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

SAR EVALUATION REPORT

For

Panasonic

FCC ID: UCE215063A
Model: 401PM

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Prepared for

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REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	10 March 2015	Initial Issue	--
1	11 March 2015	The following amendments are made in the report: 1. Re-test was performed on Body-worn test at 10mm and new results are included in Section 10 2. Simultaneous Transmission was re-evaluated and tables amended in Section 11 3. Attestation of test results updated with values obtained after retest	Sandhya Menon
2	09 April 2015	The following amendments are made in the report 1. The following note is included in Section 7.2: '10mm represents the minimum separation distance achieved with typical available carry accessories to be used with the handset, as advised by the manufacturer '	Sandhya Menon

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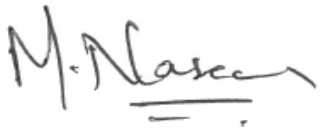
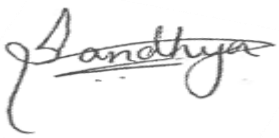
1. Attestation of Test Results

Applicant Name:	Panasonic Mobile Communications Development of Europe Ltd		
Application Purpose	☒ Original Grant		
DUT Description	Dual Mode GSM/UTRA Mobile Phone with Bluetooth		
Test Device is	An identical prototype		
Device category	Portable		
Exposure Category	General Population/Uncontrolled Exposure (1g SAR limit: 1.6 W/kg)		
Date Tested	02 March 2015 to 10 March 2015		
The highest reported SAR values	RF Exposure Conditions	Licensed	DSS
	Head	0.714 W/kg	N/A
	Body-worn	0.713 W/kg	0.033 W/kg
	Simultaneous Transmission	0.746 W/kg	0.746 W/kg
Applicable Standards	FCC 47 CFR part 2 (2.1093) Published RF Exposure KDB Procedures IEEE Std 1528-2013		
Test Results	Pass		

UL Verification Services 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 Verification Services 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 Verification Services Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services 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 Project Lead UL Verification Services Ltd.	Sandhya Menon Senior Engineer UL Verification Services Ltd.

2. Test Specification, Methods and Procedures

2.1. Test Specification

Reference:	KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
Title:	SAR Measurement Requirements for 100 MHz to 6 GHz
Purpose of Test:	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 draft standard IEEE P1528-2011.
The Equipment Under Test complied with the Specific Absorption Rate for general population/uncontrolled exposure limit of 1.6 W/kg as specified in FCC 47 CFR part 2 (2.1093) and ANSI C95.1-1992 has been tested in accordance with the reference documents in section 2.2 of this report.	

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 Communications Devices: Measurement Techniques

Thomas Schmid, Oliver Egger and Neils Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE Transaction on microwave theory and techniques,
Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with known precision”, IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

FCC KDB Publication:
447498 D01 General RF Exposure Guidance v05r02
648474 D04 Handset SAR v01r02
865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
865664 D02 RF Exposure Reporting v01r01
941225 D01 3G SAR Procedures v03

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 4.2 contains a list of the test equipment used.

