SAR Compliace Test Report

APPLICANT NAME & ADDRESS :	DATA & LOCATION OF TESTING
Gen2wave Co., Ltd.	**Dates of testing :** 2020-03-10 ~ 2020-03-13
7th fl., Point town B/D, 187-4, Gumi-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Rep of Korea	**Test Site :** 140-16 Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

Test Device :	FCC ID : 2AWCDRP70A-BIO MODEL : RP70A BIO Additional Model(s) : MetaDolce MD7200-BIO, RP70 APPLICANT : Gen2wave Co., Ltd.
Test Report No. :	ESTSFC2005-001
FCC Rule Part(s) :	FCC 47 CFR § 2.1093, IEEE STD 1528- 2013
Applicant Type :	Certification
Rule Part(s) :	Published RF exposure KDB procedures (IEEE Std 1528-2013) o 248227 D01 802.11 Wi-Fi SAR v02r02 o 447498 D01 General RF Exposure Guidance v06 o 447498 D03 Supplement C Cross-Reference v01 o 616217 D04 SAR for laptop and tablets v01r02 o 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04 o 865664 D02 RF Exposure Reporting v01r02 o 941225 D01 3G SAR Procedures v03r01 o 941225 D05 SAR for LTE Devices v02r04
Number of page :	123
Test results :	The Tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced recept in full, without written approval of the laboratory.
Date and Signatures :	2020-05-06

Report Prepared By :	Engineer / Sun-Duk Hong	Engineering Manager / In-Ki Hong
	(Signature)	(Signature)

Table of Contents

1. SUMMARY FOR TEST REPORT

FCC ID	Gen2wave Co., Ltd.
Date of test	2020-03-10 ~ 2020-03-13
Measurement performed by	Sun-Duk Hong
Technical Reviewer	In-Ki Hong
EUT Type	Portable Data Collection Terminal
Frequency	Bluetooth : 2402 ~ 2480 MHz 802.11b/g/n20 : 2412 ~ 2462 MHz 802.11a/n20/n40/ac80 : 5150 ~ 5250 MHz, 5745~5825 MHz LTE FDD2 : 1850~1910 MHz LTE FDD4 : 1710~1755 MHz LTE FDD5 : 824~849 MHz LTE FDD13 : 777~787 MHz WCDMA BAND2 : 1852.4~1907.6 MHz WCDMA BAND4 : 1712.4~1752.6 MHz WCDMA BAND5 : 826.4~846.6 MHz
Duty Cycle	>98%
Battery Type	3.7 V (BATTERY)

1.1 Limb Configuration

Max. SAR Measurement Standalone

BAND	Tx. FREQ UENCY (MHz)	SAR(W/kg) 10g – Limb (W/kg)
WCDMA 2	1 852.4 ~ 1 907.6	2.448
WCDMA 4	1 712.4 ~ 1 752.6	2.435
WCDMA 5	826.4 ~ 846.6	1.168
LTE FDD2	1 850 ~ 1 910	**2.719**
LTE FDD4	1 710 ~ 1 755	2.437
LTE FDD5	824 ~ 849	1.043
LTE FDD13	777 ~ 787	1.273

Simultaneous SAR Summary

BAND	Limb			Highest Scaled 10g(W/kg)
WCDMA 2 + WIFI + BT	2.448	0.04	0.08	2.568
WCDMA 4 + WIFI + BT	2.435	0.04	0.08	2.555
WCDMA 5 + WIFI + BT	1.168	0.04	0.08	1.288
LTE FDD2 + WIFI + BT	2.719	0.04	0.08	**2.839**
LTE FDD4 + WIFI + BT	2.437	0.04	0.08	2.557
LTE FDD5 + WIFI + BT	1.043	0.04	0.08	1.163
LTE FDD13 + WIFI + BT	1.273	0.04	0.08	1.393

Hotspot Simultaneous SAR Summary

BAND	Limb			Highest Scaled 10g(W/kg)
WCDMA 2 + WIFI + BT	2.448	0.05	0.10	2.598
WCDMA 4 + WIFI + BT	2.435	0.05	0.10	2.585
WCDMA 5 + WIFI + BT	1.168	0.05	0.10	1.318
LTE FDD2 + WIFI + BT	2.719	0.05	0.10	**2.869**
LTE FDD4 + WIFI + BT	2.437	0.05	0.10	2.587
LTE FDD5 + WIFI + BT	1.043	0.05	0.10	1.193
LTE FDD13 + WIFI + BT	1.273	0.05	0.10	1.423

1.3.1 WCDMA Conducted Power

WCDMA BAND2		9262 (1852.4 MHz)	9400 (1880.0 MHz)	9538 (1907.6 MHz)
RMC		**23.36**	**23.13**	**23.15**
HSDPA	Sub 1	22.43	22.19	22.09
	Sub 2	22.37	22.15	22.09
	Sub 3	21.88	21.67	21.62
	Sub 4	21.89	21.68	21.63
HSUPA	Sub 1	22.43	22.23	22.14
	Sub 2	21.84	21.70	21.70
	Sub 3	22.38	22.16	22.11
	Sub 4	22.48	22.26	22.22
	Sub 5	22.37	22.15	22.11
DC-HSDPA	Sub 1	22.43	23.02	23.02
	Sub 2	22.37	23.01	23.01
	Sub 3	21.88	22.50	22.50
	Sub 4	21.89	22.59	22.48

WCDMA BAND4		1312 (1712.4 MHz)	1413 (1732.6 MHz)	1513 (1752.6 MHz)
RMC		**23.54**	**23.50**	**23.46**
HSDPA	Sub 1	22.54	22.48	22.39
	Sub 2	22.58	22.47	22.47
	Sub 3	22.00	22.00	22.00
	Sub 4	21.99	21.98	21.99
HSUPA	Sub 1	22.30	22.44	22.30
	Sub 2	22.03	21.98	22.00
	Sub 3	22.59	22.57	22.46
	Sub 4	22.61	22.56	22.46
	Sub 5	22.58	22.48	22.48
DC-HSDPA	Sub 1	23.41	23.39	23.33
	Sub 2	23.39	23.38	23.32
	Sub 3	22.88	22.87	22.81
	Sub 4	22.87	22.86	22.80

WCDMA BAND5		4132 (826.4 MHz)	4183 (836.6 MHz)	4233 (846.6 MHz)
RMC		**23.29**	**23.26**	**23.36**
HSDPA	Sub 1	22.24	22.31	22.44
	Sub 2	22.32	22.32	22.39
	Sub 3	21.78	21.71	21.93
	Sub 4	21.75	21.77	21.92
HSUPA	Sub 1	22.23	22.33	22.40
	Sub 2	21.80	21.79	21.93
	Sub 3	22.28	22.29	22.36
	Sub 4	22.30	22.37	22.43
	Sub 5	22.25	22.33	22.40
DC-HSDPA	Sub 1	23.16	23.15	23.23
	Sub 2	23.25	23.13	23.22
	Sub 3	22.74	22.62	22.71
	Sub 4	22.73	22.61	22.70

1.3.2 LTE Conducted Power

LTE FDD2						
BW(MHz)	**Modulation**	**RB size**	**RB Offset**	**Power(dBm) Low**	**Power(dBm) Mid**	**Power(dBm) High**
Frequency (MHz)				1860.0	1880.0	1900.0
Channel				18700	18900	19100
20	QPSK	1	Low	23.27	23.29	22.89
		1	Mid	23.35	23.73	22.92
		1	High	23.23	23.17	22.80
		50	Low	22.33	22.22	22.11
		50	Mid	22.16	22.04	22.18
		50	High	22.34	22.24	22.86
		100	-	22.20	22.38	21.96
	16QAM	1	Low	22.24	22.79	22.54
		1	Mid	22.31	22.89	22.91
		1	High	22.10	22.85	22.92
		50	Low	21.32	21.20	21.16
		50	Mid	21.39	21.12	21.09
		50	High	21.29	21.25	21.05
		100	-	21.21	21.16	21.18
Frequency (MHz)				1857.5	1880	1902.5
Channel				18675	18900	19125
15	QPSK	1	Low	23.30	23.33	22.92
		1	Mid	23.36	23.77	22.94
		1	High	23.25	23.18	22.83
		36	Low	22.36	22.30	22.15
		36	Mid	22.21	22.08	22.21
		36	High	22.37	22.29	21.90
		75	-	22.23	22.43	22.00
	16QAM	1	Low	22.26	22.83	22.61
		1	Mid	22.35	22.91	22.95
		1	High	22.12	22.88	22.94
		36	Low	21.35	21.24	21.19
		36	Mid	21.42	21.16	21.07
		36	High	21.32	21.30	21.09
		75	-	21.30	21.22	21.21
Frequency (MHz)				1855.0	1880.0	1905.0
Channel				18650	18900	19150
10	QPSK	1	Low	23.31	23.37	22.96
		1	Mid	**23.44**	**23.78**	**23.02**
		1	High	23.28	23.23	22.87
		25	Low	22.38	22.34	22.20
		25	Mid	22.24	22.13	22.25
		25	High	22.40	22.32	21.94
		50	-	22.25	22.47	22.11
	16QAM	1	Low	22.31	22.84	22.63
		1	Mid	22.37	22.94	22.97
		1	High	22.19	22.92	22.96
		25	Low	21.38	21.26	21.22
		25	Mid	21.45	21.21	21.11
		25	High	21.34	21.34	21.08
		50	-	21.33	21.27	21.25

LTE FDD2						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)				1852.5	1880.0	1907.5
Channel				18625	18900	19175
5	QPSK	1	Low	23.29	23.37	22.91
		1	Mid	23.35	23.73	22.93
		1	High	23.26	23.19	22.84
		12	Low	22.35	22.29	22.14
		12	Mid	22.21	22.08	22.21
		12	High	22.38	22.28	21.89
		25	-	22.17	22.45	22.01
	16QAM	1	Low	22.29	22.82	22.61
		1	Mid	22.34	22.90	22.94
		1	High	22.12	22.90	21.18
		12	Low	21.35	21.21	21.08
		12	Mid	21.43	21.17	21.04
		12	High	21.31	21.29	21.21
		25	-	21.30	21.22	21.09
Frequency (MHz)				1908.5	1880.0	1851.5
Channel				18615	18900	19185
3	QPSK	1	Low	23.32	23.38	22.95
		1	Mid	23.37	23.77	22.96
		1	High	23.29	23.24	22.88
		8	Low	22.38	22.34	22.18
		8	Mid	22.23	22.12	22.26
		8	High	22.40	22.30	21.93
		15	-	22.19	22.46	22.03
	16QAM	1	Low	22.32	22.86	22.64
		1	Mid	22.37	22.92	22.97
		1	High	22.15	22.91	22.98
		8	Low	21.37	21.25	21.21
		8	Mid	21.46	21.22	21.12
		8	High	21.34	21.34	21.08
		15	-	21.32	21.26	21.26
Frequency (MHz)				1909.3	1880.0	1850.7
Channel				18607	18900	19193
1.4	QPSK	1	Low	23.31	23.31	22.99
		1	Mid	23.34	23.72	22.92
		1	High	23.26	23.21	22.84
		3	Low	23.28	23.22	23.05
		3	Mid	23.11	23.02	23.14
		3	High	23.30	23.19	22.83
		6	-	22.16	22.42	22.00
	16QAM	1	Low	22.29	22.84	22.61
		1	Mid	22.34	22.87	22.93
		1	High	22.13	22.88	22.95
		3	Low	22.26	22.12	22.09
		3	Mid	22.35	22.09	22.00
		3	High	22.24	22.22	21.99
		6	-	22.29	21.22	21.23

LTE FDD4						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)				1720.0	1732.0	1745.0
Channel				20050	20175	20300
20	QPSK	1	Low	23.64	23.34	23.50
		1	Mid	23.61	23.71	23.65
		1	High	23.30	23.68	23.80
		50	Low	22.53	22.41	22.77
		50	Mid	22.52	22.51	22.60
		50	High	22.51	22.63	22.58
		100	-	22.50	22.52	22.76
	16QAM	1	Low	22.56	22.36	23.38
		1	Mid	22.65	22.97	23.29
		1	High	22.51	23.11	23.50
		50	Low	21.45	21.56	21.66
		50	Mid	21.52	21.60	21.46
		50	High	21.60	21.66	21.69
		100	-	21.49	21.60	21.78
Frequency (MHz)				1717.5	1732.5	1747.5
Channel				20025	20175	20325
15	QPSK	1	Low	23.71	23.35	23.58
		1	Mid	23.62	23.74	23.64
		1	High	23.35	23.69	23.83
		36	Low	22.56	22.46	22.81
		36	Mid	22.54	22.55	22.63
		36	High	22.52	22.68	22.62
		75	-	22.50	22.57	22.80
	16QAM	1	Low	22.58	22.40	23.43
		1	Mid	22.69	22.99	23.33
		1	High	22.53	23.14	23.52
		36	Low	21.48	21.60	21.69
		36	Mid	21.55	21.62	21.49
		36	High	21.63	21.71	21.73
		75	-	21.51	21.59	21.82
Frequency (MHz)				1715.0	1732.5	1750.0
Channel				20000	20175	20350
10	QPSK	1	Low	23.72	23.39	23.60
		1	Mid	23.62	23.75	23.65
		1	High	23.38	23.74	23.87
		25	Low	22.58	22.50	22.84
		25	Mid	22.57	22.62	22.64
		25	High	22.51	22.71	22.66
		50	-	22.44	22.61	22.85
	16QAM	1	Low	22.63	22.42	23.45
		1	Mid	22.71	23.02	23.35
		1	High	22.56	23.18	23.55
		25	Low	21.52	21.60	21.74
		25	Mid	21.58	21.67	21.51
		25	High	21.65	21.75	21.76
		50	-	21.54	21.69	21.81

LTE FDD4						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)				1712.5	1732.5	1752.5
Channel				19975	20175	20375
5	QPSK	1	Low	23.70	23.38	23.57
		1	Mid	23.61	23.70	23.63
		1	High	23.32	23.71	23.81
		12	Low	22.54	22.45	22.80
		12	Mid	22.54	22.55	22.63
		12	High	22.51	22.67	22.61
		25	-	22.47	22.59	22.81
	16QAM	1	Low	22.61	22.39	23.43
		1	Mid	22.62	22.95	23.32
		1	High	22.53	23.16	23.52
		12	Low	21.48	21.57	21.68
		12	Mid	21.56	21.61	21.50
		12	High	21.62	21.70	21.72
		25	-	21.50	21.64	21.79
Frequency (MHz)				1711.5	1732.5	1753.5
Channel				19965	20175	20385
3	QPSK	1	Low	23.70	23.41	23.61
		1	Mid	23.62	23.70	23.66
		1	High	**23.43**	**23.71**	**23.88**
		8	Low	22.58	22.50	22.84
		8	Mid	22.56	22.59	22.68
		8	High	22.57	22.69	22.65
		15	-	22.49	22.60	22.83
	16QAM	1	Low	22.64	22.43	23.46
		1	Mid	22.71	23.00	23.35
		1	High	22.56	23.18	23.56
		8	Low	21.51	21.61	21.71
		8	Mid	21.59	21.68	21.54
		8	High	21.65	21.75	21.76
		15	-	21.53	21.68	21.87
Frequency (MHz)				1710.7	1732.5	1754.3
Channel				19957	20175	20393
1.4	QPSK	1	Low	23.71	23.38	23.58
		1	Mid	23.62	23.69	23.60
		1	High	23.36	23.70	23.84
		3	Low	23.48	23.38	23.71
		3	Mid	23.44	23.50	23.56
		3	High	23.47	23.58	23.55
		6	-	22.46	22.56	22.80
	16QAM	1	Low	22.61	22.41	23.43
		1	Mid	22.62	22.94	23.31
		1	High	22.54	23.14	23.53
		3	Low	22.39	22.48	22.59
		3	Mid	22.46	22.51	22.42
		3	High	22.55	22.63	22.61
		6	-	21.50	21.64	21.84

LTE FDD5						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)				829.0	836.5	844.0
Channel				20450.00	20525	20600.00
10	QPSK	1	Low	23.85	23.91	24.05
		1	Mid	23.95	24.00	23.82
		1	High	23.83	23.96	22.90
		25	Low	22.81	22.82	22.91
		25	Mid	22.84	22.85	22.89
		25	High	22.95	22.95	22.92
		50	-	22.93	22.94	22.86
	16QAM	1	Low	23.48	23.15	22.74
		1	Mid	23.20	23.49	22.72
		1	High	23.31	23.10	21.93
		25	Low	21.75	21.86	21.73
		25	Mid	21.91	21.77	21.70
		25	High	21.94	21.78	21.75
		50	-	21.76	21.80	21.63
Frequency (MHz)				826.5	836.5	846.5
Channel				20425	20525	20625
5	QPSK	1	Low	23.92	23.90	23.80
		1	Mid	**24.01**	**24.07**	**24.12**
		1	High	24.05	23.98	23.82
		12	Low	22.84	22.87	22.94
		12	Mid	22.86	22.89	22.94
		12	High	22.98	22.97	22.91
		25	-	22.96	22.99	22.96
	16QAM	1	Low	23.50	23.19	22.91
		1	Mid	23.24	23.51	22.78
		1	High	23.33	23.13	22.76
		12	Low	21.78	21.90	21.96
		12	Mid	21.94	21.79	21.76
		12	High	21.97	21.83	21.75
		25	-	21.78	21.84	21.80
Frequency (MHz)				825.5	836.5	847.5
Channel				20415	20625	20635
3	QPSK	1	Low	23.92	24.03	23.89
		1	Mid	24.00	24.04	24.10
		1	High	24.09	24.04	23.86
		8	Low	22.86	22.91	23.84
		8	Mid	22.88	22.93	23.87
		8	High	23.01	22.98	23.86
		15	-	22.92	23.02	22.91
	16QAM	1	Low	23.56	23.22	22.91
		1	Mid	23.26	23.52	22.76
		1	High	23.36	23.17	22.75
		8	Low	21.80	21.91	22.86
		8	Mid	21.98	21.85	22.69
		8	High	21.99	21.87	22.64
		15	-	21.80	21.88	21.80

LTE FDD5						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)				824.7	836.5	848.3
Channel				20407	20625	20643
1.4	QPSK	1	Low	23.90	23.99	23.89
		1	Mid	23.97	23.99	24.10
		1	High	24.06	23.99	23.86
		3	Low	23.76	23.79	23.84
		3	Mid	23.76	23.83	23.87
		3	High	23.91	23.87	23.86
		6	-	22.89	22.98	23.96
	16QAM	1	Low	23.53	23.20	22.91
		1	Mid	23.23	23.47	22.76
		1	High	23.34	23.13	22.75
		3	Low	22.69	22.78	22.86
		3	Mid	22.87	22.72	22.69
		3	High	22.89	22.75	22.64
		6	-	21.77	21.84	21.80

LTE FDD13						
BW(MHz)	Modulation	RB size	RB Offset	Power(dBm) Low	Power(dBm) Mid	Power(dBm) High
Frequency (MHz)					782.0	
Channel					23230	
10	QPSK	1	Low		23.83	
		1	Mid		**23.92**	
		1	High		23.78	
		25	Low		22.91	
		25	Mid		22.85	
		25	High		22.95	
		50	-		22.88	
	16QAM	1	Low		23.18	
		1	Mid		23.48	
		1	High		23.01	
		25	Low		21.84	
		25	Mid		21.90	
		25	High		21.95	
		50	-		21.89	
Frequency (MHz)				779.5	782.0	784.5
Channel				23205	23230	23255
5	QPSK	1	Low	23.74	23.71	23.82
		1	Mid	23.84	23.75	23.80
		1	High	23.63	23.76	23.72
		12	Low	22.95	22.84	22.90
		12	Mid	22.92	22.87	22.91
		12	High	22.82	22.89	22.90
		25	-	22.88	22.81	22.87
	16QAM	1	Low	23.13	22.48	22.65
		1	Mid	23.21	22.50	22.42
		1	High	23.12	22.23	22.50
		12	Low	21.57	21.59	21.75
		12	Mid	21.70	21.80	21.72
		12	High	21.83	21.67	21.64
		25	-	21.80	22.03	21.65

1.3.3 WIFI Conducted Power

2.4 GHz Conducted Power (dBm)				
Freq (MHz)	Channel	Mode		
		802.11b	802.11g	802.11n HT20
2412	1	-3.30	-4.33	-3.41
2437	6	-2.49	-3.06	-3.28
2462	11	-2.09	-2.47	-2.52

5 GHz Conducted Power (dBm)			
Freq (MHz)	Channel	Mode	
		802.11a	802.11n HT20
5180	36	-2.34	-3.63
5220	44	-2.84	-3.35
5240	48	-2.63	-3.26

5 GHz Conducted Power (dBm)			
Freq (MHz)	Channel	Mode	
		802.11a	802.11n HT20
5745	149	-8.18	-4.47
5785	157	-9.24	-5.18
5825	165	-8.91	-5.02

5 GHz Conducted Power (dBm)		
Freq (MHz)	Channel	Mode
		802.11n HT40
5190	38	-7.86
5230	46	-8.12

5 GHz Conducted Power (dBm)		
Freq (MHz)	Channel	Mode
		802.11n HT40
5755	151	-8.07
5795	159	-8.24

5 GHz Conducted Power (dBm)		
Freq (MHz)	Channel	Mode
		802.11ac VHT80
5210	42	-8.69

5 GHz Conducted Power (dBm)		
Freq (MHz)	Channel	Mode
		802.11ac VHT80
5775	155	-12.10

1.3.4 BLUETOOTH Conducted Power

2.4 GHz Conducted Power (dBm)			
Freq (MHz)	Channel	Mode	
		BDR	EDR
2402	0	0.79	-4.08
2441	38	-0.63	-3.47
2480	79	-0.79	-3.42

2.4 GHz Conducted Power (dBm)		
Freq (MHz)	Channel	Mode
		LE
2402	0	-0.75
2440	19	-0.13
2480	39	-0.45

2. DESCRIPTION OF THE DEVICE UNDER TEST

The FCC rules for evaluating portable devices for RF exposure compliance are contained in 47 CFR §2.1093. For purposes of RF exposure evaluation, a portable device is defined as a transmitting device designed to be used with any part of its radiating structure in direct contact with the user's body or within 20 cm of the body of a user or bystanders under normal operating conditions. This category of devices would include hand-held that incorporate the radiating antenna into the hand-piece and wireless transmitters that are carried next to the body. Portable sevices are evaluated with respect to SAR limits for RF exposure. The applicable SAR limit for portable transmitters used by consumers is 1.6 W/kg, which is averaged over any one gram of tissue defined as a tissue volume in the shape of a cube.

