

COMOSAR E-Field Probe Calibration Report

Ref: ACR.197.12.21.BES.A

WALTEK TESTING GROUP (SHENZHEN) CO., LTD

1/F., ROOM 101, BUILDING 1, HONGWEI INDUSTRIAL PARK, LIUXIAN 2ND ROAD, BLOCK 70 BAO'AN DISTRICT, SHENZHEN, GUANGDONG , CHINA MVG COMOSAR DOSIMETRIC E-FIELD PROBE SERIAL NO.: SN 18/21 EPG0356

Calibrated at MVG Z.I. de la pointe du diable Technopôle Brest Iroise – 295 avenue Alexis de Rochon 29280 PLOUZANE - FRANCE

Calibration date: 07/08/2022



Accreditations #2-6789 Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited COMOSAR E-Field Probe calibration performed at MVG, using the CALIPROBE test bench, for use with a MVG COMOSAR system only. The test results covered by accreditation are traceable to the International System of Units (SI).



	Name	Function	Date	Signature
Prepared by :	Jérôme Le Gall	Measurement Responsible	7/10/2022	A
Checked by :	Jérôme Luc	Technical Manager	7/10/2022	JES
Approved by :	Yann Toutain	Laboratory Director	7/14/2022	Gann TOUTAAN
				2022.07.14

10:05:50 +03'00'

	Customer Name
Distribution :	Waltek Testing Group (Shenzhen) Co., Ltd

Issue	Name	Date	Modifications
Α	Jérôme Luc	7/10/2022	Initial release

Page: 2/10



TABLE OF CONTENTS

1	Dev	ice Under Test4	
2	Proc	luct Description4	
	2.1	General Information	4
3	Mea	surement Method4	
	3.1	Linearity	4
	3.2	Sensitivity	5
	3.3	Lower Detection Limit	5
	3.4	Isotropy	5
	3.1	Boundary Effect	5
4	Mea	surement Uncertainty	
5	Cali	bration Measurement Results	
	5.1	Sensitivity in air	6
	5.2	Linearity	7
	5.3	Sensitivity in liquid	8
	5.4	Isotropy	9
6	List	of Equipment10	

Page: 3/10



1 DEVICE UNDER TEST

Device Under Test			
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE		
Manufacturer	MVG		
Model	SSE2		
Serial Number	SN 18/21 EPGO356		
Product Condition (new / used)	New		
Frequency Range of Probe	0.15 GHz-6GHz		
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.221 MΩ		
	Dipole 2: R2=0.197 MΩ		
	Dipole 3: R3=0.195 MΩ		

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards.

In the second second second second second second	
The local division of	

Figure 1 – *MVG COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

Page: 4/10

Template_ACR.DDD.N.YY.MVGB.ISSUE_COMOSAR Probe vI



3.2 <u>SENSITIVITY</u>

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 to 360 degrees in 15-degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°-180°) in 15° increments. At each step the probe is rotated about its axis (0°-360°).

3.1 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

The boundary effect uncertainty can be estimated according to the following uncertainty approximation formula based on linear and exponential extrapolations between the surface and $d_{be} + d_{step}$ along lines that are approximately normal to the surface:

$$SAR_{uncertainly} [\%] = \delta SAR_{be} \frac{\left(d_{be} + d_{step}\right)^2}{2d_{step}} \frac{\left(e^{-d_{be}/(\delta/2)}\right)}{\delta/2} \quad \text{for } \left(d_{be} + d_{step}\right) < 10 \text{ mm}$$

where	
SARuncertainty	is the uncertainty in percent of the probe boundary effect
dbe	is the distance between the surface and the closest zoom-scan measurement
Δ_{sten}	point, in millimetre is the separation distance between the first and second measurement points that
step	are closest to the phantom surface, in millimetre, assuming the boundary effect at the second location is negligible
δ	is the minimum penetration depth in millimetres of the head tissue-equivalent
	liquids defined in this standard, i.e., $\delta \approx 14$ mm at 3 GHz;
⊿SAR _{be}	in percent of SAR is the deviation between the measured SAR value, at the
	distance d_{be} from the boundary, and the analytical SAR value.

