Nemko Korea Co., Ltd.

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FCC and IC SAR EVALUATION REPORT FOR CLASS II PERMISSIVE CHANGE

Applicant :

129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do,16677,
Korea
Attn. : Mr. JunTaek Oh

Dates of Issue : Jan 13, 2022
Test Report No. : NK-21-R-458-1
Test Site : Nemko Korea Co., Ltd.

FCC	**A3LSMR180L**
IC	**649E-SMR180L**
Brand Name	**Samsung**
Contact Person	**129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea** **Mr. JunTaek Oh** **Telephone No. : +82-10-3311-0003**

Applied Standard:	FCC 47 CFR Part 2(2.1093) and IC RSS-102 Issue 5
Classification:	FCC Part 15 Spread Spectrum Transmitter (DSS) Digital Transmission System (DTS)
EUT Type:	Bluetooth Headset

Jan. 13. 2022

Tested By : Wonjae Song
Test Engineer

Jan. 13. 2022

Reviewed By : Seungyong Shin
Technical Manager

Revision History

Rev.	Issue Date	Revisions	Revised By
00	June 24, 2020	Initial issue	
01	July 16, 2020	Class I Permissive Change 1. Antenna change (Basic Report : Initial Report NK-20-R-143-1)	
02	Jan 13, 2022	Class II Permissive Change 1. Antenna change and minor change in PCB layout (Basic Report : Amendment 1 Report NK-20-R-184-1)	

TABLE OF CONTENTS

1. SCOPE

Measurement and determination of electromagnetic field intended to be used at a position near the human body with radio frequency device at distance up to and including 200mm from a human body for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 2 and IC RSS-102 Issue5.

Responsible Party :	Samsung Electronics Co., Ltd.
Contact Person :	JunTaek Oh
Manufacturer :	Samsung Electronics Co., Ltd. 129, Samsung-ro, Yeongtong-gu, Suwon-si,Gyeonggi-do, 16677, Korea

- FCC ID A3LSMR180L
- IC : 649E-SMR180L
- Model: SM-R180
- HVIN SM-R180L
- Brand Name: Samsung
- EUT Type: Bluetooth Headset
- Classification: Part 15 Spread Spectrum Transmitter (DSS)
  Digital Transmission System (DTS)
- Applied Standard: FCC 47 CFR Part 2(2.1093) and IC RSS-102 Issue 5
- Test Procedure(s): IEEE 1528-2013
  IEC/IEEE 62209-1528:2020
  KDB 447498 D01 General RF exposure Guidance v06
- Dates of Test: Dec 27, 2021 ~ Jan 6, 2022
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **Samsung Electronics Co., Ltd. FCC ID : A3LSMR180L** and
IC : 649E-SMR180L.

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at
80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.

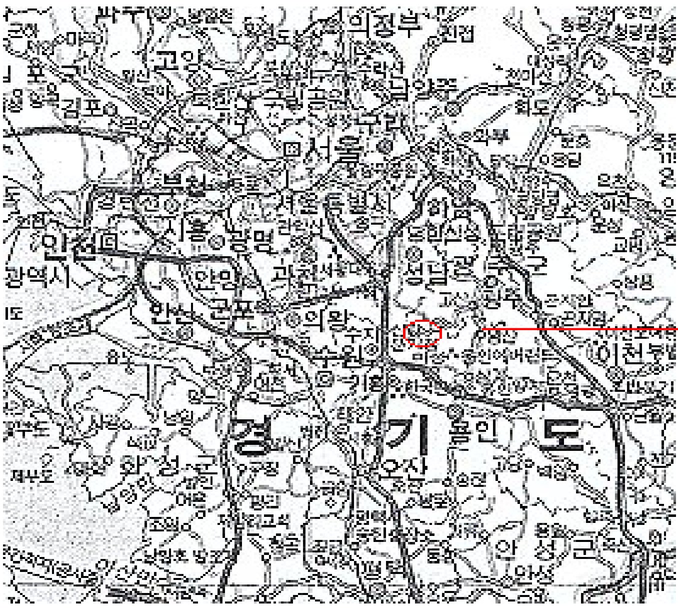

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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. KT155
Industry Canada	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the transceiver which is the Bluetooth 5.0 module supporting BDR/EDR/LE mode.
The Mobile phone was used to control the EUT to transmit the wanted TX channel by the testing program (BudsOdin2.0) which manufacturer supported. The Mobile phone was removed after controlling the EUT to transmit the wanted signal. The EUT was tested at the lowest channel, middle channel and the highest channel with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

3.1.1 Operating Environment

Parameters	**Recording during test**	**Accepted deviation**
Ambient temperature	(20.2 ~ 20.8) ℃	(18 ~ 25) ℃
Relative Humidity	(38.0 ~ 42.0) %	(30 ~ 70) %

3.1.2 Table of test power setting

Frequency	Mode	Power setting Level
2402 MHz ~ 2480 MHz	GFSK	Max
	π/4DQPSK	Max
	8DPSK	Max
2402 MHz ~ 2480 MHz	LE 1M	Default
	LE 2M	Default

3.1.3 Table of test channels

Frequency band	Mode	Test Channel (CH)	Frequency (MHz)
2.4 GHz	GFSK, π/4DQPSK, 8DPSK	0	2402
		39	2441
		78	2480
2.4 GHz	LE 1M, LE 2M	0	2402
		19	2440
		39	2480

3.1.4 Antenna TX mode information

Frequency band	Mode	Antenna TX mode	Support MIMO
2.4 GHz	GFSK, π/4DQPSK, 8DPSK	■ 1TX, □ 2TX	□ Yes, ■ No
2.4 GHz	LE 1M, 2M	■ 1TX, □ 2TX	□ Yes, ■ No

3.1.5 Additional Information Related to Testing

SAR testing was performed all EUT orientations with a device-to-phantom separation distance of 0 mm, according to KDB 447498 requirements.
There is no change except for antenna change and minor change in PCB layout.
(Refer to 'description of change')
Minor change in PCB layout does not affect to radio performance.
There is no change of power setting level.

SAR testing was performed in worst case(BT GFSK, BLE1M) with highest measured SAR in basic report report (NK-20-R-184-1).
Highest measured SAR was higher than highest measured SAR in basic report (NK-20-R-184-1).
Therefore, Class II permissive change is required according to KDB 178919 D01 v06 VI.B.2).

3.2 Support Equipment

Equipment	Manufacturer	Model Name	Serial Number
Mobile phone	Samsung	SM-G960N	R39K30EN92F

3.3. Maximum Target power among production units

Tune up tolerance is specified in operation description page 2.

Mode	Minimum power (dBm)	Maximum power(dBm)
GFSK	10	12.5
π/4DQPSK	5.5	8
8DPSK	5.5	8
LE 1M	10	12.5
LE 2M	10	12.5

3.4 SAR testing EUT configuration

Device Type	Band/Mode	Device edge for SAR Testing					
		Front	Back	Left edge	Right edge	Top	Bottom
Headset	Bluetooth 2.4 GHz	Yes	Yes	Yes	Yes	Yes	Yes

3.5 SAR Test consideration

Per FCC KDB 447498 D01v06, The SAR exclusion threshold for distance < 50mm is defined by the following equation.

$$\frac{(max.power\ of\ channel,including\ tune-up\ tolerance,mW)}{(min.test\ separation\ distance,mm)} \times \sqrt{f(GHz)} \leq 3.0 \quad \{1\text{ g SAR}\}$$

$$\frac{(max.power\ of\ channel,including\ tune-up\ tolerance,mW)}{(min.test\ separation\ distance,mm)} \times \sqrt{f(GHz)} \leq 7.5 \quad \{10\text{ g SAR}\}$$

Mode	Frequency	Maximum Conducted power	Maximum tune up Power	E.I.R.P *)	Separation	FCC SAR exclusion			IC SAR exclusion	
						≤ 3.0	≤ 7.5	FCC SAR Test	IC Limit	IC SAR Test
	[GHz]	[mW]	[mW]	[mW]	[mm]	1-g SAR	10-g SAR		[mW]	
GFSK	2.402	14.24	17.78	3.80	5	4.41	N/A	Yes	≤ 4.26	Yes
4DQPSK	2.402	4.66	6.31	2.56	5	1.45	N/A	No	≤ 4.26	Yes
8DPSK	2.402	4.64	6.31	2.82	5	1.44	N/A	No	≤ 4.26	Yes
LE 1M	2.480	13.63	17.78	2.58	5	4.29	N/A	Yes	≤ 3.94	Yes
LE 2M	2.480	13.40	17.78	2.61	5	4.22	N/A	Yes	≤ 3.94	Yes

*) E.I.R.P = [Maximum conducted power] + [Ant gain(-7.50 dBi)]

In case of FCC, Bluetooth 4DQPSK, 8DPSK SAR test was not required.

Per RSS-102 issue 5, The maximum tune up power was applied to testing, because maximum tune up power was higher than E.I.R.P.

IC SAR Limit was calculated using linear interpolation and below table.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

For IC exclusion, SAR testing was required for all modes.

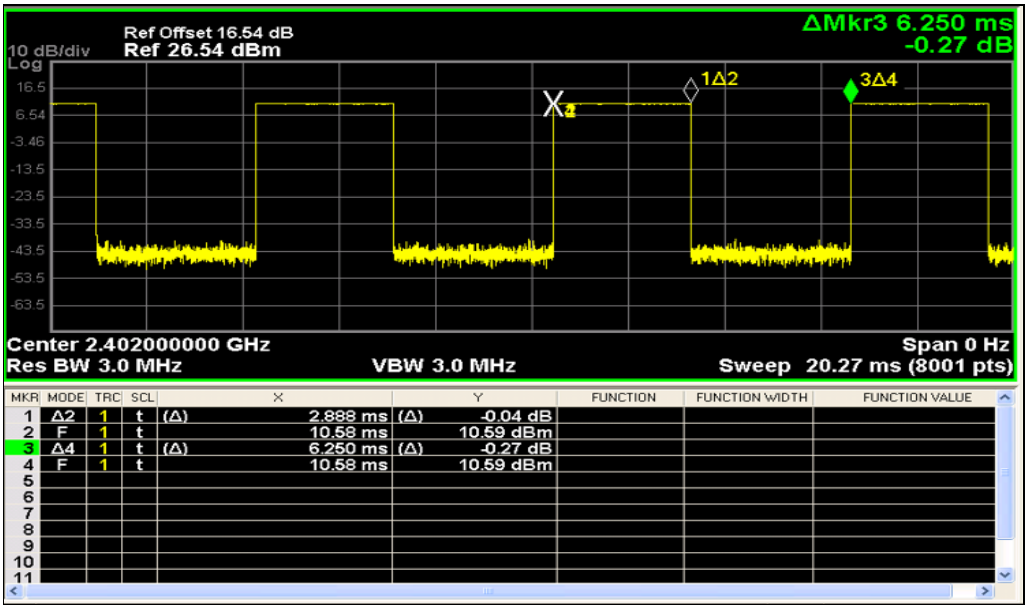
But SAR testing was performed in worst case (BT GFSK, BLE 1M).

