

# SAR TEST REPORT



The following samples were submitted and identified on behalf of the client as:

Product Name	Notebook PC
Brand Name	HP
Model No.	HSN-W01C
Prepared for	HP Inc.
	3390 East Harmony Road, Fort Collins Colorado, USA
	80528
Standards	IEEE/ANSI C95.1-1992, IEEE 1528-2013,
	KDB248227D01v02r02,KDB865664D01v01r04,
	KDB865664D02v01r02,KDB447498D01v06,
	KDB616217D04v01r02,
FCC ID	B94-8265NGWR
Date of Receipt	May. 04, 2018
Date of Test(s)	May. 08, 2018 ~ May. 14, 2018
Date of Issue In the configuration tested, the EUT	May. 21, 2018 complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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#### Signed on behalf of SGS

Clerk / Ruby Ou	Engineer / Bond Tsai	Asst. Manager / John Yeh
Ruby Ou	Bondisai	John Teh
	<u> </u>	Date: May. 21, 201

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# **Revision History**

Report Number	Revision	Description	Issue Date
E5/2018/50001	Rev.00	Initial creation of document	May. 21, 2018

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# **1. General Information**

# 1.1 Testing Laboratory

SGS Taiwan Ltd. Electronics & Communication Laboratory					
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Tel	+886-2-2299-3279				
Fax +886-2-2298-0488					
Internet	http://www.tw.sgs.com/				

# **1.2 Details of Applicant**

Company Name	HP Inc.
Company Address	3390 East Harmony Road, Fort Collins Colorado, USA 80528

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# **1.3 Description of EUT**

General Information of	Host:						
Equipment Under Test	Notebook PC	Notebook PC					
Brand Name	IP						
Model No.	HSN-W01C						
Integrated Module	Brand Name : Intel						
	Model Name : 8265NGW						
FCC ID	B94-8265NGWR						
Mode of Operation	WLAN802.11 a/b/g/n(20M/40M)/ac(	20M/40	)M/80	M)			
Duty Cycle	WLAN802.11 a/b/g/n(20M/40M)/ ac(20M/40M/80M)		1				
	Bluetooth		1				
	WLAN802.11 b/g/n(20M)	2412	_	2472			
	WLAN802.11 n(40M)	2422	—	2462			
	WLAN802.11 a/n(20M)/ac(20M) 5.2G	5180	—	5240			
	WLAN802.11 n(40M)/ac(40M) 5.2G	5190	—	5230			
	WLAN802.11 ac(80M) 5.2G	5210					
	WLAN802.11 a/n(20M)/ac(20M) 5.3G	5260	—	5320			
	WLAN802.11 n(40M)/ac(40M) 5.3G	5270	—	5310			
TX Frequency Range (MHz)	WLAN802.11 ac(80M) 5.3G		5290				
	WLAN802.11 a/n/ac(20M) 5.6G	5500	—	5720			
	WLAN802.11 n/ac(40M) 5.6G	5510	—	5710			
	WLAN802.11 ac(80M) 5.6G	5530	—	5690			
	WLAN802.11 a/n(20M)/ac(20M) 5.8G	5745	—	5825			
	WLAN802.11 n(40M)/ac(40M) 5.8G	5710	—	5795			
	WLAN802.11 ac(80M) 5.8G		5775				
	Bluetooth	2402	—	2480			

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	WLAN802.11 b/g/n(20M)	1	_	13
	WLAN802.11 n(40M)		—	11
	WLAN802.11 a/n(20M)/ac(20M) 5.2G	36	_	48
	WLAN802.11 n(40M)/ac(40M) 5.2G	38	_	46
	WLAN802.11 ac(80M) 5.2G		42	
	WLAN802.11 a/n(20M)/ac(20M) 5.3G	52	_	64
<b>.</b>	WLAN802.11 n(40M)/ac(40M) 5.3G		_	62
Channel Number (ARFCN)	WLAN802.11 ac(80M) 5.3G		58	
	WLAN802.11 a/n/ac(20M) 5.6G		_	144
	WLAN802.11 n/ac(40M) 5.6G	102	_	142
	WLAN802.11 ac(80M) 5.6G		_	138
	WLAN802.11 a/n(20M)/ac(20M) 5.8G	149	_	165
	WLAN802.11 n(40M)/ac(40M) 5.8G		_	159
	WLAN802.11 ac(80M) 5.8G		155	
	Bluetooth	0	_	78

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Max. SAR (1g) (Unit: W/Kg)								
Antenna	Band	Measured	Reported	Channel	Position			
	WLAN802.11 b	0.31	0.31	6	Top side			
	WLAN802.11 n(40M) 5.2G	0.46	0.46	46	Top side			
Main	WLAN802.11 n(40M) 5.3G	0.47	0.47	54	Top side			
	WLAN802.11 ac(80M) 5.6G	0.48	0.48	106	Top side			
	WLAN802.11 ac(80M) 5.8G	0.55	0.56	155	Top side			
	WLAN802.11 b	0.56	0.56	6	Top side			
	Bluetooth (GFSK)	0.05	0.06	78	Top side			
Δυγ	WLAN802.11 n(40M) 5.2G	0.35	0.35	38	Top side			
Aux	WLAN802.11 n(40M) 5.3G	0.37	0.37	54	Top side			
	WLAN802.11 ac(80M) 5.6G	0.32	0.33	138	Top side			
	WLAN802.11 ac(80M) 5.8G	0.31	0.31	155	Top side			

#### Antenna Information

Tablet mode									
Vendor		INF	PAQ			INPAQ			
Antenna		Main (	(PIFA)			Aux (	PIFA)		
Part Number	025.	90192.0001	(81EAAL15.0	GJQ)	025.	90193.0001	(81EAAL15.0	GJR)	
Frequency	2.4G	5.2G	5.5G	5.8G	2.4G	5.2G	5.5G	5.8G	
Gain (dBi)	-1.56	2.61	0.42	-1.43	-0.78	-1.01	0.16	-2.1	
			1	NB mode					
Antenna		Main (	(PIFA)			Aux (	PIFA)		
Part Number	025.90192.0001 (81EAAL15.GJQ)				025.	90193.0001	(81EAAL15.0	GJR)	
Frequency	2.4G	5.2G	5.5G	5.8G	2.4G	5.2G	5.5G	5.8G	
Gain (dBi)	-4.42	-1.53	-1.70	-0.12	-0.9	0.35	-0.16	-3.39	

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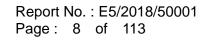
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Antenna	SI	SO	MIMO
Band	Chain 0	Chain 1	Chain0+1
WLAN802.11b	V	V	-
WLAN802.11g	V	V	-
WLAN802.11n(20M)	V	V	V
WLAN802.11n(40M)	V	V	V
WLAN802.11a	V	V	-
WLAN802.11n(20M) 5G	V	V	V
WLAN802.11n(40M) 5G	V	V	V
WLAN802.11ac(20M) 5G	V	V	V
WLAN802.11ac(40M) 5G	V	V	V
WLAN802.11ac(80M) 5G	V	V	V

#### WLAN802.11 a/b/g/n(20M/40M)/ac(20M/40M/80M) conducted power table:

#### Main (Chain 0) (full power)

Main Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)		
		1	2412		18.00	17.93		
		2	2417		20.00	19.96		
	802.11b	6	2437	1Mbps	20.00	19.98		
		10	2457		20.00	19.92		
		11	2462		19.00	18.87		
	802.11g	1	2412	6Mbps	17.00	16.92		
		2	2417		19.00	18.95		
		6	2437		20.00	19.96		
2450 MHz		10	2457		19.00	18.90		
2400 1011 12		11	2462		17.00	16.93		
		1	2412		17.00	16.94		
		2	2417		19.00	18.88		
	802.11n20-HT0	6	2437	MCS0	20.00	19.97		
		10	2457		19.00	18.89		
		11	2462		17.00	16.93		
		3	2422		16.00	15.86		
	802.11n40-HT0	6	2437	MCS0	16.50	16.42		
		9	2452		15.00	14.96		

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		Main /	Antenna			
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
		104	5520		20.00	19.99
		116	5580		20.00	19.95
	802.11a	120	5600	GMbba	20.00	19.93
	802.11a	124	5620	6Mbps	20.00	19.88
		128	5640		20.00	19.94
		136	5680		20.00	19.97
		104	5520		20.00	19.96
		116	5580		20.00	19.99
	802.11n20-HT0	120	5600	MCS0	20.00	19.91
	оо <u>г</u> .тпго-нто	124	5620	IVICSU	20.00	19.95
		128	5640		20.00	19.90
		136	5680		20.00	19.93
	802.11ac20-VHT0	104	5520		20.00	19.99
		116	5580	MCS0	20.00	19.97
		120	5600		20.00	19.98
		124	5620		20.00	19.94
5600 MHz		128	5640		20.00	19.96
		136	5680		20.00	19.98
		144	5720		19.00	18.94
		102	5510		16.00	15.98
		110	5550		20.00	19.95
	802.11n40-HT0	118	5590	MCS0	20.00	19.99
	002.11140-1110	126	5630	10000	20.00	19.95
		134	5670		19.00	18.99
		142	5710		20.00	19.99
		102	5510		16.00	15.96
		110	5550		20.00	19.89
	802.11ac40-VHT0	118	5590	MCS0	20.00	19.92
		126	5630		20.00	19.98
		134	5670		19.00	18.97
		142	5710		20.00	19.99
		106	5530		16.00	15.99
	802.11ac80-VHT0	122	5610	MCS0	18.00	17.98
		138	5690		20.00	19.98

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	Main Antenna									
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)				
		149	5745		20.00	19.99				
	802.11a	157	5785	6Mbps	20.00	19.96				
		165	5825		20.00	19.93				
	802.11n20-HT0	149	5745	MCS0	20.00	19.97				
		157	5785		20.00	19.95				
		165	5825		20.00	19.98				
5800 MHz		149	5745		20.00	19.89				
5000 1011 12	802.11ac20-VHT0	157	5785	MCS0	20.00	19.94				
		165	5825		20.00	19.99				
	802.11n40-HT0	151	5755	MCS0	20.00	19.96				
	002.11140-1110	159	5795	NIC30	20.00	19.98				
	802.11ac40-VHT0	151	5755	MCS0	20.00	19.95				
	002.118040-01110	159	5795	10000	20.00	19.90				
	802.11ac80-VHT0	155	5775	MCS0	18.00	17.99				

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# Aux (Chain 1) (full power)

Aux Antenna									
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)			
		1	2412		18.00	17.95			
		2	2417		20.00	19.97			
	802.11b	6	2437	1Mbps	20.00	19.99			
		10	2457		20.00	19.95			
		11	2462		19.00	18.86			
		1	2412	6Mbps	16.00	15.94			
		2	2417		19.00	18.96			
	802.11g	6	2437		20.00	19.99			
2450 MHz		10	2457		19.00	18.93			
2430 1011 12		11	2462		16.00	15.86			
		1	2412		16.00	15.95			
		2	2417		19.00	18.97			
	802.11n20-HT0	6	2437	MCS0	20.00	19.93			
		10	2457		19.00	18.95			
		11	2462		16.00	15.98			
		3	2422		13.00	12.91			
	802.11n40-HT0	6	2437	MCS0	16.50	16.46			
		9	2452		15.00	14.97			

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	Aux Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)			
		36	5180		18.00	17.95			
	802.11a	40	5200	6Mbps	20.00	19.96			
	002.118	44	5220	Olvibps	20.00	19.99			
		48	5240		20.00	19.98			
	802.11n20-HT0	36	5180	MCS0	18.00	17.92			
		40	5200		20.00	19.89			
		44	5220		20.00	19.91			
		48	5240		20.00	19.93			
5.15-5.25 GHz		36	5180		18.00	17.99			
	802.11ac20-VHT0	40	5200	MCS0	20.00	19.92			
	002.118620-01110	44	5220	WC30	20.00	19.00			
		48	5240		20.00	19.97			
	802.11n40-HT0	38	5190	MCS0	17.00	16.96			
	002.11140-1110	46	5230	IVIC30	20.00	19.99			
	802.11ac40-VHT0	38	5190	MCS0	17.00	16.95			
	002.11a040-VH10	46	5230	IVICSU	20.00	19.97			
	802.11ac80-VHT0	42	5210	MCS0	13.00	12.99			

	Aux Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)			
		52	5260		20.00	19.99			
	802.11a	56	5280	6Mbps	20.00	19.93			
	002.118	60	5300	olviops	20.00	19.97			
		64	5320		17.00	16.93			
	802.11n20-HT0	52	5260	MCS0	20.00	19.94			
		56	5280		20.00	19.96			
		60	5300		20.00	19.99			
		64	5320		17.00	16.92			
5.25-5.35 GHz		52	5260		20.00	19.98			
	802.11ac20-VHT0	56	5280	MCS0	20.00	19.95			
	002.118020-01110	60	5300	WCCO	20.00	19.97			
		64	5320		17.00	16.93			
	802.11n40-HT0	54	5270	MCS0	20.00	19.96			
	002.11140-1110	62	5310	10000	13.00	12.95			
	802.11ac40-VHT0	54	5270	MCS0	20.00	19.99			
	002.118040-01110	62	5310	NIC30	13.00	12.95			
	802.11ac80-VHT0	58	5290	MCS0	11.00	10.97			

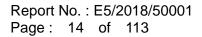
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		Aux An	Itenna			
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
	802.11a	104 116 120 124 128 136	5520 5580 5600 5620 5640 5680	6Mbps	20.00 20.00 20.00 20.00 20.00 20.00	19.96 19.99 19.91 19.94 19.96 19.98
	802.11n20-HT0	104 116 120 124 128 136	5520 5580 5600 5620 5640 5680	MCS0	20.00 20.00 20.00 20.00 20.00 20.00	19.92 19.93 19.99 19.95 19.93 19.88
5600 MHz	802.11ac20-VHT0	104 116 120 124 128 136 144	5520 5580 5600 5620 5640 5680 5720	MCS0	20.00 20.00 20.00 20.00 20.00 20.00 19.00	19.90 19.99 19.96 19.93 19.95 19.97 18.99
	802.11n40-HT0	102 110 118 126 134 142	5510 5550 5590 5630 5670 5710	MCS0	18.00 20.00 20.00 20.00 19.00 20.00	17.95 19.98 19.96 19.89 18.92 19.95
	802.11ac40-VHT0	102 110 118 126 134 142	5510 5550 5590 5630 5670 5710	MCS0	18.00 20.00 20.00 20.00 19.00 20.00	17.95 19.99 19.96 19.94 18.90 19.96
	802.11ac80-VHT0	106 122 138	5530 5610 5690	MCS0	13.00 19.00 19.00	12.96 18.98 18.99

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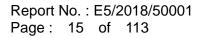
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		Aux Ar	ntenna			
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
		149	5745		20.00	19.96
	802.11a	157	5785	6Mbps	20.00	19.92
		165	5825		20.00	19.88
	802.11n20-HT0	149	5745	MCS0	20.00	19.99
		157	5785		20.00	19.93
		165	5825		20.00	19.97
5800 MHz		149	5745		20.00	19.95
5000 WII 12	802.11ac20-VHT0	157	5785	MCS0	20.00	19.92
		165	5825		20.00	19.89
	802.11n40-HT0	151	5755	MCS0	20.00	19.91
	002.11140-1110	159	5795	10000	20.00	19.99
	802.11ac40-VHT0	151	5755	MCS0	20.00	19.91
	002.110040-01110	159	5795		20.00	19.94
	802.11ac80-VHT0	155	5775	MCS0	18.00	17.95

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# Main (Chain 0) (reduced power)

	Main Antenna									
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)				
		1	2412		18.00	17.93				
		2	2417		20.00	19.96				
	802.11b	6	2437	1Mbps	20.00	19.98				
		10	2457		20.00	19.92				
		11	2462		19.00	18.87				
		1	2412	6Mbps	17.00	16.92				
		2	2417		19.00	18.95				
	802.11g	6	2437		20.00	19.96				
2450 MHz		10	2457		19.00	18.90				
2430 1011 12		11	2462		17.00	16.93				
		1	2412		17.00	16.94				
		2	2417		19.00	18.88				
	802.11n20-HT0	6	2437	MCS0	20.00	19.97				
		10	2457		19.00	18.89				
		11	2462		17.00	16.93				
		3	2422		16.00	15.86				
	802.11n40-HT0	6	2437	MCS0	16.50	16.42				
		9	2452		15.00	14.96				

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		Main A	Antenna			
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
		36	5180		16.00	15.96
	802.11a	40	5200	6Mbps	16.00	15.93
	002.11a	44	5220	olviops	16.00	15.97
		48	5240		16.00	15.95
		36	5180		16.00	15.94
	802.11n20-HT0	40	5200	MCS0	16.00	15.95
	ου <u>2.1112</u> 0-ΠΤΟ	44	5220	NIC30	16.00	15.90
		48	5240		16.00	15.93
5.15-5.25 GHz		36	5180		16.00	15.87
	802.11ac20-VHT0	40	5200	MCS0	16.00	15.90
	002.11ac20-01110	44	5220	IVICSU	16.00	15.89
		48	5240		16.00	15.93
	802.11n40-HT0	38	5190	MCS0	16.00	15.95
		46	5230	IVIC30	16.00	15.97
	802.11ac40-VHT0	38	5190	MCS0	16.00	15.92
	002.118040-01110	46	5230	10030	16.00	15.90
	802.11ac80-VHT0	42	5210	MCS0	13.00	12.97
		Main /	Antenna			
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
		52	5260		16.00	15.96
	802.11a	56	5280	6Mbpc	16.00	15.98
	ouz.11a	60	5300	6Mbps	16.00	15.95
		64	5320		16.00	15.94
		52	5260		16.00	15.93
	802.11n20-HT0	56	5280	MCS0	16.00	15.98
	ου <u>2.11112</u> 0-ΠΤΟ	60	5300	IVICSU	16.00	15.99
				1		

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802.11ac20-VHT0

802.11n40-HT0

802.11ac40-VHT0

802.11ac80-VHT0

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SGS Taiwan Ltd.