2.1 Antenna Description

Type	PiFA Antenna ,PCB Antenna
Location	the type of the device (Fig. 4.5)

2.2 Device Description

Serial numbers	NONE
Exposure environment	Uncontrolled exposure
Device category	Handheld devices
Mode(s) of Operation	802.11b/g/n/ac , LTE , WCDMA
Modulation Mode(s)	DSSS,OFDM,QPSK, 16QAM
Duty Cycle	>98%
test signal method	□ Base station simulator ■ Internal test code

3. TEST CONDITIONS

3.1 Ambient Conditions

Ambient Temperature (˚C)	(20 ~ 21)
Tissue simulating liquid temperature (˚C)	(20 ~ 21)
Humidity (% R.H.)	(49 ~ 51)

3.2 RF Characteristics of The Test Site

This measurement were performed in a fully enclosed RF Shielded environment

3.3 Test Signal, Frequencies, And Output Power

The Mobile Computer was placed into simulated call mode

In all operation bands the measurements were performed on lowest, middle and highest channels.

The Mobile Computer was placed into simulated call mode was set to maximum power level during the all tests and at the beginning of the each test the battery was fully charged.

DASY4 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement. These records were used to monitor stability of power output.

Fig. 4.1 SAR Measurement System

4. DESCRIPTION OF THE TEST EQUIPMENT

An SAR measurement system usually consists of a small diameter isotropic electric field probe, a multiple axis probe positioning system, a test device holder, one or more phantom models, the field probe instrumentation, a computer and other electronic equipment for controlling the probe and making the measurements. Other supporting equipment, such as a network analyzer, power meters and RF signal generators, are also required to measure the dielectric parameters of the simulated tissue media and to verify the measurement accuracy of the SAR system.

4.1 Test System Specifications

Test Equipment	Model	Serial Number	Cal. Date
DAE	DAE4	551	2021-01-24
E-Field Probe	ES3DV3	3123	2021-01-29
Dipole Antenna	D750V3	1162	2020-07-24
	D835V2	475	2020-11-14
	D900V2	1d023	2020-11-14
	D1750V2	1151	2020-07-20
	D1800V2	2d059	2020-11-19
	D1900V2	5d058	2020-11-14
Network analyzer	8753ES	MY40000609	2020-12-03
Signal generator	SMBV100A	256663	2020-12-03
RF Power meter	EPM-442A	GB37170412	2020-12-02
Power Sensor	8481A	3318A96476	2020-12-02
Power Sensor	8481A	2702A59566	2020-12-02
Dielectric Probe	85070D	US01440154	-
Power Amplifier	BBS3Q7ECK	1026	2020-12-02
Power Amplifier	BBS3K8CEM	1002	2020-12-02
LP Filter 1.5GHz	LA-15N	0302	2020-12-02
LP Filter 3.0GHz	LA-30N	0301	2020-12-02
LP Filter 6.0GHz	LA-60N	40059	2020-12-02
Attenuator	50FH-010-5	74868	2020-12-02
Attenuator	8491B	21828	2020-12-02
Dual Directional Coupler	772D	3736A22424	2020-12-02
Dual Directional Coupler	778D	17575	2020-12-02
Wireless Communications Test Set	E5515C	GB42230119	2020-12-03
Wideband radio Communication Tester	CMW500	137216	2020-12-03

4.2 SAR Measurement Setup

Measurement are performed using the DASY4 dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG(SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium IV computer, near-field probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field(EMF) (see Fig. 5.1) A cell controller system contains the power supply, robot controller, teach pendant(Joystick), and a remote control used to drive the robot motors. The pc consists of the Intel Pentium IV 2.4 GHz computer with WindowsXP system and SAR measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.

Is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

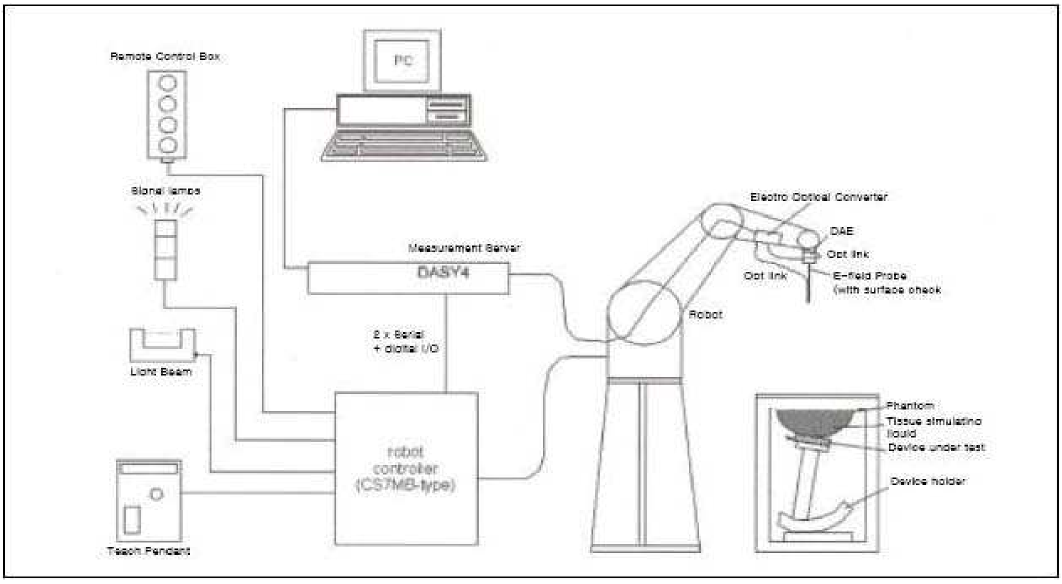


Fig. 4.1 SAR Measurement System Setup

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gainswitching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the Ethernet Card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

4.3 DASY4 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration (see Fig.5.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box in the robot arm and provides an automatic detection transmitter, the other half to a synchronized receiver.

As the probe approach the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches coupling is zero. The distance of the coupling maximum to the surface is probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2^{nd} order fitting (see Fig. 5.2). The approach is stopped at reaching the maximum.

Isotropic E-Field Probe

Isotropic E-Field Probe for Dosimetric Measurements	
Construction	Symmetrical design with triangular core Interleafed sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycol)
Calibration	In air from 10 MHz to 3 GHz In brain and muscle simulating tissue at frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy ± 8%) Calibration for other liquids and frequencies upon request
Frequency	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.3 dB in brain tissue (rotation normal to probe axis)
Dynamic Range	5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 20 mm Body diameter: 12 mm Tip diameter: 3.9 mm Distance from probe tip to dipole centers: 2.7 mm

Fig. 4.2 Probe Specifications

4.4 Phantom & Equivalent Tissues

SAM Phantom

The SAM Twin Phantom V4.0 is constructed of the fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Head & Muscle simulation Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydroxethlcellullose(HEC) gelling agent and saline solution (see Fig 5.3). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been specified in IEEE1528(2013) are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulation liquids are according to the data by C. Gabriel and G. Hartagrove. (see Fig. 5.3)

Frequency	Head		Body	
(MHz)	εr	σ (S/m)	εr	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.9	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

Fig.4.3 Head and body tissue parameters by the IEEE SCC-34/SC-2 in P1528

Ingredients (% by weight)								
	750		835		900		1 900	
Tissue Type	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**
Water	41.2	51.7	41.45	52.4	41.05	56.0	54.9	40.4
Salt(NaCl)	1.4	1.0	1.45	1.4	1.35	0.76	0.18	0.5
Sugar	57	47.2	56.0	45.0	56.5	41.76	0.0	58.0
HEC	0.2	0.0	1.0	1.0	1.0	1.21	0.0	1.0
Bactericide	0.2	0.1	0.1	0.1	0.1	0.27	0.0	0.1
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0

Salt:	99 % Pure Sodium Chloride
Water:	De-ionized, 16 M resistivity
DGBE:	99 % Di(ethylene glycol) butyl ether, 〔2-(2-butoxyethoxy) ethanol〕
Triton X-100 (ultra pure):	Polyethylene glycol mono 〔4-(1,1,3,3-tetramethylbutyl)pheny〕 ether
Sugar:	98 % Pure Sucrose
HEC:	Hydroxyethyl Cellulose

Fig. 4.4 Composition of the Tissue Equivalent Matter

Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device enables the rotation of the accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Note : A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

4.5 Transmitting antenna information

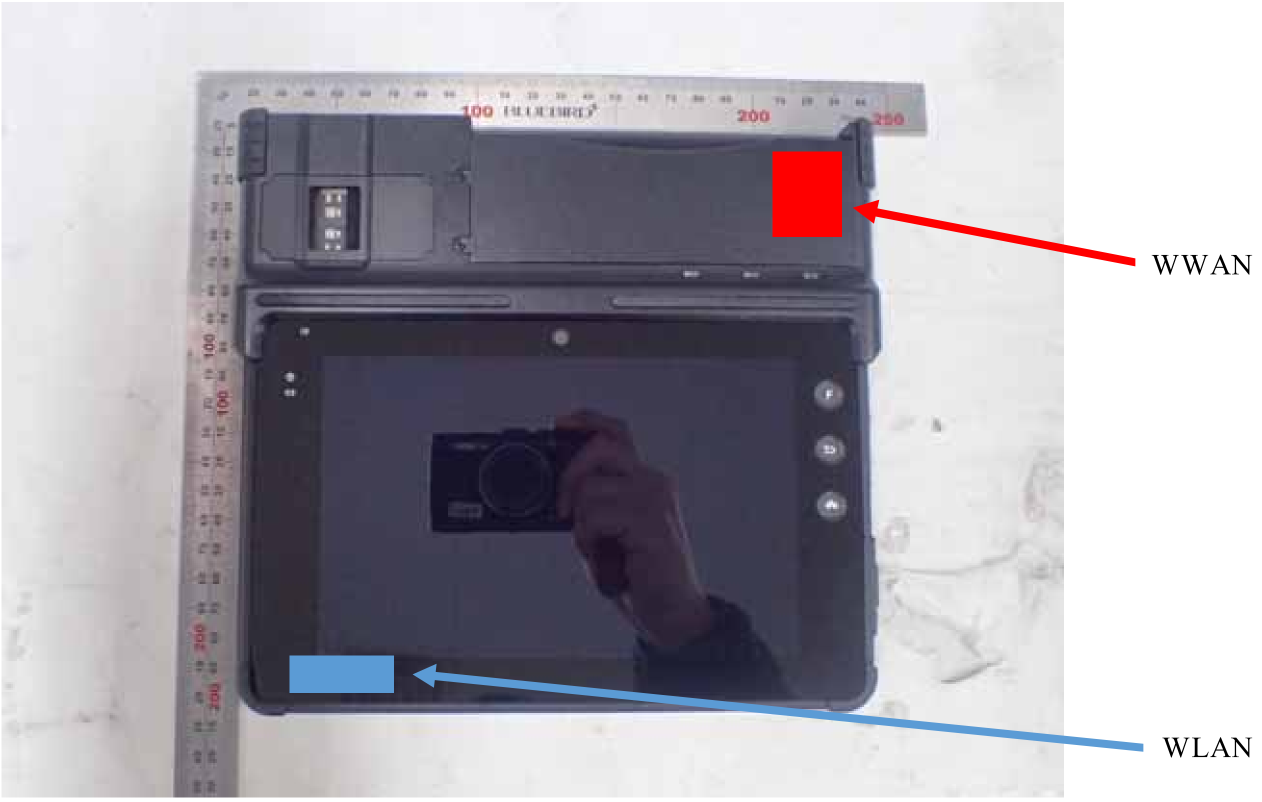


Fig. 4.5 Antenna information

ANTENNA	Front	Rear	Left Edge	Right Edge	Top Edge	Bottom Edge
3G LTE	YES	YES	NO	YES	YES	NO

Note: According to KDB941225 antenna-to-edge>2.5cm, SAR is not required.

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Definition of Reference Point

5.1.1 EAR Reference point

The point "M" is the reference point for the center of the mouth, "ERP" is the ear reference point. The ERP are 15mm posterior to the entrance to the ear canal(EEC) along the B-M line (Back-Mouth), as shown is figure 6.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the ERP is called the Reference Pivoting Line (see Figure 6.1) B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

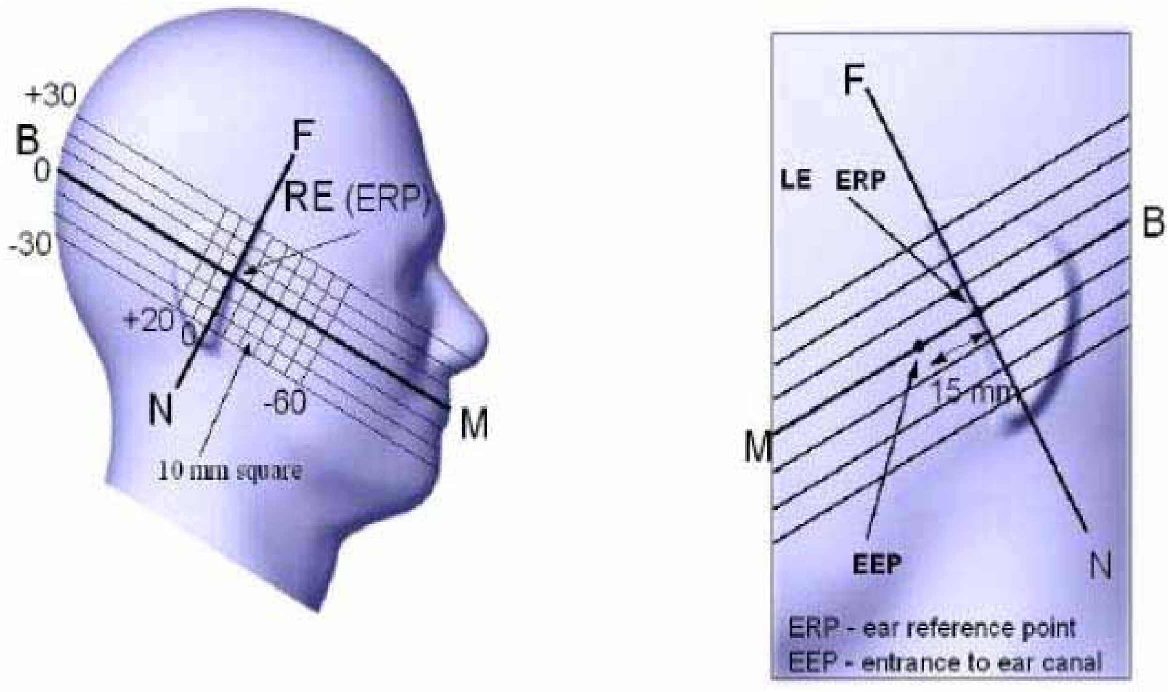


Figure 5.1 Close-up side view of ERP

5.1.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (see Fig. 6.2). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

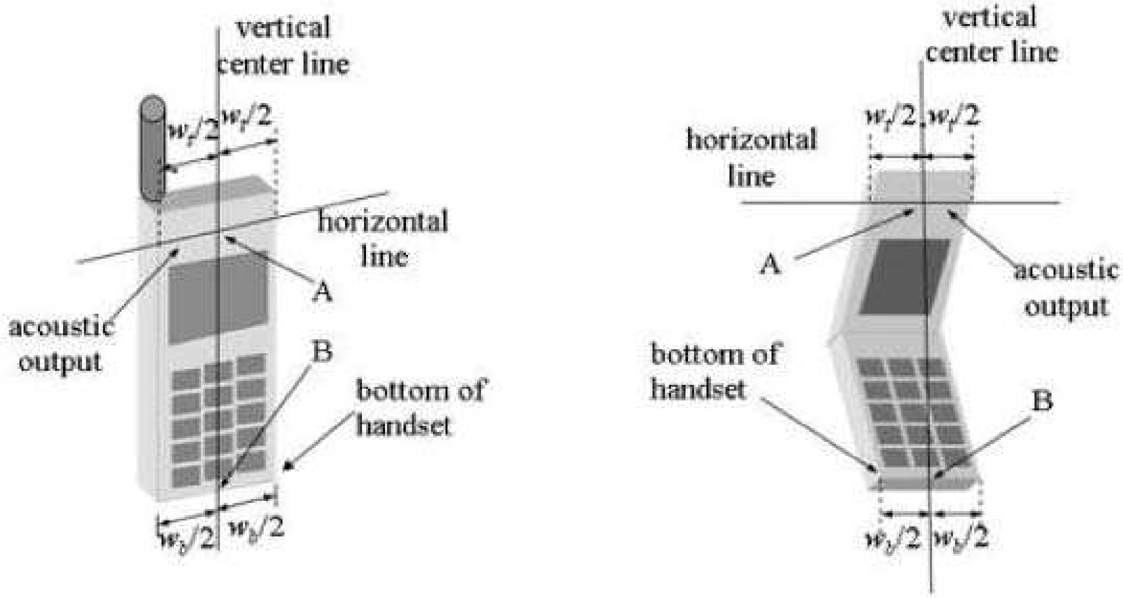


Figure 5.2 Handset Vertical Center & Horizontal Line Reference Points

5.2 Test Configuration Positions

Positioning for Cheek/Touch

1) Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover . (If the phone can also be used with the cover closed both configurations must be tested.)

2) Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width wt of the handset at the level of the acoustic output (point A on Figures 6.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 6.2). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not ecessarily parallel to the front face of the handset (see Figure 6.2), especially for clamshell handsets, handsets with lip pieces, and other irregularly- shaped handsets.

3) Position the handset close to the surface of the phantom touch that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.3), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

4) Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.

5) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).

6) Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.

