SAR Test Report

Report No.:LCSA12223086E

Issued for

GL Technologies (Hong Kong) Limited

Unit 601, Building 5W, Hong Kong Science Park, Shatin, N.T., Hong Kong

Product Name:	4G LTE Wireless Router
Brand Name:	GL-iNET
Model Name:	GL-XE300C4
Series Model(s):	N/A
FCC ID:	2AFIW-XE300C4G
Test Standards:	ANSI/IEEE Std. C95.1-1992 FCC 47 CFR Part 2 (2.1093) IEC/IEEE 62209-1528
Max. SAR (1g)	Body: 1.082 W/kg

TEST REPORT

Applicant's name	:	GL Technologies (Hong Kong) Limited
Address..................................	:	Unit 601, Building 5W, Hong Kong Science Park, Shatin, N.T., Hong Kong
Manufacture's Name	:	Shenzhen Guanglian Zhitong Technology Co., LTD
Address..................................	:	Room 305-306, Skyworth Digital Building, Shiyan Street, Baoan District, Shenzhen, China

Product description

Product Name	:	4G LTE Wireless Router
Brand Name	:	GL-iNET
Model Name	:	GL-XE300C4
Series Model(s)......................	:	N/A
Standards	:	ANSI/IEEE Std. C95.1-1992 FCC 47 CFR Part 2 (2.1093) IEC/IEEE 62209-1528

Date of Test

Date (s) of performance of tests.............	:	04 Dec. 2023 ~ 12 Dec. 2023
Date of Issue	:	22 Dec. 2023
Test Result	:	**Pass**

Compiled by:	**Supervised by:**	**Approved by:**
Jay Zhan	Cary Luo	Gavin Liang
Jay Zhan/ File administrators	Cary Luo / Technique principal	Gavin Liang / Manager

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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	22 Dec. 2023	LCSA12223086E	ALL	Initial Issue

1. General Information

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

1.1 EUT Description

Product Name	4G LTE Wireless Router
Brand Name	GL-iNET
Model Name	GL-XE300C4
Series Model(s)	N/A
Model Difference	N/A
Battery	Rated Voltage: 3.7V Charge Limit Voltage: 4.2V Capacity: 5000mAh 18.5Wh
Device Category	Portable
Product stage	Production unit
RF Exposure Environment	General Population / Uncontrolled
Hardware Version	V1.0
Software Version	3.201
Frequency Range	GSM 850: 824 MHz ~ 849 MHz PCS1900: 1850 MHz ~ 1910 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV:1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz~2570 MHz LTE Band 12: 690 MHz ~ 720 MHz LTE Band 13: 770 MHz ~ 790 MHz LTE Band 25:1850MHz~1930 MHz LTE Band 26:810MHz~850 MHz LTE Band 38: 2570 MHz~2620MHz LTE Band 41: 2496 MHz ~ 2690 MHz WLAN802.11b/g/n20: 2412 MHz ~ 2462 MHz WLAN 802.11n40: 2422 MHz ~ 2452 MHz

Max. Reported SAR(1g): (Limit:1.6W/kg)	Band	Mode	Body Worn and Hotspot(W/kg)
	PCB	GSM 850	0.417
	PCB	GSM 1900	1.078
	PCB	WCDMA Band II	0.474
	PCB	WCDMA Band V	0.627
	PCB	WCDMA Band IV	0.509
	PCB	LTE Band 2	0.675
	PCB	LTE Band 4	1.082
	PCB	LTE Band 5	0.263

	PCB	LTE Band 7	1.080
	PCB	LTE Band 12	0.678
	PCB	LTE Band 13	0.777
	PCB	LTE Band 25	0.665
	PCB	LTE Band 26	0.643
	PCB	LTE Band 38	0.615
	PCB	LTE Band 41	0.782
	DTS	2.4G WLAN ANT1	0.491
	DTS	2.4G WLAN ANT2	0.328
	DTS	2.4G WLAN_ANT_1+2	0.511
1-g Sum SAR			1.593
FCC Equipment Class	PCS Licensed Transmitter(PCB) Digital Transmission System (DTS)		
Operating Mode	GSM: GSM Voice; GPRS/EGPRS Class 12 WCDMA: RMC, HSDPA, HSUPA Release 6 LTE: QPSK, 16QAM WLAN: 802.11 a/b/g/n20/n40		
Antenna Specification	GSM/WCDMA/LTE: PIFA Antenna WLAN: PCB Antenna		
DTM Mode	Not Support		
Sample Number	A231225024		
Note: Only single-card testing is supported			

1.2 Test Environment

Ambient conditions in the SAR laboratory:

Items	Required
Temperature (℃)	18-25
Humidity (%RH)	30-70

1.3 Test Factory

Shenzhen LCS Compliance Testing Laboratory Ltd..

