KDB 865664 D01 SAR Measurement 100MHz to 6GHz
FCC 47 CFR part 2 (2.1093)

SAR EVALUATION REPORT

For

Datecs

Model: BluePad-5000

FCC ID: YRWBLUEPAD-5000

REPORT NUMBER UL-SAR-RP11963121-516B V3.0
ISSUE DATE: 31 JANUARY 2020

Prepared for

DATECS LTD
DATECS STREET No 4
SOFIA
1592
BULGARIA

Prepared by

UL VS LTD
UNIT 1-3 HORIZON, KINGSLAND BUSINESS PARK
WADE ROAD, BASINGSTOKE, HAMPSHIRE, RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001

0644

REVISION HISTORY

Ver.	Issue Date	Revisions	Revised By
1.0	16 April 2019	Initial Issue	--
2.0	12 June 2019	The following amendments were made in the report: 1. Typo for hardware and software corrected in section 6.1 2. Typo corrected in section 1	Naseer Mirza
3.0	31 January 2020	The following amendments were made in the report: 1. Updated Simultaneous Transmission reported SAR in section 1 2. Added section 10.4 – standalone test exclusion 3. Updated Simultaneous Transmission Analysis in Section 11.2	Naseer Mirza

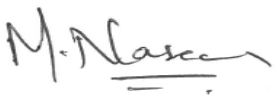
TABLE OF CONTENTS

1. Attestation of Test Results

Applicant Name:	Datecs Ltd					
Model:	BluePad-5000					
Test Device is	A representative test sample					
Device category	Desktop mobile payment terminal					
Date Tested	15 February 2018 to 03 April 2019					
ICNIRP Guidelines Limits for SAR Exposure Characteristics	General Population/Localised SAR (Extremity) – 10g SAR limit 4.0 W/kg					
The highest reported SAR values for Localized SAR	RF Exposure Conditions		Equipment Class			
			Licensed	DTS	U-NII	DSS
	Standalone	Extremity	1.07 W/Kg	0.07 W/Kg	N/A	N/A
	Simultaneous Transmission	Extremity	1.18 W/Kg	1.18 W/Kg	N/A	1.18 W/Kg
Applicable Standards	FCC 47 CFR part 2 (2.1093) KDB publications IEEE Std 1528-2013					
Test Results	Pass					

UL VS Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL VS Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties are in accordance with the above standard 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(s), 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 VS Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL VS Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by UKAS. This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:	Prepared By:
	
Naseer Mirza Lead Project Engineer UL VS Ltd.	Marc Montserrat Senior Engineer UL VS Ltd.

2. Test Specification, Methods and Procedures

2.1. Test Specification

Reference:	KDB Publication Number: 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
Title:	SAR Measurement Requirements for 100 MHz to 6 GHz
Introduction:	The SAR Measurement procedures for 100MHz to 6GHz are described in this document. Field probes, tissue dielectric properties, SAR scans, measurement accuracy and variability of the measured results are discussed. The field probe and SAR scan requirements are derived from criteria considered in standard IEEE 1528-2013. The wireless product and technology specific procedures in applicable KDB publications are required to be used unless further guidance has been approved by the FCC.
Purpose of Test:	To determine if the Equipment Under Test complies with the Specific Absorption Rate for general population/uncontrolled exposure limit of 4.0 W/kg as specified in FCC 47 CFR part 2 (2.1093).

2.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

IEEE 1528:2013

IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques.

FCC KDB Publication:

KDB 248227 D01 802 11 Wi-Fi SAR v02r02
KDB 447498 D01 General RF Exposure Guidance v06
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 SAR Reporting v01r02

2.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Section 4.3 contains a list of the test equipment used.

