

# Hearing Aid Compatibility (HAC) **TEST REPORT** <For RF-Emission Measurement>

LTE Module (WWAN) / Frey (WLAN)		
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Taiwan		
XMR201607EC25V (WWAN) / SPYIM0002 (WLAN)		
Jul. 18, 2017		
Oct. 26, 2017		

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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Signed on behalf of SGS

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Mate Kno

Date: Oct. 26, 2017

台灣檢驗科技股份有限公司

Supervisor

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John Yeh Date: Oct. 26, 2017

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# **Revision History**

Report Number	Revision	Description	Issue Date
E5/2017/90018	Rev.00	Initial creation of document	Sep. 22, 2017
E5/2017/90018	Rev.01	1 <sup>st</sup> modification	Oct. 17, 2017
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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

Company Name	SGS Taiwan Ltd. Electronics & Communication Laboratory	
Company address	No.2, Keji 1st Rd., Guishan Township, Taoyuan County 333,	
	Taiwan (R.O.C.)	
Telephone	+886-2-2299-3279	
Fax	+886-2-2298-0488	
Website	http://www.tw.sgs.com/	

### 3. Details of Applicant

Applicant Name	unitech electronics co., ltd.
Applicant Address	5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist., New Taipei
Applicant Address	City, Taiwan

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# 4. Description of EUT

EUT Name	Rugged Handheld Computer				
Brand Name	unitech				
Model No.	PA730				
Model No. of LTE Module	EC25-V				
Model No. of BT/WLAN Module	Frey M1-0000, Frey M1-0010				
Scope:	The test report covers the radiated e the standards referenced in the report approval of the module in this specified	ort to allov			
WWAN FCC ID	XMR201607EC25V				
WLAN FCC ID	SPYIM0002				
Host FCC ID	HLEPA730BTNFL				
	LTE FDD				
Mode of Operation	⊠WLAN802.11 a/b/g/n(20M/40M)				
	⊠Bluetooth				
	LTE FDD (support VoLTE)		1		
Duty Cycle	WLAN802.11 a/b/g/n(20M/40M)		1		
	Bluetooth		1		
	LTE FDD Band 4	1710	_	1755	
	LTE FDD Band 13	777	_	787	
	WLAN802.11 b/g/n(20M)	2412	_	2462	
TX Frequency Range	WLAN802.11 n(40M)	2422		2452	
(MHz)	WLAN802.11 a/n(20M) 5.2G	5180	_	5240	
	WLAN802.11 n(40M) 5.2G	5190	_	5230	
	WLAN802.11 a/n(20M) 5.3G	5260	_	5320	
	WLAN802.11 n(40M) 5.3G	5270	_	5310	

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	WLAN802.11 a/n(20M) 5.6G	5500	—	5720
	WLAN802.11 n(40M) 5.6G	5510	—	5710
TX Frequency Range (MHz)	WLAN802.11 a/n(20M) 5.8G	5745	_	5825
(	WLAN802.11 n(40M) 5.8G	5710	_	5795
	Bluetooth	2402	_	2480
	LTE FDD Band 4	19957	—	20393
	LTE FDD Band 13	23205	—	23255
	WLAN802.11 b/g/n(20M)	1	_	11
	WLAN802.11 n(40M)	3		9
	WLAN802.11 a/n(20M) 5.2G	36	_	48
	WLAN802.11 n(40M) 5.2G	38	_	46
Channel Number (ARFCN)	WLAN802.11 a/n(20M) 5.3G	52	_	64
	WLAN802.11 n(40M) 5.3G	54	_	62
	WLAN802.11 a/n(20M) 5.6G	100		144
	WLAN802.11 n(40M) 5.6G	102		142
	WLAN802.11 a/n(20M) 5.8G	149	_	165
	WLAN802.11 n(40M) 5.8G	142	_	159
	Bluetooth	0	_	78

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# 5. Air Interfaces and Bands

	Band	Туре		Simultaneous	Voice Over	Power
Air- Interface	(MHZ)	Transport	C63.19 tested	Transmitter	Digital Transport	Reduction
		папэрон		but not tested	OTT capability	Reduction
LTE	IV	VD	Yes (Note 1.)	Yes, WiFi or Bluetooth	Yes	No
LIC	XIII	٧D			Yes	No
WiFi	2450	DT	No	Yes, WWAN or BT	Yes	No
WiFi	5000	DT	No	Yes, WWAN or BT	Yes	No
Bluetooth	2450	DT	No	Yes, WWAN or BT	No	No
VO= CMRS Voice Service			Note			
DT= Digital Transport			1.It applies the low	power exemption b	ased on ANSI	
VD=CMRS IP Voice Service and Digital Transport			C63.19-2011			

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### 6. Test Environment

Ambient Temperature	21.7° C
Relative Humidity	<80 %

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### 7. Description of test system

7.1 Measurement system Diagram for SPEAG Robotic

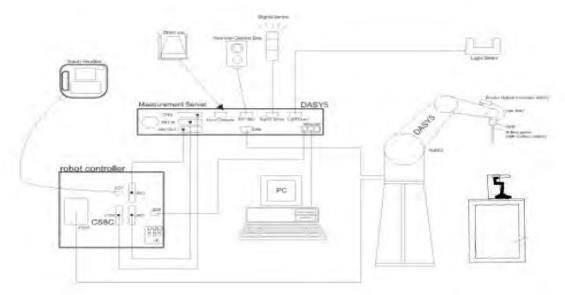


Fig.1 The SPEAG Robotic Diagram

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.
- A probe alignment unit which improves the (absolute) accuracy of the probe

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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	ITE	
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

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

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#### 8. Test Procedure

_	Test Instructions
*	Confirm proper operation of probes and instrumentation
2	Position WD
8	Configure WD TX operation
1	fer 5.4.1.2 (1-3)
2	Initialize field probe
2	Scan Area
	er 5.4.1.2 (4-6)
	er 304112 (940)
_	+
*	Identify exclusion area.
2	Resean or rounalyze open area
	to determine maximum
>	Direct method: Record RF
	Audio Interference Level, in dB(V/m)
÷	Indirect method: Add the MIF
	to the maximum steady state
	rms field strength and record
	RF Audio Interference Level. in dB(V/m)
T	er 5,4,1,2 (7-9) & 5,4,1,3
	+
2	Identify and record the category
P	er 5.4.1.2 (9-10)
	1

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.
- 3. 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.
- 5. 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  $5 \times 5$  cm region were performed and recorded. A 360° rotation 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 v04r01 2.d) 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.

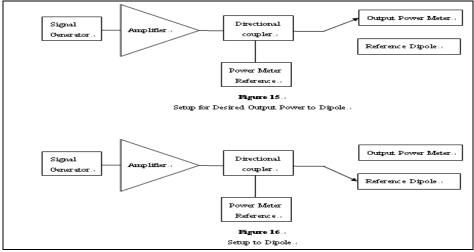


Fig.3 System verification

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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)

e) Without changing the square-law detector or weighting system, and using RF 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 KDB285076 D01, the handset can also use the MIF values predetermined by the test equipment manufacturer, and the following table lists the 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(dB)
10170	CAD (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 20MHz,16- QAM)	-9.76
10176	CAE (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 10MHz,16- QAM)	-9.76
10178	CAE (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 5MHz,16- QAM)	-9.76
10182	CAD (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 15MHz,16- QAM)	-9.76
10185	CAD (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 3MHz,16- QAM)	-9.76
10188	CAE (8.1.2017)	LTE-FDD (SC-FDMA,1RB, 1.4MHz,16- QAM)	-9.76

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# 11. Maximum conducted output power

				FDD Band 4				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				1720	20050	22.35	23	0
			0	1732.5	20175	22.18	23	0
				1745	20300	22.89	23	0
				1720	20050	22.63	23	0
		1 RB	50	1732.5	20175	22.59	23	0
				1745	20300	22.64	23	0
				1720	20050	22.61	23	0
			99	1732.5	20175	22.11	23	0
				1745	20300	22.57	23	0
				1720	20050	21.53	22	0-1
	QPSK		0	1732.5	20175	21.67	22	0-1
				1745	20300	21.54	22	0-1
				1720	20050	21.71	22	0-1
		50 RB	25	1732.5	20175	21.58	22	0-1
				1745	20300	21.36	22	0-1
				1720	20050	21.66	22	0-1
			50	1732.5	20175	21.29	22	0-1
				1745	20300	21.26	22	0-1
				1720	20050	21.65	22	0-1
		100	ORB	1732.5	20175	21.48	22	0-1
20			-	1745	20300	21.49	22	0-1
20				1720	20050	21.68	22	0-1
			0	1732.5	20175	21.36	22	0-1
				1745	20300	21.64	22	0-1
				1720	20050	21.58	22	0-1
		1 RB	50	1732.5	20175	21.75	22	0-1
				1745	20300	21.65	22	0-1
				1720	20050	21.60	22	0-1
			99	1732.5	20175	20.94	22	0-1
				1745	20300	21.02	22	0-1
				1720	20050	20.75	21	0-2
	16-QAM		0	1732.5	20175	20.70	21	0-2
				1745	20300	20.53	21	0-2
				1720	20050	20.60	21	0-2
		50 RB	25	1732.5	20175	20.61	21	0-2
		50	1745	20300	20.50	21	0-2	
				1720	20050	20.67	21	0-2
			50	1732.5	20175	20.36	21	0-2
				1745	20300	20.34	21	0-2
				1720	20050	20.60	21	0-2
		100	)RB	1732.5	20175	20.41	21	0-2
				1745	20300	20.57	21	0-2

