

FCC SAR Compliance Test Report

For

TECNO MOBILE LIMITED

ROOMS 05-15, 13A/F., SOUTH TOWER,

WORLD FINANCE CENTRE, HARBOUR CITY, 17 CANTON ROAD, TSIM SHA TSUI,

KOWLOON, HONG KONG

Model: T660

Test Engineer: Lily Zhao

Report Number: FCC17060493A-SAR

Report Date: 2017-06-14

FCC ID: 2ADYY- T660

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Table of contents

1	General information	4
1.1	Notes	4
1.2	Application details	4
1.3	Statement of Compliance	5
1.4	EUT Information	6
2	Testing laboratory	7
3	Test Environment	7
4	Applicant and Manufacturer	7
5	Test standard/s:	8
5.1	RF exposure limits	9
5.2	SAR Definition	9
6	SAR Measurement System	10
6.1	The Measurement System	10
6.2	Robot	11
6.3	Probe	11
6.4	Measurement procedure	11
6.5	Description of interpolation/extrapolation scheme	12
6.6	Phantom	13
6.7	Device Holder	14
6.8	Video Positioning System	15
6.9	Tissue simulating liquids: dielectric properties	16
6.10	Tissue simulating liquids: parameters	17
7	System Check	18
7.1	System check procedure	18
7.2	System check results	19
8	SAR Test Test Configuration	20
8.1	GSM Test Configurations	20
9	Detailed Test Results	21
9.1	Conducted Power measurements	21
9.1.1	Conducted Power of GSM850	21

9.1.2	Conducted Power of GSM1900.....	22
9.1.3	Conducted Power of BT	22
9.2	SAR test results	23
9.2.1	Results overview of GSM850.....	24
9.2.2	Results overview of GSM1900.....	25
9.2.3	Stand-alone SAR test exclusion.....	26
9.2.4	Simultaneous Transmission Possibilities.....	27
9.2.5	SAR Summation Scenario	28
10	Measurement uncertainty evaluation	29
10.1	Measurement uncertainty evaluation for SAR test	29
10.2	Measurement uncertainty evaluation for system check.....	30
11	Test equipment and ancillaries used for tests	31
Annex A:	System performance verification.....	32
Annex B:	Measurement results.....	32
Annex C:	Calibration reports	32
Annex D:	Photo documentation.....	33

Modified History

REV.	Modification Description	Issued Date	Remark
REV.1.0	Initial Test Report Relesse	2017-06-14	Stars Liang

1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. Shenzhen Timeway Testing Laboratories does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report is not to be reproduced or published in full without the prior written permission.

1.2 Application details

Date of receipt of test item: 2017-06-08

Start of test: 2017-06-10

End of test: 2017-06-13

1.3 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for T660 is as below:

Band	Position	MAX Reported SAR_{1g} (W/kg)
GSM 850	Head	0.485
	Body 15mm	0.740
GSM1900	Head	0.173
	Body 15mm	0.139
The highest simultaneous SAR is 0.779W/kg per KDB690783 D01		

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits of 1.6 W/Kg as averaged over any 1g tissue according to the FCC rule §2.1093, the ANSI/IEEE C95.1:2005, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

1.4 EUT Information

Device Information:		
Product Type:	Mobile phone	
Model:	T660	
Brand Name:	TECNO	
Device Type:	Portable device	
Exposure Category:	uncontrolled environment / general population	
Production Unit or Identical Prototype:	Production Unit	
Software version:	T660-UL252A1-SAM-170518V1	
Hardware version :	T660_UL252_PCB_V1.0	
Antenna Type :	Internal Antenna	
Device Operating Configurations:		
Supporting Mode(s) :	GSM850/1900, BT	
Modulation:	GSM(GMSK), BT(GFSK/ π /4-DQPSK/ 8-DPSK)	
Device Class :	Class B, No DTM Mode	
Operating Frequency Range(s)	Band	TX(MHz)
	GSM850	824~849
	GSM1900	1850~1910
	BT	2402~2480
GPRS class level:	GPRS class 12	
Test Channels (low-mid-high):	128-190-251(GSM850)	
	512-661-810(GSM1900)	
	0-39-78(BT)	
Power Source:	3.7 VDC/1100mAh Rechargeable Battery	

