



SAR EVALUATION REPORT

Applicant Name:

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Date of Testing:

04/27/15 - 05/21/15

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

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FCC ID:

A3LSMT817A

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-T817A

Equipment Class	Band & Mode	Tx Frequency	SAR
			1 gm Body (W/kg)
PCB	UMTS 850	826.40 - 846.60 MHz	1.03
PCB	UMTS 1900	1852.4 - 1907.6 MHz	1.09
PCB	LTE Band 12	699.7 - 715.3 MHz	1.07
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	1.04
PCB	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	1.04
PCB	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	1.10
PCB	LTE Band 30	2307.5 - 2312.5 MHz	1.10
DTS	2.4 GHz WLAN	2412 - 2462 MHz	1.07
NII	U-NII-1	5180 - 5240 MHz	
NII	U-NII-2A	5260 - 5320 MHz	1.01
NII	U-NII-2C	5500 - 5720 MHz	0.94
NII	U-NII-3	5745 - 5825 MHz	0.88
DSS/DTS	Bluetooth	2402 - 2480 MHz	0.11
Simultaneous SAR per KDB 690783 D01v01r03:			1.56

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.


Randy Ortanez
President



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FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 1 of 89

T A B L E O F C O N T E N T S

1	DEVICE UNDER TEST	3
2	LTE INFORMATION	9
3	INTRODUCTION	11
4	DOSIMETRIC ASSESSMENT	12
5	SAR TESTING PROCEDURES	13
6	RF EXPOSURE LIMITS	14
7	FCC MEASUREMENT PROCEDURES.....	15
8	RF CONDUCTED POWERS.....	20
9	SYSTEM VERIFICATION.....	61
10	SAR DATA SUMMARY	63
11	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	70
12	SAR MEASUREMENT VARIABILITY	83
13	EQUIPMENT LIST	84
14	MEASUREMENT UNCERTAINTIES	85
15	CONCLUSION.....	87
16	REFERENCES	88
APPENDIX A: SAR TEST PLOTS		
APPENDIX B: SAR DIPOLE VERIFICATION PLOTS		
APPENDIX C: PROBE AND DIPOLE CALIBRATION CERTIFICATES		
APPENDIX D: SAR TISSUE SPECIFICATIONS		
APPENDIX E: SAR SYSTEM VALIDATION		
APPENDIX F: DUT ANTENNA DIAGRAM & SAR TEST SETUP PHOTOGRAPHS		
APPENDIX G: SENSOR TRIGGERING DATA SUMMARY		

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
		Page 2 of 89

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
UMTS 850	Data	826.40 - 846.60 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 30	Data	2307.5 - 2312.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
U-NII-1	Data	5180 - 5240 MHz
U-NII-2A	Data	5260 - 5320 MHz
U-NII-2C	Data	5500 - 5720 MHz
U-NII-3	Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses independent power reduction mechanisms for WLAN and PCB SAR compliance. The power reduction mechanisms are activated when the device is used in close proximity to the user's body.

Since the device is a full sized tablet, the Body SAR was evaluated per FCC KDB Publication 616217 D04 for full sized tablets.

1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Main Antenna Maximum Power

Mode / Band		Modulated Average (dBm)		
		3GPP RMC	3GPP HSDPA	3GPP HSUPA
		Rel 99	Rel 5	Rel 6
UMTS Band 5 (850 MHz)	Maximum	23.5	23.5	23.5
	Nominal	23.0	23.0	23.0
UMTS Band 2 (1900 MHz)	Maximum	22.5	22.5	22.5
	Nominal	22.0	22.0	22.0

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 3 of 89	

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	23.5
	Nominal	23.0
LTE Band 17	Maximum	23.5
	Nominal	23.0
LTE Band 5 (Cell)	Maximum	23.5
	Nominal	23.0
LTE Band 4 (AWS)	Maximum	23.5
	Nominal	23.0
LTE Band 2 (PCS)	Maximum	23.5
	Nominal	23.0
LTE Band 30	Maximum	22.5
	Nominal	22.0

Main Antenna Reduced Power – Body at 0.0 mm

Mode / Band		Modulated Average (dBm)		
		3GPP RMC	3GPP HSDPA	3GPP HSUPA
		Rel 99	Rel 5	Rel 6
UMTS Band 5 (850 MHz)	Maximum	17.0	17.0	17.0
	Nominal	16.5	16.5	16.5
UMTS Band 2 (1900 MHz)	Maximum	15.0	15.0	15.0
	Nominal	14.5	14.5	14.5

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	18.5
	Nominal	18.0
LTE Band 17	Maximum	18.5
	Nominal	18.0
LTE Band 5 (Cell)	Maximum	17.5
	Nominal	17.0
LTE Band 4 (AWS)	Maximum	14.5
	Nominal	14.0
LTE Band 2 (PCS)	Maximum	15.5
	Nominal	15.0
LTE Band 30	Maximum	11.0
	Nominal	10.5

WLAN/BT Maximum Power

Mode / Band		Modulated Average (dBm)		
		ANT 1	ANT 2	MIMO
IEEE 802.11b (2.4 GHz)	Maximum	17.5	17.5	
	Nominal	17.0	17.0	
IEEE 802.11g (2.4 GHz)	Maximum	15.5	15.5	
	Nominal	15.0	15.0	
IEEE 802.11n (2.4 GHz)	Maximum	14.5	14.5	17.5
	Nominal	14.0	14.0	17.0
Bluetooth	Maximum	10.0		
	Nominal	9.5		
Bluetooth LE	Maximum	5.5		
	Nominal	5.0		

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 4 of 89	

Mode / Band		Modulated Average (dBm)								
		20 MHz Bandwidth			40 MHz Bandwidth			80 MHz Bandwidth		
		ANT 1	ANT 2	MIMO	ANT 1	ANT 2	MIMO	ANT 1	ANT 2	MIMO
IEEE 802.11a (5 GHz)	Maximum	13.5	13.5							
	Nominal	13.0	13.0							
IEEE 802.11n (5 GHz)	Maximum	13.5	13.5	16.5	12.5	12.5	15.5			
	Nominal	13.0	13.0	16.0	12.0	12.0	15.0			
IEEE 802.11ac (5 GHz)	Maximum	13.5	13.5	16.5	12.5	12.5	15.5	11.5	11.5	14.5
	Nominal	13.0	13.0	16.0	12.0	12.0	15.0	11.0	11.0	14.0

WLAN Reduced Power at 0.0 mm

Mode / Band		Modulated Average (dBm)		
		ANT 1	ANT 2	MIMO
IEEE 802.11b (2.4 GHz)	Maximum	14.5	12.5	
	Nominal	14.0	12.0	
IEEE 802.11g (2.4 GHz)	Maximum	14.5	12.5	
	Nominal	14.0	12.0	
IEEE 802.11n (2.4 GHz)	Maximum	14.5	12.5	16.5
	Nominal	14.0	12.0	16.0

Mode / Band		Modulated Average (dBm)								
		20 MHz Bandwidth			40 MHz Bandwidth			80 MHz Bandwidth		
		ANT 1	ANT 2	MIMO	ANT 1	ANT 2	MIMO	ANT 1	ANT 2	MIMO
IEEE 802.11a (5 GHz)	Maximum	8.5	7.5							
	Nominal	8.0	7.0							
IEEE 802.11n (5 GHz)	Maximum	8.5	7.5	10.5	8.5	7.5	10.5			
	Nominal	8.0	7.0	10.0	8.0	7.0	10.0			
IEEE 802.11ac (5 GHz)	Maximum	8.5	7.5	10.5	8.5	7.5	10.5	8.5	7.5	10.5
	Nominal	8.0	7.0	10.0	8.0	7.0	10.0	8.0	7.0	10.0

1.4 DUT Antenna Locations

The overall diagonal dimension of the device is > 200 mm. A diagram showing the locations of the device antennas can be found in Appendix F: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.

Table 1-1
Sides for SAR Testing

Mode	Back	Top	Bottom	Right	Left
UMTS 850	Yes	Yes	No	Yes	Yes
UMTS 1900	Yes	Yes	No	Yes	Yes
LTE Band 12	Yes	Yes	No	Yes	Yes
LTE Band 4 (Cell)	Yes	Yes	No	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	Yes
LTE Band 30	Yes	Yes	No	Yes	No
2.4 GHz WLAN	Yes	Yes	Yes	Yes	Yes
2.4 GHz Bluetooth	Yes	No	Yes	Yes	Yes
5.8 GHz WLAN	Yes	Yes	Yes	Yes	Yes

Note:

1. Per FCC KDB 616217 D04v01r01, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v05r01.
2. Per the Manufacturers request top and left edge were tested for WLAN antenna 1, top edge for WLAN antenna 2 and left edge for BT

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 5 of 89	

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



Figure 1-1
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05 3) procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body
1	UMTS + 2.4 GHz WI-FI	Yes
2	UMTS + 5 GHz WI-FI	Yes
3	UMTS + 2.4 GHz Bluetooth	Yes
4	LTE + 2.4 GHz WI-FI	Yes
5	LTE + 5 GHz WI-FI	Yes
6	LTE + 2.4 GHz Bluetooth	Yes

1. 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.
3. This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 6 of 89

1.6 Miscellaneous SAR Test Considerations

(A) WIFI

This device supports IEEE 802.11ac with the following features:

- a) Up to 80 MHz Bandwidth only
- b) No aggregate channel configurations
- c) 2 Tx antenna output
- d) 256 QAM is supported
- e) Band gap channels are supported

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB 248227 D01Wi-Fi SAR v02.

(B) Licensed Transmitter(s)

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v03.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r03.

This device supports both LTE Band 12 and LTE Band 17. Since the supported frequency span for LTE Band 17 falls completely within the supported frequency span for LTE Band 12, LTE Band 17 has the same or lower target power as LTE Band 12, and both LTE bands share the same transmission path, SAR was only assessed for LTE Band 12.

This device supports inter-band LTE Carrier Aggregation (CA) in the downlink only. All uplink communications are identical to Release 8 specifications. Per FCC KDB Publication 941225 D05A v01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 7 of 89

1.7 Guidance Applied

- FCC KDB Publication 941225 D01v03, D05v02r03, D05Av01r01 (3G/4G)
- FCC KDB Publication 248227 D01Wi-Fi SAR v02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01r01 (Tablet SAR Considerations)

1.8 Device Serial Numbers

Several samples were used with identical hardware to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.

	Max Power Serial Number	Reduced Power Serial Number
UMTS 850	8026	6798
UMTS 1900	8026	6798
LTE Band 12	7318	8134
LTE Band 5 (Cell)	7598	8117
LTE Band 4 (AWS)	7598	6947
LTE Band 2 (PCS)	7598	6947
LTE Band 30	7318	5650
2.4 GHz WLAN	6905	7937
5 GHz WLAN	6905	7937
Bluetooth	6905	-

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 8 of 89	

2

LTE INFORMATION

LTE Information			
FCC ID	A3LSMT817A		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
	LTE Band 30 (2307.5 - 2312.5 MHz)		
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 17: 5MHz, 10 MHz		
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 30: 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 12: 1.4 MHz	699.7 (23017)	707.5 (23095)	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	707.5 (23095)	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
LTE Band 30: 5 MHz	2307.5 (27685)	2310 (27710)	2312.5 (27735)
LTE Band 30: 10 MHz	N/A	2310 (27710)	N/A
UE Category	6		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for	YES		
LTE Carrier Aggregation Possible Combinations	Please see next page for LTE Carrier Aggregation Possible Combinations.		
LTE Carrier Aggregation Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICI, WIFI Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 9 of 89	

LTE B12(PCC) + LTE B2(SCC)	LTE B12(PCC) + LTE B30(SCC)	LTE B17(PCC) + LTE B2(SCC)	B5(PCC) + B4(SCC)	B5(PCC) + B2(SCC)	B5(PCC) + B30(SCC)	B4(PCC) + B12(SCC)
3MHz (B12) + 5MHz (B2)	5MHz (B12) + 5MHz (B30)	5MHz (B17) + 5MHz (B2)	5MHz (B5) + 5MHz (B4)	5MHz (B5) + 5MHz (B2)	5MHz (B5) + 5MHz (B30)	1.4MHz (B4) + 3MHz (B12)
3MHz (B12) + 10MHz (B2)	5MHz (B12) + 10MHz (B30)	5MHz (B17) + 10MHz (B2)	5MHz (B5) + 10MHz (B4)	5MHz (B5) + 10MHz (B2)	5MHz (B5) + 10MHz (B30)	1.4MHz (B4) + 5MHz (B12)
3MHz (B12) + 15MHz (B2)	10MHz (B12) + 5MHz (B30)	10MHz (B17) + 5MHz (B2)	5MHz (B5) + 15MHz (B4)	5MHz (B5) + 15MHz (B2)	10MHz (B5) + 5MHz (B30)	1.4MHz (B4) + 10MHz (B12)
3MHz (B12) + 20MHz (B2)	10MHz (B12) + 10MHz (B30)	10MHz (B17) + 10MHz (B2)	5MHz (B5) + 20MHz (B4)	5MHz (B5) + 20MHz (B2)	10MHz (B5) + 10MHz (B30)	3MHz (B4) + 3MHz (B12)
5MHz (B12) + 5MHz (B2)			10MHz (B5) + 5MHz (B4)	10MHz (B5) + 5MHz (B2)		3MHz (B4) + 5MHz (B12)
5MHz (B12) + 10MHz (B2)			10MHz (B5) + 10MHz (B4)	10MHz (B5) + 10MHz (B2)		3MHz (B4) + 10MHz (B12)
5MHz (B12) + 15MHz (B2)			10MHz (B5) + 15MHz (B4)	10MHz (B5) + 15MHz (B2)		5MHz (B4) + 3MHz (B12)
5MHz (B12) + 20MHz (B2)			10MHz (B5) + 20MHz (B4)	10MHz (B5) + 20MHz (B2)		5MHz (B4) + 5MHz (B12)
10MHz (B12) + 5MHz (B2)						5MHz (B4) + 10MHz (B12)
10MHz (B12) + 10MHz (B2)						10MHz (B4) + 3MHz (B12)
10MHz (B12) + 15MHz (B2)						10MHz (B4) + 5MHz (B12)
10MHz (B12) + 20MHz (B2)						10MHz (B4) + 10MHz (B12)
						15MHz (B4) + 3MHz (B12)
						15MHz (B4) + 5MHz (B12)
						15MHz (B4) + 10MHz (B12)
						20MHz (B4) + 3MHz (B12)
						20MHz (B4) + 5MHz (B12)
						20MHz (B4) + 10MHz (B12)
B4(PCC) + B17(SCC)	B4(PCC) + B29(SCC)	B4(PCC) + B5(SCC)	B4(PCC) + B30(SCC)	B2(PCC) + B12(SCC)	B2(PCC) + B17(SCC)	B2(PCC) + B29(SCC)
5MHz (B4) + 5MHz (B17)	5MHz (B4) + 3MHz (B29)	5MHz (B4) + 5MHz (B5)	5MHz (B4) + 5MHz (B30)	5MHz (B2) + 3MHz (B12)	5MHz (B2) + 5MHz (B17)	5MHz (B2) + 3MHz (B29)
5MHz (B4) + 10MHz (B17)	5MHz (B4) + 5MHz (B29)	5MHz (B4) + 10MHz (B5)	5MHz (B4) + 10MHz (B30)	5MHz (B2) + 5MHz (B12)	5MHz (B2) + 10MHz (B17)	5MHz (B2) + 5MHz (B29)
10MHz (B4) + 5MHz (B17)	5MHz (B4) + 10MHz (B29)	10MHz (B4) + 5MHz (B5)	10MHz (B4) + 5MHz (B30)	5MHz (B2) + 10MHz (B12)	10MHz (B2) + 5MHz (B17)	5MHz (B2) + 10MHz (B29)
10MHz (B4) + 10MHz (B17)	10MHz (B4) + 3MHz (B29)	10MHz (B4) + 10MHz (B5)	10MHz (B4) + 10MHz (B30)	10MHz (B2) + 3MHz (B12)	10MHz (B2) + 10MHz (B17)	10MHz (B2) + 3MHz (B29)
	10MHz (B4) + 5MHz (B29)	15MHz (B4) + 5MHz (B5)	15MHz (B4) + 5MHz (B30)	10MHz (B2) + 5MHz (B12)		10MHz (B2) + 5MHz (B29)
	10MHz (B4) + 10MHz (B29)	15MHz (B4) + 10MHz (B5)	15MHz (B4) + 10MHz (B30)	10MHz (B2) + 10MHz (B12)		10MHz (B2) + 10MHz (B29)
	15MHz (B4) + 3MHz (B29)	20MHz (B4) + 5MHz (B5)	20MHz (B4) + 5MHz (B30)	15MHz (B2) + 3MHz (B12)		15MHz (B2) + 3MHz (B29)
	15MHz (B4) + 5MHz (B29)	20MHz (B4) + 10MHz (B5)	20MHz (B4) + 10MHz (B30)	15MHz (B2) + 5MHz (B12)		15MHz (B2) + 5MHz (B29)
	15MHz (B4) + 10MHz (B29)			15MHz (B2) + 10MHz (B12)		15MHz (B2) + 10MHz (B29)
	20MHz (B4) + 3MHz (B29)			20MHz (B2) + 3MHz (B12)		20MHz (B2) + 3MHz (B29)
	20MHz (B4) + 5MHz (B29)			20MHz (B2) + 5MHz (B12)		20MHz (B2) + 5MHz (B29)
	20MHz (B4) + 10MHz (B29)			20MHz (B2) + 10MHz (B12)		20MHz (B2) + 10MHz (B29)
B2(PCC) + B5(SCC)	B2(PCC) + B30(SCC)	B30(PCC) + B12(SCC)	B30(PCC) + B29(SCC)	B30(PCC) + B5(SCC)	B30(PCC) + B4(SCC)	B30(PCC) + B2(SCC)
5MHz (B2) + 5MHz (B5)	5MHz (B2) + 5MHz (B30)	5MHz (B30) + 5MHz (B12)	5MHz (B30) + 5MHz (B29)	5MHz (B30) + 5MHz (B5)	5MHz (B30) + 5MHz (B4)	5MHz (B30) + 5MHz (B2)
5MHz (B2) + 10MHz (B5)	5MHz (B2) + 10MHz (B30)	5MHz (B30) + 10MHz (B12)	5MHz (B30) + 10MHz (B29)	5MHz (B30) + 10MHz (B5)	5MHz (B30) + 10MHz (B4)	5MHz (B30) + 10MHz (B2)
10MHz (B2) + 5MHz (B5)	10MHz (B2) + 5MHz (B30)	10MHz (B30) + 5MHz (B12)	10MHz (B30) + 5MHz (B29)	10MHz (B30) + 5MHz (B5)	5MHz (B30) + 15MHz (B4)	5MHz (B30) + 15MHz (B2)
10MHz (B2) + 10MHz (B5)	10MHz (B2) + 10MHz (B30)	10MHz (B30) + 10MHz (B12)	10MHz (B30) + 10MHz (B29)	10MHz (B30) + 10MHz (B5)	5MHz (B30) + 20MHz (B4)	5MHz (B30) + 20MHz (B2)
15MHz (B2) + 5MHz (B5)	15MHz (B2) + 5MHz (B30)				10MHz (B30) + 5MHz (B4)	10MHz (B30) + 5MHz (B2)
15MHz (B2) + 10MHz (B5)	15MHz (B2) + 10MHz (B30)				10MHz (B30) + 10MHz (B4)	10MHz (B30) + 10MHz (B2)
20MHz (B2) + 5MHz (B5)	20MHz (B2) + 5MHz (B30)				10MHz (B30) + 15MHz (B4)	10MHz (B30) + 15MHz (B2)
20MHz (B2) + 10MHz (B5)	20MHz (B2) + 10MHz (B30)				10MHz (B30) + 20MHz (B4)	10MHz (B30) + 20MHz (B2)

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 10 of 89

3 INTRODUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,” Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

Equation 3-1
SAR Mathematical Equation

$$SAR = \frac{d}{dt} \left(\frac{dU}{dm} \right) = \frac{d}{dt} \left(\frac{dU}{\rho dv} \right)$$

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m³)
- E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 11 of 89

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
 - a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

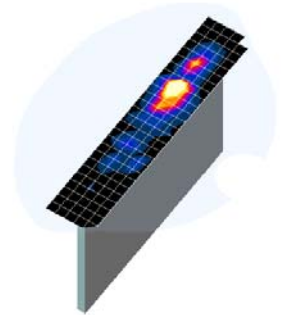


Figure 4-1
Sample SAR Area
Scan

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01*

Frequency	Maximum Area Scan Resolution (mm) ($\Delta x_{\text{area}}, \Delta y_{\text{area}}$)	Maximum Zoom Scan Resolution (mm) ($\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$)	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
				$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)^*$	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

FCC ID: A3LSMT817A		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet			Page 12 of 89

5 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v05 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.2 Proximity Sensor Considerations

This device uses independent proximity sensors to reduce data powers in tablet-device use conditions for both PCB and WLAN operations.

While the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum output power allowed. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the sensor activation distance for the back side and top edge of the device is 25 mm, a conservative distance of 24 mm was tested for SAR on the back side and top edge at maximum power for UMTS and LTE. Since the sensor activation distance for the back side of the device is 5 mm, a conservative distance of 4 mm was tested for SAR on the back side at maximum power for WLAN. Sensor triggering distance summary data is included in Appendix G. The sensor does not trigger power reduction from the front of the device.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antenna.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 13 of 89

6 RF EXPOSURE LIMITS

6.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

6.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 6-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 14 of 89

7 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

7.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is ≤ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is ≤ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

7.3 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03 "3G SAR Measurement Procedures."

The device is placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a "point SAR" at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

7.4 SAR Measurement Conditions for UMTS

7.4.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC with TPC (transmit power control) set to all "1s" or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 15 of 89

7.4.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all “1s”. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCH_n configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or DPDCH_n, for the highest reported SAR configuration in 12.2 kbps RMC.

7.4.3 SAR Measurements with Rel 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

7.4.4 SAR Measurements with Rel 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA.

When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing.

7.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r03 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

7.5.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

7.5.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

7.5.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 16 of 89

7.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r03:

- a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
 - i. The required channel and offset combination with the highest maximum output power is required for SAR.
 - ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
 - iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
- b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
- d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to $\frac{1}{2}$ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

7.5.5 Downlink Carrier Aggregation

LTE Carrier Aggregation (CA) measurements are made in accordance to 3GPP TS 36.521-1 V10.4.0 (2012-12). The RRC connection is only handled by one cell, the Primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds the Secondary component carrier (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. Additional output powers are measured using two carriers in the downlink for the release 8 configurations with the highest output power among all channels, RB configurations and bandwidths for each uplink band. Per FCC KDB Publication 941225 D05A v01r01, no SAR measurements are required when the average output power with downlink carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink carrier aggregation inactive.

7.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01Wi-Fi SAR v02 for more details.

7.6.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 17 of 89

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

7.6.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

7.6.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

7.6.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

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

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

7.6.5 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations;

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 18 of 89

for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

7.6.6 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 7.6.5).

7.6.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

7.6.8 MIMO SAR considerations

Per KDB 248227 D01 Wi-Fi SAR v02, the simultaneous SAR provisions in KDB Publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 19 of 89

8.1 UMTS Conducted Powers

Table 8-1
Maximum Average RF Output Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.76	22.68	22.63	22.17	22.05	22.01	-
6	HSDPA	Subtest 1	23.20	23.10	22.47	21.79	22.20	22.10	0
6		Subtest 2	23.19	22.92	22.37	21.62	22.08	21.93	0
6		Subtest 3	22.62	22.58	22.04	21.48	21.83	21.63	0.5
6		Subtest 4	22.37	22.32	21.79	21.48	21.83	21.67	0.5
6	HSUPA	Subtest 1	22.87	22.82	22.26	20.87	21.20	21.11	0
6		Subtest 2	21.95	21.82	21.41	20.52	20.94	20.82	2
6		Subtest 3	22.61	22.55	22.05	20.80	21.15	21.04	1
6		Subtest 4	21.79	21.72	21.46	19.79	20.19	20.01	2
6		Subtest 5	22.61	22.55	21.86	20.69	20.92	20.88	0

Table 8-2
Reduced Average RF Output Powers – Body at 0.0 cm

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	16.96	16.94	16.84	14.68	14.88	14.96	-
6	HSDPA	Subtest 1	16.88	16.83	17.00	14.81	15.00	14.91	0
6		Subtest 2	16.73	16.70	16.90	14.71	14.96	15.00	0
6		Subtest 3	16.85	16.64	16.85	14.72	14.97	14.93	0.5
6		Subtest 4	16.83	16.70	16.91	14.59	14.96	14.92	0.5
6	HSUPA	Subtest 1	15.62	15.51	15.63	14.01	14.21	14.07	0
6		Subtest 2	16.77	16.59	16.78	14.52	14.92	14.87	2
6		Subtest 3	16.19	16.05	16.24	14.67	15.00	14.97	1
6		Subtest 4	16.72	16.53	16.75	14.55	14.93	14.82	2
6		Subtest 5	15.65	15.54	15.69	14.62	14.96	14.93	0

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.



Figure 8-1
Power Measurement Setup

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 20 of 89	

8.2 LTE Conducted Powers

8.2.1 LTE Band 12

Table 8-3
LTE Band 12 Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	23.30	0	0
	707.5	23095	10	QPSK	1	25	23.33	0	0
	707.5	23095	10	QPSK	1	49	23.26	0	0
	707.5	23095	10	QPSK	25	0	22.04	0-1	1
	707.5	23095	10	QPSK	25	12	21.92	0-1	1
	707.5	23095	10	QPSK	25	25	21.85	0-1	1
	707.5	23095	10	QPSK	50	0	21.99	0-1	1
	707.5	23095	10	16QAM	1	0	22.30	0-1	1
	707.5	23095	10	16QAM	1	25	22.45	0-1	1
	707.5	23095	10	16QAM	1	49	22.33	0-1	1
	707.5	23095	10	16QAM	25	0	21.00	0-2	2
	707.5	23095	10	16QAM	25	12	20.89	0-2	2
	707.5	23095	10	16QAM	25	25	20.91	0-2	2
	707.5	23095	10	16QAM	50	0	20.96	0-2	2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-4
LTE Band 12 Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	23.48	0	0
	701.5	23035	5	QPSK	1	12	23.50	0	0
	701.5	23035	5	QPSK	1	24	23.48	0	0
	701.5	23035	5	QPSK	12	0	22.17	0-1	1
	701.5	23035	5	QPSK	12	6	22.18	0-1	1
	701.5	23035	5	QPSK	12	13	22.19	0-1	1
	701.5	23035	5	QPSK	25	0	22.13	0-1	1
	701.5	23035	5	16-QAM	1	0	22.42	0-1	1
	701.5	23035	5	16-QAM	1	12	22.40	0-1	1
	701.5	23035	5	16-QAM	1	24	22.44	0-1	1
	701.5	23035	5	16-QAM	12	0	21.06	0-2	2
	701.5	23035	5	16-QAM	12	6	21.11	0-2	2
	701.5	23035	5	16-QAM	12	13	21.10	0-2	2
	701.5	23035	5	16-QAM	25	0	21.14	0-2	2
Mid	707.5	23095	5	QPSK	1	0	23.08	0	0
	707.5	23095	5	QPSK	1	12	23.04	0	0
	707.5	23095	5	QPSK	1	24	23.03	0	0
	707.5	23095	5	QPSK	12	0	21.98	0-1	1
	707.5	23095	5	QPSK	12	6	21.93	0-1	1
	707.5	23095	5	QPSK	12	13	21.88	0-1	1
	707.5	23095	5	QPSK	25	0	21.91	0-1	1
	707.5	23095	5	16-QAM	1	0	22.24	0-1	1
	707.5	23095	5	16-QAM	1	12	22.26	0-1	1
	707.5	23095	5	16-QAM	1	24	22.31	0-1	1
	707.5	23095	5	16-QAM	12	0	20.89	0-2	2
	707.5	23095	5	16-QAM	12	6	20.85	0-2	2
	707.5	23095	5	16-QAM	12	13	20.89	0-2	2
	707.5	23095	5	16-QAM	25	0	20.92	0-2	2
High	713.5	23155	5	QPSK	1	0	23.38	0	0
	713.5	23155	5	QPSK	1	12	23.21	0	0
	713.5	23155	5	QPSK	1	24	23.31	0	0
	713.5	23155	5	QPSK	12	0	21.96	0-1	1
	713.5	23155	5	QPSK	12	6	21.84	0-1	1
	713.5	23155	5	QPSK	12	13	21.89	0-1	1
	713.5	23155	5	QPSK	25	0	21.90	0-1	1
	713.5	23155	5	16-QAM	1	0	22.38	0-1	1
	713.5	23155	5	16-QAM	1	12	22.37	0-1	1
	713.5	23155	5	16-QAM	1	24	22.34	0-1	1
	713.5	23155	5	16-QAM	12	0	20.84	0-2	2
	713.5	23155	5	16-QAM	12	6	20.81	0-2	2
	713.5	23155	5	16-QAM	12	13	20.77	0-2	2
	713.5	23155	5	16-QAM	25	0	20.79	0-2	2

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 21 of 89

Table 8-5
LTE Band 12 Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	700.5	23025	3	QPSK	1	0	23.49	0	0
	700.5	23025	3	QPSK	1	7	23.48	0	0
	700.5	23025	3	QPSK	1	14	23.50	0	0
	700.5	23025	3	QPSK	8	0	22.11	0-1	1
	700.5	23025	3	QPSK	8	4	22.20	0-1	1
	700.5	23025	3	QPSK	8	7	22.21	0-1	1
	700.5	23025	3	QPSK	15	0	22.11	0-1	1
	700.5	23025	3	16-QAM	1	0	22.47	0-1	1
	700.5	23025	3	16-QAM	1	7	22.49	0-1	1
	700.5	23025	3	16-QAM	1	14	22.50	0-1	1
	700.5	23025	3	16-QAM	8	0	21.10	0-2	2
	700.5	23025	3	16-QAM	8	4	21.16	0-2	2
	700.5	23025	3	16-QAM	8	7	21.14	0-2	2
	700.5	23025	3	16-QAM	15	0	20.98	0-2	2
Mid	707.5	23095	3	QPSK	1	0	23.32	0	0
	707.5	23095	3	QPSK	1	7	23.26	0	0
	707.5	23095	3	QPSK	1	14	23.30	0	0
	707.5	23095	3	QPSK	8	0	21.95	0-1	1
	707.5	23095	3	QPSK	8	4	21.89	0-1	1
	707.5	23095	3	QPSK	8	7	21.86	0-1	1
	707.5	23095	3	QPSK	15	0	21.97	0-1	1
	707.5	23095	3	16-QAM	1	0	22.18	0-1	1
	707.5	23095	3	16-QAM	1	7	22.08	0-1	1
	707.5	23095	3	16-QAM	1	14	22.06	0-1	1
	707.5	23095	3	16-QAM	8	0	20.90	0-2	2
	707.5	23095	3	16-QAM	8	4	20.87	0-2	2
	707.5	23095	3	16-QAM	8	7	20.83	0-2	2
	707.5	23095	3	16-QAM	15	0	20.97	0-2	2
High	714.5	23165	3	QPSK	1	0	23.35	0	0
	714.5	23165	3	QPSK	1	7	23.35	0	0
	714.5	23165	3	QPSK	1	14	23.22	0	0
	714.5	23165	3	QPSK	8	0	21.76	0-1	1
	714.5	23165	3	QPSK	8	4	21.85	0-1	1
	714.5	23165	3	QPSK	8	7	21.83	0-1	1
	714.5	23165	3	QPSK	15	0	21.84	0-1	1
	714.5	23165	3	16-QAM	1	0	22.28	0-1	1
	714.5	23165	3	16-QAM	1	7	22.29	0-1	1
	714.5	23165	3	16-QAM	1	14	22.33	0-1	1
	714.5	23165	3	16-QAM	8	0	20.61	0-2	2
	714.5	23165	3	16-QAM	8	4	20.70	0-2	2
	714.5	23165	3	16-QAM	8	7	20.65	0-2	2
	714.5	23165	3	16-QAM	15	0	20.71	0-2	2

Table 8-6
LTE Band 12 Conducted Powers - 1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	699.7	23017	1.4	QPSK	1	0	23.48	0	0
	699.7	23017	1.4	QPSK	1	2	23.47	0	0
	699.7	23017	1.4	QPSK	1	5	23.50	0	0
	699.7	23017	1.4	QPSK	3	0	23.31	0	0
	699.7	23017	1.4	QPSK	3	2	23.34	0	0
	699.7	23017	1.4	QPSK	3	3	23.38	0	0
	699.7	23017	1.4	QPSK	6	0	22.18	0-1	1
	699.7	23017	1.4	16-QAM	1	0	22.49	0-1	1
	699.7	23017	1.4	16-QAM	1	2	22.50	0-1	1
	699.7	23017	1.4	16-QAM	1	5	22.49	0-1	1
	699.7	23017	1.4	16-QAM	3	0	22.06	0-1	1
	699.7	23017	1.4	16-QAM	3	2	22.21	0-1	1
Mid	699.7	23017	1.4	16-QAM	3	3	22.13	0-1	1
	699.7	23017	1.4	16-QAM	6	0	21.12	0-2	2
	707.5	23095	1.4	QPSK	1	0	23.23	0	0
	707.5	23095	1.4	QPSK	1	2	23.24	0	0
	707.5	23095	1.4	QPSK	1	5	23.30	0	0
	707.5	23095	1.4	QPSK	3	0	23.10	0	0
	707.5	23095	1.4	QPSK	3	2	23.08	0	0
	707.5	23095	1.4	QPSK	3	3	22.99	0	0
	707.5	23095	1.4	QPSK	6	0	21.98	0-1	1
	707.5	23095	1.4	16-QAM	1	0	22.25	0-1	1
	707.5	23095	1.4	16-QAM	1	2	22.24	0-1	1
	707.5	23095	1.4	16-QAM	1	5	22.27	0-1	1
High	707.5	23095	1.4	16-QAM	3	0	22.05	0-1	1
	707.5	23095	1.4	16-QAM	3	2	22.01	0-1	1
	707.5	23095	1.4	16-QAM	3	3	22.03	0-1	1
	707.5	23095	1.4	16-QAM	6	0	20.80	0-2	2
	715.3	23173	1.4	QPSK	1	0	23.28	0	0
	715.3	23173	1.4	QPSK	1	2	23.26	0	0
	715.3	23173	1.4	QPSK	1	5	23.22	0	0
	715.3	23173	1.4	QPSK	3	0	23.06	0	0
	715.3	23173	1.4	QPSK	3	2	23.04	0	0
	715.3	23173	1.4	QPSK	3	3	22.98	0	0
	715.3	23173	1.4	QPSK	6	0	21.93	0-1	1
	715.3	23173	1.4	16-QAM	1	0	22.36	0-1	1
	715.3	23173	1.4	16-QAM	1	2	22.40	0-1	1
	715.3	23173	1.4	16-QAM	1	5	22.39	0-1	1
	715.3	23173	1.4	16-QAM	3	0	22.18	0-1	1
	715.3	23173	1.4	16-QAM	3	2	22.10	0-1	1
	715.3	23173	1.4	16-QAM	3	3	22.00	0-1	1
	715.3	23173	1.4	16-QAM	6	0	20.71	0-2	2

Table 8-7
LTE Band 12 Conducted Powers - 10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	17.61	0	0
	707.5	23095	10	QPSK	1	25	17.60	0	0
	707.5	23095	10	QPSK	1	49	17.65	0	0
	707.5	23095	10	QPSK	25	0	16.38	0-1	1
	707.5	23095	10	QPSK	25	12	16.45	0-1	1
	707.5	23095	10	QPSK	25	25	16.34	0-1	1
	707.5	23095	10	QPSK	50	0	16.36	0-1	1
	707.5	23095	10	16QAM	1	0	16.77	0-1	1
	707.5	23095	10	16QAM	1	25	16.71	0-1	1
	707.5	23095	10	16QAM	1	49	16.75	0-1	1
	707.5	23095	10	16QAM	25	0	15.34	0-2	2
	707.5	23095	10	16QAM	25	12	15.42	0-2	2
	707.5	23095	10	16QAM	25	25	15.40	0-2	2
	707.5	23095	10	16QAM	50	0	15.45	0-2	2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 23 of 89		

Table 8-8
LTE Band 12 Conducted Powers - 5 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	17.77	0	0
	701.5	23035	5	QPSK	1	12	17.64	0	0
	701.5	23035	5	QPSK	1	24	17.74	0	0
	701.5	23035	5	QPSK	12	0	16.64	0-1	1
	701.5	23035	5	QPSK	12	6	16.64	0-1	1
	701.5	23035	5	QPSK	12	13	16.69	0-1	1
	701.5	23035	5	QPSK	25	0	16.63	0-1	1
	701.5	23035	5	16-QAM	1	0	16.81	0-1	1
	701.5	23035	5	16-QAM	1	12	16.86	0-1	1
	701.5	23035	5	16-QAM	1	24	16.86	0-1	1
	701.5	23035	5	16-QAM	12	0	15.50	0-2	2
	701.5	23035	5	16-QAM	12	6	15.52	0-2	2
	701.5	23035	5	16-QAM	12	13	15.55	0-2	2
	701.5	23035	5	16-QAM	25	0	15.61	0-2	2
Mid	707.5	23095	5	QPSK	1	0	17.70	0	0
	707.5	23095	5	QPSK	1	12	17.62	0	0
	707.5	23095	5	QPSK	1	24	17.71	0	0
	707.5	23095	5	QPSK	12	0	16.37	0-1	1
	707.5	23095	5	QPSK	12	6	16.35	0-1	1
	707.5	23095	5	QPSK	12	13	16.36	0-1	1
	707.5	23095	5	QPSK	25	0	16.33	0-1	1
	707.5	23095	5	16-QAM	1	0	16.71	0-1	1
	707.5	23095	5	16-QAM	1	12	16.63	0-1	1
	707.5	23095	5	16-QAM	1	24	16.61	0-1	1
	707.5	23095	5	16-QAM	12	0	15.36	0-2	2
	707.5	23095	5	16-QAM	12	6	15.34	0-2	2
	707.5	23095	5	16-QAM	12	13	15.38	0-2	2
	707.5	23095	5	16-QAM	25	0	15.48	0-2	2
High	713.5	23155	5	QPSK	1	0	17.77	0	0
	713.5	23155	5	QPSK	1	12	17.64	0	0
	713.5	23155	5	QPSK	1	24	17.73	0	0
	713.5	23155	5	QPSK	12	0	16.63	0-1	1
	713.5	23155	5	QPSK	12	6	16.54	0-1	1
	713.5	23155	5	QPSK	12	13	16.68	0-1	1
	713.5	23155	5	QPSK	25	0	16.52	0-1	1
	713.5	23155	5	16-QAM	1	0	16.82	0-1	1
	713.5	23155	5	16-QAM	1	12	16.86	0-1	1
	713.5	23155	5	16-QAM	1	24	16.85	0-1	1
	713.5	23155	5	16-QAM	12	0	15.50	0-2	2
	713.5	23155	5	16-QAM	12	6	15.51	0-2	2
	713.5	23155	5	16-QAM	12	13	15.55	0-2	2
	713.5	23155	5	16-QAM	25	0	15.61	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 24 of 89		

Table 8-9
LTE Band 12 Conducted Powers - 3 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	700.5	23025	3	QPSK	1	0	18.04	0	0
	700.5	23025	3	QPSK	1	7	17.93	0	0
	700.5	23025	3	QPSK	1	14	18.06	0	0
	700.5	23025	3	QPSK	8	0	16.66	0-1	1
	700.5	23025	3	QPSK	8	4	16.74	0-1	1
	700.5	23025	3	QPSK	8	7	16.72	0-1	1
	700.5	23025	3	QPSK	15	0	16.73	0-1	1
	700.5	23025	3	16-QAM	1	0	17.06	0-1	1
	700.5	23025	3	16-QAM	1	7	17.00	0-1	1
	700.5	23025	3	16-QAM	1	14	16.99	0-1	1
	700.5	23025	3	16-QAM	8	0	15.68	0-2	2
	700.5	23025	3	16-QAM	8	4	15.76	0-2	2
	700.5	23025	3	16-QAM	8	7	15.75	0-2	2
	700.5	23025	3	16-QAM	15	0	15.75	0-2	2
	707.5	23095	3	QPSK	1	0	17.76	0	0
Mid	707.5	23095	3	QPSK	1	7	17.77	0	0
	707.5	23095	3	QPSK	1	14	17.82	0	0
	707.5	23095	3	QPSK	8	0	16.51	0-1	1
	707.5	23095	3	QPSK	8	4	16.37	0-1	1
	707.5	23095	3	QPSK	8	7	16.42	0-1	1
	707.5	23095	3	QPSK	15	0	16.47	0-1	1
	707.5	23095	3	16-QAM	1	0	16.85	0-1	1
	707.5	23095	3	16-QAM	1	7	16.62	0-1	1
	707.5	23095	3	16-QAM	1	14	16.66	0-1	1
	707.5	23095	3	16-QAM	8	0	15.44	0-2	2
	707.5	23095	3	16-QAM	8	4	15.38	0-2	2
	707.5	23095	3	16-QAM	8	7	15.37	0-2	2
	707.5	23095	3	16-QAM	15	0	15.52	0-2	2
	714.5	23165	3	QPSK	1	0	17.69	0	0
	714.5	23165	3	QPSK	1	7	17.59	0	0
High	714.5	23165	3	QPSK	1	14	17.70	0	0
	714.5	23165	3	QPSK	8	0	16.43	0-1	1
	714.5	23165	3	QPSK	8	4	16.40	0-1	1
	714.5	23165	3	QPSK	8	7	16.44	0-1	1
	714.5	23165	3	QPSK	15	0	16.38	0-1	1
	714.5	23165	3	16-QAM	1	0	16.64	0-1	1
	714.5	23165	3	16-QAM	1	7	16.58	0-1	1
	714.5	23165	3	16-QAM	1	14	16.56	0-1	1
	714.5	23165	3	16-QAM	8	0	15.32	0-2	2
	714.5	23165	3	16-QAM	8	4	15.32	0-2	2
	714.5	23165	3	16-QAM	8	7	15.36	0-2	2
	714.5	23165	3	16-QAM	15	0	15.38	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 25 of 89		

Table 8-10
LTE Band 12 Conducted Powers - 1.4 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	699.7	23017	1.4	QPSK	1	0	17.84	0	0
	699.7	23017	1.4	QPSK	1	2	17.88	0	0
	699.7	23017	1.4	QPSK	1	5	17.87	0	0
	699.7	23017	1.4	QPSK	3	0	17.72	0	0
	699.7	23017	1.4	QPSK	3	2	17.78	0	0
	699.7	23017	1.4	QPSK	3	3	17.79	0	0
	699.7	23017	1.4	QPSK	6	0	16.72	0-1	1
	699.7	23017	1.4	16-QAM	1	0	17.00	0-1	1
	699.7	23017	1.4	16-QAM	1	2	17.10	0-1	1
	699.7	23017	1.4	16-QAM	1	5	17.19	0-1	1
	699.7	23017	1.4	16-QAM	3	0	16.51	0-1	1
	699.7	23017	1.4	16-QAM	3	2	16.60	0-1	1
	699.7	23017	1.4	16-QAM	3	3	16.57	0-1	1
	699.7	23017	1.4	16-QAM	6	0	15.53	0-2	2
Mid	707.5	23095	1.4	QPSK	1	0	17.76	0	0
	707.5	23095	1.4	QPSK	1	2	17.69	0	0
	707.5	23095	1.4	QPSK	1	5	17.79	0	0
	707.5	23095	1.4	QPSK	3	0	17.51	0	0
	707.5	23095	1.4	QPSK	3	2	17.50	0	0
	707.5	23095	1.4	QPSK	3	3	17.52	0	0
	707.5	23095	1.4	QPSK	6	0	16.50	0-1	1
	707.5	23095	1.4	16-QAM	1	0	16.85	0-1	1
	707.5	23095	1.4	16-QAM	1	2	16.51	0-1	1
	707.5	23095	1.4	16-QAM	1	5	16.72	0-1	1
	707.5	23095	1.4	16-QAM	3	0	16.48	0-1	1
	707.5	23095	1.4	16-QAM	3	2	16.38	0-1	1
	707.5	23095	1.4	16-QAM	3	3	16.38	0-1	1
	707.5	23095	1.4	16-QAM	6	0	15.49	0-2	2
High	715.3	23173	1.4	QPSK	1	0	17.64	0	0
	715.3	23173	1.4	QPSK	1	2	17.65	0	0
	715.3	23173	1.4	QPSK	1	5	17.71	0	0
	715.3	23173	1.4	QPSK	3	0	17.34	0	0
	715.3	23173	1.4	QPSK	3	2	17.38	0	0
	715.3	23173	1.4	QPSK	3	3	17.42	0	0
	715.3	23173	1.4	QPSK	6	0	16.34	0-1	1
	715.3	23173	1.4	16-QAM	1	0	16.67	0-1	1
	715.3	23173	1.4	16-QAM	1	2	16.60	0-1	1
	715.3	23173	1.4	16-QAM	1	5	16.79	0-1	1
	715.3	23173	1.4	16-QAM	3	0	16.36	0-1	1
	715.3	23173	1.4	16-QAM	3	2	16.47	0-1	1
	715.3	23173	1.4	16-QAM	3	3	16.48	0-1	1
	715.3	23173	1.4	16-QAM	6	0	15.66	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet

8.2.2

LTE Band 5 (Cell)

Table 8-11

LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	23.11	0	0
	836.5	20525	10	QPSK	1	25	23.15	0	0
	836.5	20525	10	QPSK	1	49	22.98	0	0
	836.5	20525	10	QPSK	25	0	21.66	0-1	1
	836.5	20525	10	QPSK	25	12	21.65	0-1	1
	836.5	20525	10	QPSK	25	25	21.62	0-1	1
	836.5	20525	10	QPSK	50	0	21.60	0-1	1
	836.5	20525	10	16QAM	1	0	21.83	0-1	1
	836.5	20525	10	16QAM	1	25	21.85	0-1	1
	836.5	20525	10	16QAM	1	49	21.79	0-1	1
	836.5	20525	10	16QAM	25	0	20.57	0-2	2
	836.5	20525	10	16QAM	25	12	20.52	0-2	2
	836.5	20525	10	16QAM	25	25	20.55	0-2	2
	836.5	20525	10	16QAM	50	0	20.51	0-2	2

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-12

LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	22.99	0	0
	826.5	20425	5	QPSK	1	12	23.01	0	0
	826.5	20425	5	QPSK	1	24	23.05	0	0
	826.5	20425	5	QPSK	12	0	21.62	0-1	1
	826.5	20425	5	QPSK	12	6	21.65	0-1	1
	826.5	20425	5	QPSK	12	13	21.72	0-1	1
	826.5	20425	5	QPSK	25	0	21.63	0-1	1
	826.5	20425	5	16-QAM	1	0	22.15	0-1	1
	826.5	20425	5	16-QAM	1	12	22.19	0-1	1
	826.5	20425	5	16-QAM	1	24	22.20	0-1	1
	826.5	20425	5	16-QAM	12	0	20.55	0-2	2
	826.5	20425	5	16-QAM	12	6	20.63	0-2	2
	826.5	20425	5	16-QAM	12	13	20.70	0-2	2
	826.5	20425	5	16-QAM	25	0	20.70	0-2	2
	836.5	20525	5	QPSK	1	0	23.02	0	0
Mid	836.5	20525	5	QPSK	1	12	23.06	0	0
	836.5	20525	5	QPSK	1	24	23.10	0	0
	836.5	20525	5	QPSK	12	0	21.78	0-1	1
	836.5	20525	5	QPSK	12	6	21.77	0-1	1
	836.5	20525	5	QPSK	12	13	21.80	0-1	1
	836.5	20525	5	QPSK	25	0	21.69	0-1	1
	836.5	20525	5	16-QAM	1	0	22.23	0-1	1
	836.5	20525	5	16-QAM	1	12	22.21	0-1	1
	836.5	20525	5	16-QAM	1	24	22.36	0-1	1
	836.5	20525	5	16-QAM	12	0	20.62	0-2	2
	836.5	20525	5	16-QAM	12	6	20.64	0-2	2
	836.5	20525	5	16-QAM	12	13	20.69	0-2	2
	836.5	20525	5	16-QAM	25	0	20.60	0-2	2
High	846.5	20625	5	QPSK	1	0	23.03	0	0
	846.5	20625	5	QPSK	1	12	23.01	0	0
	846.5	20625	5	QPSK	1	24	23.06	0	0
	846.5	20625	5	QPSK	12	0	21.60	0-1	1
	846.5	20625	5	QPSK	12	6	21.61	0-1	1
	846.5	20625	5	QPSK	12	13	21.55	0-1	1
	846.5	20625	5	QPSK	25	0	21.61	0-1	1
	846.5	20625	5	16-QAM	1	0	22.06	0-1	1
	846.5	20625	5	16-QAM	1	12	22.15	0-1	1
	846.5	20625	5	16-QAM	1	24	22.22	0-1	1
	846.5	20625	5	16-QAM	12	0	20.62	0-2	2
	846.5	20625	5	16-QAM	12	6	20.60	0-2	2
	846.5	20625	5	16-QAM	12	13	20.56	0-2	2
	846.5	20625	5	16-QAM	25	0	20.57	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 27 of 89

Table 8-13
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	22.97	0	0
	825.5	20415	3	QPSK	1	7	23.05	0	0
	825.5	20415	3	QPSK	1	14	23.08	0	0
	825.5	20415	3	QPSK	8	0	21.62	0-1	1
	825.5	20415	3	QPSK	8	4	21.66	0-1	1
	825.5	20415	3	QPSK	8	7	21.71	0-1	1
	825.5	20415	3	QPSK	15	0	21.64	0-1	1
	825.5	20415	3	16-QAM	1	0	22.19	0-1	1
	825.5	20415	3	16-QAM	1	7	22.21	0-1	1
	825.5	20415	3	16-QAM	1	14	22.20	0-1	1
	825.5	20415	3	16-QAM	8	0	20.54	0-2	2
	825.5	20415	3	16-QAM	8	4	20.66	0-2	2
	825.5	20415	3	16-QAM	8	7	20.69	0-2	2
	825.5	20415	3	16-QAM	15	0	20.67	0-2	2
	836.5	20525	3	QPSK	1	0	23.00	0	0
Mid	836.5	20525	3	QPSK	1	7	23.10	0	0
	836.5	20525	3	QPSK	1	14	23.13	0	0
	836.5	20525	3	QPSK	8	0	21.75	0-1	1
	836.5	20525	3	QPSK	8	4	21.80	0-1	1
	836.5	20525	3	QPSK	8	7	21.78	0-1	1
	836.5	20525	3	QPSK	15	0	21.71	0-1	1
	836.5	20525	3	16-QAM	1	0	22.26	0-1	1
	836.5	20525	3	16-QAM	1	7	22.25	0-1	1
	836.5	20525	3	16-QAM	1	14	22.33	0-1	1
	836.5	20525	3	16-QAM	8	0	20.59	0-2	2
	836.5	20525	3	16-QAM	8	4	20.63	0-2	2
	836.5	20525	3	16-QAM	8	7	20.66	0-2	2
	836.5	20525	3	16-QAM	15	0	20.59	0-2	2
	847.5	20635	3	QPSK	1	0	22.99	0	0
	847.5	20635	3	QPSK	1	7	23.01	0	0
	847.5	20635	3	QPSK	1	14	23.05	0	0
High	847.5	20635	3	QPSK	8	0	21.62	0-1	1
	847.5	20635	3	QPSK	8	4	21.64	0-1	1
	847.5	20635	3	QPSK	8	7	21.59	0-1	1
	847.5	20635	3	QPSK	15	0	21.58	0-1	1
	847.5	20635	3	16-QAM	1	0	22.06	0-1	1
	847.5	20635	3	16-QAM	1	7	22.19	0-1	1
	847.5	20635	3	16-QAM	1	14	22.20	0-1	1
	847.5	20635	3	16-QAM	8	0	20.61	0-2	2
	847.5	20635	3	16-QAM	8	4	20.60	0-2	2
	847.5	20635	3	16-QAM	8	7	20.53	0-2	2
	847.5	20635	3	16-QAM	15	0	20.58	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 28 of 89	

Table 8-14
LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	22.96	0	0
	824.7	20407	1.4	QPSK	1	2	23.05	0	0
	824.7	20407	1.4	QPSK	1	5	23.05	0	0
	824.7	20407	1.4	QPSK	3	0	22.59	0	0
	824.7	20407	1.4	QPSK	3	2	22.67	0	0
	824.7	20407	1.4	QPSK	3	3	22.74	0	0
	824.7	20407	1.4	QPSK	6	0	21.60	0-1	1
	824.7	20407	1.4	16-QAM	1	0	22.23	0-1	1
	824.7	20407	1.4	16-QAM	1	2	22.23	0-1	1
	824.7	20407	1.4	16-QAM	1	5	22.21	0-1	1
	824.7	20407	1.4	16-QAM	3	0	21.52	0-1	1
	824.7	20407	1.4	16-QAM	3	2	21.69	0-1	1
	824.7	20407	1.4	16-QAM	3	3	21.70	0-1	1
	824.7	20407	1.4	16-QAM	6	0	20.68	0-2	2
Mid	836.5	20525	1.4	QPSK	1	0	22.99	0	0
	836.5	20525	1.4	QPSK	1	2	23.06	0	0
	836.5	20525	1.4	QPSK	1	5	23.09	0	0
	836.5	20525	1.4	QPSK	3	0	22.76	0	0
	836.5	20525	1.4	QPSK	3	2	22.79	0	0
	836.5	20525	1.4	QPSK	3	3	22.80	0	0
	836.5	20525	1.4	QPSK	6	0	21.67	0-1	1
	836.5	20525	1.4	16-QAM	1	0	22.24	0-1	1
	836.5	20525	1.4	16-QAM	1	2	22.22	0-1	1
	836.5	20525	1.4	16-QAM	1	5	22.34	0-1	1
	836.5	20525	1.4	16-QAM	3	0	21.60	0-1	1
	836.5	20525	1.4	16-QAM	3	2	21.67	0-1	1
	836.5	20525	1.4	16-QAM	3	3	21.66	0-1	1
	836.5	20525	1.4	16-QAM	6	0	20.55	0-2	2
High	848.3	20643	1.4	QPSK	1	0	23.03	0	0
	848.3	20643	1.4	QPSK	1	2	22.99	0	0
	848.3	20643	1.4	QPSK	1	5	23.08	0	0
	848.3	20643	1.4	QPSK	3	0	22.62	0	0
	848.3	20643	1.4	QPSK	3	2	22.67	0	0
	848.3	20643	1.4	QPSK	3	3	22.63	0	0
	848.3	20643	1.4	QPSK	6	0	21.55	0-1	1
	848.3	20643	1.4	16-QAM	1	0	22.09	0-1	1
	848.3	20643	1.4	16-QAM	1	2	22.22	0-1	1
	848.3	20643	1.4	16-QAM	1	5	22.18	0-1	1
	848.3	20643	1.4	16-QAM	3	0	21.58	0-1	1
	848.3	20643	1.4	16-QAM	3	2	21.64	0-1	1
	848.3	20643	1.4	16-QAM	3	3	21.57	0-1	1
	848.3	20643	1.4	16-QAM	6	0	20.58	0-2	2

Table 8-15
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	16.59	0	0
	836.5	20525	10	QPSK	1	25	17.15	0	0
	836.5	20525	10	QPSK	1	49	16.62	0	0
	836.5	20525	10	QPSK	25	0	15.94	0-1	1
	836.5	20525	10	QPSK	25	12	15.87	0-1	1
	836.5	20525	10	QPSK	25	25	15.86	0-1	1
	836.5	20525	10	QPSK	50	0	15.93	0-1	1
	836.5	20525	10	16QAM	1	0	16.00	0-1	1
	836.5	20525	10	16QAM	1	25	16.06	0-1	1
	836.5	20525	10	16QAM	1	49	16.04	0-1	1
	836.5	20525	10	16QAM	25	0	14.92	0-2	2
	836.5	20525	10	16QAM	25	12	14.90	0-2	2
	836.5	20525	10	16QAM	25	25	14.85	0-2	2
	836.5	20525	10	16QAM	50	0	14.97	0-2	2

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 29 of 89

Table 8-16
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	17.11	0	0
	826.5	20425	5	QPSK	1	12	17.17	0	0
	826.5	20425	5	QPSK	1	24	17.10	0	0
	826.5	20425	5	QPSK	12	0	16.06	0-1	1
	826.5	20425	5	QPSK	12	6	16.04	0-1	1
	826.5	20425	5	QPSK	12	13	16.03	0-1	1
	826.5	20425	5	QPSK	25	0	16.01	0-1	1
	826.5	20425	5	16-QAM	1	0	16.14	0-1	1
	826.5	20425	5	16-QAM	1	12	16.18	0-1	1
	826.5	20425	5	16-QAM	1	24	16.10	0-1	1
	826.5	20425	5	16-QAM	12	0	15.02	0-2	2
	826.5	20425	5	16-QAM	12	6	14.99	0-2	2
	826.5	20425	5	16-QAM	12	13	14.96	0-2	2
	826.5	20425	5	16-QAM	25	0	15.00	0-2	2
Mid	836.5	20525	5	QPSK	1	0	17.13	0	0
	836.5	20525	5	QPSK	1	12	17.15	0	0
	836.5	20525	5	QPSK	1	24	17.11	0	0
	836.5	20525	5	QPSK	12	0	15.97	0-1	1
	836.5	20525	5	QPSK	12	6	15.94	0-1	1
	836.5	20525	5	QPSK	12	13	15.93	0-1	1
	836.5	20525	5	QPSK	25	0	16.10	0-1	1
	836.5	20525	5	16-QAM	1	0	16.11	0-1	1
	836.5	20525	5	16-QAM	1	12	16.18	0-1	1
	836.5	20525	5	16-QAM	1	24	16.10	0-1	1
	836.5	20525	5	16-QAM	12	0	14.92	0-2	2
	836.5	20525	5	16-QAM	12	6	14.90	0-2	2
	836.5	20525	5	16-QAM	12	13	14.92	0-2	2
	836.5	20525	5	16-QAM	25	0	14.94	0-2	2
High	846.5	20625	5	QPSK	1	0	17.18	0	0
	846.5	20625	5	QPSK	1	12	17.19	0	0
	846.5	20625	5	QPSK	1	24	17.11	0	0
	846.5	20625	5	QPSK	12	0	15.89	0-1	1
	846.5	20625	5	QPSK	12	6	15.83	0-1	1
	846.5	20625	5	QPSK	12	13	15.85	0-1	1
	846.5	20625	5	QPSK	25	0	15.92	0-1	1
	846.5	20625	5	16-QAM	1	0	15.86	0-1	1
	846.5	20625	5	16-QAM	1	12	15.96	0-1	1
	846.5	20625	5	16-QAM	1	24	15.88	0-1	1
	846.5	20625	5	16-QAM	12	0	14.89	0-2	2
	846.5	20625	5	16-QAM	12	6	14.81	0-2	2
	846.5	20625	5	16-QAM	12	13	14.85	0-2	2
	846.5	20625	5	16-QAM	25	0	14.87	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 30 of 89

Table 8-17
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	17.46	0	0
	825.5	20415	3	QPSK	1	7	17.48	0	0
	825.5	20415	3	QPSK	1	14	17.43	0	0
	825.5	20415	3	QPSK	8	0	16.28	0-1	1
	825.5	20415	3	QPSK	8	4	16.20	0-1	1
	825.5	20415	3	QPSK	8	7	16.22	0-1	1
	825.5	20415	3	QPSK	15	0	16.24	0-1	1
	825.5	20415	3	16-QAM	1	0	16.49	0-1	1
	825.5	20415	3	16-QAM	1	7	16.50	0-1	1
	825.5	20415	3	16-QAM	1	14	16.47	0-1	1
	825.5	20415	3	16-QAM	8	0	15.34	0-2	2
	825.5	20415	3	16-QAM	8	4	15.26	0-2	2
	825.5	20415	3	16-QAM	8	7	15.28	0-2	2
	825.5	20415	3	16-QAM	15	0	15.30	0-2	2
	825.5	20415	3	16-QAM	15	0	15.30	0-2	2
Mid	836.5	20525	3	QPSK	1	0	17.49	0	0
	836.5	20525	3	QPSK	1	7	17.44	0	0
	836.5	20525	3	QPSK	1	14	17.43	0	0
	836.5	20525	3	QPSK	8	0	16.26	0-1	1
	836.5	20525	3	QPSK	8	4	16.21	0-1	1
	836.5	20525	3	QPSK	8	7	16.20	0-1	1
	836.5	20525	3	QPSK	15	0	16.20	0-1	1
	836.5	20525	3	16-QAM	1	0	16.49	0-1	1
	836.5	20525	3	16-QAM	1	7	16.47	0-1	1
	836.5	20525	3	16-QAM	1	14	16.48	0-1	1
	836.5	20525	3	16-QAM	8	0	15.28	0-2	2
	836.5	20525	3	16-QAM	8	4	15.22	0-2	2
	836.5	20525	3	16-QAM	8	7	15.21	0-2	2
	836.5	20525	3	16-QAM	15	0	15.15	0-2	2
	836.5	20525	3	16-QAM	15	0	15.15	0-2	2
High	847.5	20635	3	QPSK	1	0	17.30	0	0
	847.5	20635	3	QPSK	1	7	17.21	0	0
	847.5	20635	3	QPSK	1	14	17.28	0	0
	847.5	20635	3	QPSK	8	0	16.08	0-1	1
	847.5	20635	3	QPSK	8	4	16.05	0-1	1
	847.5	20635	3	QPSK	8	7	15.96	0-1	1
	847.5	20635	3	QPSK	15	0	16.12	0-1	1
	847.5	20635	3	16-QAM	1	0	16.44	0-1	1
	847.5	20635	3	16-QAM	1	7	16.16	0-1	1
	847.5	20635	3	16-QAM	1	14	16.26	0-1	1
	847.5	20635	3	16-QAM	8	0	15.02	0-2	2
	847.5	20635	3	16-QAM	8	4	15.03	0-2	2
	847.5	20635	3	16-QAM	8	7	15.03	0-2	2
	847.5	20635	3	16-QAM	15	0	15.09	0-2	2
	847.5	20635	3	16-QAM	15	0	15.09	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 31 of 89

Table 8-18
LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	17.37	0	0
	824.7	20407	1.4	QPSK	1	2	17.38	0	0
	824.7	20407	1.4	QPSK	1	5	17.42	0	0
	824.7	20407	1.4	QPSK	3	0	17.25	0	0
	824.7	20407	1.4	QPSK	3	2	17.21	0	0
	824.7	20407	1.4	QPSK	3	3	17.20	0	0
	824.7	20407	1.4	QPSK	6	0	16.20	0-1	1
	824.7	20407	1.4	16-QAM	1	0	16.45	0-1	1
	824.7	20407	1.4	16-QAM	1	2	16.45	0-1	1
	824.7	20407	1.4	16-QAM	1	5	16.48	0-1	1
	824.7	20407	1.4	16-QAM	3	0	16.18	0-1	1
	824.7	20407	1.4	16-QAM	3	2	16.16	0-1	1
	824.7	20407	1.4	16-QAM	3	3	16.10	0-1	1
	824.7	20407	1.4	16-QAM	6	0	15.25	0-2	2
Mid	836.5	20525	1.4	QPSK	1	0	17.39	0	0
	836.5	20525	1.4	QPSK	1	2	17.44	0	0
	836.5	20525	1.4	QPSK	1	5	17.48	0	0
	836.5	20525	1.4	QPSK	3	0	17.25	0	0
	836.5	20525	1.4	QPSK	3	2	17.23	0	0
	836.5	20525	1.4	QPSK	3	3	17.26	0	0
	836.5	20525	1.4	QPSK	6	0	16.22	0-1	1
	836.5	20525	1.4	16-QAM	1	0	16.50	0-1	1
	836.5	20525	1.4	16-QAM	1	2	16.43	0-1	1
	836.5	20525	1.4	16-QAM	1	5	16.45	0-1	1
	836.5	20525	1.4	16-QAM	3	0	16.32	0-1	1
	836.5	20525	1.4	16-QAM	3	2	16.08	0-1	1
	836.5	20525	1.4	16-QAM	3	3	16.10	0-1	1
	836.5	20525	1.4	16-QAM	6	0	15.30	0-2	2
High	848.3	20643	1.4	QPSK	1	0	17.24	0	0
	848.3	20643	1.4	QPSK	1	2	17.16	0	0
	848.3	20643	1.4	QPSK	1	5	17.23	0	0
	848.3	20643	1.4	QPSK	3	0	17.09	0	0
	848.3	20643	1.4	QPSK	3	2	16.99	0	0
	848.3	20643	1.4	QPSK	3	3	17.08	0	0
	848.3	20643	1.4	QPSK	6	0	16.11	0-1	1
	848.3	20643	1.4	16-QAM	1	0	16.45	0-1	1
	848.3	20643	1.4	16-QAM	1	2	16.42	0-1	1
	848.3	20643	1.4	16-QAM	1	5	16.26	0-1	1
	848.3	20643	1.4	16-QAM	3	0	15.93	0-1	1
	848.3	20643	1.4	16-QAM	3	2	15.88	0-1	1
	848.3	20643	1.4	16-QAM	3	3	15.98	0-1	1
	848.3	20643	1.4	16-QAM	6	0	15.04	0-2	2

