

## ANNEX E DIPOLE CALIBRATION CERTIFICATE

### Dipole 2450 MHz

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



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

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **CTTL-BJ (Auden)**

Certificate No: **CD2450V3-1021\_Aug20**

### CALIBRATION CERTIFICATE

Object	CD2450V3 - SN: 1021					
Calibration procedure(s)	QA CAL-20.v7 Calibration Procedure for Validation Sources in air					
Calibration date:	August 18, 2020					
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 $(22 \pm 3)^\circ\text{C}$ 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	01-Apr-20 (No. 217-03100/03101)	Apr-21			
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21			
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21			
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21			
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21			
Probe EF3DV3	SN: 4013	31-Dec-19 (No. EF3-4013_Dec19)	Dec-20			
DAE4	SN: 781	27-Dec-19 (No. DAE4-781_Dec19)	Dec-20			
Secondary Standards	ID #	Check Date (in house)	Scheduled Check			
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-17)	In house check: Oct-20			
Power sensor HP E4412A	SN: US38485102	05-Jan-10 (in house check Oct-17)	In house check: Oct-20			
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-17)	In house check: Oct-20			
RF generator R&S SMT-06	SN: 837633/005	10-Jan-19 (in house check Jan-19)	In house check: Oct-20			
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20			
Calibrated by:	Name Leif Klynsner	Function Laboratory Technician	Signature 			
Approved by:	Katja Pokovic	Technical Manager				
Issued: August 18, 2020 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.						

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Accreditation No.: **SCS 0108**

#### References

[1] ANSI-C63.19-2011  
American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

#### Methods Applied and Interpretation of Parameters:

- Coordinate System:** y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- Measurement Conditions:** Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- Antenna Positioning:** The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections. It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- Feed Point Impedance and Return Loss:** These parameters are measured using a Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminated by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- E-field distribution:** E field is measured in the x-y-plane with an isotropic E-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelism to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

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.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Phantom</b>	HAC Test Arch	
<b>Distance Dipole Top - Probe Center</b>	15 mm	
<b>Scan resolution</b>	$dx, dy = 5 \text{ mm}$	
<b>Frequency</b>	$2450 \text{ MHz} \pm 1 \text{ MHz}$	
<b>Input power drift</b>	$< 0.05 \text{ dB}$	

### Maximum Field values at 2450 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	$85.8 \text{ V/m} = 38.67 \text{ dBV/m}$
Maximum measured above low end	100 mW input power	$85.4 \text{ V/m} = 38.62 \text{ dBV/m}$
Averaged maximum above arm	100 mW input power	<b><math>85.6 \text{ V/m} \pm 12.8 \% \text{ (k=2)}</math></b>

### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters

Frequency	Return Loss	Impedance
2250 MHz	18.4 dB	$63.0 \Omega + 4.2 \text{ j} \Omega$
2350 MHz	30.9 dB	$52.3 \Omega - 1.8 \text{ j} \Omega$
2450 MHz	27.9 dB	$53.9 \Omega - 1.4 \text{ j} \Omega$
2550 MHz	30.0 dB	$50.5 \Omega - 3.1 \text{ j} \Omega$
2650 MHz	19.2 dB	$59.7 \Omega - 7.1 \text{ j} \Omega$

#### 3.2 Antenna Design and Handling

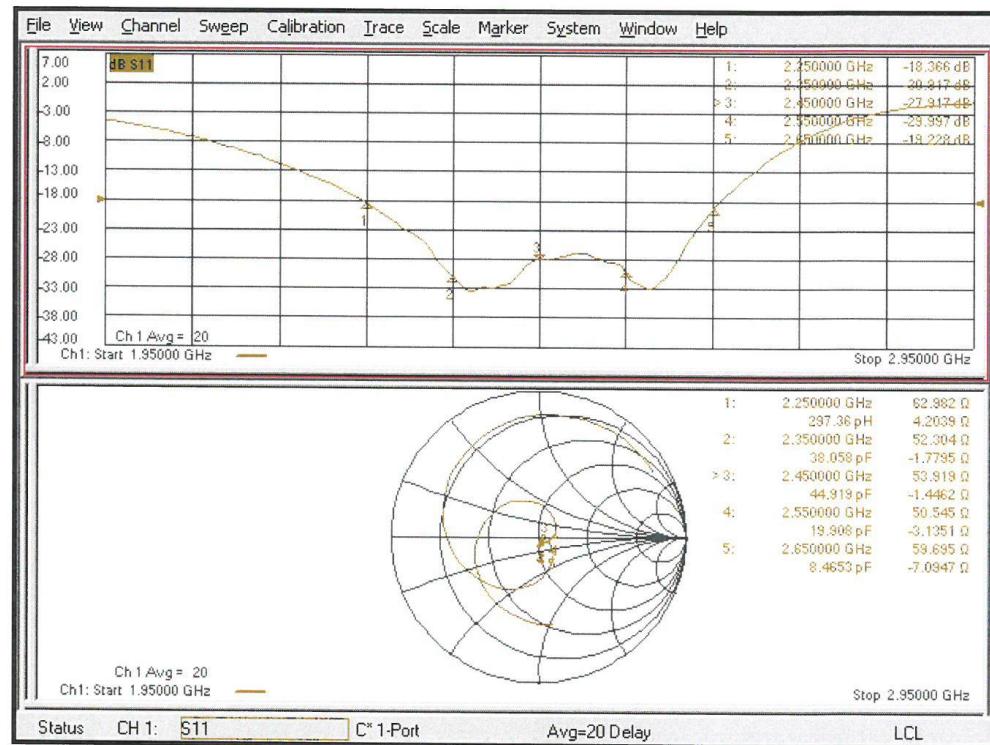
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

