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Prüfbericht - Nr.: *Test Report No.:*	**Appendix 10**		**Seite 1 von 33** *Page 1 of 33*
Auftraggeber: *Client:*	**BTL Industries Ltd. 161 Cleveland Way, Stevenage, Hertfordshire, SG1 6BU, United Kingdom**		
Gegenstand der Prüfung: *Test item:*	**BTL Flexi 12 ECG**		
Bezeichnung: *Identification:*	**Flexi 12**	**Serien-Nr.:** *Serial No.*	**07600B000151**
Wareneingangs-Nr.: *Receipt No.:*	**1803201744**	**Eingangsdatum:** *Date of receipt:*	**10.01.2017**
Prüfort: *Testing location:*	**Refer Page 4 of 33 for test facilities**		
Prüfgrundlage: *Test specification:*	**IEC 62209-2 :2010** **IEEE Std 1528-2013** **RSS 102, Issue 5**		
Prüfergebnis: *Test Result:*	**Siehe Testergebnis Zusammenfassung** *See test result summary*		
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland (India) Pvt. Ltd.** TUV Rheinland India Pvt Ltd. 82/A, West Wing, 3rd Main Road Electronic Cit Phase 1, Bangalore – 560100		

geprüft / *tested by:*

Datum / *Date*	Name/Stellung / *Name/Position*	Unterschrift / *Signature*
21.02.2017	Shrikanth S Naik Sr.Engineer	

kontrolliert / *reviewed by:*

Datum / *Date*	Name/Stellung / *Name/Position*	Unterschrift / *Signature*
24.02.2017	Saibaba Siddapur Assistant Manager	

Sonstiges /*Other Aspects:* **Contains FCC ID:2ALCO-CC3100PROD1**
Contains IC: 22520- CC3100PROD1

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*
	F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*
	N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*
	N/T	=	*nicht getestet*		*N/T*	=	*not tested*

Test Result Summary:

Protocol	SAR type	Measure SAR (W/kg)	Reported SAR (W/Kg)	Result
802.11b	Body	0.768	1.085	Pass
802.11g	Body	0.725	1.024	Pass

Note: SAR test was performed with EUT touching the phantom.

Content

List of Test and Measurement Instruments

Equipment	Model	Serial Number	Periodicity	Cal due date
E-Filed Probe EX3DV4	SP-EX3 004 CC	3886	Yearly	17.03.2017
DAE 3	SD 000 D03 AE	322	Yearly	15.03.2017
RF and microwave Signal Generator	SMB100A	108788	Yearly	05.12.2017
Power Sensor	E4412A	MY50360055	Yearly	13.04.2017
Power Meter	N1913A	MY50000459	Yearly	17.04.2017
Dipole D2450V2	SA AAD 245 BB	902	Yearly	09.03.2017
Dielectric Probe	DAKS-3.5	1062	Yearly	4.12.2017

Testing Facilities:

1) TUV Rheinland (India) Private Limited
No. 108, West Wing
Electronic city Phase I
Bangalore – 560100

General Product Information

Product Function and Intended Use

The ECG system is intended for acquisition, processing, recording, analysis and presentation of 12-lead simultaneous resting ECG for diagnostic purposes. The ECG system should be used in hospitals and healthcare facilities, by trained ECG technicians and qualified healthcare professionals for effective usage, maintenance and troubleshooting of the ECG system. The ECG system acquires and processes 12 lead resting ECG data of a patient. The processed data and generated reports should be used by qualified physicians for cardiac examination and diagnosis. It is advised to not use the interpretations as a sole basis for making clinical decisions. Any other application of data and reports, other than its intended use are not advised and considered misuse of the system. The ECG system is not intended for use at Home.

Ratings and System Details

Frequency Range	2400MHz – 2480MHz
No. of channel	Refer page 5
Channel Spacing	5MHz
Data Rate	802.11b: 1,2, 5.5,11 Mbps 802.11g: 6, 9, 12, 18, 24, 36,48, 54 Mbps
Modulation	802.11b: DSSS with CCK 802.11g: OFDM with BPSK, QPSK, 16-QAM, 64-QAM
Number of antenna	One
Antenna Gain	1.9 dBi
Supply Voltage	3.6 VDC
Dimensions	86.7 mm X82 mm X24.5mm
Environmental Condition	Operating temperature is 10°C to 40°C

Test Set-up and Operation Mode

Principle of Configuration Selection

Transmission was enabled with continuous transmission on low, mid and high channel.

Test Operation and Test Software

Test software was used to enable the continuous transmission, changing channels (low/mid/high) and data rates on the EUT for the tests in this report.

Special Accessories and Auxiliary Equipment

- A laptop computer was used to configure the EUT in continuous transmission mode on different channel and data rate.

List of Centre Frequencies:

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2400 – 2483.5	1	2412
	2	2417
	3	2422
	4	2427
	5	2432
	6	2437
	7	2442
	8	2447
	9	2452
	10	2457
	11	2462

Maximum Transmitted Power:

Mode	Channel Frequency (MHz)	Transmit Power (dBm)
802.11b	2412	12.18
	2437	14.14
	2462	12.24
802.11g	2412	12.75
	2437	14.64
	2462	12.98

Test Results

1. SAR Limits

The below standards are applied for SAR testing of this product under FCC & IC regulations.

IEEE Std C95.3-2002: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc.

IEEE Std 1528-2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques, Inst. of Electrical and Electronics Engineers, Inc.

KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04.
RSS 102, Issue 5

Limits:

Body Region	Devices Used by the General Public SAR Limit (W/kg)
Localized Head and Trunk	1.6

2. Tissue simulating liquid dielectric parameters

For the purpose of the tests as described in this report the following tissue dielectric parameters have been determined by use of a Vector Network Analyzer (VNA). The tables indicate the dielectric parameters of the liquids used during the tests. The indicated required values are derived from IEEE Std 1528-2013 & FCC KDB “865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04”

Dielectric parameters for 2450MHz Tissue

Broad band liquid **MBBL600 – 6000 V1** was used for the tests for 2.4GHz – 2.4835GHz band frequencies.

The following liquid validation results were obtained, where the maximum deviation should not be more than ±10% of the Relative values (standard).

Results for 2.45GHz Band

Frequency (MHz)	Measured Liquid Temperature (°C)	Measured relative Permittivity	Measured Conductivity (S/m)	Relative Permittivity Standard	Conductivity Standard (S/m)	Relative Permittivity Deviation (%)	Conductivity Deviation (%)
2450	22.5	51.84	1.92	52.70	1.95	-1.64	-1.69

