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C.I.F. A29 507 456

Test report No:

NIE: 69207RAN.002

Test report
IEEE Std 1528™-2013

(*) Identification of item tested	Humanox shin guards Pack HUOX 50
(*) Trademark	Humanox Soccer
(*) Model and /or type reference	HUOX 50 Soccer shin guards (Right)
(*) Other identification of the product	HW version: V2.0 SW Version: V29 FCC ID : 2A292-HUX5R25
(*) Features	Bluetooth LE, GSM
Applicant	Humanox Soccer, S.A. Lugar de la Oropéndola, Calle “D”, 1, (Esquina con Avda. Víctimas del Terrorismo) 11500 El Puerto de Santa María (Cádiz)
Test method requested, standard	1. IEEE Std 1528™-2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. 2. FCC 47 CFR Part 2.1093. (10-1-15 Edition) Radiofrequency radiation exposure evaluation: portable devices.
Summary	Considering the results of the performed test, the item under test is IN COMPLIANCE with FCC 47CFR Part 2.1093 exposure limits. The maximum 10-g Extremity SAR found during this test has been 3.58 W/kg, for GPRS 850 mode.
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager 2021.12.01 10:32:38 +01'00'
Date of issue	2021-12-01
Report template No	FDT08_23 (*) “Data provided by the client”

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies

Uncertainty

Uncertainty (factor k=2) was calculated according to the following documents:

1. DEKRA Testing and Certification S.A.U. internal document PODT000.
2. FCC OET KDB 865664 D01 - SAR Measurement Requirements for 100 MHz to 6 GHz v01r04 (August 2015).

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested", “Other identification of the product”, “Features” and “Test sample description”).
2. Maximum output power and testing distance.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: the client

Sample M/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
69207B/08	Smart shin guard PCB conducted	HUOX 50	20200316_GVC	2021/11/10

Sample M/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
67113/04	Smart shin guard Case	HUOX 50	862549047784742	2021/01/15
67113/34	Smart shin guard PCB radiated	HUOX 50	20200316_GVC	2021/03/30

1. Sample M/01 has undergone the test(s) specified in subclause “Test method requested”: Conducted average output power.
2. Sample M/02 has undergone the test(s) specified in subclause “Test method requested”: SAR evaluation for 2G.

Test sample description

Description of product .... :	Soccer shin guard with IoT technology		
Software version......................... :	V29		
Hardware version .... :	V2.0		
Mounting position .... :	☐	Table top equipment	
	☐	Wall/Ceiling mounted equipment	
	☐	Floor standing equipment	
	☐	Hand-held equipment	
	☒	Other: Extremity (shins)	
Accessories (not part of the test item)... :	Description	Type	Manufacturer
	Charging adapter	---	
Copy of marking plate:			

Identification of the client

Humanox Soccer, S.A.
Lugar de la Oropéndola, Calle “D”, 1, (Esquina con Avda. Víctimas del Terrorismo)
11500 El Puerto de Santa María (Cádiz)

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-08-13
Date (finish)	2021-11-10

Document history

Report number	Date	Description
69207RAN.002	2021-12-01	First release

Environmental conditions

Date	Max. Temp. ºC	Min. Temp. ºC	Max. Hum. %	Min. Hum. %	Limit
From 2021-08-13 to 2021-11-10	24.97	21.14	69.00	45.00	18-25 ºC, 30-70%

Remarks and comments

1: Only plots of the highest reported SAR for each test position and mode/band are included in appendix C.

2: The tests have been performed by the technical personnel: Francisco J. Sánchez.

3: References

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093 and the following FCC Published RF exposure KDB procedures:

- FCC OET KDB 447498 D01 General RF Exposure Guidance v06 (October 2015)
- FCC OET KDB 865664 D01 - SAR Measurement Requirements for 100 MHz to 6 GHz v01r04 (August 2015).
- FCC OET KDB 865664 D02 RF Exposure Reporting v01r02 (October 2015)
- FCC OET KDB 941225 D01 3G SAR Procedures v03r01 (October 2015).

4: The instrumentation utilized to perform the tests covered in this test report is listed in the following table:

Equipment	NC
Dosimetric E-field probe SPEAG EX3DV4	6125
Data acquisition device SPEAG DAE4	3430
Electro-optical converter SPEAG EOC3	3438
Robot Stäubli RX60BL, Robot controller Stäubli CS7MB	3420
Measurement server SPEAG DASY5 SE UMS 011 BS	3847
Oval flat phantom SPEAG ELI 4	3525
SAR measurement software SPEAG DASY52 V52.10.4.1527	3423
SAR postprocessing software SPEAG SEMCAD X	3423
900 MHz dipole validation kit SPEAG D900V2	3426
1800 MHz dipole validation kit SPEAG D1800V2	3427
Body Tissue Equivalent Liquids for 835 MHz band	3632
Body Tissue Equivalent Liquids for 900 MHz band	3632
Body Tissue Equivalent Liquids for 1900 MHz band	3634
Universal Radio Communication Tester R&S CMW 500	3934
Vector network analyzer Agilent FieldFox N9923A	4482
Dielectric probe kit SPEAG DAK-3.5	4171
Power meter Agilent E4419B	4393
RF Generator R&S SMU200	3346
DC Power supply Agilent U8002A	4835
Dual directional coupler HP 778D	1084
Power amplifier MITEQ AMF-4D-00400600-50-30P	3485
6 dB attenuator Weinschel 75 A-6-11	2400
SPEAG Mounting Device for Hand-held devices	3424
Power sensor DC 50 MHz to 18 GHz R&S model NRP-Z81	4164
Digital thermometer LKM Electronics model DTM300-Spezial	4170
Temperature and humidity probe HUMIDIPROBE Pico Technology	3453

Testing verdicts

Not applicable :	N/A
Pass :	P
Fail :	F
Not measured :	N/M

Summary

FCC 47CFR Part 2.1093	VERDICT			
	N/A	P	F	NM
GSM 850		P		
GSM 1900		P		
Bluetooth		P[1]		

1: Technology not subject to testing. Verdict has been determined through RF Exposure assessment (See Appendix B, Section 2.2. Bluetooth of this document for more details).

