



# TEST REPORT

**APPLICANT** : Allied Universal Electronic Monitoring US, Inc.  
**PRODUCT NAME** : Smartwatch  
**MODEL NAME** : NC3-6605AVL  
**BRAND NAME** : aWatch  
**FCC ID** : NC3-6605AVL  
**STANDARD(S)** : FCC 47 CFR Part 2 (2.1093)  
: IEEE 1528-2013  
**RECEIPT DATE** : 2025-06-10  
**TEST DATE** : 2025-06-20 to 2025-06-25  
**ISSUE DATE** : 2025-07-15

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Changed History		
Version	Date	Reason for Change
1.0	2025-07-15	First edition



# 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during test as bellows:

Frequency Band		Highest SAR Summary	
		Next to mouth (Separation 10 mm)	Wrist-worn (Separation 0 mm)
		1g(W/kg)	10g (W/kg)
LTE	LTE Band 2	1.013	0.856
	LTE Band 5	0.783	0.250
	LTE Band 12	0.134	0.174
	LTE Band 13	0.503	0.364
	LTE Band 66/4	0.903	0.592
	LTE Band 71	0.111	0.144
WLAN	WLAN 2.4GHz	0.143	0.098
	WLAN 5GHz	0.125	0.077
2.4GHz Bands	Bluetooth	0.041	0.019

Max Scaled SAR	Next to mouth	1.156	Limit: 1.6 W/Kg
	Wrist-worn	0.954	Limit: 4.0 W/Kg

**Note:**

1. The highest simultaneous transmission is scalar summation of Reported standalone SAR per FCCKDB 690783 D01 v01r03, and scalar SAR summation of all possible simultaneous transmission scenarios are < 1.6 W/kg (for next to mouth mode) or < 4.0 W/kg (for wrist-worn mode).
2. This device is compliance with Specific Absorption Rate (SAR) for general population or uncontrolled exposure limits specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
3. For FDD-LTE Band 4 is fully covered by FDD-LTE Band 66, therefore only FDD-LTE Band 66 was tested.
4. The declarations of EUT presented in the report are provided by applicant and/or manufacturer, and the test laboratory is not responsible for the accuracy of the information.



## 2. Technical Information

Note: Provide by Applicant.

### 2.1. Applicant and Manufacturer Information

<b>Applicant:</b>	Allied Universal Electronic Monitoring US, Inc.
<b>Applicant Address:</b>	1838 Gunn Highway, Odessa, Florida, United States, 33556
<b>Manufacturer:</b>	Rhino Mobility LLC
<b>Manufacturer Address:</b>	8 The Green, Suite A, Dover, Delaware, 19901, USA

### 2.2. Equipment under Test (EUT) Description

<b>Product Name:</b>	Smartwatch
<b>EUT No.:</b>	8#,9#
<b>Hardware Version:</b>	Wear_TickTock-MB V02
<b>Software Version:</b>	V2_004_20250613
<b>Operation Frequency:</b>	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz WLAN 2.4GHz: 2412 MHz ~ 2462 MHz WLAN 5.5GHz: 5500 MHz ~ 5700 MHz WLAN 5.8GHz: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
<b>Modulation Technology:</b>	LTE: QPSK, 16QAM, 64QAM 802.11b : DSSS 802.11a/g/n-HT20 : OFDM BR+EDR: GFSK (1Mbps), $\pi/4$ -DQPSK (2Mbps), 8-DPSK (3Mbps) Bluetooth LE: GFSK (1Mbps, 2Mbps)
<b>VoLTE Mode:</b>	Support
<b>SIM Cards Description:</b>	LTE

Note: For a more detailed description, please refer to specification or user's manual supplied by the applicant and/or manufacturer.



### 2.3. Environment of Test Site

<b>Temperature:</b>	18°C~25°C
<b>Humidity:</b>	35%~75% RH

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the Factory. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.

The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 35 dB.

## 3. Introduction

### 3.1. 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. The standard recommends limits for two tiers of groups, occupational or controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational or controlled exposure limits are higher than the limits for general population or uncontrolled.

### 3.2. 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 ( $\rho$ ). The equation description is as below:

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C \left( \frac{\delta T}{\delta t} \right)$$

Where: C is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  is the exposure duration, or related to the electrical field in the tissue by

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and E is the RMS electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

## 4. RF Exposure Limits

### 4.1. Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population or uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

**SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

**Note:**

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

### 4.2. Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population or uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.



