APPENDIX H: IEEE 802.11AX RU SAR EXCLUSION

1.1 IEEE 802.11ax RU SAR Exclusion

To make the most efficient use of the additional available subcarriers (data tones), IEEE 802.11ax can utilize Orthogonal Frequency-Division Multiple Access (OFDMA) which divides the existing 802.11 channels into smaller subchannels called Resource Units (RUs). Possible RU sizes are: 26T, 52T, 106T, 242T, 484T and 996T.

Per FCC Guidance, 802.11ax was considered a higher order 802.11 mode when compared to a/b/g/n/ac to apply KDB Publication 248227 D01v02r02 for OFDM mode selection. Therefore, SAR tests were not required for 802.11ax based on the maximum allowed output powers of OFDM modes and the reported SAR values. Per FCC Guidance, maximum conducted powers were performed for each RU size to demonstrate that the output powers would not be higher than the other OFDM 802.11 modes.

1.2 IEEE 802.11ax RU Target Powers



1.2.1 Maximum 802.11ax RU WLAN Output Power

Reduced 802.11ax RU WLAN Output Power – Receiver Active or NR 1.2.2 Active and 2.4 GHz WLAN and/or 5 GHz WLAN

			SISO (ANT	1/2) /in dBm		MIMO (ALL) /in dBm				
Tones		2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz	2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz	
00T	Maximum	14	11	11	11	14	11	11	11	
201	Nominal	13	10	10	10	13	10	10	10	
FOT	Maximum	16	13	13	13	16	13	13	13	
521	Nominal	15	12	12	12	15	12	12	12	
1067	Maximum	16	13	13	13	16	14	14	14	
1001	Nominal	15	12	12	12	15	13	13	13	
	Maurinauma	16	13	13	13	16	14	14	14	
040T	T	ch. 11: 14.5				ch. 11: 14.5				
2421	Nominal	15	12	12	12	15	13	13	13	
	Norminal	ch. 11: 13.5				ch. 11: 13.5				
	Maurinauma			13	13			14	14	
101	Waximum									
4041	Nominal			12	12			13	13	
	Norminal									
006T	Maximum				13				14	
3901	Nominal				12				13	

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			SISO (ANT	1/2) /in dBm			MIMO (AL	L) /in dBm	
Tones		2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz	2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz
	Maximum	14	11	11	11	14	11	11	11
261	Nominal	13	10	10	10	13	10	10	10
COT	Maximum	16	13	13	13	16	13	13	13
521	Nominal	15	12	12	12	15	12	12	12
1067	Maximum	16	13	13	13	16	14	14	14
1001	Nominal	15	12	12	12	15	13	13	13
	Mandana	16	13	13	13	16	14	14	14
DADT.	Maximum	ch. 11: 14.5				ch. 11: 14.5			
2421	Nominal	15	12	12	12	15	13	13	13
	Nominai	ch. 11: 13.5				ch. 11: 13.5			
	Maximum			13	13			14	14
494T	IVIDAIITTUITT								
4041	Nominal			12	12			13	13
	Nominai								
996T	Maximum				13				14
	Nominal				12				13

1.2.3 Reduced 802.11ax RU WLAN Output Power During Conditions with Simultaneous 2.4 GHz WLAN and 5 GHz WLAN

1.2.4 Reduced 802.11ax RU WLAN Output Power During Conditions with Receiver Active and Simultaneous 2.4 GHz WLAN and 5 GHz WLAN and/or NR Active

T			SISO (ANT	1/2) /in dBm		MIMO (ALL) /in dBm					
Tones		2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz	2.4GHz	5GHz/20MHz	5GHz/40MHz	5GHz/80MHz		
DET.	Maximum	13	11	11	11	13	11	11	11		
201	Nominal	12	10	10	10	12	10	10	10		
EOT	Maximum	13	13	13	13	13	13	13	13		
521	Nominal	12	12	12	12	12	12	12	12		
1007	Maximum	13	13	13	13	13	13	13	13		
1061	Nominal	12	12	12	12	12	12	12	12		
0.407	Maximum	13	13	13	13	13	13	13	13		
2421	Nominal	12	12	12	12	12	12	12	12		
1017	Maximum			13	13			13	13		
4841	Nominal			12	12			12	12		
Tago	Maximum				13				13		
5901	Nominal				12				12		

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1.3 IEEE 802.11ax Measured Powers

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)	Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
			0	13.37				37	15.38
2412	1	26T	4	13.86	2412	1	52T	38	15.94
			8	13.30				40	15.01
			0	13.99				37	15.99
2437	6	26T	4	13.58	2437	6	52T	38	15.20
			8	13.09				40	15.40
			0	13.70				37	15.16
2462	11	26T	4	13.62	2462	11	52T	38	15.33
			8	13.52				40	15.71
Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)					
			53	17.93	Free				Avg Constant
2412	1	106T	54	17.95	[MHz]	Channel	Tones	RU Index	Powers
2/37	6	106T	53	17.29	[]				(dBm)
2437	U	1001	54	17.07	2412	1	242T	61	15.65
2462	11	106T	53	17.65	2437	6	242T	61	17.57
2402		1061	54	17.33	2462	11	242T	61	14.09

 Table 1

 Maximum 2.4 GHz 802.11ax RU Output Power – Ant 1

	FCC ID: A3LSMN986U		SAR EVALUATION REPORT	SAMSUNG	Reviewed by: Quality Manager
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				Powers (dBm)	[MHz]	Channel	Tones	RU Index	Conducted Powers (dBm)
2442			0	13.77				37	15.24
2412	1	26T	4	13.76	2412	1	52T	38	15.99
			8	13.42				40	15.59
	6		0	13.79	2437		52T	37	15.99
2437		26T	4	13.54		6		38	15.11
			8	13.49				40	15.47
			0	13.04				37	15.35
2462	11	26T	4	13.31	2462	11	52T	38	15.72
			8	13.67				40	15.01

Table 2Maximum 2.4 GHz 802.11ax RU Output Power – Ant 2

Freq	Channel	Tones	RU Index	Conducted					
[IVIHZ]				dBm)	Erog				Avg
2/12	1	106T	53	17.54		Channel	Tones	RU Index	Conducted
2412	I	1001	54 17.48	נואודצן				Powers (dBm)	
0.407		100-	53	17.52					(ubili)
2437	6	106T	54	17.75	2412	1	242T	61	15.81
2462	44	4007	53	17.15	2437	6	242T	61	17.38
	11	1061	54	17.54	2462	11	242T	61	13.93

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Table 3 Maximum 5 GHz 802.11ax RU Output Power - Ant 1

			1								1																	
		Freq			Avg Co	onducted Power	r (dBm)			Frog			Avg Co	onducted Power	r (dBm)													
	Band	INU-1	Channel	Tones		RU Index			Band	INU-1	Channel	Tones		RU Index														
		[INITZ]			0	4	8						37	39	40													
		5180	36	26T	10.62	10.95	10.86			5180	36	52T	12.63	12.83	12.82													
>	1	5200	40	26T	10.66	10.98	10.86	>	1	5200	40	52T	12.80	12.92	12.80													
		5240	48	26T	10.77	10.08	10.92			5240	48	52T	12.78	12.12	12.94													
		5260	52	26T	10.46	10.85	10.57			5260	52	52T	12.75	12.94	12.76													
	2A	5280	56	26T	10.60	10.95	10.70	P	2A	5280	56	52T	12.74	12.96	12.84													
		5320	64	26T	10.73	10.99	10.78			5320	64	52T	12.88	12.99	12.87													
		5500	100	26T	10.90	10.30	10.99			5500	100	52T	12.84	12.99	12.86													
50	2C	5600	120	26T	10.09	10.37	10.10	5	2C	5600	120	52T	12.10	12.20	12.99													
		5720	144	26T	10.62	10.81	10.50			5720	144	52T	12.60	12.70	12.55													
		5745	149	26T	10.97	10.20	10.76			5745	149	52T	12.99	12.99	12.79													
	3	5785	157	26T	10.66	10.14	10.68		3	5785	157	52T	12.70	12.96	12.73													
		5825	165	26T	10.24	10.64	10.21			5825	165	52T	12.29	12.56	12.31													
					Ava Co	onducted Power	r (dBm)						Ava Co	onducted Power	r (dBm)													
	Band	Freq	Channel	Tones		RU Index			Band	Freq	Channel	Tones		RU Index	<u> </u>													
		[MHz]	••••••		53	54	N/A			[MHz]			61	N/A	N/A													
		5180	36	106T	14 73	14.80				5180	36	242T	16.48	TU/A	N/A													
>	1	5200	40	106T	14 70	14.82		>	1	5200	40	242T	17.48															
		5240	48	106T	14.82	14.91				5240	48	242T	17.10															
<u> </u>		5260	52	106T	14.63	14.62				5260	52	242T	17.37															
N	2A	5280	56	106T	14.66	14.68		<u>N</u>	2A	5280	56	242T	17.40															
_		5320	64	106T	14 70	14 74		<u>+</u>		5320	64	242T	16.62															
2		5500	100	106T	14 70	14 79				5500	100	242T	17.30															
50	2C	5600	120	106T	14.90	14.82		50	2C	5600	120	242T	17.47															
		5720	144	106T	14 41	14.34				5720	144	242T	17.93															
ľ		5745	149	106T	14.94	14.82				5745	149	242T	17.66															
	3	5785	157	106T	14.70	14.66			3	5785	157	242T	17.48															
		5825	165	106T	14.26	14.27				5825	165	242T	17.06															
			5025 105											100				Ανα Ο	nducted Power	r (dBm)						Ανα Ο	onducted Power	r (dBm)
	Band	Freq	Channel	Tones	s RU Index B		Band	Freq	Channel	Tones		RU Index	()															
	Bana	[MHz]	onamo	101100	0	8	17		Band	[MHz]	onamer	101100	37	40	44													
3		5190	38	26T	10.06	10.23	10.17	2	_	5190	38	52T	12.23	12 32	12 33													
m	1	5230	46	26T	10.00	10.25	10.17	m	1	5230	46	52T	12.23	12.32	12.33													
N		5270	54	26T	10.11	10.20	10.02	N		5270	54	52T	12.02	12.01	12.10													
Î	2A -	5310	62	26T	10.00	10.00	10.00	Î	2A	5310	62	52T	12.20	12.00	12.01													
⋝		5510	102	26T	10.33	10.13	10.53	5		5510	102	52T	12.55	12.10	12.20													
ō	20	5590	118	26T	10.01	10.38	10.34	ō	2C	5590	118	52T	12.01	12.36	12.70													
4		5710	142	26T	10.20	10.03	10.95	4		5710	142	52T	12.36	12.00	12.00													
		5755	151	26T	10.42	10.43	10.32			5755	151	52T	12.79	12.34	12.60													
	3	5795	159	26T	10.71	10.21	10.54		3	5795	159	52T	12.99	12.15	12.93													
					Avg Co	nducted Power	r (dBm)						Avg Co	onducted Power	r (dBm)													
	Band	Freq	Channel	Tones		RU Index	. ,		Band	Freq	Channel	Tones		RU Index	. ,													
_		[MHZ]			53	54	56			[MHZ]			61	62	N/A													
3		5190	38	106T	14.52	14.34	14.56	3		5190	38	242T	16.64	16.65														
m	1	5230	46	106T	14.65	14.36	14.65	m	1	5230	46	242T	16.73	16.63														
N		5270	54	106T	14.39	14.98	14.45	N		5270	54	242T	16.54	16.53														
I	2A	5310	62	106T	14.44	14.99	14.41	I	2A	5310	62	242T	16.62	16.57														
Σ		5510	102	106T	14.49	14.23	14.71	Σ		5510	102	242T	16.43	16.56														
ᅙ	2C	5590	118	106T	14.61	14.25	14.58	9	2C	5590	118	242T	16.49	16.58														
4		5710	142	106T	14.36	14.74	14.25	40		5710	142	242T	16.18	16.12														
		5755	151	106T	14.86	14.26	14.81			5755	151	242T	16.65	16.65														
	3	5795	159	106T	14.27	14.90	14.21		3	5795	159	242T	16.24	16.18														

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	From				Avg Conducted Power (dBm)					
	Band	[MHz]	Channel	Tones	RU Index					
					65	N/A	N/A			
S	4	5190	38	484T	15.42					
m	'	5230	46	484T	16.57					
N	24	5270	54	484T	16.30					
_ _	27	5310	62	484T	14.68					
Σ		5510	102	484T	16.58					
1	2C	5590	118	484T	16.49					
N		5710	142	484T	16.17					
	2	5755	151	484T	16.48					
	3	5795	159	484T	16.14					

					Ava Co	onducted Power	(dBm)						Ava Co	onducted Power	(dBm)
>	Band	Freq	Channel	Tones	5.0	RU Index	()	>	Band	Freq	Channel	Tones	5.0	RU Index	
3		[MHz]			0	18	36	\gtrsim		[MHz]			37	44	52
ш.	1	5210	42	26T	10.19	10.94	10.42	ш.	1	5210	42	52T	12.36	12.86	12.50
42	2A	5290	58	26T	10.98	10.83	10.12	P	2A	5290	58	52T	12.21	12.73	12.36
Ш		5530	106	26T	10.48	10.21	10.52	ŧ		5530	106	52T	12.59	12.96	12.78
NO	2C	5610	122	26T	10.55	10.13	10.36	6	2C	5610	122	52T	12.61	12.91	12.41
8(5690	138	26T	10.45	10.94	10.96	₩ ₩		5690	138	52T	12.53	12.65	12.96
	3	5775	155	26T	10.43	10.99	10.09		3	5775	155	52T	12.67	12.89	12.34
		Francis			Avg Co	onducted Power	(dBm)			E			Avg Co	onducted Power	(dBm)
N	Band	Freq	Channel	Tones		RU Index		<	Band	Freq	Channel	Tones		RU Index	
B					53	56	60	m					61	62	64
N	1	5210	42	106T	14.53	14.82	14.61	N	1	5210	42	242T	15.77	15.89	15.83
Ĥ	2A	5290	58	106T	14.37	14.71	14.46	Î	2A	5290	58	242T	15.58	15.63	15.61
M		5530	106	106T	14.57	14.83	14.59	⋝		5530	106	242T	15.87	15.95	15.87
10	2C	5610	122	106T	14.57	14.79	14.61	0	2C	5610	122	242T	15.74	15.90	15.77
8		5690	138	106T	14.49	14.54	14.07	œ		5690	138	242T	15.69	15.74	15.39
	3	5775	155	106T	14.78	14.83	14.38		3	5775	155	242T	15.71	15.95	15.29
		From			Avg Co	onducted Power	(dBm)			From			Avg Co	onducted Power	(dBm)
~	Band	[MH ₇]	Channel	Tones		RU Index		2	Band	[MH ₇]	Channel	Tones		RU Index	
B		[]			65	66	N/A	m		[]			67	N/A	N/A
2	1	5210	42	484T	15.50	15.63		N	1	5210	42	996T	14.51		
OMHz	2A	5290	58	484T	15.32	15.38		Î	2A	5290	58	996T	14.63		
		5530	106	484T	15.53	15.81				5530	106	996T	15.60		
	2C	5610	122	484T	15.60	15.62		ō	2C	5610	122	996T	15.47		
œ		5690	138	484T	15.40	15.32		∞		5690	138	996T	15.27		
	3	5775	155	484T	15.60	15.64			3	5775	155	996T	15.36		

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Table 4 Maximum 5 GHz 802.11ax RU Output Power - Ant 2

					Avg Co	onducted Power	r (dBm)						Avg Co	onducted Power	r (dBm)
	Band	Freq	Channel	Tones		RU Index			Band	Freq	Channel	Tones		RU Index	
		[MHz]	•		0	4	8			[MHz]			37	39	40
		5180	36	26T	10.82	10.23	10.21	-		5180	36	52T	12.92	12.25	12.20
>	1	5200	40	26T	10.80	10.13	10.11	>	1	5200	40	52T	12.84	12.16	12.13
S<		5240	48	26T	10.72	10.11	10.99	\geq		5240	48	52T	12.81	12.13	12.05
		5260	52	26T	10.70	10.03	10.99			5260	52	52T	12.73	12.17	12.18
P	2A	5280	56	26T	10.74	10.02	10.01	P	2A	5280	56	52T	12.77	12.25	12.16
ŧ		5320	64	26T	10.75	10.03	10.98	1		5320	64	52T	12.82	12.18	12.99
0		5500	100	26T	10.94	10.18	10.04	6		5500	100	52T	12.91	12.35	12.98
2(2C	5600	120	26T	10.97	10.13	10.99	5	2C	5600	120	52T	12.97	12.44	12.96
		5720	144	26T	10.96	10.21	10.01			5720	144	52T	12.95	12.29	12.99
		5745	149	26T	10.89	10.34	10.94			5745	149	52T	12.99	12.15	12.98
	3	5785	157	26T	10.98	10.48	10.23		3	5785	157	52T	12.99	12.37	12.12
		5825	165	26T	10.80	10.44	10.12			5825	165	52T	12.97	12.26	12.01
		F ace as			Avg Co	onducted Power	r (dBm)			From			Avg Co	onducted Power	r (dBm)
	Band	[MH ₇]	Channel	Tones		RU Index			Band	[MH ₇]	Channel	Tones		RU Index	
		[101112]			53	54	N/A			[1411.12]			61	N/A	N/A
		5180	36	106T	14.88	14.18				5180	36	242T	16.74		
2	1	5200	40	106T	14.79	14.97		2	1	5200	40	242T	17.76		
m		5240	48	106T	14.71	14.98		m		5240	48	242T	17.60		
N		5260	52	106T	14.67	14.97		N		5260	52	242T	17.67		
Ϋ́	2A	5280	56	106T	14.77	14.97		・主	2A	5280	56	242T	17.64		
20MH		5320	64	106T	14.75	14.88		Σ		5320	64	242T	16.98		
		5500	100	106T	14.99	14.97		0		5500	100	242T	17.75		
	2C	5600	120	106T	14.99	14.98		7	2C	5600	120	242T	17.72		
		5720	144	106T	14.95	14.94				5720	144	242T	17.75		
		5745	149	106T	14.70	14.65				5745	149	242T	17.44		
	3	5785	157	106T	14.78	14.88			3	5785	157	242T	17.59		
		5825	165	106T	14.67	14.79				5825	165	242T	17.51		
	_	Frea		_	Avg Co	onducted Power	r (dBm)			Frea		_	Avg Co	onducted Power	r (dBm)
	Band	[MHz]	Channel	Tones		RU Index			Band	[MHz]	Channel	Tones		RU Index	
2		=			0	8	17	2		= 100		E O T	37	40	44
₹ N	1	5190	38	261	10.28	10.67	10.39		1	5190	38	521	12.47	12.63	12.54
		5230	46	261	10.18	10.53	10.35			5230	46	521	12.45	12.52	12.59
P	2A	5270	54	261	10.12	10.30	10.31	\mathbf{P}	2A	5270	54	521 52T	12.38	12.54	12.54
Ī		5310	62	201	10.07	10.19	10.12	1		5310	62	521	12.30	12.40	12.34
NO	20	5510	102	201	10.32	10.20	10.50	6	20	5510	1102	521 52T	12.52	12.57	12.03
4	20	5390	142	201 26T	10.23	10.21	10.52	4	20	5590	142	521 52T	12.29	12.30	12.43
		5755	151	201 26T	10.34	10.43	10.52			5755	151	52T	12.51	12.50	12.04
	3	5795	159	26T	10.00	10.00	10.01		3	5795	159	52T	12.01	12.00	12.02
		0100	100	201	Ava Ca	onducted Power	r (dBm)			0100	100	021	Ava Ca	onducted Power	r (dBm)
	Band	Freq	Channel	Tones	3 *	RU Index			Band	Freq	Channel	Tones	.	RU Index	(**)
_		[MHz]	•		53	54	56			[MHz]			61	62	N/A
3		5190	38	106T	14.65	14.58	14.64	3		5190	38	242T	16.98	16.87	
Δ	1	5230	46	106T	14.53	14.50	14.65	m	1	5230	46	242T	16.88	16.79	
N		5270	54	106T	14.48	14.45	14.50	N		5270	54	242T	16.74	16.76	
I	2A	5310	62	106T	14.44	14.34	14.43	I	2A	5310	62	242T	16.72	16.62	
Σ		5510	102	106T	14.70	14.30	14.89	Σ		5510	102	242T	16.63	16.70	
9	2C	5590	118	106T	14.64	14.13	14.58	9	2C	5590	118	242T	16.46	16.56	
V		5710	142	106T	14.67	14.27	14.77	V		5710	142	242T	16.57	16.65	
		5755	151	106T	14.49	14.35	14.67			5755	151	242T	16.57	16.76	
	3	5795	159	106T	14.27	14.40	14.50		3	5795	159	242T	16.56	16.70	

	FCC ID: A3LSMN986U	PCTEST Pour la be part d @ channel	SAR EVALUATION REPORT	SAMSUNG	Reviewed by: Quality Manager
	Test Dates:	DUT Type:			APPENDIX H:
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		F			Avg Co	nducted Power	r (dBm)	
	Band	Freq	Channel	Tones		RU Index		
-		[IVIFIZ]			65	N/A	N/A	
5	1	5190	38	484T	15.56			
Ш		5230	46	484T	16.70			
N	24	5270	54	484T	16.60			
I	ZA	5310	62	484T	14.67			
\geq		5510	102	484T	16.77			
9	2C	5590	118	484T	16.79			
V		5710	142	484T	16.91			
	2	5755	151	484T	16.78			
	3	5795	159	484T	16.75			

		F actor			Avg Co	onducted Power	(dBm)						Avg Co	onducted Power	(dBm)
2	Band	Freq ™⊔-1	Channel	Tones		RU Index		2	Band	Freq ™⊔-1	Channel	Tones		RU Index	
m		נאורזצן			0	18	36	m		נאורזצן			37	44	52
N	1	5210	42	26T	10.22	10.99	10.33	N	1	5210	42	52T	12.46	12.99	12.52
Ť	2A	5290	58	26T	10.02	10.66	10.03	Ť	2A	5290	58	52T	12.21	12.76	12.28
		5530	106	26T	10.26	10.82	10.21			5530	106	52T	12.50	12.80	12.42
5	2C	5610	122	26T	10.18	10.65	10.10	0	2C	5610	122	52T	12.31	12.56	12.24
õ		5690	138	26T	10.28	10.86	10.23	õ		5690	138	52T	12.39	12.65	12.32
	3	5775	155	26T	10.26	10.17	10.47		3	5775	155	52T	12.37	12.87	12.63
		Frag			Avg Co	onducted Power	(dBm)			Frag			Avg Co	onducted Power	(dBm)
2	Band	[MHz]	Channel	Tones		RU Index		2	Band	[MHz]	Channel	Tones		RU Index	
m		[]			53	56	60	m		[]			61	62	64
N	1	5210	42	106T	14.53	14.93	14.52	N	1	5210	42	242T	15.87	15.30	15.69
Ĥ	2A	5290	58	106T	14.30	14.72	14.30	Ĥ	2A	5290	58	242T	15.62	15.94	15.38
5		5530	106	106T	14.55	14.77	14.52	5		5530	106	242T	15.63	15.98	15.62
0	2C	5610	122	106T	14.40	14.70	14.38	0	2C	5610	122	242T	15.43	15.85	15.50
œ		5690	138	106T	14.49	14.61	14.44	œ		5690	138	242T	15.50	15.84	15.47
	3	5775	155	106T	14.23	14.50	14.45		3	5775	155	242T	15.38	15.74	15.54
		Erog			Avg Co	onducted Power	(dBm)			Erog			Avg Co	onducted Power	(dBm)
3	Band	[MHz]	Channel	Tones		RU Index		3	Band	[MHz]	Channel	Tones		RU Index	
m		[]			65	66	N/A	m		[]			67	N/A	N/A
N	1	5210	42	484T	15.66	15.62		N	1	5210	42	996T	14.71		
Ĥ	2A	5290	58	484T	15.41	15.47		Ĥ	2A	5290	58	996T	14.69		
ਙ		5530	106	484T	15.68	15.75		5		5530	106	996T	15.31		
0	2C	5610	122	484T	15.54	15.70		0	2C	5610	122	996T	15.13		
œ		5690	138	484T	15.58	15.83		œ		5690	138	996T	15.99		
	3	5775	155	484T	15.40	15.64			3	5775	155	996T	15.95		

	FCC ID: A3LSMN986U	Read is to part of @ classed	SAR EVALUATION REPORT	SAMSUNG	Reviewed by: Quality Manager
	Test Dates:	DUT Type:			APPENDIX H:
	04/22/20 - 06/07/20	Portable Handset			Page 8 of 8
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APPENDIX I: PROBE AND DIPOLE CALIBRATION CERTIFICATES

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 6004 Zurich, Switzerland





S

Schweizertscher Kalibrierdienst Service suisse d'étalonnage

C Service suisse d'etaionnage Servizio svizzero di taratura

S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client PC Test

Certificate No: D5GHzV2-1057_Jan18

Objeci	D5GHzV2 - SN:1	057	
Calibration procedure(s)	QA CAL-22.v2 Calibration proce	dure for dipole validation kits be	tween 3-6 GHz
			RN
Calibration date:	January 16, 2018	3	01-25-2018
This calibration cartificate docum	onie ina imagendiju to por	incluin derde which welfan the etc. Inclu	RNV
The measurements and the unce	rtaintles with confidence p	ional standards, which realize the physical un robability are given on the following pages a	nits of measurements (SI). p^{++} and are part of the certificate. $(n) + (n) + ($
All calibrations have been conduc	ted in the closed laborato	ry facility: environment lemperature (22 \pm 3)°	² C and humidity < 70%BN
Calibration Equipment used (M&1	E critical for calibration)		sul Al
			Curr
Primery Standards	D #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Act-17 (No. 217-02521)	Anr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Atlenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-10
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Anr-18
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No EX3-3503 Dec17)	
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
Samadary Standarda	1.0.4	Oback Data to be a	
Power mater EDM 4404		CRECK Date (In nouse)	Scheduled Check
Power concer HP 9/94A	ON. GD0/400/04	07-Oct-15 (in nouse check Oct-16)	in house check: Oct-18
	SN: US3/292/83	07-0ct-15 (in house check Oct-16)	in house check: Oct-18
FUNCI SCINCT AF 6461A	GN: M141092317	U/-Uct-15 (in house check Oct-16)	In house check: Oct-18
Notwork Applyment ID 87505	SN: 1009/2	15-Jun-15 (in house check Oct-16)	In house check; Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
O BAR AND A REAL	Leif Klysner	Laboratory Technician	Defligen
Calibrated by:			
Callbrated by: Approved by:	Katja Pokovic	Technical Manager	66165

Certificate No: D5GHzV2-1057_Jan18

Calibration Laboratory of

Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst

- S Service sulsse d'étalonnage
- С Servizio svizzero di taratura
- S Swiss Calibration Service

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

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 5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.55 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

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	35.8 ± 6 %	4.90 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 ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.06 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

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 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.41 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 ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.64 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz The following parameters and calculations were applied.

	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	46.6 ± 6 %	5.94 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 ³ (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	79.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	6.15 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.72 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

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	46.2 ± 6 %	6.22 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 ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.0 Ω - 5.5 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.7 Ω - 2.1 jΩ
Return Loss	- 26.2 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	52.7 Ω + 0.0 jΩ
Return Loss	- 31.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.3 Ω - 6.7 jΩ
Return Loss	- 23.4 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	48.4 Ω - 3.9 jΩ
Return Loss	- 27.4 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	55.3 Ω - 1.6 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	52.6 Ω + 1.1 jΩ
Return Loss	- 31.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	51.8 Ω - 0.4 jΩ
Return Loss	- 34.9 dB

General Antenna Parameters and Design

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG	
Manufactured on	November 27, 2006	

Appendix (Additional assessments outside the scope of SCS 0108)

Measurement Conditions (f=5200 MHz)

DASY system configuration, as far as not given on page 1 and 3.

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

SAR result with SAM Head (Top)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W/kg ± 20.3 % (k=2)
	· · ·	
SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Mouth)

SAR averaged over 1 cm ³ (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	85.6 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Neck)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.6 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Ear)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition			
SAR measured	100 mW input power	5.16 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	51.7 W/kg ± 20.3 % (k=2)		
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition			
SAR measured	100 mW input power	1.76 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	17.7 W/kg ± 19.9 % (k=2)		

Measurement Conditions (f=5800 MHz)

DASY system configuration, as far as not given on page 1 and 3.

