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Accreditation No.: SCS 108

Client **Huawei-SZ (Auden)**

Certificate No: TMFS_1030_Nov12

CALIBRATION CERTIFICATE

Object / Identification	TMFS – SN: 1030
Calibration procedure(s)	QA CAL-24.v3 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date	November 21, 2012

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The calibrations have been conducted in the R&D laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Cal / Check Date**	**Scheduled Calibration Check**
AMCC	1050	12-Oct-11 (in house check Oct-11)	Oct-13
Reference Probe AM1DV2	SN: 1008	18-Jan-12 (No. AM1D-1008_Jan12)	Jan-13
AMMI Audio Measuring Instrument	1062	26-Sep-12 (in house check Sep-12)	Sep-14
Agilent WF Generator 33120A	MY40005266	12-Oct-11 (in house check Oct-11)	Oct-13
Keithley Multimeter Type 2001	SN: 0661047	22-Oct-12 (in house check Oct-12)	Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: November 21, 2012

References

[1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

[2] DASY manual, Chapter "Hearing Aid Compatibility (HAC) T-Coil Extension"

Methods Applied and Interpretation of Parameters

- *Coordinate System:* The TMFS is mounted underneath the HAC Test Arch touching equivalently to a wireless device according to [2] 29.2.2.: In "North" orientation, the TMFS signal connector is directed to the north, with x and y axes of TMFS and Test arch coinciding (see fig. 1). The rotational symmetry axis of the TMFS is aligned to the center of the HAC test Arch. For East, South and West configuration, the TMFS has been rotated clockwise in steps of 90°, so the connector looks into the specified direction. The evaluation of the radial direction is referenced to the device orientation (x equivalent to South direction).

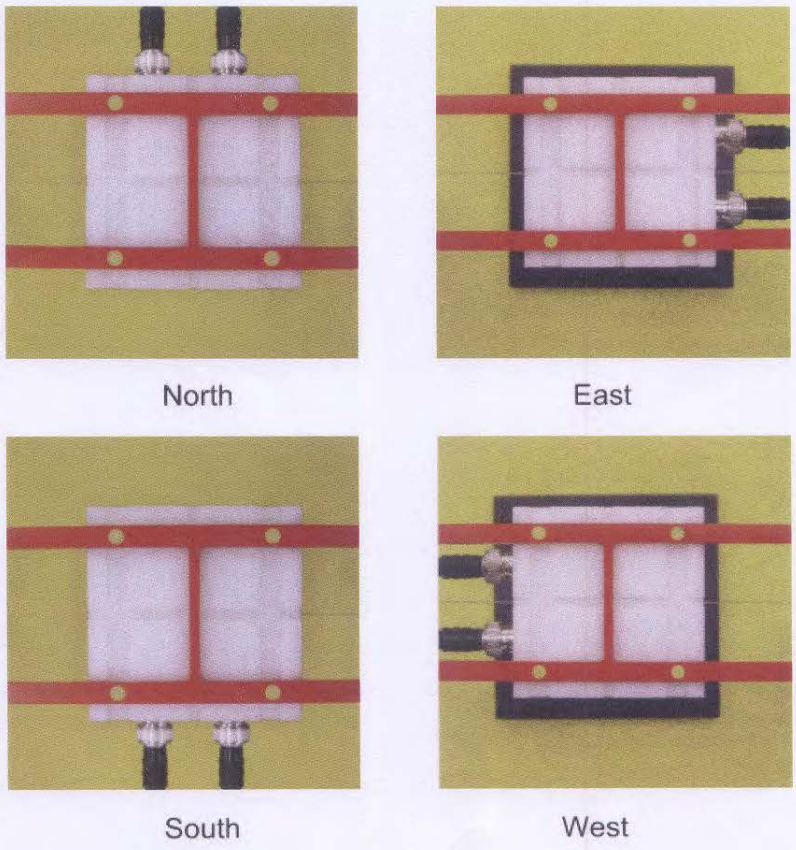

Fig. 1 TMFS scanning measurement configurations

- *Measurement Plane:* In coincidence with standard [1], the measurement plane (probe sensor center) is selected to be at a distance of 10 mm above the the surface of the TMFS touching the frame. The 50 x 50 mm scan area is aligned to the center of the unit. The scanning plane is verified to be parallel to the phantom frame before the measurements using the predefined "Geometry and signal check" procedure according to the predefined procedures described in [2].

