Siemens Site
Yearly Performance Evaluation
Siemens Trio, 3T - Room S3
15-Jun-08

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MRI Equipment Evaluation Summary & Signature Page

Site Name: Siemens Site **MRAP #** 00055-06

Address: **Survey Date:** 6/15/08

City, State, Zip **Report Date:** 7/2/08

MRI Mfg: Siemens **Model:** Trio **Field:** 3T

MRI Scientist: Moriel NessAiver, Ph.D. **Signature:** Moriel NessAiver, Ph.D.

Equipment Evaluation Tests	Pass	Fail *	N/A
1. Magnetic field homogeneity:	☒	☐	☐
2. Slice position accuracy:	☒	☐	☐
3. Table positioning reproducibility:	☒	☐	☐
4. Slice thickness accuracy:	☐	☒	☐
5. RF coils' performance:			
a. Volume QD Coils	☒	☐	☐
b. Phase Array Coils	☒	☒	☐
c. Surface Coils	☒	☐	☐
6. Inter-slice RF interference (Crosstalk):	☒	☐	☐
7. Soft Copy Display	☒	☐	☐
8. Hard Copy Display	☐	☒	☐

Evaluation of Site's Technologist QC Program	Pass	Fail *	N/A
1. Set up and positioning accuracy: (daily)	☒	☐	☐
2. Center frequency: (daily)	☒	☐	☐
3. Transmitter attenuation or gain: (daily)	☒	☐	☐
4. Geometric accuracy measurments: (daily)	☒	☐	☐
5. Spatial resolution measurements: (daily)	☒	☐	☐
6. Low contrast detectability: (daily)	☒	☐	☐
7. Head Coil SNR (daily)	☒	☐	☐
8. Body Coil SNR (weekly)	☒	☐	☐
9. Fast Spin Echo (FSE/TSE) ghosting levels: (daily)	☒	☐	☐
10. Film quality control: (weekly)	☒	☐	☐
11. Visual checklist: (weekly)	☒	☐	☐

*See comments page for description of any failures.

Specific Comments and Recommendations

1. Magnet homogeneity is very good.
2. The LCD display is fine but the data sent to the laser camera is very badly out of calibration.
3. The ACR T2 sequence has moderately high ghosting. Not so bad that it would cause failure, but higher than desirable.
4. The T2 weighted TSE and the T1-FLASH sequence both have excessively large slice thicknesses, unfortunately, there is nothing that can be done in the field… this is a sequence design problem.
5. The spine coil has three channels with SNR values below 90. Typical values should be around 130-150.
6.
7.
8.
9.
10.
11.
12.
13.

NOTE: Please be sure to read appendix D for an explanation of the new format of this document.

MRI Equipment Performance Evaluation Data Form

Site Name: Siemens Site

Contact	Title	Phone	Fax	eMail
	Chief Tech			
	QA Tech			
	MRI Director			

Equipment Information

MRI Manufacturer: Siemens Model: Trio SN: 33142 Software: Syngo B13

Camera Manufacturer: Model: SN: Software:

PACS Manufacturer: Model: SN: Software:

ACR Phantom Number used: J5534

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In	Out/In	Out/In
Measured Phantom Center	-3.6	-3.8	-3.8	-3.9

Comment: Reproducibility is very good. The basic calibration is off by 3-4 mm.

2. Magnetic Field Homogeneity See appendix A for field plots. **PASS**

Last Year CF: **123248516** This Year CF: **123248090** CF Change: **-426**

GRE TR: 500, TE: 10 & 12.46 Flip Angle: 45, FOV: 40

5 mm skip 5 mm, BW: 33.3KHz, 256x128, 2nex

	15 cm	20 cm	25 cm
Axial:	**0.02**	**0.03**	**0.06**
Coronal:	**0.09**	**0.16**	**0.26**
Sagittal:	**0.08**	**0.15**	**0.25**

Comments: The shim is very good.

3. Slice Thickness Accuracy

FOV: 250mm Matrix: 256x256 (Slice #1 from ACR Phantom) All values in mm

Sequence	TR	TE	Flip	NSA	Calc	Target	% Error
SE (ACR)	500	20	90	1	5.55	5	11.0%
SE (Site T1)	500	14	90	1	5.96	5	19.2%
SE (20/80)	2000	20	90	1	5.56	5	11.2%
SE (20/80)	2000	80	90	1	4.67	5	-6.6%
TSE(13)	500	102	90	1	6.50	5	30.0%
TSE(3)	500	8.9	90	3	5.80	5	16.0%
T1-Flash	250	12	70	2	6.80	5	36.0%

Comments: The TSE(13) and T1-FLASH are exceptionally large. The TSE(3) is also larger than expected.

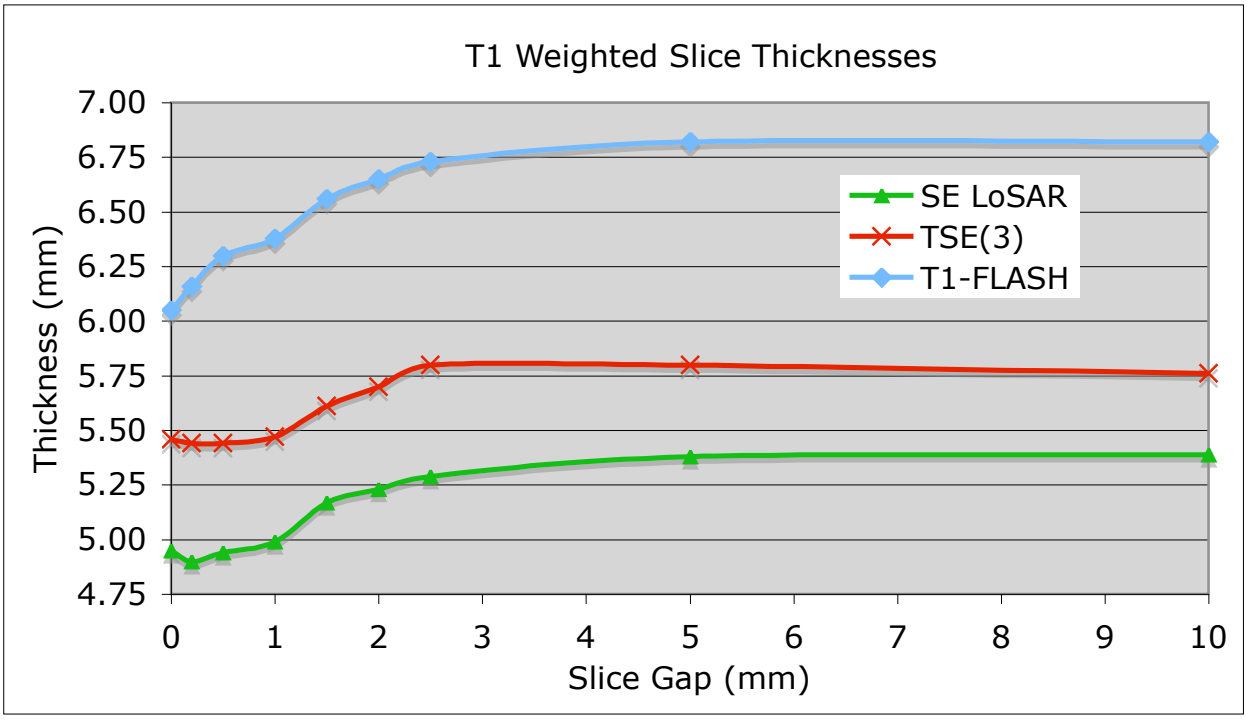
4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of three T1 weighted sequences when the slice gap varies from 200% down to 0% (contiguous) As the slices get closer together it is expected that the edges of the slices will overlap causing a deterioration of the slice profile. The data shown below clearly demonstrates this effect. Once the slice gap drops below 50% of the slice thickness, the measured slice profiles begin to change. When imaging sequences are designed, there are always tradeoffs. One of the major concerns at 3T is RF power absorption (SAR). One approach to reduce SAR is to use a gradient echo or T1-FLASH sequence. It is expected that this sequence have a poorly *SHAPED* profile but it is still expected to at least approximate the desired thickness. This sequence had a maximum thickness of over 6.8 mm or a 36% error.

All of the slice profiles can be seen in appendix B.

Sequence Type	TR	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices
SE Lo SAR	500	10	25	256x256	1	5	11
TSE(3)	500	8.9	25	256x256	3	5	11
T1-FLASH	250	12	25	256x256	2	5	11

Skip	SE LoSAR	TSE(3)	T1-FLASH
0	4.95	5.46	6.05
0.2	4.9	5.44	6.16
0.5	4.94	5.44	6.3
1	4.99	5.47	6.38
1.5	5.17	5.61	6.56
2	5.23	5.7	6.65
2.5	5.29	5.8	6.73
5	5.38	5.8	6.82
10	5.39	5.76	6.82



5. Soft & Hard Copy Displays

Luminance Meter Make/Model: Tektronix J16 Digital Photometer Cal Expires: 4/6/06

Monitor Description: Siemens LCD

Luminance Measured: Ft. lamberts

Measured Data					
Which Monitor	Center of Image Display	Top Left Corner	Top Right Corner	Bottom Left Corner	Bottom Right Corner
Console	39.5	39.7	35.4	36.4	33

Uniformity		
MAX	MIN	Percent Delta
39.7	33	18%

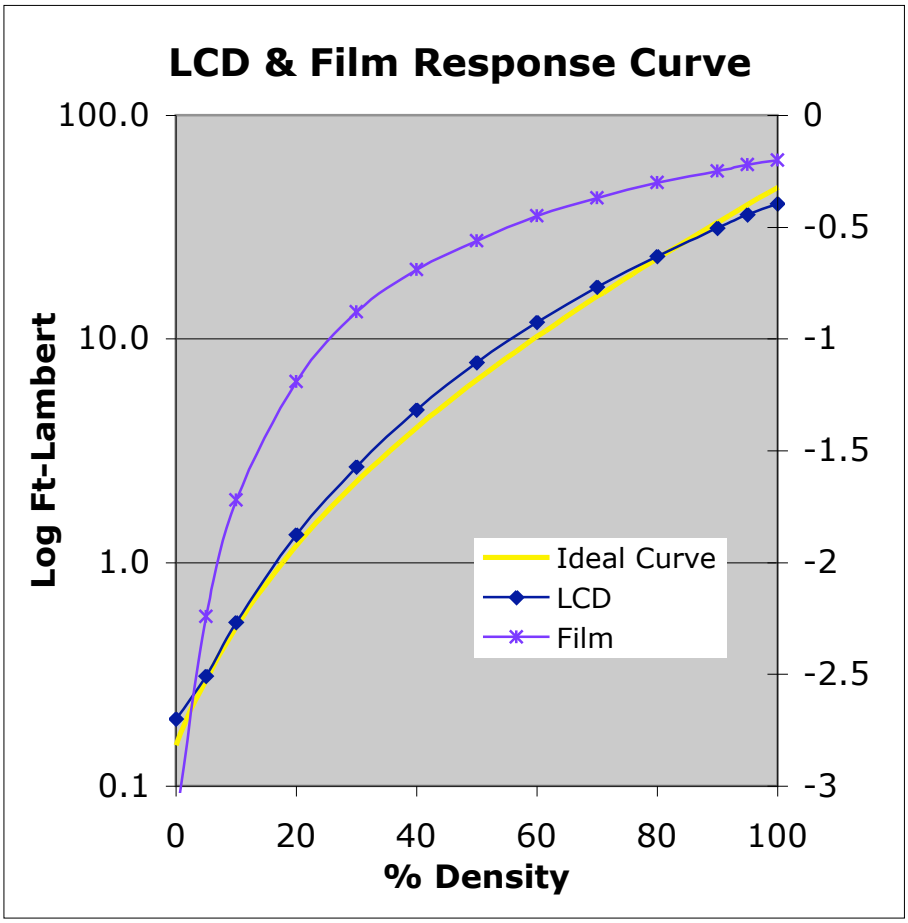
SMPTE
OK?
Y

% delta =200% x (max-min)/(max+center) (>30% is action limit)

Minimum Brightness must be > 26.24 Ft. Lamberts

The soft copy (LCD) is excellent. The film does not come close to matching what is displayed.

Density	Ft-Lamber	Film Density
0	0.20	-3.15
5	0.31	-2.24
10	0.54	-1.72
20	1.33	-1.19
30	2.69	-0.88
40	4.81	-0.69
50	7.86	-0.56
60	11.86	-0.45
70	17.1	-0.37
80	23.4	-0.3
90	31.4	-0.25
95	36.0	-0.22
100	40.2	-0.2



Coil and Other Hardware Inventory List

Site Name: Siemens Site

ACR Magnet #: 6 Nickname: Siemens 3

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☐	Body Matrix	Siemens	08622651			1106	2
☐	Body Matrix	Siemens	08622651			1105	2
☐	Head Matrix	Siemens	8622644			1071	4
☐	Neck Matrix	Siemens	8622677			1062	2
☐	Shoulder - Large	InVivo	8623626			1030	4
☐	Spine Array	Siemens	8622743			1068	8
☒	Body Coil - Integrated	Siemens					1
☒	Body Matrix	Siemens	08622651			1043	2
☒	Body Matrix	Siemens	08622651			1340	2
☒	Breasts - 4 channel	InVivo	8622727		Nov, 2005	1028	4
☒	Head Matrix	Siemens	8622644			1116	4
☒	Head/Neck Matrix	Siemens	8622677		Feb, 2006	1095	4
☒	Knee - 8 channel	InVivo	8622693		Feb, 2006	1043	8
☒	Shoulder - Large	InVivo	8623626		Mar, 2006	1077	4
☒	Shoulder - Small	InVivo	8622719			1031	4
☒	Spine Array	Siemens	8622743			1021	8
☒	Wrist Coil - CP	Siemens	8622701		Dec, 2005	10020	1
☐							

RF Coil Performance Evaluation

Coil: Body Coil - Integrated

Mfg.: Siemens

Mfg. Date: _____ Coil ID: 605

Phantom: GE Shim sphere - WATER!

Test Date: 6/15/2008

Model: _____

Revision: _____

SN: _____

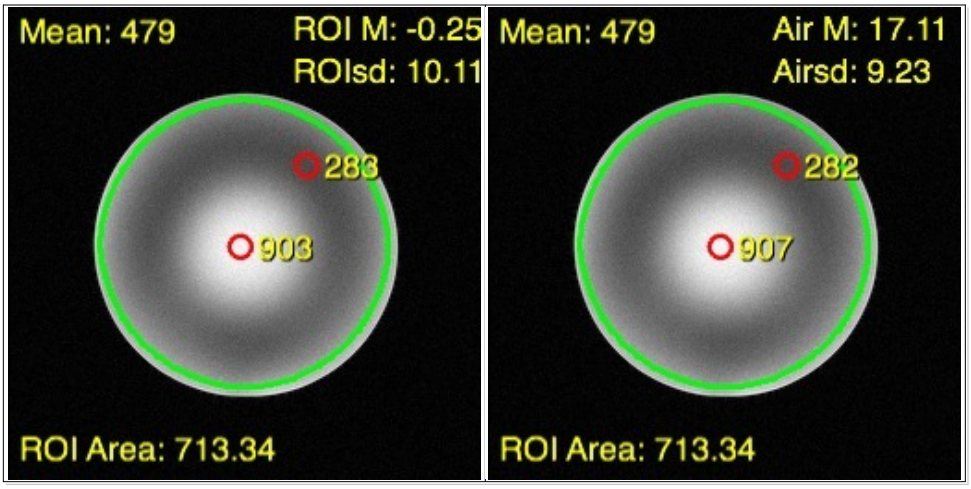
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: Body

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	479	903	283	-0.3	10.11	NEMA	33.5	15.5	63.2	47.7%
A	479	907	282	17.1	9.23	Air	34.0	15.7	64.4	47.4%



Test Images

RF Coil Performance Evaluation

Coil: Body Coil - Integrated

Mfg.: Siemens

Mfg. Date: _____ Coil ID: 605

Phantom: Siemens oil sphere

Test Date: 6/15/2008

Model: _____

Revision: _____

SN: _____

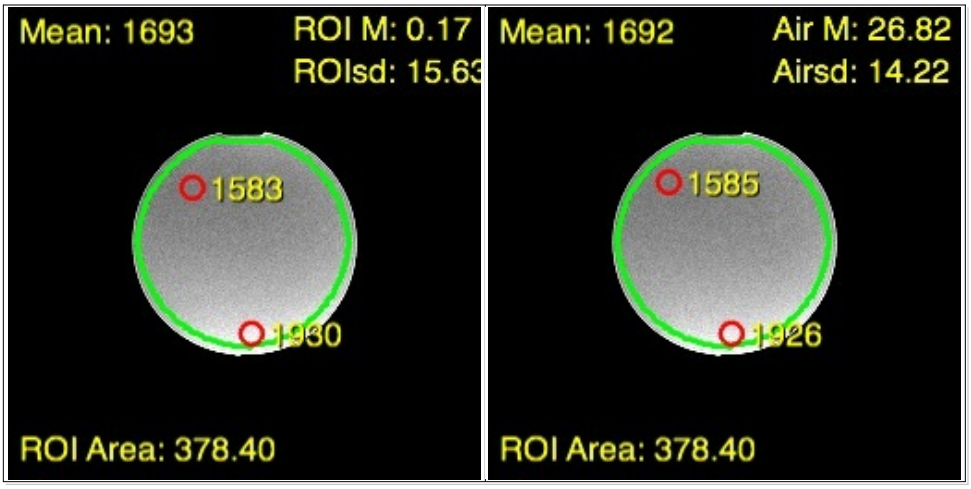
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: Body

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,693	1,930	1,583	0.2	15.63	NEMA	76.6	35.3	87.3	90.1%
A	1,692	1,926	1,585	26.8	14.22	Air	78.0	36.0	88.8	90.3%



Test Images

RF Coil Performance Evaluation

Coil: Body Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1133
Phantom: 2 Large cylinders

Test Date: 6/15/2008
Model: 08622651
Revision: _____
SN: 1043
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: B12

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	857	1,370	456	0.0	2.82	NEMA
N	894	1,322	503	-0.3	2.77	NEMA
A	857	1,371	456	5.9	2.48	Air
A	895	1,322	504	5.9	2.48	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
214.9	99.1	343.6	49.9%
228.2	105.3	337.5	55.1%
226.5	104.4	362.3	49.9%
236.5	109.1	349.3	55.2%

