

Hearing Aid Compatibility (HAC) <u>TEST REPORT</u> <For RF-Emission Measurement>

Product Name	Smartphone		
Model No.(EUT):	U452TL		
Trade Mark:	UMX		
Company Name	Unimax communications		
Company Address	18201 McDurmott St.West Suite E,Irvine,CA 92614		
Manufacturer's Name	Unimaxcomm		
	Room 602, Building-B, Shenzhen Software Park T3, Hi-Tech		
Manufacturer's Address	Park South, Nan Shan District, Shenzhen, China		
Factory's Name	Unimaxcomm		
Room 602, Building-B, Shenzhen Software Park T3,			
Factory's Address	Park South, Nan Shan District,		
FCC ID	P46-U452TL		
Date of receive	Feb. 12, 2018		
Date of Issue	Mar. 23, 2018		
Standards:			

ANSI C63.19-2011

FCC RULE PART(S): 47 CFR PART 20.19(B) HAC CATEGORY: M4 (M Category)

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

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Sr. Engineer

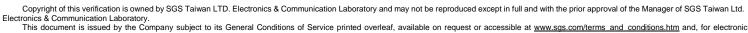
Mate Kno Matt Kuo

Date: Mar. 23, 2018

Asst. Manager

John Teh

John Yeh Date: Mar. 23, 2018



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Revision History

Report Number	Revision	Description	Issue Date
E5/2018/20026	Rev.00	Initial creation of document	Mar. 19, 2018
E5/2018/20026	Rev.01	1 st modification	Mar. 23, 2018
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1. Introduction

The purpose of the Hearing Aid Compatibility is to enable measurements of the near electric fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2011

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:

a) Radio frequency (RF) measurements of the near-field electric fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.

Hence, the following are measurements made for the WD: **RF E-Field emissions**

The measurement plane is parallel to, and 1.5cm in front of, the reference plane.

Applications for certification of equipment operation under part 20, that a manufacturer is seeking to certify as hearing aid compatible, as set forth in §20.19 of that part, shall include a statement indication compliance with the test requirements of §20.19 and indicating the appropriate U-rating for the equipment. The manufacturer of the equipment shall be responsible for maintaining the test results.

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2. Testing Laboratory

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	Taiwan (R.O.C.)	
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Website	http://www.tw.sgs.com/	

3. Details of Applicant

Applicant Name	Unimax communications	
Applicant Address	18201 McDurmott St.West Suite E,Irvine,CA 92614	
Manufacturer's		
Name	Unimaxcomm	
Manufacturer's	Room 602, Building-B, Shenzhen Software Park T3, Hi-Tech Park	
Address	South, Nan Shan District, Shenzhen, China	
Factory's Name	Unimaxcomm	
Factory's Address	Room 602, Building-B, Shenzhen Software Park T3, Hi-Tech Park	
actory 5 Address	South, Nan Shan District,	

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4. Description of EUT

EUT Name	Smartphone			
Trade Mark	UMX			
Model No.	U452TL			
FCC ID	P46-U452TL			
Mode of Operation	WCDMA ⊠LTE FDD (Support VoLTE) WLAN802.11 b/g/n(20M) (Support VoWLAN) ⊠Bluetooth			
	WCDMA		1	
	LTE FDD		1	
Duty Cycle	WLAN802.11 b/g/n(20M)		1	
	Bluetooth		1	
	WCDMA Band II	1850	_	1910
	WCDMA Band IV	1710	—	1755
	WCDMA Band V	824	—	849
	LTE FDD Band 2	1850	—	1910
TX Frequency Range	LTE FDD Band 4	1710	-	1755
(MHz)	LTE FDD Band 12	699		716
	LTE FDD Band 66	1710	-	1780
	LTE FDD Band 71	665.5		695.5
	WLAN802.11 b/g/n(20M)	2412	_	2462
	Bluetooth	2402	—	2480
	WCDMA Band II	9262	_	9538
Channel Number	WCDMA Band IV	1312	_	1513
(ARFCN)	WCDMA Band V	4132	_	4233
	LTE FDD Band 2	18607	_	19193

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Channel Number (ARFCN)	LTE FDD Band 4	19957	—	20393
	LTE FDD Band 12	23017	_	23173
	LTE FDD Band 66	131979	2	132665
	LTE FDD Band 71	133147	4-5	133447
	WLAN802.11 b/g/n(20M)	1		11
	Bluetooth	0	_	78

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5. Air Interfaces and Bands

Air- Interface	Band	Туре	ANSI C63.19 tested	Simultaneous Transmitter	Name of Voice Service	Power Reduction
WCDMA	II IV V	VO	Yes (Note 1.)	BT or Wi-Fi	WCDMA	NA
LTE	2 4 12 66 71	VD	Yes (Note 1.)	BT or Wi-Fi	VoLTE	NA
Wi-Fi	2450	VD	Yes (Note 1.)	WCDMA or LTE	VoWLAN	NA
BT	2450	DT	NA	WCDMA or LTE	NA	NA
Where: VO = CMRS Vo DT = Digital Tra VD = IP Voice 3	ansport onl	y (no voice		Note 1.It applies the low C63.19-2011	power exemption b	ased on ANSI

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6. Test Environment

Ambient Temperature	21.7° C	
Relative Humidity	<80 %	2012

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7. Description of test system

7.1 Measurement system Diagram for SPEAG Robotic

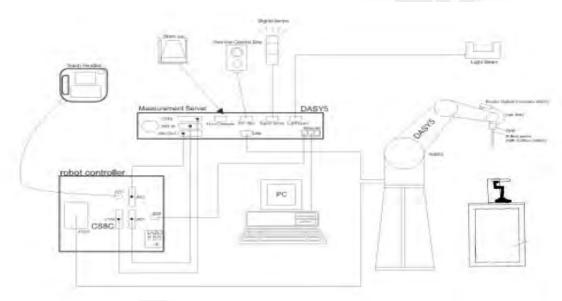


Fig.1 The SPEAG Robotic Diagram

The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- E Field probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.

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- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch phantom.
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.





