**DEKRA Testing and Certification, S.A.U.**
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909

Lab. Company Number: 4621A

Test Report No:
76889RRF.002A1

# Test Report
## USA FCC Part 15.225, 15.209
## CANADA RSS-210, RSS-Gen

| | |
|---|---|
| (*) Identification of item tested | Key Fob |
| (*) Trademark | iLOQ |
| (*) Model and /or type reference | K55S.2 |
| Other identification of the product | FCC ID: 2A2HZ-FOB55S2<br>IC: 30160-FOB55S2 |
| (*) Features | NFC, USB-C<br>HW version: E2196C2<br>SW version: 32790 |
| Applicant | iLOQ OY<br>Elektroniikkatie 10, 90590 OULU, Finland |
| Test method requested, standard | USA FCC Part 15.225 (10-1-21 Edition): Operation within the band 13.110 -14.010.<br>USA FCC Part 15.209 (10-1-21 Edition): Radiated emission limits, general requirements.<br>CANADA RSS-210 Issue 10 (December 2019).<br>CANADA RSS-Gen Issue 5 Amendment 2 (February 2021).<br>ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices. |
| Summary | IN COMPLIANCE |
| Approved by (name / position & signature) | José Manuel Gómez Galván<br>EMC Consumer & RF<br>Lab. Manager<br>Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456) |
| Date of issue | 2024-02-20 |
| Report template No | FDT08_24<br>(*) "Data provided by the client" |

# Index

# Acronyms

| Acronym ID | Acronym Description |
|---|---|
| Freq | Frequency |
| Freq Rng | Frequency Range |
| FreqError% | Frequency Error |
| FreqErrorHz | Frequency Error in Hz |
| Mod | Modulation |
| Pol | Polarization |
| QuasiPeak | Radiated Quasi Peak Level |
| T | Temperature |
| Un | Nominal Voltage |

# Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.



# General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

# Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

The total uncertainty of the measurement system for the radiated emissions of EUT from 9 kHz to 30 MHz is: Measurement uncertainty ≤ ±3.08 dB (with factor k = 2).

The total uncertainty of the measurement system for the radiated emissions of EUT from 30 MHz to 200 MHz is: Measurement uncertainty ≤ ±5.35 dB (with factor k = 2).

The total uncertainty of the measurement system for the conducted testing of EUT is:

Frequency Tolerance of the Carrier Signal: Measurement uncertainty ≤ ± 12.3 kHz

Occupied Bandwidth ≤ ± 1.42 kHz

Field strength of emissions within the band ≤ ± 3.44 dB

# Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample consists of a Key Fob. The iLOQ K55S.2 Key Fob is used for operating digital lock cylinders in the iLOQ 5 Series locking system for users without a compatible NFC-enabled smartphone for unlocking. The Key Fob supplies the required operating power to the lock over the NFC field during opening, thus the locks do not need their own power supply.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

# Usage of samples

Samples undergoing test have been selected by: The client.

| Id | Control Number | Description | Model | Serial Nº | Date of Reception | Application |
|---|---|---|---|---|---|---|
| S/01 | 76889B_11.1 | Key Fob | K55S.2 | 34800923 | 2023-11-02 | Element Under Test |

Notes referenced to samples during the project:

| Id | Type |
|---|---|
| S/01 | Test samples used for conducted and radiated testing. |

