



DECLARATION OF COMPLIANCE SAR ASSESSMENT PCII Part 1 of 2 Report

Motorola Solutions Inc. EME Test Laboratory Motorola Solutions Malaysia Sdn Bhd Plot 2A, Medan Bayan Lepas, Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia.	Date of Report: 02/19/2025 Report Revision: A
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Responsible Engineer: Report Author: Date/s Tested: Test Location: Manufacturer: Manufacturer Location: DUT Description: Test TX mode(s): Max. Power output: Tx Frequency Bands: Signaling type: Model(s) Tested: Model(s) Certified: Serial Number(s): Classification: Firmware Version: Applicant Name: Applicant Address: FCC ID: FCC Test Firm Registration Number: IC: ISED Test Site registration:	Puteri Alifah Ilyana Binti Nor Rahim (EME Engineer) Puteri Alifah Ilyana Binti Nor Rahim (EME Engineer) 12/14/2024-12/16/2024, 12/18/2024-12/19/2024, 12/21/2024, 12/25/2024-12/27/2024, 12/29/2024-12/30/2024, 1/7/2025, 1/9/2025-1/12/2025, 1/16/2025, 2/18/2025-2/19/2025 Penang EME Laboratory Motorola Solutions Malaysia Sdn Bhd. Plot 2A, Medan Bayan Lepas Mukim, 12 SWD, 11900 Bayan Lepas, Penang, Malaysia Handheld Portable – MXP600 350-470 ROM CLR MSPD(5:8), SSPD (1:4.55), Bluetooth, Bluetooth LE, WLAN 2.4GHz and WLAN 5.0GHz Refer table 3 Refer table 3 Refer table 3 AZH77PCN6TZ5AN Refer section 1.0 Introduction 767TAV3818, 767TAV3886, 767TAV3887, 767TAV3885 Occupational/Controlled Environment R55.000.9735 Motorola Solutions Inc. Plot 2A, Medan Bayan Lepas, Mukim 12 SWD, 11900 Bayan Lepas, Penang, Malaysia AZ489FT7150; This report contains results that are immaterial for FCC equipment approval, which are clearly identified. 823256 109U-89FT7150 This report contains results that are immaterial for ISED equipment approval, which are clearly identified. 24843
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The test results clearly demonstrate compliance with Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093 and RSS-102 (Issue 6).

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report (no deviation from standard methods). This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory. I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. The results and statements contained in this report pertain only to the device(s) evaluated.

Saw Sun Hock (Approval Signatory)
Approved Date: 02/21/2025

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Report Revision History

Date	Revision	Comments
02/19/2025	A	Initial release

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number AZH77PCN6TZ5AN. The information herein is to show evidence of Class II Permissive Change compliance based on the SAR evaluation of RF Power Amplifier changes. This device is classified as Occupational/Controlled Environment and models certified is listed as below:

Models	Hardware Version ID Number (HVIN)	Product Marketing Name (PMN)	Description
AZH77PCN6TZ5AN	AZH77PCN6TZ5AN	MXP600	MXP600 350-470 ROM CLR

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)	Max Calc at Head (W/kg)
		1g-SAR	1g-SAR	1g-SAR
TNF	450-470 (LMR)	3.63 ⁽¹⁾	0.53 ⁽²⁾	3.85 ⁽³⁾
*DSS	2402-2480 (BT/BT LE)	NA	NA	NA
DTS	2412-2462 (WLAN 2.4GHz)	0.089	0.037	0.351
NII	5180-5825 (WLAN 5GHz)	0.569	0.107	0.727
Simultaneous Results		4.20 ⁽⁴⁾	0.64 ⁽⁵⁾	4.58 ⁽⁶⁾

Note:

- (1) New highest SAR result for Body is 3.63 W/kg compared with previous on filed SAR result is 3.44 W/kg
- (2) New highest SAR result for Face is 0.53 W/kg compared with previous on filed SAR result is 0.43 W/kg
- (3) New highest SAR result for Head is 3.85 W/kg compared with previous on filed SAR result is 3.50 W/kg
- (4) New highest SAR result for Body is 4.20 W/kg compared with previous on filed SAR result is 4.01 W/kg
- (5) New highest SAR result for Face is 0.64 W/kg compared with previous on filed SAR result is 0.54 W/kg
- (6) New highest SAR result for Head is 4.58 W/kg compared with previous on filed SAR result is 4.23 W/kg
- * Results not required per KDB (refer to sections 13.7 and 14.0)

3.0 Abbreviations / Definitions

- BT: Bluetooth
- CNR: Calibration Not Required
- CW: Continuous Wave
- DSP: Digital Signal Processor
- DSS: Direct Spread Spectrum
- DUT: Device Under Test
- EME: Electromagnetic Energy

FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
LMR: Land Mobile Radio
LTE: Long Term Evolution
NA: Not Applicable
PSM: Public Safety Microphone
PTT: Push to Talk
RSM: Remote Speaker Microphone
SAR: Specific Absorption Rate
TDMA: Time Division Multiple Access
TNF: Licensed Non-Broadcast Transmitter Held to Face

Audio accessories: These accessories allow communication while the DUT is worn on the body.

Body worn accessories: These accessories allow the DUT to be worn on the body of the user.

Maximum Power: Defined as the upper limit of the production line final test station.

4.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C.: 1997.
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2019
- Ministry of Health (Canada) Safety Code 6 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 6) – Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
- ANATEL, Brazil Regulatory Authority, Resolution No 700 of September 28, 2018 "Approves the Regulation on the Assessment of Human Exposure to Electric, Magnetic and Electromagnetic Fields Associated with the Operation of Radio communication Transmitting Stations.
- IEC/IEEE 62209-1528-2020- Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)

- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r03
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- FCC KDB – 447498 D01 General RF Exposure Guidance v06
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02r02

5.0 SAR Limits

Table 2

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average - ANSI - (averaged over the whole body)	0.08	0.4
Spatial Peak - ANSI - (averaged over any 1-g of tissue)	1.6	8.0
Spatial Peak – ICNIRP/ANSI - (hands/wrists/feet/ankles averaged over 10-g)	4.0	20.0
Spatial Peak - ICNIRP - (Head and Trunk 10-g)	2.0	10.0

6.0 Description of Device Under Test (DUT)

This portable device operates in dispatch, phone and packet data modes. It uses one digital technology: Time Division Multiple Access (TDMA). This device also contains WLAN technology for data capabilities and Bluetooth technology for short range wireless devices.

The TDMA technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. The radios can be used by transmitting Multi Slot Packed Data (MSPD) with 5:8 (62.5%) duty cycle and Single Slot Packed Data (SSPD) with 1:4.55 (22%) duty cycle at maximum transmit power.

This device also incorporates a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 77.0% and BT LE is 63.0%.

WLAN 2.4GHz 802.11 b/g/n operate using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM). WLAN 5 GHz 802.11 a/n/ac operates using Orthogonal Frequency-Division Multiplexing (OFDM).

The intended operating positions are “against the head” in the phone mode, “in front of the face” in PTT mode with front/back of the DUT at least 2.5 cm from the mouth, and “against the body” in data, phone or PTT mode by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio. Operation at the body without an audio accessory attached is possible by means of BT accessories.

Table 3 below summarizes the technologies, bands, maximum duty cycles and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 3

Radio Type	Band (MHz)	Transmission	Duty Cycle (%)	Conducted (Average Detector) Maximum Power (W)
LMR	350-470	MSPD	62.5	2.51
LMR	350-470	SSPD	22	3.00
BT	2402-2480	FHSS	77	0.0025
BT LE	2402-2480	FHSS	63	0.0025
WLAN 2.4GHz	2412-2462	802.11b/g/n	97	0.01778
WLAN 5GHz	5180-5825	802.11a/n/ac	97	0.0158 0.0100 (Channel 116)

7.0 Optional Accessories and Test Criteria

This device are offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in section 4.0 assess compliance of these devices. The following sections identify the test criteria and details for each accessory category applicable for this PCII filing only. Detail listing of all approved offered accessories available in the original filing report.

7.1 Antennas

There are two antennas applicable for this PCII filing. The Table below lists its descriptions.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	PMAE4022B	DMR UHF Whip Antenna (380-480MHz)	Yes	Yes
2	AN000395A01	Antenna, Chip, Chip Ceramic Antenna, GNSS, Dual Band WIFI. Dual Feed. 1560-1610MHz, 2400-2485MHz, 5150-5850MHz	Yes	Yes; only for WLAN

7.2 Batteries

There are three batteries applicable for this PCII filing. The Table below lists its descriptions.

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	PMNN4801A	Li-Ion IMPRES 2 IP68 1900T	Yes	Yes	Default battery for body testing
2	PMNN4802A	Li-Ion IMPRES 2 IP68 3400T	Yes	Yes	Default battery for face testing
3	PMNN4582A	Battery Pack , Batt Li-Ion IMPRES 2 IP68 2900T	Yes	Yes	

7.3 Body worn Accessory

There is only one body worn applicable for this PCII filing. The Table below lists its descriptions.

Table 6

Body worn No.	Body worn Models	Description	Selected for test	Tested	Comments
10	RLN4570A	Breakaway Chest Pack	Yes	Yes	

7.4 Audio Accessory

There is no audio applicable for this PCII filing.

8.0 Description of Test System

DASY5™ Test System



8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 7

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.10.4.1527	DAE4	EX3DV4 (E-Field)

The **DASY5™ system** are operated per the instructions in the **DASY5™ system Users Manual**. The complete manual is available directly from SPEAG™. All measurement equipment used to assess SAR compliance was calibrated according to ISO/IEC 17025 A2LA guidelines. Section 9.0 presents additional test equipment information. Appendices B and C present the applicable calibration certificates.

8.2 Description of Phantom(s)

Table 8

Phantom Type	Phantom(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Triple Flat	NA	200MHz -6GHz; Er = 3-5, Loss Tangent = ≤ 0.05	280x175x175	2mm +/- 0.2mm	Wood	< 0.05
SAM	√	300MHz -6GHz; Er = < 5, Loss Tangent = ≤ 0.05	Human Model			
Oval Flat	√	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤ 0.05	600x400x190			

8.3 Description of Simulated Tissue

The sugar based simulate tissue is produced by placing the correct measured amount of De-ionized water into a large container. Each of the dried ingredients are weighed and added to the water carefully to avoid clumping. If the solution has a high sugar concentration the water is pre-heated to aid in dissolving the ingredients.

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 10. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (percent by mass)

Table 9

Ingredients	450MHz	2450MHz ⁽¹⁾	5GHz ⁽¹⁾
Sugar	56.0	NA	NA
Diacetin	0	NA	NA
De ionized –Water	39.1	NA	NA
Salt	3.8	NA	NA
HEC	1.0	NA	NA
Bact.	0.1	NA	NA

Note: ⁽¹⁾ SPEAG provides Motorola proprietary stimulant ingredients for the 2.4 GHz and 5 GHz bands

9.0 Additional Test Equipment

The Table below lists additional test equipment used during the SAR assessment.

Table 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
SPEAG PROBE	EX3DV4	7882	06/25/24	06/25/27
SPEAG PROBE	EX3DV4	7511	7/23/2024	7/23/2027
SPEAG DAE	DAE4	850	04/14/22	04/14/25
SPEAG DAE	DAE4	1294	12/8/2023	12/8/2026
AMPLIFIER	10W1000C	312859	CNR	CNR
AMPLIFIER	5S1G4	313326	CNR	CNR
AMPLIFIER	5S4G11	312663	CNR	CNR
SIGNAL GENERATOR	E4438C	MY45091093	08/17/24	08/17/25
POWER METER	E4416A	MY50001037	09/06/24	09/06/25
POWER METER	E4419B	MY45103725	07/18/24	07/18/25
POWER METER	E4418B	GB40206480	1/15/2024	1/15/2025 *
POWER METER	E4419B	GB42420608	12/19/2024	12/19/2025
POWER SENSOR	E4412A	MY61050006	04/29/24	04/29/25
POWER SENSOR	E4412A	MY61060011	04/29/24	04/29/25
POWER SENSOR	E9301B	MY41495733	9/12/2024	9/12/2025
POWER SENSOR	E9301B	MY55210006	2/1/2024	2/1/2025 *
BI-DIRECTIONAL COUPLER	3020A	41935	08/20/24	08/20/25
BI-DIRECTIONAL COUPLER	3024	61136	08/05/24	08/05/25
POWER SOURCE	SE UMS 160 CA	4251	04/02/24	04/02/25
DIGITAL THERMOMETER	1523	3492108	01/23/24	01/23/25 *
THERMOMETER	HH806AU	080307	08/10/24	08/10/25
THERMOMETER	HH202A	35881	01/17/24	01/17/25 *
TEMPERATURE PROBE	PR-10L-4-100-1/4-6-BX	WNWR037791	01/26/24	01/26/25 *
TEMPERATURE PROBE	80PK-22	06032017	10/16/24	10/16/25
TEMPERATURE PROBE	80PK-22	05032017	12/28/23	12/28/24 *
DATA LOGGER	DSB	16398050	09/07/24	09/07/25
DATA LOGGER	DSB	16326820	12/08/24	12/08/25
DATA LOGGER	DSB	16326831	12/08/24	12/08/25
DATA LOGGER	DSB	16398306	12/31/23	12/31/24 *
DIELECTRIC ASSESSMENT KIT	DAK-3.5	1156	04/08/24	04/08/25
NETWORK ANALYZER	E5071B	MY42403147	06/06/24	06/06/25
SPEAG DIPOLE	D450V3	1054	07/16/24	07/16/27
SPEAG DIPOLE	D450V3	1053	02/17/22	02/17/25 *
SPEAG DIPOLE	D2450V2	782	07/16/24	07/16/27
SPEAG DIPOLE	D5GHzV2	1022	04/11/24	04/11/27

Note: “*” Equipment used for test dates prior to equipment calibration due date.

10.0 SAR Measurement System Validation and Verification

DASY output files of the probe/dipole calibration certificates and system verification test results are included in appendices B, C & D respectively.

10.1 System Validation

The SAR measurement system was validated according to procedures in KDB 865664. The validation status summary Table is below.

Table 11

Dates	Probe Calibration Point	Probe SN	Measured Tissue Parameters		Validation			
			σ	ϵ_r	Sensitivity	Linearity	Isotropy	
CW								
7/9/2024	Head	450	7882	0.85	42.18	Pass	Pass	Pass
11/29/2024		2450	7511	1.78	41.48	Pass	Pass	Pass
2/19/2025		5250		4.38	38.82	Pass	Pass	Pass
7/11/2024		2450		7882	1.86	38.84	Pass	Pass
7/11/2024		5250	4.47		33.59	Pass	Pass	Pass
7/11/2024		5500	4.73		33.15	Pass	Pass	Pass
7/14/2024		5600	4.97		34.13	Pass	Pass	Pass
7/14/2024		5800	5.20		33.76	Pass	Pass	Pass
WLAN								
11/29/2024	Head	2450	7511	1.88	41.04	Pass	Pass	Pass
2/19/2025		5250		4.38	38.82	Pass	Pass	Pass
7/15/2024		2450	7882	1.84	38.68	Pass	Pass	Pass
7/15/2024		5250		4.51	35.06	Pass	Pass	Pass
7/15/2024		5500		4.78	34.64	Pass	Pass	Pass
7/16/2024		5600		4.89	34.48	Pass	Pass	Pass
7/16/2024		5800		5.11	34.14	Pass	Pass	Pass

10.2 System Verification

System verification checks were conducted each day during the SAR assessment. The results are normalized to 1W. Appendix D includes DASY plots with the largest deviation from the qualified source SAR target for each dipole (Bold). The Table below summarizes the daily system check results used for the SAR assessment.