2 Testing laboratory

Test Site	QTC Certification & Testing Co., Ltd.
Test Location	2nd Floor,Bl Building,Fengyeyuan Industrial Plant,, Liuxian 2st. Road, Xin'an Street, Bao'an District,,Shenzhen,518000
Telephone	+86-755-26996144 EXT:8164
Fax	+86-755-26996253

3 Test Environment

	Required	Actual
Ambient temperature:	18 – 25 °C	22 ± 2 °C
Tissue Simulating liquid:	22 ± 2 °C	22 ± 2 °C
Relative humidity content:	30 – 70 %	30 – 70 %

4 Applicant and Manufacturer

Applicant/Client Name:	TECNO MOBILE LIMITED
Applicant Address:	ROOMS 05-15, 13A/F., SOUTH TOWER, WORLD FINANCE CENTRE, HARBOUR CITY, 17 CANTON ROAD, TSIM SHA TSUI, KOWLOON, HONG KONG
Manufacturer Name:	SHENZHEN TECNO TECHNOLOGY CO.,LTD.
Manufacturer Address:	1-4th Floor,3rd Building,Pacific Industrial Park,No.2088,Shenyan Road,Yantian District,Shenzhen,Guangdong,China

5 Test standard/s:

ANSI Std C95.1-2005	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
IEEE Std 1528-2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
IEEE Std 1528a-2005	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom)
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 5 March 2015)
KDB447498 D01	General RF Exposure Guidance v06
KDB648474 D04	Head set SAR v01r03
KDB865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB865664 D02	RF Exposure Reporting v01r02

5.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body/Arms/Legs)	1.60 mW/g	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Head/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

The limit applied in this test report is shown in bold letters

Notes:

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

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

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

5.2 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dW) absorbed by(dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m³)

E = rms electric field strength (V/m)

6 SAR Measurement System

6.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:

- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Device holder
- Head simulating tissue

The following figure shows the system.



The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

6.2 Robot

The COMOSAR system uses the high precision robots KR 6 R900 sixx type out of the newer series from Satimo SA (France). For the 6-axis controller COMOSAR system, the KUKA robot controller version from Satimo is used. The KR 6 R900 sixx robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

6.3 Probe

For the measurements the Specific Dosimetric E-Field Probe SSE 5 with following specifications is used



- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 5 mm
- Distance between probe tip and sensor center: 2.5mm
- Distance between sensor center and the inner phantom surface: 4 mm
(repeatability better than +/- 1mm)
- Probe linearity: <0.25 dB
- Axial Isotropy: <0.25 dB
- Spherical Isotropy: <0.50 dB
- Calibration range: 300 to 2600MHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and suface normal line:less than 30°

6.4 Measurement procedure

The following steps are used for each test position

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.

- Measurement of the SAR distribution with a grid of 8 to 16 mm * 8 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
- Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8 * 4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

6.5 Description of interpolation/extrapolation scheme

- The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimise measurements errors, but the highest local SAR will occur at the surface of the phantom.
- An extrapolation is used to determine these highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1 mm step.
- The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR average over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