- *Measurement Conditions:* Calibration of AM1D probe and AMMI are according to [2]. The 1 kHz sine signal for the level measurement is supplied from an external, independent generator via a BNC cable to TMFS IN and monitored at TMFS OUT with an independent RMS voltmeter or Audio Analyzer. The level is set to 0.5 Vrms and monitored during the scans.

- For the *frequency response*, a higher suppression of the background ambient magnetic field over the full frequency range was achieved by placing the TMFS in a magnetically shielded box. The AM1D probe was fixed without robot positioner near the axial maximum for this measurement. The background noise suppression was typ. 30 dB at 100 Hz (minimum) and 42 dB at 1 kHz. The predefined multisine signal (48k_multisine_50-10000_10s.wav) was used and evaluated in the third-octave bands from 100 Hz to 10000 Hz.

1 Measurement Conditions

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

DASY Version	DASY5	V52.8.3 (988)
DASY PP Version	SEMCAD	V14.6.7 (6848)
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance TMFS Top - Probe Centre	10 mm	
Scan resolution	dx, dy = 5 mm	area = 50 x 50 mm
Frequency	for field scans	1 kHz
Signal level to TMFS	for field scans	500 mV RMS
Signal	for frequency response	multisine signal 50-10000 Hz, each third-octave band

Table 1: System configuration

2 Axial Maximum Field

Configuration	East	South	West	North	Subset Average	Average
Axial Max	-20.20	-20.20	-20.19	-20.20		**-20.20**
TMFS Y Axis 1st Max	-25.77	-25.86	-25.82	-25.81		
TMFS Y Axis 2nd Max	-26.01	-26.05	-25.90	-26.00		
Longitudinal Max Avg	-25.89	-25.96	-25.86	-25.91	**-25.90**	
TMFS X Axis 1st Max	-25.94	-25.88	-25.91	-25.96		
TMFS X Axis 2nd Max	-25.63	-25.65	-25.65	-25.59		
Transversal Max Avg	-25.79	-25.77	-25.78	-25.78	**-25.78**	
Radial Max						**-25.84**

Table 2: Axial and radial field maxima measured with probe center at 10mm distance in dB A/m

The maximum was calculated as the average from the values measured in the 4 orientations listed in table 2.

Axial Maximum **-20.20 dB A/m** (+/- 0.33dB, k=2)

3 Radial Maximum Field

In addition, the average from the 16 maxima of the radial field listed in table 2 (measured at 10mm) was calculated:

Radial Maximum **-25.84 dB A/m**

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%.

4 Appendix

4.1 Frequency response

Max. deviation measured, relative to 1 kHz: **min. -0.03, max. 0.00 dB**

Frequency [Hz]	Response [dB]
100	0.00
125	-0.01
160	0.00
200	0.00
250	-0.01
315	0.00
400	0.00
500	0.00
630	0.00
800	0.00
1000	**0.00**
1250	-0.01
1600	-0.01
2000	-0.01
2500	-0.01
3150	-0.01
4000	-0.02
5000	-0.02
6300	-0.02
8000	-0.03
10000	-0.03

