SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std. 1528-2013
RSS-102 ISSUE 5

For
Harman TAG2.0 OBD II device

FCC ID: 2AHPN-HSA-20UG-BA
IC ID: 6434C-HSA20UGBA

Model Name: HSA-20UG-BA

Report Number: 4789869259-SAR-1
Issue Date: May 17, 2021

Prepared for
Harman International Industries, Inc.
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Prepared by
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Revision History

Rev.	Date	Revisions	Revised By
V1.0	May 17, 2020	Initial Issue	\

Note:

1. The Measurement result for the sample received is<Pass> according to < IEEE Std. 1528-2013><RSS-102, Issue 5> when <Accuracy Method> decision rule is applied.

2. This test report is only published to and used by the applicant, and it is not for evidence purpose in China.

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1. Attestation of Test Results

Applicant Name		Harman International Industries, Inc.		
Address		30001 , Cabot Drive, Novi, MI 48377, USA		
EUT Name		Harman TAG2.0 OBD II device		
Model		HSA-20UG-BA		
Sample Status		Normal		
Trade Mark		/		
Sample Received Date		March 26, 2021		
Date of Tested		April 25,2021 to April 29, 2021		
Applicable Standards		FCC 47 CFR § 2.1093 IEEE Std. 1528-2013 KDB publication		
Exposure Category		**SAR Limits (W/Kg)**		
		Peak spatial-average (1g of tissue)		**Extremity (Hands, wrists, ankles, etc.) (10g of tissue)**
General population / Uncontrolled exposure		1.6		4
RF Exposure Conditions		**Equipment Class - Highest Reported SAR (W/kg)**		
		PCB	**DTS**	**DSS**
Head		\	\	\
Body & Hotspot		1.002	0.490	0.081
Extremity		\	\	\
Simultaneous Transmission	**Head**	\		
	Body & Hotspot	1.246		
	Extremity	\		
Test Results		Pass		

Prepared By:	Reviewed By:	Approved By:
Jacky Jiang Project Engineer	Shawn Wen Laboratory Leader	Stephen Guo Laboratory Manager

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, RSS-102, Issue 5, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR
- 447498 D01 General RF Exposure Guidance
- 690783 D01 SAR Listings on Grants
- 865664 D01 SAR measurement 100 MHz to 6 GHz
- 865664 D02 RF Exposure Reporting
- 447498 D03 Supplement C Cross-Reference
- 941225 D01 3G SAR Procedures
- 941225 D05 SAR for LTE Devices

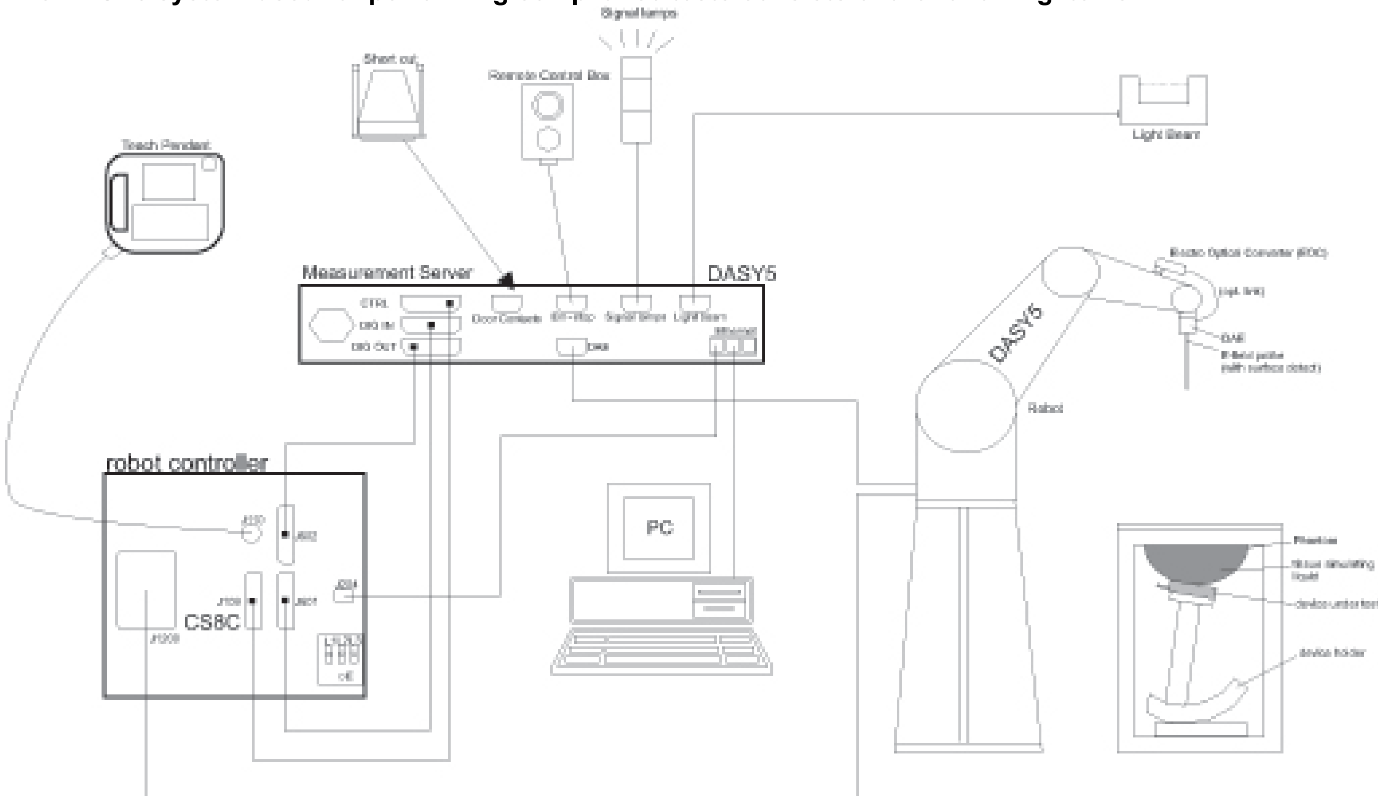
3. Facilities and Accreditation

Test Location	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch.
Address	Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
Accreditation Certificate	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with A2LA. **FCC (FCC Recognized No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules **IC(Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320. **VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011
Description	All measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake Hi-Tech Development Zone Dongguan, People’s Republic of China

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY5 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 Win 7 and the DASY52 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.

4.2. SAR Scan Procedures

Step 1: 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. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: 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 locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) 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 KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose 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 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

			$\leq$ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm*	3 – 4 GHz: $\leq$ 5 mm* 4 – 6 GHz: $\leq$ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 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 $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Name of equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
ENA Network Analyzer	Keysight	E5080A	MY55100583	2021.11.19
Dielectric Probe kit	SPEAG	SM DAK 040 SA	1155	NCR
DC power supply	Keysight	E36103A	MY55350020	2021.11.19
Signal Generator	Rohde & Schwarz	SME06	837633\001	2021.11.19
BI-Directional Coupler	WERLATONE	C8060-102	3423	2021.11.19
Peak and Average Power Sensor	Keysight	E9323A	MY55440013	2021.12.05
Peak and Average Power Sensor	Keysight	E9323A	MY55420006	2021.12.05
Dual Channel PK Power Meter	Keysight	N1912A	MY55416024	2021.12.05
Amplifier	CORAD TECHNOLOGY LTD	AMF-4D-00400600-50-30P	1983561	NCR
Dosimetric E-Field Probe	SPEAG	EX3DV4	7383	2021.11.29
Data Acquisition Electronic	SPEAG	DAE3	427	2022.04.08
Dipole Kit 750 MHz	SPEAG	D750V2	1153	2021.12.06
Dipole Kit 835 MHz	SPEAG	D835V2	4d206	2021.12.05
Dipole Kit 1800 MHz	SPEAG	D1800V2	2d212	2021.12.06
Dipole Kit 1900 MHz	SPEAG	D1900V2	5d212	2021.12.07
Dipole Kit 2450 MHz	SPEAG	D2450V2	977	2021.11.19
Software	SPEAG	DASY52	N/A	NCR
Twin Phantom	SPEAG	SAM V5.0	1805	NCR
ELI Phantom	SPEAG	ELI V5.0	1235	NCR
Thermometer	/	GX-138	150709653	2020.12.09
Thermometer	VICTOR	ITHX-SD-5	18470005	2020.12.10
Wideband Radio Communication Tester	R&S	CMW500	155523	2021.12.05