7) While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point

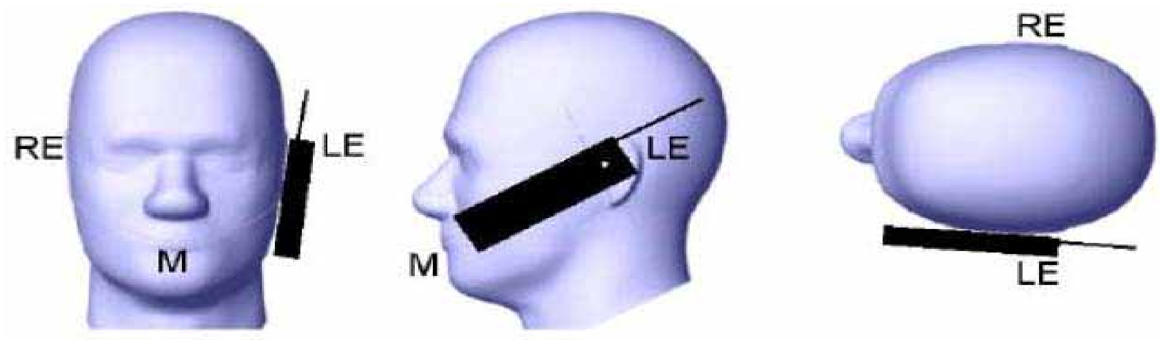


Figure 5.3 "Cheek" or "Touch" Position.

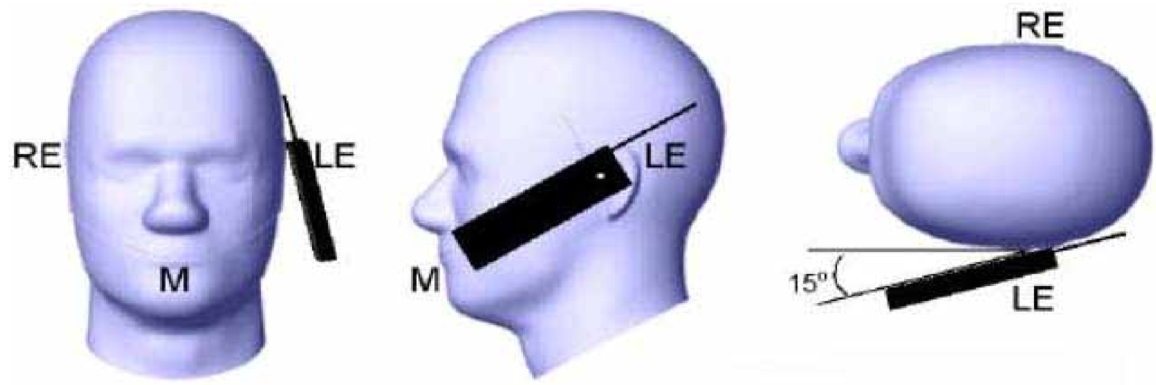


Figure 5.3 "Tilted" Position.

Positioning for Ear / 15° Tilted

1) Repeat steps 1 to 7 of 6.2(Positioning for Cheek/Touch) to place the device in the "cheek position."
2) While maintaining the orientation of the phone retract the phone parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
3) Rotate the phone around the horizontal line by 15 degree.
4) While maintaining the orientation of the phone, move the phone parallel to the reference plane until any part of the phone touches the head. (In this position, point A will be located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the phone shall be reduced. The tilted position is obtained if any part of the phone is in contact of the ear as well as a second part of the phone is contact with the head.

Body Holder / Belt Clip Configurations

Body-worn operation configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used. Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are supplied with the device, the device is tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested. Body-worn accessories may not always be supplied of available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distance between the back of the device and the flat phantom is used. All test position spacings are documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration. In all case SAR measurements are performed to investigate the worst case positioning. Worst-case positioning is then documented and used to perform Body SAR testing. In order for users to be aware of the body-worn operation requirements for meeting RF exposure compliance, operation instructing instructions and cautions statements are included in the user's manual.

5.3 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Nest cube scan, 5x5x7 points; spacing between each point 5x5x5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

5.4 SAR Averaging Methods

The maximum SAR value is averaged over its volume using interpolation and extrapolation. The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a Knot" ?condition [W.Gander, Computerma-thematik, p. 141-150](x, y and z directions) [Numerical Recipes in C, Second Edition, p 123]. The extrapolation is based on least square algorithm [W.Gander, Computermathematik, p.168-180]. Through the points in the first 30 mm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points calculated from the surface, have a distance of 1mm from one another.

6. MEASUREMENT UNCERTAINTY

According to CENELEC [17], typical worst-case uncertainty of field measurements is 5 dB. For well-defined modulation characteristics the uncertainty can be reduced to 3 dB.

ERROR Description	Uncertainty value ±%	Probability Distribution	Divisor	ci 1 10g	Standard unc. (10g)	vi or Veff
MEASUREMENT SYSTEM						
Probe Calibration	± 6.0	normal	1	1	± 6.00%	∞
Axial Isotropy	± 4.7	rectangular	√3	$(1\text{-cp})^{1/2}$	± 2.71%	∞
Spherical Isotropy	± 9.6	rectangular	√3	$(\text{cp})^{1/2}$	± 3.90%	∞
Boundary Effects	± 1.0	rectangular	√3	1	± 0.58%	∞
Probe Linearity	± 4.7	rectangular	√3	1	± 2.71%	∞
Modulation Response	± 3.5	rectangular	√3	1	± 2.00%	∞
System Detection Limits	± 1.0	rectangular	√3	1	± 0.58%	∞
Readout Electronics	± 0.3	normal	1	1	± 0.30%	∞
Response time	± 0.8	rectangular	√3	1	± 0.46%	∞
Integration time	± 2.6	rectangular	√3	1	± 1.50%	∞
RF Amnient Conditions	± 3.0	rectangular	√3	1	± 1.73%	∞
Probe Positioner Mechanical Tolerance	± 0.4	rectangular	√3	1	± 0.23%	∞
Probe Positioning with respect to Phantom Shell	± 2.9	rectangular	√3	1	± 1.67%	∞
Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation	± 1.0	rectangular	√3	1	± 0.58%	∞
Test Sample Related						
Test Sample Positioning	± 2.09	normal	1	1	± 2.09%	M-1
Device Holder Uncertainty	± 3.60	normal	1	1	± 3.60%	M-1
Output Power Validation – SAR drift measurement	± 5.0	rectangular	√3	1	± 2.89%	∞
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	± 4.0	rectangular	√3	1	± 2.31%	∞
SAR Correction	± 5.0	normal	1	1	± 5.0%	∞
Liquid Conductivity – measurement uncertainty	± 2.5	normal	1	0.43	± 1.24%	M
Liquid Conductivity – temperature uncertainty	± 5.0	rectangular	√3	0.43	± 1.08%	∞
Liquid Permittivity – measurement uncertainty	± 2.5	normal	1	0.49	± 1.23%	M
Liquid Permittivity – temperature uncertainty	± 5.0	rectangular	√3	0.49	± 1.49%	∞
Combined Standard Uncertainty					±11.37 %	330
Coverage Factor for 95%				*K = 2*		
Expanded Standard Uncertainty					± 22.73 %	

Tissue Verification

7.1 Simulated Tissue Verification

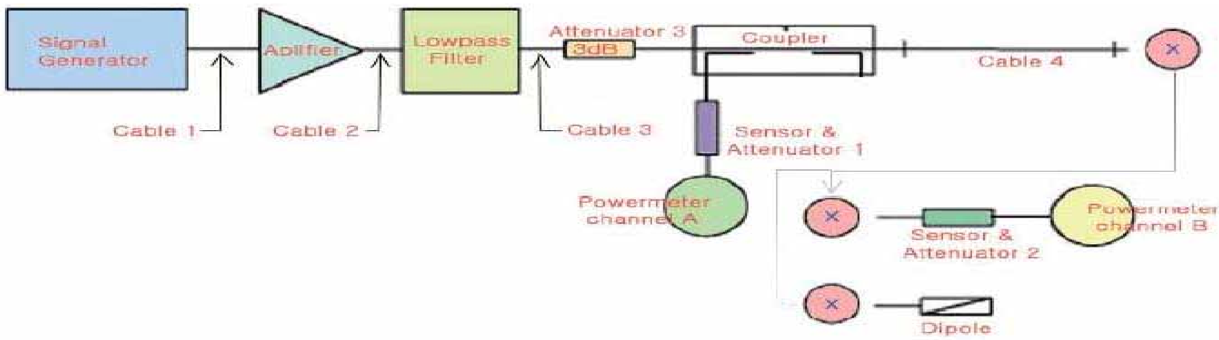
MEASURED TISSUE PARAMETERS								
DATE	Tissue Type	Freq (MHz)	Measured		TARGET		% Dev σ	% Dev ε
			Conductivity, σ (S/m)	Dielectric Constant, ε	Conductivity, σ (S/m)	Dielectric Constant, ε		
2020/3/10	BODY	826.4	0.934	55.60	0.93	55.60	0.00	0.00
		836.6	0.944	55.50	0.94	55.50	0.00	0.00
		846.6	0.955	55.50	0.95	55.50	0.10	0.00
2020/3/10		826.5	0.934	55.60	0.93	55.60	0.00	0.00
		836.5	0.970	55.20	0.94	55.50	2.75	-0.54
		846.5	0.954	55.50	0.95	55.50	0.00	0.00
2020/3/11								
		782.0	0.970	55.33	1.00	55.80	-3.00	-0.84
2020/3/12		1712.4	1.460	53.68	1.42	52.80	2.82	1.67
		1732.6	1.480	53.65	1.44	52.70	2.78	1.80
		1752.6	1.490	53.63	1.45	52.60	2.76	1.96
2020/3/12		1711.5	1.460	53.68	1.42	52.80	2.82	1.67
		1732.5	1.480	53.65	1.44	52.70	2.78	1.80
		1753.5	1.490	53.63	1.45	52.60	2.76	1.96
2020/3/13		1852.4	1.520	53.30	1.49	51.50	2.01	3.50
		1880.0	1.520	53.30	1.53	51.40	-0.65	3.70
		1907.6	1.520	53.30	1.55	51.40	-1.94	3.70
2020/3/13		1855.0	1.520	53.30	1.50	51.50	1.33	3.50
		1880.0	1.520	53.30	1.53	51.40	-0.65	3.70
		1905.0	1.520	53.30	1.55	51.40	-1.94	3.70

7. SYSTEM VERIFICATION

Table 7.2 System Validation

SYSTEM DIPOLE VALIDATION TARGET & MEASURED						
Tissue	**System Validation Kit:**	**Forward Power (W)**	**Targeted SAR 1g (mW/g)**	**Measured SAR 1g (mW/g)**	**Deviation (%)**	**Test Date**
750 MHz BODY	D750V3(S/N:1162)	1.0	8.55	8.76	2.46	2020-03-11
835 MHz BODY	D835V2(S/N:475)	1.0	9.58	9.92	3.55	2020-03-10
1 750 MHz BODY	D1750V2(S/N:1151)	1.0	36.40	37.60	3.30	2020-03-12
1 900 MHz BODY	D1900V2(S/N:5d058)	1.0	39.90	37.36	-6.37	2020-03-13

SYSTEM DIPOLE VALIDATION TARGET & MEASURED						
Tissue	**System Validation Kit:**	**Forward Power (W)**	**Targeted SAR 10g (mW/g)**	**Measured SAR 10g (mW/g)**	**Deviation (%)**	**Test Date**
750 MHz BODY	D750V3(S/N:1162)	1.0	5.64	5.48	-2.84	2020-03-11
835 MHz BODY	D835V2(S/N:475)	1.0	6.29	6.36	1.11	2020-03-10
1 750 MHz BODY	D1750V2(S/N:1151)	1.0	19.30	20.36	5.49	2020-03-12
1 900 MHz BODY	D1900V2(S/N:5d058)	1.0	21.00	19.72	-6.10	2020-03-13



8. RESULTS

Mode	Body/EUT Position	Freq (MHz)	Ch	Power (dBm)	Power Drift (dB)	10g SAR (W/Kg)	Dist (mm)	scaling Factor	Scaled SAR (mW/g)
IEEE STD 1528-2013-SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								4.0 W/kg (W/kg) averaged over 10 gram	
WCDMA BAND2	FRONT	1880.0	9400	23.73	-0.132	0.279	0	1.064	0.297
	REAR				-0.042	2.300	0	1.064	2.448
	RIGHT				-0.011	0.505	0	1.064	0.537
	TOP				0.156	0.272	0	1.064	0.289
	REAR	1852.4	9262	23.86	-0.159	2.370	0	1.033	2.448
	REAR	1907.6	9538	23.85	-0.083	2.300	0	1.035	2.381
WCDMA BAND4	FRONT	1732.6	1413	23.50	-0.095	0.536	0	1.122	0.601
	REAR				0.071	1.740	0	1.122	1.952
	RIGHT				0.017	0.576	0	1.122	0.646
	TOP				0.040	0.244	0	1.122	0.274
	REAR	1712.4	1312	23.54	0.117	2.190	0	1.112	2.435
	REAR	1752.6	1513	23.46	0.038	2.050	0	1.132	2.321
WCDMA BAND5	FRONT	836.6	4183	23.26	-0.126	0.266	0	1.186	0.315
	REAR				-0.002	0.895	0	1.186	1.061
	RIGHT				0.057	0.283	0	1.186	0.336
	TOP				-0.058	0.119	0	1.186	0.141
	REAR	826.4	4132	23.29	-0.105	0.992	0	1.178	1.168
	REAR	846.6	4233	23.36	-0.105	0.910	0	1.159	1.054
LTE FDD2	FRONT	1880.0	18900	23.78	-0.121	0.234	0	1.052	0.246
	REAR				-0.229	2.290	0	1.052	2.409
	RIGHT				-0.035	0.514	0	1.052	0.541
	TOP				0.281	0.232	0	1.052	0.244
	REAR	1855.0	18650	23.44	-0.190	2.210	0	1.138	2.514
	REAR	1905.0	19150	23.02	0.017	2.170	0	1.253	**2.719**
LTE FDD4	FRONT	1732.5	20175	23.71	0.147	0.121	0	1.069	0.129
	REAR				-0.161	2.280	0	1.069	2.437
	RIGHT				-0.081	0.217	0	1.069	0.232
	TOP				0.083	0.120	0	1.069	0.128
	REAR	1711.5	19965	23.43	-0.176	2.100	0	1.140	2.395
	REAR	1753.5	20385	23.88	-0.026	2.090	0	1.028	2.149
LTE FDD5	FRONT	836.5	20525	24.07	-0.246	0.301	0	0.984	0.296
	REAR				-0.008	1.060	0	0.984	1.043
	RIGHT				-0.045	0.334	0	0.984	0.329
	TOP				-0.139	0.115	0	0.984	0.113
	REAR	826.5	20425	24.01	0.001	1.030	0	0.998	1.028
	REAR	846.5	20625	24.12	0.056	1.000	0	0.973	0.973
LTE FDD13	FRONT	782.0	23230	23.92	-0.051	0.270	0	1.019	0.275
	REAR				0.092	1.250	0	1.019	1.273
	RIGHT				-0.190	0.130	0	1.019	0.132
	TOP				0.034	0.167	0	1.019	0.170

8.1 Estimated SAR Calculation

According to KDB 447498 D01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of <= 0.4 W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(mW)}}{\text{Min. Test Separation Distance}_{(mm)}} \times \frac{\sqrt{f_{(GHz)}}}{7.5}$$

If the minimum test separation distance is < 5 mm, a distance of 5 mm is used for estimated SAR calculation. When the test separation distance is > 50 mm, the 0.4 W/kg is used for SAR-1g.

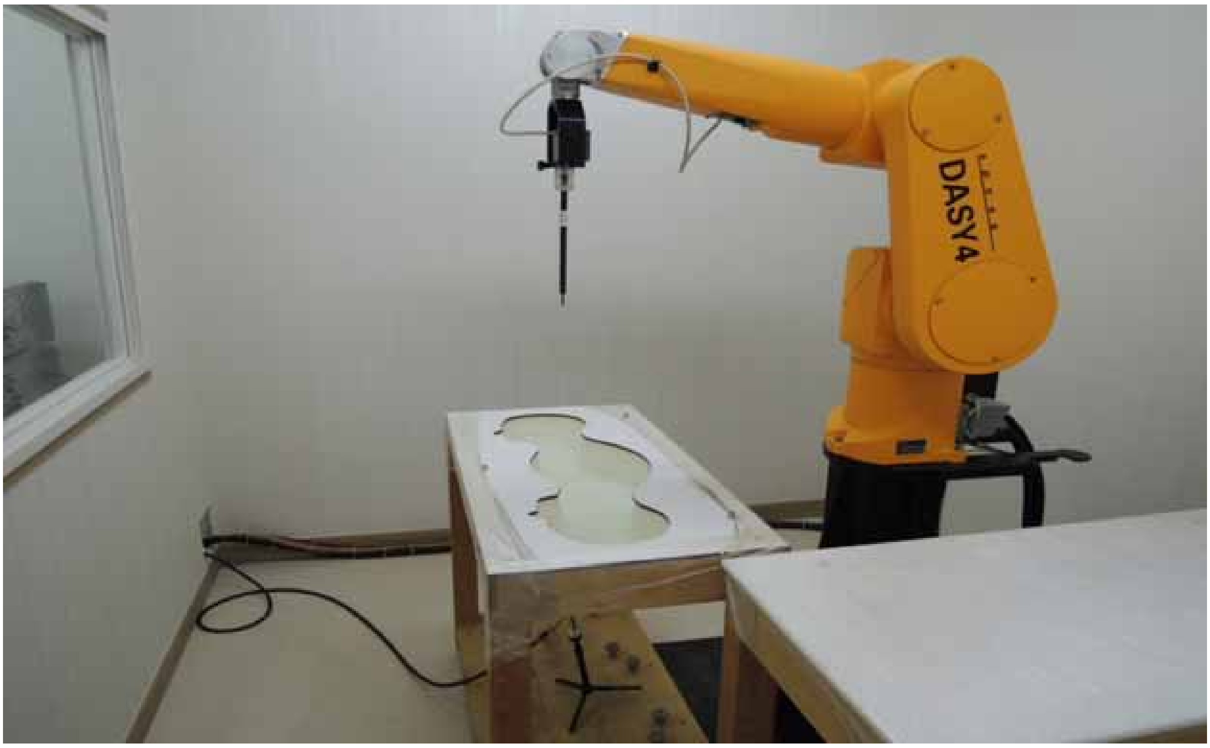
MODE	Frequency (MHz)	Maximum Allowed Power (mW)	Separation Distance (mm)	≤ 3.0	≤ 7.5
				1g SAR	10g SAR
BDR	2402	1.20	5	0.19	
		1.20	10	0.10	
		1.20	5		0.04

MODE	Frequency (MHz)	Maximum Allowed Power (mW)	Separation Distance (mm)	≤ 3.0	≤ 7.5
				1g SAR	10g SAR
2.4 GHz 802.11b	2462	0.63	5	0.10	
		0.63	10	0.05	
		0.63	5		0.04

