SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
Smart Bracelet + GSM/W-CDMA

Model: MCKEE2
FCC ID: 2AB8ZND2

Report Number: 14U19370-S1
Issue Date: 12/5/2014

Prepared for
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NVLAP LAB CODE 200065-0

REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	12/5/2014	Initial Issue	--

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1. Attestation of Test Results

Applicant Name	INTEL CORPORATION			
FCC ID	2AB8ZND2			
DUT Description	Smart Bracelet + GSM/W-CDMA			
Exposure Category	General Population/Uncontrolled Exposure			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures Case by case KDB Guidance			
Date tested	12/1/2014 – 12/4/2014			
The Highest Reported SAR (W/kg)				
RF Exposure Conditions	Equipment Class			
	Licensed	DSS (BT)	DTS	U-NII
Extremity	1.984	Not Supported		
Simultaneous Tx	Not Supported			

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 Verification Services Inc.	Mark Balauro Laboratory Technician UL Verification Services Inc.

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, and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05r02
- 941225 D01 3G SAR Procedures v03
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r03

3. Facilities and Accreditation

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

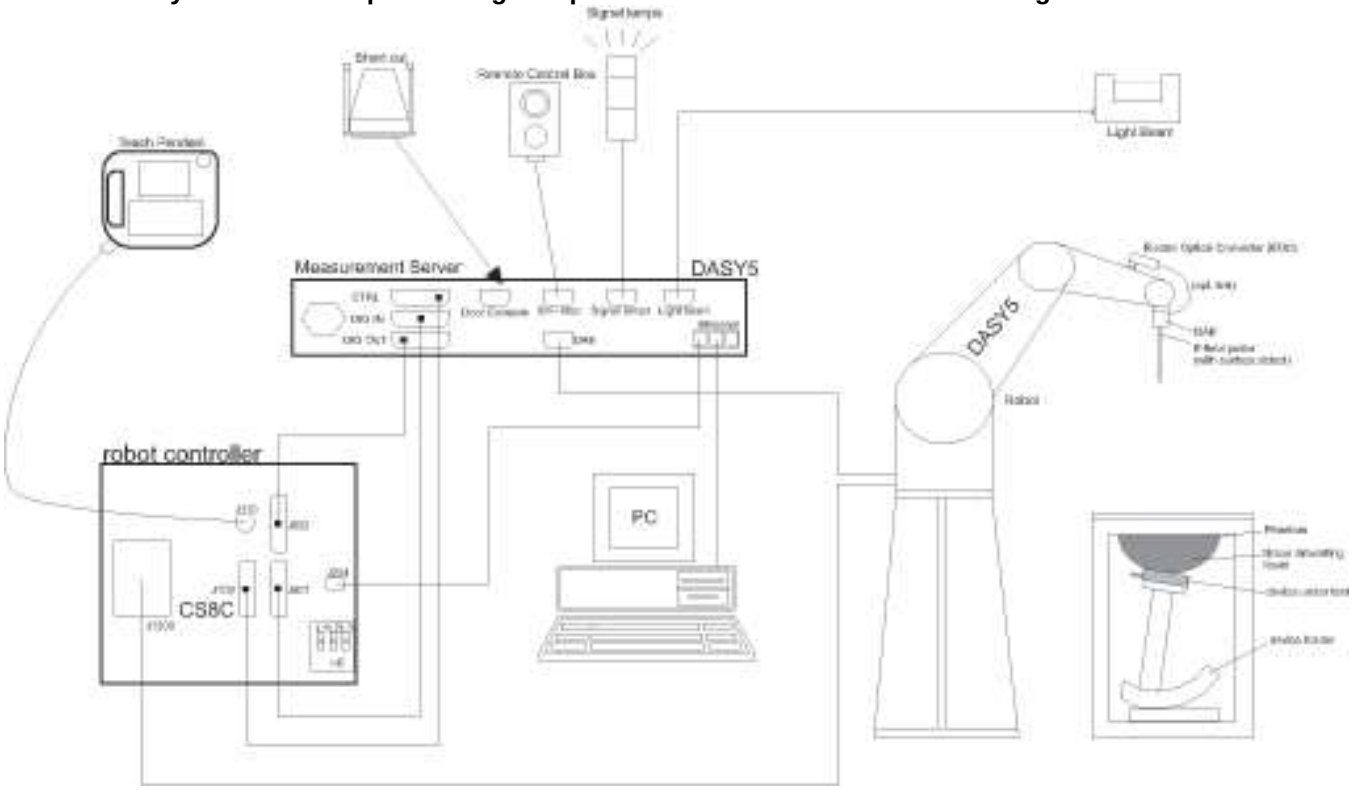
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.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 Procedure

The following custom procedure was prescribed by SPEAG:

Step 1: Phantom Position Measurements
Phantom Position Measurements allows the technician to verify the points as well as verify the Z-coordinate of the *Test Bed Plane*.