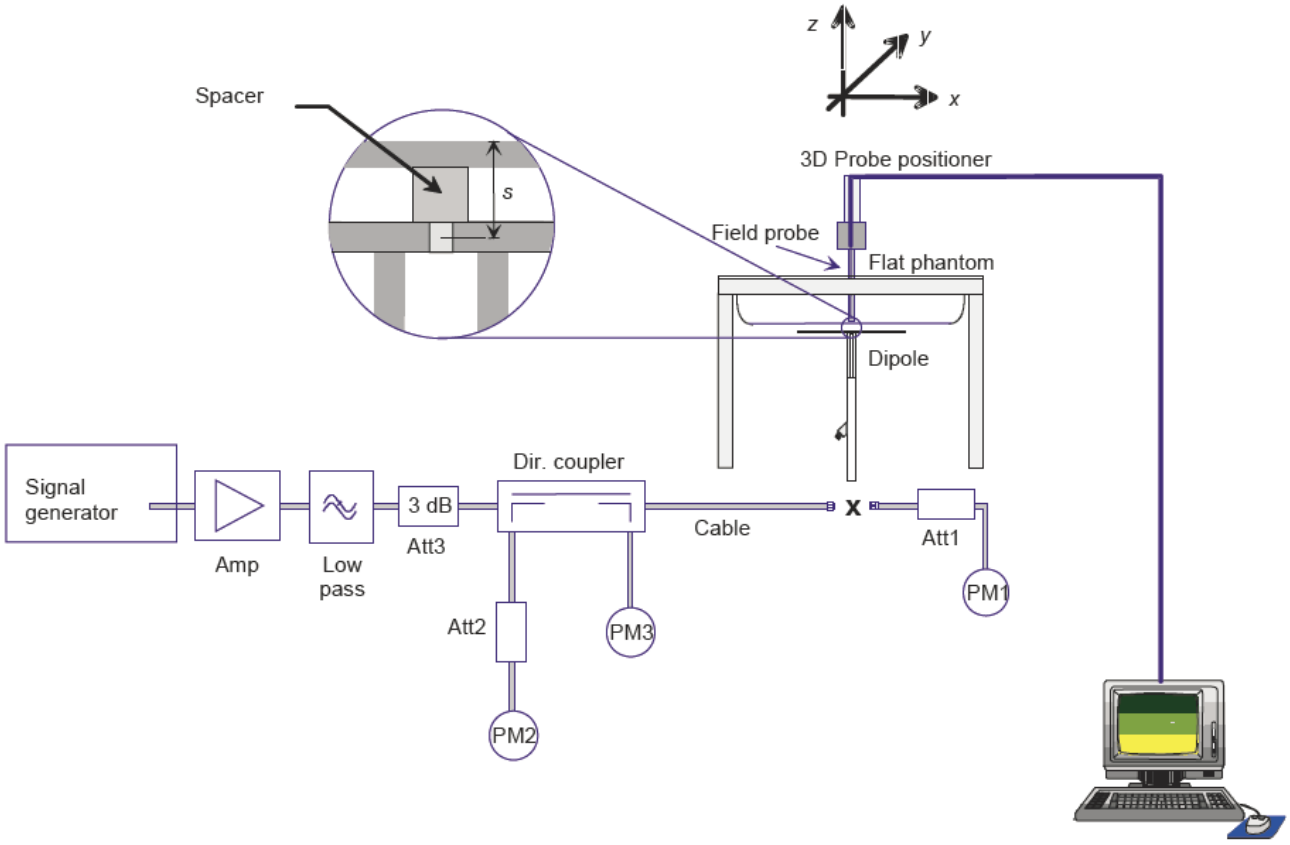
3. System Validation

The purpose of the system performance check (system check) is to verify that the system operates within its specifications at the device test frequency. The system check is to make sure that the system works correctly at the time of the compliance test. The system check has been performed using the specified tissue-equivalent liquid and at a chosen fixed frequency that is within ± 10% of the compliance test mid-band frequency. The system check is performed prior to compliance tests and the result must always be within ±10% of the target value corresponding to the test frequency, liquid and the source used. The system check detects possible short-term drift and uncertainties in the system, such as:

a) Changes in the liquid parameters (e.g., due to water evaporation or temperature change),
b) Test system component failures,
c) Test system component drift,
d) Operator errors in the set-up or software parameters,
e) Other possible adverse conditions in the system configuration, e.g., RF interference.

The results show that this system check is within ±10% of the expected values.

System check Setup



Results

At 2450 MHz a system check was performed according to KDB 865664 D01. The following system performance check results were obtained (referenced to 1W):

Frequency (MHz)	Target Value (W/kg)	Measured Value (W/kg)	Deviation from Target value (%)	Permissible deviation from target value (%)
2450	53.1	52.6	0.94	±10

System Validation: 2450 MHz

Temperature of Liquid	: 22.5 ºC
Test Frequency	: 2450MHz
Measured Conductivity	: 1.92 S/m
Measured Permittivity	: 51.84

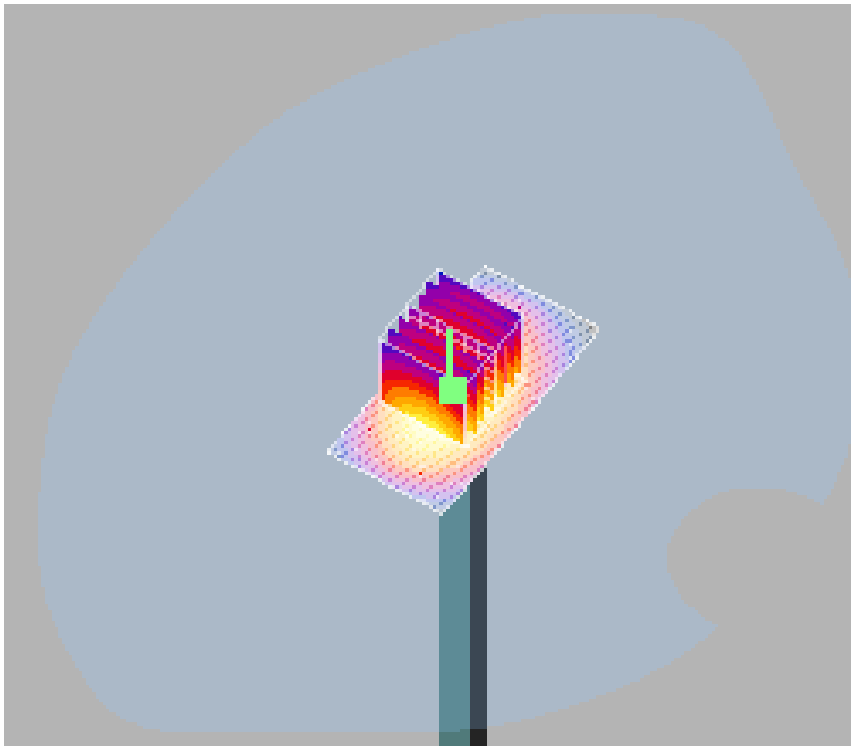
Area Scan

Power input to Dipole	: 50mW
Grid Dimension	: 41mmX81mmx1mm
SAR Normalized to 1W power	: 52.8 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 18.5 V/m
Measured SAR	: 2.63 W/kg
Normalized to 1W power	: 52.6 W/Kg
Power Drift	: 0.28 dB

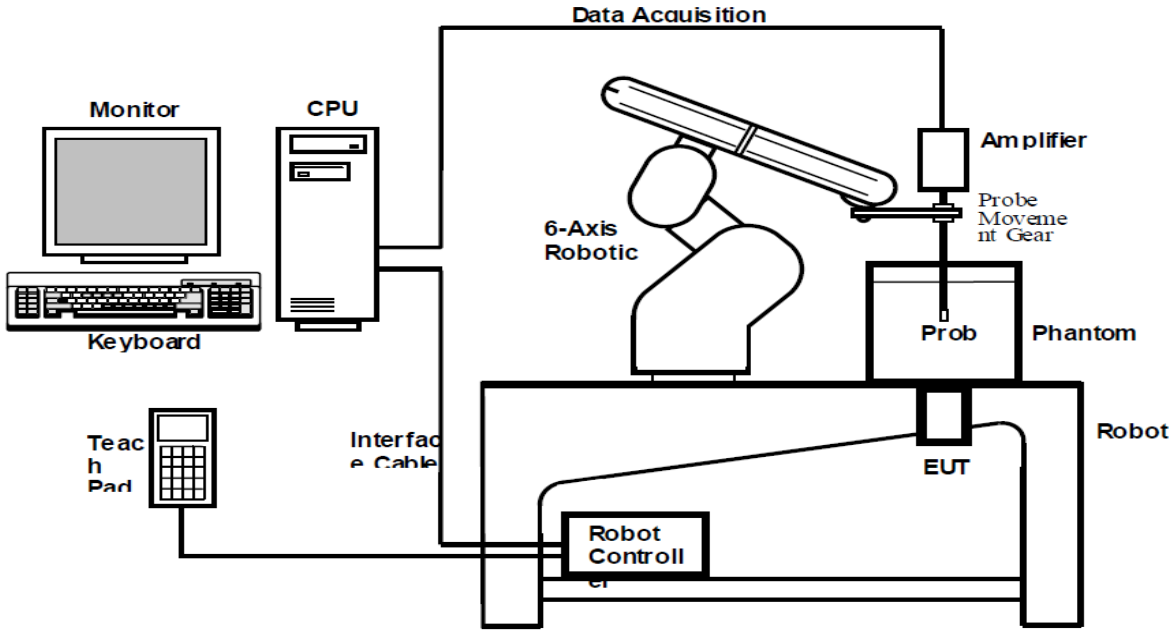
Measurement Plot



4. Specific Absorption rate of EUT

System Description

The SAR measurement system used by TUV India is the SPEAG DASY4, which consists of a Staubli robot-arm and controller, SPEAG probe and amplifier and an appropriate phantom as required and considered appropriate for the applied test. The robot is used to move and manipulate the probe to programmed positions inside the phantom to obtain the SAR readings from the EUT.



The system is remote controlled by a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans by calculating the measured values into corresponding SAR values based on the currently acceptable calculation methods.

The position and digitized shape of the phantom are made available to the software for accurate positioning of the probe and reduction of set-up time.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centered at that point to determine volume averaged SAR level.