# Test sample description

<table>
<tr><td rowspan="2">Ports…… :</td><td rowspan="2">Port name and description</td><td colspan="4">Cable</td></tr>
<tr><td>Specified max length [m]</td><td>Attached during test</td><td>Shielded</td><td>Coupled to patient(3)</td></tr>
<tr><td></td><td>USB service port (USB-C interface for service and charging)</td><td>< 3m</td><td>[ ]</td><td>[ ]</td><td>[ ]</td></tr>
<tr><td>Supplementary information to the ports…… :</td><td colspan="5">.....</td></tr>
<tr><td rowspan="3">Rated power supply .....:</td><td rowspan="2">Voltage and Frequency</td><td colspan="4">Reference poles</td></tr>
<tr><td>L1</td><td>L2</td><td>L3</td><td>N</td><td>PE</td></tr>
<tr><td>[X]</td><td colspan="5">DC: Lithium-ion polymer rechargeable battery. DC 3.7V, 220mAh, 0.814Wh</td></tr>
<tr><td></td><td>[X]</td><td colspan="5">DC: USB -C port, nom. 5 VDC</td></tr>
<tr><td>Rated Power .....:</td><td colspan="6">USB-C port: max. 0,5 W (5 V/ 0,1 A)</td></tr>
<tr><td>Clock frequencies.....:</td><td colspan="6">27.12MHz, 32.768kHz, 1MHz, 100kHz, 48MHz, 24MHz</td></tr>
<tr><td>Other parameters .....:</td><td colspan="6">.....</td></tr>
<tr><td>Software version .....:</td><td colspan="6">32790</td></tr>
<tr><td>Hardware version .....:</td><td colspan="6">E2196C2</td></tr>
<tr><td>Dimensions in cm (W x H x D) ....:</td><td colspan="6">41 mm x 50,2 mm x 13,7 mm</td></tr>
<tr><td rowspan="5">Mounting position .....:</td><td>[ ]</td><td colspan="5">Table top equipment</td></tr>
<tr><td>[ ]</td><td colspan="5">Wall/Ceiling mounted equipment</td></tr>
<tr><td>[ ]</td><td colspan="5">Floor standing equipment</td></tr>
<tr><td>[X]</td><td colspan="5">Hand-held equipment</td></tr>
<tr><td>[ ]</td><td colspan="5">Other: .....</td></tr>
<tr><td rowspan="2">Modules/parts.....:</td><td colspan="3">Module/parts of test item</td><td>Type</td><td>Manufacturer</td></tr>
<tr><td colspan="3">.....</td><td>.....</td><td>.....</td></tr>
<tr><td rowspan="2">Accessories (not part of the test item) .....:</td><td colspan="3">Description</td><td>Type</td><td>Manufacturer</td></tr>
<tr><td colspan="3">.....</td><td>.....</td><td>.....</td></tr>
<tr><td rowspan="2">Documents as provided by the applicant.....:</td><td colspan="3">Description</td><td>File name</td><td>Issue date</td></tr>
<tr><td colspan="3">.....</td><td>.....</td><td>.....</td></tr>
</table>

(3) Only for Medical Equipment

# Identification of the client

Bittium Wireless
Ritaharjuntie 1, 90590 Oulu, Finland

# Testing period and place

| | |
|---|---|
| **Test Location** | DEKRA Testing and Certification S.A.U. |
| **Date (start)** | 2023-11-08 |
| **Date (finish)** | 2023-11-21 |

# Document history

| Report number | Date | Description |
|---|---|---|
| 76889RRF.002 | 2023-12-20 | First release. |
| 76889RRF.002A1 | 2024-02-20 | Second release. Modification due to missing information.<br>This modification test report cancels and replaces the test report 76889RRF.002 |

# Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 75 % |

In the semianechoic chamber, the following limits were not exceeded during the test.

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 75 % |

In the chamber for conducted measurements, the following limits were not exceeded during the test:

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 75 % |

# Remarks and comments

The tests have been performed by the technical personnel: Alvaro Gutierrez Naranjo, Ireneo Bibang Bacale and Valentin Andarias Diaz.

