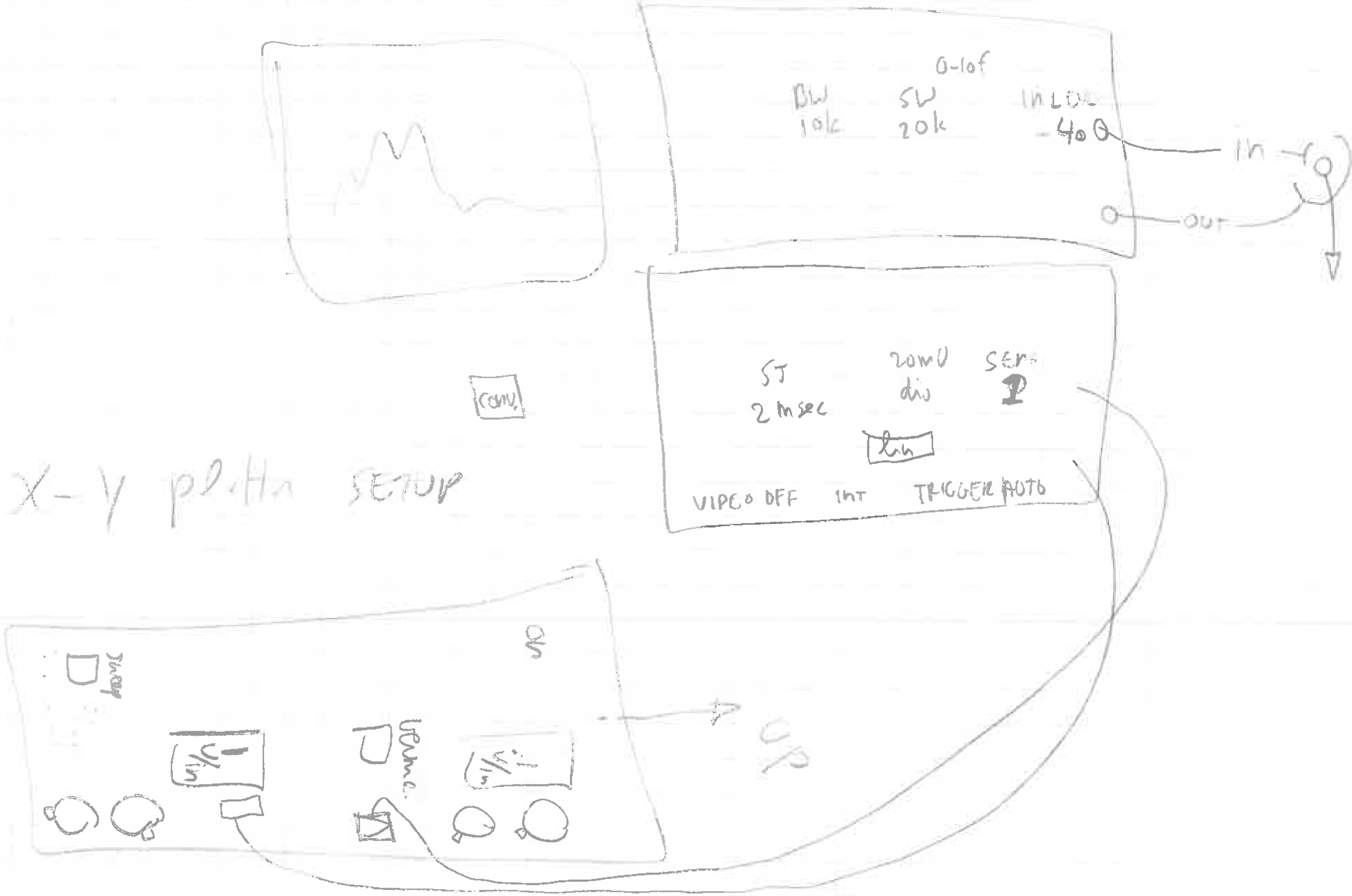
756 3369

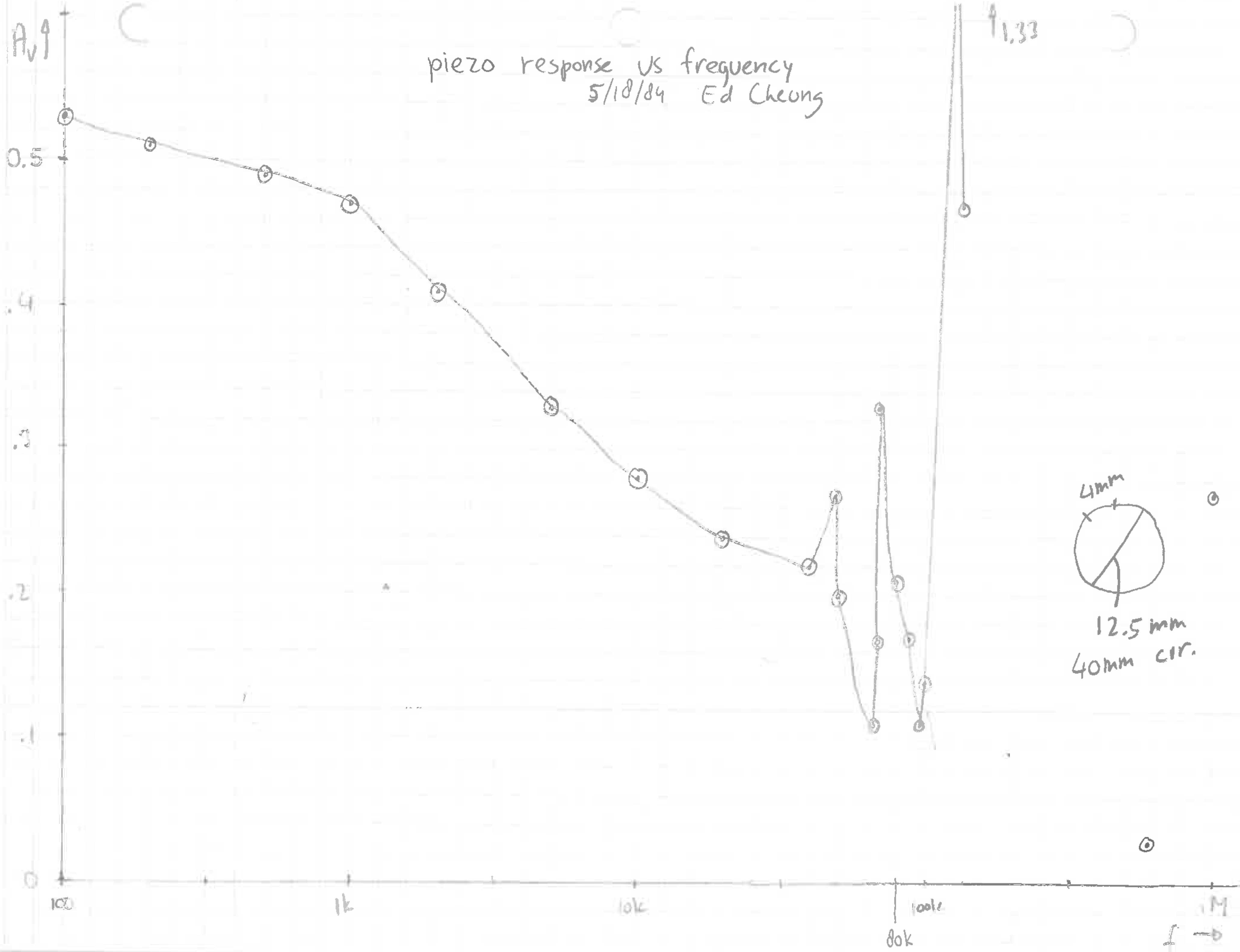
SPECTRUM ANALYZER SETUP

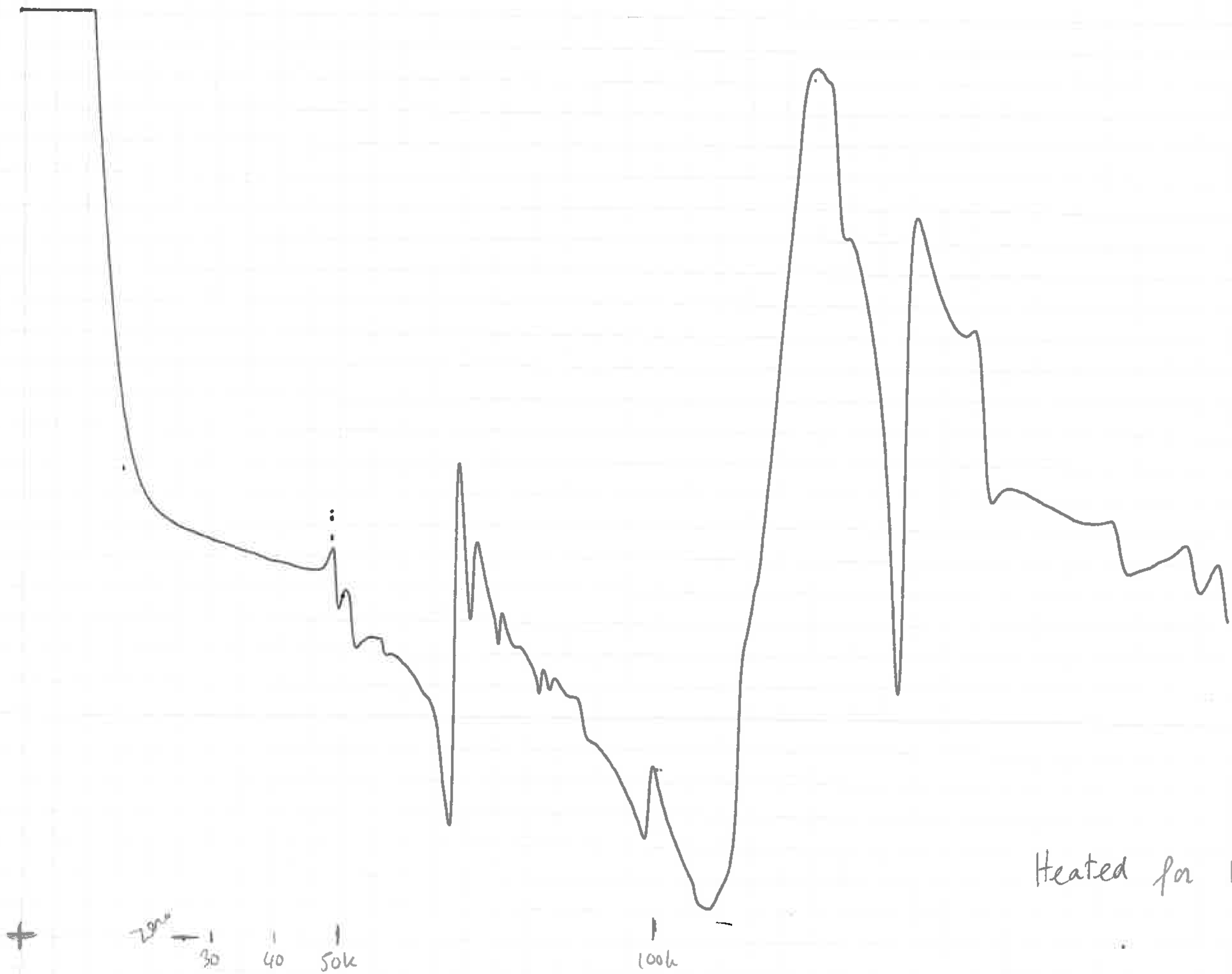


f	~~V_{out}~~	p-p V_{in}	V_{out}	Av
100	~~16~~	30	16	0.53
200	~~15.2~~		15.2	0.51
500			14.6	.49
1k			14	.47
2k			12.4	.41
5k			10	.33
10k			8.4	.28
20k			7.2	.24
40k			6.6	.22
peak 49k			8.1	.27
50k			6	.2
66k 67k			3.4 5	.11 .17
69k			10	.33
80k			6.4	.21
90k			5	.17
97k			3.4	.11
100k			4.2	.14
130k			40	1.33
135k			14	.47
min 600k			1	.03
8-1M			≃ 8	.27

