SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
MiiS Horus Control Unit Set

FCC ID: 2AFB3M-DSC300P

Model Name: MiiS Horus Scope DSC 300P

Model No. of Lens: MiiS Horus Scope DEC 100, MiiS Horus Scope EEC 100, MiiS Horus Scope DEA 100, Illumination Light Source (ILS 100), MiiS Horus Scope DEA 200P, MiiS Horus Scope DGC 100, MiiS Horus Scope DOC 100S, MiiS Horus Scope DOC 300S, MiiS Horus Scope DDC 100, MiiS Horus Scope DDC 200, MiiS Horus Scope Adapter 300

Report Number: 4788934758-US-S0-V0
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Revision History

Rev.	Date	Revisions	Revised By
V0	8/6/2019	Initial Issue	Sky Zhou
-	8/20/2019	P.5 Revise DSS to DTS (BLE)	Sky Zhou
-	8/22/2019	P.24 Delete " Only DTS supports hotspot"	Sky Zhou

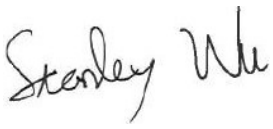
Table of Contents

1. Attestation of Test Results

Applicant Name	Medimaging Integrated Solution Inc.	
FCC ID	2AFB3M-DSC300P	
Model Name	MiiS Horus Scope DSC 300P	
Model No. of Lens	MiiS Horus Scope DEC 100, MiiS Horus Scope EEC 100, MiiS Horus Scope DEA 100, Illumination Light Source (ILS 100), MiiS Horus Scope DEA 200P, MiiS Horus Scope DGC 100, MiiS Horus Scope DOC 100S, MiiS Horus Scope DOC 300S, MiiS Horus Scope DDC 100, MiiS Horus Scope DDC 200, MiiS Horus Scope Adapter 300	
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013	
Exposure Category	SAR Limits (W/Kg)	
	Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population/ Uncontrolled exposure	4	
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)	
	DTS	DTS (BLE)
Extremities	0.104	0.017
Simultaneous TX (MIMO)	0.468	
Date Tested	6/6/2019 ~ 6/18/2019	
Test Results	Pass	

Underwriters Laboratories Taiwan Co., Ltd., tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd., based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd., and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd., will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of any government. This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Authorized By:	Prepared By:
	
Stanley Wu Senior Project Engineer Underwriters Laboratories Taiwan Co., Ltd.	Sky Zhou Engineer Underwriters Laboratories Taiwan Co., Ltd.

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

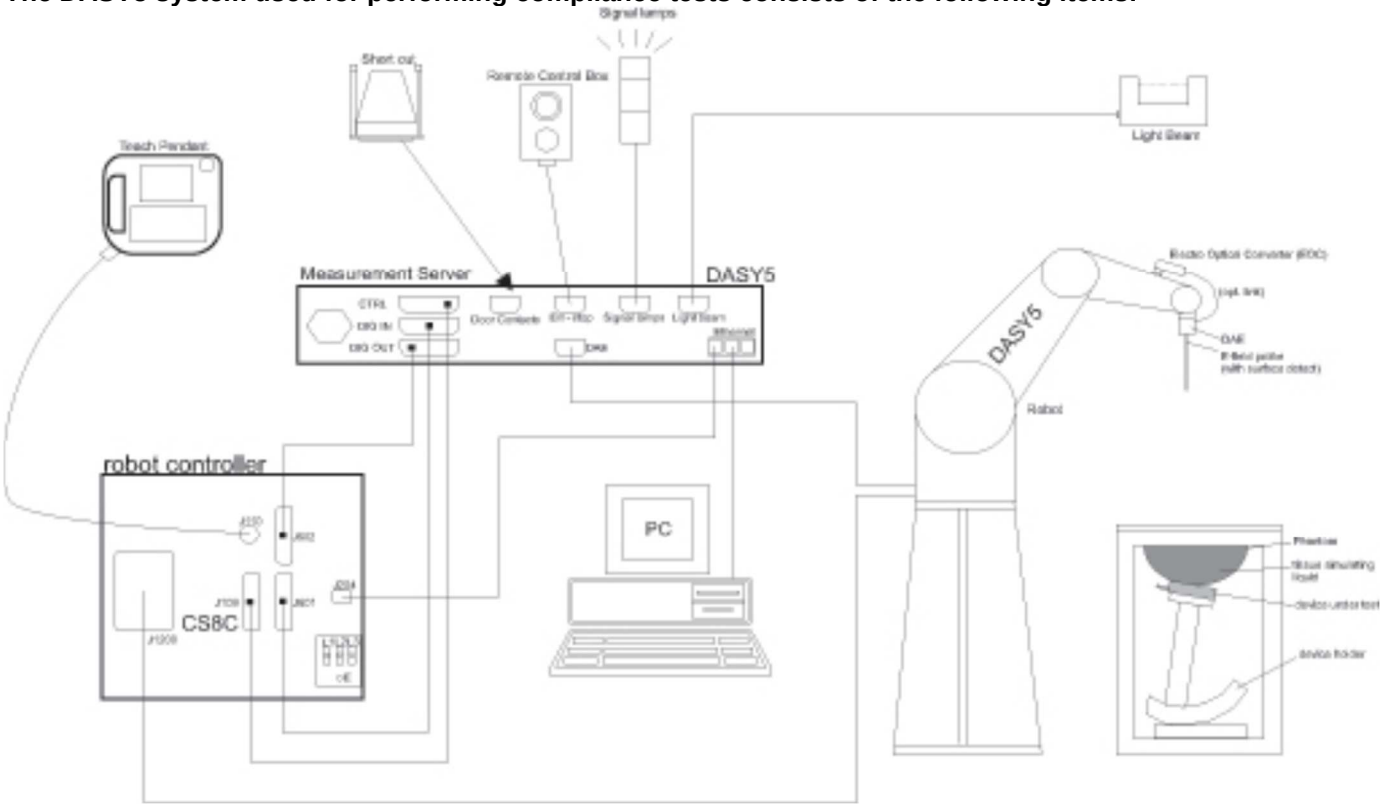
Underwriters Laboratories Taiwan Co., Ltd.,
SAR Room

Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



- A standard high precision 6-axis robot 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 WinXP or Win7 and 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.

4.2. 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

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. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). 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 Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 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.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 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.</td></tr>
</table>

Step 4: 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.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	MS46322B	1740002	2019/12/25
Dielectric Probe kit	SPEAG	DAK-3.5	1250	2019/9/18
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 CB	2019/9/18
Thermometer	DER EE	DE-3003	P0006880	2020/1/3

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
EXG-B RF Vector Signal Generator	Keysight Technologies	N5182B	MY56200244	2020/1/3
Power Meter	Keysight	N1914A	MY56360007	2019/12/13
Power Meter	ANRITSU	ML2495A	1645002	2019/12/16
Power Sensor	Keysight	N8481H	MY56350009	2019/12/13
Power Sensor	ANRITSU	MA2411B	1531202	2019/12/16
Amplifier	Mini-Circuits	ZHL-42W+	51701624	N/A
Amplifier	Mini-Circuits	ZVE-8G+	88201629	N/A
20dB Directional Coupler	N/A	N/A	150820087	N/A
DC Power Supply	GW Insrek	GPD-2303S	GEQ902177	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe	SPEAG	EX3DV4	3901	2019/9/27
Data Acquisition Electronics	SPEAG	DAE4	1360	2019/12/18
System Validation Dipole	SPEAG	D2450V2	988	2019/12/7
FSV40 Signal Analyzer	Rohde & Schwarz	FSV40	101490	2019/9/24

UL Software

Software Version
DASY NEO52 D10.1 S14.6.11
SEMCAD-X-PostPro

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, 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 Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

Product Name	MiiS Horus Control Unit Set
Model Name	MiiS Horus Scope DSC 300P
Model No. of Lens	MiiS Horus Scope DEC 100, MiiS Horus Scope EEC 100, MiiS Horus Scope DEA 100, Illumination Light Source (ILS 100), MiiS Horus Scope DEA 200P, MiiS Horus Scope DGC 100, MiiS Horus Scope DOC 100S, MiiS Horus Scope DOC 300S, MiiS Horus Scope DDC 100, MiiS Horus Scope DDC 200, MiiS Horus Scope Adapter 300
Device Dimension	Overall (Length x Width x height): 202.5 mm x 89 mm x 79 mm
Back Cover	☒ Normal Battery Cover
Battery Options	☒ Standard –Rechargeable Li-ion Battery, Rating 3.6Vdc, 3350mAh
Hardware Version	B1
Software Version	V1.0-190620-0023.01-MI
Sample Stage	Production equivalent

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20) 802.11n (HT40)	100% (802.11b/g/n 20MHz BW/n 40MHz BW)
Bluetooth	2.4 GHz	LE	62.94%

6.3. Maximum Output Power

At the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit.

Band/ Mode		Tune up Power (dBm) (Average Power)	
		Chain 0	Chain 1
2.4 GHz	802.11b	17.5	
	802.11g	15.5	
	802.11n HT20(MIMO)	11.5	
	802.11n HT40(MIMO)	11.5	

Band/ Mode		Tune up Power (dBm) (Peak Power)
Bluetooth	BLE	-8.5

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-edge(s) distances.