Used instrumentation:

| Control No. | Equipment | Model | Manufacturer | Next Calibration |
|---|---|---|---|---|
| 6791 | SEMIANECHOIC ABSORBER LINED CHAMBER IV | FACT 3 200 STP | ETS LINDGREN | N/A |
| 6792 | SHIELDED ROOM | S101 | ETS LINDGREN | N/A |
| 0242 | ACTIVE LOOP ANTENNA 9 KHZ-30 MHz | 11966A | HEWLETT PACKARD | 2024-08 |
| 5641 | HYBRID BILOG ANTENNA 30MHz-6GHz | 3142E | ETS LINDGREN | 2024-09 |
| 6144 | RF PRE-AMPLIFIER G>40dB 10MHz-6GHz | BLNA 0160-01N | BONN ELEKTRONIK | 2024-07 |
| 7817 | EMI TEST RECEIVER 2Hz-44GHz | ESW44 | ROHDE AND SCHWARZ | 2023-12 |
| 9555 | TWO-CHANNEL POWER SUPPLY, 32V, 10/5A, 188W | HMP2020 | ROHDE AND SCHWARZ | N/A |
| 7760 | DIGITAL MULTIMETER | 175 | FLUKE | 2024-11 |
| 4848 | SOFTWARE FOR EMC/RF TESTING | EMC32 | ROHDE AND SCHWARZ | -- |
| 6157 | SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz | FSV40 | ROHDE AND SCHWARZ | 2025-01 |
| 8002 | TEMPERATURE CHAMBER MK56 BINDER | MK 56 | BINDER | 2024-03 |

# Testing verdicts

| | |
|---|---|
| Fail | F |
| Inconclusive | I |
| Not applicable | N/A |
| Not measured | N/M |
| Pass | P |

# Summary

**RFID (NFC 13.56 MHz).**

| FCC PART 15 PARAGRAPH / RSS-210 | | |
|---|---|---|
| **Requirement – Test case** | **Verdict** | **Remark** |
| FCC 15.225 (a) / RSS-210 B.6 (a)(i) Field strength of emissions within the band 13.553 MHz -13.567 MHz | P | |
| FCC 15.225 (b) / RSS-210 B.6 (a)(ii) Field strength of emissions within the band 13.410 - 13.553 MHz and 13.567 – 13.710 MHz | P | |
| FCC 15.225 (c) / RSS-210 B.6 (a)(iii) Field strength of emissions within the band 13.110 - 13.410 MHz and 13.710 – 14.010 MHz | P | |
| FCC 15.225 (d) / RSS-210 B.6 (a)(iv) Field strength of emissions outside of the band 13.110 MHz -14.010 MHz | P | |
| FCC 15.225 (e) / RSS-210 B.6 (b) Frequency tolerance of the carrier signal | P | |
| Supplementary information and remarks:<br>None. | | |

# **Appendix A:** Test results

# INDEX

# TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

| | |
|---|---|
| Vnominal: | 3.7 Vdc |
| Vminimum: | 3.145 Vdc |
| Vmaximum: | 4.255 Vdc |
| Type of Power Supply: | DC (Lithium-ion polymer rechargeable battery). |

ANTENNA (*):

| | |
|---|---|
| Type of Antenna: | Integral (PCB Loop). |
| Maximum Declared Antenna Gain: | N/A. |

TEST FREQUENCIES (*):

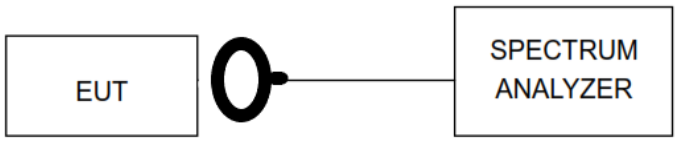
| | |
|---|---|
| Nominal Operating Frequency: | 13.56 MHz |
| Modulation: | ASK |

# TEST SETUP

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.

For frequency stability test the EUT was placed inside a climatic chamber and connected to a frequency meter using a low loss cable. An external DC power supply was connected to the EUT for voltage variation test.




Coupling device

For extreme test conditions the EUT was placed inside a climatic chamber and connected to a spectrum analyzer using a low-loss cable and a coupling device. An external DC power supply was connected to the EUT for voltage variation test.

