# Test Report

HELEM2501000013-1 v1.0

FINAS
Finnish Accreditation Service
T004 (EN ISO/IEC 17025)

## INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS

| | |
|---|---|
| Equipment Under Test: | WSI Module |
| Trademark: | GE HealthCare |
| Model: | WSI01 |
| Type: | - |
| Customer / Manufacturer: | GE Healthcare Finland Oy<br>Kuortaneenkatu 2<br>FI-00510, Helsinki<br>Finland |
| FCC Rule Part: | §15.225 |
| IC Rule Part: | RSS-Gen Issue 5, Amendment 1, Amendment 2<br>RSS-210 Issue 11 |

| | | | |
|---|---|---|---|
| Date: | 13 August 2025 | Date: | 13 August 2025 |
| Issued by: | Lauri Sippola<br>Testing Engineer | Checked by: | Rauno Repo<br>Senior EMC Specialist |

# TABLE OF CONTENTS

## GENERAL REMARKS

## Disclaimer

*This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at **http://www.sgs.com/en/Terms-and-Conditions.aspx** and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at **http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx***

*Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.*

*Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only*.

## RELEASE HISTORY

| Version | Changes | Issued |
|---|---|---|
| 1.0 | Initial release | 13 August 2025 |

# PRODUCT DESCRIPTION

## Equipment Under Test

| | |
|---|---|
| Trademark: | GE HealthCare |
| Model: | WSI01 |
| Type: | - |
| Serial number: | WSI4R-24240172 |
| Hardware version: | MWS rev. 4 (mass production equivalent) |
| Firmware version: | wsi-module-hw20-mfg_0.0.217-97.7.20ea881 |
| Software version: | N/A |
| FCC ID: | 2AO8L-WSI01 |
| IC: | 25821-WSI01 |

## General Description

The WSI module is a GEHC radio product that enables a host device to communicate with GEHC wireless sensors. The operation utilizes GEHC's proprietary MBAN radio technology for patient data transfer and NFC radio technology for device pairing.

## Classification

| | |
|---|---|
| Fixed device | ☐ |
| Mobile Device (Human body distance > 20 cm) | ☐ |
| Portable Device (Human body distance < 20 cm) | ☒ |

## Samples and Modifications

| No. | Name | Description |
|---|---|---|
| 1 | WSI01 | Normal sample |

## Specifications

| | |
|---|---|
| Operating frequency range: | 13.56 MHz |
| Number of channels: | 1 |
| Nominal channel bandwidth: | according to NFC standards ISO/IEC 14443A/B |
| Modulation: | according to NFC standards ISO/IEC 14443A/B |
| Data rate: | according to NFC standards ISO/IEC 14443A/B |
| Antenna model: | Pulse W3965 |
| EUT dimensions: | 22 x 30 x 2.4 mm (PCIe M.2 2230) |
| Power requirements: | 3.3 VDC ± 5 % |
| Operating temperature range: | +0…+65 °C |

## Ports and Cables

| Cable / Port | Description |
|---|---|
| USB | M.2 adapter card to Raspberry Pi |
| DC input (EUT) | Powering the EUT during Frequency stability and Occupied bandwidth tests |
| DC input (Raspberry Pi) | Powering the Raspberry Pi with an AC/DC power supply |

## Peripherals

| Peripheral | Description / Usage |
|---|---|
| WSI host device | Raspberry Pi 5, used to command the EUT |
| M.2 adapter | GEHC Raspberry Pi Hat for WSI M.2 Module rev. 1, used for enabling the M.2 E-key interface between Raspberry Pi and the EUT |
| NFC sample card | NFC Forum Type 2 tag with NXP NTAG213 IC |
| AC/DC power supply | Dell HA130PM170, used for AC Power-Line Conducted Emissions test |

The peripherals were provided by the customer.

## SUMMARY OF TESTING

| Test Specification | Description of Test | Result |
|---|---|---|
| §15.203 | Antenna Requirement | **PASS** |
| §15.207(a) / RSS-Gen 8.8 | AC Power-Line Conducted Emissions | **PASS** |
| §15.225(a)-(d) / RSS-210 B.6(a) | Radiated Emissions | **PASS** |
| §15.225(e) / RSS-210 B.6(b) | Frequency Stability | **PASS** |
| RSS-Gen 6.7 | Occupied Bandwidth 99 % | **PASS** |

*The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.4 of ANSI C63.10-2020.*

## EUT Test Conditions

The EUT was configured to continuously power cycle the WSI NFC IC and while NFC on read an external passive NFC reference card. The hub_mcu_utility and wsi_nfc_power_cycling.sh were used to command the NFC radio. The EUT was powered and controlled from a Raspberry Pi host device via an M.2 adapter card. The EUT was connected to the antenna (Pulse W3965) provided by the customer.

Conducted RF tests were performed with a near-field probe and a spectrum analyzer.

**Table 1:** Normal and extreme test conditions

| Test conditions: | | Temperature [°C] | Voltage [V] |
|---|---|---|---|
| Normal | | +20…+25 | 3.3 |
| Extreme | Minimum | +0 | 3.1 |
| | Maximum | +65 | 3.8 |

The extreme temperature and voltage ranges are declared by the manufacturer.

