Fermilab

TS-SSC 91-221

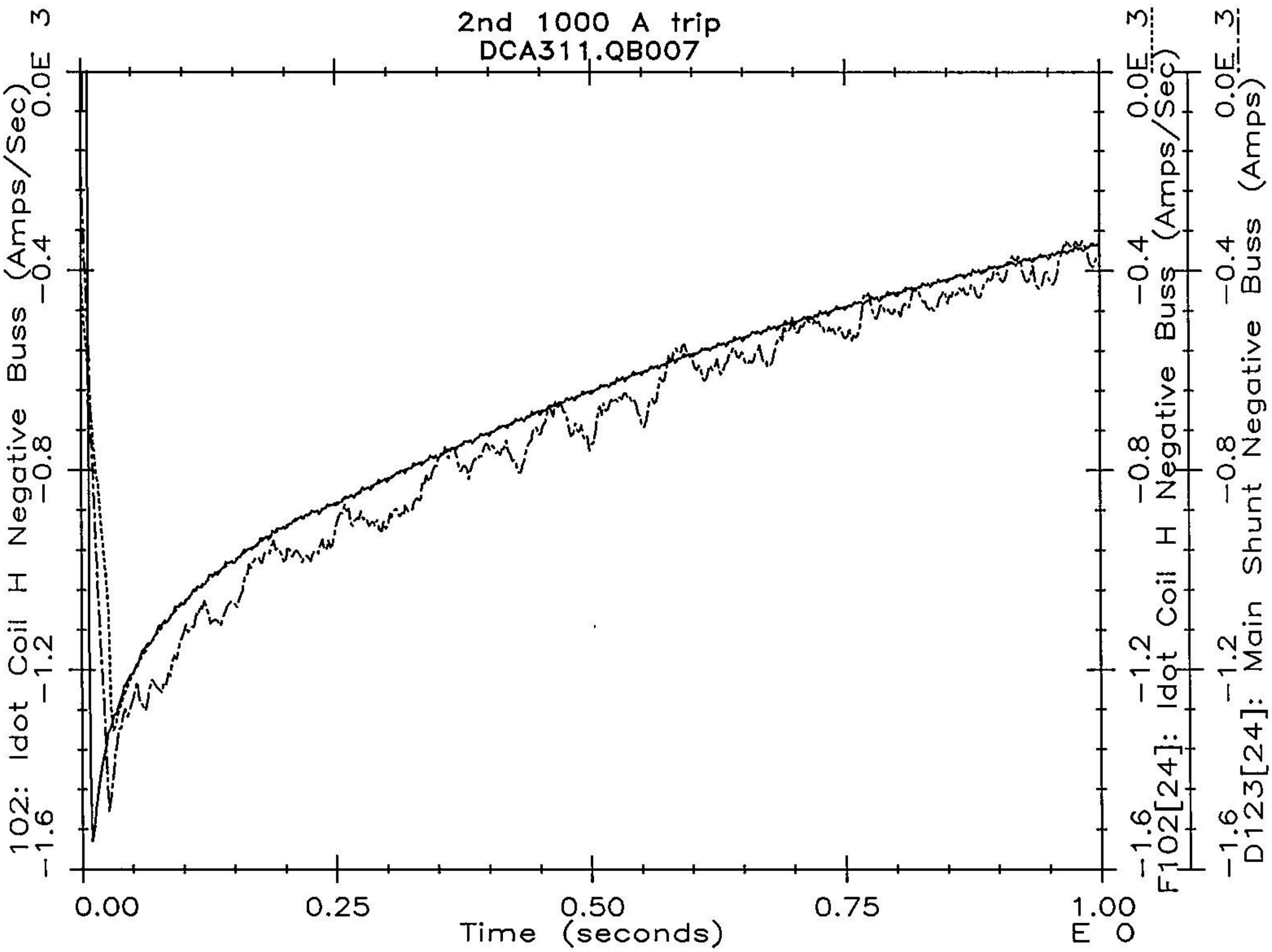
From: FNAL::JBS 11-NOV-1991 23:23:45.26
To: FNAL::ORRIS
CC: MYSELF
Subj: Long 50 mm magnet inductance

