SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
Mobile Point of Sale Terminal

FCC ID: B32V240MPLUS
Model Name: V240m Plus 3GBW

Report Number: 11631998-S1V2
Issue Date: 11/16/2017

Prepared for
VERIFONE INC
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ROCKLIN, CA, 95765 USA

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	8/23/2017	Initial Issue	--
V2	11/16/2017	Section 6.1: Updated Device Dimensions Section 6.3: Updated Maximum Output Power Section 7.1: Updated Tables Section 10.7: Removed Section Section 10.8: Removed Section	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name	Verifone Inc			
FCC ID	B32V240MPLUS			
Model Name	V240m Plus 3GBW			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
Exposure Category	SAR Limits (W/Kg)			
	Peak spatial-average(1g of tissue)		Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population / Uncontrolled exposure	1.6		4	
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)			
	PCE	DTS	NII	DSS
Extremity	3.755	0.161	0.096	N/A
Date Tested	5/3/2017 to 5/30/2017 and 6/30/2017			
Test Results	Pass			

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:
	
David Weaver Program Manager UL Verification Services Inc.	Vanessa Moestopo 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:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01

3. Facilities and Accreditation

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

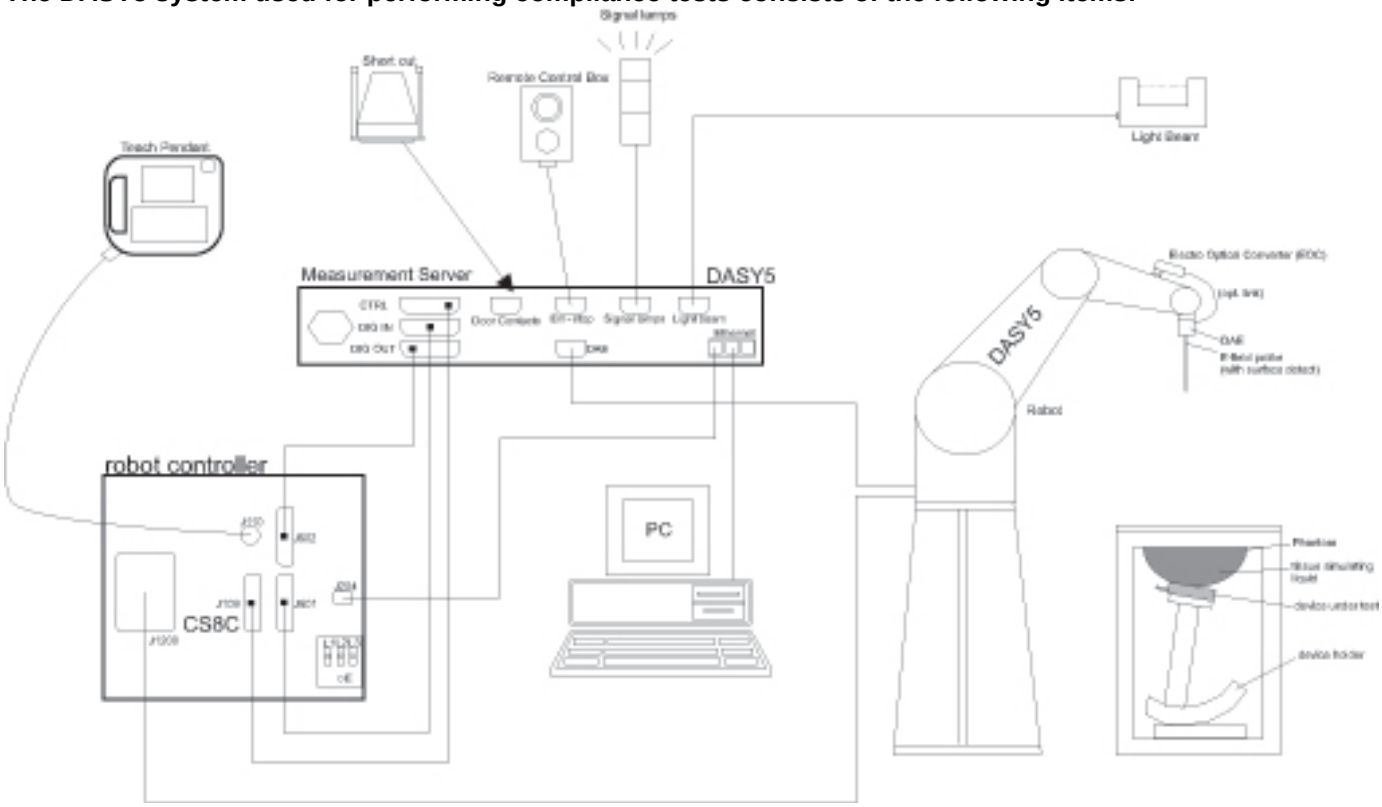
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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

	≤ 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

			≤ 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	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
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.