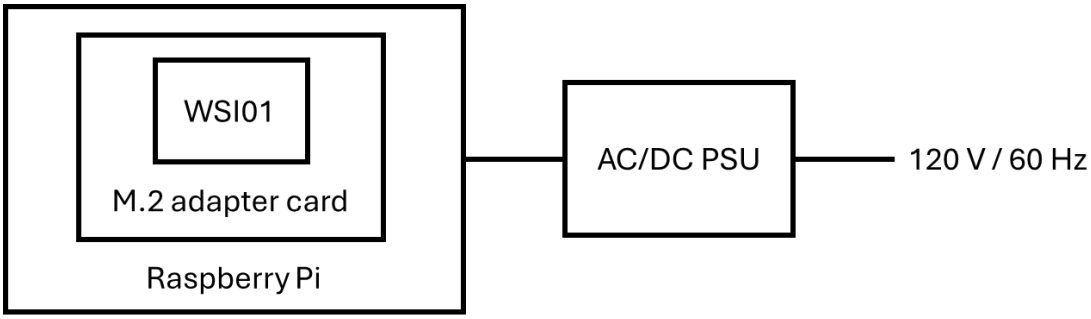


**Figure 1:** Test setup block diagram for AC Power-Line Conducted Emissions

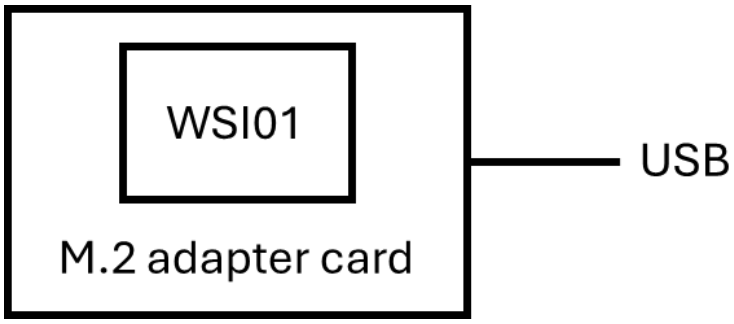


**Figure 2:** Test setup block diagram for Radiated Emissions

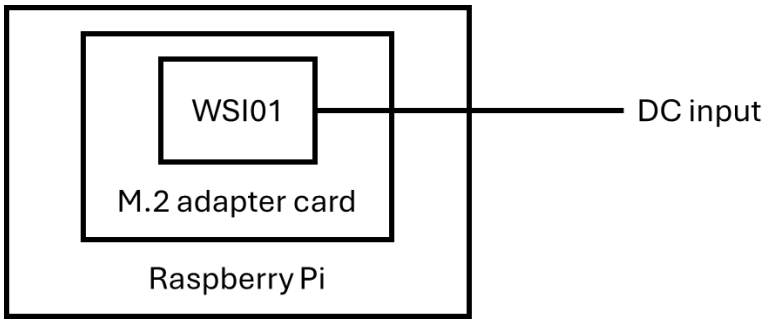


**Figure 3:** Test setup block diagram for Frequency stability and Occupied Bandwidth

## Test Facility

| | |
|---|---|
| Testing Laboratory / address:<br>FCC designation number: **FI0002**<br>ISED CAB identifier: **T004** | SGS Fimko Ltd<br>Takomotie 8<br>FI-00380, HELSINKI<br>FINLAND |
| Test Site: | ☐ K10LAB, ISED Canada registration number: **8708A-1**<br>☒ K5LAB, ISED Canada registration number: **8708A-2**<br>☐ T10LAB |

# TEST RESULTS

## Antenna Requirement

| | |
|---|---|
| **Standard:** | FCC Rule §15.203 |
| **Tested by:** | HEM |
| **Date:** | 27 January 2025 |

**FCC Rule: §15.203**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

| Specification | Requirement (at least one of the following shall be applied) | Conclusion |
|---|---|---|
| §15.203 | 1. Permanently attached antenna<br>2. Unique coupling to the intentional radiator<br>3. Professionally installed radio. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded. | **PASS** |
| Note | Option 1 is used | |

## AC Power-Line Conducted Emissions

| | |
|---|---|
| **Standard:** | ANSI C63.10-2020 clause 6.2 |
| **Tested by:** | HEM |
| **Date:** | 28 February 2025 |
| **Temperature:** | 22 °C |
| **Humidity:** | 39 %RH |
| **Measurement uncertainty:** | ± 2.9 dB, level of confidence 95 % (k = 2) |
| **Test result:** | **PASS** |

**FCC Rule: §15.207(a)**
**RSS-Gen clause 8.8**

For radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in the table below, as measured using a 50 µH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

| Frequency of emission [MHz] | Conducted limit [dBµV] | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

* The level decreases linearly with the logarithm of the frequency

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

The correction factor (dB) in the final result table contains the sum of the transducers (cables + transient limiter + LISN). The reported QuasiPeak and CAverage values include the correction factor.

## Test results

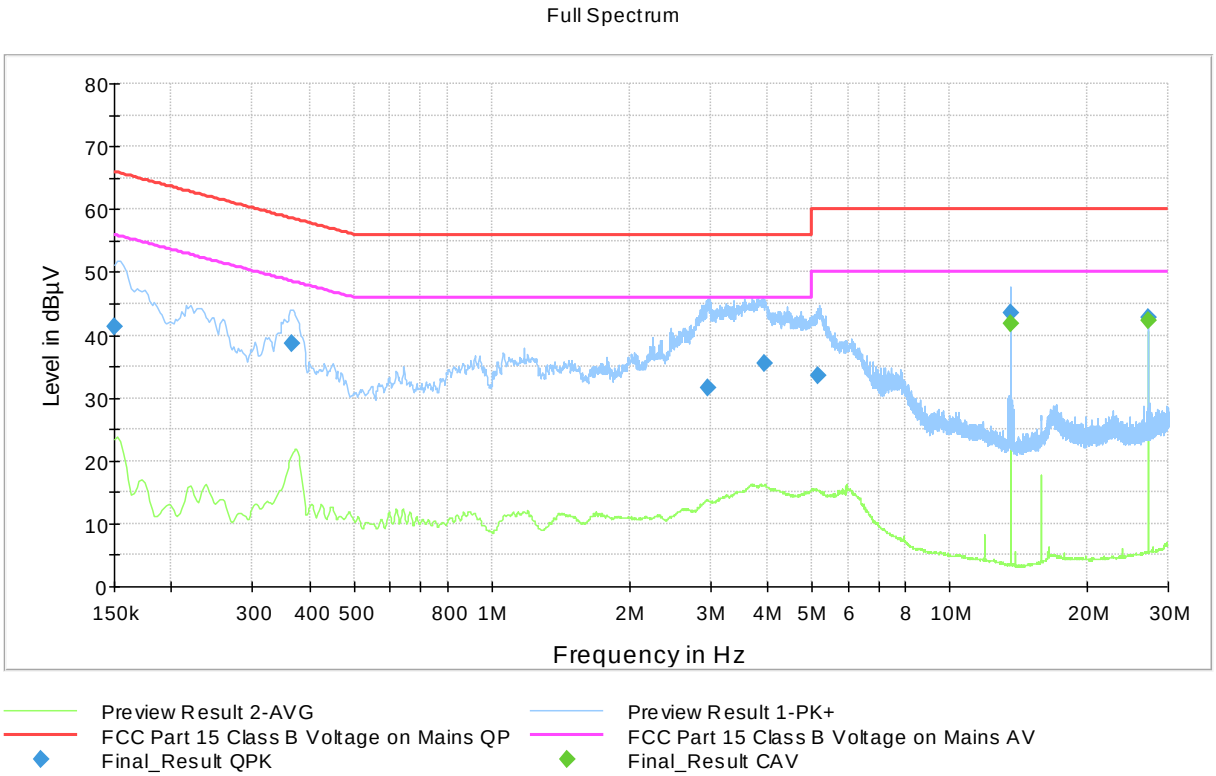


**Figure 4:** AC Power-Line Conducted Emissions

**Table 2:** Test results for AC Power-Line Conducted Emissions

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.150000 | 41.23 | --- | 66.00 | 24.77 | 15 x 1000.0 | 9.000 | N | 9.7 |
| 0.366750 | 38.56 | --- | 58.57 | 20.01 | 15 x 1000.0 | 9.000 | N | 9.7 |
| 2.959500 | 31.71 | --- | 56.00 | 24.29 | 15 x 1000.0 | 9.000 | L1 | 9.9 |
| 3.952000 | 35.46 | --- | 56.00 | 20.54 | 15 x 1000.0 | 9.000 | L1 | 10.0 |
| 5.157750 | 33.44 | --- | 60.00 | 26.56 | 15 x 1000.0 | 9.000 | N | 10.0 |
| 13.558500 | 43.60 | --- | 60.00 | 16.40 | 15 x 1000.0 | 9.000 | N | 10.4 |
| 13.562500 | --- | 41.77 | 50.00 | 8.23 | 15 x 1000.0 | 9.000 | L1 | 10.4 |
| 27.119250 | --- | 42.25 | 50.00 | 7.75 | 15 x 1000.0 | 9.000 | L1 | 10.7 |
| 27.119250 | 42.70 | --- | 60.00 | 17.30 | 15 x 1000.0 | 9.000 | N | 10.8 |

