

FCC SAR TEST REPORT

Test File No : F690501-RF-SAR000540-A3

Equipment Under Test	Telematics
Model Name	TFBMEIBN3EU
Variant Model	TFBMNINN0EN, TFBMEIBN3FR
Module Name	TM16FNNABM0
Applicant	LG Electronics USA, Inc.
Address of Applicant	111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, United States, 07632
FCC ID	BEJTFBMEIBN3EU
Module FCC ID	BJETM16FNNABM0
Exposure Category	General Population/Uncontrolled Exposure
Standards	FCC 47 CFR Part 2 (2.1093) IEEE 1528, 2013
Receipt No.	GPRI2410001117SR
Date of Receipt	2024-10-15
Date of SAR Test(s)	2025-01-06 ~2025-01-21
Date of Issue	2025-06-17
Test Result	Refer to the Page 07
Measurement Uncertainty	Refer to the Page 37

In the configuration tested, the EUT complied with the standards specified above.

This test report does not assure KOLAS accreditation.

Remarks:

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.



Report prepared by /
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Revision history

Revision	Date of issue	Revisions	Revised By
-	Mar 27, 2025	Initial issue	
A1	Apr 03, 2025	Revision Update - Added module information	Jayden Jung
A2	May 21, 2025	Revision Update - WLAN 6GHz UNII 6,8 Updated - Updated frequency and power for WLAN 6 GHz UNII 5 low Ch	Jayden Jung
A3	Jun 17, 2025	Revision Update - Fixed antenna gain and added measurement uncertainty	Jayden Jung

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1 Testing Laboratory

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2 Details of Applicant

Applicant	LG Electronics USA, Inc.
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3 Details of Manufacturer

Applicant	LG Electronics Inc.
Address	128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Republic of Korea, 07336

4 Description of EUT(s)

EUT Type	Telematics								
Model Name	TFBMEIBN3EU								
Variant Model	TFBMNINN0EN, TFBMEIBN3FR								
Module Name	TM16FNNABM0								
TFBMEIBN3EU & Variant Model Difference	Those models are technically identical, but the only difference is digital portions.								
	Model Name		*Installation capability on PCB		GNSS	WiFi / BT	Backup Battery	Model Remark	
	TFBMEIBN3EU		O		O	O	O	Basic Model	
	TFBMNINN0EN		X		O	O	X		
	TFBMEIBN3FR		O		O	O	O		
	* Cellular Antennas is mounted on TFBMEIBN3EU, TFBMNINN0EN, TFBMEIBN3FR								
O: Popped									
X: De-Popped									
WLAN/BT Antenna Gain	Band		Ant1	Ant2	Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4
	2.4GHz		5.06	4.96	4.10	2.90	8.02	7.60	7.06
	5GHz	UNII 1	6.46	6.43	2.20	5.00	9.46	7.60	8.77
		UNII 2A	5.73	5.84	2.20	5.00	8.80	7.15	8.38
		UNII 2C	6.86	5.21	1.90	5.00	9.08	7.74	8.99
		UNII 3	5.67	4.29	2.40	5.00	8.02	7.20	8.35
	6GHz	UNII 5	2.86	0.77	2.40	-	4.89	5.64	-
		UNII 6	0.66	0.31	2.50	-	3.50	4.64	-
		UNII 7	1.11	0.12	2.50	-	3.59	4.84	-
		UNII 8	-2.71	-0.95	3.00	-	1.23	3.62	-
	BT		5.06	-					
	Software Version								
v010.046.077									
Hardware Version									
Rev. C3									
Serial Number									
355353850006970									

Mode of Operation	WCDMA II / WCDMA V / LTE Band 2 / LTE Band 4 / LTE Band 5 / LTE Band 7 / LTE Band 12 / LTE Band 13 / LTE Band 17 / LTE Band 25 / LTE Band 26 / LTE Band 38 / LTE Band 48 / LTE Band 66 / LTE Band 71 / 5G NR n2 / 5G NR n5 / 5G NR n7 / 5G NR n12 / 5G NR n25 / 5G NR n41 / 5G NR n48 / 5G NR n48 MIMO / 5G NR n66 / 5G NR n71 / 5G NR n77 / 5G NR n77 MIMO / 5G NR n78 / 5G NR n78 MIMO / WLAN / Bluetooth LE
Tx Frequency Range	WCDMA II : 1 850.0 ~ 1 910.0 MHz WCDMA V : 824.0 ~ 849.0 MHz LTE Band 2 : 1 850.0 ~ 1 910.0 MHz LTE Band 4 : 1 710.0 ~ 1 755.0 MHz LTE Band 5 : 824.0 ~ 849.0 MHz LTE Band 7 : 2 500.0 ~ 2 570.0 MHz LTE Band 12 : 699.0 ~ 716.0 MHz LTE Band 13 : 777.0 ~ 787.0 MHz LTE Band 17 : 704.0 ~ 716.0 MHz LTE Band 25 : 1 850 ~ 1 915.0 MHz LTE Band 26 : 814.0 ~ 849.0 MHz LTE Band 38 : 2 570.0 ~ 2 620.0 MHz LTE Band 48 : 3 550.0 ~ 3 700.0 MHz LTE Band 66 : 1 710.0 ~ 1 780.0 MHz LTE Band 71 : 663.0 ~ 698.0 MHz 5G NR n2 : 1 850.0 ~ 1 910.0 MHz 5G NR n5 : 824.0 ~ 849.0 MHz 5G NR n7 : 2 500.0 ~ 2 570.0 MHz 5G NR n12 : 699.0 ~ 716.0 MHz 5G NR n25 : 1 850.0 ~ 1 915.0 MHz 5G NR n41 : 2 496.0 ~ 2 690.0 MHz 5G NR n48 : 3 550.0 ~ 3 700.0 MHz 5G NR n48 MIMO : 3 550.0 ~ 3 700.0 MHz 5G NR n66 : 1 710.0 ~ 1 780.0 MHz 5G NR n71 : 663.0 ~ 698.0 MHz 5G NR n77 DoD : 3 450.0 ~ 3 550.0 MHz 5G NR n77 : 3 700.0 ~ 3 980.0 MHz 5G NR n77 DoD MIMO : 3 450.0 ~ 3 550.0 MHz 5G NR n77 MIMO : 3 700.0 ~ 3 980.0 MHz 5G NR n78 DoD : 3 450.0 ~ 3 550.0 MHz 5G NR n78 : 3 700.0 ~ 3 800.0 MHz 5G NR n78 DoD MIMO : 3 450.0 ~ 3 550.0 MHz 5G NR n78 MIMO : 3 700.0 ~ 3 800.0 MHz WLAN 2.4 GHz : 2 412.0 MHz ~ 2 462.0 MHz U-NII 1 : 5 180.0 MHz ~ 5 240.0 MHz U-NII 2A : 5 260.0 MHz ~ 5 320.0 MHz U-NII 2C : 5 500.0 MHz ~ 5 720.0 MHz U-NII 3 : 5 745.0 MHz ~ 5 825.0 MHz U-NII 5 : 5 935.0 ~ 6 415.0 MHz U-NII 6 : 6 425.0 ~ 6 525.0 MHz U-NII 7 : 6 535.0 ~ 6 855.0 MHz U-NII 8 : 6 875.0 ~ 7 125.0 MHz Bluetooth LE : 2 402.0 MHz ~ 2 480.0 MHz