Refer to clause 3.1.5 in this report.

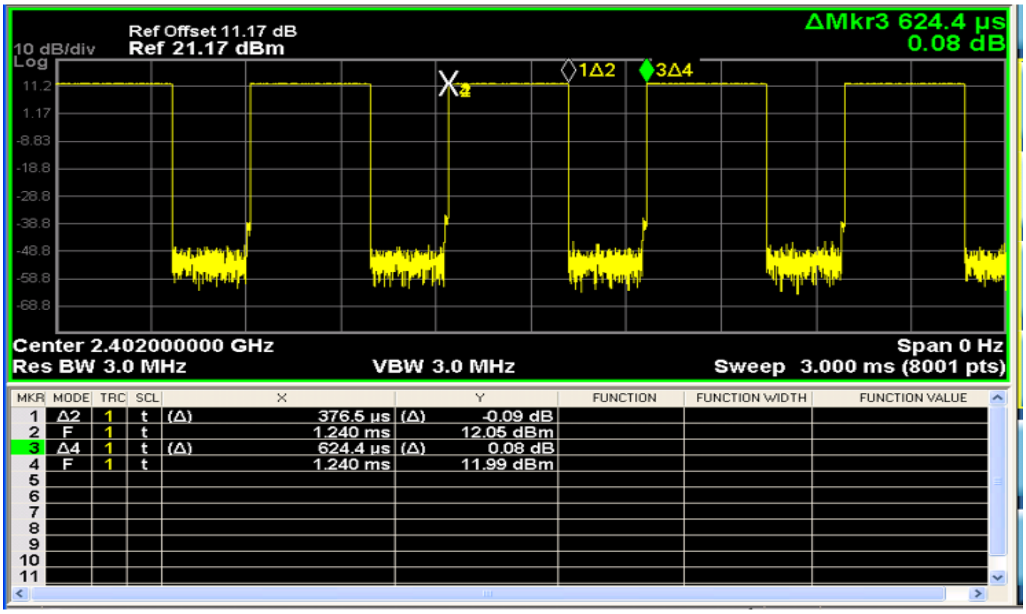
3.6 Bluetooth duty cycle plot

Per October 2016 TCB Workshop Notes, When call box and Bluetooth protocol are used, time-domain plots are required to identify duty factor supporting the test setup and results.

Mode	Packet	On time (ms)	On-Off time (ms)	Duty cycle (%)
BDR(GFSK)	DH5	2.888	6.25	46.21



Mode	On time (µs)	On-Off time (µs)	Duty cycle (%)
BLE1M	624.4	376.5	60.30



3.7 EUT Information

The EUT is the **Samsung Electronics Co., Ltd. Bluetooth Headset FCC ID: A3LSMR180L, IC: 649E-SMR180L.**

Specifications:

EUT Type	Bluetooth Headset
Model Name	SM-R180
Brand Name	Samsung
Frequency of Operation	2402 MHz ~ 2480 MHz
Average Output Power (Conducted)	GFSK : 11.54 dBm π/4 DQPSK : 6.69 dBm 8DPSK : 6.67 dBm LE 1M : 11.46 dBm LE 2M : 11.30dBm
Highest Reported SAR	1.198 W/kg
FCC Classification	FCC Part 15 Spread Spectrum Transmitter (DSS) Digital Transmission System (DTS)
Channel Number	DSS : 79 ch DTS : 40 ch
Modulation	GFSK, π/4 DQPSK, 8DPSK
Antenna Gain	-7.50 dBi (peak)
Power	3.7 Vdc
Dimensions (L x W x H)	About 15 cm x 26 cm X 14 cm
Weight	About 5 g
HVIN (Hardware Version Identification Number)	SM-R180L
FVIN (Firmware Version Identification Number)	R180.001
Remarks	-

3.8 Description of change

- No Comment

3.9 Variants covered by this report

- No Comment

3.10 Modification

- No Comment

4. GUIDANCE APPLIED

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

- FCC 47 CFR Part 2(2.1093)
- RSS-102 Issue 5
- IEEE 1528-2013
- IEC/IEEE 62209-1528:2020
- FCC KDB Publication 447498 D01 v06
- FCC KDB Publication 865664 D01 v01r04
- FCC KDB Publication 865664 D02 v01r02
- April 2019 TCB Workshop Notes (Tissue Simulating Liquids)
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)

5. DESCRIPTION OF TEST EQUIPMENT

5.1 SAR Measurement Setup

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, H/P computer, nearfield probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 5.1).

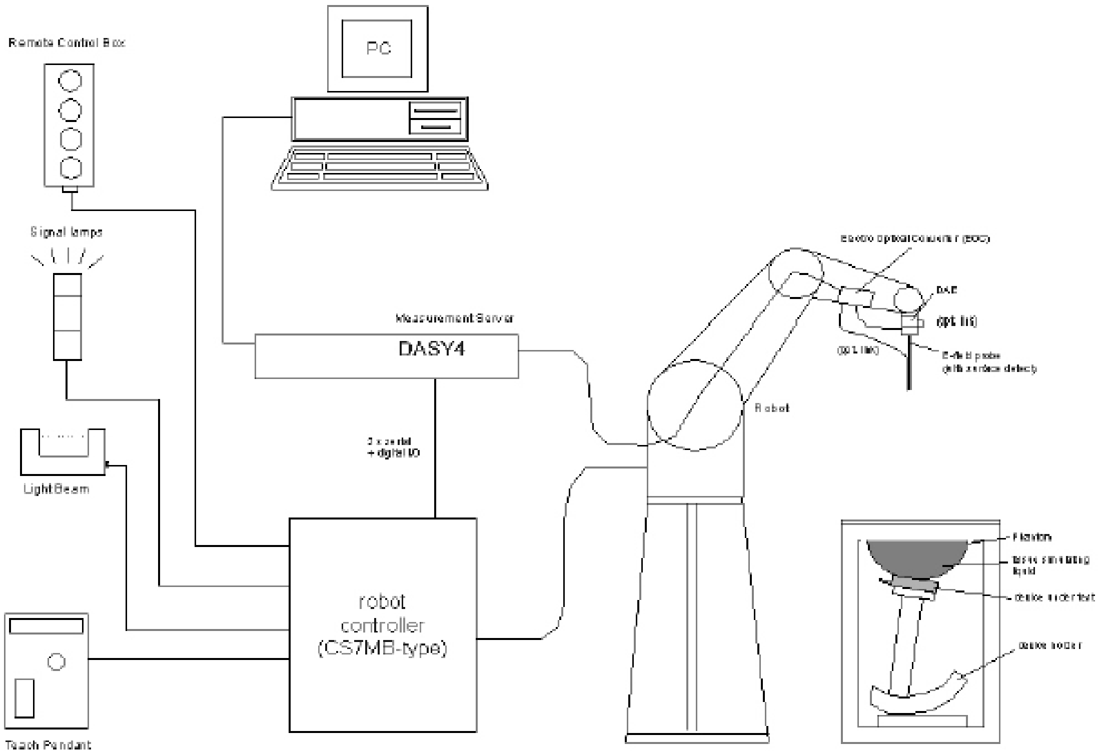


Figure 5.1 SAR Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the H/P computer with Windows XP system and SAR Measurement Software DASY4, LCD monitor, mouse and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.

A Data Acquisition Electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.

Is connected to the Electro-Optical Coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the measurement server.

System Electronics

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with autozeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

5.2 E-field Probe

The SAR measurement were conducted with the dosimetric probe designed in the classical triangular configuration (see Fig.5.3) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates.

The probe is equipped with an optical multi-fiber line ending at the front of the probe tip (see Fig.5.4). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface.

Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a System maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero.

The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.5.2). The approach is stopped at reaching the maximum.

Figure 5.2 DAE System

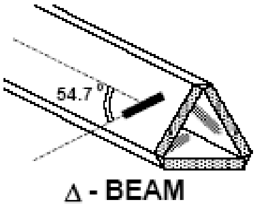


Figure 5.3 Triangular Probe Configuration

Figure 5.4 Probe Thick-Film Technique

Probe Specifications

Manufacturer : SPEAG

model name: EX3DV4

Serial number : 3947

Probe spec : refer to the Appendix C

Probe calibration : July 29, 2021

5.3 SAM Phantom

The SAM Twin Phantom V4.0C is constructed of a fiberglass shell Integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users.

It 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 all predefined phantom positions and measurement grids by manually teaching three points in the robot.

(See Figure 5.5)

Figure 5.5 SAM Twin Phantom

Phantom Specification

Construction : The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2013.

It 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 evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Shell Thickness : 2 ± 0.2 mm

Filling Volume : Approx. 25 liters

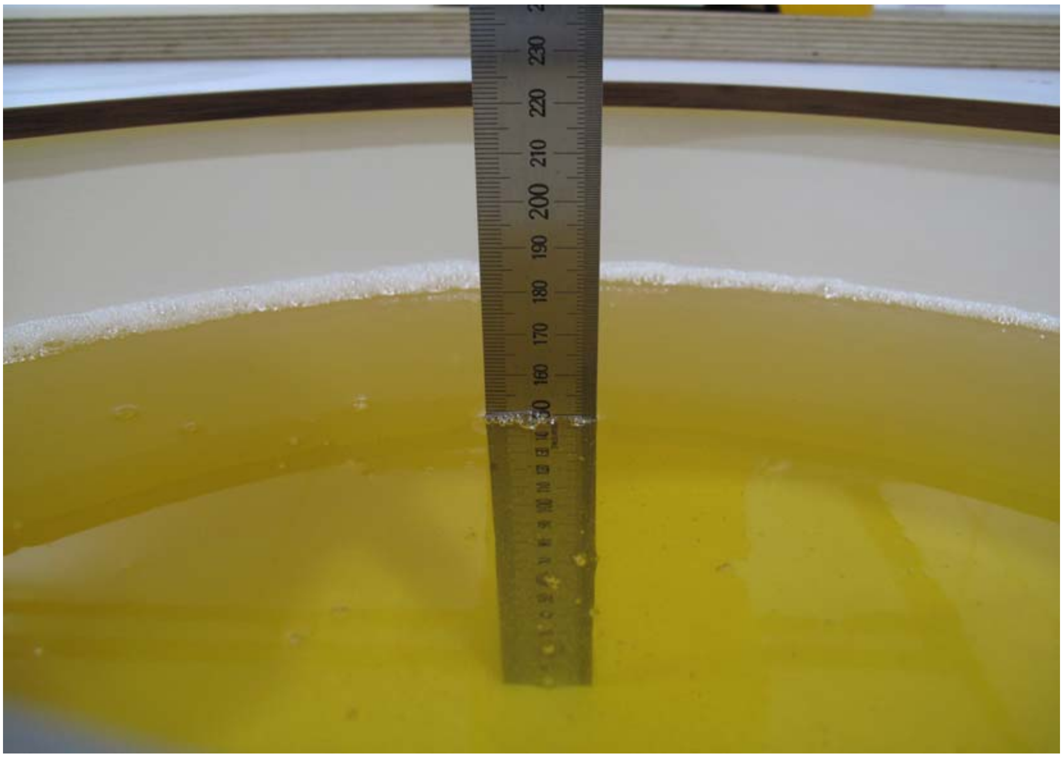
Dimensions : Height; 830 mm; Length: 1000 mm; Width: 500 mm

5.4 Simulating Mixture Characterization

The dielectric properties of the liquid material used in the phantom shall be those listed in Table 5.1. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table.

