

Test Report

HELEM2312000488-1-2 v1.1



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

Equipment Under Test: NFC/PIN Door Reader

Trademark: iLOQ

Model: N504i

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

Issued by:

A handwritten signature in blue ink that appears to read 'Henri Mäki'.

Henri Mäki
Testing Engineer

Date: 22 May 2024

Checked by:

A handwritten signature in blue ink that appears to read 'Rauno Repo'.

Rauno Repo
Senior EMC Specialist

TABLE OF CONTENTS

TABLE OF CONTENTS	2
GENERAL REMARKS.....	3
Disclaimer	3
RELEASE HISTORY	4
PRODUCT DESCRIPTION	5
Equipment Under Test	5
General Description.....	5
Classification	5
Samples and modifications	5
Specifications	6
Ports and cables.....	6
Peripherals	6
SUMMARY OF TESTING.....	7
EUT Test Conditions during Testing	7
Test Facility	8
TEST RESULTS	9
Antenna Requirement	9
AC Power-Line Conducted Emissions	10
Radiated Emissions.....	12
Frequency Stability.....	17
Occupied Bandwidth 99 %	19
TEST EQUIPMENT	20
AC Power-Line Conducted Emissions	20
Radiated Emissions.....	20
Frequency Stability, Occupied Bandwidth 99 %	20

GENERAL REMARKS**Disclaimer**

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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	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 Door Reader
Trademark: iLOQ
Model: N504i
Type: -
Serial no: 201414881
FCC ID: 2A2HZN504I
IC: 30160-N504I
Radio module or chip: STMicroelectronics ST95HF (NFC 13.56 MHz)

General Description

iLOQ N504i is an NFC/PIN door 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.

Door 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. Door readers can also be connected directly to the main bus of the N500 Net Bridge to work as a hotspot for updating keys. Door 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.

Door readers use NFC technology to read and write data to iLOQ S5 and S50 keys, but also MIFARE RFID tags can be read. Door 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.

Door readers can be installed directly to the door leaf or near the door, at a maximum distance of 10 m from a door module.

Classification

Fixed device	<input checked="" type="checkbox"/>
Mobile Device (Human body distance > 20cm)	<input type="checkbox"/>
Portable Device (Human body distance < 20cm)	<input type="checkbox"/>

Samples and modifications

No.	Name	Description
1	N504i 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:	153 x 39 x 16 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.

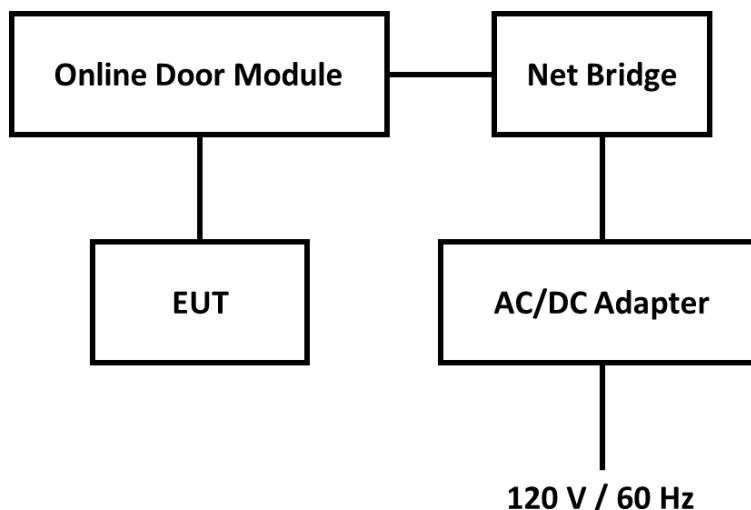


Figure 1: Test setup block diagram

Test Facility

Testing Laboratory / address: FCC designation number: FI0002 ISED CAB identifier: T004	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	<input type="checkbox"/> K10LAB, ISED Canada registration number: 8708A-1 <input checked="" type="checkbox"/> K5LAB, ISED Canada registration number: 8708A-2 <input type="checkbox"/> 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	<ol style="list-style-type: none">1. Permanently attached antenna2. Unique coupling to the intentional radiator3. 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