Test Equipment used for Test Dates 5/3/2017 to 5/30/2017:

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	8753ES	MY40001647	8/23/2017
Dielectric Probe kit	SPEAG	DAK-3.5	1087	11/8/2017
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	11/8/2017
Thermometer	Traceable Calibration Control Co.	4242	140493798	8/9/2017

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator *	Agilent	N5181A	MY50140610	5/9/2017
Power Meter	Keysight	N1912A	MY55196004	7/8/2017
Power Sensor	Agilent	E9323A	US40411556	11/11/2017
Power Sensor *	Agilent	E9323A	MY53070009	6/13/2017
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795093	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
DC Power Supply	BK PRECISION	E3610A	KR24104150	N/A
Synthesized Signal Generator	Agilent	N5181A	MY50140630	5/16/2018
Power Meter	Keysight	N1912A	MY50001018	10/11/2017
Power Sensor	Agilent	N1921A	MY53260001	10/17/2017
Power Sensor	Agilent	N1921A	MY53070007	3/1/2018
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	HP	1611	215-02292	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab E)	SPEAG	EX3DV4	3772	2/16/2018
E-Field Probe (SAR Lab F)	SPEAG	EX3DV4	3686	8/25/2017
E-Field Probe (SAR Lab G)	SPEAG	EX3DV4	3749	1/23/2018
E-Field Probe (SAR Lab H)	SPEAG	EX3DV4	3989	2/16/2018
Data Acquisition Electronics (SAR Lab E)	SPEAG	DAE4	1357	2/13/2018
Data Acquisition Electronics (SAR Lab F)	SPEAG	DAE4	1352	11/11/2017
Data Acquisition Electronics (SAR Lab G)	SPEAG	DAE4	1380	7/25/2017
Data Acquisition Electronics (SAR Lab H)	SPEAG	DAE4	1472	3/10/2018
System Validation Dipole	SPEAG	D835V2	4d002	11/8/2017
System Validation Dipole	SPEAG	D1900V2	5d043	11/8/2017
System Validation Dipole	SPEAG	D1900V2	5d163	9/19/2017
System Validation Dipole	SPEAG	D2450V2	748	2/8/2018
System Validation Dipole	SPEAG	D2450V2	899	3/10/2018
System Validation Dipole	SPEAG	D5GHzV2	1003	2/13/2018
System Validation Dipole	SPEAG	D5GHzV2	1168	11/14/2017
Thermometer (SAR Lab E, F, G, H)	EXTECH	445703	NSN	6/13/2017

Name of Equipment	Manufacturer	Type/Model	T Number	Serial No.	Cal. Due Date
Power Meter	Keysight	N1911A	T1269	MY55196016	3/1/2018
Power Meter	Keysight	N1911A	T1264	MY55196016	7/8/2016
Power Sensor	Keysight	N1921A	T1223	MY55120015	3/1/2018
Power Sensor	Keysight	N1921A	T1225	MY55200003	3/1/2018
Base Station Simulator	R & S	CMW500	T959	137873-WG	7/8/2017
Base Station Simulator	R & S	CMW500	T 970	137875-DZ	7/1/2017

Note:

*Equipment not used past calibration date

Test Equipment used for Test Dates 6/30/2017:

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
S-Parameter Network Analyzer	Agilent	8753ES	CCS00912-1C	8/23/2017
Dielectric Probe kit	SPEAG	DAK-3.5	1103	2/16/2018
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	11/8/2017
Thermometer	Control Company	Traceable	122529162	11/112017

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	HP	8665B	3546A00784	9/2/2017
Power Meter	HP	437B	3125U11347	8/30/2017
Power Meter	HP	437B	3125U09516	9/27/2017
Power Sensor	HP	8481A	1926A16917	10/7/2017
Power Sensor	HP	8481A	2702A76223	9/14/2017
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808938	N/A
Directional coupler	Werlatone	C8060-102	2710	N/A
DC Power Supply	HP	6296A	2841A-05955	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab 3)	SPEAG	EX3DV4	3871	8/25/2017
Data Acquisition Electronics (SAR Lab 3)	SPEAG	DAE4	1343	8/15/2017
System Validation Dipole	SPEAG	D1900V2	5d163	9/19/2017
Thermometer (SAR Lab 3)	EXTECH	445703	CCS-237	6/6/2017

Name of Equipment	Manufacturer	Type/Model	T Number	Serial No.	Cal. Due Date
Power Meter	Keysight	N1911A	T1269	MY55196016	3/1/2018
Power Meter	Keysight	N1911A	T1264	MY55196016	7/8/2016
Power Sensor	Keysight	N1921A	T1223	MY55120015	3/1/2018
Power Sensor	Keysight	N1921A	T1225	MY55200003	3/1/2018
Base Station Simulator	R & S	CMW500	T959	137873-WG	7/8/2017
Base Station Simulator	R & S	CMW500	T 970	137875-DZ	7/1/2017

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.

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width x Height): 162.93 mm x 75.33 mm x 53.4 mm Overall Diagonal: 140.32 mm Display Diagonal: 89.65 mm		
Back Cover	☒ Normal Battery Cover		
Battery Options	☒ Standard – Lithium-ion battery, Rating 3.7Vdc, 9.1Wh		
Test sample information	**S/N**	**IMEI**	**Notes**
	313-855-582	357042065790728	SAR Conducted unit
	313-855-575	N/A	EMC Conducted unit
	313-855-581	N/A	EMC Conducted unit
	313-855-856	357042065755523	SAR Radiated unit
	313-855-592	357042065731524	SAR Secondary Radiated unit
Hardware Version	DVT1.1		
Software Version	VOS2 30640XXX		

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode		Duty Cycle used for SAR testing
GSM	850 1900	GPRS (GMSK) EGPRS (8PSK)	GPRS Multi-Slot Class: ☐ Class 8 - 1 Up, 4 Down ☐ Class 10 - 2 Up, 4 Down ☒ Class 12 - 4 Up, 4 Down ☐ Class 33 - 4 Up, 5 Down	GSM Voice: 12.5% (E)GPRS: 1 Slot: 12.5% 2 Slots: 25% 3 Slots: 37.5% 4 Slots: 50%
	Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No			
W-CDMA (UMTS)	Band II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5)		100%
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)		100%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40)		100%
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No			
	Does this device support Band gap channel? ☐ Yes ☒ No			
Bluetooth	2.4 GHz	Version 4.1 LE		N/A

6.3. Maximum Output Power from Tune-up Procedure

Per KDB 941225 D01 3G SAR Procedures:

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.

