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# Contribution of F5, F10 Extraction Magnets to Slow Spill

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## AGS Studies Report

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Reported by I-H Chiang

Subject Contribution of F5, F10 Extraction Magnets to Slow Spill

### Observations and Conclusion

Technical Note 199 reported the transfer function of the extraction power supplies. There existed a large component of LILCO 360 in the spill can not be explained by the ripple of the extraction power supplies. The present effort is to establish a permanent easy-to-use system such that we can monitor the power supplies and the slow spill routinely. The system consists of a HP 3651A Signal Analyzer, two sets of cables between control room and the power supplies houses. Also some work was done on the power supplies such that we can easily drive the power supplies with non 60 cycle source. A dedicated source synchronizer was built. This is to provide a Syn. trigger for the HP analyzer. Since the SEB ripple can be derived from various sources, the Syn. box provides a mean to average out the uncorrelated signal.

During the study, it was observed that the F10 power supplies has large LILCO Syn. ripples. J.W. Glenn observed that there is correlation between the spill ripple and the F10 power supply ripple. The transfer function of the F5 and F10 to the slow spill were measured. The results are shown in Tables 1 and 2.

From Table 2 the implied transfer function of 360 component is 2.1% [(2.09 + 2.29)/2] spill modulation per 34.5 mv [(35.2 + 33.7)/2]. Which is equivalent to 16.4 mv per 1% of beam modulation. Figures 1-4 show the effects of the F10 360 Hum Bucking circuit. The 360 component change from 36.41 mv to 6.1 mv. The net reduction is about 30 mv. From the measured transfer function we predict the 360 component of spill should be reduced by

$$30 \text{ mv}/16.4 \text{ (mv/\%spill)} = 1.8\%$$

The dc component of the C10SEC is 395 mv. The predicted reduction at 360 is 7.1 mv. The 360 components of C10SEC is 14 mv and 7.1 mv before and after Hum Bucking circuit activated. The net reduction is 6.9 mv which agree with the prediction. This agreement gives more confidence about the method. We will continue to perform the measurement of the other pertinent power supplies. With all the data in hand, we will then decide how to proceed to reduce the ripple of the power supplies.

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tabel 1 F5 Transfer Function

| Freq | Power supply mv. DC | @freq | % | C10 Sec DC | Meas. @Freq | % | Ratio |
|---|---|---|---|---|---|---|---|
| 50.00 | 5167.00 | 491.00 | 9.50 | 585.50 | 331.30 | 56.58 | 5.95 |
| 80.00 | 5245.00 | 402.00 | 7.66 | 1030.00 | 536.00 | 52.04 | 6.79 |
| 140.00 | 5360.00 | 214.30 | 4.00 | 880.00 | 293.00 | 33.30 | 8.33 |
| 200.00 | 5430.00 | 113.00 | 2.08 | 811.00 | 146.50 | 18.06 | 8.68 |
| 260.00 | 5489.00 | 70.60 | 1.29 | 784.00 | 66.40 | 8.47 | 6.58 |
| 314.00 | 5489.00 | 51.20 | 0.93 | 699.00 | 41.20 | 5.89 | 6.32 |
| 380.00 | 5489.00 | 35.10 | 0.64 | 813.00 | 23.50 | 2.89 | 4.52 |

tabel 2 F10 Transfer Function

| Freq | Power supply mv. DC | @freq | % | C10 Sec DC | Meas. @Freq | % | Ratio |
|---|---|---|---|---|---|---|---|
| 50.00 | 7210.00 | 104.00 | 1.44 | 798.50 | 111.60 | 13.98 | 9.69 |
| 80.00 | 7230.00 | 69.70 | 0.96 | 798.50 | 68.40 | 8.57 | 8.89 |
| 140.00 | 7220.00 | 46.80 | 0.65 | 767.40 | 37.80 | 4.93 | 7.60 |
| 200.00 | 7240.00 | 40.40 | 0.56 | 775.00 | 29.80 | 3.85 | 6.89 |
| 260.00 | 7215.00 | 36.80 | 0.51 | 794.00 | 24.80 | 3.12 | 6.12 |
| 320.00 | 7230.00 | 35.20 | 0.49 | 793.00 | 16.60 | 2.09 | 4.30 |
| 380.00 | 7207.00 | 33.70 | 0.47 | 795.70 | 18.20 | 2.29 | 4.89 |