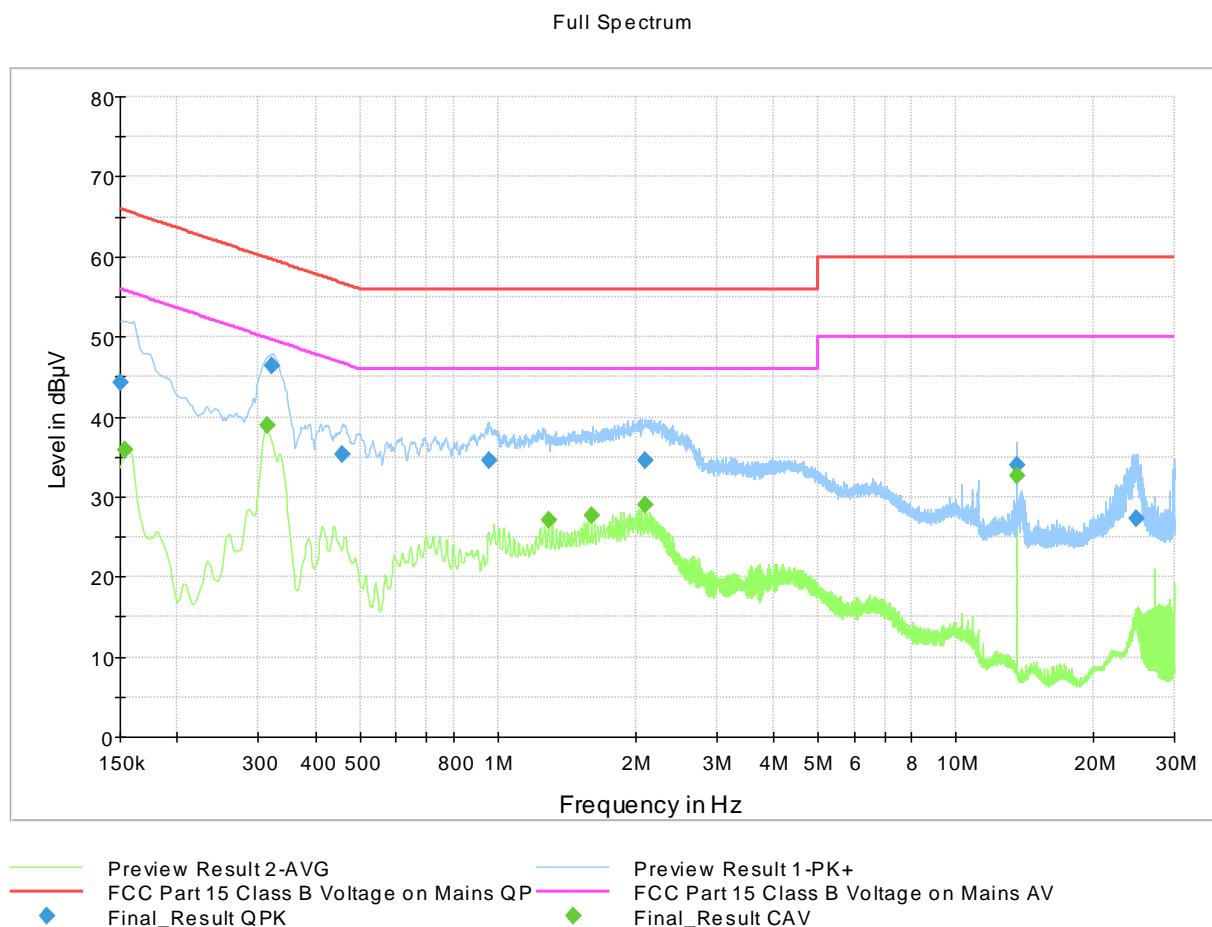
* The level decreases linearly with the logarithm of the frequency

