Test Report

HELEM2312000488-2-2 v1.1

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

Equipment Under Test:	NFC/PIN Wall Reader
Trademark:	iLOQ
Model:	N505i
Type:	-
Customer:	iLOQ Oy Elektroniikkatie 10 FI-90590 Oulu Finland
FCC Rule Part:	§15.225
IC Rule Part:	RSS-210, Issue 10, 2019 RSS-Gen, Issue 5 Amendment 2, 2021

Date:	22 May 2024	Date:	22 May 2024
Issued by:	Henri Mäki Testing Engineer	Checked by:	Rauno Repo Senior EMC Specialist

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GENERAL REMARKS

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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	22 March 2024
1.1	FCC and IC IDs corrected on Page 5. Description of LISN location added to AC Power-Line Conducted Emissions test results. Information regarding measurement distance and extrapolation factor clarified in Radiated Emissions test results. Test results for 20 dB Bandwidth removed.	22 May 2024

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test:	NFC/PIN Wall Reader
Trademark:	iLOQ
Model:	N505i
Type:	-
Serial no:	218183715
FCC ID:	2A2HZN505I
IC:	30160-N505I
Radio module or chip:	STMicroelectronics ST95HF (NFC 13.56 MHz)

General Description

iLOQ N505i is an NFC/PIN wall reader used to read and write data to iLOQ keys. A valid key will open the door, and each time the key is used, it will be updated with the latest data.

Wall readers are connected either to the reader bus of the N501 Standalone Door Module, the N502 Online Door Module, the N503 Offline Door Module, or to the chain bus of the N507 Online I/O Module. Wall readers can also be connected directly to the main bus of the N500 Net Bridge to work as a hotspot for updating keys. Wall readers are connected to host modules with four leads cable including RS-485 bus and DC power supply (A, B and DC- , DC+). Power supply is 12 V with door modules and 40 V with N500 and N507.

Wall readers use NFC technology to read and write data to iLOQ S5 and S50 keys, but also MIFARE RFID tags can be read. Wall readers are equipped with a keypad that can be configured to demand a key + PIN-code combination or, for lower security, open the door with just an access code.

Wall readers can be installed near the door, at a maximum distance of 10 m from a door module.

Classification

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

Samples and modifications

No.	Name	Description
1	N505i EMC1	Test sample supplied by the customer

Specifications

Operating Frequency Range:	13.56 MHz
Channels:	-
Antenna Type:	Integral inductive coil
Antenna Gain:	-
Antenna Count:	1
EUT Dimensions:	97 x 93 x 17.5 mm
Power Requirements:	12 VDC or 40 VDC, 1.5 W

Ports and cables

Cable / Port	Description
DC power supply and RS-485 bus	Connected to iLOQ N502 Online Door Module during testing.

Peripherals

Peripheral	Description / Usage
Online Door Module	iLOQ N502, DC power supply and RS-485 communication to the EUT. Connected to the EUT and peripheral Net Bridge during testing.
Net Bridge	iLOQ N500, connected to the peripheral Online Door Module and AC/DC adapter during testing.
AC/DC adapter	Mean Well GSM60A24, power supply to the peripheral Net Bridge unit during testing.

The peripherals were supplied 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 1.3 of ANSI C63.10-2020.

EUT Test Conditions during Testing

Configuration of the EUT was made to correspond to the actual assembling conditions as far as possible. The Net Bridge is the host of the system, providing power and communicating with Online Door Module via main bus (40 VDC and RS-485). The EUT is connected to the peripheral Online Door Module, which provides 12 VDC and RS-485 communication. The Net Bridge sends status message queries via main bus to Online Door Module, which asks status messages from the EUT. Online Door Module receives status messages from the EUT, poll processor pin states, and sends messages to Net Bridge.
Additionally, the EUT is set to play a song, the push button LEDs are on, and the NFC radio is continuously transmitting modulated signal.

The test conditions were proposed by the customer.

