Proficiency Test of Conducted Emission Measurements PTC(CE-AUTO-0.15-108-II)

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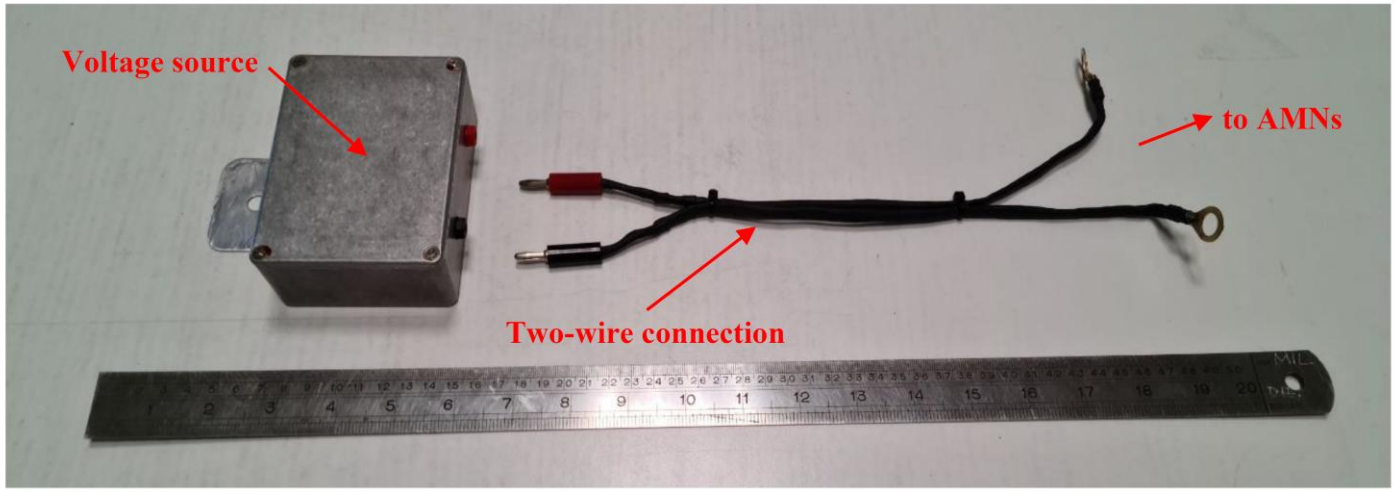
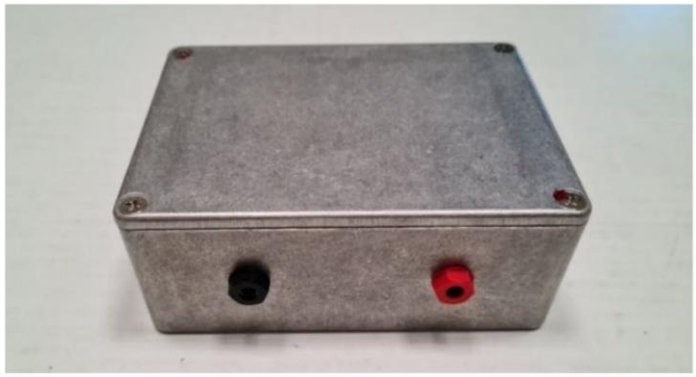
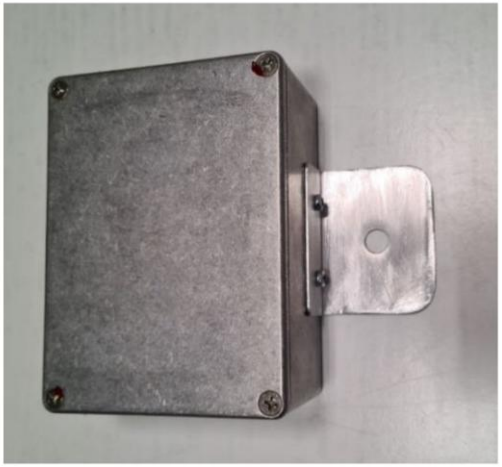
Travelling Sample for the 150 kHz to 108 MHz frequency range







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

General information

- Number of participants: 10
- Start date: Week 15 2025
- Stop date: Week 48 2025
- Issues faced:
  - Delays in receiving the test report from laboratories
- Scheme of the proficiency test PTC(CE-AUTO-0.15-108-II):
  https://www.dinfo.unifi.it/vp-436-schemes-of-the-proficiency-tests.html

Measurement procedure – 1 of 2

- Disturbance voltage measurement must be preceded by a preliminary verification of the correct operation of the Sample.
- The preliminary verification shall be carried out as follows:
  - Connect the Sample to the reference ground plane through the angled flange.
  - Connect the Sample to the AMNs through the two-wire connection.
  - - Measure the amplitude of the harmonic whose frequency is the closest to 408 kHz. Use average detector. The reading shall be 58 dB(µV) ± 6 dB (at both RED and BLACK terminals).
- If the preliminary verification is successful then the Laboratory can pass to the next step, i.e. the conducted emission measurement, otherwise the Coordinator shall be informed, and the conducted emission measurement is temporarily delayed.
- Measurements shall be carried out in accordance with the methods described in §6.3 of CISPR 25:2021 in the frequency range from 150 kHz to 108 MHz.

