

Appendix A – System Validation Plots and Data

Test Result for UIM Dielectric Parameter

Sun 01/Jul/2012 10:39:02

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.7000	55.73	0.96	55.45	0.93
0.7090	55.69	0.96	55.39	0.95*
0.7100	55.69	0.96	55.39	0.95
0.7110	55.69	0.96	55.39	0.95*
0.7200	55.65	0.96	55.35	0.96
0.7300	55.61	0.96	55.30	0.98
0.7400	55.57	0.96	55.26	0.98
0.7500	55.53	0.96	55.21	0.99
0.7600	55.49	0.96	55.16	1.00

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 21/Jun/2012 01:55:49

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.8050	55.32	0.97	55.13	0.94
0.8150	55.28	0.97	55.07	0.95
0.8242	55.24	0.97	55.02	0.96*
0.8250	55.24	0.97	55.02	0.96
0.8264	55.23	0.97	55.01	0.96*
0.8350	55.20	0.97	54.98	0.98
0.8366	55.20	0.97	54.97	0.98*
0.8450	55.17	0.98	54.93	0.99
0.8466	55.17	0.98	54.92	0.99*
0.8488	55.16	0.98	54.91	1.00*
0.8550	55.14	0.99	54.88	1.02
0.8650	55.11	1.01	54.84	1.04

* value interpolated

Test Result for UIM Dielectric Parameter

Sat 30/Jun/2012 07:31:22

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.8050	55.32	0.97	54.49	0.95
0.8150	55.28	0.97	54.42	0.96
0.8250	55.24	0.97	54.37	0.98
0.8290	55.23	0.97	54.35	0.98*
0.8350	55.20	0.97	54.32	0.99
0.8365	55.20	0.97	54.32	0.99*
0.8440	55.17	0.98	54.28	1.00*
0.8450	55.17	0.98	54.28	1.00
0.8550	55.14	0.99	54.23	1.02
0.8650	55.11	1.01	54.18	1.03

* value interpolated

Test Result for UIM Dielectric Parameter

Sun 01/Jul/2012 06:47:36

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.8050	55.32	0.97	54.12	0.94
0.8150	55.28	0.97	54.06	0.95
0.8250	55.24	0.97	54.01	0.97
0.8290	55.23	0.97	54.00	0.97*
0.8350	55.20	0.97	53.97	0.98
0.8365	55.20	0.97	53.32	0.98*
0.8440	55.17	0.98	53.92	0.99*
0.8450	55.17	0.98	53.92	0.99
0.8550	55.14	0.99	53.88	1.00
0.8650	55.11	1.01	53.83	1.02

* value interpolated

Test Result for UIM Dielectric Parameter

Mon 02/Jul/2012 06:21:51

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.8050	55.32	0.97	54.93	0.93
0.8150	55.28	0.97	54.87	0.95
0.8250	55.24	0.97	54.82	0.96
0.8290	55.23	0.97	54.79	0.97*
0.8350	55.20	0.97	54.76	0.97
0.8365	55.20	0.97	54.76	0.97*
0.8440	55.17	0.98	54.72	0.98*
0.8450	55.17	0.98	54.72	0.98
0.8550	55.14	0.99	54.67	0.99
0.8650	55.11	1.01	54.64	1.01

* value interpolated

Test Result for UIM Dielectric Parameter

Sat 23/Jun/2012 06:08:23

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.7200	53.51	1.47	53.65	1.49
1.7300	53.48	1.48	53.62	1.50
1.7325	53.48	1.48	53.62	1.50*
1.7400	53.46	1.48	53.59	1.50
1.7450	53.45	1.49	53.58	1.51*
1.7500	53.43	1.49	53.56	1.51
1.7600	53.41	1.49	53.53	1.51
1.7700	53.38	1.50	53.49	1.52
1.7800	53.35	1.51	53.45	1.52

* value interpolated

Test Result for UIM Dielectric Parameter

Sun 24/Jun/2012 05:28:23

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.7200	53.51	1.47	53.48	1.48
1.7300	53.48	1.48	53.46	1.48
1.7325	53.48	1.48	53.46	1.48*
1.7400	53.46	1.48	53.43	1.49
1.7450	53.45	1.49	53.42	1.50*
1.7500	53.43	1.49	53.40	1.50
1.7600	53.41	1.49	53.37	1.51
1.7700	53.38	1.50	53.35	1.52
1.7800	53.35	1.51	53.32	1.52

* value interpolated

Test Result for UIM Dielectric Parameter

Wed 27/Jun/2012 04:28:23

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.7200	53.51	1.47	53.52	1.49
1.7300	53.48	1.48	53.38	1.50
1.7325	53.48	1.48	53.38	1.50*
1.7400	53.46	1.48	53.36	1.51
1.7450	53.45	1.49	53.35	1.52*
1.7500	53.43	1.49	53.32	1.52
1.7600	53.41	1.49	53.30	1.53
1.7700	53.38	1.50	53.27	1.55
1.7800	53.35	1.51	53.23	1.55

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 21/Jun/2012 05:46:23

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	52.73	1.53
1.8502	53.30	1.52	52.73	1.53*
1.8524	53.30	1.52	52.73	1.53*
1.8600	53.30	1.52	52.71	1.54
1.8700	53.30	1.52	52.70	1.55
1.8800	53.30	1.52	52.68	1.56
1.8900	53.30	1.52	52.66	1.57
1.9000	53.30	1.52	52.65	1.58
1.9076	53.30	1.52	52.63	1.59*
1.9098	53.30	1.52	52.63	1.59*
1.9100	53.30	1.52	52.63	1.59

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 28/Jun/2012 07:04:26

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	52.97	1.50
1.8600	53.30	1.52	52.94	1.51
1.8700	53.30	1.52	52.92	1.53
1.8800	53.30	1.52	52.89	1.54
1.8900	53.30	1.52	52.86	1.55
1.9000	53.30	1.52	52.84	1.56
1.9100	53.30	1.52	52.81	1.58

* value interpolated

Test Result for UIM Dielectric Parameter

Fri 29/Jun/2012 05:46:11

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	53.23	1.47
1.8600	53.30	1.52	53.21	1.49
1.8700	53.30	1.52	53.19	1.50
1.8800	53.30	1.52	53.16	1.52
1.8900	53.30	1.52	53.14	1.53
1.9000	53.30	1.52	53.11	1.55
1.9100	53.30	1.52	53.09	1.56

* value interpolated

Test Result for UIM Dielectric Parameter

Sat 30/Jun/2012 06:33:53

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	52.83	1.51
1.8600	53.30	1.52	52.81	1.53
1.8700	53.30	1.52	52.78	1.54
1.8800	53.30	1.52	52.76	1.55
1.8900	53.30	1.52	52.73	1.56
1.9000	53.30	1.52	52.71	1.58
1.9100	53.30	1.52	52.69	1.59

* value interpolated

Test Result for UIM Dielectric Parameter

Wed 04/Jul/2012 06:57:41

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	53.30	1.50
1.8600	53.30	1.52	53.27	1.51
1.8700	53.30	1.52	53.25	1.52
1.8800	53.30	1.52	53.22	1.53
1.8900	53.30	1.52	53.19	1.54
1.9000	53.30	1.52	53.17	1.56
1.9100	53.30	1.52	53.14	1.57

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 05/Jul/2012 05:42:41

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	53.13	1.50
1.8600	53.30	1.52	53.10	1.51
1.8700	53.30	1.52	53.08	1.53
1.8800	53.30	1.52	53.05	1.54
1.8900	53.30	1.52	53.03	1.55
1.9000	53.30	1.52	53.00	1.57
1.9100	53.30	1.52	52.97	1.59

* value interpolated

Test Result for UIM Dielectric Parameter

Fri 22/Jun/2012 06:05:19

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.4100	52.75	1.91	52.45	1.91
2.4120	52.75	1.91	52.45	1.91*
2.4200	52.74	1.92	52.43	1.92
2.4300	52.73	1.93	52.41	1.94
2.4370	52.72	1.94	52.39	1.95*
2.4400	52.71	1.94	52.38	1.95
2.4500	52.70	1.95	52.35	1.96
2.4600	52.69	1.96	52.33	1.97
2.4620	52.69	1.96	52.34	1.97*
2.4700	52.67	1.98	52.30	1.98

* Value was interpolated

Test Result for UIM Dielectric Parameter

Wed 18/Jul/2012 03:02:41

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.7200	53.51	1.47	53.65	1.47
1.7300	53.48	1.48	53.62	1.49
1.7325	53.48	1.48	53.61	1.49*
1.7400	53.46	1.48	53.59	1.50
1.7450	53.45	1.49	53.58	1.51*
1.7500	53.43	1.49	53.56	1.51
1.7600	53.41	1.49	53.52	1.52
1.7700	53.38	1.50	53.48	1.54
1.7800	53.35	1.51	53.45	1.55

* value interpolated

Test Result for UIM Dielectric Parameter

Wed 18/Jul/2012 07:56:33

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	53.28	1.48
1.8600	53.30	1.52	53.26	1.50
1.8700	53.30	1.52	53.23	1.50
1.8800	53.30	1.52	53.21	1.52
1.8900	53.30	1.52	53.19	1.53
1.9000	53.30	1.52	53.17	1.55
1.9100	53.30	1.52	53.14	1.56

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 19/Jul/2012 07:36:25

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.8050	55.32	0.97	54.50	0.93
0.8150	55.28	0.97	54.45	0.94
0.8250	55.24	0.97	54.41	0.97
0.8290	55.23	0.97	54.40	0.98*
0.8350	55.20	0.97	54.36	0.98
0.8365	55.20	0.97	54.36	0.98*
0.8440	55.17	0.98	54.33	0.99*
0.8450	55.17	0.98	54.33	0.99
0.8550	55.14	0.99	54.29	1.00
0.8650	55.11	1.01	54.26	1.02

* value interpolated

Test Result for UIM Dielectric Parameter

Thu 19/Jul/2012 04:16:39

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.7000	55.73	0.96	55.30	0.93
0.7090	55.69	0.96	55.26	0.95*
0.7100	55.69	0.96	55.25	0.95
0.7110	55.69	0.96	55.25	0.95*
0.7200	55.65	0.96	55.21	0.96
0.7300	55.61	0.96	55.16	0.97
0.7400	55.57	0.96	55.12	0.97
0.7500	55.53	0.96	55.07	0.97
0.7600	55.49	0.96	55.03	0.98

* value interpolated

Test Result for UIM Dielectric Parameter

Sat 25/Aug/2012 06:57:41

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
1.8500	53.30	1.52	53.07	1.51
1.8524	53.30	1.52	53.07	1.51*
1.8600	53.30	1.52	53.06	1.52
1.8700	53.30	1.52	53.04	1.53
1.8800	53.30	1.52	53.02	1.54
1.8900	53.30	1.52	53.01	1.55
1.9000	53.30	1.52	52.99	1.57
1.9076	53.30	1.52	52.98	1.58*
1.9100	53.30	1.52	52.97	1.58

* value interpolated

Test Result for UIM Dielectric Parameter

Fri 24/Aug/2012 03:05:19

Freq Frequency(GHz)

FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma

FCC_eB FCC Limits for Body Epsilon

FCC_sB FCC Limits for Body Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.4100	52.75	1.91	52.45	1.91
2.4120	52.75	1.91	52.45	1.91*
2.4200	52.74	1.92	52.43	1.92
2.4300	52.73	1.93	52.41	1.94
2.4370	52.72	1.94	52.39	1.95*
2.4400	52.71	1.94	52.38	1.95
2.4500	52.70	1.95	52.35	1.96
2.4600	52.69	1.96	52.33	1.97
2.4620	52.69	1.96	52.34	1.97*
2.4700	52.67	1.98	52.30	1.98

* Value was interpolated

SAR Test Report - Plot 1

By Operator : Jay
Measurement Date : 01-Jul-2012
Starting Time : 01-Jul-2012 10:47:45 AM
End Time : 01-Jul-2012 11:02:55 AM
Scanning Time : 910 secs

Product Data

Device Name : Validation
Serial No. : 750
Type : Dipole
Model : ALS-D-750-S-2
Frequency : 750.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 180.2 mm
Width : 3.6 mm
Depth : 97.0 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 1.033 W/kg
Power Drift-Finish: 1.020 W/kg
Power Drift (%) : -1.199

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 750
Frequency : 750.00 MHz
Last Calib. Date : 01-Jul-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 55.21 F/m
Sigma : 0.99 S/m
Density : 1000.00 kg/cu. m

Probe Data

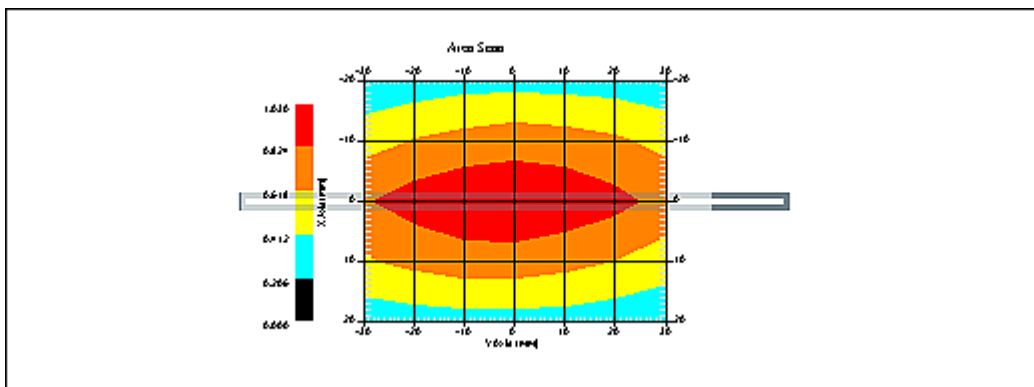
Name : Probe 217 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 750.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 25.00 °C
Set-up Date : 01-Jul-2012
Set-up Time : 9:21:48 AM
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

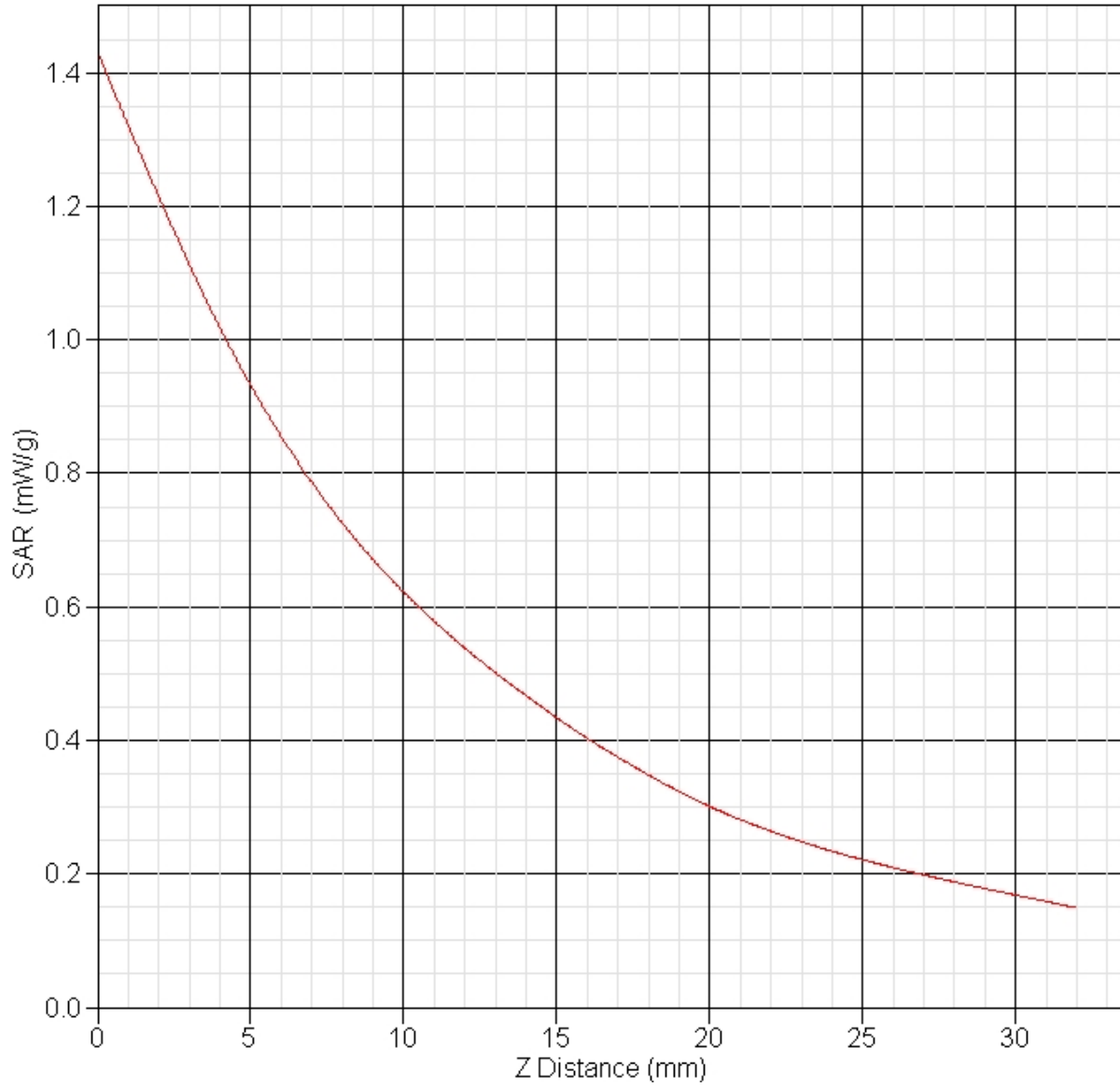
Other Data

DUT Position : Touch
Separation : 15 mm
Channel : Mid



1 gram SAR value : 0.896 W/kg
10 gram SAR value : 0.568 W/kg
Area Scan Peak SAR : 1.028 W/kg
Zoom Scan Peak SAR : 1.431 W/kg

SAR-Z Axis
at Hotspot x:0.26 y:-0.21



SAR Test Report - Plot 2

By Operator : Jay
Measurement Date : 30-Jun-2012
Starting Time : 30-Jun-2012 07:50:41 PM
End Time : 30-Jun-2012 08:05:52 PM
Scanning Time : 911 secs

Product Data

Device Name : Validation
Serial No. : 835
Type : Dipole
Model : ALS-D-835-S-2
Frequency : 835.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 161 mm
Width : 3.6 mm
Depth : 89.8 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 1.216 W/kg
Power Drift-Finish: 1.178 W/kg
Power Drift (%) : -3.128

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 835
Frequency : 835.00 MHz
Last Calib. Date : 30-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 54.32 F/m
Sigma : 0.99 S/m
Density : 1000.00 kg/cu. m

Probe Data

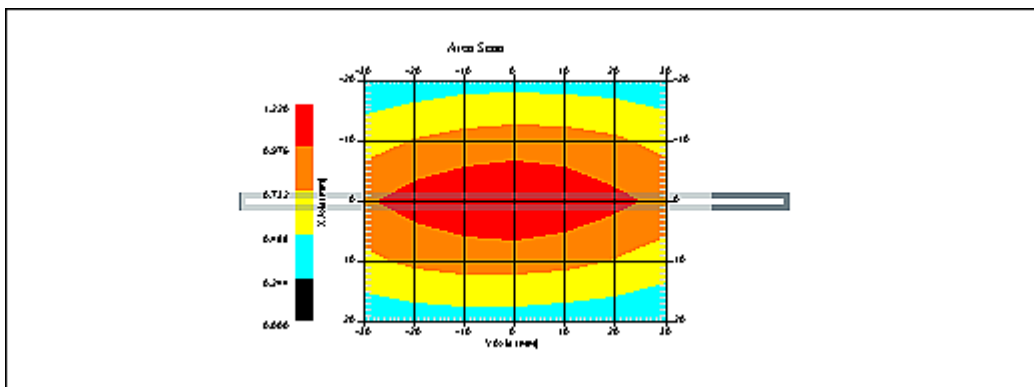
Name : Probe 217 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.4
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 25.00 °C
Set-up Date : 30-Jun-2012
Set-up Time : 9:21:48 AM
Area Scan : 5x7x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

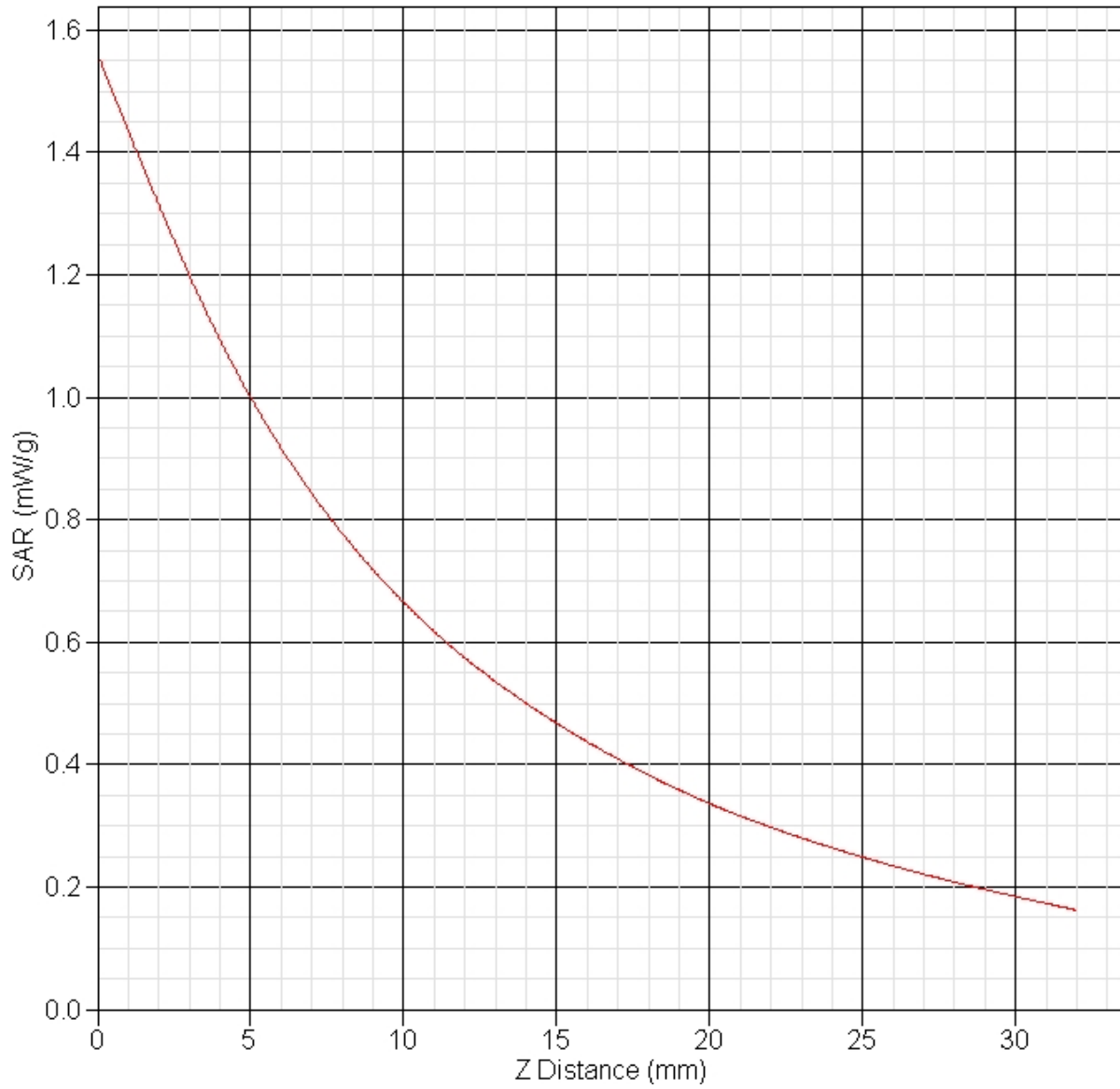
Other Data

DUT Position : Touch
Separation : 15 mm
Channel : Mid



1 gram SAR value : 1.004 W/kg
10 gram SAR value : 0.633 W/kg
Area Scan Peak SAR : 1.218 W/kg
Zoom Scan Peak SAR : 1.561 W/kg

SAR-Z Axis
at Hotspot x:0.25 y:-0.20



SAR Test Report - Plot 3

By Operator : Jay
Measurement Date : 24-Jun-2012
Starting Time : 24-Jun-2012 06:34:22 AM
End Time : 24-Jun-2012 06:47:21 AM
Scanning Time : 779 secs

Product Data

Device Name : Validation
Serial No. : 1028
Type : Dipole
Model : D1750V2
Frequency : 1750.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 72.0 mm
Width : 3.6 mm
Depth : 41.7 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 4.552 W/kg
Power Drift-Finish: 4.532 W/kg
Power Drift (%) : -0.448

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1750
Frequency : 1750.00 MHz
Last Calib. Date : 24-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 53.40 F/m
Sigma : 1.50 S/m
Density : 1000.00 kg/cu. m

Probe Data

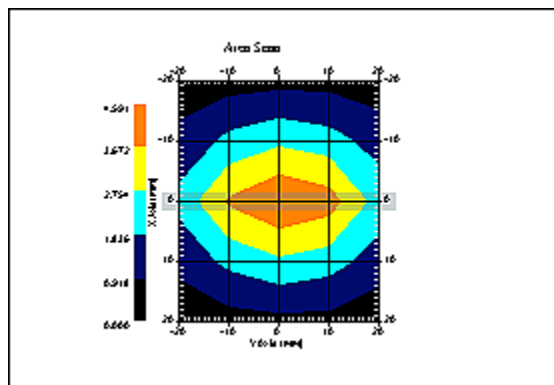
Name : Probe 217 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1735.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5.2
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 24-Jun-2012
Set-up Time : 8:39:41 AM
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

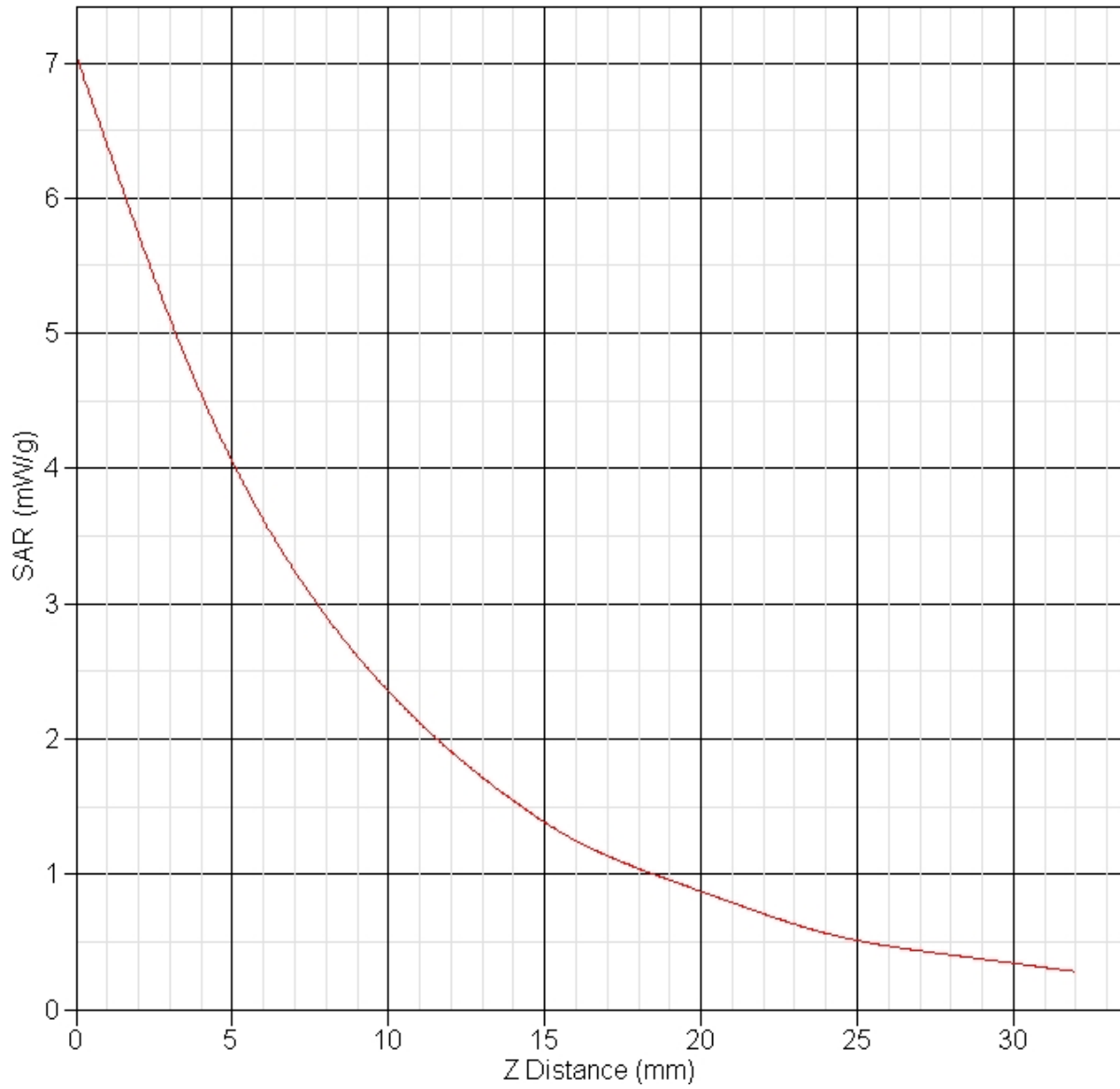
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 3.993 W/kg
10 gram SAR value : 2.076 W/kg
Area Scan Peak SAR : 4.591 W/kg
Zoom Scan Peak SAR : 7.066 W/kg

SAR-Z Axis
at Hotspot x:0.22 y:-0.14



SAR Test Report - Plot 4

By Operator : Jay
Measurement Date : 29-Jun-2012
Starting Time : 29-Jun-2012 05:58:15 AM
End Time : 29-Jun-2012 06:11:18 AM
Scanning Time : 783 secs

Product Data

Device Name : Validation
Serial No. : 1900
Type : Dipole
Model : ALS-D-1900-S-2
Frequency : 1900.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 68 mm
Width : 3.6 mm
Depth : 39.5 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 4.658 W/kg
Power Drift-Finish: 4.657 W/kg
Power Drift (%) : -0.024

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1900
Frequency : 1900.00 MHz
Last Calib. Date : 29-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 49.00 RH%
Epsilon : 53.11 F/m
Sigma : 1.55 S/m
Density : 1000.00 kg/cu. m

Probe Data

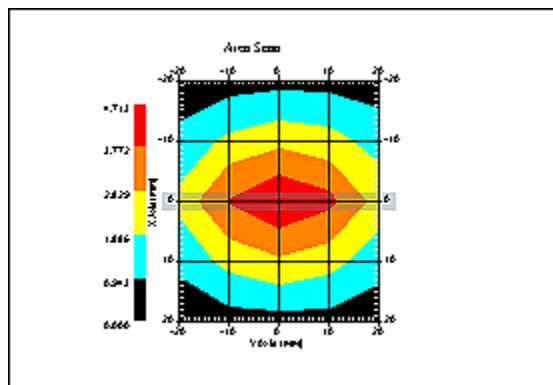
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.8
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 29-Jun-2012
Set-up Time : 8:39:41 AM
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

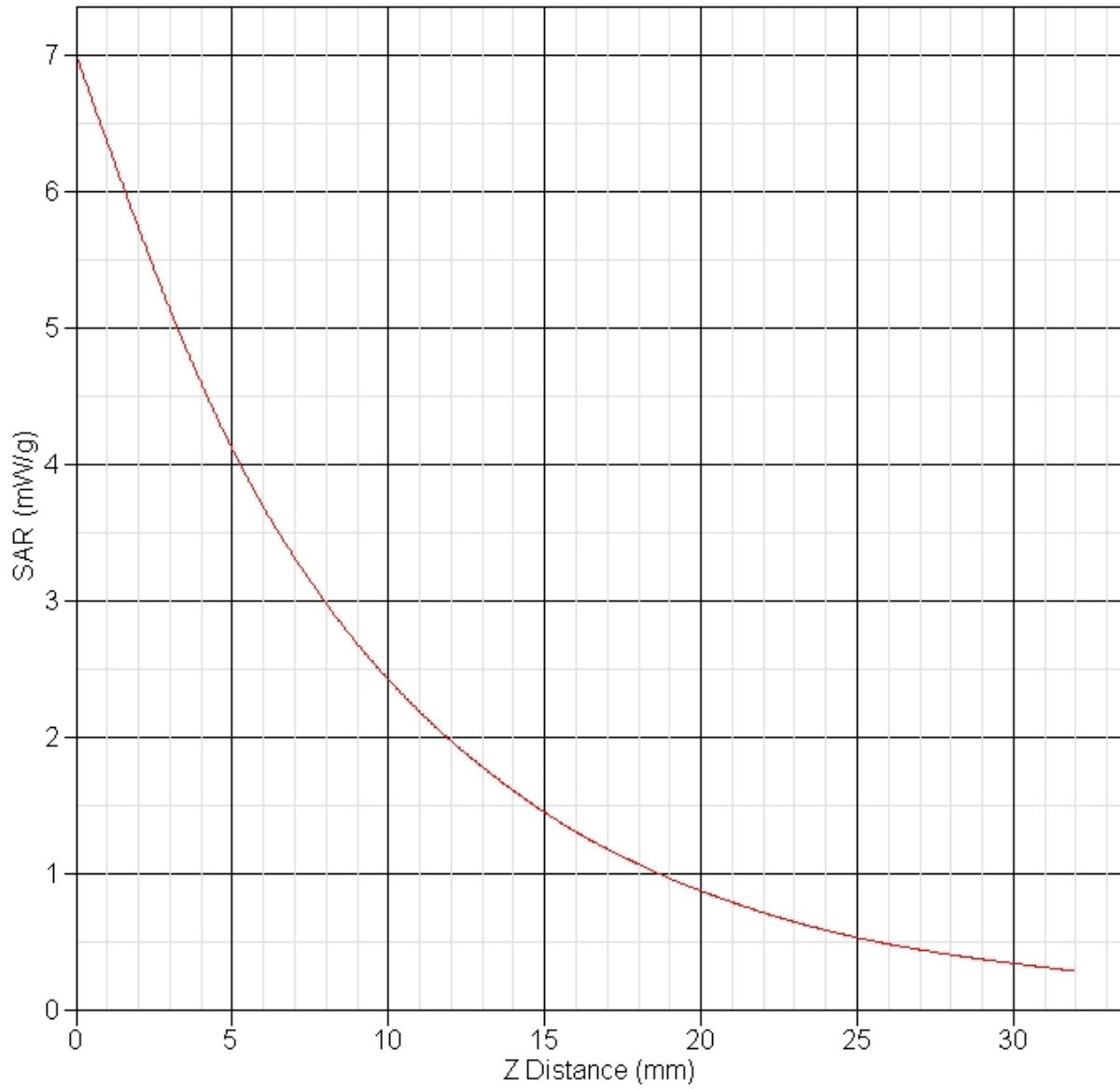
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 3.912 W/kg
10 gram SAR value : 2.041 W/kg
Area Scan Peak SAR : 4.713 W/kg
Zoom Scan Peak SAR : 7.006 W/kg

SAR-Z Axis
at Hotspot x:0.22 y:-0.15



SAR Test Report - Plot 5

By Operator : Jay
Measurement Date : 22-Jun-2012
Starting Time : 22-Jun-2012 06:13:46 PM
End Time : 22-Jun-2012 06:26:56 PM
Scanning Time : 790 secs

