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Title

FIXING"" OF FOUR MORE RARE EARTH QUADRUPOLE MAGNETS BY THE AHLBACH TECHNIQUE

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7466

SUBJECT

"FIXING" of Four More Rare Earth Quadrupole Magnets
By The Halbach Technique

NAME

Michael I. Green

DATE

March 1, 1982

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*Appendices will be supplied upon request only.

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INTRODUCTION

Los Alamos National Laboratory requested that the Magnetic Measurements Engineering (MME) Group of the Lawrence Berkeley Laboratory (LBL) evaluate the error harmonics of four segmented Rare Earth Cobalt (REC) quadrupole magnets, and reduce undesired harmonics.

Using the procedure reported in LBL Electronics Engineering Note, MT 308,¹ the amplitudes of the third, fourth, fifth, and real part of the sixth harmonic were all reduced to below 0.1% of the fundamental amplitude.

DESCRIPTION OF QUADRUPOLES

The quadrupoles are identified as P/N 62, 62-1, 62-2, and 62-3. For record purposes, the quadrupole identified as P/N 62 was renamed S/N 62-0. Although the physics of the design of these quadrupoles appears identical to that reported earlier, the mechanical design is different. The sideways tolerances of the magnetic blocks is really excellent and may be the reason why only one of the four quadrupoles needed a second run.

I would recommend that the inner ring not be stamped with the pole number as the stamping results in deformations that loosen the tolerances between the inner ring and the magnet blocks. Also, the inside diameter of the inner ring was deformed such that the quadrupoles would not slide completely onto our mounting jig, requiring slight machining of the jig.

HARDWARE AND SOFTWARE

The hardware and software are essentially the same as reported earlier with the following exceptions.

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Minimal alphanumeric characters have been added to the plot of the raw data and the LSI-11/23 microprocessor was used instead of the LSI-11/2.

Appendix A (which will be supplied upon request) is a directory to the disks and programs used for these measurements and those reported upon in engineering note MT 308.

RESULTS

The results of this program are summarized in Table I. The amplitudes of the third, fourth, fifth, and real part of the sixth harmonic for each quadrupole were reduced to below 0.1% of the fundamental amplitude. The shim schedules used to "fix" the quadrupoles is given in Table II.

One might ask if there is a worsening of the higher harmonics after "fixing" the third through sixth harmonics. A perusal of the amplitudes of the seventh through eighteenth harmonics does not reveal any strong systematic tendency. It appears that they are just as likely to increase as decrease and the change is not strongly dependent upon the harmonic number. Typically, harmonics above the fourteenth are in the noise level.

Appendix B (which will be supplied upon request) contains computer output of the measurements and the shim calculation program.

ACKNOWLEDGEMENTS

My thanks to Don Nelson for his suggestions and editing of this note.

REFERENCE

1. M.I. Green, LBL Electronics Engineering Note MT 308, January 7, 1982.

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Quad. S/N	Data Set	Shim Sched.	B3/B2 (%)	B4/B2 (%)	B5/B2 (%)	Re B6/B2 (%)
62-0	02250A	none	1.246	1.043	0.684	1.948
▪	02250B	1	0.065	0.080	0.126	0.018
▪	02250C	2	0.039	0.022	0.014	0.009
62-1	02251A	none	1.381	1.559	1.257	1.353
▪	02251B	3	0.046	0.071	0.029	0.007
62-2	02252A	none	0.423	0.423	0.484	2.444
▪	02252B	4	0.037	0.072	0.026	0.015
62-3	02253A	none	0.376	0.254	0.602	1.916
▪	02253B	5	0.058	0.009	0.014	0.031

TABLE I Error Harmonic Ratios

Quadrupole S/N	Data Set	Shim Schedule	Pole 0	Pole 1	Pole 2	Pole 3	Pole 4	Pole 5	Pole 6	Pole 7
62-0	02250B	1	26	27	18	30	1	17	0	46
62-0	02250C	2	25	27	17	29	1	15	0	48
62-1	02251B	3	21	41	48	47	0	40	20	15
62-2	02252B	4	5	23	0	29	5	35	0	19
62-3	02253B	5	10	20	6	31	1	22	0	18

TABLE II Shim Schedule (mils)

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

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NAME Michael I. Green

DATE March 1, 1982

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Magnetic Measurements Engineering (4)
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*Appendices Included

SUBJECT

"FIXING" of Four More Rare Earth Quadrupole Magnets
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Page	Disk No.	Contents
A2	MG 33	LSI-11/2 FORTRAN source and object module files, backup disk.
A3	MG 35	LSI-11/2 load modules and data files, backup disk.
A4	MG 38	LSI-11/23 load modules and all data files, backup disk.
A5	MG 39	LSI-11/23 FORTRAN source and object module files, backup disk.
A6	MME 16	LSI-11/2 operating system disk.
A7	MME 37	LSI-11/2 FORTRAN source and object module files, working disk.
A8	MME 38	LSI-11/2 load modules and data files, working disk.
A9	MME 39	LSI-11/23 operating system disk.
A10	MME 41	LSI-11/23 FORTRAN source and object module files, working disk.
A11	MME 42	LSI-11/23 load modules and data files, working disk.
A12	MME 43	LSI-11/23 FORTRAN source and object module files, working disk.

APPENDIX A
Disk and Program Directory

Page	Disk No.	Contents
A2	MG 33	LSI-11/2 FORTRAN source and object module files, backup disk.
A3	MG 35	LSI-11/2 load modules and data files, backup disk.
A4	MG 38	LSI-11/23 load modules and all data files, backup disk.
A5	MG 39	LSI-11/23 FORTRAN source and object module files, backup disk.
A6	MME 16	LSI-11/2 operating system disk.
A7	MME 37	LSI-11/2 FORTRAN source and object module files, working disk.
A8	MME 38	LSI-11/2 load modules and data files, working disk.
A9	MME 39	LSI-11/23 operating system disk.
A10	MME 41	LSI-11/23 FORTRAN source and object module files, working disk.
A11	MME 42	LSI-11/23 load modules and data files, working disk.
A12	MME 43	LSI-11/23 FORTRAN source and object module files, working disk.

APPENDIX A
Disk and Program Directory

LAWRENCE BERKELEY LABORATORY · UNIVERSITY OF CALIFORNIA
ENGINEERING NOTE

Book No. 643
Appendix A

FILE NO.
MT 313

PAGE
A1 of A12

SUBJECT

"FIXING" of Four More Rare Earth Quadrupole Magnets
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01-Mar-82			
ARRAY .FOR	6	01-Dec-79	FL10LB.OBJ 303 26-Mar-81
BELL1 .FOR	2	12-Jun-81	FMTRX1.DAT 2 29-Dec-81
BELL1 .OBJ	6	27-Jul-81	QDADJ1.FOR 11 31-Dec-81
CMCVFT.SAV	25	05-Aug-81	QDADJ1.LST 18 31-Dec-81
DASDM1.TXT	3	03-Oct-81	QDADJ1.OBJ 12 31-Dec-81
DEVTBL.TXT	1	29-Apr-81	QDADJ1.SAV 32 31-Dec-81
DP2NTG.FOR	3	24-Jun-81	QDADJ2.BAK 14 30-Dec-81
DP2NTG.OBJ	7	27-Jul-81	QDADJ2.FOR 14 31-Dec-81
DRFTC .FOR	3	15-Jun-81	QDADJ2.LST 21 31-Dec-81
DRFTC .OBJ	6	27-Jul-81	QDADJ2.OBJ 13 31-Dec-81
F4FFT .OBJ	4	19-May-80	QDADJ2.SAV 35 31-Dec-81
G .COM	1	18-Dec-81	QDANAL.FOR 11 22-Dec-81
GMADD .FOR	3	01-Dec-79	QDANAL.LST 19 22-Dec-81
GMPRD .FOR	3	01-Dec-79	QDANAL.OBJ 15 22-Dec-81
GMPRD .LST	6	23-Dec-81	QDANAL.SAV 90 22-Dec-81
GMPRD .OBJ	5	23-Dec-81	QDSBR .FOR 3 22-Dec-81
GMSUB .FOR	3	01-Dec-79	QDSBR .LST 6 22-Dec-81
GMTRA .FOR	3	01-Dec-79	QDSBR .OBJ 6 22-Dec-81
GPIB .OBJ	11	29-Apr-81	RDATA .FOR 5 12-Jun-81
GTPRD .FOR	3	01-Dec-79	RDATA .OBJ 6 27-Jul-81
HRDWR .FOR	3	12-Jun-81	RTRV2 .FOR 5 22-Dec-81
HRDWR .OBJ	5	27-Jul-81	RTRV2 .LST 8 22-Dec-81
INIT .FOR	3	21-Dec-81	RTRV2 .OBJ 7 22-Dec-81
INIT .LST	6	21-Dec-81	SAVE0 .FOR 4 22-Dec-81
INIT .OBJ	5	21-Dec-81	SAVE0 .LST 7 22-Dec-81
LOC .FOR	4	01-Dec-79	SAVE0 .OBJ 6 22-Dec-81
MADD .FOR	6	01-Dec-79	SAVE2 .FOR 5 22-Dec-81
MINV .FOR	8	01-Dec-79	SAVE2 .LST 8 22-Dec-81
MTRTST.FOR	6	29-Dec-81	SAVE2 .OBJ 7 22-Dec-81
MTRTST.LST	9	29-Dec-81	SCALE .FOR 3 22-May-81
MTRTST.OBJ	7	29-Dec-81	SCALE .OBJ 5 27-Jul-81
MTRTST.SAV	25	29-Dec-81	SCOIL1.FOR 4 27-May-81
NMTRX1.DAT	2	29-Dec-81	SCOIL1.OBJ 7 27-Jul-81
PHAMPL.OBJ	2	19-May-80	SCOIL1.TXT 2 29-May-81
PLOT1 .FOR	2	19-Jun-81	SCOIL2.FOR 1 27-Jul-81
PLOT1 .OBJ	5	27-Jul-81	1228A1.DAT 2 29-Dec-81

72 Files, 919 Blocks
 55 Free blocks

01-Mar-82

CMCVFT.SAV	25	05-Aug-81	1230B5.DAT	2	30-Dec-81
DASDM1.TXT	3	03-Oct-81	1230B6.DAT	2	30-Dec-81
DSKDIR.TXT	1	29-Dec-81	1230B7.DAT	2	30-Dec-81
MTRTST.SAV	25	29-Dec-81	1230B8.DAT	2	30-Dec-81
NMTRX1.DAT	2	29-Dec-81	1230C1.DAT	2	30-Dec-81
FMTRX1.DAT	2	29-Dec-81	1230C2.DAT	2	30-Dec-81
QDADJ1.SAV	32	31-Dec-81	1230C3.DAT	2	30-Dec-81
QDADJ2.SAV	35	31-Dec-81	1230C4.DAT	2	30-Dec-81
QDANAL.SAV	90	22-Dec-81	1230C5.DAT	2	30-Dec-81
REPRT1.BAK	4	06-Jan-81	1230C6.DAT	2	30-Dec-81
REPRT1.TXT	6	07-Jan-81	1230C7.DAT	2	30-Dec-81
1229A1.DAT	2	29-Dec-81	1230C8.DAT	2	30-Dec-81
1229A2.DAT	2	29-Dec-81	1230D1.DAT	2	30-Dec-81
1229A3.DAT	2	29-Dec-81	1230D2.DAT	2	30-Dec-81
1229A4.DAT	2	29-Dec-81	1230D3.DAT	2	30-Dec-81
1229A5.DAT	2	29-Dec-81	1230D4.DAT	2	30-Dec-81
1229A6.DAT	2	29-Dec-81	1230D5.DAT	2	30-Dec-81
1229A7.DAT	2	29-Dec-81	1230D6.DAT	2	30-Dec-81
1230A1.DAT	2	30-Dec-81	1230D7.DAT	2	30-Dec-81
1230A2.DAT	2	30-Dec-81	1230D8.DAT	2	30-Dec-81
1230A3.DAT	2	30-Dec-81	1230E1.DAT	2	30-Dec-81
1230A4.DAT	2	30-Dec-81	1231A1.DAT	2	31-Dec-81
1230A5.DAT	2	30-Dec-81	1231A2.DAT	2	31-Dec-81
1230A6.DAT	2	30-Dec-81	1231A3.DAT	2	31-Dec-81
1230A7.DAT	2	30-Dec-81	1231A4.DAT	2	31-Dec-81
1230A8.DAT	2	30-Dec-81	1231A5.DAT	2	31-Dec-81
1230B1.DAT	2	30-Dec-81	1231B1.DAT	2	31-Dec-81
1230B2.DAT	2	30-Dec-81	1231B2.DAT	2	31-Dec-81
1230B3.DAT	2	30-Dec-81	1231B3.DAT	2	31-Dec-81
1230B4.DAT	2	30-Dec-81	1231B4.DAT	2	31-Dec-81

