FCC SAR TEST REPORT

Product Name:	Mobile Phone
Trade Mark:	BLU
Model No.:	Z5
Add. Model No.:	N/A
Report Number:	211201025SAR-1
Test Standards:	FCC 47 CFR Part 2 §2.1093
	ANSI/IEEE C95.1-1992
	IEEE Std 1528-2013
FCC ID:	YHLBLUZ5215
Test Result:	PASS
Date of Issue:	December 28, 2021

Prepared for:

BLU Products, Inc. 10814 NW 33rd St # 100 Doral, FL 33172, USA

Prepared by:

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Version

Version No.	Date	Description
V1.0	December 28, 2021	Original Report



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1. GENERAL INFORMATION

1.1. STATEMENT OF COMPLIANCE

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:

Equipment Class	Mode	Highest Reported Head SAR _{1g} (W/kg)	Highest Reported Body-worn SAR _{1g} (1.0 cm Gap) (W/kg)
DCE	GSM 850	1.137	1.233
PCE	PCS 1900	1.038	1.268
DSS	Bluetooth	0.02	0.01
Highest Simultaneous Transmission SAR		Head (W/kg)	Body-worn (W/kg)
PCE + DSS		1.16	1.28



1.2. CLIENT INFORMATION

Applicant:	BLU Products, Inc.
Address of Applicant:	10814 NW 33rd St # 100 Doral, FL 33172, USA
Manufacturer:	BLU Products, Inc.
Address of Manufacturer:	10814 NW 33rd St # 100 Doral, FL 33172, USA

1.3. EUT INFORMATION

1.3.1. General Description of EUT

Product Name:	Mobile Phone
Trade Mark:	BLU
Model No.:	Z5
Add. Model No.:	N/A
FCC ID:	YHLBLUZ5215
DUT Stage:	Identical Prototype
IMEI Code:	351258040604430, 351258040604448
Sample Received Date:	December 2, 2021
Sample Tested Date:	December 20, 2021 to December 27, 2021

1.3.2. Description of Accessories

Adapter		
Model No.:	US-JY-0500	
Input:	100-240 V~50/60 Hz 0.15A	
Output:	5.0 V == 550mA	
DC Cable:	1 Meter, Unshielded without ferrite	

Battery		
Model No.:	N5C600T	
Battery Type:	Lithium-ion	
Rated Voltage:	3.7 Vdc	
Limited Charge Voltage:	4.2 Vdc	
Rated Capacity:	600 mAh	

1.3.3. EUT Tx Frequency Bands

RF Type	Band(s)	Tx Frequency Range (Unit: MHz)
GSM	GSM 850:	824.2 - 848.8
GSINI	PCS 1900:	1850.2 - 1909.8
Bluetooth	2.4 GHz:	2402 - 2480

1.3.4. Wireless Technologies

GSM	Voice GPRS (Multi-Slot Class: 12-4UP)			
Bluetooth	BR+EDR			
Device Class (GSM)	В			
Antenna Type	BT: Wire antenna GSM: PIFA Antenna			
	SIM 1: GSM SIM 2: GSM Note :			
Dual SIM	This device support dual SIM but they share the same antenna. Since these two			
	SIM are used for subscriber identification only and it is not related to RF identity,			
	only SIM1 was used for SAR testing.			

1.4. MAXIMUM CONDUCTED POWER

The maximum conducted average power including tune-up tolerance is shown as below.

> GSM

Mode	Maximum conducted average power (dBm)		
	GSM 850	PCS 1900	
GSM (GMSK, 1Tx-slot)	33.0	30.5	
GPRS (GMSK, 1Tx-slot)	33.0	30.5	
GPRS (GMSK, 2Tx-slot)	31.0	28.0	
GPRS (GMSK, 3Tx-slot)	29.0	26.0	
GPRS (GMSK, 4Tx-slot)	26.5	23.5	

Bluetooth

Mode	Modulation	Maximum Conducted Power (dBm)
	GFSK	-2.5
BR + EDR	π/4-DQPSK	-3.0
	8-DPSK	-3.0

1.5. OTHER INFORMATION

None.

