TEST REPORT

Dt&C

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1. Report No : DRRFCC2008-0083(1)
2. Customer
   - Name : BLUEBIRD INC.
   - Address : 3F, 115, Irwon-ro, Gangnam-gu, Seoul, South Korea
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Smart POS Payment Terminal / SP500
   FCC ID : SS4SP500
5. Test Method Used :IEEE 1528-2013 , FCC SAR KDB Publications (Details in test report)
   Test Specification : CFR 47 Part 2 subpart 2.1093
6. Date of Test : 2020.07.13 ~ 2020.07.29
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
8. Testing Environment : Refer to attached test report
9. Test Result : Refer to attached test report.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name : BumJun Park (Signature)	Technical Manager Name : HakMin Kim (Signature)

2020 . 09 . 03 .

DT&C Co., Ltd.

Not abided by KS Q ISO / IEC 17025 and KOLAS accreditation.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Tested by	Reviewed by
DRRFCC2008-0083	Aug. 21, 2020	Initial issue	BumJun Park	HakMin Kim
DRRFCC2008-0083(1)	Sep. 3, 2020	Revised of section 10.	BumJun Park	HakMin Kim

Table of Contents

1. DESCRIPTION OF DEVICE

1.1 General Information

EUT type	Smart POS Payment Terminal
FCC ID	SS4SP500
Equipment model name	SP500
Equipment add model name	N/A
FCC & ISED MRA Designation No.	KR0034
ISED#	5470A
Equipment serial no.	Identical prototype
Mode(s) of Operation	WCDMA 850, WCDMA 1900, LTE Band 12, 5, 4, 2, 2.4 G W-LAN (802.11b/g/n-HT20/n-HT40), 5 G W-LAN (802.11a/n-HT20/n-HT40), Bluetooth

	Band	Mode	Operating Modes	Bandwidth	Frequency
TX Frequency Range	WCDMA 850	WCDMA	Voice/Data	-	826.4 ~ 846.6 MHz
	WCDMA 1900	WCDMA	Voice/Data	-	1852.4 ~ 1907.6 MHz
	LTE Band 12	LTE	Voice/Data	1.4/3/5/10MHz	699.7 ~ 715.3 MHz
	LTE Band 5	LTE	Voice/Data	1.4/3/5/10MHz	824.7 ~ 848.3 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1710.7 ~ 1754.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1850.7 ~ 1909.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20/HT40	2412 ~ 2462 MHz
	5.2 GHz W-LAN	802.11a/n	Voice/Data	HT20	5180 ~ 5240 MHz
		802.11n	Voice/Data	HT40	5190 ~ 5230 MHz
	5.3 GHz W-LAN	802.11a/n	Voice/Data	HT20	5260 ~ 5320 MHz
		802.11n	Voice/Data	HT40	5270 ~ 5310 MHz
	5.6 GHz W-LAN	802.11a/n	Voice/Data	HT20	5500 ~ 5720 MHz
		802.11n	Voice/Data	HT40	5510 ~ 5710 MHz
	5.8 GHz W-LAN	802.11a/n	Voice/Data	HT20	5745 ~ 5825 MHz
		802.11n	Voice/Data	HT40	5755 ~ 5795 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz
RX Frequency Range	WCDMA 850	WCDMA	Voice/Data	-	871.4 ~ 891.6 MHz
	WCDMA 1900	WCDMA	Voice/Data	-	1932.4 ~ 1987.6 MHz
	LTE Band 12	LTE	Voice/Data	1.4/3/5/10MHz	729.7 ~ 745.3 MHz
	LTE Band 5	LTE	Voice/Data	1.4/3/5/10MHz	869.7 ~ 893.3 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	2110.7 ~ 2154.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1930.7 ~ 1989.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20/HT40	2412 ~ 2462 MHz
	5.2 GHz W-LAN	802.11a/n	Voice/Data	HT20	5180 ~ 5240 MHz
		802.11n	Voice/Data	HT40	5190 ~ 5230 MHz
	5.3 GHz W-LAN	802.11a/n	Voice/Data	HT20	5260 ~ 5320 MHz
		802.11n	Voice/Data	HT40	5270 ~ 5310 MHz
	5.6 GHz W-LAN	802.11a/n	Voice/Data	HT20	5500 ~ 5720 MHz
		802.11n	Voice/Data	HT40	5510 ~ 5710 MHz
	5.8 GHz W-LAN	802.11a/n	Voice/Data	HT20	5745 ~ 5825 MHz
		802.11n	Voice/Data	HT40	5755 ~ 5795 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz

Equipment Class	Band	Reported SAR 1g SAR (W/kg) Body
PCB	WCDMA 850	1.04
PCB	WCDMA 1900	1.19
PCB	LTE Band 12	0.34
PCB	LTE Band 5	0.69
PCB	LTE Band 4	0.81
PCB	LTE Band 2	1.19
DTS	2.4 GHz W-LAN	0.65
U-NII-1	5.2 GHz W-LAN	0.78
U-NII-3	5.8 GHz W-LAN	0.48
DSS	Bluetooth	0.17
Simultaneous SAR per KDB 690783 D01v01r03		**1.47**

FCC Equipment Class	Licensed Portable Transmitter (PCB) Part 15 Spread Spectrum Transmitter(DSS) Digital Transmission System(DTS) Unlicensed National Information Infrastructure (UNII)
Date(s) of Tests	2020.07.13 ~ 2020.07.29
Antenna Type	Internal Antenna
Functions	● Simultaneous transmission between [WCDMA & WLAN], [LTE & WLAN]. ● VoIP is supported.

1.2 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.3 Nominal and Maximum Output Power Specifications

The Nominal and Maximum Output Power Specifications are in section 8 of this test report.

1.4 Simultaneous Transmission Capabilities

The Simultaneous Transmission Capabilities are in section 11 of this test report.

1.5 Miscellaneous SAR Test Considerations

(A) BT for SAR configuration

Per FCC KDB 447498 D01v06, **the 1g SAR exclusion threshold for distances < 50 mm** is defined by the following equation:

$$[(\textit{max. power of channel, including tune-up tolerance, mW}) / (\textit{min. test separation distance, mm})] \cdot [\sqrt{f_{(GHz)}}] \leq 3.0 \text{ for 1-g SAR}$$

Based on the maximum conducted power of **Bluetooth** (rounded to the nearest mW) and the antenna to user separation distance, **Bluetooth SAR was required;** [(15/5)* √2.480] =**4.8** > 3.0.

Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Tested sides for Body SAR configuration

(1) Per FCC KDB 447498 D01v06, **the 1g SAR exclusion threshold for distances < 50 mm** is defined by the following equation:

$$[(\textit{max. power of channel, including tune-up tolerance, mW}) / (\textit{min. test separation distance, mm})] \cdot [\sqrt{f_{(GHz)}}] \leq 3.0 \text{ for 1-g SAR}$$

Table 1.4.1 SAR Test Exclusion for Edges (Antennas < 50 mm)

FREQUENCY		Mode/ Band	Service	Tune up Max Power [mW]	# of Time Slots	Separation Distance [mm]				Calculated Threshold Power [mW]			
MHz	Ch					Top	Bottom	Right	Left	Top	Bottom	Right	Left
846.6	4233	WCDMA 850	RMC	251	-	155	0	0	0	> 50mm [Note]	46.2 (O)	46.2 (O)	46.2 (O)
1907.6	9538	WCDMA 1900	RMC	165	-	155	0	0	0	> 50mm [Note]	45.8 (O)	45.8 (O)	45.8 (O)
707.5	23095	LTE B12	-	199	-	155	0	0	0	> 50mm [Note]	33.6 (O)	33.6 (O)	33.6 (O)
836.5	20525	LTE B5	-	208	-	155	0	0	0	> 50mm [Note]	38.2 (O)	38.2 (O)	38.2 (O)
1732.5	20175	LTE B4	-	186	-	155	0	0	0	> 50mm [Note]	49.0 (O)	49.0 (O)	49.0 (O)
1900.0	19100	LTE B2	-	186	-	155	0	0	0	> 50mm [Note]	51.3 (O)	51.3 (O)	51.3 (O)
2462.0	11	2.4 GHz W-LAN	-	39	-	16	136	80	3	3.9 (O)	> 50mm [Note]	> 50mm [Note]	12.5 (O)
5825.0	165	5 GHz W-LAN	-	19	-	16	136	80	3	3.0 (O)	> 50mm [Note]	> 50mm [Note]	9.6 (O)
2480.0	78	Bluetooth	-	15	-	16	136	80	3	1.5 (X)	> 50mm [Note]	> 50mm [Note]	4.8 (O)

Note: Please refer to Table 1.4.2.

(2) Per FCC KDB 447498 D01v06, **the SAR exclusion threshold for distances > 50 mm** is defined by the following equation: (the SAR test exclusion threshold is determined according to the following, and as illustrated in KDB 447498 Appendix B.)

1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·($f_{(MHz)}$/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

Table 1.4.2 SAR Test Exclusion for Edges (Antennas > 50 mm)

FREQUENCY		Mode/ Band	Service	Tune up Max Power [mW]	# of Time Slots	Separation Distance [mm]				Calculated Threshold Power [mW]			
MHz	Ch					Top	Bottom	Right	Left	Top	Bottom	Right	Left
846.6	4233	WCDMA 850	RMC	251	-	155	0	0	0	757 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
1907.6	9538	WCDMA 1900	RMC	165	-	155	0	0	0	1159 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
707.5	23095	LTE B12	-	199	-	155	0	0	0	659 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
836.5	20525	LTE B5	-	208	-	155	0	0	0	750 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
1732.5	20175	LTE B4	-	186	-	155	0	0	0	1159 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
1900.0	19100	LTE B2	-	186	-	155	0	0	0	1159 (X)	< 50mm [Note]	< 50mm [Note]	< 50mm [Note]
2462.0	11	2.4 GHz W-LAN	-	39	-	16	136	80	3	< 50mm [Note]	956 (X)	396 (X)	< 50mm [Note]
5825.0	165	5 GHz W-LAN	-	19	-	16	136	80	3	< 50mm [Note]	922 (X)	362 (X)	< 50mm [Note]
2480.0	78	Bluetooth	-	15	-	16	136	80	3	< 50mm [Note]	956 (X)	396 (X)	< 50mm [Note]

Note: Please refer to Table 1.4.1.

Table 1.4.3 Determined EUT sides for SAR Testing

Mode	EUT Sides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
WCDMA 850	X	O	O	O	O	O
WCDMA 1900	X	O	O	O	O	O
LTE B12	X	O	O	O	O	O
LTE B5	X	O	O	O	O	O
LTE B4	X	O	O	O	O	O
LTE B2	X	O	O	O	O	O
2.4 GHz W-LAN	O	X	O	O	X	O
5 GHz W-LAN	O	X	O	O	X	O
Bluetooth	X	X	O	O	X	O

Note: Particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v06.

(C) Licensed Transmitter(s)

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 D05v02r04.

1.6 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01 (3G SAR Procedures)
- FCC KDB Publication 941225 D05v02r05 (SAR for LTE Devices)
- FCC KDB Publication 941225 D05Av01r02 (LTE Rel.10 KDB Inquiry Sheet)
- FCC KDB Publication 248227 D01v02r02 (802.11 Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 648474 D04v01r03 (Handset SAR)
- FCC KDB Publication 941225 D07 v01r02 (UMPC Mini Tablet)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02v01r02 (RF Exposure Reporting)
- April 2015 TCB Workshop Notes (Simultaneous transmission summation clarified)
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)

1.7 Device Serial Numbers

Several samples with identical hardware were used 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. The serial numbers used for each test are indicated alongside the results in Section 10.

2. LTE INFORMATION

LTE Information					
FCC ID	**SS4SP500**				
Form Factor	Smart POS Payment Terminal				
Frequency Range of each LTE transmission Band	LTE Band 12 (699.7 ~ 715.3 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)				
Channel Bandwidths	LTE Band 12 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz LTE Band 5 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz LTE Band 4 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz LTE Band 2 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Number and Frequencies(MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 12: 1.4 MHz	699.7 (23017)	N/A	707.5 (23095)	N/A	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	N/A	707.5 (23095)	N/A	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	N/A	707.5 (23095)	N/A	713.5 (23155)
LTE Band 12: 10 MHz	704.0 (23060)	N/A	**707.5 (23095)** Note1	N/A	711.0 (23130)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	N/A	836.5 (20525)	N/A	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	N/A	836.5 (20525)	N/A	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	N/A	836.5 (20525)	N/A	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829.0 (20450)	N/A	**836.5 (20525)** Note2	N/A	844.0 (20600)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	N/A	1732.5 (20175)	N/A	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	N/A	1732.5 (20175)	N/A	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	N/A	1732.5 (20175)	N/A	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715.0 (20000)	N/A	1732.5 (20175)	N/A	1750.0 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	N/A	1732.5 (20175)	N/A	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720.0 (20050)	N/A	**1732.5 (20175)** Note3	N/A	1745.0 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	N/A	1880.0 (18900)	N/A	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	N/A	1880.0 (18900)	N/A	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	N/A	1880.0 (18900)	N/A	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855.0 (18650)	N/A	1880.0 (18900)	N/A	1905.0 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	N/A	1880.0 (18900)	N/A	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	**1860.0 (18700)**	N/A	**1880.0 (18900)**	N/A	**1900.0 (19100)**
UE Category	4				
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 SAR Testing?	Yes				
LTE Carrier Aggregation Possible Combinations	LTE Carrier Aggregation is not supported.				
LTE Additional Information	This device does not support CA features on 3GPP Release 11. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 11 Features are not supported: Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, MDH, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.				

Note(s)
1. LTE B12 can not contain three non-overlapping channels of 10 MHz bandwidth.
   Per KDB 941225 D05v02r05, 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.
2. LTE B5(Cell) can not contain three non-overlapping channels of 10 MHz bandwidth.
   Per KDB 941225 D05v02r05, 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.
3. LTE B4 (AWS) can not contain three non-overlapping channels of 20 MHz bandwidth.
   Per KDB 941225 D05v02r05, 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.

3. INTROCUCTION

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.

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. 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. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring 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 National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) 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 Fig. 3.1)

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

Fig. 3.1 SAR Mathematical Equation

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/m^3)

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 relations 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.

4. DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to
FCC KDB Publication 865664 D01v01r04 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 D01v01r04 (See Table 4.1) and IEEE1528-2013.

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.

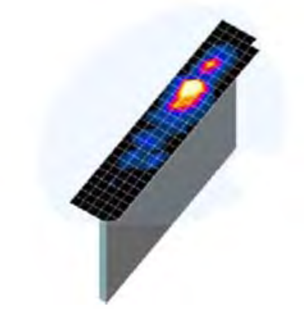


Figure 4.1
Sample SAR Area Scan

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 D01v01r04 (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.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>½·δ·ln(2) mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

Table 4.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

5. TEST CONFIGURATION POSITIONS FOR HANDSETS

5.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

5.2 SAR Testing for Tablet per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, 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 D01v06 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.

6. RF EXPOSURE LIMITS

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.

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 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

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.0

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.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

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).

7. FCC MEASUREMENT PROCEDURES

Power measurements were performed using a base station simulator under digital average power.

7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, 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 D01v01r03.

7.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01.

The device was 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 were 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 was 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 deviated by more than 5%, the SAR test and drift measurements were repeated.

7.3 SAR Measurement Conditions for WCDMA (UMTS)

7.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1s”.

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 (release 5), 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.

7.3.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all“1s”.

7.3.3 Release 5 HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with WCDMA and requires an active DPCCH. The default test configuration is to measure SAR in WCDMA with HSDPA remain inactive, to establish a radio link between the test device and a communication test set using a 12.2 kbps RMC configured in Test Loop Mode 1. SAR for HSDPA is selectively measured using the highest reported SAR configuration in WCDMA, with an FRC in H-set 1 and a 12.2 kbps RMC. SAR is selectively confirmed for other physical channel configurations (DPCCH & DPDCHn) according to exposure conditions, device operating capabilities and maximum output power specified for production units, including tune-up tolerance by applying the 3G SAR test reduction procedures. Maximum output power is verified according to the applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	CM (dB)(2)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$
Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$.
Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.