Note:

1) As per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
   a) There is no physical damage on the dipole;
   b) System check with specific dipole is within 10% of calibrated value;
   c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
   d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

5. Measurement Uncertainty

5.1. Uncertainty budget list (30MHz to 3GHz).

Uncertainty component	Tol. (±%)	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	U_i, 1g (±%)	U_i, 10g (±%)
Measurement system							
Probe Calibration	6.1	N	1	1	1	6.1	6.1
Axial Isotropy	4.7	R	$\sqrt{3}$	$\sqrt{0.5}$	$\sqrt{0.5}$	1.9	1.9
Hemispherical Isotropy	9.6	R	$\sqrt{3}$	$\sqrt{0.5}$	$\sqrt{0.5}$	3.9	3.9
Boundary Effects	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Linearity	4.7	R	$\sqrt{3}$	1	1	2.7	2.7
System Detection Limits	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Modulation Response^{m}	2.4	R	$\sqrt{3}$	1	1	1.4	1.4
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.8	R	$\sqrt{3}$	1	1	0.5	0.5
Integration Time	2.6	R	$\sqrt{3}$	1	1	1.5	1.5
RF Ambient Noise	3.0	R	$\sqrt{3}$	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	$\sqrt{3}$	1	1	1.7	1.7
Probe Positioner	0.4	R	$\sqrt{3}$	1	1	0.2	0.2
Probe Positioning	2.9	R	$\sqrt{3}$	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	$\sqrt{3}$	1	1	1.2	1.2
Test sample related							
Device Positioning	2.9	N	1	1	1	2.9	2.9
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	$\sqrt{3}$	1	1	2.9	2.9
Power Scaling	0	R	$\sqrt{3}$	1	1		
Phantom and set-up							
Phantom Uncertainty	6.1	R	$\sqrt{3}$	1	1	3.5	3.5
SAR correction	1.9	R	$\sqrt{3}$	1	0.84	1.1	0.9
Liquid Conductivity (mea.)	2.5	R	$\sqrt{3}$	0.78	0.71	1.1	1.0
Liquid Permittivity (mea.)	2.5	R	$\sqrt{3}$	0.26	0.26	0.4	0.4
Temp. unc. - Conductivity	3.4	R	$\sqrt{3}$	0.23	0.26	0.5	0.5
Temp. unc. - Permittivity	0.4	R	$\sqrt{3}$	0.78	0.71	0.2	0.2
Combined standard uncertainty						10.58	10.54
Expanded uncertainty (95% confidence interval) k=2						21.27	21.20

6. Device Under Test (DUT) Information

6.1. DUT Description

The EUT is a Harman TAG2.0 OBD II device with WCDMA/HSDPA//HSUPA/DC-HSUPA/LTE radio, IEEE 802.11 b/g/n radio.	
Device Dimension	Overall (Length x Width x Height): 75 mm x 52 mm x 28.6 mm
Accessory	None
Hardware Version	N75NA_TAG20_R4.0.1
Software Version	V1.0

6.2. Wireless Technology

Wireless technologies	Frequency bands	Operating mode
W-CDMA (UMTS)	Band 2/4/5	UMTS Rel. 99 (Data) HSDPA (Rel. 5) HSUPA (Rel. 6) HSPA+ (Rel.8)
LTE	FDD Band 2 FDD Band 4 FDD Band 5 FDD Band 12 FDD Band 13 FDD Band 66	QPSK 16QAM ☐ Rel. 10 Does not support Carrier Aggregation (CA) ☐ Rel. 10 Carrier Aggregation (Downlink only) ☐ Rel. 11 Carrier Aggregation (2 Uplink and 2 Downlinks)
Wi-Fi	2.4GHz	802.11b 802.11g 802.11n (HT20)
BT	2.4GHz	V4.2

7. RF Exposure Conditions

The Device is a OBD device, which will be close to human's leg when used. SAR was tested with a distance of 10 mm of the below position of the device.

8. Test Configuration

8.1. UMTS Test Configuration

1. Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the procedures description in section 5.2 of 3GPP TS 34.121,using the appropriate RMC or AMR with TPC(transmit power control) set to all “1s” for WCDMA/HSDPA or applying the required inner loop power control procedure to maintain maximum output power while HSUPA is active. Result for all applicable physical channel configurations(DPCCH, DPDCHn and spreading codes, HSDPA, HSPA) Should be tabulated in the SAR report .All configuration that are not supported by the DUT or cannot be measured due to technical or equipment limitation should be clearly identified.

2. WCDMA

Body SAR Measurements

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all “1”s”. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the handset with 12.2 kbps RMC as the primary mode

3. HSDPA

SAR for body exposure configurations is measured according to the “Body SAR Measurements”” procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode. This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as “otherwise” in the applicable procedures; SAR measurement is required for the secondary mode.

As per KDB941225 D01, the 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures for the highest reported SAR body exposure configuration in 12.2 kbps RMC.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HAPRQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The □c and □d gain factors for DPCCH and DPDCH were set according to the values in the below table, □hs for HS-DPCCH is set automatically to the correct value when ΔACK, ΔNACK, ΔCQI = 8. The variation of the □c /□d ratio causes a power reduction at sub-tests 2 - 4.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: ΔACK, ΔNACK and ΔCQI = 8 $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\beta_{hs} = 30/15 * \beta_c$

Note 2 : CM=1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH,DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 3 : For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.
Settings of required H-Set 1 QPSK acc. to 3GPP 34.121

Parameter	Value
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI"s
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

HSDPA UE category

HS-DSCH Category	Maximum HS-DSCH Codes Received	Minimum Inter-TTI Interval	Maximum HS-DSCH Transport Block Bits/HS-DSCH TTI	Total Soft Channel Bits
1	5	3	7298	19200
2	5	3	7298	28800
3	5	2	7298	28800
4	5	2	7298	38400
5	5	1	7298	57600
6	5	1	7298	67200
7	10	1	14411	115200
8	10	1	14411	134400
9	15	1	25251	172800
10	15	1	27952	172800
11	5	2	3630	14400
12	5	1	3630	28800
13	15	1	34800	259200
14	15	1	42196	259200
15	15	1	23370	345600
16	15	1	27952	345600

4. HSUPA
SAR for body exposure configurations is measured according to the "Body SAR Measurements"" procedures of 3G device. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

As per KDB941225 D01v03, the 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures for the highest reported body exposure SAR configuration in 12.2 kbps RMC.

Due to inner loop power control requirements in HSDPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSDPA should be configured according to the values indicated below as well as other applicable procedures described in the „WCDMA Handset" and „Release 5 HSDPA Data Device" sections of 3G device.

Subtests for WCDMA Release 6 HSUPA

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

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

HSUPA UE category

UE E-DCH Category	Maximum E-DCH Codes Transmitted	Number of HARQ Processes	E-DCH TTI(ms)	Minimum Speading Factor	Maximum E-DCH Transport Block Bits	Max Rate (Mbps)
1	1	4	10	4	7110	0.7296
2	2	8	2	4	2798	1.4592
	2	4	10	4	14484	
3	2	4	10	4	14484	1.4592
4	2	8	2	2	5772	2.9185
	2	4	10	2	20000	2.00
5	2	4	10	2	20000	2.00
6 (No DPDCH)	4	8	10	2SF2&2SF4	11484	5.76
	4	4	2		20000	2.00
7 (No DPDCH)	4	8	2	2SF2&2SF4	22996	?
	4	4	10		20000	?

