

EMC Test Report

According to

Title 47 CFR Part 15 Subpart B

ISED ICES-Gen Issue 1; Amendment 1 (February 2021)

ISED ICES-003 Issue 7

ANSI C63.4:2014+A1:2017

DUT Name: TempCast FMP100
Model No. : FMP103
Customer: Vaisala Oyj
Address: Vanha Nurmijärventie 21, 01670 Vantaa, Finland
Summary: IN COMPLIANCE
Date of Reception: 13.6.2023
Date(s) of Test(s): 13.6.2023 – 14.6.2023

Tested by (Test Engineer)


Pekka Pulkkinen

Approved by (Technical Manager)


Jukka Rauma

The test report shall not be reproduced except in full, without the written approval of the laboratory. This report is only for the equipment which is described in page 4.

Contents

| | |
|---|----|
| 1. General Information | 3 |
| 2. Test Samples | 4 |
| 3. Configuration and Operation Modes | 4 |
| 4. Test sample description | 5 |
| 5. Test description..... | 7 |
| 5.1. FCC subpart 15B and ICES-003, radiated emission test procedure | 7 |
| 5.2. FCC subpart 15B and ICES-003, conducted emission test procedure..... | 9 |
| 6. Uncertainties..... | 9 |
| 6.1. Emission measurement uncertainties | 9 |
| 7. Summary | 10 |
| 8. Radiated Emissions | 11 |
| 9. Test Equipment List..... | 16 |
| Appendix A: Test Setup Photographs | 17 |

| Document Version History | Date of issue | Comments | Approved by |
|--------------------------|---------------|---|-------------|
| v0.1 | 21.6.2023 | Initial version | |
| v1.0 | 27.6.2023 | Approved version | Jukka Rauma |
| v2.0 | 15.9.2023 | Internal and external pictures removed. Page11 mention about OM2 removed | Jukka Rauma |

1. General Information

Test Engineer(s): Pekka Pulkkinen

Location:

| | |
|------------------------------|---|
| Test Firm Name | Eurofins Electric & Electronics Finland Oy (EEEE) |
| Test Site | Yrttipellontie, Peltola |
| Address of Test Site | Yrttipellonte 6, 90230 Oulu, Finland |
| FCC Designation number | FI0008 |
| FCC site registration number | 771880 |
| ISED number | 29576 |
| CAB Identifier | T290 |

Customer: Vaisala Oyj
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Sami Lehtonen
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sami.lehtonen@vaisala.com

Climate Conditions: Temperature: 15 – 35 °C
Air pressure: 860 – 1060 hPa
Humidity: 30-60 rH%
These limits were not exceeded during testing.

2. Test Samples

General description:

Vaisala TempCast is an easy and affordable way to monitor key temperature parameters from any critical location. The wireless, pole-mounted sensor has different variants to measure air temperature, relative humidity, and surface temperature.

TempCast FMP100 family includes following configurations/variants:

- FMP102 – equipped with IOTHMP sensor (HMP9** based sensor)
- FMP103 – equipped with MT11 and IOTHMP

Test samples:

| Sample number | Serial number | Manufacturer | DUT Type | Model | HW version | SW version | Comments |
|---------------|---------------|--------------|----------|--------|------------|------------|-------------|
| 3772ER005 | V1850056 | Vaisala Oyj | TempCast | FMP103 | G | 1.0.9 | Emission FW |

Accessories / Monitoring devices:

| Sample number | Serial number | Manufacturer | DUT Type | Model | HW version | SW version | Comments |
|---------------|---------------|--------------|-----------------|-------|------------|------------|----------|
| 3772ER003 | 606D3C4EE4F2 | Lenovo | Docking station | | | | |

3. Configuration and Operation Modes

| Operation Mode | Description |
|----------------|---|
| OM1 | EUT ON. Bluetooth Low Energy in RX mode. Power supply: 2 x 3.6 VDC batteries. |

4. Test sample description

| | | |
|-----------------------------------|--|---|
| Model | FMP103 | |
| Additional model(s) | FMP102 | |
| Brand name | TempCast FMP100 | |
| FCC ID | 2AO39-FMP100 | |
| IC | 23830-FMP100 | |
| Class | Class B | |
| Highest internal frequency | 2483.5 MHz (Radio frequency) | |
| Radio module 1 | Type | Bluetooth Low Energy (LE) |
| | Model | nRF52840 |
| | Manufacturer | Nordic Semiconductor |
| | FCC-ID | 2AO39-FMP100 |
| | IC | 23830-FMP100 |
| Antenna | Type | Quarter wave PCB antenna. Manufacturer Vaisala Oyj |
| | | |
| Radio module 2 | Type | NB-IoT/LTE Cat M1/GNSS Radio module |
| | Model | nRF9160 |
| | Manufacturer | Nordic Semiconductor |
| | FCC-ID | 2ANP000NRF9160 |
| | IC | 24529-NRF9160 |
| Antenna | Type | Integrated, Laird EFF692SA3S |
| Manufacturer | Vaisala Oyj Vanha Nyurmijärventie 21 01670 Vantaa Finland | |

| Additional variants (not tested and not evaluated variants) | | |
|--|--------------------------|-----------------|
| Not tested variant | | |
| 1 | Product Type Description | TempCast FMP100 |
| | Model name | FMP102 |
| | Brand name | Vaisala |
| | Hardware Version | G |
| | Software version | 1.09 |
| Comment: those named additional variants above have not been tested. Those additional variants of the series have been declared by manufacturer. | | |

| | Port | | Cable | | |
|---|-------------------------------------|--|--------------------------|--------------------------|--------------------------|
| | Name and description | Shielded | Specified max length [m] | Attached during test | |
| Ports | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | | <input type="checkbox"/> | |
| Supplementary information to the ports | | | | | |
| Rated power supply | Voltage and Frequency | | Reference poles | | |
| | | | L1 | N | PE |
| | <input type="checkbox"/> | AC 230 V <input type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | AC 240 V <input type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | AC 110 V <input type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | AC 100 V <input type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | Other: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | DC: 7.2 V Battery | | | | |
| Rated Power | | | | | |
| Clock frequencies | | | | | |
| Other parameters | | | | | |
| Dimensions in cm (W x H x D) | 316 mm x 300 mm x 133 mm | | | | |
| Weight | 1.4 kg sensor, 0.6 bracket | | | | |
| Mounting position | <input checked="" type="checkbox"/> | Table top equipment | | | |
| | <input type="checkbox"/> | Wall/Ceiling mounted equipment | | | |
| | <input type="checkbox"/> | Floor standing equipment | | | |
| | <input type="checkbox"/> | Hand-held equipment | | | |
| | <input checked="" type="checkbox"/> | Other: Mounted on a mast/street lamp/pole | | | |