Table 5.1 Composition of the Head Tissue Equivalent Matter

INGREDIENTS	SIMULATING TISSUE
	2450 MHz Head
De-ionised water	56.23 %
Oxyethylated Sorbitan Mono Laurate	43.67 %
Ethyldihydro	0.1 %
Sum	100 %



2 GHz (Head) Tissue Simulating Liquid, Depth: 150 mm

5.5 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.6) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening.

The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the Complex anatomical and geometrical structure of the hand that may produce infinite number of configurations .
To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure 5.6 Device Holder

6. SAR MEASUREMENT PROCEDURE

EUT at the maximum power level is placed by a non metallic device holder in the above described positions at a shell phantom of a human being.

The distribution of the electric field strength *E* is measured in the tissue simulating liquid within the shell phantom. For this miniaturized field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density *p* of the tissue in the SEMCAD software.

The software is able to determine the averaged SAR values (averaging region 1g or 10g) for compliance testing. The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the sharp of a cube. The measurement times takes about 20 minutes.

The following steps are used for each test position:

STEP 1

Establish a call with the maximum output power with a base station simulator.

The connection between the mobile phone and the base station simulator is established via air interface.

STEP 2

Measurement of the local E-Field value at a fixed location (P1).

This value serves as a reference value for calculating a possible power drift.

STEP 3

Measurement of the SAR distribution with a grid spacing of 15mm × 15mm and a constant distance to the inner surface of the phantom.

Since the sensors can not directly measure at 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 this values the area of the maximum SAR is calculated by a interpolation scheme (combination of a least-square fitted function and a weighted average method). Additional peaks within 3dB of the maximum SAR are searched.

STEP 4

Around this points, a cube of 30mm×30mm×30mm is assessed by measuring 5×5×5 points.

With these data, the peak spatial-average SAR value can be calculated with the SEMCAD software.

STEP 5

The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard's method [DASY4].

STEP 6

Repetition of the E-Field measurement at the fixed location(P1) and repetition of the whole procedure if the two results differ by more than ±0.223dB.

7. LIMITS FOR SPECIFIC ABSORPTION RATE (SAR)

HUMAN EXPOSURE	SAR (W/kg)	
	General Population / Uncontrolled Exposure Environment	Occupational / Controlled Exposure Environment
Spatial Peak SAR (Brain)	1.6	8.0
Spatial Average SAR (Whole Body)	0.08	0.4
Spatial Peak SAR (Hands, Wrists, Feet and Ankles)	4.0	20.0

1. This limits accord to SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6
2. The Spatial Peak value of the SAR averaged over any 1g of tissue 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 10g of tissue and over the appropriate averaging time.

8. MEASUREMENT UNCERTAINTY

2.4 GHz Band

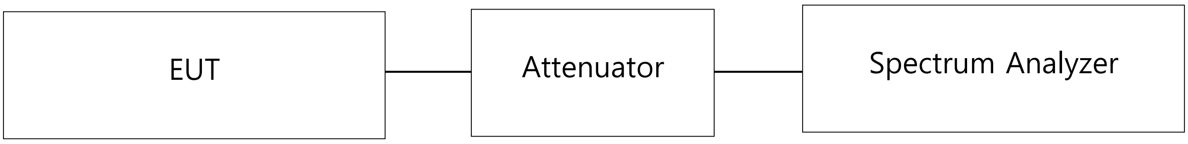
Uncertainty Component	Tolerance (±%)	Prob. Dist.	Divisor	(Ci) (1g)	Standard Uncertainty (±%) (1g)	(Vi)
Measurement System						
Probe Calibration	6.00	Normal	1	1	6.00	∞
Axial Isotropy	4.70	Rectangular	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	Rectangular	1.73	0.7	3.88	∞
Boundary Effects	1.00	Rectangular	1.73	1	0.58	∞
Linearity	4.70	Rectangular	1.73	1	2.72	∞
System Detection Limits	1.00	Rectangular	1.73	1	0.58	∞
Readout Electronics	1.00	Normal	1	1	1.00	∞
Response Time	0.80	Rectangular	1.73	1	0.46	∞
Integration Time	2.60	Rectangular	1.73	1	1.50	∞
RF Ambient Conditions	3.00	Rectangular	1.73	1	1.73	∞
Probe Positioner	0.40	Rectangular	1.73	1	0.23	∞
Probe Positioning	2.90	Rectangular	1.73	1	1.68	∞
Max. SAR Eval.	1.00	Rectangular	1.73	1	0.58	∞
Test Sample Related						
Device Positioning	5.66	Normal	1	1	5.66	11
Device Holder	4.94	Normal	1	1	4.94	5
Power Drift	5.00	Rectangular	1.73	1	2.90	∞
Phantom and Setup						
Phantom Uncertainty	4.00	Rectangular	1.73	1	2.31	∞
Medium Conductivity Temperature	5.00	Rectangular	1	0.78	3.90	∞
Liquid Conductivity(Meas.)	3.00	Normal	1	0.64	1.92	5
Medium Permittivity Temperature	5.00	Rectangular	1	0.23	1.20	∞
Liquid Permittivity(meas.)	2.96	Normal	1	0.60	1.78	5
Combined Std. Uncertainty		RSS			**12.80**	59
Expanded STD Uncertainty		*k* = 2			**25.70**	

The above measurement uncertainties are according to IEEE 62209-1528.

9. OUTPUT POWER MEASUREMENT

9.1 Measurement procedure for Output Power

EUTs average output power was measured at low, middle, high channels with a Spectrum Analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.



Power measurement Test Setup

9.2 Conducted RF Output Power (Unit: dBm)

Mode	Measured Frequency (MHz)	Measured Output Power (dBm)
GFSK	2402	11.54
	2441	10.93
	2480	10.62
4QDPSK	2402	6.69
	2441	6.05
	2480	6.30
8DPSK	2402	6.67
	2441	5.93
	2480	6.31
LE 1M	2402	11.46
	2440	11.31
	2480	11.35
LE 2M	2402	11.24
	2440	11.30
	2480	11.27

10. SYSTEM VERIFICATION

10.1 Tissue Verification

For the measurement of the following parameters the DAK-3.5 was used, representing the open-ended slim form probe measurement procedure. The measured values should be within ±5% of the recommended values given by IEEE 1528-2013.

Table 12.1 Measured Tissue Parameters

Date	Liquid Type	Liquid Temp. (℃)	Freq (MHz)	Measured relative Permittivity (ε)	Measured Conductivity (S/m)	Target relative Permittivity (ε)	Target Conductivity (S/m)	Permittivity Error (%)	Conductivity Error (%)
Jan 02.2022	2G /Head	20.80	2402	38.970	1.722	39.285	1.757	-0.800	-1.990
			2441	38.190	1.761	39.216	1.792	-2.620	-1.730
			2480	37.600	1.860	39.162	1.833	-3.990	1.470
Jan 03.2022	2G /Head	20.70	2402	38.670	1.747	39.285	1.757	-1.570	-0.570
			2441	38.500	1.755	39.216	1.792	-1.830	-2.060
			2480	37.870	1.860	39.162	1.833	-3.300	1.470
Jan 04.2022	2G /Head	20.80	2402	37.590	1.713	39.285	1.757	-4.310	-2.500
			2441	37.590	1.829	39.216	1.792	-4.150	2.060
			2480	37.990	1.844	39.162	1.833	-2.990	0.060
Jan 05.2022	2G /Head	20.20	2402	37.800	1.682	39.285	1.757	-3.780	-4.270
			2441	38.120	1.837	39.216	1.792	-2.790	2.510
			2480	38.470	1.793	39.162	1.833	-1.770	-2.180
Jan 06.2022	2G /Head	20.40	2402	37.890	1.690	39.285	1.757	-3.550	-3.810
			2441	37.700	1.781	39.216	1.792	-3.870	-0.610
			2480	37.740	1.784	39.162	1.833	-3.630	-2.670

10.2 Test System Verification

A complete 1 g and/or 10 g averaged SAR measurement is performed using a standard source. The input power of the standard source is adjusted to produce a 1 g and/or 10 g averaged SAR value falling in the range of 0.4 W/kg to 10 W/kg. The 1 g and/or 10 g averaged SAR is measured at frequencies in Table 12.2 within the range to be used in compliance tests. The results are normalized to 1 W forward input power and compared with the reference SAR value.
Refer to Appendix B for each plot.