Measurement procedure – 2 of 2

- Measurement of the disturbance voltage generated by the Sample is carried out at the measurement frequencies reported in Table 1. Both RED and BLACK terminals voltage to ground shall be measured. Use average detector.
- **Frequencies are provided to rapidly identify the harmonic to be measured. Do not blindly measure voltage at the indicated frequency. Measure the amplitude of the harmonic at the closest frequency to the one indicated by the Coordinator**
- The Sample shall be placed on a non-conductive, low relative permittivity material, at (50 ± 5) mm above the reference ground plane.
- The case of the Sample shall be grounded to the reference ground plane through the angled flange.
- NOTE: Take measures to assure good electrical contact between the Sample enclosure and the reference ground plane by cleaning the respective surfaces and using metallic tape to increase the contact surface.

Reference values

- Reference values are:
  - x^* reference value of the voltage at a given frequency
  - s^* standard deviation of the voltage 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

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

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

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

} Initial reference value

$\delta = 1{,}5 s^*$

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

} Transformed set of data

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

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

} New reference value (iterative algorithm)

Excerpt from Annex C, algorithm A of ISO 13528:2022

Performance statistic ζ (Participant)

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

$$\zeta_i = \frac{x_i - X}{\sqrt{u_{xi}^2 + u_X^2}} \qquad X = x^*, u_X = \frac{1{,}25 \cdot s^*}{\sqrt{p}}, u_{xi} = \frac{U_{lab,i}}{2}$$