60 Files, 323 Blocks
651 Free blocks

MG 35

LSI-11/2 Load Modules and Data Files,
Backup Disk

01-Mar-82
CMCVFT.SAV 25 05-Aug-81 1230B3.DAT 2 30-Dec-81
NMTRX1.DAT 2 29-Dec-81 1230B4.DAT 2 30-Dec-81
FMTRX1.DAT 2 29-Dec-81 1230B5.DAT 2 30-Dec-81
QDADJ1.SAV 33 20-Jan-82 1230B6.DAT 2 30-Dec-81
QDADJ2.SAV 36 20-Jan-82 1230B7.DAT 2 30-Dec-81
QDANAL.SAV 100 23-Feb-82 1230B8.DAT 2 30-Dec-81
02250A.DAT 2 25-Feb-82 1230C1.DAT 2 30-Dec-81
02250B.DAT 2 25-Feb-82 1230C2.DAT 2 30-Dec-81
02250C.DAT 2 25-Feb-82 1230C3.DAT 2 30-Dec-81
02251A.DAT 2 25-Feb-82 1230C4.DAT 2 30-Dec-81
02251B.DAT 2 25-Feb-82 1230C5.DAT 2 30-Dec-81
02252A.DAT 2 25-Feb-82 1230C6.DAT 2 30-Dec-81
02252B.DAT 2 25-Feb-82 1230C7.DAT 2 30-Dec-81
02253A.DAT 2 25-Feb-82 1230C8.DAT 2 30-Dec-81
02253B.DAT 2 25-Feb-82 1230D1.DAT 2 30-Dec-81
1229A1.DAT 2 29-Dec-81 1230D2.DAT 2 30-Dec-81
1229A2.DAT 2 29-Dec-81 1230D3.DAT 2 30-Dec-81
1229A3.DAT 2 29-Dec-81 1230D4.DAT 2 30-Dec-81
1229A4.DAT 2 29-Dec-81 1230D5.DAT 2 30-Dec-81
1229A5.DAT 2 29-Dec-81 1230D6.DAT 2 30-Dec-81
1229A6.DAT 2 29-Dec-81 1230D7.DAT 2 30-Dec-81
1229A7.DAT 2 29-Dec-81 1230D8.DAT 2 30-Dec-81
1230A1.DAT 2 30-Dec-81 1230E1.DAT 2 30-Dec-81
1230A2.DAT 2 30-Dec-81 1231A1.DAT 2 31-Dec-81
1230A3.DAT 2 30-Dec-81 1231A2.DAT 2 31-Dec-81
1230A4.DAT 2 30-Dec-81 1231A3.DAT 2 31-Dec-81
1230A5.DAT 2 30-Dec-81 1231A4.DAT 2 31-Dec-81
1230A6.DAT 2 30-Dec-81 1231A5.DAT 2 31-Dec-81
1230A7.DAT 2 30-Dec-81 1231B1.DAT 2 31-Dec-81
1230A8.DAT 2 30-Dec-81 1231B2.DAT 2 31-Dec-81
1230B1.DAT 2 30-Dec-81 1231B3.DAT 2 31-Dec-81
1230B2.DAT 2 30-Dec-81 1231B4.DAT 2 31-Dec-81
64 Files, 314 Blocks
660 Free blocks

MG 38 LSI-11/23 Load Modules and All
Data Files, Backup Disk

01-Mar-82

BELL1 .FOR	2	12-Jun-81	QDADJ1.LST	18	19-Jan-82
BELL1 .LST	3	19-Jan-82	QDADJ1.OBJ	17	19-Jan-82
BELL1 .OBJ	7	19-Jan-82	QDADJ1.SAV	33	20-Jan-82
DP2NTG.FOR	3	24-Jun-81	QDADJ2.FOR	14	31-Dec-81
DP2NTG.LST	6	19-Jan-82	QDADJ2.LST	21	19-Jan-82
DP2NTG.OBJ	9	19-Jan-82	QDADJ2.OBJ	20	19-Jan-82
DRFTC .FOR	3	15-Jun-81	QDADJ2.SAV	36	20-Jan-82
DRFTC .LST	6	19-Jan-82	QDANAL.FOR	11	22-Dec-81
DRFTC .OBJ	8	19-Jan-82	QDANAL.LST	19	19-Jan-82
F4FFT .OBJ	4	19-May-80	QDANAL.OBJ	20	19-Jan-82
G .COM	1	19-Jan-82	QDSBR .FOR	3	22-Dec-81
GMPRD .FOR	3	01-Dec-79	QDSBR .LST	6	19-Jan-82
GMPRD .LST	6	19-Jan-82	QDSBR .OBJ	7	19-Jan-82
GMPRD .OBJ	7	19-Jan-82	RDATA .FOR	5	19-Jan-82
HRDWR .FOR	3	19-Jan-82	RDATA .LST	8	19-Jan-82
HRDWR .LST	7	19-Jan-82	RDATA .OBJ	8	19-Jan-82
HRDWR .OBJ	8	19-Jan-82	RTRV2 .FOR	5	22-Dec-81
INIT .FOR	4	22-Feb-82	RTRV2 .LST	8	19-Jan-82
INIT .LST	6	22-Feb-82	RTRV2 .OBJ	9	19-Jan-82
INIT .OBJ	7	22-Feb-82	SAVE0 .FOR	4	22-Dec-81
MTRTST.FOR	6	29-Dec-81	SAVE0 .LST	7	19-Jan-82
MTRTST.LST	9	19-Jan-82	SAVE0 .OBJ	8	19-Jan-82
MTRTST.OBJ	10	19-Jan-82	SAVE2 .FOR	5	22-Dec-81
NMTRX1.DAT	2	29-Dec-81	SAVE2 .LST	8	19-Jan-82
O .COM	1	23-Feb-82	SAVE2 .OBJ	10	19-Jan-82
PHAMPL.OBJ	2	19-May-80	SCALE .FOR	3	22-May-81
PLOT1 .FOR	4	23-Feb-82	SCALE .LST	5	19-Jan-82
PLOT1 .LST	8	23-Feb-82	SCALE .OBJ	6	19-Jan-82
PLOT1 .OBJ	9	23-Feb-82	SCOIL1.FOR	4	27-May-81
PL10LB.OBJ	384	18-Jan-82	SCOIL1.LST	7	19-Jan-82
PMTRX1.DAT	2	29-Dec-81	SCOIL1.OBJ	9	19-Jan-82
QDADJ1.FOR	11	31-Dec-81	SCOIL1.TXT	2	29-May-81

64 Files, 897 Blocks
77 Free blocks

01-Mar-82

BA	.SYS	7P	01-Mar-80	LS	.SYS	2P	01-Mar-80
BINCOM	.SAV	10P	01-Mar-80	MACRO	.SAV	51P	01-Mar-80
CREF	.SAV	6P	01-Mar-80	NL	.SYS	2P	01-Mar-80
D	.COM	1P	29-Jan-80	PIP	.SAV	23P	01-Mar-80
DIR	.SAV	17P	01-Mar-80	RESORC	.SAV	15P	01-Mar-80
DUMP	.SAV	8P	01-Mar-80	RT11SJ	.SYS	67P	01-Mar-80
DUP	.SAV	41P	01-Mar-80	SETDAT	.SAV	2P	08-Jan-82
DY	.SYS	4P	01-Mar-80	SRCCOM	.SAV	13P	01-Mar-80
FORMAT	.SAV	19P	01-Mar-80	STARTS	.COM	1P	08-Jan-81
FORTRA	.SAV	176P	12-Feb-81	SWAP	.SYS	25P	01-Mar-80
K52	.SAV	55P	01-Mar-80	SYSLIB	.OBJ	200P	13-Feb-81
LIBR	.SAV	22P	01-Mar-80	SYSMAC	.SML	42P	01-Mar-80
LINK	.SAV	41P	01-Mar-80	TT	.SYS	2P	01-Mar-80

26 Files, 852 Blocks
122 Free blocks

MME 16 LSI-11/2 Operating System Disk

01-Mar-82					
ARRAY .FOR	6	01-Dec-79	FL10LR.OBJ	303	26-Mar-81
BELL1 .FOR	2	12-Jun-81	FMTRX1.DAT	2	29-Dec-81
BELL1 .OBJ	6	27-Jul-81	QDADJ1.FOR	11	31-Dec-81
CMCVFT.SAV	25	05-Aug-81	QDADJ1.LST	18	31-Dec-81
DASIM1.TXT	3	03-Oct-81	QDADJ1.OBJ	12	31-Dec-81
DEVTBL.TXT	1	29-Apr-81	QDADJ1.SAV	32	31-Dec-81
DP2NTG.FOR	3	24-Jun-81	QDADJ2.BAK	14	30-Dec-81
DP2NTG.OBJ	7	27-Jul-81	QDADJ2.FOR	14	31-Dec-81
DRFTC .FOR	3	15-Jun-81	QDADJ2.LST	21	31-Dec-81
DRFTC .OBJ	6	27-Jul-81	QDADJ2.OBJ	13	31-Dec-81
F4FFT .OBJ	4	19-May-80	QDADJ2.SAV	35	31-Dec-81
G .COM	1	18-Dec-81	QDANAL.FOR	11	22-Dec-81
GMADD .FOR	3	01-Dec-79	QDANAL.LST	19	22-Dec-81
GMPRD .FOR	3	01-Dec-79	QDANAL.OBJ	15	22-Dec-81
GMPRD .LST	6	23-Dec-81	QDANAL.SAV	90	22-Dec-81
GMPRD .OBJ	5	23-Dec-81	QDSBR .FOR	3	22-Dec-81
GMSUB .FOR	3	01-Dec-79	QDSBR .LST	6	22-Dec-81
GMTRA .FOR	3	01-Dec-79	QDSBR .OBJ	6	22-Dec-81
GPIB .OBJ	11	29-Apr-81	RDATA .FOR	5	12-Jun-81
GTPRD .FOR	3	01-Dec-79	RDATA .OBJ	6	27-Jul-81
HRDWR .FOR	3	12-Jun-81	RTRV2 .FOR	5	22-Dec-81
HRDWR .OBJ	5	27-Jul-81	RTRV2 .LST	8	22-Dec-81
INIT .FOR	3	21-Dec-81	RTRV2 .OBJ	7	22-Dec-81
INIT .LST	6	21-Dec-81	SAVE0 .FOR	4	22-Dec-81
INIT .OBJ	5	21-Dec-81	SAVE0 .LST	7	22-Dec-81
LOC .FOR	4	01-Dec-79	SAVE0 .OBJ	6	22-Dec-81
MADD .FOR	6	01-Dec-79	SAVE2 .FOR	5	22-Dec-81
MINV .FOR	8	01-Dec-79	SAVE2 .LST	8	22-Dec-81
MTRTST.FOR	6	29-Dec-81	SAVE2 .OBJ	7	22-Dec-81
MTRTST.LST	9	29-Dec-81	SCALE .FOR	3	22-May-81
MTRTST.OBJ	7	29-Dec-81	SCALE .OBJ	5	27-Jul-81
MTRTST.SAV	25	29-Dec-81	SCOIL1.FOR	4	27-May-81
NMTRX1.DAT	2	29-Dec-81	SCOIL1.OBJ	7	27-Jul-81
PHAMPL.OBJ	2	19-May-80	SCOIL1.TXT	2	29-May-81
PLOT1 .FOR	2	19-Jun-81	SCOIL2.FOR	1	27-Jul-81
PLOT1 .OBJ	5	27-Jul-81	1228A1.DAT	2	29-Dec-81

72 Files, 919 Blocks

55 Free blocks

01-Mar-82

CMCVFT.SAV	25	05-Aug-81	1230B5.DAT	2	30-Dec-81
DASDM1.TXT	3	03-Oct-81	1230B6.DAT	2	30-Dec-81
DSKDIR.TXT	1	29-Dec-81	1230B7.DAT	2	30-Dec-81
MTRTST.SAV	25	29-Dec-81	1230B8.DAT	2	30-Dec-81
NMTRX1.DAT	2	29-Dec-81	1230C1.DAT	2	30-Dec-81
PMTRX1.DAT	2	29-Dec-81	1230C2.DAT	2	30-Dec-81
QDADJ1.SAV	32	31-Dec-81	1230C3.DAT	2	30-Dec-81
QDADJ2.SAV	35	31-Dec-81	1230C4.DAT	2	30-Dec-81
QDANAL.SAV	90	22-Dec-81	1230C5.DAT	2	30-Dec-81
REPRT1.BAK	4	06-Jan-81	1230C6.DAT	2	30-Dec-81
REPRT1.TXT	6	07-Jan-81	1230C7.DAT	2	30-Dec-81
1229A1.DAT	2	29-Dec-81	1230C8.DAT	2	30-Dec-81
1229A2.DAT	2	29-Dec-81	1230D1.DAT	2	30-Dec-81
1229A3.DAT	2	29-Dec-81	1230D2.DAT	2	30-Dec-81
1229A4.DAT	2	29-Dec-81	1230D3.DAT	2	30-Dec-81
1229A5.DAT	2	29-Dec-81	1230D4.DAT	2	30-Dec-81
1229A6.DAT	2	29-Dec-81	1230D5.DAT	2	30-Dec-81
1229A7.DAT	2	29-Dec-81	1230D6.DAT	2	30-Dec-81
1230A1.DAT	2	30-Dec-81	1230D7.DAT	2	30-Dec-81
1230A2.DAT	2	30-Dec-81	1230D8.DAT	2	30-Dec-81
1230A3.DAT	2	30-Dec-81	1230E1.DAT	2	30-Dec-81
1230A4.DAT	2	30-Dec-81	1231A1.DAT	2	31-Dec-81
1230A5.DAT	2	30-Dec-81	1231A2.DAT	2	31-Dec-81
1230A6.DAT	2	30-Dec-81	1231A3.DAT	2	31-Dec-81
1230A7.DAT	2	30-Dec-81	1231A4.DAT	2	31-Dec-81
1230A8.DAT	2	30-Dec-81	1231A5.DAT	2	31-Dec-81
1230B1.DAT	2	30-Dec-81	1231B1.DAT	2	31-Dec-81
1230B2.DAT	2	30-Dec-81	1231B2.DAT	2	31-Dec-81
1230B3.DAT	2	30-Dec-81	1231B3.DAT	2	31-Dec-81
1230B4.DAT	2	30-Dec-81	1231B4.DAT	2	31-Dec-81

