

Panasonic Corporation of North America

SAR TEST REPORT

SCOPE OF WORK:

SAR report for FCC

Model:

EYFMH1WC, EYFMH2WC,
EYFMH1WP, EYFMH2WP

REPORT NUMBER

2309A1404SHA-003

ISSUE DATE

December 22, 2023

DOCUMENT CONTROL NUMBER

TTRFFCCSAR_V1
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FCC ID: ACJ-EYFMH

Summary

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR § 2.1093: Radio frequency Radiation Exposure Evaluation: Portable Device

IEC/IEEE 62209-1528: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

FCC KDB Publication 865664 D01: SAR measurement 100 MHz to 6 GHz v01r04 describes SAR measurement procedures for devices operating between 100 MHz to 6 GHz;

PREPARED BY: **REVIEWED BY:**



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TEST REPORT

Contents

REVISION HISTORY..... 4

SAR SUMMARY..... 5

1 GENERAL INFORMATION 6

1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 6

1.2 RF TECHNICAL INFORMATION 7

1.3 DESCRIPTION OF TEST FACILITY 8

1.4 INSTRUMENT LIST 9

2 MEASUREMENT UNCERTAINTY..... 10

3 TISSUE DIELECTRIC PARAMETER MEASUREMENTS 11

3.1 TARGET FOR TISSUE DIELECTRIC PARAMETER 11

3.2 VERIFICATION RESULTS..... 13

4 SYSTEM VERIFICATION..... 14

4.1 SYSTEM PERFORMANCE CHECK 14

4.2 SYSTEM PERFORMANCE CHECK RESULT..... 15

4.3 WCDMA MEASUREMENT PROCEDURES FOR SAR 16

4.4 SAR MEASUREMENT FOR LTE 17

4.5 BLUETOOTH & WI-FI MEASUREMENT PROCEDURES FOR SAR..... 19

4.6 POWER DRIFT..... 19

5 MEASUREMENT PROCEDURES..... 20

5.1 RF EXPOSURE LIMIT 20

5.2 BLOCK DIAGRAM OF TEST SETUP 21

5.3 TEST CONDITIONS AND TEST METHOD 22

6 CONDUCTED RF OUTPUT POWER 23

6.1 GSM MEASUREMENT RESULT..... 23

6.2 WCDMA CONDUCTED OUTPUT POWER 24

6.3 LTE CONDUCTED PEAK OUTPUT POWER..... 25

6.4 WIFI CONDUCTED POWER..... 28

6.5 BLUETOOTH OUTPUT POWER 28

7 SCALING FACTOR CALCULATION 29

8 SAR TEST EXCLUSION CONSIDERATION AND SAR MEASUREMENT POSITIONS 29

8.1 SAR TEST EXCLUSION CONSIDERATION 29

8.2 SAR MEASUREMENT POSITIONS 29

9 SAR TEST RESULTS..... 30

10 SIMULTANEOUS TRANSMISSIONS ANALYSIS 31

10.1 SIMULTANEOUS TRANSMISSION MODE 31

10.2 SIMULTANEOUS TRANSMISSION FOR HEAD 31

10.3 SIMULTANEOUS TRANSMISSION FOR BODY 31

APPENDIX I: CALIBRATION REPORTS..... 32

APPENDIX II: TEST SETUP 32

APPENDIX III: MEASUREMENT RESULTS PLOTS 32

Revision History

Report No.	Version	Description	Issued Date
2309A1404SHA-003	Rev. 01	Initial issue of report	December 22, 2023

SAR Summary

Highest Standalone SAR Summary

Exposure Position	FrequencyBand	Measured SAR-1g 1g-SAR(W/kg)	Highest Scaled 1g-SAR(W/kg)
Body-supported (0mm Gap)	WIFI 2.4G	0.141	0.178
Body-supported (0mm Gap)	WIFI 5.2G	0.0826	0.373

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)







Product name	: Impact wrench
Type/Model	: EYFMH1WC, EYFMH2WC, EYFMH1WP, EYFMH2WP
Description of EUT	: The EUT is Impact wrench with WLAN function, There are four models. Details refer to model list. We tested all of models and put the worst test data into this report.
Exposure Category	: Population/Uncontrolled
Rating	: DC 14.4V
Hardware version	: /
Software version	: /
Sample received date	: November 22, 2023
Date of test	: November 22, 2023~ December 22, 2023

Model list:

4 model codes of EYFMH*W* all have same wireless communication features for WLAN. The difference between model codes are "Anvil type", "Shut-off Torque range" and "Identification plate".