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

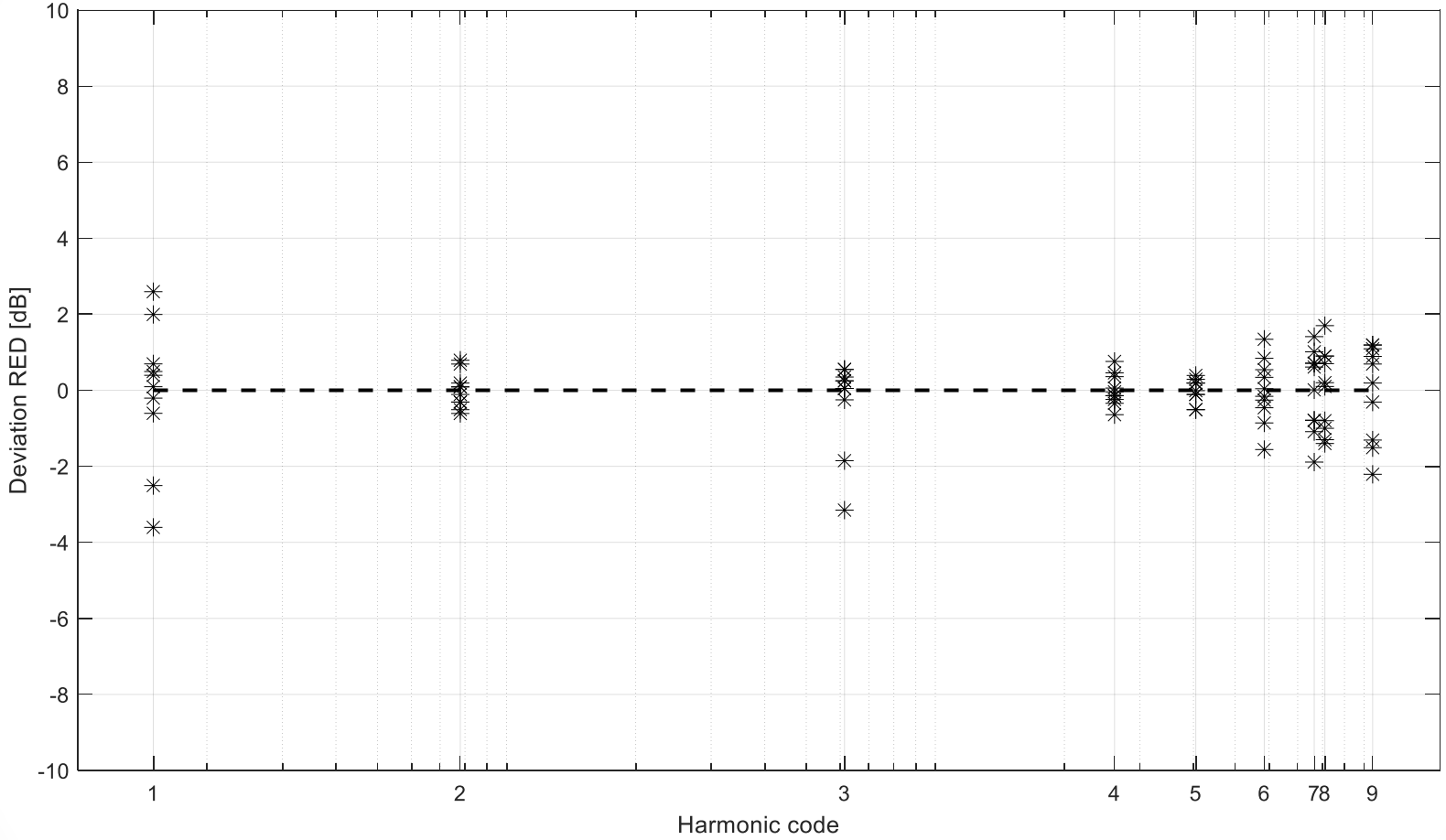
Results

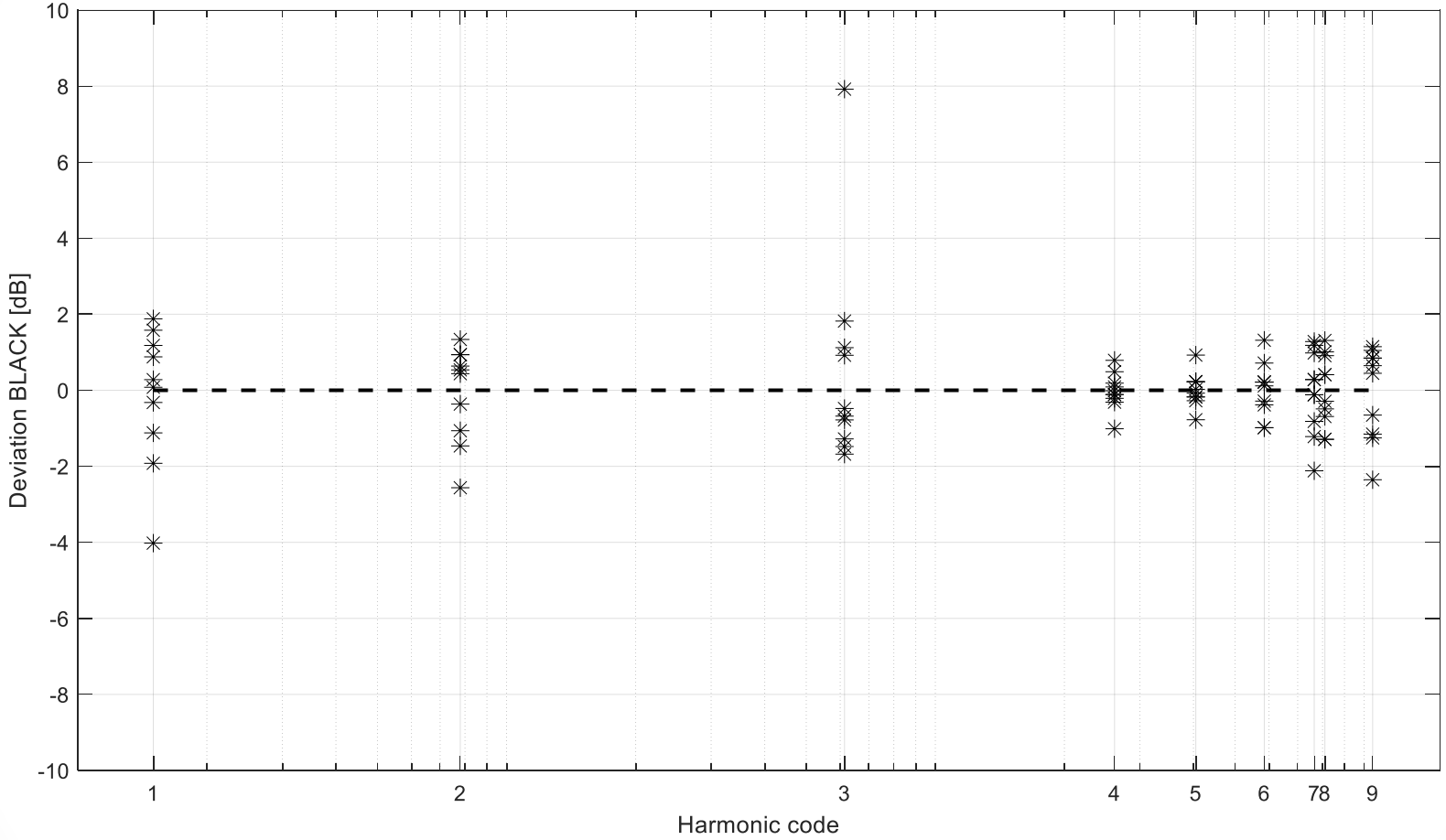
Harmonic code to frequency conversion

Band	Harmonic code	Frequency MHz
B	1	0.15
B	2	0.78
B	3	6.14
B	4	26.18
B	5	40.5
C	6	58.5
C	7	76.5
C	8	81.0
C	9	104.7