8.2.3 LTE Band 4 (AWS)

Table 8-19
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	23.44	0	0
	1732.5	20175	20	QPSK	1	50	23.45	0	0
	1732.5	20175	20	QPSK	1	99	23.47	0	0
	1732.5	20175	20	QPSK	50	0	21.86	0-1	1
	1732.5	20175	20	QPSK	50	25	21.95	0-1	1
	1732.5	20175	20	QPSK	50	50	21.96	0-1	1
	1732.5	20175	20	QPSK	100	0	21.93	0-1	1
	1732.5	20175	20	16QAM	1	0	22.06	0-1	1
	1732.5	20175	20	16QAM	1	50	21.96	0-1	1
	1732.5	20175	20	16QAM	1	99	22.06	0-1	1
	1732.5	20175	20	16QAM	50	0	20.85	0-2	2
	1732.5	20175	20	16QAM	50	25	20.98	0-2	2
	1732.5	20175	20	16QAM	50	50	20.82	0-2	2
	1732.5	20175	20	16QAM	100	0	20.92	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 32 of 89	

Table 8-20
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	23.29	0	0
	1717.5	20025	15	QPSK	1	36	23.41	0	0
	1717.5	20025	15	QPSK	1	74	23.41	0	0
	1717.5	20025	15	QPSK	36	0	22.04	0-1	1
	1717.5	20025	15	QPSK	36	18	22.03	0-1	1
	1717.5	20025	15	QPSK	36	37	22.05	0-1	1
	1717.5	20025	15	QPSK	75	0	21.99	0-1	1
	1717.5	20025	15	16QAM	1	0	22.22	0-1	1
	1717.5	20025	15	16QAM	1	36	21.99	0-1	1
	1717.5	20025	15	16QAM	1	74	22.20	0-1	1
	1717.5	20025	15	16QAM	36	0	21.06	0-2	2
	1717.5	20025	15	16QAM	36	18	21.02	0-2	2
	1717.5	20025	15	16QAM	36	37	20.95	0-2	2
	1717.5	20025	15	16QAM	75	0	21.09	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	22.98	0	0
	1732.5	20175	15	QPSK	1	36	23.23	0	0
	1732.5	20175	15	QPSK	1	74	23.11	0	0
	1732.5	20175	15	QPSK	36	0	21.94	0-1	1
	1732.5	20175	15	QPSK	36	18	21.94	0-1	1
	1732.5	20175	15	QPSK	36	37	22.00	0-1	1
	1732.5	20175	15	QPSK	75	0	21.87	0-1	1
	1732.5	20175	15	16QAM	1	0	22.22	0-1	1
	1732.5	20175	15	16QAM	1	36	22.36	0-1	1
	1732.5	20175	15	16QAM	1	74	22.25	0-1	1
	1732.5	20175	15	16QAM	36	0	20.82	0-2	2
	1732.5	20175	15	16QAM	36	18	20.83	0-2	2
	1732.5	20175	15	16QAM	36	37	20.89	0-2	2
	1732.5	20175	15	16QAM	75	0	20.85	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.29	0	0
	1747.5	20325	15	QPSK	1	36	23.19	0	0
	1747.5	20325	15	QPSK	1	74	23.22	0	0
	1747.5	20325	15	QPSK	36	0	21.95	0-1	1
	1747.5	20325	15	QPSK	36	18	21.92	0-1	1
	1747.5	20325	15	QPSK	36	37	21.90	0-1	1
	1747.5	20325	15	QPSK	75	0	21.83	0-1	1
	1747.5	20325	15	16QAM	1	0	22.04	0-1	1
	1747.5	20325	15	16QAM	1	36	22.10	0-1	1
	1747.5	20325	15	16QAM	1	74	22.26	0-1	1
	1747.5	20325	15	16QAM	36	0	20.86	0-2	2
	1747.5	20325	15	16QAM	36	18	20.83	0-2	2
	1747.5	20325	15	16QAM	36	37	21.10	0-2	2
	1747.5	20325	15	16QAM	75	0	20.76	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 33 of 89		

Table 8-21
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	23.33	0	0
	1715	20000	10	QPSK	1	25	23.38	0	0
	1715	20000	10	QPSK	1	49	23.42	0	0
	1715	20000	10	QPSK	25	0	22.08	0-1	1
	1715	20000	10	QPSK	25	12	22.07	0-1	1
	1715	20000	10	QPSK	25	25	22.03	0-1	1
	1715	20000	10	QPSK	50	0	21.96	0-1	1
	1715	20000	10	16QAM	1	0	22.19	0-1	1
	1715	20000	10	16QAM	1	25	22.00	0-1	1
	1715	20000	10	16QAM	1	49	22.21	0-1	1
	1715	20000	10	16QAM	25	0	21.03	0-2	2
	1715	20000	10	16QAM	25	12	21.00	0-2	2
	1715	20000	10	16QAM	25	25	20.95	0-2	2
	1715	20000	10	16QAM	50	0	21.11	0-2	2
	1732.5	20175	10	QPSK	1	0	22.95	0	0
Mid	1732.5	20175	10	QPSK	1	25	23.20	0	0
	1732.5	20175	10	QPSK	1	49	23.11	0	0
	1732.5	20175	10	QPSK	25	0	21.91	0-1	1
	1732.5	20175	10	QPSK	25	12	21.88	0-1	1
	1732.5	20175	10	QPSK	25	25	22.04	0-1	1
	1732.5	20175	10	QPSK	50	0	21.90	0-1	1
	1732.5	20175	10	16QAM	1	0	22.22	0-1	1
	1732.5	20175	10	16QAM	1	25	22.33	0-1	1
	1732.5	20175	10	16QAM	1	49	22.21	0-1	1
	1732.5	20175	10	16QAM	25	0	20.85	0-2	2
	1732.5	20175	10	16QAM	25	12	20.83	0-2	2
	1732.5	20175	10	16QAM	25	25	20.86	0-2	2
	1732.5	20175	10	16QAM	50	0	20.83	0-2	2
	1750	20350	10	QPSK	1	0	23.30	0	0
	1750	20350	10	QPSK	1	25	23.20	0	0
High	1750	20350	10	QPSK	1	49	23.19	0	0
	1750	20350	10	QPSK	25	0	21.93	0-1	1
	1750	20350	10	QPSK	25	12	21.95	0-1	1
	1750	20350	10	QPSK	25	25	21.90	0-1	1
	1750	20350	10	QPSK	50	0	21.81	0-1	1
	1750	20350	10	16QAM	1	0	22.08	0-1	1
	1750	20350	10	16QAM	1	25	22.07	0-1	1
	1750	20350	10	16QAM	1	49	22.29	0-1	1
	1750	20350	10	16QAM	25	0	20.89	0-2	2
	1750	20350	10	16QAM	25	12	20.84	0-2	2
	1750	20350	10	16QAM	25	25	21.08	0-2	2
	1750	20350	10	16QAM	50	0	20.72	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 34 of 89		

Table 8-22
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	23.30	0	0
	1712.5	19975	5	QPSK	1	12	23.36	0	0
	1712.5	19975	5	QPSK	1	24	23.40	0	0
	1712.5	19975	5	QPSK	12	0	22.10	0-1	1
	1712.5	19975	5	QPSK	12	6	22.04	0-1	1
	1712.5	19975	5	QPSK	12	13	22.05	0-1	1
	1712.5	19975	5	QPSK	25	0	21.96	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.17	0-1	1
	1712.5	19975	5	16-QAM	1	12	21.98	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.21	0-1	1
	1712.5	19975	5	16-QAM	12	0	21.03	0-2	2
	1712.5	19975	5	16-QAM	12	6	20.96	0-2	2
	1712.5	19975	5	16-QAM	12	13	20.99	0-2	2
	1712.5	19975	5	16-QAM	25	0	21.11	0-2	2
	1732.5	20175	5	QPSK	1	0	22.99	0	0
Mid	1732.5	20175	5	QPSK	1	12	23.17	0	0
	1732.5	20175	5	QPSK	1	24	23.09	0	0
	1732.5	20175	5	QPSK	12	0	21.89	0-1	1
	1732.5	20175	5	QPSK	12	6	21.93	0-1	1
	1732.5	20175	5	QPSK	12	13	22.03	0-1	1
	1732.5	20175	5	QPSK	25	0	21.90	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.21	0-1	1
	1732.5	20175	5	16-QAM	1	12	22.29	0-1	1
	1732.5	20175	5	16-QAM	1	24	22.25	0-1	1
	1732.5	20175	5	16-QAM	12	0	20.89	0-2	2
	1732.5	20175	5	16-QAM	12	6	20.84	0-2	2
	1732.5	20175	5	16-QAM	12	13	20.85	0-2	2
	1732.5	20175	5	16-QAM	25	0	20.81	0-2	2
	1752.5	20375	5	QPSK	1	0	23.32	0	0
	1752.5	20375	5	QPSK	1	12	23.24	0	0
High	1752.5	20375	5	QPSK	1	24	23.18	0	0
	1752.5	20375	5	QPSK	12	0	21.91	0-1	1
	1752.5	20375	5	QPSK	12	6	21.92	0-1	1
	1752.5	20375	5	QPSK	12	13	21.88	0-1	1
	1752.5	20375	5	QPSK	25	0	21.81	0-1	1
	1752.5	20375	5	16-QAM	1	0	22.09	0-1	1
	1752.5	20375	5	16-QAM	1	12	22.10	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.27	0-1	1
	1752.5	20375	5	16-QAM	12	0	20.93	0-2	2
	1752.5	20375	5	16-QAM	12	6	20.80	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.06	0-2	2
	1752.5	20375	5	16-QAM	25	0	20.76	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 35 of 89		

Table 8-23
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	23.33	0	0
	1711.5	19965	3	QPSK	1	7	23.39	0	0
	1711.5	19965	3	QPSK	1	14	23.40	0	0
	1711.5	19965	3	QPSK	8	0	22.08	0-1	1
	1711.5	19965	3	QPSK	8	4	22.06	0-1	1
	1711.5	19965	3	QPSK	8	7	22.05	0-1	1
	1711.5	19965	3	QPSK	15	0	21.98	0-1	1
	1711.5	19965	3	16-QAM	1	0	22.19	0-1	1
	1711.5	19965	3	16-QAM	1	7	22.01	0-1	1
	1711.5	19965	3	16-QAM	1	14	22.21	0-1	1
	1711.5	19965	3	16-QAM	8	0	21.07	0-2	2
	1711.5	19965	3	16-QAM	8	4	20.97	0-2	2
	1711.5	19965	3	16-QAM	8	7	21.01	0-2	2
	1711.5	19965	3	16-QAM	15	0	21.02	0-2	2
	1732.5	20175	3	QPSK	1	0	23.01	0	0
Mid	1732.5	20175	3	QPSK	1	7	23.20	0	0
	1732.5	20175	3	QPSK	1	14	23.13	0	0
	1732.5	20175	3	QPSK	8	0	21.92	0-1	1
	1732.5	20175	3	QPSK	8	4	21.91	0-1	1
	1732.5	20175	3	QPSK	8	7	22.06	0-1	1
	1732.5	20175	3	QPSK	15	0	21.82	0-1	1
	1732.5	20175	3	16-QAM	1	0	22.25	0-1	1
	1732.5	20175	3	16-QAM	1	7	22.30	0-1	1
	1732.5	20175	3	16-QAM	1	14	22.25	0-1	1
	1732.5	20175	3	16-QAM	8	0	20.88	0-2	2
	1732.5	20175	3	16-QAM	8	4	20.85	0-2	2
	1732.5	20175	3	16-QAM	8	7	20.86	0-2	2
	1732.5	20175	3	16-QAM	15	0	20.83	0-2	2
	1753.5	20385	3	QPSK	1	0	23.35	0	0
	1753.5	20385	3	QPSK	1	7	23.28	0	0
High	1753.5	20385	3	QPSK	1	14	23.20	0	0
	1753.5	20385	3	QPSK	8	0	21.88	0-1	1
	1753.5	20385	3	QPSK	8	4	21.95	0-1	1
	1753.5	20385	3	QPSK	8	7	21.91	0-1	1
	1753.5	20385	3	QPSK	15	0	21.79	0-1	1
	1753.5	20385	3	16-QAM	1	0	22.05	0-1	1
	1753.5	20385	3	16-QAM	1	7	22.10	0-1	1
	1753.5	20385	3	16-QAM	1	14	22.25	0-1	1
	1753.5	20385	3	16-QAM	8	0	20.91	0-2	2
	1753.5	20385	3	16-QAM	8	4	20.77	0-2	2
	1753.5	20385	3	16-QAM	8	7	21.03	0-2	2
	1753.5	20385	3	16-QAM	15	0	20.78	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 36 of 89		

Table 8-24
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	23.33	0	0
	1710.7	19957	1.4	QPSK	1	2	23.43	0	0
	1710.7	19957	1.4	QPSK	1	5	23.42	0	0
	1710.7	19957	1.4	QPSK	3	0	23.12	0	0
	1710.7	19957	1.4	QPSK	3	2	23.04	0	0
	1710.7	19957	1.4	QPSK	3	3	23.07	0	0
	1710.7	19957	1.4	QPSK	6	0	22.01	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	22.23	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	22.04	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	22.23	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	22.05	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	21.95	0-1	1
Mid	1710.7	19957	1.4	16-QAM	3	3	21.99	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	21.00	0-2	2
	1732.5	20175	1.4	QPSK	1	0	22.98	0	0
	1732.5	20175	1.4	QPSK	1	2	23.17	0	0
	1732.5	20175	1.4	QPSK	1	5	23.16	0	0
	1732.5	20175	1.4	QPSK	3	0	22.91	0	0
	1732.5	20175	1.4	QPSK	3	2	22.99	0	0
	1732.5	20175	1.4	QPSK	3	3	23.06	0	0
	1732.5	20175	1.4	QPSK	6	0	21.92	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	22.26	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	22.31	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	22.26	0-1	1
High	1732.5	20175	1.4	16-QAM	3	0	21.90	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	21.83	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	21.87	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	20.85	0-2	2
	1754.3	20393	1.4	QPSK	1	0	23.36	0	0
	1754.3	20393	1.4	QPSK	1	2	23.29	0	0
	1754.3	20393	1.4	QPSK	1	5	23.16	0	0
	1754.3	20393	1.4	QPSK	3	0	22.90	0	0
	1754.3	20393	1.4	QPSK	3	2	22.94	0	0
	1754.3	20393	1.4	QPSK	3	3	22.88	0	0
	1754.3	20393	1.4	QPSK	6	0	21.76	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	22.05	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	22.06	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	22.28	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	21.87	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	21.81	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	22.01	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	20.76	0-2	2

Table 8-25
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	14.39	0	0
	1732.5	20175	20	QPSK	1	50	14.29	0	0
	1732.5	20175	20	QPSK	1	99	14.34	0	0
	1732.5	20175	20	QPSK	50	0	13.04	0-1	1
	1732.5	20175	20	QPSK	50	25	13.08	0-1	1
	1732.5	20175	20	QPSK	50	50	13.07	0-1	1
	1732.5	20175	20	QPSK	100	0	13.06	0-1	1
	1732.5	20175	20	16QAM	1	0	13.00	0-1	1
	1732.5	20175	20	16QAM	1	50	13.12	0-1	1
	1732.5	20175	20	16QAM	1	99	13.19	0-1	1
	1732.5	20175	20	16QAM	50	0	12.12	0-2	2
	1732.5	20175	20	16QAM	50	25	12.17	0-2	2
	1732.5	20175	20	16QAM	50	50	12.06	0-2	2
	1732.5	20175	20	16QAM	100	0	12.05	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 37 of 89		

Table 8-26
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	14.43	0	0
	1717.5	20025	15	QPSK	1	36	14.46	0	0
	1717.5	20025	15	QPSK	1	74	14.44	0	0
	1717.5	20025	15	QPSK	36	0	13.27	0-1	1
	1717.5	20025	15	QPSK	36	18	13.34	0-1	1
	1717.5	20025	15	QPSK	36	37	13.31	0-1	1
	1717.5	20025	15	QPSK	75	0	13.27	0-1	1
	1717.5	20025	15	16QAM	1	0	13.44	0-1	1
	1717.5	20025	15	16QAM	1	36	13.50	0-1	1
	1717.5	20025	15	16QAM	1	74	13.42	0-1	1
	1717.5	20025	15	16QAM	36	0	12.29	0-2	2
	1717.5	20025	15	16QAM	36	18	12.35	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	14.29	0	0
	1732.5	20175	15	QPSK	1	36	14.45	0	0
	1732.5	20175	15	QPSK	1	74	14.31	0	0
	1732.5	20175	15	QPSK	36	0	13.29	0-1	1
	1732.5	20175	15	QPSK	36	18	13.28	0-1	1
	1732.5	20175	15	QPSK	36	37	13.34	0-1	1
	1732.5	20175	15	QPSK	75	0	13.27	0-1	1
	1732.5	20175	15	16QAM	1	0	13.48	0-1	1
	1732.5	20175	15	16QAM	1	36	13.43	0-1	1
	1732.5	20175	15	16QAM	1	74	13.50	0-1	1
	1732.5	20175	15	16QAM	36	0	12.30	0-2	2
	1732.5	20175	15	16QAM	36	18	12.31	0-2	2
High	1732.5	20175	15	16QAM	36	37	12.36	0-2	2
	1732.5	20175	15	16QAM	75	0	12.28	0-2	2
	1747.5	20325	15	QPSK	1	0	14.15	0	0
	1747.5	20325	15	QPSK	1	36	14.19	0	0
	1747.5	20325	15	QPSK	1	74	14.28	0	0
	1747.5	20325	15	QPSK	36	0	13.07	0-1	1
	1747.5	20325	15	QPSK	36	18	13.03	0-1	1
	1747.5	20325	15	QPSK	36	37	13.04	0-1	1
	1747.5	20325	15	QPSK	75	0	13.01	0-1	1
	1747.5	20325	15	16QAM	1	0	13.24	0-1	1
	1747.5	20325	15	16QAM	1	36	13.33	0-1	1
	1747.5	20325	15	16QAM	1	74	13.34	0-1	1
	1747.5	20325	15	16QAM	36	0	12.09	0-2	2
	1747.5	20325	15	16QAM	36	18	12.06	0-2	2
	1747.5	20325	15	16QAM	36	37	12.07	0-2	2
	1747.5	20325	15	16QAM	75	0	12.09	0-2	2
	1747.5	20325	15	16QAM	75	0	12.09	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 38 of 89		

Table 8-27
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	14.43	0	0
	1715	20000	10	QPSK	1	25	14.30	0	0
	1715	20000	10	QPSK	1	49	14.33	0	0
	1715	20000	10	QPSK	25	0	13.38	0-1	1
	1715	20000	10	QPSK	25	12	13.44	0-1	1
	1715	20000	10	QPSK	25	25	13.39	0-1	1
	1715	20000	10	QPSK	50	0	13.47	0-1	1
	1715	20000	10	16QAM	1	0	13.50	0-1	1
	1715	20000	10	16QAM	1	25	13.42	0-1	1
	1715	20000	10	16QAM	1	49	13.44	0-1	1
	1715	20000	10	16QAM	25	0	12.47	0-2	2
	1715	20000	10	16QAM	25	12	12.46	0-2	2
	1715	20000	10	16QAM	25	25	12.50	0-2	2
	1715	20000	10	16QAM	50	0	12.48	0-2	2
	1715	20000	10	16QAM	50	0	12.48	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	14.37	0	0
	1732.5	20175	10	QPSK	1	25	14.43	0	0
	1732.5	20175	10	QPSK	1	49	14.00	0	0
	1732.5	20175	10	QPSK	25	0	13.24	0-1	1
	1732.5	20175	10	QPSK	25	12	13.31	0-1	1
	1732.5	20175	10	QPSK	25	25	13.25	0-1	1
	1732.5	20175	10	QPSK	50	0	13.28	0-1	1
	1732.5	20175	10	16QAM	1	0	13.50	0-1	1
	1732.5	20175	10	16QAM	1	25	13.41	0-1	1
	1732.5	20175	10	16QAM	1	49	13.28	0-1	1
	1732.5	20175	10	16QAM	25	0	12.27	0-2	2
	1732.5	20175	10	16QAM	25	12	12.34	0-2	2
	1732.5	20175	10	16QAM	25	25	12.32	0-2	2
	1732.5	20175	10	16QAM	50	0	12.27	0-2	2
	1732.5	20175	10	16QAM	50	0	12.27	0-2	2
High	1750	20350	10	QPSK	1	0	14.20	0	0
	1750	20350	10	QPSK	1	25	14.21	0	0
	1750	20350	10	QPSK	1	49	14.33	0	0
	1750	20350	10	QPSK	25	0	13.11	0-1	1
	1750	20350	10	QPSK	25	12	13.10	0-1	1
	1750	20350	10	QPSK	25	25	13.12	0-1	1
	1750	20350	10	QPSK	50	0	13.14	0-1	1
	1750	20350	10	16QAM	1	0	13.47	0-1	1
	1750	20350	10	16QAM	1	25	13.42	0-1	1
	1750	20350	10	16QAM	1	49	13.38	0-1	1
	1750	20350	10	16QAM	25	0	12.17	0-2	2
	1750	20350	10	16QAM	25	12	12.20	0-2	2
	1750	20350	10	16QAM	25	25	12.16	0-2	2
	1750	20350	10	16QAM	50	0	12.14	0-2	2
	1750	20350	10	16QAM	50	0	12.14	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 39 of 89		

Table 8-28
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	14.46	0	0
	1712.5	19975	5	QPSK	1	12	14.33	0	0
	1712.5	19975	5	QPSK	1	24	14.36	0	0
	1712.5	19975	5	QPSK	12	0	13.41	0-1	1
	1712.5	19975	5	QPSK	12	6	13.47	0-1	1
	1712.5	19975	5	QPSK	12	13	13.42	0-1	1
	1712.5	19975	5	QPSK	25	0	13.44	0-1	1
	1712.5	19975	5	16-QAM	1	0	13.47	0-1	1
	1712.5	19975	5	16-QAM	1	12	13.45	0-1	1
	1712.5	19975	5	16-QAM	1	24	13.47	0-1	1
	1712.5	19975	5	16-QAM	12	0	12.29	0-2	2
	1712.5	19975	5	16-QAM	12	6	12.43	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	12.24	0-2	2
	1712.5	19975	5	16-QAM	25	0	12.21	0-2	2
	1732.5	20175	5	QPSK	1	0	14.40	0	0
	1732.5	20175	5	QPSK	1	12	14.31	0	0
	1732.5	20175	5	QPSK	1	24	14.03	0	0
	1732.5	20175	5	QPSK	12	0	13.27	0-1	1
	1732.5	20175	5	QPSK	12	6	13.34	0-1	1
	1732.5	20175	5	QPSK	12	13	13.28	0-1	1
	1732.5	20175	5	QPSK	25	0	13.31	0-1	1
	1732.5	20175	5	16-QAM	1	0	13.24	0-1	1
	1732.5	20175	5	16-QAM	1	12	13.20	0-1	1
	1732.5	20175	5	16-QAM	1	24	13.42	0-1	1
High	1732.5	20175	5	16-QAM	12	0	12.30	0-2	2
	1732.5	20175	5	16-QAM	12	6	12.37	0-2	2
	1732.5	20175	5	16-QAM	12	13	12.35	0-2	2
	1732.5	20175	5	16-QAM	25	0	12.30	0-2	2
	1752.5	20375	5	QPSK	1	0	14.23	0	0
	1752.5	20375	5	QPSK	1	12	14.24	0	0
	1752.5	20375	5	QPSK	1	24	14.36	0	0
	1752.5	20375	5	QPSK	12	0	13.14	0-1	1
	1752.5	20375	5	QPSK	12	6	13.13	0-1	1
	1752.5	20375	5	QPSK	12	13	13.15	0-1	1
	1752.5	20375	5	QPSK	25	0	13.17	0-1	1
	1752.5	20375	5	16-QAM	1	0	13.50	0-1	1
	1752.5	20375	5	16-QAM	1	12	13.45	0-1	1
	1752.5	20375	5	16-QAM	1	24	13.41	0-1	1
	1752.5	20375	5	16-QAM	12	0	12.20	0-2	2
	1752.5	20375	5	16-QAM	12	6	12.23	0-2	2
	1752.5	20375	5	16-QAM	12	13	12.19	0-2	2
	1752.5	20375	5	16-QAM	25	0	12.17	0-2	2

Table 8-29
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	14.36	0	0
	1711.5	19965	3	QPSK	1	7	14.39	0	0
	1711.5	19965	3	QPSK	1	14	14.37	0	0
	1711.5	19965	3	QPSK	8	0	13.20	0-1	1
	1711.5	19965	3	QPSK	8	4	13.27	0-1	1
	1711.5	19965	3	QPSK	8	7	13.24	0-1	1
	1711.5	19965	3	QPSK	15	0	13.20	0-1	1
	1711.5	19965	3	16-QAM	1	0	13.37	0-1	1
	1711.5	19965	3	16-QAM	1	7	13.43	0-1	1
	1711.5	19965	3	16-QAM	1	14	13.35	0-1	1
	1711.5	19965	3	16-QAM	8	0	12.22	0-2	2
	1711.5	19965	3	16-QAM	8	4	12.32	0-2	2
	1711.5	19965	3	16-QAM	8	7	12.28	0-2	2
	1711.5	19965	3	16-QAM	15	0	12.28	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	14.22	0	0
	1732.5	20175	3	QPSK	1	7	14.38	0	0
	1732.5	20175	3	QPSK	1	14	14.24	0	0
	1732.5	20175	3	QPSK	8	0	13.22	0-1	1
	1732.5	20175	3	QPSK	8	4	13.21	0-1	1
	1732.5	20175	3	QPSK	8	7	13.27	0-1	1
	1732.5	20175	3	QPSK	15	0	13.20	0-1	1
	1732.5	20175	3	16-QAM	1	0	13.41	0-1	1
	1732.5	20175	3	16-QAM	1	7	13.36	0-1	1
	1732.5	20175	3	16-QAM	1	14	13.43	0-1	1
	1732.5	20175	3	16-QAM	8	0	12.23	0-2	2
	1732.5	20175	3	16-QAM	8	4	12.24	0-2	2
	1732.5	20175	3	16-QAM	8	7	12.29	0-2	2
	1732.5	20175	3	16-QAM	15	0	12.31	0-2	2
High	1753.5	20385	3	QPSK	1	0	14.08	0	0
	1753.5	20385	3	QPSK	1	7	14.12	0	0
	1753.5	20385	3	QPSK	1	14	14.29	0	0
	1753.5	20385	3	QPSK	8	0	13.22	0-1	1
	1753.5	20385	3	QPSK	8	4	13.31	0-1	1
	1753.5	20385	3	QPSK	8	7	13.22	0-1	1
	1753.5	20385	3	QPSK	15	0	13.41	0-1	1
	1753.5	20385	3	16-QAM	1	0	13.17	0-1	1
	1753.5	20385	3	16-QAM	1	7	13.26	0-1	1
	1753.5	20385	3	16-QAM	1	14	13.27	0-1	1
	1753.5	20385	3	16-QAM	8	0	12.02	0-2	2
	1753.5	20385	3	16-QAM	8	4	12.34	0-2	2
	1753.5	20385	3	16-QAM	8	7	12.33	0-2	2
	1753.5	20385	3	16-QAM	15	0	12.02	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 41 of 89		

Table 8-30
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	14.35	0	0
	1710.7	19957	1.4	QPSK	1	2	14.22	0	0
	1710.7	19957	1.4	QPSK	1	5	14.25	0	0
	1710.7	19957	1.4	QPSK	3	0	14.22	0	0
	1710.7	19957	1.4	QPSK	3	2	14.03	0	0
	1710.7	19957	1.4	QPSK	3	3	14.11	0	0
	1710.7	19957	1.4	QPSK	6	0	13.39	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	13.42	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	13.34	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	13.36	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	13.33	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	13.18	0-1	1
	1710.7	19957	1.4	16-QAM	3	3	13.20	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	12.21	0-2	2
Mid	1732.5	20175	1.4	QPSK	1	0	14.29	0	0
	1732.5	20175	1.4	QPSK	1	2	14.35	0	0
	1732.5	20175	1.4	QPSK	1	5	14.03	0	0
	1732.5	20175	1.4	QPSK	3	0	14.31	0	0
	1732.5	20175	1.4	QPSK	3	2	14.12	0	0
	1732.5	20175	1.4	QPSK	3	3	14.11	0	0
	1732.5	20175	1.4	QPSK	6	0	13.20	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	13.42	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	13.33	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	13.20	0-1	1
	1732.5	20175	1.4	16-QAM	3	0	13.03	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	13.15	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	13.48	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	12.19	0-2	2
High	1754.3	20393	1.4	QPSK	1	0	14.12	0	0
	1754.3	20393	1.4	QPSK	1	2	14.13	0	0
	1754.3	20393	1.4	QPSK	1	5	14.25	0	0
	1754.3	20393	1.4	QPSK	3	0	14.03	0	0
	1754.3	20393	1.4	QPSK	3	2	14.28	0	0
	1754.3	20393	1.4	QPSK	3	3	14.31	0	0
	1754.3	20393	1.4	QPSK	6	0	13.06	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	13.39	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	13.34	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	13.30	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	13.01	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	13.16	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	13.11	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	12.06	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 42 of 89		

8.2.4

LTE Band 2 (PCS)

Table 8-31
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	23.13	0	0
	1860	18700	20	QPSK	1	50	23.27	0	0
	1860	18700	20	QPSK	1	99	23.36	0	0
	1860	18700	20	QPSK	50	0	22.00	0-1	1
	1860	18700	20	QPSK	50	25	22.16	0-1	1
	1860	18700	20	QPSK	50	50	22.19	0-1	1
	1860	18700	20	QPSK	100	0	22.09	0-1	1
	1860	18700	20	16QAM	1	0	22.35	0-1	1
	1860	18700	20	16QAM	1	50	22.33	0-1	1
	1860	18700	20	16QAM	1	99	22.45	0-1	1
	1860	18700	20	16QAM	50	0	21.14	0-2	2
	1860	18700	20	16QAM	50	25	21.08	0-2	2
	1860	18700	20	16QAM	50	50	21.09	0-2	2
	1860	18700	20	16QAM	100	0	20.99	0-2	2
	1880.0	18900	20	QPSK	1	0	23.35	0	0
	1880.0	18900	20	QPSK	1	50	23.34	0	0
Mid	1880.0	18900	20	QPSK	1	99	23.32	0	0
	1880.0	18900	20	QPSK	50	0	21.95	0-1	1
	1880.0	18900	20	QPSK	50	25	22.03	0-1	1
	1880.0	18900	20	QPSK	50	50	21.99	0-1	1
	1880.0	18900	20	QPSK	100	0	21.97	0-1	1
	1880.0	18900	20	16QAM	1	0	22.50	0-1	1
	1880.0	18900	20	16QAM	1	50	22.40	0-1	1
	1880.0	18900	20	16QAM	1	99	22.49	0-1	1
	1880.0	18900	20	16QAM	50	0	20.99	0-2	2
	1880.0	18900	20	16QAM	50	25	21.04	0-2	2
	1880.0	18900	20	16QAM	50	50	21.03	0-2	2
	1880.0	18900	20	16QAM	100	0	20.91	0-2	2
	1900	19100	20	QPSK	1	0	23.11	0	0
	1900	19100	20	QPSK	1	50	23.15	0	0
	1900	19100	20	QPSK	1	99	23.33	0	0
High	1900	19100	20	QPSK	50	0	21.93	0-1	1
	1900	19100	20	QPSK	50	25	21.90	0-1	1
	1900	19100	20	QPSK	50	50	21.95	0-1	1
	1900	19100	20	QPSK	100	0	21.89	0-1	1
	1900	19100	20	16QAM	1	0	22.32	0-1	1
	1900	19100	20	16QAM	1	50	22.25	0-1	1
	1900	19100	20	16QAM	1	99	22.34	0-1	1
	1900	19100	20	16QAM	50	0	20.92	0-2	2
	1900	19100	20	16QAM	50	25	20.89	0-2	2
	1900	19100	20	16QAM	50	50	20.96	0-2	2
	1900	19100	20	16QAM	100	0	20.89	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 43 of 89

Table 8-32
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	23.48	0	0
	1857.5	18675	15	QPSK	1	36	23.42	0	0
	1857.5	18675	15	QPSK	1	74	23.46	0	0
	1857.5	18675	15	QPSK	36	0	22.03	0-1	1
	1857.5	18675	15	QPSK	36	18	22.17	0-1	1
	1857.5	18675	15	QPSK	36	37	22.10	0-1	1
	1857.5	18675	15	QPSK	75	0	22.06	0-1	1
	1857.5	18675	15	16QAM	1	0	22.32	0-1	1
	1857.5	18675	15	16QAM	1	36	22.45	0-1	1
	1857.5	18675	15	16QAM	1	74	22.42	0-1	1
	1857.5	18675	15	16QAM	36	0	20.94	0-2	2
	1857.5	18675	15	16QAM	36	18	21.04	0-2	2
	1857.5	18675	15	16QAM	36	37	21.08	0-2	2
	1857.5	18675	15	16QAM	75	0	21.06	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	23.25	0	0
	1880.0	18900	15	QPSK	1	36	23.29	0	0
	1880.0	18900	15	QPSK	1	74	23.27	0	0
	1880.0	18900	15	QPSK	36	0	22.05	0-1	1
	1880.0	18900	15	QPSK	36	18	22.09	0-1	1
	1880.0	18900	15	QPSK	36	37	22.11	0-1	1
	1880.0	18900	15	QPSK	75	0	22.01	0-1	1
	1880.0	18900	15	16QAM	1	0	22.45	0-1	1
	1880.0	18900	15	16QAM	1	36	22.40	0-1	1
	1880.0	18900	15	16QAM	1	74	22.38	0-1	1
	1880.0	18900	15	16QAM	36	0	21.07	0-2	2
	1880.0	18900	15	16QAM	36	18	20.97	0-2	2
	1880.0	18900	15	16QAM	36	37	20.98	0-2	2
	1880.0	18900	15	16QAM	75	0	20.99	0-2	2
High	1902.5	19125	15	QPSK	1	0	23.23	0	0
	1902.5	19125	15	QPSK	1	36	23.13	0	0
	1902.5	19125	15	QPSK	1	74	23.20	0	0
	1902.5	19125	15	QPSK	36	0	21.76	0-1	1
	1902.5	19125	15	QPSK	36	18	21.83	0-1	1
	1902.5	19125	15	QPSK	36	37	21.89	0-1	1
	1902.5	19125	15	QPSK	75	0	21.84	0-1	1
	1902.5	19125	15	16QAM	1	0	22.23	0-1	1
	1902.5	19125	15	16QAM	1	36	22.13	0-1	1
	1902.5	19125	15	16QAM	1	74	22.19	0-1	1
	1902.5	19125	15	16QAM	36	0	20.79	0-2	2
	1902.5	19125	15	16QAM	36	18	20.78	0-2	2
	1902.5	19125	15	16QAM	36	37	20.84	0-2	2
	1902.5	19125	15	16QAM	75	0	20.81	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 44 of 89		

Table 8-33
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	23.47	0	0
	1855	18650	10	QPSK	1	25	23.49	0	0
	1855	18650	10	QPSK	1	49	23.48	0	0
	1855	18650	10	QPSK	25	0	22.05	0-1	1
	1855	18650	10	QPSK	25	12	22.08	0-1	1
	1855	18650	10	QPSK	25	25	22.22	0-1	1
	1855	18650	10	QPSK	50	0	22.10	0-1	1
	1855	18650	10	16QAM	1	0	22.35	0-1	1
	1855	18650	10	16QAM	1	25	22.42	0-1	1
	1855	18650	10	16QAM	1	49	22.45	0-1	1
	1855	18650	10	16QAM	25	0	21.02	0-2	2
	1855	18650	10	16QAM	25	12	21.12	0-2	2
	1855	18650	10	16QAM	25	25	21.15	0-2	2
	1855	18650	10	16QAM	50	0	21.13	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	23.21	0	0
	1880.0	18900	10	QPSK	1	25	23.29	0	0
	1880.0	18900	10	QPSK	1	49	23.26	0	0
	1880.0	18900	10	QPSK	25	0	21.87	0-1	1
	1880.0	18900	10	QPSK	25	12	21.96	0-1	1
	1880.0	18900	10	QPSK	25	25	21.93	0-1	1
	1880.0	18900	10	QPSK	50	0	21.90	0-1	1
	1880.0	18900	10	16QAM	1	0	22.13	0-1	1
	1880.0	18900	10	16QAM	1	25	22.15	0-1	1
	1880.0	18900	10	16QAM	1	49	22.26	0-1	1
	1880.0	18900	10	16QAM	25	0	20.85	0-2	2
	1880.0	18900	10	16QAM	25	12	20.92	0-2	2
	1880.0	18900	10	16QAM	25	25	20.90	0-2	2
	1880.0	18900	10	16QAM	50	0	20.81	0-2	2
High	1905	19150	10	QPSK	1	0	23.05	0	0
	1905	19150	10	QPSK	1	25	23.14	0	0
	1905	19150	10	QPSK	1	49	23.05	0	0
	1905	19150	10	QPSK	25	0	21.69	0-1	1
	1905	19150	10	QPSK	25	12	21.63	0-1	1
	1905	19150	10	QPSK	25	25	21.78	0-1	1
	1905	19150	10	QPSK	50	0	21.75	0-1	1
	1905	19150	10	16QAM	1	0	21.90	0-1	1
	1905	19150	10	16QAM	1	25	21.98	0-1	1
	1905	19150	10	16QAM	1	49	21.94	0-1	1
	1905	19150	10	16QAM	25	0	20.66	0-2	2
	1905	19150	10	16QAM	25	12	20.69	0-2	2
	1905	19150	10	16QAM	25	25	20.78	0-2	2
	1905	19150	10	16QAM	50	0	20.66	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 45 of 89		

Table 8-34
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	23.35	0	0
	1852.5	18625	5	QPSK	1	12	23.47	0	0
	1852.5	18625	5	QPSK	1	24	23.49	0	0
	1852.5	18625	5	QPSK	12	0	22.22	0-1	1
	1852.5	18625	5	QPSK	12	6	22.24	0-1	1
	1852.5	18625	5	QPSK	12	13	22.31	0-1	1
	1852.5	18625	5	QPSK	25	0	22.20	0-1	1
	1852.5	18625	5	16-QAM	1	0	22.45	0-1	1
	1852.5	18625	5	16-QAM	1	12	22.49	0-1	1
	1852.5	18625	5	16-QAM	1	24	22.48	0-1	1
	1852.5	18625	5	16-QAM	12	0	21.12	0-2	2
	1852.5	18625	5	16-QAM	12	6	21.23	0-2	2
	1852.5	18625	5	16-QAM	12	13	21.26	0-2	2
	1852.5	18625	5	16-QAM	25	0	21.14	0-2	2
	1880.0	18900	5	QPSK	1	0	23.25	0	0
Mid	1880.0	18900	5	QPSK	1	12	23.32	0	0
	1880.0	18900	5	QPSK	1	24	23.44	0	0
	1880.0	18900	5	QPSK	12	0	21.95	0-1	1
	1880.0	18900	5	QPSK	12	6	21.97	0-1	1
	1880.0	18900	5	QPSK	12	13	21.91	0-1	1
	1880.0	18900	5	QPSK	25	0	21.94	0-1	1
	1880.0	18900	5	16-QAM	1	0	22.22	0-1	1
	1880.0	18900	5	16-QAM	1	12	22.21	0-1	1
	1880.0	18900	5	16-QAM	1	24	22.23	0-1	1
	1880.0	18900	5	16-QAM	12	0	20.87	0-2	2
	1880.0	18900	5	16-QAM	12	6	20.89	0-2	2
	1880.0	18900	5	16-QAM	12	13	20.94	0-2	2
	1880.0	18900	5	16-QAM	25	0	21.00	0-2	2
	1907.5	19175	5	QPSK	1	0	23.00	0	0
	1907.5	19175	5	QPSK	1	12	23.11	0	0
High	1907.5	19175	5	QPSK	1	24	23.05	0	0
	1907.5	19175	5	QPSK	12	0	21.66	0-1	1
	1907.5	19175	5	QPSK	12	6	21.70	0-1	1
	1907.5	19175	5	QPSK	12	13	21.67	0-1	1
	1907.5	19175	5	QPSK	25	0	21.67	0-1	1
	1907.5	19175	5	16-QAM	1	0	21.69	0-1	1
	1907.5	19175	5	16-QAM	1	12	21.90	0-1	1
	1907.5	19175	5	16-QAM	1	24	21.85	0-1	1
	1907.5	19175	5	16-QAM	12	0	20.85	0-2	2
	1907.5	19175	5	16-QAM	12	6	20.78	0-2	2
	1907.5	19175	5	16-QAM	12	13	20.77	0-2	2
	1907.5	19175	5	16-QAM	25	0	20.66	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 46 of 89		

Table 8-35
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	18615	3	QPSK	1	0	23.49	0	0
	1851.5	18615	3	QPSK	1	7	23.48	0	0
	1851.5	18615	3	QPSK	1	14	23.48	0	0
	1851.5	18615	3	QPSK	8	0	22.20	0-1	1
	1851.5	18615	3	QPSK	8	4	22.25	0-1	1
	1851.5	18615	3	QPSK	8	7	22.33	0-1	1
	1851.5	18615	3	QPSK	15	0	22.25	0-1	1
	1851.5	18615	3	16-QAM	1	0	22.30	0-1	1
	1851.5	18615	3	16-QAM	1	7	22.29	0-1	1
	1851.5	18615	3	16-QAM	1	14	22.36	0-1	1
	1851.5	18615	3	16-QAM	8	0	21.22	0-2	2
	1851.5	18615	3	16-QAM	8	4	21.29	0-2	2
	1851.5	18615	3	16-QAM	8	7	21.30	0-2	2
	1851.5	18615	3	16-QAM	15	0	21.33	0-2	2
Mid	1880.0	18900	3	QPSK	1	0	23.30	0	0
	1880.0	18900	3	QPSK	1	7	23.34	0	0
	1880.0	18900	3	QPSK	1	14	23.26	0	0
	1880.0	18900	3	QPSK	8	0	21.96	0-1	1
	1880.0	18900	3	QPSK	8	4	21.95	0-1	1
	1880.0	18900	3	QPSK	8	7	22.02	0-1	1
	1880.0	18900	3	QPSK	15	0	21.95	0-1	1
	1880.0	18900	3	16-QAM	1	0	22.20	0-1	1
	1880.0	18900	3	16-QAM	1	7	22.13	0-1	1
	1880.0	18900	3	16-QAM	1	14	22.19	0-1	1
	1880.0	18900	3	16-QAM	8	0	20.81	0-2	2
	1880.0	18900	3	16-QAM	8	4	20.84	0-2	2
	1880.0	18900	3	16-QAM	8	7	20.88	0-2	2
	1880.0	18900	3	16-QAM	15	0	20.81	0-2	2
High	1908.5	19185	3	QPSK	1	0	23.13	0	0
	1908.5	19185	3	QPSK	1	7	23.23	0	0
	1908.5	19185	3	QPSK	1	14	23.18	0	0
	1908.5	19185	3	QPSK	8	0	21.80	0-1	1
	1908.5	19185	3	QPSK	8	4	21.84	0-1	1
	1908.5	19185	3	QPSK	8	7	21.67	0-1	1
	1908.5	19185	3	QPSK	15	0	21.91	0-1	1
	1908.5	19185	3	16-QAM	1	0	22.05	0-1	1
	1908.5	19185	3	16-QAM	1	7	22.09	0-1	1
	1908.5	19185	3	16-QAM	1	14	22.00	0-1	1
	1908.5	19185	3	16-QAM	8	0	20.71	0-2	2
	1908.5	19185	3	16-QAM	8	4	20.74	0-2	2
	1908.5	19185	3	16-QAM	8	7	20.65	0-2	2
	1908.5	19185	3	16-QAM	15	0	20.69	0-2	2

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 47 of 89	

Table 8-36
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	18607	1.4	QPSK	1	0	23.48	0	0
	1850.7	18607	1.4	QPSK	1	2	23.49	0	0
	1850.7	18607	1.4	QPSK	1	5	23.46	0	0
	1850.7	18607	1.4	QPSK	3	0	23.41	0	0
	1850.7	18607	1.4	QPSK	3	2	23.43	0	0
	1850.7	18607	1.4	QPSK	3	3	23.46	0	0
	1850.7	18607	1.4	QPSK	6	0	22.39	0-1	1
	1850.7	18607	1.4	16-QAM	1	0	22.40	0-1	1
	1850.7	18607	1.4	16-QAM	1	2	22.43	0-1	1
	1850.7	18607	1.4	16-QAM	1	5	22.48	0-1	1
	1850.7	18607	1.4	16-QAM	3	0	22.24	0-1	1
	1850.7	18607	1.4	16-QAM	3	2	22.43	0-1	1
	1850.7	18607	1.4	16-QAM	3	3	22.47	0-1	1
	1850.7	18607	1.4	16-QAM	6	0	21.16	0-2	2
	1880.0	18900	1.4	QPSK	1	0	23.33	0	0
	1880.0	18900	1.4	QPSK	1	2	23.42	0	0
Mid	1880.0	18900	1.4	QPSK	1	5	23.39	0	0
	1880.0	18900	1.4	QPSK	3	0	23.07	0	0
	1880.0	18900	1.4	QPSK	3	2	23.13	0	0
	1880.0	18900	1.4	QPSK	3	3	23.18	0	0
	1880.0	18900	1.4	QPSK	6	0	21.86	0-1	1
	1880.0	18900	1.4	16-QAM	1	0	22.30	0-1	1
	1880.0	18900	1.4	16-QAM	1	2	22.39	0-1	1
	1880.0	18900	1.4	16-QAM	1	5	22.37	0-1	1
	1880.0	18900	1.4	16-QAM	3	0	21.94	0-1	1
	1880.0	18900	1.4	16-QAM	3	2	21.97	0-1	1
	1880.0	18900	1.4	16-QAM	3	3	22.00	0-1	1
	1880.0	18900	1.4	16-QAM	6	0	20.88	0-2	2
	1909.3	19193	1.4	QPSK	1	0	23.18	0	0
	1909.3	19193	1.4	QPSK	1	2	23.14	0	0
	1909.3	19193	1.4	QPSK	1	5	23.20	0	0
	1909.3	19193	1.4	QPSK	3	0	23.03	0	0
High	1909.3	19193	1.4	QPSK	3	2	23.02	0	0
	1909.3	19193	1.4	QPSK	3	3	23.04	0	0
	1909.3	19193	1.4	QPSK	6	0	21.87	0-1	1
	1909.3	19193	1.4	16-QAM	1	0	22.23	0-1	1
	1909.3	19193	1.4	16-QAM	1	2	22.46	0-1	1
	1909.3	19193	1.4	16-QAM	1	5	22.36	0-1	1
	1909.3	19193	1.4	16-QAM	3	0	22.02	0-1	1
	1909.3	19193	1.4	16-QAM	3	2	22.00	0-1	1
	1909.3	19193	1.4	16-QAM	3	3	21.93	0-1	1
	1909.3	19193	1.4	16-QAM	6	0	20.81	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 48 of 89		

Table 8-37
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	15.04	0	0
	1860	18700	20	QPSK	1	50	14.99	0	0
	1860	18700	20	QPSK	1	99	15.07	0	0
	1860	18700	20	QPSK	50	0	13.76	0-1	1
	1860	18700	20	QPSK	50	25	13.89	0-1	1
	1860	18700	20	QPSK	50	50	13.92	0-1	1
	1860	18700	20	QPSK	100	0	13.80	0-1	1
	1860	18700	20	16QAM	1	0	13.84	0-1	1
	1860	18700	20	16QAM	1	50	13.90	0-1	1
	1860	18700	20	16QAM	1	99	14.20	0-1	1
	1860	18700	20	16QAM	50	0	12.82	0-2	2
	1860	18700	20	16QAM	50	25	12.90	0-2	2
	1860	18700	20	16QAM	50	50	12.93	0-2	2
	1860	18700	20	16QAM	100	0	12.79	0-2	2
	1880.0	18900	20	QPSK	1	0	15.46	0	0
	1880.0	18900	20	QPSK	1	50	15.45	0	0
Mid	1880.0	18900	20	QPSK	1	99	15.43	0	0
	1880.0	18900	20	QPSK	50	0	14.21	0-1	1
	1880.0	18900	20	QPSK	50	25	14.25	0-1	1
	1880.0	18900	20	QPSK	50	50	14.25	0-1	1
	1880.0	18900	20	QPSK	100	0	14.15	0-1	1
	1880.0	18900	20	16QAM	1	0	14.09	0-1	1
	1880.0	18900	20	16QAM	1	50	14.27	0-1	1
	1880.0	18900	20	16QAM	1	99	14.26	0-1	1
	1880.0	18900	20	16QAM	50	0	13.22	0-2	2
	1880.0	18900	20	16QAM	50	25	13.27	0-2	2
	1880.0	18900	20	16QAM	50	50	13.28	0-2	2
	1880.0	18900	20	16QAM	100	0	13.15	0-2	2
High	1900	19100	20	QPSK	1	0	15.43	0	0
	1900	19100	20	QPSK	1	50	15.44	0	0
	1900	19100	20	QPSK	1	99	15.50	0	0
	1900	19100	20	QPSK	50	0	14.26	0-1	1
	1900	19100	20	QPSK	50	25	14.13	0-1	1
	1900	19100	20	QPSK	50	50	14.11	0-1	1
	1900	19100	20	QPSK	100	0	14.12	0-1	1
	1900	19100	20	16QAM	1	0	14.24	0-1	1
	1900	19100	20	16QAM	1	50	14.13	0-1	1
	1900	19100	20	16QAM	1	99	14.39	0-1	1
	1900	19100	20	16QAM	50	0	13.21	0-2	2
	1900	19100	20	16QAM	50	25	13.12	0-2	2
	1900	19100	20	16QAM	50	50	13.24	0-2	2
	1900	19100	20	16QAM	100	0	13.13	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 49 of 89		

Table 8-38
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	15.30	0	0
	1857.5	18675	15	QPSK	1	36	15.25	0	0
	1857.5	18675	15	QPSK	1	74	15.33	0	0
	1857.5	18675	15	QPSK	36	0	14.02	0-1	1
	1857.5	18675	15	QPSK	36	18	14.15	0-1	1
	1857.5	18675	15	QPSK	36	37	14.18	0-1	1
	1857.5	18675	15	QPSK	75	0	14.06	0-1	1
	1857.5	18675	15	16QAM	1	0	14.10	0-1	1
	1857.5	18675	15	16QAM	1	36	14.16	0-1	1
	1857.5	18675	15	16QAM	1	74	14.46	0-1	1
	1857.5	18675	15	16QAM	36	0	13.08	0-2	2
	1857.5	18675	15	16QAM	36	18	13.16	0-2	2
	1857.5	18675	15	16QAM	36	37	13.19	0-2	2
	1857.5	18675	15	16QAM	75	0	13.05	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	15.49	0	0
	1880.0	18900	15	QPSK	1	36	15.40	0	0
	1880.0	18900	15	QPSK	1	74	15.48	0	0
	1880.0	18900	15	QPSK	36	0	14.19	0-1	1
	1880.0	18900	15	QPSK	36	18	14.42	0-1	1
	1880.0	18900	15	QPSK	36	37	14.46	0-1	1
	1880.0	18900	15	QPSK	75	0	14.41	0-1	1
	1880.0	18900	15	16QAM	1	0	14.44	0-1	1
	1880.0	18900	15	16QAM	1	36	14.20	0-1	1
	1880.0	18900	15	16QAM	1	74	14.46	0-1	1
	1880.0	18900	15	16QAM	36	0	13.46	0-2	2
	1880.0	18900	15	16QAM	36	18	13.47	0-2	2
	1880.0	18900	15	16QAM	36	37	13.48	0-2	2
	1880.0	18900	15	16QAM	75	0	13.50	0-2	2
High	1902.5	19125	15	QPSK	1	0	15.37	0	0
	1902.5	19125	15	QPSK	1	36	15.38	0	0
	1902.5	19125	15	QPSK	1	74	15.44	0	0
	1902.5	19125	15	QPSK	36	0	14.20	0-1	1
	1902.5	19125	15	QPSK	36	18	14.07	0-1	1
	1902.5	19125	15	QPSK	36	37	14.05	0-1	1
	1902.5	19125	15	QPSK	75	0	14.06	0-1	1
	1902.5	19125	15	16QAM	1	0	14.18	0-1	1
	1902.5	19125	15	16QAM	1	36	14.07	0-1	1
	1902.5	19125	15	16QAM	1	74	14.33	0-1	1
	1902.5	19125	15	16QAM	36	0	13.15	0-2	2
	1902.5	19125	15	16QAM	36	18	13.06	0-2	2
	1902.5	19125	15	16QAM	36	37	13.18	0-2	2
	1902.5	19125	15	16QAM	75	0	13.07	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 50 of 89		

Table 8-39
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	15.23	0	0
	1855	18650	10	QPSK	1	25	15.18	0	0
	1855	18650	10	QPSK	1	49	15.26	0	0
	1855	18650	10	QPSK	25	0	14.00	0-1	1
	1855	18650	10	QPSK	25	12	14.08	0-1	1
	1855	18650	10	QPSK	25	25	14.11	0-1	1
	1855	18650	10	QPSK	50	0	14.29	0-1	1
	1855	18650	10	16QAM	1	0	14.03	0-1	1
	1855	18650	10	16QAM	1	25	14.09	0-1	1
	1855	18650	10	16QAM	1	49	14.39	0-1	1
	1855	18650	10	16QAM	25	0	13.01	0-2	2
	1855	18650	10	16QAM	25	12	13.09	0-2	2
	1855	18650	10	16QAM	25	25	13.12	0-2	2
	1855	18650	10	16QAM	50	0	13.03	0-2	2
	1880.0	18900	10	QPSK	1	0	15.43	0	0
Mid	1880.0	18900	10	QPSK	1	25	15.42	0	0
	1880.0	18900	10	QPSK	1	49	15.40	0	0
	1880.0	18900	10	QPSK	25	0	14.18	0-1	1
	1880.0	18900	10	QPSK	25	12	14.22	0-1	1
	1880.0	18900	10	QPSK	25	25	14.22	0-1	1
	1880.0	18900	10	QPSK	50	0	14.12	0-1	1
	1880.0	18900	10	16QAM	1	0	14.06	0-1	1
	1880.0	18900	10	16QAM	1	25	14.24	0-1	1
	1880.0	18900	10	16QAM	1	49	14.23	0-1	1
	1880.0	18900	10	16QAM	25	0	13.19	0-2	2
	1880.0	18900	10	16QAM	25	12	13.24	0-2	2
	1880.0	18900	10	16QAM	25	25	13.25	0-2	2
	1880.0	18900	10	16QAM	50	0	13.12	0-2	2
	1905	19150	10	QPSK	1	0	15.34	0	0
	1905	19150	10	QPSK	1	25	15.35	0	0
	1905	19150	10	QPSK	1	49	15.41	0	0
High	1905	19150	10	QPSK	25	0	14.17	0-1	1
	1905	19150	10	QPSK	25	12	14.04	0-1	1
	1905	19150	10	QPSK	25	25	14.02	0-1	1
	1905	19150	10	QPSK	50	0	14.03	0-1	1
	1905	19150	10	16QAM	1	0	14.15	0-1	1
	1905	19150	10	16QAM	1	25	14.04	0-1	1
	1905	19150	10	16QAM	1	49	14.30	0-1	1
	1905	19150	10	16QAM	25	0	13.12	0-2	2
	1905	19150	10	16QAM	25	12	13.03	0-2	2
	1905	19150	10	16QAM	25	25	13.15	0-2	2
	1905	19150	10	16QAM	50	0	13.04	0-2	2

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 51 of 89		

Table 8-40
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	15.31	0	0
	1852.5	18625	5	QPSK	1	12	15.26	0	0
	1852.5	18625	5	QPSK	1	24	15.34	0	0
	1852.5	18625	5	QPSK	12	0	14.08	0-1	1
	1852.5	18625	5	QPSK	12	6	14.16	0-1	1
	1852.5	18625	5	QPSK	12	13	14.19	0-1	1
	1852.5	18625	5	QPSK	25	0	14.37	0-1	1
	1852.5	18625	5	16-QAM	1	0	14.11	0-1	1
	1852.5	18625	5	16-QAM	1	12	14.17	0-1	1
	1852.5	18625	5	16-QAM	1	24	14.47	0-1	1
	1852.5	18625	5	16-QAM	12	0	13.09	0-2	2
	1852.5	18625	5	16-QAM	12	6	13.17	0-2	2
	1852.5	18625	5	16-QAM	12	13	13.20	0-2	2
	1852.5	18625	5	16-QAM	25	0	13.11	0-2	2
	1880.0	18900	5	QPSK	1	0	15.37	0	0
Mid	1880.0	18900	5	QPSK	1	12	15.36	0	0
	1880.0	18900	5	QPSK	1	24	15.34	0	0
	1880.0	18900	5	QPSK	12	0	14.12	0-1	1
	1880.0	18900	5	QPSK	12	6	14.16	0-1	1
	1880.0	18900	5	QPSK	12	13	14.16	0-1	1
	1880.0	18900	5	QPSK	25	0	14.06	0-1	1
	1880.0	18900	5	16-QAM	1	0	14.00	0-1	1
	1880.0	18900	5	16-QAM	1	12	14.18	0-1	1
	1880.0	18900	5	16-QAM	1	24	14.17	0-1	1
	1880.0	18900	5	16-QAM	12	0	13.13	0-2	2
	1880.0	18900	5	16-QAM	12	6	13.18	0-2	2
	1880.0	18900	5	16-QAM	12	13	13.19	0-2	2
	1880.0	18900	5	16-QAM	25	0	13.06	0-2	2
	1907.5	19175	5	QPSK	1	0	15.41	0	0
	1907.5	19175	5	QPSK	1	12	15.42	0	0
	1907.5	19175	5	QPSK	1	24	15.48	0	0
High	1907.5	19175	5	QPSK	12	0	14.24	0-1	1
	1907.5	19175	5	QPSK	12	6	14.22	0-1	1
	1907.5	19175	5	QPSK	12	13	14.09	0-1	1
	1907.5	19175	5	QPSK	25	0	14.10	0-1	1
	1907.5	19175	5	16-QAM	1	0	14.21	0-1	1
	1907.5	19175	5	16-QAM	1	12	14.11	0-1	1
	1907.5	19175	5	16-QAM	1	24	14.37	0-1	1
	1907.5	19175	5	16-QAM	12	0	13.19	0-2	2
	1907.5	19175	5	16-QAM	12	6	13.07	0-2	2
	1907.5	19175	5	16-QAM	12	13	13.20	0-2	2
	1907.5	19175	5	16-QAM	25	0	13.11	0-2	2

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 52 of 89	

Table 8-41
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	18615	3	QPSK	1	0	15.22	0	0
	1851.5	18615	3	QPSK	1	7	15.17	0	0
	1851.5	18615	3	QPSK	1	14	15.25	0	0
	1851.5	18615	3	QPSK	8	0	13.94	0-1	1
	1851.5	18615	3	QPSK	8	4	14.07	0-1	1
	1851.5	18615	3	QPSK	8	7	14.10	0-1	1
	1851.5	18615	3	QPSK	15	0	14.11	0-1	1
	1851.5	18615	3	16-QAM	1	0	14.02	0-1	1
	1851.5	18615	3	16-QAM	1	7	14.08	0-1	1
	1851.5	18615	3	16-QAM	1	14	14.38	0-1	1
	1851.5	18615	3	16-QAM	8	0	13.00	0-2	2
	1851.5	18615	3	16-QAM	8	4	13.08	0-2	2
	1851.5	18615	3	16-QAM	8	7	13.11	0-2	2
	1851.5	18615	3	16-QAM	15	0	13.08	0-2	2
	1880.0	18900	3	QPSK	1	0	15.41	0	0
	1880.0	18900	3	QPSK	1	7	15.32	0	0
	1880.0	18900	3	QPSK	1	14	15.40	0	0
Mid	1880.0	18900	3	QPSK	8	0	14.11	0-1	1
	1880.0	18900	3	QPSK	8	4	14.34	0-1	1
	1880.0	18900	3	QPSK	8	7	14.38	0-1	1
	1880.0	18900	3	QPSK	15	0	14.33	0-1	1
	1880.0	18900	3	16-QAM	1	0	14.36	0-1	1
	1880.0	18900	3	16-QAM	1	7	14.12	0-1	1
	1880.0	18900	3	16-QAM	1	14	14.38	0-1	1
	1880.0	18900	3	16-QAM	8	0	13.42	0-2	2
	1880.0	18900	3	16-QAM	8	4	13.39	0-2	2
	1880.0	18900	3	16-QAM	8	7	13.38	0-2	2
	1880.0	18900	3	16-QAM	15	0	13.42	0-2	2
High	1908.5	19185	3	QPSK	1	0	15.29	0	0
	1908.5	19185	3	QPSK	1	7	15.30	0	0
	1908.5	19185	3	QPSK	1	14	15.36	0	0
	1908.5	19185	3	QPSK	8	0	14.12	0-1	1
	1908.5	19185	3	QPSK	8	4	14.09	0-1	1
	1908.5	19185	3	QPSK	8	7	14.22	0-1	1
	1908.5	19185	3	QPSK	15	0	14.03	0-1	1
	1908.5	19185	3	16-QAM	1	0	14.10	0-1	1
	1908.5	19185	3	16-QAM	1	7	13.99	0-1	1
	1908.5	19185	3	16-QAM	1	14	14.25	0-1	1
	1908.5	19185	3	16-QAM	8	0	13.07	0-2	2
	1908.5	19185	3	16-QAM	8	4	12.98	0-2	2
	1908.5	19185	3	16-QAM	8	7	13.10	0-2	2
	1908.5	19185	3	16-QAM	15	0	12.99	0-2	2

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 53 of 89	

Table 8-42
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	18607	1.4	QPSK	1	0	15.23	0	0
	1850.7	18607	1.4	QPSK	1	2	15.18	0	0
	1850.7	18607	1.4	QPSK	1	5	15.26	0	0
	1850.7	18607	1.4	QPSK	3	0	15.03	0	0
	1850.7	18607	1.4	QPSK	3	2	15.19	0	0
	1850.7	18607	1.4	QPSK	3	3	15.28	0	0
	1850.7	18607	1.4	QPSK	6	0	14.03	0-1	1
	1850.7	18607	1.4	16-QAM	1	0	14.03	0-1	1
	1850.7	18607	1.4	16-QAM	1	2	14.09	0-1	1
	1850.7	18607	1.4	16-QAM	1	5	14.39	0-1	1
	1850.7	18607	1.4	16-QAM	3	0	14.24	0-1	1
	1850.7	18607	1.4	16-QAM	3	2	14.21	0-1	1
	1850.7	18607	1.4	16-QAM	3	3	14.32	0-1	1
	1850.7	18607	1.4	16-QAM	6	0	12.98	0-2	2
	1880.0	18900	1.4	QPSK	1	0	15.42	0	0
	1880.0	18900	1.4	QPSK	1	2	15.33	0	0
Mid	1880.0	18900	1.4	QPSK	1	5	15.41	0	0
	1880.0	18900	1.4	QPSK	3	0	15.32	0	0
	1880.0	18900	1.4	QPSK	3	2	15.23	0	0
	1880.0	18900	1.4	QPSK	3	3	15.03	0	0
	1880.0	18900	1.4	QPSK	6	0	14.34	0-1	1
	1880.0	18900	1.4	16-QAM	1	0	14.37	0-1	1
	1880.0	18900	1.4	16-QAM	1	2	14.13	0-1	1
	1880.0	18900	1.4	16-QAM	1	5	14.39	0-1	1
	1880.0	18900	1.4	16-QAM	3	0	14.38	0-1	1
	1880.0	18900	1.4	16-QAM	3	2	14.32	0-1	1
	1880.0	18900	1.4	16-QAM	3	3	14.22	0-1	1
	1880.0	18900	1.4	16-QAM	6	0	13.43	0-2	2
	1909.3	19193	1.4	QPSK	1	0	15.30	0	0
	1909.3	19193	1.4	QPSK	1	2	15.31	0	0
	1909.3	19193	1.4	QPSK	1	5	15.37	0	0
	1909.3	19193	1.4	QPSK	3	0	15.28	0	0
High	1909.3	19193	1.4	QPSK	3	2	15.22	0	0
	1909.3	19193	1.4	QPSK	3	3	14.99	0	0
	1909.3	19193	1.4	QPSK	6	0	13.99	0-1	1
	1909.3	19193	1.4	16-QAM	1	0	14.11	0-1	1
	1909.3	19193	1.4	16-QAM	1	2	14.00	0-1	1
	1909.3	19193	1.4	16-QAM	1	5	14.26	0-1	1
	1909.3	19193	1.4	16-QAM	3	0	14.03	0-1	1
	1909.3	19193	1.4	16-QAM	3	2	14.11	0-1	1
	1909.3	19193	1.4	16-QAM	3	3	14.28	0-1	1
	1909.3	19193	1.4	16-QAM	6	0	13.00	0-2	2

