MEASUREMENT OF PULSED MAGNETIC FIELD REPRODUCIBILITY

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Introduction

In order to successfully develop a pulsed magnetic field NMR capability, it is necessary to understand the temporal behavior of the capacitor bank/magnet system. Two quantities of interest are the reproducibility of the peak field of the magnet for successive pulses and the time from pulse initiation to the peak field.

Experimental

A succession of pulses was measured on one of the 50 tesla 25mm bore magnets at a peak field of 40 tesla. The same charge voltage was selected for each of these pulses and the magnet was cooled to its base temperature before it was pulsed. There was no measure of the actual voltage on the bank at the time of pulsing. It was assumed that the time between reaching the bank charge voltage and the bank trigger signal was the same for each pulse. This is not strictly true, but the difference in time cannot be more than the control software processing time variations from one pulsing sequence to the next. Likely no more than a few milliseconds, which translates into the order of 1 volt uncertainty in the capacitor charge at firing time from pulse to pulse

Peak Field Measurements (RAW DATA)

Pulse No.	Pulse voltage	Peak Field	Time
1.	6.036	40.22	-----
2.	6.036	40.19	10:50
3.	6.036	40.16	12:16
4	6.036	40.19	13:27
5	6.036	40.17	14:29
5	6.036	40.20	15:20
7.	6.036	40.11	16:24
8.	6.036	40.18	17:21

If we throw out pulses 1 and 7 we can argue that we have 6 good pulses out of 8 that could yield NMR data. This would give and average field for these pulses of 40.18T with a standard deviation of 130 gauss.

The next question is the temporal location on the peak field relative to a trigger signal. By looking at the zero crossing times of the dB/dt signal that occurs at the peak field we can get an accurate measure of this time. The spread in crossing times observed from the above data was less than 2 microseconds. Note: the risetime of the Pulse 7.2 ms.

Another interesting measurement is the jitter between the bank firing signal and the data acquisition trigger. This was determined to be 40 Nanoseconds.