F10 V

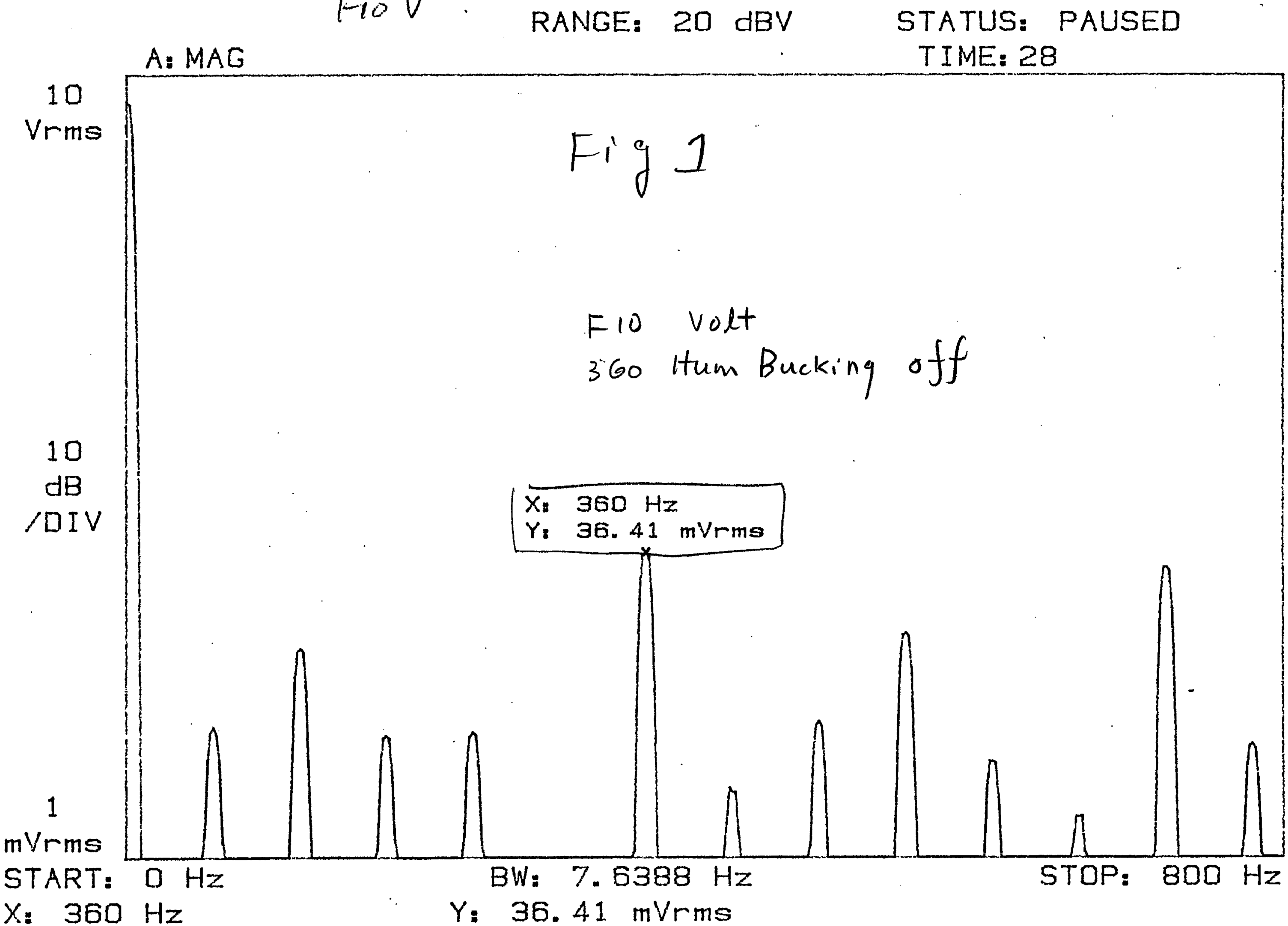