8.2.5 LTE Band 30

Table 8-43
LTE Band 30 Conducted Powers -10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	2310.0	27710	10	QPSK	1	0	22.31	0	0
	2310.0	27710	10	QPSK	1	25	22.24	0	0
	2310.0	27710	10	QPSK	1	49	22.21	0	0
	2310.0	27710	10	QPSK	25	0	20.99	0-1	1
	2310.0	27710	10	QPSK	25	12	20.98	0-1	1
	2310.0	27710	10	QPSK	25	25	20.93	0-1	1
	2310.0	27710	10	QPSK	50	0	20.94	0-1	1
	2310.0	27710	10	16QAM	1	0	21.31	0-1	1
	2310.0	27710	10	16QAM	1	25	21.30	0-1	1
	2310.0	27710	10	16QAM	1	49	21.33	0-1	1
	2310.0	27710	10	16QAM	25	0	19.93	0-2	2
	2310.0	27710	10	16QAM	25	12	20.01	0-2	2
	2310.0	27710	10	16QAM	25	25	20.00	0-2	2
	2310.0	27710	10	16QAM	50	0	19.88	0-2	2

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 54 of 89

Table 8-44
LTE Band 30 Conducted Powers -5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	2310.0	27710	5	QPSK	1	0	22.09	0	0
	2310.0	27710	5	QPSK	1	12	22.12	0	0
	2310.0	27710	5	QPSK	1	24	22.05	0	0
	2310.0	27710	5	QPSK	12	0	20.95	0-1	1
	2310.0	27710	5	QPSK	12	6	20.93	0-1	1
	2310.0	27710	5	QPSK	12	13	20.93	0-1	1
	2310.0	27710	5	QPSK	25	0	20.87	0-1	1
	2310.0	27710	5	16-QAM	1	0	21.03	0-1	1
	2310.0	27710	5	16-QAM	1	12	20.91	0-1	1
	2310.0	27710	5	16-QAM	1	24	21.01	0-1	1
	2310.0	27710	5	16-QAM	12	0	19.84	0-2	2
	2310.0	27710	5	16-QAM	12	6	19.87	0-2	2
	2310.0	27710	5	16-QAM	12	13	19.91	0-2	2
	2310.0	27710	5	16-QAM	25	0	19.90	0-2	2

Note: LTE Band 30 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-45
LTE Band 30 Conducted Powers -10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	2310.0	27710	10	QPSK	1	0	10.58	0	0
	2310.0	27710	10	QPSK	1	25	10.71	0	0
	2310.0	27710	10	QPSK	1	49	10.75	0	0
	2310.0	27710	10	QPSK	25	0	9.61	0-1	1
	2310.0	27710	10	QPSK	25	12	9.63	0-1	1
	2310.0	27710	10	QPSK	25	25	9.68	0-1	1
	2310.0	27710	10	QPSK	50	0	9.67	0-1	1
	2310.0	27710	10	16QAM	1	0	9.80	0-1	1
	2310.0	27710	10	16QAM	1	25	9.86	0-1	1
	2310.0	27710	10	16QAM	1	49	9.90	0-1	1
	2310.0	27710	10	16QAM	25	0	8.59	0-2	2
	2310.0	27710	10	16QAM	25	12	8.71	0-2	2
	2310.0	27710	10	16QAM	25	25	8.76	0-2	2
	2310.0	27710	10	16QAM	50	0	8.66	0-2	2

Table 8-46
LTE Band 30 Conducted Powers -10 MHz Bandwidth
Reduced Power – Body at 0.0 cm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	2310.0	27710	5	QPSK	1	0	10.46	0	0
	2310.0	27710	5	QPSK	1	12	10.49	0	0
	2310.0	27710	5	QPSK	1	24	10.56	0	0
	2310.0	27710	5	QPSK	12	0	9.59	0-1	1
	2310.0	27710	5	QPSK	12	6	9.67	0-1	1
	2310.0	27710	5	QPSK	12	13	9.65	0-1	1
	2310.0	27710	5	QPSK	25	0	9.55	0-1	1
	2310.0	27710	5	16-QAM	1	0	9.50	0-1	1
	2310.0	27710	5	16-QAM	1	12	9.43	0-1	1
	2310.0	27710	5	16-QAM	1	24	9.52	0-1	1
	2310.0	27710	5	16-QAM	12	0	8.63	0-2	2
	2310.0	27710	5	16-QAM	12	6	8.61	0-2	2
	2310.0	27710	5	16-QAM	12	13	8.59	0-2	2
	2310.0	27710	5	16-QAM	25	0	8.58	0-2	2

Note: LTE Band 30 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 55 of 89	

8.2.6 LTE Carrier Aggregation Conducted Powers

Table 8-47
LTE Carrier Aggregation Conducted Powers

PCC						SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Frequency [MHz]	PCC (UL) Channel	PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Frequency [MHz]	SCC (DL) Channel	LTE Rel 10 Tx.Power (dBm)	LTE Rel. 8 Tx.Power (dBm)
LTE B12	5	701.5	23035	1	12	LTE B2	20	1960	900	23.43	23.50
LTE B12	5	701.5	23035	1	12	LTE B30	10	2355	9820	23.35	23.50
LTE B5	10	836.5	20525	1	25	LTE B4	20	2132.5	2175	23.04	23.15
LTE B5	10	836.5	20525	1	25	LTE B2	20	1960	900	23.02	23.15
LTE B5	10	836.5	20525	1	25	LTE B30	10	2355	9820	23.07	23.15
LTE B4	20	1732.5	20175	1	99	LTE B29	10	722.5	9715	23.21	23.47
LTE B4	20	1732.5	20175	1	99	LTE B12	10	737.5	5095	23.19	23.47
LTE B4	10	1715	20000	1	49	LTE B17	10	740	5790	23.18	23.42
LTE B4	20	1732.5	20175	1	99	LTE B5	10	881.5	2525	23.17	23.47
LTE B4	20	1732.5	20175	1	99	LTE B30	10	2355	9820	23.16	23.47
LTE B2	10	1855	18650	1	25	LTE B29	10	722.5	9715	23.48	23.49
LTE B2	10	1855	18650	1	25	LTE B12	10	737.5	5095	23.49	23.49
LTE B2	10	1855	18650	1	25	LTE B17	10	740	5790	23.48	23.49
LTE B2	10	1855	18650	1	25	LTE B5	10	881.5	2525	23.44	23.49
LTE B2	10	1855	18650	1	25	LTE B30	10	2355	9820	23.46	23.49
LTE B30	10	2310	27710	1	0	LTE B29	10	722.5	9715	22.16	22.31
LTE B30	10	2310	27710	1	0	LTE B12	10	737.5	5095	22.12	22.31
LTE B30	10	2310	27710	1	0	LTE B5	10	881.5	2525	22.14	22.31
LTE B30	10	2310	27710	1	0	LTE B4	20	2132.5	2175	22.19	22.31
LTE B30	10	2310	27710	1	0	LTE B2	20	1960	900	22.15	22.31

Table 8-48
LTE Carrier Aggregation Conducted Powers
Reduced Power – Body at 0.0 cm

PCC						SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Frequency [MHz]	PCC (UL) Channel	PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Frequency [MHz]	SCC (DL) Channel	LTE Rel 10 Tx.Power (dBm)	LTE Rel. 8 Tx.Power (dBm)
LTE B12	5	701.5	23035	1	0	LTE B2	20	1960	900	18.00	17.77
LTE B12	5	701.5	23035	1	0	LTE B30	10	2355	9820	17.80	17.77
LTE B5	5	846.5	20625	1	12	LTE B2	20	1960	900	16.55	17.19
LTE B5	5	846.5	20625	1	12	LTE B4	20	2132.5	2175	16.60	17.19
LTE B5	5	846.5	20625	1	12	LTE B30	10	2355	9820	16.65	17.19
LTE B4	5	1712.5	19975	1	0	LTE B17	10	740	5790	14.18	14.46
LTE B4	15	1717.5	20025	1	36	LTE B29	10	722.5	9715	14.07	14.46
LTE B4	15	1717.5	20025	1	36	LTE B12	10	737.5	5095	14.27	14.46
LTE B4	15	1717.5	20025	1	36	LTE B5	10	881.5	2525	14.08	14.46
LTE B4	15	1717.5	20025	1	36	LTE B30	10	2355	9820	14.17	14.46
LTE B2	20	1900	19100	1	99	LTE B29	10	722.5	9715	14.87	15.50
LTE B2	20	1900	19100	1	99	LTE B12	10	737.5	5095	14.83	15.50
LTE B2	20	1900	19100	1	99	LTE B5	10	881.5	2525	14.84	15.50
LTE B2	20	1900	19100	1	99	LTE B30	10	2355	9820	14.90	15.50
LTE B2	5	1907.5	19175	1	24	LTE B17	10	740	5790	14.82	15.48
LTE B30	10	2310	27710	1	49	LTE B29	10	722.5	9715	10.65	10.75
LTE B30	10	2310	27710	1	49	LTE B12	10	737.5	5095	10.63	10.75
LTE B30	10	2310	27710	1	49	LTE B5	10	881.5	2525	10.64	10.75
LTE B30	10	2310	27710	1	49	LTE B2	20	1960	900	10.63	10.75
LTE B30	10	2310	27710	1	49	LTE B4	20	2132.5	2175	10.61	10.75

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 56 of 89

Notes:

1. The device does not support all Rel. 10 Carrier Aggregation features due to modem chipset limitation.
2. The device only supports downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. Power measurements were performed with two DL carriers for the Release 8 configuration that had the highest output power (across all bandwidths, channels and RB Configurations) for each band
3. This device only supports inter-band CA with 2 carriers:

LTE B12 (PCC) + LTE B2 (SCC)	LTE B2 (PCC) + LTE B12 (SCC)
LTE B12 (PCC) + LTE B30 (SCC)	LTE B2 (PCC) + LTE B17 (SCC)
LTE B17 (PCC) + LTE B2 (SCC)	LTE B2 (PCC) + LTE B29 (SCC)
LTE B5 (PCC) + LTE B4 (SCC)	LTE B2 (PCC) + LTE B5 (SCC)
LTE B5 (PCC) + LTE B2 (SCC)	LTE B2 (PCC) + LTE B30 (SCC)
LTE B5 (PCC) + LTE B30 (SCC)	LTE B30 (PCC) + LTE B12 (SCC)
LTE B4 (PCC) + LTE B12 (SCC)	LTE B30 (PCC) + LTE B29 (SCC)
LTE B4 (PCC) + LTE B17 (SCC)	LTE B30 (PCC) + LTE B5 (SCC)
LTE B4 (PCC) + LTE B29 (SCC)	LTE B30 (PCC) + LTE B4 (SCC)
LTE B4 (PCC) + LTE B5 (SCC)	LTE B30 (PCC) + LTE B2 (SCC)
LTE B4 (PCC) + LTE B30 (SCC)	
4. This device supports both LTE Band 12 and LTE Band 17. Since the supported frequency span for LTE Band 17 falls completely within the supported frequency span for LTE band 12, LTE Band 17 has same or lower target power as LTE Band 12, and both LTE bands share the same transmission path, LTE CA SAR combinations were only assessed for LTE Band 12 and PCC.
5. All control and acknowledge data is sent on uplink channels that operate identical to release 8 specifications.

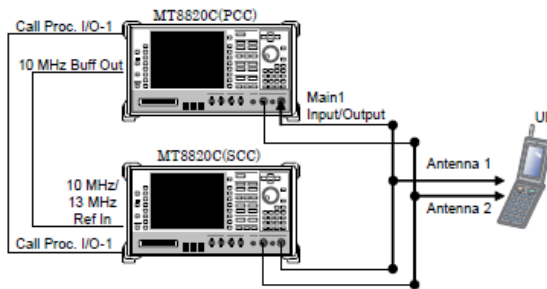


Figure 8-2
Power Measurement Setup

8.3 WLAN Conducted Powers

Table 8-49
2.4 GHz Average RF Power Antenna 1

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	17.42	15.25
2437	6	16.85	15.15
2462	11	17.49	15.05

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 57 of 89	

Table 8-50
2.4 GHz Average RF Power Antenna 1
Reduced Power – Body at 0.0 cm

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	13.92	13.98	13.89
2437	6	14.30	14.14	13.28
2462	11	14.26	14.20	14.25

Table 8-51
2.4 GHz Average RF Power Antenna 2

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	17.11	14.96
2437	6	16.49	14.67
2462	11	16.38	15.31

Table 8-52
2.4 GHz Average RF Power Antenna 2
Reduced Power – Body at 0.0 cm

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	12.18	11.54	11.60
2437	6	12.13	11.45	11.55
2462	11	11.73	11.87	11.87

Table 8-53
5 GHz (20 MHz Bandwidth) Average RF Power – Antenna 1

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	12.66	12.22	12.64
5200	40	12.85	12.51	12.40
5220	44	12.90	12.64	12.43
5240	48	13.06	12.88	12.56
5260	52	13.30	13.17	13.11
5280	56	13.33	13.09	13.23
5300	60	13.19	13.00	13.34
5320	64	13.01	12.99	13.33
5500	100	13.30	13.24	13.01
5580	116	12.52	12.51	13.29
5660	132	12.74	12.74	12.49
5720	144	12.84	12.76	12.50
5745	149	13.31	13.16	12.90
5785	157	13.33	13.25	12.97
5825	165	13.33	13.25	13.10

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 58 of 89		

Table 8-54
5 GHz (80 MHz Bandwidth) Average RF Power – Antenna 1
Reduced Power – Body at 0.0 cm

5GHz (80MHz) Conducted Power		
Freq [MHz]	Channel	IEEE Transmission Mode
		802.11ac
5210	42	8.23
5290	58	8.24
5530	106	7.87
5690	138	7.64
5775	155	7.83

Table 8-55
5 GHz (20 MHz Bandwidth) Average RF Power – Antenna 2

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	12.74	12.63	12.57
5200	40	12.60	12.55	12.64
5220	44	12.65	12.47	12.47
5240	48	12.56	12.46	12.37
5260	52	12.98	12.88	12.88
5280	56	12.89	12.79	12.73
5300	60	12.84	12.80	12.76
5320	64	12.84	12.75	12.86
5500	100	12.99	12.92	12.97
5580	116	13.10	13.04	12.99
5660	132	13.02	13.09	12.98
5720	144	13.19	13.07	13.05
5745	149	12.49	12.34	12.42
5785	157	12.45	12.33	12.33
5825	165	12.43	12.37	12.36

Table 8-56
5 GHz (80 MHz Bandwidth) Average RF Power – Antenna 2
Reduced Power – Body at 0.0 cm

5GHz (80MHz) Conducted Power		
Freq [MHz]	Channel	IEEE Transmission Mode
		802.11ac
5210	42	7.06
5290	58	7.02
5530	106	6.77
5690	138	6.73
5775	155	7.03

Justification for test configurations for WLAN per KDB Publication 248227 D01Wi-Fi SAR v02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
Page 59 of 89		

- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- The bolded data rate and channel above were tested for SAR.

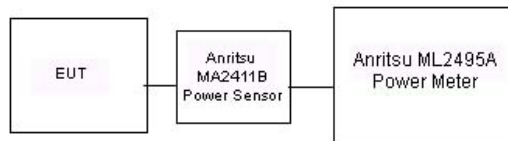


Figure 8-3
Power Measurement Setup for Bandwidths < 50 MHz

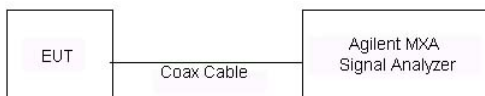


Figure 8-4
Power Measurement Setup for Bandwidths > 50 MHz

Table 8-57
Bluetooth Average RF Power

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	9.18	8.271
2441	1.0	39	9.45	8.819
2480	1.0	78	8.97	7.888
2402	2.0	0	4.63	2.904
2441	2.0	39	5.45	3.511
2480	2.0	78	4.89	3.080
2402	3.0	0	4.69	2.947
2441	3.0	39	5.51	3.552
2480	3.0	78	4.95	3.123

Note: The bolded data rate and channel above was tested for SAR.

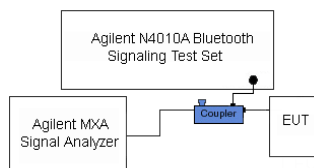


Figure 8-5
Power Measurement Setup

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 60 of 89

9.1 Tissue Verification

Table 9-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
5/4/2015	750B	22.0	695	0.915	54.994	0.959	55.745	-4.59%	-1.35%
			710	0.929	54.841	0.960	55.687	-3.23%	-1.52%
			725	0.943	54.708	0.961	55.629	-1.87%	-1.66%
			740	0.956	54.543	0.963	55.570	-0.73%	-1.85%
			755	0.969	54.393	0.964	55.512	0.52%	-2.02%
4/27/2015	835B	21.5	820	0.978	54.362	0.969	55.258	0.93%	-1.62%
			835	0.992	54.192	0.970	55.200	2.27%	-1.83%
			850	1.007	54.064	0.988	55.154	1.92%	-1.98%
4/30/2015	835B	22.0	820	0.968	53.396	0.969	55.258	-0.10%	-3.37%
			835	0.981	53.240	0.970	55.200	1.13%	-3.55%
			850	0.996	53.116	0.988	55.154	0.81%	-3.70%
4/27/2015	1750B	21.4	1710	1.408	53.031	1.463	53.537	-3.76%	-0.95%
			1750	1.451	52.881	1.488	53.432	-2.49%	-1.03%
			1790	1.497	52.760	1.514	53.326	-1.12%	-1.06%
5/1/2015	1900B	21.0	1850	1.509	52.315	1.520	53.300	-0.72%	-1.85%
			1880	1.539	52.225	1.520	53.300	1.25%	-2.02%
			1910	1.576	52.030	1.520	53.300	3.68%	-2.38%
5/21/2015	2450B	22.5	2300	1.763	51.660	1.809	52.900	-2.54%	-2.34%
			2310	1.775	51.630	1.816	52.887	-2.26%	-2.38%
			2320	1.786	51.588	1.826	52.873	-2.19%	-2.43%
4/29/2015	2450B	22.2	2401	1.903	51.513	1.903	52.765	0.00%	-2.37%
			2450	1.962	51.310	1.950	52.700	0.62%	-2.64%
			2499	2.028	51.126	2.019	52.638	0.45%	-2.87%
			5260	5.344	48.108	5.369	48.933	-0.47%	-1.69%
04/27/2015	5200B-5800B	21.0	5280	5.374	48.052	5.393	48.906	-0.35%	-1.75%
			5300	5.409	48.022	5.416	48.879	-0.13%	-1.75%
			5500	5.652	47.731	5.650	48.607	0.04%	-1.80%
			5520	5.681	47.670	5.673	48.580	0.14%	-1.87%
			5540	5.713	47.612	5.696	48.553	0.30%	-1.94%
			5600	5.803	47.570	5.766	48.471	0.64%	-1.86%
			5680	5.920	47.400	5.860	48.363	1.02%	-1.99%
			5700	5.951	47.399	5.883	48.336	1.16%	-1.94%
			5745	5.999	47.334	5.936	48.275	1.06%	-1.95%
			5765	6.018	47.310	5.959	48.248	0.99%	-1.94%
			5785	6.058	47.224	5.982	48.220	1.27%	-2.07%
			5800	6.073	47.223	6.000	48.200	1.22%	-2.03%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 61 of 89

9.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

Table 9-2
System Verification Results

SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
A	750	BODY	05/04/2015	24.2	22.0	0.100	1046	3331	0.890	8.290	8.900	7.36%
J	835	BODY	04/27/2015	20.9	21.9	0.100	4d133	3022	0.940	9.350	9.400	0.53%
D	835	BODY	04/30/2015	23.3	22.7	0.100	4d133	3209	0.990	9.350	9.900	5.88%
G	1750	BODY	04/27/2015	22.3	21.4	0.100	1008	3318	3.580	37.600	35.800	-4.79%
K	1900	BODY	05/01/2015	22.3	21.0	0.100	5d141	3288	4.020	40.000	40.200	0.50%
G	2300	BODY	05/21/2015	22.3	21.0	0.100	1008	3318	4.640	48.100	46.400	-3.53%
J	2450	BODY	04/29/2015	21.4	21.7	0.100	719	3319	5.560	51.800	55.600	7.34%
E	5300	BODY	04/27/2015	20.9	20.6	0.050	1057	3589	3.840	74.200	76.800	3.50%
E	5500	BODY	04/27/2015	20.9	20.6	0.050	1057	3589	3.780	79.200	75.600	-4.55%
E	5600	BODY	04/27/2015	21.0	20.7	0.050	1057	3589	3.910	77.700	78.200	0.64%
E	5800	BODY	04/27/2015	21.1	20.7	0.050	1057	3589	3.450	75.100	69.000	-8.12%

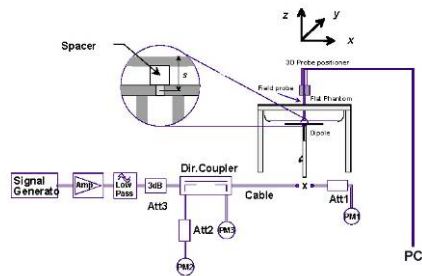


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 62 of 89

10 SAR DATA SUMMARY

10.1 Standalone SAR Data

Table 10-1
UMTS Body SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.5	22.68	0.02	24 mm	8026	1:1	back	0.273	1.208	0.330	
836.60	4183	UMTS 850	RMC	23.5	22.68	0.02	24 mm	8026	1:1	top	0.336	1.208	0.406	
826.40	4132	UMTS 850	RMC	17.0	16.96	0.02	0 mm	6798	1:1	back	0.911	1.009	0.919	
836.60	4183	UMTS 850	RMC	17.0	16.94	0.02	0 mm	6798	1:1	back	0.926	1.014	0.939	
846.60	4233	UMTS 850	RMC	17.0	16.84	0.20	0 mm	6798	1:1	back	0.920	1.038	0.955	
826.40	4132	UMTS 850	RMC	17.0	16.96	0.05	0 mm	6798	1:1	top	0.984	1.009	0.993	
836.60	4183	UMTS 850	RMC	17.0	16.94	0.04	0 mm	6798	1:1	top	0.993	1.014	1.007	A1
846.60	4233	UMTS 850	RMC	17.0	16.84	0.01	0 mm	6798	1:1	top	0.989	1.038	1.027	
836.60	4183	UMTS 850	RMC	23.5	22.68	0.07	0 mm	8026	1:1	right	0.258	1.208	0.312	
836.60	4183	UMTS 850	RMC	23.5	22.68	0.15	0 mm	8026	1:1	left	0.146	1.208	0.176	
836.60	4183	UMTS 850	RMC	17.0	16.94	0.11	0 mm	6798	1:1	top	0.904	1.014	0.917	
1880.00	9400	UMTS 1900	RMC	22.5	22.05	0.04	24 mm	8026	1:1	back	0.183	1.109	0.203	
1880.00	9400	UMTS 1900	RMC	22.5	22.05	0.03	24 mm	8026	1:1	top	0.227	1.109	0.252	
1852.40	9262	UMTS 1900	RMC	15.0	14.68	-0.07	0 mm	6798	1:1	back	0.887	1.076	0.954	
1880.00	9400	UMTS 1900	RMC	15.0	14.88	-0.06	0 mm	6798	1:1	back	0.926	1.028	0.952	
1907.60	9538	UMTS 1900	RMC	15.0	14.96	-0.04	0 mm	6798	1:1	back	1.080	1.009	1.090	A2
1880.00	9400	UMTS 1900	RMC	15.0	14.88	-0.17	0 mm	6798	1:1	top	0.404	1.028	0.415	
1880.00	9400	UMTS 1900	RMC	22.5	22.05	0.05	0 mm	8026	1:1	right	0.059	1.109	0.065	
1880.00	9400	UMTS 1900	RMC	22.5	22.05	0.04	0 mm	8026	1:1	left	0.440	1.109	0.488	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note: Blue entry represents variability measurement

Table 10-2
LTE Band 12 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	23.5	23.33	0.04	0	7318	QPSK	1	25	24 mm	back	1:1	0.077	1.040	0.080	
707.50	23095	Mid	LTE Band 12	10	22.5	22.04	-0.04	1	7318	QPSK	25	0	24 mm	back	1:1	0.057	1.112	0.063	
707.50	23095	Mid	LTE Band 12	10	23.5	23.33	0.01	0	7318	QPSK	1	25	24 mm	top	1:1	0.095	1.040	0.099	
707.50	23095	Mid	LTE Band 12	10	22.5	22.04	0.08	1	7318	QPSK	25	0	24 mm	top	1:1	0.072	1.112	0.080	
707.50	23095	Mid	LTE Band 12	10	18.5	17.65	-0.01	0	8134	QPSK	1	49	0 mm	back	1:1	0.588	1.216	0.715	
707.50	23095	Mid	LTE Band 12	10	17.5	16.45	-0.02	1	8134	QPSK	25	12	0 mm	back	1:1	0.428	1.274	0.545	
707.50	23095	Mid	LTE Band 12	10	18.5	17.65	-0.09	0	8134	QPSK	1	49	0 mm	top	1:1	0.876	1.216	1.065	
707.50	23095	Mid	LTE Band 12	10	17.5	16.45	-0.06	1	8134	QPSK	25	12	0 mm	top	1:1	0.641	1.274	0.817	
707.50	23095	Mid	LTE Band 12	10	17.5	16.36	-0.20	1	8134	QPSK	50	0	0 mm	top	1:1	0.646	1.300	0.840	
707.50	23095	Mid	LTE Band 12	10	23.5	23.33	-0.09	0	7318	QPSK	1	25	0 mm	right	1:1	0.108	1.040	0.112	
707.50	23095	Mid	LTE Band 12	10	22.5	22.04	0.15	1	7318	QPSK	25	0	0 mm	right	1:1	0.090	1.112	0.100	
707.50	23095	Mid	LTE Band 12	10	23.5	23.33	0.05	0	7318	QPSK	1	25	0 mm	left	1:1	0.082	1.040	0.085	
707.50	23095	Mid	LTE Band 12	10	22.5	22.04	0.08	1	7318	QPSK	25	0	0 mm	left	1:1	0.063	1.112	0.070	
707.50	23095	Mid	LTE Band 12	10	18.5	17.65	-0.08	0	8134	QPSK	1	49	0 mm	top	1:1	0.877	1.216	1.066	A3
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entry represents variability measurement

FCC ID: A3LSMT817A		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 63 of 89	

Table 10-3
LTE Band 5 (Cell) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	23.15	-0.02	0	7598	QPSK	1	25	24 mm	back	1:1	0.278	1.084	0.301	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	21.66	-0.11	1	7598	QPSK	25	0	24 mm	back	1:1	0.197	1.213	0.239	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	23.15	0.02	0	7598	QPSK	1	25	24 mm	top	1:1	0.329	1.084	0.357	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	21.66	-0.04	1	7598	QPSK	25	0	24 mm	top	1:1	0.230	1.213	0.279	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.15	0.06	0	8117	QPSK	1	25	0 mm	back	1:1	0.957	1.084	1.037	A4
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	15.94	0.04	1	8117	QPSK	25	0	0 mm	back	1:1	0.708	1.138	0.806	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	15.93	0.02	1	8117	QPSK	50	0	0 mm	back	1:1	0.698	1.140	0.796	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.15	0.01	0	8117	QPSK	1	25	0 mm	top	1:1	0.759	1.084	0.823	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	15.94	0.07	1	8117	QPSK	25	0	0 mm	top	1:1	0.586	1.138	0.667	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	15.93	0.04	1	8117	QPSK	50	0	0 mm	top	1:1	0.571	1.140	0.651	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	23.15	0.06	0	7598	QPSK	1	25	0 mm	right	1:1	0.179	1.084	0.194	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	21.66	0.06	1	7598	QPSK	25	0	0 mm	right	1:1	0.141	1.213	0.171	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	23.15	0.01	0	7598	QPSK	1	25	0 mm	left	1:1	0.249	1.084	0.270	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	21.66	0.00	1	7598	QPSK	25	0	0 mm	left	1:1	0.200	1.213	0.243	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Table 10-4
LTE Band 4 (AWS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.47	0.11	0	7598	QPSK	1	99	24 mm	back	1:1	0.227	1.007	0.229	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.96	0.05	1	7598	QPSK	50	50	24 mm	back	1:1	0.163	1.132	0.185	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.47	-0.01	0	7598	QPSK	1	99	24 mm	top	1:1	0.252	1.007	0.254	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.96	0.11	1	7598	QPSK	50	50	24 mm	top	1:1	0.192	1.132	0.217	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	14.5	14.39	-0.07	0	6947	QPSK	1	0	0 mm	back	1:1	0.604	1.026	0.620	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	13.5	13.08	-0.14	1	6947	QPSK	50	25	0 mm	back	1:1	0.494	1.102	0.544	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	14.5	14.39	-0.04	0	6947	QPSK	1	0	0 mm	top	1:1	0.199	1.026	0.204	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	13.5	13.08	0.03	1	6947	QPSK	50	25	0 mm	top	1:1	0.187	1.102	0.206	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.47	0.04	0	7598	QPSK	1	99	0 mm	right	1:1	0.273	1.007	0.275	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.96	0.10	1	7598	QPSK	50	50	0 mm	right	1:1	0.204	1.132	0.231	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.47	-0.05	0	7598	QPSK	1	99	0 mm	left	1:1	1.010	1.007	1.017	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.96	-0.06	1	7598	QPSK	50	50	0 mm	left	1:1	0.758	1.132	0.858	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.93	-0.20	1	7598	QPSK	100	0	0 mm	left	1:1	0.720	1.140	0.821	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.47	0.04	0	7598	QPSK	1	99	0 mm	left	1:1	1.030	1.007	1.037	A5
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Uncontrolled Exposure/General Population																			

Note: Blue entry represents variability measurement

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 64 of 89	

Table 10-5
LTE Band 2 (PCS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.36	0.02	0	7598	QPSK	1	99	24 mm	back	1:1	0.197	1.033	0.204	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.19	0.00	1	7598	QPSK	50	50	24 mm	back	1:1	0.148	1.074	0.159	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.36	-0.05	0	7598	QPSK	1	99	24 mm	top	1:1	0.245	1.033	0.253	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.19	0.16	1	7598	QPSK	50	50	24 mm	top	1:1	0.191	1.074	0.205	
1860.00	18700	Low	LTE Band 2 (PCS)	20	15.5	15.07	-0.19	0	6947	QPSK	1	99	0 mm	back	1:1	0.943	1.104	1.041	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	15.5	15.46	-0.12	0	6947	QPSK	1	0	0 mm	back	1:1	1.030	1.009	1.039	
1900.00	19100	High	LTE Band 2 (PCS)	20	15.5	15.50	-0.06	0	6947	QPSK	1	99	0 mm	back	1:1	1.100	1.000	1.100	A6
1860.00	18700	Low	LTE Band 2 (PCS)	20	14.5	13.92	0.08	1	6947	QPSK	50	50	0 mm	back	1:1	0.741	1.143	0.847	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	14.5	14.25	0.10	1	6947	QPSK	50	25	0 mm	back	1:1	0.742	1.059	0.786	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.5	14.26	0.06	1	6947	QPSK	50	0	0 mm	back	1:1	0.854	1.057	0.903	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	14.5	14.15	0.10	1	6947	QPSK	100	0	0 mm	back	1:1	0.757	1.084	0.821	
1900.00	19100	High	LTE Band 2 (PCS)	20	15.5	15.50	-0.05	0	6947	QPSK	1	99	0 mm	top	1:1	0.456	1.000	0.456	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.5	14.26	-0.02	1	6947	QPSK	50	0	0 mm	top	1:1	0.383	1.057	0.405	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.36	0.05	0	7598	QPSK	1	99	0 mm	right	1:1	0.055	1.033	0.057	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.19	0.05	1	7598	QPSK	50	50	0 mm	right	1:1	0.052	1.074	0.056	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.36	-0.08	0	7598	QPSK	1	99	0 mm	left	1:1	0.585	1.033	0.604	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.19	0.03	1	7598	QPSK	50	50	0 mm	left	1:1	0.448	1.074	0.481	
1900.00	19100	High	LTE Band 2 (PCS)	20	15.5	15.50	0.06	0	6947	QPSK	1	99	0 mm	back	1:1	0.999	1.000	0.999	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entry represents variability measurement

Table 10-6
LTE Band 30 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
2310.00	27710	Mid	LTE Band 30	10	22.5	22.31	0.07	0	7318	QPSK	1	0	24 mm	back	1:1	0.126	1.045	0.132	
2310.00	27710	Mid	LTE Band 30	10	21.5	20.99	-0.07	1	7318	QPSK	25	0	24 mm	back	1:1	0.091	1.125	0.102	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.31	-0.04	0	7318	QPSK	1	0	24 mm	top	1:1	0.022	1.045	0.023	
2310.00	27710	Mid	LTE Band 30	10	21.5	20.99	0.14	1	7318	QPSK	25	0	24 mm	top	1:1	0.017	1.125	0.019	
2310.00	27710	Mid	LTE Band 30	10	11.0	10.75	-0.01	0	5650	QPSK	1	49	0 mm	back	1:1	0.943	1.059	0.999	
2310.00	27710	Mid	LTE Band 30	10	10.0	9.68	0.02	1	5650	QPSK	25	25	0 mm	back	1:1	0.735	1.076	0.791	
2310.00	27710	Mid	LTE Band 30	10	10.0	9.67	0.01	1	5650	QPSK	50	0	0 mm	back	1:1	0.732	1.079	0.790	
2310.00	27710	Mid	LTE Band 30	10	11.0	10.75	0.04	0	5650	QPSK	1	49	0 mm	top	1:1	0.193	1.059	0.204	
2310.00	27710	Mid	LTE Band 30	10	10.0	9.68	0.06	1	5650	QPSK	25	25	0 mm	top	1:1	0.138	1.076	0.148	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.31	-0.10	0	7318	QPSK	1	0	0 mm	right	1:1	0.969	1.045	1.013	
2310.00	27710	Mid	LTE Band 30	10	21.5	20.99	0.01	1	7318	QPSK	25	0	0 mm	right	1:1	0.764	1.125	0.860	
2310.00	27710	Mid	LTE Band 30	10	21.5	20.94	-0.14	1	7318	QPSK	50	0	0 mm	right	1:1	0.741	1.138	0.843	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.31	0.04	0	7318	QPSK	1	0	0 mm	right	1:1	1.050	1.045	1.097	A7
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entry represents variability measurement

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 65 of 89

**Table 10-7
DTS Body SAR**

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	17.5	17.42	0.02	4 mm	1	6905	1	back	99.8	0.260	1.019	1.002	0.266	
2462	11	802.11b	DSSS	22	17.5	17.49	-0.01	4 mm	1	6905	1	back	99.8	0.830	1.002	1.002	0.834	
2437	6	802.11b	DSSS	22	14.5	14.30	0.02	0 mm	1	7937	1	back	99.8	1.020	1.047	1.002	1.070	A8
2462	11	802.11b	DSSS	22	14.5	14.26	0.04	0 mm	1	7937	1	back	99.8	0.956	1.057	1.002	1.012	
2462	11	802.11b	DSSS	22	17.5	17.49	0.18	0 mm	1	6905	1	top	99.8	0.003	1.002	1.002	0.003	
2462	11	802.11b	DSSS	22	17.5	17.49	-0.05	0 mm	1	6905	1	bottom	99.8	0.220	1.002	1.002	0.220	
2462	11	802.11b	DSSS	22	17.5	17.49	-0.08	0 mm	1	6905	1	right	99.8	0.245	1.002	1.002	0.245	
2462	11	802.11b	DSSS	22	17.5	17.49	0.16	0 mm	1	6905	1	left	99.8	0.027	1.002	1.002	0.027	
2412	1	802.11b	DSSS	22	17.5	17.11	-0.06	4 mm	2	6905	1	back	99.9	0.235	1.094	1.001	0.257	
2412	1	802.11b	DSSS	22	12.5	12.18	0.09	0 mm	2	7937	1	back	99.9	0.430	1.076	1.001	0.463	
2412	1	802.11b	DSSS	22	17.5	17.11	-0.17	0 mm	2	6905	1	top	99.9	0.002	1.094	1.001	0.002	
2412	1	802.11b	DSSS	22	17.5	17.11	-0.15	0 mm	2	6905	1	bottom	99.9	0.116	1.094	1.001	0.127	
2412	1	802.11b	DSSS	22	17.5	17.11	-0.13	0 mm	2	6905	1	right	99.9	0.064	1.094	1.001	0.070	
2412	1	802.11b	DSSS	22	17.5	17.11	-0.09	0 mm	2	6905	1	left	99.9	0.006	1.094	1.001	0.007	
2437	6	802.11b	DSSS	22	14.5	14.30	-0.06	0 mm	1	7937	1	back	99.8	0.907	1.047	1.002	0.952	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT																		
Spatial Peak								Body										
Uncontrolled Exposure/General Population								1.6 W/kg (mW/g) averaged over 1 gram										

Note: Blue entries represent variability measurement

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 66 of 89

Table 10-8
NII Body SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g) (W/kg)	Plot #
MHz	Ch.													(W/kg)				
5300	60	802.11ac	OFDM	20	13.5	13.34	0.10	4 mm	1	6905	6.5	back	98.2	0.399	1.038	1.019	0.422	
5290	58	802.11ac	OFDM	80	8.5	8.24	0.01	0 mm	1	7937	29.3	back	95.5	0.832	1.062	1.047	0.926	
5300	60	802.11ac	OFDM	20	13.5	13.34	0.03	0 mm	1	6905	6.5	top	98.2	0.002	1.038	1.019	0.002	
5300	60	802.11ac	OFDM	20	13.5	13.34	0.00	0 mm	1	6905	6.5	bottom	98.2	0.129	1.038	1.019	0.137	
5300	60	802.11ac	OFDM	20	13.5	13.34	-0.05	0 mm	1	6905	6.5	right	98.2	0.335	1.038	1.019	0.355	
5300	60	802.11ac	OFDM	20	13.5	13.34	-0.09	0 mm	1	6905	6.5	left	98.2	0.005	1.038	1.019	0.005	
5260	52	802.11a	OFDM	20	13.5	12.98	-0.02	4 mm	2	6905	6	back	99.0	0.619	1.127	1.010	0.705	
5290	58	802.11ac	OFDM	80	7.5	7.02	0.05	0 mm	2	7937	29.3	back	95.8	0.864	1.117	1.044	1.007	A9
5260	52	802.11a	OFDM	20	13.5	12.98	-0.11	0 mm	2	6905	6	top	99.0	0.002	1.127	1.010	0.002	
5260	52	802.11a	OFDM	20	13.5	12.98	0.19	0 mm	2	6905	6	bottom	99.0	0.220	1.127	1.010	0.250	
5260	52	802.11a	OFDM	20	13.5	12.98	0.07	0 mm	2	6905	6	right	99.0	0.018	1.127	1.010	0.020	
5260	52	802.11a	OFDM	20	13.5	12.98	-0.04	0 mm	2	6905	6	left	99.0	0.028	1.127	1.010	0.032	
5500	100	802.11a	OFDM	20	13.5	13.30	0.04	4 mm	1	6905	6	back	98.4	0.295	1.047	1.017	0.314	
5530	106	802.11ac	OFDM	80	8.5	7.87	0.04	0 mm	1	7937	29.3	back	95.5	0.609	1.156	1.047	0.737	
5500	100	802.11a	OFDM	20	13.5	13.30	-0.03	0 mm	1	6905	6	top	98.4	0.003	1.047	1.017	0.003	
5500	100	802.11a	OFDM	20	13.5	13.30	0.08	0 mm	1	6905	6	bottom	98.4	0.061	1.047	1.017	0.065	
5500	100	802.11a	OFDM	20	13.5	13.30	0.02	0 mm	1	6905	6	right	98.4	0.232	1.047	1.017	0.247	
5500	100	802.11a	OFDM	20	13.5	13.30	-0.06	0 mm	1	6905	6	left	98.4	0.003	1.047	1.017	0.003	
5720	144	802.11a	OFDM	20	13.5	13.19	-0.03	4 mm	2	6905	6	back	99.0	0.411	1.074	1.010	0.445	
5530	106	802.11ac	OFDM	80	7.5	6.77	0.08	0 mm	2	7937	29.3	back	95.8	0.760	1.183	1.044	0.939	
5690	138	802.11ac	OFDM	80	7.5	6.73	-0.07	0 mm	2	7937	29.3	back	95.8	0.663	1.194	1.044	0.827	
5720	144	802.11a	OFDM	20	13.5	13.19	-0.14	0 mm	2	6905	6	top	99.0	0.003	1.074	1.010	0.003	
5720	144	802.11a	OFDM	20	13.5	13.19	0.00	0 mm	2	6905	6	bottom	99.0	0.197	1.074	1.010	0.214	
5720	144	802.11a	OFDM	20	13.5	13.19	-0.15	0 mm	2	6905	6	right	99.0	0.005	1.074	1.010	0.005	
5720	144	802.11a	OFDM	20	13.5	13.19	-0.11	0 mm	2	6905	6	left	99.0	0.017	1.074	1.010	0.018	
5785	157	802.11a	OFDM	20	13.5	13.33	0.16	4 mm	1	6905	6	back	98.4	0.333	1.040	1.017	0.352	
5775	155	802.11ac	OFDM	80	8.5	7.83	0.20	0 mm	1	7937	29.3	back	95.5	0.717	1.167	1.047	0.876	
5785	157	802.11a	OFDM	20	13.5	13.33	-0.02	0 mm	1	6905	6	top	98.4	0.006	1.040	1.017	0.006	
5785	157	802.11a	OFDM	20	13.5	13.33	0.11	0 mm	1	6905	6	bottom	98.4	0.062	1.040	1.017	0.065	
5785	157	802.11a	OFDM	20	13.5	13.33	0.05	0 mm	1	6905	6	right	98.4	0.207	1.040	1.017	0.219	
5785	157	802.11a	OFDM	20	13.5	13.33	0.02	0 mm	1	6905	6	left	98.4	0.005	1.040	1.017	0.005	
5745	149	802.11a	OFDM	20	13.5	12.49	-0.18	4 mm	2	6905	6	back	99.0	0.334	1.262	1.010	0.426	
5775	155	802.11ac	OFDM	80	7.5	7.03	-0.05	0 mm	2	7937	29.3	back	95.8	0.608	1.114	1.044	0.707	
5745	149	802.11a	OFDM	20	13.5	12.49	-0.09	0 mm	2	6905	6	top	99.0	0.005	1.262	1.010	0.006	
5745	149	802.11a	OFDM	20	13.5	12.49	0.15	0 mm	2	6905	6	bottom	99.0	0.166	1.262	1.010	0.211	
5745	149	802.11a	OFDM	20	13.5	12.49	-0.11	0 mm	2	6905	6	right	99.0	0.004	1.262	1.010	0.005	
5745	149	802.11a	OFDM	20	13.5	12.49	0.04	0 mm	2	6905	6	left	99.0	0.015	1.262	1.010	0.019	
5290	58	802.11ac	OFDM	80	7.5	7.02	0.06	0 mm	2	7937	29.3	back	95.8	0.729	1.117	1.044	0.850	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body										
Spatial Peak								1.6 W/kg (mW/g)										
Uncontrolled Exposure/General Population								averaged over 1 gram										

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 67 of 89

Table 10-9
Bluetooth Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2441	39	Bluetooth	FHSS	10.0	9.45	-0.07	0 mm	6905	1	back	1:1	0.098	1.135	0.111	A10
2441	39	Bluetooth	FHSS	10.0	9.45	0.03	0 mm	6905	1	bottom	1:1	0.009	1.135	0.010	
2441	39	Bluetooth	FHSS	10.0	9.45	0.14	0 mm	6905	1	right	1:1	0.023	1.135	0.026	
2441	39	Bluetooth	FHSS	10.0	9.45	-0.15	0 mm	6905	1	left	1:1	0.000	1.135	0.000	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in KDB 616217 D04v01r01, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.
7. Per FCC KDB 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations. SAR tests were required for top, right, and left edges for main antenna 1, top and right edges for main antenna 2, bottom and right edges for BT/WLAN antenna 1 and bottom, right and left for WLAN antenna 2. Additionally, top and left edge was tested for WLAN antenna 1, top edge for WLAN antenna 2 and left edge for BT per the manufactures request.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03. HSPA SAR was not required per 3G Test Reduction Procedures.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 68 of 89

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r03. The general test procedures used for testing can be found in Section 7.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
4. Per KDB Publication 941225 D05Av01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01Wi-Fi SAR v02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 7.6.4 for more information.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01Wi-Fi SAR v02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 7.6.5 for more information.
3. Per KDB Publication 248227 D01Wi-Fi SAR v02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498. Please see Section 11 for complete analysis.
4. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT	 Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 69 of 89

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

11.3 Body Simultaneous Transmission Analysis

Table 11-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.955	1.070	0.463	See Note 1	1.418	1.533	See Note 1	0.01	0.01	0.03
	Top	1.027	0.003	0.002	1.030	1.029	0.005	1.032	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.312	0.245	0.070	0.557	0.382	0.315	0.627	N/A	N/A	N/A
	Left	0.176	0.027	0.007	0.203	0.183	0.034	0.210	N/A	N/A	N/A
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.090	1.070	0.463	See Note 1	1.553	1.533	See Note 1	0.02	0.01	0.03
	Top	0.415	0.003	0.002	0.418	0.417	0.005	0.420	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.065	0.245	0.070	0.310	0.135	0.315	0.380	N/A	N/A	N/A
	Left	0.488	0.027	0.007	0.515	0.495	0.034	0.522	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.715	1.070	0.463	See Note 1	1.178	1.533	See Note 1	0.01	0.01	0.03
	Top	1.066	0.003	0.002	1.069	1.068	0.005	1.071	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.112	0.245	0.070	0.357	0.182	0.315	0.427	N/A	N/A	N/A
	Left	0.085	0.027	0.007	0.112	0.092	0.034	0.119	N/A	N/A	N/A

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 70 of 89

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.037	1.070	0.463	See Note 1	1.500	1.533	See Note 1	0.01	0.01	0.03
	Top	0.823	0.003	0.002	0.826	0.825	0.005	0.828	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.194	0.245	0.070	0.439	0.264	0.315	0.509	N/A	N/A	N/A
	Left	0.270	0.027	0.007	0.297	0.277	0.034	0.304	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.620	1.070	0.463	See Note 1	1.083	1.533	See Note 1	0.01	0.01	0.03
	Top	0.206	0.003	0.002	0.209	0.208	0.005	0.211	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.275	0.245	0.070	0.520	0.345	0.315	0.590	N/A	N/A	N/A
	Left	1.037	0.027	0.007	1.064	1.044	0.034	1.071	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.100	1.070	0.463	See Note 1	1.563	1.533	See Note 1	0.02	0.01	0.03
	Top	0.456	0.003	0.002	0.459	0.458	0.005	0.461	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	0.057	0.245	0.070	0.302	0.127	0.315	0.372	N/A	N/A	N/A
	Left	0.604	0.027	0.007	0.631	0.611	0.034	0.638	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 30 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.999	1.070	0.463	See Note 1	1.462	1.533	See Note 1	0.02	0.01	0.03
	Top	0.204	0.003	0.002	0.207	0.206	0.005	0.209	N/A	N/A	N/A
	Bottom	0.400	0.220	0.127	0.620	0.527	0.347	0.747	N/A	N/A	N/A
	Right	1.097	0.245	0.070	1.342	1.167	0.315	1.412	N/A	N/A	N/A
	Left	0.400	0.027	0.007	0.427	0.407	0.034	0.434	N/A	N/A	N/A

Table 11-2
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.955	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	1.027	0.006	0.006	1.033	1.033	0.012	1.039	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.312	0.355	0.020	0.667	0.332	0.375	0.687	N/A	N/A	N/A
	Left	0.176	0.005	0.032	0.181	0.208	0.037	0.213	N/A	N/A	N/A
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.090	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	0.415	0.006	0.006	0.421	0.421	0.012	0.427	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.065	0.355	0.020	0.420	0.085	0.375	0.440	N/A	N/A	N/A
	Left	0.488	0.005	0.032	0.493	0.520	0.037	0.525	N/A	N/A	N/A

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 71 of 89	

Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.715	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	1.066	0.006	0.006	1.072	1.072	0.012	1.078	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.112	0.355	0.020	0.467	0.132	0.375	0.487	N/A	N/A	N/A
	Left	0.085	0.005	0.032	0.090	0.117	0.037	0.122	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.037	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	0.823	0.006	0.006	0.829	0.829	0.012	0.835	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.194	0.355	0.020	0.549	0.214	0.375	0.569	N/A	N/A	N/A
	Left	0.270	0.005	0.032	0.275	0.302	0.037	0.307	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.620	0.926	1.007	1.546	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	0.206	0.006	0.006	0.212	0.212	0.012	0.218	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.275	0.355	0.020	0.630	0.295	0.375	0.650	N/A	N/A	N/A
	Left	1.037	0.005	0.032	1.042	1.069	0.037	1.074	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	1.100	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.01	0.01	0.04
	Top	0.456	0.006	0.006	0.462	0.462	0.012	0.468	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	0.057	0.355	0.020	0.412	0.077	0.375	0.432	N/A	N/A	N/A
	Left	0.604	0.005	0.032	0.609	0.636	0.037	0.641	N/A	N/A	N/A
Simult Tx	Configuration	LTE Band 30 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
SAR	Back	0.999	0.926	1.007	See Note 1	See Note 1	See Note 1	See Note 1	0.02	0.01	0.04
	Top	0.204	0.006	0.006	0.210	0.210	0.012	0.216	N/A	N/A	N/A
	Bottom	0.400	0.137	0.250	0.537	0.650	0.387	0.787	N/A	N/A	N/A
	Right	1.097	0.355	0.020	1.452	1.117	0.375	1.472	N/A	N/A	N/A
	Left	0.400	0.005	0.032	0.405	0.432	0.037	0.437	N/A	N/A	N/A

Table 11-3
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2			1	2	1+2
SAR	Back	0.955	0.111	1.066	SAR	Back	1.090	0.111	1.201
	Top	1.027	0.400	1.427		Top	0.415	0.400	0.815
	Bottom	0.400	0.010	0.410		Bottom	0.400	0.010	0.410
	Right	0.312	0.026	0.338		Right	0.065	0.026	0.091
	Left	0.176	0.000	0.176		Left	0.488	0.000	0.488

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 72 of 89	

Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2			1	2	1+2
SAR	Back	0.715	0.111	0.826	SAR	Back	1.037	0.111	1.148
	Top	1.066	0.400	1.466		Top	0.823	0.400	1.223
	Bottom	0.400	0.010	0.410		Bottom	0.400	0.010	0.410
	Right	0.112	0.026	0.138		Right	0.194	0.026	0.220
	Left	0.085	0.000	0.085		Left	0.270	0.000	0.270
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2			1	2	1+2
SAR	Back	0.620	0.111	0.731	SAR	Back	1.100	0.111	1.211
	Top	0.206	0.400	0.606		Top	0.456	0.400	0.856
	Bottom	0.400	0.010	0.410		Bottom	0.400	0.010	0.410
	Right	0.275	0.026	0.301		Right	0.057	0.026	0.083
	Left	1.037	0.000	1.037		Left	0.604	0.000	0.604
Simult Tx	Configuration	LTE Band 30 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 30 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2			1	2	1+2
SAR	Back	0.999	0.111	1.110	SAR	Back	0.999	0.111	1.110
	Top	0.204	0.400	0.604		Top	0.204	0.400	0.604
	Bottom	0.400	0.010	0.410		Bottom	0.400	0.010	0.410
	Right	1.097	0.026	1.123		Right	1.097	0.026	1.123
	Left	0.400	0.000	0.400		Left	0.400	0.000	0.400

Table 11-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
Back Side	UMTS 850	< 0.955	0.834	0.257	See Note 1	<1.212	1.091	See Note 1	<0.01	<0.01	0.02
Back Side	UMTS 1900	< 1.090	0.834	0.257	See Note 1	<1.347	1.091	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 12	< 0.715	0.834	0.257	<1.549	<0.972	1.091	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 5 (Cell)	< 1.037	0.834	0.257	See Note 1	<1.294	1.091	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 4 (AWS)	< 0.620	0.834	0.257	<1.454	<0.877	1.091	See Note 1	<0.01	<0.00	0.02
Back Side	LTE Band 2 (PCS)	< 1.100	0.834	0.257	See Note 1	<1.357	1.091	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 30	< 0.999	0.834	0.257	See Note 1	<1.256	1.091	See Note 1	<0.01	<0.01	0.02

Table 11-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 0.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)				SPLSR		
		1	2	3	1+2	1+3	2+3	1+2+3	1+2	1+3	2+3
Back Side	UMTS 850	< 0.955	0.422	0.705	<1.377	See Note 1	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	UMTS 1900	< 1.090	0.422	0.705	<1.512	See Note 1	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 12	< 0.715	0.422	0.705	<1.137	<1.420	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 5 (Cell)	< 1.037	0.422	0.705	<1.459	See Note 1	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 4 (AWS)	< 0.620	0.422	0.705	<1.042	<1.325	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 2 (PCS)	< 1.100	0.422	0.705	<1.522	See Note 1	1.127	See Note 1	<0.01	<0.01	0.02
Back Side	LTE Band 30	< 0.999	0.422	0.705	<1.421	See Note 1	1.127	See Note 1	<0.01	<0.01	0.02

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT					Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet				Page 73 of 89	

Table 11-6
Simultaneous Transmission Scenario with 2.4 GHz WLAN Back Side (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	1+2	1+3	2+3	1+2+3
Back Side	UMTS 850	0.330	< 0.834	<0.257	< 1.164	< 0.587	< 1.091	< 1.421
Back Side	UMTS 1900	0.203	< 0.834	<0.257	< 1.037	< 0.460	< 1.091	< 1.294
Back Side	LTE Band 12	0.080	< 0.834	<0.257	< 0.914	< 0.337	< 1.091	< 1.171
Back Side	LTE Band 5 (Cell)	0.301	< 0.834	<0.257	< 1.135	< 0.558	< 1.091	< 1.392
Back Side	LTE Band 4 (AWS)	0.229	< 0.834	<0.257	< 1.063	< 0.486	< 1.091	< 1.320
Back Side	LTE Band 2 (PCS)	0.204	< 0.834	<0.257	< 1.038	< 0.461	< 1.091	< 1.295
Back Side	LTE Band 30	0.132	< 0.834	<0.257	< 0.966	< 0.389	< 1.091	< 1.223

Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN Top Edge (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	1+2	1+3	2+3	1+2+3
Top Edge	UMTS 850	0.406	< 0.003	< 0.002	< 0.409	< 0.408	< 0.005	< 0.411
Top Edge	UMTS 1900	0.252	< 0.003	< 0.002	< 0.255	< 0.254	< 0.005	< 0.257
Top Edge	LTE Band 12	0.099	< 0.003	< 0.002	< 0.102	< 0.101	< 0.005	< 0.104
Top Edge	LTE Band 5 (Cell)	0.357	< 0.003	< 0.002	< 0.360	< 0.359	< 0.005	< 0.362
Top Edge	LTE Band 4 (AWS)	0.254	< 0.003	< 0.002	< 0.257	< 0.256	< 0.005	< 0.259
Top Edge	LTE Band 2 (PCS)	0.253	< 0.003	< 0.002	< 0.256	< 0.255	< 0.005	< 0.258
Top Edge	LTE Band 30	0.023	< 0.003	< 0.002	< 0.026	< 0.025	< 0.005	< 0.028

Table 11-8
Simultaneous Transmission Scenario with 5 GHz WLAN Back Side (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	1+2	1+3	2+3	1+2+3
Back Side	UMTS 850	0.330	< 0.422	<0.705	< 0.752	< 1.035	< 1.127	< 1.457
Back Side	UMTS 1900	0.203	< 0.422	<0.705	< 0.625	< 0.908	< 1.127	< 1.330
Back Side	LTE Band 12	0.080	< 0.422	<0.705	< 0.502	< 0.785	< 1.127	< 1.207
Back Side	LTE Band 5 (Cell)	0.301	< 0.422	<0.705	< 0.723	< 1.006	< 1.127	< 1.428
Back Side	LTE Band 4 (AWS)	0.229	< 0.422	<0.705	< 0.651	< 0.934	< 1.127	< 1.356
Back Side	LTE Band 2 (PCS)	0.204	< 0.422	<0.705	< 0.626	< 0.909	< 1.127	< 1.331
Back Side	LTE Band 30	0.132	< 0.422	<0.705	< 0.554	< 0.837	< 1.127	< 1.259

Table 11-9
Simultaneous Transmission Scenario with 5 GHz WLAN Top Edge (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	1+2	1+3	2+3	1+2+3
Top Edge	UMTS 850	0.406	< 0.006	< 0.006	< 0.412	< 0.412	< 0.012	< 0.418
Top Edge	UMTS 1900	0.252	< 0.006	< 0.006	< 0.258	< 0.258	< 0.012	< 0.264
Top Edge	LTE Band 12	0.099	< 0.006	< 0.006	< 0.105	< 0.105	< 0.012	< 0.111
Top Edge	LTE Band 5 (Cell)	0.357	< 0.006	< 0.006	< 0.363	< 0.363	< 0.012	< 0.369
Top Edge	LTE Band 4 (AWS)	0.254	< 0.006	< 0.006	< 0.260	< 0.260	< 0.012	< 0.266
Top Edge	LTE Band 2 (PCS)	0.253	< 0.006	< 0.006	< 0.259	< 0.259	< 0.012	< 0.265
Top Edge	LTE Band 30	0.023	< 0.006	< 0.006	< 0.029	< 0.029	< 0.012	< 0.035

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 74 of 89	

Table 11-10
Simultaneous Transmission Scenario with Bluetooth Back Side (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Back Side	UMTS 850	0.330	< 0.111	< 0.441
Back Side	UMTS 1900	0.203	< 0.111	< 0.314
Back Side	LTE Band 12	0.080	< 0.111	< 0.191
Back Side	LTE Band 5 (Cell)	0.301	< 0.111	< 0.412
Back Side	LTE Band 4 (AWS)	0.229	< 0.111	< 0.34
Back Side	LTE Band 2 (PCS)	0.204	< 0.111	< 0.315
Back Side	LTE Band 30	0.132	< 0.111	< 0.243

Table 11-11
Simultaneous Transmission Scenario with Bluetooth Top Edge (Body at 2.4 cm)

Configuration	Mode	3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Top Edge	UMTS 850	0.406	0.400	0.806
Top Edge	UMTS 1900	0.252	0.400	0.652
Top Edge	LTE Band 12	0.099	0.400	0.499
Top Edge	LTE Band 5 (Cell)	0.357	0.400	0.757
Top Edge	LTE Band 4 (AWS)	0.254	0.400	0.654
Top Edge	LTE Band 2 (PCS)	0.253	0.400	0.653
Top Edge	LTE Band 30	0.023	0.400	0.423

Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was less than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. When the test separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v05.
3. For SAR summation for body (back side at 4 mm), UMTS/LTE SAR values for 0 mm were used since the 0 mm test distance for UMTS/LTE SAR values were more conservative. "<" denotes that the 0 mm UMTS/LTE SAR values were used for summation purposes.
4. For SAR summation for body (back side at 24 mm), WLAN SAR values for 4 mm (back side) were used since the 4 mm (back side) test distance for WLAN SAR values were more conservative. Bluetooth SAR values for 0 mm were used since the 0 mm test distance for Bluetooth SAR values were more conservative. "<" denotes that the 4 mm WLAN SAR and 0 mm for Bluetooth SAR values were used for summation purposes.
5. For SAR summation for body (top edge at 24 mm), WLAN SAR values for 0 mm were used since the 0 mm test distance for WLAN SAR values were more conservative. "<" denotes that the 0 mm WLAN SAR values were used for summation purposes.
6. MIMO body SAR is determined by the sum of 1g single transmission chain SAR values because the summation represents higher output power and yields more conservative result per KDB 248227 D01Wi-Fi SAR v02.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 75 of 89	

11.4 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v05, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04 , simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{\text{Tx1} - \text{Tx2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

Table 11-12
Peak SAR Locations for Body Back Side at 0 mm

Mode/Band	x (mm)	y (mm)
Reduced 2.4 GHz WLAN Ant 1	16.00	76.00
Reduced 2.4 GHz WLAN Ant 2	-39.00	110.00
Reduced 5 GHz WLAN Ant 1	20.00	68.00
Reduced 5 GHz WLAN Ant 2	-43.00	108.00
Reduced UMTS 850 MHz	-61.50	-108.00
Reduced UMTS 1900 MHz	-84.00	-102.00
Reduced LTE B12	-38.50	-91.00
Reduced LTE B5	-62.00	-120.00
Reduced LTE B4	-69.00	-120.50
Reduced LTE B2	-84.00	-105.00
Reduced LTE B30	8.20	-102.40

Table 11-13
Peak SAR Locations for Body Back Side at 4 mm

Mode/Band	x (mm)	y (mm)
Max 2.4 GHz WLAN Ant 1	10.80	77.20
Max 2.4 GHz WLAN Ant 2	-44.00	105.00
Max 5 GHz WLAN Ant 1	18.00	78.00
Max 5 GHz WLAN Ant 2	-43.00	114.00

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 76 of 89

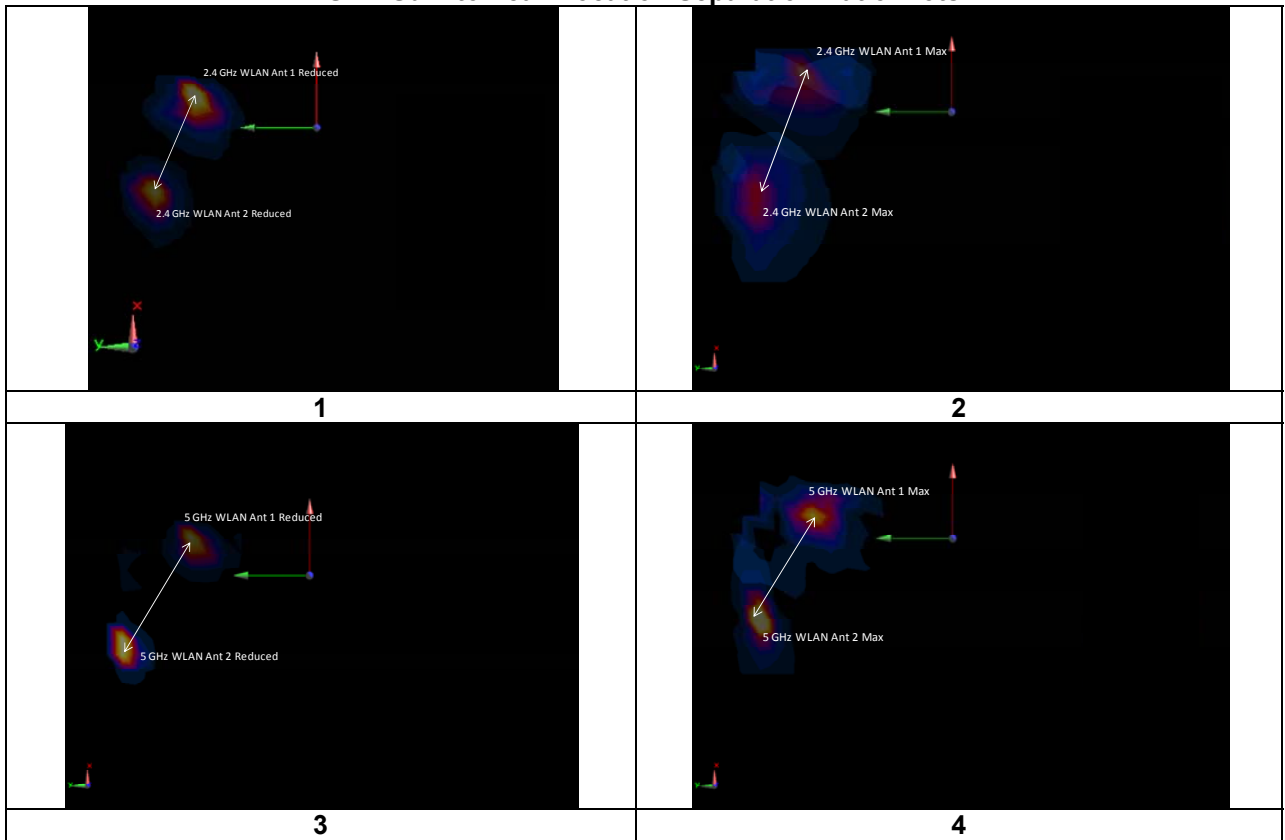
Table 11-14
SAR Sum to Peak Location Separation Ratio Calculations

