Test Report

HELEM2108000327-2

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:	Indoor air quality transmitter
Model:	eGate-Kombi-LWUS-RHT-CO2-TVOC-Dust40-DP
Manufacturer:	Nokeval Oy Rounionkatu 107 FI-37150, Nokia Finland
Customer:	Nokeval Oy Rounionkatu 107 FI-37150, Nokia Finland
FCC Rule Part:	15.247
IC Rule Part:	RSS-247, Issue 2, 2017 RSS-GEN Issue 5 Amendment 2, 2021
KDB:	558074 D01 15.247 Meas Guidance v05r02 Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under §15.247 of the FCC rules (April 2, 2019)

- *partial testing, see test suite for details*

Date:	10 June 2022	Date:	10 June 2022
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	1 March 2022
1.1	General Description corrected. Integral antenna gain added to Ratings and declarations	6 June 2022
1.2	EUT Test Conditions corrected. Unwanted emissions (radiated) test description updated on page 13.	10 June 2022

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test:	Indoor air quality transmitter
Model:	eGate-Kombi-LWUS-RHT-CO2-TVOC-Dust40-DP
Type:	-
Trademark:	eGate
Serial no:	N110552 (conducted RF tests), N110554 (other tests)
FCC ID:	2A3B4CMWX01
IC:	-
Radio module or chip:	Murata CMWX1ZZABZ-093

General Description

The equipment under test is an indoor air quality transmitter, which measures temperature, humidity, CO2, TVOC, particles, and differential pressure. The equipment includes a LoRaWAN radio which operates in the 902.3-914.9 MHz band.

Classification

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

Modifications Incorporated in the EUT

A modified sample was provided with the integral antenna replaced with a 50 Ω RF connector.

Ratings and declarations

Operating Frequency Range (OFR):	uplink	902.3-914.9 MHz (125 kHz BW)
	uplink	903.0-914.2 MHz (500 kHz BW)
	downlink	923.3-927.5 MHz (500 kHz BW)
Channels:	uplink	64 (125 kHz BW)
	uplink	8 (500 kHz BW)
	downlink	8 (500 kHz BW)
Channel separation:	uplink	200 kHz (125 kHz BW)
	uplink	1.6 MHz (500 kHz BW)
	downlink	600 kHz (500 kHz BW)
Transmission technique:	CSS	
Modulation:	LoRa	
Antenna type:	Integral	
Integral Antenna gain:	+2.4 dBi	

Power Supply

Operating voltage range:	5 ± 0.5 VDC

Mechanical Size of the EUT

Height: 87 mm	Width: 75 mm	Length: 95 mm

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**
§15.247(a)(1)(i) / RSS-247 5.1 a)	20 dB Bandwidth	**N/T**
§15.247(a)(1) / RSS-247 5.1 b)	Carrier Frequency Separation	**N/T**
§15.247(a)(1)(i) / RSS-247 5.1 c)	Number of Hopping Channels	**N/T**
§15.247(a)(1)(i) / RSS-247 5.1 c)	Average Time of Occupancy	**N/T**
§15.247(a)(2) / RSS-247 5.2 a)	6 dB Bandwidth	**N/T**
§15.247(e) / RSS-247 5.2 b)	Power Spectral Density	**N/T**
§15.247(b)(2) / RSS-247 5.4 a)	Maximum Peak Conducted Output Power	**PASS**
§15.247(d) / RSS-247 5.5	Unwanted Emissions (radiated)	**PASS**
§15.247(d) / RSS-247 5.5	Band-Edge Measurement and Unwanted Emissions (conducted)	**PASS *)**
RSS-GEN 6.7	99% Occupied Bandwidth	**N/T**

*) Only Band-Edge Measurement was performed

The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.10-2013.

EUT Test Conditions during Testing

The EUT was in continuous transmit mode during all the tests. The EUT was configured into the wanted channel using software provided by the manufacturer (Nokeval MekuWin v1.22.0). The EUT was powered with a peripheral AC/DC power supply.