Table 12

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date	Deviation (%)
7882	IEEE/IEC Head	SPEAG D450V3 / 1054	4.64 ± 10%	1.24	4.96	12/14/2024@	6.9
				1.27	5.08	12/15/2024@	9.5
				1.05	4.20	12/18/2024	-9.5
		SPEAG D450V3 / 1053	4.60 ± 10%	1.14	4.56	1/9/2025	-0.9
		SPEAG D2450V2 / 782	52.80 ± 10%	1.69	53.48	2/17/2025	1.3
		SPEAG D5250V2 / 1022	79.10 ± 10%	7.39	73.90	12/19/2024	-6.6
				7.15	71.50	12/26/2024	-9.6
				7.49	74.90	12/27/2024	-5.3
				7.95	79.50	12/29/2024	0.5
				7.59	75.90	1/7/2025	-4.0
		SPEAG D5500V2 / 1022	85.80 ± 10%	8.91	89.10	1/6/2025@	3.8
		SPEAG D5600V2 / 1022	81.90 ± 10%	7.60	76.00	12/25/2024	-7.2
				7.60	76.00	1/10/2025@	-7.2
		SPEAG D5800V2 / 1022	79.70 ± 10%	7.38	73.80	12/20/2024@	-7.4
				7.29	72.90	12/27/2024	-8.5
				7.80	78.00	12/30/2024	-2.1
				7.93	79.30	1/10/2025@	-0.5
				7.71	77.10	1/10/2025@	-3.3
				7.72	77.20	1/11/2025@	-3.1

Table 12 (Continued)

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date	Deviation (%)
7511	IEEE/IEC Head	SPEAG D2450V2 / 782	52.80 ± 10%	1.68	53.16	12/14/2024	0.7
				1.61	50.95	12/15/2024@	-3.5
		SPEAG D5250V2 / 1022	79.10 ± 10%	7.63	76.30	2/19/2025	-3.5

Note: '@' indicates that system verification check covers next test day

10.3 Equivalent Tissue Test Results

Simulated tissue prepared for SAR measurements is measured daily and within 24 hours prior to actual SAR testing to verify that the tissue is within +/- 5% of target parameters at the center of the transmit band. This measurement is done using the applicable equipment indicated in section 9.0. The Table below summarizes the measured tissue parameters used for the SAR assessment.

Table 13

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
406	IEEE/IEC Head	0.87 (0.83-0.91)	44.0 (41.8-46.2)	0.859	43.320	12/18/2024
416.3		0.87 (0.83-0.91)	43.9 (41.7-46.1)	0.867	43.358	12/16/2024@
		0.868	43.073	12/18/2024		
430		0.87 (0.83-0.91)	43.7 (41.6-45.9)	0.879	43.032	12/16/2024@
		0.880	42.772	12/18/2024		
450		0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.889	44.477	12/14/2024
				0.889	44.477	12/15/2024@
				0.896	42.607	12/16/2024@
				0.897	42.341	12/18/2024
460		0.87 (0.83-0.91)	43.4 (41.3-45.6)	0.856	43.006	1/9/2025
				0.898	44.264	12/15/2024@
				0.904	42.383	12/16/2024@
470		0.87 (0.83-0.91)	43.4 (41.2-45.6)	0.865	42.809	1/9/2025
				0.907	44.044	12/15/2024@
				0.913	42.183	12/16/2024@

Table 13 (Continued)

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
2412	IEEE/ IEC Head	1.77 (1.59-1.94)	39.3 (35.3-43.2)	1.882	41.141	12/14/2024
				1.856	41.175	12/15/2024
				1.757	40.620	12/16/2024@
2437		1.79 (1.61-1.97)	39.2 (35.3-43.1)	1.899	41.025	12/14/2024
				1.876	41.130	12/15/2024
				1.776	40.572	12/16/2024@
				1.826	41.632	2/17/2025@
2450		1.80 (1.62-1.98)	39.2 (35.3-43.1)	1.904	40.952	12/14/2024
				1.886	41.106	12/15/2024@
				1.787	40.543	12/16/2024@
				1.837	41.611	2/17/2025@
2462		1.81 (1.63-1.99)	39.2 (35.3-43.1)	1.909	40.901	12/14/2024
				1.796	40.513	12/16/2024@
				1.848	41.590	2/17/2025@
5250		4.71 (4.24-5.18)	36.0 (32.4-39.5)	4.286	36.245	12/18/2024@
				4.242	32.712	12/26/2024
				4.486	33.281	12/27/2024
	4.582			36.264	12/29/2024	
	4.245			36.444	1/7/2025	
	4.325			33.660	2/19/2025	
5260	4.72 (4.25-5.19)	35.9 (32.3-39.5)	4.440	33.526	12/19/2024@	
			4.251	32.692	12/26/2024	
5280	4.74 (4.27-5.21)	35.9 (32.3-39.5)	4.520	33.233	12/27/2024	
			4.615	32.216	12/29/2024	
5320	4.78 (4.30-5.26)	35.9 (32.3-39.5)	4.655	36.146	12/29/2024	
			4.319	36.364	1/7/2025	
			4.391	33.551	2/19/2025	
5500	4.97 (4.47-5.46)	35.7 (32.1-39.2)	4.676	32.518	12/25/2024	
			4.515	36.117	1/6/2025@	
			4.515	36.117	1/7/2025@	
			4.560	34.703	1/10/2025@	
5600	5.07 (4.56-5.58)	35.5 (32.0-39.1)	4.794	32.393	12/25/2024	
			4.673	34.529	1/10/2025	
5640	5.11 (4.60-5.62)	35.5 (31.9-39.0)	4.893	32.658	1/11/2025	
			4.715	34.461	1/11/2025@	
5720	5.19 (4.67-5.71)	35.4 (31.8-38.9)	4.833	32.451	12/30/2024	
			4.989	32.494	1/11/2025@	

Table 13 (Continued)

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
5745	IEEE/ IEC Head	5.22 (4.69-5.74)	35.4 (31.8-38.9)	4.880	32.430	12/21/2024@
				5.021	32.322	12/27/2024
				4.831	34.283	1/10/2025
				5.016	32.453	1/11/2025
5785		5.26 (4.73-5.78)	35.3 (31.8-38.8)	5.057	32.361	1/11/2025@
5800		5.27 (4.74-5.80)	35.3 (31.8-38.8)	4.941	32.329	12/20/2024@
				5.075	32.218	12/27/2024
				4.923	32.296	12/30/2024
				5.166	33.535	1/9/2025@
				4.895	34.184	1/10/2025@
				5.076	32.330	1/11/2025@
5825		5.30 (4.77-5.83)	35.3 (31.7-38.8)	4.919	34.151	1/10/2025@
	5.108			32.294	1/11/2025@	

Note: '@' indicates that tissue test result covers next test day (within 24 hours)

11.0 Environmental Test Conditions

The EME Laboratory’s ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/- 2°C of the temperature at which the dielectric properties were determined. The liquid depth within the phantom used for measurements was at least 15cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The Table below presents the range and average environmental conditions during the SAR tests reported herein:

Table 14

	Target	Measured
Ambient Temperature	18 – 25 °C	Range: 20.5 – 23.2°C Avg. 21.85 °C
Tissue Temperature	18 – 25 °C	Range: 18.2 – 23.3°C Avg. 21.95°C

Relative humidity target range is a recommended target

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the SAR scans are repeated.

12.0 DUT Test Setup and Methodology

12.1 Measurements

SAR measurements were performed using the DASY system described in section 8.0 using zoom scans. Oval flat phantoms filled with applicable simulated tissue were used for body and face testing.

The Table below includes the step sizes and resolution of area and zoom scans per KDB 865664 requirements.

Table 15

Description		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: ΔxArea, ΔyArea		≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
		When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom		≤ 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: ΔzZoom(n)	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the guidelines specified in KDB 643646.

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described below and illustrated in Appendix G.

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory as well as with and without the offered audio accessories as applicable.

12.3.2 Head

The DUT was placed against the right and left heads of the SAM phantom in the cheek touch and 15° tilt positions.

12.3.3 Face

The DUT was positioned with its' front and back sides separated 2.5cm from the phantom.

12.4 DUT Test Channels

The number of test channels was determined by using the following IEEE 1528 equation. The use of this equation produces the same or more test channels compared to the FCC KDB 447498 number of test channels formula.

$$N_c = 2 * \text{roundup}[10 * (f_{\text{high}} - f_{\text{low}}) / f_c] + 1$$

Where

N_c = Number of channels

F_{high} = Upper channel

F_{low} = Lower channel

F_c = Center channel

12.5 SAR Result Scaling Methodology

The calculated 1-gram averaged SAR results indicated as “Max Calc. 1g-SAR” in the data Tables is determined by scaling the measured SAR to account for power leveling variations and drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the “Max Calc. 1g-SAR” are scaled using the following formula:

$$\text{Max_Calc} = \text{SAR_meas} \cdot 10^{\frac{-\text{Drift}}{10}} \cdot \frac{P_{\text{max}}}{P_{\text{int}}} \cdot \text{DC}$$

P_{max} = Maximum Power (W)

P_{int} = Initial Power (W)

Drift = DASY drift results (dB)

SAR_meas = Measured 1-g Avg. SAR (W/kg)

DC = Transmission mode duty cycle in % where applicable

50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:

If $P_{int} > P_{max}$, then $P_{max}/P_{int} = 1$.

Drift = 1 for positive drift

Additional SAR scaling was applied using the methodologies outlined in FCC KDB 865664 using tissue sensitivity values. SAR was scaled for conditions where the tissue permittivity was measured above the nominal target and for tissue conductivity that was measured below the nominal target. Negative or reduced SAR scaling is not permitted.

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan. For conservative assessment, MSPD 5:8 (62.5%) data transmission was tested for body exposure; SSPD 1:4.55 (22%) phone mode was tested for head exposure and SSPD 1:4.55 (22%) PTT mode was tested for face exposure. A 50% duty cycle was applied to PTT configurations in the final results. WLAN tests were performed in 2.4 GHz 802.11b and 5 GHz 802.11a mode.

Standalone and simultaneous BT testing were assessed in sections 13.7 and 14.0 per the guidelines of KDB 447498.

13.0 DUT Test Data

13.1 Assessments for FCC LMR (450-470 MHz band)

The DUT was assessed at the highest applicable configuration at the body found during the initial compliance assessment on filed with the FCC. SAR plots of the highest SAR results (bolded) are present in Appendix E.

Table 16

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Highest Body Configuration									
PMAE4022B	PMNN4801A	RLN4570A	None	450.000	2.51	-0.07	3.42	3.48	MFR-AB-241214-21
Highest Face Configuration									
PMAE4022B	PMNN4801A	@Front	None	450.000	3.00	-0.16	1.02	0.53	MIN-FACE-241215-06@
Highest Head Configuration									
PMAE4022B	PMNN4802A	Left, Tilt	None	450.000	3.00	0.09	3.81	3.81	MIN-LEAR-241216-08@

13.2 Assessments for FCC WLAN 2.4GHz

The DUT was assessed at the highest applicable configuration at the body found during the initial compliance assessment on filed with the FCC. SAR plots of the highest SAR results (bolded) are present in Appendix E.

Table 17

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Highest Body Configuration									
AN000395A01	PMNN4582A	RLN4570A	None	2437.000	0.012	-0.33	0.031	0.050	BL-AB-250218-01@
Highest Face Configuration									
AN000395A01	PMNN4582A	@Front	None	2462.000	0.012	-0.17	0.011	0.017	BL-FACE-241215-08
Highest Head Configuration									
AN000395A01	PMNN4582A	Left, Tilt	None	2462.000	0.012	-0.20	0.165	0.258	BL-LEAR-250218-05@

13.3 Assessments for FCC WLAN 5GHz

The DUT was assessed at the highest applicable configuration at the body found during the initial compliance assessment on filed with the FCC. SAR plots of the highest SAR results (bolded) are present in Appendix E.

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
WLAN 5GHz UNII-2A (5.25 – 5.35GHz)									
Highest Body Configuration									
AN000395A01	PMNN4801A	RLN4570A	None	5260.000	0.011	-0.21	0.116	0.175	BAD(MAN)-AB-241219-03@
Highest Face Configuration									
AN000395A01	PMNN4802A	@Back	None	5260.000	0.012	-0.23	0.012	0.017	MFR-FACE-241219-05@
Highest Head Configuration									
AN000395A01	PMNN4802A	Right, Tilt	None	5260.000	0.012	-0.13	0.116	0.157	MFR-REAR-241226-16

Table 18 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
WLAN 5GHz UNII-2C (5.47 – 5.725GHz)									
Highest Body Configuration									
AN000395A01	PMNN4801A	RLN4570A	None	5500.000	0.012	-0.34	0.105	0.150	BL-AB-250107-01@
Highest Face Configuration									
AN000395A01	PMNN4801A	@Back	None	5500.000	0.012	-0.07	0.019	0.026	BL-FACE-250107-03@
Highest Head Configuration									
AN000395A01	PMNN4582A	Right, Tilt	None	5500.000	0.011	-0.27	0.108	0.162	MFR-REAR-241225-14
WLAN 5HHz UNII-3 (5.65 – 5.85GHz)									
Highest Body Configuration									
AN000395A01	PMNN4582A	RLN4570A	None	5745.000	0.011	-0.09	0.111	0.165	MIN-AB-241221-01@
Highest Face Configuration									
AN000395A01	PMNN4582A	@Back	None	5825.000	0.012	-0.35	0.020	0.029	MIN-FACE-241221-02@
Highest Head Configuration									
AN000395A01	PMNN4582A	Right, Tilt	None	5825.000	0.012	-0.17	0.107	0.151	MAN-REAR-241227-11

13.4 Assessments for ISED, Canada LMR

Based on the assessment results for body, face and head per KDB643646, additional tests were not required for ISED, Canada frequency range as the testing performed is compliance with the Industry Canada frequency range.

As per ISED Notice 2016-DRS001, additional tests were required the low, mid and high frequency channels (406.1MHz-430MHz & 450MHz-470MHz) for the highest configuration from body, face -and head. The SAR results are in table below. SAR plots of the highest result for body, face and head (bolded) are present in Appendix E.