Analysis of Uncombined Images

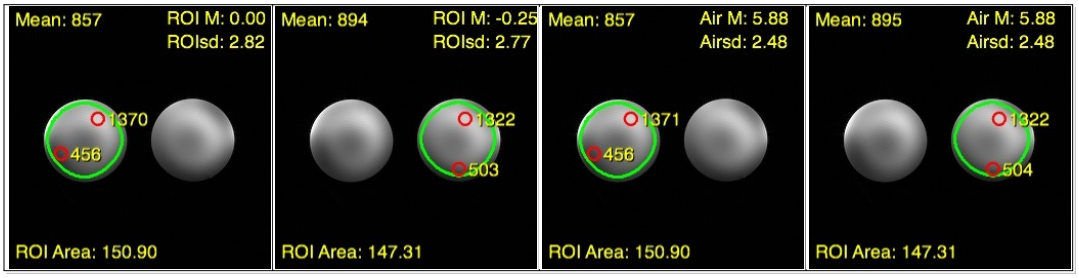
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	594	982	2.27	Air
2	682	1,056	2.27	Air
3	617	960	2.33	Air
4	576	818	2.33	Air

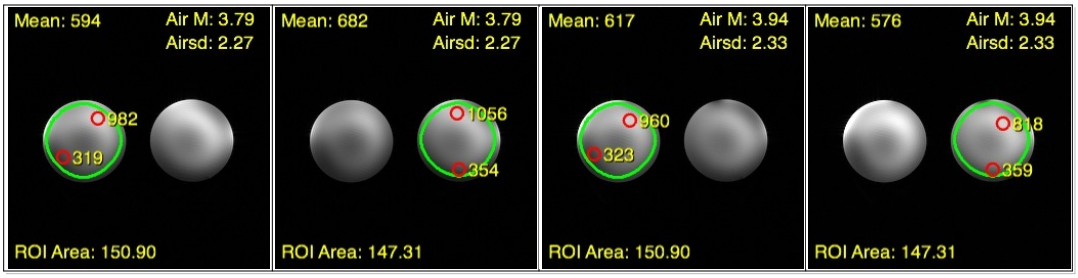
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
171.5	87%	283.5	93%
196.9	100%	304.8	100%
173.5	88%	270.0	89%
162.0	82%	230.1	75%

Composites



Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Body Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1133
Phantom: 2 Large cylinders

Test Date: 6/15/2008
Model: 08622651
Revision: _____
SN: 1043
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	50	256	256	25.6	2	3	-

Coil Mode: B12

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	744	1,243	189	0.0	2.48	NEMA
N	709	1,227	96	-0.4	2.15	NEMA
A	744	1,243	188	4.8	2.04	Air
A	709	1,227	96	4.8	2.04	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
212.2	69.2	354.5	26.4%
233.2	76.1	403.6	14.5%
239.0	77.9	399.3	26.3%
227.8	74.3	394.1	14.5%

Analysis of Uncombined Images

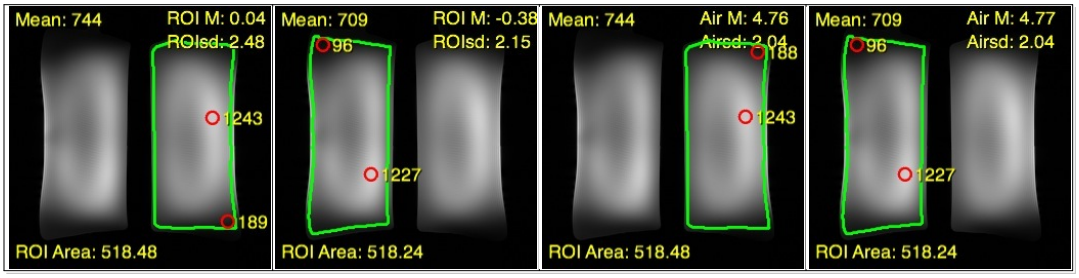
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	381	1,058	1.82	Air
2	458	1,183	1.80	Air
3	441	1,217	1.89	Air
4	440	1,084	1.89	Air

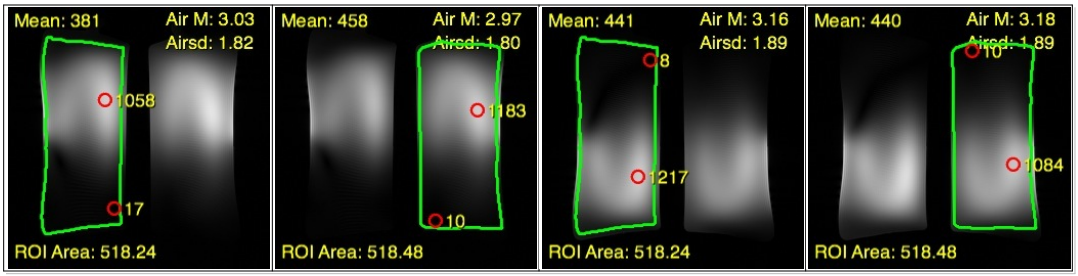
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
137.2	82%	380.9	88%
166.7	100%	430.7	100%
152.9	92%	422.0	98%
152.6	91%	375.8	87%

Composites



Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Body Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1134
Phantom: 2 Large cylinders

Test Date: 6/15/2008
Model: 08622651
Revision: _____
SN: 1340
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: B12

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	947	1,413	514	1.9	12.86	NEMA
N	908	1,439	497	-1.9	4.86	NEMA
A	945	1,398	526	5.9	2.49	Air
A	910	1,440	493	5.9	2.49	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
52.1	24.0	77.7	53.3%
132.1	60.9	209.4	51.3%
248.7	114.7	367.9	54.7%
239.5	110.4	379.0	51.0%

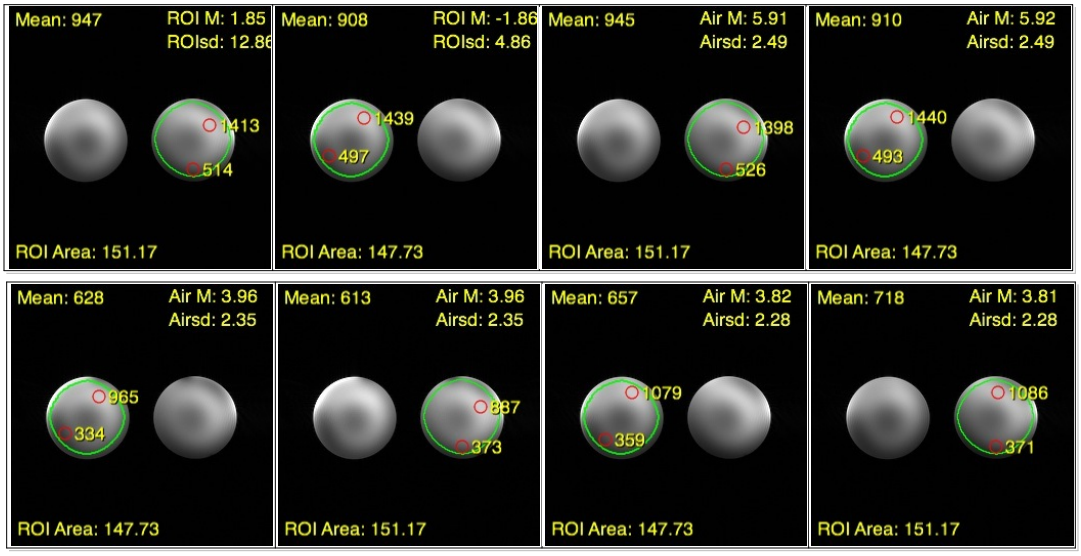
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	628	965	2.35	Air
2	613	887	2.35	Air
3	657	1,079	2.28	Air
4	718	1,086	2.28	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
175.1	85%	269.1	86%
170.9	83%	247.3	79%
188.8	92%	310.1	99%
206.4	100%	312.1	100%



RF Coil Performance Evaluation

Coil: Body Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1134
Phantom: 2 Large cylinders

Test Date: 6/15/2008
Model: 08622651
Revision: _____
SN: 1340
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	50	256	256	25.6	2	3	-

Coil Mode: B12

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	758	1,262	177	-0.6	2.16	NEMA
N	725	1,265	100	0.3	2.39	NEMA
A	759	1,262	178	4.8	2.08	Air
A	724	1,264	100	4.8	2.08	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
248.2	80.9	413.2	24.6%
214.5	70.0	374.3	14.7%
239.1	78.0	397.6	24.7%
228.1	74.4	398.2	14.7%

Analysis of Uncombined Images

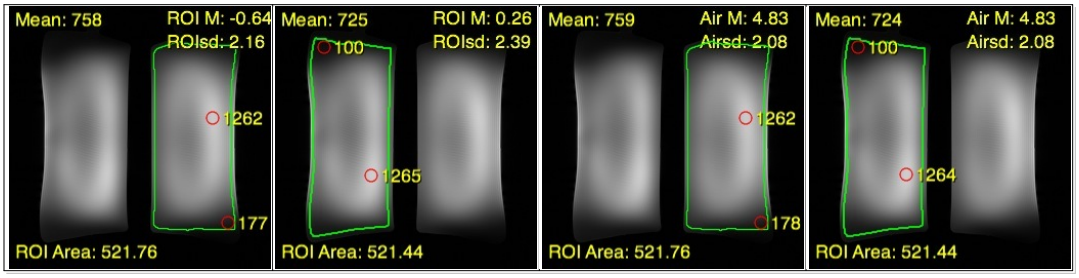
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	393	1,089	1.85	Air
2	470	1,194	1.83	Air
3	449	1,254	1.91	Air
4	455	1,099	1.92	Air

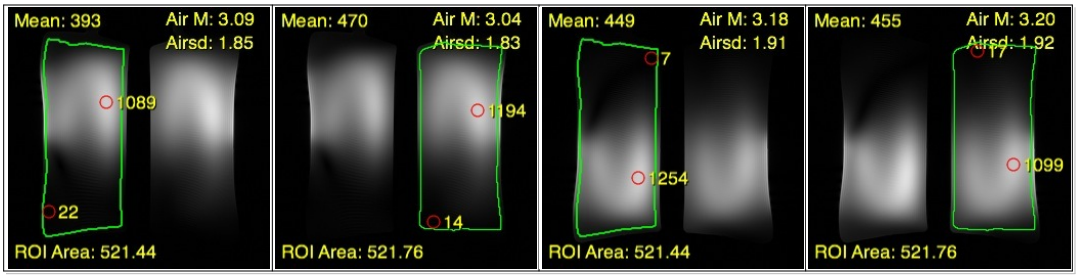
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
139.2	83%	385.7	90%
168.3	100%	427.6	99%
154.0	92%	430.2	100%
155.3	92%	375.1	87%

Composites

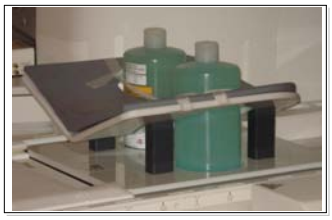


Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Breasts - 4 channel
Mfg.: InVivo
Mfg. Date: 11/1/2005 Coil ID: 606
Phantom: One bottle in each breast

Test Date: 6/15/2008
Model: 8622727
Revision:
SN: 1028
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: Bilateral Breast

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	1,600	2,356	795	0.9	2.68	NEMA
N	1,633	2,220	797	1.1	1.87	NEMA
A	1,599	2,355	793	4.7	1.55	Air
A	1,632	2,218	797	4.7	1.55	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
422.2	194.7	621.7	50.5%
617.6	284.8	839.6	52.8%
676.0	311.8	995.6	50.4%
690.0	318.2	937.7	52.9%

Analysis of Uncombined Images

Measured Data

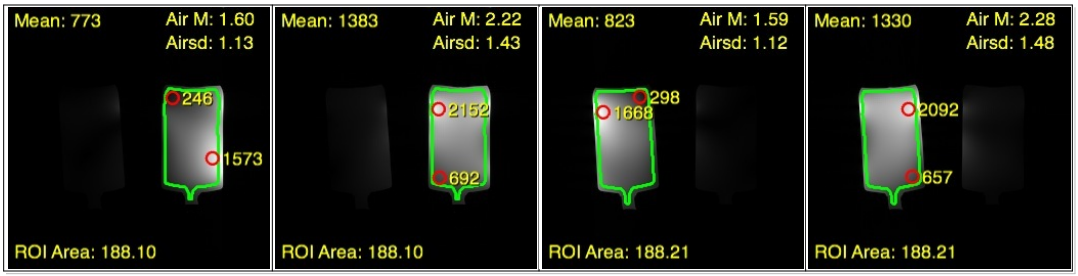
Ch	Mean	Max	Noise SD	Noise Type
1	773	1,573	1.13	Air
2	1,383	2,152	1.43	Air
3	823	1,668	1.12	Air
4	1,330	2,092	1.48	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
448.3	71%	912.2	93%
633.8	100%	986.2	100%
481.5	76%	975.9	99%
588.9	93%	926.3	94%

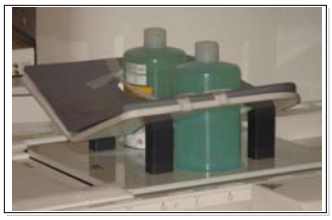
Composites

Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Breasts - 4 channel
Mfg.: InVivo
Mfg. Date: 11/1/2005 Coil ID: 606
Phantom: One bottle in each breast

Test Date: 6/15/2008
Model: 8622727
Revision:
SN: 1028
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	50	256	256	25.6	1	3	-

Coil Mode: Bilateral Breast

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,671	1,846	1,488	1.0	2.44	NEMA
N	1,636	1,789	1,495	1.0	2.95	NEMA
A	1,670	1,844	1,489	7.4	2.23	Air
A	1,635	1,790	1,491	7.4	2.23	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
484.3	223.4	535.0	89.3%
392.2	180.9	428.9	91.0%
490.7	226.3	541.9	89.3%
480.5	221.6	526.0	90.9%

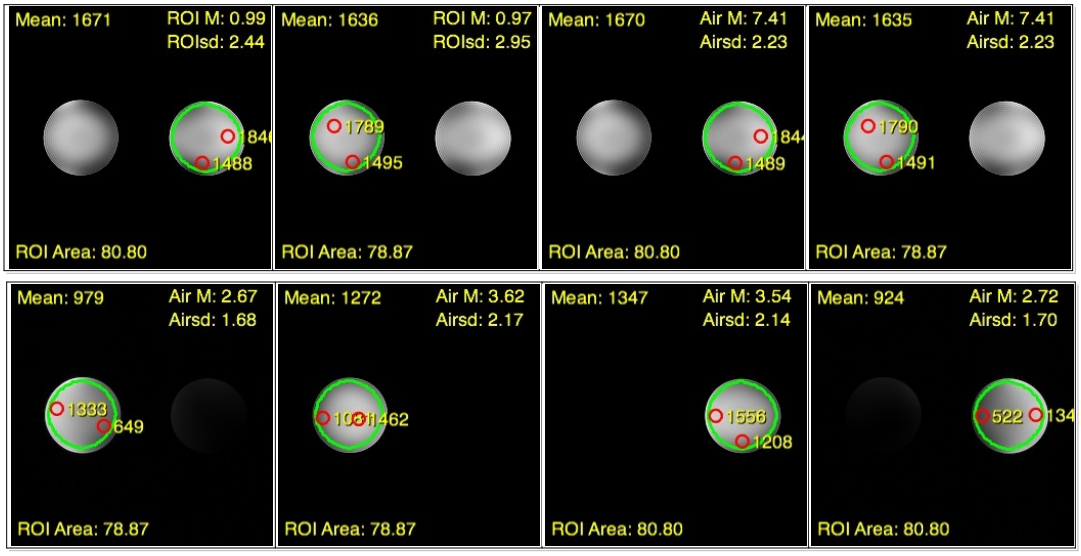
Analysis of Uncombined Images

Measured Data

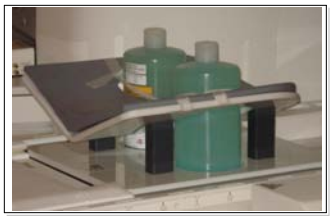
Ch	Mean	Max	Noise SD	Noise Type
1	979	1,333	1.68	Air
2	1,272	1,462	2.17	Air
3	1,347	1,556	2.14	Air
4	924	1,346	1.70	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
381.9	93%	520.0	100%
384.1	93%	441.5	85%
412.5	100%	476.5	92%
356.2	86%	518.8	100%



RF Coil Performance Evaluation



Coil: Breasts - 4 channel
Mfg.: InVivo
Mfg. Date: 11/1/2005 Coil ID: 606
Phantom: One bottle in each breast

Test Date: 6/15/2008
Model: 8622727
Revision:
SN: 1028
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: Left Breast

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,631	2,240	803	1.0	1.74	NEMA
A	1,630	2,238	802	2.9	1.42	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
662.9	305.7	910.4	52.8%
752.2	346.9	1032.8	52.8%

Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	771	1,562	1.14	Air
2	1,394	2,192	1.42	Air

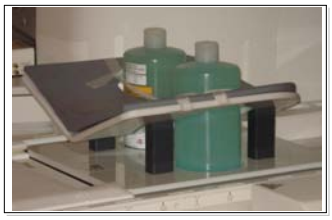
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
443.2	69%	897.9	89%
643.3	100%	1011.6	100%

Composites

Channel 1 Channel 2

RF Coil Performance Evaluation



Coil: Breasts - 4 channel
Mfg.: InVivo
Mfg. Date: 11/1/2005 Coil ID: 606
Phantom: One bottle in each breast

Test Date: 6/15/2008
Model: 8622727
Revision:
SN: 1028
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.73	1	3	100

Coil Mode: Right Breast

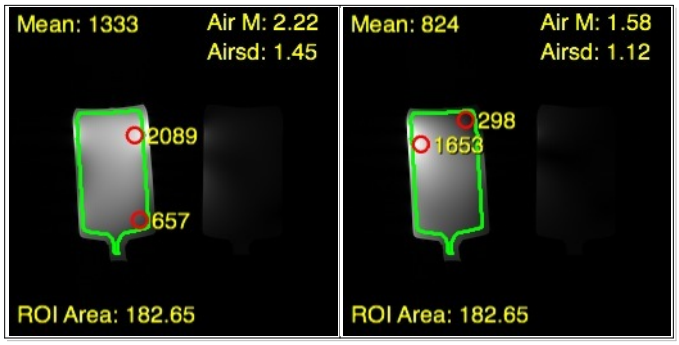
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,593	2,371	761	0.1	2.09	NEMA	539.0	249.2	802.3	48.6%
A	1,593	2,372	760	2.9	1.42	Air	735.1	339.9	1094.6	48.5%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	1,333	2,089	1.45	Air	602.4	100%	944.1	98%
2	824	1,653	1.12	Air	482.1	80%	967.2	100%

Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Head Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1135
Phantom: ACR Phantom

Test Date: 6/15/2008
Model: 8622644
Revision: _____
SN: 1116
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	25.6	1	3	-

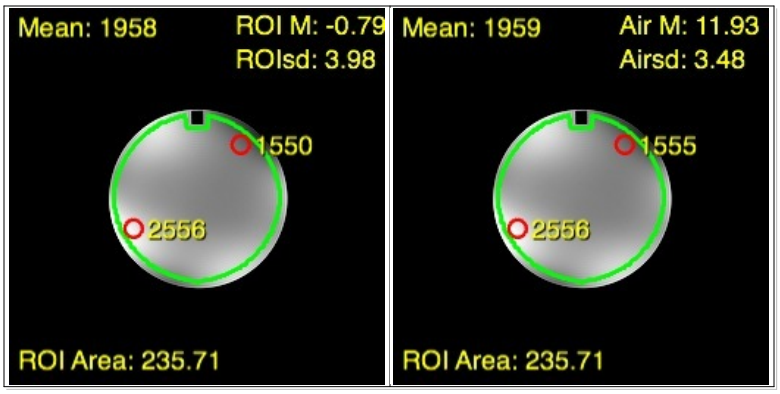
Coil Mode: Head 1,2,3,4

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,958	2,556	1,550	-0.8	3.98	NEMA	347.9	250.7	454.2	75.5%
A	1,959	2,556	1,555	11.9	3.48	Air	368.9	265.8	481.3	75.7%

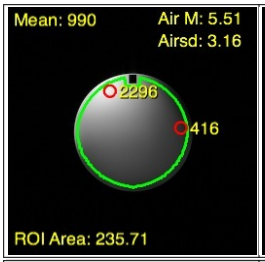
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	990	2,296	3.16	Air	205.3	100%	476.1	100%
2	940	2,107	3.26	Air	189.0	92%	423.5	89%
3	602	1,421	2.29	Air	172.3	84%	406.6	85%
4	892	2,376	3.31	Air	176.6	86%	470.4	99%



Composites

Channel 1



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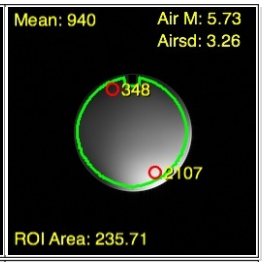
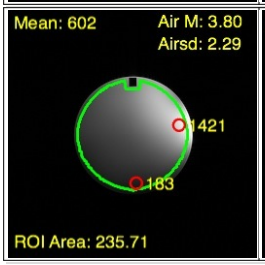
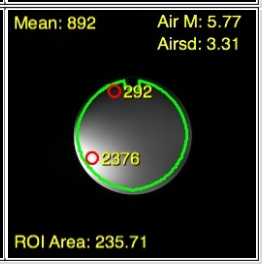




Channel 3



Channel 4

RF Coil Performance Evaluation

Coil: Head/Neck Matrix
Mfg.: Siemens
Mfg. Date: 2/1/2006 Coil ID: 1136
Phantom: Large Cylinder

Test Date: 6/15/2008
Model: 8622677
Revision:
SN: 1095
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

Coil Mode: a HE1-4; NE1,2 Superior

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,114	1,462	676	-1.3	7.36	NEMA
A	1,115	1,462	678	19.0	4.91	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
107.0	95.2	140.5	63.2%
148.8	132.4	195.1	63.4%

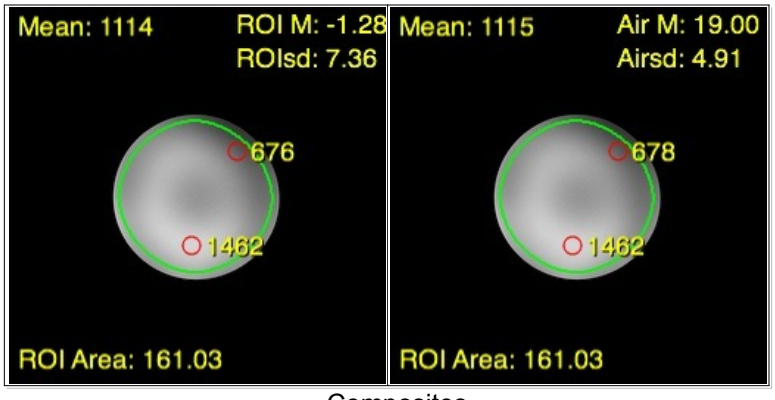
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	410	781	4.33	Air
2	301	668	2.25	Air
3	429	842	4.96	Air
4	631	1,175	3.08	Air
5	423	774	4.78	Air
6	245	455	2.89	Air

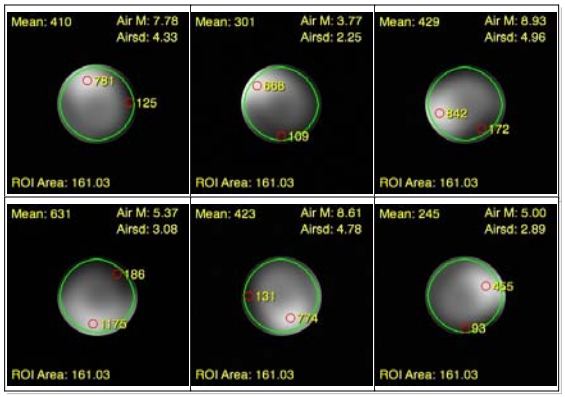
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
62.0	46%	118.2	47%
87.7	65%	194.6	78%
56.7	42%	111.2	44%
134.3	100%	250.0	100%
58.0	43%	106.1	42%
55.6	41%	103.2	41%



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Head/Neck Matrix
Mfg.: Siemens
Mfg. Date: 2/1/2006 Coil ID: 1136
Phantom: Large Cylinder

Test Date: 6/15/2008
Model: 8622677
Revision:
SN: 1095
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

Coil Mode: b He1-4 Ne1,2 Inferior

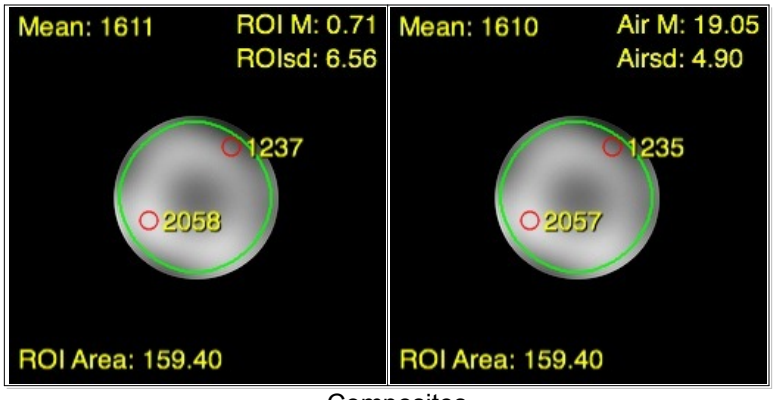
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,611	2,058	1,237	0.7	6.56	NEMA	173.7	154.5	221.9	75.1%
A	1,610	2,057	1,235	19.1	4.90	Air	215.3	191.5	275.1	75.0%

Analysis of Uncombined Images

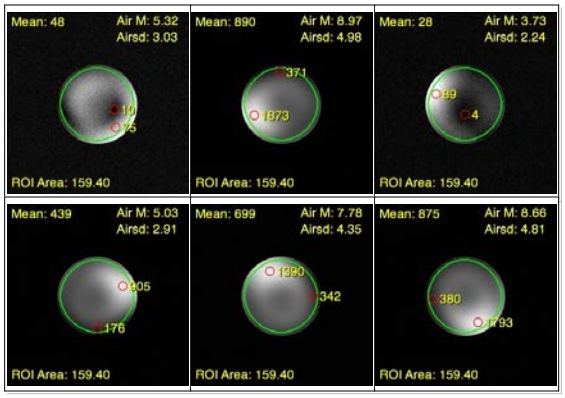
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	48	75	3.03	Air	10.4	9%	16.2	7%
2	890	1,873	4.98	Air	117.1	98%	246.5	100%
3	28	89	2.24	Air	8.2	7%	26.0	11%
4	439	905	2.91	Air	98.9	83%	203.8	83%
5	699	1,390	4.35	Air	105.3	88%	209.4	85%
6	875	1,793	4.81	Air	119.2	100%	244.3	99%

The two very low SNR channels are located up at the superior end of the coil.



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Head/Neck Matrix
Mfg.: Siemens
Mfg. Date: 2/1/2006 Coil ID: 1136
Phantom: Large Cylinder

Test Date: 6/15/2008
Model: 8622677
Revision:
SN: 1095
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	50	256	256	25.6	1	3	-

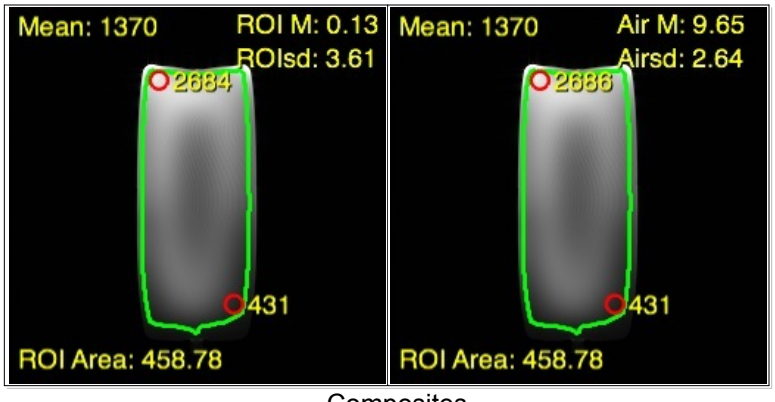
Coil Mode: c He1-4 Ne1,2

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,370	2,684	431	0.1	3.61	NEMA	268.4	123.8	525.8	27.7%
A	1,370	2,686	431	9.7	2.64	Air	340.1	156.8	666.7	27.7%

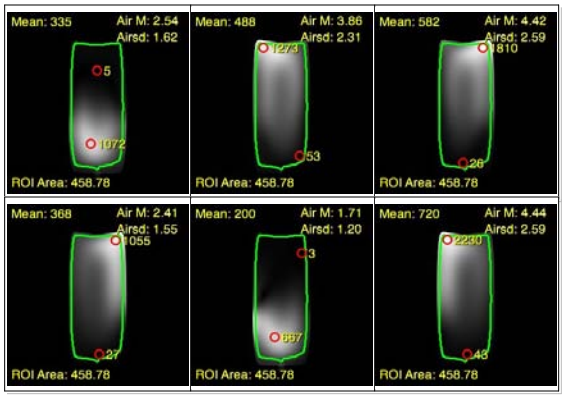
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	335	1,072	1.62	Air	135.5	74%	433.6	77%
2	488	1,273	2.31	Air	138.4	76%	361.1	64%
3	582	1,810	2.59	Air	147.3	81%	458.0	81%
4	368	1,055	1.55	Air	155.6	85%	446.0	79%
5	200	667	1.20	Air	109.2	60%	364.2	65%
6	720	2,230	2.59	Air	182.2	100%	564.2	100%



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Head/Neck Matrix
Mfg.: Siemens
Mfg. Date: 2/1/2006 Coil ID: 1136
Phantom: Large Cylinder

Test Date: 6/15/2008
Model: 8622677
Revision:
SN: 1095
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

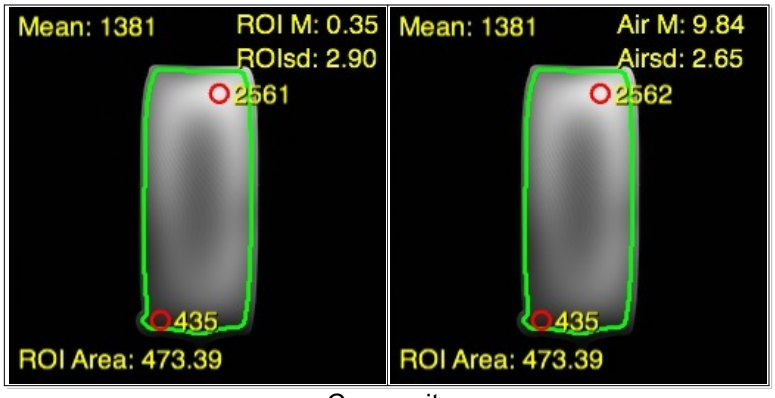
Coil Mode: d He1-4 Ne1,2

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,381	2,561	435	0.4	2.90	NEMA	336.8	155.3	624.5	29.0%
A	1,381	2,562	435	9.8	2.65	Air	341.5	157.5	633.5	29.0%

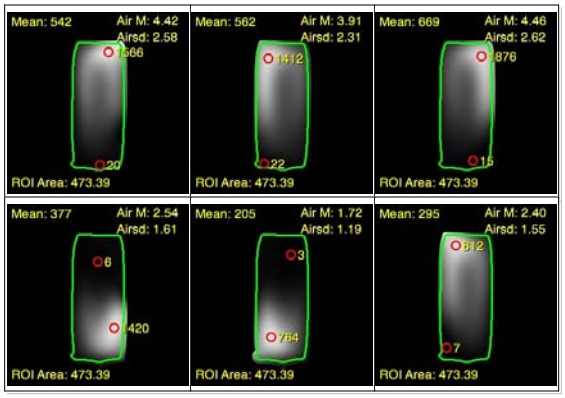
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	542	1,566	2.58	Air	137.7	82%	397.8	69%
2	562	1,412	2.31	Air	159.4	95%	400.6	69%
3	669	1,876	2.62	Air	167.3	100%	469.2	81%
4	377	1,420	1.61	Air	153.4	92%	578.0	100%
5	205	764	1.19	Air	112.9	67%	420.7	73%
6	295	812	1.55	Air	124.7	75%	343.3	59%



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Knee - 8 channel
Mfg.: InVivo
Mfg. Date: 2/1/2006 Coil ID: 612
Phantom: 8 channel knee coil

Test Date: 6/15/2008
Model: 8622693
Revision:
SN: 1043
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	25.6	1	3	-

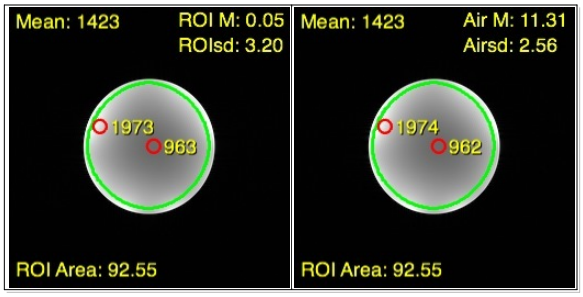
Coil Mode: 8Ch_Knee

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,423	1,973	963	0.1	3.20	NEMA	314.5	580.1	436.0	65.6%
A	1,423	1,974	962	11.3	2.56	Air	364.3	671.9	505.3	65.5%

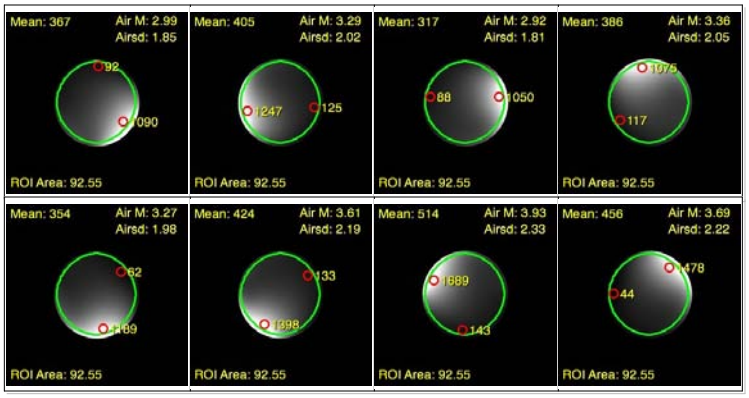
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	367	1,090	1.85	Air	130.0	90%	386.1	81%
2	405	1,247	2.02	Air	131.4	91%	404.5	85%
3	317	1,050	1.81	Air	114.8	79%	380.2	80%
4	386	1,075	2.05	Air	123.4	85%	343.6	72%
5	354	1,189	1.98	Air	117.2	81%	393.5	83%
6	424	1,398	2.19	Air	126.9	88%	418.3	88%
7	514	1,689	2.33	Air	144.6	100%	475.0	100%
8	456	1,478	2.22	Air	134.6	93%	436.3	92%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Shoulder - Large
Mfg.: InVivo
Mfg. Date: 3/1/2006 Coil ID: 1137
Phantom: Small Cylinder

Test Date: 6/15/2008
Model: 8623626
Revision:
SN: 1077
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

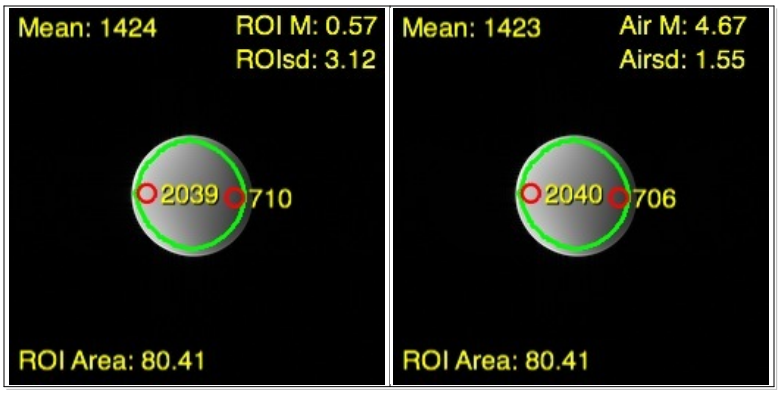
Coil Mode: Shoulder

Analysis of Composite Image

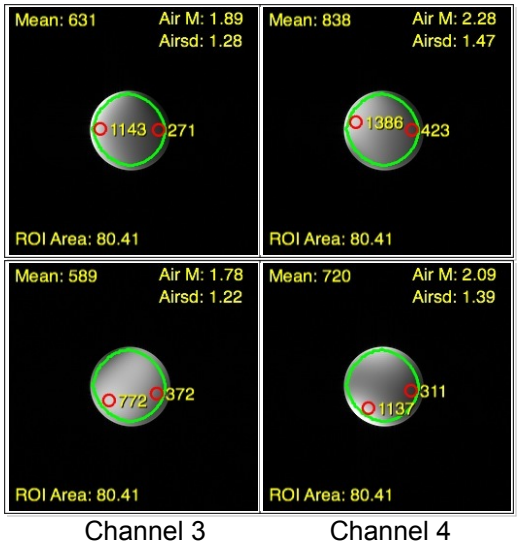
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,424	2,039	710	0.6	3.12	NEMA	322.8	287.1	462.2	51.7%
A	1,423	2,040	706	4.7	1.55	Air	601.6	535.2	862.5	51.4%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	631	1,143	1.28	Air	323.0	86%	585.2	95%
2	838	1,386	1.47	Air	373.6	100%	617.9	100%
3	589	772	1.22	Air	316.4	85%	414.7	67%
4	720	1,137	1.39	Air	339.4	91%	536.0	87%