RF Air interface	Mode	Time Slots	Max. RF Output Power (dBm)	
			Tune-up Limit	Frame Pwr
GSM850	Voice/GPRS	1	33.5	24.47
	GPRS	2	30.5	24.48
	GPRS	3	28.5	24.24
	GPRS	4	**27.5**	**24.49**
	EGPRS	1	27.5	18.47
	EGPRS	2	24.5	18.48
	EGPRS	3	23.0	18.74
	EGPRS	4	21.5	18.49
GSM1900	Voice/GPRS	1	30.5	21.47
	GPRS	2	27.5	21.48
	GPRS	3	25.0	20.74
	GPRS	4	**24.0**	**20.99**
	EGPRS	1	26.5	17.47
	EGPRS	2	23.5	17.48
	EGPRS	3	22.0	17.74
	EGPRS	4	20.5	17.49

RF Air interface	Mode	Max. RF Output Power (dBm)
W-CDMA Band II	R99	**23.5**
	HSDPA	23.5
W-CDMA Band V	R99	**24.0**
	HSDPA	24.0

RF Air interface	Mode	Max. RF Output Power (dBm)
WiFi 2.4 GHz	802.11b	16.5
	802.11g	14.0
	802.11n HT20	13.0
WiFi 5.2 GHz	802.11a	14.5
	802.11n HT20	14.5
	802.11n HT40	14.5
	802.11ac VHT80	14.5
WiFi 5.3 GHz	802.11a	14.5
	802.11n HT20	14.0
	802.11n HT40	14.0
	802.11ac VHT80	14.0
WiFi 5.6 GHz	802.11a	14.5
	802.11n HT20	14.0
	802.11n HT40	14.0
	802.11ac VHT80	14.0
WiFi 5.8 GHz	802.11a	14.0
	802.11n HT20	13.0
	802.11n HT40	13.0
	802.11ac VHT80	13.0
Bluetooth	GFSK, EDR	7.5
	LE	5.0

6.4. Duty Cycle Factor Analysis

The duty cycle factor analysis was the subject of a KDB enquiry and accepted by the FCC. Refer to Appendix G for the specific details on maximum transaction time of the device.

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:

- 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 WWAN

Antennas < 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)							Calculated Threshold Value						
			dBm	mW	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front
Cellular	GPRS 4 Slots	848.8	26.50	223	5.00	5.00	142.63	4.00	3.30	21.21	10.00	41.1 -MEASURE-	41.1 -MEASURE-	> 50 mm	41.1 -MEASURE-	41.1 -MEASURE-	9.8 -MEASURE-	20.5 -MEASURE-
Cellular	GPRS 4 Slots	1909.8	23.50	112	5.00	5.00	142.63	4.00	3.30	21.21	10.00	31 -MEASURE-	31 -MEASURE-	> 50 mm	31 -MEASURE-	31 -MEASURE-	7.4 -EXEMPT-	15.5 -MEASURE-
Cellular	W-CDMA 2	1907.6	23.00	200	5.00	5.00	142.63	4.00	3.30	21.21	10.00	55.2 -MEASURE-	55.2 -MEASURE-	> 50 mm	55.2 -MEASURE-	55.2 -MEASURE-	13.2 -MEASURE-	27.6 -MEASURE-
Cellular	W-CDMA 5	846.6	23.00	200	5.00	5.00	142.63	4.00	3.30	21.21	10.00	36.8 -MEASURE-	36.8 -MEASURE-	> 50 mm	36.8 -MEASURE-	36.8 -MEASURE-	8.8 -MEASURE-	18.4 -MEASURE-

Note(s):

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

Antennas > 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)							Calculated Threshold Value						
			dBm	mW	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front
Cellular	GPRS 4 Slots	848.8	26.50	223	5.00	5.00	142.63	4.00	3.30	21.21	10.00	< 50 mm	< 50 mm	687 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm	< 50 mm
Cellular	GPRS 4 Slots	1909.8	23.50	112	5.00	5.00	142.63	4.00	3.30	21.21	10.00	< 50 mm	< 50 mm	1034.8 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm	< 50 mm
Cellular	W-CDMA 2	1907.6	23.00	200	5.00	5.00	142.63	4.00	3.30	21.21	10.00	< 50 mm	< 50 mm	1034.9 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm	< 50 mm
Cellular	W-CDMA 5	846.6	23.00	200	5.00	5.00	142.63	4.00	3.30	21.21	10.00	< 50 mm	< 50 mm	685.8 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm	< 50 mm

Note(s):