1.6. TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China Telephone: +86 (0) 755 2823 0888 Fax: +86 (0) 755 2823 0886

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1.7. TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

Shenzhen UnionTrust Quality and Technology Co., Ltd.

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194 Test Firm Registration Number: 259480

1.8. GUIDANCE STANDARD

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2 §2.1093, IEEE Std 1528-2013, ANSI/IEEE C95.1-1992, the following FCC Published RF exposure KDB procedures:

KDB 865664 D01 v01r04				
KDB 865664 D02 v01r02				
KDB 248227 D01 v02r02				
KDB 447498 D01 v06				
KDB 648474 D04 v01r03				
KDB 941225 D01 v03r01				
KDB 941225 D06 v02r01				

2. SPECIFIC ABSORPTION RATE (SAR) 2.1. INTRODUCTION

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling, by appropriate techniques, to produce specific absorption rates (SARs) as averaged over the whole-body, any 1 g or any 10 g of tissue (defined as a tissue volume in the shape of a cube). All SAR values are to be averaged over any six-minute period. When portable device was used within 20 cm of the user's body, SAR evaluation of the device will be required. The SAR limit in chapter 2.3.

2.2. SAR DEFINITION

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

2.3. SAR LIMITS

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles	
0.4	8.0	20.0	

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Note:

1) Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

- 2) At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.
- 3) The SAR limit is specified in FCC 47 CFR Part 2 §2.1093, ANSI/IEEE C95.1-1992.

3. SAR MEASUREMENT SYSTEM

3.1. SPEAG DASY SYSTEM

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.



3.1.1. Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

3.1.2. Probe

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

<u> </u>		
Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

-		
Model	ES3DV3	
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	5 μW/g to 100 mW/g Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	

3.1.3. Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detectors for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16-bit resolution and two range settings: 4mV 400mV)	Armin .
Input Offset Voltage	< 5µV (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

3.1.4. Phantom

Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	Phantom for compliance testing of handheld and body- mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

3.1.5. Device Holder

Model	Mounting Device	
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

3.1.6. System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with I/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

3.2. SAR SCAN PROCEDURE

3.2.1. SAR Reference Measurement (drift)

Prior to the SAR test, local SAR shall be measured at a stationary reference point where the SAR exceeds the lower detection limit of the measurement system.

3.2.2. Area Scan

Measurement procedures for evaluating the SAR of wireless device start with a coarse measurement grid to determine the approximate location of the local peak SAR values. This is known as the area-scan procedure. All antennas and radiating structures that may contribute to the measured SAR or influence the SAR distribution must be included in the area scan. The area scan measurement resolution must enable the extrapolation algorithms of the SAR system to correctly identify the peak SAR location(s) for subsequent zoom scan measurements to correctly determine the 1-g SAR. Area scans are performed at a constant distance from the phantom surface, determined by the measurement frequencies. When a measured peak is closer than ½ the zoom scan volume dimension (x, y) from the edge of the area scan region, unless the entire peak and gram-averaging volume are both captured within the zoom scan volume, the area scan must be repeated by shifting and expanding the area scan region to ensure all peaks are away from the area scan boundary. The area scan resolutions specified in the table below must be applied to the SAR measurements.

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

3.2.3. Zoom Scan

To evaluate the peak spatial-average SAR values with respect to 1 g or 10 g cubes, fine resolution volume scans, called zoom scans, are performed at the peak SAR locations identified during the area scan. If the cube volume within the zoom scan chosen to calculate the peak spatial-average SAR touches any boundary of the zoom-scan volume, the zoom scan shall be repeated with the center of the zoom-scan volume shifted to the new maximum SAR location. For any secondary peaks found in the area scan that are within 2 dB of the maximum peak and are not within this zoom scan, the zoom scan shall be performed for such peaks, unless the peak spatial-average SAR at the location of the maximum peak is more than 2 dB below the applicable SAR limit (i.e., 1 W/kg for a 1.6 W/kg 1 g limit, or 1.26 W/kg for a 2 W/kg 10 g limit). The zoom scan resolutions specified in the table below must be applied to the SAR measurements.