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7.2 E Field Probe

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material	ITA	
Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)		
Frequency	(extended to 20 MHz for MRI), Linearity: ± 0.2 dB (100 MHz to 3 GHz)	ER3DV6 E-Field Probe	
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)		
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB		
Dimensions	Tip diameter: 8 mm Distance from probe tip to dipole centers: 2.5 mm		

7.3 Test Arch

Description	Enables easy and well defined	
	positioning of the phone and	
	validation dipoles as well as simple	
	teaching of the robot.	
Dimensions	length: 370 mm	
	width: 370 mm	
	height: 370 mm	Test Arch

7.4 Phone Holder

Description	Supports accurate and reliable positioning of any phone Effect on near field <+/- 0.5 dB	
		Phone Holder

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8. Test Procedure

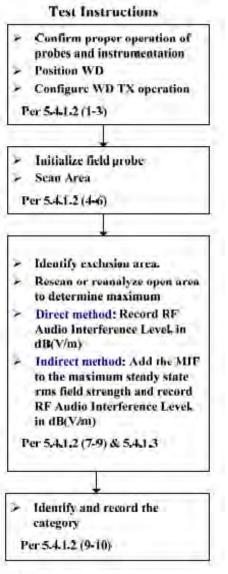


Fig.2 RF emission flow chart

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The following illustrate a typical RF emissions test scan over a wireless communications device (Indirect method):

- 1. Proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed.
- 2. WD is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.
- The WD operation for maximum rated RF output power was configured and confirmed with the base station simulator, at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test.
- 4. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The WD audio output was positioned tangent (as physically possible) to the measurement plane.
- A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the HAC Phantom.
- 6. The measurement system measured the field strength at the reference location.
- 7. Measurements at 5mm increments in the 5 × 5 cm region were performed and recorded. A 360 orotation about the azimuth axis at the maximum interpolated position was measured. For the worst-case condition, the peak reading from this rotation was used in re-evaluating the HAC category.
- 8. The system performed a drift evaluation by measuring the field at the reference location.

Note.

Per KDB 285076 D01 v05 2.c) 1), handsets that that have the ability to support concurrent connections using simultaneous transmissions shall be independently tested for each air interface/band given in ANSI C63.19-2011. At the present time ANSI C63.19 does not provide simultaneous transmission test procedures.

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9. System Verification

A dipole antenna meeting the requirements given in ANSI C63.19-2011 was placed in the position normally occupied by the WD.

The length of the dipole was scanned by E-field probes and the maximum values for each were recorded.

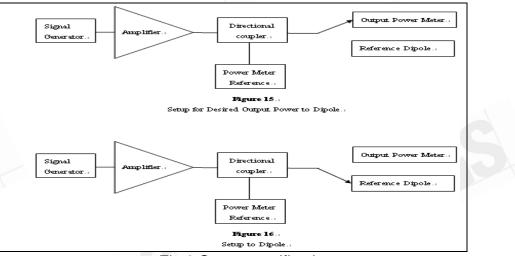


Fig.3 System verification

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10. Modulation Interference Factor

For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF

The MIF may be determined using a radiated RF field or a conducted RF signal,

b) Using RF illumination or conducted coupling, apply the specific modulated signal in

question to the measurement system at a level within its confirmed operating dynamic range.

- Measure the steady-state rms level at the output of the fast probe or sensor. C)
- Measure the steady-state average level at the weighting output. d)

Without changing the square-law detector or weighting system, and using RF e) illumination or conducted coupling, substitute for the specific modulated signal a 1 kHz, 80% amplitude modulated carrier at the same frequency and adjust its strength until the level at the weighting output equals the step d) measurement.

f) Without changing the carrier level from step e), remove the 1 kHz modulation and again

measure the steady-state rms level indicated at the output of the fast probe or sensor.

g) The MIF for the specific modulation characteristic is provided by the ratio of the step f)

measurement to the step c) measurement, expressed in dB $(20 \times \log(\text{step f}))/\text{step c}))$.

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Based on the KDB285076D01v05, the handset can also use the MIF values predetermined by the test equipment manufacturer, and the following table lists the worst case MIF values evaluated by DASY manufacturer (SPEAG), and the test result will be calculated with the MIF parameter automatically.

UID	UID version	Communication system	MIF
10011	CAB (12.5.2017)	UMTS-FDD (WCDMA)	-27.23
10170	CAD (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 20MHz,16-QAM)	-9.76
10176	CAE (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 10MHz,16-QAM)	-9.76
10178	CAE (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 5MHz,16-QAM)	-9.76
10182	CAD (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 15MHz,16-QAM)	-9.76
10185	CAD (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 3MHz,16-QAM)	-9.76
10188	CAE (12.5.2017)	LTE-FDD (SC-FDMA,1RB, 1.4MHz,16-QAM)	-9.76
10061	CAB (12.5.2017)	IEEE 802.11b Wi-Fi 2.4GHz	-2.02
10077	CAB (12.5.2017)	IEEE 802.11g Wi-Fi 2.4GHz	0.12

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11. Maximum Average Antenna Input Power

Band	Maximum Tune-up limit power (dBm)
WCDMA BII	23.7
WCDMA BIV	23.7
WCDMA BV	23.7
LTE B2/4/12/66/71	24.5
WLAN 802.11b	14
WLAN 802.11g	13



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12. Justification of held to ear modes tested

I. Analysis of RF air interface technologies

a. The device support VoLTE and VoWLAN, but HAC test for them can be excluded.

b. Based on ANSI. C63.19-2011. An RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operating modes. If a device supports multiple RF air interfaces, each RF air interface shall be evaluated individually.

The MIF plus the maximum average antenna input power for all modes are investigated below to determine the testing requirements for this device.

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II. Low power exemption

Air interference	Maximum Average Antenna input power (dBm)	Worst case MIF (dB)	Maximum Average Antenna input power + MIF (dBm)	Low power exemption
WCDMA BII	23.7	-27.23	-3.53	Yes
WCDMA BIV	23.7	-27.23	-3.53	Yes
WCDMA BV	23.7	-27.23	-3.53	Yes
LTE B2	24.5	-9.76	14.74	Yes
LTE B4	24.5	-9.76	14.74	Yes
LTE B12	24.5	-9.76	14.74	Yes
LTE B66	24.5	-9.76	14.74	Yes
LTE B71	24.5	-9.76	14.74	Yes
WLAN802.11b	14	-2.02	11.98	Yes
WLAN802.11g	13	0.12	13.12	Yes

We used the predetermined MIF to evaluate the low power exemption.

Based on ANSI C63.19 2011, RF emission testing for WCDMA/LTE/WLAN is exempted.

Based on ANSI C63.19 2011, WCDMA/LTE/WLAN that is exempted from testing shall be rated as M4.