## Radiated Emissions

| | |
|---|---|
| **Standard:** | ANSI C63.10-2020 clause 6.3-6.5 |
| **Tested by:** | HEM, PKA |
| **Date:** | 6 February 2025 |
| **Temperature:** | 23 °C |
| **Humidity:** | 25 %RH |
| **Measurement uncertainty:** | ± 4.51 dB, level of confidence 95 % (k = 2) |
| **Test result:** | **PASS** |

**FCC Rule: §15.225(a)-(d)**
**RSS-210 clause B.6(a)**

The field strength of any emissions within the band 13.110-14.010 MHz shall not exceed the following limits:

| Frequency range [MHz] | Limit [µV/m] | Distance [m] | Detector |
|---|---|---|---|
| 13.110 – 13.410 | 106 | 30 | Quasi-peak |
| 13.410 – 13.553 | 334 | 30 | Quasi-peak |
| 13.553 – 13.567 | 15848 | 30 | Quasi-peak |
| 13.567 – 13.710 | 334 | 30 | Quasi-peak |
| 13.710 – 14.010 | 106 | 30 | Quasi-peak |

The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209 and RSS-Gen.

| Frequency range [MHz] | Limit [µV/m] | Distance [m] | Detector |
|---|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 | Quasi-peak |
| 0.490 – 1.705 | 24000/F(kHz) | 30 | Quasi-peak |
| 1.705 – 30 | 30 | 30 | Quasi-peak |
| 30 – 88 | 100 | 3 | Quasi-peak |
| 88 – 216 | 150 | 3 | Quasi-peak |
| 216 – 960 | 200 | 3 | Quasi-peak |
| 960 – 1000 | 5000 | 3 | Quasi-peak |

The radiated tests are performed in a semi-anechoic chamber with a measurement distance of 3 meters. The results below 30 MHz are extrapolated to 30 m or 300 m distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

The correction factor (dB/m) in the final result table contains the sum of the transducers (antenna + cables + extrapolation factor below 30 MHz). The reported values include the correction factor.

## Test results

**Table 3:** Test results for Radiated Emissions

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 1.174000 | -4.21 | 26.23 | 30.44 | 15 x 1000.0 | 9.000 | GP * | V | 156.0 | -20.5 |
| 13.563000 | 1.47 | 84.00 | 82.53 | 15 x 1000.0 | 9.000 | coax * | V | 110.0 | -20.3 |
| 13.559000 | 3.92 | 84.00 | 80.08 | 15 x 1000.0 | 9.000 | copl * | V | 315.0 | -20.3 |
| 13.559000 | 8.28 | 84.00 | 75.72 | 15 x 1000.0 | 9.000 | GP * | V | 79.0 | -20.3 |
| 27.121500 | -10.16 | 29.50 | 39.66 | 15 x 1000.0 | 9.000 | copl * | V | 311.0 | -19.9 |
| 40.705000 | 25.71 | 40.00 | 14.29 | 15 x 1000.0 | 120.000 | 105.0 | V | 102.0 | 17.2 |
| 46.045000 | 24.83 | 40.00 | 15.17 | 15 x 1000.0 | 120.000 | 100.0 | V | 27.0 | 17.8 |
| 213.955000 | 28.12 | 43.50 | 15.38 | 15 x 1000.0 | 120.000 | 100.0 | V | 192.0 | 15.5 |
| 624.975000 | 36.11 | 46.00 | 9.89 | 15 x 1000.0 | 120.000 | 100.0 | V | 215.0 | 27.5 |
| 749.945000 | 32.09 | 46.00 | 13.91 | 15 x 1000.0 | 120.000 | 100.0 | V | 73.0 | 29.2 |
| 847.875000 | 21.27 | 46.00 | 24.73 | 15 x 1000.0 | 120.000 | 331.0 | V | 267.0 | 30.2 |

* coax/copl/GP = measurement loop antenna in coaxial/coplanar/ground parallel orientation