Test results

Table 1: Test results for AC Power-Line Conducted Emissions

Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	44.27	---	66.00	21.73	15 x 1000.0	9.000	N	9.7
0.154000	---	35.83	55.78	19.95	15 x 1000.0	9.000	L1	9.7
0.313250	---	38.97	49.88	10.91	15 x 1000.0	9.000	N	9.7
0.322250	46.46	---	59.65	13.19	15 x 1000.0	9.000	N	9.7
0.456000	35.35	---	56.77	21.42	15 x 1000.0	9.000	N	9.7
0.958000	34.53	---	56.00	21.47	15 x 1000.0	9.000	N	9.8
1.289250	---	27.05	46.00	18.95	15 x 1000.0	9.000	N	9.8
1.600750	---	27.68	46.00	18.32	15 x 1000.0	9.000	N	9.9
2.094250	---	28.95	46.00	17.05	15 x 1000.0	9.000	N	9.9
2.094750	34.65	---	56.00	21.35	15 x 1000.0	9.000	N	9.9
13.558500	33.98	---	60.00	26.02	15 x 1000.0	9.000	L1	10.4
13.558500	---	32.72	50.00	17.28	15 x 1000.0	9.000	L1	10.4
24.697750	27.34	---	60.00	32.66	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 [μ V/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 [μ V/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 (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
13.556750	16.58	84.00	67.42	15 x 1000.0	9.000	coax *	V	153.0	-20.3
13.556750	14.03	84.00	69.96	15 x 1000.0	9.000	copl *	V	88.0	-20.3
93.830000	30.29	43.50	13.21	15 x 1000.0	120.000	100.0	V	261.0	12.8
257.610000	35.48	46.00	10.52	15 x 1000.0	120.000	108.0	V	333.0	17.8
271.170000	39.97	46.00	6.03	15 x 1000.0	120.000	100.0	H	70.0	18.5
284.730000	42.33	46.00	3.67	15 x 1000.0	120.000	100.0	H	72.0	19.0
301.410000	32.78	46.00	13.22	15 x 1000.0	120.000	108.0	H	184.0	19.4
333.150000	34.28	46.00	11.72	15 x 1000.0	120.000	108.0	H	195.0	20.4

* 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.