Product Data

Device Name : Validation
Serial No. : 2450
Type : Dipole
Model : ALS-D-2450-S-2
Frequency : 2450.00 MHz
Max. Transmit Pwr : 0.1 W
Drift Time : 0 min(s)
Length : 51.5 mm
Width : 3.6 mm
Depth : 30.4 mm
Antenna Type : Internal
Orientation : Touch
Power Drift-Start : 6.188 W/kg
Power Drift-Finish: 6.204 W/kg
Power Drift (%) : 0.260

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 2450
Frequency : 2450.00 MHz
Last Calib. Date : 22-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 45.00 RH%
Epsilon : 52.35 F/m
Sigma : 1.96 S/m
Density : 1000.00 kg/cu. m

Probe Data

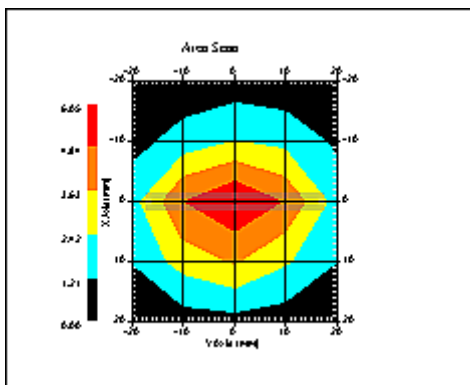
Name : Probe 217 - RFEL
Model : E020
Type : E-Field Triangle
Serial No. : 2175
Last Calib. Date : 07-Sep-2011
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 3.94
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jun-2012
Set-up Time : 7:40:13 AM
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

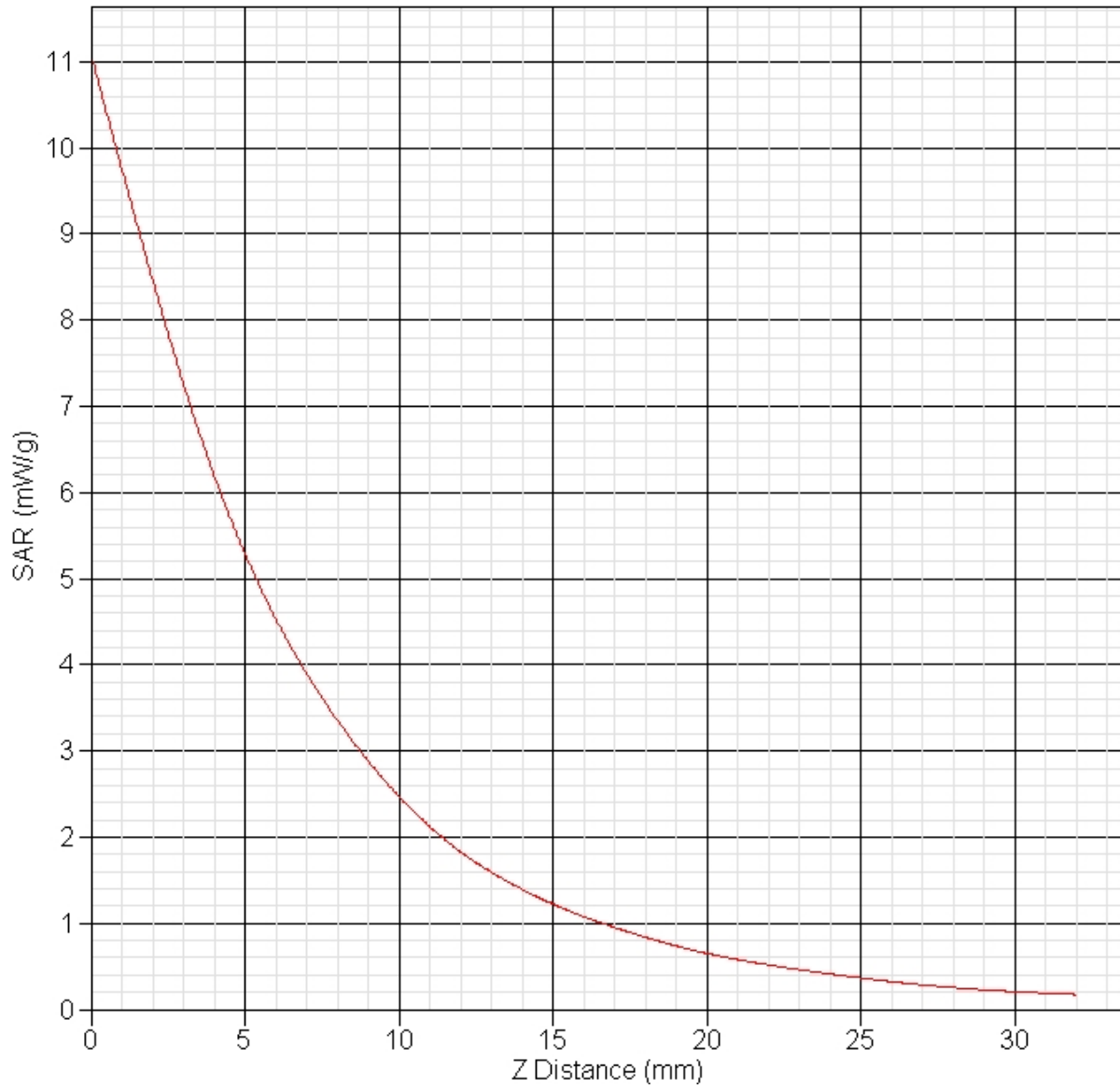
Other Data

DUT Position : Touch
Separation : 10 mm
Channel : Mid



1 gram SAR value : 5.268 W/kg
10 gram SAR value : 2.367 W/kg
Area Scan Peak SAR : 6.049 W/kg
Zoom Scan Peak SAR : 11.090 W/kg

SAR-Z Axis
at Hotspot x:0.22 y:-0.14



Appendix B – SAR Test Data Plots

SAR Test Report - Plot 1

By Operator : Jay
Measurement Date : 21-Jun-2012
Starting Time : 21-Jun-2012 07:11:14 PM
End Time : 21-Jun-2012 07:31:22 PM
Scanning Time : 1208 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : WCDMA
Model : MiFi 5792
Frequency : 846.60 MHz - Channel 4233
Max. Transmit Pwr : 0.244 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side A
Power Drift-Start : 0.639 W/kg
Power Drift-Finish: 0.663 W/kg
Power Drift (%) : 3.800

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 846
Frequency : 846.60 MHz
Last Calib. Date : 21-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 54.92 F/m
Sigma : 0.99 S/m
Density : 1000.00 kg/cu. m

Probe Data

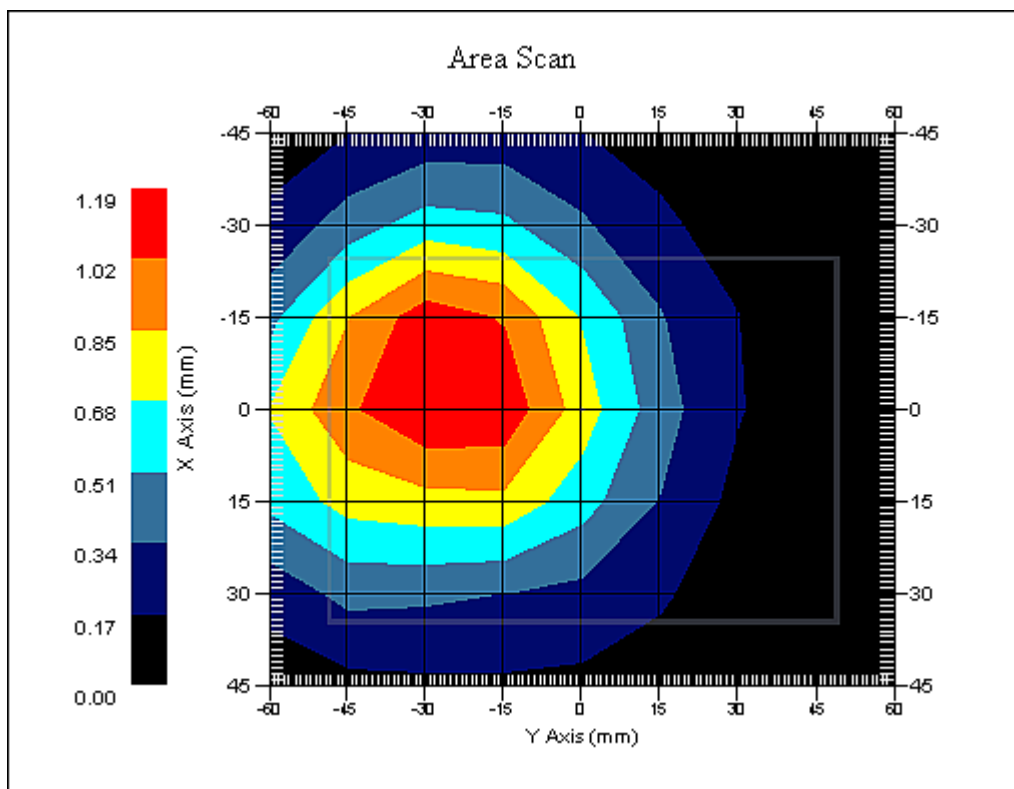
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.4
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 21-Jun-2012
Set-up Time : 12:50:57 PM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

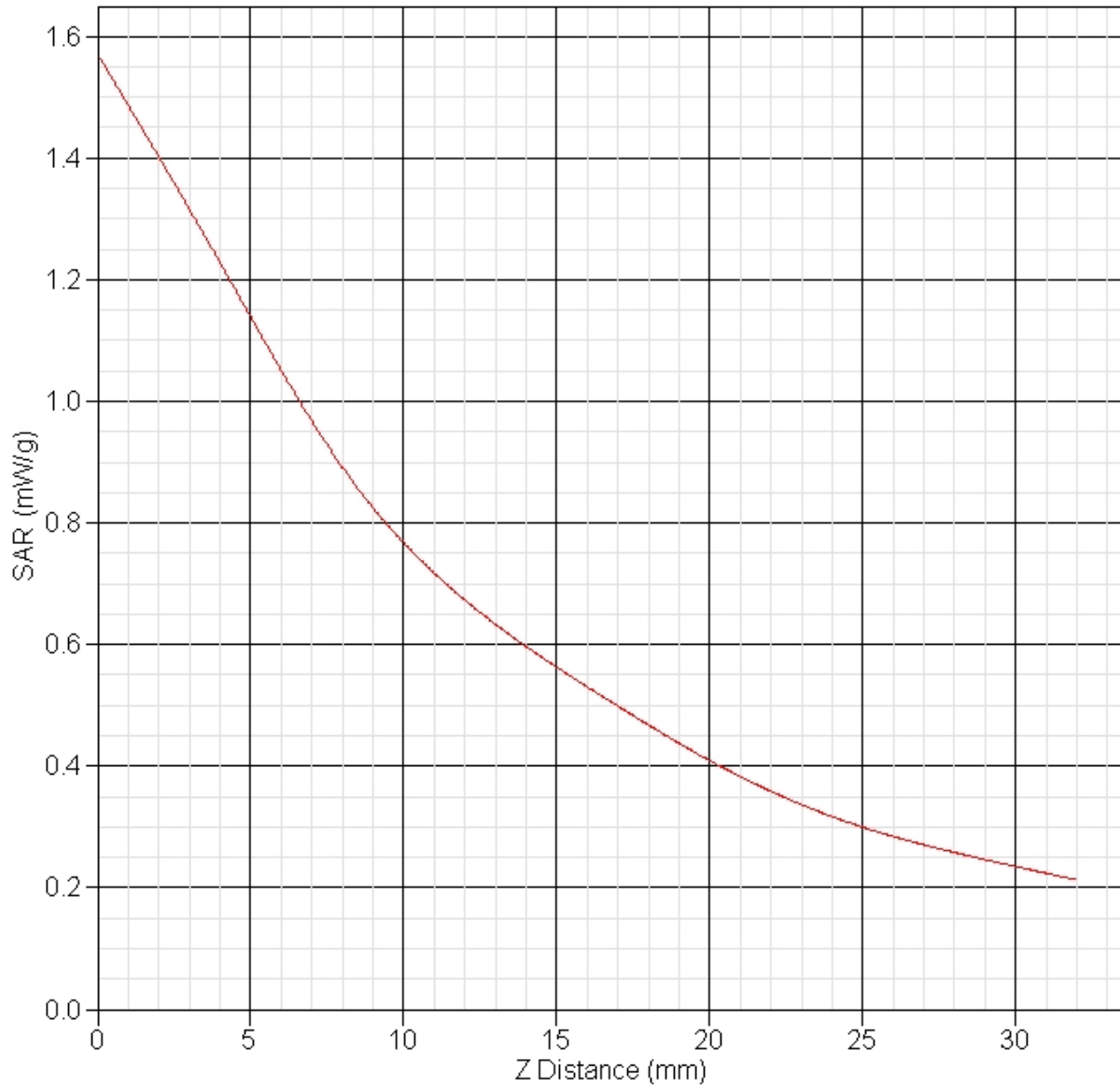
Other Data

DUT Position : Side A
Separation : 10 mm
Channel : High



1 gram SAR value : 1.173 W/kg
10 gram SAR value : 0.786 W/kg
Area Scan Peak SAR : 1.190 W/kg
Zoom Scan Peak SAR : 1.571 W/kg

SAR-Z Axis
at Hotspot x:7.11 y:-29.94



SAR Test Report - Plot 2

By Operator : Jay
Measurement Date : 21-Jun-2012
Starting Time : 21-Jun-2012 03:32:24 PM
End Time : 21-Jun-2012 03:59:13 PM
Scanning Time : 1609 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : GPRS - 1 Slot
Model : MiFi 5792
Frequency : 836.60 MHz - Channel 190
Max. Transmit Pwr : 2 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side A
Power Drift-Start : 0.285 W/kg
Power Drift-Finish: 0.295 W/kg
Power Drift (%) : 3.541

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 836
Frequency : 836.60 MHz
Last Calib. Date : 21-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 54.97 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

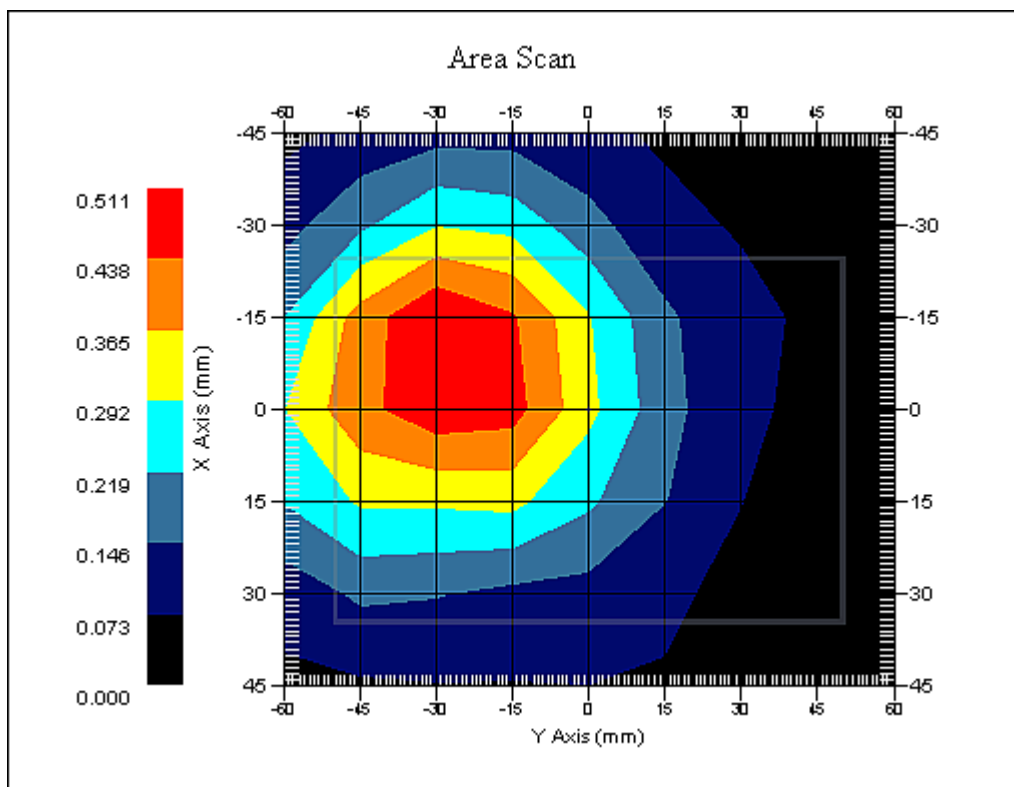
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 835.00 MHz
Duty Cycle Factor: 8.3
Conversion Factor: 6.4
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8.3
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 21-Jun-2012
Set-up Time : 12:50:57 PM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

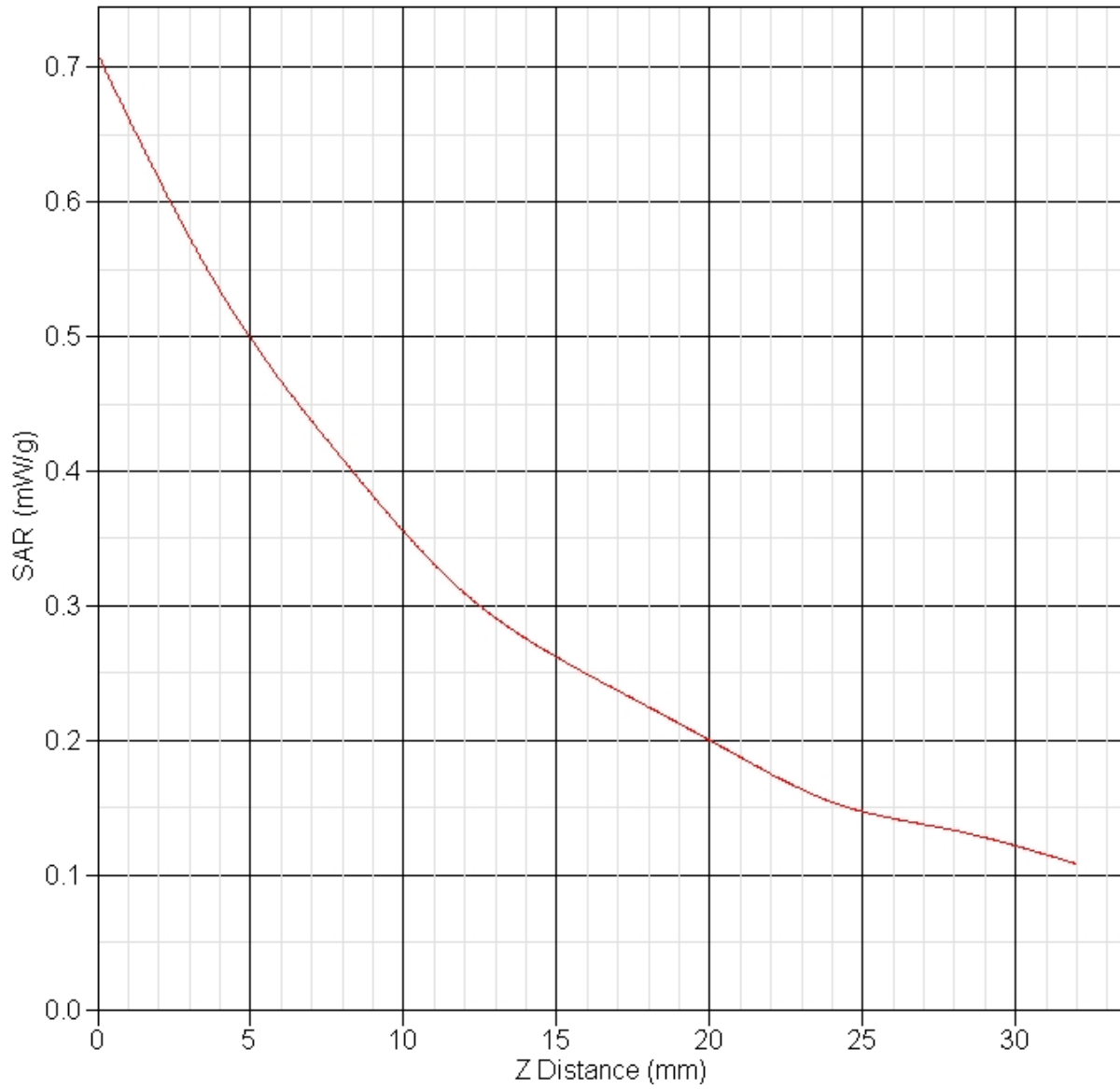
Other Data

DUT Position : Side A
Separation : 10 mm
Channel : Mid



1 gram SAR value : 0.483 W/kg
10 gram SAR value : 0.322 W/kg
Area Scan Peak SAR : 0.510 W/kg
Zoom Scan Peak SAR : 0.710 W/kg

SAR-Z Axis
at Hotspot x:8.12 y:-21.94



SAR Test Report - Plot 3

By Operator : Jay
Measurement Date : 21-Jun-2012
Starting Time : 21-Jun-2012 07:58:00 AM
End Time : 21-Jun-2012 08:28:12 AM
Scanning Time : 1812 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : WCDMA
Model : MiFi 5792
Frequency : 1880.00 MHz - Channel 9400
Max. Transmit Pwr : 0.243 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side A
Power Drift-Start : 0.424 W/kg
Power Drift-Finish: 0.419 W/kg
Power Drift (%) : -1.248

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1880
Frequency : 1880.00 MHz
Last Calib. Date : 21-Jun-2012
Temperature : 21.00 °C
Ambient Temp. : 24.00 °C
Humidity : 42.00 RH%
Epsilon : 52.68 F/m
Sigma : 1.56 S/m
Density : 1000.00 kg/cu. m

Probe Data

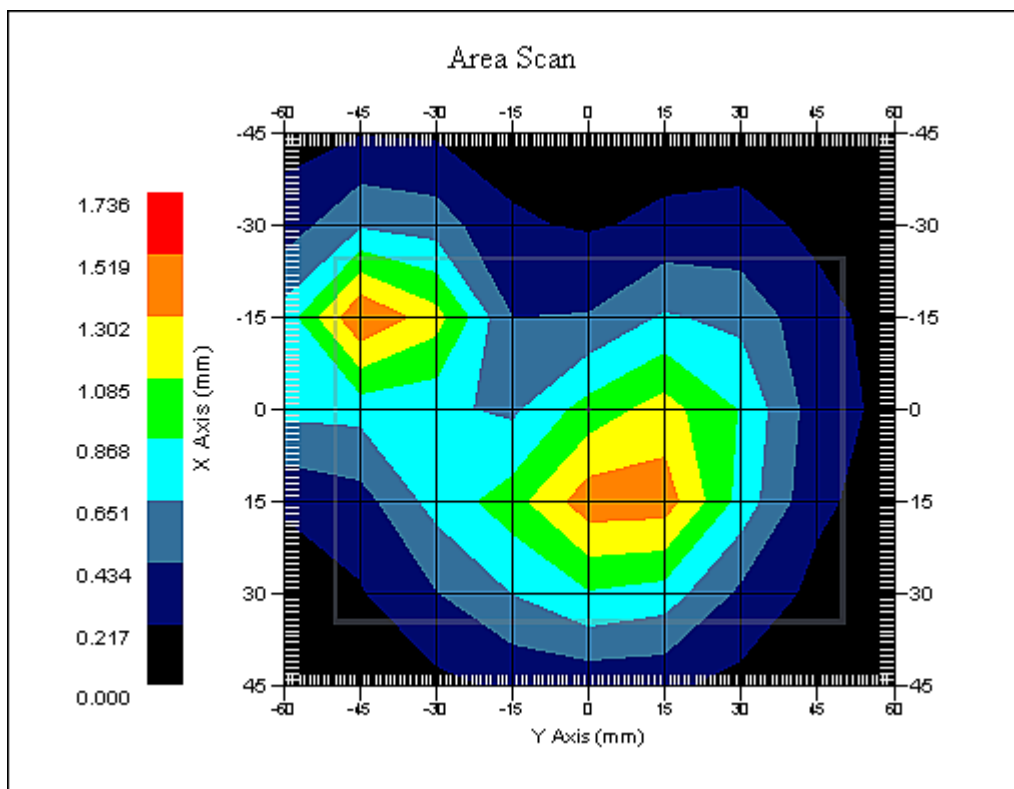
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.8
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 21-Jun-2012
Set-up Time : 6:06:23 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

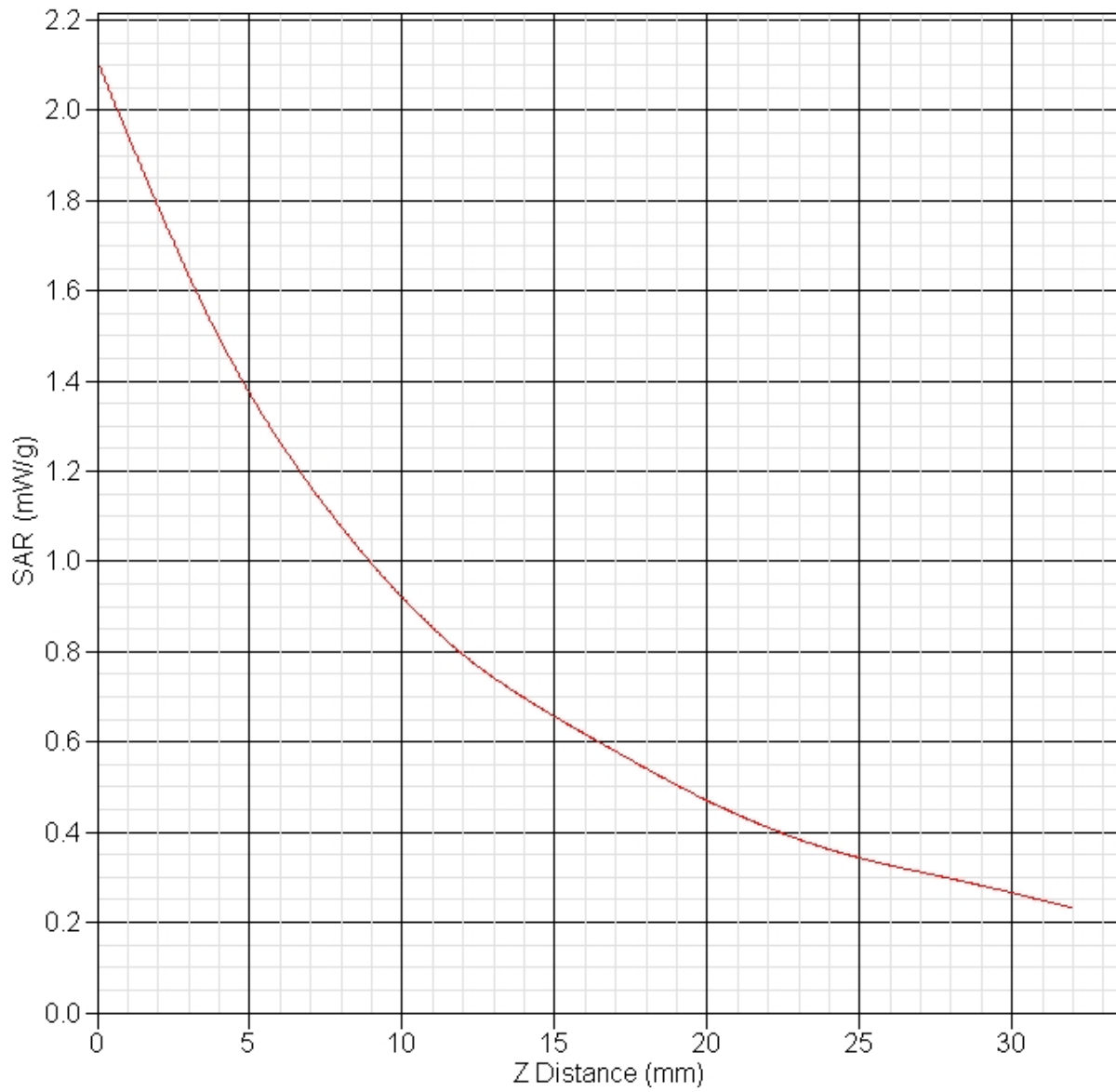
Other Data

DUT Position : Side A
Separation : 10 mm
Channel : Mid



1 gram SAR value : 1.395 W/kg
10 gram SAR value : 0.884 W/kg
Area Scan Peak SAR : 1.520 W/kg
Zoom Scan Peak SAR : 2.111 W/kg

SAR-Z Axis
at Hotspot x:30.11 y:8.05



SAR Test Report - Plot 4

By Operator : Jay
Measurement Date : 21-Jun-2012
Starting Time : 21-Jun-2012 11:36:33 AM
End Time : 21-Jun-2012 12:13:18 PM
Scanning Time : 2205 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : GPRS - 1 Slot
Model : MiFi 5792
Frequency : 1880.00 MHz - Channel 661
Max. Transmit Pwr : 1 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side A
Power Drift-Start : 0.169 W/kg
Power Drift-Finish: 0.177 W/kg
Power Drift (%) : 4.734

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1880
Frequency : 1880.00 MHz
Last Calib. Date : 21-Jun-2012
Temperature : 21.00 °C
Ambient Temp. : 24.00 °C
Humidity : 42.00 RH%
Epsilon : 52.68 F/m
Sigma : 1.56 S/m
Density : 1000.00 kg/cu. m

Probe Data

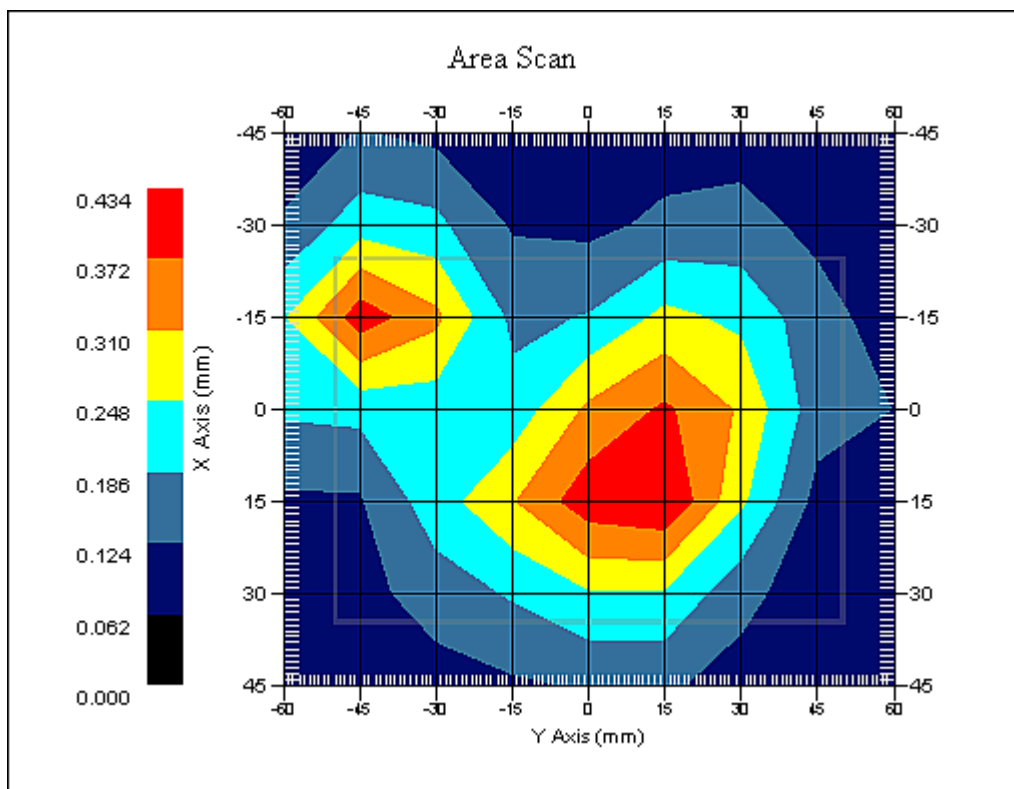
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1900.00 MHz
Duty Cycle Factor: 8.3
Conversion Factor: 4.8
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 8.3
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 21-Jun-2012
Set-up Time : 6:06:23 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

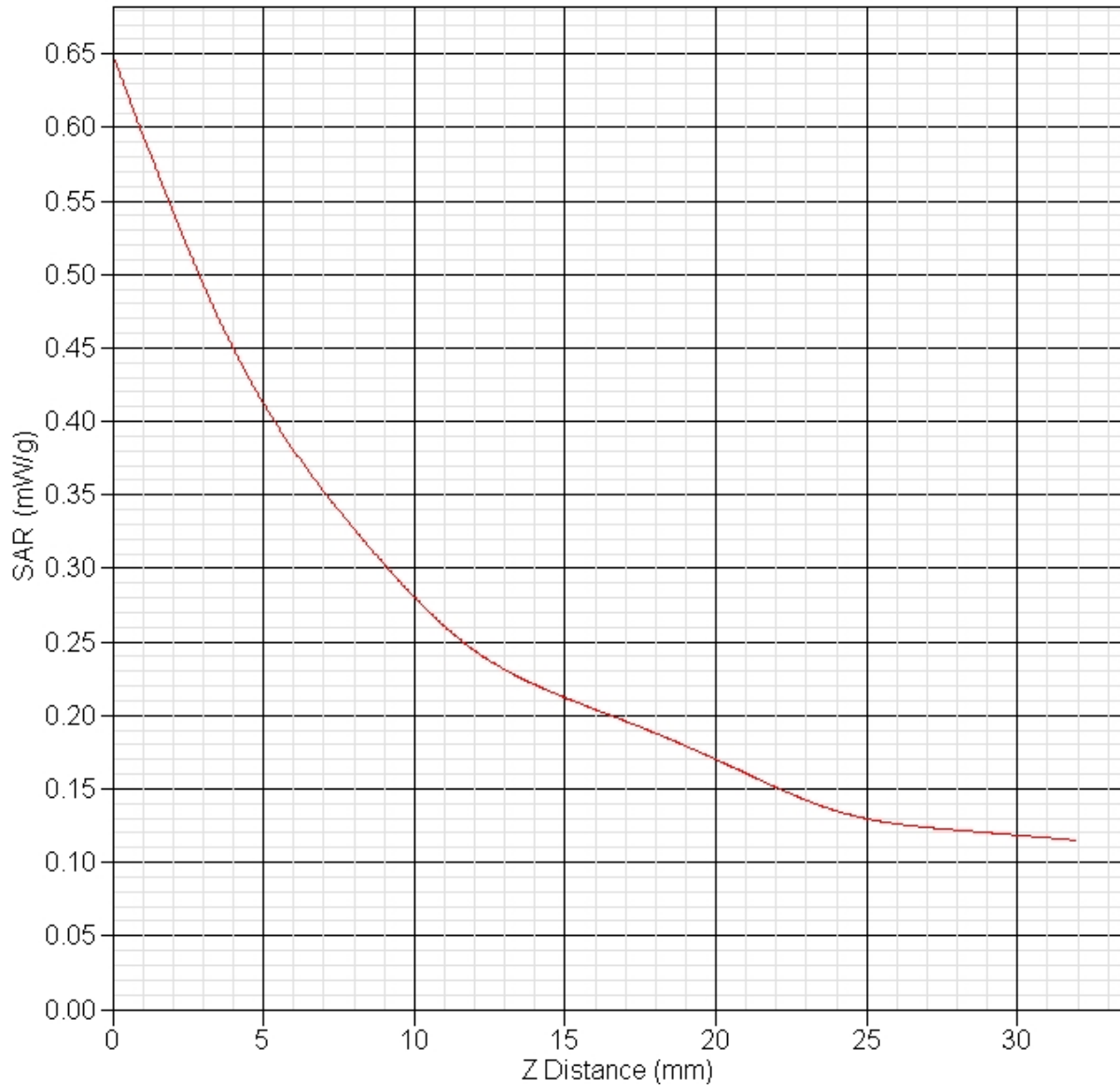
Other Data

DUT Position : Side A
Separation : 10 mm
Channel : Mid



1 gram SAR value : 0.430 W/kg
10 gram SAR value : 0.287 W/kg
Area Scan Peak SAR : 0.433 W/kg
Zoom Scan Peak SAR : 0.650 W/kg