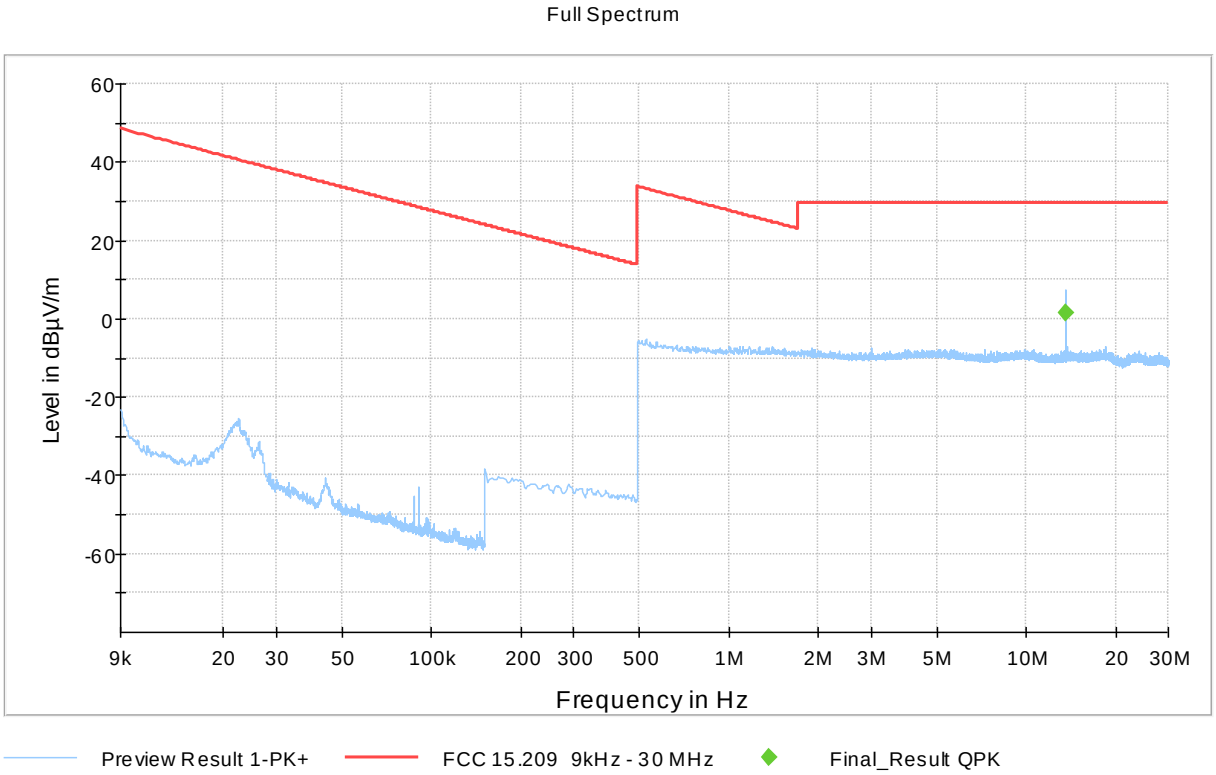


**Figure 5:** Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coaxial orientation

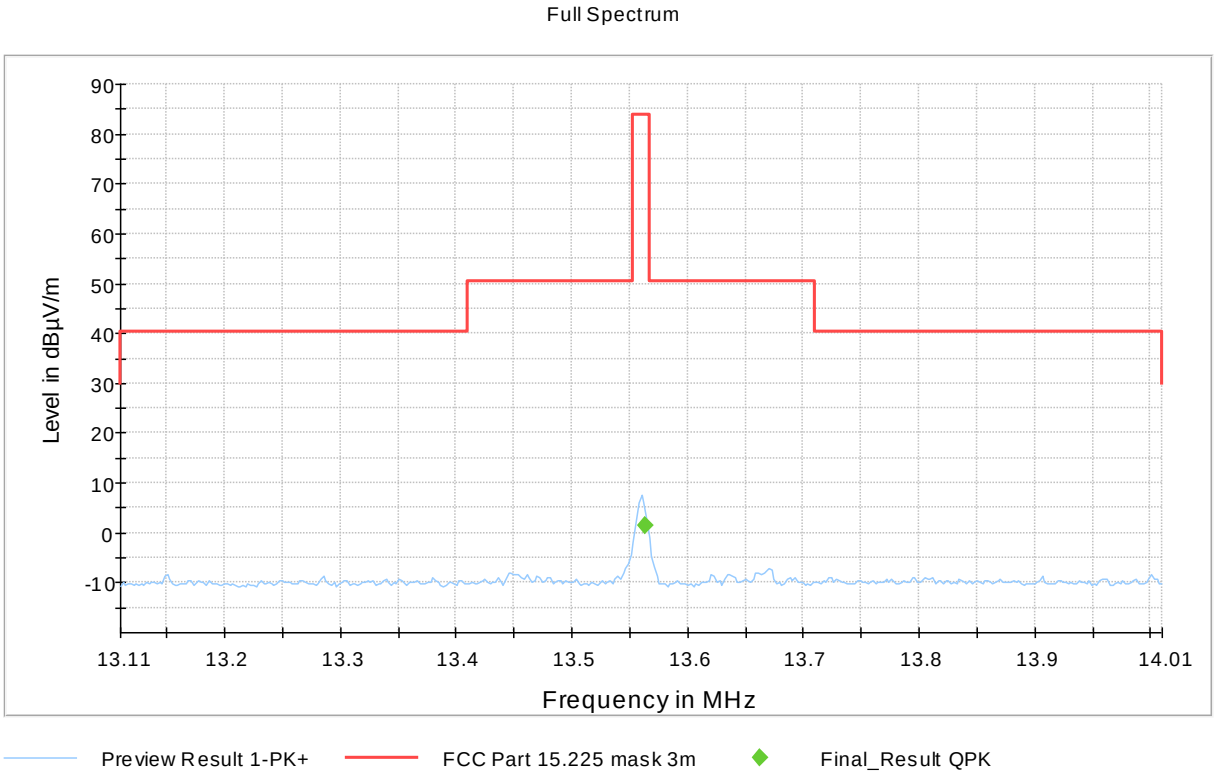


**Figure 6:** Emissions within the 13.110-14.010 MHz band, coaxial orientation

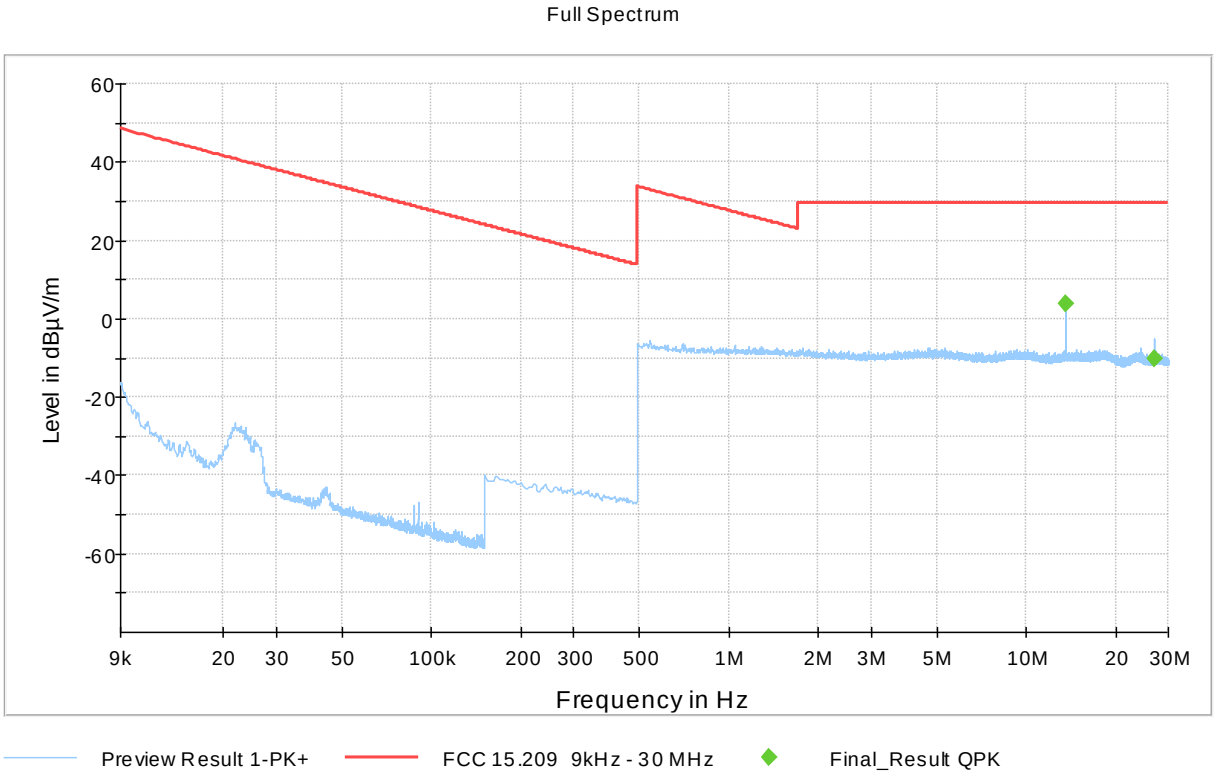


**Figure 7:** Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coplanar orientation

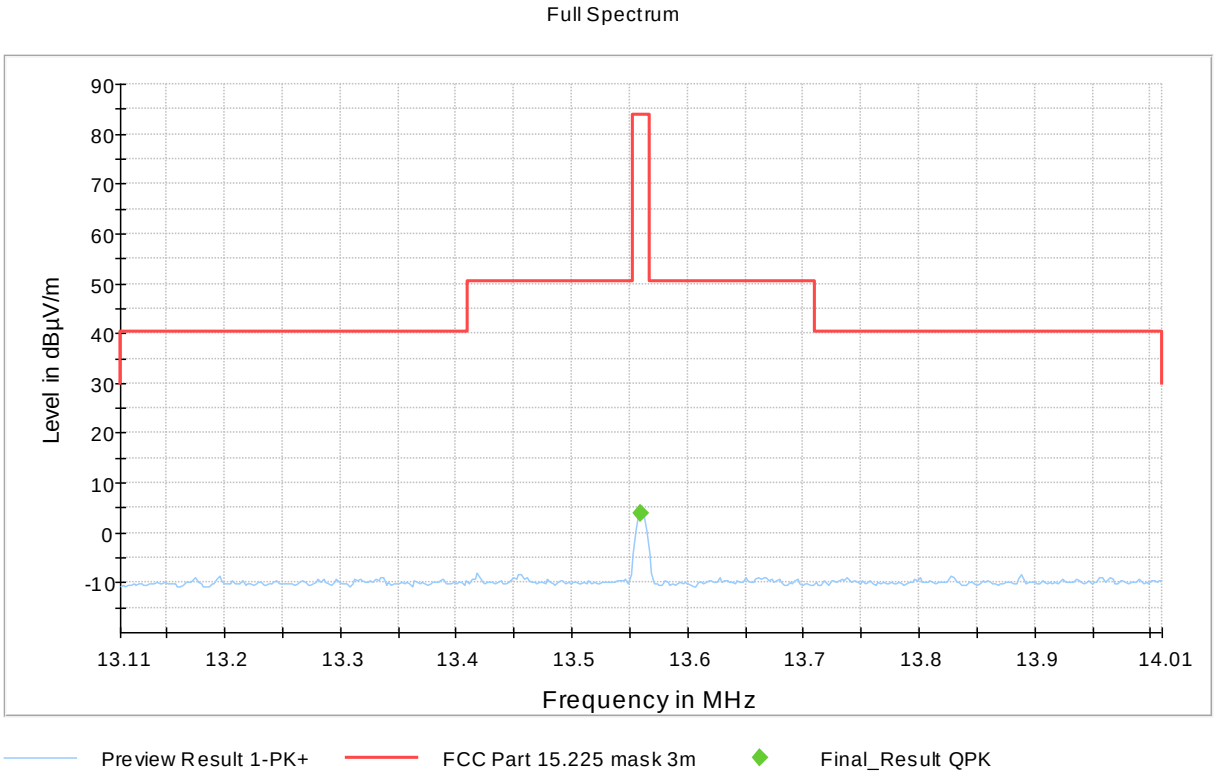