3. Facilities and Accreditation

The measurement facilities used to collect data are located at

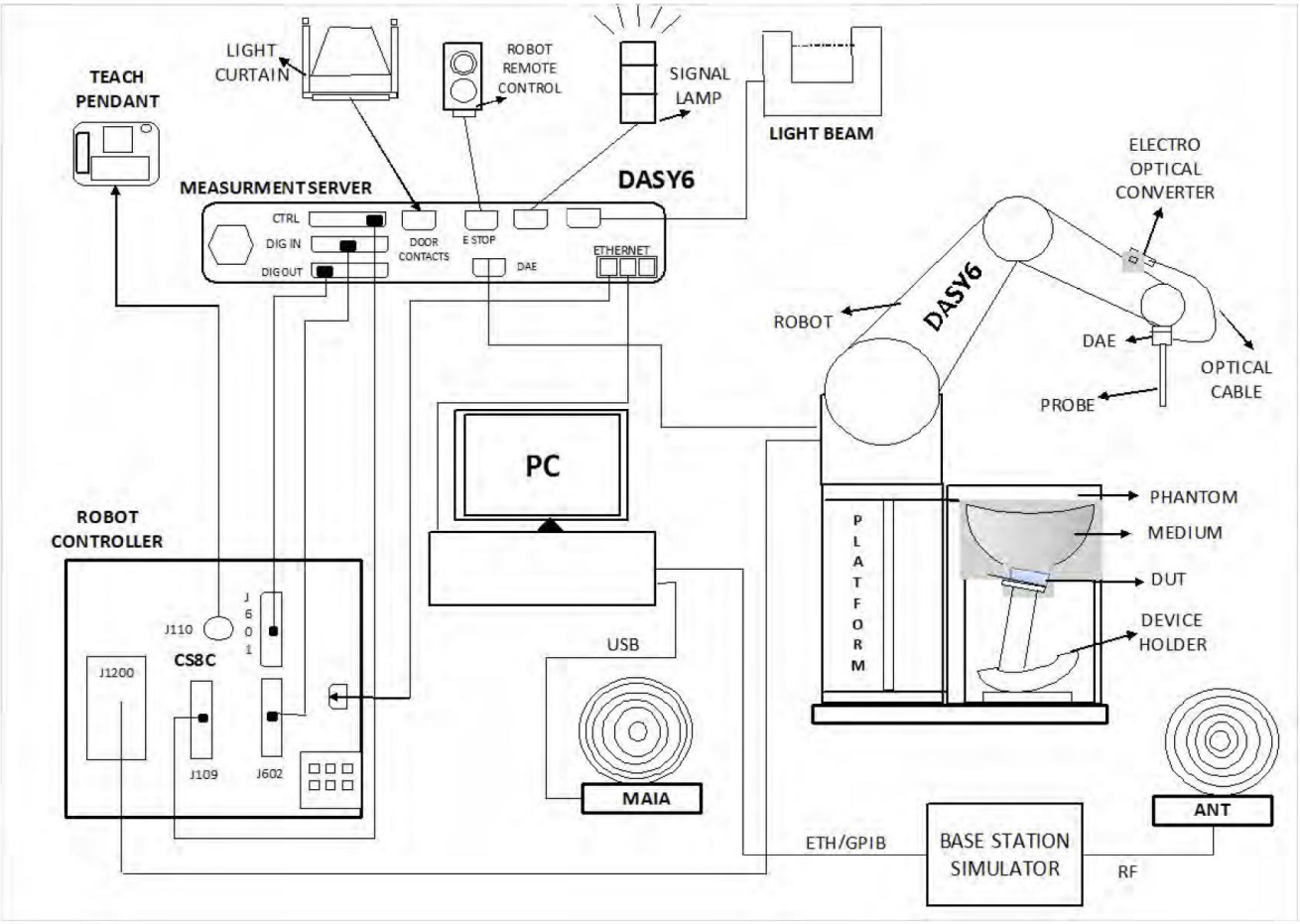
Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG UK	Facility Type
SAR Lab 60	Controlled Environment Chamber
Unit 1 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, UK	Facility Type
SAR Lab 60	Controlled Environment Chamber

UL VS Limited is accredited by UKAS (United Kingdom Accreditation Service, Accredited to ISO/IEC 17025: 2005), Laboratory UKAS Code 0644.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY test systems 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 Win 8.1 or Win 10 with DASY software installed.
- 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 Measurement Procedure

4.2.1. Normal SAR Measurement Procedure

The following procedure shall be performed for each of the test conditions Measure the local SAR at a test point within 8 mm of the phantom inner surface that is closest to the DUT.

a) Measure the two-dimensional SAR distribution within the phantom (area scan procedure).
b) The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grid spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ ln(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and ln(x) is the natural logarithm. The maximum variation of the sensor-phantom surface distance shall be ± 1 mm for frequencies below 3 GHz and ± 0,5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional uncertainty evaluation is needed.
c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks; additional peaks shall be measured only when the primary peak is within 2 dB 6 of the SAR compliance limit (e.g., 1 W/kg for 1,6 W /kg 1 g limit, or 1,26 W/kg for 2 W /kg, 10 g limit).
d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step c) (zoom scan procedure). The horizontal grid step shall be (24 / f [GHz]) mm or less but not more than 8 mm. The minimum zoom scan size is 30 mm by 30 mm by 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom scan size can be reduced to 22 mm by 22 mm by 22 mm. The grid step in the vertical direction shall be (8-f [GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12/f [GHz]) mm or less but not more than 4 mm, and the spacing between farther points shall increase by an incremental factor not exceeding 1,5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ ln(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and ln(x) is the natural logarithm. Separate grids shall be centred on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved if the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5º.
e) Use post processing (e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.
f) The local SAR should be measured at the same location as in Step a). SAR drift is assessed and reported in the uncertainty budget.
In the event that the evaluation of measurement drift exceeds the 5 % tolerance, it is required that SAR be reassessed following guidelines contained within this standard.
If the drift is larger than 5 %, then the measurement drift shall be considered a bias, not an uncertainty. A correction shall be applied to the measured SAR value. It is not necessary to record the drift in the uncertainty budget (i.e. ui = 0 %). The uncertainty budget reported in a measurement report should correspond to the highest SAR value reported (after correction, if applicable). Alternatively, the uncertainty budget reported should cover all measurements, i.e., it should report a conservative value.