According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

SAR Test Exclusion Calculations for WLAN

Antennas < 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)							Calculated Threshold Value						
		dBm	mW	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front
Wi-Fi 2.4 GHz	2462	16.50	45	5.00	5.00	152.63	58.21	3.30	4.00	10.00	14.1 -MEASURE-	14.1 -MEASURE-	> 50 mm	> 50 mm	14.1 -MEASURE-	14.1 -MEASURE-	7.1 -EXEMPT-
Wi-Fi 5.2 GHz	5240	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	12.8 -MEASURE-	12.8 -MEASURE-	> 50 mm	> 50 mm	12.8 -MEASURE-	12.8 -MEASURE-	6.4 -EXEMPT-
Wi-Fi 5.3 GHz	5320	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	12.9 -MEASURE-	12.9 -MEASURE-	> 50 mm	> 50 mm	12.9 -MEASURE-	12.9 -MEASURE-	6.5 -EXEMPT-
Wi-Fi 5.5 GHz	5700	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	13.4 -MEASURE-	13.4 -MEASURE-	> 50 mm	> 50 mm	13.4 -MEASURE-	13.4 -MEASURE-	6.7 -EXEMPT-
Wi-Fi 5.8 GHz	5825	14.00	25	5.00	5.00	152.63	58.21	3.30	4.00	10.00	12.1 -MEASURE-	12.1 -MEASURE-	> 50 mm	> 50 mm	12.1 -MEASURE-	12.1 -MEASURE-	6 -EXEMPT-
Bluetooth	2480	7.50	6	5.00	5.00	152.63	58.21	3.30	4.00	10.00	1.9 -EXEMPT-	1.9 -EXEMPT-	> 50 mm	> 50 mm	1.9 -EXEMPT-	1.9 -EXEMPT-	0.9 -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

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)							Calculated Threshold Value						
		dBm	mW	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Rear Slant	Edge 1	Edge 2	Edge 3	Edge 4	Front
Wi-Fi 2.4 GHz	2462	16.50	45	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1121.9 mW -EXEMPT-	177.7 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Wi-Fi 5.2 GHz	5240	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1091.8 mW -EXEMPT-	147.6 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Wi-Fi 5.3 GHz	5320	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1091.3 mW -EXEMPT-	147.1 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Wi-Fi 5.5 GHz	5700	14.50	28	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1089.1 mW -EXEMPT-	144.9 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Wi-Fi 5.8 GHz	5825	14.00	25	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1088.5 mW -EXEMPT-	144.3 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm
Bluetooth	2480	7.50	6	5.00	5.00	152.63	58.21	3.30	4.00	10.00	< 50 mm	< 50 mm	1121.6 mW -EXEMPT-	177.4 mW -EXEMPT-	< 50 mm	< 50 mm	< 50 mm

Note(s):

According to KDB 447498, 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	Rear	Rear Slant	Front	Edge 1 (Top Edge)	Edge 2 (Right Edge)	Edge 3 (Bottom Edge)	Edge 4 (Left Edge)
GSM850 Full Power	Yes	Yes	Yes	No	Yes	Yes	Yes
GSM1900 Full Power	Yes	Yes	Yes	No	Yes	Yes	No
W-CDMA Band 2 Full Power	Yes	Yes	Yes	No	Yes	Yes	Yes
W-CDMA Band 5 Full Power	Yes	Yes	Yes	No	Yes	Yes	Yes
Wi-Fi 2.4 GHz SISO (Main Antenna)	Yes	Yes	No	No	No	Yes	Yes
Wi-Fi 5 GHz SISO (Main Antenna)	Yes	Yes	No	No	No	Yes	Yes
Bluetooth	No	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

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
E	5/9/2017	2450	Body	2450	51.27	52.70	-2.71	1.99	1.95	2.21
				2400	51.42	52.77	-2.56	1.93	1.90	1.63
				2480	51.09	52.66	-2.99	2.02	1.99	1.45
E	5/24/2017	2450	Body	2450	50.28	52.70	-4.59	1.93	1.95	-0.87
				2400	50.38	52.77	-4.53	1.87	1.90	-1.53
				2480	50.15	52.66	-4.77	1.97	1.99	-1.36
F	5/30/2017	835	Body	835	54.48	55.20	-1.30	1.01	0.97	4.54
				805	54.70	55.33	-1.15	0.97	0.97	0.76
				905	53.65	55.00	-2.45	1.08	1.05	2.14
G	5/8/2017	5200	Body	5200	48.06	49.02	-1.96	5.39	5.29	1.74
				5150	48.19	49.09	-1.83	5.33	5.24	1.73
				5350	47.89	48.82	-1.90	5.59	5.47	2.13
G	5/8/2017	5600	Body	5600	47.43	48.48	-2.16	5.91	5.76	2.59
				5500	47.54	48.61	-2.21	5.80	5.64	2.72
				5725	47.35	48.31	-1.98	6.12	5.91	3.63
G	5/8/2017	5800	Body	5800	47.25	48.20	-1.97	6.22	6.00	3.70
				5700	47.37	48.34	-2.01	6.09	5.88	3.65
				5850	47.03	48.20	-2.43	6.27	6.00	4.55
G	5/12/2017	1900	Body	1900	51.04	53.30	-4.24	1.48	1.52	-2.43
				1850	51.34	53.30	-3.68	1.53	1.52	0.92
				1920	50.88	53.30	-4.54	1.55	1.52	1.71
G	5/15/2017	1900	Body	1900	52.81	53.30	-0.92	1.57	1.52	3.36
				1850	52.92	53.30	-0.71	1.54	1.52	1.12
				1920	52.79	53.30	-0.96	1.59	1.52	4.61
G	5/15/2017	835	Body	835	53.54	55.20	-3.01	1.02	0.97	4.85
				805	53.88	55.33	-2.63	0.98	0.97	1.81
				905	52.86	55.00	-3.89	1.09	1.05	3.47