Step 2: SAR Measurement
For this particular project, a modified Area Scan is used to perform the measurements. The internal volume of the wristband is minimal; thus, the Area Scan parameters are smaller than prescribed by 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03. This allows enough coverage to measure SAR efficiently and precisely.

4.3. Test Rationale and Procedure

The DUT's unique rigid wrist worn design and antenna implementation necessitated the use of provisional measurement methods in order for scans to be performed in areas inaccessible by standard methods. Given the stated complications and the inconsistent nature of provisional measurement methods in general, however, any and all approaches taken would require review and approval by the FCC for the results to be acceptable.

For this purpose, the test lab adopted the following materials and procedure, taken from SPEAG's technical note "Smart-watch Testing with DASY52" and approved by the FCC, to facilitate measurements and conditions that best simulated the exposure conditions the end-user would be subjected to. These procedures and materials were then reviewed by the FCC and further refined until deemed acceptable by the FCC.

Purpose

To ensure precise robot controlled detection and good accessibility of the internal volume of the wristband.

Materials

- A test-bed made from low-loss material (which dielectric parameters are listed in Section 11)
- A plastic anchor: to hold the *watch phantom* in a constant position for repeatability
- Styrofoam doughnut: to emulate free space
- Vacuum sealer/bags: to prevent the Muscle Simulating Liquid from damaging the DUT

Procedure

1. Build a test-bed, or *watch phantom*, made from low-loss, low-permittivity material, but rigid surface.
   a. It is recommended to use a test-bed size of 20x20 cm.

2. Build an anchor that fits within an ELI Phantom and that can hold the *watch phantom* in place.

3. Place both the anchor and *watch phantom* inside a dry ELI Phantom; teach the robot the *watch phantom*'s three reference points (as demonstrated in Appendix A) using surface detection.

4. Once the phantom has been taught, run *Step 1* of the DASY test file, provided by SPEAG.
   a. Make sure the proprieties for Z as close to 0mm as possible..
   b. *Step 1* is used to determine the Test Bed Plane location (Z axis) to ensure that probe distance from the DUT is a consistent 4mm.

5. Export the newly taught *watch phantom* and import the phantom into *Step 2* of the DASY test file, provided by SPEAG.
   a. Measurements performed in Step 2 will use a special probe configuration provided by SPEAG that performs Area Scan measurements without surface detection,.

6. Seal the DUT in a vacuum sealed bag and insert it into the *watch phantom*.

7. Place the *watch phantom* with the DUT in/on the anchor and begin *Step 2* to perform the measurement.
   a. The dimensions of these Area Scan measurements can be found in the corresponding plots.
   b. A Pre-Scan is run to determine a location in which to do Power Reference measurement. This is followed by an Area Scan and finally a Power Drift measurement is taken.

8. The measurement results were then post-processed by SPEAG to determine the actual 10-g SAR, and routine measurement warning messages that occurred due to the unusual nature of the measurements were also confirmed to be negligible by SPEAG. The warning messages are related to the maximum deviation angle of the probe to the normal surface. This limit has been extended to allow larger measurement area inside the watch.

4.4.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	E753ES	MY40000980	4/7/2015
Dielectronic Probe kit	SPEAG	DAK-3.5	1082	9/16/2015
Dielectronic Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529163	10/8/2015
Thermometer	EXTECH	445703	CCS-200	3/24/2015