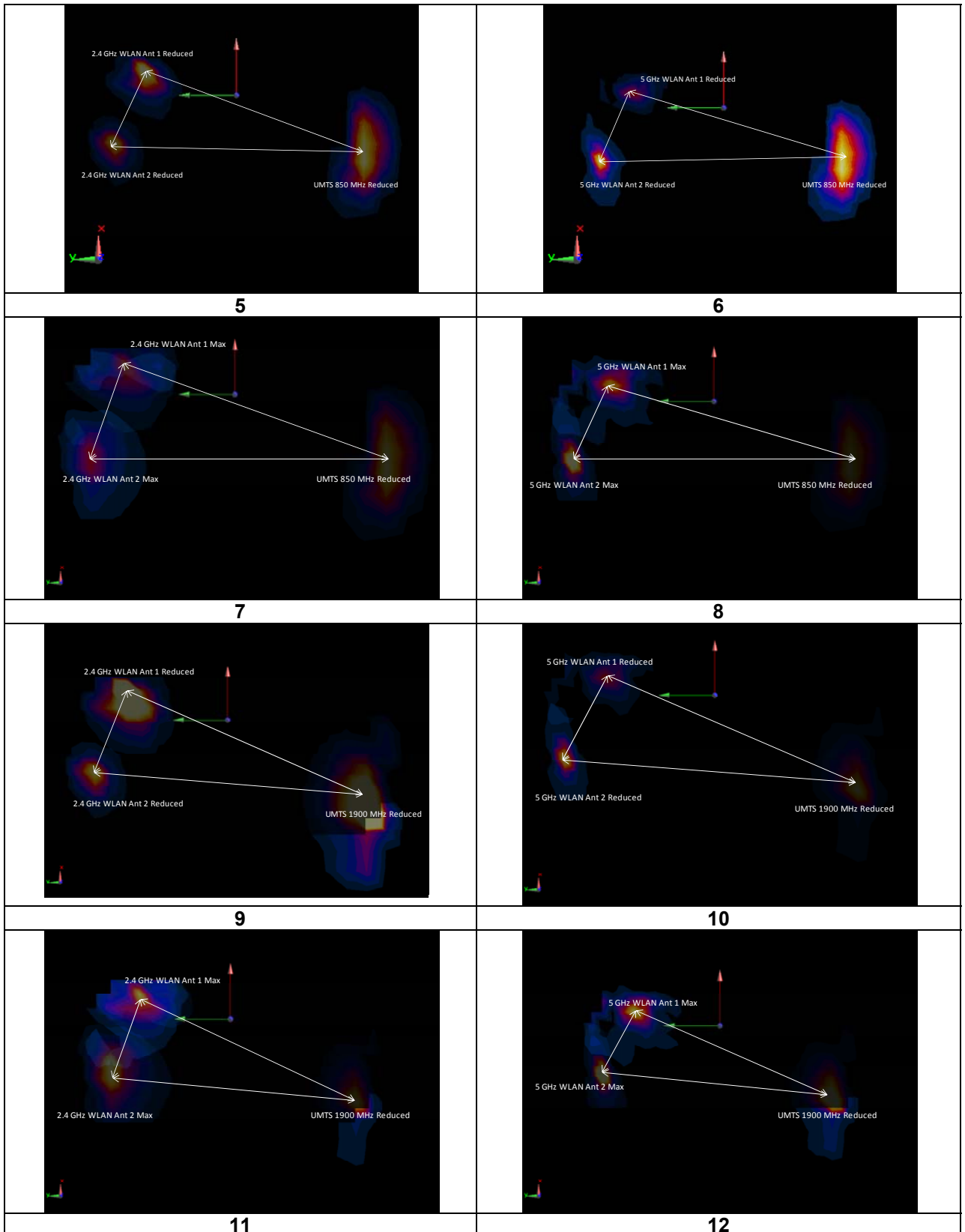
Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio	Plot Number
Ant "a"	Ant "b"	a	b	a+b	D _{a-b}	(a+b) ^{1.5} /D _{a-b}	
Reduced 2.4 GHz WLAN Ant 1	Reduced 2.4 GHz WLAN Ant 2	1.070	0.463	1.533	64.66	0.03	1
Max 2.4 GHz WLAN Ant 1	Max 2.4 GHz WLAN Ant 2	0.834	0.257	1.091	61.45	0.02	2
Reduced 5 GHz WLAN Ant 1	Reduced 5 GHz WLAN Ant 2	0.926	1.007	1.933	74.63	0.04	3
Max 5 GHz WLAN Ant 1	Max 5 GHz WLAN Ant 2	0.422	0.705	1.127	70.83	0.02	4
Reduced UMTS 850 MHz	Reduced 2.4 GHz WLAN Ant 1	0.955	1.070	2.025	199.66	0.01	5
Reduced UMTS 850 MHz	Reduced 2.4 GHz WLAN Ant 2	0.955	0.463	1.418	219.16	0.01	
Reduced UMTS 850 MHz	Reduced 5 GHz WLAN Ant 1	0.955	0.926	1.881	193.95	0.01	6
Reduced UMTS 850 MHz	Reduced 5 GHz WLAN Ant 2	0.955	1.007	1.962	216.79	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced UMTS 850 MHz	0.834	<0.955	<1.789	198.81	<0.01	7
Max 2.4 GHz WLAN Ant 2	Reduced UMTS 850 MHz	0.257	<0.955	<1.212	213.72	<0.01	
Max 5 GHz WLAN Ant 1	Reduced UMTS 850 MHz	0.422	<0.955	<1.377	202.28	<0.01	8
Max 5 GHz WLAN Ant 2	Reduced UMTS 850 MHz	0.705	<0.955	<1.660	222.77	<0.01	
Reduced UMTS 1900 MHz	Reduced 2.4 GHz WLAN Ant 1	1.090	1.070	2.160	204.17	0.02	9
Reduced UMTS 1900 MHz	Reduced 2.4 GHz WLAN Ant 2	1.090	0.463	1.553	216.72	0.01	
Reduced UMTS 1900 MHz	Reduced 5 GHz WLAN Ant 1	1.090	0.926	2.016	199.29	0.01	10
Reduced UMTS 1900 MHz	Reduced 5 GHz WLAN Ant 2	1.090	1.007	2.097	213.97	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced UMTS 1900 MHz	0.834	<1.090	<1.924	202.73	<0.01	11
Max 2.4 GHz WLAN Ant 2	Reduced UMTS 1900 MHz	0.257	<1.090	<1.347	210.83	<0.01	
Max 5 GHz WLAN Ant 1	Reduced UMTS 1900 MHz	0.422	<1.090	<1.512	206.89	<0.01	12
Max 5 GHz WLAN Ant 2	Reduced UMTS 1900 MHz	0.705	<1.090	<1.795	219.86	<0.01	
Reduced LTE B12	Reduced 2.4 GHz WLAN Ant 1	0.715	1.070	1.785	175.67	0.01	13
Reduced LTE B12	Reduced 2.4 GHz WLAN Ant 2	0.715	0.463	1.178	201.00	0.01	
Reduced LTE B12	Reduced 5 GHz WLAN Ant 1	0.715	0.926	1.641	169.42	0.01	14
Reduced LTE B12	Reduced 5 GHz WLAN Ant 2	0.715	1.007	1.722	199.05	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced LTE B12	0.834	<0.715	<1.549	175.28	<0.01	15
Max 2.4 GHz WLAN Ant 2	Reduced LTE B12	0.257	<0.715	<0.972	196.08	<0.01	
Max 5 GHz WLAN Ant 1	Reduced LTE B12	0.422	<0.715	<1.137	178.19	<0.01	16
Max 5 GHz WLAN Ant 2	Reduced LTE B12	0.705	<0.715	<1.420	205.05	<0.01	
Reduced LTE B5	Reduced 2.4 GHz WLAN Ant 1	1.037	1.070	2.107	210.95	0.01	17
Reduced LTE B5	Reduced 2.4 GHz WLAN Ant 2	1.037	0.463	1.500	231.15	0.01	
Reduced LTE B5	Reduced 5 GHz WLAN Ant 1	1.037	0.926	1.963	205.11	0.01	18
Reduced LTE B5	Reduced 5 GHz WLAN Ant 2	1.037	1.007	2.044	228.79	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced LTE B5	0.834	<1.037	<1.871	210.21	<0.01	19
Max 2.4 GHz WLAN Ant 2	Reduced LTE B5	0.257	<1.037	<1.294	225.72	<0.01	
Max 5 GHz WLAN Ant 1	Reduced LTE B5	0.422	<1.037	<1.459	213.55	<0.01	20
Max 5 GHz WLAN Ant 2	Reduced LTE B5	0.705	<1.037	<1.742	234.77	<0.01	
Reduced LTE B4	Reduced 2.4 GHz WLAN Ant 1	0.620	1.070	1.690	214.10	0.01	21
Reduced LTE B4	Reduced 2.4 GHz WLAN Ant 2	0.620	0.463	1.083	232.44	0.01	
Reduced LTE B4	Reduced 5 GHz WLAN Ant 1	0.620	0.926	1.546	208.45	0.01	22
Reduced LTE B4	Reduced 5 GHz WLAN Ant 2	0.620	1.007	1.627	229.97	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced LTE B4	0.834	<0.620	<1.454	213.20	<0.01	23
Max 2.4 GHz WLAN Ant 2	Reduced LTE B4	0.257	<0.620	<0.877	226.88	<0.00	
Max 5 GHz WLAN Ant 1	Reduced LTE B4	0.422	<0.620	<1.042	216.73	<0.01	24
Max 5 GHz WLAN Ant 2	Reduced LTE B4	0.705	<0.620	<1.325	235.94	<0.01	
Reduced LTE B2	Reduced 2.4 GHz WLAN Ant 1	1.100	1.070	2.170	206.79	0.02	25
Reduced LTE B2	Reduced 2.4 GHz WLAN Ant 2	1.100	0.463	1.563	219.66	0.01	
Reduced LTE B2	Reduced 5 GHz WLAN Ant 1	1.100	0.926	2.026	201.85	0.01	26
Reduced LTE B2	Reduced 5 GHz WLAN Ant 2	1.100	1.007	2.107	216.91	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced LTE B2	0.834	<1.100	<1.934	205.39	<0.01	27
Max 2.4 GHz WLAN Ant 2	Reduced LTE B2	0.257	<1.100	<1.357	213.78	<0.01	
Max 5 GHz WLAN Ant 1	Reduced LTE B2	0.422	<1.100	<1.522	209.51	<0.01	28
Max 5 GHz WLAN Ant 2	Reduced LTE B2	0.705	<1.100	<1.805	222.81	<0.01	
Reduced LTE B30	Reduced 2.4 GHz WLAN Ant 1	0.999	1.07	2.069	178.57	0.02	29
Reduced LTE B30	Reduced 2.4 GHz WLAN Ant 2	0.999	0.463	1.462	217.58	0.01	
Reduced LTE B30	Reduced 5 GHz WLAN Ant 1	0.999	0.926	1.925	170.81	0.02	30
Reduced LTE B30	Reduced 5 GHz WLAN Ant 2	0.999	1.007	2.006	216.54	0.01	
Max 2.4 GHz WLAN Ant 1	Reduced LTE B30	0.834	<0.999	<1.833	179.62	<0.01	31
Max 2.4 GHz WLAN Ant 2	Reduced LTE B30	0.257	<0.999	<1.256	213.87	<0.01	
Max 5 GHz WLAN Ant 1	Reduced LTE B30	0.422	<0.999	<1.421	180.67	<0.01	32
Max 5 GHz WLAN Ant 2	Reduced LTE B30	0.705	<0.999	<1.704	222.37	<0.01	

Note: Plots 1 – 4 Max and Reduced 2.4 and 5 GHz WLAN are also represented on following plots to show the maximum SPLSR among the possible simultaneous transmission.

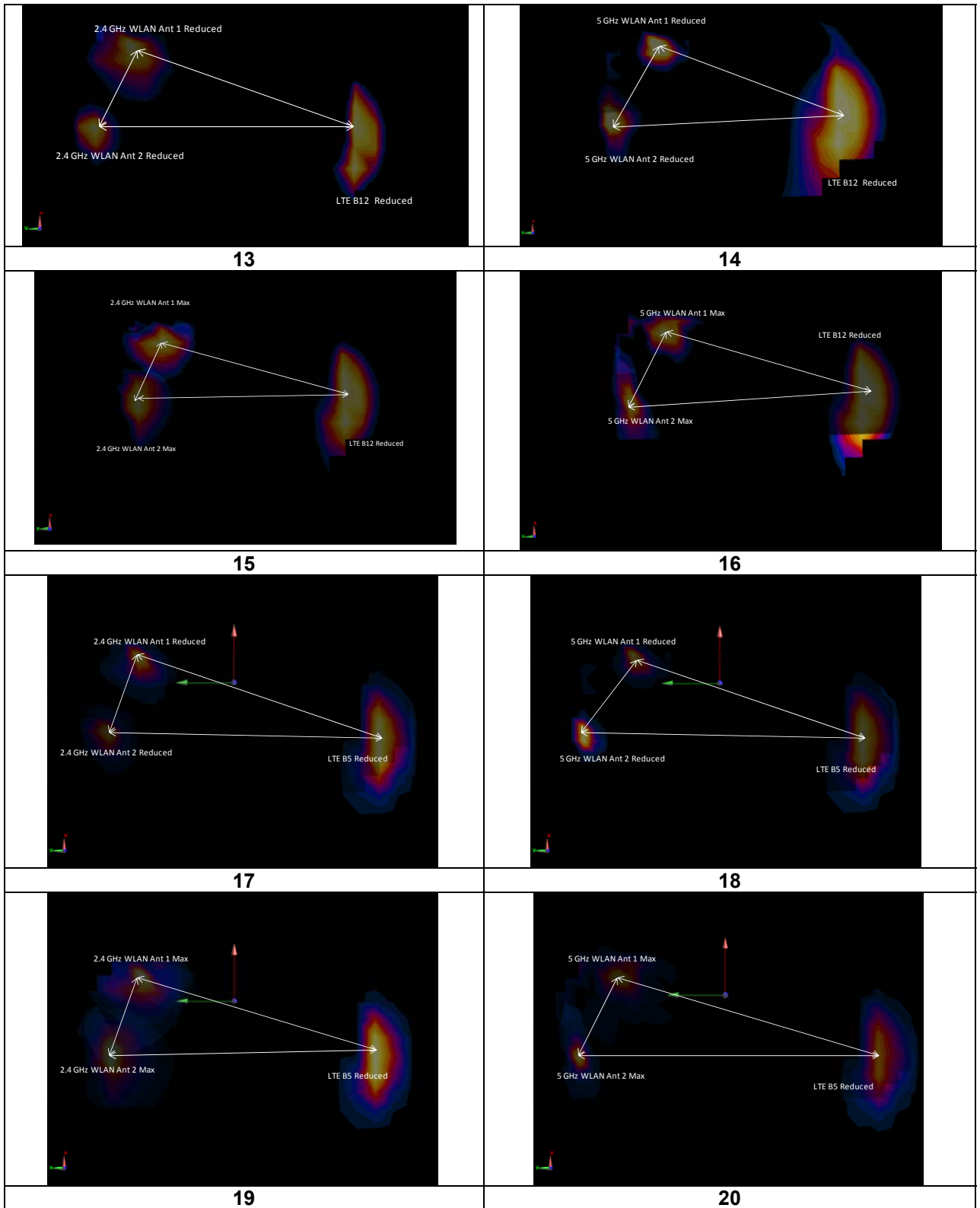
FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 77 of 89	

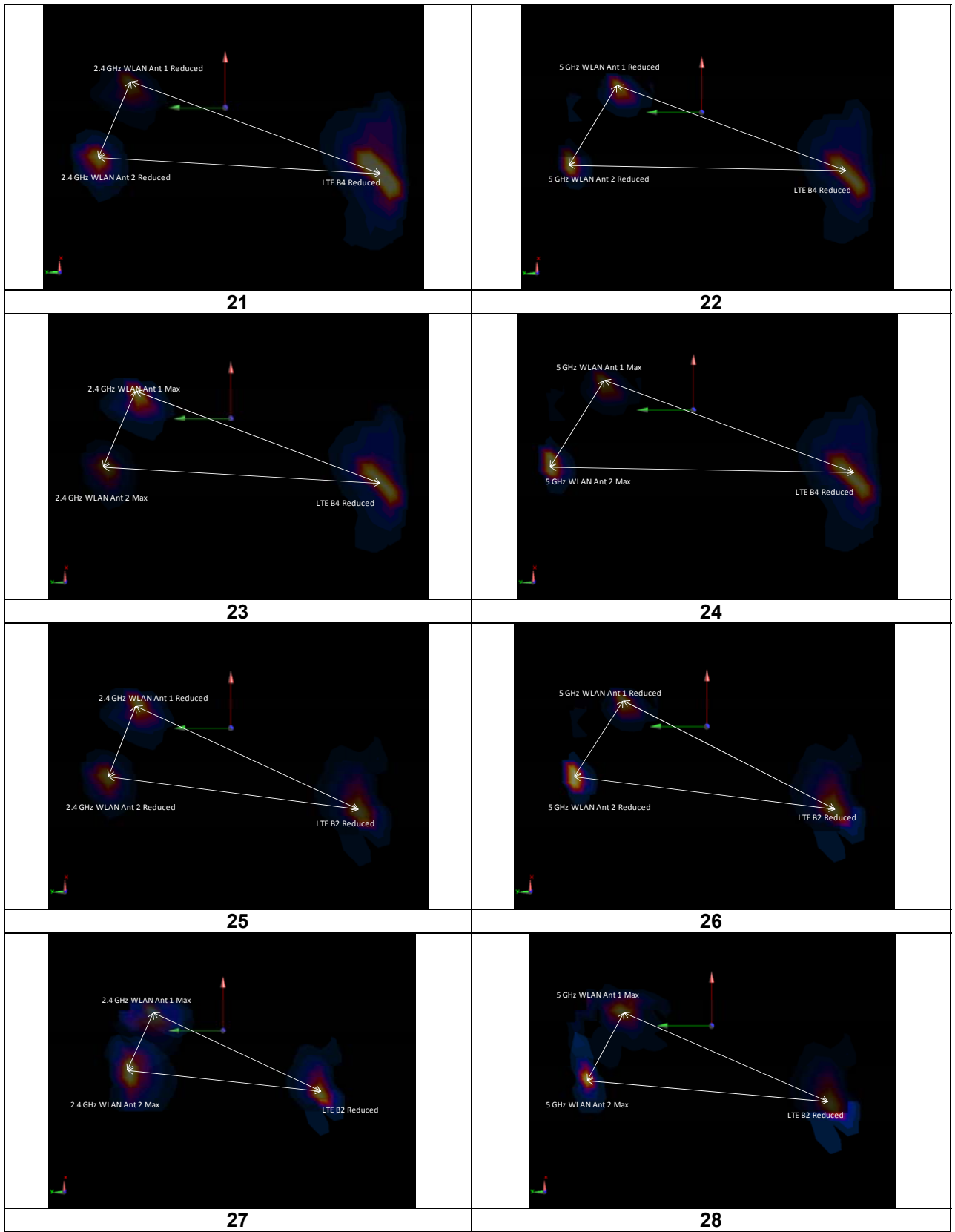
Table 11-15
SAR Sum to Peak Location Separation Ratio Plots





FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 79 of 89





FCC ID: A3LSMT817A



SAR EVALUATION REPORT



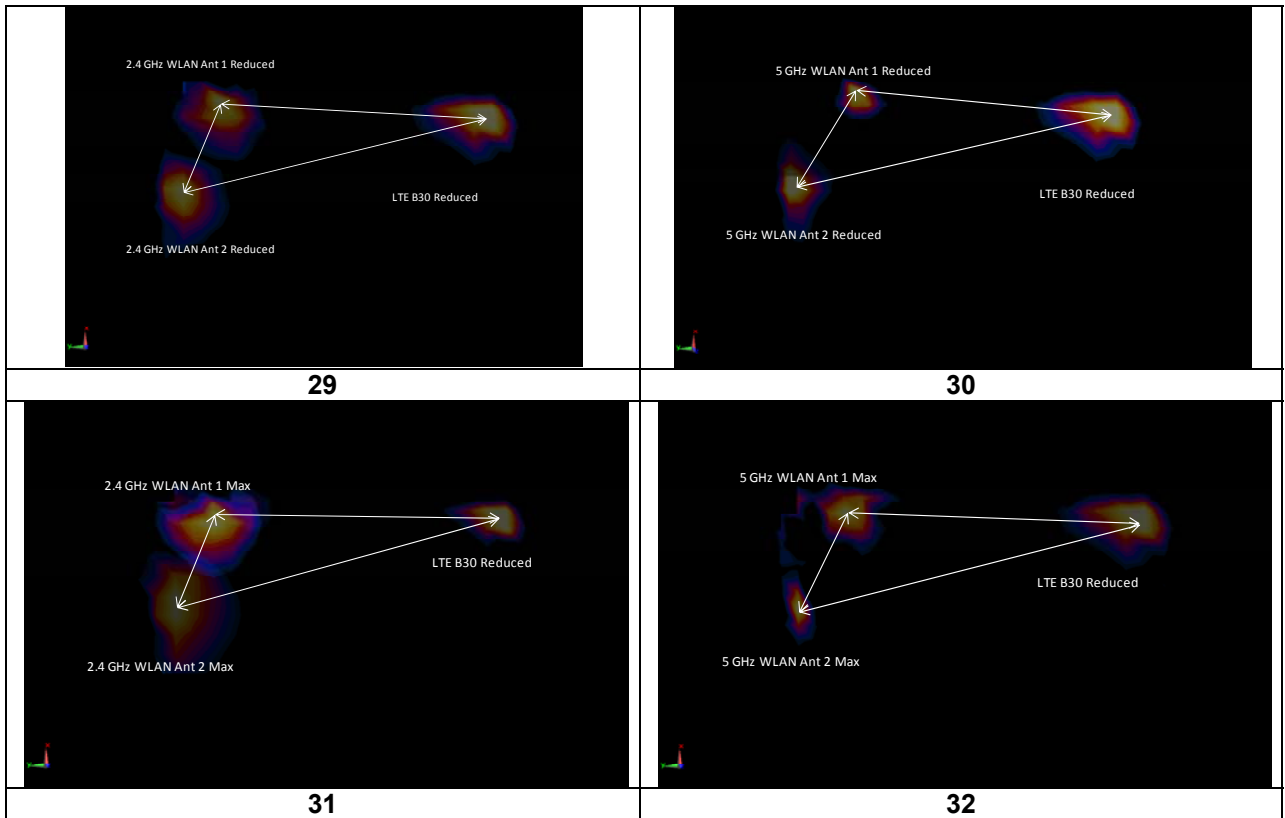
Reviewed by:
Quality Manager

Document S/N:
0Y1504300815.A3L

Test Dates:
04/27/15 - 05/21/15

DUT Type:
Portable Tablet

Page 81 of 89



11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05 and IEEE 1528-2013 Section 6.3.4.1.2.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 82 of 89

12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

- 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
- 2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg ($\sim 10\%$ from the 1-g SAR limit).
- 3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
- 4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	836.60	4183	UMTS 850	RMC	N/A	top	0 mm	0.993	0.904	1.10	N/A	N/A	N/A	N/A
750	707.50	23095	LTE Band 12	QPSK, 1 RB, 49 RB Offset	N/A	top	0 mm	0.876	0.877	1.00	N/A	N/A	N/A	N/A
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 99 RB Offset	N/A	left	0 mm	1.010	1.030	1.02	N/A	N/A	N/A	N/A
1900	1900.00	19100	LTE Band 2 (PCS)	QPSK, 1 RB, 99 RB Offset	N/A	back	0 mm	1.100	0.999	1.10	N/A	N/A	N/A	N/A
2300	2310.00	27710	LTE Band 30	QPSK, 1 RB, 0 RB Offset	N/A	right	0 mm	0.969	1.050	1.08	N/A	N/A	N/A	N/A
2450	2437.00	6	802.11b 22 MHz Bandwidth	DSSS, ANT 1	1	back	0 mm	1.020	0.907	1.12	N/A	N/A	N/A	N/A
5300	5290.00	58	802.11ac 80 MHz Bandwidth	OFDM, ANT 2	29.3	back	0 mm	0.864	0.729	1.19	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT							Body							
Spatial Peak							1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population							averaged over 1 gram							

12.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 83 of 89

13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8753ES	S-Parameter Network Analyzer	3/12/2015	Annual	3/12/2016	MY40000670
Agilent	E4432B	ESG-D Series Signal Generator	3/16/2015	Annual	3/16/2016	US40053896
Agilent	E4438C	ESG Vector Signal Generator	3/13/2015	Annual	3/13/2016	MY42082385
Agilent	E5515C	Wireless Communications Test Set	2/23/2015	Biennial	2/23/2017	GB41450275
Agilent	E5515C	Wireless Communications Test Set	11/20/2014	Annual	11/20/2015	GB42361078
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/15/2015	Annual	3/15/2016	MY45470194
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB44450273
Agilent	N5182A	MXG Vector Signal Generator	10/27/2014	Annual	10/27/2015	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	3/16/2015	Annual	3/16/2016	MY47420651
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344545
Anritsu	MA24106A	USB Power Sensor	3/11/2015	Annual	3/11/2016	1344554
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344555
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344556
Anritsu	MA2411B	Pulse Power Sensor	11/17/2014	Annual	11/17/2015	1126066
Anritsu	MA2411B	Pulse Power Sensor	11/17/2014	Annual	11/17/2015	1207364
Anritsu	ML2495A	Power Meter	10/31/2013	Biennial	10/31/2015	941001
Anritsu	ML2496A	Power Meter	3/13/2015	Annual	3/13/2016	1351001
Anritsu	MT8820C	Radio Communication Analyzer	3/10/2015	Annual	3/10/2016	6200901190
Anritsu	MT8820C	Radio Communication Analyzer	9/19/2014	Annual	9/19/2015	6201144418
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
Control Company	4040	Digital Thermometer	3/18/2015	Biennial	3/18/2017	150194895
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	111313123
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671801
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	6/6/2014	Annual	6/6/2015	109892
Rohde & Schwarz	CMW500	Radio Communication tester	5/5/2015	Annual	5/5/2016	140144
Rohde & Schwarz	CMW500	Radio Communication Tester	4/8/2015	Annual	4/8/2016	140148
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
SPEAG	D1765V2	1765 MHz SAR Dipole	5/7/2014	Annual	5/7/2015	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	4/14/2015	Annual	4/14/2016	5d141
SPEAG	D2300V2	2300 MHz SAR Dipole	1/27/2015	Annual	1/27/2016	1008
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/21/2015	Annual	1/21/2016	1057
SPEAG	D750V3	750 MHz Dipole	2/19/2015	Annual	2/19/2016	1046
SPEAG	D835V2	835 MHz SAR Dipole	7/24/2014	Annual	7/24/2015	4d133
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/14/2015	Annual	1/14/2016	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/12/2014	Annual	8/12/2015	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2014	Annual	9/17/2015	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/31/2014	Annual	10/31/2015	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/13/2015	Annual	3/13/2016	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2014	Annual	9/18/2015	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/13/2015	Annual	3/13/2016	1368
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/21/2014	Annual	10/21/2015	1091
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	7/15/2014	Annual	7/15/2015	1039
SPEAG	ES3DV2	SAR Probe	8/19/2014	Annual	8/19/2015	3022
SPEAG	ES3DV3	SAR Probe	3/19/2015	Annual	3/19/2016	3209
SPEAG	ES3DV3	SAR Probe	9/24/2014	Annual	9/24/2015	3288
SPEAG	ES3DV3	SAR Probe	1/23/2015	Annual	1/23/2016	3318
SPEAG	ES3DV3	SAR Probe	3/19/2015	Annual	3/19/2016	3319
SPEAG	ES3DV3	SAR Probe	8/20/2014	Annual	8/20/2015	3331
SPEAG	EX3DV4	SAR Probe	1/22/2015	Annual	1/22/2016	3589
VWR	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	111859323

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. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

All equipment was used within the respective calibration dates.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet
© 2015 PCTEST Engineering Laboratory, Inc.		Page 84 of 89

14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1	1.0	1.0	6.0	6.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.1	11.7
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.2	23.5

The above measurement uncertainties are according to IEEE Std. 1528-2003

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 85 of 89

Applicable for frequencies up to 6 GHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System									
Probe Calibration	E.2.1	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.4	12.0
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0

The above measurement uncertainties are according to IEEE Std. 1528-2003

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	Page 86 of 89	

15 CONCLUSION

15.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 87 of 89

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Document S/N: OY1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 88 of 89

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Document S/N: 0Y1504300815.A3L	Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet		Page 89 of 89

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 6798

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Body, Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.983 \text{ S/m}$; $\epsilon_r = 53.227$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-30-2015; Ambient Temp: 23.3°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3209; ConvF(6.07, 6.07, 6.07); Calibrated: 3/19/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/13/2015

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 850, Body SAR, Top Edge, Mid.ch

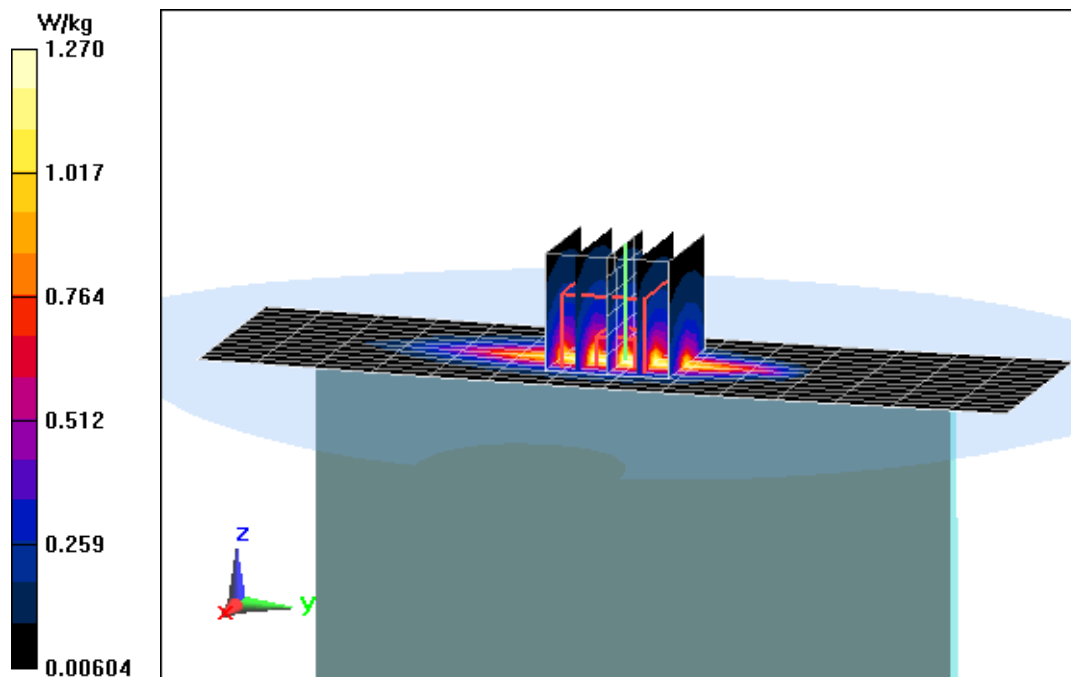
Area Scan (13x15x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 34.38 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.06 W/kg

SAR(1 g) = 0.993 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 6798

Communication System: UID 0, UMTS; Frequency: 1907.6 MHz; Duty Cycle: 1:1

Medium: 1900 Body, Medium parameters used (interpolated):

$f = 1907.6 \text{ MHz}$; $\sigma = 1.573 \text{ S/m}$; $\epsilon_r = 52.046$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 05-01-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1900, Body SAR, Back side, High.ch

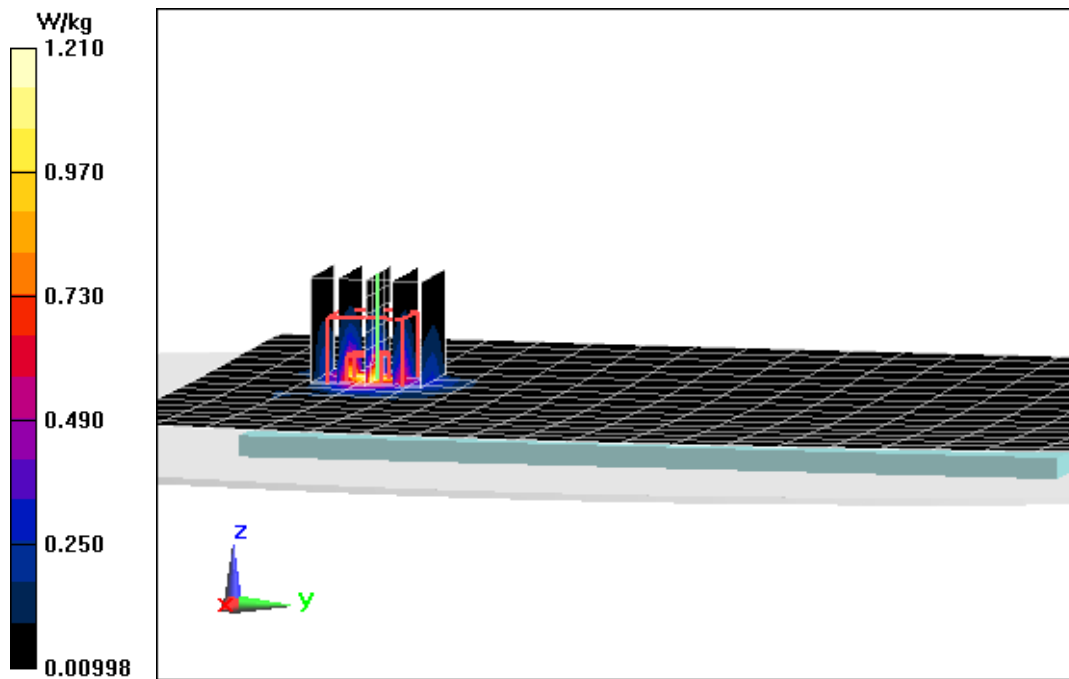
Area Scan (9x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (6x6x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 29.06 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 2.22 W/kg

SAR(1 g) = 1.08 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 8134

Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.927 \text{ S/m}$; $\epsilon_r = 54.867$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 05-04-2015; Ambient Temp: 24.2°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3331; ConvF(6.12, 6.12, 6.12); Calibrated: 8/20/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 12, Body SAR, Top Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

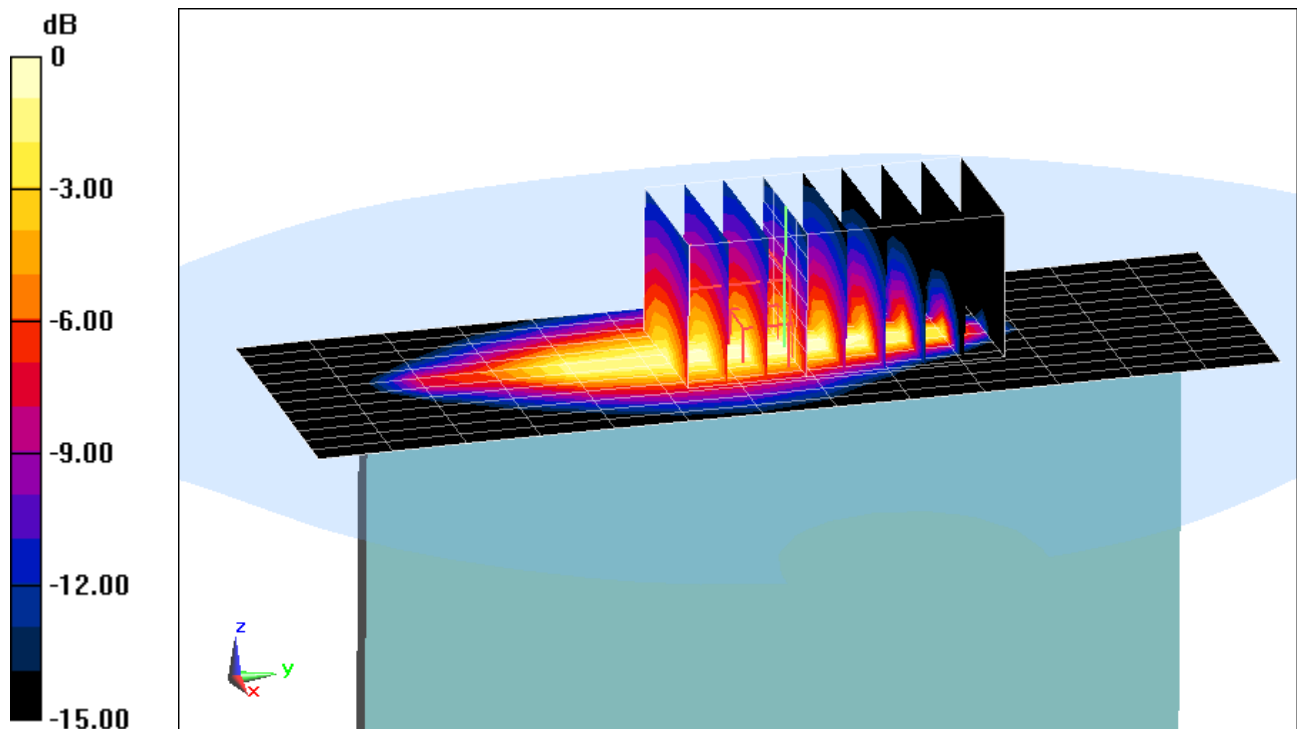
Area Scan (13x14x1): Measurement grid: dx=5mm, dy=15mm

Zoom Scan (5x9x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 32.56 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 2.44 W/kg

SAR(1 g) = 0.877 W/kg



0 dB = 1.20 W/kg = 0.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 8117

Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body, Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.994 \text{ S/m}$; $\epsilon_r = 54.179$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-27-2015; Ambient Temp: 20.9°C; Tissue Temp: 21.9°C

Probe: ES3DV2 - SN3022; ConvF(5.98, 5.98, 5.98); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

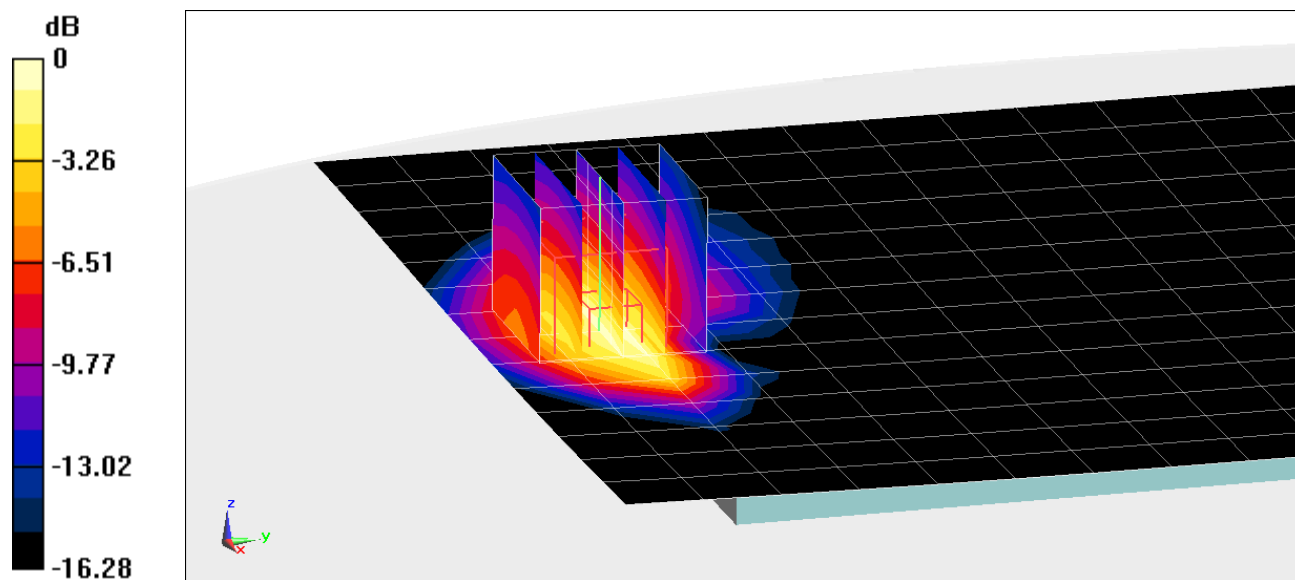
Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 33.10 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 1.84 W/kg

SAR(1 g) = 0.957 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 7598

Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750 Body, Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.432 \text{ S/m}$; $\epsilon_r = 52.947$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-27-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3318; ConvF(4.95, 4.95, 4.95); Calibrated: 1/23/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/14/2015

Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2027

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 4 (AWS), Body SAR, Left Edge, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset**

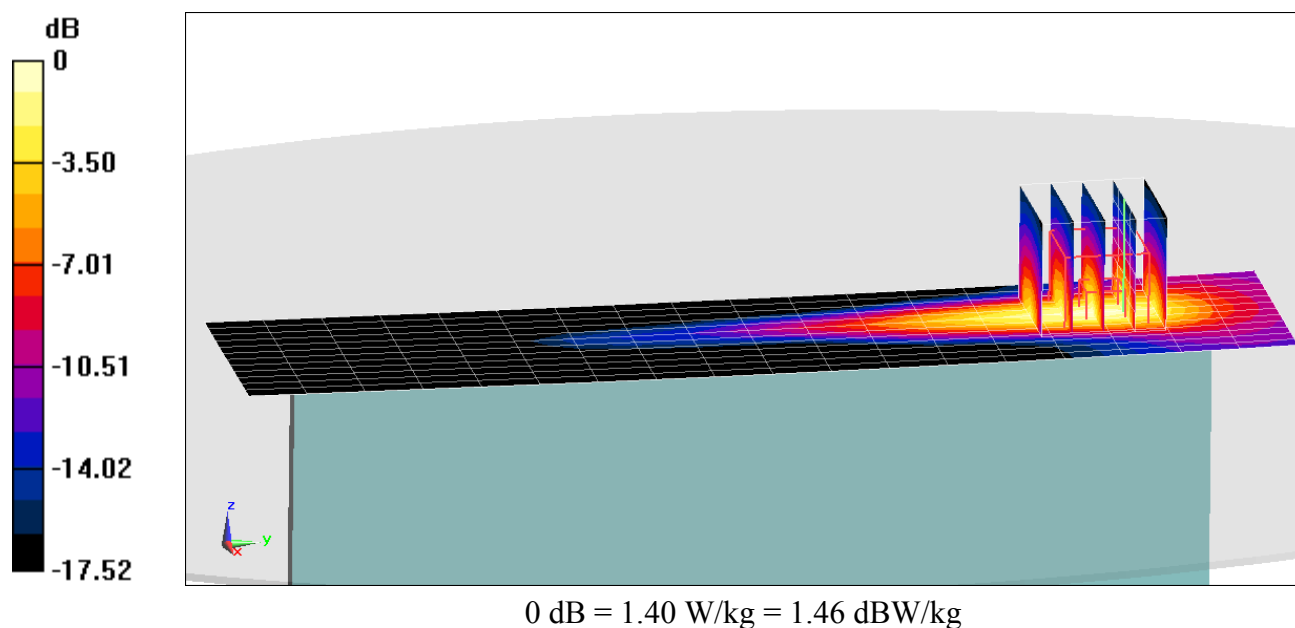
Area Scan (13x19x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 28.23 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.27 W/kg

SAR(1 g) = 1.03 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 6947

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body, Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.564 \text{ S/m}$; $\epsilon_r = 52.095$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 05-01-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Body SAR, Back Side, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset**

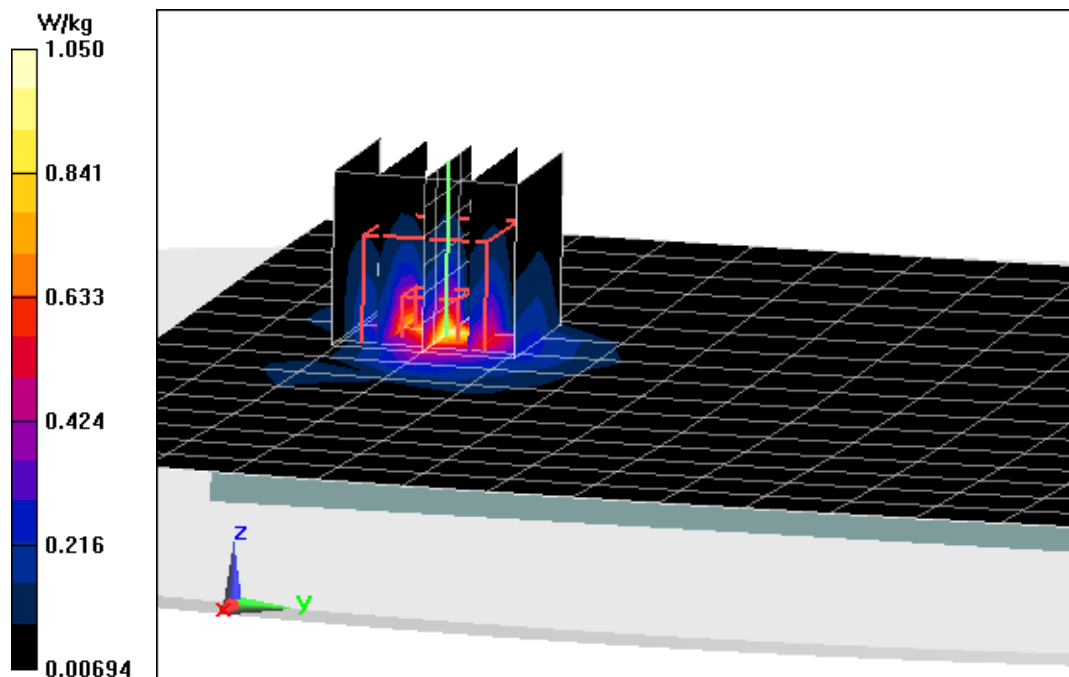
Area Scan (10x21x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 29.52 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.24 W/kg

SAR(1 g) = 1.1 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 7318

Communication System: UID 0, LTE Band 30; Frequency: 2310 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2310 \text{ MHz}$; $\sigma = 1.775 \text{ S/m}$; $\epsilon_r = 51.63$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 05-21-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3318; ConvF(4.52, 4.52, 4.52); Calibrated: 1/23/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/14/2015

Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2027

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 30, Body SAR, Right Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

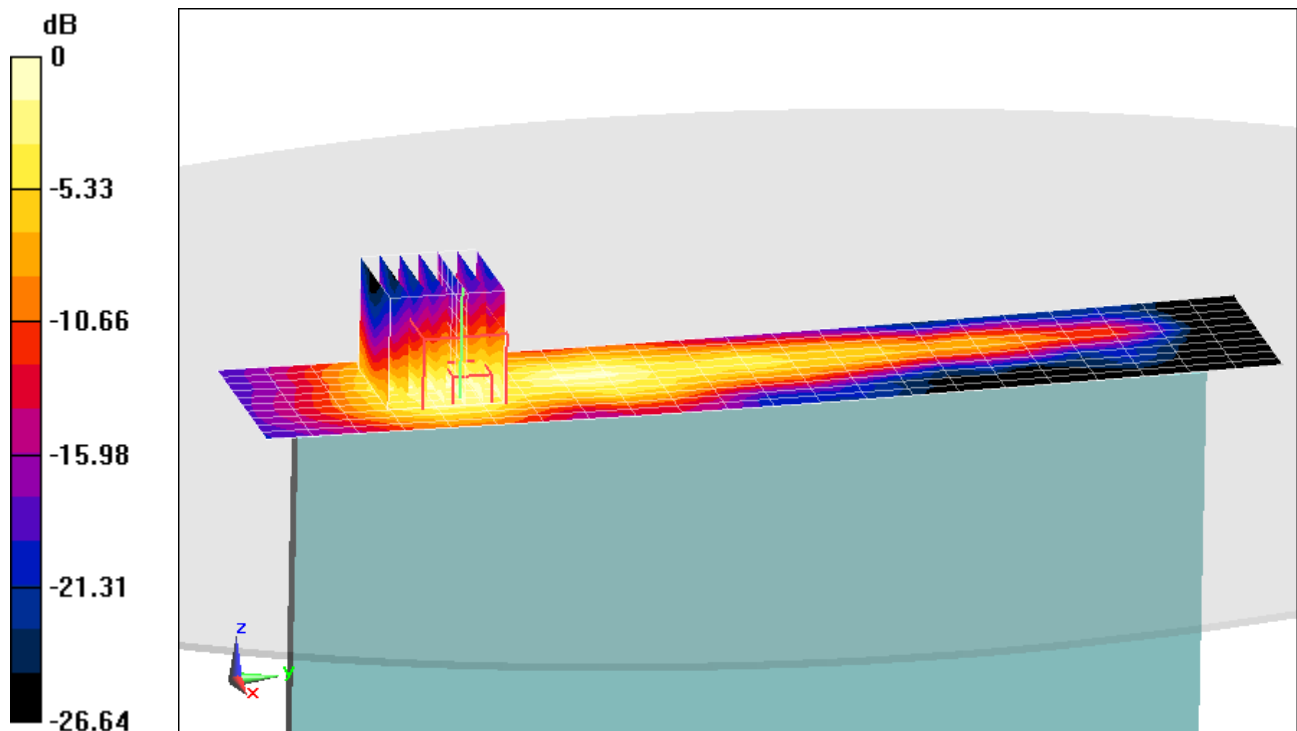
Area Scan (11x23x1): Measurement grid: $dx=5\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 1: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 22.19 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.66 W/kg

SAR(1 g) = 1.05 W/kg



0 dB = 1.38 W/kg = 1.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 7937

Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body, Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.946 \text{ S/m}$; $\epsilon_r = 51.364$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-29-2015; Ambient Temp: 21.4°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3319; ConvF(4.11, 4.11, 4.11); Calibrated: 3/19/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/13/2015

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Body SAR, Ch 6, 1 Mbps, Back Side, Antenna 1

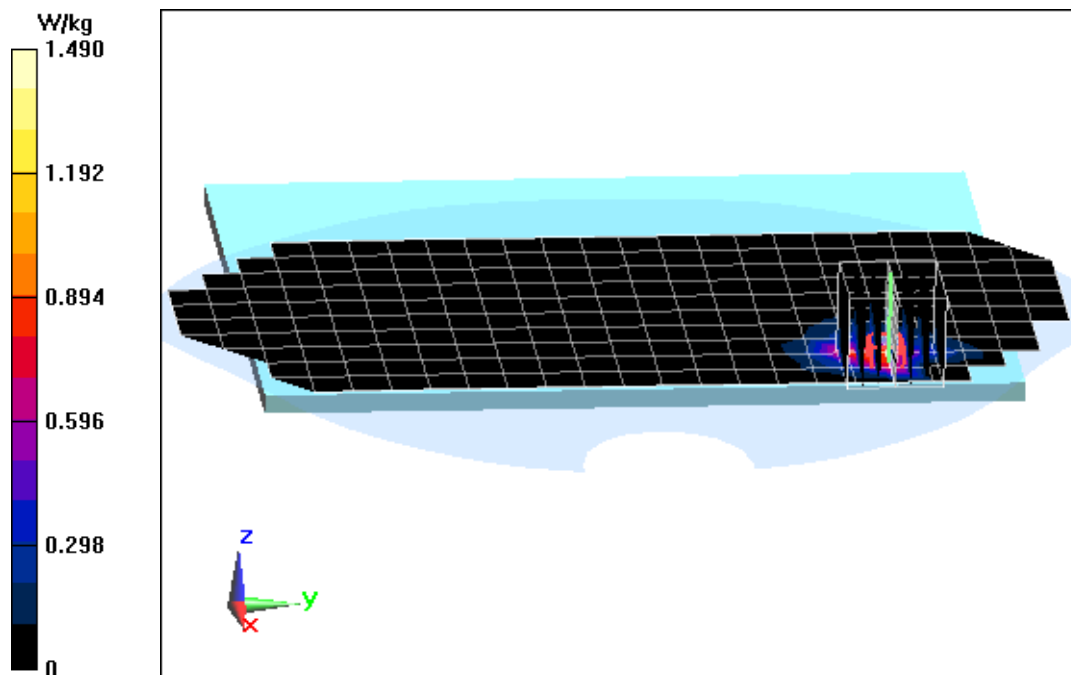
Area Scan (11x24x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 22.06 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.18 W/kg

SAR(1 g) = 1.02 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 7937

Communication System: UID 0, IEEE 802.11ac; Frequency: 5290 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used (interpolated):

$f = 5290 \text{ MHz}$; $\sigma = 5.391 \text{ S/m}$; $\epsilon_r = 48.037$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-27-2015; Ambient Temp: 20.9°C; Tissue Temp: 20.6°C

Probe: EX3DV4 - SN3589; ConvF(3.79, 3.79, 3.79); Calibrated: 1/22/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2014

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: IEEE 802.11ac, 5.3 GHz, 80 MHz Bandwidth,
Body SAR, Ch 58, 29.3 Mbps, Back Side, Antenna 2**

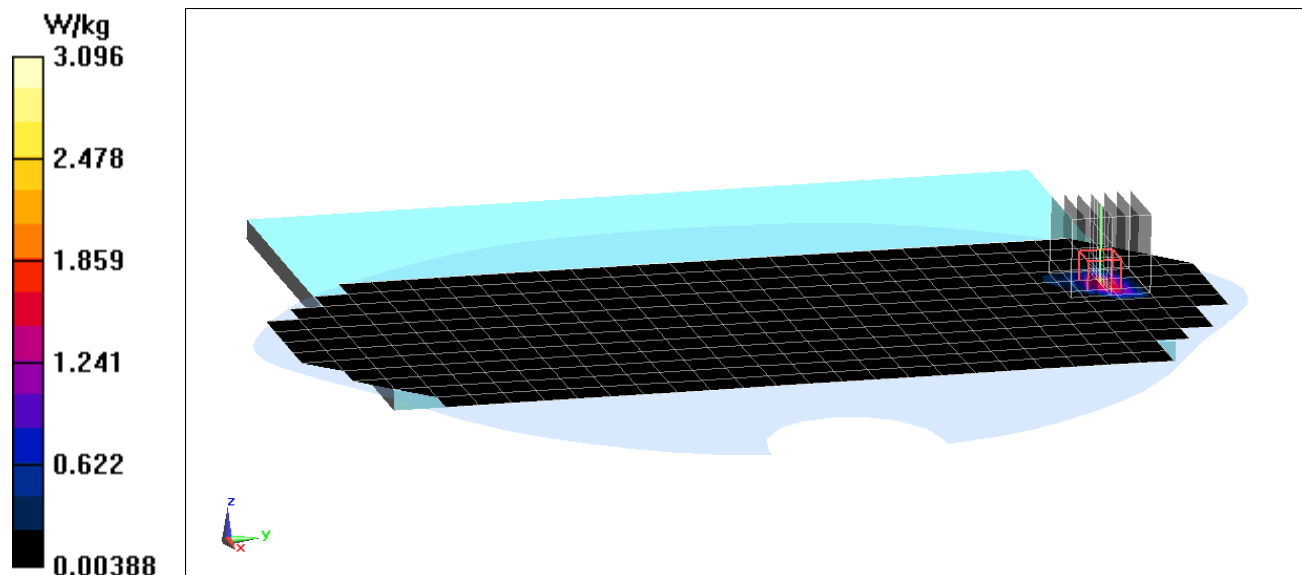
Area Scan (13x29x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 11.40 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 8.90 W/kg

SAR(1 g) = 0.864 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT817A; Type: Portable Tablet; Serial: 6905

Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1

Medium: 2450 Body, Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 1.951 \text{ S/m}$; $\epsilon_r = 51.347$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-29-2015; Ambient Temp: 21.4°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3319; ConvF(4.11, 4.11, 4.11); Calibrated: 3/19/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/13/2015

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: Bluetooth, Body SAR, Ch 39, 1 Mbps, Back Side

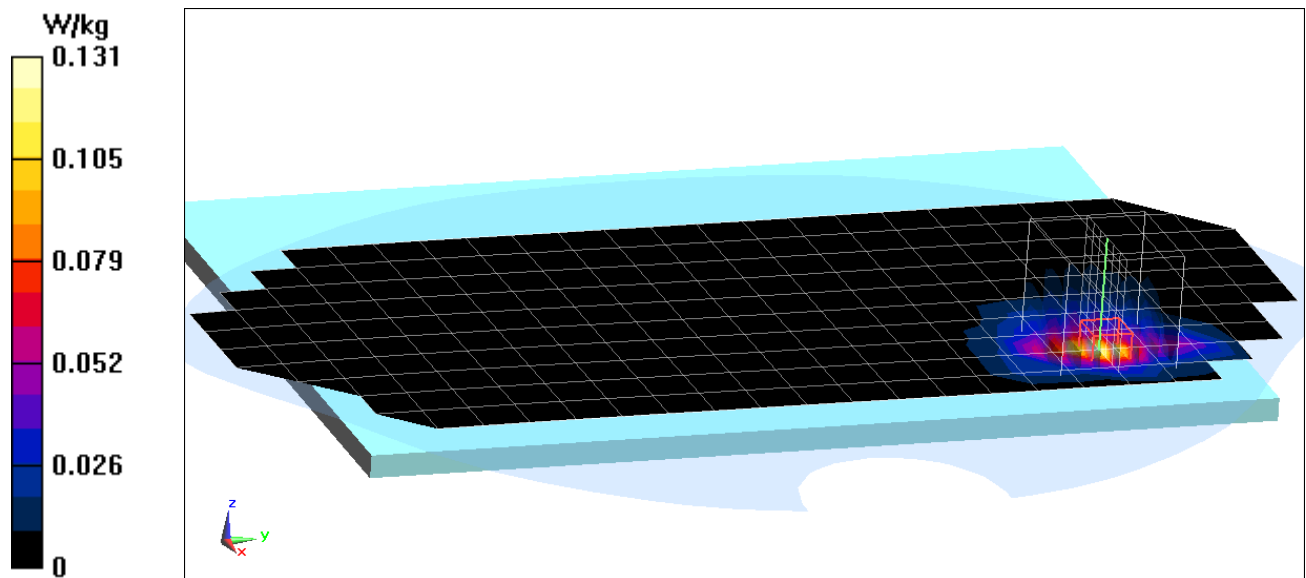
Area Scan (11x24x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.720 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.255 W/kg

SAR(1 g) = 0.098 W/kg



APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1046

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.965 \text{ S/m}$; $\epsilon_r = 54.443$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 05-04-2015; Ambient Temp: 24.2°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3331; ConvF(6.12, 6.12, 6.12); Calibrated: 8/20/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

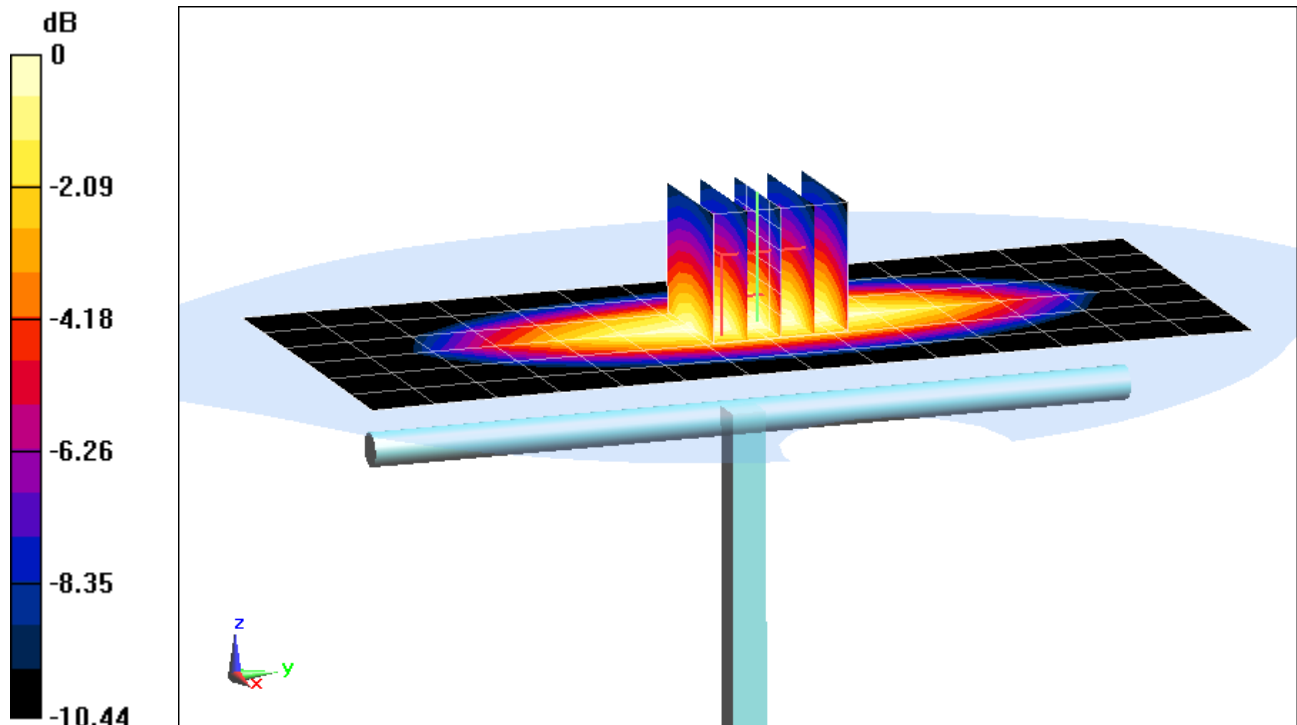
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.31 W/kg

SAR(1 g) = 0.890 W/kg

Deviation = 7.36%



0 dB = 1.03 W/kg = 0.13 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body, Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.992 \text{ S/m}$; $\epsilon_r = 54.192$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-27-2015; Ambient Temp: 20.9°C; Tissue Temp: 21.9°C

Probe: ES3DV2 - SN3022; ConvF(5.98, 5.98, 5.98); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

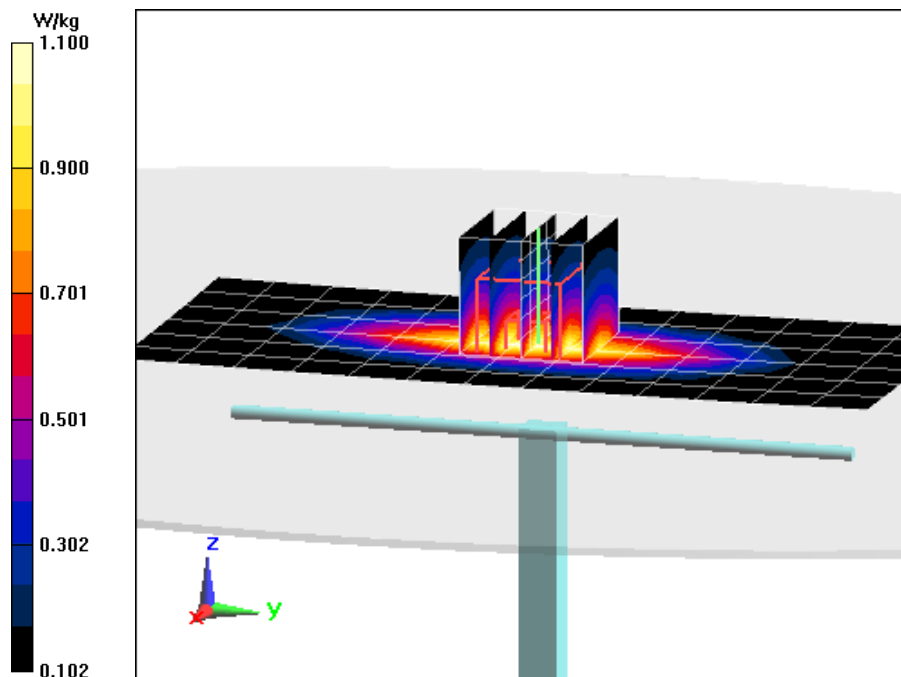
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.37 W/kg

SAR(1 g) = 0.940 W/kg

Deviation = 0.53%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body, Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.981 \text{ S/m}$; $\epsilon_r = 53.24$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-30-2015; Ambient Temp: 23.3°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3209; ConvF(6.07, 6.07, 6.07); Calibrated: 3/19/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/13/2015

