

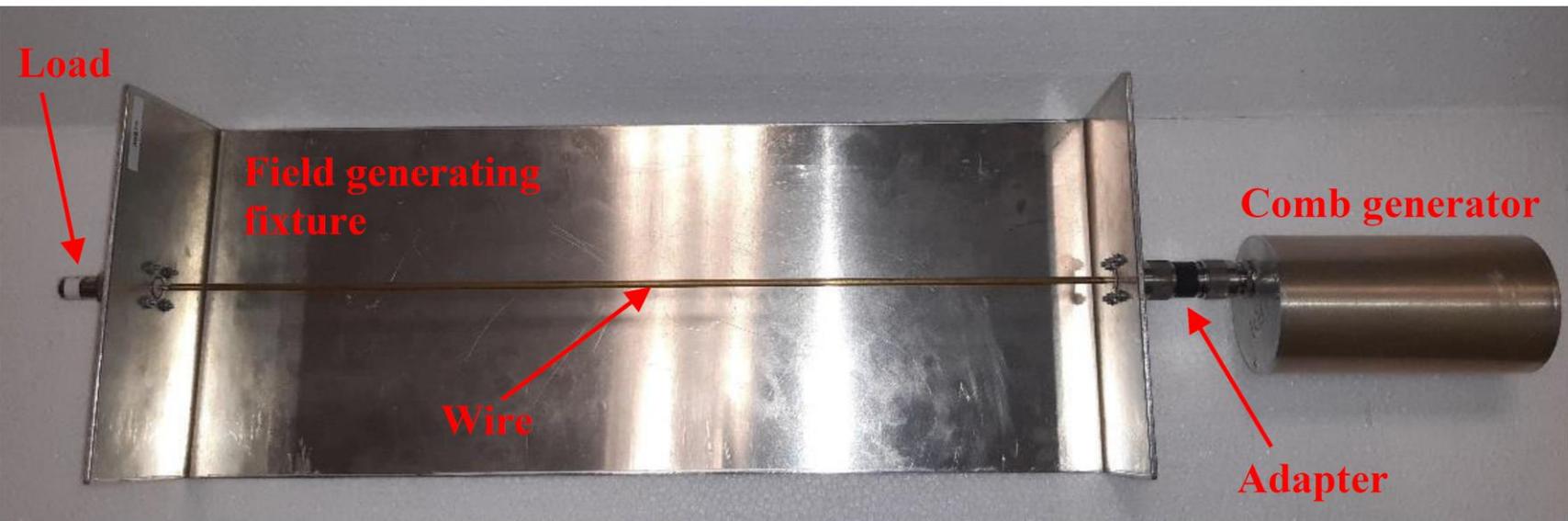
Proficiency Test of Radiated Emission Measurements PTC(RE-AUTO-015-1000- II) – ALSE Test Method

Firenze, March 10, 2026

Rev. 0

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Travelling Sample for the 150 kHz to 1000 MHz frequency range



Detailed description is in clause 6. of the scheme of the proficiency test.

General information

- Number of participants: 10
- Start date: Apr. 2025
- Stop date: Mar. 2026
- Issues faced:
 - Issuing of the proficiency test report from participating laboratories needs to be frequently solicited by the Coordinator
- Scheme of the proficiency test PTC(RE-AUTO-015-1000-II):
<https://www.dinfo.unifi.it/vp-436-schemes-of-the-proficiency-tests.html>

Measurement procedure

- Field measurement must be preceded by a preliminary verification of the correct operation of the Sample. If the preliminary verification is successful then the Laboratory can pass to the next step, i.e. the radiated emission measurement.
- Measurement of the field generated by the Sample is carried out by using different receiving antennas, depending on the measurement frequency.
- Distance d from the wire of the field-generating fixture to the reference of the receiving antenna is 1000 mm (horizontal). The EMI receiver's detector shall be set to average. Details of the measurement setup not specified here are provided by §6.5 of CISPR 25:2021 in the frequency range from 150 kHz to 1 GHz. The use of the same measuring instrumentation and setup as used for ordinary testing activity is recommended.
- The measurement result provided by the Laboratory shall be the estimate x , expressed in dB(μ V/m), of each electric field-strength harmonic.