7.1. Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 § 4.3.1 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

SAR Test Exclusion Calculations for WLAN

Antennas < 50mm to adjacent edges

SISO

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6
Antenna1															
Wi-Fi 2.4 GHz	2462	17.50	56	13.91	5	157.61	5	24.72	34.26	6.3 -EXEMPT-	17.6 -MEASURE-	> 50 mm	17.6 -MEASURE-	3.5 -EXEMPT-	2.6 -EXEMPT-
Antenna2															
Bluetooth	2480	-8.50	1	13.91	5	154.7	5	44	34.26	0.1 -EXEMPT-	0.3 -EXEMPT-	> 50 mm	0.3 -EXEMPT-	0 -EXEMPT-	0 -EXEMPT-

MIMO

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6
Antenna1															
Wi-Fi 2.4 GHz	2462	11.50	14	13.91	3.94	157.61	2.74	24.72	34.26	1.6 -EXEMPT-	4.4 -EXEMPT-	> 50 mm	4.4 -EXEMPT-	0.9 -EXEMPT-	0.6 -EXEMPT-
Antenna2															
Wi-Fi 2.4 GHz	2462	11.50	14	13.91	5	154.7	5	44	34.26	1.6 -EXEMPT-	4.4 -EXEMPT-	> 50 mm	4.4 -EXEMPT-	0.5 -EXEMPT-	0.6 -EXEMPT-

Note(s):

According to KDB 447498, if the calculated threshold value is >7.5 then SAR testing is required.

Antennas > 50mm to adjacent edges

SISO

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6
Antenna1															
Wi-Fi 2.4 GHz	2462	17.50	56	13.91	3.94	157.61	2.74	24.72	34.26	< 50 mm	< 50 mm	1171.7 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Antenna2															
Bluetooth	2480	-8.50	1	13.91	5	154.7	5	44	34.26	< 50 mm	< 50 mm	1142.3 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm

MIMO

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6
Antenna1															
Wi-Fi 2.4 GHz	2462	11.50	14	13.91	3.94	157.61	2.74	24.72	34.26	< 50 mm	< 50 mm	1171.7 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Antenna2															
Wi-Fi 2.4 GHz	2462	11.50	14	13.91	5	154.7	5	44	34.26	< 50 mm	< 50 mm	1142.6 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm

Note(s):

According to KDB 447498 (RSS-102 Issue 5 § 2.5.1), if the calculated Power threshold is less than the output power then SAR testing is required.

7.2. Required Test Configurations

The table below identifies the standalone test configurations required for this device according to the findings in Section 7.1:

Test Configurations	Edge 1	Edge 2	Edge 3	Edge 4	Edge 5	Edge 6
Wi-Fi 2.4 GHz SISO (Antenna 1)	No	Yes	No	Yes	No	No
Bluetooth	No	No	No	No	No	No
Wi-Fi 2.4 GHz MIMO (Antenna 1)	No	No	No	No	No	No
Wi-Fi 2.4 GHz MIMO (Antenna 2)	No	No	No	No	No	No

Note(s):

Yes = Testing is required.

No = Testing is not required.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 2 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2019/6/17	Head	2400	38.73	39.29	-1.41	1.81	1.76	3.22
		2450	38.59	39.20	-1.56	1.87	1.80	3.76
		2480	38.49	39.16	-1.71	1.89	1.83	3.42

8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 1.4 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 1.4 mm
- The dipole input power (forward power) was 250 mW (below 3 GHz) and 100 mW (3 - 6 GHz).
- The results are normalized to 1 W input power.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
				Zoom Scan to 250 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 250 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
2019/6/17	Head	D2450V2_988	2019/12/6	13.20	52.8	52.90	-0.19	6.13	24.52	24.80	-1.13	1
2019/6/18	Head	D2450V2_988	2019/12/6	12.50	50.0	52.90	-5.48	5.86	23.44	24.80	-5.48	2

9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4GHz (DTS Band)

SISO

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
2.4	802.11b	1 Mbps	1	2412	16.33	17.5	Yes
			6	2437	16.35		
			11	2462	16.38		
	802.11g	6 Mbps	1	2412	Not Required	15.5	No
			6	2437			
			11	2462			
	802.11n (HT20)	6.5 Mbps	1	2412		14.5	No
			6	2437			
			11	2462			
	802.11n (HT40)	13.5 Mbps	3	2422		14.5	No
			6	2437			
			9	2452			