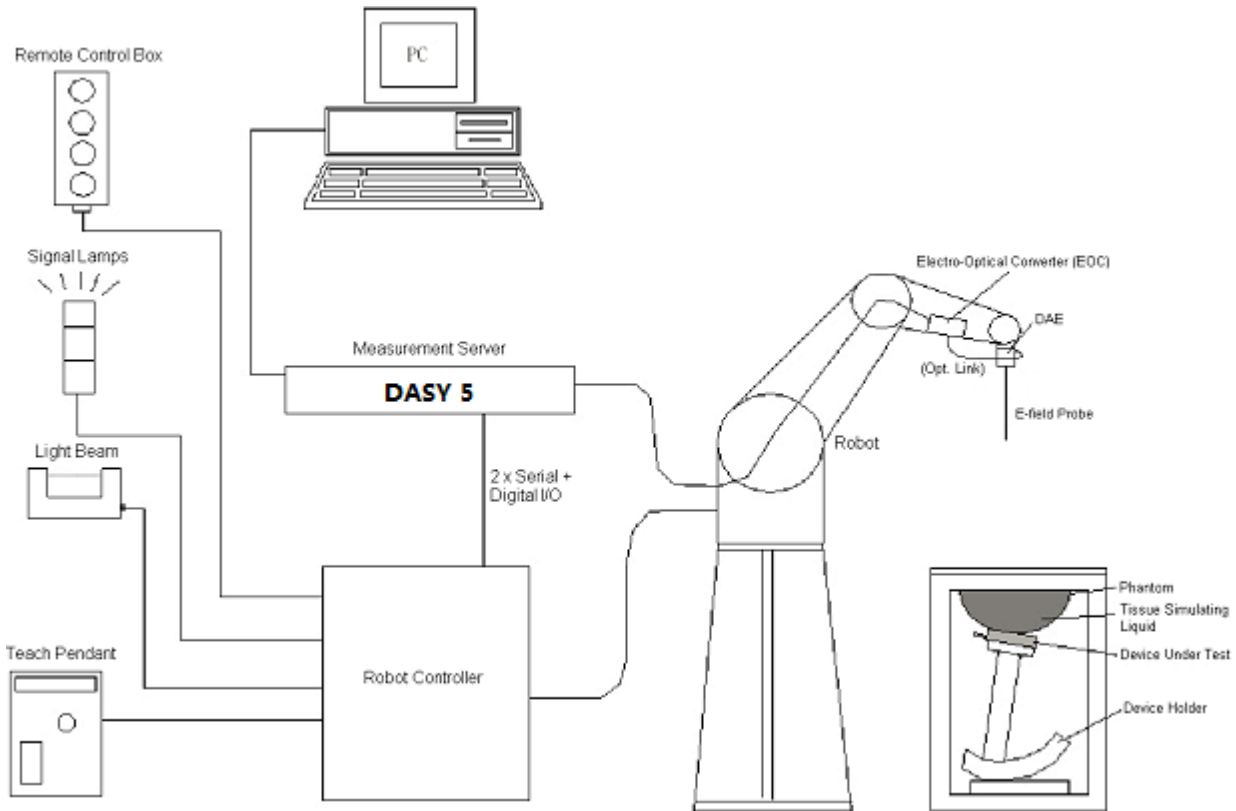


## 5. Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Remark
FCC 47 CFR Part 2 (2.1093)	Radio Frequency Radiation Exposure Evaluation: Portable Devices	/
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	/
KDB 447498 D01v06	General RF Exposure Guidance	/
KDB 248227 D01v02r02	SAR Measurement Procedures for 802.11 Transmitters	/
KDB 865664 D01v01r04	SAR Measurement 100 MHz to 6 GHz	/
KDB 865664 D02v01r02	RF Exposure Reporting	/
KDB 941225 D05v02r05	SAR Evaluation Consideration for LTE Devices	/
KDB 941225 D06v02r01	SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities	/
<b>Note:</b> Any additions, deviation, or exclusions from the method shall be noted in the "Remark".		

## 6. SAR Measurement System



**Fig.6.1 SPEAG DASY System Configurations**

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software.
- A data acquisition electronic (DAE) attached to the robot arm extension.
- A dosimetric probe equipped with an optical surface detector system.
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals.
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning.
- A computer operating Windows XP.
- DASY software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom.
- A device holder.
- Tissue simulating liquid.
- Dipole for evaluating the proper functioning of the system.

Component details are described in the following sub-sections.

## 6.1. E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG). 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. This probe has a built in optical surface detection system to prevent from collision with phantom.

### ➤ E-Field Probe Specification

#### <EX3DV3 Probe>

<b>Construction</b>	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
<b>Frequency</b>	10 MHz to 3 GHz; Linearity: $\pm 0.2$ dB
<b>Directivity</b>	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.4$ dB in HSL (rotation normal to probe axis)
<b>Dynamic Range</b>	5 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB
<b>Dimensions</b>	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm

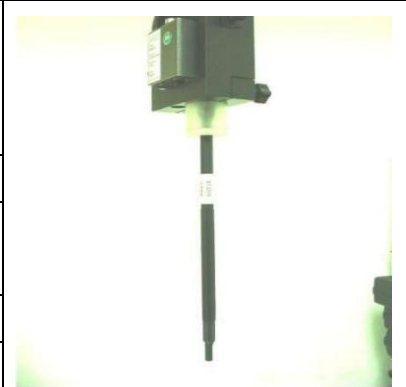


Fig 6.2 Photo of ES3DV3

#### <EX3DV4 Probe>

<b>Construction</b>	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
<b>Frequency</b>	10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB
<b>Directivity</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB
<b>Dimensions</b>	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm



Fig 6.3 Photo of EX3DV4

### ➤ E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy shall be evaluated and within  $\pm 0.25$  dB. The sensitivity parameters (Norm X, Norm Y and Norm Z), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to annex F of this report.

## 6.2. Data Acquisition Electronics (DAE)

The Data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig. 6.4 Photo of DAE

## 6.3. Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) 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)
- Low maintenance costs (virtually maintenance free due to direct drive gears; nobelt drives)
- Jerk-free straight movements
- Low ELF interference (motor control fields shielded via the closed metallic constructionshields)



Fig. 6.5 Photo of Robot

## 6.4. Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400MHz, Intel Celeron), chip-disk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.