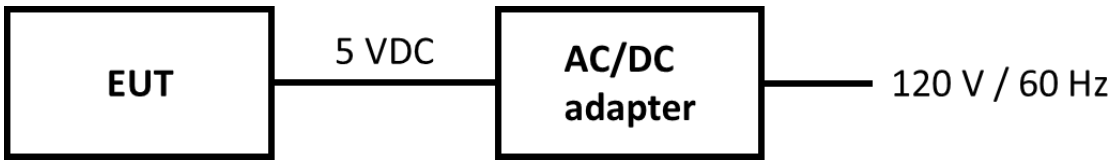

Figure 1: Test setup block diagram

Table 1: Worst-case test frequencies and settings

Uplink channel	Frequency [MHz]	Bandwidth [kHz]	Spreading Factor
0	902.3	125	10
71	914.2	500	8

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: 24 February 2022

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 C63.10-2013
Tested by:	HEM
Date:	24 February 2022
Temperature:	23 °C
Humidity:	33 %RH
Measurement uncertainty:	± 2.9 dB, level of confidence 95 % (k = 2)
Test result:	**PASS**

FCC Rule: 15.207 (a)
RSS-GEN 8.8

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

During the test the EUT was set to transmit on channel 0.

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

*Decreases with the logarithm of the frequency.