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
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SAR result with SAM Head (Top)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	86.3 W/kg ± 20.3 % (k=2)
SAR averaged over 10 $\rm cm^3$ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Mouth)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	88.9 W/kg ± 20.3 % (k=2)
SAR for nominal Head TSL parameters	normalized to 1W	88.9 W/kg ± 20.3 % (k=

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Neck)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	100 mW input power	8.33 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	83.4 W/kg ± 20.3 % (k=2)	
SAB averaged over 10 cm ³ (10 d) of Head TSI	condition		

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Ear)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	5.68 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.8 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.9 W/kg ± 19.9 % (k=2)

DASY5 Validation Report for Head TSL

Date: 11.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1057

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz; $\sigma = 4.55$ S/m; $\varepsilon_r = 36.2$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 4.9$ S/m; $\varepsilon_r = 35.8$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5750 MHz; $\sigma = 5.06$ S/m; $\varepsilon_r = 35.5$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.51, 5.51, 5.51); Calibrated: 30.12.2017, ConvF(5.05, 5.05, 5.05); Calibrated: 30.12.2017, ConvF(4.98, 4.98, 4.98); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 modified; 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=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.54 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 27.5 W/kg SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.28 W/kg Maximum value of SAR (measured) = 17.7 W/kg

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 = 72.77 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 32.2 W/kg SAR(1 g) = 8.41 W/kg; SAR(10 g) = 2.4 W/kg Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 70.93 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 31.4 W/kg SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.3 W/kg Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg



DASY5 Validation Report for Body TSL

Date: 10.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1057

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 5.41$ S/m; $\varepsilon_r = 47.3$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5250 MHz; $\sigma = 5.48$ S/m; $\varepsilon_r = 47.2$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 5.94$ S/m; $\varepsilon_r = 46.6$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5750 MHz; $\sigma = 6.15$ S/m; $\varepsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 6.22$ S/m; $\varepsilon_r = 46.2$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.35, 5.35, 5.35); Calibrated: 30.12.2017, ConvF(5.26, 5.26, 5.26); Calibrated: 30.12.2017, ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2017, ConvF(4.57, 4.57, 4.57); Calibrated: 30.12.2017, ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(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 = 64.05 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 27.6 W/kg SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.06 W/kg Maximum value of SAR (measured) = 17.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.53 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 29.4 W/kg SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.13 W/kg Maximum value of SAR (measured) = 17.9 W/kg

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 = 65.09 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 34.0 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=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.45 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 32.9 W/kg SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.14 W/kg Maximum value of SAR (measured) = 18.9 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 = 63.14 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 33.3 W/kg SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.13 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Body TSL



DASY5 Validation Report for SAM Head

Date: 16.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1057

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.59$ S/m; $\epsilon r = 36.5$; $\rho = 1000$ kg/m3, Medium parameters used: f = 5800 MHz; $\sigma = 5.28$ S/m; $\epsilon r = 35.4$; $\rho = 1000$ kg/m3 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.75, 5.75, 5.75); Calibrated: 30.12.2017, ConvF(4.96, 4.96, 4.96); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

SAM Head/Top - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm Reference Value = 72.99 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 30.6 W/kg SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.35 W/kg Maximum value of SAR (measured) = 19.7 W/kg

SAM Head/Top - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mmReference Value = 73.00 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 36.5 W/kg SAR(1 g) = 8.62 W/kg; SAR(10 g) = 2.41 W/kg Maximum value of SAR (measured) = 21.9 W/kg

SAM Head/Mouth - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.79 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 29.5 W/kg SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.37 W/kg Maximum value of SAR (measured) = 20.7 W/kg SAM Head/Mouth - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.69 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 34.9 W/kg

SAR(1 g) = 8.88 W/kg; SAR(10 g) = 2.44 W/kgMaximum value of SAR (measured) = 23.0 W/kg

SAM Head/Neck - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm Reference Value = 72.48 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 27.9 W/kg SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.37 W/kg Maximum value of SAR (measured) = 19.3 W/kg

SAM Head/Neck - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.90 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 33.4 W/kgSAR(1 g) = 8.33 W/kg; SAR(10 g) = 2.35 W/kgMaximum value of SAR (measured) = 21.8 W/kg

SAM Head/Ear - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 54.68 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 16.3 W/kg SAR(1 g) = 5.16 W/kg; SAR(10 g) = 1.76 W/kg Maximum value of SAR (measured) = 11.1 W/kg

SAM Head/Ear - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 56.96 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 21.2 W/kg SAR(1 g) = 5.68 W/kg; SAR(10 g) = 1.89 W/kg Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg



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http://www.pctest.com



Certification of Calibration

Object

D5GHzV2 - SN: 1057

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

1/16/2019

Extension Calibration date:

Description:

SAR Validation Dipole at 5250, 5600, and 5750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	2/8/2018	Annual	2/8/2019	US39170122
Agilent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Pulse Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330156
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/3/2018	Annual	10/3/2019	1558
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091
SPEAG	EX3DV4	SAR Probe	8/23/2018	Annual	8/23/2019	7308
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D5GHzV2 – SN: 1057	01/16/2019	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	Measured Head SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5250	1/16/2018	1/16/2019	1.203	3.96	3.63	-8.33%	1.14	1.04	-8.77%	50	47.6	2.4	-5.5	-6.7	1.2	-25.2	-22.8	9.60%	PASS
5600	1/16/2018	1/16/2019	1.203	4.205	3.84	-8.68%	1.2	1.09	-9.17%	54.7	52.5	2.2	-2.1	1.6	3.7	-26.2	-30.6	-16.80%	PASS
5750	1/16/2018	1/16/2019	1.203	4.025	3.76	-6.58%	1.15	1.07	-6.96%	52.7	54.4	1.7	0	0.1	0.1	-31.5	-27.5	12.70%	PASS
Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	Measured Body SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5250	1/16/2018	1/16/2019	1.203	3.795	3.73	-1.71%	1.06	1.03	-2.37%	48.4	45.9	2.5	-3.9	-4	0.1	-27.4	-24.5	10.50%	PASS
5600	1/16/2018	1/16/2019	1.203	3.995	4.06	1.63%	1.12	1.12	0.45%	55.3	51	4.3	-1.6	2.8	4.4	-25.6	-30.7	-20.00%	PASS
5750	1/16/2018	1/16/2019	1.203	3.835	3.65	-4.82%	1.06	1.02	-3.77%	52.6	52.9	0.3	1.1	0.6	0.5	-31.2	-30.7	1.60%	PASS

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Impedance & Return-Loss Measurement Plot for Head TSL

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Impedance & Return-Loss Measurement Plot for Body TSL

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Certification of Calibration

Object

D5GHzV2 – SN: 1057

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

1/16/2020

Extension Calibration date:

Description:

SAR Validation Dipole at 5250, 5600, and 5750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2020	181334684		
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable DAK	9/10/2019	Annual	9/10/2020	1045
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	1/15/2020	Annual	1/15/2021	1328004
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	5/16/2019	Annual	5/16/2020	7406
SPEAG	EX3DV4	SAR Probe 6/19/2019 Annual				7409
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/20/2019	Annual	6/20/2020	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/8/2019	Annual	5/8/2020	728

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Daga 1 of 4
D5GHzV2 – SN: 1057	01/16/2020	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	Measured Head SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5250	1/16/2018	1/16/2020	1.203	3.96	3.72	-6.06%	1.14	1.05	-7.89%	50	46.9	3.1	-5.5	-6.3	0.8	-25.2	-22.8	9.50%	PASS
5600	1/16/2018	1/16/2020	1.203	4.205	3.91	-7.02%	1.2	1.11	-7.50%	54.7	52.9	1.8	-2.1	-1.4	0.7	-26.2	-30.2	-15.20%	PASS
5750	1/16/2018	1/16/2020	1.203	4.025	3.72	-7.58%	1.15	1.05	-8.70%	52.7	52.4	0.4	0	-2.3	2.3	-31.5	-29.8	5.30%	PASS
Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	Measured Body SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5250	1/16/2018	1/16/2020	1.203	3.795	3.75	-1.19%	1.06	1.04	-1.42%	48.4	51	2.6	-3.9	-2.8	1.1	-27.4	-30.6	-11.80%	PASS
5600	1/16/2018	1/16/2020	1.203	3.995	3.98	-0.38%	1.12	1.1	-1.35%	55.3	53.6	1.7	-1.6	0.2	1.8	-25.6	-29.2	-14.00%	PASS
5750	1/16/2018	1/16/2020	1.203	3.835	3.87	0.91%	1.06	1.06	0.00%	52.6	52.8	0.2	1.1	0.5	0.6	-31.2	-31.4	-0.20%	PASS

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Impedance & Return-Loss Measurement Plot for Head TSL

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Impedance & Return-Loss Measurement Plot for Body TSL

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PC Test

Client





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Accreditation No.: SCS 0108

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

Certificate No: D5GHzV2-1191_Sep19

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CALIBRA	ATION CERTIFICATE

Object	D5GHzV2 - SN:1	191	
Calibration procedure(s)	QA CAL-22.v4 Calibration Proce	dure for SAR Validation Sources b	etween 3-6 GHz BN 09/26/2014
Calibration date:	September 17, 2	019	
This calibration certificate documer The measurements and the uncerta	nts the traceability to nati ainties with confidence p	onal standards, which realize the physical units robability are given on the following pages and a	of measurements (SI). are part of the certificate.
All calibrations have been conducte	ed in the closed laborato	y facility: environment temperature (22 \pm 3)°C a	ind humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 3503	25-Mar-19 (No. EX3-3503 Mar19)	Mar-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seitz	چ چ	<u>A</u>
Approved by:	Katja Pokovic	Technical Manager	alle
This calibration certificate shall not	be reproduced except in	full without written approval of the laboratory.	Issued: September 18, 2019

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst S

Service suisse d'étalonnage С

Servizio svizzero di taratura

S Swiss Calibration Service

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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 5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5250 MHz

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

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

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	34.6 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	141 AG 107 AG	

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	1 11-41 17	

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

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 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.44 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 ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
		· · · · · · · · · · · · · · · · · · ·

normalized to 1W

20.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

SAR for nominal Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	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	46.2 ± 6 %	5.98 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 ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5750 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.19 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz The following parameters and calculations were applied.

<u>.</u>	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	45.9 ± 6 %	6.26 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5800 MHz

SAR for nominal Body TSL parameters

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.0 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg

normalized to 1W

21.0 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	53.5 Ω - 6.2 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.4 Ω - 4.3 jΩ
Return Loss	- 22.8 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	59.1 Ω + 1.9 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	50.9 Ω - 8.6 jΩ
Return Loss	- 21.3 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	53.2 Ω - 4.1 jΩ
Return Loss	- 26.0 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.1 Ω - 4.2 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	60.3 Ω + 2.3 jΩ
Return Loss	- 20.4 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.5 Ω + 2.3 jΩ
Return Loss	- 22.7 dB

General Antenna Parameters and Design

	1	
Electrical Delay (one direction)		1.202 ns
•••		

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

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

Appendix (Additional assessments outside the scope of SCS 0108)

Measurement Conditions (f=5200 MHz)

DASY system configuration, as far as not given on page 1 and 3.

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	Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
	i maniform		

SAR result with SAM Head (Top)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Mouth)

SAR averaged over 1 cm ³ (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	83.8 W/kg ± 20.3 % (k=2)
	Net	
SAR averaged over 10 cm ⁻ (10 g) of Head 15L	condition	
SAR averaged over 10 cm ⁻ (10 g) of Head 1SL SAR measured	100 mW input power	2.36 W/kg

SAR result with SAM Head (Neck)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Ear)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	5.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.1 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	17.8 W/kg ± 19.9 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Measurement Conditions (f=5800 MHz)

DASY system configuration, as far as not given on page 1 and 3.		
Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

SAR result with SAM Head (Top)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.7 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg

normalized to 1W

normalized to 1W

23.3 W/kg ± 19.9 % (k=2)

23.6 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Mouth)

SAR for nominal Head TSL parameters

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.5 W/kg ± 20.3 % (k=2)
$242 \qquad $	condition	
SAR averaged over 10 cm (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.37 W/kg

SAR result with SAM Head (Neck)

SAR for nominal Head TSL parameters

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.9 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.9 % (k=2)

SAR result with SAM Head (Ear)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	5.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.9 W/kg ± 20.3 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.1 W/kg ± 19.9 % (k=2)

DASY5 Validation Report for Head TSL

Date: 13.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz; σ = 4.53 S/m; ϵ_r = 35.1; ρ = 1000 kg/m³, Medium parameters used: f = 5600 MHz; σ = 4.88 S/m; ϵ_r = 34.6; ρ = 1000 kg/m³, Medium parameters used: f = 5750 MHz; σ = 5.03 S/m; ϵ_r = 34.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 76.95 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 28.0 W/kg SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.32 W/kg Maximum value of SAR (measured) = 18.2 W/kg

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 = 76.89 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 30.9 W/kg SAR(1 g) = 8.33 W/kg; SAR(10 g) = 2.36 W/kg Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.20 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 31.6 W/kg SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.29 W/kg Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 5.44$ S/m; $\varepsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5250 MHz; $\sigma = 5.51$ S/m; $\varepsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 5.98$ S/m; $\varepsilon_r = 46.2$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5750 MHz; $\sigma = 6.19$ S/m; $\varepsilon_r = 46; \rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 6.26$ S/m; $\varepsilon_r = 45.9; \rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.26$ S/m; $\varepsilon_r = 45.9; \rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.26$ S/m; $\varepsilon_r = 45.9; \rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.26$ S/m; $\varepsilon_r = 45.9$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.14, 5.14, 5.14) @ 5200 MHz, ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.74, 4.74, 4.74) @ 5600 MHz, ConvF(4.62, 4.62, 4.62) @ 5750 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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 = 68.78 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 28.7 W/kg SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.11 W/kg Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.09 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 30.3 W/kg SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.16 W/kg Maximum value of SAR (measured) = 18.1 W/kg

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 = 68.19 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 34.3 W/kg SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.22 W/kg Maximum value of SAR (measured) = 19.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 66.80 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 35.1 W/kg SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.15 W/kg Maximum value of SAR (measured) = 18.9 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 = 67.13 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 33.8 W/kg SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.12 W/kg Maximum value of SAR (measured) = 18.5 W/kg



Impedance Measurement Plot for Body TSL

<u>F</u> ile	<u>V</u> iew	<u>C</u> hannel :	Sw <u>e</u> ep	Calibration	<u>Trace</u> <u>S</u> cale	e Marker	5 <u>v</u> stem	Window	Help		
								~	1:	5.200000 GHz 2.5474 cF	50,932 Ω -9.6279 D
							T	X	2:	5.250000 GHz	-3.6273 Ω 53.213 Ω
						X	1	11-4	<u>.</u>	7.4556 pF	-4.0661 Ω 50.105 Ω
1.1					/	$^{\prime}$ \times	Х.	1	31	5.600000 GHZ 6.7035 pF	-4.2397 Ω
0.000						~~~	1 <u> </u>	SA.	4:	5,750000 GHz	60.292 Ω
								i staller i stal	>5:	64.987 pH 5.800008 GHz	2.34/9 0 57.493 0
							<u></u> 第一 大	7 H		64.232 pH	2,3408 Ω
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					λ	\times	~	$\overline{\mathbf{F}}$			
					N.	$\langle \sim$	<u> </u>	S.			
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	Ch1: St	art 5.00000 Gl	Hz							ыор	6.00000 072
10	.00	AB SIA							1:	5.200000 GHz	-21.344 dB
5.	00 H										
1110									2:	<u>- 5.150000 GHz</u> 5.000000 GHz	
111	00									5.00000 GHz 5.000000 GHz 5.00000 GHz	<u>-25.391-d8</u> -21.443 dB -20.383 dB
5	00 .00								2: 3: 4: >5:	5.50000 GHz 5.600000 GHz 5.50000 GHz 5.50000 GHz 5.60000 GHz	<u>25.381-dB</u> -21.443 dB -20.383 dB <u>22 732 dB</u>
-5 -1	00 .00 0.00					· · · · · · · · · · · · · · · · · · ·			2: 3: 4: >5:	5.(50000 GHz 5.(00000 GHz 5.(50000 GHz 5.30000 GHz	<u>-25,381-dB</u> -21,443 dB -20,383 dB -22,732 dB
-5 -11 -11	00 .00 0.00 5.00								2: 3: 4: >5:	5.50000 GHz 5.400000 GHz 5.750000 GHz 5.800000 GHz	25.391.48 -21.443.48 -20.383.48 -22.732.48
5 5 11 1 1 1 2	00 .00 0.00 5.00 0.00								2: 3: 4: 25: 5: 25:	5,50000 GHz 5,600000 GHz 5,50000 GHz 5,80000 GHz	-25.391 dB -21.443 dB -20.383 dB -22 732 dB
5 -11 -11 -12 -2	00 .00 0.00 5.00 0.00								2: 3: 4: >5: 2 4: 4	5,50000 GHz 5,600000 GHz 5,50000 GHz 5,50000 GHz 5,80000 GHz	25.391 dB -21.443 dB -20.383 d8 -22.732 dB
	00 .00 0.00 5.00 0.00 \$.00								2: 3: 4: >5:	5.550000 GHz 5.400000 GHz 5.50000 GHz 5.80000 GHz	-25.291.48 -21.443.dB -20.383.dB -22.732.dB
	00 .00 5.00 5.00 5.00 5.00 0.00 5.00								2: 3: 4: 5:	5.150000 GHz 5.600000 GHz 5.750000 GHz 5.800000 GHz	-25.391.4B -21.443.dB -20.383.dB -22.732.dB
	00 .00 5.00 5.00 5.00 5.00 5.00 0.00	Ch 1 Avg =	20						2: 3: 4: ≥5: 22 4	5,50000 GHz 5,600000 GHz 5,50000 GHz 5,50000 GHz 5,80000 GHz	- 25.391 dB -21.443 dB -20.383 dB -22.732 dB
	00 .00 5.00 5.00 5.00 5.00 5.00 5.00 Ch1: St	Ch 1 Avg = 3 3rt 5.00000 G	20 Hz						2: 3: 4: ≥5: 	5.50000 GHz 5.60000 GHz 5.50000 GHz 5.80000 GHz 5.80000 GHz	25.291.48 -21.443.48 -20.383.48 -22.732.48

DASY5 Validation Report for SAM Head

Date: 17.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; σ = 4.55 S/m; ϵ_r = 36.2; ρ = 1000 kg/m³, Medium parameters used: f = 5800 MHz; σ = 5.28 S/m; ϵ_r = 34.9; ρ = 1000 kg/m³ Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: SAM Head
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

SAM/Head/Top - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm Reference Value = 74.84 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 27.5 W/kg SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.34 W/kg Maximum value of SAR (measured) = 18.5 W/kg

SAM/Head/Top - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm Reference Value = 70.45 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 32.3 W/kg SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg Maximum value of SAR (measured) = 20.2 W/kg

SAM/Head/Mouth - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 76.86 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 29.3 W/kg SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.36 W/kg Maximum value of SAR (measured) = 19.8 W/kg

SAM/Head/Mouth - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mmReference Value = 71.46 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 34.0 W/kg SAR(1 g) = 8.56 W/kg; SAR(10 g) = 2.37 W/kg SAM/Head/Neck - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.71 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.36 W/kgMaximum value of SAR (measured) = 19.2 W/kg

SAM/Head/Neck - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm,

dz=1.4mm Reference Value = 71.62 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 32.1 W/kg SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.26 W/kg Maximum value of SAR (measured) = 20.2 W/kg

SAM/Head/Ear - 5200/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 57.89 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 16.7 W/kg SAR(1 g) = 5.11 W/kg; SAR(10 g) = 1.78 W/kg Maximum value of SAR (measured) = 11.4 W/kg

SAM/Head/Ear - 5800/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.22 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 21.0 W/kg SAR(1 g) = 5.6 W/kg; SAR(10 g) = 1.92 W/kg Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 11.4 W/kg = 10.57 dBW/kg

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S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Certificate No: D750V3-1003_Mar20

PC Test Client

Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GF Calibration date: March 16, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	HZ 13NV 1321 041321
Calibration date: March 16, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	BN 04 130 15 3.
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	04 13° 1 e.
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 \pm 3)°C and humidity < 70%.	
Calibration Equipment used (M&TE critical for calibration)	
Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibra	ition
Power meter NRP SN: 104778 03-Apr-19 (No. 217-02892/02893) Apr-20	
Power sensor NRP-Z91 SN: 103244 03-Apr-19 (No. 217-02892) Apr-20	
Power sensor NRP-Z91 SN: 103245 03-Apr-19 (No. 217-02893) Apr-20	
Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Apr-20	
ype-N mismatch combination SN: 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20	
Reference Probe EX3DV4 SN: 7349 31-Dec-19 (No. EX3-7349_Dec19) Dec-20	
DAE4 SN: 601 27-Dec-19 (No. DAE4-601_Dec19) Dec-20	
Secondary Standards ID # Check Date (in house) Scheduled Check	
Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check: O	ct-20
Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Or	ct-20
Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) In house check: Oct-18	ct-20
IF generator R&S SMT-06SN: 10097215-Jun-15 (in house check Oct-18)In house check: Oct-18	ct-20
Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-19) In house check: Or	ct-20
Name Function Signature	
Calibrated by: Jeton Kastrati Laboratory Technician	
+	×
Approved by: Katja Pokovic Technical Manager	
pent	

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- S Swiss Calibration Service

Accreditation No.: SCS 0108

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.5 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.78 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.77 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54. 7 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		ar da mi ta

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.61 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.67 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω - 0.1 jΩ
Return Loss	- 26.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.8 Ω - 2.4 jΩ
Return Loss	- 30.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 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

DASY5 Validation Report for Head TSL

Date: 16.03.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.88$ S/m; $\varepsilon_r = 42.5$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 60.72 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 3.27 W/kg **SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.43 W/kg** Smallest distance from peaks to all points 3 dB below = 16.5 mm Ratio of SAR at M2 to SAR at M1 = 66.2% Maximum value of SAR (measured) = 2.90 W/kg



0 dB = 2.90 W/kg = 4.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.03.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ϵ_r = 54.7; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.61, 10.61, 10.61) @ 750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 57.60 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 3.23 W/kg **SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg** Smallest distance from peaks to all points 3 dB below = 21.2 mm Ratio of SAR at M2 to SAR at M1 = 66.6% Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 4.58 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation I	No.:	SCS	0108

Certificate No: D750V3-1161_Oct18

PC Test Client

CALIBRATION C	BRIEKA I:	E	
Object	D750V3 - SN:11(51	
Calibration procedure(s) QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz			
Calibration date:	October 19, 2018)	BN 10-30-2018
This calibration certificate documer	its the traceability to nati	onal standards, which realize the physical	units of measurements (SI). BNV
The measurements and the uncertain	ainties with confidence p	robability are given on the following pages	and are part of the certificate. 10^{-20}
All calibrations have been conducte Calibration Equipment used (M&TE	ed in the closed laborato critical for calibration)	ry facility: environment temperature (22 \pm 3)°C and humidity < 70%.
Primary Standards	ה#	Cal Date (Cortificate No.)	Scheduled Calibration
Power mater NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards		Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (In house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	-
			A Contraction of the contraction
Approved by:	Katja Pokovic	Technical Manager	Lelly
			Issued: October 22, 2018

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

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Accreditation No.: SCS 0108

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

	v i v	
DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		m == ===

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.03 W/kg ± 17.0 % (k=2)
μ	······································	
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.26 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity	
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m	
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.96 mho/m ± 6 %	
Body TSL temperature change during test	< 0.5 °C			

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.43 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.55 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.6 Ω - 1.9 jΩ
Return Loss	- 25.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.6 Ω - 4.2 jΩ
Return Loss	- 27.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.032 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 19, 2015

DASY5 Validation Report for Head TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.89$ S/m; $\varepsilon_r = 40.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 58.51 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 3.04 W/kg SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.32 W/kg Maximum value of SAR (measured) = 2.70 W/kg



0 dB = 2.70 W/kg = 4.31 dBW/kg

<u>F</u> ile	⊻iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	<u>T</u> race <u>S</u> cale	e M <u>a</u> rker	S <u>y</u> stem <u>V</u>	<u>V</u> indow <u>H</u> e	lp			
								: 750.0 50.0	112.30	Hz pF Hz	55 - 1.3 56.1 - 1	i.621 Ω 8896 Ω 38 mU 7.556 °
	Ch1: St	Ch 1 Avg = art 550,000 t	20 에Hz	50004							Stop 95	0.000 MHz
10. 5.(-5.) -10 -15 -20 -25 -30 -35 -40	00 00 00 .00 .00 .00 .00 .00 .00 Ch1: St	<u>Ch 1 Avg =</u> art 550.000 l	20 MHz				> 1	. 750.0		Hz	-25.	015 dB
St	atus	CH 1:	511		C* 1-Port		Ava=20 D	elau				C

DASY5 Validation Report for Body TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ϵ_r = 55.1; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 57.57 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.18 W/kg SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.39 W/kg Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Impedance Measurement Plot for Body TSL

Eile	<u>V</u> iew	<u>C</u> hannel	Sweep	Calibration	<u>T</u> race <u>S</u> cale	Marker	System <u>V</u>	/indow <u>H</u> e	»lp			
					A	XXX		: 750.0 750.0	100000 M 51.109 100000 M	Hz pF Hz	50. -4.1 41.7 -78	640 Ω 521 Ω 09 mU 3.869 °
	Ch1: St	Ch 1 Avg = at 550.000 (20 MHz			·····					Stop 950).000 MHz
10. 5.0 -5.0 -10 -15 -20 -25 -30 -35 -30 -40	00 10 10 100 1.00 1.00 1.00 1.00 1.00 Ch11: St	69.211 <u>Ch 1 Avg =</u> art 550.000	20 MHz				> 1	: 750.0		Hz	-27.5	595 dB
S	atus	CH 1· 1	511		C* 1-Port		Ava=20 D	elay			L	CL


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Certification of Calibration

Object

D750V3 – SN:1161

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: October 18, 2019

Description: SAR Validation Dipole at 750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	4/24/2019	Annual	4/24/2020	7357
SPEAG	EX3DV4	SAR Probe	7/16/2019	Annual	7/16/2020	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/18/2019	Annual	4/18/2020	1407

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D750V3 – SN:1161	10/18/2019	raye 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 23.0 dBm	Measured Head SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	Measured Head SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
10/19/2018	10/18/2019	1.032	1.61	1.64	2.12%	1.05	1.08	2.66%	55.6	53.2	2.4	-1.9	-3.4	1.5	-25	-26.8	-7.30%	PASS
			Certificate			Certificate												
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	SAR Target Body (1g) W/kg @ 23.0 dBm	Measured Body SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL

Object:	Date Issued:	Page 2 of 4
D750V3 – SN:1161	10/18/2019	Fage 2 014

Impedance & Return-Loss Measurement Plot for Head TSL



15:34:00 18.10.2019

Object:	Date Issued:	Page 3 of 4
D750V3 – SN:1161	10/18/2019	raye 5 01 4

Impedance & Return-Loss Measurement Plot for Body TSL



15:35:04 18.10.2019

Object:	Date Issued:	Dago 4 of 4
D750V3 – SN:1161	10/18/2019	Fage 4 01 4

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- С Servizio svizzero di taratura
- S **Swiss Calibration Service**

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Accreditation No.:	SCS	0108

Certificate No: D835V2-4d132_Jan20 Client PC Test CALIBRATION CERTIFICATE D835V2 - SN:4d132 Object Calibration procedure(s) QA CALUE III in i cration BNY 2-05-2020 January 13, 2020 Calibration date: This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 03-Apr-19 (No. 217-02892/02893) Apr-20 Power sensor NRP-Z91 SN: 103244 03-Apr-19 (No. 217-02892) Apr-20 Power sensor NRP-Z91 SN: 103245 03-Apr-19 (No. 217-02893) Apr-20 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Apr-20 Type-N mismatch combination SN: 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20 Reference Probe EX3DV4 SN: 7349 31-Dec-19 (No. EX3-7349 Dec19) Dec-20 DAE4 SN: 601 27-Dec-19 (No. DAE4-601_Dec19) Dec-20 ID # Secondary Standards Check Date (in house) Scheduled Check SN: GB39512475 Power meter E4419B 30-Oct-14 (in house check Feb-19) In house check: Oct-20 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Oct-20 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) In house check: Oct-20 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-18) In house check: Oct-20 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-19) In house check: Oct-20 Name Function Signature Leif Klysner Calibrated by: Laboratory Technician Katla Pokovic Approved by: Technical Manager Issued: January 21, 2020

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole • positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. 0 No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power. 0
- 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%.