Fig. 6.6 Photo of Server for DASY5

## 6.5. Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions.

During probe rotations, the probe tip will keep its actual position.



Fig. 6.7 Photo of Light Beam

## 6.6. Phantom

### <SAM Twin Phantom>

<b>Shell Thickness</b>	2 ± 0.2 mm (sagging: <1%) Center ear point: 6 ± 0.2 mm
<b>Filling Volume Dimensions</b>	Approx. 25 liters Length: 1000 mm; Width: 500 mm; Height: adjustable feet
<b>Measurement Areas</b>	Left Head, Right Head, Flat phantom



Fig. 6.8 Photo of SAM Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

## 6.7. Device Holder

### <Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ±0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has

two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP).

Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon = 3$  and loss tangent  $\delta = 0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

### <Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.



Fig 6.9 Device Holder



Fig 6.10 Laptop Extension Kit

## 6.8. Data Storage and Evaluation

### ➤ Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verifications of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [mW/g]). Some of these units are not available in certain situations



or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

➤ **Data Evaluation**

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

<b>Probe Parameters:</b>	- Sensitivity	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion	ConvF <sub>i</sub>
	- Diode compression point	dcp <sub>i</sub>
<b>Device Parameters:</b>	- Frequency	f
	- Crest	cf
<b>Media Parameters:</b>	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With V<sub>i</sub> = compensated signal of channel i, (i = x, y, z)

U<sub>i</sub> = input signal of channel i, (i = x, y, z)

cf = crest factor of exciting field (DASY parameter)

dcp<sub>i</sub> = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated:

$$\text{E- Field Probes: } E_i = \sqrt{\frac{v_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-Field Probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$



With  $V_i$  = compensated signal of channel  $i$ , ( $i = x, y, z$ )

Norm $_i$  = sensor sensitivity of channel  $i$ , ( $i = x, y, z$ ),  $\mu V / (V/m)^2$

ConvF = sensitivity enhancement in solution

$a_{ij}$  = sensor sensitivity factors for H-field probes

$f$  = carrier frequency (GHz)

$E_i$  = electric field strength of channel  $i$  in V/m

$H_i$  = magnetic field strength of channel  $i$  in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

With

SAR = local specific absorption rate in mW/g

$E_{tot}$  = total field strength in V/m

$\sigma$  = conductivity in (mho/m) or (Siemens/m)

$\rho$  = equipment tissue density in g/cm<sup>3</sup>

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.





## 6.9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial No./ SW Version	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1223	2022.08.22	2025.08.21
SPEAG	900MHz System Validation Kit	D900V2	1d064	2024.10.21	2027.10.20
SPEAG	1800MHz System Validation Kit	D1800V2	2d158	2024.10.21	2027.10.20
SPEAG	2000MHz System Validation Kit	D2000V2	1050	2024.10.22	2027.10.21
SPEAG	2450MHz System Validation Kit	D2450V2	805	2024.10.22	2027.10.21
SPEAG	5000MHz System Validation Kit	D5GHzV2	1176	2024.10.22	2027.10.21
SPEAG	DOSIMETRIC ASSESSMENT SYSTEM Software	DASY52	52.10.4.1527	NCR	NCR
SPEAG	Dosimetric E-Field Probe	ES3DV3	3295	2024.07.17	2025.07.16
SPEAG	Data Acquisition Electronics	DAE4	1324	2024.07.05	2025.07.04
SPEAG	Dosimetric E-Field Probe	EX3DV4	3823	2024.11.11	2025.11.10
SPEAG	Data Acquisition Electronics	DAE4	480	2024.11.11	2025.11.10
SPEAG	Dielectric Assessment KIT	DAK-3.5	1279	2025.03.18	2026.03.17
SPEAG	SAM 2	QD000P40CC	1464	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Network Emulator	CMW500	165755	2025.01.06	2026.01.05
Anritsu	Network Emulator	MT8820C	6201274521	2025.01.06	2026.01.05
Agilent	Network Analyzer	E5071B	MY42404762	2025.01.06	2026.01.05
mini-circuits	Amplifier	ZHL-42W+	608501717	NCR	NCR
mini-circuits	Amplifier	ZVE-8G+	754401735	NCR	NCR
Agilent	Signal Generator	N5182B	MY53050509	2024.09.11	2025.09.10
R&S	Power Sensor	NRP8S	103215	2025.01.06	2026.01.05
Agilent	Power Meter	E4416A	MY45102093	2024.09.11	2025.09.10
R&S	Power Sensor	NRP8S	103240	2025.01.06	2026.01.05
Anritsu	Power Meter	E4418B	GB43318055	2025.05.15	2026.05.14
Agilent	Dual Directional Coupler	778D	50422	NA	NA
MCL	Attenuation	351-218-010	N/A	NA	NA
R&S	Spectrum Analyzer	N9030A	MY54170556	2024.09.18	2025.09.17
KTJ	Thermo meter	TA298	N/A	2024.11.05	2025.11.04
SPEAG	Tissue Simulating Liquids	HBBL600-10000V6		24H	

**Note:**

1. The calibration certificate of DASY can be referred to annex F of this report.



2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
4. The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit is provided by SPEAG.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1 W input power according to the ratio of 1 W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it.
6. Attenuator insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
7. N.C.R means No Calibration Requirement.

## 7. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 7.1, for body SAR testing, the liquid height from the centre of the flat phantom to liquid top surface is larger than 15 cm, which is shown in Fig. 7.2.