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
HP Signal Generator	HP	8665B	3546A00784	6/23/2015
Power Meter	Agilent	N1911A	MY53060016	8/7/2015
Power Sensor	Agilent	E9323A	MY53070003	5/1/2015
Power Meter	HP	437B	3125U09516	10/6/2015
Power Sensor	HP	8481A	3318A95392	10/6/2015
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1622052	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2711	N/A
DC Power Supply	Sorensen Ametek	XT20-3	1318A00530	N/A
Synthesized Signal Generator	Agilent	8665B	3438A00633	7/10/2015
Power Meter	HP	437B	3125U11347	8/27/2015
Power Sensor	HP	8481A	1926A16917	10/10/2015
Power Meter	HP	437B	3125U16345	6/16/2015
Power Sensor	HP	8481A	2702A60780	6/16/2015
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808938	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2710	N/A
DC Power Supply	HP	6296A	2841A-05955	N/A
E-Field Probe (SAR 4)	SPEAG	EX3DV4	3929	5/9/2015
Data Acquisition Electronics (SAR 4)	SPEAG	DAE4	1377	8/27/2015
System Validation Dipole	SPEAG	D835V2	4d117	5/16/2015
System Validation Dipole	SPEAG	D1900V2	5d163	9/11/2015
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/3/2015

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	137873-wG	7/14/2015

5. Device Under Test (DUT) Information

5.1. DUT Description

Model: MCKEE2	
Device Dimension	Please Refer to Appendix A “Photos and Antenna Locations” for detailed device dimensions.
Battery Back Cover	Device contains a non-removable back cover
Battery Options	Device contains a non-removable battery

5.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
GSM	850, 1900	GPRS (GMSK)	GPRS: 1 Slot: 12.5%; 2 Slots: 25%, 3 Slots: 37.5%, 4 Slots: 50%,
	GPRS Multi-Slot Class: ☐ Class 8 - One Up ☐ Class 10 - Two Up ☒ Class 12 - Four Up ☐ Class 33 - Four Up DTM (Dual Transfer Mode): Not supported		
WCDMA (UMTS)	Band V and II	UMTS Rel. 99 (Data) HSDPA HSUPA	100%

Notes:

1. Per Operational Description, Device does not support EGPRS.
2. Bluetooth can transmit while the Device is worn. Bluetooth is used for charging purposes only.

5.3. Nominal and Maximum Output Power

Upper limit (dB): -1.0 ~ 1.0		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
GSM 850	GPRS 1 slot	32.5	**33.5**
	GPRS 2 slots	29.7	**30.7**
	GPRS 3 slots	27.9	**28.9**
	GPRS 4 slots	26.9	**27.9**
GSM 1900	GPRS 1 slot	29.5	**30.5**
	GPRS 2 slots	27.7	**28.7**
	GPRS 3 slots	25.9	**26.9**
	GPRS 4 slots	24.9	**25.9**
WCDMA Band V	R99	23.5	**24.5**
	HSDPA	23.5	**24.5**
	HSUPA	23.5	**24.5**
Upper limit (dB): -0.5 ~ 0.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
WCDMA Band II	R99	22.7	**23.2**
	HSDPA	22.7	**23.2**
	HSUPA	22.7	**23.2**

5.4. Simultaneous Transmission Condition

Simultaneous Transmission is not supported

6. RF Exposure Conditions (Test Configurations)

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

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Antenna-to-edge/surface	SAR Required
WWAN	Extremity (Hand/Wrist/Ankle)	0	NA	Yes

7. Conducted Output Power Measurements

7.1. GSM850 and GSM1900

GSM850 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
850	GPRS (GMSK)	CS1	1	128	824.2	33.3	24.3
				190	836.6	33.3	24.3
				251	848.8	33.3	24.3
			2	128	824.2	30.5	24.5
				190	836.6	30.5	24.5
				251	848.8	30.5	24.5
			3	128	824.2	28.7	24.4
				190	836.6	28.7	24.4
				251	848.8	28.7	24.4
			4	**128**	**824.2**	**27.5**	**24.5**
				190	**836.6**	**27.6**	**24.6**
				251	**848.8**	**27.6**	**24.6**

Notes:

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Extremity: GMSK (GPRS) mode with 4 time slots, based on the output power measurements above

GSM1900 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
1900	GPRS (GMSK)	CS1	1	512	1850.2	29.9	20.9
				661	1880.0	29.9	20.9
				810	1909.8	30.0	21.0
			2	512	1850.2	27.0	21.0
				661	1880.0	27.1	21.1
				810	1909.8	27.1	21.1
			3	512	1850.2	25.1	20.8
				661	1880.0	25.2	20.9
				810	1909.8	25.3	21.0
			4	**512**	**1850.2**	**24.0**	**21.0**
				661	**1880.0**	**24.1**	**21.1**
				810	**1909.8**	**24.3**	**21.3**