台灣檢驗科技股份有限公司

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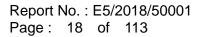
15.94

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13.92

11.90





		Main A	Antenna			
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
		100	5500		16.00	15.96
		116	5580		16.00	15.98
	802.11a	120	5600	GMbpo	16.00	15.90
	802.11a	124	5620	6Mbps	16.00	15.86
		128	5640		16.00	15.89
		140	5700		16.00	15.94
		100	5500		16.00	15.99
		116	5580		16.00	15.97
		120	5600	MOCO	16.00	15.86
	802.11n20-HT0	124	5620	MCS0	16.00	15.92
		128	5640		16.00	15.90
		140	5700		16.00	15.96
		100	5500		16.00	15.99
		116	5580		16.00	15.97
		120	5600	MCS0	16.00	15.92
	802.11ac20-VHT0	124	5620		16.00	15.90
5600 MHz		128	5640		16.00	15.91
		140	5700		16.00	15.95
		144	5720		16.00	15.98
		102	5510		16.00	15.95
		110	5550		16.00	15.97
	802.11n40-HT0	118	5590	MCS0	16.00	15.92
		126	5630		16.00	15.90
		134	5670		16.00	15.96
		102	5510		16.00	15.98
		110	5550		16.00	15.99
	802.11ac40-VHT0	118	5590	MCS0	16.00	15.93
	002.11aC40-VH10	126	5630	IVICSU	16.00	15.87
		134	5670		16.00	15.93
		142	5710		16.00	15.91
		106	5530		16.00	15.97
	802.11ac80-VHT0	122	5610	MCS0	16.00	15.92
		138	5690		16.00	15.94

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	Main Antenna								
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)			
		149	5745		16.00	15.94			
	802.11a	157	5785	6Mbps	16.00	15.99			
		165	5825		16.00	15.92			
	802.11n20-HT0	149	5745	MCS0	16.00	15.84			
		157	5785		16.00	15.89			
		165	5825		16.00	15.93			
5800 MHz		149	5745		16.00	15.92			
5000 1011 12	802.11ac20-VHT0	157	5785	MCS0	16.00	15.95			
		165	5825		16.00	15.99			
	802.11n40-HT0	151	5755	MCS0	16.00	15.89			
	002.11140-1110	159	5795	10000	16.00	15.90			
	802.11ac40-VHT0	151	5755	MCS0	16.00	15.94			
	002.110040-01110	159	5795	10000	16.00	15.88			
	802.11ac80-VHT0	155	5775	MCS0	16.00	15.98			

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# Aux (Chain 1) (reduced power)

Aux Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)			
		1	2412		18.00	17.95		
		2	2417		20.00	19.97		
	802.11b	6	2437	1Mbps	20.00	19.99		
		10	2457		20.00	19.95		
		11	2462		19.00	18.86		
		1	2412		15.94			
		2	2417		19.00	18.96		
	802.11g	6	2437	6Mbps	20.00	19.99		
2450 MHz		10	2457		19.00	18.93		
2430 1011 12		11	2462		16.00	15.86		
		1	2412	16.00	16.00	15.95		
		2	2417		19.00	18.97		
	802.11n20-HT0	6	2437	MCS0	20.00	19.93		
		10	2457		19.00	18.95		
		11	2462		16.00	15.98		
		3			13.00	12.91		
	802.11n40-HT0	6	2437	MCS0	16.50	16.46		
		9	2452		15.00	14.97		

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Aux Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)		
		36	5180		16.00	15.92		
	802.11a	40	5200	6Mbps	16.00	15.95		
	002.118	44	5220	000000	16.00	15.99		
		48			16.00	15.96		
		36	5180	MCS0	16.00	15.92		
	802.11n20-HT0	40	5200		16.00	15.89		
	002.11120-1110	44	5220	10000	16.00	15.90		
		48	5240		16.00	15.94		
5.15-5.25 GHz		36	5180		16.00	15.93		
	802.11ac20-VHT0	40	5200	MCS0	16.00	15.95		
	002.118020-01110	44	5220	10000	16.00	15.91		
		48	5240		16.00	15.89		
	802.11n40-HT0	38	5190	MCS0	16.00	15.97		
	002.11140-1110	46	5230	10000	16.00	15.94		
	802.11ac40-VHT0	38	5190	MCS0	16.00	15.88		
	002.118040-01110	46	5230	10000	16.00	15.93		
	802.11ac80-VHT0	42	5210	MCS0	13.00	12.86		

Aux Antenna										
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)				
		52	5260		16.00	15.98				
	802.11a	56	5280	6Mbps	16.00	15.95				
	002.114	60	5300	olvibps	16.00	15.96				
		64	5320		16.00	15.97				
		52	5260	MCS0	16.00	15.89				
	802.11n20-HT0	56	5280		16.00	15.89 15.92 15.90				
	002.11120-1110	60	5300		16.00	15.90				
		64	5320		16.00	15.96				
5.25-5.35 GHz		52	5260		16.00	15.94				
	802.11ac20-VHT0	56	5280	MCS0	16.00	15.95           15.96           15.97           15.89           15.92           15.96           15.96           15.96           15.98           15.93           15.93           15.92				
	002.118620-01110	60	5300	10000	16.00	16.0015.9416.0015.9916.0015.98				
		64	5320		16.00	15.93				
	802.11n40-HT0	54	5270	MCS0	16.00	15.92				
	002.11140-1110	62	5310	NO SU	13.00	12.92				
	802.11ac40-VHT0	54	5270	MCS0	16.00	15.85				
	002.110040-01110	62	5310	10000	13.00	12.94				
	802.11ac80-VHT0	58	5290	MCS0	11.00	10.93				

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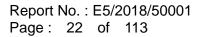
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	Aux Antenna								
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)			
	802.11a	100 116 120 124 128	5500 5580 5600 5620 5640	6Mbps	16.00 16.00 16.00 16.00 16.00	15.98 15.99 15.95 15.86 15.90			
	802.11n20-HT0	140 100 116 120 124 128 140	5700 5500 5580 5600 5620 5640 5700	MCS0	16.00 16.00 16.00 16.00 16.00 16.00 16.00	15.97 15.96 15.98 15.90 15.92 15.94 15.95			
5600 MHz	802.11ac20-VHT0	140 100 116 120 124 128 140 144	5500 5580 5600 5620 5640 5700 5720	MCS0	16.00 16.00 16.00 16.00 16.00 16.00 16.00	15.93 15.93 15.97 15.92 15.90 15.94 15.97 15.95			
	802.11n40-HT0	102 110 118 126 134	5510 5550 5590 5630 5670	MCS0	16.00 16.00 16.00 16.00 16.00	15.99 15.95 15.90 15.91 15.93			
	802.11ac40-VHT0	102 110 118 126 134 142	5510 5550 5630 5670 5710	MCS0	16.00 16.00 16.00 16.00 16.00 16.00	15.98 15.99 15.92 15.90 15.96 15.94			
	802.11ac80-VHT0	106 122 138	5530 5610 5690	MCS0	13.00 16.00 16.00	12.94 15.91 15.94			

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Aux Antenna							
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)	
		149	5745		16.00	15.92	
	802.11a	157	5785	6Mbps	16.00	15.90	
		165	5825		16.00	15.94	
		149		16.00	15.99		
	802.11n20-HT0	157	5785	MCS0	16.00	15.97	
		165	5825		16.00	15.98	
5800 MHz		149	5745		16.00	15.93	
5000 WI 12	802.11ac20-VHT0	157	5785	MCS0	16.00	15.87	
		165	5825		16.00	15.91	
	802.11n40-HT0	151	5755	MCS0	16.00	15.89	
	002.11140-1110	159	5795	10030	16.00	15.88	
	802.11ac40-VHT0	151	5755	MCS0	16.00	15.95	
	002.110040-01110	159	5795	10000	16.00	15.97	
	802.11ac80-VHT0	155	5775	MCS0	16.00	15.93	

# Bluetooth conducted power table:

Mode	Channel Frequency (MHz)		Average Output Power (dBm)			Max. Rated Avg. Power + Max. Tolerance (dBm)
		1Mbps	2Mbps	3Mbps	Power + Max. Tolerance (dBill)	
	CH 00	2402	10.52	7.53	6.26	
BR/EDR	CH 39	2441	10.74	7.98	6.51	11.5
	CH 78	2480	10.83	7.95	6.54	

Mode	Channel	Frequency (MHz)		Max. Rated Avg. Power + Max. Tolerance (dBm)
			GFSK	Power + Max. Tolerance (dBill)
	CH 00	2402	6.69	
LE	CH 20	2442	6.73	7
	CH 39	2480	6.81	

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# **1.4 Test Environment**

Ambient Temperature: 22±2° C Tissue Simulating Liquid: 22±2° C

# **1.5 Operation Description**

Use chipset specific software to control the EUT, and makes it transmit in maximum power. Measurements are performed respectively on the lowest, middle and highest channels of the operating band(s). The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged.

EUT was tested as below based on KDB inquiry.

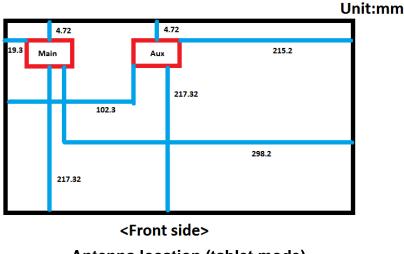
#### Tablet mode

Main antenna: Back/top/left sides\_0mm with reduced power

Aux antenna: Back/top sides\_0mm with reduced power

### Laptop mode

SAR measurement for Laptop SAR with full power is not required since the distance between antenna and user is > 20cm.



Antenna location (tablet mode)

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Note:

802.11b DSSS SAR Test Requirements:

- 1. SAR is measured for 2.4 GHz 802.11b DSSS mode using the highest measured maximum output power channel, when the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq$ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

802.11g/n OFDM SAR Test Exclusion Requirements:

SAR is not required for 802.11g/n since the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

Initial Test Configuration:

- 4. An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band.
- 5. SAR is measured using the highest measured maximum output power channel. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is  $\leq 1.2$ W/kg or all required channels are tested.
- 6. Since the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg, SAR is not required for subsequent test configuration.
- 7. For WLAN Main/Aux antennas, 5.2n(40M) / 5.3n(40M) / 5.6ac(80M) / 5.8ac(80M) is chosen to be the initial test configurations.
- 8. BT and WLAN Aux use the same antenna path, but they can't transmit at the same time.

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- 9. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR for the highest output channel is ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz.
- 10. According to KDB865664 D01, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is ≥ 0.8 W/kg, repeated that measurement once. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~10% from the 1-g SAR limit)
- 11.Based on KDB447498D01,
  - (1) SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances≤ 50 mm are determined by:

 $\frac{\text{Max.tune up power(mW)}}{\text{Min.test separation distance(mm)}} \times \sqrt{f(\text{GHz})} \le 3$ 

When the minimum test separation distance is < 5mm, 5mm is applied to determine SAR test exclusion.

(2) For test separation distances > 50 mm, and the frequency at 100 MHz to 1500MHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

[(Threshold at 50mm in step1) + (test separation distance-50mm) x  $\left(\frac{f(MHz)}{150}\right)$ ] (mW),

(3) For test separation distances > 50 mm, and the frequency at >1500MHz to 6GHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

[(Threshold at 50mm in step1) + (test separation distance-50mm)x10](mW),

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	Mode	WLAN Main 2.45GHz	WLAN Main 5GHz
Max. tune	-up power(dBm)	20	16
Max. tune	-up power(mW)	100.000	39.811
	Test separation distance	less than 5	less than 5
Top side	Calculation value	31.382	19.217
	Require SAR testing?	YES	YES
	Test separation distance	298.2	298.2
Right side	>20cm	YES	YES
	Require SAR testing?	NO	NO
	Test separation distance	19.3	19.3
Left side	Calculation value	8.130	4.978
	Require SAR testing?	YES	YES
	Test separation distance	217.32	217.32
Bottom side	>20cm	YES	YES
	Require SAR testing?	NO	NO
	Test separation distance	less than 5	less than 5
Back side	Calculation value	31.382	19.217
	Require SAR testing?	YES	YES

	Mode		WLAN Aux 5GHz	BT
Max. tune	up power(dBm)	20	16	11.5
Max. tune	-up power(mW)	100.000	39.811	14.125
	Test separation distance	less than 5	less than 5	less than 5
Top side	Calculation value	31.382	19.217	4.449
	Require SAR testing?	YES	YES	YES
Right side	Test separation distance	215.2	215.2	215.2
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
	Test separation distance	102.3	102.3	102.3
Left side	Calculation value	618.598	585.150	618.250
	Require SAR testing?	NO	NO	NO
	Test separation distance	217.32	217.32	217.32
Bottom side	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
	Test separation distance	less than 5	less than 5	less than 5
Back side	Calculation value	31.382	19.217	4.449
	Require SAR testing?	YES	YES	YES

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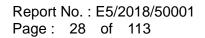
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# 1.6 Triggering verification for power reduction

The device is a convertible laptop computer with a lid open up to x360 degree. There are the sensors within this device, and the sensors can calculate the angle between the screen and the keyboard base, and then reduce the maximum power when operating in tablet mode.

Also, the G-sensor will calculate the hinge angle for power reduction and its operation is no related the triggering distance and coverage.

When the device is operated in the laptop mode, the power reduction will not be triggered, but when it is operating in the tablet mode, the power reduction will be triggered. Besides, the power reduction is a single fixed level of power reduction.

For the triggering verification, the measured conducted output power is monitored qualitatively to identify the triggering characteristics and recorded quantitatively, versus hinge angle.