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

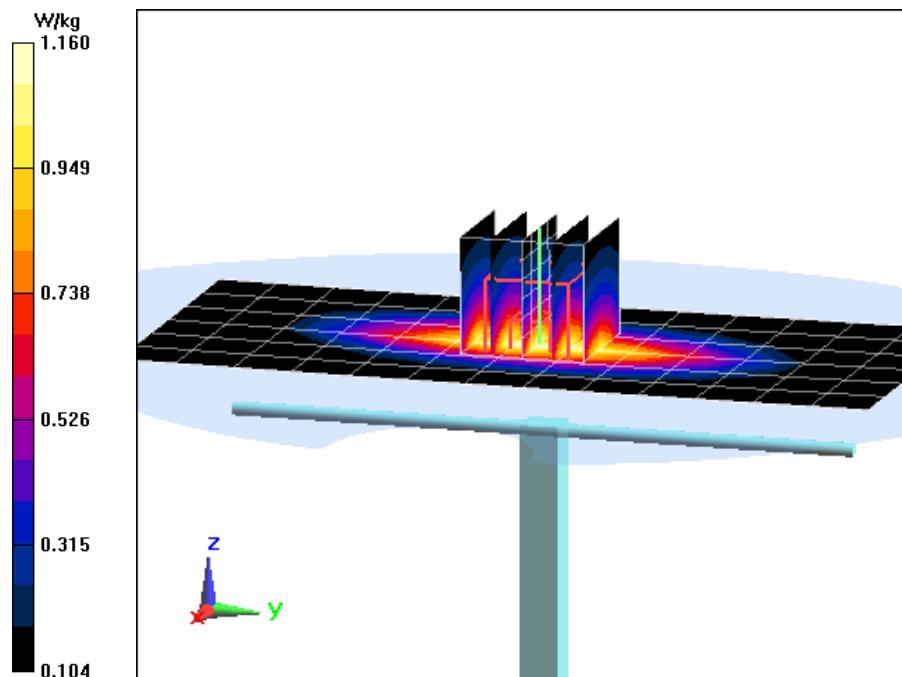
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.45 W/kg

SAR(1 g) = 0.990 W/kg

Deviation = 5.88%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body, Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.451 \text{ S/m}$; $\epsilon_r = 52.881$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-27-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3318; ConvF(4.95, 4.95, 4.95); Calibrated: 1/23/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/14/2015

Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2027

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

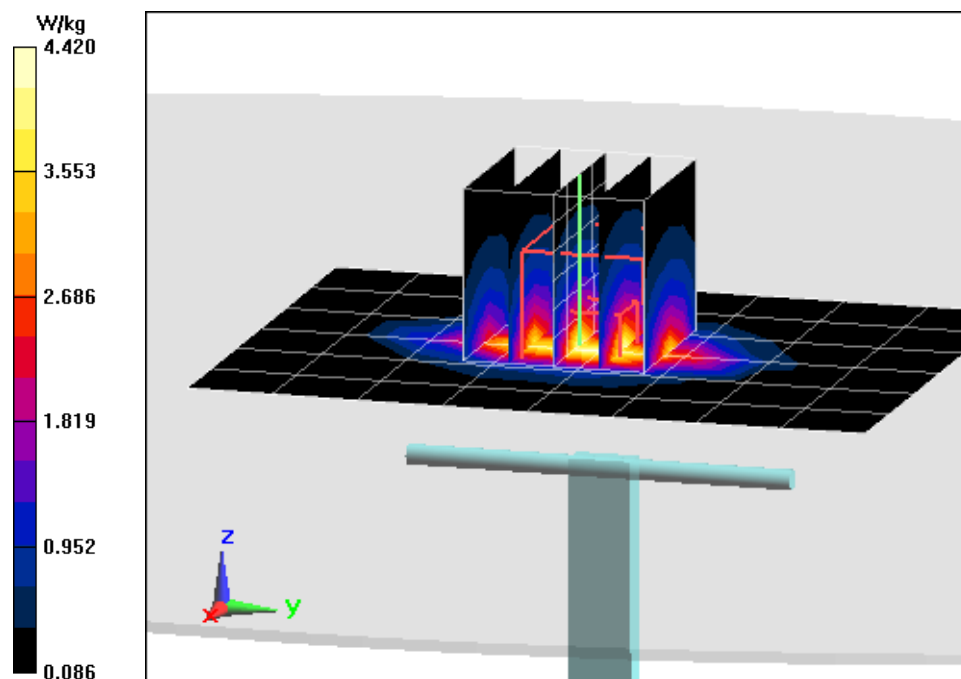
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.29 W/kg

SAR(1 g) = 3.58 W/kg

Deviation = -4.79%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body, Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.564 \text{ S/m}$; $\epsilon_r = 52.095$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-01-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

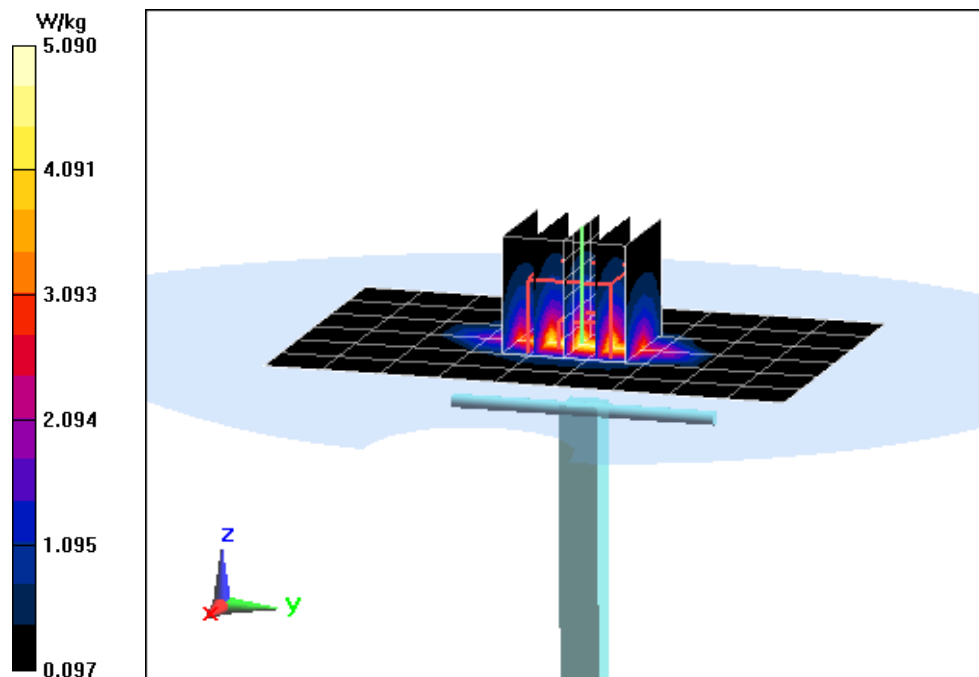
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.15 W/kg

SAR(1 g) = 4.02 W/kg

Deviation = 0.50%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: 1008

Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2300 \text{ MHz}$; $\sigma = 1.763 \text{ S/m}$; $\epsilon_r = 51.66$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-21-2015; Ambient Temp: 22.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3318; ConvF(4.52, 4.52, 4.52); Calibrated: 1/23/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/14/2015

Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2027

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2300 MHz System Verification

Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

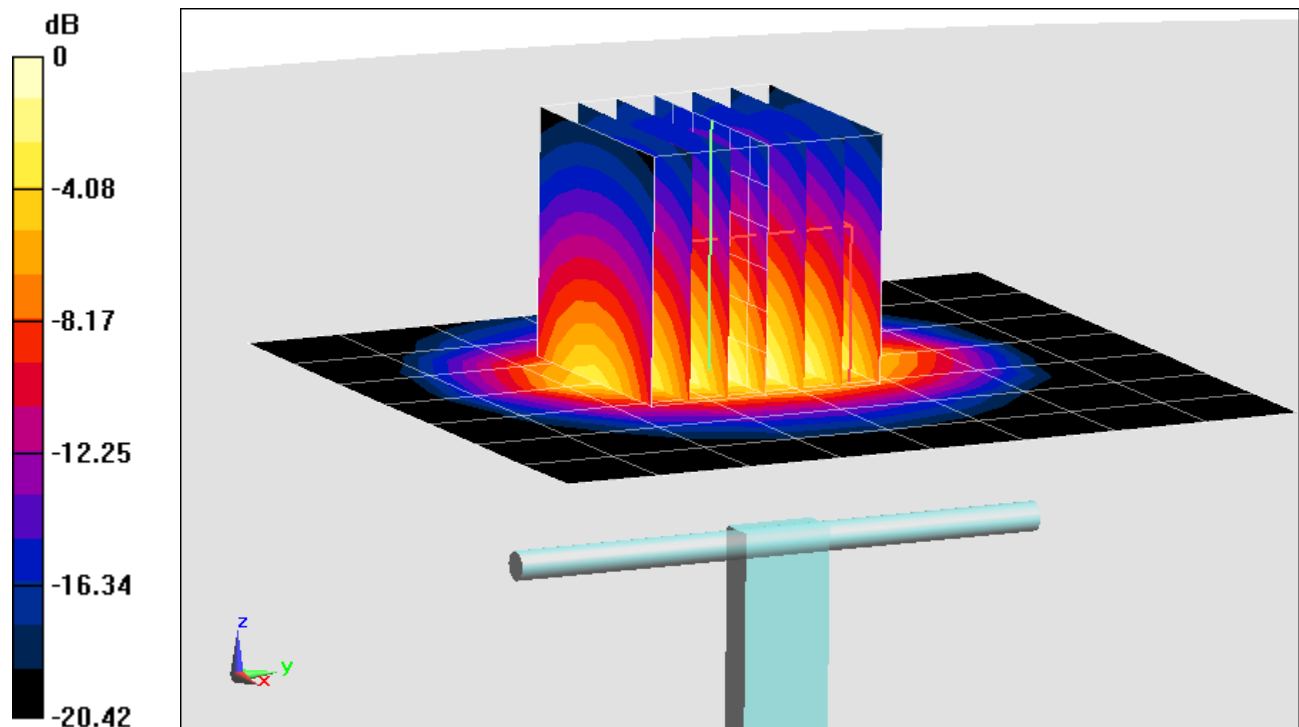
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 9.33 W/kg

SAR(1 g) = 4.64 W/kg

Deviation = -3.53%



0 dB = 6.06 W/kg = 7.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body, Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.962 \text{ S/m}$; $\epsilon_r = 51.31$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-29-2015; Ambient Temp: 21.4°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3319; ConvF(4.11, 4.11, 4.11); Calibrated: 3/19/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/13/2015

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

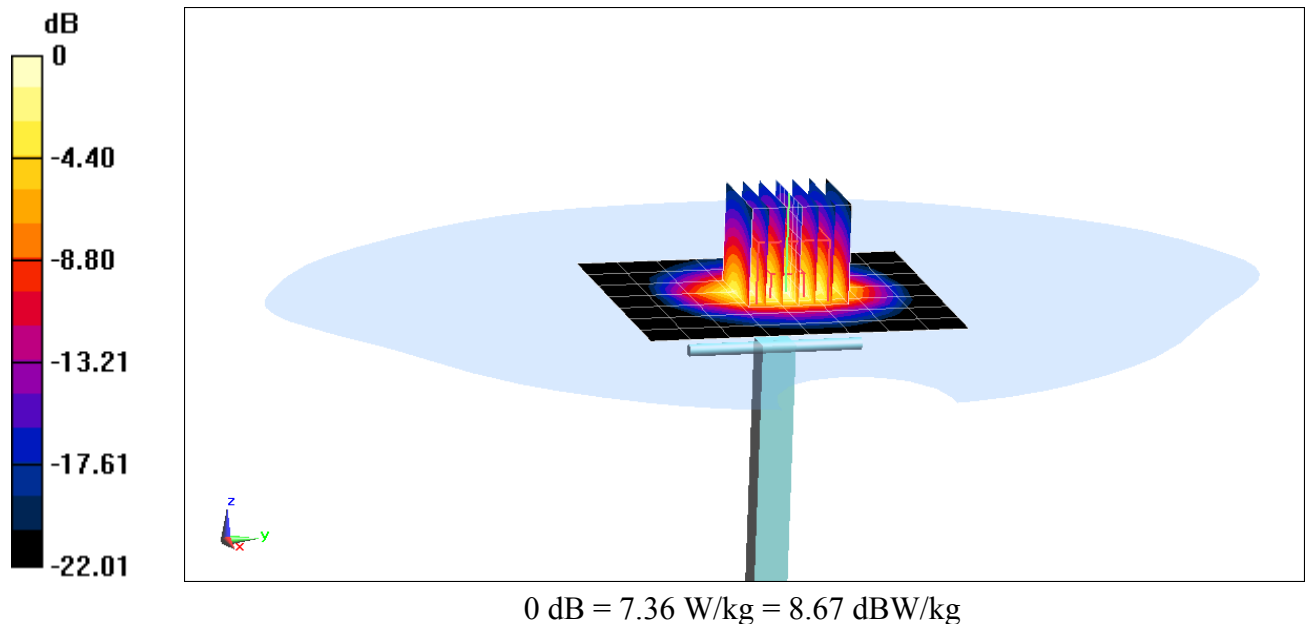
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 11.8 W/kg

SAR(1 g) = 5.56 W/kg

Deviation = 7.34%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.409 \text{ S/m}$; $\epsilon_r = 48.022$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-27-2015; Ambient Temp: 20.9°C; Tissue Temp: 20.6°C

Probe: EX3DV4 - SN3589; ConvF(3.79, 3.79, 3.79); Calibrated: 1/22/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2014

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm

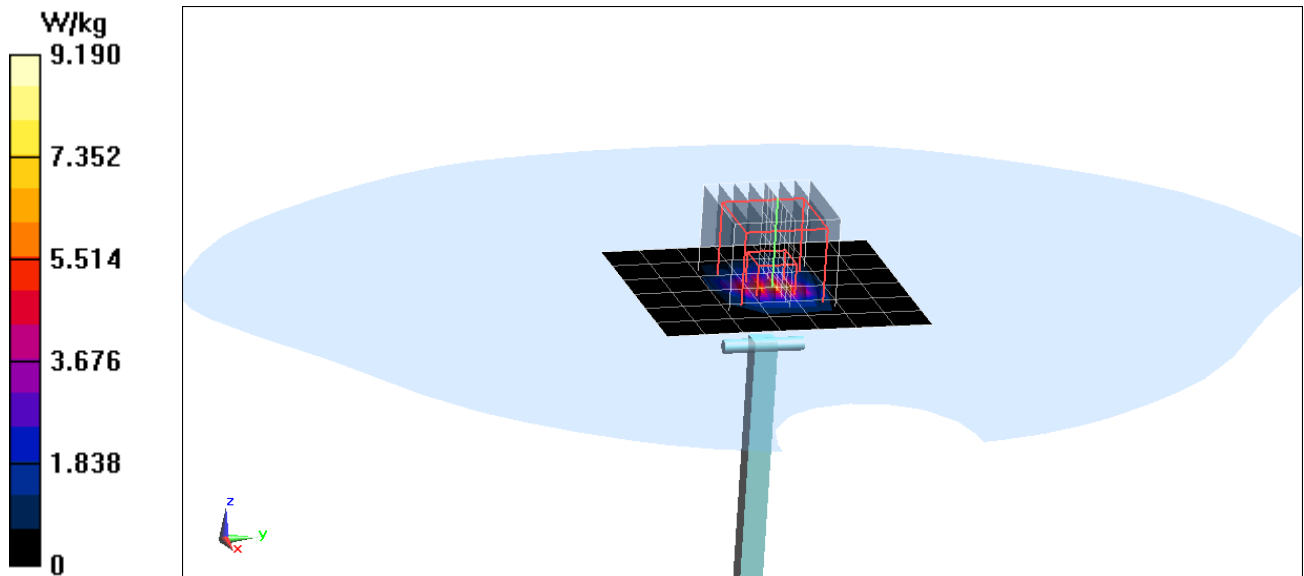
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 17.0 dBm (50 mW)

Peak SAR (extrapolated) = 16.0 W/kg

SAR(1 g) = 3.84 W/kg

Deviation = 3.50%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.652 \text{ S/m}$; $\epsilon_r = 47.731$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-27-2015; Ambient Temp: 20.9°C; Tissue Temp: 20.6°C

Probe: EX3DV4 - SN3589; ConvF(3.65, 3.65, 3.65); Calibrated: 1/22/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2014

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

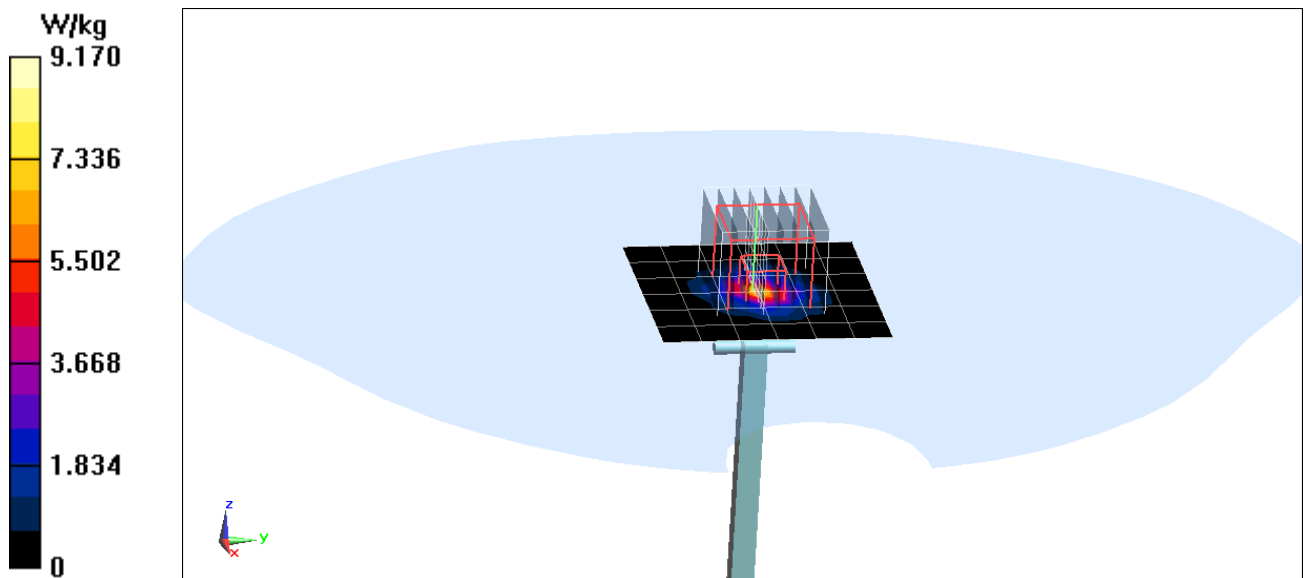
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 17.0 dBm (50 mW)

Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 3.78 W/kg

Deviation = -4.55%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.803 \text{ S/m}$; $\epsilon_r = 47.57$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-27-2015; Ambient Temp: 21.0°C; Tissue Temp: 20.7°C

Probe: EX3DV4 - SN3589; ConvF(3.42, 3.42, 3.42); Calibrated: 1/22/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2014

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

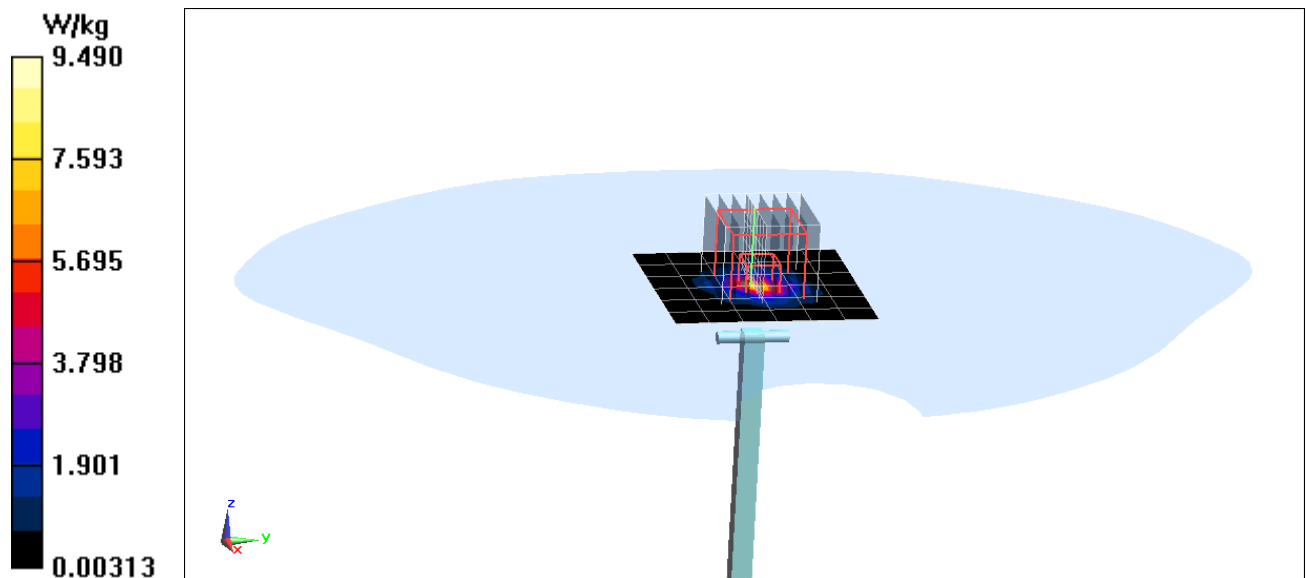
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 17.0 dBm (50 mW)

Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 3.91 W/kg

Deviation = 0.64%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.073 \text{ S/m}$; $\epsilon_r = 47.223$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-27-2015; Ambient Temp: 21.1°C; Tissue Temp: 20.7°C

Probe: EX3DV4 - SN3589; ConvF(3.79, 3.79, 3.79); Calibrated: 1/22/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2014

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

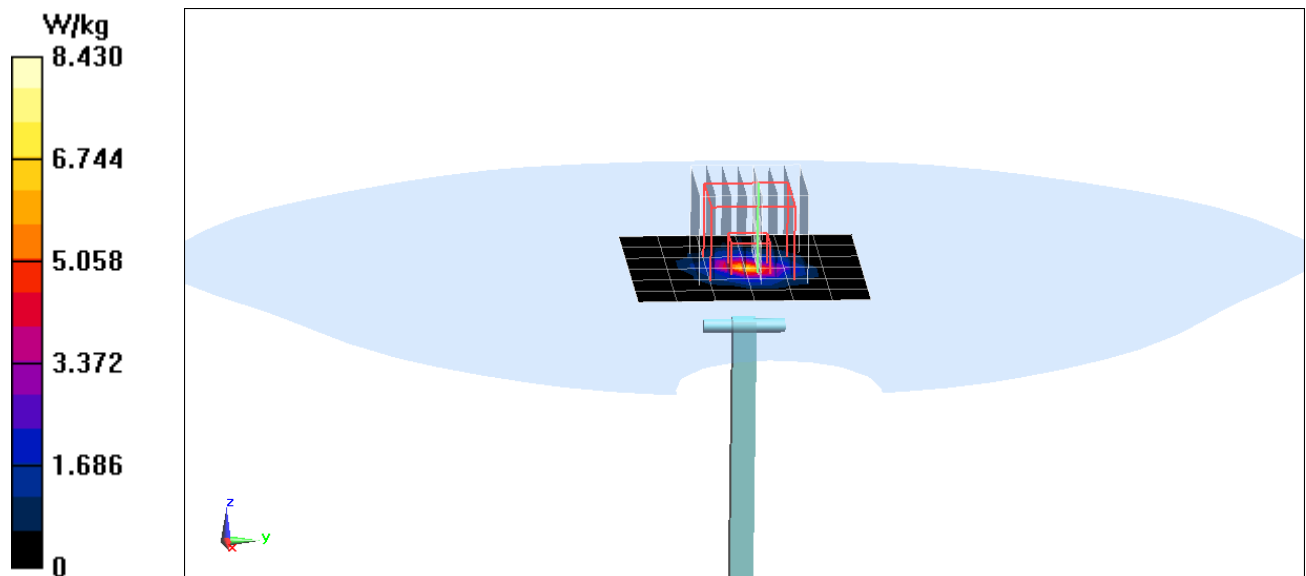
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 17.0 dBm (50 mW)

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 3.45 W/kg

Deviation = -8.12%



APPENDIX C: PROBE CALIBRATION



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: **D750V3-1046_Feb15**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1046**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

BN ✓
 3/6/2015

Calibration date: **February 19, 2015**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: February 19, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	41.6 $\pm$ 6 %	0.90 mho/m $\pm$ 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	2.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.04 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.28 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.9 $\pm$ 6 %	0.98 mho/m $\pm$ 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	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.29 W/kg $\pm$ 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	5.47 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.8 \Omega + 1.5 j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.4 \Omega - 1.3 j\Omega$
Return Loss	- 34.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.038 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	September 02, 2011

DASY5 Validation Report for Head TSL

Date: 18.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/ $P_{in}=250 \text{ mW}$, $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

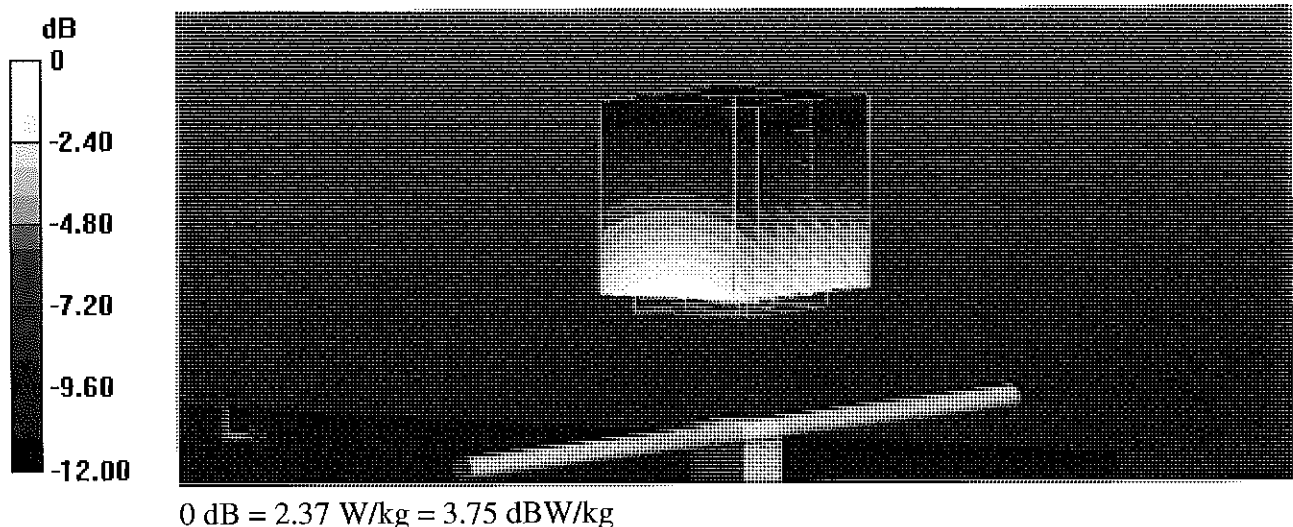
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.99 V/m ; Power Drift = 0.01 dB

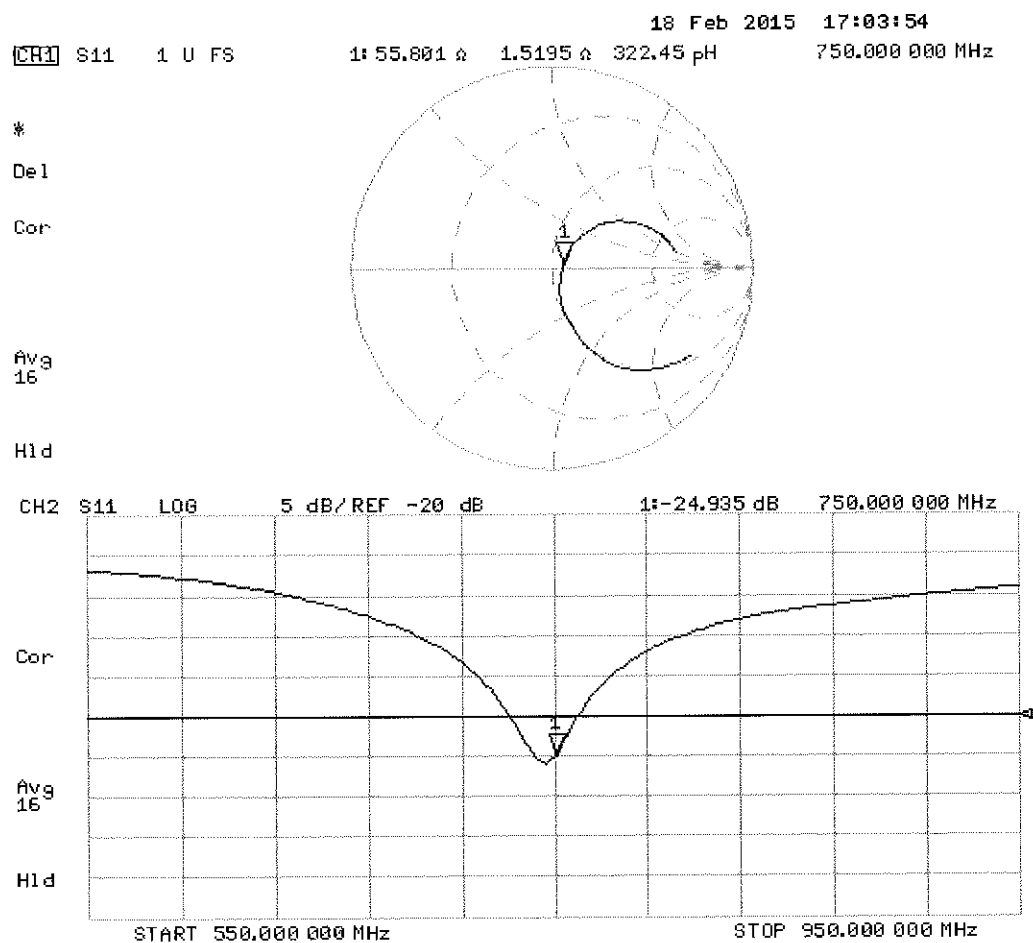
Peak SAR (extrapolated) = 3.02 W/kg

SAR(1 g) = 2.03 W/kg ; SAR(10 g) = 1.33 W/kg

Maximum value of SAR (measured) = 2.37 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/ $P_{in}=250 \text{ mW}$, $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

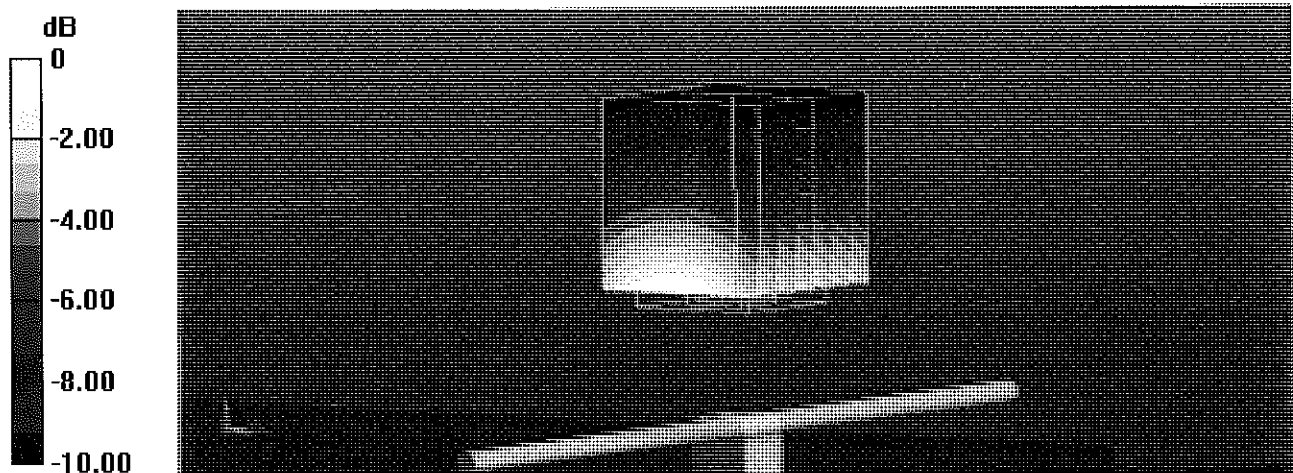
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.00 V/m ; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 3.10 W/kg

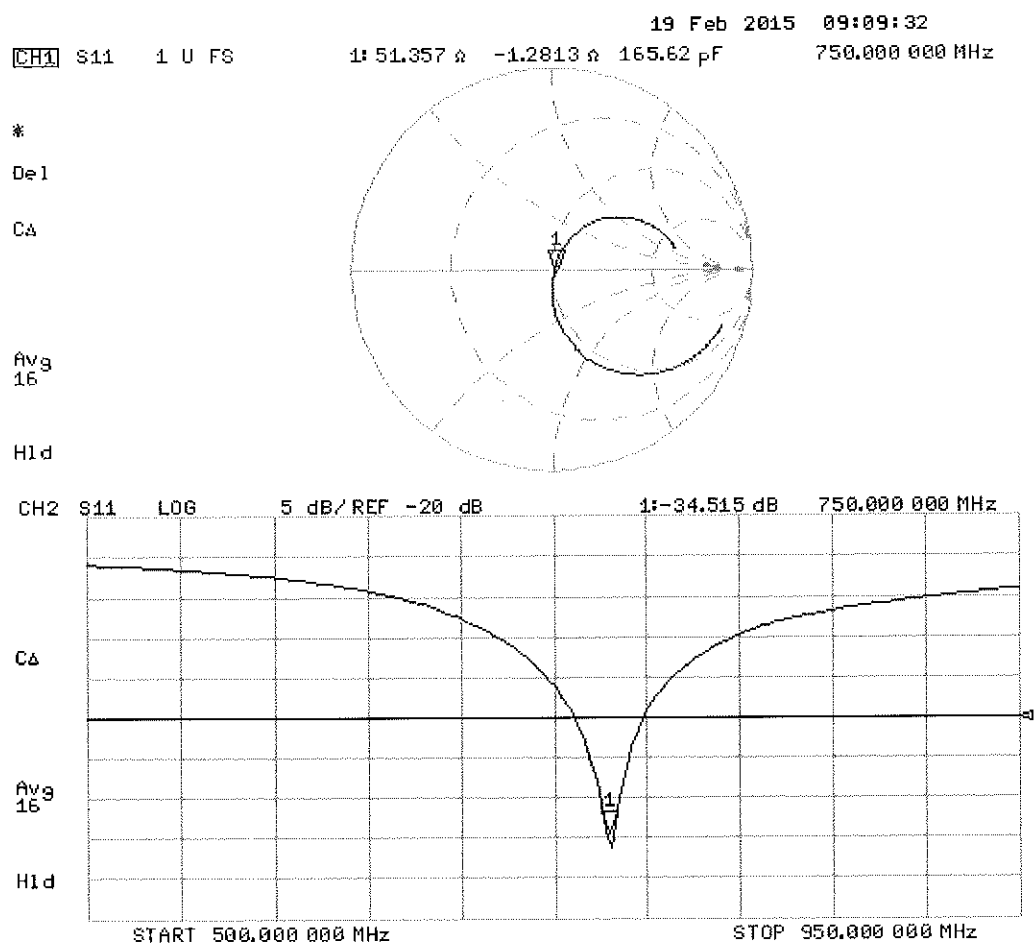
SAR(1 g) = 2.12 W/kg ; SAR(10 g) = 1.39 W/kg

Maximum value of SAR (measured) = 2.46 W/kg



0 dB = 2.46 W/kg = 3.91 dBW/kg

Impedance Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d133_Jul14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d133**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

CC
W/CM

Calibration date: **July 24, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8763E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Signature

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

Issued: July 24, 2014

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.94 mho/m $\pm$ 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	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.20 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.96 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.02 mho/m $\pm$ 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.35 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.15 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6 Ω - 1.0 j Ω
Return Loss	- 34.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 3.3 j Ω
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 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	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 24.07.2014

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: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

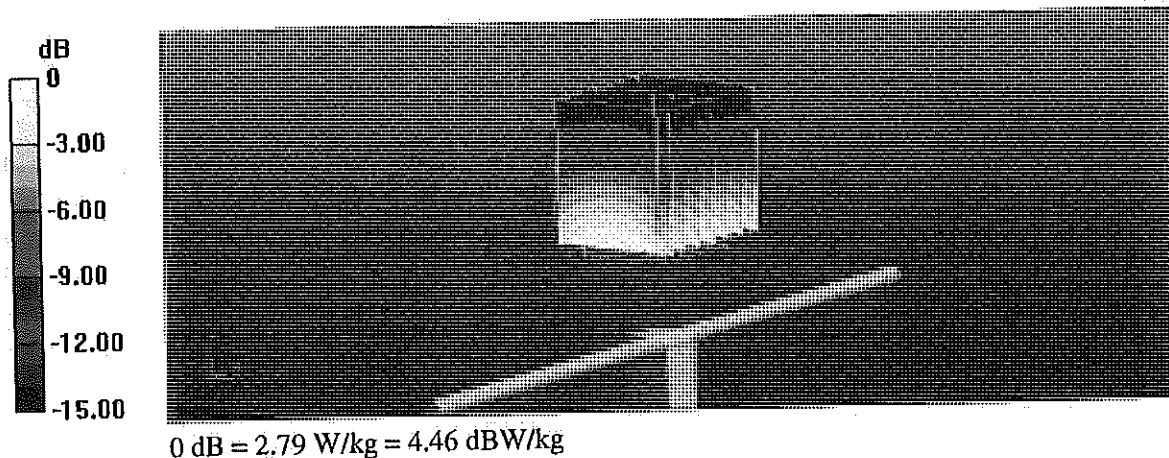
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.07 V/m; Power Drift = 0.03 dB

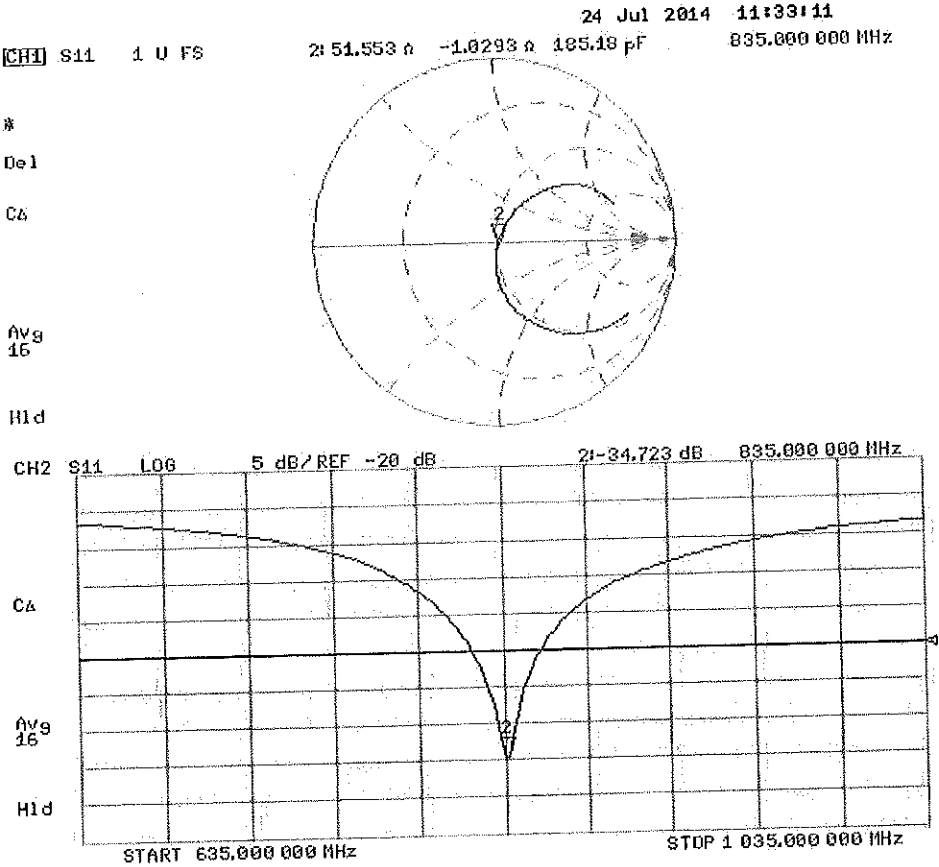
Peak SAR (extrapolated) = 3.58 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.07.2014

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; $\sigma = 1.02$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

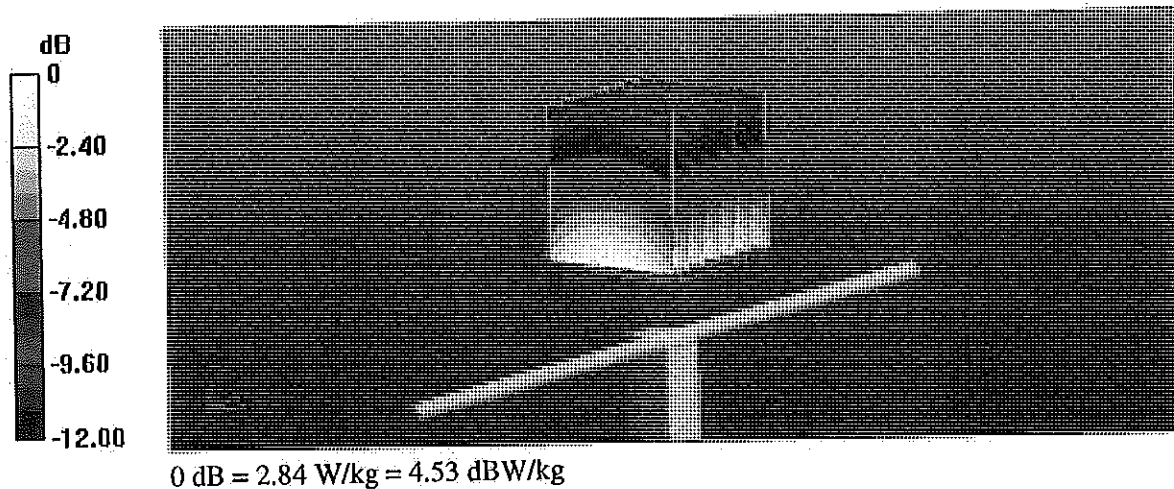
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.61 V/m; Power Drift = -0.01 dB

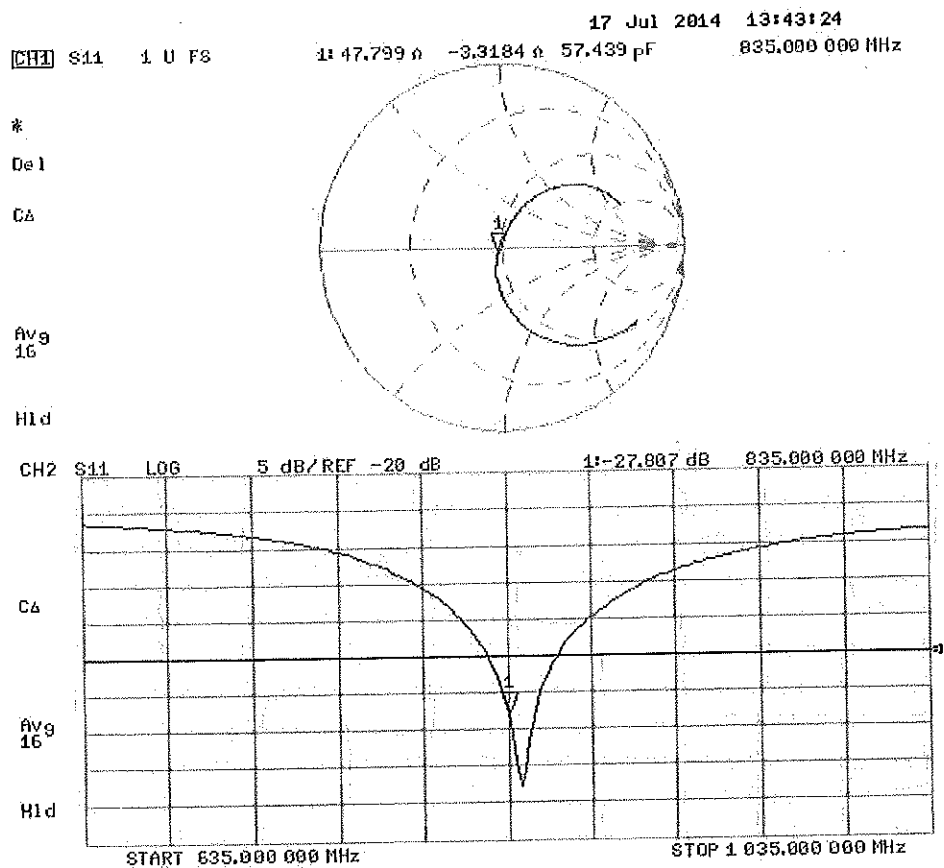
Peak SAR (extrapolated) = 3.59 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.84 W/kg



Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1765V2-1008_May14**

CALIBRATION CERTIFICATE

Object **D1765V2 - SN: 1008**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

CCV
 6/2/14

Calibration date: **May 07, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: May 12, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.5 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.2 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.7 Ω - 6.1 j Ω
Return Loss	- 23.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.7 Ω - 6.4 j Ω
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 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

DASY5 Validation Report for Head TSL

Date: 07.05.2014

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; $\sigma = 1.36$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

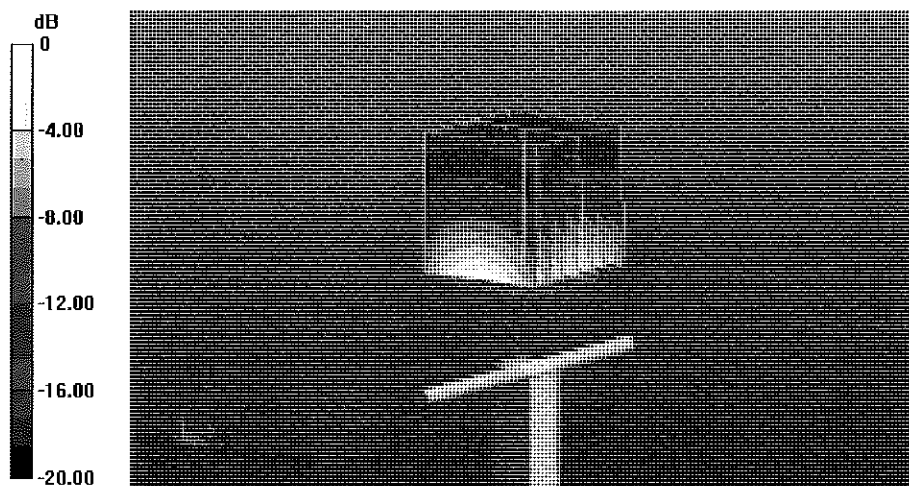
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.06 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.87 W/kg

Maximum value of SAR (measured) = 11.7 W/kg

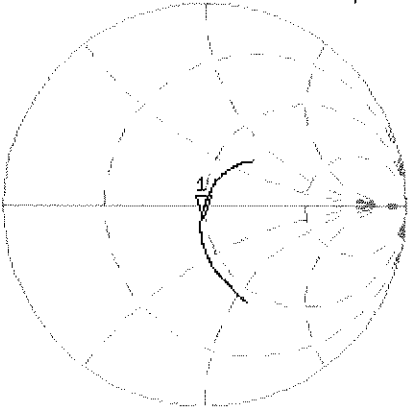


0 dB = 11.7 W/kg = 10.68 dBW/kg

Impedance Measurement Plot for Head TSL

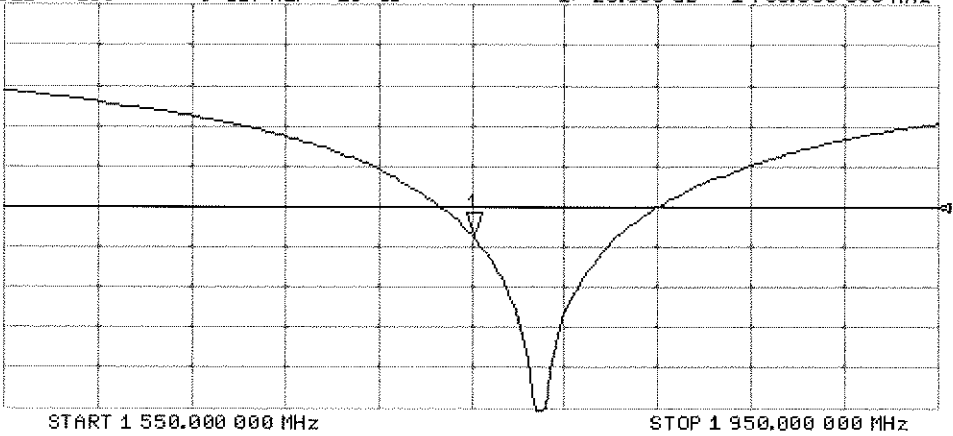
7 May 2014 09:22:36
[CH1] S11 1 U FS 1: 47.709 Ω -6.0566 Ω 15.016 pF 1 750.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.588 dB 1 750.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 07.05.2014

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; $\sigma = 1.48$ S/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

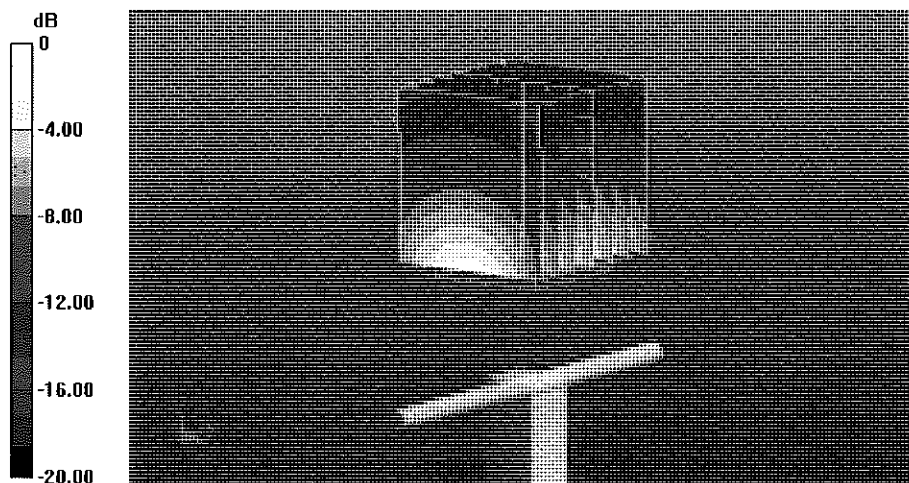
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.01 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.41 W/kg; SAR(10 g) = 5.02 W/kg

Maximum value of SAR (measured) = 11.8 W/kg

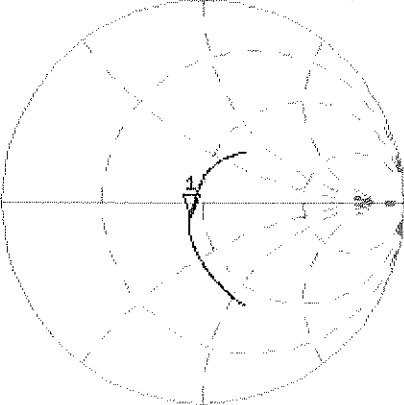


0 dB = 11.8 W/kg = 10.72 dBW/kg

Impedance Measurement Plot for Body TSL

7 May 2014 09:21:55
[CH1] S11 1 U FS 1: 43.727 $\angle$ -6.3691 $\angle$ 14.279 pF 1 750.000 000 MHz

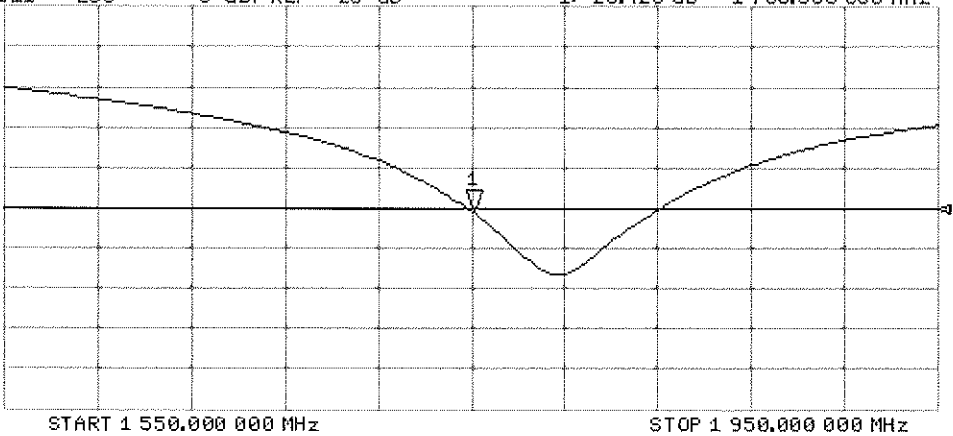
*
De1
CA



Avg
16
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-20.428 dB 1 750.000 000 MHz

CA
Avg
16
H1d





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Accreditation No.: **SCS 0108**

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Client **PC Test**

Certificate No: **D1900V2-5d141_Apr15**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d141**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **April 14, 2015**

PN ✓
 4/29/15

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Claudio Leubler **Function** Laboratory Technician

Signature

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

Issued: April 14, 2015

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.6 $\pm$ 6 %	1.37 mho/m $\pm$ 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	39.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.9 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.8 $\pm$ 6 %	1.50 mho/m $\pm$ 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	9.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.0 \Omega + 4.6 j\Omega$
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.2 \Omega + 5.6 j\Omega$
Return Loss	- 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d141

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.37$ S/m; $\epsilon_r = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

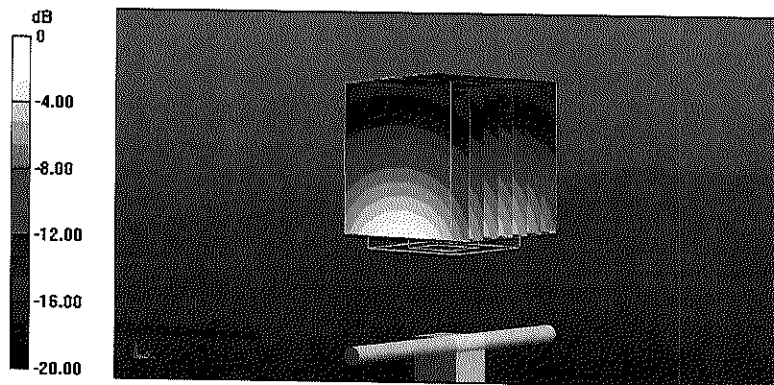
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.18 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.2 W/kg

Maximum value of SAR (measured) = 12.5 W/kg

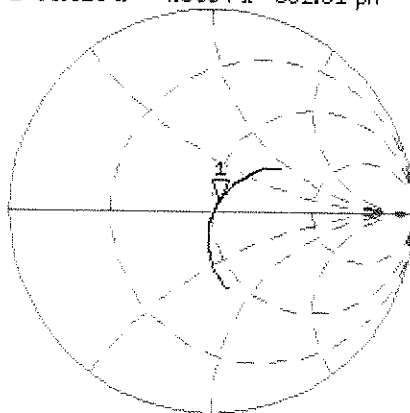


0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL

14 Apr 2015 13:39:53
 [CH1] S11 1 U FS 1: 53.010 Ω 4.5664 Ω 382.51 pF 1 900.000 000 MHz

*
 De1
 CA



Avg
 16

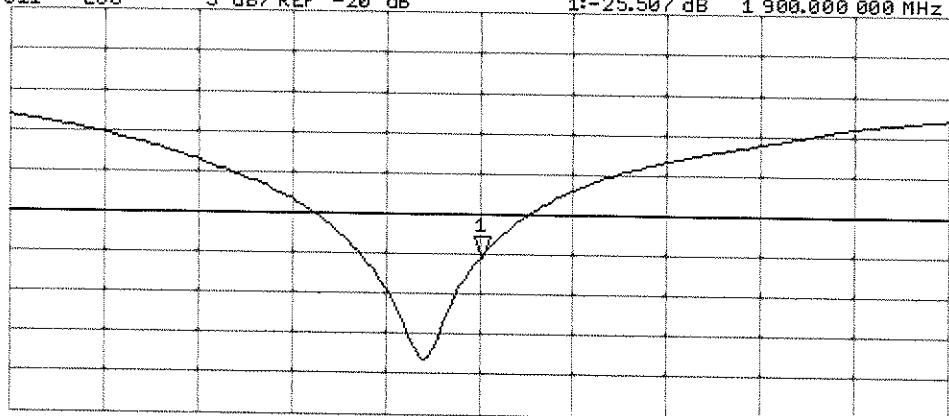
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.507 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d141

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.5$ S/m; $\epsilon_r = 52.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

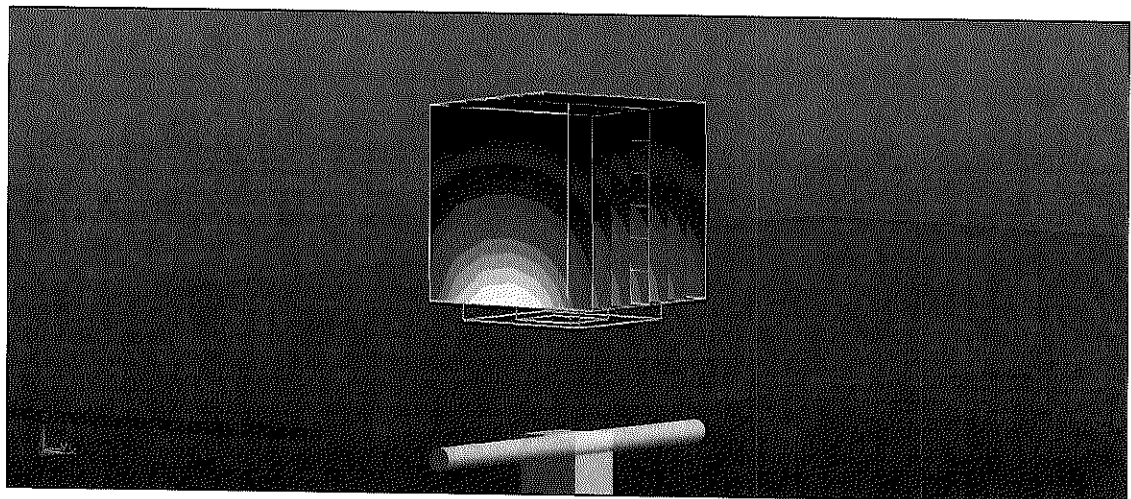
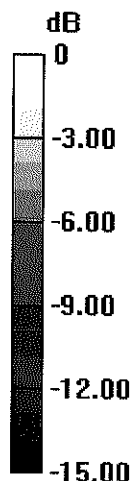
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.73 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.29 W/kg

Maximum value of SAR (measured) = 12.5 W/kg

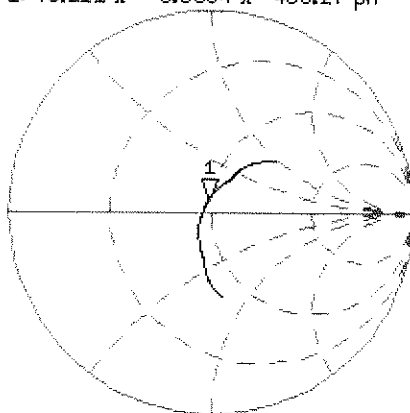


0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Body TSL

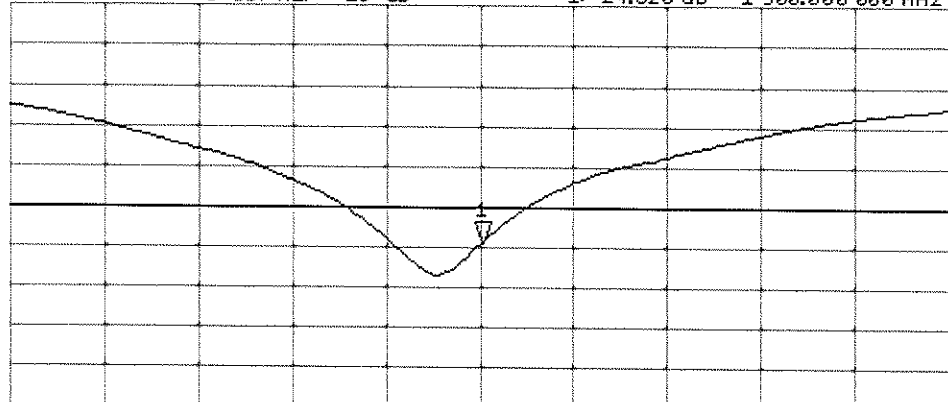
14 Apr 2015 13:39:04
 CH1 S11 1 U FS 1: 48.211 Ω 5.5664 Ω 466.27 pH 1 900.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-24,520 dB 1 900.000 000 MHz

CA
 Avg
 16
 H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2300V2-1008_Jan15**

CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1008**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

CC
2/3/15

Calibration date: **January 27, 2015**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: January 27, 2015

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



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Accreditation No.: **SCS 0108**

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:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	39.9 $\pm$ 6 %	1.71 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	49.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.0 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	48.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.81 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.0 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8 Ω - 2.0 j Ω
Return Loss	- 32.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 1.5 j Ω
Return Loss	- 26.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.169 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	October 30, 2007

DASY5 Validation Report for Head TSL

Date: 27.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used: $f = 2300$ MHz; $\sigma = 1.71$ S/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.75, 4.75, 4.75); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

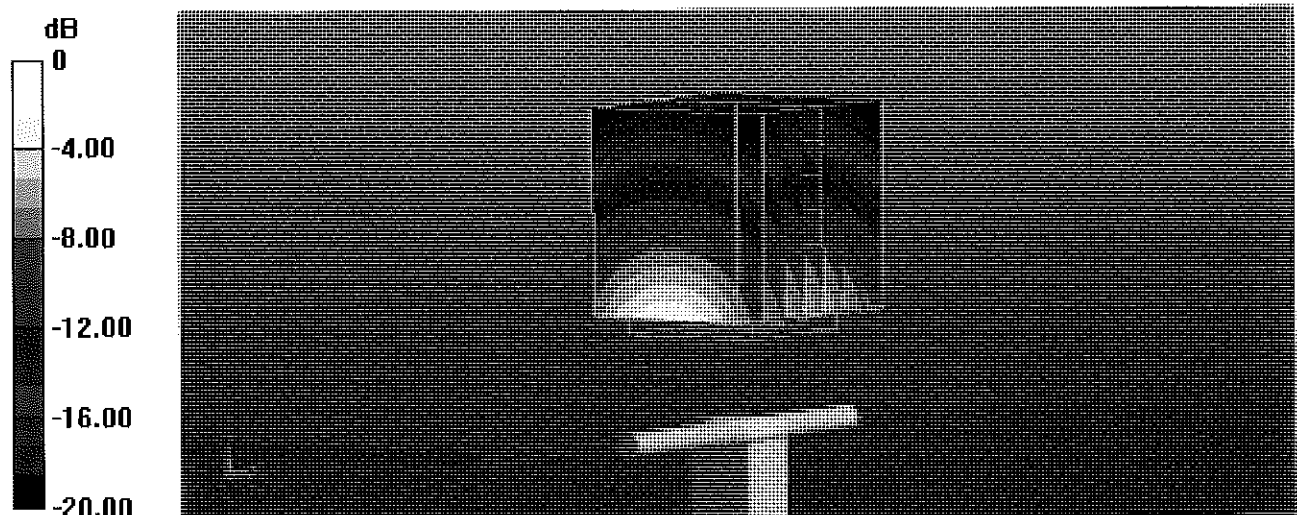
Dipole Calibration for Head Tissue/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.6 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 24.1 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6.04 W/kg

Maximum value of SAR (measured) = 16.3 W/kg

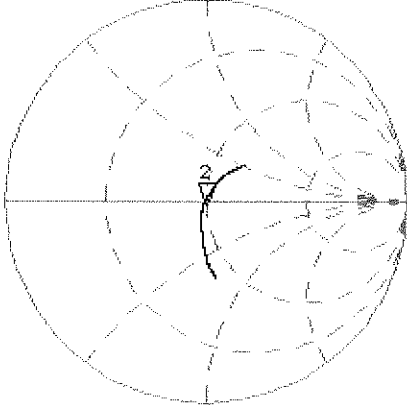


0 dB = 16.3 W/kg = 12.12 dBW/kg

Impedance Measurement Plot for Head TSL

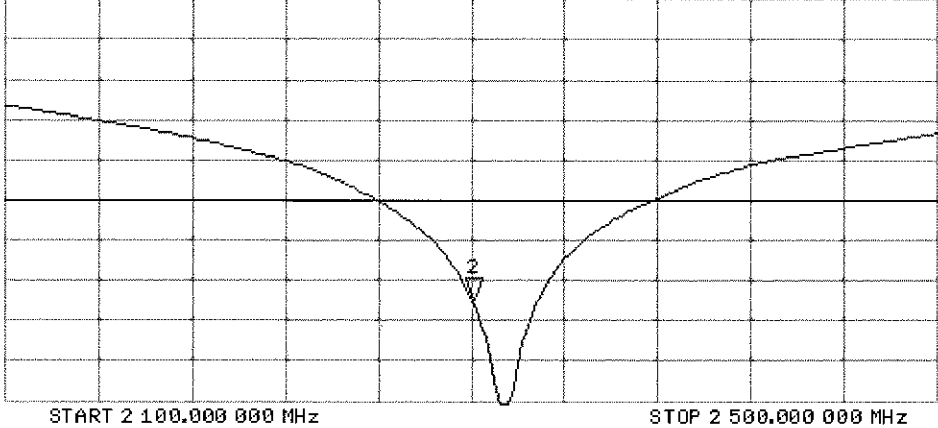
26 Jan 2015 17:09:25
CH1 S11 1 U FS 2: 48.832 Ω -2.0469 Δ 33.807 pF 2 300.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 2:-32.452 dB 2 300.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 27.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used: $f = 2300$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.44, 4.44, 4.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