		≤ 3 GHz	> 3 GHz		
		≤ 2 GHz: ≤ 8 mm	3 – 4 GHz: ≤ 5 mm*		
Maximum 200m sca	an spatial resolutio	2 – 3 GHz: ≤ 5 mm*	4 – 6 GHz: ≤ 4 mm*		
				3 – 4 GHz: ≤ 4 mm	
	uniform grid: ΔZ	_{zoom} (n)	≤ 5 mm	4 – 5 GHz: ≤ 3 mm	
Maximum zoom				5 – 6 GHz: ≤ 2 mm	
Scan spatial		$\Delta Z_{Zoom}(1)$: between		3 – 4 GHz: ≤ 3 mm	
resolution, normal		1 ST two points closest	≤ 4 mm	4 – 5 GHz: ≤ 2.5 mm	
to phantom	graded	to phantom surface		5 – 6 GHz: ≤ 2 mm	
surface	grid	$\Delta Z_{Zoom}(n>1)$:			
		between subsequent	≤ 1.5·ΔZ _Z	_{oom} (n-1) mm	
		points			
				3 – 4 GHz: ≥ 28 mm	
Minimum zoom	x, y, z		≥ 30 mm	4 – 5 GHz: ≥ 25 mm	
scan volume				5 – 6 GHz: ≥ 22 mm	
Note: δ is the penet	tration depth of a	plane-wave at normal inci	dence to the tissue me	dium; see IEEE Std	
1528-2013 for	r details.				

* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is \leq 1.4 W/kg, \leq 8 mm, \leq 7 mm and \leq 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.

3.2.4. SAR Drift Measurement

The local SAR (or conducted power) shall be measured at exactly the same location as in 3.2.1 section. The absolute value of the measurement drift (the difference between the SAR measured in 3.2.1 and 3.2.4 section) shall be recorded. The SAR drift shall be kept within \pm 5%.

3.3. EQUIPMENT LIST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D835V2	4d005	Apr. 13, 2021	3 Year
System Validation Dipole	SPEAG	D1900V2	509	Apr. 14, 2021	3 Year
Dosimetric E-Field Probe	SPEAG	ES3DV3	3090	Apr. 26, 2021	1 Year
Data Acquisition Electronics	SPEAG	DAE4	662	Apr. 09, 2021	1 Year
Wideband Radio Communication Tester	R&S	CMW500	120932	Apr. 22, 2021	1 Year
ENA Series Network Analyzer	Agilent	8753ES	US39170317	Nov. 05, 2021	1 Year
Dielectric Assessment Kit	SPEAG	DAK-3.5	1056	N/A	N/A
USB/GPIB Interface	Agilent	82357B	N10149	N/A	N/A
Signal Generator	R&S	SMB100A	103718	Apr. 22, 2021	1 Year
POWER METER	R&S	NRP	101293	Nov. 05, 2021	1 Year
Thermometer	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	18022507	Nov. 10, 2021	1 Year
Dual Directional Coupler	Agilent	778D	MY52180234	Nov. 05, 2021	1 Year
Amplifier	Mini-Circuit	ZHL42	QA1252001	N/A	N/A
DC Source	Agilent	66319B	MY43000795	Nov. 05, 2021	1 Year

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

3.5. TISSUE DIELECTRIC PARAMETER MEASUREMENT & SYSTEM VERIFICATION

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

3.5.1. Tissue Simulating Liquids

The temperature of the tissue-equivalent medium used during measurement must also be within 18 °C to 25 °C and within \pm 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.