Figure 7.1 Table 1

7.3.4 Release 6 HSUPA Data Devices

The following procedures are applicable to HSPA (HSUPA/HSDPA) data devices operating under 3GPP Release 6. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSUPA operates in conjunction with WCDMA and HSDPA. SAR is initially measured in WCDMA test configurations with HSPA remain inactive. The default test configuration is to establish a radio link between the test device and a communication test set to configure a 12.2 kbps RMC in Test Loop Mode 1. SAR for HSPA is selectively measured with HS-DPCCH, E-DPCCH and E-DPDCH, all enabled, along with a 12.2 kbps RMC using the highest reported SAR configuration in WCDMA with 12.2 kbps RMC only.
An FRC is configured according to HS-DPCCH Sub-test 1 using H-set 1 and QPSK. HSPA is configured according to E-DCH Sub-test 5 requirements. SAR for other HSPA sub-test configurations is confirmed selectively according to exposure conditions, E-DCH UE Category and maximum output power of production units, including tune-up tolerance by applying the 3G SAR test reduction procedure. Maximum output power is verified according to procedures in applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories for HS-DPCCH and HSPA, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}(1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM(2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} cannot be set directly; it is set by Absolute Grant Value.

Figure 7.2 Table 2

7.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02r05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR. The call simulator was used for LTE output power measurement 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).

7.4.1 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.

7.4.2 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.

7.4.3 A-MPR

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

7.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r05:

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 channel 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. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
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 0.5 dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

7.5 SAR Testing with 802.11 Transmitters

The normal network operating configurations are not suitable for measuring the SAR of 802.11 b/g/n transmitters. 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 248227D01v02r02 for more details.

7.5.1 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. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the 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.

7.5.2 U-NII and U-NII-2A

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following, with respect to the highest reported SAR and maximum output power specified for production units. The procedures are applied independently to each exposure configuration; for example, head, body, hotspot mode etc.

1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

7.5.3 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 Rader (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 measurements and probe calibration frequency points requirements.

7.5.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured.

7.5.5 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a 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 exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

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.

7.5.6 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; for example, 802.11a and 802.11n 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 80211n or 802.11g then 802.11n is used for SAR measurement. When the maximum output power ware 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.

7.5.7 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 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.

7.5.8 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 applicable. When the highest reported SAR for the initial test configuration, adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power is ≤ 1.2 W/kg, no additional SAR testing for the subsequent test configurations is required.

8. RF CONDUCTED POWERS

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 D01v06

8.1 WCDMA Nominal and Maximum Output Power Spec and Conducted Powers

3GPP Release Version	Mode			Cellular Band (dBm)	PCS Band (dBm)	3GPP MPR (dB)
99	WCDMA	Voice	Maximum	24.0	22.2	-
			Nominal	23.5	21.7	
5	HSDPA	Subtest 1	Maximum	24.0	22.2	0
			Nominal	23.5	21.7	
5		Subtest 2	Maximum	24.0	22.2	0
			Nominal	23.5	21.7	
5		Subtest 3	Maximum	23.5	21.7	0.5
			Nominal	23.0	21.2	
5		Subtest 4	Maximum	23.5	21.7	0.5
			Nominal	23.0	21.2	
6	HSUPA	Subtest 1	Maximum	24.0	22.2	0
			Nominal	23.5	21.7	
6		Subtest 2	Maximum	22.0	20.2	2
			Nominal	21.5	19.7	
6		Subtest 3	Maximum	23.0	21.2	1
			Nominal	22.5	20.7	
6		Subtest 4	Maximum	22.0	20.2	2
			Nominal	21.5	19.7	
6		Subtest 5	Maximum	24.0	22.2	0
			Nominal	23.5	21.7	

Table 8.2.1 WCDMA Nominal and Maximum Output Power Spec

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	23.99	23.91	23.92	22.16	22.19	22.03	-
99		12.2 kbps AMR	-	-	-	-	-	-	-
5	HSDPA	Subtest 1	23.66	23.61	23.62	21.89	21.91	21.63	0
5		Subtest 2	23.75	23.66	23.68	21.72	21.87	21.67	0
5		Subtest 3	23.17	23.08	23.14	21.23	21.28	21.08	0.5
5		Subtest 4	23.17	23.07	23.13	21.23	21.27	21.08	0.5
6	HSUPA	Subtest 1	23.39	23.37	23.38	21.52	21.25	21.00	0
6		Subtest 2	21.98	21.64	21.67	20.20	19.75	20.03	2
6		Subtest 3	22.60	22.58	22.59	20.67	20.61	20.52	1
6		Subtest 4	21.98	21.92	21.96	20.15	20.17	20.14	2
6		Subtest 5	23.68	23.64	23.65	21.78	21.94	21.71	0

Table 8.2.2 WCDMA Conducted Power

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

The manufacturer declares that the HSDPA and HSUPA transmitter's power will not exceed the R99 maximum transmit power in devices based on Qualcomm's HSPA chipset solutions.

Figure 8.1 Power Measurement Setup

8.2 LTE Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average[dBm]
LTE Band 12	Maximum	23.0
	Nominal	22.5

Table 8.2.1.1 Nominal and Maximum Output Power Spec

1) LTE Band 12

LTE Band 12 Conducted Power– 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23095 (707.5 MHz) Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
QPSK	1	0	22.88	≤ 1	0
	1	**25**	22.92		
	1	49	22.77		
	25	0	21.69		1
	25	**12**	21.77		
	25	25	21.65		
	50	0	21.61		1
16QAM	1	0	21.94	≤ 1	1
	1	25	21.95		
	1	49	21.83		
	25	0	20.86	≤ 2	2
	25	12	20.92		
	25	25	20.83		
	50	0	20.79		2

Table 8.2.1.2 LTE Conducted Power

Note : LTE B12 can not contain three non-overlapping channels of 10 MHz bandwidth.
Per KDB 941225 D05v02r05, 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.

LTE Band 12 Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23155 (713.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.75	22.84	22.71	≤ 1	0
	1	12	22.83	22.91	22.75		
	1	24	22.73	22.81	22.69		
	12	0	21.54	21.52	21.56		1
	12	6	21.66	21.54	21.60		
	12	13	21.53	21.41	21.55		
	25	0	21.65	21.46	21.58		1
16QAM	1	0	21.73	21.80	21.71	≤ 1	1
	1	12	21.85	21.88	21.83		
	1	24	21.70	21.75	21.68		
	12	0	20.55	20.50	20.48	≤ 2	2
	12	6	20.73	20.63	20.60		
	12	13	20.62	20.50	20.45		
	25	0	20.47	20.62	20.49		2

Table 8.2.1.3 LTE Conducted Power

LTE Band 12 Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23025 (700.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23165 (714.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.72	22.75	22.71	≤ 1	0
	1	7	22.80	22.83	22.78		
	1	14	22.70	22.72	22.65		
	8	0	21.47	21.51	21.50		1
	8	4	21.57	21.54	21.55		
	8	7	21.48	21.52	21.47		
	15	0	21.54	21.47	21.54		1
16QAM	1	0	21.82	21.86	21.79	≤ 1	1
	1	7	21.92	21.94	21.89		
	1	14	21.80	21.85	21.77		
	8	0	20.64	20.59	20.54	≤ 2	2
	8	4	20.75	20.67	20.63		
	8	7	20.48	20.55	20.58		
	15	0	20.64	20.64	20.61		2

Table 8.2.1.4 LTE Conducted Power

LTE Band 12 Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23017 (699.7 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23173 (715.3 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.73	22.82	22.58	≤ 1	0
	1	2	22.84	22.90	22.64		
	1	5	22.59	22.71	22.54		
	3	0	22.65	22.64	22.45		0
	3	2	22.71	22.78	22.56		
	3	3	22.59	22.57	22.45		
	6	0	21.61	21.51	21.40		1
16QAM	1	0	21.68	21.73	21.58	≤ 1	1
	1	2	21.82	21.93	21.73		
	1	5	21.58	21.71	21.55		
	3	0	21.68	21.73	21.64		1
	3	2	21.78	21.85	21.69		
	3	3	21.65	21.70	21.55		
	6	0	20.61	20.36	20.35	≤ 2	2

Table 8.2.1.5 LTE Conducted Power

Band & Mode		Modulated Average[dBm]
LTE Band 5	Maximum	23.2
	Nominal	22.7

Table 8.2.2.1 Nominal and Maximum Output Power Spec

2) LTE Band 5 (Cell)

LTE Band 5 (Cell) Conducted Power– 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
QPSK	**1**	**0**	**22.97**	≤ 1	0
	1	25	22.85		
	1	49	22.78		
	25	**0**	**21.66**		1
	25	12	21.58		
	25	25	21.55		
	50	0	21.64		1
16QAM	1	0	22.11	≤ 1	1
	1	25	21.95		
	1	49	21.91		
	25	0	20.71	≤ 2	2
	25	12	20.70		
	25	25	20.63		
	50	0	20.68		2

Table 8.2.2.2 LTE Conducted Power

Note : LTE B5(Cell) can not contain three non-overlapping channels of 10 MHz bandwidth.
Per KDB 941225 D05v02r05, 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.

LTE Band 5 (Cell) Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.91	22.90	22.87	≤ 1	0
	1	12	22.73	22.71	22.69		
	1	24	22.72	22.67	22.60		
	12	0	21.65	21.63	21.60		1
	12	6	21.61	21.60	21.57		
	12	13	21.58	21.52	21.51		
	25	0	21.64	21.61	21.56		1
16QAM	1	0	21.85	21.83	21.79	≤ 1	1
	1	12	21.75	21.68	21.65		
	1	24	21.68	21.65	21.63		
	12	0	20.70	20.60	20.55	≤ 2	2
	12	6	20.56	20.55	20.53		
	12	13	20.55	20.53	20.50		
	25	0	20.65	20.56	20.54		2

Table 8.2.2.3 LTE Conducted Power

LTE Band 5 (Cell) Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.98	22.87	22.81	≤ 1	0
	1	7	22.81	22.76	22.56		
	1	14	22.79	22.62	22.51		
	8	0	21.64	21.60	21.58		1
	8	4	21.59	21.56	21.53		
	8	7	21.57	21.54	21.51		
	15	0	21.57	21.51	21.50		1
16QAM	1	0	22.09	22.06	21.80	≤ 1	1
	1	7	21.95	21.71	21.68		
	1	14	21.90	21.67	21.50		
	8	0	20.81	20.79	20.73	≤ 2	2
	8	4	20.75	20.70	20.58		
	8	7	20.64	20.59	20.52		
	15	0	20.69	20.66	20.59		2

Table 8.2.2.4 LTE Conducted Power

LTE Band 5 (Cell) Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.87	22.79	22.74	≤ 1	0
	1	2	22.79	22.77	22.68		
	1	5	22.76	22.67	22.57		
	3	0	22.78	22.71	22.59		0
	3	2	22.74	22.63	22.52		
	3	3	22.70	22.58	22.51		
	6	0	21.57	21.51	21.50		1
16QAM	1	0	21.96	21.89	21.67	≤ 1	1
	1	2	21.92	21.83	21.61		
	1	5	21.72	21.66	21.52		
	3	0	21.79	21.70	21.66		1
	3	2	21.75	21.66	21.62		
	3	3	21.60	21.55	21.51		
	6	0	20.65	20.58	20.53	≤ 2	2

Table 8.2.2.5 LTE Conducted Power

Band & Mode		Modulated Average[dBm]
LTE Band 4	Maximum	22.7
	Nominal	22.2

Table 8.2.3.1 Nominal and Maximum Output Power Spec

3) LTE Band 4

LTE Band 4 (AWS) Conducted Power– 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
QPSK	**1**	**0**	22.53	≤ 1	0
	1	50	22.41		
	1	99	22.33		
	50	**0**	21.31		1
	50	25	21.21		
	50	50	21.08		
	100	**0**	21.28		1
16QAM	1	0	21.61	≤ 1	1
	1	50	21.58		
	1	99	21.45		
	50	0	20.47	≤ 2	2
	50	25	20.21		
	50	50	20.17		
	100	0	20.19		2

Table 8.2.3.2 LTE Conducted Power

Note: LTE B4 (AWS) can not contain three non-overlapping channels of 20 MHz bandwidth.
Per KDB 941225 D05v02r05, 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.

LTE Band 4 (AWS) Conducted Power– 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20325 (1747.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.36	22.42	22.35	≤ 1	0
	1	36	22.30	22.32	22.27		
	1	74	22.15	22.18	22.13		
	36	0	21.29	21.30	21.18		1
	36	18	21.15	21.19	21.11		
	36	37	21.13	21.15	21.05		
	75	0	21.21	21.23	21.11		1
16QAM	1	0	21.50	21.55	21.35	≤ 1	1
	1	36	21.30	21.33	21.15		
	1	74	21.15	21.17	21.13		
	36	0	20.24	20.25	20.16	≤ 2	2
	36	18	20.18	20.19	20.15		
	36	37	20.11	20.17	20.05		
	75	0	20.09	20.16	20.07		2

Table 8.2.3.3 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20000 (1715.0 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20350 (1750.0 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.35	22.42	22.33	≤ 1	0
	1	25	22.34	22.38	22.21		
	1	49	22.27	22.28	22.16		
	25	0	21.19	21.28	21.15		1
	25	12	21.15	21.25	21.10		
	25	25	21.12	21.16	21.05		
	50	0	21.08	21.11	21.05		1
16QAM	1	0	21.53	21.56	21.42	≤ 1	1
	1	25	21.41	21.44	21.35		
	1	49	21.39	21.40	21.30		
	25	0	20.17	20.23	20.13	≤ 2	2
	25	12	20.10	20.11	20.08		
	25	25	20.09	20.10	20.03		
	50	0	20.16	20.17	20.11		2

Table 8.2.3.4 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 19975 (1712.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20375 (1752.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.40	22.42	22.34	≤ 1	0
	1	12	22.27	22.38	22.19		
	1	24	22.24	22.35	22.18		
	12	0	21.15	21.20	21.14		1
	12	6	21.14	21.16	21.13		
	12	13	21.05	21.08	21.03		
	25	0	21.13	21.19	21.11		1
16QAM	1	0	21.57	21.60	21.34	≤ 1	1
	1	12	21.31	21.32	21.29		
	1	24	21.27	21.30	21.25		
	12	0	20.16	20.29	20.12	≤ 2	2
	12	6	20.14	20.20	20.09		
	12	13	20.11	20.13	20.05		
	25	0	20.11	20.17	20.10		2

Table 8.2.3.5 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20385 (1753.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.39	22.43	22.31	≤ 1	0
	1	7	22.27	22.30	22.22		
	1	14	22.25	22.26	22.18		
	8	0	21.24	21.28	21.20		1
	8	4	21.17	21.27	21.16		
	8	7	21.15	21.24	21.13		
	15	0	21.18	21.20	21.10		1
16QAM	1	0	21.43	21.47	21.40	≤ 1	1
	1	7	21.33	21.38	21.32		
	1	14	21.25	21.28	21.23		
	8	0	20.29	20.39	20.27	≤ 2	2
	8	4	20.27	20.35	20.14		
	8	7	20.25	20.28	20.11		
	15	0	20.27	20.30	20.26		2

Table 8.2.3.6 LTE Conducted Power

TE Band 4 (AWS) Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20393 (1754.3 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.37	22.44	22.32	≤ 1	0
	1	2	22.25	22.30	22.20		
	1	5	22.23	22.29	22.18		
	3	0	22.25	22.35	22.21		0
	3	2	22.22	22.28	22.13		
	3	3	22.20	22.22	22.05		
	6	0	21.21	21.24	21.15		1
16QAM	1	0	21.35	21.45	21.30	≤ 1	1
	1	2	21.18	21.27	21.16		
	1	5	21.15	21.16	21.11		
	3	0	21.29	21.30	21.06		1
	3	2	21.23	21.25	21.03		
	3	3	21.15	21.21	21.02		
	6	0	20.06	20.10	20.04	≤ 2	2

Table 8.2.3.7 LTE Conducted Power

Band & Mode		Modulated Average[dBm]
LTE Band 2(PCS)	Maximum	22.7
	Nominal	22.2

Table 8.2.4.1 Nominal and Maximum Output Power Spec

4) LTE Band 2 (PCS)

LTE Band 2 (PCS) Conducted Power– 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	**1**	**0**	**22.55**	**22.57**	**22.43**	≤ 1	0
	1	50	22.31	22.33	22.16		
	1	99	22.33	22.36	22.22		
	50	**0**	**21.24**	**21.26**	**21.21**		1
	50	25	21.15	21.17	21.14		
	50	50	21.23	21.25	21.20		
	100	**0**	21.21	**21.24**	21.20		1
16QAM	1	0	21.55	21.57	21.50	≤ 1	1
	1	50	21.40	21.44	21.35		
	1	99	21.43	21.45	21.41		
	50	0	20.31	20.35	20.25	≤ 2	2
	50	25	20.20	20.21	20.15		
	50	50	20.28	20.30	20.19		
	100	0	20.22	20.28	20.16		2