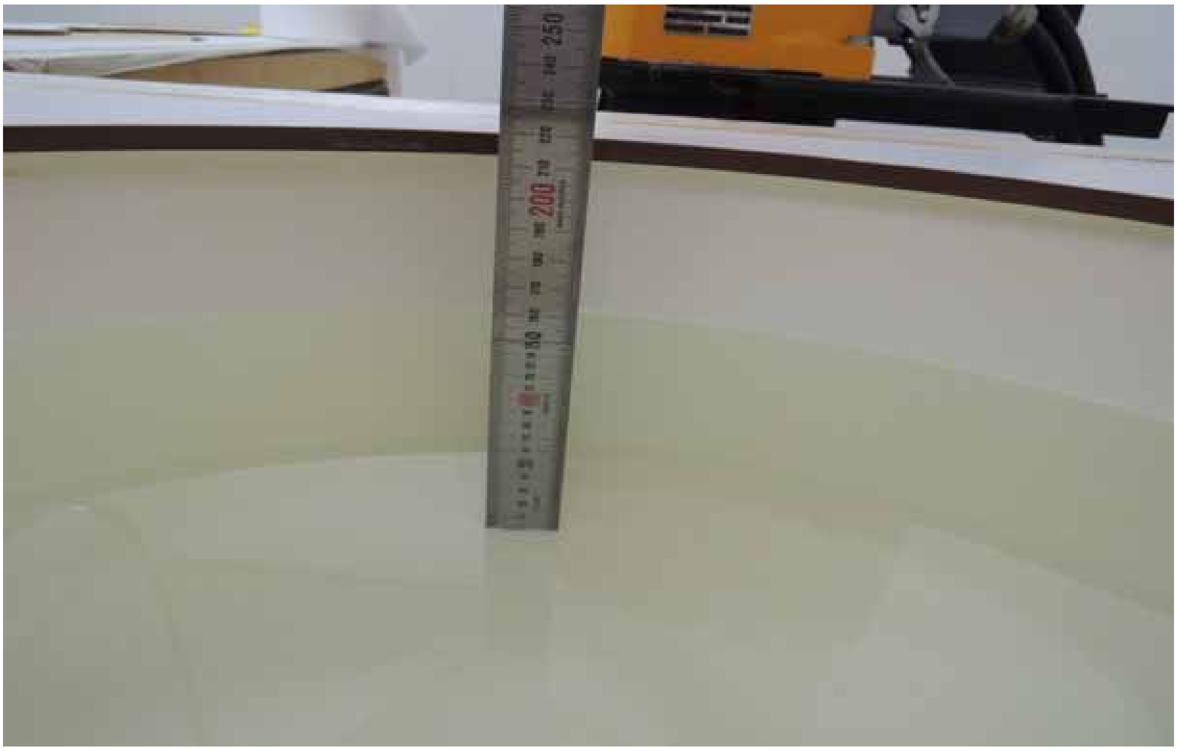
MODE	Frequency (MHz)	Maximum Allowed Power (mW)	Separation Distance (mm)	≤ 3.0	≤ 7.5
				1g SAR	10g SAR
5 GHz WLAN BAND1	5180	0.63	5	0.10	
		0.63	10	0.05	
		0.63	5		0.02
5 GHz WLAN BAND4	5745	0.63	5	0.10	
		0.63	10	0.05	
		0.63	5		0.04

APPENDIX A : Validation Test Data

Dipole Validation



Liquid depth



Date: 2020-03-11

Test Laboratory: ESTECH

VALIDATION 750

DUT: Dipole 750 MHz; Type: D750V2; Serial: D750V2 - SN:xxx

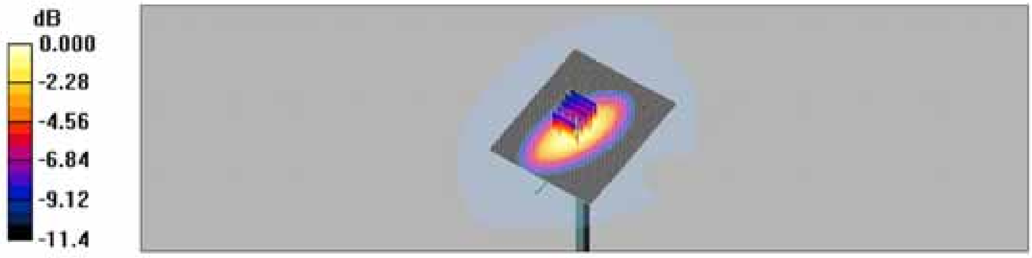
Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 750 MHz; σ = 0.992 mho/m; ε_r = 56; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.17, 6.17, 6.17); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (81x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.43 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.1 V/m; Power Drift = -0.164 dB
Peak SAR (extrapolated) = 3.51 W/kg
SAR(1 g) = 2.19 mW/g; SAR(10 g) = 1.37 mW/g
Maximum value of SAR (measured) = 2.55 mW/g



0 dB = 2.55mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

VALIDATION 835

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:xxx

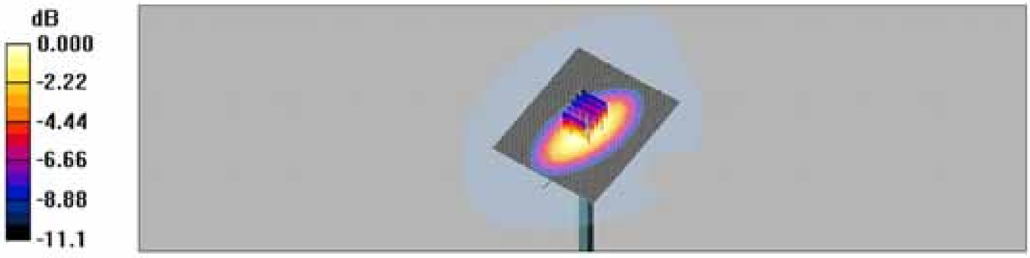
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 835 MHz; σ = 0.942 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (81x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.95 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.4 V/m; Power Drift = -0.061 dB
Peak SAR (extrapolated) = 3.47 W/kg
SAR(1 g) = 2.48 mW/g; SAR(10 g) = 1.59 mW/g
Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

VALIDATION 1750

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: Not Specified

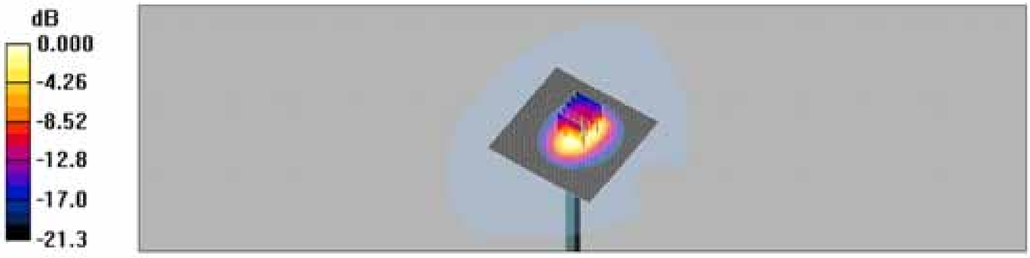
Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1750 MHz; σ = 1.45 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 11.6 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 88.5 V/m; Power Drift = -0.191 dB
Peak SAR (extrapolated) = 18.7 W/kg
SAR(1 g) = 9.4 mW/g; SAR(10 g) = 5.09 mW/g
Maximum value of SAR (measured) = 10.9 mW/g



0 dB = 10.9mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

VALIDATION 1900

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:xxx

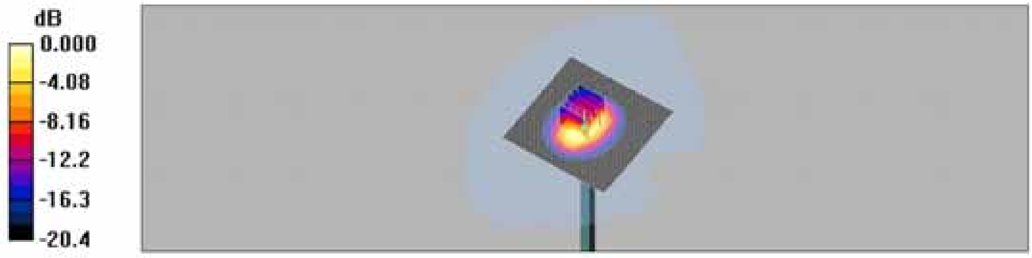
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.32 mho/m; ε_r = 41.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.12, 5.12, 5.12); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 12.0 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 96.9 V/m; Power Drift = -0.032 dB
Peak SAR (extrapolated) = 16.6 W/kg
SAR(1 g) = 9.34 mW/g; SAR(10 g) = 4.93 mW/g
Maximum value of SAR (measured) = 11.2 mW/g



0 dB = 11.2mW/g

APPENDIX B : SAR Test Data

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

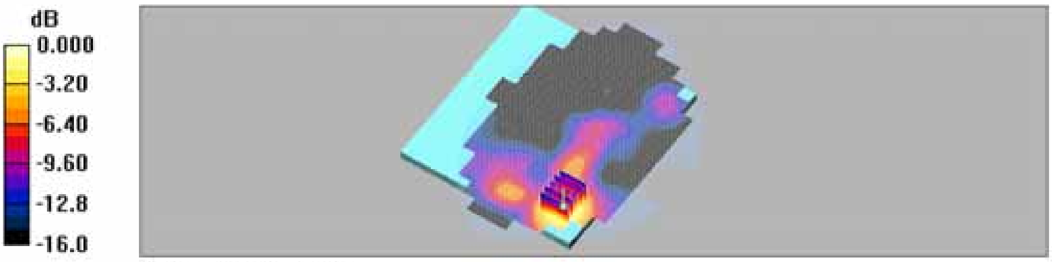
Communication System: WCDMA2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.529 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.10 V/m; Power Drift = -0.132 dB
Peak SAR (extrapolated) = 0.688 W/kg
SAR(1 g) = 0.449 mW/g; SAR(10 g) = 0.279 mW/g
Maximum value of SAR (measured) = 0.529 mW/g



0 dB = 0.529mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

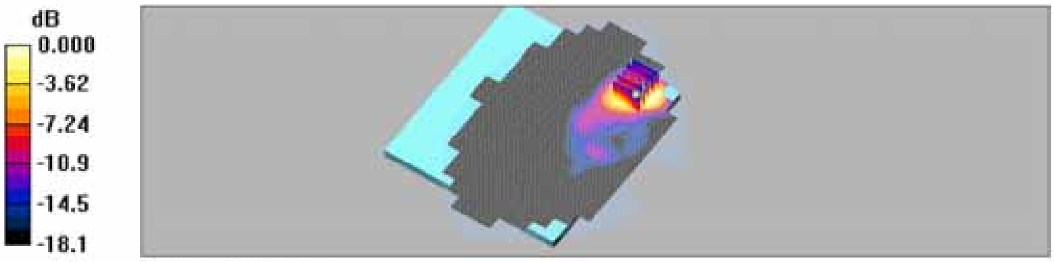
Communication System: WCDMA2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.48 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.22 V/m; Power Drift = -0.042 dB
Peak SAR (extrapolated) = 7.24 W/kg
SAR(1 g) = 4.09 mW/g; SAR(10 g) = 2.3 mW/g
Maximum value of SAR (measured) = 4.77 mW/g



0 dB = 4.77mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

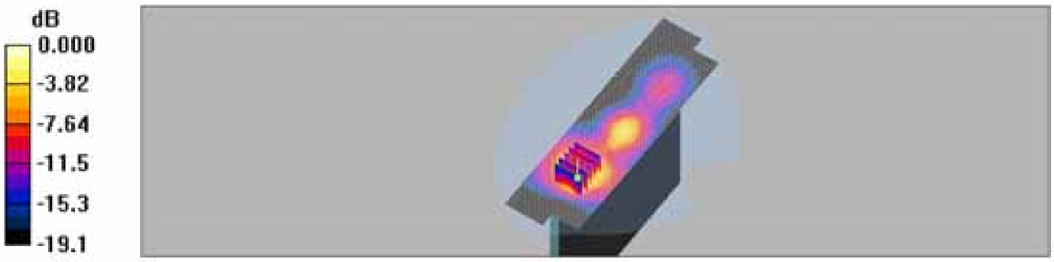
Communication System: WCDMA2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.05 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.8 V/m; Power Drift = -0.011 dB
Peak SAR (extrapolated) = 1.58 W/kg
SAR(1 g) = 0.936 mW/g; SAR(10 g) = 0.505 mW/g
Maximum value of SAR (measured) = 1.18 mW/g



0 dB = 1.18mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

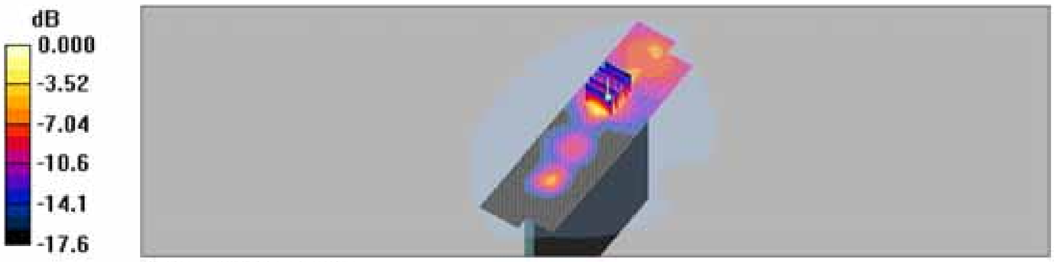
Communication System: WCDMA2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.680 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.83 V/m; Power Drift = 0.156 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.536 mW/g; SAR(10 g) = 0.272 mW/g
Maximum value of SAR (measured) = 0.697 mW/g



0 dB = 0.697mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

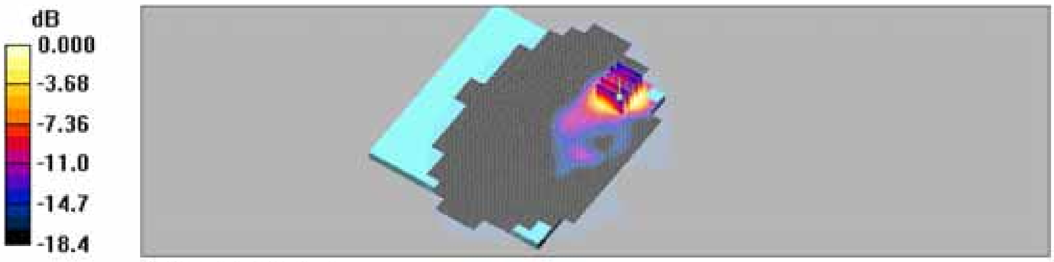
Communication System: WCDMA2; Frequency: 1852.4 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1852.4 MHz; σ = 1.49 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.55 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.97 V/m; Power Drift = -0.159 dB
Peak SAR (extrapolated) = 7.57 W/kg
SAR(1 g) = 4.23 mW/g; SAR(10 g) = 2.37 mW/g
Maximum value of SAR (measured) = 5.05 mW/g



0 dB = 5.05mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO WCDMA2 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

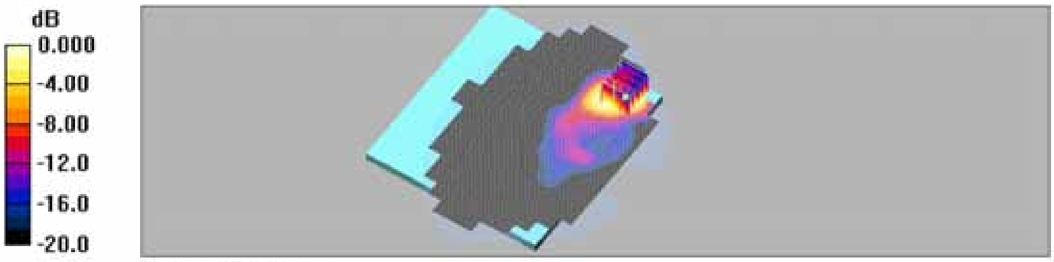
Communication System: WCDMA2; Frequency: 1907.6 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1908 MHz; σ = 1.55 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.56 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.55 V/m; Power Drift = -0.083 dB
Peak SAR (extrapolated) = 7.11 W/kg
SAR(1 g) = 4.06 mW/g; SAR(10 g) = 2.3 mW/g
Maximum value of SAR (measured) = 4.74 mW/g



0 dB = 4.74mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

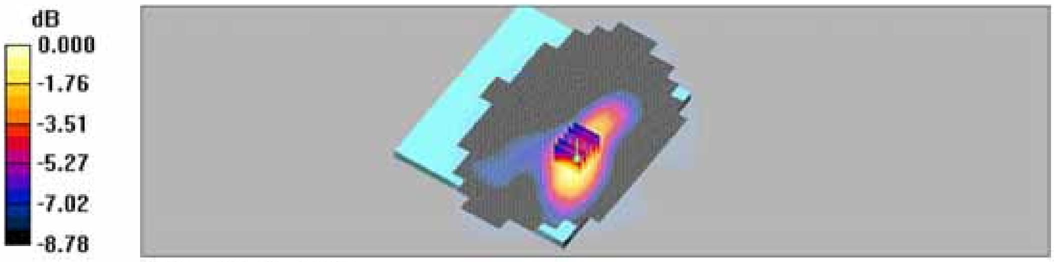
Communication System: WCDMA4; Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.6 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.793 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.9 V/m; Power Drift = -0.095 dB
Peak SAR (extrapolated) = 0.919 W/kg
SAR(1 g) = 0.726 mW/g; SAR(10 g) = 0.536 mW/g
Maximum value of SAR (measured) = 0.803 mW/g



0 dB = 0.803mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

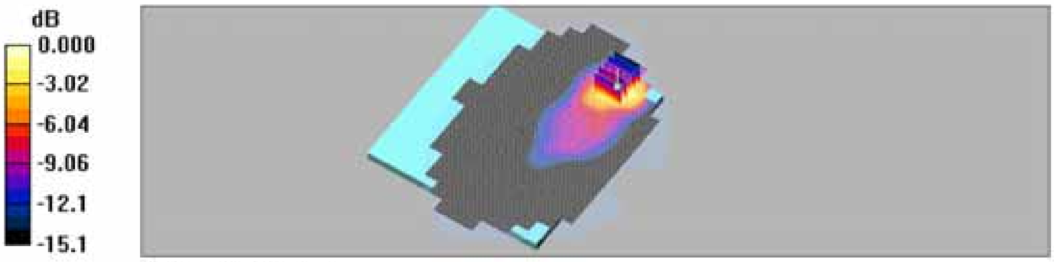
Communication System: WCDMA4; Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.6 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 3.68 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.6 V/m; Power Drift = 0.071 dB
Peak SAR (extrapolated) = 5.67 W/kg
SAR(1 g) = 3.14 mW/g; SAR(10 g) = 1.74 mW/g
Maximum value of SAR (measured) = 4.07 mW/g



0 dB = 4.07mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

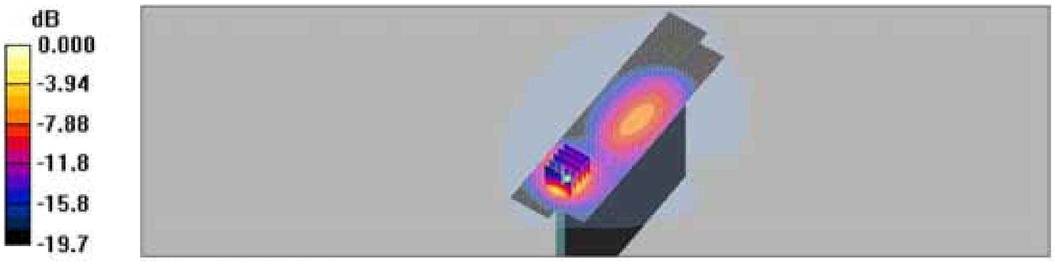
Communication System: WCDMA4; Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.6 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.67 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.6 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 1.32 mW/g; SAR(10 g) = 0.576 mW/g
Maximum value of SAR (measured) = 1.97 mW/g



0 dB = 1.97mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

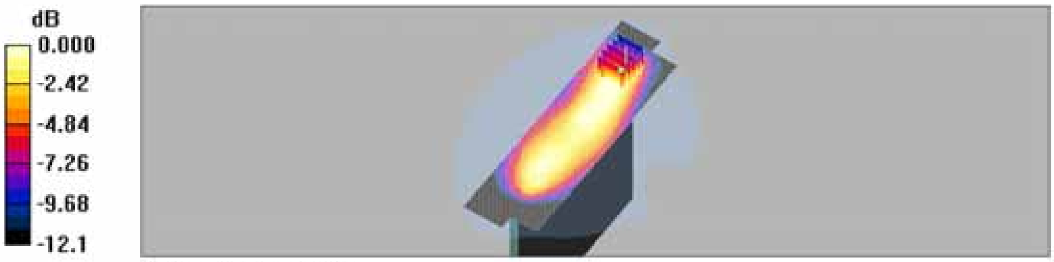
Communication System: WCDMA4; Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.6 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.451 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.0 V/m; Power Drift = 0.040 dB
Peak SAR (extrapolated) = 0.545 W/kg
SAR(1 g) = 0.352 mW/g; SAR(10 g) = 0.244 mW/g
Maximum value of SAR (measured) = 0.404 mW/g