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13. ANSI C63.19-2011 performance and categories

The measurements were performed to ensure compliance to the ANSI C63.19-2011 standard,

Category	E-Field Emissions dB(V/m) < 960MHz
M1	50-55
M2	45-50
M3	40-45
M4	<40

Category	E-Field Emissions dB(V/m) > 960MHz
M1	40-45
M2	35-40
M3	30-35
M4	<30

WD RF audio interference level categories in logarithmic units

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14. Instruments List

14. III5ti uiik					
Manufacturer	Device	Туре	Serial number	Date of last calibration	Date of next calibration
Schmid & Partner Engineering AG	E-Field Probe	ER3DV6	2306	Mar.20,2017	Mar.19,2018
Schmid & Partner	835/1880 MHz System Validation	CD835V3	1052	Mar.20,2017	Mar.19,2018
Engineering AG	Dipole	CD1880V3	1044	Mar.20,2017	Mar.19,2018
Schmid & Partner Engineering AG	Data acquisition Electronics	DAE4	547	Mar.22,2017	Mar.21,2018
Schmid & Partner	Software	DASY52	N/A	Calibration	Calibration
Engineering AG	Soliwale	52.8.8	IN/A	not required	not required
Agilant	Dielectric Probe Kit	85070D	US01440168	Calibration	Calibration
Agilent	Dielectric Probe Kit	000700	0301440100	not required	not required
Agilent	Dual-directional coupler	778D	MY52180302	Apr.13,2017	Apr.12,2018
Agilent	RF Signal Generator	N5181A	MY50144143	Mar.01,2017	Feb.28,2018
R&S	Radio Communication Test	CMU200	113505	Dec.20,2017	Dec.19,2018
Schmid & Partner Engineering AG	Test Arch SD HAC	P01	1047	Calibration not required	Calibration not required
Agilent	Power Meter	E4417A	MY52240003	Dec.21,2017	Dec.20,2018
Agilent	Power Sensor	E9301H	MY52200003	Dec.21,2017	Dec.20,2018

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15. Summary of Results

Band	Worst case MIF	Maximum Average Antenna input power (dBm)	Maximum Average Antenna input power + worst case MIF	Low power exemption	RESULT
WCDMA B2	-27.23	23.7	-3.53	YES	M4
WCDMA B4	-27.23	23.7	-3.53	YES	M4
WCDMA B5	-27.23	23.7	-3.53	YES	M4
LTE B2	-9.63	24.5	13.37	YES	M4
LTE B4	-9.63	24.5	13.37	YES	M4
LTE B12	-9.63	24.5	13.37	YES	M4
LTE B66	-9.63	24.5	13.37	YES	M4
LTE B71	-9.63	24.5	13.37	YES	M4
WLAN802.11b	-2.02	14	11.98	YES	M4
WLAN802.11g	0.12	13	13.12	YES	M4

Based on ANSI. C63.19 2011, RF emission testing for WCDMA/LTE/WLAN is exempted.

Based on ANSI. C63.19 2011, WCDMA/LTE/WLAN that is exempted from testing shall be rated as M4.

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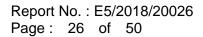
16. DAE & Probe Calibration Certificate

Engineering AG aughausstrasse 43, 8004 Zurich	y of 1. Switzerland		Schweizerischer Kallbrierdianst Service sulfase d'élitionnege Servizio svizzero di taratura Swies Calibration Service
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Schweizerisch er Kalibrierdie ie d'é Servizio svizzeno di terme **Buiss Calibration Service**

Accreditation No.: SCS 0108

Glossary

SG:

DAE Connector andle

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

Methods Applied and Interpretation of Parameters

The Swiss Accorditation Service is one of the signatories to the EA Mullilateral Agreement for the recognition of calibiration certificates

- 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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - DC Voltage Measurement Linearity: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - Common mode sensitivity, influence of a positive or negative common mode voltage on the differential measurement.
 - Channel separation: Influence of a voltage on the neighbor channels not subject to an input voltage
 - AD Converter Values with inputs shorled. Values on the internal AD converter corresponding to zero input voltage
 - Input Offset Measurement: Output voltage and statistical results over a large number of zero voltage measurements.
 - Input Offset Current: Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - Input resistance: Typical value for information: DAE input resistance at the connector. during internal auto-zeroing and during measurement.
 - Low Battery Alarm Voltage: Typical value for information. Below this voltage, a battery alarm signal is generated.
 - Power consumption: Typical value for information. Supply currents in various operating modes.

Certificate No: DAE4-547_Mar17

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DC Voltage Measurement

1L\$B =	0.1UV.	full rithge =	+100+300 mV
1LSB =	61nV.	full range =	-1+3mV
	11.SB =	1LSB = 61nV.	

Calibration Factors	х	Y	Z
High Bange	403.189 / 0.02% (k=2)	403.093±0.02% (k=2)	402.739±0.02% (k=2)
Low Range	3.95348 ± (.50% (k=2)	3.90456 ± 1.50% (k=2)	3.96243 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	91.0 °± 1 =
and the second in the property of the second s	31.0 + 1





Circlinale No: DAE4-647_Mart1

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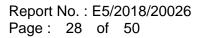
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Appendix (Additional assessments outside the scope of SCS0108)

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	200031.23	0,59	0.00
Channel X + Input	20005,44	2.04	0.01
Channel X - Input	-20000.97	4.91	-0.02
Channel Y + Input	200029.80	-1.03	-0.00
Channel Y + Input	20000.30	-3.03	-0.02
Channel Y - Input	-20007.73	-1.72	0.01
Channel Z + Input	200030.21	-0.96	-0.00
Channel Z + Input	20003.13	-0.21	-0.00
Channel Z - Input	-20005.14	0.81	-0.00

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2000.02	-0.08	-0.00
Channel X + Input	200 18	0.35	0.18
Channel X - Input	-200.16	0.00	-0.00
Channel Y + Input	2000.10	0.06	0.00
Channel Y + Input	199.43	-0.40	-0.20
Channel Y - Input	-200.77	-0.70	0:35
Channel Z + Input	2000,19	0.28	0.01
Channel Z + Input	198.82	-1.00	-0.50
Channel Z - Input	-201.46	-1.37	0.68

2. Common mode sensitivity

DASY measurement parameters. Auto Zero Time: 3 arc; Measuring time: 3 arc.

Low Range srage Reading (µV)
-5.00
4,50
-4.21
-0.41
4.93
-8.12



3. Channel separation

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

	Input Voltage (mV)	Channel X (µV)	Channel ¥ (µV)	Channel Z (µV)
Channel X	200	-	2.65	-2.08
Channel Y	200	10,56		3.60
Channel Z	200	4.55	7.85	

Certilicate No: DAE4-547_Mor17

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4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)	
Channel X	16364	15364	
Channel Y	16476	16801	
Channel Z	16077	16468	



DASY measurement parameters: Auto Zero Time: 3 soc; Measuring time: 3 soc locul 10MD

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	-0.53	-1.14	0.26	0.31
Channel Y	-1.03	-2.43	-0.21	0.32
Channel Z	-1.56	-2.31	-0.62	0,35

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <251A

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Yec)	-7,6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA	
Supply (+ Vcc)	+0.01	+6	+14	
Supply (- Voc)	-0.01	B	-9	



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Report No. : E5/2018/20026 Page : 30 of 50

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Schweizenscher Kalibrierdienst Service adisse d'âblionnage Service svizzero di taratera Swiss Calibration Service