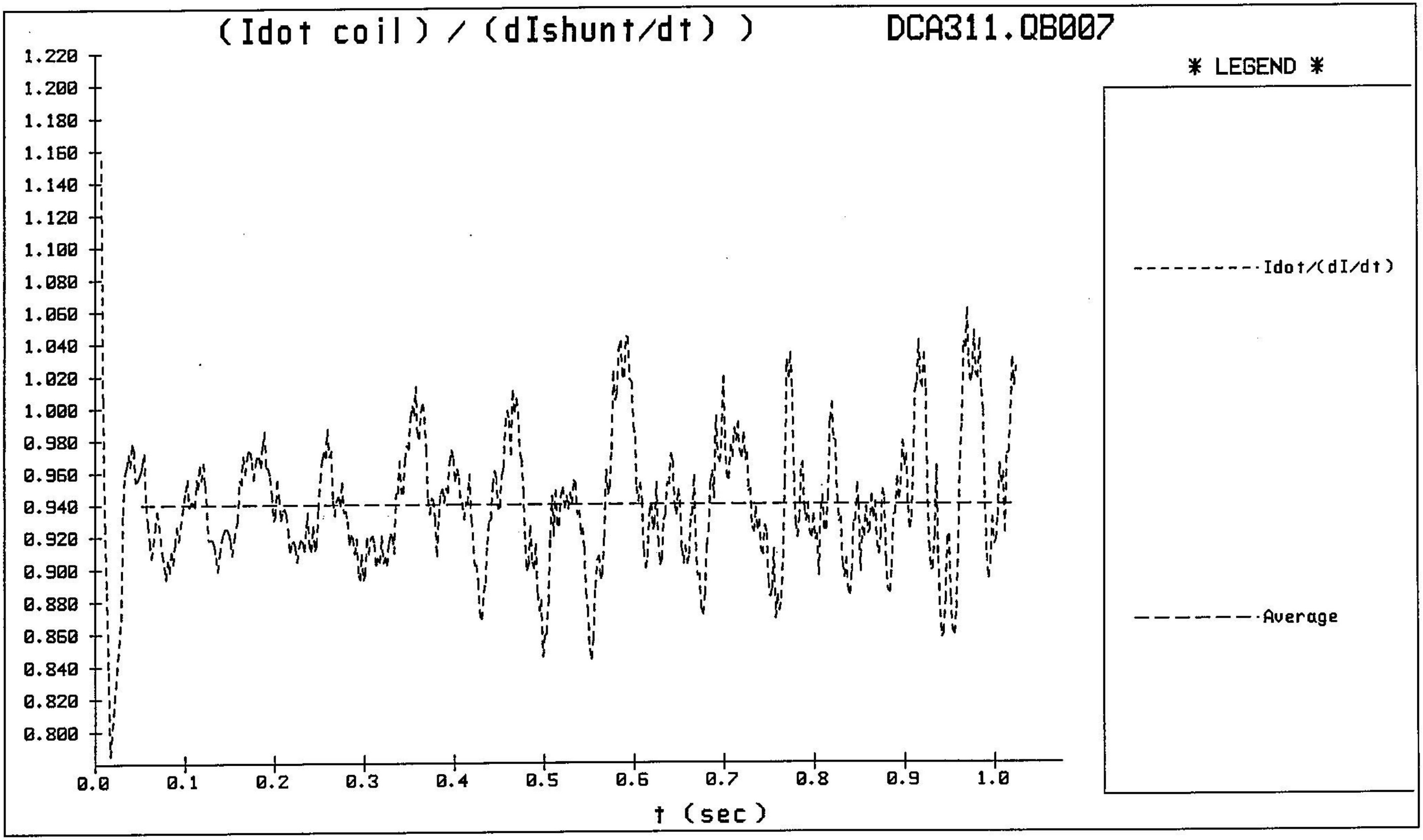
I have done the following exercise with the data from DCA311.QB007 and find the following:

1) The inductance loaded for the Idot coil appears to be off by about 6%. That is, the dI/dt reported by the Idot coil is 94% of that deduced by differentiating the shunt signal. I tend to believe the shunt much more than the Idot coil, so I believe that it is the latter that has the wrong constants. I also believe that I determined this at some point during my time testing 40 mm magnets, but decided not to do anything about it so as to keep consistency through the whole set of data. Perhaps this should be fixed as we start 50 mm magnets.