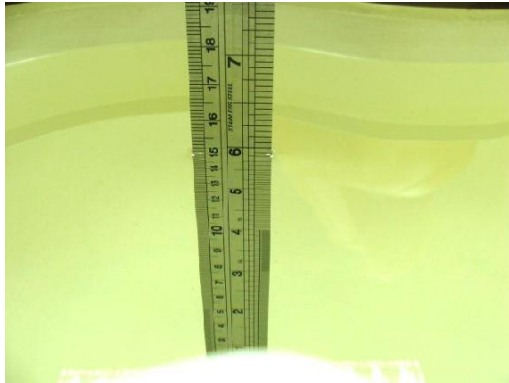


Fig 7.1 Photo of Liquid Height for Head SAR



Fig 7.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquids

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800,1900,2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%



**Note:** Please refer to the validation results for dielectric parameters of each frequency band. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a SPEAG Dielectric Assessment KIT and an Agilent Network Analyzer.

**Table 1: Dielectric Performance of Tissue Simulating Liquid**

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Conductivity Target (σ)	Delta (σ)(%)	Limit (%)	Date
750	HSL	22.1	0.875	0.89	-1.69	±5	2025/6/20
900	HSL	22.1	0.936	0.97	-3.51	±5	2025/6/20
1800	HSL	22.1	1.354	1.40	-3.29	±5	2025/6/20
2000	HSL	22.2	1.379	1.40	-1.50	±5	2025/6/20
2450	HSL	22.2	1.744	1.80	-3.11	±5	2025/6/25
5600	HSL	22.2	5.078	5.07	0.16	±5	2025/6/25
5750	HSL	22.3	5.271	5.22	0.98	±5	2025/6/25

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Permittivity (εr)	Permittivity Target (εr)	Delta (εr) (%)	Limit (%)	Date
750	HSL	22.1	40.883	41.90	-2.43	±5	2025/6/20
900	HSL	22.1	40.286	41.50	-2.93	±5	2025/6/20
1800	HSL	22.1	38.667	40.00	-3.33	±5	2025/6/20
2000	HSL	22.2	38.464	40.00	-3.84	±5	2025/6/20
2450	HSL	22.2	37.814	39.20	-3.54	±5	2025/6/25
5600	HSL	22.2	35.250	35.50	-0.70	±5	2025/6/25
5750	HSL	22.3	34.973	35.35	-1.07	±5	2025/6/25

## 8. SAR System Verification

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

### ➤ Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

### ➤ System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

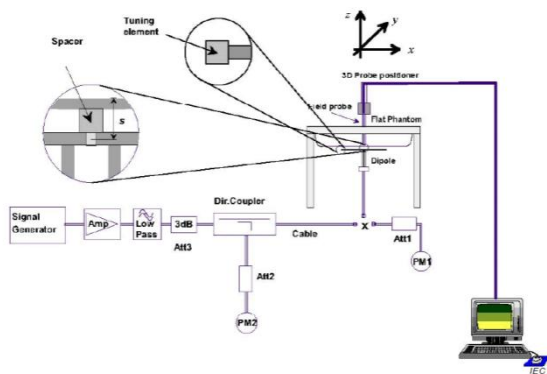


Fig.8.1 System Verification Setup Diagram

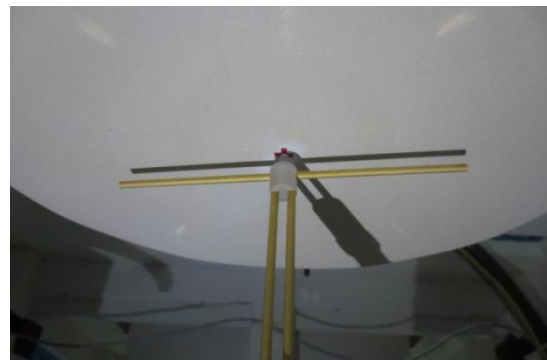


Fig.8.2 Photo of Dipole setup



➤ **System Verification Results**

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10%. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table as below indicates the system performance check can meet the variation criterion and the plots can be referred to annex C of this report.

Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N
750	250	D750V3-1223	3925	1324
900	250	D900V2-1d064	3925	1324
1800	250	D1800V2-2d158	3925	1324
2000	250	D2000V2-1050	3925	1324
2450	100	D2450V2-805	3925	1324
5600	100	D5GHzV2-1176-5600	3823	480
5750	100	D5GHzV2-1176-5750	3823	480

**<1g SAR>**

Date	Frequency (MHz)	Tissue Type	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2025/6/20	750	HSL	2.20	8.54	8.8	3.04
2025/6/20	900	HSL	2.86	10.90	11.44	4.95
2025/6/20	1800	HSL	9.69	39.20	38.76	-1.12
2025/6/20	2000	HSL	9.85	41.40	39.4	-4.83
2025/6/25	2450	HSL	5.16	52.80	51.6	-2.27
2025/6/25	5600	HSL	8.58	82.40	85.8	4.13
2025/6/25	5750	HSL	8.11	77.20	81.1	5.05