Accreditation No.: SCS 0108

Certificate No: ER3-2306_Mar17

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liper	ER3DV6 - SN:2306						
Calibratium procedure(s)	GA CAL-02.v8, GA CAL-25.v0 Calibration procedure for E-field probes optimized for close near field evaluations in air						
albration town	March 20, 2017						
he measurements and the unco	stainius with confidence prot cled in the closed laboratory t	iii standards, which make the physical limits splity are given on the following pages and a table): environment temperature $G\Sigma=31\%$ a	ins part of this certificate.				
Primary Standards	L ID	Cal Date (Certificate No.)	Servidued Cathering				
Power maker NRP	56: 104778	OI-Apr-16 (No. 217-02288/02380)	Apr-17				
Poww sensor NF0P 201	Sh: 103244	05-Apr-76 (No. 217-02288)	Apr-17				
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17				
Reference 20 dB Attenuator	SN. 35277 (29x)	05-Apr-16 (No. 217-02293)	Apr-17				
Reference Probe ER30W8	SN, 2328	14-0d-16 (No ER3-2328_0ct16)	Qdd-17				
DAEA	SN: 789	3-Mai-17 (No. DAE4-789_Mair17)	Mitr-15				
Secondary Standards	(D)	Check Date (in house)	Scheduled Check				
Power meter E4419E	SN: GB#1293874	(6-Apr-16 (in house check Juni 16)	In house check Jun-16				
Fower sensor E4412A	SN: MY41498067	06-Apr-16 (in house check Jun-16)	In no.se check, Jun-18				
Power sensor E4412A	5N: 000110210	06-Apr-16 (In house check Jun-16)	In house sheet, Jun 16				
RF generator HP 8848C	SN: US3642U01700	Q4-Aug-99 (in house check Jum/18)	in house check: Jun-10				
Natwork Analyzer HP 8763E	SN 11S37380585	18-Clat-Ct (in house sheck Oct-16)	In house theck: Oct-17				
	Name	Function	Signature				
Calibrated by	Michael Weber	Laboratory Techeiclan	Mes				
Approved by	Kata Pokovic	Technical Menager	belly				
		-	Issued: March 21, 2017				
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Report No. : E5/2018/20026 Page : 31 of 50



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Accreditation No.: SCS 0108



Molalisteral Agreement in the recognition of calibration certificates

Glossary: NDRMx,y,z DCP CF A, B, C, D Polarization o	sensitivity in free space clipte compression pbint crest factor (1/duty_cycle) of the RF signal modulation dependent inearization parameters a rotation around probe axis
Polarization 8	a rotation around an axis that is in the plane normal to probe axis (all measurement center).
Connector Angle	i.e., b = 0 is normal to probe axis information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antancas, from 9 kHz to 40 GHz", December 2005
- b) CTIA Test Plan for Hearing Aid Compatibility, Rev 3.0, November 2013.

Methods Applied and Interpretation of Parameters:

- NORMx y,z Assessed for E-field polarization 3 = 0 for XY sensors and 4 = 90 for Z sensor (f < 900 MHz in TEM-cell; 1> 1800 MHz; R22 waveguide).
- NORM(f)x,y,z = NORMx,y,il * Inequency_response (see Frequency Response Chart).
- DCPs.y.z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but externined based on the signal characteristics
- Ay, y, z; By, y, z; Cx, y, z; Dx, y, z; A, B, C, D are numerical inearctation 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 diodo.
- Spherical isotropy (3D deviation from isotropy) in a locally homogeneous field realized using an open waveguide setup.
- Sensor Offset. The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe wils). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NDRMx (no uncertainty required).

Centricate No: ER3-2308_Mar17

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Report No. : E5/2018/20026 Page : 32 of 50



March 20, 2011



Probe ER3DV6

SN:2306

Manufactured: Calibrated: December 17, 2002 March 20, 2017

(Note: non-compatible with DASY2 systems)

Centicale No: ER3-2306_Mar11

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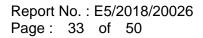
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ER3DV6 - SN:2306

March 20. 2017

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2306

Basic Calibration Parameters

	Sensor X	Sennor Y	Sensor 2	Unc (k=2)
Norm (uV/(VImF)	1.06	1.09	1.21	± 10.1 %
DCP (mV) st	101.#	99.7	104.6	

Modulation Calibration Parameters

UID	Communication System Name		A	B dBõV	C	D Bh	VR mV	Unc ^t (k=2)
0	CW	X	0.0	0/0	1,0	00.00	155,3	±3-3.%
		¥	0,0	0,0	1,0		166,3	
		Z	0.0	0.0	1.0		:160.4	1
10010 CAA	SAR Validation (Square, 100ma, 10ma)	x	0.45	51.0	5.1	10.00	37.4	12.7 %
		Y.	TLA7	50.1	3,4	_	39.4	
		2	0.54	51.1	5.5	-	39.0	
10021- DAC	GSM-FDD (TDMA, GMSK)	x	4.46	787	20.5	8,39	143.7	±1.7 %
		V.	4.66	0.08	21.4		115.5	
		Z	3.61	80.1	20.B		149.5	
10061 CAB	IEEE 802,116 WIRT 2,4 GHz (DSSS, 11 Mbps)	×	3.86	74.5	.22,5	1.60	145.3	20.7 %
		¥.	3.07	69.8	20.2		115.9	_
		Z.	4.61	77.8	:23.6		108,6	
10077 CAB	IEEE 802.11g WIFi 2.4 GHz (DSS5/OFDM, 54 M00s)	×	10.27	70,8	25.3	11.00	128,6	±0.5 9
		·¥	10.52	72,0	26.2		142.4	-
	and the second sec	2	1D.88	72.7	26.7		137.9	
10173- CAC	LTE-TOD (SC-FDMA, 1 RB, 20 MHz, 15-DAM)	x	6 (5	71.8	25,4	历史。	115.3	179
		- ¥.	6.32	72.9	26,3		127.6	
		- Z	6,84	73.9	26,0		124.3	
10235- DAC	LTE-TUD (SC-FDMA, 1 R8, 10 MHz, 16-QAM)	×	6.16	71.4	25.0	9.48	1152	±1.8 %
		- <u>8</u> .	6 31	72.8	2601		126.9	
· · · · · ·	at and a set of the set of the	Ζ.	6,61	73.B	26.0		122,7	1
10238- CAG	LTE/TDD (SC-FDMA, 1 RB, 15 MHz, 16-DAM)	.8	6.11	71.6	25.3	3.48	115.0	±17.9
-		Y	6.32	72/8	:201;3		126.6	
		Z.	0.72	73.3	15.7		122.3	2
10236- AAB	GBMA2000, RG1, SO3, 1/8th Rate 25 ±	Ĥ.	0.24	78.1	28.6	12.40	87.2	±1.2.9
1010		Y-	6.44	74.周	29.9		95.6	-
		2	1.27	76.6	29,5		93.6	

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%.

⁹ Manetical linearization parameter uncertainly not impuried.

"Locastanty is determined using the max, deviation from linear response eaching recongular detination rand in represend for the square of the faild years.