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body (406.1-430MHz)									
PMAE4022B	PMNN4801A	RLN4570A	None	406.000	2.51	-0.09	4.21	4.30	MFR-AB-241218-08
				416.300	2.51	-0.10	4.14	4.24	MFR-AB-241218-09
				430.000	2.51	-0.12	3.94	4.05	MFR-AB-241218-07

Table 19 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body (450-470MHz)									
PMAE4022B	PMNN4801A	RLN4570A	None	450.000	2.51	-0.07	3.42	3.48	MFR-AB-241214-21
				460.000	2.50	0.25	3.62	3.63	MFR-AB-241215-01@
				470.000	2.48	-0.05	3.33	3.41	MFR-AB-241215-02@
Face (406.1-430MHz)									
PMAE4022B	PMNN4801A	@Front	None	406.000	3.00	0.09	1.21	0.61	MFR-FACE-241218-10
				416.300	3.00	-0.10	1.12	0.57	MFR-FACE-241218-11
				430.000	3.00	-0.05	1.08	0.55	MFR-FACE-241218-12
Face (450-470MHz)									
PMAE4022B	PMNN4801A	@Front	None	450.000	3.00	-0.16	1.02	0.53	MIN-FACE-241215-06@
				460.000	3.00	0.02	0.94	0.47	MIN-FACE-241215-07@
				470.000	3.00	0.02	0.85	0.43	MIN-FACE-241215-08@
Head (406.1-430MHz)									
PMAE4022B	PMNN4802A	Left, Tilt	None	406.000	3.00	-0.01	3.71	3.72	MFR-LEAR-241218-13
				416.300	3.00	-0.06	3.90	3.95	MIN-LEAR-241216-16@
				430.000	2.99	0.01	3.75	3.76	MIN-LEAR-241216-11@
Head (450-470MHz)									
PMAE4022B	PMNN4802A	Left, Tilt	None	450.000	3.00	0.09	3.81	3.81	MIN-LEAR-241216-08@
				460.000	3.00	-0.09	3.77	3.85	MIN-LEAR-241216-12@
				470.000	2.99	0.02	3.62	3.63	MIN-LEAR-241216-13@

13.5 Assessments for ISED, Canada WLAN 2.4GHz

As per ISED Notice 2016-DRS001, additional tests were required the low, mid and high frequency channels for the highest configuration from Face that previous original filing (exceeded on filed SAR value). The SAR results are in table below. SAR plots of the highest result for Body, Face and Head (bolded) are present in Appendix E.

Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
WLAN 2.4GHz Body Configuration									
AN000395A01	PMNN4582A	RLN4570A	None	2412.000	0.012	-0.19	0.029	0.046	BL-AB-241214-02
				2437.000	0.012	-0.33	0.031	0.050	BL-AB-250218-01@
				2462.000	0.012	-0.07	0.023	0.035	BL-AB-250218-01@
WLAN 2.4GHz Face Configuration									
AN000395A01	PMNN4582A	Radio @ front 2.5cm	None	2412.000	0.012	0.09	0.008	0.012	BL-FACE-241215-02
				2437.000	0.012	0.16	0.006	0.009	BL-FACE-241215-06
				2462.000	0.012	-0.17	0.011	0.017	BL-FACE-241215-08
WLAN 2.4GHz Head Configuration									
AN000395A01	PMNN4852A	Left. Tilt	None	2412.000	0.012	-0.05	0.112	0.170	BL-LEAR-241216-02@
				2437.000	0.012	0.18	0.142	0.213	BL-LEAR-250218-03@
				2462.000	0.012	-0.20	0.165	0.258	BL-LEAR-250218-05@

13.6 Assessments for ISED, Canada WLAN 5GHz

As per ISED Notice 2016-DRS001, additional tests were required the low, mid and high frequency channels for the highest configuration from Face that previous original filing (exceeded on filed SAR value). The SAR results are in table below. SAR plots of the highest result for Body, Face and Head (bolded) are present in Appendix E.

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
WLAN 5GHz UNII-2A (5.25 – 5.35GHz)									
Body Configuration									
AN000395A01	PMNN4801A	RLN4570A	None	5260.000	0.011	-0.21	0.116	0.175	BAD(MAN)-AB-241219-03@
				5280.000	0.011	-0.29	0.139	0.218	MAN-AB-241229-02
				5320.000	0.011	-0.28	0.128	0.202	MAN-AB-241229-03

Table 21 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Face Configuration									
AN000395A01	PMNN4802A	@Back	None	5260.000	0.012	-0.23	0.012	0.017	MFR-FACE-241219-05@
				5280.000	0.012	-0.09	0.025	0.034	MIN-FACE-241229-04
				5320.000	0.012	-0.21	0.013	0.018	MFR-FACE-250219-10
Head Configuration									
AN000395A01	PMNN4802A	Right, Tilt	None	5260.000	0.012	-0.13	0.116	0.157	MFR-REAR-241226-16
				5280.000	0.012	-0.18	0.069	0.096	MAN-REAR-241227-12
				5320.000	0.012	-0.10	0.137	0.186	EMR-REAR-250107-09@
WLAN 5GHz UNII-2C (5.47 – 5.725GHz)									
Body Configuration									
AN000395A01	PMNN4801A	RLN4570A	None	5500.0000	0.012	-0.34	0.105	0.150	BL-AB-250107-01@
				5640.0000	0.012	-0.07	0.196	0.267	ZIQ-AB-250111-09
				5720.0000	0.013	-0.14	0.137	0.181	MAN-AB-241230-02
Face Configuration									
AN000395A01	PMNN4801A	@Back	None	5500.0000	0.012	-0.07	0.019	0.026	BL-FACE-250107-03@
				5640.0000	0.012	-0.05	0.036	0.049	ZIQ-FACE-250111-08
				5720.0000	0.013	-0.47	0.015	0.021	MAN-FACE-241230-03
Head Configuration									
AN000395A01	PMNN4582A	Right, Tilt	None	5500.0000	0.011	-0.27	0.108	0.162	MFR-REAR-241225-14
				5640.0000	0.011	0.03	0.290	0.432	MAN-REAR-241231-10
				5720.0000	0.010	-0.19	0.109	0.178	MAN-REAR-241228-03

Table 21 (Continued)

WLAN 5GHz UNII-3 (5.65 – 5.85GHz)									
Body Configuration									
AN000395A01	PMNN4582A	RLN4570A	None	5745.0000	0.011	-0.09	0.111	0.165	MIN-AB-241221-01@
				5785.0000	0.012	-0.15	0.143	0.206	AR-AB-241230-04
				5825.0000	0.012	-0.12	0.139	0.194	AR-AB-241230-05
Face Configuration									
AN000395A01	PMNN4582A	@Back	None	5745.0000	0.011	-1.04	0.014	0.026	AR-FACE-241230-06
				5785.0000	0.012	-0.71	0.018	0.029	MAN-FACE-241230-07
				5825.0000	0.012	-0.35	0.020	0.029	MIN-FACE-241221-02@
Head Configuration									
AN000395A01	PMNN4582A	Right, Tilt	None	5745.0000	0.011	-0.03	0.119	0.174	MIN-REAR-241228-07
				5785.0000	0.012	-0.29	0.103	0.153	MAN-REAR-241228-04
				5825.0000	0.012	-0.17	0.107	0.151	MAN-REAR-241227-11

13.7 Assessment at the Bluetooth band

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion for standalone Bluetooth transmitter;

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{F_{(\text{GHz})}}] = 0.8, \text{ which is } \leq 3 \text{ for 1-g SAR}$$

Where:

Max. power = 1.925 mW (2.5 mW*77.0 % duty cycle)

Min. test separation distance = 5mm for actual test separation < 5mm

F(GHz) = 2.48 GHz

Per the result from the calculation above, the standalone SAR assessment was not required for Bluetooth band. Therefore, SAR results for Bluetooth are not reported herein.

13.8 Shortened Scan Assessment

A “shortened” scan using the highest SAR configuration overall from above was performed to validate the SAR drift of the full DASY5™ coarse and zoom scans. Note that the shortened scan represents the zoom scan performance result; this is obtained by first running a coarse scan to find the peak area and then, using a newly charged battery, a zoom scan only was performed. The results of the shortened cube scan presented in Appendix F demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The SAR result (bolded) from the Table below is provided in Appendix F.

Table 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4022B	PMNN4802A	Left, Tilt	None	460.000	2.99	-0.04	3.29	3.33	EMR-LEAR-250109-02

14.0 Simultaneous Transmission Exclusion for BT

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion to an antenna that transmits simultaneously with other antennas for test distances ≤ 50mm:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{F(\text{GHz})} / X] = 0.1 \text{ W/kg, which is } \leq 0.4 \text{ W/kg (1g)}$$

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g

Max. power = 1.925 mW (2.5 mW*77.0 % duty cycle)

Min. test separation distance = 5mm for actual test separation < 5mm

F(GHz) = 2.48 GHz

Per the result from the calculation above, simultaneous exclusion is applied and therefore SAR results are not reported herein.

15.0 Simultaneous Transmission between LMR and WiFi

The Table below summarizes the simultaneous transmissions between LMR and WLAN bands for this device.

Table 23

Exposure Conditions	Item	Capable Simultaneous Transmit Configurations
Body-Worn	1	LMR + Wifi 2.4 GHz
	2	LMR + Wifi 5 GHz
	3	LMR + BT
	4	LMR + Wifi 5 GHz + BT
Face	1	LMR + Wifi 2.4 GHz
	2	LMR + Wifi 5 GHz
	3	LMR + BT
	4	LMR + Wifi 5 GHz + BT

This device uses a single transmitter module and antenna for both WLAN and BT. WLAN and BT cannot transmit simultaneously. WLAN 2.4GHz and 5GHz are sharing the same antenna, only one technology to transmit at a single time. WLAN 2.4GHz and BT are sharing the same antenna and they are in the same frequency range, thus only WLAN 2.4GHz is selected for simultaneous transmission as the WLAN 2.4GHz power is higher than BT power, thus BT is exclude from simultaneous transmission.

16.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands and ISED Canada Frequency bands, the highest Operational Maximum Calculated 1-gram average SAR values found for this filing:

Table 24

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)	Max Calc at Head (W/kg)
		1g-SAR	1g-SAR	1g-SAR
FCC US				
LMR	450-470	3.63 ⁽¹⁾	0.53 ⁽²⁾	3.85 ⁽³⁾
WLAN 2.4 GHz	2412 - 2462	0.089	0.037	0.351
WLAN 5 GHz	5180 - 5825	0.569	0.107	0.727
Highest Simultaneous Transmission SAR	Sum of SAR (W/kg)	4.20 ⁽⁴⁾	0.64 ⁽⁵⁾	4.58 ⁽⁶⁾
ISED Canada				
LMR	406.1-430	4.37	0.61 ⁽⁷⁾	3.95 ⁽⁸⁾
	450-470	3.63 ⁽¹⁾	0.53 ⁽²⁾	3.85 ⁽³⁾
WLAN 2.4 GHz	2412 - 2462	0.089	0.037	0.351
WLAN 5 GHz	5180 - 5825	0.569	0.107	0.727
Highest Simultaneous Transmission SAR	Sum of SAR (W/kg)	4.94	0.72 ⁽⁹⁾	4.68 ⁽¹⁰⁾
Overall				
LMR	350.1-470	5.04	0.61	5.23
WLAN 2.4 GHz	2412 - 2462	0.089	0.037	0.351
WLAN 5 GHz	5180 - 5825	0.569	0.107	0.727
Highest Simultaneous Transmission SAR	Sum of SAR (W/kg)	5.61	0.72	5.96

Note:

- (1) New highest SAR result for Body is 3.63 W/kg compared with previous on filed SAR result is 3.44 W/kg
- (2) New highest SAR result for Face is 0.53 W/kg compared with previous on filed SAR result is 0.43 W/kg
- (3) New highest SAR result for Head is 3.85 W/kg compared with previous on filed SAR result is 3.50 W/kg
- (4) New highest SAR result for Body is 4.20 W/kg compared with previous on filed SAR result is 4.01 W/kg
- (5) New highest SAR result for Face is 0.64 W/kg compared with previous on filed SAR result is 0.54 W/kg
- (6) New highest SAR result for Head is 4.58 W/kg compared with previous on filed SAR result is 4.23 W/kg
- (7) New highest SAR result for Face is 0.61 W/kg compared with previous on filed SAR result is 0.58 W/kg
- (8) New highest SAR result for Head is 3.95 W/kg compared with previous on filed SAR result is 3.70 W/kg
- (9) New highest SAR result for Face is 0.72 W/kg compared with previous on filed SAR result is 0.69 W/kg
- (10) New highest SAR result for Head is 4.68 W/kg compared with previous on filed SAR result is 4.46 W/kg

The test results clearly demonstrate compliance with FCC/ISED Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093 and ISED RSS-102 (Issue 6).

17.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is not required because SAR results are below 4.0W/kg (Occupational).

18.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value for Occupational exposure is less than 7.5W/kg.

Per the guidelines of ISO/IEC 17025 a reported system uncertainty is required and therefore measurement uncertainty budget is included in Appendix A.

Appendix A
Measurement Uncertainty Budget

Uncertainty Budget for System Validation (dipole & flat phantom) for 300 MHz to 800MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	$e = f(d,k)$	<i>f</i>	<i>g</i>	$h = c \times f / e$	$i = c \times g / e$	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (\pm %)	Prob. Dist.	Div.	c_i (1 g)	c_i (10 g)	1 g u_i (\pm %)	10 g u_i (\pm %)	v_i
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			$k=2$				19	18	

Notes for uncertainty budget Tables:

- a) Column headings a-k are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) c_i - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) u_i – SAR uncertainty
- h) v_i - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for System Validation (dipole & flat phantom) for 800 MHz to 3 GHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	$e = f(d,k)$	<i>f</i>	<i>g</i>	$h = cxf/e$	$i = cxg/e$	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob. Dist.	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	5.5	N	1.00	1	1	5.5	5.5	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				17	17	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for System Validation (dipole & flat phantom) for 3 to 6 GHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob. Dist.	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t. Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Dipole									
Dipole Axis to Liquid Distance	⁸ E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				19	18	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test, for 100 MHz to 800 MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	$e = f(d,k)$	<i>f</i>	<i>g</i>	$h = c x f / e$	$i = c x g / e$	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty							12	11	482
Expanded Uncertainty (95% CONFIDENCE LEVEL)							23	23	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test, for 800 MHz to 3 GHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	5.5	N	1.00	1	1	5.5	5.5	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	381
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				21	21	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test for 3 to 6 GHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	$e = f(d,k)$	<i>f</i>	<i>g</i>	$h = c \times f / e$	$i = c \times g / e$	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. ($\pm \%$)	Prob Dist	Div.	c_i (1 g)	c_i (10 g)	1 g u_i ($\pm\%$)	10 g u_i ($\pm\%$)	v_i
Measurement System									
Probe Calibration	E.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	465
Expanded Uncertainty (95% CONFIDENCE LEVEL)			$k=2$				23	23	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) c_i - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) u_i – SAR uncertainty
- h) v_i - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Appendix B
Probe Calibration Certificates

Calibration Laboratory of
 Schmid & Partner
 Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
S Service suisse d'étalonnage
C Servizio svizzero di taratura
S Swiss Calibration Service

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 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Motorola Solutions**
 Bayan Lepas, Malaysia

Certificate No. **EX-7882_Jun24**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7882**

Calibration procedure(s) **QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6,
 QA CAL-25.v8
 Calibration procedure for dosimetric E-field probes**