0 dB = 0.404mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

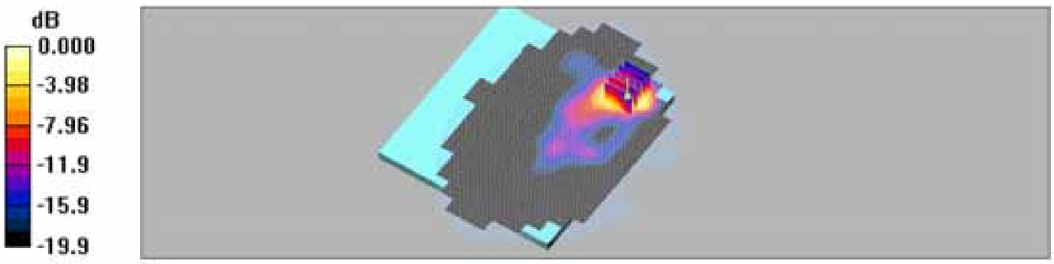
Communication System: WCDMA4; Frequency: 1712.4 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1712.5 MHz; σ = 1.42 mho/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.52 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.9 V/m; Power Drift = 0.117 dB
Peak SAR (extrapolated) = 7.84 W/kg
SAR(1 g) = 4.11 mW/g; SAR(10 g) = 2.19 mW/g
Maximum value of SAR (measured) = 5.20 mW/g



0 dB = 5.20mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO WCDMA4 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

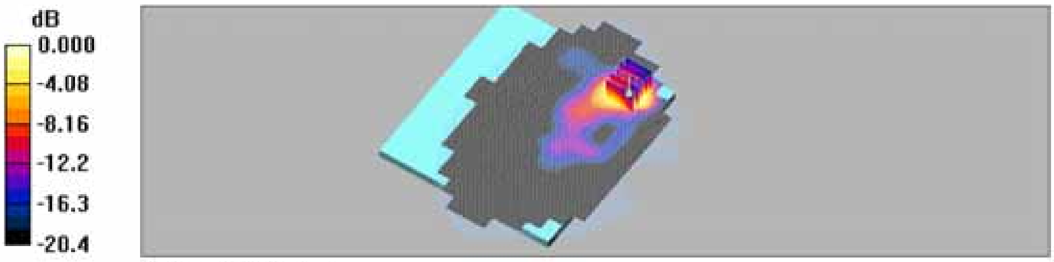
Communication System: WCDMA4; Frequency: 1752.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1752.6 MHz; σ = 1.45 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.07 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.8 V/m; Power Drift = 0.038 dB
Peak SAR (extrapolated) = 7.28 W/kg
SAR(1 g) = 3.85 mW/g; SAR(10 g) = 2.05 mW/g
Maximum value of SAR (measured) = 4.88 mW/g



0 dB = 4.88mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

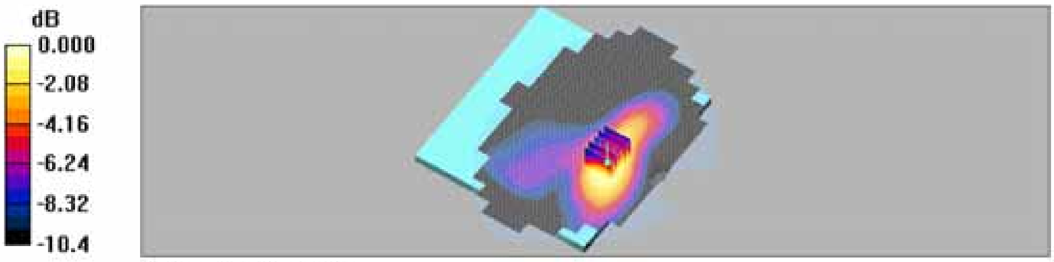
Communication System: WCDMA5; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.423 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.1 V/m; Power Drift = -0.126 dB
Peak SAR (extrapolated) = 0.504 W/kg
SAR(1 g) = 0.376 mW/g; SAR(10 g) = 0.266 mW/g
Maximum value of SAR (measured) = 0.424 mW/g



0 dB = 0.424mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

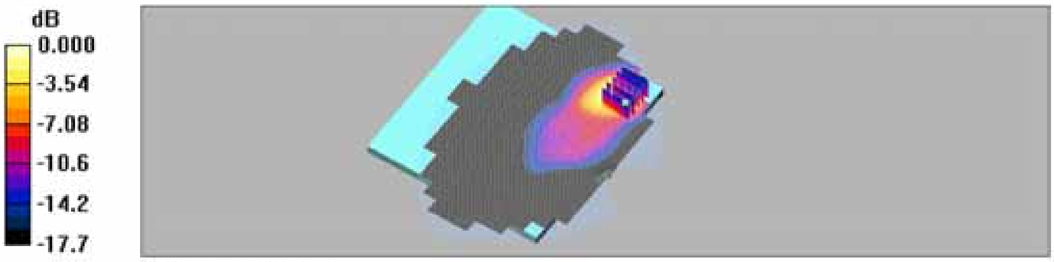
Communication System: WCDMA5; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.95 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.7 V/m; Power Drift = -0.002 dB
Peak SAR (extrapolated) = 4.11 W/kg
SAR(1 g) = 1.66 mW/g; SAR(10 g) = 0.895 mW/g
Maximum value of SAR (measured) = 2.42 mW/g



0 dB = 2.42mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

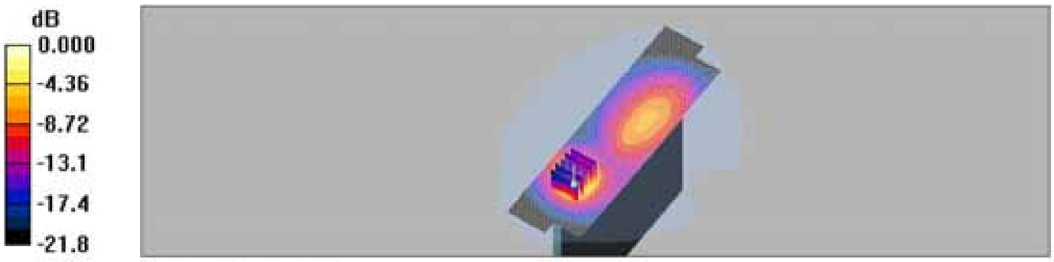
Communication System: WCDMA5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.724 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.2 V/m; Power Drift = 0.057 dB
Peak SAR (extrapolated) = 1.83 W/kg
SAR(1 g) = 0.665 mW/g; SAR(10 g) = 0.283 mW/g
Maximum value of SAR (measured) = 0.929 mW/g



0 dB = 0.929mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

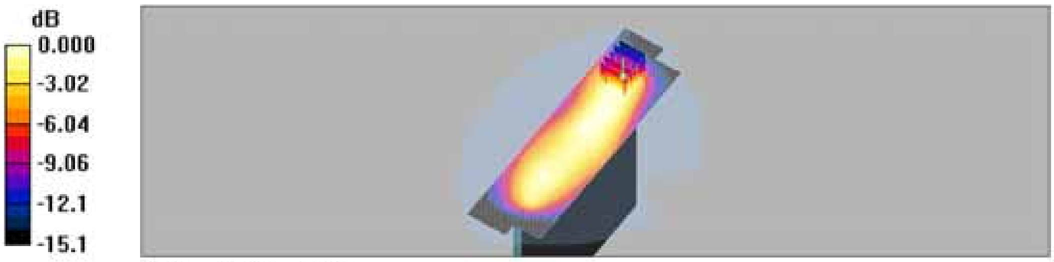
Communication System: WCDMA5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.259 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.3 V/m; Power Drift = -0.058 dB
Peak SAR (extrapolated) = 0.328 W/kg
SAR(1 g) = 0.190 mW/g; SAR(10 g) = 0.119 mW/g
Maximum value of SAR (measured) = 0.230 mW/g



0 dB = 0.230mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

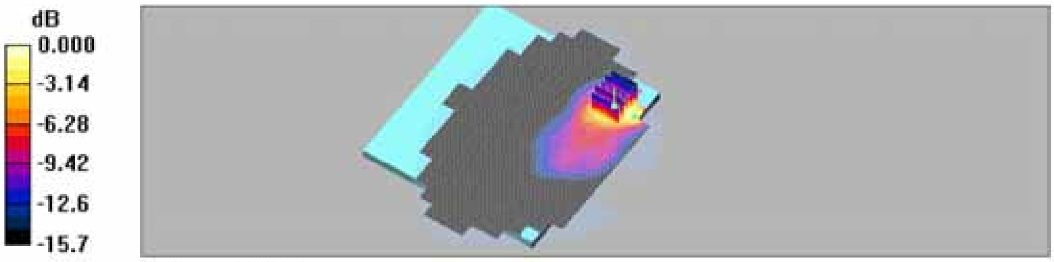
Communication System: WCDMA5; Frequency: 826.4 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 826.4 MHz; σ = 0.934 mho/m; ε_r = 55.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.41 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.1 V/m; Power Drift = -0.105 dB
Peak SAR (extrapolated) = 3.47 W/kg
SAR(1 g) = 1.82 mW/g; SAR(10 g) = 0.992 mW/g
Maximum value of SAR (measured) = 2.39 mW/g



0 dB = 2.39mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO WCDMA5 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

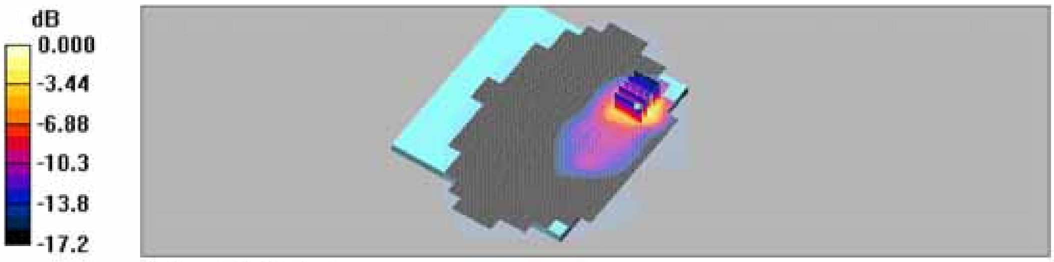
Communication System: WCDMA5; Frequency: 846.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 846.6 MHz; σ = 0.955 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.92 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.6 V/m; Power Drift = -0.105 dB
Peak SAR (extrapolated) = 5.37 W/kg
SAR(1 g) = 1.78 mW/g; SAR(10 g) = 0.910 mW/g
Maximum value of SAR (measured) = 2.67 mW/g



0 dB = 2.67mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

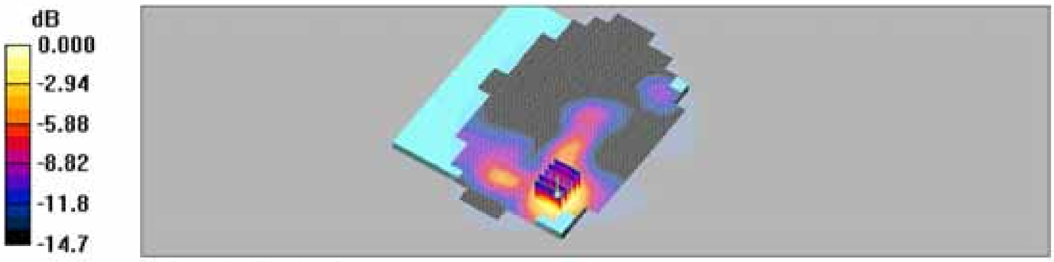
Communication System: LTE2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.447 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.51 V/m; Power Drift = -0.121 dB
Peak SAR (extrapolated) = 0.566 W/kg
SAR(1 g) = 0.375 mW/g; SAR(10 g) = 0.234 mW/g
Maximum value of SAR (measured) = 0.441 mW/g



0 dB = 0.441mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

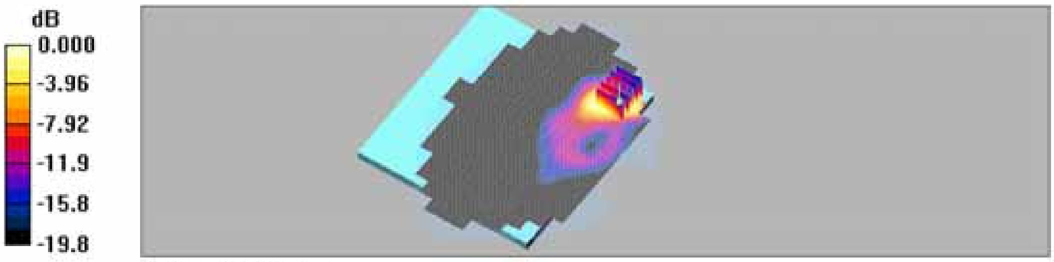
Communication System: LTE2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.25 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.71 V/m; Power Drift = -0.229 dB
Peak SAR (extrapolated) = 7.21 W/kg
SAR(1 g) = 4.08 mW/g; SAR(10 g) = 2.29 mW/g
Maximum value of SAR (measured) = 4.87 mW/g



0 dB = 4.87mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

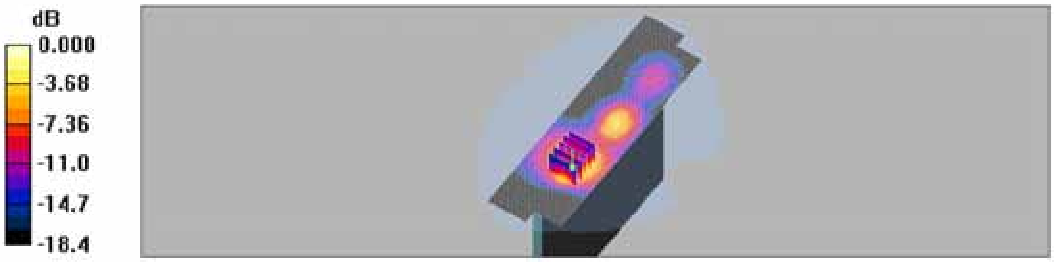
Communication System: LTE2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.40 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.3 V/m; Power Drift = -0.035 dB
Peak SAR (extrapolated) = 1.67 W/kg
SAR(1 g) = 0.968 mW/g; SAR(10 g) = 0.514 mW/g
Maximum value of SAR (measured) = 1.26 mW/g



0 dB = 1.26mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

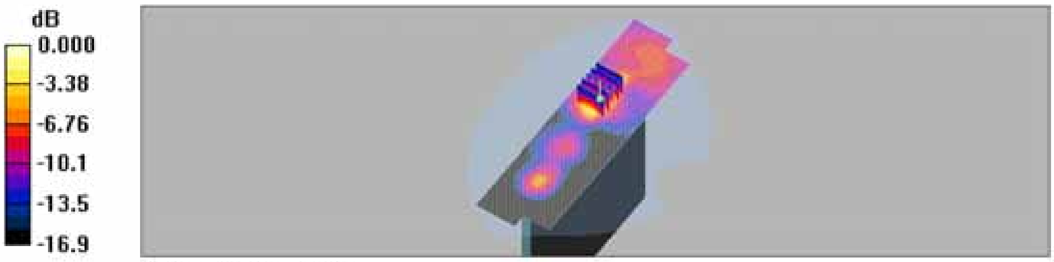
Communication System: LTE2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.53 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.570 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.96 V/m; Power Drift = 0.281 dB
Peak SAR (extrapolated) = 0.823 W/kg
SAR(1 g) = 0.448 mW/g; SAR(10 g) = 0.232 mW/g
Maximum value of SAR (measured) = 0.578 mW/g



0 dB = 0.578mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

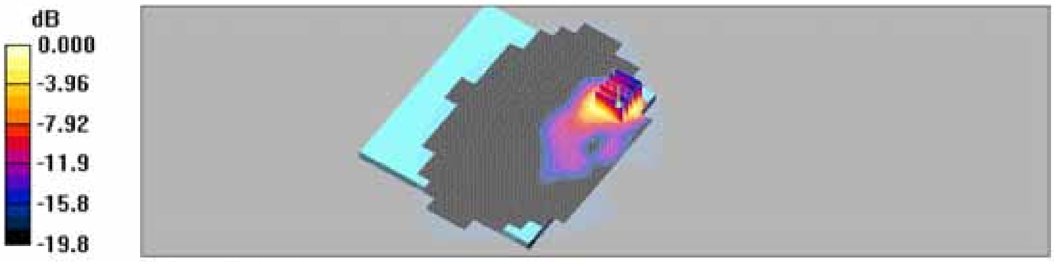
Communication System: LTE2; Frequency: 1855 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1855 MHz; σ = 1.5 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.04 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.41 V/m; Power Drift = -0.190 dB
Peak SAR (extrapolated) = 6.98 W/kg
SAR(1 g) = 3.98 mW/g; SAR(10 g) = 2.21 mW/g
Maximum value of SAR (measured) = 4.72 mW/g



0 dB = 4.72mW/g

Date: 2020-03-13

Test Laboratory: ESTECH

RP70A BIO LTE2 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

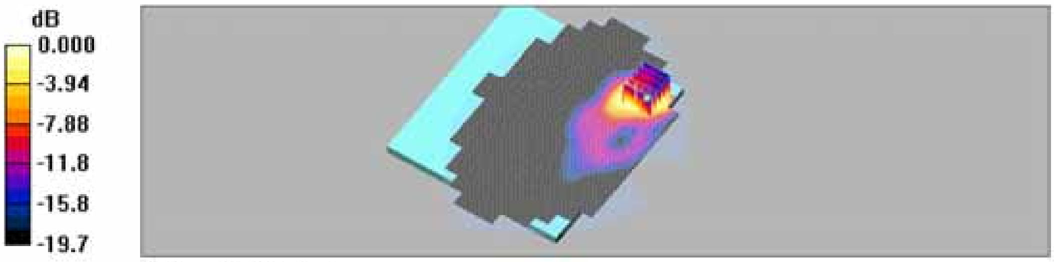
Communication System: LTE2; Frequency: 1905 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1905 MHz; σ = 1.55 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(4.87, 4.87, 4.87); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.06 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.45 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 6.58 W/kg
SAR(1 g) = 3.83 mW/g; SAR(10 g) = 2.17 mW/g
Maximum value of SAR (measured) = 4.50 mW/g



0 dB = 4.50mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

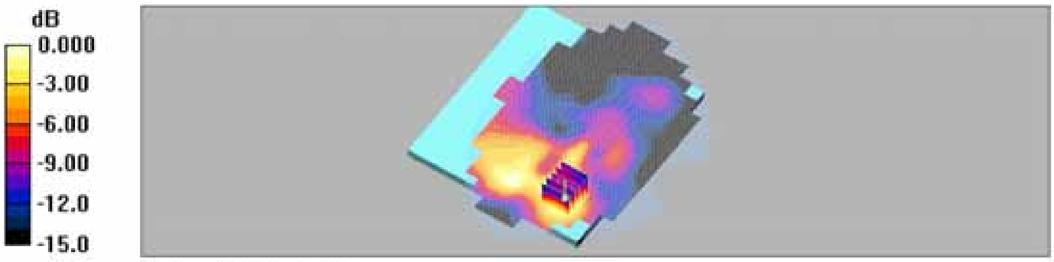
Communication System: LTE4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1732.5 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.229 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.73 V/m; Power Drift = 0.147 dB
Peak SAR (extrapolated) = 0.298 W/kg
SAR(1 g) = 0.194 mW/g; SAR(10 g) = 0.121 mW/g
Maximum value of SAR (measured) = 0.224 mW/g



0 dB = 0.224mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

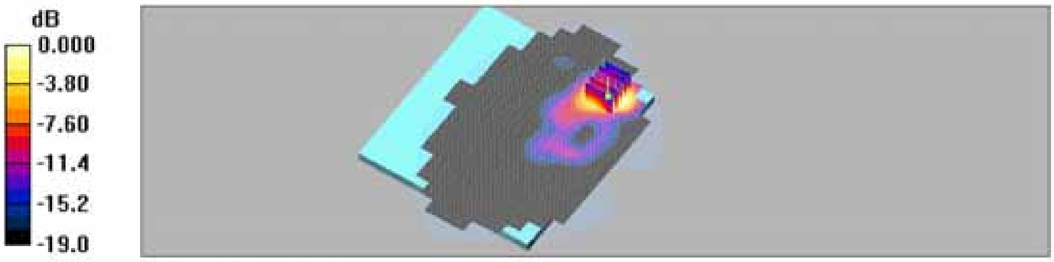
Communication System: LTE4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1732.5 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.58 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.0 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 8.20 W/kg
SAR(1 g) = 4.25 mW/g; SAR(10 g) = 2.28 mW/g
Maximum value of SAR (measured) = 5.09 mW/g