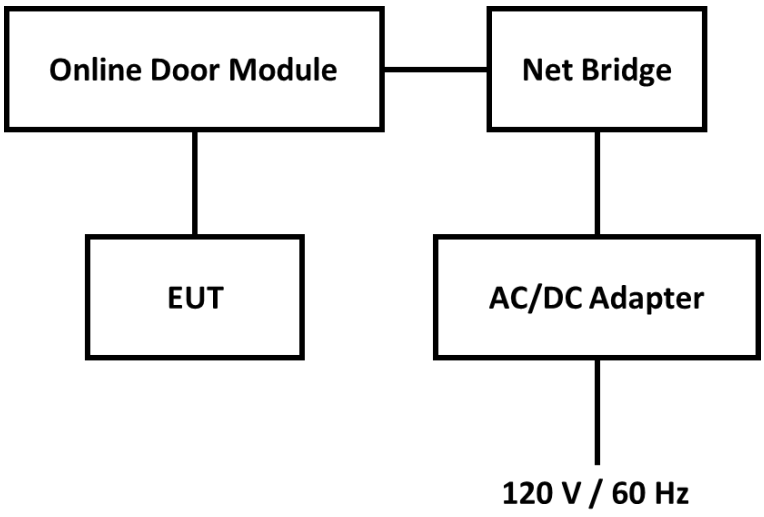

Figure 1: Test setup block diagram

Test Facility

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

TEST RESULTS

Antenna Requirement

Standard: FCC Rule §15.203
Tested by: HEM
Date: 21 December 2023

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 2. Unique coupling to the intentional radiator 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
Tested by:	HEM
Date:	21 December 2023
Temperature:	23.4 °C
Humidity:	32 %RH
Barometric pressure:	981 hPa
Measurement uncertainty:	± 2.9 dB, level of confidence 95 % (k = 2)
Test result:	**PASS**

FCC Rule: §15.207(a)
RSS-Gen 8.8

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in §15.207(a) and RSS-Gen 8.8, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

For equipment that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the equipment.

Conducted disturbance voltage was measured with a LISN from 150 kHz to 30 MHz with a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors. The LISN was located on the ground behind the vertical conducting plane.

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

Test results

Table 1: 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)
0.154000	---	35.70	55.78	20.08	15 x 1000.0	9.000	L1	9.7
0.158000	43.50	---	65.57	22.07	15 x 1000.0	9.000	N	9.7
0.311000	---	38.77	49.94	11.17	15 x 1000.0	9.000	N	9.7
0.322250	46.42	---	59.65	13.23	15 x 1000.0	9.000	N	9.7
0.956750	35.15	---	56.00	20.85	15 x 1000.0	9.000	N	9.8
0.978500	---	26.98	46.00	19.02	15 x 1000.0	9.000	N	9.8
2.092500	---	29.20	46.00	16.80	15 x 1000.0	9.000	N	9.9
2.112750	33.79	---	56.00	22.21	15 x 1000.0	9.000	L1	9.9
13.558500	42.71	---	60.00	17.29	15 x 1000.0	9.000	L1	10.4
13.558500	---	42.70	50.00	7.30	15 x 1000.0	9.000	L1	10.4
24.791000	---	18.88	50.00	31.12	15 x 1000.0	9.000	L1	10.6
24.795000	26.16	---	60.00	33.84	15 x 1000.0	9.000	L1	10.6

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.