**Figure 8:** Emissions within the 13.110-14.010 MHz band, coplanar orientation

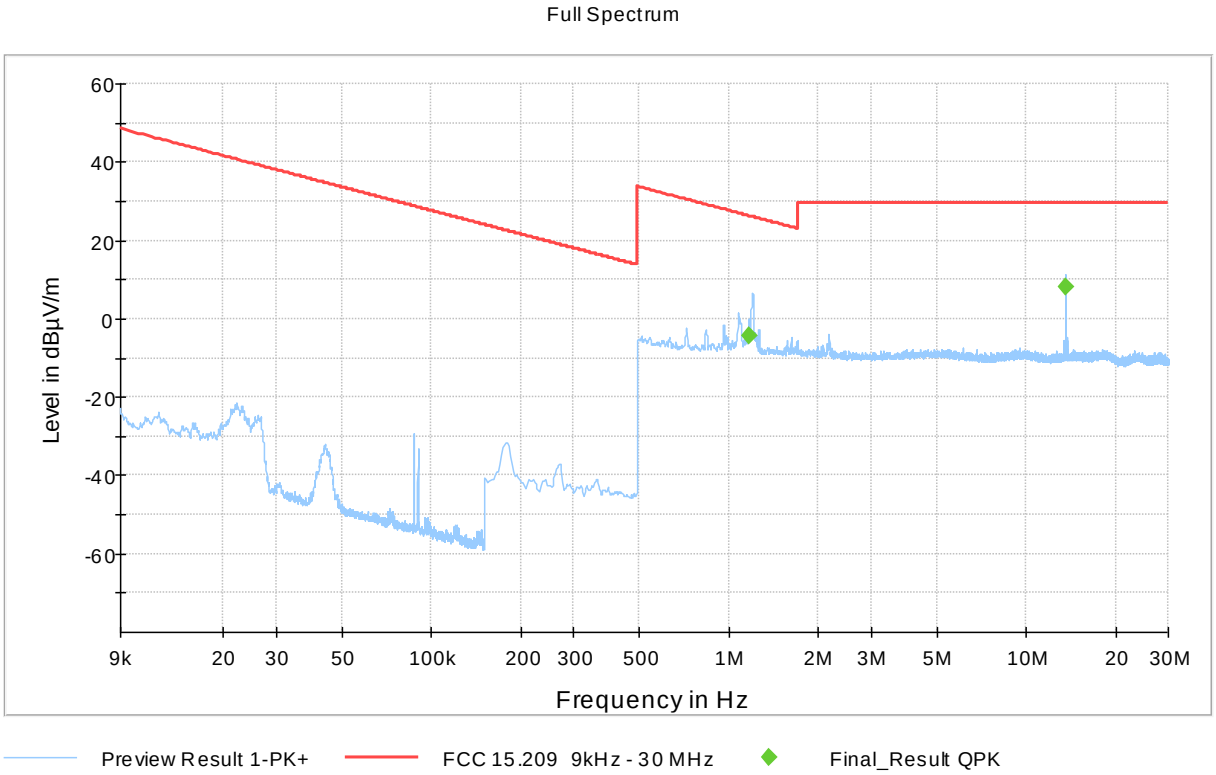


**Figure 9:** Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in ground parallel orientation

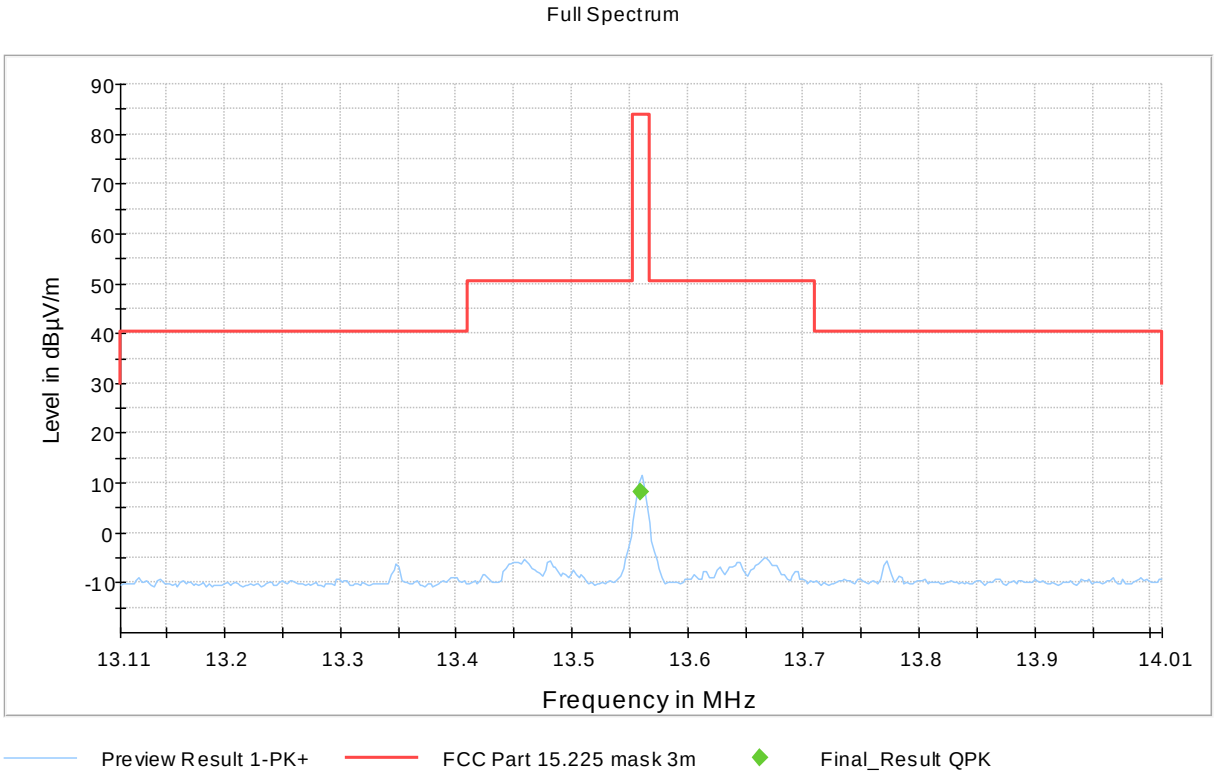


**Figure 10:** Emissions within the 13.110-14.010 MHz band, ground parallel orientation

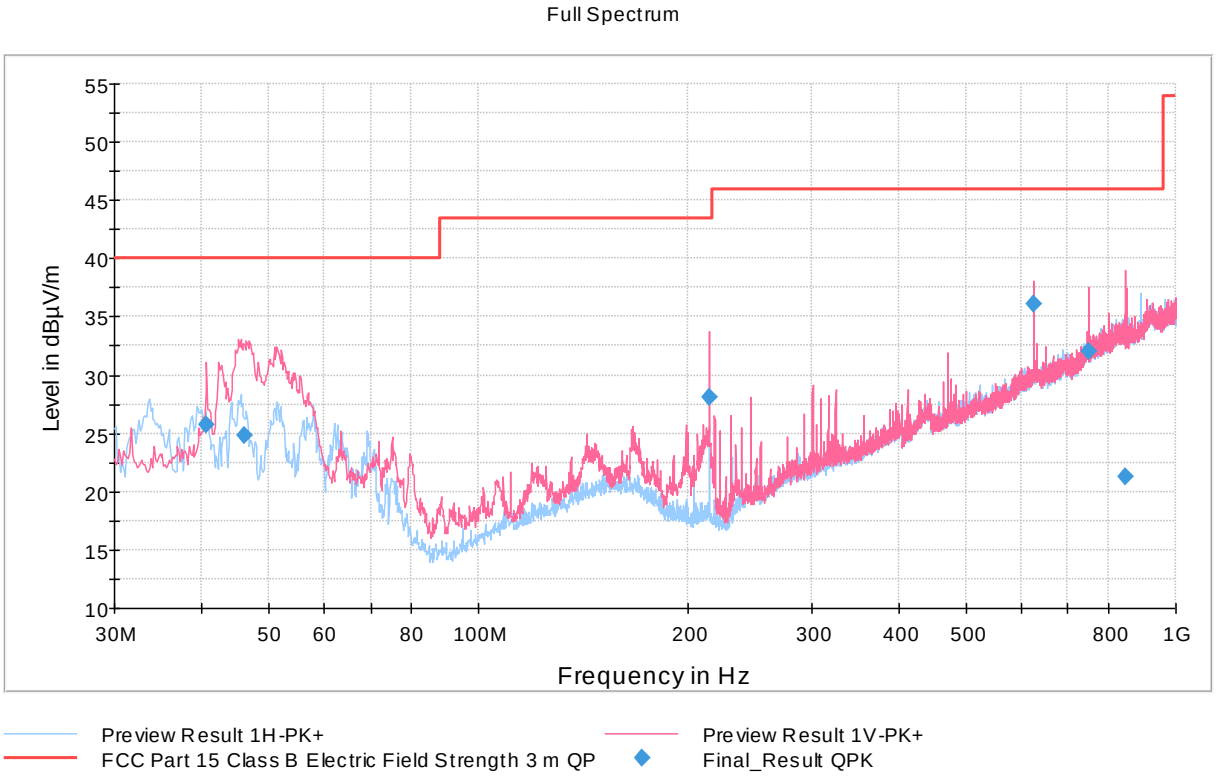


**Figure 11:** Radiated emissions 30 – 1000 MHz

## Frequency Stabilty

| | |
|---|---|
| **Standard:** | ANSI C63.10-2020 clause 6.8 |
| **Tested by:** | HEM |
| **Date:** | 27 January 2025 |
| **Temperature:** | 23 °C |
| **Humidity:** | 26 %RH |
| **Test result:** | **PASS** |

**FCC Rule: §15.225(e)**
**RSS-210 B.6(b)**

The frequency tolerance of the carrier signal shall be maintained within ±0.01 % (±100 ppm) of the operating frequency over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of +20 °C.