Certificate No: ER\$-2305_Mar17

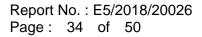
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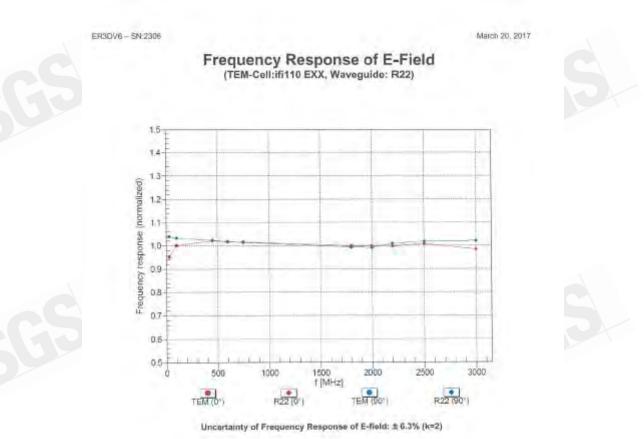
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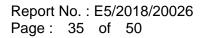
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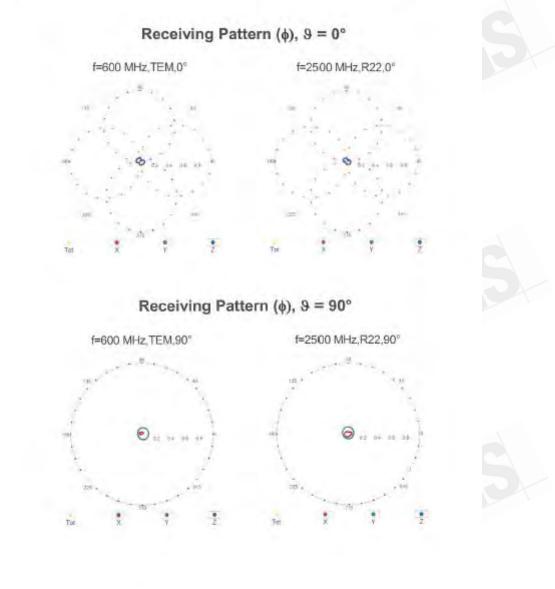






ER3DV6 - SN:2306

March 20, 2017



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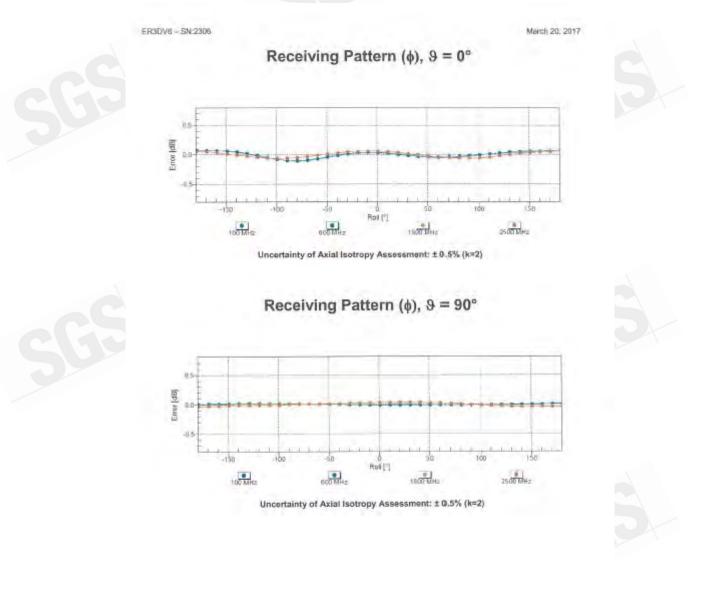
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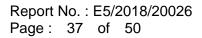
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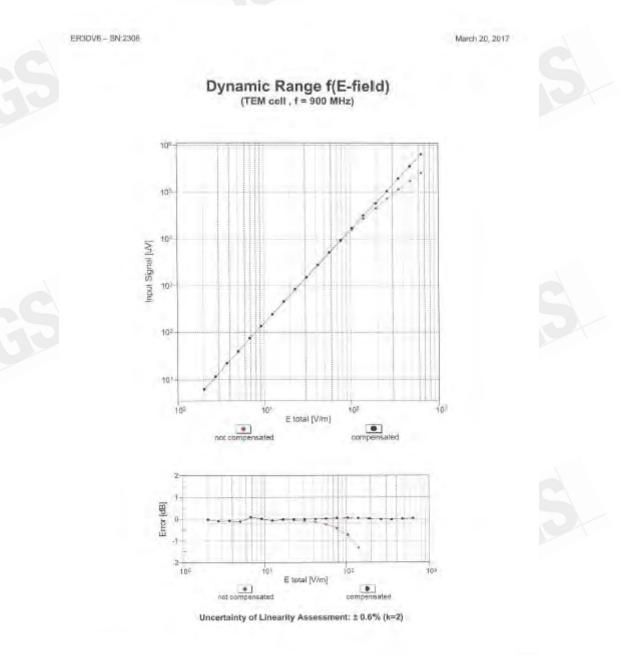
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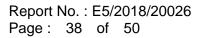
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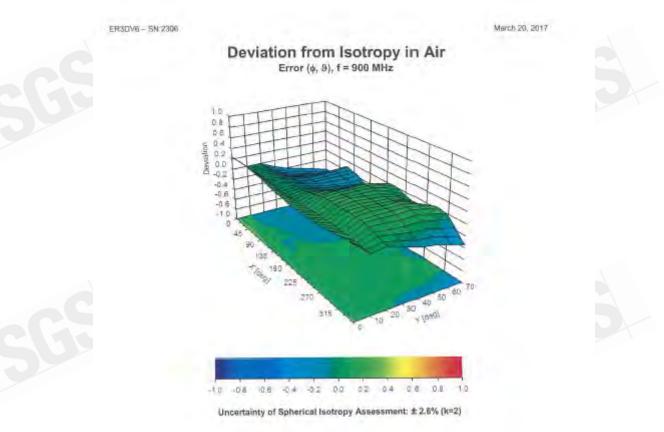
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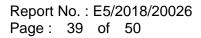
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ER30V6 - SN 2000

March 20, 2011

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2306

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (")	130.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	bidaeib
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length;	10 mm
Tip Diameter	-8 min
Probe Trp to Sensor X Calibailion Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm





Certificate No. ER3-2306_Mar*7

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17. Uncertainty Budget

Error Description	Uncert. value	Prob. Dist.	Div.	(c _i) E	$\binom{(c_i)}{\mathbf{H}}$	Std. Unc. E	Std. Unc H
Measurement System					-		
Probe Calibration	$\pm 5.1\%$	N	1	1	1	±5.1%	$\pm 5.1\%$
Axial Isotropy	$\pm 4.7\%$	R	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7\%$
Sensor Displacement	$\pm 16.5 \%$	R	$\sqrt{3}$	1	0.145	$\pm 9.5\%$	$\pm 1.4\%$
Boundary Effects	$\pm 2.4\%$	R	$\sqrt{3}$	1	1	±1.4%	±1.4%
Phantom Boundary Effect	$\pm 7.2\%$	R	$\sqrt{3}$	1	0	±4.1%	±0.0%
Linearity	±4.7%	R	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7 \%$
Scaling with PMR calibration	$\pm 10.0\%$	R	$\sqrt{3}$	1	1 -	±5.8%	$\pm 5.8\%$
System Detection Limit	±1.0%	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$
Readout Electronics	$\pm 0.3\%$	N	1	1	1	$\pm 0.3\%$	$\pm 0.3 \%$
Response Time	±0.8%	R	$\sqrt{3}$	1	1	$\pm 0.5\%$	±0.5%
Integration Time	$\pm 2.6\%$	R	$\sqrt{3}$	1	1	±1.5%	±1.5%
RF Ambient Conditions	$\pm 3.0\%$	R	$\sqrt{3}$	1	1	$\pm 1.7\%$	$\pm 1.7\%$
RF Reflections	$\pm 12.0\%$	R	$\sqrt{3}$	1	1	±6.9%	$\pm 6.9\%$
Probe Positioner	$\pm 1.2\%$	R	$\sqrt{3}$	1	0.67	±0.7%	$\pm 0.5 \%$
Probe Positioning	$\pm 4.7\%$	R	$\sqrt{3}$	1	0.67	$\pm 2.7\%$	±1.8%
Extrap. and Interpolation	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	±0.6%
Test Sample Related	-		122	TT - 2			
Device Positioning Vertical	$\pm 4.7\%$	R	$\sqrt{3}$	1	0.67	$\pm 2.7\%$	±1.8%
Device Positioning Lateral	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$
Device Holder and Phantom	$\pm 2.4\%$	R	$\sqrt{3}$	1	1	±1.4%	$\pm 1.4\%$
Power Drift	$\pm 5.0\%$	R	$\sqrt{3}$	1	1	$\pm 2.9\%$	$\pm 2.9\%$
Phantom and Setup Related			1.5.5.				
Phantom Thickness	$\pm 2.4\%$	R	$\sqrt{3}$	1	0.67	$\pm 1.4\%$	$\pm 0.9\%$
Combined Std. Uncertainty				1.2.2		$\pm 16.3\%$	$\pm 12.3\%$
Expanded Std. Uncertainty on Power						$\pm 32.6\%$	$\pm 24.6\%$

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18. System Validation from Original Equipment Supplier

chmid & Partner Engineering AG ughauastrasse 13, 2004 Zurict	y of h, Swilzenand	Hacenera C s	Schweizerlischer Kalibrierdienst Service suitse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
credited by the Swiss Accreditat e Swiss Accreditation Service utilateral Agreement for the re	is one of the signatories	to the EA	creditation No.: SCS 0108
ient SGS-TW (Aude	~		CD835V3-1052_Mar17
CALIBRATION	CERTIFICATI		
Disinct	CD835V3 - SN: 1	1052	
Calification procedure(%)	QA CAL-20.v6 Calibration proce	dure for dipoles in air	
Calibration date:	March 20, 2017		
All calibrations have been condu	cord in the closed laborate	ry facility: environment temperature (22 $\pm3/2$	
M calibrations have been condu Calibration Equipment used (M& Primary Standards	TE critical for calibration)	ny facility: environment temperature (22 a S)*C Cel Date (Centilicate No.)	and humidity < 70%.
All colibrations have been condu Colibration Equipment used (M& Primary Standards Power meter NHP	TE critical for calibration)	ry facility: environment temperature (22 ± 3)/0 Cel Date (Centificate No.) 06-Apr-16 (No. 217-02286/02289)	and humidity < 70%. Scheduled Calibration Age-17
All calibrations have been conduc Calibration Equipment used (M& Primary Standards, Power sensor NRP Power sensor NRP-291	TE critical for calibration)	ry facility: environment temperature (22 ± 3)/C Cel Date (Certificate No.) 05-Apr-16 (No. 217-02288/02280) 06-Apr-16 (No. 217-02286)	and humidity < 70%. Scheduled Calibration Age-17 Age-17
Al calibrations have been condu Calibration Equipment used (M& Primary Standards Power meter NEP Power sensor NEP-291 Power sensor NEP-291	TE critical for calibration) D # Site 104778 Site 104778 Site 103244 Site 103245	ry facility: anveconment temperature (22 a S)/C Cel Date (Certilicate No.) 06-Apr-16 (No. 217-02285/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289)	Scheduled Calibration Apr-17 Apr-17 Apr-17
All collibrations have been conduc Calibration Equipment used (MS ² Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Alternator	TE critical (or calibration) D # SR: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	ry facility: environment temperature (22 a 3)/0 Cel Date (Centificate No.) 06-Apr-16 (No. 217-02286/02289) 06-Apr-16 (No. 217-02286) 06-Apr-16 (No. 217-02299) 06-Apr-16 (No. 217-02292)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17
All colibrations have been conduct Calibration Equipment used (M& Primary Standards, Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 db Attenuator Type-N mismatch combination	TE critical for calibration) D # Site 104778 Site 104778 Site 103244 Site 103245	ry facility: anveconment temperature (22 a S)/C Cel Date (Certilicate No.) 06-Apr-16 (No. 217-02285/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289)	and humidity < 70%. Scheduled Calibration Apr-17 Apr-17 Apr-17
All colibrations have been conduc Dationation Equipment used (M& Primary Standards, Power technol (MPP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Alterustor Type-N mismatch combination Probe ERSIDV6	TE critical for calibration) D # She 104778 Shu 103244 Shu 103245 Shu 103245 Shu 103245 Shu 5056 (20k) Shu 5047.2 / 06327	ry facility: environment temperature (22 ± 8)/0 Cel Date (Certificate No.) 06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02295)	and humidity < 70%. Scheduled Calibration Age-17 Age-17 Age-17 Age-17 Age-17 Age-17
All collibrations have been conduct Databation Equipment used (M& Primary Standards, Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Altenuistor Type-N mismatch combination Probe ERSIDV6 Probe H3DV6	tood in the closed laborate TE critical (or calibration) ID # SNc 104778 SNc 103244 SNc 103244 SNc 103244 SNc 103245 SNc 5058 (20k) SNc 5047.2 / 06327 SNc 2336	ny facility: environment temperature (22 ± 3)/C Cel Date (Certificate No.) 06-Apr-16 (No. 217-02286/12289) 06-Apr-16 (No. 217-02280) 06-Apr-16 (No. 217-02290) 06-Apr-16 (No. 217-02290) 30-Dec-16 (No. ER3-2336_Dec16)	Scheduled Calibration Age-17 Age-17 Age-17 Age-17 Age-17 Age-17 Dec-17 Dec-17
All colibrations have been conduc Databation Equipment used (MS Primary Standards Power meter NRIP Power sensor NRIP-291 Reference 20 dB Altenuator Type-N mismatch combination Probe ERSDV6 Probe H3DV6 DAEB Bacondary Standards	code in the closed laborate TE critical (or calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5058 (20k) SN: 2336 SN: 6065 SN: 781 ID #	ny facility: environment temperature (22 ± 3)/C Cel Date (Certificate No.) 06-Apr-16 (No. 217-02288/12289) 06-Apr-16 (No. 217-02286) 06-Apr-16 (No. 217-02296) 06-Apr-16 (No. 217-02296) 06-Apr-16 (No. 217-02296) 30-Dec-16 (No. ER3-2236, Dec16) 30-Dec-16 (No. H3-6085, Dec16) 02-Sep-16 (No. DAE4-781_Sep16) Check Date (in focuse)	and humidity < 70%. Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Sinp-17 Scheduled Check
All colibrations have been conduc Dationation Equipment used (M& Primary Standards, Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Attenuator Type-N mismatch combination Probe ERSIDV6 Probe HSDV6 DAEa Secondary Standards Power malor Agilent 44198	tood in the closed laborate TE critical for calibration) ID # SN: 103244 SN: 103244 SN: 103244 SN: 103244 SN: 103244 SN: 5038 (20k) SN: 5038 (20k) SN: 2336 SN: 2336 SN: 2336 SN: 26842420191	ny facility: environment temperature (22 ± 3)/C Cel Date (Certificate No.) 05-Apt-16 (No. 217-02285/02289) 05-Apt-16 (No. 217-02285) 05-Apt-16 (No. 217-02295) 05-Apt-16 (No. 217-02295) 30-Dec-16 (No. ERB-2336, Dec16) 30-Dec-16 (No. H3-6065, Dec16) 02-Sept-16 (No. DAE4-781, Sep16) Check Date (in focuse) 09-Oct-09 (in house check Sep-14)	Scheduled Calibration Age-17 Age-17 Age-17 Age-17 Age-17 Age-17 Dec-17 Dec-17 Dec-17 Stee-17 Steeduled Check In house check: Oct-17
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Certificate No: CD835V3-1052_Mar17