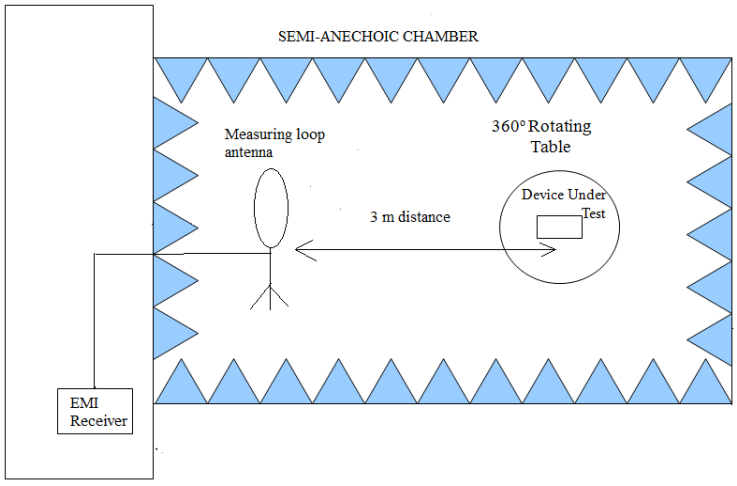
RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Loop antenna for the range between 9 kHz to 30 MHz and Bilog antenna for the range between 30 MHz to 200 MHz) is situated at a distance of 3 m.

For radiated emissions in the range 9 kHz to 30 MHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 40 dB per decade is used to normalize the measured data for determining compliance.

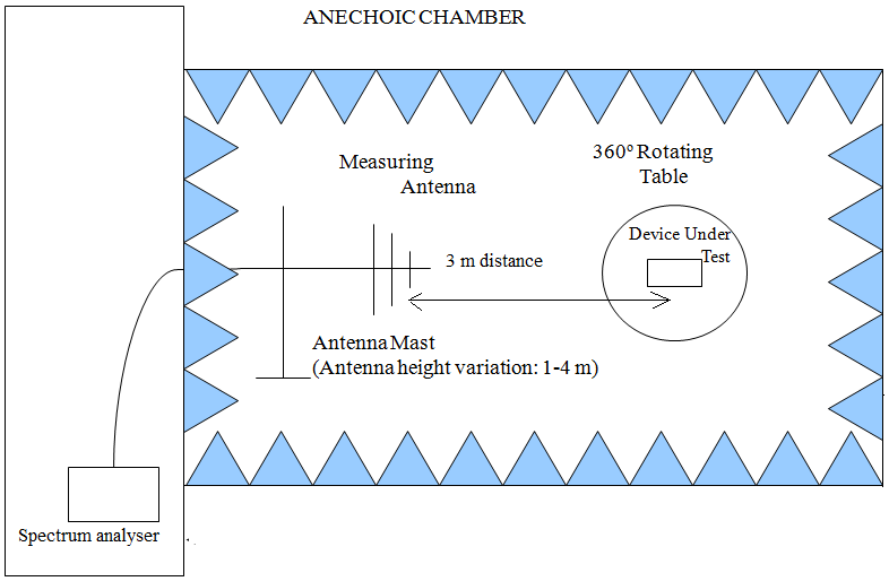
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and in the range between 30 MHz and 200 MHz the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.
In the range between 9 kHz and 30 MHz the measurements were made in the three different orientation planes of the loop antenna to determine the maximum received field.
In the range between 30 MHz and 200 MHz the measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup 9 kHz to 30 MHz:




Shielded Control Room For Radiated Measurements

Radiated measurements setup 30 MHz to 200 MHz:



# TEST CASES DETAILS

## Occupied Bandwidth

### Results

99 % Occupied Bandwidth and 20 dB Bandwidth.

