

CERTIFICATE OF CALIBRATION

Number **25/12245**

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LabCal - Wavecontrol

Radio-electric Calibration Laboratory
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08018 Barcelona

WAVECONTROL

ITEM	EM Field Meter + Isotropic EM Field Probe
BRAND	Wavecontrol
MODEL	Meter: SMP2 Probe: WPF60
IDENTIFICATION	Meter: 22SN1914 Probe: 22WP230188
APPLICANT	Bureau Veritas Consumer Products Services (Hong Kong) No. 19, Huaya 2nd Rd., Guishan Dist., Taoyuan City 33383, Taiwan 33383 Taoyuan City (Taiwan)
DATE/S OF CALIBRATION	18/06/2025

Authorized Signatories

Date of issue: 19/06/2025



David Guayerbas
Laboratory Technician

Signature Not
Verified
Digitally signed by
ALEJANDRO CLAYSA
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Date: 2025.06.25
08:13:28 CEST
Reason: Wavecontrol
Location: Barcelona

Laboratory Director

*This certificate is issued in accordance with the conditions of accreditation granted by ENAC, according to standard ISO 17025, which has assessed the measurement capability of the laboratory and its traceability to national standards.
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This certificate has been issued by digital signature, any print of it will be considered a copy.*



Measurement:

The calibration of field strength monitors involves the generation of a known linearly polarised electromagnetic field, approximating to a plane wave, into which the probe or sensor is placed.

Over the frequency range of 1 – 800 MHz, an absorber loaded TEM cell is used to generate the known field. The probe under test is positioned parallel to the electric field and perpendicular to the direction of propagation.

Over the frequency range of 800 MHz – 40 GHz the probe is positioned on a low reflectivity mount inside a microwave anechoic chamber on the bore sight of a linearly polarised horn antenna. The probe under test is always perpendicular to the direction of propagation and parallel to the electric field.

Three calibration parameters are obtained:

1- Correction factor (CF)

For each measurement, the input power to the test facility is adjusted so that the actual field strength is set to a specific value. The field strength indicated by the probe under calibration is then read and the correction factor calculated using the following definition:

$$CF = \frac{\text{Actual Field Strength}}{\text{Indicated Field Strength}} \quad CF^2 = \frac{\text{Actual Power Density}}{\text{Indicated Power Density}}$$

The indicated field strength must be multiplied by the appropriate correction factor to give the actual field strength.

2- Linearity

The linearity can be calculated as the variation of the Correction Factor as a function of the field strength applied to the probe for a frequency value.

3- Frequency response

The frequency response can be calculated as the variation of the Correction Factor as a function of the frequency for a fixed field value applied to the probe.

Traceability:

NPL (National Physical Laboratory)

Reference standards:

IEEE Std 1309:2013 “Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40 GHz”.

Uncertainties:

The uncertainty of calibration for this device is as follows:

1 MHz - 10 MHz:	± 1.2 dB
10 MHz - 300 MHz:	± 1.3 dB
300 MHz – 500 MHz:	± 1.1 dB
500 MHz - 800 MHz:	± 1.5 dB
800 MHz - 1 GHz:	± 1.2 dB
1 GHz - 2.5 GHz:	± 1.2 dB
2.5 GHz - 8 GHz:	± 1.3 dB
8 GHz - 18 GHz:	± 1.8 dB
18 GHz - 40 GHz:	± 2.8 dB

The measurement uncertainties above apply only when the probe is supported in a low reflectivity mount. The user should be aware of the effects of reflections from nearby objects, including human body, and should allow additional measurement uncertainties accordingly.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with the EA-4/02 M document.

Environmental conditions:

Humidity	Temperature
$(50 \pm 20) \% \text{ rH}$	$(23 \pm 2) ^\circ\text{C}$

The uncertainties refer to the measured devices only. They relate to the on-the-day values and make no allowance for drift or operation under other environmental conditions.

Procedure:

PC-1205 – Calibration of electric field probes in the range 100 kHz – 800 MHz

PC-1206 – Calibration of electric field probes in the range 800 MHz – 40 GHz

Both methods follow the *Standard probe method*. A reference probe is used to measure and calibrate the field used for calibrating the probe under calibration.