Module Tx Frequency Range	WCDMA II : 1 850.0 ~ 1 910.0 MHz WCDMA V : 824.0 ~ 849.0 MHz LTE Band 2 : 1 850.0 ~ 1 910.0 MHz LTE Band 4 : 1 710.0 ~ 1 755.0 MHz LTE Band 5 : 824.0 ~ 849.0 MHz LTE Band 7 : 2 500.0 ~ 2 570.0 MHz LTE Band 12 : 699.0 ~ 716.0 MHz LTE Band 13 : 777.0 ~ 787.0 MHz LTE Band 17 : 704.0 ~ 716.0 MHz LTE Band 25 : 1 850 ~ 1 915.0 MHz LTE Band 26 : 814.0 ~ 849.0 MHz LTE Band 38 : 2 570.0 ~ 2 620.0 MHz LTE Band 48 : 3 550.0 ~ 3 700.0 MHz LTE Band 66 : 1 710.0 ~ 1 780.0 MHz LTE Band 71 : 663.0 ~ 698.0 MHz 5G NR n2 : 1 850.0 ~ 1 910.0 MHz 5G NR n5 : 824.0 ~ 849.0 MHz 5G NR n7 : 2 500.0 ~ 2 570.0 MHz 5G NR n12 : 699.0 ~ 716.0 MHz 5G NR n25 : 1 850.0 ~ 1 915.0 MHz 5G NR n41 : 2 496.0 ~ 2 690.0 MHz 5G NR n48 : 3 550.0 ~ 3 700.0 MHz 5G NR n66 : 1 710.0 ~ 1 780.0 MHz 5G NR n71 : 663.0 ~ 698.0 MHz 5G NR n77 DoD : 3 450.0 ~ 3 550.0 MHz 5G NR n77 : 3 700.0 ~ 3 980.0 MHz 5G NR n77 DoD MIMO : 3 450.0 ~ 3 550.0 MHz 5G NR n77 MIMO : 3 700.0 ~ 3 980.0 MHz 5G NR n78 DoD : 3 450.0 ~ 3 550.0 MHz 5G NR n78 : 3 700.0 ~ 3 800.0 MHz 5G NR n78 DoD MIMO : 3 450.0 ~ 3 550.0 MHz 5G NR n78 MIMO : 3 700.0 ~ 3 800.0 MHz
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5 The Highest Reported SAR Values

Band	Highest Reported SAR 1g (W/kg)
5G NR n48 Ant1+2	0.025
5G NR n77 PC2 Ant1+2	0.092
5G NR n77 PC2 DoD Ant1+2	0.037
5G NR n77 PC2 Diversity Ant1+2	0.101
5G NR n77 PC2 DoD Diversity Ant1+2	0.050
5G NR n78 Ant1+2	0.071
5G NR n78 DoD Ant1+2	0.035
Simultaneous SAR(TER) per KDB 690783 D01v01r03 :	0.221

6 Test Methodology

ANSI/IEEE C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

Test tests documented in this report were performed in accordance with IEEE Standard 1528-2013 and the following published KDB procedures.

☒	KDB 865664 D01v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz
☒	KDB 865664 D02v01r02	RF Exposure Compliance Reporting and Documentation Considerations
☐	KDB 447498 D01v06	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
☒	KDB 447498 D04v01	Interim General RF Exposure Guidance
☐	KDB 447498 D02v02r01	SAR Measurement Procedures for USB Dongle Transmitters
☐	KDB 248227 D01v02r02	SAR Guidance For IEEE 802.11 (Wi-Fi) Transmitters
☐	KDB 615223 D01v01r01	802.16e/WiMax SAR Measurement Guidance
☐	KDB 616217 D04v01r02	SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers
☐	KDB 643646 D01v01r03	SAR Test Considerations for Occupational PTT Radios
☐	KDB 648474 D03v01r04	Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers
☐	KDB 648474 D04v01r03	SAR Evaluation Considerations for Wireless Handsets
☐	KDB 680106 D01v03r01	RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications
☐	KDB 941225 D01v03r01	3G SAR Measurement Procedures
☐	KDB 941225 D05v02r05	SAR Evaluation Considerations for LTE Devices
☐	KDB 941225 D06v02r01	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
☐	KDB 941225 D07v01r02	SAR Evaluation Procedures for UMPC Mini-Tablet Devices

7 Testing Environment

Ambient temperature	: 18°C ~ 25°C
Relative humidity	: 30% ~ 70%
Liquid temperature of during the test	: $\pm 2^{\circ}\text{C}$
Ambient noise & Reflection	: < 0.012 W/kg

8 Specific Absorption Rate (SAR)

8.1 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/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled

8.2 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:

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

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

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

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

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

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

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

8.3 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.3-2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the

MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Partial Peak SAR (Partial)	1.60 mW/g	8.00 mW/g
Partial Average SAR (Whole Body)	0.08 mW/g	0.40 mW/g
Partial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

1. The spatial Peak value of the SAR averaged over any 1g 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.

9 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. 1. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E_i|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.

The DASY system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli TX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- A dosimeter probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- Data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

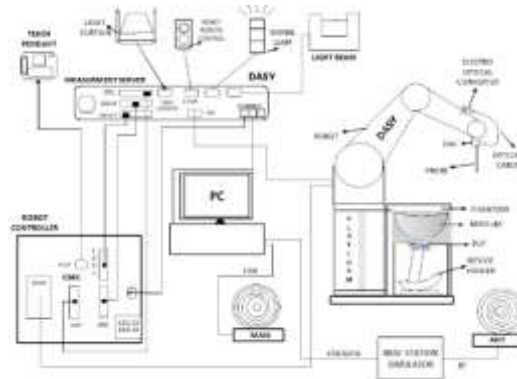


Fig a. The microwave circuit arrangement used for SAR system verification

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows.
- DASY software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Verification dipole kits allowing to validate the proper functioning of the system.

10 System Components

10.1 Probe

Construction	: Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	: Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835 and HSL1900. Additional CF-Calibration for other liquids and frequencies upon request.
Frequency	: 10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	: ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	: $10\mu\text{W/g}$ to $> 100\text{ mW/g}$; Linearity: ± 0.2 dB(noise: typically $< 1\mu\text{W/g}$)
Dimensions	: Overall length: 337 mm (Tip length: 20 mm) Tip diameter: 2.5 mm (Body diameter: 12 mm) Distance from probe tip to dipole centers: 1 mm
Application	: High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%



EX3DV4 E-Field Probe

NOTE:

1. The Probe parameters have been calibrated by the SPEAG. Please reference “APPENDIX C” for the Calibration Certification Report.

