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Via Giacomo Peroni, 400/402 - 00131 Roma
Cap. Soc. Int. Ver. 100.000,00 euro

CERTIFICATE OF CALIBRATION

Item	Electric and Magnetic field Analyzer 5.00 Hz - 100.00 kHz
Manufacturer	NARDA S.T.S. / PMM
Model	EHP-50C
Serial number	352WN00404
Calibration procedure	INTERNAL PROCEDURE EHP-1001-STD
Date(s) of measurements	2022-09-29
Date of emission	2022-09-29
Result of calibration	MEASUREMENT RESULTS WITHIN SPECIFICATIONS
Certificate number	22-S-13122

This document displays the procedure and the instrumental chain used to verify the compliance of the equipment under calibration to the technical characteristics required. The results shown in the next pages comes with the traceability chain of the laboratory and the related calibration certificates in their course of validity. Uncertainty declared in this document has been determined in compliance with the document EA-4/02 Expression of uncertainty of Measurement in Calibration and is expressed with a covering factor k=2, corresponding to a confidence level of about 95%.

Person in charge
Jan Bulli Wilkinson

Measurement operator
Ing. Marco Borrega

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LABORATORY CHAIN OF TRACEABILITY

The following table shows the equipment used for this calibration procedure along with the reference list for traceability

Equipment	Standard	Model	Calibration
Signal Generator	Frequency	Agilent N5183A	LAT 019 67260
Function/Arbitrary Waveform Generator	Frequency	Rigol DG4202	LAT 019 67271
Multimeter	A.C. Voltage	Hewlett Packard 34401A	LAT 019 67280
Power Sensor	R.F. Power	Agilent U2004A	LAT 019 67265
Power Sensor	R.F. Power	Agilent U2004A	LAT 019 67268
Power Sensor	R.F. Power	Agilent U2000A	LAT 019 67262
Directional Cuopler	R.F. Power	Agilent 772D-001	LAT 019 67275
Directional Cuopler	R.F. Power	Werlatone C6110-10	LAT 019 66278
20dB attenuator 7mm	Attenuation	Mini-Circuits BW-N20W5+	LAT 019 67252
30dB attenuator 7mm	Attenuation	Mini-Circuits UNAT-30+	LAT 019 67281
30dB attenuator 7mm	Attenuation	Mini-Circuits UNAT-30+	LAT 019 67283
30dB attenuator 7mm	Attenuation	Mini-Circuits UNAT-30+	LAT 019 67285
30dB attenuator 7mm	Attenuation	Mini-Circuits UNAT-30+	LAT 019 67286
Double Guide Horn Antenna	--	ETS Lindgren 3116B	UKAS 2020010177-1
Electric Field Probe	Electric Field	NARDA S.T.S. EP-603	LAT 008 80504716E

METHOD OF CALIBRATION

The calibration procedure of a field strength monitor requires the generation of a field of a known strength, frequency and polarization. This field is called reference field.

The degree of knowledge of the characteristics of the field is directly related to the environment where it is generated: if it's possible to have the field propagate in an almost-plane wave configuration then the profile can be easily monitored through analytic calculus or reference standard.

Dual field probes have sensors to measure magnetic and electric field separately. To calibrate the probe is then necessary to generate these fields separately.

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Low frequency electric field is generated inside a square section TEM cell with side of 60cm, magnetic field is generated inside a Helmholtz Coil System.
The calibration agrees with IEC 61786, "Measurement of low frequency magnetic and electric fields with regard to exposure of human beings – Special requirements for instruments".

CALIBRATION UNCERTAINTY

The uncertainty stated in this document does not take into account the long term stability of the monitor. For the purpose of this certificate the expanded uncertainties are given below.

Domain	Uncertainty
E-Field, frequencies up to 100kHz	6,5%
H-Field, frequencies up to 100kHz	5,5%

MEASUREMENT CONDITIONS

All the instruments considered in the chain, comprising the equipment under calibration, were turned on at least 15 minutes (or the minimum warm up time stated in the manual, if present) to avoid any thermal drift.
The environmental conditions of temperature and relative humidity were monitored during the entire calibration procedure.