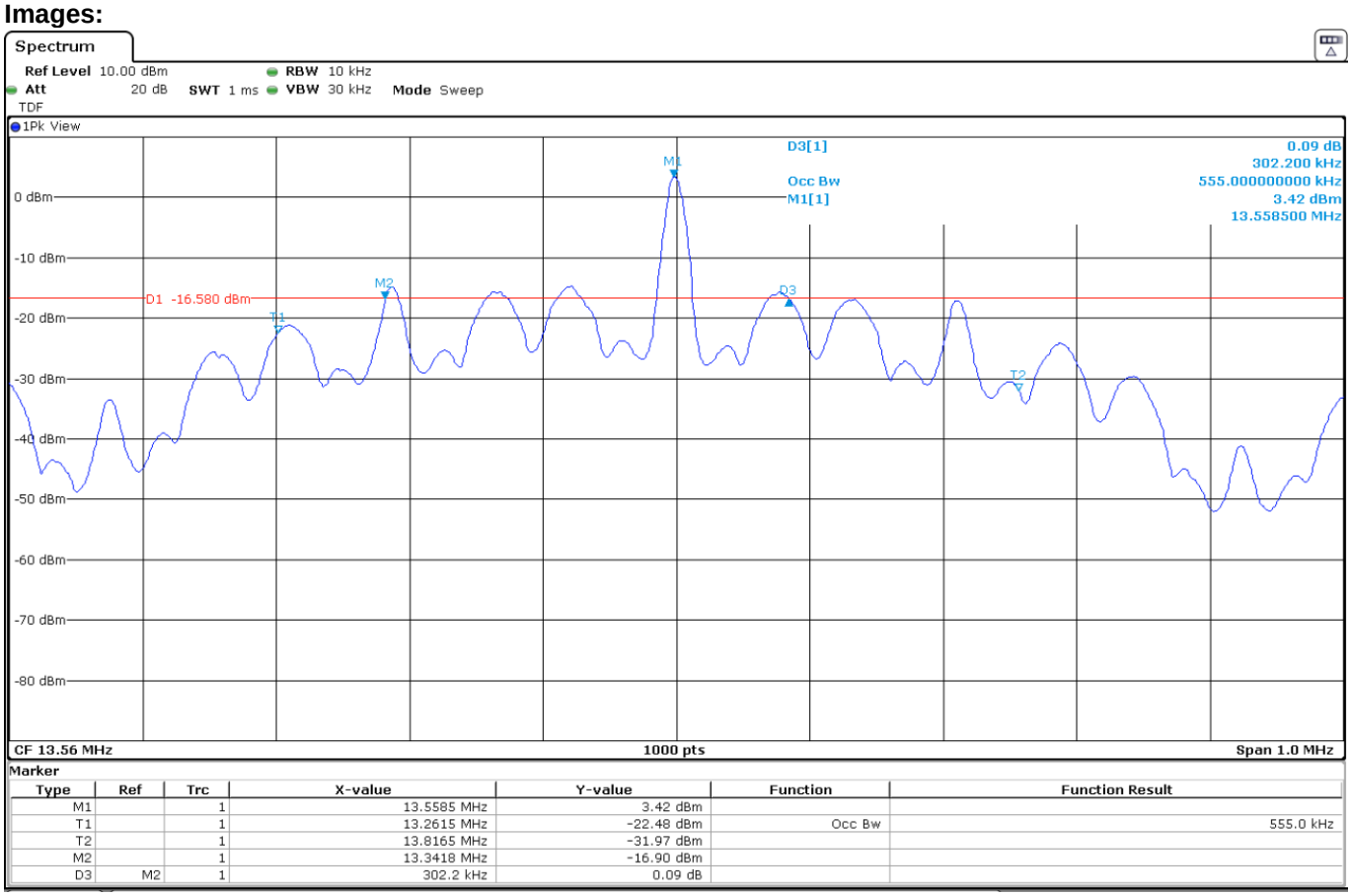
Modulation: ASK

| Freq (MHz) | 99% Occupied Bandwidth (kHz) | 20dBw (kHz) |
|---|---|---|
| 13.56 | 555.0 | 302.2 |

### *Attachments*

Modulation = ASK Frequency MHz = 13.56

### Images:



# FCC 15.225 (a) (b) (c) / RSS-210 B.6 (a) (b) (c). Field strength of emissions within the band 13.553 -13.567 MHz, 13.410 - 13.553 MHz and 13.567 - 13.710 MHz, 13.110 - 13.410 MHz and 13.710 - 14.010 MHz

SPECIFICATION:

- **FCC 15.225 (a) / RSS-210 B.6 (a). Field strength of emissions within the band 13.553 -13.567 MHz**

The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBµV/m) at 30 meters.

