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TEST REPORT

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KCTL

1. Client

- Name : UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO.,LTD.
- Address : 141, Lane 351, Sec.1,Taiping Road., Tsaotuen, Nantou 54261, Taiwan
- Date of Receipt : 2020-09-25

2. Use of Report : Class II Permissive Change

3. Name of Product and Model : 802.11b/g/n + BT Wireless LAN Module
- Model Number : WM-BN-BM-26_A_FF3
- Manufacturer and Country of Origin : UNIVERSAL GLOVAL SCIENTIFIC INDUSTRIAL CO., LTD. / 141, Lane 351, Sec.1, Taiping Road., Tsaotuen, Nantou 54261, Taiwan

4. Host Product Name : Digital Camera
- Host Model Name : FF200003
- Manufacturer : FUJIFILM CORPORATION
- Brand Name : FUJIFILM

5. FCC ID Number : COF-WMBNBM26A

6. Date of Test : 2020-10-07

7. Location of Test : ■ Permanent Testing Lab □ On Site Testing (Address: Address of testing location)

8. Test Standards : IEEE 1528-2013, IEEE/ANSI C95.1-1992
KDB248227D01v02r02, KDB865664D01v01r04
KDB865664D02v01r02, KDB447498D01v06

9. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Mungi Jeong (Signature)	Technical Manager Name : Jongwon Ma (Signature)

2020-10-16

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2020-10-16	Originally issued	-

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1. General information

Client	:	UNIVERSAL GLOBAL SCIENTIFIC INDUSTRIAL CO.,LTD.
Address	:	141, Lane 351, Sec.1,Taiping Road., Tsaotuen, Nantou 54261, Taiwan
Manufacturer	:	FUJIFILM CORPORATION
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Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132
		VCCI Registration No. : R-3327, G-198, C-3706, T-1849
		Industry Canada Registration No. : 8035A
		KOLAS No.: KT231

1.2 Report Overview

This report details the results of testing carried out on the samples listed in section 2, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this test report is used in any configuration other than that detailed in the test report, the manufacturer must ensure the new configuration complies with all relevant standards and certification requirements. Any mention of KCTL Inc. Wireless lab or testing done by KCTL Inc. Wireless lab made in connection with the distribution or use of the tested product must be approved in writing by KCTL Inc. Wireless lab.

2. Device information

2.1 Basic description

Product Name		802.11b/g/n + BT Wireless LAN Module
Product Model Number		WM-BN-BM-26_A_FF3
Product Manufacturer		UNIVERSAL GLOVAL SCIENTIFIC INDUSTRIAL CO., LTD.
Host Product Name		Digital Camera
Host Model Number		FF200003
Host Manufacturer		FUJIFILM CORPORATION
Brand Name		FUJIFILM
Product Serial Number	Radiation	P1000086
	Conduction	P1OP-0002
Mode of Operation		WLAN 2.4 ㎓ , Bluetooth
Tx Freq. Range		WLAN 2.4 ㎓: 2 412.0 ㎒ ~ 2 462.0 ㎒ Bluetooth: 2 402.0 ㎒ ~ 2 480.0 ㎒

Note: RF exposure evaluation covers only BLE portion, Bluetooth EDR mode not used and excluded in SAR report.

2.2 Summary of SAR Test Results

Band	Equipment Class	Highest Reported 1g SAR (W/kg) Body
2.4 ㎓ WLAN	DTS	**< 0.1**
Bluetooth	DSS	< 0.1
Simultaneous SAR per KDB 690783 D01v01r03		N/A

2.3 #WLAN Antenna information

Antenna	Chip antenna
Frequency	2.4G
Gain (dBi)	3.68

2.4 #Maximum Tune-up power

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

2.4.1 #Maximum WLAN and Bluetooth Output Power

Band	Mode	Channel	Output Power (dB m)		
			Target	Max. Allowed	SAR Test
WLAN 2.4 GHz	802.11b	All Channel	13.00	**14.00**	Yes
	802.11g	All Channel	13.00	**14.00**	No
	802.11n(HT20)	All Channel	13.00	**14.00**	No

Band	Mode	Channel	Output Power (dB m)		
			Target	Max. Allowed	SAR Test
Bluetooth	LE	All Channel	5.00	**6.00**	Yes

2.5 SAR Test Configurations

2.5.1 #DUT Antenna Locations

A diagram showing the location of the device antennas can be found in Appendix C.