Radiated Emissions

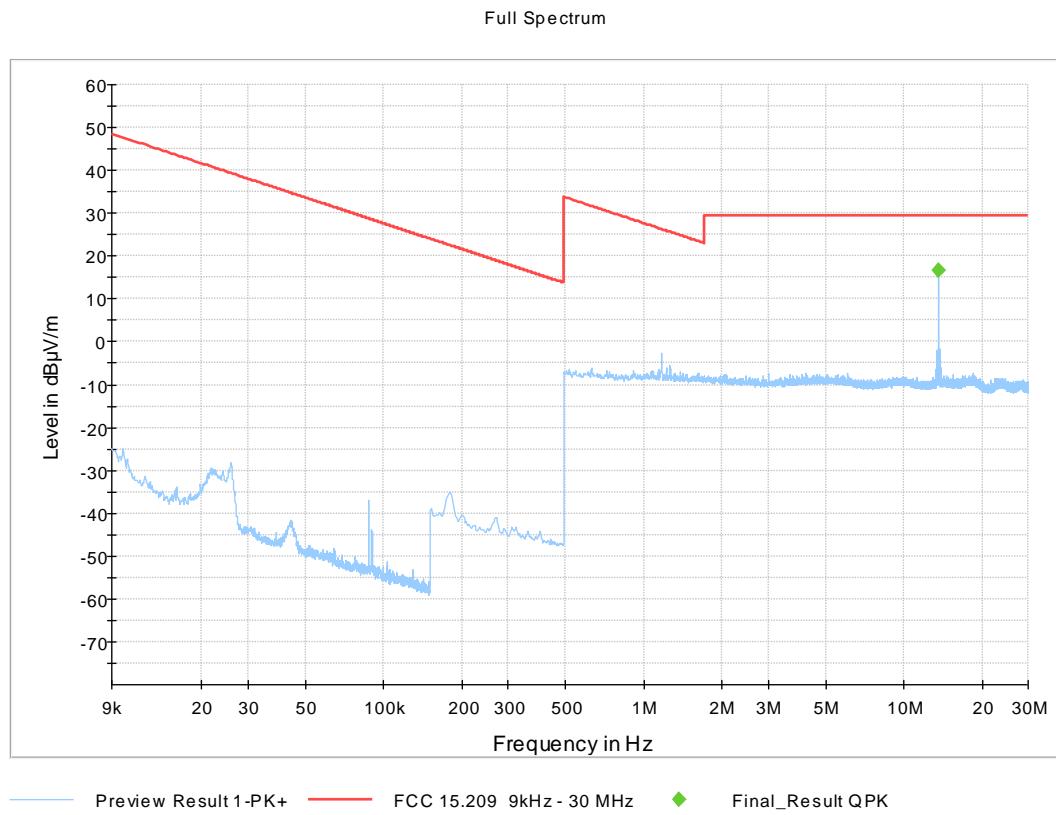


Figure 3: Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coaxial orientation