Calibration date **June 25, 2024**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.
 All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.
 Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
OCP DAK-3.5 (weighted)	SN: 1249	05-Oct-23 (OCP-DAK3.5-1249_Oct23)	Oct-24
OCP DAK-12	SN: 1016	05-Oct-23 (OCP-DAK12-1016_Oct23)	Oct-24
Reference 20 dB Attenuator	SN: CC2552 (20x)	26-Mar-24 (No. 217-04046)	Mar-25
DAE4	SN: 660	23-Feb-24 (No. DAE4-660_Feb24)	Feb-25
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: D00110210	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-22)	In house check: Jun-24
Network Analyzer E8359A	SN: US41060477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by	Jeffrey Katzman	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: June 25, 2024

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
 Schmid & Partner
 Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland



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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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Accreditation No.: **SCS 0108**

Glossary

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ψ	ψ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices – Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- **NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- **NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- **DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media.
- **PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- **ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- **Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- **Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- **Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

EX3DV4 - SN:7882

June 25, 2024

Parameters of Probe: EX3DV4 - SN:7882

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k = 2)
Norm ($\mu V/(V/m)^2$) ^A	0.52	0.60	0.59	±10.1%
DCP (mV) ^B	106.3	107.5	106.8	±4.7%

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc ^E k = 2
0	CW	X	0.00	0.00	1.00	0.00	145.4	±2.5%	±4.7%
		Y	0.00	0.00	1.00		166.5		
		Z	0.00	0.00	1.00		156.4		
10352	Pulse Waveform (200Hz, 10%)	X	1.51	60.49	6.15	10.00	60.0	±2.7%	±9.6%
		Y	1.48	60.39	6.33		60.0		
		Z	1.46	60.31	6.14		60.0		
10353	Pulse Waveform (200Hz, 20%)	X	0.80	60.00	4.68	6.99	80.0	±2.2%	±9.6%
		Y	0.81	60.00	4.99		80.0		
		Z	0.83	60.00	4.83		80.0		
10354	Pulse Waveform (200Hz, 40%)	X	0.08	121.46	1.15	3.98	95.0	±2.6%	±9.6%
		Y	0.23	141.85	0.15		95.0		
		Z	20.00	72.00	7.00		95.0		
10355	Pulse Waveform (200Hz, 60%)	X	2.62	158.67	6.33	2.22	120.0	±1.6%	±9.6%
		Y	9.47	158.25	20.00		120.0		
		Z	8.57	159.02	15.81		120.0		
10387	QPSK Waveform, 1 MHz	X	0.43	61.07	10.50	1.00	150.0	±3.8%	±9.6%
		Y	0.56	62.86	11.88		150.0		
		Z	0.59	64.00	12.04		150.0		
10388	QPSK Waveform, 10 MHz	X	1.14	63.93	12.51	0.00	150.0	±1.3%	±9.6%
		Y	1.32	65.10	13.59		150.0		
		Z	1.36	65.65	13.76		150.0		
10396	64-QAM Waveform, 100 kHz	X	1.53	63.06	15.12	3.01	150.0	±1.0%	±9.6%
		Y	1.61	63.66	15.45		150.0		
		Z	1.71	64.84	15.96		150.0		
10399	64-QAM Waveform, 40 MHz	X	2.65	65.46	14.50	0.00	150.0	±1.8%	±9.6%
		Y	2.80	65.89	14.85		150.0		
		Z	2.85	66.23	15.00		150.0		
10414	WLAN CCDF, 64-QAM, 40 MHz	X	3.77	66.10	15.14	0.00	150.0	±3.2%	±9.6%
		Y	3.98	66.33	15.42		150.0		
		Z	3.87	65.89	15.21		150.0		

Note: For details on UID parameters see Appendix

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).
^B Linearization parameter uncertainty for maximum specified field strength.
^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4 - SN:7882

June 25, 2024

Parameters of Probe: EX3DV4 - SN:7882

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 msV ⁻²	T2 msV ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	T6
x	8.9	64.52	33.34	2.26	0.00	4.90	0.19	0.00	1.00
y	10.5	75.48	32.79	2.67	0.00	4.90	0.31	0.00	1.00
z	10.8	78.21	33.34	3.72	0.00	4.92	0.51	0.00	1.00

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	56.3°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3–4 mm for an Area Scan job.

EX3DV4 - SN:7882

June 25, 2024

Parameters of Probe: EX3DV4 - SN:7882

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
150	52.3	0.76	12.40	12.40	12.40	0.00	1.00	±13.3%
300	45.3	0.87	11.58	11.58	11.58	0.09	1.00	±13.3%
450	43.5	0.87	10.72	10.72	10.72	0.16	1.30	±13.3%
750	41.9	0.89	9.45	9.45	9.45	0.52	0.80	±11.0%
835	41.5	0.90	9.17	9.17	9.17	0.49	0.80	±11.0%
900	41.5	0.97	8.94	8.94	8.94	0.32	1.04	±11.0%
1450	40.5	1.20	8.14	8.14	8.14	0.39	0.80	±11.0%
1810	40.0	1.40	7.88	7.88	7.88	0.30	0.86	±11.0%
1900	40.0	1.40	7.81	7.81	7.81	0.32	0.86	±11.0%
2100	39.8	1.49	7.68	7.68	7.68	0.37	0.86	±11.0%
2300	39.5	1.67	7.53	7.53	7.53	0.40	0.90	±11.0%
2450	39.2	1.80	7.36	7.36	7.36	0.39	0.90	±11.0%
2600	39.0	1.96	7.30	7.30	7.30	0.34	0.90	±11.0%
3500	37.9	2.91	6.62	6.62	6.62	0.30	1.35	±13.1%
3700	37.7	3.12	6.49	6.49	6.49	0.30	1.35	±13.1%
5250	35.9	4.71	5.05	5.05	5.05	0.40	1.80	±13.1%
5500	35.6	4.96	4.56	4.56	4.56	0.40	1.80	±13.1%
5600	35.5	5.07	4.42	4.42	4.42	0.40	1.80	±13.1%
5750	35.4	5.22	4.60	4.60	4.60	0.40	1.80	±13.1%

^C Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.

^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. Therefore, The uncertainty stated is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

EX3DV4 - SN:7882

June 25, 2024

Parameters of Probe: EX3DV4 - SN:7882

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
150	61.9	0.80	11.72	11.72	11.72	0.00	1.00	±13.3%
300	58.2	0.92	11.36	11.36	11.36	0.02	1.35	±13.3%
450	56.7	0.94	10.57	10.57	10.57	0.11	1.20	±13.3%
750	55.5	0.96	9.86	9.86	9.86	0.45	0.80	±11.0%
835	55.2	0.97	9.64	9.64	9.64	0.48	0.80	±11.0%
900	55.0	1.05	9.50	9.50	9.50	0.48	0.80	±11.0%
1450	54.0	1.30	8.62	8.62	8.62	0.41	0.80	±11.0%
1810	53.3	1.52	8.22	8.22	8.22	0.47	0.86	±11.0%
1900	53.3	1.52	7.92	7.92	7.92	0.38	0.86	±11.0%
2100	53.2	1.62	7.74	7.74	7.74	0.44	0.86	±11.0%
2300	52.9	1.81	7.63	7.63	7.63	0.40	0.90	±11.0%
2450	52.7	1.95	7.54	7.54	7.54	0.42	0.90	±11.0%
2600	52.5	2.16	7.45	7.45	7.45	0.31	0.90	±11.0%
3500	51.3	3.31	6.23	6.23	6.23	0.40	1.35	±13.1%
3700	51.0	3.55	6.06	6.06	6.06	0.40	1.35	±13.1%
5250	48.9	5.36	4.50	4.50	4.50	0.50	1.90	±13.1%
5500	48.6	5.65	4.25	4.25	4.25	0.50	1.90	±13.1%
5600	48.5	5.77	4.13	4.13	4.13	0.50	1.90	±13.1%
5750	48.3	5.94	4.11	4.11	4.11	0.50	1.90	±13.1%

^C Frequency validity above 300MHz of ±100MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3GHz and below ±2% for frequencies between 3–6GHz at any distance larger than half the probe tip diameter from the boundary.

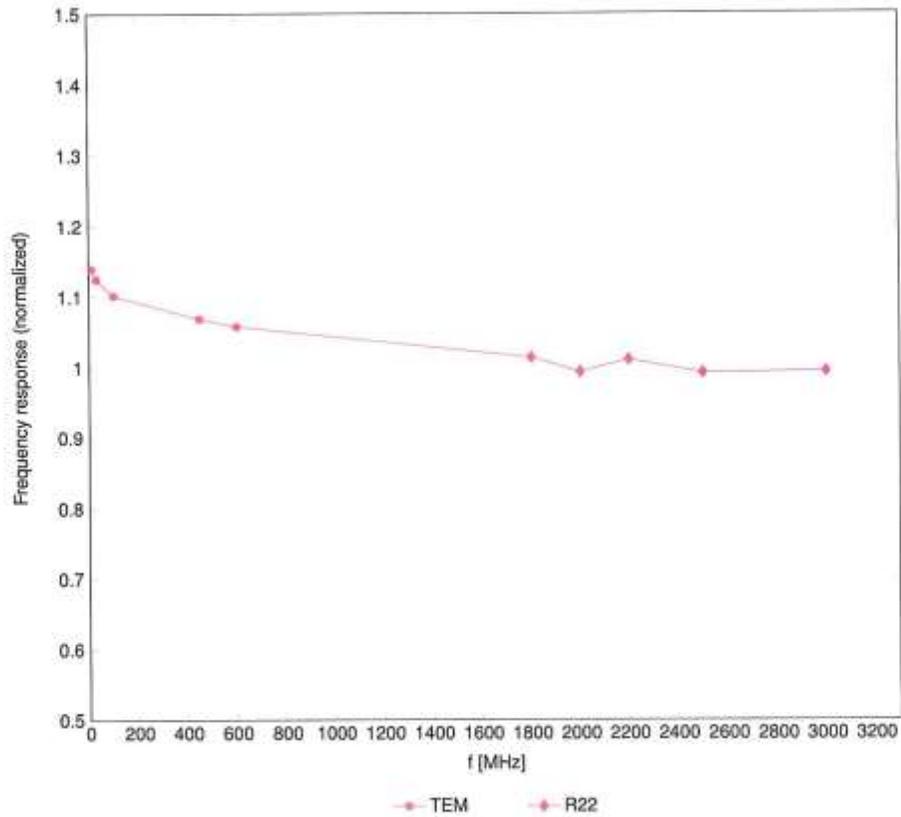
^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. Therefore, The uncertainty stated is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

EX3DV4 - SN:7882

June 25, 2024

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide:R22)

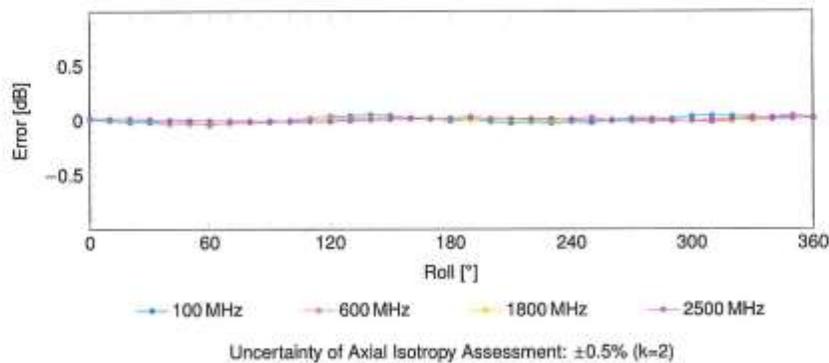
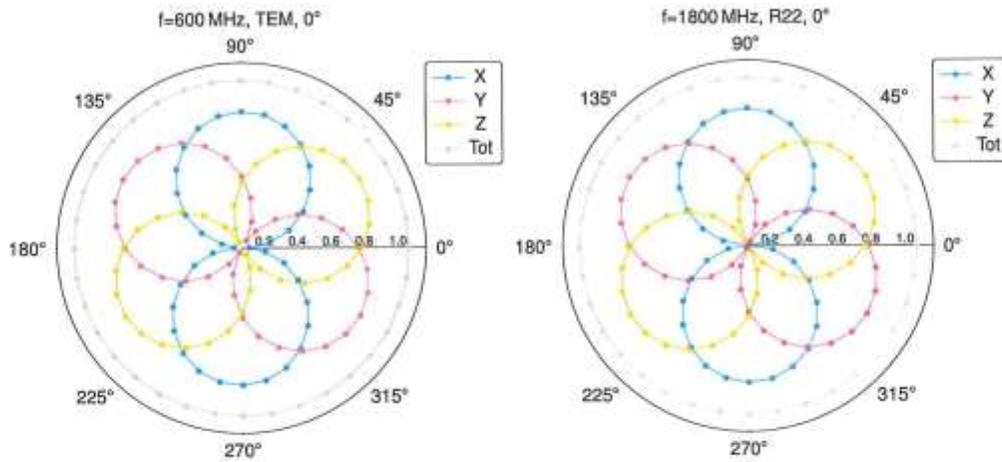


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

EX3DV4 - SN:7882

June 25, 2024

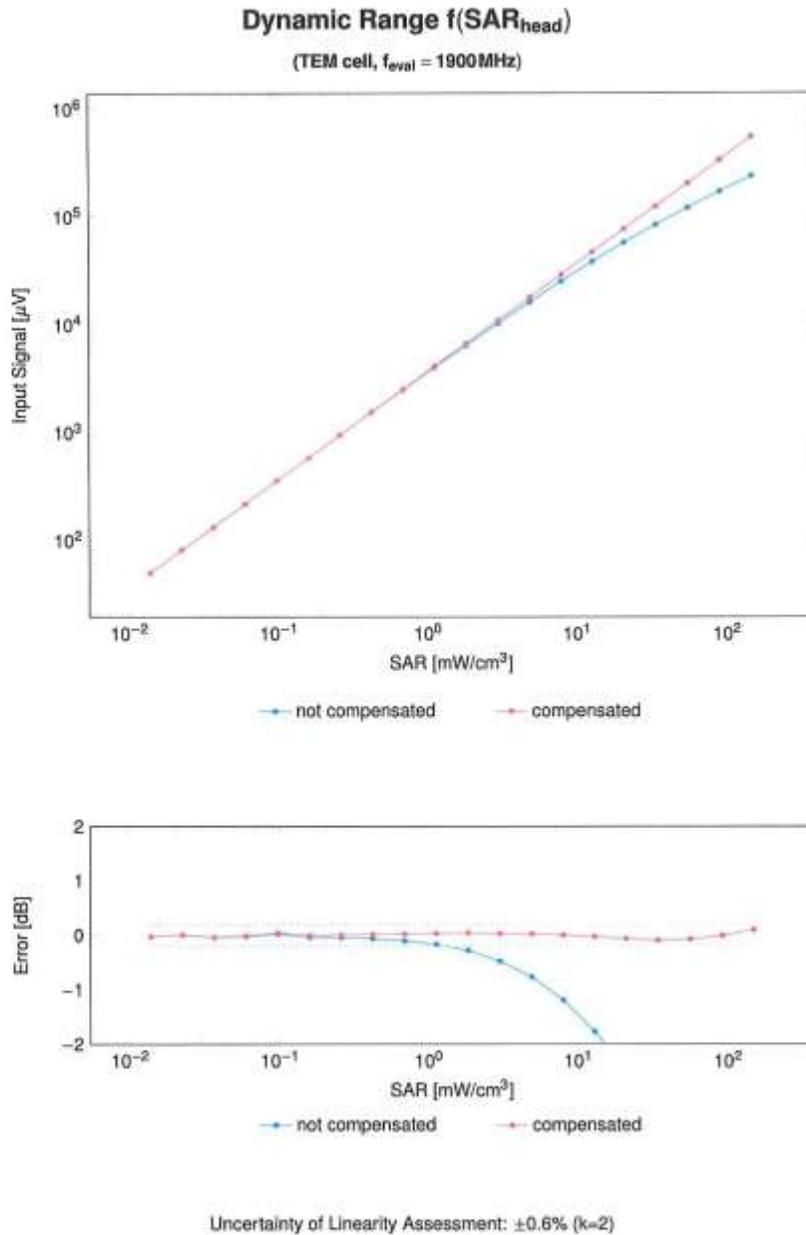
Receiving Pattern (ϕ), $\theta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4 - SN:7882