2.5.2 SAR Test Exclusion Considerations

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{\text{Max Power of Channel(mW)}}{\text{Test Separation Distance(mm)}} \times \sqrt{\text{Frequency(GHz)}} \leq 3.0(1\text{g} - \text{SAR})$$

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances > 50 mm is defined by the following equation:

$$\{[\textit{Power allowed at numeric threshold for } 50\ mm] + [(\textit{Test separation distance} - 50\ mm) \times 10]\}\quad mW, for > 1500\ MHz\ and\ \leq 6\ GHz$$

Band	Freq. [MHz]	Output Power		Separation distances [mm]						SAR Exemption					
		dBm	mW	Front	Rear	Left	Right	Top	Bottom	Front	Rear	Left	Right	Top	Bottom
2.4 GHz WLAN	2 462.0	14.00	25	12	59	16	130	59	43	3.27 Measure	186mW EXEMPT	2.45 EXEMPT	896mW EXEMPT	186mW EXEMPT	0.91 EXEMPT
Bluetooth LE	2 480.0	6.00	4	12	59	16	130	59	43	0.52 EXEMPT	185mW EXEMPT	0.39 EXEMPT	895mW EXEMPT	185mW EXEMPT	0.15 EXEMPT

Note 1: For distances < 5mm, a distance of 5mm is used to determine SAR exclusion and estimated SAR value.
Note 2: Output power is the maximum rated power (including tune-up or manufacturing tolerances) and includes source-based averaging.
Note 3: If the antenna separation distance is > 50mm then the value listed is the output power threshold, above which SAR measurement is required. For separation <= 50mm the value is the KDB 447498 calculated value and must be less than 3.0 for SAR exemption.
Note 4: Formulas round separation distance to nearest mm and power to nearest mW before calculating thresholds or exemption values.

Mode	Device Edge for SAR Testing (Front View)					
	Front	Rear	Left Edge	Right Edge	Top	Bottom
2.4 GHz WLAN	Yes	No	No	No	No	No
Bluetooth LE	*Yes	No	No	No	No	No

Note: Request of the applicant, the Bluetooth LE SAR test was performed.

2.6 #Simultaneous Transmission Configurations

According to FCC KDB 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.
This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

No.	Scenario	RF Exposure Condition
		Body
1	2.4 ㎓ WLAN + Bluetooth LE	No

Notes:

- It does not to transmit simultaneously the Bluetooth LE and 2.4 ㎓ WLAN.
- It is to use the Bluetooth LE and 2.4 ㎓ WLAN same antenna path.

2.7 SAR Test Methods and Procedures

The tests documented in this report were performed in accordance with IEEE 1528-2013 and the following published KDB procedures:

- IEEE 1528-2013
- IEEE/ANSI C95.1-1992
- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 865664 D01 SAR measurement 100 ㎒ to 6 ㎓ v01r04
- 865664 D02 RF Exposure Reporting v01r02
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)

3. Specific Absorption Rate

3.1 Introduction

The SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational / controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

3.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\boldsymbol{\delta}\mathbf{T}}{\boldsymbol{\delta}\mathbf{t}}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

4. SAR Measurement Procedures

4.1 SAR Scan Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 1.4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.
Step 2: Area Scan & Zoom Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot and Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing1 g and 10 g of simulated tissue. If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly. Area Scan & Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04.

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm ± 1 mm	½·δ·ln(2) mm 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details. * When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 3: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

5. RF Exposure Limits

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Partial Peak SAR [1] (Partial)	1.60 mW/g	8.00 mW/g
Partial Average SAR [2] (Whole Body)	0.08 mW/g	0.40 mW/g
Partial Peak SAR [3] (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

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

6. SAR General Measurement Procedures

6.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

6.2 SAR Testing with 802.11 Transmitters

The normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.