SAR-Z Axis
at Hotspot x:30.10 y:7.06



SAR Test Report - Plot 5

By Operator : Jay
Measurement Date : 04-Jul-2012
Starting Time : 04-Jul-2012 07:23:01 AM
End Time : 04-Jul-2012 07:53:04 AM
Scanning Time : 1803 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : LTE - 20 MHz BW - QPSK - 1 RB 0 Offset
Model : MiFi 5792
Frequency : 1860.00 MHz - Channel 18700
Max. Transmit Pwr : 0.251 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side C
Power Drift-Start : 0.366 W/kg
Power Drift-Finish: 0.357 W/kg
Power Drift (%) : -2.460

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1860
Frequency : 1860.00 MHz
Last Calib. Date : 04-Jul-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 45.00 RH%
Epsilon : 53.27 F/m
Sigma : 1.51 S/m
Density : 1000.00 kg/cu. m

Probe Data

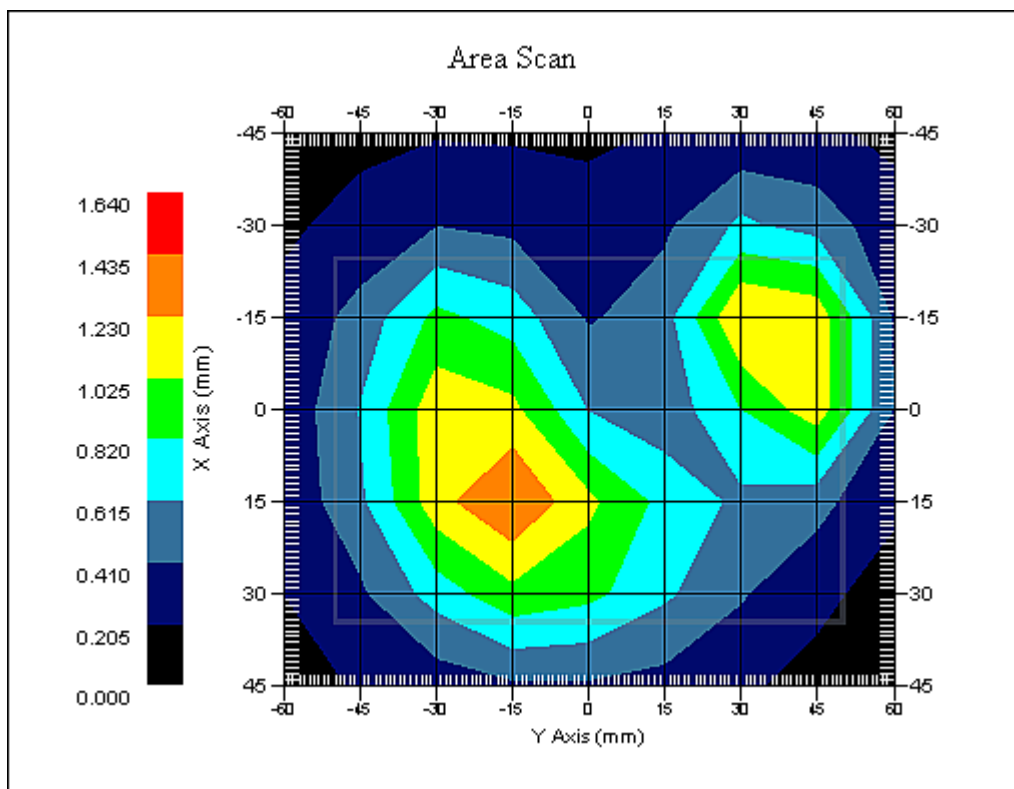
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 4.8
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 04-Jul-2012
Set-up Time : 9:50:32 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

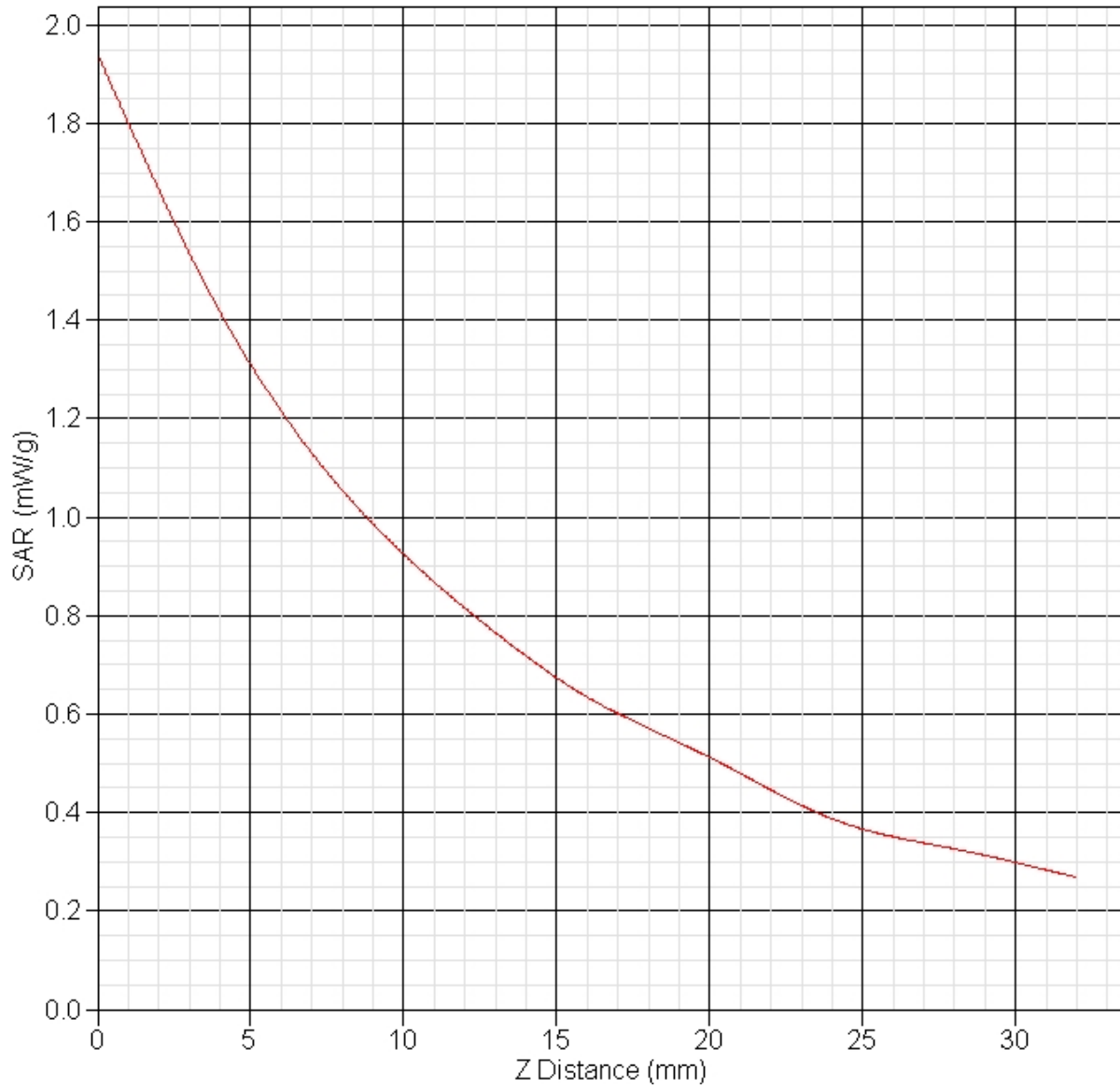
Other Data

DUT Position : Side C
Separation : 5 mm at battery
Channel : Low



1 gram SAR value : 1.342 W/kg
10 gram SAR value : 0.886 W/kg
Area Scan Peak SAR : 1.438 W/kg
Zoom Scan Peak SAR : 1.941 W/kg

SAR-Z Axis
at Hotspot x:30.19 y:-14.94



SAR Test Report - Plot 6

By Operator : Jay
Measurement Date : 23-Jun-2012
Starting Time : 23-Jun-2012 09:01:00 AM
End Time : 23-Jun-2012 09:21:29 AM
Scanning Time : 1229 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : LTE - 20 MHz BW - QPSK - 1 RB 0 Offset
Model : MiFi 5792
Frequency : 1745.00 MHz - Channel 20300
Max. Transmit Pwr : 0.251 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side A
Power Drift-Start : 0.675 W/kg
Power Drift-Finish: 0.653 W/kg
Power Drift (%) : -3.232

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 1745
Frequency : 1745.00 MHz
Last Calib. Date : 23-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 45.00 RH%
Epsilon : 53.58 F/m
Sigma : 1.51 S/m
Density : 1000.00 kg/cu. m

Probe Data

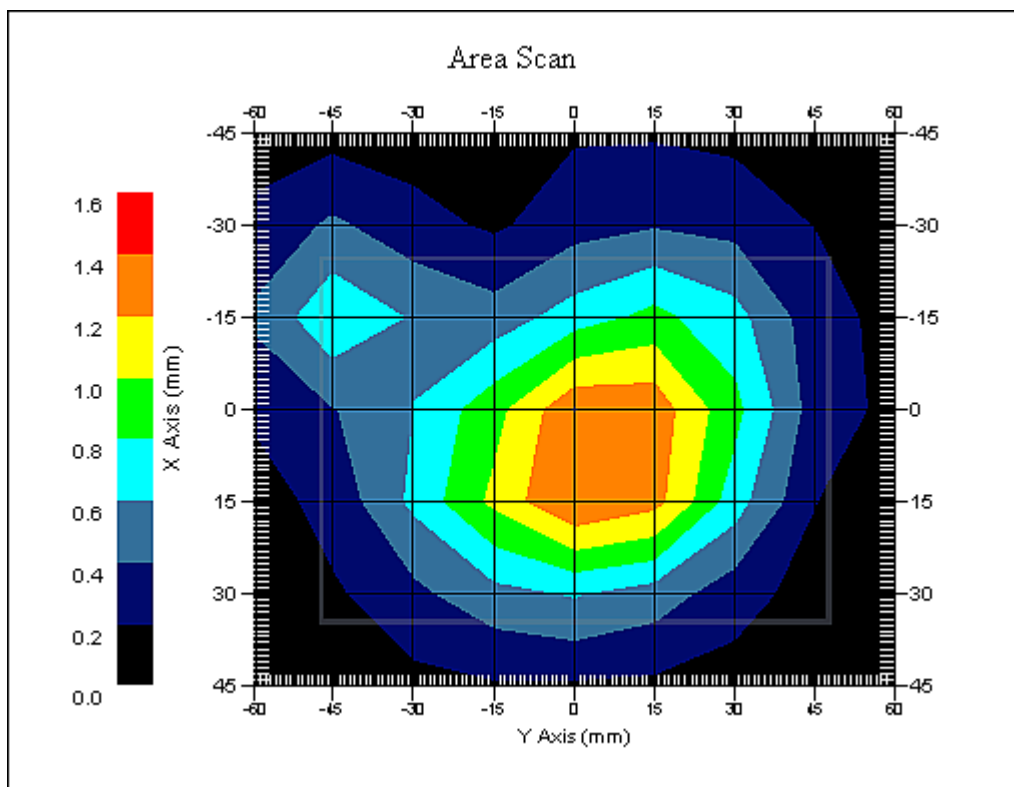
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 1735.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5.2
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 23-Jun-2012
Set-up Time : 5:56:31 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

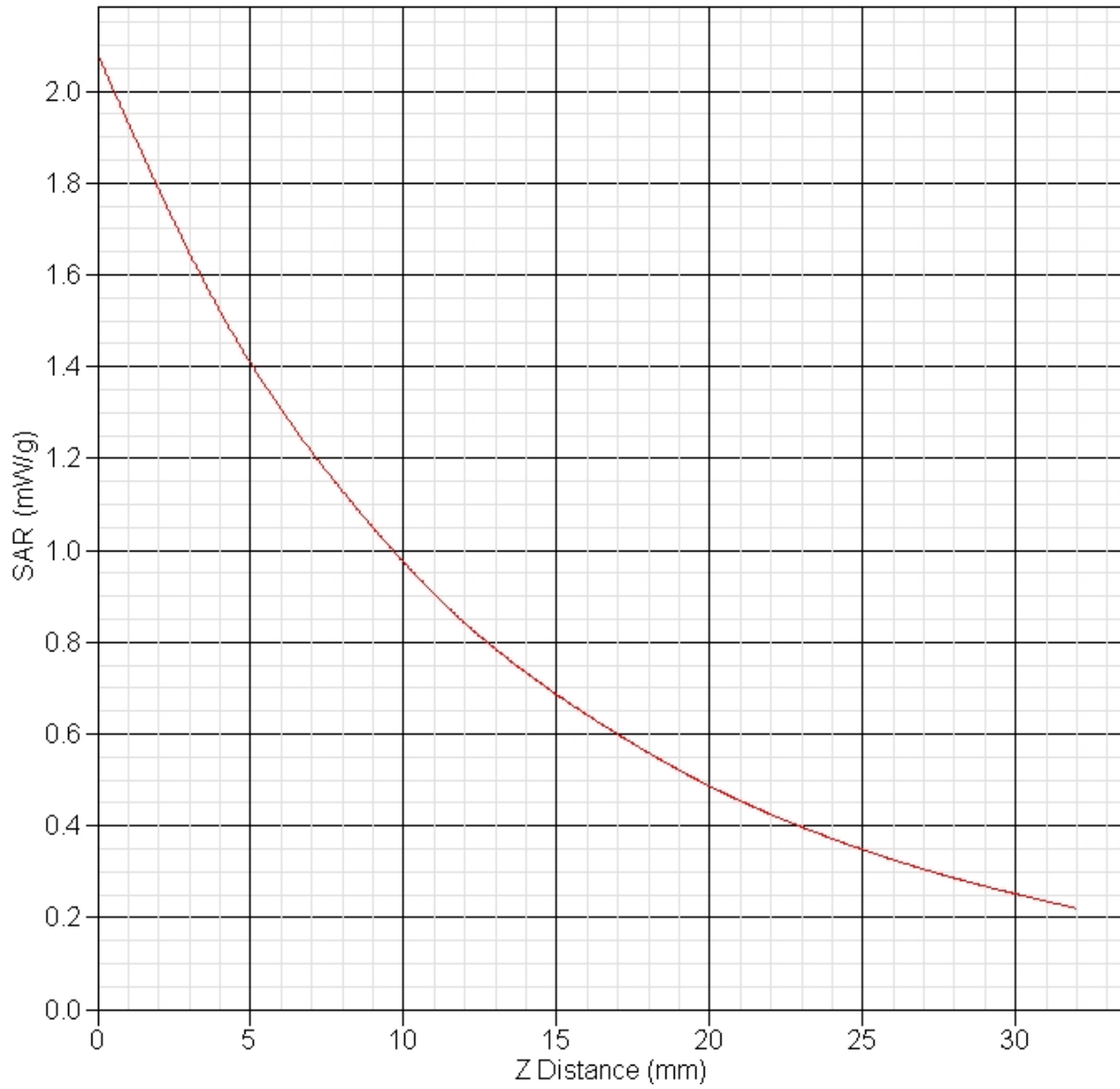
Other Data

DUT Position : Side A
Separation : 10 mm
Channel : High



1 gram SAR value : 1.350 W/kg
10 gram SAR value : 0.853 W/kg
Area Scan Peak SAR : 1.401 W/kg
Zoom Scan Peak SAR : 2.081 W/kg

SAR-Z Axis
at Hotspot x:22.11 y:8.05



SAR Test Report - Plot 7

By Operator : Jay
Measurement Date : 01-Jul-2012
Starting Time : 01-Jul-2012 06:40:57 PM
End Time : 01-Jul-2012 07:01:35 PM
Scanning Time : 1238 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : LTE - 10 MHz BW - QPSK - 1 RB 0 Offset
Model : MiFi 5792
Frequency : 836.50 MHz
Max. Transmit Pwr : 0.251 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side C
Power Drift-Start : 0.689 W/kg
Power Drift-Finish: 0.676 W/kg
Power Drift (%) : -1.881

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 836
Frequency : 836.50 MHz
Last Calib. Date : 01-Jul-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 40.00 RH%
Epsilon : 53.32 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

Probe Data

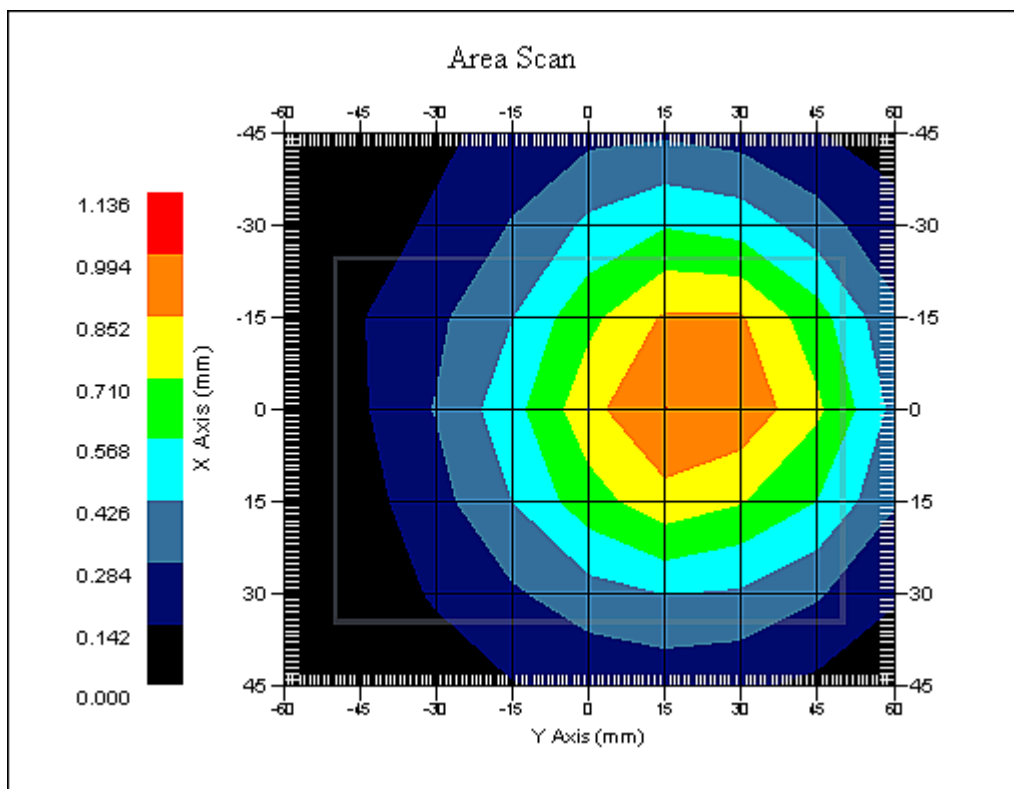
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 835.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.4
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 01-Jul-2012
Set-up Time : 7:17:27 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

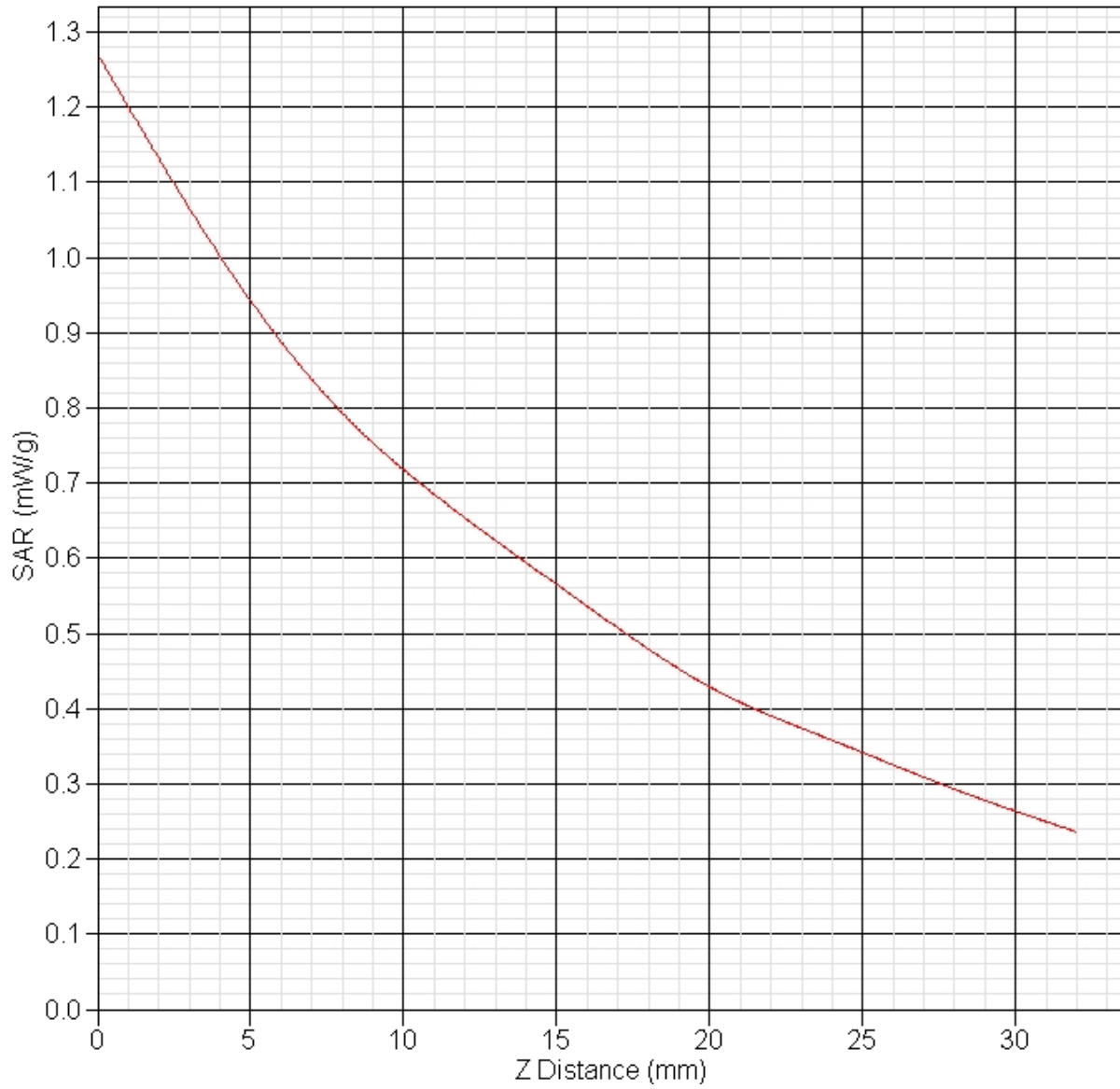
Other Data

DUT Position : Side C
Separation : 5 mm at battery
Channel : Mid



1 gram SAR value : 0.942 W/kg
10 gram SAR value : 0.695 W/kg
Area Scan Peak SAR : 0.997 W/kg
Zoom Scan Peak SAR : 1.271 W/kg

SAR-Z Axis
at Hotspot x:15.16 y:15.06



SAR Test Report - Plot 8

By Operator : Jay
Measurement Date : 01-Jul-2012
Starting Time : 01-Jul-2012 02:55:15 PM
End Time : 01-Jul-2012 03:15:38 PM
Scanning Time : 1223 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : LTE - 10 MHz BW - QPSK - 1 RB 0 Offset
Model : MiFi 5792
Frequency : 710.00 MHz - Channel 23790
Max. Transmit Pwr : 0.251 W
Drift Time : 0 min(s)
Length : 72 mm
Width : 100 mm
Depth : 22 mm
Antenna Type : Internal
Orientation : Side C
Power Drift-Start : 0.616 W/kg
Power Drift-Finish: 0.593 W/kg
Power Drift (%) : -3.732

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 710
Frequency : 710.00 MHz
Last Calib. Date : 01-Jul-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 41.00 RH%
Epsilon : 55.39 F/m
Sigma : 0.95 S/m
Density : 1000.00 kg/cu. m

Probe Data

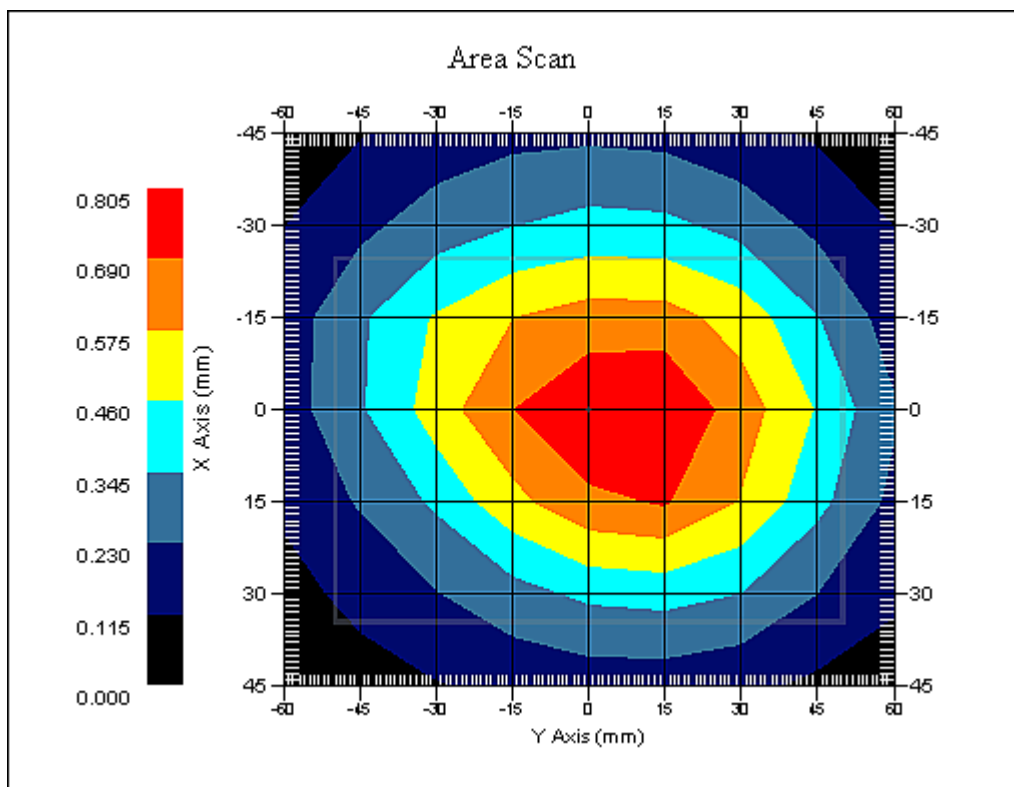
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 750.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 6.3
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 01-Jul-2012
Set-up Time : 11:07:55 AM
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

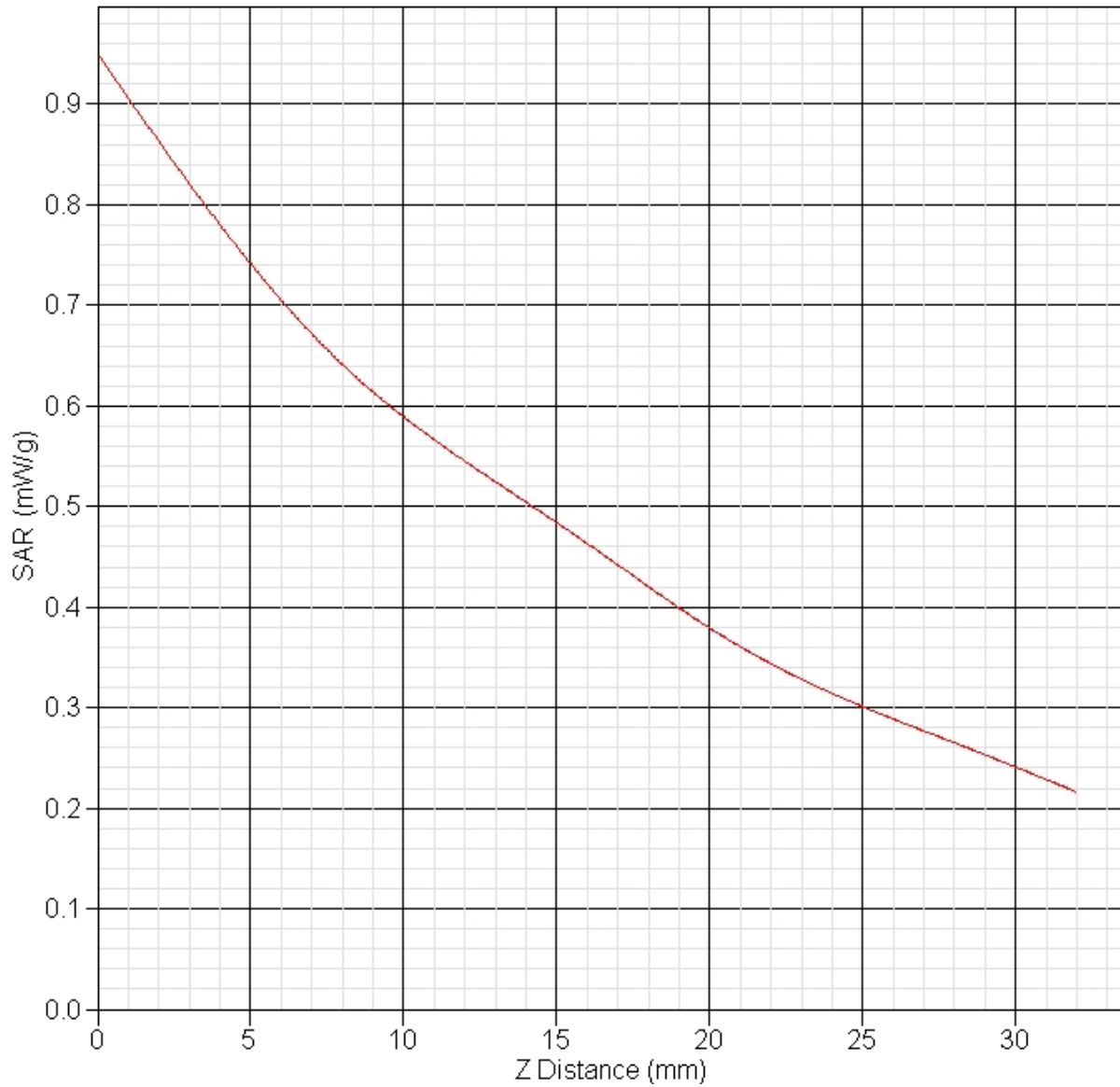
Other Data

DUT Position : Side C
Separation : 5 mm at battery
Channel : Mid



1 gram SAR value : 0.745 W/kg
10 gram SAR value : 0.559 W/kg
Area Scan Peak SAR : 0.803 W/kg
Zoom Scan Peak SAR : 0.950 W/kg

SAR-Z Axis
at Hotspot x:15.22 y:7.06



SAR Test Report - Plot 9

By Operator : Jay
Measurement Date : 22-Jun-2012
Starting Time : 22-Jun-2012 08:31:23 PM
End Time : 22-Jun-2012 08:48:17 PM
Scanning Time : 1014 secs

Product Data

Device Name : Novatel Wireless
Serial No. : SA310512700011
Mode : 802.11b
Model : MiFi 5792
Frequency : 2437.00 MHz
Max. Transmit Pwr : 0.05 W
Drift Time : 0 min(s)
Length : 22 mm
Width : 100 mm
Depth : 72 mm
Antenna Type : Internal
Orientation : Side B
Power Drift-Start : 0.166 W/kg
Power Drift-Finish: 0.167 W/kg
Power Drift (%) : 0.603

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Size (mm) : 280 x 280 x 200
Serial No. : System Default
Location : Center
Description : Uni-Phantom

Tissue Data

Type : BODY
Serial No. : 2437
Frequency : 2437.00 MHz
Last Calib. Date : 22-Jun-2012
Temperature : 20.00 °C
Ambient Temp. : 23.00 °C
Humidity : 43.00 RH%
Epsilon : 52.39 F/m
Sigma : 1.95 S/m
Density : 1000.00 kg/cu. m

Probe Data

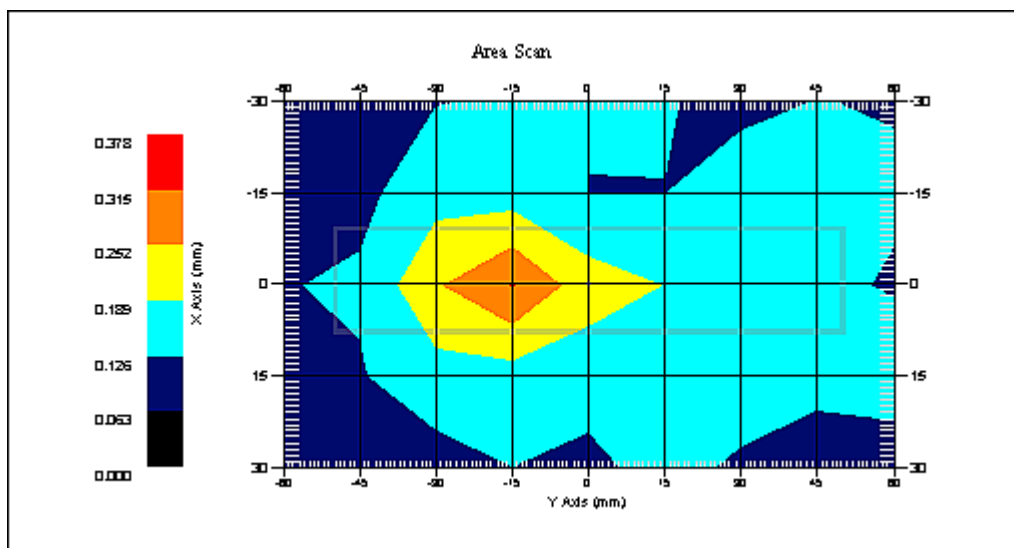
Name : RFEL 217
Model : E020
Type : E-Field Triangle
Serial No. : 217
Last Calib. Date : 07-Sep-2011
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 3.94
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 22-Jun-2012
Set-up Time : 6:53:18 AM
Area Scan : 5x9x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