Note:

1) When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4.UE categories 1 to 6 support QPSK only. UE category 7 supports QPSK and 16QAM. (TS25.306-7.3.0).

5. DC-HSDPA

SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a Second serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS 34.108 v9.5.0. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.0
Levels for HSDPA connection setup

Parameter During Connection setup	Unit	Value
P-CPICH_Ec/Ior	dB	-10
P-CCPCH and SCH_Ec/Ior	dB	-12
PICH _Ec/Ior	dB	-15
HS-PDSCH	dB	off
HS-SCCH_1	dB	off
DPCH_Ec/Ior	dB	-5
OCNS_Ec/Ior	dB	-3.1

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

The measurements were performed with a Fixed Reference Channel (FRC) H-Set 12 with QPSK

Parameter	Value
Nominal average inf. bit rate	60 kbit/s
Inter-TTI Distance	1 TTI"s
Number of HARQ Processes	6 Processes
Information Bit Payload	120 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	960 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	3200 SMLs
Coding Rate	0.15
Number of Physical Channel Codes	1

Note:

1) The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table above.
2) Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.

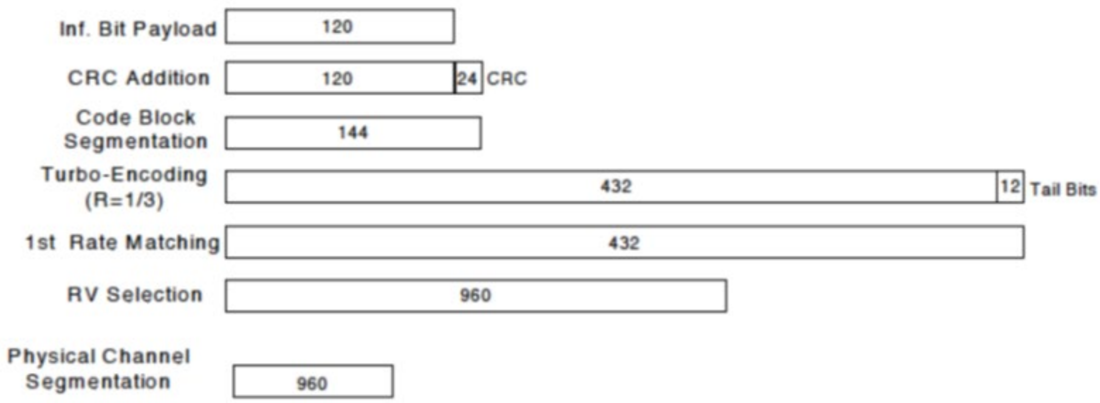


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

The following 4 Sub-tests for HSDPA were completed according to Release 5 procedures. A summary of subtest settings are illustrated below:

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5
Note 1: Δ ACK, Δ NACK and Δ CQI=8 $A_{hs}=\beta_{hs}/\beta_c=30/15$ $\beta_{hs}=30/15*\beta_c$ Note 2: CM=1 for β_c/β_d= 12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases. Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15							

Up commands are set continuously to set the UE to Max power.

Note:

1) The Dual Carriers transmission only applies to HSDPA physical channels.
2) The Dual Carriers belong to the same Node and are on adjacent carriers.
3) The Dual Carriers do not support MIMO to serve UEs configured for dual cell operation.
4) The Dual Carriers operate in the same frequency band.
5) The device doesn't support the modulation of 16QAM in uplink but 64QAM in downlink for DC-HSDPA mode.
6) The device doesn’t support carrier aggregation for it just can operate in Release 8.

8.2. LTE(FDD) Test Configuration

Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR. The R&S CMW500 was used for LTE output power measurements and SAR testing. Max power control was used so the UE transmits with maximum output power during SAR testing. SAR must be measured with the maximum TTI (transmit time interval) supported by the device in each LTE configuration.

1) Spectrum Plots for RB configurations

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

2) MPR

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

3) A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by using Network Signaling Value of “NS=01”on the base station simulator.

4) SAR test requirements

A) Largest channel bandwidth standalone SAR test requirements

i) QPSK with 1 RB allocation

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. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

ii) QPSK with 50% RB allocation

The procedures required for 1 RB allocation in i) are applied to measure the SAR for QPSK with 50% RB allocation.

iii) QPSK with 100% RB allocation

For 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 in i) and ii) 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.

iv) Higher order modulations

For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in above sections to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

B) Other channel bandwidth standalone SAR test requirements

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

8.3. Wi-Fi Test Configuration

For Wi-Fi SAR testing, a communication link is set up with the testing software for Wi-Fi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The test procedures in KDB 248227D01 are applied.

8.3.1. Initial Test Position Procedure

For exposure condition with multiple test position, such as handsets operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4W/kg, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8W/kg or all test position are measured. For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

8.3.2. Initial Test Configuration Procedure

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2 of KDB 248227D01). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode. For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration.

When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

8.3.3. Sub Test Configuration Procedure

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units.

When the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

8.3.4. 2.4GHz Wi-Fi SAR Test Procedures

Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions.

A) 802.11b DSSS SAR Test Requirements

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

1) When the reported SAR of the highest measured maximum output power channel (section 3.1 of KDB 248227D01) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

B) 2.4GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3 of KDB 248227D01). SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

C) SAR Test Requirements for OFDM configurations

When SAR measurement is required for 802.11 g/n OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

9. Conducted Output Power Measurements

9.1. Power measurement result of UMTS Band 2,4,5

Band	WCDMA 2		
Tx Channel	9262	9400	9538
Frequency	1852.4	1880	1907.6
Rel99	23.89	23.91	23.81
HSDPA Subtest-1	22.51	22.37	22.44
HSDPA Subtest-2	21.81	21.90	21.93
HSDPA Subtest-3	22.07	21.96	22.07
HSDPA Subtest-4	22.17	21.99	22.13
HSUPA Subtest-1	22.14	21.76	22.38
HSUPA Subtest-2	20.95	21.48	20.99
HSUPA Subtest-3	20.62	21.22	20.92
HSUPA Subtest-4	21.54	21.95	21.56
HSUPA Subtest-5	22.80	22.63	22.63
DC-HSDPA Subtest-1	22.51	22.37	22.44
DC-HSDPA Subtest-2	21.81	21.90	21.93
DC-HSDPA Subtest-3	22.07	21.96	22.07
DC-HSDPA Subtest-4	22.17	21.99	22.13
Band	WCDMA 4		
Tx Channel	1312	1413	1513
Frequency	1712.4	1732.6	1752.6
Rel99	23.65	23.86	23.82
HSDPA Subtest-1	22.35	22.89	22.66
HSDPA Subtest-2	21.92	22.27	22.27
HSDPA Subtest-3	21.91	22.31	22.22
HSDPA Subtest-4	22.04	22.24	22.25

HSUPA Subtest-1	22.59	21.96	22.02
HSUPA Subtest-2	22.18	21.38	21.35
HSUPA Subtest-3	21.57	20.82	21.20
HSUPA Subtest-4	22.11	21.75	21.76
HSUPA Subtest-5	22.82	22.73	22.78
DC-HSDPA Subtest-1	22.35	22.89	22.66
DC-HSDPA Subtest-2	21.92	22.27	22.27
DC-HSDPA Subtest-3	21.91	22.31	22.22
DC-HSDPA Subtest-4	22.04	22.24	22.25
Band	**WCDMA 5**		
Tx Channel	**4132**	**4182**	**4233**
Frequency	**826.4**	**836.4**	**846.6**
Rel99	22.66	22.66	23.42
HSDPA Subtest-1	21.48	21.65	21.75
HSDPA Subtest-2	21.03	21.15	21.39
HSDPA Subtest-3	21.16	21.15	21.36
HSDPA Subtest-4	21.15	21.10	21.41
HSUPA Subtest-1	21.39	21.26	20.66
HSUPA Subtest-2	20.11	20.36	20.02
HSUPA Subtest-3	20.02	19.37	20.00
HSUPA Subtest-4	20.75	20.51	20.97
HSUPA Subtest-5	21.55	21.41	21.91
DC-HSDPA Subtest-1	21.48	21.65	21.75
DC-HSDPA Subtest-2	21.03	21.15	21.39
DC-HSDPA Subtest-3	21.16	21.15	21.36
DC-HSDPA Subtest-4	21.15	21.10	21.41

Note:

1) The bolded 12.2kbps RMC mode was selected for SAR testing (primary mode).
2) As per KDB941225 D01v03, When the maximum output power and tune-up tolerance specified for production units in a Second mode is ≤ ¼ dB higher than the primary mode or when the highest *reported* SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of Second to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR evaluation is not required for Second mode.