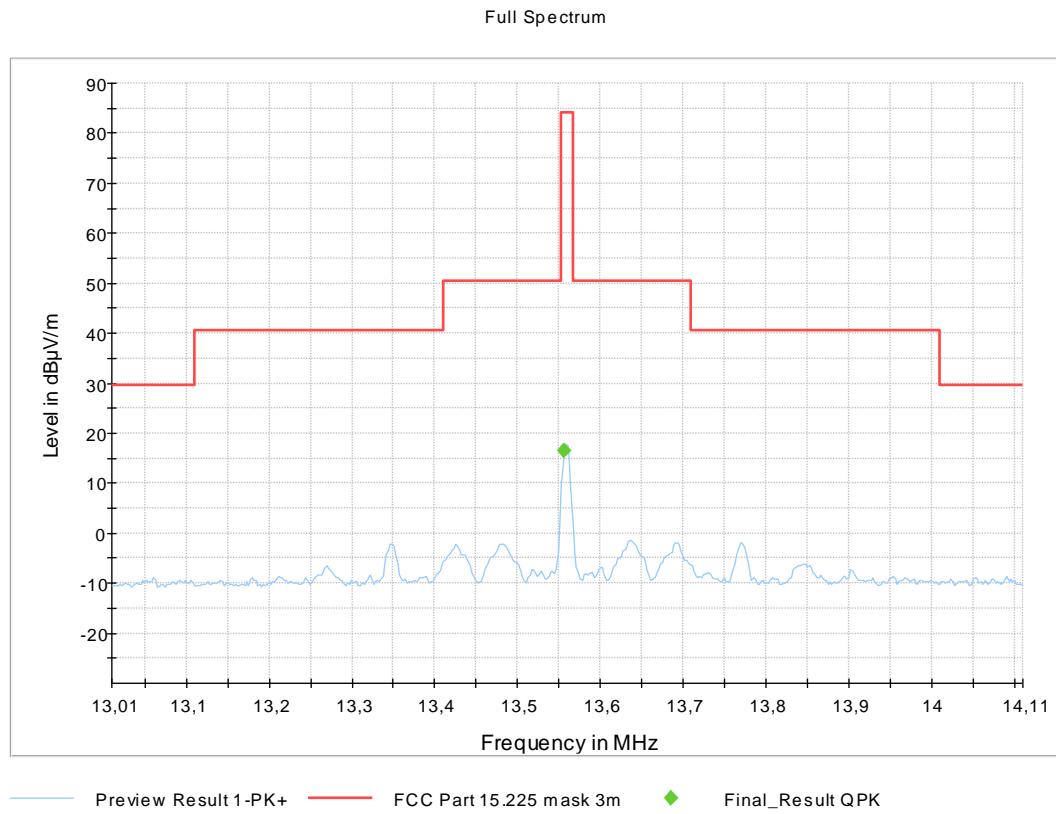


Figure 4: Emissions within the 13.110-14.010 MHz band, coaxial orientation

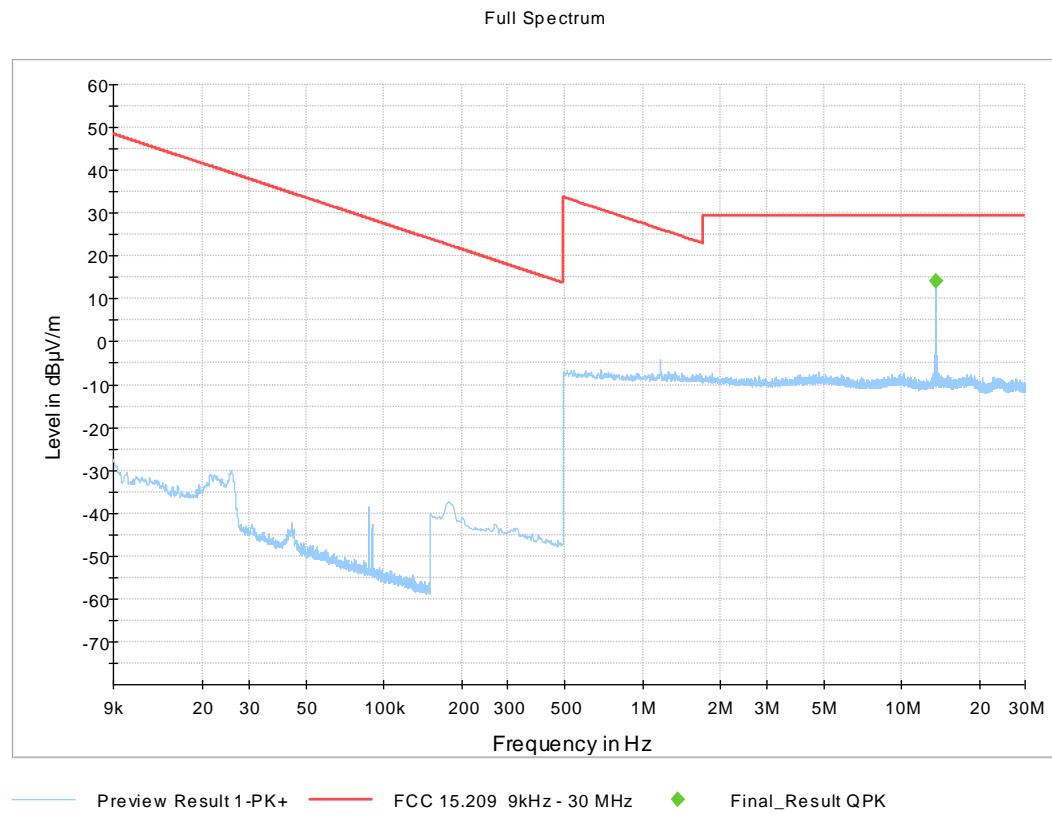


Figure 5: Radiated emissions 9 kHz – 30 MHz, measurement loop antenna in coplanar orientation

