1/3/86

Number 195

AGS Studies Report

Date(s)-----December 23, 1985 Time(s)---0400-0700

Experimenters--H. Ashby, J. Curto, A. Feltman

Reported by-----A. Feltman

Subject ----Injection Porch Parameters for Heavy Ion Injection.

Observations and Conclusions

The Injection Porch length was set to 800 milliseconds so that more accurate measurements of the subharmonic components of ripple could be obtained. Each stations output D.C. voltage was set to 250 volts yielding a total of 500 volts across the Main Magnet. Both station firing times were then adjusted to minimize the subharmonic ripple components. Station two was then readjusted to introduce a small controlled amount of ripple. This will then allow an evaluation of the kind of tolerances required for Heavy Ion injection.

Frequency spectrums averaged over fifty pulses were taken at the following points.----

1) Station one before the ripple filter.
2) Station two before the ripple filter.
3) Station one after the ripple filter.
4) Station two after the ripple filter.
5) Magnet current.

As indicated in the spectrum diagrams for station #1 before and after the ripple filter all the subharmonic components of ripple are well behaved. The 360 Hz. component of ripple however is somewhat higher than anticipated and although the ripple adjustment controls of this station were able to minimize it they were not able to reduce it to zero. It appeared as though there was a quadrature component of 360 Hz signal being introduced from an ununderstood reason. This will be investigated in greater detail.

For station #2, the results are not so easily interpretable because of some inconsistencies that have not been fully analyzed at present time. All components of signals as determined by the spectrum analyzer after the ripple filter were about 10% higher than they should have been. This includes even the D.C. component of magnet voltage. If a 10% correction is included in the data everything falls into place.

The magnet current frequency spectrum shows that the 60 Hz. component of current is of the order of 0.3 Amps. R.M.S. and do to the fact this was intentionally introduced, could in Principal be reduced to essentially zero. The most troublesome component of subharmonic is the 1400 Hz. component. This component is about equivalent to 4.0 amps Peak to Peak. This Peak to Peak value is about 4% of the injection current and can Produce Prohibitively large radial excursions of the beam Position during injection. I do not believe this number for the following reason.----------

If the Power supply were Phased back to Produce zero volts D.C. (the worst condition for ripple), the raw ripple would be 750 volts Peak to Peak at 1400 Hz. The waveform would be a Pup tent which would therefore yield a value of 2(750)/(3.1416)=477 volts Peak to Peak applied to an inductance of greater than 0.5H. This would yield a current of something of the order of 0.1 Amps. Peak to Peak at 1400 Hz. The conclusion could only be that the 4.0 Amps Peak to Peak is inconsistent with the rough calculation of 0.1 Amps Peak to Peak. Additional studies will be required to resolve this discrepancy.