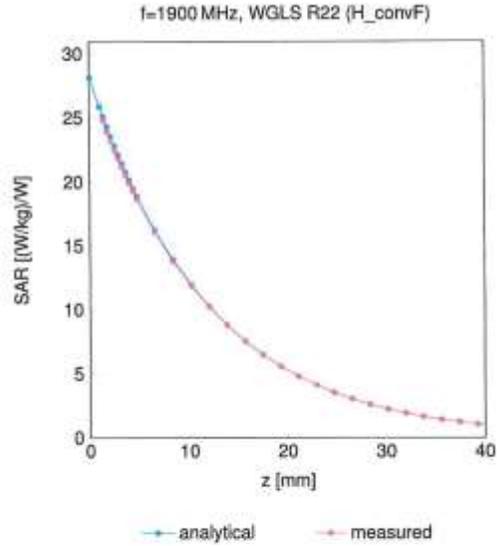
June 25, 2024



EX3DV4 - SN:7882

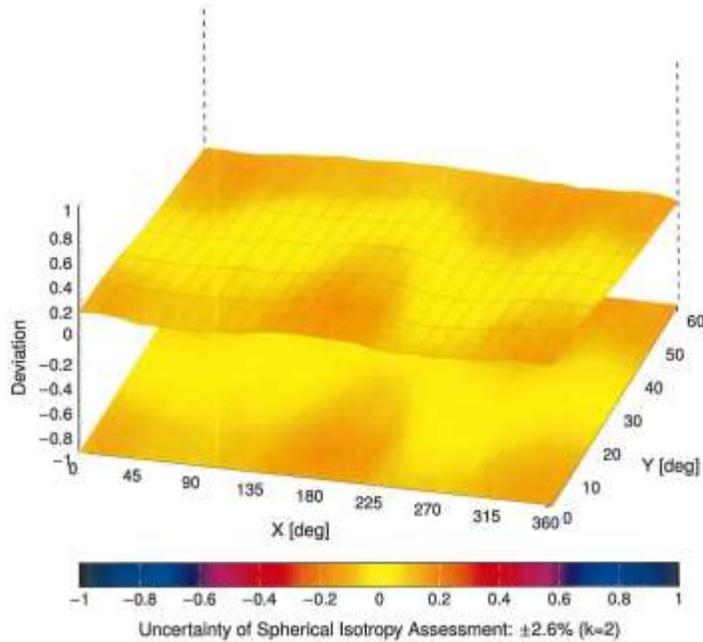
June 25, 2024

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



**Calibration Laboratory of
Schmid & Partner
Engineering AG**
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Motorola Solutions**
Bayan Lepas, Malaysia

Certificate No. **EX-7511_Jul24**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7511**

Calibration procedure(s) **QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6,
QA CAL-25.v8**
Calibration procedure for dosimetric E-field probes

Calibration date **July 23, 2024**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3) °C and humidity < 70%.
Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
OCP DAK-3.5 (weighted)	SN: 1249	05-Oct-23 (OCP-DAK3.5-1249_Oct23)	Oct-24
OCP DAK-12	SN: 1016	05-Oct-23 (OCP-DAK12-1016_Oct23)	Oct-24
Reference 20 dB Attenuator	SN: CC2552 (20x)	26-Mar-24 (No. 217-04046)	Mar-25
DAE4	SN: 660	23-Feb-24 (No. DAE4-660_Feb24)	Feb-25
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-24)	In house check: Jun-26
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-24)	In house check: Jun-26
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-24)	In house check: Jun-26
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-24)	In house check: Jun-26
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by	Krešimir Franjić	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: July 23, 2024

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices – Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- **NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- **NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- **DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media.
- **PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- **ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- **Spherical Isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- **Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- **Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

EX3DV4 - SN:7511

July 23, 2024

Parameters of Probe: EX3DV4 - SN:7511

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k = 2)
Norm ($\mu V / (V/m)^2$) ^A	0.46	0.37	0.44	±10.1%
DCP (mV) ^B	101.1	100.1	100.9	±4.7%

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc ^E k = 2
0	CW	X	0.00	0.00	1.00	0.00	156.7	±3.0%	±4.7%
		Y	0.00	0.00	1.00		158.9		
		Z	0.00	0.00	1.00		157.7		
10352	Pulse Waveform (200Hz, 10%)	X	1.76	62.39	7.87	10.00	60.0	±3.2%	±9.6%
		Y	2.49	66.05	10.35		60.0		
		Z	1.92	63.18	8.36		60.0		
10353	Pulse Waveform (200Hz, 20%)	X	0.93	60.84	6.16	6.99	80.0	±2.4%	±9.6%
		Y	1.94	67.35	9.84		80.0		
		Z	1.05	61.71	6.73		80.0		
10354	Pulse Waveform (200Hz, 40%)	X	0.44	60.00	5.00	3.98	95.0	±1.4%	±9.6%
		Y	2.66	72.56	10.47		95.0		
		Z	0.50	60.66	5.50		95.0		
10355	Pulse Waveform (200Hz, 60%)	X	0.26	60.08	4.82	2.22	120.0	±0.9%	±9.6%
		Y	20.00	84.09	12.19		120.0		
		Z	0.44	63.06	6.40		120.0		
10387	QPSK Waveform, 1 MHz	X	1.61	67.46	15.20	1.00	150.0	±2.7%	±9.6%
		Y	1.49	66.80	14.56		150.0		
		Z	1.68	68.14	15.61		150.0		
10388	QPSK Waveform, 10 MHz	X	2.11	67.81	15.74	0.00	150.0	±1.1%	±9.6%
		Y	1.98	67.15	15.28		150.0		
		Z	2.18	68.42	16.09		150.0		
10396	64-QAM Waveform, 100 kHz	X	2.42	68.99	18.18	3.01	150.0	±0.8%	±9.6%
		Y	2.31	68.22	17.77		150.0		
		Z	2.43	69.13	18.37		150.0		
10399	64-QAM Waveform, 40 MHz	X	3.45	67.16	15.82	0.00	150.0	±1.2%	±9.6%
		Y	3.37	66.88	15.62		150.0		
		Z	3.36	66.77	15.67		150.0		
10414	WLAN CCDF, 64-QAM, 40 MHz	X	4.56	65.25	15.33	0.00	150.0	±2.6%	±9.6%
		Y	4.66	65.74	15.55		150.0		
		Z	4.62	65.45	15.45		150.0		

Note: For details on UID parameters see Appendix

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Linearization parameter uncertainty for maximum specified field strength.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4 - SN:7511

July 23, 2024

Parameters of Probe: EX3DV4 - SN:7511

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 msV ⁻²	T2 msV ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	T6
x	31.9	234.84	34.72	5.60	0.00	4.93	1.41	0.01	1.00
y	30.4	226.10	35.32	3.16	0.00	5.01	1.14	0.06	1.00
z	32.4	237.89	34.61	5.70	0.00	4.94	1.17	0.04	1.00

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	-3.5°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3–4 mm for an Area Scan job.

EX3DV4 - SN:7511

July 23, 2024

Parameters of Probe: EX3DV4 - SN:7511

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
150	52.3	0.76	12.04	12.04	12.04	0.00	1.00	±13.3%
300	45.3	0.87	10.92	10.92	10.92	0.09	1.00	±13.3%
450	43.5	0.87	10.26	10.26	10.26	0.16	1.30	±13.3%
750	41.9	0.89	9.39	9.39	9.39	0.43	0.84	±11.0%
835	41.5	0.90	9.08	9.08	9.08	0.26	1.16	±11.0%
900	41.5	0.97	8.92	8.92	8.92	0.46	0.82	±11.0%
1450	40.5	1.20	8.35	8.35	8.35	0.43	0.80	±11.0%
1810	40.0	1.40	7.97	7.97	7.97	0.26	0.86	±11.0%
1900	40.0	1.40	7.71	7.71	7.71	0.29	0.86	±11.0%
2100	39.8	1.49	7.58	7.58	7.58	0.20	0.86	±11.0%
2300	39.5	1.67	7.22	7.22	7.22	0.32	0.90	±11.0%
2450	39.2	1.80	7.03	7.03	7.03	0.33	0.90	±11.0%
2600	39.0	1.96	6.79	6.79	6.79	0.30	0.90	±11.0%
3500	37.9	2.91	6.55	6.55	6.55	0.35	1.30	±13.1%
3700	37.7	3.12	6.51	6.51	6.51	0.35	1.30	±13.1%
5250	35.9	4.71	5.10	5.10	5.10	0.40	1.80	±13.1%
5500	35.6	4.96	4.56	4.56	4.56	0.40	1.80	±13.1%
5600	35.5	5.07	4.44	4.44	4.44	0.40	1.80	±13.1%
5800	35.3	5.27	4.51	4.51	4.51	0.40	1.80	±13.1%

^C Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe lip diameter from the boundary.

^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

EX3DV4 - SN:7511

July 23, 2024

Parameters of Probe: EX3DV4 - SN:7511

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
150	61.9	0.80	11.59	11.59	11.59	0.00	1.00	±13.3%
300	58.2	0.92	10.97	10.97	10.97	0.02	1.35	±13.3%
450	58.7	0.94	10.52	10.52	10.52	0.11	1.20	±13.3%
750	55.5	0.96	9.34	9.34	9.34	0.46	0.83	±11.0%
835	55.2	0.97	9.21	9.21	9.21	0.42	0.80	±11.0%
900	55.0	1.05	9.04	9.04	9.04	0.44	0.80	±11.0%
1450	54.0	1.30	8.09	8.09	8.09	0.31	0.80	±11.0%
1810	53.3	1.52	7.68	7.68	7.68	0.33	0.86	±11.0%
1900	53.3	1.52	7.45	7.45	7.45	0.40	0.86	±11.0%
2100	53.2	1.62	7.22	7.22	7.22	0.46	0.86	±11.0%
2300	52.9	1.81	7.06	7.06	7.06	0.38	0.90	±11.0%
2450	52.7	1.95	6.96	6.96	6.96	0.32	0.90	±11.0%
2600	52.5	2.16	6.83	6.83	6.83	0.29	0.90	±11.0%
3500	51.3	3.31	6.08	6.08	6.08	0.40	1.35	±13.1%
3700	51.0	3.55	5.88	5.88	5.88	0.40	1.35	±13.1%
5250	48.9	5.36	4.44	4.44	4.44	0.50	1.90	±13.1%
5500	48.6	5.65	3.98	3.98	3.98	0.50	1.90	±13.1%
5600	48.5	5.77	3.86	3.86	3.86	0.50	1.90	±13.1%
5800	48.2	6.00	3.93	3.93	3.93	0.50	1.90	±13.1%

^C Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.

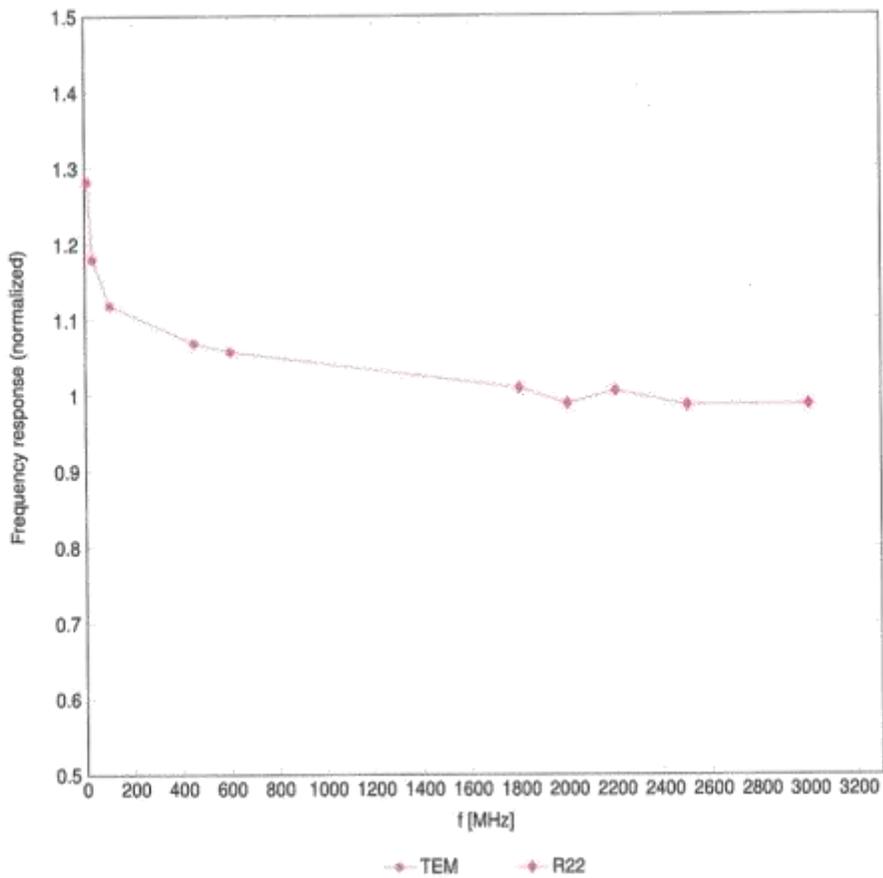
^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

EX3DV4 - SN:7511

July 23, 2024

Frequency Response of E-Field

(TEM-Cell:ifl110 EXX, Waveguide:R22)