Data on piezo

piezo response vs frequency
5/18/84 Ed Cheung





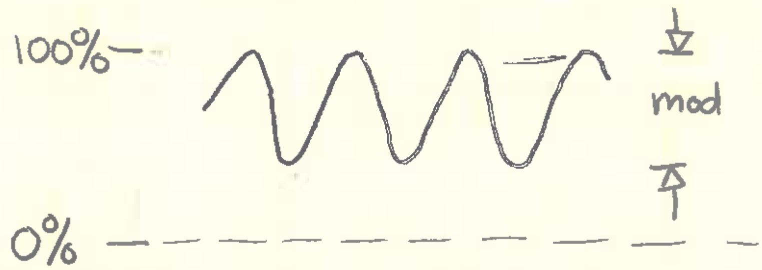
Heated for 15 min

First piezo was defective ED CHEUNG

Piezo II

Piezo Efficiency

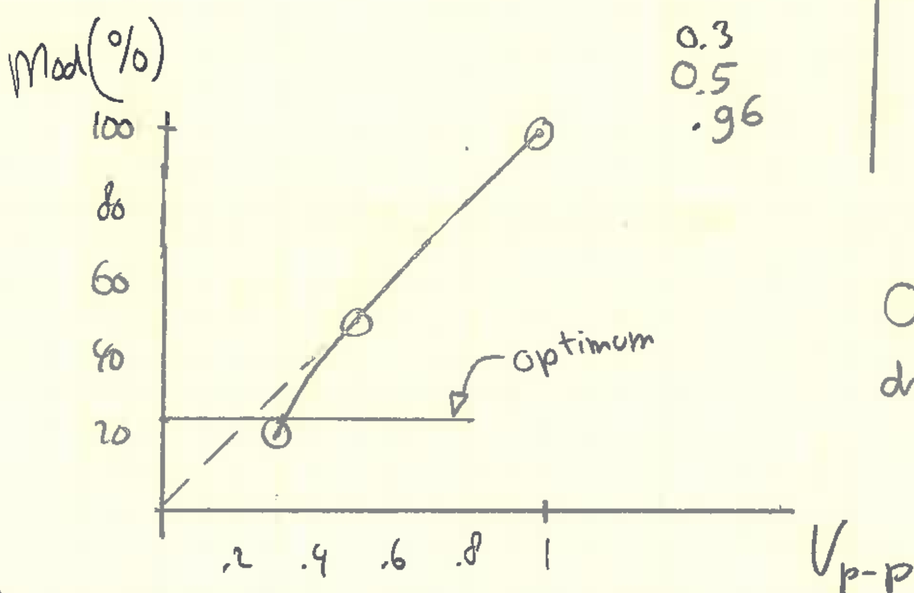
page 1



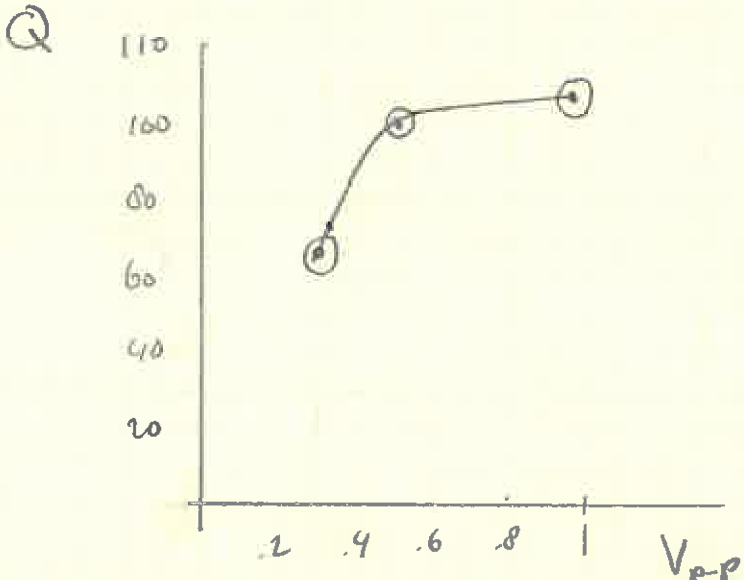
Define $Q = \dfrac{\text{mod}}{V_{DRIVE}}$

Data :

V_{DRIVE} p-p	Mod (%)
0.3	20
0.5	50
.96	100



Optimum piezo drive is at 77% = 23% mod.