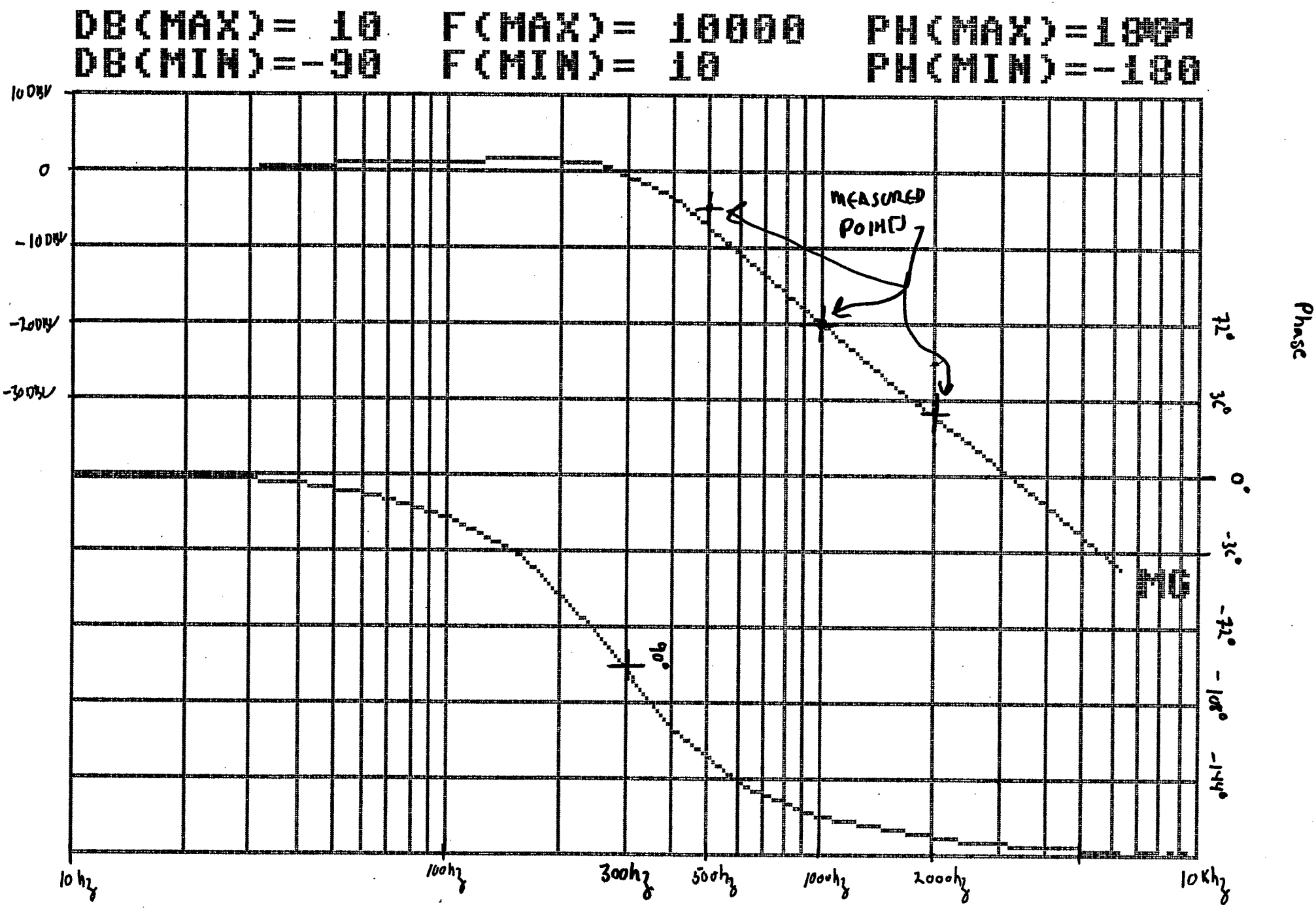
At the conclusion of the run, the bus connections to the ripple filter were Pulled and the ripple filter Parameters were measured. The individual Pancakes of the inductors were measured and also the series aiding inductance of each inductor was measured. The results are as follows----------

Station #1 upper Pancake----------3.352 mh.
Station #1 lower Pancake----------3.276 mh.
Station #1 series aiding inductance---9.46 mh.

Station #2 upper Pancake----------3.34 mh.
Station #2 lower Pancake----------3.27 mh.
Station #2 series aiding inductance---9.68 mh.

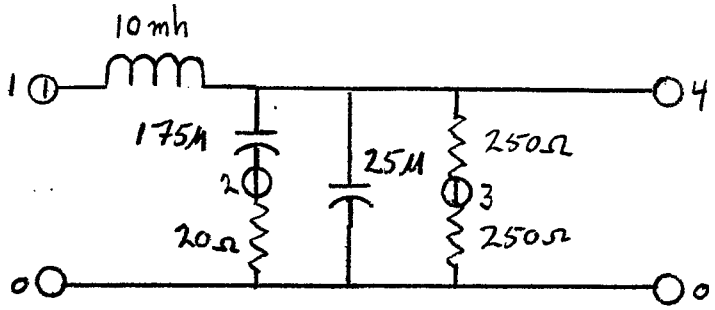
Using a nominal value of 10 mh. for the ripple filter inductance, the frequency magnitude and Phase responses of the ripple filter were calculated and compared to several nominal measured Point on the roll of. The ripple filter calculations agree very well with the measurements. The filter break frequency is at about 300 hz. and the roll off is about 40 db. Per decade or 12 db. Per octave. The overshoot is 28% at 200 hz.

As Previously Pointed out, station #2 had some subharmonic ripple left in. This ripple can now be used to compare the filter against calculations. At 360 hz, the filter response calculates that it should be down to about 80% . the 360 hz component before and after the filter measure 21.3 and 16 (corrected) volts P/P. this is 75%, which agrees closely with calculations. At 720 hz., the filter calculation predicts that the filter response should be about 20%. the 720 hz. before and after the filter measured 251.5 and 54 (corrected) volts P/P. this is a response of 21%, which is a good close fit.