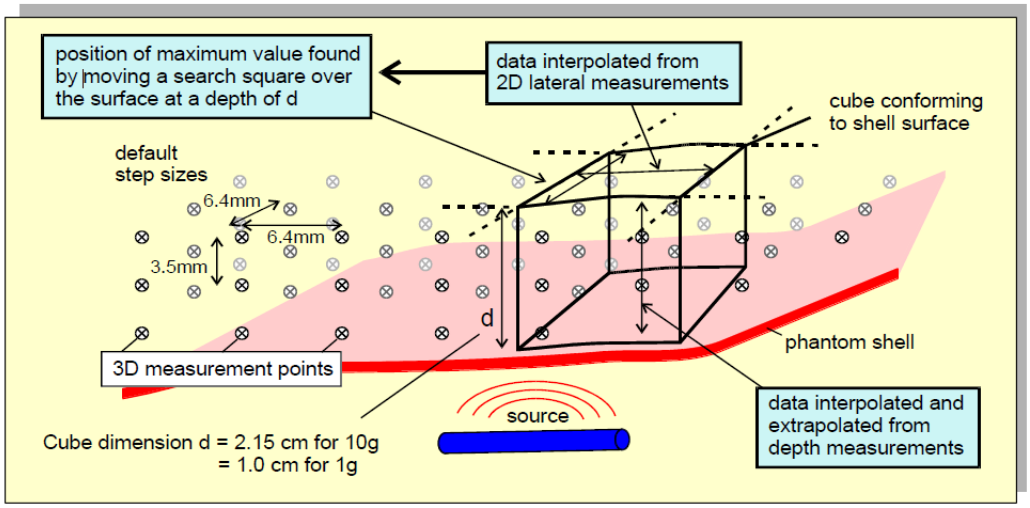
Measurement Procedure

During the SAR measurement, the positioning of the probe is performed with sufficient accuracy to obtain repeatable measurements in the presence of rapid spatial attenuation phenomena. The accurate positioning of the E-field probe is accomplished by using the high precision robot. The robot can be taught to position the probe sensor following a specific pattern of points.

After an area scan has been done a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power (SAR) drift during measurement to be assessed.

Step size and scan information

For the EUT"s 2.4 GHz band a 30 x 30 mm area is scanned centered around the hotspot using 6 steps in the x-y plane and 10 steps of 3.0 mm in the z plane. The first area scan is performed with the probe tip 5 mm above the phantom bottom shell. For the EUT"s 5 GHz band a 24 x 24 mm area is scanned centered around the hotspot using 6 steps in the x-y plane and 6 steps of 3 mm in the z plane. The first area scan is performed with the probe tip 2 mm above the phantom bottom shell.



SARA2 Interpolation and Extrapolation schemes

SARA2 software contains support for both 2D cubic B-spline interpolation as well as 3D cubic B-spline interpolation. In addition, for extrapolation purposes, a general n_{th} order polynomial fitting routine is implemented following a singular value decomposition algorithm. A 4_{th} order polynomial fit is used by default for data extrapolation.

Interpolations of 2D area scan

The 2D cubic B-spline interpolation is used after the initial area scan at fixed distance from the phantom shell wall. The initial scan data are collected with approximately 10 mm spatial resolution and spline interpolation is used to find the location of the local maximum to within a 1mm resolution for positioning the subsequent 3D scanning.

Extrapolation of 3D scan

For the 3D scan, data are collected on a spatially regular 3D grid having (by default) 6.4 mm steps in the lateral dimensions and 3.5 mm steps in the depth direction (away from the source). DASY4 enables full control over the selection of alternative step sizes in all directions. The digitized shape of the Flat Phantom is available to the DASY4 software, which decides which points in the 3D array are sufficiently well within the shell wall to be visited by the SAR probe. After the data collection, 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.

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Interpolation of 3D scan and volume averaging

The procedure used for defining the shape of the volumes used for SAR averaging in the SARA2 software follow the method of adapting the surface of the „cube" to conform with the surface of the phantom. This is called, here, the conformal scheme.

For each row of data in the depth direction, the data are extrapolated and interpolated to les s than 1 mm spacing and average values are calculated from the phantom surface for the row of data over distances corresponding to the requisite depth for 10g and 1g cubes. These results in two 2D arrays of data, which are then cubic B-spline interpolated to sub mm lateral resolution. A search routine then moves an averaging square around through the 2D array and records the maximum value of the corresponding 1g and 10g volume averages. For measurements in rectangular, box phantoms, the distance between the phantom wall and the closest set of gridded data points is entered into the software.

The default step size (dstep) used is 3.5 mm, but this is under user-control. The compromise is with time of scan, so it is not practical to make it much smaller or scan times become long and power -drop influences become larger. The robot positioning system specification for the repeatability of the positioning (dss) is 0.04 mm.

The flat phantom is made from Polymethylmethacrylate (PMMA), a low-loss dielectric material with dielectric constant and loss tangent less than 5.0 and 0.05 respectively. The shell thickness for all regions coupled to the test device and its antenna are within 2.0 ± 0.2 mm.

For the upright phantom, the alignment is based upon registration of the rotation axis of the phantom on its 253 mm-diameter base plate bearing and the position of the probe axis when commanded to go to the axial position. A laser alignment tool is provided. This enables the registration of the phantom tip (dmis) to be assured to within approx. 0.2 mm. This alignment is done with reference to the actual probe tip after installation and probe alignment.

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Summary of Results

The tests were done with all 6 EUT orientation and only worst case orientation test results are reported in the test report.

Protocol	Channel Frequency (MHz)	Measured Power EIRP (dBm)	Measured Power EIRP (mW)	Tune-Up Scaling Factor (dB)	Tune-Up Scaling Factor (mW)	Maximum Tuneup Tolerance (mw)	Measured SAR (W/kg)	Reported SAR (W/kg)	Limit (W/kg)	Result	Worst Case EUT Position
802.11b	2412	14.08	25.58	1.5	1.41	36.13	0.572	0.808	1.6	Pass	Edge 2
	2437	16.04	40.18	1.5	1.41	56.76	0.768	**1.085**	1.6	Pass	Edge 2
	2462	14.14	25.94	1.5	1.41	36.64	0.701	0.990	1.6	Pass	Edge 2
	2437	16.04	40.18	1.5	1.41	56.76	0.583	0.824	1.6	Pass	Face 1
	2437	16.04	40.18	1.5	1.41	56.76	0.149	0.210	1.6	Pass	Face 2
	2437	16.04	40.18	1.5	1.41	56.76	0.016	0.023	1.6	Pass	Edge 1
	2437	16.04	40.18	1.5	1.41	56.76	0.006	0.009	1.6	Pass	Edge 3
	2437	16.04	40.18	1.5	1.41	56.76	0.006	0.009	1.6	Pass	Edge 4
802.11 g	2437	16.54	45.08	1.5	1.41	63.68	0.725	**1.024**	1.6	Pass	Edge 2
	2437	16.54	45.08	1.5	1.41	63.68	0.573	0.809	1.6	Pass	Face 1

Note:
EUT was tested for all 6 orientation and data rate and channels only worst case test results are reported in the test report.
Client has provided ±1.5dB as the variation from sample to sample based on the production data, so 1.5dB scaling factor is used for the calculation.

Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2412

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.91 S/m
Measured Permittivity : 52.97

Area Scan

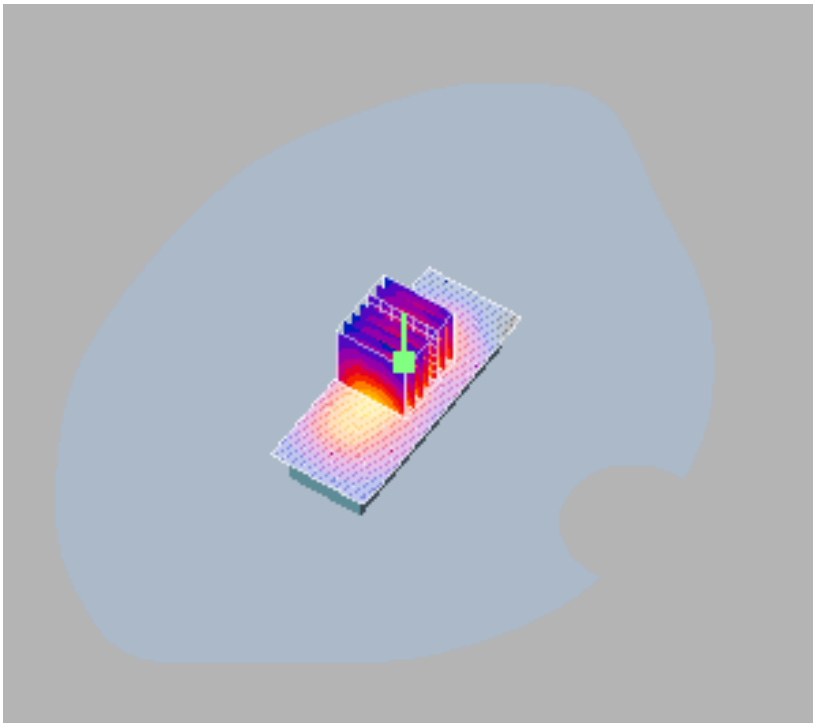
Grid Dimension : 40mmX101mmX1mm
Maximum SAR : 0.705 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 16.6 V/m
Measured SAR : 0.572 W/Kg
Power Drift : -0.44 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