Measurement procedure

- Frequency range 150 kHz to 30 MHz

The scope of the measurement is to obtain an estimate of the electric field strength, in dB(μ V/m), emitted by the Sample and sensed by a vertical monopole antenna at 1 m distance from the wire of the field-generating fixture. The reference of the monopole antenna for distance measurement is the rod.

- Frequency range 30 MHz to 300 MHz

The scope of the measurement is to obtain an estimate of the electric field strength, in dB(μ V/m), emitted by the Sample and sensed by a biconical antenna at 1 m distance from the wire of the field-generating fixture. Both vertical polarization and horizontal polarization are measured. The estimate of the electric field strength shall be the maximum reading between the two polarizations. The reference of the biconical antenna for distance measurement is the phase center.

- Frequency range 300 MHz to 1000 MHz

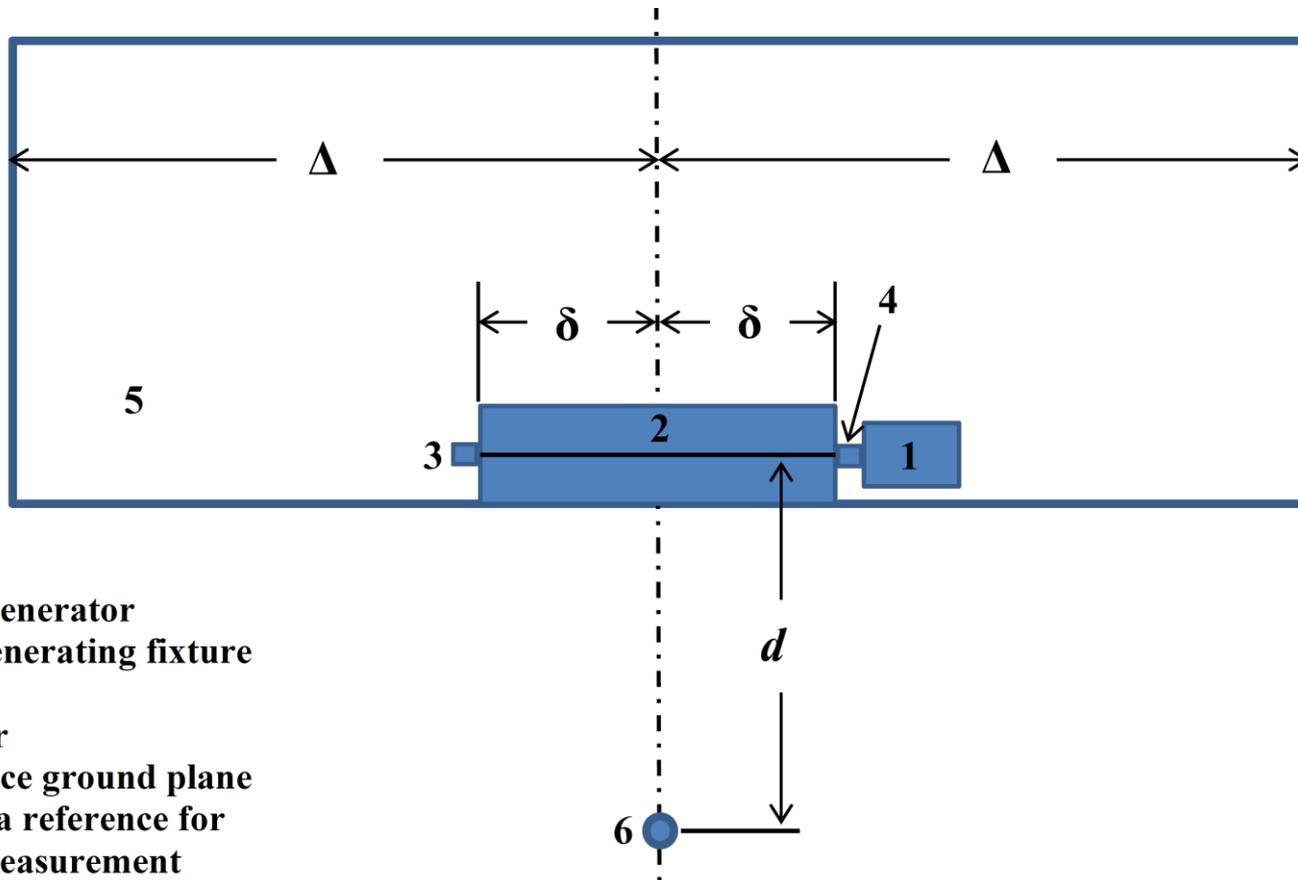
The scope of the measurement is to obtain an estimate of the electric field strength, in dB(μ V/m), emitted by the Sample and sensed by a log-periodic antenna at 1 m distance from the wire of the field-generating fixture. Both vertical polarization and horizontal polarization are measured. The estimate of the electric field strength shall be the maximum reading between the two polarizations. The reference of the log-periodic antenna for distance measurement is the tip.