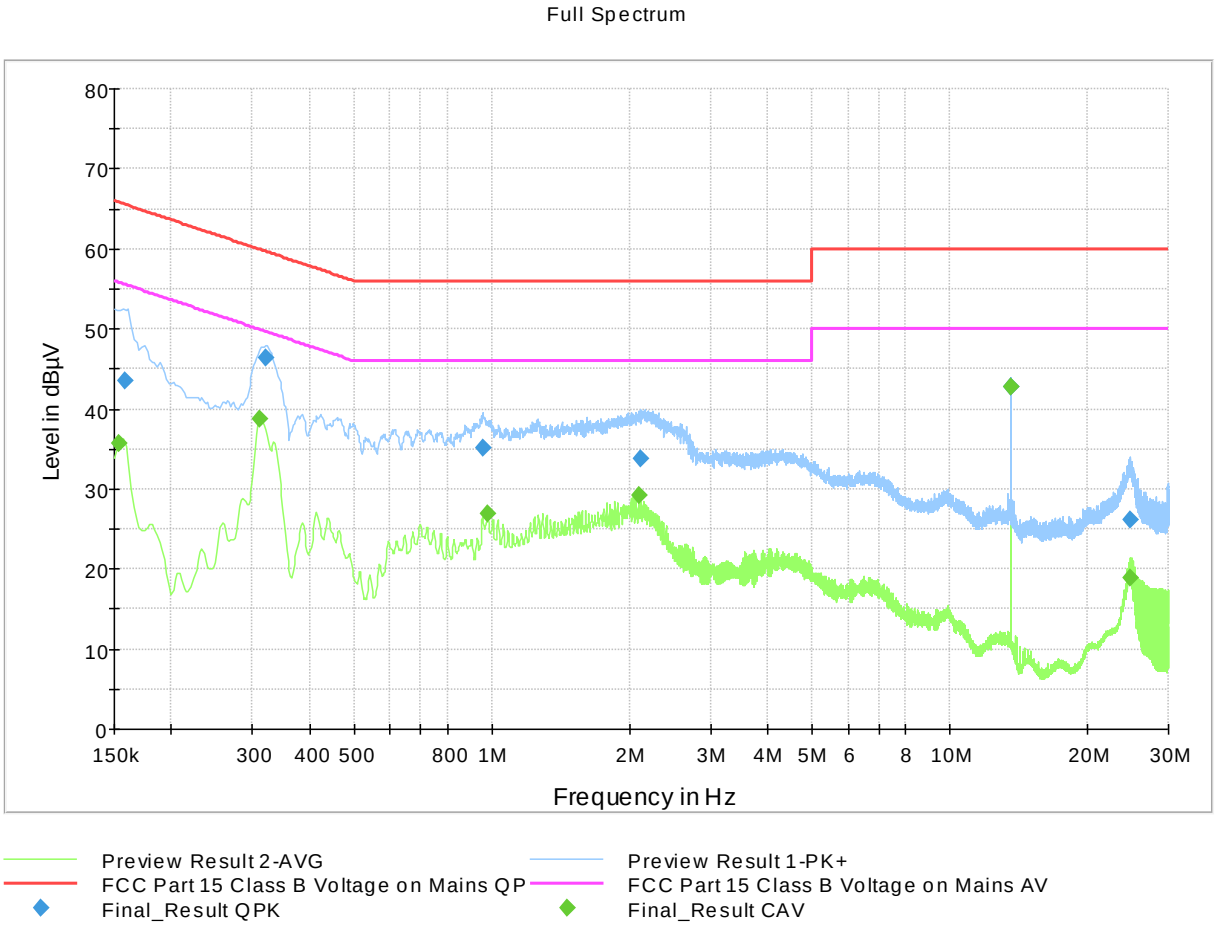

Figure 2: AC Power-Line Conducted Emissions

Radiated Emissions

Standard:	ANSI C63.10-2020
Tested by:	HEM
Date:	21 December 2023
Temperature:	23.4 °C
Humidity:	32 %RH
Barometric pressure:	981 hPa
Measurement uncertainty:	± 4.51 dB, level of confidence 95 % (k = 2)
Test result:	**PASS**

FCC Rule: §15.225(a)-(d)
RSS-210 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

In the frequency range 9 kHz to 30 MHz the measurements are performed at a distance of 3 meters, and the results are extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

In the frequency range 30 MHz to 1 GHz the measurements are performed at a distance of 3 meters.

Test results

Table 2: 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)
13.556750	17.54	84.00	66.46	15 x 1000.0	9.000	coax *	V	156.0	-20.3
13.560750	14.76	84.00	69.24	15 x 1000.0	9.000	copl *	V	92.0	-20.3
301.410000	36.51	46.00	9.49	15 x 1000.0	120.000	123.0	H	192.0	19.4
317.290000	41.59	46.00	4.41	15 x 1000.0	120.000	100.0	H	179.0	20.1
333.150000	39.80	46.00	6.20	15 x 1000.0	120.000	108.0	H	196.0	20.4
366.100000	35.35	46.00	10.65	15 x 1000.0	120.000	183.0	H	169.0	21.3
393.220000	36.31	46.00	9.69	15 x 1000.0	120.000	138.0	V	87.0	21.7
420.300000	34.77	46.00	11.23	15 x 1000.0	120.000	138.0	H	314.0	22.6