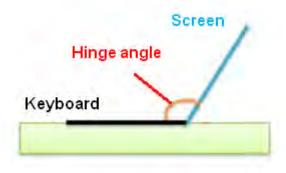


Illustration of hinge angle

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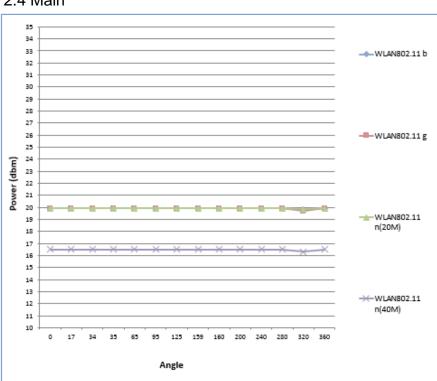
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#### 1.6.1 Results and conclusion

The measured output power versus hinge angle is tabulated in the following table, and the triggering verification complies with the device mode / power level declared by the manufacturer.

Laptop mode: full power  $(35^{\circ} - 159^{\circ})$ 

Tablet mode: reduced power



2.4 Main

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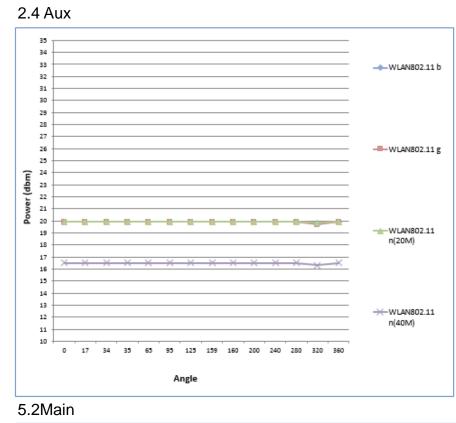
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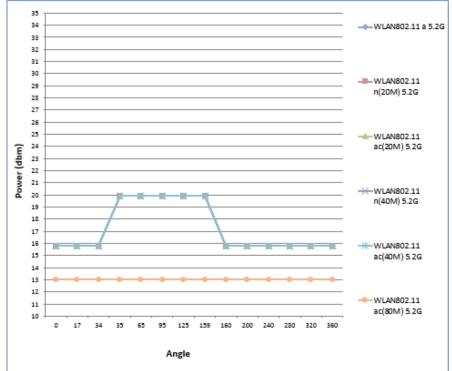
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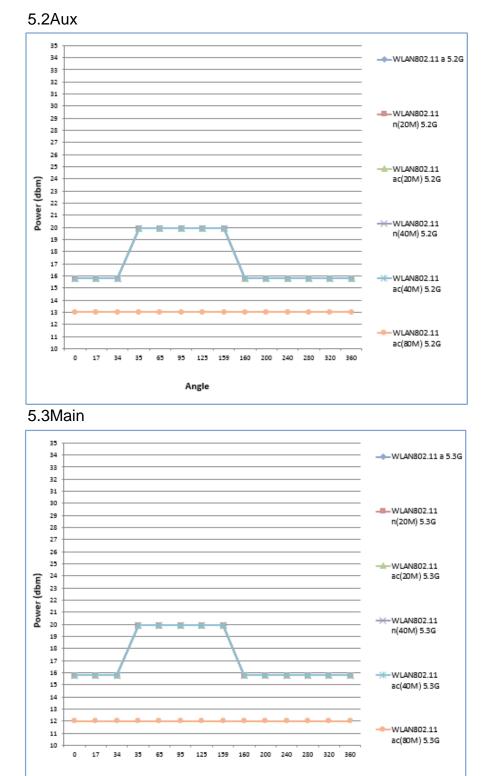
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Angle

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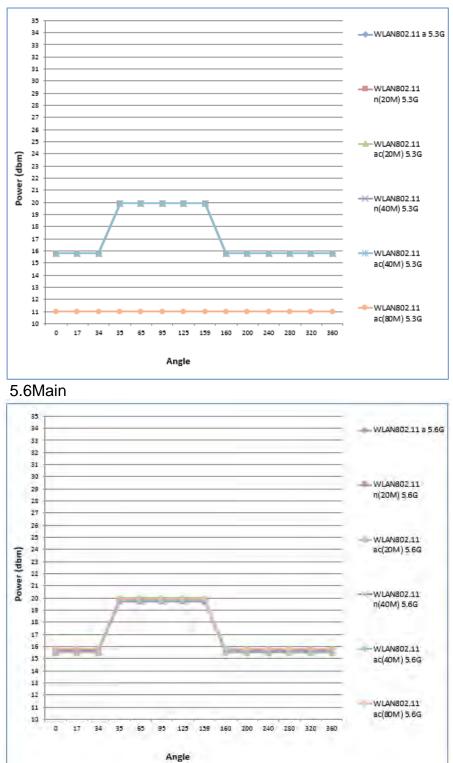
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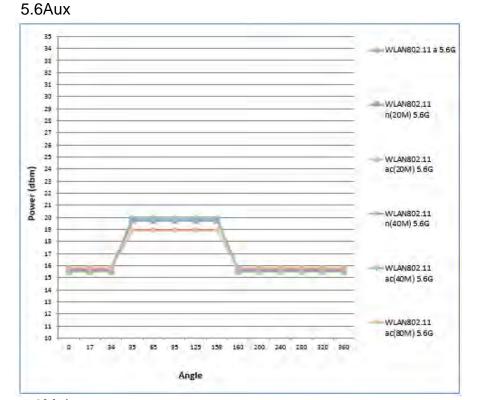
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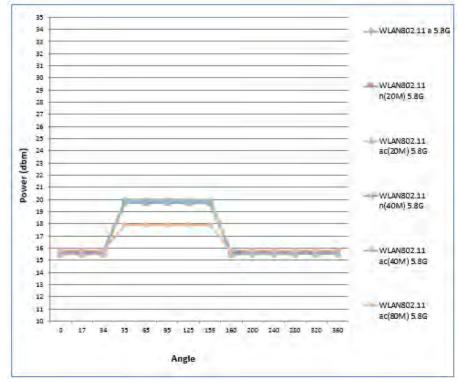
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#### 5.8Main



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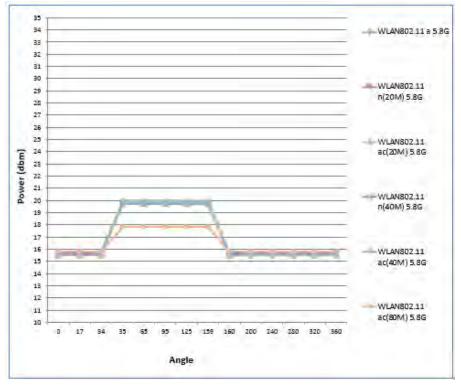
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### **1.7 The SAR Measurement System**

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR=  $\sigma$  (|Ei|<sup>2</sup>)/  $\rho$  where  $\sigma$  and  $\rho$  are the conductivity and mass density of the tissue-simulant.

The DASY 5 system for performing compliance tests consists of the following items:

- 1. A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- 2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage intissue simulating liquid. The probe is equipped with an optical surface detector system.
- 3. A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

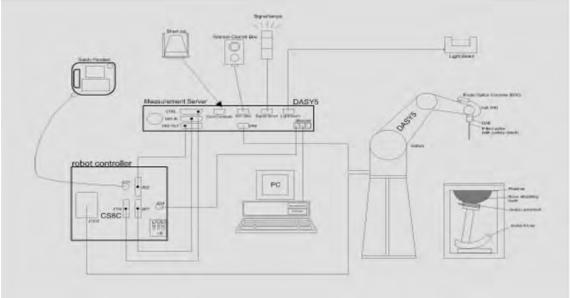


Fig. a The block diagram of SAR system

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- 4. The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- 5. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- 6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- 7. A computer operating Windows 7.
- 8. DASY 5 software.
- 9. Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- 10. The SAM twin phantom enabling testing left-hand and right-hand usage.
- 11. The device holder for handheld mobile phones.
- 12. Tissue simulating liquid mixed according to the given recipes.
- 13. Validation dipole kits allowing to validate the proper functioning of the system.

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#### **1.8 System Components**

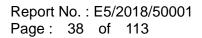
#### **EX3DV4 E-Field Probe**

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)					
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 2450/5200/5300/5600/5800 MHz Additional CF for other liquids and frequencies upon request					
Frequency	10 MHz to > 6 GHz					
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)					
Dynamic	$10 \mu\text{W/g}$ to > 100 mW/g					
Range	Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)					
Dimensions	Tip diameter: 2.5 mm					
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.					

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Model	ELI	
Construction	body-mounted wireless device to 6 GHz. ELI is fully constandard and all known tissure optimized regarding its perfor- our standard phantom tables. liquid. Reference markings of the complete setup, including and measurement grids, by	compliance testing of handheld and es in the frequency range of 30 MHz ompatible with the IEC 62209-2 ue simulating liquids. ELI has been ormance and can be integrated into A cover prevents evaporation of the on the phantom allow installation of g all predefined phantom positions teaching three points. The phantom dosimetric probes and dipoles.
Shell	2 ± 0.2 mm	
Thickness		
Filling Volume	Approx. 30 liters	
Dimensions	Major axis: 600 mm	THE REPORT OF THE PARTY OF THE
	Minor axis: 400 mm	

#### **DEVICE HOLDER**

Construction	The device holder (Supporter) for Notebook is made by POM (polyoxymethylene resin ) , which is non-metal and non-conductive. The height can be adjusted to fit varies kind of notebooks.	
		Device Holder

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#### **1.9 SAR System Verification**

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 2450/5200/5300/5600/5800 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the liquid depth above the ear reference points was  $\geq$  15 cm  $\pm$  5 mm (frequency  $\leq$  3 GHz) or  $\geq$  10 cm  $\pm$  5 mm (frequency > 3 G Hz) in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

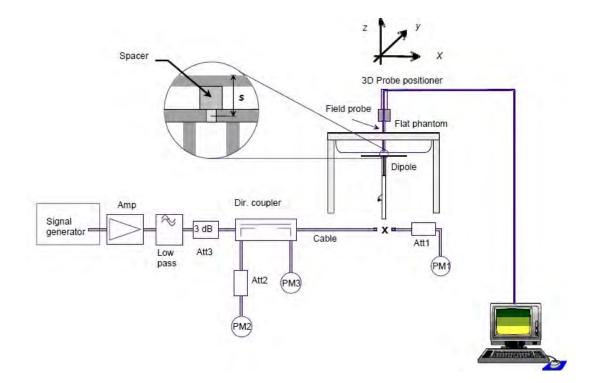


Fig. b The block diagram of system verification

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Validation Kit	S/N	Frequ (Mł	-	1W Target SAR-1g (mW/g)	Measured SAR-1g (mW/g)	Measured SAR-1g normalized to 1W (mW/g)	Deviation (%)	Measured Date
D2450V2	735	2450	Body	50.6	12.8	51.2	1.19%	May. 08, 2018
		5200	Body	74.2	7.24	72.4	-2.43%	May. 09, 2018
D5GHzV2	1040	5300	Body	76.8	7.75	77.5	0.91%	May. 10, 2018
D5GH2V2	1040	5600	Body	80	7.96	79.6	-0.50%	May. 11, 2018
		5800	Body	76.9	7.43	74.3	-3.38%	May. 14, 2018

Table 1. Results of system verification

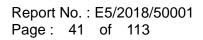
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#### 1.10 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this Head-simulant fluid were measured by using the Agilent Model 85070E Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Network Analyzer.

All dielectric parameters of tissue simulates were measured within 24 hours of SAR measurements. The measured conductivity and permittivity are all within  $\pm$  5% of the target values.

The depth of the tissue simulant in the flat section of the phantom was  $\geq$  15 cm ± 5 mm (Frequency  $\leq$ 3G) or  $\geq$  10 cm ± 5 mm (Frequency >3G) during all tests. (Fig. 2)

Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ɛr	Measured Conductivity, σ (S/m)	% dev ɛr	% dev σ
		2402	52.764	1.904	52.885	1.939	-0.23%	-1.83%
		2417	52.744	1.918	52.814	1.962	-0.13%	-2.27%
		2437	52.717	1.938	52.739	1.986	-0.04%	-2.50%
	May. 08, 2018	2441	52.712	1.941	52.745	1.993	-0.06%	-2.66%
		2450	52.700	1.950	52.699	2.006	0.00%	-2.87%
		2457	52.691	1.960	52.670	2.016	0.04%	-2.86%
		2480	52.662	1.993	52.576	2.047	0.16%	-2.73%
		5190	49.028	5.288	49.728	5.144	-1.43%	2.72%
		5200	49.014	5.299	49.568	5.141	-1.13%	2.99%
	May. 09, 2018	5220	48.987	5.323	49.548	5.187	-1.14%	2.55%
		5230	48.974	5.334	49.578	5.169	-1.23%	3.10%
		5240	48.960	5.346	49.679	5.207	-1.47%	2.60%
		5260	48.933	5.369	49.619	5.177	-1.40%	3.58%
		5270	48.919	5.381	49.460	5.285	-1.11%	1.78%
Body	May 10 2010	5280	48.906	5.393	49.370	5.273	-0.95%	2.22%
	May. 10, 2018	5300	48.879	5.416	49.301	5.258	-0.86%	2.92%
		5310	48.865	5.428	49.201	5.296	-0.69%	2.43%
		5320	48.851	5.439	49.312	5.310	-0.94%	2.38%
		5510	48.594	5.661	48.638	5.600	-0.09%	1.08%
		5530	48.566	5.685	48.598	5.639	-0.07%	0.80%
	May. 11, 2018	5550	48.539	5.708	48.529	5.675	0.02%	0.58%
	Way. 11, 2016	5600	48.471	5.766	48.560	5.759	-0.18%	0.13%
		5670	48.376	5.848	48.173	5.874	0.42%	-0.44%
		5690	48.349	5.872	48.293	5.885	0.12%	-0.23%
		5710	48.322	5.895	47.974	5.931	0.72%	-0.61%
		5755	48.261	5.947	47.980	5.949	0.58%	-0.03%
	May. 14, 2018	5775	48.234	5.971	48.001	6.034	0.48%	-1.06%
		5795	48.207	5.994	47.407	6.260	1.66%	-4.43%
		5800	48.200	6.000	47.917	5.991	0.59%	0.15%

#### Table 2. Dielectric Parameters of Tissue Simulant Fluid

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#### The composition of the tissue simulating liquid:

Frequency			Ingredient							
Frequency (MHz)	Mode	DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	Total amount		
2450M	Body	301.7ml	698.3ml	_	_	_	_	1.0L(Kg)		

#### Body Simulating Liquids for 5 GHz, Manufactured by SPEAG:

Ingredients	Water	Esters, Emulsifiers, Inhibitors	Sodium and Salt
(% by weight)	60-80	20-40	0-1.5

Table 3. Recipes for Tissue Simulating Liquid

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#### 1.11 Evaluation Procedures

The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- 1. The extraction of the measured data (grid and values) from the Zoom Scan.
- 2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- 3. The generation of a high-resolution mesh within the measured volume
- 4. The interpolation of all measured values from the measurement grid to the high-resolution grid
- 5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- 6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within –2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements.

The measured volume of 30x30x30mm contains about 30g of tissue.

The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D

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interpolation to get all points within the measured volume. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

#### **1.12 Probe Calibration Procedures**

For the calibration of E-field probes in lossy liquids, an electric field with an accurately known field strength must be produced within the measured liquid. For standardization purposes it would be desirable if all measurements which are necessary to assess the correct field strength would be traceable to standardized measurement procedures. In the following two different calibration techniques are summarized:

#### **1.12.1 Transfer Calibration with Temperature Probes**

In lossy liquids the specific absorption rate (SAR) is related both to the electric field (*E*) and the temperature gradient ( $\delta T / \delta t$ ) in the liquid.

$$SAR = C \frac{\delta T}{\delta t}$$
,

whereby  $\sigma$  is the conductivity,  $\rho$  the density and c the heat capacity of the liquid.