Test results

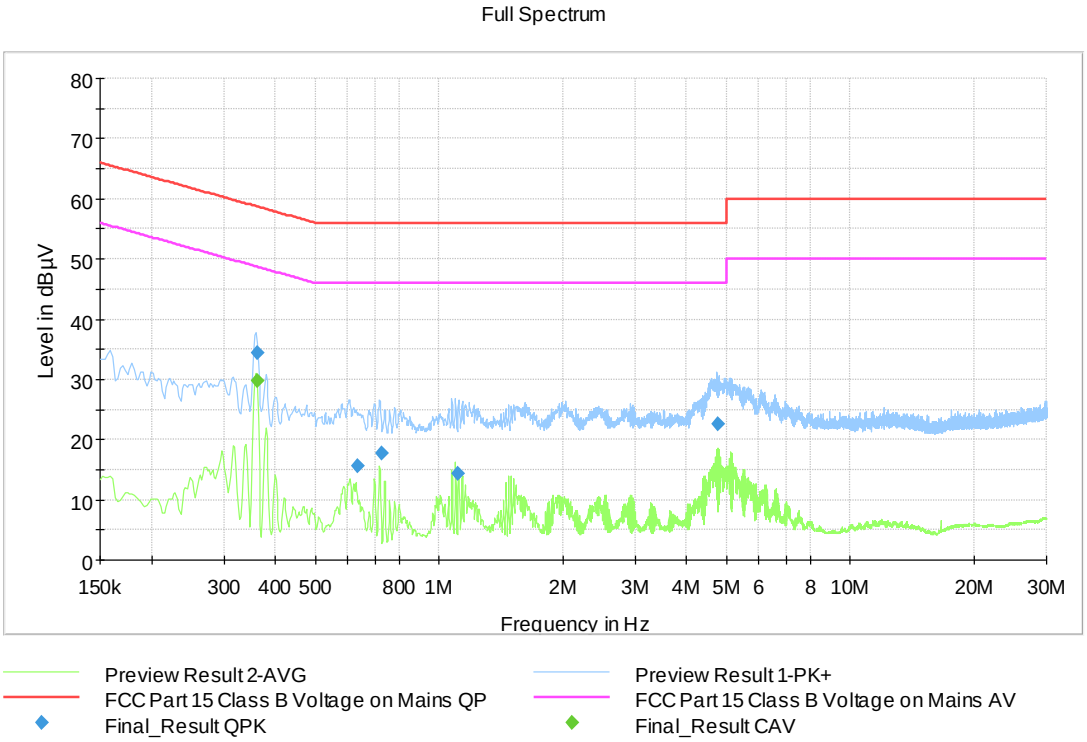

Figure 2: The measured curves with peak- and average detector

Table 2: Final measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.362250	---	29.72	48.68	18.96	15 x 1000.0	9.000	N	9.7
0.362250	34.36	---	58.68	24.32	15 x 1000.0	9.000	L1	9.7
0.633750	15.66	---	56.00	40.34	15 x 1000.0	9.000	N	9.7
0.724000	17.74	---	56.00	38.26	15 x 1000.0	9.000	L1	9.8
1.109250	14.27	---	56.00	41.73	15 x 1000.0	9.000	L1	9.8
4.755500	22.63	---	56.00	33.37	15 x 1000.0	9.000	L1	10.0

The correction factor in the final result table contains the sum of the transducers (LISN + cables).
The result value is the measured value corrected with the correction factor.

Maximum Peak Conducted Output Power

Standard: ANSI C63.10-2013
Tested by: HEM
Date: 25 February 2022
Temperature: 23 °C
Humidity: 33 %RH
Test result: **PASS**

FCC Rule: §15.247(b)(2)
RSS-247 5.4 a)

For frequency hopping systems operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels.

For digital transmission systems employing digital modulation techniques operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1 W.

Test results

Table 3: Maximum Peak Conducted Output Power results

Channel	Output Power [dBm]	Output Power [W]	Limit [W]	Result
0	17.19	0.052	1.0	PASS
71	16.92	0.049	1.0	PASS

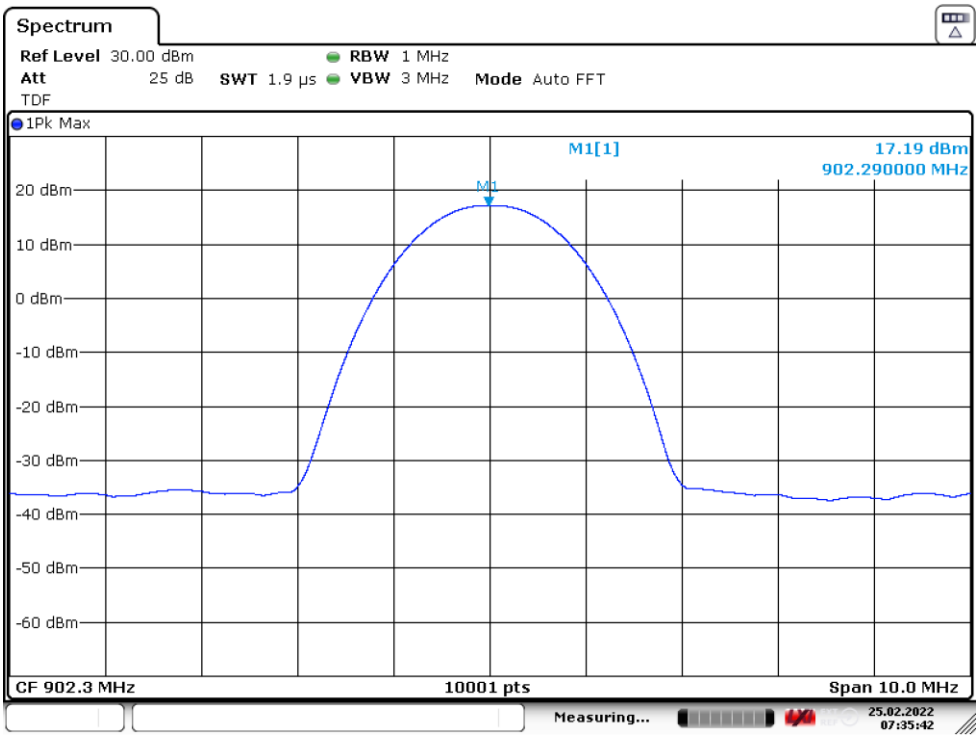

Figure 3: Maximum Peak Conducted Output Power (Channel 0)