- **FCC 15.225 (b) / RSS-210 B.6 (b). Field strength of emissions within the band 13.410 - 13.553 MHz and 13.567 - 13.710 MHz**

Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter (50.47 dBµV/m) at 30 meters.

- **FCC 15.225 (c) / RSS-210 B.6 (c). Field strength of emissions within the band 13.110 - 13.410 MHz and 13.710 - 14.010 MHz**

Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter (40.51 dBµV/m) at 30 meters.

RESULTS:

Measurement distance: 3 meters.

- **NFC - ASK Modulation:**

**- Band 13.553 -13.567 MHz**

| Frequency (MHz) | Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector) | Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade) |
|---|---|---|
| 13.560 | 13.53 | -26.47 |

**- Band 13.410 - 13.553 MHz**

| Frequency (MHz) | Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector) | Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade) |
|---|---|---|
| 13.551 | -11.19 | -51.19 |

**- Band 13.567-13.710 MHz**

| Frequency (MHz) | Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector) | Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade) |
|---|---|---|
| 13.569 | -12.09 | -52.09 |

**- Band 13.110-13.410 MHz**

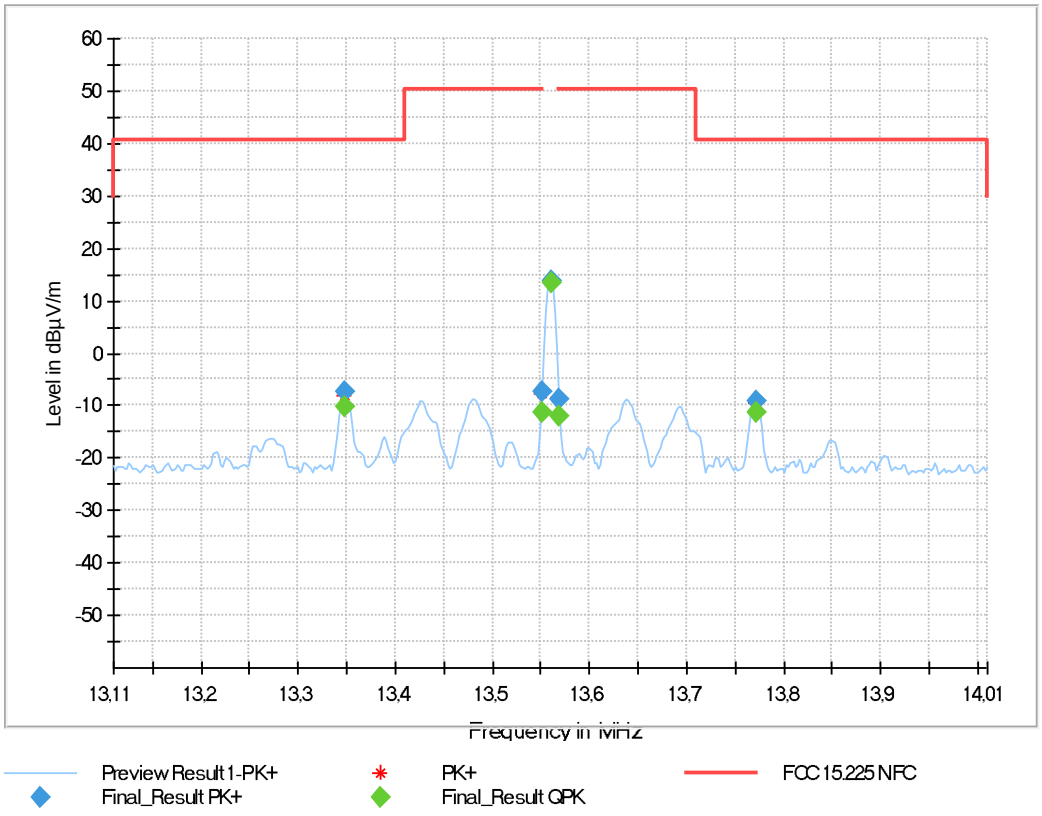
| Frequency (MHz) | Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector) | Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade) |
|---|---|---|
| 13.349 | -10.15 | -50.15 |