- If a bilog receiving antenna is employed in the frequency range from 30 MHz to 1000 MHz then the antenna reference shall be the one used for antenna calibration.

General recommendations

- Minimize common mode current along the receiving antenna cable by routing the cable perpendicular to the wire of the Sample and parallel to the floor.
- Check possible intermodulation effects when using the monopole antenna by inserting an attenuator (e.g. 6 dB) between the output of the comb generator output and the input of the field generating fixture (the receiver reading should decrease by no more than 6 dB).
- Check the balance of the biconical antenna by rotating it by 180° (the receiver reading should not significantly vary). Repeat the check in horizontal polarization and in vertical polarization.
- Take measures to assure good electrical contact between the field-generating fixture and the reference ground plane by cleaning the respective surfaces, clamping the fixture to the table and using metallic tape to increase the contact surface.

Measurement setup



- 1 – comb generator
- 2 – field-generating fixture
- 3 – load
- 4 – adapter
- 5 – reference ground plane
- 6 – antenna reference for distance measurement

Measurement frequencies

Table 1: Table to be used for recording the electromagnetic field measurement result x and measurement uncertainty U_{lab} . Columns 7 and 8 shall be filled up by the Laboratory, the other columns (5, 6 and 9) will be filled up by the Coordinator.

1	2	3	4	5	6	7	8	9
Receiving antenna	Comb generator	Harmonic #	Frequency MHz	x^* dB(μ V/m)	s^* dB	x dB(μ V/m)	U_{lab} dB	ζ
Monopole	LF01	1	0,125	-	-			-
Monopole	LF01	4	0,875	-	-			-
Monopole	LF01	59	14,625	-	-			-
Monopole	LF01	115	28,625	-	-			-
Biconical	HF01	14	70	-	-			-
Biconical	HF01	32	160	-	-			-
Log-periodic	HF01	62	310	-	-			-
Log-periodic	HF01	110	550	-	-			-
Log-periodic	HF01	150	750	-	-			-
Log-periodic	HF01	180	900	-	-			-

Reference values

- Reference values are:
 - x^* reference value of the electric field at a given frequency
 - s^* standard deviation of the electric field at a given frequency
- x^* and s^* are obtained through the robust statistical analysis in terms of robust mean and robust standard deviation

Robust statistical analysis

$x_1, x_2, \dots, x_i, \dots, x_p$ } Raw data (p participants)

$x^* = \text{median of } x_i \quad (i = 1, 2, \dots, p)$

$s^* = 1,483 \text{ median of } |x_i - x^*| \quad (i = 1, 2, \dots, p)$

} Initial reference value

$\delta = 1,5s^*$

$x_i^* = \begin{cases} x^* - \delta, & \text{if } x_i < x^* - \delta \\ x^* + \delta, & \text{if } x_i > x^* + \delta \\ x_i, & \text{otherwise} \end{cases}$

} Transformed set of data

$x^* = \sum x_i^* / p$

$s^* = 1,134 \sqrt{\sum (x_i^* - x^*)^2 / (p - 1)}$

} New reference value
(iterative algorithm)



Performance statistic z

- Performance statistic ζ (§9.6 of ISO 13528:2022) that the Coordinator applies to the Participant providing the measurement result x_i and u_{xi} (best estimate and standard uncertainty)

$$\zeta_i = \frac{x_i - X}{\sqrt{u_{xi}^2 + u_X^2}}$$

where, $X = x^*$ is the reference value and $u_X = 1,25s^*/\sqrt{N}$ is the standard uncertainty of the reference values and N is the number of participants

$$\begin{cases} 2 < |\zeta_i| < 3 \Rightarrow \textit{warning} \\ 3 < |\zeta_i| \Rightarrow \textit{action} \end{cases}$$