6.6 Phantom

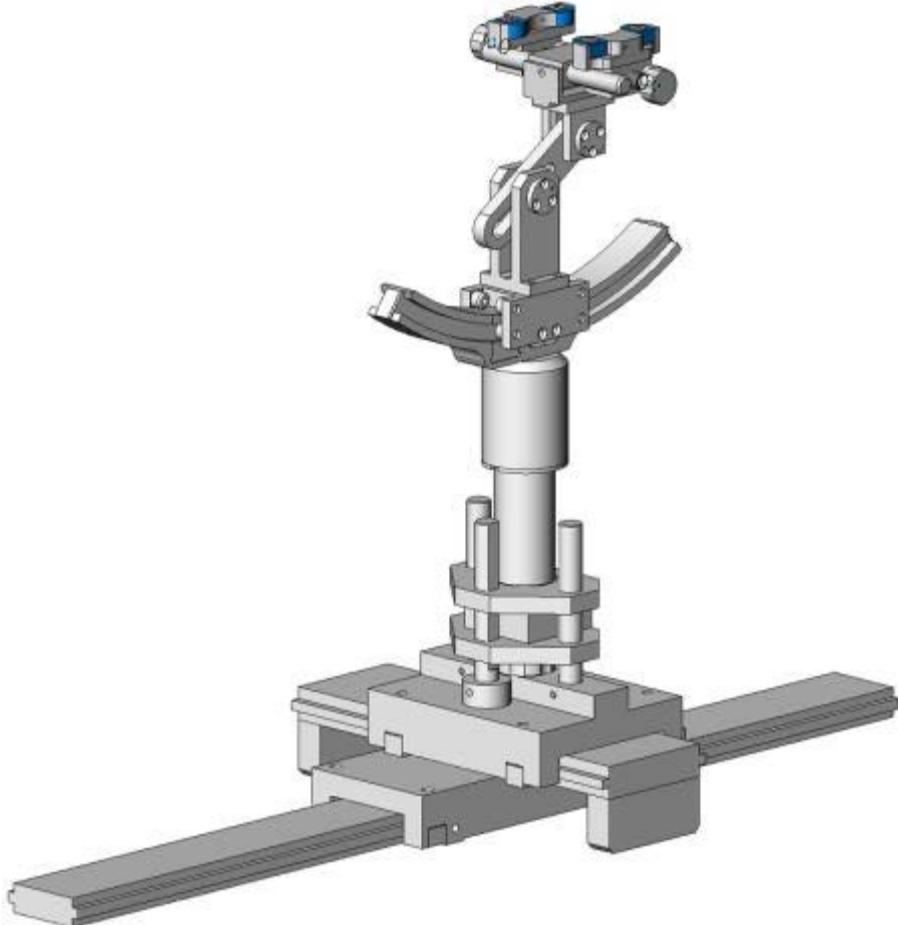
For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.



System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.7 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is lower than 1°.



Device holder

System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

6.8 Video Positioning System

- The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts. The camera is piloted by the main computer with firewire link.
- During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.
- The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



6.9 Tissue simulating liquids: dielectric properties

The following materials are used for producing the tissue-equivalent materials.

(Liquids used for tests are marked with):

Ingredients(% of weight)	Frequency (MHz)				
frequency band	<input type="checkbox"/> 450	<input checked="" type="checkbox"/> 835	<input type="checkbox"/> 1800	<input checked="" type="checkbox"/> 1900	<input type="checkbox"/> 2450
Tissue Type	Head	Head	Head	Head	Head
Water	38.56	41.45	52.64	55.242	62.7
Salt (NaCl)	3.95	1.45	0.36	0.306	0.5
Sugar	56.32	56.0	0.0	0.0	0.0
HEC	0.98	1.0	0.0	0.0	0.0
Bactericide	0.19	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	36.8
DGBE	0.0	0.0	47.0	44.542	0.0
Ingredients(% of weight)	Frequency (MHz)				
frequency band	<input type="checkbox"/> 450	<input checked="" type="checkbox"/> 835	<input type="checkbox"/> 1800	<input checked="" type="checkbox"/> 1900	<input type="checkbox"/> 2450
Tissue Type	Body	Body	Body	Body	Body
Water	51.16	52.4	69.91	69.91	73.2
Salt (NaCl)	1.49	1.40	0.13	0.13	0.04
Sugar	46.78	45.0	0.0	0.0	0.0
HEC	0.52	1.0	0.0	0.0	0.0
Bactericide	0.05	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.96	26.7

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

6.10 Tissue simulating liquids: parameters

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		ϵ_r (+/-5%)	σ (S/m) (+/-5%)	ϵ_r	σ (S/m)		
835MHz Head	825	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.34	0.91	21.6°C	2017-6-10
	835	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.33	0.92		
	850	41.50 (39.43~43.58)	0.90 (0.86~0.95)	40.11	0.94		
835MHz Body	825	55.20 (52.44~57.96)	0.97 (0.92~1.02)	54.04	0.98	21.6°C	2017-6-10
	835	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.93	0.99		
	850	55.20 (52.44~57.96)	0.99 (0.94~1.04)	53.69	1.01		
1900MHz Head	1850	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.93	1.37	21.6°C	2017-6-13
	1880	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.91	1.40		
	1900	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.98	1.41		
	1910	40.00 (38.00~42.00)	1.40 (1.33~1.47)	39.97	1.42		
1900MHz Body	1850	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.23	1.49	21.6°C	2017-6-13
	1880	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.36	1.53		
	1900	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.37	1.56		
	1910	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.37	1.57		