10.2 ELI Phantom

Construction	: Phantom for compliance testing of handheld and bodymounted 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.
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ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure



ELI Phantom

Shell Thickness	: 2.0 mm $\pm$ 0.1 mm
Dimensions	: Major axis : 600 mm Minor axis : 400 mm

10.3 Device Holder

Construction: : In combination with the Twin SAM PhantomV4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device Holder

11 SAR Measurement Procedures

11.1 Normal SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 1.4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2 and 3: Area Scan & Zoom Scan Procedures

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

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1 g and 10 g.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1. SAR drift shall be kept within $\pm 5\%$ and if it without $\pm 5\%$, SAR retest according to measurement procedure step 1~4.

< Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04 >

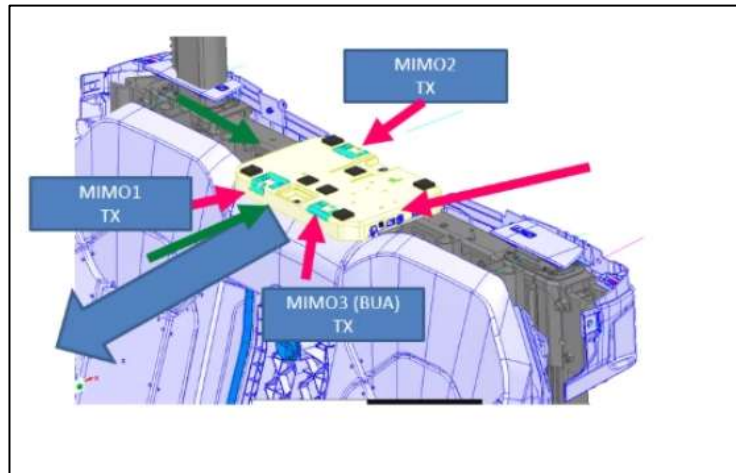
			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm $\pm$ 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm $\pm$ 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			$30^{\circ} \pm 1^{\circ}$	$20^{\circ} \pm 1^{\circ}$
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ 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: Δx_{Zoom} , Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

12 Definition of Reference^{*}

12.1 Other consumer electronic devices

The exposure conditions of transmitters and modules incorporated in certain consumer electronic devices, such as printers, cameras, and camcorders may vary according to the installation and operating configurations required by the host products. Details of the transmitter and antenna configurations, antenna to user test separation distance, device operating configurations, etc., are required to determine SAR test exclusion or SAR measurement requirements for each host product. When SAR tests are required, a KDB inquiry is recommended to confirm the test setup. Unless the transmitter is used in a specific/dedicated host device, the standalone and simultaneous transmission SAR procedures for transmitters and modules should be applied. These must be fully explained in the permissive change documentation or equipment approval filing, whichever is applicable.

“Intended use distance” specified by the manufacturer: When there is no regulatory requirement, the intended use condition or distance specified by the manufacturer shall be used. This information shall be acquired from the user documentation accompanying the DUT. This device is mounted on the vehicle, and the physical distance from the device is 45mm. By manufacturer declaration, the test distance is 45mm. Testing of all six faces of the DUT might not be required; justification shall be provided when omitting testing of some faces. The SAR was tested only in two positions, the Front and Right Edge.



- The data marked ^{*} in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(^{*}) provided by the customer.

13 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig 1. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within $\pm 10\%$ from the target SAR values. These tests were done at 3500 / 3700 / 3900 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1. (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was in the range $(22 \pm 2)^\circ \text{C}$, the relative humidity was in the range $(55 \pm 5) \% \text{ R.H}$ and the liquid depth above the ear reference points was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (frequency $\leq 3 \text{ GHz}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (frequency $> 3 \text{ GHz}$) in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

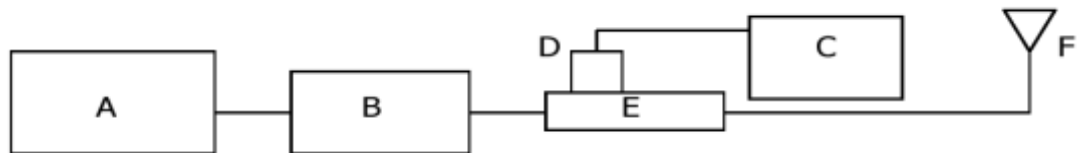


Fig 1. The microwave circuit arrangement used for SAR system verification

- A. Signal Generator
- B. RF Amplifier
- C. Power Meter
- D. Power Sensor
- E. Dual Directional Coupler
- F. Reference dipole Antenna



Photo of the dipole Antenna

SAR System Verification

Dipole Validation Kits		Probe S/N	Freq. (MHz)	Input Power (W)	Target SAR values (W/Kg)	1 W normalized Measured SAR (W/Kg)	SAR Deviation (%)	Date	Temperature (°C)	
Model	S/N				1g	1g	1g		Ambient	Liquid
D3500V2	1058	7412	3 500	0.10	65.30	63.70	-2.45	2025-01-10	21.9	21.5
D3500V2	1058	7412	3 500	0.10	65.30	62.90	-3.68	2025-01-16	22.0	21.5
D3500V2	1058	7412	3 500	0.10	65.30	63.00	-3.52	2025-01-17	21.7	21.4
D3700V2	1005	7412	3 700	0.10	65.70	69.10	5.18	2025-01-06	22.1	21.5
D3700V2	1005	7412	3 700	0.10	65.70	65.60	-0.15	2025-01-20	22.2	21.6
D3900V2	1036	7412	3 900	0.10	68.00	65.40	-3.82	2025-01-07	22.4	21.2
D3900V2	1036	7412	3 900	0.10	68.00	66.20	-2.65	2025-01-21	22.3	21.5

Table 1 Results system verification

14 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Speag Model DAK-3.5 in conjunction with Keysight E5063A Network Analyzer by using a procedure.