5. Test description

5.1. FCC subpart 15B and ICES-003, radiated emission test procedure

Radiated tests were performed in a semi-anechoic chamber that has met NSA requirements (4 dB tolerance) according to

- CISPR 16-1-4 Ed. 4.0 2019-01 Validation of a SAC (6.8) using the Reference Site Method (RSM) (6.6);
- ANSI C63.4a -2017 Validation of radiated emission test sites (30MHz – 1 GHz) (Annex D)

sVSWR requirements (1 -18 GHz) are met according to

- CISPR 16-1-4 Ed. 4.0 2019-01 sVSWR site validation – standard test procedure (7, 7.6)

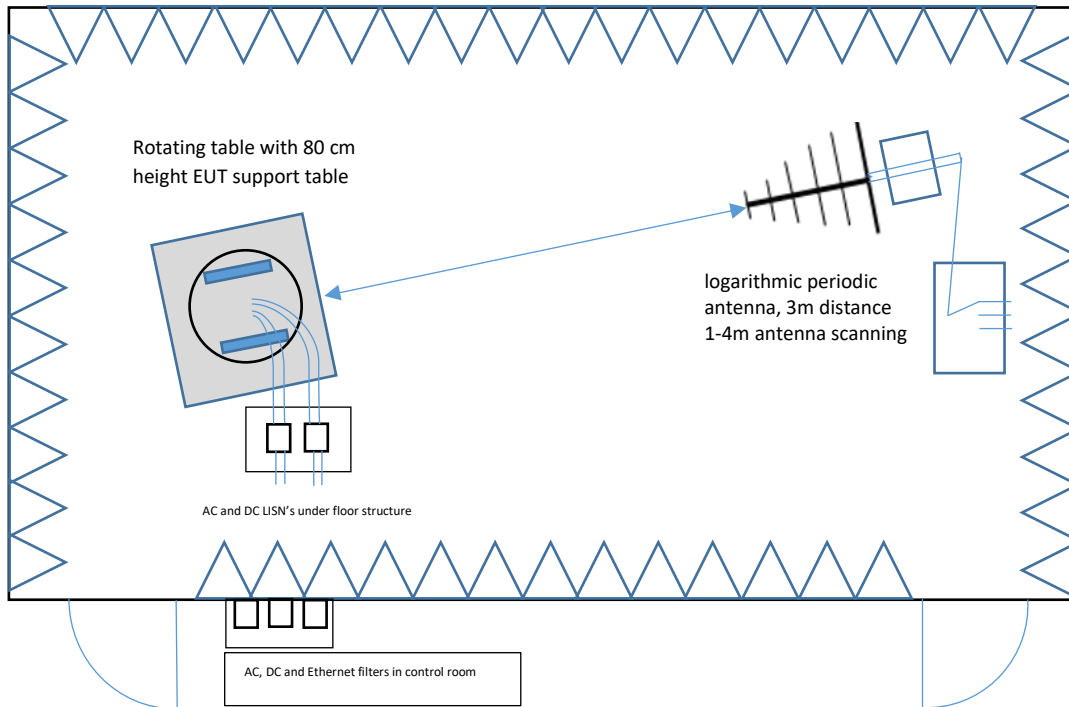
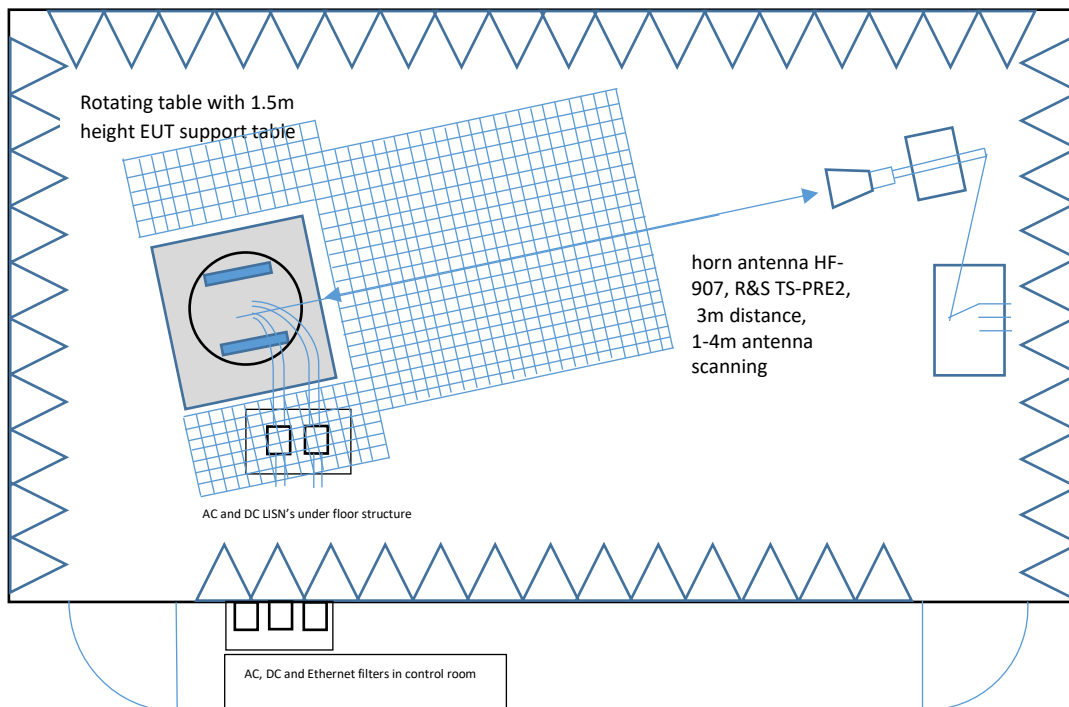
2 different measurement antenna was used, located at a distance of 3 m.

- linear polarized logarithmic periodic antenna for frequency range 30-1000 MHz
- and double-ridged horn antenna for the frequency range 1-18 GHz

The equipment under test was set up on a non-conductive support, 80 cm above the ground plane. EUT power supply LISN's for AC and DC were located under the ground reference plane. The field strength was calculated by adding correction factor to the measured level from the EMI receiver. This correction factor includes antenna factor, cable loss and pre-amplifier gain.