Appendix A: Test configuration

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1. GENERAL INTRODUCTION

1.1. Application Standard

The Federal Communications Commission (FCC) sets the limits for General Population/Uncontrolled exposure to radio frequency electromagnetic fields for transmitting devices designed to be used within 20 centimetres of the body of the user under FCC 47 CFR Part 1.1310, paragraph (c).

1.2. General requirements

The SAR measurement has been performed continuing the following considerations and environment conditions:

- The ambient temperature shall be in the range of 18ºC to 25ºC and the variation shall not exceed +/- 2ºC during the test.
- The ambient humidity shall be in the range of and 30% - 70%.
- The device battery shall be fully charged before each measurement.

1.3. Measurement system requirements

The measurement system used for SAR tests fullfils the procedural and technical requirements described at the reference standards used.

1.4. Phantom requirements

The phantom model for body measurements is an elliptical open-top container with a flat bottom, with the following shape and dimensions:

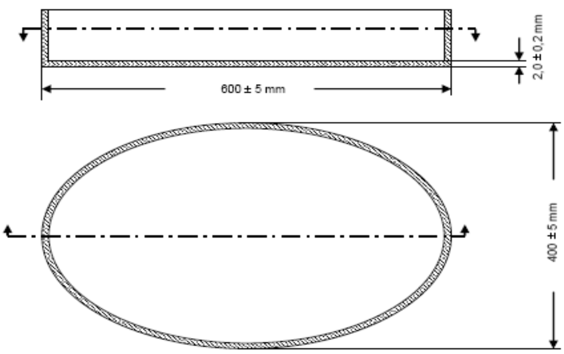


Figure 1: Proportions and shape of Phantom shell

1.5. Measurement Liquids requirements.

The liquids used to simulate the human tissues, must fullfil the requirements of the dielectric properties required. These target dielectric properties per FCC OET KDB 865664 D01 instructions come from the dipole and probe calibration data which are included in Appendix B, Section 3, of this document.

To minimize the effect of reflections on peak spatial-average SAR values, from the upper surface of the tissue-equivalent liquid, the depth of the liquid should be at least 15 cm.

2. MEASUREMENT SYSTEM

2.1. Measurement System

The DASY5 system for performing compliance tests consists of the following items:

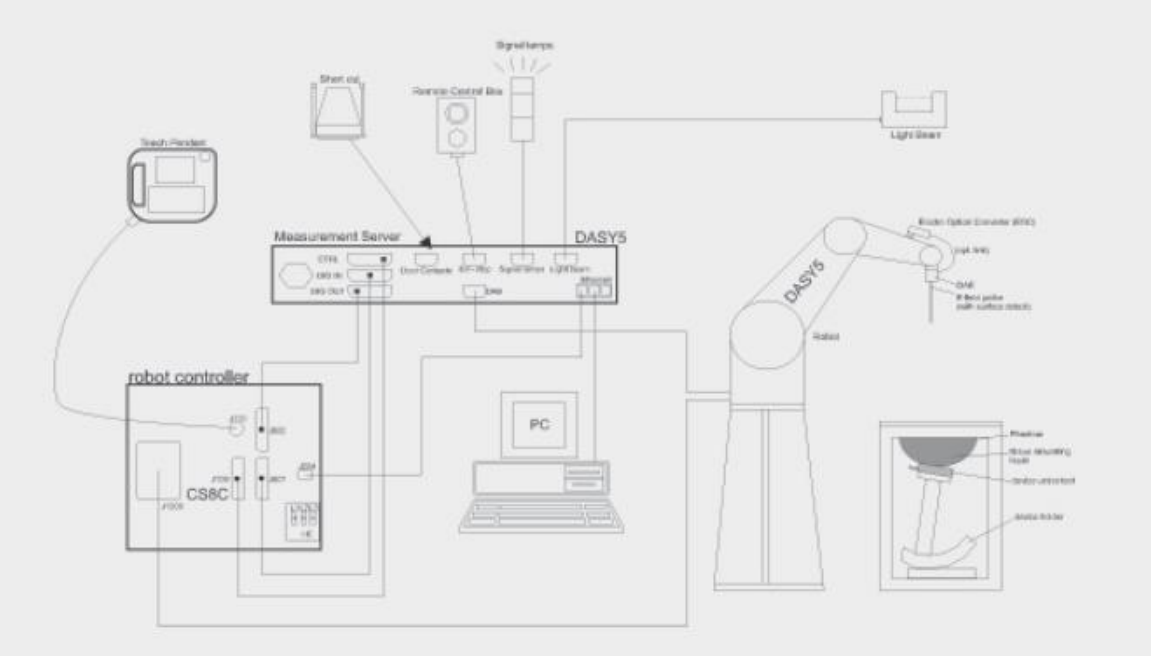


Figure 2: SAR Measurement system

A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).

An isotropic field probe optimized and calibrated for the targeted measurement.

A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.

The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.

The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.

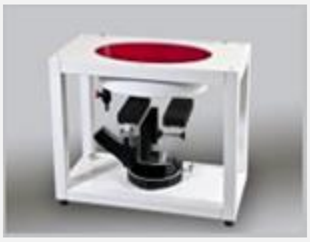
A computer running the DASY5 software.

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

The phantom, the device holder and other accessories according to the targeted measurement.

Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1.0 mm

Model	DAE4
Construction	Signal amplifier, multiplexer, A/D converter, and control logic. Serial optical link communication with DASY4/5 embedded system (fully remote controlled). Two-step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5 µV (with auto zero)
Input Resistance	200 MOhm
Input Blas Current	< 50 fA



Model	ELI
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.
Material	Vinylester, glass fiber reinforced (VE-GF)
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)
Shell Thickness	2 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	Approx. 30 liters
Wooden Support	SPEAG standard phantom table

Model	Mounting Device for Hand-Held Transmitters
Construction	In combination with the Twin SAM V5.0/V5.0c or ELI Phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Material	Polyoxymethylene (POM)

Model	System Validations Kits 450 MHz – 6 GHz		
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feedpoint impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.		
Frequency	450 MHz to 5800 MHz		
Return Loss	20 dB at specified validation position		
Dimensions (length and overall height in mm)	**Product**	**Dipole length**	**Overall height**
	D450V3	290.0	330.0
	D750V3	179.0	330.0
	D900V2	148.5	340.0
	D1800V2	72.5	300.0
	D2000V2	65.0	300.0
	D2300V2	56.3	290.0
	D2450V2	52.0	290.0
	D2600V2	49.2	290.0
	D3300V2	38.0	285.0
	D3500V2	37.0	285.0
	D3700V2	34.7	285.0
	D3900V2	32.0	280.0
	D4200V2	30.1	280.0
	D4600V2	27.0	280.0
	D4900V2	25.0	280.0
	D5GHzV2	20.6	300.0

2.2. Test Positions of device relative to head and body

The device under test is a smart guard shin system that will be used on the user legs.

The device has been tested with its back face touching the flat phantom as it will be used under its normal use conditions.

2.3. Test to be performed

Test shall be performed for at the test position previously described, using the channel producing the highest rated output power. Additionally the other applicable test frequency channels must be measure for the test configuration providing the highest SAR for each applicable transmitting band.

2.4. Description of interpolation/extrapolation scheme

The local SAR inside the Phantom is measured using small dipole sensing elements inside a probe element. The probe tip must not be in contact with the Phantoms surface in order to minimise measurement errors, but the highest local SAR is obtained from measurements at a certain distances from the shell trough extrapolation. The accurate assessment of the maximum SAR averaged over 1 gr and 10 gr. requires a very fine resolution in the three dimensional scanned data array. Since the measurements have to be performed over a limited time, the measured data have to be interpolated to provide an array of sufficient resolution.

The interpolation of 2D area scan is used after the initial area scan, at a fixed distance from the Phantom shell wall. The initial scan data is collected with approx. 15 mm spatial resolution and this interpolation is used to find the location of the local maximum for positioning the subsequent 3D scanning within a 1 mm resolution.

For the 3D scan, data is collected on a spatially regular 3D grid having 5 mm steps in both directions. After the data collection by the SAR probe, the data are extrapolated in the depth direction to assign values to points in the 3D array closer to the shell wall. A notional extrapolation value is also assigned to the first point outside the shell wall so that subsequent interpolation schemes will be applicable right up to the shell wall boundary.

2.5. Determination of the largest peak spatial-average SAR

To determine the maximum value of the peak spatial-average SAR of a DUT, all device positions, configurations and operational modes should be tested for each frequency band.

The averaging volume shall be chosen as 1gr. of contiguous tissue. The cubic volumes, over which the SAR measurements are averaged after extrapolation and interpolation, are chosen in order to include the highest values of local SAR.

The maximum SAR level for the DUT will be the maximum level obtained of the performed measurements, and indicated in the previous points.

2.6. System Validation

Prior to the SAR measurements, system verification is done to verify the system accuracy. A complete SAR evaluation is done using a half-wavelength dipole as source with the frequency of the mid-band channel of the operating band, or within 10% of this channel.

The measured 1 gr. and 10 gr. SAR should be within 10% of the expected target values specified in the calibration certificate of the dipole, for the specific tissue and frequency used.

3. UNCERTAINTY

Uncertainty for 300 MHz – 3 GHz

ERROR SOURCES	Uncertainty value (± %)	Probability distribution	Divisor	(c_i) 1g	(c_i) 10g	Standard uncertainty (1g) (± %)	Standard uncertainty (10g) (± %)
Measurement Equipment							
Probe Calibration	6.650	6.650	N	1	1	1	6.650
Axial Isotropy	3.500	3.500	R	√3	0.7	0.7	1.415
Hemisfericall Isotropy	2.320	2.320	R	√3	0.7	0.7	0.938
Boundary effect	1.000	1.000	R	√3	1	1	0.577
Linearity	4.700	4.700	R	√3	1	1	2.714
System Detection limits	0.250	0.250	R	√3	1	1	0.144
Probe modulation response	4.800	4.800	N	1	1	1	4.800
Readout electronics	0.300	0.300	N	1	1	1	0.300
Response time	1.010	1.010	R	√3	1	1	0.583
Integration time	2.600	2.600	R	√3	1	1	1.501
RF Ambient noise	3.000	3.000	R	√3	1	1	1.732
RF Ambient reflections	3.000	3.000	R	√3	1	1	1.732
Probe positioner mech. restrictions	0.400	0.400	R	√3	1	1	0.231
Probe positioning with respect to phantom shell	2.900	2.900	R	√3	1	1	1.674
Max. SAR Eval.	2.000	2.000	R	√3	1	1	1.155
Test Sample Related							
Device holder uncertainty	2.900	N	1	1	1	2.900	2.900
Test sample positioning	3.600	N	1	1	1	3.600	3.600
Drift of output power	5.000	R	√3	1	1	2.887	2.887
Phantom and Setup							
Phantom uncertainty (shape and thickness tolerances)	6.100	R	√3	1	1	3.522	3.522
Algorithm for correcting SAR for deviations in permittivity and conductivity	1.900	R	√3	1	0.84	1.097	0.921
Liquid conductivity (meas.)	2.454	N	1	0.78	0.71	1.914	1.742
Liquid permittivity (meas.)	2.454	N	1	0.26	0.26	0.638	0.638
Liquid conductivity – temperature uncertainty	5.220	R	√3	0.78	0.71	2.351	2.140
Liquid permittivity – temperature uncertainty	0.840	R	√3	0.23	0.26	0.112	0.126
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{m} c_i^2 \cdot u_i^2}$					**12.00**	**11.92**
Expanded uncertainty (confidence interval of 95%)	*ue =2.00 uc*					**24.00**	**23.84**

Table 1: Uncertainty Assessment for 300 MHz - 3 GHz.