**<10g SAR>**

Date	Frequency (MHz)	Tissue Type	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2025/6/20	750	HSL	1.44	5.57	5.76	3.41
2025/6/20	900	HSL	1.87	7.00	7.48	6.86
2025/6/20	1800	HSL	5.09	20.70	20.36	-1.64
2025/6/20	2000	HSL	5.12	21.00	20.48	-2.48
2025/6/25	2450	HSL	2.48	24.50	24.8	1.22
2025/6/25	5600	HSL	2.40	22.80	24	5.26
2025/6/25	5750	HSL	2.26	21.20	22.6	6.60

**Note:** System checks the specific test data please see annex C



## 9. EUT Testing Position

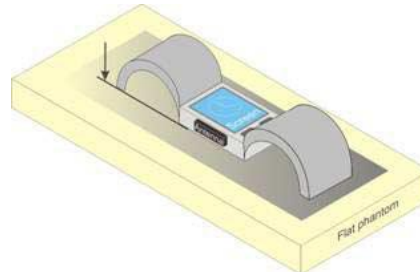
This EUT was tested in two different positions. They are front of face for head with phantom 10 mm gap, wrist-worn of the EUT with phantom 0 mm gap, as illustrated below, please refer to annex B for the test setup photos.

### 9.1. SAR Evaluations near the Mouth/Jaw Regions of theSAM

Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the device positioned in direct contact against a flat phantom filled with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions; otherwise, if applicable, the neck or a curved head region of the SAM phantom may be used, provided the device positioning and SAR probe access issues have been addressed through a KDB inquiry. When other device positioning and SAR measurement considerations are necessary, a KDB inquiry is also required for the test results to be acceptable; for example, devices with rigid wrist bands or electronic circuitry and/or antenna(s) incorporated in the wrist bands. These test configurations are applicable only to devices that are worn on the wrist and cannot support other use conditions; therefore, the operating restrictions must be fully demonstrated in both the test reports and user manuals.

## 9.2. Limb-worn Accessory Configurations

- To position the device parallel to the phantom surface with either keypad up or down.
- To adjust the device parallel to the flat phantom.
- To adjust the distance between the device surface and the flat phantom to 10 mm or holster surface and the flat phantom to 0 mm.



**Fig.9.1 Illustration for Limb-worn Position**





## 10.Measurement Procedures

The measurement procedures are as bellows:

### <Conducted power measurement>

- For WWAN power measurement, use base station simulator to configure EUT WWAN transition in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- Read the WWAN RF power level from the base station simulator.
- For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band.
- Connect EUT RF port through RF cable to the power meter or spectrum analyzer, and measure WLAN/BT output power.

### <Conducted power measurement>

- Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- Place the EUT in positions as annex B demonstrates.
- Set scan area, grid size and other setting on the DASY software.
- Measure SAR results for the highest power channel on each testing position.
- Find out the largest SAR result on these testing positions of each band.
- Measure SAR results for other channels in worst SAR testing position if the Reported SAR or highest power channel is larger than 0.8 W/kg.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Area scan
- Zoom scan
- Power drift measurement



## 10.1. Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a “cube” measurement. The measured volume must include the 1g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- Extraction of the measured data (grid and values) from the Zoom Scan.
- Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters).
- Generation of a high-resolution mesh within the measured volume.
- Interpolation of all measured values from the measurement grid to the high-resolution grid
- Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- Calculation of the averaged SAR within masses of 1 g and 10 g.

## 10.2. Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement 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. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

## 10.3. Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r04 quoted below.

		$\leq 3$ GHz	$> 3$ GHz	
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		$5 \pm 1$ mm	$\frac{3}{4} \delta \cdot \ln(2) \pm 0.5$ mm	
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$	
Maximum area scan spatial resolution: $\Delta x_{Area}$ , $\Delta y_{Area}$		$\leq 2$ GHz: $\leq 15$ mm 2 – 3 GHz: $\leq 12$ mm	3 – 4 GHz: $\leq 12$ mm 4 – 6 GHz: $\leq 10$ 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 $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.		
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$		$\leq 2$ GHz: $\leq 8$ mm 2 – 3 GHz: $\leq 5$ mm*	3 – 4 GHz: $\leq 5$ mm* 4 – 6 GHz: $\leq 4$ mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	$\leq 5$ mm	3 – 4 GHz: $\leq 4$ mm 4 – 5 GHz: $\leq 3$ mm 5 – 6 GHz: $\leq 2$ mm	
	graded grid	$\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4$ mm	3 – 4 GHz: $\leq 3$ mm 4 – 5 GHz: $\leq 2.5$ mm 5 – 6 GHz: $\leq 2$ mm
		$\Delta z_{Zoom}(n>1)$ : between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	$\geq 30$ mm	3 – 4 GHz: $\geq 28$ mm 4 – 5 GHz: $\geq 25$ mm 5 – 6 GHz: $\geq 22$ mm	
Note: $\delta$ 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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 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.				

## 10.4. Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD post-processor scan combine and subsequently superpose these measurement data to calculating the multiband SAR.



## 10.5. SAR Averaged Methods

In DASYS, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1g and 10g cubes, the extrapolation distance should not be larger than 5 mm.

## 10.6. Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASYS measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



# 11.SAR Test Configuration

<LTE Mode>

## LTE Target MPR level

The device implements maximum power reduction per 3GPP 36.101 requirements where the MPR target is as below table. The MPR settings are implemented configured into firmware and cannot be disabled by the end user or LTE carrier network.