Composites



RF Coil Performance Evaluation

Coil: Shoulder - Large

Mfg.: InVivo

Mfg. Date: 3/1/2006 Coil ID: 1137

Phantom: Small Cylinder

Test Date: 6/15/2008

Model: 8623626

Revision:

SN: 1077

# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	25.6	1	3	-

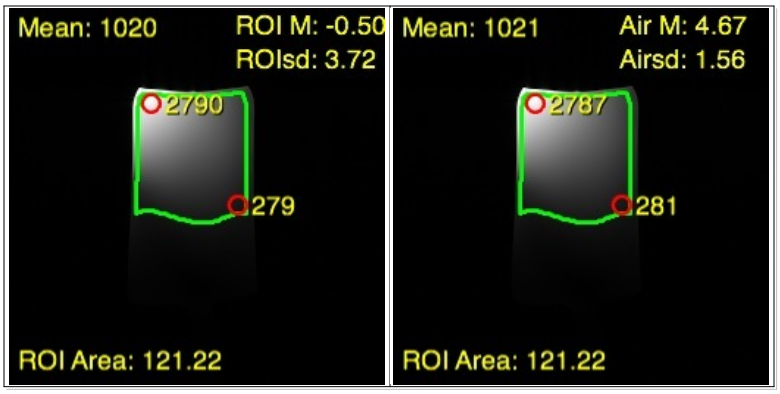
Coil Mode: Shoulder

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,020	2,790	279	-0.5	3.72	NEMA	193.9	172.5	530.4	18.2%
A	1,021	2,787	281	4.7	1.56	Air	428.9	381.5	1170.7	18.3%

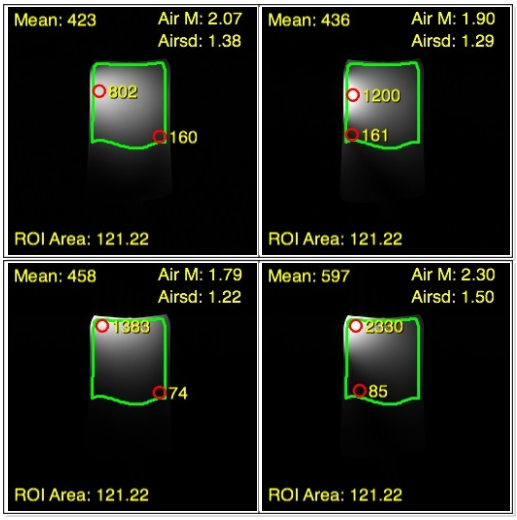
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	423	802	1.38	Air	200.9	77%	380.8	37%
2	436	1,200	1.29	Air	221.5	85%	609.6	60%
3	458	1,383	1.22	Air	246.0	94%	742.9	73%
4	597	2,330	1.50	Air	260.8	100%	1017.9	100%



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Shoulder - Small
Mfg.: InVivo
Mfg. Date: _____ Coil ID: 630
Phantom: Small Cylinder

Test Date: 6/15/2008
Model: 8622719
Revision: _____
SN: 1031
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

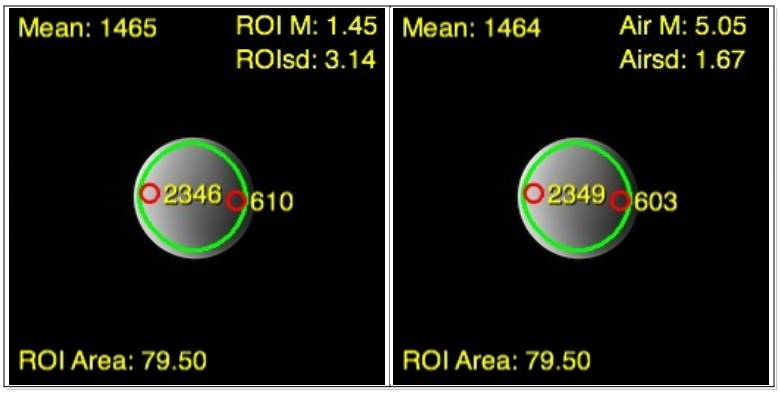
Coil Mode: Shoulder

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,465	2,346	610	1.5	3.14	NEMA	330.0	293.5	528.4	41.3%
A	1,464	2,349	603	5.1	1.67	Air	574.5	511.1	921.7	40.9%

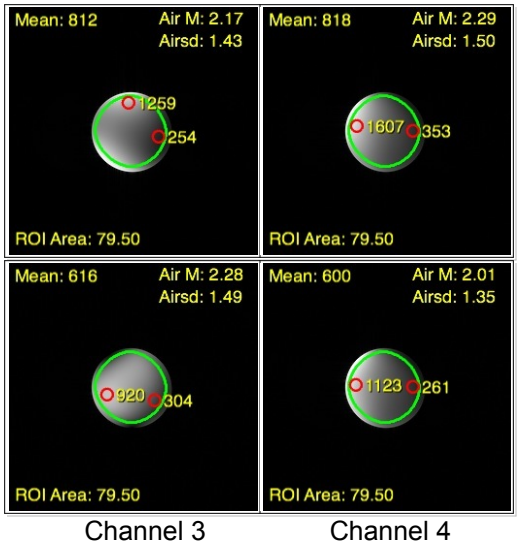
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	812	1,259	1.43	Air	372.1	100%	576.9	82%
2	818	1,607	1.50	Air	357.4	96%	702.1	100%
3	616	920	1.49	Air	270.9	73%	404.6	58%
4	600	1,123	1.35	Air	291.2	78%	545.1	78%



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Shoulder - Small

Mfg.: InVivo

Mfg. Date: _____ Coil ID: 630

Phantom: Small Cylinder

Test Date: 6/15/2008

Model: 8622719

Revision: _____

SN: 1031

# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	25.6	1	3	-

Coil Mode: Shoulder

Analysis of Composite Image

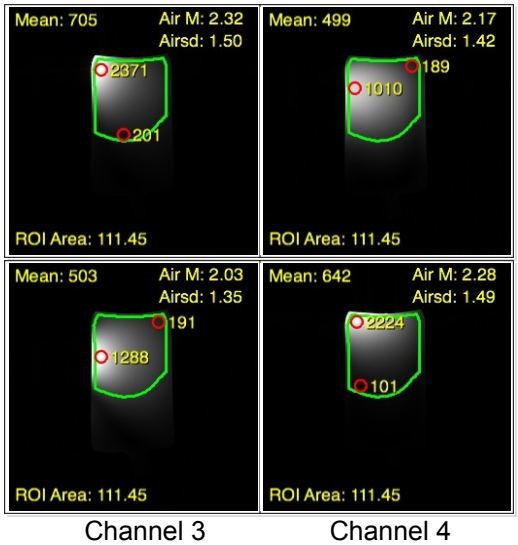
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,264	3,298	451	0.2	2.31	NEMA	387.0	344.3	1009.7	24.1%
A	1,264	3,301	450	5.1	1.65	Air	502.0	446.6	1311.0	24.0%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	705	2,371	1.50	Air	308.0	100%	1035.8	100%
2	499	1,010	1.42	Air	230.3	75%	466.1	45%
3	503	1,288	1.35	Air	244.2	79%	625.2	60%
4	642	2,224	1.49	Air	282.4	92%	978.1	94%

Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Spine Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1138
Phantom: Large cylinder in middle

Test Date: 6/15/2008
Model: 8622743
Revision: _____
SN: 1021
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

Coil Mode: SP 1,2

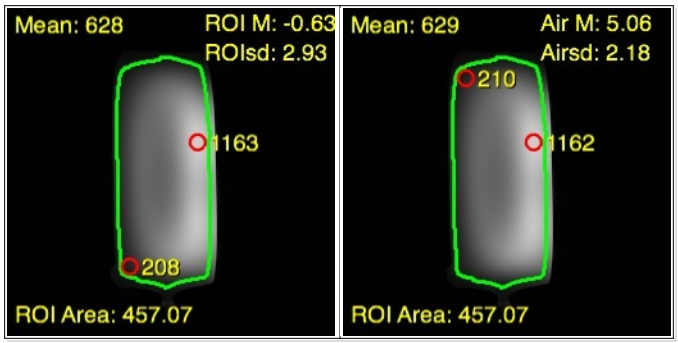
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	628	1,163	208	-0.6	2.93	NEMA	151.6	69.9	280.7	30.3%
A	629	1,162	210	5.1	2.18	Air	189.1	87.2	349.3	30.6%

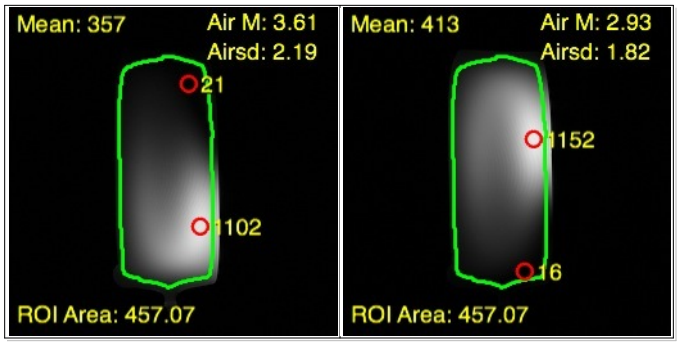
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	357	1,102	2.19	Air	106.8	72%	329.7	79%
2	413	1,152	1.82	Air	148.7	100%	414.8	100%

Channel 2 has 30% lower SNR than it should



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Spine Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1138
Phantom: Large cylinder in middle

Test Date: 6/15/2008
Model: 8622743
Revision: _____
SN: 1021
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

Coil Mode: SP 3,4

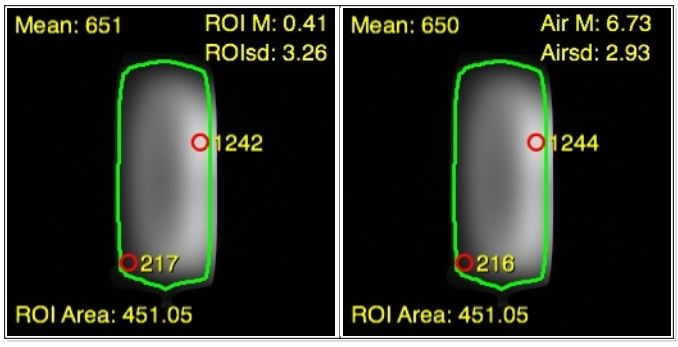
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	651	1,242	217	0.4	3.26	NEMA	141.2	65.1	269.4	29.7%
A	650	1,244	216	6.7	2.93	Air	145.4	67.0	278.2	29.6%

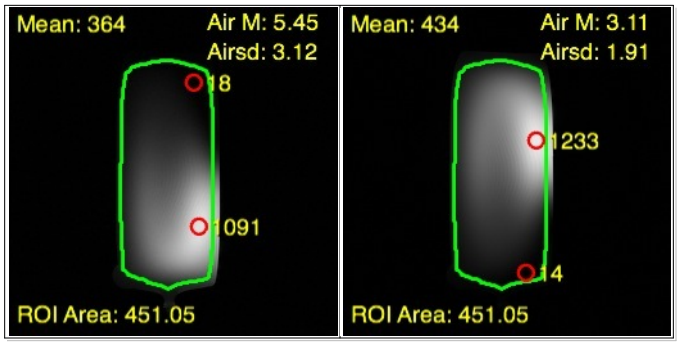
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
4	364	1,091	3.12	Air	76.5	51%	229.1	54%
3	434	1,233	1.91	Air	148.9	100%	423.0	100%

Channel 4 has 50% lower SNR than it should



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Spine Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1138
Phantom: Large cylinder in middle

Test Date: 6/15/2008
Model: 8622743
Revision: _____
SN: 1021
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

Coil Mode: SP 5,6

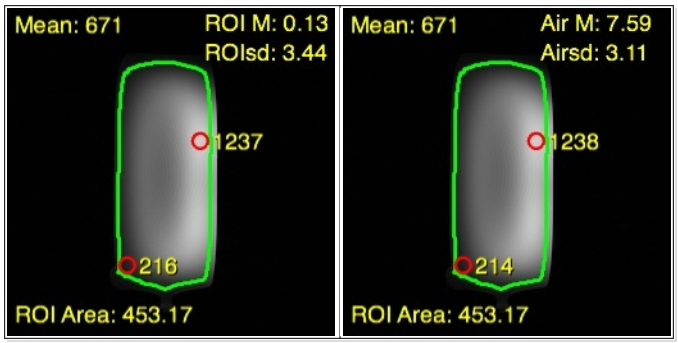
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	671	1,237	216	0.1	3.44	NEMA	137.9	63.6	254.3	29.7%
A	671	1,238	214	7.6	3.11	Air	141.4	65.2	260.9	29.5%

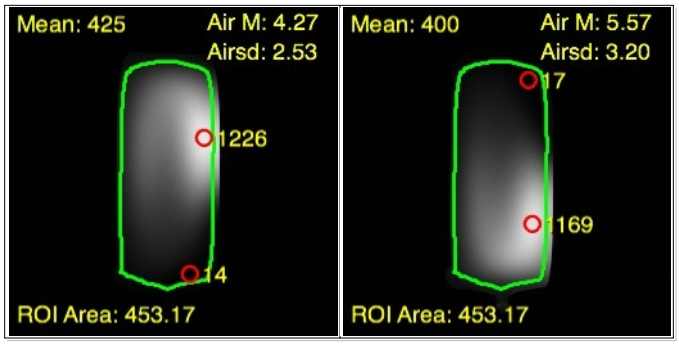
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
5	425	1,226	2.53	Air	110.1	100%	317.6	100%
6	400	1,169	3.20	Air	81.9	74%	239.4	75%

Channel 6 SNR is 25-40% lower than it should be.



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Spine Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1138
Phantom: Large cylinder in middle

Test Date: 6/15/2008
Model: 8622743
Revision:
SN: 1021
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

Coil Mode: SP 7,8

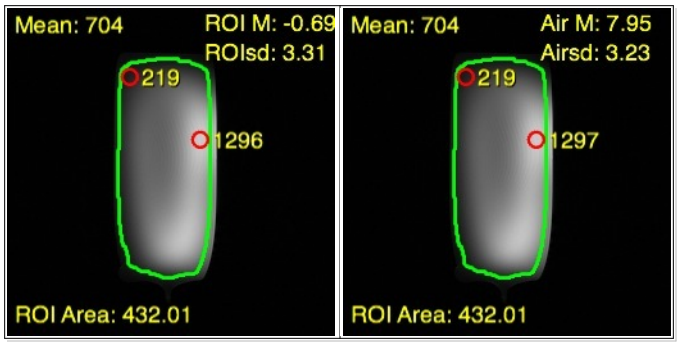
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	704	1,296	219	-0.7	3.31	NEMA	150.4	69.4	276.9	28.9%
A	704	1,297	219	8.0	3.23	Air	142.8	65.9	263.1	28.9%

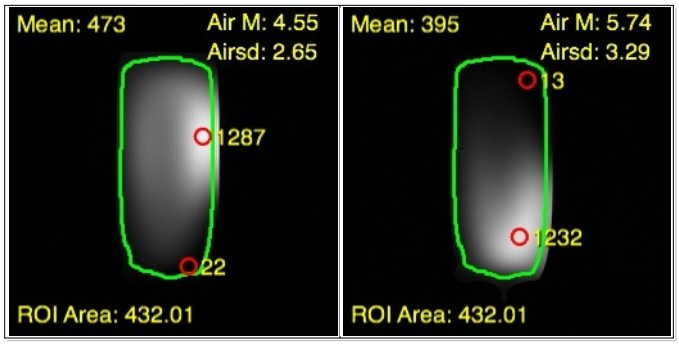
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
7	473	1,287	2.65	Air	117.0	100%	318.3	100%
8	395	1,232	3.29	Air	78.7	67%	245.4	77%

Channel 8 SNR is 30-40% lower than it should be.