Area Scan Parameters:

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Zoom Scan Parameters:

			≤ 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

4.3. Test Equipment

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

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A2547	Data Acquisition Electronics	SPEAG	DAE4	1438	27 April 2017	12
A2110	Data Acquisition Electronics	SPEAG	DAE4	431	08 Jun 2018	12
A2545	Probe	SPEAG	EX3DV4	3995	04 May 2017	12
PRE0189107	Probe	SPEAG	ES3DV3	3358	21 Jan 2019	12
A2588	900 MHz Dipole	SPEAG	D900V2	1d168	21 Sep 2017	12
A1237	1900 MHz Dipole	SPEAG	D1900V2	540	20 Sep 2017	12
A1322	2450 MHz Dipoles	SPEAG	D2450	725	17 Sep 2018	12
G0611	Robot Power Supply	SPEAG	DASY52	F14/5UA6A1/C/01	Calibrated as part of system	-
M1876	Robot Arm	Staubli	TX60 L	F14/5UA6A1/A/01	Calibrated as part of system	-
A2440	Body Handset Positioner	SPEAG	MD4HACV5	None	Calibrated before use	-
M1755	DAK Fluid Probe	SPEAG	SM DAK 040 CA	1089	Calibrated before use	-
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	12 Oct 2017	12
PRE0151154	Network Analyser	R&S	ZND	100151	03 Jan 2019	12
M1855	Power Sensor	R & S	NRP-Z51	103246	08 Nov 2017	12
A2621	Digital Camera	Nikon	S3600	41010357	N/A	-
PRE0159220	Power Source	SPEAG	SE UMS 160 AB	1025	15 May 2017	12
PRE0159221	Power Source	SPEAG	SE UMS 160 AB	1026	07 Nov 2018	12
A2252	Phantom	SPEAG	Eli Phantom	1177	Calibrated as part of system	-
PRE0141348	Phantom Support Structure	SPEAG	DASY6 Phantom Table	-	Calibrated as part of system	-
PRE0155856	RS Hygrometer	RS Components	408-6109	612Q19R(1)	11 Apr 2017	12
PRE0155856	RS Hygrometer	RS Components	408-6109	612Q19R(1)	11 Apr 2018	12
PRE0140104	RF Coax Cable	RM Coax	FB311A1020003030	-	Calibrated before use	-

4.3.1. SAR System Specifications

Robot System		
Positioner:	Stäubli Unimation Corp. Robot Model: TX60L	
Repeatability:	±0.030 mm	
No. of Axis:	6	
Serial Number:	F14/5UA6A1/A/01	
Reach:	920 mm	
Payload:	2.0 kg	
Control Unit:	CS8C	
Programming Language:	V+	
Data Acquisition Electronic (DAE) System		
Serial Number:	DAE4 SN: 1438, 431	
PC Controller		
PC:	HP EliteDesk 800	
Operating System:	Windows 10	
Data Card:	DASY5 Measurement Servers	
Data Converter		
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.	
Software:	DASY5 PRO Software	
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.	
PC Interface Card		
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 and DAE4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.	
Phantom		
Phantom:	Eli Phantom	
Shell Material:	Fibreglass	
Thickness:	2.0 ±0.1 mm	
E-Field Probe		
Model:	EX3DV4	ES3DV3
Serial No:	3995	3358
Construction:	Triangular core	Triangular core
Frequency:	10 MHz to >6 GHz	10 MHz to > 4 GHz
Linearity:	±0.2 dB (30 MHz to 6 GHz)	±0.2 dB (30 MHz to 4 GHz)
Probe Length (mm):	337	337
Probe Diameter (mm):	10	10
Tip Length (mm):	9	10
Tip Diameter (mm):	2.5	4
Sensor X Offset (mm):	1	2
Sensor Y Offset (mm):	1	2
Sensor Z Offset (mm):	1	2

5. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Test Name	Confidence Level	Calculated Uncertainty
Uncertainty- Freq. < 3 GHz Body Configuration 10 g	95%	±18.58%
Uncertainty- Freq. > 3 GHz Body Configuration 10 g	95%	±16.51%

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

5.1. Uncertainty – Freq. < 3 GHz Body Configuration 10 g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (10g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	5.050	5.050	normal (k=1)	1.0000	1.0000	5.050	5.050	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.300	0.300	Rectangular	1.7321	1.0000	0.173	0.173	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	8.520	8.520	Rectangular	1.7321	1.0000	4.919	4.919	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	0.025	0.025	normal (k=1)	1.0000	1.0000	0.025	0.025	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.4300	1.241	1.241	∞
A	Liquid Conductivity (measured value)	2.340	2.340	normal (k=1)	1.0000	0.4300	1.006	1.006	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.4900	1.415	1.415	∞
A	Liquid Permittivity (measured value)	1.150	1.150	normal (k=1)	1.0000	0.4900	0.564	0.564	5
	Combined standard uncertainty			t-distribution			9.49	9.49	>500
	Expanded uncertainty			k = 1.96			18.59	18.59	>500