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						MPR	3GPP
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Target (dB)	MPR (dB)
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1	≤ 1

**Note:** The measurement result showed some difference from the target MPR level, due to expected 0.5 dB measurement tolerance

## LTE Bands

LTE Bands	Channel bandwidth / Transmission bandwidth configuration [RB]					
	1.4	3.0	5	10	15	20
	MHz	MHz	MHz	MHz	MHz	MHz
2	√	√	√	√	√	√
4	√	√	√	√	√	√
5	√	√	√	√	N/A	N/A
12	√	√	√	√	N/A	N/A
13	N/A	N/A	√	√	N/A	N/A
66	√	√	√	√	√	√
71	N/A	N/A	√	√	√	√

**Note:**

1. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
2. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
3. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
4. Per KDB 941225 D05v02r05, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.



5. Per KDB 941225 D05v02r05, 16QAM/64QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB941225 D05v02r05, 16QAM/64QAM SAR testing is not required.
6. Per KDB 941225 D05v02r05, smaller bandwidth output power for each RB allocation configuration is > not ½ Db higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported band width is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
7. For LTE B4 / B5 the maximum bandwidth does not support three non-overlapping channels, per KDB941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.
8. LTE band 4 SAR test was covered by Band 66; according to April 2015 TCB workshop, SAR test for overlapping LTE bands can be reduced if
  - a. The maximum output power, including tolerance, for the smaller band is ≤ the larger band to qualify for the SAR test exclusion.
  - b. The channel bandwidth and other operating parameters for the smaller band are fully supported by the larger band.
9. According to 2017 TCB workshop, for 64 QAM and 16 QAM should be verified by checking the signal constellation with a call box to avoid incorrect maximum power levels due to MPR and other requirements associated with signal modulation, and the following figure is taken from the "Fundamental Measurement >> Modulation Analysis >>constellation" mode of the device connect to the CMW500 base station, therefore, the device 64QAM and 16QAM signal modulation are correct. Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design: only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards: b) A-MPR (additional MPR) must be disabled.
10. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/ (duty cycle)"
  - c. For WWAN: Reported SAR (W/kg) = Measured SAR(W/kg) \* Tune-up Scaling Factor
  - d. For WLAN/Bluetooth: Reported SAR (W/kg) = Measured SAR(W/kg) \* Duty Cycle scaling factor \* Tune-up scaling factor
  - e. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The Reported TDD LTE SAR = measured SAR (W/kg) \* Tune-up Scaling Factor\* scaling factor for extended cyclic prefix.
11. Per KDB 447498 D01v06, for each exposure position, 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
12. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required



only when the measured SAR is  $\geq 0.8$ W/kg.

13. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is  $\leq 1.2$  W/kg, SAR testing with a headset connected to the handset is not required.

#### <WLAN 2.4GHz>

1. SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
  - a. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
  - b. When the reported SAR is  $> 0.8$  W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.
2. 2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is  $> 1.2$  W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test configuration Procedures should be followed.
3. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is  $\leq 0.4$  W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is  $\leq 0.8$  W/kg or all test positions are measured.
4. Justification for test configurations for WLAN per KDB Publication 248227 D02DR02-41929 for 2.4 GHz WI-FI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
5. A fixed level power reduction is applied for WiFi when handset operates "held to the body" condition or "held to the ear" condition, the power reduction triggered by audio receiver detection and call establish status.
6. Per KDB 248227 D01v02r02, In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. SAR is not required for the following 2.4 GHz OFDM conditions:
  - a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
  - b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.



## 12. Conducted RF Output Power

Remark: The output power of LTE/WLAN/Bluetooth was recorded in annex E of this report.

## 13. Exposure Positions Consideration

### ➤ EUT Antenna Location

The location of antenna was recorded in annex B
LTE ANT: TX/RX: LTE Band 2/4/5/12/13/66/71
WIFI&GPS ANT: TX/RX: WLAN 2.4GHz/5GHz, Bluetooth, GPS_L1
GPS ANT: TX/RX: GPS_L5

**Note:**

1. Next to mouth/Wrist-worn mode SAR assessments are required.
2. Per KDB 447498 D01v06, When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with body tissue-equivalent medium.





## 14. SAR Test Results Summary

### ➤ General Note

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a) Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b) For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)".
  - c) For WLAN/Bluetooth: Reported SAR (W/kg) = Measured SAR (W/kg) \* Duty Cycle scaling factor \* Tune-up scaling factor.
2. Per KDB 447498 D01v06, for each exposure position, 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:
  - a)  $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz
  - b)  $\leq 0.6$  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)  $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$ W/kg.
4. Per KDB 447498 D01v06, for each exposure position, if the highest output power channel Reported SAR  $\leq 0.8$  W/kg, other channels SAR testing is not necessary.