60 Files, 323 Blocks
651 Free blocks

MME 38 LSI-11/2 Load Modules and Data Files,
Working Disk

```
01-Mar-82
BA      .SYS      7P 01-Mar-80      LINK  .SAV      41P 01-Mar-80
BINCOM.SAV    10P 01-Mar-80      LS    .SYS      2P 21-Sep-81
CMCLIB.OBJ    25P 13-Dec-78      MACRO .SAV     51P 01-Mar-80
CREF  .SAV     6P 01-Mar-80      NL    .SYS      2P 01-Mar-80
DEVTBL.TXT    1P 23-Oct-81      PIP   .SAV     23P 01-Mar-80
DIR   .SAV    17P 01-Mar-80      RESORC.SAV    15P 01-Mar-80
DUMP  .SAV     8P 01-Mar-80      RT11SJ.SYS   67P 01-Mar-80
DUP   .SAV    41P 21-Sep-81      SETDAT.SAV    2P 07-Jan-82
DY    .SYS     4P 21-Sep-81      SRCCOM.SAV   13P 01-Mar-80
FORMAT.SAV   19P 01-Mar-80      STARTS.COM    1P 15-Jan-82
FORTRA.SAV  129P 15-Jan-82      SWAP  .SYS    25P 01-Mar-80
GPIB  .OBJ    11P 23-Oct-81      SYSLIB.OBJ   202P 15-Jan-82
INI   .COM     1P 19-Jan-82      SYSMAC.SNL   42P 11-Jan-82
K52   .SAV    55P 01-Mar-80      TT     .SYS     2P 01-Mar-80
LIBR  .SAV    22P 21-Sep-81
29 Files, 844 Blocks
130 Free blocks
```

01-Mar-82				
BELL1 .FOR	2	12-Jun-81	QDADJ1.OBJ	17 19-Jan-82
BELL1 .LST	3	19-Jan-82	QDADJ1.SAV	33 20-Jan-82
BELL1 .OBJ	7	19-Jan-82	QDADJ2.FOR	14 31-Dec-81
DP2NTG.FOR	3	24-Jun-81	QDADJ2.LST	21 19-Jan-82
DP2NTG.LST	6	19-Jan-82	QDADJ2.OBJ	20 19-Jan-82
DP2NTG.OBJ	9	19-Jan-82	QDADJ2.SAV	36 20-Jan-82
DRFTC .FOR	3	15-Jun-81	QDANAL.FOR	11 22-Dec-81
DRFTC .LST	6	19-Jan-82	QDANAL.LST	19 19-Jan-82
DRFTC .OBJ	8	19-Jan-82	QDANAL.OBJ	20 19-Jan-82
F4FFT .OBJ	4	19-May-80	QDSBR .FOR	3 22-Dec-81
G .COM	1	19-Jan-82	QDSBR .LST	6 19-Jan-82
GMPRD .FOR	3	01-Dec-79	QDSBR .OBJ	7 19-Jan-82
GMPRD .LST	6	19-Jan-82	RDATA .FOR	5 19-Jan-82
GMPRD .OBJ	7	19-Jan-82	RDATA .LST	8 19-Jan-82
HRDWR .FOR	3	19-Jan-82	RDATA .OBJ	8 19-Jan-82
HRDWR .LST	7	19-Jan-82	RTRV2 .FOR	5 22-Dec-81
HRDWR .OBJ	8	19-Jan-82	RTRV2 .LST	8 19-Jan-82
INIT .FOR	4	22-Feb-82	RTRV2 .OBJ	9 19-Jan-82
INIT .LST	6	22-Feb-82	SAVE0 .FOR	4 22-Dec-81
INIT .OBJ	7	22-Feb-82	SAVE0 .LST	7 19-Jan-82
MTRTST.FOR	6	29-Dec-81	SAVE0 .OBJ	8 19-Jan-82
MTRTST.LST	9	19-Jan-82	SAVE2 .FOR	5 22-Dec-81
MTRTST.OBJ	10	19-Jan-82	SAVE2 .LST	8 19-Jan-82
NMTRX1.DAT	2	29-Dec-81	SAVE2 .OBJ	10 19-Jan-82
PHAMPL.OBJ	2	19-May-80	SCALE .FOR	3 22-May-81
PLOT1 .FOR	2	19-Jun-81	SCALE .LST	5 19-Jan-82
PLOT1 .LST	5	19-Jan-82	SCALE .OBJ	6 19-Jan-82
PLOT1 .OBJ	8	19-Jan-82	SCOIL1.FOR	4 27-May-81
PL10LB.OBJ	384	18-Jan-82	SCOIL1.LST	7 19-Jan-82
PMTRX1.DAT	2	29-Dec-81	SCOIL1.OBJ	9 19-Jan-82
QDADJ1.FOR	11	31-Dec-81	SCOIL1.TXT	2 29-May-81
QDADJ1.LST	18	19-Jan-82		

63 Files, 890 Blocks
 84 Free blocks

MME 41 LSI-11/23 FORTRAN Source and Object
 Module Files, Working Disk

01-Mar-82					
CHCVFT.SAV	25	05-Aug-81	1230B3.DAT	2	30-Dec-81
NMTRX1.DAT	2	29-Dec-81	1230B4.DAT	2	30-Dec-81
FMTRX1.DAT	2	29-Dec-81	1230B5.DAT	2	30-Dec-81
QDADJ1.SAV	33	20-Jan-82	1230B6.DAT	2	30-Dec-81
QDADJ2.SAV	36	20-Jan-82	1230B7.DAT	2	30-Dec-81
QDANAL.SAV	100	23-Feb-82	1230B8.DAT	2	30-Dec-81
02250A.DAT	2	25-Feb-82	1230C1.DAT	2	30-Dec-81
02250B.DAT	2	25-Feb-82	1230C2.DAT	2	30-Dec-81
02250C.DAT	2	25-Feb-82	1230C3.DAT	2	30-Dec-81
02251A.DAT	2	25-Feb-82	1230C4.DAT	2	30-Dec-81
02251B.DAT	2	25-Feb-82	1230C5.DAT	2	30-Dec-81
02252A.DAT	2	25-Feb-82	1230C6.DAT	2	30-Dec-81
02252B.DAT	2	25-Feb-82	1230C7.DAT	2	30-Dec-81
02253A.DAT	2	25-Feb-82	1230C8.DAT	2	30-Dec-81
02253B.DAT	2	25-Feb-82	1230D1.DAT	2	30-Dec-81
1229A1.DAT	2	29-Dec-81	1230D2.DAT	2	30-Dec-81
1229A2.DAT	2	29-Dec-81	1230D3.DAT	2	30-Dec-81
1229A3.DAT	2	29-Dec-81	1230D4.DAT	2	30-Dec-81
1229A4.DAT	2	29-Dec-81	1230D5.DAT	2	30-Dec-81
1229A5.DAT	2	29-Dec-81	1230D6.DAT	2	30-Dec-81
1229A6.DAT	2	29-Dec-81	1230D7.DAT	2	30-Dec-81
1229A7.DAT	2	29-Dec-81	1230D8.DAT	2	30-Dec-81
1230A1.DAT	2	30-Dec-81	1230E1.DAT	2	30-Dec-81
1230A2.DAT	2	30-Dec-81	1231A1.DAT	2	31-Dec-81
1230A3.DAT	2	30-Dec-81	1231A2.DAT	2	31-Dec-81
1230A4.DAT	2	30-Dec-81	1231A3.DAT	2	31-Dec-81
1230A5.DAT	2	30-Dec-81	1231A4.DAT	2	31-Dec-81
1230A6.DAT	2	30-Dec-81	1231A5.DAT	2	31-Dec-81
1230A7.DAT	2	30-Dec-81	1231B1.DAT	2	31-Dec-81
1230A8.DAT	2	30-Dec-81	1231B2.DAT	2	31-Dec-81
1230B1.DAT	2	30-Dec-81	1231B3.DAT	2	31-Dec-81
1230B2.DAT	2	30-Dec-81	1231B4.DAT	2	31-Dec-81

64 Files, 314 Blocks
660 Free blocks

MME 42 LSI-11/23 Load Modules and Data Files,
Working Disk

01-Mar-82					
BELL1 .OBJ	7	19-Jan-82	PLOT1 .OBJ	9	23-Feb-82
DF2NTG.OBJ	9	19-Jan-82	PL10LB.OBJ	385	23-Feb-82
DRFTC .OBJ	8	19-Jan-82	QDADJ1.OBJ	17	19-Jan-82
F .COM	1	23-Feb-82	QDADJ2.OBJ	20	19-Jan-82
F4FFT .OBJ	4	19-May-80	QDANAL.MAF	24	23-Feb-82
GMFRD .OBJ	7	19-Jan-82	QDANAL.OBJ	20	19-Jan-82
GPIB .OBJ	11	23-Oct-81	QDANAL.SAV	100	23-Feb-82
HRDWR .OBJ	8	19-Jan-82	QDSBR .OBJ	7	19-Jan-82
INIT .OBJ	7	22-Feb-82	RDATA .OBJ	8	19-Jan-82
O .BAK	1	23-Feb-82	RTRV2 .OBJ	9	19-Jan-82
O .COM	1	23-Feb-82	SAVE0 .OBJ	8	19-Jan-82
PHAMPL.OBJ	2	19-May-80	SAVE2 .OBJ	10	19-Jan-82
PLOT1 .FOR	4	23-Feb-82	SCALE .OBJ	6	19-Jan-82
PLOT1 .LST	8	23-Feb-82	SCQIL1.OBJ	9	19-Jan-82
28 Files, 710 Blocks					
264 Free blocks					

MME 43 LSI-11/23 FORTRAN Source and Object
Module Files, Working Disk

ENGINEERING NOTEBook No.
643

FILE NO.

MT 313

PAGE

B1

SUBJECT

"FIXING" of Four More Rare Earth Quadrupole Magnets
By The Halbach Technique

NAME

Michael I. Green

DATE

March 1, 1982

Page	Quad. S/N	Data Set	Time	Program	Description
2 - 3	62-0	02250A	10:18:40	QDANAL	No shims, harmonic analysis.
4	62-0	.	.	QDADJ1	Shim calculation.
5 - 6	62-0	02250B	13:52:06	QDANAL	Shim schedule 1, harmonic analysis.
7	62-0	.	.	QDADJ1	Shim calculation.
8 - 9	62-0	02250C	14:48:12	QDANAL	Shim schedule 2, harmonic analysis.
10	62-0	.	.	QDADJ1	Shim calculation.
11 - 12	62-1	02251A	15:00:45	QDANAL	No shims, harmonic analysis.
13	62-1	.	.	QDADJ1	Shim calculation.
14 - 15	62-1	02251B	15:42:29	QDANAL	Shim schedule 3, harmonic analysis.
16	62-1	.	.	QDADJ1	Shim calculation.
17 - 18	62-2	02252A	16:16:33	QDANAL	No shims, harmonic analysis.
19	62-2	.	.	QDADJ1	Shim calculation.
20 - 21	62-2	02252B	16:39:01	QDANAL	Shim schedule 4, harmonic analysis.
22	62-2	.	.	QDADJ1	Shim calculation.
23 - 24	62-3	02253A	17:02:03	QDANAL	No shims, harmonic analysis.
25	62-3	.	.	QDADJ1	Shim calculation
26 - 27	62-3	02253B	17:26:08	QDANAL	Shim schedule 5, harmonic analysis.
28	62-3	.	.	QDADJ1	Shim calculation.

APPENDIX B
Computer Output

THE DATE IS 25-FEB-82 TIME 10:18:40
2* search coil, LANL REC QUADRUPOLE, S/N 62- 0
ADJUSTING PHASE
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-366647. COUNTS DRIFT OVER 129 POINTS WITH -2864. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 107782.4 COUNTS
DIPOLE STRENGTH = 0.000027, PHASE ANGLE = -165.96

