FCC SAR Test Report

APPLICANT	:	Motorola Mobility LLC
EQUIPMENT	:	Mobile Cellular Phone
BRAND NAME	:	Motorola
MODEL NAME	:	XT2201-4
FCC ID	:	IHDT56AB3
STANDARD	:	FCC 47 CFR Part 2 (2.1093)

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA192317-13	Rev. 01	Initial issue of report.	May 07, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Motorola Mobility LLC, Mobile Cellular Phone, XT2201-4, a**re as follows.

Highest 1g SAR Summary						
Equipment Class	Frequency Band		Head (Separation 0mm)	Hotspot (Separation 5mm)	Body-worn (Separation 5mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)			
Licensed	5G NR	n48	**0.91**	**0.97**	**1.25**	1.50
Highest 10g SAR Summary						
Equipment Class	Frequency Band		Product Specific 10g SAR (W/kg) (Separation 0mm)			Highest Simultaneous Transmission 10g SAR (W/kg)
Licensed	5G NR	n48	**3.14**			3.14
Date of Testing:			2022/4/10			

Remark: This is a variant report for XT2201-4, the difference between current project and previous project is enabled 5G NR n48 by software. So according to the difference, only added 5G NR n48 full testing, and other bands SAR test results are leverage from original report which can be referred to original report (Sporton Report Number FA192317-02).

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR05-KS	CN1257	314309

Applicant	
Company Name	Motorola Mobility LLC
Address	222 W,Merchandise Mart Plaza, Chicago IL 60654 USA

Manufacturer	
Company Name	Motorola Mobility LLC
Address	222 W,Merchandise Mart Plaza, Chicago IL 60654 USA

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D05A Rel.10 LTE SAR Test Guidance v01r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
Model Name	XT2201-4
FCC ID	IHDT56AB3
IMEI Code	357193870008333
Wireless Technology and Frequency Range	GSM850: 824 MHz ~ 849 MHz GSM1900: 1850 MHz ~ 1910 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz 5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3800 MHz 5G NR n260 : 37 GHz~40 GHz 5G NR n261 : 27.5 GHz~28.35 GHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz WLAN 6E U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6E U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6E U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6E U-NII-8: 6875 MHz ~ 7125 MHz Bluetooth: 2402 MHz ~ 2480 MHz WPC: 110 kHz ~ 148 kHz NFC: 13.56 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+(16QAM uplink is not supported) LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR : CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 WLAN 6GHz 802.11a WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE WPC: ASK NFC: ASK
HW Version	DVT2
SW Version	S1SH32.10
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
EUT Stage	Identical Prototype
Remark:	

1. This device supports VoIP in GPRS, EGPRS, WCDMA and LTE (e.g. for 3rd-party VoIP), LTE supports VoLTE operation.
2. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
3. This device 5.2GHz WLAN/5.8GHz WLAN support hotspot operation, and 5.2GHz WLAN/5.8GHz WLAN supports WiFi Direct (GC/GO), and 5.3GHz / 5.5GHz supports WiFi Direct (GC only). WIFI 6E has no hotspot function.
4. The 2.4GHz/5GHz/6GHz WLAN can transmit in MIMO antenna mode only and it has no SISO antenna mode.
5. This device does not support DTM operation and supports GPRS/EGPRS mode up to multi-slot class 12.
6. This device has NFC operations, the NFC antenna is integrated into the device for this model, therefore, all SAR test were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the antenna can be found in the operational description. According to FCC KDB publication 447498 D01v06, transmitters are consider to be operating simultaneously when there is overlapping transmission, with the exception of transmission during network hand-offs with maximum hand-off duration less than 30 seconds.
7. The device implements the power management and proximity sensor /receiver detection/hotspot mode for SAR compliance at different exposure conditions (head, body-worn, hotspot, extremity) and the Qualcomm smart transmit will manage to ensure the power level not exceeding the associated power table. Details about the power management decision and sensor detection are provided in the operational description. And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
8. For WLAN when transmit simultaneous with WWAN, power reduction will be activated to head and Handheld. For WLAN when transmit simultaneous with WWAN and Proximity sensors trigger, power reduction will be activated to body-worn and Handheld.
9. For some WWAN bands, sensor on reduced power level is higher than hotspot reduced power level, so front/back sensor on SAR can represent hotspot conservatively.
10. This device implements antenna tuning techniques for several WWAN (cellular) operating modes and frequencies for the purpose of improving antenna efficiency over a broad range of frequencies. Specifically, these techniques are employed in the WCDMA, LTE and 5GNR modes. In this report SAR was measured according to the normally required SAR configurations with the tuner active and worst tune state (auto tune) was used for SAR testing. The detail descriptions of the antenna tuner and supplemental data for additional information can be referred to original report.
11. 5G NR n77 supports HPUE, HPUE power and SAR testing performed separately.
12. 5G NR n77 HUPE with higher power, 5G NR n77 HUPE SAR can represent power class 3 level SAR.
13. 5G NR n48/n77/n78 supports MIMO mode at Antenna 2 and Antenna 7.
14. For 5G NR n77 HUPE, duty cycle is 50% considered in SAR testing. For 5G NR test, using FTM (Factory Test Mode) to perform SAR with default 100% transmission.
15. NSA and SA mode should perform SAR separately. For the maximum power of NSA mode is the same as SA total power level, so SA SAR can represent NSA mode SAR.
16. 5GNR NSA mode, the power level is the same as 5GNR SA mode, so 5GNR NSA mode and SA mode power table only show one time.
17. 5G NR supports CP-OFDM and DFT-s-OFDM modulation, for DFT-s-OFDM power is higher than CP-OFDM, so only show DFT-s-OFDM power table and chose DFT-s-OFDM to perform SAR testing.
18. For DFT-s-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for the CP-OFDM mode will not higher than DFT-s-OFDM mode, therefore, CP-OFDM measurement is unnecessary.
19. This device supports 5GNR FR1 bands as following table, including NSA mode and SA mode. NSA and SA mode performed SAR separately.
20. SAR Power density test report for WIFI 6E U-NII-5/6/7/8 will be separately submitted. About co-located SAR with WWAN/Bluetooth, always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and U-NII-5/6/7/8.
21. RF exposure report for WPC (Wireless power charging) will be separately submitted.
22. The device support DBS (Dual Band Simultaneous) function, when the device 2.4GHz and 5GHz or 6GHz transmit at the same time the module will limit different output power for simultaneous transmission compliance.

<5G NR>

Mode	Band	Duplex	SCS(KHz)	Bandwidths(BW)
NSA	n2	FDD	15	5, 10, 15, 20
	n5	FDD	15	5, 10, 15, 20
	n66	FDD	15	5, 10, 15, 20, 30, 40
	n77	TDD	30	20, 30, 40, 50, 60, 70, 80, 90, 100
	n78	TDD	30	20, 30, 40, 50, 60, 70, 80, 90, 100
SA	n2	FDD	15	5, 10, 15, 20
	n5	FDD	15	5, 10, 15, 20
	n66	FDD	15	5, 10, 15, 20, 30, 40
	n48	TDD	30	10, 20, 30, 40

	n77	TDD	30	20, 30, 40, 50, 60, 70, 80, 90, 100
	n78	TDD	30	20, 30, 40, 50, 60, 70, 80, 90, 100

4.2 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r05	
FCC ID	IHDT56AB3
Equipment Name	Mobile Cellular Phone
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz
Channel Bandwidth	LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 7: 5MHz, 10MHz, 15MHz, 20MHz LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 13: 5MHz, 10MHz LTE Band 48: 5MHz, 10MHz, 15MHz, 20MHz LTE Band 66:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
uplink modulations used	QPSK / 16QAM / 64QAM / 256QAM
LTE Voice / Data requirements	Voice and Data
LTE Release Version	R16, Cat18
CA Support	Supported, Uplink and Downlink
LTE MPR permanently built-in by design	**Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3** Modulation | Channel bandwidth / Transmission bandwidth (N_{RB}) | MPR (dB) 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz QPSK: > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 1 16 QAM: ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 16 QAM: > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 2 64 QAM: ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 2 64 QAM: > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 3 256 QAM: ≥ 1 | ≤ 5
LTE A-MPR	In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)
Spectrum plots for RB configuration	A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.
Power reduction applied to satisfy SAR compliance	Yes, when operating in Proximity sensors/receiver/hotspot detect mechanism, head/body -worn /hotspot/extremity will trigger reduced power for some bands applied to satisfy SAR compliance, the detail please referred to original report.
LTE Carrier Aggregation Combinations	Inter-Band and Intra-Band possible combinations and the detail power verification please referred to original report.
LTE Carrier Aggregation Additional Information	1. This device supports LTE Carrier Aggregation (CA) in the uplink for intra-band and inter-band with two component carriers in the uplink. SAR Measurements and conducted powers were evaluated per FCC Guidance. 2. This device supports maximum of 7 carriers in the downlink and 2 carriers in the uplink.

Transmission (H, M, L) channel numbers and frequencies in each LTE band												
LTE Band 2												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900
LTE Band 4												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745
LTE Band 5								
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5
H	20643	848.3	20635	847.5	20625	846.5	20600	844
LTE Band 7								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20775	2502.5	20800	2505	20825	2507.5	20850	2510
M	21100	2535	21100	2535	21100	2535	21100	2535
H	21425	2567.5	21400	2565	21375	2562.5	21350	2560
LTE Band 12								
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	23017	699.7	23025	700.5	23035	701.5	23060	704
M	23095	707.5	23095	707.5	23095	707.5	23095	707.5
H	23173	715.3	23165	714.5	23155	713.5	23130	711
LTE Band 13				
	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Freq.(MHz)	Channel #	Freq.(MHz)
L	23205	779.5	23230	782
M	23230	782		
H	23255	784.5		

LTE Band 66												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq.(MHz)
L	131979	1710.7	131987	1711.5	131997	1712.5	132022	1715	132047	1717.5	132072	1720
M	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745
H	132665	1779.3	132657	1778.5	132647	1777.5	132622	1775	132597	1772.5	132572	1770

LTE Band 48								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	55265	3552.5	55290	3555	55315	3557.5	55340	3560
LM	55810	3607	55815	3607.5	55820	3608	55830	3609
MH	56170	3643	56165	3642.5	56160	3642	56150	3641
H	56715	3697.5	56690	3695	56665	3692.5	56640	3690

4.3 General 5G NR SAR Test and Reporting Considerations

5G NR Information	
Operating Frequency Range of each 5G NR transmission band	5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3800 MHz
Channel Bandwidth	5G NR n2: 5MHz, 10MHz, 15MHz, 20MHz 5G NR n5: 5MHz, 10MHz, 15MHz, 20MHz 5G NR n66: 5MHz, 10MHz, 15MHz, 20MHz, 30MHz, 40MHz 5G NR n48: 10MHz, 20MHz, 30MHz, 40MHz 5G NR n77: 20MHz, 30MHz, 40MHz, 50MHz, 60MHz, 70MHz, 80MHz, 90MHz, 100MHz 5G NR n78: 20MHz, 30MHz, 40MHz, 50MHz, 60MHz, 70MHz, 80MHz, 90MHz, 100MHz
SCS	FDD: SCS15KHz, TDD: SCS30KHz
uplink modulations used	DFT-s-OFDM: PI/2 BPSK / QPSK / 16QAM / 64QAM / 256QAM CP-OFDM: QPSK / 16QAM / 64QAM / 256QAM
A-MPR (Additional MPR) disabled for SAR Testing?	Yes
LTE Anchor Bands for n2	LTE B5/13/66
LTE Anchor Bands for n5	LTE B2/48/66
LTE Anchor Bands for n66	LTE B2/5/13
LTE Anchor Bands for n77	LTE B5/7
LTE Anchor Bands for n78	LTE B5/7

Transmission (H, M, L) channel numbers and frequencies in each 5G NR band								
NR Band 2								
	Bandwidth 5MHz		Bandwidth 10MHz		Bandwidth 15MHz		Bandwidth 20MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	370500	1852.5	371000	1855	371500	1857.5	372000	1860
M	376000	1880	376000	1880	376000	1880	376000	1880
H	381500	1907.5	381000	1905	380500	1902.5	380000	1900

Transmission (H, M, L) channel numbers and frequencies in each 5G NR band								
NR Band 5								
	Bandwidth 5MHz		Bandwidth 10MHz		Bandwidth 15MHz		Bandwidth 20MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	165300	826.5	165800	829	166300	831.5	166800	834
M	167300	836.5	167300	836.5	167300	836.5	167300	836.5
H	169300	846.5	168800	844	168300	841.5	167800	839