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
G	5/18/2017	5200	Body	5200	47.24	49.02	-3.63	5.53	5.29	4.50
				5150	47.29	49.09	-3.66	5.46	5.24	4.33
				5350	46.99	48.82	-3.74	5.70	5.47	4.27
G	5/18/2017	5600	Body	5600	46.61	48.48	-3.85	5.96	5.76	3.45
				5500	46.80	48.61	-3.73	5.87	5.64	4.00
				5725	46.44	48.31	-3.87	6.17	5.91	4.49
G	5/18/2017	5800	Body	5800	46.46	48.20	-3.61	6.22	6.00	3.63
				5700	46.47	48.34	-3.87	6.12	5.88	4.19
				5850	46.31	48.20	-3.92	6.29	6.00	4.83
G	5/19/2017	1900	Body	1900	51.55	53.30	-3.28	1.58	1.52	3.68
				1850	51.71	53.30	-2.98	1.54	1.52	1.18
				1920	51.48	53.30	-3.41	1.59	1.52	4.87
G	5/19/2017	2450	Body	2450	50.28	52.70	-4.59	2.04	1.95	4.46
				2400	50.49	52.77	-4.33	1.95	1.90	2.90
				2480	50.21	52.66	-4.66	2.08	1.99	4.21
G	5/24/2017	1900	Body	1900	52.45	53.30	-1.59	1.52	1.52	-0.26
				1850	52.43	53.30	-1.63	1.47	1.52	-3.16
				1920	52.40	53.30	-1.69	1.54	1.52	1.12
H	5/19/2017	835	Body	835	52.90	55.20	-4.17	1.00	0.97	2.62
				805	53.10	55.33	-4.04	0.97	0.97	-0.23
				905	52.25	55.00	-5.00	1.06	1.05	0.81
H	5/23/2017	5800	Body	5800	46.79	48.20	-2.93	6.22	6.00	3.73
				5700	46.97	48.34	-2.84	6.10	5.88	3.73
				5850	46.68	48.20	-3.15	6.29	6.00	4.90
H	5/23/2017	5600	Body	5600	47.07	48.48	-2.90	5.95	5.76	3.21
				5500	47.24	48.61	-2.82	5.82	5.64	3.13
				5725	46.89	48.31	-2.94	6.14	5.91	3.90
H	5/23/2017	5200	Body	5200	47.74	49.02	-2.61	5.42	5.29	2.42
				5150	47.86	49.09	-2.50	5.36	5.24	2.40
				5350	47.49	48.82	-2.72	5.61	5.47	2.64
3	6/30/2017	1900	Body	1900	50.73	53.30	-4.82	1.56	1.52	2.83
				1850	50.83	53.30	-4.63	1.53	1.52	0.66
				1920	50.69	53.30	-4.90	1.58	1.52	3.95

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.

SAR Lab	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 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
E	5/9/2017	Body	D2450V2 SN:899	3/10/2018	5.240	52.40	50.30	4.17	2.400	24.00	23.70	1.27	1,2
E	5/24/2017	Body	D2450V2 SN:748	2/8/2018	5.060	50.60	51.30	-1.36	2.340	23.40	23.90	-2.09	3,4
F	5/26/2017	Body	D835V2 SN:4d002	11/8/2017	0.913	9.13	9.55	-4.40	0.588	5.88	6.33	-7.11	
F	5/30/2017	Body	D835V2 SN:4d002	11/8/2017	1.050	10.50	9.55	9.95	0.690	6.90	6.33	9.00	5,6
G	5/8/2017	Body	D5GHzV2 SN:1003 (5.2 GHz)	2/13/2018	7.360	73.60	70.50	4.40	2.070	20.70	19.80	4.55	
G	5/8/2017	Body	D5GHzV2 SN:1003 (5.6 GHz)	2/13/2018	8.310	83.10	78.30	6.13	2.310	23.10	22.00	5.00	
G	5/8/2017	Body	D5GHzV2 SN:1003 (5.8 GHz)	2/13/2018	7.910	79.10	73.50	7.62	2.190	21.90	20.50	6.83	
G	5/12/2017	Body	D1900V2 SN:5d043	11/9/2017	3.990	39.90	39.10	2.05	2.030	20.30	20.70	-1.93	
G	5/15/2017	Body	D1900V2 SN:5d043	11/9/2017	4.190	41.90	39.10	7.16	2.140	21.40	20.70	3.38	7,8
G	5/15/2017	Body	D835V2 SN:4d002	11/8/2017	1.020	10.20	9.55	6.81	0.669	6.69	6.33	5.69	9,10
G	5/18/2017	Body	D5GHzV2 SN:1003 (5.2 GHz)	2/13/2018	7.630	76.30	70.50	8.23	2.160	21.60	19.80	9.09	11,12
G	5/18/2017	Body	D5GHzV2 SN:1003 (5.6 GHz)	2/13/2018	8.390	83.90	78.30	7.15	2.340	23.40	22.00	6.36	
G	5/18/2017	Body	D5GHzV2 SN:1003 (5.8 GHz)	2/13/2018	7.470	74.70	73.50	1.63	2.080	20.80	20.50	1.46	
G	5/19/2017	Body	D1900V2 SN:5d043	11/9/2017	4.020	40.20	39.10	2.81	2.070	20.70	20.70	0.00	
G	5/19/2017	Body	D2450V2 SN:899	3/10/2018	4.960	49.60	50.30	-1.39	2.290	22.90	23.70	-3.38	13,14
G	5/24/2017	Body	D1900V2 SN:5d043	11/9/2017	4.030	40.30	39.10	3.07	2.080	20.80	20.70	0.48	
H	5/19/2017	Body	D835V2 SN:4d002	11/8/2017	0.998	9.98	9.55	4.50	0.687	6.87	6.33	8.53	15,16
H	5/23/2017	Body	D5GHzV2 SN:1168 (5.2 GHz)	11/14/2017	7.720	77.20	73.60	4.89	2.150	21.50	20.50	4.88	
H	5/23/2017	Body	D5GHzV2 SN:1168 (5.6 GHz)	11/14/2017	8.450	84.50	78.60	7.51	2.340	23.40	22.00	6.36	
H	5/23/2017	Body	D5GHzV2 SN:1168 (5.8 GHz)	11/14/2017	8.030	80.30	73.90	8.66	2.220	22.20	20.50	8.29	17,18
3	6/30/2017	Body	D1900V2 SN:5d163	9/19/2017	4.100	41.00	39.60	3.54	2.160	21.60	21.00	2.86	19,20