Table 8.2.4.2 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.33	22.36	22.31	≤ 1	0
	1	36	22.18	22.28	22.15		
	1	74	22.24	22.31	22.22		
	36	0	21.18	21.20	21.17		1
	36	18	21.08	21.11	21.05		
	36	37	21.10	21.13	21.07		
	75	0	21.08	21.10	21.05		1
16QAM	1	0	21.50	21.55	21.27	≤ 1	1
	1	36	21.27	21.35	21.15		
	1	74	21.32	21.40	21.16		
	36	0	20.18	20.21	20.08	≤ 2	2
	36	18	20.05	20.13	20.03		
	36	37	20.11	20.20	20.07		
	75	0	20.05	20.17	20.04		2

Table 8.2.4.3 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.47	22.49	22.33	≤ 1	0
	1	25	22.31	22.34	22.20		
	1	49	22.35	22.38	22.23		
	25	0	21.21	21.25	21.18		1
	25	12	21.13	21.15	21.03		
	25	25	21.18	21.20	21.05		
	50	0	21.04	21.05	21.02		1
16QAM	1	0	21.57	21.58	21.49	≤ 1	1
	1	25	21.15	21.20	21.13		
	1	49	21.23	21.28	21.21		
	25	0	20.31	20.35	20.22	≤ 2	2
	25	12	20.23	20.25	20.15		
	25	25	20.26	20.27	20.17		
	50	0	20.10	20.14	20.05		2

Table 8.2.4.4 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.42	22.48	22.39	≤ 1	0
	1	12	22.28	22.33	22.25		
	1	24	22.33	22.35	22.30		
	12	0	21.21	21.23	21.13		1
	12	6	21.12	21.16	21.08		
	12	13	21.13	21.21	21.10		
	25	0	21.10	21.16	21.09		1
16QAM	1	0	21.61	21.65	21.58	≤ 1	1
	1	12	21.38	21.40	21.35		
	1	24	21.40	21.45	21.39		
	12	0	20.25	20.29	20.19	≤ 2	2
	12	6	20.15	20.22	20.13		
	12	13	20.17	20.25	20.15		
	25	0	20.15	20.21	20.10		2

Table 8.2.4.5 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.50	22.52	22.49	≤ 1	0
	1	7	22.39	22.40	22.13		
	1	14	22.41	22.43	22.17		
	8	0	21.16	21.19	21.10		1
	8	4	21.07	21.13	21.03		
	8	7	21.15	21.18	21.09		
	15	0	21.12	21.15	21.07		1
16QAM	1	0	21.50	21.57	21.40	≤ 1	1
	1	7	21.25	21.28	21.10		
	1	14	21.40	21.44	21.35		
	8	0	20.25	20.29	20.20	≤ 2	2
	8	4	20.14	20.24	20.11		
	8	7	20.20	20.27	20.17		
	15	0	20.15	20.20	20.13		2

Table 8.2.4.6 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	22.47	22.48	22.13	≤ 1	0
	1	2	22.21	22.25	22.00		
	1	5	22.25	22.27	22.03		
	3	0	22.18	22.20	22.10		0
	3	2	22.05	22.08	22.00		
	3	3	22.16	22.18	22.05		
	6	0	21.12	21.15	21.01		1
16QAM	1	0	21.33	21.38	21.24	≤ 1	1
	1	2	21.11	21.18	21.09		
	1	5	21.18	21.25	21.15		
	3	0	21.16	21.20	21.14		1
	3	2	21.02	21.04	21.01		
	3	3	21.11	21.17	21.10		
	6	0	20.05	20.11	20.04	≤ 2	2

Table 8.2.4.7 LTE Conducted Power

8.3 WLAN Nominal and Maximum Output Power Spec and Conducted Powers

Band (GHz)	Mode	Ch	Modulated Average[dBm]	
			Maximum	Nominal
2.4	802.11b	1~11	16.0	15.0
	802.11g	1~11	14.0	13.0
	802.11n HT20	1~11	14.0	13.0
	802.11n HT40	1~11	14.0	13.0

Table 8.3.1 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11 (2.4 GHz) Conducted Power[dBm]
802.11b	2412	1	15.68
	2437	**6**	15.76
	2462	11	15.50
802.11g	2412	1	13.30
	2437	6	13.42
	2462	11	13.22
802.11n (HT-20)	2412	1	13.75
	2437	6	13.74
	2462	11	13.78
802.11n (HT-40)	2422	3	13.84
	2437	6	13.93
	2452	9	13.95

Table 8.3.2 IEEE 802.11 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]	
			Maximum	Nominal
5 (UNII)	802.11a	36-165	13.0	12.0
	802.11n (20MHz)	36-165	12.0	11.0
	802.11n (40MHz)	38-159	12.0	11.0

Table 8.3.3 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11a (5 GHz) Conducted Power[dBm]
802.11a	5180	36	12.71
	5200	40	12.65
	5220	**44**	12.80
	5240	48	12.77
	5260	52	12.89
	5280	56	12.97
	5300	60	12.81
	5320	64	12.91
	5500	100	12.66
	5580	116	12.73
	5660	132	12.82
	5720	144	12.65
	5745	149	12.74
	5785	157	12.69
	5825	**165**	12.79

Table 8.3.4 IEEE 802.11a Average RF Power

Mode	Freq. (MHz)	Channel	IEEE 802.11n HT20 (5 GHz) Conducted Power[dBm]
802.11n (HT-20)	5180	36	11.86
	5200	40	11.75
	5220	44	11.79
	5240	48	11.72
	5260	52	11.85
	5280	56	11.89
	5300	60	11.79
	5320	64	11.81
	5500	100	11.72
	5580	116	11.79
	5660	132	11.82
	5720	144	11.80
	5745	149	11.66
	5785	157	11.71
	5825	165	11.78

Table 8.3.5 IEEE 802.11n HT20 Average RF Power

Mode	Freq. (MHz)	Channel	IEEE 802.11n HT40 (5 GHz) Conducted Power[dBm]
802.11n (HT-40)	5190	38	11.82
	5230	46	11.77
	5270	54	11.69
	5310	62	11.75
	5510	102	11.68
	5550	110	11.81
	5670	134	11.89
	5710	142	11.85
	5755	151	11.76
	5795	159	11.71

Table 8.3.6 IEEE 802.11n HT40 Average RF Power

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02:

- 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.
- 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, duo to an even number of channels, both channels were measured.
- Output Power and SAR is not required for 802.11 g/n HT20/ac VHT20 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjust SAR is ≤ 1.2 W/kg.
- The underlined data rate and channel above were tested for SAR.

The average output powers of this device were tested by below configuration.

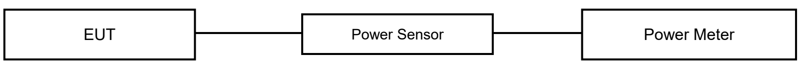


Figure 8.3 Power Measurement Setup

8.4 Bluetooth Conducted Powers

Burst Modulated Average[dBm]		
Bluetooth 1 Mbps	Maximum	13.0
	Nominal	12.0
Bluetooth 2 Mbps	Maximum	11.0
	Nominal	10.0
Bluetooth 3 Mbps	Maximum	11.0
	Nominal	10.0
Bluetooth LE	Maximum	3.0
	Nominal	2.0

Table 8.4.1 Nominal and Maximum Output Power Spec (Burst)

Frame Modulated Average[dBm]		
Bluetooth 1 Mbps	Maximum	11.85
	Nominal	10.85
Bluetooth 2 Mbps	Maximum	9.85
	Nominal	8.85
Bluetooth 3 Mbps	Maximum	9.85
	Nominal	8.85
Bluetooth LE	Maximum	0.96
	Nominal	-0.04

Table 8.4.2 Nominal and Maximum Output Power Spec (Frame)

Channel	Frequency	Burst AVG Output Power (1Mbps)	Frame AVG Output Power (1Mbps)	Burst AVG Output Power (2Mbps)	Frame AVG Output Power (2Mbps)	Burst AVG Output Power (3Mbps)	Frame AVG Output Power (3Mbps)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)
Low	2402	11.91	10.76	9.97	8.82	9.96	8.81
Mid	2441	12.79	11.64	10.89	9.74	10.88	9.73
High	2480	11.47	10.32	9.49	8.34	9.49	8.34

Table 8.4.3 Bluetooth Burst and Frame Average RF Power

Channel	Frequency	Burst AVG Output Power(LE)	Frame AVG Output Power(LE)
	(MHz)	(dBm)	(dBm)
Low	2402	2.54	0.50
Mid	2440	2.93	0.89
High	2480	2.53	0.49

Table 8.4.4 Bluetooth LE Burst and Frame Average RF Power

- **Bluetooth Conducted Powers procedures**

1. Bluetooth (BDR, EDR)
   1) Enter DUT mode in EUT and operate it.
      When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
   2) Instruments and EUT were connected like Figure 8.4.1(A).
   3) The maximum output powers of BDR(1 Mbps), EDR(2, 3 Mbps) and each frequency were set by a Bluetooth Tester.
   4) Power levels were measured by a Power Meter.

2. Bluetooth (LE)
   1) Enter LE mode in EUT and operate it.
      When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
   2) Instruments and EUT were connected like Figure 8.4.1(B).
   3) The average conducted output powers of LE and each frequency can measurement according to setting program in EUT.
   4) Power levels were measured by a Power Meter.

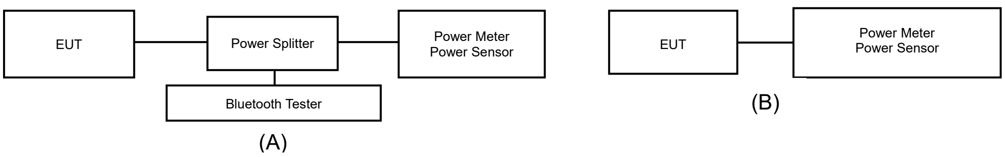


Figure 8.4.1 Average Power Measurement Setup

- **Bluetooth Transmission Plot**

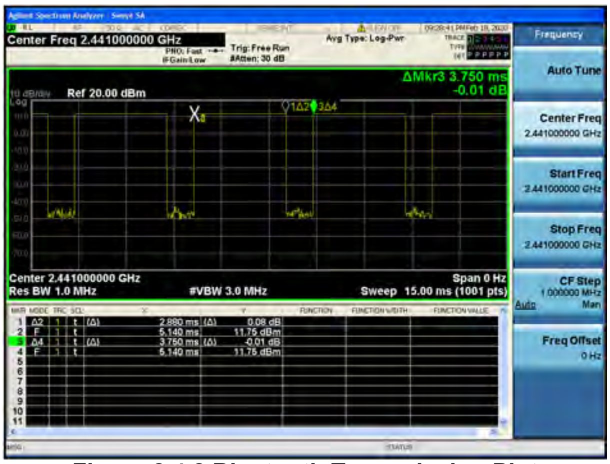


Figure 8.4.2 Bluetooth Transmission Plot

- **Bluetooth Duty Cycle Calculation**

Duty Cycle = Pulse/Period * 100% = (2.880/3.750) * 100 = 76.8%

9. SYSTEM VERIFICATION

9.1 Tissue Verification

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Jul. 28. 2020	750 Head	22.1	21.9	707.5	42.129	0.887	42.432	0.863	0.72	-2.71
				750.0	41.900	0.890	41.878	0.903	-0.05	1.46
Jul. 27. 2020	835 Head	22.3	22.0	826.4	41.542	0.899	42.743	0.887	2.89	-1.33
				829.0	41.528	0.899	42.712	0.889	2.85	-1.11
				835.0	41.500	0.900	42.628	0.894	2.72	-0.67
				836.5	41.500	0.901	42.607	0.896	2.67	-0.55
				836.6	41.500	0.901	42.605	0.896	2.66	-0.55
				844.0	41.500	0.910	42.510	0.902	2.43	-0.88
				846.6	41.500	0.912	42.478	0.904	2.36	-0.88
Jul. 21. 2020	1800 Head	22.3	22.2	1712.4	40.126	1.350	41.083	1.303	2.38	-3.48
				1720.0	40.114	1.354	41.060	1.311	2.36	-3.18
				1732.4	40.097	1.361	41.023	1.323	2.31	-2.79
				1732.5	40.097	1.361	41.022	1.323	2.31	-2.79
				1745.0	40.079	1.369	40.969	1.335	2.22	-2.48
				1752.6	40.069	1.373	40.938	1.343	2.17	-2.18
				1770.0	40.043	1.383	40.859	1.360	2.04	-1.66
				1800.0	40.000	1.400	40.739	1.390	1.85	-0.71
Jul. 20. 2020	1900 Head	22.1	21.8	1850.2	40.000	1.400	41.373	1.389	3.43	-0.79
				1852.4	40.000	1.400	41.367	1.391	3.42	-0.64
				1860.0	40.000	1.400	41.349	1.398	3.37	-0.14
				1880.0	40.000	1.400	41.283	1.418	3.21	1.29
				1900.0	40.000	1.400	41.211	1.437	3.03	2.64
				1907.6	40.000	1.400	41.183	1.443	2.96	3.07
				1909.8	40.000	1.400	41.177	1.445	2.94	3.21
Jul. 29. 2020	2450 Head	22.4	22.3	2402.0	39.282	1.757	39.485	1.808	0.52	2.90
				2412.0	39.265	1.766	39.444	1.820	0.46	3.06
				2437.0	39.222	1.788	39.365	1.851	0.36	3.52
				2441.0	39.215	1.792	39.352	1.856	0.35	3.57
				2450.0	39.200	1.800	39.323	1.866	0.31	3.67
				2462.0	39.184	1.813	39.290	1.879	0.27	3.64
				2467.0	39.177	1.818	39.273	1.884	0.25	3.63
				2472.0	39.171	1.823	39.251	1.889	0.20	3.62
				2480.0	39.160	1.832	39.217	1.897	0.15	3.55
Jul. 13. 2020	5200 Head	21.3	21.0	5180.0	36.020	4.639	35.312	4.645	-1.97	0.13
				5190.0	36.010	4.650	35.289	4.655	-2.00	0.11
				5200.0	36.000	4.660	35.267	4.668	-2.04	0.17
				5210.0	35.990	4.670	35.253	4.681	-2.05	0.24
				5220.0	35.980	4.680	35.243	4.691	-2.05	0.24
				5230.0	35.970	4.690	35.230	4.700	-2.06	0.21
				5240.0	35.960	4.700	35.214	4.712	-2.07	0.26
Jul. 14. 2020	5800 Head	22.2	21.9	5745.0	35.355	5.215	34.509	5.365	-2.39	2.88
				5755.0	35.345	5.225	34.497	5.377	-2.40	2.91
				5775.0	35.325	5.245	34.463	5.395	-2.44	2.86
				5785.0	35.315	5.255	34.440	5.408	-2.48	2.91
				5795.0	35.305	5.265	34.422	5.422	-2.50	2.98
				5800.0	35.300	5.270	34.414	5.428	-2.51	3.00
				5825.0	35.275	5.296	34.389	5.453	-2.51	2.96

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 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.

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which 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 , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\varepsilon_r\varepsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

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 $j = \sqrt{-1}$.

9.2 Test System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at using the SAR Dipole kit(s). (Graphic Plots Attached)

Table 9.2.1 System Verification Results (1g)

SYSTEM DIPOLE VERIFICATION TARGET & MEASURED												
SAR System #	Freq. [MHz]	SAR Dipole kits	Date(s)	Tissue Type	Ambient Temp. [°C]	Liquid Temp. [°C]	Probe S/N	Input Power (mW)	1 W Target SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation [%]
B	750	D750V3,SN:1049	Jul. 28. 2020	Head	22.1	21.9	7368	250	8.47	2.12	8.48	0.12
B	835	D835V2,SN:4d159	Jul. 27. 2020	Head	22.3	22.0	7368	250	9.47	2.41	9.64	1.80
B	1800	D1800V2, SN:2d202	Jul. 21. 2020	Head	22.3	22.2	7368	100	39.6	3.83	38.30	-3.28
B	1900	D1900V2, SN:5d176	Jul. 20. 2020	Head	22.1	21.8	7368	100	39.3	4.01	40.10	2.04
B	2450	D2450V2,SN: 726	Jul. 29. 2020	Head	22.4	22.3	7368	100	51.2	5.24	52.40	2.34
B	5200	D5GHzV2, SN:1212	Jul. 13. 2020	Head	21.3	21.0	7368	100	80.2	7.84	78.40	-2.24
B	5800	D5GHzV2, SN:1212	Jul. 14. 2020	Head	22.2	21.9	7368	100	81.5	8.10	81.00	-0.61

Note1 : System Verification was measured with input 250 mW, 100 mW and normalized to 1W.
Note2 : Full system validation status and results can be found in Appendix D.