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.3
Extrapolation	Advanced Extrapolation	· · · ·
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.6 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.65 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.30 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.53 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.96 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.64 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.4 Ω - 3.1 jΩ
Return Loss	- 30.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.7 Ω - 5.5 jΩ
Return Loss	- 24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 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

DASY5 Validation Report for Head TSL

Date: 13.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 42.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 62.94 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.60 W/kg SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.58 W/kg Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 67.1% Maximum value of SAR (measured) = 3.20 W/kg



0 dB = 3.20 W/kg = 5.05 dBW/kg

Impedance Measurement Plot for Head TSL

File	<u>V</u> iew	Channel	Sw <u>e</u> ep	Calibration	n <u>Trace S</u> ca	e M <u>a</u> rker	System W	indow <u>H</u> e	lp.		
		Ch 1 Aug	20			XXXX		835.0	00000 M 60.623 00000 M	Hz pF Hz 3	50.361 Ω -3.1441 Ω 1.518 mU -81.664 °
L.	Ch1: Sta	off 635.000 l	ZU MHz	insistent						St	op 1.03500 GHz
10.0 5.00 -5.00 -10.0 -15.0 -25.0 -25.0 -30.0 -35.0 -40.0 C	0 { 0	iB S11	20 MHz				> 1:	835.0		H2 -	30.029 dB
	1993 (A. 1997) 1997 - 1997 (A. 1997)	CH 1.			TAN AN	gereen een een een een een een een een ee	A _ 70 D	12450344303		egegyzeige	en presidente

DASY5 Validation Report for Body TSL

Date: 13.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d132

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.99$ S/m; $\epsilon_r = 55.1$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 60.64 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.71 W/kg SAR(1 g) = 2.53 W/kg; SAR(10 g) = 1.68 W/kg Smallest distance from peaks to all points 3 dB below = 16.2 mm Ratio of SAR at M2 to SAR at M1 = 68.2% Maximum value of SAR (measured) = 3.33 W/kg



0 dB = 3.20 W/kg = 5.05 dBW/kg

Impedance Measurement Plot for Body TSL

1: 835.000000 MHz 48. 34.503 pF -5.5 2: 835.000000 MHz 57.48 -10	.684 Ω 5242 Ω 56 mU 00.20 °
	ст. с
Ch1: Start 635.000 MHz Stop 1.0	03500 GHz
10.00 > 1 835.000000 MHz -24.8 0.00 - - - - 5.00 - - - - -10.00 - - - - - -10.00 -	913 dB

Appendix: Transfer Calibration at Four Validation Locations on SAM Head¹

Evaluation Condition

SAR result with SAM Head (Top \cong C0)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.34 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	6.19 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Mouth \cong F90)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.80 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	6.59 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Neck \cong H0)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.32 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	6.30 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Ear \cong D90)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	8.01 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	5.40 W/kg ± 16.9 % (k=2)

 $^{^{1}}$ Additional assessments outside the current scope of SCS 0108

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



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Client PC Test			Certificate No: D835V2-4d047_Mar19
GALERATIONC	ernie (gat:		
Object	D835V2 - SN:4d0	947	
Calibration procedure(s)	QA CAL-05:v11 Calibration Proce	dure for SAR Validati	ion Sources between 0.7-3 GHz
			BN
Calibration date:	March 13, 2019		04-12-2019
This calibration certificate document The measurements and the uncert	nts the traceability to nati ainties with confidence p	ional standards, which realize robability are given on the foll	the physical units of measurements (SI). $04 - 30 - 202$ lowing pages and are part of the certificate.
All calibrations have been conduct	ed in the closed laborato	ry facility: environment tempe	rature (22 \pm 3)°C and humidity < 70%.
Calibration Equipment used (M&TE	E critical for calibration)		:
Primary Standards	1D #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/	/02673) Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)) Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)) Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)) Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)) Apr-19
Reference Probe EX3DV4	SN: 7349	31-Dec-18 (No. EX3-7349	Dec18) Dec-19
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_	_Oct18) Oct-19
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	07-Oct-15 (in house check	: Feb-19) In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check	Oct-18) In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check	Oct-18) In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check	(Oct-18) in house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check	(Oct-18) In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Ter	chnician .
Approved by:	Katja Pokovic	Technical:Man	ager UU
			issued: March 13, 2019

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

ssued: March 13, 2019

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst

- S Service suisse d'étalonnage С
 - Servizio svizzero di taratura
- S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.9 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.42 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.47 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.27 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 Ω - 2.6 jΩ
Return Loss	- 30.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω - 6.1 jΩ
Return Loss	- 22.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.387 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

DASY5 Validation Report for Head TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.91 S/m; ϵ_r = 41.9; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10, 10, 10) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 62.48 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 3.60 W/kg SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 5.02 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.03.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d047

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 1.01$ S/m; $\varepsilon_r = 54.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.15, 10.15, 10.15) @ 835 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 60.49 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.58 W/kg SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.61 W/kg Maximum value of SAR (measured) = 3.23 W/kg



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

Impedance Measurement Plot for Body TSL







Certification of Calibration

Object

D835V2 - SN: 4d047

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 3/13/2020

Description:

SAR Validation Dipole at 835 MHz

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable DAK	9/10/2019	Annual	9/10/2020	1045
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	12/17/2019	Annual	12/17/2020	941001
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	9/19/2019	Annual	9/19/2020	7551
SPEAG	EX3DV4	SAR Probe	1/21/2020	Annual	1/21/2021	7488
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2019	Annual	9/17/2020	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/13/2020	Annual	1/13/2021	1530

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Daga 1 of 4
D835V2 – SN: 4d047	03/13/2020	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
3/13/2019	3/13/2020	1.387	1.884	1.87	-0.74%	1.226	1.22	-0.49%	51.4	48.8	2.6	-2.6	-3.6	1.0	-30.7	-28.4	7.60%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
3/13/2019	3/13/2020	1.387	1.894	1.91	0.84%	1.254	1.26	0.48%	46.8	45.6	1.2	-6.1	-2.2	3.9	-22.9	-25.9	-12.90%	PASS

Object:	Date Issued:	Daga 2 of 4
D835V2 – SN: 4d047	03/13/2020	Fage 2 01 4



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Dogo 2 of 4
D835V2 – SN: 4d047	03/13/2020	Page 5 01 4



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Dago 4 of 4
D835V2 – SN: 4d047	03/13/2020	Fage 4 01 4

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Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service

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

Certificate No: D835V2-4d133_Oct18

Accreditation No.: SCS 0108

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С

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PC Test

Client

GALAIBBAANIONEG	E HIE CALE	i					
Object	D835V2 - SN:4d1	133					
Calibration procedure(s)	QA CAL-05 v10 Calibration procedure for dipole validation kits above 700 MHz						
Callbration date:	October 19, 2018)	10/30/2018 BN 10-20-2010				
This calibration certificate documer The measurements and the uncerta	ns the traceability to nati ainties with confidence p	onal standards, which realize the physical uni robability are given on the following pages an	its of measurements (SI). d'are part of the certificate.				
All calibrations have been conducts Calibration Equipment used (M&TE	ed in the closed laborator E critical for calibration)	ry facility: environment temperature (22 ± 3)°C	C and humidity < 70%.				
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration				
Power meter NBP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Anr-19				
Power sensor NBP-791	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19				
Power sensor NBP-791	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19				
Beference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19				
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19				
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349 Dec17)	Dec-18				
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19				
Secondary Standards	ID #	Check Date (In house)	Scheduled Check				
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20				
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20				
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20				
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20				
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19				
Calibrated by:	Name Manu Seitz	Function Laboratory Technician	Signature				
Approved by:	Katja Pokovic	Cechnical Manager	enter EUG				
This calibration certificate shall not	be reproduced except Ir	full without written approval of the laboratory	Issued: October 22, 2018				

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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- S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.43 W/kg ± 17.0 % (k=2)
	· · · ·	· · · · · · · · · · · · · · · · · · ·
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.10 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.9 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.75 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.40 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6 Ω - 2.4 jΩ
Return Loss	- 32.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.0 Ω - 6.7 jΩ
Return Loss	- 21.1 dB

General Antenna Parameters and Design

	Electrical Delay (one direction)	1.397 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
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 19.10.2018

Test Laboratory: The name of your organization

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d133

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.91$ S/m; $\varepsilon_r = 40.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 63.02 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.68 W/kg SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.54 W/kg Maximum value of SAR (measured) = 3.24 W/kg



0 dB = 3.24 W/kg = 5.11 dBW/kg

Impedance Measurement Plot for Head TSL

File	⊻jew	Channel	Sw <u>e</u> ep	Calibration	<u>T</u> race <u>S</u> cale	M <u>a</u> rker	S <u>y</u> stem	Window He	slp.			
					A			1: 835.0 2 835.0	000000 M 79.672 000000 M	Hz pF Hz	50 -2. 24.4 -7	1.571 Ω 3924 Ω 148 mU 5.225 °
	Ch1;St	Ch 1 Avg = art 635,000 (20 MHz			·····					Stop 1	.03500 GHz
50, 40, 30, 10, -10, -20, -30, -30, -50, -50,	00 00 00 00 00 00 00 00 0.00 0.00 0.00	Ch 1 Awg = art 635.000	20 MHz					1: 835.0		Hz	-32	235 dB
St	alus	CH 1:	S11		C* 1-Port		Avg=20) Delay				LCL

DASY5 Validation Report for Body TSL

Date: 19.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d133

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.98$ S/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 61.61 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.69 W/kg SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg Maximum value of SAR (measured) = 3.28 W/kg



0 dB = 3.28 W/kg = 5.16 dBW/kg

Impedance Measurement Plot for Body TSL





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Certification of Calibration

Object

D835V2 – SN:4d133

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: October 18, 2019

Description: S

SAR Validation Dipole at 835 MHz.

Calibration Equipment used:

Manufacturer	Model	Description		Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	9/19/2019	Annual	9/19/2020	7551
SPEAG	EX3DV4	SAR Probe	4/24/2019	Annual	4/24/2020	7357
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2019	Annual	9/17/2020	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/18/2019	Annual	4/18/2020	1407

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Page 1 of 4	
D835V2 – SN:4d133	10/18/2019	Fage 1 014	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 23.0 dBm	Measured Head SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	Measured Head SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
10/19/2018	10/18/2019	1.397	1.886	2.03	7.64%	1.22	1.32	8.20%	50.6	49.5	1.1	-2.4	-3.2	0.8	-32.2	-29.8	7.50%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 23.0 dBm	Measured Body SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured (mpedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
40/40/2040	10/10/00/00	1 007	1.05	0.07	0.450/	4.00								4.0	04.4	00.0	0.000/	0100

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D835V2 – SN:4d133	10/18/2019	Fage 2 014		

Impedance & Return-Loss Measurement Plot for Head TSL



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D835V2 – SN:4d133	10/18/2019	Faye 5 01 4	
Impedance & Return-Loss Measurement Plot for Body TSL



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D835V2 – SN:4d133	10/18/2019	Fage 4 01 4

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

Client

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

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Certificate No: D1750V2-1150_Oct18

Accreditation No.: SCS 0108

ALIBRAT	ION CERT	<i>IIFICATE</i>

PC Test

Object	D1750V2 SN 11	50	an al an
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	dure for dipole validation kits above 7	'00 MHz
Calibration date:	October 22, 2018		BN1- 1013012018
This calibration certificate documer The measurements and the uncerta	its the traceability to nati ainties with confidence p	onal standards, which realize the physical units of robability are given on the following pages and are	10-20-2019 measurements (SI). part of the certificate.
Calibration Equipment used (M&TE	eritical for calibration)	y racing, environment temperature (22 \pm 3) C and	Пиплику < 70%.
Primary Standards	1D#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349 Dec17)	DEC-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards	D#	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
Calibrated by:	Name Michael Weber	Function Laboratory Technician	signature N.W.L.S.
Approved by:	Katja Pokovic	Technical Manager	EU E
This calibration certificate shall not	be reproduced except in	full without written approval of the laboratory.	Issued: October 22, 2018

Certificate No: D1750V2-1150_Oct18

Calibration Laboratory of

Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





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- S Swiss Calibration Service

Accreditation No.: SCS 0108

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Glossarv:

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. ٠ No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.8 ± 6 %	1.33 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5±6%	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.4 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω - 0.4 jΩ
Return Loss	- 40.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω - 0.1 jΩ
Return Loss	- 29.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 10, 2015

DASY5 Validation Report for Head TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.33$ S/m; $\epsilon_r = 38.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electromics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 108.1 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 16.7 W/kg SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.76 W/kg Maximum value of SAR (measured) = 14.0 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1150

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ϵ_r = 53.5; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 102.1 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 16.0 W/kg SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.82 W/kg Maximum value of SAR (measured) = 13.6 W/kg



0 dB = 13.6 W/kg = 11.34 dBW/kg

Impedance Measurement Plot for Body TSL





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http://www.pctest.com



Certification of Calibration

Object

D1750V2 - SN:1150

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

October 18, 2019

Extended Calibration date:

Description:

SAR Validation Dipole at 1750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	8/16/2019	Annual	8/16/2020	7308
SPEAG	EX3DV4	SAR Probe	4/24/2019	Annual	4/24/2020	7357
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/18/2019	Annual	4/18/2020	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/14/2019	Annual	8/14/2020	1450

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D1750V2 – SN:1150	10/18/2019	raye 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
10/22/2018	10/18/2019	1.217	3.65	3.8	4.11%	1.92	2	4.17%	50.9	49.3	1.6	0.4	-0.7	1.1	-40.1	-40.2	-0.20%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
10/22/2018	10/18/2019	1.217	3.66	3.82	4.37%	1.94	2.02	4.12%	46.6	44.7	1.9	-0.1	-0.8	0.7	-29.2	-25	14.40%	PASS

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D1750V2 – SN:1150	10/18/2019	Faye 2 01 4

Impedance & Return-Loss Measurement Plot for Head TSL



15:15:52 18.10.2019

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D1750V2 – SN:1150	10/18/2019	Fage 5 01 4

Impedance & Return-Loss Measurement Plot for Body TSL



15:19:09 18.10.2019

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D1750V2 – SN:1150	10/18/2019	Fage 4 01 4

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

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Swiss Calibration Service

Accreditation No.: SCS 0108

Multilateral Agreement for the recognition of calibration certificates Certificate No: D1765V2-1008 May18 Client PC Test GALIBRATION CERTIFICATE Object D1765V2 - SN.1008 QA CAL-05 v10 Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz

May 23, 2018

Calibration date:

BNV 05/2012019 BNV 05/2012020 Extended This catibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

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	Primary Standards	1D #	Cal Date (Certificate No.)	Scheduled Calibration
ĺ	Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
ļ	Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
	Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
1	Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
	Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
	Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
	DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
	Secondary Standards	1D#	Check Date (in house)	Scheduled Check
	Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Ocl-16)	In house check: Oct-18
	Power sensor HP 8461A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
	Power sensor HP 8461A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	in house check: Oci-18
	RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct~18
	Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
		Name	Function	Signature
	Calibrated by:	Manu Seitz	Laboratory Technician	Al
	Approved by:	Katja Pokovic	Technical Manager	- UM
				1610 195
			····· •	

issued: May 23, 2018 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D1765V2-1008_May18

Page 1 of 11

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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S Swiss Calibration Service

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	·····
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5.0 mm	
Frequency	1750 MHz ± 1 MHz	U 4 - 1

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permitti∨ity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		<u> </u>

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.2 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.0 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.9 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.7 Ω - 6.5 jΩ
Return Loss	- 23.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.3 Ω - 6.0 jΩ
Return Loss	- 20.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.210 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	October 06, 2005

Appendix (Additional assessments outside the scope of SCS 0108)

Measurement Conditions

DASY system configuration, as far as not given on page 1 and 3.

Phantom SAM Head Phantom For usage with cSAR3DV2-

SAR result with SAM Head (Top)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.4 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.95 W/kg
CAD for nominal Hand TOL nerometers	permelized to 114/	10.0 W/(m + 16.0 % (k-2))

SAR result with SAM Head (Mouth)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.2 W/kg ± 17.5 % (k=2)
SAB averaged over 10 cm ³ (10 d) of Head TSI	condition	

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Neck)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	37.4 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.2 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Ear)

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	7.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	28.7 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm ³ (10 g) of head 15L	condition	
SAR averaged over 10 cm ^o (10 g) of head 1SL SAR measured	250 mW input power	4.01 W/kg

DASY5 Validation Report for Head TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.34 S/m; ϵ _r = 39; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 106.6 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 16.4 W/kg SAR(1 g) = 8.94 W/kg; SAR(10 g) = 4.71 W/kg Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg



DASY5 Validation Report for Body TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ϵ_r = 53.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm Reference Value = 102.4 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 16.1 W/kg SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.92 W/kg Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg



DASY5 Validation Report for SAM Head

Date: 23.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.37$ S/m; $\varepsilon_r = 41.8$; $\rho = 1000$ kg/m³ Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: SAM Head
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

SAM/Head/Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 105.8 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 16.4 W/kg SAR(1 g) = 9.26 W/kg; SAR(10 g) = 4.95 W/kg Maximum value of SAR (measured) = 13.9 W/kg

SAM/Head/Mouth/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 104.2 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 16.6 W/kg SAR(1 g) = 9.47 W/kg; SAR(10 g) = 5.06 W/kg Maximum value of SAR (measured) = 13.7 W/kg

SAM/Head/Neck/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.7 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 15.8 W/kg SAR(1 g) = 9.26 W/kg; SAR(10 g) = 5.02 W/kg Maximum value of SAR (measured) = 13.8 W/kg

SAM/Head/Ear/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 90.46 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 11.8 W/kg SAR(1 g) = 7.12 W/kg; SAR(10 g) = 4.01 W/kg Maximum value of SAR (measured) = 10.3 W/kg



0 dB = 10.3 W/kg = 10.13 dBW/kg



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http://www.pctest.com



Certification of Calibration

Object

D1765V2 - SN: 1008

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 5/17/2019

Description:

SAR Validation Dipole at 1750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	3/11/2019	Annual	3/11/2020	US39170122
Agilent	N5182A	MXG Vector Signal Generator	11/28/2018	Annual	11/28/2019	MY47420603
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1027293
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1126066
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Therm./ Clock/ Humidity Monitor	10/9/2018	Biennial	10/9/2020	181647811
Control Company	4352	Ultra Long Stem Thermometer	6/6/2018	Biennial	6/6/2020	181334678
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	EX3DV4	SAR Probe	6/25/2018	Annual	6/25/2019	7409
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/18/2018	Annual	6/18/2019	1334
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	3914
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/14/2019	Annual	2/14/2020	1272
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D1765V2 – SN: 1008	05/17/2019	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5/23/2018	5/17/2019	1.21	3.62	3.63	0.28%	1.9	1.92	1.05%	47.7	47	0.7	-6.5	-6	0.5	-23	-23.3	-1.20%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5/23/2018	5/17/2019	1.21	3.74	3.95	5.61%	1.99	2.08	4.52%	43.3	44.6	1.3	-6	-7	1	-20.3	-20.5	-0.90%	PASS

Object:	Date Issued:	Page 2 of 4
D1765V2 – SN: 1008	05/17/2019	Fage 2 014



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Daga 2 of 4	
D1765V2 – SN: 1008	05/17/2019	Fage 5 01 4	



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Daga 4 of 4	
D1765V2 – SN: 1008	05/17/2019	Fage 4 01 4	





Certification of Calibration

Object

D1765V2 - SN: 1008

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 5/23/2020

Description:

SAR Validation Dipole at 1750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable DAK	9/10/2019	Annual	9/10/2020	1045
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	12/17/2019	Annual	12/17/2020	941001
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench (8" lb)	5/23/2018	Biennial	5/23/2020	22217
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	4/21/2020	Annual	4/21/2021	7357
SPEAG	EX3DV4	SAR Probe	7/16/2019	Annual	7/16/2020	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/12/2020	Annual	3/12/2021	1368

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D1765V2 – SN: 1008	05/23/2020	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5/23/2018	5/23/2020	1.21	3.62	3.65	0.83%	1.90	1.94	2.11%	47.7	45.9	1.9	-6.5	-6.1	0.4	-23	-22.3	3.10%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5/23/2018	5/23/2020	1.21	3.74	4.00	6.95%	1.99	2.12	6.53%	43.3	43.7	0.4	-6.0	-4.8	1.2	-20.3	-21.5	-5.80%	PASS

Object:	Date Issued:	Page 2 of 4
D1765V2 – SN: 1008	05/23/2020	Fage 2 014



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Dogo 2 of 4	
D1765V2 – SN: 1008	05/23/2020	Fage 5 01 4	



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Dego 4 of 4	
D1765V2 – SN: 1008	05/23/2020	Fage 4 01 4	

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



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Accreditation No.: S	SCS 01	08
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Certificate No: D1900V2-5d080_Oct18

Client PC Test

	D1900V2 - SN:50	080	
alibration procedure(s)	QA CAL-05.v10 Calibration proce	dure for dipole validation kits abo	ve 700 MHz
			BN
alibration date:	October 23, 2018		10-20-20-8
This calibration certificate documen The measurements and the uncerta All calibrations have been conducte Calibration Equipment used (M&TE	its the traceability to nati aintles with confidence p ed in the closed laborato critical for calibration)	onal standards, which realize the physical uni robability are given on the following pages an ry facility: environment temperature (22 ± 3)°C	Its of measurements (SI). 10-20-20-20-20-20-20-20-20-20-20-20-20-20
Primary Standards	D#	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
ower sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
ower sensor NRP-Z91	S N: 103245	04-Apr-18 (No. 217-02673)	Apr-19
leference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
vpe-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
eference Probe EX3DV/4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
AE4	SN: 601	04-0ct-18 (No. DAE4-601_0ct18)	Oct-19
AE4	SN: 601 ID #	04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house)	Oct-19 Scheduled Check
AE4 secondary Standards	SN: 601	04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house) 07-Oct-15 (in house check Oct-18)	Oct-19 Scheduled Check In house check: Oct-20
econdary Standards wer meter EPM-442A ower sensor HP 8481A	SN: 601 ID # SN: GB37480704 SN: US37292783	04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20
PAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	04-Oct-18 (No. DAE4-601_Oct18) Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Decondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) Function	Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19 Signature
DAE4 <u>Secondary Standards</u> Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Jetwork Analyzer Agilent E8358A Calibrated by:	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeton Kastrati	Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) Function	Oct-19 <u>Scheduled Check</u> In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19 Signature UUU
AE4 <u>econdary Standards</u> ower meter EPM-442A ower sensor HP 8481A ower sensor HP 8481A IF generator R&S SMT-06 letwork Analyzer Agilent E8358A calibrated by: .pproved by:	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeton Kastrati Katja Pokovic	Check Date (in house) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) Function Laboratory Technician	Oct-19 <u>Scheduled Check</u> In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19 Signature Signature

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Glossary:

Tel	tiesus simulating liquid
	lissue simulating inquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.3 ± 6 %	1.40 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.8 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.7 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.9 ± 6 %	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 7.9 jΩ
Return Loss	- 21.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.1 Ω + 8.1 jΩ
Return Loss	- 21.5 dB

General Antenna Parameters and Design

Electrical Delay (one d	irection)	1.193 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 28, 2006
DASY5 Validation Report for Head TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.4$ S/m; $\varepsilon_r = 40.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 110.0 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 18.7 W/kg SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.18 W/kg Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.47 S/m; ϵ_r = 52.9; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.86 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 17.3 W/kg SAR(1 g) = 9.62 W/kg; SAR(10 g) = 5.09 W/kg Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg





PCTEST ENGINEERING LABORATORY, INC. 7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654

http://www.pctest.com



Certification of Calibration

Object

D1900V2 - SN:5d080

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

October 18, 2019

Extended Calibration date:

Description:

SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description		Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/13/2019	Annual	8/13/2020	1041
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	3914
SPEAG	EX3DV4	SAR Probe	5/16/2019	Annual	5/16/2020	7406
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/8/2019	Annual	5/8/2020	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/14/2019	Annual	2/14/2020	1272

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Page 1 of 4
D1900V2 – SN: 5d080	10/18/2019	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
10/23/2018	10/18/2019	1.193	3.98	4.16	4.52%	2.07	2.13	2.90%	52.5	50.4	2.1	7.9	6.2	1.7	-21.8	-24.2	-10.90%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured (mpedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
10/23/2018	10/18/2019	1.193	3.92	4.21	7.40%	2.06	2.16	4.85%	48.1	46.5	1.6	8.1	6.6	1.5	-21.5	-22.2	-3.40%	PASS

Object:	Date Issued:	Daga 2 of 4
D1900V2 – SN: 5d080	10/18/2019	Fage 2 01 4

Impedance & Return-Loss Measurement Plot for Head TSL



14:46:49 18.10.2019

Object:	Date Issued:	Page 3 of 4	
D1900V2 – SN: 5d080	10/18/2019	Fage 5 01 4	

Impedance & Return-Loss Measurement Plot for Body TSL



14:48:18 18.10.2019

Object:	Date Issued:	Page 4 of 4	
D1900V2 – SN: 5d080	10/18/2019	Fage 4 01 4	

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PC Test

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Certificate No: D1900V2-5d148_Feb19

Accreditation No.: SCS 0108

CALIBRATION C	ERTIFICATI	E					
Object	D1900V2 - SN:5	d 1 48					
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz						
	Gailbration Ploce	edure for SAH validation Soun	Ces between 0.7-3 GHz				
Calibration date:	February 21, 201	9	BNV	0			
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). $02-26-202$ The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.							
All calibrations have been conduct	ed in the closed laborato	ry facility: environment temperature (22 \pm	:3)°C and humidity < 70%.				
Calibration Equipment used (M&TE	E critical for calibration)						
Primary Standards	[ID #	Cal Date (Certificate No.)	Scheduled Calibration				
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19				
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19				
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19				
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19				
Type-N mlsmatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Арг-19				
Reference Probe EX3DV4	SN: 7349	31-Dec-18 (No. EX3-7349_Dec18)	Dec-19	-			
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19				
Secondary Standards	ID #	Check Date (in house)	Scheduled Check				
Power meter E4419B	SN: GB39512475	07-Oct-15 (in house check Feb-19)	In house check: Oct-20				
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20				
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (In house check Oct-18)	In house check: Oct-20				
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20				
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19				
0	Name	Function	SIgnature				
Calibrated by:	Manu Seitz	Laboratory Technician	A CAR				
Approved by:	Kalja Pokovic	Technical Manager	EUC				
This calibration certificate shall not	be reproduced except in	full without written annraval of the laborat	Issued: February 21, 2019				

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Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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S Swiss Calibration Service

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.65 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω + 6.8 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4 Ω + 7.8 jΩ
Return Loss	- 21.9 dB

General Antenna Parameters and Design

Electrical Deley (one direction)	
Electrical Delay (one direction)	1 170 ns
	1.170113

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		SPEAC
		JEAG

DASY5 Validation Report for Head TSL

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.38$ S/m; $\varepsilon_r = 40.9$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 109.4 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 17.8 W/kg **SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.05 W/kg** Maximum value of SAR (measured) = 15.0 W/kg



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

Impedance Measurement Plot for Head TSL

<u>Eile Y</u>	ļew	Channel	Sw <u>e</u> ep	Calibration	<u>T</u> race <u>S</u> cal	e M <u>a</u> rker	System	Window	Help			
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10.00 5.00 0.00 -5.00 -10.00 -15.00 -20.00 -25.00 -30.00 -35.00 -40.00 Ch1	∎ 1: Star	LS 1	20 Hz								-23.	166 dB

DASY5 Validation Report for Body TSL

Date: 21.02.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.47$ S/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.23, 8.23, 8.23) @ 1900 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 103.7 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 17.0 W/kg SAR(1 g) = 9.56 W/kg; SAR(10 g) = 5.05 W/kg Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

Impedance Measurement Plot for Body TSL

s⊡ie Gaa	View	Channel	Sweep	Calibration	<u>Trace S</u> cal	e M <u>a</u> rker	System	Window	Help			
		Ch 1 Avg =	20		A				1.900000 C 652.32 1.900000 C	GHz 9 pH GHz	48 7. 80.4 9	3.446 Ω 7874 Ω 112 mU 16.762 °
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10.	00		1		I	I	I					·····
0.0 -5.(-10 -15 -20 -25 -30 -35 -40	10 - 10 - 10 - 100 -	 Ch 1 Avg = rt 1.70000 G	20							Hz	-21.	894 dB