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Accreditation No.: SCS 0108

According by the Swas According on Service (SAS) The Swiss Accorditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration pertificates

References

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ANSI-063.19-2011

Calibration Laboratory of

Engineering AG Zeughausstrasse 43, 8004 Zunch, Switzerland

Schmid & Partner

American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Mathods 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 america (mounted on the table) fowards 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 connected
 is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a
 directional couplar. While the dipole under text is connected, the forward power is adjusted to the same level.
- Anlenna 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 like 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 log 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 vertiled. 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 (upper surface of the dipole) and the matching grid reference point (upper surface of the dipole) and the matching grid reference point (upper 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 HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from envobstacles.
- E-Netr destribution: E field is measured in the x-y-plane with an isotropic ER3D-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 compensatilities or any toor-paralletity 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 uncertainly of measurement is stated as the standard uncertainly of measurement multiplied by the coverage factor k=2, which find a normal distribution corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

DASY Version	DASY5	V52.8.8
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	835 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 835 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	109.4 V/m = 40.78 dBV/m
Maximum measured above low end	100 mW input power	107.9 V/m = 40.68 dBV/m
Averaged maximum above arm	100 mW input power	108.7 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	15.6 dB	41.2 Ω - 12.5 jΩ
835 MHz	28.6 dB	51.0 Ω + 3.6 jΩ
900 MHz	17.1 dB	52.8 Ω - 14.3 jΩ
950 MHz	20.3 dB	49.8 Ω + 9.7 jΩ
960 MHz	15.0 dB	60.8 Ω + 16.8 jΩ

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 dipote 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.

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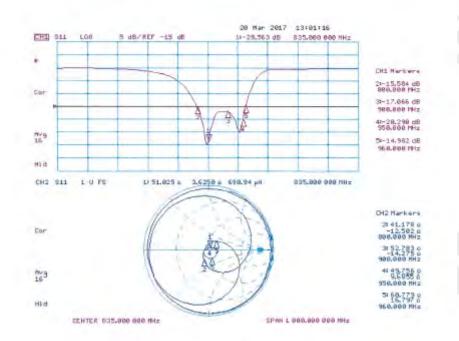
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Impedance Measurement Plot





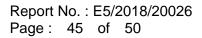
Certificate No: CD835V3-1052_Mar17 Page 4 of 5

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Date: 17.03.2017



DASY5 E-field Result

SG

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1052

Communication System: UID 0 – CW ; Frequency; 835 MHz Medium parameters used: $\sigma = 0$ S/m, s, = 1; p = 1000 kg/m³ Phantom section: RF Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ER3DV6 SN2336; ConvF(1, 1, 1); Calibrated: 30.12.2016;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.09.2016
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070

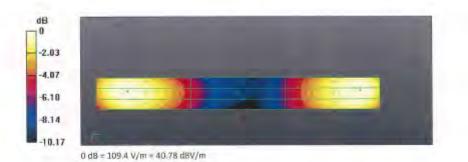
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DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=15mm/Hearing Aid Compatibility Test (41x361x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm Reference Value = 108.8 V/m; Power Drift = -0.01 dB Applied MiF = 0.00 dB RF audio interference level = 40.78 dBV/m Emission category: M3

Grid 1 M3	Grid 2 M3	Grid 3 M3
40.35 dBV/m	40.66 dBV/m	40.6 dBV/m
Grid 4 M4	Grid 5 M4	Grid 6 M4
35.78 dBV/m	35.98 dBV/m	35.9 dBV/m
Grid 7 M3	Grid 8 M3	Grid 9 M3
40.46 dBV/m	40.78 dBV/m	40.74 dBV/m