Page: 5/10

Template_ACR.DDD.N.YY.MVGB.ISSUE_COMOSAR Probe vI



The measured worst case boundary effect SARuncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Incertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Expanded uncertainty 95 % confidence level k = 2					14 %

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters			
Liquid Temperature	20 +/- 1 °C		
Lab Temperature	20 +/- 1 °C		
Lab Humidity	30-70 %		

5.1 SENSITIVITY IN AIR

Normx dipole 1 $(\mu V/(V/m)^2)$	Normy dipole $2 (\mu V/(V/m)^2)$	Normz dipole 3 $(\mu V/(V/m)^2)$
0.98	0.94	0.75

DCP dipole 1	DCP dipole 2	DCP dipole 3
105	107	104

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula: $E = \sqrt{E_1^2 + E_2^2 + E_3^2}$

Page: 6/10

Template_ACR.DDD.N.YY.MVGB.ISSUE_COMOSAR Probe vI



Dipole 1

Dipole 2

Dipole 3









Linearity:+/-1.73% (+/-0.08dB)

Page: 7/10



SENSITIVITY IN LIQUID 5.3

Liquid	<u>Frequency</u> (MHz +/- 100MHz)	<u>ConvF</u>
HL750	750	1.66
BL750	750	1.76
HL850	835	1.71
BL850	835	1.78
HL900	900	1.88
BL900	900	1.85
HL1800	1800	2.11
BL1800	1800	2.15
HL1900	1900	2.21
BL1900	1900	2.30
HL2000	2000	2.41
BL2000	2000	2.39
HL2450	2450	2.29
BL2450	2450	2.60
HL2600	2600	2.22
BL2600	2600	2.41
HL3300	3300	2.64
BL3300	3300	2.16
HL3500	3500	2.05
BL3500	3500	2.20
HL3700	3700	2.27
BL3700	3700	2.24
HL3900	3900	2.38
BL3900	3900	2.45
HL4200	4200	2.42
BL4200	4200	2.53
HL4600	4600	2.41
BL4600	4600	2.64
HL4900	4900	2.21
BL4900	4900	2.46
HL5200	5200	1.91
BL5200	5200	1.84
HL5400	5400	2.12
BL5400	5400	2.02
HL5600	5600	2.25
BL5600	5600	2.20
HL5800	5800	2.14
BL5800	5800	2.11

LOWER DETECTION LIMIT: 8mW/kg



5.4 ISOTROPY

HL1800 MHz



Page: 9/10



LIST OF EQUIPMENT 6

Equipment Summary Sheet							
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date			
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.			
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.			
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2022	05/2024			
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2022	05/2024			
Multimeter	Keithley 2000	1160271	02/2020	02/2023			
Signal Generator	Rohde & Schwarz SMB	106589	04/2022	04/2024			
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.			
Power Meter	NI-USB 5680	170100013	05/2022	05/2024			
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.			
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.			
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.			
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.			
Temperature / Humidity Sensor	Testo 184 H1	44220687	05/2020	05/2023			

Page: 10/10



SAR Reference Dipole Calibration Report

Ref: ACR.104.1.15.SATU.A

Waltek Testing Group (Shenzhen) Co., Ltd. 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road BAO'AN DISTRICT SHENZHEN, P.R.C. (518101) MVG COMOSAR REFERENCE DIPOLE FREQUENCY: 2450 MHZ SERIAL NO.: SN 13/15 DIP 2G450-364

Calibrated at MVG US 2105 Barrett Park Dr. - Kennesaw, GA 30144



Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



			1	
	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/11/2020	JES
Checked by :	Jérôme LUC	Product Manager	3/11/2020	Jez
Approved by :	Kim RUTKOWSKI	Quality Manager	3/11/2020	thim nuthowski

	Customer Name
Distribution :	Waltek Testing Group (Shenzhen) Co., Ltd.