MIMO

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
MIMO Chain 0	2.4	802.11n (HT20)	6.5 Mbps	1	2412	10.36	11.5	No
				6	2437	10.53		
				11	2462	10.25		
		802.11n (HT40)	13.5 Mbps	3	2422	10.29	11.5	No
				6	2437	10.46		
				9	2452	10.32		
MIMO Chain 1	2.4	802.11n (HT20)	6.5 Mbps	1	2412	10.21	11.5	No
				6	2437	10.24		
				11	2462	10.49		
		802.11n (HT40)	13.5 Mbps	3	2422	10.55	11.5	No
				6	2437	10.01		
				9	2452	10.76		

Note(s):

1. SAR is not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 3 W/kg.
2. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

9.2. Bluetooth

Measured Results

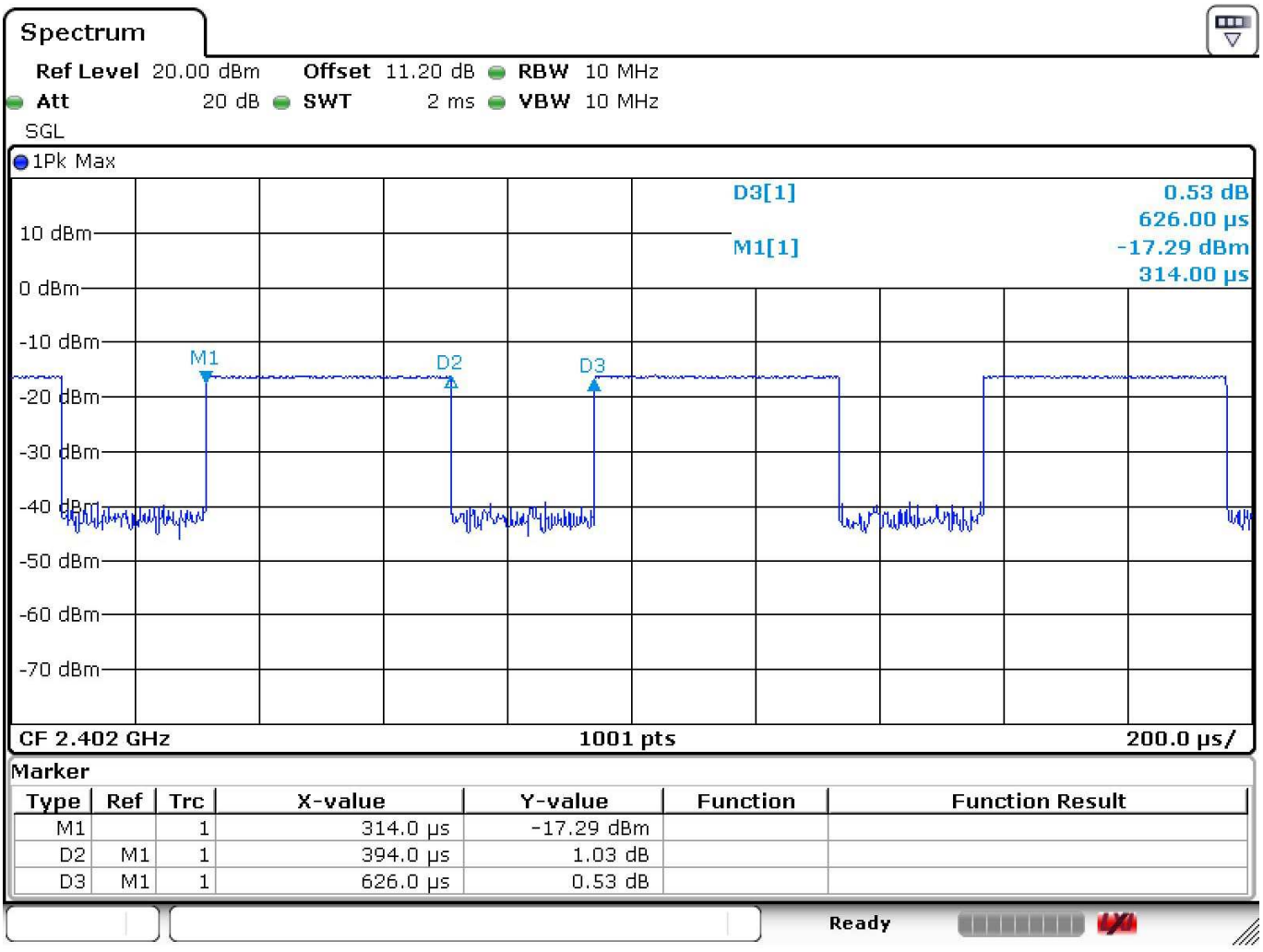
Band (GHz)	Mode	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Meas. Avg Pwr (mW)
2.4	LE, GFSK	0	2402	-9.90	0.10
		19	2440	-10.16	0.10
		39	2480	-11.03	0.08

Duty Factor Measured Results

Mode	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	0.394	0.626	62.94%	1.59

Duty Cycle plots

GFSK



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10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 248227 D01 SAR meas for 802.11:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- The multiplied by 2.5 when 10-g extremity SAR is considered.