> **Next to Mouth SAR Data**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR <sub>1g</sub> (W/kg)	Reported SAR <sub>1g</sub> (W/kg)
1#	LTE Band 2/1RB#0 20M	Front Side	18900	22.47	23.5	1.268	0.799	1.013
	LTE Band 2/1RB#0 20M	Front Side	18700	22.42	23.5	1.282	0.725	0.930
	LTE Band 2/1RB#0 20M	Front Side	19100	22.39	23.5	1.291	0.758	0.979
	LTE Band 2/50RB#0 20M	Front Side	18900	21.59	22.5	1.233	0.640	0.789
	<b>LTE Band 2/100RB#0 20M</b>	Front Side	18900	21.48	22.5	1.265	0.613	0.775
2#	LTE Band 5/1RB#0 10M	Front Side	20525	22.72	24.00	1.343	0.583	0.783
	LTE Band 5/25RB#0 10M	Front Side	20525	21.67	23.00	1.358	0.492	0.668
3#	LTE Band 12/1RB#0 10M	Front Side	23095	23.03	24.00	1.250	0.107	0.134
	LTE Band 12/25RB#0 10M	Front Side	23095	22.07	23.00	1.239	0.088	0.109
4#	LTE Band 13/1RB#0 10M	Front Side	23230	22.95	24.00	1.274	0.395	0.503
	LTE Band 13/25RB#0 10M	Front Side	23230	21.78	23.00	1.324	0.307	0.407
5#	LTE Band 66/1RB#0 20M	Front Side	132322	23.00	24.00	1.259	0.717	0.903
	LTE Band 66/1RB#0 20M	Front Side	132072	22.92	24.00	1.282	0.625	0.801
	LTE Band 66/1RB#0 20M	Front Side	132572	22.96	24.00	1.271	0.676	0.859
	LTE Band 66/50RB#0 20M	Front Side	132322	21.95	23.00	1.274	0.574	0.731
	<b>LTE Band 66/100RB#0 20M</b>	Front Side	132322	21.91	23.00	1.285	0.542	0.697
6#	LTE Band 71/1RB#0 20M	Front Side	133322	23.10	24.00	1.230	0.090	0.111
	LTE Band 71/50RB#0 20M	Front Side	133322	22.34	23.00	1.164	0.079	0.092
7#	WLAN 2.4GHz/802.11b	Front Side	6	16.28	17.00	1.180	0.120	0.143
8#	WLAN 5.5GHz/802.11a	Front Side	116	14.39	15.50	1.291	0.095	0.125
9#	WLAN 5.8GHz/802.11a	Front Side	165	13.99	15.00	1.262	0.023	0.029
10#	Bluetooth/DH5	Front Side	0	6.64	7.50	1.219	0.031	0.041

**Note:**

1. Per KDB 447498 D01v06, for each exposure position, if the highest output power channel Reported SAR  $\leq 0.8$ W/kg, other channels SAR testing is not necessary.
2. Per KDB 447498 D01v06, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium.
3. Per KDB 447498 D01v06, Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR.
4. Per KDB 248227 D01v02r02, for 802.11b DSSS , when the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required in that exposure configuration.
5. Per KDB248227 D01v02r02, OFDM SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the



adjusted SAR is  $\leq 1.2$  W/kg.

6. The 2.4G WLAN reported 1g SAR (W/kg) should be scaled with the duty cycle scaling factor 1.010, 1.020 for WLAN 5.5GHz 802.11a, and 1.015 for WLAN 5.8GHz 802.11a.
7. According to 2016 Oct. TCB workshop for Bluetooth SAR consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation. The duty cycle of Bluetooth is 77.01 %, Therefore the duty cycle scaling factor 1.082 should be used to calculating the reported SAR.

#### > Wrist-worn SAR Data

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR <sub>10g</sub> (W/kg)	Reported SAR <sub>10g</sub> (W/kg)
11#	LTE Band 2/1RB#0 20M	Back Side	18900	22.47	23.5	1.268	0.675	0.856
	LTE Band 2/50RB#0 20M	Back Side	18900	21.59	22.5	1.233	0.542	0.668
12#	LTE Band 5/1RB#0 10M	Back Side	20525	22.72	24.00	1.343	0.186	0.250
	LTE Band 5/25RB#0 10M	Back Side	20525	21.67	23.00	1.358	0.151	0.205
13#	LTE Band 12/1RB#0 10M	Back Side	23095	23.03	24.00	1.250	0.139	0.174
	LTE Band 12/25RB#0 10M	Back Side	23095	22.07	23.00	1.239	0.102	0.126
14#	LTE Band 13/1RB#0 10M	Back Side	23230	22.95	24.00	1.274	0.286	0.364
	LTE Band 13/25RB#0 10M	Back Side	23230	21.78	23.00	1.324	0.159	0.211
15#	LTE Band 66/1RB#0 20M	Back Side	132322	23.00	24.00	1.259	0.470	0.592
	LTE Band 66/50RB#0 20M	Back Side	132322	21.95	23.00	1.274	0.376	0.479
16#	LTE Band 71/1RB#0 20M	Back Side	133322	23.10	24.00	1.230	0.117	0.144
	LTE Band 71/50RB#0 20M	Back Side	133322	22.34	23.00	1.164	0.083	0.097
17#	WLAN 2.4GHz/802.11b	Back Side	6	16.28	17.00	1.180	0.082	0.098
18#	WLAN 5.5GHz/802.11a	Back Side	116	14.39	15.50	1.291	0.058	0.077
19#	WLAN 5.8GHz/802.11a	Back Side	165	13.99	15.00	1.262	0.019	0.024
20#	Bluetooth/DH5	Back Side	0	6.64	7.50	1.219	0.015	0.019

#### Note:

1. Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR  $\leq 2.0$ W/kg, other channels SAR testing is not necessary.
2. Per KDB 447498 D01v06, When SAR evaluation is required, SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with head tissue-equivalent medium.
3. Per KDB 447498 D01v06, Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR.
4. Per KDB 248227 D01v02r02, for 802.11b DSSS, when the reported SAR of the highest



measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required in that exposure configuration.