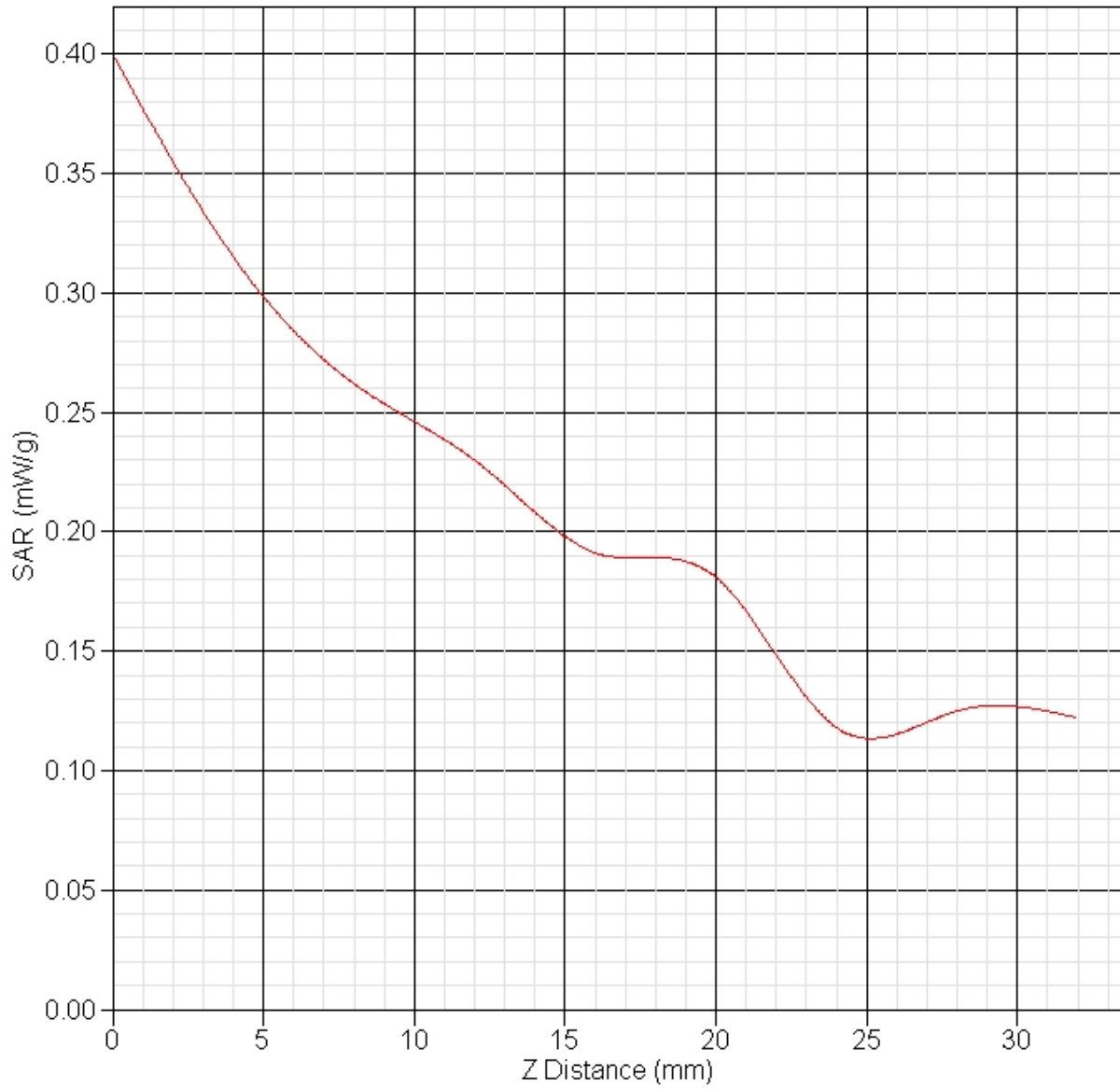
Other Data

DUT Position : Side B
Separation : 10 mm
Channel : Mid



1 gram SAR value : 0.287 W/kg
10 gram SAR value : 0.205 W/kg
Area Scan Peak SAR : 0.317 W/kg
Zoom Scan Peak SAR : 0.400 W/kg

SAR-Z Axis
at Hotspot x:0.17 y:-14.94



Multi-Band Average SAR – Plot 10

Multi-Band Configurations:

DASY Configuration for 2450 MHz Testing/Side A/Volume Scan:

Date/Time: 8/24/2012 4:24:30 PM

Test Laboratory: RF Exposure Lab

File Name: [Geneva Simultaneous.da53:1](#)

DUT: MiFi5792; Type: Hotspot; Serial: 11

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1; PMF: 1

Medium: MSL2450 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.95$ mho/m; $\epsilon_r = 52.39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3693; ConvF(6.76, 6.76, 6.76); Calibrated: 08/20/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn759; Calibrated: 8/15/2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1065
- Measurement SW: DASY52, Version 52.8 (1)

DASY Configuration for 1900 MHz Testing/Side A/Volume Scan:

Date/Time: 8/25/2012 10:46:38 AM

Test Laboratory: RF Exposure Lab

File Name: [Geneva Simultaneous.da53:3](#)

DUT: MiFi5792; Type: Hotspot; Serial: 11

Communication System: WCDMA; Frequency: 1880 MHz; Duty Cycle: 1:1; PMF: 1

Medium: MSL1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.54$ mho/m; $\epsilon_r = 53.02$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

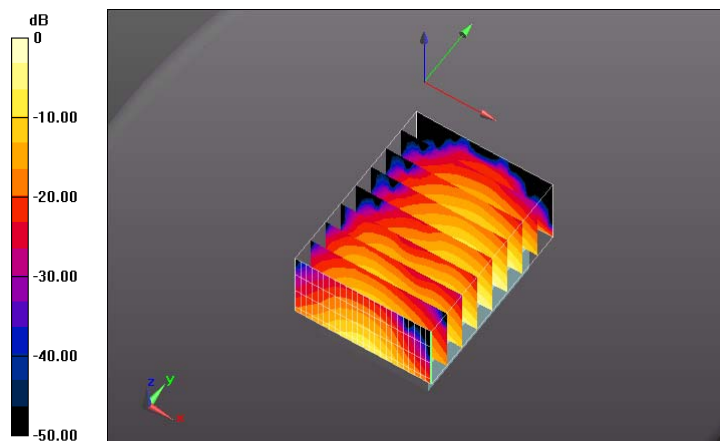
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3693; ConvF(7.13, 7.13, 7.13); Calibrated: 08/20/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn759; Calibrated: 8/15/2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1065
- Measurement SW: DASY52, Version 52.8 (1)

Multi Band Result:

SAR(1 g) = 1.46 mW/g; SAR(10 g) = 0.912 mW/g

Maximum value of SAR (interpolated) = 2.33 mW/g



0 dB = 2.33 mW/g = 7.35 dB mW/g

Multi-Band Average SAR – Plot 11

Multi-Band Configurations:

DASY Configuration for 2450 MHz Testing/Side C/Volume Scan:

Date/Time: 8/24/2012 4:51:05 PM

Test Laboratory: RF Exposure Lab

File Name: [Geneva Simultaneous.da53:1](#)

DUT: MiFi5792; Type: Hotspot; Serial: 11

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1; PMF: 1

Medium: MSL2450 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.95$ mho/m; $\epsilon_r = 52.39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3693; ConvF(6.76, 6.76, 6.76); Calibrated: 08/20/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn759; Calibrated: 8/15/2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1065
- Measurement SW: DASY52, Version 52.8 (1)

DASY Configuration for 1900 MHz Testing/Side C/Volume Scan:

Date/Time: 8/25/2012 11:07:56 AM

Test Laboratory: RF Exposure Lab

File Name: [Geneva Simultaneous.da53:3](#)

DUT: MiFi5792; Type: Hotspot; Serial: 11

Communication System: WCDMA; Frequency: 1852.4 MHz; Duty Cycle: 1:1; PMF: 1

Medium: MSL1900 Medium parameters used : $f = 1852.4$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 53.07$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

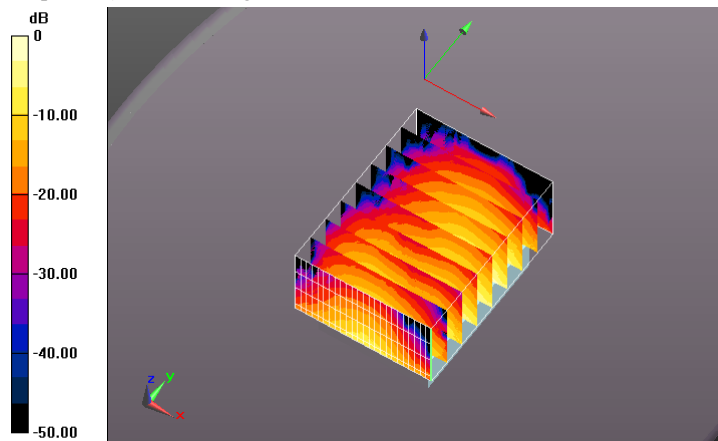
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3693; ConvF(7.13, 7.13, 7.13); Calibrated: 08/20/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn759; Calibrated: 8/15/2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1065
- Measurement SW: DASY52, Version 52.8 (1)

Multi Band Result:

SAR(1 g) = 1.45 mW/g; SAR(10 g) = 0.900 mW/g

Maximum value of SAR (interpolated) = 2.52 mW/g



0 dB = 2.33 mW/g = 7.35 dB mW/g

Appendix D – Probe Calibration Data Sheets

NCL CALIBRATION LABORATORIES

Calibration File No.: PC1333-1350

Client.: RFEL

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic RF Probe

Record of Calibration

Head and Body

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 217

Calibration Procedure: D01-032-E020-V2, D22-012-Tissue, D28-002-Dipole

Project No: RFEL-PC-5620

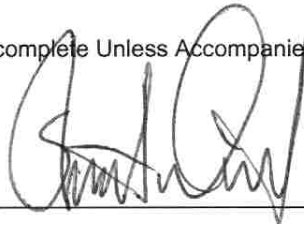
Calibrated: 7th September 2011

Released on: 7th September 2011

Approved By: Stuart Nicol

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____



NCL CALIBRATION LABORATORIES

303 Terry Fox Drive, Suite 102
Kanata, Ontario
CANADA K2K 3J1

Division of APREL
TEL: (613) 435-8300
FAX: (613) 435-8306

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the references listed below. Calibration is performed using accepted methodologies as per the references listed below. Probes are calibrated for air, and tissue and the values reported are the results from the physical quantification of the probe through meteorological practices.

Calibration Method

Probes are calibrated using the following methods.

<1000MHz

TEM Cell for sensitivity in air

Standard phantom using temperature transfer method for sensitivity in tissue

>1000MHz

Waveguide* method to determine sensitivity in air and tissue

*Waveguide is numerically (simulation) assessed to determine the field distribution and power

The boundary effect for the probe is assessed using a standard flat phantom where the probe output is compared against a numerically simulated series of data points

References

- IEEE Standard 1528 (2003) including Amendment 1
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- EN 62209-1 (2006)
Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures-Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- IEC 62209-2 Ed. 1.0 (2010-03)
Human exposure to RF fields from hand-held and body-mounted wireless devices - Human models, instrumentation, and procedures - Part 2: specific absorption rate (SAR) for wireless communication devices (30 MHz - 6 GHz)
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

NCL Calibration Laboratories

Division of APREL Inc.

Conditions

Probe 217 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 1.5°C
Temperature of the Tissue: 21 °C +/- 1.5°C
Relative Humidity: < 60%

Primary Measurement Standards

Instrument	Serial Number	Cal date
Power meter Anritsu MA2408A	90025437	Nov.4, 2010
Power Sensor Anritsu MA2481D	103555	Nov 4, 2010
Attenuator HP 8495A (70dB)	1944A10711	Sept. 14, 2010
Network Analyzer Anritsu MT8801C	MB11855	Feb. 8, 2011

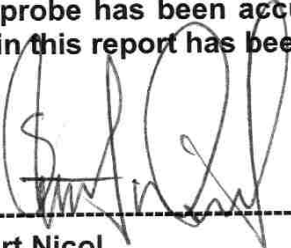
Secondary Measurement Standards

Signal Generator Agilent E4438C -506 MY55182336 June 7, 2011

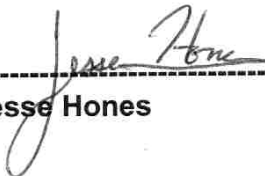
Attestation

The below named signatories have conducted the calibration and review of the data which is presented in this calibration report.

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol



Jesse Hones

Probe Summary

Probe Type:	E-Field Probe E020
Serial Number:	217
Frequency:	750MHz
Sensor Offset:	1.56
Sensor Length:	2.5
Tip Enclosure:	Composite*
Tip Diameter:	< 2.9 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	$1.2 \mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	95 mV

NCL Calibration Laboratories

Division of APREL Inc.

Calibration for Tissue (Head H, Body B)

Frequency	Tissue Type	Measured Epsilon	Measured Sigma	Calibration Uncertainty	Tolerance Uncertainty for 5%*	Conversion Factor
450 H	Head	45.31	0.91	4.1	3.6	5.8
450 B	Body	56.77	0.99	4.1	3.6	6.0
650 B	Body	57.42	0.91	3.96	3.5	6.2
750 H	Head	42.16	0.87	3.94	3.5	6.2
750 B	Body	55.54	0.94	3.94	3.4	6.3
835 H	Head	42.5	0.93	3.5	3.4	6.4
835 B	Body	56.37	0.954	3.5	3.4	6.4
900 H	Head	41.89	1.0	3.5	3.4	6.1
900 B	Body	53.68	1.05	3.5	3.4	6.1
1450 H	Head	X	X	X	X	X
1450 B	Body	X	X	X	X	X
1500 H	Head	X	X	X	X	X
1500 B	Body	X	X	X	X	X
1640 H	Head	39.0	1.25	3.5	2.7	5.2
1640 B	Body	52.03	1.39	3.5	2.7	5.0
1735 H	Head	X	X	X	X	X
1735 B	Body	51.68	1.5	3.5	2.7	5.2
1800 H	Head	38.38	1.39	3.5	2.7	4.9
1800 B	Body	51.54	1.56	3.5	2.7	5.1
1900 H	Head	38.4	1.43	3.5	2.7	4.9
1900 B	Body	52.08	1.59	3.5	2.7	4.8
2000 H	Head	X	X	X	X	X
2000 B	Body	X	X	X	X	X
2100 H	Head	X	X	X	X	X
2100 B	Body	X	X	X	X	X
2300 H	Head	X	X	X	X	X
2300 B	Body	X	X	X	X	X
2450 H	Head	38.2	1.82	3.5	3.5	3.91
2450B	Body	51.74	1.96	3.5	3.5	3.94
2600 H	Head	X	X	X	X	X
2600 B	Body	51.18	2.16	3.5	3.5	4.0
3000 H	Head	X	X	X	X	X
3000 B	Body	X	X	X	X	X
3600 H	Head	X	X	X	X	X
3600 B	Body	X	X	X	X	X
5200 H	Head	X	X	X	X	X
5200 B	Body	X	X	X	X	X
5600 H	Head	X	X	X	X	X
5600 B	Body	X	X	X	X	X
5800 H	Head	X	X	X	X	X
5800 B	Body	X	X	X	X	X

Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

Spatial Resolution:

The spatial resolution uncertainty is less than 1.5% for 4.9mm diameter probe.
The spatial resolution uncertainty is less than 1.0% for 2.5mm diameter probe.

DAQ-PAQ Contribution

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 M Ω .

Boundary Effect:

For a distance of 0.58mm the worst case evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

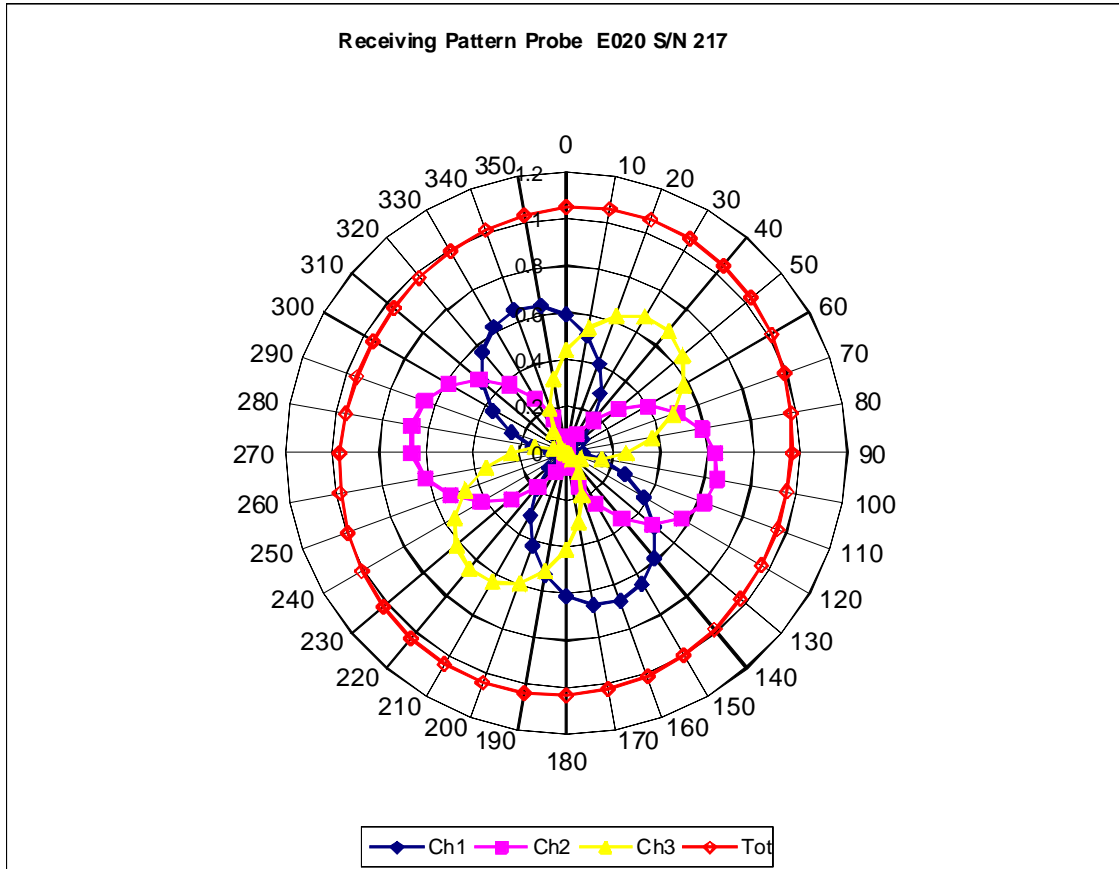
NOTES:

*The maximum deviation from the centre frequency when comparing the lower to upper range is listed.

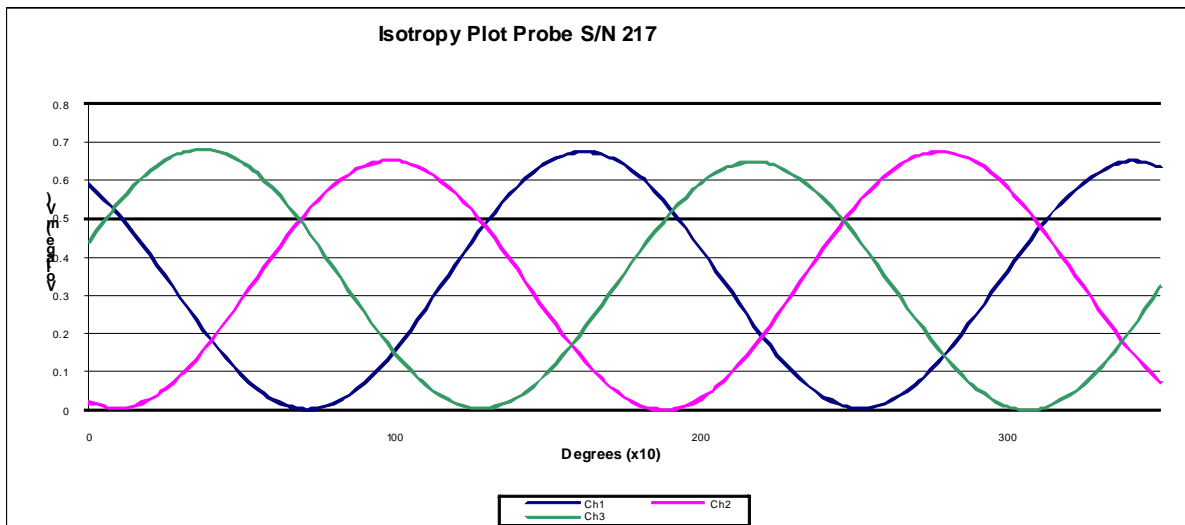
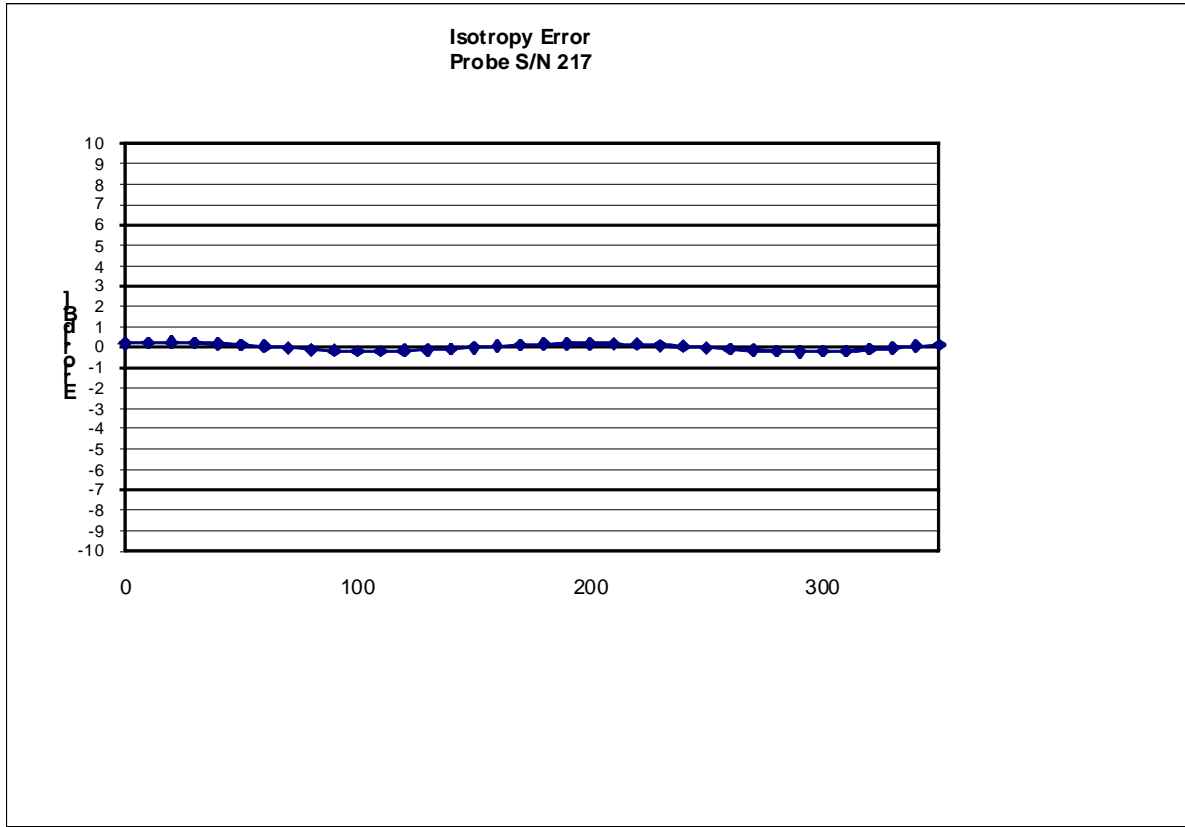
The probe was received in good condition.

Probe was calibrated on new DAC-PAQ.

Receiving Pattern Air



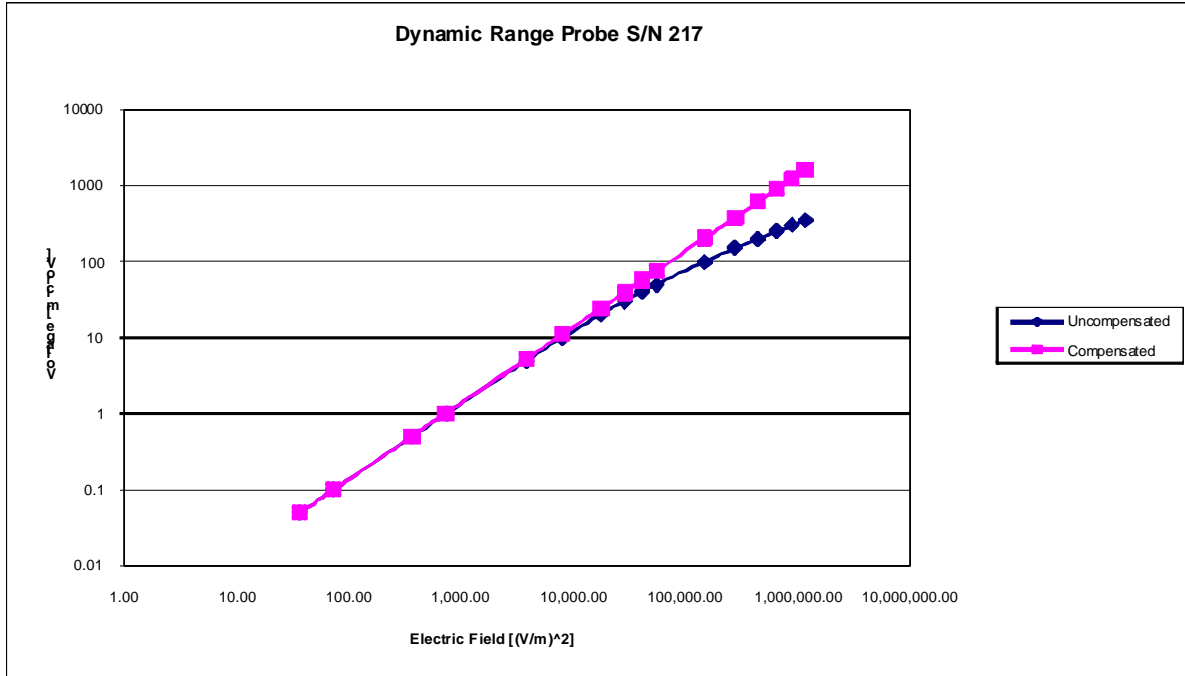
Isotropy Error



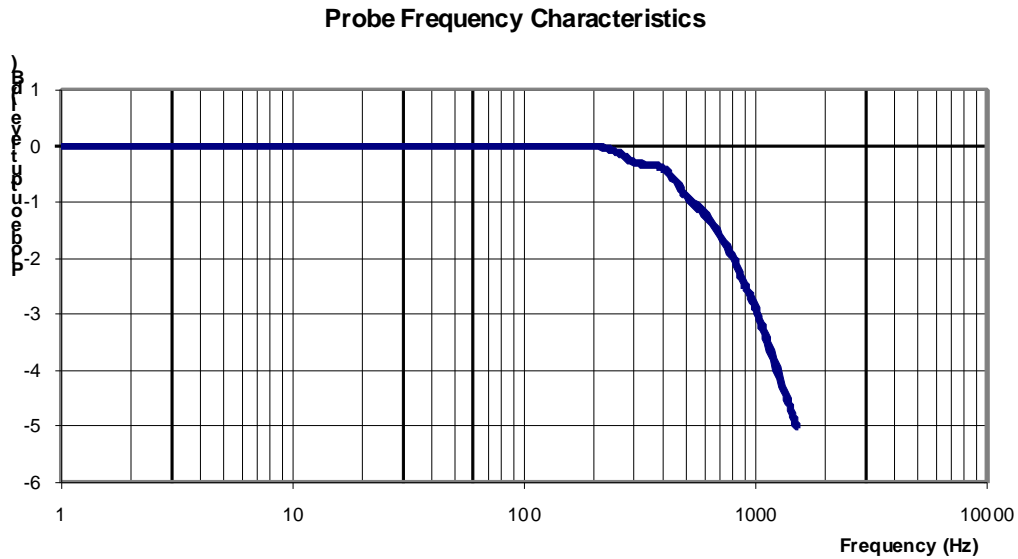
Isotropicity Tissue:

0.12 dB

Dynamic Range



Video Bandwidth



Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1.02 KHz: 3 dB

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2011.



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RF Exposure Lab**

Certificate No: **EX3-3693_Aug12**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3693**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 20, 2012**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	

Issued: August 20, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}; A, B, C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3693

Manufactured: April 22, 2009
Calibrated: August 20, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3693

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.49	0.48	0.46	$\pm 10.1 \%$
DCP (mV) ^B	98.3	100.5	98.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	161.4	$\pm 3.0 \%$
			Y	0.00	0.00	1.00	154.4	
			Z	0.00	0.00	1.00	158.9	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3693

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	8.99	8.99	8.99	0.23	1.20	± 12.0 %
835	41.5	0.90	8.55	8.55	8.55	0.18	1.56	± 12.0 %
1750	40.1	1.37	8.00	8.00	8.00	0.51	0.76	± 12.0 %
1900	40.0	1.40	7.67	7.67	7.67	0.75	0.63	± 12.0 %
2450	39.2	1.80	6.72	6.72	6.72	0.29	1.09	± 12.0 %
2550	39.1	1.91	6.55	6.55	6.55	0.39	0.93	± 12.0 %
5200	36.0	4.66	4.97	4.97	4.97	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.78	4.78	4.78	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.22	4.22	4.22	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.34	4.34	4.34	0.40	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3693

Calibration Parameter Determined in Body Tissue Simulating Media

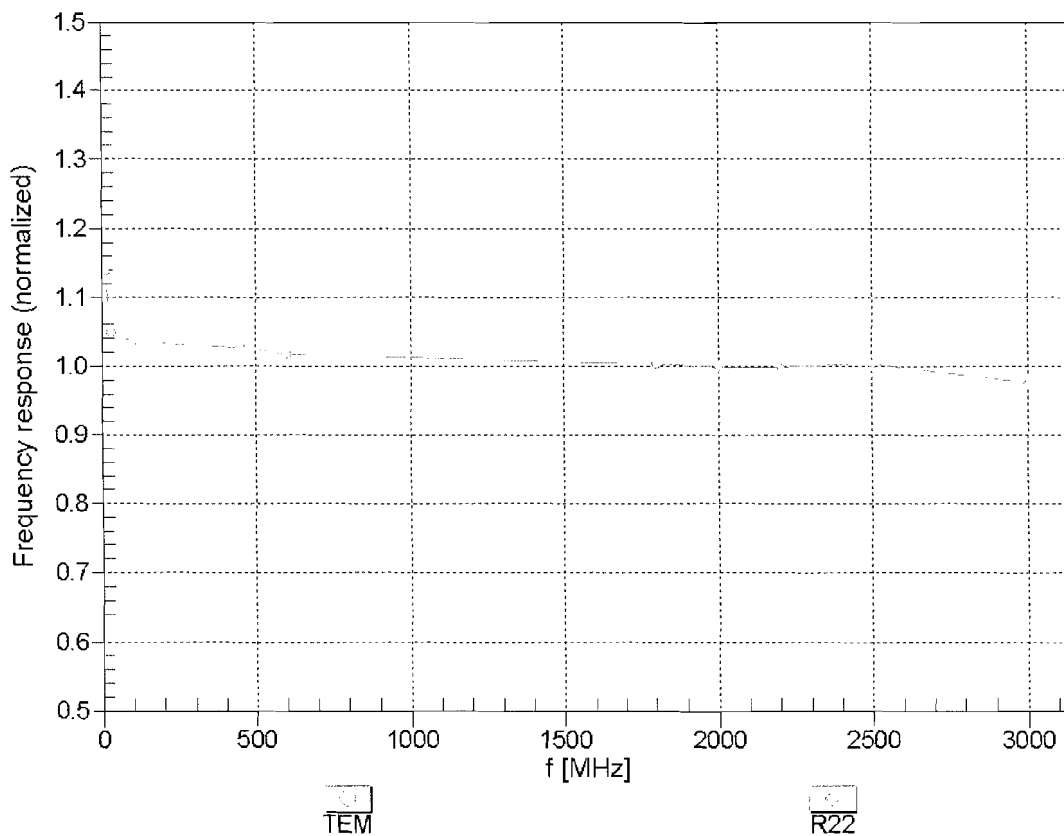
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.84	8.84	8.84	0.29	1.09	± 12.0 %
835	55.2	0.97	8.87	8.87	8.87	0.60	0.71	± 12.0 %
1750	53.4	1.49	7.43	7.43	7.43	0.41	0.85	± 12.0 %
1900	53.3	1.52	7.13	7.13	7.13	0.41	0.82	± 12.0 %
2450	52.7	1.95	6.76	6.76	6.76	0.80	0.50	± 12.0 %
2550	52.6	2.09	6.75	6.75	6.75	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.31	4.31	4.31	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.24	4.24	4.24	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.76	3.76	3.76	0.45	1.90	± 13.1 %
5800	48.2	6.00	4.08	4.08	4.08	0.50	1.90	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

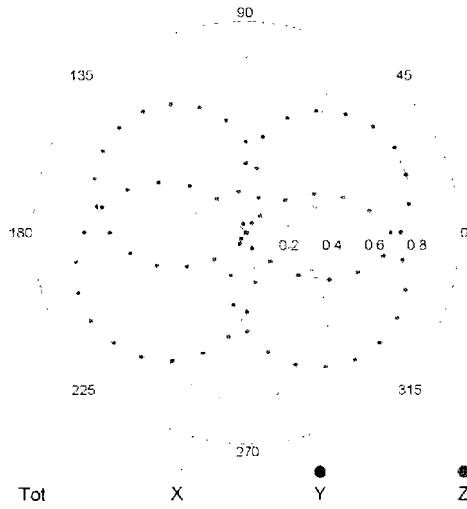
(TEM-Cell: ifi110 EXX, Waveguide: R22)



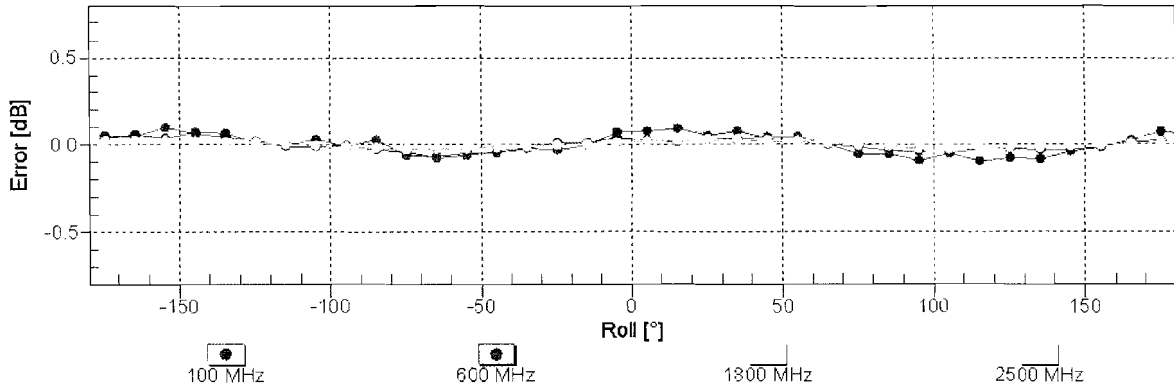
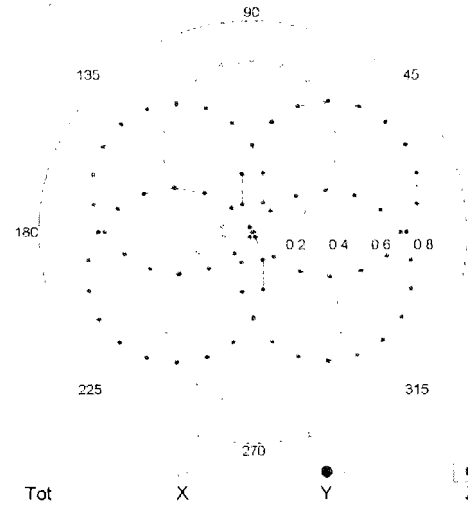
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