Measurement procedure

- EUT was set in a manner that is most representative of the equipment as typically used (i.e., as specified in the EUT instruction manual)
 - o In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the orientation (attitude) having maximum or near-maximum emission level.
- in exploratory measurements for full frequency range
 - o turntable was rotated with 45° steps (from 0° to 315°)
 - o measurement was done in both vertical and horizontal antenna polarization with antenna height of 1m
 - o measurement was done with peak detector to find the frequencies of maximum emissions and at least six highest peaks related to the limits were chosen
- these peak values were further maximized by scanning the turntable position 0 to 360 degrees and the antenna height 1 to 4m
- for maximized values, final measurement was done with
 - o quasi-peak detector for 30MHz to 1GHz frequency range
 - o with Average detector for 1GHz to 18GHz frequency range

Radiated measurements setup from 30 MHz to 1 GHz:Radiated measurements setup from 1 GHz to 18 GHz:

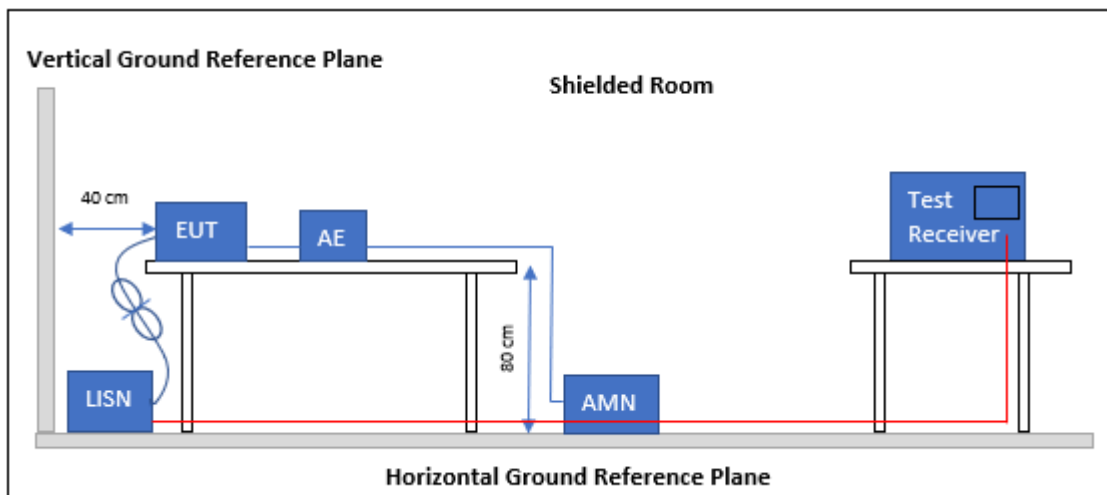
5.2. FCC subpart 15B and ICES-003, conducted emission test procedure

The equipment under test was set up on a non-conductive support, 80 cm above the ground plane and 40 cm distance of vertical ground plane. Test setup is described in pictures below.

Measurement procedure

- EUT was operated in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement
- in exploratory measurements for full frequency range
 - o measurement was done with peak and average detector to find the frequencies of maximum emissions for each current-carrying conductor of each power cord associated with the EUT and at least six highest peaks related to the limits were chosen per conductor
 - o the one configuration and arrangement and mode of operation that produces the highest emissions related to the limit across all the measured conductors was recorded.
- for this configuration and its maximized values, final measurement for each current-carrying conductor was done with quasi-peak detector and average detector

Conducted emission test setup



6. Uncertainties

6.1. Emission measurement uncertainties

| Description | Expanded Uncertainty (k=2) |
|--------------------------------|----------------------------|
| AC conducted emission | 2,24 |
| Radiated emission ≤ 1 GHz | 4,62 |
| Radiated emission > 1 GHz | 5,72 |

7. Summary

Table is modified according to applicable tests

| Title 47 CFR 15B, ISED ICES-003 Issue 7 | | | |
|--|---|---------|--------|
| Reference | Requirement – Test case | Verdict | Remark |
| FCC 15.109 ICES-003, 3.2.2 | Radiated emission. Electromagnetic field measure (30 MHz – 1000 MHz) | PASS | |
| FCC 15.109 ICES-003, 3.2.2 | Radiated emission. Electromagnetic field measure (1 GHz – 12,75 GHz) | PASS | |
| FCC 15.109 ICES-003, 3.2.2 | Radiated emission. Electromagnetic field measure (12,75 GHz – 18 GHz) | N/R | (1) |
| FCC 15.107 ICES-003, 3.2.1 | Continuous conducted emission (150 kHz – 30 MHz) | N/R | (2) |
| The DUT has been tested and passes the FCC Part 15 Subpart B without any modifications. | | Yes | |
| <p>Supplementary information and remarks:</p> <p>(1) Range: $f > 12.75$ GHz. Test is required only if the 5th harmonics of the EUT's maximum internal work frequency is higher than 12.75GHz.</p> <p>(2) Not applicable according to Clause 15.107 of the standard if battery powered device.</p> <p>Possible test case verdicts</p> <p>PASS = Test object meet the requirements</p> <p>FAIL = Test object does not meet the requirements</p> <p>N/T = Required by standard but not tested</p> <p>N/R = Not required by standard for the test object</p> | | | |

8. Radiated Emissions

Reference: FCC 15.109, ICES-003, 3.2.2
Test method: ANSI C63.4:2014+A1:2017 Section 8

The applied limit for radiated emissions, 3 m distance, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart B, Secs. 15.109 & ICES-003 Issue 7, section 3.2.2.

FCC part 15, subpart B

| Limits, Class B Frequency of emission MHz) | Quasi-peak Limit for 3m | |
|--|-------------------------|----------|
| | (microvolt/meter) | (dBuV/m) |
| 30-88 | 100 | 40 |
| 88-216 | 150 | 43.5 |
| 216-960 | 200 | 46 |
| Above 960 | 500 | 54 |

ICES-003, Issue 7

| Limits, Class B Frequency of emission MHz) | Quasi-peak Limit for 3m | |
|--|-------------------------|----------|
| | (microvolt/meter) | (dBuV/m) |
| 30-88 | 100 | 40 |
| 88-216 | 150 | 43.5 |
| 216-230 | 200 | 46 |
| 230-960 | 223 | 47 |
| Above 960 | 500 | 54 |