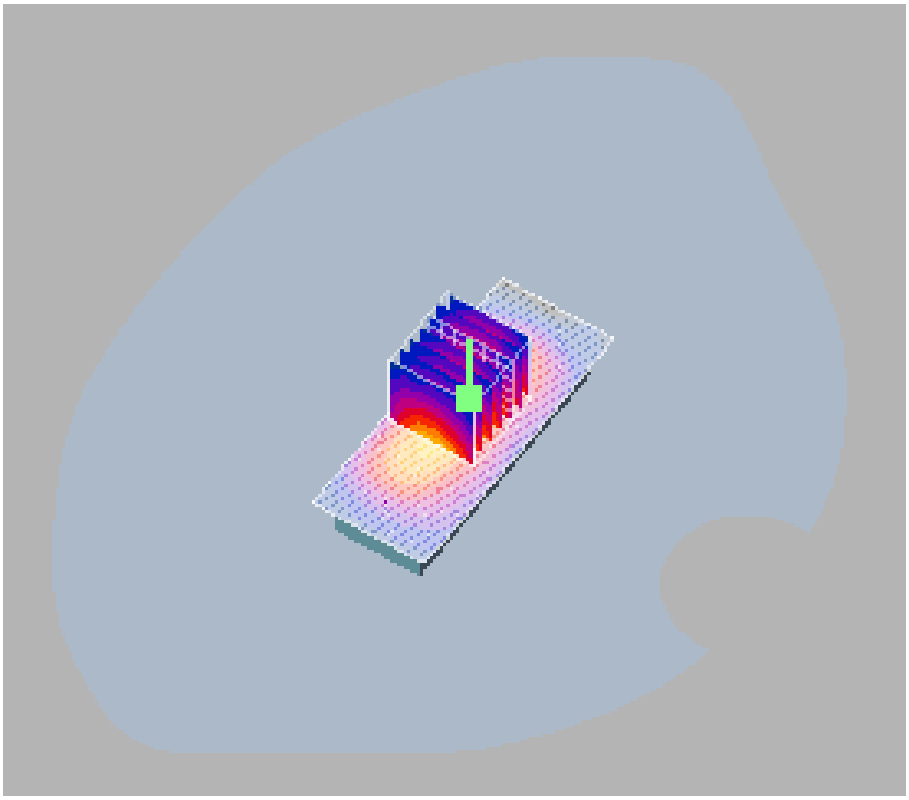
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.967 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 17.7 V/m
Measured SAR	: 0.768 W/Kg
Power Drift	: 0.35 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2462

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.93 S/m
Measured Permittivity	: 52.07

Area Scan

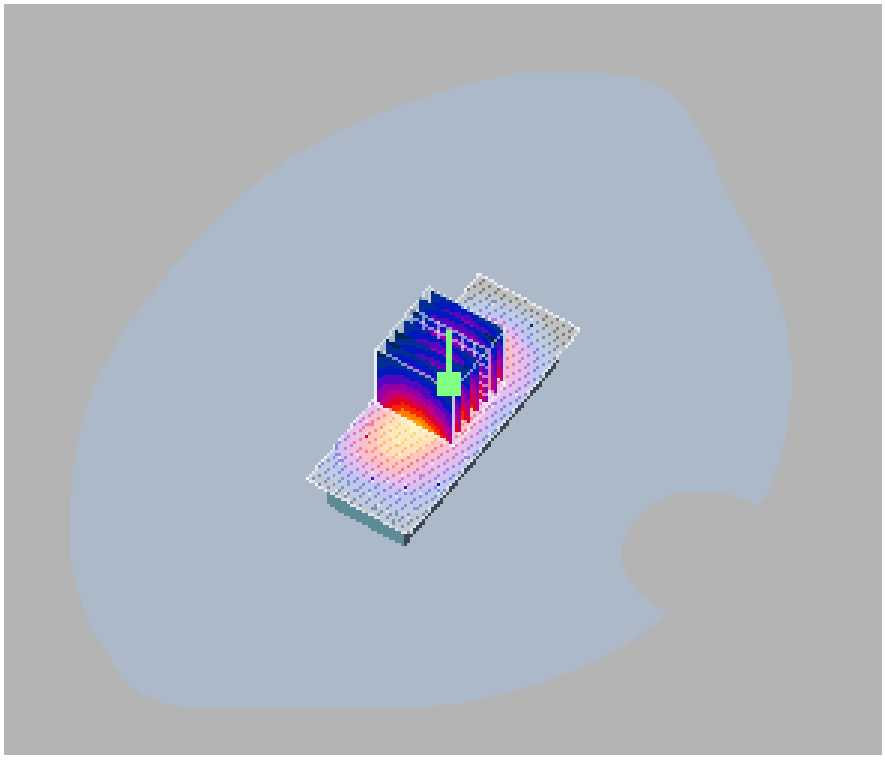
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.871 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 17.5 V/m
Measured SAR	: 0.701 W/Kg
Power Drift	: 0.1 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

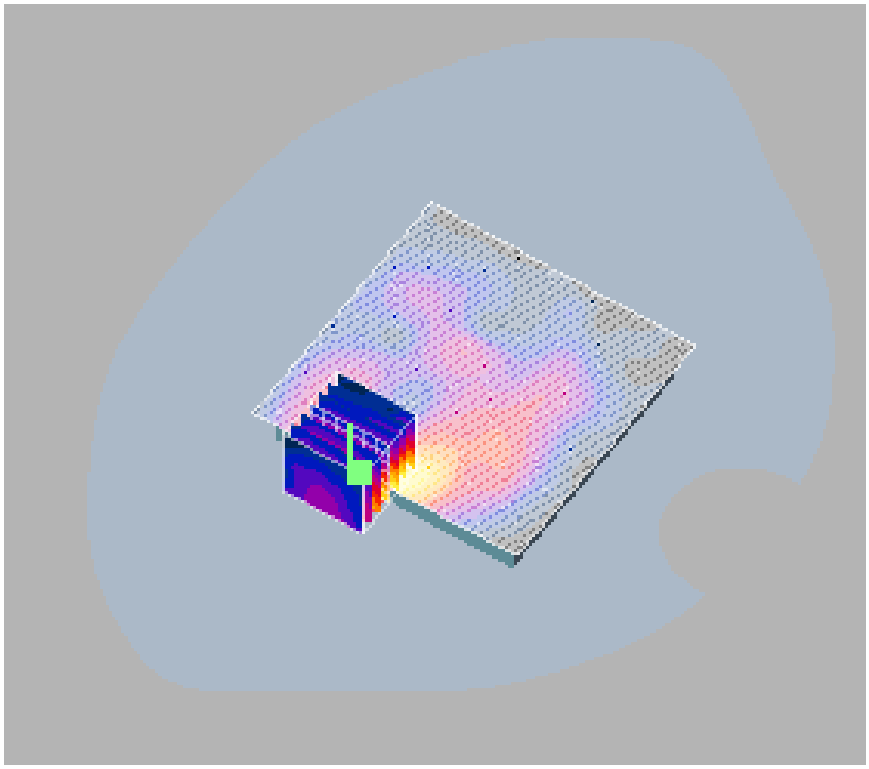
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.602 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 4.15 V/m
Measured SAR	: 0.583 W/Kg
Power Drift	: 0.5 dB

Measurement Plot:

EUT Position: Face 1



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

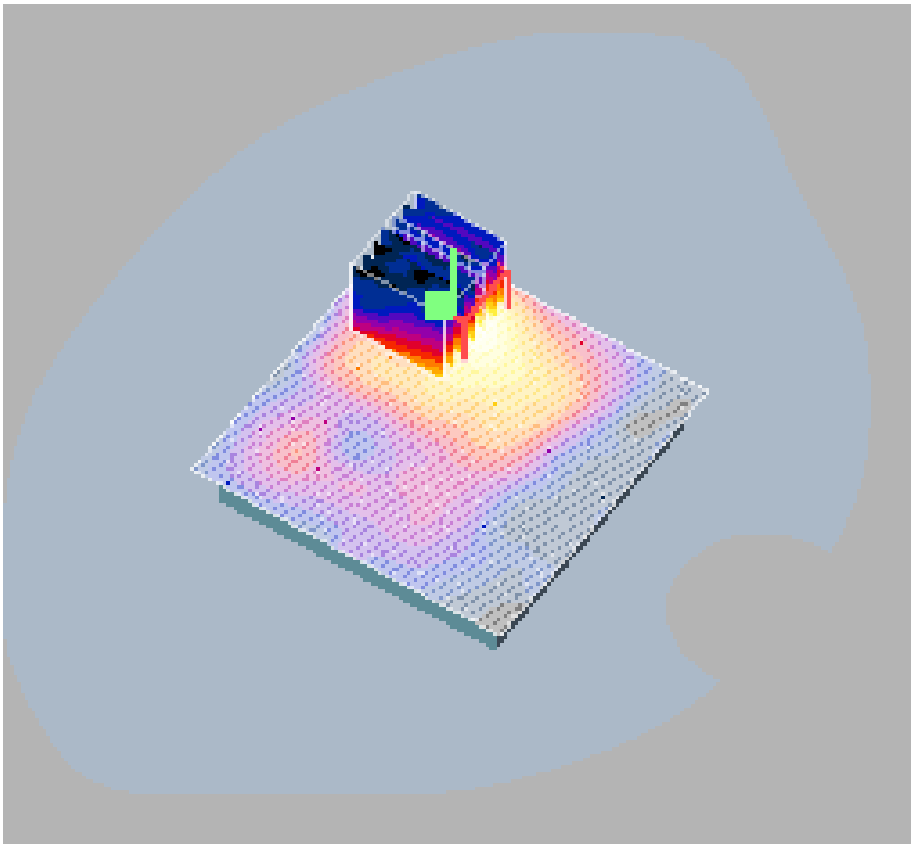
Grid Dimension	: 101mmX101mmX1mm
Maximum SAR	: 0.175 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 4.22 V/m
Measured SAR	: 0.149 W/Kg
Power Drift	: 0.18 dB

Measurement Plot:

EUT Position: Face 2



Protocol	Data rate	Channel Frequency (MHz)

802.11b	1 Mbps	2437

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.914 S/m
Measured Permittivity : 52.23

Area Scan

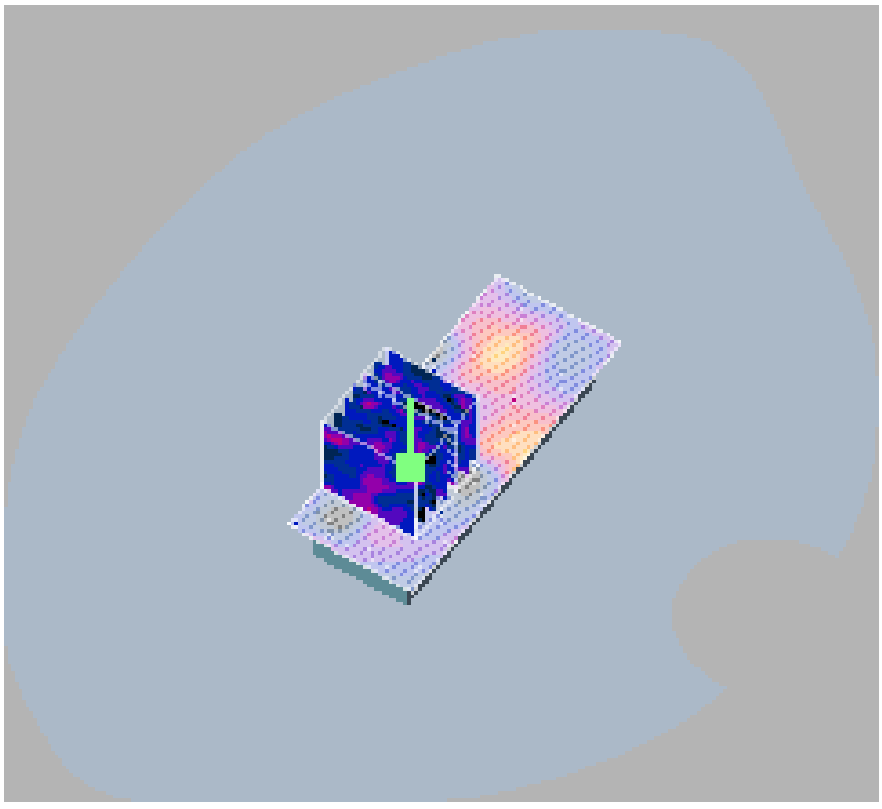
Grid Dimension : 41mmX101mmX1mm
Maximum SAR : 0.023 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 1.94 V/m
Measured SAR : 0.016 W/Kg
Power Drift : 0.7 dB

Measurement Plot:

EUT Position: Edge 1



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2437

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.914 S/m
Measured Permittivity : 52.23

Area Scan

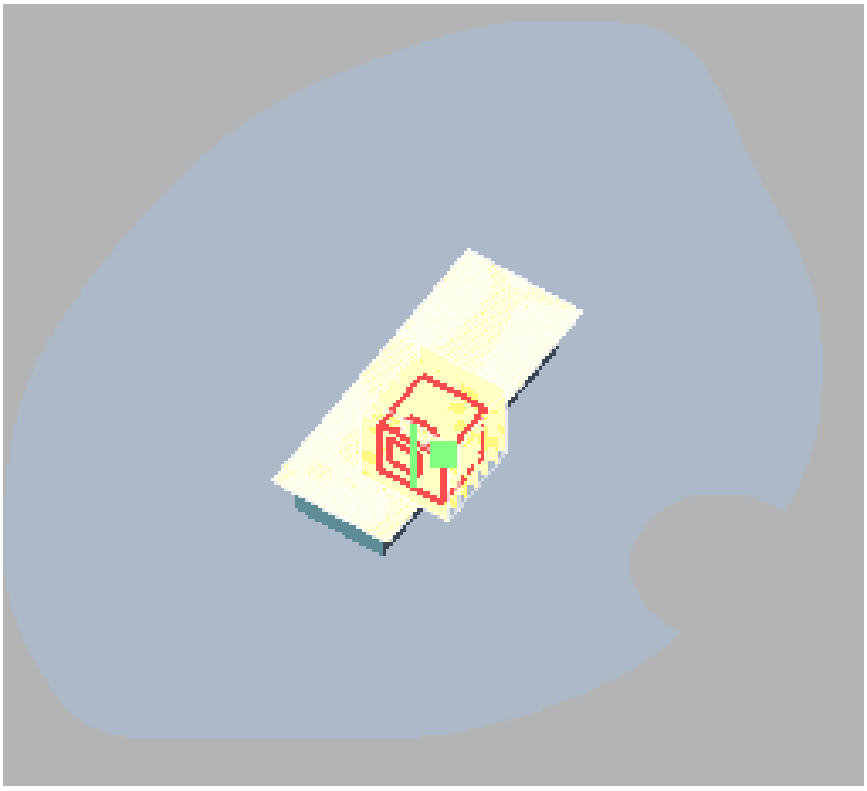
Grid Dimension : 41mmX101mmX1mm
Maximum SAR : 0.01 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 0.354 V/m
Measured SAR : 0.00611 W/Kg
Power Drift : 0.5 dB

Measurement Plot:

EUT Position: Edge 3



Protocol	Data rate	Channel Frequency (MHz)
802.11b	1 Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