Hence, the electric field in lossy liquid can be measured indirectly by measuring the temperature gradient in the liquid. Non-disturbing temperature probes (optical probes or thermistor probes with resistive lines) with high spatial resolution (<1-2 mm) and fast reaction time (<1 s) are available and can be easily calibrated with high precision [1]. The setup and the exciting source have no influence on the calibration; only the relative positioning uncertainties of the standard temperature probe and the E-field probe to be calibrated must be considered. However, several problems limit the available accuracy of probe calibrations with temperature probes:

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- The temperature gradient is not directly measurable but must be evaluated from temperature measurements at different time steps. Special precaution is necessary to avoid measurement errors caused by temperature gradients due to energy equalizing effects or convection currents in the liquid. Such effects cannot be completely avoided, as the measured field itself destroys the thermal equilibrium in the liquid. With a careful setup these errors can be kept small.
- The measured volume around the temperature probe is not well defined. It is difficult to calculate the energy transfer from a surrounding gradient temperature field into the probe. These effects must be considered, since temperature probes are calibrated in liquid with homogeneous temperatures. There is no traceable standard for temperature rise measurements.
- The calibration depends on the assessment of the specific density, the heat capacity and the conductivity of the medium. While the specific density and heat capacity can be measured accurately with standardized procedures (~ 2% for c; much better for ρ), there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed ±5%.
- Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about  $\pm 10\%$  (RSS) [2]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in [3]. The estimated uncertainty of the setup is  $\pm 5\%$  (RSS) when the same liquid is used for the calibration and for actual measurements and  $\pm 7-9\%$  (RSS) when not, which is in good agreement with the estimates given in [2].

#### 1.12.2 Calibration with Analytical Fields

In this method a technical setup is used in which the field can be calculated analytically from measurements of other physical magnitudes (e.g., input power). This corresponds to the standard field method for probe calibration in air; however, there is no standard defined for fields in lossy liquids.

When using calculated fields in lossy liquids for probe calibration, several points must be considered in the assessment of the uncertainty:

- The setup must enable accurate determination of the incident power.
- The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.
- Due to the small wavelength in liquids with high permittivity, even small

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setups might be above the resonant cutoff frequencies. The field distribution in the setup must be carefully checked for conformity with the theoretical field distribution.

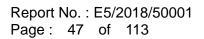
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#### 1.13 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1, By the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

- (1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube).
- Occupational/Controlled limits apply when persons are exposed as a (2) consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.
- Limits for General Population/Uncontrolled exposure: 0.08 W/kg as (3) averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not

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exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section. (Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Brain)	1.60 W/kg	8.00 W/kg
Spatial Average SAR (Whole Body)	0.08 W/kg	0.40 W/kg
Spatial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 W/kg	20.00 W/kg

Table 4. RF exposure limits

Notes:

- 1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
- 2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

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### 2. Summary of Results WLAN Antenna (reduced power)

Antenna	Mode	Position	Distance (mm)	СН	Freq. (MHz)	Max. Rated Avg. Power + Max.	Measured Avg. Power	Scaling	Averaged S (W/		Plot page
			()		(	Tolerance (dBm)	(dBm)		Measured	Reported	page
		Back side	0	6	2437	20.00	19.98	100.46%	0.052	0.052	-
	WLAN802.11 b	Top side	0	6	2437	20.00	19.98	100.46%	0.310	0.311	55
		Left side	0	6	2437	20.00	19.98	100.46%	0.239	0.240	-
		Back side	0	46	5230	16.00	15.97	100.69%	0.041	0.041	-
	WLAN802.11 n(40M) 5.2G	Top side	0	46	5230	16.00	15.97	100.69%	0.457	0.460	56
		Left side	0	46	5230	16.00	15.97	100.69%	0.136	0.137	-
		Back side	0	54	5270	16.00	15.94	101.39%	0.041	0.042	-
Main	WLAN802.11 n(40M) 5.3G	Top side	0	54	5270	16.00	15.94	101.39%	0.467	0.473	57
		Left side	0	54	5270	16.00	15.94	101.39%	0.132	0.134	-
		Back side	0	106	5530	16.00	15.97	100.69%	0.040	0.040	-
	WLAN802.11 ac(80M) 5.6G	Top side	0	106	5530	16.00	15.97	100.69%	0.477	0.480	58
		Left side	0	106	5530	16.00	15.97	100.69%	0.171	0.172	-
		Back side	0	155	5775	16.00	15.98	100.46%	0.037	0.037	-
	WLAN802.11 ac(80M) 5.8G	Top side	0	155	5775	16.00	15.98	100.46%	0.553	0.556	59
		Left side	0	155	5775	16.00	15.98	100.46%	0.189	0.190	-

#### WLAN Aux Antenna (reduced power)

Antenna	a Mode Position		Distance (mm)	СН	Freq. (MHz)	Max. Rated Avg. Power + Max.	Measured Avg. Power	Scaling	Averaged S (W/	0	Plot page
			( )		~ /	Tolerance (dBm)	(dBm)		Measured	Reported	1.54
	WLAN802.11 b	Back side	0	6	2437	20.00	19.99	100.23%	0.101	0.101	-
	W LAINOUZ. I I D	Top side	0	6	2437	20.00	19.99	100.23%	0.559	0.560	60
	Bluetooth (GFSK)	Back side	0	78	2480	11.50	10.83	116.68%	0.006	0.007	-
	Bideloolin (GFSR)	Top side	0	78	2480	11.50	10.83	116.68%	0.053	0.062	61
		Back side	0	38	5190	16.00	15.97	100.69%	0.070	0.070	-
Aux	WLAN802.11 n(40M) 5.2G	Top side	0	38	5190	16.00	15.97	100.69%	0.352	0.354	62
Aux	WLAN802.11 n(40M) 5.3G	Back side	0	54	5270	16.00	15.92	101.86%	0.061	0.062	-
	WLANOUZ. 11 11(4010) 5.30	Top side	0	54	5270	16.00	15.92	101.86%	0.367	0.374	63
	WLAN802.11 ac(80M) 5.6G	Back side	0	138	5690	16.00	15.94	101.39%	0.053	0.054	-
		Top side	0	138	5690	16.00	15.94	101.39%	0.324	0.329	64
		Back side	0	155	5775	16.00	15.93	101.62%	0.056	0.057	-
	WLAN802.11 ac(80M) 5.8G	Top side	0	155	5775	16.00	15.93	101.62%	0.306	0.311	65

#### Note:

 $\frac{\text{reported SAR}}{\text{measured SAR}} = \frac{P2(mW)}{P1(mW)} = 10^{\left(\frac{P2-P1}{10}\right)(dBm)}$ Scaling = Reported SAR = measured SAR \* (scaling) Where P2 is maximum specified power, P1 is measured conducted power

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## 3. Simultaneous Transmission Analysis

#### Simultaneous Transmission Scenarios:

Simultaneous Transmit Configurations	Body
2.4GHz WLAN MIMO	Yes
5GHz WLAN MIMO	Yes
BT + 2.4GHz WLAN Main	Yes
BT + 5GHz WLAN Main	Yes

Note:

1. Bluetooth and WLAN Aux share the same antenna path, and BT can transmit with WLAN Main simultaneously.

2. For 2.4/5GHz WLAN Main and Aux antennas, the maximum output power of each antenna during simultaneous transmission is the same with that used in standalone transmission, and we used the sum of 1-g SAR provision in KDB447498D01 to exclude the simultaneous transmitted SAR measurement.

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#### 3.1 Estimated SAR calculation

According to KDB447498 D01v06 – When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

Estimated SAR =  $\frac{\text{Max.tune up power (mW)}}{\text{Min.test separation distance(mm)}} \times \frac{\sqrt{f(\text{GHz})}}{7.5}$ 

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

Mode / Band	position	test separation distance	Estimated SAR(W/kg)
ВТ	left side of tablet mode	> 50mm	0.4
WLAN Aux	left side of tablet mode	> 50mm	0.4

#### 3.1 SPLSR evaluation and analysis

Per KDB447498D01, when the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR sum to peak location separation ratio(SPLSR).

The simultaneous transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion.

The ratio is determined by (SAR1 + SAR2)^1.5/Ri, rounded to two decimal digits, and must be  $\leq$  0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

SAR1 and SAR2 are the highest reported or estimated SAR for each antenna in the pair, and Ri is the separation distance between the peak SAR locations for the antenna pair in mm.

When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna.

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#### 2.4 GHz WLAN MIMO (Tablet mode with reduced power)

No.	Conditions	Position	Max. WLAN Main	Max. WLAN Aux	SAR Sum	SPLSR
		Back side	0.052	0.101	0.153	ΣSAR<1.6, Not required
1	2.4 GHz WLAN Main + WLAN Aux	Top side	0.311	0.560	0.871	ΣSAR<1.6, Not required
		Left side	0.240	0.400	0.640	ΣSAR<1.6, Not required

#### 5 GHz WLAN MIMO (Tablet mode with reduced power)

No.	Conditions	Position	Max. WLAN Main	Max. WLAN Aux	SAR Sum	SPLSR
		Back side	0.042	0.070	0.112	ΣSAR<1.6, Not required
2	5 GHz WLAN Main + WLAN Aux	Top side	0.556	0.374	0.93	ΣSAR<1.6, Not required
		Left side	0.190	0.400	0.59	ΣSAR<1.6, Not required

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No.	Conditions	Position	Max. WLAN Main	BT	SAR Sum	SPLSR
		Back side	0.052	0.007	0.059	ΣSAR<1.6, Not required
3	2.4 GHz WLAN Main + BT	Top side	0.311	0.062	0.373	ΣSAR<1.6, Not required
		Left side	0.240	0.400	0.64	ΣSAR<1.6, Not required

#### BT+ 5GHz WLAN Main (Tablet mode with reduced power)

No.	Conditions	Position	Main	BT	SAR Sum	SPLSR
		Back side	0.042	0.007	0.049	ΣSAR<1.6, Not required
4	5 GHz WLAN Main + BT	Top side	0.556	0.062	0.618	ΣSAR<1.6, Not required
		Left side	0.190	0.400	0.59	ΣSAR<1.6, Not required

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## 4. Instruments List

Manufacturer	Device	Туре	Serial number	Date of last calibration	Date of next calibration
SPEAG	Dosimetric E-Field Probe	EX3DV4	7466	Jul.04,2017	Jul.03,2018
SPEAG	System Validation	D2450V2	735	Dec.15,2017	Dec.14,2018
OF LAG	Dipole	D5GHzV2	1040	Jul.13,2017	Jul.12,2018
SPEAG	Data acquisition Electronics	DAE4	547	Mar.16,2018	Mar.15,2019
SPEAG	Software	DASY 52 V52.8.8	N/A	Calibration not required	Calibration not required
SPEAG	Phantom	ELI	N/A	Calibration not required	Calibration not required
Agilent	Network Analyzer	E5071C	MY46107530	Feb.26,2018	Feb.25,2019
Agilent	Dielectric Probe Kit	85070E	MY44300677	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	MY46151242	Jul.11,2017	Jul.10,2018
Agilent	Signal Generator	N5181A	MY50144143	Mar.15,2018	Mar.14,2019
Agilent	Power Meter	E4417A	MY52240003	Dec.21,2017	Dec.20,2018
Agilopt	Power Sensor	E9301H	MY52200003	Dec.21,2017	Dec.20,2018
Agilent		L93011	MY52200004	Dec.21,2017	Dec.20,2018
Changzhou Xinwang	Digital thermometer	PT1	EC14011603-1	Jun.05,2017	Jun.04,2018

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### 5. Measurements

Date: 2018/5/8

### WLAN 802.11b Body Top side CH 6\_0mm Main

Communication System: WLAN 2.45G; Frequency: 2437 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2437 MHz;  $\sigma$  = 1.986 S/m;  $\epsilon_r$  = 52.739;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.4°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(7.94, 7.94, 7.94); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16 •
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

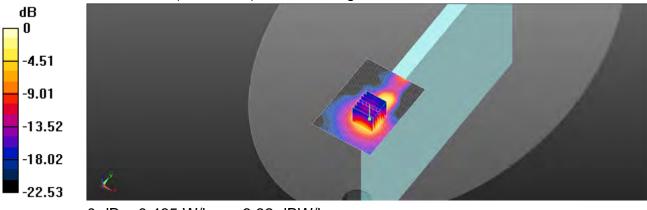
Configuration/Area Scan (71x101x1): Interpolated grid: dx=12 mm, dy=12 mm Maximum value of SAR (interpolated) = 0.459 W/kg

Configuration/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0.7320 V/m; Power Drift = 0.15 dB Peak SAR (extrapolated) = 0.631 W/kg

SAR(1 g) = 0.310 W/kg; SAR(10 g) = 0.144 W/kg

Maximum value of SAR (measured) = 0.465 W/kg



0 dB = 0.465 W/kg = -3.32 dBW/kg

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Date: 2018/5/9

#### WLAN 802.11n(40M) 5.2G\_Body\_Top side\_CH 46\_0mm\_Main

Communication System: WLAN 5G; Frequency: 5230 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5230 MHz;  $\sigma$  = 5.169 S/m;  $\epsilon_r$  = 49.579;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.3°C; Liquid temperature: 21.8°C

**DASY5** Configuration:

- Probe: EX3DV4 SN7466; ConvF(5.2, 5.2, 5.2); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body •
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

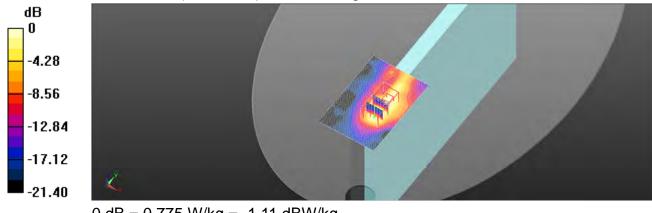
Configuration/Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.830 W/kg

#### Configuration/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.323 V/m; Power Drift = -0.12 dB Peak SAR (extrapolated) = 1.84 W/kg SAR(1 g) = 0.457 W/kg; SAR(10 g) = 0.162 W/kgMaximum value of SAR (measured) = 0.894 W/kg

Configuration/Zoom Scan (7x7x12)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.323 V/m; Power Drift = -0.12 dB Peak SAR (extrapolated) = 1.70 W/kg SAR(1 g) = 0.389 W/kg; SAR(10 g) = 0.129 W/kgMaximum value of SAR (measured) = 0.775 W/kg



0 dB = 0.775 W/kg = -1.11 dBW/kg

Date: 2018/5/10

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### WLAN 802.11n(40M) 5.3G\_Body\_Top side\_CH 54\_0mm\_Main

Communication System: WLAN 5G; Frequency: 5270 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5270 MHz;  $\sigma$  = 5.285 S/m;  $\epsilon_r$  = 49.46;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(5.1, 5.1, 5.1); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

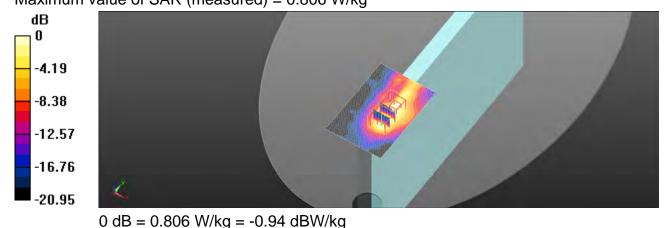
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.853 W/kg

## Configuration/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=2mm Reference Value = 1.155 V/m; Power Drift = 0.18 dB Peak SAR (extrapolated) = 1.86 W/kg SAR(1 g) = 0.467 W/kg; SAR(10 g) = 0.165 W/kg Maximum value of SAR (measured) = 0.917 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 1:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.155 V/m; Power Drift = 0.18 dB Peak SAR (extrapolated) = 1.79 W/kg SAR(1 g) = 0.400 W/kg; SAR(10 g) = 0.131 W/kg Maximum value of SAR (measured) = 0.806 W/kg