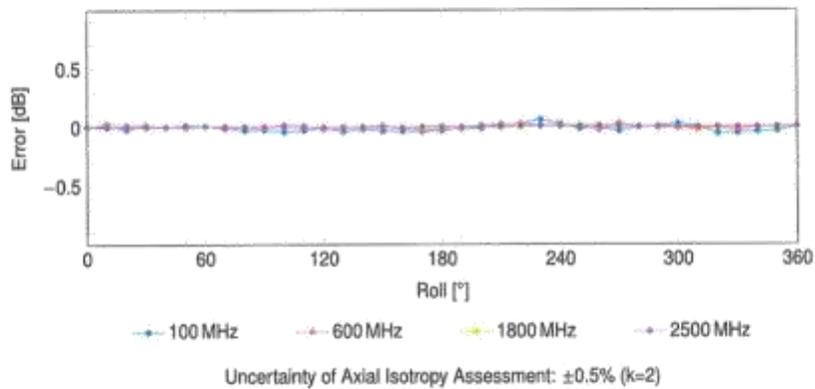
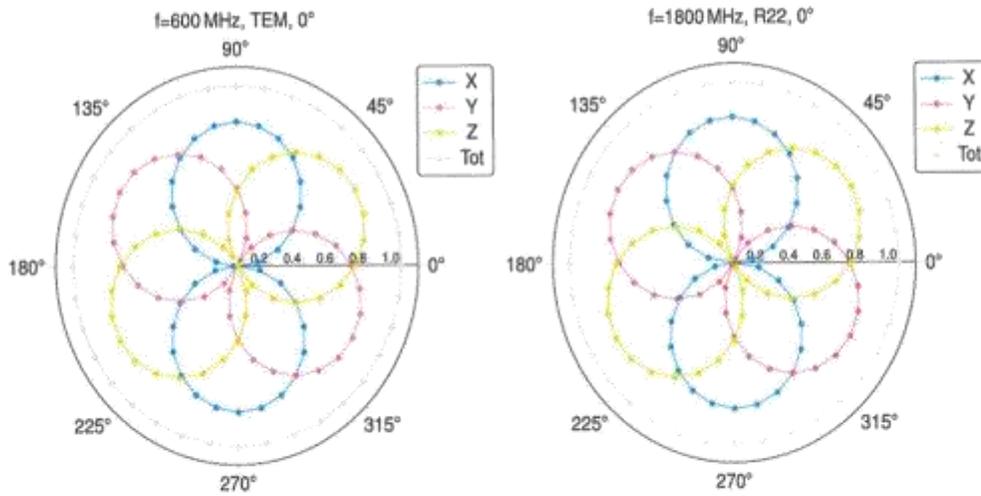


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4 - SN:7511

July 23, 2024

Receiving Pattern (ϕ), $\theta = 0^\circ$

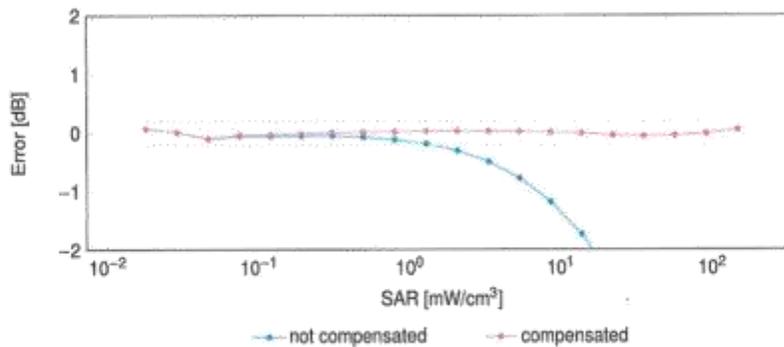
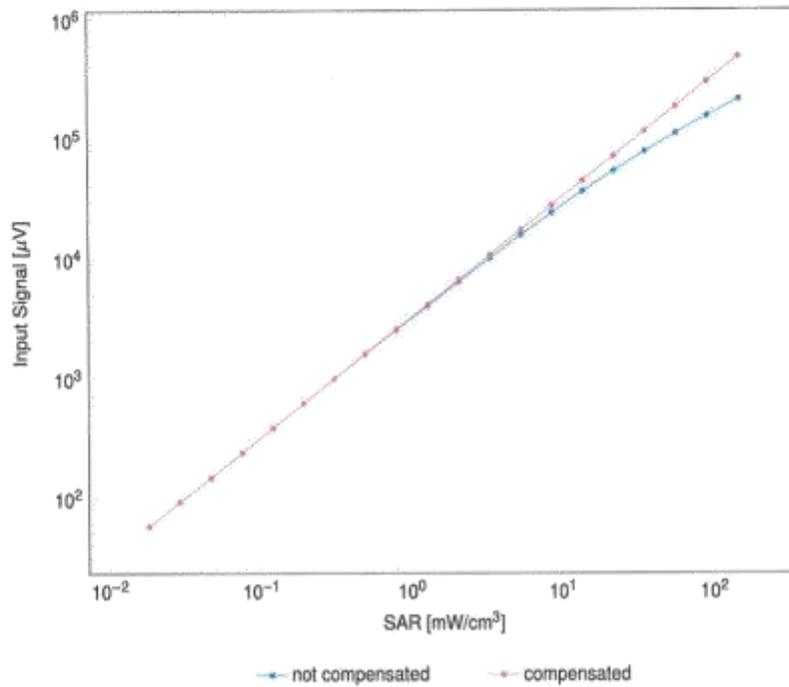


EX3DV4 - SN:7511

July 23, 2024

Dynamic Range f(SAR_{head})

(TEM cell, f_{eval} = 1900MHz)

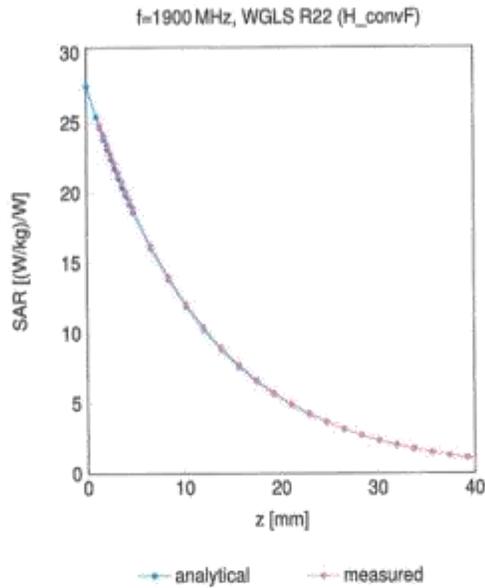


Uncertainty of Linearity Assessment: ±0.6% (k=2)

EX3DV4 - SN:7511

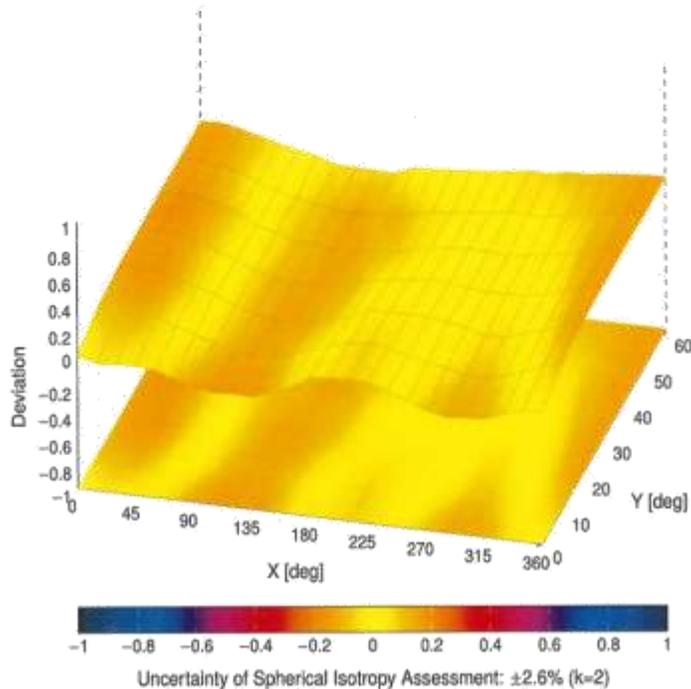
July 23, 2024

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900MHz



Appendix C

Dipole Calibration Certificates

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D450V3-1053_Feb22**

CALIBRATION CERTIFICATE

Object **D450V3 - SN:1053**

Calibration procedure(s) **QA CAL-15.v9
Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **February 17, 2022**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310882 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3877	31-Dec-21 (No. EX3-3877_Dec21)	Dec-22
DAE4	SN: 654	26-Jan-22 (No. DAE4-654_Jan22)	Jan-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: G841293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name Jeffrey Katzman	Function Laboratory Technician	Signature 
Approved by:	Name Sven Kühn	Deputy Manager	

Issued: February 18, 2022

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL tissue simulating liquid
ConvF sensitivity in TSL / NORM x,y,z
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) DASYS System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.3 ± 6 %	0.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.60 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.757 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.07 W/kg ± 17.6 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.2 ± 6 %	0.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	4.63 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.780 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	3.12 W/kg ± 17.6 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	58.5 Ω - 1.7 j Ω
Return Loss	- 21.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.0 Ω - 6.8 j Ω
Return Loss	- 22.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.351 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 15.02.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

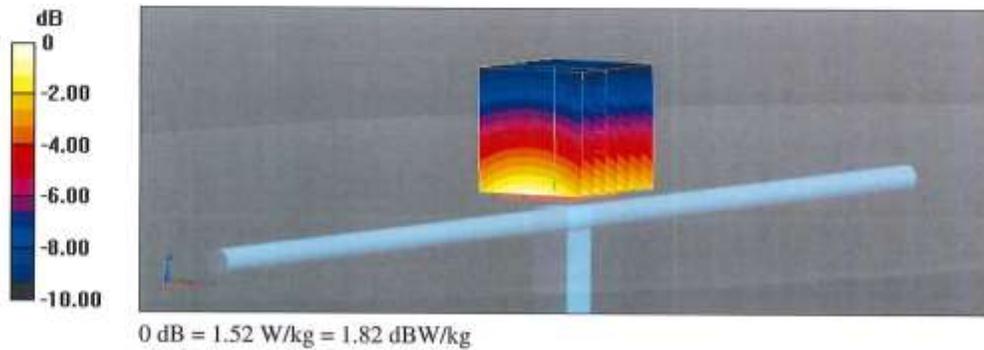
Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.85 \text{ S/m}$; $\epsilon_r = 43.3$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

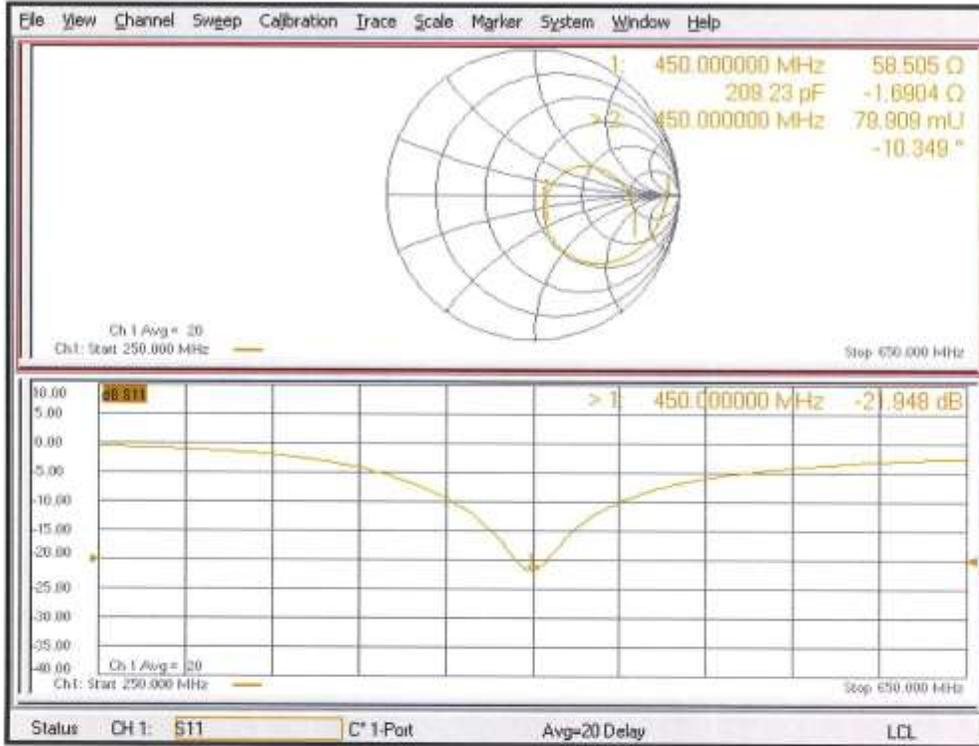
- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 39.17 V/m; Power Drift = 0.02 dB
 Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.13 W/kg; SAR(10 g) = 0.757 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 15 mm)
 Ratio of SAR at M2 to SAR at M1 = 64.8%
 Maximum value of SAR (measured) = 1.52 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.02.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

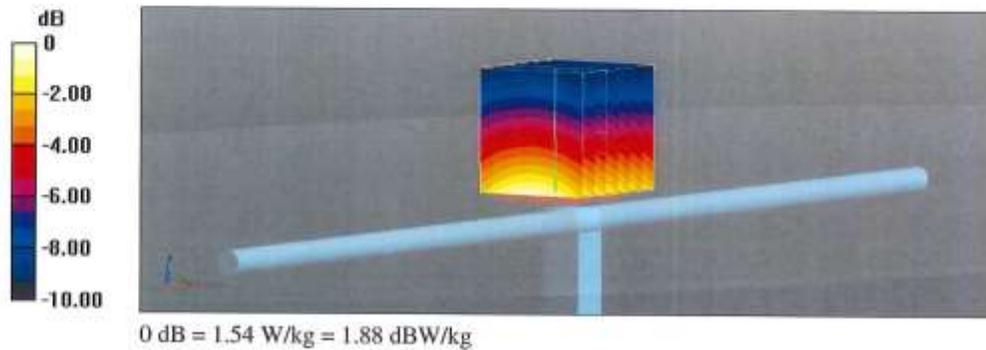
Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 56.2$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

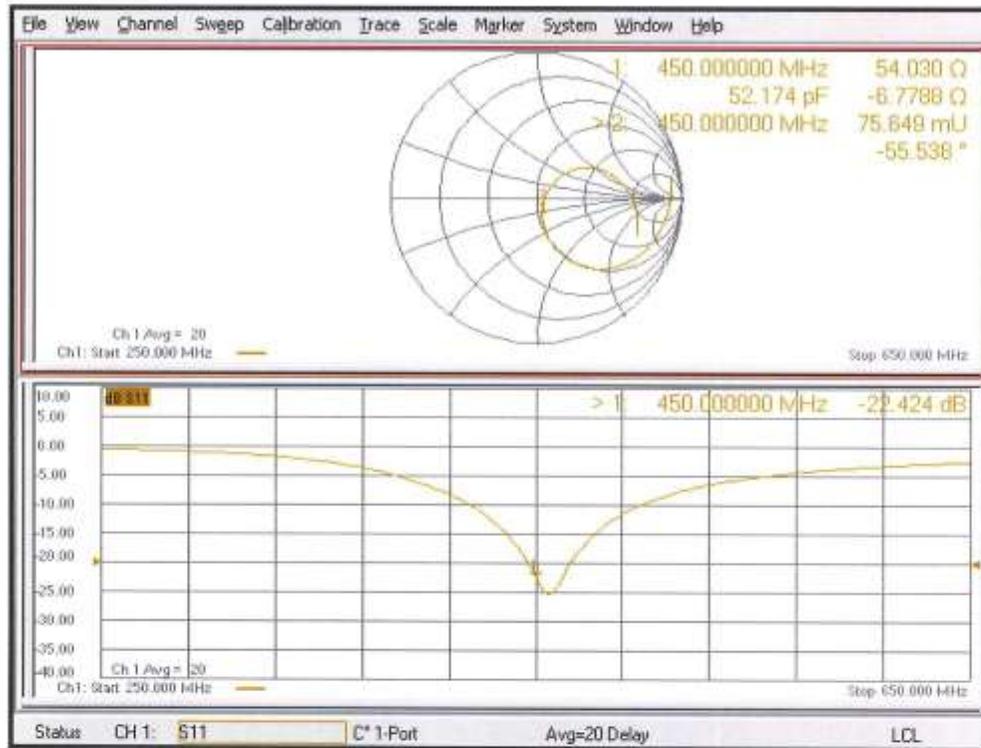
- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 41.70 V/m; Power Drift = -0.04 dB
 Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.780 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 15 mm)
 Ratio of SAR at M2 to SAR at M1 = 66.3%
 Maximum value of SAR (measured) = 1.54 W/kg