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Wrist Coil - CP

Mfg.: Siemens

Mfg. Date: 12/1/2005 Coil ID: 611

Phantom: Wrist phantom

Test Date: 6/15/2008

Model: 8622701

Revision:

SN: 10020

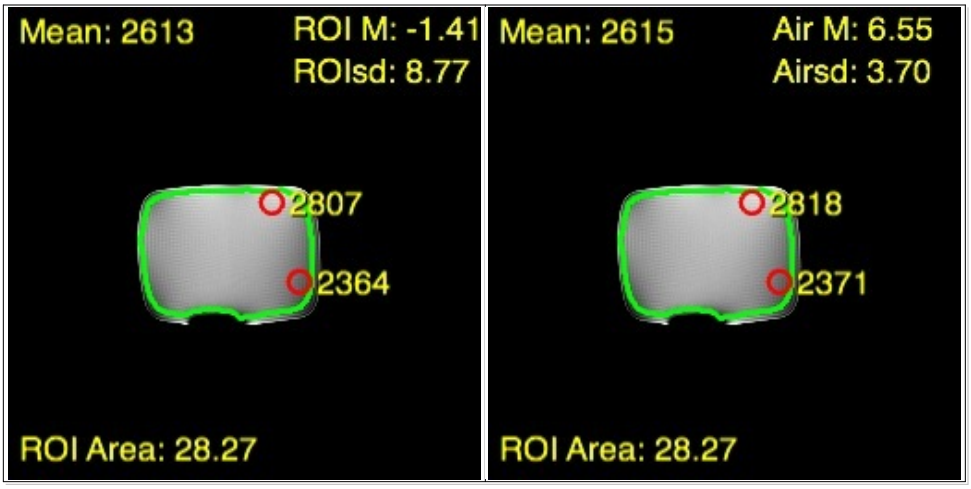
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	18	256	256	25.6	1	3	-

Coil Mode: Wrist

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	2,613	2,807	2,364	-1.4	8.77	NEMA	210.7	749.8	226.4	91.4%
A	2,615	2,818	2,371	6.6	3.70	Air	463.1	1648.1	499.1	91.4%



Test Images

RF Coil Performance Evaluation

Coil: Wrist Coil - CP
Mfg.: Siemens
Mfg. Date: 12/1/2005 Coil ID: 611
Phantom: Wrist phantom

Test Date: 6/15/2008
Model: 8622701
Revision:
SN: 10020
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	24	256	256	25.6	1	3	-

Coil Mode: Wrist

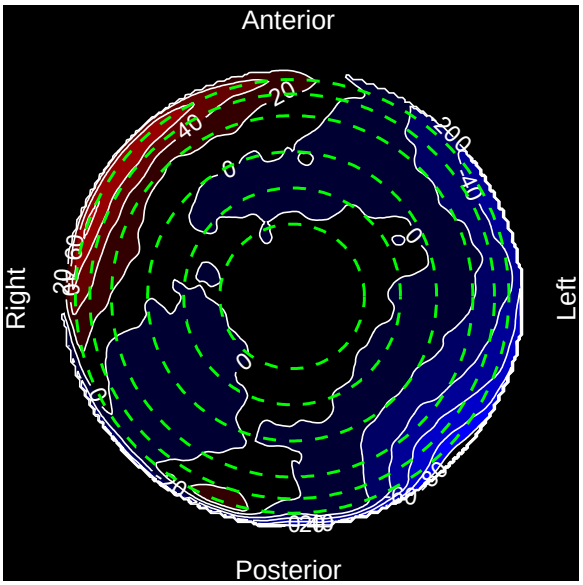
Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,911	2,746	602	-0.3	6.26	NEMA	215.9	432.1	310.2	36.0%
A	1,911	2,757	602	3.5	2.12	Air	590.7	1182.4	852.2	35.8%

Test Images

Appendix A: Magnet Homogeneity Field Maps
Siemens #3
Trio 3T - 3 central planes
Measured June 15, 2008

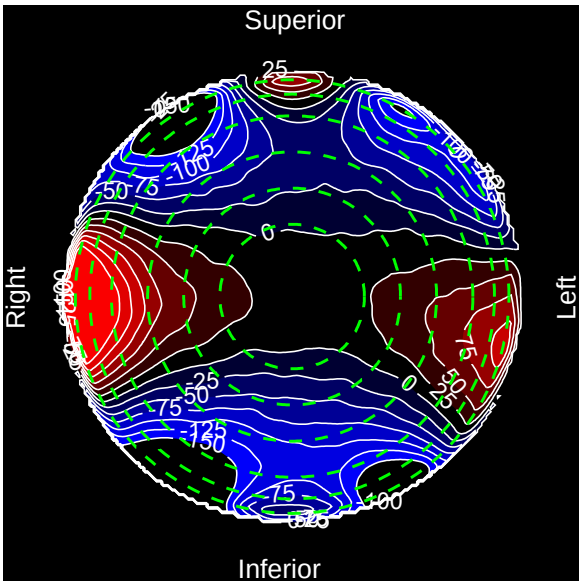
Axial



Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-0.1	1.0	1.1	0.01	0.54	0.2
15	-1.1	1.0	2.0	0.02	0.27	0.4
20	-2.1	1.3	3.3	0.03	-0.03	0.6
25	-4.8	3.0	7.8	0.06	-0.22	1.0
28	-7.2	5.8	13.0	0.10	-0.25	1.6
30	-8.9	8.3	17.3	0.14	-0.21	2.1

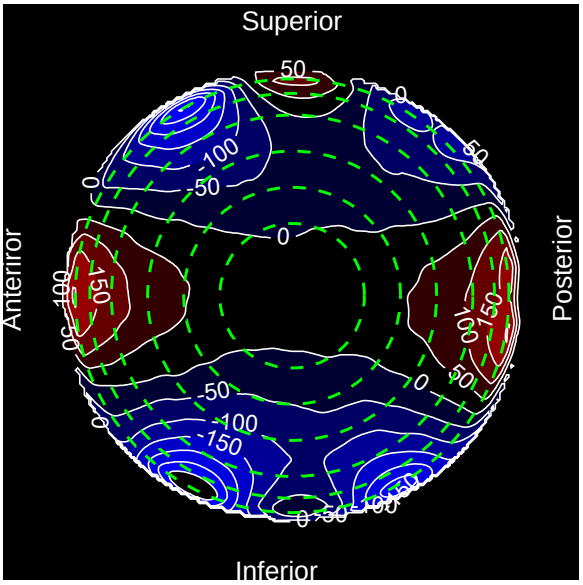
Coronal



Coronal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-1.6	3.4	5.0	0.04	1.41	1.0
15	-5.6	5.7	11.3	0.09	0.70	2.1
20	-11.0	9.2	20.2	0.16	-0.19	3.5
25	-17.0	16.1	33.1	0.26	-1.20	5.4
28	-22.7	21.6	44.3	0.35	-1.76	6.8
30	-26.8	25.3	52.1	0.41	-2.11	7.8

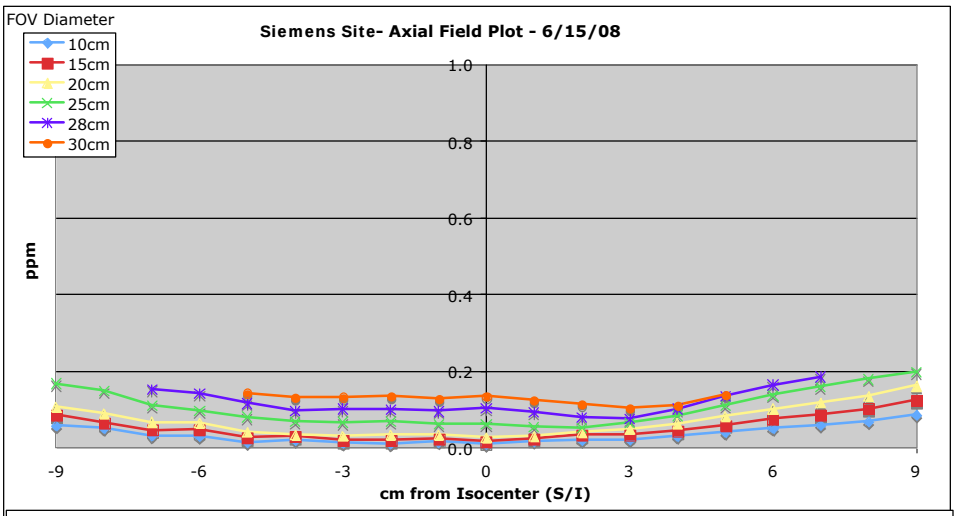
Sagittal

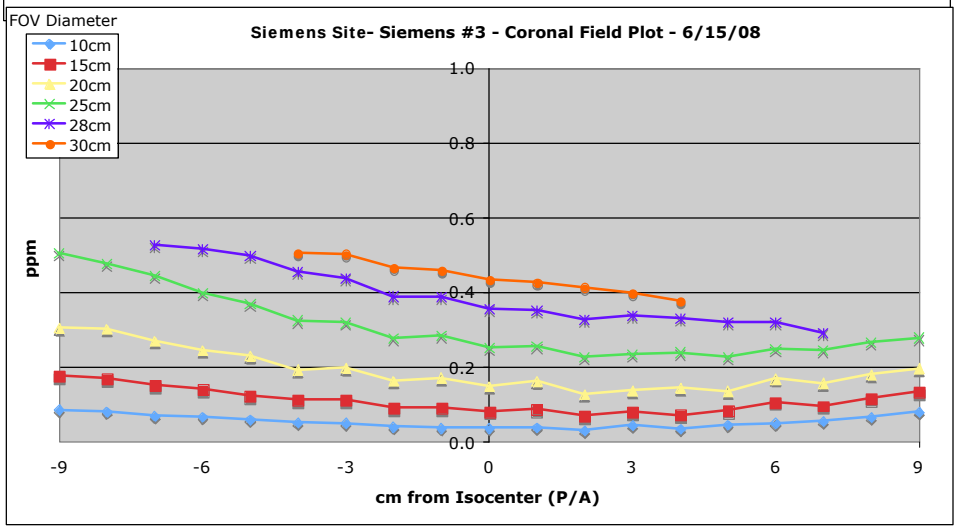


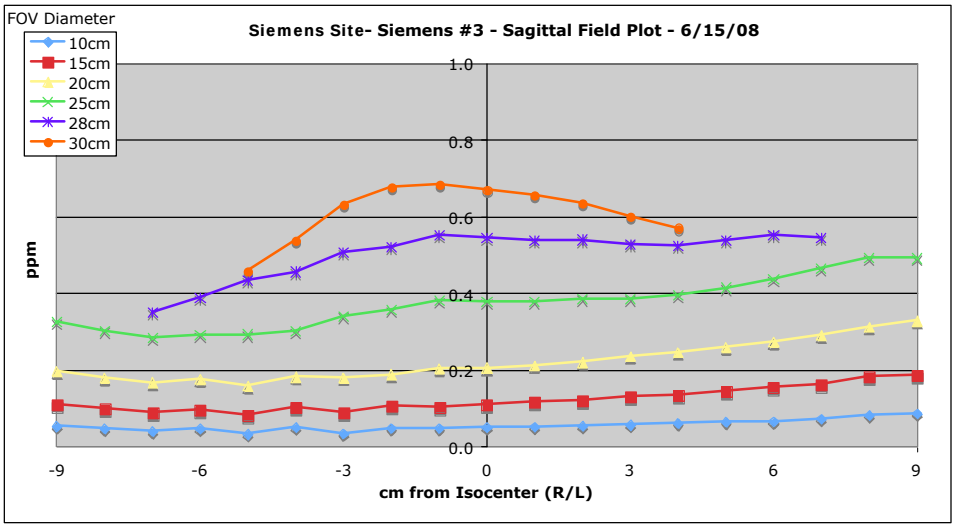
Sagittal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-1.5	3.1	4.6	0.04	1.31	0.9
15	-5.2	5.2	10.4	0.08	0.70	2.0
20	-10.9	8.1	19.0	0.15	-0.07	3.5
25	-19.6	12.4	32.0	0.25	-1.03	5.4
28	-29.2	16.3	45.5	0.36	-1.55	6.9
30	-35.6	19.7	55.3	0.43	-1.89	8.2

Appendix A: Magnet Homogeneity Field Maps
Siemens #3
Trio 3T
Measured June 15, 2008

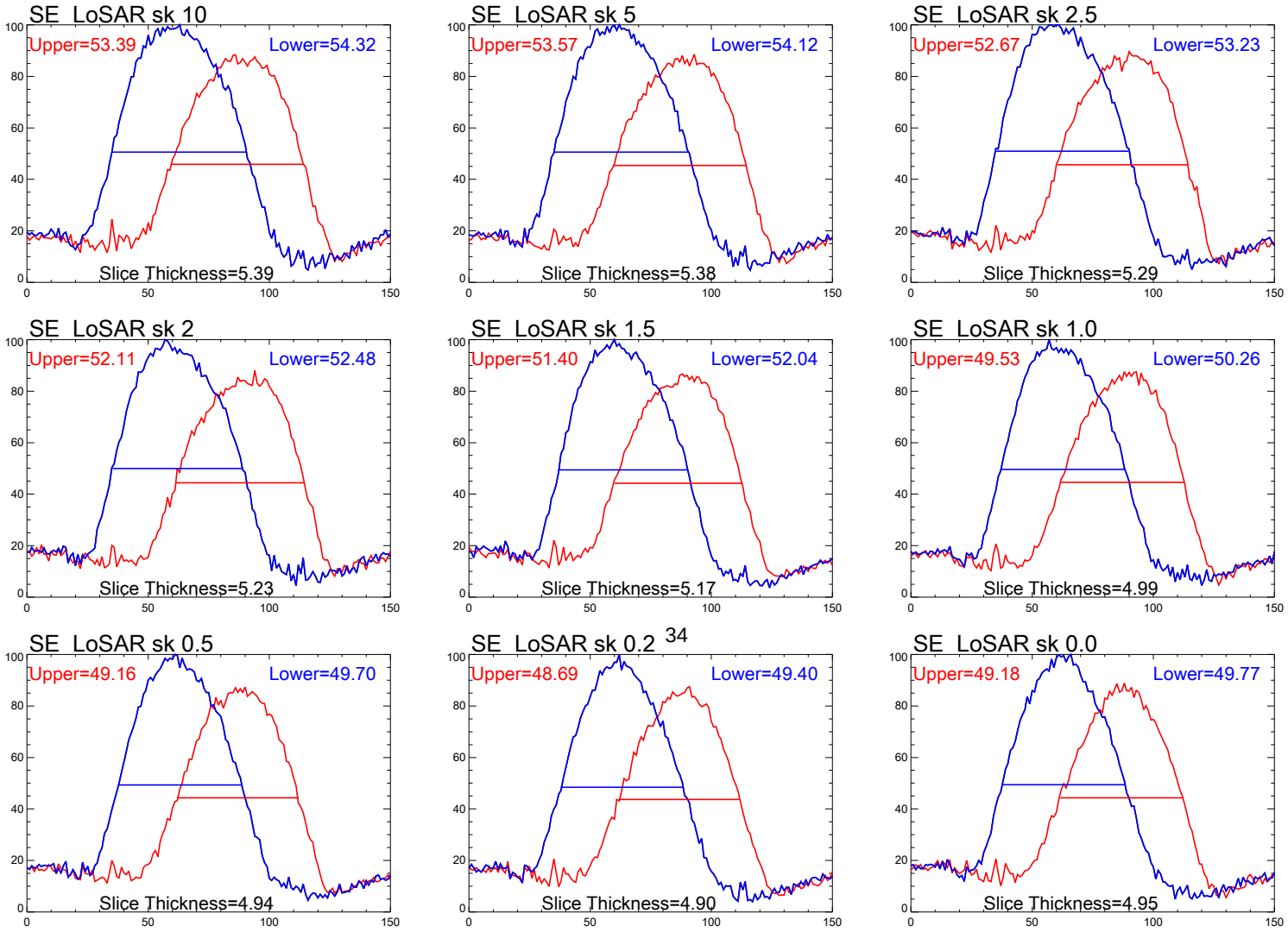


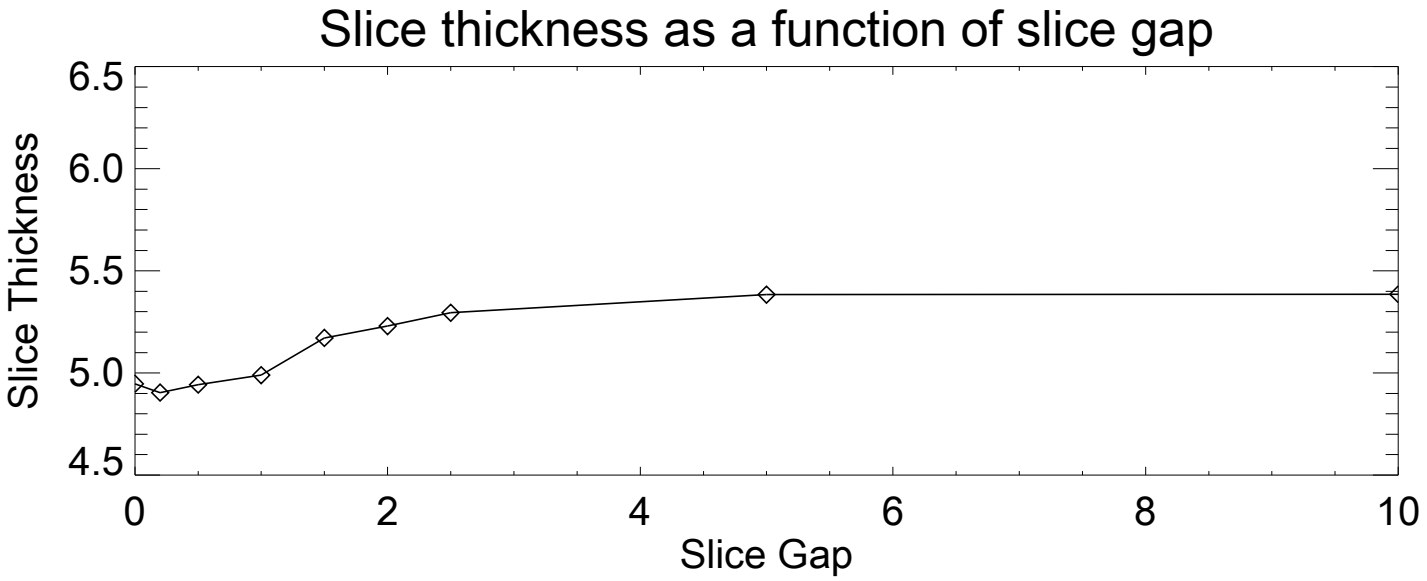




Appendix B: RF Slice Profiles and Crosstalk

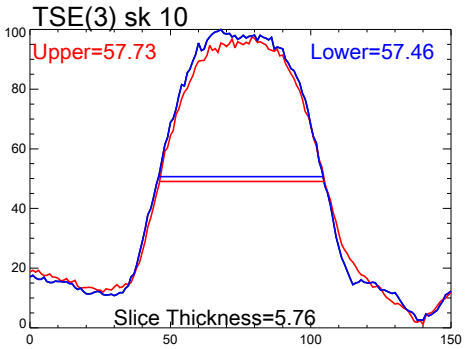
Spin Echo - Lo SAR
TR/TE: 500/10
Flip Angle: 90°
BW = 25.6 KHz
nex = 1
Scan time: 2:09