3. Facilities and Accreditation

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

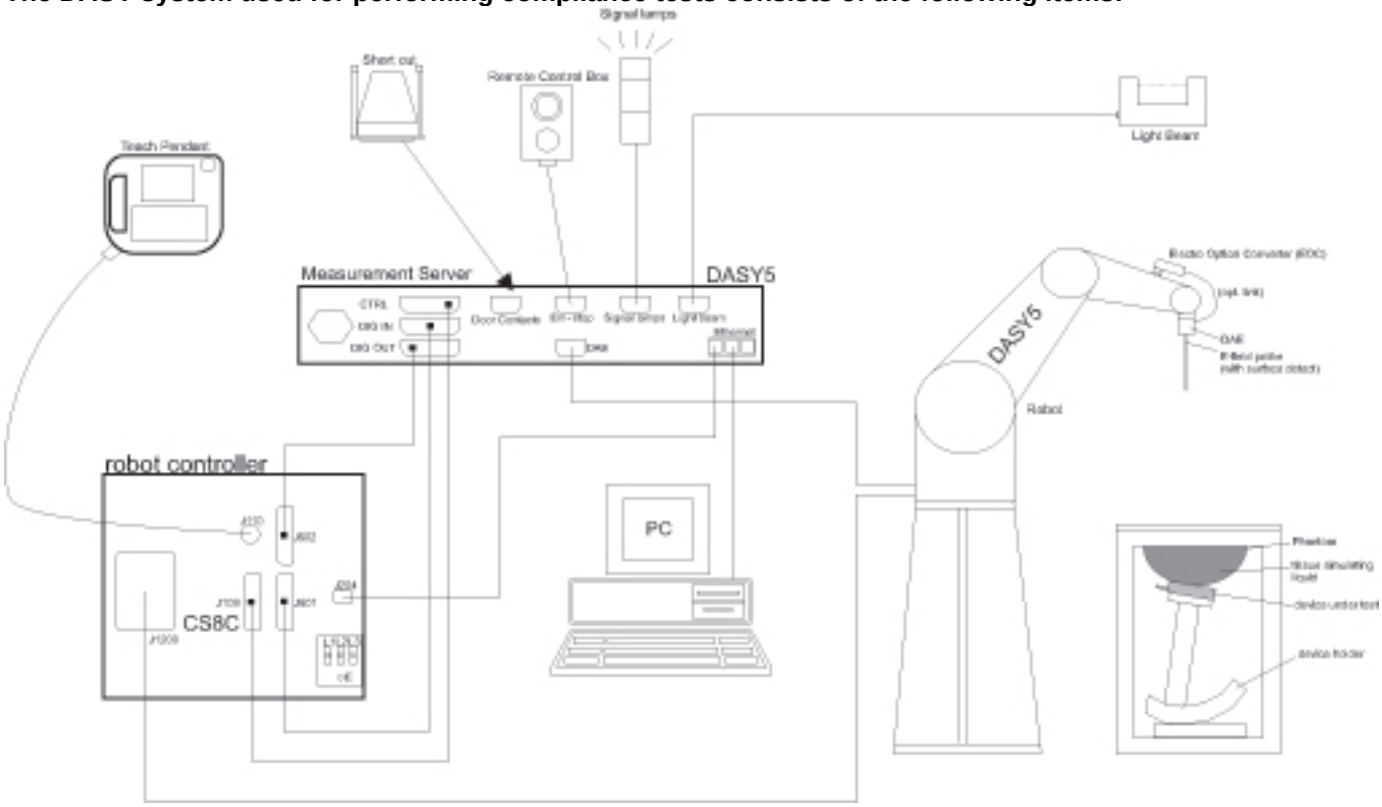
Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG UK	Facility Type
SAR Lab 60	Controlled Environment Chamber

UL Verification Services Ltd, is accredited by UKAS (United Kingdom Accreditation Service), Laboratory UKAS Code 0644.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY 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 DASY 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 Measurement Procedure

4.2.1. Normal SAR Measurement Procedure

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 62209-1 / IEC 62209-2 standards. 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 v01r03

	≤ 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 v01r03

			≤ 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. Volumetric Scan Procedure

Step 1: Repeat Step 1-4 in Section 4.3

Step 2: Volume Scan

Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

Step 3: 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.

4.4. Test Equipment

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

Dielectric Property Measurements & System Check

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A2547	Data Acquisition Electronics	SPEAG	DAE4	1438	12 May 2014	12
A1185	Probe	SPEAG	ET3 DV6	1528	16 Apr 2014	12
A1237	1900 MHz Dipole Kit	SPEAG	D1900V2	540	08 Dec 2014	12
G0611	Robot Power Supply	SPEAG	DASY52	None	Calibrated before use	-
M1876	Robot Arm	Staubli	TX60 L	F14/5T5ZA1/A/01	Calibrated before use	-
M1860	Spectrum Analizer	HP	8590E	3911A01646	Calibrated before use	-
A1182	Handset Positioner	SPEAG	V3.0	None	-	-
A2442	Handset Positioner	SPEAG	MD4HHTV5	None	-	-
M1755	DAK Fluid Probe	SPEAG	SM DAK 040 CA	1089	Calibrated before use	-
M1565	Communication Test Set	Agilent	8960 Series 10 (E5515C)	GB46311280	10 Dec 2014	12
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	26 Oct 2014	12
A2621	Digital Camera	Nikon	S3600	41010357	-	-
M1838	Signal Generator	R&S	SME06	831377/005	14 Apr 2014	12
M1840	Dual Channel Power Meter	R & S	NRVD	844860/040	16 Apr 2014	12
M1848	Power Sensor	R & S	ZRPZ1	831430/004	16 Apr 2014	12
M1847	Power Sensor	R & S	ZRPZ1	831430/003	16 Apr 2014	12
A2100	Directional Coupler	RF-Lambda	11101300748	None	Calibrated as part of system	-
A2403	Amplifier	Mini-Circuits	ZHL-42W	15542	Calibrated as part of system	-
S0570	SAR Lab	UL	Site 60	N/A	Calibrated before use	-
A2552	SAM Phantom	SPEAG	SAM a	1836	Calibrated before use	-