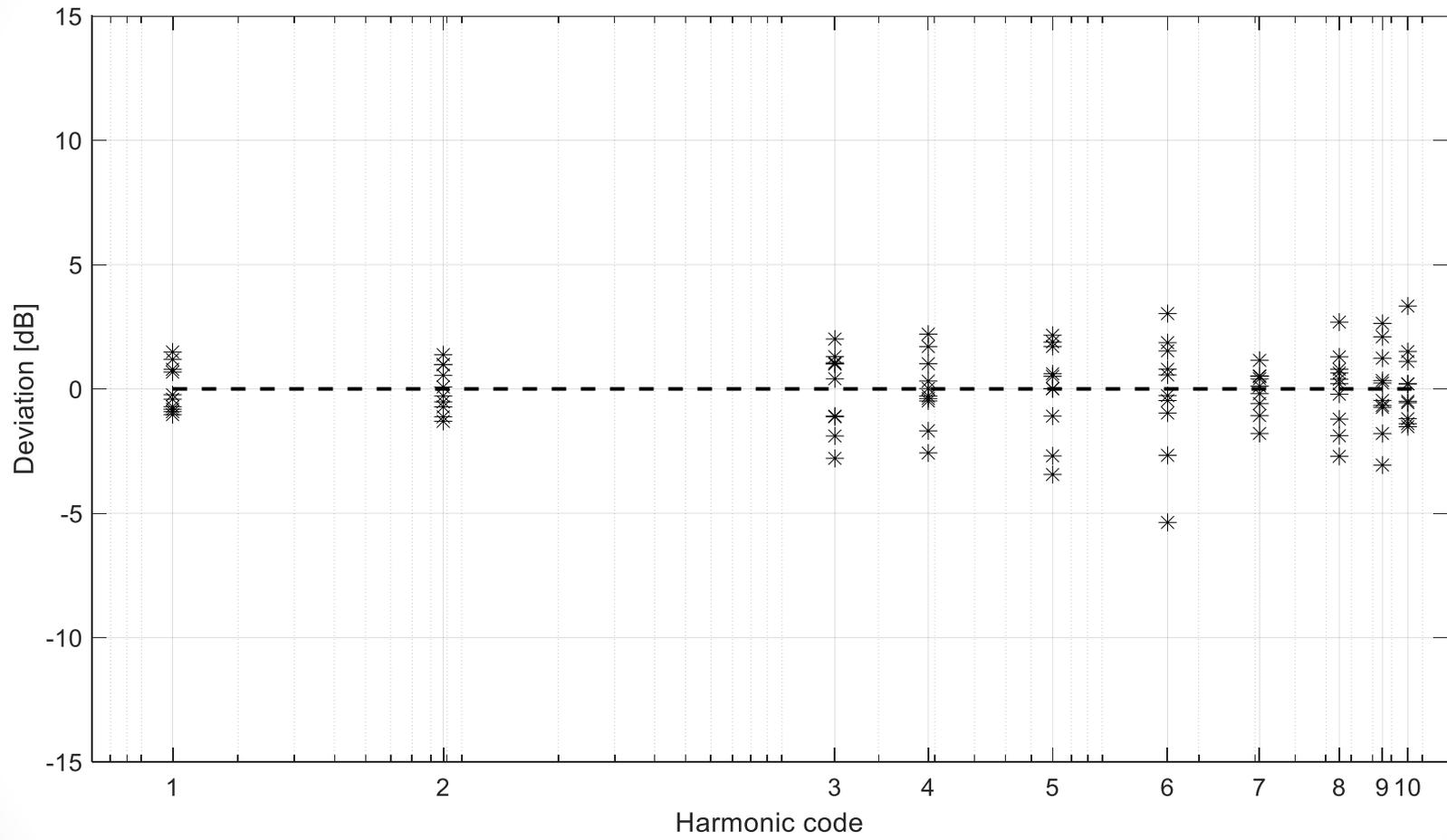
Results

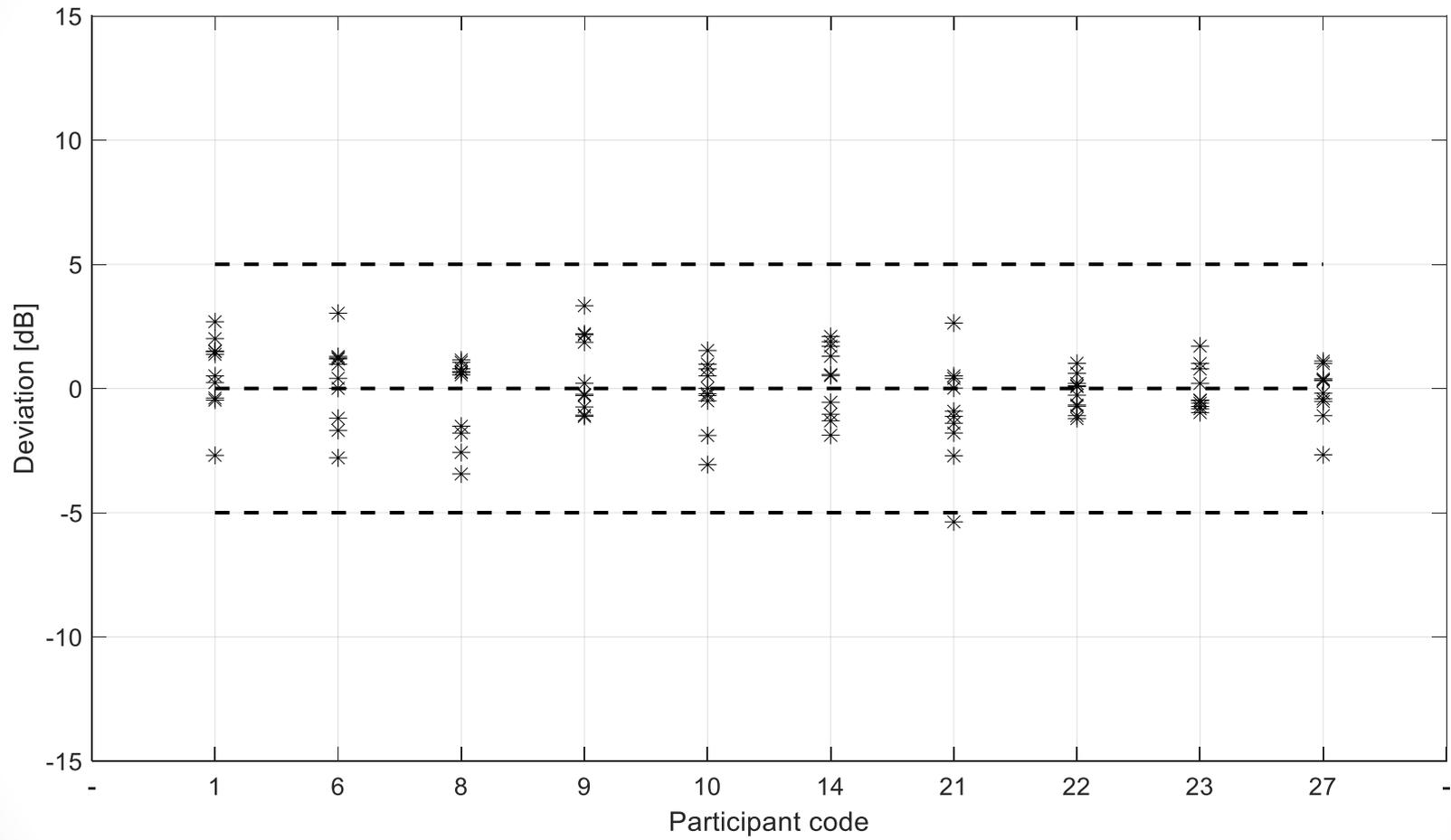
Harmonic code to frequency conversion