(See Table2-1).

Table 2-1 Specification for each Model code

Product No.	Anvil type	Shut-off Torque range	Identification plate
EYFMH1WC		20 ~ 60Nm	
EYFMH2WC	Pin Hole with retainer ring	50 ~ 120Nm	
EYFMH1WP		20 ~ 60Nm	
EYFMH2WP	Detent Pin	50 ~ 120Nm	

1.2 RF Technical Information

Supported Band	:	WIFI 2.4GHz: 2400-2483.5MHz WIFI 5.2GHz: 5150-5250MHz
Tested Band	:	WIFI 2.4GHz: 2400-2483.5MHz WIFI 5.2GHz: 5150-5250MHz
Modulation	:	WIFI(OFDM/DSSS)

Wireless Technology and Frequency Range				
Wireless Technology	Modulation	Operating mode	Tx (MHz)	Rx (MHz)
Wi-Fi 2.4G	DSSS, OFDM	802.11b/g/n-HT20	2412 ~ 2462	2412 ~ 2462
Wi-Fi 5.2G	OFDM	802.11a/n-HT20	5180 ~ 5240	5180 ~ 5240

Does this device support 2.4G/5.2G MIMO? Yes No

1.3 Description of Test Facility

Name : Intertek Testing Services Shanghai
Address : No.999 Gaolang East Road, WuXi, Jiangsu, P.R.China
Telephone : 86 21 61278200
Telefax : 86 21 54262353

The test facility is recognized, certified, or accredited by these organizations :
FCC Accredited Lab
Designation Number: CN0175
IC Registration Lab
CAB identifier.: CN0014
A2LA Accreditation Lab
Certificate Number: 3309.02

Tests were sub-contracted.

Name : Shenzhen UnionTrust Quality and Technology Co., Ltd.
Address : Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng Science and Technology Park, Longhua District, Shenzhen, China
Telephone : +86 (0) 755 2823 0888
Telefax : +86 (0) 755 2823 0886

The test facility is recognized, certified, or accredited by these organizations :
CNAS Accreditation Lab
Registration No. CNAS L9069
FCC Accredited Lab
Designation Number: CN1194
A2LA Accreditation Lab
Certificate Number: 4312.01

1.4 Instrument list

Equipment	Manufacturer	Type	Internal no.	Due Date
System Validation Dipole	SPEAG	D2450V2	1014	May 19, 2024
System Validation Dipole	SPEAG	D5GHzV2	1280	May. 17, 2024
Dosimetric E-Field Probe	SPEAG	ES3DV3	3090	Mar. 15, 2024
Dosimetric E-Field Probe	SPEAG	EX3DV4	7506	Jun. 29, 2024
Data Acquisition Electronics	SPEAG	DAE4	662	Mar. 08, 2024
ENA Series Network Analyzer	Agilent	8753ES	US39170317	Oct. 31, 2024
Dielectric Assessment Kit	SPEAG	DAK-3.5	1056	N/A
USB/GPIB Interface	Agilent	82357B	N10149	N/A
Signal Generator	R&S	SMB100A	103718	Apr. 14, 2024
POWER METER	R&S	NRP	101293	Oct. 27, 2024
Thermometer	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	18022507	Oct. 30, 2024
Dual Directional Coupler	Agilent	778D	MY52180234	Oct. 27, 2024
Amplifier	Mini-Circuit	ZHL42	QA1252001	Apr. 15, 2024
DC Source	Agilent	66319B	MY43000795	Oct. 31, 2024