B'L(EFF) = 0.1659 TESLA, WITH PHASE ANGLE -0.55

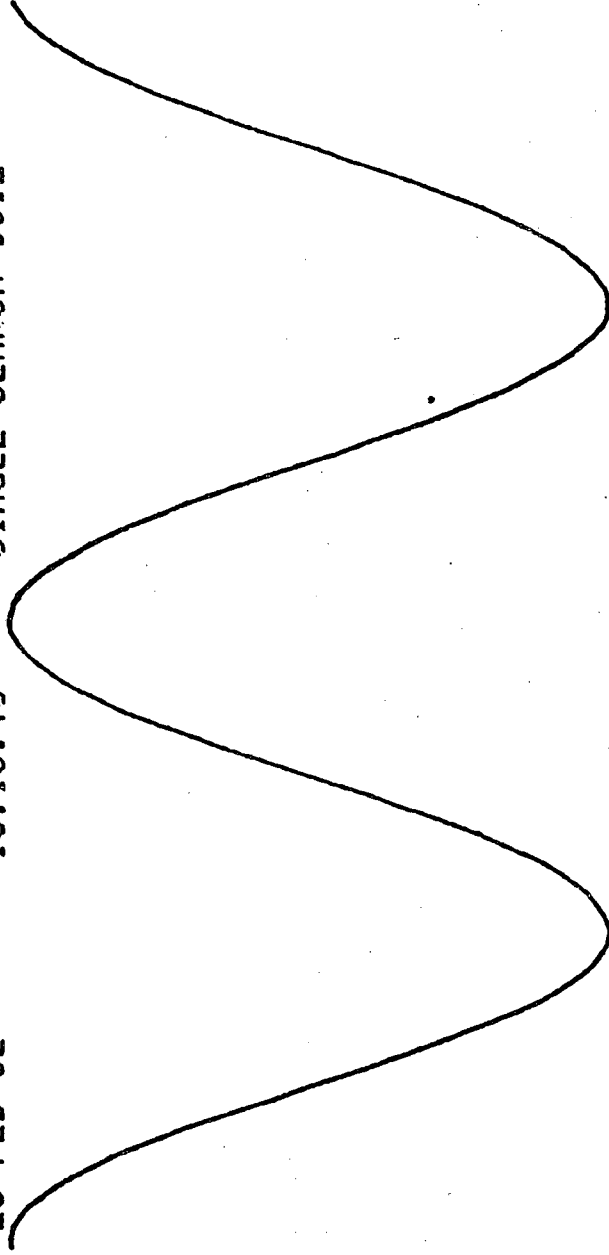
-----BUCKED COILS-----

51172. COUNTS DRIFT OVER 129 POINTS WITH 400. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 171183.4 COUNTS

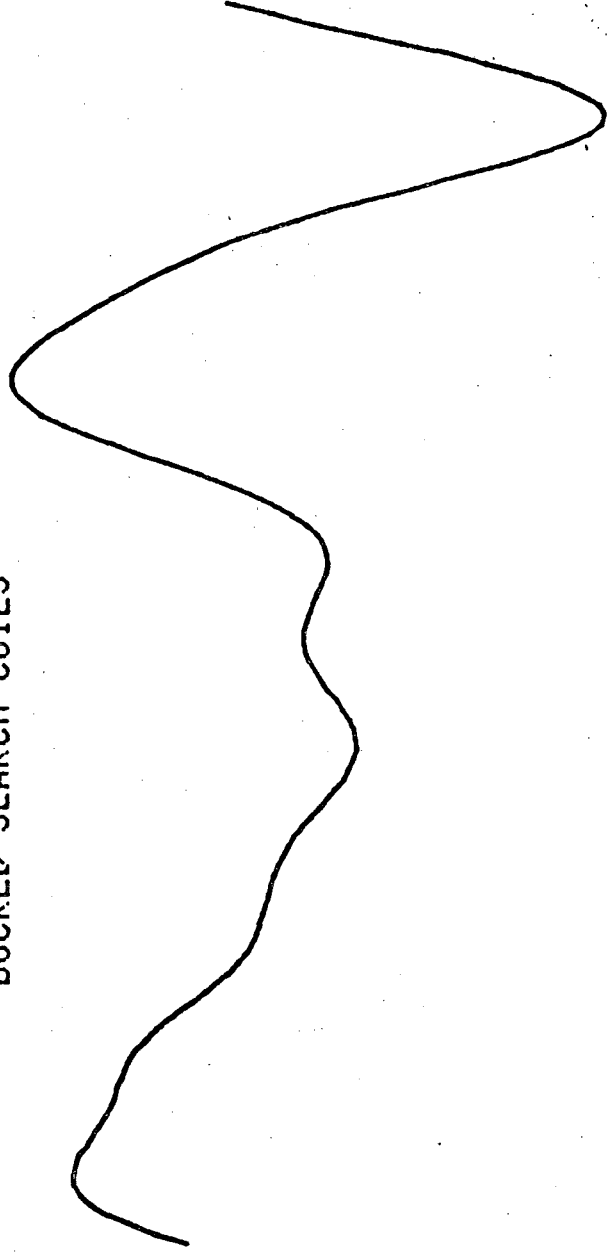
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	64542.	12.46	-63.2
4	25386.	10.43	-16.1
5	11105.	6.84	-59.9
6	17300.	19.81	10.4
7	2337.	4.61	38.8
8	691.	2.44	162.1
9	678.	4.19	-161.4
10	742.	8.06	159.3
11	206.	3.90	180.7
12	72.	2.37	-83.4
13	19.	1.07	150.2
14	71.	6.86	-136.1
15	63.	10.43	-146.8
16	95.	26.81	-97.5
17	52.	24.72	-153.6
18	69.	55.38	-167.0

Harmonic Analysis saved in disk file: 02250A.DAT

25-FEB-82 ---- 10:18:40 ----SINGLE SEARCH COIL----



-----BUCKED SEARCH COILS-----



file 02250A.DAT, date: 25-FEB-82, time: 10:18:40 has been retrieved.

2" search coil, LANL REC QUADRUPOLE, S/N 62- 0

ADJUSTING PHASE

The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B'L(eff) = 0.1659 AT -0.5 degrees.

N	B(N)/B(2)	ANGLE	ROTATED	B(N)/B(2)*1000	
	* 1000	DEG	ANGLE	REAL	IMAGINARY
3	12.46	-63.2	161.8	-11.84	3.89
4	10.43	-16.1	253.9	-2.90	-10.02
5	6.84	-59.9	255.1	-1.76	-6.61
6	19.81	10.4	370.4	19.48	3.59
7	4.61	38.8	443.8	0.50	4.58
8	2.44	162.1	612.1	-0.75	-2.32
9	4.19	-161.4	333.6	3.75	-1.86
10	8.06	159.3	699.3	7.54	-2.85
11	3.90	180.7	765.7	2.72	2.79
12	2.37	-83.4	546.6	-2.35	-0.27
13	1.07	150.2	825.2	-0.28	1.04
14	6.86	-136.1	583.9	-4.94	-4.76
15	10.43	-146.8	618.2	-2.13	-10.21
16	26.81	-97.5	712.5	26.58	-3.50
17	24.72	-153.6	701.4	23.44	-7.88
18	55.38	-167.0	733.0	53.95	12.49

The P-matrix identification is:

PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	26.1
1	27.8
2	18.2
3	30.8
4	1.5
5	17.3
6	0.0
7	46.9

THE DATE IS 25-FEB-82 TIME 13:52:06
2nd search coil, LANL REC QUADRUPOLE, S/N 62- 0
POLE<SHIM:0<26, 1<27, 2<18, 3<29, 4<1, 5<17, 6<0, 7<46
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-345934. COUNTS DRIFT OVER 129 POINTS WITH -2703. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 105087.8 COUNTS
DIPOLE STRENGTH = 0.000056, PHASE ANGLE = -119.77

B'L(EFF) = 0.1604 TESLA, WITH PHASE ANGLE 0.19

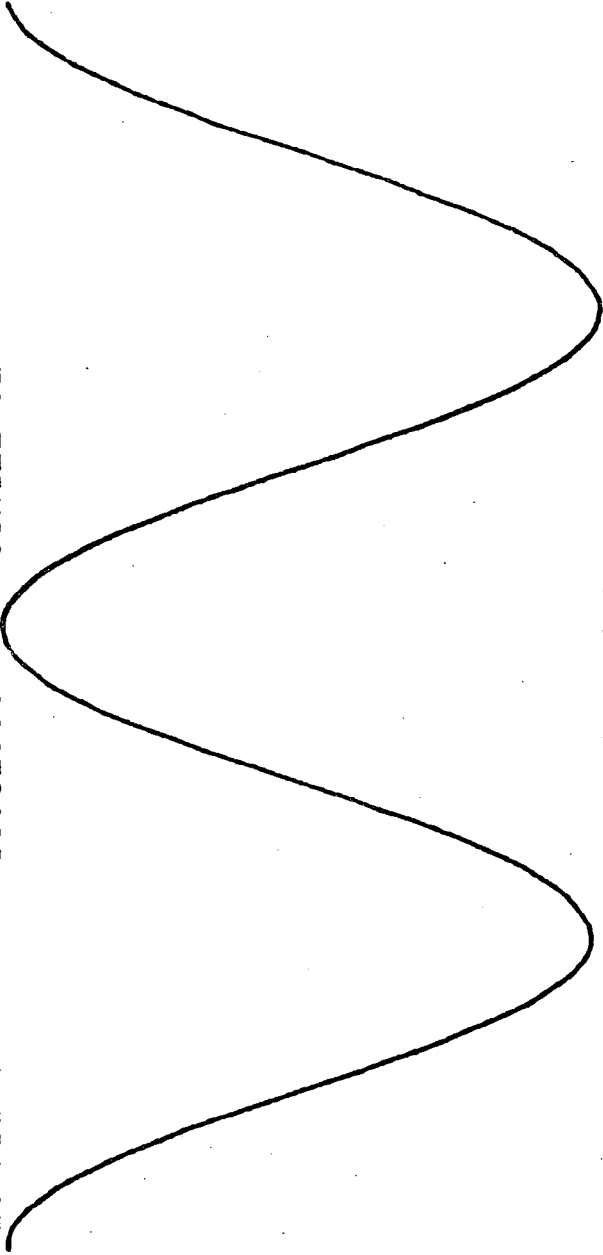
-----BUCKED COILS-----

106712. COUNTS DRIFT OVER 129 POINTS WITH 834. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 96031.0 COUNTS

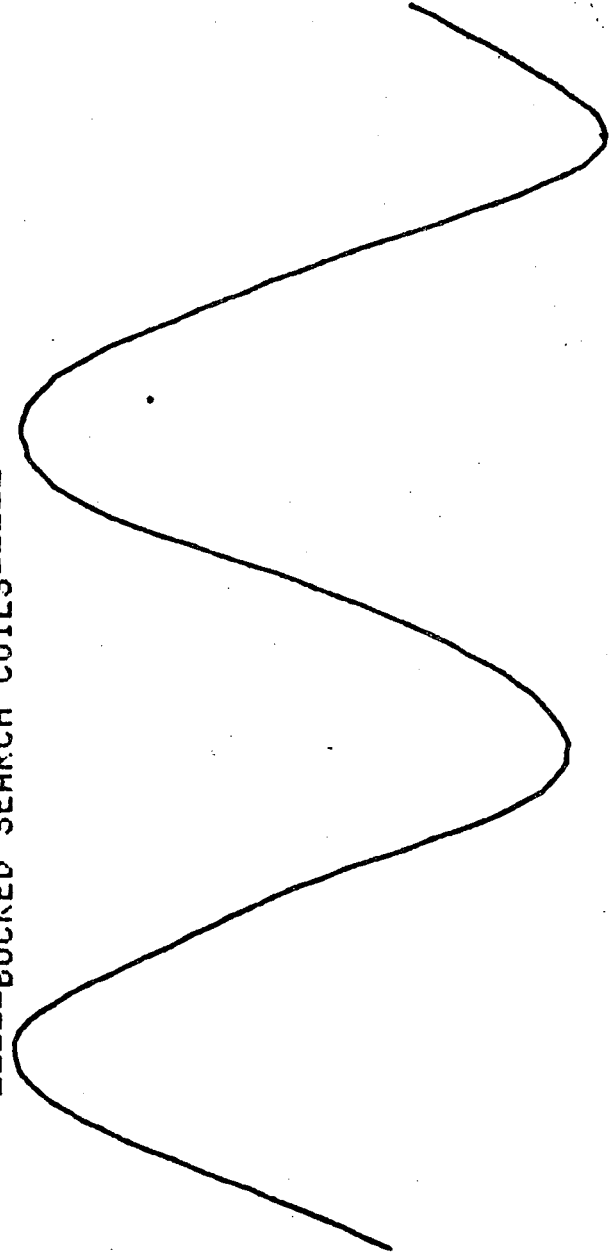
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	3255.	0.65	1.2
4	1884.	0.80	-13.1
5	1983.	1.26	51.8
6	3664.	4.34	87.6
7	688.	1.40	-4.4
8	1493.	5.45	175.8
9	654.	4.18	-167.7
10	484.	5.43	15.3
11	327.	6.38	-109.5
12	130.	4.42	-80.6
13	106.	6.20	-84.3
14	130.	12.98	-32.2
15	22.	3.75	118.1
16	20.	5.89	18.8
17	16.	7.87	-48.2
18	50.	41.82	-106.4

Harmonic Analysis saved in disk file: 02250B.DAT

25-FEB-82 ---- 13:52:06 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02250R.DAT, date: 25-FEB-82, time: 13:52:06 has been retrieved.
2" search coil, LANL REC QUADRUPOLE, S/N 62- 0
POLE<SHIM:0<26, 1<27, 2<18, 3<29, 4<1, 5<17, 6<0, 7<46
The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B'L(eff) = 0.1604 AT 0.2 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000 REAL	IMAGINARY
3	0.65	1.2	226.2	-0.45	-0.47
4	0.80	-13.1	256.9	-0.18	-0.78
5	1.26	51.8	366.8	1.25	0.15
6	4.34	87.6	447.6	0.18	4.33
7	1.40	-4.4	400.6	1.07	0.91
8	5.45	175.8	625.8	-0.40	-5.44
9	4.18	-167.7	327.3	3.52	-2.26
10	5.43	15.3	555.3	-5.24	-1.43
11	6.38	-109.5	475.5	-2.75	5.76
12	4.42	-80.6	549.4	-4.36	-0.72
13	6.20	-84.3	590.7	-3.93	-4.80
14	12.98	-32.2	687.8	10.99	-6.91
15	3.75	118.1	883.1	-3.59	1.09
16	5.89	18.8	828.8	-1.90	5.58
17	7.87	-48.2	806.8	0.44	7.86
18	41.82	-106.4	793.6	11.79	40.12

The P-matrix identification is:
PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	0.8
1	1.6
2	0.6
3	0.8
4	2.0
5	0.0
6	1.7
7	3.3

THE DATE IS 25-FEB-82 TIME 14:48:12
2" search coil, LANL REC QUADRUPOLE, S/N 62- 0
POLE<SHIM: 0<25, 1<27, 2<17, 3<29, 4<1, 5<15, 6<0, 7<48
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-354889. COUNTS DRIFT OVER 129 POINTS WITH -2773. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 104623.4 COUNTS
DIPOLE STRENGTH = 0.000038, PHASE ANGLE = -119.40