5. Per KDB248227 D01v02r02, OFDM SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.
6. The 2.4G WLAN reported 1g SAR (W/kg) should be scaled with the duty cycle scaling factor 1.010, 1.020 for WLAN 5.5GHz 802.11a, and 1.015 for WLAN 5.8GHz 802.11a.
7. According to 2016 Oct. TCB workshop for Bluetooth SAR consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation. The duty cycle of Bluetooth is 77.01 %, Therefore the duty cycle scaling factor 1.082 should be used to calculating the reported SAR.

## 15. Simultaneous Transmission Evaluation

### 15.1. Simultaneous Transmission Consideration

No.	Simultaneous Transmission Consideration	Next to Mouth	Wrist-worn
1	WWAN + WLAN 2.4/5GHz	Yes	Yes
2	WWAN + Bluetooth	Yes	Yes

**Note:**

1. Simultaneous Transmission SAR evaluation is not required for BT and WLAN 2.4GHz, because the software mechanism have been incorporated to guarantee that the WLAN 2.4GHz and Bluetooth transmitters would not simultaneously operate.
2. Per KDB 447498D01v06, simultaneous transmission SAR evaluation procedures is as followed:

Step 1: If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.

Step 2: If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

Step 3: If the ratio of SAR to peak separation distance is  $\leq 0.04$ , Simultaneous SAR measurement is not required.

Step 4: If the ratio of SAR to peak separation distance is  $> 0.04$ , Simultaneous SAR measurement is required and simultaneous transmission SAR value is calculated.

(The ratio is determined by:  $(SAR_1 + SAR_2) ^{1.5} / R_i \leq 0.04$ ,

$R_i$  is the separation distance between the peak SAR locations for the antenna pair in mm.



## 15.2. Simultaneous Transmission Analysis

### ➤ Next to Mouth Simultaneous Transmission for WWAN + WLAN 2.4GHz/5GHz

WWAN Band	Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
		WWAN	2.4GHz WLAN	5GHz WLAN		
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)		
LTE Band 2	Front Side	1.013	0.143	0.125	1.156	1.138
LTE Band 5	Front Side	0.783	0.143	0.125	0.926	0.908
LTE Band 12	Front Side	0.164	0.143	0.125	0.307	0.289
LTE Band 13	Front Side	0.503	0.143	0.125	0.646	0.628
LTE Band 66/4	Front Side	0.903	0.143	0.125	1.046	1.028
LTE Band 71	Front Side	0.111	0.143	0.125	0.254	0.236

### ➤ Next to Mouth Simultaneous Transmission for WWAN + Bluetooth

WWAN Band	Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
		WWAN	Bluetooth	
		1g SAR (W/kg)	1g SAR (W/kg)	
LTE Band 2	Front Side	1.013	0.041	1.054
LTE Band 5	Front Side	0.783	0.041	0.824
LTE Band 12	Front Side	0.164	0.041	0.205
LTE Band 13	Front Side	0.503	0.041	0.544
LTE Band 66/4	Front Side	0.903	0.041	0.944
LTE Band 71	Front Side	0.111	0.041	0.152

### ➤ Wrist-worn Simultaneous Transmission for WWAN + WLAN 2.4GHz/5GHz

WWAN Band	Exposure Position	1	2	3	1+2 Summed 10g SAR (W/kg)	1+3 Summed 10g SAR (W/kg)
		WWAN	2.4GHz WLAN	5GHz WLAN		
		10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)		
LTE Band 2	Back Side	0.856	0.098	0.077	0.954	0.933
LTE Band 5	Back Side	0.322	0.098	0.077	0.420	0.399
LTE Band 12	Back Side	0.174	0.098	0.077	0.272	0.251
LTE Band 13	Back Side	0.364	0.098	0.077	0.462	0.441
LTE Band 66/4	Back Side	0.592	0.098	0.077	0.690	0.669
LTE Band 71	Back Side	0.144	0.098	0.077	0.242	0.221



➤ **Wrist-worn Simultaneous Transmission for WWAN + Bluetooth**

WWAN Band	Exposure Position	1	2	1+2 Summed 10g SAR (W/kg)
		WWAN	Bluetooth	
		10g SAR (W/kg)	10g SAR (W/kg)	
LTE Band 2	Back Side	0.856	0.019	0.875
LTE Band 5	Back Side	0.322	0.019	0.341
LTE Band 12	Back Side	0.174	0.019	0.193
LTE Band 13	Back Side	0.364	0.019	0.383
LTE Band 66/4	Back Side	0.592	0.019	0.611
LTE Band 71	Back Side	0.144	0.019	0.163



## 16. Measurement Uncertainty

According to KDB 865664 D01 SAR measurement 100 MHz to 6GHz, when the highest measured 1-g SAR is less than 1.5 W/kg and 10-g extremity SAR less than 3.75 W/kg, the expanded SAR measurement uncertainty must be less than 30% with a confidence interval of  $k=2$ . When these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE 1528-2013 is not required in the SAR report and submitted for equipment approval. For this device, both the 1-g SAR is less than 1.5 W/kg and 10-g extremity SAR less than 3.75 W/kg. Therefore the measurement uncertainty table is not required in this report.

## 17. Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested. Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.





# Annex A General Information

## 1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

## 2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

## 3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

### Note:

The main report is end here and the other annex (B,C,D,E,F) will be submittedseparately.

\*\*\*\*\* END OF MAIN REPORT \*\*\*\*\*