2 Measurement Uncertainty

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g) (± %)	Standard Uncertainty (10g) (± %)	Vi Veff
Measurement System								
Probe Calibration (< 3 GHz)	7.5	N (k=2)	2	1	1	3.75	3.75	∞
Probe Calibration (> 3 GHz)	6.3	N (k=2)	2	1	1	3.15	3.15	∞
Axial Isotropy	1.2	N (k=2)	2	0.7	0.7	0.42	0.42	∞
Hemispherical Isotropy	3.2	N (k=2)	2	0.7	0.7	1.12	1.12	∞
Boundary Effects	2	Rectangular	√3	1	1	1.15	1.15	∞
Linearity	0.9	N (k=2)	2	1	1	0.45	0.45	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Modulation Response	2.4	Rectangular	√3	1	1	1.39	1.39	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Response Time	0	Rectangular	√3	1	1	0.00	0.00	∞
Integration Time	1.7	Rectangular	√3	1	1	0.98	0.98	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.87	3.87	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	2.31	2.31	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	2.30	2.40	30
Device Holder	2.8 / 2.8	Normal	1	1	1	2.80	2.80	30
Power Drift	5	Rectangular	√3	1	1	2.89	2.89	∞
Power Scaling	0	Rectangular	√3	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	4.56	4.56	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	0.69	0.47	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	1.13	1.02	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	1.53	1.39	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	0.05	0.06	∞
Combined Standard Uncertainty (k = 1) (≤ 3 GHz)						9.64	9.62	
Combined Standard Uncertainty (k = 1) (> 3 GHz)						9.42	9.40	
Max. Expanded Uncertainty (k = 2)						19.27	19.23	

3 Tissue Dielectric Parameter Measurements

3.1 Target for Tissue Dielectric Parameter

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within $\pm 2^\circ\text{C}$ 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 24 hours of use; or earlier if the dielectric parameters can become out of tolerance.

Recommended Dielectric Performance of Tissue

Ingredients (% by weight)	Frequency (MHz)											
	450		835		915		1900		2450		2600	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.46	52.4	41.05	56.0	54.9	40.4	62.7	73.2	55.24	64.49
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04	0.5	0.024
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0	44.45	32.25
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.2	52.5	39.0	52.5
Conductivity (s/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.80	1.78	1.96	2.16

Frequency: 5200/5400/5600/5800MHz	
Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

Target Tissue Dielectric Parameters

Frequency (MHz)	Head Tissue	
	ϵ_r	$\sigma(S/m)$
750	41.9	0.89
835	41.5	0.90
1750	40.1	1.37
1900	40.0	1.40
2000	40.0	1.40
2300	39.5	1.67
2450	39.2	1.80
2600	39.0	1.96
5250	35.9	4.71
5600	35.5	5.07
5750	35.4	5.22

3.2 Verification results

Frequency (MHz)	Test Date	Temp °C	Measured Dielectric Parameters		Target Dielectric Parameters		Limit (Within ±5%)	
			ϵ_r	$\sigma(s/m)$	ϵ_r	$\sigma(s/m)$	Dev $\epsilon_r(\%)$	Dev $\sigma(\%)$
2450	Dec. 07, 2023	21.2	37.880	1.724	39.20	1.80	-3.37	-4.22
5250	Dec. 10, 2023	21.1	36.140	4.669	35.93	4.71	0.58	-0.87

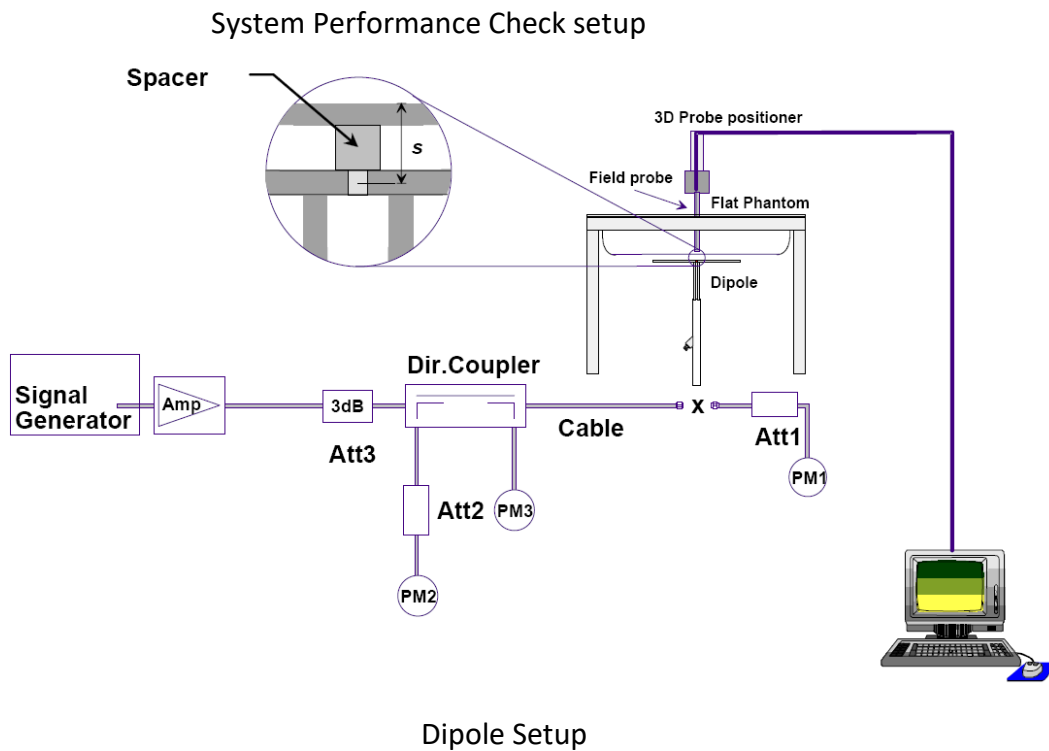
Note: The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.