B'L(EFF) = 0.1603 TESLA, WITH PHASE ANGLE -0.14

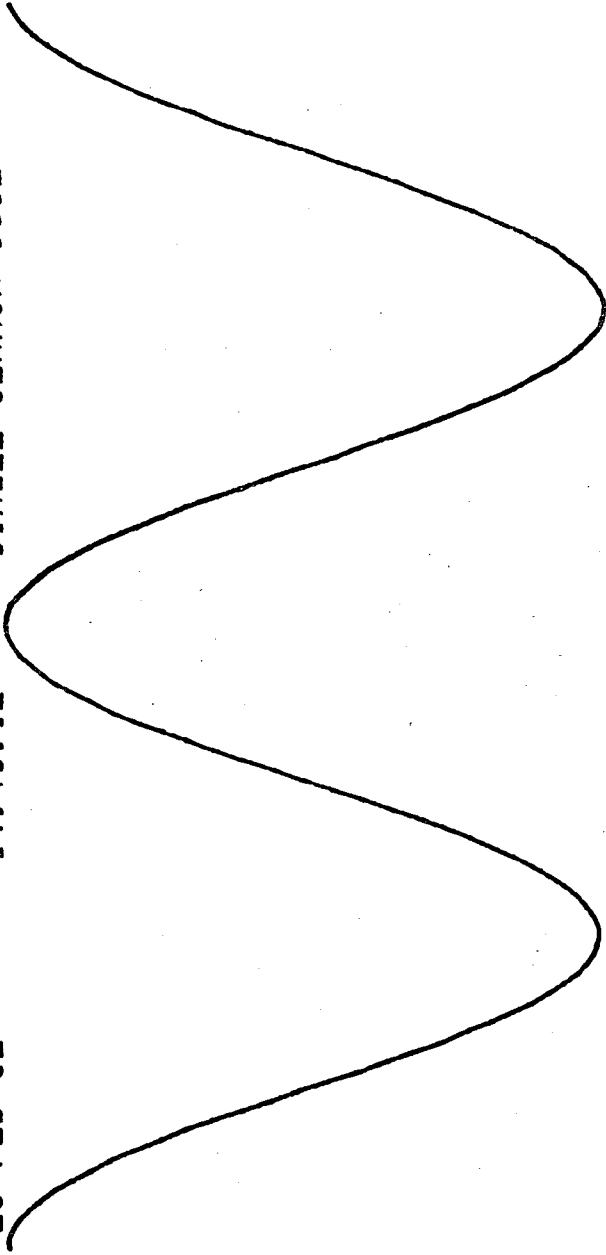
-----BUCKED COILS-----

96139. COUNTS DRIFT OVER 129 POINTS WITH 751. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 94000.1 COUNTS

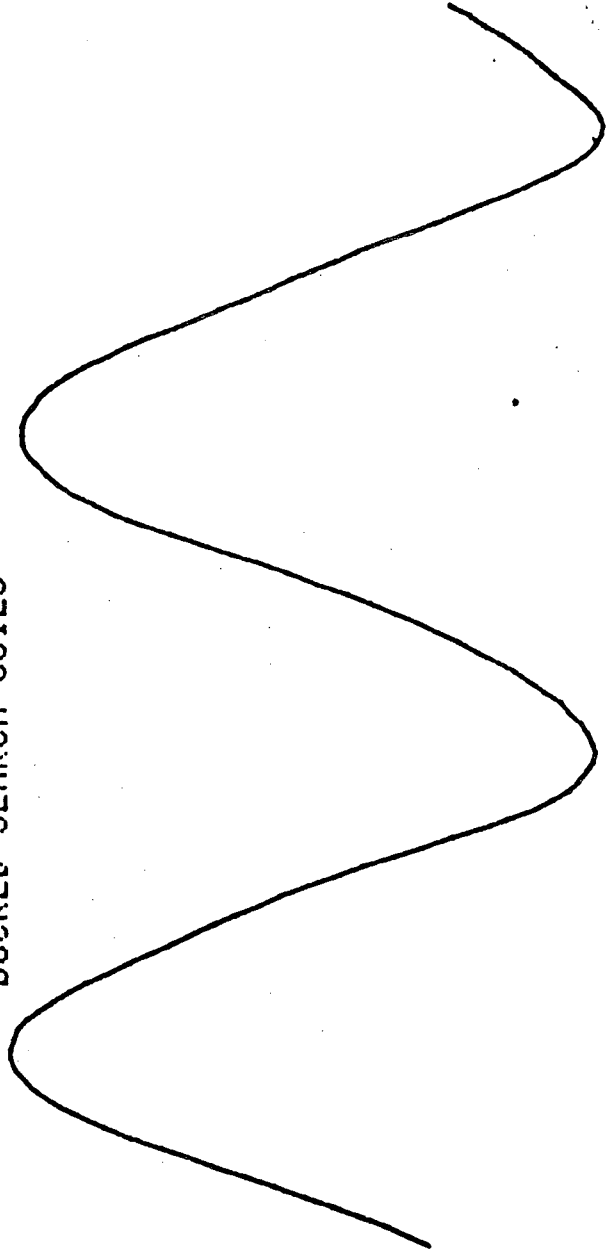
N	S(N) (COUNTS)	B(N)/R(2) (*1000)	ANGLE (DEG)
3	1943.	0.39	99.9
4	527.	0.22	-159.9
5	220.	0.14	156.5
6	3830.	4.54	88.9
7	538.	1.10	30.6
8	1562.	5.71	175.5
9	617.	3.95	-164.9
10	436.	4.90	4.6
11	379.	7.41	-111.5
12	158.	5.37	-67.1
13	108.	6.31	-79.5
14	116.	11.64	-43.1
15	21.	3.51	38.9
16	63.	18.29	-99.1
17	9.	4.53	155.7
18	25.	20.84	173.0

Harmonic Analysis saved in disk file: 022500.DAT

25-FEB-82 ---- 14:48:12 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02250C.DAT, date: 25-FEB-82, time: 14:48:12 has been retrieved.

2" search coil, LANL REC QUADRUPOLE, S/N 62- 0

POLE<SHIM: 0<25, 1<27, 2<17, 3<29, 4<1, 5<15, 6<0, 7<48 .

The single coil attenuation is 101.6, the V/f range is 0.001 volts.

The reference radius is 0.035000 meters.

B'L(eff) = 0.1603 AT -0.1 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000	
				REAL	IMAGINARY
3	0.39	99.9	324.9	0.32	-0.22
4	0.22	-159.9	110.1	-0.08	0.21
5	0.14	156.5	471.5	-0.05	0.13
6	4.54	88.9	448.9	0.09	4.54
7	1.10	30.6	435.6	0.27	1.06
8	5.71	175.5	625.5	-0.45	-5.69
9	3.95	-164.9	330.1	3.42	-1.97
10	4.90	4.6	544.6	-4.88	-0.39
11	7.41	-111.5	473.5	-2.96	6.79
12	5.37	-67.1	562.9	-4.95	-2.09
13	6.31	-79.5	595.5	-3.57	-5.20
14	11.64	-43.1	676.9	8.50	-7.95
15	3.51	38.9	803.9	0.37	3.49
16	18.29	-99.1	710.9	18.06	-2.90
17	4.53	155.7	1010.7	1.61	-4.24
18	20.84	173.0	1073.0	20.68	-2.54

The P-matrix identification is:

PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	0.2
1	0.3
2	0.0
3	0.5
4	0.7
5	0.9
6	0.6
7	0.1

THE DATE IS 25-FEB-82 TIME 15:00:45
2" search coil, LANL REC QUADRUPOLE, S/N 62- 1
NO SHIMS
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-331882. COUNTS DRIFT OVER 129 POINTS WITH -2593. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 101979.3 COUNTS
DIPOLE STRENGTH = 0.000058, PHASE ANGLE = 97.73
B'L(EFF) = 0.1549 TESLA, WITH PHASE ANGLE 1.78

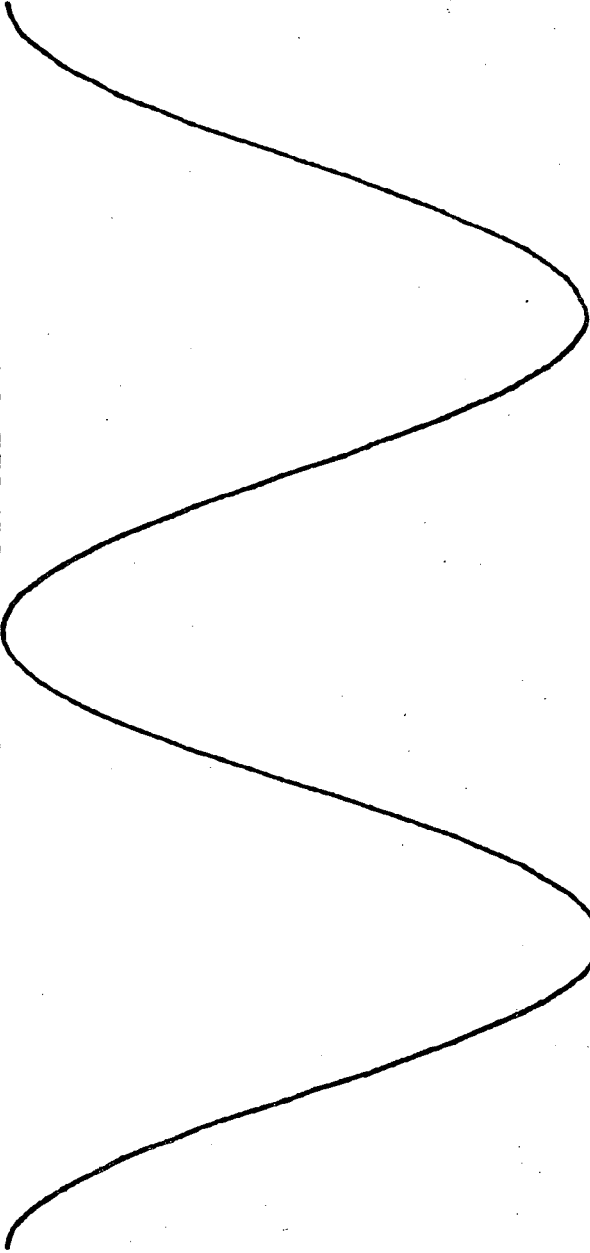
-----BUCKED COILS-----

119882. COUNTS DRIFT OVER 129 POINTS WITH 937. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 149100.2 COUNTS

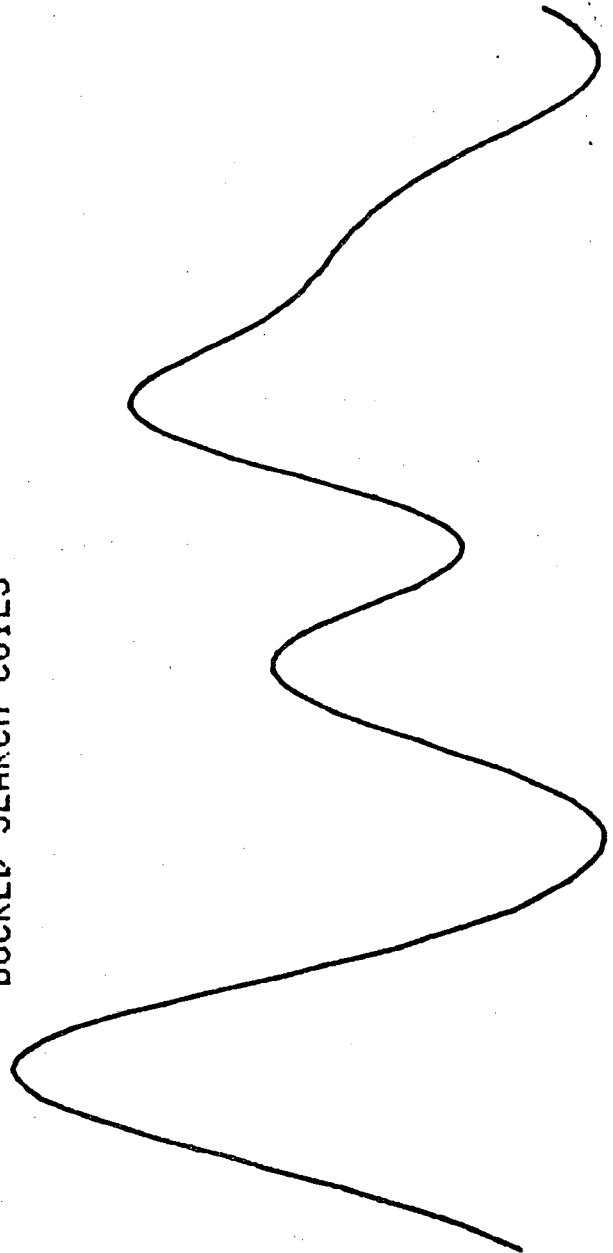
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	66795.	13.81	-135.6
4	35434.	15.59	110.2
5	19066.	12.57	-127.7
6	12019.	14.73	23.3
7	466.	0.98	150.6
8	1728.	6.54	-96.1
9	616.	4.08	41.1
10	373.	4.34	38.5
11	131.	2.66	84.4
12	61.	2.13	-134.6
13	68.	4.14	31.3
14	56.	5.78	155.0
15	33.	5.81	139.2
16	56.	16.80	-28.6
17	73.	37.50	-107.8
18	79.	68.05	-167.1

Harmonic Analysis saved in disk file: 02251A.DAT

25-FEB-82 ---- 15:00:45 ----SINGLE SEARCH COIL----



-----BUCKED SEARCH COILS-----



file 02251A.DAT, date: 25-FEB-82, time: 15:00:45 has been retrieved.