Notes:

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Extremity: GMSK (GPRS) mode with 4 time slots, based on the output power measurements above

7.2. WCDMA Band V and II

Release 99

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The DUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 2
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
WCDMA Band V	Rel 99 (RMC, 12.2 kbps)	4132	826.4	23.6
		4183	836.6	23.7
		4233	846.6	23.5
WCDMA Band II	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	23.0
		9400	1880.0	22.7
		9538	1907.6	22.9

HSDPA

The following 4 Sub-tests were completed according to Release 7 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set 1			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	11/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	MPR (dB)	0	0	0.5	0.5
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs=βhs/βc	30/15			

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
WCDMA Band V	Subtest 1	4132	826.4	0	23.6
		4183	836.6	0	23.7
		4233	846.6	0	23.6
	Subtest 2	4132	826.4	0	23.6
		4183	836.6	0	23.7
		4233	846.6	0	23.6
	Subtest 3	4132	826.4	0.5	23.7
		4183	836.6	0.5	23.7
		4233	846.6	0.5	23.6
	Subtest 4	4132	826.4	0.5	23.7
		4183	836.6	0.5	23.6
		4233	846.6	0.5	23.5
WCDMA Band II	Subtest 1	9262	1852.4	0	22.9
		9400	1880.0	0	22.7
		9538	1907.6	0	22.8
	Subtest 2	9262	1852.4	0	22.8
		9400	1880.0	0	22.6
		9538	1907.6	0	22.6
	Subtest 3	9262	1852.4	0.5	22.7
		9400	1880.0	0.5	22.5
		9538	1907.6	0.5	22.7
	Subtest 4	9262	1852.4	0.5	22.7
		9400	1880.0	0.5	22.6
		9538	1907.6	0.5	22.7

Maximum output power levels that are possible for all subtests reported.

HSPA (HSDPA & HSUPA)

The following 5 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	HSPA				
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2 kbps RMC				
	HSDPA FRC	H-Set 1				
	HSUPA Test	HSPA				
	Power Control Algorithm	Algorithm 2				Algorithm 1
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	0
	βec	209/225	12/15	30/15	2/15	5/15
	βc/βd	11/15	11/15	15/9	2/15	15/0
	βhs	22/15	12/15	30/15	4/15	5/15
	βed	1309/225	94/75	47/15 47/15	56/75	47/15
	CM (dB)	1	3	2	3	1
	MPR (dB)	0	2	1	2	0
HSDPA Specific Settings	DACK	8				0
	DNAK	8				0
	DCQI	8				0
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	Ahs = βhs/βc	30/15				
HSUPA Specific Settings	E-DPDCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E-TFCIs	5	5	2	5	1
	Reference E-TFCI	11	11	11	11	67
	Reference E-TFCI PO	4	4	4	4	18
	Reference E-TFCI	67	67	92	67	67
	Reference E-TFCI PO	18	18	18	18	18
	Reference E-TFCI	71	71	71	71	71
	Reference E-TFCI PO	23	23	23	23	23
	Reference E-TFCI	75	75	75	75	75
	Reference E-TFCI PO	26	26	26	26	26
	Reference E-TFCI	81	81	81	81	81
	Reference E-TFCI PO	27	27	27	27	27
	Maximum Channelisation Codes	2xSF2				SF4

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
WCDMA Band V	Subtest 1	4132	826.4	0	22.7
		4183	836.6	0	22.7
		4233	846.6	0	22.8
	Subtest 2	4132	826.4	2	20.5
		4183	836.6	2	20.8
		4233	846.6	2	20.8
	Subtest 3	4132	826.4	1	21.5
		4183	836.6	1	21.5
		4233	846.6	1	21.5
	Subtest 4	4132	826.4	2	20.7
		4183	836.6	2	20.6
		4233	846.6	2	20.7
	Subtest 5	4132	826.4	0	22.7
		4183	836.6	0	22.7
		4233	846.6	0	22.8
WCDMA Band II	Subtest 1	9262	1852.4	0	22.4
		9400	1880.0	0	22.4
		9538	1907.6	0	22.5
	Subtest 2	9262	1852.4	2	20.3
		9400	1880.0	2	20.4
		9538	1907.6	2	20.5
	Subtest 3	9262	1852.4	1	21.3
		9400	1880.0	1	21.2
		9538	1907.6	1	21.3
	Subtest 4	9262	1852.4	2	20.6
		9400	1880.0	2	20.7
		9538	1907.6	2	20.9
	Subtest 5	9262	1852.4	0	22.3
		9400	1880.0	0	22.5
		9538	1907.6	0	22.5

8. Dielectric Property Measurements

8.1. 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

8.2. Dielectric Property Measurements Results

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.