#### LTE FDD Band 4 / Band 13 conducted power table:

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				FDD Band 4				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				1717.5	20025	22.48	23	0
			0	1732.5	20175	22.52	23	0
				1747.5	20325	22.46	23	0
				1717.5	20025	22.54	23	0
		1 RB	36	1732.5	20175	22.54	23	0
				1747.5	20325	22.39	23	0
				1717.5	20025	22.50	23	0
			74	1732.5	20175	22.29	23	0
				1747.5	20325	22.55	23	0
				1717.5	20025	21.55	22	0-1
	QPSK		0	1732.5	20175	21.74	22	0-1
				1747.5	20325	21.47	22	0-1
				1717.5	20025	21.60	22	0-1
		36 RB	18	1732.5	20175	21.63	22	0-1
				1747.5	20325	21.30	22	0-1
				1717.5	20025	21.67	22	0-1
			37	1732.5	20175	21.47	22	0-1
				1747.5	20325	21.34	22	0-1
				1717.5	20025	21.67	22	0-1
		75	RB	1732.5	20175	21.49	22	0-1
15				1747.5	20325	21.42	22	0-1
15				1717.5	20025	21.75	22	0-1
			0	1732.5	20175	21.25	22	0-1
				1747.5	20325	21.65	22	0-1
				1717.5	20025	21.12	22	0-1
		1 RB	36	1732.5	20175	21.67	22	0-1
				1747.5	20325	21.04	22	0-1
				1717.5	20025	21.42	22	0-1
			74	1732.5	20175	21.41	22	0-1
				1747.5	20325	21.31	22	0-1
				1717.5	20025	20.60	21	0-2
	16-QAM		0	1732.5	20175	20.66	21	0-2
				1747.5	20325	20.61	21	0-2
				1717.5	20025	20.60	21	0-2
		36 RB 18	1732.5	20175	20.65	21	0-2	
			1747.5	20325	20.41	21	0-2	
			1717.5	20025	20.64	21	0-2	
			1732.5	20175	20.47	21	0-2	
				1747.5	20325	20.35	21	0-2
				1717.5	20025	20.68	21	0-2
		75	RB	1732.5	20175	20.46	21	0-2
				1747.5	20325	20.59	21	0-2

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				FDD Band 4				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				1717.5	20025	22.48	23	0
			0	1732.5	20175	22.52	23	0
				1747.5	20325	22.46	23	0
				1717.5	20025	22.54	23	0
		1 RB	36	1732.5	20175	22.54	23	0
				1747.5	20325	22.39	23	0
				1717.5	20025	22.50	23	0
			74	1732.5	20175	22.29	23	0
				1747.5	20325	22.55	23	0
				1717.5	20025	21.55	22	0-1
	QPSK		0	1732.5	20175	21.74	22	0-1
				1747.5	20325	21.47	22	0-1
				1717.5	20025	21.60	22	0-1
		36 RB	18	1732.5	20175	21.63	22	0-1
				1747.5	20325	21.30	22	0-1
				1717.5	20025	21.67	22	0-1
			37	1732.5	20175	21.47	22	0-1
				1747.5	20325	21.34	22	0-1
				1717.5	20025	21.67	22	0-1
		75	RB	1732.5	20175	21.49	22	0-1
15			-	1747.5	20325	21.42	22	0-1
10				1717.5	20025	21.75	22	0-1
			0	1732.5	20175	21.25	22	0-1
				1747.5	20325	21.65	22	0-1
				1717.5	20025	21.12	22	0-1
		1 RB	36	1732.5	20175	21.67	22	0-1
				1747.5	20325	21.04	22	0-1
				1717.5	20025	21.42	22	0-1
			74	1732.5	20175	21.41	22	0-1
				1747.5	20325	21.31	22	0-1
				1717.5	20025	20.60	21	0-2
	16-QAM		0	1732.5	20175	20.66	21	0-2
				1747.5	20325	20.61	21	0-2
				1717.5	20025	20.60	21	0-2
		36 RB	36 RB 18	1732.5	20175	20.65	21	0-2
		37	1747.5	20325	20.41	21	0-2	
			1717.5	20025	20.64	21	0-2	
			37	1732.5	20175	20.47	21	0-2
				1747.5	20325	20.35	21	0-2
				1717.5	20025	20.68	21	0-2
		75	RB	1732.5	20175	20.46	21	0-2
				1747.5	20325	20.59	21	0-2

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				FDD Band 4				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				1715	20000	22.39	23	0
			0	1732.5	20175	22.57	23	0
				1750	20350	22.09	23	0
				1715	20000	22.67	23	0
		1 RB	25	1732.5	20175	22.46	23	0
				1750	20350	22.49	23	0
				1715	20000	22.41	23	0
			49	1732.5	20175	22.22	23	0
				1750	20350	22.52	23	0
				1715	20000	21.52	22	0-1
	QPSK		0	1732.5	20175	21.69	22	0-1
				1750	20350	21.33	22	0-1
				1715	20000	21.65	22	0-1
		25 RB	12	1732.5	20175	21.61	22	0-1
				1750	20350	21.38	22	0-1
				1715	20000	21.62	22	0-1
			25	1732.5	20175	21.49	22	0-1
				1750	20350	21.51	22	0-1
				1715	20000	21.67	22	0-1
		50	RB	1732.5	20175	21.59	22	0-1
10				1750	20350	21.42	22	0-1
10				1715	20000	21.69	22	0-1
			0	1732.5	20175	21.26	22	0-1
				1750	20350	21.07	22	0-1
				1715	20000	21.71	22	0-1
		1 RB	25	1732.5	20175	21.80	22	0-1
				1750	20350	20.85	22	0-1
				1715	20000	21.56	22	0-1
			49	1732.5	20175	21.44	22	0-1
				1750	20350	21.33	22	0-1
				1715	20000	20.88	21	0-2
	16-QAM		0	1732.5	20175	20.69	21	0-2
				1750	20350	20.59	21	0-2
				1715	20000	20.70	21	0-2
		25 RB 12	1732.5	20175	20.86	21	0-2	
				1750	20350	20.42	21	0-2
		25		1715	20000	20.59	21	0-2
			25	1732.5	20175	20.52	21	0-2
				1750	20350	20.47	21	0-2
				1715	20000	20.58	21	0-2
		50	RB	1732.5	20175	20.44	21	0-2
				1750	20350	20.61	21	0-2

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				FDD Band 4					
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)	
				1712.5	19975	22.46	23	0	
			0	1732.5	20175	22.49	23	0	
				1752.5	20375	22.37	23	0	
				1712.5	19975	22.45	23	0	
		1 RB	12	1732.5	20175	22.56	23	0	
				1752.5	20375	22.56	23	0	
				1712.5	19975	21.97	23	0	
			24	1732.5	20175	22.21	23	0	
				1752.5	20375	22.50	23	0	
				1712.5	19975	21.38	22	0-1	
	QPSK		0	1732.5	20175	21.64	22	0-1	
				1752.5	20375	21.32	22	0-1	
				1712.5	19975	21.51	22	0-1	
		12 RB	6	1732.5	20175	21.65	22	0-1	
				1752.5	20375	21.48	22	0-1	
			13	1712.5	19975	21.58	22	0-1	
				1732.5	20175	21.46	22	0-1	
				1752.5	20375	21.65	22	0-1	
				1712.5	19975	21.56	22	0-1	
		25	RB	1732.5	20175	21.58	22	0-1	
5				1752.5	20375	21.44	22	0-1	
5				1712.5	19975	21.37	22	0-1	
			0	0	1732.5	20175	21.54	22	0-1
				1752.5	20375	20.78	22	0-1	
				1712.5	19975	21.06	22	0-1	
		1 RB	12	1732.5	20175	21.09	22	0-1	
				1752.5	20375	21.12	22	0-1	
				1712.5	19975	20.97	22	0-1	
			24	1732.5	20175	21.24	22	0-1	
				1752.5	20375	21.19	22	0-1	
				1712.5	19975	20.32	21	0-2	
	16-QAM		0	1732.5	20175	20.57	21	0-2	
				1752.5	20375	20.26	21	0-2	
				1712.5	19975	20.41	21	0-2	
		12 RB	6	1732.5	20175	20.40	21	0-2	
		13		1752.5	20375	20.25	21	0-2	
				1712.5	19975	20.55	21	0-2	
			13	1732.5	20175	20.62	21	0-2	
				1752.5	20375	20.62	21	0-2	
				1712.5	19975	20.46	21	0-2	
		25	RB	1732.5	20175	20.45	21	0-2	
				1752.5	20375	20.50	21	0-2	

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				FDD Band 4				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				1711.5	19965	22.65	23	0
			0	1732.5	20175	22.71	23	0
				1753.5	20385	22.15	23	0
				1711.5	19965	22.58	23	0
		1 RB	7	1732.5	20175	22.51	23	0
				1753.5	20385	22.54	23	0
				1711.5	19965	22.39	23	0
			14	1732.5	20175	22.43	23	0
				1753.5	20385	22.60	23	0
				1711.5	19965	21.55	22	0-1
	QPSK		0	1732.5	20175	21.68	22	0-1
				1753.5	20385	21.30	22	0-1
				1711.5	19965	21.52	22	0-1
		8 RB	4	1732.5	20175	21.65	22	0-1
				1753.5	20385	21.48	22	0-1
				1711.5	19965	21.49	22	0-1
			7	1732.5	20175	21.62	22	0-1
				1753.5	20385	21.43	22	0-1
				1711.5	19965	21.51	22	0-1
		15F	RB	1732.5	20175	21.60	22	0-1
3				1753.5	20385	21.44	22	0-1
5				1711.5	19965	21.75	22	0-1
			0	1732.5	20175	21.08	22	0-1
				1753.5	20385	20.85	22	0-1
				1711.5	19965	21.64	22	0-1
		1 RB	7	1732.5	20175	20.82	22	0-1
				1753.5	20385	21.36	22	0-1
				1711.5	19965	21.16	22	0-1
			14	1732.5	20175	21.50	22	0-1
				1753.5	20385	21.29	22	0-1
				1711.5	19965	20.57	21	0-2
	16-QAM		0	1732.5	20175	20.62	21	0-2
				1753.5	20385	20.14	21	0-2
				1711.5	19965	20.57	21	0-2
		8 RB	4	1732.5	20175	20.61	21	0-2
		7		1753.5	20385	20.20	21	0-2
				1711.5	19965	20.63	21	0-2
			7	1732.5	20175	20.52	21	0-2
				1753.5	20385	20.37	21	0-2
				1711.5	19965	20.43	21	0-2
		15	RB	1732.5	20175	20.75	21	0-2
				1753.5	20385	20.47	21	0-2