NR Band 66												
	Bandwidth 5MHz		Bandwidth 10MHz		Bandwidth 15MHz		Bandwidth 20MHz		Bandwidth 30MHz		Bandwidth 40MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	342500	1712.5	343000	1715	343500	1717.5	344000	1720	345000	1725	346000	1730
M	349000	1745	349000	1745	349000	1745	349000	1745	349000	1745	349000	1745
H	355500	1777.5	355000	1775	354500	1772.5	354000	1770	353000	1765	352000	1760

NR Band 48								
	Bandwidth10MHz		Bandwidth20MHz		Bandwidth30MHz		Bandwidth 40MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	637000	3555	637334	3560.01	637668	3565.02	638000	3570
M	641666	3624.99	641666	3624.99	641666	3624.99	641666	3624.99
H	646332	3694.98	646000	3690	645666	3684.99	645332	3679.98

NR Band 77																				
	Bandwidth 20MHz		Bandwidth 30MHz		Bandwidth 40MHz		Bandwidth 50MHz		Bandwidth 60MHz		Bandwidth 70MHz		Bandwidth 80MHz		Bandwidth 90MHz		Bandwidth 100MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	647334	3710.01	647668	3715.02	648000	3720	648334	3725.01	648668	3730.02	649000	3735	649334	3740.01	649668	3745.02	650000	3750
M	656000	3840	656000	3840	656000	3840	656000	3840	656000	3840	656000	3840	656000	3840	656000	3840	656000	3840
H	664668	3970.02	664334	3965.01	664000	3960	663668	3955.02	663334	3950.01	663000	3945	662668	3940.02	662334	3935.01	662000	3930

NR Band 78																		
	Bandwidth 20MHz		Bandwidth 30MHz		Bandwidth 40MHz		Bandwidth 50MHz		Bandwidth 60MHz		Bandwidth 70MHz		Bandwidth 80MHz		Bandwidth 90MHz		Bandwidth 100MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	647334	3710.01	647668	3715.02	648000	3720	648334	3725.01	648668	3730.02	649000	3735	649334	3740.01	649668	3745.02		
M	650000	3750	650000	3750	650000	3750	650000	3750	650000	3750	650000	3750	650000	3750	650000	3750	650000	3750
H	652668	3790.02	652334	3785.01	652000	3780	651668	3775.02	651334	3770.01	651000	3765	650668	3760.02	650334	3755.01		

For <3450 MHz ~ 3550 MHz >

NR Band 77																		
	Bandwidth 20MHz		Bandwidth 30MHz		Bandwidth 40MHz		Bandwidth 50MHz		Bandwidth 60MHz		Bandwidth 70MHz		Bandwidth 80MHz		Bandwidth 90MHz		Bandwidth 100MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	630668	3460.02	631000	3465	631334	3470.01	631668	3475.02	632000	3480	632334	3485.01	632668	3490.02	633000	3495		
M	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01
H	636000	3540	635666	3534.99	635332	3529.98	635000	3525	634666	3519.99	634332	3514.98	634000	3510	633666	3504.99		

NR Band 78																		
	Bandwidth 20MHz		Bandwidth 30MHz		Bandwidth 40MHz		Bandwidth 50MHz		Bandwidth 60MHz		Bandwidth 70MHz		Bandwidth 80MHz		Bandwidth 90MHz		Bandwidth 100MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	630668	3460.02	631000	3465	631334	3470.01	631668	3475.02	632000	3480	632334	3485.01	632668	3490.02	633000	3495		
M	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01	633334	3500.01
H	636000	3540	635666	3534.99	635332	3529.98	635000	3525	634666	3519.99	634332	3514.98	634000	3510	633666	3504.99		

5. Smart Transmit feature for RF Exposure compliance

The RF exposure limit is defined based on time-averaged RF exposure. The product implements Qualcomm Smart Transmit feature which controls the instantaneous transmitting power for WWAN transmitter to ensure the product in compliance with RF exposure limit over a defined time window, for SAR (transmit frequency ≤ 6GHz). To control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is compliant to the regulation requirement.

This report describes the procedures for the SAR char generation, and the parameters obtained from SAR characterization (referred to as SAR char, respectively) will be used as input for Smart Transmit. SAR char will be entered via the Embedded File System (EFS) to enable the Smart Transmit Feature.

<Terminologies in this report>

P_{limit}	The time-averaged RF power which corresponds to SAR_design_target.
P_{max}	Maximum target power level
SAR_design_target:	The design target for SAR compliance. It should be less than regulatory SAR limit to account for all device design related uncertainty.
SAR char	P_{limit} for all the technologies/bands for all applicable DSI

<SAR Characterization>

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at 6 GHz or below. It will then be used as input for Smart Transmit to control and manage RF exposure for f < 6 GHz.

<SAR design target and uncertainty>

	Uncertainty dB (k=2)
Total uncertainty	1.5

To account for total uncertainty, SAR_design_target should be determined as:

$$SAR\_design\_target < SAR_{regulatory\_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of SAR_design_target, below the predefined time-averaged power limit, for each characterized technology and band.

Smart Transmit allows the device to transmit at higher power instantaneously, as high as Pmax, when needed, but enforces power limiting to maintain time-averaged transmit power to Plimit. Below table shows Plimit EFS settings and maximum tune up output power Pmax configured for this EUT for various transmit conditions (Device State Index DSI).

<P_{limit} for supported technologies and bands (P_{limit} in EFS file)>

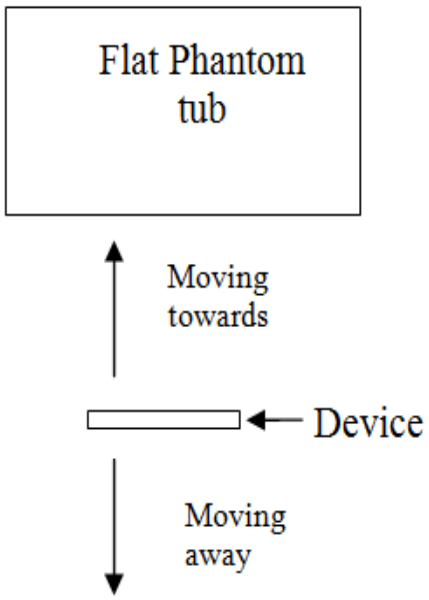
Band	Antenna	Head DSI 2 Standalone	Head DSI 2 Simultaneous	Body Worn DSI 3 Standalone	Body Worn & Hotspot DSI 3 Simultaneous	Extremely DSI6 Standalone	Extremely DSI6 Simultaneous	Sensor Off DSI4	Pmax*
FR1 n48	Ant 2	24.4	—	16.6	15.2	19.1	17.6	23.0	23.0
FR1 n48	Ant 7	28.9	—	18.8	17.1	22.3	20.8	23.0	23.0
FR1 n48	Ant 3	35.9	—	24.1	23.0	—	—	23.0	23.0
FR1 n48	Ant 8	37.1	—	19.3	17.7	19.3	19.3	19.3	19.3

Note: 1) *P_{max} is used for RF tune up procedure. The maximum allowed output power is equal to Pmax + 1.0 dB uncertainty.
2) All P_{limit} power levels entered in the Table correspond to average power levels after accounting for duty cycle in the case TDD modulation schemes (for e.g., GSM & LTE TDD).
3) The max allowed output power is the Plimit + 1.0 dB device uncertainty, and if Plimit is higher than Pmax, the device output power will be Pmax instead.
4) 5G NR n48 ant 3, and ant 8 support SRS (Sounding Reference Signal) functionality.

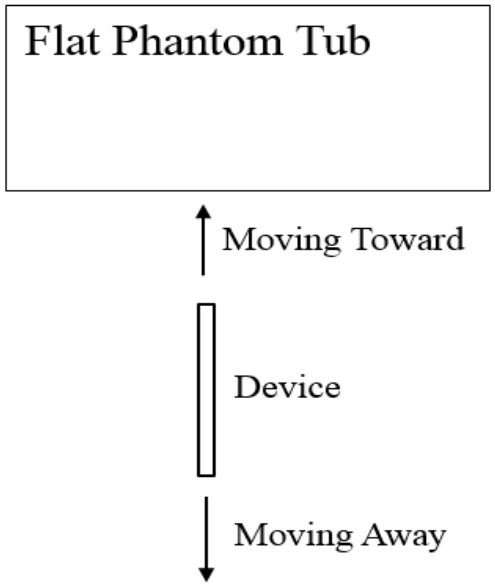
6. Proximity Sensor Triggering Test

<Proximity Sensor Triggering Distance>:

1. Proximity sensor triggering distance testing was performed according and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed and the tissue-equivalent medium for highest frequency (5850MHz) and lowest (835MHz) frequency was used for proximity sensor triggering testing.
2. Capacitive proximity sensors placed coincident with antenna elements at the top and bottom ends of the phone are utilized to determine when the device comes in proximity of the user's body at the front or back of the device.
3. The output power will reduce to body worn power level when top and bottom sensor pad be detected.
4. The sensors used to detect the proximity of the user's body at the front or back surface of the device use a detection threshold distance. The data shown in the sections below shows the distance(s). When front or back body worn condition is detected reduced power will be active.
5. The device employs proximity sensors also can detect the presence of the user's a finger or hand when handheld state at the front/back/top/bottom/left/right sides of the device. When front/back/top/bottom/left/right sides of handheld condition is detected reduced power will be active.
6. For verification of compliance of power reduction scheme, additional SAR testing with EUT transmitting at full RF power at a conservative trigger distance -1mm was performed:



Sensor detection test set-up, front and back sides



Sensor detection test set-up, top, bottom, left and right sides

<P-Sensor>

Proximity Sensor Triggering Distance (mm)				
Position	Front		Back	
	Moving towards	Moving away	Moving towards	Moving away
Minimum	19	21	22	23

<Handheld for ANT0>

Position	Front		Back		Bottom Side	
	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away
Minimum	10	13	13	15	15	17

<Handheld for ANT1>

Proximity Sensor Triggering Distance (mm)								
Position	Front		Back		Right Side		Top Side	
	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away
Minimum	10	12	13	15	7	8	14	15

<Handheld for ANT2/7>

Proximity Sensor Triggering Distance (mm)								
Position	Front		Back		Left Side		Top Side	
	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away
Minimum	6	7	19	23	21	24	4	5

<Handheld for ANT5>

Proximity Sensor Triggering Distance (mm)		
Position	Back	
	Moving towards	Moving away
Minimum	8	9

<Handheld for ANT6>

Proximity Sensor Triggering Distance (mm)		
Position	Back	
	Moving towards	Moving away
Minimum	5	7

7. RF Exposure Limits

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The 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.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

8. Specific Absorption Rate (SAR)

8.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

8.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

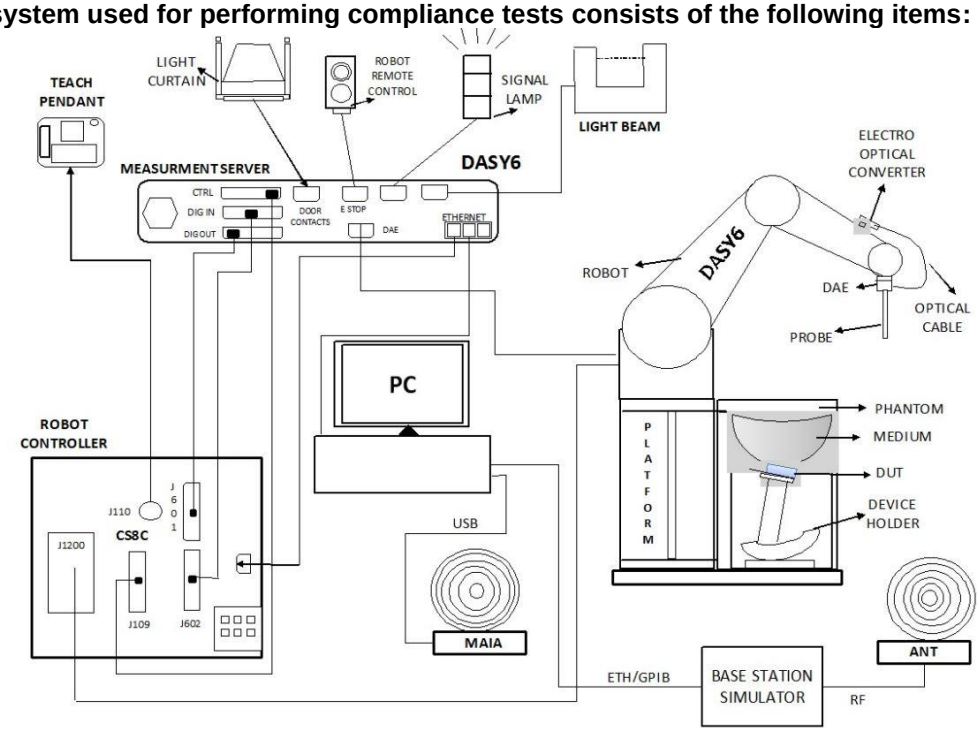
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

