



COMOHAC T-coil Probe Calibration Report

Ref : ACR.49.22.22.BES.A

BTF TESTING LAB (SHENZHEN) CO., LTD.
F101,201 AND 301, BUILDING 1, BLOCK 2, TANTOU
INDUSTRIAL PARK, TANTOU COMMUNITY
SONGGANG STREET, BAO'AN DISTRICT, SHENZHEN,
CHINA
MVG COMOHAC T-COIL PROBE
SERIAL NO.: SN 07/17 TCP38

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

Calibration date: 02/06/2023



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

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Summary:

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

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
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<i>Checked by :</i>	Jérôme Luc	Technical Manager	2/6/2023	
<i>Approved by :</i>	Yann Toutain	Laboratory Director	2/6/2023	

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	<i>Customer Name</i>
<i>Distribution :</i>	BTF Testing Lab (Shenzhen) Co., Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme Luc	2/6/2023	Initial release



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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC T-COIL PROBE
Manufacturer	MVG
Model	STCOIL
Serial Number	SN 07/17 TCP38
Product Condition (new / used)	New
Frequency Range of Probe	200-5000 Hz

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOHAC T-coil Probes are built in accordance to the ANSI C63.19 and IEEE 1027 standards.



Figure 1 – MVG COMOHAC T-coil Probe

Coil Dimension	6.55 mm length * 2.29 mm diameter
DC resistance	860.6 Ω
Wire size	51AWG
Inductance at 1 kHz	132.1 mH at 1 kHz

3 MEASUREMENT METHOD

All methods used to perform the measurements and calibrations comply with the ANSI C63.19 and IEEE 1027 standards. All measurements were performed using a Helmholtz coil built according to the specifications outlined in ANSI C63.19 and IEEE 1027.

3.1 SENSITIVITY

The T-coil was positioned within the Helmholtz coil in axial orientation. Using an audio generator connected to the input of the Helmholtz coil, a known field (1 A/m) was generated within the coil and the T-coil probe reading recorded over the frequency range of 100 Hz to 1000 Hz.

3.2 LINEARITY

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field within the coil from 0 dB A/m to -50 dB A/m and the T-coil reading recorded at each power level (10 dB steps).

3.3 SIGNAL TO NOISE MEASUREMENT OF THE CALIBRATION SYSTEM

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field of -50 dB A/m. The T-coil reading was recorded. The audio generator is then turned off and the T-coil reading recorded.

4 MEASUREMENT UNCERTAINTY

The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

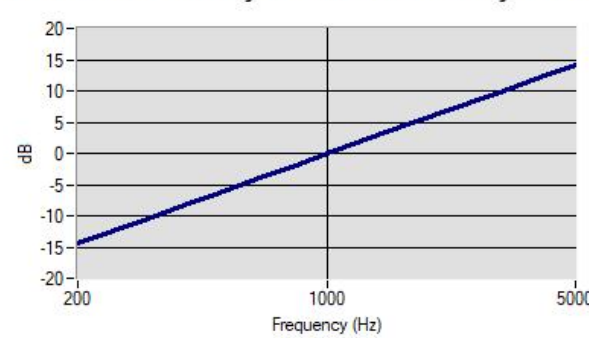
Uncertainty analysis of the T-coil probe calibration				
Uncertainty Component	Tol. ($\pm$ dB)	Prob. Dist.	Div.	Uncertainty (dB)
Expanded uncertainty (confidence level of 95%, $k = 2$)		N	$k=2$	0.42

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Lab Temperature	20 $\pm$ 1°C
Lab Humidity	30-70 %

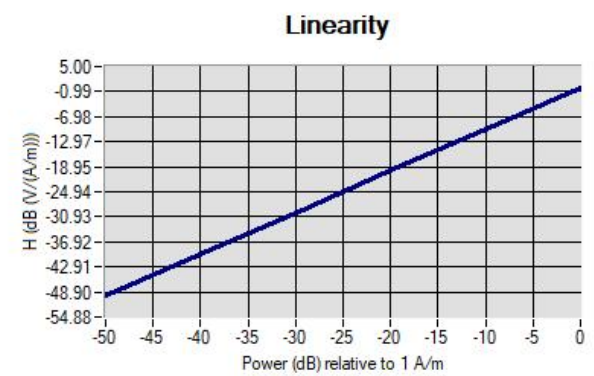
5.1 SENSITIVITY

Probe coil sensitivity relative to sensitivity at 1000 Hz



	Measured	Required
Sensitivity at 1 kHz	-60.04 dB (V/A/m)	-60.5 $\pm$ 0.5 dB (V/A/m)
Max. deviation from Sensitivity	0.43 dB	$\pm$ 0.5 dB