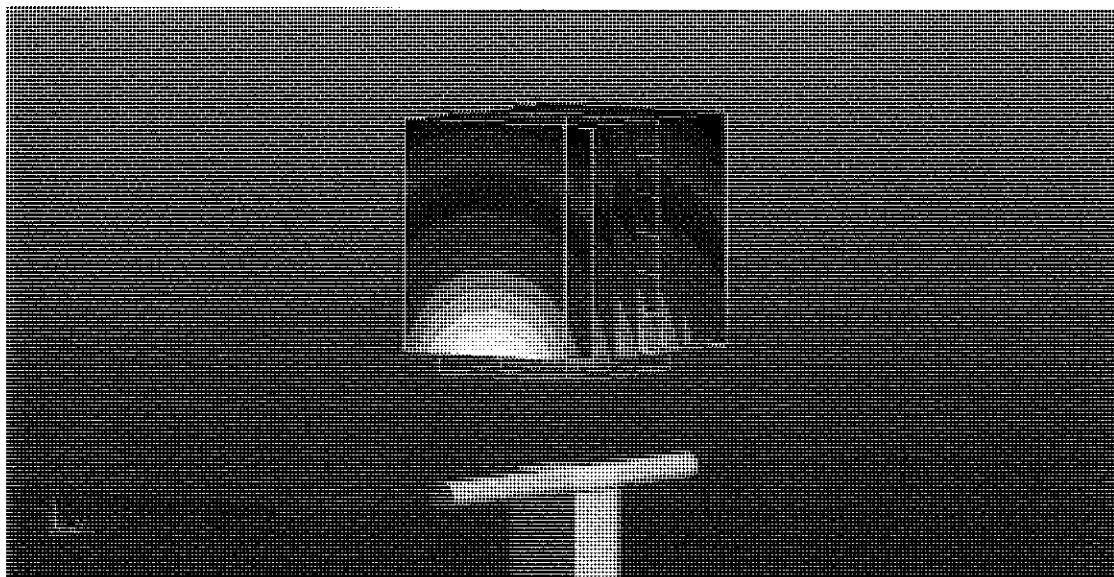
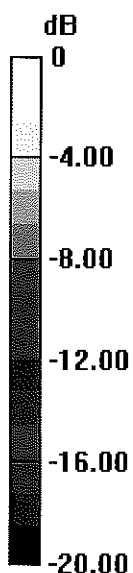
Dipole Calibration for Body Tissue/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.62 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 24.0 W/kg

SAR(1 g) = 12.2 W/kg; SAR(10 g) = 5.81 W/kg

Maximum value of SAR (measured) = 15.7 W/kg



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

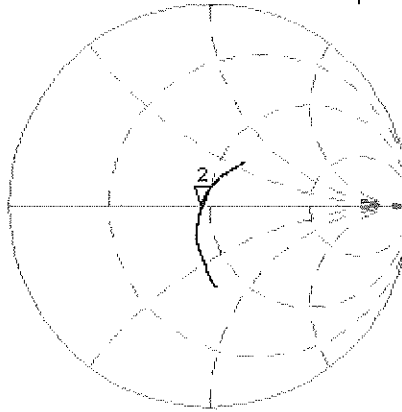
Impedance Measurement Plot for Body TSL

26 Jan 2015 17:08:00
 [CH1] S11 1 U FS 2: 45.758 Ω -1.4863 Ω 46.556 pF 2 300.000 000 MHz

*
 Del
 CΔ

Av9
 16

H1d

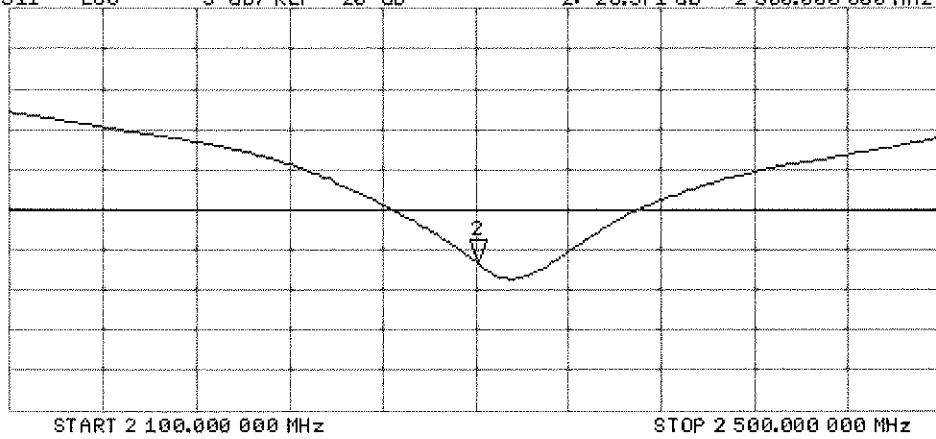


CH2 S11 LOG 5 dB/REF -20 dB 2:-26.571 dB 2 300.000 000 MHz

CΔ

Av9
 16

H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719_Aug14**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 11, 2014**

✓ KOK
9/8/14

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Michael Weber** Function: **Laboratory Technician**

Signature

M. Weber

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: August 12, 2014

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Accreditation No.: **SCS 108**

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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:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 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 $\pm$ 0.2) °C	38.0 $\pm$ 6 %	1.82 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.5 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.9 \Omega + 3.0 j\Omega$
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.8 j\Omega$
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 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	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

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; $\sigma = 1.82$ S/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

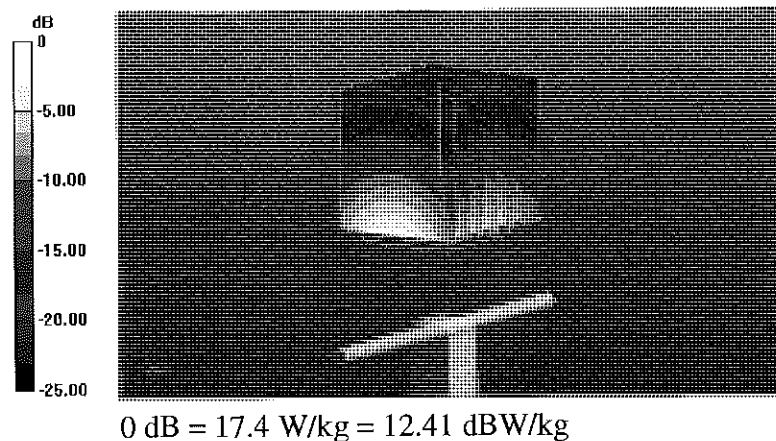
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.6 V/m; Power Drift = 0.03 dB

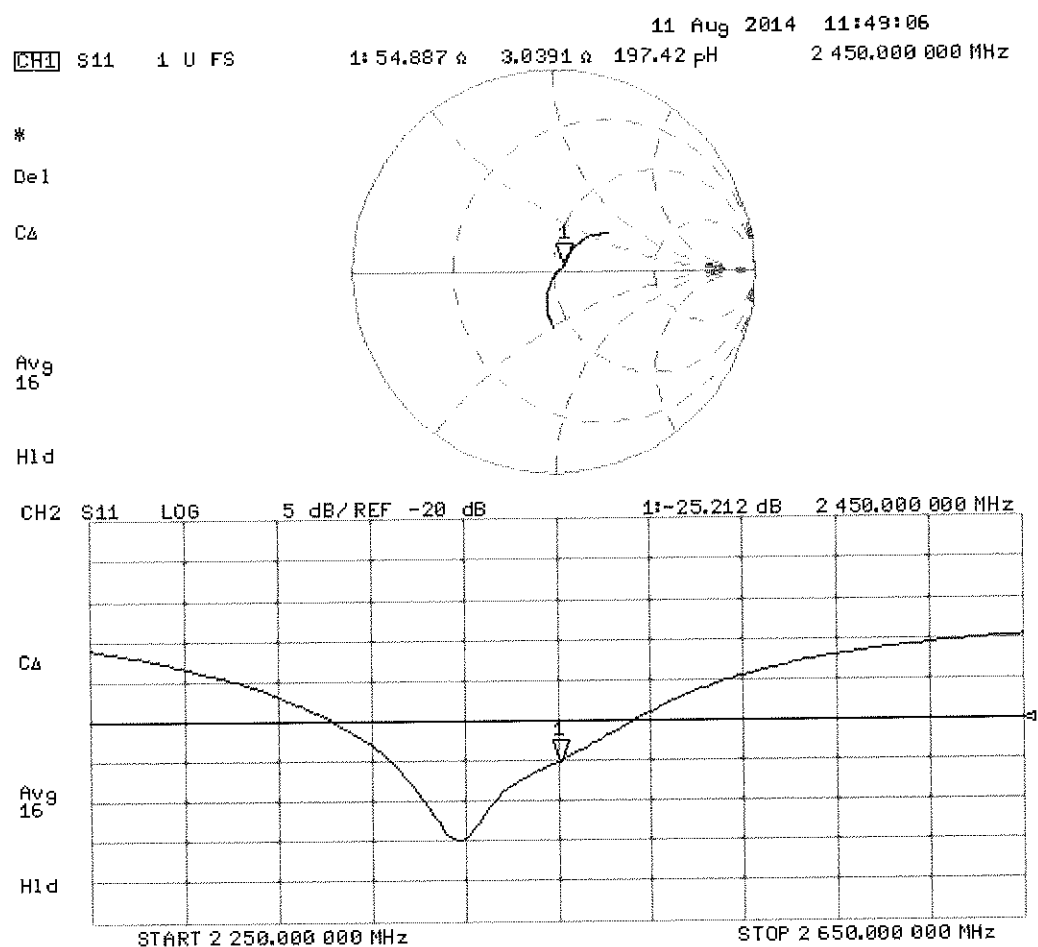
Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg

Maximum value of SAR (measured) = 17.4 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

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; $\sigma = 2.02$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

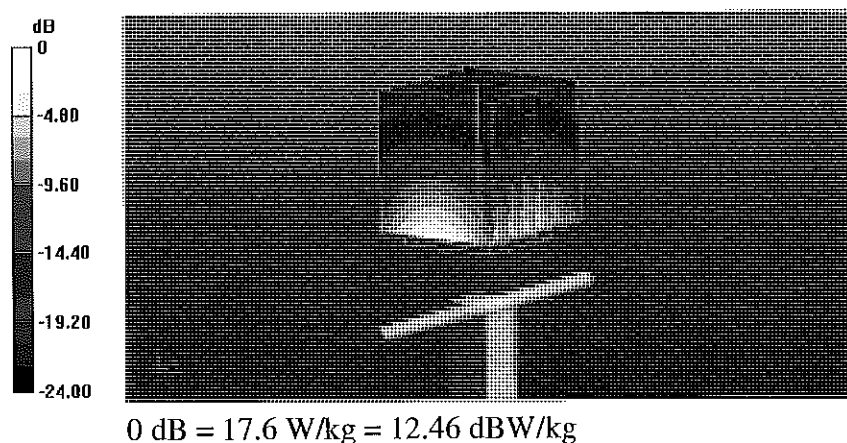
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.08 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg

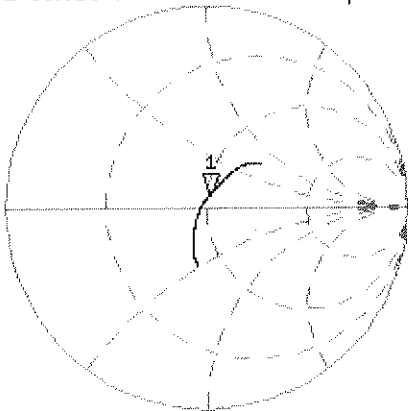
Maximum value of SAR (measured) = 17.6 W/kg



Impedance Measurement Plot for Body TSL

11 Aug 2014 11:48:32
[CH1] S11 1 U FS 1: 50.928 $\angle$ 5.8223 $\angle$ 378.22 pH 2 450.000 000 MHz

*
De1
CA



Avg
15

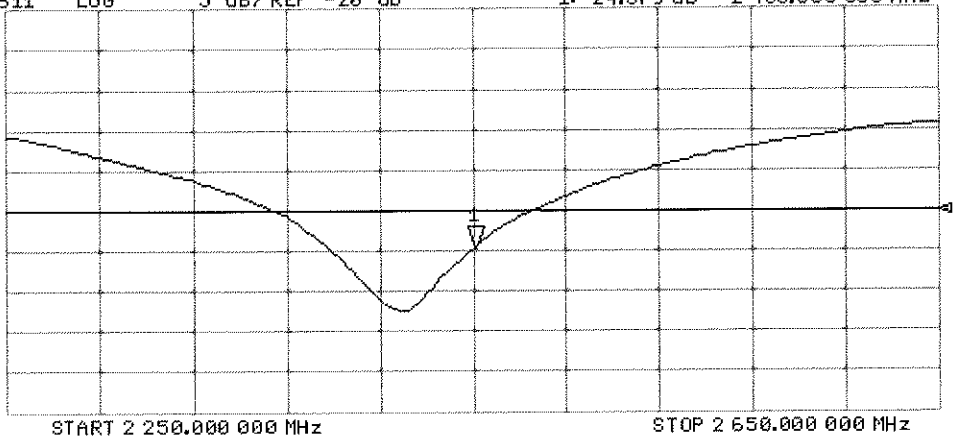
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -24.679 dB 2 450.000 000 MHz

CA

Avg
15

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1057_Jan15**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1057**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

CC
 2/3/15

Calibration date: **January 21, 2015**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe EX3DV4	SN: 3503	30-Dec-14 (No. EX3-3503_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Michael Weber **Function** Laboratory Technician

Signature

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

Issued: January 22, 2015

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



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- 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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.8
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 $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	36.3 $\pm$ 6 %	4.56 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

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	81.5 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.1 ± 6 %	4.66 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.7 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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 ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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	35.6 ± 6 %	4.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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 ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.18 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	22.9 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	49.4 ± 6 %	5.42 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.2 ± 6 %	5.55 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.82 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 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	48.7 ± 6 %	5.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (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	77.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	21.5 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	48.4 ± 6 %	6.25 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	20.6 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.0 Ω - 9.4 j Ω
Return Loss	- 20.4 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.3 Ω - 4.2 j Ω
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	49.2 Ω - 5.0 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.4 Ω - 4.8 j Ω
Return Loss	- 24.1 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	51.8 Ω - 2.6 j Ω
Return Loss	- 30.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	48.2 Ω - 8.4 j Ω
Return Loss	- 21.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.6 Ω - 3.6 j Ω
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.4 Ω - 4.1 j Ω
Return Loss	- 27.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	55.1 Ω - 4.0 j Ω
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	51.6 Ω - 1.6 j Ω
Return Loss	- 33.0 dB

General Antenna Parameters and Design

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

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

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

DASY5 Validation Report for Head TSL

Date: 21.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.56$ S/m; $\epsilon_r = 36.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.66$ S/m; $\epsilon_r = 36.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 35.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.97$ S/m; $\epsilon_r = 35.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.18$ S/m; $\epsilon_r = 35.4$; $\rho = 1000$ 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: 30.12.2014, ConvF(5.21, 5.21, 5.21); Calibrated: 30.12.2014, ConvF(5.12, 5.12, 5.12); Calibrated: 30.12.2014, ConvF(4.92, 4.92, 4.92); Calibrated: 30.12.2014, ConvF(4.9, 4.9, 4.9); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.51 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 29.8 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.30 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 20.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.33 V/m; Power Drift = 0.07 dB

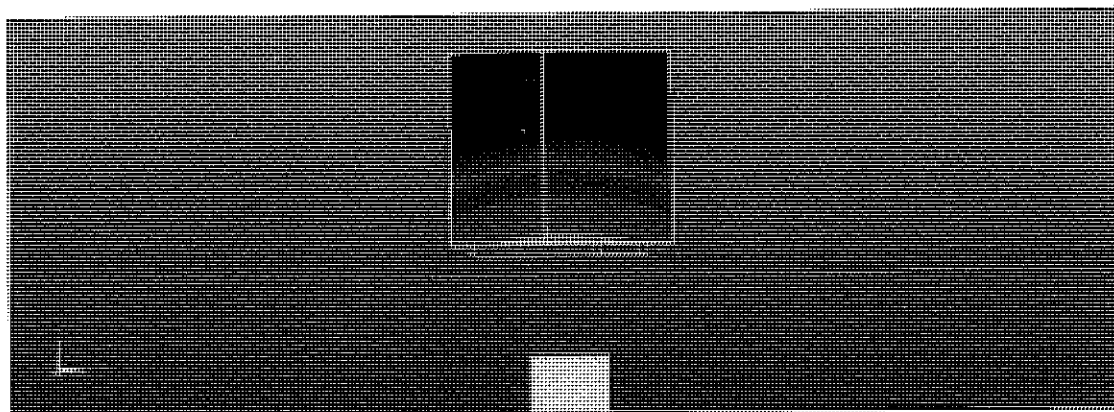
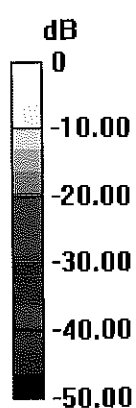
Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.43 W/kg; SAR(10 g) = 2.38 W/kg

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

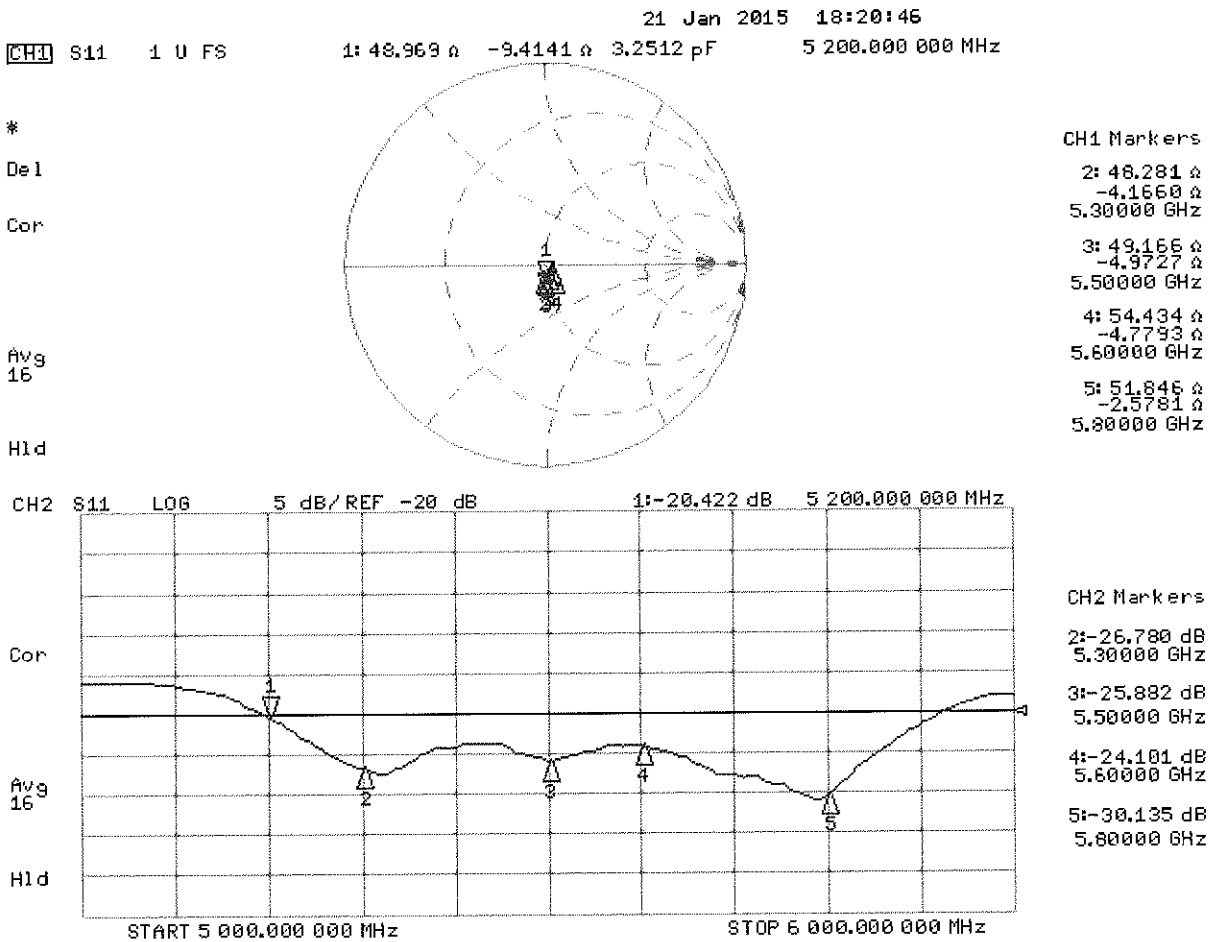
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.47 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.38 W/kg; SAR(10 g) = 2.37 W/kg
Maximum value of SAR (measured) = 20.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.34 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.42$ S/m; $\epsilon_r = 49.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.55$ S/m; $\epsilon_r = 49.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.82$ S/m; $\epsilon_r = 48.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.96$ S/m; $\epsilon_r = 48.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.25$ S/m; $\epsilon_r = 48.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.95, 4.95, 4.95); Calibrated: 30.12.2014, ConvF(4.78, 4.78, 4.78); Calibrated: 30.12.2014, ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2014, ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2014, ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 58.76 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 28.9 W/kg

SAR(1 g) = 7.37 W/kg; SAR(10 g) = 2.05 W/kg

Maximum value of SAR (measured) = 17.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.35 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 29.8 W/kg

SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.04 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 33.7 W/kg

SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 19.2 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 = 57.74 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

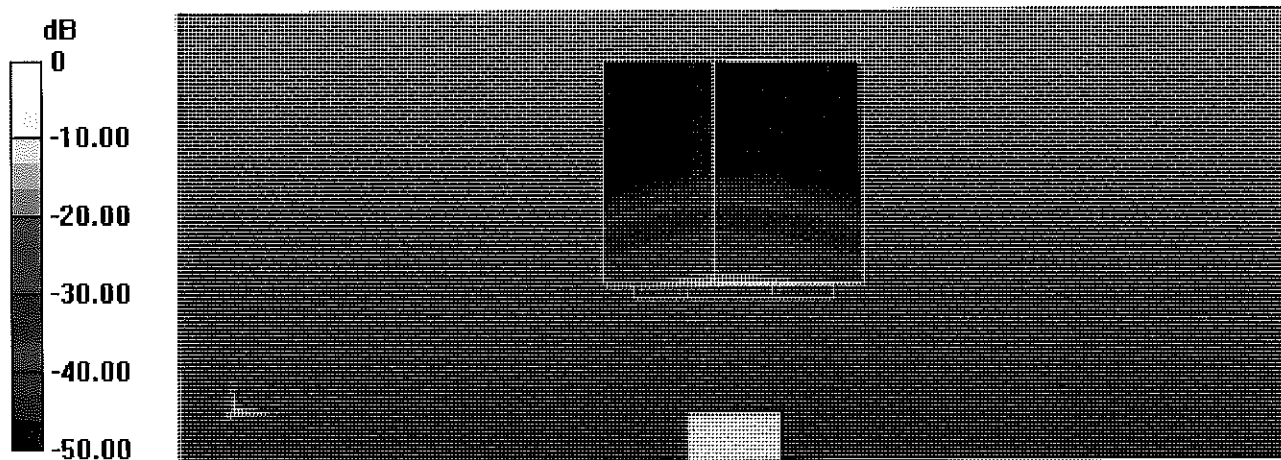
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.86 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 34.7 W/kg

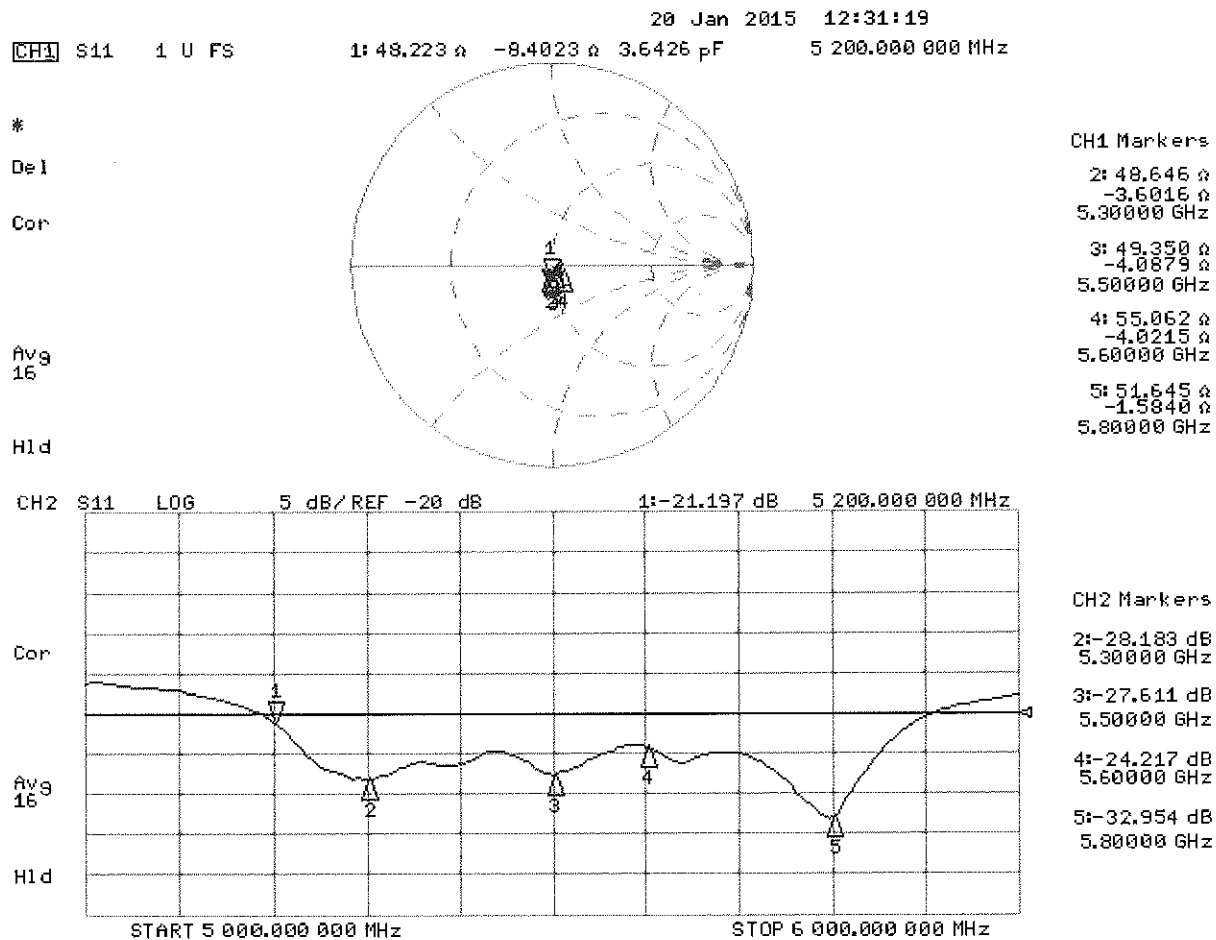
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.06 W/kg

Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Body TSL



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



S Schweizerischer Kalibrierdienst
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Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug14/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3022_Aug14)

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

CC
D/M/Y

Calibration date: **August 19, 2014**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: November 3, 2014



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

Accreditation No.: **SCS 108**

Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 19, 2014

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

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.00	1.04	0.96	$\pm 10.1 \%$
DCP (mV) ^B	103.0	96.3	101.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	181.8	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		183.0	
		Z	0.0	0.0	1.0		192.3	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.51	63.1	12.7	10.00	42.6	$\pm 1.9 \%$
		Y	2.62	63.1	12.9		42.7	
		Z	3.12	65.7	13.6		40.4	
10011- CAB	UMTS-FDD (WCDMA)	X	3.33	67.8	19.2	2.91	145.9	$\pm 0.9 \%$
		Y	3.13	64.9	16.9		147.4	
		Z	3.20	66.4	18.2		139.6	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.05	70.1	19.8	1.87	147.2	$\pm 0.9 \%$
		Y	2.62	65.1	16.2		147.4	
		Z	2.85	68.2	18.4		141.7	
10013- CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.10	70.9	23.6	9.46	143.9	$\pm 3.0 \%$
		Y	11.04	70.2	22.9		144.2	
		Z	10.77	70.2	23.1		134.7	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	19.66	99.7	28.6	9.39	126.0	$\pm 1.9 \%$
		Y	11.04	89.6	25.5		138.9	
		Z	10.45	88.8	24.9		137.5	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	20.19	99.6	28.5	9.57	142.0	$\pm 2.5 \%$
		Y	10.53	88.4	25.0		145.5	
		Z	15.52	96.5	27.8		147.6	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	31.93	99.6	25.2	6.56	149.5	$\pm 1.9 \%$
		Y	12.70	87.9	22.2		148.0	
		Z	27.00	99.8	25.7		135.3	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	38.32	99.8	23.8	4.80	148.1	$\pm 2.2 \%$
		Y	9.80	83.2	19.3		138.8	
		Z	31.96	99.9	24.2		128.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.03	99.5	22.8	3.55	130.5	$\pm 2.2 \%$
		Y	40.27	99.6	23.0		148.1	
		Z	43.09	99.7	22.5		140.1	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	38.93	99.4	20.4	1.16	146.7	$\pm 1.9 \%$
		Y	32.83	92.5	17.9		139.2	
		Z	31.94	99.5	20.8		133.1	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.66	66.8	19.3	4.57	144.5	$\pm 1.2 \%$
		Y	4.56	65.3	17.9		137.2	
		Z	4.52	66.1	18.7		131.7	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.82	66.0	18.7	3.97	140.3	±0.9 %
		Y	3.77	64.5	17.3		133.6	
		Z	3.79	65.7	18.4		128.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.40	66.2	18.5	3.98	130.9	±1.2 %
		Y	4.39	65.0	17.4		131.1	
		Z	4.47	66.3	18.4		140.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.30	67.3	19.8	5.67	137.4	±1.7 %
		Y	6.25	66.3	18.9		135.9	
		Z	6.36	67.4	19.7		147.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.14	66.8	19.6	5.80	134.6	±1.7 %
		Y	6.17	66.1	18.9		133.9	
		Z	6.24	67.0	19.7		144.5	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.82	66.3	19.4	5.75	131.2	±1.7 %
		Y	5.82	65.4	18.6		130.3	
		Z	5.91	66.5	19.4		140.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.00	68.5	21.2	8.10	124.3	±2.5 %
		Y	9.89	67.9	20.6		124.0	
		Z	10.05	68.6	21.2		133.2	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.01	68.6	21.2	8.07	125.8	±2.5 %
		Y	9.91	67.9	20.7		125.8	
		Z	10.09	68.8	21.3		134.7	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.69	75.5	26.4	9.28	144.7	±3.3 %
		Y	9.09	72.7	24.6		143.2	
		Z	8.54	72.0	24.5		124.8	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.82	66.2	19.4	5.75	131.3	±1.9 %
		Y	6.06	66.3	19.1		149.2	
		Z	5.91	66.5	19.4		140.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.27	66.9	19.7	5.82	136.5	±1.4 %
		Y	6.19	65.8	18.7		128.4	
		Z	6.33	67.0	19.6		145.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.81	66.4	19.7	5.73	134.8	±1.7 %
		Y	4.92	66.1	19.1		149.9	
		Z	4.78	66.4	19.6		141.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.83	76.6	27.2	9.21	131.4	±3.5 %
		Y	7.54	74.5	25.8		147.8	
		Z	7.71	76.7	27.4		145.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.90	66.9	20.0	5.72	147.6	±1.4 %
		Y	4.90	66.0	19.1		148.0	
		Z	4.78	66.4	19.6		141.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.90	66.9	20.0	5.72	148.1	±1.4 %
		Y	4.89	65.9	19.0		146.9	
		Z	4.80	66.5	19.7		142.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.80	68.7	21.4	8.09	135.1	±2.7 %
		Y	9.78	68.2	20.9		135.5	
		Z	9.70	68.5	21.2		130.2	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.79	68.7	21.4	8.10	136.4	±2.7 %
		Y	9.81	68.3	20.9		138.0	
		Z	9.72	68.6	21.3		132.8	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.68	68.6	21.3	8.03	136.0	±2.7 %
		Y	9.74	68.3	21.0		137.4	
		Z	9.62	68.5	21.2		132.6	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.20	69.1	21.5	8.06	143.4	±2.5 %
		Y	9.91	60.0	20.7		125.8	
		Z	10.27	69.4	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.87	66.9	19.6	5.97	139.5	±1.9 %
		Y	7.04	66.9	19.3		149.3	
		Z	6.89	67.0	19.5		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.66	75.9	26.9	9.21	126.1	±3.0 %
		Y	7.17	73.1	25.1		132.1	
		Z	7.18	74.6	26.3		128.0	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.58	73.1	25.3	9.24	127.6	±3.3 %
		Y	8.22	71.0	23.7		126.9	
		Z	8.83	74.3	26.0		149.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.69	75.5	26.5	9.30	143.8	±3.3 %
		Y	8.88	72.0	24.2		135.2	
		Z	8.83	72.9	25.1		131.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.87	67.0	19.2	4.87	141.2	±1.4 %
		Y	5.77	65.8	18.1		136.0	
		Z	5.71	66.3	18.6		132.7	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	67.2	19.2	3.96	147.3	±0.9 %
		Y	4.29	65.3	17.6		139.2	
		Z	4.31	66.3	18.5		139.6	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.60	67.1	19.1	3.46	137.8	±0.7 %
		Y	3.44	64.8	17.2		129.6	
		Z	3.48	66.2	18.4		130.5	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.50	66.9	18.9	3.39	139.5	±0.7 %
		Y	3.38	64.8	17.2		132.0	
		Z	3.48	66.5	18.5		133.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.12	66.7	19.6	5.81	133.3	±1.9 %
		Y	6.35	66.7	19.3		149.3	
		Z	6.17	66.8	19.5		132.7	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.72	67.4	20.0	6.06	138.7	±1.7 %
		Y	6.63	66.3	19.1		131.4	
		Z	6.72	67.3	19.9		138.7	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.90	69.9	19.8	1.71	146.4	±0.5 %
		Y	2.54	65.2	16.5		139.3	
		Z	2.75	68.1	18.5		146.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.12	69.3	21.9	8.36	142.9	±3.0 %
		Y	10.01	68.5	21.3		135.2	
		Z	10.11	69.3	21.9		141.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.59	68.2	19.0	3.76	126.7	±0.7 %
		Y	4.59	67.2	18.0		142.4	
		Z	4.64	68.5	19.0		143.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.64	68.8	19.3	3.77	147.1	±0.9 %
		Y	4.47	67.1	17.9		139.6	
		Z	4.54	68.4	18.9		147.2	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.66	69.0	19.4	1.54	145.8	±0.5 %
		Y	2.40	64.8	16.2		140.0	
		Z	2.62	67.8	18.4		147.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.97	69.1	21.7	8.23	142.0	±3.0 %
		Y	10.08	68.9	21.4		145.8	
		Z	10.01	69.2	21.8		143.3	

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%.

[^] The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

[^] Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	41.9	0.89	6.39	6.39	6.39	0.20	2.24	± 12.0 %
835	41.5	0.90	6.18	6.18	6.18	0.23	1.98	± 12.0 %
1750	40.1	1.37	5.04	5.04	5.04	0.51	1.35	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.38	1.66	± 12.0 %
2450	39.2	1.80	4.31	4.31	4.31	0.66	1.28	± 12.0 %
2600	39.0	1.96	4.13	4.13	4.13	0.76	1.28	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
450	56.7	0.94	6.78	6.78	6.78	0.12	1.30	± 13.3 %
600	56.1	0.95	6.72	6.72	6.72	0.05	1.20	± 13.3 %
750	55.5	0.96	6.02	6.02	6.02	0.23	2.05	± 12.0 %
835	55.2	0.97	5.98	5.98	5.98	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.66	1.25	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.33	2.02	± 12.0 %
2450	52.7	1.95	4.05	4.05	4.05	0.80	1.01	± 12.0 %
2600	52.5	2.16	3.94	3.94	3.94	0.68	1.03	± 12.0 %

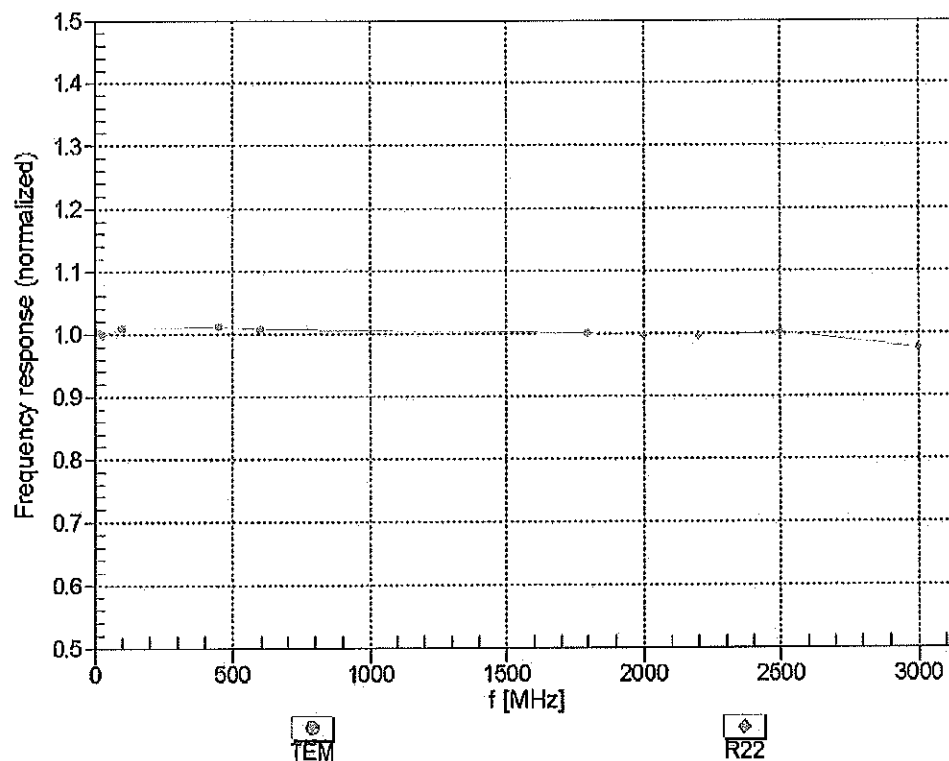
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 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.

^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

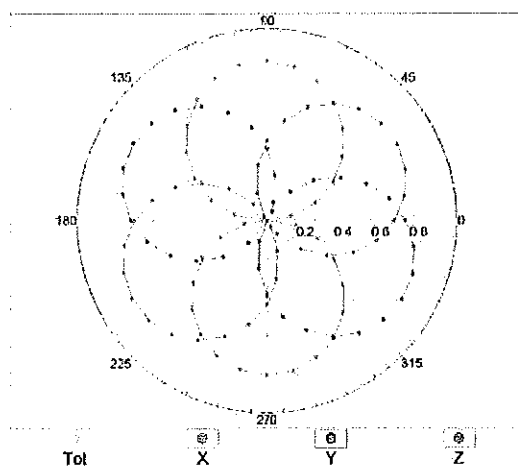
(TEM-Cell:ifi110 EXX, Waveguide: R22)



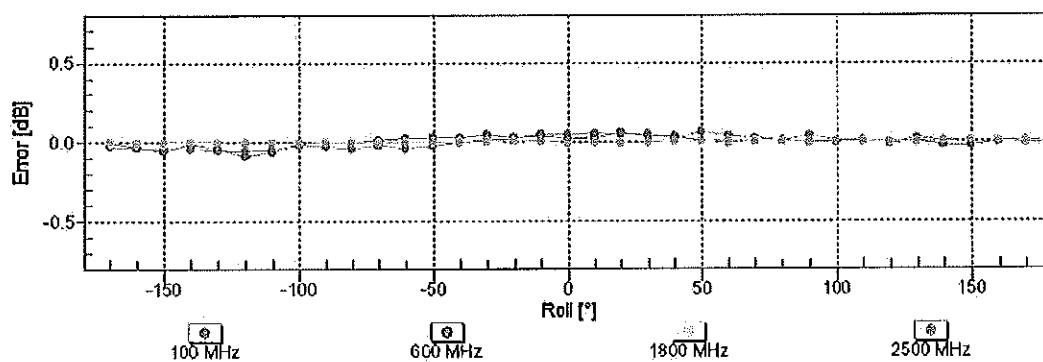
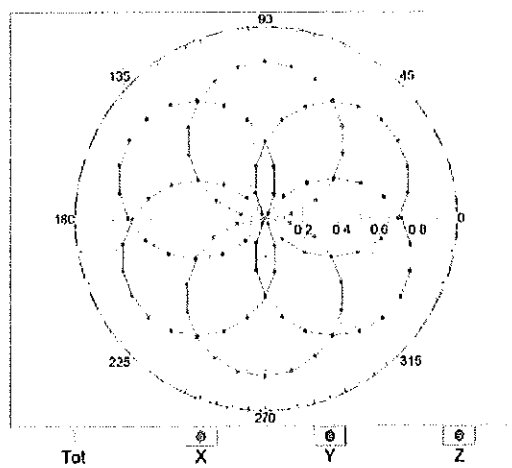
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

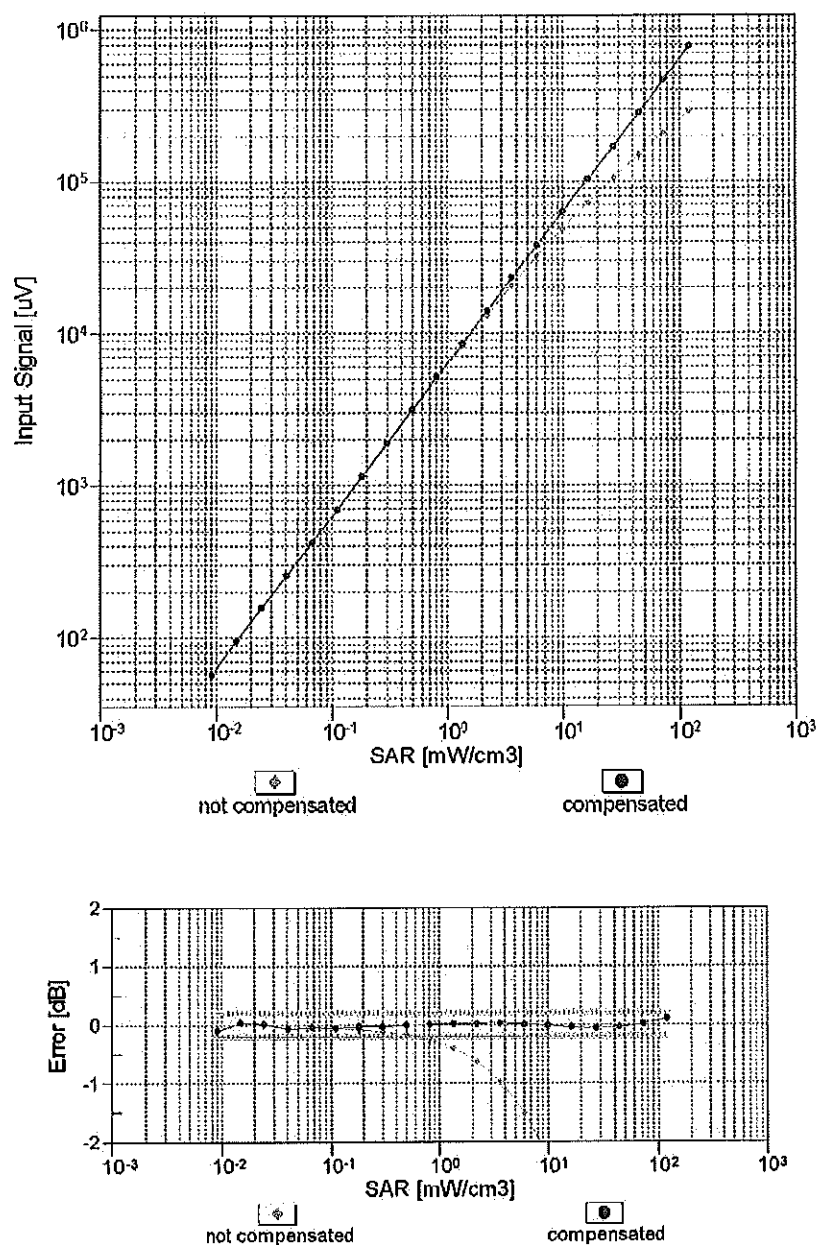


f=1800 MHz,R22



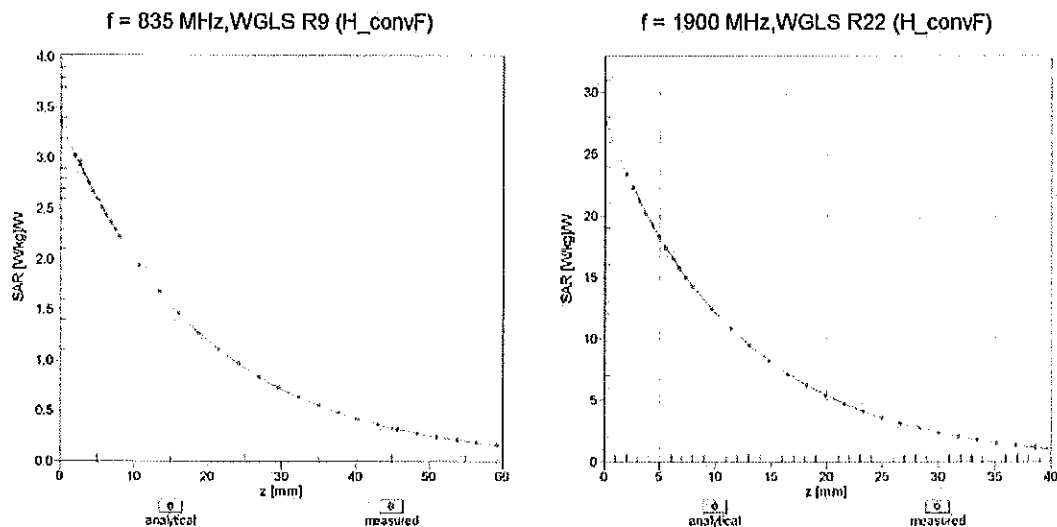
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



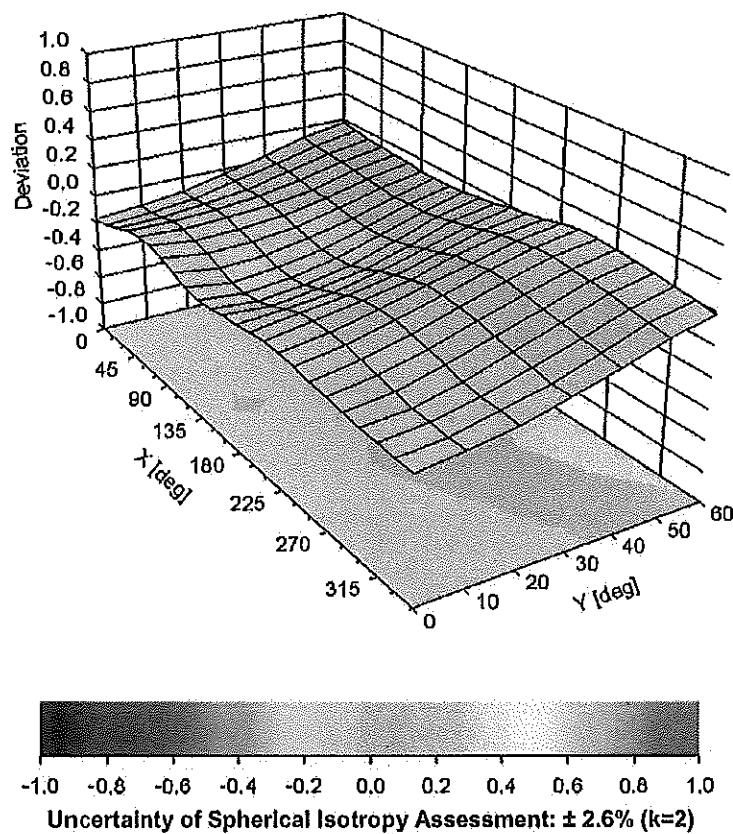
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-80.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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: **ES3-3209_Mar15**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 19, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Israe Elnaouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 19, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 19, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.35	1.33	1.14	± 10.1 %
DCP (mV) ^B	102.0	100.9	103.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	214.5	±3.5 %
		Y	0.0	0.0	1.0		192.6	
		Z	0.0	0.0	1.0		199.1	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.61	65.1	12.2	10.00	42.3	±1.7 %
		Y	1.39	57.8	8.9		42.7	
		Z	4.57	70.3	14.0		38.3	
10011- CAB	UMTS-FDD (WCDMA)	X	3.12	66.3	18.1	2.91	130.3	±0.7 %
		Y	3.08	65.6	17.5		132.2	
		Z	3.32	67.7	19.0		137.6	
10012- CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.54	66.8	17.8	1.87	131.1	±0.7 %
		Y	2.67	67.1	17.7		131.6	
		Z	2.85	69.2	19.1		138.0	
10013- CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.78	70.5	23.4	9.46	146.9	±2.7 %
		Y	10.39	69.2	22.5		123.5	
		Z	10.50	69.9	23.1		128.4	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	3.65	74.2	17.7	9.39	130.0	±1.9 %
		Y	6.62	83.5	22.0		149.4	
		Z	4.25	76.8	19.2		136.2	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	3.95	75.3	18.4	9.57	138.8	±2.5 %
		Y	4.99	78.2	19.8		143.3	
		Z	4.11	75.8	18.9		129.3	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	6.44	80.3	17.7	6.56	135.0	±1.7 %
		Y	3.76	73.7	16.0		144.2	
		Z	11.61	88.5	20.7		148.0	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	43.77	99.9	21.8	4.80	131.8	±1.7 %
		Y	13.95	87.5	19.0		142.7	
		Z	39.96	99.9	22.1		145.6	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	62.88	99.8	20.4	3.55	144.5	±2.2 %
		Y	2.45	70.4	12.9		130.3	
		Z	80.83	99.9	19.9		135.1	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.32	58.4	4.3	1.16	144.1	±1.9 %
		Y	16.25	79.9	12.1		129.5	
		Z	95.90	91.1	14.4		134.6	
10100- CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.32	67.4	19.8	5.67	138.3	±1.4 %
		Y	6.35	67.3	19.5		144.4	
		Z	6.20	67.1	19.6		127.7	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.72	73.1	25.3	9.29	138.6	±2.7 %
		Y	8.88	72.9	24.9		147.9	
		Z	8.48	72.3	24.9		127.4	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.14	66.9	19.6	5.80	136.2	±1.7 %
		Y	6.20	66.8	19.4		142.8	
		Z	6.10	66.8	19.6		126.2	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.05	68.9	21.4	8.07	126.8	±2.2 %
		Y	9.98	68.5	21.1		132.4	
		Z	10.23	69.4	21.7		140.4	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.16	72.2	25.0	9.28	133.6	±2.7 %
		Y	8.33	72.0	24.5		142.6	
		Z	8.40	73.1	25.6		147.5	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.83	66.5	19.4	5.75	133.1	±1.4 %
		Y	5.89	66.3	19.2		139.3	
		Z	6.00	67.2	19.9		146.5	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.26	66.9	19.6	5.82	138.8	±1.7 %
		Y	6.34	67.0	19.5		145.1	
		Z	6.22	66.9	19.7		128.8	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.77	66.7	19.8	5.73	135.9	±1.4 %
		Y	4.89	66.6	19.5		141.8	
		Z	4.85	66.8	19.9		128.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.77	75.0	26.9	9.21	144.2	±2.5 %
		Y	6.56	72.6	25.2		131.1	
		Z	6.68	74.0	26.4		137.1	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.80	66.9	19.9	5.72	135.2	±1.4 %
		Y	4.87	66.5	19.5		140.6	
		Z	5.03	67.7	20.4		149.4	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.77	66.7	19.8	5.72	134.7	±1.2 %
		Y	4.88	66.5	19.5		140.6	
		Z	4.84	66.8	19.9		127.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.97	69.5	21.9	8.10	145.2	±2.2 %
		Y	9.60	68.2	21.0		125.1	
		Z	9.80	69.1	21.7		133.9	
10225-CAB	UMTS-FDD (HSPA+)	X	6.95	67.5	19.8	5.97	147.3	±1.4 %
		Y	6.73	66.4	19.1		128.7	
		Z	6.89	67.4	19.8		137.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.85	75.4	27.2	9.21	146.0	±2.5 %
		Y	6.54	72.5	25.1		131.6	
		Z	6.76	74.4	26.6		138.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.58	71.3	24.6	9.24	126.6	±2.5 %
		Y	7.73	71.1	24.2		133.3	
		Z	7.82	72.4	25.3		139.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.18	72.2	25.1	9.30	133.6	±2.7 %
		Y	8.35	72.0	24.6		141.1	
		Z	8.42	73.2	25.6		147.0	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.22	66.1	18.4	3.96	128.8	±0.9 %
		Y	4.24	65.9	18.1		133.8	
		Z	4.39	67.1	19.0		141.7	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.51	66.7	18.6	3.46	140.9	±0.7 %
		Y	3.52	66.2	18.1		143.4	
		Z	3.58	67.2	19.0		131.7	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.45	66.7	18.5	3.39	142.0	±0.7 %
		Y	3.50	66.4	18.2		146.9	
		Z	3.61	67.8	19.3		132.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.15	66.9	19.6	5.81	136.3	±1.4 %
		Y	6.20	66.8	19.4		140.3	
		Z	6.11	66.8	19.6		126.6	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.80	67.8	20.1	6.06	143.2	±1.7 %
		Y	6.80	67.5	19.9		147.4	
		Z	6.71	67.6	20.1		131.9	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.31	70.0	22.4	8.37	147.9	±3.0 %
		Y	9.88	68.5	21.3		127.2	
		Z	10.13	69.5	22.1		135.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.60	68.6	18.9	3.76	128.2	±0.5 %
		Y	4.58	67.9	18.4		134.2	
		Z	4.86	69.6	19.5		142.6	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.57	68.9	19.1	3.77	149.7	±0.5 %
		Y	4.51	68.0	18.5		132.3	
		Z	4.78	69.6	19.5		140.3	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.47	67.0	17.9	1.54	128.1	±0.7 %
		Y	2.46	66.4	17.4		132.5	
		Z	2.72	69.1	19.2		140.6	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.12	69.7	22.1	8.23	146.8	±2.7 %
		Y	9.66	68.2	21.1		125.0	
		Z	9.91	69.2	21.8		134.3	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 7 and 8).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.34	6.34	6.34	0.29	2.02	± 12.0 %
835	41.5	0.90	6.04	6.04	6.04	0.23	2.57	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.80	1.08	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.10	2.40	± 12.0 %
2300	39.5	1.67	4.76	4.76	4.76	0.70	1.27	± 12.0 %
2450	39.2	1.80	4.53	4.53	4.53	0.80	1.22	± 12.0 %
2600	39.0	1.96	4.36	4.36	4.36	0.75	1.31	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.12	6.12	6.12	0.34	1.81	± 12.0 %
835	55.2	0.97	6.07	6.07	6.07	0.37	1.79	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.67	1.43	± 12.0 %
1900	53.3	1.52	4.57	4.57	4.57	0.57	1.53	± 12.0 %
2300	52.9	1.81	4.28	4.28	4.28	0.80	1.19	± 12.0 %
2450	52.7	1.95	4.12	4.12	4.12	0.72	1.15	± 12.0 %
2600	52.5	2.16	3.92	3.92	3.92	0.80	1.10	± 12.0 %

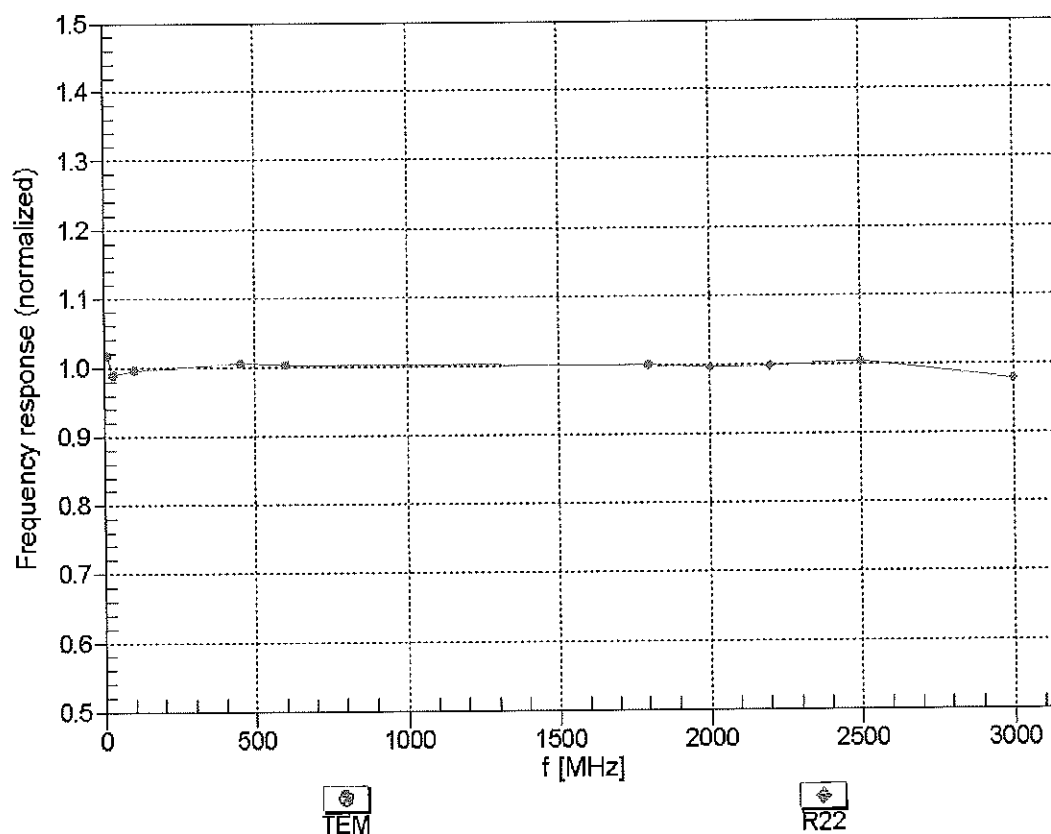
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 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.