Freq. (MHz)	Target Value		Measure Value		Deviation (%)		Date	Liquid Temperature (°C)
	Permittivity	Conductivity (S/m)	Permittivity	Conductivity (S/m)	Permittivity	Conductivity (S/m)		
3 500*	37.90	2.91	38.958	2.819	2.79	-3.13	2025-01-10	21.5
3 500.01	37.90	2.91	38.958	2.819	2.79	-3.13		
3 500*	37.90	2.91	37.770	2.947	-0.34	1.27	2025-01-16	21.5
3 500.01	37.90	2.91	37.770	2.947	-0.34	1.27		
3 500*	37.90	2.91	36.886	2.881	-2.68	-1.00	2025-01-17	21.4
3 500.01	37.90	2.91	36.886	2.881	-2.68	-1.00		
3 700*	37.70	3.12	36.693	3.087	-2.67	-1.06	2025-01-06	21.5
3 624.99	37.70	3.12	36.859	3.017	-2.23	-3.30		
3 700*	37.70	3.12	38.111	3.056	1.09	-2.05	2025-01-20	21.6
3 750.00	37.70	3.12	37.927	3.101	0.60	-0.61		
3 900*	37.50	3.33	37.228	3.483	-0.73	4.59	2025-01-07	21.2
3 840.00	37.50	3.33	37.343	3.415	-0.42	2.55		
3 900*	37.50	3.33	37.646	3.278	0.39	-1.56	2025-01-21	21.5
3 840.00	37.50	3.33	37.742	3.215	0.65	-3.45		

Note: The data marked (*) in this table was Permittivity/Conductivity results of Verification

The brain mixtures consist of a viscous gel using hydroxethylcellulose(HEC) gelling agent and saline solution. Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation. The dielectric properties of the liquid material required to fill the phantom shell shall be target. For 3.4 to 10.0 GHz, the tests were done with using stimulating liquid made by SPEAG.

Frequency (MHz)	450	835	900	1800-2000	2450	2600
Tissue Type	Body					
Ingredient (% by weight)						
Water	38.91	40.29	40.29	55.24	45.0	45.0
Salt (NaCl)	3.79	1.38	1.38	0.31	0	0
Sugar	56.93	57.90	57.90	0	0	0
HEC	0.25	0.24	0.24	0	0	0
Bactericide	0.12	0.18	0.18	0	0	0
Triton X-100	0	0	0	0	0	0
DGBE	0	0	0	44.45	55.0	55.0
Tissue parameter target by IEEE 1528-2013						
Dielectric Constant	43.5	41.5	41.5	40.0	39.2	39.0
Conductivity (S/m)	0.87	0.90	0.97	1.40	1.80	1.96
Salt: 99+% Pure Sodium Chloride Water: De-ionized, 16 M ⁺ resistivity				Sucrose: 98+% Pure Sucrose HEC: Hydroxyethyl Cellulose		
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]						

15 Justification for Extended SAR Dipole Calibrations

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20 % of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB publication 865664 D01V01r04:

3500V2_Head (SN : 1058)				
3500 MHz				
Measurement Date	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
2024-08-08	-24.101	0.86	51.13	0.20

3700V2_Head (SN : 1005)				
3700 MHz				
Measurement Date	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
2024-08-07	-23.443	3.71	47.28	-1.90

3900V2_Head (SN : 1036)				
3900 MHz				
Measurement Date	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
2024-08-05	-24.925	15.58	49.25	1.80

16 Instruments List

Test Platform	SPEAG DASY System				
Manufacture	SPEAG				
Description	SAR Test System				
Software Reference	DASY52: 52.10.4(1527) SEMCAD X: 14.6.14(7483)				
Equipment	Type	Serial Number	Cal Date	Cal Interval	Cal Due
Phantom	ELI Phantom	TP-1244	N/A	N/A	N/A
Verification Dipole	D3500V2	1058	2023-09-28	Biennial	2025-09-28
Verification Dipole	D3700V2	1005	2023-09-27	Biennial	2025-09-27
Verification Dipole	D3900V2	1036	2023-09-27	Biennial	2025-09-27
Dielectric Assessment Kit	DAK-3.5	1107	2024-05-21	Annual	2025-05-21
DAE	DAE3	567	2024-02-16	Annual	2025-02-16
E-Field Probe	EX3DV4	7412	2024-03-18	Annual	2025-03-18
Network Analyzer	E5063A	MY54706220	2025-01-08	Annual	2026-01-08
Power Meter	N1914A	MY56120017	2024-06-03	Annual	2025-06-03
Power Meter	E4416A	GB41292123	2024-06-10	Annual	2025-06-10
Power Sensor	E9300H	MY41495307	2024-04-17	Annual	2025-04-17
Power Sensor	E9300H	MY41495314	2024-04-17	Annual	2025-04-17
Power Sensor	N8481A	MY63190004	2024-07-05	Annual	2025-07-05
Power Sensor	N8481A	MY63190005	2024-07-05	Annual	2025-07-05
Signal Generator	SMBV100A	262093	2024-05-14	Annual	2025-05-14
RF Amplifier	AMP2027	10008	2024-03-07	Annual	2025-03-07
Dual Directional Coupler	772D	MY52180226	2024-03-05	Annual	2025-03-05
LP Filter	LA-60N	LF04	2024-03-05	Annual	2025-03-05
Digital Thermometer	SDT25	19041500179	2024-08-29	Annual	2025-08-29
Hygro-Thermometer	TE-201	TE-201-1	2024-05-29	Annual	2025-05-29
Attenuator	05AS102-K03	A1	2024-12-06	Annual	2025-12-06
Attenuator	05AS102-K20	A4	2024-12-06	Annual	2025-12-06
Attenuator	18N-20	21	2024-11-27	Annual	2025-11-27
Signal Analyzer	FSQ26	201057	2024-03-18	Annual	2025-03-18



17 FCC Power Measurement Procedures

The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5 % occurred, the tests were repeated.

18 Measured and Reported SAR

Per FCC KDB Publication 447498 D04v01, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

19 5G NR FR1*

19.1 5G NR FR1 Test Application

This device supports 5G NR FR1 Band n48, n77 and n78 is declared by the manufacturer used to configuration for frequency, SCS, Bandwidth, Target power, and etc. The RB Configuration was evaluated all using reference to SCS / Bandwidth / Modulation supported by Section 6.1-1 of TS38.521-1.

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to MPR is 3GPP TS38.101-1 Section 6.2.2.

NR test was evaluated under Maximum power in NR single mode. In NR standalone mode, NR power states in the highest power, and the SAR measurement is determined by measuring LTE and 5G NR respectively.

5G NR Band	Mode	SCS (kHz)	Bandwidth (MHz)	Waveform	UL Modulation	RB Configuration	EN-DC (LTE Band)
n48	SA	30	20, 30, 40	CP OFDM	QPSK	Inner 1RB left	-
n77	SA	30	20, 30, 40, 50, 60, 70, 80, 90, 100		16QAM	Inner 1RB Right	-
n78	SA	30	20, 30, 40, 50, 60, 70, 80, 90, 100		64QAM	Inner Full	-
n77 Diversity	SA	30	20, 30, 40, 50, 60, 70, 80, 90, 100	DFT-s-OFDM / CP OFDM	Pi/2 BPSK QPSK 16QAM 64QAM 256QAM	Outer Full Edge 1RB Left Edge Full Left Edge 1RB Right Edge Full Right	-

- The data marked * in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(*) provided by the customer.