DB(MAX)= 10
DB(MIN)=-90
F(MAX)= 10000
F(MIN)= 10
PH(MAX)=180
PH(MIN)=-180
10 DB
0
-10 DB
-20 DB
-30 DB
MEASURED POINT
90°
72°
36°
0°
-36°
-72°
-108°
-144°
Phase
10 hz
100hz
300hz
500hz
1000hz
2000hz
10 Khz

THE CIRCUIT ELEMENTS ARE:

R02=20 R03=250 R34=250 L14=.01
C24=175E-6 C04=25E-6

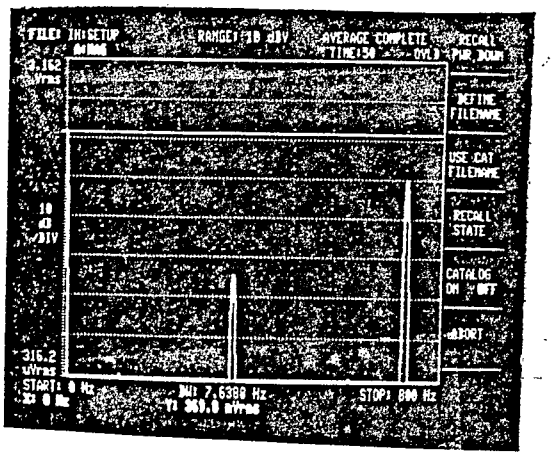


FREQ.(HZ)	V-4 /V-1 MAG	PHASE
10	1.00763109	-.15621
11.2201846	1.00952485	-.19856
12.5892541	1.01186362	-.25495
14.1253754	1.01473858	-.33025
15.8489319	1.01825272	-.43085
17.7827941	1.02251876	-.56507
19.9526232	1.02765515	-.74351
22.3872114	1.03377938	-.97940
25.1188643	1.04099858	-1.2888
28.1838293	1.04939765	-1.6906
31.6227766	1.05902626	-2.2066
35.481339	1.06988727	-2.8603
39.8107171	1.08192977	-3.6766
44.6683593	1.09505047	-4.6810
50.1187234	1.10910579	-5.8986
56.2341325	1.12393433	-7.3539
63.0957346	1.13938612	-9.0721
70.7945786	1.15535152	-11.080
79.4328236	1.17178067	-13.410
89.125094	1.18868305	-16.104
100	1.20609504	-19.216
112.201846	1.22399805	-22.820
125.892541	1.24215761	-27.015
141.253755	1.25983302	-31.933
158.489319	1.27528332	-37.739
177.827941	1.28500561	-44.631
199.526231	1.28280195	-52.802
223.872114	1.2593215	-62.378
251.188643	1.20371462	-73.284
281.838293	1.10907766	-85.113
316.227765	.979440841	-97.141
354.813388	.830685882	-108.55
398.107169	.682376209	-118.76
446.683591	.548685544	-127.54
501.187231	.435749053	-134.93
562.341323	.343914402	-141.10
630.957341	.270761099	-146.26
707.94578	.213074037	-150.60
794.32823	.167773021	-154.27
891.250933	.132235182	-157.41
999.999993	.104341285	-160.10
1122.01845	.0824201093	-162.44

FREQ.(HZ)	V-4 /V-1 MAG	PHASE
1258.9254	.0651675681	-164.47
1412.53753	.0515696785	-166.24
1584.89318	.0408380575	-167.80
1778.2794	.0323587128	-169.17
1995.2623	.0256523504	-170.37
2238.72112	.0203438851	-171.44
2511.88641	.0161390846	-172.39
2818.38291	.0128066447	-173.22
3162.27763	.0101643908	-173.97
3548.13386	8.06861691E-03	-174.63
3981.07167	6.40581254E-03	-175.22
4466.83588	5.08622056E-03	-175.74
5011.87228	4.03863712E-03	-176.20
5623.41319	3.20719355E-03	-176.62
6309.57337	2.54705284E-03	-176.99
7079.45775	2.02287299E-03	-177.31
7943.28225	1.60662121E-03	-177.61
8912.50926	1.27605585E-03	-177.87
9999.99986	1.01352593E-03	-178.10