6.2.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 – 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

6.2.2 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.

6.2.3 2.4 ㎓ SAR Test Requirement

SAR is measured for 2.4 ㎓ 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following.

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel; i.e., all channels require testing.

2.4 ㎓ 802.11g/n OFDM are additionally evaluated for SAR if highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 ㎓ band, the Initial Test Configuration Procedures should be followed.

6.2.4 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 ㎓ and 5 ㎓ band, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel band width, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

6.2.5 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 ㎓ bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 ㏈ of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements.

6.2.6 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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7. RF Average Conducted Output Power

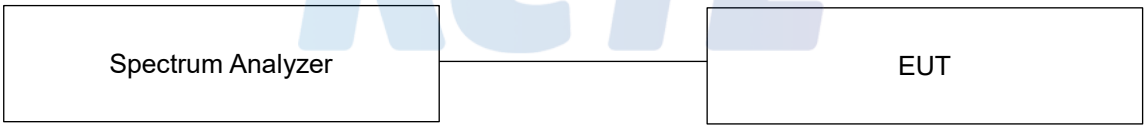
7.1 WLAN Average Conducted Output Power

Band	Freq. [MHz]	Channel	Mode		
			802.11b	802.11g	802.11n(HT20)
WLAN 2.4 GHz	2 412.0	1	12.05	12.66	12.53
	2 437.0	6	12.26	12.76	12.75
	2 462.0	11	12.49	13.17	12.97