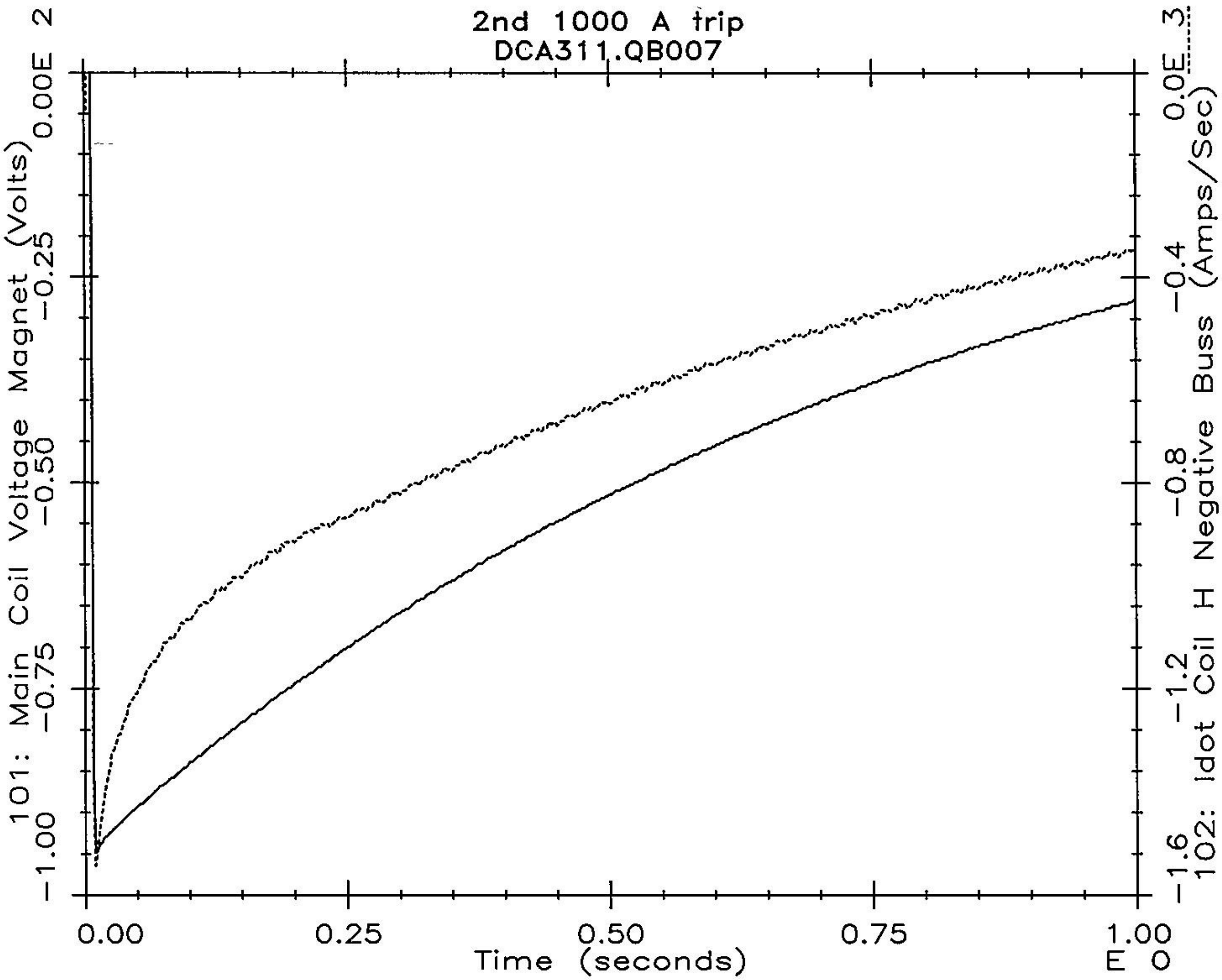
2) The ratio of the total magnet voltage to the dI/dt reported by the Idot coil is, for 0.3 < t < 1.0 sec, 80.1 mH. (Starting the average after 0.3 sec allows the magnet inductance to recover from the "trauma" of dump firing and stopping at 1 sec keeps us well away from "zero divide by zero.") Since the true dI/dt is 6% larger than that used in this calculation, the true inductance is found to be 75.3 mH. This is just under 1% larger than that calculated by Ramesh Gupta who designed the cross section. The difference is, I would guess, within the uncertainty of the calibrations of the various isolation amplifiers.

3) To get the inner quarter coil inductance fraction I look at the ratio of inner to outer coil voltage. The two outer coil voltages track each other very well, but the inner coils, at least on the high gain channels, differ significantly (on the order of 10%) from each other. The inner coils do not obviously differ from each other by a constant offset or a constant gain difference, so I am not sure what to do. I plotted both the upper inner to outer and the lower inner to outer ratios. The latter was more constant over the period 0.3 < t < 1.0 sec, so I have chosen to believe that it is more correct. The ratio is not quite constant over this period, however, varying from 0.542 at 0.3 sec to 0.552 at 1.0 sec. I blindly take the average over the this period which turns out to be 0.548. This corresponds to the ratio L(inner quarter coil) / L(total) = 0.177+-0.001, where the error bar comes from the range of the inner/outer ratio over the time period used. If I use the upper coil ratio, I get something like 0.172+-0.002. If you can sort out the upper inner - lower inner signal difference, we can get a little more solid number.