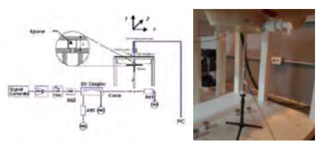


Figure 9.1 Dipole Verification Test Setup Diagram & Photo

10. SAR TEST RESULTS

10.1 Standalone Body SAR Results

Table 10.1.1 WCDMA Body SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
836.6	4183	WCDMA 850	RMC	24.00	23.91	-0.030	5 mm [Bottom]	FCC #1	N/A	1:1	0.344	1.021	0.351	
836.6	4183	WCDMA 850	RMC	24.00	23.91	0.040	5 mm [Front]	FCC #1	N/A	1:1	0.279	1.021	0.285	
836.6	4183	WCDMA 850	RMC	24.00	23.91	-0.020	5 mm [Rear #1]	FCC #1	N/A	1:1	0.760	1.021	0.776	
826.4	4132	WCDMA 850	RMC	24.00	23.99	-0.010	5 mm [Rear #2]	FCC #1	N/A	1:1	1.040	1.002	**1.042**	A1
836.6	4183	WCDMA 850	RMC	24.00	23.91	0.020	5 mm [Rear #2]	FCC #1	N/A	1:1	0.921	1.021	0.940	
846.6	4233	WCDMA 850	RMC	24.00	23.92	0.080	5 mm [Rear #2]	FCC #1	N/A	1:1	0.931	1.019	0.949	
836.6	4183	WCDMA 850	RMC	24.00	23.91	0.010	5 mm [Right]	FCC #1	N/A	1:1	0.208	1.021	0.212	
836.6	4183	WCDMA 850	RMC	24.00	23.91	-0.100	5 mm [Left]	FCC #1	N/A	1:1	0.254	1.021	0.259	
826.4	4132	WCDMA 850	RMC	24.00	23.99	-0.050	5 mm [Rear #2]	FCC #1	N/A	1:1	1.020	1.002	1.022	
826.4	4132	WCDMA 850	RMC	24.00	23.99	0.010	5 mm [Rear #2]	FCC #1	N/A	1:1	1.000	1.002	1.002	
1852.4	9262	WCDMA 1900	RMC	22.20	22.16	0.160	5 mm [Bottom]	FCC #1	N/A	1:1	0.926	1.009	0.934	
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	-0.000	5 mm [Bottom]	FCC #1	N/A	1:1	1.040	1.002	1.042	
1907.6	9538	WCDMA 1900	RMC	22.20	22.03	0.190	5 mm [Bottom]	FCC #1	N/A	1:1	1.130	1.040	1.175	
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	-0.070	5 mm [Front]	FCC #1	N/A	1:1	0.284	1.002	0.285	
1852.4	9262	WCDMA 1900	RMC	22.20	22.16	0.050	5 mm [Rear #1]	FCC #1	N/A	1:1	0.825	1.009	0.832	
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	-0.100	5 mm [Rear #1]	FCC #1	N/A	1:1	1.110	1.002	1.112	
1907.6	9538	WCDMA 1900	RMC	22.20	22.03	0.060	5 mm [Rear #1]	FCC #1	N/A	1:1	1.080	1.040	1.123	
1852.4	9262	WCDMA 1900	RMC	22.20	22.16	-0.190	5 mm [Rear #2]	FCC #1	N/A	1:1	0.982	1.009	0.991	
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	0.180	5 mm [Rear #2]	FCC #1	N/A	1:1	1.140	1.002	1.142	
1907.6	9538	WCDMA 1900	RMC	22.20	22.03	0.110	5 mm [Rear #2]	FCC #1	N/A	1:1	1.140	1.040	**1.186**	A2
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	0.030	5 mm [Right]	FCC #1	N/A	1:1	0.115	1.002	0.115	
1880.0	9400	WCDMA 1900	RMC	22.20	22.19	-0.020	5 mm [Left]	FCC #1	N/A	1:1	0.465	1.002	0.466	
1907.6	9538	WCDMA 1900	RMC	20.20	20.03	0.110	5 mm [Rear #2]	FCC #1	N/A	1:1	1.070	1.040	1.113	
1907.6	9538	WCDMA 1900	RMC	21.20	20.03	0.110	5 mm [Rear #2]	FCC #1	N/A	1:1	1.100	1.309	1.440	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.
2. Purple entries represent SIM2 (This device supports Dual SIM and is 1 RF Path.) measurements.
3. Orange entries represent variability measurements.

Table 10.1.2 LTE B12 Body SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
707.5	23095	LTE B12	10	23.00	22.92	0.080	0	5 mm [Bottom]	FCC #1	QPSK	1	25	1:1	0.097	1.019	0.099	
707.5	23095	LTE B12	10	22.00	21.77	0.130	1	5 mm [Bottom]	FCC #1	QPSK	25	12	1:1	0.084	1.054	0.089	
707.5	23095	LTE B12	10	23.00	22.92	0.020	0	5 mm [Front]	FCC #1	QPSK	1	25	1:1	0.120	1.019	0.122	
707.5	23095	LTE B12	10	22.00	21.77	0.080	1	5 mm [Front]	FCC #1	QPSK	25	12	1:1	0.098	1.054	0.103	
707.5	23095	LTE B12	10	23.00	22.92	0.110	0	5 mm [Rear #1]	FCC #1	QPSK	1	25	1:1	0.262	1.019	0.267	
707.5	23095	LTE B12	10	22.00	21.77	-0.090	1	5 mm [Rear #1]	FCC #1	QPSK	25	12	1:1	0.226	1.054	0.238	
707.5	23095	LTE B12	10	23.00	22.92	0.090	0	5 mm [Rear #2]	FCC #1	QPSK	1	25	1:1	0.334	1.019	**0.340**	A3
707.5	23095	LTE B12	10	22.00	21.77	0.040	1	5 mm [Rear #2]	FCC #1	QPSK	25	12	1:1	0.277	1.054	0.292	
707.5	23095	LTE B12	10	23.00	22.92	0.090	0	5 mm [Right]	FCC #1	QPSK	1	25	1:1	0.117	1.019	0.119	
707.5	23095	LTE B12	10	22.00	21.77	-0.010	1	5 mm [Right]	FCC #1	QPSK	25	12	1:1	0.098	1.054	0.103	
707.5	23095	LTE B12	10	23.00	22.92	0.100	0	5 mm [Left]	FCC #1	QPSK	1	25	1:1	0.116	1.019	0.118	
707.5	23095	LTE B12	10	22.00	21.77	0.010	1	5 mm [Left]	FCC #1	QPSK	25	12	1:1	0.103	1.054	0.109	
707.5	23095	LTE B12	10	23.00	22.92	0.030	0	5 mm [Rear #2]	FCC #1	QPSK	1	25	1:1	0.317	1.019	0.323	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Body** **1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.
2. Purple entries represent SIM2 (This device supports Dual SIM and is 1 RF Path.) measurements.

Table 10.1.3 LTE B5 Body SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
836.5	20525	LTE B5	10	23.20	22.97	0.050	0	5 mm [Bottom]	FCC #1	QPSK	1	0	1:1	0.239	1.054	0.252	
836.5	20525	LTE B5	10	22.20	21.66	0.080	1	5 mm [Bottom]	FCC #1	QPSK	25	0	1:1	0.178	1.132	0.201	
836.5	20525	LTE B5	10	23.20	22.97	0.180	0	5 mm [Front]	FCC #1	QPSK	1	0	1:1	0.179	1.054	0.189	
836.5	20525	LTE B5	10	22.20	21.66	0.000	1	5 mm [Front]	FCC #1	QPSK	25	0	1:1	0.139	1.132	0.157	
836.5	20525	LTE B5	10	23.20	22.97	0.180	0	5 mm [Rear #1]	FCC #1	QPSK	1	0	1:1	0.469	1.054	0.494	
836.5	20525	LTE B5	10	22.20	21.66	0.030	1	5 mm [Rear #1]	FCC #1	QPSK	25	0	1:1	0.378	1.132	0.428	
836.5	20525	LTE B5	10	23.20	22.97	0.160	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	0.654	1.054	**0.689**	A4
836.5	20525	LTE B5	10	22.20	21.66	-0.070	1	5 mm [Rear #2]	FCC #1	QPSK	25	0	1:1	0.414	1.132	0.469	
836.5	20525	LTE B5	10	23.20	22.97	0.110	0	5 mm [Right]	FCC #1	QPSK	1	0	1:1	0.182	1.054	0.192	
836.5	20525	LTE B5	10	22.20	21.66	-0.080	1	5 mm [Right]	FCC #1	QPSK	25	0	1:1	0.127	1.132	0.144	
836.5	20525	LTE B5	10	23.20	22.97	-0.150	0	5 mm [Left]	FCC #1	QPSK	1	0	1:1	0.136	1.054	0.143	
836.5	20525	LTE B5	10	22.20	21.66	0.020	1	5 mm [Left]	FCC #1	QPSK	25	0	1:1	0.107	1.132	0.121	
836.5	20525	LTE B5	10	23.20	22.97	0.090	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	0.514	1.054	0.542	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Body** **1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.
2. Purple entries represent SIM2 (This device supports Dual SIM and is 1 RF Path.) measurements.

Table 10.1.4 LTE B4 Body SAR

MEASUREMENT RESULTS

FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	22.70	22.53	0.100	0	5 mm [Bottom]	FCC #1	QPSK	1	0	1:1	0.630	1.040	0.655	
1732.5	20175	LTE B4	20	21.70	21.31	0.190	1	5 mm [Bottom]	FCC #1	QPSK	50	0	1:1	0.505	1.094	0.552	
1732.5	20175	LTE B4	20	22.70	22.53	-0.160	0	5 mm [Front]	FCC #1	QPSK	1	0	1:1	0.309	1.040	0.321	
1732.5	20175	LTE B4	20	21.70	21.31	-0.050	1	5 mm [Front]	FCC #1	QPSK	50	0	1:1	0.240	1.094	0.263	
1732.5	20175	LTE B4	20	22.70	22.53	-0.040	0	5 mm [Rear #1]	FCC #1	QPSK	1	0	1:1	0.761	1.040	0.791	
1732.5	20175	LTE B4	20	21.70	21.31	0.090	1	5 mm [Rear #1]	FCC #1	QPSK	50	0	1:1	0.597	1.094	0.653	
1732.5	20175	LTE B4	20	22.70	22.53	-0.030	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	0.778	1.040	**0.809**	A5
1732.5	20175	LTE B4	20	21.70	21.31	-0.040	1	5 mm [Rear #2]	FCC #1	QPSK	50	0	1:1	0.634	1.094	0.694	
1732.5	20175	LTE B4	20	21.70	21.28	-0.040	1	5 mm [Rear #2]	FCC #1	QPSK	100	0	1:1	0.625	1.102	0.689	
1732.5	20175	LTE B4	20	22.70	22.53	0.060	0	5 mm [Right]	FCC #1	QPSK	1	0	1:1	0.159	1.040	0.165	
1732.5	20175	LTE B4	20	21.70	21.31	0.060	1	5 mm [Right]	FCC #1	QPSK	50	0	1:1	0.124	1.094	0.136	
1732.5	20175	LTE B4	20	22.70	22.53	0.130	0	5 mm [Left]	FCC #1	QPSK	1	0	1:1	0.760	1.040	0.790	
1732.5	20175	LTE B4	20	21.70	21.31	0.100	1	5 mm [Left]	FCC #1	QPSK	50	0	1:1	0.590	1.094	0.645	
1732.5	20175	LTE B4	20	22.70	22.53	0.100	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	0.751	1.040	0.781	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.
2. Purple entries represent SIM2 (This device supports Dual SIM and is 1 RF Path.) measurements.

Table 10.1.5 LTE B2 Body SAR

MEASUREMENT RESULTS

FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1860.0	18700	LTE B2	20	22.70	22.55	-0.140	0	5 mm [Bottom]	FCC #1	QPSK	1	0	1:1	0.848	1.035	0.878	
1880.0	18900	LTE B2	20	22.70	22.57	0.010	0	5 mm [Bottom]	FCC #1	QPSK	1	0	1:1	0.878	1.030	0.904	
1880.0	18900	LTE B2	20	21.70	21.26	-0.190	1	5 mm [Bottom]	FCC #1	QPSK	50	0	1:1	0.733	1.107	0.811	
1880.0	18900	LTE B2	20	21.70	21.24	-0.140	1	5 mm [Bottom]	FCC #1	QPSK	100	0	1:1	0.732	1.112	0.814	
1900.0	19100	LTE B2	20	22.70	22.43	-0.150	0	5 mm [Bottom]	FCC #1	QPSK	1	0	1:1	0.984	1.064	1.047	
1880.0	18900	LTE B2	20	22.70	22.57	-0.010	0	5 mm [Front]	FCC #1	QPSK	1	0	1:1	0.275	1.030	0.283	
1880.0	18900	LTE B2	20	21.70	21.26	-0.020	1	5 mm [Front]	FCC #1	QPSK	50	0	1:1	0.213	1.107	0.236	
1860.0	18700	LTE B2	20	22.70	22.55	0.150	0	5 mm [Rear #1]	FCC #1	QPSK	1	0	1:1	0.920	1.035	0.952	
1860.0	18700	LTE B2	20	21.70	21.24	0.040	1	5 mm [Rear #1]	FCC #1	QPSK	50	0	1:1	0.741	1.112	0.824	
1880.0	18900	LTE B2	20	22.70	22.57	0.040	0	5 mm [Rear #1]	FCC #1	QPSK	1	0	1:1	0.985	1.030	1.015	
1880.0	18900	LTE B2	20	21.70	21.26	0.030	1	5 mm [Rear #1]	FCC #1	QPSK	50	0	1:1	0.829	1.107	0.918	
1880.0	18900	LTE B2	20	21.70	21.24	-0.010	1	5 mm [Rear #1]	FCC #1	QPSK	100	0	1:1	0.829	1.112	0.922	
1900.0	19100	LTE B2	20	22.70	22.43	0.190	0	5 mm [Rear #1]	FCC #1	QPSK	1	0	1:1	1.090	1.064	1.160	
1900.0	19100	LTE B2	20	21.70	21.21	0.040	1	5 mm [Rear #1]	FCC #1	QPSK	50	0	1:1	0.897	1.119	1.004	
1860.0	18700	LTE B2	20	22.70	22.55	-0.060	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	1.060	1.035	1.097	
1860.0	18700	LTE B2	20	21.70	21.24	-0.110	1	5 mm [Rear #2]	FCC #1	QPSK	50	0	1:1	0.787	1.112	0.875	
1880.0	18900	LTE B2	20	22.70	22.57	-0.170	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	1.120	1.030	1.154	
1880.0	18900	LTE B2	20	21.70	21.26	-0.170	1	5 mm [Rear #2]	FCC #1	QPSK	50	0	1:1	0.846	1.107	0.937	
1880.0	18900	LTE B2	20	21.70	21.24	-0.130	1	5 mm [Rear #2]	FCC #1	QPSK	100	0	1:1	0.847	1.112	0.942	
1900.0	19100	LTE B2	20	22.70	22.43	-0.150	0	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	1.120	1.064	**1.192**	A6
1900.0	19100	LTE B2	20	21.70	21.21	0.160	1	5 mm [Rear #2]	FCC #1	QPSK	50	0	1:1	0.922	1.119	1.032	
1880.0	18900	LTE B2	20	22.70	22.57	-0.010	0	5 mm [Right]	FCC #1	QPSK	1	0	1:1	0.109	1.030	0.112	
1880.0	18900	LTE B2	20	21.70	21.26	0.040	1	5 mm [Right]	FCC #1	QPSK	50	0	1:1	0.085	1.107	0.094	
1880.0	18900	LTE B2	20	22.70	22.57	-0.130	0	5 mm [Left]	FCC #1	QPSK	1	0	1:1	0.461	1.030	0.475	
1880.0	18900	LTE B2	20	21.70	21.26	0.050	1	5 mm [Left]	FCC #1	QPSK	50	0	1:1	0.359	1.107	0.397	
1860.0	18700	LTE B2	20	22.70	22.43	0.040	1	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	1.110	1.064	1.181	
1860.0	18700	LTE B2	20	22.70	22.43	-0.080	1	5 mm [Rear #2]	FCC #1	QPSK	1	0	1:1	1.110	1.064	1.181	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.
2. Purple entries represent SIM2 (This device supports Dual SIM and is 1 RF Path.) measurements.
3. Orange entries represent variability measurements.