Certification of Calibration

Object

D1900V2 - SN: 5d148

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

2/21/2020

Extension Calibration date:

Description:

SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334684
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	10/11/2019	Annual	10/11/2020	101307
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAKS-3.5	Portable DAK	9/10/2019	Annual	9/10/2020	1045
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	MA2411B	Pulse Power Sensor	8/8/2019	Annual	8/8/2020	1339008
Anritsu	ML2495A	Power Meter	12/17/2019	Annual	12/17/2020	941001
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
MiniCircuits	ZHDC-16-63-S+	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
SPEAG	EX3DV4	SAR Probe	9/19/2019	Annual	9/19/2020	7551
SPEAG	EX3DV4	SAR Probe	7/16/2019	Annual	7/16/2020	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2019	Annual	9/17/2020	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1322

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK-

Object:	Date Issued:	Daga 1 of 4
D1900V2 – SN: 5d148	02/21/2020	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
2/21/2019	2/21/2020	1.17	3.91	4.15	6.14%	2.04	2.13	4.41%	51.8	53.7	1.9	6.8	2.7	4.1	-23.2	-27.1	-16.70%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
2/21/2019	2/21/2020	1.17	3.91	4.06	3.84%	2.05	2.08	1.46%	48.4	50.9	2.5	7.8	5.4	2.4	-21.9	-25.3	-15.60%	PASS

Object:	Date Issued:	Page 2 of 4
D1900V2 – SN: 5d148	02/21/2020	Fage 2 014



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Page 3 of 4
D1900V2 – SN: 5d148	02/21/2020	Fage 5 01 4

Impedance & Return-Loss Measurement Plot for Body TSL



14:33:44 21.02.2020

Object:	Date Issued:	Page 4 of 4
D1900V2 – SN: 5d148	02/21/2020	Fage 4 01 4

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





S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage Servizio svizzero di taratura

S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client PC Test Certificate No: D2300V2-1073 Aug18 **IBRATION CERTIFICATE** CAI Object D2300V2 - SN:1073 Calibration procedure(s) QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz BNV 19-06-2018 BNV 08 10 120 Calibration date: August 13, 2018 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 04-Apr-18 (No. 217-02672/02673) Apr-19 Power sensor NRP-Z91 SN: 103244 04-Apr-18 (No. 217-02672) Apr-19 Power sensor NRP-Z91 SN: 103245 04-Apr-18 (No. 217-02673) Apr-19 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-18 (No. 217-02682) Apr-19 Type-N mismatch combination SN: 5047.2 / 06327 04-Apr-18 (No. 217-02683) Apr-19 Reference Probe EX3DV4 SN: 7349 30-Dec-17 (No. EX3-7349_Dec17) Dec-18 DAE4 SN: 601 26-Oct-17 (No. DAE4-601_Oct17) Oct-18 Secondary Standards ID # Check Date (in house) Scheduled Check Power meter EPM-442A SN: GB37480704 07-Oct-15 (in house check Oct-16) In house check: Oct-18 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-16) In house check: Oct-18 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-16) In house check: Oct-18 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-16) In house check: Oct-18 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-17) In house check: Oct-18 Name Function Calibrated by: Michael Weber Laboratory Technician Approved by: Katja Pokovic Technical Manager

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

Certificate No: D2300V2-1073_Aug18

Issued: August 13, 2018

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S

Schweizerischer Kalibrierdienst

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S Swiss Calibration Service

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2300 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.2 ± 6 %	1.70 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	49.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	47.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 5.2 jΩ
Return Loss	- 25.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.5 Ω - 4.1 jΩ
Return Loss	- 23.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
	1.1/1 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 16, 2015

DASY5 Validation Report for Head TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073

Communication System: UID 0 - CW; Frequency: 2300 MHz Medium parameters used: f = 2300 MHz; σ = 1.7 S/m; ϵ_r = 38.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 115.9 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 24.1 W/kg SAR(1 g) = 12.5 W/kg; SAR(10 g) = 6.02 W/kg Maximum value of SAR (measured) = 20.2 W/kg



Impedance Measurement Plot for Head TSL

File	<u>⊻</u> iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	<u>T</u> race	<u>S</u> cale	M <u>a</u> rker	S <u>y</u> stem	<u>W</u> indow	Help				
	061-92	Ch 1 Avg =	20							2.30	0000 G 13.259 0000 G	Hz pF Hz	50 -5. 52.0 -8).050 Ω 2189 Ω)94 mU 6.467 °
		arc 2.100001											Stop 2	.50000 GHz
10. 5.0 -5.0 -10 -15 -20 -25 -30 -35 -40	00 10 10 10 10 100 100 100 100	<u>Ch 1 Avg =</u> art 2.10000 1	20 GHz							2.30		Hz	-25.	50000 GHz
St	atus	CH 1:	511		C*1 Po	rt		Avg=20	Delay					

DASY5 Validation Report for Body TSL

Date: 13.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1073

Communication System: UID 0 - CW; Frequency: 2300 MHz Medium parameters used: f = 2300 MHz; σ = 1.85 S/m; ϵ_r = 52.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 107.5 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 22.9 W/kg SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.86 W/kg Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg





PCTEST ENGINEERING LABORATORY, INC. 7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654

http://www.pctest.com



Certification of Calibration

Object

D2300V2 - SN: 1073

Calibration procedure(s)

Procedure for Calibration Extension for SAR Dipoles.

Calibration date:

08/09/2019

Description:

SAR Validation Dipole at 2300 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Test Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK-

Object:	Date Issued:	Dogo 1 of 4
D2300V2 – SN: 1073	08/09/2019	Fage 1014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
8/13/2018	8/9/2019	1.171	4.92	5.21	5.89%	2.38	2.49	4.62%	50.1	47.5	2.6	-5.2	-4.2	1	-25.7	-26.1	-1.60%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
8/13/2018	8/9/2019	1.171	4.77	5.05	5.87%	2.32	2.4	3.45%	45.5	44.4	1.1	-4.1	-3.3	0.8	-23.9	-23.2	2.80%	PASS

Object:	Date Issued:	Page 2 of 4
D2300V2 – SN: 1073	08/09/2019	Fage 2 014



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Page 3 of 4
D2300V2 – SN: 1073	08/09/2019	Fage 5 01 4



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Dogo 4 of 4
D2300V2 – SN: 1073	08/09/2019	Fage 4 01 4

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PC Test

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Accreditation No.: SCS 0108

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

Certificate No: D2450V2-719_Aug19

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:7	19	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources b	etween 0.7-3 GHz
Calibration date:	August 14, 2019		BNW 68 20 20 9
This calibration certificate documer The measurements and the uncert	nts the traceability to nati ainties with confidence p	onal standards, which realize the physical units or robability are given on the following pages and a	of measurements (SI). re part of the certificate.
All calibrations have been conducte	ed in the closed laborato	ry facility: environment temperature (22 \pm 3)°C a	nd humidity < 70%.
Calibration Equipment used (M&TE	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047,2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	tills
This calibration certificate shall not	be reproduced except in	full without written approval of the laboratory	Issued: August 15, 2019

Calibration Laboratory of

Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





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Glossarv:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	37.8 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.25 W/kg

SAR measured	250 mW input power	6.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.7 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1 .95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.8 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 5.6 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.0 Ω + 8.4 jΩ
Return Loss	- 21.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 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
manalastared by	0. Erte
DASY5 Validation Report for Head TSL

Date: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ϵ_r = 37.8; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 117.1 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 26.6 W/kg SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.25 W/kg Maximum value of SAR (measured) = 21.8 W/kg



0 dB = 21.8 W/kg = 13.38 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 2.01 S/m; ϵ_r = 50.8; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.94, 7.94, 7.94) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 105.2 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 25.6 W/kg **SAR(1 g) = 13 W/kg; SAR(10 g) = 6.09 W/kg** Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg

Impedance Measurement Plot for Body TSL

File	View	⊆hannel	Sweep	Calibration	<u>I</u> race <u>S</u>	tale Marker	System	<u>Wi</u> ndow <u>H</u> e	qle			
		Ch 1 Avg =	20					1: 2.4 2 2 2 4	450000 G 548.95 450000 G	Hz pH Hz	51.00 8.419 83.658 78.4	10 Ω 16 Ω mU 64 °
	Ch1: 8t	art 2.25000	GHz	azună							Stop 2.6500	00 GHz
10. 5.0	00						>	1: 2.	450000 G	Hz	-21.55	0 dB
10. 5.0 0.0	00 00						>	1: 2.	450000 G	Hz	-2 .55	D dB
10. 5.0 0.0 -5.0 -10	00)0)0)0)0)00							1: 2.	450000 G	Hz	-2 .55	0 dB
10. 5.0 0.0 -5.1 -10 -15 -20	00)0)0)0)0)00 ;.00							1: 2.	450000 G	Hz	-21.55	
10. 5.0 -5.1 -10 -15 -20 -25	00 00 00 00 00 00 00 00 00							1: 2.	450000 G	Hz	-21.55	
10. 5.0 -5.0 -10 -15 -20 -25 -25 -25	00 00 00 00 00 000 000							1: 2.	450000 G	Hz	-21.55	
10. 5.0 -5.1 -10 -15 -20 -25 -30 -30 -40	00 00 00 00 000 0.00 0.00 0.00 0.00	12 311	20 GHz					1: 2.		Hz	-21.55	0 dB

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Accreditation No.: SCS 0108

PC Test Client Certificate No: D2450V2-797_Sep17 . . **CALIBRATION CERTIFICATE**

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Object	D2450V2 - SN:7	97	
Callbration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits ab	ove 700 MHz らく
Callbration date:	September 11, 2	017	Extended PMV 9/20/2011
This calibration certificate docume The measurements and the unce All calibrations have been conduct	ents the traceability to nat rtainties with confidence p ted in the closed laborato	ional standards, which realize the physical u probability are given on the following pages a ny facility: environment temperature (22 \pm 3)	of measurements (SI). BN^{-1} and are part of the certificate. $0q 1o 20^{1}9^{\circ}$ and humidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meier NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 505B (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349 May17)	Max-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17
	Name .	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technickan	Miller
Approved by:	Katja Pokovic	Technical Manager	Cliff
			Issued: September 11, 2017

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

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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Glossarv:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters;

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the ٠ nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
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	37.8 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

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SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	······································
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 16.5 % (k=2)

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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	51.9 ± 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 ³ (1 g) of Body TSL	Condition	· · · · · · · · · · · · · · · · · · ·
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.1 W/kg ± 17.0 % (k≃2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 7.4 jΩ
Return Loss	- 21.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7 Ω + 9.1 jΩ
Return Loss	- 20,9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ϵ_r = 37.8; ρ = 1000 kg/m³ 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: 28.03.2017
- 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=5mmReference Value = 113.5 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 26.9 W/kg SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.28 W/kg Maximum value of SAR (measured) = 21.6 W/kg



0 dB = 21.6 W/kg = 13.34 dBW/kg

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ϵ_r = 51.9; ρ = 1000 kg/m³ 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: 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 105.4 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 25.6 W/kg SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 20.3 W/kg



 $0 \, dB = 20.3 \, W/kg = 13.07 \, dBW/kg$

Impedance Measurement Plot for Body TSL



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. PCTEST ENGINEERING LABORATORY, INC. 7185 Oakland Mills Road, Columbia, MD

7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.pctest.com



Certification of Calibration

Object

D2450V2 - SN: 797

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 11, 2018

Description:

SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Blennial	3/31/2019	170232394
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	8iennial	5/2/2019	170330156
Amplifier Research	15\$1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Keysight	7720	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Callbration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Agilent	8753ES	S-Parameter Vector Network Analyzer	8/30/2018	Annuai	8/30/2019	MY40003841
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT .	N/A	CBT	N/A
SPEAG	DAK-3,5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7410
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2018	Annual	7/11/2019	1322
SPEAG	ES3DV3	SAR Probe	3/13/2018	Annual	3/13/2019	3319
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/7/2018	Annual	3/7/2019	1368
Anritsu	MA2411B	Puise Power Sensor	3/2/2018	Annual	3/2/2019	1207364
Anritsu	MA2411B	Puise Power Sensor	3/2/2018	Annual	3/2/2019	1339018
Anritsu	ML2495A	Power Meter	10/22/2017	Annuəl	10/22/2018	1328004
Agllent	N5182A	MXG Vector Signal Generator	4/18/2018	Annual	4/18/2019	MY47420800
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	Свт	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	3XOK

Object:	Date Issued:	Page 1 of 4
D2450V2 - SN: 797	09/11/2018	Fage 1 014

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/11/2018	1.152	5.27	5.52	4.74%	2.48	2.54	2.42%	53.8	49.8	4	7.4	7.1	0.3	-21.9	-23	-4.80%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/11/2018	1.152	5.11	5.17	1.17%	2.42	2.37	-2.07%	49.7	49.8	0.1	9.1	7.2	1.9	-20.9	-22.6	-8.20%	PASS

Object:	Date Issued:	Daga 2 of 4
D2450V2 – SN: 797	09/11/2018	Fage 2 01 4



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Page 3 of 4
D2450V2 SN: 797	09/11/2018	



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Page 4 of 4	
D2450V2 - SN: 797	09/11/2018		`



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Certification of Calibration

Object

D2450V2 - SN: 797

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

September 9, 2019

Extended Calibration date:

Description:

SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7417
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	665
SPEAG	EX3DV4	SAR Probe	7/15/2019	Annual	7/15/2020	7547
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/11/2019	Annual	7/11/2020	1323
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/11/2018	Annual	9/11/2019	1091

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path.

Measurement Uncertainty = $\pm 23\%$ (k=2)

	Name	Function	Signature
Calibrated By:	Brodie Halbfoster	Team Lead Engineer	BRODIE HALBFOSTER
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	XOK

Object:	Date Issued:	Dogo 1 of 4
D2450V2 – SN: 797	09/9/2019	Fage 1 01 4

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/9/2019	1.152	5.27	5.19	-1.52%	2.48	2.41	-2.82%	53.8	51.1	2.7	7.4	6.8	0.6	-21.9	-23.4	-6.70%	PASS
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/9/2019	1.152	5.11	5.17	1.17%	2.42	2.38	-1.65%	49.7	46	3.7	9.1	5.5	3.6	-20.9	-23.5	-12.40%	PASS

Object:	Date Issued:	Daga 2 of 4
D2450V2 – SN: 797	09/9/2019	Faye 2 01 4



Impedance & Return-Loss Measurement Plot for Head TSL

Object:	Date Issued:	Daga 2 of 4
D2450V2 – SN: 797	09/9/2019	Fage 5 01 4



Impedance & Return-Loss Measurement Plot for Body TSL

Object:	Date Issued:	Dogo 4 of 4
D2450V2 – SN: 797	09/9/2019	Fage 4 01 4

Calibration Laboratory of

PC Test

Client

Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst

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- S **Swiss Calibration Service**

Accreditation No.: SCS 0108

S

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

Certificate No: D2600V2-1064_Jun19

CALIBRATION CERTIFICATE

Object	D26001/2 - SNI:11)E/	
	D200072-011.11		
			BNV LogIQ
Calibration procedure(s)	QA CAL-05 v11		17/81/2014
	Calibration Proce	dure for SAB Validation Source	s between 0 7-3 GHz
	Culibration 11000	Care for CAIT validation bedice.	S Detween 0.7-0 On Z
	1		
Calibration date:	June 14, 2019		
This calibration certificate documer	nts the traceability to nati	onal standards, which realize the physical u	nits of measurements (SI).
The measurements and the uncerta	ainties with confidence p	robability are given on the following pages a	nd are part of the certificate.
All calibrations have been conducte	ed in the closed laborator	ry facility: environment temperature (22 \pm 3)°	°C and humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	1111 -
			MINE
			n en
Approved by:	Katja Pokovic	Technical Manager	2111
		.	tell-
	an a		
			Issued: June 20, 2019
This calibration cortificate shall not	he reproduced event in	full without written approval of the laborator	u
The calloration certificate shall for	se reproduced except in	nui minoui whiten appioval of the laborator	y.

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Schweizerischer Kalibrierdienst

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- Servizio svizzero di taratura S

Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossarv:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.3 ± 6 %	2.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	58.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	26.0 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.5 ± 6 %	2.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	25.0 W/kg ± 16.5 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω - 6.9 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω - 4.4 jΩ
Return Loss	- 24.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 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 by	SPEAG

DASY5 Validation Report for Head TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064

Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; σ = 2.03 S/m; ϵ_r = 37.3; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.69, 7.69, 7.69) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 120.9 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 30.2 W/kg **SAR(1 g) = 14.9 W/kg; SAR(10 g) = 6.59 W/kg** Maximum value of SAR (measured) = 25.1 W/kg



Impedance Measurement Plot for Head TSL

File	⊻iew	<u>C</u> hannel Sw <u>e</u> ep	Calibration Tra	ice <u>S</u> cale M <u>a</u> rker	System	<u>W</u> indow <u>H</u> e	lp		
		Ch 1 Aug = 20				1: 2.6 2:00 2:00 2:00 2:00 2:00 2:00 2:00 2:0	300000 GH 8.8630 p 300000 GH	lz 4 IF -6 Iz 69. -{	9.847 Ω .9066 Ω 025 mU 37.316 °
	Ch1:St	on iAvg ≈ 20 art 2.40000 GHz —						Stop 2	2.80000 GHz
10, 5,(-5,(-10 -15 -20 -25 -30 -35 -40	00 0 0 00 00 00 00 00 00 00 00 00 00 00	Ch 1 Avg = 20 art 2.40000 GHz				1: 2.8		1z -2:	2.80000 GHz
St	atus	CH 1: 511	C*	1-Port	Avg=20	Delay			LCL

DASY5 Validation Report for Body TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1064

Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.22$ S/m; $\varepsilon_r = 50.5$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.8, 7.8, 7.8) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 110.6 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 28.9 W/kg SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.33 W/kg Maximum value of SAR (measured) = 23.6 W/kg



0 dB = 23.6 W/kg = 13.73 dBW/kg

Impedance Measurement Plot for Body TSL

File	View	Channel	Sw <u>e</u> ep	Calibration	<u>Trace</u> <u>S</u> cale	e M <u>a</u> rker	System	Window	Help				
	Ch1: Sta	Ch 1 Avg = art 2,4000 0	20 3Hz		A				2.600 1 2.600	0000 Gi 14.009 0000 G	Hz pF Hz	4(-4. 56.(-1	5.645 Ω 3696 Ω 344 mU 24.93 °
		A DESCRIPTION OF THE OWNER OF THE											
10. 5.0	00 10 -	13 40 19					>	1:	2.600	0000 G	Hz	-24	.891 dB
10. 5.(0.(00 00						>	1:	2.600)000 G	Hz	-24	.891 dB
10. 5.(0.(-5.)							>	1;	2.600)000 G	Hz	-24	.891 dB
10, 5,(-5,(-10 -15	00 00 00 00 00.	**************************************					>	1:	2.800)000 G	Hz	-24	.891 dB
10. 5.(-5.) -10 -15 -20	00 00 00 00 00. 00.						>	1:	2.800	0000 C	Hz	-24	891 dB
10, 5,(-5,) -10 -15 -20 -25	00 90 90 90 90 90 90 90						>		2.800	0000 G	Hz	-24	.891 dB
10. 5.(-5.) -10 -15 -20 -25 -30	00 10 10 10 10 10 10 10 10 10						>		2.800	0000 G	Hz	-24	.991 dB
10. 5.(-5.) -10 -15 -20 -25 -30 -35 -30	00 00 00 00 00 00 00 00 00	18 512	20				>		2.600	0000 C	Hz	-24	891 dB
10. 5.(-5.) -10 -15 -20 -25 -30 -35 -40	00 00 00 00 00 00 00 00 00 00 00 00 00	Ch 1 Avg = art 2,40000 (20 3Hz						2.600	0000 C	Hz	-24	.891 dB

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





S

С

Schweizerischer Kalibrierdienst

- Service suisse d'étalonnage Servizio svizzero di taratura
- Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client **PC Test**

Certificate No: EX3-3589_Jan20/2

CALIBRATION CERTIFICATE (Replacement of No: EX3-3589_Jan20)

Object	EX3DV4 - SN:3589	
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes	20
Calibration date:	January 21, 2020	
This calibration certificate docum The measurements and the unce	ents the traceability to national standards, which realize the physical units of measurements (SI). artainties with confidence probability are given on the following pages and are part of the certificate.	

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	27-Dec-19 (No. DAE4-660_Dec19)	Dec-20
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec19)	Dec-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Colle
			og ngr
Approved by:	Katja Pokovic	Technical Manager	1/11-
			aces
			Issued: March 31, 2020
This calibration certificate	e shall not be reproduced except in fu	Il without written approval of the labo	ratory.

Calibration Laboratory of

Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization 8	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

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 handheld 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"

Methods Applied and Interpretation of Parameters:

- NORMx, y, z; Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz; R22 waveguide). NORMx, y, z are only intermediate values, i.e., the uncertainties of NORMx, y, z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,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 f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx, y, z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m) ²) ^A	0.44	0.40	0.39	± 10.1 %
DCP (mV) ^B	101.5	97.7	97.9	

Calibration Results for Modulation Response

UID	Communication System Name		Α	В	C	D	VR	Max	Max
			dB	dBõV		dB	mV	dev.	Unc ^E
]								(k=2)
0	CW	X	0.00	0.00	1.00	0.00	138.1	± 3.5 %	±4.7 %
		Y	0.00	0.00	1.00		148.9		
		Z	0.00	0.00	1.00		137.1		
10352-	Pulse Waveform (200Hz, 10%)	X	20.00	93.40	23.88	10.00	60.0	± 1.9 %	±9.6 %
AAA		Y	20.00	90.04	21.55		60.0		
		Z	20.00	93.40	23.50		60.0		
10353-	Pulse Waveform (200Hz, 20%)	X	20.00	93.53	22.66	6.99	80.0	± 1.0 %	± 9.6 %
AAA		Y	20.00	90.11	20.16		80.0		
		Z	20.00	93.36	22.20		80.0		
10354-	Pulse Waveform (200Hz, 40%)	X	20.00	95.38	22.01	3.98	95.0	± 1.0 %	± 9.6 %
AAA		Y	20.00	88.87	17.82		95.0		
		Z	20.00	94.79	21.35		95.0		
10355-	Pulse Waveform (200Hz, 60%)	X	20.00	102.43	23.98	2.22	120.0	±1.1%	± 9.6 %
AAA		Y	20.00	86.64	15.26		120.0		
		Z	20.00	97.99	21.51		120.0		
10387-	QPSK Waveform, 1 MHz	X	0.93	64.33	11.56	0.00	150.0	± 3.3 %	± 9.6 %
AAA		Y	0.54	60.00	7.11		150.0		
		Z	0.68	61.48	9.17		150.0		
10388-	QPSK Waveform, 10 MHz	X	2.38	69.01	16.27	0.00	150.0	± 1.3 %	±9.6 %
AAA		Y	2.02	66.96	14.92		150.0		
		Z	2.15	67.54	15.53		150.0		
10396-	64-QAM Waveform, 100 kHz	X	3,79	73.46	20.06	3.01	150.0	± 0.6 %	±9.6 %
AAA		Y	3.12	69.91	18.24		150.0		
		Z	4.11	75.05	20.59		150.0		
10399-	64-QAM Waveform, 40 MHz	X	3.59	67.56	16.03	0.00	150.0	± 2.5 %	± 9.6 %
AAA		Y	3.37	66.67	15.43		150.0		1
		Z	3.46	66.93	15.67		150.0		
10414-	WLAN CCDF, 64-QAM, 40MHz	X	4.95	65.82	15.63	0.00	150.0	± 4.6 %	± 9.6 %
AAA		Y	4.77	65.46	15.41		150.0		
		7	4 80	65 52	15/6	1	150.0	1	1

Note: For details on UID parameters see Appendix

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

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6). ^B Numerical linearization parameter: uncertainty not required.

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

	C1 fF	C2 fF	α V ⁻¹	T1 ms.V ⁻²	T2 ms.V ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	Т6
X	52.5	386.65	34.73	26.61	1.15	5.10	1.30	0.45	1.01
Y	44.4	339.10	36.93	20.74	1.47	5.06	0.00	0.71	1.01
Z	44.1	325.90	34.85	22.88	1.09	5.07	1.71	0.36	1.01

Sensor Model Parameters

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-32.6
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

5								
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	8.70	8.70	8.70	0.38	1.00	± 12.0 %
835	41.5	0.90	8.58	8.58	8.58	0.47	0.80	± 12.0 %
1750	40.1	1.37	7.55	7.55	7.55	0.52	0.87	± 12.0 %
1900	40.0	1.40	7.25	7.25	7.25	0.43	0.87	± 12.0 %
2300	39.5	1.67	7.11	7.11	7.11	0.45	0.86	± 12.0 %
2450	39.2	1.80	6.85	6.85	6.85	0.47	0.85	± 12.0 %
2600	39.0	1.96	6.60	6.60	6.60	0.41	0.86	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity above 300 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 calibration 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

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

The ConvF uncertainty for indicated target tissue parameters. ^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than \pm 1% for frequencies below 3 GHz and below \pm 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	8.49	8.49	8.49	0.49	0.81	± 12.0 %
835	55.2	0.97	8.27	8.27	8.27	0.29	1.03	± 12.0 %
1750	53.4	1.49	6.93	6.93	6.93	0.41	0.87	± 12.0 %
1900	53.3	1.52	6.72	6.72	6.72	0.35	0.87	± 12.0 %
2300	52.9	1.81	6.62	6.62	6.62	0.34	0.86	± 12.0 %
2450	52.7	1.95	6.60	6.60	6.60	0.40	0.86	± 12.0 %
2600	52.5	2.16	6.35	6.35	6.35	0.37	0.90	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

^c Frequency validity above 300 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 calibration 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz. ^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to

^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to \pm 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. ^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

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



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

Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)


Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)