9. System Description and Setup

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 or Win10 and the DASY5 or DASY6 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

9.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/g)
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

9.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

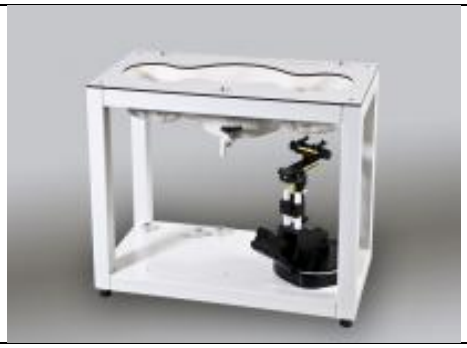
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Photo of DAE

9.3 Phantom

<SAM Twin Phantom>

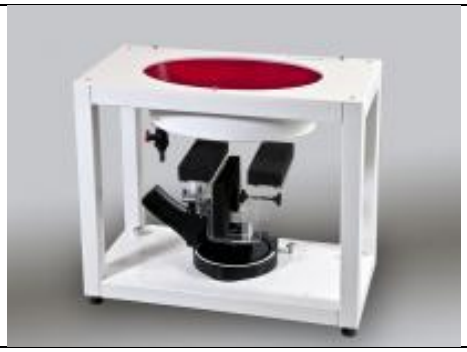
Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom



The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm



The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

9.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

10. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

10.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

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

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

10.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

10.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	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.	

10.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 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.

10.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

10.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

11. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	3500MHz System Validation Kit	D3500V2	1037	2020/11/25	2023/11/24
SPEAG	3700MHz System Validation Kit	D3700V2	1008	2020/11/25	2023/11/24
SPEAG	Data Acquisition Electronics	DAE4	1691	2021/10/4	2022/10/3
SPEAG	Dosimetric E-Field Probe	EX3DV4	3857	2021/11/24	2022/11/23
SPEAG	SAM Twin Phantom	SAM Twin	TP-2074	NCR	NCR
Testo	Thermo-Hygrometer	608-H1	1241332126	2022/1/6	2023/1/5
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46106933	2021/7/31	2022/7/30
SPEAG	Dielectric Probe Kit	DAK-3.5	1138	2021/6/9	2022/6/8
Anritsu	Vector Signal Generator	MG3710A	6201682672	2022/1/6	2023/1/5
Rohde & Schwarz	Power Meter	NRVD	102081	2021/8/12	2022/8/11
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2021/8/12	2022/8/11
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2021/8/12	2022/8/11
EXA	Spectrum Analyzer	FSV7	101631	2021/10/14	2022/10/13
FLUKE	DIGITAC THERMOMETER	51II	97240029	2021/10/23	2022/10/22
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	

Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

12. System Verification

12.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.2.

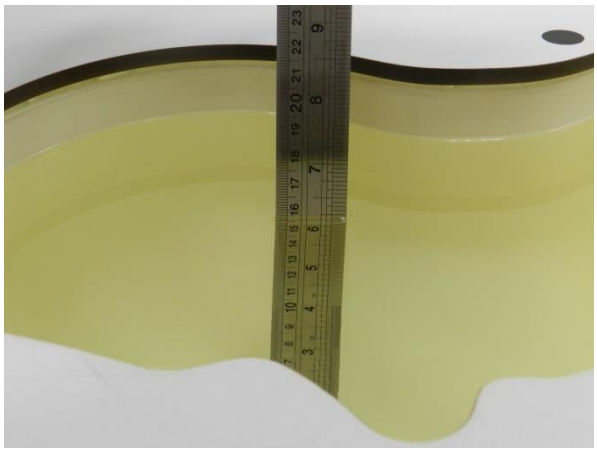


Fig 11.1 Photo of Liquid Height for Head SAR

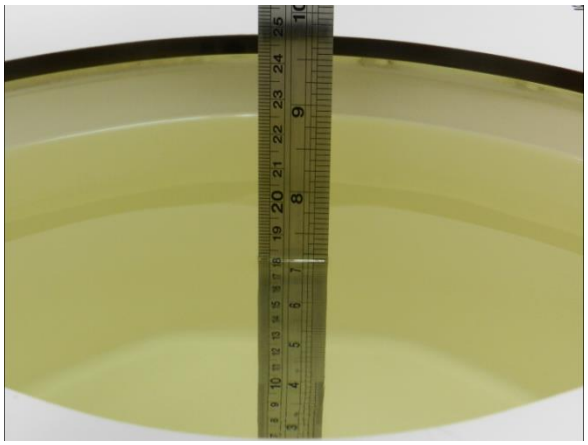


Fig 11.2 Photo of Liquid Height for Body SAR

12.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
3500	Head	22.7	2.780	39.600	2.91	37.90	-4.47	4.49	±5	2022/4/10
3700	Head	22.7	2.980	38.300	3.12	37.70	-4.49	1.59	±5	2022/4/10

12.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2022/4/10	3500	Head	50	1037	3857	1691	3.430	68.00	68.6	0.88
2022/4/10	3700	Head	50	1008	3857	1691	3.250	67.60	65	-3.85

<10g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2022/4/10	3500	Head	50	1037	3857	1691	1.330	25.40	26.6	4.72
2022/4/10	3700	Head	50	1008	3857	1691	1.290	24.40	25.8	5.74

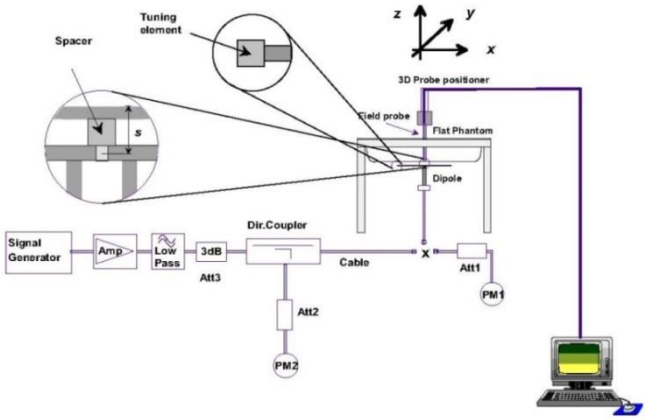


Fig 11.3.1 System Performance Check Setup

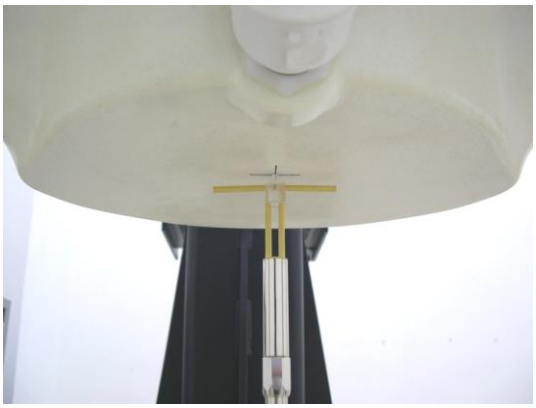


Fig 11.3.2 Setup Photo

13. RF Exposure Positions

13.1 Ear and handset reference point

Figure 12.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled “M,” the left ear reference point (ERP) is marked “LE,” and the right ERP is marked “RE.” Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 12.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 12.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 12.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

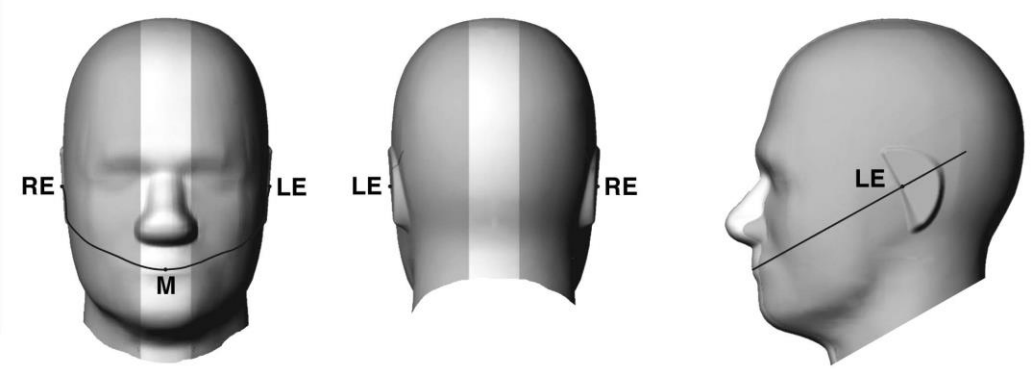


Fig 12.1.1 Front, back, and side views of SAM twin phantom

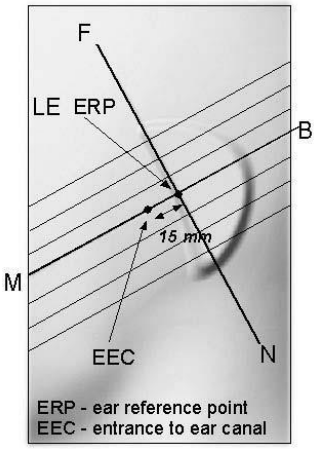


Fig 12.1.2 Close-up side view of phantom showing the ear region.

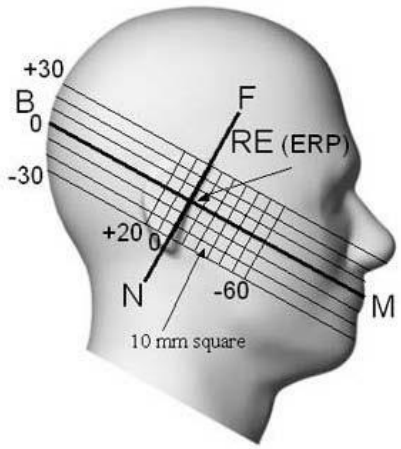


Fig 12.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

13.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Figure 12.2.1 and Figure 12.2.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 12.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 12.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 12.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 12.2.3. The actual rotation angles should be documented in the test report.