Table 10.1.6 DTS Body SAR

MEASUREMENT RESULTS

FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
MHz	Ch														
2437.0	6	802.11b	16.00	15.76	-0.140	5 mm [Top]	FCC #2	0.028	1	97.3	0.026	1.057	1.028	0.028	
2437.0	6	802.11b	16.00	15.76	-0.120	5 mm [Front]	FCC #2	0.057	1	97.3	0.056	1.057	1.028	0.061	
2437.0	6	802.11b	16.00	15.76	-0.180	5 mm [Rear #1]	FCC #2	0.057	1	97.3	0.055	1.057	1.028	0.060	
2437.0	6	802.11b	16.00	15.76	-0.010	5 mm [Rear #3]	FCC #2	0.060	1	97.3	0.058	1.057	1.028	0.063	
2437.0	6	802.11b	16.00	15.76	-0.110	5 mm [Left]	FCC #2	0.585	1	97.3	0.602	1.057	1.028	**0.654**	A7
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.

Adjusted SAR results for OFDM SAR

FREQUENCY		Mode/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm]	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2437.0	6	802.11b	DSSS	16.0	0.654	2437.0	802.11g	OFDM	14.0	0.631	**0.413**	X
2437.0	6	802.11b	DSSS	16.0	0.654	2437.0	802.11n (HT-20)	OFDM	14.0	0.631	**0.413**	X
2437.0	6	802.11b	DSSS	16.0	0.654	2437.0	802.11n (HT-40)	OFDM	14.0	0.631	**0.413**	X
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure						Body 1.6 W/kg (mW/g) averaged over 1 gram						

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 10.1.7 UNII Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5220.0	44	802.11a	13.00	12.80	-0.030	5 mm [Top]	FCC #2	0.143	6	87.3	0.142	1.047	1.145	0.170	
5220.0	44	802.11a	13.00	12.80	-0.190	5 mm [Front]	FCC #2	0.051	6	87.3	0.043	1.047	1.145	0.052	
5220.0	44	802.11a	13.00	12.80	0.010	5 mm [Rear #1]	FCC #2	0.223	6	87.3	0.220	1.047	1.145	0.264	
5220.0	44	802.11a	13.00	12.80	-0.010	5 mm [Rear #3]	FCC #2	0.234	6	87.3	0.234	1.047	1.145	0.281	
5220.0	44	802.11a	13.00	12.80	0.090	5 mm [Left]	FCC #2	0.645	6	87.3	0.652	1.047	1.145	**0.782**	A8
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.

Table 10.1.8 UNII Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
5825.0	165	802.11a	13.00	12.79	0.020	5 mm [Top]	FCC #2	0.126	6	87.3	0.122	1.050	1.145	0.147	
5825.0	165	802.11a	13.00	12.79	-0.030	5 mm [Front]	FCC #2	0.034	6	87.3	0.027	1.050	1.145	0.032	
5825.0	165	802.11a	13.00	12.79	-0.030	5 mm [Rear #1]	FCC #2	0.199	6	87.3	0.201	1.050	1.145	0.242	
5825.0	165	802.11a	13.00	12.79	-0.060	5 mm [Rear #3]	FCC #2	0.205	6	87.3	0.211	1.050	1.145	0.254	
5825.0	165	802.11a	13.00	12.79	0.080	5 mm [Left]	FCC #2	0.381	6	87.3	0.401	1.050	1.145	**0.482**	A9
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.

Table 10.1.9 Bluetooth Body SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Rate [Mbps]	Duty Cycle (%)	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441.0	39	Bluetooth	11.85	11.64	0.090	5 mm [Top]	FCC #2	1	76.8	0.006	1.050	1.302	0.008	
2441.0	39	Bluetooth	11.85	11.64	-0.060	5 mm [Front]	FCC #2	1	76.8	0.008	1.050	1.302	0.011	
2441.0	39	Bluetooth	11.85	11.64	-0.010	5 mm [Rear #1]	FCC #2	1	76.8	0.016	1.050	1.302	0.022	
2441.0	39	Bluetooth	11.85	11.64	-0.120	5 mm [Rear #3]	FCC #2	1	76.8	0.016	1.050	1.302	0.022	
2441.0	39	Bluetooth	11.85	11.64	0.120	5 mm [Left]	FCC #2	1	76.8	0.122	1.050	1.302	**0.167**	A10
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram						

Note(s):
1. Please refer to the Test photo (SAR) for details on the test position indicated by Blue entries represent.

10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all 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 D01v06.
6. Per FCC KDB Publication 648474 D04v01r03, body SAR was evaluated without a headset connected to the device. Since the standalone reported body SAR was not > 1.2 W/kg, no additional body SAR evaluations using a headset cable were performed.

WCDMA (UMTS) Notes:

1. WCDMA (UMTS) mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. AMR and HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v06, 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 > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r05. The general test procedures used for testing can be found in Section 8.4.4.
2. According to FCC KDB 941225 D05v02r05, when the reported SAR is ≤ 0.8 W/kg, testing of the 100% RB allocation and required test channels is not required.
   Otherwise, SAR is required for the remaining required test channels using the 1 RB, 50% RB and 100% RB allocation with highest output power for that channel.
   Only one channel, and as reported SAR values for 1 RB allocation and 50% RB allocation were less than 1.45 W/kg only the highest power RB offset for each allocation was required.
3. 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.
4. A-MPR was disabled for all SAR tests by setting NS=1 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).
5. SAR test reduction is applied using the following criteria:
   Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is > 0.8 W/kg, testing for other channels is performed at the highest output power level for 1 RB, and 50% RB configuration for that channel. Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg. Testing for 16QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK. Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

WLAN Notes:

1. The initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 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 duo to the maximum allowed powers and the highest reported DSSS SAR when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output and the adjust SAR is ≤ 1.2 W/kg.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 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.
4. When the maximum reported 1g averaged SAR ≤ 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 to determine compliance.

Bluetooth Notes:

1. Bluetooth SAR was measured with the device connected to a call with hopping disabled with DH5 operation and Tx test mode type. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. Refer to section 8.4 for the time-domain plot and calculation for the duty factor of the device.

11. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to handsets with built-in unlicensed transmitters such as 802.11b/g/n 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 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2,simultaneous transmission SAR test exclusion may be applied when the sum of the sum 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6 W/kg. The different test positon 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 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, 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.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06.

Table 11.3.1 Simultaneous SAR Cases

No.	Capable Transmit Configuration	Body SAR	Note
1	WCDMA + Wi-Fi 2.4 GHz	Yes	
2	WCDMA + Wi-Fi 5 GHz	Yes	
3	WCDMA + Bluetooth 2.4 GHz	Yes	
4	LTE + Wi-Fi 2.4 GHz	Yes	
5	LTE + Wi-Fi 5 GHz	Yes	
6	LTE + Bluetooth 2.4 GHz	Yes	

Notes:

1. VoIP is supported in LTE, WCDMA
2. WCDMA and LTE can not transmit simultaneously since they share the same chip.
3. Bluetooth and WLAN (2.4 GHz, 5 GHz) are not operated at same time.

11.4 Body SAR Simultaneous Transmission Analysis

Table 11.4.1 Simultaneous Transmission Scenario : 3G/4G + 2.4 GHz W-LAN (Body at 0 mm)

Exposure Condition	Mode	Configuration	3G/4G SAR (W/kg)	2.4G W-LAN SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Body SAR	WCDMA 850	Top	-	0.028	0.028
		Bottom	0.351	-	0.351
		Front	0.285	0.061	0.346
		Rear	1.042	0.063	**1.105**
		Right	0.212	-	0.212
		Left	0.259	0.654	0.913
	WCDMA 1900	Top	-	0.028	0.028
		Bottom	1.175	-	1.175
		Front	0.285	0.061	0.346
		Rear	1.186	0.063	**1.249**
		Right	0.115	-	0.115
		Left	0.466	0.654	1.120
	LTE Band 12	Top	-	0.028	0.028
		Bottom	0.099	-	0.099
		Front	0.122	0.061	0.183
		Rear	0.340	0.063	0.403
		Right	0.119	-	0.119
		Left	0.118	0.654	**0.772**
	LTE Band 5	Top	-	0.028	0.028
		Bottom	0.252	-	0.252
		Front	0.189	0.061	0.250
		Rear	0.689	0.063	0.752
		Right	0.192	-	0.192
		Left	0.143	0.654	**0.797**
	LTE Band 4	Top	-	0.028	0.028
		Bottom	0.655	-	0.655
		Front	0.321	0.061	0.382
		Rear	0.809	0.063	0.872
		Right	0.165	-	0.165
		Left	0.790	0.654	**1.444**
	LTE Band 2	Top	-	0.028	0.028
		Bottom	1.047	-	1.047
		Front	0.283	0.061	0.344
		Rear	1.192	0.063	**1.255**
		Right	0.112	-	0.112
		Left	0.475	0.654	1.129

Table 11.4.2 Simultaneous Transmission Scenario : 3G/4G + 5.2 GHz W-LAN (Body at 0 mm)

Exposure Condition	Mode	Configuration	3G/4G SAR (W/kg)	5.2G W-LAN SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Body SAR	WCDMA 850	Top	-	0.170	0.170
		Bottom	0.351	-	0.351
		Front	0.285	0.052	0.337
		Rear	1.042	0.281	**1.323**
		Right	0.212	-	0.212
		Left	0.259	0.782	1.041
	WCDMA 1900	Top	-	0.170	0.170
		Bottom	1.175	-	1.175
		Front	0.285	0.052	0.337
		Rear	1.186	0.281	**1.467**
		Right	0.115	-	0.115
		Left	0.466	0.782	1.248
	LTE Band 12	Top	-	0.170	0.170
		Bottom	0.099	-	0.099
		Front	0.122	0.052	0.174
		Rear	0.340	0.281	0.621
		Right	0.119	-	0.119
		Left	0.118	0.782	**0.900**
	LTE Band 5	Top	-	0.170	0.170
		Bottom	0.252	-	0.252
		Front	0.189	0.052	0.241
		Rear	0.689	0.281	**0.970**
		Right	0.192	-	0.192
		Left	0.143	0.782	0.925
	LTE Band 4	Top	-	0.170	0.170
		Bottom	0.655	-	0.655
		Front	0.321	0.052	0.373
		Rear	0.809	0.281	1.090
		Right	0.165	-	0.165
		Left	0.790	0.782	**1.572**
	LTE Band 2	Top	-	0.170	0.170
		Bottom	1.047	-	1.047
		Front	0.283	0.052	0.335
		Rear	**1.192**	**0.281**	1.473
		Right	0.112	-	0.112
		Left	0.475	0.782	1.257

Table 11.4.3 Simultaneous Transmission Scenario : 3G/4G + 5.8 GHz W-LAN (Body at 0 mm)

Exposure Condition	Mode	Configuration	3G/4G SAR (W/kg) 1	5.8G W-LAN SAR (W/kg) 2	ΣSAR (W/kg) 1+2
Body SAR	WCDMA 850	Top	-	0.147	0.147
		Bottom	0.351	-	0.351
		Front	0.285	0.032	0.317
		Rear	1.042	0.254	**1.296**
		Right	0.212	-	0.212
		Left	0.259	0.482	0.741
	WCDMA 1900	Top	-	0.147	0.147
		Bottom	1.175	-	1.175
		Front	0.285	0.032	0.317
		Rear	1.186	0.254	**1.440**
		Right	0.115	-	0.115
		Left	0.466	0.482	0.948
	LTE Band 12	Top	-	0.147	0.147
		Bottom	0.099	-	0.099
		Front	0.122	0.032	0.154
		Rear	0.340	0.254	0.594
		Right	0.119	-	0.119
		Left	0.118	0.482	**0.600**
	LTE Band 5	Top	-	0.147	0.147
		Bottom	0.252	-	0.252
		Front	0.189	0.032	0.221
		Rear	0.689	0.254	**0.943**
		Right	0.192	-	0.192
		Left	0.143	0.482	0.625
	LTE Band 4	Top	-	0.147	0.147
		Bottom	0.655	-	0.655
		Front	0.321	0.032	0.353
		Rear	0.809	0.254	1.063
		Right	0.165	-	0.165
		Left	0.790	0.482	**1.272**
	LTE Band 2	Top	-	0.147	0.147
		Bottom	1.047	-	1.047
		Front	0.283	0.032	0.315
		Rear	1.192	0.254	**1.446**
		Right	0.112	-	0.112
		Left	0.475	0.482	0.957

Table 11.4.4 Simultaneous Transmission Scenario : 3G/4G + Bluetooth (Body at 0 mm)

Exposure Condition	Mode	Configuration	3G/4G SAR (W/kg) 1	Bluetooth SAR (W/kg) 2	ΣSAR (W/kg) 1+2
Body SAR	WCDMA 850	Top	-	0.008	0.008
		Bottom	0.351	-	0.351
		Front	0.285	0.011	0.296
		Rear	1.042	0.022	**1.064**
		Right	0.212	-	0.212
		Left	0.259	0.167	0.426
	WCDMA 1900	Top	-	0.008	0.008
		Bottom	1.175	-	1.175
		Front	0.285	0.011	0.296
		Rear	1.186	0.022	**1.208**
		Right	0.115	-	0.115
		Left	0.466	0.167	0.633
	LTE Band 12	Top	-	0.008	0.008
		Bottom	0.099	-	0.099
		Front	0.122	0.011	0.133
		Rear	0.340	0.022	**0.362**
		Right	0.119	-	0.119
		Left	0.118	0.167	0.285
	LTE Band 5	Top	-	0.008	0.008
		Bottom	0.252	-	0.252
		Front	0.189	0.011	0.200
		Rear	0.689	0.022	**0.711**
		Right	0.192	-	0.192
		Left	0.143	0.167	0.310
	LTE Band 4	Top	-	0.008	0.008
		Bottom	0.655	-	0.655
		Front	0.321	0.011	0.332
		Rear	0.809	0.022	0.831
		Right	0.165	-	0.165
		Left	0.790	0.167	**0.957**
	LTE Band 2	Top	-	0.008	0.008
		Bottom	1.047	-	1.047
		Front	0.283	0.011	0.294
		Rear	1.192	0.022	**1.214**
		Right	0.112	-	0.112
		Left	0.475	0.167	0.642

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results 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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

12. SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, 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 (~ 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
5. The same procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure to the corresponding SAR thresholds.