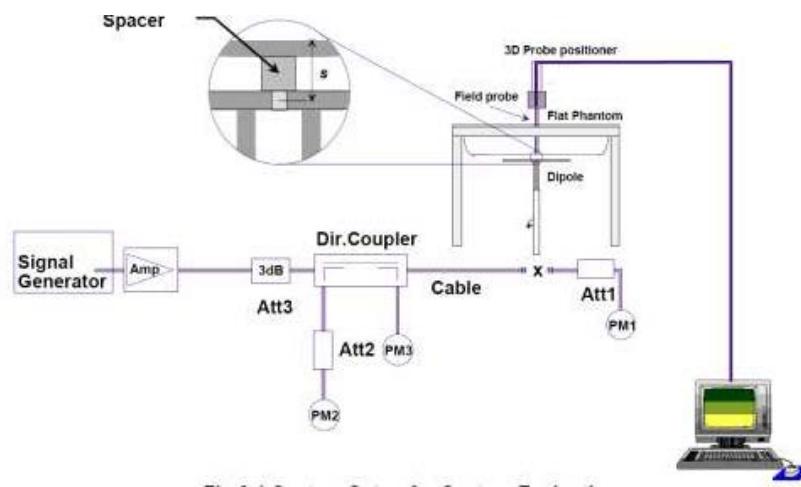
ϵ_r = Relative permittivity, σ = Conductivity

7 System Check

7.1 System check procedure

The System check is performed by using a System check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 100 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the System check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



7.2 System check results

The system Check is performed for verifying the accuracy of the complete measurement system and performance of the software. The following table shows System check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D835V2 Head	9.56 (8.60~10.52)	6.19 (5.57~6.81)	9.70	6.15	21.6°C	2017/06/10
D1900V2 Head	39.46 (35.51~43.41)	20.42 (18.38~22.46)	39.98	21.07	21.6°C	2017/06/13
D835V2 Body	9.86 (8.87~10.85)	6.38 (5.74~7.02)	10.15	6.45	21.6°C	2017/06/10
D1900V2 Body	40.06 (36.05~44.07)	20.76 (18.68~22.84)	39.33	20.94	21.6°C	2017/06/13

Note: All SAR values are normalized to 1W forward power.

8 SAR Test Test Configuration

8.1 GSM Test Configurations

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5.

9 Detailed Test Results

9.1 Conducted Power measurements

The output power was measured using an integrated RF connector and attached RF cable.

9.1.1 Conducted Power of GSM850

GSM850(SIM1)		Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM(CS)		33.07	32.99	33.06	-9.03	24.04	23.96	24.03
GPRS (GMSK)	1 Tx Slot	32.11	32.10	32.12	-9.03	23.08	23.07	23.09
	2 Tx Slots	31.26	31.27	31.28	-6.02	25.24	25.25	25.26
	3 Tx Slots	30.61	30.62	30.65	-4.26	26.35	26.36	26.39
	4 Tx Slots	29.90	29.85	29.96	-3.01	26.89	26.84	26.95

Note: 1) The conducted power of GSM850 is measured with RMS detector.

- 2) Source Based time Average Power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
- 3) The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.
- 4) channel /Frequency: 128/824.2; 190/836.6; 251/848.8

9.1.2 Conducted Power of GSM1900

GSM1900(SIM1)	Burst-Averaged output Power (dBm)			Division Factors	Source Based time Average Power(dBm)		
	512CH	661CH	810CH		512CH	661CH	810CH
GSM(CS)	29.43	29.95	29.97	-9.03	20.40	20.92	20.94
GPRS (GMSK)	1 Tx Slot	29.35	28.92	28.96	-9.03	20.32	19.89
	2 Tx Slots	28.50	27.82	27.88	-6.02	22.48	21.80
	3 Tx Slots	27.63	27.39	27.38	-4.26	23.37	23.13
	4 Tx Slots	26.96	26.81	26.90	-3.01	23.95	23.80

Note: 1) The conducted power of GSM1900 is measured with RMS detector.

2) Source Based time Average Power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3) The bolded GPRS 4Tx slots mode was selected for SAR testing according the highest Source Based time Average Power table.