5.2. Uncertainty – Freq. > 3 GHz Body Configuration 10 g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (10g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	5.050	5.050	normal (k=1)	1.0000	1.0000	5.050	5.050	B
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	B
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	B
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	B
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	B
B	Linearity	0.300	0.300	Rectangular	1.7321	1.0000	0.173	0.173	B
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	B
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	B
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	B
B	Integration Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	B
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	B
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	B
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	B
B	Extrapolation and integration / Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	B
A	Test Sample Positioning	0.554	0.554	normal (k=1)	1.0000	1.0000	0.554	0.554	A
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	A
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	B
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	B
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	B
A	Liquid Conductivity (measured value)	2.420	2.420	normal (k=1)	1.0000	0.6400	1.549	1.549	A
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	B
A	Liquid Permittivity (measured value)	1.610	1.610	normal (k=1)	1.0000	0.6000	0.966	0.966	A
	Combined standard uncertainty			t-distribution			8.43	8.43	
	Expanded uncertainty			k = 1.96			16.51	16.51	

6. Device Under Test (DUT)

6.1. DUT Description

DUT Description:	Desktop mobile payment terminal.	
Samples Used:	**Radiated Samples**	S/N: 1917900011 S/N: 1917900008 S/N: 1919900005
	Conducted Samples	S/N: 1917900010 S/N: 1918900004
Hardware Version Number:	02.05.20.00BSWU	
Software Version Number:	03.01.19.87	
Country of Manufacture:	Bulgaria	
Device dimension	Overall (Length x Width x Depth): 49 mm x 76 mm x 172 mm	
Date of Receipt:	08 February 2018	
Accessory	☐ Headset	
Battery Options	☒ Standard – Lithium-ion battery ☐ Extended (large capacity)	
Antenna Type:	Internal integral	
Antenna Length:	None Stated	
Number of Antenna Positions:	Cellular Antenna ~ WWAN ~ Cellular	
	Wi-Fi Antenna ~ WLAN ~ Wi-Fi (2.4GHz)	
	Bluetooth Antenna ~ WPAN ~ Bluetooth	

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode		Duty Cycle
GSM	850 1900	☐ Voice (GMSK), ☒ 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 ☐ DTM (Dual Transfer Mode)	☐ GSM Voice: 12.50%; GPRS: ☒ 1 Slot: 12.50% ☒ 2 Slots: 25.00% ☒ 3 Slots: 37.50% ☒ 4 Slots: 50.00%
W-CDMA ☒ (FDD) ☐ (TDD)	Band 2 Band 5	WCDMA Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6)		100.00%
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)		100.00%
Bluetooth	2.4 GHz	☐ Core Spec. 2.0 ☐ Core Spec. 2.1 ☒ Core Spec. 3.0 ☐ Core Spec. 4.0 ☐ Core Spec. 4.1 ☐ Core Spec. 4.2 ☐ Core Spec. 5.0 ☐ Power Class 1 ☒ Power Class 2 ☐ Power Class 3	Basic Rate (BDR) Enhanced Data Rate (EDR)	77% (DH5, 720Kb/s) 77% (2-DH5/3-DH5, 2Mbps and 3Mbps)

Additional Information Related to Testing:

GSM			
Band	**Description**		
EGSM850	Frequency Range: 880 - 915 MHz		
	Channel Number	Channel Description	Frequency (MHz)
	128	Low	824.2
	190	Middle	836.6
	251	High	848.8
PCS1900	Frequency Range: 1710 - 1785 MHz		
	Channel Number	Channel Description	Frequency (MHz)
	512	Low	1850.2
	661	Middle	1880.0
	810	High	1909.8

WCDMA			
Band	**Description**		
WCDMA FDD 2	Frequency Range: 1922 - 1978 MHz		
	Channel Number	Channel Description	Frequency (MHz)
	9262	Low	1852.4
	9400	Middle	1880.0
	9538	High	1907.6
WCDMA FDD 5	Frequency Range: 826 - 847 MHz		
	Channel Number	Channel Description	Frequency (MHz)
	4132	Low	826.4
	4183	Middle	836.6
	4233	High	846.6

Additional Information Related to Testing:

Wi-Fi						
Band	Description					
	20 MHz BW Ch.#	Frq. (MHz)	40 MHz BW Ch.#	Frq. (MHz)	80 MHz BW Ch.#	Frq. (MHz)
Wi-Fi 2.4 GHz (802.11b/g/n)	1	2412.0	N/A			
	2	2417.0				
	3	2422.0				
	4	2427.0				
	5	2432.0				
	6	2437.0				
	7	2442.0				
	8	2447.0				
	9	2452.0				
	10	2457.0				
	11	2462.0				
	12	2467.0				
	13	2472.0				

Bluetooth			
Specification	Description		
	Frequency Range: 2402 - 2480 MHz		
	Channel Number	Channel Description	Frequency (MHz)
BDR/EDR	0	Low	2402.0
	39	Middle	2441.0
	78	High	2480.0

6.3.Nominal and Maximum Output Power

(From customer)