20 Maximum Output Power Specifications

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D04v01

5G NR Maximum Power

Mode	Maximum / Normal	Maximum / Normal Output Power (dBm)
5G NR n48	Maximum	21.00
	Normal	20.00
5G NR n77	Maximum	25.00
	Normal	23.00
5G NR n77 DoD	Maximum	25.00
	Normal	23.00
5G NR n77 Diversity	Maximum	26.50
	Normal	25.00
5G NR n77 Diversity DoD	Maximum	26.50
	Normal	25.00
5G NR n78	Maximum	25.00
	Normal	23.00
5G NR n78 DoD	Maximum	25.00
	Normal	23.00

21 RF Conducted Power Measurement

21.1 5G NR

According to October 2020 TCB Workshop Guidance, NR FR1 SAR evaluations are being generally based on adapting the existing LTE SAR procedures (FCC KDB 941225 D05V02r05). Therefore, NR SAR for the lower bandwidths was not required for testing based on the measured output power and the reported NR SAR for the highest bandwidth.

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS38.521-1 specification.

The allowed Maximum Power Reduction(MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS38.521-1.

The allowed A-MPR values specified Table 6.2.3.3.1-1 of 3GPP TS38.521-1 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”

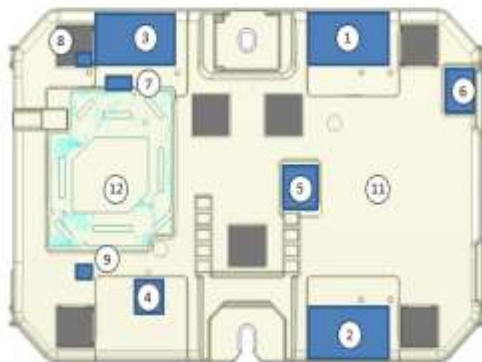
Uplink RB allocations were used to Table 6.1-1 of the 3GPP TS38.521-1.

22 RF Conducted Power

- Refer to Appendix E.

23 DUT Antenna Locations*

Rear View



No.	Antenna	TX	Band
1	MIMO1	O	2G, 3G, LTE NR below 3GHz
2	MIMO2	O	LTE, NR above 3GHz
3	MIMO3	O	2G, 3G, LTE NR below 3GHz
4	Wi-Fi1	O	BT LE / <u>WiFi</u> 1
5	Wi-Fi2	O	<u>WiFi</u> 2
6	Wi-Fi3	O	<u>WiFi</u> 3
7	Wi-Fi4	O	<u>WiFi</u> 4

<The Distance information of Antenna to Edges of Car Telematics Modem>

- The data marked * in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(*) provided by the customer.

24 SAR Test Exclusion Applied

Based on the maximum tune-up tolerance limit of WLAN, BT and the antenna to use separation distance, Table “Exempt” SAR was not required and Table “Measure” SAR was required.

The threshold power for frequency bands below 6 GHz was calculated with the SAR-based Exemption formula shown in 447498 D04.

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

The threshold power for frequency bands above 6 GHz has been calculated by the formula in Table b.1 of 447498 D04.

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R ²
1.34	–	30	35.6 m	–	1.6 m	3,450 R ² /f ²
30	–	300	1.6 m	–	159 mm	3.83 R ²
300	–	1,500	159 mm	–	31.8 mm	0.0128 R ² f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R ²
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

WLAN Ant	Frequency (GHz)	ERP		Distance (mm)		Power Threshold (mW)		SAR Exemption	
		dBm	mw	Front	Right Edge	Front	Right Edge	Front	Right Edge
WLAN 2.4GHz Ant3	2.462	6.75	4.73	45	45	178.97	178.97	Exempt	Exempt
WLAN 2.4GHz Ant4	2.462	8.25	6.68	45	45	178.97	178.97	Exempt	Exempt
WLAN 2.4GHz MIMO	2.462	13.37	21.73	45	45	178.97	178.97	Exempt	Exempt
WLAN 5GHz Ant3	5.825	6.25	4.22	45	45	135.41	135.41	Exempt	Exempt
WLAN 5GHz Ant4	5.825	8.85	7.67	45	45	135.41	135.41	Exempt	Exempt
WLAN 5GHz MIMO	5.825	13.51	22.44	45	45	135.41	135.41	Exempt	Exempt
WLAN 6GHz Ant3	6.855	3.35	2.16	45	45	38.88	38.88	Exempt	Exempt
WLAN 6GHz MIMO	6.855	6.54	4.51	45	45	38.88	38.88	Exempt	Exempt
BT LE	2.480	5.91	3.90	45	45	178.55	178.55	Exempt	Exempt



25 SAR Data Summary

25.1 SAR data

5G NR n48 Ant1+2 Body SAR									Ambient Temperature (°C)		22.1				
									Liquid Temperature (°C)		21.5				
									Date		2025-01-06				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	CP-OFDM	QPSK	30	40	3 624.99	641666	1	1	N/A	45	21.00	0.011	21.00	1.000	0.011
Front	CP-OFDM	QPSK	30	40	3 624.99	641666	53	26	N/A	45	20.93	0.010	21.00	1.016	0.010
Right Edge	CP-OFDM	QPSK	30	40	3 624.99	641666	1	1	N/A	45	21.00	0.023	21.00	1.000	0.023
Right Edge	CP-OFDM	QPSK	30	40	3 624.99	641666	53	26	N/A	45	20.93	0.025	21.00	1.016	0.025

5G NR n77 PC2 Ant1+2 Body SAR									Ambient Temperature (°C)		22.4				
									Liquid Temperature (°C)		21.2				
									Date		2025-01-07				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	CP-OFDM	QPSK	30	100	3 840.00	656000	1	1	N/A	45	23.13	0.029	25.00	1.538	0.045
Front	CP-OFDM	QPSK	30	100	3 840.00	656000	135	68	N/A	45	23.09	0.024	25.00	1.552	0.037
Right Edge	CP-OFDM	QPSK	30	100	3 840.00	656000	1	1	N/A	45	23.13	0.060	25.00	1.538	0.092
Right Edge	CP-OFDM	QPSK	30	100	3 840.00	656000	135	68	N/A	45	23.09	0.057	25.00	1.552	0.088

5G NR n77 PC2 DoD Ant1+2 Body SAR									Ambient Temperature (°C)		21.9				
									Liquid Temperature (°C)		21.5				
									Date		2025-01-10				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	CP-OFDM	QPSK	30	100	3 500.01	633334	1	1	N/A	45	23.08	0.006	25.00	1.556	0.009
Front	CP-OFDM	QPSK	30	100	3 500.01	633334	135	68	N/A	45	23.01	0.007	25.00	1.581	0.011
Right Edge	CP-OFDM	QPSK	30	100	3 500.01	633334	1	1	N/A	45	23.08	0.024	25.00	1.556	0.037
Right Edge	CP-OFDM	QPSK	30	100	3 500.01	633334	135	68	N/A	45	23.01	0.022	25.00	1.581	0.035