^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

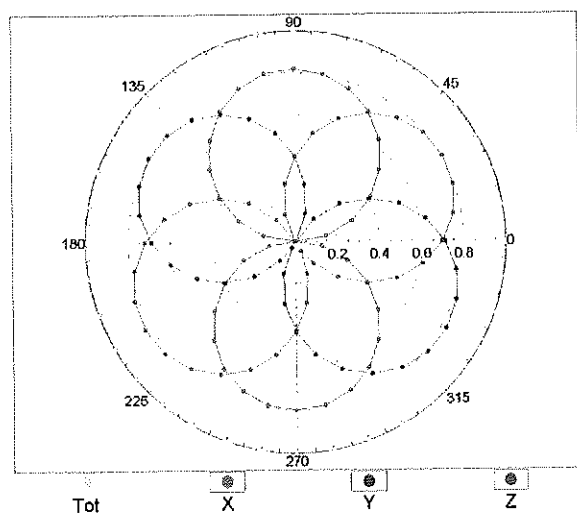
(TEM-Cell:ifi110 EXX, Waveguide: R22)



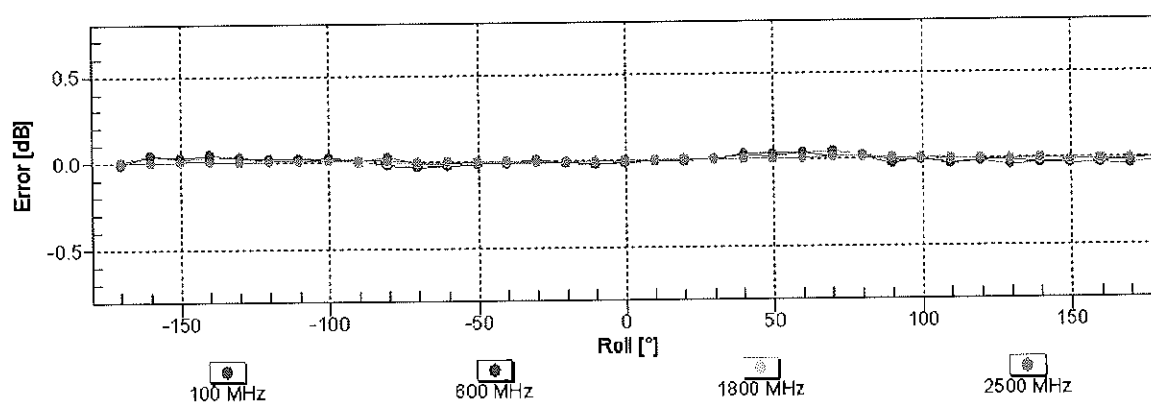
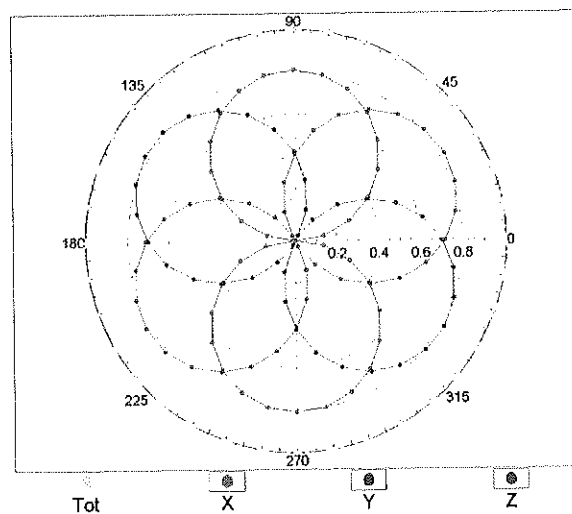
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

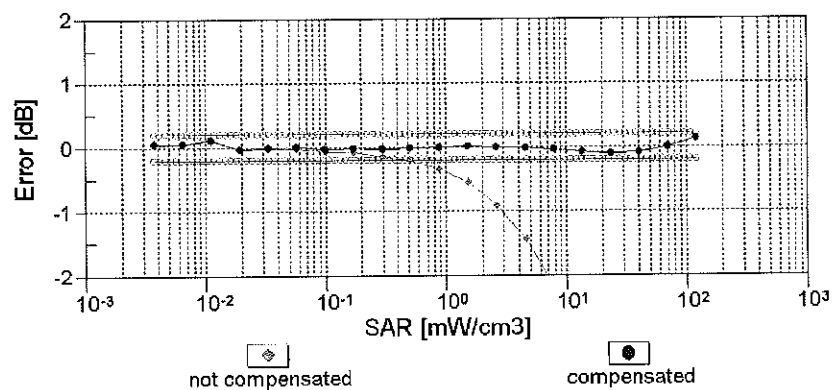
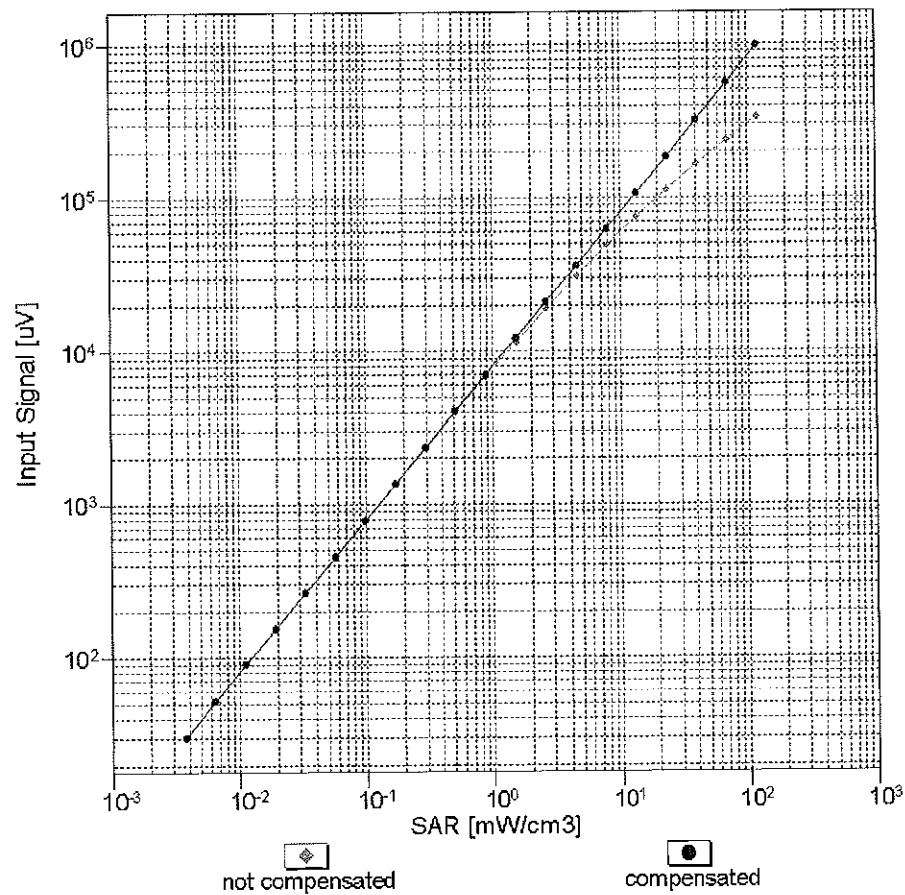


f=1800 MHz,R22



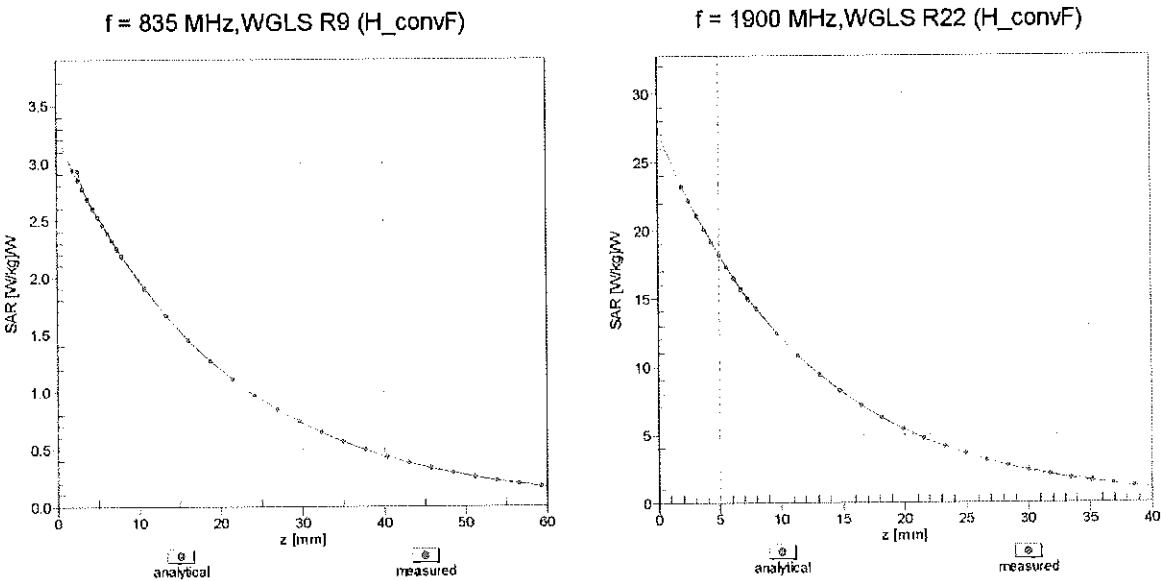
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

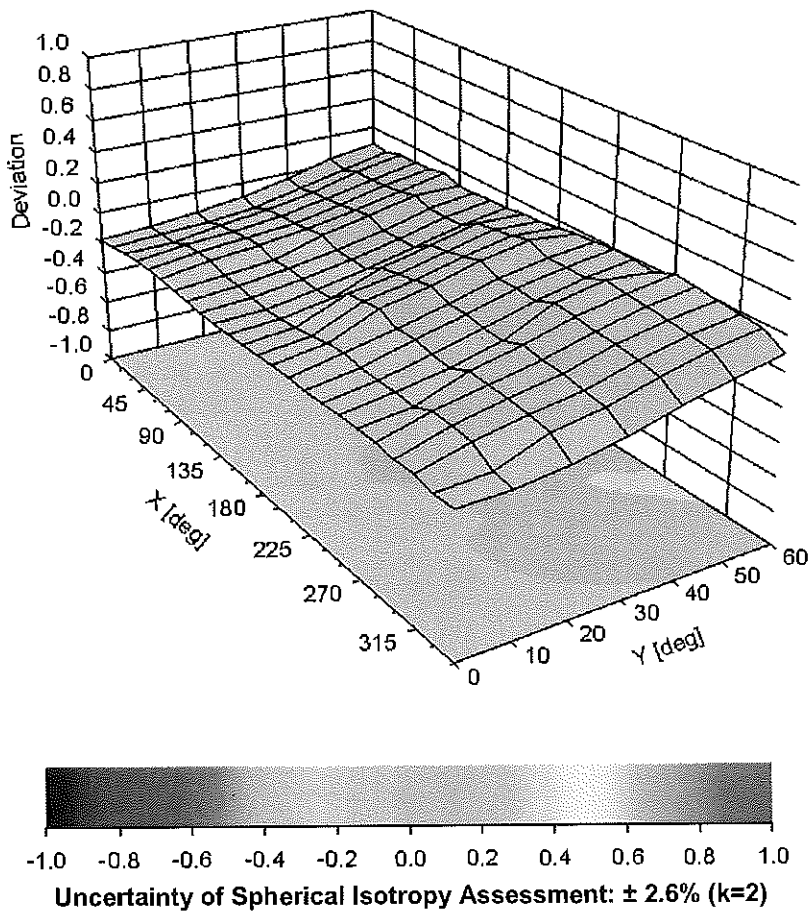


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), f = 900 MHz



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-40.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3288_Sep14/2**

CALIBRATION CERTIFICATE (Replacement of No:ES3-3288_Sep14)

Object

ES3DV3 - SN:3288

Calibration procedure(s)

QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

CC
10/12/14

Calibration date:

September 24, 2014

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 3, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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

Accreditation No.: **SCS 108**

Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3288

Manufactured:	July 6, 2010
Repaired:	September 18, 2014
Calibrated:	September 24, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.05	1.16	0.92	$\pm 10.1 \%$
DCP (mV) ^B	105.1	104.6	106.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	195.8	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		175.9	
		Z	0.0	0.0	1.0		177.1	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.71	61.9	11.4	10.00	40.3	$\pm 2.2 \%$
		Y	2.37	60.2	11.2		42.6	
		Z	1.54	56.6	8.9		41.2	
10011- CAB	UMTS-FDD (WCDMA)	X	3.29	67.1	18.4	2.91	133.8	$\pm 0.5 \%$
		Y	3.43	67.9	18.9		139.5	
		Z	3.45	68.1	18.9		141.3	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.99	68.9	18.6	1.87	135.1	$\pm 0.7 \%$
		Y	3.59	72.4	20.4		140.7	
		Z	3.54	72.4	20.3		143.0	
10013- CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.15	70.8	23.3	9.46	132.3	$\pm 3.5 \%$
		Y	11.29	70.8	23.2		141.1	
		Z	11.07	70.7	23.2		139.2	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	14.71	90.5	24.5	9.39	149.0	$\pm 1.9 \%$
		Y	16.40	92.8	26.0		131.3	
		Z	11.34	87.2	23.6		126.1	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	15.91	92.2	25.3	9.57	138.9	$\pm 2.5 \%$
		Y	21.25	96.9	27.2		142.0	
		Z	11.68	87.2	23.5		145.9	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	38.62	99.8	24.7	6.56	123.8	$\pm 2.2 \%$
		Y	36.71	99.7	25.2		128.1	
		Z	36.56	99.4	24.5		129.5	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	56.60	99.6	22.6	4.80	138.8	$\pm 1.9 \%$
		Y	46.94	99.9	23.7		149.9	
		Z	51.17	99.8	22.9		144.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	70.88	100.0	21.6	3.55	147.5	$\pm 1.9 \%$
		Y	52.58	99.8	22.6		129.4	
		Z	76.98	99.8	21.2		128.7	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	98.89	99.5	18.9	1.16	135.8	$\pm 1.4 \%$
		Y	78.39	99.6	19.5		141.7	
		Z	95.21	95.5	17.1		143.4	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.72	66.7	18.9	4.57	133.7	$\pm 0.9 \%$
		Y	4.85	67.1	19.1		137.7	
		Z	4.81	67.4	19.2		141.9	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.91	66.3	18.6	3.97	129.5	±0.7 %
		Y	4.00	66.6	18.7		133.7	
		Z	3.99	66.8	18.8		137.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.9	18.7	3.98	141.4	±0.7 %
		Y	4.78	67.5	19.0		147.7	
		Z	4.57	66.8	18.6		127.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.59	68.2	20.1	5.67	149.2	±1.4 %
		Y	6.36	67.3	19.6		130.7	
		Z	6.36	67.5	19.6		133.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.8	20.0	5.80	146.6	±1.4 %
		Y	6.23	66.8	19.4		128.8	
		Z	6.24	67.1	19.6		131.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.08	67.1	19.6	5.75	143.2	±1.4 %
		Y	6.20	67.4	19.8		148.0	
		Z	5.92	66.6	19.3		128.5	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.32	69.3	21.5	8.10	137.0	±2.2 %
		Y	10.31	69.1	21.4		143.5	
		Z	10.37	69.5	21.6		146.1	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.35	69.4	21.6	8.07	138.3	±2.2 %
		Y	10.36	69.3	21.4		146.4	
		Z	10.42	69.6	21.6		149.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.95	75.7	26.2	9.28	134.9	±3.3 %
		Y	10.37	76.0	26.1		146.6	
		Z	9.77	75.4	26.0		142.5	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.12	67.2	19.7	5.75	144.9	±1.4 %
		Y	6.21	67.4	19.8		148.8	
		Z	5.91	66.5	19.3		128.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.28	66.7	19.4	5.82	125.5	±1.2 %
		Y	6.37	66.8	19.4		129.7	
		Z	6.36	67.1	19.6		132.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.08	67.6	20.2	5.73	147.0	±1.2 %
		Y	4.95	66.6	19.6		128.6	
		Z	4.91	66.9	19.8		131.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.18	77.2	27.2	9.21	123.4	±2.7 %
		Y	8.37	76.6	26.6		129.5	
		Z	7.97	76.7	26.9		128.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	67.4	20.1	5.72	146.2	±1.4 %
		Y	5.10	67.3	20.0		142.8	
		Z	4.87	66.7	19.6		129.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.04	67.4	20.0	5.72	145.5	±1.2 %
		Y	5.12	67.4	20.0		143.4	
		Z	4.87	66.7	19.6		129.9	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.92	68.9	21.4	8.09	131.0	±2.2 %
		Y	9.84	68.5	21.1		130.0	
		Z	9.94	69.0	21.4		138.6	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.90	68.9	21.4	8.10	130.8	±2.2 %
		Y	9.81	68.4	21.0		131.4	
		Z	9.95	69.1	21.5		140.5	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.81	68.8	21.3	8.03	130.0	±2.2 %
		Y	9.89	68.9	21.3		138.1	
		Z	9.89	69.1	21.5		140.5	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.25	69.2	21.4	8.06	137.1	±2.2 %
		Y	10.30	69.2	21.4		144.4	
		Z	10.38	69.6	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.90	66.8	19.3	5.97	132.8	±1.4 %
		Y	7.09	67.3	19.6		142.0	
		Z	7.04	67.4	19.6		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.61	81.9	29.6	9.21	149.3	±2.7 %
		Y	8.66	77.6	27.1		133.7	
		Z	8.20	77.5	27.3		132.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.16	74.5	25.8	9.24	126.3	±3.0 %
		Y	9.62	75.0	25.8		137.4	
		Z	9.16	74.8	25.9		135.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.97	75.7	26.3	9.30	133.7	±3.3 %
		Y	10.38	75.9	26.1		146.1	
		Z	9.91	75.7	26.3		143.8	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.6	18.7	4.87	129.9	±0.9 %
		Y	6.01	67.1	19.0		135.7	
		Z	5.95	67.1	19.0		139.4	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.40	66.7	18.6	3.96	136.4	±0.7 %
		Y	4.55	67.3	19.0		138.3	
		Z	4.56	67.6	19.1		144.3	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.9	18.7	3.46	127.4	±0.5 %
		Y	3.77	67.6	19.1		130.2	
		Z	3.72	67.5	19.0		134.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.58	67.0	18.7	3.39	128.4	±0.5 %
		Y	3.73	67.7	19.1		132.7	
		Z	3.69	67.8	19.1		136.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.7	19.9	5.81	145.5	±1.4 %
		Y	6.49	67.7	19.9		149.5	
		Z	6.23	67.0	19.6		129.5	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.74	67.3	19.8	6.06	126.7	±1.4 %
		Y	6.83	67.5	19.8		132.9	
		Z	6.81	67.6	19.9		135.8	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.00	69.9	19.4	1.71	133.9	±0.5 %
		Y	3.30	71.5	20.1		141.0	
		Z	3.22	71.4	20.0		142.9	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.17	69.2	21.8	8.36	130.5	±2.5 %
		Y	10.20	69.1	21.6		138.4	
		Z	10.20	69.4	21.8		140.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.75	68.3	18.8	3.76	138.5	±0.7 %
		Y	5.00	69.1	19.2		146.7	
		Z	4.92	69.2	19.1		148.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.73	68.6	18.9	3.77	136.3	±0.7 %
		Y	4.97	69.4	19.4		143.7	
		Z	4.91	69.6	19.3		146.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.65	68.1	18.5	1.54	135.2	±0.5 %
		Y	3.05	70.8	19.9		140.7	
		Z	2.87	69.8	19.3		144.8	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.00	69.0	21.5	8.23	130.8	±2.2 %
		Y	10.06	68.9	21.4		138.6	
		Z	10.08	69.3	21.7		141.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.81	6.81	6.81	0.37	1.70	± 12.0 %
835	41.5	0.90	6.51	6.51	6.51	0.45	1.52	± 12.0 %
1750	40.1	1.37	5.38	5.38	5.38	0.44	1.58	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.80	1.18	± 12.0 %
2450	39.2	1.80	4.56	4.56	4.56	0.80	1.21	± 12.0 %
2600	39.0	1.96	4.44	4.44	4.44	0.80	1.22	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.31	1.89	± 12.0 %
835	55.2	0.97	6.32	6.32	6.32	0.55	1.39	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.57	1.44	± 12.0 %
1900	53.3	1.52	4.82	4.82	4.82	0.51	1.54	± 12.0 %
2450	52.7	1.95	4.36	4.36	4.36	0.71	1.07	± 12.0 %
2600	52.5	2.16	4.22	4.22	4.22	0.80	1.07	± 12.0 %

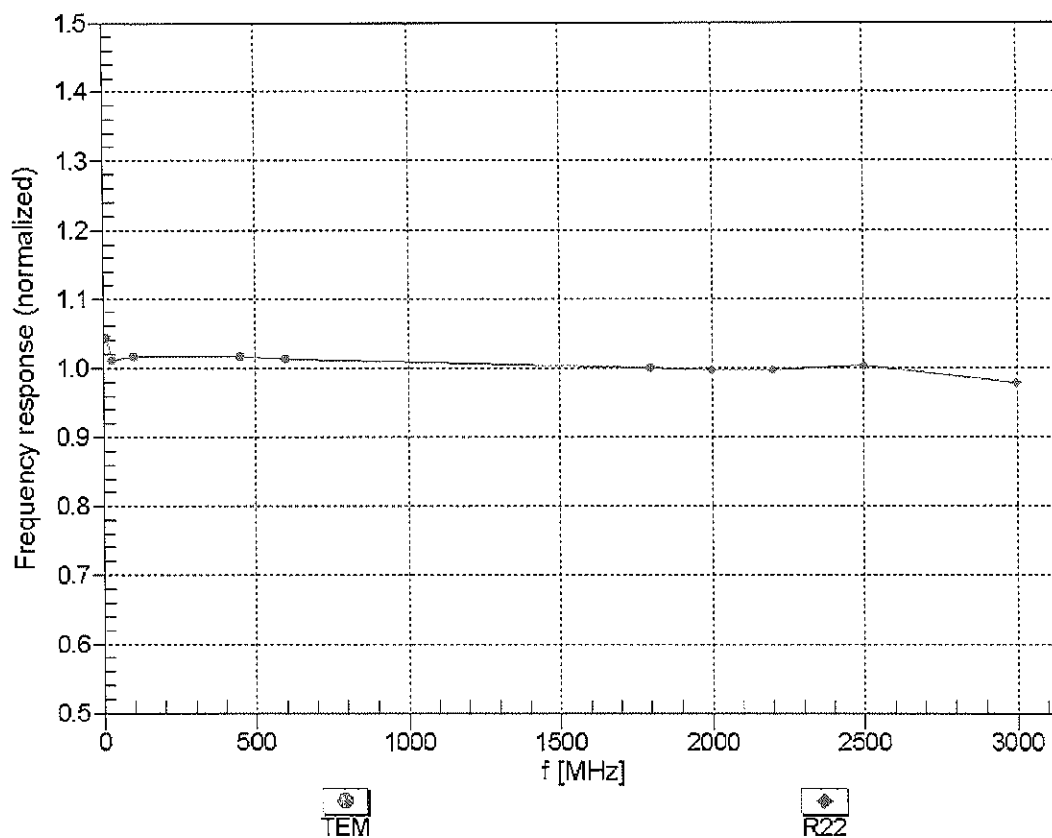
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 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.

^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

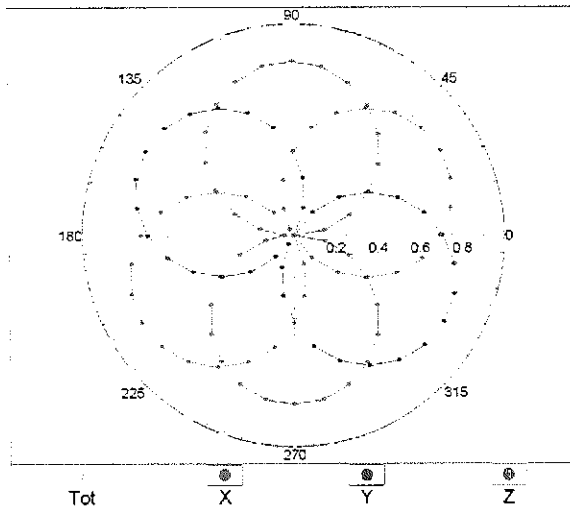
(TEM-Cell:ifi110 EXX, Waveguide: R22)



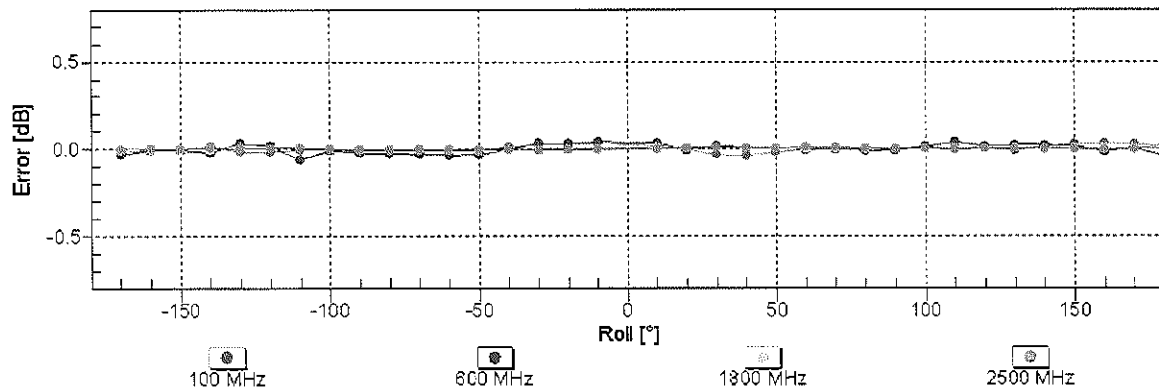
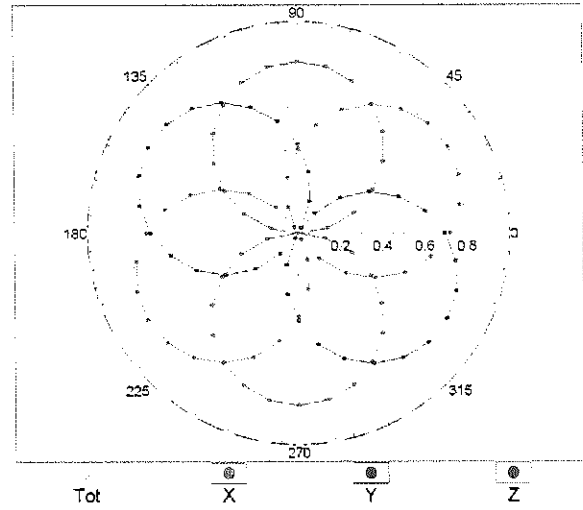
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

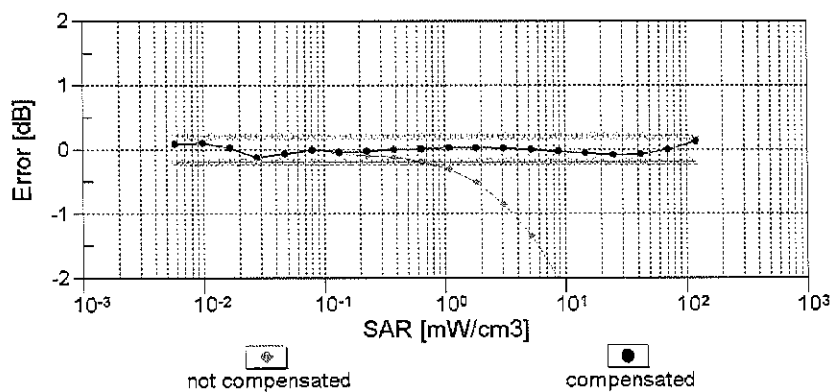
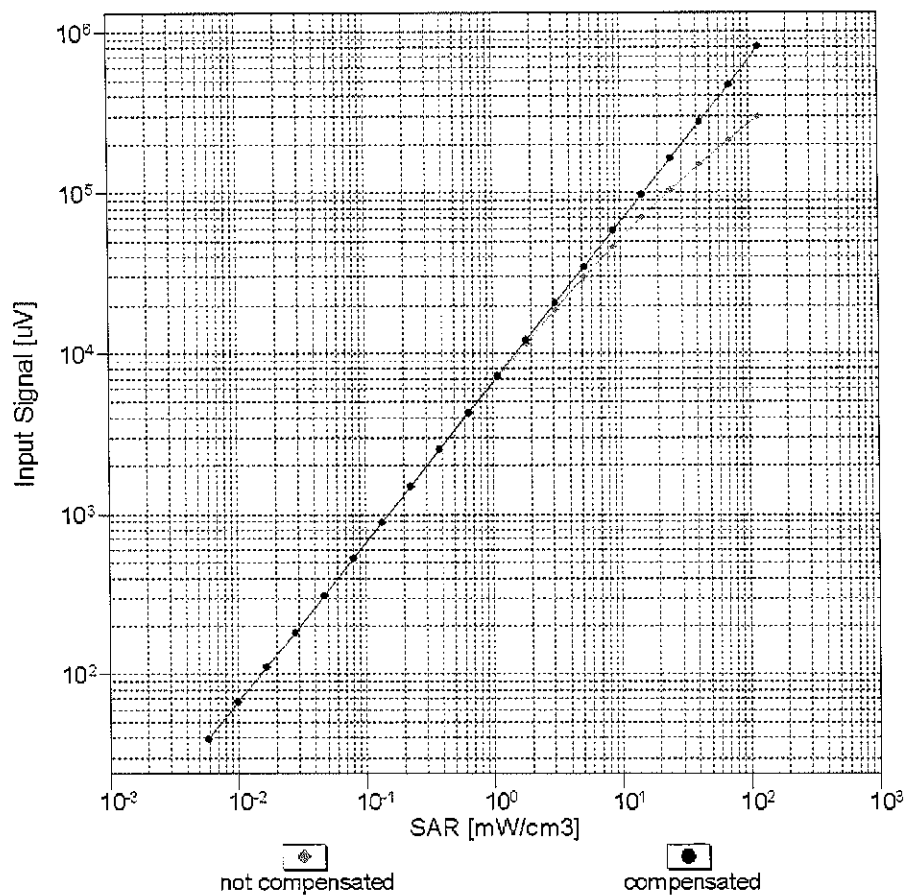


f=1800 MHz,R22



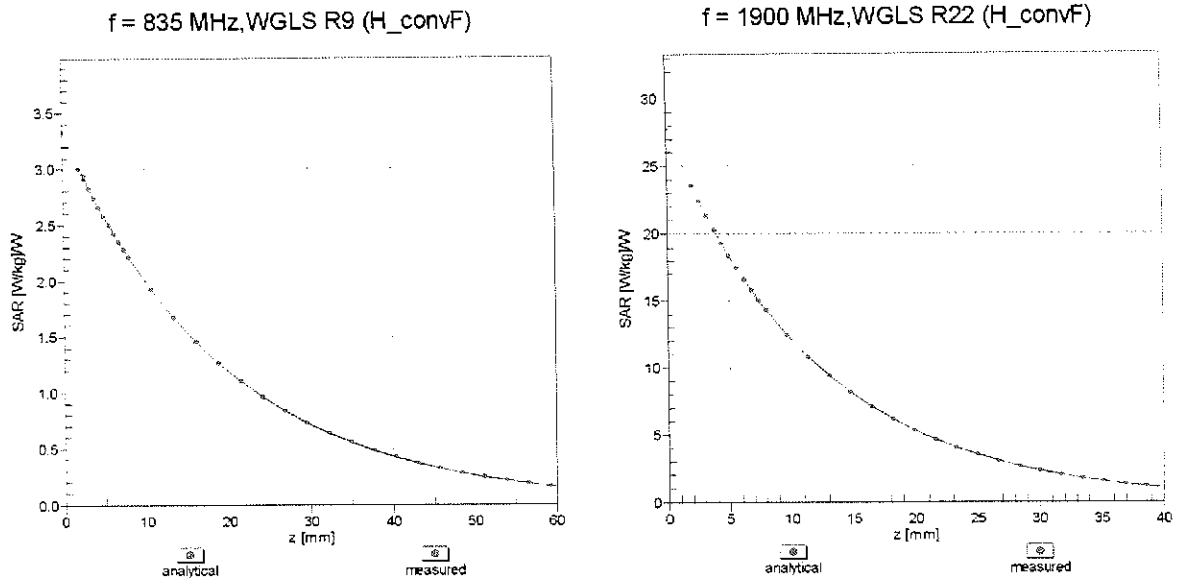
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$)



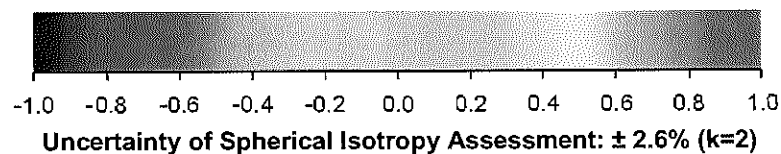
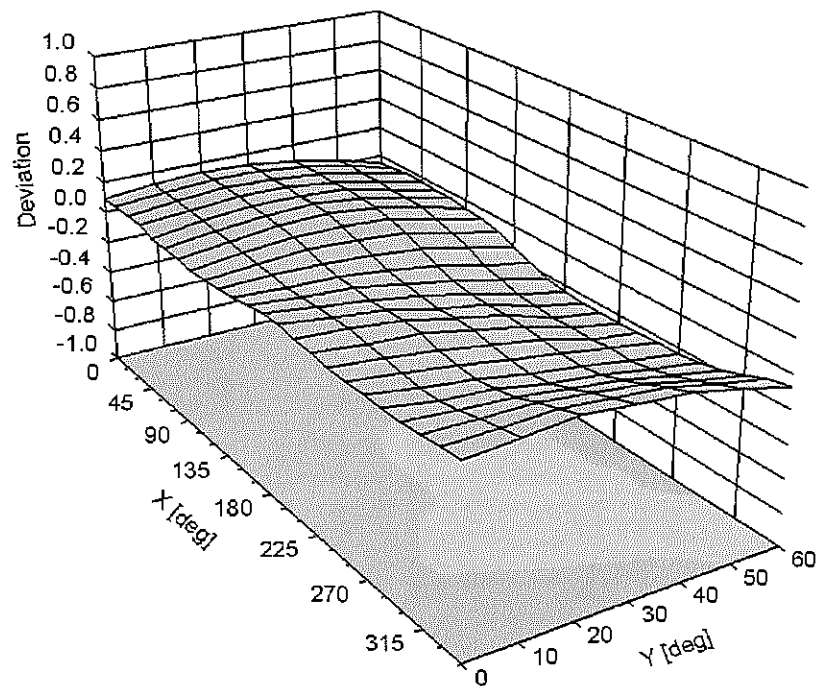
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-110
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



Accredited by the Swiss Accreditation Service (SAS)
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3318_Jan15**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3318**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

CC
 1/30/15

Calibration date: **January 23, 2015**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Israe Elnaouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
			Issued: January 26, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
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Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3318

Manufactured: January 10, 2012
Calibrated: January 23, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.15	0.92	1.28	$\pm 10.1 \%$
DCP (mV) ^B	106.4	109.2	103.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	200.6	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		185.3	
		Z	0.0	0.0	1.0		207.7	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.26	66.4	14.0	10.00	41.4	$\pm 1.2 \%$
		Y	1.76	59.6	9.8		36.1	
		Z	1.82	57.7	9.6		43.6	
10011-CAB	UMTS-FDD (WCDMA)	X	3.48	68.9	19.9	2.91	120.2	$\pm 0.5 \%$
		Y	3.76	70.1	19.9		146.0	
		Z	3.11	66.0	17.9		124.4	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.71	74.2	21.7	1.87	121.7	$\pm 0.7 \%$
		Y	3.65	73.3	20.7		147.5	
		Z	2.77	67.4	17.8		126.6	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.68	69.5	22.7	9.46	114.7	$\pm 2.5 \%$
		Y	10.82	70.4	23.0		139.8	
		Z	11.22	71.1	23.7		122.2	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	16.13	95.0	26.6	9.39	122.7	$\pm 2.2 \%$
		Y	4.61	73.1	17.2		130.8	
		Z	15.10	92.0	25.4		135.9	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	17.03	96.8	27.5	9.57	113.0	$\pm 1.9 \%$
		Y	4.15	71.7	16.8		119.9	
		Z	21.50	98.0	27.5		130.9	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	35.51	99.5	24.5	6.56	147.6	$\pm 2.7 \%$
		Y	6.12	77.2	17.1		118.1	
		Z	38.50	99.7	24.7		114.0	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	45.57	99.9	23.2	4.80	113.3	$\pm 1.7 \%$
		Y	2.73	68.4	12.6		133.3	
		Z	54.59	99.9	22.9		131.0	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	53.68	99.5	21.9	3.55	123.0	$\pm 3.0 \%$
		Y	60.05	99.8	21.1		144.9	
		Z	66.60	99.6	21.6		140.7	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	20.92	99.4	21.8	1.16	136.6	$\pm 2.2 \%$
		Y	95.40	88.3	13.8		117.6	
		Z	100.00	99.5	18.7		110.1	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.50	68.1	20.2	5.67	130.5	$\pm 1.2 \%$
		Y	6.11	66.7	19.2		107.2	
		Z	6.55	68.2	20.1		142.7	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	9.76	74.8	25.9	9.29	116.0	±2.5 %
		Y	8.85	72.2	24.1		134.9	
		Z	10.83	77.4	27.2		131.5	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.36	67.7	20.1	5.80	128.7	±1.2 %
		Y	5.92	66.1	19.0		106.6	
		Z	6.42	67.7	20.0		140.4	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.20	69.1	21.6	8.07	118.1	±2.5 %
		Y	10.27	69.3	21.4		143.9	
		Z	10.43	69.7	21.8		131.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.09	73.7	25.5	9.28	112.0	±2.7 %
		Y	8.35	71.5	23.9		131.1	
		Z	9.58	74.4	25.6		126.8	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.01	67.0	19.8	5.75	126.4	±1.2 %
		Y	6.17	67.7	19.9		148.9	
		Z	6.07	67.1	19.7		137.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.41	67.4	19.9	5.82	130.9	±0.9 %
		Y	6.06	66.2	19.0		109.1	
		Z	6.54	67.7	20.0		142.6	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.79	66.5	19.8	5.73	109.4	±0.9 %
		Y	4.82	67.1	19.8		128.8	
		Z	4.85	66.4	19.5		119.0	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.44	79.3	28.7	9.21	125.1	±2.5 %
		Y	7.15	75.0	26.0		144.0	
		Z	10.13	83.8	30.8		141.9	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.13	68.2	20.8	5.72	146.5	±0.9 %
		Y	4.77	66.8	19.6		125.2	
		Z	4.81	66.2	19.4		118.5	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.11	68.1	20.7	5.72	146.4	±0.9 %
		Y	4.79	67.0	19.7		126.0	
		Z	4.88	66.6	19.7		118.9	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.63	68.3	21.2	8.10	108.2	±2.5 %
		Y	9.84	68.9	21.3		135.5	
		Z	9.99	69.2	21.7		124.0	
10225-CAB	UMTS-FDD (HSPA+)	X	6.99	67.3	19.7	5.97	134.8	±0.9 %
		Y	6.73	66.8	19.2		115.9	
		Z	6.71	66.2	19.0		106.3	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.79	76.4	27.0	9.21	126.4	±2.5 %
		Y	7.19	75.1	26.1		144.7	
		Z	10.12	83.9	30.9		142.0	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.19	71.9	24.7	9.24	103.3	±2.2 %
		Y	7.76	70.8	23.6		122.0	
		Z	9.31	75.2	26.4		119.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.90	73.0	25.1	9.30	108.7	±2.2 %
		Y	8.38	71.6	24.0		129.7	
		Z	10.15	76.5	26.9		126.1	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.42	67.2	19.2	3.96	119.1	±0.7 %
		Y	4.71	68.5	19.5		143.8	
		Z	4.39	66.7	18.6		131.7	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.65	67.5	19.3	3.46	111.3	±0.5 %
		Y	3.89	69.0	19.6		130.9	
		Z	3.49	66.1	18.2		122.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.60	67.6	19.3	3.39	114.4	±0.5 %
		Y	3.85	69.1	19.7		133.4	
		Z	3.45	66.2	18.2		123.7	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.36	67.6	20.1	5.81	128.7	±1.2 %
		Y	5.95	66.1	19.0		106.5	
		Z	6.39	67.6	19.9		140.7	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.98	68.4	20.6	6.06	134.9	±1.2 %
		Y	6.52	66.7	19.3		111.3	
		Z	7.06	68.6	20.5		146.2	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.97	69.7	19.7	3.76	122.2	±0.5 %
		Y	5.31	71.6	20.2		143.6	
		Z	4.54	67.3	18.2		133.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.77	69.4	19.6	3.77	120.8	±0.5 %
		Y	5.40	72.4	20.6		141.3	
		Z	4.71	68.5	18.9		131.5	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.07	71.7	20.7	1.54	120.5	±0.7 %
		Y	3.52	73.8	21.0		142.0	
		Z	2.38	66.1	17.4		129.6	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.73	68.3	21.2	8.23	114.7	±2.5 %
		Y	9.99	69.2	21.5		138.0	
		Z	10.10	69.4	21.9		125.3	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 7 and 8).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.58	6.58	6.58	0.36	1.73	± 12.0 %
835	41.5	0.90	6.39	6.39	6.39	0.80	1.14	± 12.0 %
1750	40.1	1.37	5.27	5.27	5.27	0.76	1.19	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.44	1.55	± 12.0 %
2300	39.5	1.67	4.78	4.78	4.78	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.55	1.49	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.32	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.22	6.22	6.22	0.67	1.28	± 12.0 %
835	55.2	0.97	6.23	6.23	6.23	0.80	1.19	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.40	1.77	± 12.0 %
1900	53.3	1.52	4.76	4.76	4.76	0.60	1.48	± 12.0 %
2300	52.9	1.81	4.52	4.52	4.52	0.80	1.19	± 12.0 %
2450	52.7	1.95	4.37	4.37	4.37	0.72	1.23	± 12.0 %
2600	52.5	2.16	4.17	4.17	4.17	0.80	1.00	± 12.0 %

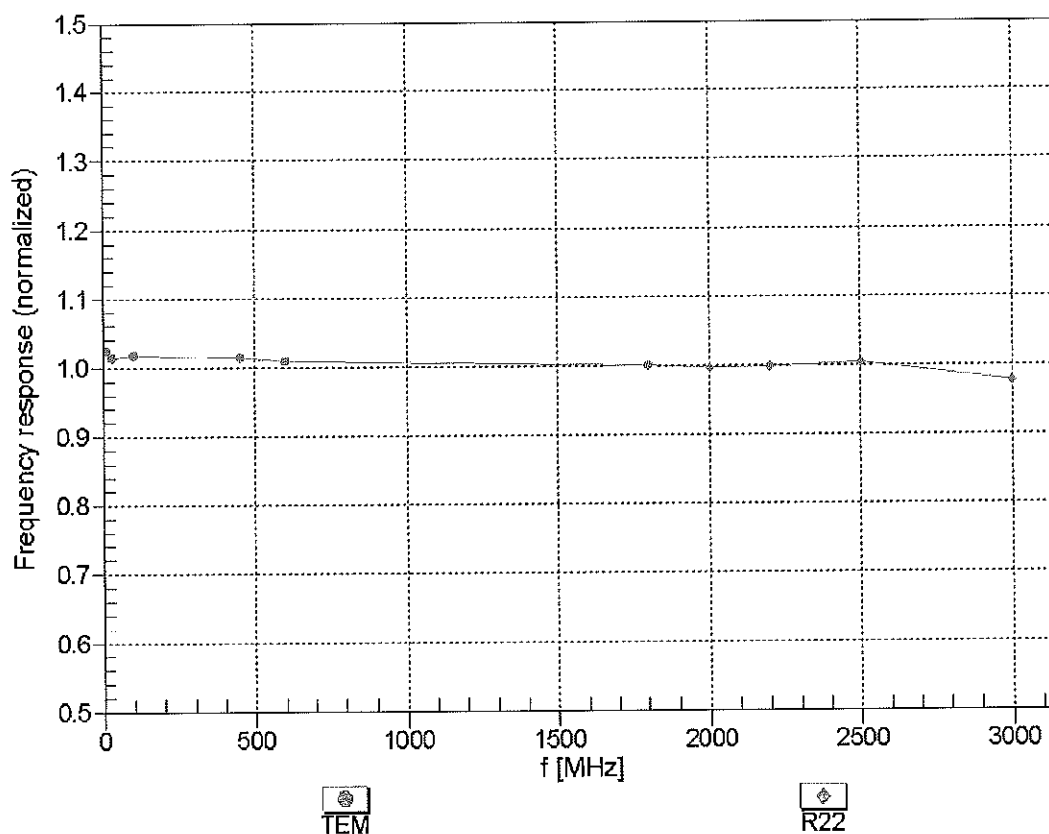
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10 , 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 $\pm 10\%$ 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 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.

Frequency Response of E-Field

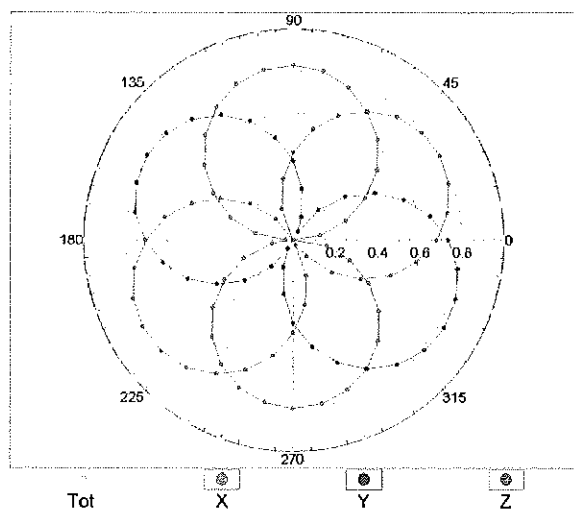
(TEM-Cell:ifi110 EXX, Waveguide: R22)



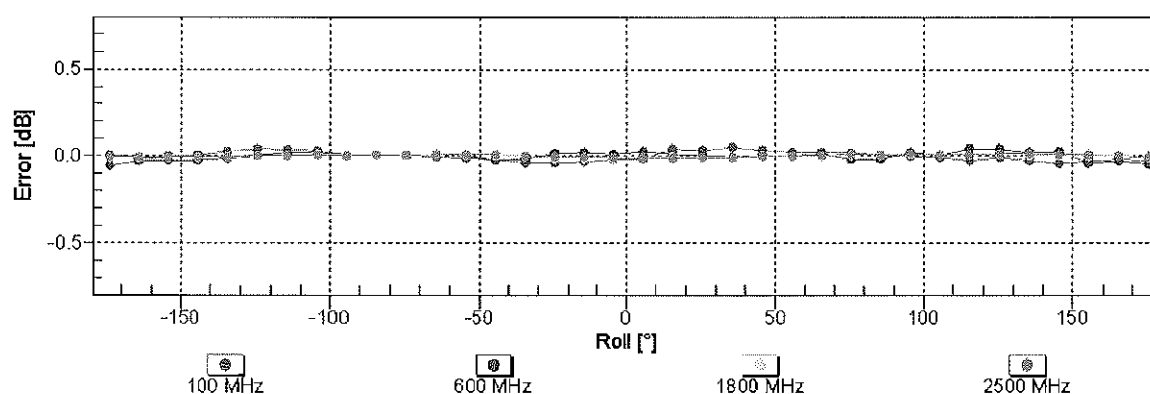
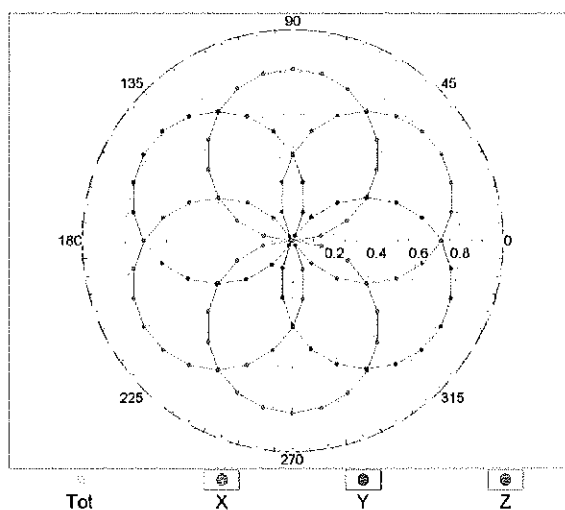
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM



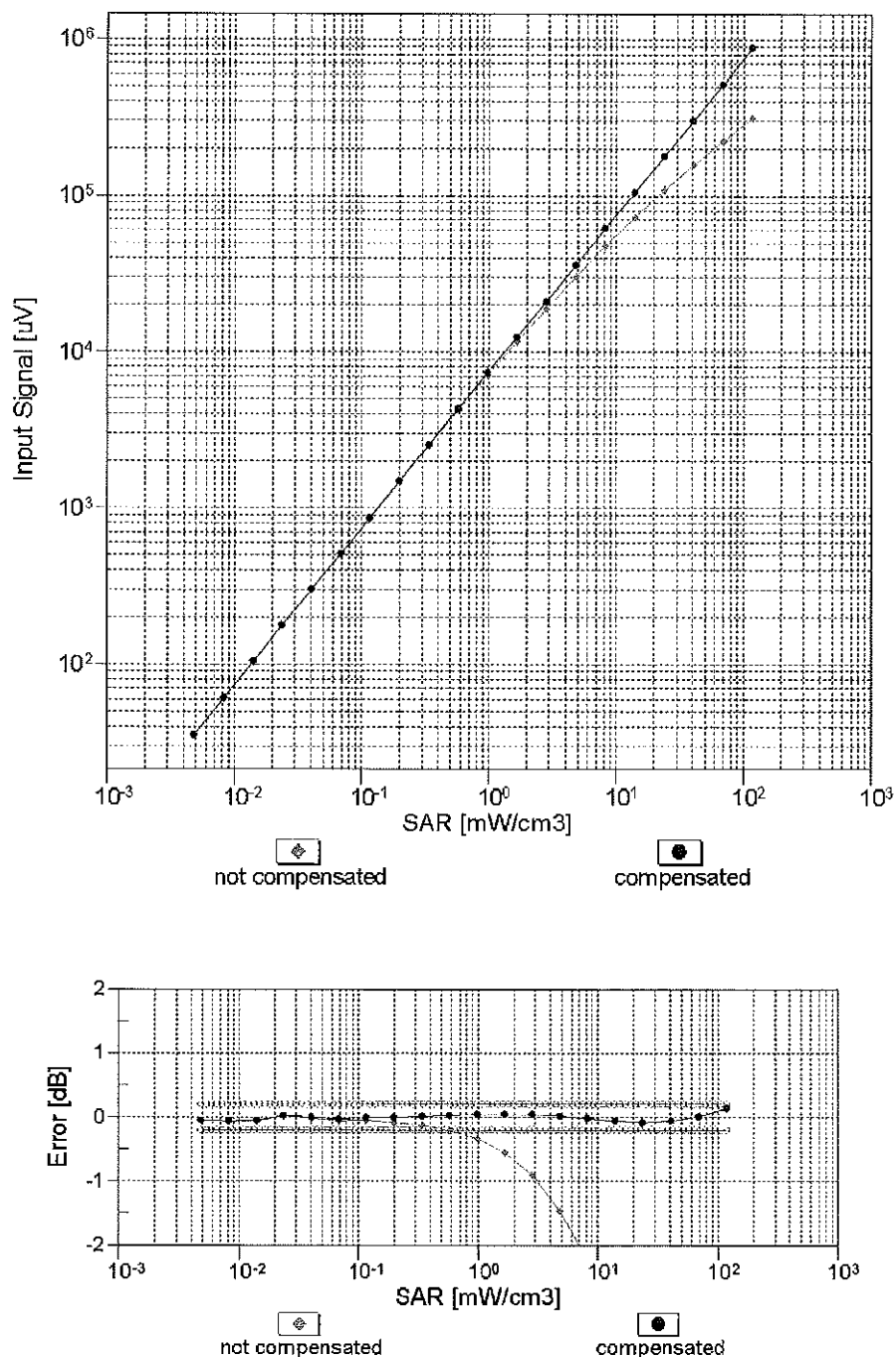
f=1800 MHz,R22



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

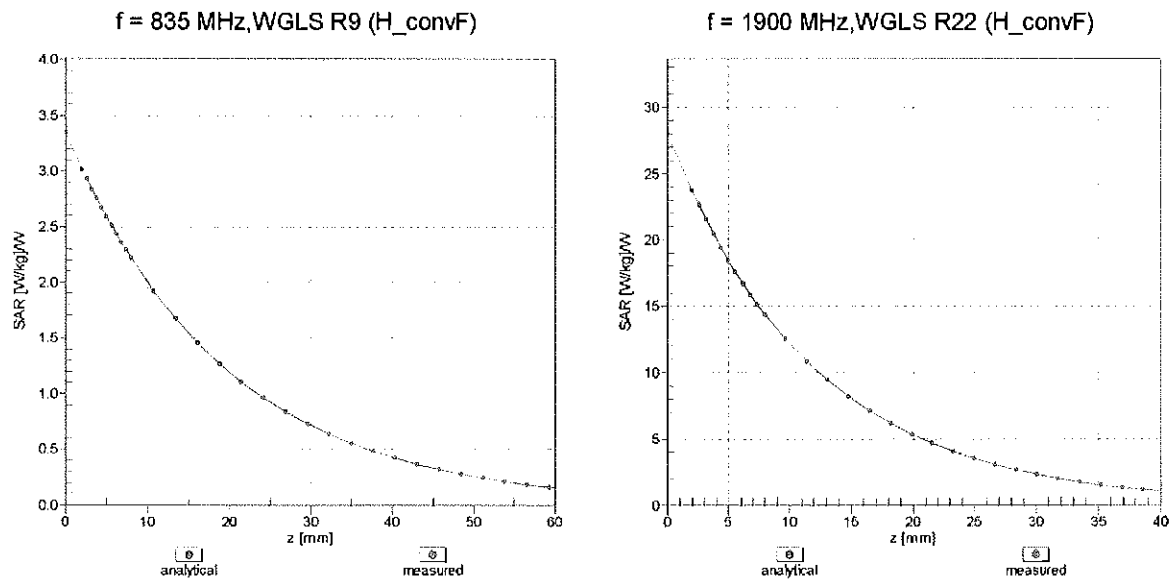
Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)



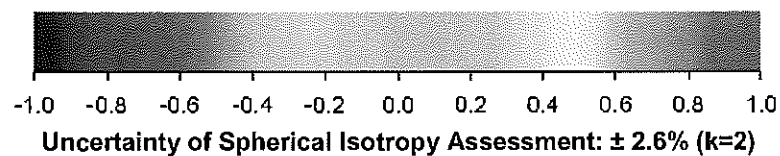
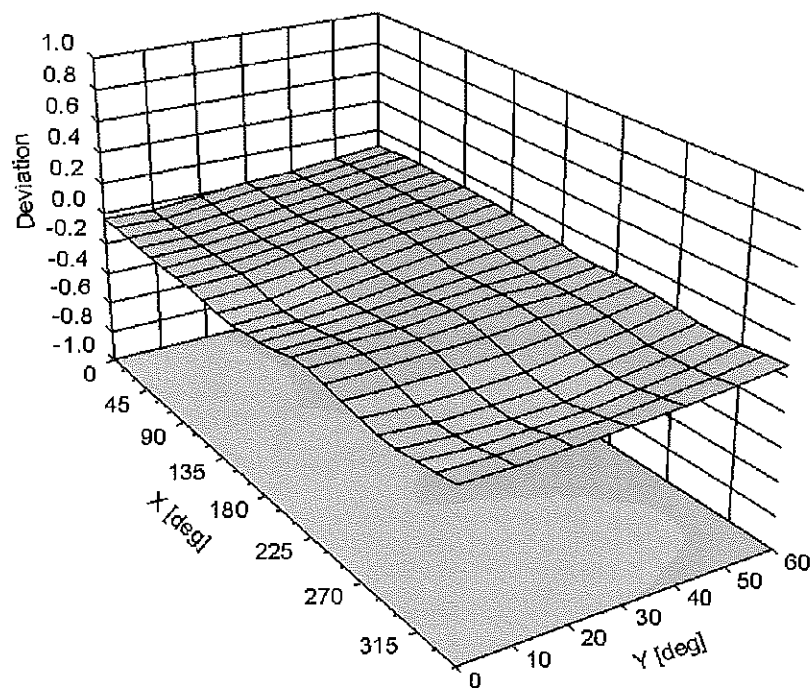
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-104.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3319_Mar15**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3319**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 19, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Israe Elnaouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 19, 2015

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3319

Manufactured: January 10, 2012
Calibrated: March 19, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.12	1.08	1.15	± 10.1 %
DCP (mV) ^B	104.4	106.0	104.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	176.1	±3.3 %
		Y	0.0	0.0	1.0		192.7	
		Z	0.0	0.0	1.0		174.6	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.26	64.8	13.4	10.00	41.7	±1.9 %
		Y	2.66	62.2	11.7		39.5	
		Z	3.51	64.8	13.2		42.1	
10011-CAB	UMTS-FDD (WCDMA)	X	3.47	68.1	19.1	2.91	142.9	±0.5 %
		Y	3.37	67.9	19.1		133.0	
		Z	3.57	68.7	19.4		138.6	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.48	71.8	20.2	1.87	143.9	±0.7 %
		Y	3.23	70.9	19.9		134.6	
		Z	3.68	72.8	20.6		140.5	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.18	70.5	23.1	9.46	143.4	±3.3 %
		Y	10.98	70.5	23.2		129.9	
		Z	11.19	70.6	23.1		138.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	15.55	92.7	26.1	9.39	126.5	±1.7 %
		Y	21.21	98.0	27.2		142.0	
		Z	19.50	96.1	27.0		125.4	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	23.54	100.0	28.4	9.57	142.6	±2.2 %
		Y	23.24	99.9	28.0		137.4	
		Z	23.57	99.6	28.2		139.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	17.00	90.2	22.7	6.56	128.9	±2.2 %
		Y	35.20	99.7	24.9		148.2	
		Z	33.12	99.6	25.4		123.8	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	44.20	99.6	23.6	4.80	146.0	±1.9 %
		Y	49.99	99.9	23.0		136.6	
		Z	41.43	99.6	23.9		141.4	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	46.56	99.7	22.7	3.55	127.7	±2.2 %
		Y	58.11	99.8	21.9		145.3	
		Z	55.65	99.6	22.2		124.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	34.25	99.4	21.1	1.16	140.3	±1.7 %
		Y	40.72	100.0	20.6		135.7	
		Z	45.39	100.0	20.8		136.4	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.30	67.1	19.5	5.67	127.4	±1.4 %
		Y	6.58	68.4	20.3		149.0	
		Z	6.55	68.0	19.9		146.3	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.47	75.6	25.8	9.29	146.6	±3.0 %
		Y	10.18	75.8	26.3		136.2	
		Z	10.38	75.3	25.6		140.8	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.18	66.6	19.4	5.80	126.9	±1.4 %
		Y	6.40	67.8	20.1		147.0	
		Z	6.44	67.6	19.9		145.7	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.24	69.0	21.3	8.07	142.7	±2.5 %
		Y	10.25	69.2	21.5		136.7	
		Z	10.16	68.8	21.2		136.6	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.85	74.8	25.6	9.28	140.8	±3.0 %
		Y	9.49	74.7	25.9		130.5	
		Z	9.90	74.8	25.6		136.8	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.13	67.1	19.7	5.75	146.6	±1.4 %
		Y	6.11	67.4	19.9		147.7	
		Z	6.12	67.1	19.7		142.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.33	66.7	19.4	5.82	128.9	±1.4 %
		Y	6.33	67.1	19.7		128.7	
		Z	6.57	67.6	19.9		147.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.89	66.4	19.5	5.73	127.5	±1.2 %
		Y	4.99	67.5	20.2		149.3	
		Z	5.09	67.3	20.0		145.1	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.99	75.8	26.3	9.21	127.6	±2.7 %
		Y	9.29	81.7	29.6		149.8	
		Z	8.04	75.8	26.3		123.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.08	67.3	20.0	5.72	149.3	±1.4 %
		Y	5.00	67.6	20.3		145.0	
		Z	5.09	67.3	20.0		145.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.08	67.3	20.0	5.72	148.5	±1.4 %
		Y	5.06	67.9	20.4		147.1	
		Z	5.11	67.4	20.0		144.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.89	68.7	21.2	8.10	134.6	±2.2 %
		Y	9.84	68.9	21.4		130.4	
		Z	9.82	68.5	21.1		130.4	
10225-CAB	UMTS-FDD (HSPA+)	X	7.02	67.1	19.5	5.97	138.0	±1.4 %
		Y	6.88	67.0	19.5		133.2	
		Z	7.01	67.1	19.5		134.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.01	75.9	26.4	9.21	128.0	±2.7 %
		Y	9.39	82.1	29.9		149.7	
		Z	8.34	76.9	26.9		129.1	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.05	73.6	25.1	9.24	130.6	±3.0 %
		Y	8.76	73.7	25.5		123.6	
		Z	9.10	73.6	25.1		127.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.81	74.7	25.6	9.30	139.3	±3.0 %
		Y	9.50	74.8	25.9		130.7	
		Z	9.81	74.6	25.5		135.0	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.49	67.1	18.9	3.96	140.1	±0.7 %
		Y	4.46	67.2	19.0		137.6	
		Z	4.52	67.1	18.9		137.1	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.68	67.0	18.8	3.46	129.3	±0.7 %
		Y	3.64	67.3	19.0		130.3	
		Z	3.84	67.9	19.2		148.6	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.64	67.2	18.8	3.39	131.8	±0.5 %
		Y	3.60	67.4	19.1		128.2	
		Z	3.71	67.5	19.0		128.0	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.5	19.9	5.81	147.2	±1.7 %
		Y	6.39	67.7	20.0		145.4	
		Z	6.42	67.5	19.8		143.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.73	67.1	19.7	6.06	129.7	±1.4 %
		Y	6.75	67.5	19.9		130.8	
		Z	6.75	67.3	19.7		126.2	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.14	68.9	21.5	8.37	136.7	±2.5 %
		Y	10.23	69.5	22.0		136.5	
		Z	10.13	68.9	21.5		132.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.97	69.2	19.3	3.76	143.5	±0.5 %
		Y	4.87	69.3	19.4		141.0	
		Z	5.02	69.2	19.3		139.6	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.91	69.3	19.4	3.77	139.8	±0.7 %
		Y	4.67	68.9	19.1		138.9	
		Z	4.89	69.1	19.3		137.1	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.93	70.1	19.6	1.54	137.8	±0.7 %
		Y	2.84	69.8	19.6		138.2	
		Z	3.04	70.8	19.9		134.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.94	68.7	21.3	8.23	134.6	±2.2 %
		Y	10.00	69.1	21.7		134.1	
		Z	9.89	68.5	21.2		130.1	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 7 and 8).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.69	6.69	6.69	0.40	1.70	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.43	1.62	± 12.0 %
1750	40.1	1.37	5.29	5.29	5.29	0.80	1.16	± 12.0 %
1900	40.0	1.40	5.10	5.10	5.10	0.80	1.24	± 12.0 %
2300	39.5	1.67	4.77	4.77	4.77	0.64	1.38	± 12.0 %
2450	39.2	1.80	4.55	4.55	4.55	0.80	1.29	± 12.0 %
2600	39.0	1.96	4.39	4.39	4.39	0.80	1.31	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unct. (k=2)
750	55.5	0.96	6.10	6.10	6.10	0.34	1.80	± 12.0 %
835	55.2	0.97	6.07	6.07	6.07	0.47	1.56	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.70	1.36	± 12.0 %
1900	53.3	1.52	4.53	4.53	4.53	0.71	1.39	± 12.0 %
2300	52.9	1.81	4.24	4.24	4.24	0.80	1.26	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.80	1.10	± 12.0 %
2600	52.5	2.16	3.90	3.90	3.90	0.80	1.11	± 12.0 %

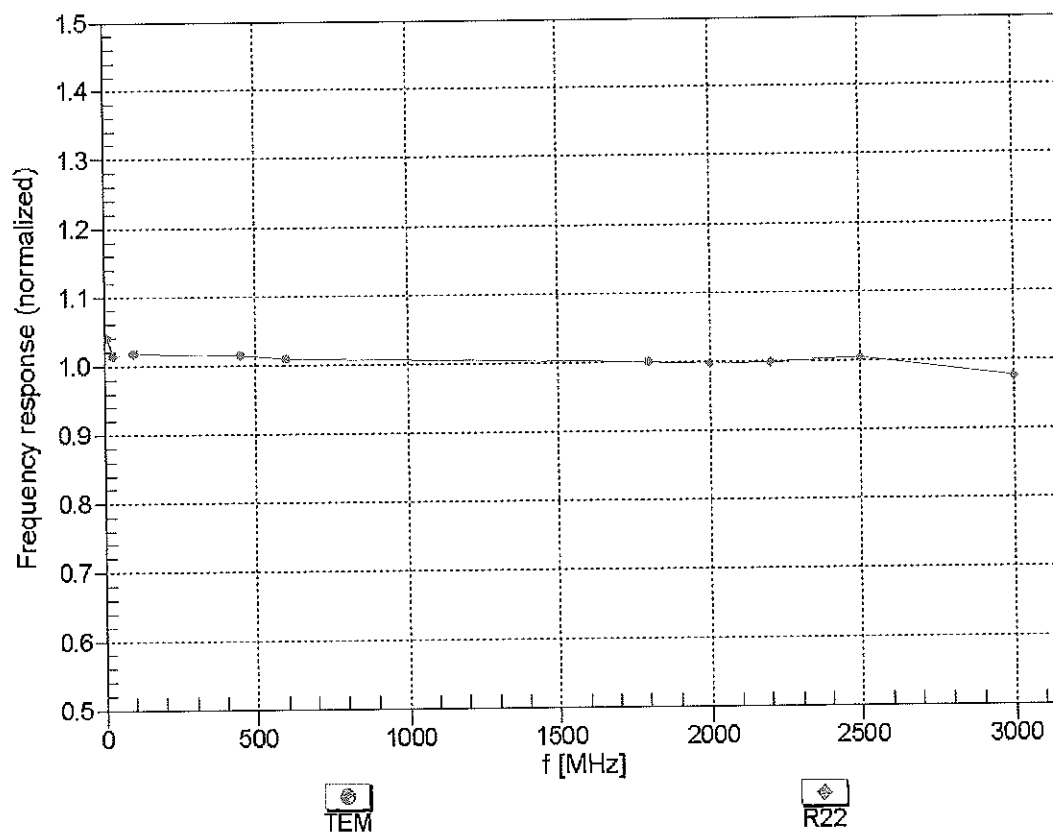
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 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.