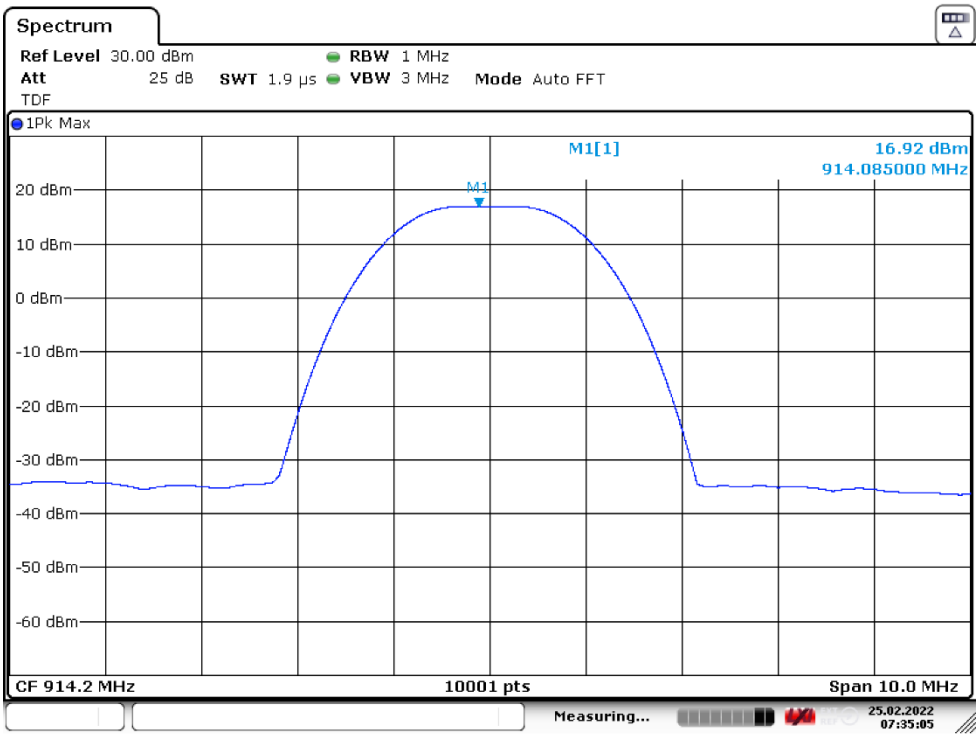

Figure 4: Maximum Peak Conducted Output Power (Channel 71)

Unwanted Emissions (radiated)

Standard: ANSI C63.10-2013
Tested by: HEM
Date: 24 February 2022
Temperature: 23 °C
Humidity: 33 %RH
Measurement uncertainty: ± 4.51 dB, level of confidence 95 % (k = 2)
Test result: **PASS**

FCC Rule: 15.247(d), 15.209(a)
RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
0.009-0.490	2400/F(kHz)	48.5-13.8	Quasi-peak
0.490-1.705	24000/F(kHz)	33.8-22.97	Quasi-peak
1.705-30.0	30	29.54	Quasi-peak
30 – 80	100	40.0	Quasi-peak
88 – 216	150	43.5	Quasi-peak
216 – 960	200	46.0	Quasi-peak
960 – 1000	500	53.9	Quasi-peak
Above 1000	500	53.9	Average
Above 1000	5000	73.9	Peak

The final measurements were performed in the worst-case EUT orientation.