RF Air interface	Mode	Target (dBm)	Max. tune-up tolerance limit (dBm)
GSM850	GPRS / EGPRS 1 slot (GMSK)	32.5	-1.0~+1.0
	GPRS / EGPRS 2 slots (GMSK)	32.5	-1.0~+1.0
	GPRS / EGPRS 3 slots (GMSK)	29.5	-1.0~+1.0
	GPRS / EGPRS 4 slots (GMSK)	29.5	-1.0~+1.0
	EGPRS 1 slot (8PSK)	27.0	-1.0~+1.0
	EGPRS 2 slots (8PSK)	27.0	-1.0~+1.0
	EGPRS 3 slots (8PSK)	27.0	-1.0~+1.0
	EGPRS 4 slots (8PSK)	27.0	-1.0~+1.0
PCS1900	GPRS / EGPRS 1 slot (GMSK)	29.5	-1.0~+1.0
	GPRS / EGPRS 2 slots (GMSK)	29.5	-1.0~+1.0
	GPRS / EGPRS 3 slots (GMSK)	29.5	-1.0~+1.0
	GPRS / EGPRS 4 slots (GMSK)	29.5	-1.0~+1.0
	EGPRS 1 slot (8PSK)	25.5	-1.0~+1.0
	EGPRS 2 slots (8PSK)	25.5	-1.0~+1.0
	EGPRS 3 slots (8PSK)	25.5	-1.0~+1.0
	EGPRS 4 slots (8PSK)	25.5	-1.0~+1.0
UMTS FDD 2	RMC 12.2 Kbps (R99)	22.0	-1.0 ~ +1.0
	HSDPA Subset 1 to 4	22.0	-3.0 ~ +1.0
	HSUPA Subset 1 to 5	22.0	-3.0 ~ +1.0
UMTS FDD 5	RMC 12.2 Kbps (R99)	22.0	-1.0 ~ +1.0
	HSDPA Subset 1 to 4	22.0	-3.0 ~ +1.0
	HSUPA Subset 1 to 5	22.0	-3.0 ~ +1.0

(From customer)

			Target (dBm) applicable to antenna A only						
Band	Channel	Center Frequency (MHz)	802.11b			802.11g		802.11n HT20	
			1DSSS	2DSSS	11CCK	6OFDM	9OFDM	18OFDM	MCS7
Wi-Fi 2.4 GHz	1	2412	12.20	12.20	12.60	11.30	11.30	11.00	11.40
	2	2417	12.00	12.00	12.60	11.00	11.00	11.00	11.20
	3	2422	12.80	12.80	13.00	11.60	11.60	11.60	11.50
	4	2427	12.80	12.80	13.00	11.60	11.60	11.70	11.30
	5	2432	13.00	13.00	13.00	11.70	11.70	11.70	12.40
	6	2437	14.20	14.20	14.20	12.30	12.30	12.00	14.00
	7	2442	13.70	13.70	14.00	12.30	12.30	12.40	12.10
	8	2447	14.50	14.50	14.50	12.30	12.30	12.40	13.20
	9	2452	12.80	12.80	13.00	11.50	11.50	11.50	12.20
	10	2457	12.70	12.70	13.00	11.50	11.50	11.50	11.30
	11	2462	13.00	13.00	13.00	11.50	12.50	12.00	12.60
	12	2467	Not Supported						
	13	2472							

WiFi 2.4 GHz - Tolerance (dB)	+/-1.00	+/-1.00	+/-1.00	+/-1.00	+/-1.00	+/-1.00	+/-1.00

RF Air interface	Mode/Packet Type	Channel	Target	Max. tune-up tolerance limit (dBm)
Bluetooth	DH5	ALL	2.80	-1.0~+1.0
	2DH5	ALL	2.00	-1.0~+1.0
	3DH5	ALL	2.00	-1.0~+1.0

RF Air interface	Target	Max. tune-up tolerance limit (dBm)
RFID	-57.00	-1.0~+1.0

Note:

1. The nominal and maximum average source based rated powers declared and supplied by manufacturer are shown in the above tables.

7. RF Exposure Conditions (Test Configurations)

7.1. RF Exposure Conditions (Test Configurations)

Technology Antenna	Configuration	Antenna-to-User Separation	Position	Antenna-to-Edge Separation (mm)	Evaluation Considered
Cellular Antenna	Extremity (Body)	0mm	Front	<25mm	Yes
			Back	<25mm	Yes
			Edge 1 (Top Edge)	>25mm	No
			Edge 2 (Right Edge)	<25mm	Yes
			Edge 3 (Bottom Edge)	>25mm	No
			Edge 4 (Left Edge)	>25mm	No
Wi-Fi Antenna	Extremity (Body)	0mm	Front	<25mm	Yes
			Back	<25mm	Yes
			Edge 1 (Top Edge)	>25mm	No
			Edge 2 (Right Edge)	>25mm	No
			Edge 3 (Bottom Edge)	>25mm	No
			Edge 4 (Left Edge)	<25mm	Yes
Bluetooth Antenna	Extremity (Body)	0mm	Front	<25mm	Yes
			Back	<25mm	Yes
			Edge 1 (Top Edge)	>25mm	No
			Edge 2 (Right Edge)	<25mm	Yes
			Edge 3 (Bottom Edge)	>25mm	No
			Edge 4 (Left Edge)	>25mm	No

7.2. SAR Test Exclusion Consideration

Frequency Band	Configuration
	Body
GSM 850	No
PCS1900	No
WCDMA FDD 2	No
WCDMA FDD 5	No

Frequency Band	Configuration
	Body
WLAN 2.4 GHz	No
Bluetooth	Yes
RFID	Yes

Note:

1. As per KDB publication 447498 D01, The Frequency Bands with Rated Power including Upper tolerance, which qualify for **Standalone SAR Test Exclusion**, are as per the above table.
2. The details for the Maximum Rated Power and tolerance(s) can be found in section 6.3

8. Conducted output power measurements

8.1. RF Output Average Power Measurement: GSM

GPRS (GMSK) – Coding Scheme: CS1

Band	Channel	Frequency (MHz)	Avg Power (dBm)				Frame Power (dBm)			
			1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks	1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks
GSM 850	128	824.2	32.23	32.13	30.23	29.13	23.20	26.11	25.97	26.12
	190	836.6	32.13	32.03	30.13	29.03	23.10	26.01	25.87	26.02
	251	848.8	32.23	32.13	30.13	29.13	23.20	26.11	25.87	26.12
PCS 1900	512	1850.2	29.23	29.23	29.23	29.13	20.20	23.21	24.97	26.12
	661	1880.0	29.13	29.13	29.03	29.03	20.10	23.11	24.77	26.02
	810	1909.8	28.83	28.83	28.73	28.73	19.80	22.81	24.47	25.72

EDGE (GMSK) – Coding Scheme: MCS4

Band	Channel	Frequency (MHz)	Avg Power (dBm)				Frame Power (dBm)			
			1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks	1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks
GSM 850	128	824.2	32.23	32.13	30.23	29.13	23.20	26.11	25.97	26.12
	190	836.6	32.13	32.03	30.13	29.03	23.10	26.01	25.87	26.02
	251	848.8	32.23	32.13	30.13	29.13	23.20	26.11	25.87	26.12
PCS 1900	512	1850.2	29.23	29.23	29.23	29.13	20.20	23.21	24.97	26.12
	661	1880.0	29.13	29.13	29.03	29.03	20.10	23.11	24.77	26.02
	810	1909.8	28.83	28.83	28.73	28.73	19.80	22.81	24.47	25.72

EDGE (GMSK) – Coding Scheme: MCS9

Band	Channel	Frequency (MHz)	Avg Power (dBm)				Frame Power (dBm)			
			1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks	1 Uplink	2 Uplinks	3 Uplinks	4 Uplinks
GSM 850	128	824.2	26.43	26.43	26.33	26.33	17.40	20.41	22.07	23.32
	190	836.6	26.43	26.33	26.33	26.33	17.40	20.31	22.07	23.32
	251	848.8	26.43	26.43	26.33	26.33	17.40	20.41	22.07	23.32
PCS 1900	512	1850.2	25.33	25.23	25.23	25.13	16.30	19.21	20.97	22.12
	661	1880.0	25.23	25.13	25.13	25.03	16.20	19.11	20.87	22.02
	810	1909.8	24.93	24.93	24.93	24.83	15.90	18.91	20.67	21.82

8.1. RF Output Average Power Measurement: WCDMA

8.1.1. RMC / HSDPA / HSUPA

Modes		HSDPA				HSUPA					WCDMA
Sets		1	2	3	4	1	2	3	4	5	RMC 12.2kbps
Band	Channel	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]	Power [dBm]
Band 2 (1900 MHz)	UL: 9262 DL: 9662	21.93	22.03	21.63	21.93	21.73	19.83	20.63	20.03	20.93	22.23
	UL: 9400 DL: 9800	21.43	21.13	20.73	21.13	20.93	19.13	19.73	19.23	20.23	21.43
	UL: 9538 DL: 9938	21.43	21.23	20.83	21.13	20.73	19.13	19.83	19.23	20.33	21.43
Band 5 (850 MHz)	UL: 4132 DL: 4357	21.93	21.93	21.43	21.93	21.63	19.73	20.53	19.83	20.83	22.03
	UL: 4183 DL: 4408	22.23	22.33	21.83	22.23	22.03	20.03	20.83	20.23	21.23	22.33
	UL: 4233 DL: 4458	21.43	21.53	20.93	21.43	21.43	19.23	20.13	19.53	20.43	21.53
ßc		2	12	15	15	11	6	15	2	15	
ßd		15	15	8	4	15	15	9	15	15	
ΔACK, ΔNACK, ΔCQI		8	8	8	8	8	8	8	8	8	
AGV		-	-	-	-	20	12	15	17	21	

8.2. RF Output Average Power Measurement: Wi-Fi

8.2.1. Wi-Fi 802.11b/g/n (2.4 GHz)

		Avg Power (dBm)	
		WI-FI Antenna	
Channel Number	Frequency (MHz)	11 Mbps	Operating Mode
1	2412	12.70	802.11b (11-CCK)
2	2417	12.70	
3	2422	13.20	
4	2427	13.20	
5	2432	13.20	
6	2437	14.70	
7	2442	14.20	
8	2447	14.70	
9	2452	13.30	
10	2457	13.30	
11	2462	13.30	
12	2467	Not Supported	
13	2472	Not Supported	

Note:
Conducted power measurements were not performed for mode 802.11g and 802.11n HT20 due to max. rated power being equal or lower to mode 802.11b.