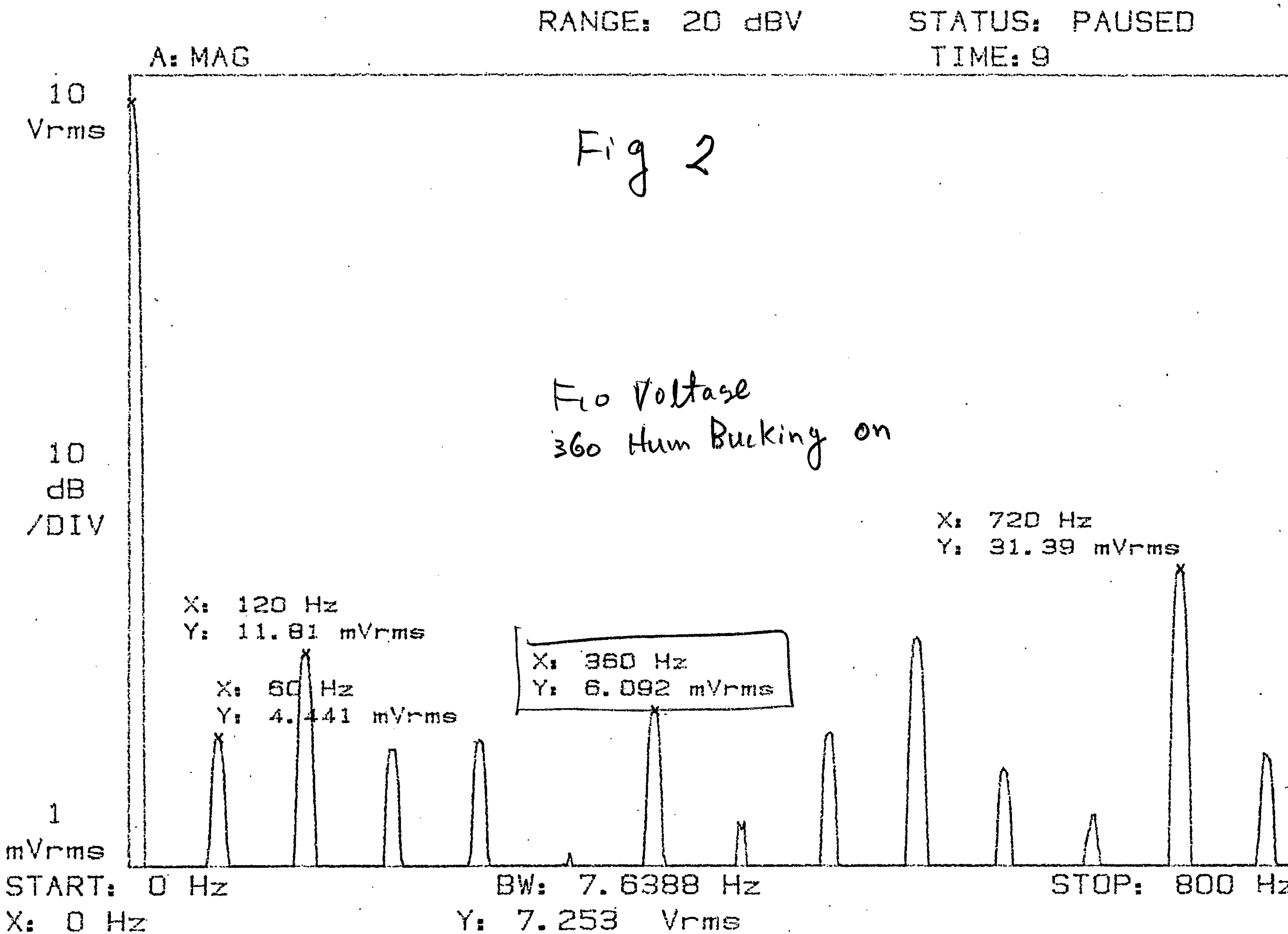