5G NR n77 Diversity Ant1+2 Body SAR									Ambient Temperature (°C)		22.3				
									Liquid Temperature (°C)		21.5				
									Date		2025-01-21				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	DFT-s-OFDM	QPSK	30	100	3 840.00	656000	1	1	N/A	45	24.84	0.038	26.50	1.466	0.056
Front	DFT-s-OFDM	QPSK	30	100	3 840.00	656000	135	67	N/A	45	24.66	0.036	26.50	1.528	0.055
Right Edge	DFT-s-OFDM	QPSK	30	100	3 840.00	656000	1	1	N/A	45	24.84	0.069	26.50	1.466	0.101
Right Edge	DFT-s-OFDM	QPSK	30	100	3 840.00	656000	135	67	N/A	45	24.66	0.059	26.50	1.528	0.090

5G NR n77 Diversity DoD Ant1+2 Body SAR									Ambient Temperature (°C)		22.0, 21.7				
									Liquid Temperature (°C)		21.5, 21.4				
									Date		2025-01-16, 2025-01-17				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	DFT-s-OFDM	QPSK	30	100	3 500.01	633334	1	1	N/A	45	24.88	0.008	26.50	1.452	0.012
Front	DFT-s-OFDM	QPSK	30	100	3 500.01	633334	135	67	N/A	45	24.79	0.014	26.50	1.483	0.021
Right Edge	DFT-s-OFDM	QPSK	30	100	3 500.01	633334	1	1	N/A	45	24.88	0.034	26.50	1.452	0.049
Right Edge	DFT-s-OFDM	QPSK	30	100	3 500.01	633334	135	67	N/A	45	24.79	0.034	26.50	1.483	0.050

5G NR n78 Ant1+2 Body SAR									Ambient Temperature (°C)		22.2				
									Liquid Temperature (°C)		21.6				
									Date		2025-01-20				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	CP-OFDM	QPSK	30	100	3 750.00	650000	1	1	N/A	45	23.42	0.030	25.00	1.439	0.043
Front	CP-OFDM	QPSK	30	100	3 750.00	650000	135	68	N/A	45	23.11	0.024	25.00	1.545	0.037
Right Edge	CP-OFDM	QPSK	30	100	3 750.00	650000	1	1	N/A	45	23.42	0.046	25.00	1.439	0.066
Right Edge	CP-OFDM	QPSK	30	100	3 750.00	650000	135	68	N/A	45	23.11	0.046	25.00	1.545	0.071



5G NR n78 DoD Ant1+2 Body SAR									Ambient Temperature (°C)		22.0, 21.7				
									Liquid Temperature (°C)		21.5, 21.4				
									Date		2025-01-16, 2025-01-17				
Position	Waveform	Mod.	SCS (kHz)	BW (MHz)	Freq. (MHz)	Ch.	RB Size	RB Offset	Sensor State (Grip)	Space (mm)	Measure Power (dBm)	Measure 1 g SAR (W/kg)	Tune-Up Limit (dBm)	Power Scaling Factor	Scaling 1 g SAR (W/kg)
Front	CP-OFDM	QPSK	30	100	3 500.01	633340	1	1	N/A	45	23.44	0.014	25.00	1.432	0.020
Front	CP-OFDM	QPSK	30	100	3 500.01	633340	135	68	N/A	45	23.24	0.015	25.00	1.500	0.023
Right Edge	CP-OFDM	QPSK	30	100	3 500.01	633340	1	1	N/A	45	23.44	0.021	25.00	1.432	0.030
Right Edge	CP-OFDM	QPSK	30	100	3 500.01	633340	135	68	N/A	45	23.24	0.023	25.00	1.500	0.035

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D04v01.
2. Liquid tissue depth was at least 15 cm for all frequencies.
3. All modes of operation were investigated, and worst-case results are reported.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
6. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D04v01.

5G NR Notes:

1. According to FCC guidance, SAR test for NR bands and LTE anchor Bands were performed separately due to limitations in SAR probe calibration factors. And, Due to test setup limitations, SAR testing for NR was performed using test mode software to establish the connection.
2. NR configurations of SAR test were determined according to Section 5.2 of KDB 941225 D05.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.
4. According to FCC guidance, NR modulations and RB sizes/offsets were selected for testing such that configurations with the highest output power were evaluated for SAR tests.
5. This device supports 5G FR1 capabilities with overlapping transmission frequency ranges. When the supported frequency range of an NR band falls completely within an NR band with a larger transmission frequency range, both NR bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both NR bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.
6. 5G NR n48, n77 and n78 MIMO only support CP-OFDM and 5G NR n77 Diversity support DFT-s-OFDM, CP-OFDM.
7. 5G NR n48, n77 and n78 is synchronized using maximum duty cycle of 100 %. SAR testing was performed using FTM mode with a 100 % duty cycle applied to match final duty cycle.

26 Simultaneous SAR Results

26.1 Simultaneous Scenario

Simultaneous scenario	WWAN	Bluetooth LE Ant1	WLAN 2.4/5/6GHz Ant3	WLAN 2.4/5GHz Ant4	WLAN 2.4/5/6GHz Ant1+2	WLAN 2.4/5/6GHz Ant1+3	WLAN 2.4/5GHz Ant1+4
1	O	X	X	X	X	X	X
2	O	O	X	X	X	X	X
3	O	X	O	X	X	X	X
4	O	X	X	O	X	X	X
5	O	X	X	X	O	X	X
6	O	X	X	X	X	O	X
7	O	X	X	X	X	X	O

26.2 Simultaneous SAR Results

Simultaneous Transmission SAR were calculated by TER through the formula of 447498 D04.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

ANT	Ant Gain (dB)							
	2.4GHz	5GHz				6GHz		
		UNII 1	UNII 2A	UNII 2C	UNII 3	UNII 5	UNII 6	UNII 7
WLAN Ant3	4.10	2.20	2.20	1.90	2.40	2.40	2.50	2.50
WLAN Ant4	2.90	5.00	5.00	5.00	5.00	-	-	-
WLAN Ant1+2	8.02	9.46	8.80	9.08	8.02	4.89	3.50	3.59
WLAN Ant1+3	6.43	7.60	7.15	7.74	7.20	5.64	4.64	4.84
WLAN Ant1+4	7.06	8.77	8.38	8.99	8.35	-	-	-
BT LE Ant1	5.06	-	-	-	-	-	-	-