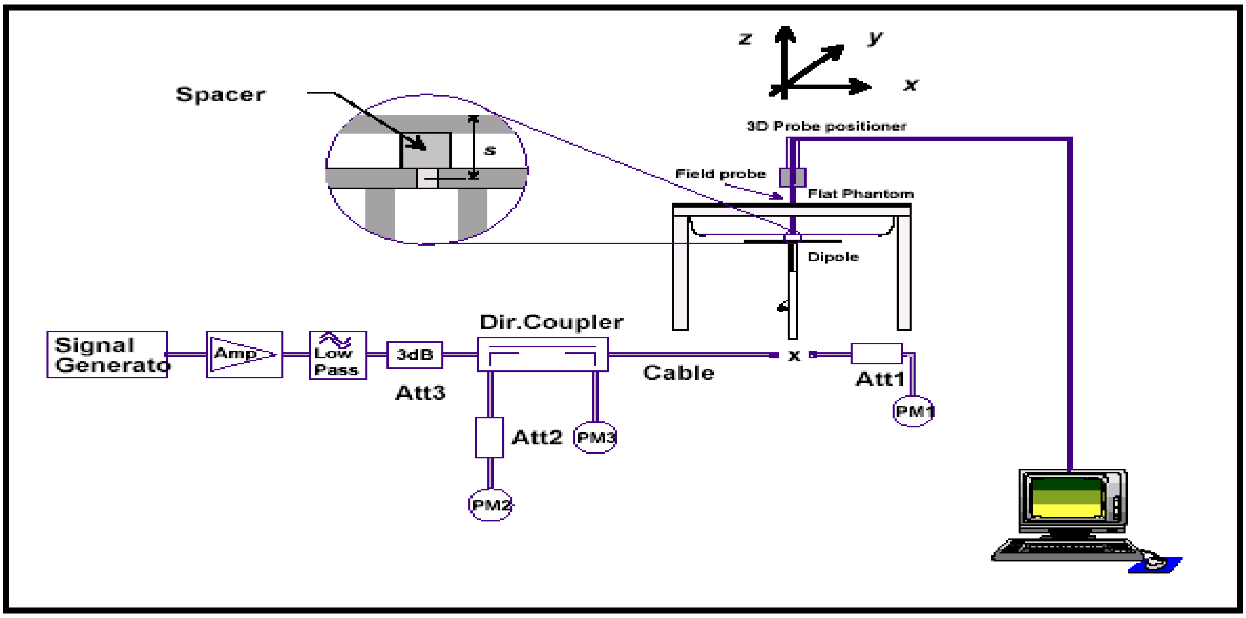
Table 12.2 System Verification Results

Date	Liquid Temperature (°C)	Measured Frequency (MHz)	Targeted 1 g SAR (W/kg)	Measured 1 g SAR (W/kg)	Normalized 1 g SAR (W/kg)	Deviation (%)	Verification Kit	Plot No.
Jan 02.2022	20.80	2450	51.80	12.90	51.60	-0.39	D2450V2 SN: 774	#V01
Jan 03.2022	20.70	2450	51.80	12.60	50.40	-2.70	D2450V2 SN: 774	#V02
Jan 04.2022	20.80	2450	51.80	12.70	50.80	-1.93	D2450V2 SN: 774	#V03
Jan 05.2022	20.20	2450	51.80	13.10	52.40	1.16	D2450V2 SN: 774	#V04
Jan 06.2022	20.40	2450	51.80	12.50	50.00	-3.47	D2450V2 SN: 774	#V05

10.3 System Verification Test Setup

The system verification is verified to the ±10% of the specifications at each frequency band by using the system validation kit.

1. Perform internal calibration of each equipment.
2. Cabling the system, using the verification kit equipment.
3. The input level is set to be about 250 mW from the signal generator to the dipole antenna.
4. Dipole antenna was located below the phantom.
5. System verification was performed and 1g / 10g SAR was measured.
6. The results were normalized to 1 W input power.
7. Check if the 1 W normalized value was within ±10% of the target value.



11. SAR MEASUREMENT RESULTS

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   Scaling Factor = Maximum Tune-up limit power (mW) / EUT RF Power (mW),
   Where tune-up limit is the maximum rated power among all production units.
   Reported SAR (W/kg) = Scaling Factor * Duty Factor * Measured SAR (W/kg)

2. Tune-up limit power is refer to page 8.

Measured Frequency		Mode	Test distance	Average Power (mW)	Maximum Tune-Up Limit pwr (mW)	Scaling Factor	EUT Configuration	Measured SAR 1g (W/kg)	Duty Factor	Reported SAR 1g (W/kg)	Plot No.
MHz	CH										
2441	39	GFSK	0 mm	12.39	17.78	1.44	Front	0.021	2.159	0.065	
							Back	0.277		0.858	#S01
							Left	0.057		0.177	
							Right	0.097		0.301	
							Top	0.041		0.127	
							Bottom	0.023		0.071	
2402	0			14.26		1.25	Back	0.445		**1.198**	#S02
2480	78			11.53		1.54	Back	0.218		0.726	#S03
2440	19	LE1M	0 mm	13.52	17.78	1.32	Front	0.021	1.658	0.046	
							Back	0.357		0.778	#S04
							Left	0.086		0.188	
							Right	0.101		0.220	
							Top	0.051		0.111	
							Bottom	0.030		0.065	
2402	0			14.00		1.27	Back	0.567		**1.194**	#S05
2480	39			13.65		1.30	Back	0.273		0.590	#S06

12. TEST EQUIPMENTS

Description	Model	Serial No.	Data of next Calibration
Shield Room	NKRFS1	20020415	N/A
Staubli Robot Unit	RX60L	F05/51E1A1/A/01	N/A
Electro-Optical Converter	EOC3	398	N/A
SAM Twin Phantom V4.0C	TP-1358	SM 000 T02 DA	N/A
Device Holder	DH2005	SD HAC H01CA	N/A
Dielectric Probe Kit	85070E	MY44300121	N/A
Data Acquisition Electronics	DAE4	672	2022.09.27
E-Field Probe	EX3DV4	3947	2022.07.29
Validation Dipole Antenna	D2450V2	774	2022.04.20
Digital thermometer	DTM3000	3187	2022.10.18
Power Amplifier	5800842	-	2022.01.11
Network Analyzer	8753E	JP38161044	2022.10.13
Dual Directional Coupler	11692D	1212A02175	2022.07.12
Spectrum Analyzer	N9020A	MY51110087	2022.07.12
Power Meter	NRVS	835360/002	2022.01.12
Power Sensor	NRV-Z5	833722/006	2022.01.12
Power Meter	437B	2912U01687	2022.10.14
Power Sensor	8481A	MY41098315	2022.10.14
Power Meter	ML2437A	97310060	2022.07.23
Power Sensor	MA2474A	181289	2022.07.23
Signal Generator	SMB100A	175861	2022.07.13
Vector Signal Generator	SMBV100A	257152	2022.10.14
Dielectric Field probe	DAK 3.5	1128	2022.08.25
Power Divider	11636B	09331	2022.10.13
10 dB Attenuator	8491B	57773	2022.10.14
10 dB Attenuator	SA26B-10	1643	2022.07.12

13. CONCLUSION

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada,, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. The results and statements relate only to the item(s) tested.

APPENDIX A. PLOTS OF SAR RESULTS

#S01

Date/Time: 2022-01-02 PM 9:01:42

Test Laboratory: Nemko Korea   File Name: GFSK Back gap 0mm position_2441_8D96.da4

DUT: SM-R180   Type: Bluetooth Headset   Serial: N/A   Applicant: Samsung Electronics

Communication System: Bluetooth   Frequency: 2441 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2441 MHz; σ = 1.76 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.725 mW/g

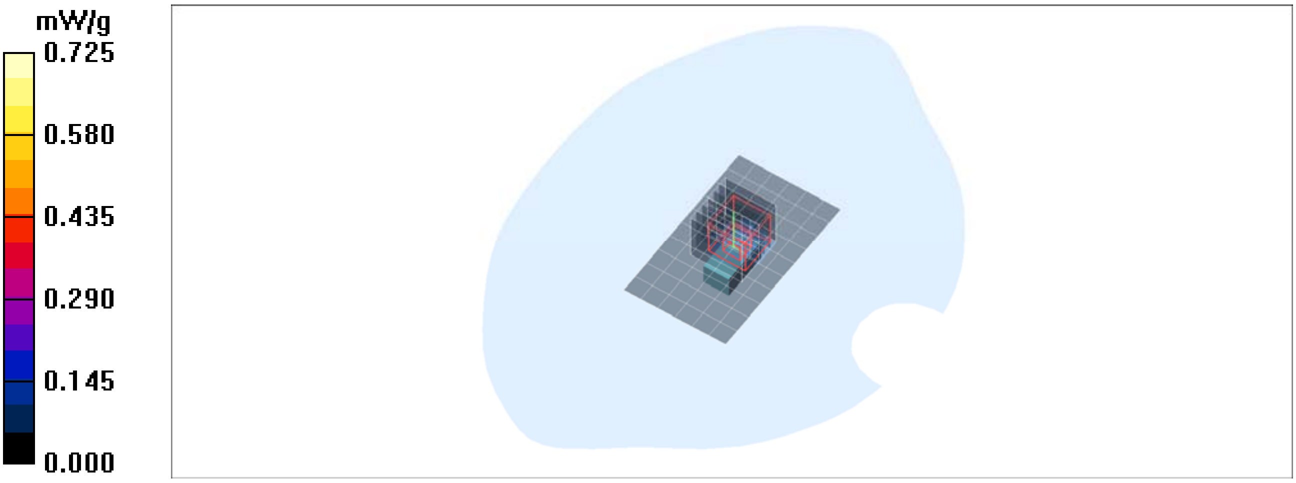
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.0 V/m; Power Drift = 0.069 dB

Peak SAR (extrapolated) = 2.00 W/kg

SAR(1 g) = 0.277 mW/g

Maximum value of SAR (measured) = 0.800 mW/g



Date/Time: 2022-01-02 PM 8:37:58

Test Laboratory: Nemko Korea   File Name: GFSK Back gap 0mm position_2402_8D96.da4

DUT: SM-R180   Type: Bluetooth Headset   Serial: N/A   Applicant: Samsung Electronics

Communication System: Bluetooth   Frequency: 2402 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2402 MHz; σ = 1.72 mho/m; ε_r = 39; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.11 mW/g

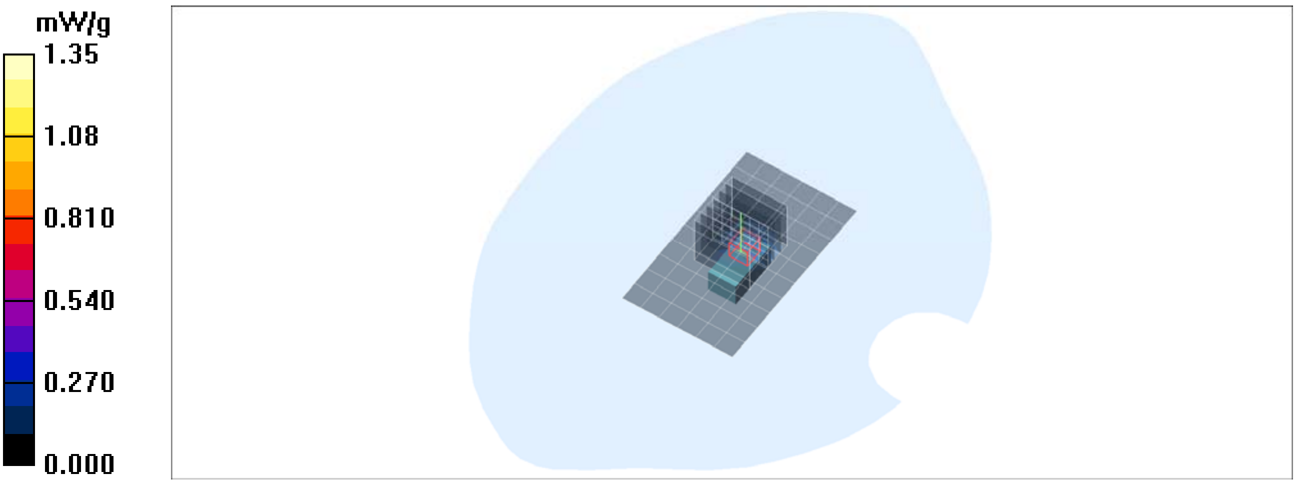
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.5 V/m; Power Drift = 0.047 dB