9. Conducted Output Power Measurements

9.1. GSM

GSM850 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Measured Max Pwr	
						Burst (dBm)	Frame (dBm)
850	GPRS (GMSK)	CS1	1	128	824.2	32.5	23.5
				190	836.6	32.5	23.5
				251	848.8	32.4	23.4
			2	128	824.2	29.7	23.6
				190	836.6	29.7	23.6
				251	848.8	29.6	23.5
			3	128	824.2	27.9	23.6
				190	836.6	27.9	23.6
				251	848.8	27.8	23.5
			4	128	824.2	26.8	23.8
				190	836.6	26.8	23.8
				251	848.8	26.7	23.6
	EGPRS (8PSK)	MCS5	1	128	824.2	26.7	17.7
				190	836.6	26.7	17.6
				251	848.8	26.6	17.6
			2	128	824.2	24.1	18.0
				190	836.6	24.0	18.0
				251	848.8	24.0	18.0
			3	128	824.2	22.1	17.8
				190	836.6	22.0	17.8
				251	848.8	21.8	17.5
			4	128	824.2	20.7	17.6
				190	836.6	20.7	17.7
				251	848.8	20.6	17.6

Notes:

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

- GMSK (GPRS) mode with 4 time slots, based on the Tune-up Procedure. Refer to §6.3.
- SAR is not required for EGPRS (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4db higher than GMSK GPRS or the adjusted SAR of the highest reported SAR of GMSK GPRS is ≤ 1.2W/kg.

GSM1900 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Measured Max. Pwr	
						Burst (dBm)	Frame (dBm)
1900	GPRS (GMSK)	CS1	1	512	1850.2	28.8	19.7
				661	1880.0	28.6	19.6
				810	1909.8	28.7	19.6
			2	512	1850.2	25.9	19.9
				661	1880.0	25.8	19.8
				810	1909.8	25.5	19.5
			3	512	1850.2	24.2	19.9
				661	1880.0	24.0	19.7
				810	1909.8	23.2	19.0
			4	512	1850.2	23.0	20.0
				661	1880.0	22.8	19.8
				810	1909.8	22.5	19.5
	EGPRS (8PSK)	MCS5	1	512	1850.2	25.3	16.3
				661	1880.0	25.4	16.3
				810	1909.8	25.3	16.2
			2	512	1850.2	22.4	16.3
				661	1880.0	22.4	16.4
				810	1909.8	22.3	16.3
			3	512	1850.2	20.6	16.3
				661	1880.0	20.6	16.3
				810	1909.8	20.5	16.2
			4	512	1850.2	19.4	16.4
				661	1880.0	19.4	16.4
				810	1909.8	19.3	16.3

Notes:

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

- GMSK (GPRS) mode with 4 time slots, based on the Tune-up Procedure. Refer to §6.3.
- SAR is not required for EGPRS (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4db higher than GMSK GPRS or the adjusted SAR of the highest reported SAR of GMSK GPRS is ≤ 1.2W/kg.

9.2. W-CDMA

Release 99 Setup Procedures used to establish the test signals

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

HSDPA Setup Procedures used to establish the test signals

The following 4 Sub-tests were completed according to Release 5 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
W-CDMA 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	11/15	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			

W-CDMA Band II Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Max. Meas. Avg Pwr (dBm)
W-CDMA Band II	Rel 99	RMC, 12.2 kbps	9262	1852.4	N/A	23.0
			9400	1880.0	N/A	22.6
			9538	1907.6	N/A	23.0
	HSDPA	Subtest 1	9262	1852.4	0	23.2
			9400	1880.0	0	22.8
			9538	1907.6	0	22.5
		Subtest 2	9262	1852.4	0	22.7
			9400	1880.0	0	22.3
			9538	1907.6	0	21.9
		Subtest 3	9262	1852.4	0.5	22.5
			9400	1880.0	0.5	22.1
			9538	1907.6	0.5	21.8
		Subtest 4	9262	1852.4	0.5	22.3
			9400	1880.0	0.5	22.0
			9538	1907.6	0.5	21.6