Impedance Measurement Plot for Body TSL



**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

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Client **Motorola Solutions**
Bayan Lepas, Malaysia

Certificate No. **D450V3-1054_Jul24**

CALIBRATION CERTIFICATE			
Object	D450V3 - SN:1054		
Calibration procedure(s)	QA CAL-15.v11 Calibration Procedure for SAR Validation Sources below 700 MHz		
Calibration date:	July 16, 2024		
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 3877	10-Jan-24 (No. EX3-3877_Jan24)	Jan-25
DAE4	SN: 654	15-Jan-24 (No. DAE4-654_Jan24)	Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter NRP2	SN: 107193	09-Nov-21 (in house check Dec-22)	In house check: Dec-24
Power sensor NRP-Z91	SN: 100922	15-Dec-09 (in house check Dec-22)	In house check: Dec-24
Power sensor NRP-Z91	SN: 100418	01-Jan-04 (in house check Dec-22)	In house check: Dec-24
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-24)	In house check: Jun-26
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
Calibrated by:	Name Krešimir Franjić	Function Laboratory Technician	Signature
Approved by:	Sven Kühn	Technical Manager	
			Issued: July 16, 2024
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL tissue simulating liquid
ConvF sensitivity in TSL / NORM x,y,z
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Heid And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	45.4 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.64 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.773 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.09 W/kg ± 17.6 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.5 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	4.72 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.804 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	3.19 W/kg ± 17.6 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	58.1 Ω - 1.5 j Ω
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	55.6 Ω - 4.4 j Ω
Return Loss	- 23.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.351 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 15.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1054

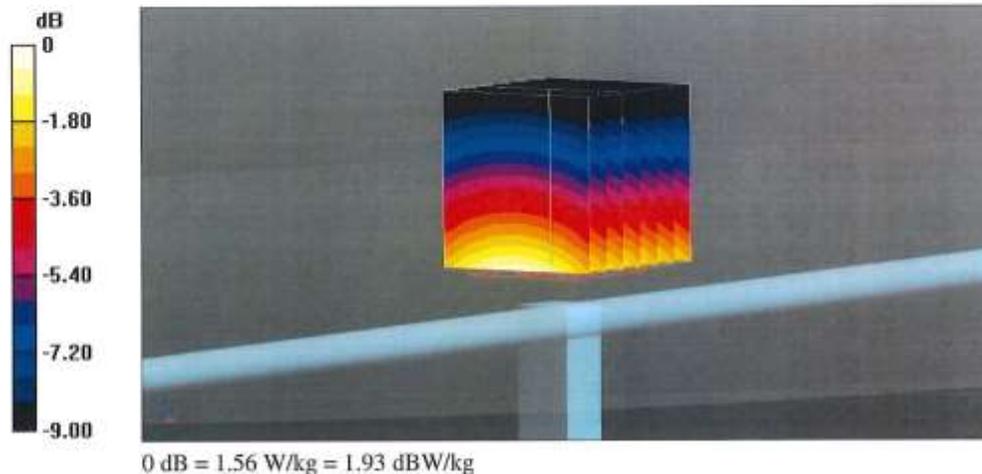
Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.88 \text{ S/m}$; $\epsilon_r = 45.4$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

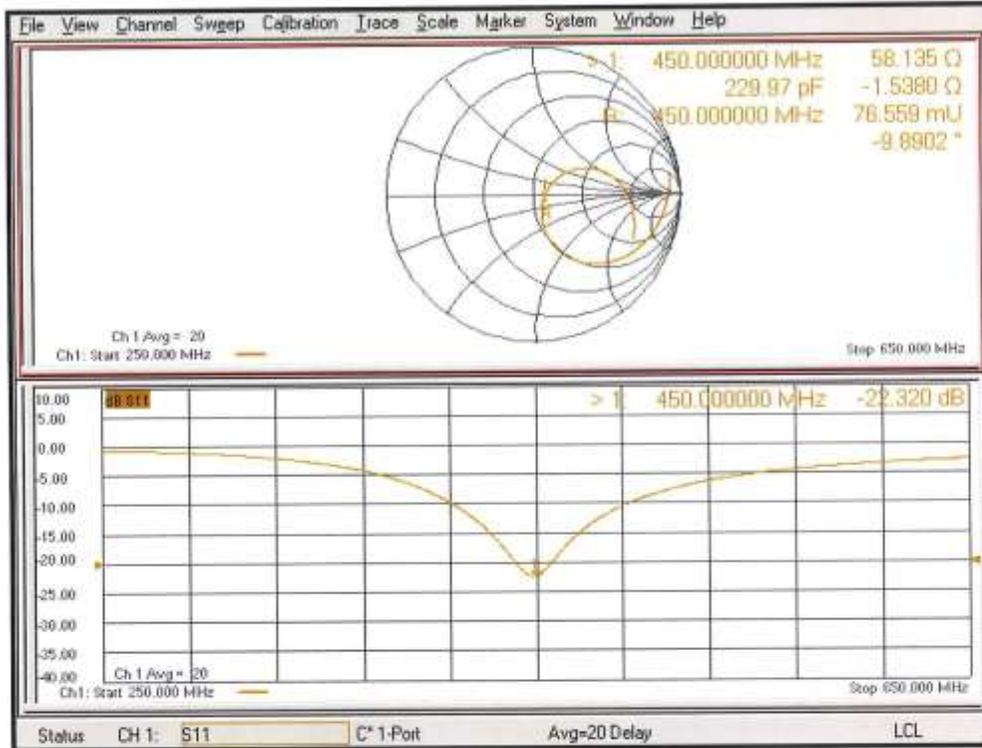
- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 10.01.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 15.01.2024
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 38.96 V/m; Power Drift = -0.01 dB
 Peak SAR (extrapolated) = 1.80 W/kg
SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.773 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 15 mm)
 Ratio of SAR at M2 to SAR at M1 = 64.1%
 Maximum value of SAR (measured) = 1.56 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1054

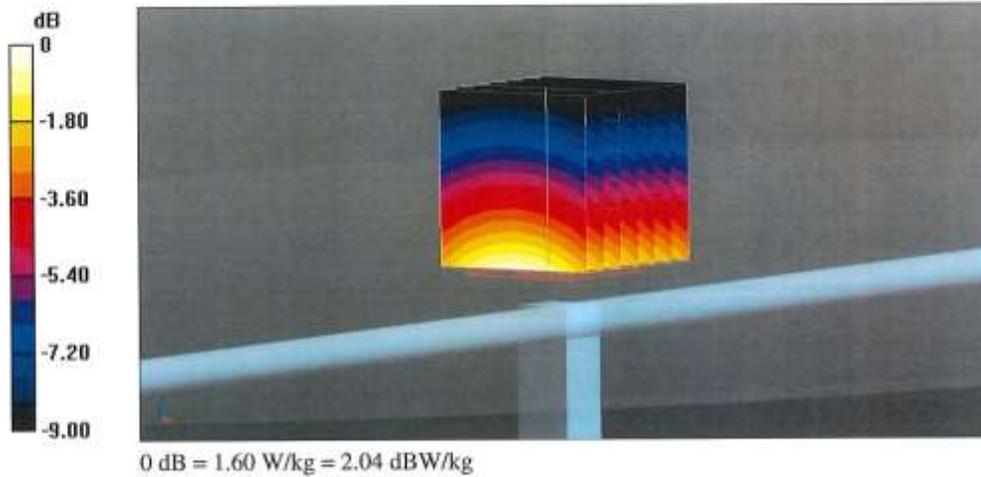
Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: $f = 450$ MHz; $\sigma = 0.95$ S/m; $\epsilon_r = 56.5$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

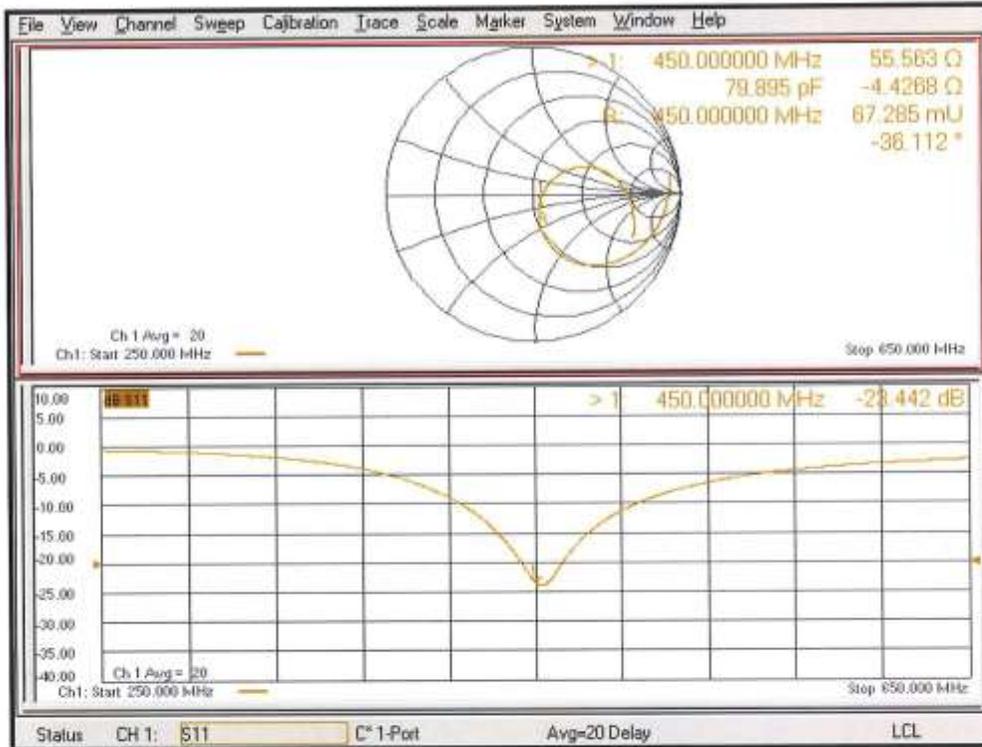
- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 10.01.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 15.01.2024
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 42.70 V/m; Power Drift = -0.06 dB
 Peak SAR (extrapolated) = 1.82 W/kg
SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.804 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 15 mm)
 Ratio of SAR at M2 to SAR at M1 = 65.5%
 Maximum value of SAR (measured) = 1.60 W/kg



Impedance Measurement Plot for Body TSL



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Client **Motorola Solutions**
Bayan Lepas, Malaysia

Certificate No. **D2450V2-782_Jul24**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN:782**

Calibration procedure(s) **QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **July 16, 2024**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)*°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
DAE4	SN: 601	22-May-24 (No. DAE4-601_May24)	May-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8356A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

Calibrated by: **Jeffrey Katzman** (Name), **Laboratory Technician** (Function), *[Signature]* (Signature)

Approved by: **Sven Kühn** (Name), **Technical Manager** (Function), *[Signature]* (Signature)

Issued: July 17, 2024

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Accreditation No.: **SCS 0108**

Glossary:

TSL tissue simulating liquid
 ConvF sensitivity in TSL / NORM x,y,z
 N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) DASYS System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.82 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.3 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω + 3.5 jΩ
Return Loss	- 28.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 Ω + 5.2 jΩ
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.155 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

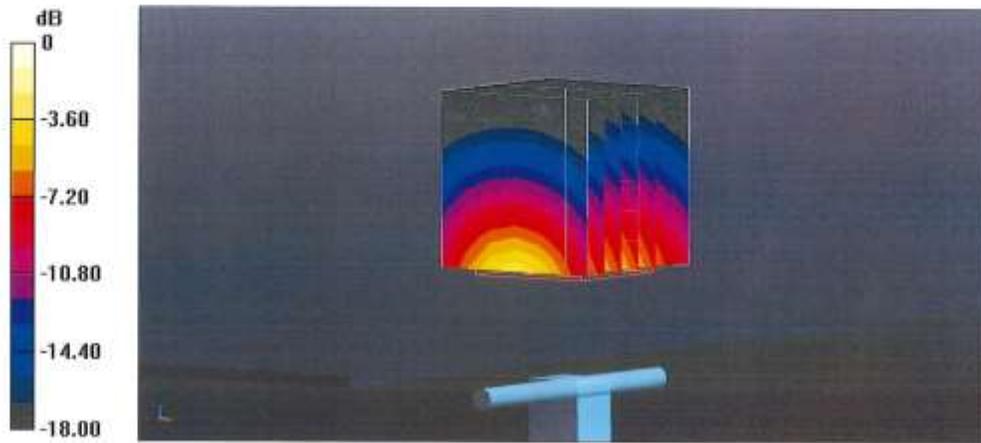
Communication System: UID 0 - CW; Frequency: 2450 MHz
 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.82$ S/m; $\epsilon_r = 37.7$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