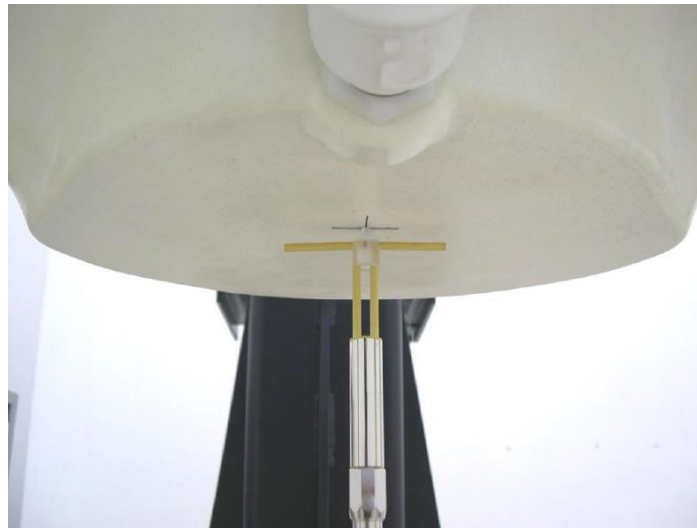
4 System Verification

4.1 System Performance Check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured using the dielectric probe kit and the network analyzer. A system check measurement for every day was made following the determination of the dielectric parameters of the Tissue simulates, using the dipole validation kit. The dipole antenna was placed under the flat section of the twin SAM phantom.

System check is performed regularly on all frequency bands where tests are performed with the DASY system.





Target Tissue Dielectric Parameters

Frequency (MHz)	Head Tissue	
	Target SAR _{1g}	Target SAR _{10g}
835	9.64	6.27
1750	35.7	18.8
1900	39.8	20.2
2100	42.9	21.1
2300	48.4	22.8
2450	52.0	23.8
2600	57.6	25.5
5250	77.6	22.2
5600	80.0	22.8
5750	77.3	21.8

4.2 System Performance Check Result

Frequency (MHz)	Test Date	Temp °C	Measured SAR _{1g}	1W Normalized SAR _{1g} (W/kg)	1W Target SAR _{1g} (W/kg)	Limit (±10%)
2450	Dec. 07, 2023	21.2	12.800	51.20	51.80	-1.16
5250	Dec. 10, 2023	21.1	7.990	79.90	79.20	0.88

Note : Target Values used derive from the calibration certificate Data Storage and Evaluation.

4.3 WCDMA Measurement Procedures for SAR

The following procedures are applicable to WCDMA handsets operating under 3GPP Release99, Release 5 and Release 6. The default test configuration is to measure SAR with an established radio link between the DUT and a communication test set using a 12.2kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other physical channel configurations (DPCCH & DPDCHn), HSDPA and HSPA (HSUPA/HSDPA) modes according to output power, exposure conditions and device operating capabilities. Both uplink and downlink should be configured with the same RMC or AMR, when required. SAR for Release 5 HSDPA and Release 6 HSPA are measured using the applicable FRC (fixed reference channel) and E-DCH reference channel configurations. Maximum output power is verified according to applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. When Maximum Power Reduction (MPR) is not implemented according to Cubic Metric (CM) requirements for Release 6 HSPA, the following procedures do not apply.