Peak SAR (extrapolated) = 3.33 W/kg

SAR(1 g) = 0.445 mW/g

Maximum value of SAR (measured) = 1.35 mW/g



Date/Time: 2022-01-03 PM 3:54:07

Test Laboratory: Nemko Korea   File Name: GFSK Back gap 0mm position_2480_8D96.da4

DUT: SM-R180   Type: Bluetooth Headset   Serial: N/A   Applicant: Samsung Electronics

Communication System: Bluetooth   Frequency: 2480 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2480 MHz; σ = 1.86 mho/m; ε_r = 37.9; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.728 mW/g

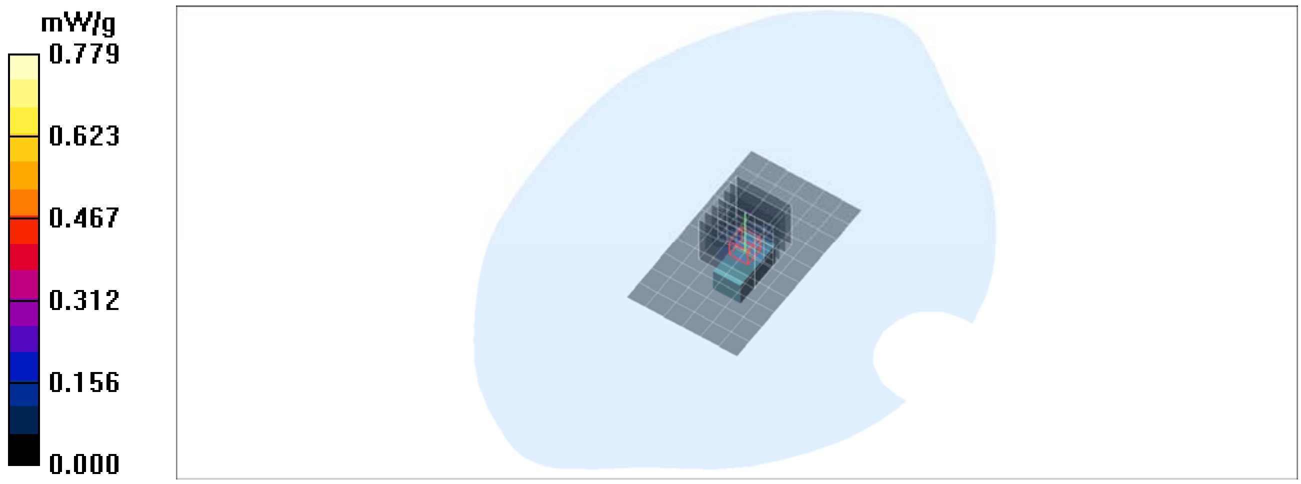
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.6 V/m; Power Drift = -0.079 dB

Peak SAR (extrapolated) = 1.79 W/kg

SAR(1 g) = 0.218 mW/g

Maximum value of SAR (measured) = 0.779 mW/g



Date/Time: 2022-01-02 PM 2:45:58

Test Laboratory: Nemko Korea File Name: BLE1M Back gap 0mm position_2440_8D96.da4

DUT: SM-R180 Type: Bluetooth Headset Serial: N/A Applicant: Samsung Electronics

Communication System: Bluetooth Frequency: 2440 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2440 MHz; σ = 1.76 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.17 mW/g

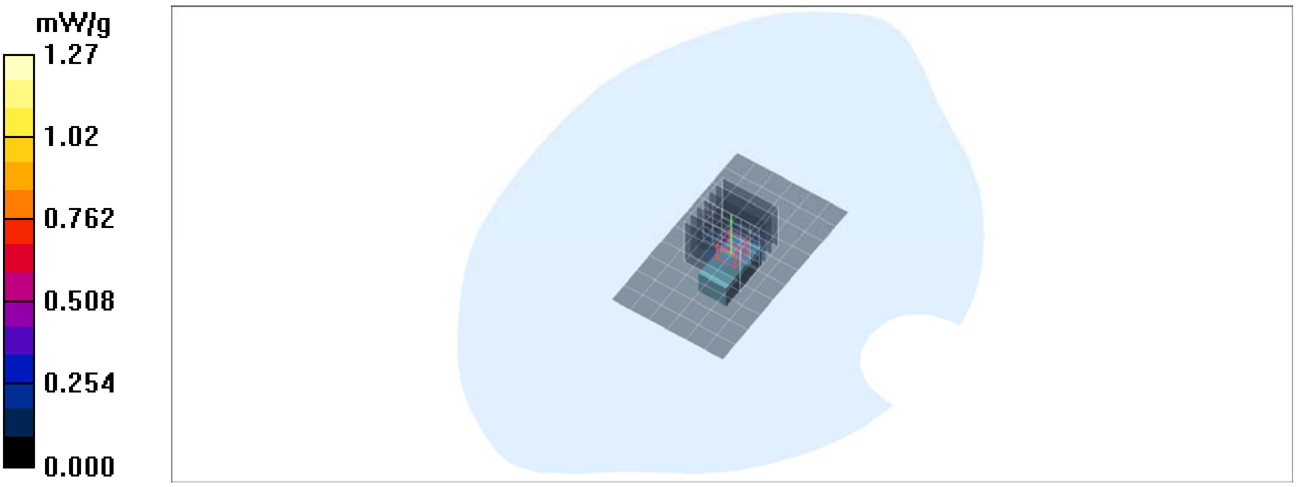
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.0 V/m; Power Drift = 0.066 dB

Peak SAR (extrapolated) = 2.70 W/kg

SAR(1 g) = 0.357 mW/g

Maximum value of SAR (measured) = 1.27 mW/g



Date/Time: 2022-01-02 PM 7:44:58

Test Laboratory: Nemko Korea File Name: BLE1M Back gap 0mm position_2402_8D96.da4

DUT: SM-R180 Type: Bluetooth Headset Serial: N/A Applicant: Samsung Electronics

Communication System: Bluetooth Frequency: 2402 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2402 MHz; σ = 1.72 mho/m; ε_r = 39; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.81 mW/g

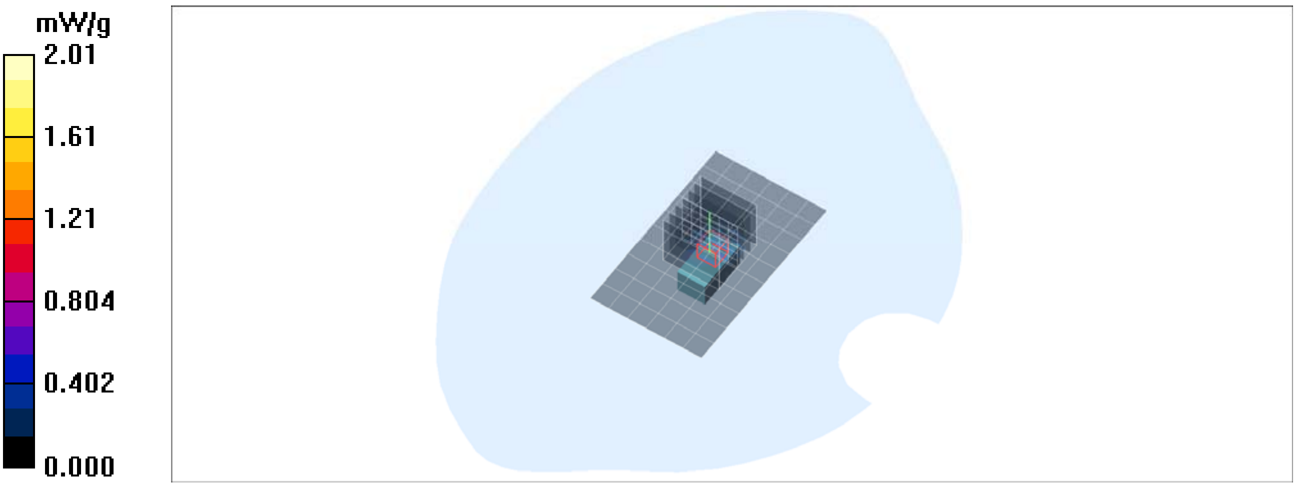
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 33.5 V/m; Power Drift = 0.021 dB

Peak SAR (extrapolated) = 4.52 W/kg

SAR(1 g) = 0.567 mW/g

Maximum value of SAR (measured) = 2.01 mW/g



Date/Time: 2022-01-02 PM 8:09:23

Test Laboratory: Nemko Korea   File Name: BLE1M Back gap 0mm position_2480_8D96.da4

DUT: SM-R180   Type: Bluetooth Headset   Serial: N/A   Applicant: Samsung Electronics

Communication System: Bluetooth   Frequency: 2480 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2480 MHz; σ = 1.86 mho/m; ε_r = 37.6; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SM-R180 Left_Back side Gap 0mm Position/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.792 mW/g

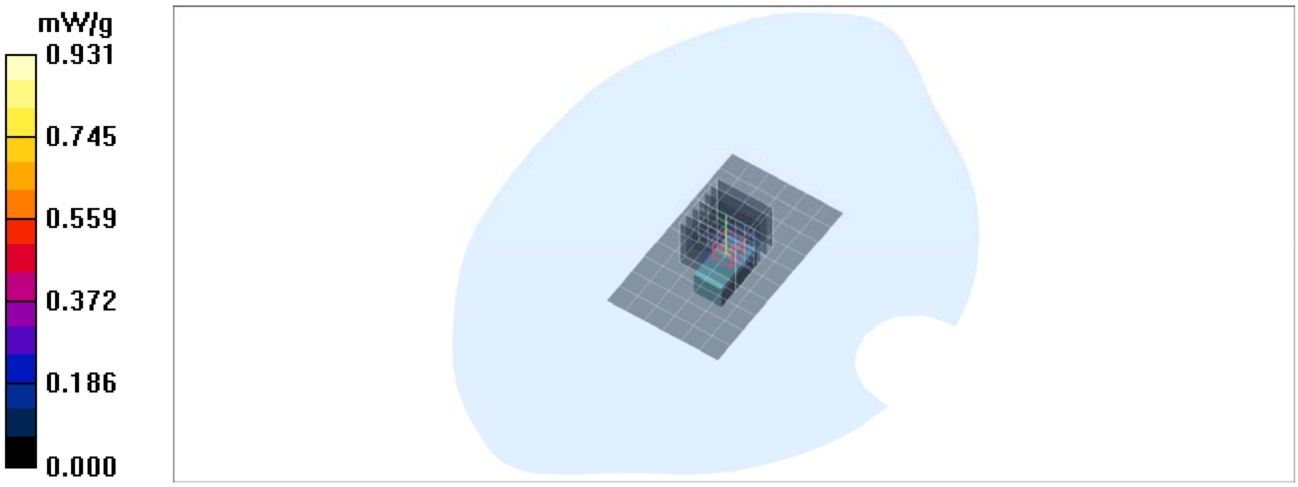
SM-R180 Left_Back side Gap 0mm Position/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.8 V/m; Power Drift = 0.057 dB