101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China FCC test Firm Registration No.: 625569

IC Registration No.: 12108A

A2LA Certificate No.: 4338.01

2. Test Standards and Limits

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	ANSI/IEEE Std. C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	IEC/IEEE 62209-1528	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)
4	FCC KDB 447498 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
5	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
6	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
7	FCC KDB 648474 D04 v01r03	SAR Evaluation Considerations for Wireless Handsets
8	FCC KDB 248227 D01 Wi-Fi SAR v02r02	SAR Considerations for 802.11 Devices

(A). Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

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

Population/Uncontrolled Environments:

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

Occupational/Controlled Environments:

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

NOTE

GENERAL POPULATION/UNCONTROLLED EXPOSURE

PARTIAL BODY LIMIT

1.6 W/kg

3. SAR Measurement System

3.1 SAR Measurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

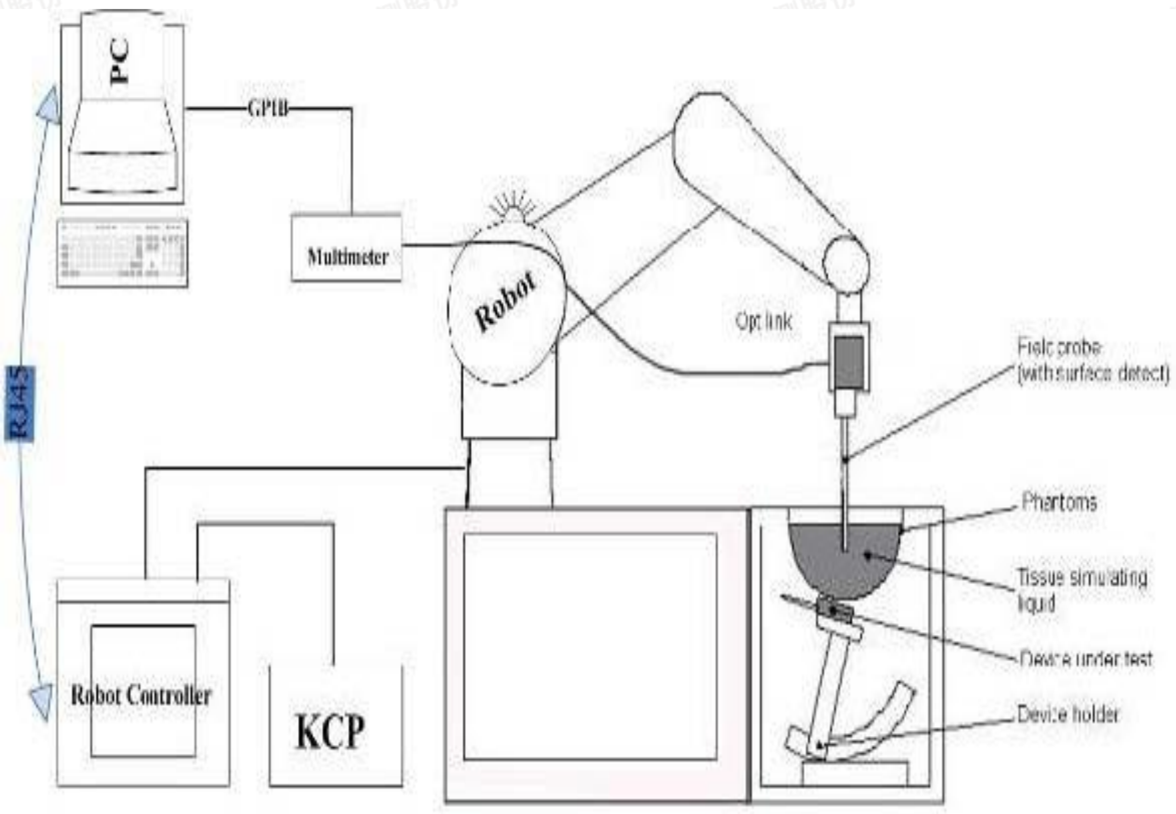
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



3.2OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPGO376(manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

CalibrationISO/IEC 17025 calibration service available.