9.2. Power measurement result of LTE Band 2

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18607	**18900**	**19193**
Band 2 1.4MHz	QPSK	1	0	22.28	22.24	22.26
		1	3	22.18	22.26	22.42
		1	5	22.08	22.12	22.35
		3	0	22.12	22.29	22.42
		3	2	22.17	22.15	22.32
		3	3	22.11	22.22	22.31
		6	0	21.25	21.18	21.44
	16QAM	1	0	21.22	21.06	21.41
		1	3	21.27	21.28	21.52
		1	5	21.24	21.18	21.34
		3	0	20.89	21.05	21.09
		3	2	21.04	20.86	21.21
		3	3	20.83	20.93	21.05
		6	0	20.31	20.14	20.36
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18615	**18900**	**19185**
Band 2 3MHz	QPSK	1	0	22.38	22.35	22.32
		1	7	22.39	22.27	22.33
		1	14	22.35	22.24	22.58
		8	0	21.47	21.53	21.58
		8	4	21.48	21.46	21.51

		8	7	21.42	21.4	21.55
		15	0	21.5	21.48	21.54
	16QAM	1	0	21.39	21.37	21.5
		1	7	21.41	21.39	21.44
		1	14	21.35	21.33	21.47
		8	0	20.76	20.56	20.6
		8	4	20.61	20.45	20.6
		8	7	20.6	20.49	20.71
		15	0	20.59	20.48	20.53

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18625	18900	19175
Band 2 5MHz	QPSK	1	0	22.51	22.4	22.35
		1	13	22.38	22.45	22.43
		1	24	22.39	22.5	22.45
		12	0	21.44	21.43	21.62
		12	6	21.45	21.44	21.51
		12	13	21.44	21.51	21.58
		25	0	21.48	21.48	21.54
	16QAM	1	0	21.28	21.58	21.64
		1	13	21.68	21.57	21.64
		1	24	21.43	21.43	21.45
		12	0	20.51	20.5	20.56
		12	6	20.45	20.44	20.57
		12	13	20.44	20.5	20.56

		25	0	20.49	20.48	20.74
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18650	**18900**	**19150**
Band 2 10MHz	QPSK	1	0	22.3	22.27	22.26
		1	25	22.45	22.62	22.68
		1	49	22.21	22.2	22.35
		25	0	21.61	21.6	21.66
		25	13	21.52	21.53	21.67
		25	25	21.55	21.54	21.69
		50	0	21.59	21.58	21.64
	16QAM	1	0	21.51	21.49	21.55
		1	25	21.85	21.74	21.9
		1	49	21.42	21.4	21.46
		25	0	20.57	20.55	20.72
		25	13	20.61	20.66	20.72
		25	25	20.6	20.45	20.52
		50	0	20.57	20.55	20.62
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18675	**18900**	**19125**
Band 2 15MHz	QPSK	1	0	22.65	22.74	23.34
		1	38	23.02	23.11	23.15
		1	74	23.09	23.07	23.14
		36	0	22.06	21.99	22.1
		36	18	21.97	21.89	22.26

		36	39	22.02	21.92	22.18
		75	0	22.02	22.08	22.28
	16QAM	1	0	21.98	21.96	22.14
		1	38	22.03	21.93	22.28
		1	74	21.89	21.97	21.97
		36	0	22.02	21.73	22.42
		36	18	21.93	21.96	22.26
		36	39	22.07	21.98	21.99
		75	0	20.95	21.04	21.25

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				18700	**18900**	**19100**
Band 2 20MHz	QPSK	1	0	22.99	22.99	23.35
		1	50	23.17	23.18	23.4
		1	99	22.9	23.06	23.19
		50	0	22.14	22.02	22.39
		50	25	22.05	22.01	22.33
		50	50	22	22.2	22.32
		100	0	22.08	22.11	22.32
	16QAM	1	0	22.04	21.93	22.32
		1	50	21.99	22.21	22.55
		1	99	22.06	22.18	22.12
		50	0	20.97	20.99	21.26
		50	25	21	20.95	21.27
		50	50	20.97	21.04	21.23

		100	0	20.91	21.05	21.2

9.3. Power measurement result of LTE Band 4

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				19957	20175	20393
Band 4 1.4MHz	QPSK	1	0	23.16	23.26	23.4
		1	3	23.28	23.62	23.43
		1	5	23.2	23.47	23.44
		3	0	23.21	23.45	23.44
		3	2	23.2	23.39	23.42
		3	3	23.21	23.44	23.41
		6	0	22.24	22.4	22.48
	16QAM	1	0	22.15	22.18	22.29
		1	3	22.13	22.43	22.61
		1	5	22.37	22.01	22.42
		3	0	22.19	22.44	22.53
		3	2	22.24	22.5	22.53
		3	3	22.32	22.51	22.42
		6	0	21.18	21.41	21.63
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				19965	20175	20385
Band 4 3MHz	QPSK	1	0	23.25	23.34	23.54
		1	7	23.23	23.28	23.48

		1	14	23.14	23.36	23.5
		8	0	22.31	22.44	22.5
		8	4	22.2	22.46	22.53
		8	7	22.27	22.38	22.61
		15	0	22.22	22.42	22.51
	16QAM	1	0	22.09	22.1	22.6
		1	7	21.9	22.35	22.68
		1	14	22.2	22.42	22.41
		8	0	21.31	21.37	21.51
		8	4	21.19	21.39	21.39
		8	7	21.25	21.32	21.49
		15	0	21.27	21.4	21.29

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				19975	20175	20375
Band 4 5MHz	QPSK	1	0	23.13	23.28	23.56
		1	13	23.07	23.19	23.63
		1	24	22.97	23.27	23.49
		12	0	22.24	22.41	22.67
		12	6	22.23	22.41	22.59
		12	13	22.19	22.39	22.67
		25	0	22.27	22.47	22.67
	16QAM	1	0	22.19	22.57	22.6
		1	13	22.31	22.55	22.6
		1	24	22.03	22.43	22.87

		12	0	21.17	21.5	21.69
		12	6	21.33	21.45	21.68
		12	13	21.13	21.39	21.61
		25	0	21.15	21.39	21.32
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20000	20175	20350
Band 4 10MHz	QPSK	1	0	23.26	23.27	23.59
		1	25	23.24	23.53	23.78
		1	49	23.19	23.37	23.6
		25	0	22.28	22.37	22.72
		25	13	22.27	22.38	22.73
		25	25	22.22	22.45	22.69
		50	0	22.19	22.47	22.71
	16QAM	1	0	22.42	22.54	22.66
		1	25	22.18	22.48	22.88
		1	49	22.21	22.38	22.88
		25	0	21.21	21.31	21.7
		25	13	21.27	21.4	21.68
		25	25	21.21	21.33	21.67
		50	0	21.23	21.39	21.66
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20025	20175	20325
Band 4 15MHz	QPSK	1	0	23.17	22.89	23.4
		1	38	23.03	23.11	23.42