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

Power Measurement Setup

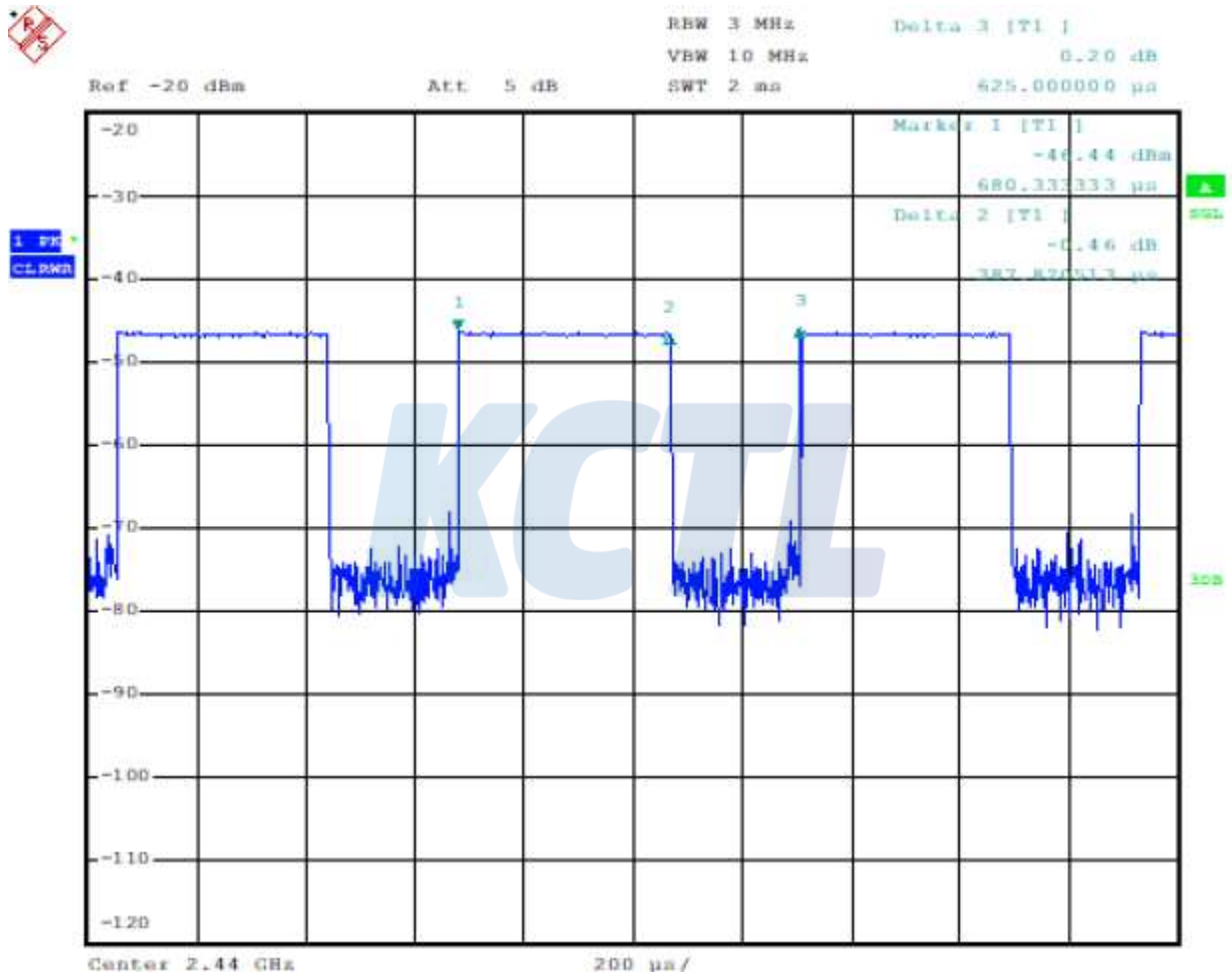


7.2 Bluetooth Average Conducted Output Power

Mode	Freq. [MHz]	Channel	Conducted Powers
			(dBm)
LE	2 402.0	0	4.55
	2 440.0	19	5.77
	2 480.0	39	5.30

7.3 Wireless Band Duty Cycle

Wireless Bands	Frequency Bands	Mode		Duty Cycle (%)	
WLAN	2.4 GHz	802.11b		99.70	
Bluetooth	Mode	On Time (ms)	On-Off Time (ms)	Duty Cycle (%)	Duty Cycle Compensate Factor
	LE	0.387	0.625	62.0	1.612



8. System Verification

8.1 Tissue Verification

The dielectric properties for this Tissue Simulant Liquids were measured by using the SPEAG Model DAK3.5 Dielectric Probe in conjunction with Agilent E5071B Network Analyzer (300 kHz – 8 500 ㎒). The Conductivity (σ) and Permittivity (ρ) are listed in Table 1.For the SAR measurement given in this report. The temperature variation of the Tissue Simulant Liquids was (22 ± 2) ℃.

Freq. (㎒)	Limit/Measured		Permittivity (ρ)	Conductivity (σ)	Temp. (°C)
2 450.0	Recommended Limit		39.20 ± 5 % (37.24 ~ 41.16)	1.80 ± 5 % (1.71 ~ 1.89)	22 ± 2
	Measured	2020-10-07	38.38	1.84	20.39

<Table 1. Measurement result of Tissue electric parameters>

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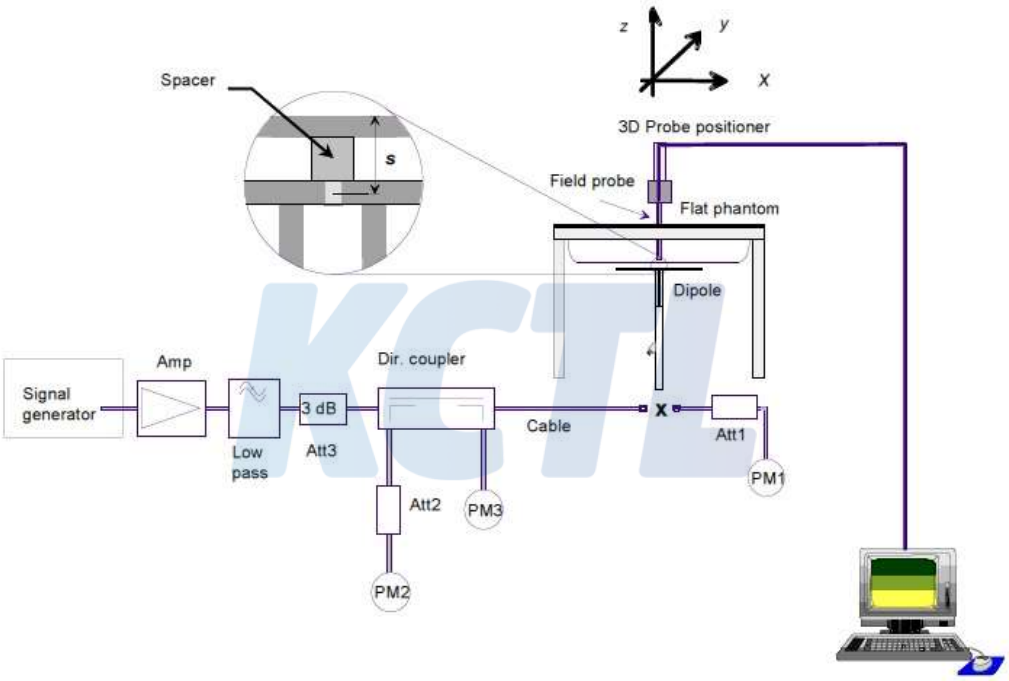
8.2 Test System Verification