ANT	ERP							
	2.4GHz	5GHz				6GHz		
		UNII 1	UNII 2A	UNII 2C	UNII 3	UNII 5	UNII 6	UNII 7
WLAN Ant3	9.45	6.05	6.05	5.75	6.25	3.25	3.35	3.35
WLAN Ant4	8.25	8.85	8.85	8.85	8.85	-	-	-
WLAN Ant1+2	13.37	13.31	12.65	12.93	11.87	5.74	4.35	4.44
WLAN Ant1+3	11.78	11.45	11.00	11.59	11.05	6.49	5.49	5.69
WLAN Ant1+4	12.41	12.62	12.23	12.84	12.20	-	-	-
BT LE Ant1	5.91	-	-	-	-	-	-	-

ANT	TER							
	2.4GHz	5GHz				6GHz		
		UNII 1	UNII 2A	UNII 2C	UNII 3	UNII 5	UNII 6	UNII 7
WLAN Ant3	0.049	0.030	0.030	0.028	0.031	0.054	0.056	0.056
WLAN Ant4	0.037	0.057	0.057	0.057	0.057	-	-	-
WLAN Ant1+2	0.121	0.158	0.136	0.145	0.114	0.096	0.070	0.071
WLAN Ant1+3	0.110	0.103	0.093	0.106	0.094	0.115	0.091	0.095
WLAN Ant1+4	0.097	0.135	0.123	0.142	0.123	-	-	-
BT LE Ant1	0.022	-	-	-	-	-	-	-



- WWAN+WLAN 2.4GHz / Position: Front

WWAN Configuration	SAR	SAR TER	WLAN 2.4GHz TER					Simultaneous TER (WWAN+WLAN2.4GHz)				
			Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4	Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4
5G NR n48 Ant1+2	0.011	0.007	0.049	0.037	0.121	0.110	0.097	0.056	0.044	0.128	0.117	0.104
5G NR n77 PC2 Ant1+2	0.045	0.028	0.049	0.037	0.121	0.110	0.097	0.077	0.065	0.149	0.138	0.125
5G NR n77 DoD PC2 Ant1+2	0.011	0.007	0.049	0.037	0.121	0.110	0.097	0.056	0.044	0.128	0.117	0.104
5G NR n77 Diversity Ant1+2	0.056	0.035	0.049	0.037	0.121	0.110	0.097	0.084	0.072	0.156	0.145	0.132
5G NR n77 Diversity DoD Ant1+2	0.021	0.013	0.049	0.037	0.121	0.110	0.097	0.062	0.050	0.134	0.123	0.110
5G NR n78 Ant1+2	0.043	0.027	0.049	0.037	0.121	0.110	0.097	0.076	0.064	0.148	0.137	0.124
5G NR n78 DoD Ant1+2	0.023	0.014	0.049	0.037	0.121	0.110	0.097	0.063	0.051	0.135	0.124	0.111

- WWAN+WLAN 2.4GHz / Position: Right Edge

WWAN Configuration	SAR	SAR TER	WLAN 2.4GHz TER					Simultaneous TER (WWAN+WLAN2.4GHz)				
			Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4	Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4
5G NR n48 Ant1+2	0.025	0.016	0.049	0.037	0.121	0.110	0.097	0.065	0.053	0.137	0.126	0.113
5G NR n77 PC2 Ant1+2	0.092	0.058	0.049	0.037	0.121	0.110	0.097	0.107	0.095	0.179	0.168	0.155
5G NR n77 DoD PC2 Ant1+2	0.037	0.023	0.049	0.037	0.121	0.110	0.097	0.072	0.060	0.144	0.133	0.120
5G NR n77 Diversity Ant1+2	0.101	0.063	0.049	0.037	0.121	0.110	0.097	0.112	0.100	0.184	0.173	0.160
5G NR n77 Diversity DoD Ant1+2	0.050	0.031	0.049	0.037	0.121	0.110	0.097	0.080	0.068	0.152	0.141	0.128
5G NR n78 Ant1+2	0.071	0.044	0.049	0.037	0.121	0.110	0.097	0.093	0.081	0.165	0.154	0.141
5G NR n78 DoD Ant1+2	0.035	0.022	0.049	0.037	0.121	0.110	0.097	0.071	0.059	0.143	0.132	0.119



- WWAN+WLAN 5GHz / Position: Front

WWAN Configuration	SAR	SAR TER	WLAN 5GHz TER					Simultaneous TER (WWAN+WLAN5GHz)				
			Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4	Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4
5G NR n48 Ant1+2	0.011	0.007	0.031	0.057	0.158	0.106	0.142	0.038	0.064	0.165	0.113	0.149
5G NR n77 PC2 Ant1+2	0.045	0.028	0.031	0.057	0.158	0.106	0.142	0.059	0.085	0.186	0.134	0.170
5G NR n77 DoD PC2 Ant1+2	0.011	0.007	0.031	0.057	0.158	0.106	0.142	0.038	0.064	0.165	0.113	0.149
5G NR n77 Diversity Ant1+2	0.056	0.035	0.031	0.057	0.158	0.106	0.142	0.066	0.092	0.193	0.141	0.177
5G NR n77 Diversity DoD Ant1+2	0.021	0.013	0.031	0.057	0.158	0.106	0.142	0.044	0.070	0.171	0.119	0.155
5G NR n78 Ant1+2	0.043	0.027	0.031	0.057	0.158	0.106	0.142	0.058	0.084	0.185	0.133	0.169
5G NR n78 DoD Ant1+2	0.023	0.014	0.031	0.057	0.158	0.106	0.142	0.045	0.071	0.172	0.120	0.156

- WWAN+WLAN 5GHz / Position: Right Edge

WWAN Configuration	SAR	SAR TER	WLAN 5GHz TER					Simultaneous TER (WWAN+WLAN5GHz)				
			Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4	Ant3	Ant4	Ant1+2	Ant1+3	Ant1+4
5G NR n48 Ant1+2	0.025	0.016	0.031	0.057	0.158	0.106	0.142	0.047	0.073	0.174	0.122	0.158
5G NR n77 PC2 Ant1+2	0.092	0.058	0.031	0.057	0.158	0.106	0.142	0.089	0.115	0.216	0.164	0.200
5G NR n77 DoD PC2 Ant1+2	0.037	0.023	0.031	0.057	0.158	0.106	0.142	0.054	0.080	0.181	0.129	0.165
5G NR n77 Diversity Ant1+2	0.101	0.063	0.031	0.057	0.158	0.106	0.142	0.094	0.120	0.221	0.169	0.205
5G NR n77 Diversity DoD Ant1+2	0.050	0.031	0.031	0.057	0.158	0.106	0.142	0.062	0.088	0.189	0.137	0.173
5G NR n78 Ant1+2	0.071	0.044	0.031	0.057	0.158	0.106	0.142	0.075	0.101	0.202	0.150	0.186
5G NR n78 DoD Ant1+2	0.035	0.022	0.031	0.057	0.158	0.106	0.142	0.053	0.079	0.180	0.128	0.164