4.5. SAR System Specifications

Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability:	±0.030 mm
No. of Axis:	6
Serial Number:	F14/5T5ZA1/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
PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY4 Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY5 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 16 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.
E-Field Probe	
Model:	ET3DV6
Serial No:	1528
Construction:	Triangular core
Frequency:	10 MHz to 2.55GHz
Linearity:	±0.2 dB (30 MHz to 2.55GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	10
Tip Diameter (mm):	6.8
Sensor X Offset (mm):	2.7
Sensor Y Offset (mm):	2.7
Sensor Z Offset (mm):	2.7
Phantom	
Phantom:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm

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
Specific Absorption Rate - PCS 1900 Head Configuration 1g	95%	±18.88%
Specific Absorption Rate - PCS 1900 Body Configuration 1g	95%	±18.26%

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 - PCS 1900 Head Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
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	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
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	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
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	2.490	2.490	normal (k=1)	1.0000	1.0000	2.490	2.490	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	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	3.560	3.560	normal (k=1)	1.0000	0.6400	2.278	2.278	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	2.620	2.620	normal (k=1)	1.0000	0.6000	1.572	1.572	5
	Combined standard uncertainty			t-distribution			9.63	9.63	>500
	Expanded uncertainty			k = 1.96			18.88	18.88	>500

5.2. Uncertainty - PCS Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
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	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
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	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
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	1.860	1.860	normal (k=1)	1.0000	1.0000	1.860	1.860	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	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	2.610	2.610	normal (k=1)	1.0000	0.6400	1.670	1.670	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	2.140	2.140	normal (k=1)	1.0000	0.6000	1.284	1.284	5
	Combined standard uncertainty			t-distribution			9.32	9.32	>500
	Expanded uncertainty			k = 1.96			18.26	18.26	>500

6. Equipment Under Test (EUT)

6.1. Identification of Equipment Under Test (EUT)

Serial Number/ IMEI Number:	**Radiated Samples:** 004401221425016 – Was used to perform PCS 1900 Head and Body SAR measurements only. **Conducted Sample:** 004401221425198 - Was used to perform Cellular conducted power measurements only.
Hardware Version Number:	Rev C
Software Version Number:	ACPU: B-S51CS1-10.01.002 CCPU: S51CS1_Cv62010101
Country of Manufacture:	Japan
Date of Receipt:	26 February 2015

DUT Descriptions	The EUT supports GSM 1900MHz and *Bluetooth* bands.
Operating Configurations	Held to head Body-worn
Device dimension	Overall (Length x Width x Depth): 211 mm x 51 mm x 10.5 mm (EUT Open) Overall (Length x Width x Depth): 112 mm x 51 mm x 17 mm (EUT Closed)
Back Cover	☒ Normal Battery Cover ☐ Normal Battery Cover with NFC ☐ Wireless Charger Battery Cover ☐ Wireless Charger Battery Cover with NFC
Accessory	☒ Headset
Battery Options	☒ Standard – Lithium-ion battery ☐ Extended (large capacity)

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle
GSM	1900	Voice (GMSK) GPRS (GMSK)	GSM Voice: 12.0%; GPRS 1 Slot: 12.0%; 2 Slots: 25%
	GPRS Multi-Slot Class: ☐ Class 8 - One Up ☒ Class 10 - Two Up ☐ Class 12 - Four Up		
Bluetooth	-	BR EDR	<100%

6.3. Nominal and Maximum Output Power

(From customer)

		RF Output Power (dBm)	
RF Air interface	**Mode**	**Target (dBm)**	**Max. tune-up tolerance limit (dB)**
PCS1900	Voice	29.0	-1.0 ~ +1.5
	GPRS 1 slot (GMSK)	29.0	-1.0 ~ +1.5
	GPRS 2 slots (GMSK)	27.0	-1.0 ~ +1.5
Bluetooth	BR	0.0	-4.0 ~ +2.0
	EDR	0.0	-4.0 ~ +2.0

6.4. Simultaneous Transmission Conditions

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the *reported* standalone SAR of each applicable simultaneous transmitting antenna.

	Simultaneous transmission conditions	
	WWAN	**WPAN**
#	**GSM Voice / Data**	***Bluetooth***
1	X	X

Note:

Based on the customer declaration, the following is the only possible combination of the Simultaneous Transmission possibilities in the EUT:

1. WWAN + WPAN

6.5.Additional Information Related to Testing

Equipment Category	2G PCS	TDMA 1900	Voice GPRS (Data)
	Bluetooth	2.4 GHz	BR EDR
Type of Unit	Portable Transceiver		
Intended Operating Environment:	Within GSM and *Bluetooth* Coverage		
Transmitter Maximum Output Power Characteristics:	PCS1900	Communication Test Set was configured to allow the EUT to transmit at a maximum power using Power Control Level (PCL) setting of 0.	