STATION #1

BEFORE FILTER



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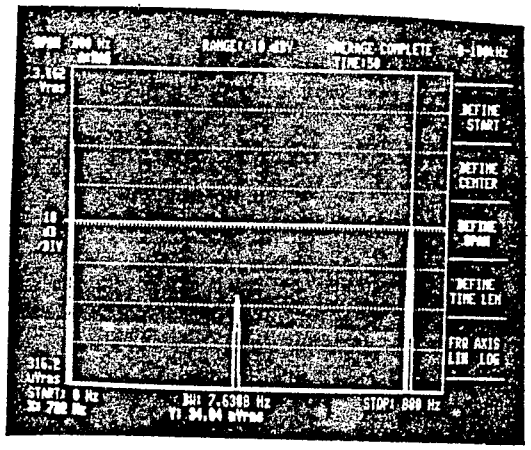
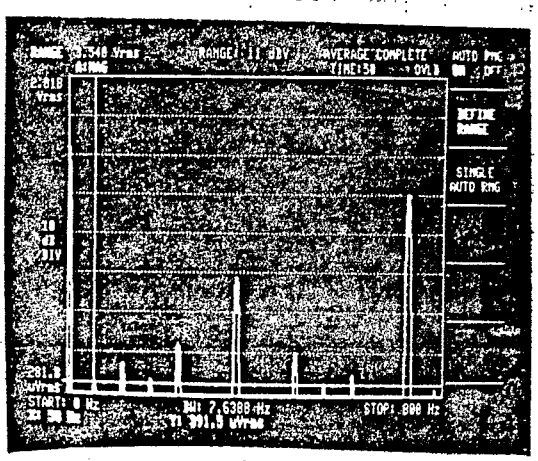


D.C	261.5V	258V
120	1V P/P	—
360	16.5V P/P	11.7V P/P
720	270.2V P/P	96V P/P

STATION #2

BEFORE FILTER



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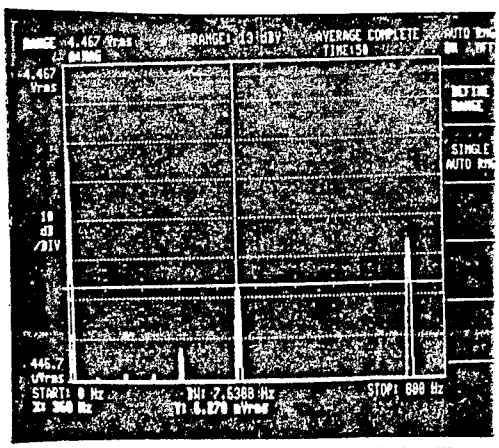

DC	249	273 → 245
60	1V P/P	1.41V P/P → 1.25V P/P
120	1.85V P/P	1.5V P/P 1.35V P/P
180	1.18V P/P	1.55V P/P 1.4V P/P
240	2.85V P/P	2.8V P/P 2.54V P/P
360	21.24V P/P	17.7V P/P 16V P/P
720	251.5V P/P	60V P/P 54V PP

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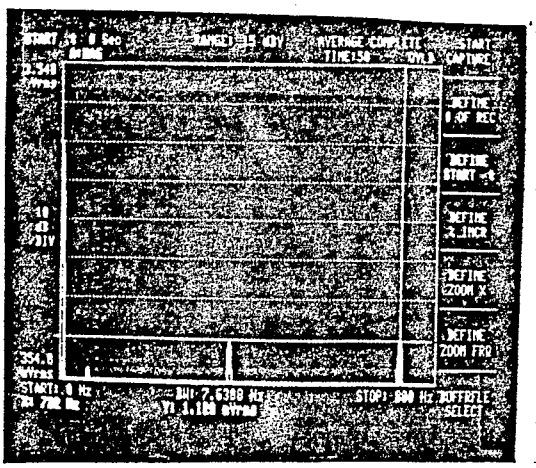
I MAGNET