FREQUENCY FLATNESS

Frequency flatness calibration confronts the field value shown by the equipment under test with the reference field at different frequencies.
Electric field is obtained through the propagation of a TEM mode inside a TEM cell.
The field strength generated inside a TEM cell with a distance d between the outer and inner conductor, powered from a Pnet and loaded on an impedance ZTEM is given by the relation (Myron L. Crawford Generation of Standard EM Fields Using TEM Transmission Cells, November 1974)

$$E_{cal} = \frac{\sqrt{P_{net} \times Z_{tem}}}{\mathrm{d}} \left[\frac{V}{m}\right]$$

Magnetic field is obtained by having a current standard through an Helmholtz Coil System. The approximated H field in the center of the coil set is given by the relation

$$\mathrm{H} = \frac{0.7155 \times N \times I}{r^{\cdot}} \left[\frac{A}{m}\right]$$

where N is the number of turns for each coil, r is the radius of each coil and I is the current running through the set.

This calibration procedure determines a correction factor to be used in measurements. The actual field can be obtained by multiplying the measured field value by the correction factor.

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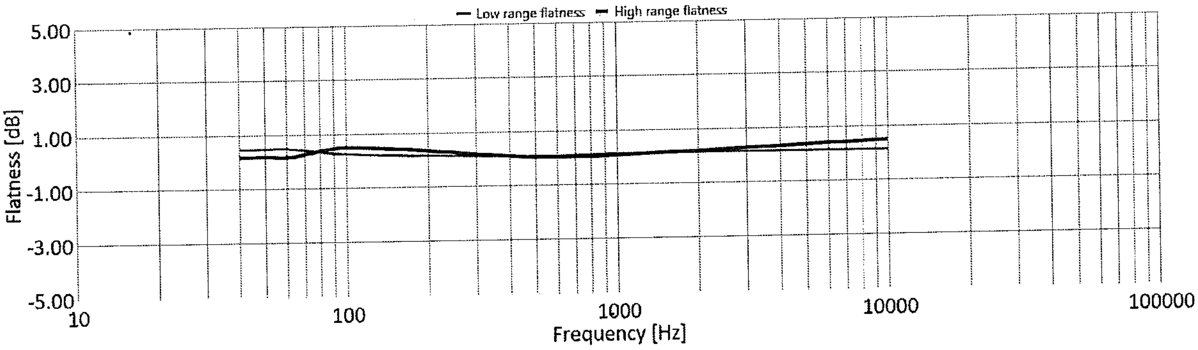
ELECTRIC FIELD FLATNESS

The following results were obtained from the measurement, Low Range and High Range refers respectively to the 1kV/m range and 100kV/m range.

The measurements results are respectively from the X, Y and Z axis readings.

X AXIS

Frequency [Hz]	Reference Field [V/m]	Measured Field [V/m] (Low Range)	Measured Field [V/m] (High Range)	Correction Factor (Low Range)	Correction Factor (High Range)
40.0000	100.0000	105.5792	101.9752	0.9472	0.9806
50.0000	100.0000	105.5792	102.2274	0.9472	0.9782
60.0000	100.0000	105.7460	101.8431	0.9457	0.9819
100.0000	100.0000	103.0506	105.9614	0.9704	0.9437
500.0000	100.0000	101.0353	100.6586	0.9898	0.9935
1000.0000	100.0000	101.6047	101.0381	0.9842	0.9897
10000.0000	100.0000	101.6241	105.9614	0.9840	0.9437



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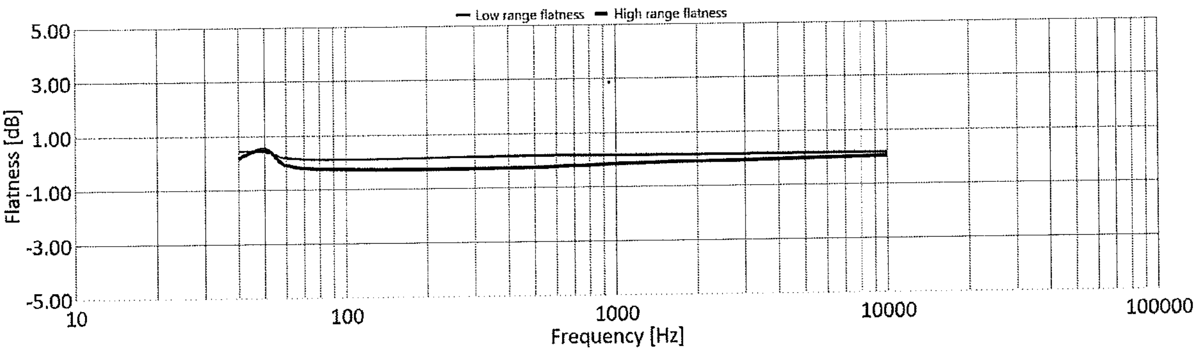
Y AXIS