Table 12.1 Body SAR Measurement Variability Results

Frequency		Mode	Service	# of Time Slots	Spacing [Side]	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)	
826.4	4132	WCDMA 850	RMC	-	5 mm [Rear #2]	1.040	1.000	1.04	-	-	-	-
1907.6	9538	WCDMA 1900	RMC	-	5 mm [Rear #2]	1.110	1.100	1.01	-	-	-	-
1880.0	18900	LTE B2	-	-	5 mm [Bottom]	1.120	1.110	1.01	-	-	-	-
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Body 1.6 W/kg (mW/g) averaged over 1 gram					

12.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for 1g and < 3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

13. EQUIPMENT LIST

Table 13.1.1 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SPEAG	TX60L	N/A	N/A	F14/5VR2A1/A/01
☒	Robot Controller	SPEAG	CS8C	N/A	N/A	F14/5VR2A1/C/01
☒	Joystick	SPEAG	N/A	N/A	N/A	D21142605A
☒	Intel Core i7-4770 3.40 GHz Windows 7 Professional	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Device Holder	SPEAG	SD000H01HA	N/A	N/A	N/A
☒	Twin SAM Phantom	SPEAG	QD000P40CD	N/A	N/A	1220
☒	Data Acquisition Electronics	SPEAG	DAE4V1	2020-04-22	2021-04-22	1391
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	2020-01-30	2021-01-30	7368
☒	750MHz SAR Dipole	SPEAG	D750V3	2020-01-22	2022-01-22	1049
☒	835MHz SAR Dipole	SPEAG	D835V2	2020-05-19	2022-05-19	4d159
☒	1800MHz SAR Dipole	SPEAG	D1800V2	2020-03-20	2022-03-20	2d202
☒	1900MHz SAR Dipole	SPEAG	D1900V2	2020-05-19	2022-05-19	5d176
☒	2450MHz SAR Dipole	SPEAG	D2450V2	2019-09-19	2021-09-19	726
☒	5GHz SAR Dipole	SPEAG	D5GHzV2	2020-02-27	2022-02-27	1212
☒	Network Analyzer	Agilent	E5071C	2020-06-24	2021-06-24	MY46106970
☒	Signal Generator	Agilent	E4438C	2020-06-24	2021-06-24	US41461520
☒	Amplifier	RFBAY.Inc	MPA-40-40	2019-12-16	2020-12-16	21151801
☒	Amplifier	EMPOWER	BBS3Q7ELU	2020-06-24	2021-06-24	1020
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2020-06-24	2021-06-24	1005
☒	Power Meter	HP	EPM-442A	2019-12-16	2020-12-16	GB37170267
☒	Power Meter	HP	EPM-442A	2019-12-16	2020-12-16	GB37170413
☒	Power Sensor	HP	8481A	2019-12-16	2020-12-16	US37294267
☒	Power Sensor	HP	8481A	2019-12-16	2020-12-16	3318A96566
☒	Power Sensor	HP	8481A	2019-12-16	2020-12-16	2702A65976
☒	Dual Directional Coupler	Agilent	778D-012	2019-12-16	2020-12-16	50228
☒	Directional Coupler	HP	772D	2020-06-24	2021-06-24	2889A01064
☒	Low Pass Filter 1GHz	Wainwright Instruments	WLK6-1000-1400-9000-60SS	2020-06-24	2021-06-24	165
☒	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	2020-06-24	2021-06-24	2
☒	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	2020-06-24	2021-06-24	2
☒	Low Pass Filter 6.0GHz	Micro LAB	LA-60N	2019-12-16	2020-12-16	03942
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2019-12-16	2020-12-16	BP4387
☒	Attenuators	Cernexwave	CFADC2603U5	2020-06-24	2021-06-24	C11711
☒	Dielectric Probe kit	SPEAG	DAK-3.5	2019-11-19	2020-11-19	1092
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2020-06-24	2021-06-24	GB41321164
☒	Wideband Radio Communication Tester	Rohde Schwarz	CMW500	2019-12-16	2020-12-16	101414
☒	Radio Communication Analyzer	Agilent	E5515E	2020-06-24	2021-06-24	MY52113012
☒	Power Splitter	Anritsu	K241B	2019-12-16	2020-12-16	1301183
☒	Bluetooth Tester	TESCOM	TC-3000C	2020-06-24	2021-06-24	3000C000563

NOTE(S):

1. The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by DT&C before each test. The brain and muscle simulating material are calibrated by DT&C using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain and muscle-equivalent material. Each equipment item was used solely within its respective calibration period.
2. 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. 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.

14. MEASUREMENT UNCERTAINTIES

750 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	4.0	Normal	1	0.78	0.71	3.1	2.8	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.0	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	2.0	Rectangular	√3	0.78	0.71	0.9	0.8	∞
Temp. unc. - Permittivity	1.9	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**11**	330
Expanded Uncertainty (k=2)						**24**	**22**	

$U(1\ g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % k = 2)
$U(10\ g) = k \cdot u_c$
= 2 · 11 %
= 22 % (The confidence level is about 95 % k = 2)

The above measurement uncertainties are according to IEEE Std 1528

835 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	3.9	Normal	1	0.78	0.71	3.0	2.8	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	3.8	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	1.8	Rectangular	√3	0.78	0.71	0.8	0.7	∞
Temp. unc. - Permittivity	1.7	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						**12**	**11**	330
Expanded Uncertainty (k=2)						**24**	**22**	

$U(1\ g) = k \cdot u_c$
$= 2 \cdot 12\ \%$
$= 24\ \%$ (The confidence level is about 95 % $k = 2$)
$U(10\ g) = k \cdot u_c$
$= 2 \cdot 11\ \%$
$= 22\ \%$ (The confidence level is about 95 % $k = 2$)

The above measurement uncertainties are according to IEEE Std 1528

1 800 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	4.0	Normal	1	0.78	0.71	3.1	2.8	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.2	Normal	1	0.23	0.26	1.0	1.1	10
Temp. unc. - Conductivity	2.1	Rectangular	√3	0.78	0.71	0.9	0.9	∞
Temp. unc. - Permittivity	2.1	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**11**	330
Expanded Uncertainty (k=2)						**24**	**22**	

$U(1\,g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % k = 2)
$U(10\,g) = k \cdot u_c$
= 2 · 11 %
= 22 % (The confidence level is about 95 % k = 2)

The above measurement uncertainties are according to IEEE Std 1528

1 900 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	3.8	Normal	1	0.78	0.71	3.0	2.7	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.0	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	1.8	Rectangular	√3	0.78	0.71	0.8	0.7	∞
Temp. unc. - Permittivity	1.9	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**11**	330
Expanded Uncertainty (k=2)						**24**	**22**	

$U(1\ g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % $k = 2$)
$U(10\ g) = k \cdot u_c$
= 2 · 11 %
= 22 % (The confidence level is about 95 % $k = 2$)

2 450 MHz Head

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	4.2	Normal	1	0.78	0.71	3.3	3.0	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.0	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	2.0	Rectangular	√3	0.78	0.71	0.9	0.8	∞
Temp. unc. - Permittivity	1.8	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						**12.**	**12**	330
Expanded Uncertainty (k=2)						**24**	**24**	

$U(1\ g) = k \cdot u_c$
= 2 . 12 %
= 24 % (The confidence level is about 95 % k = 2)
$U(10\ g) = k \cdot u_c$
= 2 . 12 %
= 24 % (The confidence level is about 95 % k = 2)

The above measurement uncertainties are according to IEEE Std 1528

5300 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.55	Normal	1	1	1	6.6	6.6	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	3.8	Normal	1	0.78	0.71	3.0	2.7	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.2	Normal	1	0.23	0.26	1.0	1.1	10
Temp. unc. - Conductivity	1.8	Rectangular	√3	0.78	0.71	0.8	0.7	∞
Temp. unc. - Permittivity	.2.0	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**12**	330
Expanded Uncertainty (k=2)						**24**	**24**	

$U(1\,g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % k = 2)
$U(10\,g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % k = 2)

The above measurement uncertainties are according to IEEE Std 1528

5500 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.55	Normal	1	1	1	6.6	6.6	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	3.7	Normal	1	0.78	0.71	2.9	2.6	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	3.9	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	1.8	Rectangular	√3	0.78	0.71	0.8	0.7	∞
Temp. unc. - Permittivity	1.9	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**12**	330
Expanded Uncertainty (k=2)						**24**	**24**	

$U(1\ g) = k \cdot u_c$
= 2 . 12 %
= 24 % (The confidence level is about 95 % $k = 2$)
$U(10\ g) = k \cdot u_c$
= 2 . 12 %
= 24 % (The confidence level is about 95 % $k = 2$)

The above measurement uncertainties are according to IEEE Std 1528

5800 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.55	Normal	1	1	1	6.6	6.6	∞
Isotropy	1.3	Normal	1	1	1	1.3	1.3	∞
Boundary Effects	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Probe Linearity	0.3	Normal	1	1	1	0.3	0.3	∞
Probe modulation response	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Algorithms for Max. SAR Eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
SAR correction	0.0	Normal	1	1	0.84	0.0	0.0	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	3.8	Normal	1	0.78	0.71	3.0	2.7	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.0	Normal	1	0.23	0.26	0.9	1.0	10
Temp. unc. - Conductivity	1.8	Rectangular	√3	0.78	0.71	0.8	0.7	∞
Temp. unc. - Permittivity	1.9	Rectangular	√3	0.23	0.26	0.3	0.3	∞
Combined Standard Uncertainty						**12**	**12**	330
Expanded Uncertainty (k=2)						**24**	**24**	

$U(1\,g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % $k = 2$)
$U(10\,g) = k \cdot u_c$
= 2 · 12 %
= 24 % (The confidence level is about 95 % $k = 2$)

The above measurement uncertainties are according to IEEE Std 1528

15. CONCLUSION

Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are every 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 impossible biological effect 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 innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

16. REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radiofrequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radiofrequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003,Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. -124.

[9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid& Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct.1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bio electromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, Computer mathematick, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3 GHz), Feb. 2005.

[21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands) Issue 5, March 2015.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225,D01-D07

[24] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v02

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474D02-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] 615223 D01 802 16e WI-Max SAR Guidance v01, Nov. 13, 2009

[30] Anexo à Resolução No. 533, de 10 de September de 2009.

[31] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), Mar. 2010.

APPENDIX A. – Probe Calibration Data

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 0108

Client **DT&C (Dymstec)** **Certificate No: EX3-7368_Jan20**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7368
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	January 30, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: January 30, 2020

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

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

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

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

Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.48	0.56	0.41	± 10.1 %
DCP (mV)[B]	103.2	100.2	100.3	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	185.3	± 3.5 %	± 4.7 %
		Y	0.0	0.0	1.0		173.0		
		Z	0.0	0.0	1.0		174.3		

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 Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 5).
[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:7368

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-23.8
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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

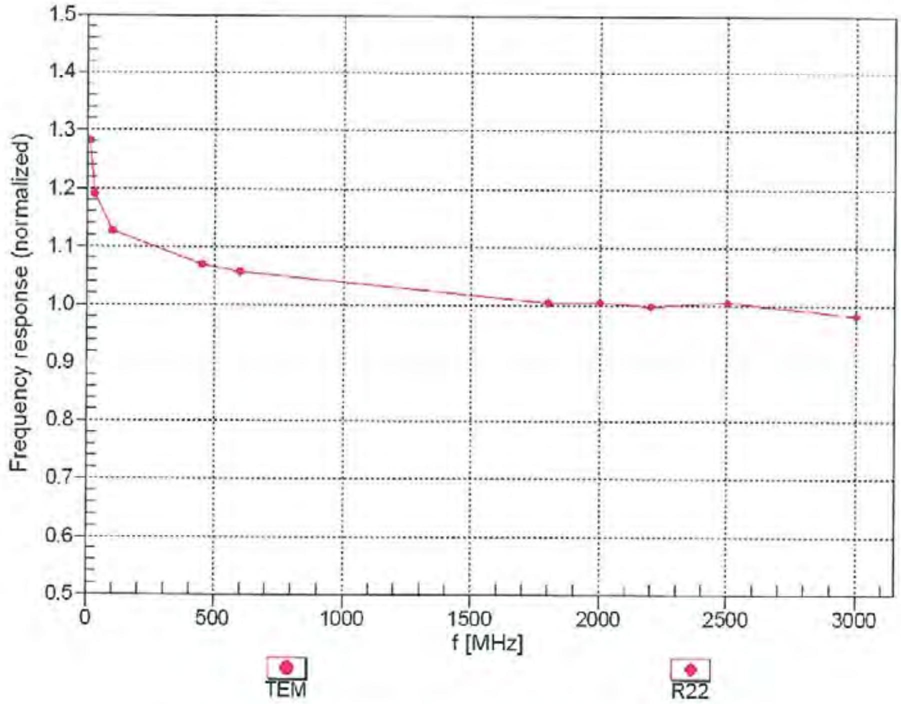
Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	9.89	9.89	9.89	0.64	0.82	± 12.0 %
835	41.5	0.90	9.67	9.67	9.67	0.56	0.84	± 12.0 %
900	41.5	0.97	9.46	9.46	9.46	0.38	1.05	± 12.0 %
1750	40.1	1.37	8.78	8.78	8.78	0.38	0.85	± 12.0 %
1900	40.0	1.40	8.43	8.43	8.43	0.29	0.85	± 12.0 %
2450	39.2	1.80	7.81	7.81	7.81	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.44	7.44	7.44	0.35	0.90	± 12.0 %
3500	37.9	2.91	7.05	7.05	7.05	0.35	1.30	± 13.1 %
3700	37.7	3.12	6.98	6.98	6.98	0.35	1.30	± 13.1 %
5200	36.0	4.66	5.66	5.66	5.66	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.45	5.45	5.45	0.40	1.80	± 13.1 %
5500	35.6	4.96	5.04	5.04	5.04	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.85	4.85	4.85	0.40	1.80	± 13.1 %
5800	35.3	5.27	5.02	5.02	5.02	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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to 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)

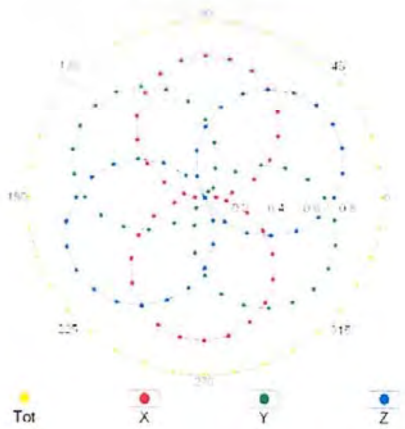


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

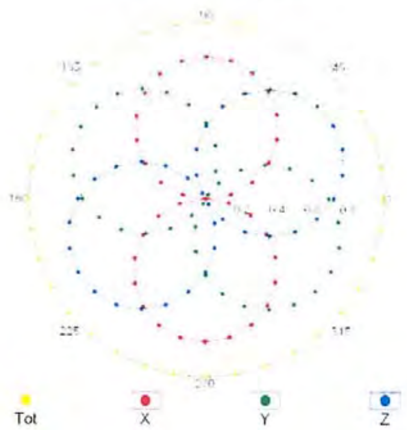
EX3DV4– SN:7368 January 30, 2020

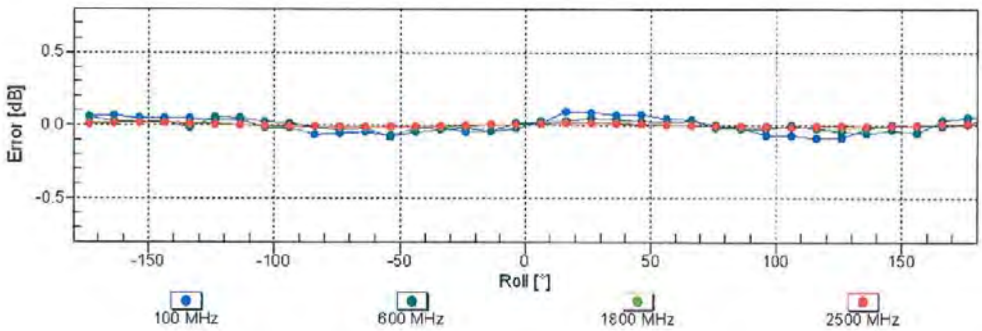
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

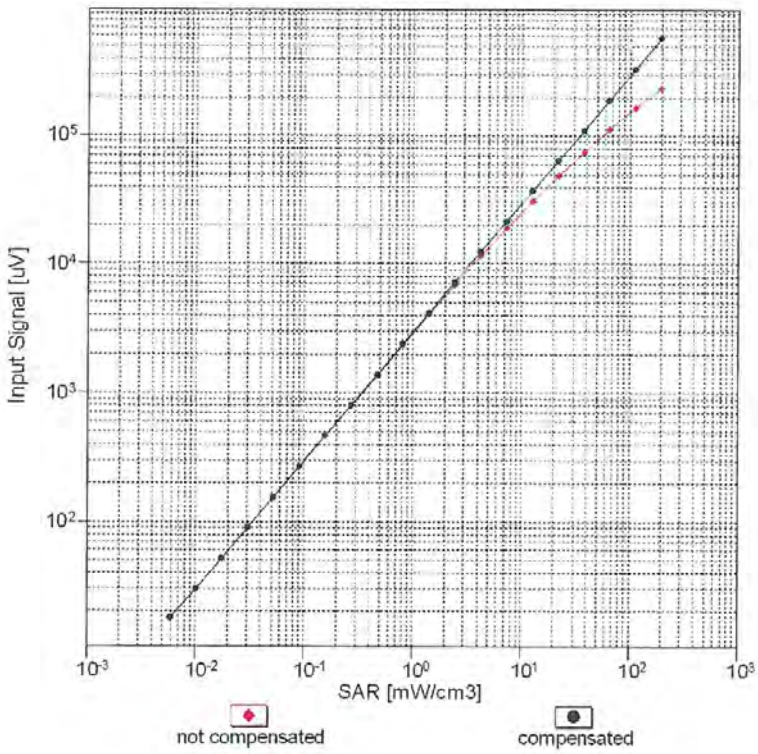


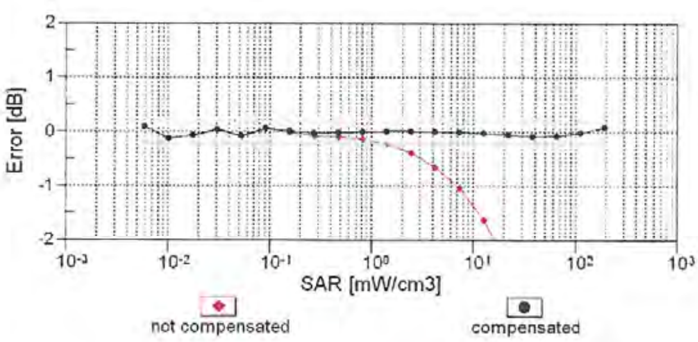


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

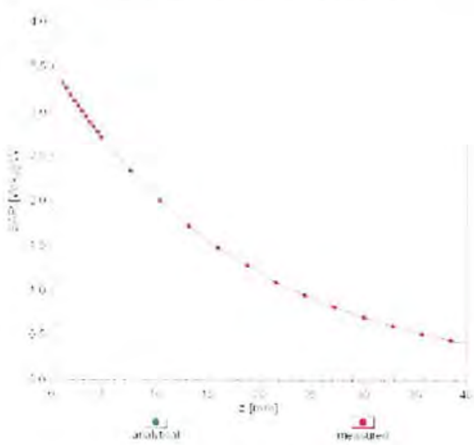
(TEM cell , f_{eval}= 1900 MHz)