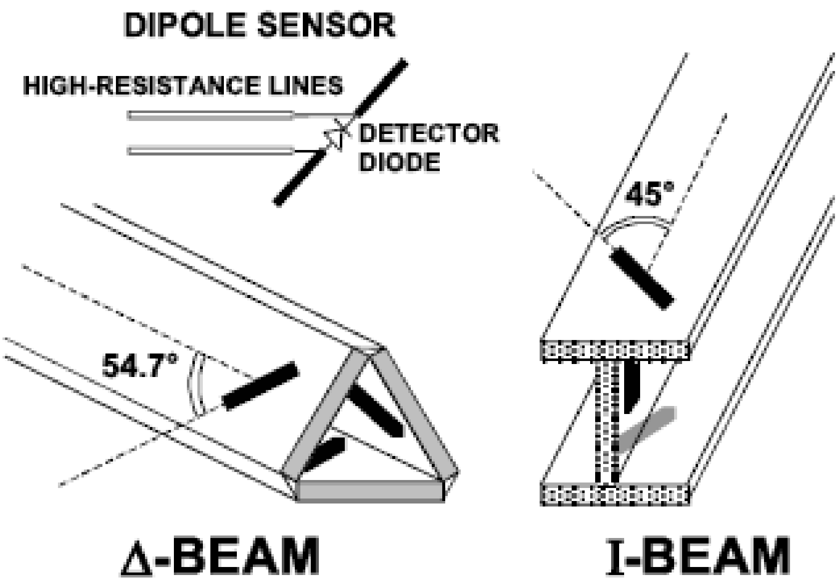
Frequency	450 MHz to 6 GHz; Linearity:0.25dB(450 MHz to 6GHz)
Directivity	0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm

Application General dosimetry up to 6 GHz
Dosimetry in strong gradient fields
Compliance tests of Mobile Phones

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

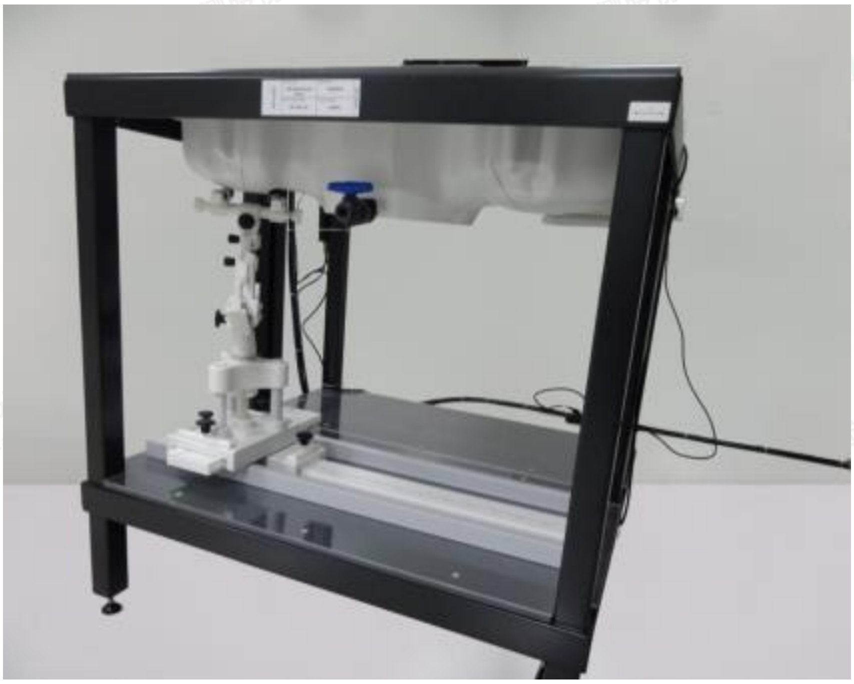
The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



3.3Phantoms

The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

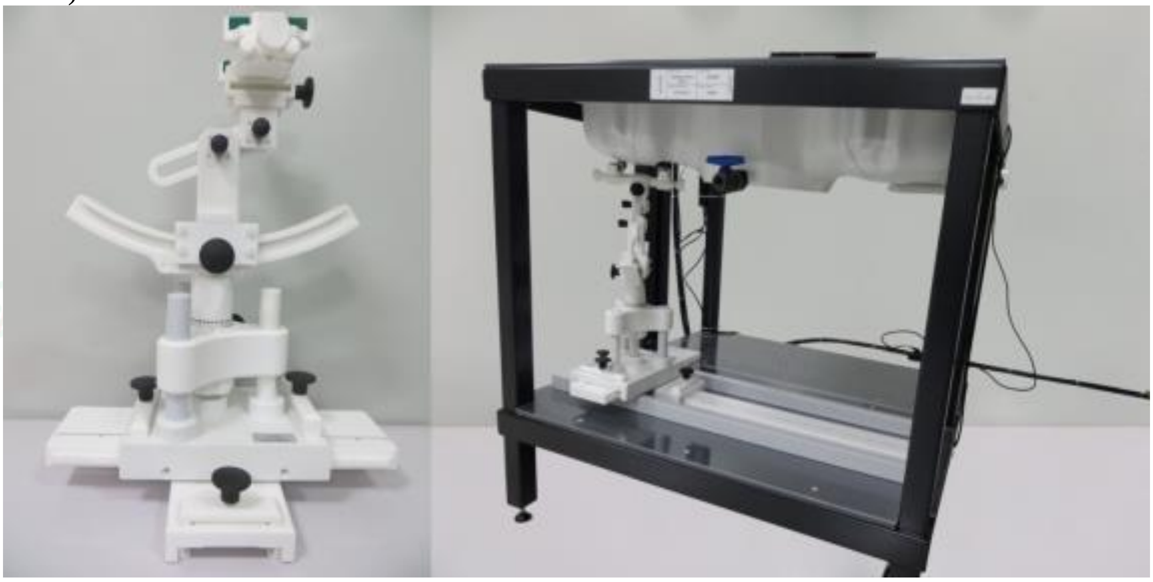
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