Piezo used : no2

Turns on piezo: 50

Width of feedback: 4 mm

f = 108.7 kHz

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Piezo efficiency

What we learned:

The optimum piezo modulation is 23% (according to Aram's calculations). The drive voltage needed is .32 V. This voltage is too low. We would like to have 2 V_{p-p} into the multiplier. Instead of amplyfing this to 2 V_{pp} we could increase the drive and altennate it through a pot.

.32 increase to 2

decrease windings:

$$\frac{0.32}{2} \cdot 50 = 8$$

We will wind a new piezo with only <u>10</u> windings. Drive needed:

$$V_{DRIVE} = 1.6\ V_{p-p}$$

(goodnuff)

This incredible response is possible thanks to the coincidence that the optimum piezo frequency:

$$f = \frac{1}{2T} \qquad T = 5\mu s$$

$$f = 100kHz$$

to the natural frequency is very close of the piezo.

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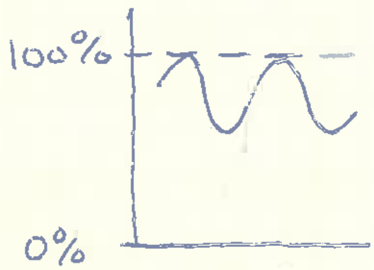
PIEZO III

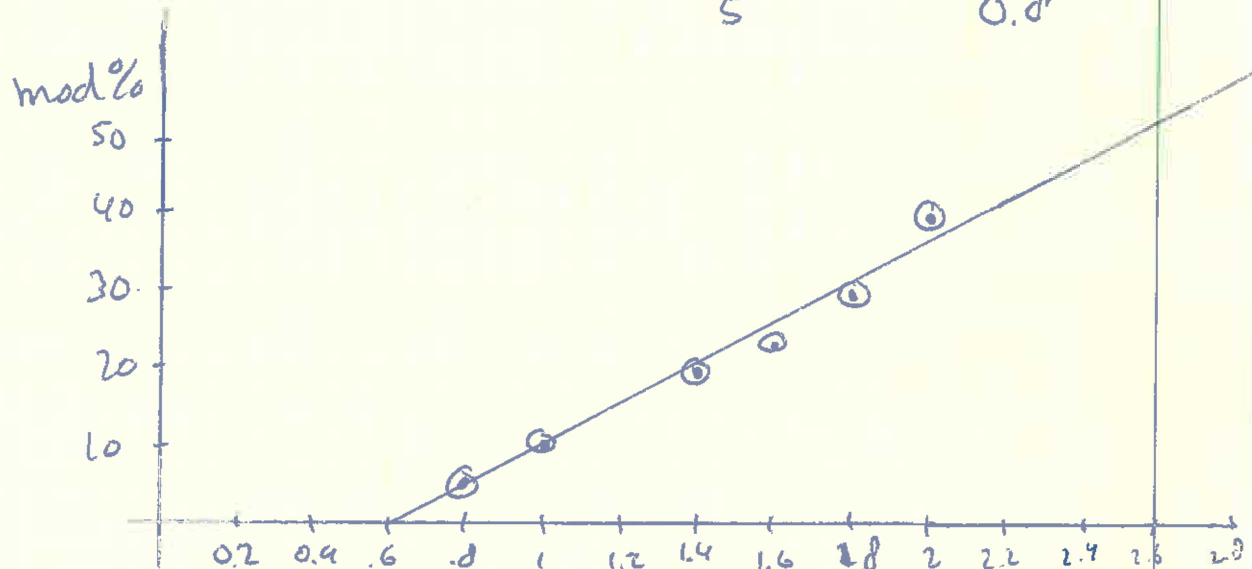
This third piezo has been wrapped.

$n = 10$

Feedback = 4mm (standard)



mod	$V_{p\text{-}p}$
10	1
20	1.4
30	1.8
40	2
23	1.6
5	0.8



Votage required for 23% = 1.6 V

$$Q = \frac{23}{1.6} = 14.4$$

This value is very close to one fifth the value obtained with the other piezo with 50 turns.