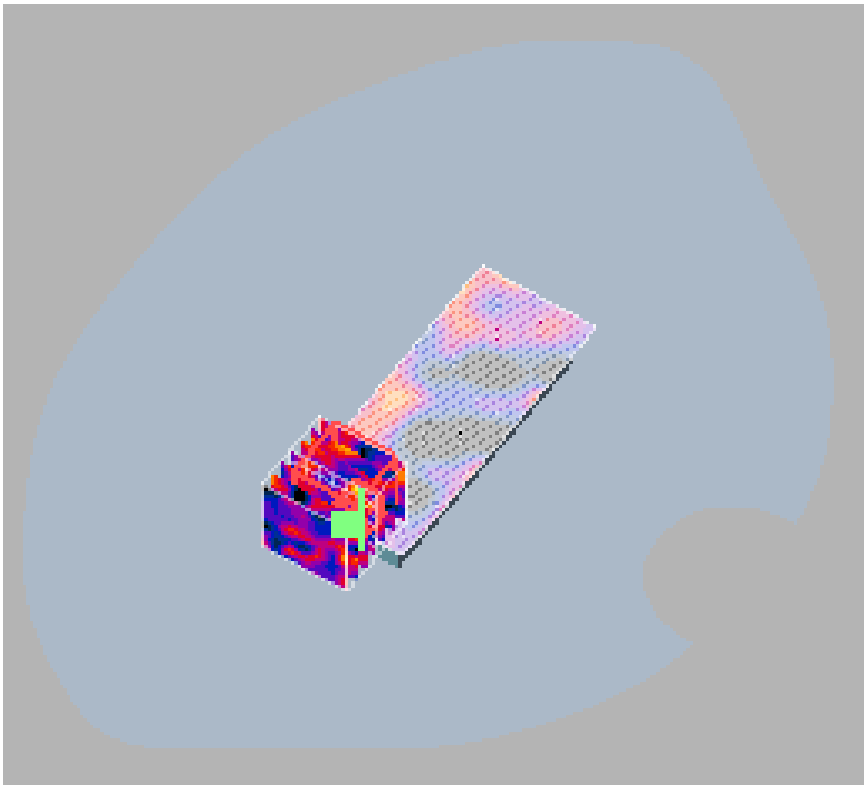
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.010 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 1.18 V/m
Measured SAR	: 0.00638 W/Kg
Power Drift	: 1.86 dB

Measurement Plot:

EUT Position: Edge 4



Protocol	Data rate	Channel Frequency (MHz)
802.11b	11Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

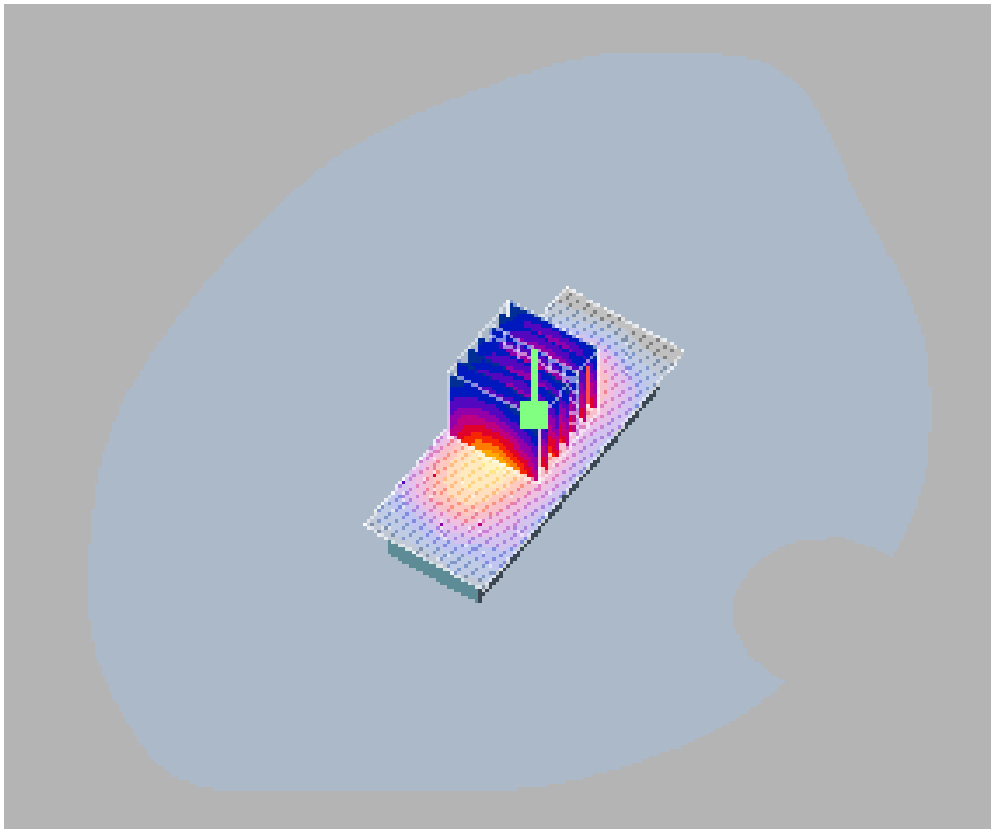
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.764 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 16.1 V/m
Measured SAR	: 0.611 W/Kg
Power Drift	: 0.27 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11g	6 Mbps	2437

Temperature of Liquid	: 22.5 ºC
Measured Conductivity	: 1.914 S/m
Measured Permittivity	: 52.23

Area Scan

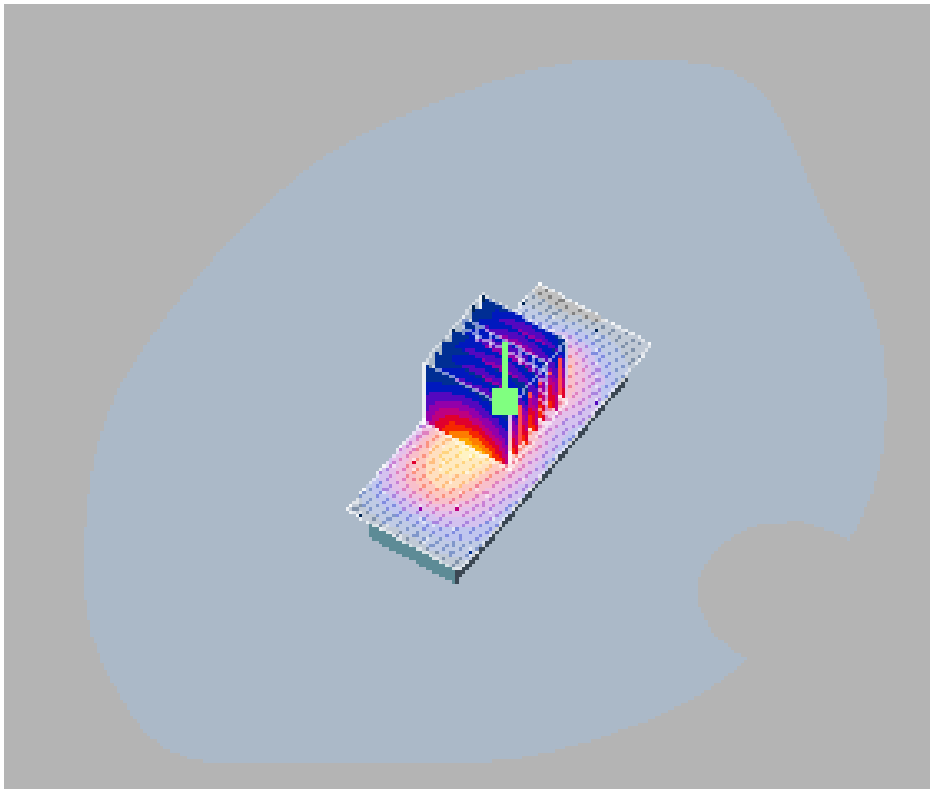
Grid Dimension	: 41mmX101mmX1mm
Maximum SAR	: 0.881 W/Kg

Zoom Scan

Grid Dimension	: 7mmX7mmX7mm
Power Reference	: 17.4 V/m
Measured SAR	: 0.725 W/Kg
Power Drift	: 0.24 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11g	6Mbps	2437

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.914 S/m
Measured Permittivity : 52.23