3.4Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement
The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the

phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

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

Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$ mm	
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 IEEE Std 1528-2013 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Power Drift measurement

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6Data Storage and Evaluation

Data Storage

The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [℃], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the OPENSAR components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field
dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\mathrm{H-fieldprobes:} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

4. Tissue Simulating Liquids

4.1 Simulating Liquids Parameter Check

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It’s satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Ingredient	750MHz		835MHz		1800 MHz		1900 MHz		2450MHz		2600MHz		5000MHz	
(% Weight)	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	39.28	51.3	41.45	52.5	54.5	40.2	54.9	40.4	62.7	73.2	60.3	71.4	65.5	78.6
Preventol	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DGBE	0.00	0.00	0.00	0.00	45.33	59.31	44.92	59.10	36.80	26.70	39.10	28.40	0.00	0.00
Triton X-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.2	10.7

Target Frequency (MHz)	Head	
	ε_r	σ(S/m)
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1640	40.2	1.31
1800	40.0	1.40
1900	40.0	1.40
2000	40.0	1.40
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
5200	36.0	4.66
5800	35.3	5.27

LIQUID MEASUREMENT RESULTS

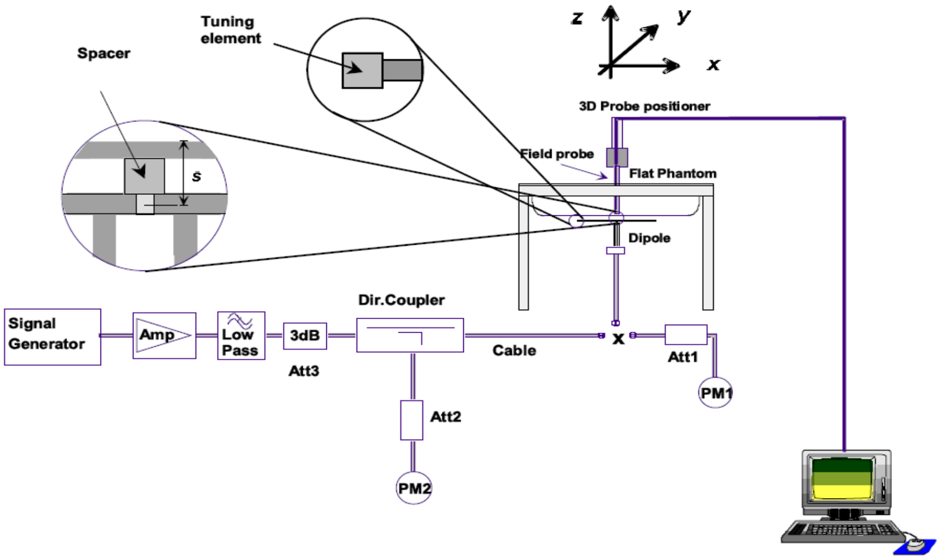
Date	Ambient		Simulating Liquid		Parameters	Target	Measured	Deviation %	Limited %
	Temp. [°C]	Humidity %	Frequency (MHz)	Temp. [°C]					
2023-12-04	22.0	47	708	21.7	Permittivity	42.13	42.58	1.08	±5
					Conductivity	0.89	0.89	0.32	±5
2023-12-04	22.0	47	711	21.7	Permittivity	42.11	42.54	1.03	±5
					Conductivity	0.89	0.91	2.55	±5
2023-12-04	22.0	47	750	21.8	Permittivity	41.90	42.33	1.03	±5
					Conductivity	0.89	0.87	-2.25	±5
2023-12-04	22.1	48	782	21.8	Permittivity	41.73	42.46	1.75	±5
					Conductivity	0.89	0.85	-4.72	±5
2023-12-05	21.3	48	826.4	21.1	Permittivity	41.54	40.87	-1.61	±5
					Conductivity	0.90	0.93	3.45	±5
2023-12-05	21.3	48	835	21.0	Permittivity	41.50	40.96	-1.30	±5
					Conductivity	0.90	0.91	1.11	±5
2023-12-05	21.4	48	836.6	21.1	Permittivity	41.49	41.22	-0.66	±5
					Conductivity	0.90	0.94	4.42	±5
2023-12-05	21.4	48	841.5	21.1	Permittivity	41.47	41.10	-0.89	±5
					Conductivity	0.90	0.86	-4.53	±5
2023-12-05	21.4	48	844	21.2	Permittivity	41.46	42.13	1.62	±5
					Conductivity	0.90	0.89	-1.23	±5
2023-12-06	23.7	41	1712.5	23.4	Permittivity	40.13	40.37	0.61	±5
					Conductivity	1.35	1.37	1.48	±5
2023-12-06	23.7	41	1720	23.4	Permittivity	40.11	41.55	3.58	±5
					Conductivity	1.35	1.41	4.11	±5
2023-12-06	23.8	41	1732.5	23.5	Permittivity	40.10	41.13	2.58	±5
					Conductivity	1.36	1.37	0.63	±5
2023-12-06	23.8	41	1745	23.5	Permittivity	40.08	40.29	0.53	±5
					Conductivity	1.37	1.32	-3.55	±5
2023-12-06	23.8	41	1800	23.5	Permittivity	40.00	41.18	2.95	±5
					Conductivity	1.40	1.39	-0.71	±5
2023-12-07	23.7	46	1850.2	23.4	Permittivity	40.00	40.93	2.33	±5
					Conductivity	1.40	1.42	1.43	±5
2023-12-07	23.8	46	1880	23.5	Permittivity	40.00	40.34	0.85	±5
					Conductivity	1.40	1.41	0.71	±5