RANGE: 20 dBV
STATUS: PAUSED
A: MAG
TIME: 28
10 Vrms
10 dB /DIV
1 mVrms
F10 Volt
360 Hum Bucking off
X: 360 Hz
Y: 36.41 mVrms
START: 0 Hz
BW: 7.6388 Hz
STOP: 800 Hz
X: 360 Hz
Y: 36.41 mVrms

Fig 1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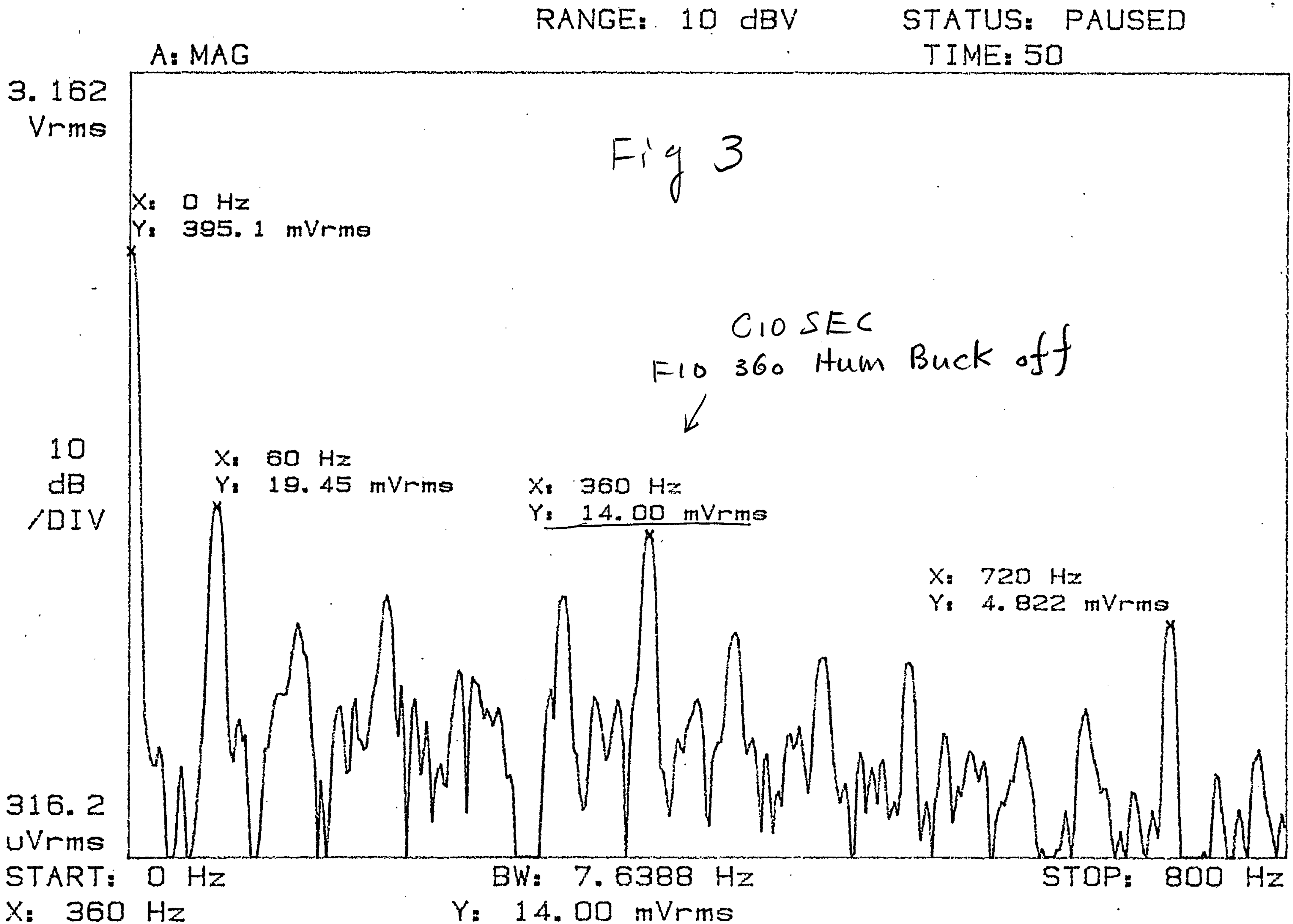
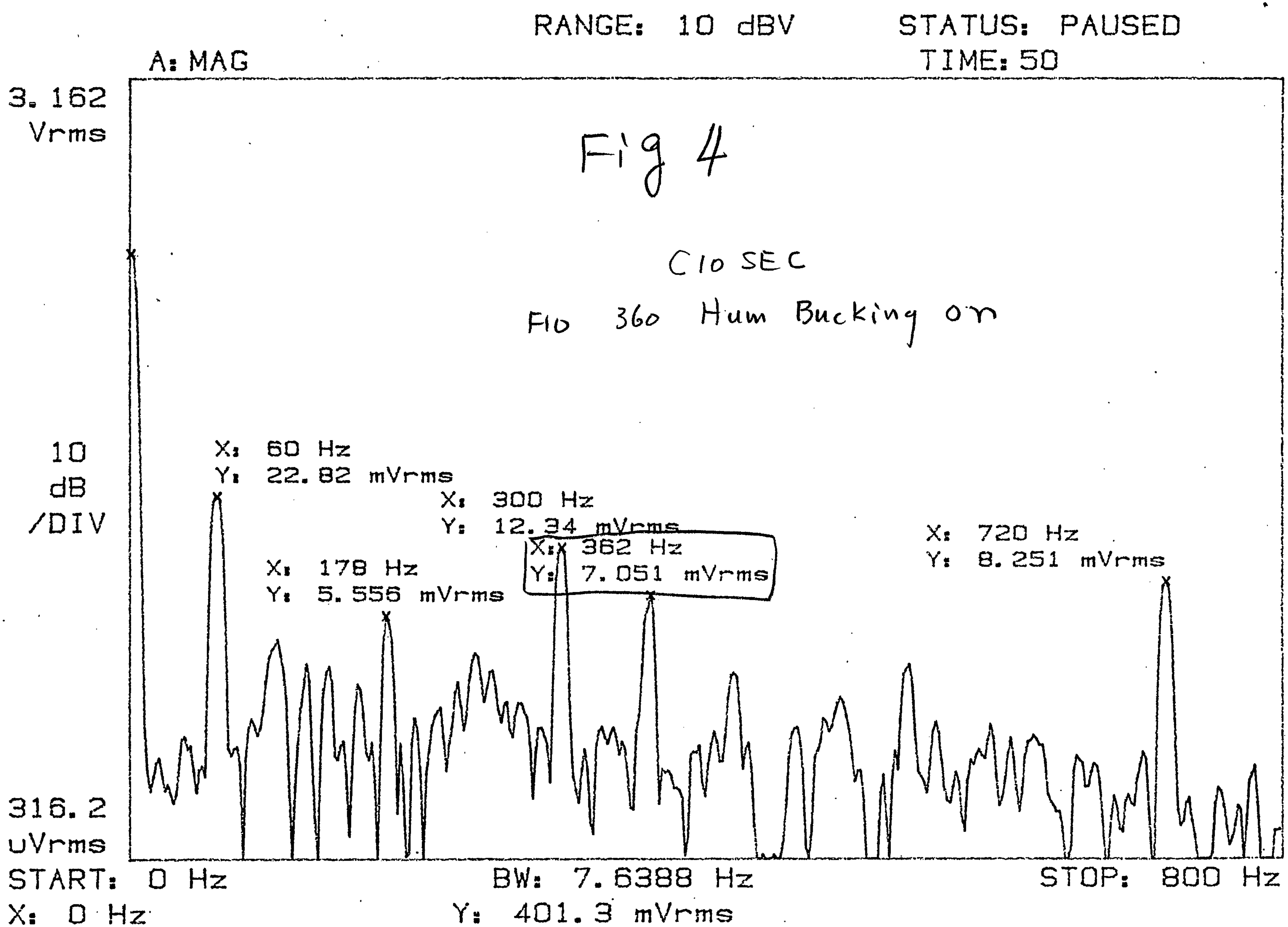
STATUS: PAUSED
A: MAG
TIME: 9
10 Vrms
Fig 2
F10 Voltage
360 Hum Bucking on
10 dB /DIV
X: 720 Hz
Y: 31.39 mVrms
X: 120 Hz
Y: 11.81 mVrms
X: 360 Hz
Y: 6.092 mVrms
X: 60 Hz
Y: 4.441 mVrms
1 mVrms
START: 0 Hz
BW: 7.6388 Hz
STOP: 800 Hz
X: 0 Hz
Y: 7.253 Vrms


RANGE: 10 dBV
STATUS: PAUSED
A: MAG
TIME: 50
3.162
Vrms
Fig 3
X: 0 Hz
Y: 395.1 mVrms
C10 SEC
F10 360 Hum Buck off
10
dB
/DIV
X: 60 Hz
Y: 19.45 mVrms
X: 360 Hz
Y: 14.00 mVrms
X: 720 Hz
Y: 4.822 mVrms
316.2
uVrms
START: 0 Hz
BW: 7.6388 Hz
STOP: 800 Hz
X: 360 Hz
Y: 14.00 mVrms


RANGE: 10 dBV
STATUS: PAUSED
A: MAG
TIME: 50
3.162 Vrms
Fig 4
C10 SEC
F10 360 Hum Bucking on
10 dB /DIV
X: 60 Hz
Y: 22.82 mVrms
X: 300 Hz
Y: 12.34 mVrms
X: 362 Hz
Y: 7.051 mVrms
X: 178 Hz
Y: 5.556 mVrms
X: 720 Hz
Y: 8.251 mVrms
316.2 uVrms
START: 0 Hz
BW: 7.6388 Hz
STOP: 800 Hz
X: 0 Hz
Y: 401.3 mVrms