The frequency of the carrier is measured at the startup, and after 2 min, 5 min and 10 min after the startup.

### Test results

Manufacturer's specification for operating temperature and voltage ranges are +0…+65 °C and 3.3 V ± 5 %. The measurements are performed with 3.3 V +15 %/-6 % input voltages.

**Table 4:** Measured frequencies with temperature variation

| Temperature [°C] | Voltage [VDC] | Measured frequency [MHz] | | | |
|---|---|---|---|---|---|
| | | Startup | 2 min | 5 min | 10 min |
| +0 | 3.3 | 13.560017 | 13.560019 | 13.560019 | 13.560019 |
| +10 | | 13.560017 | 13.560015 | 13.560015 | 13.560015 |
| +20 | | 13.560006 | 13.560001 | 13.560001 | 13.560001 |
| +30 | | 13.559986 | 13.559979 | 13.559979 | 13.559979 |
| +40 | | 13.559966 | 13.559961 | 13.559961 | 13.559961 |
| +50 | | 13.559955 | 13.559955 | 13.559955 | 13.559955 |
| +55 | | 13.559955 | 13.559959 | 13.559959 | 13.559959 |
| +65 | | 13.559981 | 13.559988 | 13.559988 | 13.559988 |

**Table 5:** Measured frequencies with voltage variation

| Temperature [°C] | Voltage [VDC] | Measured frequency [MHz] | | | |
|---|---|---|---|---|---|
| | | Startup | 2 min | 5 min | 10 min |
| +20 | 3.1 (-6 %) | 13.559981 | - | - | - |
| | 3.3 (nominal) | 13.560006 | 13.560001 | 13.560001 | 13.560001 |
| | 3.8 (+15 %) | 13.559986 | - | - | - |

**Table 6:** Test results for Frequency Stability (temperature variation)

| Temperature [°C] | Voltage [VDC] | Deviation [ppm] | | | |
|---|---|---|---|---|---|
| | | Startup | 2 min | 5 min | 10 min |
| +0 | 3.3 | 1.25 | 1.40 | 1.40 | 1.40 |
| +10 | | 1.25 | 1.11 | 1.11 | 1.11 |
| +20 | | 0.44 | 0.07 | 0.07 | 0.07 |
| +30 | | -1.03 | -1.55 | -1.55 | -1.55 |
| +40 | | -2.51 | -2.88 | -2.88 | -2.88 |
| +50 | | -3.32 | -3.32 | -3.32 | -3.32 |
| +60 | | -3.32 | -3.02 | -3.02 | -3.02 |
| +65 | | -1.40 | -0.88 | -0.88 | -0.88 |

**Table 7:** Test results for Frequency Stability (voltage variation)

| Temperature [°C] | Voltage [VDC] | Deviation [ppm] | | | |
|---|---|---|---|---|---|
| | | Startup | 2 min | 5 min | 10 min |
| +20 | 3.1 (-6 %) | -1.40 | - | - | - |
| | 3.3 (nominal) | 0.44 | 0.07 | 0.07 | 0.07 |
| | 3.8 (+15 %) | -1.03 | - | - | - |

The spectrum analyzer figure with the worst-case result is presented:

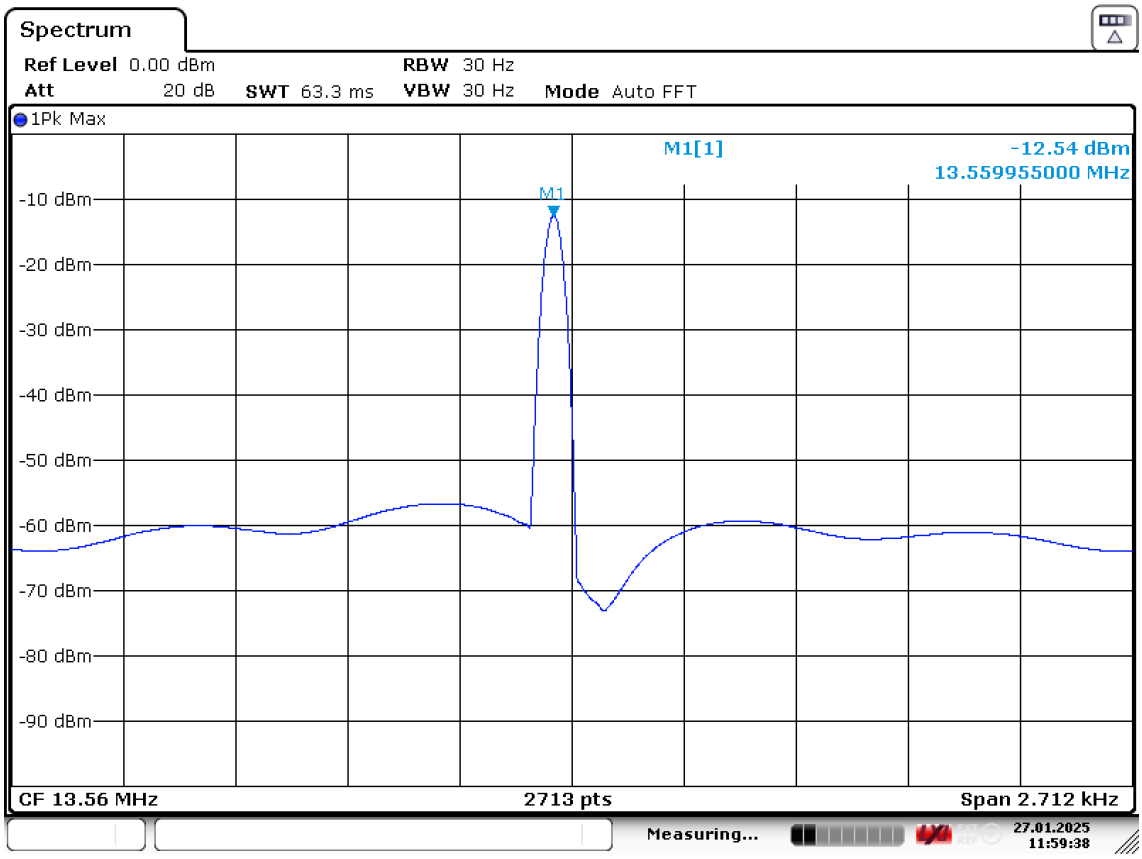


**Figure 12:** Frequency Stability (+50 °C, 3.3 VDC, 10 min after startup)

## Occupied Bandwidth 99 %

| | |
|---|---|
| **Standard:** | RSS-Gen clause 6.7 |
| **Tested by:** | HEM |
| **Date:** | 27 January 2025 |
| **Temperature:** | 23 °C |
| **Humidity:** | 26 %RH |
| **Test result:** | **PASS** |