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FDD Band 4									
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)	
				1710.7	19957	22.33	23	0	
			0	1732.5	20175	22.55	23	0	
				1754.3	20393	22.19	23	0	
				1710.7	19957	22.52	23	0	
		1 RB	2	1732.5	20175	22.61	23	0	
				1754.3	20393	22.54	23	0	
				1710.7	19957	22.29	23	0	
			5	1732.5	20175	22.47	23	0	
				1754.3	20393	22.42	23	0	
				1710.7	19957	22.34	23	0	
	QPSK		0	1732.5	20175	22.53	23	0	
				1754.3	20393	22.35	23	0	
				1710.7	19957	22.45	23	0	
		3 RB	2	1732.5	20175	22.53	23	0	
				1754.3	20393	22.49	23	0	
				1710.7	19957	22.48	23	0	
			3	1732.5	20175	22.56	23	0	
				1754.3	20393	22.49	23	0	
				1710.7	19957	21.55	22	0-1	
		61	RB	1732.5	20175	21.60	22	0-1	
1.4				1754.3	20393	21.32	22	0-1	
			0	1710.7	19957	21.51	22	0-1	
			0	1732.5	20175	21.44	22	0-1	
				1754.3	20393	21.46	22	0-1	
		1.55		1710.7	19957	21.72	22	0-1	
		1 RB	2	1732.5	20175	21.37	22	0-1	
				1754.3	20393	21.28	22	0-1	
			-	1710.7	19957	21.35	22	0-1	
			5	1732.5	20175	21.40	22	0-1	
				1754.3	20393	21.62	22	0-1	
	16-QAM		0	1710.7 1732.5	19957 20175	21.51 21.51	22 22	0-1 0-1	
			U				22	0-1	
				1754.3 1710.7	20393 19957	21.19 21.78	22	-	
		3 PR	2	1710.7	20175	21.78	22	0-1 0-1	
		3 RB 2	1754.3	20175	21.75	22	0-1		
				1754.5	19957	21.24	22	0-1	
		3	3	1732.5	20175	21.00	22	0-1	
			Ŭ	1754.3	20393	21.73	22	0-1	
			1	1734.3	19957	20.57	22	0-1	
		66	RB	1732.5	20175	20.71	21	0-2	
		0		1754.3	20393	20.27	21	0-2	

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				FDD Band 13				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
			0	782	23230	22.69	23	0
		1 RB	25	782	23230	22.61	23	0
	QPSK		49	782	23230	22.85	23	0
		0	782	23230	21.76	22	0-1	
		25 RB	12	782	23230	21.84	22	0-1
			25	782	23230	21.92	22	0-1
10		50	RB	782	23230	21.88	22	0-1
10			0	782	23230	21.59	22	0-1
		1 RB	25	782	23230	21.75	22	0-1
			49	782	23230	21.85	22	0-1
	16-QAM 25 RB	0	782	23230	20.68	21	0-2	
		25 RB	12	782	23230	20.82	21	0-2
			25	782	23230	20.84	21	0-2
		50	RB	782	23230	20.79	21	0-2

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				FDD Band 13				
BW(Mhz)	Modulation	RB Size	RB Offset	Frequency (MHz)	Channel	Conducted power (dBm)	Target Power + Max. Tolerance (dBm)	MPR Allowed per 3GPP(dB)
				779.5	23205	22.49	23	0
			0	782	23230	22.66	23	0
				784.5	23255	22.42	23	0
				779.5	23205	22.73	23	0
		1 RB	12	782	23230	22.81	23	0
				784.5	23255	22.84	23	0
				779.5	23205	22.24	23	0
			24	782	23230	22.78	23	0
				784.5	23255	22.81	23	0
				779.5	23205	21.71	22	0-1
	QPSK		0	782	23230	21.77	22	0-1
				784.5	23255	21.78	22	0-1
				779.5	23205	21.76	22	0-1
		12 RB	6	782	23230	21.95	22	0-1
				784.5	23255	21.91	22	0-1
				779.5	23205	21.78	22	0-1
			13	782	23230	21.91	22	0-1
				784.5	23255	21.84	22	0-1
				779.5	23205	21.71	22	0-1
		25	RB	782	23230	21.91	22	0-1
5			-	784.5	23255	21.94	22	0-1
0			0	779.5	23205	21.46	22	0-1
				782	23230	21.50	22	0-1
				784.5	23255	21.48	22	0-1
				779.5	23205	21.41	22	0-1
		1 RB	12	782	23230	21.27	22	0-1
				784.5	23255	21.22	22	0-1
				779.5	23205	21.53	22	0-1
			24	782	23230	21.72	22	0-1
				784.5	23255	21.18	22	0-1
				779.5	23205	20.63	21	0-2
	16-QAM		0	782	23230	20.59	21	0-2
				784.5	23255	20.88	21	0-2
				779.5	23205	20.57	21	0-2
		12 RB	6	782	23230	20.82	21	0-2
				784.5	23255	20.77	21	0-2
				779.5	23205	20.58	21	0-2
			13	782	23230	20.87	21	0-2
				784.5	23255	20.83	21	0-2
				779.5	23205	20.62	21	0-2
		25	RB	782	23230	20.80	21	0-2
				784.5	23255	20.87	21	0-2

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# 12. Justification of held to ear modes tested

#### I. Analysis of RF air interface technologies

a. OTT data services are outside the current definition of a managed CMRS service and are currently not required to be evaluated.

b. The device doesn't support Wi-Fi calling, DT means digital transport, not intended for CMRS service, so HAC test for Wi-Fi is not required.

c. 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 worst case average 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 input power (dBm)	Worst case MIF (dB)	Maximum input power + MIF (dBm)	HAC test required
LTE B4	23	-9.76	13.24	No
LTE B13	23	-9.76	13.24	No

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

# Based on ANSI. C63.19 2011, RF emission testing for LTE B4/13 is exempted.

**#** Based on ANSI. C63.19 2011, LTE B4/13 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

Manufacturer	Device	Туре	Serial number	Date of last calibration	Date of next calibration
Schmid & Partner Engineering AG	E-Field Probe	ER3DV6	2306	Nov.23,2016	Nov.22,2017
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	Soltwale	52.8.8	IN/A	not required	not required
Agilent	Dielectric Probe Kit	85070D	US01440168	Calibration	Calibration
Agiletit	Dielectric Flobe Nit	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
Anritsu	Radio Communication Test	MT8820C	6201061014	Jan.05,2017	Jan.04,2018
Schmid & Partner Engineering AG	Test Arch SD HAC	P01	1047	Calibration not required	Calibration not required
Agilent	Power Meter	E4417A	MY52240003	Jan.20,2017	Jan.19,2018
Agilent	Power Sensor	E9301H	MY52200004	Oct.17,2016	Oct.16,2017

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# 15. Summary of Results

Band	Worst case Modulation Interference Factor	Maximum output power (dBm)	Maximum output power + MIF	HAC test required	RESULT
LTE B4	-9.63	23	13.37	No	M4
LTE B13	-9.63	23	13.37	No	M4

# Based on ANSI. C63.19 2011, RF emission testing for LTE B4/13 is exempted. # Based on ANSI. C63.19 2011, LTE B4/13 that is exempted from testing shall be rated as M4.

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### 16. DAE & Probe Calibration Certificate

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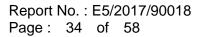
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ecognition of calibration of		
ien)	Certificate No:	DAE4-547_Mar17
CERTIFICATE		
DAE4 - SD 000 D0	04 BM - SN: 547	
QA CAL-06.v29 Calibration proced	ure for the data acquisition electro	onics (DAE)
March 22, 2017		
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Calibration Laboratory of Schmid & Partner Engineering AG Zeighaustimise 63, 8004 Zurich, Switzenime



S S S S S

Schweizertocher Kalibrierdienst Service suinne d'étalonnage Servizie svizzerro di tetaune Beriss Calibrition Service

Accreditation No.: SCS 0108

Accention by the Swiss Accendition Service (SAS) The Swiss Accenditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibiration certificates

#### Glossary

DAE Connector angle

data acquisition electronics gle 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 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 shorted. 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 verious operating modes.

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#### DC Voltage Measurement

A/D - Converter Reso	Ilulion nominal			
High Range:	1LSB =	6.1µV.	full range =	-100+300 mV
Low Range:	1LSB =	61nV	full range =	-1+3mV
DASY measurement	parameters. Aut	to Zero Time: 3	sec, Measuring	time: 3 sec

<b>Calibration Factors</b>	X	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 ± 1.50% (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
Connector Angle to be used in LMST system	air0.1.1.

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#### Appendix (Additional assessments outside the scope of SCS0108)

#### 1. DC Voltage Linearity 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 200029.80 1.03 + Input -0.00 Channel Y 20000.30 -3.03 0.02 + Input 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	0.36	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	-0.79	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 aec; Measuring time: 3 aec.