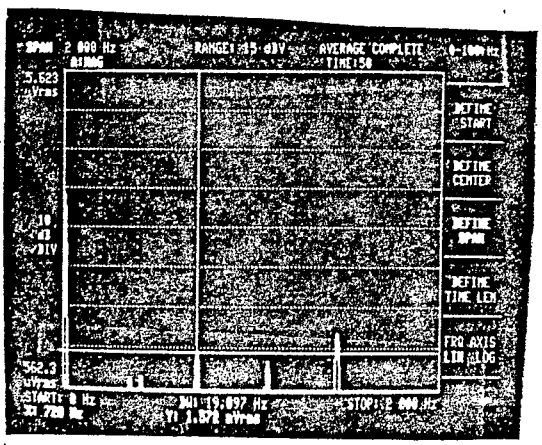


D.C. = 351/√2 = 248 mV = 150A AV

60 = .482 μVRMS = 0.3AMPS

360 = 1 μVRMS = 0.6 AMPS

720 = 1.12 μVRMS = 0.672 AMPS



DC = 149.8/√2

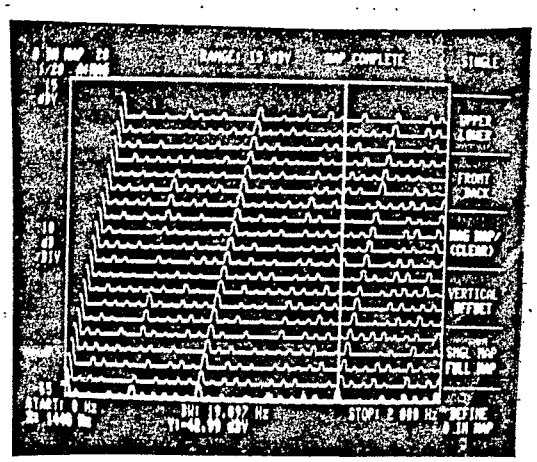
360 = .763 mV

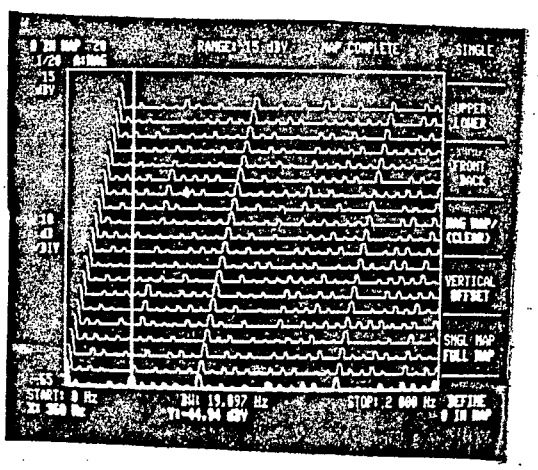
420 = .82 mV

720 = 1.572 mV

1085 = 1.2 mV

1440 = 2.664 mV = 1.5984 AMPS 4APP





12/18/85

Number 194

AGS Studies Report

Date(s) December 9, 1985 Time(s) 0300-0700

Experimenter(s) A. Feltman, F. Heimroth, C. Staal

Reported by A. Feltman

Subject Injection Porch Setup for Heavy Ion Injection

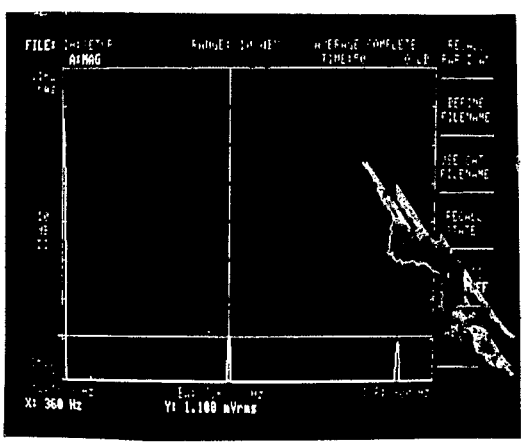
Observations and Conclusion

A complete new set of ICOMA cards were installed into the injection porch control buckets. Between weeding out bad cards, trouble-shooting and re-aligning both stations, about three hours were used up before tets were ready to be run. An additional hour was lost trying to determine who was supposed to have the machine and when.

Because of the time crunch, even though the power supply was not really finely adjusted to obtain complete elimination of the lower frequency components of ripple, it was decided to take some preliminary measurements.

The 360 Hz and 720 Hz Siemens synchronized components of ripple averaged over 50 pulses of magnet current were measured. At 600 Amps the average rms value of the 360 Hz component of current ripple was 0.6 Amps. The 720 Hz component was of the same order of magnitude. It is felt that this amount of ripple could be reduced by one or two magnitudes with more meticulous adjustment of the power supply.

There was no sign of 60, 120, 180, 240, or 300 Hz present.

After completion of tests, the power supply was restored to the original condition. The machine was run for a few minutes to confirm that previous operating parameters were restored.

At 6:00 a.m., the power supply was secured to allow time for main magnet leakage current measurements. These measurements were conducted with 400 volts on each half of the main magnet to ground. Section "A" drew 3 mA and section "B" drew 2.5 mA.