2" search coil, LANL REC QUADRUPOLE, S/N 62- 1

NO SHIMS

The single coil attenuation is 101.6; the V/f range is 0.001 volts.

The reference radius is 0.035000 meters.

B'L(eff) = 0.1549 AT 1.8 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000	
				REAL	IMAGINARY
3	13.81	-135.6	89.4	0.15	13.81
4	15.59	110.2	380.2	14.64	5.38
5	12.57	-127.7	187.3	-12.47	-1.59
6	14.73	23.3	383.3	13.53	5.83
7	0.98	150.6	555.6	-0.95	-0.26
8	6.54	-96.1	353.9	6.50	-0.69
9	4.08	41.1	536.1	-4.07	0.28
10	4.34	38.5	578.5	-3.40	-2.70
11	2.66	84.4	669.4	1.69	-2.05
12	2.13	-134.6	495.4	-1.51	1.49
13	4.14	31.3	706.3	4.02	-0.98
14	5.78	155.0	875.0	-5.24	2.44
15	5.81	139.2	904.2	-5.80	-0.42
16	16.80	-28.6	781.4	8.03	14.75
17	37.50	-107.8	747.2	33.36	17.14
18	68.05	-167.1	732.9	66.34	15.16

The F-matrix identification is:

FMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	20.5
1	40.5
2	48.0
3	46.6
4	0.0
5	39.3
6	20.0
7	15.7

THE DATE IS 25-FEB-82 TIME 15:42:29

2nd search coil, LANL REC QUADRUPOLE, S/N 62- 1

REPEAT OF 15:36:13 AS DATA WAS NOT SAVED

THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.

THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-274850. COUNTS DRIFT OVER 129 POINTS WITH -2147. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 96840.8 COUNTS
DIPOLE STRENGTH = 0.000045, PHASE ANGLE = 75.33

B/L(EFF) = 0.1483 TESLA, WITH PHASE ANGLE 1.93

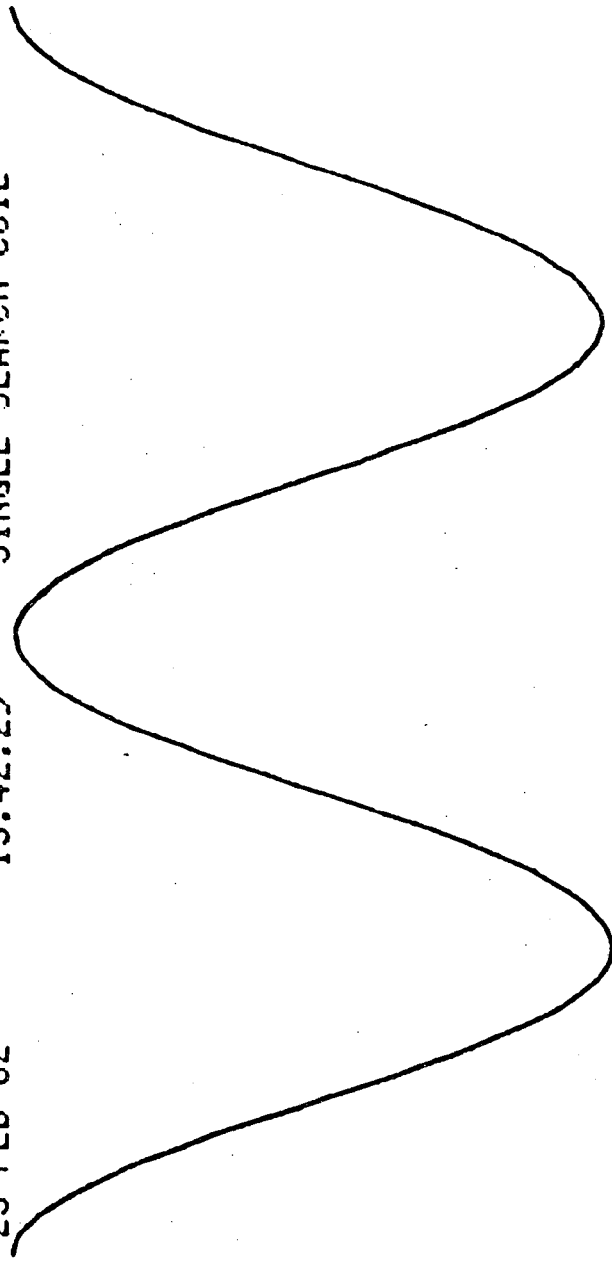
-----BUCKED COILS-----

163053. COUNTS DRIFT OVER 129 POINTS WITH 1274. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 88444.9 COUNTS

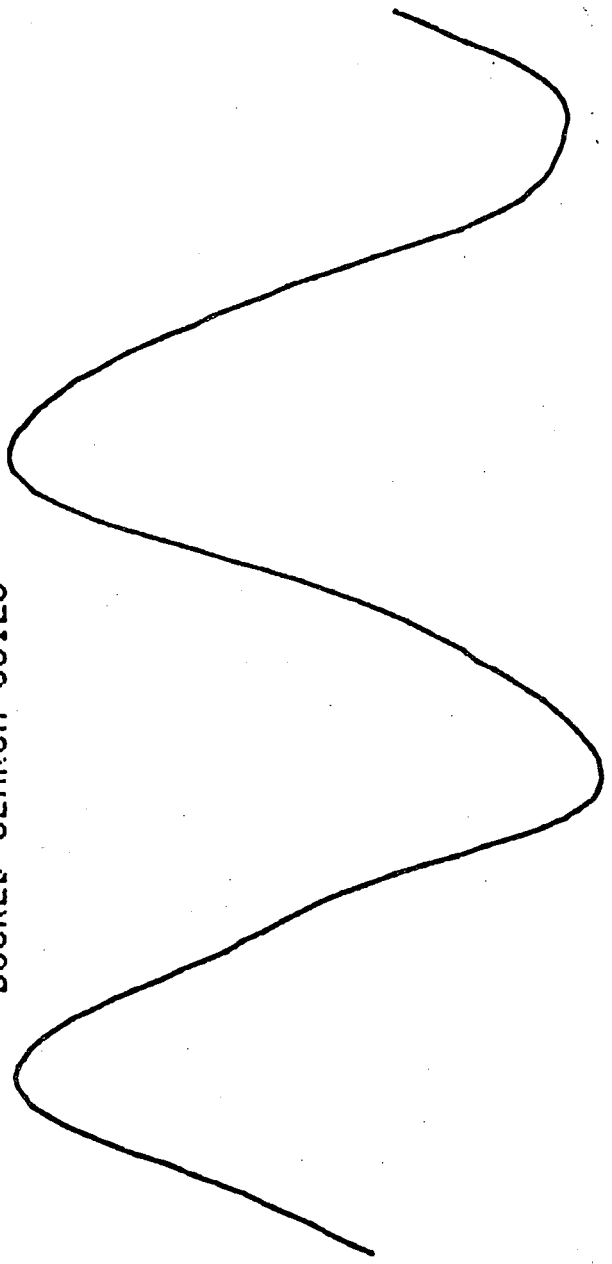
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	2148.	0.46	2.6
4	1548.	0.71	166.7
5	426.	0.29	-70.0
6	4465.	5.72	89.3
7	2872.	6.34	-50.9
8	715.	2.82	-45.7
9	684.	4.73	27.3
10	1532.	18.62	7.0
11	198.	4.19	-138.2
12	267.	9.80	123.6
13	94.	5.93	-121.1
14	37.	4.04	-16.7
15	67.	12.49	-200.4
16	40.	12.65	-169.2
17	24.	12.60	-167.7
18	45.	40.95	-178.6

Harmonic Analysis saved in disk file: 02251B.DAT

25-FEB-92 ---- 15:42:29 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02251B.DAT, date: 25-FEB-82, time: 15:42:29 has been retrieved.

2" search coil, LANL REC QUADRUPOLE, S/N 62- 1

REPEAT OF 15:36:13 AS DATA WAS NOT SAVED

The single coil attenuation is 101.6, the V/f range is 0.001 volts.

The reference radius is 0.035000 meters.

B'L(eff) = 0.1483 AT 1.9 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000	
				REAL	IMAGINARY
3	0.46	2.6	227.6	-0.31	-0.34
4	0.71	166.7	436.7	0.16	0.69
5	0.29	-70.0	245.0	-0.12	-0.27
6	5.72	89.3	449.3	0.07	5.72
7	6.34	-50.9	354.1	6.30	-0.65
8	2.82	-45.7	404.3	2.02	1.97
9	4.73	27.3	522.3	-4.51	1.44
10	18.62	7.0	547.0	-18.48	-2.26
11	4.19	-138.2	446.8	0.23	4.19
12	9.80	123.6	753.6	8.16	5.42
13	5.93	-121.1	553.9	-5.76	-1.42
14	4.04	-16.7	703.3	3.87	-1.16
15	12.49	-200.4	564.6	-11.35	-5.21
16	12.65	-169.2	640.8	2.38	-12.43
17	12.60	-167.7	687.3	10.60	-6.81
18	40.95	-178.6	721.4	40.94	0.98

The P-matrix identification is:

PMTRX1.DAT 81-dec-29

The "block" identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	1.3
1	1.4
2	1.0
3	0.0
4	0.5
5	1.9
6	1.2
7	1.0

THE DATE IS 25-FEB-82 TIME 16:16:33
2" search coil, LANL REC QUADRUPOLE, S/N 62- 2
NO SHIMS
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-337105. COUNTS DRIFT OVER 129 POINTS WITH -2634. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 106116.4 COUNTS
DIPOLE STRENGTH = 0.000036, PHASE ANGLE = 68.86
B'L(EFF) = 0.1630 TESLA, WITH PHASE ANGLE 0.64

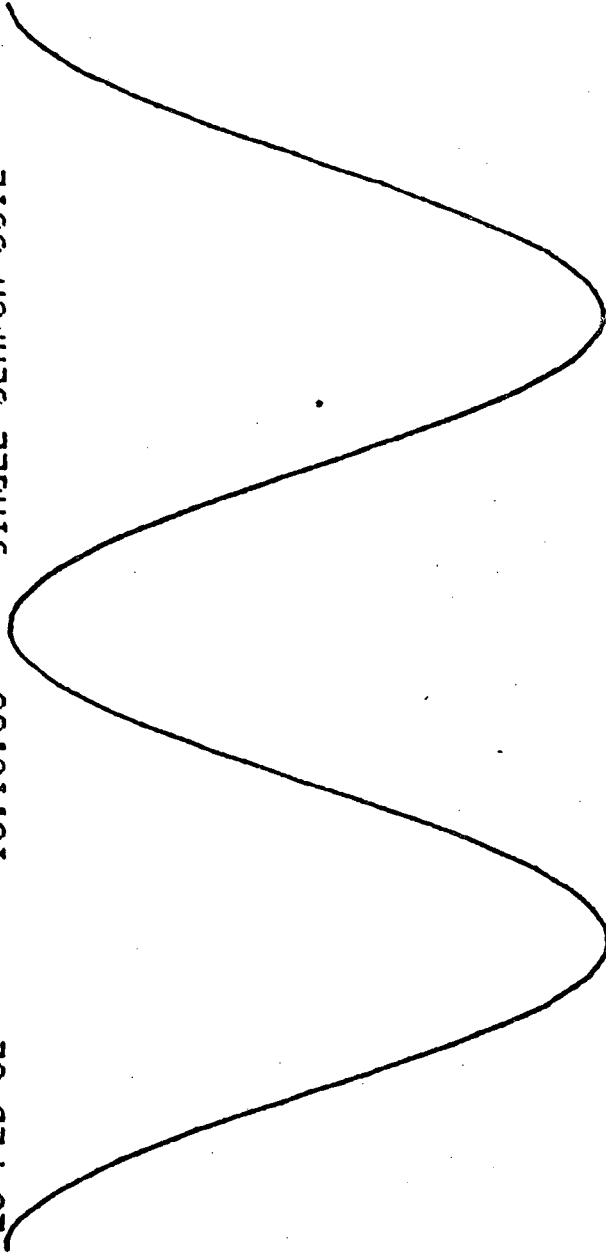
-----BUCKED COILS-----

117409. COUNTS DRIFT OVER 129 POINTS WITH 917. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 124502.1 COUNTS

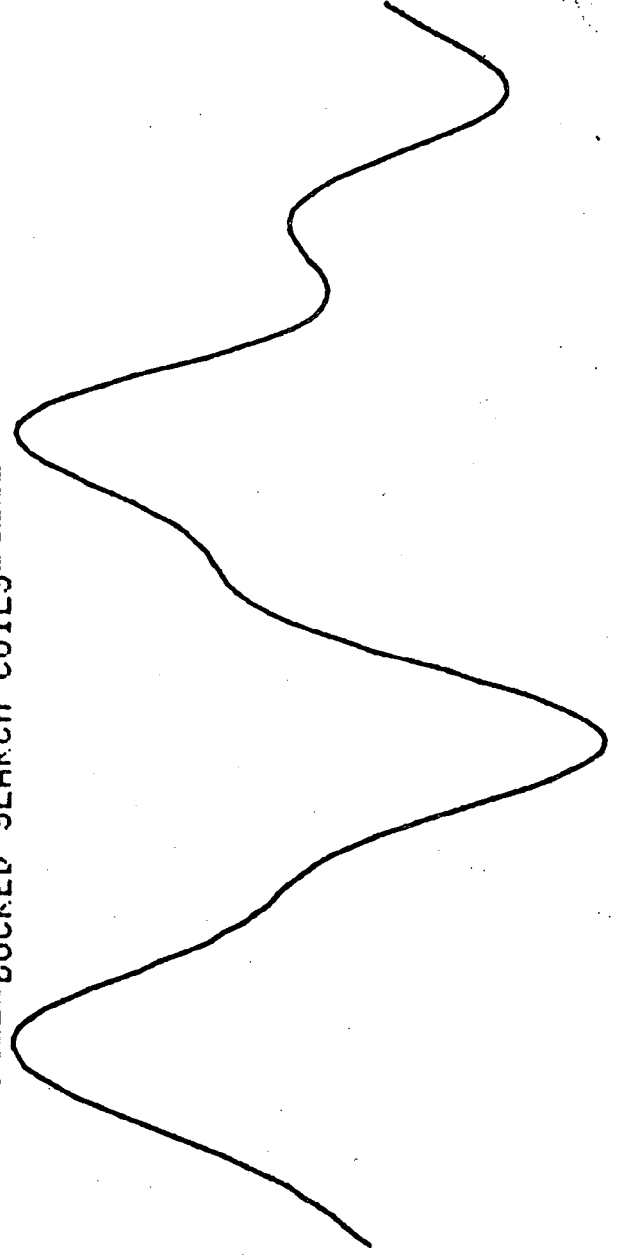
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	21555.	4.23	130.3
4	10111.	4.23	-136.1
5	7723.	4.84	-131.5
6	21332.	24.85	10.4
7	1947.	3.91	131.8
8	644.	2.31	95.2
9	1187.	7.46	64.2
10	377.	4.16	46.6
11	158.	3.04	135.1
12	132.	4.42	160.2
13	49.	2.82	32.9
14	132.	13.04	-135.4
15	56.	9.38	-104.4
16	38.	10.93	-24.3
17	33.	15.89	-55.9
18	53.	43.30	-176.3

Harmonic Analysis saved in disk file: 02252A.DAT

25-FEB-82 ---- 16:16:33 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02252A.DAT, date: 25-FEB-82, time: 16:16:33 has been retrieved.
2* search coil, LANL REC QUADRUPOLE, S/N 62- 2
NO SHIMS

The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B/L(eff) = 0.1630 AT 0.6 degrees.