4. SAR LIMIT

Having a worst case measurement, the SAR limit is valid for general population/uncontrolled exposure.

The SAR values have to be averaged over a mass of 1 gr. (SAR 1 gr.) with the shape of a cube and averaged over a mass of 10 gr (Extremity SAR 10 gr). These levels could not exceed the values indicated in the application Standard:

Standard	Exposure	SAR	SAR Limit (W/kg)
FCC 47 CFR Part 1.1310, Paragraph (c)	General population	SAR 1-g.	1.6
FCC 47 CFR Part 1.1310, Paragraph (c)	General population - Extremity	SAR 10-g.	4.0

Table 2: SAR limit

5. DEVICE UNDER TEST

5.1. Dimensions

Dimensions	Millimetres
Length x Width x Height	170.0 x 80.0 x 8.0

Table 3: Dimensions

5.2. Wireless Technology

Wireless Technology	Frequency Bands	Modes
GSM	850 / 1900	- GPRS (GMSK, Multi-slot class 33)
Bluetooth	2.4 GHz	- Bluetooth LE

Table 4: Supported modes

5.3. Simultaneous Transmission

Simultaneous transmission evaluation was performed according to FCC OET KDB 447498 D01 General RF Exposure Guidance v06 (October 2015). The detailed simultaneous transmission combination is:

Capable Transmit Configurations
WWAN+BT

Table 5: Simultaneous transmission

5.4. Antenna Location

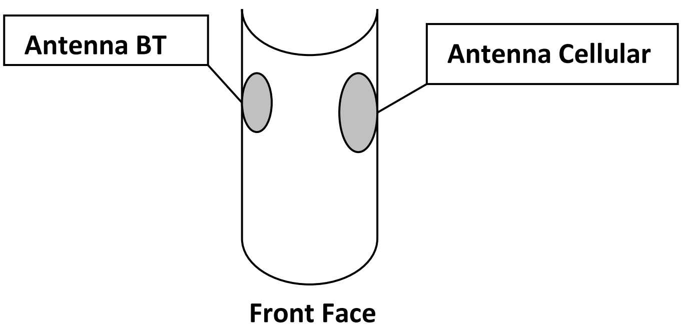


Figure 3: Antenna location sketch

Appendix B: Test results

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1. TEST CONDITIONS

1.1. Power supply (V):

V_n = 3.7 V rechargeable battery

Type of power supply = DC Voltage from rechargeable 3.7 V battery.

1.2. Temperature (ºC):

T_n = +20.00 to +25.00

The subscript n indicates normal test conditions.

1.3. DUT and test-site configurations

The device under test is an intelligent sensorized shin guard system used to obtain user metrics

For supported GPRS data modes the DUT was tested over extremity exposure conditions. A fully charged battery was used for every test sequence.

The device was placed with its back face touching the flat phantom into its normal use conditions.

1.4. Test signal, Output Power and Frequencies

The sample was put into operation by using a test mode supplied by the manufacturer, setting the maximum output power for each supported band.

In the operating bands and test positions, the measurements were performed on middle channels. In each band, for those positions where the maximum averaged SAR was found, measurements were performed on lowest and highest channels except those with applicable test reductions.

The target power alignments, including tune-up tolerance, for RF components declared by the manufacturer for each supported technology are:

Band	Burst Averaged Output Power (dBm)				Frame Averaged Output Power (dBm)			
	1 Tx slot	2 Tx slots	3 Tx slots	4 Tx slots	1 Tx slot	2 Tx slots	3 Tx slots	4 Tx slots
GPRS 900	32.5	31.50	30.5	30.5	23.47	25.48	27.49	27.49
GPRS 1800	29.5	29.5	29.5	29.5	20.47	23.48	25.24	26.49

Band	Maximum Output Power (dBm)
	Bluetooth LE
2.4 GHz	4.9

2. CONDUCTED AVERAGE POWER MEASUREMENTS

2.1. GSM/GPRS/EGPRS Bands

- GPRS 850: For data mode. PCL 5, CS1 coding scheme and Gamma 3 were set to allow DUT's max power transmission for each slot.

GPRS 850 - Frame Average Output Power							
Channel Number	Frequency (MHz)	Power (dBm) 1 Slot	Power (dBm) 2 Slots	Power (dBm) 3 Slots	Power (dBm) 4 Slots	PCL	Modulation
128	824.2	22.82	25.88	26.02	26.45	5	GMSK-CS1
190	836.6	22.74	25.81	25.98	26.37	5	GMSK-CS1
251	848.8	22.66	25.71	25.90	26.25	5	GMSK-CS1

GPRS 850 - Average Burst Output Power							
Channel Number	Frequency (MHz)	Power (dBm) 1 Slot	Power (dBm) 2 Slots	Power (dBm) 3 Slots	Power (dBm) 4 Slots	PCL	Modulation
128	824.2	31.9	31.9	30.3	29.5	5	GMSK-CS1
190	836.6	31.8	31.8	30.2	29.4	5	GMSK-CS1
251	848.8	31.7	31.7	30.2	29.3	5	GMSK-CS1

- GPRS1900: For data mode. PCL 0, CS1 coding scheme and Gamma 3 were set to allow max power transmission for each slot.