For Release 5 HSDPA Data Devices:

Sub-test	β_c	β_d	β_d (SF)	β_c / β_d	β_{hs}	CM/dB
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15	15/15	64	12/15	24/25	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

For Release 6 HSPA Data Devices

Sub-test	β_c	β_d	β_d (SF)	β_c / β_d	β_{hs}	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (dB)	MPR (dB)	AG Index	E-TPCI
1	11/15	15/15	64	11/15	22/15	209/225	1039/225	4	1	1.5	1.5	20	75
2	6/15	15/15	64	6/15	12/15	12/15	12/15	4	1	1.5	1.5	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}:47/15$ $\beta_{ed2}:47/15$	4	2	1.5	1.5	15	92
4	2/15	15/15	64	2/15	4/15	4/15	56/75	4	1	1.5	1.5	17	71
5	15/15	15/15	64	15/15	24/15	30/15	134/15	4	1	1.5	1.5	21	81

Rel.8 DC-HSDPA (Cat 24)

SAR test exclusion for Rel.8 DC-HSDPA must satisfy the SAR test exclusion requirements of Rel.5 HSDPA. SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion.

4.4 SAR Measurement for LTE

SAR tests for LTE are performed with a base station simulator. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

All powers were measured with the base station simulator.

SAR is evaluated separately according to the following procedures for the different test positions in each exposure condition – head, body, body-worn accessories and other use conditions. The procedures in the following subsections are applied separately to test each LTE frequency band.

1) 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 among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing 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.

2) QPSK with 50% RB allocation

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

3) 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 1) and 2) 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.

TDD test:

TDD testing is performed using guidance from FCC KDB 941225 D05 and the SAR test guidance provided in April 2013 TCB works hop notes. TDD is tested at the highest duty factor using UL-DL configuration 0 with special subframe configuration 6 and applying the FDD LTE procedures in KDB 941225 D05. SAR testing is performed using the extended cyclic prefix listed in 3GPP TS 36.211.

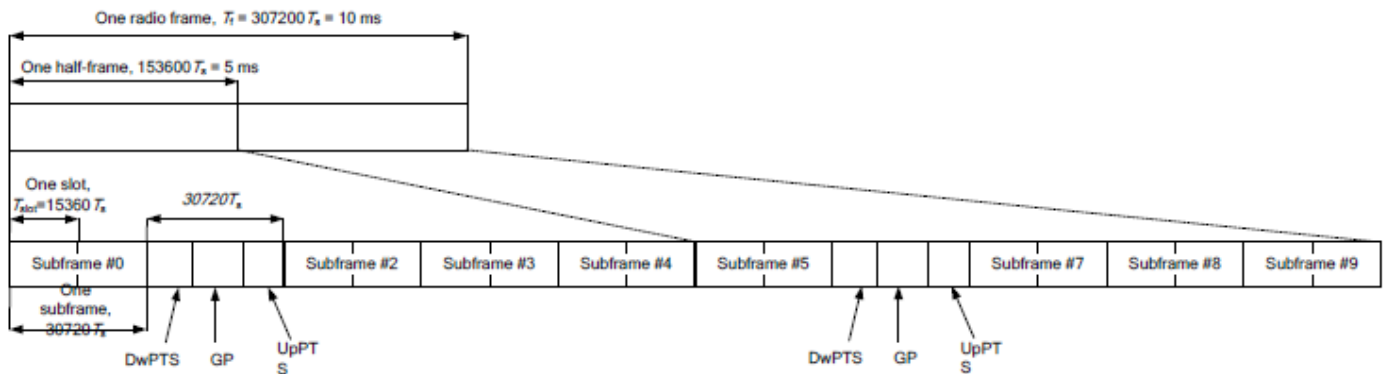


Figure 9.2: Frame structure type 2 (for 5 ms switch-point periodicity)

Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$		
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-		
9	$13168 \cdot T_s$			-		

Uplink-downlink configurations

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number										
		0	1	2	3	4	5	6	7	8	9	
0	5 ms	D	S	U	U	U	D	S	U	U	U	
1	5 ms	D	S	U	U	D	D	S	U	U	D	
2	5 ms	D	S	U	D	D	D	S	U	D	D	
3	10 ms	D	S	U	U	U	D	D	D	D	D	
4	10 ms	D	S	U	U	D	D	D	D	D	D	
5	10 ms	D	S	U	D	D	D	D	D	D	D	
6	5 ms	D	S	U	U	U	D	S	U	U	D	

Duty factor is calculated by:

$$\text{Duty factor} = \frac{\text{uplink frame} \cdot 6 + \text{UpPTS} \cdot 2}{\text{one frame length}}$$

$$= \frac{(30720 \cdot T_s \cdot 6 + 5120 \cdot T_s \cdot 2)}{307200 \cdot T_s}$$

$$= 0.633$$

4.5 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable. Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

4.6 Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position.