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-2.09	-5.00
	- 200	6.80	4,50
Channel Y	200	-0.67	4.21
	- 200	0,37	-0.41
Channel Z	200	5.07	4.93
	+ 200	-7,67	-8.12

#### 3. Channel separation

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

	Input Voltage (mV)	Channel X (µV)	Channel Y (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	

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#### 4. AD-Converter Values with inputs shorted

DASY	measuremen	parameters:	Auto Zero	me: 3 sec;	Measuring	time: 3 sec
_						

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

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 soc; Measuring time: 3 sec Inclui 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 (- Vcc)	-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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ALIDDATION	OFDIELOATE		
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Object.	ER3DV6 - SN:230	16	
Calibration procedure(s)	QA CAL-02.v8, Q		and a second second second
		dure for E-field probes optimized f	for close near field
	evaluations in air		
Calibration date:	November 22, 20	16	
venumenton date:	November 23, 20	10	
This calibration cartificate accur	nanle the tracephility to entire	on consistent union sealing the physical unite	of manufamonte /CIV
		nal standards, which realize the physical units	
Ine measurements and the uno	ertainties with confidence pro	bability are given on the following pages and	and part of the cettificate.
All calibrations have been cond	ucted in the closed laboratory	lacity environment temperature (22 ± 3)°C :	and numidity < 70%.
All calibrations have been cond	ucted in the closed laboratory		and humidity < 70%.
			and $minidity < 70\%$ .
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Calibration Equipment used (M	TE entical for calibration)	laciity environment temperature (22 ± 3)*C t Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M Primary Standards Power meter NRP	TE entical for calibration)	Cal Date (Certilicate No.) 06-Apc 16 (No. 217-02268/02269)	Scheduled Calibration
Calibration Equipment used (M Primery Standards Power meter NRP Power sonsor NRP-Z91	TE entical for calibration) ID SN: 104778 SN: 103244	Laciity         environment temperature (22 ± 3)*C ±           Cal Date (Certificate No.)         06-Apc-16 (No. 217-02268/02269)           06-Apc-16 (No. 217-02288)	Scheduled Calibration Apr-17 Apr-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245	Cability         environment temperature (22 ± 3)*C t           Cal Date (Certilicate No.)           06-Ap<16 (No. 217-02288/02289)	Scheduled Calibration Apr-17 Apr-17 Apr-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20x)	Iability         environment temperature (22 ± 3)*C =           Cal Date (Certificate No.)           06-Ap=16 (No. 217-02288/02289)           06-Ap=16 (No. 217-02288)           06-Ap=16 (No. 217-02288)           05-Ap=16 (No. 217-02283)           05-Ap=16 (No. 217-02283)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Reference Probe ER3DV6	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245	Iability         environment temperature (22 ± 3)*C =           Cal Date (Certificate No.)         06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288)         06-Ap-16 (No. 217-02288)           06-Ap-16 (No. 217-02289)         05-Ap-16 (No. 217-02289)           05-Ap-16 (No. 217-02289)         04-Oct-16 (No. ER3-2328_Oct16)	Scheduled Calibration Apr-17 Apr-17 Apr-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Reference Probe ER3DV6	ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20x) SN: 2328	Iability         environment temperature (22 ± 3)*C =           Cal Date (Certificate No.)           06-Ap=16 (No. 217-02288/02289)           06-Ap=16 (No. 217-02288)           06-Ap=16 (No. 217-02288)           05-Ap=16 (No. 217-02283)           05-Ap=16 (No. 217-02283)	Scheduled Caltration Apr-17 Apr-17 Apr-17 Apr-17 Oct-17 Oct-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sonsor NRP-201 Power sensor NRP-201 Reference 20 dB Altenuator Reference Probe ER3DV6 DAE4	ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20x) SN: 2328	Iability         environment temperature (22 ± 3)*C =           Cal Date (Certificate No.)         06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288)         06-Ap-16 (No. 217-02288)           06-Ap-16 (No. 217-02289)         05-Ap-16 (No. 217-02289)           05-Ap-16 (No. 217-02289)         04-Oct-16 (No. ER3-2328_Oct16)	Scheduled Caltration Apr-17 Apr-17 Apr-17 Apr-17 Oct-17 Oct-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Alternuator Reference 20 dB Alternuator Reference Probe ER3DV6 DAE4 Secondary Standards	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20k) SN: 2328 SN: 789	Laciity: environment temperature (22 ± 3)*C + Cal Date (Certilicate No.) 06-Apr-16 (No. 217-02268/02289) 06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02288) 05-Apr-16 (No. 217-02283) 14-Oct-16 (No. 217-02293) 14-Oct-16 (No. 2R3-2328_Oct16) 11-Nov-16 (No. DAE4-789_Nov16)	Sobeduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dot-17 Nov-17
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Alternuator Reference Probe ER3DV6 DAE4 Secondary Standards Power meter E4419B	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245 SN: 85277 (20x) SN: 2328 SN: 789 ID	Cability         environment temperature (22 ± 3)*C t           Cal Date (Certificate No.)         06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288)         06-Ap-16 (No. 217-02289)           06-Ap-16 (No. 217-02289)         05-Ap-16 (No. 217-02289)           05-Ap-16 (No. 217-02289)         05-Ap-16 (No. 217-02289)           05-Ap-15 (No. 247-02289)         05-Ap-16 (No. 217-02289)           05-Ap-15 (No. 247-02289)         05-Ap-15 (No. 247-02289)           05-Ap-15 (No. DAE4-789_Nov16)         11-Nov-15 (No. DAE4-789_Nov16)           Check Date (in house)         0	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dot-17 Nov-17 Scheduled Check
Calibration Equipment used (M Primary Standards Power meter NRP Power sonsor NRP-291 Power sonsor NRP-291 Reference 20 B Altenuator Reference 20 B Altenuator Reference 20 B Altenuator DAE4 Sacondary Standards Power meter E4419B Power sonsor E4412A	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20x) SN: 2328 SN: 2328 SN: 789 ID SN: GB41283874	Cal Date (Certilicate No.)           Cal Date (Certilicate No.)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           Check Date (in house)           OE-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)	Scheduled Calibration Apr-17 Aor-17 Apr-17 Apr-17 Dol-17 Nov-17 Scheduled Check In house check Jun-18 In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Reference Probe ER3DV6 DAE4 Secondary Standards Power sensor E44198 Power sensor E4412A RF generator HP 8648C	ID           SN: 104778           SN: 103244           SN: 103245           SN: 55277 (20x)           SN: 228           SN: 789           ID           SN: GB41283874           SN: 00110210           SN: US3642U01700	Cel Dale (Certilicale No.)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 247-02293)           14-Oct-16 (No. 247-02293)           14-Oct-16 (No. DAE4-789_Nov16)           05-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Oct-17 Oct-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18 In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Reference Probe ER3DV6 DAE4 Secondary Standards Power sensor E44198 Power sensor E4412A RF generator HP 8648C	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103245 SN: 55277 (20x) SN: 2328 SN: 789 ID SN: GB41283874 SN: GB41283874 SN: MY41498087 SN: 000110210	Cal Date (Certilicate No.)           Cal Date (Certilicate No.)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           Check Date (in house)           OE-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)	Scheduled Calibration Apr-17 Aor-17 Apr-17 Apr-17 Dol-17 Nov-17 Scheduled Check In house check Jun-18 In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Reference Probe ER3DV6 DAE4 Secondary Standards Power sensor E44198 Power sensor E4412A RF generator HP 8648C	ID           SN: 104778           SN: 103244           SN: 103245           SN: 55277 (20x)           SN: 228           SN: 789           ID           SN: GB41283874           SN: 00110210           SN: US3642U01700	Cel Dale (Certilicale No.)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 247-02293)           14-Oct-16 (No. 247-02293)           14-Oct-16 (No. DAE4-789_Nov16)           05-Apr-16 (in house check Jun-16)           06-Apr-16 (in house check Jun-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sonsor NRP-291 Power sensor NRP-291 Reference 20 B Altenuator Reference Probe ER30V6 DAE4 Secondary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A RF generator NP 8648C Notwork Analyzor NP 8763E	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 2328 SN: 2328 SN: 2328 SN: 789 ID SN: GB41283874 SN: GB41283874 SN: 000110210 SN: US3642U01700 SN: US37300696 Name	Cal Date (Certificate No.)           06-Apr-16 (No. 217-02268/02289)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. 247-02293)           06-Apr-16 (in house)           06-Apr-16 (in house)           06-Apr-16 (in house check Jun-16)           07-Apr-16 (in house check Jun-16)           08-Apr-16 (in house check Jun-16)           18 Oct 01 (in house check Oct-16)           Function	Scheduled Calibration Apr-17 Apr-17 Apr-17 Oct-17 Oct-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18 In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sonsor NRP-291 Power sensor NRP-291 Reference 20 B Altenuator Reference Probe ER30V6 DAE4 Secondary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A RF generator NP 8648C Notwork Analyzor NP 8763E	ID SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 55277 (20x) SN: 2328 SN: 2328 SN: 789 ID SN: GB41283874 SN: MY41498087 SN: 000110210 SN: 003642001700 SN: US37300686	Cal Date (Certificate No.)           Cal Date (Certificate No.)           06-Ape-16 (No. 217-02288/02289)           06-Ape-16 (No. 217-02288)           05-Ape-16 (No. 217-02283)           14-Oct-16 (No. 217-02283)           05-Ape-16 (no. 217-02283)           05-Ape-16 (no. 217-02283)           05-Ape-16 (no. 217-02283)           05-Ape-16 (no. 217-02283)           06-Ape-16 (no. 217-02283)           06-Ape-16 (no. 217-02283)           06-Ape-16 (no. 217-02293)           10-04-Ape-16 (no. 0404-789_Nov16)           06-Ape-16 (no bouse check Jun-16)           07-Ape-90 (no bouse check Qui 16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sonsor NRP-291 Power sensor NRP-291 Reference 20 B Altenuator Reference Probe ER30V6 DAE4 Secondary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A RF generator NP 8648C Notwork Analyzor NP 8763E	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 2328 SN: 2328 SN: 2328 SN: 789 ID SN: GB41283874 SN: GB41283874 SN: 000110210 SN: US3642U01700 SN: US37300696 Name	Cal Date (Certificate No.)           06-Apr-16 (No. 217-02268/02289)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. 247-02293)           06-Apr-16 (in house)           06-Apr-16 (in house)           06-Apr-16 (in house check Jun-16)           07-Apr-16 (in house check Jun-16)           08-Apr-16 (in house check Jun-16)           18 Oct 01 (in house check Oct-16)           Function	Scheduled Calibration Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Altenuator Reference 20 dB Altenuator Reference 20 dB Altenuator Bater Power sensor 20 dB Altenuator Reference 20 d	TE entical for calibration) ID SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 2328 SN: 2328 SN: 2328 SN: 789 ID SN: GB41283874 SN: GB41283874 SN: 000110210 SN: US3642U01700 SN: US37300696 Name	Cal Date (Certificate No.)           06-Apr-16 (No. 217-02268/02289)           06-Apr-16 (No. 217-02288/02289)           06-Apr-16 (No. 217-02288)           06-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02289)           05-Apr-16 (No. 217-02293)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. 247-02293)           06-Apr-16 (in house)           06-Apr-16 (in house)           06-Apr-16 (in house check Jun-16)           07-Apr-16 (in house check Jun-16)           08-Apr-16 (in house check Jun-16)           18 Oct 01 (in house check Oct-16)           Function	Scheduled Calibration. Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M	ID         SN: 104778           SN: 103244         SN: 103245           SN: 103245         SN: 2328           SN: 2328         SN: 2328           SN: 2328         SN: 2328           SN: 000110210         SN: 000110210           SN: 00542001700         SN: US3642001700           SN: US37300696         Name           Niichael Weber         Ser	Cal Date (Certificate No.)           06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02289)           05-Ap-16 (No. 217-02283)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. DAE4-789_Nov16)           06-Apr-16 (in house)           06-Apr-16 (in house check Jun-16)           07-Aug-99 (in house check Jun-16)           18 Oct 01 (in house check Jun-16)           Function           Laboratory Technician	Scheduled Calibration. Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18
Calibration Equipment used (M Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Altenuator Reference 20 dB Altenuator Reference 20 dB Altenuator Bater Power sensor 20 dB Altenuator Reference 20 d	ID         SN: 104778           SN: 103244         SN: 103245           SN: 103245         SN: 2328           SN: 2328         SN: 2328           SN: 2328         SN: 2328           SN: 000110210         SN: 000110210           SN: 00542001700         SN: US3642001700           SN: US37300696         Name           Niichael Weber         Ser	Cal Date (Certificate No.)           06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288/02289)           06-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02288)           05-Ap-16 (No. 217-02289)           05-Ap-16 (No. 217-02283)           14-Oct-16 (No. 217-02293)           14-Oct-16 (No. DAE4-789_Nov16)           06-Apr-16 (in house)           06-Apr-16 (in house check Jun-16)           07-Aug-99 (in house check Jun-16)           18 Oct 01 (in house check Jun-16)           Function           Laboratory Technician	Scheduled Calibration. Apr-17 Apr-17 Apr-17 Dot-17 Dot-17 Nov-17 Scheduled Check In house check: Jun-18 In house check: Jun-18