### RSS-Gen clause 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

### Test results

**Table 8:** Test results for Occupied Bandwidth 99 %

| OBW 99% [MHz] | Limit [MHz] | Result |
|---|---|---|
| 1.005497 | N/A | **PASS** |

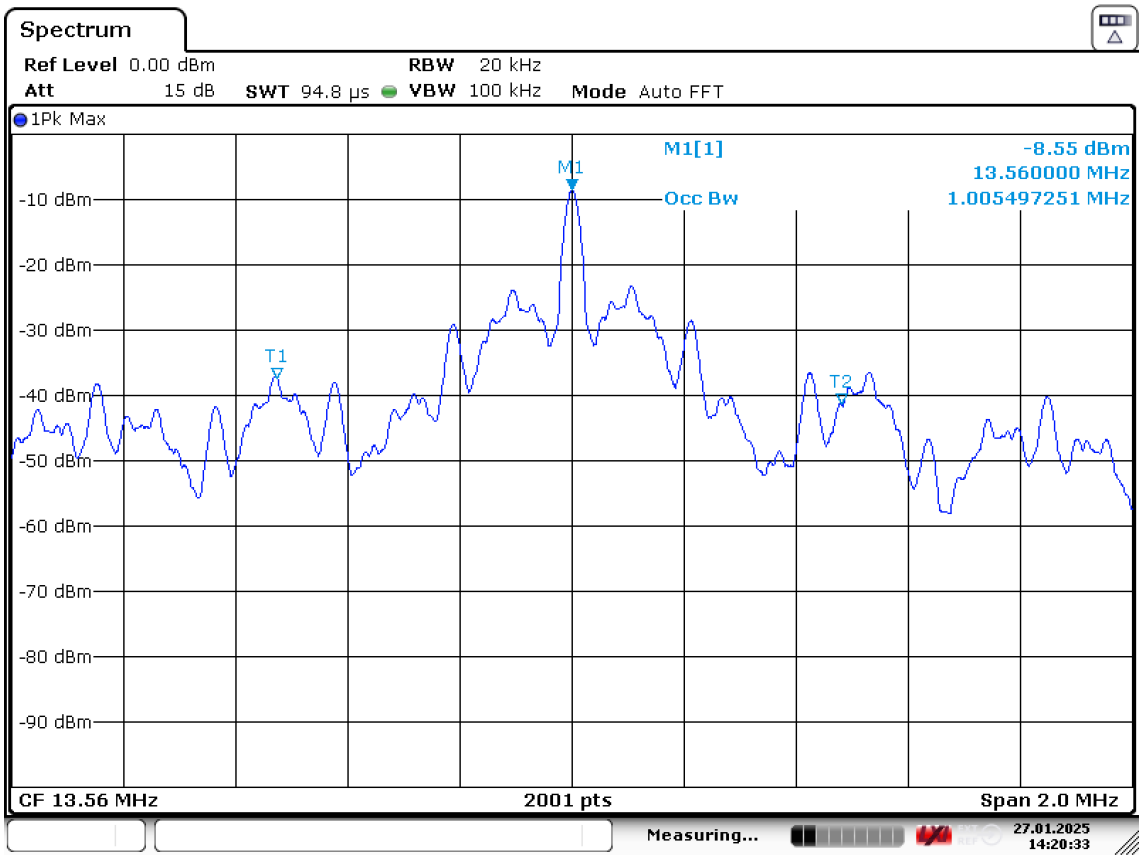


**Figure 13:** Occupied Bandwidth 99 %

# TEST EQUIPMENT

## AC Power-Line Conducted Emissions

| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| COAX CHAIN K5 EMI CE 9kHz-30MHz | - | C054+FP1SF+C153 | - | 2024-03-28 | 2025-03-28 |
| EMI TEST RECEIVER | ROHDE & SCHWARZ | ESW26 | inv. 10679 | 2024-06-12 | 2025-06-11 |
| LISN | ROHDE & SCHWARZ | ENV216 | inv. 9611 | 2025-02-18 | 2026-02-18 |
| POWER SUPPLY | CALIFORNIA INSTR. | 5001 iX Series II | inv. 7826 | NCR | NCR |
| TEMPERATURE/ HUMIDITY SENSOR | EDS | OW-ENV-TH, K5 SAC | inv. 10517 | 2024-11-02 | 2025-11-02 |
| TEST SOFTWARE | ROHDE & SCHWARZ | EMC-32 | - | - | - |

## Radiated Emissions

| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| ANTENNA | ROHDE & SCHWARZ | HFH2-Z2 , 335.4711.52 | inv. 8013 | 2024-11-18 | 2025-11-18 |
| ANTENNA | SCHWARZBECK | VULB 9168 | inv. 8911 | 2024-12-11 | 2026-12-11 |
| ANTENNA MAST | MATURO | TAM 4.0E | inv. 10181 | NCR | NCR |
| ATTENUATOR | PASTERNACK | PE 7004-4 (4dB) | inv. 10126 | 2024-12-11 | 2026-12-11 |
| COAX CHAIN K5 EMI < 1GHz | - | C053+FP3AirC+C138 | - | 2024-03-28 | 2025-03-28 |
| EMI TEST RECEIVER | ROHDE & SCHWARZ | ESW26 | inv. 10679 | 2024-06-12 | 2025-06-11 |
| MAST & TURNTABLE CONTROLLER | MATURO | NCD | inv. 10183 | NCR | NCR |
| TEMPERATURE/ HUMIDITY SENSOR | EDS | OW-ENV-TH, K5 SAC | inv. 10517 | 2024-11-02 | 2025-11-02 |
| TEST SOFTWARE | ROHDE & SCHWARZ | EMC-32 | - | - | - |
| TURNTABLE | MATURO | DS430 UPGRADED | inv. 10182 | NCR | NCR |

## Frequency Stability, Occupied Bandwidth 99 %

| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| CABLE | HUBER & SUHNER | SUCOFLEX 104 | inv. C050 | 2024-07-16 | 2025-07-16 |
| NEAR-FIELD PROBE SET | ROHDE & SCHWARZ | HS-14 1026.7744.02 | inv. 7883 | NCR | NCR |
| MULTIMETER | FLUKE | 289 | inv. 221117A | 2024-11-25 | 2025-11-25 |
| POWER SUPPLY | THANDAR | PL330TP | inv. 9787 | NCR | NCR |
| SPECTRUM ANALYZER | ROHDE & SCHWARZ | FSV40 | inv. 9093 | 2024-06-13 | 2025-06-12 |
| TEMPERATURE CHAMBER | CTS | T-65/50 | inv. 10521 | NCR | NCR |
| TEMPERATURE/HUMIDITY METER | VAISALA | HMT 333 | inv. 8638 | 2024-09-03 | 2025-09-03 |

NCR = No Calibration Required

**END OF REPORT**