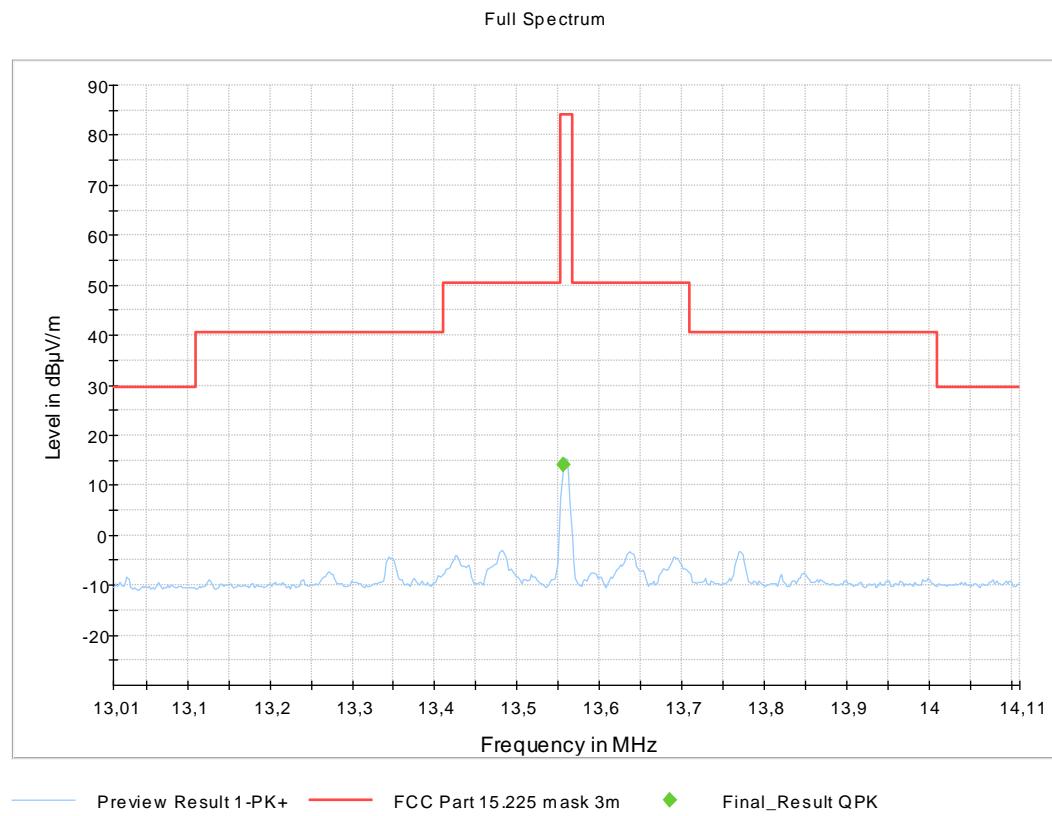


Figure 6: Emissions within the 13.110-14.010 MHz, coplanar orientation

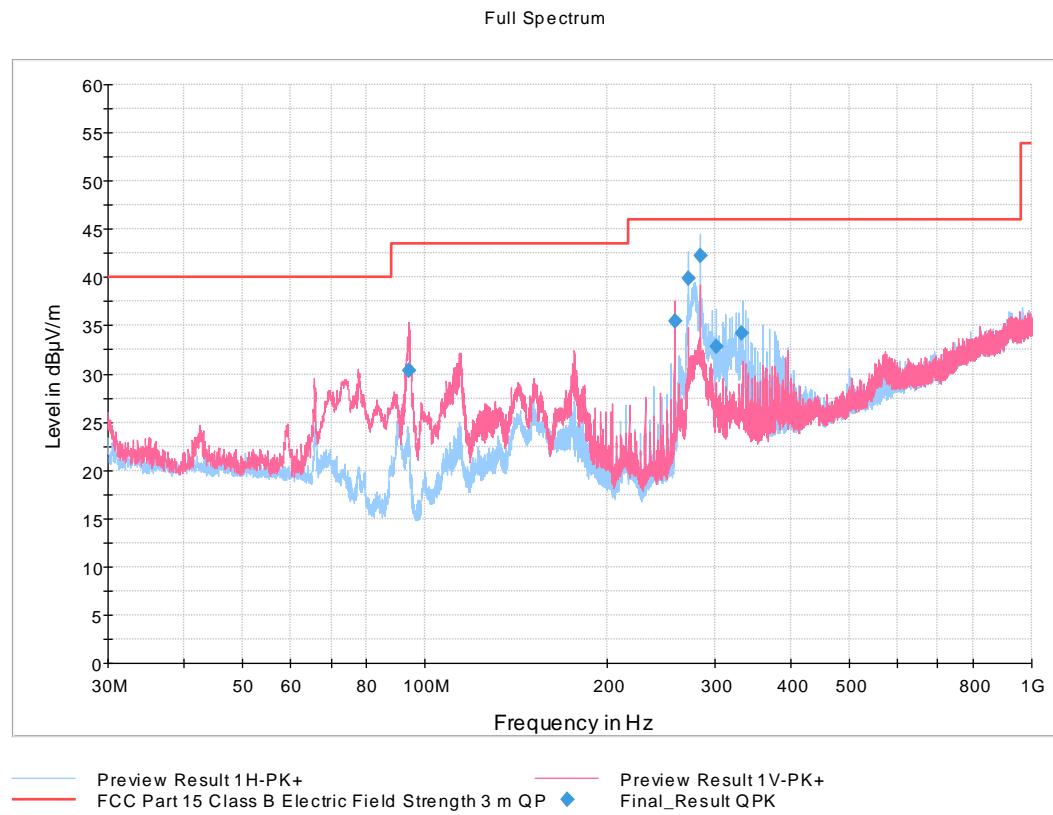


Figure 7: Radiated emissions 30 – 1000 MHz

Frequency Stability

Standard: ANSI C63.10-2020
Tested by: HEM
Date: 22 December 2023
Temperature: 22.8 °C
Humidity: 39 %RH
Barometric pressure: 971 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 $\pm 0.01\%$ (± 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

Table 3: Measured frequencies with temperature variation

Temperature [°C]	Voltage [VDC]	Measured frequency [MHz]			
		Startup	2 min	5 min	10 min
-20	12	13.558818680	13.558827000	13.558829560	13.558830520
-10		13.558848760	13.558851310	13.558851950	13.558852270
