SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
2.4 GHz to sub-GHz pass-through device

FCC ID: QZC-UFTR1
Model Name: UFTR1

Report Number: R11662377-S1V2
Issue Date: 6/21/2017

Prepared for
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Revision History

Ver.	Date	Revisions	Revised By
1	3/27/2017	Initial Issue	Richard Jankovics
2	6/21/2017	Updated 900 MHz standalone value and its effect on the sum of SAR in Simultaneous Transmission SAR Analysis, and updated Simultaneous Tx value in Attestation of Test Results	Richard Jankovics

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1. Attestation of Test Results

Applicant Name	Elster Solutions LLC		
FCC ID	QZC-UFTR1		
Model Name	UFTR1		
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013		
SAR Limits (W/Kg)			
Exposure Category	Peak spatial-average (1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population / Uncontrolled exposure	1.6	4	
The Highest Reported SAR (W/kg)			
RF Exposure Conditions	**900 MHz**	**451.35 MHz**	**BLE**
Body-worn	0.582	1.497	N/A
Simultaneous TX	0.708		
Date Tested	3/13/2017 to 3/24/2017		
Test Results	Pass		

UL LLC 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 UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. 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 UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:	Prepared By:
Dave Weaver Program Manager UL LLC	Richard Jankovics WiSE Engineer UL LLC

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:

- 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 2800 Perimeter Park Dr, Morrisville, NC, USA.

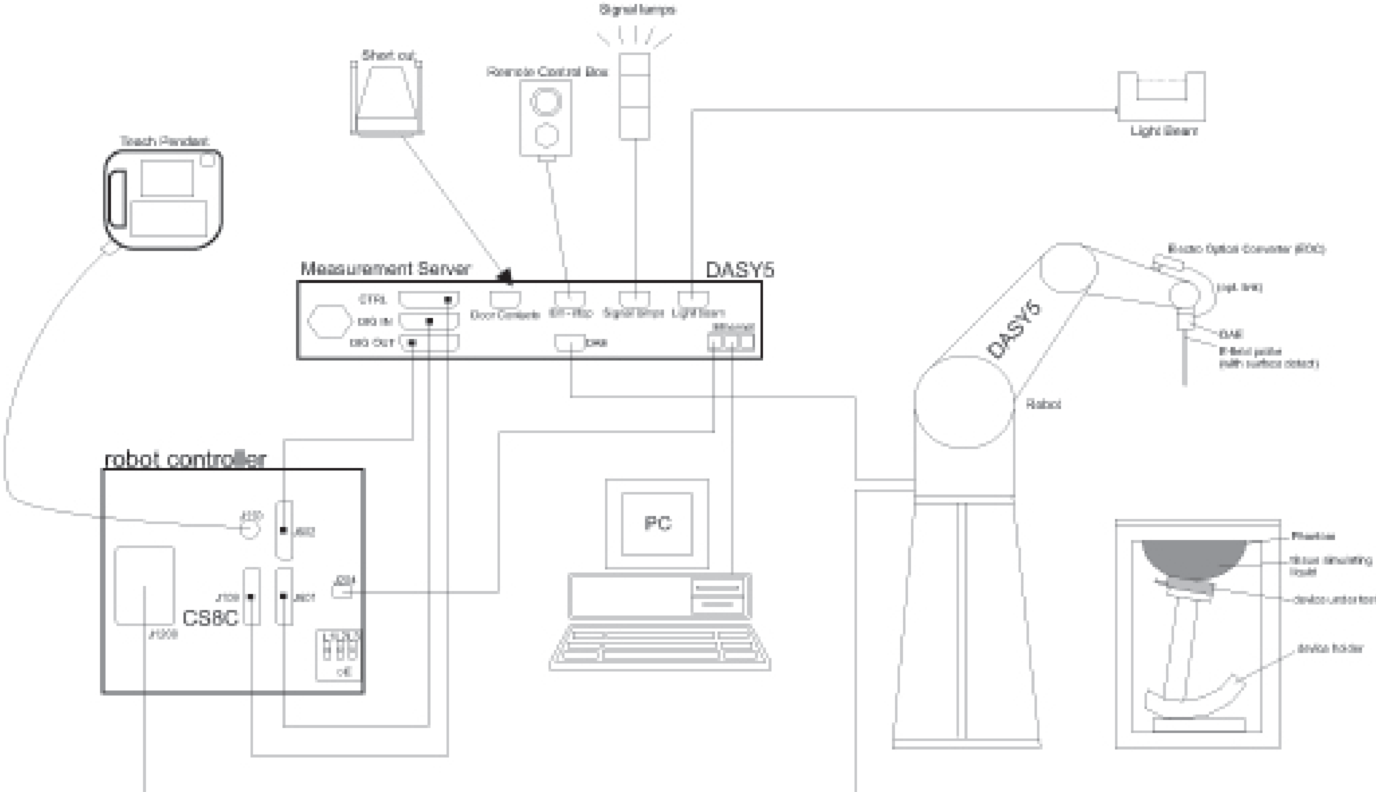
- SAR Lab 1A

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2002460.htm.