Frequency [Hz]	Reference Field [V/m]	Measured Field [V/m] (Low Range)	Measured Field [V/m] (High Range)	Correction Factor (Low Range)	Correction Factor (High Range)
40.0000	100.0000	105.3228	102.1677	0.9495	0.9788
50.0000	100.0000	105.0711	106.2150	0.9517	0.9415
60.0000	100.0000	102.2000	99.1537	0.9785	1.0085
100.0000	100.0000	101.3553	97.2147	0.9866	1.0287
500.0000	100.0000	102.2200	97.2147	0.9783	1.0287
1000.0000	100.0000	102.0790	98.4178	0.9796	1.0161
10000.0000	100.0000	102.0790	100.5132	0.9796	0.9949



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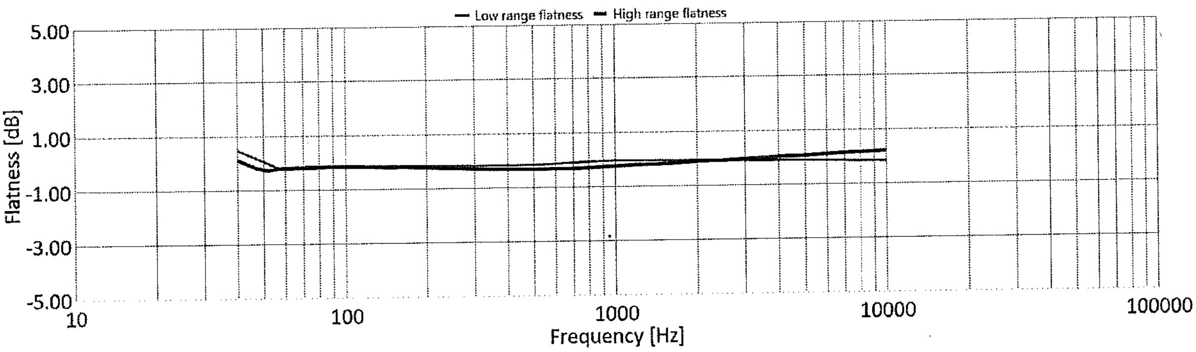
Z AXIS

Frequency [Hz]	Reference Field [V/m]	Measured Field [V/m] (Low Range)	Measured Field [V/m] (High Range)	Correction Factor (Low Range)	Correction Factor (High Range)
40.0000	100.0000	105.7000	101.5288	0.9461	0.9849
50.0000	100.0000	100.7289	97.2711	0.9928	1.0281
60.0000	100.0000	97.6251	98.0146	1.0243	1.0203
100.0000	100.0000	98.4311	98.3790	1.0159	1.0165
500.0000	100.0000	98.2798	96.4217	1.0175	1.0371
1000.0000	100.0000	99.6483	97.3104	1.0035	1.0276
10000.0000	100.0000	98.2798	102.5883	1.0175	0.9748



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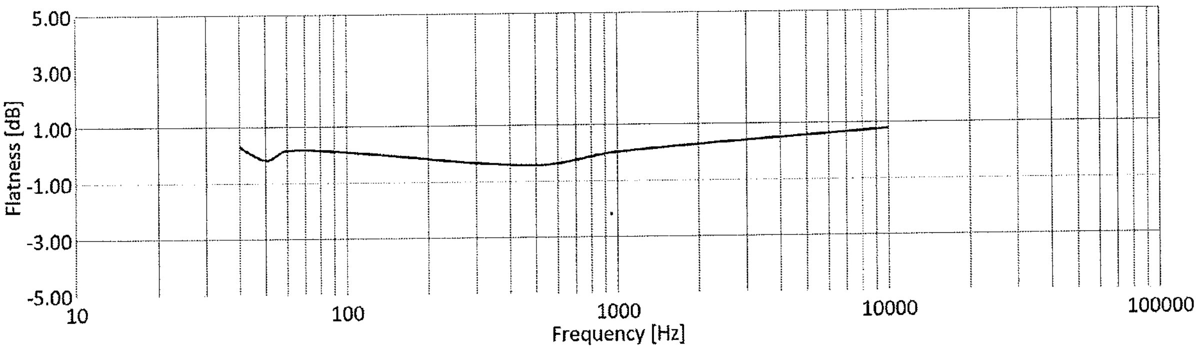
MAGNETIC FIELD FLATNESS

The following results were obtained from the measurements, the first set of measurements were made using the 100uT range with a reference field of 10 uT. The second set of measurements were made using the 10mT range with a reference field of 50 uT.
The measurements results are respectively from the X, Y and Z axis readings.

