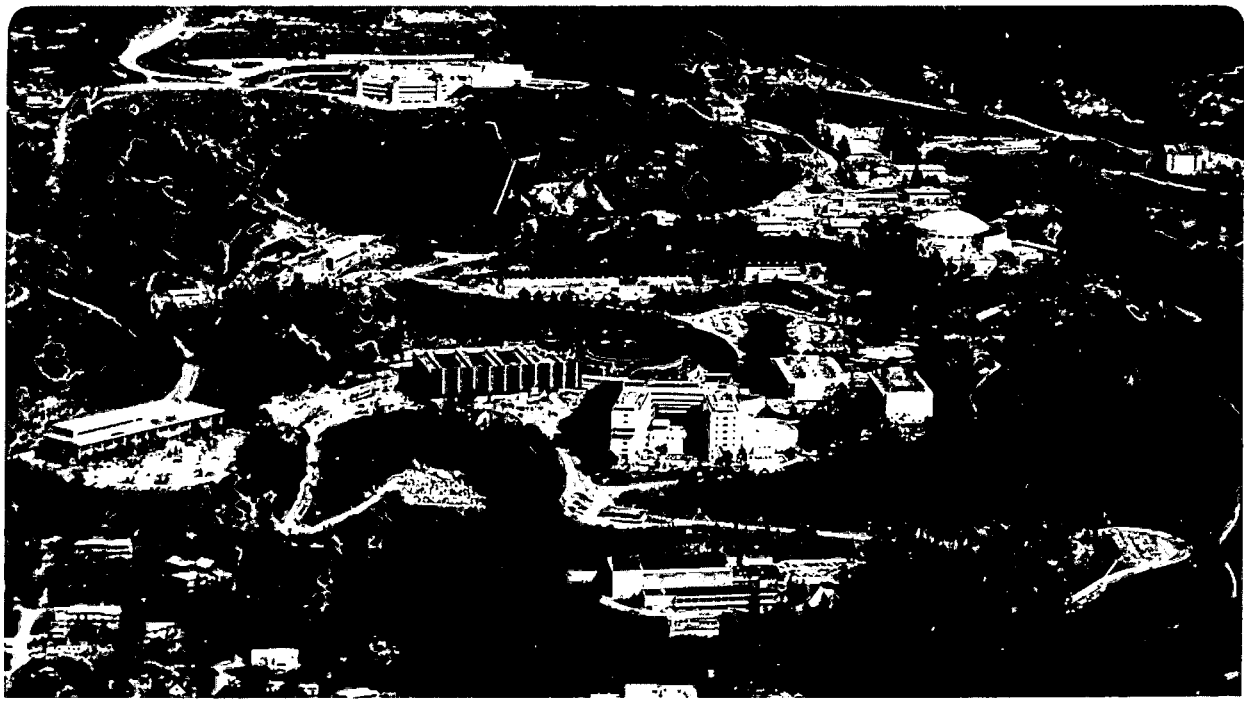
Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

Engineering & Technical Services Division

For Reference

Not to be taken from this room



DISCLAIMER

LAWRENCE BERKELEY LABORATORY - UNIVERSITY OF CALIFORNIA
ENGINEERING NOTE

Book No. 477 | FILE NO. MT - 288 | PAGE 1 of 3

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: M.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

LAWRENCE BERKELEY LABORATORY - UNIVERSITY OF CALIFORNIA
ENGINEERING NOTE

Book No. 477 | FILE NO. MT - 288 | PAGE 2 of 3

SUBJECT
CALIBRATION OF HALL EFFECT INSTRUMENTATION FOR IBM

NAME Donald H. Nelson

DATE May 16, 1980

Device	Mfg.	Model No.	S/N	IBM No.
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

Device	Mfg.	Model No.	Identification
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

This work was supported by the U.S. Dept. of Energy under Contract DE-AC03-76SF00098.

Probe	Cal.	B_{NMR} (Gauss)	B_{H1} (Orientation 1)* (Gauss)	$\frac{\Delta B_{H1}}{B_{H1} - B_{NMR}} \times 100$ (%)	B_{H2} (Orientation 2)* (Gauss)	$\frac{\Delta B_{H2}}{\lvert B_{H2} \rvert - B_{NMR}} \times 100$ (%)
Model T-8031 S/N 69746	7488 (stamped on probe)	9728.5	9734	0.06	-9751	0.23
		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 (selected value)	9658.0	9658	0.00	-9680	0.23
		8513.3	8514	0.01	-8534	0.24
		9063.5	9066	0.03	-9080	0.18
Model HTL-8000 S/N 69576	7444 (stamped on probe)	8438.8	8507	0.81	-8521	0.97
		8858.0	8931	0.82	-8944	0.97
		9431.1	9510	0.84	-9525	1.00
	7383 (selected value)	9431.5	9432	0.01	-9447	0.16
		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.

LAWRENCE BERKELEY LABORATORY - UNIVERSITY OF CALIFORNIA
ENGINEERING NOTE
Book No. 477
SUBJECT: CALIBRATION OF HALL EFFECT INSTRUMENTATION FOR IBM
FILE NO. MT - 283
PAGE 3 of 3
NAME Donald H. Nelson
DATE May 16, 1980

LBID-504

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U.S. Department of Energy to the exclusion of others that may be suitable.

TECHNICAL INFORMATION DEPARTMENT
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720