SAR Lab 4

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
12/1/2014	Body 835	e'	53.5900	Relative Permittivity (ϵ_r):	53.59	55.20	-2.92	5
		e"	21.5300	Conductivity (σ):	1.00	0.97	3.05	5
	Body 820	e'	53.7300	Relative Permittivity (ϵ_r):	53.73	55.28	-2.80	5
		e"	21.6200	Conductivity (σ):	0.99	0.97	1.79	5
	Body 850	e'	53.4100	Relative Permittivity (ϵ_r):	53.41	55.16	-3.17	5
		e"	21.5200	Conductivity (σ):	1.02	0.99	3.03	5
12/1/2014	Body 1900	e'	51.4600	Relative Permittivity (ϵ_r):	51.46	53.30	-3.45	5
		e"	14.4000	Conductivity (σ):	1.52	1.52	0.09	5
	Body 1850	e'	51.6800	Relative Permittivity (ϵ_r):	51.68	53.30	-3.04	5
		e"	14.3100	Conductivity (σ):	1.47	1.52	-3.16	5
	Body 1910	e'	51.4400	Relative Permittivity (ϵ_r):	51.44	53.30	-3.49	5
		e"	14.4000	Conductivity (σ):	1.53	1.52	0.61	5

9. 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.

9.1. 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.

9.2. Reference Target SAR Values

The reference SAR values are obtained from the calibration certificate of system validation dipoles. The measured values are normalized to 1 Watt.

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)		
				1g/10g	Head	Body
D835V2	4d117	5/16/2014	835	1g	9.23	9.61
				10g	5.98	6.31
D1900V2	5d163	9/11/2014	1900	1g	40.8	40.6
				10g	21.2	21.4

9.3. 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.

SAR Lab 4

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W			
12/1/2014	D1900V2	5d163	Body	1g	3.89	3.86	38.6	40.60	-4.93	1, 2
				10g	1.95	2.01	20.1	21.40	-6.07	
12/1/2014	D835V2	4d142	Body	1g	0.915	0.893	8.93	9.22	-3.15	3, 4
				10g	0.613	0.584	5.84	6.05	-3.47	

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 941225 D01 SAR test for 3G devices:

Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher than that measured without HSPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2.

Composition of the base:

Material	Dielectric Constant	Dielectric Loss
Acrylic	1.55	0.005

Note(s):

1. Dielectric Constant was provided by the polymer manufacture
2. Acrylic is not a problem with Glycol in the test setup. The Acrylic does not degrade when placed into the Muscle Tissue-Simulating Liquid.

10.1. GSM850

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Extremity	GPRS 4 Slots	0	Wrist	190	836.6	27.9	27.6	1.230	1.318	1

10.2. GSM1900

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Extremity	GPRS 4 Slots	0	Wrist	661	1880.0	25.9	24.1	0.964	1.459	2

10.3. WCDMA Band V

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Extremity	Rel. 99 RMC	0	Wrist	4183	836.6	24.5	23.7	1.650	**1.984**	3

10.4. WCDMA Band II

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Extremity	Rel 99 RMC	0	Wrist	9400	1880.0	23.2	22.7	1.370	1.537	4

11. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 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 < 2 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 2 W/kg, 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 > 1.2 or when the original or repeated measurement is ≥ 3.625 W/kg (~ 10% from the 10g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥3.75 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.2.

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
850	GSM 850	Extremity	Custom	No	1.23	N/A	1.00
	WCDMA Band V	Extremity	Custom	No	1.65	N/A	1.00
1900	GSM 1900	Extremity	Custom	No	0.964	N/A	1.00
	WCDMA Band II	Extremity	Custom	No	1.37	N/A	1.00

Note(s):
Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.

12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission is not supported.

13. Appendixes

Refer to separated files for the following appendixes.

A. Photos and Antenna Locations

B. System Performance Check Plots

C. Highest SAR Test Plots

D. Tissue Material Ingredients

E. Calibration Certificate for E-Field Probes

F. Calibration Certificates for Dipoles

G. Smart Watch Testing Application Note

END OF REPORT