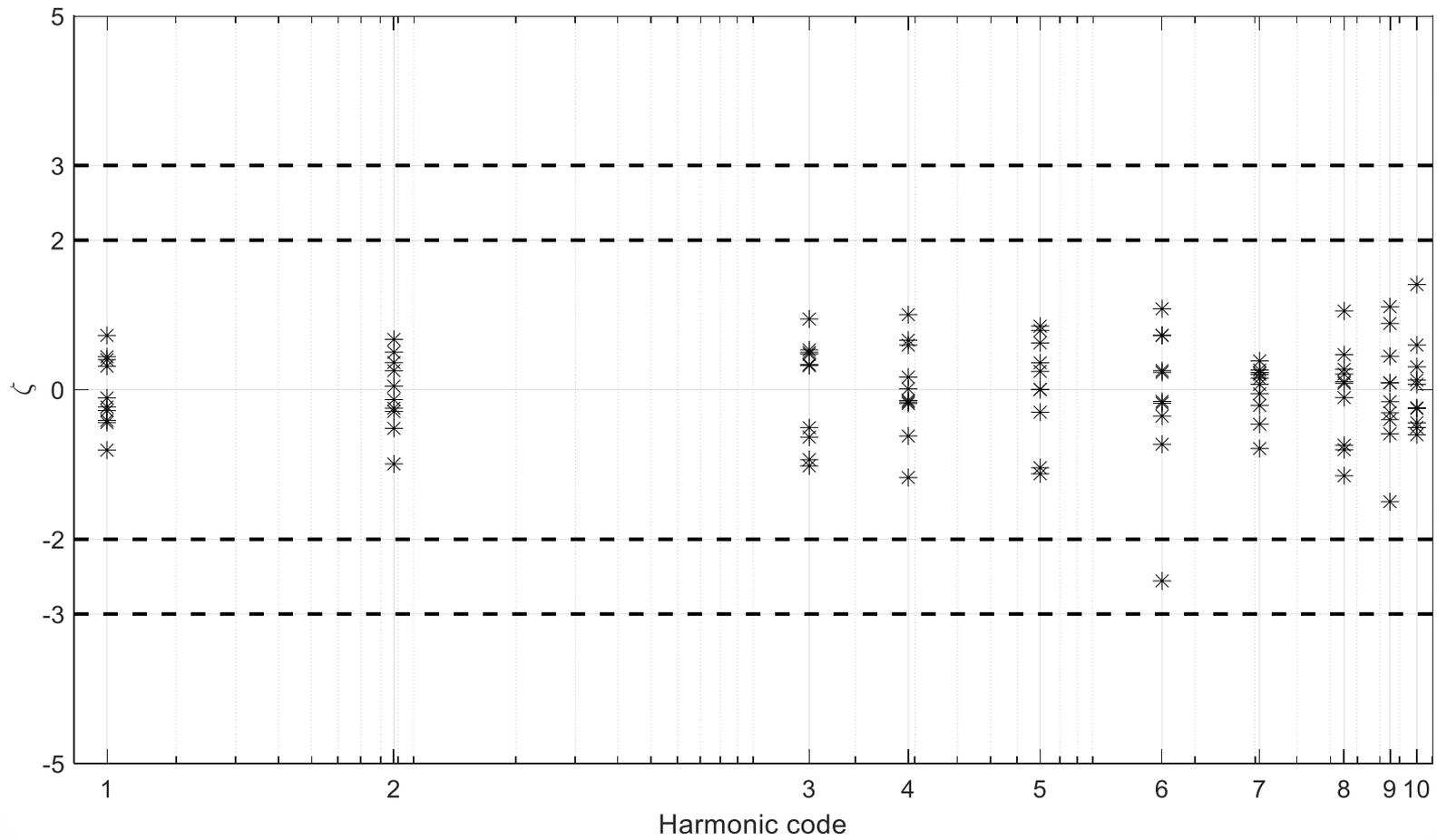
Receiving antenna	Harmonic code	Frequency MHz
Monopole	1	0,125
Monopole	2	0,875
Monopole	3	14,625
Monopole	4	28,625
Biconical	5	70
Biconical	6	160
Biconical	7	310
Log-periodic	8	550
Log-periodic	9	750
Log-periodic	10	900