This ensures that the power drift during one measurement is within 5%.

5 Measurement Procedures

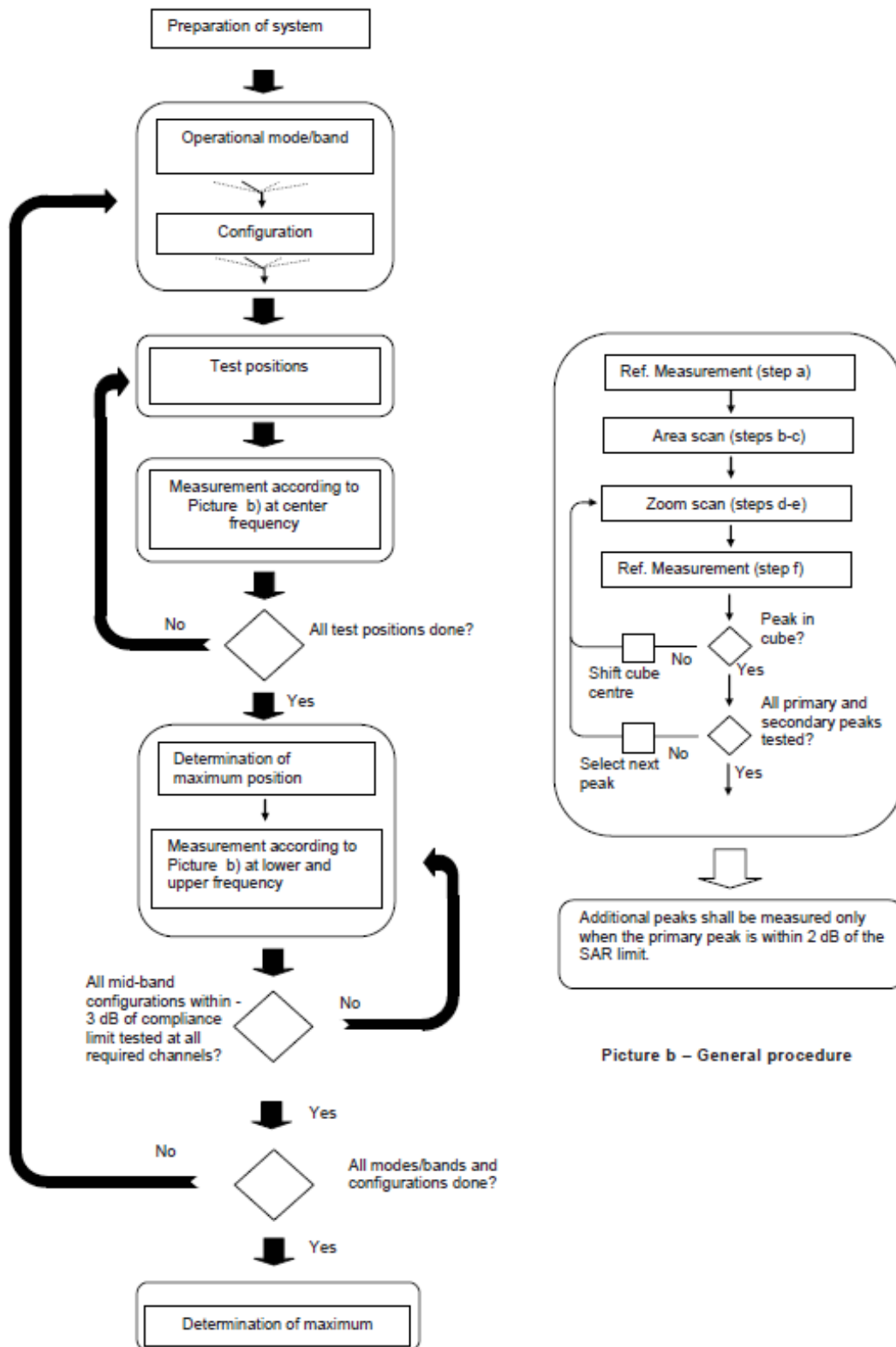
5.1 RF exposure Limit

Human Exposure	Uncontrolled Environment General Population
Spatial Peak SAR* (Brain/Body)	1.60 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g
Spatial Peak SAR*** (Limbs)	4.00 mW/g

Note: 1. The limit applied in this test report is shown in bold letter;

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

5.2 Block Diagram of Test Setup



Picture a - Tests to be performed

TEST REPORT

5.3 Test Conditions and Test Method

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: $\Delta x_{Area}, \Delta y_{Area}$		≤ 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.	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 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 1 st 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.			