Peak SAR (extrapolated) = 2.05 W/kg

SAR(1 g) = 0.273 mW/g

Maximum value of SAR (measured) = 0.931 mW/g



APPENDIX B. PLOTS OF SYSTEM Verification

#V01

Date/Time: 2022-01-02 PM 12:46:39

Test Laboratory: Nemko Korea File Name: System Verification for 2.45GHz_2022-01-02.da4

DUT: Dipole 2450 MHz Type: D2450V2 Serial: D2450V2 - SN:774

Communication System: CW (2.4G) Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2450 MHz; σ = 1.77 mho/m; ε_r = 38; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2.4GHz System Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 16.0 mW/g

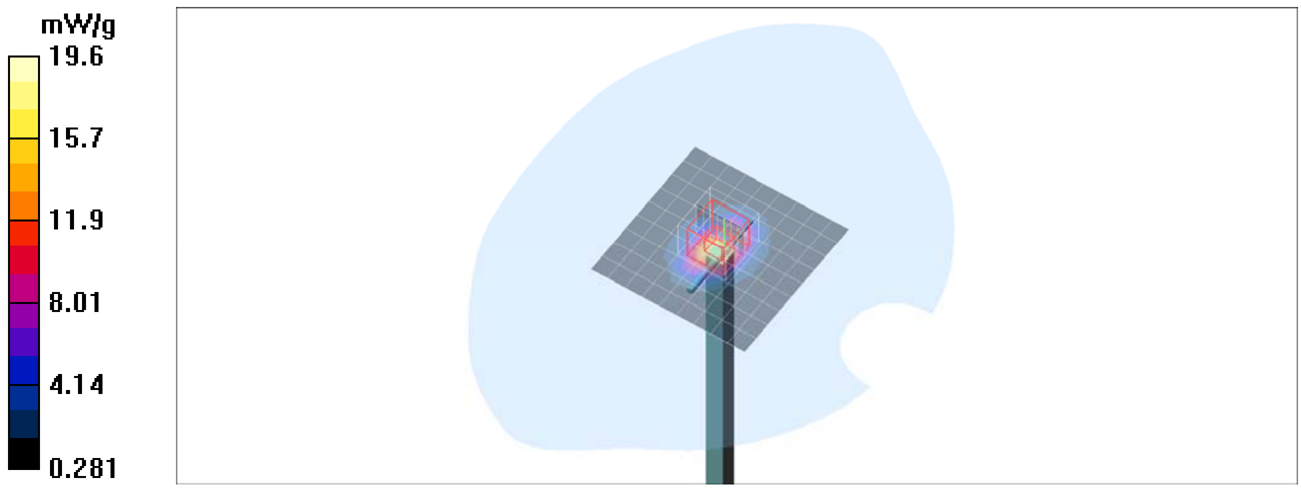
2.4GHz System Verification/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 107.1 V/m; Power Drift = 0.007 dB

Peak SAR (extrapolated) = 26.3 W/kg

SAR(1 g) = 12.9 mW/g; SAR(10 g) = 5.98 mW/g

Maximum value of SAR (measured) = 19.6 mW/g



Date/Time: 2022-01-03 AM 11:50:22

Test Laboratory: Nemko Korea   File Name: System Verification for 2.45GHz_2022-01-03.da4

DUT: Dipole 2450 MHz   Type: D2450V2   Serial: D2450V2 - SN:774

Communication System: CW (2.4G)   Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2450 MHz; σ = 1.77 mho/m; ε_r = 38.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2.4GHz System Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 17.0 mW/g

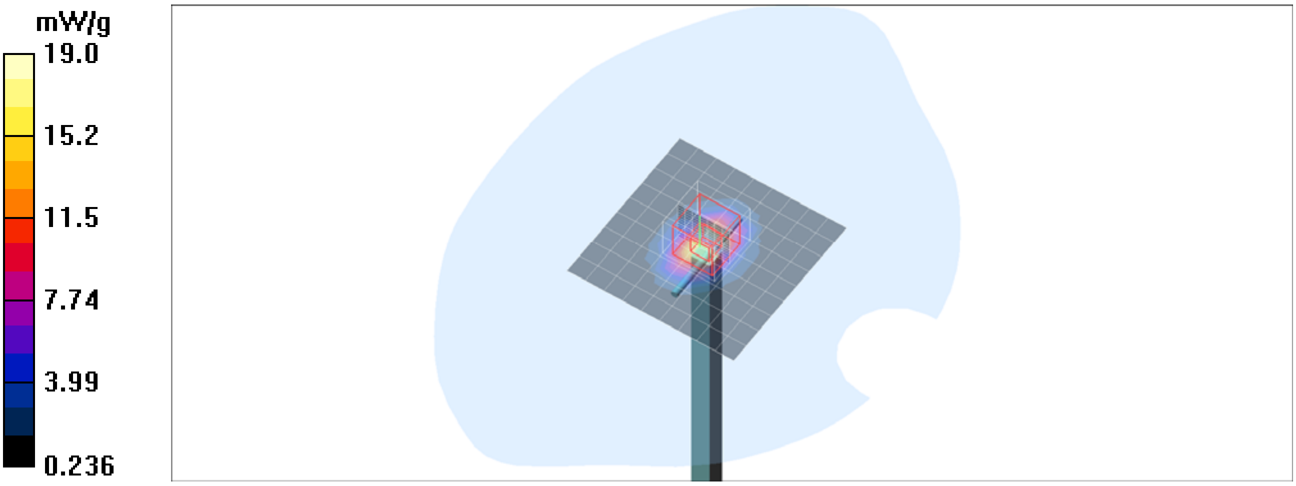
2.4GHz System Verification/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 107.1 V/m; Power Drift = 0.007 dB

Peak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.75 mW/g

Maximum value of SAR (measured) = 19.0 mW/g



#V03

Date/Time: 2022-01-04 PM 3:35:49

Test Laboratory: Nemko Korea   File Name: System Verification for 2.45GHz_2022-01-04.da4

DUT: Dipole 2450 MHz   Type: D2450V2   Serial: D2450V2 - SN:774

Communication System: CW (2.4G)   Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2450 MHz; σ = 1.84 mho/m; ε_r = 37.7; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2.4GHz System Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 16.3 mW/g

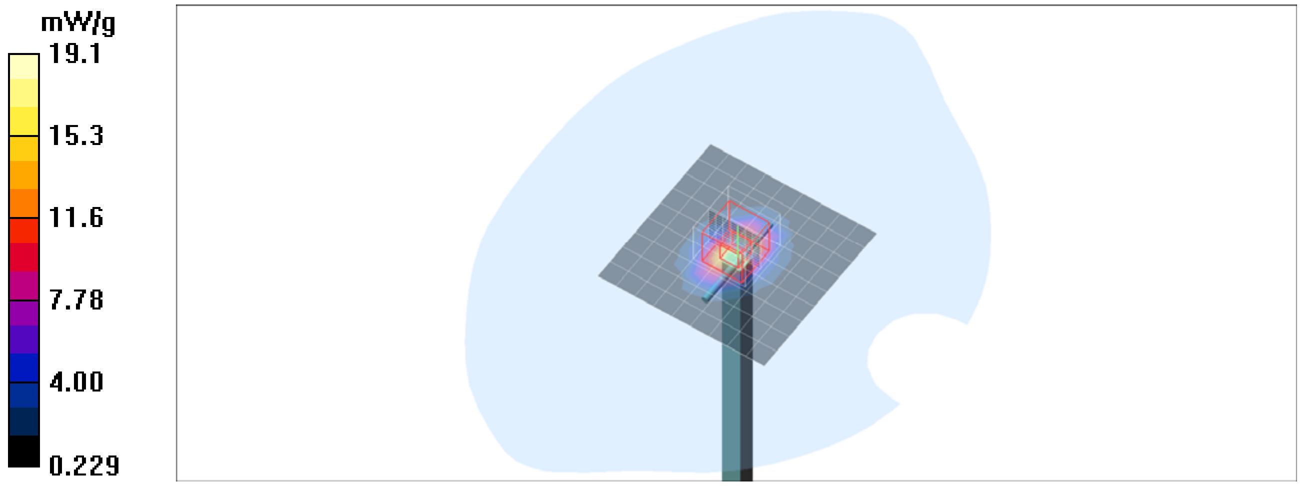
2.4GHz System Verification/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 105.4 V/m; Power Drift = 0.033 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.83 mW/g

Maximum value of SAR (measured) = 19.1 mW/g



Date/Time: 2022-01-05 PM 1:51:37

Test Laboratory: Nemko Korea   File Name: System Verification for 2.45GHz_2022-01-05.da4

DUT: Dipole 2450 MHz   Type: D2450V2   Serial: D2450V2 - SN:774

Communication System: CW (2.4G)   Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2450 MHz; σ = 1.85 mho/m; ε_r = 38.3; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2.4GHz System Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 17.8 mW/g