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

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

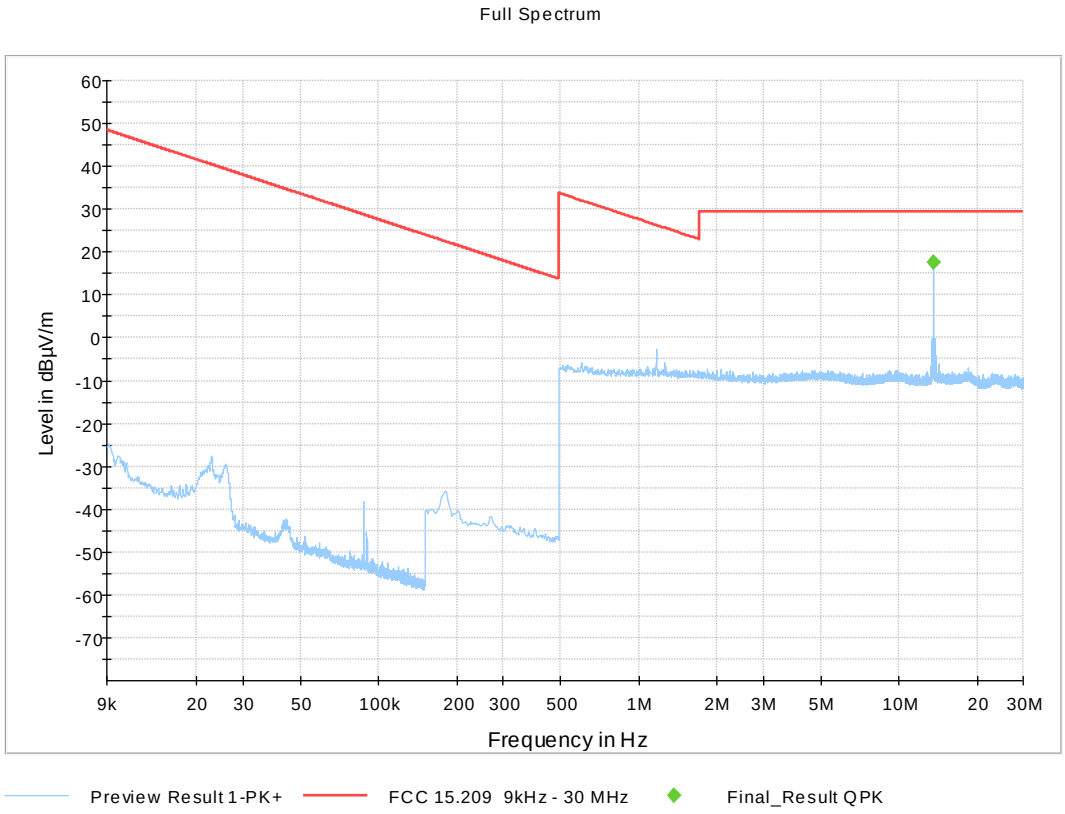

Figure 3: Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coaxial orientation