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Calibration Laboratory of Schmid & Partner Engineering AG Zaughausstrasse 43, 8004 Zunch, Switterland



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#### Glossary:

 NORMx.y,2
 sensitivity in free space

 DCP
 diode compression point

 CF
 crest factor (1/duty\_cycle) of the RF signal

 A, B, C, D
 modulation dependent linearization parameters

 Polarization ψ
 ψ rotation around probe axis

 Polarization %
 # rotation around an axis that is in the plane normal to probe axis (at measurement center).

 i.e., % = 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 antennas, 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 9 = 0 for XY sensors and 9 = 90 for Z sensor (f < 900 MHz in TEM-cell; f > 1800 MHz; R22 waveguide).
- NORM(I)x, y,z = NORMx, y,z \* Irequency\_response (see Frequency Response Chart).
- DCPx,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 determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z; A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration hange expressed in RMS voltage across the diode.
- 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 axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

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ER3DV6 - SN:2306

November 23, 2016

# Probe ER3DV6

## SN:2306

Manufactured: Calibrated: December 17, 2002 November 23, 2016

(Note: non-compatible with DASY2 systems)

Certificate No: ER3-2306\_Nov16

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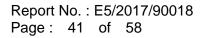
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#### ER3DV0 - SN:2300

#### November 23, 2016

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

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) <sup>2</sup> )	1.05	1.08	1.19	± 10.1 %
DCP (mV) <sup>6</sup>	102.1	101.9	104.6	1

#### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	c	D dB	WR mV	Unc <sup>±</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	153.2	±3.3 %
-		Y	0.0	0.0	5.0		166.4	11-21-21-2
		Z	0.0	0.0	1.0	1	156.4	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	×	0.33	.50,6	4,6	10.00	36.4	±2:7 %
		Y	0.34	49.4	4.6		37.8	
		Z	0.42	50.7	4.4	1.00	36.9	100.00
10021- DAC	GSM-FDD (TDMA, GMSK)	×	2.39	69.1	15.0	9,39	131.5	±2.5 %
1000		Y	3.16	76.0	19.5		139.0	
		2	2.56	68.9	15.1		130.6	
10295- AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	x	5.49	70.5	26.8	12.49	80.8	<b>計</b> 4%
_		Y	5.73	72.3	28.6		87.7	
Sec		Z	6.01	72.1	27.0		84.7	

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%.

Numerical Investigation parameter: uncertainty not required. Uncertainty is determined using the max, deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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t (886-2) 2299-3279 台灣檢驗科技股份有限公司

f (886-2) 2298-0488

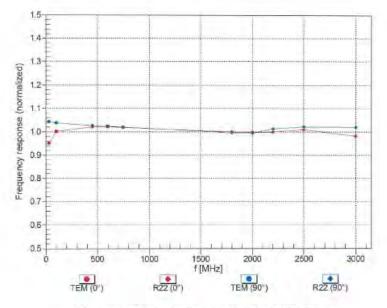


Report No. : E5/2017/90018 Page : 42 of 58

ER3DV6 - SN:2306

November 23, 2016

#### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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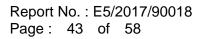
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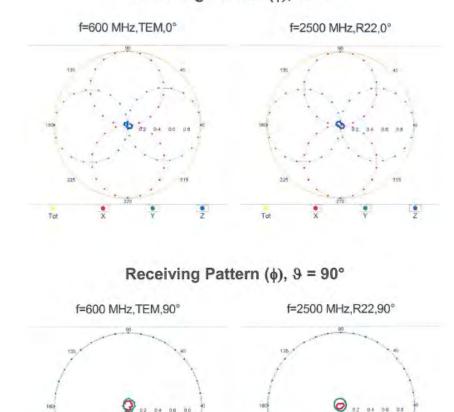
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ER3DV6 - SN:2306

November 23, 2016



Receiving Pattern (\$), 9 = 0°

Certificate No: ER3-2306\_Nov16

Tot

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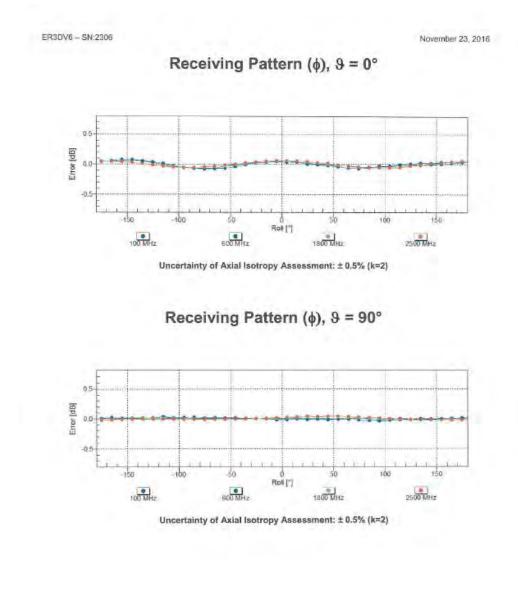
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Certificate No: ER3-2306\_Nov16

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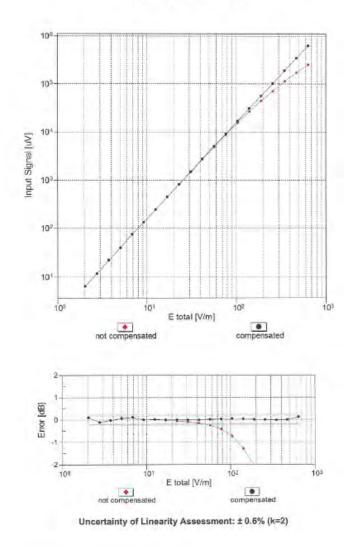
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ER3DV6 - SN:2306

November 23, 2016



#### Dynamic Range f(E-field) (TEM cell , f = 900 MHz)

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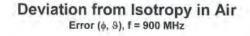
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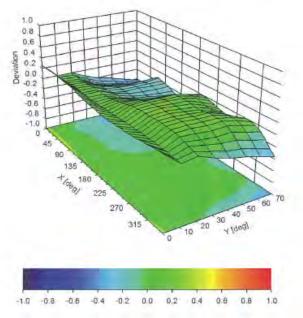


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ER3DV6 - SN:2306

November 23, 2016





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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ER3DV6 - SN.2306

November 23, 2016

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

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (*)	134.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diamater	10 mm
Tip Length	10 mm
Tip Diameter	8 mm
Probe Tip to Sensor X Calibration Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm

Cartificate No. ER3-2306\_Nov16

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### **17. Uncertainty Budget**