FCC part 15, subpart B and ICES-003, Issue 7

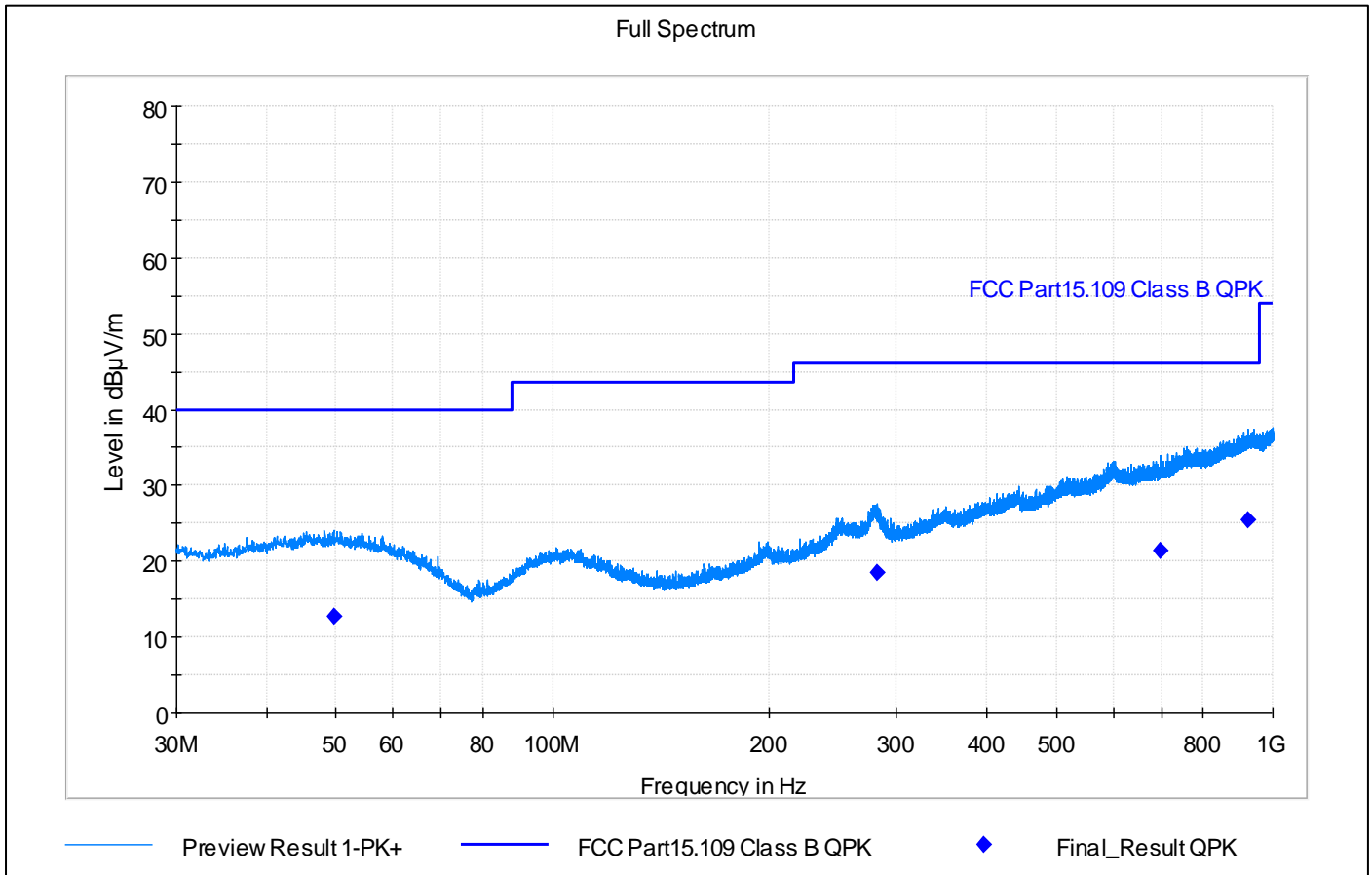
| Frequency of emission MHz) | Average Limit for 3m | | Peak Limit for 3m |
|---|----------------------|----------|-------------------|
| | (microvolt/meter) | (dBuV/m) | (dBuV/m) |
| Above 1000 | 500 | 54 | 74 |
| Frequencies above 1 GHz, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test, as per §15.35(b) | | | |

Tested sample(s): 3772ER005
Operation mode(s) tested: OM1
Test results: PASS
Note:

Test data:

| Operation mode(s) | Configuration | Test Verdict |
|-------------------|---|--------------|
| OM1 | Bluetooth LE RX, Frequency Range: 30 MHz – 1GHz | PASS |
| OM1 | Bluetooth LE RX, Frequency Range: 1 – 12.75 GHz | PASS |

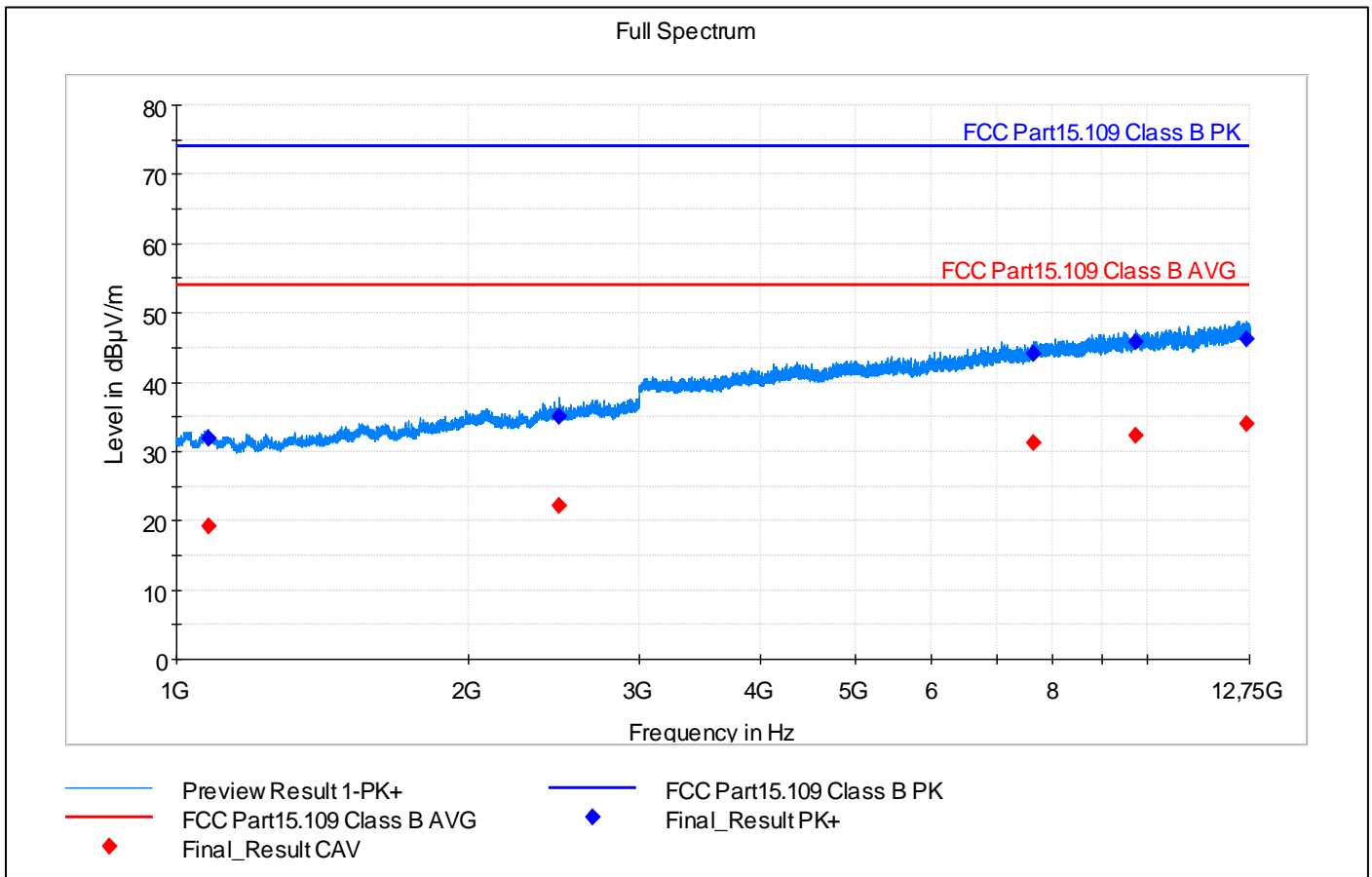
FCC part 15, subpart B Graph and final result table for 30 MHz – 1 GHz, OM1:



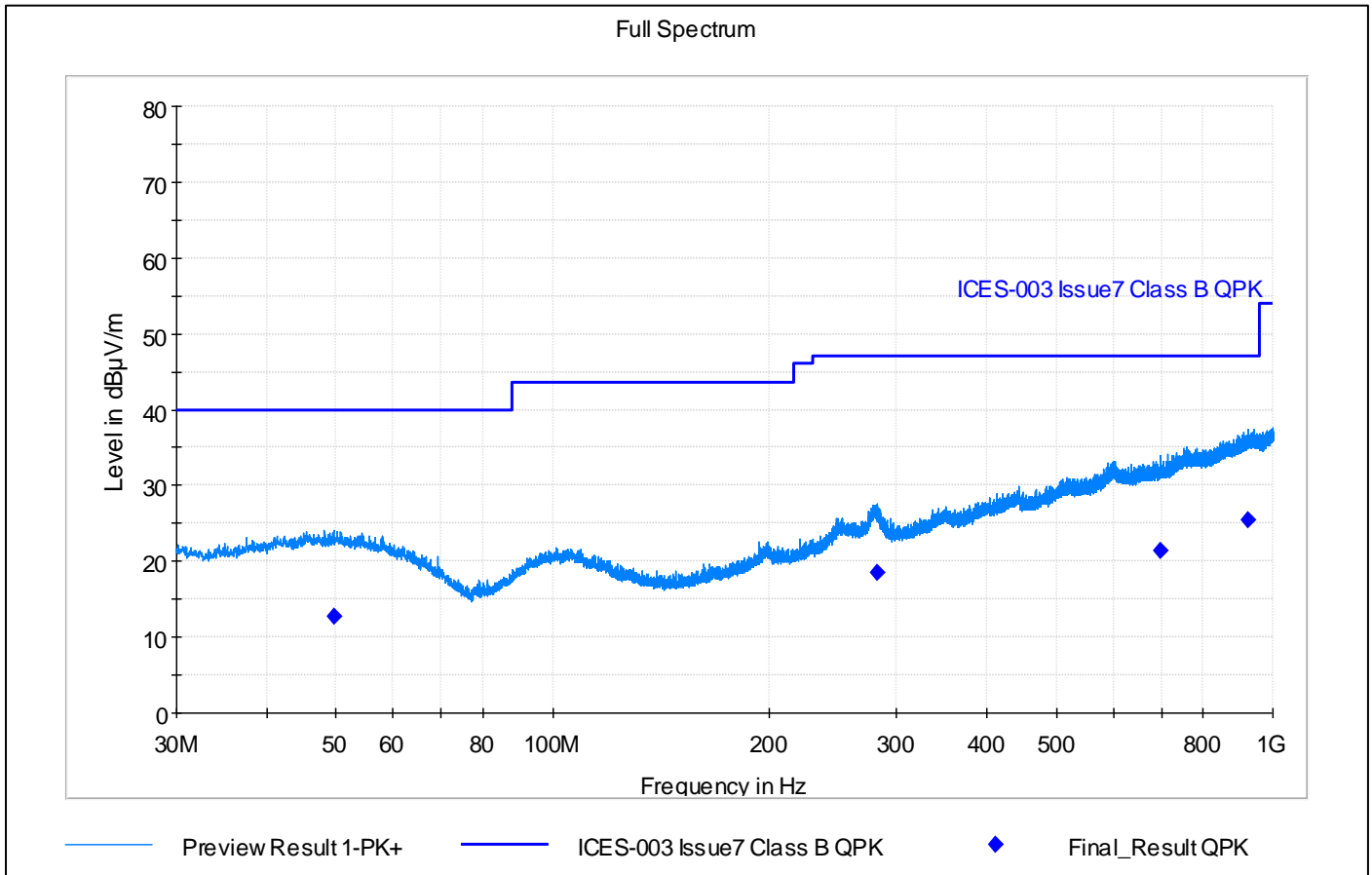
Final Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Elevation (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|----------------|-------------|------------|-----------------|-------------|-----|---------------|-----------------|--------------|---------|
| 49.560000 | 12.72 | 40.00 | 27.28 | 15000.0 | 120.000 | 212.0 | V | 248.0 | 90.0 | 21.0 | PASS |
| 281.820000 | 18.56 | 46.00 | 27.44 | 15000.0 | 120.000 | 120.0 | H | 6.0 | 0.0 | 21.9 | PASS |
| 698.100000 | 21.35 | 46.00 | 24.65 | 15000.0 | 120.000 | 225.0 | V | 91.0 | 0.0 | 30.5 | PASS |
| 922.800000 | 25.51 | 46.00 | 20.49 | 15000.0 | 120.000 | 182.0 | H | 1.0 | 90.0 | 34.1 | PASS |

FCC part 15 subpart B, Graph and final result table for 1 GHz – 12,75 GHz, OM1:



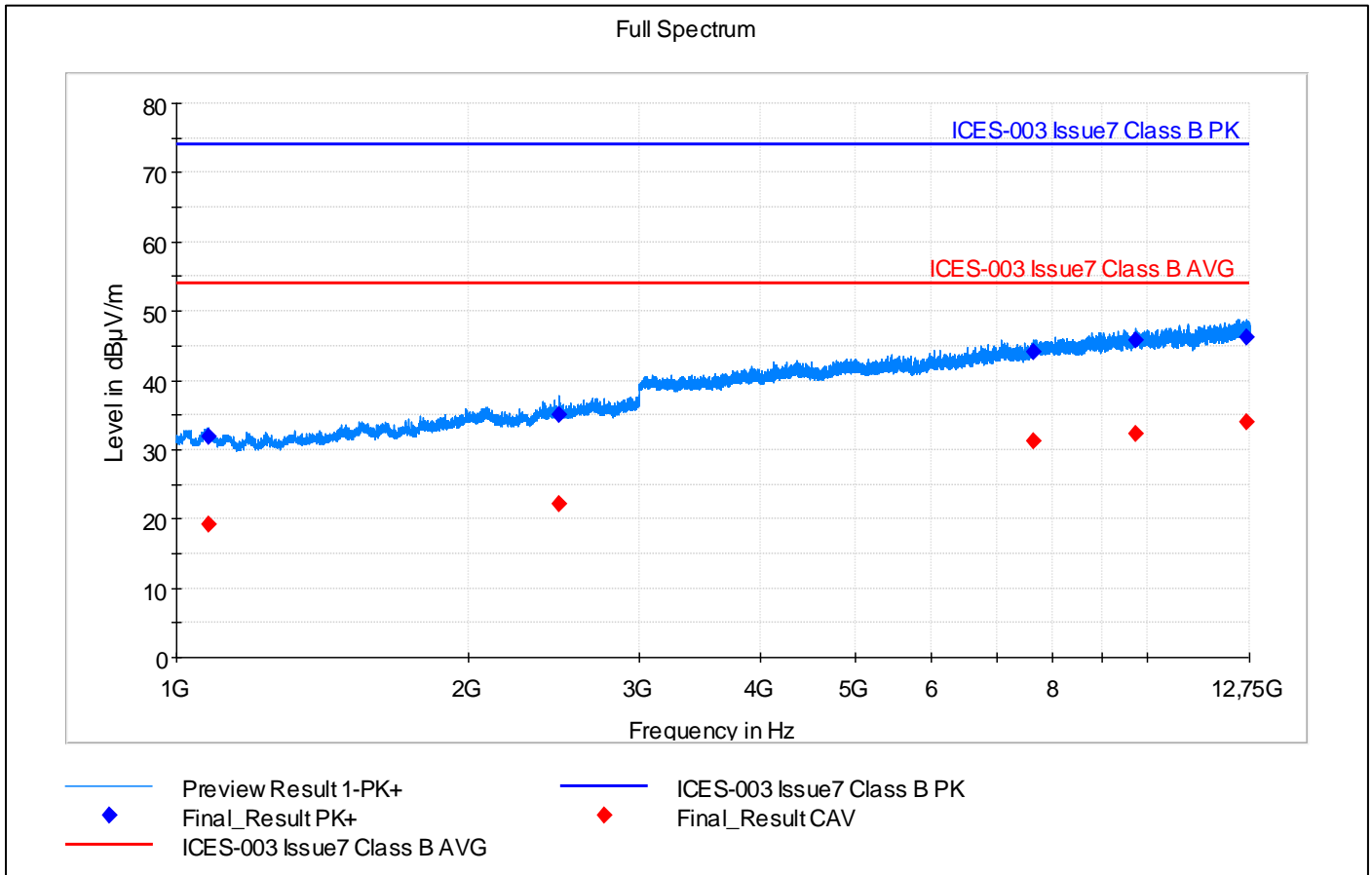
ICES-003, Graph and final result table for 30 MHz – 1 GHz, OM1:



Final Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Elevation (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|----------------|-------------|------------|-----------------|-------------|-----|---------------|-----------------|--------------|---------|
| 49.560000 | 12.72 | 40.00 | 27.28 | 15000.0 | 120.000 | 212.0 | V | 248.0 | 90.0 | 21.0 | PASS |
| 281.820000 | 18.56 | 47.00 | 28.44 | 15000.0 | 120.000 | 120.0 | H | 6.0 | 0.0 | 21.9 | PASS |
| 698.100000 | 21.35 | 47.00 | 25.65 | 15000.0 | 120.000 | 225.0 | V | 91.0 | 0.0 | 30.5 | PASS |
| 922.800000 | 25.51 | 47.00 | 21.49 | 15000.0 | 120.000 | 182.0 | H | 1.0 | 90.0 | 34.1 | PASS |

ICES-003, Graph and final result table for 1 GHz – 12.75 GHz, OM1:



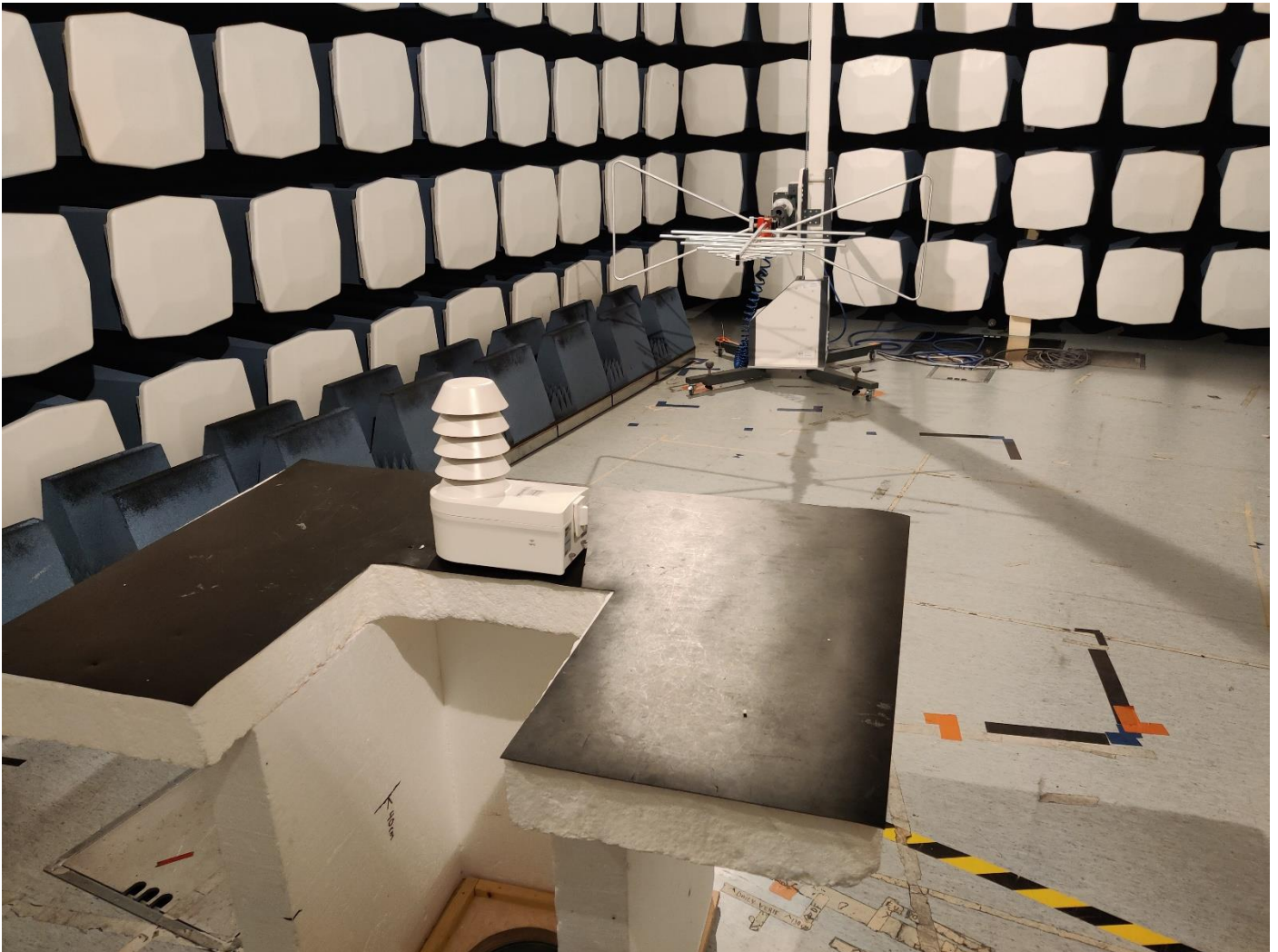
Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|------------|-----------------|-------------|-----|---------------|--------------|---------|
| 1077.750000 | --- | 19.25 | 54.00 | 34.75 | 500.0 | 1000.000 | 376.0 | V | 7.0 | -6.1 | PASS |
| 1077.750000 | 31.80 | --- | 74.00 | 42.20 | 500.0 | 1000.000 | 376.0 | V | 7.0 | -6.1 | PASS |
| 2479.000000 | 34.94 | --- | 74.00 | 39.06 | 500.0 | 1000.000 | 180.0 | H | 292.0 | 0.4 | PASS |
| 2479.000000 | --- | 22.23 | 54.00 | 31.77 | 500.0 | 1000.000 | 180.0 | H | 292.0 | 0.4 | PASS |
| 7626.750000 | 44.20 | --- | 74.00 | 29.80 | 500.0 | 1000.000 | 345.0 | H | 177.0 | 16.0 | PASS |
| 7626.750000 | --- | 31.21 | 54.00 | 22.79 | 500.0 | 1000.000 | 345.0 | H | 177.0 | 16.0 | PASS |
| 9746.000000 | 45.73 | --- | 74.00 | 28.27 | 500.0 | 1000.000 | 106.0 | V | 122.0 | 19.2 | PASS |
| 9746.000000 | --- | 32.34 | 54.00 | 21.66 | 500.0 | 1000.000 | 106.0 | V | 122.0 | 19.2 | PASS |
| 12656.750000 | --- | 33.93 | 54.00 | 20.07 | 500.0 | 1000.000 | 332.0 | H | 290.0 | 23.8 | PASS |
| 12656.750000 | 46.32 | --- | 74.00 | 27.68 | 500.0 | 1000.000 | 332.0 | H | 290.0 | 23.8 | PASS |