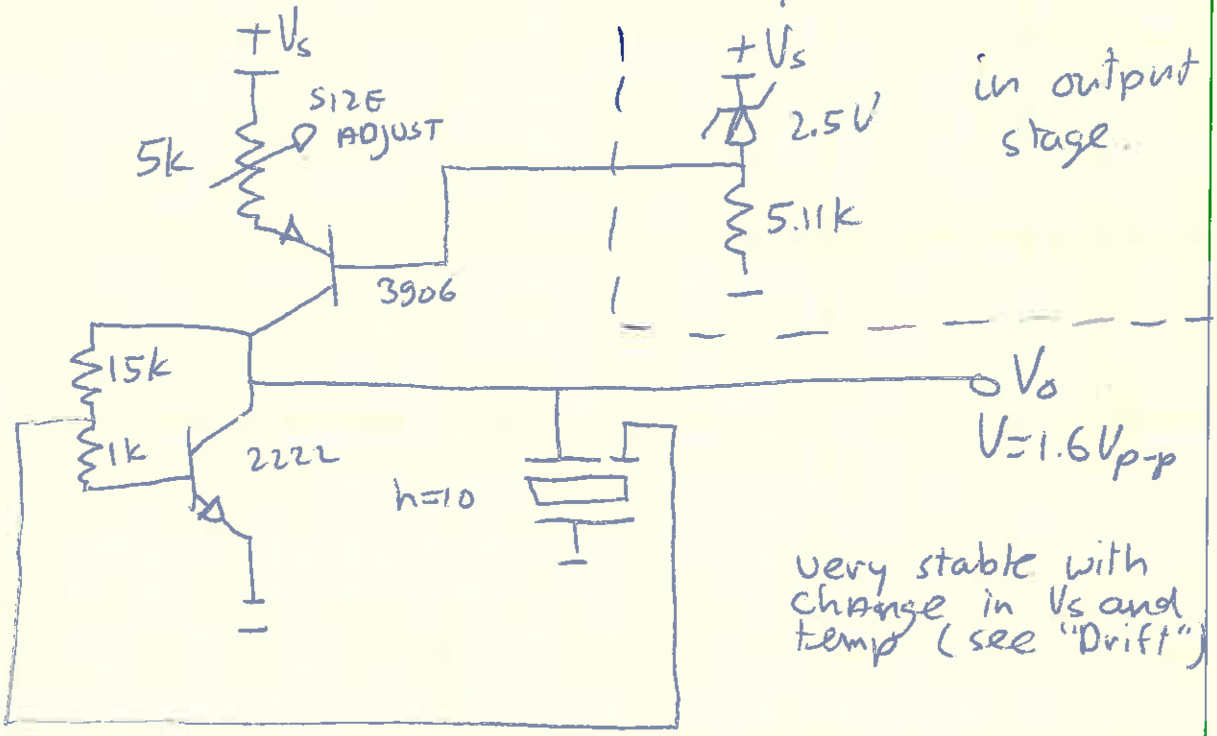
$$5 \cdot 14.4 = 72$$

The Q of the other piezo at 23% modulation is 72 also. This means the piezos behave extremely similar, only one is five times stronger than the other.

The reason that the graph hits the voltage axis at 0.6 V is because of the buffer. At V = 0.6 the piezo is stretching but the buffer is absorbing it. This cancels the modulation. As we increase drive the buffer will be completely squeezed and ~~it~~ it will transmit the ~~moti~~ motion to the fiber.