%         N           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R	R R R R R R R R R R	$   \begin{array}{c}     1 \\     \sqrt{3} \\     1 \\     \sqrt{3} \\     \sqrt{3} \\     1   \end{array} $	1 1 1 1 1 1 1 1 1 1	1 0.145 1 0 1 1 1 1 1	$\begin{array}{c} \pm 5.1\% \\ \pm 2.7\% \\ \pm 9.5\% \\ \pm 1.4\% \\ \pm 4.1\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \\ \pm 0.3\% \end{array}$	$\begin{array}{c} \pm 5.1 \% \\ \pm 2.7 \% \\ \pm 1.4 \% \\ \pm 1.4 \% \\ \pm 0.0 \% \\ \pm 2.7 \% \\ \pm 5.8 \% \\ \pm 0.6 \% \\ \pm 0.3 \% \end{array}$
%         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         N           %         R	R R R R R R R R R R		1 1 1 1 1 1 1 1	1 0.145 1 0 1 1 1 1	$\begin{array}{c} \pm 2.7\% \\ \pm 9.5\% \\ \pm 1.4\% \\ \pm 4.1\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \\ \pm 0.3\% \end{array}$	$\begin{array}{r} \pm 2.7\%\\ \pm 1.4\%\\ \pm 1.4\%\\ \pm 0.0\%\\ \pm 2.7\%\\ \pm 5.8\%\\ \pm 0.6\%\end{array}$
%         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R	R R R R R R N R	$\begin{array}{c} \sqrt{3} \\ 1 \\ \sqrt{3} \end{array}$	1 1 1 1 1 1 1 1	0.145 1 0 1 1 1 1 1	$\begin{array}{c} \pm 9.5\%\\ \pm 1.4\%\\ \pm 4.1\%\\ \pm 2.7\%\\ \pm 5.8\%\\ \pm 0.6\%\\ \pm 0.3\%\end{array}$	$\begin{array}{c} \pm 1.4\% \\ \pm 1.4\% \\ \pm 0.0\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \end{array}$
%         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R	R R R R R R R R	$\begin{array}{c} \sqrt{3} \\ \sqrt{3} \\ \sqrt{3} \\ \sqrt{3} \\ \sqrt{3} \\ \sqrt{3} \\ 1 \\ \sqrt{3} \end{array}$	1 1 1 1 1 1	1 0 1 1 1 1	$\begin{array}{c} \pm 1.4\% \\ \pm 4.1\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \\ \pm 0.3\% \end{array}$	$\begin{array}{c} \pm 1.4\% \\ \pm 0.0\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \end{array}$
%         R           %         R           %         R           %         R           %         R           %         R           %         R           %         R	R R R R N R		1 1 1 1 1	0 1 1 1 1	$\begin{array}{c} \pm 4.1\% \\ \pm 2.7\% \\ \pm 5.8\% \\ \pm 0.6\% \\ \pm 0.3\% \end{array}$	$\pm 0.0\%$ $\pm 2.7\%$ $\pm 5.8\%$ $\pm 0.6\%$
%         R           %         R           %         R           %         R           %         R           %         R	R R N R	$\frac{\sqrt{3}}{\sqrt{3}}$ $\frac{\sqrt{3}}{\sqrt{3}}$ $\frac{1}{\sqrt{3}}$	1 1 1 1	1 1 1 1	$\pm 2.7\%$ $\pm 5.8\%$ $\pm 0.6\%$ $\pm 0.3\%$	$\pm 2.7\%$ $\pm 5.8\%$ $\pm 0.6\%$
%         R           %         R           %         N           %         R	R R N R	$\frac{\sqrt{3}}{\sqrt{3}}$ 1 $\sqrt{3}$	1 1 1	1 1 1	$\pm 5.8\%$ $\pm 0.6\%$ $\pm 0.3\%$	$\pm 5.8\%$ $\pm 0.6\%$
% R % N % R	R N R	$\sqrt{3}$ 1 $\sqrt{3}$	1	1	±0.6% ±0.3%	±0.6%
% N % R	N R	$\frac{1}{\sqrt{3}}$	1	1	±0.3%	
% R	R	_	7	1		$\pm 0.3\%$
		_	1	1 <b>1</b>		and the second se
% R	R	_		1	$\pm 0.5 \%$	$\pm 0.5 \%$
		$\sqrt{3}$	1	1	$\pm 1.5\%$	±1.5%
% R	R	$\sqrt{3}$	1	1	$\pm 1.7\%$	$\pm 1.7\%$
% R	R	$\sqrt{3}$	1	1	$\pm 6.9\%$	$\pm 6.9\%$
% R	R	$\sqrt{3}$	1	0.67	±0.7%	$\pm 0.5 \%$
% R	R	$\sqrt{3}$	1	0.67	$\pm 2.7\%$	$\pm 1.8\%$
% R	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$
			(T			
% R	R	$\sqrt{3}$	1	0.67	$\pm 2.7\%$	$\pm 1.8\%$
% R	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6 \%$
% R	R	$\sqrt{3}$	1	1	±1.4%	$\pm 1.4\%$
% R	R	$\sqrt{3}$	1	1	$\pm 2.9\%$	$\pm 2.9\%$
% R	R	$\sqrt{3}$	1	0.67	$\pm 1.4\%$	$\pm 0.9\%$
	-		1.2.2		$\pm 16.3\%$	$\pm 12.3\%$
					100.007	$\pm 24.6\%$
0	% 1 % 1	% R	% R √3 % R √3	$\%$ R $\sqrt{3}$ 1 % R $\sqrt{3}$ 1	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

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## **18. System Validation from Original Equipment Supplier**