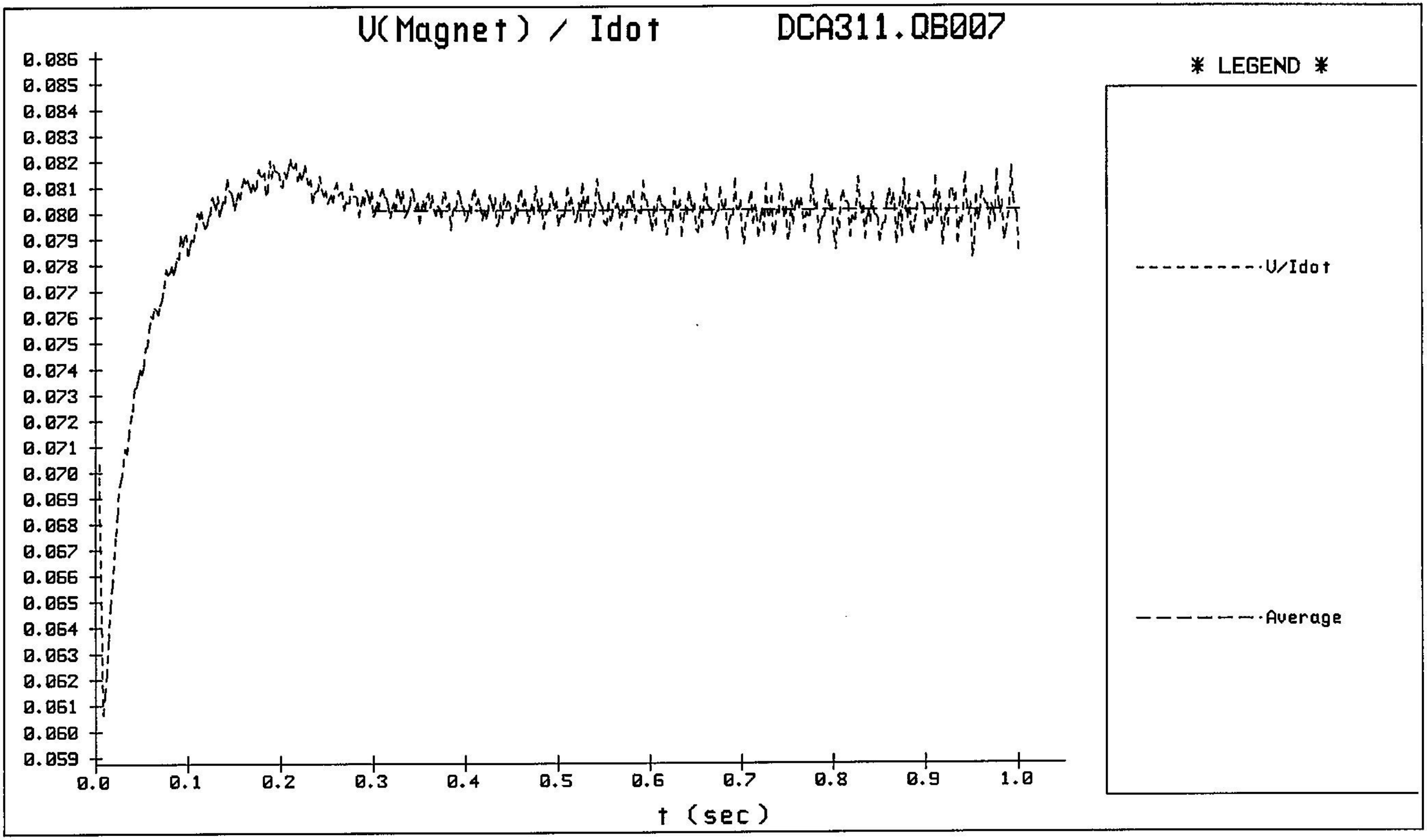

2nd 1000 A trip
DCA311.QB007
102: Idot Coil H Negative Buss (Amps/Sec)
0.0E 3
-0.4
-0.8
-1.2
-1.6
F102[24]: Idot Coil H Negative Buss (Amps/Sec)
D123[24]: Main Shunt Negative Buss (Amps)
0.00
0.25
0.50
0.75
1.00
E 0
Time (seconds)