The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with $\leq \pm 0.5$ cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with $\leq \pm 0.5$ cm variation for measurements > 3 GHz. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.



Tissue Dielectric Parameters for Head and Body								
Target Frequency	He	ad	Bo	dy				
(MHz)	r	(S/m)	r	(S/m)				
750	41.9	0.89	55.5	0.96				
835	41.5	0.90	55.2	0.97				
900	41.5	0.97	55.0	1.05				
1450	40.5	1.20	54.0	1.30				
1640	40.3	1.29	53.8	1.40				
1750	40.1	1.37	53.4	1.49				
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				
2300	39.5	1.67	52.9	1.81				
2450	39.2	1.80	52.7	1.95				
2600	39.0	1.96	52.5	2.16				
3500	37.9	2.91	51.3	3.31				
5200	36.0	4.66	49.0	5.30				
5300	35.9	4.76	48.9	5.42				
5500	35.6	4.96	48.6	5.65				
5600	35.5	5.07	48.5	5.77				
5800	35.3	5.27	48.2	6.00				
	(r = relative permittiv	ity, = conductivity	and $= 1000 \text{ kg/m3}$					

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The following table gives the recipes for tissue simulating liquids.

	Recipes of Tissue Simulating Liquid											
Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono- hexylether				
H750	0.2	-	0.2	1.4	57.0	-	41.1	-				
H835	0.1	-	1.0	1.4	57.0	-	40.5	-				
H900	0.1	-	1.0	1.5	56.5	-	40.9	-				
H1450	-	45.5	-	0.7	-	-	53.8	-				
H1640	-	45.8	-	0.5	-	-	53.7	-				
H1750	-	44.5	-	0.3	-	-	55.2	-				
H1800	-	44.9	-	0.2	-	-	54.9	-				
H1900	-	44.9	-	0.2	-	-	54.9	-				
H2000	-	50	-	-	-	-	50	-				
H2300	-	44.9	-	0.1	_	_	55.0	-				
H2450	-	45.0	-	0.1	-	-	54.9	-				
H2600	-	45.1	-	0.1	-	-	54.8	-				
H3500	-	8.0	-	0.2	-	20.0	71.8	-				
H5G	-	-	-	-	-	17.2	65.52	17.3				
B750	0.2	-	0.2	0.8	48.8	-	50.0	-				
B835	0.2	-	0.2	0.9	48.5	-	50.2	-				
B900	0.2	-	0.2	0.9	48.2	-	50.5	-				
B1450	-	34.0	-	0.3	-	-	65.7	-				
B1640	-	32.5	-	0.3	-	-	67.2	-				
B1750	-	29.4	-	0.4	-	-	70.2	-				
B1800	-	29.5	-	0.4	-	-	70.1	-				
B1900	-	29.5	-	0.3	-	-	70.2	-				
B2000	-	30.0	-	0.2	-	-	69.8	-				
B2300	-	31.0	-	0.1	-	-	68.9	-				
B2450	-	31.4	-	0.1	-	-	68.5	-				
B2600	-	31.8	-	0.1	-	-	68.1	-				
B3500	-	28.8	-	0.1	-	-	71.1	-				
B5G	-	-	-	-	-	10.7	78.6	10.7				

3.5.2. System Check Description

The system check procedure provides a simple, fast, and reliable test method that can be performed daily or before every SAR measurement. The objective here is to ascertain that the measurement system has acceptable accuracy and repeatability. This test requires a flat phantom and a radiating source. The system verification setup is shown as below.



3.5.3. Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (°C)	Measured Conductivity (σ)	Measured Permittivity (ε _r)	Target Conductivity (σ)	Target Permittivity (ε _r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Dec. 20, 2021	Head	835	21.6	0.936	40.870	0.90	41.50	4.03	-1.52
Dec. 22, 2021	Head	1900	21.4	1.418	39.420	1.40	40.00	1.29	-1.45

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within \pm 5% of the target values. The variation of the liquid temperature must be within \pm 2 °C during the test.