Table 3: Frequency response

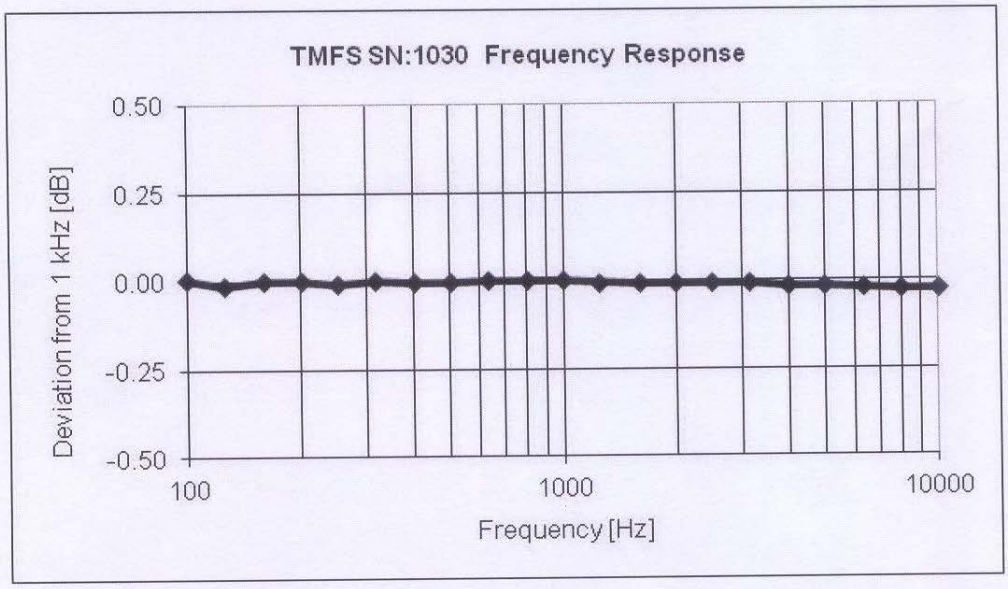

Fig. 2 Frequency response 100 to 10'000 Hz

4.2 Field plots

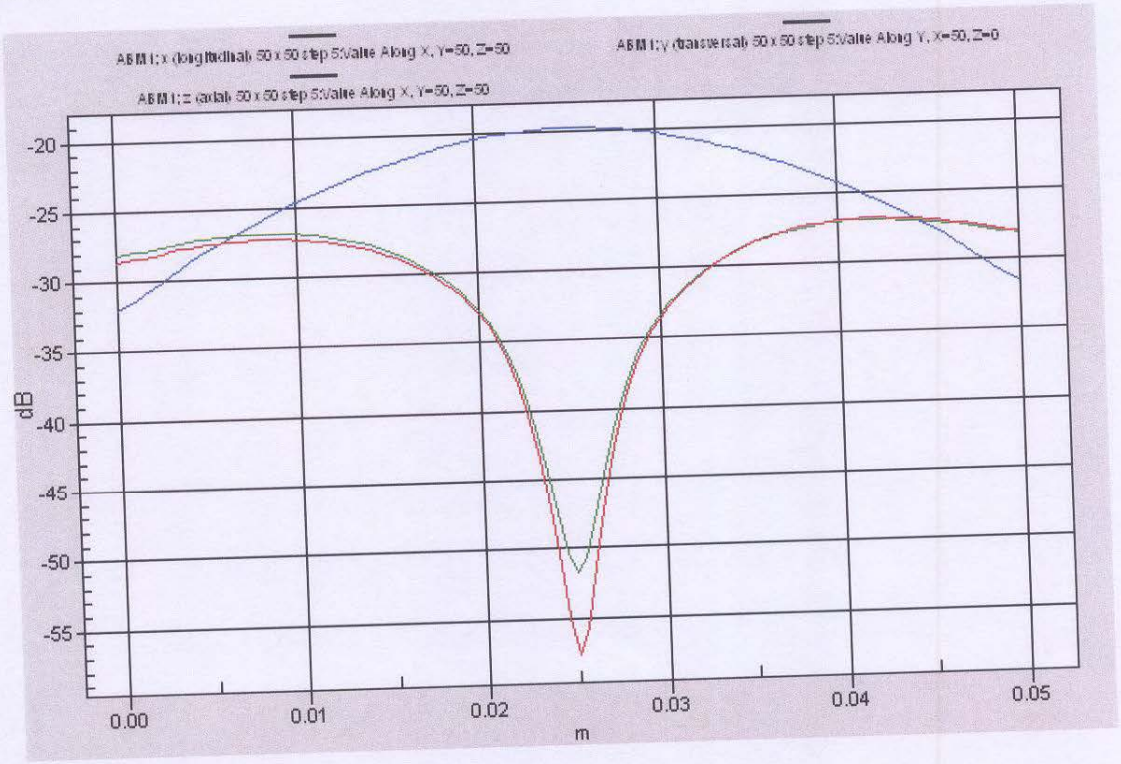

Fig. 3: Typical 2D field plots for x (red), y (green) and z (blue) components