		1	74	23.05	23.2	23.46
		36	0	22	21.98	22.35
		36	18	21.82	22.24	22.28
		36	39	22.17	22.34	22.34
		75	0	22.01	22.25	22.56
	16QAM	1	0	21.99	22	22.24
		1	38	21.97	22.08	22.36
		1	74	21.91	22.13	22.35
		36	0	21.96	21.84	22.4
		36	18	21.9	21.98	22.2
		36	39	21.9	22.3	22.34
		75	0	20.99	21.18	21.47
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20050	20175	20300
Band 4 20MHz	QPSK	1	0	23.01	22.97	23.08
		1	50	23.03	23.23	23.78
		1	99	23.21	23.29	22.44
		50	0	22	22.15	22.56
		50	25	22.02	22.16	22.35
		50	50	22.12	22.3	22.34
		100	0	22.03	22.11	22.31
	16QAM	1	0	22	22.06	22.28
		1	50	22.22	22.4	22.48
		1	99	22.17	22.52	22.34

		50	0	21	21.07	21.36
		50	25	21.09	21.13	21.33
		50	50	21.04	21.1	21.41
		100	0	21.05	21.12	21.35

9.4. Power measurement result of LTE Band 5

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20407	20525	20643
Band 5 1.4MHz	QPSK	1	0	22.11	21.89	22.17
		1	3	22.11	22.05	22.22
		1	5	21.89	21.99	21.98
		3	0	21.98	21.88	22.18
		3	2	22.05	21.91	22.18
		3	3	22	21.96	22.14
		6	0	21.1	20.91	21.22
	16QAM	1	0	21.06	20.88	21.13
		1	3	21.16	20.95	21.31
		1	5	21	21.1	21.31
		3	0	21.01	20.93	21.2
		3	2	21.09	20.99	21.3
		3	3	20.95	20.84	21.18
		6	0	20.06	19.92	20.2
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20415	20525	20635

Band 5 3MHz	QPSK	1	0	22.11	22	22.24
		1	7	22.03	21.93	22.3
		1	14	22.01	22.06	22.34
		8	0	21.14	21.01	21.33
		8	4	21.09	21.01	21.25
		8	7	20.92	21.06	21.34
		15	0	20.98	20.99	21.28
	16QAM	1	0	21.22	20.85	21.36
		1	7	20.92	20.9	21.32
		1	14	20.89	21.1	21.39
		8	0	20.11	20.07	20.25
		8	4	20.04	20.11	20.34
		8	7	20.07	20.03	20.31
		15	0	19.98	20	20.3

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20425	20525	20625
Band 5 5MHz	QPSK	1	0	22.12	21.69	22.12
		1	13	21.94	21.98	22.16
		1	24	21.78	22.01	22.1
		12	0	20.95	21	21.2
		12	6	20.97	21.01	21.18
		12	13	21.1	21.05	21.22
		25	0	21	21	21.32
	16QAM	1	0	21.15	20.89	21.33

		1	13	20.87	21.12	21.4
		1	24	20.82	21.02	21.46
		12	0	20.04	19.87	20.2
		12	6	20	19.98	20.26
		12	13	20.18	20.02	20.23
		25	0	19.93	20.15	20.15
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				20450	20525	20600
Band 5 10MHz	QPSK	1	0	22.01	21.59	22.17
		1	25	22.15	22.04	22.39
		1	49	21.89	22.05	22.21
		25	0	21.28	20.95	21.09
		25	13	21.04	20.96	21.1
		25	25	21.29	21.05	21.69
		50	0	22.01	21.59	22.17
	16QAM	1	0	21.02	20.66	21.33
		1	25	21.22	21.16	21.17
		1	49	21.01	21.17	21.31
		25	0	20.37	19.93	20.17
		25	13	20.6	19.93	20.06
		25	25	20.04	20.05	20.35
		50	0	20.14	20	20.13

9.5. Power measurement result of LTE Band 12

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel 23017	Channel 23095	Channel 23173
Band 12 1.4MHz	QPSK	1	0	22.53	22.43	22.81
		1	3	22.64	22.51	22.47
		1	5	22.43	22.49	22.47
		3	0	22.46	22.53	22.52
		3	2	22.39	22.46	22.45
		3	3	22.43	22.34	22.48
		6	0	21.5	21.42	21.4
	16QAM	1	0	21.85	21.71	21.5
		1	3	21.58	21.83	21.37
		1	5	21.48	21.53	21.32
		3	0	21.39	21.49	21.52
		3	2	21.54	21.43	21.45
		3	3	21.42	21.51	21.59
		6	0	20.42	20.39	20.22
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel 23025	Channel 23095	Channel 23165
Band 12 3MHz	QPSK	1	0	22.46	22.33	22.49
		1	7	22.61	22.21	22.4
		1	14	22.61	22.31	22.35
		8	0	21.53	21.36	21.5
		8	4	21.52	21.39	21.52

		8	7	21.55	21.3	21.39
		15	0	21.53	21.29	21.47
	16QAM	1	0	21.46	21.28	21.51
		1	7	21.75	21.25	21.37
		1	14	21.44	21.31	21.07
		8	0	20.38	20.48	20.42
		8	4	20.52	20.33	20.58
		8	7	20.53	20.29	20.39
		15	0	20.54	20.26	20.45

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				23035	23095	23155
Band 12 5MHz	QPSK	1	0	22.36	22.3	22.26
		1	13	22.59	22.25	22.41
		1	24	22.55	22.25	22.34
		12	0	21.5	21.39	21.34
		12	6	21.47	21.38	21.33
		12	13	21.52	21.33	21.32
		25	0	21.53	21.29	21.4
	16QAM	1	0	21.42	21.58	21.46
		1	13	21.7	21.45	21.74
		1	24	21.6	21.3	21.67
		12	0	20.45	20.46	20.3
		12	6	20.52	20.36	20.33
		12	13	20.49	20.41	20.22

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
		25	0	20.65	20.32	20.32
Bandwidth	Modulation	RB size	RB offset	Channel 23060	Channel 23095	Channel 23130
Band 12 10MHz	QPSK	1	0	22.45	22.23	22.34
		1	25	22.46	22.37	22.72
		1	49	22.35	22.37	22.36
		25	0	21.48	21.41	21.43
		25	13	21.55	21.35	21.39
		25	25	21.56	21.35	21.46
		50	0	21.42	21.32	21.44
	16QAM	1	0	21.14	21.29	21.41
		1	25	21.76	21.15	21.58
		1	49	21.21	21.2	21.57
		25	0	20.53	20.34	20.46
		25	13	20.48	20.39	20.42
		25	25	20.46	20.3	20.57
		50	0	20.48	20.3	20.4

9.6. Power measurement result of LTE Band 13

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				23205	23230	23255
Band 13 5MHz	QPSK	1	0	22.76	22.77	22.62
		1	13	22.84	22.69	22.64
		1	24	22.63	22.67	22.77
		12	0	21.69	21.75	21.63
		12	6	21.74	21.73	21.61
		12	13	21.75	21.72	21.69
		25	0	21.68	21.61	21.64
	16QAM	1	0	21.64	21.45	21.98
		1	13	21.53	21.55	21.95
		1	24	21.37	21.59	21.56
		12	0	20.68	20.65	20.59
		12	6	20.63	20.67	20.59
		12	13	20.71	20.49	20.8
		25	0	20.66	20.64	20.61
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				23230	23230	23230
Band 13 10MHz	QPSK	1	0	22.83	22.8	22.75
		1	25	22.86	22.78	22.8
		1	49	22.76	22.59	22.54
		25	0	21.72	21.65	21.57
		25	13	21.78	21.66	21.62

		25	25	21.68	21.57	21.64
		50	0	21.65	21.54	21.51
	16QAM	1	0	21.74	21.54	21.73
		1	25	21.71	21.74	21.79
		1	49	21.59	21.63	21.57
		25	0	20.76	20.59	20.6
		25	13	20.67	20.65	20.58
		25	25	20.61	20.54	20.51
		50	0	20.6	20.49	20.58

9.7. Power measurement result of LTE Band 66

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel 131979	Channel 132322	Channel 132665
Band 66 1.4MHz	QPSK	1	0	22.19	22.52	22.49
		1	3	22.29	22.72	22.55
		1	5	22.22	22.69	22.42
		3	0	22.25	22.69	22.53
		3	2	22.2	22.67	22.48
		3	3	22.16	22.7	22.4
		6	0	21.19	21.5	21.43
	16QAM	1	0	21.12	21.75	21.65
		1	3	21.39	21.76	21.75
		1	5	21.26	21.82	21.46
		3	0	21.32	21.71	21.52
		3	2	21.24	21.75	21.37
		3	3	21.14	21.46	21.53
		6	0	20.19	20.58	20.47