Calibration engineer: David Guayerbas

Calibration set-up:



Figure 1: Calibration set-up in the absorber loaded TEM cell

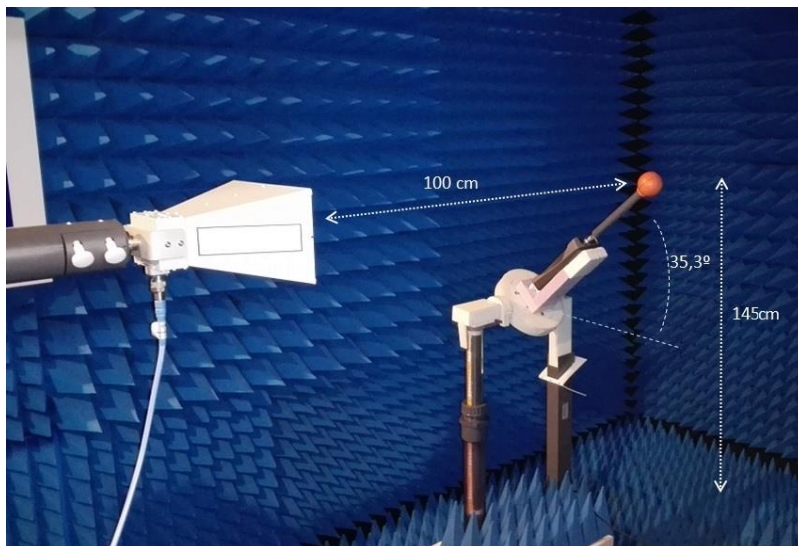


Figure 2: Calibration set-up in the anechoic chamber

The position of the probe inside the TEM cell is specified in Figure 1. The main axis of the probe is parallel to the cell walls.

The probe is positioned on the bore sight of the horn antenna inside the anechoic chamber, at the distance and height specified in Figure 2.

The position and orientation of the probe relative to the applied field to calibrate the 3 axis is specified in Figure 3.

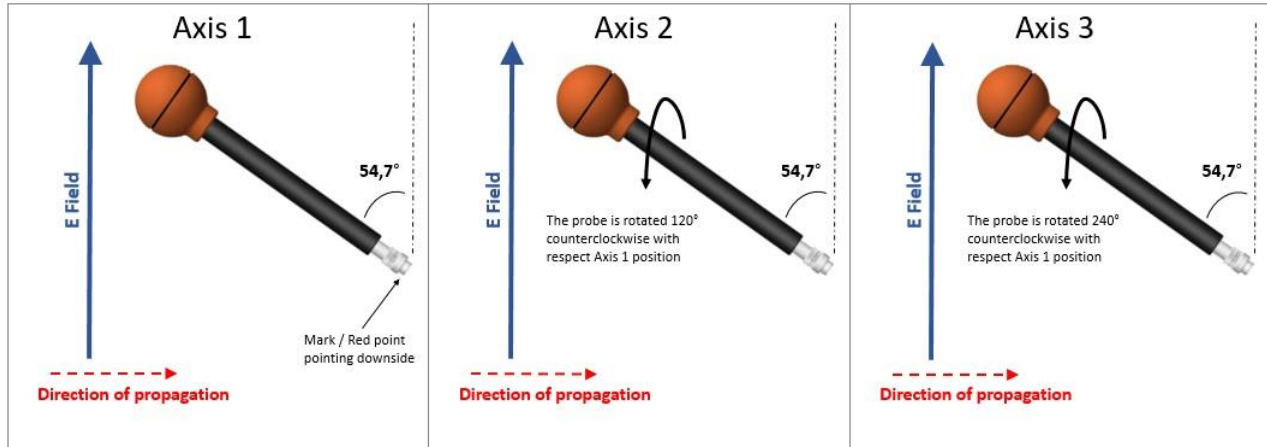


Figure 3: Position and orientation of the probe

Results:

The correction factors (CF) for the requested calibration points are shown below.

The correction factors for each axis and the average correction factor are given. This average correction factor must be applied to the measured value for the total field.

The average correction factor is the arithmetic mean of the correction factors for the three axes.