W-CDMA Band V Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Max. Meas. Avg Pwr (dBm)
W-CDMA Band V	Rel 99	RMC, 12.2 kbps	4132	826.4	N/A	23.8
			4183	836.6	N/A	23.6
			4233	846.6	N/A	23.7
	HSDPA	Subtest 1	4132	826.4	0	23.8
			4183	836.6	0	23.5
			4233	846.6	0	23.6
		Subtest 2	4132	826.4	0	23.1
			4183	836.6	0	22.9
			4233	846.6	0	23.0
		Subtest 3	4132	826.4	0.5	22.9
			4183	836.6	0.5	22.7
			4233	846.6	0.5	22.7
		Subtest 4	4132	826.4	0.5	22.6
			4183	836.6	0.5	22.4
			4233	846.6	0.5	22.4

9.3. Wi-Fi 2.4GHz (DTS Band)

Measured Results

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	15.8	16.5	Yes
			6	2437	16.1		
			11	2462	16.2		
	802.11g	6 Mbps	1	2412	Not Required	14.0	No
			6	2437			
			11	2462			
	802.11n (HT20)	6.5 Mbps	1	2412		13.0	No
			6	2437			
			11	2462			

Note(s):

1. SAR not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 3.0 W/kg (10-g Extremity).

9.4. Wi-Fi 5GHz (U-NII Bands)

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	12.8	14.5	Yes
			60	5300	13.1		
			64	5320	12.1		
	802.11n (HT20)	6.5 Mbps	52	5260	Not Required	14.0	No
			60	5300			
			64	5320			
	802.11n (HT40)	13.5 Mbps	54	5270		14.0	No
			62	5310			
	802.11ac (VHT80)	58.5 Mbps	58	5290		14.0	No
5.5 (U-NII 2C)	802.11a	6 Mbps	100	5500	12.5	14.5	Yes
			116	5580	12.5		
			140	5700	12.6		
	802.11n (HT20)	6.5 Mbps	100	5500	Not Required	14.0	No
			116	5580			
			140	5700			
	802.11n (HT40)	13.5 Mbps	102	5510		14.0	No
			118	5590			
			134	5670			
	802.11ac (VHT80)	58.5 Mbps	106	5530		14.0	No
			122	5610			
			138	5690			
5.8 (U-NII 3)	802.11a	6 Mbps	149	5745	12.7	14.0	Yes
			157	5785	12.8		
			165	5825	12.7		
	802.11n (HT20)	6.5 Mbps	149	5745	Not Required	13.0	No
			157	5785			
			165	5825			
	802.11n (HT40)	13.5 Mbps	151	5755		13.0	No
			159	5795			
	802.11ac (VHT80)	58.5 Mbps	155	5775		13.0	No

Note(s):

1. For “Not required”, SAR Test reduction was applied per KDB 248227.
2. When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest *reported* SAR for UNII band 2A is
   - ≤ 3.0 W/kg (10-g Extremity), SAR is not required for UNII band I
   - > 3.0 W/kg (10-g Extremity), both bands should be tested independently for SAR.

9.5. Bluetooth

Maximum tune-up tolerance limit is 7.5 dBm. This power level qualifies for exclusion of SAR testing. Refer to §7.1 Standalone SAR Test Exclusion Considerations.

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:
When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode

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.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

10.1. GSM 850 Measured SAR Results with Time Based Averaging Applied

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
						Tune-up limit	Meas.	Meas.	Scaled			
Extremity	GPRS 4 Slots	0	Rear	190	836.6	27.5	26.8	0.962	1.130	68.75%	0.777	
			Rear Slant	190	836.6	27.5	26.8	1.020	1.198	68.75%	**0.824**	1
			Front	190	836.6	27.5	26.8	0.213	0.250	68.75%	0.172	
			Edge 2	190	836.6	27.5	26.8	0.306	0.360	68.75%	0.247	
			Edge 3	190	836.6	27.5	26.8	0.718	0.844	68.75%	0.580	
			Edge 4	190	836.6	27.5	26.8	0.156	0.183	68.75%	0.126	

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

10.2. GSM 1900 Measured SAR Results with Time Based Averaging Applied

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
						Tune-up limit	Meas.	Meas.	Scaled			
Extremity	GPRS 4 Slots	0	Rear	661	1880.0	24.5	22.8	0.986	1.462	68.75%	1.005	
			Rear Slant	512	1850.2	24.5	23.0	1.790	2.546	68.75%	1.750	
				661	1880.0	24.5	22.8	1.790	2.654	68.75%	**1.824**	2
				810	1909.8	24.5	22.5	1.680	2.644	68.75%	1.818	
			Front	661	1880.0	24.5	22.8	0.191	0.283	68.75%	0.195	
			Edge 2	661	1880.0	24.5	22.8	0.245	0.363	68.75%	0.250	
			Edge 3	661	1880.0	24.5	22.8	0.874	1.296	68.75%	0.891	