^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

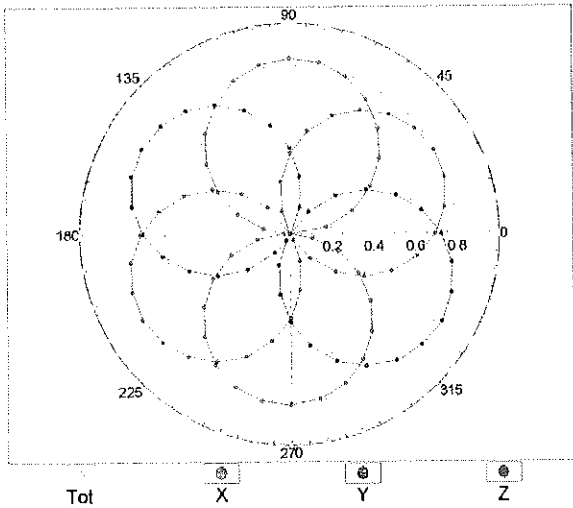
(TEM-Cell:ifi110 EXX, Waveguide: R22)



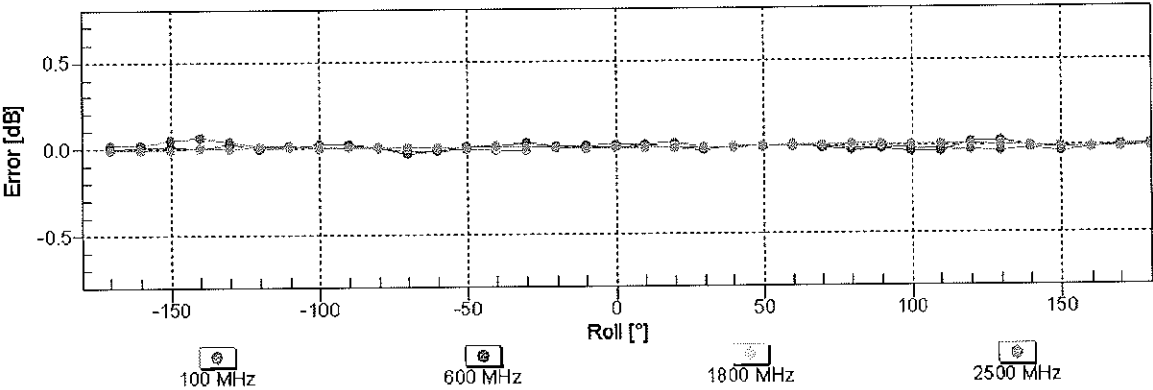
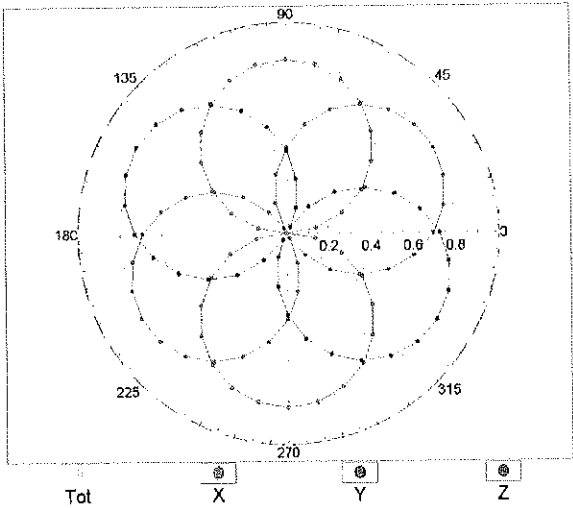
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

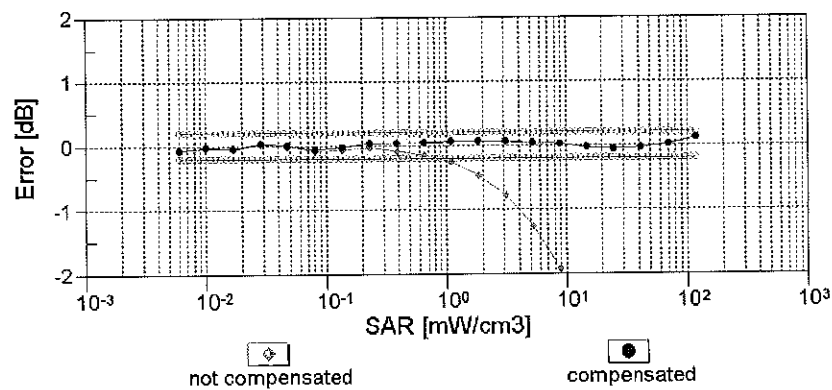
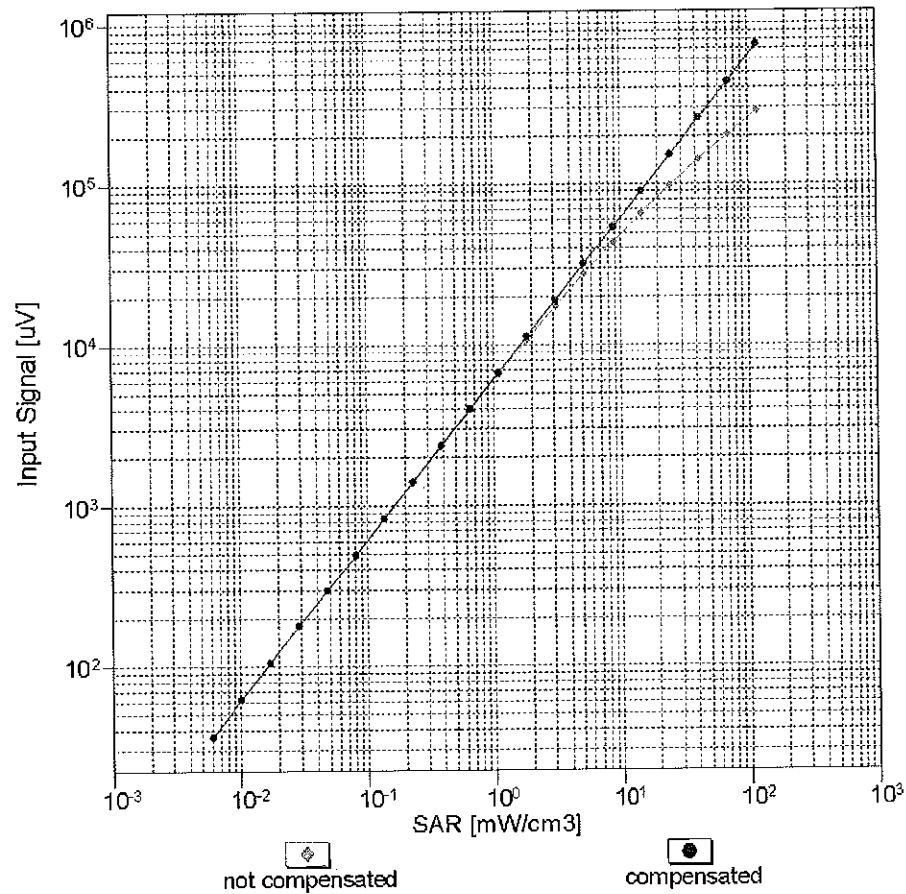


f=1800 MHz,R22



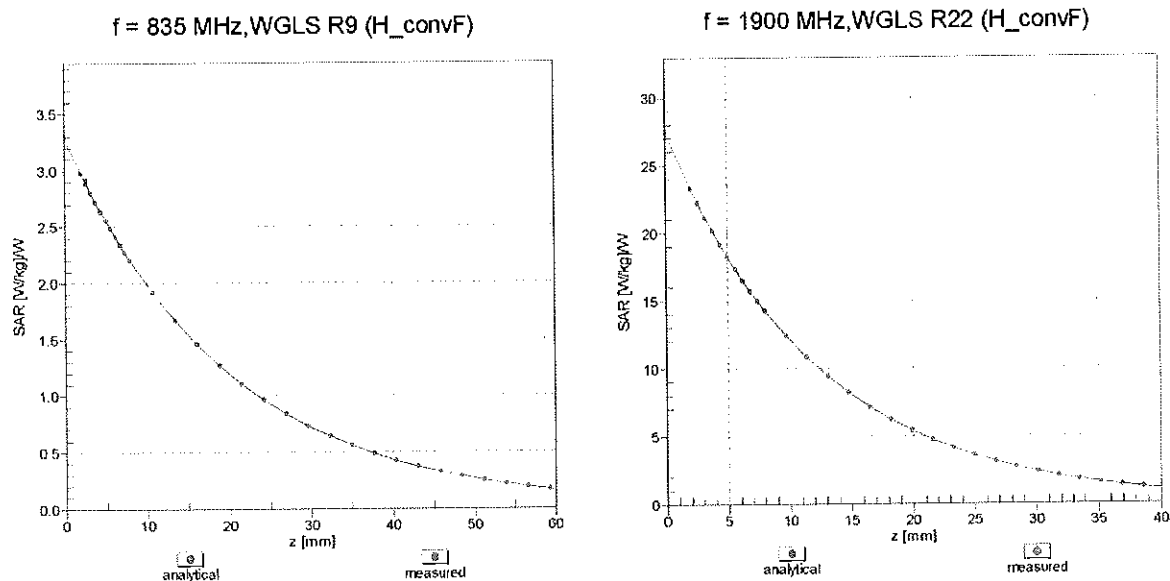
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)



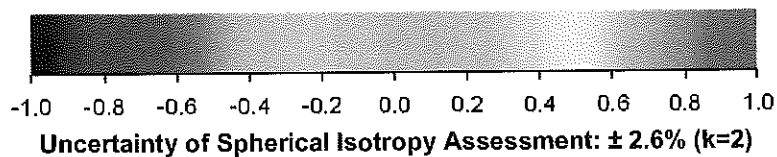
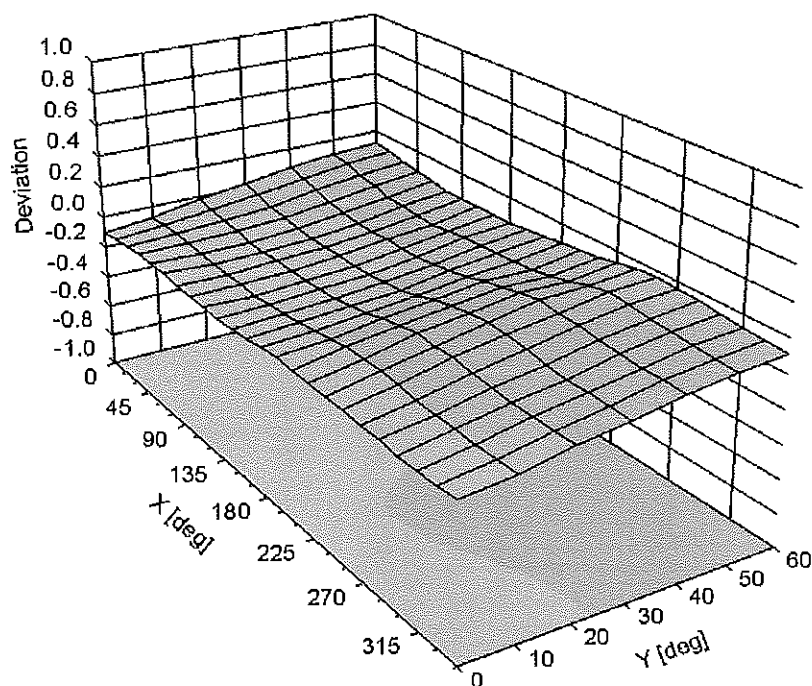
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-120.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3331_Aug14/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3331_Aug14)

Object **ES3DV3 - SN:3331**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

CC
2014/09

Calibration date: **August 20, 2014**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8763E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Lelf Klysner	Function Laboratory Technician	Signature
Approved by:	Kelja Pokovic	Technical Manager	
			Issued: November 3, 2014
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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

Accreditation No.: **SCS 108**

Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3331

Manufactured: January 24, 2012
Calibrated: August 20, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3331

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.16	1.22	0.65	$\pm 10.1 \%$
DCP (mV) ^B	97.2	104.5	101.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	196.9	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		202.0	
		Z	0.0	0.0	1.0		182.4	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.20	62.4	12.3	10.00	41.8	$\pm 1.7 \%$
		Y	3.15	62.4	12.1		43.7	
		Z	36.65	88.0	19.5		35.8	
10011-CAB	UMTS-FDD (WCDMA)	X	3.03	63.8	15.9	2.91	133.8	$\pm 0.9 \%$
		Y	3.28	67.2	18.6		140.9	
		Z	3.32	66.8	18.3		146.0	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.51	63.6	15.0	1.87	134.4	$\pm 0.9 \%$
		Y	3.11	69.9	19.3		144.5	
		Z	2.92	68.3	18.4		145.1	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.32	70.3	22.8	9.46	135.4	$\pm 3.5 \%$
		Y	11.79	72.2	24.2		146.6	
		Z	11.30	70.4	22.8		145.6	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	11.03	85.1	23.4	9.39	127.4	$\pm 2.2 \%$
		Y	25.94	99.5	28.1		119.9	
		Z	11.02	88.4	24.4		123.1	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	12.84	87.5	24.3	9.57	138.6	$\pm 2.5 \%$
		Y	26.90	99.8	28.2		146.7	
		Z	10.27	87.7	24.4		113.6	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	14.52	85.4	20.8	6.56	149.8	$\pm 2.2 \%$
		Y	38.05	99.6	25.4		119.6	
		Z	31.13	99.9	25.4		147.0	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	6.94	75.0	16.0	4.80	136.5	$\pm 1.7 \%$
		Y	55.93	99.7	23.3		134.0	
		Z	38.81	99.8	23.8		145.4	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	4.68	71.0	13.6	3.55	149.6	$\pm 1.7 \%$
		Y	58.60	99.9	22.7		140.1	
		Z	41.15	99.6	22.7		129.1	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	1.18	62.6	8.4	1.16	134.1	$\pm 1.7 \%$
		Y	81.15	99.6	19.6		149.1	
		Z	50.90	99.9	20.1		142.0	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.57	64.6	17.2	4.57	130.2	$\pm 1.4 \%$
		Y	4.83	67.2	19.3		145.2	
		Z	4.79	66.5	18.8		141.3	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.91	64.7	17.0	3.97	148.6	±1.4 %
		Y	3.94	66.4	18.7		139.3	
		Z	3.93	65.9	18.3		136.4	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.42	64.7	16.9	3.98	138.2	±1.2 %
		Y	4.53	66.5	18.6		128.9	
		Z	4.60	66.3	18.3		127.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.39	66.6	18.8	5.67	143.8	±1.9 %
		Y	6.42	67.7	19.9		134.4	
		Z	6.37	66.9	19.2		132.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.27	66.1	18.6	5.80	140.5	±1.9 %
		Y	6.27	67.1	19.7		132.3	
		Z	6.27	66.5	19.1		131.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.98	65.6	18.4	5.75	137.0	±1.9 %
		Y	5.98	66.8	19.6		129.1	
		Z	5.98	66.2	19.1		128.1	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.08	68.1	20.6	8.10	131.5	±3.3 %
		Y	10.54	69.9	22.0		148.4	
		Z	10.46	69.1	21.2		149.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.12	68.2	20.6	8.07	132.9	±2.7 %
		Y	10.54	69.9	21.9		149.5	
		Z	10.04	68.1	20.6		123.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	10.07	74.1	24.8	9.28	135.5	±3.8 %
		Y	10.33	76.0	26.3		123.9	
		Z	9.05	71.9	23.9		145.1	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.96	65.6	18.4	5.75	137.0	±1.9 %
		Y	5.93	66.5	19.4		128.7	
		Z	6.00	66.2	19.1		129.9	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.41	66.2	18.7	5.82	141.3	±1.9 %
		Y	6.42	67.3	19.8		133.3	
		Z	6.45	66.8	19.3		133.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.01	65.6	18.5	5.73	139.9	±1.7 %
		Y	5.00	66.9	19.8		133.5	
		Z	4.88	66.1	19.2		132.6	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	9.20	77.8	26.8	9.21	149.1	±3.8 %
		Y	11.00	84.2	30.5		140.6	
		Z	7.06	72.2	24.3		129.4	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.93	65.2	18.3	5.72	131.8	±1.7 %
		Y	5.03	67.0	19.9		133.9	
		Z	4.97	66.5	19.4		148.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.97	65.4	18.3	5.72	137.6	±1.9 %
		Y	5.01	66.9	19.8		133.3	
		Z	4.96	66.5	19.4		146.6	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.74	67.7	20.4	8.09	123.4	±3.0 %
		Y	10.16	69.5	21.8		142.8	
		Z	10.03	68.5	21.0		136.4	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.71	67.7	20.4	8.10	124.5	±3.0 %
		Y	10.16	69.5	21.9		144.1	
		Z	10.17	68.9	21.2		146.1	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.59	67.5	20.3	8.03	123.8	±3.0 %
		Y	10.07	69.5	21.8		143.7	
		Z	10.08	68.9	21.2		145.5	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.01	68.0	20.5	8.06	129.1	±2.7 %
		Y	10.16	69.0	21.4		123.7	
		Z	10.02	68.1	20.7		123.3	
10225-CAB	UMTS-FDD (HSPA+)	X	6.84	65.7	18.3	5.97	128.3	±1.7 %
		Y	7.10	67.5	19.8		145.9	
		Z	7.17	67.2	19.4		146.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.23	77.8	26.8	9.21	149.7	±4.1 %
		Y	11.46	85.4	31.1		143.6	
		Z	7.17	72.6	24.5		132.3	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.84	74.4	25.0	9.24	143.3	±4.1 %
		Y	11.53	80.3	28.7		147.8	
		Z	8.43	71.1	23.5		136.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.60	72.7	24.1	9.30	124.1	±3.5 %
		Y	10.50	76.3	26.6		125.1	
		Z	9.07	72.0	23.9		144.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.95	66.0	18.0	4.87	147.1	±1.7 %
		Y	6.00	67.2	19.2		139.8	
		Z	6.11	67.0	18.9		140.5	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.17	64.3	16.7	3.96	129.0	±1.2 %
		Y	4.50	67.3	19.1		144.7	
		Z	4.48	66.6	18.5		141.5	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.50	64.4	16.6	3.46	142.1	±1.2 %
		Y	3.69	67.2	19.0		134.8	
		Z	3.67	66.6	18.5		130.8	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.45	64.5	16.5	3.39	145.2	±1.2 %
		Y	3.64	67.3	19.0		135.9	
		Z	3.66	67.0	18.7		133.8	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.28	66.1	18.6	5.81	139.0	±1.9 %
		Y	6.28	67.2	19.8		130.1	
		Z	6.29	66.6	19.2		128.4	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.86	66.8	19.1	6.06	144.5	±1.9 %
		Y	6.89	67.9	20.2		135.9	
		Z	6.88	67.3	19.6		135.0	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.32	63.0	14.7	1.71	128.7	±0.7 %
		Y	3.14	71.0	20.1		142.2	
		Z	2.95	69.2	18.9		142.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	9.99	68.0	20.8	8.36	125.5	±3.3 %
		Y	10.41	69.8	22.2		141.5	
		Z	10.36	69.1	21.4		143.6	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.41	65.2	16.6	3.76	135.0	±0.9 %
		Y	4.81	68.3	19.0		149.0	
		Z	4.82	68.1	18.7		150.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.31	65.1	16.6	3.77	131.6	±0.9 %
		Y	4.71	68.2	19.0		146.2	
		Z	4.86	68.7	19.0		147.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.13	62.1	14.2	1.54	128.1	±0.7 %
		Y	2.65	68.6	19.0		142.6	
		Z	2.74	68.5	18.7		143.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.84	67.8	20.6	8.23	125.2	±3.0 %
		Y	10.22	69.5	21.9		142.0	
		Z	10.23	68.9	21.3		144.4	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3331

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.47	6.47	6.47	0.48	1.48	± 12.0 %
835	41.5	0.90	6.24	6.24	6.24	0.30	1.98	± 12.0 %
1750	40.1	1.37	5.28	5.28	5.28	0.75	1.19	± 12.0 %
1900	40.0	1.40	5.09	5.09	5.09	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.48	4.48	4.48	0.70	1.32	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.80	1.29	± 12.0 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3331

Calibration Parameter Determined in Body Tissue Simulating Media

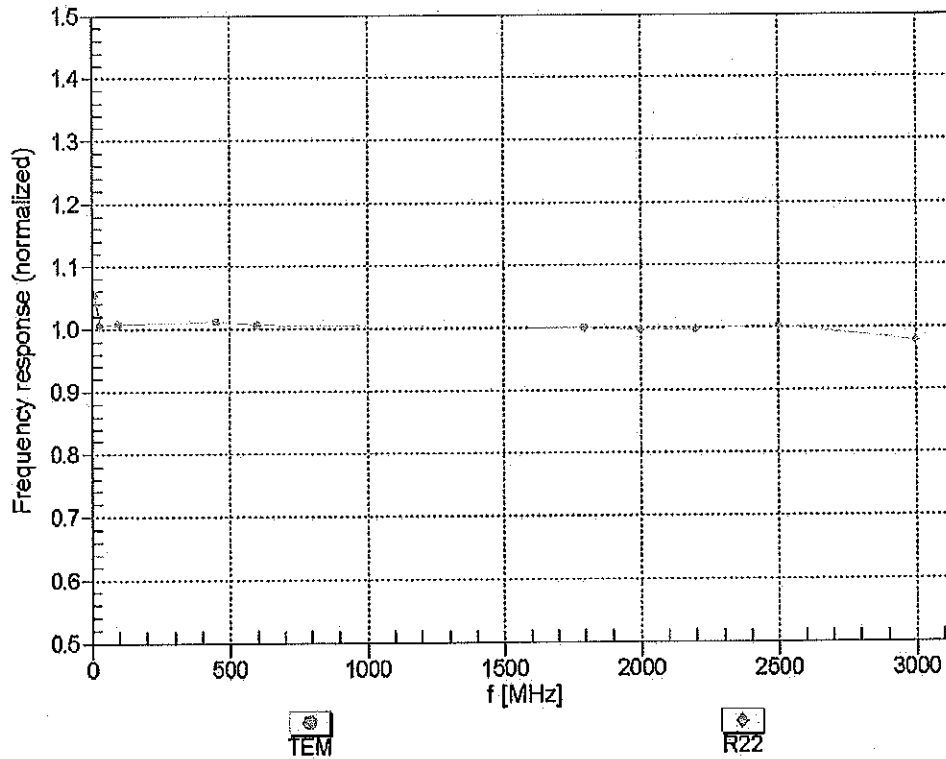
f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	55.5	0.96	6.12	6.12	6.12	0.64	1.30	± 12.0 %
835	55.2	0.97	6.14	6.14	6.14	0.80	1.14	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.46	1.67	± 12.0 %
1900	53.3	1.52	4.73	4.73	4.73	0.44	1.72	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.71	0.98	± 12.0 %
2600	52.5	2.16	4.23	4.23	4.23	0.68	1.00	± 12.0 %

^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. 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 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.

^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.

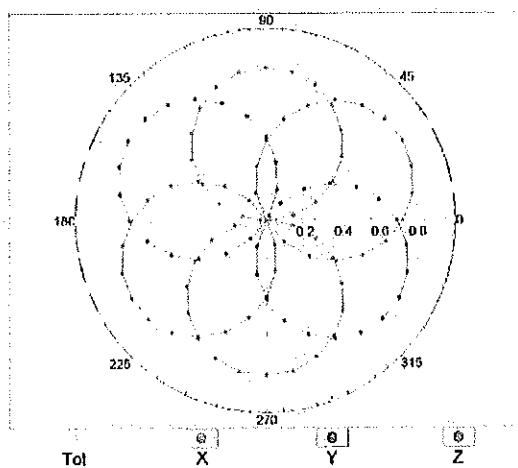
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



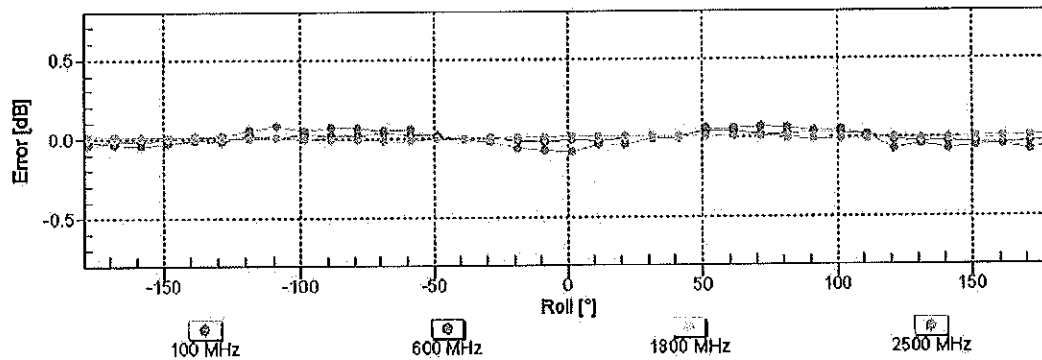
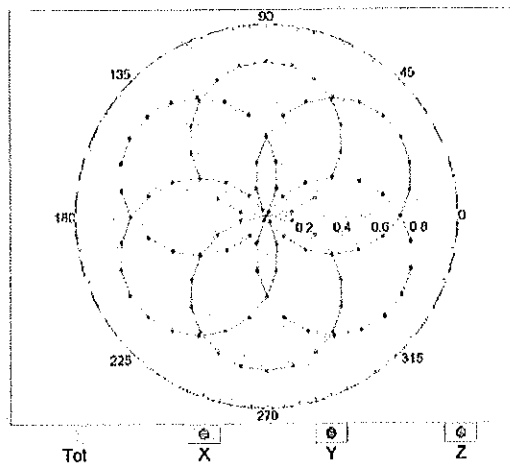
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

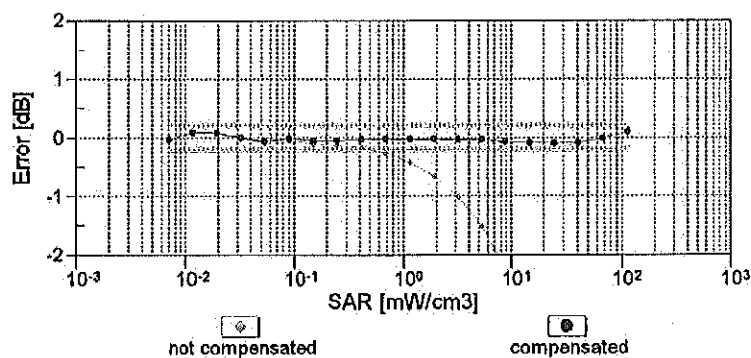
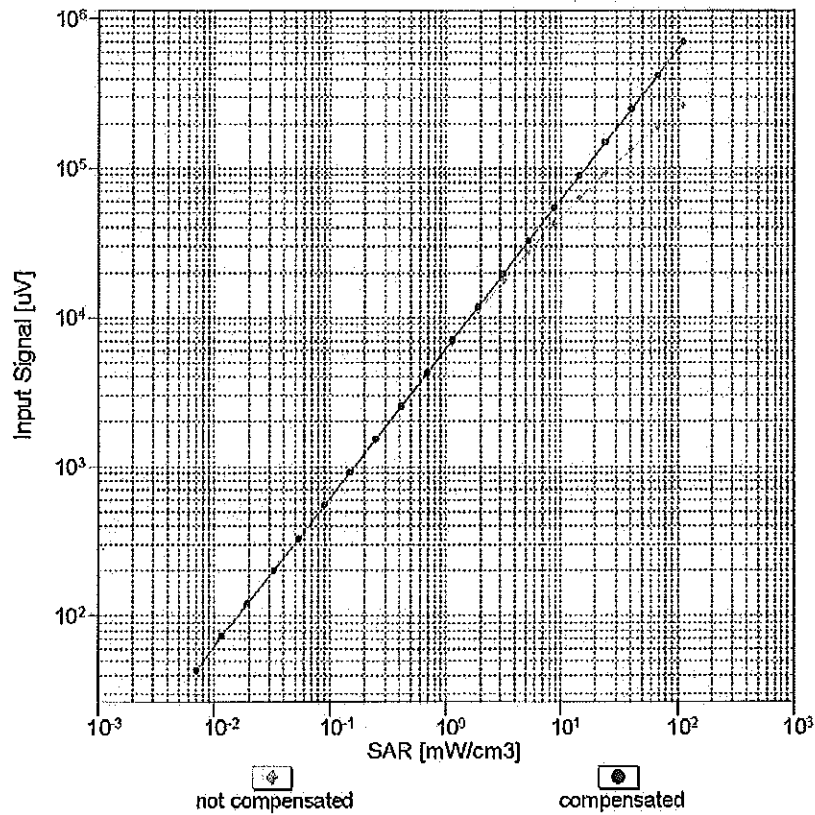


f=1800 MHz,R22



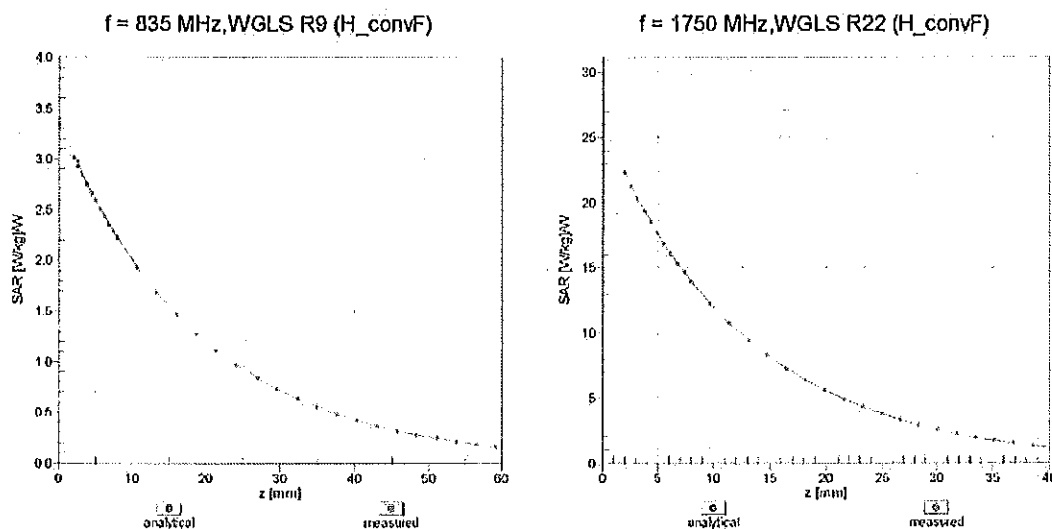
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)



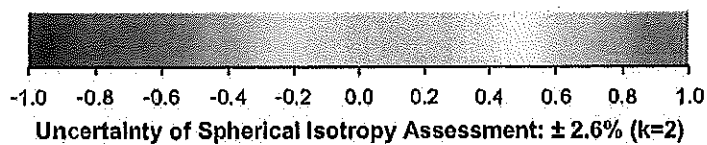
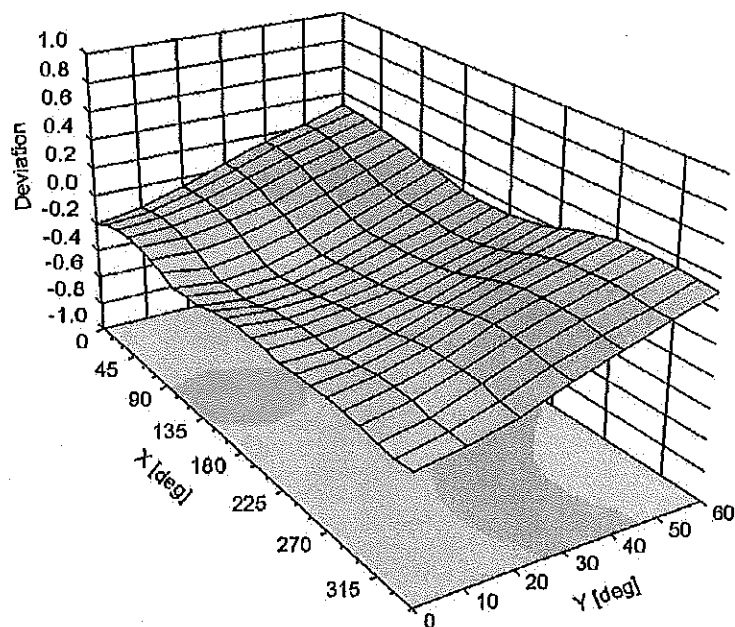
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3331**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-108.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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_Jan15**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3589**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

CC
 1/30/15

Calibration date: **January 22, 2015**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: January 26, 2015
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

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

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 22, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.46	0.41	0.39	$\pm 10.1 \%$
DCP (mV) ^B	103.1	102.4	104.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	146.6	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		143.1	
		Z	0.0	0.0	1.0		170.4	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	16.82	80.0	16.9	10.00	39.1	$\pm 0.7 \%$
		Y	7.79	73.4	15.1		39.0	
		Z	2.50	64.1	12.2		43.2	
10012- CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.02	68.9	18.6	1.87	115.1	$\pm 0.7 \%$
		Y	3.08	69.3	18.8		114.1	
		Z	3.07	70.1	19.4		134.9	
10013- CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.36	68.2	21.5	9.46	104.8	$\pm 2.5 \%$
		Y	10.20	68.2	21.6		104.2	
		Z	10.36	68.6	21.7		122.2	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	79.80	100.0	18.7	1.16	134.5	$\pm 0.9 \%$
		Y	98.53	99.4	18.2		133.2	
		Z	0.27	57.7	4.8		113.6	
10062- CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.91	67.7	20.7	8.68	104.8	$\pm 2.2 \%$
		Y	9.83	67.7	20.9		105.4	
		Z	10.08	68.3	21.1		126.6	
10103- CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.73	67.7	21.4	9.29	106.3	$\pm 1.9 \%$
		Y	8.16	69.5	22.6		106.5	
		Z	7.50	67.6	21.5		121.6	
10117- CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.91	67.7	20.3	8.07	112.1	$\pm 1.9 \%$
		Y	9.90	67.8	20.5		111.8	
		Z	10.04	68.2	20.6		134.2	
10151- CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.99	69.5	22.6	9.28	146.2	$\pm 2.2 \%$
		Y	8.43	71.4	23.8		148.8	
		Z	7.09	66.7	21.0		116.8	
10172- CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.34	69.7	22.8	9.21	118.1	$\pm 1.7 \%$
		Y	6.41	70.8	23.7		115.8	
		Z	6.10	69.1	22.6		132.9	
10196- CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.49	67.3	20.2	8.10	101.7	$\pm 1.9 \%$
		Y	9.44	67.3	20.3		106.1	
		Z	9.71	68.1	20.6		127.1	
10317- AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.70	67.5	20.5	8.36	102.8	$\pm 2.2 \%$
		Y	9.68	67.7	20.7		108.0	
		Z	9.97	68.5	21.0		127.5	

10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.73	67.5	20.4	8.37	102.2	±1.9 %
		Y	9.78	67.8	20.7		109.0	
		Z	10.00	68.4	20.9		129.9	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.39	67.9	20.7	8.60	108.7	±2.2 %
		Y	10.63	68.6	21.2		117.4	
		Z	10.71	68.9	21.2		138.2	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.38	67.8	20.5	8.53	107.9	±2.2 %
		Y	10.82	69.0	21.2		119.6	
		Z	10.65	68.6	20.9		137.1	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.06	70.1	19.2	1.54	108.9	±0.7 %
		Y	3.37	71.8	19.9		116.8	
		Z	2.93	69.8	19.1		135.5	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.23	69.0	21.2	8.23	149.0	±2.2 %
		Y	9.64	67.7	20.7		109.5	
		Z	9.67	67.8	20.5		125.2	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	9.56	67.3	20.3	8.23	101.7	±1.9 %
		Y	9.64	67.8	20.7		109.6	
		Z	9.79	68.1	20.7		128.3	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 6 and 7).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
2450	39.2	1.80	6.48	6.48	6.48	0.39	0.82	± 12.0 %
2600	39.0	1.96	6.30	6.30	6.30	0.38	0.89	± 12.0 %
5200	36.0	4.66	4.66	4.66	4.66	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.43	4.43	4.43	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.23	4.23	4.23	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.03	4.03	4.03	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.19	4.19	4.19	0.40	1.80	± 13.1 %

^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. 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 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.

^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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
2450	52.7	1.95	6.60	6.60	6.60	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.36	6.36	6.36	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.01	4.01	4.01	0.45	1.90	± 13.1 %
5300	48.9	5.42	3.79	3.79	3.79	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.65	3.65	3.65	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.42	3.42	3.42	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.79	3.79	3.79	0.50	1.90	± 13.1 %

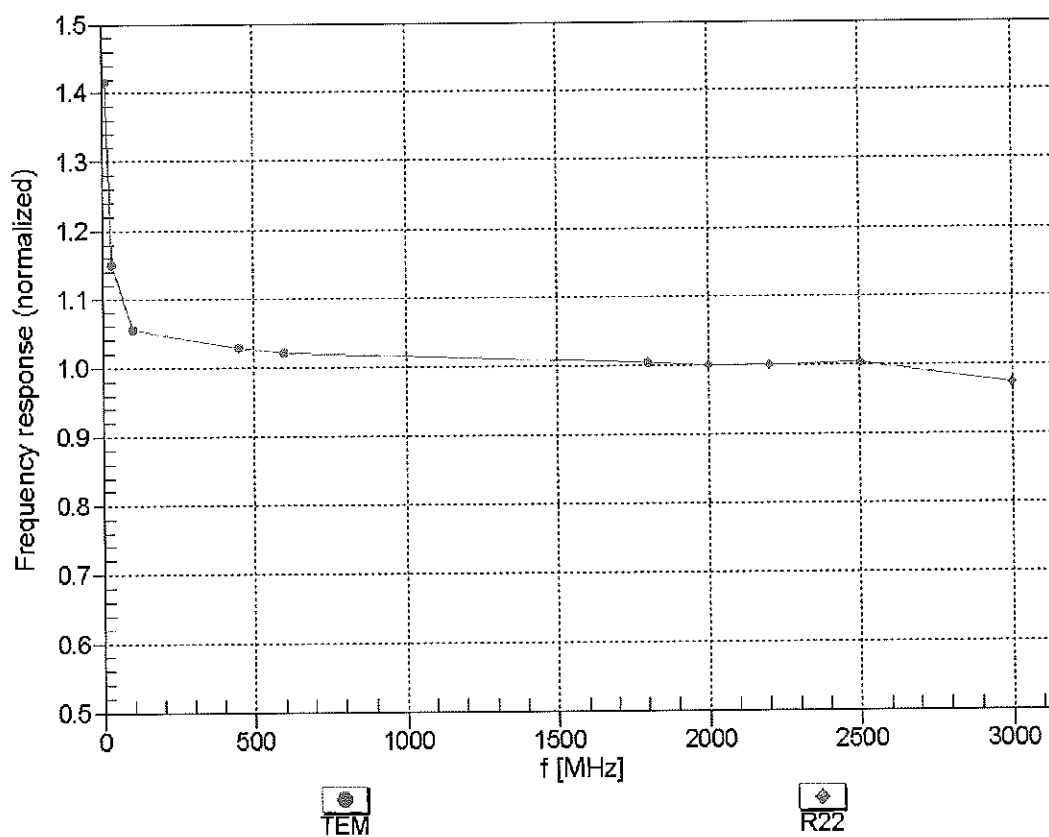
^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. 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 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.

^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

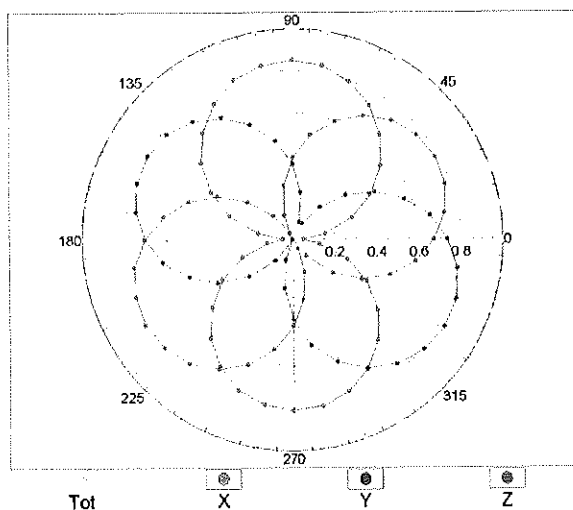
(TEM-Cell:ifi110 EXX, Waveguide: R22)



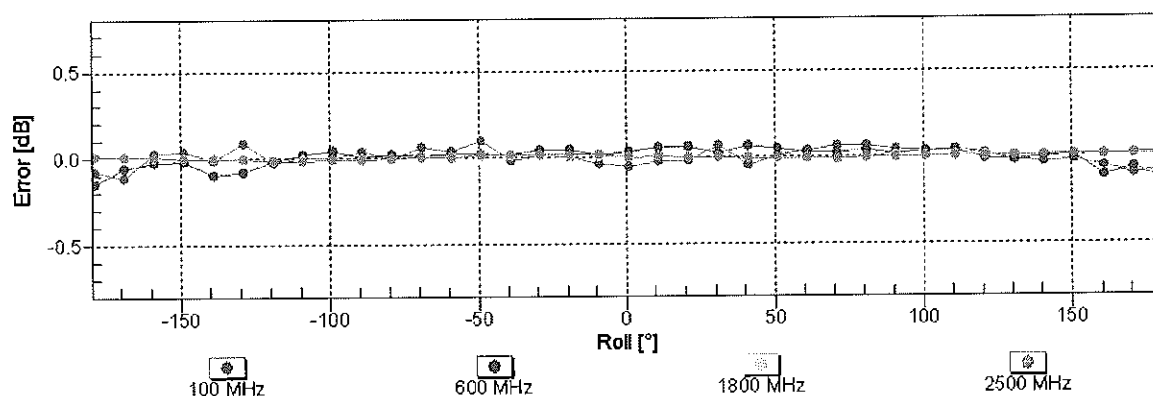
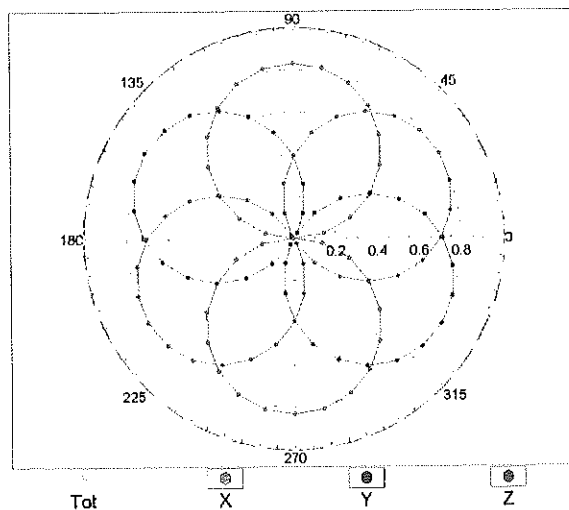
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

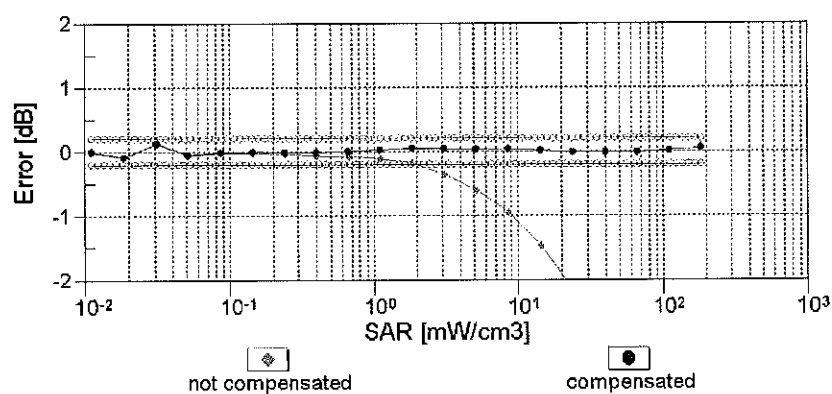
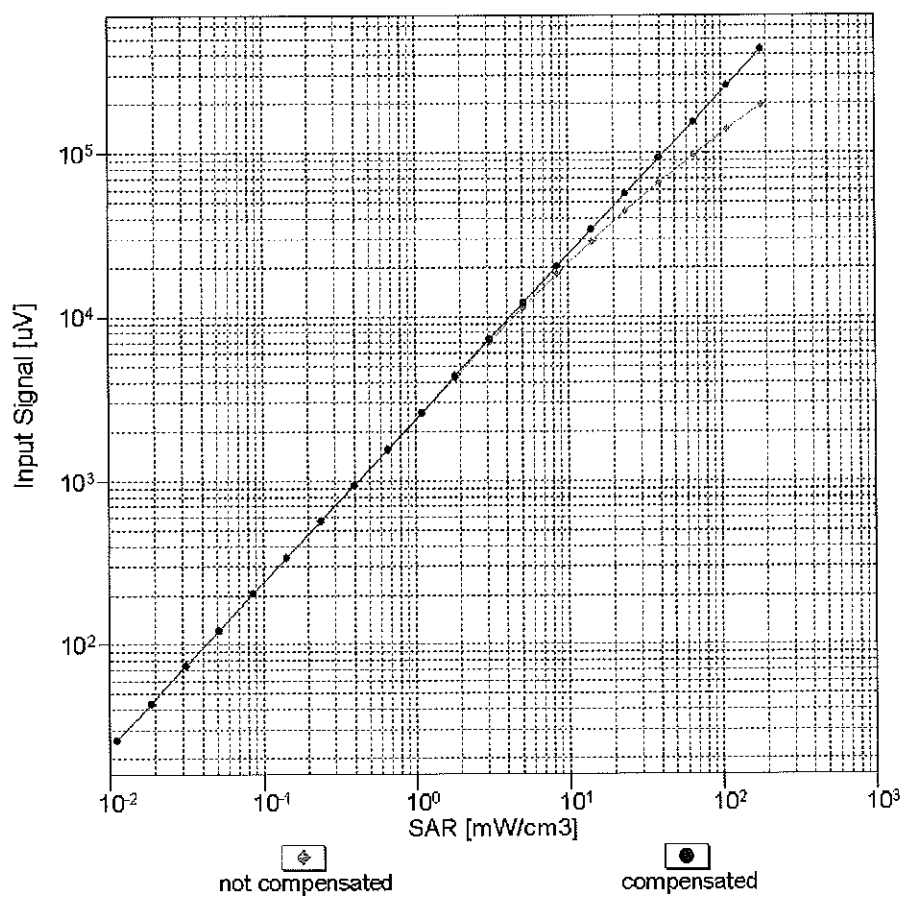
f=600 MHz,TEM



f=1800 MHz,R22

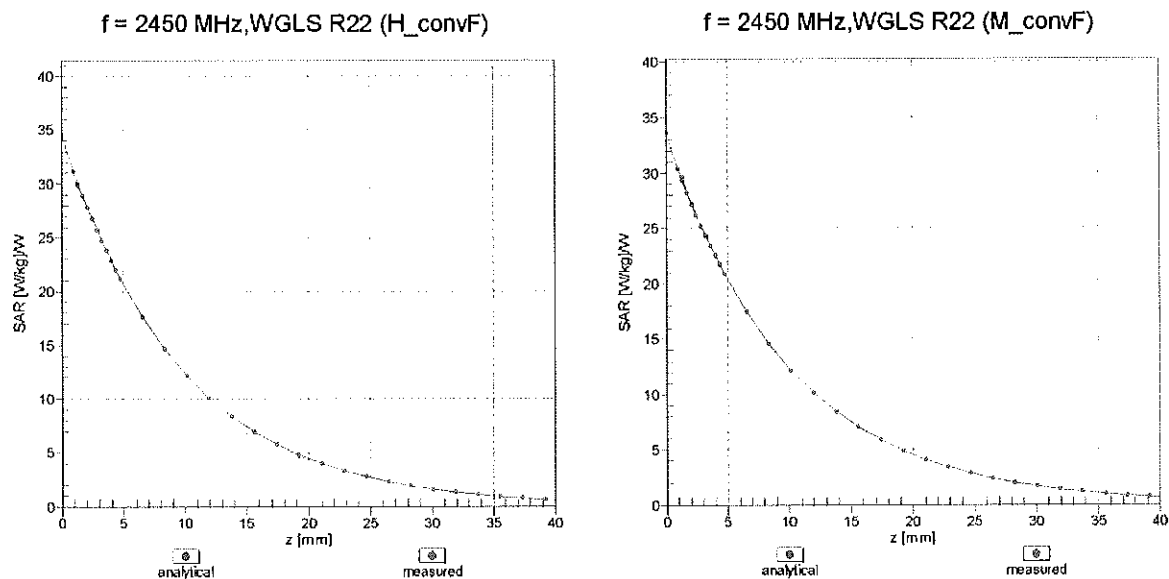
**Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)**

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



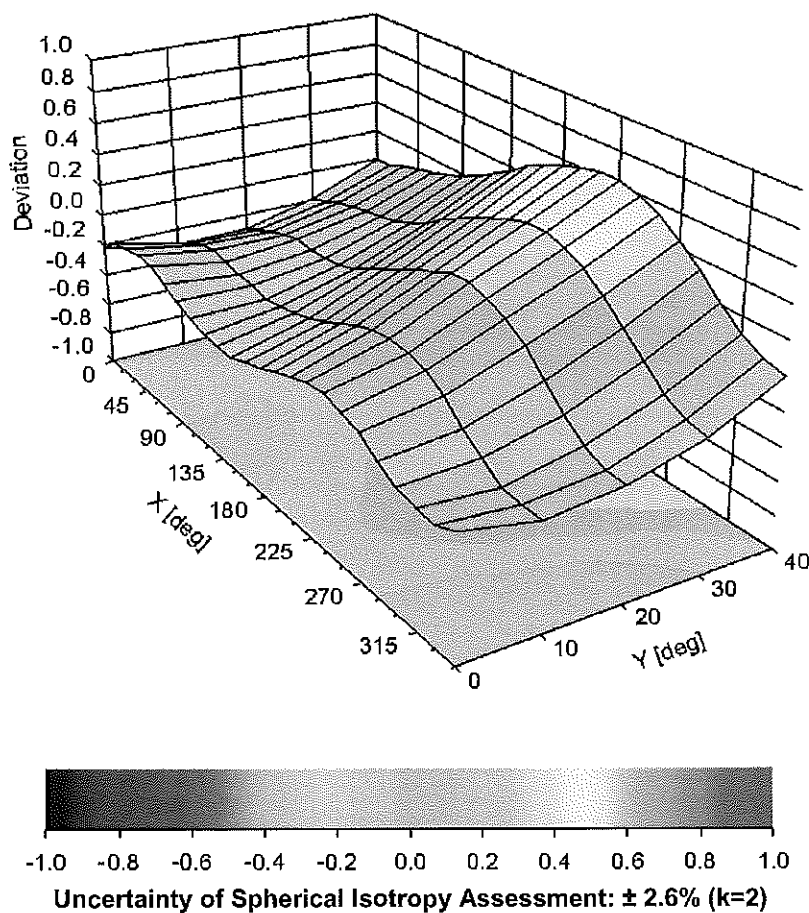
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-39.1
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

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ϵ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho' \cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	750	835	1750	1900	2450	5200-5800
Tissue	Body	Body	Body	Body	Body	Body
Ingredients (% by weight)						
Bactericide	See Page 2	0.1				
DGBE			31	29.44	26.7	
HEC		1				
NaCl		0.94	0.2	0.39	0.1	
Sucrose		44.9				
Polysorbate (Tween) 80						20
Water		53.06	68.8	70.17	73.2	80

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet			APPENDIX D: Page 1 of 2

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H ₂ O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyl-3(2H)-isothiazolone, 0.1 – 0.7%
Relevant for safety; Refer to the respective Safety Data Sheet*.	

Figure D-1

Composition of 750 MHz Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	Body Tissue Simulating Liquid (MSL750V2)
Product No.	SL AAM 075 AA (Charge: 130828-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within $\pm 2.5\%$ towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	28-Aug-13
Operator	IEN

Additional Information

TSL Density	1.212 g/cm ³
TSL Heat-capacity	3.006 kJ/(kg*K)

f [MHz]	Measured			Target		Diff. to Target [%]	
	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	57.4	24.76	0.83	56.1	0.95	2.3	-13.2
625	57.1	24.42	0.85	56.0	0.95	2.0	-11.0
650	56.8	24.09	0.87	55.9	0.96	1.6	-8.9
675	56.6	23.80	0.89	55.8	0.96	1.3	-6.7
700	56.3	23.52	0.92	55.7	0.96	1.0	-4.5
725	56.1	23.27	0.94	55.6	0.96	0.8	-2.4
750	55.8	23.03	0.96	55.5	0.96	0.5	-0.3
775	55.6	22.87	0.99	55.4	0.97	0.2	2.1
800	55.3	22.71	1.01	55.3	0.97	-0.1	4.5
825	55.1	22.54	1.03	55.2	0.98	-0.3	5.8
838	54.9	22.45	1.05	55.2	0.98	-0.5	6.4
850	54.8	22.37	1.06	55.2	0.99	-0.6	7.0
875	54.6	22.25	1.08	55.1	1.02	-0.9	6.2
900	54.4	22.13	1.11	55.0	1.05	-1.1	5.5
925	54.2	22.02	1.13	55.0	1.06	-1.5	6.6
950	53.9	21.91	1.16	54.9	1.08	-1.8	7.7
975	53.7	21.84	1.18	54.9	1.09	-2.2	9.0
1000	53.5	21.77	1.21	54.8	1.10	-2.5	10.3

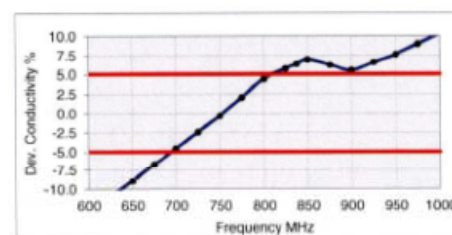
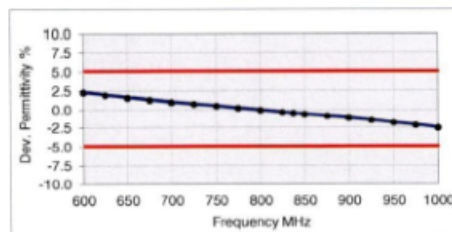


Figure D-2

750MHz Body Tissue Equivalent Matter

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet			APPENDIX D: Page 2 of 2

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε _r)	SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
A	750	1/12/2015	3331	ES3DV3	750	Body	0.975	56.380	PASS	PASS	PASS	N/A	N/A	N/A
J	835	10/13/2014	3022	ES3DV2	835	Body	0.999	53.770	PASS	PASS	PASS	GMSK	PASS	N/A
D	835	4/8/2015	3209	ES3DV3	835	Body	1.007	54.130	PASS	PASS	PASS	GMSK	PASS	N/A
G	1750	4/21/2015	3318	ES3DV3	1750	Body	1.451	51.410	PASS	PASS	PASS	N/A	N/A	N/A
K	1900	10/16/2014	3288	ES3DV3	1900	Head	1.454	39.510	PASS	PASS	PASS	GMSK	PASS	N/A
G	2300	4/9/2015	3318	ES3DV3	2300	Body	1.752	52.880	PASS	PASS	PASS	N/A	N/A	N/A
J	2450	4/28/2015	3319	ES3DV3	2450	Body	1.962	51.310	PASS	PASS	PASS	OFDM	PASS	PASS
E	5300	4/20/2015	3589	EX3DV4	5300	Body	5.460	48.600	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	4/20/2015	3589	EX3DV4	5500	Body	5.724	48.270	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	4/20/2015	3589	EX3DV4	5600	Body	5.871	48.130	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	4/20/2015	3589	EX3DV4	5800	Body	6.150	47.800	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 04/27/15 - 05/21/15	DUT Type: Portable Tablet	APPENDIX E: Page 1 of 1

APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/2015 – 05/21/2015	DUT Type: Portable Tablet			APPENDIX G: Page 1 of 5

A3LSMT817A Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and top edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

FCC ID: A3LSMT817A	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 04/27/2015 – 05/21/2015	DUT Type: Portable Tablet	APPENDIX G: Page 2 of 5

Back Side (Main Antennae)

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	30	29	28	27	26	25	24	23	22	21	20
WCDMA 850	23.14	23.39	23.27	23.38	23.26	16.93	16.86	16.95	16.74	16.69	16.81
WCDMA 1900	22.42	22.17	22.13	22.25	22.39	14.77	14.62	14.80	14.61	14.79	14.67
LTE B12	23.27	23.36	23.39	23.22	23.12	18.22	18.33	18.45	18.29	18.23	18.20
LTE B17	23.24	23.20	23.44	23.28	23.22	18.32	18.39	18.32	18.42	18.25	18.24
LTE B5	23.17	23.20	23.26	23.39	23.41	17.18	17.13	17.31	17.45	17.44	17.40
LTE B4	23.13	23.35	23.19	23.22	23.26	14.27	14.27	14.24	14.41	14.23	14.42
LTE B2	23.39	23.41	23.23	23.30	23.31	15.14	15.43	15.13	15.10	15.23	15.33
LTE B30	22.42	22.25	22.36	22.17	22.15	10.80	10.65	10.87	10.90	10.70	10.74

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	30	29	28	27	26	25	24	23	22	21	20
WCDMA 850	23.42	23.26	23.15	23.20	23.16	16.89	16.75	16.74	16.70	16.62	16.89
WCDMA 1900	22.29	22.24	22.20	22.24	22.41	14.93	14.88	14.88	14.88	14.63	14.80
LTE B12	23.14	23.43	23.27	23.37	23.33	18.29	18.35	18.15	18.28	18.16	18.37
LTE B17	23.29	23.25	23.39	23.19	23.20	18.12	18.39	18.43	18.29	18.45	18.37
LTE B5	23.24	23.41	23.34	23.28	23.16	17.24	17.21	17.29	17.21	17.10	17.21
LTE B4	23.26	23.45	23.40	23.14	23.20	14.25	14.43	14.29	14.31	14.12	14.25
LTE B2	23.15	23.44	23.14	23.24	23.23	15.20	15.23	15.39	15.31	15.21	15.41
LTE B30	22.12	22.21	22.34	22.27	22.29	10.79	10.90	10.60	10.90	10.64	10.85

Based on the most conservative measured triggering distance of 25 mm, additional SAR measurements were required at 24 mm from the back side for the above modes/bands.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/2015 – 05/21/2015	DUT Type: Portable Tablet			APPENDIX G: Page 3 of 5

Back Side (WLAN Antennae)

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	10	9	8	7	6	5	4	3	2	1	0
IEEE 802.11b (Ant 1)	17.41	17.18	17.25	17.20	17.41	14.37	14.10	14.32	14.20	14.11	14.37
IEEE 802.11b (Ant 2)	17.25	17.26	17.31	17.44	17.35	12.43	12.19	12.15	12.43	12.36	12.12
IEEE 802.11g (Ant 1)	15.41	15.40	15.13	15.24	15.42	14.11	14.12	14.22	14.36	14.10	14.44
IEEE 802.11g (Ant 2)	15.32	15.38	15.36	15.24	15.25	12.29	12.29	12.44	12.31	12.14	12.36
IEEE 802.11n (2.4GHz, SISO, Ant 1)	14.34	14.33	14.38	14.33	14.28	14.19	14.26	14.34	14.19	14.15	14.38
IEEE 802.11n (2.4GHz, SISO, Ant 2)	14.35	14.36	14.22	14.42	14.26	12.17	12.18	12.40	12.25	12.38	12.11
IEEE 802.11n (2.4GHz, MIMO)	17.18	17.43	17.30	17.21	17.15	16.24	16.21	16.15	16.37	16.36	16.38
IEEE 802.11a (Ant 1)	13.14	13.23	13.18	13.42	13.34	8.33	8.12	8.32	8.29	8.30	8.42
IEEE 802.11a (Ant 2)	13.15	13.14	13.24	13.35	13.34	7.39	7.30	7.11	7.16	7.43	7.10
IEEE 802.11n (5GHz, 20MHz BW, SISO, Ant 1)	13.22	13.15	13.41	13.16	13.35	8.39	8.19	8.33	8.26	8.42	8.36
IEEE 802.11n (5GHz, 20MHz BW, SISO, Ant 2)	13.23	13.37	13.40	13.30	13.39	7.13	7.36	7.14	7.24	7.15	7.35
IEEE 802.11n (5GHz, 20MHz BW, MIMO)	16.15	16.20	16.31	16.22	16.17	10.28	10.29	10.11	10.43	10.45	10.16
IEEE 802.11ac (5GHz, 20MHz BW, SISO, Ant 1)	13.37	13.31	13.27	13.41	13.19	8.44	8.10	8.10	8.30	8.43	8.17
IEEE 802.11ac (5GHz, 20MHz BW, SISO, Ant 2)	13.19	13.41	13.18	13.14	13.24	7.37	7.32	7.26	7.14	7.22	7.27
IEEE 802.11ac (5GHz, 20MHz BW, MIMO)	16.15	16.12	16.43	16.13	16.14	10.31	10.27	10.32	10.13	10.30	10.20
IEEE 802.11n (5GHz, 40MHz BW, SISO, Ant 1)	12.10	12.35	12.20	12.44	12.13	8.34	8.34	8.31	8.15	8.32	8.35
IEEE 802.11n (5GHz, 40MHz BW, SISO, Ant 2)	12.41	12.24	12.34	12.41	12.23	7.13	7.33	7.39	7.33	7.26	7.36
IEEE 802.11n (5GHz, 40MHz BW, MIMO)	15.16	15.26	15.24	15.30	15.29	10.29	10.27	10.29	10.27	10.29	10.39
IEEE 802.11ac (5GHz, 40MHz BW, SISO, Ant 1)	12.12	12.31	12.15	12.43	12.38	8.30	8.21	8.40	8.10	8.23	8.25
IEEE 802.11ac (5GHz, 40MHz BW, SISO, Ant 2)	12.11	12.20	12.13	12.45	12.26	7.14	7.33	7.22	7.12	7.30	7.14
IEEE 802.11ac (5GHz, 40MHz BW, MIMO)	15.18	15.32	15.10	15.12	15.18	10.20	10.24	10.26	10.14	10.44	10.39
IEEE 802.11ac (5GHz, 80MHz BW, SISO, Ant 1)	11.17	11.33	11.39	11.20	11.43	8.34	8.17	8.27	8.16	8.12	8.19
IEEE 802.11ac (5GHz, 80MHz BW, SISO, Ant 2)	11.36	11.44	11.31	11.42	11.43	7.45	7.26	7.39	7.29	7.27	7.28
IEEE 802.11ac (5GHz, 80MHz BW, MIMO)	14.19	14.41	14.28	14.44	14.45	10.39	10.22	10.21	10.45	10.22	10.24

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	10	9	8	7	6	5	4	3	2	1	0
IEEE 802.11b (Ant 1)	17.28	17.26	17.33	17.26	17.31	14.33	14.23	14.38	14.16	14.44	14.45
IEEE 802.11b (Ant 2)	17.15	17.21	17.35	17.34	17.23	12.18	12.18	12.21	12.21	12.21	12.10
IEEE 802.11g (Ant 1)	15.36	15.16	15.26	15.27	15.11	14.40	14.18	14.24	14.30	14.21	14.10
IEEE 802.11g (Ant 2)	15.28	15.36	15.39	15.22	15.43	12.13	12.43	12.36	12.16	12.17	12.41
IEEE 802.11n (2.4GHz, SISO, Ant 1)	14.15	14.14	14.17	14.45	14.35	14.43	14.16	14.35	14.23	14.31	14.45
IEEE 802.11n (2.4GHz, SISO, Ant 2)	14.15	14.40	14.40	14.23	14.40	12.24	12.15	12.14	12.32	12.18	12.15
IEEE 802.11n (2.4GHz, MIMO)	17.26	17.10	17.18	17.45	17.41	16.45	16.11	16.22	16.12	16.24	16.21
IEEE 802.11a (Ant 1)	13.24	13.32	13.23	13.44	13.18	8.32	8.23	8.31	8.31	8.33	8.21
IEEE 802.11a (Ant 2)	13.34	13.31	13.37	13.24	13.28	7.37	7.11	7.34	7.26	7.26	7.25
IEEE 802.11n (5GHz, 20MHz BW, SISO, Ant 1)	13.31	13.20	13.15	13.37	13.16	8.45	8.39	8.22	8.24	8.18	8.22
IEEE 802.11n (5GHz, 20MHz BW, SISO, Ant 2)	13.38	13.24	13.38	13.18	13.36	7.45	7.10	7.32	7.36	7.13	7.39
IEEE 802.11n (5GHz, 20MHz BW, MIMO)	16.27	16.45	16.15	16.39	16.26	10.21	10.35	10.33	10.43	10.44	10.32
IEEE 802.11ac (5GHz, 20MHz BW, SISO, Ant 1)	13.19	13.45	13.10	13.26	13.33	8.17	8.33	8.29	8.35	8.22	8.11
IEEE 802.11ac (5GHz, 20MHz BW, SISO, Ant 2)	13.41	13.19	13.13	13.45	13.15	7.14	7.30	7.16	7.22	7.11	7.29
IEEE 802.11ac (5GHz, 20MHz BW, MIMO)	16.13	16.25	16.24	16.18	16.39	10.35	10.22	10.13	10.39	10.17	10.20
IEEE 802.11n (5GHz, 40MHz BW, SISO, Ant 1)	12.33	12.14	12.19	12.29	12.18	8.22	8.16	8.41	8.42	8.15	8.43
IEEE 802.11n (5GHz, 40MHz BW, SISO, Ant 2)	12.20	12.33	12.38	12.41	12.35	7.33	7.17	7.11	7.24	7.12	7.40
IEEE 802.11n (5GHz, 40MHz BW, MIMO)	15.41	15.15	15.26	15.42	15.15	10.17	10.11	10.41	10.24	10.42	10.22
IEEE 802.11ac (5GHz, 40MHz BW, SISO, Ant 1)	12.30	12.16	12.35	12.25	12.45	8.18	8.35	8.32	8.31	8.36	8.17
IEEE 802.11ac (5GHz, 40MHz BW, SISO, Ant 2)	12.31	12.42	12.45	12.10	12.37	7.24	7.45	7.22	7.16	7.31	7.42
IEEE 802.11ac (5GHz, 40MHz BW, MIMO)	16.35	16.29	16.13	16.15	16.11	10.26	10.30	10.28	10.12	10.12	10.14
IEEE 802.11ac (5GHz, 80MHz BW, SISO, Ant 1)	11.31	11.20	11.15	11.22	11.10	8.21	8.33	8.16	8.41	8.13	8.36
IEEE 802.11ac (5GHz, 80MHz BW, SISO, Ant 2)	11.13	11.24	11.35	11.11	11.42	7.16	7.17	7.17	7.27	7.35	7.13
IEEE 802.11ac (5GHz, 80MHz BW, MIMO)	14.36	14.22	14.22	14.38	14.42	10.13	10.41	10.32	10.45	10.18	10.10

Based on the most conservative measured triggering distance of 5 mm, additional SAR measurements were required at 4 mm from the back side for the above modes/bands.

FCC ID: A3LSMT817A		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/2015 – 05/21/2015	DUT Type: Portable Tablet			APPENDIX G: Page 4 of 5

Top Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	30	29	28	27	26	25	24	23	22	21	20
WCDMA 850	23.30	23.14	23.24	23.12	23.25	16.85	16.90	16.85	16.64	16.87	16.68
WCDMA 1900	22.30	22.36	22.31	22.37	22.20	14.87	14.93	14.95	14.71	14.76	14.90
LTE B12	23.11	23.42	23.40	23.32	23.21	18.36	18.29	18.42	18.25	18.38	18.37
LTE B17	23.33	23.43	23.10	23.30	23.45	18.37	18.34	18.30	18.41	18.36	18.15
LTE B5	23.35	23.45	23.45	23.23	23.32	17.19	17.26	17.19	17.15	17.44	17.43
LTE B4	23.17	23.44	23.10	23.27	23.39	14.24	14.17	14.45	14.28	14.22	14.13
LTE B2	23.21	23.10	23.15	23.30	23.43	15.33	15.31	15.15	15.33	15.39	15.21
LTE B30	22.10	22.41	22.19	22.10	22.28	10.88	10.78	10.71	10.63	10.74	10.62

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	30	29	28	27	26	25	24	23	22	21	20
WCDMA 850	23.22	23.44	23.39	23.24	23.26	16.95	16.90	16.64	16.68	16.76	16.85
WCDMA 1900	22.38	22.26	22.11	22.13	22.20	14.87	14.80	14.74	14.78	14.80	14.84
LTE B12	23.18	23.29	23.20	23.45	23.15	18.19	18.19	18.13	18.30	18.19	18.33
LTE B17	23.35	23.21	23.29	23.36	23.33	18.34	18.15	18.24	18.21	18.35	18.42
LTE B5	23.41	23.37	23.34	23.17	23.20	17.11	17.24	17.13	17.24	17.17	17.45
LTE B4	23.32	23.20	23.16	23.30	23.22	14.29	14.13	14.40	14.19	14.22	14.36
LTE B2	23.13	23.35	23.10	23.25	23.45	15.25	15.16	15.10	15.10	15.31	15.39
LTE B30	22.21	22.40	22.27	22.19	22.23	10.88	10.60	10.92	10.68	10.83	10.93

Based on the most conservative measured triggering distance of 25 mm, additional SAR measurements were required at 24 mm from the top edge for the above modes/bands.

FCC ID: A3LSMT817A	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/27/2015 – 05/21/2015	DUT Type: Portable Tablet			APPENDIX G: Page 5 of 5