The correction factors given below must be multiplied by the measured value for the field in order to obtain the actual field value:

Linearity								
Freq. (MHz)	Actual Field (V/m)	Measured Field (V/m)			CF			
		Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	Mean
100	1.98	1.92	2.20	1.98	1.03	0.90	1.00	0.98
100	4.96	5.20	5.16	5.05	0.95	0.96	0.98	0.96
100	9.98	10.57	10.56	10.47	0.94	0.94	0.95	0.95
100	19.87	21.22	21.55	21.59	0.94	0.92	0.92	0.93
100	29.93	31.42	31.54	31.47	0.95	0.95	0.95	0.95
100	40.04	40.06	40.24	40.10	1.00	1.00	1.00	1.00
100	49.80	50.25	50.55	50.34	0.99	0.99	0.99	0.99
100	59.73	61.47	61.68	61.58	0.97	0.97	0.97	0.97
100	80.90	82.54	82.85	82.59	0.98	0.98	0.98	0.98
100	99.39	100.64	101.13	100.88	0.99	0.98	0.99	0.99

Frequency response								
Freq. (MHz)	Actual Field (V/m)	Measured Field (V/m)			CF			
		Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	Mean
1	9.94	7.75	7.92	7.91	1.28	1.26	1.26	1.27
2	9.94	9.25	9.39	9.31	1.07	1.06	1.07	1.07
4	9.93	10.08	10.10	10.05	0.99	0.98	0.99	0.99
10	10.00	10.50	10.52	10.43	0.95	0.95	0.96	0.95
27	9.98	10.64	10.64	10.58	0.94	0.94	0.94	0.94
75	9.99	10.70	10.72	10.62	0.93	0.93	0.94	0.94
100	9.98	10.58	10.53	10.48	0.94	0.95	0.95	0.95
200	10.00	9.60	9.62	9.60	1.04	1.04	1.04	1.04
433	10.00	10.90	11.37	11.26	0.92	0.88	0.89	0.89
800	9.94	9.74	9.69	9.61	1.02	1.03	1.03	1.03
950	10.07	9.87	10.27	10.19	1.02	0.98	0.99	1.00
1500	9.97	9.54	10.35	9.72	1.05	0.96	1.03	1.01
1800	9.99	8.79	8.91	9.05	1.14	1.12	1.10	1.12
2100	10.06	9.97	9.47	9.40	1.01	1.06	1.07	1.05
2450	9.96	8.41	9.13	8.88	1.18	1.09	1.12	1.13
2600	10.10	8.37	8.91	9.07	1.21	1.13	1.11	1.15
3000	9.98	9.17	8.73	8.54	1.09	1.14	1.17	1.13
3500	10.06	9.22	10.13	10.17	1.09	0.99	0.99	1.02
4000	9.93	8.90	8.91	8.38	1.11	1.11	1.18	1.14
5000	10.09	9.13	9.02	8.20	1.10	1.12	1.23	1.15
6000	10.03	8.64	8.92	9.29	1.16	1.12	1.08	1.12
8000	9.98	8.90	9.30	8.45	1.12	1.07	1.18	1.13
10000	10.06	9.77	9.39	9.92	1.03	1.07	1.01	1.04
12000	10.07	10.15	9.92	10.24	0.99	1.01	0.98	1.00
14000	9.94	8.90	9.49	8.08	1.12	1.05	1.23	1.13
16000	10.02	9.21	8.99	8.73	1.09	1.11	1.15	1.12
18000	9.93	8.67	9.38	10.22	1.15	1.06	0.97	1.06
26500	9.91	10.20	10.44	10.62	0.97	0.95	0.93	0.95
40000	10.06	10.72	11.01	12.21	0.94	0.91	0.82	0.89

The following values summarise the Linearity and Frequency response uncertainties of the calibrated device. These values can be used to calculate the total uncertainty of the measurements realised with the calibrated device:

Linearity error		
±	0.32	dB (2 - 100 V/m)
Frequency response		
+ 0.97	/ - 2.04	dB (1 MHz - 5 GHz)
+ 0.03	/ - 1.22	dB (5 - 18 GHz)