9. Dielectric Property Measurements & System Check

9.1.Tissue Dielectric Parameters

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.

IEEE 1528:2013

Target Frequency (MHz)	Body	
	ε_r	σ (S/m)
150	61.9	0.80
300	58.2	0.92
450	56.7	0.94
750	-	-
835	55.2	0.97
900	55.0	1.05
915	55.0	1.06
1450	54.0	1.30
1500	-	-
1610	53.8	1.40
1640	-	-
1750	-	-
1800	53.3	1.52
1900	53.3	1.52
2000	53.3	1.52
2100	-	-
2300	-	-
2450	52.7	1.95
2600	-	-
3000	52.0	2.73
3500	-	-
4000	-	-
4500	-	-
5000	49.3	5.07
5100	49.1	5.18
5200	49.0	5.30
5250	48.9	5.36
5300	48.9	5.42
5400	48.7	5.53
5500	48.6	5.65
5600	48.5	5.77
5700	48.3	5.88
5750	48.3	5.94
5800	48.2	6.00
6000	-	-

NOTE: For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

9.2. 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.

9.3. Reference Target SAR Values

The reference SAR values are obtained from the calibration certificate of system validation dipoles. The measured values are normalised to 1.00 Watt.

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)	
				1g/10g	Body
D900V2	1d168	21 Sep 2017	900	1g	11.0
				10g	7.08
D1900V2	540	20 Sep 2017	1900	1g	39.4
				10g	20.9
D2450V2	725	17 Sep 2018	2450	1g	50.8
				10g	23.8

9.4. Dielectric Property Measurements & System Check Results

The 1-g SAR 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. The internal limit is set to ±10%.

Site 60

System check 900 Body
Date: 14/02/2018
Validation dipole and Serial Number: D900V2 / SN: 1d168

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	23.0	21.0	**εr**	55.00	54.60	-0.72	10.00
				Σ	1.05	1.01	-3.49	10.00
				1g (W/kg)	11.00	11.01	0.12	10.00
				10g (W/kg)	7.08	7.10	0.32	10.00

System check 1900 Body
Date: 19/02/2018
Validation dipole and Serial Number: D1900V2 / SN: 540

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	23.0	21.0	**εr**	53.30	53.30	1.80	10.00
				Σ	1.52	1.58	4.12	10.00
				1g (W/kg)	39.40	40.90	3.81	10.00
				10g (W/kg)	20.90	21.14	1.19	10.00

System check 2450 Body
Date: 02/04/2019
Validation dipole and Serial Number: D2450V2 / SN: 725

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	23.0	22.0	**εr**	52.60	52.70	-0.18	10.00
				Σ	2.08	1.95	6.62	10.00
				1g (W/kg)	50.80	52.47	3.29	10.00
				10g (W/kg)	23.80	24.54	3.11	10.00

10. Measurements, Examinations and Derived Result

10.1. Specific Absorption Rate - Test Results - Cellular
For All SAR measurement in this report the 10g-SAR limit tested to is 4.0 W/Kg

10.1.1. GSM 850 Body 10g
Max Reported SAR = 0.82 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
GPRS 4Tx	0	Front	128	824.2	N/A	N/A	30.50	29.13	0.176	0.24	-	-
GPRS 4Tx	0	Back	128	824.2	N/A	N/A	30.50	29.13	0.478	0.66	-	-
GPRS 4Tx	0	Right Edge	128	824.2	N/A	N/A	30.50	29.13	0.597	0.82	-	001
GPRS 4Tx	0	Bottom Edge	128	824.2	N/A	N/A	30.50	29.13	0.136	0.19	-	-
GPRS 4Tx	0	Right Edge	190	836.6	N/A	N/A	30.50	29.03	0.435	0.61	-	-
GPRS 4Tx	0	Right Edge	251	848.8	N/A	N/A	30.50	29.13	0.316	0.43	-	-

Note(s):

10.1.2. PCS 1900 Body 10g
Max Reported SAR = 1.07 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
GPRS 4Tx	0	Front	512	1850.2	N/A	N/A	30.50	29.13	0.163	0.22	-	-
GPRS 4Tx	0	Back	512	1850.2	N/A	N/A	30.50	29.13	0.274	0.38	-	-
GPRS 4Tx	0	Right Edge	512	1850.2	N/A	N/A	30.50	29.13	0.777	1.07	-	002
GPRS 4Tx	0	Bottom Edge	512	1850.2	N/A	N/A	30.50	29.13	0.208	0.29	-	-
GPRS 4Tx	0	Right Edge	661	1880.0	N/A	N/A	30.50	29.03	0.707	0.99	-	-
GPRS 4Tx	0	Right Edge	810	1909.8	N/A	N/A	30.50	28.73	0.626	0.94	-	-

Note(s):

10.1.3.WCDMA FDD 2 Body 10g
Max Reported SAR = 0.55 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
RMC	0	Front	9262	1852.4	N/A	N/A	23.00	22.23	0.113	0.13	-	-
RMC	0	Back	9262	1852.4	N/A	N/A	23.00	22.23	0.191	0.23	-	-
RMC	0	Right Edge	9262	1852.4	N/A	N/A	23.00	22.23	0.464	0.55	-	003
RMC	0	Bottom Edge	9262	1852.4	N/A	N/A	23.00	22.23	0.138	0.16	-	-
RMC	0	Right Edge	9400	1880	N/A	N/A	23.00	21.43	0.306	0.44	-	-
RMC	0	Right Edge	9538	1907.6	N/A	N/A	23.00	21.43	0.335	0.48	-	-