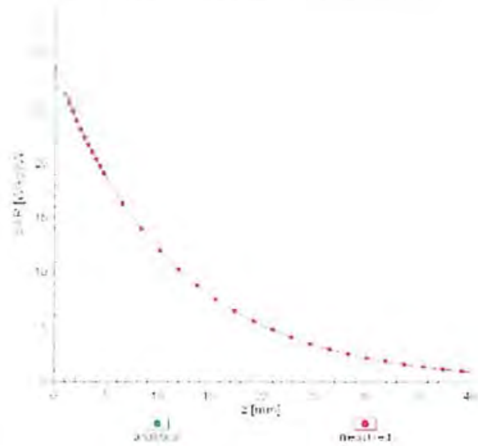




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

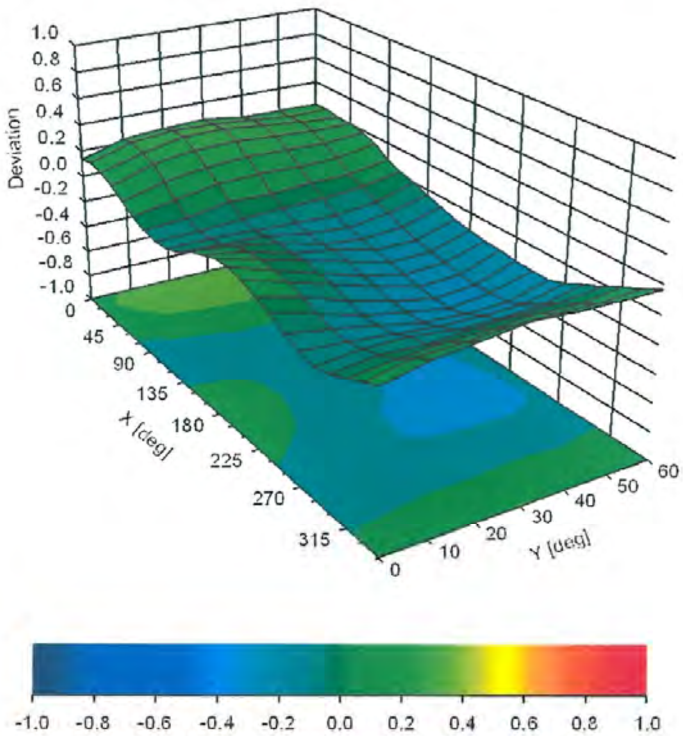
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

APPENDIX B. – Dipole Calibration Data

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

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Accreditation No.: SCS 0108

Client DT&C (Dymstec)

Certificate No: D750V3-1049_Jan20

CALIBRATION CERTIFICATE

Object	D750V3 - SN:1049
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	January 22, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: January 23, 2020

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

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.8 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.47 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.58 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.2 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.60 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6 Ω - 2.2 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω - 4.1 jΩ
Return Loss	- 27.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 22.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

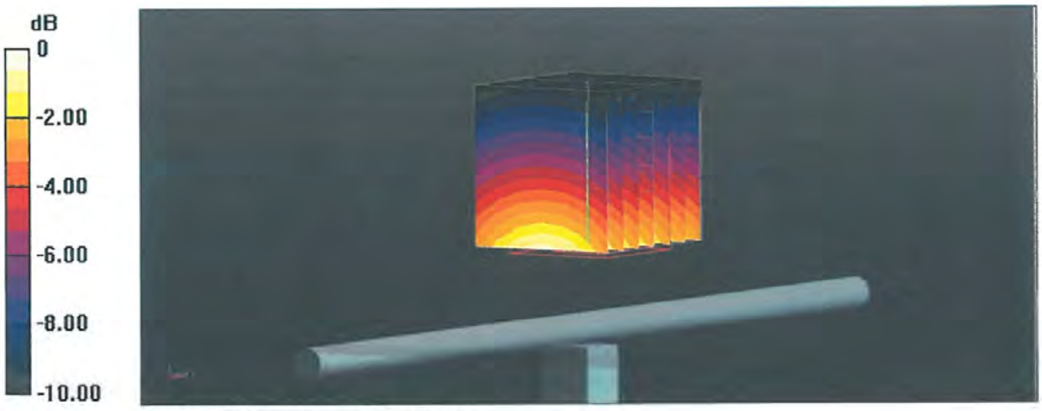
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1049

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.88 S/m; ε_r = 42.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

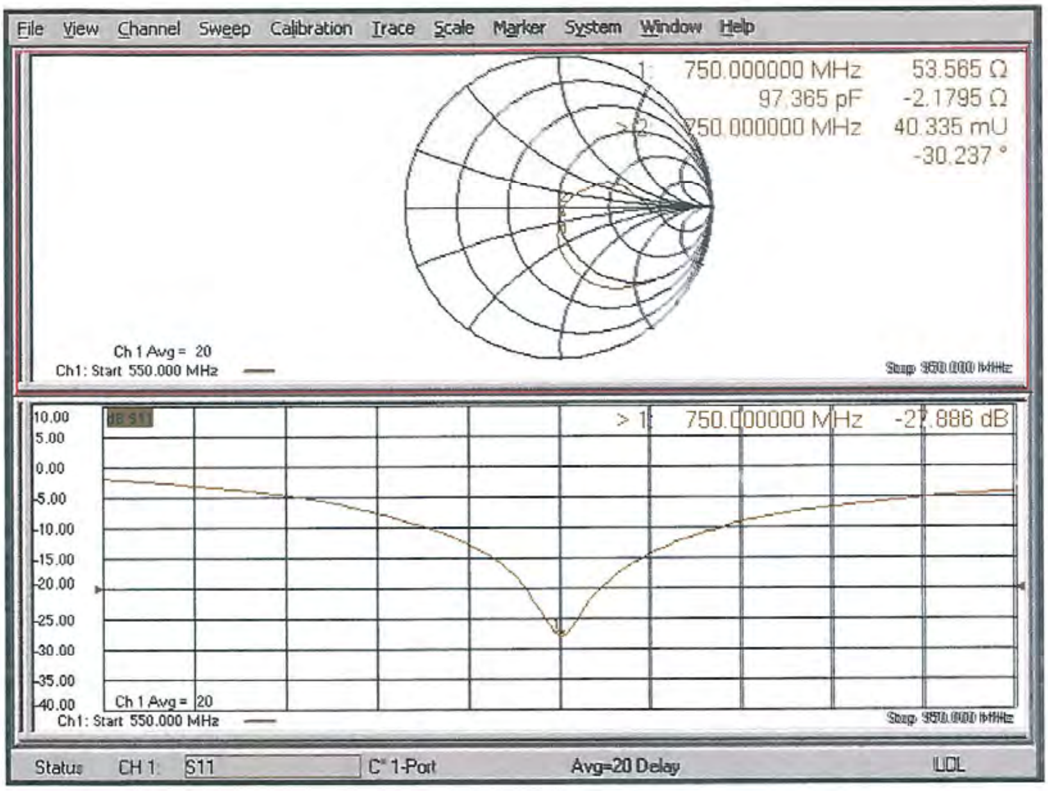
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.52 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.11 W/kg
SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.38 W/kg
Ratio of SAR at M2 to SAR at M1 = 67.1%
Maximum value of SAR (measured) = 2.78 W/kg



0 dB = 2.78 W/kg = 4.44 dBW/kg

Certificate No: D750V3-1049_Jan20 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

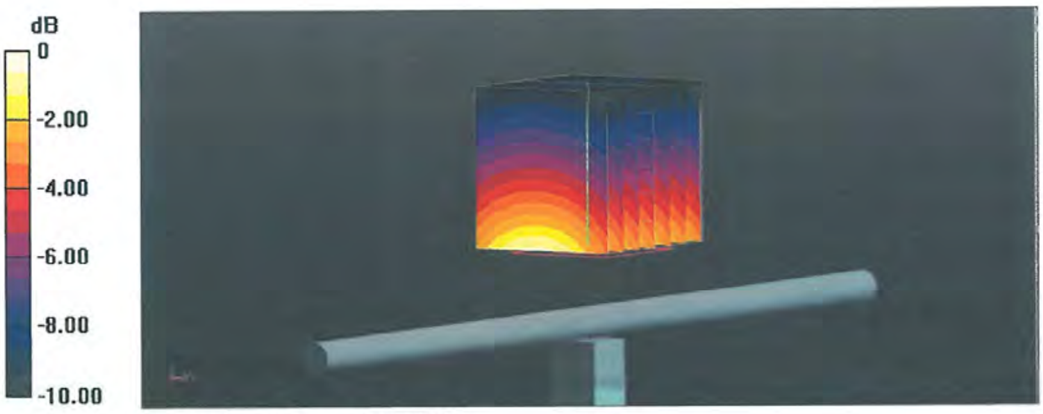
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1049

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ε_r = 55.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

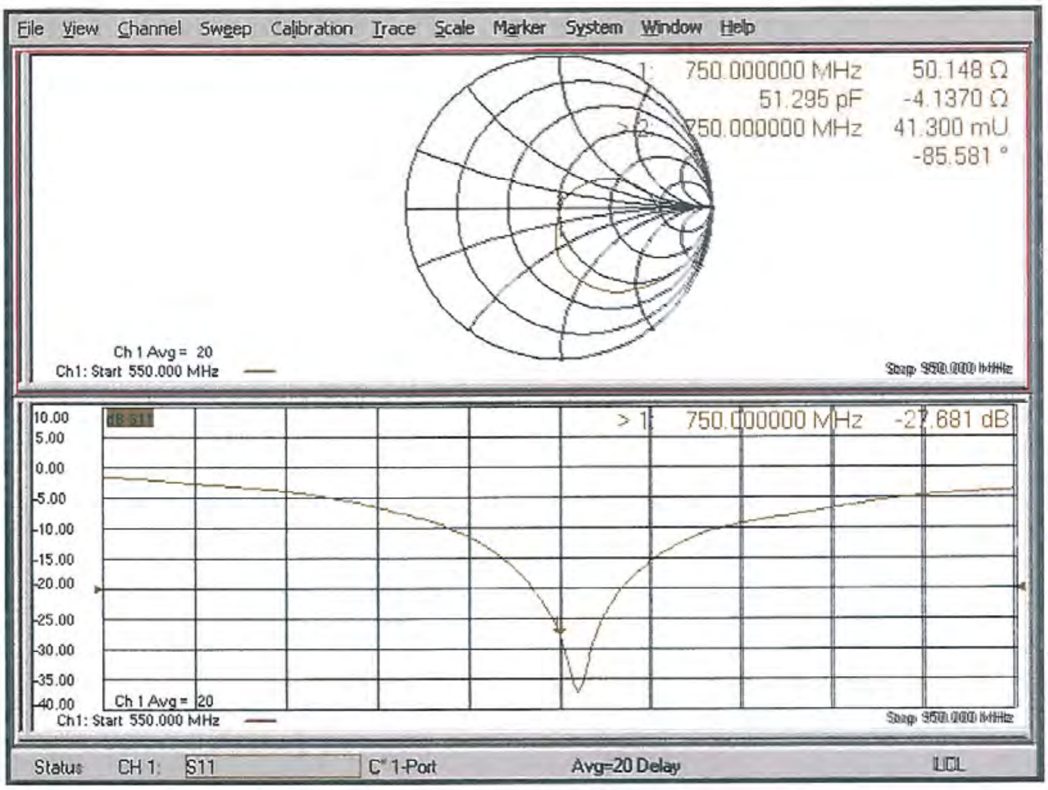
- Probe: EX3DV4 - SN7349; ConvF(10.61, 10.61, 10.61) @ 750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.29 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.16 W/kg
SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.4 W/kg
Smallest distance from peaks to all points 3 dB below = 16 mm
Ratio of SAR at M2 to SAR at M1 = 66.9%
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **D835V2-4d159_May20**

CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d159
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	May 19, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 22, 2020

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.47 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.17 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.50 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.29 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5 Ω - 4.3 jΩ
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.3 Ω - 7.0 jΩ
Return Loss	- 22.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.439 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 19.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

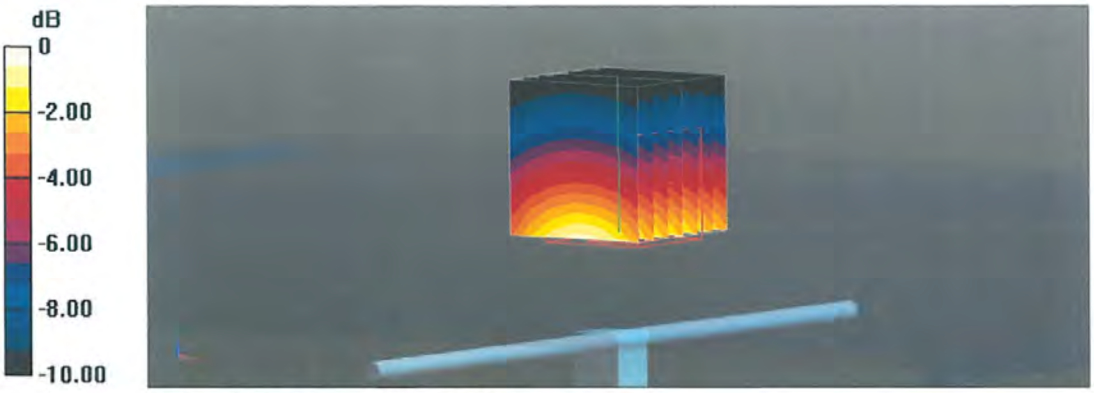
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d159

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.93$ S/m; $\varepsilon_r = 42.0$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