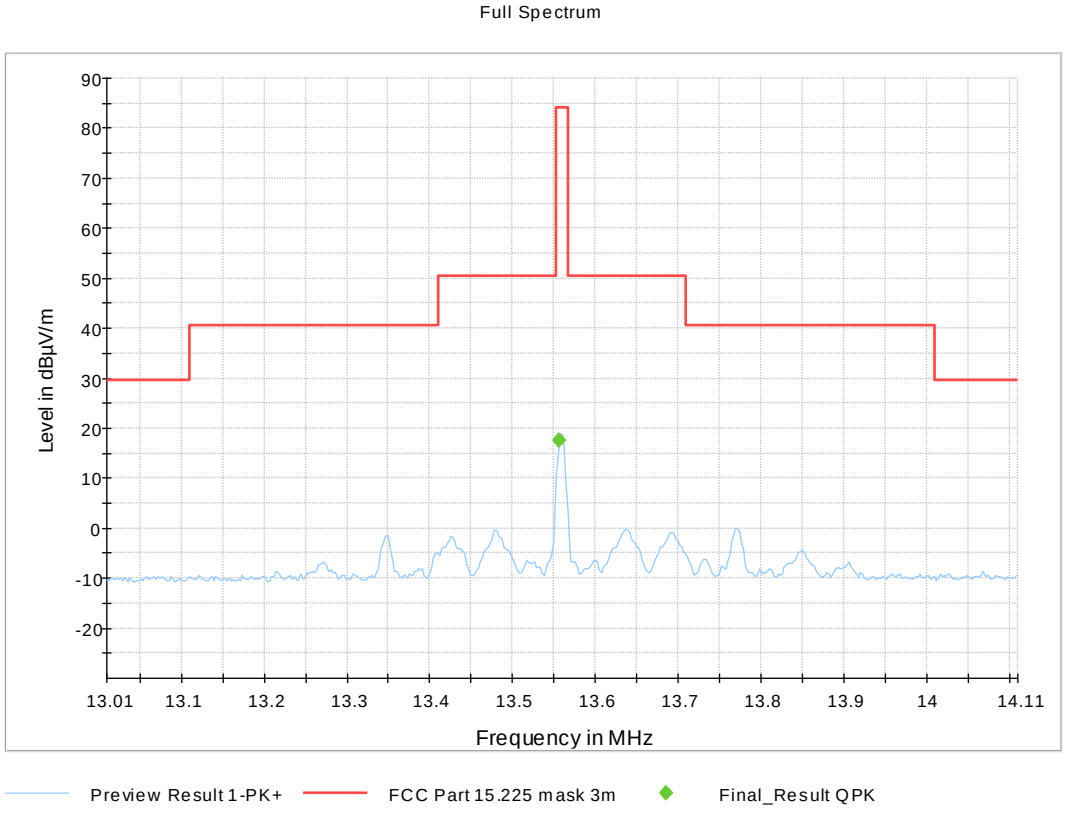

Figure 4: Emissions within the 13.110-14.010 MHz band, coaxial orientation

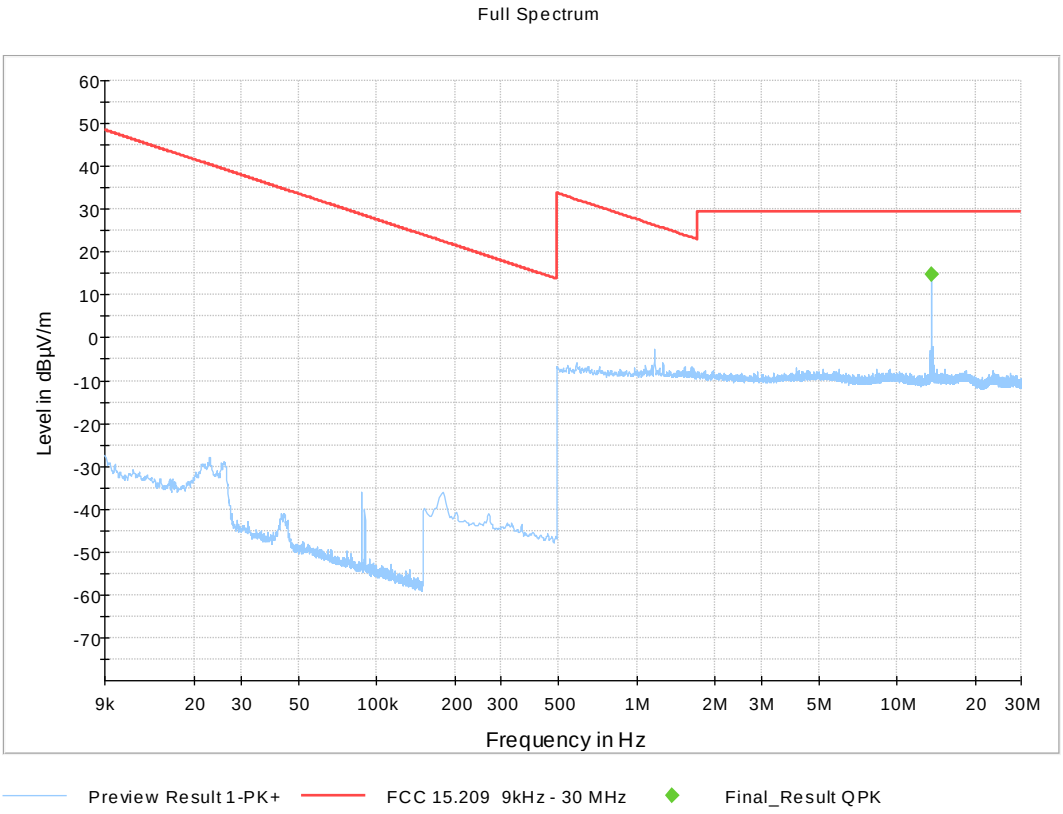

Figure 5: Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coplanar orientation