Test results

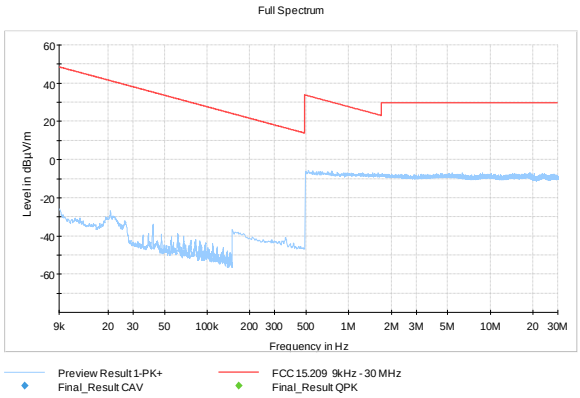

Figure 5: 9 kHz – 30 MHz (Channel 0)

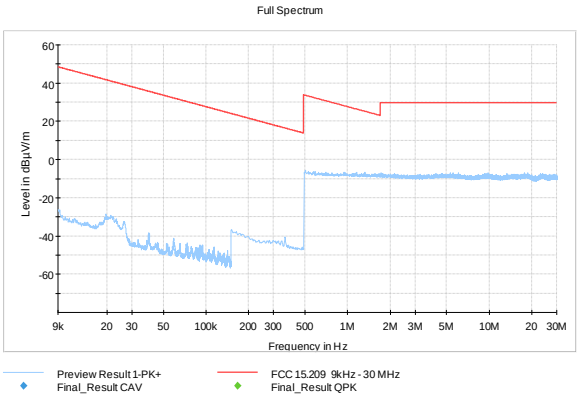

Figure 6: 9 kHz – 30 MHz (Channel 71)

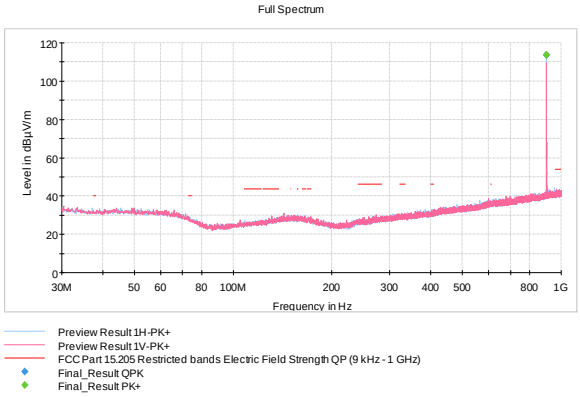

Figure 7: 30 – 1000 MHz (Channel 0)

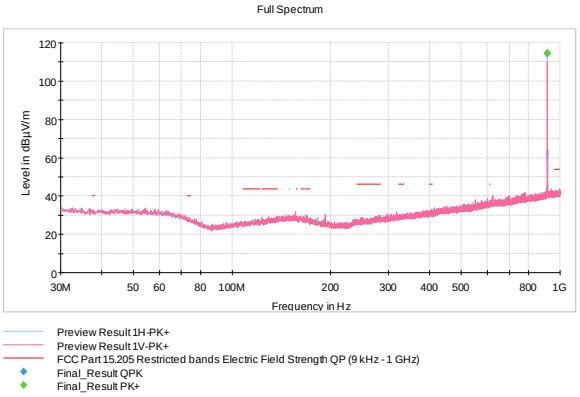

Figure 8: 30 – 1000 MHz (Channel 71)

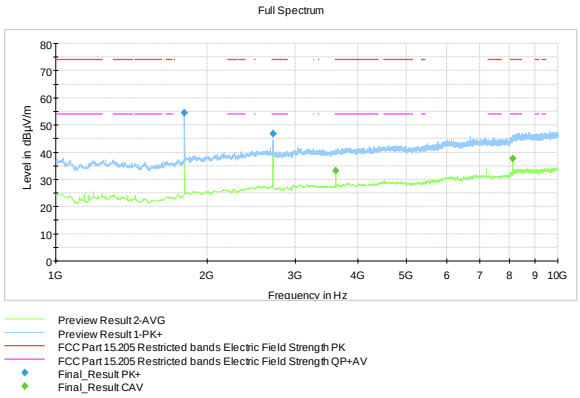

Figure 9: 1 – 10 GHz (Channel 0)