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

Certificate No: EX3-3589_Jan20/2



Conversion Factor Assessment

Appendix: Modulation Calibration Parameters

O CW CW CW 0.00 ± 4.7 % 10010 CAA SAR Validation (Gquare, 100ms, 10ms) Test 10.00 ± 4.7 % 10011 CAB IEEE 802.116 WIF12.4 GHz (DSSS, 1 Mbps) WICDMA 2.91 ± 9.6 % 10012 CAB IEEE 802.116 WIF12.4 GHz (DSSS-OFDM, 6 Mbps) WILAN 9.47 ± 9.6 % 10023 DAC GRMS-PDD (TDMA, GMSK, TN 0) GSM 9.33 ± 9.6 % 10024 DAC GRMS-PDD (TDMA, GMSK, TN 0) GSM 9.55 ± 9.6 % 10025 DAC GRMS-PDD (TDMA, GMSK, TN 0-1) GSM 9.55 ± 9.6 % 10026 DAC EDGE-FDD (TDMA, GMSK, TN 0-122) GSM 3.55 ± 9.6 % 10027 DAC GRMS-FDD (TDMA, GMSK, TN 0-122) GSM 3.55 ± 9.6 % 10028 DAC GRMS-FDD (TDMA, GMSK, TN 0-122) GSM 3.55 ± 9.6 % 10028 DAC GRMS-FDD (TDMA, GMSK, TN 0-122) GSM 3.55 ± 9.6 % 10038 CAA IEEE 802.16	UID	Rev	Communication System Name	Group		
U U/W Z/S S/S S/S <ths s<="" th=""> <ths s<="" th=""> <ths s<="" th=""></ths></ths></ths>					(dB)	<u>(K≓Z)</u>
Norm Low State St	0	CAA	CVV CAP Volidation (Square, 100ma, 10ma)		10.00	<u> </u>
Not 1 Crast Circuit Production Product	10010	CAA	SAR Validation (Square, Tooms, Toms)		2.04	19.0 % +0.6 0/
Non-Let Crew Inclusion Construction Provided and the set of the	10011				1.31	+06%
Conce Conce <th< td=""><td>10012</td><td></td><td>IEEE 002, I ID WIFI 2.4 GHZ (DOOO, I WIDDS)</td><td></td><td>0.16</td><td>+06%</td></th<>	10012		IEEE 002, I ID WIFI 2.4 GHZ (DOOO, I WIDDS)		0.16	+06%
Local Dec Construct Local Lange, Data SI, TN 0) Construct Lange, Data SI, TN 0, T) Construct Lange, Data SI, TN 0, T, Lange, Data SI, Lange, Data	10013		GSM-EDD (TDMA GMSK)	GSM	9.40	+96%
Incode Date Open End Date Date (Date) Date) Date) <thdate)< th=""></thdate)<>	10021	DAC	GPRS-EDD (TDMA, GMSK, TN 0)	GSM	9.53	+96%
Image Image <th< td=""><td>10023</td><td>DAC</td><td>GPRS-FDD (TDMA, GMSK, TN 0-1)</td><td>GSM</td><td>6.56</td><td>+9.6%</td></th<>	10023	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	GSM	6.56	+9.6%
10022 DAC EDGE-FDD (TDMA, BPEK, TN 0-1-2) GSM 9.56 ± 9.6 % 10022 DAC GPRS-FDD (TDMA, GMSK, TN 0-1-2) GSM 3.55 ± 9.6 % 10028 DAC EDGE-FDD (TDMA, GMSK, TN 0-1-2) GSM 7.78 ± 9.6 % 10030 CAA IEEE 802.15.1 Bluotooh (GFSK, DH1) Bluetoohh 5.30 ± 8.6 % 10032 CAA IEEE 802.15.1 Bluotooh (GFSK, DH3) Bluetoohh 1.87 ± 9.6 % 10032 CAA IEEE 802.15.1 Bluetooh (GFSK, DH3) Bluetoohh 4.53 ± 9.6 % 10033 CAA IEEE 802.15.1 Bluetooh (DFSK, DH3) Bluetoohh 4.53 ± 9.6 % 10033 CAA IEEE 802.15.1 Bluetooh (D-DPSK, DH3) Bluetoohh 4.77 ± 9.6 % 10033 CAA IEEE 802.15.1 Bluetooh (D-DPSK, DH5) Bluetoohh 4.77 ± 9.6 % 10034 CAA IEEE 802.15.1 Bluetooh (D-DPSK, DH5) Bluetoohh 4.07 ± 9.6 % 10035 CAA IEEE 802.15.1 Bluetooh (D-OPSK, DH5) Bluetoohh ± 9.6 % 1004	10024	DAC	EDGE-EDD (TDMA. 8PSK, TN 0)	GSM	12.62	$\pm 9.6\%$
10027 DAC GPRS FDD (TDMA, GMSK, TN 0-1-2) GSM 4.80 ± 9.6 % 10028 DAC EDGE-FDD (TDMA, GMSK, TN 0-1-2) GSM 3.55 ± 9.6 % 10029 DAC EDGE-FDD (TDMA, GMSK, TN 0-1-2) GSM 7.76 ± 9.6 % 10031 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 1.87 ± 9.6 % 10032 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 1.16 ± 9.6 % 10033 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 4.53 ± 9.6 % 10035 CAA IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH5) Bluetooth 8.33 ± 9.6 % 10036 CAA IEEE 802.15.1 Bluetooth (9.PPSK, DH5) Bluetooth 4.77 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (9.PPSK, DH5) Bluetooth 4.77 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (9.PPSK, DH5) Bluetooth 4.77 ± 9.6 % 10039 CAB CAA IEEE 802.15.1 Bluetoth (PAPASK, DH4) EEC 10	10026	DAC	EDGE-EDD (TDMA 8PSK TN 0-1)	GSM	9.55	+9.6 %
10029 DAC OPRS-FDD (TDMA, OMSK, TN 0-1-23) GSM 3.55 ± 9.6 % 10030 CAA IEEE 802 15.1 Bluetooth (GFSK, DH1) Bluetooth 5.30 ± 9.6 % 10031 CAA IEEE 802 15.1 Bluetooth (GFSK, DH3) Bluetooth 1.87 ± 9.6 % 10032 CAA IEEE 802 15.1 Bluetooth (GFSK, DH3) Bluetooth 1.16 ± 9.6 % 10033 CAA IEEE 802 15.1 Bluetooth (GFSK, DH3) Bluetooth 4.16 ± 9.6 % 10033 CAA IEEE 802 15.1 Bluetooth (PI4-DQPSK, DH3) Bluetooth 3.83 ± 9.6 % 10035 CAA IEEE 802 15.1 Bluetooth (9.DPSK, DH3) Bluetooth 4.77 ± 9.6 % 10036 CAA IEEE 802 15.1 Bluetooth (9.DPSK, DH3) Bluetooth 4.10 ± 9.6 % 10038 CAA IEEE 802 15.1 Bluetooth (9.DPSK, DH3) Bluetooth 4.10 ± 9.6 % 10044 CAA IS-97 IFA-136 FDD (TDMA/FDM, GFSK, Full Slot, 24) DECT 10.7 % ± 9.6 % 10044 CAA IS-97 IFA-136 FDD (TDMA/FDM, GFSK, Full Slot, 24) <td< td=""><td>10027</td><td>DAC</td><td>GPRS-FDD (TDMA, GMSK, TN 0-1-2)</td><td>GSM</td><td>4.80</td><td>$\pm 9.6\%$</td></td<>	10027	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	GSM	4.80	$\pm 9.6\%$
10029 DAC EDGE-FDD (TDMAR, 8PSK, TN 0-12) GSM 7.78 ± 9.6 % 10030 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 1.74 ± 9.6 % 10031 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 1.16 ± 9.6 % 10032 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 7.74 ± 9.6 % 10034 CAA IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH1) Bluetooth 4.53 ± 9.6 % 10035 CAA IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH5) Bluetooth 8.01 ± 9.6 % 10036 CAA IEEE 802.15.1 Bluetooth (9.PPSK, DH3) Bluetooth 4.77 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (9.PPSK, DH3) Bluetooth 4.10 ± 9.6 % 10042 CAB IS-84 / 15.46 FD0, TDMAFDM, PI4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 % 10044 CAA IES-1/16.107, TDMAFDM, GFSK, Dudbe Slot, 12) DECT 13.80 ± 9.6 % 10048 CAA DECT (TDD, TDMAFDM, GFSK, DudbeSlot, 12) DECT	10028	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	GSM	3.55	± 9.6 %
10030 CAA IEEE 802.15.1 Bluelooth (GFSK, DH1) Bluelooth 5.30 ± 9.6 %. 10031 CAA IEEE 802.15.1 Bluelooth (GFSK, DH3) Bluelooth 1.16 ± 9.6 %. 10032 CAA IEEE 802.15.1 Bluelooth (GFSK, DH3) Bluelooth 7.74 ± 9.6 %. 10033 CAA IEEE 802.15.1 Bluelooth (PI4-DQPSK, DH3) Bluelooth 4.53 ± 9.6 %. 10036 CAA IEEE 802.15.1 Bluelooth (PI4-DQPSK, DH3) Bluelooth 3.83 ± 9.6 %. 10036 CAA IEEE 802.15.1 Bluelooth (9.DPSK, DH3) Bluelooth 4.10 ± 9.6 %. 10037 CAA IEEE 802.15.1 Bluelooth (9.DPSK, DH3) Bluelooth 4.10 ± 9.6 %. 10038 CAA IEEE 802.15.1 Bluelooth (9.DPSK, DH3) Bluelooth 4.10 ± 9.6 %. 10042 CAA IESE 902.15.1 Bluelooth (9.DPSK, DH3) Bluelooth 4.10 ± 9.6 %. 10044 CAA IESE 902.15.1 Bluelooth (9.DPSK, DH3) AMPS 7.78 ± 9.6 %. 10044 CAA DECT (TDD, TDMAFDM, GFSK, Full Slot, 24)	10029	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	GSM	7.78	±9.6 %
10031 CAA IEEE 802.15.1 Bluetooth (GFSK, DH3) Bluetooth 1.16 ± 9.6 % 10032 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH1) Bluetooth 7.74 ± 9.6 % 10033 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH3) Bluetooth 4.53 ± 9.6 % 10035 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH5) Bluetooth 4.01 ± 9.6 % 10036 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH3) Bluetooth 8.10 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH3) Bluetooth 4.10 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (FI4-DQPSK, DH3) Bluetooth 4.10 ± 9.6 % 10038 CAA IEEE 802.15.0 CDMA2000 4.57 ± 9.6 % 10042 CAA IEEE 402.15.1 Bluetooth (FIA-DQPSK, DH3) AMPS 0.00 ± 9.6 % 10044 CAA IEEE 402.1104 KAA IEEE 402.1104 1.101 ± 9.6 % <td>10030</td> <td>CAA</td> <td>IEEE 802.15.1 Bluetooth (GFSK, DH1)</td> <td>Bluetooth</td> <td>5.30</td> <td>± 9.6 %</td>	10030	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	Bluetooth	5.30	± 9.6 %
10032 CAA IEEE 802.15.1 Bluetooth (GFSK, DH5) Bluetooth 1.16 4.9.6 % 10033 CAA IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH3) Bluetooth 4.53 4.9.6 % 10036 CAA IEEE 802.15.1 Bluetooth (PI4-DQPSK, DH5) Bluetooth 3.8.3 4.9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH3) Bluetooth 4.7.7 4.9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.7.7 4.9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.7.7 4.9.6 % 10042 CAB IS-54 / IS-136 D(TDMAFDM, GFSK, Duble Slot, 12) DECT 13.80 4.9.6 % 10044 CAA DECT (TDD, TDMAFDM, GFSK, Duble Slot, 12) DECT 10.7.8 4.9.6 % 10046 CAA DECT (TDD, TDMAFDM, GFSK, Duble Slot, 12) DECT 10.8.6 % 10.6.52 4.9.6 % <td< td=""><td>10031</td><td>CAA</td><td>IEEE 802.15.1 Bluetooth (GFSK, DH3)</td><td>Bluetooth</td><td>1.87</td><td>±9.6 %</td></td<>	10031	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	Bluetooth	1.87	±9.6 %
10033 CAA IEEE 802.15.1 Biluetooth 7.74 4.9.6 % 10034 CAA IEEE 802.15.1 Biluetooth (PI/4-DQPSK, DH3) Biluetooth 4.53 4.9.6 % 10035 CAA IEEE 802.15.1 Biluetooth (PI/4-DQPSK, DH3) Biluetooth 8.01 4.58 4.9.6 % 10036 CAA IEEE 802.15.1 Biluetooth (P-PSK, DH3) Biluetooth 4.10 4.9.6 % 10038 CAA IEEE 802.15.1 Biluetooth (P-PSK, DH3) Biluetooth 4.10 4.9.6 % 10038 CAA IEEE 802.15.1 Biluetooth (P-PSK, DH3) Biluetooth 4.10 4.9.6 % 10038 CAA IEEE 802.15.1 Biluetooth (P-PSK, DH3) AMPS 0.00 4.9.6 % 10044 CAA IS-47 (FS-FS) FD0 (TDMA/FDM, GFSK, Full Slot, 24) DECT 10.0 4.9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 10.0 4.9.6 % 10056 CAA IEEE 802.11a/MIR A GFAK, Duble Slot, 12) DECT 10.0 4.9.6 %	10032	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	Bluetooth	1.16	±9.6 %
10034 CAA IEEE 802.15.1 Bluetooth (P/4-DOPSK, DH3) Bluetooth 4.53 ± 9.6 % 10035 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH1) Bluetooth 3.83 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH3) Bluetooth 4.77 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.77 ± 9.6 % 10039 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.57 ± 9.6 % 10042 CAB IS-54 (15.13 BF0DC IDMA/FDM, PI4-ODPSK, Halfrate) AMPS 7.76 ± 9.6 % 10044 CAA IS-91/EIA/TIA.553 FD0 (FDMA, FM) AMPS 0.00 ± 9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10058 CAA DECT (TDD, TDMA/FDM, GFSK, Slouble Slot, 12) DECT 10.8 & ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 1-2-3) GSM 6.52 ± 9.6 % 10056 CAA IEEE 802.11b WIF1 2.4 GHz (DSS, 5.5 Mbps) WLAN	10033	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	Bluetooth	7.74	± 9.6 %
10036 CAA IEEE 802.15.1 Bluetooth (#J-DCPSK, DH5) Bluetooth 3.83 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (#-DCPSK, DH3) Bluetooth 4.71 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (#-DCPSK, DH3) Bluetooth 4.10 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (#-DCPSK, DH5) Bluetooth 4.10 ± 9.6 % 10044 CAA IEEE 802.15.1 Bluetooth (#-DCPSK, DH5) Bluetooth 4.10 ± 9.6 % 10044 CAA IEEE 802.15.1 Bluetooth (#-DCPSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10044 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 12) DECT 10.79 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 1.28 Mcps) TD-SCDMA 11.01 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCMA, 1.28 Mcps) WLAN 2.12 ± 9.6 % 10060 CAB IEEE 802.115 WIF1 2.4 GHz (DSSS, 5.6 Mbps) WLAN 2.12 ± 9.6 % 10061 CAB IEEE 802.113 WIF1 5 GHz (OFDM, 9 Mbps) WLAN	10034	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	Bluetooth	4.53	±9.6%
10036 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH1) Bluetooth 8.01 ± 9.6 % 10037 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.10 ± 9.6 % 10038 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.10 ± 9.6 % 10042 CAB IS-541 (15:136 FDD CTDMA/FDM, PI/4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 % 10044 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, pouble Slot, 12) DECT 10.79 ± 9.6 % 10059 CAA DECT (TDD, TDMA/FDM, GFSK, pouble Slot, 12) DECT 10.79 ± 9.6 % 10059 CAB IEEE 802.11b WiF12.4 GHz (DSS, 2 Mbps) WLAN 2.12 ± 9.6 % 10061 CAB IEEE 802.11b WiF12.4 GHz (DSS, 5.1 Mbps) WLAN 2.83 ± 9.6 % 10062 CAC IEEE 802.11a WiF15 GHz (OFDM, 18 Mbps) WLAN 2.83 ± 9.6 % 10063 CAC IEEEE 802.11a WiF15 GHz (OFDM, 18 Mbps) <td< td=""><td>10035</td><td>CAA</td><td>IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)</td><td>Bluetooth</td><td>3.83</td><td>±9.6 %</td></td<>	10035	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	Bluetooth	3.83	±9.6 %
10037 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH3) Bluetooth 4.77 ± 9.6 %. 10038 CAB CDMA2000 (1xRTT, RC1) CDMA2000 4.57 ± 9.6 %. 10042 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 %. 10044 CAA IS-91 (EMTIA-535 EDD (FDMA, FM) AMPS 0.01 ± 9.6 %. 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 10.79 ± 9.6 %. 10049 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 21) DECT 10.79 ± 9.6 %. 10056 CAA UMTS-TDD (TD-SCDMA, 1.28 Mops) TD-SCDMA 11.01 ± 9.6 %. 10056 CAA EDEC FDD (TDMA, 8PSK, TN 0-1-2-3) GSM 6.52 ± 9.6 %. 10056 CAC IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.83 ± 9.6 %. 10061 CAB IEEE 802.11a/WIFI 5 GHz (OFDM, 9 Mbps) WLAN 8.68 ± 9.6 %. 10062 CAC IEEE 802.11a/WIFI 5 GHz (OFDM, 3 Mbps) WLAN 8.63	10036	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	Bluetooth	8.01	±9.6 %
10038 CAA IEEE 802.15.1 Bluetooth (8-DPSK, DH5) Bluetooth 4.10 ± 9.6 % 10039 CAB CDMA2000 (1xRTT, RC1) CDMA2000 4.57 ± 9.6 % 10042 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 % 10044 CAA DECT 13.80 ± 9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Duble Slot, 12) DECT 10.79 ± 9.6 % 10058 DAC EDCE-FDD (TDMA, BRSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10059 CAB IEEE 802.110 WIFI 2.4 GHz (DSSS, 15 Mbps) WLAN 2.12 ± 9.6 % 10060 CAB IEEE 802.110 WIFI 2.4 GHz (DSSS, 11 Mbps) WLAN 2.83 ± 9.6 % 10061 CAC IEEE 802.110 WIFI 5 GHz (OFDM, 6 Mbps) WLAN 2.83 ± 9.6 % 10062 CAC IEEE 802.11a/W WIFI 5 GHz (OFDM, 18 Mbps) WLAN 8.68 ± 9.6 % 10063 CAC IEEE 802.11a/W WIFI 5 GHz (OFDM, 18 Mbps) WLAN 8.68 ± 9.6 %	10037	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	Bluetooth	4.77	±9.6 %
10039 CAB CDMA2000 (HRTT, RC1) CDMA2000 4.57 ± 9.6 % 10042 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 % 10044 CAA IS-91/ELA/TIA-553 FDD (FDMA, FM) AMPS 0.00 ± 9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 10.79 ± 9.6 % 10056 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 21) DECT 10.79 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 1.28 Mcps) TD-SCDMA 11.01 ± 9.6 % 10058 DAC EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10060 CAB IEEE 802.11b WIF12.4 GHz (DSSS, 5.5 Mbps) WLAN 2.83 ± 9.6 % 10061 CAB IEEE 802.11a/WIF15 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10062 CAC IEEE 802.11a/WIF15 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10064 CAC IEEE 802.11a/WIF15 GHz (OFDM, 12 Mbps) WLAN 9.00 ± 9.6	10038	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	Bluetooth	4.10	±9.6 %
10042 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) AMPS 7.78 ± 9.6 % 10044 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10049 CAA DECT (TDD, TDMA/FDM, GFSK, Doube Slot, 12) DECT 10.79 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 128 Meps) TD-SCDMA 11.01 ± 9.6 % 10058 DAC EDGE-FDD (TDMA, BPSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10060 CAB IEEEE 802.11b WIF12.4 GHz (DSSS, 5.5 Mbps) WLAN 2.18 ± 9.6 % 10061 CAB IEEE 802.11b WIF12.4 GHz (DSSS, 5.5 Mbps) WLAN 3.60 ± 9.6 % 10062 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 6 Mbps) WLAN 3.60 ± 9.6 % 10063 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10064 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 12 Mbps) WLAN 9.00 ± 9.6 % 10065 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 48 Mbps) WLAN	10039	CAB	CDMA2000 (1xRTT, RC1)	CDMA2000	4.57	±9.6 %
10044 CAA IS-91/ELATLA-553 FDD (FDMA, FM) AMPS 0.00 ± 9.6 % 10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10056 CAA DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12) DECT 10.79 ± 9.6 % 10058 DAC EDGEFDD (TDMA/FDM, GFSK, TO -1-2-3) GSM 6.52 ± 9.6 % 10058 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 2 Mbps) WLAN 2.12 ± 9.6 % 10060 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.86 % 10061 CAB IEEE 802.11a/h WIFI 5 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10062 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 12 Mbps) WLAN 8.68 ± 9.6 % 10064 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.00 ± 9.6 % 10065 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 34 Mbps) WLAN 9.00 ± 9.6 % 10066 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 34 Mbps) WLAN 10.21 ±	10042	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	AMPS	7.78	±9.6 %
10048 CAA DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) DECT 13.80 ± 9.6 % 10056 CAA DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12) DECT 10.79 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 128 Mcps) TD-SCDMA 11.01 ± 9.6 % 10058 DAC ED0E-FDD (TDMA, 8PSK, TN 0-12-3) GSM 6.52 ± 9.6 % 10060 CAB IEEE 802.11b WIF12.4 GHz (DSSS, 5.5 Mbps) WLAN 2.83 ± 9.6 % 10061 CAB IEEE 802.11a/h WIF15 GHz (OSS, 11 Mbps) WLAN 8.68 ± 9.6 % 10062 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 9 Mbps) WLAN 8.68 ± 9.6 % 10063 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10064 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 12 Mbps) WLAN 9.03 ± 9.6 % 10066 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 48 Mbps) WLAN 9.04 ± 9.6 % 10066 CAC IEEE 802.11a/h WIF15 GHz (OFDM, 48 Mbps) WLAN 10.24 <td>10044</td> <td>CAA</td> <td>IS-91/EIA/TIA-553 FDD (FDMA, FM)</td> <td>AMPS</td> <td>0.00</td> <td>±9.6 %</td>	10044	CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	AMPS	0.00	±9.6 %
10049 CAA DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12) DECT 10.79 ± 9.6 % 10056 CAA UMTS-TDD (TD-SCDMA, 1.28 Mcps) TD-SCDMA 11.01 ± 9.6 % 10058 DAC EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10050 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 2.1 Mbps) WLAN 2.12 ± 9.6 % 10061 CAB IEEE 802.11a WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.83 ± 9.6 % 10062 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 9 Mbps) WLAN 8.68 ± 9.6 % 10063 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 9 Mbps) WLAN 8.63 ± 9.6 % 10064 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 18 Mbps) WLAN 9.09 ± 9.6 % 10065 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 34 Mbps) WLAN 9.04 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 44 Mbps) WLAN 10.12 ± 9.6 % 10067 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 54 Mbps) WLAN <td< td=""><td>10048</td><td>CAA</td><td>DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)</td><td>DECT</td><td>13.80</td><td>±9.6 %</td></td<>	10048	CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	DECT	13.80	±9.6 %
10056 CAA UMTS-TDD (TD-SCDMA, 1.28 Mcps) TD-SCDMA 11.01 ± 9.6 % 10058 DAC EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10060 CAB IEEE 802.11b WiFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.12 ± 9.6 % 10061 CAB IEEE 802.11a/M WiFI 5.4 GHz (DSSS, 5.5 Mbps) WLAN 3.60 ± 9.6 % 10062 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 9 Mbps) WLAN 8.63 ± 9.6 % 10063 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 9 Mbps) WLAN 8.63 ± 9.6 % 10064 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10065 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 12 Mbps) WLAN 9.08 ± 9.6 % 10066 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 44 Mbps) WLAN 9.08 ± 9.6 % 10067 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10068 CAC IEEE 802.11a/M WiFI 5 GHz (OFDM, 48 Mbps) WLAN	10049	CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	DECT	10.79	±9.6%
10058 DAC EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) GSM 6.52 ± 9.6 % 10059 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.12 ± 9.6 % 10060 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 3.60 ± 9.6 % 10061 CAB IEEE 802.11a // WIFI 5 GHz (OSSS, 5.1 Mbps) WLAN 3.60 ± 9.6 % 10062 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10064 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10066 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 41 Mbps) WLAN 9.38 ± 9.6 % 10066 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 44 Mbps) WLAN 9.38 ± 9.6 % 10067 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 44 Mbps) WLAN 10.12 ± 9.6 % 10067 CAC IEEE 802.11a // WIFI 5 GHz (OFDM, 44 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.119 WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLA	10056	CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	TD-SCDMA	11.01	± 9.6 %
$ \begin{array}{ccccc} 10059 & CAB & EEE 802.11b WiFl 2.4 GHz (DSSS, 2 Mbps) & WLAN & 2.12 & \pm 9.6 \% \\ \hline 10060 & CAB & EEE 802.11b WiFl 2.4 GHz (DSSS, 11 Mbps) & WLAN & 2.83 & \pm 9.6 \% \\ \hline 10061 & CAB & EEE 802.11a/h WiFl 5 GHz (OFDM, 6 Mbps) & WLAN & 8.68 & \pm 9.6 \% \\ \hline 10062 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 9 Mbps) & WLAN & 8.63 & \pm 9.6 \% \\ \hline 10063 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 12 Mbps) & WLAN & 8.63 & \pm 9.6 \% \\ \hline 10066 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 12 Mbps) & WLAN & 9.09 & \pm 9.6 \% \\ \hline 10066 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 12 Mbps) & WLAN & 9.00 & \pm 9.6 \% \\ \hline 10066 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 12 Mbps) & WLAN & 9.00 & \pm 9.6 \% \\ \hline 10066 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 44 Mbps) & WLAN & 9.08 & \pm 9.6 \% \\ \hline 10066 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 36 Mbps) & WLAN & 9.38 & \pm 9.6 \% \\ \hline 10068 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 48 Mbps) & WLAN & 10.12 & \pm 9.6 \% \\ \hline 10069 & CAC & EEE 802.11a/h WiFl 5 GHz (OFDM, 54 Mbps) & WLAN & 10.24 & \pm 9.6 \% \\ \hline 10071 & CAB & EEE 802.11g/h WiFl 2.4 GHz (DSSS/OFDM, 12 Mbps) & WLAN & 10.56 & \pm 9.6 \% \\ \hline 10072 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 12 Mbps) & WLAN & 9.83 & \pm 9.6 \% \\ \hline 10073 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 12 Mbps) & WLAN & 9.62 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 24 Mbps) & WLAN & 10.30 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.77 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.77 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.30 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.77 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.77 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 36 Mbps) & WLAN & 10.77 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 GHz (DSSS/OFDM, 54 Mbps) & WLAN & 10.93 & \pm 9.6 \% \\ \hline 10076 & CAB & EEE 802.11g/WiFl 2.4 G$	10058	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	GSM	6.52	±9,6%
10060 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps) WLAN 2.83 ± 9.6 % 10061 CAD IEEE 802.11a/n WIFI 5 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10062 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 6 Mbps) WLAN 8.63 ± 9.6 % 10063 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 9 Mbps) WLAN 8.63 ± 9.6 % 10064 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.00 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 18 Mbps) WLAN 9.03 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 10.12 ± 9.6 % 10067 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10072 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 36 Mbps) <td< td=""><td>10059</td><td>CAB</td><td>IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)</td><td>WLAN</td><td>2.12</td><td>± 9.6 %</td></td<>	10059	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	WLAN	2.12	± 9.6 %
10061 CAB IEEE 802.11b WIFI 2.4 GHz (DSSS, 11 Mbps) WLAN 3.60 ± 9.6 % 10062 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10064 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 12 Mbps) WLAN 8.63 ± 9.6 % 10065 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10066 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 18 Mbps) WLAN 9.08 ± 9.6 % 10067 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 36 Mbps) WLAN 9.38 ± 9.6 % 10068 CAC IEEE 802.11a/h WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 9 Mbps) WLAN 10.24 ± 9.6 % 10072 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps)	10060	CAB	IEEE 802.11b WIFI 2.4 GHz (DSSS, 5.5 Mbps)	WLAN	2.83	± 9.6 %
10022 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 6 Mbps) WLAN 8.68 ± 9.6 % 10063 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 9 Mbps) WLAN 9.09 ± 9.6 % 10064 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 12 Mbps) WLAN 9.00 ± 9.6 % 10065 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 24 Mbps) WLAN 9.38 ± 9.6 % 10066 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 36 Mbps) WLAN 9.38 ± 9.6 % 10068 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 48 Mbps) WLAN 10.12 ± 9.6 % 10069 CAC IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.83 ± 9.6 % 10072 CAB IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 9.82 ± 9.6 % 10073 CAB IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.30 ± 9.6 % 10074 CAB IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	10061	CAB	IEEE 802.11b WIFI 2.4 GHz (DSSS, 11 Mbps)	WLAN	3.60	± 9.6 %
10053 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 12 Mbps) WLAN 8.63 ± 9.6 % 10064 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 14 Mbps) WLAN 9.00 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 9.38 ± 9.6 % 10067 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.12 ± 9.6 % 10068 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 9 Mbps) WLAN 10.26 ± 9.6 % 10072 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 9.94 ± 9.6 % 10075 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps)	10062		IEEE 802.11a/h WIFI 5 GHz (OFDM, 6 Mbps)		8.68	± 9.6 %
100b4 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 12 Mbps) WLAN 9.09 ± 9.6 % 10065 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 24 Mbps) WLAN 9.38 ± 9.6 % 10066 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 24 Mbps) WLAN 9.38 ± 9.6 % 10067 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 10.12 ± 9.6 % 10068 CAC IEEE 802.11a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11a/n WIFI 5 GHz (OFDM, 54 Mbps) WLAN 9.83 ± 9.6 % 10072 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 9 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 18 Mbps) WLAN 9.94 ± 9.6 % 10076 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps)	10063		IEEE 802.11a/h WIFI 5 GHz (OFDM, 9 Mbps)	WLAN	8.63	± 9.6 %
10005 CAC IEEE 802.11 a/n WIFI 5 GHz (OFDM, 24 Mbps) WLAN 9.00 ± 9.6 % 10066 CAC IEEE 802.11 a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 10.12 ± 9.6 % 10067 CAC IEEE 802.11 a/n WIFI 5 GHz (OFDM, 36 Mbps) WLAN 10.24 ± 9.6 % 10068 CAC IEEE 802.11 a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11 a/n WIFI 5 GHz (OFDM, 48 Mbps) WLAN 10.56 ± 9.6 % 10072 CAB IEEE 802.11 a/n WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.83 ± 9.6 % 10073 CAB IEEE 802.11 g WIFI 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11 g WIFI 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.30 ± 9.6 % 10075 CAB IEEE 802.11 g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11 g WIFI 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11 g WIFI 2.4 GH	10064		IEEE 802.11a/h WIFI 5 GHz (OFDM, 12 Mbps)	VVLAN	9.09	±9.6%
10000 CAC IEEE 802.11 a/n WIF1 5 GHz (OFDM, 24 MDpS) WLAN 9.38 ± 9.6 % 10067 CAC IEEE 802.11 a/n WIF1 5 GHz (OFDM, 36 Mbps) WLAN 10.12 ± 9.6 % 10068 CAC IEEE 802.11 a/n WIF1 5 GHz (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11 a/n WIF1 5 GHz (OFDM, 54 Mbps) WLAN 10.56 ± 9.6 % 10072 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11 g/WIF1 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10077 CAB IEEE 802.11 g/WIF1 2.4	10065		LEE 802.11a/h WIFI 5 GHZ (OFDM, 18 Mbps)		9.00	± 9.6 %
10007 CAC IEEE 802.118/n WiF1 5 GH2 (DFDM, 36 Mbps) WLAN 10.12 ± 9.6 % 10068 CAC IEEE 802.11a/n WiF1 5 GH2 (OFDM, 48 Mbps) WLAN 10.24 ± 9.6 % 10071 CAB IEEE 802.11a/n WiF1 5 GH2 (OFDM, 54 Mbps) WLAN 10.56 ± 9.6 % 10072 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 9 Mbps) WLAN 9.83 ± 9.6 % 10073 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 14 Mbps) WLAN 9.94 ± 9.6 % 10075 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 44 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 48 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 48 Mbps) WLAN 10.71 ± 9.6 % 10076 CAB IEEE 802.11g WiF1 2.4 GH2 (DSSS/OFDM, 54 Mbps) WLAN 10.71 ± 9.6 % 10077 CAB IEEE 802.11g WiF1 2.4 GH2 (D	10066				9.38	19.0%
10006 CAC TEEE 802.11a/r WIF15 GHz (OFDM, 46 Mbps) WLAN 10.24 ± 9.6 % 10069 CAC IEEE 802.11a/r WIF15 GHz (OFDM, 54 Mbps) WLAN 10.56 ± 9.6 % 10071 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.83 ± 9.6 % 10073 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10074 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 18 Mbps) WLAN 9.62 ± 9.6 % 10075 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10076 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10077 CAB IEEE 802.11g WIF12.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10082 CAB IDS-54 / IS-136 FDD (TDMA/FDM, P	10067		1 IEEE 802.118/N WIFLS GHZ (OFDM, 36 Mbps)		10.12	±9.0%
10009 CAC IEEE 802.113/I WIF1 5 GHZ (OFDIM, 34 Wipps) WLAN 10.50 ± 9.6 % 10071 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 9 Mbps) WLAN 9.83 ± 9.6 % 10072 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 18 Mbps) WLAN 9.94 ± 9.6 % 10074 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10075 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 36 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 54 Mbps) WLAN 10.94 ± 9.6 % 10081 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 54 Mbps) WLAN 10.94 ± 9.6 % 10076 CAB IEEE 802.11g WIF1 2.4 GHZ (DSSS/OFDM, 54 Mbps) WLAN 10.94 ± 9.6 % 10081 CAB IEEE 802.11g WIF	10068				10.24	19.0 %
IOUTI OAD TELE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 9 MDps) WLAN 9.83 ± 9.6 % 10072 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 12 Mbps) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 18 Mbps) WLAN 9.94 ± 9.6 % 10074 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10075 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10076 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g WIFT 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB INS-FDD (TDMA, GMSK, TN 0.4)	10069		IEEE 802.11a/11 WIFLD GHZ (UFUW, 54 MDps)		10.56	19.0%
10072 CAB TEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDIM, 12 WIDDS) WLAN 9.62 ± 9.6 % 10073 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 18 Mbps) WLAN 9.94 ± 9.6 % 10074 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10075 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10076 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 36 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g WIFT 2.4 GH2 (DSSS/OFDM, 48 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10090 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10097 CAB UMTS-FDD (HSDPA) WCDMA	100/1		IEEE 802.11g WIFI 2.4 GHZ (DSSS/OFDM, 9 MDps)		9.83	19.0%
10073 CAB IEEE 602. 11g WIF1 2.4 GHz (DSSS/OFDM, 16 Wibps) WLAN 9.94 1.9.0 % 10074 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 24 Mbps) WLAN 10.30 ± 9.6 % 10075 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.77 ± 9.6 % 10077 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10090 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10097 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSUPA, Subtest 2) WCDMA 3.98 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67	10072		IEEE 002.119 WIFI 2.4 GHZ (DOOO/OFDM, 12 MUPS)		9.02	+06%
10014 Ords IEEE 002.11g WIF1 2.4 GHz (DSSG/OF DW, 24 Mbps) WULAW 10.30 12.9.6 % 10075 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 36 Mbps) WLAN 10.77 ± 9.6 % 10076 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g WIF1 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10080 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10090 DAC GPRS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 %	10073				10.20	+96%
10070 ORD IEEE 802.11g Will 12.4 GHz (DSSS/OFDM, 48 Mbps) WEAK 10.77 13.6 % 10077 CAB IEEE 802.11g Will 2.4 GHz (DSSS/OFDM, 48 Mbps) WLAN 10.94 ± 9.6 % 10077 CAB IEEE 802.11g Will 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10090 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10097 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSUPA, Subtest 2) WCDMA 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, G4-QAM) LTE-FDD 6.60 ± 9.6 % <td>10074</td> <td></td> <td>IEEE 802 11a WIEI 2 / GHz (DSSS/OFDIVI, 24 WIDPS)</td> <td></td> <td>10.30</td> <td>+96%</td>	10074		IEEE 802 11a WIEI 2 / GHz (DSSS/OFDIVI, 24 WIDPS)		10.30	+96%
10010 Order HELE 602.11g Wir 2.4 GHz (DSSS/OFDM, 54 Mbps) WELAN 10.94 1 9.6 % 10077 CAB IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) WLAN 11.00 ± 9.6 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10090 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10097 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSUPA, Subtest 2) WCDMA 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 6.60 ± 9.6 % <td>10075</td> <td></td> <td>IEEE 802.11g WIIT 2.4 GHz (DSSS/OFDM, 30 WDps)</td> <td>WLAN</td> <td>10.77</td> <td>+96%</td>	10075		IEEE 802.11g WIIT 2.4 GHz (DSSS/OFDM, 30 WDps)	WLAN	10.77	+96%
10011 CAB IEEE 002: Fig Wit 2: 4 OF (DOGORDEDW, 04 MDps) WEAR 11.00 1 3.0 % 10081 CAB CDMA2000 (1xRTT, RC3) CDMA2000 3.97 ± 9.6 % 10082 CAB IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) AMPS 4.77 ± 9.6 % 10090 DAC GPRS-FDD (TDMA, GMSK, TN 0-4) GSM 6.56 ± 9.6 % 10097 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSUPA, Subtest 2) WCDMA 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 %	10070		IEEE 802.11g WIII 2.4 GHz (DSSS/OFDW, 40 Mbps)	WIAN	11 00	+96%
10001 0.1.0 0.1.0 0.1.0 1.9.0 1.0.0 1.9.0 1.0.0 1.9.0 1.9.0 1.0.0 1.9.0 1.9.0 1.0.0 1.9.0 1.0.0 1.9.0 1.0.0 1.9.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 1.0.0 <th< td=""><td>10077</td><td></td><td>CDMA2000 (1vRTT_RC3)</td><td>CDMA2000</td><td>3.07</td><td>+96%</td></th<>	10077		CDMA2000 (1vRTT_RC3)	CDMA2000	3.07	+96%
10002 Order to too for tool (10 mm, 1 mm Dot of to for tom tool), 1 mm Dot of tool (10 mm, 1 mm Dot of tool), 1 mm Dot of tool), 1 mm Dot of tool (10 mm, 1 mm Dot of tool), 1 mm Dot of tool), 1 mm Dot of tool), 1 mm Dot of tool, 1 mm Dot of t	10087	CAR	IS-54 / IS-136 EDD (TDMA/EDM_PI/4-DOPSK_Fullrate)	AMPS	<u> </u>	+96%
10000 Drive Office Drive Office 10097 10097 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10098 CAB UMTS-FDD (HSDPA) WCDMA 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10002		GPRS-FDD (TDMA GMSK TN 0.4)	GSM	6.56	+96%
10001 07.65 04440 FDD (HSUPA, Subtest 2) 1000440 3.98 ± 9.6 % 10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10000	CAR	UMTS-FDD (HSDPA)	WCDMA	3.98	+96%
10099 DAC EDGE-FDD (TDMA, 8PSK, TN 0-4) GSM 9.55 ± 9.6 % 10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.29 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10098	CAR	UMTS-FDD (HSUPA, Subtest 2)	WCDMA	3.98	±9.6 %
10100 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 5.67 ± 9.6 % 10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.29 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) LTE-FDD 5.80 ± 9.6 %	10099	DAC	EDGE-EDD (TDMA, 8PSK, TN 0-4)	GSM	9.55	+96%
10101 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.42 ± 9.6 % 10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 6.60 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.29 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10100	CAF	LTE-EDD (SC-EDMA, 100% RB, 20 MHz, OPSK)	LTE-FDD	5.67	±9.6 %
10102 CAE LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-FDD 6.60 ± 9.6 % 10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) LTE-FDD 5.80 ± 9.6 %	10101	CAF	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-OAM)	LTE-FDD	6.42	±9.6 %
10103 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.29 ± 9.6 % 10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) LTE-FDD 5.80 ± 9.6 %	10102	CAF	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-OAM)	LTE-FDD	6.60	±9.6 %
10104 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) LTE-TDD 9.97 ± 9.6 % 10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10103	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, OPSK)	LTE-TDD	9,29	±9.6 %
10105 CAG LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 % 10108 CAG LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) LTE-TDD 10.01 ± 9.6 %	10104	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-OAM)	LTE-TDD	9.97	±9.6%
10108 CAG LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) LTE-FDD 5.80 + 9.6 %	10105	CAG	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	LTE-TDD	10.01	± 9.6 %
	10108	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	LTE-FDD	5.80	± 9.6 %