GPRS 1900 - Frame Average Output Power							
Channel Number	Frequency (MHz)	Power (dBm) 1 Slot	Power (dBm) 2 Slots	Power (dBm) 3 Slots	Power (dBm) 4 Slots	PCL	Modulation
512	1850.2	20.71	21.01	22.38	23.59	0	GMSK-CS1
661	1880.0	20.45	21.22	22.75	23.47	0	GMSK-CS1
810	1909.8	20.53	20.86	22.34	23.60	0	GMSK-CS1

GPRS 1900 - Average Burst Output Power							
Channel Number	Frequency (MHz)	Power (dBm) 1 Slot	Power (dBm) 2 Slots	Power (dBm) 3 Slots	Power (dBm) 4 Slots	PCL	Modulation
512	1850.2	29.7	27.0	26.6	26.6	0	GMSK-CS1
661	1880.0	29.5	27.2	27.0	26.5	0	GMSK-CS1
810	1909.8	29.6	26.9	26.6	26.6	0	GMSK-CS1

2.2. Bluetooth

Based on paragraph “4.3.1 Standalone SAR test exclusion considerations” of the KDB 447498 D01 - General RF Exposure Guidance:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)]≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

Protocol	Max. Declared Output Power		Min. Test separation distance (mm)	Frequency (GHz)	Result	Test Exclusion
	(dBm)	(mW)				
Bluetooth LE	4.9	3.09	5.0	2.402 - 2.480	0.97	√

The computed value for Bluetooth is < 3.0, so Bluetooth mode qualifies for Standalone SAR test exclusion for 1-g SAR and 10-g SAR.

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

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR and x= 18,75 for 10-g extremity SAR

Estimated SAR					
Protocol	Max. Output Power		Min. Test separation distance (mm)	Frequency (GHz)	Estimated 10-g SAR
	(dBm)	(mW)			
Bluetooth LE	4.9	3.09	5.0	2.48	0.052

3. TISSUE PARAMETERS MEASUREMENTS

Frequency (MHz)	Target Body Tissue		Measured Body Tissue		Deviation %		Measured Date
	Permittivity ε	Conductivity σ [S/m]	Permittivity ε	Conductivity σ [S/m]	Permittivity ε	Conductivity σ [S/m]	
835	55.20	0.97	57.15	0.96	3.53	-0.96	2021-08-11
900	55.00	1.05	56.65	1.03	3.01	-2.04	2021-08-11
1800	53.30	1.52	53.47	1.47	0.32	-3.32	2021-08-23
1900	53.30	1.52	53.33	1.55	0.05	1.72	2021-08-23

Note: The dielectric properties have been measured by the contact probe method at 22° C.

- Composition / Information on ingredients

Head and Muscle Tissue Simulation Liquids HSL900/MSL900

H_2O Water, 35 – 58%
Sucrose Sugar, white, refined, 40 – 60%
NaCl Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7 Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1 – 0.7%

Head and Muscle Tissue Simulation Liquids HSL1800/MSL1800

H_2O Water, 52 – 75%
C8H18O3 Diethylene glycol monobutyl ether (DGBE), 25 – 48%
(CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8)
NaCl Sodium Chloride, <1.0%

4. SYSTEM CHECK MEASUREMENTS

4.1. Validation results for Body TSL

Date	Frequency (MHz)	SAR over	Fast SAR (W/kg)	SAR (W/kg)	1 W Target SAR (W/kg)	1 W Norm. SAR (W/kg)	Drift (%)
2021-08-11	900	1 gr.	2.77	2.74	11.1	10.90	-1.83
		10 gr.	1.83	1.79	7.16	7.12	-0.57
2021-08-23	1800	1 gr.	9.32	9.31	39.3	37.50	-4.58
		10 gr.	4.75	4.73	20.7	19.05	-7.97

5. MEASUREMENT RESULTS FOR SAR (SPECIFIC ABSORPTION RATE)

5.1. Summary maximum results for 1-g Head SAR measurements.

Mode	Position/Distance	Channel (Frequency)	Reported SAR 1-g (W/kg)	Limit SAR 1-g (W/kg)
GPRS 4 slots 850 MHz	Back face/0 mm	CH 128 (824.2 MHz)	3.53	4.0
GPRS 4 slots 1900 MHz	Back face/0 mm	CH 810 (1909.8 MHz)	3.39	4.0
Bluetooth (Estimated)	Back face/0 mm	CH 0 - 78 (2.402 - 2.480 MHz)	0.05	4.0

5.2. Result for simultaneous multi-band transmission

Transmission Modes	Position	Σ SARi (W/kg)	Total SAR 1-g (W/kg)	Limit SAR 1-g (W/kg)	Verdict
GPRS 850 + Bluetooth	Back Face	3.53 + 0.05	3.58	4.0	Pass

5.3. Results for GPRS 850 MHz band – 4 slots.

Position	Dist (mm)	Channel (Frequency)	Estimated SAR 1-g (W/kg)	SAR 1-g (W/kg)	Power Drift (%)	Scale factor	Reported SAR 1-g (W/kg)	Plot No.
Back face	0	CH 128 (824.2 MHz)	3.38	2.77	-4.28	1.274	3.53	1
Back face	0	CH 190 (836.6 MHz)	3.23	2.68	-1.94	1.297	3.48	
Back face	0	CH 251 (848.8 MHz)	2.72	2.21	-3.73	1.334	2.95	

5.4. Results for GPRS 1900 MHz Band – 4 slots.

Position	Dist (mm)	Channel (Frequency)	Estimated SAR 1-g (W/kg)	SAR 1-g (W/kg)	Power Drift (%)	Scale factor	Reported SAR 1-g (W/kg)	Plot No.
Back face	0	CH 810 (1909.8 MHz)	1.78	1.74	1.04	1.945	3.39	2
Back face	0	CH 661 (1880 MHz)	1.47	1.43	0.58	1.95	2.79	
Back face	0	CH 512 (1850.2 MHz)	1.68	1.64	1.62	2.004	3.29	

5.5. Variability results

According to KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, paragraph "2.8.1. SAR measurement variability", SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements.

Repeated measurements are required only when the measured 1-g SAR is ≥ 0.80 W/kg, or 10-g SAR is ≥ 2.0 W/kg, using the highest measured SAR configuration for that tissue-equivalent medium.