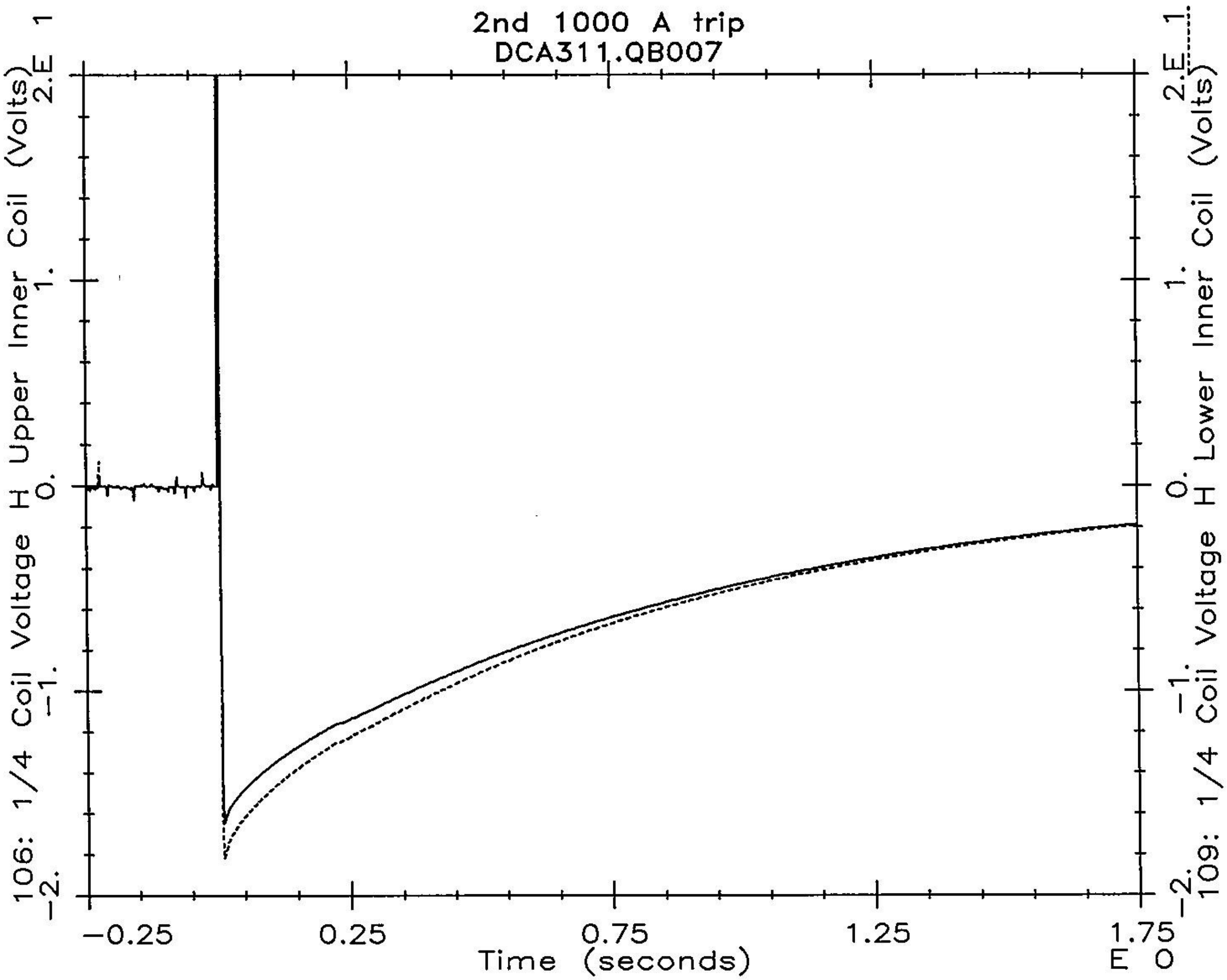


(Idot coil) / (dIshunt/dt))
DCA311.QB007
* LEGEND *
Idot/(dI/dt)
Average
1.220
1.200
1.180
1.160
1.140
1.120
1.100
1.080
1.060
1.040
1.020
1.000
0.980
0.960
0.940
0.920
0.900
0.880
0.860
0.840
0.820
0.800
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
t (sec)