5.2 LINEARITY



	Measured	Required
Linearity Slope	0.12 dB	+/- 0.5 dB

5.3 SIGNAL TO NOISE MEASUREMENT OF THE CALIBRATION SYSTEM

	Measured	Required
Signal to Noise	-67.95 dB A/m	'Reading with -50 dB A/m in coil' – 'no signal applied' > 10 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Audio Generator	National Instruments	15222AE	11/2021	11/2024
Multimeter	Keithley 2000	1160271	02/2021	02/2024
Helmholtz Coil	MVG	HC07 SN47/10	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024



COMOHAC TMFS Calibration Report

Ref : ACR.126.5.22.BES.A

BTF TESTING LAB (SHENZHEN) CO., LTD.
F101,201 AND 301, BUILDING 1, BLOCK 2, TANTOU
INDUSTRIAL PARK, TANTOU COMMUNITY
SONGGANG STREET, BAO'AN DISTRICT, SHENZHEN, CHINA
MVG COMOHAC MAGNETIC FIELD SIMULATOR
SERIAL NO.: SN 13/22 TMFS30

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

Calibration date: 05/06/2022



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

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Summary:

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



	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
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<i>Checked by :</i>	Jérôme Luc	Technical Manager	5/6/2022	<i>JS</i>
<i>Approved by :</i>	Yann Toutain	Laboratory Director	5/9/2022	<i>Yann TOUTAIN</i>

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	<i>Customer Name</i>
<i>Distribution :</i>	BTF Testing Lab (Shenzhen) Co., Ltd.

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A	Jérôme Luc	5/6/2022	Initial release



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5.1 Maximum Axial and Radial Magnetic Field Values 5

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC Magnetic Field Simulator
Manufacturer	MVG
Model	STMFS
Serial Number	SN 13/22 TMFS30
Product Condition (new / used)	New
Frequency Range	200-5000 Hz

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOHAC T-coil Probes are built in accordance to the ANSI C63.19 and ANSI S3.22-2014 standards.



Figure 1 – MVG COMOHAC Magnetic Field Simulator

3 MEASUREMENT METHOD

All methods used to perform the measurements and calibrations comply with the ANSI C63.19. All measurements were performed with the TMFS in the standard device test configuration, with the TMFS in free space, 10 mm below the coil center.

3.1 MAXIMUM AXIAL AND RADIAL MAGNETIC FIELD VALUES

An audio signal was fed into the TMFS and the magnetic field measured and recorded over an area scan with the T-coil probe in three orientations; axial and two radial. The maximum magnetic field is recorded for all three T-coil orientations.

4 MEASUREMENT UNCERTAINTY

The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in Helmholtz Coil

Uncertainty Component	Tol. ($\pm$ dB)	Prob. Dist.	Div.	Uncertainty (dB)
Expanded uncertainty 95 % confidence level k = 2		N	2	0.95

5 CALIBRATION MEASUREMENT RESULTS

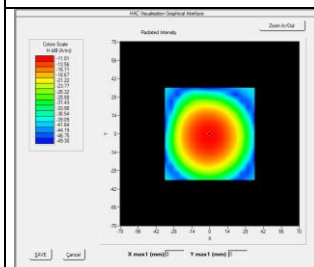
Calibration Parameters

Software	OpenHAC V2
HAC positioning ruler	SN 42/09 TABH12
T-Coil probe	SN 47/10 TCP18
Distance between TMFS and coil center	10 mm
Frequency	1025 Hz
Scan Size	X=70mm/Y=70mm
Scan Resolution	dx=5mm/dy=5mm
Output level	0.5 VAC
Lab Temperature	20 +/- 1°C
Lab Humidity	30-70 %

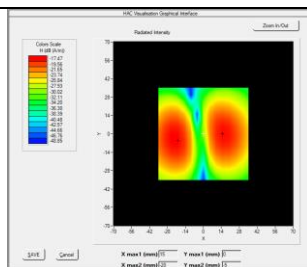
5.1 MAXIMUM AXIAL AND RADIAL MAGNETIC FIELD VALUES

Test Description	Measured Magnetic Field	
	Location	Intensity (dB A/m)
Axial	Max	-10.79
Radial H	Right side	-17.47
	Left side	-17.25
Radial V	Upper side	-16.88
	Lower side	-16.75

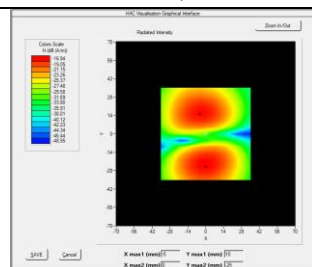
AXIAL ABM1



RADIAL H ABM1



RADIAL V ABM1





6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
HAC positioning ruler	MVG	TABH12 SN 42/09	Validated. No cal required.	Validated. No cal required.
Audio Generator	National Instruments	15222AE	11/2021	11/2024
Reference Probe	MVG	TCP 18 SN 47/10	02/2021	02/2024
Multimeter	Keithley 2000	1160271	02/2021	02/2024
Temperature / Humidity Sensor	Control Company	44225320	06/2021	06/2024