Position	Dist (mm)	Channel (Frequency)	Estimated SAR 1-g (W/kg)	SAR 1-g (W/kg)	Power Drift (%)	Plot No.
Back face	0	CH 128 (824.2 MHz)	3.38	2.77	-4.28	1
Back Face Variability	0	CH 128 (824.2 MHz)	3.21	2.66	-1.94	3

Appendix C: Measurement Reports

Plot Nº 1

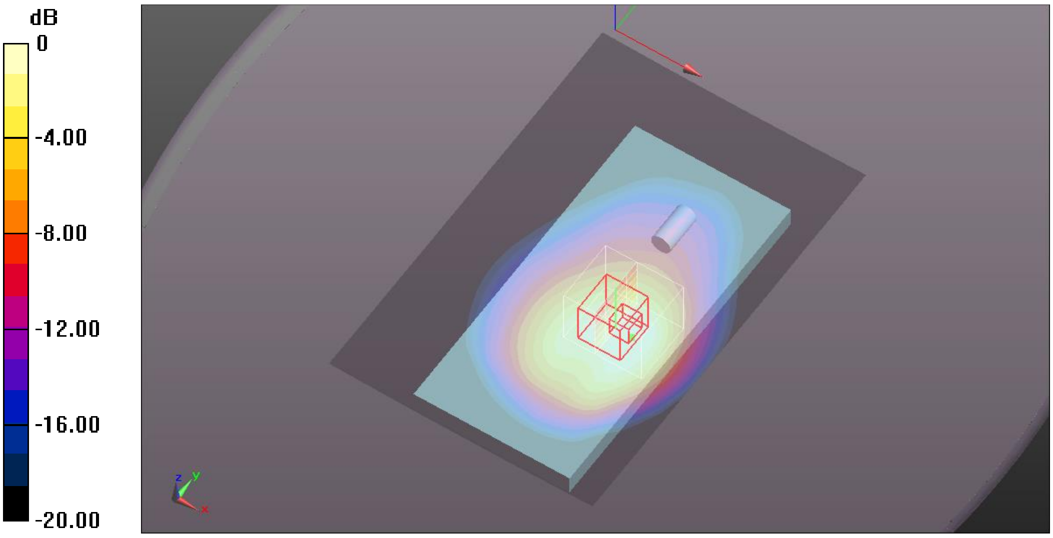
Test Laboratory: DEKRA Testing and Certification, S.A.U; Date: 13/08/2021

DUT: Humanox; Type: Shin guard; Serial: 862549047784742
Communication System: UID 10028 - DAC, GPRS-FDD (TDMA, GMSK, TN 0-1-2-3); Frequency: 824.2 MHz; Duty Cycle: 1:2.26569
Medium parameters used: f = 825 MHz; σ = 0.95 S/m; ε_r = 57.22; ρ = 1000 kg/m^3
Phantom section: Flat Section

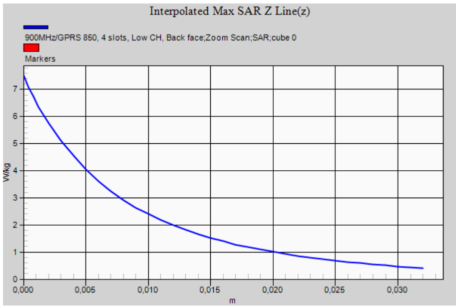
DASY5 Configuration:
- Probe: EX3DV4 - SN7461; ConvF(9.52, 9.52, 9.52) @ 824.2 MHz; Calibrated: 28/08/2020
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 19/08/2020
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Flat Phantom, d=0mm/900MHz/GPRS 850, 4 slots, Low CH, Back face/Area Scan (91x141x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 6.88 W/kg

Flat Phantom, d=0mm/900MHz/GPRS 850, 4 slots, Low CH, Back face/Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 37.10 V/m; Power Drift = -0.38 dB
Peak SAR (extrapolated) = 7.51 W/kg
SAR(1 g) = 4.44 W/kg; SAR(10 g) = 2.77 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 12.2 mm
Ratio of SAR at M2 to SAR at M1 = 62.2%
Maximum value of SAR (measured) = 5.66 W/kg



0 dB = 5.66 W/kg = 7.53 dBW/kg



Plot Nº 2

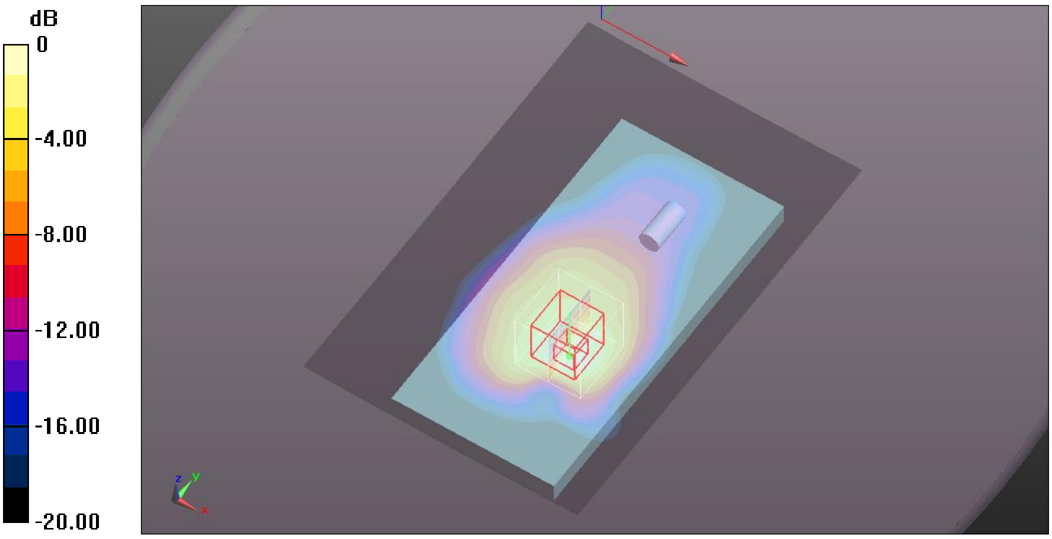
Test Laboratory: DEKRA Testing and Certification, S.A.U; Date: 24/08/2021