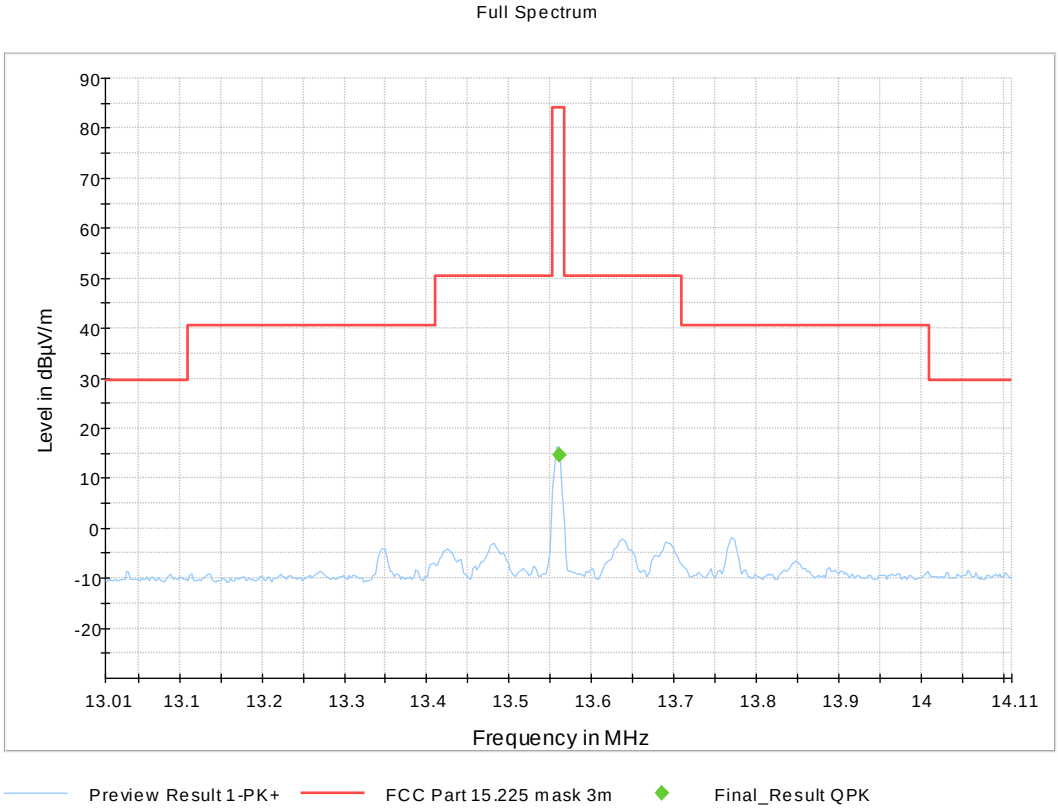

Figure 6: Emissions within the 13.110-14.010 MHz, coplanar orientation

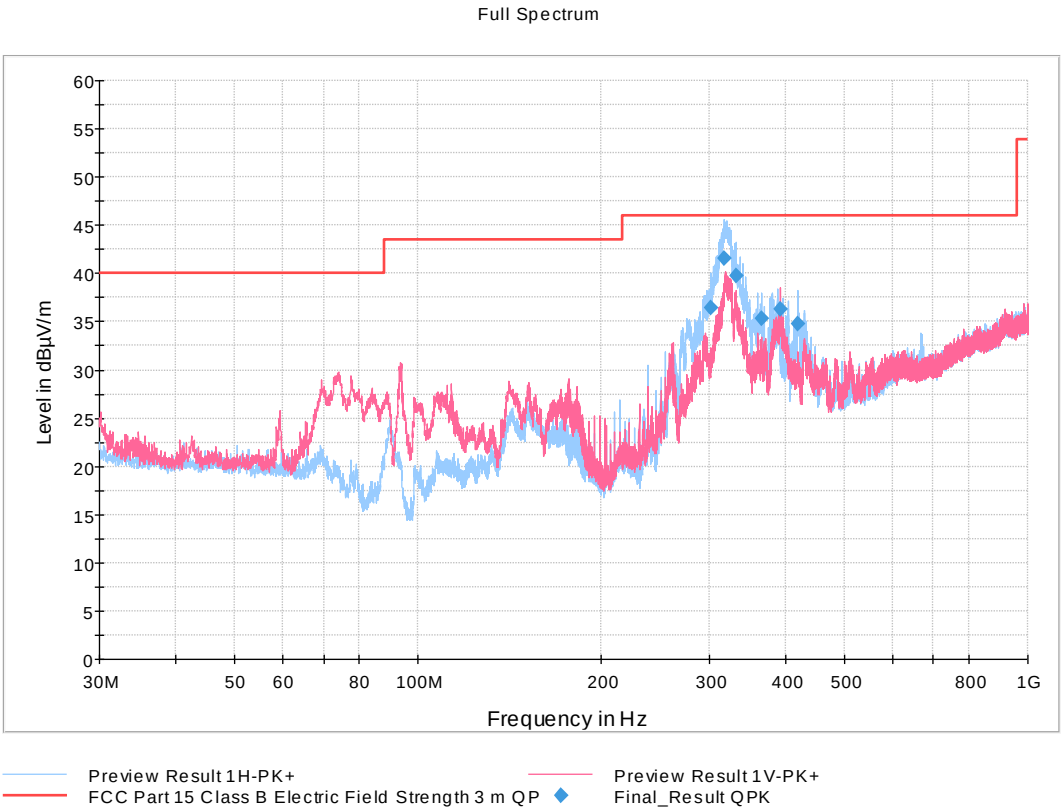

Figure 7: Radiated emissions 30 – 1000 MHz

Frequency Stabilty

Standard: ANSI C63.10-2020
Tested by: HEM
Date: 2 January 2024
Temperature: 20.8 °C
Humidity: 11 %RH
Barometric pressure: 1023 hPa

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 strartup.