4) channel /Frequency: 512/1850.2; 661/1880; 810/1909.8

9.1.3 Conducted Power of BT

The maximum output power of BT is:

Mode	1Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	3.96	3.28	2.63
Mode	2Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	2.64	2.25	1.83
Mode	3Mbps		
Channel / Frequency (MHz)	0(2402)	39(2441)	78(2480)
Average Power(dBm)	2.80	2.38	1.73

9.2 SAR test results

Notes:

- 1) Per KDB447498 D01v05 r02, the SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the scaled SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.
- 2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz. When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB447498 D01v05r02, All measurement SAR result is scaled-up to account for tune-up tolerance is compliant.
- 4) Per KDB648474 D04v01r02, body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn with headset SAR.
- 5) Per KDB865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/Kg; if the deviation among the repeated measurement is $\leq 20\%$, and the measured SAR < 1.45 W/Kg, only one repeated measurement is required.
- 6) Per KDB865664 D02v01r01, 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 details).

9.2.1 Results overview of GSM850

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR _{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Left Hand Tilted 15°	251/848.8	GPRS 4TS	0.471	0.327	-1.220	29.690	29.500	0.451	0.957
Left Hand Tilted 15°	251/848.8	GPRS 4TS	0.453	0.261	0.120	29.690	29.500	0.434	0.957
Right Hand Touched	251/848.8	GPRS 4TS	0.507	0.353	3.050	29.690	29.500	0.485	0.957
Right Hand Tilted 15°	251/848.8	GPRS 4TS	0.329	0.223	-3.490	29.690	29.500	0.315	0.957
Test Position of Body with 15mm	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR _{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Towards Phantom	251/848.8	GPRS 4TS	0.581	0.394	-1.590	29.690	29.500	0.556	0.957
Towards Ground	251/848.8	GPRS 4TS	0.773	0.431	4.220	29.690	29.500	0.740	0.957

9.2.2 Results overview of GSM1900

Test Position of Head	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR _{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Left Hand Touched	512/1850.2	GPRS 4TS	0.192	0.108	-1.390	26.960	26.500	0.173	0.899
Left Hand Tilted 15°	512/1850.2	GPRS 4TS	0.183	0.104	-0.990	26.960	26.500	0.165	0.899
Right Hand Touched	512/1850.2	GPRS 4TS	0.123	0.072	-2.630	26.960	26.500	0.111	0.899
Right Hand Tilted 15°	512/1850.2	GPRS 4TS	0.171	0.094	3.900	26.960	26.500	0.154	0.899
Test Position of Body with 15mm	Test channel /Freq.(MHz)	Test Mode	SAR Value (W/kg)		Power Drift (%)	Conducted Power (dBm)	Tune-up Limit (dBm)	Scaled SAR _{1-g} (W/kg)	Scaling Factor
			1-g	10-g					
Towards Phantom	512/1850.2	GPRS 4TS	0.064	0.036	1.940	26.960	26.500	0.058	0.899
Towards Ground	512/1850.2	GPRS 4TS	0.154	0.095	2.730	26.960	26.500	0.139	0.899

9.2.3 Stand-alone SAR test exclusion

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

a) Head position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BT	4.50	2.82	5.00	2.45	0.88	3.00	Yes

Body-Worn position

Mode	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	Calculation Result	exclusion Threshold	SAR test exclusion
BT	4.50	2.82	15.00	2.45	0.29	3.00	Yes

When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f(\text{GHz})/x}$] W/kg for test separation distances ≤ 50 mm, where $x = 7.5$ for 1-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Position	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	X	Estimated SAR(W/Kg)
BT	Head	4.5	2.82	5.00	2.45	7.50	0.118
BT	Body	4.5	2.82	15.00	2.45	7.50	0.039

9.2.4 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities are as below:

Simultaneous Transmission Possibilities				
Simultaneous Tx Combination	Configuration	Head	Body	Hotspot
2	GSM/GPRS +BT	YES	YES	NO

9.2.5 SAR Summation Scenario

Test Position		Scaled SAR _{Max}		Σ _{1-g} SAR	SPLSP
		GSM850	BT		
Head	Left Head Touched	0.451	0.118	0.569	NA
	Left Head Tilted 15°	0.434	0.118	0.552	NA
	Right Head Touched	0.485	0.118	0.603	NA
	Right Head Tilted 15°	0.315	0.118	0.433	NA
Body	Towards Phantom	0.556	0.039	0.595	NA
	Towards Ground	0.740	0.039	0.779	NA