			176 500	0.40	
10109	CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	LIE-FUD	6.43	±9.6%
10110	CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	LTE-FDD	5.75	±9.6 %
10111	CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	LTE-FDD	6,44	±9.6 %
10112	CAG	LTE-EDD (SC-EDMA 100% BB 10 MHz 64-OAM)	I TE-EDD	6.59	+96%
40442	0,0	LTE FDD (CC FDMA, 400% PB 5 MHz 64 OAM)		6.62	+96%
10113	CAG	LTE-FUD (SC-FDWA, 100% RD, 3 WITZ, 04-QAW)		0.02	10.0 %
10114	CAC	IEEE 802.11h (HT Greenfield, 13.5 Mbps, BPSK)	VVLAN	8.10	± 9.0 %
10115	CAC	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	WLAN	8.46	± 9.6 %
10116	CAC	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	WLAN	8.15	± 9.6 %
10117	CAC	IEEE 802,11n (HT Mixed, 13,5 Mbps, BPSK)	WLAN	8.07	±9.6 %
10119	CAC	IFEE 802 11n (HT Mixed 81 Mbns 16-OAM)	WIAN	8 59	+96%
10110	0/10	IEEE 002.11m (IT Mixed, 125 Mbps, 64 QAM)		9.13	+06%
10119				0.10	10.0 %
10140	CAE	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	LIE-FUD	6.49	± 9.6 %
10141	CAE	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	LTE-FDD	6.53	<u>±9.6 %</u>
10142	CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	LTE-FDD	5.73	±9.6 %_
10143	CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	LTE-FDD	6.35	± 9.6 %
10144	CAF	LTE-EDD (SC-EDMA, 100% RB, 3 MHz, 64-QAM)	LTE-FDD	6.65	± 9.6 %
10145	CAE			5.76	+96%
10145		LTE-FDD (30-FDMA, 100% RD, 1.4 MITZ, QF3R)		6.44	10.6 %
10146	CAF	LTE-FUD (SC-FUMA, 100% RB, 1.4 MHz, 16-QAM)		0.41	<u>± 9.0 %</u>
10147	CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	LIE-FDD	6.72	±9.6%
10149	CAE	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	LTE-FDD	6.42	± 9.6 %
10150	CAE	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	LTE-FDD	6.60	±9.6 %
10151	CAG	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, OPSK)	LTE-TDD	9.28	± 9.6 %
10152		LTE-TDD (SC-EDMA 50% RB 20 MHz 16-04M)	I TE-TDD	9.92	+96%
10102				10.02	+060/
10153	CAG	LTE-TDD (SC-FDMA, 50% RB, 20 MHZ, 64-QAM)		10.05	I 9.0 %
10154	CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LIE-FDD	5.75	±9.6%
10155	CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-FDD	6.43	<u>±9.6 %</u>
10156	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-FDD	5.79	±9.6 %
10157	CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	LTE-FDD	6.49	±9.6 %
10158	CAG	LTE-EDD (SC-EDMA 50% BB 10 MHz 64-OAM)	ITE-FDD	6.62	+96%
10150		LTE FDD (80 FDMA, 50% FD, 5 MHz, 64 QAM)		6.56	+0.6%
10159	CAG	LTE-FDD (SC-FDWA, 50% RB, 5 MHZ, 64-QAM)		0.00	± 9,0 %
10160	CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LIE-FDD	5.82	±9.6 %
10161	CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	LTE-FDD	6.43	± 9.6 %
10162	CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	LTE-FDD	6.58	±9.6%
10166	CAF	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	LTE-FDD	5.46	±9.6 %
10167	CAF	LTE-EDD (SC-EDMA 50% RB 14 MHz 16-OAM)	LTE-FDD	6.21	+9.6%
40169		1 TE EDD (SC EDMA 50% PD 14 MHz, 10 G/M)		6.70	+96%
10108		LTE-FDD (30-FDMA, 30% Kb, 1.4 Milz, 04-QAM)		0.13	
10169	CAE	LIE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)		5.73	±9.0 %
10170	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-FDD	6.52	±9.6%
10171	AAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	LTE-FDD	6.49	±9.6%
10172	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	LTE-TDD	9.21	±9.6 %
10173	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	LTE-TDD	9.48	±9.6 %
10174	CAG	LTE-TDD (SC-EDMA 1 RB 20 MHz 64-OAM)	I TE-TOD	10.25	+96%
10174	CAG	LTE-TDD (30-TDMA, 1 ND, 20 MHz, 04-QAW)		5 70	10.0%
10175	CAG			0.12	10.0%
10176	CAG	LIE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)		0.52	±9.0%
10177	CAI	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-FDD	5.73	±9.6%
10178	CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	LTE-FDD	6.52	<u>± 9.6 %</u>
10179	CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	LTE-FDD	6.50	±9.6 %
10180	CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	LTE-FDD	6,50	± 9,6 %
10191		LTE-EDD (SC-EDMA 1 BB 15 MH+ OPSK)		5 72	+96%
10101				0.12	TUC 0/
10182	UAL			0.02	190%
10183		LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)		0.50	± 9.0 %
10184	CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	LTE-FDD	5.73	<u>j ± 9.6 %</u>
10185	CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	LTE-FDD	6.51	±9.6 %
10186	AAF	LTE-FDD (SC-FDMA, 1 RB. 3 MHz. 64-OAM)	LTE-FDD	6.50	± 9.6 %
10187	CAF	LTE-EDD (SC-EDMA, 1 BB, 1.4 MHz, OPSK)	LTE-FDD	5.73	±96%
10107		TE EDD (SC EDMA 4 DB 4 A MU + 46 OAM)		6 6 6 7	+96%
10100				0.02	1000
10189	AAF	LIE-FUD (SC-FUMA, 1 RB, 1.4 MHz, 64-QAM)		0.50	± 9.0 %
10193		IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	WLAN	8.09	±9.6 %
10194	CAC	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	WLAN	8.12	± 9.6 %
10195	CAC	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	WLAN	8.21	± 9.6 %
10196	CAC	IEEE 802 11n (HT Mixed: 6.5 Mbns: BPSK)	WLAN	8,10	+96%
10107		IEEE 802 11n (HT Mixed 30 Mbne 16-OAM)	WLAN	8 12	+96%
1010/		IEEE 000 14n (UT Mixed CE Mine CA OAM)		0.10	4060/
10.198	LAC			0.21	1 3.0 %
10219		IEEE 802.11n (HI Mixed, 7.2 Mbps, BPSK)	WLAN	8.03	1 2 9.6 %

10220	CAC	IEEE 802 11n (HT Mixed 43.3 Mbps 16-OAM)	WIAN	8 13	+96%
10220		IEEE 802.11n (HT Mixed, 72.2 Mbps, 70 co.m/)	WIAN	8 27	+96%
10221		IEEE 802.11n (HT Mixed, 15 Mbps, 64 Qr Wy	WIAN	8.06	+96%
10222	CAC	IEEE 802.11n (ITT Mixed, 10 Mbps, BFOR)		8.48	+96%
10223	CAC	EEE 802.1111 (HT Mixed, 50 Mbps, 10-QAM)		8.08	+96%
10224				5.00	10.0%
10225	CAB			0.97	<u>±9.0 /0</u>
10226	CAB	LTE-TOD (SC-FDMA, TRB, 1.4 MHZ, 10-QAM)		9.49	<u>± 9.0 %</u>
10227	CAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)		10.26	± 9.0 %
10228	CAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)		9.22	± 9.6 %
10229	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)		9.48	±9.6%
10230	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	LTE-IDD	10.25	± 9.6 %
10231	CAD	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	LTE-TDD	9.19	±9.6 %
10232	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	LTE-TDD	9.48	±9.6 %
10233	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	LTE-TDD	10.25	±9.6 %
10234	CAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	LTE-TDD	9.21	±9.6 %
10235	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	LTE-TDD	9.48	± 9.6 %
10236	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	LTE-TDD	10.25	±9.6 %
10237	CAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	LTE-TDD	9.21	± 9.6 %
10238	CAF	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	LTE-TDD	9.48	±9.6 %
10239	CAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	LTE-TDD	10.25	±9.6 %
10240	CAF	LTE-TDD (SC-EDMA_1 RB, 15 MHz, QPSK)	LTE-TDD	9.21	+9.6%
10240	CAR	LTE-TDD (SC-FDMA, 50% RB 14 MHz 16-OAM)	LTE-TDD	9.82	±9.6%
10241	CAR	LTE-TOD (SC-FDMA 50% RB 14 MHz 64-04M)		9.86	+96%
10242	CAP	LTE-TOD (SC-FDMA 50% PR 1 / MHz OPSK)		0.00	+96%
10243				10.00	+0.6 %
10244		LTE-TOD (SC-FDMA, 50% RB, 3 MHZ, 16-QAM)		10.00	± 9.0 %
10245	CAD	LTE-TDD (SC-FDMA, 50% RB, 3 MHZ, 64-QAM)		10.06	± 9.0 %
10246	CAD	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK)		9.30	± 9.6 %
10247	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)		9,91	± 9.6 %
10248	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	LTE-TDD	10.09	± 9.6 %
10249	CAG	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	LTE-TDD	9.29	± 9.6 %
10250	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	LTE-TDD	9.81	± 9.6 %
10251	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	LTE-TDD	10.17	± 9.6 %
10252	CAG	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	LTE-TDD	9.24	± 9.6 %
10253	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	LTE-TDD	9.90	± 9.6 %
10254	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	LTE-TDD	10.14	± 9.6 %
10255	CAF	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	LTE-TDD	9.20	± 9.6 %
10256	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	LTE-TDD	9.96	±9.6 %
10257	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	LTE-TDD	10.08	±9.6 %
10258	CAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	LTE-TDD	9.34	± 9.6 %
10259	CAD	LTE-TDD (SC-EDMA, 100% BB, 3 MHz, 16-QAM)	LTE-TDD	9.98	+9.6 %
10260	CAD	LTE-TDD (SC-EDMA, 100% BB, 3 MHz, 64-QAM)	LTE-TDD	9.97	+9.6%
10260	CAD	LTE-TDD (SC-EDMA 100% RB 3 MHz OPSK)		9.24	+96%
10262	CAG	LTE-TDD (SC-EDMA, 100% RB, 5 MHz, 16-OAM)		9.83	+96%
10262		LTE-TOD (SC-EDMA 100% RB 5 MHz 64-04M)		10.16	+96%
10203				0.10	+0.6%
10204		LTE TOD (SC-FDMA, 100% RD, 3 MIRA, QF3R)		0.20	+0.6%
10200		LTE TOD (SC EDMA 1000 DD 10 MU- 64 0AM)		10.07	+06%
10200		LIE-TUD (30-FUNA, 100% RD, 10 MITZ, 04-WAN)		10.07	10.60
10267	CAG	LIE-TUD (SU-FUMA, TUU% KB, TU MHZ, QFSK)		9.30	<u><u> </u></u>
10268		LIE-TOD (SC-FDMA, 100% RB, 15 MHZ, 16-QAM)			±9.0 %
10269	CAF	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)		10.13	± 9.6 %
10270	CAF	LTE-1DD (SC-FDMA, 100% RB, 15 MHz, QPSK)		9.58	± 9.6 %
10274	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	WCDMA	4.87	± 9.6 %
10275	CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	WCDMA	3.96	± 9.6 %
10277	CAA	PHS (QPSK)	PHS	11.81	± 9.6 %
10278	CAA	PHS (QPSK, BW 884MHz, Rolloff 0.5)	PHS	11.81	±9.6%
10279	CAA	PHS (QPSK, BW 884MHz, Rolloff 0.38)	PHS	12.18	± 9.6 %
10290	AAB	CDMA2000, RC1, SO55, Full Rate	CDMA2000	3.91	± 9.6 %
10291	AAB	CDMA2000, RC3, SO55, Full Rate	CDMA2000	3.46	± 9.6 %
10292	AAB	CDMA2000, RC3, SO32, Full Rate	CDMA2000	3.39	±9.6 %
10293	AAB	CDMA2000, RC3, SO3, Full Rate	CDMA2000	3.50	± 9.6 %
10295	AAR	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	CDMA2000	12.49	±9.6%
10297		LTE-EDD (SC-EDMA, 50% RB, 20 MHz, OPSK)	LTE-FDD	5.81	+9.6%
10298		LTE-EDD (SC-EDMA, 50% RB, 3 MHz, OPSK)	LTE-FDD	5 72	±9.6 %
10200		LTE-EDD (SC-EDMA 50% RB 3 MHz 16-0AM)		6 39	+96%
10299	1 ~~~			0.00	

10300	AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	LTE-FDD	6.60	±9.6 %
10301	AAA	IEEE 802,16e WIMAX (29:18, 5ms, 10MHz, QPSK, PUSC)	WIMAX	12.03	±9,6%
10302	AAA	IEEE 802,16e WIMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3CTRL)	WIMAX	12.57	±9.6 %
10303	ΔΔΔ	IEEE 802 16e WIMAX (31:15 5ms 10MHz 64QAM PUSC)	WIMAX	12.52	+96%
10304		IEEE 802 16e WIMAX (29:18 5ms 10MHz 640AM PUSC)	WIMAX	11.86	+96%
10305		1555 802 160 WIMAX (21:15, 10me, 10MHz, 640AM, PUSC)	λ/ib/Δχ	15.24	+96%
10305		IEEE 002.100 WIMAX (31.13, 10ms, 10MHz, 04QAM, 1000)		11.67	+06%
10300		LEEE 002.100 WIMAX (29.10, 10/115, 10/01/2, 04QAW, POSC)		144.07	19.0 %
10307				14.49	± 9.0 %
10308	AAA	TEEE 802.166 WIMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)	VVIVIAX	14.40	± 9.6 %
10309	AAA	EEE 802.16e WIMAX (29:18, 10ms, 10MHz, 16QAM,AMC 2X3)	WIMAX	14.58	± 9.6 %
10310	AAA	IEEE 802.16e WIMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3	WIMAX	14.57	± 9.6 %
10311	AAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	LTE-FDD	6.06	±9.6 %
10313	AAA	IDEN 1:3	IDEN	10.51	±9.6 %
10314	AAA	IDEN 1:6	IDEN	13.48	± 9.6 %
10315	AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc dc)	WLAN	1.71	± 9.6 %
10316	AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc dc)	WLAN	8,36	± 9.6 %
10317	AAC	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc dc)	WLAN	8.36	±9.6 %
10352	AAA	Pulse Waveform (200Hz, 10%)	Generic	10.00	±9.6 %
10353		Pulse Waveform (200Hz, 20%)	Generic	6.99	± 9.6 %
10354	AAA	Pulse Waveform (200Hz, 40%)	Generic	3.98	±9.6 %
10355	AAA	Pulse Waveform (200Hz, 60%)	Generic	2 22	+96%
10356		Pulse Waveform (200Hz 80%)	Generic	0.97	+96%
10300		OPSK Waveform 1 MHz	Generic	5.10	+06%
10307			Generic	5.10	T 2.0 %
10308	MAA		Conorio	0.22	190%
10396	AAA	64-QAW Waveform, 100 KHz	Generic	0.27	±9.6%
10399	AAA	64-QAM Waveform, 40 MHz	Generic	6.27	±9.6%
10400	AAD	IEEE 802.11ac WIFI (20MHz, 64-QAM, 99pc dc)	WLAN	8.37	± 9.6 %
10401	AAD	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc dc)	WLAN	8.60	±9.6%
10402	AAD	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc dc)	WLAN	8.53	±9.6 %
10403	AAB	CDMA2000 (1xEV-DO, Rev. 0)	CDMA2000	3.76	±9.6 %
10404	AAB	CDMA2000 (1xEV-DO, Rev. A)	CDMA2000	3.77	± 9.6 %
10406	AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	CDMA2000	5.22	±9.6 %
10410	AAG	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Sub=2,3,4,7,8,9)	LTE-TDD	7.82	± 9.6 %
10414	AAA	WLAN CCDF, 64-QAM, 40MHz	Generic	8.54	± 9.6 %
10415	AAA	IEEE 802.11b WIFI 2.4 GHz (DSSS, 1 Mbps, 99pc dc)	WLAN	1.54	± 9.6 %
10416	AAA	IEEE 802,11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc dc)	WLAN	8.23	+9.6%
10417	AAB	IEEE 802 11a/b WIEI 5 GHz (OEDM 6 Mbps, 99pc dc)	WIAN	8 23	+96%
10418		IEEE 802 11a WiFi 2 4 GHz (DSSS-OEDM 6 Mbps, 99pc, Long)	WIAN	8 14	+96%
10410		IEEE 802.11g WIT2.4 CHz (DOOD OF DM, 6 Mbps, 00pc, cong)		8 10	$\pm 9.0\%$
40400		IEEE 002.11g Will 2.4 Griz (DOOG-OF DW, 0 Mbps, 30pc, Ghory		0.10	+06%
10422		IEEE 002.1111 (FT Greenfield, 7.2 Wibps, DFGN)		0.32	<u>±9.0 %</u>
10423				0.47	±9.0%
10424	AAB	IEEE 802.11n (HT Greenfield, 72.2 MDps, 64-QAW)	WLAN	8.40	± 9.6 %
10425	AAB	IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)	WLAN	8.41	± 9.6 %
10426		IEEE 802.11n (HI Greenfield, 90 Mbps, 16-QAM)		8.45	± 9.6 %
10427	AAB	IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	WLAN	8.41	± 9.6 %
10430	AAD	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	LTE-FDD	8.28	± 9.6 %
10431	AAD	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	LTE-FDD	8.38	± 9.6 %
10432	AAC	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	LTE-FDD	8.34	± 9.6 %
10433	AAC	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	LTE-FDD	8.34	±9.6 %
10434	AAA	W-CDMA (BS Test Model 1, 64 DPCH)	WCDMA	8.60	±9.6 %
10435	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Sub)	LTE-TDD	7.82	±9.6 %
10447	AAD	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1. Clipping 44%)	LTE-FDD	7,56	±9.6 %
10448	AAD	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clippin 44%)	LTE-FDD	7.53	±96%
10449	AAC	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Cliping 44%)	LTE-FDD	7.51	+96%
10450	AAC	LTE-EDD (OEDMA, 20 MHz, E-TM 3.1, Clipping 44%)	LTE-FDD	7.48	+96%
10451		W-CDMA (BS Test Model 1 64 DPCH Clipping 44%)		7 50	+96%
10462		Validation (Square 10ms 1ms)	Test	10.00	+0.6 %
10400				0.00	10.0%
10400				0.00	10.0%
10457					I 9.0 %
10458		CDMA2000 (1XEV-DO, Rev. B, 2 carriers)	CDMA2000	6.55	± 9.6 %
10459	AAA	CUMA2000 (1xEV-DO, Rev. B, 3 carriers)	CDMA2000	8.25	± 9.6 %
10460	AAA	UMTS-FDD (WCDMA, AMR)	WCDMA	2.39	± 9.6 %
10461	AAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Sub)	LTE-TDD	7.82	± 9.6 %
10462	AAB	LTE-TDD (SC-EDMA 1 RB 1.4 MHz 16-OAM UL Sub)	LITE-TOD	1 8 30	1 + 9 6 %