**- Band 13.710-14.010 MHz**

| Frequency (MHz) | Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector) | Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade) |
|---|---|---|
| 13.772 | -11.24 | -51.24 |

Spectrum analyzer parameters:

| **Subrange** | **Step Size** | **Detectors** | **IF BW** | **Meas. Time** | **Preamp** |
|---|---|---|---|---|---|
| Receiver: [ESW 44] | | | | | |
| 9 kHz - 150 kHz | 50 Hz | PK+ | 200 Hz | 0,1 s | 0 dB |
| 150 kHz - 30 MHz | 2,25 kHz | PK+ | 9 kHz | 0,1 s | 0 dB |




Verdict: PASS

# FCC 15.225 (d) / RSS-210 B.6 (a) (iv) [RSE] FCC 15.225 (d) / RSS-210 B.6 (a)(iv) Field Strength of Emissions outside of the band 13.110 MHz - 14.010 MHz

***Limits***

Field strength of any emissions appearing outside of the band 13.110 MHz - 14.010 MHz band shall not exceed the general radiated emission limits in 15.209/RSS-Gen:

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 30 |
| 1.705 - 30.0 | 30 | 29.54 | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| Above 960 | 500 | 54 | 3 |

Modulation: ASK

***Results***

No spurious frequencies at less than 20 dB below the limit.

***Verdict***

Pass

Spectrum analyzer parameters < 30 MHz:

| **Subrange** | **Step Size** | **Detectors** | **IF BW** | **Meas. Time** | **Preamp** |
|---|---|---|---|---|---|
| Receiver: [ESW 44] | | | | | |
| 9 kHz - 150 kHz | 50 Hz | PK+ | 200 Hz | 0,1 s | 0 dB |
| 150 kHz - 30 MHz | 2,25 kHz | PK+ | 9 kHz | 0,1 s | 0 dB |

Spectrum analyzer parameters > 30MHz:

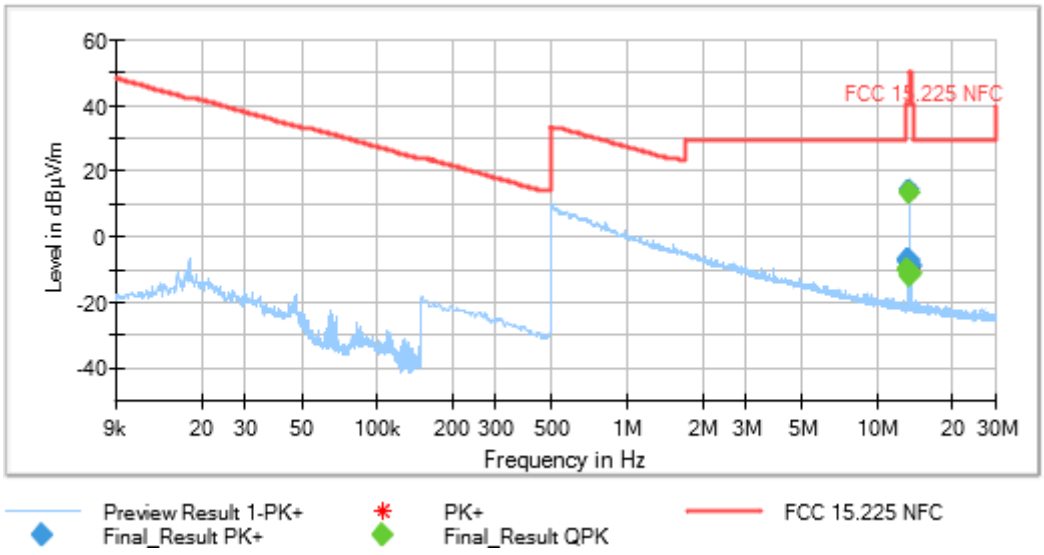
| **Subrange** | **Step Size** | **Detectors** | **Bandwidth** | **Sweep Time** | **Preamp** |
|---|---|---|---|---|---|
| Receiver: [ESW 44] | | | | | |
| 30 MHz - 200 MHz | 8,5 kHz | PK+ | 100 kHz | 1 s | 30 dB |