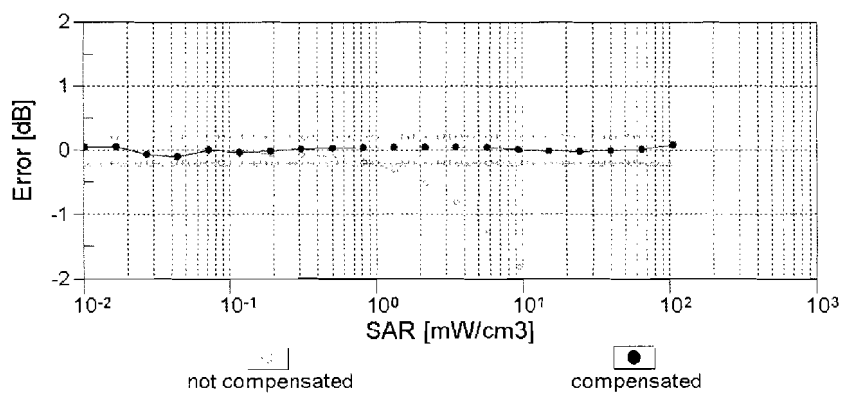
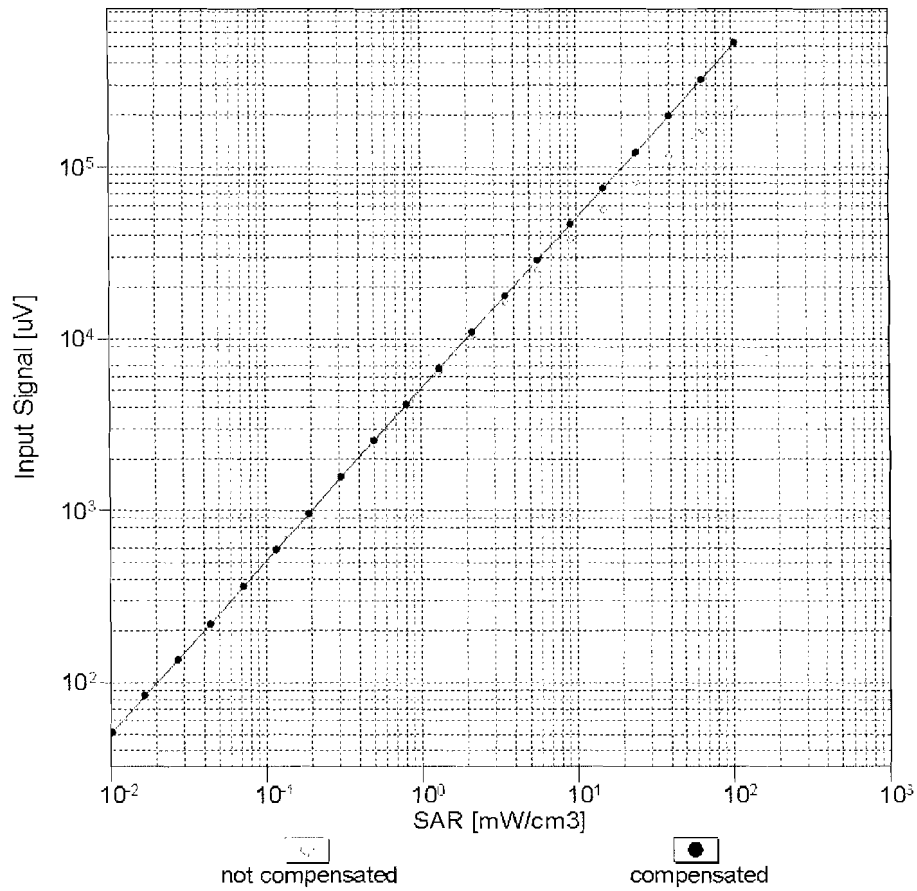


f=1800 MHz,R22



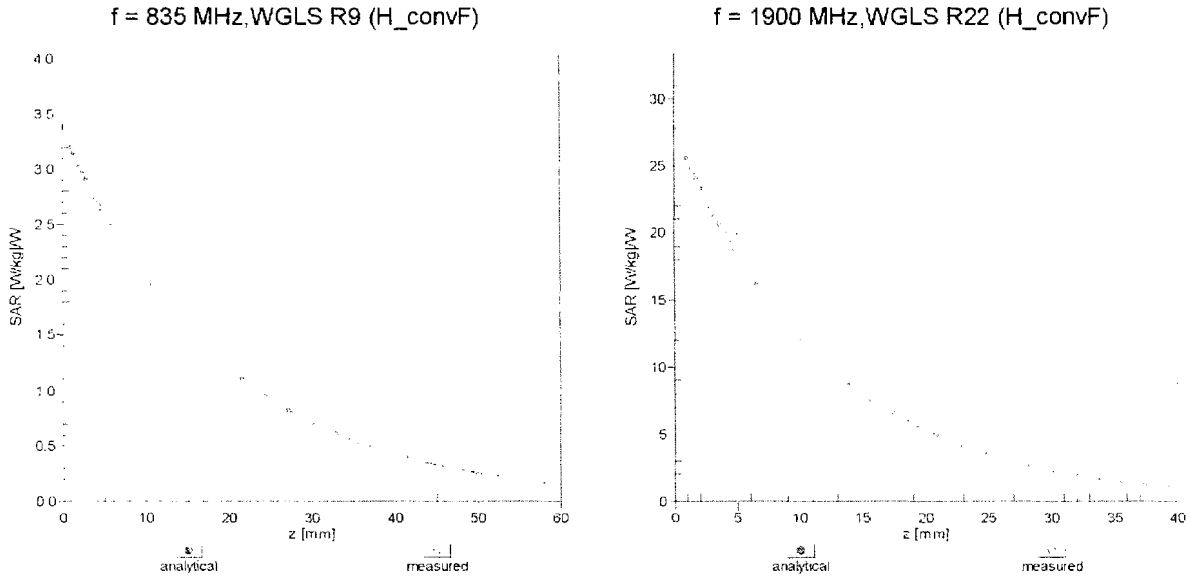
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range f(SAR_{head}) (TEM cell , f = 900 MHz)



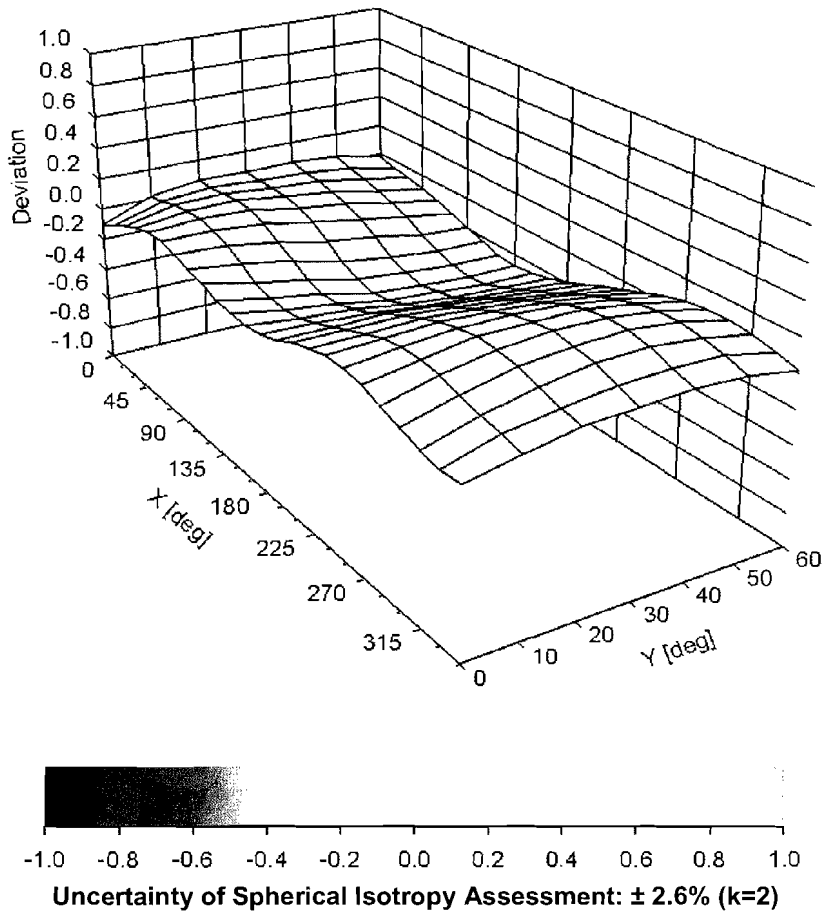
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3693

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	155.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Appendix E – Dipole Calibration Data Sheets

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1178
Project Number: RFEL-DC-750B-5548

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-750-S-2

Frequency: 750 MHz Body

Serial No: 177-00501

Customer: RFEL

Body Calibration

Calibrated: 15th November 2010
Released on: 16th November 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

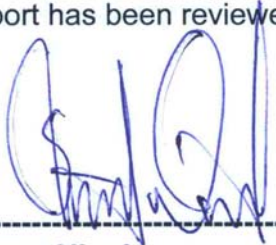
Dipole 177-00501 was a new calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol



C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

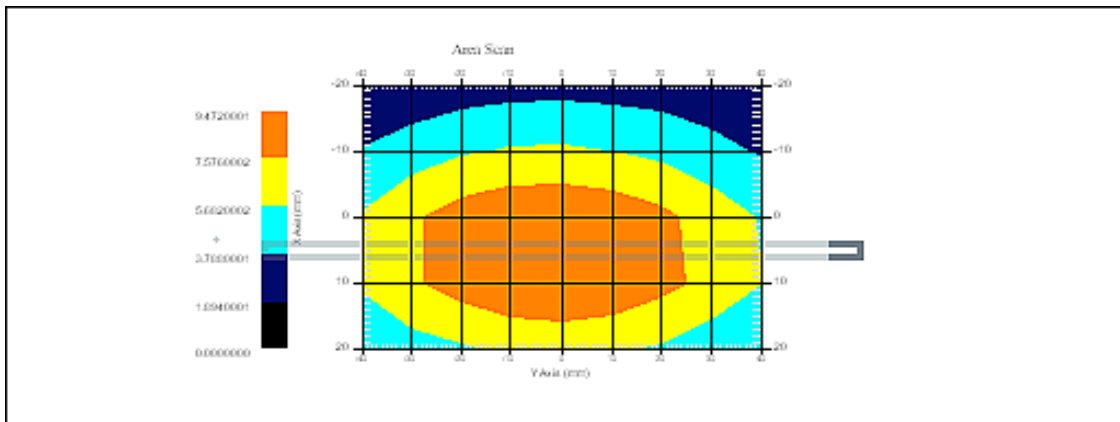
Length: 180.2 mm
Height: 97.0 mm

Electrical Specification

SWR: 1.098U
Return Loss: -27.875 dB
Impedance: 52.754 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
750 MHz	8.7	5.64	12.9



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 177-00501. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 2225.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”

Conditions

Dipole 177-00501 was a new calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

Mechanical	1%
Positioning Error	1.22%
Electrical	1.7%
Tissue	2.2%
Dipole Validation	2.2%
TOTAL	8.32% (16.64% K=2)

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
180.0 mm	97.8 mm	180.2 mm	97.0 mm

Tissue Validation

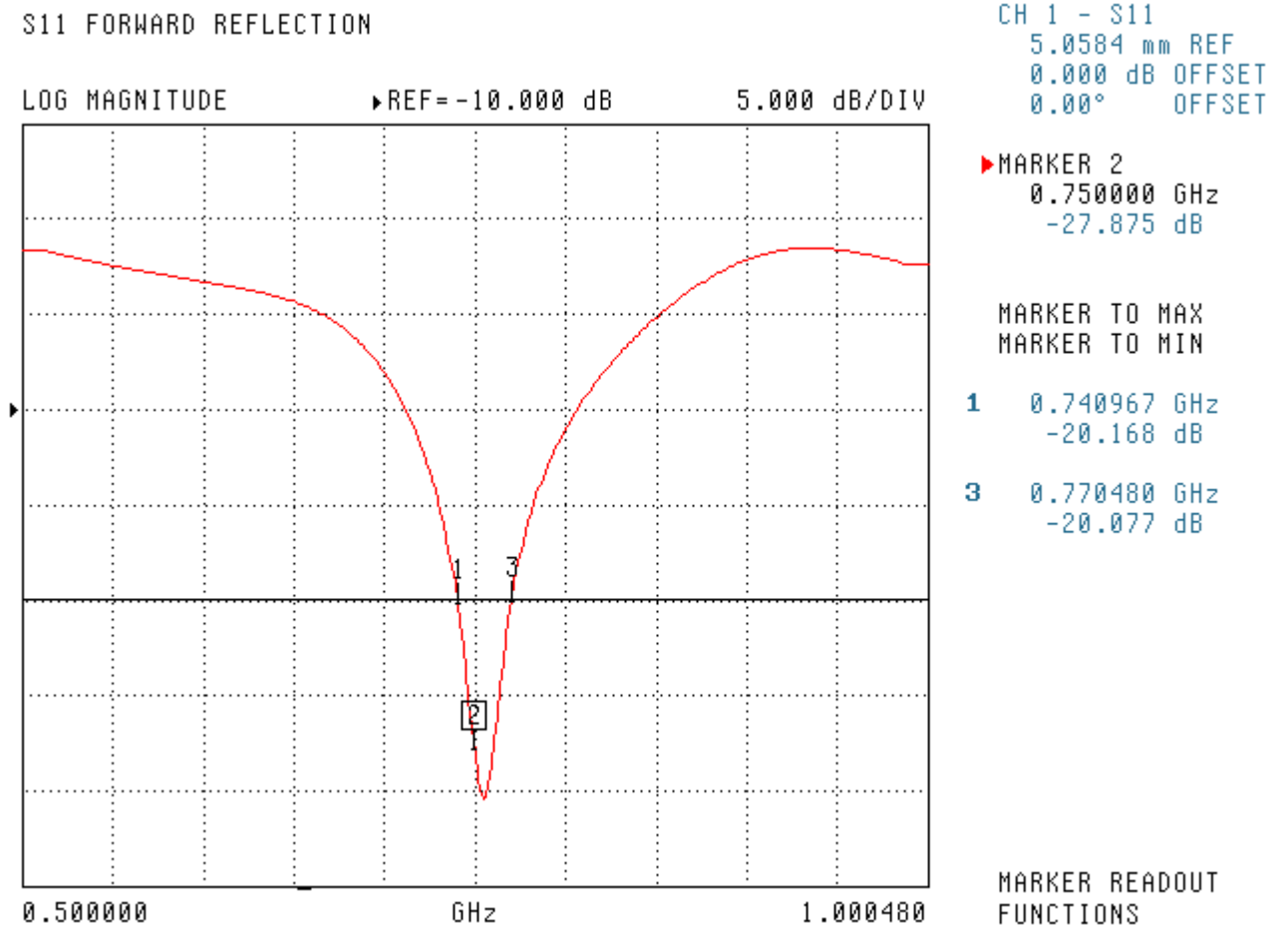
Body Tissue 750MHz	Measured
Dielectric constant, ϵ_r	57.07
Conductivity, σ [S/m]	1.02

Electrical Calibration

Test	Result
S11 RL	-27.875dB
SWR	1.098U
Impedance	52.754 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

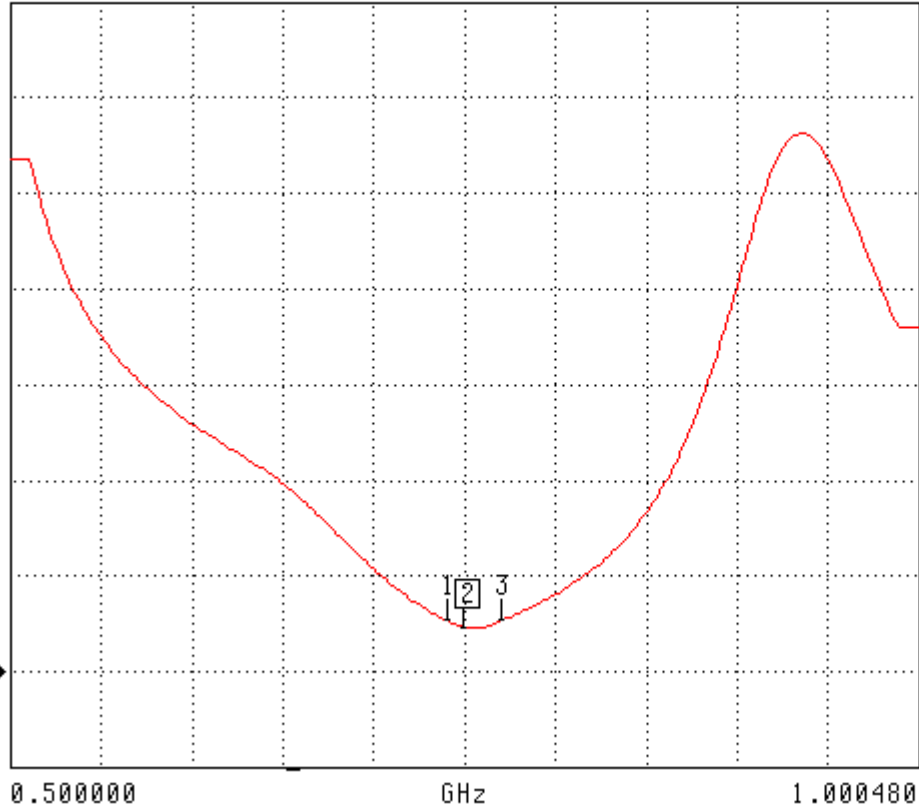
S11 Parameter Return Loss



SWR

S11 FORWARD REFLECTION

SWR REF=172.168 mU 2.000 U/DIV



CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
0.750000 GHz
1.098 U

MARKER TO MAX
MARKER TO MIN

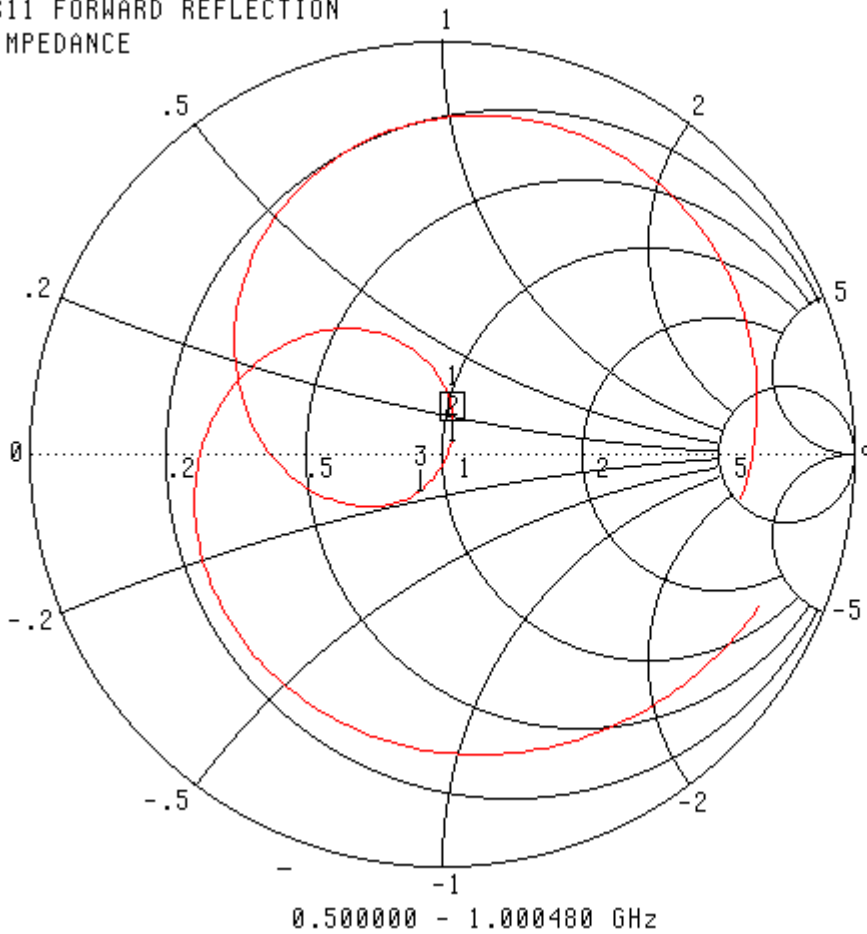
1 0.740967 GHz
1.234 U

3 0.770480 GHz
1.233 U

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
0.750000 GHz
52.754 Ω
3.122 jΩ

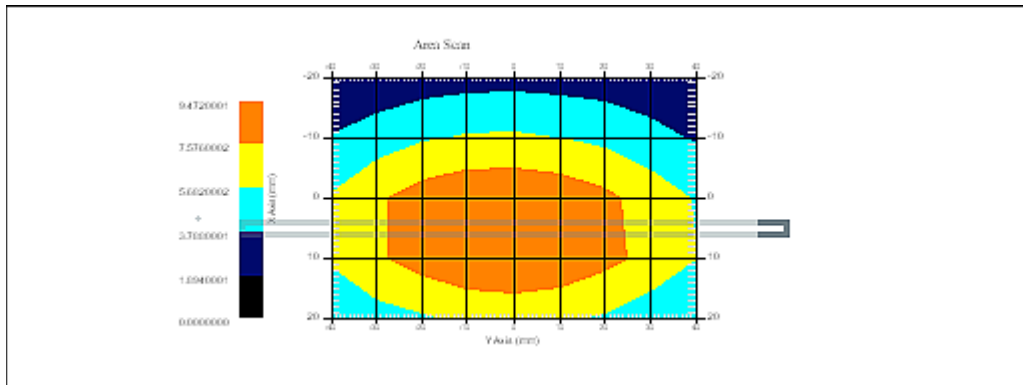
MARKER TO MAX
MARKER TO MIN

1 0.740967 GHz
51.843 Ω
10.414 jΩ
3 0.770480 GHz
44.676 Ω
-8.291 jΩ

MARKER READOUT
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
750 MHz	8.7	5.64	12.9



Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2010.

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

ALS-D-750-S-2 SN: 177-00501				
Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	Δ%
11/15/2010	-27.875		52.754	
11/17/2011	-26.342	-5.5	50.978	-3.4

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1179
Project Number: RFEL-DC-835B-5549

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-835-S-2

Frequency: 835 MHz Body

Serial No: 180-00561

Customer: RFEL

Body Calibration

Calibrated: 16th November 2010
Released on: 16th November 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

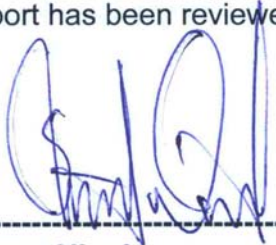
Dipole 180-00561 was a new calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol



C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

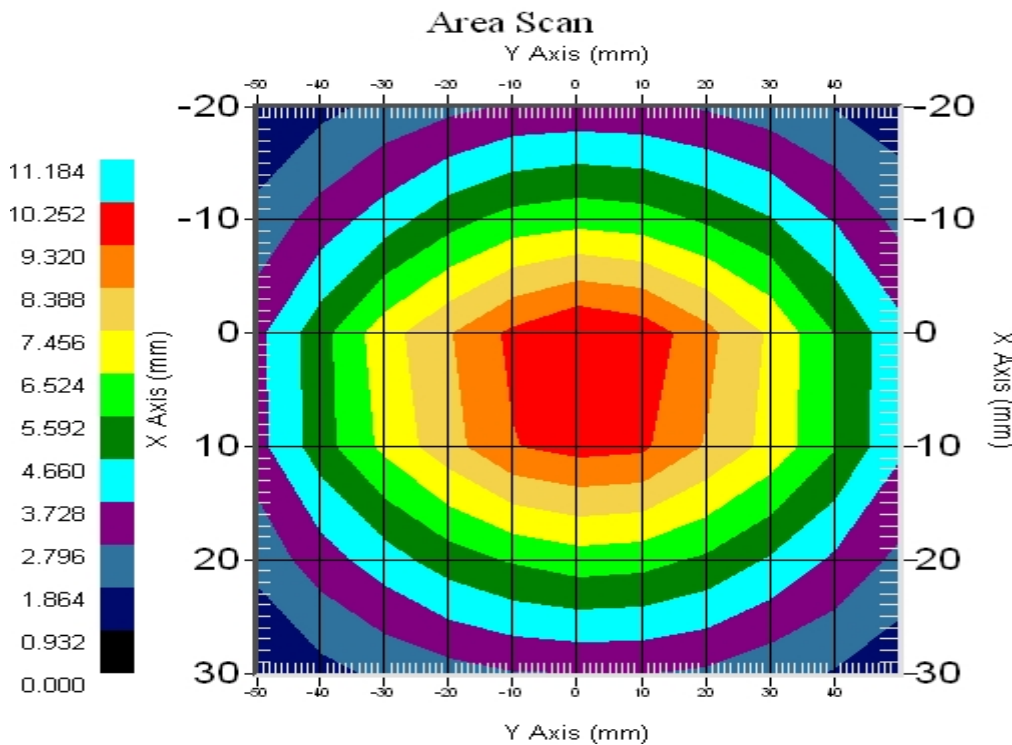
Length: 161.0 mm
Height: 89.8 mm

Electrical Specification

SWR: 1.143U
Return Loss: -24.058 dB
Impedance: 55.519 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.81	6.3	14.87



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 180-00561. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 2225.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”

Conditions

Dipole 180-00561 was a new calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

Mechanical	1%
Positioning Error	1.22%
Electrical	1.7%
Tissue	2.2%
Dipole Validation	2.2%
TOTAL	8.32% (16.64% K=2)

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
161.0 mm	89.8 mm	162.1 mm	89.8 mm

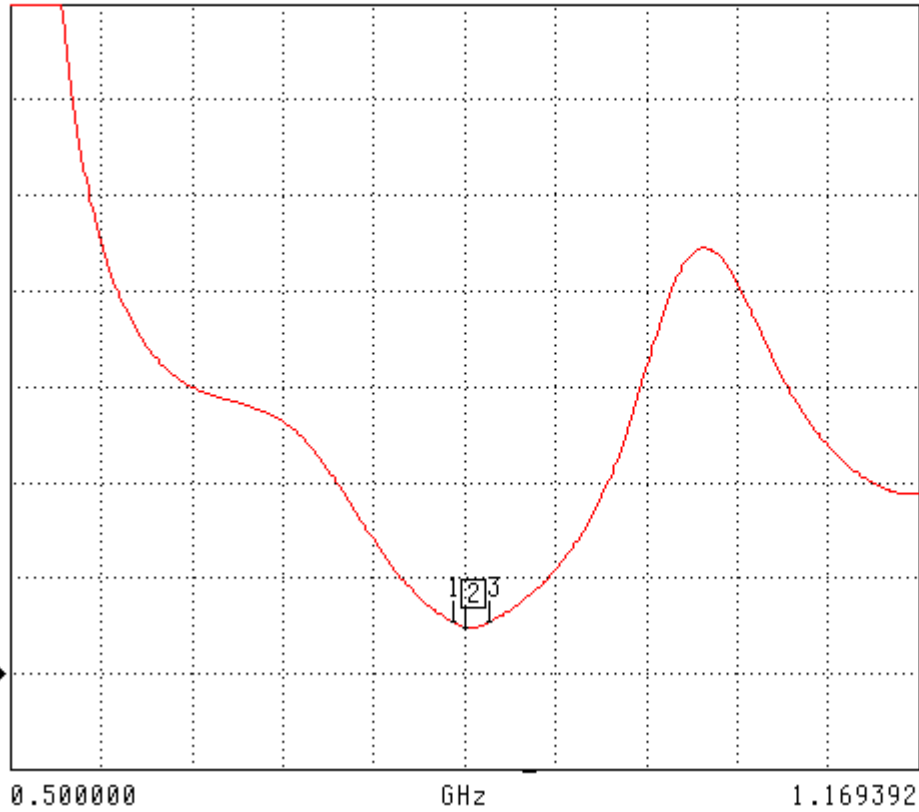
Tissue Validation

Body Tissue 835MHz	Measured
Dielectric constant, ϵ_r	57.19
Conductivity, σ [S/m]	0.97

SWR

S11 FORWARD REFLECTION

SWR REF=172.168 mU 2.000 U/DIV



CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
0.835000 GHz
1.143 U

MARKER TO MAX
MARKER TO MIN

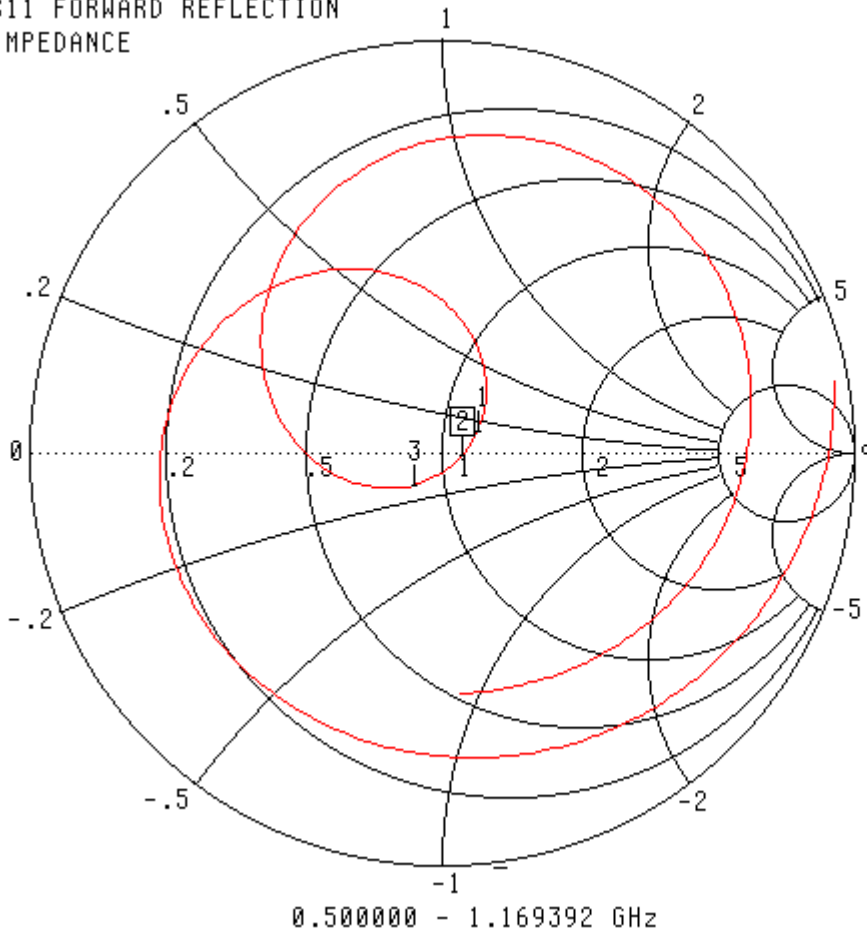
1 0.826043 GHz
1.245 U

3 0.853304 GHz
1.242 U

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
0.835000 GHz
55.519 Ω
-1.124 jΩ

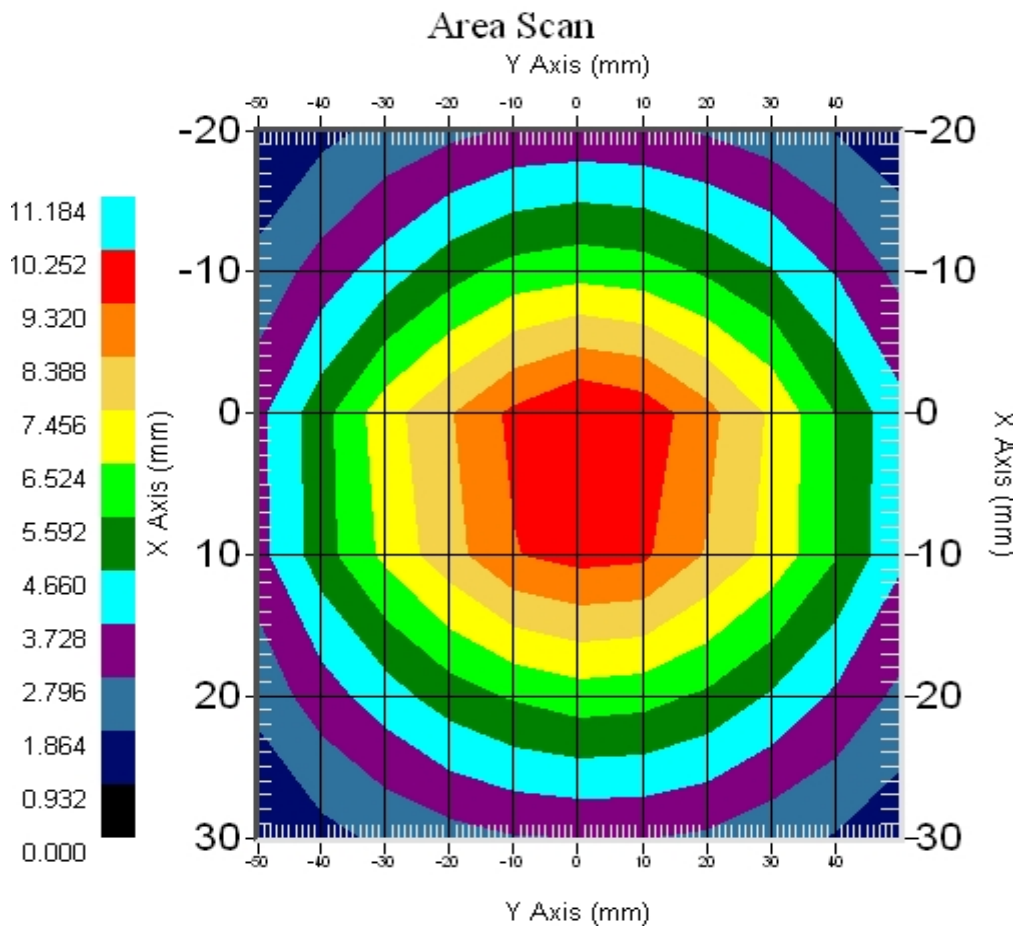
MARKER TO MAX
MARKER TO MIN

1 0.826043 GHz
59.648 Ω
6.084 jΩ
3 0.853304 GHz
43.349 Ω
-7.171 jΩ

MARKER READOUT
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.81	6.3	14.87



NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2010.

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

ALS-D-835-S-2 SN: 180-00561				
Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	Δ%
11/16/2010	-24.058		55.519	
11/17/2011	-25.391	5.5	54.652	-1.6



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RF Exposure Lab**

Certificate No: **D1750V2-1028_Mar11**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1028**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits**

Calibration date: **March 22, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Jeton Kastrati** Name Function
Laboratory Technician

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: March 22, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.33 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.10 mW / g
SAR normalized	normalized to 1W	36.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	37.1 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.83 mW / g
SAR normalized	normalized to 1W	19.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.5 mW / g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.42 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	condition	
SAR measured	250 mW input power	9.16 mW / g
SAR normalized	normalized to 1W	36.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.5 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.88 mW / g
SAR normalized	normalized to 1W	19.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	19.7 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω + 0.4 j Ω
Return Loss	- 40.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 Ω + 0.4 j Ω
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 20, 2009

See Page 9 for Calibration Extension Data.