- WWAN+WLAN 6.5GHz / Position: Front

WWAN Configuration	SAR	SAR TER	WLAN 6.5GHz TER			Simultaneous TER (WWAN+WLAN6.5GHz)		
			Ant3	Ant1+2	Ant1+3	Ant3	Ant1+2	Ant1+3
5G NR n48 Ant1+2	0.011	0.007	0.062	0.096	0.115	0.069	0.103	0.122
5G NR n77 PC2 Ant1+2	0.045	0.028	0.062	0.096	0.115	0.090	0.125	0.143
5G NR n77 DoD PC2 Ant1+2	0.011	0.007	0.062	0.096	0.115	0.069	0.103	0.122
5G NR n77 Diversity Ant1+2	0.056	0.035	0.062	0.096	0.115	0.097	0.131	0.150
5G NR n77 Diversity DoD Ant1+2	0.021	0.013	0.062	0.096	0.115	0.075	0.110	0.128
5G NR n78 Ant1+2	0.043	0.027	0.062	0.096	0.115	0.089	0.123	0.142
5G NR n78 DoD Ant1+2	0.023	0.014	0.062	0.096	0.115	0.076	0.111	0.129

- WWAN+WLAN 6.5GHz / Position: Right Edge

WWAN Configuration	SAR	SAR TER	WLAN 6.5GHz TER			Simultaneous TER (WWAN+WLAN6.5GHz)		
			Ant3	Ant1+2	Ant1+3	Ant3	Ant1+2	Ant1+3
5G NR n48 Ant1+2	0.025	0.016	0.062	0.096	0.115	0.078	0.112	0.131
5G NR n77 PC2 Ant1+2	0.092	0.058	0.062	0.096	0.115	0.120	0.154	0.173
5G NR n77 DoD PC2 Ant1+2	0.037	0.023	0.062	0.096	0.115	0.085	0.120	0.138
5G NR n77 Diversity Ant1+2	0.101	0.063	0.062	0.096	0.115	0.125	0.160	0.178
5G NR n77 Diversity DoD Ant1+2	0.050	0.031	0.062	0.096	0.115	0.093	0.128	0.146
5G NR n78 Ant1+2	0.071	0.044	0.062	0.096	0.115	0.106	0.141	0.159
5G NR n78 DoD Ant1+2	0.035	0.022	0.062	0.096	0.115	0.084	0.118	0.137



- WWAN+BT / Position: Front

WWAN Configuration	SAR	SAR TER	BT TER	Simultaneous TER (WWAN+BT)
			Ant1	Ant1
5G NR n48 Ant1+2	0.011	0.007	0.022	0.029
5G NR n77 PC2 Ant1+2	0.045	0.028	0.022	0.050
5G NR n77 DoD PC2 Ant1+2	0.011	0.007	0.022	0.029
5G NR n77 Diversity Ant1+2	0.056	0.035	0.022	0.057
5G NR n77 Diversity DoD Ant1+2	0.021	0.013	0.022	0.035
5G NR n78 Ant1+2	0.043	0.027	0.022	0.049
5G NR n78 DoD Ant1+2	0.023	0.014	0.022	0.036

- WWAN+BT / Position: Right Edge

WWAN Configuration	SAR	SAR TER	BT TER	Simultaneous TER (WWAN+BT)
			Ant1	Ant1
5G NR n48 Ant1+2	0.025	0.016	0.022	0.037
5G NR n77 PC2 Ant1+2	0.092	0.058	0.022	0.079
5G NR n77 DoD PC2 Ant1+2	0.037	0.023	0.022	0.045
5G NR n77 Diversity Ant1+2	0.101	0.063	0.022	0.085
5G NR n77 Diversity DoD Ant1+2	0.050	0.031	0.022	0.053
5G NR n78 Ant1+2	0.071	0.044	0.022	0.066
5G NR n78 DoD Ant1+2	0.035	0.022	0.022	0.044

27 SAR Measurement Variability

27.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the power supply before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2. A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg ($\sim 10\%$ from the 1-g SAR limit).
3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

27.2 Measurement Uncertainty

a	c	d	e = f(d,k)	f	g	h =	i =	k
						cxg/e	cxg/e	
Uncertainty Component	Tol	Prob .	Div.	Ci	Ci	lg	lg	Vi
	(%)	Dist.		(1g)	(10g)	ui (%)	ui (%)	(Veff)
Probe calibration	6.55	N	1.00	1.00	1.00	6.55	6.55	∞
Axial Isotropy	4.70	R	1.73	0.71	0.71	1.92	1.92	∞
Hemispherical Isotropy	9.60	R	1.73	0.71	0.71	3.92	3.92	∞
Boundary Effects	2.00	R	1.73	1.00	1.00	1.15	1.15	∞
Linearity	4.70	R	1.73	1.00	1.00	2.71	2.71	∞
System Detection Limits	0.25	R	1.73	1.00	1.00	0.14	0.14	∞
Modulation Response	4.80	R	1.73	1.00	1.00	2.77	2.77	∞
Readout Electronics	0.30	N	1.00	1.00	1.00	0.30	0.30	∞
Response Time	0.80	R	1.73	1.00	1.00	0.46	0.46	∞
Integration Time	2.60	R	1.73	1.00	1.00	1.50	1.50	∞
RF Ambient Noise	3.00	R	1.73	1.00	1.00	1.73	1.73	∞
RF Ambient Reflections	3.00	R	1.73	1.00	1.00	1.73	1.73	∞
Probe Positioner mechanical tolerance	0.40	R	1.73	1.00	1.00	0.23	0.23	∞
Probe Positioning with respect to phantom shell	6.70	R	1.73	1.00	1.00	3.87	3.87	∞
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	4.00	R	1.73	1.00	1.00	2.31	2.31	∞
Test sample positioning	1.35/2.10	N	1.00	1.00	1.00	1.35	2.10	35
Device holder uncertainty	3.98/3.17	N	1.00	1.00	1.00	3.98	3.17	3
Output power variation - SAR drift measurement	5.00	R	1.73	1.00	1.00	2.89	2.89	∞
Phantom uncertainty	6.60	R	1.73	1.00	1.00	3.81	3.81	∞
Liquid conductivity-measurement	2.89	N	1.00	0.78	0.71	2.25	2.05	59
Liquid permittivity-measurement	2.47	N	1.00	0.23	0.26	0.57	0.64	59
Liquid conductivity-temperature	1.65	R	1.73	0.78	0.71	0.74	0.68	20
Liquid permittivity – temperature	1.47	R	1.73	0.23	0.26	0.20	0.22	20
Combined standard uncertainty			RSS			12.40	12.24	281/660
Expanded uncertainty (95% CONFIDENCE INTERVAL)			k=2			24.80	24.48	



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28 Appendixes List

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Appendix C	Appendix C Photograph
Appendix D	Appendix D Probe, DAE and Dipole Calibration Certificates
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-THE END-