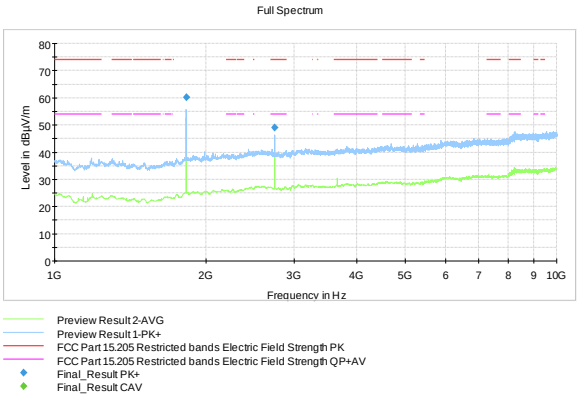

Figure 10: 1 – 10 GHz (Channel 71)

Table 4: Final Peak results

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
902.361000	113.74	---	---	15 x 1000.0	120.000	109.0	H	229.0	37.5
914.129000	114.56	---	---	15 x 1000.0	120.000	100.0	H	227.0	37.7
1804.575000	54.44	93.74 *)	39.30	15 x 1000.0	1000.000	206.0	H	46.0	2.4
1828.525000	60.30	94.56 *)	34.26	15 x 1000.0	1000.000	168.0	V	0.0	2.1
2706.875000	46.91	74.00	27.09	15 x 1000.0	1000.000	160.0	V	47.0	4.2
2742.675000	48.94	74.00	25.06	15 x 1000.0	1000.000	157.0	V	90.0	4.2

*) -20 dBc

Table 5: Final Average results

Frequency (MHz)	Caverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3609.175000	33.17	54.00	20.83	15 x 1000.0	1000.000	188.0	H	149.0	5.2
8120.625000	37.67	54.00	16.33	15 x 1000.0	1000.000	121.0	H	2.0	11.0

Table 6: Final Quasi-peak results

No final measurements were performed; no emissions detected near the limit

Band-Edge Measurement and Unwanted Emissions (conducted)

Standard: ANSI C63.10-2013
Tested by: HEM
Date: 25 February 2022
Temperature: 23 °C
Humidity: 33 %RH
Measurement uncertainty: ± 2.87 dB, level of confidence 95 % (k = 2)
Test result: **PASS**

FCC Rule: 15.247(d), 15.209(a)
RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

Note: only the Band-Edge measurement was performed.

Test results

Band-Edge Attenuation	
Lower Band-Edge	**Upper Band-Edge**
-50.18 dBc	-63.81 dBc
Limit: -20 dBc	