N	B(N)/B(2)	ANGLE	ROTATED	B(N)/B(2)*1000	
	* 1000	DEG	ANGLE	REAL	INAGINARY
3	4.23	130.3	355.3	4.22	-0.34
4	4.23	-136.1	133.9	-2.93	3.05
5	4.84	-131.5	183.5	-4.83	-0.29
6	24.85	10.4	370.4	24.44	4.49
7	3.91	131.8	536.8	-3.90	0.22
8	2.31	95.2	545.2	-2.31	-0.21
9	7.46	64.2	559.2	-7.05	-2.45
10	4.16	46.6	586.6	-2.86	-3.02
11	3.04	135.1	720.1	3.04	0.00
12	4.42	160.2	790.2	1.49	4.16
13	2.82	32.9	707.9	2.76	-0.59
14	13.04	-135.4	584.6	-9.29	-9.15
15	9.38	-104.4	660.6	4.78	-8.07
16	10.93	-24.3	785.7	4.50	9.96
17	15.89	-55.9	799.1	3.00	15.60
18	43.30	-176.3	723.7	43.20	2.81

The P-matrix identification is:
PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	5.0
1	23.1
2	0.0
3	29.3
4	4.7
5	35.1
6	0.1
7	18.9

THE DATE IS 25-FEB-82 TIME 16:39:01
2nd search coil, LANL REC QUADRUPOLE, S/N 62- 2
POLE<SHIM: 0<5, 1<23, 2<0, 3<29, 4<5, 5<35, 6<0, 7<19 MILS
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-337495, COUNTS DRIFT OVER 129 POINTS WITH -2637. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 103775.1 COUNTS
DIPOLE STRENGTH = 0.000038, PHASE ANGLE = 74.28

B/L(EFF) = 0.1593 TESLA, WITH PHASE ANGLE 0.39

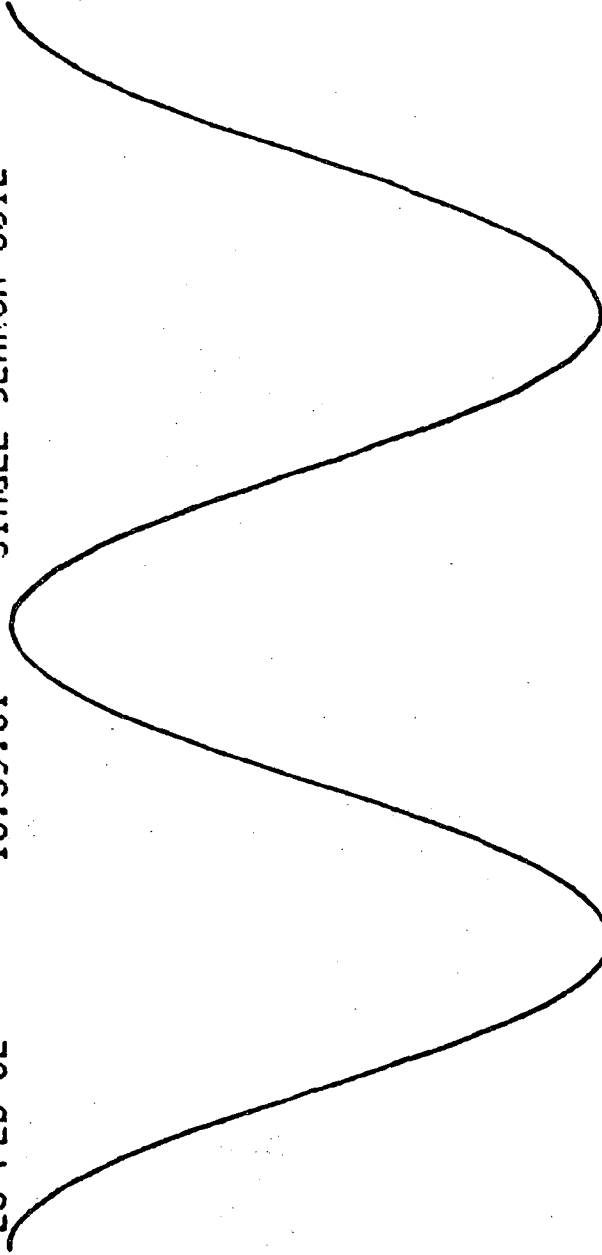
-----BUCKED COILS-----

117827, COUNTS DRIFT OVER 129 POINTS WITH 921. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 93420.4 COUNTS

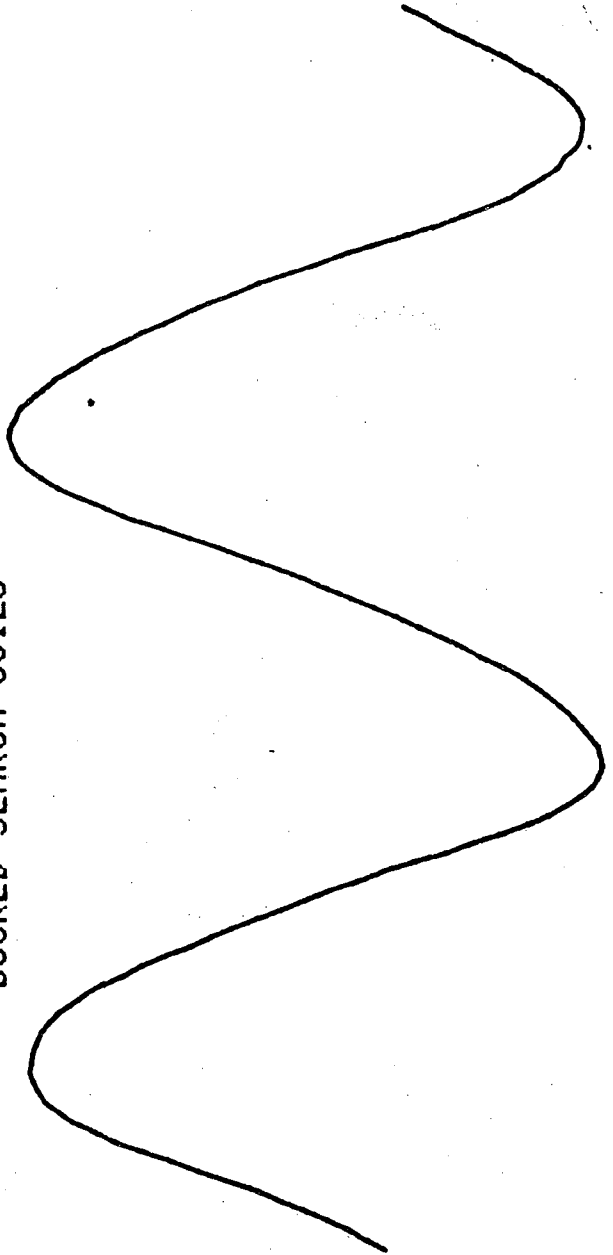
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	1845.	0.37	-11.0
4	1694.	0.72	23.6
5	402.	0.26	-61.9
6	4130.	4.92	91.7
7	54.	0.11	39.6
8	462.	1.70	37.4
9	1224.	7.88	67.9
10	914.	10.34	14.6
11	173.	3.40	143.8
12	130.	4.43	-152.3
13	88.	5.16	175.0
14	110.	11.07	-58.5
15	41.	7.05	-122.3
16	62.	18.24	55.8
17	67.	33.44	-74.2
18	23.	19.44	154.6

Harmonic Analysis saved in disk file: 02252B.DAT

25-FEB-82 ---- 16:39:01 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02252B.DAT, date: 25-FER-82, time: 16:39:01 has been retrieved.
2" search coil, LANL REC QUADRUPOLE, S/N 62- 2
POLE<SHIM: 0<5, 1<23, 2<0, 3<29, 4<5, 5<35, 6<0, 7<19 MILS
The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B/L(eff) = 0.1593 AT 0.4 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000 REAL IMAGINARY	
3	0.37	-11.0	214.0	-0.31	-0.21
4	0.72	23.6	293.6	0.29	-0.66
5	0.26	-61.9	253.1	-0.07	-0.25
6	4.92	91.7	451.7	-0.15	4.92
7	0.11	39.6	444.6	0.01	0.11
8	1.70	37.4	487.4	-1.03	1.35
9	7.88	67.9	562.9	-7.26	-3.06
10	10.34	14.6	554.6	-10.00	-2.60
11	3.40	143.8	728.8	3.36	0.52
12	4.43	-152.3	477.7	-2.06	3.92
13	5.16	175.0	850.0	-3.32	3.96
14	11.07	-58.5	661.5	5.78	-9.44
15	7.05	-122.3	642.7	1.54	-6.88
16	18.24	55.8	865.8	-15.08	10.26
17	33.44	-74.2	780.8	16.30	29.20
18	19.44	154.6	1054.6	17.56	-8.33

The F-matrix identification is:
FMTRX1.DAT 81-dec-29

The "block" identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	0.9
1	0.0
2	1.1
3	0.8
4	0.2
5	0.2
6	1.0
7	1.6

THE DATE IS 25-FEB-82 TIME 17:02:03
2* search coil, LANL REC QUADRUPOLE, S/N 62- 3
NO SHIMS, SCREWS TIGHTENED
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-309688. COUNTS DRIFT OVER 129 POINTS WITH -2419. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 106311.7 COUNTS
DIPOLE STRENGTH = 0.000027, PHASE ANGLE = 37.42