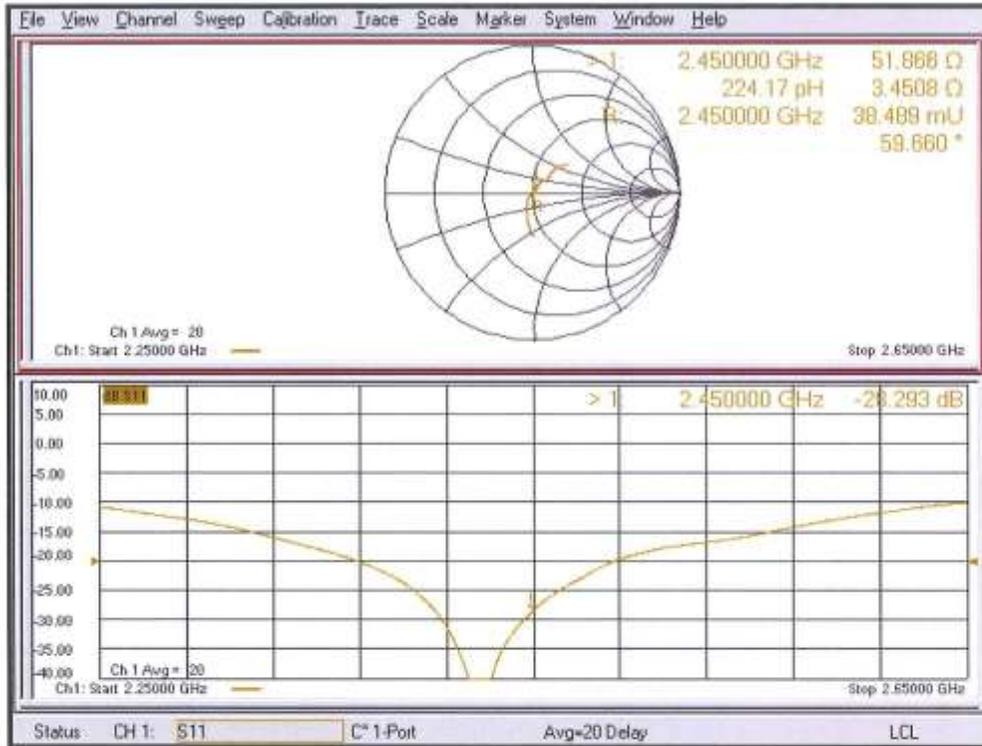
- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 117.3 V/m; Power Drift = 0.02 dB
 Peak SAR (extrapolated) = 26.4 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.25 W/kg
 Smallest distance from peaks to all points 3 dB below = 9 mm
 Ratio of SAR at M2 to SAR at M1 = 50.7%
 Maximum value of SAR (measured) = 22.0 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.07.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

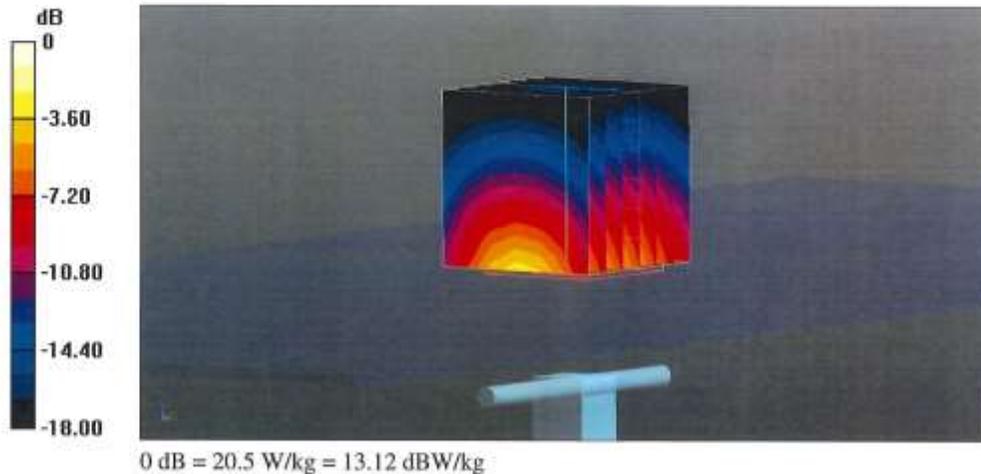
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

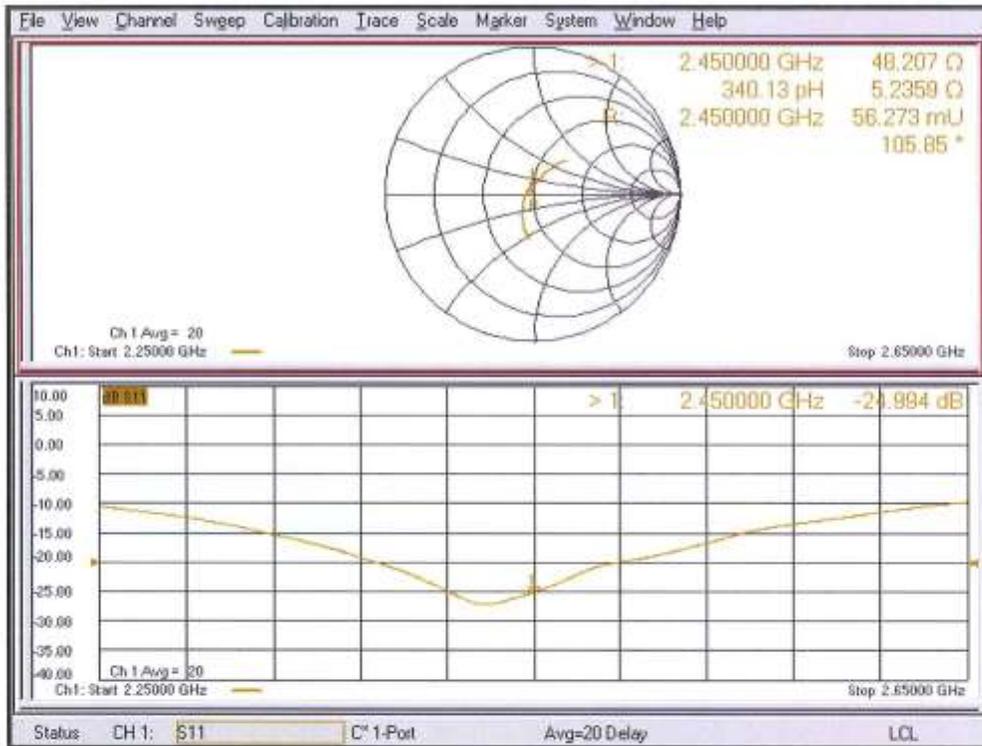
- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.05.2024
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.5 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 24.1 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.08 W/kg
Smallest distance from peaks to all points 3 dB below = 8.5 mm
Ratio of SAR at M2 to SAR at M1 = 54.3%
Maximum value of SAR (measured) = 20.5 W/kg



Impedance Measurement Plot for Body TSL



**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Client **Motorola Solutions**
Bayan Lepas, Malaysia

Certificate No. **D5GHzV2-1022_Apr24**

CALIBRATION CERTIFICATE

Object: **D5GHzV2 - SN:1022**

Calibration procedure(s): **QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **April 11, 2024**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 3503	07-Mar-24 (No. EX3-3503_Mar24)	Mar-25
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: April 12, 2024

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Glossary:

TSL tissue simulating liquid
ConvF sensitivity in TSL / NORM x,y,z
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.4 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.99 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.21 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.38 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.3 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.7 ± 6 %	5.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.6 ± 6 %	6.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.3 ± 6 %	6.28 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.9 Ω + 1.8 j Ω
Return Loss	- 34.2 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.5 Ω + 3.9 j Ω
Return Loss	- 28.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.9 Ω + 5.9 j Ω
Return Loss	- 22.1 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.6 Ω + 7.2 j Ω
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	50.9 Ω + 3.0 j Ω
Return Loss	- 30.3 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.8 Ω + 4.8 j Ω
Return Loss	- 26.4 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.7 Ω + 6.6 j Ω
Return Loss	-20.5 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.3 Ω + 8.3 j Ω
Return Loss	-20.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.208 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 11.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1022

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.6$ S/m; $\epsilon_r = 36.4$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5500$ MHz; $\sigma = 4.87$ S/m; $\epsilon_r = 35.9$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5600$ MHz; $\sigma = 4.99$ S/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5800$ MHz; $\sigma = 5.21$ S/m; $\epsilon_r = 35.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5.04, 5.04, 5.04) @ 5500 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.86, 4.86, 4.86) @ 5800 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.80V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 27.1W/kg

SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.26 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.1%

Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.45 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 33.3 W/kg

SAR(1 g) = 8.57 W/kg; SAR(10 g) = 2.42 W/kg

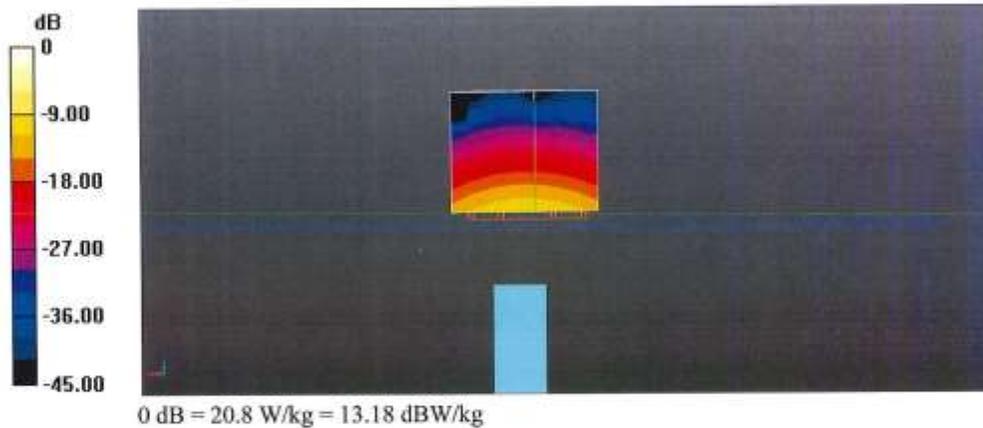
Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.3%

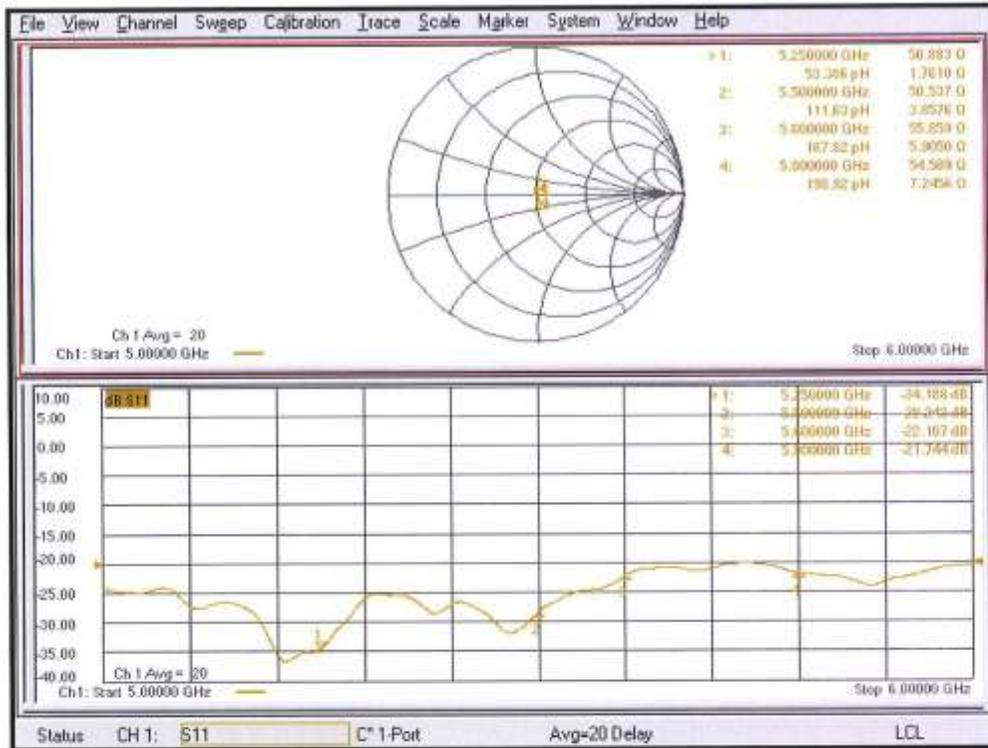
Maximum value of SAR (measured) = 20.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.24 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 67.3%
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 71.05 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.26 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 65.2%
Maximum value of SAR (measured) = 19.7 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1022

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 5.49$ S/m; $\epsilon_r = 49.3$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5500$ MHz; $\sigma = 5.85$ S/m; $\epsilon_r = 48.7$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5600$ MHz; $\sigma = 6$ S/m; $\epsilon_r = 48.6$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5800$ MHz; $\sigma = 6.28$ S/m; $\epsilon_r = 48.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.15, 5.15, 5.15) @ 5250 MHz, ConvF(4.69, 4.69, 4.69) @ 5500 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.48, 4.48, 4.48) @ 5800 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.19 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.10 W/kg

Smallest distance from peaks to all points 3 dB below = 6.8 mm

Ratio of SAR at M2 to SAR at M1 = 67.4%

Maximum value of SAR (measured) = 16.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.28 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.21 W/kg

Smallest distance from peaks to all points 3 dB below = 6.9 mm

Ratio of SAR at M2 to SAR at M1 = 65.2%

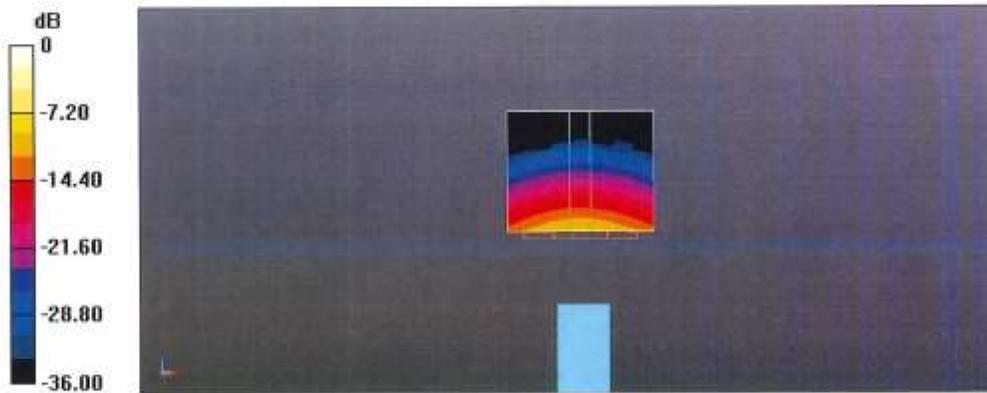
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.34 V/m; Power Drift = -0.09 dB
 Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.18 W/kg
 Smallest distance from peaks to all points 3 dB below = 7.2 mm
 Ratio of SAR at M2 to SAR at M1 = 65.1%
 Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.36 V/m; Power Drift = -0.07 dB
 Peak SAR (extrapolated) = 31.5 W/kg
SAR(1 g) = 7.46 W/kg; SAR(10 g) = 2.07 W/kg
 Smallest distance from peaks to all points 3 dB below = 7.2 mm
 Ratio of SAR at M2 to SAR at M1 = 63.5%
 Maximum value of SAR (measured) = 17.9 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Body TSL



Dipole Data

The table below includes dipole impedance and return loss measurement data measured by Motorola Solutions' EME lab. The results meet the requirements stated in KDB 865664.

Dipole D450V3-1053	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
04/14/22	53.67	-6.74	-23.23
02/11/23	49.82	-7.88	-21.75
2/21/24	51.93	-7.78	-21.32

Dipole D450V3-1054	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
08/15/24	62.26	-6.15	-20.27

Dipole D2450V2-782	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
08/14/24	52.01	3.89	-27.40

Dipole D5250V2-1022	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
05/12/24	49.05	-2.88	-29.89

Dipole D5500V2-1022	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
05/12/24	53.00	4.90	-24.83

Dipole D5600V2-1022	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
08/20/24	55.39	5.12	-22.20

Dipole D5800V2-1022	Head		
	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB
08/20/24	55.83	7.55	-21.30