3.5.4. System Verification

The measuring result for system verification is tabulated as below.

Test Date	Tissue Type	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Dec. 20, 2021	Head	835	9.45	0.101	10.10	6.88	4d005	3090	662
Dec. 22, 2021	Head	1900	39.60	0.423	42.30	6.82	509	3090	662

Note:

Comparing to the reference SAR value, the validation data should be within its specification of 10%. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

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4. SAR MEASUREMENT EVALUATION

4.1. EUT CONFIGURATION AND SETTING

Connections between EUT and System Simulator

For WWAN SAR testing, the EUT was linked and controlled by base station emulator. Communication between the EUT and the emulator was established by air link. The distance between the EUT and the communicating antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during SAR testing.

4.1.1. GSM Configuration and Testing

GSM (GMSK: CS1) voice mode transmits with 1 time slot. GPRS (GMSK: CS1) and EDGE (GMSK: MCS1, 8PSK: MCS9) may transmit up to 4 time slots in the 8 time-slot frame according to the multislot class implemented in a device.



4.2. EUT TESTING POSITION

4.2.1. Head Exposure Conditions

RF Exposure Conditions	Test Position	Separation Distance	SAR test exclusion	
	Right Cheek		N/A	
Head	Right Tilted	0.0m		
Head	Left Cheek	0 cm		
	Left Tilted			

Note:

- 1) Head exposure for voice mode of handset is limited to next to the ear exposure conditions.
- 2) Devices that are designed to transmit next to the ear must be tested using the SAM phantom.
- 3) Other head exposure conditions, for example, in-front-of the face, should be tested using a flat phantom according to the required published RF exposure KDB procedures.
- 4) When data mode operates in next to the ear configurations, either data alone or in conjunction with voice transmissions, SAR evaluation is required for such use conditions.
- 5) When device supports VoIP, SAR evaluation for head Exposure Conditions using the most appropriate wireless data mode configurations is required.





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Define two imaginary lines on the handset

- 1) The vertical centerline passes through two points on the front side of the handset the midpoint of the width wt of the handset at the level of the acoustic output, and the midpoint of the width wb of the bottom of the handset.
- 2) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
- 3) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.





4.2.2. Body-worn Accessory Exposure Conditions

RF Exposure Test Position Conditions		Separation Distance	SAR test exclusion	
Body-worn	Front Face	0.35 cm	NI/A	
	Rear Face	0 ~ 2.5 cm	IN/A	

Note:

- Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.
- 2) Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.
- 3) A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets should be used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer according to the typical body-worn accessories users may acquire at the time of equipment certification, but not more than 2.5 cm, to enable users to purchase aftermarket body-worn accessories with the required minimum separation.
- 4) Devices that are designed to operate on the body of users using lanyards and straps or without requiring additional body-worn accessories must be tested for SAR compliance using a conservative minimum test separation distance ≤ 5 mm to support compliance.
- 5) When device supports VoIP, SAR evaluation for body-worn accessory Exposure Conditions using the most appropriate wireless data mode configurations is required.
- 6) Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories.
- 7) When the reported SAR for a 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 the body-worn accessory with a headset attached to the handset.



4.3. MEASURED CONDUCTED POWER RESULT

4.3.1. Conducted Power of GSM Bands

The measuring conducted average power (Unit: dBm) is shown as below.