***Attachments***

Modulation = ASK Frequency MHz = 13.56

Frequency Range MHz = [0.009, 30] Polarization = Frontal side (worst case)

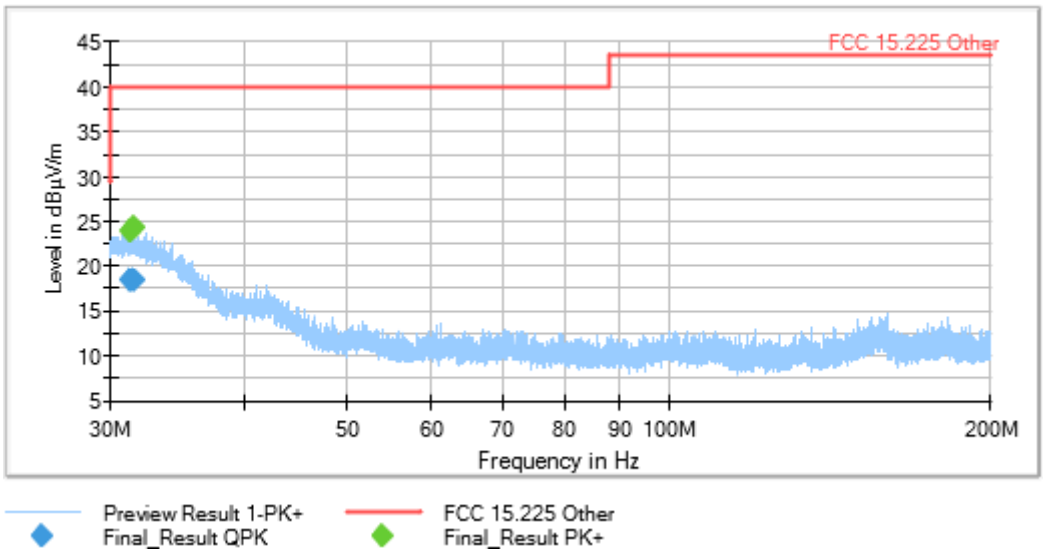
**Images:**




Modulation = ASK Frequency MHz = 13.56

Frequency Range MHz = [30, 200] Polarization = H/V

**Images:**



# FCC 15.225 (e) / RSS-210 (b) Freq Tolerance FCC 15.225 (e) / RSS-210 B.6 (b) Frequency Tolerance of the Carrier Signal

***Limits***

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees 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 degrees C. For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Modulation: ASK

***Results***

| Freq (MHz) | T (ºC) | Voltage (V) | Freq Error (Hz) | Freq Error (%) |
|---|---|---|---|---|
| 13.56 | -20 | 3.70 | 163.500 | 0.001 |
| | -10 | | 132.000 | 0.001 |
| | 0 | | 114.000 | 0.001 |
| | 10 | | 121.500 | 0.001 |
| | 20 | 3.15 | 126.000 | 0.001 |
| | | 3.70 | 135.000 | 0.001 |
| | | 4.25 | 135.000 | 0.001 |
| | 30 | 3.70 | 150.000 | 0.001 |
| | 40 | | 154.500 | 0.001 |
| | 50 | | 144.000 | 0.001 |

***Verdict***

Pass