Note: Simultaneous Tx Combination of GSM850 and BT

Test Position		Scaled SAR _{Max}		Σ _{1-g} SAR	SPLSP
		GSM1900	BT		
Head	Left Head Touched	0.173	0.118	0.291	NA
	Left Head Tilted 15°	0.165	0.118	0.283	NA
	Right Head Touched	0.111	0.118	0.229	NA
	Right Head Tilted 15°	0.154	0.118	0.272	NA
Body	Towards Phantom	0.058	0.039	0.097	NA
	Towards Ground	0.139	0.039	0.178	NA

Note: Simultaneous Tx Combination of GSM1900 and BT

MAX.ΣSAR_{1g} = 0.779W/kg < 1.6 W/kg, so the Simultaneous SAR is not required for BT and GSM antenna.

10 Measurement uncertainty evaluation

10.1 Measurement uncertainty evaluation for SAR test

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo. The breakdown of the individual uncertainties is as follows:

Measurement Uncertainty evaluation for SAR test								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i (1g)	C_i (10g)	$1g U_i$ (±%)	$10g U_i$ (±%)	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.8	5.8	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system Detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	3	N	1	1	1	3.00	3.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF Ambient Conditions-Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF Ambient Conditions-Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe Positioner Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and Integration Algorithms for Max.SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Test sample Related								
Test Sample Positioning	2.6	N	1	1	1	2.60	2.60	11
Device Holder Uncertainty	3	N	1	1	1	3.00	3.00	7
Output Power Variation-SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
SAR scaling	2	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity (meas.)	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity (meas.)	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.42	∞
Combined Standard Uncertainly		Rss				10.63	10.54	
Expanded Uncertainty{95% CONFIDENCE INTERVAL}		k				21.26	21.08	

10.2 Measurement uncertainty evaluation for system check

The following table includes the uncertainty table of the IEEE 1528. The values are determined by Satimo. The breakdown of the individual uncertainties is as follows:

Uncertainty For System Performance Check								
Uncertainty Component	Tol. (±%)	Prob. Dist.	Div.	C_i 1g	C_i 10g	$1g$ $U_i(\pm\%)$	$10g$ $U_i(\pm\%)$	V_i
measurement system								
Probe Calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	$\sqrt{3}$	$(1-C_p)^{1/2}$	$(1-C_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	$\sqrt{3}$	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
system detection Limits	1	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation response	0	N	1	1	1	0.00	0.00	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0	R	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
RF ambient Conditions – Reflections	3	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioned Mechanical Tolerance	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
Dipole								
Deviation of experimental source from numerical source	4	N	1	1	1	4.00	4.00	∞
Input power and SAR drift measurement	5	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole axis to liquid Distance	2	R	$\sqrt{3}$	1	1	1.16	1.16	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	$\sqrt{3}$	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	2	N	1	1	0.84	2.00	1.68	∞
Liquid conductivity (meas.)	2.5	N	1	0.64	0.43	1.60	1.08	5
Liquid conductivity (target.)	5	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	5
Liquid Permittivity (meas.)	2.5	N	1	0.60	0.49	1.50	1.23	∞
Liquid Permittivity (target.)	5	R	$\sqrt{3}$	0.60	0.49	1.73	1.41	∞
Combined Standard Uncertainty		Rss				10.28	9.98	
Expanded Uncertainty (95% Confidence interval)		k				20.57	19.95	