Issue	Date	Modifications
А	3/11/2020	Initial release

Page: 2/11





TABLE OF CONTENTS

1	Intro	oduction	
2	Dev	ice Under Test	
3	Proc	luct Description	
	3.1	General Information	4
4	Mea	surement Method	
	4.1	Return Loss Requirements	5
	4.2	Mechanical Requirements	5
5	Mea	surement Uncertainty	
	5.1	Return Loss	5
	5.2	Dimension Measurement	5
	5.3	Validation Measurement	5
6	Cali	bration Measurement Results	
	6.1	Return Loss and Impedance In Head Liquid	6
	6.2	Return Loss and Impedance In Body Liquid	6
	6.3	Mechanical Dimensions	6
7	Vali	dation measurement7	
	7.1	Head Liquid Measurement	7
	7.2	SAR Measurement Result With Head Liquid	8
	7.3	Body Liquid Measurement	9
	7.4	SAR Measurement Result With Body Liquid	10
8	List	of Equipment11	

Page: 3/11



1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test				
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE			
Manufacturer	MVG			
Model	SID2450			
Serial Number	SN 13/15 DIP 2G450-364			
Product Condition (new / used)	New			

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 <u>GENERAL INFORMATION</u>

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole

Page: 4/11



4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 <u>RETURN LOSS REQUIREMENTS</u>

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 <u>RETURN LOSS</u>

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss			
400-6000MHz	0.1 dB			

5.2 **DIMENSION MEASUREMENT**

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length		
3 - 300	0.05 mm		

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty		
1 g	20.3 %		

Page: 5/11





6 CALIBRATION MEASUREMENT RESULTS

6.1 <u>RETURN LOSS AND IMPEDANCE IN HEAD LIQUID</u>



6.2 <u>RETURN LOSS AND IMPEDANCE IN BODY LIQUID</u>



6.3 MECHANICAL DIMENSIONS

Frequency MHz	Ln	nm	h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	

Page: 6/11



450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 <u>HEAD LIQUID MEASUREMENT</u>

Frequency	Relative permittivity (&')		Conductivity (σ) S/m	
MHz		(0)		
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11





1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps': 38.9 sigma : 1.79
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	required measured		measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

Page: 8/11



1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	53.76 (5.38)	24	24.32 (2.43)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	





7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ɛr')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %	PASS	1.95 ±5 %	PASS

Page: 9/11





2600	52.5 ±5 %	2.16 ±5 %	
3000	52.0 ±5 %	2.73 ±5 %	
3500	51.3 ±5 %	3.31 ±5 %	
5200	49.0 ±10 %	5.30 ±10 %	
5300	48.9 ±10 %	5.42 ±10 %	
5400	48.7 ±10 %	5.53 ±10 %	
5500	48.6 ±10 %	5.65 ±10 %	
5600	48.5 ±10 %	5.77 ±10 %	
5800	48.2 ±10 %	6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.7 sigma : 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	50.33 (5.03)	23.38 (2.34)



Page: 10/11



8 LIST OF EQUIPMENT

Equipment Summary Sheet						
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date		
SAM Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.		
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.		
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2019	02/2022		
Calipers	Carrera	CALIPER-01	12/2019	12/2022		
Reference Probe	MVG	EPG122 SN 18/11	10/2019	10/2020		
Multimeter	Keithley 2000	1188656	12/2019	12/2022		
Signal Generator	Agilent E4438C	MY49070581	12/2019	12/2022		
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.		
Power Meter	HP E4418A	US38261498	12/2019	12/2020		
Power Sensor	HP ECP-E26A	US37181460	12/2019	12/2022		
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.		
Temperature and Humidity Sensor	Control Company	11-661-9	8/2018	8/2021		

Page: 11/11

Appendix A. Extended Calibration SAR Dipole

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dBm, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2020-03-11	-21.10	/	45.2	/	7.3	/
2021-03-01	-22.02	19.09	46.0	0.8	7.0	0.3
2022-03-08	-21.48	8.38	46.6	1.4	6.5	0.8

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2020-03-11	-22.73	/	48.7	/	7.2	/
2021-03-01	-23.42	14.69	48.9	0.2	7.0	0.2
2022-03-08	-23.28	11.90	49.3	0.6	6.8	0.4

The Return-Loss is <-20dB, and within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the value result should support extended.