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10463	AAB	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL Sub)	LTE-TDD	8 56	+96%
10464	AAC	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Sub)	LTE-TDD	7 82	+96%
10465	AAC	LTE-TDD (SC-EDMA 1 RB 3 MHz 16-OAM LIL Sub)		8.32	+96%
10466		LTE-TOD (SC-EDMA 1 RB 3 MHz 64-OAM UL Sub)		9.52	+06%
10467	AAE	LTE-TOD (SC EDMA 1 PR 5 MHz ODSK UL Sub)		700	10.6%
10401		LTE-TOD (SC EDMA 1 PR 5 MHz 16 OAM LIL Sub)		0.02	± 9.0 %
10400		TE TOD (SC-FDWA, I RD, S WITZ, TO QAW, UL SUD)		0.32	± 9.0 %
10409		LTE-TOD (SC-PDIMA, TRB, 5 MHZ, 64-QAM, OL SUD)		8.55	± 9.6 %
10470	AAF	LTE-TOD (SC-PDMA, 1 RB, 10 MHz, QPSK, UL SUD)		7.82	±9.6%
10471		LTE-TDD (SC-FDMA, 1 RB, 10 MHZ, 16-QAM, UL Sub)	LIE-IDD	8.32	±9.6%
10472		LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL Sub)	LIE-IDD	8.57	±9.6 %
10473	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Sub)	LTE-TDD	7.82	±9.6 %
10474	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Sub)	LTE-TDD	8.32	<u>±9.6 %</u>
10475	AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL Sub)	LTE-TDD	8.57	±9.6 %
10477	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Sub)	LTE-TDD	8.32	± 9.6 %
10478	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Sub)	LTE-TDD	8.57	±9.6 %
10479	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Sub)	LTE-TDD	7.74	±9.6 %
10480	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Sub)	LTE-TDD	8.18	± 9.6 %
10481	AAB	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Sub)	LTE-TDD	8.45	± 9.6 %
10482	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Sub)	LTE-TDD	7.71	±9.6 %
10483	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, Sub)	LTE-TDD	8.39	+9.6%
10484	AAC	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Sub)	LTE-TDD	8.47	+96%
10485	AAF	TE-TDD (SC-EDMA 50% RB 5 MHz OPSK III Sub)		7 50	+96%
10486		LTE-TOD (SC-EDMA 50% RB 5 MHz 16-OAM UL Sub)		0.00	+06%
10400		LTE TOD (SC EDMA 50% RB 5 MHz 64 OAM HI Sub)		0.00	± 9.0 %
10407				0.00	± 9.0 %
10400		LTE-TOD (SO-FDMA, 50% RB, 10 MHZ, QFSR, 0L SUD)		7.70	± 9.0 %
10409		LTE-TOD (SC-FDIMA, 50% RB, 10 MHZ, 16-QAM, UL SUD)		8.31	± 9.6 %
10490		LTE-100 (SC-FDMA, 50% RB, 10 MHZ, 64-QAM, 0L SUD)	LIE-IDD	8.54	± 9.6 %
10491	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHZ, QPSK, UL SUB)		1.14	±9.6%
10492	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Sub)		8.41	±9.6%
10493	AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM, UL Sub)	LTE-TDD	8.55	±9.6 %
10494	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Sub)	LTE-TDD	7.74	±9.6 %
10495	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Sub)	LTE-TDD	8.37	±9.6 %
10496	AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM, UL Sub)	LTE-TDD	8.54	±9.6 %
10497	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Sub)	LTE-TDD	7.67	±9.6 %
10498	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Sub)	LTE-TDD	8.40	± 9.6 %
10499	AAB	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM, UL Sub)	LTE-TDD	8.68	±9.6 %
10500	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Sub)	LTE-TDD	7.67	±9.6 %
10501	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Sub)	LTE-TDD	8.44	±9.6%
10502	AAC	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM, UL Sub)	LTE-TDD	8.52	±9.6%
10503	AAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Sub)	LTE-TDD	7.72	±9.6 %
10504	AAF	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Sub)	LTE-TOD	8.31	+9.6%
10505	AAF	LTE-TDD (SC-EDMA, 100% RB, 5 MHz, 64-QAM, UL Sub)	ITE-TDD	8.54	+96%
10506	AAF	LTE-TDD (SC-EDMA 100% RB 10 MHz OPSK UL Sub)	ITE-TOD	7 74	+96%
10507	AAF	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-0AM, UL Sub)		8.26	+96%
10508	AAF	1 TE-TDD (SC-EDMA 100% RB 10 MHz 64-04M UL Sub)		8 55	+96%
10509		1 TE-TDD (SC-EDMA 100% RB 15 MHz OPSK 111 Sub)		7 00	+96%
10510		TETDD (SC-EDMA 100% RB 15 MHz 16 OAM HI Sub)		9 10	+060/
10511		1 TE-TDD (SC-EDMA 100% PR 15 MHz 64 OAM 11 Sub)		0.49	T 0 0 0
10512		TETED (SCEDMA 400% DR 20 MHz ODEK HI SUB)		774	<u> </u>
10512		LIL-IDD (SO-FDMA, 100% ND, 20 MHZ, QFSN, UL SUD)		1.14	<u> </u>
10013		LTE TOD (SO-FDIMA, 100% KD, 20 MIL- 04 OAM UL SUD)		0.42	
10014		LTE-TUD (SU-FUNA, 100% KB, 20 MHZ, 64-QAM, UL SUD)		8.45	± 9.6 %
10515	AAA	IEEE 002.110 WIFI 2.4 GHZ (DSSS, 2 MDps, 99pc dc)		1.58	± 9.6 %
10516		IEEE 802.110 WIFI 2.4 GHZ (DSSS, 5.5 MDps, 99pc dc)	VVLAN	1.57	±9.6%
10517		IEEE 802.110 WIFI 2.4 GHZ (DSSS, 11 Mbps, 99pc dc)	WLAN	1.58	± 9.6 %
10518		IEEE 802.11a/h WIFI 5 GHz (OFDM, 9 Mbps, 99pc dc)	WLAN	8.23	±9.6%
10519	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc dc)	WLAN	8.39	±9.6%
10520	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc dc)	WLAN	8.12	± 9.6 %
10521	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc dc)	WLAN	7.97	±9.6 %
10522	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc dc)	WLAN	8.45	±9.6 %
10523	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 99pc dc)	WLAN	8.08	±9.6 %
10524	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 99pc dc)	WLAN	8.27	± 9.6 %
10525	AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc dc)	WLAN	8.36	± 9.6 %
10526	AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc dc)	WLAN	8.42	± 9.6 %
10527	AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 99pc dc)	WLAN	8.21	±9.6 %

40500			14/1 4 5 1	0.00	
10528	AAB	TEEE 802.11ac WIFI (20MHz, MCS3, 99pc dc)	WLAN	8.36	± 9.6 %
10529	AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 99pc dc)	WLAN	8.36	± 9.6 %
10531	AAB	IEEE 802 11ac WiEi (20MHz, MCS6, 99nc dc)	WIAN	843	+96%
10001				0.70	10.0%
10532	AAB	THEE BUZ. TTAC WIFT (ZUNIFIZ, MICS7, 99pc dc)	WLAN	8.29	±9.0%
10533	AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 99pc dc)	WLAN	8.38	±9.6 %
10534	AAB	IEEE 802,11ac WiFi (40MHz, MCS0, 99pc dc)	WLAN	8.45	± 9.6 %
10535	ΔΔR	IEEE 802 11ac W/IEI (40MHz MCS1 99pc dc)	WIAN	8.45	+96%
10000				0.45	1 0.0 %
10536	AAB	IEEE 802.11ac WiFi (40MHz, MCS2, 99pc dc)	WLAN	8.32	± 9.6 %
10537	AAB	IEEE 802.11ac WiFi (40MHz, MCS3, 99pc dc)	WLAN	8.44	±9.6 %
10538	AAB	IEEE 802.11ac WiEi (40MHz, MCS4, 99pc dc)	WIAN	8 54	+96%
10540				0.01	+06%
10540	AAD		WLAN	0.39	±9.0 %
10541	AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 99pc dc)	WLAN	8.46	± 9.6 %
10542	AAB	IEEE 802.11ac WiFi (40MHz, MCS8, 99pc dc)	WLAN	8.65	±9.6 %
10543	AAB	IFEE 802 11ac WIEI (40MHz MCS9, 99pc dc)	W/LAN	8.65	+96%
40544		1222 002.11 do Will (40Mile, MOGO, 00pc do)		0.00	
10544	AAB		WLAN	8.47	±9.6 %
10545	AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc dc)	WLAN	8.55	±9.6 %
10546	AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 99pc dc)	WLAN	8 35	+96%
10547		IEEE 802 11ac \//iEi /80MHz_MCS3_90pc do)		9.40	+06%
10347			VVLAN	0.49	± 9.0 %
10548	AAB	IEEE 802.11ac WIFI (80MHz, MCS4, 99pc dc)	WLAN	8.37	±9.6 %
10550	AAB	IEEE 802.11ac WiFi (80MHz, MCS6, 99pc dc)	WLAN	8.38	±9.6 %
10551	AAR	IEEE 802 11ac WIEI (80MHz_MCS7_99pc dc)	WIAN	8 50	+96%
10552				0.00	1000
10552	AAB		WLAN	0.4Z	±9.0%
10553	AAB	EEE 802.11ac WiFi (80MHz, MCS9, 99pc dc)	WLAN	8.45	±9.6 %
10554	AAC	IEEE 802.11ac WiFi (160MHz, MCS0, 99pc dc)	WLAN	8.48	± 9.6 %
10555	AAC	IEEE 802 11ac WIEI (160MHz_MCS1_99pc.dc)	10/1 AN	8 / 7	+96%
10000	1010			0.47	
10556	AAC	TEEE 802.11ac WIFI (160MHz, MCS2, 99pc dc)	WLAN	8.50	±9.6%
10557	AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 99pc dc)	WLAN	8.52	±9.6 %
10558	AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 99pc dc)	WLAN	8.61	± 9.6 %
10560		IEEE 902 11ac WIEI (160MHz MCS6 00pc do)		0.72	106%
10300	17010		VULAIN	0.73	± 9.0 %
10561	AAC	LIEEE 802.11ac WiFi (160MHz, MCS7, 99pc dc)	WLAN	8.56	±9.6 %
10562	AAC	IEEE 802.11ac WiFi (160MHz, MCS8, 99pc dc)	WLAN	8.69	±9.6 %
10563	AAC	IEEE 802 11ac WiEi (160MHz MCS9 99pc dc)	WIAN	8 77	+96%
10564	A A A	IEEE 202 11a M/IEI 2 4 CHz (DSSS OEDM 0 Mbns 00no do)		0.25	+0.6%
10504			VVLAN	0.20	19.0 %
10565	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 99pc dc)	WLAN	8.45	±9.6 %
10566	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 99pc dc)	WLAN	8.13	± 9.6 %
10567	AAA	IEEE 802 11g WIEI 2.4 GHz (DSSS-OEDM, 24 Mbns, 99pc dc)	WIAN	8.00	+96%
10507		IEEE 002.44 a WiEi 2.4 Oliz (DOGO OFDM, 24 Mbps, 00ps ds)		0.00	10.0 %
10300	AAA		VVLAN	0.37	I9.0 %
10569	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 99pc dc)	WLAN	8.10	±9.6 %
10570	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 99pc dc)	WLAN	8.30	±9.6 %
10571	ΔΔΔ	IEEE 802 11h WIEI 2 4 GHz (DSSS_1 Mbps_90pc.dc)	WI AN	1 99	+96%
40570		IEEE 002.115 Will 2.4 Olds (DOCC, 1 Mbps, 00pc do)		1.00	10.0 %
10572	AAA	1222 110 WIFI 2.4 GHZ (DSSS, 2 Wibps, 90pc dc)	VVLAN	1.99	±9.6%
10573	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 90pc dc)	WLAN	1.98	± 9.6 %
10574	AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 90pc dc)	WLAN	1.98	± 9.6 %
10575	ΔΔΔ	IEEE 802 11a WiEi 2.4 GHz (DSSS-OEDM 6 Mbps, 90pc dc)	WI AN	9.50	+96%
10010				0.08	- 3.0 %
10576	AAA	TEEE 002.11g WIFI 2.4 GHZ (DSSS-OFDIM, 9 MDps, 90pc dc)	VVLAN	8.60	±9.6%
10577		IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc dc)	WLAN	8.70	<u>±9.6</u> %
10578	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc dc)	WLAN	8.49	± 9.6 %
10579	ΔΔΔ	IEEE 802 11g WIEI 2 4 GHz (DSSS-OEDM 24 Mbns 90ng do)	WIAN	95.8	+96%
10010	1 1 1 1	TEE 002 11 g THE 2.4 OF (DOOD OF DW, 24 WDD, 000 00)		0.00	+0.0 /0
10580	1 AAA		VVLAN	0.76	± 9.0 %
10581	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc dc)	WLAN	8.35	<u>±9.6</u> %
10582	AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc dc)	WLAN	8.67	±9.6 %
10583	ΔΔR	IEEE 802 11a/h WIEI 5 GHz (OEDM 6 Mbrs 90pc dc)	WIAN	8 50	+96%
10000				0.03	
10584	AAB		VVLAN	0.00	<u> </u>
10585		IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc dc)	WLAN	8.70	<u>±9.6 %</u>
10586	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 90pc dc)	WLAN	8.49	± 9.6 %
10587	AAR	IEEE 802 11a/h WIEI 5 GHz (OEDM 24 Mbrs 90nc dc)	WLAN	92.8	+96%
10500				0.00	10.0 %
10588	AAB		VVLAN	8.76	±9.0%
10589	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 90pc dc)	WLAN	8.35	<u>±9.6 %</u>
10590	AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 90pc dc)	WLAN	8,67	±9.6 %
10591	AAP	IEEE 802 11n (HT Mixed 20MHz MCS0 90no do)	WI AN	29.8	+0.6%
40500	1 100			0.00	1 0 0 70
10592	AAB	IEEE 802.11h (H1 Mixed, 20MHz, MCS1, 90pc dc)	VVLAN	8.79	± 9.6 %
10593	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS2, 90pc dc)	WLAN	8.64	±9.6 %
10594	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS3, 90nc dc)	WLAN	8.74	±9.6 %
10505	AAP	IFFE 802 11n (HT Mixed 20MHz MCG4 00ng da)	WLAN	0.74	+0.6.0/
10090	1 ~~0	ILLE OUZ. I II (I II WINCU, ZUWITZ, WICO4, SUPC UC)		0.74	1 1 3.0 70

10506		IEEE 802 14n (UT Mixed 20MUz MCSS 00ne de)	34/1.4.51	0.74	+069/
10590	AAD		VVLAIN	0.71	± 9.0 %
10597	AAB	TEEE 802.11h (HT MIXED, 20MHZ, MCS6, 90pc dc)	WLAN	8.72	± 9.6 %
10598	AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS7, 90pc dc)	WLAN	8.50	± 9.6 %
10599	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc dc)	WLAN	8,79	± 9.6 %
10600	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc dc)	WLAN	8.88	+96%
10601	ΔΔΒ	IEEE 802 11n (HT Mixed 40MHz MCS2 90nc dc)		8.82	+ 9.6 %
40000		IEEE 002.1 m (IT Mixed, 40MHz, MOO2, 50pc dc)		0.02	1 3.0 %
10602	AAD		VVLAN	8.94	± 9.0 %
10603	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS4, 90pc dc)	WLAN	9.03	±9.6 %
10604	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS5, 90pc dc)	WLAN	8.76	± 9.6 %
10605	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS6, 90pc dc)	WLAN	8.97	± 9.6 %
10606	AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS7, 90pc dc)	WIAN	8.82	+96%
10607		IEEE 802 1100 WIEI (20MHz, MCS0, 900c dc)		9.64	106%
10001	AAD			0.04	± 9.0 %
10608	AAB	TEEE 802.11ac WIFI (20MHZ, MCS1, 90pc dc)	WLAN	8.77	±9.6%
10609	AAB	IEEE 802.11ac WiFi (20MHz, MCS2, 90pc dc)	WLAN	8.57	±9.6 %
10610	AAB	IEEE 802.11ac WiFi (20MHz, MCS3, 90pc dc)	WLAN	8.78	±9.6 %
10611	AAB	IEEE 802.11ac WiFi (20MHz, MCS4, 90pc dc)	WLAN	8.70	±9.6 %
10612	AAR	IEEE 802 11ac WiEi (20MHz MCS5 90nc dc)	WIAN	8 77	+96%
10612		IEEE 902 1100 WII (20MHz, MCC6, 00pc do)		0.71	+06%
10013			WLAN	0.94	±9.0 %
10614	AAB	TEEE 802.11ac WIFI (20MHz, MCS7, 90pc dc)	WLAN	8.59	±9.6%
10615	AAB	IEEE 802.11ac WiFi (20MHz, MCS8, 90pc dc)	WLAN	8.82	± 9.6 %
10616	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc dc)	WLAN	8.82	± 9.6 %
10617	AAB	IEEE 802.11ac WiFi (40MHz, MCS1. 90pc dc)	WLAN	8.81	± 9,6 %
10618	AAR	IEEE 802 11ac WiEI (40MHz MCS2 90pc dc)	WIAN	8 59	+96%
10610		IEEE 802 1100 WIEI (40MHz, MCC2, 00pc do)		0.00	10.0 %
10019	1 MAD			0.00	TAD %
10620	AAB	IEEE 802.11ac WIFI (40MHz, MCS4, 90pc dc)	WLAN	8.87	±9.6 %
10621	AAB	IEEE 802.11ac WiFi (40MHz, MCS5, 90pc dc)	WLAN	8.77	± 9.6 %
10622	AAB	IEEE 802.11ac WIFI (40MHz, MCS6, 90pc dc)	WLAN	8.68	± 9.6 %
10623	AAB	IEEE 802.11ac WiFi (40MHz, MCS7, 90pc dc)	WLAN	8.82	+9.6%
10624	AAB	IEEE 802 11ac WiEi (40MHz, MCS8, 90pc dc)	WIAN	8.96	+96%
10625		1EEE 902 1100 Will (40MHz, MCSD, 00pp da)		0.00	+069/
10020	AAD		WLAN	8.96	±9.0 %
10626	AAB	TEEE 802.11ac WIFI (80MHZ, MCSU, 90pc dc)	WLAN	8.83	±9.6%
10627	AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc dc)	WLAN	8.88	±9.6 %
10628	AAB	IEEE 802.11ac WiFi (80MHz, MCS2, 90pc dc)	WLAN	8.71	±9.6%
10629	AAB	IEEE 802,11ac WiFi (80MHz, MCS3, 90pc dc)	WLAN	8.85	+9.6%
10630	ΔΔΒ	IEEE 802 11ac WiEi (80MHz, MCS4, 90pc dc)	WIAN	8 72	+96%
10600		IEEE 002.1100 WITI (00MHz, MOOT, 00p0.00)		0.12	+0.6 %
10031	AAD		VVLAIN	8.81	±9.0 %
10632	AAB	IEEE 802.11ac WIFI (80MHZ, MCS6, 90pc dc)	WLAN	8.74	±9.6 %
10633	AAB	IEEE 802.11ac WiFi (80MHz, MCS7, 90pc dc)	WLAN	8.83	±9.6%
10634	AAB	IEEE 802.11ac WiFi (80MHz, MCS8, 90pc dc)	WLAN	8.80	±9.6%
10635	AAB	IEEE 802,11ac WiFi (80MHz, MCS9, 90oc dc)	WLAN	8.81	±9.6%
10636	AAC	IFEE 802 11ac WiFi (160MHz_MCS0_90nc.dc)	WI AN	8.83	+96%
10637		IEEE 902 11co M/IEI (160MHz, MCC4, 90pc do)	W/LANI	0.00	+0.6 %
10037	AAC			0.79	19.0%
10638	AAC	TEEE 802.11ac WIFI (160WHZ, WCS2, 90pc dc)	WLAN	8.86	±9.6%
10639	AAC	IEEE 802.11ac WiFi (160MHz, MCS3, 90pc dc)	WLAN	8.85	±9.6 %
10640	AAC	IEEE 802.11ac WiFi (160MHz, MCS4, 90pc dc)	WLAN	8.98	±9.6 %
10641	AAC	IEEE 802.11ac WiFi (160MHz, MCS5, 90pc dc)	WLAN	9.06	± 9.6 %
10642	AAC	IEEE 802,11ac WiFi (160MHz, MCS6, 90pc dc)	WLAN	9.06	+9.6%
10643		IEEE 802 11ac WIEI (160MHz, MCS7, 90pc do)	WLAN	8 80	+96%
10644	1010			0.08	
10044	AAU			9.05	±9.0%
10645		IEEE 802.11ac WiFi (160MHz, MCS9, 90pc dc)	WLAN	9.11	±9.6 %
10646	AAG	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Sub=2,7)	LTE-TDD	11.96	±9.6 %
10647	AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Sub=2,7)	LTE-TDD	11.96	±9.6%
10648	AAA	CDMA2000 (1x Advanced)	CDMA2000	3.45	±96%
10652		TE-TDD (OEDMA 5 MHz E-TM 3.1 Clipping 44%)		6.01	+96%
10652		LTE-TOD (OFDMA 10 MHz E TM 3.4 Offening 449/)		7 40	±0.0 /0
10000				1.42	<u> </u>
10654		L1E-1DD (OFDIMA, 15 MHZ, E-1M 3.1, Clipping 44%)		6.96	±9.6%
10655	AAE	LTE-TDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)	LTE-TDD	7.21	±9.6 %
10658	AAA	Pulse Waveform (200Hz, 10%)	Test	10.00	±9.6%
10659	AAA	Pulse Waveform (200Hz, 20%)	Test	6.99	±9.6 %
10660	AAA	Pulse Waveform (200Hz, 40%)	Test	3 98	+96%
10661		Pulse Waveform (200Hz, 60%)	Teet	2.00	+0.6 %
10001		Dulas Waysform (2001- 200/)	Test		<u> </u>
10062	AAA	Pulse waveform (200Hz, 80%)		0.97	± 9.6 %
10670		Bluetooth Low Energy	Bluetooth	2.19	±9.6%
10671	AAA	IEEE 802,11ax (20MHz, MCS0, 90pc dc)	WLAN	9.09	± 9.6 %

40070				0 57	106%
10672	AAA	TEEE 802.11ax (20MHz, MCS1, 90pc dc)	WLAN	6.57	± 9.0 %
10673	AAA	1EEE 802.11ax (20MHz, MCS2, 90pc dc)	WLAN	8.78	±9.6%
10674	AAA	IEEE 802.11ax (20MHz, MCS3, 90pc dc)	WLAN	8.74	± 9.6 %
10675	AAA	IEEE 802 11ax (20MHz, MCS4, 90pc dc)	WLAN	8.90	±9.6 %
10676		JEEE 802 11ax (20MHz_MCS5_90pc dc)	WLAN	8.77	+9.6 %
10070		IEEE 002.11ax (20MHz, MCS6, 00ps do)		873	+96%
10077	AAA			0.70	+06%
10678	AAA	TEEE 802.11ax (20MHz, MCS7, 90pc dc)	VVLAN	0.70	<u>± 9.0 %</u>
10679	AAA	IEEE 802.11ax (20MHz, MCS8, 90pc dc)	WLAN	8.89	± 9.6 %
10680	AAA	IEEE 802.11ax (20MHz, MCS9, 90pc dc)	WLAN	8.80	±9.6 %
10681	AAA	IEEE 802.11ax (20MHz, MCS10, 90pc dc)	WLAN	8.62	± 9.6 %
10682		IEEE 802 11ax (20MHz_MCS11_90nc.dc)	WLAN	8.83	±9.6 %
10002		IEEE 002.11ax (20MHz, MCS0, 00pc dc)		8 4 2	+96%
10003				0.42	+0.6.9/
10684	AAA	TEEE 802.11ax (20MHz, MCS1, 99pc dc)	VVLAN	0.20	<u>±9.0 %</u>
10685	AAA	IEEE 802.11ax (20MHz, MCS2, 99pc dc)	WLAN	8.33	± 9.6 %
10686	AAA	IEEE 802.11ax (20MHz, MCS3, 99pc dc)	WLAN	8.28	± 9.6 %
10687	AAA	IEEE 802,11ax (20MHz, MCS4, 99pc dc)	WLAN	8.45	± 9.6 %
10688		JEEE 802 11ax (20MHz_MCS5_99pc_dc)	WLAN	8.29	± 9.6 %
10000		IEEE 002.11ax (20MHz, MOS6, 00pc do)		8 55	+96%
10009	AAA			0.00	
10690	AAA	TEEE 802.11ax (20MHz, MCS7, 99pc dc)	VVLAN	0.29	± 9.0 %
10691	AAA	IEEE 802.11ax (20MHz, MCS8, 99pc dc)	WLAN	8.25	±9.6 %
10692	AAA	IEEE 802.11ax (20MHz, MCS9, 99pc dc)	WLAN	8.29	±9.6 %
10693	AAA	IEEE 802.11ax (20MHz, MCS10, 99pc dc)	WLAN	8.25	±9.6 %
10694	ΑΑΑ	IEEE 802 11ax (20MHz, MCS11, 99pc dc)	WLAN	8.57	±9.6 %
10605		LEEE 802 11ax (40MHz MCS0 800c dc)	WIAN	8 78	+96%
10095				0.70	±0.0 /0
10696	AAA	IEEE 802.11ax (40MHz, MCS1, 90pc dc)	VVLAN	8.91	±9.0%
10697	AAA	IEEE 802.11ax (40MHz, MCS2, 90pc dc)	WLAN	8,61	± 9.6 %
10698	AAA	IEEE 802.11ax (40MHz, MCS3, 90pc dc)	WLAN	8.89	±9.6 %
10699	AAA	IEEE 802.11ax (40MHz, MCS4, 90pc dc)	WLAN	8.82	±9.6 %
10700	AAA	IEEE 802,11ax (40MHz, MCS5, 90pc dc)	WLAN	8.73	± 9.6 %
10701		IEEE 802 11ax (10MHz, MCS6, 90pc dc)	WI AN	8.86	+96%
10701	~~~	IEEE 002.11ax (40MHz, MCC0, 30pc dc)		9 70	10.0%
10702	AAA	IEEE 802.11ax (40MHz, MCS7, 90pc dc)	VVLAIN	0.70	± 9.0 %
10703		IEEE 802.11ax (40MHz, MCS8, 90pc dc)	WLAN	8.82	±9.6%
10704	AAA	IEEE 802.11ax (40MHz, MCS9, 90pc dc)	WLAN	8.56	± 9.6 %
10705	AAA	IEEE 802.11ax (40MHz, MCS10, 90pc dc)	WLAN	8.69	±9.6 %
10706	AAA	IEEE 802.11ax (40MHz, MCS11, 90pc dc)	WLAN	8.66	± 9.6 %
10707	ΔΔΔ	IEEE 802 11ax (40MHz_MCS0_99pc.dc)	WIAN	8.32	+96%
10709		1222 002.11 dx (40MHz, MCC1, 90pc do)		8.55	+96%
10708				0.00	+0.6.9/
10709	AAA	IEEE 802.11ax (40MHz, MCS2, 99pc dc)	VVLAN	8.33	±9.0%
10710	AAA	IEEE 802.11ax (40MHz, MCS3, 99pc dc)	WLAN	8.29	± 9.6 %
10711	AAA	IEEE 802.11ax (40MHz, MCS4, 99pc dc)	WLAN	8.39	± 9.6 %
10712	AAA	IEEE 802.11ax (40MHz, MCS5, 99pc dc)	WLAN	8.67	± 9.6 %
10713		LEEE 802 11ax (40MHz, MCS6, 99pc dc)	WLAN	8.33	± 9.6 %
10714		IEEE 802 11ox (10MHz, MCS7, 99pc dc)	WIAN	8.26	+96%
10714				0.20	+0.6 %
10/15				0.40	<u>1 3.0 %</u>
10716		IEEE 802.11ax (40MHz, MCS9, 99pc dc)	VVLAN	8.30	± 9.0 %
10717	AAA	IEEE 802.11ax (40MHz, MCS10, 99pc dc)	WLAN	8.48	± 9.6 %
10718	AAA	IEEE 802.11ax (40MHz, MCS11, 99pc dc)	WLAN	8.24	± 9.6 %
10719	AAA	IEEE 802.11ax (80MHz, MCS0, 90pc dc)	WLAN	8.81	± 9.6 %
10720	ΑΑΔ	IEEE 802,11ax (80MHz, MCS1, 90nc dc)	WLAN	8.87	± 9.6 %
10701		IEEE 802 11ax (80MHz MCS2 90nc do)	WIAN	8 76	+96%
10721				0.70	10.0 %
10722	AAA			0.00	<u> </u>
10723		IEEE 802.11ax (80MHz, MCS4, 90pc dc)	WLAN	8.70	±9.6%
10724	AAA	IEEE 802.11ax (80MHz, MCS5, 90pc dc)	WLAN	8.90	<u>±9.6 %</u>
10725	AAA	IEEE 802.11ax (80MHz, MCS6, 90pc dc)	WLAN	8.74	± 9.6 %
10726	AAA	IEEE 802.11ax (80MHz. MCS7. 90pc dc)	WLAN	8.72	± 9.6 %
10727		IEEE 802 11ax (80MHz, MCS8, 90nc dc)	WLAN	8.66	±9.6%
10720		IFEE 802 11av (80MHz MCS0 90nc do)	WIAN	8.65	+96%
10720	AAA			0.00	10,0 /0
10729	AAA			0.04	<u>19.0%</u>
10730		IEEE 802.11ax (80MHz, MCS11, 90pc dc)	WLAN	8.67	±9.6%
10731	AAA	IEEE 802.11ax (80MHz, MCS0, 99pc dc)	WLAN	8.42	± 9.6 %
10732	AAA	IEEE 802.11ax (80MHz, MCS1, 99pc dc)	WLAN	8.46	± 9.6 %
10733	AAA	IEEE 802,11ax (80MHz, MCS2, 99pc dc)	WLAN	8.40	± 9.6 %
10734		IEEE 802 11ax (80MHz, MCS3, 99pc dc)	WLAN	8 25	+96%
40705		IEEE 802 11ax (contrib, MCC0, cope do)		8 22	+0.6%
10/35				1 0.00	1 1 3.0 /0