2023-12-07	23.7	46	1882.5	23.4	Permittivity	40.00	40.13	0.33	±5
					Conductivity	1.40	1.45	3.57	±5
2023-12-07	23.7	46	1900	23.4	Permittivity	40.00	40.89	2.23	±5
					Conductivity	1.40	1.42	1.43	±5
2023-12-07	23.8	46	1905	23.6	Permittivity	40.00	40.89	2.23	±5
					Conductivity	1.40	1.43	2.14	±5
2023-12-07	23.9	47	1909.8	23.6	Permittivity	40.00	40.89	2.23	±5
					Conductivity	1.40	1.42	1.43	±5
2023-12-08	22.2	55	2412	21.9	Permittivity	39.27	40.07	2.04	±5
					Conductivity	1.77	1.75	-0.92	±5
2023-12-08	22.3	55	2422	22.0	Permittivity	39.25	39.31	0.15	±5
					Conductivity	2.14	1.82	2.53	±5
2023-12-08	22.3	55	2450	22.0	Permittivity	39.20	40.17	2.47	±5
					Conductivity	1.80	1.82	1.11	±5
2023-12-12	23.6	60	2510	23.3	Permittivity	39.12	39.45	0.84	±5
					Conductivity	1.86	2.39	-0.75	±5
2023-12-12	23.7	60	2535	23.4	Permittivity	39.09	39.85	1.95	±5
					Conductivity	1.89	1.88	-0.56	±5
2023-12-12	23.8	61	2560	23.5	Permittivity	39.05	39.35	0.76	±5
					Conductivity	1.92	1.89	-1.43	±5
2023-12-12	23.8	61	2600	23.5	Permittivity	39.00	39.56	1.44	±5
					Conductivity	1.96	2.00	2.04	±5
2023-12-12	23.7	61	2610	23.4	Permittivity	38.99	39.22	0.60	±5
					Conductivity	1.97	1.94	-1.56	±5
2023-12-12	23.9	61	2680	23.6	Permittivity	38.89	39.21	0.81	±5
					Conductivity	2.05	2.03	-0.75	±5

5. SAR System Validation

5.1 The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Photo of Dipole Setup

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.While calibration intervals not exceed 3 years.

SID750 SN 07/14 DIP 0G750-302 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-29	-34.80		50.7		1.6	
2022-09-29	-34.35	-1.29	51.2	0.5	1.5	-0.1
2023-09-29	-34.42	-1.09	51.3	0.4	1.5	-0.1

SID835 SN 07/14 DIP 0G835-303 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-29	-24.49		54.9		2.8	
2022-09-29	-24.17	-1.31	54.5	-0.4	2.6	-0.2
2023-09-29	-24.20	-1.18	54.2	-0.7	2.5	-0.3

SID1800 SN 07/14 DIP 1G800-301 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-29	-20.26		43.1		6.9	
2022-09-29	-20.13	-0.64	42.9	-0.2	6.7	-0.2
2023-09-29	-20.15	-0.54	42.8	-0.3	6.6	-0.3