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel 131987	Channel 132322	Channel 132657
Band 66 3MHz	QPSK	1	0	22.09	22.55	22.43
		1	7	22.11	22.43	22.35
		1	14	22.12	22.48	22.37
		8	0	21.14	21.45	21.22
		8	4	21.11	21.45	21.25
		8	7	21.09	21.53	21.23
		15	0	21.17	21.4	21.25

	16QAM	1	0	21.2	21.64	21.52
		1	7	21.25	21.47	21.39
		1	14	21.1	21.38	21.34
		8	0	20.19	20.41	20.27
		8	4	20.18	20.62	20.25
		8	7	20.11	20.47	20.22
		15	0	19.92	20.54	20.26
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				131997	132322	132647
Band 66 5MHz	QPSK	1	0	21.91	22.5	22.28
		1	13	22.01	22.42	22.27
		1	24	21.92	22.36	22.24
		12	0	21	21.41	21.24
		12	6	20.97	21.41	21.25
		12	13	21.03	21.37	21.22
		25	0	20.99	21.37	21.3
	16QAM	1	0	21.24	21.5	21.48
		1	13	21.2	21.37	21.63
		1	24	20.92	21.45	21.34
		12	0	19.98	20.42	20.2
		12	6	19.98	20.33	20.27
		12	13	20.04	20.4	20.32
		25	0	19.9	20.41	20.3
Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				132022	132322	132622

Band 66 10MHz	QPSK	1	0	22.11	22.56	22.35
		1	25	22.12	22.54	22.37
		1	49	22.13	22.41	22.25
		25	0	21.05	21.44	21.35
		25	13	21.05	21.45	21.31
		25	25	21.17	21.48	21.29
		50	0	21.05	21.45	21.27
	16QAM	1	0	21.1	21.63	21.54
		1	25	21.16	21.46	21.35
		1	49	21.1	21.51	21.23
		25	0	20.07	20.5	20.55
		25	13	20.07	20.57	20.34
		25	25	20.17	20.44	20.34
		50	0	20.02	20.45	20.27

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel 132047	Channel 132322	Channel 132597
Band 66 15MHz	QPSK	1	0	22.16	22.58	22.5
		1	38	22.1	22.62	22.36
		1	74	22.37	22.37	22.4
		36	0	20.91	21.45	21.46
		36	18	21.02	21.68	21.55
		36	39	21.24	21.54	21.34
		75	0	21.2	21.58	21.35
	16QAM	1	0	21.33	21.34	21.49
		1	38	21.17	21.5	21.26

		1	74	21.14	21.57	21.42
		36	0	20.98	21.69	21.37
		36	18	21.36	21.68	21.38
		36	39	21.24	21.41	21.15
		75	0	20.25	20.57	20.46

Bandwidth	Modulation	RB size	RB offset	Average Power (dBm)		
				Channel	Channel	Channel
				132072	132322	132572
Band 66 20MHz	QPSK	1	0	22.2	22.53	22.33
		1	50	22.32	22.66	22.57
		1	99	22.44	22.37	22.41
		50	0	21.1	21.65	21.44
		50	25	21.14	21.64	21.44
		50	50	21.28	21.56	21.4
		100	0	21.26	21.6	21.46
	16QAM	1	0	21.27	21.21	21.44
		1	50	21.4	21.86	21.35
		1	99	21.46	21.61	21.71
		50	0	20.16	20.6	20.39
		50	25	20.14	20.61	20.39
		50	50	20.31	20.59	20.46
		100	0	20.26	20.63	20.4

9.9. Power measurement result of 2.4 GHz Wi-Fi

Mode	Channel	Frequency (MHz)	Data Rate	Average Power (dBm)	Tune-up Limit (dBm)	SAR Test	Duty Cycle (%)
802.11b	1	2412	1Mbps	18.72	19.0	Required	98.85
	6	2437		18.73	19.0		
	11	2462		18.77	19.0		
802.11g	1	2412	6Mbps	Not Required	15.5	Excluded	\
	6	2437					
	11	2462					
802.11n-HT20	1	2412	MCS0		16.0	Excluded	\
	6	2437					
	11	2462					

9.10. Power measurement result of BT

BT	Channel	Average Conducted Power (dBm)	Tune-up Limit (dBm)	Duty Cycle (%)
GFSK	0	9.71	10.0	76.8
	39	9.50	10.0	
	78	9.70	10.0	
8DPSK	0	7.90	8.0	\
	39	7.90	8.0	
	78	7.61	8.0	

BT	Channel	Average Conducted Power (dBm)	Tune-up Limit (dBm)	Duty Cycle (%)
BLE	0	5.58	6.0	\
	19	5.15		
	39	4.38		

10. Dielectric Property Measurements & System Check

10.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters
FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

Dielectric Property Measurements Results:

Liquid	Freq.	Liquid Parameters				Deviation(%)		Limit (%)	Temp. (℃)	Test Date
		Measured		Target						
		ϵ_r	σ	ϵ_r	σ	ϵ_r	σ			
Head 750	695	42.660	0.917	42.23	0.89	1.02	3.03	±5	23.1	April 25, 2021
	750	42.720	0.932	41.90	0.89	1.96	4.72			
	790	42.310	0.927	41.73	0.90	1.39	3.00			
Head 835	805	42.210	0.929	41.66	0.90	1.32	3.19		22.7	April 26, 2021
	835	42.100	0.943	41.50	0.90	1.45	4.74			
	905	43.500	0.938	41.50	0.97	4.82	-3.30			
Head 1800	1720	41.130	1.358	40.13	1.35	2.49	0.59		22.7	April 26, 2021
	1780	41.150	1.411	40.03	1.39	2.80	1.51			
	1800	41.220	1.420	40.00	1.40	3.05	1.43			
Head 1900	1850	41.180	1.440	40.00	1.40	2.95	2.86		22.7	April 26, 2021
	1900	41.040	1.439	40.00	1.40	2.60	2.79			
	1920	41.030	1.453	40.00	1.40	2.58	3.79			
Head 2450	2400	40.230	1.847	39.20	1.80	2.63	2.61		22.3	April 29, 2021
	2450	40.200	1.873	39.20	1.80	2.55	4.06			
	2480	40.050	1.877	39.20	1.80	2.17	4.28			

10.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm (above 1GHZ) and 15mm (below 1GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7*7*7 (below 3 GHz) and/or 8*8*7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 1.4 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

System Check Results:

T.S. Liquid		Messured Results: Zoom Scan (W/Kg)	Messured Results: Normalize to 1W (W/Kg)	Target (Ref. value)	Delta (%)	Limit (%)	Temp. (℃)	Test Date
Head 750	1-g	1.99	7.96	8.24	-3.40	±10	23.1	April 25, 2021
	10-g	1.28	5.12	5.52	-7.25			
Head 835	1-g	2.41	9.64	9.8	-1.63	±10	23.1	April 26, 2021
	10-g	1.57	6.28	6.52	-3.68			
Head 1800	1-g	9.28	37.12	38.84	-4.43	±10	22.7	April 26, 2021
	10-g	5.02	20.08	20.48	-1.95			
Head 1900	1-g	10.03	40.12	40.4	-0.69	±10	22.3	April 26, 2021
	10-g	5.29	21.16	20.12	5.17			
Head 2450	1-g	12.79	51.16	53.2	-3.83	±10	21.9	April 29, 2021
	10-g	6.02	24.08	24.84	-3.06			

Note:

1) The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target value.