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 2.1 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

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
</table>

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

			≤ 3 GHz	> 3 GHz
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	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
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 draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* 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.

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
Reflectometer (VNA)	Copper Mountain Technologies	R140	190514	2018-02-21
Dielectric Probe	SPEAG	DAKS-3.5	1051	2018-02-21
Shorting Block	SPEAG	DAK-1.2/3.5 Short	SM DAK 200 CA	NA
Thermometer	Fisher Scientific	Traceable	161016511	2018-12-21

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Signal Generator	Keysight	N5181A	MY50140788	2017-03-31
Power Meter	Keysight	N1912A	MY55136012	2017-04-30
Power Sensor	Keysight	N1921A	MY55090030	2017-04-30
Power Sensor	Keysight	N1921A	MY55090023	2017-04-30
Amplifier	Amplical	AMP0.4G-34-27	150507	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	3266	N/A
DC Power Supply	GW	Dual Tracking Power Supply	B900219	N/A
E-Field Probe (SAR Lab 1A)	SPEAG	EX3DV4	7356	2017-04-20
Data Acquisition Electronics (SAR Lab 1A)	SPEAG	DAE4	1343	2017-08-15
System Validation Dipole	SPEAG	D450V3	1051	2018-09-21
System Validation Dipole	SPEAG	D900V2	1d180	2018-02-14
Environmental Meter	Traceable	15-077-963	161016511	2018-12-21

Note: System Validation Dipole D450V3 is calibrated at 3 yearly intervals in accordance with KDB 865644 D01. The verification plot is included in appendix F.

Dipole Validation

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Vector Network Analyzer	Keysight	E5063A	MY54100681	2017-03-31
VNA Calibration Kit	Keysight	N1912A	MY55136012	2017-04-30
Environmental Meter	Traceable	15-077-963	161016511	2018-12-21
Thermometer	Fisher Scientific	Traceable	161016511	2018-12-21

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 extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

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6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall Length: (Length x Width): 107.92 mm (195.8 mm including antenna) x 92.96 mm Overall Diagonal: 93.12 mm	
Back Cover	☒ The rechargeable battery is not user accessible.	
Battery Options	☒ The rechargeable battery is not user accessible.	
Test sample information	**S/N**	**Notes**
	5D26226G010108163700009	The front of the DUT, as identified throughout this report, refers to the side facing the user. This device is fastened to the user via a belt-clip.
Hardware Version	Rev C	
Software Version	255.28	

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wake-up Tone	451.35 MHz	2GFSK	100%
900 Interface Band	902.4 – 927.6 MHz	2FSK	50% (max declared 50%)
Bluetooth	2.4 GHz	BLE	N/A

6.3. Maximum Declared Output Power

RF Air interface	Mode	Max. RF Output Power (dBm)	Max. RF Output Power adjusted for duty cycle (dBm)
451	2GFSK	27.0	NA
900	2FSK	24.0	21.0

Note(s):

- 900 MHz radio output power is 24 dBm, however the manufacturer indicates a maximum duty cycle of 50%, therefore the effective output power is 21 dBm.

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and 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 to determine the minimum test separation distance:

- o 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.
- o 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.

<u>SAR Test Exclusion Calculations</u>

Antennas < 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
450	Wake-up tone	451.35	27.00	501	N/A	N/A	N/A	N/A	N/A	2.54	N/A	N/A	N/A	N/A	N/A	67.3 -MEASURE-
900	900 interface	927.6	21.00	126	N/A	N/A	N/A	N/A	N/A	6.35	N/A	N/A	N/A	N/A	N/A	20.2 -MEASURE-
BLE	BLE	2480	4.00	3	N/A	N/A	N/A	N/A	N/A	5.08	N/A	N/A	N/A	N/A	N/A	0.9 -EXEMPT-

Note(s):

- According to KDB 447498 (RSS-102 Issue 5 § 2.5.1), if the calculated threshold value is >3 then SAR testing is required.
- 900 MHz radio output power is 24 dBm, however the manufacturer indicates a maximum duty cycle of 50%, therefore the effective output power is 21 dBm.
- The normal use of this device is Body-worn only; therefore, Edge testing was not performed.

Antennas > 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
450	Wake-up tone	451.35	27.00	501	N/A	N/A	N/A	N/A	N/A	2.54	N/A	N/A	N/A	N/A	N/A	*< 50 mm*
900	900 interface	927.6	21.00	126	N/A	N/A	N/A	N/A	N/A	6.35	N/A	N/A	N/A	N/A	N/A	*< 50 mm*
BLE	BLE	2480	4.00	3	N/A	N/A	N/A	N/A	N/A	5.08	N/A	N/A	N/A	N/A	N/A	*< 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.
- 900 MHz radio output power is 24 dBm, however the manufacturer indicates a maximum duty cycle of 50%, therefore the effective output power is 21 dBm.
- The normal use of this device is Body-worn only; therefore, Edge testing was not performed.