DASY5 Validation Report for Head

Date/Time: 22.03.2011 09:57:13

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1028

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.33$ mho/m; $\epsilon_r = 40$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.25, 5.25, 5.25); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2829)

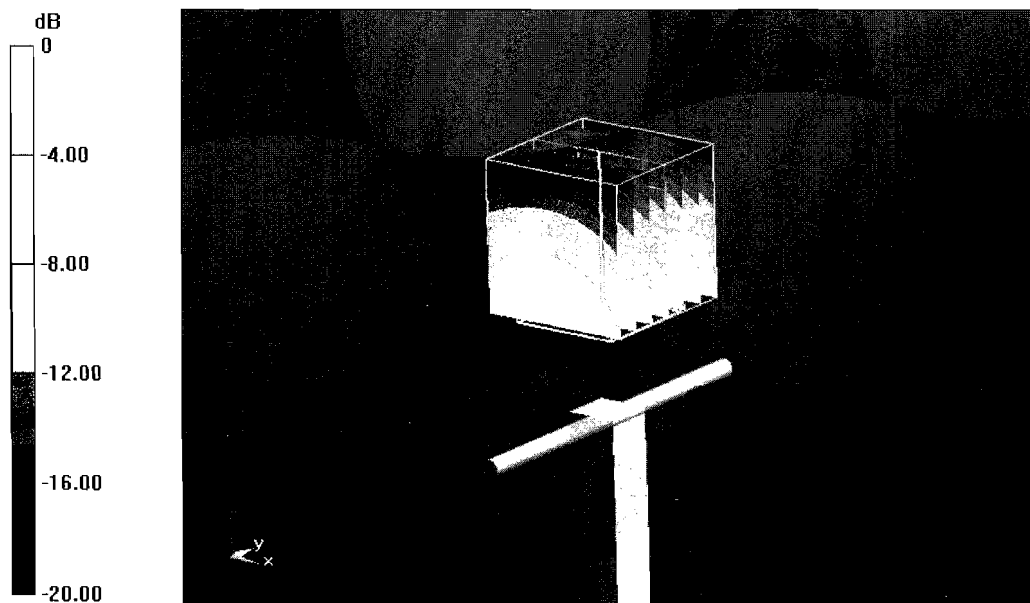
Pin=250 mW/d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 95.148 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.392 W/kg

SAR(1 g) = 9.1 mW/g; SAR(10 g) = 4.83 mW/g

Maximum value of SAR (measured) = 11.256 mW/g



0 dB = 11.260mW/g

Impedance Measurement Plot for Head TSL

22 Mar 2011 09:55:42

[CH1] S11 1 U FS 1: 50.830 Ω 0.3691 Ω 33.572 μH 1 750.000 000 MHz

*

Del

CA



Avg
16

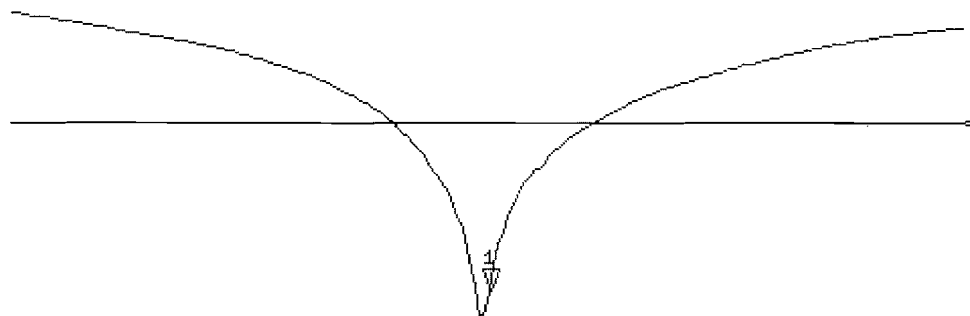
↑

CH2 S11 LOG 5 dB/REF -20 dB 1: -40.877 dB 1 750.000 000 MHz

CA

Avg
16

↑



START 1 550.000 000 MHz

STOP 1 950.000 000 MHz

DASY5 Validation Report for Body TSL

Date/Time: 21.03.2011 10:29:55

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1028

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.42$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.8, 4.8, 4.8); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2829)

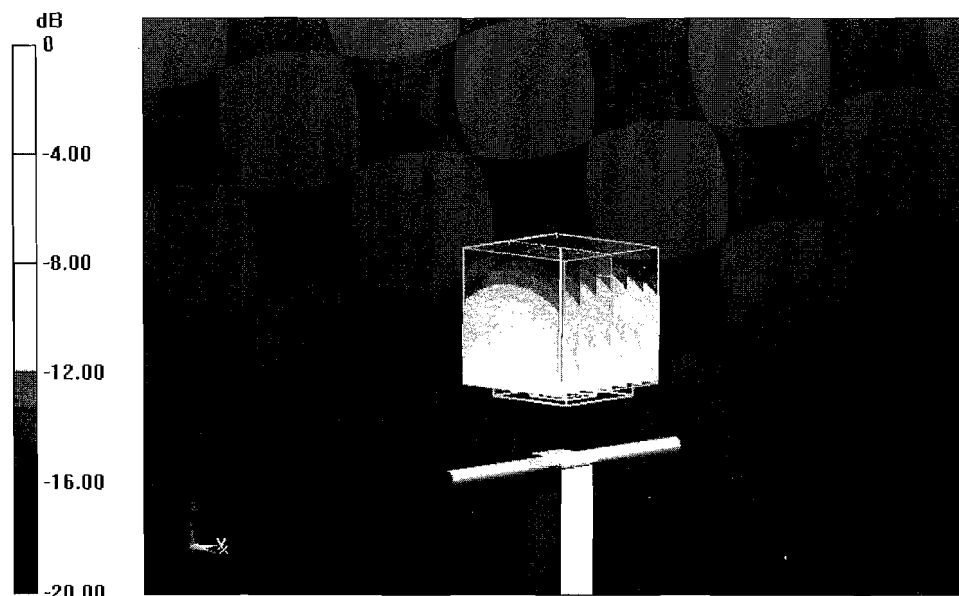
Pin=250 mW/d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.722 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 15.935 W/kg

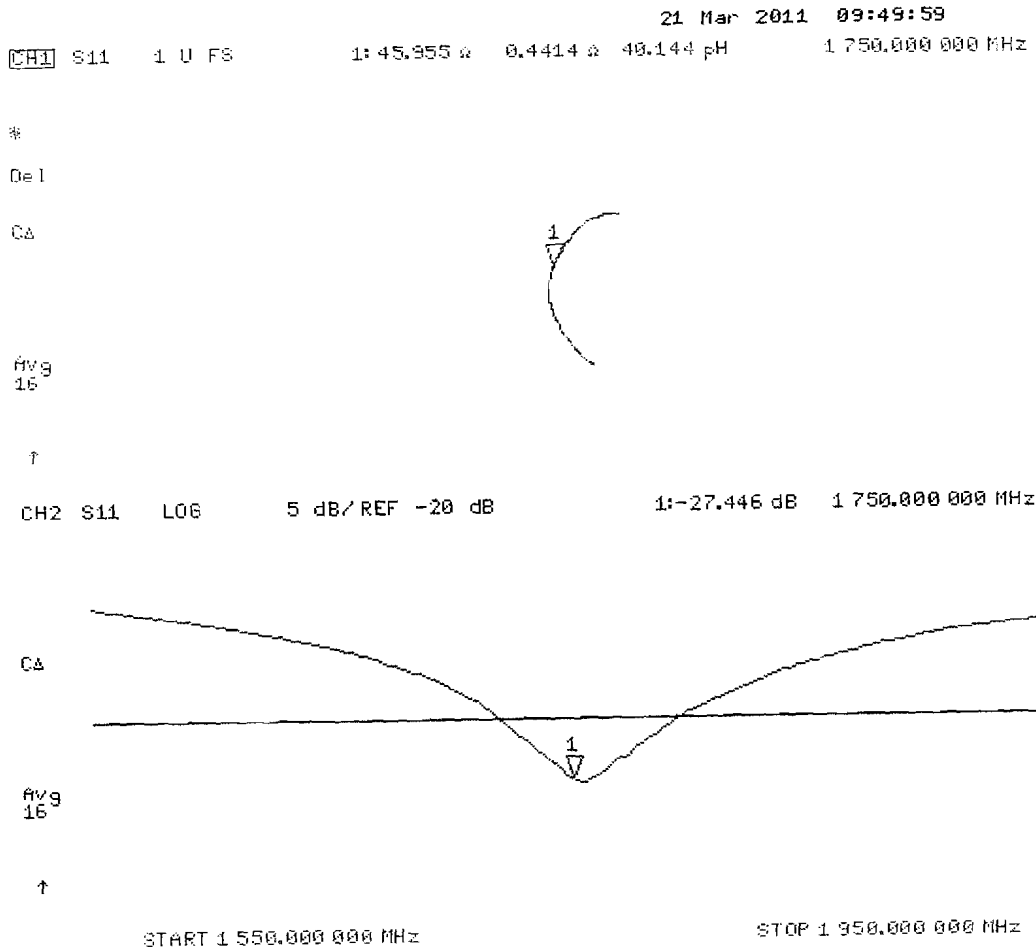
SAR(1 g) = 9.16 mW/g; SAR(10 g) = 4.88 mW/g

Maximum value of SAR (measured) = 11.561 mW/g



0 dB = 11.560mW/g

Impedance Measurement Plot for Body TSL



Extended Calibration

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

D1750V2 SN:1028 - Head				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\Omega$
3/22/2011	-40.9		50.8	
6/13/2012	-39.7	-2.9	52.3	1.5

D1750V2 SN:1028 - Body				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\Omega$
3/22/2011	-27.4		46.0	
6/13/2012	-29.4	7.3	44.8	-1.2

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1180
Project Number: RFEL-DC-1900B-5550

C E R T I F I C A T E O F C A L I B R A T I O N

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-1900-S-2

Frequency: 1900 MHz Body

Serial No: 210-00713

Customer: RFEL

Body Calibration

Calibrated: 16 November 2010
Released on: 16th November 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

Dipole 210-00713 was new and taken from stock prior to calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol



C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

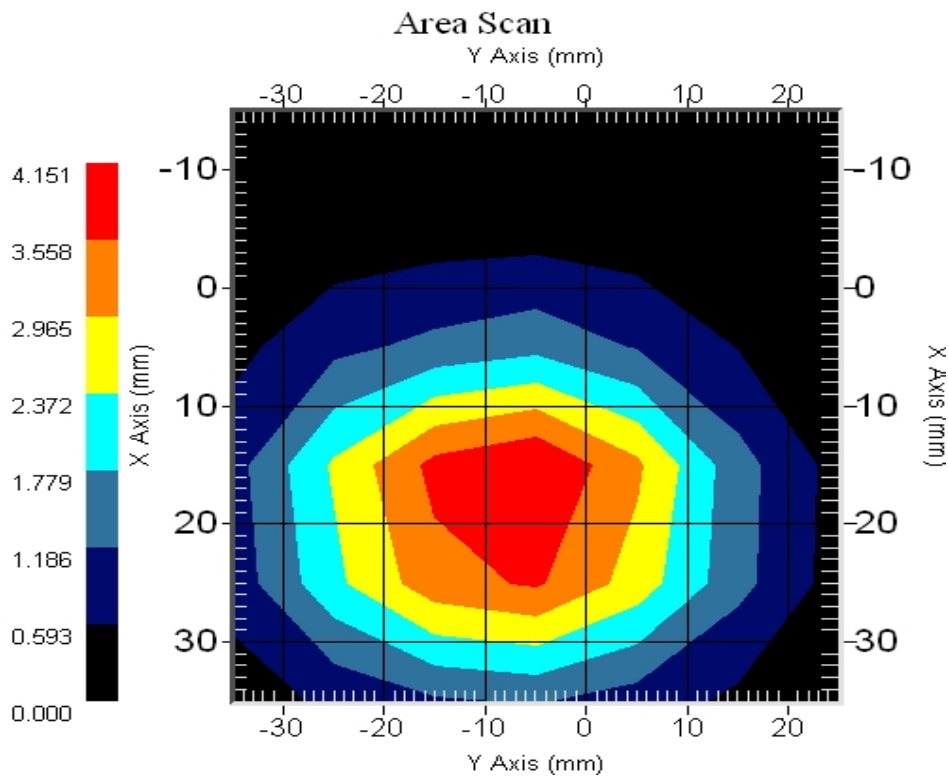
Length: 67.1 mm
Height: 38.9 mm

Electrical Specification

SWR: 1.122U
Return Loss: -24.913dB
Impedance: 53.469Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	40.9	20.9	71.7



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 210-00713. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 226.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”

Conditions

Dipole 210-00713 was new taken from stock.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

Mechanical	1%
Positioning Error	1.22%
Electrical	1.7%
Tissue	2.2%
Dipole Validation	2.2%
TOTAL	8.32% (16.64% K=2)

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	67.1mm	38.9 mm

Tissue Validation

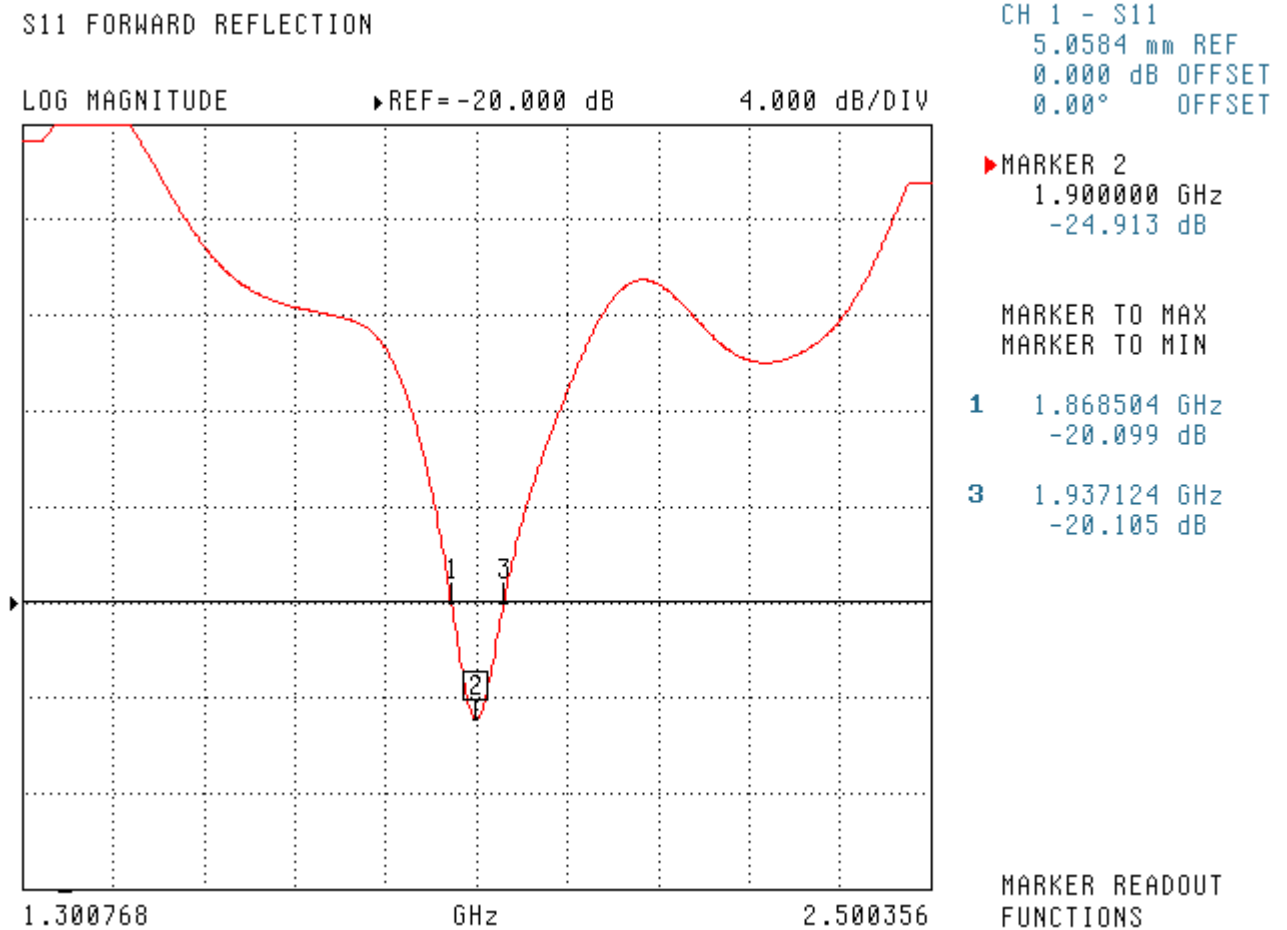
Body Tissue 1900 MHz	Measured
Dielectric constant, ϵ_r	53.87
Conductivity, σ [S/m]	1.55

Electrical Calibration

Test	Result
S11 R/L	-24.913dB
SWR	1.122U
Impedance	53.469 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

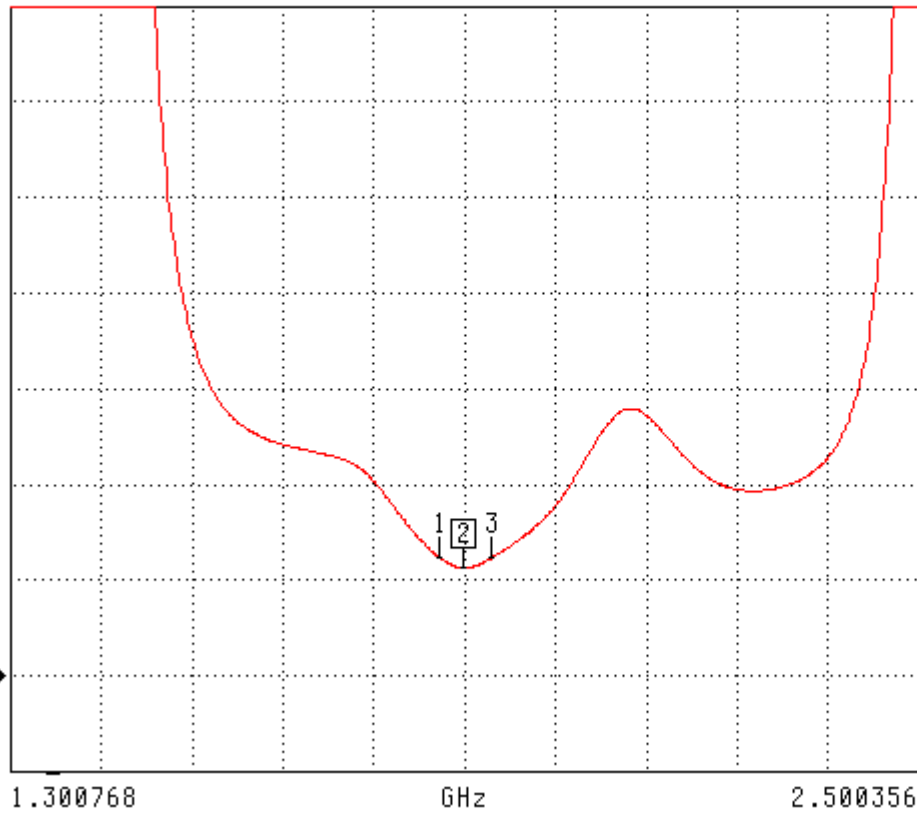
S11 Parameter Return Loss



SWR

S11 FORWARD REFLECTION

SWR REF=0.000 pU 1.000 U/DIV



CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
1.900000 GHz
1.122 U

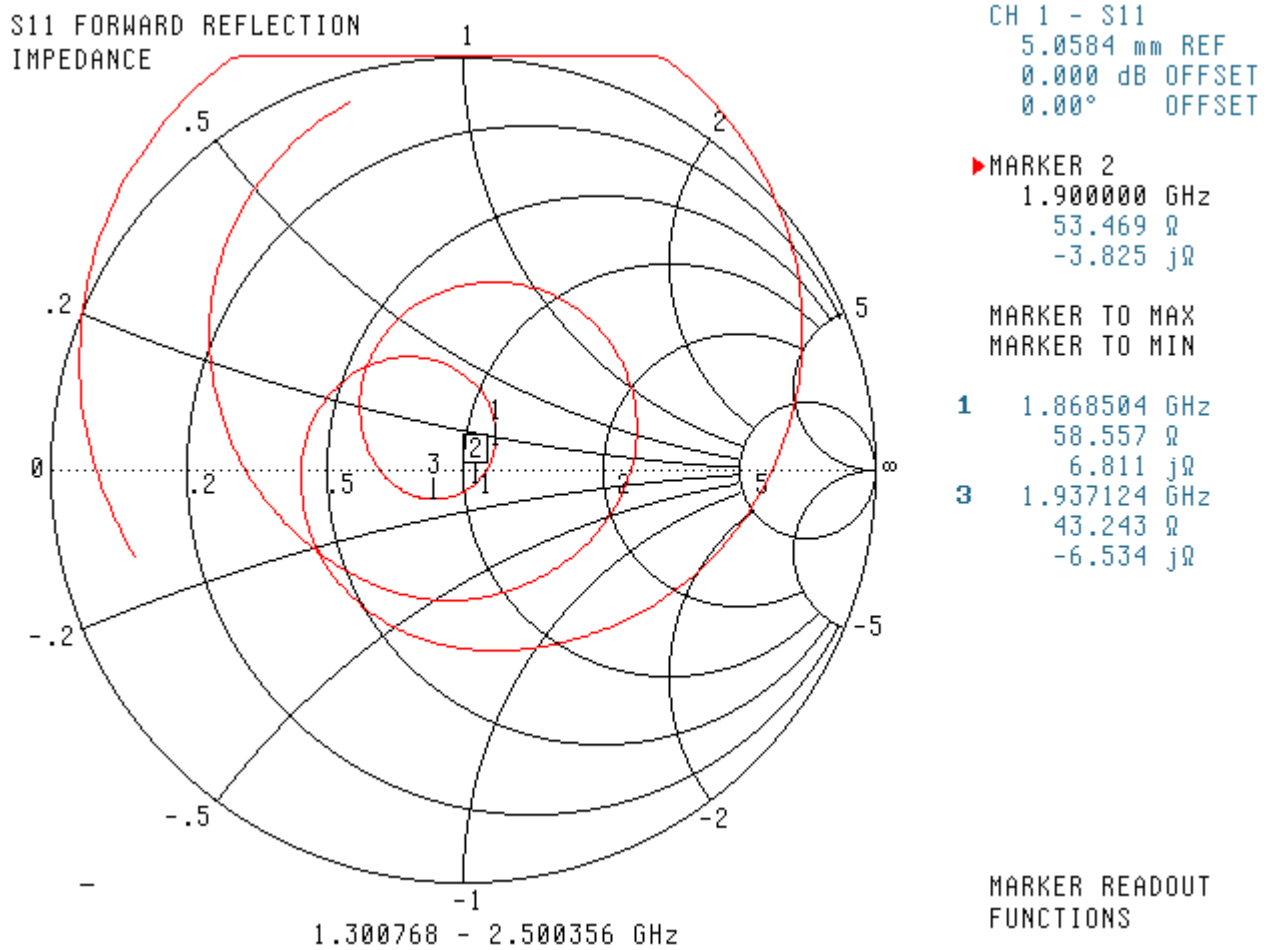
MARKER TO MAX
MARKER TO MIN

1 1.868504 GHz
1.231 U

3 1.937124 GHz
1.226 U

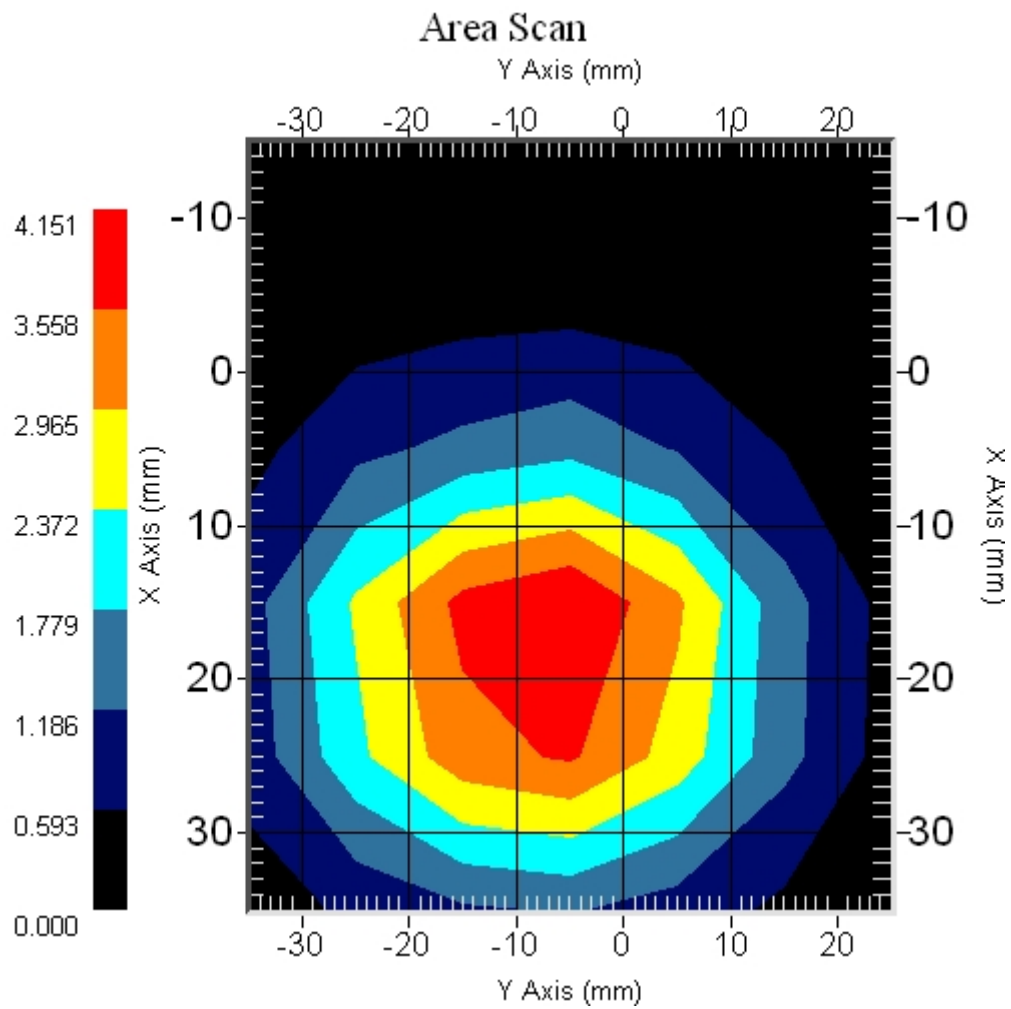
MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	40.9	20.9	71.7



NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List 2010.

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

ALS-D-1900-S-2 SN: 210-00713				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\%$
11/16/2010	-24.913		53.469	
11/17/2011	-23.943	-3.9	54.375	1.7



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RF Exposure Lab**

Certificate No: **D1900V2-5d116_Nov10/2**

CALIBRATION CERTIFICATE (Replacement of No:D1900V2-5d116_Nov10)

Object **D1900V2 - SN: 5d116**

Calibration procedure(s) **QA CAL-05.v7
Calibration procedure for dipole validation kits**

Calibration date: **November 12, 2010**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Dimce Iliev** Name: **Dimce Iliev** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature
D. Iliev
K. Pokovic

Issued: June 12, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.3 \pm 6 %	1.40 mho/m \pm 6 %
Head TSL temperature during test	(22.0 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR normalized	normalized to 1W	40.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.2 mW /g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.9 mW /g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.99 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.9 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.26 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.0 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω + 6.9 j Ω
Return Loss	- 23.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω + 7.2 j Ω
Return Loss	- 21.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 21, 2009

See Page 9 for Calibration Extension Data.

DASY5 Validation Report for Head TSL

Date/Time: 10.11.2010 16:13:01

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d116

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.4$ mho/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

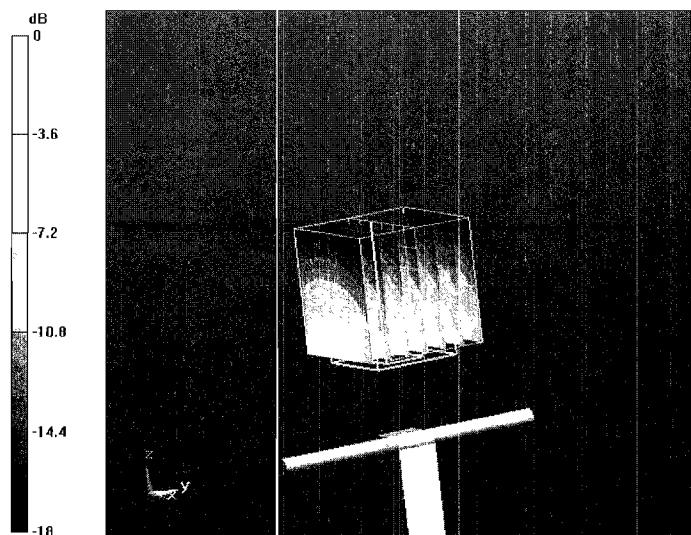
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.5 V/m; Power Drift = 0.071 dB

Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 12.6 mW/g



0 dB = 12.6mW/g

Impedance Measurement Plot for Head TSL

10 Nov 2010 13:05:17

CH1 S11 1 U FS 1: 51.660 Ω 6.9160 Ω 579.33 μ H 1 900.000 000 MHz

*

Del

CA

AVG
16

↑

CH2 S11 L06 5 dB/REF -20 dB 1: -23.122 dB 1 900.000 000 MHz

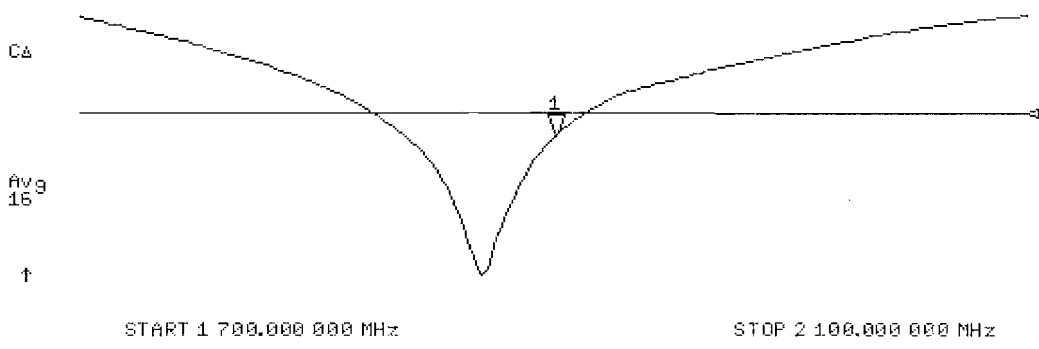
CA

AVG
16

↑

START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



DASY5 Validation Report for Body

Date/Time: 12.11.2010 15:58:32

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d116

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.52 \text{ mho/m}$; $\epsilon_r = 52.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

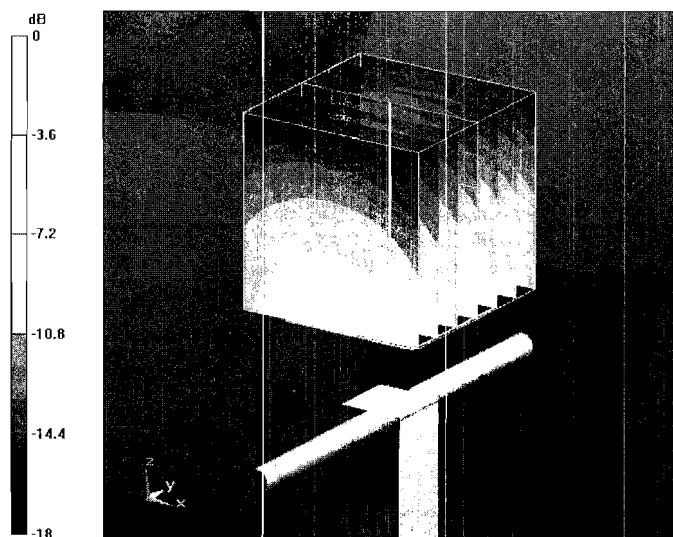
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.7 V/m; Power Drift = -0.020 dB

Peak SAR (extrapolated) = 17.1 W/kg

SAR(1 g) = 9.99 mW/g; SAR(10 g) = 5.26 mW/g

Maximum value of SAR (measured) = 12.6 mW/g



0 dB = 12.6mW/g

Impedance Measurement Plot for Body TSL

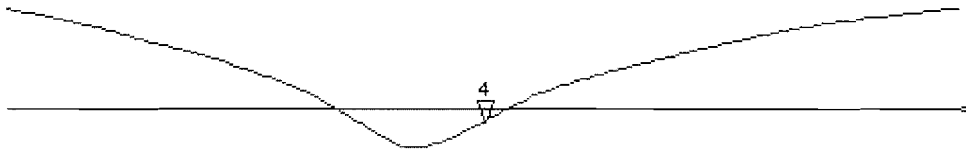
12 Nov 2010 10:38:43
 [CH1] S11 1 U FS 4: 46.572 Ω 7.1953 Ω 502.72 pF 1 900.000 000 MHz

*
 Del
 CA
 Avg
 16



CH2 S11 LOG 5 dB/REF -20 dB 4: -21.690 dB 1 900.000 000 MHz

CA
 Avg
 16



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

Extended Calibration

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

D1900V2 SN: 5d116 - Head				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\Omega$
11/12/2010	-23.1		51.7	
6/14/2012	-24.9	7.8	53.2	1.5

D1900V2 SN: 5d116 - Body				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\Omega$
11/12/2010	-21.7		46.6	
6/14/2012	-22.4	3.2	47.3	0.7

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1182

Project Number: RFEB-5552

C E R T I F I C A T E O F C A L I B R A T I O N

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-2450-S-2

Frequency: 2450 MHz Body

Serial No: RFE-278

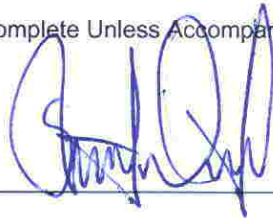
Customer: RFEL

Body Calibration

Calibrated: 18th November 2010
Released on: 19th November 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____



NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

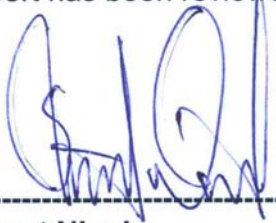
Dipole RFE-278 was a new calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol



C. Teodorian

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

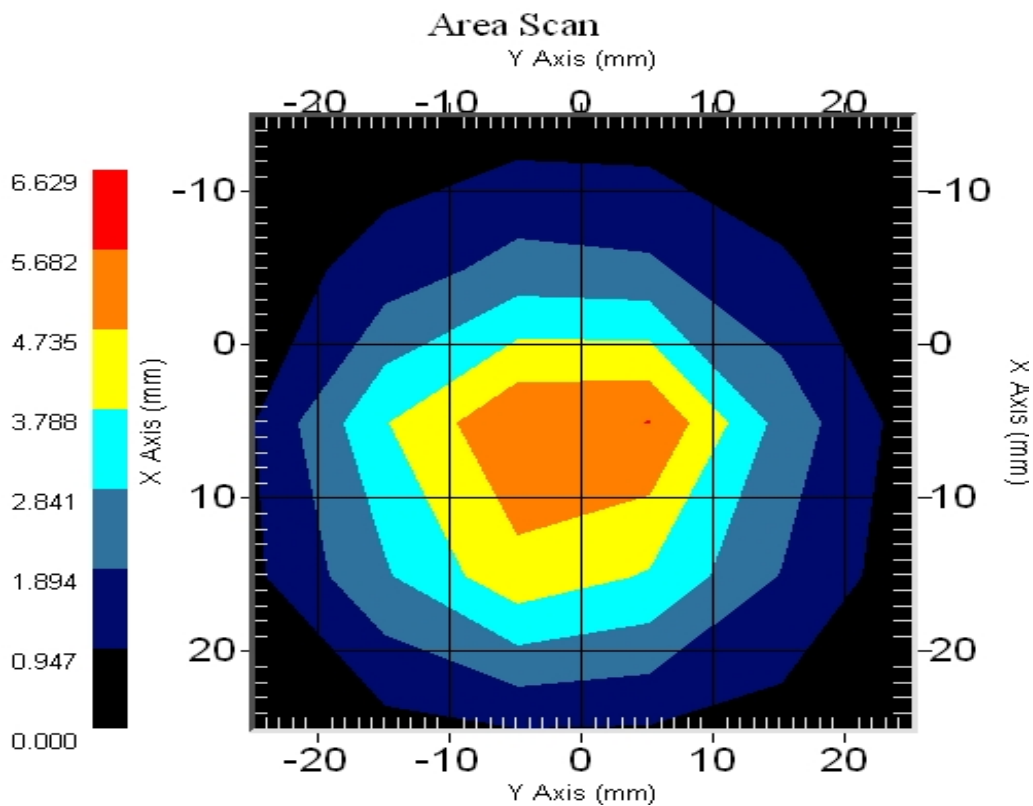
Length: 51.5 mm
Height: 30.4 mm

Electrical Specification

SWR: 1.249 U
Return Loss: -19.170 dB
Impedance: 42.223 Ω

System Validation Results @ 100mW

Frequency	1 Gram	10 Gram	Peak
2450 MHz	5.15	2.31	10.01



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole RFE-278. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 226.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”