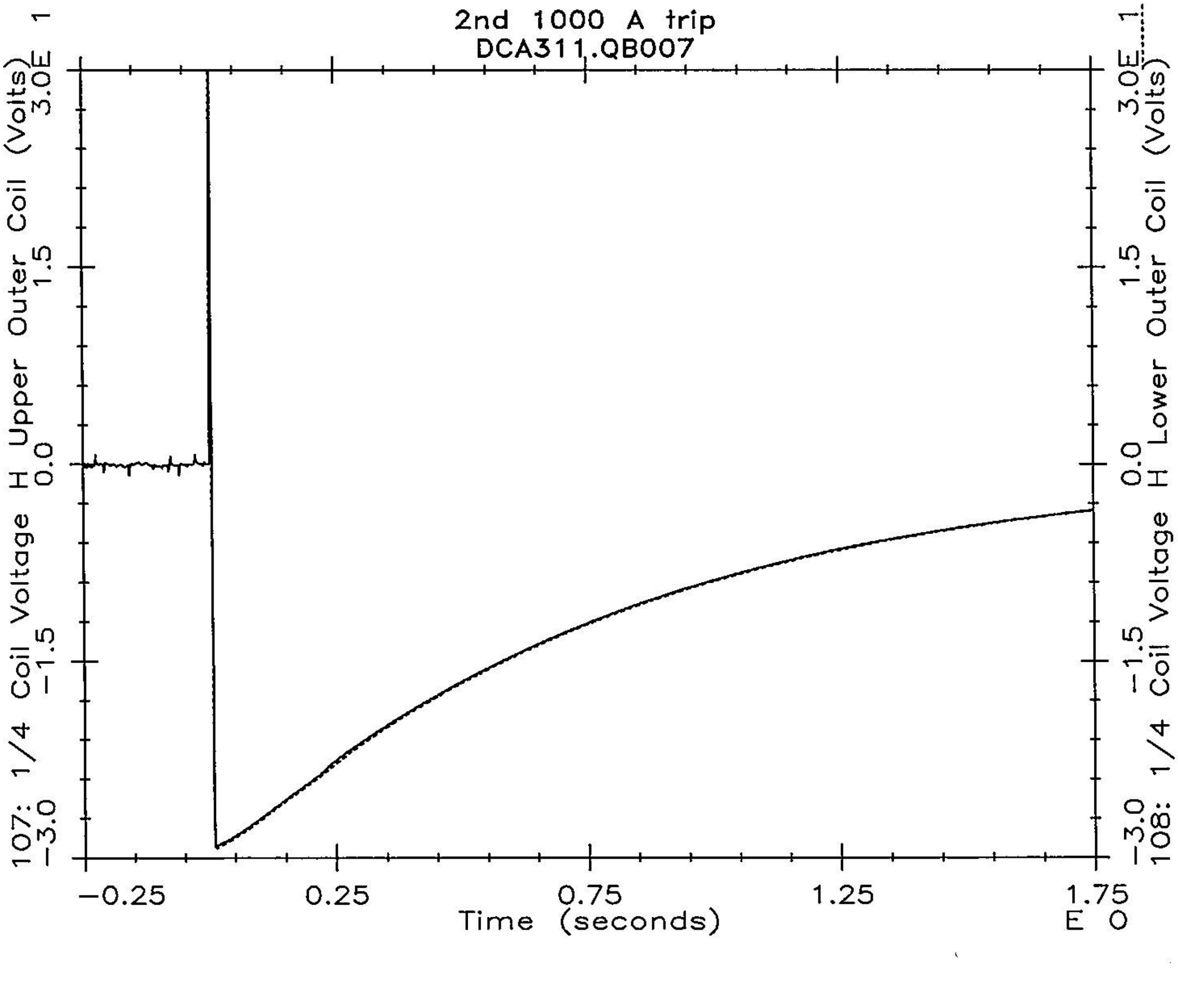


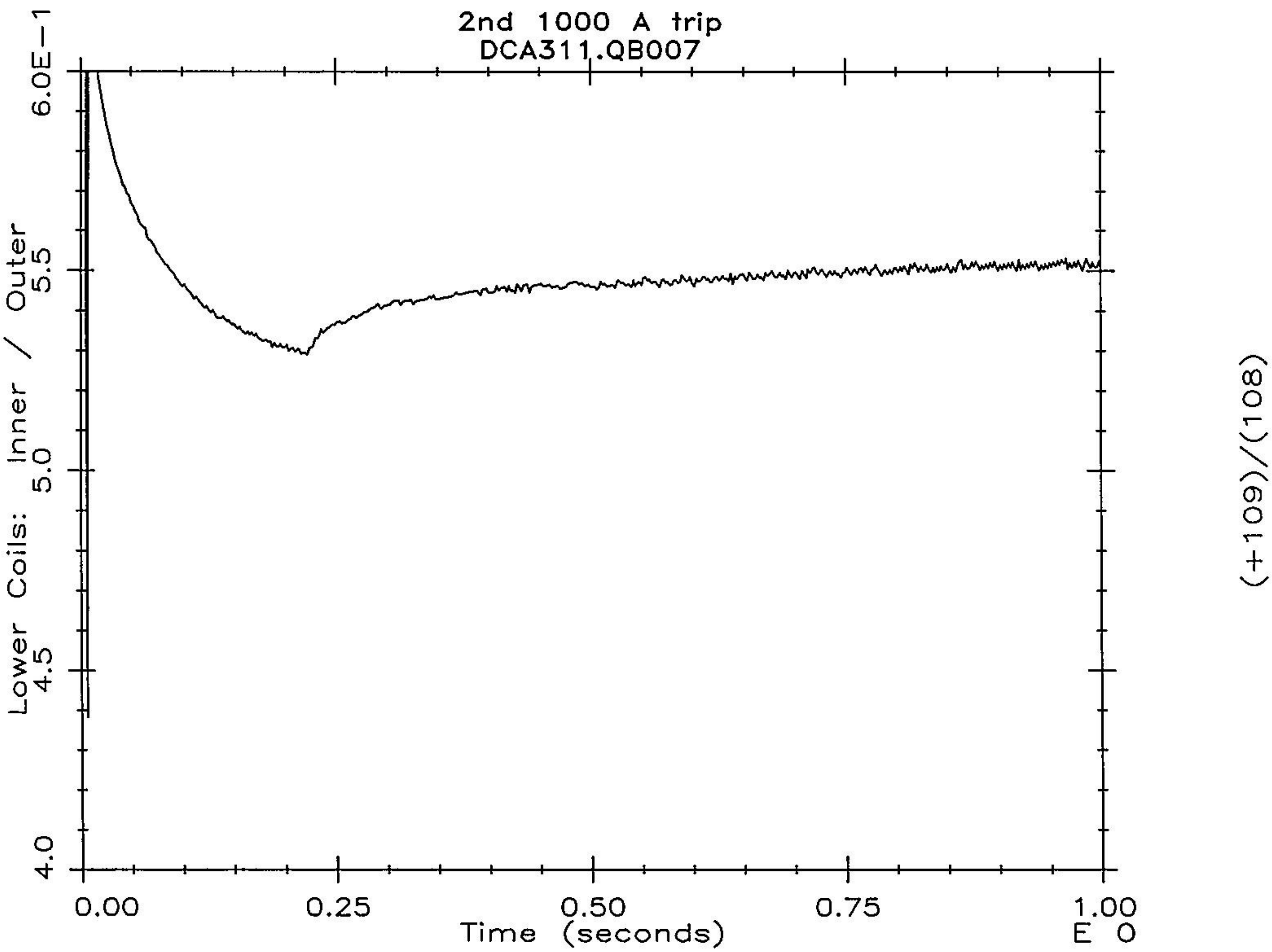
2nd 1000 A trip
DCA311.QB007
101: Main Coil Voltage Magnet (Volts)
0.00E 2
-0.25
-0.50
-0.75
-1.00
102: Idot Coil H Negative Buss (Amps/Sec)
0.0E 3
-0.4
-0.8
-1.2
-1.6
0.00
0.25
0.50
0.75
1.00
E 0
Time (seconds)