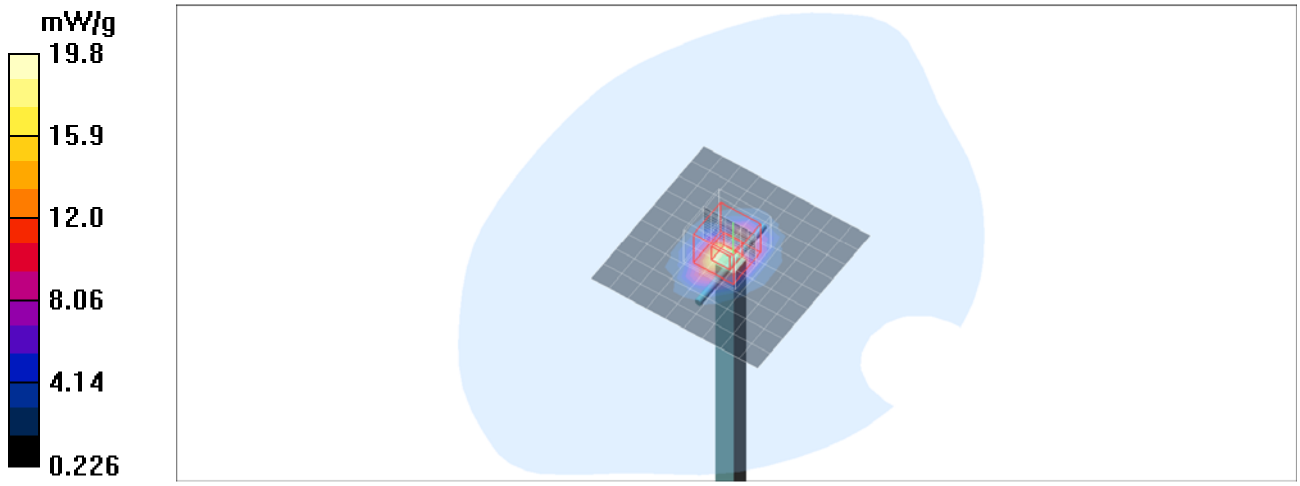
2.4GHz System Verification/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 105.5 V/m; Power Drift = 0.089 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 13.1 mW/g; SAR(10 g) = 5.91 mW/g

Maximum value of SAR (measured) = 19.8 mW/g



Date/Time: 2022-01-06 AM 11:03:26

Test Laboratory: Nemko Korea   File Name: System Verification for 2.45GHz_2022-01-06.da4

DUT: Dipole 2450 MHz   Type: D2450V2   Serial: D2450V2 - SN:774

Communication System: CW (2.4G)   Frequency: 2450 MHz

Duty Cycle: 1:1 Phantom section: Flat Section

Medium parameters used: f = 2450 MHz; σ = 1.8 mho/m; ε_r = 37.7; ρ = 1000 kg/m^3

DASY4 Configuration:

Probe: EX3DV4 - SN3947; ConvF(7.75, 7.75, 7.75); Calibrated: 2021-07-29

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn672; Calibrated: 2021-09-27

Phantom: SAM Phantom; Type: SAM; Serial: TP-1358

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2.4GHz System Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 17.2 mW/g

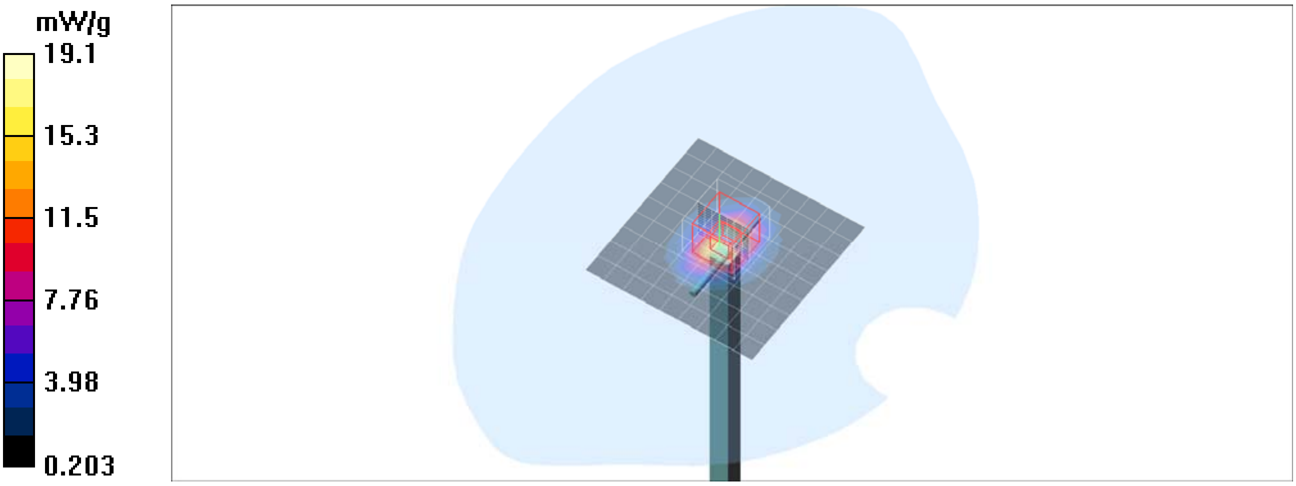
2.4GHz System Verification/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 106.2 V/m; Power Drift = -0.071 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.63 mW/g

Maximum value of SAR (measured) = 19.1 mW/g



APPENDIX C. CALIBRATION REPORT OF THE PROBE

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Nemko (Dymstec)**

Certificate No: **EX3-3947_Jul21**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3947

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

Calibration date: July 29, 2021

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	23-Dec-20 (No. DAE4-660_Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013_Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 30, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: EX3-3947_Jul21 Page 1 of 10

Calibration Laboratory of
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Engineering AG
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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) 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-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Certificate No: EX3-3947_Jul21 Page 2 of 10

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3947

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.33	0.56	± 10.1 %
DCP (mV)[B]	100.3	106.3	100.5	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	153.3	± 2.5 %	± 4.7 %
		Y	0.0	0.0	1.0		153.8		
		Z	0.0	0.0	1.0		148.0		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4– SN:3947 July 29, 2021

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3947

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	160.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

Certificate No: EX3-3947_Jul21 Page 4 of 10

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3947

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
2450	39.2	1.80	7.75	7.75	7.75	0.38	0.90	± 12.0 %
5200	36.0	4.66	5.34	5.34	5.34	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.12	5.12	5.12	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.70	4.70	4.70	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.61	4.61	4.61	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.65	4.65	4.65	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4– SN:3947 July 29, 2021

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3947

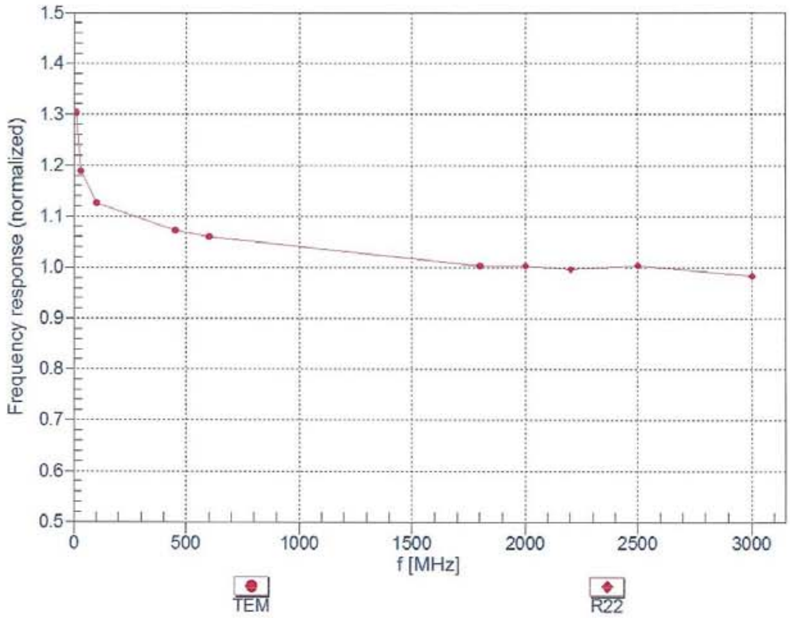
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
2450	52.7	1.95	7.56	7.56	7.56	0.43	0.93	± 12.0 %
5200	49.0	5.30	4.66	4.66	4.66	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.51	4.51	4.51	0.50	1.90	± 13.1 %
5500	48.6	5.65	4.16	4.16	4.16	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.03	4.03	4.03	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.07	4.07	4.07	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Certificate No: EX3-3947_Jul21 Page 6 of 10

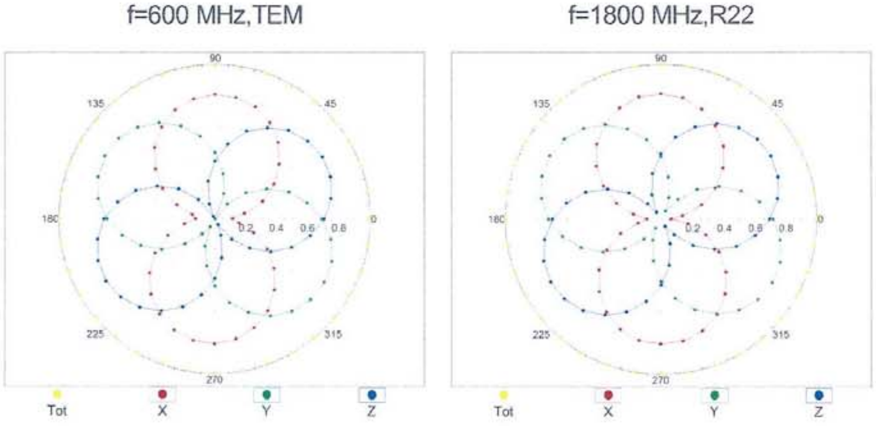
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

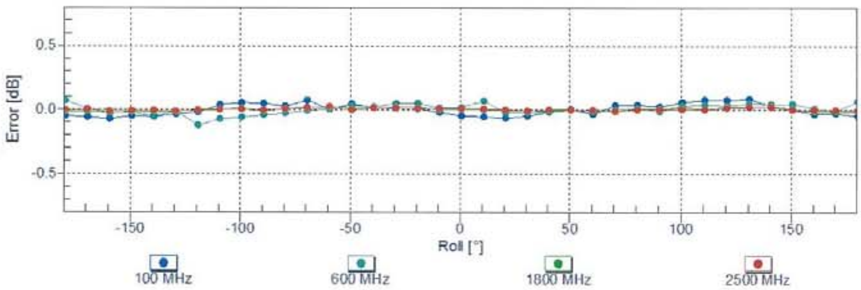


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3947 July 29, 2021

Receiving Pattern (ϕ), ϑ = 0°

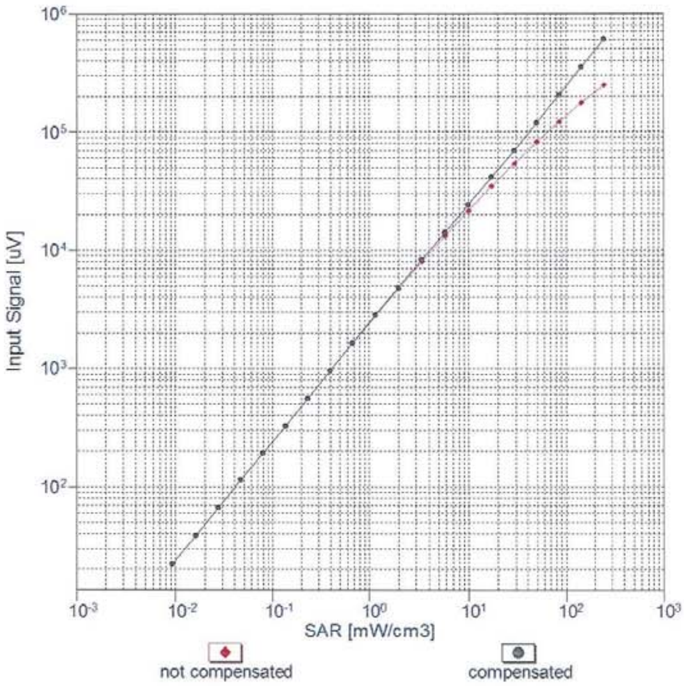


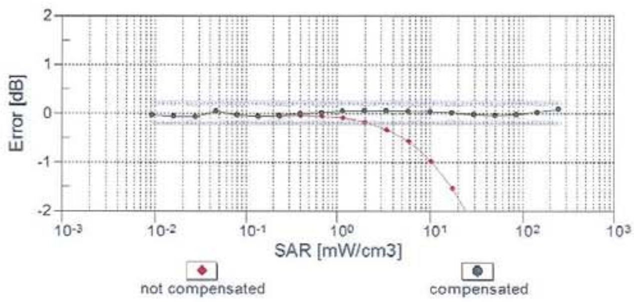


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: EX3-3947_Jul21 Page 8 of 10