Conditions

Dipole RFE-278 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

Mechanical	1%
Positioning Error	1.22%
Electrical	1.7%
Tissue	2.2%
Dipole Validation	2.2%
TOTAL	8.32% (16.64% K=2)

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
51.5 mm	30.4 mm	52.1 mm	31.0 mm

Tissue Validation

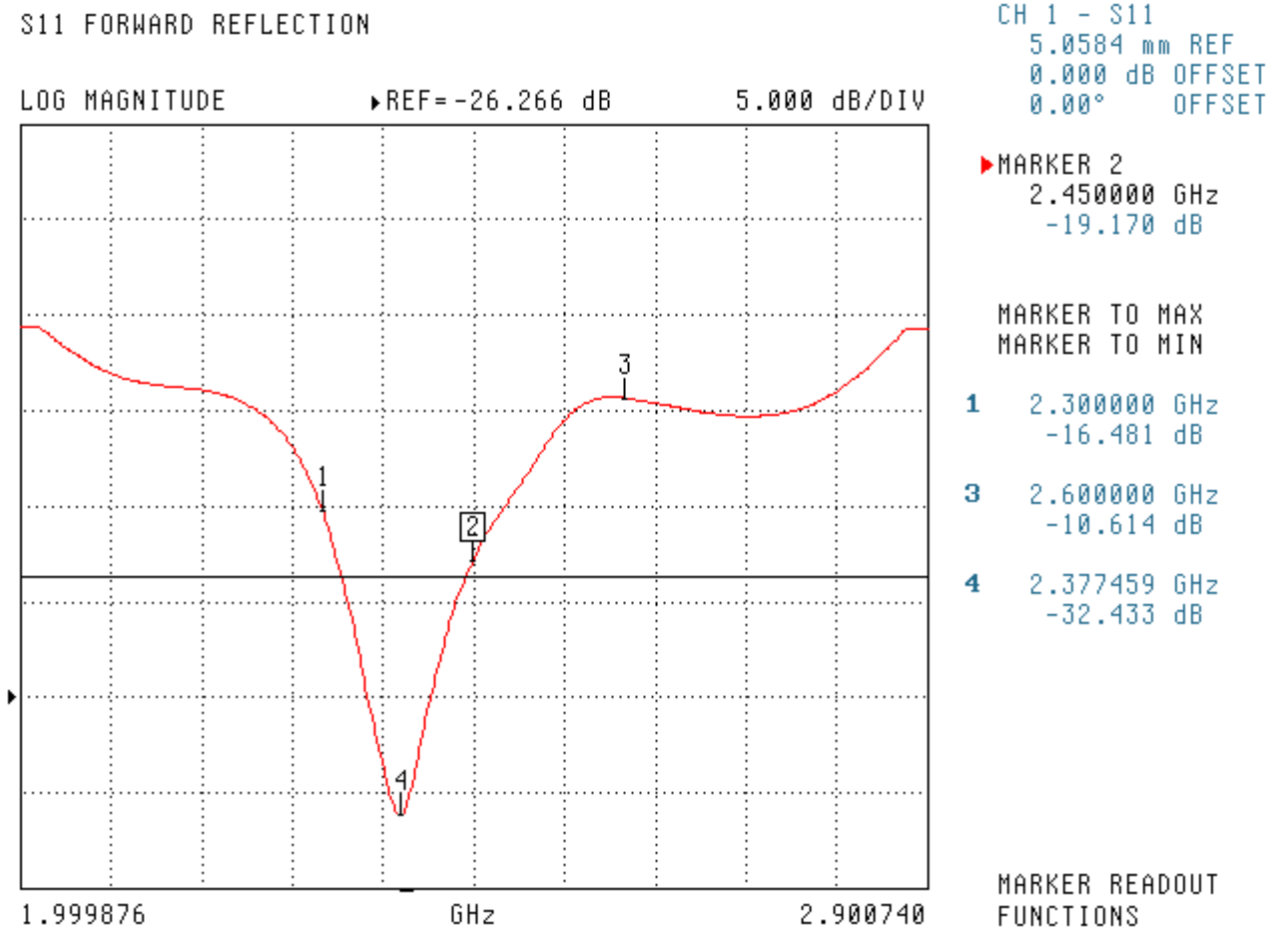
Body Tissue 2450 MHz	Measured
Dielectric constant, ϵ_r	52.0
Conductivity, σ [S/m]	1.92

Electrical Calibration

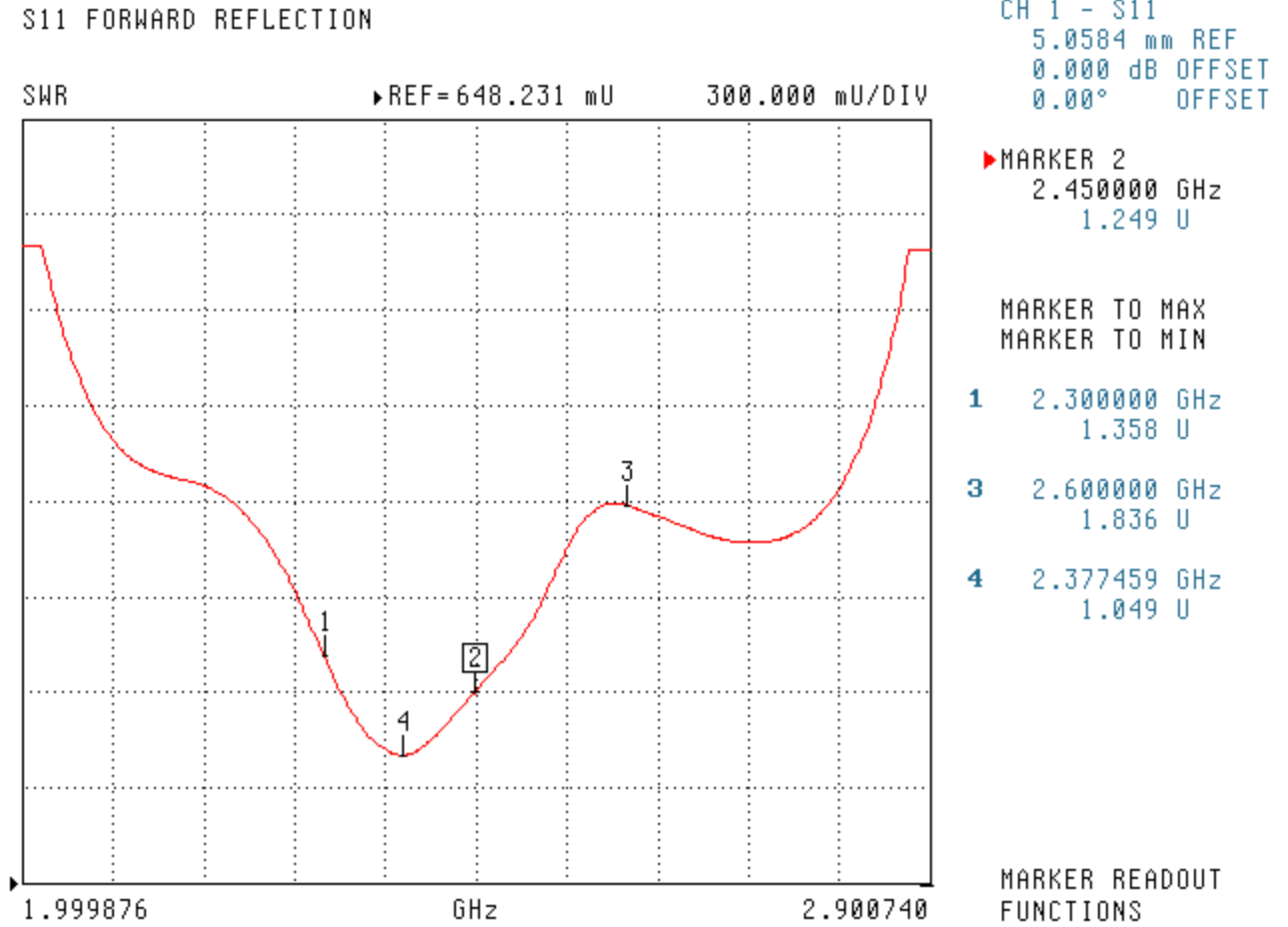
Test	Result
S11 R/L	-19.170 dB
SWR	1.249 U
Impedance	42.223 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

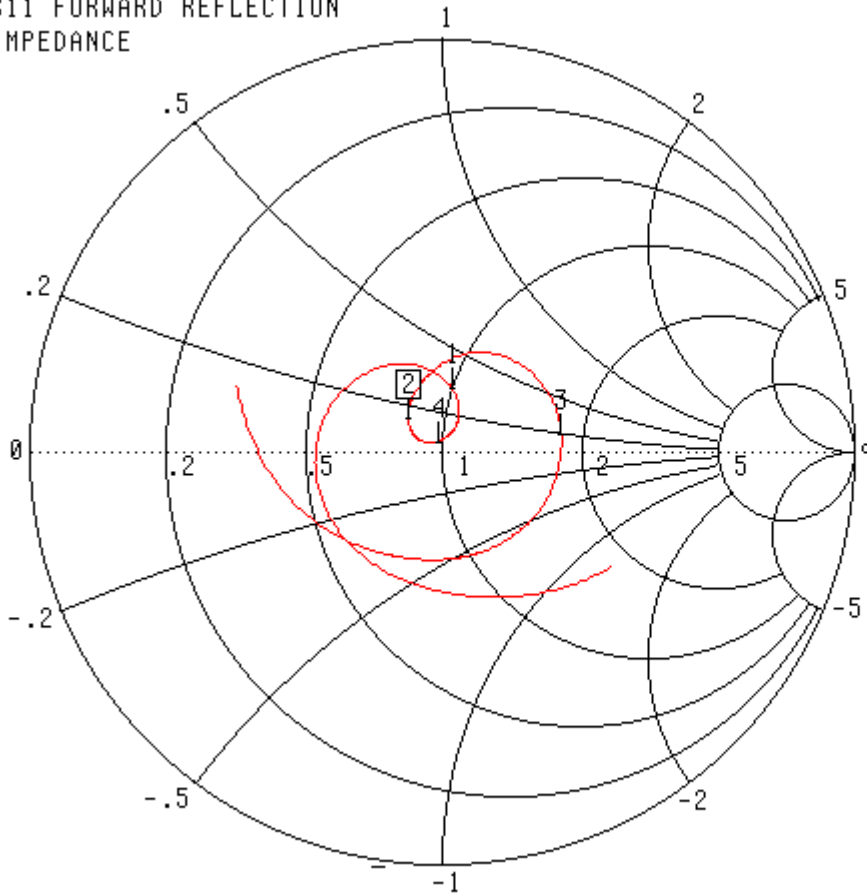


SWR



Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



1.999876 - 2.900740 GHz

CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET

▶ MARKER 2
2.450000 GHz
42.223 Ω
6.687 jΩ

MARKER TO MAX
MARKER TO MIN

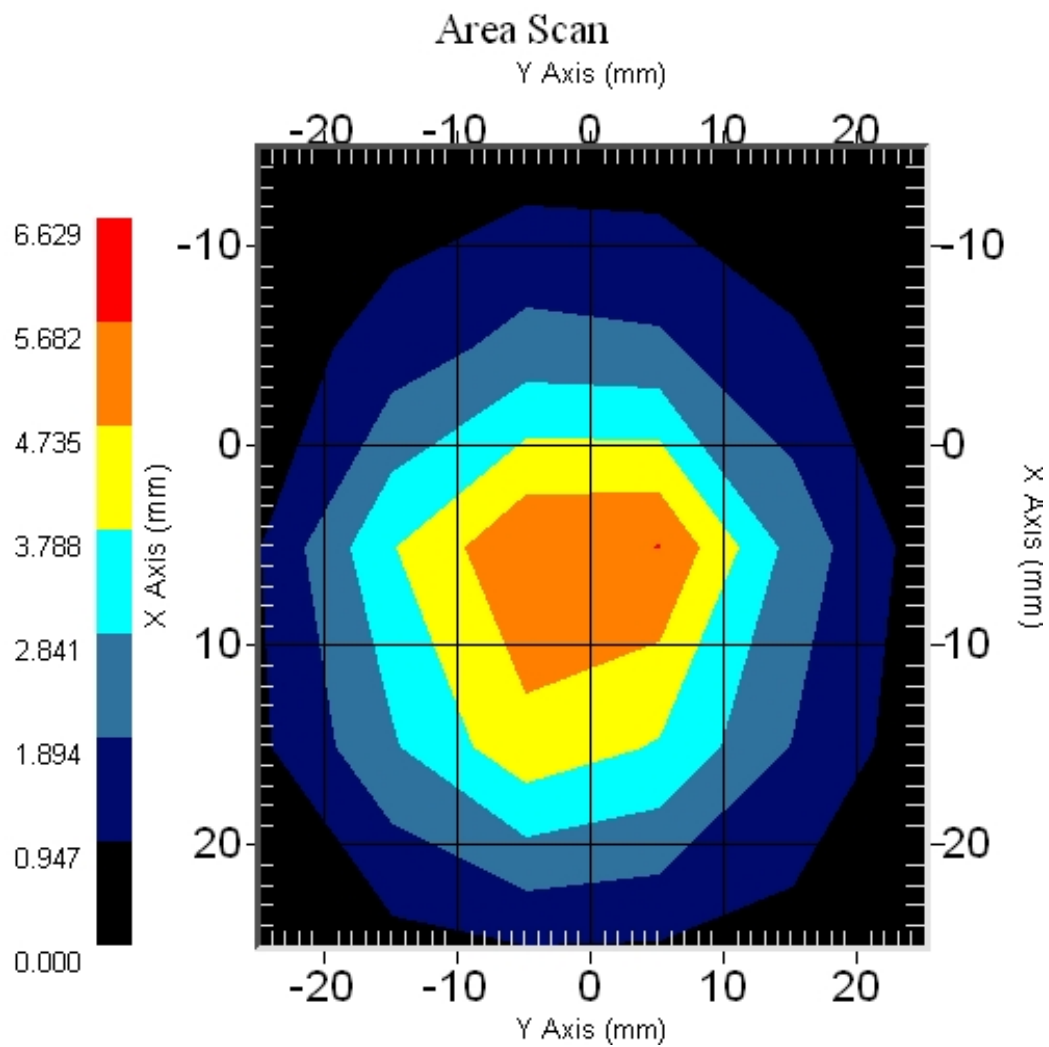
- 1 2.300000 GHz
50.520 Ω
15.426 jΩ
- 3 2.600000 GHz
90.912 Ω
7.723 jΩ
- 4 2.377459 GHz
49.380 Ω
2.028 jΩ

MARKER READOUT
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

Results @ 100mW

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
2450 MHz	5.15	2.31	10.01



NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2010.

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

ALS-D-2450-S-2 SN: RFE-278				
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance (Ω)	$\Delta\%$
11/18/2010	-19.170		42.223	
11/17/2011	-20.046	4.6	41.259	-2.3



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RF Exposure Lab**

Certificate No: **D2450V2-829_Nov10/2**

CALIBRATION CERTIFICATE (Replacement of No:D2450V2-829_Nov10)

Object **D2450V2 - SN: 829**

Calibration procedure(s) **QA CAL-05.v7
Calibration procedure for dipole validation kits**

Calibration date: **November 11, 2010**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Jeton Kastrati** Name Function
Laboratory Technician

Approved by: **Katja Pokovic** Name Function
Technical Manager

Signature

Issued: June 12, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.8 ± 6 %	1.72 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR normalized	normalized to 1W	52.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	53.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.15 mW / g
SAR normalized	normalized to 1W	24.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 mW / g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	1.92 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.5 mW / g
SAR normalized	normalized to 1W	50.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.79 mW / g
SAR normalized	normalized to 1W	23.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.2 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.8 Ω + 2.8 j Ω
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4 Ω + 5.2 j Ω
Return Loss	- 25.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 11, 2008

See Page 9 for Calibration Extension Data.

DASY5 Validation Report for Head TSL

Date/Time: 11.11.2010 11:45:20

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:829

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.72$ mho/m; $\epsilon_r = 38.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

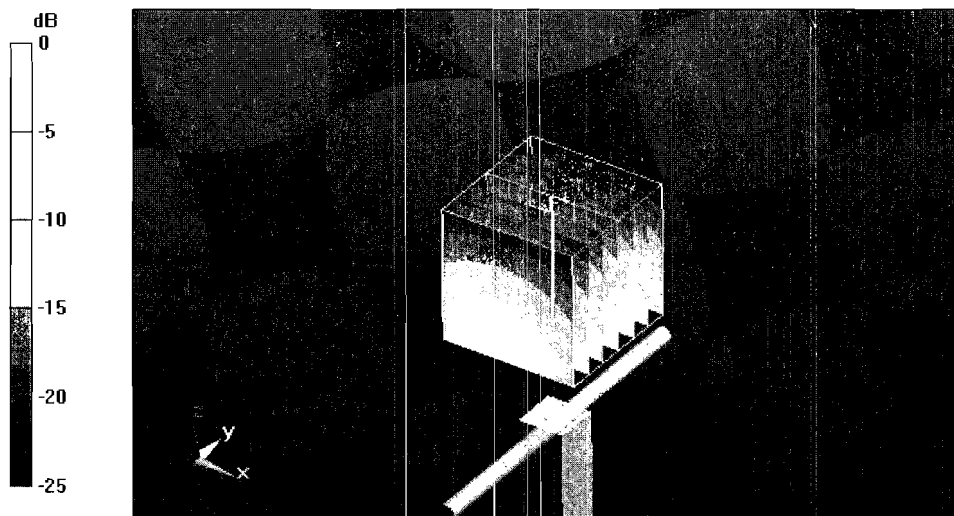
Pin=250 mW/d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.9 V/m; Power Drift = 0.036 dB

Peak SAR (extrapolated) = 26.9 W/kg

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.15 mW/g

Maximum value of SAR (measured) = 16.9 mW/g



0 dB = 16.9mW/g

Impedance Measurement Plot for Head TSL

11 Nov 2010 11:07:42

CH1 S11 1 U FS 1: 52.826 Ω 2: 8105 Ω 182.58 pF 2 450.000 000 MHz

*

De1

Cor

Avg
16

↑

CH2 S11 LOG 5 dB/REF -20 dB 1: -28.230 dB 2 450.000 000 MHz

Cor

Avg
16

↑

START 2 250.000 000 MHz

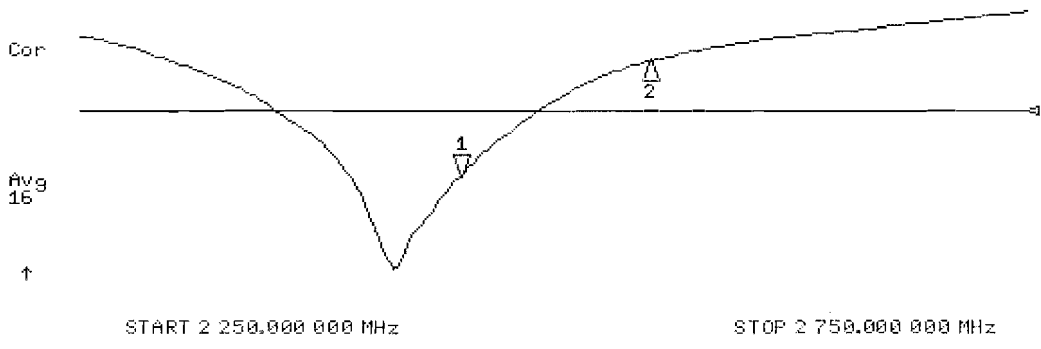
STOP 2 750.000 000 MHz

CH1 Markers

1: 51.811 Ω
2: 81.611 Ω
2.55000 GHz

CH2 Markers

1: -13.905 dB
2: 2.55000 GHz



DASY5 Validation Report for Body

Date/Time: 11.11.2010 13:58:40

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:829

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.92$ mho/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

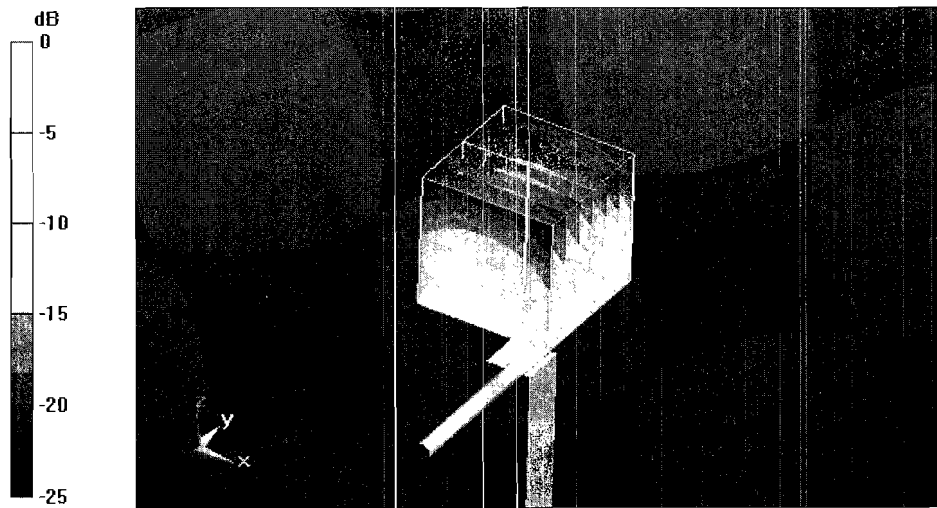
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.5 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 26.2 W/kg

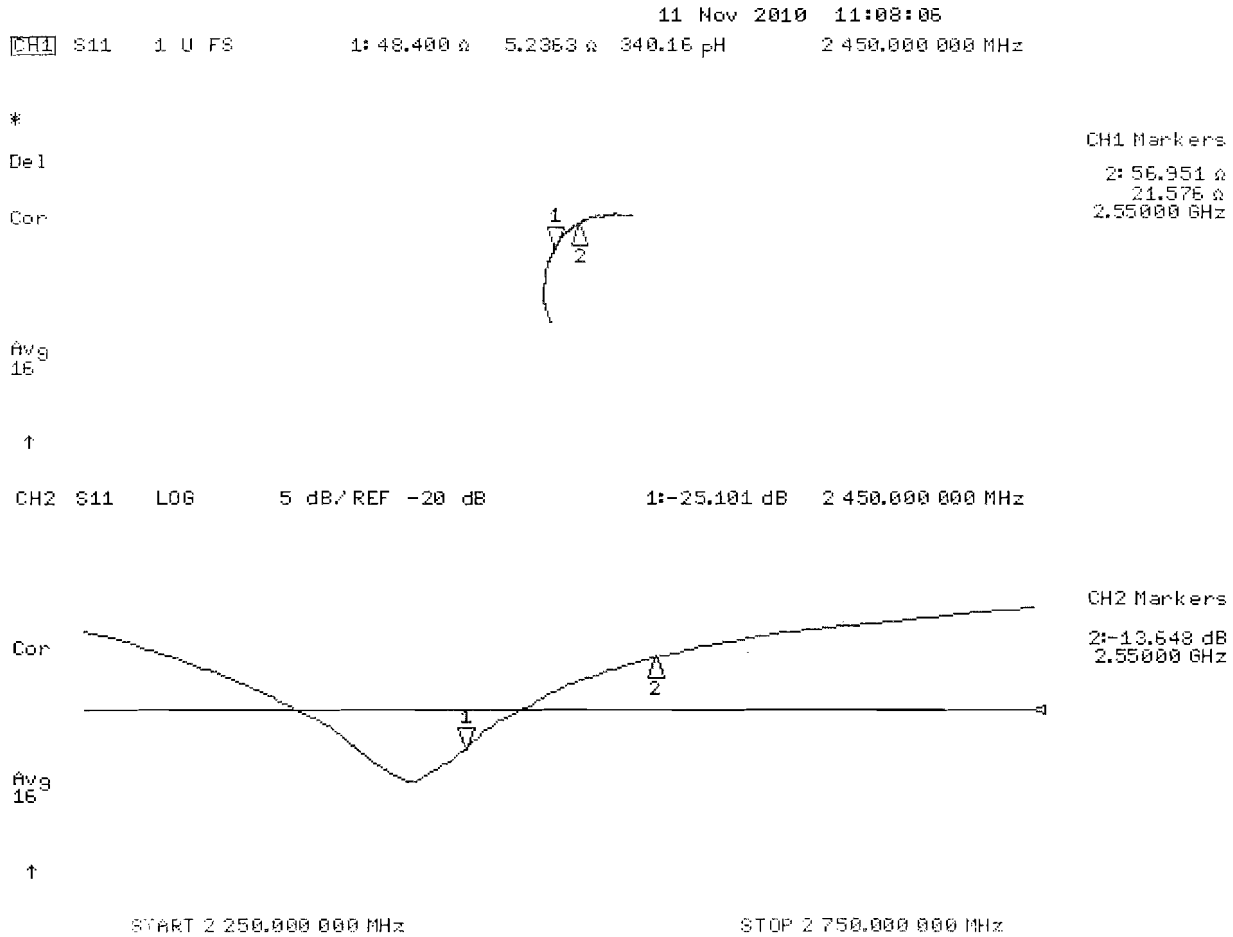
SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.79 mW/g

Maximum value of SAR (measured) = 16.5 mW/g



0 dB = 16.5mW/g

Impedance Measurement Plot for Body TSL



Extended Calibration

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

D2450V2 SN: 829 - Head				
Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
11/11/2010	-28.2		52.8	
6/14/2012	-29.1	3.2	52.1	-0.7

D2450V2 SN: 829 - Body				
Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
11/11/2010	-25.1		48.4	
6/14/2012	-24.6	-2.0	49.2	0.8

Appendix F – Phantom Calibration Data Sheets

NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to National Standards.

Thickness of the UniPhantom is 2 mm \pm 10%
Pinna thickness is 6 mm \pm 10%

Resolution:	0.01 mm	Calibrated to:	0.0 mm
Stability:	OK	Accuracy:	< 0.1 mm

Calibrated By: Karen K. Feb 17/04.

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

Appendix G – KDB990635

OET Inquiry System Inquiry Tracking Number 990635



Office of Engineering and Technology

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- [Equipment Authorization System \(EAS\)](#)
- [Telecommunications Certification Bodies \(TCB\)](#)

Reply to an OET Inquiry Response

Currently Displaying Inquiry Tracking Number: **990635**

Contact Information:

Customer First Name: Kevin
Customer Last Name: Giddings
Telephone Number: 403-295-4855
Extension:
E-mail Address: wireless1@nvtl.com

Address:

Line 1: N/A
Line 2:
P.O. Box:
City: N/A
State:
Zip Code:
Country:

Inquiry Details on 01/16/2012:

First category: Radio Frequency Exposure - MPE; SAR
Second category: Portable - Part 2.1093
Third category: Test Procedure for SAR
Subject: Novatel - New MiFi industrial design
Inquiry: Please find attached our KDB inquiry presentation with regards to a SAR evaluation of a new MiFi industrial design.

Best regards,

Kevin Giddings

FCC Response on 01/24/2012:

Please see the JPEG attachment entitled *KDB990635 Response* for the response to your inquiry.

---Reply from Customer on 01/27/2012---

We do not agree with the proposed SAR configuration for the back of the device. Please see the response package with its additional information.

Regards,

Kevin Giddings

FCC Response on 02/01/2012:

The additional information provided for the left and right edges in slide 7 is appreciated and conforms to our understanding of SAR testing requirements for this device. For the bottom face position in slide 5, we still stand

<https://apps.fcc.gov/betcf/kdb/forms/ReplyToResponse2.cfm>[6/19/2012 12:22:53 PM]

OET Inquiry System Inquiry Tracking Number 990635

by our previous test position requirement originally provided in *KDB990635 Response*.

---Reply from Customer on 02/05/2012---

Could you please explain the rationale for requesting that 70? spacing is to be used at the battery well portion of this design for the bottom side SAR testing?

This device is a stand alone personal wireless router? as described in KDB 941225 D06. It is larger than previous routers we have developed and includes a touch display that will help ensure that the device is used in the controlled use conditions of a home or office (i.e. on a table top).

This ruling is very important for this current design that has been in development for the last 8 months and for the family of products that will follow using this industrial profile.

Best regards,
Kevin Giddings

---Reply from Customer on 02/15/2012---

As we are currently in development for this product, could we please receive a response for our Feb 05 reply.

Thank you,
Kevin Giddings

FCC Response on 02/17/2012:

If there is an issue with SAR compliance utilizing the FCC Lab proposed test configuration, we are willing to discuss and/or review preliminary test data. The applicant may also choose to file directly with the FCC if alternative test conditions preclude TCB review.

---Reply from Customer on 02/23/2012---

We are concerned with our SAR compliance for this test configuration and want to avoid any delays and costs that this configuration and ruling will impose.

Again, could you please explain the rationale for requesting that 70? spacing is to be used at the battery well portion of this design?

We want to understand any specific FCC reasons, concerns or test method justifications so that we can better appreciate the design constraints SAR will have on our new products. This rationale will educate us and improve our ability to interpret of the published rules and guidance.

Regards,
Kevin

FCC Response on 03/06/2012:

The intention is not to test at zero gap for the device, but to provide a 10 mm test distance from the antenna to the phantom. Your test distance proposal for the top face takes this into consideration and we want to see this for the bottom face as well. We are willing to discuss via conference call if so desired.

---Reply from Customer on 03/11/2012---

We would like to arrange for a conference call. Can you instruct us how to coordinate and make these arrangements? When can the FCC be available for this call?

FYI, we had sent an email to Kwok and Rashmi with regards to discussing this configuration. I will notify them that we are addressing this issue through this inquiry.

We should have three NVTL attendees: Kevin Giddings, Todd Gallagher and Bill Babbitt
Regards

---Reply from Customer on 03/15/2012---

Can we make the call arrangements for early next week?

<https://apps.fcc.gov/oetcf/kdb/forms/ReplyToResponse2.cfm>[6/19/2012 12:22:53 PM]

OET Inquiry System Inquiry Tracking Number 990635

FCC Response on 03/21/2012:

Would this Thursday (the 22nd) in the afternoon work as a possible call time? The FCC Lab does not have the ability to set up the call on our end; we would need to call you.

---Reply from Customer on 03/21/2012---

We are available tomorrow afternoon (March 22nd). Please indicate back to us what time works for you.

Please use the following dial in number: Dial in # 866-521-6849, p/c: 213-462-1368

As Kevin Giddings is currently in Taiwan I will be hosting the call. Also on the call from Novatel will be Bill Babbitt our antenna design engineer.

Thank you.

Todd Gallagher

tgallagher@nvtl.com

403-295-4891

FCC Response on 03/21/2012:

2:30 PM EST would work for us.

---Reply from Customer on 05/07/2012---

As discussed on our call please find attached a test summary with the SAR numbers at 0mm, 5mm, 8mm, and 10mm (area scan). The SAR summary is shown on page 12. The 1900 band was selected as it is our worst case transmit frequency for SAR.

In the area scan we had the lab outline the location of the battery and the main TX antenna for your reference. This information can be found starting on page 16.

Please let me know if there is anything else you require.

Thank you.

Todd Gallagher

FCC Response on 05/11/2012:

Thank you for the SAR data. If possible, please provide a summary of the other SAR results required by the hotspot procedures (the different sides and surfaces required according to the antenna location).

Also, please take note of the following:

1] There is information in sections 1 and 2 of the SAR report that will need updating for the final version; procedures should be with respect to 1528-2003 and KDB 941225 only; head liquid does not apply and body parameters are with respect to Supplement C 01-01 etc. For section 5, note that test codes may be used (through KDB inquiry) only if call boxes are unavailable commercially.

2] The SAR number for 0 mm in the SAR data summary table does not match the results in the SAR plot.

---Reply from Customer on 05/15/2012---

The SAR data submitted on the battery location was specific to this request. We did not obtain results in other orientations as our goal was to present data that would aid the FCC in determining the separation distance at the battery location. As we continue to finalize our design we are experiencing difficulties in obtaining data consistent with our expectations on the other orientations. The expectation is that we will pass on the other sides at values greater than 1.2W/kg.

If there is a concern or an orientation you would like to see please let us know. We can coordinate the lab time and get the product in for additional SAR testing.

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OET Inquiry System Inquiry Tracking Number 990635

As we are into the final stretch of our design are there any conclusions drawn with respect to the phantom distance at the battery location?

We are expecting to have final production samples for test in the middle of June. It is expected that all the SAR testing will need to be performed again based on slight changes to the exterior of the device.

Thank you.

Todd Gallagher

FCC Response on 05/23/2012:

We feel the results of the other orientations are necessary in order to make a decision.

---Reply from Customer on 06/04/2012---

Please find attached the remaining SAR numbers as requested in previous correspondence. We have re-tested the data on the battery side (side C?) as changes were made to the design that improved our SAR numbers.

We are scheduled to begin official SAR testing on our production quality samples on June 18th.

Let me know if you have any additional questions.

Best regards,

Todd Gallagher

FCC Response on 06/07/2012:

Thank you for the additional SAR data. Can you be more specific about the design changes that improved the SAR numbers?

---Reply from Customer on 06/07/2012---

The original modem was in the Alpha? (early) stage of design. The results found in the last SAR report reflect the Beta devices that have the latest hardware.

The changes reflect:

1. Alpha PCB's to Beta PCB's ? A large number of small fixes used to correct errors on the first board. See #3.
2. Different antenna design ? The antenna was changed to improve performance
3. Antenna feed was moved to the opposite side of PCB

Let us know if you have any additional questions.

Best regards,

Todd Gallagher

---Reply from Customer on 06/13/2012---

Please let us know if there is any additional information required to complete this request. We are scheduled to start testing on Monday June 18th.

Thank you.

Todd Gallagher

FCC Response on 06/13/2012:

Utilizing the *Test Position with Battery at 5mm Gap* on Side C for this specific device will be allowed for SAR compliance purposes. This is a one time exception and does not convey approval for use on future devices.

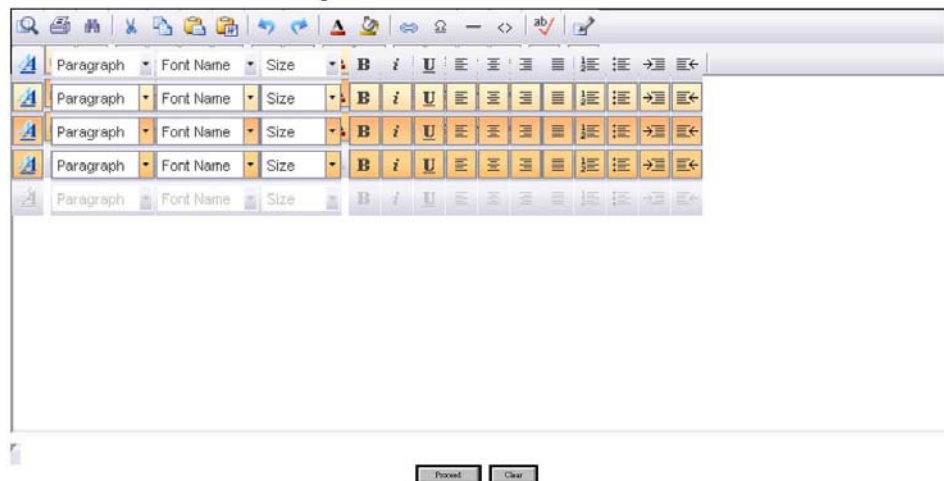
Attachment List:

<https://apps.fcc.gov/oetcf/kdb/forms/ReplyToResponse2.cfm>[6/19/2012 12:22:53 PM]

OET Inquiry System Inquiry Tracking Number 990635

[KDB990635 Response](#)

Enter any additional comments below:



The image shows a rich text editor interface. At the top, there is a toolbar with various icons for text formatting and editing. Below the toolbar, there are five rows of formatting options, each starting with a 'Paragraph' dropdown menu, followed by 'Font Name' and 'Size' dropdowns, and then a set of icons for bold, italic, underline, strikethrough, text color, background color, bulleted list, numbered list, indent, and outdent. The main area of the editor is a large, empty text box. At the bottom of the editor, there are two buttons: 'Printed' and 'Clear'.