11. Measured SAR Results

General Notes:

1) Same mode and same distance is selected to conduct SAR evaluation for body-worn and hotspot scenario.
2) As per KDB447498 D01, all SAR measurement results are scaled to the maximum tune-up tolerance limit to demonstrate SAR compliance.
3) As per KDB447498 D01, 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:
   ● ≤ 0.8W/kg for 1-g or 2.0W/kg for 10-g respectively, when the transmission band is ≤ 100MHz.
   ● ≤ 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.
   When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
4) As per KDB865664 D01 for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤20%, and the measured SAR <1.45W/Kg, only one repeated measurement is required.
5) As per KDB941225 D06, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.
6) As per KDB648474 D04, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is ≤1.2 W/kg, no additional SAR evaluations using a headset are required.
7) As per KDB865664 D02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing (Refer to appendix B for detailed SAR plots).
8) Additional SAR tests in simultaneous transmission fixed power reduction scenario are also tested in some frequency bands and required test positions for the SAR worst case, which are only used to ensure simultaneous transmission SAR test exclusion. The standalone SAR compliance still uses the SAR results tested at the maximum output power level.
9) As per KDB 648474D04, for handsets with additional batteries, the highest reported SAR for each wireless technology, frequency band, operating mode and applicable exposure condition (head, body-worn accessory, hotspot mode, etc.) must be repeated with the specific accessory attached. In addition, for test cases where the measured SAR for a handset is greater than 1.2 W/kg, these tests should also be repeated with the additional batteries.
10) As per KDB 648474 D04, Phones with built-in NFC functions do not require separate SAR testing and can generally be tested according to the SAR measurement procedures normally required for the phone. Influences of the hardware introduced by the built-in NFC functions are inherently considered through testing of the other transmitters that require SAR.
11) Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.

GSM Notes:

1) As per KDB941225 D01, SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.
2) As per KDB648474 D04, the device does not support DTM function. Body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.

UMTS Notes:

1) As per KDB941225 D01, when the maximum output power and tune-up tolerance specified for production units in a Second mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of Second to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the Second mode.

LTE Notes:

1) The LTE test configurations are determined according to KDB941225 D05. The general test procedures used for SAR testing can be found in Section 8.3.
2) A-MPR was disabled for all SAR test by setting NS_01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames(maximum TTI)
3) According to KDB 941225 D05, for Time-Division Duplex (TDD) systems, SAR is tested using a fixed periodic duty factor according to the highest transmission duty factor (63.33%) implemented for the device and supported by the defined 3GPP LTE TDD configurations.

Wi-Fi Notes:

As per KDB248227 D01:

1) When reported SAR for the initial test position is ≤ 0.4W/kg, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8W/kg or all test position are measured. For all positions/configurations tested using the initial test position and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested.
2) The highest SAR measured for the initial test position or initial test configuration should be used to determine SAR test exclusion according to the sum of 1-g SAR and SAR peak to location ratio provisions in KDB 447498. In addition, a test lab may also choose to perform standalone SAR measurements for test positions and 802.11 configurations that are not required by the initial test position or initial test configuration procedures and apply the results to determine simultaneous transmission SAR test exclusion, according to sum of 1-g and SAR peak to location ratio requirements to reduce the number of simultaneous transmission SAR measurements.

11.1. SAR measurement Result

Scenario and Distance (Body & Hotspot 10mm)	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Scaled (W/Kg)
			Tune-up	Meas.	1-g (W/Kg)		
WCDMA Band 2							
Front Surface	RMC 12.2KBPS	9400	24.0	23.91	0.341	0.06	0.348
Back Surface	RMC 12.2KBPS	9400	24.0	23.91	0.678	-0.05	0.692
Left Edge	RMC 12.2KBPS	9400	24.0	23.91	0.059	0.04	0.060
Right Edge	RMC 12.2KBPS	9400	24.0	23.91	0.283	-0.01	0.289
Top Edge	RMC 12.2KBPS	9262	24.0	23.89	0.921	0.07	0.945
Top Edge	RMC 12.2KBPS	9400	24.0	23.91	0.871	-0.02	0.889
Top Edge	RMC 12.2KBPS	9538	24.0	23.81	0.943	0.04	0.985
WCDMA Band 4							
Front Surface	RMC 12.2KBPS	1413	24.0	23.86	0.300	0.10	0.310
Back Surface	RMC 12.2KBPS	1413	24.0	23.86	0.491	0.04	0.507
Left Edge	RMC 12.2KBPS	1413	24.0	23.86	0.116	0.18	0.120
Right Edge	RMC 12.2KBPS	1413	24.0	23.86	0.273	0.02	0.282
Top Edge	RMC 12.2KBPS	1312	24.0	23.65	0.916	0.11	0.993
Top Edge	RMC 12.2KBPS	1413	24.0	23.86	0.921	0.06	0.951
Top Edge	RMC 12.2KBPS	1513	24.0	23.82	0.961	0.06	1.002
WCDMA Band 5							
Front Surface	RMC 12.2KBPS	4182	23.0	22.66	0.180	0.07	0.195
Back Surface	RMC 12.2KBPS	4183	23.0	22.66	0.277	0.06	0.300
Left Edge	RMC 12.2KBPS	4182	23.0	22.66	0.238	-0.04	0.257
Right Edge	RMC 12.2KBPS	4182	23.0	22.66	0.178	-0.04	0.192
Top Edge	RMC 12.2KBPS	4182	23.0	22.66	0.112	-0.11	0.121

Scenario and Distance (Body & Hotspot 10mm)	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Scaled (W/Kg)
			Tune-up	Meas.	1-g (W/Kg)		
LTE Band 2 20 MHz 1RB							
Front Surface	20M QPSK 1RB#49	19100	23.5	23.40	0.336	0.01	0.344
Back Surface	20M QPSK 1RB#49	19100	23.5	23.40	0.739	0.07	0.756
Left Edge	20M QPSK 1RB#49	19100	23.5	23.40	0.243	0.12	0.249
Right Edge	20M QPSK 1RB#49	19100	23.5	23.40	0.080	0.06	0.082
Top Edge	20M QPSK 1RB#49	19100	23.5	23.40	0.737	-0.06	0.754
LTE Band 2 20 MHz 50%RB							
Front Surface	20M QPSK 50RB#0	19100	22.5	22.39	0.236	0.08	0.242
Back Surface	20M QPSK 50RB#0	19100	22.5	22.39	0.563	0.08	0.577
Left Edge	20M QPSK 50RB#0	19100	22.5	22.39	0.194	0.01	0.199
Right Edge	20M QPSK 50RB#0	19100	22.5	22.39	0.063	0.08	0.064
Top Edge	20M QPSK 50RB#0	19100	22.5	22.39	0.526	-0.01	0.539
LTE Band 4 20 MHz 1RB							
Front Surface	20M QPSK 1RB#49	20300	24.0	23.78	0.282	0.04	0.297