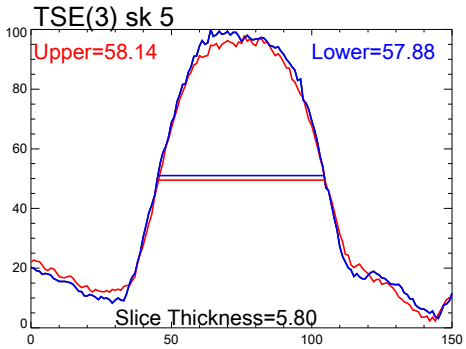


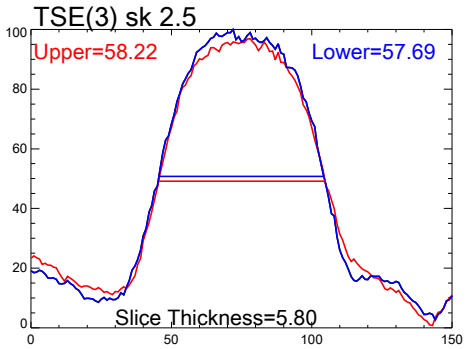


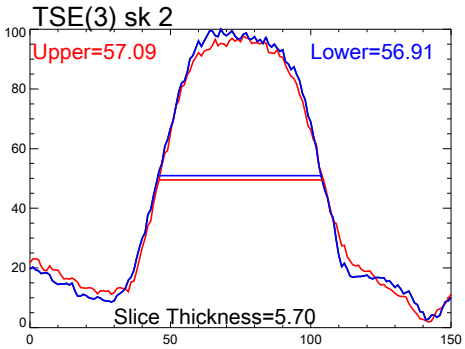
Appendix B: RF Slice Profiles and Crosstalk

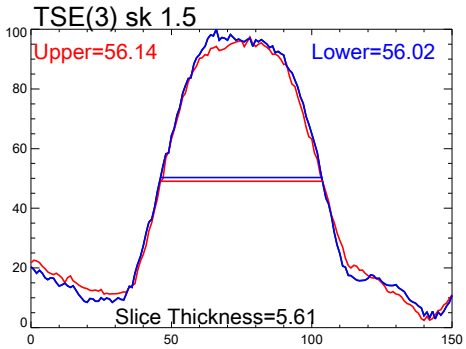
Turbo Spin Echo
ETL= 3
TR/TE = 500/8.9
BW = 29.4 4 KHz
nex = 3
Scan time: 2:09

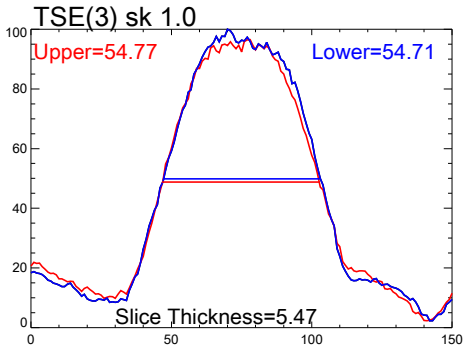


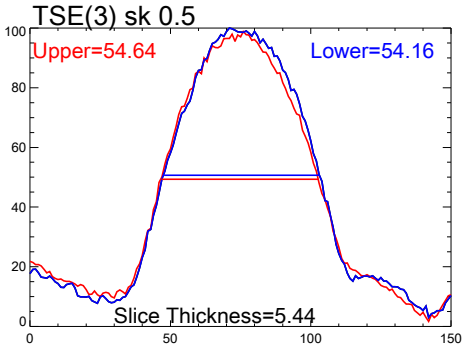


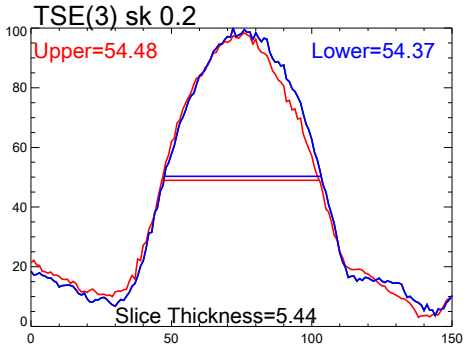


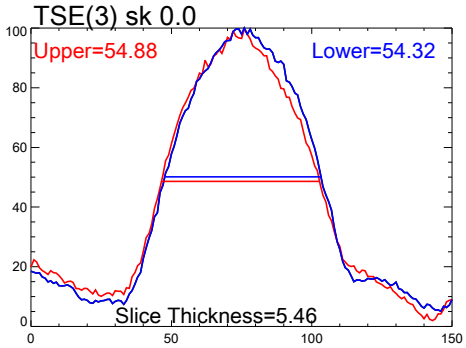


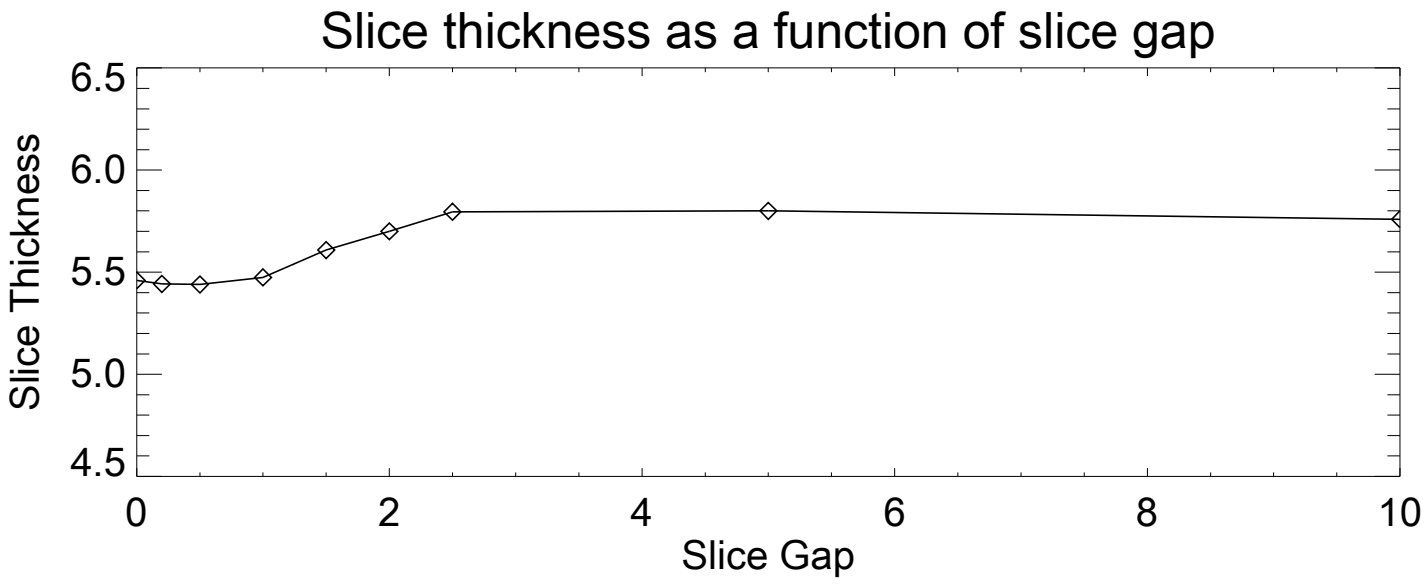






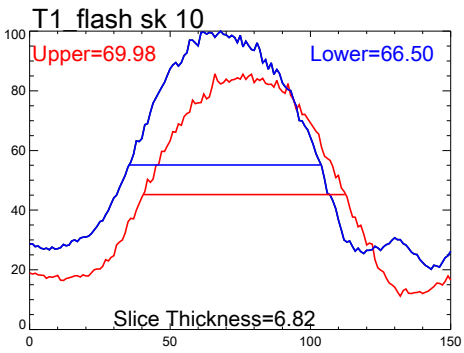


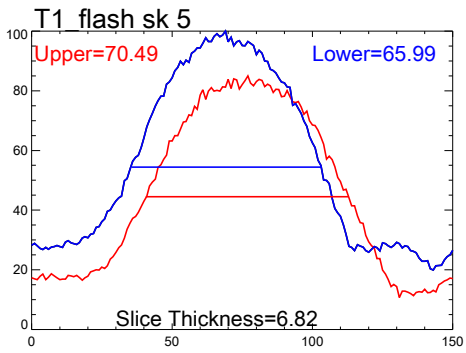


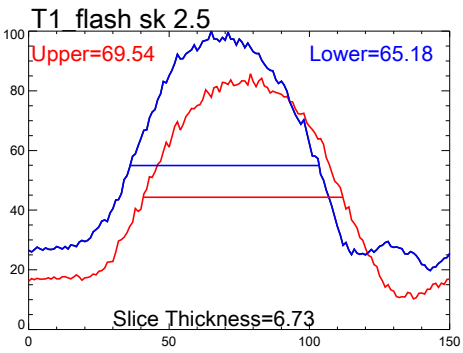


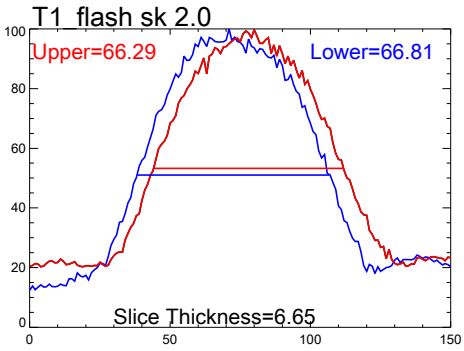
Appendix B: RF Slice Profiles and Crosstalk

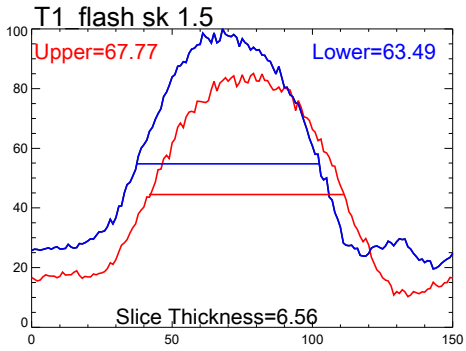
T1-FLASH
Flip = 70°
TR/TE = 250 / 2.46
BW = 29.4 KHz
nex = 2
Scan time: 2:09

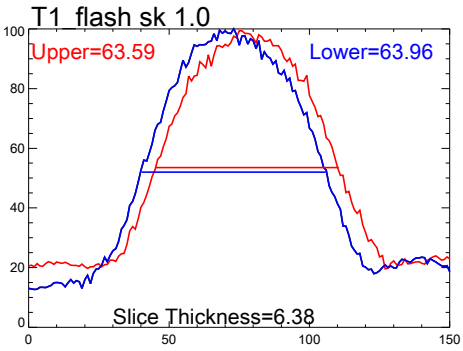


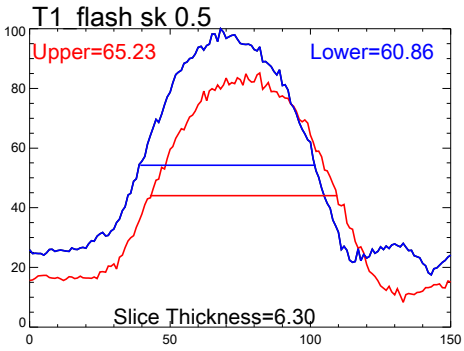


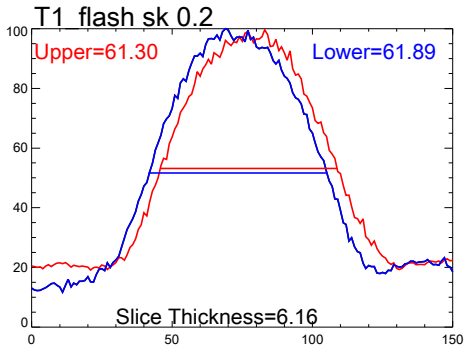


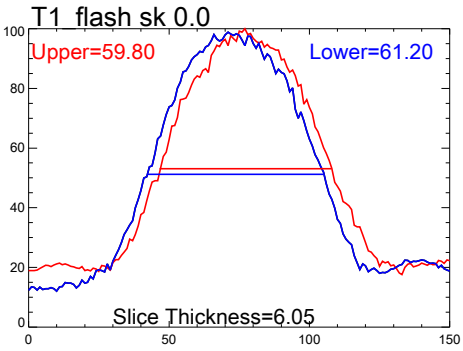


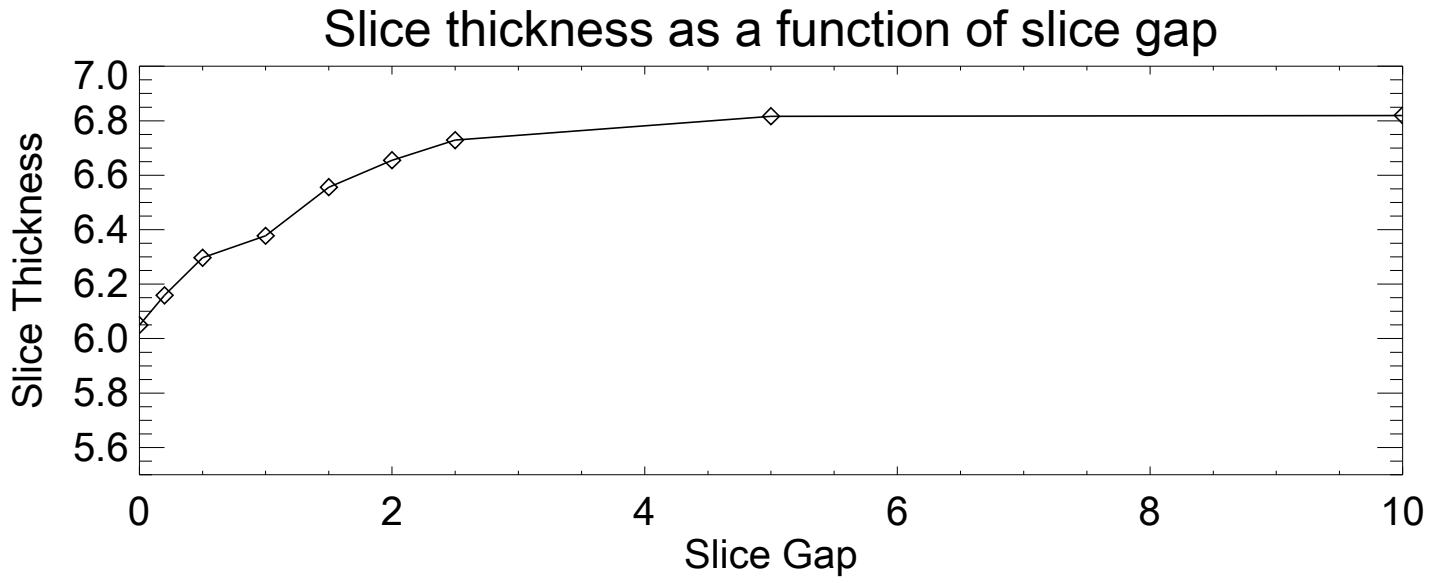












Siemens Site **Siemens 3**

Coil Used: **Head Matrix** Test Date: **6/15/2008**

	Sagittal Locator	
1	Length of phantom, end to end (mn 148± 2)	146.9

= calculated field

		(SE 500/20)	(SE 2000/20)	(SE 2000/80)	(Site T1)	(Site T2)
	Slice Location #1	ACR T1	ACR PD	ACR T2	Site T1	Site T2
2	Resolution	0.9	0.9	0.9	0.9	0.9
3	(1.10, 1.00, 0.90 mm)	0.9	0.9	0.9	0.9	0.9
4	Slice Thickness Top	57.2	57.2	47.2	60.8	66.0
5	(fwhm in mm) Bottom	53.9	54.0	46.2	58.4	64.1
6	Calculated value 5.0±0.7	5.55	5.56	4.67	5.96	6.50
7	Wedge (mm) = + = -	0.1	0.1	0.1	-0.7	0.4
8	Diameter (mm) (190±2)	191.1	191.1	191.1	190.9	191.0
9		190.5	190.5	190.5	190.4	190.6
	Slice Location #5					
10	Diameter (mm) (190±2)	191.2	191.2	191.1	10.7	190.7
11		190.4	190.4	190.5	190.4	190.7
12		189.9	189.9	189.8	190.4	190.4
13		190.5	190.5	190.4	190.8	191.0
	Slice Location #7					
14	Signal Big ROI	2345	2428	1109	2775	1369
15	(mean only) High	2600	2698	1247	3856	1518
16	Low	2028	2097	958	2244	1154
17	Uniformity (>87.5%)	87.6%	87.5%	86.9%	73.6%	86.4%
18	Background Noise Top	11.5 ± 7.89	12.1 ± 7.83	6.5 ± 3.93	7.2 ± 4.30	7.3 ± 4.42
19	Bottom	11.8 ± 8.04	12.4 ± 8.39	7.1 ± 4.36	8.7 ± 4.37	7.7 ± 4.43
20	(mean ±std dev) Left	20.9 ± 13.9	22.3 ± 12.9	22.2 ± 7.69	7.3 ± 4.35	25.0 ± 8.65
21	Right	29.3 ± 15.3	34.5 ± 17.5	20.7 ± 7.97	13.9 ± 6.15	24.4 ± 8.90
22	Ghosting Ratio (<2.5%)	0.6%	0.7%	1.3%	0.1%	1.3%
23	SNR (no spec)	294	299	268	640	309
	Low Con Detectability					
24	Slice Location #8 1.4%	10	9	9	10	6
25	Slice Location #9 2.5%	10	10	10	10	9
26	Slice Location #10 3.6%	10	10	10	10	10
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	40	39	39	40	35
	Slice Location #11					
29	Wedge (mm) = + = -	-0.1	-0.1	-0.3	-0.2	-0.1
30	Slice Position Error	-0.2	-0.2	-0.4	0.6	-0.5

Siemens Site

Siemens 3

Sequence parameters

Test Date: **6/15/2008**

Coil Used:**Head Matrix**

Test ID **297**

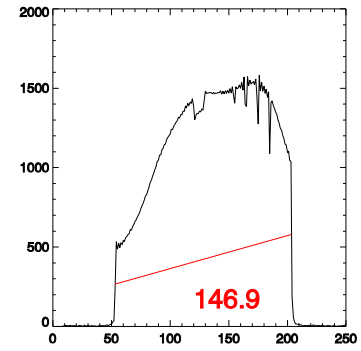
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	25.6	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	25.6	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	19.2	8:32
Site T1	SE	750	7.4	24	1	11	5	5	1	256	256	25.6	3:14
Site T2	TSE(13)	5000	102	24	1	11	5	5	1	320	320	24.32	2:04