Band		GSM 850									
Channel	128	190	251	512	661	810					
Frequency (MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8					
Maximum Burst-Averaged Output Power											
GSM (GMSK, 1Tx-slot)	31.98	32.20	32.43	29.71	29.86	29.75					
GPRS (GMSK, 1Tx-slot)	31.97	32.19	32.42	29.72	29.86	29.76					
GPRS (GMSK, 2Tx-slot)	29.96	30.12	30.26	27.48	27.50	27.37					
GPRS (GMSK, 3Tx-slot)	27.97	28.14	28.37	25.36	25.39	25.29					
GPRS (GMSK, 4Tx-slot)	25.76	25.97	26.12	23.15	23.19	23.02					
	М	aximum Frame	-Averaged Outp	out Power							
GSM (GMSK, 1Tx-slot)	22.98	23.20	23.43	20.71	20.86	20.75					
GPRS (GMSK, 1Tx-slot)	22.97	23.19	23.42	20.72	20.86	20.76					
GPRS (GMSK, 2Tx-slot)	23.96	24.12	24.26	21.48	21.50	21.37					
GPRS (GMSK, 3Tx-slot)	23.71	23.88	24.11	21.10	21.13	21.03					
GPRS (GMSK, 4Tx-slot)	22.76	22.97	23.12	20.15	20.19	20.02					

Note:

1) SAR testing was performed on the maximum frame-averaged power mode.

2) The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum burst-averaged power based on time slots. The calculated method is shown as below:

3) Frame-averaged power = 10 x log (Burst-averaged power mW x Slot used / 8)

4.3.2. Conducted Power of BT

	Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
			0	2402	-6.46
		GFSK	39	2441	-5.36
			78	2480	-2.97
			0	2402	-6.93
	BR + EDR	π/4-DQPSK	39	2441	-5.83
			78	2480	-3.46
			0	2402	-6.99
		8-DPSK	39	2441	-5.83
			78	2480	-3.45

4.4. SAR TEST EXCLUSION EVALUATIONS

4.4.1. Standalone SAR Test Exclusion Considerations

According to KDB 447498 D01, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The 1-g and 10-g SAR test exclusion thresholds are determined by the following:

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm: 1)

 $\frac{Max.Tune\ up\ Power_{(mW)}}{Min.Test\ Separation\ Distance_{(mm)}} \times \sqrt{f_{(GHz)} \le 3.0\ for\ SAR-1g} \le 7.5\ for\ SAR-10g$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

- For 100 MHz to 1500 MHz and test separation distances > 50 mm: 2) {[Threshold for 50 mm in step a)] + [(test separation distance – 50 mm) \cdot (f_(MHz)/150)]} mW
- For > 1500 MHz and ≤ 6 GHz and test separation distances > 50 mm: 3) {[Threshold for 50 mm in step a)] + [(test separation distance - 50 mm) ·10]} mW

When the calculated result in step a) is <= 3.0 for SAR-1g exposure condition, or <= 7.5 for SAR-10g exposure condition, the SAR testing exclusion is applied.

When the device output power is less than the calculated result (power threshold, mW) shown in in step b) and c), the SAR testing exclusion is applied.

Ĩ		Max.	Max.		Head			Body-Worn		
	Mode	Tune-up Power (dBm)	Tune-up Power (mW)	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	
	BT	-2.5	0.56	5	0.2	No	10	0.1	No	

4.4.2. Estimated SAR Calculation

According to KDB 447498 D01, when an antenna qualifies for the standalone SAR test exclusion and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

a) For test separation distances \leq 50 mm:

Estimated SAR = $\frac{Max.Tune up Power_{(mW)}}{Min.Test Separation Distance_{(mm)}} \times \frac{\sqrt{f(GHz)}}{x}$

Where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

b) For test separation distances > 50 mm, 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR.

Mode / Band	Frequency (GHz)	Max. Tune-up Power (dBm)	Test Position	Separation Distance (mm)	Estimated SAR (W/kg)
BT (DSS)	2.48	-2.5	Head	5	0.02
BT (DSS)	2.48	-2.5	Body	10	0.01

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4.5. SAR TESTING RESULTS

4.5.1. SAR Test Reduction Considerations

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 SAR for the mid-band or highest output power channel is:

- a) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- b) ≤ 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
- c) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz





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4.5.2. SAR Results for Head Exposure Condition