Test results

Table 3: Measured frequencies with temperature variation

Temperature [°C]	Voltage [VDC]	Measured frequency [MHz]			
		Startup	2 min	5 min	10 min
-20	12	13.558819000	13.558826680	13.558829240	13.558830840
-10		13.558850030	13.558851630	13.558852270	13.558852910
0		13.558853230	13.558852270	13.558850670	13.558849720
+10		13.558830520	13.558827640	13.558825720	13.558824440
+20		13.558797240	13.558791800	13.558788920	13.558787000
+30		13.558755320	13.558748930	13.558746370	13.558744130
+40		13.558712450	13.558707650	13.558705090	13.558703170
+50		13.558680450	13.558677250	13.558675010	13.558674370

Table 4: Measured frequencies with voltage variation

Temperature [°C]	Voltage [VDC]	Measured frequency [MHz]			
		Startup	2 min	5 min	10 min
+20	10.2	13.558787960	-	-	-
	12	13.558797240	13.558791800	13.558788920	13.558787000
	13.8	13.558789240	-	-	-
	34	13.558793720	-	-	-
	40	13.558789880	-	-	-
	46	13.558793080	-	-	-

Table 5: Test results for Frequency Stability (temperature variation)

Temperature [°C]	Voltage [VDC]	Deviation [%]			
		Startup	2 min	5 min	10 min
-20	12	-0.008709	-0.008653	-0.008634	-0.008622
-10		-0.008481	-0.008469	-0.008464	-0.008459
0		-0.008457	-0.008464	-0.008476	-0.008483
+10		-0.008624	-0.008646	-0.008660	-0.008669
+20		-0.008870	-0.008910	-0.008931	-0.008945
+30		-0.009179	-0.009226	-0.009245	-0.009262
+40		-0.009495	-0.009531	-0.009549	-0.009564
+50		-0.009731	-0.009755	-0.009771	-0.009776

Table 6: Test results for Frequency Stability (voltage variation)

Temperature [°C]	Voltage [VDC]	Deviation [%]			
		Startup	2 min	5 min	10 min
+20	10.2	-0.008938	-	-	-
	12	-0.008870	-0.008910	-0.008931	-0.008945
	13.8	-0.008929	-	-	-
	34	-0.008896	-	-	-
	40	-0.008924	-	-	-
	46	-0.008901	-	-	-

The spectrum analyzer figure with the worst-case result (+50 °C, 12 VDC, 10 min after startup) is presented:

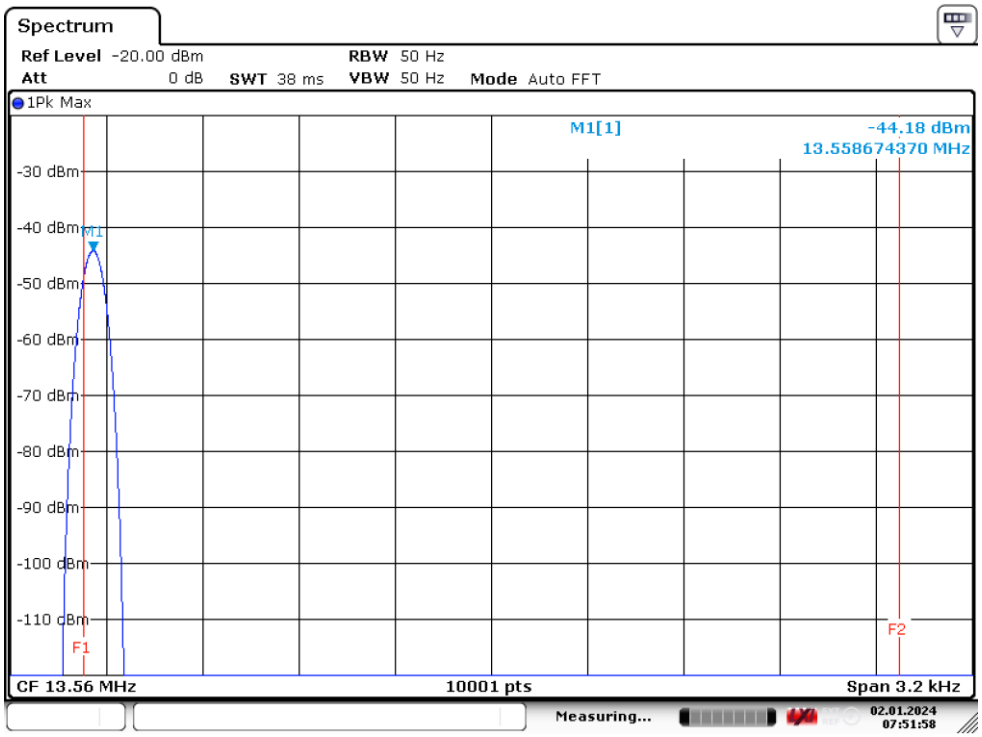

Figure 8: Frequency stability (+50 °C, 12 VDC, 10 min after startup)

Occupied Bandwidth 99 %

Standard:	RSS-Gen
Tested by:	HEM
Date:	2 January 2024
Temperature:	20.8 °C
Humidity:	11 %RH
Barometric pressure:	1023 hPa
Test result:	**PASS**

RSS-Gen 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 transmitter emission is contained.