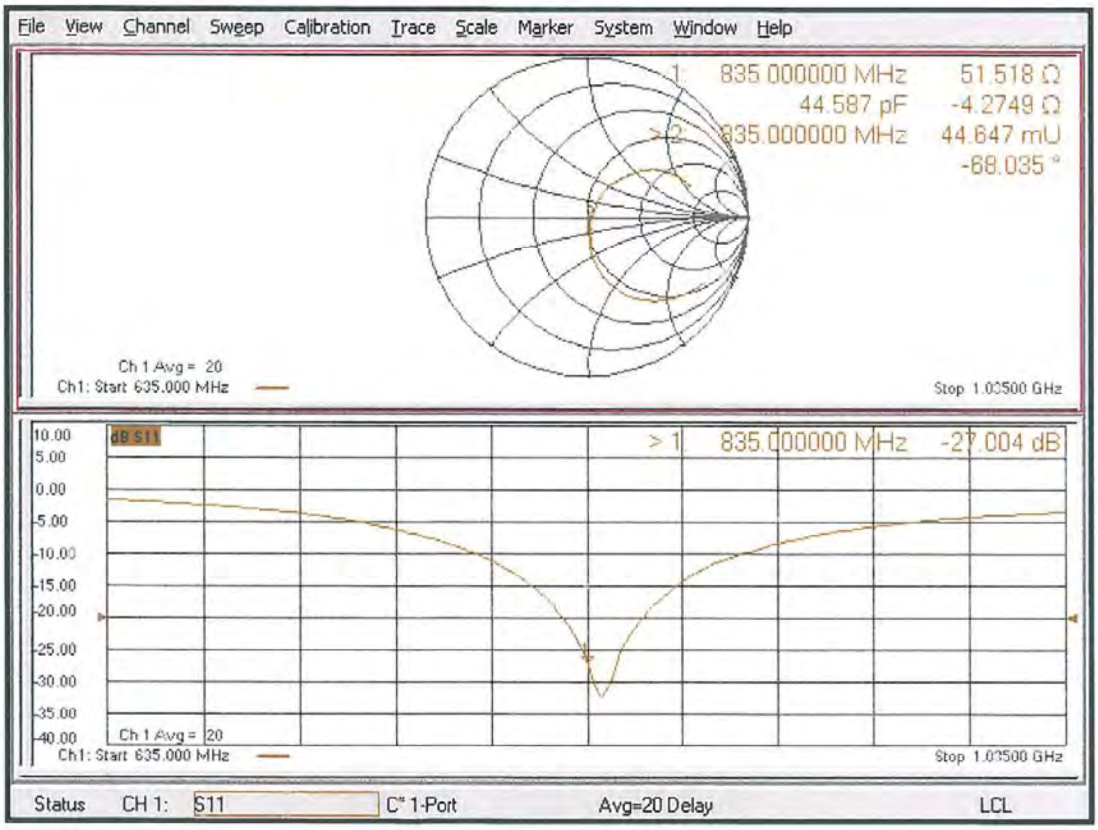
- Probe: EX3DV4 - SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.34 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg
Smallest distance from peaks to all points 3 dB below = 17 mm
Ratio of SAR at M2 to SAR at M1 = 67.5%
Maximum value of SAR (measured) = 3.18 W/kg



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

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d159_May20 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 19.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

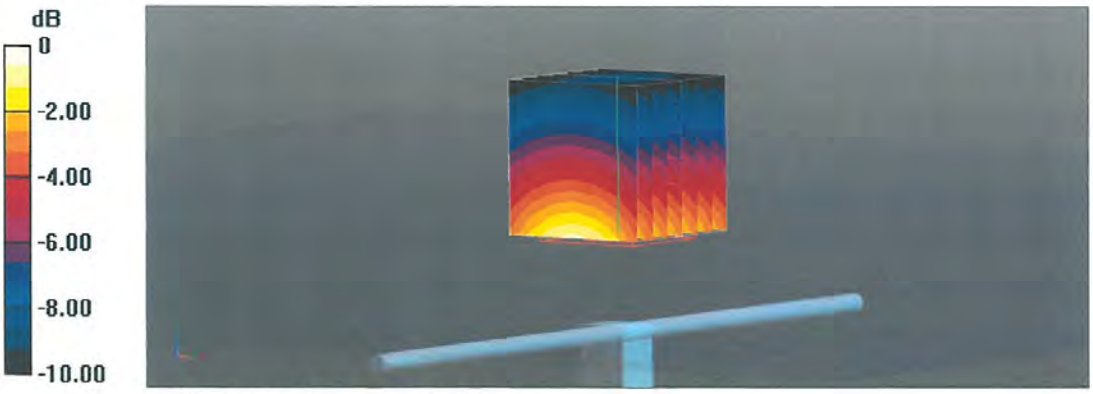
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d159

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

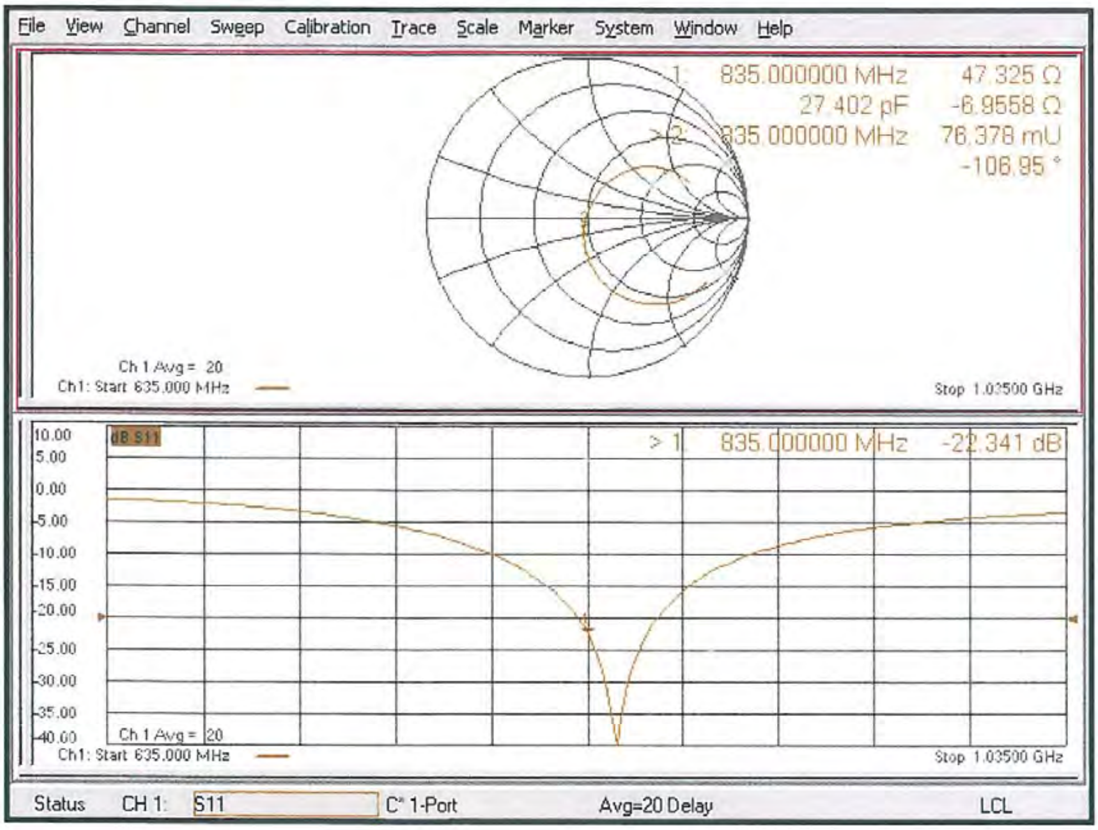
- Probe: EX3DV4 - SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.84 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.53 W/kg
SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.59 W/kg
Smallest distance from peaks to all points 3 dB below = 15.3 mm
Ratio of SAR at M2 to SAR at M1 = 68.5%
Maximum value of SAR (measured) = 3.17 W/kg



0 dB = 3.17 W/kg = 5.01 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d159_May20 Page 8 of 8

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

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Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **D1800V2-2d202_Mar20**

CALIBRATION CERTIFICATE

Object	D1800V2 - SN:2d202
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	March 20, 2020

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: March 20, 2020

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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.6 Ω - 2.0 jΩ
Return Loss	- 32.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.0 Ω - 3.5 jΩ
Return Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.212 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 20.03.2020

Test Laboratory: SPEAG, Zurich, Switzerland

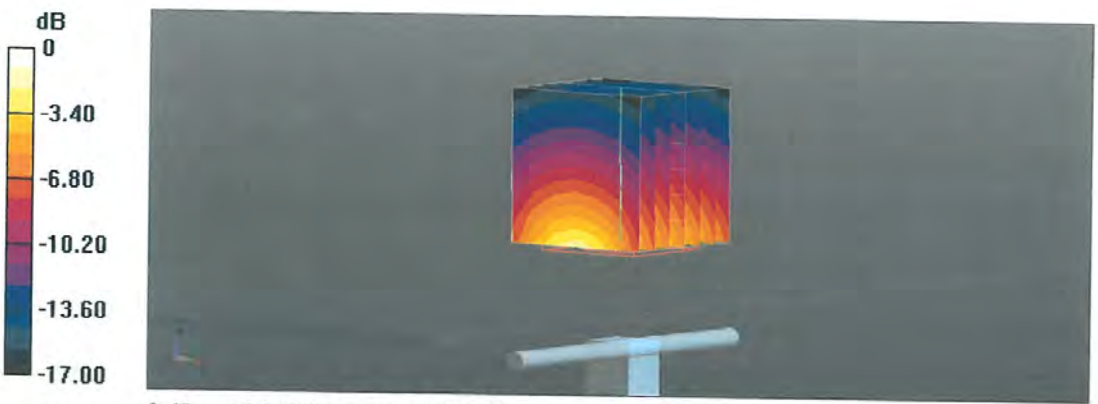
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d202

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.37 S/m; ε_r = 40.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

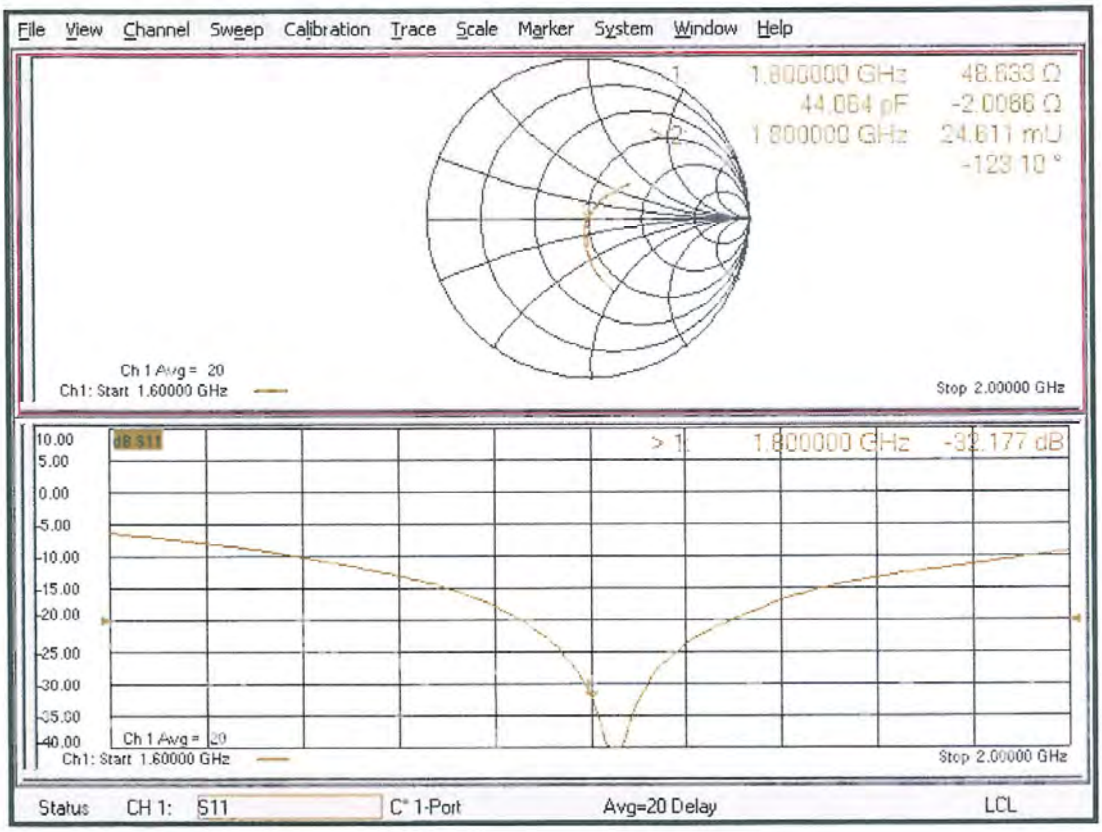
- Probe: EX3DV4 - SN7349; ConvF(8.64, 8.64, 8.64) @ 1800 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 110.3 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 18.1 W/kg
SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.13 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 54.4%
Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.03.2020

Test Laboratory: SPEAG, Zurich, Switzerland

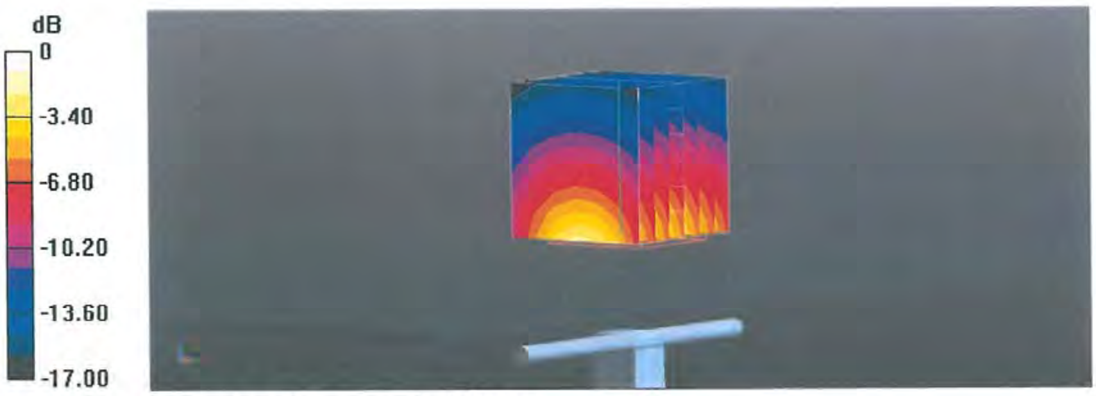
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d202

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.48 S/m; ε_r = 53.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

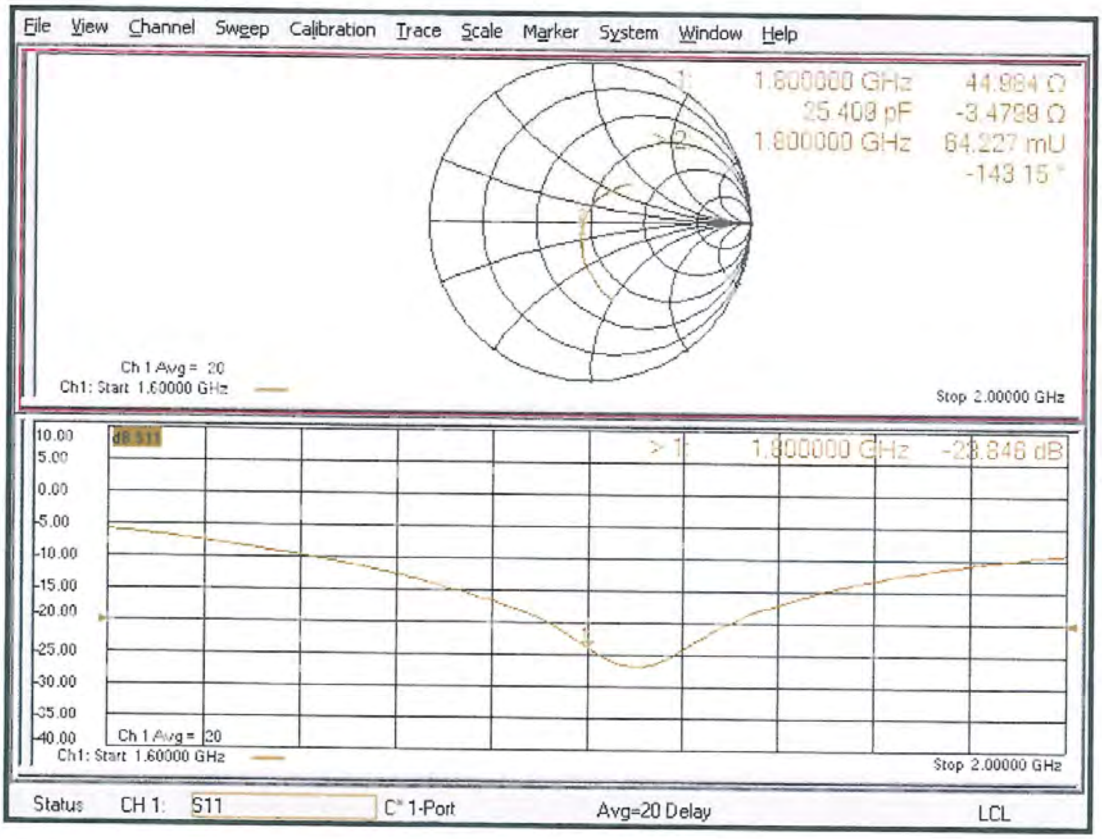
- Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1800 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 104.2 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 17.1 W/kg
SAR(1 g) = 9.59 W/kg; SAR(10 g) = 5.04 W/kg
Smallest distance from peaks to all points 3 dB below = 9.8 mm
Ratio of SAR at M2 to SAR at M1 = 57.2%
Maximum value of SAR (measured) = 14.5 W/kg



0 dB = 14.5 W/kg = 11.61 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D1800V2-2d202_Mar20 Page 8 of 8