6 Conducted RF Output Power

6.1 GSM Measurement result

GSM850		Measured Power (dBm)			Division Factors	Averaged Power (dBm)		
		128CH	190CH	251CH		28CH	190CH	251CH
GSM (CS)		/	/	/	/	/	/	/
GPRS (GMSK)	1 Tx Slot	/	/	/	/	/	/	/
	2 Tx Slots	/	/	/	/	/	/	/
	3 Tx Slots	/	/	/	/	/	/	/
	4 Tx Slots	/	/	/	/	/	/	/
EDGE (8PSK)	1 Tx Slot	/	/	/	/	/	/	/
	2 Tx Slots	/	/	/	/	/	/	/
	3 Tx Slots	/	/	/	/	/	/	/
	4 Tx Slots	/	/	/	/	/	/	/
GSM1900		Measured Power (dBm)			Division Factors	Averaged Power (dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM (CS)		/	/	/	/	/	/	/
GPRS (GMSK)	1 Tx Slot	/	/	/	/	/	/	/
	2 Tx Slots	/	/	/	/	/	/	/
	3 Tx Slots	/	/	/	/	/	/	/
	4 Tx Slots	/	/	/	/	/	/	/
EDGE (8PSK)	1 Tx Slot	/	/	/	/	/	/	/
	2 Tx Slots	/	/	/	/	/	/	/
	3 Tx Slots	/	/	/	/	/	/	/
	4 Tx Slots	/	/	/	/	/	/	/

Note: To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -

9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -

6.02dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -

4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -

3.01dB

6.2 WCDMA Conducted output Power

Item	band	WCDMA 850			WCDMA 1900		
	Frequency	4132	4183	4233	9262	9400	9538
	Subtest	dBm			dBm		
WCDMA	RMC 12.2Kbps	/	/	/	/	/	/
HSDPA	1	/	/	/	/	/	/
	2	/	/	/	/	/	/
	3	/	/	/	/	/	/
	4	/	/	/	/	/	/
HSUPA	1	/	/	/	/	/	/
	2	/	/	/	/	/	/
	3	/	/	/	/	/	/
	4	/	/	/	/	/	/
	5	/	/	/	/	/	/

Note: WCDMA SAR was tested under RMC 12.2kbps with HSPA Inactive .HSPA SAR was not requires since the average output power of the HSPA subtests was not more than 0.25dB higher than the RMC level and SAR was less than 1.2W/kg. It is expected by the manufacturer that MPR for some HSPA subtests may be up to 2dB more than specified by 3GPP, but also as low as 0dB according to the chipset implementation in this model

6.3 LTE Conducted peak output Power

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						MPR (dB)
	1.4	3	5	10	15	20	
	MHz	MHz	MHz	MHz	MHz	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

LTE FDD Band 2				Conducted Power (dBm)		
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
				18607	18900	19193
1.4MHz	QPSK	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
	16QAM	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
				18615	18900	19185
3MHz	QPSK	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/

TEST REPORT

	16QAM	/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	
				18625	18900	19175	
5MHz	QPSK	/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
	16QAM	/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
	Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
					18650	18900	19150
10MHz	QPSK	/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
	16QAM	/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	
	Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
					18675	18900	19125
		/	/	/	/	/	
		/	/	/	/	/	
		/	/	/	/	/	

TEST REPORT

15MHz	QPSK	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
	16QAM	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel
				18700	18900	19100
20MHz	QPSK	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
	16QAM	/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/
		/	/	/	/	/

6.4 WIFI Conducted Power

WLAN 2.4GHz Band Conducted Power

Channel/Freq.(MHz)	Maximum Conducted Out Power (dBm)		
	802.11b	802.11g	802.11n(HT20)
1(2412)	11.73	5.92	5.90
6(2437)	12.05	6.03	5.48
11(2462)	12.04	6.16	6.14

WLAN 5.2GHz Band Conducted Power

Channel/Freq.(MHz)	Maximum Conducted Out Power (dBm)	
	802.11a	802.11n(HT20)
36(5180)	11.92	11.85
40(5200)	13.45	11.80
48(5240)	12.53	12.31

Note: choosing the highest output power channel to test SAR and determine further SAR exclusion
 For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at lowest data rate is not required. 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 $\leq 1.2\text{W/Kg}$. Thus the SAR can be excluded.