0 dB = 5.09mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

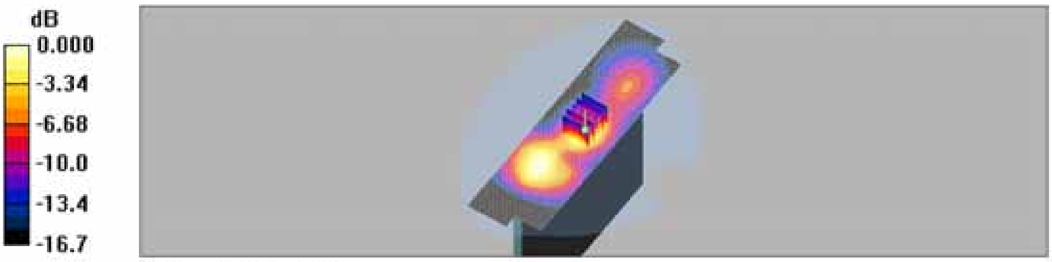
Communication System: LTE4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1732.5 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.503 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.8 V/m; Power Drift = -0.081 dB
Peak SAR (extrapolated) = 0.650 W/kg
SAR(1 g) = 0.387 mW/g; SAR(10 g) = 0.217 mW/g
Maximum value of SAR (measured) = 0.474 mW/g



0 dB = 0.474mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

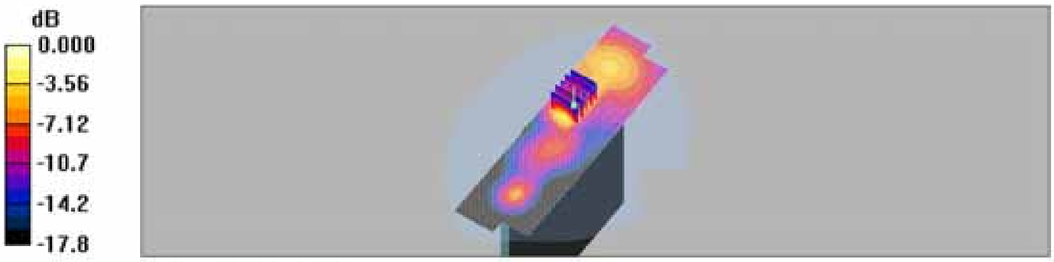
Communication System: LTE4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1732.5 MHz; σ = 1.44 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.274 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.94 V/m; Power Drift = 0.083 dB
Peak SAR (extrapolated) = 0.425 W/kg
SAR(1 g) = 0.232 mW/g; SAR(10 g) = 0.120 mW/g
Maximum value of SAR (measured) = 0.296 mW/g



0 dB = 0.296mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

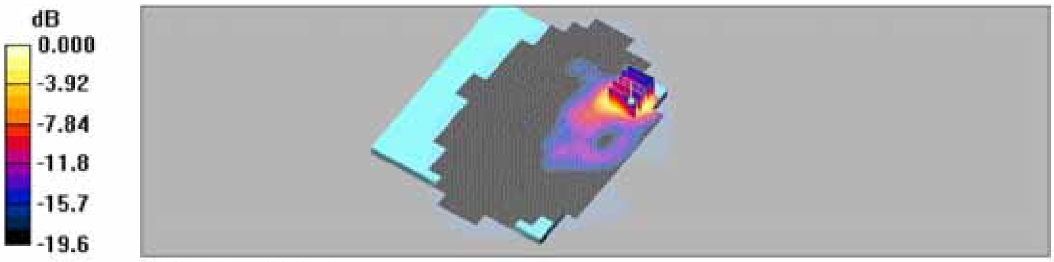
Communication System: LTE4; Frequency: 1711.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1711.5 MHz; σ = 1.42 mho/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.72 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.07 V/m; Power Drift = -0.176 dB
Peak SAR (extrapolated) = 7.56 W/kg
SAR(1 g) = 3.97 mW/g; SAR(10 g) = 2.1 mW/g
Maximum value of SAR (measured) = 5.10 mW/g



0 dB = 5.10mW/g

Date: 2020-03-12

Test Laboratory: ESTECH

RP70A BIO LTE4 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

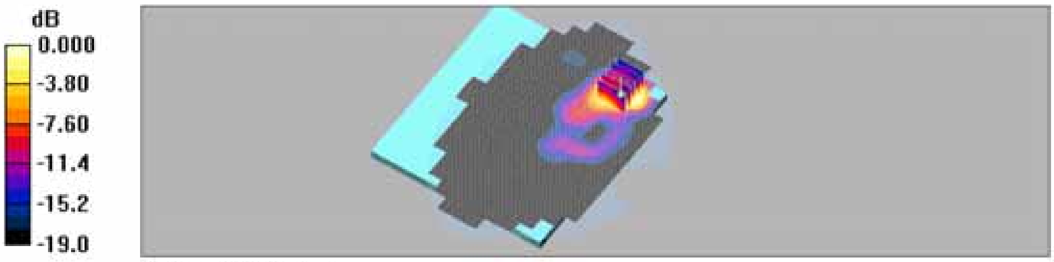
Communication System: LTE4; Frequency: 1753.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1753.5 MHz; σ = 1.45 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(5.11, 5.11, 5.11); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.43 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.5 V/m; Power Drift = -0.026 dB
Peak SAR (extrapolated) = 7.27 W/kg
SAR(1 g) = 3.85 mW/g; SAR(10 g) = 2.09 mW/g
Maximum value of SAR (measured) = 4.68 mW/g



0 dB = 4.68mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

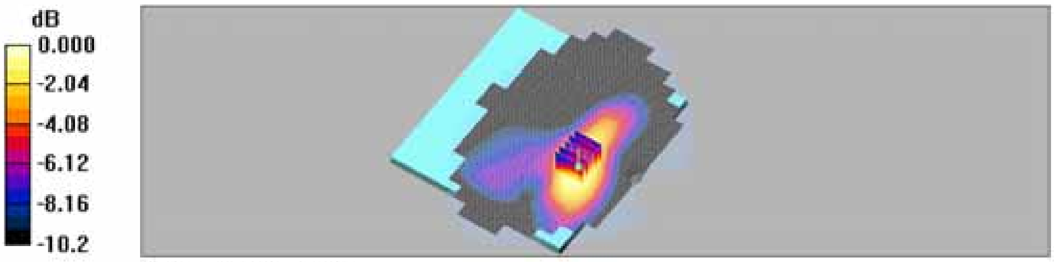
Communication System: LTE5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.482 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.4 V/m; Power Drift = -0.246 dB
Peak SAR (extrapolated) = 0.563 W/kg
SAR(1 g) = 0.421 mW/g; SAR(10 g) = 0.301 mW/g
Maximum value of SAR (measured) = 0.469 mW/g



0 dB = 0.469mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

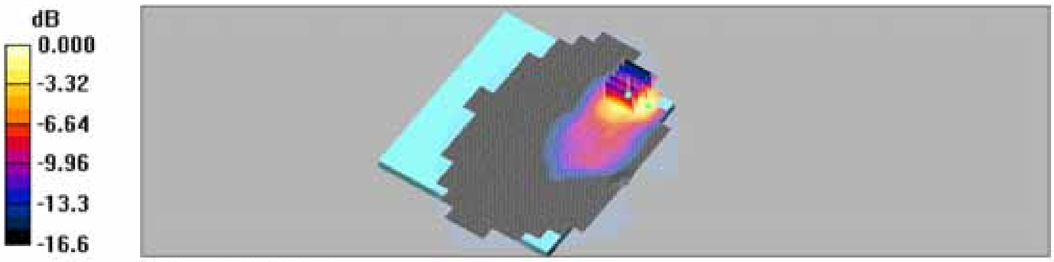
Communication System: LTE5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.02 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.2 V/m; Power Drift = -0.008 dB
Peak SAR (extrapolated) = 3.67 W/kg
SAR(1 g) = 1.96 mW/g; SAR(10 g) = 1.06 mW/g
Maximum value of SAR (measured) = 2.44 mW/g



0 dB = 2.44mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

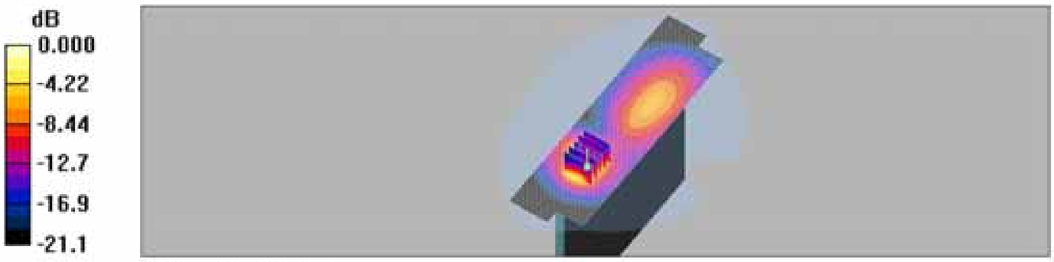
Communication System: LTE5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.662 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.1 V/m; Power Drift = -0.045 dB
Peak SAR (extrapolated) = 2.11 W/kg
SAR(1 g) = 0.782 mW/g; SAR(10 g) = 0.334 mW/g
Maximum value of SAR (measured) = 1.06 mW/g



0 dB = 1.06mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

Communication System: LTE5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.944 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

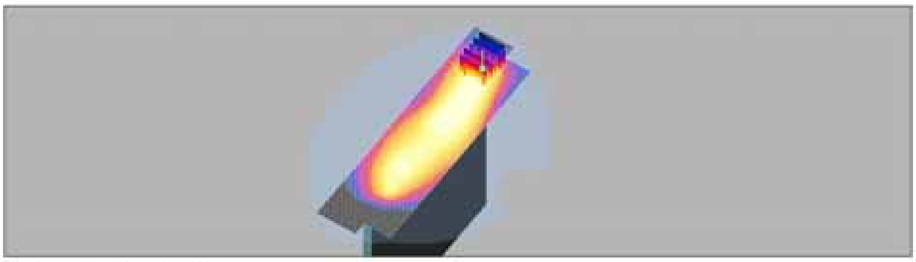
DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.232 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.0 V/m; Power Drift = -0.139 dB
Peak SAR (extrapolated) = 0.317 W/kg
SAR(1 g) = 0.185 mW/g; SAR(10 g) = 0.115 mW/g
Maximum value of SAR (measured) = 0.221 mW/g

dB
0.000
-2.84
-5.68
-8.52
-11.4
-14.2



0 dB = 0.221mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 REAR ANT1 LOW

DUT: RP70A; Type: Not Specified; Serial: Not Specified

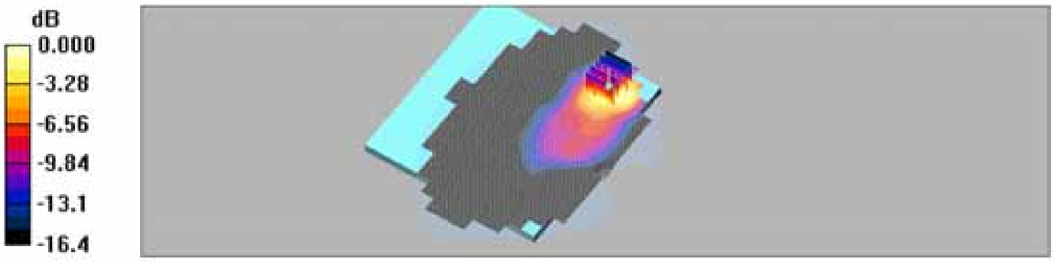
Communication System: LTE5; Frequency: 826.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 826.5 MHz; σ = 0.934 mho/m; ε_r = 55.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.93 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.3 V/m; Power Drift = 0.001 dB
Peak SAR (extrapolated) = 3.48 W/kg
SAR(1 g) = 1.88 mW/g; SAR(10 g) = 1.03 mW/g
Maximum value of SAR (measured) = 2.31 mW/g



0 dB = 2.31mW/g

Date: 2020-03-10

Test Laboratory: ESTECH

RP70A BIO LTE5 REAR ANT1 HIGH

DUT: RP70A; Type: Not Specified; Serial: Not Specified

Communication System: LTE5; Frequency: 846.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 846.5 MHz; σ = 0.954 mho/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

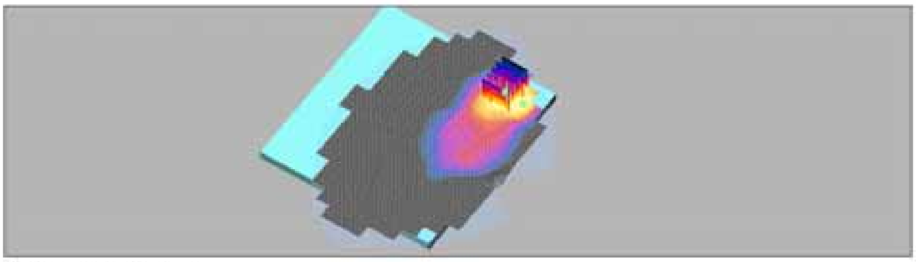
DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.08, 6.08, 6.08); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.97 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.1 V/m; Power Drift = 0.056 dB
Peak SAR (extrapolated) = 3.60 W/kg
SAR(1 g) = 1.9 mW/g; SAR(10 g) = 1 mW/g
Maximum value of SAR (measured) = 2.26 mW/g

dB
0.000
-3.42
-6.84
-10.3
-13.7
-17.1



0 dB = 2.26mW/g

Date: 2020-03-11

Test Laboratory: ESTECH

RP70A BIO LTE14 FRONT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

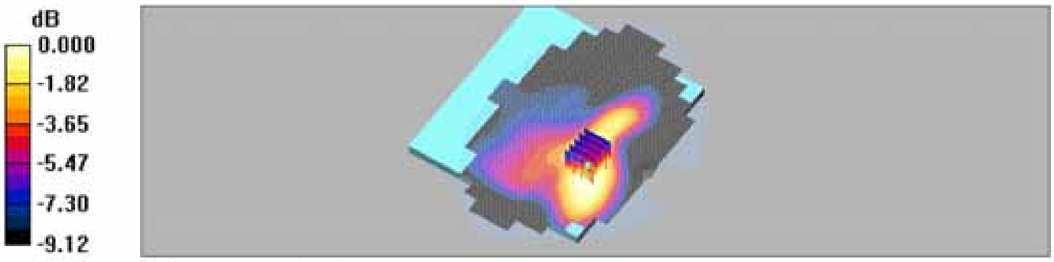
Communication System: LTE14; Frequency: 793 MHz;Duty Cycle: 1:1
Medium parameters used (extrapolated): f = 793 MHz; σ = 1 mho/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.17, 6.17, 6.17); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.414 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.0 V/m; Power Drift = -0.051 dB
Peak SAR (extrapolated) = 0.489 W/kg
SAR(1 g) = 0.365 mW/g; SAR(10 g) = 0.270 mW/g
Maximum value of SAR (measured) = 0.405 mW/g



0 dB = 0.405mW/g

Date: 2020-03-11

Test Laboratory: ESTECH

RP70A BIO LTE14 REAR ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

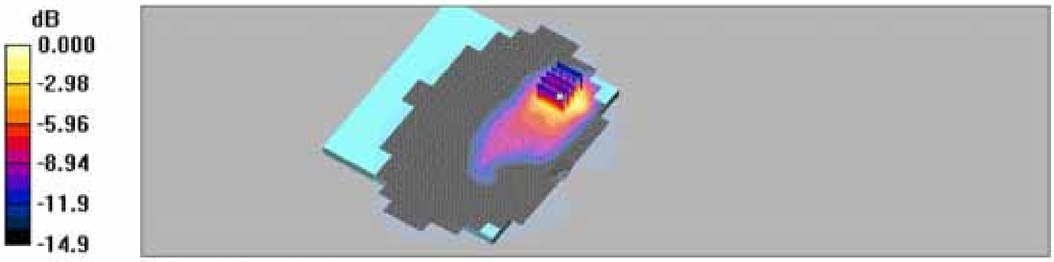
Communication System: LTE14; Frequency: 793 MHz;Duty Cycle: 1:1
Medium parameters used (extrapolated): f = 793 MHz; σ = 1 mho/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.17, 6.17, 6.17); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (161x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.52 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.1 V/m; Power Drift = 0.092 dB
Peak SAR (extrapolated) = 5.18 W/kg
SAR(1 g) = 2.06 mW/g; SAR(10 g) = 1.25 mW/g
Maximum value of SAR (measured) = 2.99 mW/g



0 dB = 2.99mW/g

Date: 2020-03-11

Test Laboratory: ESTECH

RP70A BIO LTE14 RIGHT ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

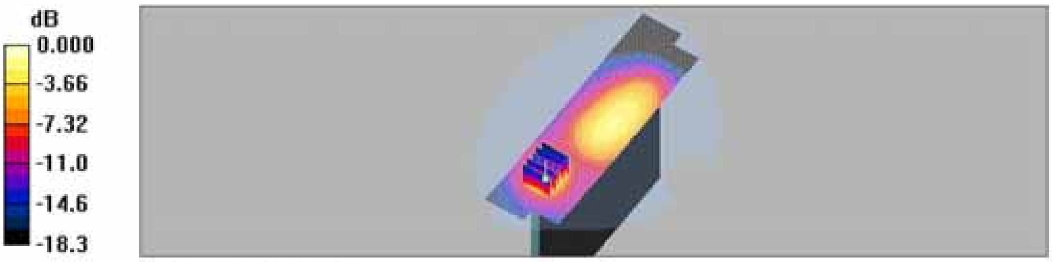
Communication System: LTE14; Frequency: 793 MHz;Duty Cycle: 1:1
Medium parameters used (extrapolated): f = 793 MHz; σ = 1 mho/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.17, 6.17, 6.17); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.299 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.8 V/m; Power Drift = -0.190 dB
Peak SAR (extrapolated) = 0.724 W/kg
SAR(1 g) = 0.286 mW/g; SAR(10 g) = 0.130 mW/g
Maximum value of SAR (measured) = 0.412 mW/g



0 dB = 0.412mW/g

Date: 2020-03-11

Test Laboratory: ESTECH

RP70A BIO LTE14 TOP ANT1

DUT: RP70A; Type: Not Specified; Serial: Not Specified

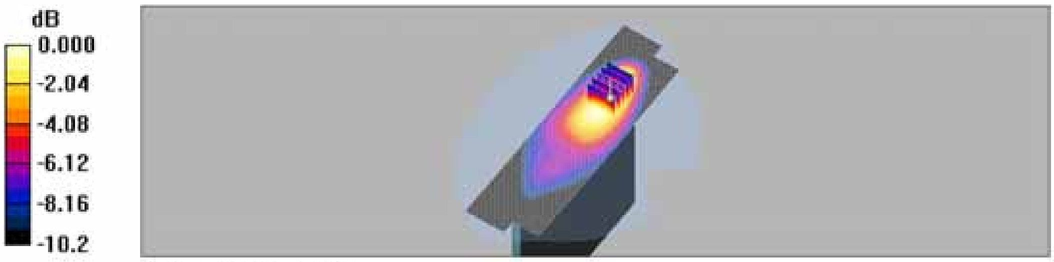
Communication System: LTE14; Frequency: 793 MHz;Duty Cycle: 1:1
Medium parameters used (extrapolated): f = 793 MHz; σ = 1 mho/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3123; ConvF(6.17, 6.17, 6.17); Calibrated: 2020-01-29
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn551; Calibrated: 2020-01-24
- Phantom: SAM 1800; Type: SAM; Serial: TP 1263
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Area Scan (51x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.280 mW/g

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.6 V/m; Power Drift = 0.034 dB
Peak SAR (extrapolated) = 0.343 W/kg
SAR(1 g) = 0.241 mW/g; SAR(10 g) = 0.167 mW/g
Maximum value of SAR (measured) = 0.275 mW/g