The microwave circuit arrangement for system verification is sketched below picture.
The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within ± 10% from the t arget SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the Table 2. During the tests, the ambient temperature of the laboratory was in the range (22 ± 2) ℃, th e relative humidity was in the range(50 ± 20)% and the liquid depth Above the ear/grid refer ence points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



Verification Kit	Probe S/N	Frequency (㎒)	Tissue Type	Limit/Measured (Normalized to 1 W)		
D2450V3 SN: 895	EX3DV4 SN: 7540	2 450.0	HSL	Recommended Limit 1g (Normalized)		52.40 ± 10 % (47.16~57.64)
				Measured	2020-10-07	54.00

<Table 1. System Verification>

9. SAR Test Results

9.1 Standalone Body SAR Test Results

WLAN 2.4 GHz										
Mode	EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Plot No.
802.11b	Front	0	2 462.0	12.49	14.00	1.416	1.003	0.059	**0.084**	1
	Front Tilt	0	2 462.0	12.49	14.00	1.416	1.003	0.020	0.028	

Bluetooth										
Mode	EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Plot No.
Bluetooth LE	Front	0	2 440.0	5.77	6.00	1.054	1.612	N/A	N/A	
	Front Tilt	0	2 440.0	5.77	6.00	1.054	1.612	0.003	**0.005**	2

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings and the standard batteries are the only options.
4. Liquid tissue depth was at least 15 cm.
5. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
6. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
7. The “N/A” means there is no SAR value or the SAR is too low to be.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.
3. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured.
4. WLAN transmission was verified using a spectrum analyzer.
5. In case of “Front Tilt” position, it has been additional verified considering the case of lens mounting. Refer to the appendix E for detailed location.
6. WLAN & Bluetooth transmission was verified using a spectrum analyzer.

10. SAR Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) **Repeated measurements are not required when the original highest measured SAR is < 0.80 W/㎏.**
2) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
3) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Band	Frequency (㎒)	EUT Position	Separation Distance (㎜)	Measured 1 g SAR (W/kg)	Repeated 1g SAR (W/kg)	Ratio
N/A						

11. Measurement Uncertainty

Per KDB 865664 D01 SAR measurement 100㎒ to 6㎓, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of *k* = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Standard 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

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12. Test Equipment Information