0		13.558852270	13.558850990	13.558850350	13.558849720
+10		13.558833080	13.558829240	13.558827320	13.558826040
+20		13.558797560	13.558793080	13.558790840	13.558788920
+30		13.558756280	13.558753080	13.558747650	13.558745410
+40		13.558714370	13.558708290	13.558705410	13.558704130
+50		13.558675970	13.558675330	13.558675010	13.558675010

Table 4: Measured frequencies with voltage variation

Temperature [°C]	Voltage [VDC]	Measured frequency [MHz]			
		Startup	2 min	5 min	10 min
+20	10.2	13.558789880	-	-	-
	12	13.558797560	13.558793080	13.558790840	13.558788920
	13.8	13.558789560	-	-	-
	34	13.558795000	-	-	-
	40	13.558790200	-	-	-
	46	13.558795640	-	-	-

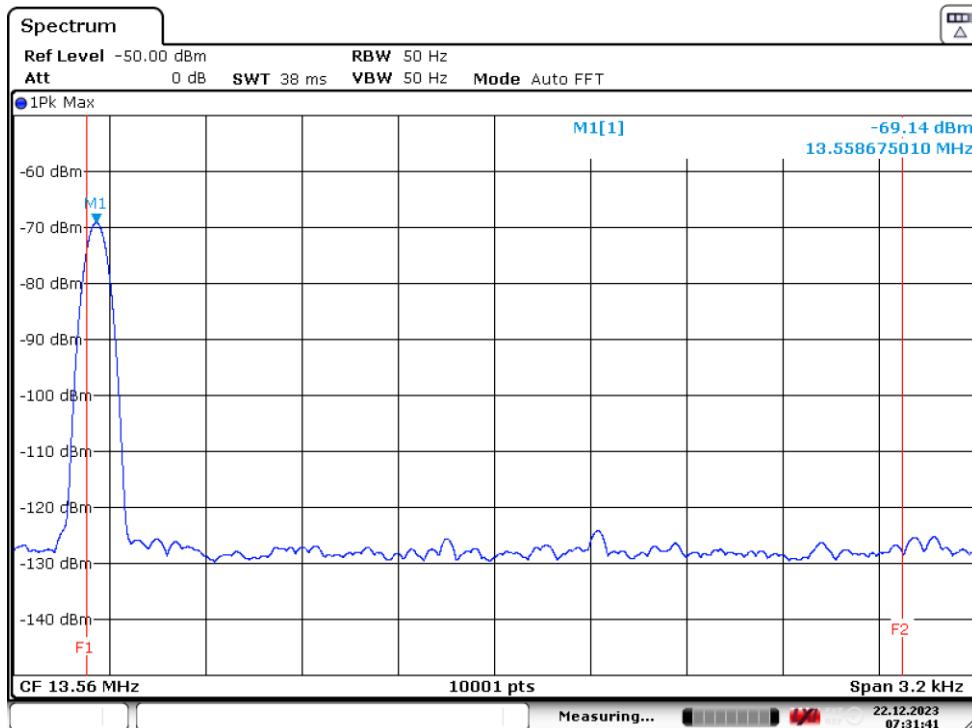
Table 5: Test results for Frequency Stability (temperature variation)