11 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

	Manufacturer	Device Type	Type(Model)	Serial number	calibration	
					Last Cal.	Due Date
<input checked="" type="checkbox"/>	SATIMO	COMOSAR DOSIMETRIC E FIELD PROBE	SSE5	SN 09/13 EP170	2016-07-25	2017-07-24
<input checked="" type="checkbox"/>	SATIMO	COMOSAR 835 MHz REFERENCE DIPOLE	SID835	SN 14/13 DIP0G835-235	2016-07-25	2017-07-24
<input type="checkbox"/>	SATIMO	COMOSAR 900 MHz REFERENCE DIPOLE	SID900	SN 14/13 DIP0G900-231	2016-07-25	2017-07-24
<input type="checkbox"/>	SATIMO	COMOSAR 1800 MHz REFERENCE DIPOLE	SID1800	SN 14/13 DIP1G800-232	2016-07-25	2017-07-24
<input checked="" type="checkbox"/>	SATIMO	COMOSAR 1900 MHz REFERENCE DIPOLE	SID1900	SN 14/13 DIP1G900-236	2016-07-25	2017-07-24
<input type="checkbox"/>	SATIMO	COMOSAR 2000 MHz REFERENCE DIPOLE	SID2000	SN 14/13 DIP2G000-237	2016-07-25	2017-07-24
<input type="checkbox"/>	SATIMO	COMOSAR 2450 MHz REFERENCE DIPOLE	SID2450	SN 14/13 DIP2G450-238	2016-07-25	2017-07-24
<input type="checkbox"/>	SATIMO	COMOSAR 2600 MHz REFERENCE DIPOLE	SID2600	SN 28/14 DIP2G600-327	2016-07-25	2017-07-24
<input checked="" type="checkbox"/>	SATIMO	Software	OPENSAR	N/A	2016-07-25	2017-07-24
<input checked="" type="checkbox"/>	SATIMO	Phantom	COMOSAR IEEE SAM PHANTOM	SN 14/13 SAM99	N/A	N/A
<input checked="" type="checkbox"/>	R & S	Universal Radio Communication Tester	CMU 200	117528	N/A	N/A
<input checked="" type="checkbox"/>	HP	Network Analyser	8753D	3410A08889	2016-08-19	2017-08-18
<input checked="" type="checkbox"/>	HP	Signal Generator	E4421B	GB39340770	2016-08-19	2017-08-18
<input checked="" type="checkbox"/>	Keithley	Multimeter	Keithley 2000	4014539	2016-08-19	2017-08-18
<input checked="" type="checkbox"/>	SATIMO	Amplifier	Power Amplifier	MODU-023-A-0004	2016-08-19	2017-08-18
<input checked="" type="checkbox"/>	Agilent	Power Meter	E4418B	GB43312909	2016-08-19	2017-08-18
<input checked="" type="checkbox"/>	Agilent	Power Meter Sensor	E4412A	MY41500046	2016-10-13	2017-10-12
<input checked="" type="checkbox"/>	Agilent	Power Meter	E4417A	GB41291826	2016-10-13	2017-10-12
<input checked="" type="checkbox"/>	Agilent	Power Meter Sensor	8481H	MY41091215	2016-10-13	2017-10-12

Annex A: System performance verification

(Please See the SAR Measurement Plots of annex A.)

Annex B: Measurement results

(Please See the SAR Measurement Plots of annex B.)

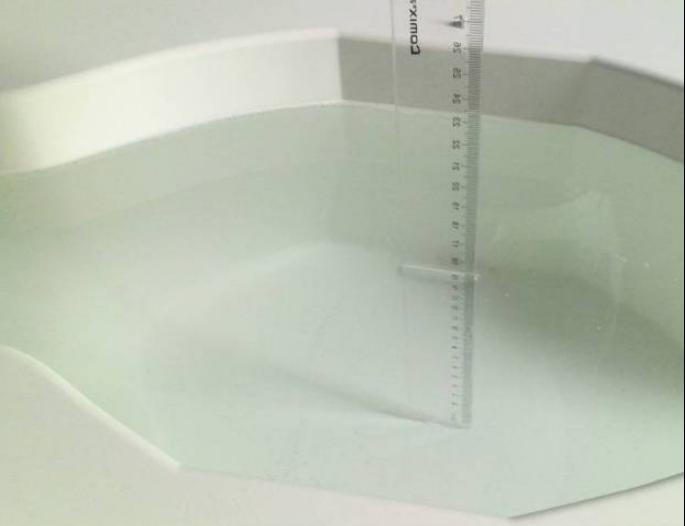
Annex C: Calibration reports

(Please See the Calibration reports of annex C.)

Annex D: Photo documentation

Photo 1: Measurement System OPENSAR	Photo 2: Front view
	
Photo 3: Rear View	Photo 4: Left Head Touched
	

Photo 5: Left Head Tilted 15°	Photo 6: Right Head Touched
Photo 7: Right Head Tilted 15°	Photo 4: Towards Phantom 15mm

Photo 5: Towards Ground 15mm	Photo 10: 850MHz Liquid Depth \geq 15.0cm
	
Photo 11: 1800~1900MHz Liquid Depth \geq 15.0cm	

End