Test Platform	SPEAG DASY5 System			
Version	DASY52: 52.10.4.1527 / SEMCAD: 14.6.14 (7483)			
Location	KCTL Inc, 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea			
Manufacture	SPEAG			
Hardware Reference				
Equipment	Model	Serial Number	Date of Calibration	Due date of next Calibration
Shield Room	-	8F - 2	-	-
DASY5 Robot	TX90XL	F12/5L7FA1/A/01	-	-
Phantom	2mm Oval Phantom ELI5	1178	-	-
Mounting Device	Mounting Device	-	-	-
DAE	DAE4	1586	2020-04-22	2021-04-22
Probe	EX3DV4	7540	2020-04-28	2021-04-28
ESG Vector Signal Generator	E4438C	MY42080486	2020-05-11	2021-05-11
Dual Power Meter	E4419B	GB43312301	2020-05-12	2021-05-12
Power Sensor	8481H	3318A 19379	2020-05-12	2021-05-12
Power Sensor	8481H	3318A 19377	2020-05-12	2021-05-12
Attenuator	8491B 3dB	17387	2020-05-12	2021-05-12
Attenuator	8491B 10dB	29425	2020-05-12	2021-05-12
Attenuator	8491B-6dB	MY39270294	2020-05-12	2021-05-12
Power Amplifier	2055-BBS3Q7E9I	1005D/C0521	2020-03-12	2021-03-12
Dual Directional Coupler	772D	2839A00719	2020-05-12	2021-05-12
Low Pass Filter	LA-30N	40058	2020-05-12	2021-05-12
Dipole Validation Kits	D2450V2	895	2020-07-21	2022-07-21
Network Analyzer	E5071B	MY42403524	2020-02-27	2021-02-27
Dielectric Assessment Kit	DAK-3.5	1078	2020-05-19	2021-05-19
Humidity/Temp.	MHB-382SD	23107	2020-05-14	2021-05-14

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13. Test System Verification Results

Date: 2020-10-07

Test Laboratory: KCTL Inc.
File Name: 2450 MHz Verification Input Power 100 mW 2020-10-07.da5:0

DUT: Dipole 2450 MHz D2450V2, Type: D2450V2, Serial: D2450V2 - SN:895

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.844 S/m; ε_r = 38.381; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

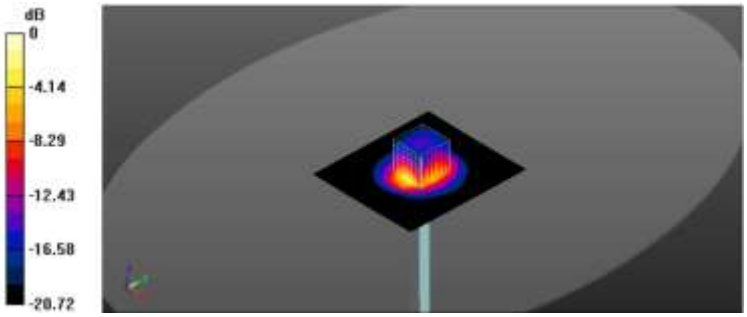
- Probe: EX3DV4 - SN7540; ConvF(7.46, 7.46, 7.46) @ 2450 MHz; ; Calibrated: 2020-04-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

Configuration/2450 MHz Verification Input Power 100 mW 2020-10-07/Area Scan (10x11x1):
Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 7.88 W/kg

Configuration/2450 MHz Verification Input Power 100 mW 2020-10-07/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 70.91 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 11.0 W/kg
SAR(1 g) = 5.4 W/kg; SAR(10 g) = 2.58 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.6%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 8.89 W/kg



0 dB = 8.89 W/kg = 9.49 dBW/kg

14. Test Results

1)

Date: 2020-10-07

Test Laboratory: KCTL Inc.
File Name: 1. 2.4G 802.11b Body.da53:0

DUT: FF200003, Type: Digital Camera, Serial: P1000086

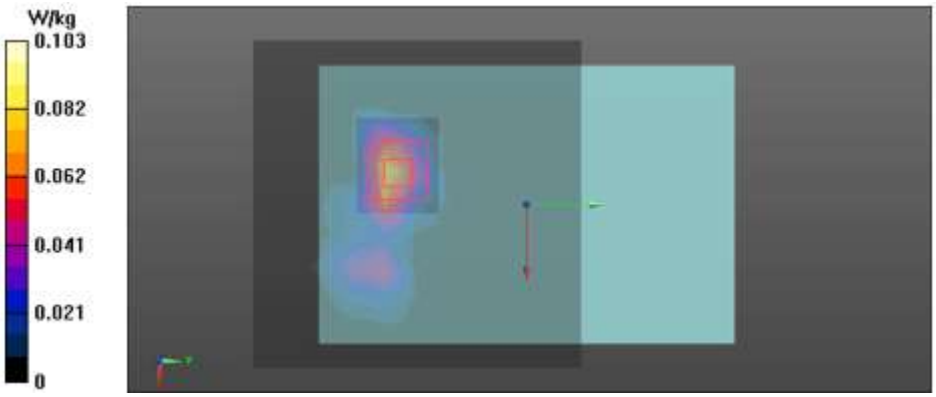
Communication System: UID 0, 2.4GWLAN (0); Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; σ = 1.858 S/m; ε_r = 38.33; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7540; ConvF(7.46, 7.46, 7.46) @ 2462 MHz; ; Calibrated: 2020-04-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