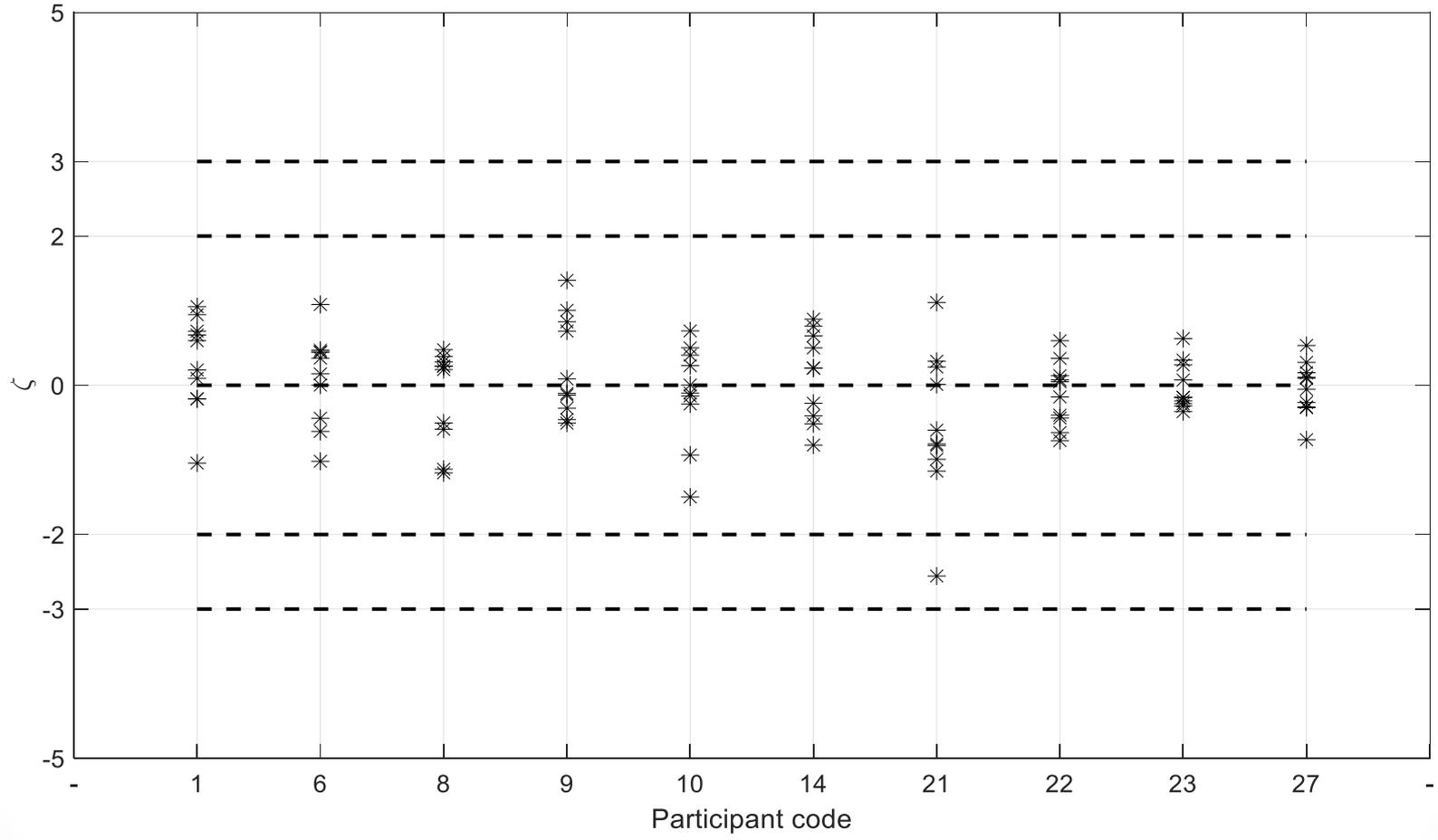
Interpretation of results

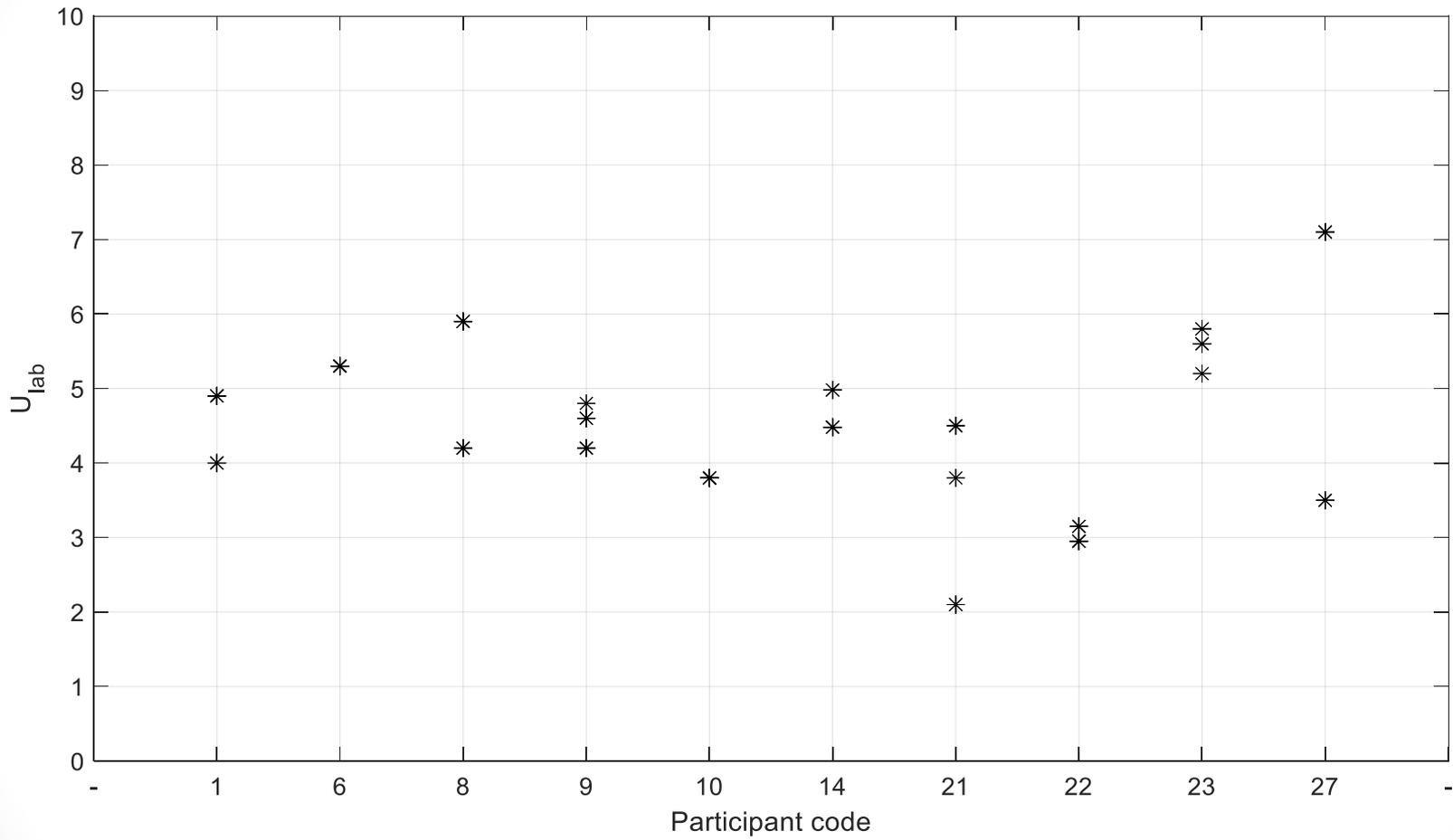
- Results are reported as:
 - Raw deviation between x_i , the measurement result of the i -th laboratory at a given frequency, and x^* reference value of the electric field at the same frequency
 - Performance statistic ζ_i of the i -th laboratory at a given frequency











Remarks

- The measurement results provided by the 10 participants at the 10 measurement frequencies selected by the Coordinator are approximately within ± 5 dB from the reference values.
- 100 measurement results were provided by the participants, and only 1 warning signal was issued
- The expanded measurement uncertainty declared by the laboratories is generally below 6 dB (one exception at 7 dB).
- The robust standard deviation s^* is below 2,3 dB over the full frequency range