10.1. Wi-Fi_Body (DTS Band)

Frequency Band	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	Meas.	Scaled	
2.4GHz	802.11b	Chain 0	0	Edge 2_DEC 100	6	2437.0	100.0%	17.5	16.35	0.010	0.013	0.003	0.004	
				Edge 4_DDC 200	6	2437.0	100.0%	17.5	16.35	0.235	0.306	0.074	0.096	
				Edge 4_DGC 100	6	2437.0	100.0%	17.5	16.35	0.226	0.295	0.070	0.091	
				Edge 4_DDC 100	6	2437.0	100.0%	17.5	16.35	0.234	0.305	0.074	0.096	
				Edge 4_EEC 100	6	2437.0	100.0%	17.5	16.35	0.214	0.279	0.067	0.087	
				Edge 4_DEA 200P	6	2437.0	100.0%	17.5	16.35	0.239	0.311	0.077	0.100	
				Edge 4_DOC 300S	6	2437.0	100.0%	17.5	16.35	0.212	0.276	0.066	0.086	
				Edge 4_DEA 100	6	2437.0	100.0%	17.5	16.35	0.250	0.326	0.078	0.102	
				Edge 4_DEA 100+ILS 100	6	2437.0	100.0%	17.5	16.35	0.223	0.291	0.070	0.091	
				Edge 4_DOC 100S	6	2437.0	100.0%	17.5	16.35	0.218	0.284	0.068	0.089	
				Edge 4_Adapter 300	6	2437.0	100.0%	17.5	16.35	0.191	0.249	0.059	0.077	
				Edge 4_DEC 100	6	2437.0	100.0%	17.5	16.35	0.249	0.324	0.080	0.104	1

10.2. Bluetooth

RF Air interface	RF Exposure Conditions	Frequency (GHz)	Max. tune-up tolerance Power		Min. test separation distance (mm)	SAR test exclusion Result*	Estimated 10-g SAR (W/kg)
			(dBm)	(mW)			
Bluetooth	Extremities	2.480	0.0	1	5	0.3	0.017

Conclusion:

*: The computed value is ≤ 7.5; therefore, this qualifies for Standalone SAR test exclusion.

11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated		Second Repeated		Third Repeated
						Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)
2400	Wi-Fi 802.11b/g/n	Extremity	Edge 4	No	0.080	N/A	N/A	N/A	N/A	N/A

Note(s):

The original highest measured SAR is < 2 W/kg (10-g) is not require repeated measurements.

12. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Extremities	1	DTS Antenna 1	+	DTS Antenna 2
Notes:				
1. DTS cannot transmit simultaneously with Bluetooth.				
2. DTS Antenna 1 supports b/g/n20/n40				
3. DTS Antenna 2 supports n20/n40				

Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - o When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - o When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - o When the minimum test separation distance is > 50 mm, the estimated 10-g SAR value is 1 W/kg
3. Please refer to Estimated SAR Tables to see which test positions are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of 10-g SAR values < 3 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR for WLAN

MIMO

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)	Estimated 10-g SAR Value (W/kg)
		dBm	mW		
Antenna1					
Wi-Fi 2.4 GHz	2462	11.50	14	5	0.234
Antenna2					
Wi-Fi 2.4 GHz	2462	11.50	14	5	0.234

12.1. Sum of the SAR for Wi-Fi MIMO

Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
DTS Ant 1 ①	DTS Ant 2 ②	DTS Ant1 + DTS Ant2 ① + ②
0.234	0.234	0.468

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 10-g SAR is < 4 W/kg or the SPLSR is < 0.1 for all circumstances that require SPLSR calculation.

Appendixes

Refer to separated files for the following appendixes.

4788934758-US-S0-V0 Appendix A: Antenna Dimensions and Separation Distances

4788934758-US-S0-V0 Appendix B: SAR System Check Plots

4788934758-US-S0-V0 Appendix C: Highest SAR Test Plots

4788934758-US-S0-V0 Appendix D: SAR Liquid Tissue Ingredients

4788934758-US-S0-V0 Appendix E: SAR Probe and Dipole Calibration Certificates

END OF REPORT