DUT: Humanox; Type: Shin guard; Serial: 862549047784742
Communication System: UID 10028 - DAC, GPRS-FDD (TDMA, GMSK, TN 0-1-2-3); Frequency: 1909.8 MHz; Duty Cycle: 1:2.26569
Medium parameters used: f = 1910 MHz; σ = 1.56 S/m; ε_r = 53.32; ρ = 1000 kg/m^3
Phantom section: Flat Section

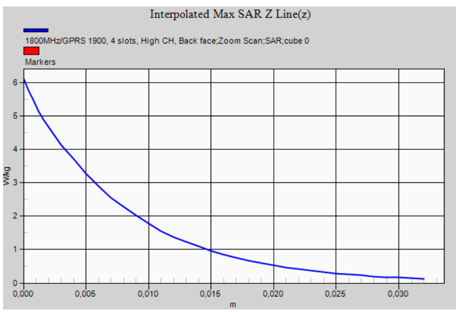
DASY5 Configuration:
- Probe: EX3DV4 - SN7461; ConvF(8.06, 8.06, 8.06) @ 1909.8 MHz; Calibrated: 28/08/2020
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 19/08/2020
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Flat Phantom, d=0mm/1800MHz/GPRS 1900, 4 slots, High CH, Back face/Area Scan (91x141x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.10 W/kg

Flat Phantom, d=0mm/1800MHz/GPRS 1900, 4 slots, High CH, Back face/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.33 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 6.12 W/kg
SAR(1 g) = 3.3 W/kg; SAR(10 g) = 1.74 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 11.3 mm
Ratio of SAR at M2 to SAR at M1 = 55.7%
Maximum value of SAR (measured) = 4.71 W/kg



0 dB = 4.71 W/kg = 6.73 dBW/kg



<u>Plot Nº 3</u>

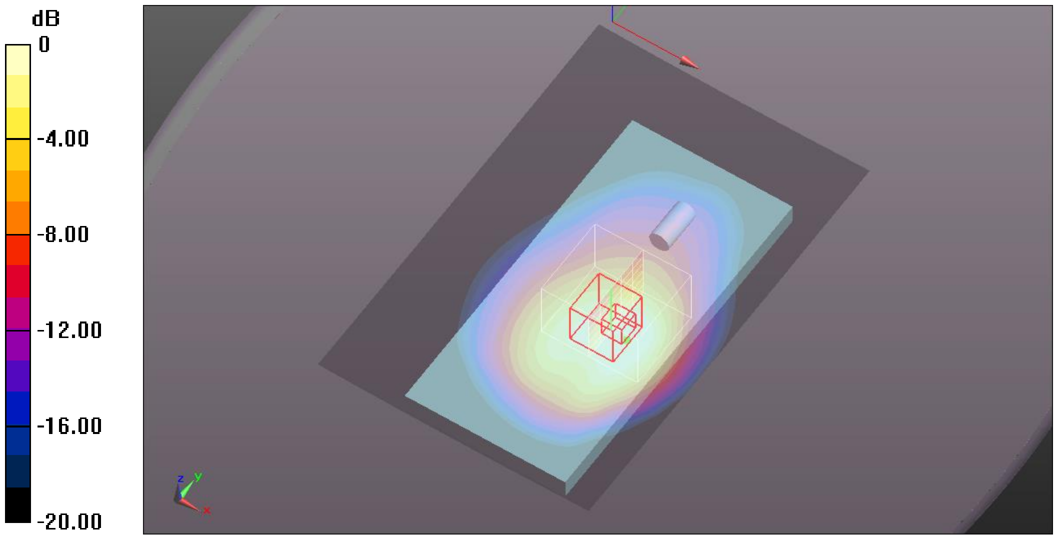
Test Laboratory: DEKRA Testing and Certification, S.A.U; Date: 13/08/2021

DUT: Humanox; Type: Shin guard; Serial: 862549047784742
Communication System: UID 10028 - DAC, GPRS-FDD (TDMA, GMSK, TN 0-1-2-3); Frequency: 824.2 MHz; Duty Cycle: 1:2.26569
Medium parameters used: f = 825 MHz; σ = 0.95 S/m; ε_r = 57.22; ρ = 1000 kg/m^3
Phantom section: Flat Section

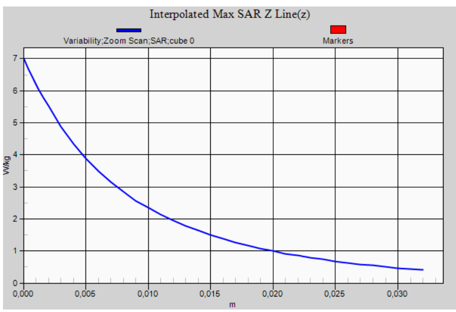
DASY5 Configuration:
- Probe: EX3DV4 - SN7461; ConvF(9.52, 9.52, 9.52) @ 824.2 MHz; Calibrated: 28/08/2020
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 19/08/2020
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Flat Phantom, d=0mm 2/900MHz/GPRS 850, 4 slots, Low CH, Back face - Variability/Area Scan (91x141x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 6.47 W/kg

Flat Phantom, d=0mm 2/900MHz/GPRS 850, 4 slots, Low CH, Back face - Variability/Zoom Scan (7x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.57 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 7.00 W/kg
SAR(1 g) = 4.18 W/kg; SAR(10 g) = 2.66 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 12.5 mm
Ratio of SAR at M2 to SAR at M1 = 64.9%
Maximum value of SAR (measured) = 5.19 W/kg