SID1900 SN 38/18 DIP 1G900-466 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-22	-26.43		50.5		4.7	
2022-09-22	-26.33	-0.38	50.2	-0.3	4.5	-0.2
2023-09-22	-26.40	-0.11	50.1	-0.4	4.6	-0.1

SID2450 SN 07/14 DIP 2G450-306 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-29	-25.59		44.7		-1.1	
2022-09-29	-25.68	0.35	44.8	0.1	-1.0	0.1
2023-09-29	-25.70	0.43	44.5	-0.2	-1.1	0.0

SID2600 SN 38/18 DIP 2G600-468 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021-09-22	-29.14		49.2		3.4	
2022-09-22	-29.12	-0.07	49.1	-0.1	3.2	-0.2
2023-09-22	-29.10	-0.07	49.2	0.0	3.3	-0.1

5.2 Validation Result

Comparing to the original SAR value provided by MVG, the validation data should be within its specification of 10 %.

Date	Freq.	Power	Tested Value	Normalized SAR	Target SAR	Tolerance	Limit
	(MHz)	(mW)	(W/Kg)	(W/kg)	1g(W/kg)	(%)	(%)
2023-12-04	750	100	0.873	8.73	8.38	4.18	10
2023-12-05	835	100	0.955	9.55	9.6	-0.52	10
2023-12-06	1800	100	3.710	37.10	38.13	-2.70	10
2023-12-07	1900	100	3.868	38.68	40.03	-3.37	10
2023-12-08	2450	100	5.604	56.04	53.89	3.99	10
2023-12-12	2600	100	5.755	57.55	56.91	1.12	10

Note:

1. The tolerance limit of System validation ±10%.
2. The dipole input power (forward power) was 100 mW.
3. The results are normalized to 1 W input power.

6. SAR Evaluation Procedures

The procedure for assessing the average SAR value consists of the following steps:
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 16mm * 8 to16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot 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.

Area Scan& Zoom Scan:

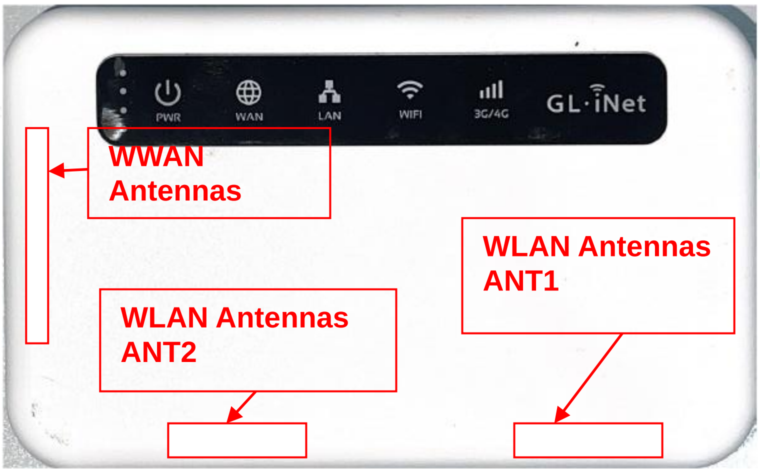
First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR -distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r01 quoted below.
When the 1-g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

7. EUT Antenna Location Sketch

It is a Mobile Phone, support GSM/WCDMA/LTE/WLAN mode.

Top side

Left side



Right side

Bottom side (Front view)

Note:
1). Per KDB648474 D04, because the overall diagonal distance of this devices is 286mm>160mm, it is considered as "TABLET PC" device.
2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/Kg.
3). According to the KDB941225 D06 Hot Spot SAR v02, the edges with less than 25 mm distance to the antennas need to be tested for SAR.
4). Per KDB 616217 D04, The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the displaysection of a full-size tablet, away from the edges, are generally limited to the user's hands.

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
WWAN	<5	<5	9	11	<5	95
WLAN 1	5	5	15	60	80	40
WLAN 2	5	5	15	60	30	90

Positions for SAR tests; Hotspot mode						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
WWAN	Yes	Yes	No	Yes	Yes	Yes
WLAN 1	Yes	Yes	Yes	No	No	No
WLAN 2	Yes	Yes	Yes	No	No	No

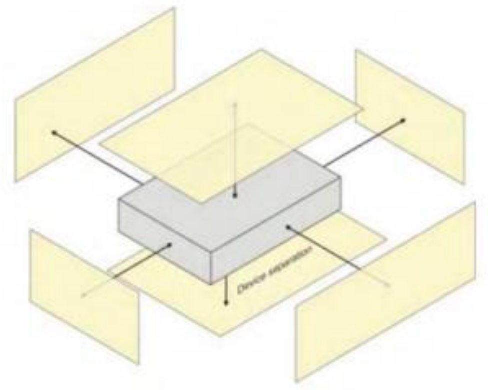
General Note: Referring to KDB 941225 D06 v02, When the overall device length and width are ≥9cm*5cm, the test distance is 10mm, SAR must be measured for all sides and surfaces with a transmitting antenna located with 25mm from that surface or edge.