Transmitter Frequency Range:	PCS1900	(1850 to 1910) MHz		
Transmitter Frequency Allocation of EUT When Under Test:	**Bands**	**Channel Number**	**Channel Description**	**Frequency (MHz)**
	PCS1900	512	Low	1850.2
		661	Middle	1880.0
		810	High	1909.8

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A.1 "Antenna Locations and Separation Distances" for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Head

For WWAN (GSM)

Test Configurations	SAR Required	Note
Touch Left	Yes	
Tilt Left (15°)	Yes	
Touch Right	Yes	
Tilt Right (15°)	Yes	

7.2. Body-worn Accessory

For WWAN (GSM) and Bluetooth

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	<25 mm	Yes	A conservative minimum test separation distance for supporting off-the-shelf **body-worn** accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. 10mm represents the minimum separation distance achieved with typical available carry accessories to be used with the handset, as advised by the manufacturer
Front	<25 mm	Yes	

Note:

1. As per KDB 447498 D01 General RF Exposure Guidance v05r02, The Frequency Bands with Rated Power including Upper tolerance, which qualify for **Standalone SAR Test Exclusion,** are as per the above table.

   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*)] * [$\sqrt{f_{(GHz)}}$] ≤ 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.

   Applying the above formula for ***Bluetooth*** **Body-worn** we get:
   - For 2.4 GHz, [(1.585)/10]*[√2.4] =0.245 ≤ 3.0

8. Conducted Output Power Measurements

8.1.RF Output Average Power Measurement: GSM

8.1.1.PCS1900

Voice Mode GSM (GMSK)

Channel Number	Frequency (MHZ)	Avg Power (dBm)
512	1850.2	28.8
661	1880.0	28.8
810	1909.8	28.8

GPRS (GMSK) – Coding Scheme: CS1

Channel Number	Frequency (MHZ)	Avg Burst Power (dBm)		Frame Power (dBm)	
		1Uplink	2Uplink	1Uplink	2Uplink
512	1850.2	28.8	26.8	19.8	20.8
661	1880.0	28.7	26.8	19.7	20.8
810	1909.8	28.8	26.8	19.8	20.8

EDGE (MCS4) and EDGE 8PSK (MCS9) modes are not supported on the device hence, no measurements are available .

Note:

Scale factor for uplink time slot:

1. 1 Uplink: time slot ratio = 8:1 => 10*log(8/1) = **9.03 dB**
2. 2 Uplink: time slot ratio = 8:2 => 10*log(8/2) = **6.02 dB**

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

- Head & Body-worn Accessory: GMSK Voice Mode
- Body-worn (Data): GMSK (GPRS) mode with **2 uplink**, based on the output power measurements above

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.

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz; IEEE1528:2013 & IEC 62209-1:2005

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
750	41.9	0.89		
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
1500	40.4	1.23		
1610	40.3	1.29	53.8	1.40
1640	40.2	1.31		
1750	40.1	1.37		
1800	40.0	1.40	53.3	1.52
1900	40.0	1.40	53.3	1.52
2000	40.0	1.40	53.3	1.52
2100	39.8	1.49		
2300	39.5	1.67		
2450	39.2	1.80	52.7	1.95
2600	39.0	1.96		
3000	38.5	2.40	52.0	2.73
3500	37.9	2.91		
4000	37.4	3.43		
4500	36.8	3.94		
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
6000	35.1	5.48		

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 Watt.

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)		
				1g/10g	Head	Body
D1900V2	540	08/12/2014	1900	1g	40.10	40.00
				10g	20.90	21.10

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 5%.