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ocredited by the Swiss Accreditation he Swise Accreditation Service withateral Agreement for the rec	is one of the signatories	to the EA	oreditation No.: SCS 0108
SGS-TW (Auder	n)	Certilicate No:	CD1880V3-1044_Mar1
CALIBRATION C	CERTIFICATE	E	
Object	CD1880V3 - SN:	1044	
Calibiation (eccedure(e)	QA CAL-20,v6 Calibration proce	dure for dipoles in air	
Calibration date:	March 20, 2017		
	TE estimation without an		
Calibration Equipment used (M&T Primary Standards	ID 4	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meter NRP	ID # Sfc: (04778	05-Apr-16 (No. 217-02289(02299)	Apr-17
Primary Standards Power meter NRP Power sensor NRP-Z91	ID # SN: (04778 SN: 103244	05-Apr-16 (No. 217-02288/02289) 05-Apr-16 (No. 217-02288)	Apr-17 Apr-17
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-201	ID # SN: 104778 SN: 103244 SN: 103245	06-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02288) 05-Apr-16 (No. 217-02288)	Apr-17 Apr-17 Apr-17 Apr-17
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (20k)	05-Apr-16 (No. 217-02288/02289) D6-Apr-16 (No. 217-02288) D5-Apr-16 (No. 217-02288) 05-Apr-16 (No. 217-02280)	Apr-17 Apr-17 Apr-17 Apr-17
Primary Standards Power mater NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination	ID # SN2 104778 SN2 103244 SN2 103245 SN1 5058 (20K) SN2 5058 (20K) SN2 5047.2 / 05327	05-Apr-16 (No. 217-0228902289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02280) 05-Apr-16 (No. 217-02280) 05-Apr-16 (No. 217-02285)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Probe ER3DV6	ID # SN2 1047778 SN1 103244 SN1 103245 SN1 5058 (20k) SN1 6047 2 / 06327 SN1 2336	05-Apr-16 (No. 217-02288/02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02285) 30-Dec-16 (No. EH3-2336_Dec16)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17
Primary Standards Power Inster NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination	ID # SN2 104778 SN2 103244 SN2 103245 SN1 5058 (20K) SN2 5058 (20K) SN2 5047.2 / 05327	05-Apr-16 (No. 217-0228902289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02280) 05-Apr-16 (No. 217-02280) 05-Apr-16 (No. 217-02285)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Neference 20 dB Aftenuator Type-N mismatch combination Proba ERZID/6 Probe H3DV6	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047 2 / 05327 SN: 5047 2 / 05327 SN: 6065	05-Apr-16 (No. 217-02288/02289) 05-Apr-16 (No. 217-02288) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02285) 30-Dec-16 (No. EH3-2386, Dec-16) 30-Dec-16 (No. H3-6065, Dec-16)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17
Primary Standards Power Inster NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Proba ERSIDVE Probe H3DV6 DAE4	ID # SN: 103244 SN: 103245 SN: 103245 SN: 103245 SN: 103245 SN: 103245 SN: 103245 SN: 103245 SN: 2035 SN: 2035 SN: 2035 SN: 2035	05-Apr-16 (No. 217-02288/02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02285) 30-Dec-16 (No. EH3-2336_Dec-16) 30-Dec-16 (No. EH3-2336_Dec-16) 02-Sep-16 (No. LAE-4-781_Sep16)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Sep-17
Primary Standards Power Inster NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismitch combination Probe ER3DV6 DAE4 Becondary Standards	ID # SN: 103244 SN: 103245 SN: 5056 (20k) SN: 5056 (20k) SN: 2336 SN: 6065 SN: 781	05-Apr-16 (No. 217-02288/02289) 05-Apr-16 (No. 217-02288) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02285) 30-Dec-16 (No. EH3-2336_Dec-16) 30-Dec-16 (No. H3-6065_Dec-16) 02-Sep-16 (No. H3-6065_Dec-16) 02-Sep-16 (No. DAE4-781_Sep16) Check Data (In house)	Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Sap-17 Sapeduled Check
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Calibration Laboratory of Schmid & Partner Engineering AG Zeuphaustrase 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 0108

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Accremited by the Swise Accremitation Service (SAS) The Swise Accreditation Service is one of the signatories to the ILA Multilateral Agreement for the recognition of calibration certificates

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) (owards its feed point between the two dipole arms, z-axis is formal to the other axis: 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 on-auxiliary power meter connected to a
 directional coupler. While the dipole under test is connected, the forward power is adjusted to the same lavel.
- Anterins 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 periodly in a line. It is installed on the HAC dipole positioner with its arms parallel below the detectric reference where and able to move classically 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 DASYS Surface Check job. Before the measurement, the distance between phantom surface and probe to its verified. The proper device reference point (upper surface of the dipole) and the matching gird reference point (upper surface of the dipole) and the matching gird reference point (upper surface of the dipole) and the matching gird reference point (upper surface of the dipole) and the probe is essential for the accuracy.
- Fauld Point Impedance and Return Loss: These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating 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 ER3D-field probe with 100 mW forward power to the anterna lead 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 mittal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms 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-perallelity 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 imported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponda to a coverage probability of approximately 95%.

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Measurement Conditions

DASY system configuration, as far as not giv		
DASY Version	DASY5	V52.8.8
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 1880 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	92.0 V/m = 39.28 dBV/m
Maximum measured above low end	100 mW input power	89.9 V/m = 39.08 dBV/m
Averaged maximum above arm	100 mW input power	91.0 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	23.5 dB	54.7 Ω + 5.2 jΩ
1880 MHz	20.0 dB	58.9 Ω + 6.3 jΩ
1900 MHz	20.3 dB	60.3 Ω + 2.6 jΩ
1950 MHz	26.7 dB	53.2 Ω - 3.5 jΩ
2000 MHz	21.7 dB	46.1 Ω + 6.9 jΩ

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

Do not apply force to cipole arms, as they are liable to bend. The soldered connections near the teedpoint 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.

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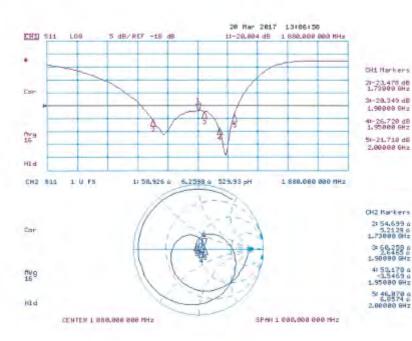


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Impedance Measurement Plot



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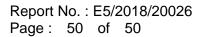
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DASY5 E-field Result

SGS

Test Laboratory: SPEAG Lab2

Date: 17.03.2017

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1044 Communication System: UID 0 - CW ; Frequency: 1880 MHz Medium parameters used: $\sigma = 0$ S/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³ Phantom section: RF Section Measurement Standard: DASYS [IEEE/IEC/ANSI C63.39-2011]

DASY52 Configuration

Probe: ER3DV6 - 5N2336; ConvF(1, 1, 1); Calibrated: 30.12.2016;

- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 5n781; Calibrated: 02.09.2016
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070

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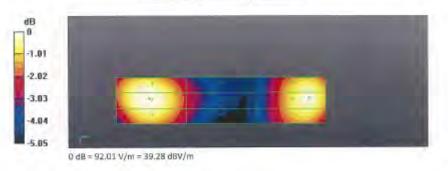
DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=15mm/Hearing Aid Compatibility Test (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm Reference Value = 162.5 V/m; Power Drift = -0.03 dB Applied MIF = 0.00 dB RF audio interference level = 39.28 dBV/m

Emission category: M2

	Grid 2 M2 39.28 dBV/m	Grid 3 M2
Grid 4 M2	Grid 5 MZ	Grid 5 M2
36.9 dBV/m Grid 7 M2	37.07 dBV/m Grid 8 M2	36.98 dBV/m Grid 9 MZ
38.8 dBV/m	39.08 dBV/m	



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End of 1st part of report

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