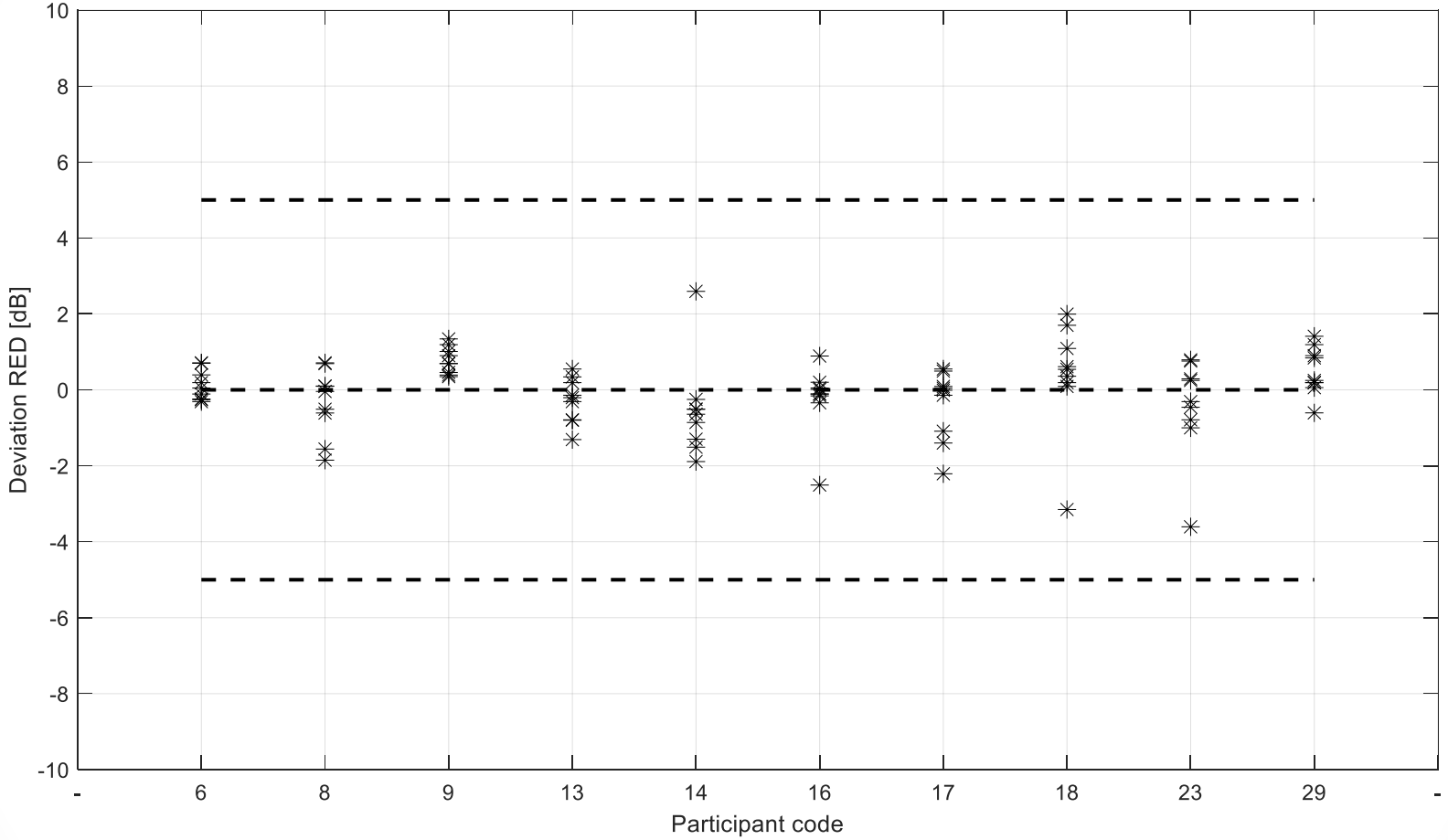
Interpretation of results

- Results are reported as:
  - Deviation between x_i, the measurement result of the i-th laboratory at a given frequency, and x^* reference value of the disturbance voltage at the same frequency
  - Performance statistic ζ_i of the i-th laboratory at a given frequency
  - Distinction is made between voltages at the RED and BLACK terminals