8. EUT Test Position

This EUT was tested in Front Side, Back Side, Left Edge, Right Edge, Top Edge, Bottom Edge.

8.1 Hotspot mode exposure position condition

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing function, the relevant hand and body exposure condition are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surface and edges with a transmitting antenna located within 25 mm form that surface or edge. When form factor of a handset is smaller than 9cm x 5cm, a test separation distance of 5mm (instead of 10mm) is required for testing hotspot mode. When the separate distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).



9. Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in IEEE 1528: 2013.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Uncertainty Component	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Veff
Measurement System								
Probe calibration	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	3.5	R	√3	$\sqrt{1-C_p}$	$\sqrt{1-C_p}$	1.43	1.43	∞
Hemispherical Isotropy	5.9	R	√3	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary effect	1.0	R	√3	1	1	0.58	0.58	∞
Linearity	4.7	R	√3	1	1	2.71	2.71	∞
System detection limits	1.0	R	√3	1	1	0.58	0.58	∞
Readout Electronics	0.5	N	1	1	1	0.50	0.50	∞
Response Time	0.0	R	√3	1	1	0.00	0.00	∞
Integration Time	1.4	R	√3	1	1	0.81	0.81	∞
RF ambient Conditions - Noise	3.0	R	√3	1	1	1.73	1.73	∞
RF ambient Conditions - Reflections	3.0	R	√3	1	1	1.73	1.73	∞

Probe positioner Mechanical Tolerance	1.4	R	√3	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	1.4	R	√3	1	1	0.81	0.81	∞
Max. SAR Evaluation	1.0	R	√3	1	1	0.6	0.6	∞
Test sample Related								
Device positioning	2.6	N	1	1	1	2.6	2.6	11
Device holder	3.0	N	1	1	1	3.0	3.0	7
Drift of output power	5.0	N	√3	1	1	2.89	2.89	∞
System check source(dipole)								
Deviation between experimental dipoles	2.0	N	1	1	1	2.0	2.0	∞
Input power and SAR drift measurement	4.7	R	√3	1	1	2.7	2.7	∞
Dipole axis to liquid distance	1.0	R	√3	1	1	0.6	0.6	∞
System check source								
Deviation between experimental source	–	N	1	0	0	–	–	7
Input power and SAR drift measurement	–	R	√3	1	1	–	–	∞
Other source contributions	–	R	√3	1	1	–	–	∞
Phantom and Tissue Parameters								
Phantom uncertainty	4.00	R	√3	1	1	2.31	2.31	∞
Liquid conductivity (target)	2.50	N	1	0.78	0.71	1.95	2.14	5
Liquid conductivity (meas)	4.00	N	1	0.23	0.26	0.92	1.04	5
Liquid Permittivity (target)	2.50	N	1	0.78	0.71	1.95	2.14	∞
Liquid Permittivity (meas)	5.00	N	1	0.23	0.26	1.15	1.30	∞
Combined Standard		RSS	$U_c = \sqrt{\sum_{i=1}^{n} C_i^2 U_i^2}$			10.63 %	10.54 %	
Expanded Uncertainty (95% Confidence interval)	U = k U_C , k=2					21.26 %	21.08 %	

10. Conducted Power Measurement

10.1 Test Result

Burst Average Power (dBm)						
Band	GSM 850			PCS 1900		
Channel	128	190	251	512	661	810
Frequency (MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GPRS (GMSK, 1-Slot)	31.08	31.37	31.38	28.98	28.87	28.74
GPRS (GMSK, 2-Slot)	30.60	30.95	30.89	28.49	28.47	28.24
GPRS (GMSK, 3-Slot)	30.11	30.48	30.43	28.01	27.98	27.77
GPRS (GMSK, 4-Slot)	29.62	30.02	29.98	27.60	27.55	27.47
EGPRS(8PSK, 1-Slot)	27.47	27.71	27.68	27.38	27.60	26.75
EGPRS(8PSK, 2-Slot)	26.72	26.93	26.90	26.66	26.85	25.97
EGPRS(8PSK, 3-Slot)	25.95	26.18	26.17	25.95	26.12	25.25
EGPRS(8PSK, 4-Slot)	25.15	25.43	25.41	25.18	25.35	25.35
Remark: GPRS, CS4 coding scheme. EGPRS, MCS5 coding scheme. Multi-Slot Class 8, Support Max 4 downlink, 1 uplink, 5 working link Multi-Slot Class 10, Support Max 4 downlink, 2 uplink, 5 working link Multi-Slot Class 12, Support Max 4 downlink, 4 uplink, 5 working link						