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Date: 2018/5/11

#### WLAN 802.11ac(80M) 5.6G\_Body\_Top side\_CH 106\_0mm\_Main

Communication System: WLAN 5G; Frequency: 5530 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5530 MHz;  $\sigma$  = 5.639 S/m;  $\epsilon_r$  = 48.598;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

Ambient temperature: 22.6°C; Liquid temperature: 21.2°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(4.27, 4.27, 4.27); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

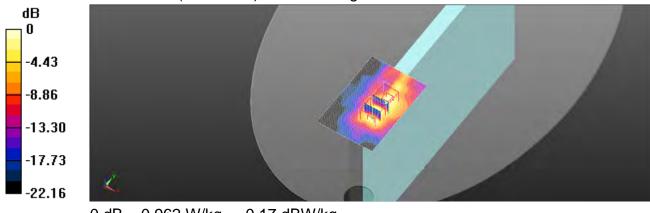
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.835 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.8380 V/m; Power Drift = 0.16 dB Peak SAR (extrapolated) = 1.93 W/kg SAR(1 g) = 0.477 W/kg; SAR(10 g) = 0.169 W/kg Maximum value of SAR (measured) = 0.965 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 1:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.8380 V/m; Power Drift = 0.16 dB Peak SAR (extrapolated) = 2.06 W/kg SAR(1 g) = 0.445 W/kg; SAR(10 g) = 0.138 W/kg Maximum value of SAR (measured) = 0.962 W/kg



0 dB = 0.962 W/kg = -0.17 dBW/kg

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Date: 2018/5/14

#### WLAN 802.11ac(80M) 5.8G\_Body\_Top side\_CH 155\_0mm\_Main

Communication System: WLAN 5G; Frequency: 5775 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5775 MHz;  $\sigma$  = 6.034 S/m;  $\epsilon_r$  = 48.001;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

Ambient temperature: 22.1°C; Liquid temperature: 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(4.48, 4.48, 4.48); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

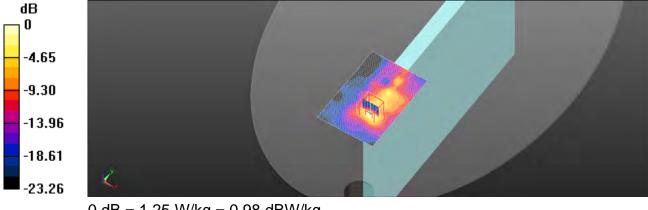
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 1.24 W/kg

# **Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.282 V/m; Power Drift = -0.19 dB Peak SAR (extrapolated) = 2.79 W/kg

SAR(1 g) = 0.553 W/kg; SAR(10 g) = 0.152 W/kg

Maximum value of SAR (measured) = 1.25 W/kg



0 dB = 1.25 W/kg = 0.98 dBW/kg

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Date: 2018/5/8

#### WLAN 802.11b\_Body\_Top side\_CH 6\_0mm\_Aux

Communication System: WLAN 2.45G; Frequency: 2437 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2437 MHz;  $\sigma$  = 1.986 S/m;  $\epsilon_r$  = 52.739;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.4°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(7.94, 7.94, 7.94); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

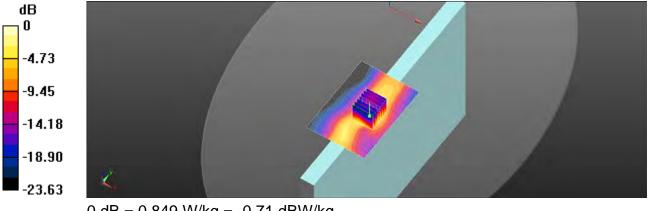
**Configuration/Area Scan (71x101x1):** Interpolated grid: dx=12 mm, dy=12 mm Maximum value of SAR (interpolated) = 0.856 W/kg

# **Configuration/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 10.73 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 1.15 W/kg

SAR(1 g) = 0.559 W/kg; SAR(10 g) = 0.260 W/kg

Maximum value of SAR (measured) = 0.849 W/kg



0 dB = 0.849 W/kg = -0.71 dBW/kg

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Date: 2018/5/8

#### Bluetooth(GFSK)\_Body\_Top side\_CH 78\_0mm\_Aux

Communication System: Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2480 MHz;  $\sigma$  = 2.047 S/m;  $\epsilon_r$  = 52.576;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.4°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(7.94, 7.94, 7.94); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

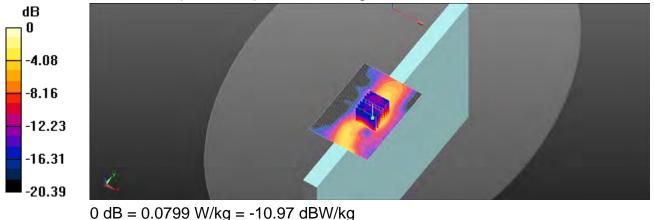
**Configuration/Area Scan (71x101x1):** Interpolated grid: dx=12 mm, dy=12 mm Maximum value of SAR (interpolated) = 0.0811 W/kg

# **Configuration/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.181 V/m; Power Drift = 0.17 dB Peak SAR (extrapolated) = 0.112 W/kg

SAR(1 g) = 0.053 W/kg; SAR(10 g) = 0.025 W/kg

Maximum value of SAR (measured) = 0.0799 W/kg



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Date: 2018/5/9

#### WLAN 802.11n(40M) 5.2G\_Body\_Top side\_CH 38\_0mm\_Aux

Communication System: WLAN 5G; Frequency: 5190 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5190 MHz;  $\sigma$  = 5.144 S/m;  $\epsilon_r$  = 49.727;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

Ambient temperature: 22.3°C; Liquid temperature: 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(5.2, 5.2, 5.2); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

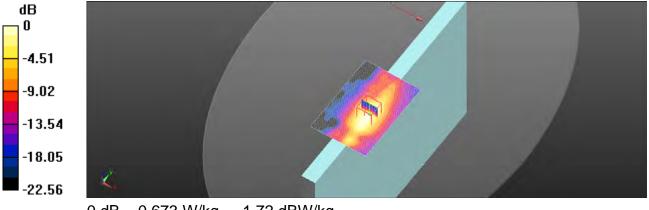
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.659 W/kg

# **Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.991 V/m; Power Drift = 0.12 dBPeak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.352 W/kg; SAR(10 g) = 0.133 W/kg

Maximum value of SAR (measured) = 0.673 W/kg



0 dB = 0.673 W/kg = -1.72 dBW/kg

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Date: 2018/5/10

#### WLAN 802.11n(40M) 5.3G\_Body\_Top side\_CH 54\_0mm\_Aux

Communication System: WLAN 5G; Frequency: 5270 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5270 MHz;  $\sigma$  = 5.285 S/m;  $\epsilon_r$  = 49.46;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.8°C

Ambient temperature. 22.1 °C, Elquid temperature.

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(5.1, 5.1, 5.1); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

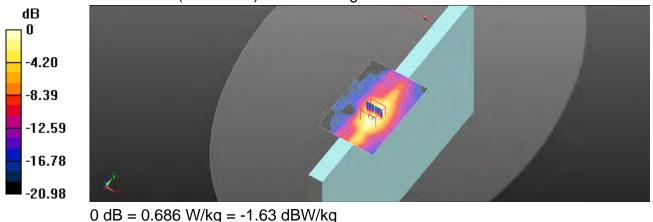
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.707 W/kg

# **Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.462 V/m; Power Drift = 0.17 dB Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.367 W/kg; SAR(10 g) = 0.140 W/kg

Maximum value of SAR (measured) = 0.686 W/kg



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Date: 2018/5/11

#### WLAN 802.11ac(80M) 5.6G\_Body\_Top side\_CH 138\_0mm\_Aux

Communication System: WLAN 5G; Frequency: 5690 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5690 MHz;  $\sigma$  = 5.885 S/m;  $\epsilon_r$  = 48.293;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

Ambient temperature: 22.6°C; Liquid temperature: 21.2°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(4.27, 4.27, 4.27); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

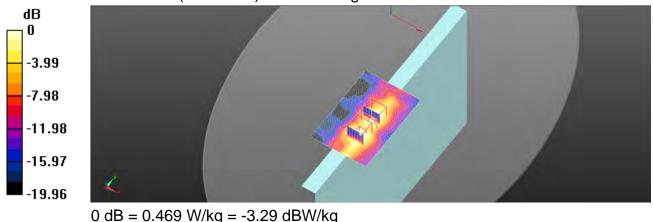
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.632 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 5.379 V/m; Power Drift = 0.11 dB Peak SAR (extrapolated) = 1.43 W/kg SAR(1 g) = 0.324 W/kg; SAR(10 g) = 0.107 W/kg Maximum value of SAR (measured) = 0.647 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 1:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 5.379 V/m; Power Drift = 0.11 dB Peak SAR (extrapolated) = 1.02 W/kg SAR(1 g) = 0.245 W/kg; SAR(10 g) = 0.094 W/kg Maximum value of SAR (measured) = 0.469 W/kg



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Date: 2018/5/14

#### WLAN 802.11ac(80M) 5.8G\_Body\_Top side\_CH 155\_0mm\_Aux

Communication System: WLAN 5G; Frequency: 5775 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5775 MHz;  $\sigma$  = 6.034 S/m;  $\epsilon_r$  = 48.001;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

Ambient temperature: 22.1°C; Liquid temperature: 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 SN7466; ConvF(4.48, 4.48, 4.48); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

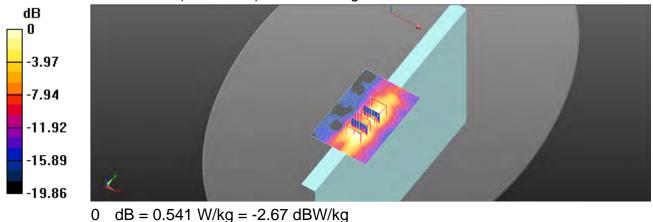
**Configuration/Area Scan (81x121x1):** Interpolated grid: dx=10 mm, dy=10 mm Maximum value of SAR (interpolated) = 0.673 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 6.096 V/m; Power Drift = -0.13 dB Peak SAR (extrapolated) = 1.51 W/kg SAR(1 g) = 0.306 W/kg; SAR(10 g) = 0.108 W/kg Maximum value of SAR (measured) = 0.651 W/kg

**Configuration/Zoom Scan (7x7x12)/Cube 1:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 6.096 V/m; Power Drift = -0.13 dB Peak SAR (extrapolated) = 1.22 W/kg SAR(1 g) = 0.274 W/kg; SAR(10 g) = 0.097 W/kg Maximum value of SAR (measured) = 0.541 W/kg



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## **6.SAR System Performance Verification**

#### Dipole 2450 MHz\_SN:735

Date: 2018/5/8

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz;  $\sigma$  = 2.006 S/m;  $\epsilon_r$  = 52.699;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.4°C

#### **DASY5** Configuration:

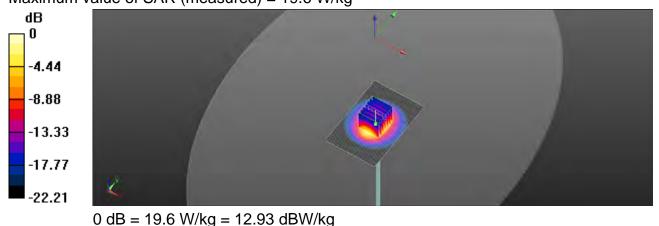
- Probe: EX3DV4 SN7466; ConvF(7.94, 7.94, 7.94); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

# **Configuration/Pin=250mW/Area Scan (61x91x1):** Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 20.6 W/kg

#### Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid:

dx=5mm, dy=5mm, dz=5mm Reference Value = 101.0 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 26.6 W/kg SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.93 W/kg Maximum value of SAR (measured) = 19.6 W/kg



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### Dipole 5200 MHz\_SN:1040

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5200 MHz;  $\sigma$  = 5.141 S/m;  $\epsilon_r$  = 49.568;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.3°C; Liquid temperature: 21.8°C

DASY5 Configuration:

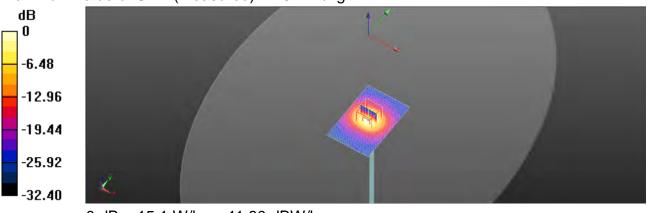
- Probe: EX3DV4 SN7466; ConvF(5.2, 5.2, 5.2); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Configuration/Pin=100mW/Area Scan (61x91x1):** Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 15.6 W/kg

#### Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

dx=4mm, dy=4mm, dz=2mm Reference Value = 56.01 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 28.7 W/kg SAR(1 g) = 7.24 W/kg; SAR(10 g) = 2.05 W/kg Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg = 11.80 dBW/kg

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### Dipole 5300 MHz\_SN:1040

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5300 MHz;  $\sigma$  = 5.258 S/m;  $\epsilon_r$  = 49.301;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.8°C

DASY5 Configuration:

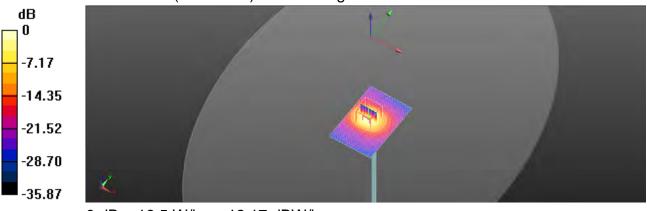
- Probe: EX3DV4 SN7466; ConvF(5.1, 5.1, 5.1); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Configuration/Pin=100mW/Area Scan (61x91x1):** Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 16.4 W/kg

#### Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

dx=4mm, dy=4mm, dz=2mm Reference Value = 47.84 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 32.6 W/kg SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.17 W/kg Maximum value of SAR (measured) = 16.5 W/kg



0 dB = 16.5 W/kg = 12.17 dBW/kg

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### Dipole 5600 MHz\_SN:1040

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5600 MHz;  $\sigma$  = 5.759 S/m;  $\epsilon_r$  = 48.56;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.6°C; Liquid temperature: 21.2°C

DASY5 Configuration:

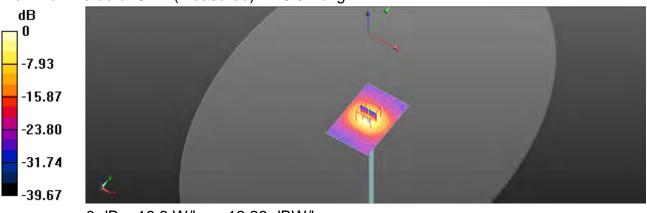
- Probe: EX3DV4 SN7466; ConvF(4.27, 4.27, 4.27); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Configuration/Pin=100mW/Area Scan (61x91x1):** Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 18.0 W/kg

#### Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

dx=4mm, dy=4mm, dz=2mm Reference Value = 57.62 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 34.3 W/kg SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.26 W/kg Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 16.8 W/kg = 12.26 dBW/kg

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### Dipole 5800 MHz\_SN:1040

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5800 MHz;  $\sigma$  = 5.991 S/m;  $\epsilon_r$  = 47.917;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Ambient temperature: 22.1°C; Liquid temperature: 21.5°C

DASY5 Configuration:

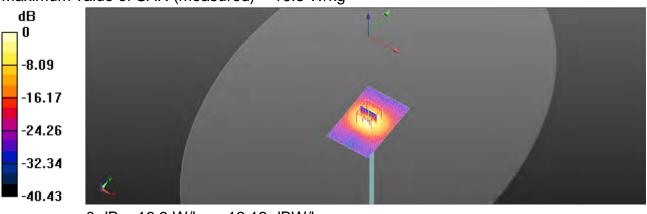
- Probe: EX3DV4 SN7466; ConvF(4.48, 4.48, 4.48); Calibrated: 2017/7/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2018/3/16
- Phantom: Body
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Configuration/Pin=100mW/Area Scan (61x91x1):** Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 16.0 W/kg

#### Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid:

dx=4mm, dy=4mm, dz=2mm Reference Value = 54.06 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 33.1 W/kg SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.1 W/kg Maximum value of SAR (measured) = 16.3 W/kg



0 dB = 16.3 W/kg = 12.12 dBW/kg

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## 7. DAE & Probe Calibration Certificate

Engineering AG sughausstrasse 43, 8004 Zurin	ry of		S Schweizerlächer Kalibrierdienst C Service suitse d'étalonnage Servizio svizzeno di faratura Swise Calibration Service
Accerdined by the Swiss Accerdit The Swiss Accerditation Servic Autilisteral Agreement for the	te is one of the signatories	s to the EA	ditation No.: SCS 0108
Client SGS (Auden)		Certifi	cale No: DAE4-547_Mar18
CALIBRATION	CERTIFICATE		1 2
Object	DAE4 - SD 000 D	04 BM - SN: 547	
Calibration procedure(s)	QA CAL-06.v29 Calibration proces	dure for the data acquisition	n electronics (DAE)
Calibration dete;	March 16, 2018		
The measurements and the uno	ettainlies with confidence on clad in the closed leboratory	mel standards, which realize the physio obability are given on the following pa / leality: environment temperature (2	ages and are part of the certificate.
The measuromants and the uno All calibrations have been condu Calibration Equipment used (Mö	ettiinlies with conflidence on clad in the closed laboratory TE critical for calibration)	obability and given on the following pa / lacility: emvironment temperature (2	ages and are part of the certificate. $2\pm 3)^{\circ}$ C and humidity $< 70\%$ .
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The measurements and the uno All calibrations have been condu Calibration Equipment used (M8 Primary Standards Keithlay Multimeter Type 2001	ettainties with conflidence pr ctral in the closed laboratory TE critical for calibration)	obability and given on the following pa ( locility: emiroriment temperature (2 Cal Date (Centificate No.) 31-Aug-17 (No:21082)	ages and are part of the certificate. 2 ± 3)°C and humicity < 70%. Schedulod Galibration Aug-10
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#### Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizertscher Kallbrierdieven Service suisse d'étalonnage Servizie evizzere di taratara Swiss Calibration Service

Accrucitation No.: SCS 0108

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According by the Swiss Accorditation Service (SAS) The Swiss Accorditation Service is one of the signatorias to the EA Multilateral Agreement for the recognition of calibration certificates

#### Glossary

DAE Connector angle

#### data acquisition electronics 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.

Certilicate Nor DAE4-547\_Mar18

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## **DC Voltage Measurement**

High Range:	1LSB =	6.7µV	full range =	100+300 mV
Low Range:	1LSB =	6TnV.	full rance =	

<b>Calibration Factors</b>	х	¥	Z
High Range	403-254 ± 0.02% (k=2)	403.158 ± 0.02% (k=2)	402.803 ± 0.02% (k=2)
Low Range	3.95439 ± 1.50% (k=2)	3.90484 ± 1.50% (k=2)	3.96300 ± 1.50% (k=2)

#### **Connector Angle**

Connector Angle to be used in DASY system	90.5 °±1 °
	1000 at 1

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## Appendix (Additional assessments outside the scope of SCS0108)

#### 1. DC Voltage Linearity

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	200032.85	-2.13	-0.00
Channel X + Input	20008.76	3.21	0.02
Channel X - Input	-20000.69	4.51	-0.02
Channel Y + Input	200033.55	-4.13	-0.00
Channel Y + Input	20003.79	-1,78	-0.01
Channel Y - Input	-20006.44	-1.22	0.01
Channel Z + Input	200031.86	-3.06	-0.00
Channel Z + Input	20006.10	0.58	0.00
Channel Z - Input	-20003.99	1.29	-0.01

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2001.72	0.18	0,07
Channel X + Input	201,65	0.01	0.01
Channel X - Input	-198.51	-0.28	0.14
Channel Y + Input	2001.34	-0.09	-0,00
Channel Y + Input	200,96	-0.70	-0.35
Channel Y - Input	-199.61	-1.33	0.67
Channel Z + Input	2001,33	-0.06	-0.00
Channel Z + Input	200,08	-1,48	-0,74
Channel Z - Input	-200,28	-1.91	0.96

#### 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	-3.69	-5,17	
	+ 200	5.60	4.08	
Channel Y	200	-0.50	-1,15	
	- 200	0.25	-0,51	
Channel Z	200	5.51	5.17	
1	- 200	-7.92	-8.28	

#### 3. Channel separation

DASY measurement parameter	5: Auto Zero Time	a: 3 sec: Meas	uring time: 3 sec
----------------------------	-------------------	----------------	-------------------

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	1. 1.	3.20	-2.58
Channel Y	200	9.59	~	3.91
Channel Z	200	5.09	7.98	-

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#### 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	16383	15273
Channel Y	16469	16100
Channel Z	16083	17048

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec input 10M0

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	-1,57	-2.25	-0.71	0.35
Channel Y	0.27	-0.91	1.98	0.42
Channel 2	0.12	-1.25	1.42	0.47

## 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <251A

## 7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhim)
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 (+ Vec)	+0,01	-+6	+14
Supply (- Vec)	-0.01	-8	-9

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**Calibration Laboratory of** Schmid & Partner Engineering AG aughousemente 43, 8004 Zunch, Bwitzerler



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Accorditation No.1 SCS 0108

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GI			

alogen ]-	
TSL	lissue simulating liquid
NORMs.y.z	sensitivity in free space
CONVE	sensitivity in TSL / NORMX, y.z.
DCP	diade compression point
CF	crest factor (1/duty_cycle) of the RF signal
W. B. C. D	modulation dependent lineerization parameters
Polarization o	protation around probe axis
Polarization 8	It rotation around an axis that is in the plane normal to probe axis (at measurement center).
	e_ 8 = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Callbration is Performed According to the Following Standards:

- IEEE 5td 1528-2013, 'IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement 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 Spacific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ser (through cy range 6/300 MHz to 8 GHz)" July 2016 c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication device used in close proximity to the human body (frequency tange 6/30 MHz to 8 GHz)" March 2010 d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 8 GHz)"
- unication devices

#### Methods Applied and Interpretation of Parameters:

- NORMA, y, z. Assessed for E-field polarization  $\theta = 0$  (f  $\leq 900$  MHz in TEM-cell, f > 1800 MHz. R22 waveguide). NORMA, y, z are only intermediate values, i.e., the uncertainties of NORMA, y, z does not affect the E<sup>1</sup>-field uncertainty inside TSL (see below ConvF). NORM(f)x, y, z = NORMA, y, z \* frequency\_response (see Frequency Response Chart). This linearization is NORM(f)x, y, z = NORMA, y, z \* frequency\_response (see Frequency Response Chart). This linearization is
- implemented in DASY4 software versions later than 4.2. The uncertainty of the traquency response is included in the stated uncertainty of Com/F.
- DCPx, y, 2: DCP are numerical linearization parameters assassed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Av, y.z; Ex, y.z; Cx, y.z; Dx, y.z; VRx, y.z: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for ( < 800 MHz) and inside waveguide using analytical field distributions based on powe measurements for t > 800 MHz. The same satures are used for assessment of the parameters applied for boundary companisation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASYA software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMs.y.z. " ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent Com/F is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical (sotropy (3D deviation from isotropy): in a field of low gradients realized using a fial pharitom exposed by a patch antenna. Sensor Diffset. The sensor offset corresponds to the offset of virtual measurement center from the probe to
- (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMs (no . uncertainty required).

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EX3DV4 - SN:7466

July 4, 2017

# Probe EX3DV4

## SN:7466

Manufactured: Calibrated: October 25, 2016 July 4, 2017

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

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EX3DV4- SN:7466

July 4, 2017

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7466

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) <sup>2</sup> ) <sup>4</sup>	0.46	0.40	0.63	± 10.1 %
DCP (mV) <sup>a</sup>	96.7	100.3	93.7	

#### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	С	D dB	VR mV	Unc <sup>≃</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	145.9	±3.0 %
		Y	0.0	0.0	1.0		148.6	
		Z	0.0	0.0	1.0		130.0	

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).
<sup>B</sup> Numerical linearization parameter: uncertainty not required.
<sup>III</sup> Uncertainty is determined using the max, deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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EX3DV4-- SN:7466

July 4, 2017

f (MHz) <sup>c</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>13</sup> (mm)	Unc (k=2)
835	41.5	0.90	10.20	10.20	10.20	0.60	0.84	± 12.0
900	41.5	0.97	9.95	9.95	9.95	0.42	0.94	± 12.0
1750	40.1	1.37	8.84	.8.84	8.84	0.34	0.80	± 12.0
1900	40.0	1.40	8.52	8.52	8.52	0.35	0.80	± 12.0
2000	40.0	1.40	8.47	8.47	8.47	0.35	0.80	± 12.0
2450	39.2	1.80	7.81	7.81	7.81	0.35	0.99	± 12.0
2600	39.0	1.96	7.58	7.58	7.58	0.37	0.95	± 12.0
5200	36.0	4,66	5.81	5.81	5.81	0.35	1.80	± 13.1
5300	35.9	4.76	5.56	5.56	5.56	0.35	1.80	± 13.1
5600	35.5	6.07	4.98	4.98	4.98	0.40	1.80	± 13.1
5800	35.3	5.27	5.17	5.17	5.17	0.40	1.80	±13.1

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7466

<sup>6</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v1.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the HSS of the Conv<sup>2</sup> uncertainty is calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for Conv<sup>2</sup> assessment at 30, 64, 128, 158 and 220 MHz respectively. Above 50 GHz frequency validity use extended to ± 10 MHz. \* A frequencies below 3 GHz, the validity of tissue parameters (s and e) can be relaxed to ± 10% if "guid componation formula is applied to measured SAR values. Af frequencies to the walkity of tissue parameters (s and e) is restricted to ± 5%. The uncertainty is the RSS of the Conv<sup>2</sup> uncertainty for indicated target tissue parameters. \* A they and the uncertainty for indicated target tissue parameters. \* A they and the test of the test of the convertex of the set of the test of the convertex of the set of the test of test of the test of test of the test of the test of the test of test

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EX3DV4- SN:7466

July 4, 2017

f (MHz) <sup>c</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>6</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
835	55.2	0.97	10.24	10.24	10.24	0.39	0.96	± 12.0
900	55.0	1.05	10.06	10.06	10.06	0.34	1.01	± 12.0
1750	53.4	1.49	8.52	8,52	8.52	0.39	0.87	± 12.0
1900	53.3	1.52	8.14	8.14	8.14	0.34	0.91	± 12.0
2000	53.3	1.52	8.30	8.30	8.30	0.33	0.94	± 12.0
2450	52.7	1.95	7.94	7.94	7.94	0.28	1.10	± 12.0
2600	52.5	2.16	7.66	7.66	7.66	0.27	1.15	± 12.0
5200	49.0	5.30	5.20	5.20	5.20	0.40	1.90	± 13.1
5300	48.9	5.42	5.10	5.10	5.10	0.40	1.90	± 13.1
5600	48.5	5.77	4.27	4.27	4.27	0.50	1.90	± 13.1
5800	48.2	6.00	4.48	4.48	4.48	0.50	1.90	± 13.1

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7466

<sup>6</sup> Frequency validity above 360 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at estimation frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity validity on the extended to ± 10 MHz.
<sup>7</sup> At frequencies below 3 GHz, the validity of tissue parameters (s and e) can be relaxed to ± 10% if liquid componsation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (s and e) can be relaxed to ± 10% if liquid componsation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (s and e) can be relaxed to ± 0%. The uncertainty is the RSS of the ConvF uncertainty for indicated target to supervise.
<sup>8</sup> At frequencies below 3 GHz, the validity of tissue parameters (s and e) is restricted to ± 6%. The uncertainty is the RSS of the ConvF uncertainty is the RSS of the ConvF uncertainty for indicated target to supervise.
<sup>9</sup> Alpha/Depth are determined during calibration. SPEA0 warrants that the remaining deviation due to the boundary effect after compensation is always less from = 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-5 GHz at any distance larger than half the probe tip diameter from the boundary.

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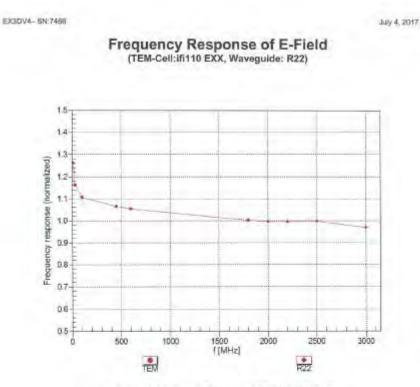
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Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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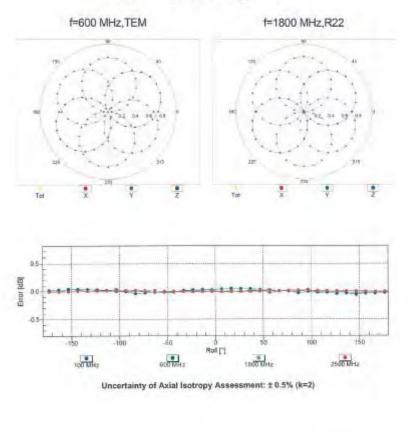
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EX30V4-SN:7466

July 4, 2017



Receiving Pattern (\$), 9 = 0°

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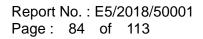
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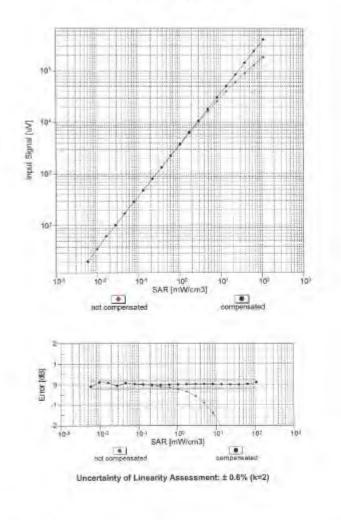




EX30V4-SN:7456

AJV-4, 2017.

## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f<sub>eval</sub>= 1900 MHz)



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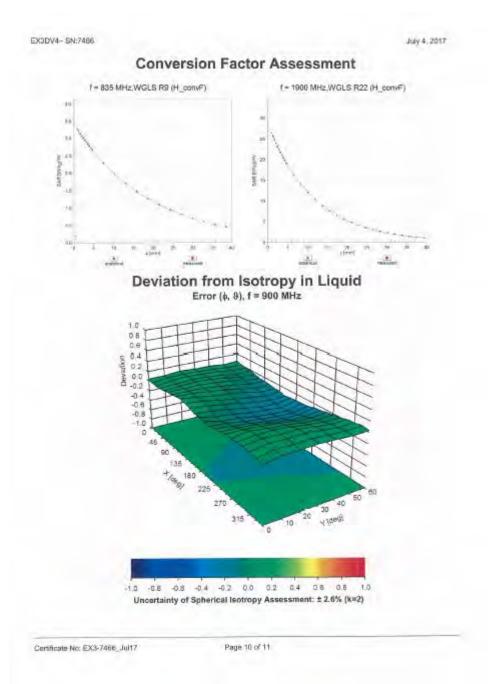
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EX3DV4-- SN:7466

July 4, 2017

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7466

#### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (")	-3.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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## 8. Uncertainty Budget

A	с	D	е		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability Distributio	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.55%	N	1	1	1	1	6.55%	6.55%	00
lsotropy , Axial	3.50%	R	√3	1.732	1	1	2.02%	2.02%	00
lsotropy, Hemispherical	9.60%	R	√3	1.732	1	1	5.54%	5.54%	œ
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	~
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	œ
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	00
Detection Limits	1.00%	R	√3	1.732	1	1	0.58%	0.58%	00
Readout Electronics	0.30%	Ν	1	1	1	1	0.30%	0.30%	00
Response time	0.80%	R	√3	1.732	1	1	0.46%	0.46%	œ
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	00
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	00
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	00
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	00
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	00
Probe Positioning with respect to phantom shell	2.90%	R	√3	1.732	1	1	1.67%	1.67%	00
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	00
Max SAR Eval	1.00%	R	√3	1.732	1	1	0.58%	0.58%	00
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	Ν	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	√3	1.732	1	1	2.89%	2.89%	00
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	œ
Liquid permittivity (mea.)	1.66%	N	1	1	0.64	0.43	1.06%	0.71%	М
Liquid Conductivity (mea.)	-4.43%	N	1	1	0.6	0.49	-2.66%	-2.17%	М
Combined standard uncertainty		RSS					12.06%	11.93%	
Expant uncertainty (95% confidence interval), K=2							24.12%	23.86%	

Measurement Uncertainty evaluation template for DUT SAR test (3-6G)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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A	с Т-1	D	e		T	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability Distributio	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.00%	Ν	1	1	1	1	6.00%	6.00%	8
lsotropy , Axial	3.50%	R	√3	1.732	1	1	2.02%	2.02%	8
lsotropy, Hemispherical	9.60%	R	√3	1.732	1	1	5.54%	5.54%	8
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	$\infty$
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	$\infty$
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	$\infty$
Detection Limits	1.00%	R	√3	1.732	1	1	0.58%	0.58%	~
Readout Electronics	0.30%	Ν	1	1	1	1	0.30%	0.30%	~
Response time	0.80%	R	√3	1.732	1	1	0.46%	0.46%	~
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	~
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	~
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	~
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	~
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	00
Probe Positioning with respect to phantom shell	2.90%	R	√3	1.732	1	1	1.67%	1.67%	~
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	~
Max SAR Eval	1.00%	R	√3	1.732	1	1	0.58%	0.58%	~
Test Sample related									
Test sample positioning	2.90%	Ν	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	Ν	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	√3	1.732	1	1	2.89%	2.89%	~
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	~
Liquid permittivity (mea.)	-0.23%	N	1	1	0.64	0.43	-0.15%	-0.10%	М
Liquid Conductivity (mea.)	-2.87%	N	1	1	0.6	0.49	-1.72%	-1.41%	М
Combined standard uncertainty		RSS					11.55%	11.49%	
Expant uncertainty (95% confidence interval), K=2							23.10%	22.99%	

Measurement Uncertainty evaluation template for DUT SAR test (0.3-3G)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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## 9. Phantom Description

Schmid & Partner Engineering AG

s а D е a

Zeughausstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9779 info@speag.com, http://www.speag.com

#### Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 5.0	
Type No	QD OVA 002 A	
Series No	1108 and higher	
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland	

Tests

Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

Test	Requirement	Details	Units tested
Shape	Internal dimensions, depth and sagging are compatible with standards	Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz	Prototypes
Material thickness	Bottom: 2.0mm +/- 0.2mm	dimension compliant with [3] for f > 800 MHz	all
Material parameters	rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids .	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	within tolerance for filling height up to 155 mm	Prototypes, samples

Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

#### Standards

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- OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
   IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific
- Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [3] IEC 62209-1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)\*, 2005-02-18 [4] IEC 62209-2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted
- wireless communication devices Human models, instrumentation, and procedures Part 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)", 2010-03-30

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of body-worn SAR measurements and system performance checks as specified in [1-4] and further standards

Date 25.7.2011

Signature / Stamp

peag s Schmid & Bertrier Engineering AG Zeugbarestrassa 43, 8004 Zuich, Schmitten Phone:441 44/25 9708, Fext-46, 645 9779

Doc No 881 - QD OVA 002 A - A

Page 1(1)

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## **10. System Validation from Original Equipment Supplier**

ccredited by the Swiss Accredit he Swiss Accreditation Servic	e is one of the signatorie	es to the EA	accreditation No.: SCS 0108
ultilateral Agreement for the	recognition of calibration	certificates	
lient Auden		Certificate N	io: D2450V2-735_Dec17
CALIBRATION (	CERTIFICATI		
Dijaci	D2450V2 - SN:7	35	
Calibration procedure(s)	QA CAL-05.V9		
	Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	December 15, 20	317	
and a state of the	December 15, 20	517	
This calibration cartificate docum	tionts the traceability to not	ional standards, which realize the physical u mbobility are given on the (oflowing pages a	rils of measurements (5))
The messate containing and one birds	communes more complete p	rocapility are given on the following pages a	nd are part of the certificate.
Al calibrations have been condu		evilatility environment temperature (32 + 32	
Vi calibrations have been condu		ry facility, environment temperature (22 ± 3)	
	cted in the closed laborato	ry facility, environment temperature (22 # 3/	
	cted in the closed laborato	ry facility, environment temperature (22 ± 3)	
aubration Equipment used (M&	cted in the closed laborato		°C and humidity < 70%.
Caribration Equipment used (M&	cted in the closed laborato TE onlical for calibration)	ry facility, environment temperature (22 ± 3) Car Date (Certificate No.) 04-Apr 17 (No. 217-02521/02522)	
Calibration Equipment used (MS htmany Standards fower moter NRP fower sensor NRP-251	cted in the closed laborato TE orfical for calibration)	Car Daté (Certificate No.)	'C and humidity < 70%. Scheduled Calibration
Calibration Equipment used (MS htmany Standards hower moter NRP hower sensor NRP-251 hower sensor NRP-251	cted in the closed laborato TE ortical for calibration) ID # SN: 104778	Cai Daté (Certificate No.) 04-Apr 17 (No. 217-02521/02522)	"C and humidity < 70%. Scheduled Calibration Apr: 18
Calibration Equipment used (MS Pamiary Standards Power motor NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	ted in the closed laborato TE ortical for calibration) ID # SN: 104778 SN: 103244	Cai Daté (Certificate No.) 04-April 7 (No. 217-02521/02522) 04-April 7 (No. 217-02521)	"C and humidity < 70%s. Scheduled Calibration Apr-18 Apr-18
Calibration Equipment used (MS Primary Stendards Power meter NRP Power sensor NRP-251 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination	TE ortical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cai Daté (Certificate No.) 04-April 7 (No. 217-02521/02522) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02522)	C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18
Calibration Equipment used (MS Permary Standards Power moter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Yope-N mismatch combination Reference Probe EX3DV4	Leff in the closed laborato TE ortical for calibration) ID # SN: 104778: SN: 103244 SN: 103244 SN: 103244 SN: 103245 SN: 504727 06327 SN: 7349	Cai Dalé (Certificate No.) D4-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (MS "minary Standards "ower moter NRP "ower sensor NRP-291 "ower sensor NRP-291 Reference 20 dB Attenuator type-N mismatch combination Telerence Probe EX3DV4	TE ortical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cai Date, (Certificate No.) D4-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	"C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (MS "similary Standards "ower motor NRP Power sensor NRP-291 Power sensor NRP-291 Redenence 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 JAE4	ID # ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5057.2 / 06327 SN: 7349 SN: 601	Cai Daté (Certificate No.) D4-April 7 (No. 217-02521/02522) D4-April 7 (No. 217-02521) D4-April 7 (No. 217-02521) D7-April 7 (No. 217-02522) D7-April 7 (No. 217-02520) 31-May-17 (No. 217-02520) 31-May-17 (No. EX3-7349_May17) 26-Oct-17 (No. DAE4-601_Oct17)	C and humidity < 70%. Scheduled Calbration Apr-18 Apr-18 Apr-18 Apr-18 May-18 Oct-18 Oct-18
Calibration Equipment used (MS Pamiary Standards "ower motel NRP Power sensor NRP-291 Power sensor NRP-291 Relation 20 dB Attenuator Pype-N mismatch combination Relevance Probe EX3DV4 DAE4 Secondary Stancards	Liber in the closed laborato TE ortical for calibration) ID # SN: 104778 SN: 104778 SN: 103244 SN: 105245 SN: 105245 SN: 105245 SN: 105245 SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	Cai Date (Certificate No.) D4-April 7 (No. 217-02521/02522) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02521) 07-April 7 (No. 217-02529) 07-April 7 (No. 217-02529) 07-April 7 (No. 217-02529) 01-May-17 (No. EX3-7249_May17) 26-Oct-17 (No. DAE4-601_Oct17) Oreck Date (in house)	C and humidity < 70%. Scheduled Calbration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Oct-18 Scheduled Check
Calibration Equipment used (MS "mmary Standards "ower motor NRP-291 "ower sensor NRP-291 Reference 20 0B Attenuator type-N mismatch combination Reference Probe EX3DV4 JAE4 Secondary Stancards Power motor EPM-442A	Lib # ID # SN: 104778 SN: 104778 SN: 103244 SN: 105245 SN: 105245 SN: 105245 SN: 10526(20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: 6B37480704	Cai Daté (Certificate No.) D4-Apr-17 (No. 217-02521/02522) 04-Api-17 (No. 217-02521) 04-Api-17 (No. 217-02521) D7-Api-17 (No. 217-02529) 07-Api-17 (No. 217-02529) 07-Api-17 (No. 217-02529) 31-May-17 (No. EX3-7849_May17) 28-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 May-18 Oct-18 Scheduled Chack In house chack: Dct-18
Calibration Equipment used (MS Pamiarly Standards Power moter NRP- Power sensor NRP-291 Power sensor NRP-291 Paderance 20 dB Attenuator Yope-N mismatch combination Reference Probe EX3DV4 DAE4 Secondatry Standards Power moter EPM-442A Power sensor HF B481A	Liber in the closed laborato TE ortical for calibration) ID # SN: 104778 SN: 104778 SN: 103244 SN: 105245 SN: 105245 SN: 105245 SN: 105245 SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	Cal Daté (Certificate No.) 04-April 7 (No. 217-02521/02522) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02522) 07-April 7 (No. 217-02529) 07-April 7 (No. 217-02529) 01-May-17 (No. 217-02529) 01-May-17 (No. EX3-7349, May17) 26-Oct-17 (No. DAE4-601_Oct17) Oreck Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 May-18 Oct-18 Scheduled Check In Fouse check: Oct-18 In house check: Oct-18
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Calibration Equipment used (MS http://www.motern.NRP-251 Power motern.NRP-251 Power sensor NRP-251 Power sensor NRP-251 Power sensor NRP-251 Power sensor Probe EX3DV4 DAE4 Secondary Stancards Power sensor HP 6481A Power sensor HP 6481A	Lefel in the closed laborato TE ortical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103240 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID # SN: 6037480704 SN: UIS37292785 SN: MM14109231 /	Cal Daté (Certificate No.) 04-April 7 (No. 217-02521/02522) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02521) 04-April 7 (No. 217-02522) 07-April 7 (No. 217-02529) 07-April 7 (No. 217-02529) 01-May-17 (No. 217-02529) 01-May-17 (No. EX3-7349, May17) 26-Oct-17 (No. DAE4-601_Oct17) Oreck Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 May-18 Oct-18 Scheduled Check In Fouse check: Oct-18 In house check: Oct-18
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Calibration Laboratory of Schmid & Partner Engineering AG Zwgbweetrasse 43, 6004 Zurich, Switzerland



S Schweizerischer Kallbriedenst C Service suisse d'italionage Service avizzero di talature S Seise Calibration Service

Adureditation No.: SCS 0108

Accredited by the Swas Accreditation Service (SAS)

The Siwiss Accredit	ition Service is one of the signatorize to the EA
Multilational Agreem	ant for the recognition of calibration certificates
Glossary:	
TSI	discussion of the state of the state of the state

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 antenne 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%.

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#### Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	13.2 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	51.4 W/kg ± 17.0 % (k=2)	
CAD avagand over 10 and (10 a) at the st TO			
SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	250 mW input power	6.07 W/kg	

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition		
SAR measured	250 mW input power	13.0 W/kg	
SAR for nominal Body TSL parameters	normalized to 1W	50.6 W/kg ± 17.0 % (k=2)	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 250 mW input power	6.06 W/kg	

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## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω + 4.9 jΩ
Return Loss	- 23.6 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7 Ω + 7.1 jΩ
Return Loss	- 22.9 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. 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	May 07, 2003

Certificate No: D2450V2-735\_Dec17

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#### **DASY5 Validation Report for Head TSL**

Date: 15.12.2017

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 735

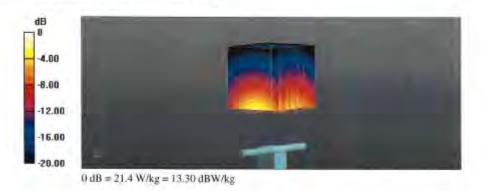
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz;  $\sigma = 1.87$  S/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.12, 8.12, 8.12); Calibrated: 31.05.2017;
- 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

#### 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 = 113.0 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 27.3 W/kg SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg Maximum value of SAR (measured) = 21.4 W/kg



Certificate No: D2450V2-735\_Dec17

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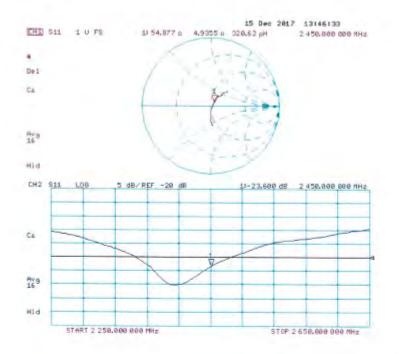
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## Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-735\_Dec17

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#### DASY5 Validation Report for Body TSL

Date: 15.12.2017

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 735

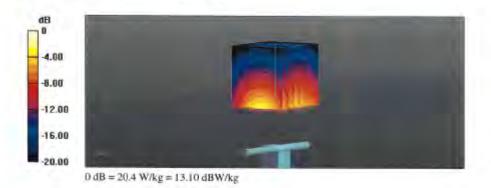
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz;  $\sigma = 2.04$  S/m;  $\varepsilon_c = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.1, 8.1, 8.1); Calibrated: 31.05.2017;
- 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

## 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 = 105.9 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 26.0 W/kg SAR(1 g) = 13 W/kg; SAR(10 g) = 6.06 W/kg Maximum value of SAR (measured) = 20.4 W/kg



Certificate No: D2450V2-735\_Dac17

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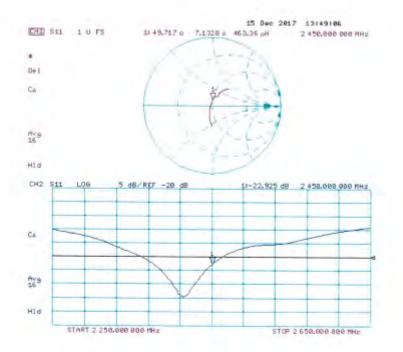
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## Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-735\_Dec17