System Check 1900 Head
Date: 02/03/2015
Validation Dipole and Serial Number: D1900V2 SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	23.0	23.0	ε_r	40.00	38.81	-2.97	5.00
				σ	1.40	1.43	2.01	5.00
				1g SAR	40.10	39.12	-2.44	5.00
				10g SAR	20.90	20.80	-0.48	5.00

System Check 1900 Body
Date: 10/03/2015
Validation Dipole and Serial Number: D1900V2 SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	23.0	21.5	ε_r	53.30	52.36	-1.76	5.00
				σ	1.52	1.55	2.01	5.00
				1g SAR	40.00	39.48	-1.30	5.00
				10g SAR	21.10	21.40	1.42	5.00

10.Measured 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 648474 D04 Handset SAR:
With headset attached, when the reported SAR for body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

10.1. Specific Absorption Rate - Test Results
For All SAR measurement in this report the 1g-SAR limit tested to is 1.6 W/Kg

10.1.1. PCS 1900 - Head Configuration 1g

Max Reported SAR = 0.714 (W/kg)

					Power (dBm)		1g : SAR Results (W/kg)		
Mode or Modulation	Dist (mm)	Test Position	Channel No.	Freq (MHz)	Tune-up limit	Meas.	Meas.	Reported	Scan No.
GMSK (Voice)	0	Touch Left Open	661	1880.0	30.5	28.8	0.453	0.670	1
GMSK (Voice)	0	Tilt Left Open	661	1880.0	30.5	28.8	0.315	0.466	2
GMSK (Voice)	0	Touch Right Open	661	1880.0	30.5	28.8	0.483	0.714	3
GMSK (Voice)	0	Tilt Right Open	661	1880.0	30.5	28.8	0.267	0.395	4

10.1.2. GPRS 1900 – Body-Worn Configuration 1g

Max Reported SAR = 0.713 (W/kg)

					Power (dBm)		1g : SAR Results (W/kg)		
Mode or Modulation	Dist (mm)	Test Position	Channel No.	Freq (MHz)	Tune-up limit	Meas.	Meas.	Reported	Scan No.
GMSK (Data 2 Slots)	10	Front Open	661	1880.0	28.5	26.8	0.256	0.379	5
GMSK (Data 2 Slots)	10	Front Closed	661	1880.0	28.5	26.8	0.482	0.713	6
GMSK (Data 2 Slots)	10	Back Open	661	1880.0	28.5	26.8	0.315	0.466	7
GMSK (Data 2 Slots)	10	Back Closed	661	1880.0	28.5	26.8	0.424	0.627	10

10.1.3. PCS 1900 – Body-Worn Configuration 1g

Max Reported SAR = 0.589 (W/kg)

					Power (dBm)		1g : SAR Results (W/kg)		
Mode or Modulation	Dist (mm)	Test Position	Channel No.	Freq (MHz)	Tune-up limit	Meas.	Meas.	Reported	Scan No.
GMSK (Voice)	10	Front Open	661	1880.0	30.5	28.8	0.215	0.318	13
GMSK (Voice)	10	Front Closed	661	1880.0	30.5	28.8	0.398	0.589	14
GMSK (Voice)	10	Back Open	661	1880.0	30.5	28.8	0.260	0.385	17
GMSK (Voice)	10	Back Closed	661	1880.0	30.5	28.8	0.346	0.512	19

10.2. Bluetooth

10.2.1. Estimated SAR

1. As per FCC KDB 447498 D01, Bluetooth maximum source based time average power was below the allowed threshold for both 10 and 15mm separation distances.
   When standalone SAR test exclusion applies 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)]·[$\sqrt{f_{(GHz)}}/x$] W/kg for test separation distances* ≤ 50 mm;
     where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.

For the estimated SAR level calculation, the Maximum Target power + Upper tolerance for *Bluetooth* = 2.0 dB (~ 1.585 mW) is considered.

- **15mm Bluetooth estimated SAR level:**

  Estimated *Bluetooth* SAR = (1.585mW/10mm)*(√2.4 / 7.5) = 0.033 W/kg

Estimated SAR Result for Body-worn Accessory Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 1-g SAR (W/kg)
Rear/Front	1.585	10	2.4	0.033

11. Simultaneous Transmission SAR Analysis

KD 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:

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

11.1. Simultaneous Transmission SAR Analysis

According to the worst case configuration Simultaneous transmission analysis of worst cases is shown in the tables below.

Overall Worst Case:

1. WWAN + WPAN

11.2. Simultaneous consideration for GSM + BT

11.2.1. PCS1900 + BT

RF Exposure Conditions	EUT Position		Simultaneous Transmission Condition			
			PCS1900 ①	*Bluetooth* ②	Σ 1g SAR (W/kg)	SPLSR (Yes/No)
Body-worn Accessory	Front Open	① + ②	0.379	0.033	0.412	No
	Front Closed	① + ②	0.713	0.033	0.746	No
	Back Open	① + ②	0.466	0.033	0.499	No
	Back Closed	① + ②	0.627	0.033	0.660	No

Note: Since Bluetooth measurements are not required for Head Configurations, this was not considered for Simultaneous transmission Analysis