Frame- Average Power(dBm)						
Band	GSM 850			PCS 1900		
Channel	128	190	251	512	661	810
Frequency (MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GPRS (GMSK, 1-Slot)	22.05	22.34	22.35	19.95	19.84	19.71
GPRS (GMSK, 2-Slot)	24.58	24.93	24.87	22.47	22.45	22.22
GPRS (GMSK, 3-Slot)	25.85	26.22	26.17	23.75	23.72	23.51
GPRS (GMSK, 4-Slot)	26.61	27.01	26.97	24.59	24.54	24.46
EGPRS(8PSK, 1-Slot)	18.44	18.68	18.65	18.35	18.57	17.72
EGPRS(8PSK, 2-Slot)	20.70	20.91	20.88	20.64	20.83	19.95
EGPRS(8PSK, 3-Slot)	21.69	21.92	21.91	21.69	21.86	20.99
EGPRS(8PSK, 4-Slot)	22.14	22.42	22.40	22.17	22.34	22.34
Remark : 1. SAR testing was performed on the maximum frame-averaged power mode. 2. The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum Burst - averaged power based on time slots. The calculated method is shown as below: Frame-averaged power = Burst averaged power (1 TX Slot) – 9.03 dB Frame-averaged power = Burst averaged power (2 TX Slots) – 6.02 dB Frame-averaged power = Burst averaged power (3 TX Slots) - 4.26 dB Frame-averaged power = Burst averaged power (4 TX Slots) – 3.01 dB						

WCDMA

Band	WCDMA Band 2			WCDMA Band 5			WCDMA Band 4		
Channel	9262	9400	9538	4132	4183	4233	1312	1413	1513
Frequency (MHz)	1852.4	1880	1907.6	826.4	836.6	846.6	1712.6	1740	1752.4
RMC 12.2Kbps	21.75	22.23	21.93	23.05	22.12	22.20	23.23	23.15	22.86
HSDPA Subtest-1	21.72	21.80	21.91	22.45	22.08	22.03	20.90	20.85	21.18
HSDPA Subtest-2	21.23	21.30	21.43	22.00	21.67	21.53	20.47	20.37	20.70
HSDPA Subtest-3	20.83	20.86	21.01	21.51	21.19	21.16	20.05	19.97	20.32
HSDPA Subtest-4	20.48	20.37	20.52	21.17	20.87	20.85	19.60	19.48	19.92
HSUPA Subtest-1	21.72	21.67	22.39	21.88	22.05	21.99	20.75	20.66	20.45
HSUPA Subtest-2	20.88	20.70	20.93	21.08	21.11	21.03	19.94	19.72	19.51
HSUPA Subtest-3	20.73	20.30	20.45	20.97	20.71	20.63	19.74	19.32	19.16
HSUPA Subtest-4	20.41	19.99	20.03	20.58	20.26	20.26	19.25	19.02	18.79
HSUPA Subtest-5	19.00	18.55	18.61	19.15	18.83	18.81	17.80	17.55	17.35

According to 3GPP 25.101 sub-clause 6.2.2, the maximum output power is allowed to be reduced by following the table.

Table 6.1A: UE maximum output power with HS-DPCCH and E-DCH

UE Transmit Channel Configuration	CM(db)	MPR(db)
For all combinations of ,DPDCH,DPCCH HS-DPCCH,E-DPDCH and E-DPCCH	0⩽ CM⩽3.5	MAX(CM-1,0)
Note: CM=1 for βc/βd=12/15, βhs/ βc=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.		

The device supports MPR to solve linearity issues (ACLR or SEM) due to the higher peak-to average ratios (PAR) of the HSUPA signal. This prevents saturating the full range of the TX DAC inside of device and provides a reduced power output to the RF transceiver chip according to the Cubic Metric (a function of the combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH).

When E-DPDCH channels are present the beta gains on those channels are reduced firsts to try to get the power under the allowed limit. If the beta gains are lowered as far as possible, then a hard limiting is applied at the maximum allowed level.

The SW currently recalculates the cubic metric every time the beta gains on the E-DPDCH are reduced. The cubic metric will likely get lower each time this is done .However, there is no reported reduction of maximum output power in the HSUPA mode since the device also provides a compensation for the power back-off by increasing the gain of TX_AGC in the transceiver (PA) device.

The end effect is that the DUT output power is identical to the case where there is no MPR in the device.