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CALIBRBITION OP HALL EFFECT INSTRUMENTATION FOR IBM

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SUBJECT

CALIBRATION OF HALL EFFECT INSTRUMENTATION
FOR IBM

NAME

Donald H. Nelson

DATE

May 16, 1980

Introduction

On May 12, 1980, I assisted See Young, IBM, San Jose, with the calibration of F.W. Bell Hall Effect instrumentation for use at the IBM plant in San Jose. Two Hall probes were calibrated in an NMR-calibrated electromagnet. I also demonstrated the extreme sensitivity of 2 F.W. Bell "Calibration" magnets to both external fields and the presence of ferromagnetic materials, and recommended using the internal calibration instead of a reference magnet.

Equipment

Table I identifies the IBM equipment tested. Table II lists the test equipment.

Procedure

1. Warm-up F.W. Bell Gaussmeter (2 hours required for best performance).
2. Place probe under test into mu-metal shield and adjust zero controls (coarse & fine) to obtain a zero reading on the most sensitive range.
3. Adjust the calibration controls (coarse & fine) so Gaussmeter output (on CAL) agrees with calibration constant stamped on probe.
4. Repeat 2 & 3 as required.
5. Measure Magnetic Field
 - a) with NMR (B_{NMR})
 - b) with Hall Probe (B_H)
 - (1) Maximum Positive Signal = B_{H1} *
 - (2) Maximum Negative Signal = B_{H2}
6. Compute error = $100(B_H - B_{NMR})/B_{NMR}$ (%)
7. Adjust calibration value for best results in region of interest and recheck.

Results

Table III lists results for two probes, each oriented to give both positive and negative signals with the selector switch set to normal.* (The magnitude of the displayed Gaussmeter signal did not change significantly with selector switch polarity).

Distribution: H.I. Green
E.C. Hartwig/L.J. Wagner/W.H. Deuser
S.C. Young (IBM)
Electronics Engineering Master File
Magnetic Measurements Engineering (4)

* See note, Table III, page 3

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<u>Device</u>	<u>Mfg.</u>	<u>Model No.</u>	<u>S/N</u>	<u>IBM No.</u>
Gaussmeter	F.W. Bell	811 A	85575	2633360
Probe	" "	T8031	69746	---
Probe	" "	HTL 8000	69576	---
Ref. Magnet	" "	VA073	85681	---
Ref. Magnet	" "	VB1839	123180	---

TABLE I Equipment Tested '80 May 12

<u>Device</u>	<u>Mfg.</u>	<u>Model No.</u>	<u>Identification</u>
12" D Magnet	Varian	V4012A	68-9210*
Regulated Power Supply	"	V2200A	68-9210*
NMR - Control Unit	LBL/CERN		010
Amplifier	"		10
Probe	"	Range 4	122

TABLE II Test Equipment

*U.C. Department of Mineral Technology

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Probe	Cal.	B_{NMR} (Gauss)	B_{H1} (Orientation 1)* (Gauss)	$\frac{\Delta B_{H1}}{B_{NMR}} \times 100$ (%)	B_{H2} (Orientation 2)* (Gauss)	$\frac{\Delta B_{H2}}{B_{NMR}} \times 100$ (%)	
Model T-8031 S/N 69746	7488	9728.5	9734	0.06	-9751	0.23	
	(stamped on probe)	9143.5	9147	0.04	-9165	0.24	
		7664.9	7671	0.08	-7680	0.20	
		6212.9	6217	0.07	-6224	0.18	
		4938.8	4941	0.04	-4945	0.13	
		4020.0	4021	0.02	-4023	0.07	
		3547.3	3548	0.02	-3551	0.10	
		9657.5	9660	0.03	-9682	0.25	
		7485	9658.0	9658	0.00	-9680	0.23
		(selected value)	8513.3	8514	0.01	-8534	0.24
		9063.5	9066	0.03	-9080	0.18	
Model HTL-8000 S/N 69576	7444	8438.8	8507	0.81	-8521	0.97	
	(stamped on probe)	8858.0	8931	0.82	-8944	0.97	
		9431.1	9510	0.84	-9525	1.00	
		7383	9431.5	9432	0.01	-9447	0.16
		(selected value)	8528.4	8528	0.00	-8540	0.14
			9017.4	9017	0.00	-9031	0.15
			3970.5	+3950	-0.52	-3954	-0.42

TABLE III Probe Calibration Data

*Note B_{H1} is the maximum positive signal and B_{H2} the maximum negative signal obtained while slowly rotating probes (about two axis). Values of B_{H2} are consistently higher than those of B_{H1} . Since the test magnet is very uniform, these differences cannot be explained by probe position errors. Since the magnitude of the calibration signal does not vary significantly when switching from normal (NOR) to reverse (REV), the differences are not due to unequal amplification of positive and negative signals. I am led to the conclusion that the differences are due either to unequal magnitudes of Hall-voltage or unequal gains in detection of the Hall-voltage for the two polarities.

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