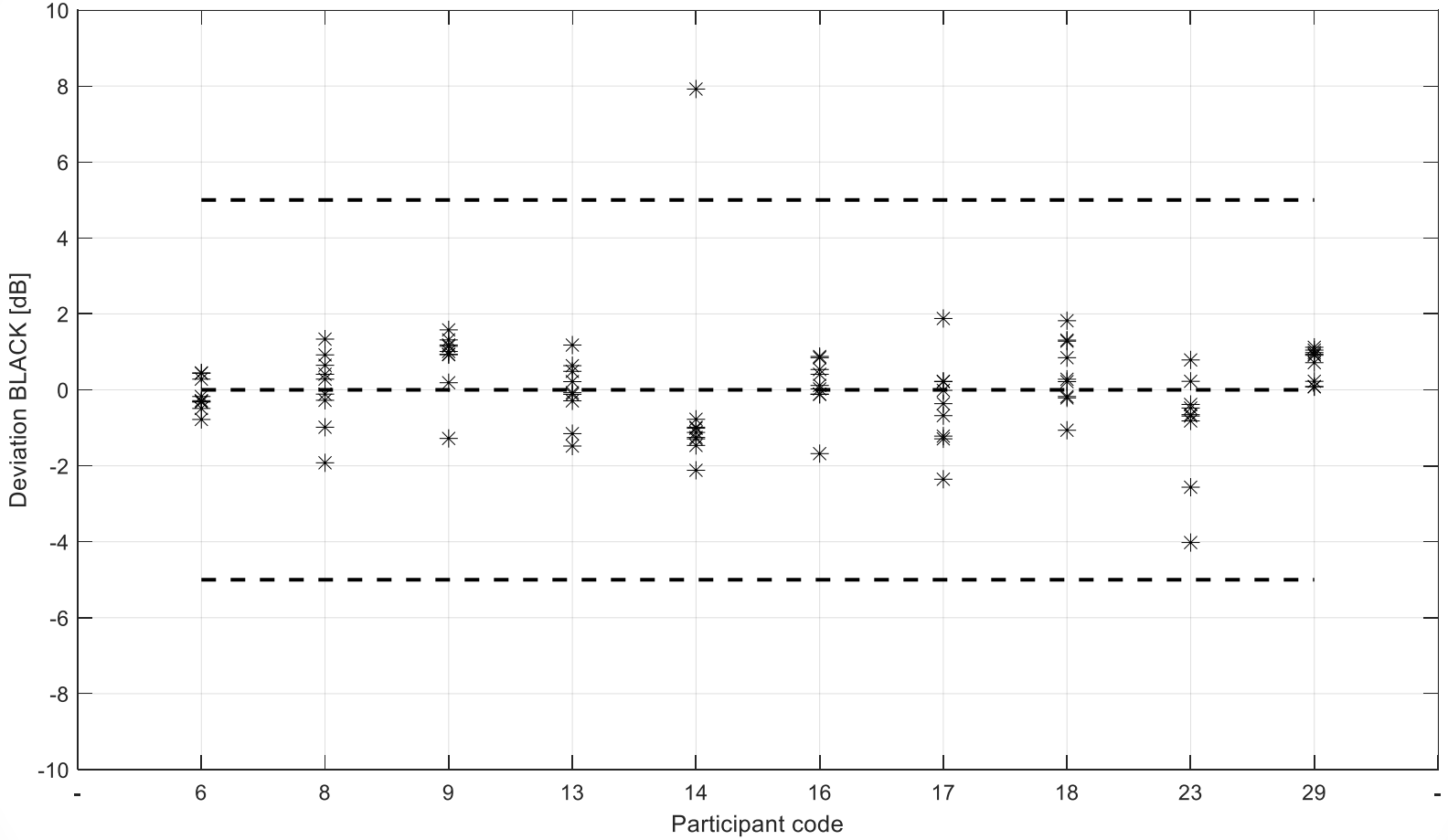

Deviation RED [dB]
10
8
6
4
2
0
-2
-4
-6
-8
-10
1
2
3
4
5
6
7
8
9