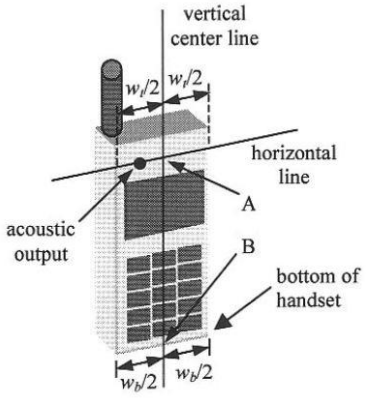


Fig 12.2.1 Handset vertical and horizontal reference lines—"fixed case

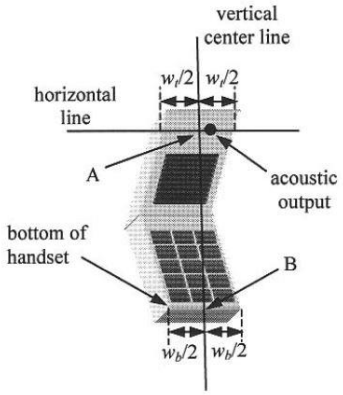


Fig 12.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

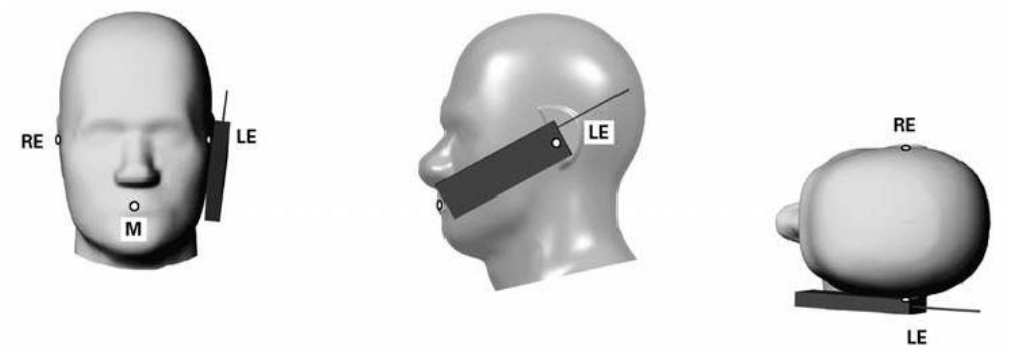


Fig 12.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

13.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 12.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

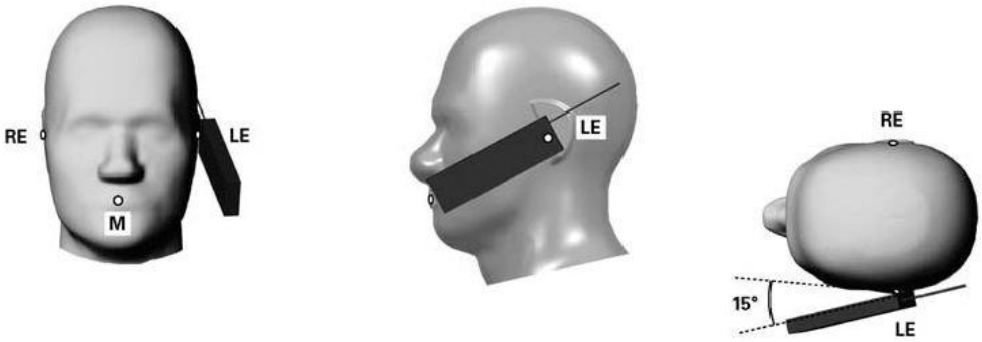


Fig 12.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

13.4 Body Worn Accessory

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 12.4). Per KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

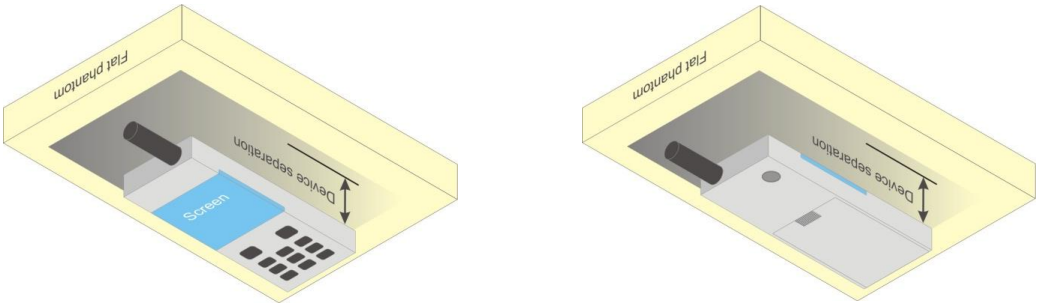


Fig 12.4 Body Worn Position

13.5 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, According to KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.6 The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

13.6 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

14. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

5G NR Output Power (Unit: dBm)

General Note:

1. 5G NR n2 / n5 / n66 / n77 / n78 is NSA and 5G NR n2 / n5 / n66 / n48 / n77 / n78 is SA mode.
2. For 5G NR test procedure was following step similar FCC KDB 941225 D05:
   a. For DFT-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for power class2 and 3, the CP-OFDM mode will not higher than DFT-OFDM mode, therefore, similar FCC KDB 941225 D05 procedure for other modulation output power for each RB allocation configuration is > not ½ dB higher than the same configuration in DFT-QPSK and the reported SAR for the DFT-QPSK configuration is ≤ 1.45 W/kg; CP-OFDM testing is not required.
   b. For DFT-OFDM output power measurement reduction, according to 38.101 maximum power reduction for power class2 and 3, for 16QAM/64QAM/256QAM and smaller bandwidth output power will spot check largest channel bandwidth worst RB configuration to ensure the 16QAM/64QAM/256QAM and smaller bandwidth output power will not ½ dB higher than the same configuration in the largest supported bandwidth.
   c. SAR testing start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel
   d. 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure
   e. QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 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
   f. PI/2 BPSK/16QAM/64QAM/256QAM output powers according to 3GPP MPR will not ½ dB higher than the same configuration in QPSK, also reported SAR for the QPSK configuration is less than 1.45 W/kg, PI/2 BPSK /16QAM/64QAM/256QAM SAR testing are not required.
   g. Smaller bandwidth output power for each RB allocation configuration for this device will not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg, smaller bandwidth SAR testing is not required for this device
3. 5G NR n77 supports HPUE, HPUE power and SAR testing performed separately.
4. 5G NR n77 HUPE with higher power, 5G NR n77 HUPE SAR can represent power class 3 level SAR.
5. For 5G NR n77 HUPE, 50% duty cycle is considered during SAR testing. For 5G NR other bands test, using FTM (Factory Test Mode) with default 100% duty cycle transmission to perform SAR testing.
6. 5G NR n48/n77/n78 supports MIMO mode at Antenna 2 and Antenna 7.
7. NSA and SA mode should perform SAR separately. For the maximum power of NSA mode is the same as SA total power level, so SA SAR can represent NSA mode SAR.
8. 5GNR NSA mode, the power level is the same as 5GNR SA mode, so 5GNR NSA mode and SA mode power table only show one time.
9. 5G NR supports CP-OFDM and DFT-s-OFDM modulation, for DFT-s-OFDM power is higher than CP-OFDM, so only show DFT-s-OFDM power table and chose DFT-s-OFDM to perform SAR testing.
10. For DFT-s-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for the CP-OFDM mode will not higher than DFT-s-OFDM mode, therefore, CP-OFDM measurement is unnecessary.

<3GPP 38.101 MPR for EN-DC>

Table 6.2.2-1 Maximum power reduction (MPR) for power class 3

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5[1]	≤ 1.2[1]	≤ 0.2[1]
		≤ 0.5[2]	≤ 0.5[2]	0[2]
	QPSK	≤ 1		0
	16 QAM	≤ 2		≤ 1
	64 QAM	≤ 2.5		
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3		≤ 1.5
	16 QAM	≤ 3		≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		

NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0 dB MPR is 26 dBm.

NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 with Pi/2 BPSK modulation and if the IE *powerBoostPi2BPSK* is set to 0 and if more than 40 % of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.

Table 6.2.2-2 Maximum power reduction (MPR) for power class 2

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5	≤ 0.5	0
	QPSK	≤ 3.5	≤ 1	0
	16 QAM	≤ 3.5	≤ 2	≤ 1
	64 QAM	≤ 3.5	≤ 2.5	
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3.5	≤ 3	≤ 1.5
	16 QAM	≤ 3.5	≤ 3	≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		

15. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.

16. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The device implements the power management and proximity sensor /receiver detection/hotspot mode for SAR compliance at different exposure conditions (head, body-worn, hotspot, extremity) and the Qualcomm smart transmit will manage to ensure the power level not exceeding the associated power table. Details about the power management decision and sensor detection are provided in the operational description. And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
5. For WLAN when transmit simultaneous with WWAN, power reduction will be activated to head and Handheld. For WLAN when transmit simultaneous with WWAN and Proximity sensors trigger, power reduction will be activated to body-worn and Handheld.
6. For some WWAN bands, sensor on reduced power level is higher than hotspot reduced power level, so front/back sensor on SAR can represent hotspot conservatively.
7. For 5G NR bands test, using FTM (Factory Test Mode) with default 100% duty cycle transmission to perform SAR testing.
8. 5G NR supports CP-OFDM and DFT-s-OFDM modulation, for DFT-s-OFDM power is higher than CP-OFDM, so only show DFT-s-OFDM power table and chose DFT-s-OFDM to perform SAR testing.
9. For DFT-s-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for the CP-OFDM mode will not higher than DFT-s-OFDM mode, therefore, CP-OFDM measurement is unnecessary.
10. Per KDB648474 D04v01r03, for smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, when hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg, however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.
    a. For this device SAR for WWAN/WLAN transmitter scaled to maximum output power mode for product specific 10g SAR is higher than 1.2W/kg of 5GNR n48, therefore product specific 10g SAR is necessary.
    b. When 10-g product specific 10g SAR is considered, SAR thresholds is specified in the procedures for SAR test reduction and exclusion should be multiplied by 2.5.
11. Smart Folio / stylus mode spot check each antenna the worst case to ensure the RF exposure is compliance at different exposure conditions.

5G NR Note:

1. For 5G NR test procedure was following step similar FCC KDB 941225 D05:
   a. SAR testing start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
   b. 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure
   c. QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 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. PI/2 BPSK/16QAM/64QAM/256QAM output powers according to 3GPP MPR will not ½ dB higher than the same configuration in QPSK, also reported SAR for the QPSK configuration is less than 1.45 W/kg, PI/2 BPSK /16QAM/64QAM/256QAM SAR testing are not required.
   e. Smaller bandwidth output power for each RB allocation configuration for this device will not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg, smaller bandwidth SAR testing is not required for this device

DSI status description：

The device has the following DSI state which used at different exposure condition.

This WWAN bands enabled with Qualcomm Smart Transmit feature which located at chapter 5. The default power is Pmax power, When Plimit power higher than Pmax power, the output power will be limited at Pmax, and so the SAR will use Pmax power to do the testing.

Exposure Condition	DSI
Head SAR-Standalone	DSI 2
Head SAR-Simultaneous	DSI 2
Body worn Mode SAR-Standalone	DSI 3
Body worn Mode SAR- Simultaneous	DSI 3
Hotspot Mode SAR	DSI 3
Extremity(Handheld) SAR-Standalone	DSI 6
Extremity(Handheld) SAR- Simultaneous	DSI 6
Sensor off SAR	DSI 4

16.1 Head SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 2	DSI2	641666	3624.99	22.77	24.00	1.327	0.02	0.624	0.828
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 2	DSI2	638000	3570	22.69	24.00	1.352	-0.07	0.563	0.761
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 2	DSI2	645332	3679.98	22.70	24.00	1.349	0.04	0.542	0.731
01	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 2	DSI2	641666	3624.99	22.59	24.00	1.384	0.06	0.659	**0.912**
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 2	DSI2	638000	3570	22.53	24.00	1.403	0.01	0.549	0.770
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 2	DSI2	645332	3679.98	22.49	24.00	1.416	0.09	0.628	0.889
	FR1 n48	40M	QPSK	100	0	DFT-30	Right Cheek	0mm	Ant 2	DSI2	641666	3624.99	21.61	23.00	1.377	-0.03	0.423	0.583
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Tilted	0mm	Ant 2	DSI2	641666	3624.99	22.77	24.00	1.327	0.09	0.403	0.535
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Tilted	0mm	Ant 2	DSI2	641666	3624.99	22.59	24.00	1.384	-0.04	0.378	0.523
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Cheek	0mm	Ant 2	DSI2	641666	3624.99	22.77	24.00	1.327	0.04	0.250	0.332
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Cheek	0mm	Ant 2	DSI2	641666	3624.99	22.59	24.00	1.384	-0.05	0.266	0.368
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Tilted	0mm	Ant 2	DSI2	641666	3624.99	22.77	24.00	1.327	0.06	0.153	0.203
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Tilted	0mm	Ant 2	DSI2	641666	3624.99	22.59	24.00	1.384	-0.01	0.154	0.213
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 7	DSI2	641666	3624.99	22.87	24.00	1.297	-0.01	0.245	0.318
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 7	DSI2	641666	3624.99	22.69	24.00	1.352	-0.09	0.185	0.250
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Tilted	0mm	Ant 7	DSI2	641666	3624.99	22.87	24.00	1.297	-0.03	0.236	0.306
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Tilted	0mm	Ant 7	DSI2	641666	3624.99	22.69	24.00	1.352	-0.18	0.192	0.260
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Cheek	0mm	Ant 7	DSI2	641666	3624.99	22.87	24.00	1.297	0.17	0.152	0.197
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Cheek	0mm	Ant 7	DSI2	641666	3624.99	22.69	24.00	1.352	-0.11	0.139	0.188
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Tilted	0mm	Ant 7	DSI2	641666	3624.99	22.87	24.00	1.297	-0.1	0.203	0.263
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Tilted	0mm	Ant 7	DSI2	641666	3624.99	22.69	24.00	1.352	0.07	0.161	0.218
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 3	DSI2	641666	3624.99	22.86	24.00	1.300	0.09	0.022	0.029
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 3	DSI2	641666	3624.99	22.64	24.00	1.368	-0.02	0.013	0.018
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Tilted	0mm	Ant 3	DSI2	641666	3624.99	22.86	24.00	1.300	0.06	0.042	0.055
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Tilted	0mm	Ant 3	DSI2	641666	3624.99	22.64	24.00	1.368	-0.01	0.039	0.053
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Cheek	0mm	Ant 3	DSI2	641666	3624.99	22.86	24.00	1.300	0.18	0.049	0.064
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Cheek	0mm	Ant 3	DSI2	641666	3624.99	22.64	24.00	1.368	-0.02	0.042	0.057
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Tilted	0mm	Ant 3	DSI2	641666	3624.99	22.86	24.00	1.300	0.04	0.023	0.030
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Tilted	0mm	Ant 3	DSI2	641666	3624.99	22.64	24.00	1.368	-0.01	0.021	0.029
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 8	DSI2	641666	3624.99	19.99	20.30	1.074	0.01	0.041	0.044
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 8	DSI2	641666	3624.99	19.75	20.30	1.135	0.17	0.022	0.025
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Tilted	0mm	Ant 8	DSI2	641666	3624.99	19.99	20.30	1.074	-0.03	0.015	0.016
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Tilted	0mm	Ant 8	DSI2	641666	3624.99	19.75	20.30	1.135	-0.06	0.020	0.023
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Cheek	0mm	Ant 8	DSI2	641666	3624.99	19.99	20.30	1.074	0.17	0.015	0.016
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Cheek	0mm	Ant 8	DSI2	641666	3624.99	19.75	20.30	1.135	-0.16	0.005	0.006
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Tilted	0mm	Ant 8	DSI2	641666	3624.99	19.99	20.30	1.074	-0.02	0.011	0.012
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Tilted	0mm	Ant 8	DSI2	641666	3624.99	19.75	20.30	1.135	0.08	0.004	0.005
Smart Folio and stylus mode																		
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Cheek	0mm	Ant 2	DSI2	641666	3624.99	22.59	24.00	1.384	-0.02	0.614	0.850
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Cheek	0mm	Ant 3	DSI2	641666	3624.99	22.86	24.00	1.300	0.11	0.031	0.040
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Cheek	0mm	Ant 8	DSI2	641666	3624.99	19.99	20.30	1.074	0.07	0.034	0.037