0 dB = 5.19 W/kg = 7.15 dBW/kg



Appendix D: System Validation Reports

Validation results in 900 MHz Band for Head TSL

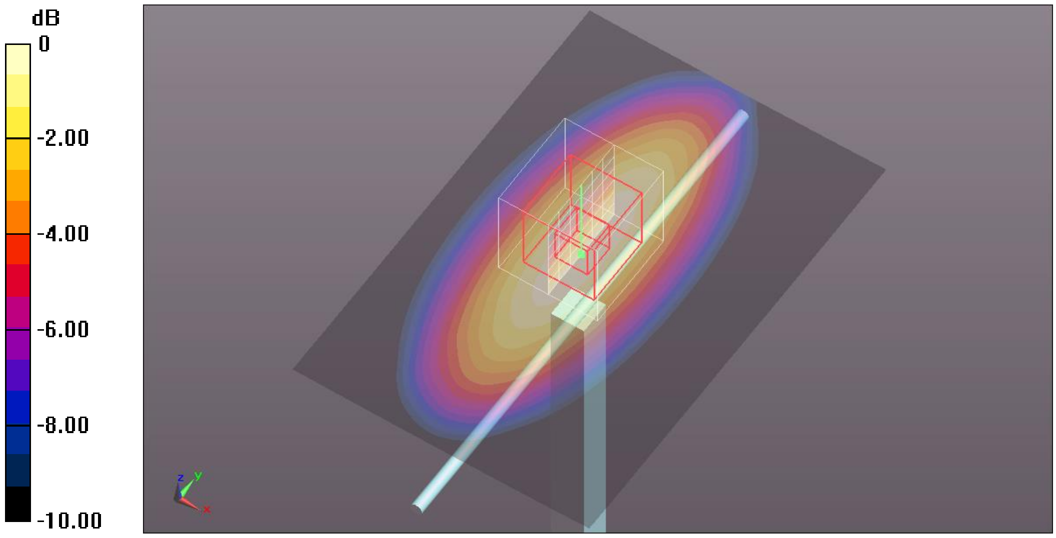
Test Laboratory: DEKRA Testing and Certification, S.A.U; Date: 11/08/2021

DUT: Dipole 900 MHz D900V2; Type: D900V2; Serial: D900V2 - SN:1d007
Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1
Medium parameters used: f = 900 MHz; σ = 1.03 S/m; ε_r = 56.65; ρ = 1000 kg/m^3
Phantom section: Flat Section

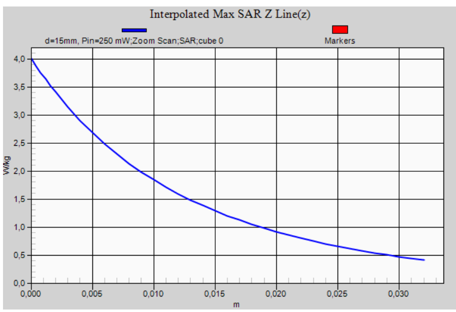
DASY5 Configuration:
- Probe: EX3DV4 - SN7461; ConvF(9.52, 9.52, 9.52) @ 900 MHz; Calibrated: 28/08/2020
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 19/08/2020
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Configuration 900 MHz Body, 2021-08-11/d=15mm, Pin=250 mW/Area Scan (61x91x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.36 W/kg

Configuration 900 MHz Body, 2021-08-11/d=15mm, Pin=250 mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.64 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 4.01 W/kg
SAR(1 g) = 2.74 W/kg; SAR(10 g) = 1.79 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 16 mm
Ratio of SAR at M2 to SAR at M1 = 67.5%
Maximum value of SAR (measured) = 3.40 W/kg



0 dB = 3.40 W/kg = 5.31 dBW/kg



Validation results in 1800 MHz Band for Head TSL

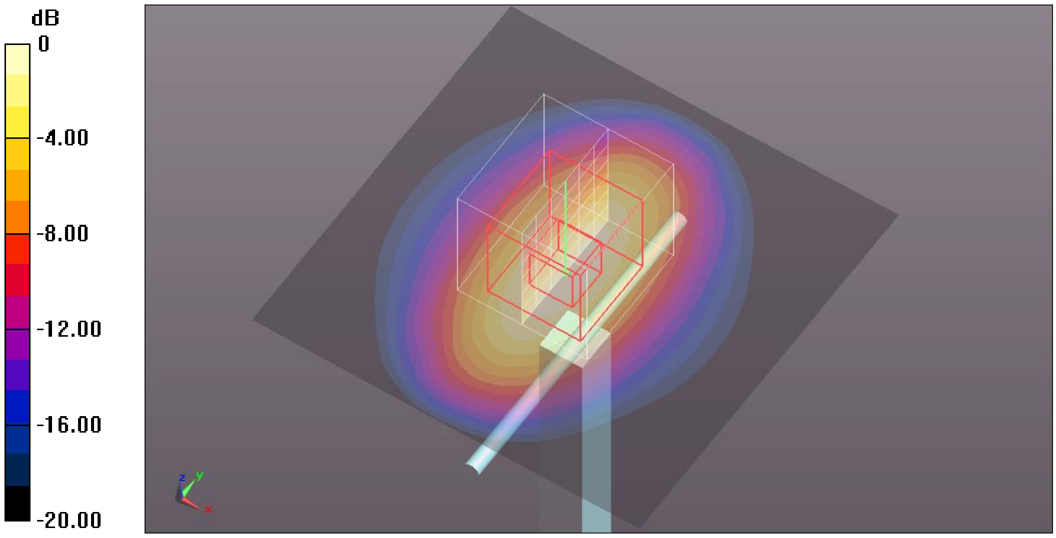
Test Laboratory: DEKRA Testing and Certification, S.A.U; Date: 23/08/2021

DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:2d099
Communication System: UID 0, CW (0); Frequency: 1800 MHz; Duty Cycle: 1:1
Medium parameters used: f = 1800 MHz; σ = 1.47 S/m; ε_r = 53.47; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:
- Probe: EX3DV4 - SN7461; ConvF(8.06, 8.06, 8.06) @ 1800 MHz; Calibrated: 28/08/2020
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 19/08/2020
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Configuration 1800MHz (1900), Body, 2021-08-23/d=10mm, Pin=250 mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 12.7 W/kg

Configuration 1800MHz (1900), Body, 2021-08-23/d=10mm, Pin=250 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.09 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.73 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 9.5 mm
Ratio of SAR at M2 to SAR at M1 = 54.9%
Maximum value of SAR (measured) = 13.3 W/kg



0 dB = 13.3 W/kg = 11.24 dBW/kg