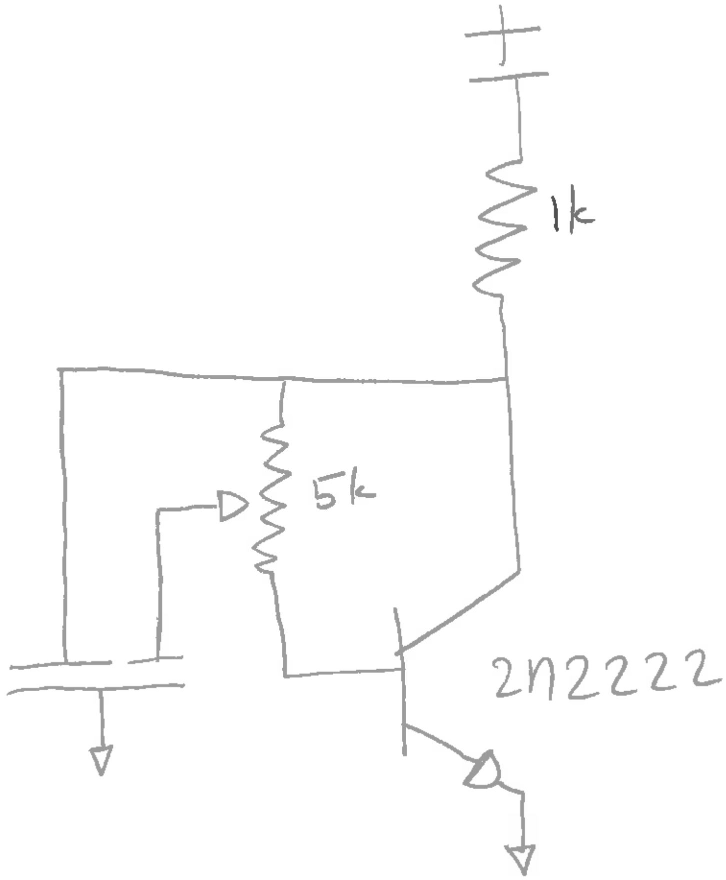
We are now forced to drive the piezo at 1.6 V instead of 0.3V as before. (about five times larger). We can therefore couple the piezo drive into the multiplier directly. There is no need for amplification. Also the piezo is less sensitive to vibration and knocks. And because there are ~~fou~~ far fewer windings on it, there are much less loss due to microbending etc. We saw this in lab. Instead of the usual 20dB loss thru the system we got 14dB loss. 6 dB more power, or 4 times more!

PIEZO Driver Final

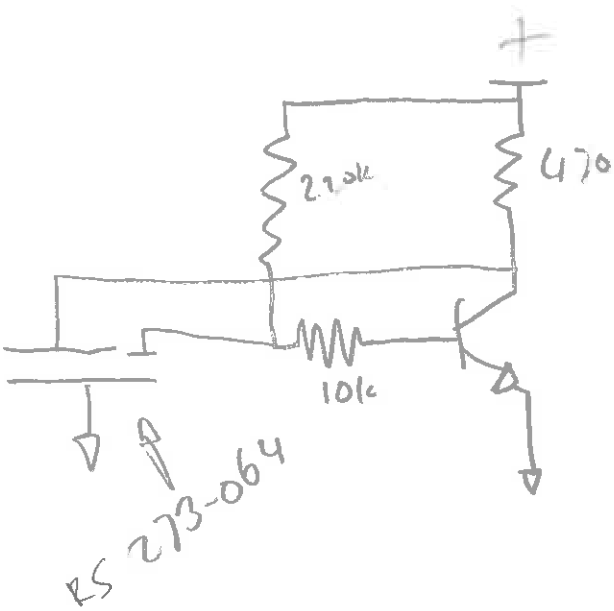


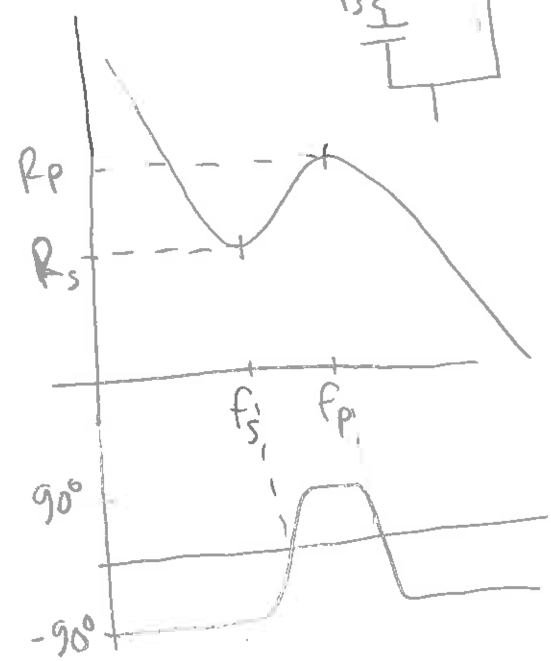
very stable with change in Vs and temp (see "Drift") piezo DRIVER III

tested



alternate :