0 dB = 0.275mW/g

APPENDIX C : SAR Tissue Data

frequency	e'	e''
1840000000.0000	51.5992	14.4543
1842000000.0000	51.5788	14.4667
1844000000.0000	51.5805	14.4760
1846000000.0000	51.5751	14.4661
1848000000.0000	51.5618	14.4797
1850000000.0000	51.5583	14.4986
1852000000.0000	51.5504	14.5025
1854000000.0000	51.5303	14.5148
1856000000.0000	51.5295	14.5198
1858000000.0000	51.5211	14.5271
1860000000.0000	51.5085	14.5281
1862000000.0000	51.4976	14.5402
1864000000.0000	51.4906	14.5405
1866000000.0000	51.4766	14.5306
1868000000.0000	51.4720	14.5472
1870000000.0000	51.4715	14.5610
1872000000.0000	51.4572	14.5634
1874000000.0000	51.4552	14.5663
1876000000.0000	51.4444	14.5693
1878000000.0000	51.4418	14.5755
1880000000.0000	51.4318	14.5839
1882000000.0000	51.4368	14.5878
1884000000.0000	51.4221	14.5936
1886000000.0000	51.4283	14.5906
1888000000.0000	51.4199	14.6009
1890000000.0000	51.4065	14.5998
1892000000.0000	51.4193	14.6102
1894000000.0000	51.4133	14.6068
1896000000.0000	51.4171	14.6086
1898000000.0000	51.4128	14.6160
1900000000.0000	51.4002	14.6114
1902000000.0000	51.4016	14.6267
1904000000.0000	51.3888	14.6132
1906000000.0000	51.3929	14.6237
1908000000.0000	51.3919	14.6227
1910000000.0000	51.3817	14.6254
1912000000.0000	51.3734	14.6267
1914000000.0000	51.3856	14.6314
1916000000.0000	51.3805	14.6454
1918000000.0000	51.3723	14.6257
1920000000.0000	51.3727	14.6179
1922000000.0000	51.3660	14.6210
1924000000.0000	51.3647	14.6233
1926000000.0000	51.3457	14.6175
1928000000.0000	51.3514	14.6296

1930000000.0000	51.3629	14.6495
1932000000.0000	51.3428	14.6504
1934000000.0000	51.3396	14.6332
1936000000.0000	51.3282	14.6458
1938000000.0000	51.3206	14.6555
1940000000.0000	51.3103	14.6613

frequency	e'	e''
1700000000.0000	52.8099	14.9037
1702500000.0000	52.8148	14.9070
1705000000.0000	52.7967	14.8953
1707500000.0000	52.7873	14.8989
1710000000.0000	52.7614	14.8863
1712500000.0000	52.7665	14.8894
1715000000.0000	52.7814	14.8955
1717500000.0000	52.7548	14.8909
1720000000.0000	52.7480	14.8925
1722500000.0000	52.7449	14.8984
1725000000.0000	52.7257	14.9026
1727500000.0000	52.7272	14.9049
1730000000.0000	52.7054	14.8966
1732500000.0000	52.6954	14.8935
1735000000.0000	52.7059	14.8884
1737500000.0000	52.6855	14.9085
1740000000.0000	52.6837	14.9061
1742500000.0000	52.6572	14.9092
1745000000.0000	52.6533	14.9085
1747500000.0000	52.6491	14.9117
1750000000.0000	52.6436	14.9088
1752500000.0000	52.6355	14.9115
1755000000.0000	52.6311	14.9186
1757500000.0000	52.6125	14.9082
1760000000.0000	52.6133	14.9036
1762500000.0000	52.6034	14.9080
1765000000.0000	52.6001	14.9069
1767500000.0000	52.5863	14.9108
1770000000.0000	52.5935	14.9047
1772500000.0000	52.5861	14.9071
1775000000.0000	52.5762	14.8933
1777500000.0000	52.5699	14.9056
1780000000.0000	52.5655	14.8982
1782500000.0000	52.5508	14.8958
1785000000.0000	52.5507	14.8847
1787500000.0000	52.5486	14.8754
1790000000.0000	52.5413	14.8814
1792500000.0000	52.5322	14.8852
1795000000.0000	52.5239	14.8812
1797500000.0000	52.5192	14.8813
1800000000.0000	52.5195	14.8700

frequency	e'	e''
820000000.0000	55.6387	20.3405
824000000.0000	55.6145	20.3156
828000000.0000	55.5813	20.3225
832000000.0000	55.5334	20.2839
836000000.0000	55.5050	20.2796
840000000.0000	55.4916	20.2851
844000000.0000	55.4919	20.2653
848000000.0000	55.4572	20.2691
852000000.0000	55.4410	20.2408
856000000.0000	55.4066	20.2579
860000000.0000	55.3759	20.2247
864000000.0000	55.3285	20.2230
868000000.0000	55.3037	20.2132
872000000.0000	55.2909	20.2230
876000000.0000	55.2584	20.2351
880000000.0000	55.2319	20.2483
884000000.0000	55.2056	20.2224
888000000.0000	55.1879	20.2176
892000000.0000	55.1574	20.2118
896000000.0000	55.1769	20.1942
900000000.0000	55.1521	20.1808
904000000.0000	55.1375	20.1616
908000000.0000	55.0877	20.1761
912000000.0000	55.0754	20.1729
916000000.0000	55.0286	20.1389
920000000.0000	55.0125	20.1552

frequency	e'	e''
690000000.0000	56.4648	24.3238
692000000.0000	56.4770	24.3548
694000000.0000	56.4923	24.3133
696000000.0000	56.4364	24.3041
698000000.0000	56.4041	24.2794
700000000.0000	56.4126	24.2664
702000000.0000	56.3804	24.2519
704000000.0000	56.4081	24.2252
706000000.0000	56.3446	24.1852
708000000.0000	56.3316	24.1673
710000000.0000	56.3469	24.1563
712000000.0000	56.3320	24.1443
714000000.0000	56.3114	24.1300
716000000.0000	56.3160	24.0843
718000000.0000	56.2654	24.0792
720000000.0000	56.2654	24.0655
722000000.0000	56.2759	24.0419
724000000.0000	56.2523	24.0295
726000000.0000	56.2570	24.0037
728000000.0000	56.2338	23.9912
730000000.0000	56.1850	23.9861
732000000.0000	56.2024	23.9447
734000000.0000	56.1939	23.9206
736000000.0000	56.1735	23.9119
738000000.0000	56.1612	23.8995
740000000.0000	56.1492	23.8870
742000000.0000	56.1489	23.8785
744000000.0000	56.1183	23.8267
746000000.0000	56.1182	23.8376
748000000.0000	56.1068	23.8250
750000000.0000	56.0418	23.7807

APPENDIX D : Calibration Certificates

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s p e a g

551

IMPORTANT NOTICE

USAGE OF THE DAE4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

TN_EH190306AE DAE4.docx 07.03.2019

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 0108

Client Estech (Dymstec)

Certificate No: DAE4-551_Jan20

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 551
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	January 24, 2020

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
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-19 (No:25949)	Sep-20
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	09-Jan-20 (in house check)	In house check: Jan-21
Calibrator Box V2.1	SE UMS 006 AA 1002	09-Jan-20 (in house check)	In house check: Jan-21

	Name	Function	Signature
Calibrated by:	Adrian Gehring	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: January 24, 2020

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

Certificate No: DAE4-551_Jan20 Page 1 of 5

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.911 ± 0.02% (k=2)	405.776 ± 0.02% (k=2)	405.479 ± 0.02% (k=2)
Low Range	3.98031 ± 1.50% (k=2)	4.01504 ± 1.50% (k=2)	4.00738 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	138.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199994.87	-0.55	-0.00
Channel X	+ Input	20005.66	3.12	0.02
Channel X	- Input	-19997.96	2.76	-0.01
Channel Y	+ Input	199996.80	1.45	0.00
Channel Y	+ Input	20003.23	0.93	0.00
Channel Y	- Input	-20002.42	-1.47	0.01
Channel Z	+ Input	199995.96	0.61	0.00
Channel Z	+ Input	20003.80	1.51	0.01
Channel Z	- Input	-20001.42	-0.47	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.75	1.01	0.05
Channel X	+ Input	202.53	0.25	0.12
Channel X	- Input	-196.48	1.18	-0.60
Channel Y	+ Input	2003.01	1.26	0.06
Channel Y	+ Input	202.11	-0.06	-0.03
Channel Y	- Input	-197.52	0.29	-0.15
Channel Z	+ Input	2002.21	0.63	0.03
Channel Z	+ Input	200.91	-1.02	-0.51
Channel Z	- Input	-198.30	-0.46	0.23

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-4.22	-6.12
	- 200	8.31	6.10
Channel Y	200	-19.43	-19.64
	- 200	19.47	19.31
Channel Z	200	20.52	19.95
	- 200	-22.31	-22.37

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-0.89	-2.99
Channel Y	200	7.18	-	0.37
Channel Z	200	10.94	4.69	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16123	15860
Channel Y	16149	16207
Channel Z	15537	17129

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.33	-0.54	2.68	0.53
Channel Y	0.71	-0.80	1.93	0.51
Channel Z	-0.21	-1.50	1.11	0.47

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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Accreditation No.: SCS 0108

Client Estech (Dymstec)

Certificate No: D750V3-1162_Jul18

CALIBRATION CERTIFICATE

Object: D750V3 - SN:1162

Calibration procedure(s): QA CAL-05.v10
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 24, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 24, 2018

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

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:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.12 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.30 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.3 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.55 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.64 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.5 Ω - 0.8 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.2 Ω - 2.2 jΩ
Return Loss	- 32.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	June 23, 2016

DASY5 Validation Report for Head TSL

Date: 24.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1162

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.89 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

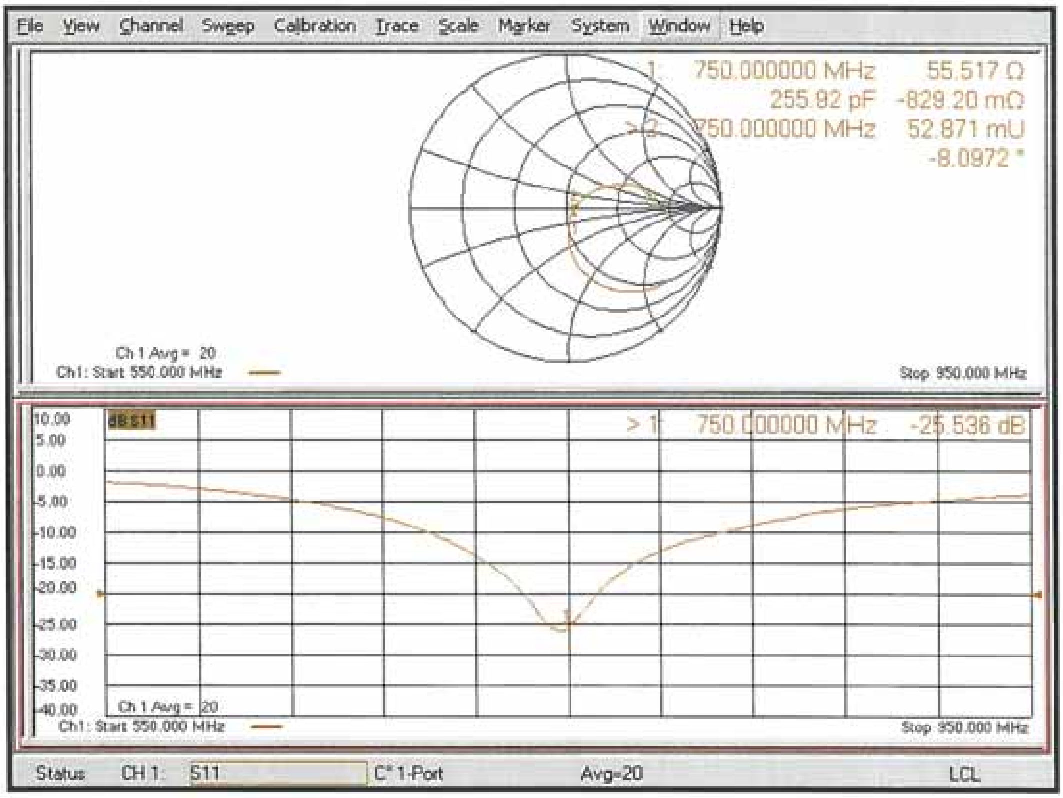
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.98 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.07 W/kg
SAR(1 g) = 2.04 W/kg; SAR(10 g) = 1.33 W/kg
Maximum value of SAR (measured) = 2.72 W/kg

0 dB = 2.72 W/kg = 4.35 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1162

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ε_r = 55.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

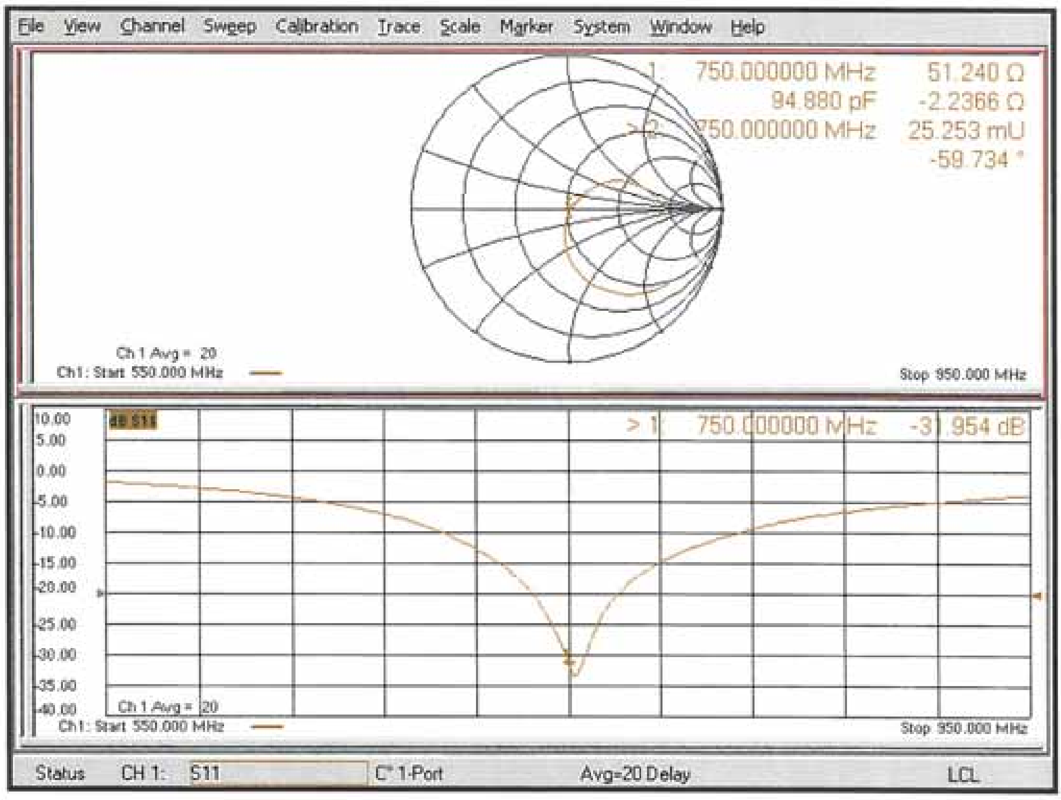
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.54 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.17 W/kg
SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.41 W/kg
Maximum value of SAR (measured) = 2.82 W/kg

0 dB = 2.82 W/kg = 4.50 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1162_Jul18 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **Estech (Dymstec)**

Certificate No: **D835V2-475_Nov18**

CALIBRATION CERTIFICATE

Object	D835V2 - SN:475
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 14, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: November 14, 2018

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

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Accreditation No.: **SCS 0108**

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:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.56 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.20 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.58 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.29 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω - 3.9 jΩ
Return Loss	- 25.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 5.3 jΩ
Return Loss	- 24.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.383 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	November 15, 2002

DASY5 Validation Report for Head TSL

Date: 14.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:475

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

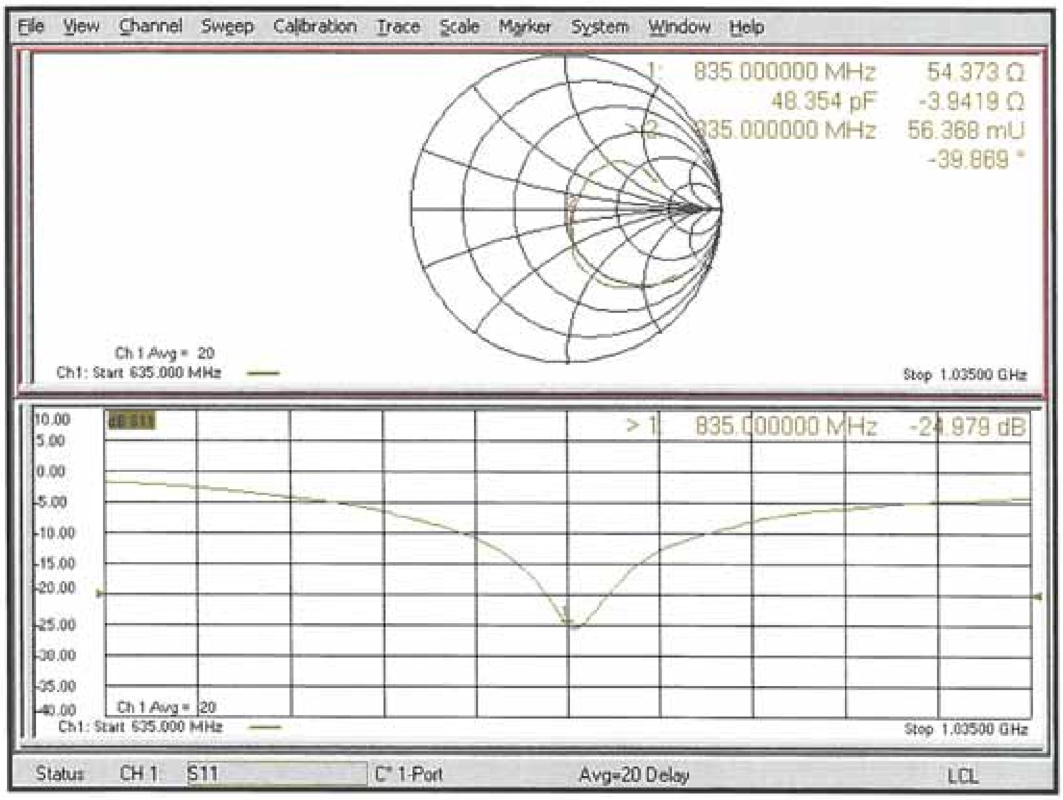
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.9, 9.9, 9.9) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 63.32 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.75 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 3.29 W/kg

0 dB = 3.29 W/kg = 5.17 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-475_Nov18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 14.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:475

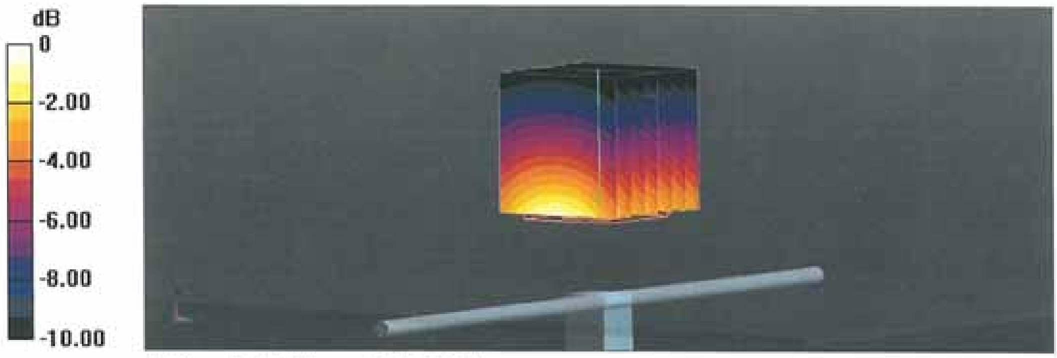
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.98 S/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.05, 10.05, 10.05) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

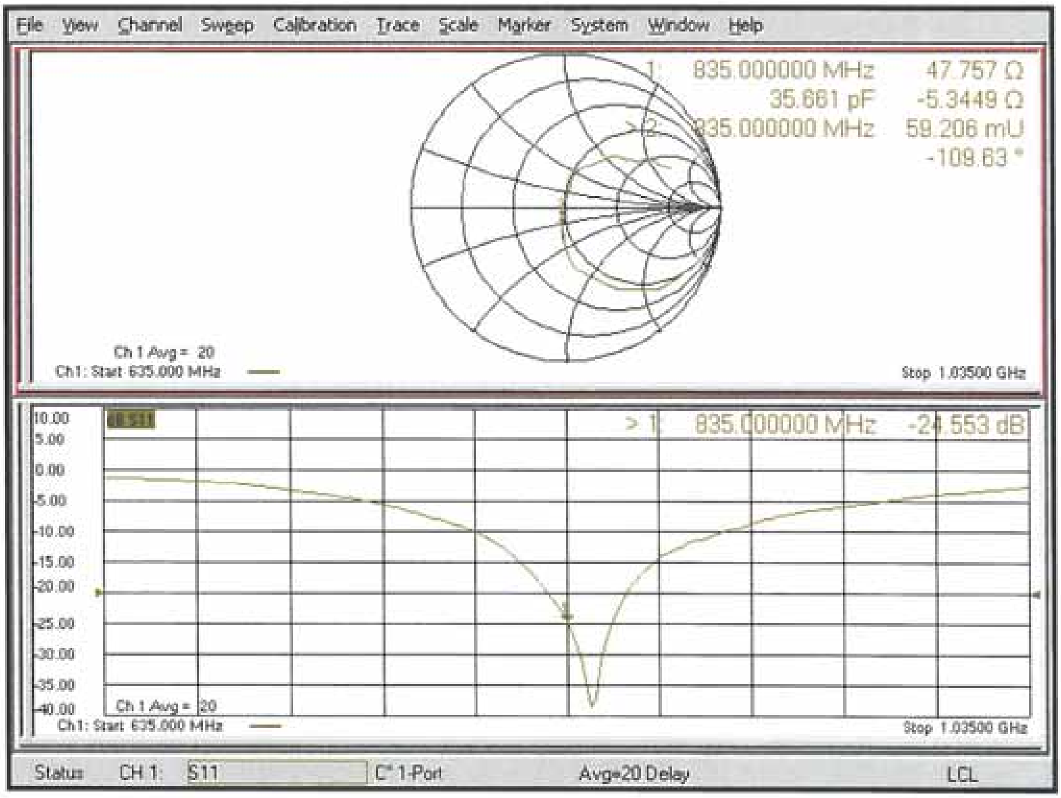
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.82 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 5.09 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D835V2-475_Nov18 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **Estech (Dymstec)**

Certificate No: **D1750V2-1151_Jul18**

CALIBRATION CERTIFICATE

Object	D1750V2 - SN:1151
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 20, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 20, 2018

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Accreditation No.: SCS 0108

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:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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.