Test results

Table 7: Test results for Occupied Bandwidth 99 %

OBW 99% [kHz]	Limit	Result
1285.871413	N/A	**PASS**

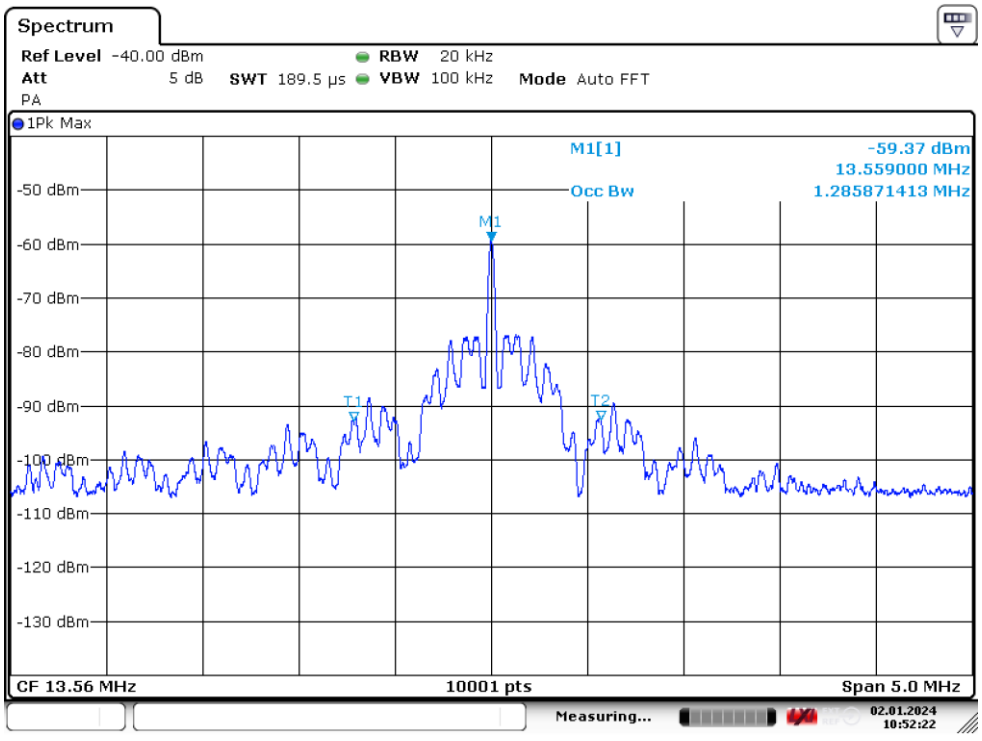

Figure 9: Occupied Bandwidth 99 %

TEST EQUIPMENT

AC Power-Line Conducted Emissions

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
CABLE	HUBER & SUHNER	RG223/U	inv. C054	2023-02-01	2024-02-01
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2023-12-15	2024-12-15
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2023-02-01	2024-02-01
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	NCR
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2023-10-30	2024-10-30
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	2022-10-25	2024-10-25
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2022-11-29	2024-11-29
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv. 10126	2023-03-13	2024-03-13
CABLE	HUBER & SUHNER	SUCOFLEX 104	inv. C053	2022-11-29	2024-11-29
CABLE	HUBER & SUHNER	SUCOFLEX 126EA	inv. C137	2022-11-29	2024-11-29
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2023-12-15	2024-12-15
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	NCR
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2023-10-30	2024-10-30
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	2023-07-13	2025-07-13
NEAR-FIELD PROBE SET	ROHDE & SCHWARZ	HS-14 1026.7744.02	inv. 7883	NCR	NCR
MULTIMETER	FLUKE	289	inv. 221117A	2023-12-05	2024-12-05
POWER SUPPLY	DELTA	SM 130-25D	inv. 10406	NCR	NCR
POWER SUPPLY	THANDAR	PL330TP	inv. 9787	NCR	NCR
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv. 9093	2023-06-16	2024-06-19
TEMPERATURE CHAMBER	CTS	T-65/50	inv. 10521	NCR	NCR
TEMPERATURE/HUMIDITY METER	VAISALA	HMT 333	inv. 8638	2023-09-08	2024-09-08

NCR = No Calibration Required

END OF REPORT