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

10.3. W-CDMA Band II Measured SAR Results with Time Based Averaging Applied

RF Exposure	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
						Tune-up limit	Meas.	Meas.	Scaled			
Extremity	Rel 99 RMC	0	Rear	9262	1852.4	23.5	23.0	1.630	1.825	68.75%	1.254	
				9400	1880.0	23.5	22.6	2.120	2.608	68.75%	1.793	
				9538	1907.6	23.5	23.0	2.090	2.345	68.75%	1.612	
			Rear Slant	9262	1852.4	23.5	23.0	3.040	3.403	68.75%	2.340	
				9400	1880.0	23.5	22.6	4.440	5.462	68.75%	**3.755**	3
				9538	1907.6	23.5	23.0	2.940	3.299	68.75%	2.268	
			Front	9400	1880.0	23.5	22.6	0.339	0.417	68.75%	0.287	
			Edge 2	9400	1880.0	23.5	22.6	0.440	0.541	68.75%	0.372	
			Edge 3	9262	1852.4	23.5	23.0	1.800	2.015	68.75%	1.385	
				9400	1880.0	23.5	22.6	1.810	2.227	68.75%	1.531	
				9538	1907.6	23.5	23.0	1.670	1.874	68.75%	1.288	
			Edge 4	9400	1880.0	23.5	22.6	0.331	0.407	68.75%	0.280	

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

10.4. W-CDMA Band V Measured SAR Results with Time Based Averaging Applied

RF Exposure	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
						Tune-up limit	Meas.	Meas.	Scaled			
Extremity	Rel 99 RMC	0	Rear	4183	836.6	24.0	23.6	0.989	1.074	68.75%	0.739	
			Rear Slant	4183	836.6	24.0	23.6	1.270	1.380	68.75%	**0.949**	4
			Front	4183	836.6	24.0	23.6	0.258	0.280	68.75%	0.193	
			Edge 2	4183	836.6	24.0	23.6	0.383	0.416	68.75%	0.286	
			Edge 3	4183	836.6	24.0	23.6	0.894	0.971	68.75%	0.668	
			Edge 4	4183	836.6	24.0	23.6	0.237	0.257	68.75%	0.177	

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

10.5. Wi-Fi 2.4GHz Measured SAR Results with Time Based Averaging Applied

Frequency Band	Mode	RF Exposure	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
								Tune-up limit	Meas.	Meas.	Scaled			
2.4GHz	802.11b 1 Mbps	Extremity	0	Rear	11	2462.0	0.130	16.5	16.2					
				Rear Slant	11	2462.0	0.211	16.5	16.2					
				Front	11	2462.0	0.105	16.5	16.2					
				Edge 3	11	2462.0	0.475	16.5	16.2					
				Edge 4	11	2462.0	0.705	16.5	16.2	0.216	0.234	68.750%	**0.161**	5

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

10.6. Wi-Fi 5GHz Measured SAR Results with Time Based Averaging Applied

Frequency Band	Mode	RF Exposure	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		10-g SAR (W/kg)		Duty Cycle	Final Reported SAR	Plot No.
								Tune-up limit	Meas.	Meas.	Scaled			
5.3 GHz U-NII 2A	802.11a 6 Mbps	Extremity	0	Rear	60	5300	0.106	14.5	13.1					
				Rear Slant	60	5300	0.351	14.5	13.1	0.038	0.052	68.75%	0.036	6
				Front	60	5300	0.010	14.5	13.1					
				Edge 3	60	5300	0.147	14.5	13.1					
				Edge 4	60	5300	0.065	14.5	13.1					
5.5 GHz U-NII 2C	802.11a 6 Mbps	Extremity	0	Rear	140	5700	0.039	14.5	12.6					
				Rear Slant	140	5700	0.366	14.5	12.6	0.041	0.064	68.75%	0.044	7
				Front	140	5700	0.012	14.5	12.6					
				Edge 3	140	5700	0.142	14.5	12.6					
				Edge 4	140	5700	0.097	14.5	12.6					
5.8 GHz U-NII 3	802.11a 6 Mbps	Extremity	0	Rear	157	5785	0.100	14.5	12.8					
				Rear Slsant	157	5785	0.704	14.5	12.8	0.095	0.139	68.75%	**0.096**	8
				Front	157	5785	0.011	14.5	12.8					
				Edge 3	157	5785	0.333	14.5	12.8					
				Edge 4	157	5785	0.125	14.5	12.8					

Note(s):

A Duty Cycle of 68.75% was used to determine Final Reported SAR with Time Based Average

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)
850	GSM 850	Extremity	Rear Slant	No	1.020	N/A	N/A	N/A	N/A	N/A
	WCDMA Band V	Extremity	Rear Slant	No	1.270	N/A	N/A	N/A	N/A	N/A
1900	GSM 1900	Extremity	Rear Slant	No	1.790	N/A	N/A	N/A	N/A	N/A
	WCDMA Band II	Extremity	Rear Slant	Yes	4.440	4.210	1.05	4.400	1.01	3.780
2400	Wi-Fi 802.11b/g/n	Extremity	Rear Slant	No	0.216	N/A	N/A	N/A	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	Extremity	Rear Slant	No	0.038	N/A	N/A	N/A	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Extremity	Rear Slant	No	0.041	N/A	N/A	N/A	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Extremity	Rear Slant	No	0.095	N/A	N/A	N/A	N/A	N/A

Note(s):

Measured SAR > 3.75 W/kg therefore, second and third repeated measurements were performed.

12. Simultaneous Transmission SAR Analysis

This device does not support Simultaneous Transmission.

Appendixes

Refer to separated files for the following appendixes.

11631998-S1V1 SAR_App A Setup Photos

11631998-S1V1 SAR_App B System Check Plots

11631998-S1V1 SAR_App C Highest Test Plots

11631998-S1V1 SAR_App D Tissue Ingredients

11631998-S1V1 SAR_App E Probe Cal. Certificates

11631998-S1V1 SAR_App F Dipole Cal. Certificates

11631998-S1V1 SAR_App G Duty Cycle Analysis

END OF REPORT