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Accreditation No.: SCS 0108

Certificate No: D5GHzV2-1040\_Jul17

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Object	D5GHzV2 - SN:1	1040	
Calibration procedure(s)	QA CAL-22.v2 Callibration proce	dure for dipole validation kits be	itween 3-6 GHz
Calibration date:	July 13, 2017		
This calibration certificate docum The measurements and the unce	ants the inacessity to nat rtainlies with confidence o	ional standards, which realize the physical o robability are given on the following pages a	nits of measurements (SI)
VI calibrations have been conduc	sted in the closed laborato	ry tacility: environment temperature (22 $\pm$ 3)	$^{\circ}C$ and humidity $<70\%$
Calibration Equipment used (M&1	E critical for calibration)		
Primary Standards	10 *	Cal Date (Certificate No.)	Scheduled Calibration
	MAR AN AND A		THE PARAMETERS SHOP AT A SALET AND STOLEN
Wer meter NFIP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr. 18
	1000000000	04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Apr-18 Apr-18
ower sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
ower sensor NRP-291 ower sensor NRP-291	SN: 103244 SN: 103245	04-Apr-17 (No. 217-02521) 04 Apr-17 (No. 217-02522)	Apr-18 Apr-18
ower sensor NRP-291 ower sensor NRP-291 leference 20 dB Attenuator	SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-17 (No. 217-02521) 04 Apr 17 (No. 217-02522) 07-Apr 17 (No. 217-02528)	Apr-18 Apr-18 Apr-18
ower sensor NRP-291 ower sensor NRP-291 leference 20 dEl Attonuator ype-N mismatch combination	SN: 103244 SN: 103245 SN: 6058 (20k) SN: 5047 2 / 06327	04-Ap+1? (No. 217-02521) 04-Ap+1? (No. 217-02522) 07-Ap+1? (No. 217-02528) 07-Ap+1? (No. 217-02528)	Apr-18 Apr-18 Apr-18 Apr-10
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-17 (No. 217-02521) 04 Apr 17 (No. 217-02522) 07-Apr 17 (No. 217-02528)	Apr-18 Apr-18 Apr-18
Powar sensor NRP-291 Powar sansar NRP-291 Reference 29 dB Attanuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 3503	04-Ap+11 (No. 217-02521) 04-Ap+17 (No. 217-02522) 07-Ap+17 (No. 217-02528) 07-Ap+17 (No. 217-02528) 31-Dec-16 (No. EX3-3503_Doc16)	Apr-18 Apr-18 Apr-19 Apr-10 Dec-12 Mar-18
Powar sensor NRP-291 Powar sensor NRP-291 Reference 20 dE Attonuation rype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 5038 (20k) SN: 5047 2 / 06327 SN: 3503 SN: 601	04-Ap+11 (No. 217-02521) 04-Ap+17 (No. 217-02522) 07-Ap+17 (No. 217-02528) 07-Ap+17 (No. 217-02528) 07-Ap+17 (No. 217-02529) 31-Dec-16 (No. EX3-3503_Doc16) 28-Mai+17 (No. DAE4-691_Mart7) Check Date (in house)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chock
Powar sensor NRP-291 Powar sensor NRP-291 Reference 20 dB Attenuation type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A	SN: 103244 SN: 103245 SN: 103245 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 SN: 604	04-Ap+11 (No. 217-02521) 04-Ap+11 (No. 217-02522) 07-Ap+11 (No. 217-02528) 07-Ap+11 (No. 217-02528) 07-Ap+11 (No. 217-02529) 31-Dec-16 (No. EX3-3503_Doc16) 28-Mai+17 (No. DAE4-601_Mart17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-16 Dec-17 Mar-18 Schedwied Chock In house check: Dct-16
Powar sensor NRP-291 Powar sensor NRP-295 Reference 20 dB Attonuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power mater EPM-442A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 SN: 504 ID # SN: 6837460704	04-Ap+1? (No. 217-02521) 04-Ap+1? (No. 217-02522) 07-Ap+1? (No. 217-02529) 07-Ap+1? (No. 217-02529) 01-Dec-16 (No. EX3-3503_Dec16) 28-Mai+1? (No. DAE4-601_Mart?) Check Date (in house) 07-Oct-16 (in house check Oct-16) 07-Oct-16 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack In house check: Dct-18 In house check: Dct-18
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attonuator (ype-N mismatch combination Reference Probe EXaDV4 DAE4 Recondary Standards Power mater EPM-442A Power mater EPM-442A Power mater EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 6084 (20k) SN: 5047 2 / 06327 SN: 5503 SN: 601 ID # SN: GB374607D4 SN: US37292783 SN: US37292783 SN: WY41052317	04-Ap+1? (No. 217-02521) 04-Ap+1? (No. 217-02522) 07-Ap+1? (No. 217-02529) 07-Ap+1? (No. 217-02529) 01-Dec+16 (No. EX3-3503_Dec16) 28-Mai-1? (No. DAE4-601_Mart?) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chock In nouse check: Dct-18 In nouse check: Dct-18 In house check: Dct-18
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attanuator Type-N mismatch combination Reference Proce EX3DV4 DAE4 Secondary Standards Power mater EPM 442A Power mater EPM 442A Power sensor NP 9481A Towns sensor NP 9491A 3F generator R&S SMT-08	SN: 103244 SN: 103245 SN: 5068 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 504 ID # SN: 601 ID # SN: 6837460704 SN: US37292783	04-Ap+1? (No. 217-02521) 04-Ap+1? (No. 217-02522) 07-Ap+1? (No. 217-02529) 07-Ap+1? (No. 217-02529) 01-Dec-16 (No. EX3-3503_Dec16) 28-Mai+1? (No. DAE4-601_Mart?) Check Date (in house) 07-Oct-16 (in house check Oct-16) 07-Oct-16 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-10 Dec-17 Mar-18 Scheduled Check In house check: Dct-18 In house check: Dct-18 In house check: Dct-18
Powar sensor NRP-291 Powar sansar NRP-291 Reference 20 dB Attanuator Type-N mismatch combination Reference Prote EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power sensor HP 9481A Power sensor HP 9481A RF ganarator R&S SMT-08	SN: 103244 SN: 103245 SN: 6058 (20k) SN: 5047 2 / 0632/ SN: 503 SN: 501 ID # SN: 6837460704 SN: U837292783 SN: U837292783 SN: U837292783	04-Ap+11 (No. 217-02521) 04-Ap+11 (No. 217-02522) 07-Ap+11 (No. 217-02529) 07-Ap+17 (No. 217-02529) 07-Ap+17 (No. 217-02529) 31-Dec+16 (ke. EX3-3503_Dec16) 28-Mai-17 (No: DAE4-601_Mart17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Powar sensor NRP-291 Powar sensor NRP-295 Reference 20 dB Attonuator Type-N mismatch contenation Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 9491A *ower sensor HP 9491A *ower sensor HP 9491A *ower sensor HP 9491A *ower sensor HP 9491A	SN: 103244 SN: 103245 SN: 5047 2 / 06327 SN: 503 SN: 601 ID # SN: GB374807D4 SN: US37292783 SN: WY41062317 SN: 10372 SN: US37390585 Name	04-Ap+11 (No. 217-02521) 04-Ap+17 (No. 217-02522) 07-Ap+17 (No. 217-02529) 07-Ap+17 (No. 217-02529) 01-Dec16 (No. EX3-3503_Dec16) 28-Mai+17 (No DAE4-601_Mart7) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 16-Oct-01 (in house check Oct-16) 18-Oct-01 (in house check Oct-16) 18-Oct-01 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-10 Dec-12 Mar-18 Scheduled Check In house check: Dct-18 In house check: Dct-18 In house check: Dct-18
Powar sensor NRP-291 Powar sensor NRP-291 Reference 20 EE Attonuator Type-N mismatch contenation Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power sensor HP 9481A Power sensor HP 9481A Power sensor HP 9481A RF ganerater DAS SMT-08 Network Analyzer HP 9753E	SN: 103244 SN: 103245 SN: 10384 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 604 D # SN: 604 SN: 60574807D4 SN: US37282783 SN: US37282783 SN: US37390585	04-Ap+11 (No. 217-02521) 04-Ap+11 (No. 217-02522) 07-Ap+11 (No. 217-02529) 07-Ap+11 (No. 217-02529) 07-Ap+11 (No. 217-02529) 31-Dec-16 (No. EX3-3503_Doc16) 28-Ma+17 (No. DAE4-601_Ma+17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 18-Oct-01 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power meter NPP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch contenation Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 9481A Power sensor HP 9481A RF generator FAS SMT-06 Network Analyzer HP 8753E Calibrated 6y	SN: 103244 SN: 103245 SN: 5047 2 / 06327 SN: 503 SN: 601 ID # SN: GB374807D4 SN: US37292783 SN: WY41062317 SN: 10372 SN: US37390585 Name	04-Ap+11 (No. 217-02521) 04-Ap+17 (No. 217-02522) 07-Ap+17 (No. 217-02529) 07-Ap+17 (No. 217-02529) 01-Dec16 (No. EX3-3503_Dec16) 28-Mai+17 (No DAE4-601_Mart7) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 16-Oct-01 (in house check Oct-16) 18-Oct-01 (in house check Oct-16) 18-Oct-01 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attanuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power sensor HP 9481A Power sensor HP 9481A RF generator IRSS SMT-08 Network Analyzer HP 8753E Calibrated 6y:	SN: 103244 SN: 103245 SN: 6058 (20k) SN: 5047 2 / 0632/ SN: 5047 2 / 0632/ SN: 5047 2 / 0632/ SN: 504 SN: 504 SN: 504 SN: 5057460704 SN: 0637460704 SN: 0637292783 SN: 0537390585 Name Left Klysner	04-Ap+11 (No. 217-02521) 04-Ap+11 (No. 217-02522) 07-Ap+11 (No. 247-02529) 07-Ap+17 (No. 247-02529) 07-Ap+17 (No. 247-02529) 01-Dec-16 (No. EX3-3503_Dac16) 28-Ma+17 (No. DAE4-601_Ma+17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 15-Jun 15 (in house check Oct-16) 16-Oct-01 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In nouse check: Dct-18 In house check: Dct-18

Certificate No: D5GHzV2-1040 Jul17

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## Report No. : E5/2018/50001 Page : 99 of 113

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Acconditation No.: SCS 0108

Accredition by the Swes Accreditation Service (SAS)

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#### Glossa

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
- 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 lilled 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%.

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#### Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5600 MHz ± 1 MHz	

#### Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.51 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.28 W/kg

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#### Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.1 ± 6 %	4.61 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.0 W / kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.37 W/kg

#### Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	$35.8 \pm 6 \%$	4.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.7 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.37 W/kg

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#### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.7 ± 6 %	4.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.4 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.43 W/kg

#### Head TSL parameters at 5800 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.0 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.32 W/kg

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#### Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mha/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.4 ± 6 %	5.45 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.2 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 100 mW input power	2.09 W/kg

#### Body TSL parameters at 5300 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.58 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.8 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 100 mW input power	2.17 W/kg

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#### Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	$46.9 \pm 6 \%$	5.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.8 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 100 mW input power	2.25 W/kg

#### Body TSL parameters at 5600 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 100 mW input power	2.25 W/kg

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#### Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	6.28 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL SAR measured	condition 100 mW input power	2.15 W/kg

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#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.8 Ω - 8.3 jΩ
Return Loss	- 21.6 dB

#### Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.3 Ω - 3.5 jΩ
Return Loss	- 28.0 dB

#### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.4 Ω - 7.0 μΩ
Return Loss	- 23.2 dB

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.6 Ω - 3.3 jΩ
Return Loss	- 23.3 dB

#### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.2 Ω - 1.8 jΩ
Return Loss	- 27.1 dB

#### Antenna Parameters with Body TSL at 5200 MHz

[	Impedance, transformed to feed point	49.1 Ω - 6.9 jΩ
- [	Return Loss	- 23.0 dB

#### Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.6 Ω - 1.6 jΩ
Return Loss	- 33.1 dB

#### Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 4.7 jΩ
Return Loss	- 26.3 dB

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#### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.5 Ω - 2.0 jΩ
Return Loss	- 22.8 dB

## Antenna Parameters with Body TSL at 5800 MHz

Imped	dance, transformed to feed point	55.6 Ω - 1.4 jΩ
Retur	n Loss	- 25.3 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns
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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	1
Manufactured on	December 30, 2005	1

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#### **DASY5 Validation Report for Head TSL**

Date: 13.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040

Communication System: UID 0 - CW; Frequency: 3200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz;  $\sigma = 4.51$  S/m;  $c_i = 36.3$ ; p = 3000 kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.61$  S/m;  $c_i = 36.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.61$  S/m;  $c_i = 36.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.92$  S/m;  $c_i = 35.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>. Medium parameters used: f = 5800 MHz;  $\sigma = 5.14$  S/m;  $c_i = 35.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantoin section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.76, 5.76, 5.76); Calibrated: 31.12.2016; ConvF(5.35, 5.35, 5.35); Calibrated; 31.12.2016; ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016; ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016; ConvF(5.01, 5.01, 5.01); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated; 28.03,2017
- Phantom: Flat Phantom 5.0 (from), Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.84 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 29.0 W/kg SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.28 W/kg Maximum value of SAR (measured) = 18.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.51 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 29.9 W/kg SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.37 W/kg Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1,4mm Reference Value = 69.97 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 32.8 W/kg SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.37 W/kg Maximum value of SAR (measured) = 19.7 W/kg

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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 70,63 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 33.4 W/kg SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.43 W/kg Maximum value of SAR (measured) = 20.1 W/kg

## Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 67.92 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 33.4 W/kg SAR(1 g) = 8.2 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg



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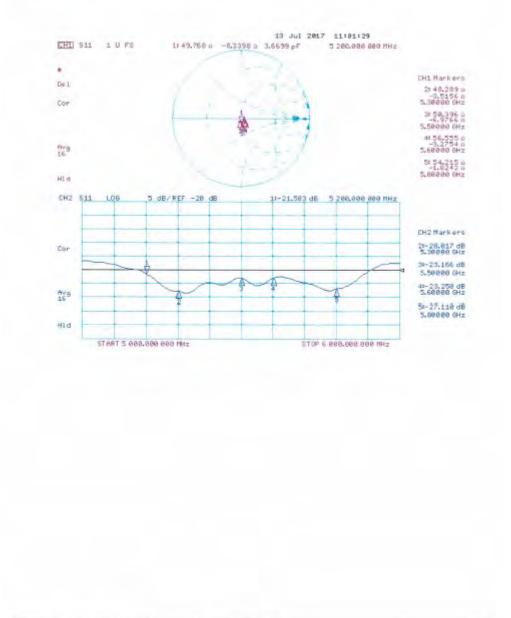
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#### Impedance Measurement Plot for Head TSL



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#### DASY5 Validation Report for Body TSL

Date: 12.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz;  $\sigma$  = 5.45 S/m;  $\varepsilon_r$  = 47.4;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma$  = 5.85 S/m;  $\varepsilon_r$  = 47.2;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma$  = 5.85 S/m;  $\varepsilon_r$  = 46.9;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 5600 MHz;  $\sigma$  = 6.28 S/m;  $\varepsilon_r$  = 46.4;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.29, 5.29, 5.29); Calibrated: 31.12.2016, ConvF(5.04, 5.04, 5.04); Calibrated: 31.12.2016, ConvF(4.62, 4.62, 4.62); Calibrated: 31.12.2016, ConvF(4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.48, 4.48, 4.48); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm. Reference Value = 64.58 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 28.8 W/kg SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.09 W/kg Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.69 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 30.5 W/kg SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.17 W/kg Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.64 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 34.0 W/kg SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.25 W/kg Maximum value of SAR (measured) = 19.8 W/kg

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Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.99 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 33.9 W/kg SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.25 W/kg Maximum value of SAR (measured) = 19.5 W/kg

## Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.02 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 34.5 W/kg SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

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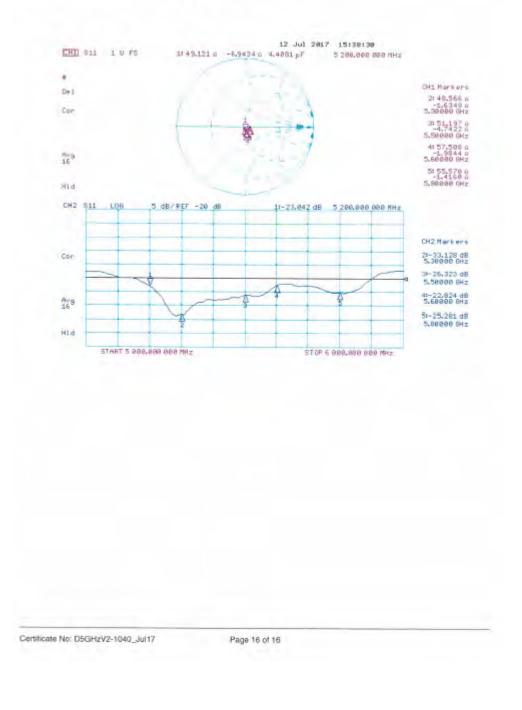
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## Impedance Measurement Plot for Body TSL



## - End of report -

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