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

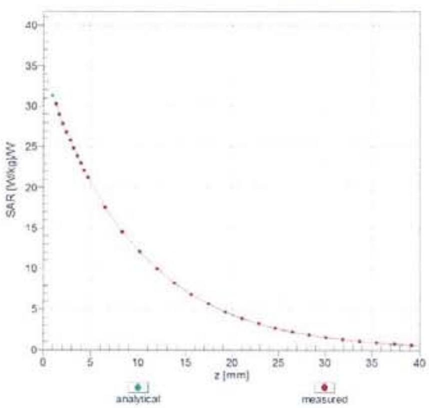


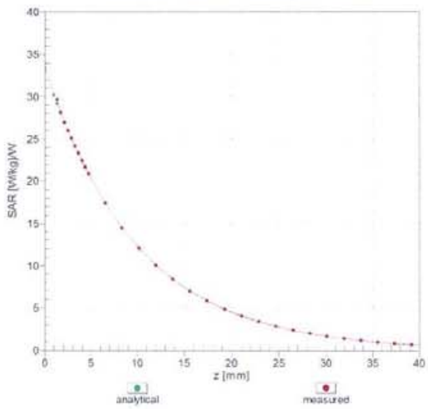


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

EX3DV4– SN:3947 July 29, 2021

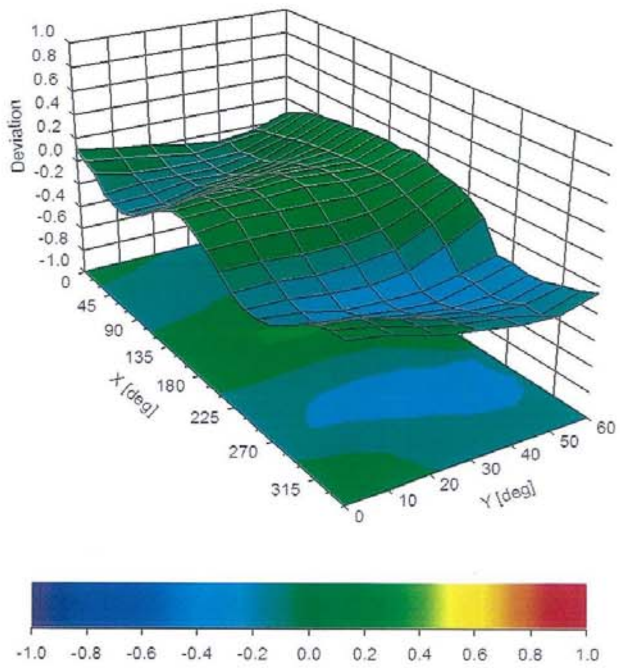
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: EX3-3947_Jul21 Page 10 of 10

APPENDIX D. CALIBRATION REPORT OF THE DIPOLE ANTENNA

Calibration Laboratory of
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Accreditation No.: **SCS 0108**

Client **Nemko (Dymstec)**

Certificate No: **D2450V2-774_Apr20**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:774
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	April 20, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 21, 2020

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Certificate No: D2450V2-774_Apr20 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.4 Ω + 4.8 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.4 Ω + 6.7 jΩ
Return Loss	- 23.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 20.04.2020

Test Laboratory: SPEAG, Zurich, Switzerland

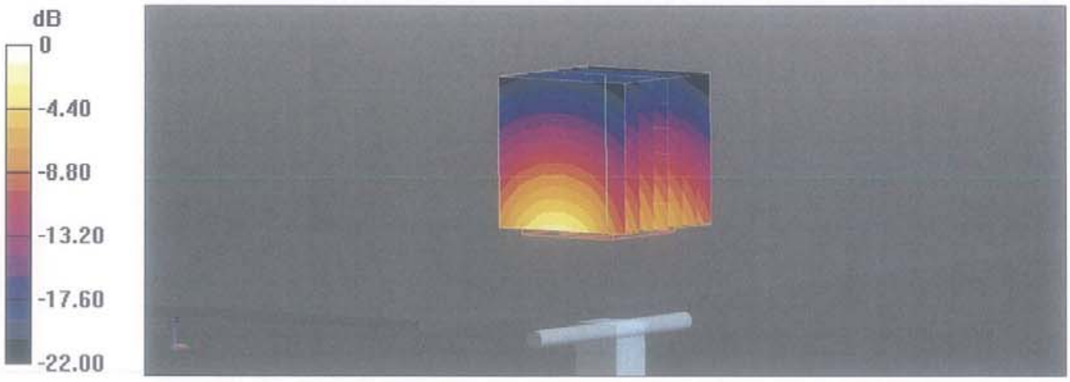
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:774

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

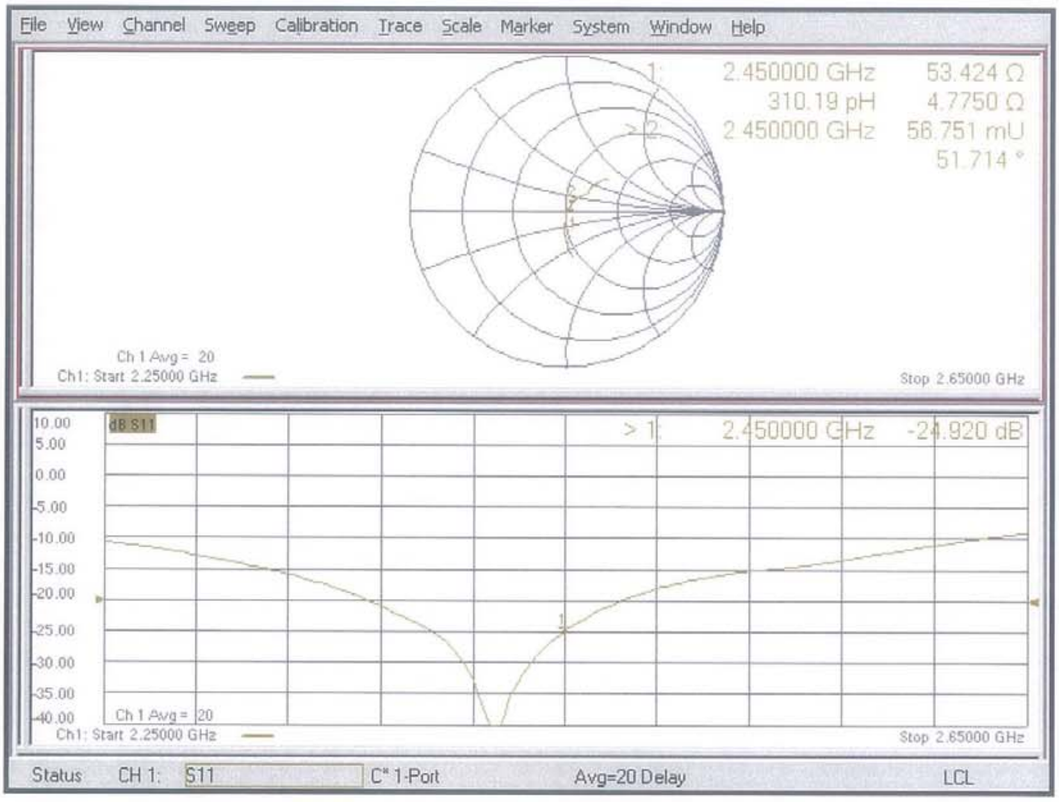
- Probe: EX3DV4 - SN7349; ConvF(7.98, 7.98, 7.98) @ 2450 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.4 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.1 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.7%
Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-774_Apr20 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 20.04.2020

Test Laboratory: SPEAG, Zurich, Switzerland

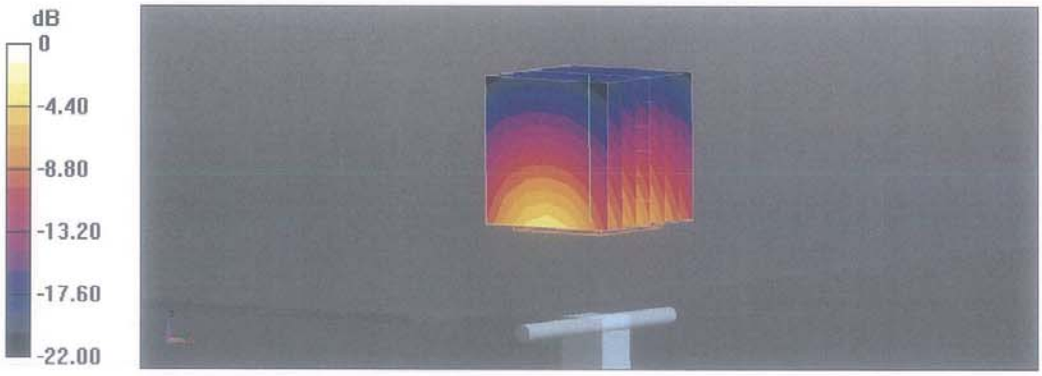
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:774

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.02, 8.02, 8.02) @ 2450 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.9 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 24.8 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6 W/kg
Smallest distance from peaks to all points 3 dB below = 8.9 mm
Ratio of SAR at M2 to SAR at M1 = 53%
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 20.6 W/kg = 13.14 dBW/kg

Impedance Measurement Plot for Body TSL