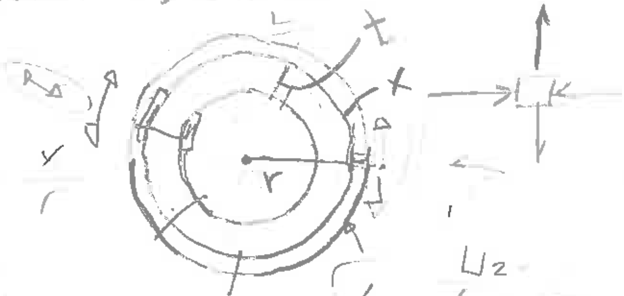
Fiber stretch calculations

$d_{33} = 374 \cdot 10^{-12}$ $\dfrac{\text{meter / meter}}{\text{volts / meter}}$

fiber $\approx \frac{1}{4}$ mm thick = 4 per mm

cylinder: thick = 3 mm Cir = 40 mm high = 19 mm

$\epsilon_\theta = \frac{u}{r}$ $\boxed{\epsilon_r = \frac{du}{dr}}$ $\frac{v}{r}$



$\dfrac{L_1 - L_0}{L_0}$ $\dfrac{v}{t}$

$$Cir_{tot} = 2(r+x)\pi = 2\left(\frac{4\cdot 10^{-2}}{2\pi} + x\right)\pi$$

$$d_{33} = \frac{\frac{x}{r}}{\frac{V}{t}} \rightarrow d_{33}\frac{V}{t} = \frac{x}{r} \rightarrow x = \frac{d_{33}\cdot V \cdot r}{t}$$

$$Cir_{tot} = \left(\frac{4\cdot 10^{-2}}{2\pi} + \frac{d_{33}\cdot V\cdot r}{t}\right)2\cdot\pi$$

$\frac{x}{t}$ $\frac{\Delta t}{t}$

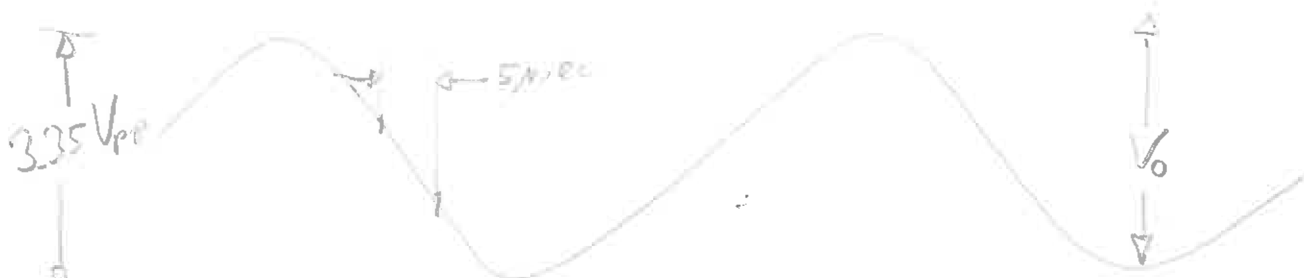
$$= 4\cdot 10^{-2} + \frac{d_{33}\cdot V\cdot 2\pi r}{t}$$

$$\text{stretch} = \frac{d_{33}\cdot V\cdot C\cdot n}{t} = 1\cdot 10^{-6}\,M$$

n = loops
C = circum.

$V\cdot n = 200.535$

$n = 60$ $V = 3.35\ V_{p\text{-}p}$



$f = 40$ kHz
$V_0 = 4-5\ V_{p\text{-}p}$

$$\Delta cir = \frac{d_{33} \cdot V \cdot 2\pi r}{t}$$

$d_{33} = 374 \cdot 10^{-12}$

$r = \frac{2 \cdot 10^{-2}}{\pi}$

$$\Delta r = \frac{\Delta cir}{2\pi} = \frac{d_{33} \cdot V \cdot r}{t}$$

$$\Delta r = V \cdot 8 \cdot 10^{-10}$$

$V = 120$ $\quad$ $\Delta r = .1\ \mu M$

$= .002\ \mu$ inch

$\Delta cir = .6\ \mu M$

$$\epsilon = \frac{.6\mu}{4 \cdot 10^{-2}} = 15\ \mu\text{strain}$$