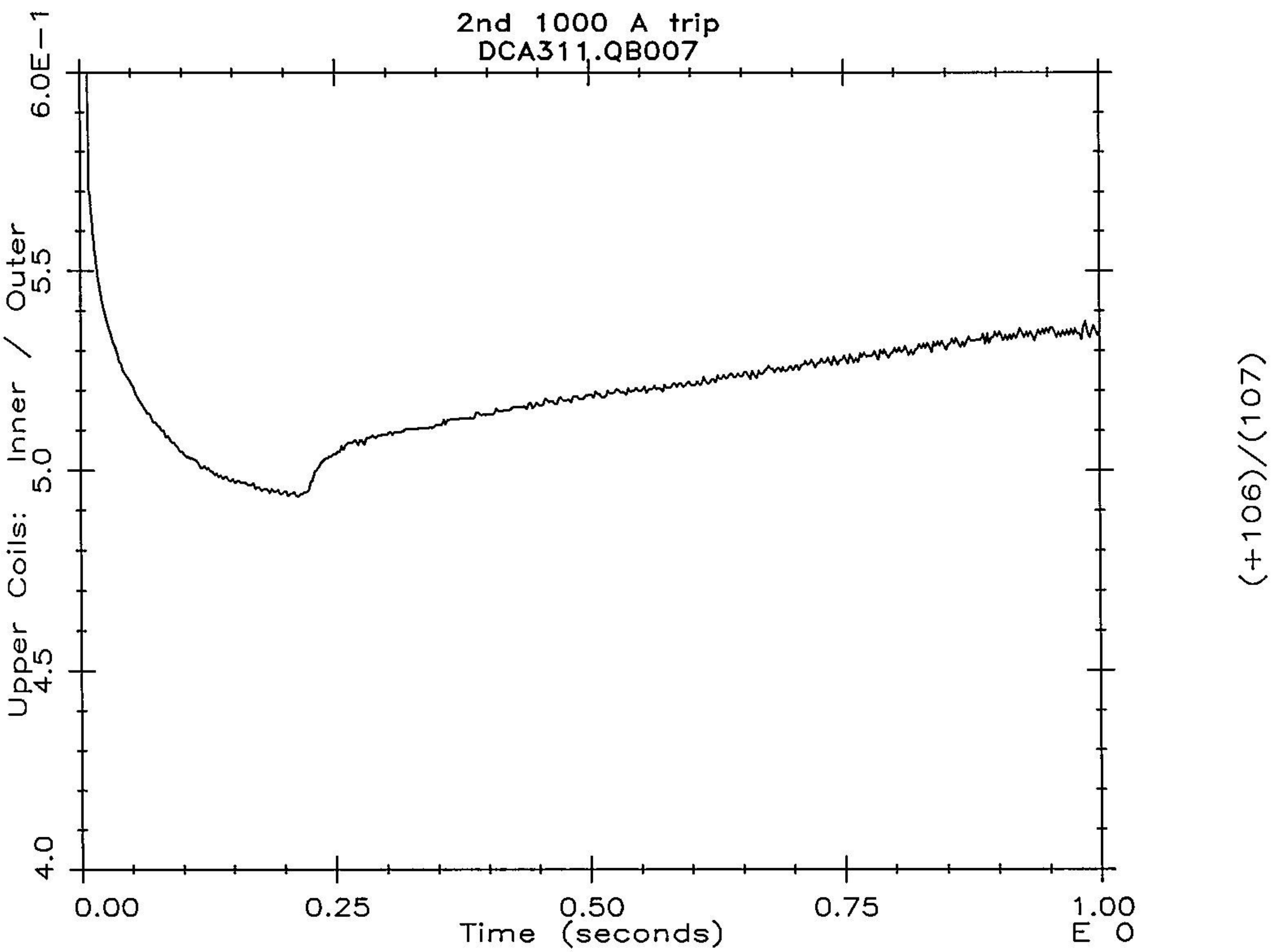

V(Magnet) / Idot
DCA311.QB007
0.086
0.085
0.084
0.083
0.082
0.081
0.080
0.079
0.078
0.077
0.076
0.075
0.074
0.073
0.072
0.071
0.070
0.069
0.068
0.067
0.066
0.065
0.064
0.063
0.062
0.061
0.060
0.059
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
t (sec)
* LEGEND *
V/Idot
Average