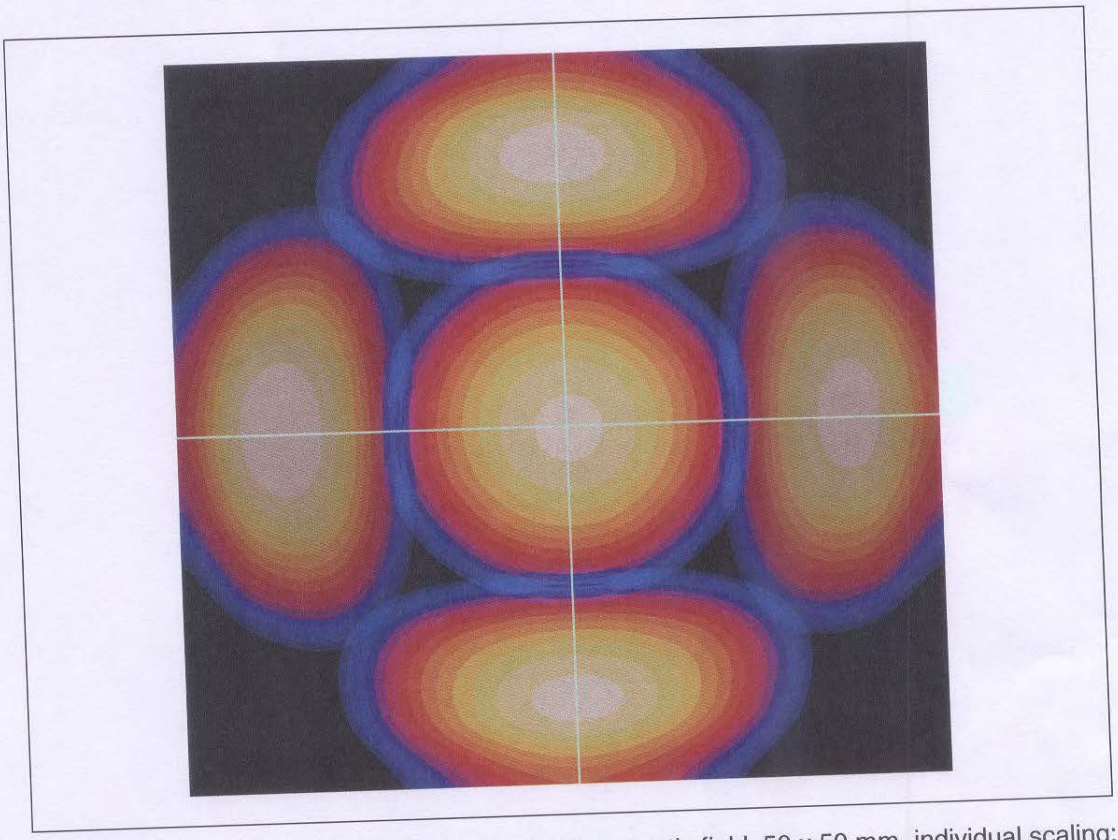

Fig. 4: Superponed field plots of z (axial), x and y radial magnetic field, 50 x 50 mm, individual scaling: white = max. field level, black = -4dB below max. The lines show the position of the 2D field plot of figure 3.