Area Scan

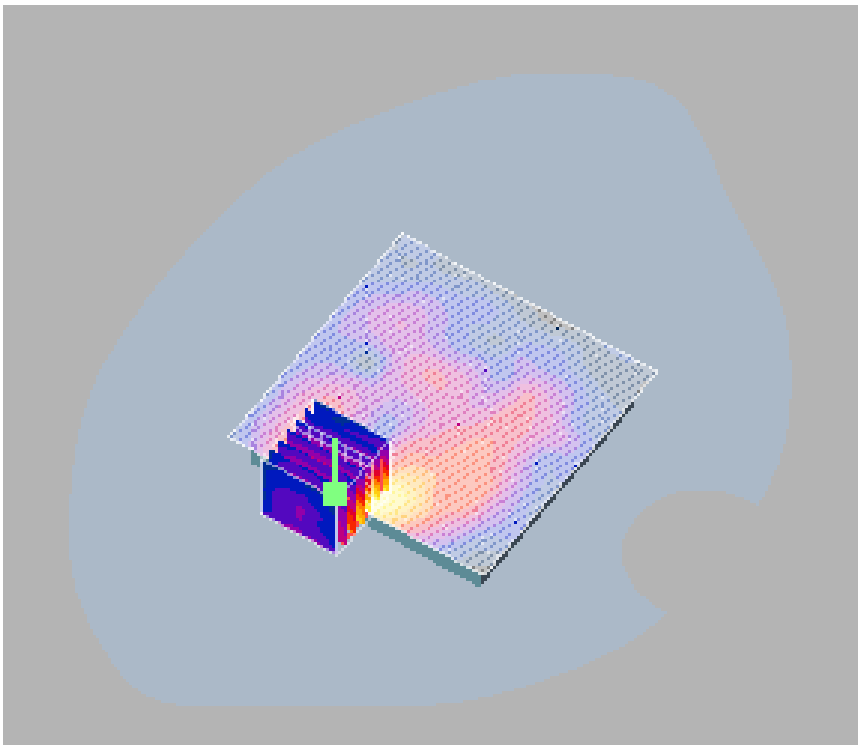
Grid Dimension : 41mmX101mmX1mm
Maximum SAR : 0.679 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 3.99 V/m
Measured SAR : 0.573 W/Kg
Power Drift : 0.7 dB

Measurement Plot:

EUT Position: Face 1



Protocol	Data rate	Channel Frequency (MHz)

802.11g	24Mbps	2437

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.914 S/m
Measured Permittivity : 52.23

Area Scan

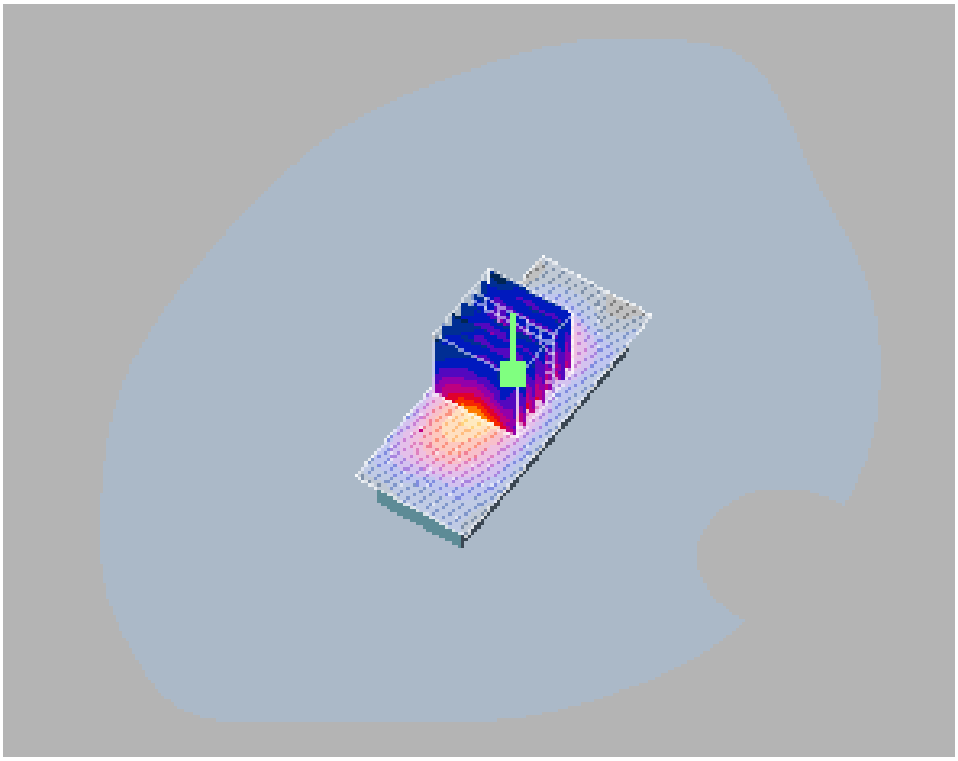
Grid Dimension : 41mmX101mmX1mm
Maximum SAR : 0.246 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 8.39 V/m
Measured SAR : 0.177 W/Kg
Power Drift : 0.6 dB

Measurement Plot:

EUT Position: Edge 2



Protocol	Data rate	Channel Frequency (MHz)
802.11g	54Mbps	2437

Temperature of Liquid : 22.5 ºC
Measured Conductivity : 1.914 S/m
Measured Permittivity : 52.23

Area Scan

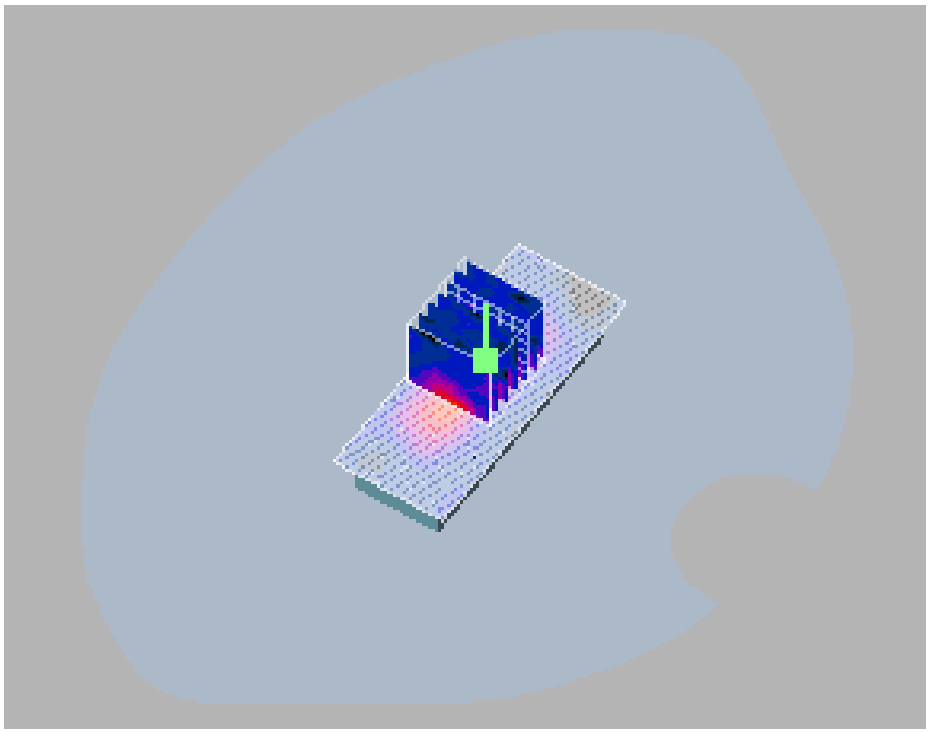
Grid Dimension : 41mmX101mmX1mm
Maximum SAR : 0.066 W/Kg

Zoom Scan

Grid Dimension : 7mmX7mmX7mm
Power Reference : 4.67V/m
Measured SAR : 0.054 W/Kg
Power Drift : 0.7 dB

Measurement Plot:

EUT Position: Edge 2

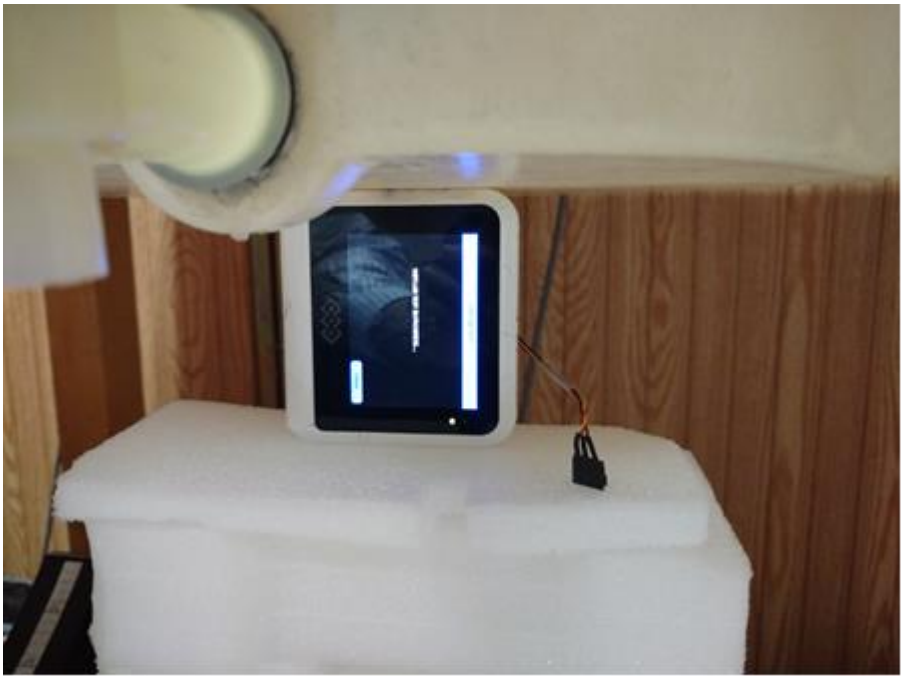


Test Setup photo:

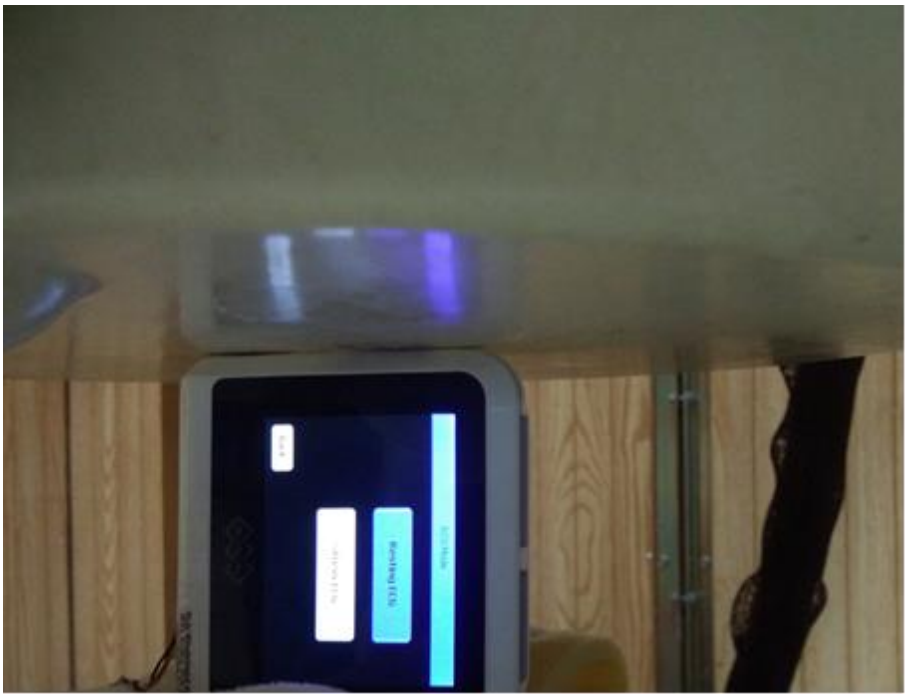
DAK setup

Face-1

Face-2



Edge-1

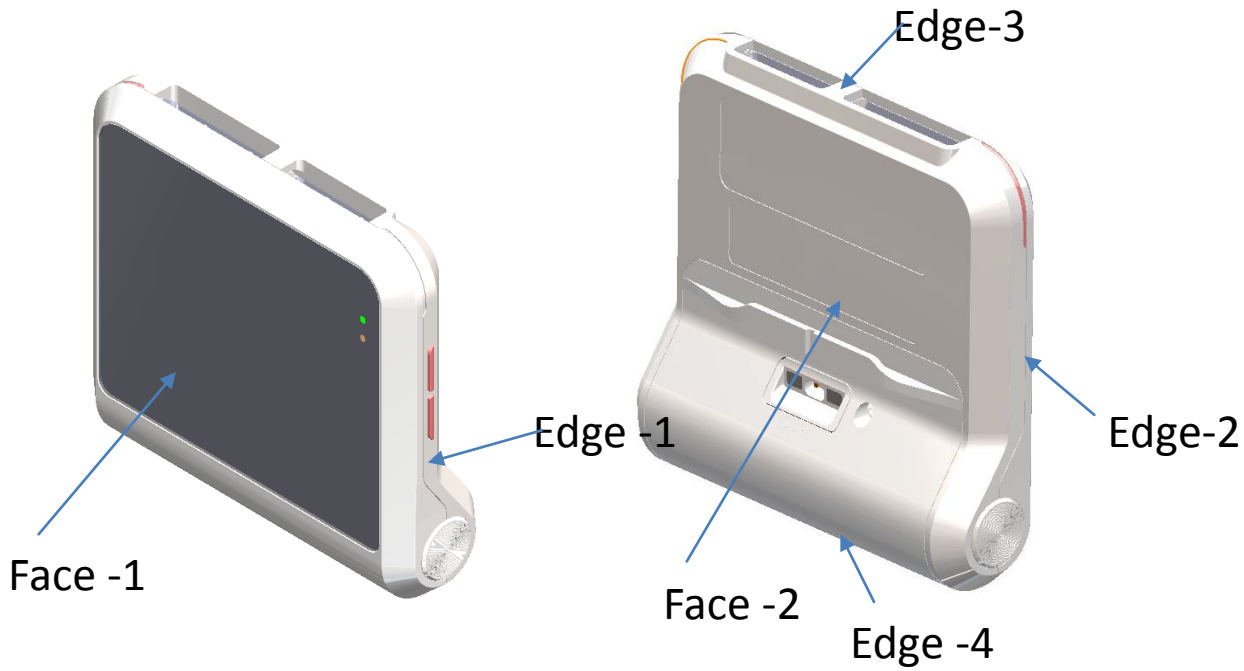


Edge-2

Edge-3

Edge-4

EUT Edge Identification:

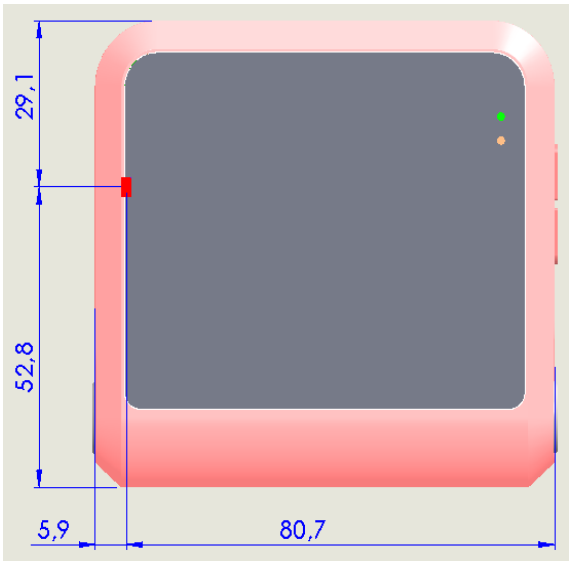


SAR Test Exclusion Thresholds for 100 MHz – 6 GHz based on the 447498 D01 General RF Exposure Guidance v06

Test Separation Distances (mm) are illustrated in the following images;

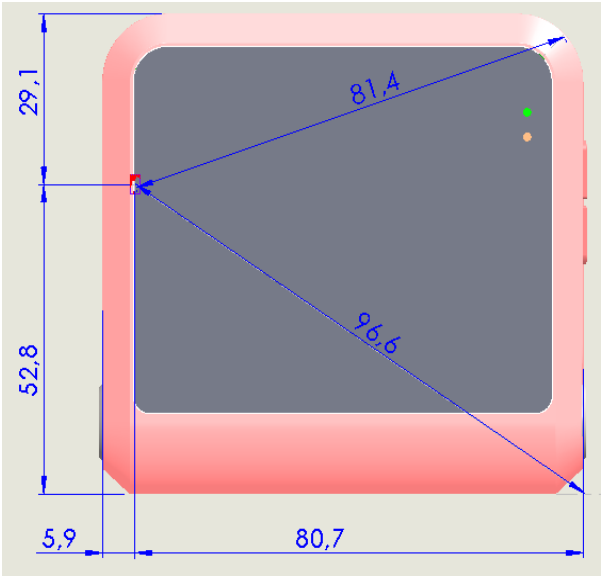
Edge-3

Edge-2



Edge-1

Edge-4



Antenna location is at edge 2 with indicated as red color dot, edge 1, edge 3 & edge 4 are separated more than 50mm & RF output power of the module was 14.62dBm

EUT Position	Separation distance (mm)	Allowed power level(dBm)
Edge 1	80.7	25.97
Edge 4	96.6	27.75
Edge 3	29.1	17.55