Magnet ID: **49** **Coil ID:** **1135** **TestID:** **297**

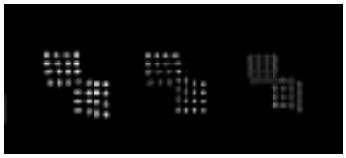
Appendix C: ACR Phantom Analysis

ACR T1

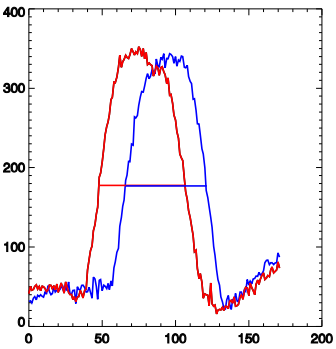
Sagital Length



High Contrast Resolution

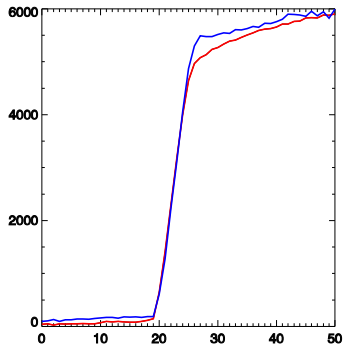


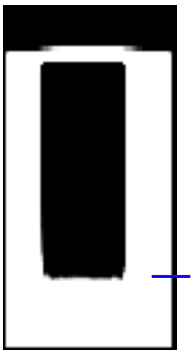
Slice Thickness



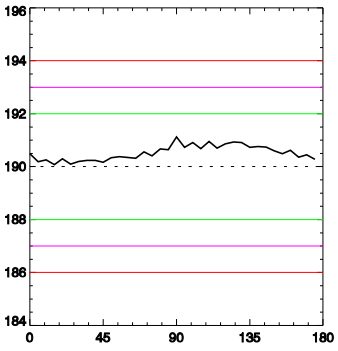
Upper=57.23
Lower=53.94
Slice Thickness=5.55

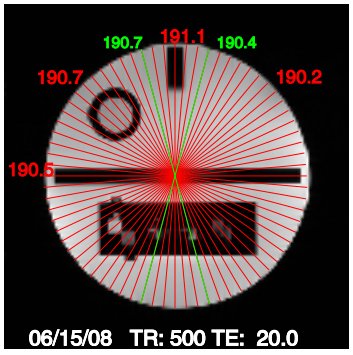
Slice Position - Inferior



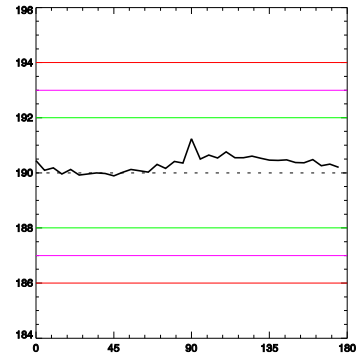


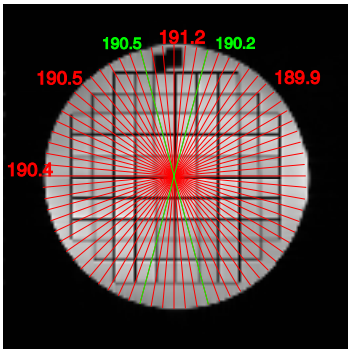
Axial Diameters - #1



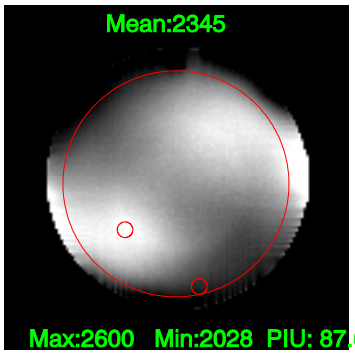


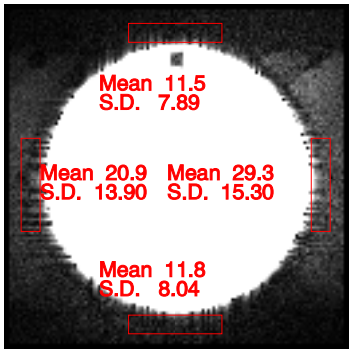
Axial Diameters - #5



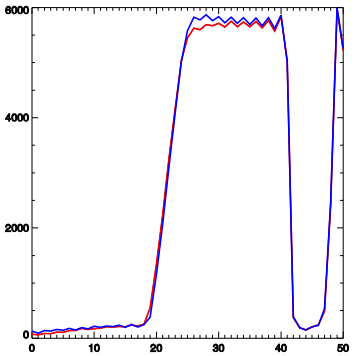


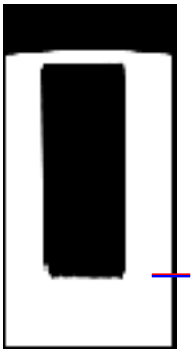
Uniformity & Ghosting - #7



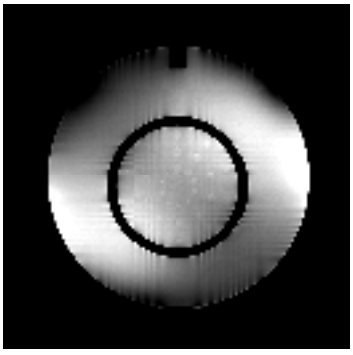


Slice Position - Superior

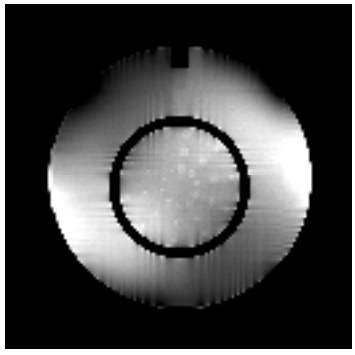




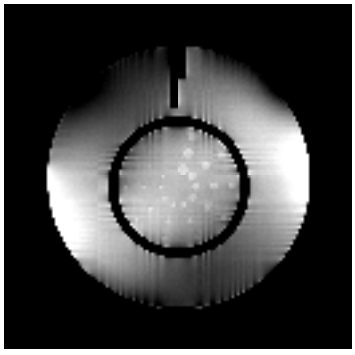
Low Contrast - #8



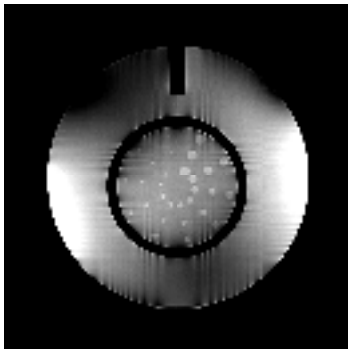
Low Contrast - #9



Low Contrast - #10



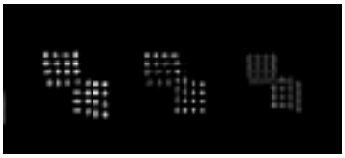
Low Contrast - #11



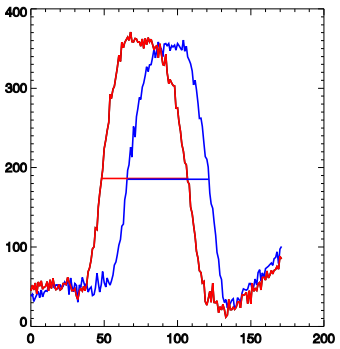
Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution



Slice Thickness

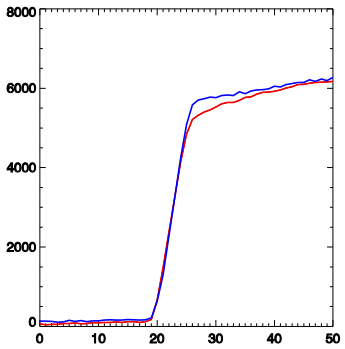


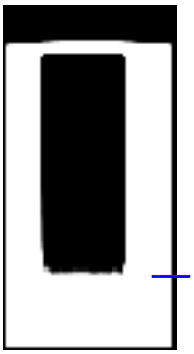
Upper=57.18

Lower=54.00

Slice Thickness=5.55

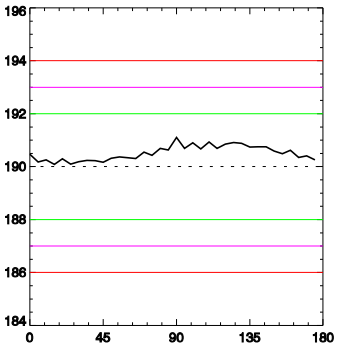
Slice Position - Inferior

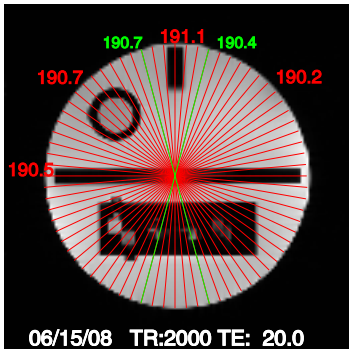




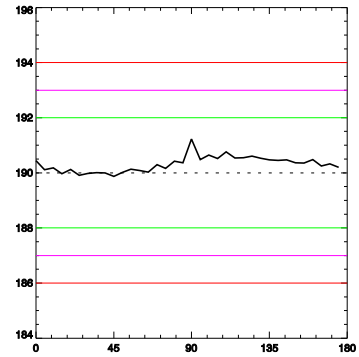
Diff.= 0.05

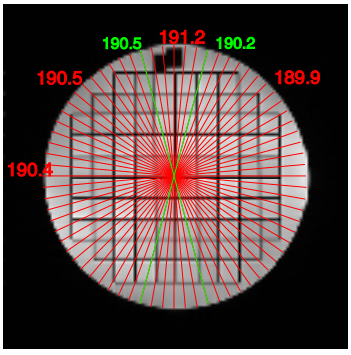
Axial Diameters - #1



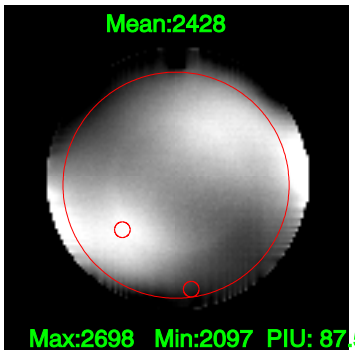


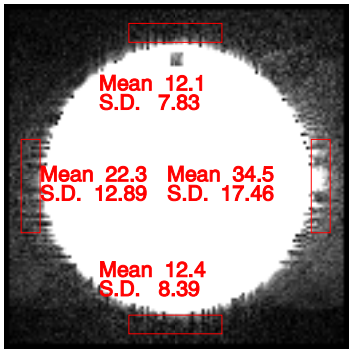
Axial Diameters - #5



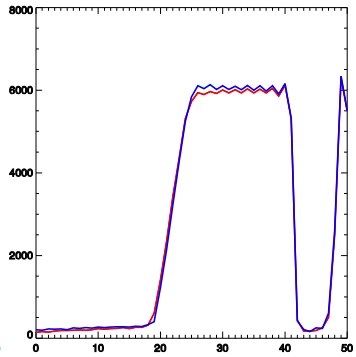


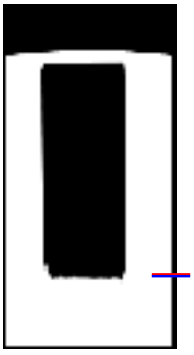
Uniformity & Ghosting - #7





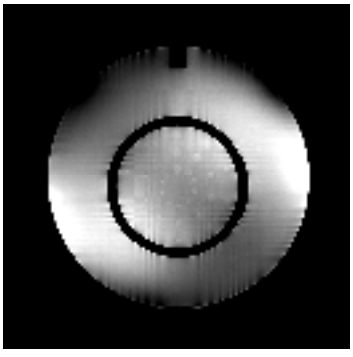
Slice Position - Superior



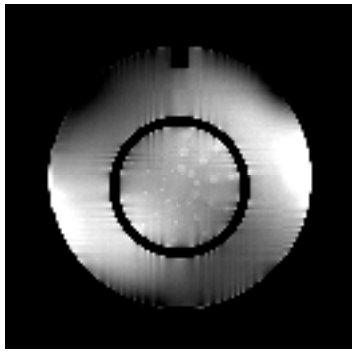


Diff.= 0.19

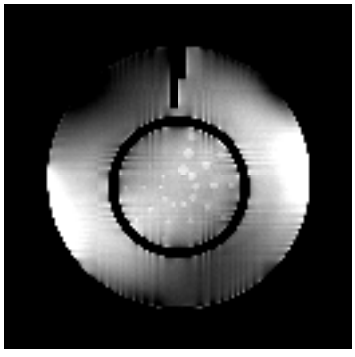
Low Contrast - #8



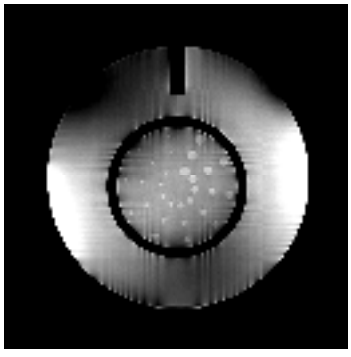
Low Contrast - #9



Low Contrast - #10



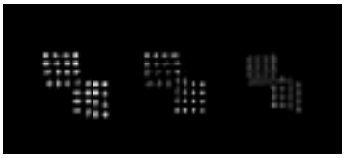
Low Contrast - #11



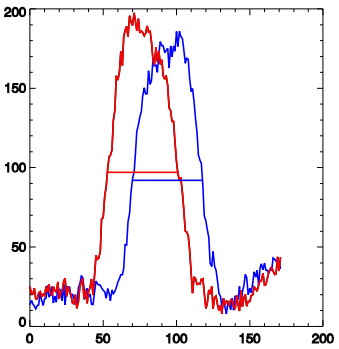
Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution

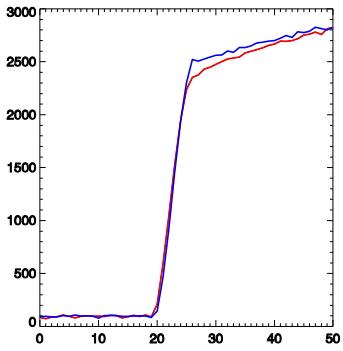


Slice Thickness

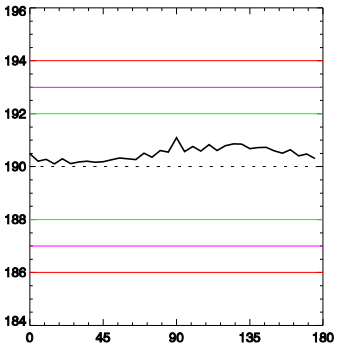


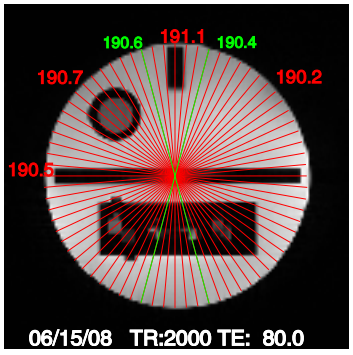
Upper=47.25
Lower=46.16
Slice Thickness=4.67

Slice Position - Inferior

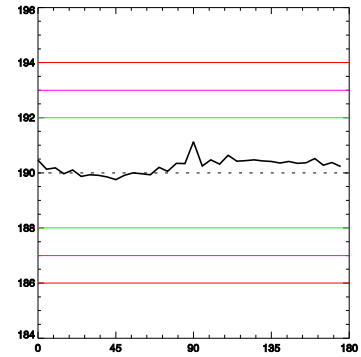


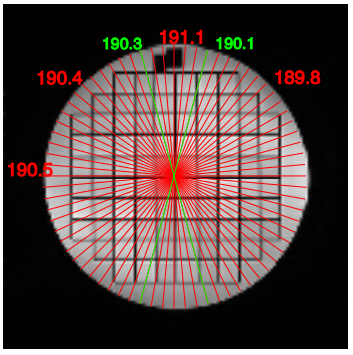
Axial Diameters - #1



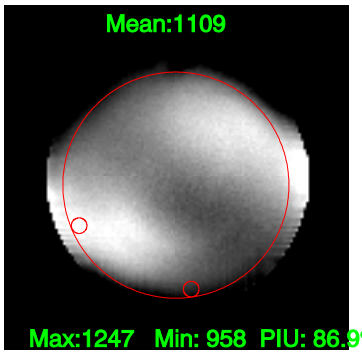


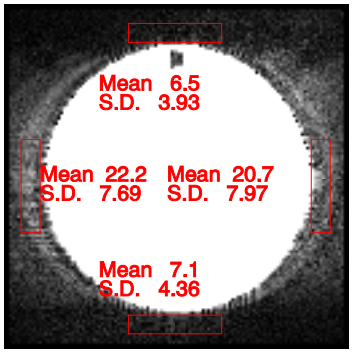
Axial Diameters - #5



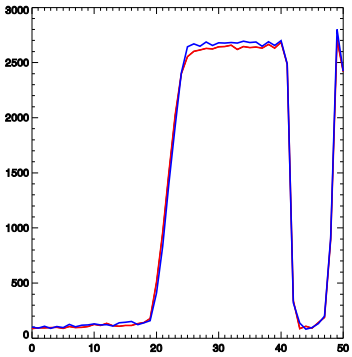


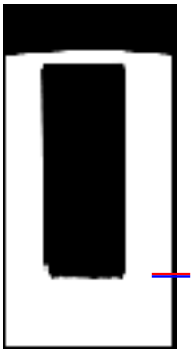
Uniformity & Ghosting - #7



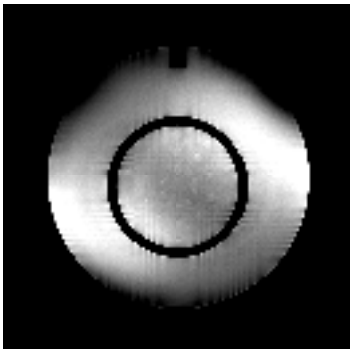


Slice Position - Superior

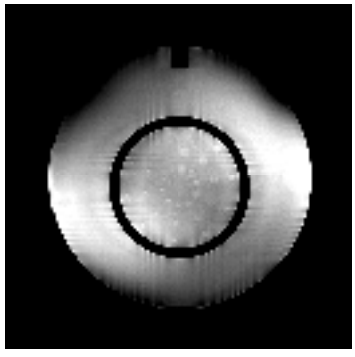




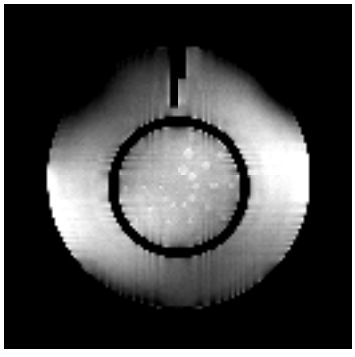
Low Contrast - #8



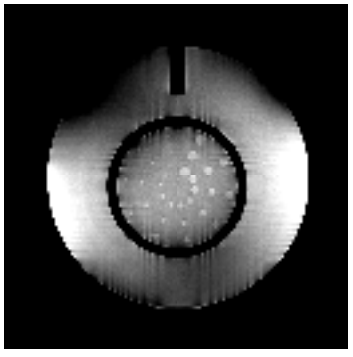
Low Contrast - #9



Low Contrast - #10



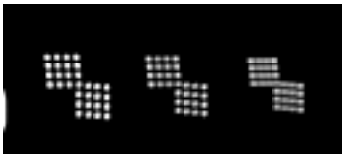
Low Contrast - #11



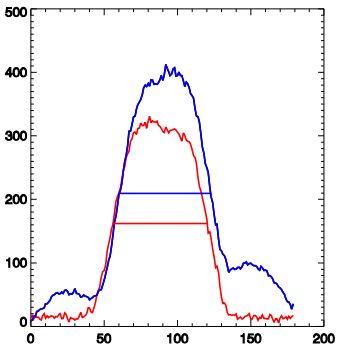
Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution



Slice Thickness

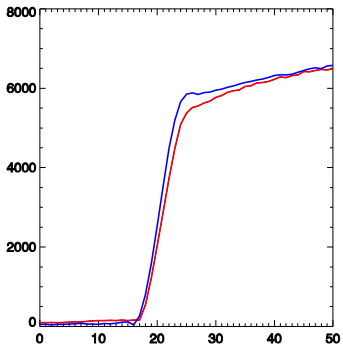


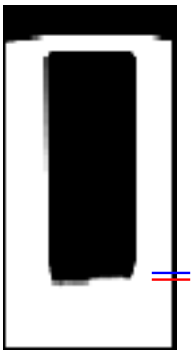
Upper=60.80

Lower=58.38

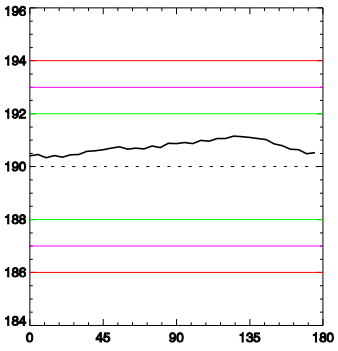
Slice Thickness=5.96

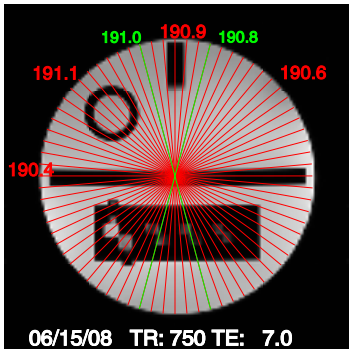
Slice Position - Inferior



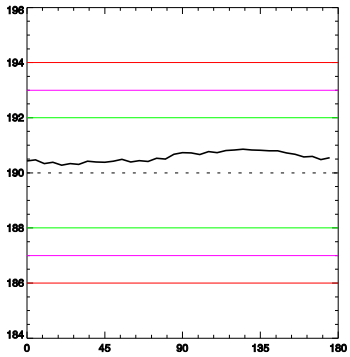


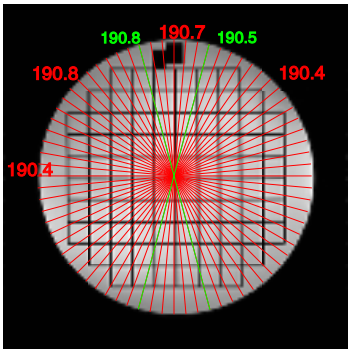
Axial Diameters - #1



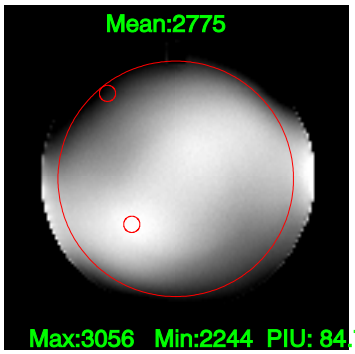


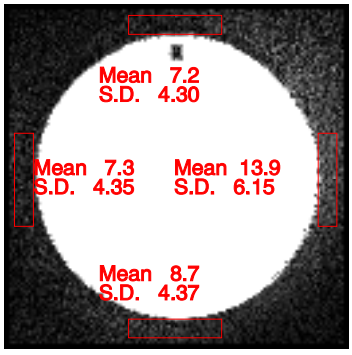
Axial Diameters - #5



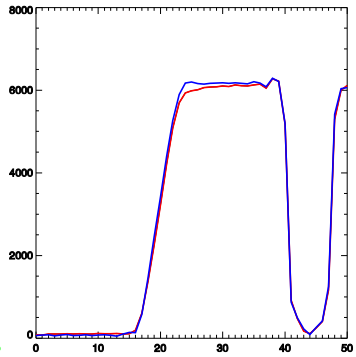


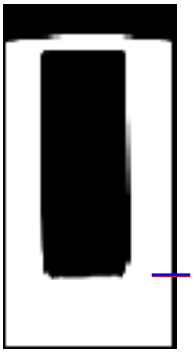
Uniformity & Ghosting - #7





Slice Position - Superior

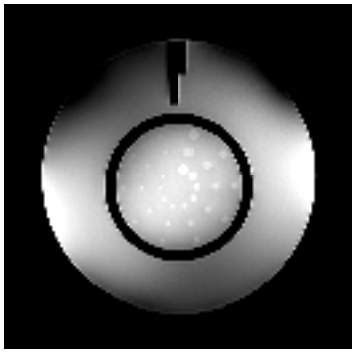




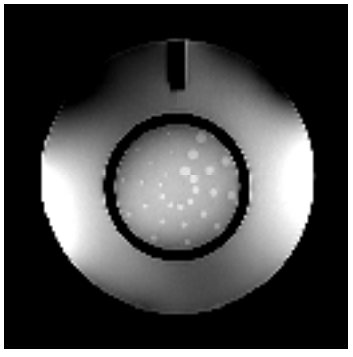
Low Contrast - #8

Low Contrast - #9

Low Contrast - #10



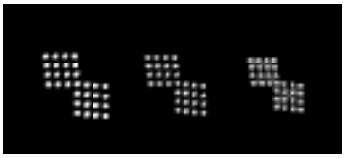
Low Contrast - #11



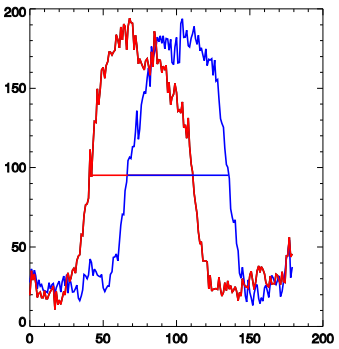
Appendix C: ACR Phantom Analysis

Site T2

High Contrast Resolution



Slice Thickness

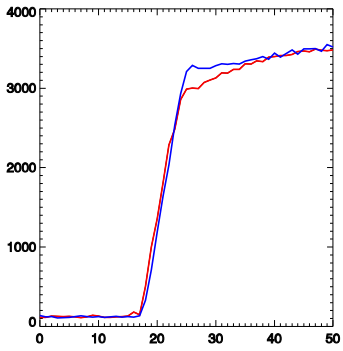


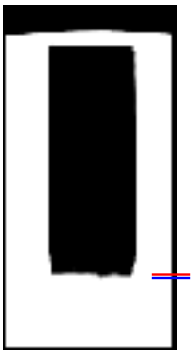
Upper=66.03

Lower=64.12

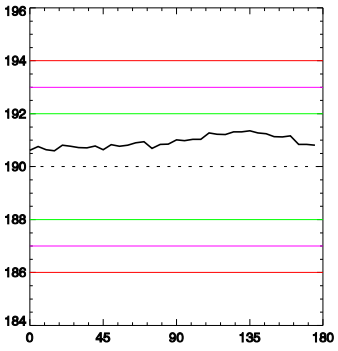
Slice Thickness=6.51

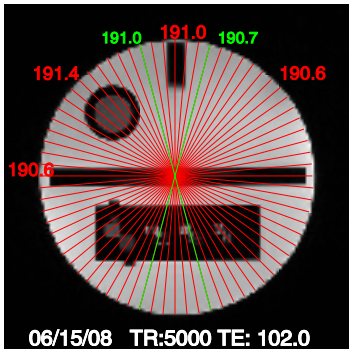
Slice Position - Inferior



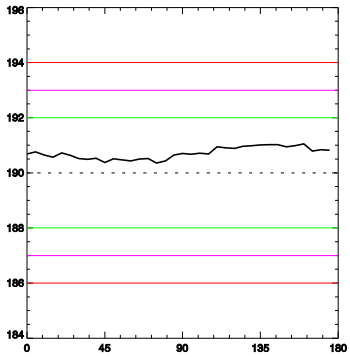


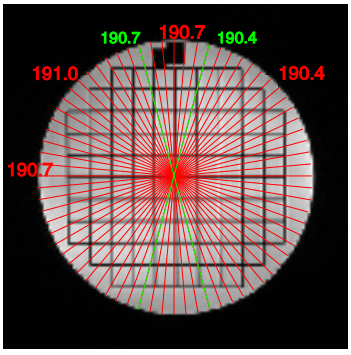
Axial Diameters - #1



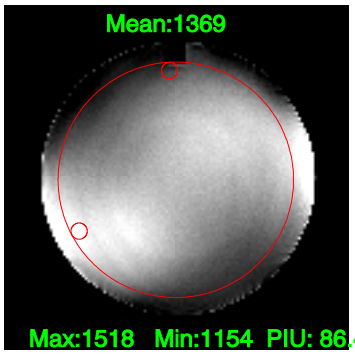


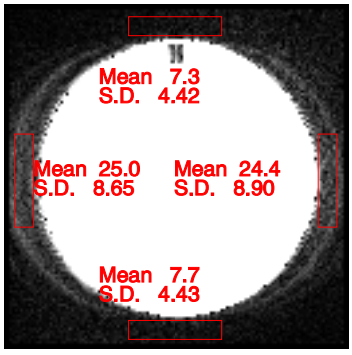
Axial Diameters - #5



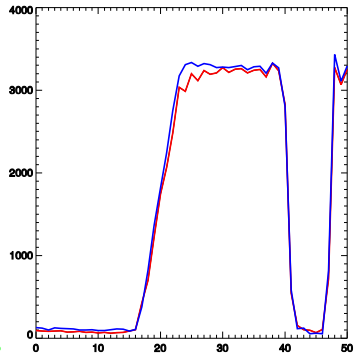


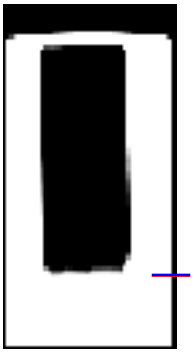
Uniformity & Ghosting - #7



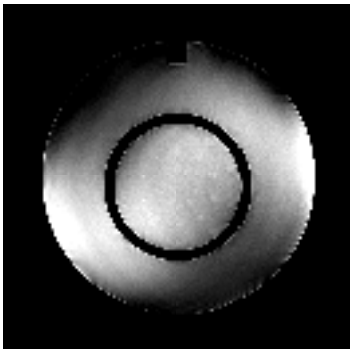


Slice Position - Superior

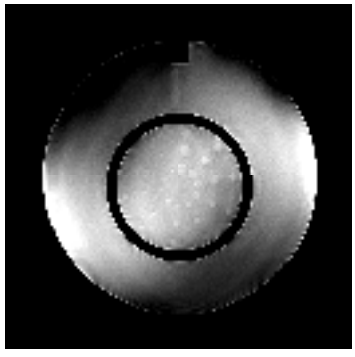




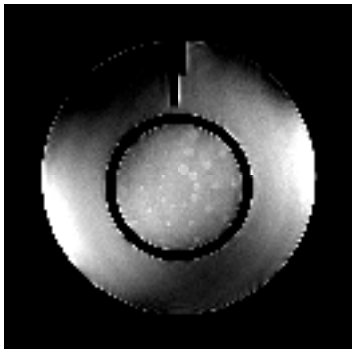
Low Contrast - #8



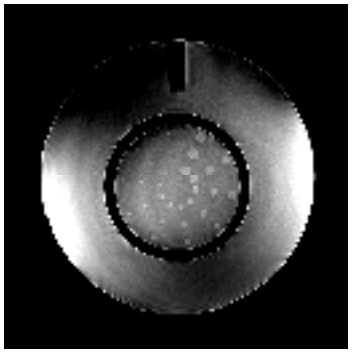
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11



Appendix D:
Explanation of RF Coil Testing Report

Introduction

The primary goal of RF coil testing is to establish some sort of base line for tracking coil performance over time. The most common measure is the Signal to Noise Ratio or SNR. In addition, we can look at overall signal uniformity, ghosting level (or better - lack of ghosting) and in the case of phased array coils we look at the SNR of each and every channel and at symmetry between channels. Unfortunately, there is no single best method for measuring SNR. Below I explain the different methods used and the rationale for each.

SNR

One needs to measure the signal in the phantom (either mean or peak or both) and then divide that by the background noise. Measuring the signal is fairly straightforward, the noise can be more problematic. The simplest method is to measure the standard deviation (SD) in the background 'air'. However, MRI images are the magnitude of complex data. The noise in the underlying complex data is Gaussian but it follows a Rician distribution when the magnitude is used. The true noise can be estimated by multiplying the measured SD by 1.526.

During the reconstruction process, most manufacturers perform various additional operations on the images, This could include geometric distortion correction, low pass filtering of the k-space data resulting in low signal at the edge of the images, RF coil intensity correction (PURE, CLEAR, SCIC, etc), and other processing during the combination of phased array data and parallel imaging techniques. All of these methods distort the background noise making it impossible to obtain an accurate (and reproducible) estimate of the image noise in the air region. The alternative is to use a method which I shall refer to as the NEMA (National Electrical Manufacturers Association) method. The signal in the phantom area is a sum of the proton signal and noise. Once the signal to noise ratio exceeds 5:1, the noise in the magnitude image is effectively Gaussian. To eliminate the proton signal, you acquire an image twice and subtract them. The measured SD in the phantom region should now be the true SD times the square root of 2. When determining the SNR using the NEMA method, calculate the mean signal of the average of the two source images then divide by .7071 x the SD measured in the same area as the mean signal.

Unfortunately, this doesn't always work. It is absolutely imperative that the RF channel scalings, both transmit and receive, be identical with both scans. Any ghosting in the system is not likely to repeat exactly for both scans and will cause a much higher SD. Finally, the phantom needs to be resting in place prior to the scan long enough for motion of the fluid to have died down. Depending on the size and shape of the phantom, this could take any where from 5 to 20 minutes.

One of the most common causes of ghosting is vibration from the helium cold-head. The best way to eliminate this artifact is to turn off the cold head, which will increase helium consumption. Because this vibration is periodic, the ghosting is usually of an N over 2 (N/2) nature. The affect inside the signal region of the phantom can be minimized by using a FOV that is twice the diameter of the phantom (measured in the PE direction.) If the noise is to be measured in the air, then be sure to NOT make measurements to either side of the phantom in the PE direction.

Scan parameters also significantly affect measured SNR. For most of the testing performed in this document I used a simple Spin Echo with a TR of 300, a TE of 20 and a slice thickness of 3mm and a receiver BW of 25.73KHz (200 Hz/pixel). The FOV was varied depending on the size of the coil and the phantom used. All of the parameters used for each test can be found on each page immediately below the coil description.

Report Layout

Each page of this report lists the data from a single test. The top third of the page describes the coil and phantom information, followed by the scan parameters used. The middle third contains the numbers measured and calculated results. This section will contain one table if the coil being tested is a single channel coil (i.e. quadrature or surface coils) and two tables if it is a multi-channel phased array coil. The entries in the table will be described further below. The bottom section contains a few lines of comments (if necessary), a picture of the coil with the phantom as used for the testing and one or more of the images that were used for the measurements.

There is usually one image for each composite image measurement and one image for each separate channel measurement. Each image shows the ROI (red line) where the mean signal was measured and two smaller ROIs (green lines) where the signal minimum and maximum was found. In the top left corner of each image is the mean signal in the large ROI. The bottom left corner contains the large ROI's area (in mm^2). The top right corner contains two numbers a mean and a standard deviation. If the NEMA method was used, then the top right corner will list the mean and SD of the large ROI (labeled ROI M and ROIsd) applied to the subtraction image. If the noise was measured in the background air the the numbers are labeled Air M and AirSD.

Data Tables

The meaning of most of the entries in the data table are should be self evident with a few exceptions. The first column in each table is labeled "Label". In the composite analysis, this field may be empty or contain some sort of abbreviation to identify some aspect of the testing. Some possibilities are the letter N for NEMA, A for Air, L for Left, R for Right, C for CLEAR, NoC for No CLEAR. In the Uncombined Image table, the label usually contains the channel number or similar descriptor. The column labeled "Noise Type" will be either Air or SubSig which stands for Subtracted Signal, *i.e*. the NEMA method. Both tables contain a column for Mean SNR and Max SNR which are the Mean or Max signal divided by the SD of the noise scaled by either 1.526 (Air) or 0.7071 (NEMA).

Composite Image Table: The final two columns in this table are "Normalized" and "Uniformity". It can be rather difficult to compare the performance of different coils particularly if different scan parameters are used. (Of course, it's even more difficult from one scanner to another.) I have standardized most of my testing to use a spin echo with a TR/TE of 300/20msec and a thickness of 3 mm. The FOV changes to depending on the size of the phantom used although I try to use a FOV that is at least twice the diameter of the phantom as measured in the PE direction. For one reason or another, a change may be made in the scan parameters (either accidentally or intentionally such as turning on No Phase Wrap to eliminate aliasing, etc.). In order to make it easier to compare SNR values I calculate a "Normalized" SNR value. This value is theoretically what the SNR would be if a FOV of 30cm, 256x256 matrix, 1 average, receiver BW of 15.6 KHz and slice thickness of 3mm had been used. Obviously, the final number is affected by the T1/T2 values of the phantoms used as well as details of the coil and magnet field strength but it can be useful in certain situations.

The "Uniformity" value is defined by the ACR as 1 - (max-min)/(max+min). This is most important when looking at volume coils or for evaluating the effectiveness of surface coil intensity correction algorithms (such as pre or post Normalization).

Uncombined Image Table: This table has two columns labeled "% of Mean" and "% of Max". When analyzing multi-channel coils it is important to understand the relationship between the different channels, the inherent symmetry that usually exists between channels. In a 8 channel head or 4 channel torso phased array coil, all of the channels are usually have about the same SNR. These two columns list how the SNR (either Mean or Max) of each channel compares to the SNR of the channel with the maximum value.