16.2 Hotspot SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	-0.03	0.055	0.069
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	0.04	0.071	0.092
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	0.03	0.744	0.930
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	DSI3 Simultaneous	638000	3570	15.13	16.20	1.279	0.03	0.711	0.910
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	DSI3 Simultaneous	645332	3679.98	15.16	16.20	1.271	0.03	0.698	0.887
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	0.11	0.614	0.798
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.03	16.20	1.309	0.11	0.601	0.787
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	0.06	0.213	0.266
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	0.09	0.204	0.265
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	-0.05	0.005	0.006
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	-0.09	0.005	0.007
	FR1 n48	40M	QPSK	1	1	DFT-30	Top Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	0.17	0.069	0.086
	FR1 n48	40M	QPSK	50	28	DFT-30	Top Side	5mm	Ant 2	DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	-0.02	0.052	0.068
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.05	0.035	0.044
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.97	18.10	1.297	0.18	0.026	0.034
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.08	0.745	0.936
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	638000	3570	17.07	18.10	1.268	-0.09	0.701	0.889
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	645332	3679.98	16.99	18.10	1.291	-0.02	0.721	0.931
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.97	18.10	1.297	0.18	0.686	0.890
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	638000	3570	16.83	18.10	1.340	-0.01	0.656	0.879
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	645332	3679.98	16.85	18.10	1.334	0.01	0.615	0.820
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.94	18.10	1.306	-0.01	0.653	0.853
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	0.09	0.052	0.065
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.97	18.10	1.297	0.11	0.052	0.067
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	0.01	0.015	0.019
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.97	18.10	1.297	0.18	0.015	0.019
	FR1 n48	40M	QPSK	1	1	DFT-30	Top Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.18	0.190	0.239
	FR1 n48	40M	QPSK	50	28	DFT-30	Top Side	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	16.97	18.10	1.297	-0.01	0.174	0.226
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.86	24.00	1.300	0.18	0.378	0.491
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	-0.01	0.400	0.547
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.86	24.00	1.300	0..01	0.703	0.914
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	638000	3570	22.78	24.00	1.324	0.11	0.656	0.869
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	645332	3679.98	22.76	24.00	1.330	-0.03	0.661	0.879
02	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	0.05	0.708	**0.968**
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	638000	3570	22.57	24.00	1.390	0.04	0.644	0.895
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	645332	3679.98	22.52	24.00	1.406	0.09	0.638	0.897
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	21.74	23.00	1.337	0.11	0.651	0.870
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.86	24.00	1.300	0.18	0.605	0.787
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	-0.09	0.525	0.718
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.86	24.00	1.300	-0.01	0.011	0.014
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	0.09	0.009	0.012
	FR1 n48	40M	QPSK	1	1	DFT-30	Bottom Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.86	24.00	1.300	0.01	0.539	0.701
	FR1 n48	40M	QPSK	50	28	DFT-30	Bottom Side	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	-0.03	0.499	0.682
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.95	18.70	1.189	0.11	0.160	0.190
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.05	0.197	0.236
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.95	18.70	1.189	0.11	0.667	0.793
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.06	0.783	0.937
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.95	18.70	1.189	-0.05	0.025	0.030
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	-0.09	0.026	0.031
	FR1 n48	40M	QPSK	1	1	DFT-30	Right Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.95	18.70	1.189	-0.01	0.093	0.111
	FR1 n48	40M	QPSK	50	28	DFT-30	Right Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	-0.01	0.094	0.112

	FR1 n48	40M	QPSK	1	1	DFT-30	Bottom Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.95	18.70	1.189	-0.18	0.179	0.213
	FR1 n48	40M	QPSK	50	28	DFT-30	Bottom Side	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.01	0.217	0.260
Smart Folio and stylus mode																		
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.01	0.721	0.906
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3	DSI3 Simultaneous	641666	3624.99	22.64	24.00	1.368	0.01	0.687	0.940
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8	DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.01	0.756	0.905

16.3 Body Worn Accessory SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Headset	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 2		DSI3	641666	3624.99	16.90	17.60	1.175	-0.03	0.078	0.092
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 2		DSI3	641666	3624.99	16.79	17.60	1.205	0.04	0.102	0.123
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2		DSI3	641666	3624.99	16.90	17.60	1.175	0.01	1.060	1.245
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2		DSI3	638000	3570	16.78	17.60	1.208	0.11	0.912	1.102
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2		DSI3	645332	3679.98	16.82	17.60	1.197	-0.09	0.946	1.132
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 2		DSI3	641666	3624.99	16.79	17.60	1.205	0.11	0.878	1.058
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 2		DSI3	638000	3570	16.51	17.60	1.285	0.03	0.799	1.027
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 2		DSI3	645332	3679.98	16.44	17.60	1.306	0.01	0.812	1.061
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 2		DSI3	641666	3624.99	16.72	17.60	1.225	0.14	0.833	1.020
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	Headset	DSI3	641666	3624.99	16.90	17.60	1.175	0.11	0.966	1.135
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 2		DSI3 Simultaneous	641666	3624.99	15.06	16.20	1.300	0.04	0.071	0.092
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2		DSI3 Simultaneous	641666	3624.99	15.23	16.20	1.250	0.03	0.744	0.930
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	18mm	Ant 2		DSI4	641666	3624.99	22.59	24.00	1.384	0.02	0.071	0.098
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	21mm	Ant 2		DSI4	641666	3624.99	22.77	24.00	1.327	0.01	0.360	0.478
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 7		DSI3	641666	3624.99	18.63	19.80	1.309	0.09	0.044	0.058
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 7		DSI3	641666	3624.99	18.55	19.80	1.334	0.18	0.034	0.045
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7		DSI3	641666	3624.99	18.63	19.80	1.309	-0.06	0.948	1.241
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7		DSI3	641666	3624.99	18.55	19.80	1.334	-0.1	0.873	1.164
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7		DSI3	638000	3570	18.42	19.80	1.374	-0.01	0.811	1.114
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 7		DSI3	645332	3679.98	18.41	19.80	1.377	0.04	0.834	1.149
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 7		DSI3	641666	3624.99	18.29	19.80	1.416	-0.03	0.855	1.211
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	Headset	DSI3	641666	3624.99	18.63	19.80	1.309	0.06	0.903	1.182
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 7		DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.05	0.035	0.044
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7		DSI3 Simultaneous	641666	3624.99	17.11	18.10	1.256	-0.08	0.745	0.936
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	18mm	Ant 7		DSI3	641666	3624.99	22.87	24.00	1.297	0.01	0.072	0.093
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	21mm	Ant 7		DSI3	641666	3624.99	22.87	24.00	1.297	0.01	0.331	0.429
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 3		DSI3	641666	3624.99	22.86	24.00	1.300	0.18	0.378	0.491
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 3		DSI3	641666	3624.99	22.64	24.00	1.368	-0.01	0.400	0.547
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3		DSI3	641666	3624.99	22.86	24.00	1.300	0..01	0.703	0.914
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3		DSI3	638000	3570	22.78	24.00	1.324	0.11	0.656	0.869
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 3		DSI3	645332	3679.98	22.76	24.00	1.330	-0.03	0.661	0.879
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3		DSI3	641666	3624.99	22.64	24.00	1.368	0.05	0.708	0.968
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3		DSI3	638000	3570	22.57	24.00	1.390	0.04	0.644	0.895
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3		DSI3	645332	3679.98	22.52	24.00	1.406	0.09	0.638	0.897
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 3		DSI3	641666	3624.99	21.74	23.00	1.337	0.11	0.651	0.870
	FR1 n48	40M	QPSK	1	1	DFT-30	Front	5mm	Ant 8		DSI3	641666	3624.99	19.99	20.30	1.074	0.18	0.225	0.242
	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 8		DSI3	641666	3624.99	19.75	20.30	1.135	0.11	0.276	0.313
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 8		DSI3	641666	3624.99	19.99	20.30	1.074	0.05	0.936	1.005
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 8		DSI3	638000	3570	19.85	20.30	1.109	0.11	0.911	1.010
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 8		DSI3	645332	3679.98	19.87	20.30	1.104	-0.01	0.904	0.998
03	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8		DSI3	641666	3624.99	19.75	20.30	1.135	-0.01	1.100	**1.249**
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8		DSI3	638000	3570	19.70	20.30	1.148	0.04	0.989	1.136
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8		DSI3	645332	3679.98	19.68	20.30	1.153	0.03	0.977	1.127
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	5mm	Ant 8		DSI3	641666	3624.99	19.70	20.30	1.148	0.09	0.963	1.106
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8	Headset	DSI3	641666	3624.99	19.75	20.30	1.135	0.11	0.993	1.127

	FR1 n48	40M	QPSK	50	28	DFT-30	Front	5mm	Ant 8		DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.05	0.197	0.236
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8		DSI3 Simultaneous	641666	3624.99	17.92	18.70	1.197	0.06	0.783	0.937
Smart Folio and stylus mode																			
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7		DSI3	645332	3679.98	18.48	19.80	1.355	-0.11	0.876	1.187
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 3		DSI3	641666	3624.99	22.64	24.00	1.368	0.01	0.687	0.940
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8		DSI3	641666	3624.99	19.75	20.30	1.135	0.09	0.983	1.116