Note(s):

10.1.4.WCDMA FDD 5 Body 10g
Max Reported SAR = 0.34 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
RMC	0	Front	4183	836.6	N/A	N/A	23.00	22.33	0.064	0.07	-	-
RMC	0	Back	4183	836.6	N/A	N/A	23.00	22.33	0.237	0.28	-	-
RMC	0	Right Edge	4183	836.6	N/A	N/A	23.00	22.33	0.252	0.29	-	-
RMC	0	Bottom Edge	4183	836.6	N/A	N/A	23.00	22.33	0.067	0.08	-	-
RMC	0	Right Edge	4132	826.4	N/A	N/A	23.00	22.03	0.272	0.34	-	004
RMC	0	Right Edge	4233	846.6	N/A	N/A	23.00	21.53	0.178	0.25	-	-

Note(s):

10.2. Specific Absorption Rate - Test Results – Wi-Fi
For All SAR measurement in this report the 10g-SAR limit tested to is 4.0 W/Kg

10.2.1.WiFi 2.4 GHz Body 10g
Max Reported SAR = 0.07 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
802.11b	0	Front	6	2437	N/A	N/A	15.20	14.70	0.02	0.02	-	-
802.11b	0	Back	6	2437	N/A	N/A	15.20	14.70	0.00	0.00	-	-
802.11b	0	Left	6	2437	N/A	N/A	15.20	14.70	0.06	0.07	-	005
802.11b	0	Left	3	2422	N/A	N/A	14.00	13.20	0.04	0.04	-	-
802.11b	0	Left	11	2462	N/A	N/A	14.00	13.30	0.05	0.06	-	-

Note(s):

10.3. 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 < 2.00 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 2.00 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 > 1.20 or when the original or repeated measurement is ≥ 3.60 W/kg (~ 10% from the 1-g 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 > 1.20.

Note: Measured 10g-SAR levels were all < 2.000 W/Kg, thus no repeat measurements were required.

10.4.Standalone SAR Test Exclusion Considerations

DUT uses an Bluetooth 2.4 GHz and RFID band, with maximum rated power of 3.8 dBm and -56.0 dBm respectively.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

- [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:
  - $f_{(GHz)}$ is the RF channel transmit frequency in GHz
  - Power and distance are rounded to the nearest mW and mm before calculation
  - The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Body Worn Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
3.80	2.399	5	2.400	0.743
-56.00	0.00000251	5	0.01356	0.0000001

Conclusion:

The computed value is <7.5; therefore, Bluetooth 2.4 GHz band qualifies for Standalone SAR test exclusion.

Estimated SAR

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)/x]* W/kg for test separation distances ≤ 50 mm, where :
  - x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Estimated SAR Result for Body-worn Exposure Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 10-g SAR (W/kg)
Front/Back/Left	2.399	5	2.4	0.040
Front/Back/Left	-56.00	5	0.01356	0.000

11. Highest Standalone SAR and Simultaneous Transmission

11.1. Highest Standalone Reported SAR

Individual Transmitter Evaluation per Band: Cellular

Exposure Configuration	Technology Band	Reported 10g - SAR (W/Kg)	Equipment Class	Highest Reported 10g SAR (W/Kg)
BODY-WORN (Separation Distance 0mm)	GSM850	0.82	PCE	1.07
	PCS1900	1.07		
	WCDMA FDD 2	0.55		
	WCDMA FDD 5	0.34		

Individual Transmitter Evaluation per Band: WiFi 2.4 GHz

Exposure Configuration	Technology Band	Reported 10g - SAR (W/Kg)	Equipment Class	Highest Reported 10g SAR (W/Kg)
BODY-WORN (Separation Distance 0mm)	WiFi 2.4 GHz	0.07	DTS	0.07

11.2. Simultaneous Transmission analysis

KDB 447498 D01 General RF Exposure Guidance, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

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

Where:

SAR_1 is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition
SAR_2 is the highest reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first
Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured for both antennas in the pair, it is determined by the actual x, y, and z coordinates in the 1-g SAR for each SAR Peak Location; based on the extrapolated and interpolated result in the zoom scan measurement using the formula:

$$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$$

A new threshold of 0.04 is also introduced in the KDB 447498. Thus, in order for a pair of simultaneously transmitting antennas, with the sum of 1-g SAR > 1.6 W/kg, to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

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

Combination under consideration	Exposure Configuration	Technology Band	Highest Reported 10g SAR (W/kg)	Equipment Class	Simultaneous transmission SUM (W/kg)	SPLSR Ratio
WWAN + WLAN + WPAN + RFID	Body Worn	PCS1900	1.07	PCE	1.18	N/A
		WiFi 2.4 GHz	0.07	DTS		
		BT	0.04	DSS		
		RFID	0.00	-		