B/L(EFF) = 0.1636 TESLA, WITH PHASE ANGLE 0.51

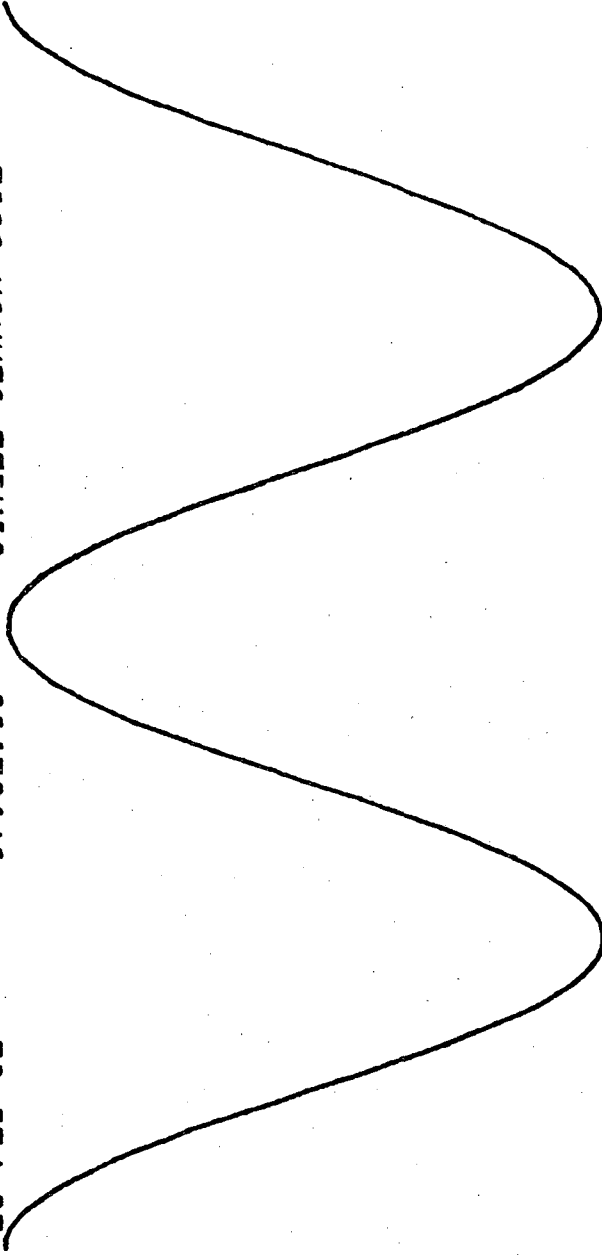
-----BUCKED COILS-----

157708. COUNTS DRIFT OVER 129 POINTS WITH 1232. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 114992.6 COUNTS

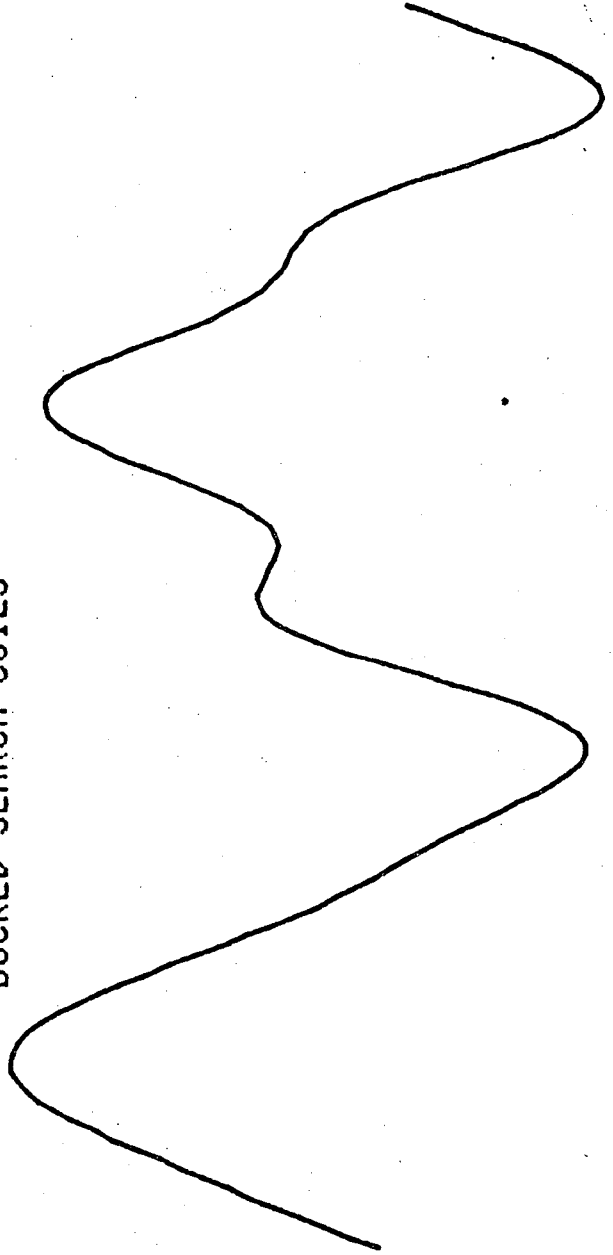
N	S(N) (COUNTS)	B(N)/B(2) (*1000)	ANGLE (DEG)
3	19199.	3.76	-141.9
4	6090.	2.54	-31.4
5	9644.	6.02	-139.6
6	16533.	19.19	-3.1
7	2977.	5.95	122.2
8	1692.	6.06	47.8
9	594.	3.72	-149.2
10	274.	3.02	-50.1
11	67.	1.29	-28.8
12	115.	3.82	116.4
13	40.	2.27	-96.6
14	154.	15.12	-173.9
15	84.	14.07	-94.6
16	6.	1.78	126.9
17	22.	10.87	70.0
18	93.	76.37	-169.9

Harmonic Analysis saved in disk file: 02253A.DAT

25-FEB-82 ---- 17:02:03 -----SINGLE SEARCH COIL-----



-----BUCKED SEARCH COILS-----



file 02253A.DAT, date: 25-FEB-82, time: 17:02:03 has been retrieved.
2" search coil, LANL REC QUADRUPOLE, S/N 62- 3
NO SHIMS, SCREWS TIGHTENED
The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B/L(eff) = 0.1636 AT 0.5 degrees.

N	B(N)/B(2) * 1000	ANGLE DEG	ROTATED ANGLE	B(N)/B(2)*1000	
				REAL	IMAGINARY
3	3.76	-141.9	83.1	0.45	3.73
4	2.54	-31.4	238.6	-1.32	-2.17
5	6.02	-139.6	175.4	-6.00	0.48
6	19.19	-3.1	356.9	19.16	-1.02
7	5.95	122.2	527.2	-5.80	1.32
8	6.06	47.8	497.8	-4.49	4.07
9	3.72	-149.2	345.8	3.61	-0.92
10	3.02	-50.1	489.9	-1.94	2.32
11	1.29	-28.8	556.2	-1.23	-0.36
12	3.82	116.4	746.4	3.42	1.70
13	2.27	-96.6	578.4	-1.78	-1.41
14	15.12	-173.9	546.1	-15.03	-1.61
15	14.07	-94.6	670.4	9.11	-10.71
16	1.78	126.9	936.9	-1.42	-1.07
17	10.87	70.0	925.0	-9.85	-4.60
18	76.37	-169.9	730.1	75.18	13.44

The P-matrix identification is:
PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	9.8
1	20.1
2	6.0
3	31.3
4	0.6
5	22.4
6	0.0
7	18.2

THE DATE IS 25-FEB-82 TIME 17:26:08
2" search coil, LANL REC QUADRUPOLE, S/N 62-3
POLE<SHIM: 0<10, 1<20, 2<6, 3<31, 4<1, 5<22, 6<0, 7<18 MILS
THE QUADRUPOLE REFERENCE RADIUS IS 0.0350000 METERS.
THE V/F IS ON THE 0.001 VOLT RANGE.

-----UNBUCKED COIL-----

-293901. COUNTS DRIFT OVER 129 POINTS WITH -2296. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 104686.9 COUNTS
DIPOLE STRENGTH = 0.000047, PHASE ANGLE = 34.57

B'L(EFF) = 0.1601 TESLA, WITH PHASE ANGLE 0.99

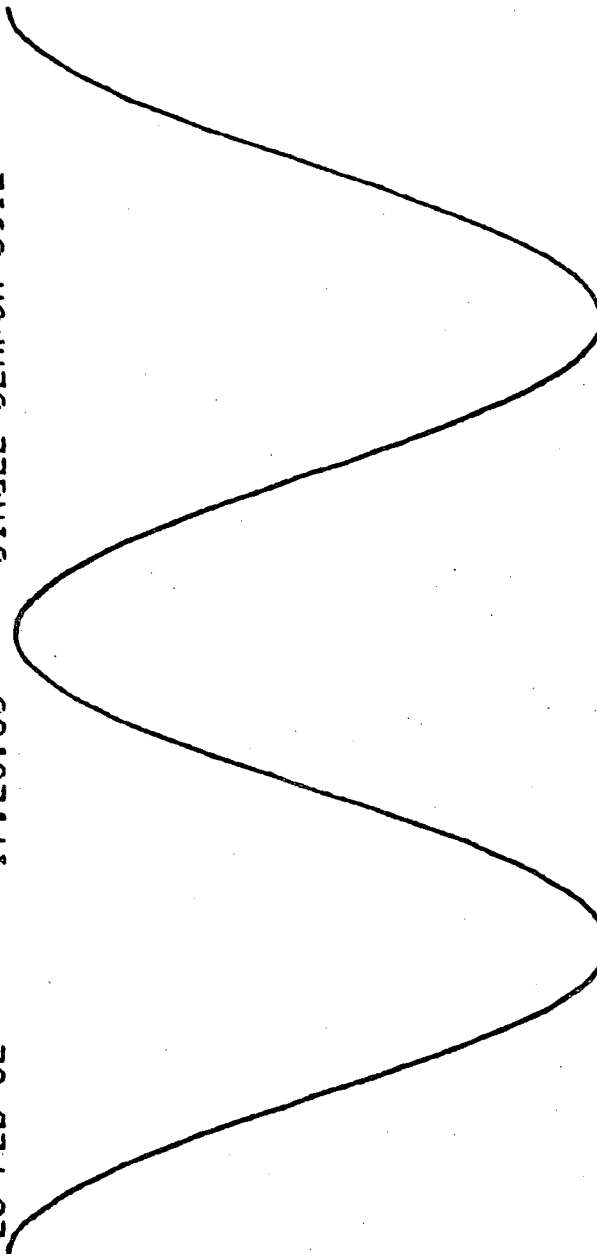
-----BUCKED COILS-----

170198. COUNTS DRIFT OVER 129 POINTS WITH 1330. DRIFT PER POINT
MAXIMUM AMPLITUDE IS 93437.6 COUNTS

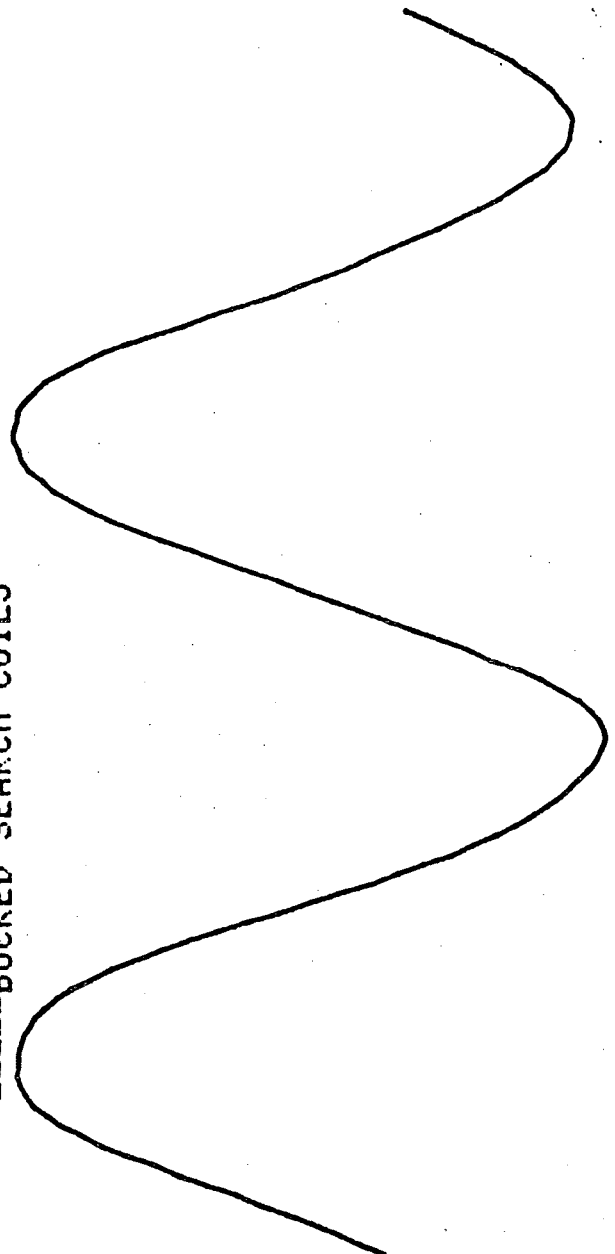
N	S(N) (COUNTS)	R(N)/R(2) (*1000)	ANGLE (DEG)
3	2915.	0.58	59.0
4	210.	0.09	173.1
5	215.	0.14	-103.6
6	612.	0.73	-64.7
7	1404.	2.87	94.8
8	1305.	4.78	55.7
9	456.	2.92	-149.0
10	786.	8.85	-15.2
11	168.	3.29	-85.9
12	77.	2.62	157.3
13	68.	3.98	-160.9
14	47.	4.76	-22.6
15	11.	1.86	-104.8
16	51.	14.77	-19.9
17	40.	19.71	-191.6
18	74.	61.50	-186.5

Harmonic Analysis saved in disk file: 02253B.DAT

25-FEB-82 ---- 17:26:08 ----SINGLE SEARCH COIL----



----BUCKED SEARCH COILS----



file 02253B.DAT, date: 25-FEB-82, time: 17:26:08 has been retrieved.
2" search coil, LANL REC QUADRUPOLE, S/N 62- 3
POLE<SHIM: 0<10, 1<20, 2<6, 3<31, 4<1, 5<22, 6<0, 7<18 MILS
The single coil attenuation is 101.6, the V/f range is 0.001 volts.
The reference radius is 0.035000 meters.

B'L(eff) = 0.1601 AT 1.0 degrees.

N	B(N)/B(2)	ANGLE	ROTATED	B(N)/B(2)*1000	
	* 1000	DEG	ANGLE	REAL	IMAGINARY
3	0.58	59.0	284.0	0.14	-0.57
4	0.09	173.1	443.1	0.01	0.09
5	0.14	-103.6	211.4	-0.12	-0.07
6	0.73	-64.7	295.3	0.31	-0.66
7	2.87	94.8	499.8	-2.19	1.85
8	4.78	55.7	505.7	-3.94	2.69
9	2.92	-149.0	346.0	2.83	-0.71
10	8.85	-15.2	524.8	-8.54	2.31
11	3.29	-85.9	499.1	-2.48	2.16
12	2.62	157.3	787.3	1.01	2.42
13	3.98	-160.9	514.1	-3.58	1.74
14	4.76	-22.6	697.4	4.40	-1.83
15	1.86	-104.8	660.2	0.93	-1.60
16	14.77	-19.9	790.1	5.03	13.89
17	19.71	-191.6	663.4	10.84	-16.46
18	61.50	-186.5	713.5	61.11	-6.95

The P-matrix identification is:
PMTRX1.DAT 81-dec-29

The 'block' identification and needed shims are:

BLOCK (NO.)	DELTA R(I) (MILS)
0	0.4
1	0.3
2	0.0
3	0.4
4	0.5
5	1.4
6	0.9
7	0.9

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.

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