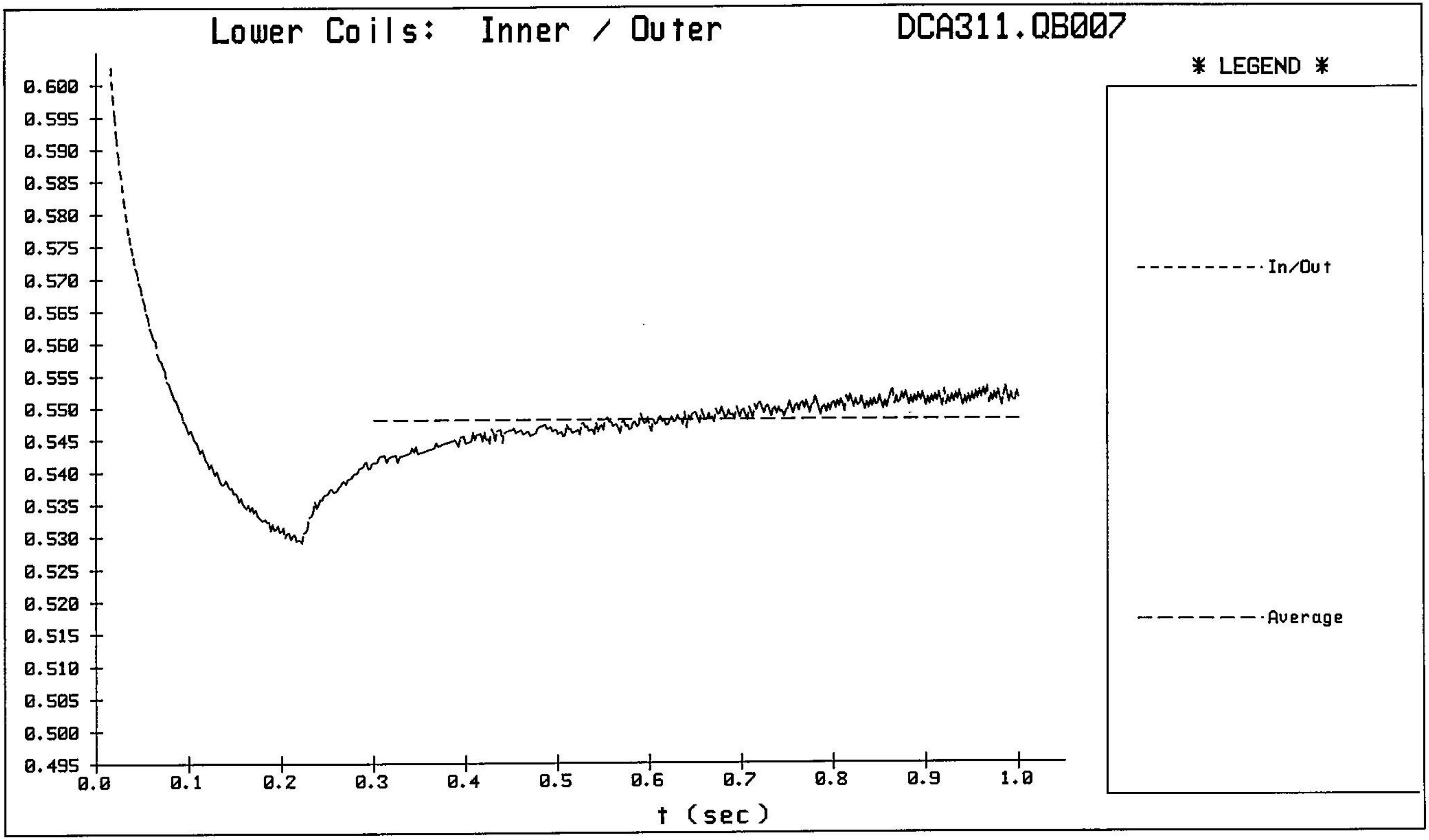
2nd 1000 A trip
DCA311.QB007
106: 1/4 Coil Voltage H Upper Inner Coil (Volts)
2.E 1
1.
0.
-1.
-2.
109: 1/4 Coil Voltage H Lower Inner Coil (Volts)
2.E 1
1.
0.
-1.
-2.
-0.25
0.25
0.75
1.25
1.75
Time (seconds)
E 0


2nd 1000 A trip
DCA311.QB007
107: 1/4 Coil Voltage H Upper Outer Coil (Volts)
108: 1/4 Coil Voltage H Lower Outer Coil (Volts)
3.0E 1
1.5
0.0
−1.5
−3.0
−0.25
0.25
0.75
1.25
1.75
Time (seconds)
E O


2nd 1000 A trip
DCA311.QB007
6.0E−1
5.5
5.0
4.5
4.0
Lower Coils: Inner / Outer
(+109)/(108)
0.00
0.25
0.50
0.75
1.00
E 0
Time (seconds)



2nd 1000 A trip
DCA311.QB007
6.0E-1
5.5
5.0
4.5
4.0
Upper Coils: Inner / Outer
0.00
0.25
0.50
0.75
1.00
E 0
Time (seconds)
(+106)/(107)


Lower Coils: Inner / Outer
DCA311.QB007
* LEGEND *
In/Out
Average
0.600
0.595
0.590
0.585
0.580
0.575
0.570
0.565
0.560
0.555
0.550
0.545
0.540
0.535
0.530
0.525
0.520
0.515
0.510
0.505
0.500
0.495
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
t (sec)