Harmonic code



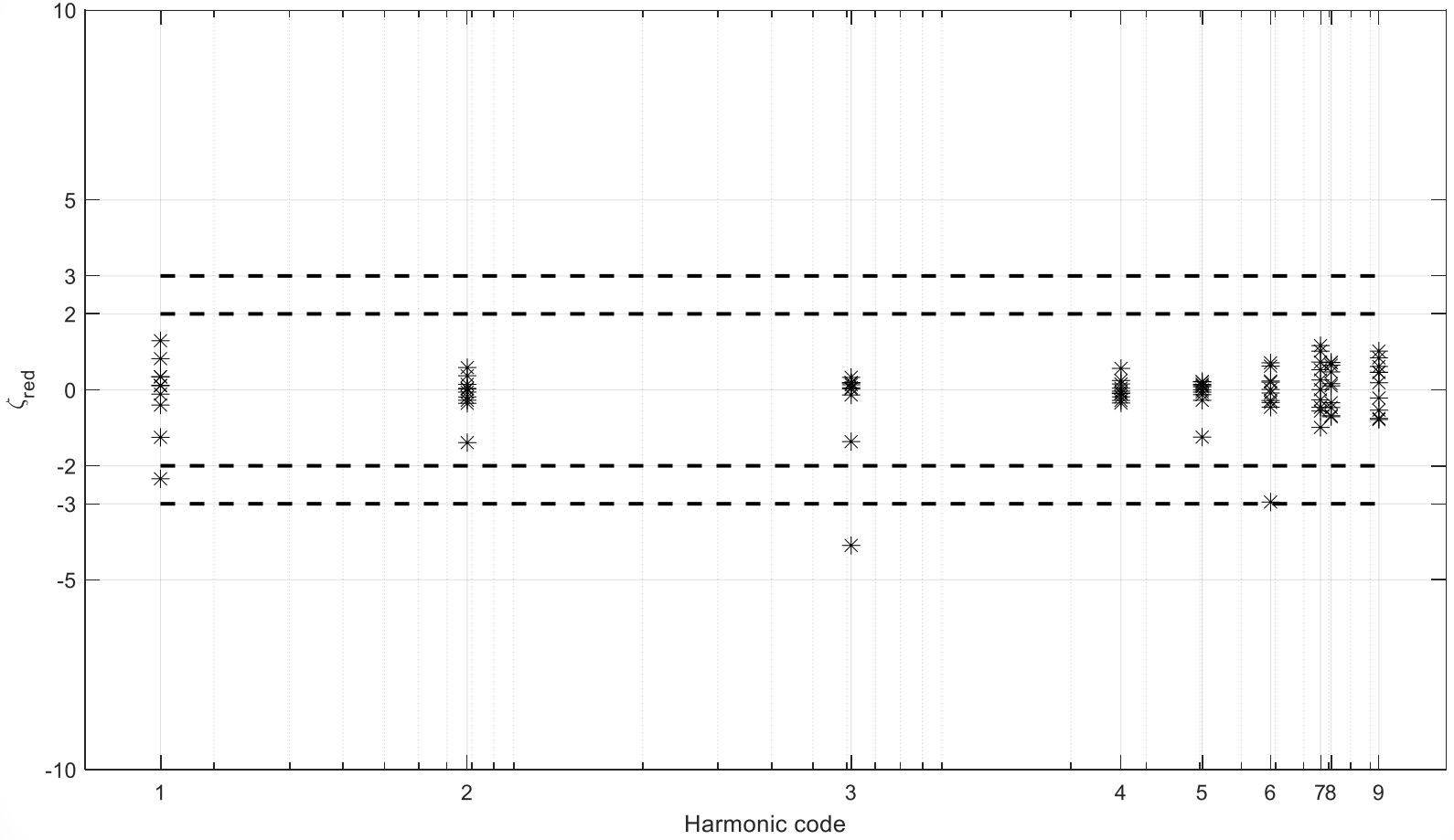
Conducted emission 150 kHz – 108 MHz