X AXIS

Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
40.0000	10.0000	10.3745	0.9639
50.0000	10.0000	9.7989	1.0205
60.0000	10.0000	10.1910	0.9813
100.0000	10.0000	10.1032	0.9898
500.0000	10.0000	9.5247	1.0499
1000.0000	10.0000	10.0360	0.9964
10000.0000	10.0000	10.9550	0.9128



Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
50.0000	50.0000	53.1379	0.9409
60.0000	50.0000	51.6103	0.9688

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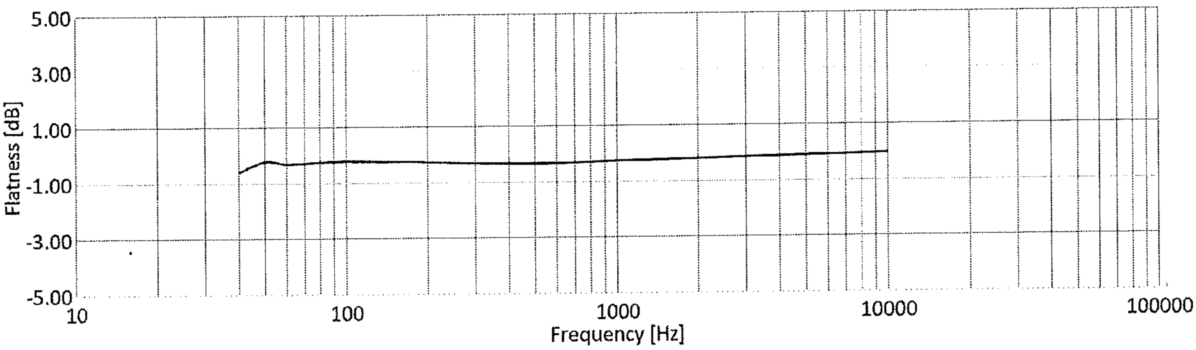
Y AXIS

Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
40.0000	10.0000	9.3246	1.0724
50.0000	10.0000	9.7460	1.0261
60.0000	10.0000	9.6545	1.0358
100.0000	10.0000	9.7479	1.0259
500.0000	10.0000	9.6228	1.0392
1000.0000	10.0000	9.7059	1.0303
10000.0000	10.0000	9.9755	1.0025



Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
50.0000	50.0000	52.1656	0.9585
60.0000	50.0000	53.1087	0.9415

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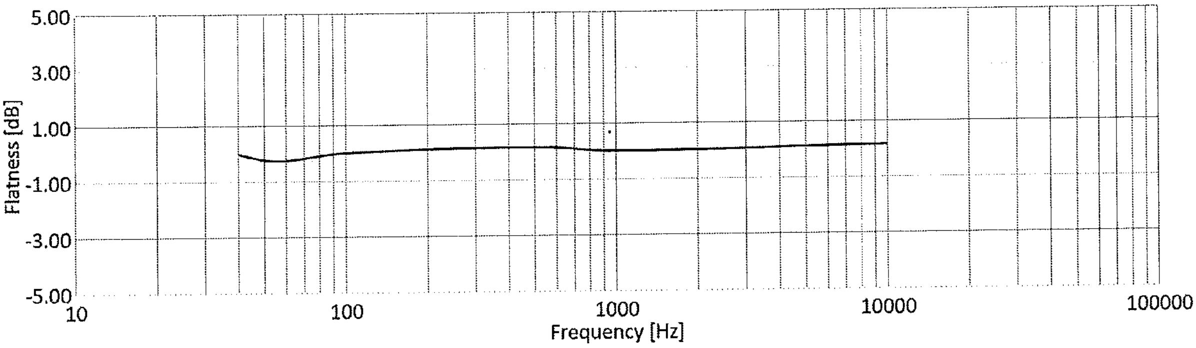
Z AXIS

Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
40.0000	10.0000	9.9822	1.0018
50.0000	10.0000	9.7460	1.0261
60.0000	10.0000	9.7179	1.0290
100.0000	10.0000	10.0103	0.9990
500.0000	10.0000	10.1978	0.9806
1000.0000	10.0000	10.0133	0.9987
10000.0000	10.0000	10.1986	0.9805



Frequency [Hz]	Reference Field [uT]	Measured Field [uT]	Correction Factor
50.0000	50.0000	51.7375	0.9664
60.0000	50.0000	52.3036	0.9560