Configuration/802.11 b_CH11_Front_0 mm/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0764 W/kg

Configuration/802.11 b_CH11_Front_0 mm/Zoom Scan (8x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.686 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.126 W/kg
SAR(1 g) = 0.059 W/kg; SAR(10 g) = 0.023 W/kg
Smallest distance from peaks to all points 3 dB below = 7 mm
Ratio of SAR at M2 to SAR at M1 = 50.3%
Maximum value of SAR (measured) = 0.103 W/kg



2)

Date: 2020-10-07

Test Laboratory: KCTL Inc.
File Name: 2. Bluetooth Body.da53:0

DUT: FF200003, Type: Digital Camera, Serial: P1000086

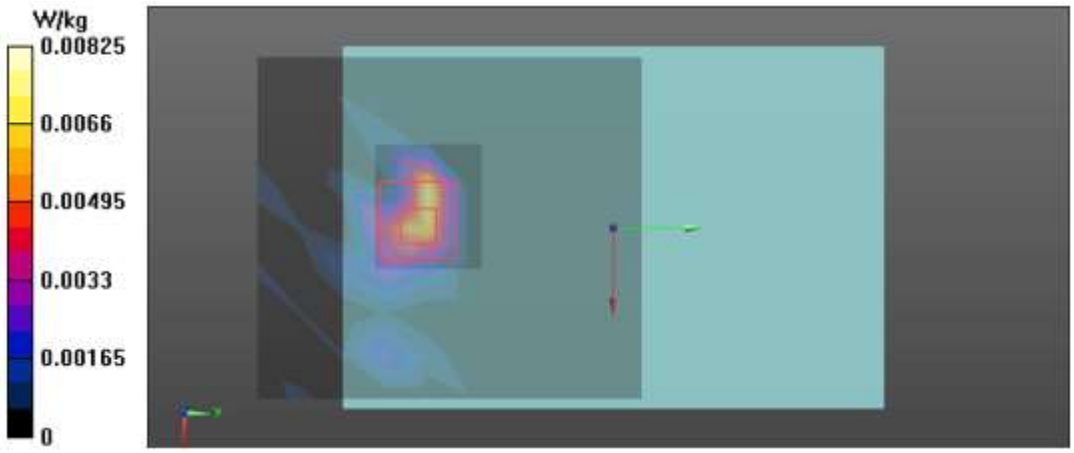
Communication System: UID 0, Bluetooth LE (0); Frequency: 2440 MHz; Duty Cycle: 1:1.6125
Medium parameters used: f = 2440 MHz; σ = 1.836 S/m; ε_r = 38.412; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7540; ConvF(7.46, 7.46, 7.46) @ 2440 MHz; ; Calibrated: 2020-04-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1586; Calibrated: 2020-04-22
- Phantom: ELI v5.0 sn1178; Type: QDOVA002AA; Serial: TP:1178
- Measurement SW: DASY52, Version 52.10 (4);

Configuration/Bluetooth_CH19_Front_0 mm/Area Scan (9x10x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.00630 W/kg

Configuration/Bluetooth_CH19_Front_0 mm/Zoom Scan (8x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.0140 W/kg
SAR(1 g) = 0.00256 W/kg; SAR(10 g) = 0.00036 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 36.8%
Maximum value of SAR (measured) = 0.00825 W/kg



Appendixes List

Appendix A	A.1 Probe Calibration certificate (EX3DV4_7540) A.2 Dipole Calibration certificate (D2450V2_895)
Appendix B	SAR Tissue Specification
Appendix C	#Antenna Location & Distance
Appendix D	EUT Photo
Appendix E	Test Setup Photo

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