Plot No.	Band	Mode	Test Position	Channel	Max. Tune- up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)	Note
	GSM 850	Voice	Right Cheek	251	33.0	32.43	0.08	0.921	1.14	1.050	
	GSM 850	Voice	Right Tilted	251	33.0	32.43	-0.09	0.468	1.14	0.534	
1	GSM 850	Voice	Left Cheek	251	33.0	32.43	-0.01	0.997	1.14	1.137	
	GSM 850	Voice	Left Tilted	251	33.0	32.43	-0.10	0.505	1.14	0.576	
	GSM 850	Voice	Left Cheek	128	33.0	31.98	-0.04	0.393	1.26	0.497	
	GSM 850	Voice	Left Cheek	190	33.0	32.20	0.03	0.618	1.20	0.743	
	GSM 850	Voice	Left Cheek	251	33.0	32.43	-0.15	0.904	1.14	1.031	Repeat
	PCS 1900	Voice	Right Cheek	661	30.5	29.86	0.08	0.76	1.16	0.881	
	PCS 1900	Voice	Right Tilted	661	30.5	29.86	-0.02	0.268	1.16	0.311	
	PCS 1900	Voice	Left Cheek	661	30.5	29.86	-0.07	0.64	1.16	0.742	
	PCS 1900	Voice	Left Tilted	661	30.5	29.86	-0.10	0.214	1.16	0.248	
2	PCS 1900	Voice	Right Cheek	512	30.5	29.71	0.04	0.865	1.20	1.038	
	PCS 1900	Voice	Right Cheek	810	30.5	29.75	0.14	0.521	1.19	0.619	
	PCS 1900	Voice	Right Cheek	512	30.5	29.71	-0.18	0.854	1.20	1.024	Repeat



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4.5.3. SAR Results for Body-worn Exposure Condition (Separation Distance is 1.0 cm)

Plot No.	Band	Mode	Test Position	Channel	Max. Tune- up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)	Note
	GSM 850	GPRS10	Front Face	251	31.0	30.26	-0.05	0.391	1.19	0.464	
3	GSM 850	GPRS10	Rear Face	251	31.0	30.26	-0.02	1.04	1.19	1.233	
	GSM 850	GPRS10	Rear Face	128	31.0	29.96	-0.01	0.544	1.27	0.691	
	GSM 850	GPRS10	Rear Face	190	31.0	30.12	0.18	0.739	1.22	0.905	
	GSM 850	GPRS10	Rear Face	251	31.0	30.26	-0.18	0.923	1.19	1.094	Repeat
	GSM 850	GPRS10	Rear Face	251	31.0	30.26	-0.05	0.598	1.19	0.709	With Earphone
	PCS 1900	GPRS10	Front Face	661	28.0	27.50	-0.05	0.362	1.12	0.406	
4	PCS 1900	GPRS10	Rear Face	661	28.0	27.50	-0.06	1.13	1.12	1.268	
	PCS 1900	GPRS10	Rear Face	512	28.0	27.48	0.05	1.01	1.13	1.138	
	PCS 1900	GPRS10	Rear Face	810	28.0	27.37	0.13	0.96	1.16	1.110	
	PCS 1900	GPRS10	Rear Face	661	28.0	27.50	0.04	1.07	1.12	1.201	Repeat
	PCS 1900	GPRS10	Rear Face	661	28.0	27.50	0.17	1.01	1.12	1.133	With Earphone

4.6. SAR MEASUREMENT VARIABILITY

4.6.1. Repeated Measurement

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10 , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated 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.

SAR repeated measurement procedure:

- 1) When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
- 2) When the highest measured SAR is >= 0.80 W/kg, repeat that measurement once.
- 3) 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 W/kg, perform a second repeated measurement.
- 4) If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20, and the original, first or second repeated measurement is >= 1.5 W/kg, perform a third repeated measurement.