credited by the Swiss Accredita	Contraction and the last		
			creditation No.: SCS 0108
Swiss Accreditation Service			
Itilateral Agreement for the h	cognition of calibration e	pertificates	
sent SGS-TW (Aude	n)	Certificate No:	CD835V3-1052 Mar17
CALIBRATION (	CERTIFICATI		
Disci	CD835V3 - SN: 1	052	
Calibration procedure(%)	QA CAL-20.V6	a second and a second	
	Calibration proce	dure for dipoles in air	
and an owned to	March On Door		
Salibration data:	March 20, 2017		
			had a second
		onal standards, which realize the physical unit	
he measurements and the unce	antembes with confidence p	robability are given on the following pagas an	d are part of the conflicate.
Il calibrations have been condu	ated in the closed laborate	ry facility: environment temperature (22 a S)/C	and humidity < 70%
		ty facility: environment temperature (22 $\pm$ S/C	and humidity < 70%
Calibration Equipment used (MS	TE critical (or calibration)		
Calibration Equipment used (MS Primary Standards	TE critical (or calibration)	Cal Date (Cartilicate No.)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter NRP	TE critical (or calibration) D # SN: 104778	Cel Date (Certificate No.) OG-Apr-16 (No. 217-02288/02289)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter NHP Power sensor NHP-201	TE critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certilicate No.) 05-Apr-16 (No. 217-02285/02289) 06-Apr-16 (No. 217-02286)	Scheduled Calibration Apr-17 Apr-17
Calibration Equipment used (MS Primary Standards Power meter NHP Power sensor NHP-291 Power sensor NHP-291	TE critical for calibration) D # SN: 104778 SN: 103244 SN: 103945	Cel Late (Certificate No.) 06-Apr-16 (No. 217-02288/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289)	Scheduled Calibration Apr-17 Apr-17 Apr-17
Calibration Equipment used (MS Primary Standards Power Inter NRP Power sensor NRP-201 Power sensor NRP-201 Réference 20 dB Altenualor	TE entical (or calibration) ID # Site 104778 Site 104778 Site 104778 Site 104745 Site 106245 Site 106245 Site 106245	Cel Date (Certificate No.) OS-Apr-16 (No. 217-02286/12289) OS-Apr-16 (No. 217-02286) OS-Apr-16 (No. 217-02289) OS-Apr-16 (No. 217-02292)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17
Calibration Equipment used (MS Primary Standards, Power meter KRP Power sensor NRP-201 Power sensor NRP-201 Référence 20 dB Altentiator Type-N mismatoh combination	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103045 SN: 5035 (20k) SN: 5047.2 / 06327	Cel Date (Certificate No.) 05-Apr-16 (No. 217-02288/02289) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02282) 05-Apr-16 (No. 217-02285)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Apr-17
Calibration Equipment used (MS Primary Standards Power treater (NFP Power sensor NFP-201 Power sensor NFP-201 Power sensor NFP-201 Reference 20 dB Alternustor Type In mismatch combination Probe ER3D/V6	TE childeal (or calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 2336	Cal Date (Certificate No.) 05-Apr-16 (No. 217-02285/12289) 06-Apr-16 (No. 217-02266) 06-Apr-16 (No. 217-02286) 05-Apr-16 (No. 217-02282) 05-Apr-16 (No. 217-02285) 30-Dect-16 (No. ER3-236, Dect6)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17
Calibration Equipment used (MS Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Alternation Pype-N mismatch combination Pype-N mismatch combination Probe ERSIDV6 Probe H3DV6	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 5045.	Cal Date (Certificate No.) 06-Apr-16 (No. 217-02288/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02282) 06-Apr-16 (No. 217-02285) 30-Dac-16 (No. ER3-236, Dac16) 30-Dac-16 (No. H3-6085, Dec18)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17
Calibration Equipment used (MS Primary Standards Power treater (NFP Power sensor NFP-201 Power sensor NFP-201 Power sensor NFP-201 Reference 20 dB Alternustor Type In mismatch combination Probe ER3D/V6	TE childeal (or calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 2336	Cal Date (Certificate No.) 05-Apr-16 (No. 217-02285/12289) 06-Apr-16 (No. 217-02266) 06-Apr-16 (No. 217-02286) 05-Apr-16 (No. 217-02282) 05-Apr-16 (No. 217-02285) 30-Dect-16 (No. ER3-236, Dect6)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17
Calibration Equipment used (MS Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Alternation Pype-N mismatch combination Pype-N mismatch combination Probe ERSIDV6 Probe H3DV6	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 5045.	Cal Date (Certificate No.) 06-Apr-16 (No. 217-02288/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02282) 06-Apr-16 (No. 217-02285) 30-Dac-16 (No. ER3-236, Dac16) 30-Dac-16 (No. H3-6085, Dec18)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17
Calibration Equipment used (MS Primary Standards Power Inster NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Altenualor Type-N mismatoh combination Probe H3DV6 Probe H3DV6 DAEE	TE critical for calibration) ID # SN: 103748 SN: 103944 SN: 103945 SN: 5056 (20k) SN: 5047.2 / 05327 SN: 2336 SN: 6085 SN: 6085 SN: 781	Cel Date (Certificate No.) 06-Apr-16 (No. 217-02286/12289) 06-Apr-16 (No. 217-02286) 06-Apr-16 (No. 217-02292) 06-Apr-16 (No. 217-02292) 06-Apr-16 (No. 217-02295) 30-Dec-16 (No. 217-02295) 30-Dec-16 (No. H3-6085 Dec16) 02-Sep-16 (No. DAE4-781_Sep16)	Scheduled Calibration Age-17 Age-17 Age-17 Age-17 Dec-17 Dec-17 Dec-17 Step-17
Calibration Equipment used (MS Primary Standard), Power treater (KRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Altenuator Type-N mismetah combinator Proba ER3D/V6 Proba ER3D/V6 DAER Secondary Standards	TE childeal (or califoration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 2336 SN: 2336 SN: 2336 SN: 2605 SN: 781 ID #	Cal Date (Certificate No.) 05-Apt-16 (No. 217-02285/02289) 05-Apt-16 (No. 217-02285) 05-Apt-16 (No. 217-02293) 05-Apt-16 (No. 217-02292) 05-Apt-16 (No. 217-02295) 30-Dec-16 (No. ER3-2336_Dec16) 30-Dec-16 (No. H3-6065_Dec16) 02-Sep-16 (No. DAE4-781_Sep16) Check Date (in bouse)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Sap-17 Sap-17 Scheduled Check
Calibration Equipment used (MS Primary Standards, Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Alternation Pools E832/V6 Probe H3DV6 DAEs Secondary Standards Power meter Agtent 4419B	TE chilical (or calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 50472 (08327 SN: 50472 (08327 SN: 50472 (08327 SN: 6045 SN: 6065 SN: 781 ID # SN: G842420191	Cal Date (Certificate No.) 06-Apr-16 (No. 217-02288/12280) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02292) 06-Apr-16 (No. 217-02295) 30-Dac-16 (No. E18-3236, Dac-16) 30-Dac-16 (No. E18-3236, Dac-16) 02-Sep-16 (No. E18-3236, Dac-16) 02-Sep-16 (No. E18-281, Sep16) Check Date (in focuse) 09-001-09 (in focuse check Sep-14)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Sap-17 Sap-17 Scheduled Check In house check: Del-17
Calibration Equipment used (MS Primary Standards, Power meter NHP Power sensor NHP-201 Power sensor NHP-201 Neterence 20 dB Altenuator Type-N mismatch combination Probe HESDV6 Probe HESDV6 Power sensor HE E4412A Power sensor HE E4412A Power sensor HE E4412A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 6065 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US38485102	Cal Late (Certificate No.) 06-Apr-16 (No. 217-02288/12289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02289) 06-Apr-16 (No. 217-02282) 06-Apr-16 (No. 217-02282) 06-Apr-16 (No. 217-02282) 06-Apr-16 (No. 218-2282, Dec16) 30-Dec-16 (No. 183-2282, Dec16) 02-Sep-16 (No. DA&-282, Dec16) 02-Sep-16 (No. DA&-781_Sep16) Check: Date (in bouse) 09-Ont-09 (in bouse check: Sep-14) 05-Jan-10 (in bouse check: Sep-14)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17
Calibration Equipment used (MS Primary Standards, "onein meter (NFP Power sensor NFP-201 Veterence 20 dB Alternustric "proba ERSID/VE Proba ERSID/VE Proba HSD/VE VAE& Secondary Standards Power meter Agtent 44198 Power meter Agtent 44198 Power meter Agtent 44198 Power sensor HP P4450A RF generator R&S SMT-06	TE critical (or calibration) ID # SN: 103244 SN: 103245 SN: 5026 (20k) SN: 5047,2 / 06327 SN: 2336 SN: 6065 SN: 781 ID # SN: 6842420191 SN: US32465102 SN: US37295597	Cel Date (Certificate No.) 05-Apr-16 (No. 217-02288/12289) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02295) 05-Apr-16 (No. 217-02295) 30-Dec-15 (No. ER3-2336, Dec16) 30-Dec-16 (No. ER3-2336, Dec16) 30-Dec-16 (No. DAE4-781_Sep16) Check Date (in focuse) 09-Oct-09 (in focuse check Sep-14) 09-Oct-09 (in focuse check Sep-14) 09-Oct-09 (in focuse check Sep-14)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Sap-17 Scheduled Check In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
Calibration Equipment used (MS Primary Standard), "Amen heter (KPP Power sensor NRP-201 Power sensor NRP-201 Power sensor NRP-201 Power sensor NRP-201 Power Nimset Normbination Probe HSDV6 Probe HSDV6 DAE8 Secondary Standards Power mater Agtent 44198 Power mater Agtent 44198 Power sensor HP 6450A RF generator R&S SMT-06	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 6065 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US37295597 SN: 832283/011 SN: US37390580	Cal Date (Certificate No.) OG-Apr-16 (No. 217-02288/12289) OG-Apr-16 (No. 217-02289) OG-Apr-16 (No. 217-02289) OG-Apr-16 (No. 217-02292) OG-Apr-16 (No. 217-02292) OG-Apr-17 (No.	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
Calibration Equipment used (MS Primary Standards Preser tester (RPP Power sensor NRP-201 Power sensor NRP-201 Power sensor NRP-201 Proba ER3DV6 Proba ER3DV6 Proba H3DV6 DAE4 Secondary Standards Power sensor HP 6452A AP generator R&S SMT-06 Vetwork Analyzer HP 8753E	TE chilical (or califoration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103244 SN: 5028 (20k) SN: 5028 (20k) SN: 5028 (20k) SN: 6065 SN: 2336 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US32485102 SN: US3228597 SN: 83228597 SN: 832285011 SN: US37380580 Name	Cal Date (Certificate No.) OS-Apr-16 (No. 217-02285/02289) OS-Apr-16 (No. 217-02285/02289) OS-Apr-16 (No. 217-02293) OS-Apr-16 (No. 217-02292) OS-Apr-16 (No. 217-02295) 30-Dec-15 (No. ER3-2236_Dec-16) 30-Dec-16 (No. H3-6065_Dec-16) 02-Sep-16 (No. DAE4-781_Sep16) Check Date (in bouse) OS-Cont-9 (in bouse check Sep-14) OS-Cont-9 (in house check Cot-16) 18-Dat-91 (in house check Cot-16) 18-Dat-91 (in house check Cot-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Dec-17 Sap-17 Scheduled Check In house check Od-17 In house check Od-17 In house check Od-17 In house check Od-17
Calibration Equipment used (MS Primary Standards "ower meter (RFP Power sensor NFP-201 Verence 20 dB Altenuator "robe EB3DV6 Probe H3DV6 DAE4 Secondary Standards Power sensor HP 6452A AF generator R&S SMT-06 Verbrink Analyzer HP 8753E	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 6065 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US37295597 SN: 832283/011 SN: US37390580	Cal Date (Certificate No.) OG-Apr-16 (No. 217-02288/12289) OG-Apr-16 (No. 217-02289) OG-Apr-16 (No. 217-02289) OG-Apr-16 (No. 217-02292) OG-Apr-16 (No. 217-02292) OG-Apr-17 (No.	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
Calibration Equipment used (MS Primary Standards Preser tester (RPP Power sensor NRP-201 Power sensor NRP-201 Power sensor NRP-201 Proba ER3DV6 Proba ER3DV6 Proba H3DV6 DAE4 Secondary Standards Power sensor HP 6452A AP generator R&S SMT-06 Vetwork Analyzer HP 8753E	TE chilical (or califoration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103244 SN: 5028 (20k) SN: 5028 (20k) SN: 5028 (20k) SN: 6065 SN: 2336 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US32485102 SN: US3228597 SN: 83228597 SN: 832285011 SN: US37380580 Name	Cal Date (Certificate No.) OS-Apr-16 (No. 217-02285/02289) OS-Apr-16 (No. 217-02285/02289) OS-Apr-16 (No. 217-02293) OS-Apr-16 (No. 217-02292) OS-Apr-16 (No. 217-02295) 30-Dec-15 (No. ER3-2236_Dec-16) 30-Dec-16 (No. H3-6065_Dec-16) 02-Sep-16 (No. DAE4-781_Sep16) Check Date (in bouse) OS-Cont-9 (in bouse check Sep-14) OS-Cont-9 (in house check Cot-16) 18-Dat-91 (in house check Cot-16) 18-Dat-91 (in house check Cot-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
Calibration Equipment used (MS Primary Standards Power sensor NRIP-201 Power sensor NRIP-201 Power sensor NRIP-201 Reference 20 dB Alternation Probe ERS20V6 Probe H3DV6 Pobe H3DV6 DAEa Secondary Standards Power moler Agtent 44198 Power sensor HIP 64412A Power sensor HIP 6450A RIP generator R&S SMT-06 Network Analyzer HIP 6753E Calibrated by:	TE chiloai (or calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 6065 SN: 6065 SN: 701 ID # SN: GB42420191 SN: US32465102 SN: US32263011 SN: US32263011 SN: US37390580 Name Johannes Kuricka	Cal Date (Certificate No.) 05-Apr-16 (No. 217-02288/12288) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02293) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 30-Dac-16 (No. E18-23286, Dac16) 30-Dac-16 (No. E18-23286, Dac16) 30-Dac-16 (No. E18-23286, Dac16) 02-Sep-16 (No. DAE4-781, Sep16) Check Date (in house check Sep-14) 05-Oan-10 (in house check Sep-14) 05-Oan-01 (in house check Sep-14) 05-Oan-01 (in house check Sep-14) 17-Aug-12 (in house check Oct-16) 18-Dari-01 (in nouse check Oct-16) 18-Dari-01 (in nouse check Oct-16) 18-Dari-01 (in nouse check Oct-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
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Calibration Equipment used (MS Phonery Standards Power mener (NEP Power sensor NEP-201 Power sensor NEP-201 Power sensor NEP-201 Pote ER320V6 Probe H3DV6 Probe H3DV6 Probe H3DV6 Power meter Agtent 44198 Power sensor HP 64412A Power sensor HP 64412A Power sensor HP 64412A Power sensor HP 64412A Power sensor HP 645CA at generator R&S SMT-06 Addwork Analyzer HP 8753E	TE chiloai (or calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 05327 SN: 5047.2 / 05327 SN: 6065 SN: 701 ID # SN: GB42420191 SN: US32465102 SN: US32263011 SN: US32263011 SN: US37390580 Name Johannes Kuricka	Cal Date (Certificate No.) 05-Apr-16 (No. 217-02288/12288) 05-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02293) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 30-Dac-16 (No. E18-23286, Dac16) 30-Dac-16 (No. E18-23286, Dac16) 30-Dac-16 (No. E18-23286, Dac16) 02-Sep-16 (No. DAE4-781, Sep16) Check Date (in house check Sep-14) 05-Oan-10 (in house check Sep-14) 05-Oan-01 (in house check Sep-14) 05-Oan-01 (in house check Sep-14) 17-Aug-12 (in house check Oct-16) 18-Dari-01 (in nouse check Oct-16) 18-Dari-01 (in nouse check Oct-16) 18-Dari-01 (in nouse check Oct-16)	Scheduled Calibration Apr-17 Apr-17 Apr-17 Apr-17 Dec-17 Dec-17 Dec-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 Step-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17 In house check: Oct-17
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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only. 除非另有說明,此報告結果僅對測試之樣品負責,同時此樣品僅保留90天。本報告未經本公司書面許可,不可部份複製。