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%.

Certificate No: D1750V2-1151_Jul18 Page 2 of 8

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω + 0.5 jΩ
Return Loss	- 39.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω + 1.1 jΩ
Return Loss	- 30.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	April 10, 2015

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	39.0 ± 6 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.1 W/kg ± 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	53.7 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	8.97 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**36.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.79 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.3 W/kg ± 16.5 % (k=2)**

DASY5 Validation Report for Head TSL

Date: 20.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

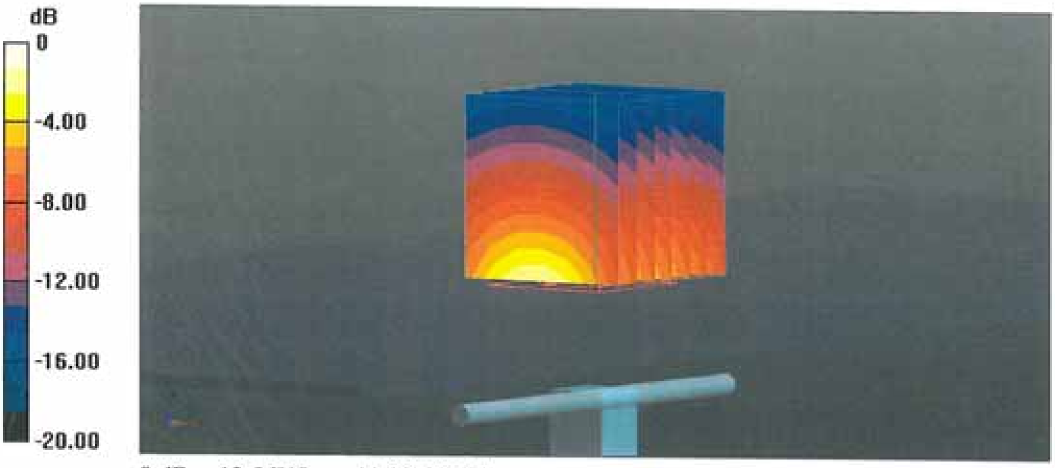
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1151

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.34 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

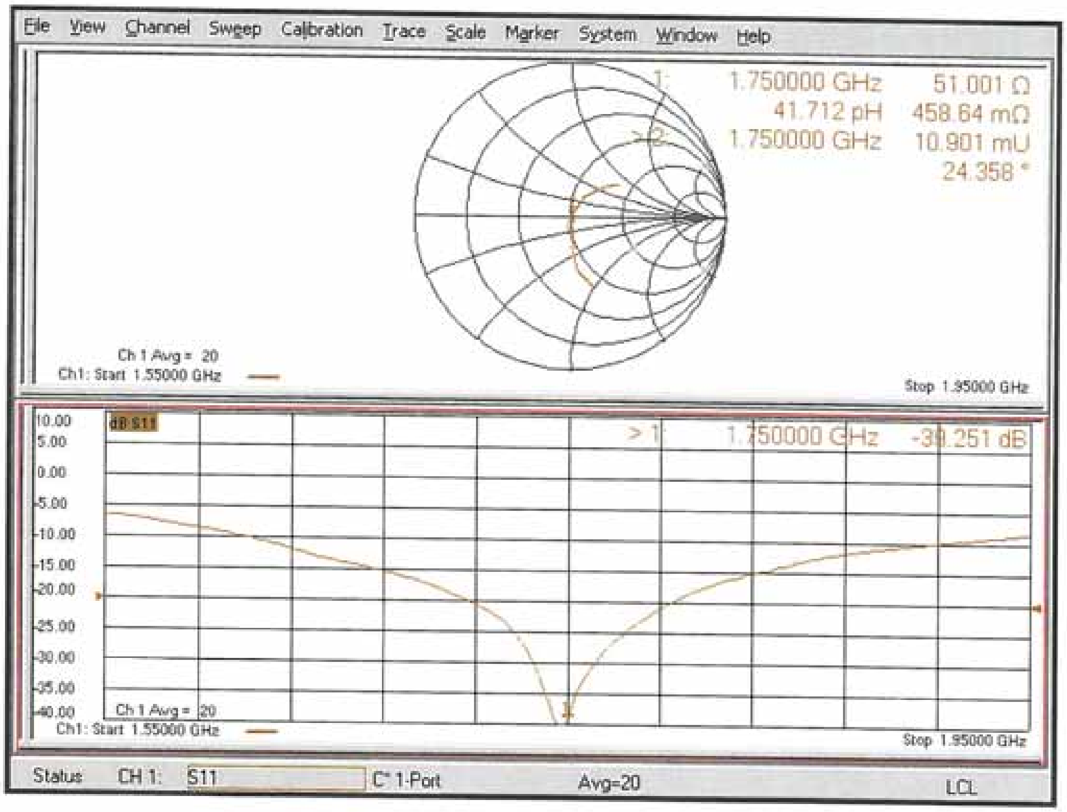
- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.9 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 8.99 W/kg; SAR(10 g) = 4.75 W/kg
Maximum value of SAR (measured) = 13.5 W/kg



0 dB = 13.5 W/kg = 11.30 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1151_Jul18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 20.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

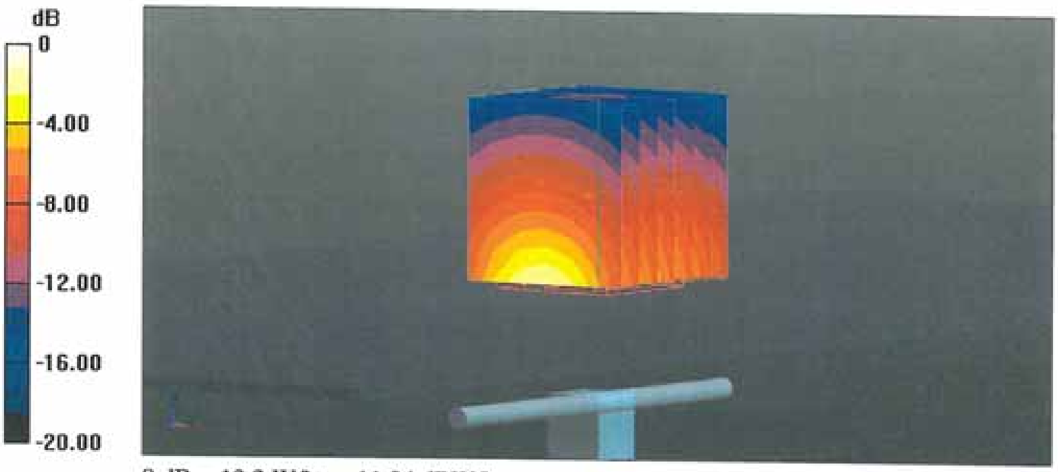
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1151

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ε_r = 53.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

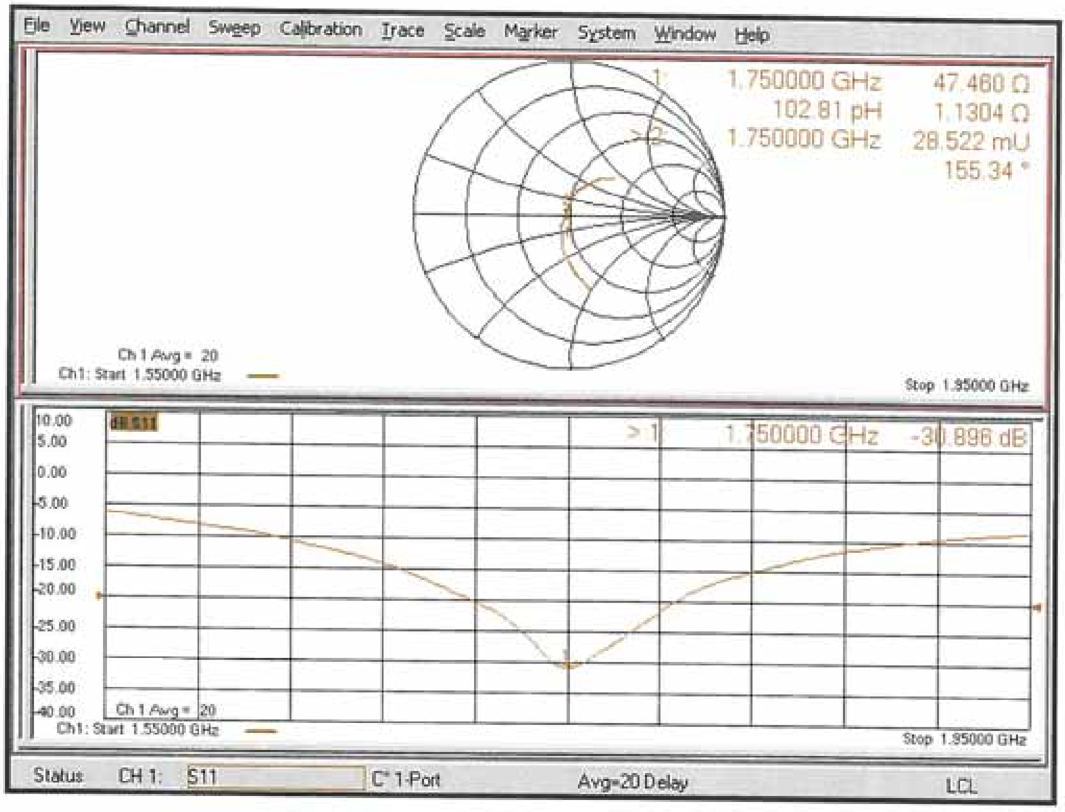
- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.5 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 15.6 W/kg
SAR(1 g) = 8.97 W/kg; SAR(10 g) = 4.79 W/kg
Maximum value of SAR (measured) = 13.3 W/kg



0 dB = 13.3 W/kg = 11.24 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1151_Jul18 Page 8 of 8

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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Swiss Calibration Service

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 0108**

Client: Estech (Dymstec)

Certificate No: D1900V2-5d058_Nov18

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d058
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 14, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: November 16, 2018

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 0108**

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:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 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 ± 0.2) °C	40.8 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.1 W/kg ± 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	53.4 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 4.8 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω + 3.5 jΩ
Return Loss	- 27.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	March 19, 2004

DASY5 Validation Report for Head TSL

Date: 14.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

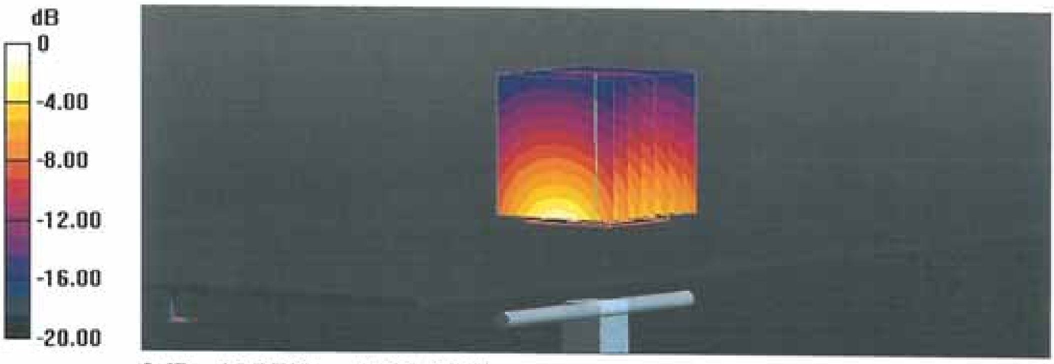
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d058

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

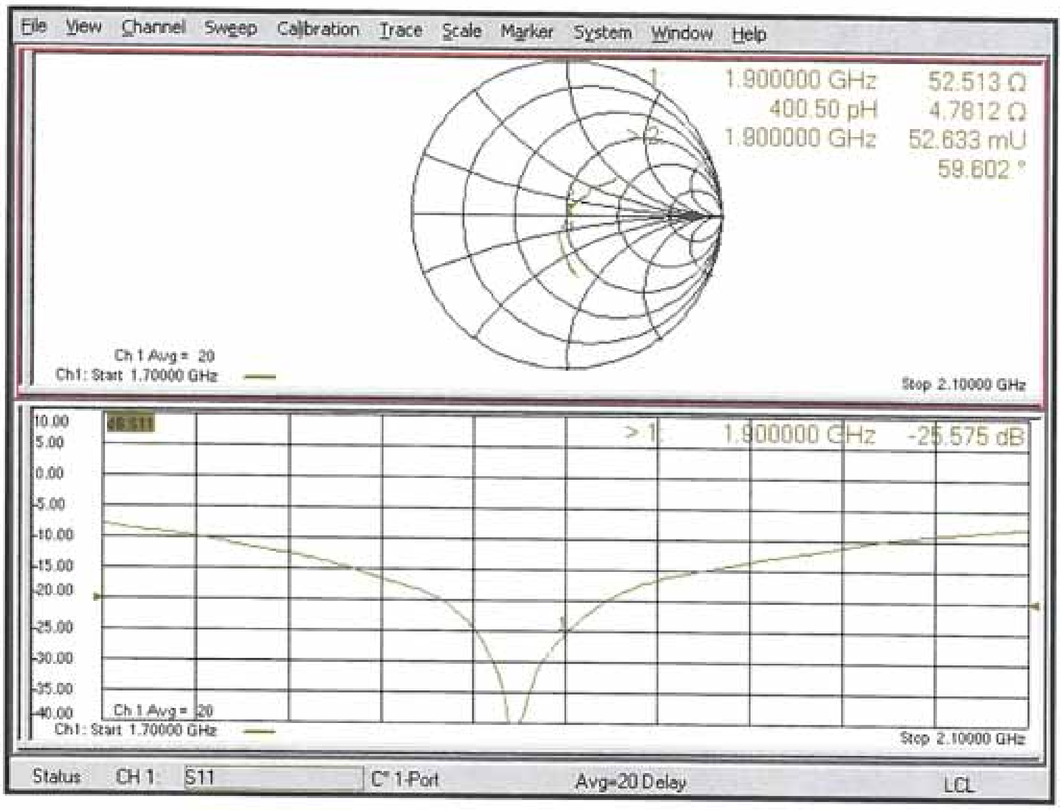
- Probe: EX3DV4 - SN7349; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.0 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg
Maximum value of SAR (measured) = 15.7 W/kg



0 dB = 15.7 W/kg = 11.96 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d058_Nov18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 14.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d058

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.49 S/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

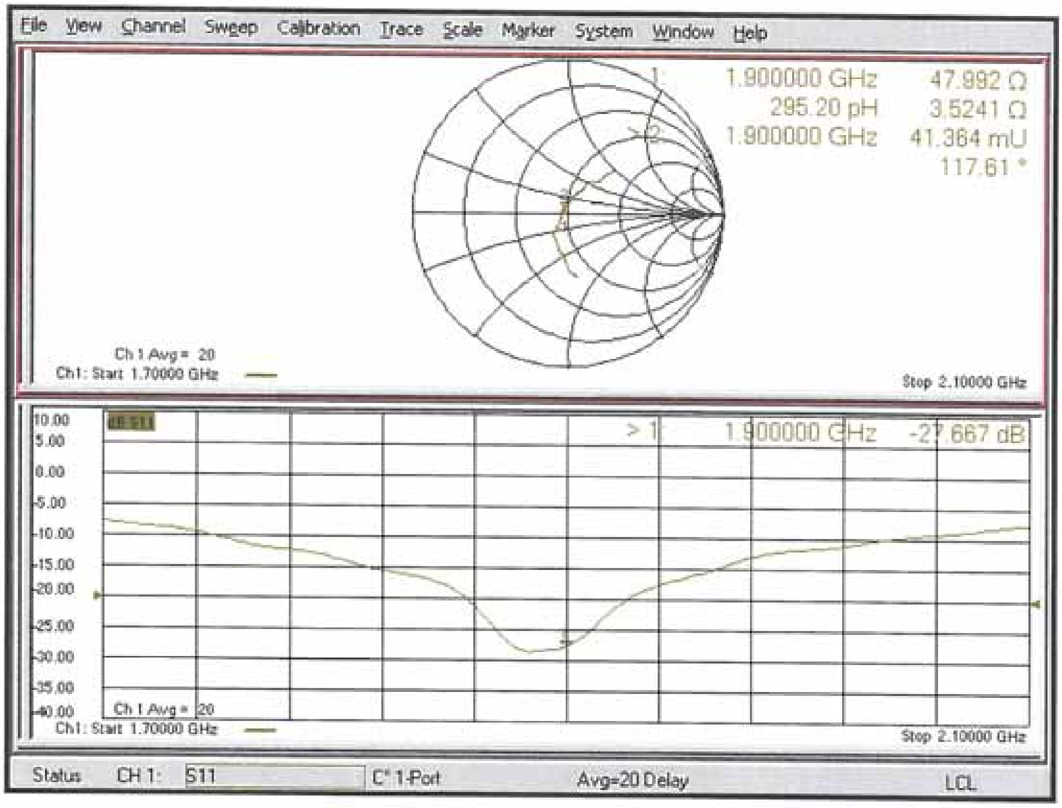
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.15, 8.15, 8.15) @ 1900 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.1 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 9.86 W/kg; SAR(10 g) = 5.2 W/kg
Maximum value of SAR (measured) = 15.0 W/kg

0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d058_Nov18 Page 8 of 8