Band	Mode	Test Position	Channel	Original Measured SAR-1g (W/kg)	1st Repeated SAR-1g (W/kg)	L/S Ratio	2nd Repeated SAR-1g (W/kg)	L/S Ratio	3rd Repeated SAR-1g (W/kg)	L/S Ratio
				Head E	Exposure Co	ndition				
GSM 850	Voice	Left Cheek	251	0.997	0.904	0.91	N/A	N/A	N/A	N/A
PCS 1900	Voice	Right Cheek	512	0.865	0.854	0.99	N/A	N/A	N/A	N/A
	Body-worn Exposure Condition									
GSM 850	GPRS10	Rear Face	251	1.04	0.923	0.89	N/A	N/A	N/A	N/A
PCS 1900	GPRS10	Rear Face	661	1.13	1.07	0.95	N/A	N/A	N/A	N/A

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4.7. SIMULTANEOUS MULTI-BAND TRANSMISSION EVALUATION

4.7.1. Simultaneous Transmission SAR Test Exclusion Considerations

a) Sum of SAR

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. When the sum of SAR1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR1g is greater than the SAR limit (SAR1g 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

b) SAR to Peak Location Separation Ratio

The simultaneous transmitting antennas in each operating mode and exposure condition combination are considered one pair at a time to determine the SPLSR.

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

The ratio is rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10 .

 SAR_1 and SAR_2 are the highest reported or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair

peak location separation distance =
$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

Where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the area or zoom scans.

When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna. Due to curvatures on the SAM phantom, when SAR is estimated for one of the antennas in an antenna pair, the measured peak SAR location will be translated onto the test device to determine the peak location separation for the antenna pair.

When SAR is estimated for both antennas, the peak location separation should be determined by the closest physical separation of the antennas, according to the feed-point or geometric center of the antennas.

c) Volume Scan

When the SPLSR is <= 0.04 for 1-g SAR and <= 0.10 for 10-g SAR, the simultaneous transmission SAR is not required. Otherwise, the enlarged zoom scan and volume scan post-processing procedures will be performed.



4.7.2. Simultaneous Transmission Possibilities

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous Transmission Configurations	Head (Voice / VoIP)	Body-worn (Voice / VoIP)	Hotspot (Data)	Extremity (Data)
GSM (Voice / Data) + BT (Data)	Yes	Yes	No	No

Simultaneous Transmission Configurations	Head Exposure Condition	Body Exposure Condition
GSM (Voice / Data) + BT (Data)	Yes	Yes



4.7.3. Max. Standalone SAR

Position		G	SM
		850	1900
	Right Cheek	1.050	1.038
Hood	Right Tilted	0.534	0.311
neau	Left Cheek	1.137	0.742
	Left Tilted	0.576	0.248
Rody worn	Front Face	0.464	0.406
Bouy-worn	Rear Face	1.233	1.268

F	Position					
	Right Cheek	0.02				
Head	Right Tilted	0.02				
пеац	Left Cheek	0.02				
	Left Tilted	0.02				
Redu worp	Front Face	0.01				
Bouy-worn	Rear Face	0.01				

4.7.4. Sum of SAR

WWAN + BT(DSS)

		Highest	GS	GSM		
Pos	sition	Simultaneous Transmission SAR	850	1900		
	Right Cheek		1.07	1.06		
Llaad	Right Tilted	1.16	0.55	0.33		
Heau	Left Cheek		1.16	0.76		
	Left Tilted		0.60	0.27		
Rody worn	Front Face	1 29	0.47	0.42		
Body-wom	Rear Face	1.28	1.24	1.28		

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*** End of Report ***

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APPENDIX A. SAR PLOTS OF SYSTEM VERIFICATION

The plots for system verification with largest deviation for each SAR system combination are shown as follows.



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APPENDIX B. SAR PLOTS OF SAR MEASUREMENT

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.



APPENDIX C. CALIBRATION CERTIFICATE FOR PROBE AND DIPOLE

The calibration certificates are shown as follows.



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APPENDIX D. PHOTOGRAPHS OF EUT AND SETUP

The photographs of EUT and setup are shown as follows.



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