### Impedance Measurement Plot



## DASY5 E-field Result

Date: 18.08.2020

Test Laboratory: SPEAG Lab2

**DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: CD2450V3 - SN: 1021**

Communication System: UID 0 - CW ; Frequency: 2450 MHz

Medium parameters used:  $\sigma = 0 \text{ S/m}$ ,  $\epsilon_r = 1$ ;  $\rho = 0 \text{ kg/m}^3$

Phantom section: RF Section

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

DASY5 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 2450 MHz; Calibrated: 31.12.2019
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 27.12.2019
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY5 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Dipole E-Field measurement @ 2450MHz/E-Scan - 2450MHz d=15mm/Hearing Aid Compatibility Test (41x181x1):**

Interpolated grid:  $dx=0.5000 \text{ mm}$ ,  $dy=0.5000 \text{ mm}$

Device Reference Point: 0, 0, -6.3 mm

Reference Value = 76.28 V/m; Power Drift = 0.02 dB

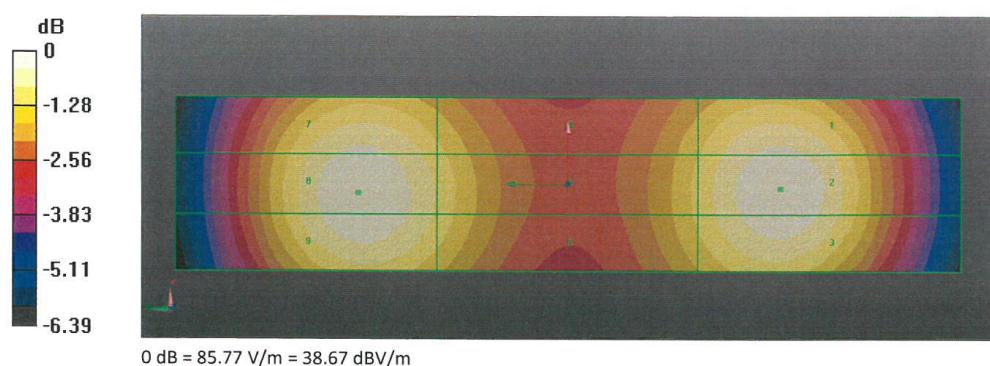
Applied MIF = 0.00 dB

RF audio interference level = 38.67 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 M2	Grid 3 M2
38.36 dBV/m	38.62 dBV/m	38.53 dBV/m
Grid 4 M2	Grid 5 M2	Grid 6 M2
37.54 dBV/m	37.77 dBV/m	37.72 dBV/m
Grid 7 M2	Grid 8 M2	Grid 9 M2
38.36 dBV/m	38.67 dBV/m	38.6 dBV/m



## ANNEX F DAE CALIBRATION CERTIFICATE



In Collaboration with  
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国际互认  
校准  
CALIBRATION  
CNAS L0570

Client :

Certificate No: Z20-60391

## CALIBRATION CERTIFICATE

Object DAE4 - SN: 1524

Calibration Procedure(s) FF-Z11-002-01  
Calibration Procedure for the Data Acquisition Electronics  
(DAEEx)

Calibration date: September 30, 2020

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( $22\pm3$ )°C and humidity<70%.

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	16-Jun-20 (CTTL, No.J20X04342)	Jun-21

Calibrated by:	Name Yu Zongying	Function SAR Test Engineer	Signature
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 02, 2020

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**Glossary:**

DAE data acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



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### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB =  $6.1\mu V$  , full range =  $-100...+300\text{ mV}$

Low Range: 1LSB =  $61\text{nV}$  , full range =  $-1.....+3\text{mV}$

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	$406.128 \pm 0.15\% \text{ (k=2)}$	$405.367 \pm 0.15\% \text{ (k=2)}$	$405.663 \pm 0.15\% \text{ (k=2)}$
Low Range	$3.99248 \pm 0.7\% \text{ (k=2)}$	$4.01837 \pm 0.7\% \text{ (k=2)}$	$3.99410 \pm 0.7\% \text{ (k=2)}$

### Connector Angle

Connector Angle to be used in DASY system	$82^\circ \pm 1^\circ$
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**The photos of HAC test are presented in the additional document:**

Appendix to test report No.I21Z60772-SEM02

The photos of HAC test