Back Surface	20M QPSK 1RB#49	20300	24.0	23.78	0.712	0.12	0.749
Left Edge	20M QPSK 1RB#49	20300	24.0	23.78	0.249	0.11	0.262
Right Edge	20M QPSK 1RB#49	20300	24.0	23.78	0.291	-0.03	0.306
Top Edge	20M QPSK 1RB#49	20300	24.0	23.78	0.721	-0.01	0.758
LTE Band 4 20 MHz 50%RB							
Front Surface	20M QPSK 50RB#0	20300	23.0	22.56	0.218	0.19	0.241
Back Surface	20M QPSK 50RB#0	20300	23.0	22.56	0.563	0.18	0.623
Left Edge	20M QPSK 50RB#0	20300	23.0	22.56	0.195	0.16	0.216
Right Edge	20M QPSK 50RB#0	20300	23.0	22.56	0.242	0.00	0.268
Top Edge	20M QPSK 50RB#0	20300	23.0	22.56	0.597	0.04	0.661
LTE Band 5 10 MHz 1RB							
Front Surface	10M QPSK 1RB#25	20600	23.0	22.39	0.221	0.09	0.254
Back Surface	10M QPSK 1RB#25	20600	23.0	22.39	0.214	0.02	0.246
Left Edge	10M QPSK 1RB#25	20600	23.0	22.39	0.143	0.01	0.165
Right Edge	10M QPSK 1RB#25	20600	23.0	22.39	0.139	-0.19	0.160
Top Edge	10M QPSK 1RB#25	20600	23.0	22.39	0.128	0.04	0.147
LTE Band 5 10 MHz 50%RB							
Front Surface	10M QPSK 25RB#25	20600	22.0	21.69	0.241	-0.11	0.259
Back Surface	10M QPSK 25RB#25	20600	22.0	21.69	0.252	0.04	0.271
Left Edge	10M QPSK 25RB#25	20600	22.0	21.69	0.143	0.01	0.154
Right Edge	10M QPSK 25RB#25	20600	22.0	21.69	0.116	-0.07	0.125
Top Edge	10M QPSK 25RB#25	20600	22.0	21.69	0.113	0.18	0.121
LTE B12 10 MHz 1RB							
Front Surface	10M QPSK 1RB#25	23130	23.0	22.72	0.135	0.00	0.144
Back Surface	10M QPSK 1RB#25	23130	23.0	22.72	0.282	-0.03	0.301
Left Edge	10M QPSK 1RB#25	23130	23.0	22.72	0.232	-0.07	0.247
Right Edge	10M QPSK 1RB#25	23130	23.0	22.72	0.113	0.02	0.121
Top Edge	10M QPSK 1RB#25	23130	23.0	22.72	0.249	-0.14	0.266
LTE B12 10 MHz 50%RB							
Front Surface	10M QPSK 25RB#25	23060	22.0	21.56	0.101	0.02	0.112
Back Surface	10M QPSK 25RB#25	23060	22.0	21.56	0.271	-0.02	0.300
Left Edge	10M QPSK 25RB#25	23060	22.0	21.56	0.18	0.08	0.199
Right Edge	10M QPSK 25RB#25	23060	22.0	21.56	0.0945	0.02	0.105
Top Edge	10M QPSK 25RB#25	23060	22.0	21.56	0.0872	0.02	0.096
LTE B13 10 MHz 1RB							
Front Surface	10M QPSK 1RB#25	23230	23.0	23.86	0.168	-0.10	0.138
Back Surface	10M QPSK 1RB#25	23230	23.0	23.86	0.302	0.09	0.248
Left Edge	10M QPSK 1RB#25	23230	23.0	23.86	0.241	-0.12	0.198
Right Edge	10M QPSK 1RB#25	23230	23.0	23.86	0.206	0.03	0.169
Top Edge	10M QPSK 1RB#25	23230	23.0	23.86	0.111	0.16	0.091
LTE B13 10 MHz 50%RB							
Front Surface	10M QPSK 25RB#12	23230	22.0	21.78	0.125	0.10	0.131
Back Surface	10M QPSK 25RB#12	23230	22.0	21.78	0.259	-0.02	0.272
Left Edge	10M QPSK 25RB#12	23230	22.0	21.78	0.199	0.01	0.209
Right Edge	10M QPSK 25RB#12	23230	22.0	21.78	0.162	-0.08	0.170
Top Edge	10M QPSK 25RB#12	23230	22.0	21.78	0.0895	-0.13	0.094
LTE Band 66 1RB							
Front Surface	20M QPSK 1RB#49	132322	23.0	22.66	0.205	0.14	0.222
Back Surface	20M QPSK 1RB#49	132322	23.0	22.66	0.500	0.16	0.541

Left Edge	20M QPSK 1RB#49	132322	23.0	22.66	0.176	0.15	0.190
Right Edge	20M QPSK 1RB#49	132322	23.0	22.66	0.21	0.16	0.226
Top Edge	20M QPSK 1RB#49	132322	23.0	22.66	0.548	-0.06	**0.593**
LTE Band 66 50%RB							
Front Surface	20M QPSK 50%RB#0	132322	22.0	21.65	0.166	0.06	0.180
Back Surface	20M QPSK 50%RB#0	132322	22.0	21.65	0.414	0.17	0.449
Left Edge	20M QPSK 50%RB#0	132322	22.0	21.65	0.147	0.10	0.159
Right Edge	20M QPSK 50%RB#0	132322	22.0	21.65	0.187	0.02	0.203
Top Edge	20M QPSK 50%RB#0	132322	22.0	21.65	0.458	0.07	0.496

11.2. SAR measurement Result of 2.4GHz Wi-Fi

Scenario and Distance (Body & Hotspot 10mm)	Test Mode	Channel/ Frequency	Power (dBm)		SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1-g (Area Scan)			
Front Surface	802.11 b	11/2437	19.0	18.77	0.183	0.04	98.85	0.195
Back Surface	802.11 b	11/2437	19.0	18.77	0.459	0.05	98.85	**0.490**
Left Edge	802.11 b	11/2437	19.0	18.77	0.267	0.08	98.85	0.285
Right Edge	802.11 b	11/2437	19.0	18.77	0.083	-0.02	98.85	0.089
Top Edge	802.11 b	11/2437	19.0	18.77	0.159	0.11	98.85	0.170

11.3. SAR measurement Result of BT

Scenario and Distance (Body & Hotspot 10mm)	Test Mode	Channel/ Frequency	Power (dBm)		SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1-g (Area Scan)			
Front Surface	GFSK	0/2402	10.0	9.71	0.023	0.01	76.80	**0.032**
Back Surface	GFSK	0/2402	10.0	9.71	0.058	-0.08	76.80	**0.081**
Left Edge	GFSK	0/2402	10.0	9.71	0.034	0.06	76.80	0.047
Right Edge	GFSK	0/2402	10.0	9.71	0.010	0.11	76.80	0.014
Top Edge	GFSK	0/2402	10.0	9.71	0.020	-0.13	76.80	0.028

11.4. OFDM mode SAR evaluation exclusion analysis.

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11b	19	79.43	0.490	\	\
802.11g	15.5	35.48	\	0.219	Excluded
802.11n20	16	39.81	\	0.246	Excluded

Note:

1) The highest reported SAR for DSSS adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted 1g SAR is ≤ 1.2 W/kg(≤ 3.0W/kg for 10g SAR), so SAR evaluation for 802.11g/n is not required.

11.5. SAR Measurement Variability

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are

repeated after the completion of all measurements requiring the same head or body tissue-equivalent

medium in a frequency band. The test device should be returned to ambient conditions (normal room

temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg;

steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

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.

Test Position	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Scaled (W/Kg)
			Tune-up	Meas.	1-g (W/Kg)		
WCDMA Band 2							
Top Edge	RMC 12.2KBPS	9538	24.0	23.81	0.939	0.02	0.981
WCDMA Band 4							
Top Edge	RMC 12.2KBPS	1513	24.0	23.82	0.950	0.06	0.990

12. Simultaneous Transmission SAR Analysis

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna.

12.1. Simultaneous Transmission Possibilities

NO.	Combination	Scenario
		Body & Hotspot
1	UMTS+2.4GHz Wi-Fi	√
2	UMTS+BT	√
3	LTE+2.4GHz Wi-Fi	√
4	LTE+BT	√

Note:

1) "√" indicates exist, "×" indicates inexistence.

12.2. Highest SAR summation calculation

Test Position	UMTS	LTE	Wifi/BT	SUM 1-g SAR	SPLSR
Front Surface	0.348	0.344	0.195	0.543	Excluded
Back Surface	0.692	0.756	0.490	**1.246**	Excluded
Left Edge	0.257	0.262	0.285	0.547	Excluded
Right Edge	0.289	0.306	0.089	0.395	Excluded
Top Edge	1.002	0.758	0.170	1.172	Excluded

Note: 1.Sum SAR_{1g} <1.6 W/Kg, the SAR to peak location separation ratio should not be considered

Appendixes

Refer to separated files for the following appendixes.

4789869259-SAR-1_App A Photo

4789869259-SAR-1_App B System Check Plots

4789869259-SAR-1_App C Highest Test Plots

4789869259-SAR-1_App D Cal. Certificates

END OF REPORT