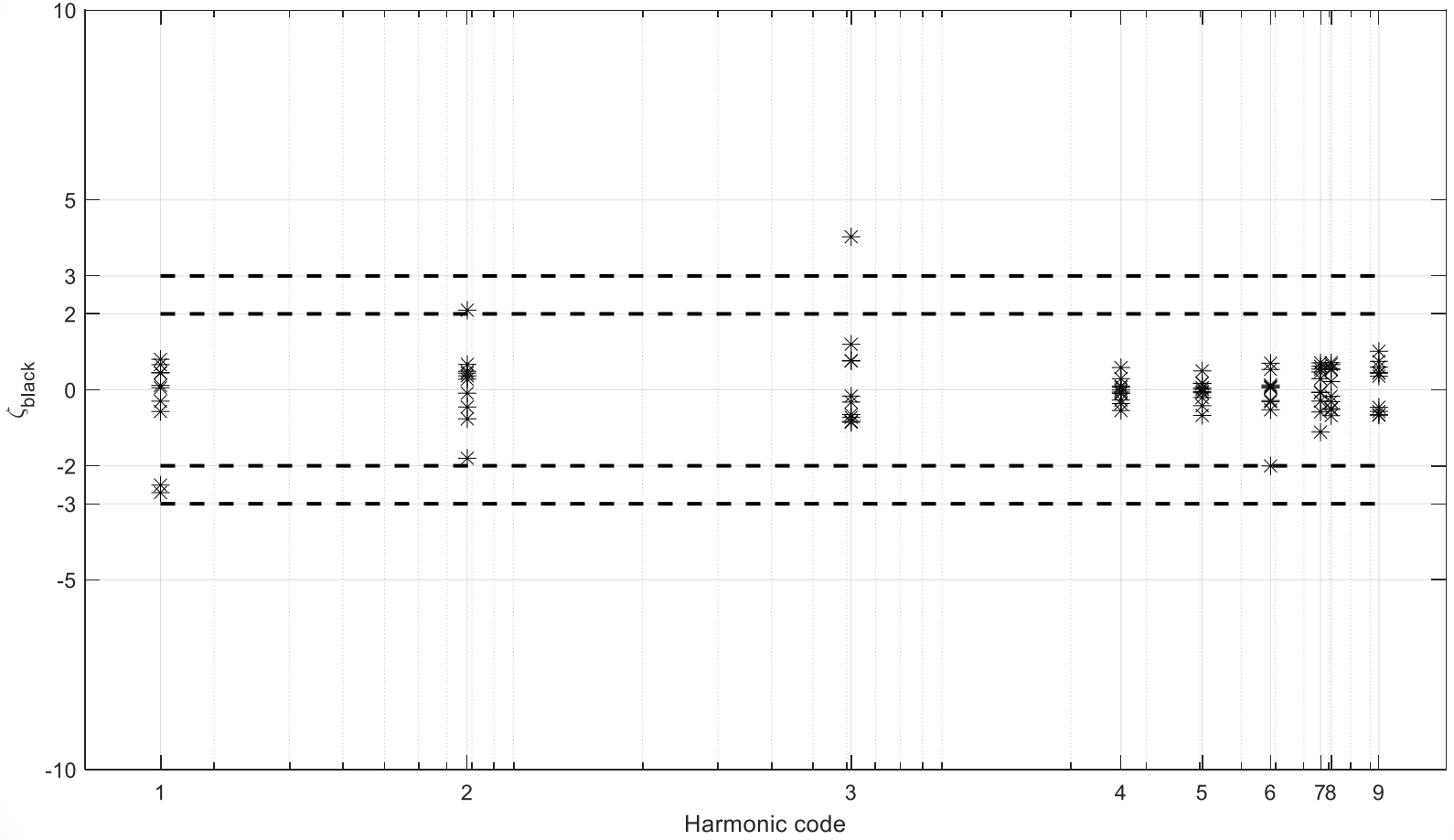


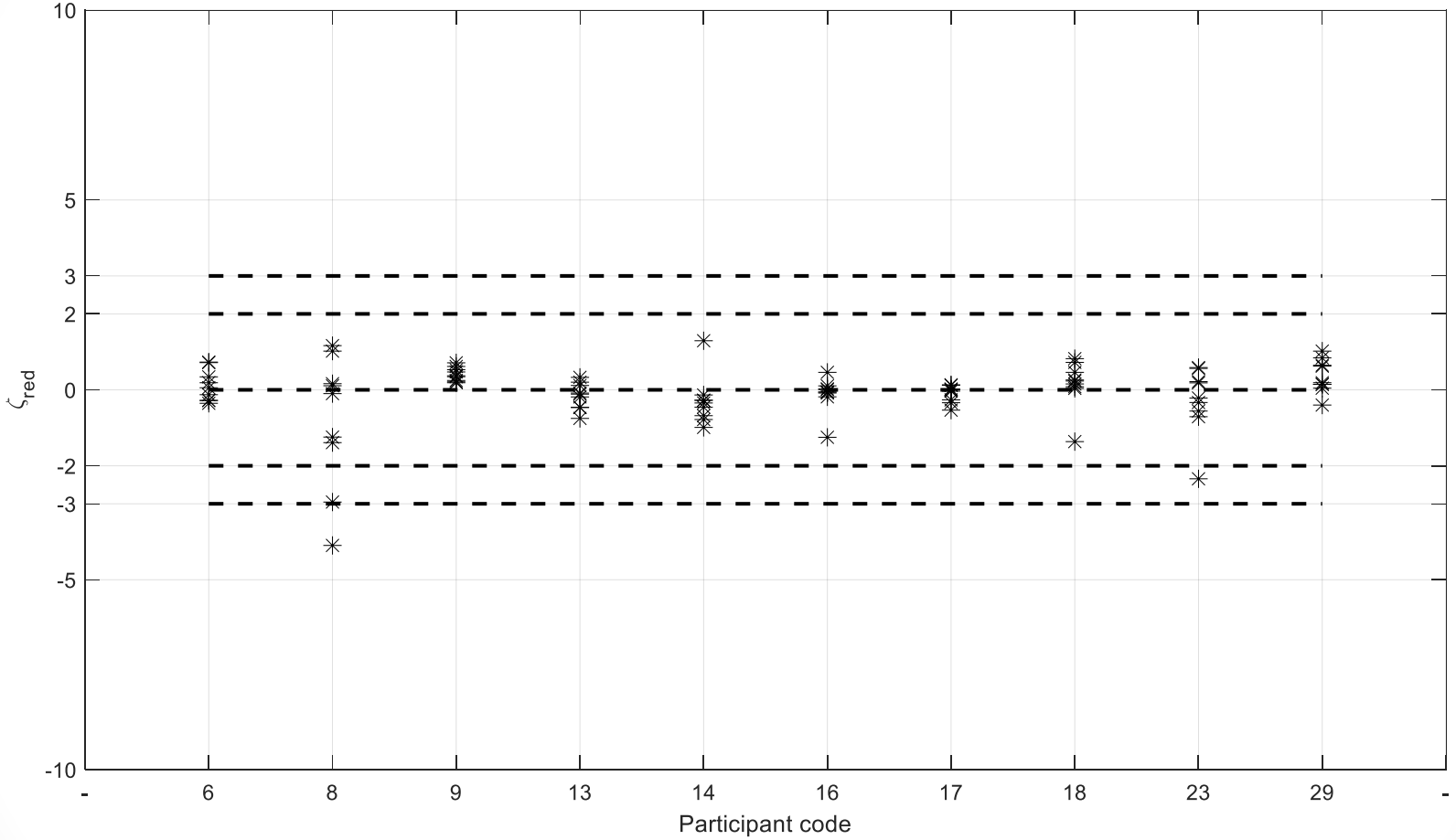
Dashed lines correspond to ±5 dB deviation