6.5 Bluetooth Output Power

Channel	Frequency (MHz)	BT5.0 Output Power(dBm)		
		GFSK	$\pi/4$ -DQPSK	8-DPSK
CH 0	2402	/	/	/
CH 39	2441	/	/	/
CH 78	2480	/	/	/
Channel	Frequency (MHz)	BLE5.0 Output Power(dBm)		
		GFSK		
CH 0	2402	/		
CH 20	2442	/		
CH 39	2480	/		

7 Scaling Factor calculation

Operation Mode	Channel	Output Power(dBm)	Tune up Power in tolerance(dBm)	Scaling Factor
WIFI 2.4G_802.11b	1	11.73	11.0 ± 1.0	1.48
	6	12.05	12.0 ± 1.0	1.26
	11	12.04	12.0 ± 1.0	1.11
WIFI 5.2G_802.11a	36	11.92	12.5 ± 1.0	1.37
	40	13.45	13.5 ± 1.0	1.08
	48	12.53	12.5 ± 1.0	1.17

8 SAR test Exclusion Consideration and SAR measurement positions

8.1 SAR test Exclusion Consideration

The 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances ≤ 50mm are determined by: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [vf(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.

- (1) f(GHz) is the RF channel transmit frequency in GHz;
- (2) Power and distance are round to the nearest mW and mm before calculation;
- (3) The result is rounded to one decimal place for comparison;
- (4) If the test separation distance(antenna-user) is < 5mm, 5mm is used for excluded SAR calculation;

Mode	Freq (GHz)	Position	SAR test exclusion threshold(mW)	RF power		SAR test exclusion
				dBm	mW	
WIFI	2450	Body (0mm)	10	12.05	16.03	no
WIFI	5200	Body (0mm)	7	13.45	22.13	no

8.2 SAR measurement positions

The Body SAR measurement positions of each band are as below:

Antenna	Front	Rear	Left Edge	Right Edge	Top Edge	Bottom Edge
WIFI Antenna Body-supported	Yes	Yes	Yes	Yes	No	No

Note: when antenna-to-edge>2.5cm, SAR is not required.

9 SAR Test Results

SAR Values of Wi-Fi 802.11b

Temperature: 21.7°C, humidity: 54.9%.							
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)				Plot No.
			SAR (W/Kg),1g	Scaled Factor	Scaled SAR (W/Kg),1g	Power drift (dB)	
Body-supported (0mm Separation)	Front Face	11/2462	0.00412	1.11	0.005	0.01	
	Rear Face	11/2462	0.137	1.11	0.152	0.02	
	Left Side	11/2462	0.01	1.11	0.011	0.03	
	Right Side	11/2462	0.00654	1.11	0.007	0.03	
	Rear Face	1/2412	0.116	1.48	0.171	-0.06	
	Rear Face	6/2437	0.141	1.26	0.178	0.06	1

SAR Values of Wi-Fi 802.11a

Temperature: 21.7°C, humidity: 54.9%.							
Test Positions		Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)				Plot No.
			SAR (W/Kg),1g	Scaled Factor	Scaled SAR (W/Kg),1g	Power drift (dB)	
Body-supported (0mm Separation)	Front Face	40/5200	<0.0001	1.08	<0.001	-0.10	
	Rear Face	40/5200	0.32	1.08	0.347	-0.03	
	Left Side	40/5200	0.015	1.08	0.016	0.00	
	Right Side	40/5200	0.0413	1.08	0.045	-0.10	
	Rear Face	36/5180	0.272	1.37	0.373	-0.04	2
	Rear Face	48/5240	0.316	1.17	0.371	-0.05	

TEST REPORT**10 Simultaneous Transmissions Analysis****10.1 Simultaneous transmission mode**

Not supported.

10.2 Simultaneous transmission for head

Not supported.

10.3 Simultaneous transmission for body

Not supported.

Appendix I: Calibration reports

See document of Appendix I

Appendix II: Test Setup

See document of Appendix II

Appendix III: Measurement Results Plots

See document of Appendix III

***** END *****