16.4 Product specific 10g SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.84	20.10	1.337	0.18	2.260	3.021
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 2	DSI6	638000	3570	18.77	20.10	1.358	0.1	2.080	2.825
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 2	DSI6	645332	3679.98	18.69	20.10	1.384	0.12	2.130	2.947
04	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.77	20.10	1.358	-0.01	2.310	**3.138**
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	638000	3570	18.64	20.10	1.400	-0.01	2.210	3.093
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	645332	3679.98	18.67	20.10	1.390	-0.01	2.190	3.044
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.58	20.10	1.419	-0.01	2.090	2.966
	FR1 n48	40M	QPSK	1	1	DFT-30	Left Side	0mm	Ant 2	DSI6	641666	3624.99	18.84	20.10	1.337	0.09	0.814	1.088
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	0mm	Ant 2	DSI6	641666	3624.99	18.77	20.10	1.358	0.08	0.903	1.227
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6 Simultaneous	641666	3624.99	17.71	18.60	1.227	0.01	1.850	2.271
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	18mm	Ant 2	DSI4	641666	3624.99	22.59	24.00	1.384	0.01	0.446	0.617
	FR1 n48	40M	QPSK	50	28	DFT-30	Left Side	20mm	Ant 2	DSI4	641666	3624.99	22.59	24.00	1.384	0.02	0.333	0.461
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.91	23.30	1.377	0.11	2.230	3.071
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 7	DSI6	638000	3570	21.80	23.30	1.413	0.09	2.180	3.079
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 7	DSI6	645332	3679.98	21.83	23.30	1.403	0.01	2.070	2.904
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.89	23.30	1.384	0.06	2.260	3.127
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	638000	3570	21.68	23.30	1.452	-0.03	2.090	3.035
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	645332	3679.98	21.66	23.30	1.459	-0.09	2.110	3.078
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.74	23.30	1.432	0.11	2.090	2.993
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6 Simultaneous	641666	3624.99	20.59	21.80	1.321	-0.08	1.640	2.167
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	18mm	Ant 7	DSI4	641666	3624.99	22.69	24.00	1.352	0.1	0.341	0.461
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 8	DSI6	641666	3624.99	19.99	20.30	1.074	0.02	1.790	1.922
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 8	DSI6	638000	3570	19.85	20.30	1.109	0.11	1.580	1.752
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 8	DSI6	645332	3679.98	19.87	20.30	1.104	0.09	1.610	1.778
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 8	DSI6	641666	3624.99	19.75	20.30	1.135	0.09	1.620	1.839
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 8	DSI6	638000	3570	19.70	20.30	1.148	-0.01	1.510	1.734
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 8	DSI6	645332	3679.98	19.68	20.30	1.153	-0.11	1.490	1.719
	FR1 n48	40M	QPSK	100	0	DFT-30	Back	0mm	Ant 8	DSI6	641666	3624.99	19.70	20.30	1.148	0.05	1.550	1.780
Smart Folio and stylus mode																		
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.77	20.10	1.358	0.02	2.010	2.730
	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.89	23.30	1.384	0.02	2.130	2.947
	FR1 n48	40M	QPSK	1	1	DFT-30	Back	0mm	Ant 8	DSI6	641666	3624.99	19.99	20.30	1.074	0.01	1.610	1.729

16.5 Repeated SAR Measurement

<1g>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Headset	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	-	DSI3	641666	3624.99	16.90	17.60	1.175	-	-	0.01	1.060	1	1.245
2nd	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 2	-	DSI3	641666	3624.99	16.90	17.60	1.175	-	-	-0.04	0.978	1.084	1.149
1st	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	-	DSI3	641666	3624.99	18.63	19.80	1.309	-	-	-0.06	0.948	1	1.241
2nd	FR1 n48	40M	QPSK	1	1	DFT-30	Back	5mm	Ant 7	-	DSI3	641666	3624.99	18.63	19.80	1.309	-	-	-0.01	0.931	1.018	1.219
1st	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8	-	DSI3	641666	3624.99	19.75	20.30	1.135	-	-	-0.01	1.100	1	1.249
2nd	FR1 n48	40M	QPSK	50	28	DFT-30	Back	5mm	Ant 8	-	DSI3	641666	3624.99	19.75	20.30	1.135	-	-	0.06	1.030	1.068	1.169

<10g>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.77	20.10	1.358	-	-	-0.01	2.310	1	3.138
2nd	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 2	DSI6	641666	3624.99	18.77	20.10	1.358	-	-	0.07	2.250	1.027	3.056
1st	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.89	23.30	1.384	-	-	0.06	2.260	1	3.127
2nd	FR1 n48	40M	QPSK	50	28	DFT-30	Back	0mm	Ant 7	DSI6	641666	3624.99	21.89	23.30	1.384	-	-	-0.07	2.170	1.041	3.002

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

17. Simultaneous Transmission Analysis

No.	Simultaneous Transmission Configurations	Portable Handset			
		Head	Body-worn	Hotspot	Product specific 10g SAR
1.	WWAN + WLAN2.4GHz	Yes	Yes	Yes	Yes
2.	WWAN + WLAN5GHz	Yes	Yes	Yes	Yes
3.	WWAN + WLAN6E	Yes	Yes		Yes
4.	WWAN + Bluetooth	Yes	Yes	Yes	Yes
5.	Bluetooth + WLAN5GHz	Yes	Yes	Yes	Yes
6.	Bluetooth + WLAN6E	Yes	Yes		Yes
7.	WWAN + Bluetooth + WLAN5GHz	Yes	Yes	Yes	Yes
8.	WWAN + Bluetooth + WLAN6E	Yes	Yes		Yes
9.	WLAN2.4GHz + WLAN5GHz	Yes	Yes	Yes	Yes
10.	WWAN + WLAN 2.4GHz + WLAN 5GHz	Yes	Yes	Yes	Yes
11.	WLAN2.4GHz + WLAN6E	Yes	Yes		Yes
12.	WWAN + WLAN 2.4GHz + WLAN6E	Yes	Yes		Yes

General Note:

1. This device supports VoIP in GPRS, EGPRS, WCDMA and LTE (e.g. for 3rd-party VoIP), LTE supports VoLTE operation.
2. WWAN above includes 5G NR bands.
3. EUT will choose each GSM, WCDMA, LTE and 5GNR according to the network signal condition; therefore, they will not operate simultaneously at any moment.
4. For EN-DC mode, Qualcomm Smart Transmit algorithm in WWAN adds directly the time-averaged RF exposure from 4G(LTE) and time-averaged RF exposure from 5G NR. Smart Transmit algorithm controls the total RF exposure from both 4G and 5G NR to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G NR operation is demonstrated in the Part 2 Report during algorithm validation. In Part 1 Report, simultaneous transmission compliance was evaluated individually with other Radios (WLAN or BT) using one of 4G or 5G NR.
5. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
6. This device 5.2GHz WLAN/5.8GHz WLAN support hotspot operation, and 5.2GHz WLAN/5.8GHz WLAN supports WLAN Direct (GC/GO), and 5.3GHz / 5.5GHz supports WLAN Direct (GC only).WIFI 6E has no hotspot function.
7. The 2.4GHz/5GHz/6GHz WLAN can transmit in MIMO antenna mode only and it has no SISO antenna mode.
8. The worst case 5 GHz WLAN SAR for each configuration was used for SAR summation.
9. WLAN 2.4GHz and Bluetooth share the same antenna so can't transmit simultaneously.
10. According to the EUT characteristic, WLAN 5GHz/6GHz and Bluetooth can transmit simultaneously.
11. According to the EUT characteristic, WLAN 5GHz/6GHz and WLAN 2.4GHz can transmit simultaneously.
12. According to the EUT characteristic, WLAN 5GHz and WLAN 6GHz can't transmit simultaneously.
13. The maximum SAR summation is calculated based on the same configuration and test position.
14. SAR Power density test report for WLAN6E U-NII-5/6/7/8 will be separately submitted. About co-located SAR with WWAN/Bluetooth, always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and U-NII-5/6/7/8.
15. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
    i) 1g Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/kg.
    ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
    iii) If SPLSR ≤ 0.04 for 1g SAR and SPLSR≤ 0.10 for 10g SAR , simultaneously transmission SAR measurement is not necessary.
    iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg and 10g SAR < 4.0W/kg.
16. This is a variant report for XT2201-4, the difference between current project and previous project is enabled 5G NR n48 by software. For co-located SAR analysis, add new 5GNR n48 evaluation to do co-located with WLAN analysis, all the test results are leveraged from original report (Sporton Report Number FA192317-02).

17.1 5G NR + LTE + WLAN + BT Sim-Tx analysis

In 5G NR + LTE + WLAN + BT simultaneous transmission, 5G NR and LTE transmission are managed and controlled by Qualcomm® Smart Transmit, while the RF exposure from WLAN and BT radios is managed using legacy approach, i.e., through a fixed power back-off if needed.

Since WLAN and BT do not employ time-averaging, 1gSAR and 10gSAR measurement for WLAN and BT need to be conducted at their corresponding rated power following current FCC test procedures to determine reported SAR values.

Smart Transmit current implementation assumes hotspots from 5G NR and LTE are collocated. Therefore, for a total of 100% exposure margin, if LTE uses x%, then the exposure margin left for 5G NR is capped to (100-x)%. Thus, the compliance equation for LTE + 5G NR is

*x% * A + (100-x)% * B ≤ 1.0,*

Where, A is normalized reported time-averaged SAR exposure ratio from LTE, and A ≤ 1.0; B is normalized reported time-averaged exposure ratio from 5G NR (i.e. SAR exposure for 5G FR1), and B ≤1.0.

Let C = normalized reported SAR exposure ratio from WLAN+BT, then for compliance,

*x% * A + (100-x)% * B + C ≤ 1.0* (1)

x% * A + (100-x)% * B ≤ x% * max(A, B) + (100-x)% * max(A, B) ≤ max(A, B)

*x% * A + (100-x)% * B + C ≤ max(A, B) + C ≤ 1.0* (2)

if A + C ≤ 1.0 and B + C ≤ 1.0 can be proven, then “x% * A + (100-x)% * B + C ≤ 1.0”. Therefore simultaneous transmission analysis for 5G NR + LTE + WLAN + BT can be performed in two steps

Step 1: Prove total exposure ratio (TER) of LTE + WLAN + BT < 1

Step 2: Prove total exposure ratio (TER) of 5G NR + WLAN + BT < 1

Above analysis is also apply to LTE inter band uplink, LTE1 + LTE2 + WLAN + BT simultaneous transmission, So inter band CA uplink no need to do additional simultaneously analysis again. Only required comply with total exposure ratio (TER) of LTE + WLAN + BT < 1.

Above analysis is also apply to NR band UL MIMO, NR1 + NR2 + WLAN + BT simultaneous transmission, So UL MIMO no need to do additional simultaneously analysis again. Only required comply with total exposure ratio (TER) of NR + WLAN + BT < 1.

17.2 Head Exposure Conditions

FR1 Band	Exposure Position	1	2	3	4	5	6	7	8	9	10	2+5	1+3	1+4+7	1+4+10	1+6+8	1+6+9	1+8+10	1+9+10
		FR1	WLAN2.4GHz Ant 4+6 DBS Only	WLAN2.4GHz Ant 4+6 WWAN+WLAN	WLAN2.4GHz Ant 4+6 WWAN+DBS	WLAN5GHz Ant 5+6 DBS Only	WLAN5GHz Ant 5+6 WWAN+WLAN	WLAN5GHz Ant 5+6 WWAN+DBS	Bluetooth Ant 4	Bluetooth Ant 6	WIFI 6E	Summed	Summed	Summed	Summed	Summed	Summed	Summed	Summed
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n48 Ant 2	Right Cheek	0.912	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.207	1.47	1.48	1.47	1.41	1.47	1.19	1.40	1.12
	Right Tilted	0.535	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.244	1.47	1.11	1.10	1.07	1.09	0.81	1.06	0.78
	Left Cheek	0.368	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.185	1.47	0.94	0.93	0.84	0.93	0.64	0.84	0.56
	Left Tilted	0.213	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.255	1.47	0.78	0.77	0.76	0.77	0.49	0.75	0.47
FR1 n48 Ant 7	Right Cheek	0.318	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.207	1.47	0.89	0.88	0.81	0.88	0.59	0.81	0.53
	Right Tilted	0.306	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.244	1.47	0.88	0.87	0.84	0.86	0.58	0.84	0.55
	Left Cheek	0.197	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.185	1.47	0.77	0.76	0.67	0.75	0.47	0.67	0.39
	Left Tilted	0.263	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.255	1.47	0.83	0.82	0.81	0.82	0.54	0.80	0.52
FR1 n48 Ant 3	Right Cheek	0.029	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.207	1.47	0.60	0.59	0.52	0.59	0.30	0.52	0.24
	Right Tilted	0.055	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.244	1.47	0.63	0.62	0.59	0.61	0.33	0.58	0.30
	Left Cheek	0.064	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.185	1.47	0.64	0.62	0.54	0.62	0.34	0.53	0.25
	Left Tilted	0.030	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.255	1.47	0.60	0.59	0.57	0.59	0.31	0.57	0.29
FR1 n48 Ant 8	Right Cheek	0.044	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.207	1.47	0.62	0.60	0.54	0.60	0.32	0.54	0.25
	Right Tilted	0.023	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.244	1.47	0.59	0.58	0.56	0.58	0.30	0.55	0.27
	Left Cheek	0.016	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.185	1.47	0.59	0.58	0.49	0.57	0.29	0.49	0.20
	Left Tilted	0.012	0.734	0.571	0.288	0.732	0.272	0.272	0.285	0.003	0.255	1.47	0.58	0.57	0.56	0.57	0.29	0.55	0.27