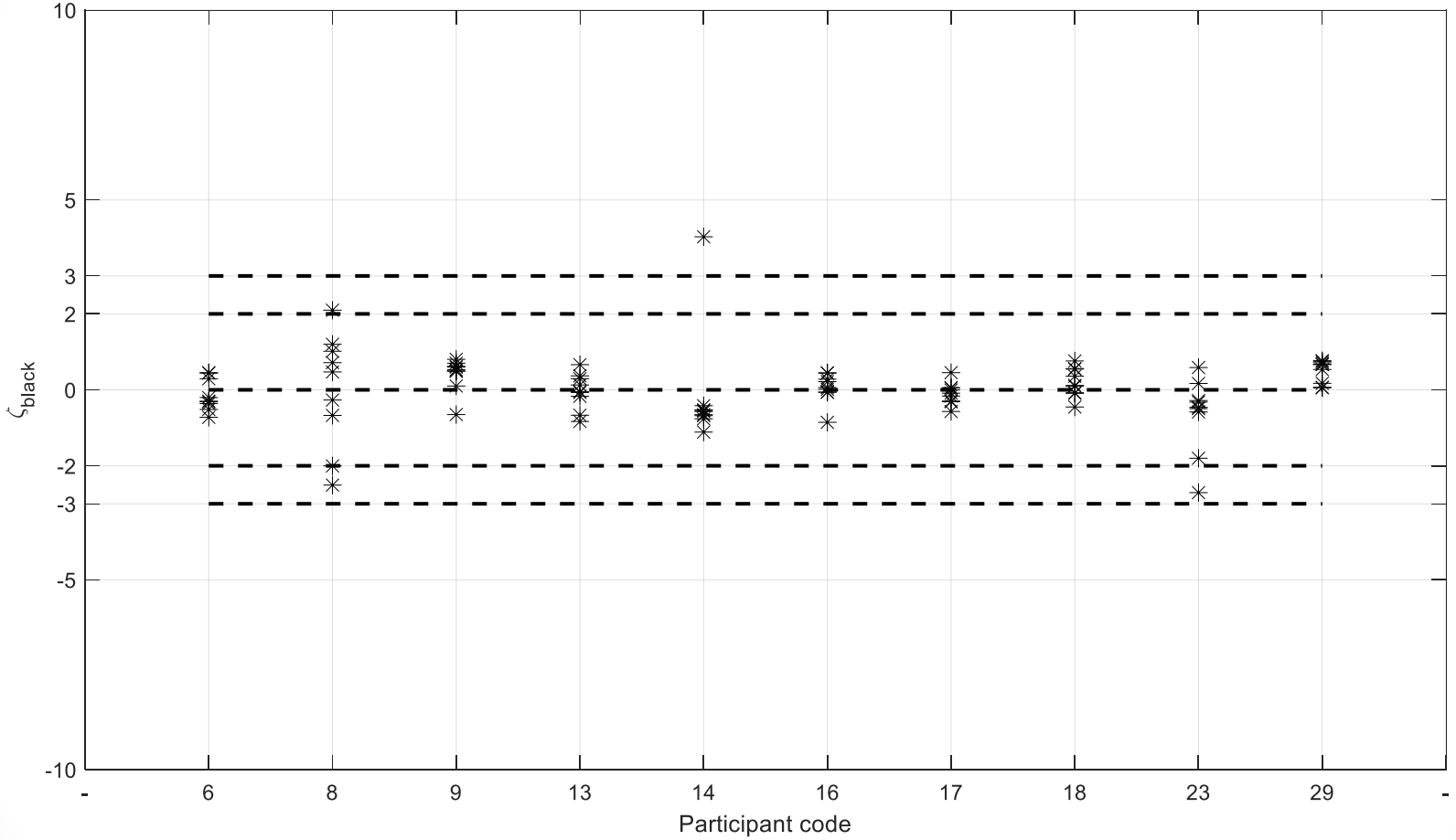


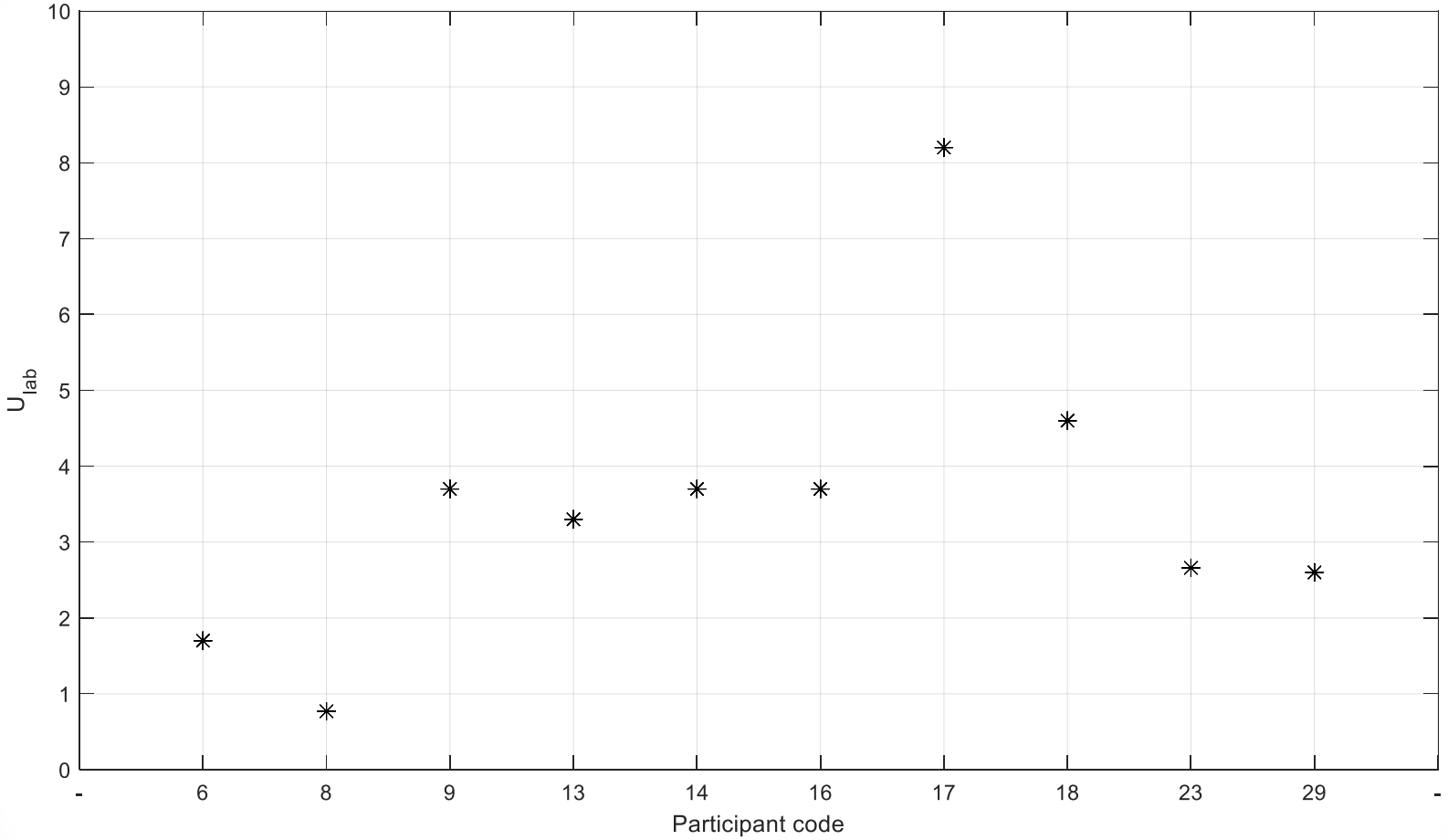
Dashed lines correspond to ±5 dB deviation


10
5
3
2
0
-2
-3
-5
-10
ζ_{red}
1
2
3
4
5
6
78
9
Harmonic code


10
5
3
2
0
-2
-3
-5
-10
ζ_{black}
1
2
3
4
5
6
78
9
Harmonic code


10
5
3
2
0
-2
-3
-5
-10
ζ_{red}
-
6
8
9
13
14
16
17
18
23
29
-
Participant code


10
5
3
2
0
-2
-3
-5
-10
ζ_{black}
-
6
8
9
13
14
16
17
18
23
29
-
Participant code


10
9
8
7
6
5
4
3
2
1
0
U_{lab}
-
6
8
9
13
14
16
17
18
23
29
-
Participant code

Band	Harmonic #	Frequency MHz	x^*_{red} dB(µV)	s^*_{red} dB	x^*_{black} dB(µV)	s^*_{black} dB
B	1	0.15	67.4	2.0	70.1	1.7
B	2	0.78	52.0	0.5	55.9	1.3
B	3	6.14	57.2	0.6	43.8	1.7
B	4	26.18	59.2	0.5	60.7	0.4
B	5	40.5	59.8	0.4	61.0	0.3
C	6	58.5	56.7	0.9	57.6	0.8
C	7	76.5	52.3	1.2	53.0	1.2
C	8	81.0	66.8	1.2	67.1	1.1
C	9	104.7	68.0	1.4	67.6	1.3

Remarks

- Most of the measurement results provided by the 10 participants (180 voltage values) are within ±5 dB from the reference value, 1 measurement result exceeds 5 dB deviation.
- One laboratory evaluated a relatively small measurement uncertainty (U_{lab} < 1 dB), another laboratory estimated a relatively large measurement uncertainty (U_{lab} > 8 dB).
- The travelling Sample was designed to apply the same voltage from line (red, black) to the reference ground plane, however the voltage measured at the two terminals is significantly different at low frequency (below 10 MHz), where also the reproducibility is worse.