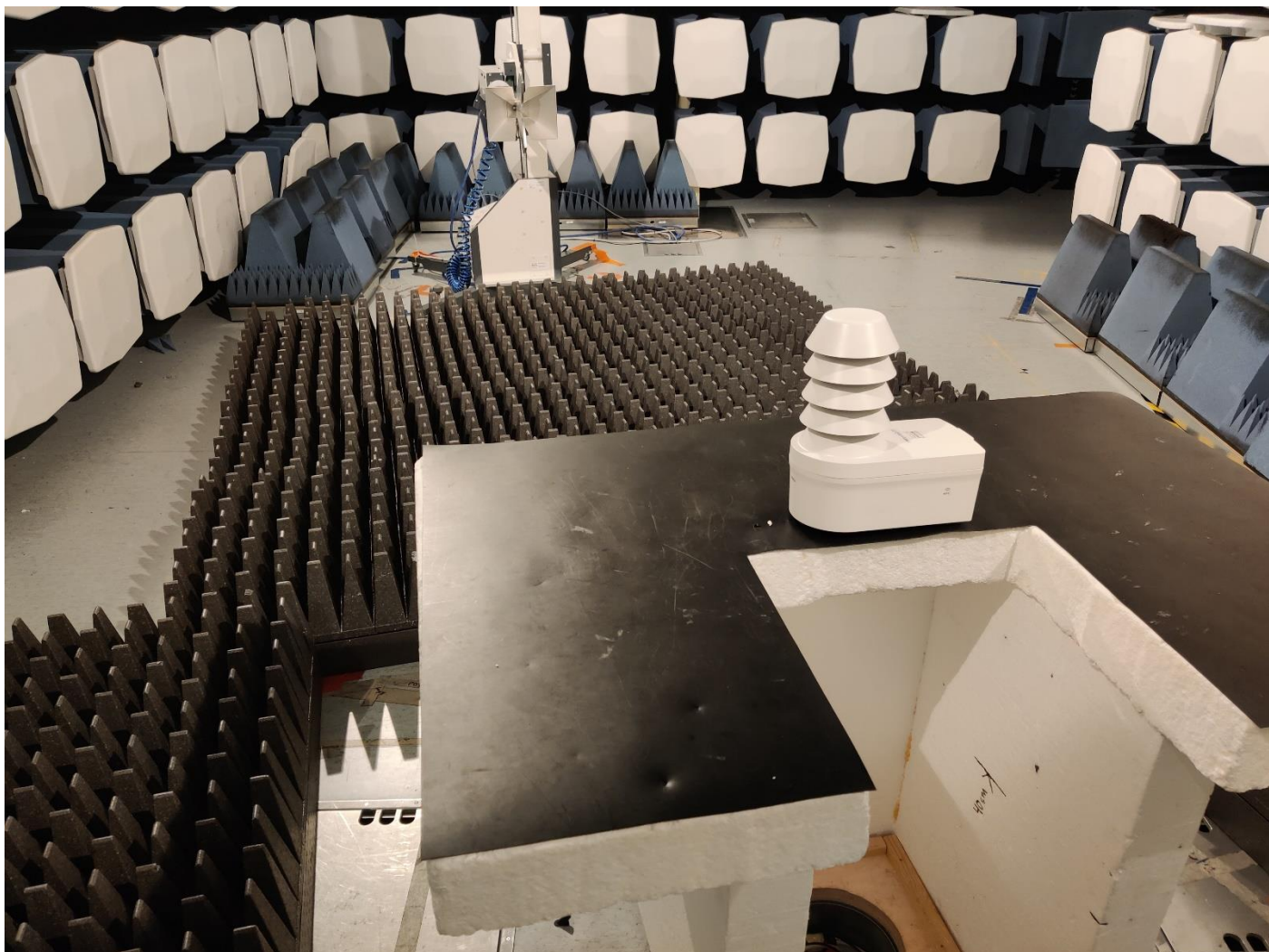
9. Test Equipment List

| New ID | Manufacturer | Equipment type | Description | Serial | Calibration information | Next calibration |
|--------|-----------------|----------------|---|------------|-------------------------|------------------|
| G4C217 | Rohde & Schwarz | HF907 | Double-Ridged Waveguide Horn Antenna 800MHz-18GHz | 100164 | 4.11.2020 | 4.11.2023 |
| G4C265 | Rohde & Schwarz | ESW26 | EMI test receiver | 101324 | 25.8.2022 | 25.8.2023 |
| G4C273 | Frankonia | ALX-4000E | Broadband Antenna, 25MHz-4GHz with 6dB (50-A-MFN-06) att. | 00816+1531 | 11.11.2020 | 11.11.2023 |
| G4C292 | Rohde & Schwarz | TS-LNA 1840 | RF Preamplifier 18 to 40 GHz | 100841 | 9.6.2022 | 9.6.2024 |
| G4C298 | Rohde & Schwarz | CMW500 | Wideband radio communication tester | 170980 | 2.3.2022 | 9.7.2023 |
| G4C469 | Rohde & Schwarz | TS_PRE2 | RF Preamplifier | 101541 | 9.6.2022 | 9.6.2024 |

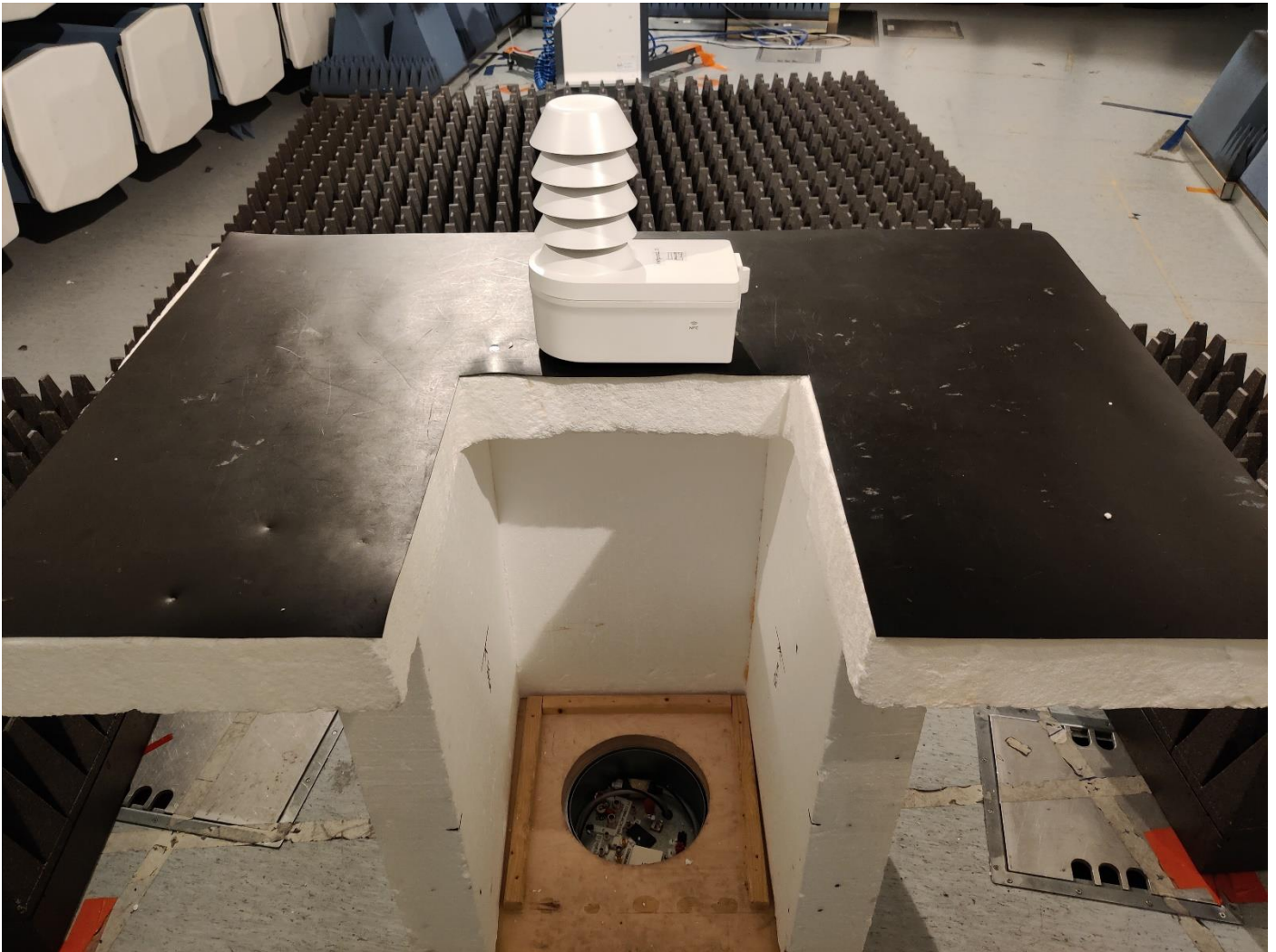
Appendix A: Test Setup Photographs



Picture 5 Radiated emission, 30 – 1000 MHz, common setup



Picture 6 Radiated emission, 1– 12,75 GHz, common setup



Picture 7 Radiated emission, EUT test setup