17.3 Hotspot Exposure Conditions

FR1 Band	Exposure Position	1	2	3	4	5	6	7	1+2	1+3+5	1+4+6	1+4+7
		FR1	WLAN2.4GHz Ant 4+6 WWAN+WLAN	WLAN2.4GHz Ant 4+6 WWAN+DBS	WLAN5GHz Ant 5+6 WWAN+WLAN	WLAN5GHz Ant 5+6 WWAN+DBS	Bluetooth Ant 4	Bluetooth Ant 6	Summed	Summed	Summed	Summed
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n48 Ant 2	Front	0.092	0.231	0.221	0.160	0.160	0.197	0.029	0.32	0.47	0.45	0.28
	Back	0.930	0.278	0.221	0.245	0.245	0.241	0.087	1.21	1.40	1.42	1.26
	Left side	0.266	0.073	0.221	0.115	0.115	0.074	0.036	0.34	0.60	0.46	0.42
	Right side	0.007	0.068	0.221	0.083	0.083	0.064	0.032	0.08	0.31	0.15	0.12
	Top side	0.086	0.439	0.221	0.276	0.276	0.287	0.009	0.53	0.58	0.65	0.37
	Bottom side								0.00	0.00	0.00	0.00
FR1 n48 Ant 7	Front	0.044	0.231	0.221	0.160	0.160	0.197	0.029	0.28	0.43	0.40	0.23
	Back	0.936	0.278	0.221	0.245	0.245	0.241	0.087	1.21	1.40	1.42	1.27
	Left side	0.067	0.073	0.221	0.115	0.115	0.074	0.036	0.14	0.40	0.26	0.22
	Right side	0.019	0.068	0.221	0.083	0.083	0.064	0.032	0.09	0.32	0.17	0.13
	Top side	0.239	0.439	0.221	0.276	0.276	0.287	0.009	0.68	0.74	0.80	0.52
	Bottom side								0.00	0.00	0.00	0.00
FR1 n48 Ant 3	Front	0.547	0.231	0.221	0.160	0.160	0.197	0.029	0.78	0.93	0.90	0.74
	Back	0.968	0.278	0.221	0.245	0.245	0.241	0.087	1.25	1.43	1.45	1.30
	Left side	0.787	0.073	0.221	0.115	0.115	0.074	0.036	0.86	1.12	0.98	0.94
	Right side	0.014	0.068	0.221	0.083	0.083	0.064	0.032	0.08	0.32	0.16	0.13
	Top side		0.439	0.221	0.276	0.276	0.287	0.009	0.44	0.50	0.56	0.29
	Bottom side	0.701							0.70	0.70	0.70	0.70
FR1 n48 Ant 8	Front	0.201	0.231	0.221	0.160	0.160	0.197	0.029	0.43	0.58	0.56	0.39
	Back	0.937	0.278	0.221	0.245	0.245	0.241	0.087	1.22	1.40	1.42	1.27
	Left side	0.031	0.073	0.221	0.115	0.115	0.074	0.036	0.10	0.37	0.22	0.18
	Right side	0.112	0.068	0.221	0.083	0.083	0.064	0.032	0.18	0.42	0.26	0.23
	Top side		0.439	0.221	0.276	0.276	0.287	0.009	0.44	0.50	0.56	0.29
	Bottom side	0.260							0.26	0.26	0.26	0.26

17.4 Body-Worn Accessory Exposure Conditions

FR1 Band	Exposure Position	1	2	3	4	5	6	7	8	9	10	2+5	1+3	1+4+7	1+4+10	1+6+8	1+6+9	1+8+10	1+9+10
		FR1	WLAN2.4GHz Ant 4+6 DBS Only	WLAN2.4GHz Ant 4+6 WWAN+WLAN	WLAN2.4GHz Ant 4+6 WWAN+DBS	WLAN5GHz Ant 5+6 DBS Only	WLAN5GHz Ant 5+6 WWAN+WLAN	WLAN5GHz Ant 5+6 WWAN+DBS	Bluetooth Ant 4	Bluetooth Ant 6	WIFI 6E Ant 5+6	Summed	Summed	Summed	Summed	Summed	Summed	Summed	Summed
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n48 Ant 2	Front	0.092	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.118	1.39	0.60	0.62	0.45	0.62	0.46	0.45	0.30
	Back	0.930	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.239	1.39	1.44	1.46	1.41	1.46	1.30	1.41	1.26
FR1 n48 Ant 7	Front	0.044	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.118	1.39	0.55	0.57	0.41	0.57	0.42	0.40	0.25
	Back	0.936	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.239	1.39	1.45	1.47	1.42	1.46	1.31	1.42	1.26
FR1 n48 Ant 3	Front	0.547	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.118	1.39	1.06	1.08	0.91	1.07	0.92	0.91	0.75
	Back	0.968	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.239	1.39	1.48	**1.50**	1.45	1.49	1.34	1.45	1.29
FR1 n48 Ant 8	Front	0.236	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.118	1.39	0.75	0.77	0.60	0.76	0.61	0.60	0.44
	Back	0.937	0.663	0.509	0.244	0.728	0.285	0.285	0.241	0.087	0.239	1.39	1.45	1.47	1.42	1.46	1.31	1.42	1.26

17.5 Product specific 10g SAR Exposure Conditions

Remark:
1. For Bluetooth Product specific 10g stand-alone SAR is not required for a transmitter or antenna, due to 1g hotspot SAR is <1.2W/kg.

FR1 Band	Exposure Position	1	2	3	1+2	1+3
		FR1	WLAN5GHz Ant 5+6 WWAN+WLAN&WWAN+DBS	WIFI 6E	Summed	Summed
		10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)
FR1 n48 Ant 2	Front	2.271	0.640	0.177	2.91	2.45
	Back	2.271	0.640	0.350	2.91	2.62
	Left side	2.271	0.640	0.098	2.91	2.37
	Right side	2.271	0.640	0.080	2.91	2.35
	Top side	2.271	0.640	0.349	2.91	2.62
	Bottom side	2.271	0.640		2.91	2.27
FR1 n48 Ant 7	Front	2.167	0.640	0.177	2.81	2.34
	Back	2.167	0.640	0.350	2.81	2.52
	Left side	2.167	0.640	0.098	2.81	2.27
	Right side	2.167	0.640	0.080	2.81	2.25
	Top side	2.167	0.640	0.349	2.81	2.52
	Bottom side	2.167	0.640		2.81	2.17
FR1 n48 Ant 8	Front	1.922	0.640	0.177	2.56	2.10
	Back	1.922	0.640	0.350	2.56	2.27
	Left side	1.922	0.640	0.098	2.56	2.02
	Right side	1.922	0.640	0.080	2.56	2.00
	Top side	1.922	0.640	0.349	2.56	2.27
	Bottom side	1.922	0.640		2.56	1.92

Test Engineer : Martin Li, Varus Wang, Light Wang, Ricky Gu, Damon Zhu

18. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

19. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.

[9] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[10] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015

[11] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015

[12] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015

[13] FCC KDB 941225 D05A v01r02, “Rel. 10 LTE SAR Test Guidance and KDB Inquiries”, Oct 2015

[14] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

------THE END------

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Date: 2022-04-10

System Check_Head_3500MHz

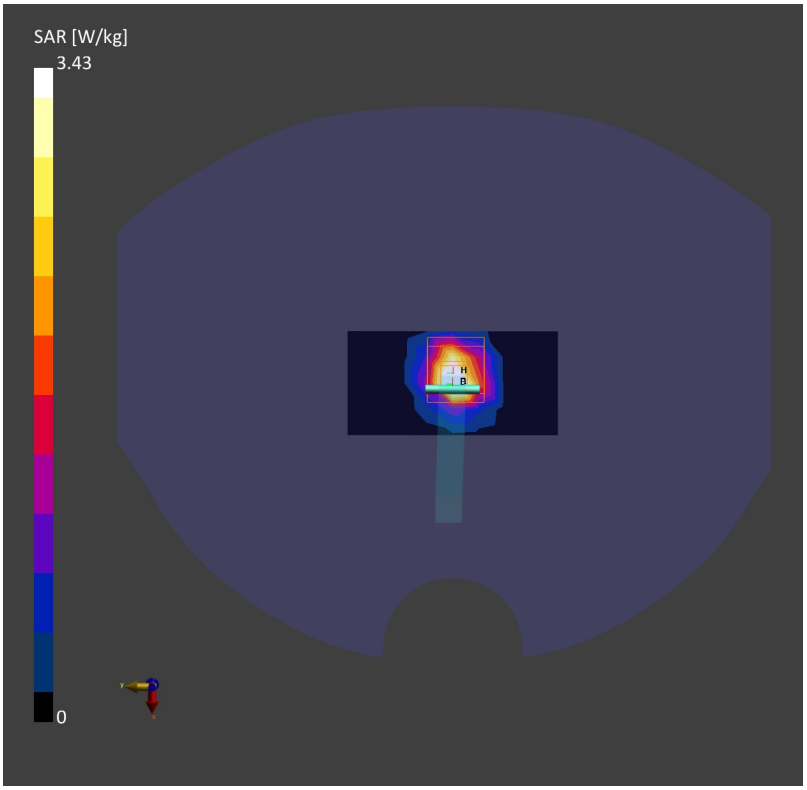
DUT: D3500V2-SN:1037

Communication System: ; Frequency: 3500.0
Medium: HSL. Medium parameters used: f= 3500.0 MHz; σ= 2.78 S/m; ε_r = 39.6
Ambient Temperature: 23.3°C; Liquid Temperature: 22.7°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.65, 6.65, 6.65); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (40.0 mm x 80.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 3.07 W/kg; SAR (10g) = 0.926 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 4.0 mm x 4.0 mm x 1.4 mm
Power Drift = 0.02 dB
SAR (1g) = 3.43 W/kg; SAR (10g) = 1.33 W/kg;



Date: 2022-04-10

System Check_Head_3700MHz

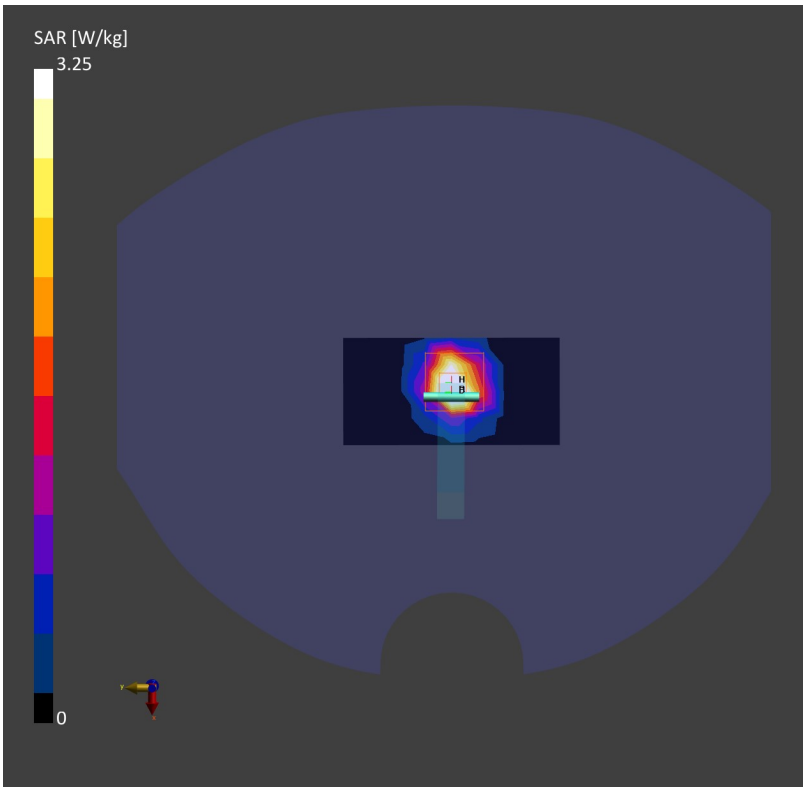
DUT: D3700V2-SN:1008

Communication System: ; Frequency: 3700.0
Medium: HSL. Medium parameters used: f= 3700.0 MHz; σ= 2.98 S/m; ε_r = 38.3
Ambient Temperature: 23.3°C; Liquid Temperature: 22.7°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.6, 6.6, 6.6); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (40.0 mm x 80.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 3.06 W/kg; SAR (10g) = 0.930 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 4.0 mm x 4.0 mm x 1.4 mm
Power Drift = -0.03 dB
SAR (1g) = 3.25 W/kg; SAR (10g) = 1.29 W/kg;



Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

Date: 2022-04-10

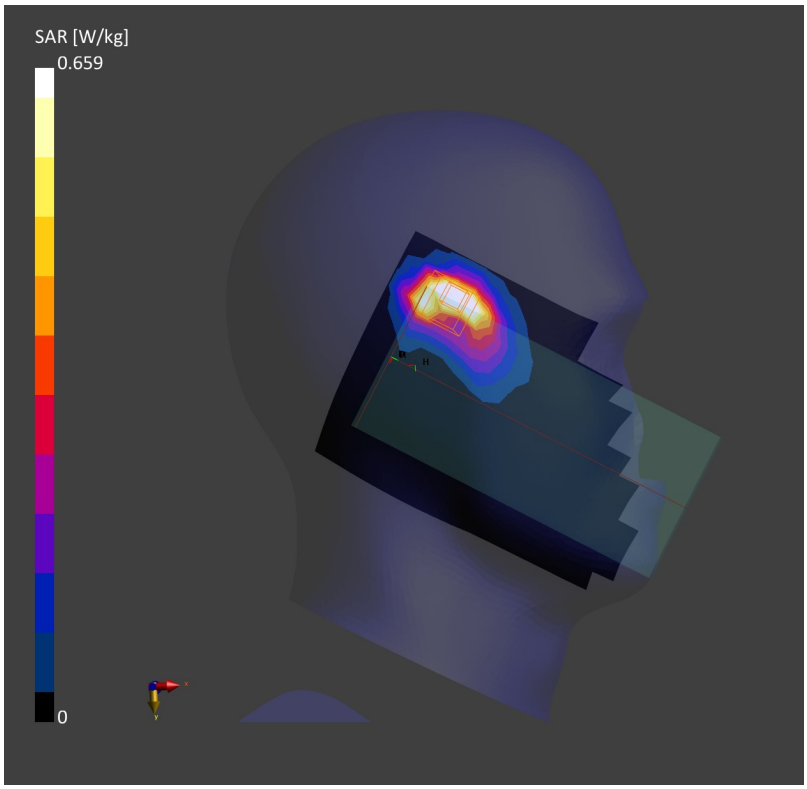
01_FR1 n48_40M_QPSK_50RB_28Offset_Right Cheek_0mm_Ch641666

Communication System: Band n48; Frequency: 3625.0
Medium: HSL. Medium parameters used: f= 3625.0 MHz; σ= 2.83 S/m; ε_r = 39.0
Ambient Temperature: 23.3°C; Liquid Temperature: 22.7°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.6, 6.6, 6.6); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: RightHead
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 200.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 0.640 W/kg; SAR (10g) = 0.254 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 4.0 mm x 4.0 mm x 1.4 mm
Power Drift = 0.06 dB
SAR (1g) = 0.659 W/kg; SAR (10g) = 0.255 W/kg;



Date: 2022-04-10

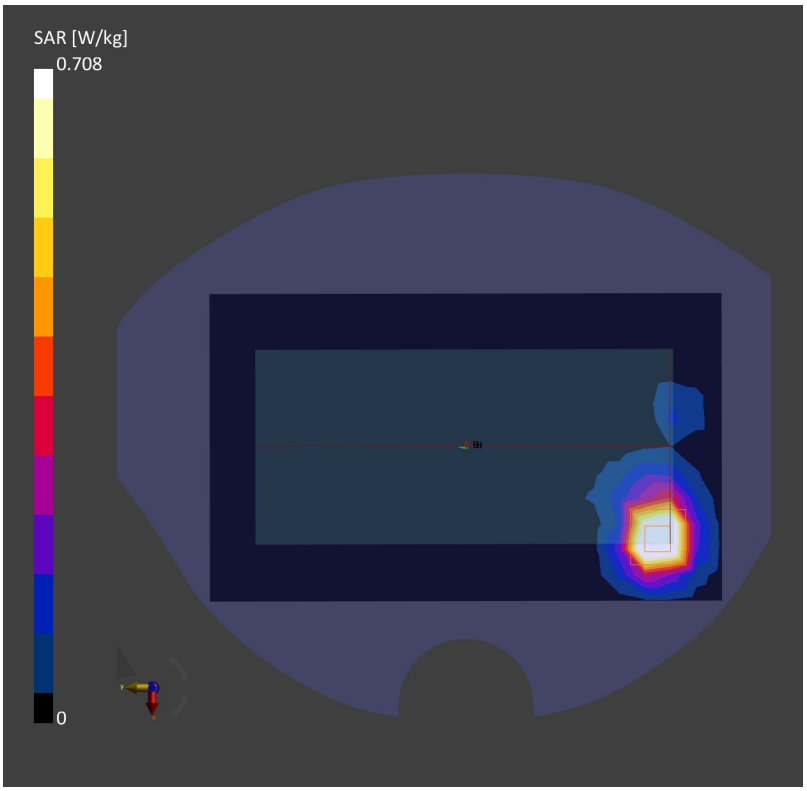
02_FR1 n48_40M_QPSK_50RB_28Offset_Back_5mm_Ch641666

Communication System: Band n48; Frequency: 3625.0
Medium: HSL. Medium parameters used: f= 3625.0 MHz; σ= 2.83 S/m; ε_r = 39.0
Ambient Temperature: 23.3°C; Liquid Temperature: 22.7°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.6, 6.6, 6.6); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 200.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 0.681 W/kg; SAR (10g) = 0.273 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 4.0 mm x 4.0 mm x 1.4 mm
Power Drift = 0.05 dB
SAR (1g) = 0.708 W/kg; SAR (10g) = 0.301 W/kg;


SAR [W/kg]
0.708
0

Date: 2022-04-10

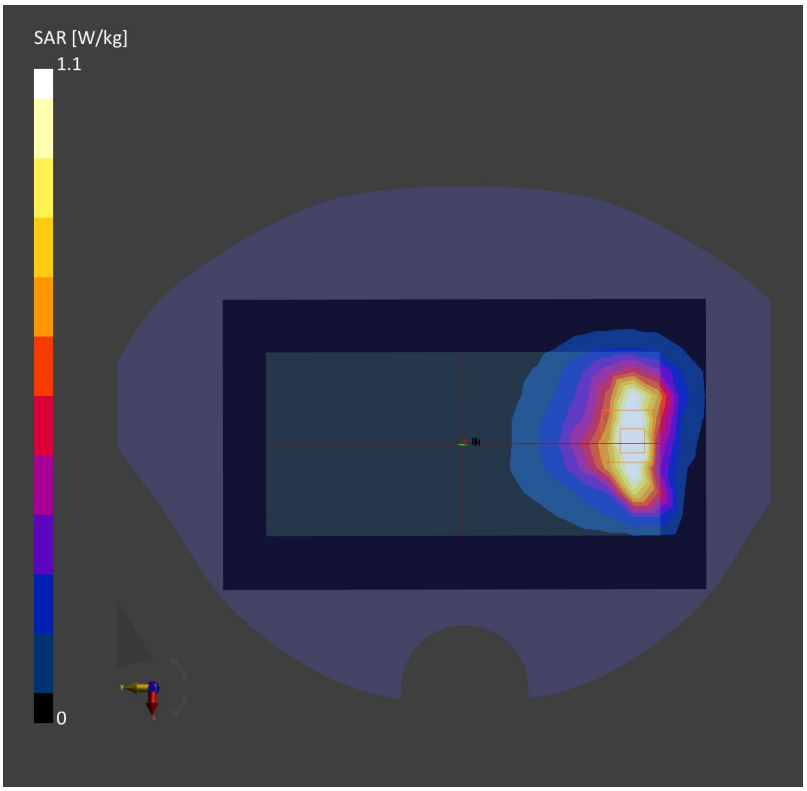
03_FR1 n48_40M_QPSK_RB50_28offset_Back_5mm_Ch641666

Communication System: Band n48; Frequency: 3625.0
Medium: HSL. Medium parameters used: f= 3625.0 MHz; σ= 2.83 S/m; ε_r = 39.0
Ambient Temperature: 23.3°C; Liquid Temperature: 22.7°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.6, 6.6, 6.6); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 200.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 1.08 W/kg; SAR (10g) = 0.447 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 5.0 mm x 5.0 mm x 1.4 mm
Power Drift = -0.01 dB
SAR (1g) = 1.10 W/kg; SAR (10g) = 0.442 W/kg;


SAR [W/kg]
1.1
0

Date: 2022-04-10

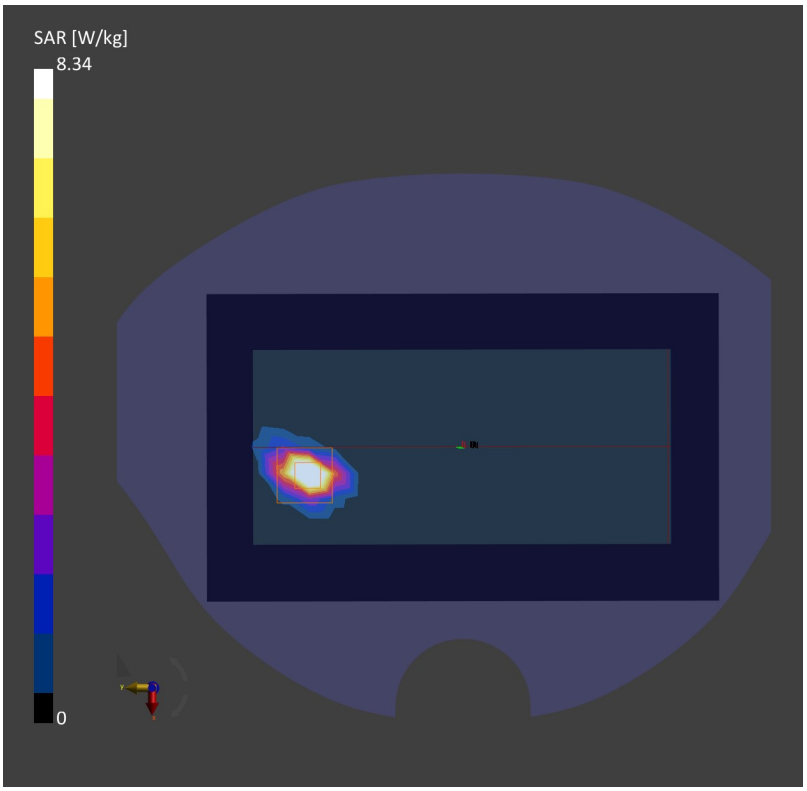
04_FR1 n48_40M_QPSK_50RB_28Offset_Back_0mm_Ch641666

Communication System: Band n48; Frequency: 3625.0
Medium: HSL. Medium parameters used: f= 3625.0 MHz; σ= 2.83 S/m; ε_r = 39.0
Ambient Temperature: 23.5°C; Liquid Temperature: 22.5°C

DASY6 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(6.6, 6.6, 6.6); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1691; Calibrated: 2021-10-04
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 200.0 mm): Measurement Grid: 10.0 mm x 10.0 mm
SAR (1g) = 7.93 W/kg; SAR (10g) = 2.26 W/kg;

Zoom Scan (24.0 mm x 24.0 mm x 22.0 mm): Measurement Grid: 4.0 mm x 4.0 mm x 1.4 mm
Power Drift = -0.01 dB
SAR (1g) = 8.34 W/kg; SAR (10g) = 2.31 W/kg;


SAR [W/kg]
8.34
0

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

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
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client Sporton

Certificate No: D3500V2-1037_Nov20

CALIBRATION CERTIFICATE

Object	D3500V2 - SN:1037
Calibration procedure(s)	QA CAL-22.v5 Calibration Procedure for SAR Validation Sources between 3-10 GHz
Calibration date:	November 25, 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: 3503	31-Dec-19 (No. EX3-3503_Dec19)	Dec-20
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

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

Issued: November 26, 2020

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 = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	2.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**68.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.4 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω - 2.1 jΩ
Return Loss	- 31.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.141 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