10736		IEEE 802 11ax (80MHz, MCS5, 99nc dc)	WIAN	8 27	+96%
10737		IEEE 802.11ax (80MHz, MCS6, 90pc do)		9.36	+06%
10737		IEE 002.11ax (00MHz, MCOO, 35pc dc)		0.00	10.0 %
10738	AAA	TEEE 802.11ax (80MHZ, MCS7, 99pc dc)	VVLAN	8.42	±9.6%
10739	AAA	IEEE 802.11ax (80MHz, MCS8, 99pc dc)	WLAN	8,29	±9.6 %
10740	AAA	IEEE 802.11ax (80MHz, MCS9, 99pc dc)	WLAN	8.48	± 9.6 %
10741	AAA	IEEE 802.11ax (80MHz, MCS10, 99pc dc)	WLAN	8.40	± 9.6 %
10742	AAA	IEEE 802.11ax (80MHz, MCS11, 99pc dc)	WLAN	8.43	± 9.6 %
10743	AAA	IEEE 802.11ax (160MHz, MCS0, 90pc dc)	WLAN	8.94	± 9.6 %
10744	AAA	IEEE 802.11ax (160MHz, MCS1, 90pc dc)	WLAN	9.16	±9.6 %
10745	AAA	IEEE 802.11ax (160MHz, MCS2, 90pc dc)	WLAN	8.93	±9.6 %
10746	AAA	IEEE 802.11ax (160MHz, MCS3, 90pc dc)	WLAN	9.11	±9.6 %
10747	AAA	IEEE 802.11ax (160MHz, MCS4, 90pc dc)	WLAN	9.04	±9.6 %
10748	AAA	IEEE 802.11ax (160MHz, MCS5, 90pc dc)	WLAN	8.93	± 9.6 %
10749	AAA	IEEE 802.11ax (160MHz, MCS6, 90pc dc)	WLAN	8.90	± 9.6 %
10750	AAA	IEEE 802.11ax (160MHz, MCS7, 90pc dc)	WLAN	8.79	± 9.6 %
10751	AAA	IEEE 802.11ax (160MHz, MCS8, 90pc dc)	WLAN	8.82	+9.6 %
10752	AAA	IEEE 802 11ax (160MHz_MCS9_90pc_dc)	WLAN	8.81	+96%
10753	ΔΔΔ	IEEE 802 11ax (160MHz, MCS10, 90pc dc)	WIAN	9.01	+96%
10754	ΔΔΔ	IEEE 802.11ax (160MHz, MCS11, 90pc dc)	WIAN	8.00	+96%
10755		IEEE 802.11ax (160MHz, MCS0, 99pc dc)		9.64	+06%
10756		IEEE 802.11ax (160MHz, MCS1, 90pc dc)		0.04	+06%
10750		IEEE 802.11ax (160MHz, MCS1, 99pc dc)		0.11	+0.6%
10759		IEEE 002.110x (100MHz, MC02, 00pp do)		0.11	±9.0 %
10750		IEEE 002.118X (100MITZ, MCO3, 99µ0 dc)		0.09	± 9.6 %
10759			VVLAIN	8.58	±9.6 %
10760	AAA	TEEE 802.11ax (160MHz, MCS5, 99pc dc)	WLAN	8.49	±9.6 %
10761		IEEE 802.11ax (160MHz, MCS6, 99pc dc)	WLAN	8.58	±96%
10762		IEEE 802.11ax (160MHz, MCS7, 99pc dc)	WLAN	8.49	±9.6 %
10763	AAA	IEEE 802.11ax (160MHz, MCS8, 99pc dc)	WLAN	8.53	±9.6 %
10764	AAA	IEEE 802.11ax (160MHz, MCS9, 99pc dc)	WLAN	8.54	±9.6 %
10765	AAA	IEEE 802.11ax (160MHz, MCS10, 99pc dc)	WLAN	8.54	± 9.6 %
10766	AAA	IEEE 802.11ax (160MHz, MCS11, 99pc dc)	WLAN	8.51	±9.6 %
10767	AAC	5G NR (CP-OFDM, 1 RB, 5 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	7.99	± 9.6 %
10768	AAC	5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.01	±9.6%
10769	AAC	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.01	±9.6 %
10770	AAC	5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.02	±9.6 %
10771	AAC	5G NR (CP-OFDM, 1 RB, 25 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.02	±9.6 %
10772	AAC	5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.23	±9.6%
10773	AAC	5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.03	±9.6 %
10774	AAC	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.02	±9.6 %
10775	AAB	5G NR (CP-OFDM, 50% RB, 5 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.31	±9.6 %
10776	AAC	5G NR (CP-OFDM, 50% RB, 10 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.30	±9.6 %
10777	AAB	5G NR (CP-OFDM, 50% RB, 15 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.30	±9.6%
10778	AAC	5G NR (CP-OFDM, 50% RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8 34	+9.6%
10779	AAB	5G NR (CP-OEDM, 50% RB, 25 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.42	+96%
10780	AAC	5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 15 kHz)	5G NR FR1 TDD	8.38	±9.6%
10781	AAC	5G NR (CP-OFDM, 50% RB, 40 MHz, OPSK, 15 kHz)	5G NR FR1 TDD	8.38	±9.6 %
10782	AAC	5G NR (CP-OFDM, 50% RB, 50 MHz, OPSK, 15 kHz)	5G NR FR1 TDD	8.43	±9.6 %
10783	AAC	5G NR (CP-OFDM, 100% RB, 5 MHz, OPSK, 15 kHz)	5G NR FR1 TDD	8.31	+9.6%
10784	AAC	5G NR (CP-OFDM, 100% RB, 10 MHz, OPSK, 15 kHz)	5G NR FR1 TDD	8 20	+96%
10785	AAC	5G NR (CP-OEDM 100% RB 15 MHz OPSK 15 kHz)	5G NR FR1 TDD	8 40	+96%
10786	AAC	5G NR (CP-OEDM 100% RB 20 MHz OPSK 15 kHz)	5G NR FR1 TDD	8 35	+96%
10787		5G NR (CP-OFDM, 100% RB 25 MHz OPSK 15 KHz)	5G NR FR1 TOD	8 11	+0.0%
10789		50 NR (OP-OFDM, 100% RB, 20 MHz, QP5K, 15 kHz)	5G NR EP1 TOD	0.44	10.0%
10780		56 NR (CP.OEDM 100% PR 40 MHz OPSK 45 KHz)		0.08	+060/
10700		50 ND (00 000M 100% PD 50 MU- 000K 15 KHZ)		0.01	± 9.0 %
10790	AAC -			0.38	± 3.0 %
10/91	AAC	CONTROPORTING TROUGHT AND AND ADDRESS AND AND ADDRESS		1.83	T 3'0 %
10792	AAC	DO NR (OP-OFDM, TRB, TU MITZ, QPSK, 30 KHZ)		7.92	±9.0%
10793	AAC	DO NR (UP-UPDM, T KB, 15 MHZ, QPSK, 30 KHZ)	DG NR FRT TDD	7.95	±9.6%
10/94	AAC	DO NR (CP-OFDM, TRB, 20 MHZ, QPSK, 30 KHZ)	DUNK FRT TDD	1.82	± 9.6 %
10/95		DG NK (CP-OFDM, 1 KB, 25 MHZ, QPSK, 30 KHZ)	DG NK FR1 IDD	/.84	± 9.6 %
10/96		DG NK (CP-OFDM, 1 RB, 30 MHz, QPSK, 30 KHz)	DG NK FR1 IDD	1.82	± 9.6 %
10/97	AAC	DU NK (CP-OFDM, 1 KB, 40 MHZ, QPSK, 30 KHZ)	DG NK FR1 TDD	8.01	± 9.6 %
10798	AAC	DG NK (UP-OFDM, 1 KB, 50 MHz, QPSK, 30 kHz)	DG NK FR1 TDD	7.89	± 9.6 %
1 10799	AAC	5 5 NR (CP-OFDM, 1 RB, 60 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.93	± 9.6 %

10801	AAC	5G NR (CP-OFDM, 1 RB, 80 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.89	±9.6%
10802	AAC	5G NR (CP-OFDM, 1 RB, 90 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7.87	± 9.6 %
10803	AAC	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	7 93	+96%
10805	AAC	5G NR (CP-OEDM 50% RB 10 MHz OPSK 30 kHz)	5G NR FR1 TDD	8 34	+96%
10000	10.0	SC ND (CD OEDM, SOV DD, 45 MILE, ODSK, 30 MILE)		0.04	1 9.0 %
10000	AAC		DG NR FRI IDD	8.37	± 9.0 %
10809	AAC	5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 30 KHz)	5G NR FR1 TDD	8.34	±9.6 %
10810	AAC	5G NR (CP-OFDM, 50% RB, 40 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.34	±9.6 %
10812	AAC	5G NR (CP-OFDM, 50% RB, 60 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.35	±9.6 %
10817	AAC	5G NR (CP-OFDM, 100% RB, 5 MHz, OPSK, 30 kHz)	5G NR FR1 TDD	8.35	+96%
10818	AAC	5G NR (CP-OEDM 100% RB 10 MHz OPSK 30 kHz)		8.34	+06%
10010		50 NR (CD OEDM, 100% RB, 10 MHz, Q1 OK, 30 KHz)		0.34	± 9.0 %
10019	AAC		JUNKFRITUD	8.33	± 9.6 %
10820	AAC	5G NR (CP-OFDM, 100% RB, 20 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.30	±9.6%
10821	AAC	5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10822	AAC	5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.41	± 9.6 %
10823	AAC	5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8 36	+96%
10824	AAC	5G NR (CP-OEDM 100% RB 50 MHz OPSK 30 kHz)	5G NR FR1 TDD	8 30	+96%
10825		50 NP (CD OEDM 100% PB 60 MHz, OPSK 20 KHz)	50 NR EP4 TDD	0.00	106%
10025	AAC		DO NR FRI TOD	8.41	±9.6 %
10827	AAC	56 NR (CP-OFDM, 100% RB, 80 MHz, QPSK, 30 KHz)	5G NR FR1 TDD	8.42	±9.6 %
10828	AAC	5G NR (CP-OFDM, 100% RB, 90 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.43	±9.6 %
10829	AAC	5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	8.40	±9.6 %
10830	AAC	5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.63	+9.6%
10831	AAC	5G NR (CP-OEDM 1 RB 15 MHz OPSK 60 kHz)	5G NR FR1 TDD	7 73	+96%
10832		50 NP (OP OEDM, 1 PP, 20 MHz, OPSK, 60 KHz)		7.70	+0.6 %
10002	AAC			1.14	<u>±9.0 %</u>
10833	AAC	5G NR (CP-OFDM, 1 RB, 25 MHZ, QPSK, 60 KHZ)	5G NR FR1 LDD	7.70	± 9.6 %
10834		5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.75	±9.6 %
10835	AAC	5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.70	± 9.6 %
10836	AAC	5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.66	+9.6%
10837	AAC	5G NR (CP-OEDM 1 RB 60 MHz OPSK 60 kHz)	5G NR FR1 TDD	7.68	+96%
10830		50 NR (OP OF DM 1 PR 90 MHz OPSK 60 KHz)		7.00	+0.6 %
10039	1000			7.70	±9.0%
10840	AAC	SG NR (CP-OFDM, 1 RB, 90 MHZ, QPSK, 60 KHZ)	5G NR FR1 TDD	1.67	±9.6%
10841	AAC	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	7.71	± 9.6 %
10843	AAC	5G NR (CP-OFDM, 50% RB, 15 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.49	±9.6 %
10844	AAC	5G NR (CP-OFDM, 50% RB, 20 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.34	±9.6 %
10846	AAC	5G NR (CP-OFDM, 50% RB, 30 MHz, OPSK, 60 kHz)	5G NR FR1 TDD	8 4 1	+96%
10854	AAC	5G NR (CP-OEDM 100% RB 10 MHz OPSK 60 kHz)	5G NR FR1 TDD	834	+96%
10004		50 NR (CR OEDM, 100% RB, 15 MHz, OPSK, 60 KHz)		0.04	19.0 %
10855	AAC	50 NR (CF-OFDM, 100% RB, 15 MHZ, QF5K, 60 KHZ)	DO NR FRI IDD	8.30	±9.0%
10856	AAC	5G NR (CP-0FDM, 100% RB, 20 MHz, QPSK, 60 kHz)	5G NR FR1 IDD	8.37	±9.6%
10857		5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.35	± 9.6 %
10858	AAC	5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.36	±9.6%
10859	AAC	5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.34	±9.6%
10860	AAC	5G NR (CP-OFDM, 100% RB, 50 MHz, OPSK, 60 kHz)	5G NR FR1 TDD	8 4 1	+96%
10861	AAC	5G NR (CP-OEDM 100% RB 60 MHz OPSK 60 kHz)		9.40	10.0%
10001		50 NR (OP-OF DM, 100% RB, 00 MHZ, QP3K, 00 MHZ)		0.40	<u>±9.0 %</u>
10003	AAC			8.41	±9.6%
10864		5G NR (CP-OFDM, 100% RB, 90 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.37	±9.6 %
10865	AAC	5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 60 kHz)	5G NR FR1 TDD	8.41	±9.6 %
10866	AAC	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.68	± 9.6 %
10868	AAC	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.89	±9.6 %
10869	AAD	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, OPSK, 120 kHz)	5G NR FR2 TDD	5.75	+96%
10870		5G NR (DET_S_OEDM 100% RB 100 MHz ODSK 120 VHz)	5G NR FP2 TDD	5.96	+96%
10070		50 ND (DET & OEDM 4 DD 400 MUH 400 MUH 400 MUH)		0.00	10.0 %
100/1		00 NR (DET-S-OFDIM, TKB, TUU MHZ, TOQAM, T2U KHZ)	DO NK FKZ IDU	0./5	±9.0%
10872	AAD	DG NK (DF I-S-UFDM, 100% KB, 100 MHz, 16QAM, 120 kHz)	5G NR FR2 TDD	6.52	±9.6%
10873	AAD	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.61	<u>±9.6</u> %
10874	AAD	5G NR (DFT-s-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.65	±9.6%
10875	AAD	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	7.78	±96%
10876	AAD	5G NR (CP-OEDM, 100% RB, 100 MHz, OPSK, 120 kHz)	5G NR FR2 TDD	8 30	+96%
10977		50 ND (CD.OEDM 1 DB 100 MH- 460AM 400 6H-)		7.00	+0.0 /0
40070		COND (OF OF DW, 110, 100 WITZ, 100AW, 120 KTZ)		1.90	<u> </u>
10878	AAU	DG NK (CP-OFDM, 100% KB, 100 MHz, 16QAM, 120 KHz)	5G NR FR2 TDD	8.41	±9.6%
10879	AAD	5G NR (CP-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	8.12	<u>±9.6</u> %
10880	AAD	5G NR (CP-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	8.38	± 9.6 %
10881	AAD	5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 120 kHz)	5G NR FR2 TDD	5.75	±9.6 %
10882	AAD	5G NR (DET-s-OEDM, 100% RB, 50 MHz, OPSK, 120 kHz)	5G NR FR2 TDD	5 06	+96%
10883		5G NR (DET_S_DEDM 1 RB 50 MHz 460AM 120 kHz)	5G NR EP2 TDD	6 57	10.0 %
10000		SC ND (DET & OEDM 4000/ DD 50 MUH 400 MH 400 MH)		0.07	10.0%
10004	MAU	00 NR (DET-S-OFDIN, 100% RB, 30 WHZ, 10QAW, 120 KHZ)	JUNK FRZ IDU	0.53	± 9.0 %
10885	AAD	5G NR (DET-S-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.61	± 9.6 %

10886	AAD	5G NR (DFT-s-OFDM, 100% RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	6.65	± 9.6 %
10887	ΔΔΠ	5G NR (CP-OEDM 1 RB 50 MHz OPSK 120 kHz)	5G NR FR2 TDD	7 78	+96%
40000		50 NR (OF OF DM, 1109, 80 MHz, QF 60, 120 KHz)	SC ND EP2 TDD	0.25	+06%
10666	AAU	36 NR (CP-OFDM, 100% RB, 30 MHZ, QPSN, 120 KHZ)	JG NR FR2 TDD	0.30	± 9.0 %
10889	AAD	5G NR (CP-OFDM, 1 RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2 TDD	8.02	± 9.6 %
10890	AAD	5G NR (CP-OFDM, 100% RB, 50 MHz, 16QAM, 120 kHz)	5G NR FR2 TDD	8.40	±9.6 %
10891	AAD	5G NR (CP-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)	5G NR FR2 TDD	8.13	± 9.6 %
10802		50 NP (CP_OEDM 100% PR 50 MHz 640AM 120 kHz)	5G NR FR2 TDD	9.11	+06%
10032	AAU			5.00	1 9.0 %
10897	AAA	5G NR (DFT-S-OFDM, 1 RB, 5 MHz, QPSK, 30 KHz)	5G NR FR1 IDD	5.66	±9.6%
10898	AAA	5G NR (DFT-s-OFDM, 1 RB, 10 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.67	± 9.6 %
10899	AAA	5G NR (DFT-s-OFDM, 1 RB, 15 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.67	± 9.6 %
10900		5G NR (DET-S-OEDM 1 RB 20 MHz OPSK 30 kHz)	5G NR FR1 TDD	5.68	+96%
10000		EC ND (DET & OEDM 1 DD 25 MHz, QF OK, 00 MHz)		5.00	106%
10901		DG NR (DF1-S-OFDM, 1 RB, 20 MITZ, QP3K, 30 KHZ)	JUNKFRITDD	0.00	<u>±9.0 %</u>
10902	AAA	5G NR (DFT-s-OFDM, 1 RB, 30 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.68	±9.6 %
10903	AAA	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.68	± 9.6 %
10904	AAA	5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.68	± 9.6 %
10905		5G NR (DET-S-OEDM 1 RB 60 MHz OPSK 30 kHz)	5G NR FR1 TDD	5.68	+96%
10303				- 5.00	10.0%
10906	AAA	5G NR (DFT-S-OFDM, 1 RB, 80 MHZ, QPSK, 30 KHZ)	5G NR FRI IDD	5.68	±9.0 %
10907	AAA	5G NR (DFT-s-OFDM, 50% RB, 5 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.78	±9.6 %
10908	AAA	5G NR (DFT-s-OFDM, 50% RB, 10 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.93	± 9.6 %
10909		5G NR (DET-s-OEDM 50% RB 15 MHz OPSK 30 kHz)	5G NR FR1 TDD	5.96	+96%
10000		50 NR (DET & OEDM, 50% PR, 10 MHz, QL 64, 00 MHz)		5.93	+06%
10910	AAA	50 NR (DFT-S-OFDM, 50% RB, 20 MHZ, QFSK, 50 KHZ)	JOINK FRI TDD	0.00	<u>±9.0 %</u>
10911	AAA	5G NR (DFT-s-OFDM, 50% RB, 25 MHz, QPSK, 30 kHz)	5G NR FR1 IDD	5.93	±9.6%
10912	AAA	5G NR (DFT-s-OFDM, 50% RB, 30 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.84	±9.6 %
10913	AAA	5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.84	±9.6 %
10914	ΔΔΔ	5G NR (DET-s-OEDM 50% RB 50 MHz OPSK 30 kHz)	5G NR FR1 TDD	5.85	+96%
10015		50 MR (DET & OFDM, 50% RB, 60 MHz, QE 64, 60 KHz)	50 MD ED1 TOD	5.00	+061/
10915			JGINK FRI TDD	0.03	<u> </u>
10916		5G NR (DFT-s-OFDM, 50% RB, 80 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.87	±9.6 %
10917	AAA	5G NR (DFT-s-OFDM, 50% RB, 100 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.94	±9.6 %
10918	AAA	5G NR (DFT-s-OFDM, 100% RB, 5 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.86	±9.6%
10010	ΔΔΔ	50 NR (DET-8-0EDM 100% RB 10 MHz 0PSK 30 kHz)	5G NR FR1 TDD	5.86	+96%
10919		50 NR (DET - OEDM, 100% RD, 10 WHZ, QESK, 30 KHZ)	SG NICT (TDD	5.00	10.0%
10920		5G NR (DFT-S-OFDM, 100% RB, 15 MHZ, QPSK, 30 KHZ)	5G NR FRI IDD	5.87	±9.6 %
10921	AAA	5G NR (DFT-s-OFDM, 100% RB, 20 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.84	±9.6 %
10922	AAA	5G NR (DFT-s-OFDM, 100% RB, 25 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.82	±9.6 %
10923	ΔΔΔ	5G NR (DET-s-OEDM 100% RB 30 MHz OPSK 30 kHz)	5G NR FR1 TDD	5.84	+96%
10024		50 NP (DET & OFDM, 100% PB 40 MHz, OPSK 30 kHz)	5G NR FR1 TDD	5.84	+96%
10924		30 NR (DFT-S-OFDW, 100% RB, 40 WIFI2, QFSR, 30 KHZ)		5.04	19.0 %
10925	AAA	5G NR (DFT-S-OFDM, 100% RB, 50 MHZ, QPSK, 30 KHZ)	5G NR FRT IDD	5.95	±9.0%
10926	AAA	5G NR (DFT-s-OFDM, 100% RB, 60 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.84	±9.6 %
10927	AAA	5G NR (DFT-s-OFDM, 100% RB, 80 MHz, QPSK, 30 kHz)	5G NR FR1 TDD	5.94	±9.6%
10928		5G NR (DET-s-OEDM 1 RB 5 MHz OPSK 15 kHz)	5G NR FR1 FDD	5.52	+96%
40020		50 NP (DET & OEDM 1 PP 10 MHz OPSK 15 kHz)		5.52	106%
10929	AAA	DO NR (DET-S-OFDW, TRD, TO WITZ, QEOR, TO KIZ)		0.02	19.0 %
10930	AAA	5G NR (DFT-s-OFDM, 1 RB, 15 MHz, QPSK, 15 KHz)	5G NR FR1 FDD	5.52	±9.6%
10931	AAA	5G NR (DFT-s-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.51	±9.6 %
10932	AAA	5G NR (DFT-s-OFDM, 1 RB, 25 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.51	± 9.6 %
10933	AAA	5G NR (DET-s-OEDM, 1 RB, 30 MHz, OPSK, 15 kHz)	5G NR FR1 FDD	5.51	+9.6%
10924		50 NR (DET_C_OEDM 1 PR 40 MHz ODSK 45 KHz)	5G NP FR1 FDD	5.51	+060/
10934				5.01	
10935	AAA	DU NK (UFT-S-UPUN, TKB, 50 MHZ, QPSK, 15 KHZ)		0.51	<u><u> </u></u>
10936	AAA	5G NR (DFT-s-OFDM, 50% RB, 5 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.90	±9.6 %
10937	AAA	5G NR (DFT-s-OFDM, 50% RB, 10 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.77	±9.6 %]
10938	AAA	5G NR (DFT-s-OFDM, 50% RB, 15 MHz, OPSK, 15 kHz)	5G NR FR1 FDD	5.90	±9.6 %
10020		50 NR (DET_e-OEDM 50% RB 20 MHz ODSK 15 kHz)	5G NR EP1 EDD	5.00	+96%
10939	1 ~~~~	SO NE (DET - OEDM FOU DE AF MUL OEDM (CHIL)		0.02	10.0 %
10940	AAA	DG NK (UF1-S-UFDM, 50% KB, 25 MHZ, QPSK, 15 KHZ)	DG NK FRI FDD	5.89	±9.0%
10941	AAA	5G NR (DFT-s-OFDM, 50% RB, 30 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.83	±9.6%
10942	AAA	5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.85	± 9.6 %
10943	AAA	5G NR (DFT-s-OFDM, 50% RB, 50 MHz, OPSK, 15 kHz)	5G NR FR1 FDD	5.95	±9.6%
10044		50 NR (DET OEDM 100% PR 5 MH7 OPSK 15 HH7)	5G NR FR1 FDD	5.90	+06%
40045		COND (DET & OEDM 4000 DD 40 MUL ODOV 45 MUL)		- 0.01 E 0F	
10945		DG NK (UFT-S-UFDM, 100% KB, 10 MHZ, QPSK, 15 KHZ)	DG NK FKT FDD	0.80	±9.0 %
10946	AAA	5G NR (DFT-s-OFDM, 100% RB, 15 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.83	± 9.6 %
10947	AAA	5G NR (DFT-s-OFDM, 100% RB, 20 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.87	±9.6 %
10948		5G NR (DET-s-OEDM 100% RB 25 MHz OPSK 15 kHz)	5G NR FR1 FDD	5.94	+9.6 %
10040	A A A	50 ND /DET & OEDM 100% PD 20 MUZ ODEV 15 HU-1		6.07	+0.6%
10949	AAA	1 30 NR (DETT-S-OFDW, 100% RD, 30 WITZ, QPSR, 15 KTZ)		0.0/	± 9.0 %
10950	AAA	5G NR (DET-S-OFDM, 100% RB, 40 MHz, QPSK, 15 kHz)	5G NK FR1 FDD	5.94	± 9.6 %
10951	AAA	5G NR (DFT-s-OFDM, 100% RB, 50 MHz, QPSK, 15 kHz)	5G NR FR1 FDD	5.92	± 9.6 %
10952	AAA	5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.25	± 9.6 %
10953	AAA	5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.15	+9.6%

10954	AAA	5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.23	±9.6 %
10955	AAA	5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.42	±9.6 %
10956	AAA	5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.14	±9.6 %
10957	AAA	5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.31	±9.6 %
10958	AAA	5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.61	±9.6 %
10959	AAA	5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.33	± 9.6 %
10960	AAA	5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.32	± 9.6 %
10961	AAA	5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.36	±9.6 %
10962	AAA	5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.40	±9.6 %
10963	AAA	5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.55	± 9.6 %
10964	AAA	5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.29	± 9.6 %
10965	AAA	5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.37	± 9.6 %
10966	AAA	5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.55	± 9.6 %
10967	AAA	5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.42	± 9.6 %
10968	AAA	5G NR DL (CP-OFDM, TM 3.1, 100 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.49	± 9.6 %

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