Please send any comments or suggestions for this site to [OET Systems Support](#)

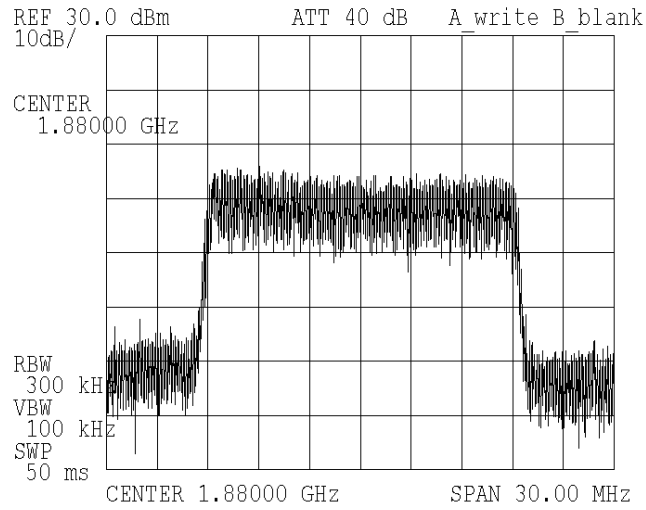
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554
[More FCC Contact Information...](#)

Phone: 888-CALL-FCC (225-5322)
TTY: 888-TELL-FCC (835-5322)
Fax: 202-418-0232
E-mail: fccinfo@fcc.gov

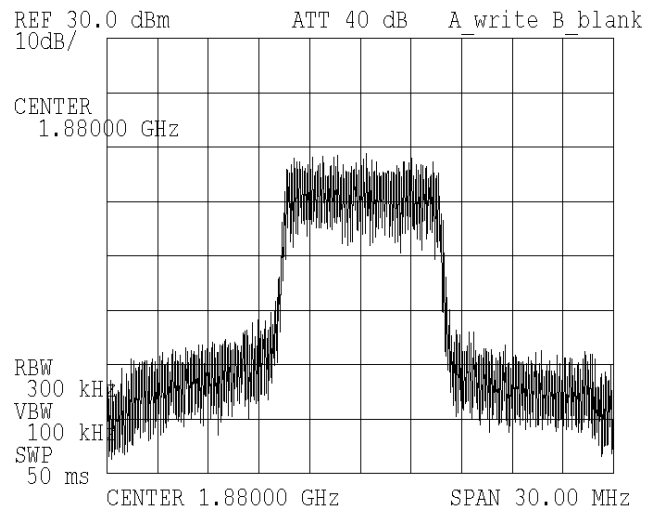
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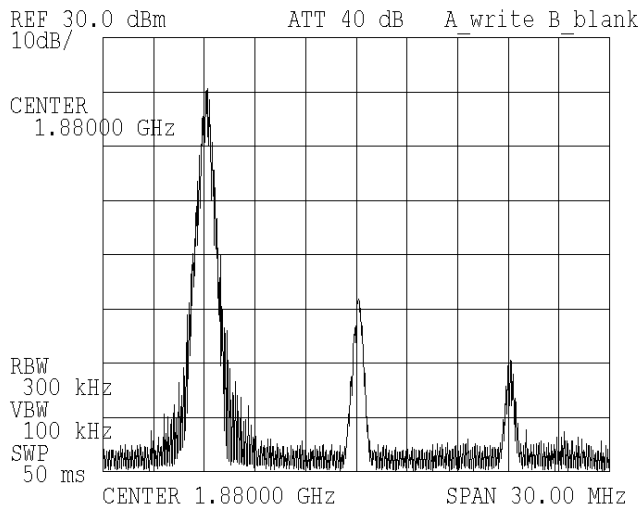
Appendix H – LTE Plots



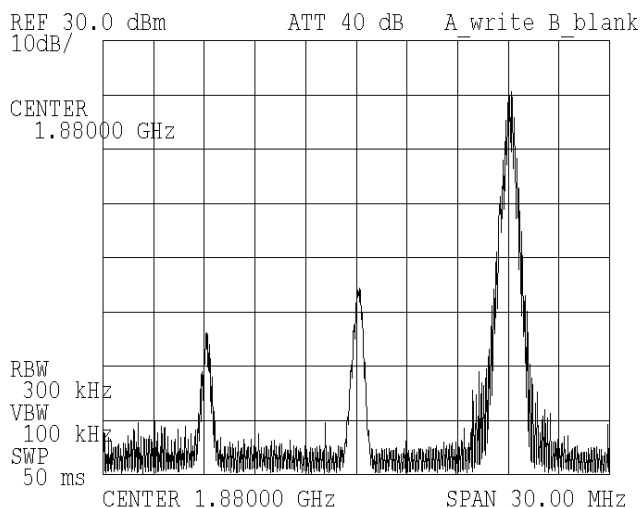
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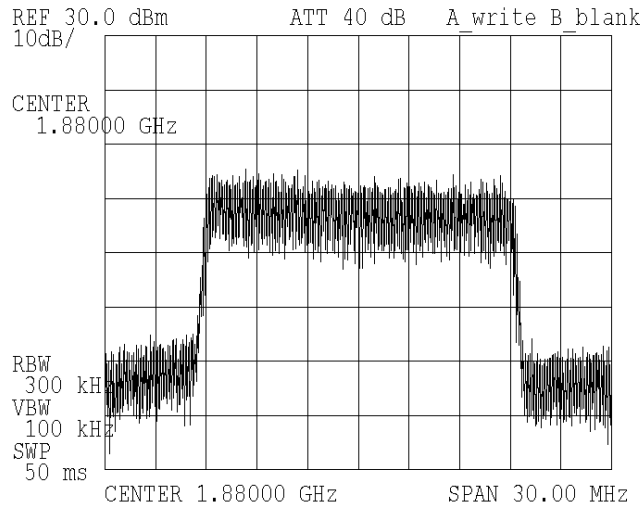
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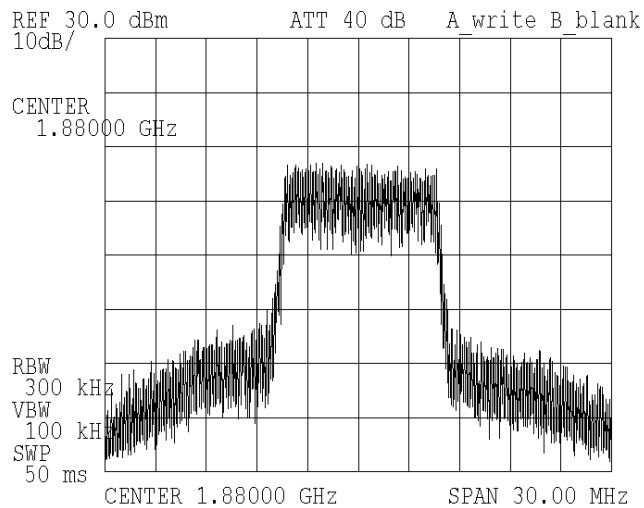
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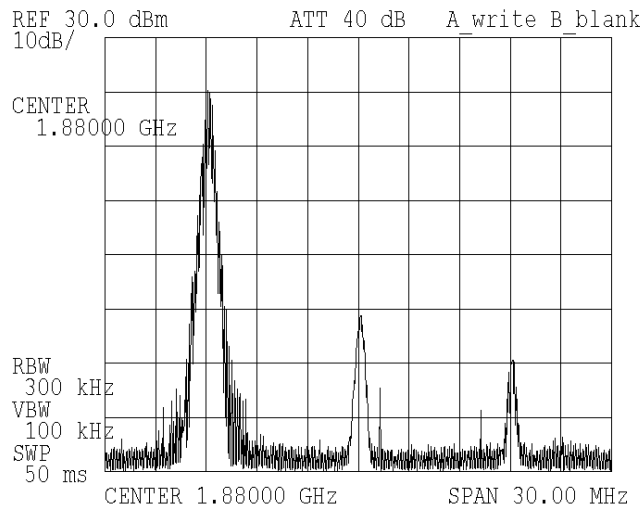
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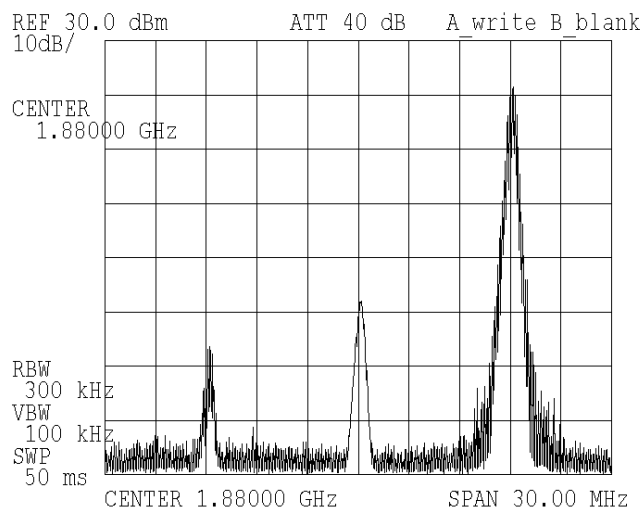
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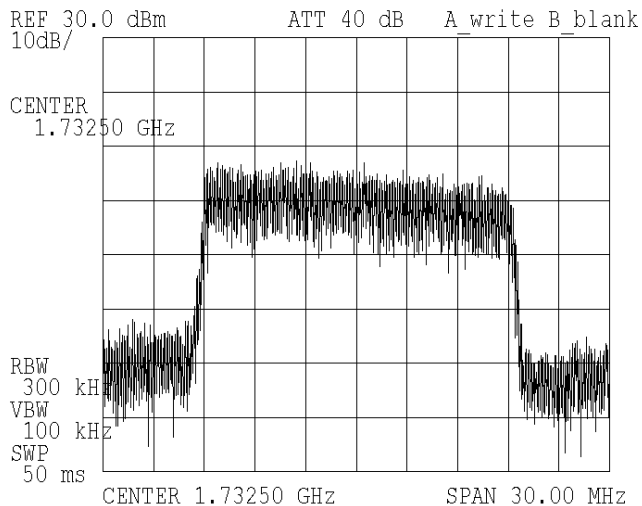
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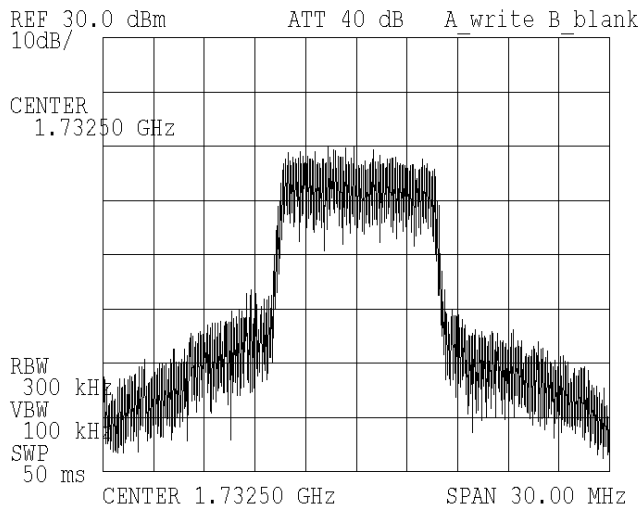
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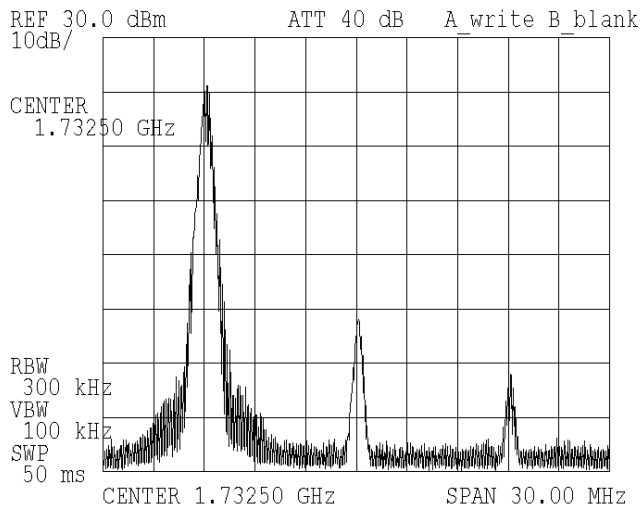
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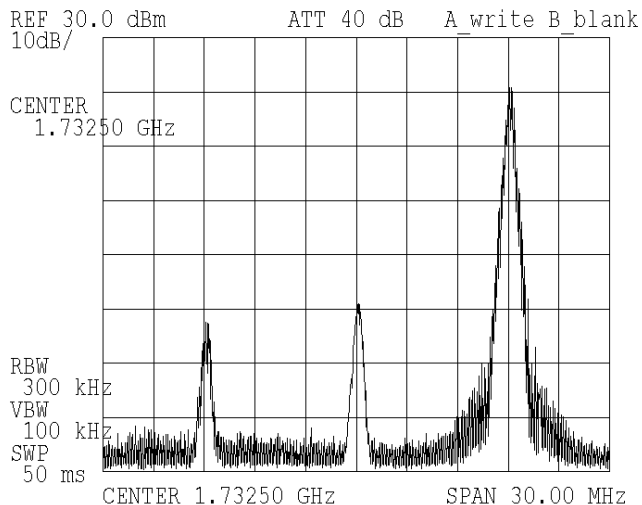
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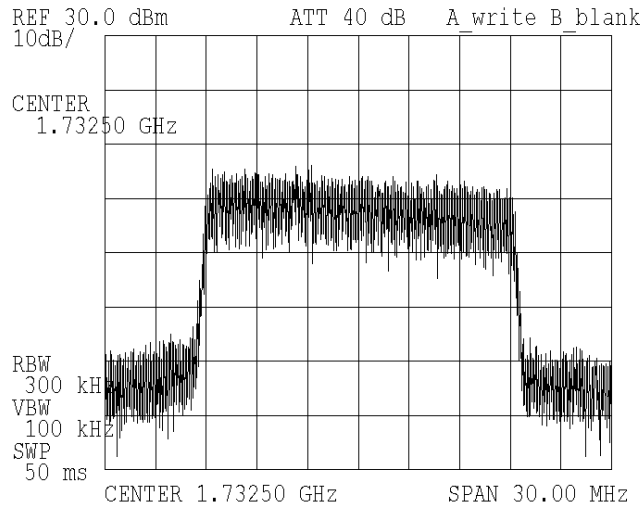
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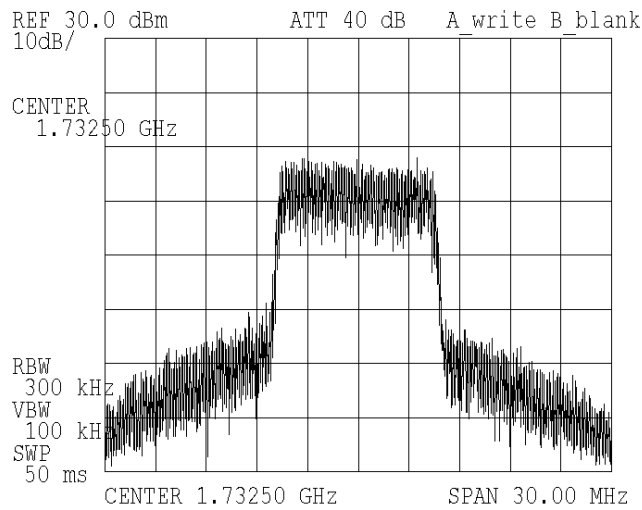
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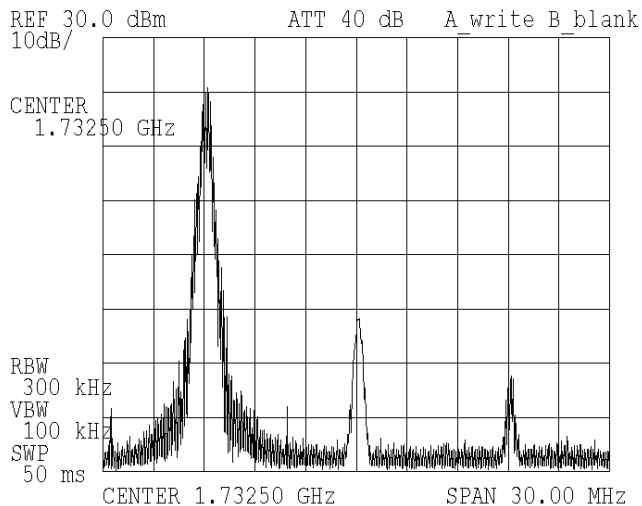
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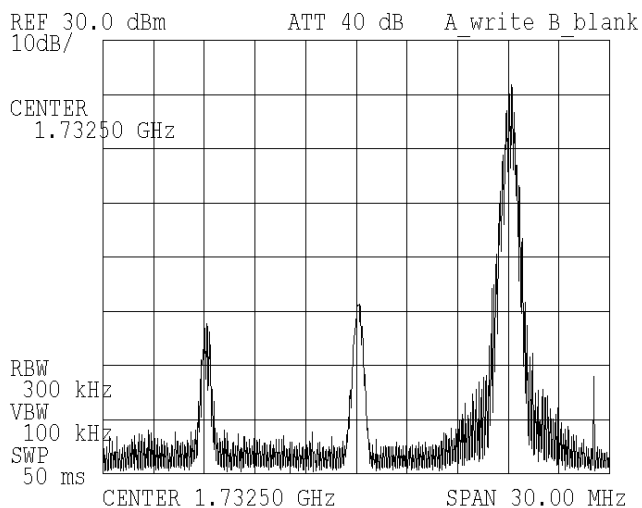
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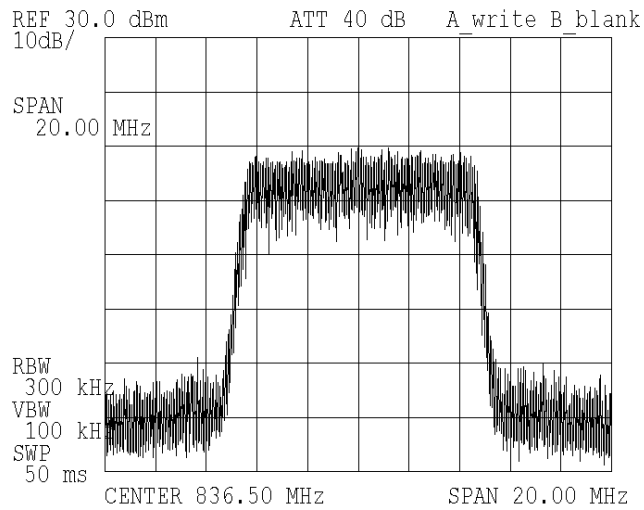
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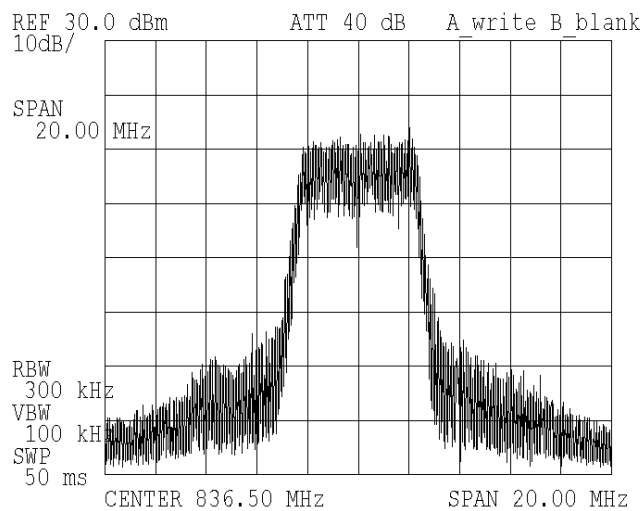
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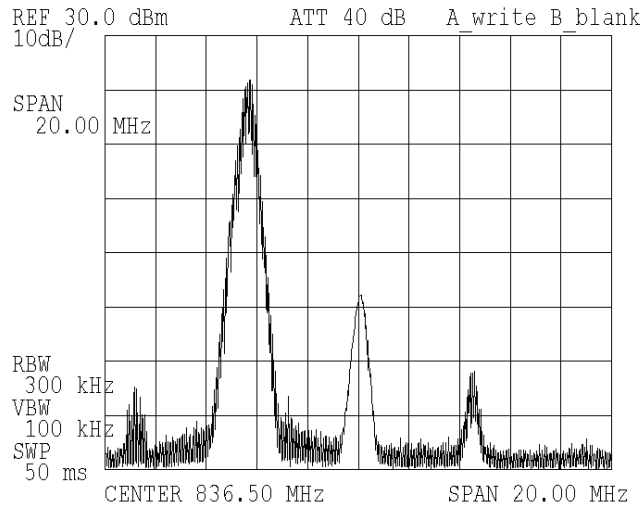
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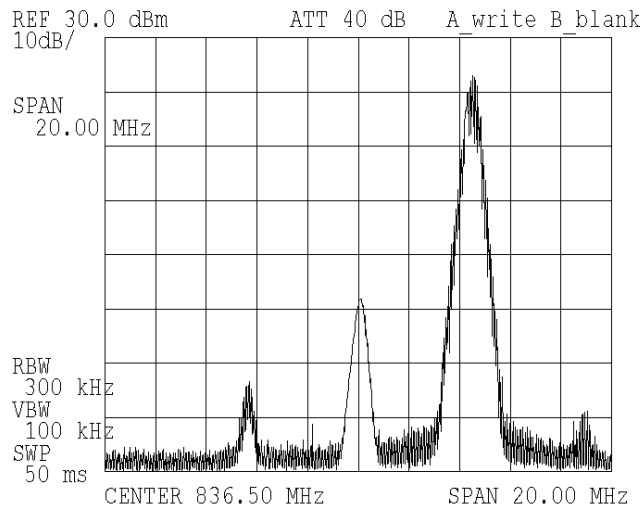
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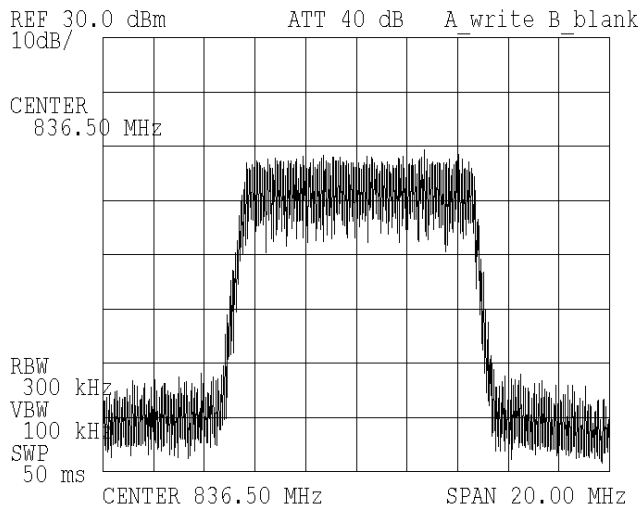
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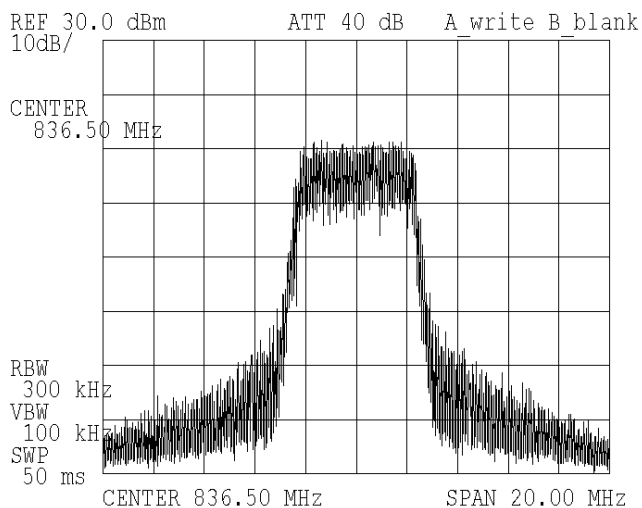
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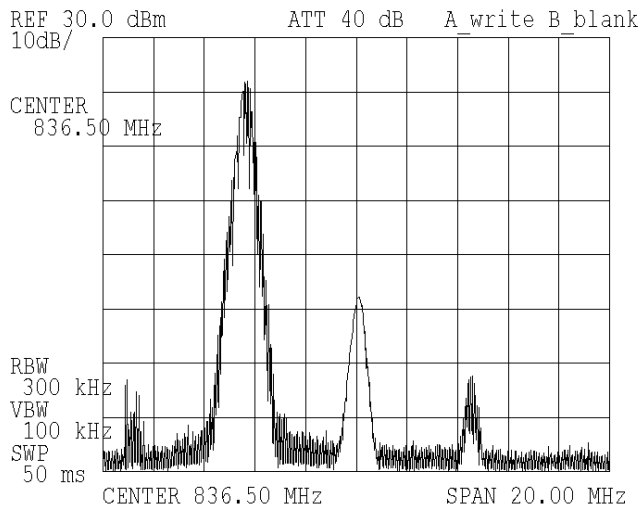
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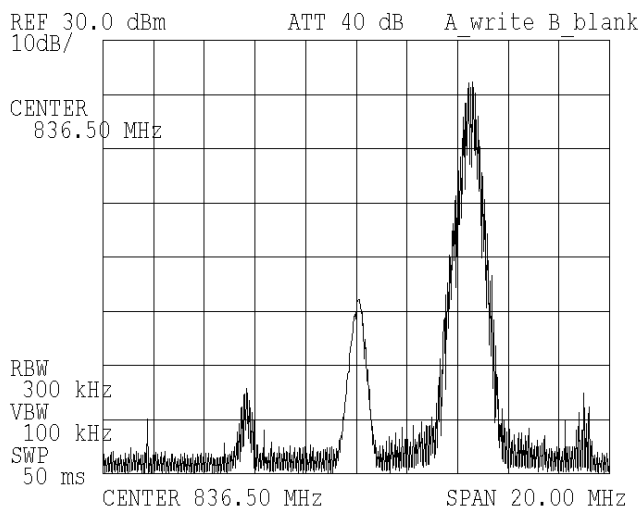
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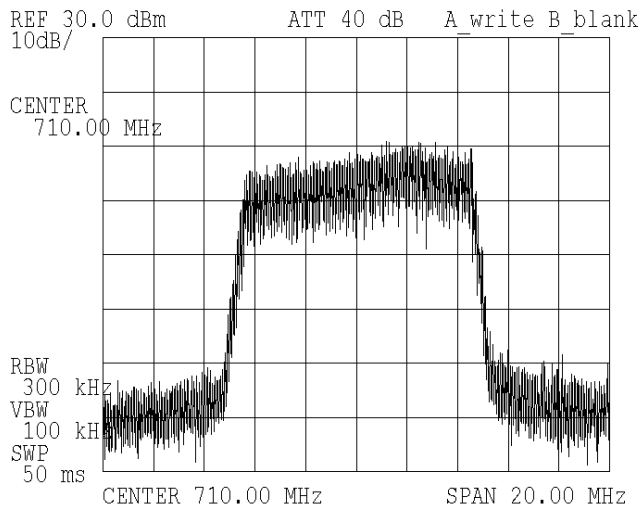
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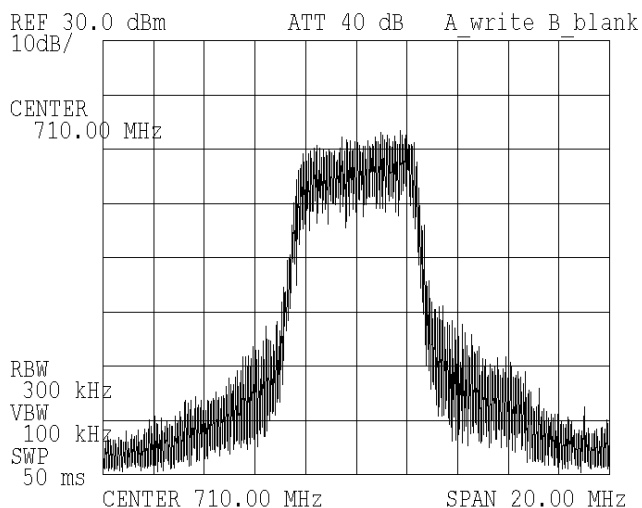
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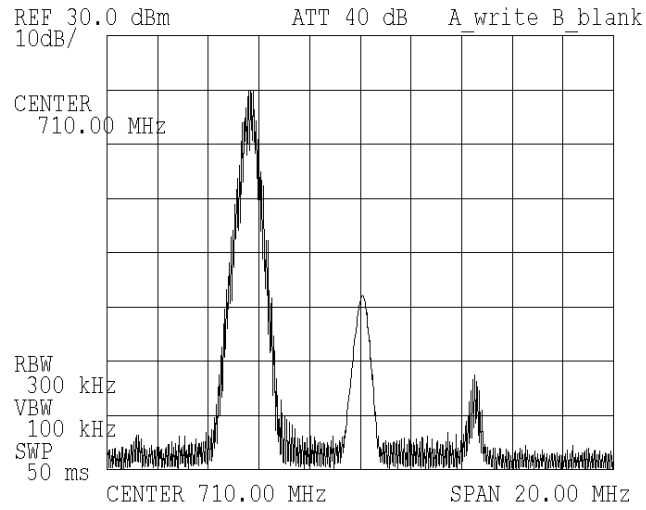
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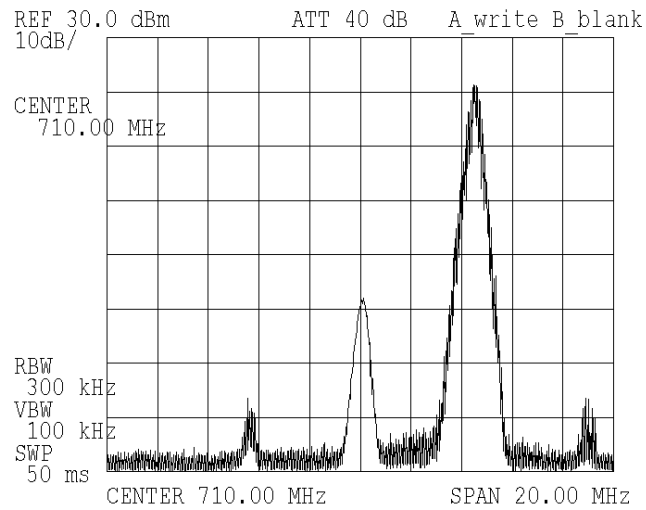
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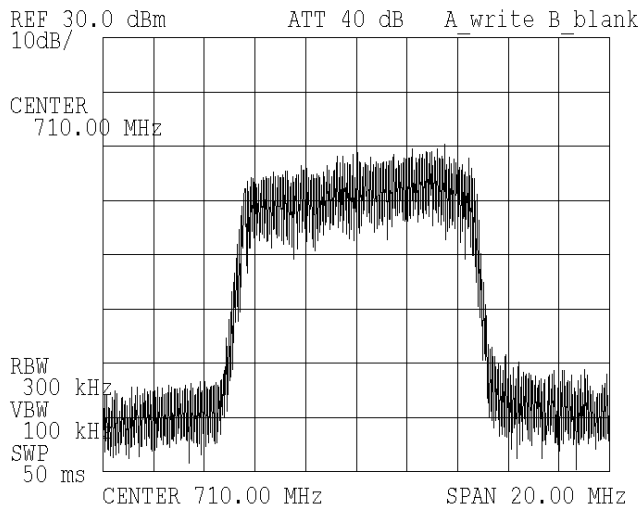
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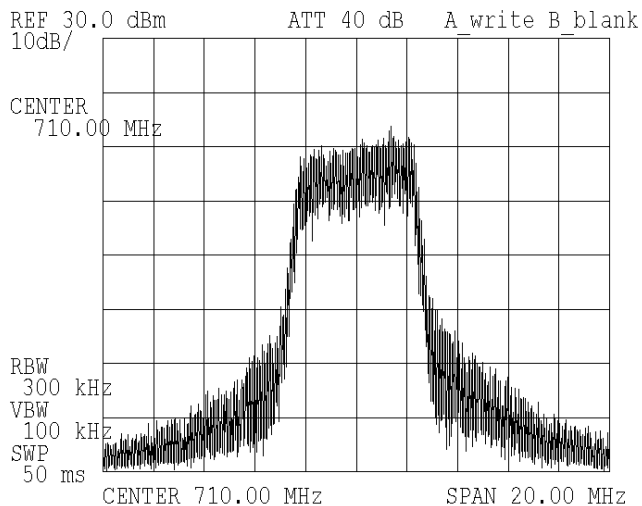
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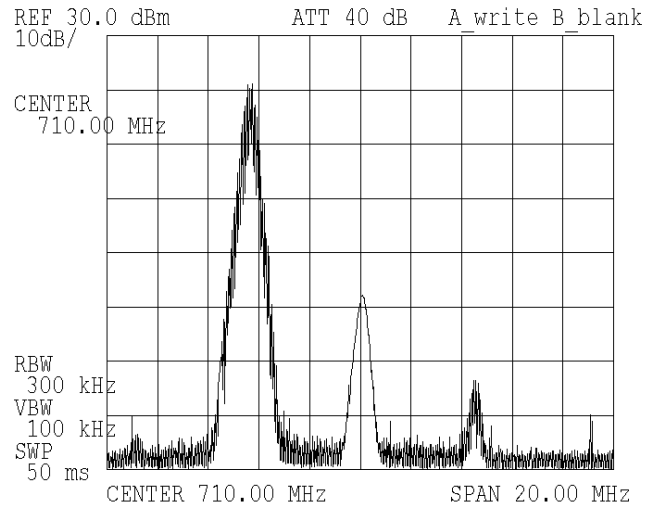
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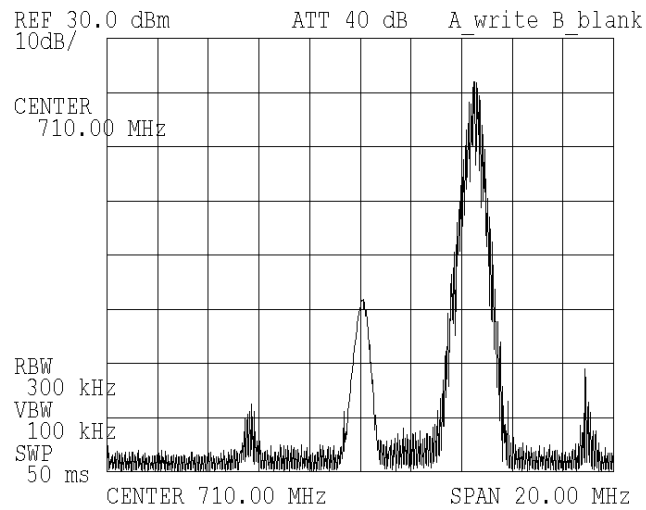
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Band 17 16QAM 50% RB Centered



Band 17 16QAM 1 RB Low



Band 17 16QAM 1 RB High