Temperature [°C]	Voltage [VDC]	Deviation [%]			
		Startup	2 min	5 min	10 min
-20	12	-0.008712	-0.008650	-0.008632	-0.008624
-10		-0.008490	-0.008471	-0.008466	-0.008464
0		-0.008464	-0.008474	-0.008478	-0.008483
+10		-0.008606	-0.008634	-0.008648	-0.008658
+20		-0.008868	-0.008901	-0.008917	-0.008931
+30		-0.009172	-0.009196	-0.009236	-0.009252
+40		-0.009481	-0.009526	-0.009547	-0.009557
+50		-0.009764	-0.009769	-0.009771	-0.009771

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

Temperature [°C]	Voltage [VDC]	Deviation [%]			
		Startup	2 min	5 min	10 min
+20	10.2	-0.008924	-	-	-
	12	-0.008868	-0.008901	-0.008917	-0.008931
	13.8	-0.008927	-	-	-
	34	-0.008886	-	-	-
	40	-0.008922	-	-	-
	46	-0.008882	-	-	-

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: 22 December 2023
Temperature: 22.8 °C
Humidity: 39 %RH
Barometric pressure: 971 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
1276.372363	N/A	PASS

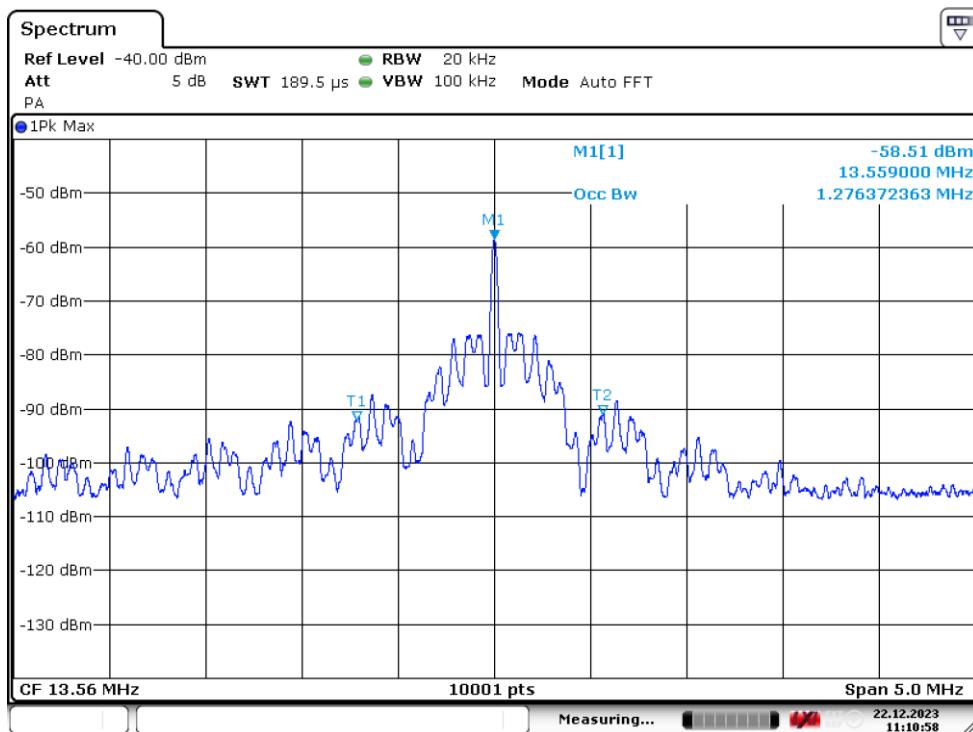


Figure 9: Occupied Bandwidth 99 %

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-ZZ , 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