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Accreditation No.: SCS 0108

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#### References

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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 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.
- Anlerina 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 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 (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 any obstacles.
- E-Neto distribution: 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 30 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 6) is determined to compensatily for any tion-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 arts.

The reported uncertainty of measurement is stated as the standard uncertainty 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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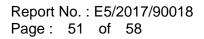
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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only. 除非另有說明,此報告結果僅對測試之樣品負責,同時此樣品僅保留90天。本報告未經本公司書面許可,不可部份複製。

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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 = 40.66 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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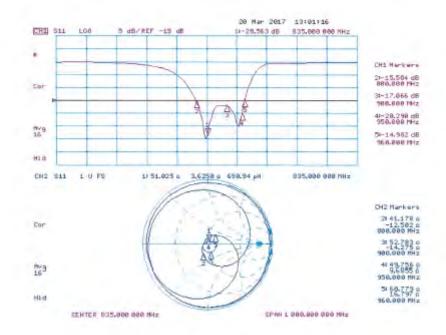
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#### Impedance Measurement Plot



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#### **DASY5 E-field Result**

Test Laboratory: SPEAG Lab2

Date: 17.03.2017

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,  $\epsilon$ , = 1; p = 1000 kg/m<sup>3</sup> 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

in the second

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

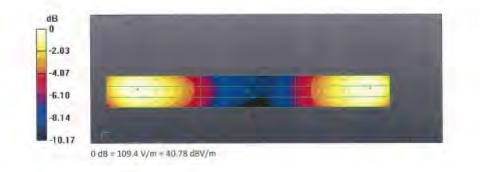
Reference Value = 108.8 V/m; Power Drift = -0.01 dB

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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Calibration date:	March 20, 2017		
summer many	March 20, 2017		
This calibration cartificate docum	ents the tradeability to natio	onal standards, which realize the physical unit	s of measurements (50)
		obability are given on the following pages and	
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Salibration Equipment used (M&	TE critical for calibration)		
Primary Standards	ID N	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	05-Apr-16 (No. 217-02289/02299)	Apr-17
ower sensor NRP-Z91	SN: 103244	05-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	05-Apr-16 (No. 217-02289)	Api-17
leference 20 dB Attenuator	SN 5058 (20k)	05-Apr-18 (No: 217-02292)	A
The second se			Apt-17
ype-N mismatch combination	SN: 5047.2/05327	05-Apr-16 (No. 217-02285)	Apr-17 Apr-17
and the second	SN: 8047.2/06327 SN: 2336	05-Apr-16 (No. 217-02285) 30-Dec-16 (No. ER3-2336_Dec16)	
Probe ER3DV6	- and a state of the second		Apr-17
Pobe ER3DV6 Pobe H3DV6	SN: 2336	30-Dec-16 (No. ER3-2336_Dec16)	Apr-17 Dec-17
Probe ERSDV6 Probe H3DV6 DAE4	SN: 2336 SN: 6065	30-Dec-16 (No. ER3-2336_Dec16) 30-Dec-16 (No. H3-6065_Dec16)	Apr-17 Dec-17 Dec-17
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Proba ER3DVE Probe H3DV6 JAE4 Secondary Standards Power meller Agilent 44198	SN: 2336 SN: 6065 SN: 781	30-Dec-16 (No. ER3-2336_Dec16) 30-Dec-16 (No. H3-6065_Dec16) 02-Sep-16 (No. DAE4-781_Sep16)	Apr-17 Dec-17 Dec-17 Sep-17 Sofeduled Check
Pinba ERSDV6 Pinba H3DV6 JAE4 Secondary Standards Secondary Standards Power meter Agilent 44188 Power sensor HP E4412A	IN: 2336 SN: 6065 SN: 781 ID # SN: GB42420191	30-Dec-16 (No. ER3-2336_Dec16) 30-Dec-16 (No. H3-6065_Dec16) 12-Sep-16 (No. DAE-4-781_Sep16) Check Date (in house) 09-Oct-09 (in house check Sep-14) 06-Jen-10 (in house check Sep-14)	Apr-17 Dec-17 Dec-17 Sep-17 Soneduled Check In floure check: Od-17
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Probe ERSDVE Probe H3DV6 DAE4 Secondary Standards Power moter Agilent 4/18B Power anstor HP 54412A Rever anstor HP 5482A RF genesater R&S SMT-06	SN: 2336 SN: 6065 SN: 781 ID # SN: GB42420191 SN: US30485102 SN: US37296897 SN: B32283/011 SN: US37390685	30-Dec-16 (No. ER3-2336_Dec16) 30-Dec-16 (No. H3-6065_Dec16) 02-Sep-16 (No. DAE-4-781_Sep16) Check Date (in house) 09-De1-09 (in house check Sep-14) 06-Jan-10 (in house check Sep-14) 06-De1-09 (in house check Sep-14) 27-Aug-12 (in house check Oct-16) 18-Oct-01 (in house check Oct-16)	Apr-17 Dec-17 Dec-17 Sep-17 Sep-17 Scheduled Check In house check: Od-17 In house check: Od-17
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#### Report No. : E5/2017/90018 Page : 55 of 58



Celibration Laboratory of Schmid & Partner Engineering AG Zeuphausstrasse 43, 8004 Zurich, Switzerand Nacina (



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Schweizenscher Kalibrierdienst Service suizze d'élatennage Servizio svizzere di teretura Swiss Calibration Service

Accreditation No.: SCS 0108

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 Alds.

#### 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) (swards its feed point between the two dipole arms, x-axe is termal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are solected 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.
- Anterine 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 Tast Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dietectric reference wire and able to move classically in vertical direction without changing its relative position to the top center of the Tast Arch phantom. The vertical distance to the probe is educed after tipole mounting with a DASYS surface. Check job. Before the measurement, the distance between phantom surface and probe tip is verified. 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 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 surface) of the dipole) and the matching grid reference point (upper surface) are surface to the probe is essential for the accuracy.
- Fault 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 teed 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 area available mean the end of the dipole arms. Assuming the dipole arms are available mean the end of the dipole arms. Assuming the dipole arms are partectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-peralletity 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 overage factor k=2, which for a normal distribution corresponde to a coverage probability of approximately 35%.

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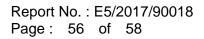
Page 2 of 9

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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	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 cipole 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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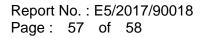
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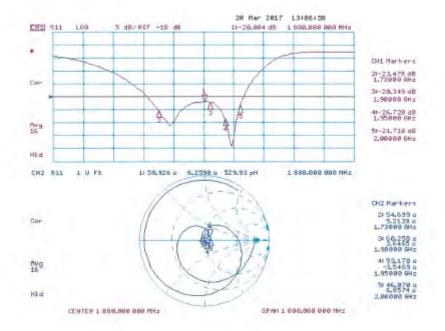
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#### Impedance Measurement Plot



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#### **DASY5 E-field Result**

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: o = 0 S/m, er = 1; p = 1000 kg/m<sup>3</sup> Phantom section: RF Section Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

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
- 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

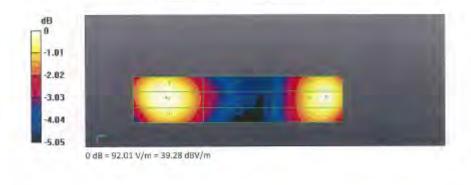
Device Reference Point: 0, 0, -6.3 mm

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: MZ

MIF scaled E-field

	Grid 2 M2 39.28 dBV/m	Grid 3 MZ 39.21 dBV/m
	Grid 5 M2 37.07 dBV/m	Grid 5 M2 36.98 dBV/m
Grid 7 M2 38.8 dBV/m	Grid 8 M2 39.08 dBV/m	Grid 9 MZ 39.01 dBV/m



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## End of 1<sup>st</sup> part of report

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