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	Rear (away from user)	Edge 1 (Top Edge)	Edge 2 (Right Edge)	Edge 3 (Bottom Edge)	Edge 4 (Left Edge)	Front (adjacent to user)
451.35 MHz Wake-up tone	No	No	No	No	No	Yes
900 MHz meter interface	No	No	No	No	No	Yes
Bluetooth	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 3 – 4 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

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Dielectric Property Measurements Results:

SAR Lab	Date	Tissue Type	Band (MHz)	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
1A	3/13/2017	Body	450	450	55.01	56.70	-2.98	0.92	0.94	-1.79
				430	55.51	56.94	-2.51	0.91	0.94	-3.16
				480	54.45	56.58	-3.77	0.95	0.94	1.09
1A	3/24/2017	Body	900	900	54.57	55.00	-0.78	1.06	1.05	0.95
				880	54.73	55.07	-0.62	1.04	1.02	1.82
				915	54.43	55.00	-1.04	1.08	1.06	1.70

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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 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- 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 Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
3/13/2017	D450V3	1051	Body	1g	0.403	4.03	4.44	-9.23	1,2
				10g	0.275	2.75	2.93	-6.14	
3/24/2017	D900V2	1d180	Body	1g	1.030	10.30	10.90	-5.50	3,4
				10g	0.669	6.69	7.07	-5.37	

9. Conducted Output Power Measurements

9.1. 451 Wake-Up Tone

Mode		Freq. (MHz)	Avg Pwr (dBm)
451	2GFSK	451.35	26.9

9.2. 900 Interface Band

Mode		Freq. (MHz)	Avg Pwr (gated) (dBm)	Avg Pwr (duty cycle 50%) (dBm)
900	2FSK	902.4	23.48	20.48
		915.2	23.85	20.85
		927.6	23.87	20.87

Note(s):

- 900 MHz radio output power is 24 dBm, however the manufacturer indicates a maximum duty cycle of 50%, therefore the effective output power is 21 dBm.

9.3. Bluetooth

Maximum tune-up tolerance limit is 4.0 dBm. This power level qualifies for exclusion of SAR testing.

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

10.1. 451 Wake Up Tone

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Standalone	2GFSK	0	Front	N/A	451.35	27.0	26.89	1.460	**1.497**	1

10.2. 900 Interface Band

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Standalone	2FSK	0	Front	N/A	915.20	24.0	23.85	0.562	**0.582**	2

Note: Power measured for 900 Interface Band was gated. Actual duty cycle was 50%.

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)
450	451 Wake-Up Tone	Standalone	Front	Yes	1.460	1.430	1.02	1.430	1.02	N/A
900	900 Interface Band	Standalone	Front	No	0.562	N/A	N/A	N/A	N/A	N/A

Note(s):

Third Repeated Measurement is not required since the original, first, and second repeated measurement is ≤ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of the largest to smallest SAR for the original, first and second repeated measurements is not > 1.20.

12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations
Standalone	1	451 Wake-Up Tone + BT
	2	900 Interface Band + BT

Notes:
1. 451 Wake-Up Tone and 900 Interface Band cannot transmit simultaneously.
2. Bluetooth can transmit w ith both 450 Wake-Up Tone and 900 ISM.

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 SAR value is 0.4 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 SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR for Bluetooth

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Estimated 1-g SAR Value (W/kg)					
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
Bluetooth	2480	4.00	3	N/A	N/A	N/A	N/A	N/A	5.08	N/A	N/A	N/A	N/A	N/A	0.126

- The normal use of this device is Body-worn only; therefore, Edge testing was not performed

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12.1. Sum of the SAR for 451 Wake-Up Tone & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	450 MHz	BT	WWAN + BT +
Front	1.497	0.126	1.623

SAR to Peak Location Separation Ratio (SPLSR)

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)		Calculated distance (mm)	SPLSR (≤ 0.04)	Volume Scan (Yes/ No)
	WWAN	BT					
Front	1.497	0.126	+	1.623	70.0	0.03	No

Note:

The calculated distance was obtained using the physical distance between antennas, as it is more conservative than the estimated distance between the 450MHz Hotspot and BLE Antenna.

12.2. Sum of the SAR for 900 Interface Band & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	900 MHz	BT	WWAN + BT +
Front	0.582	0.126	0.708

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

Appendixes

Refer to separated files for the following appendixes.

R11662377-S1V1 SAR_App A Setup Photos

R11662377-S1V1 SAR_App B System Check Plots

R11662377-S1V1 SAR_App C Highest Test Plots

R11662377-S1V1 SAR_App D Tissue Ingredients

R11662377-S1V1 SAR_App E Probe Cal. Certificates

R11662377-S1V1 SAR_App F Dipole Cal. Certificate

END OF REPORT