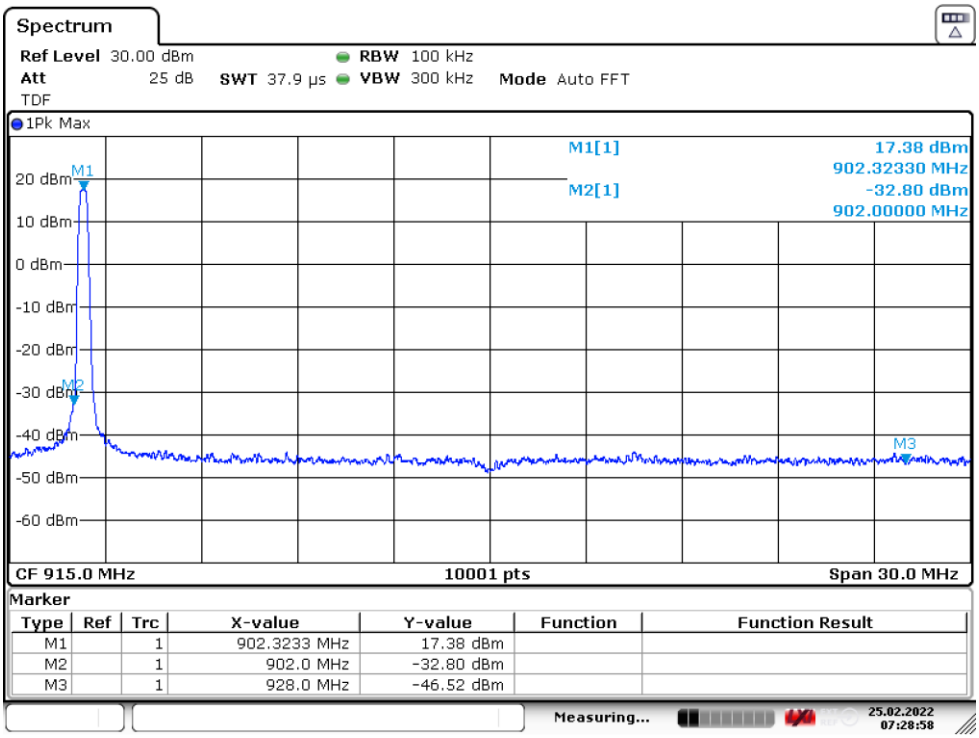

Figure 11: Band-Edge measurement (Channel 0)

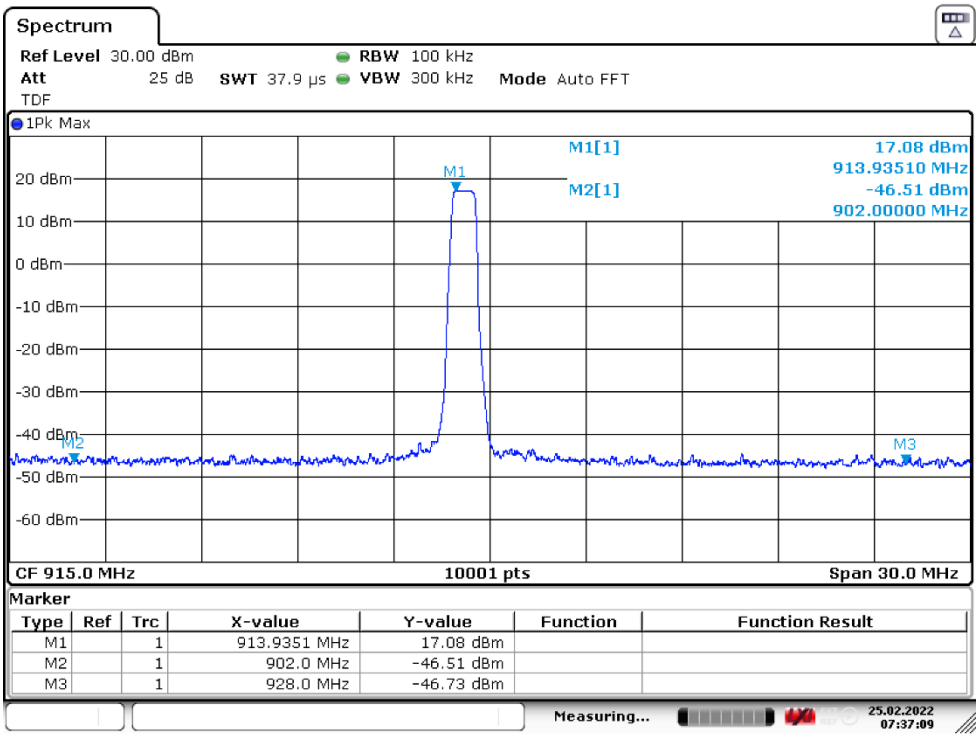

Figure 12: Band-Edge measurement (Channel 71)

TEST EQUIPMENT

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ANTENNA	EMCO	3117, emi 1-18GHz	inv. 7293	2020-03-11	2022-03-11
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv. 8013	2020-10-28	2022-10-28
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2020-11-04	2022-11-04
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	HUBER & SUHNER	6808.17.B (6 dB)	inv. 10391	2021-01-25	2023-01-25
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv. 10126	2022-02-23	2024-02-23
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2021-06-21	2022-06-21
FILTER	WAINWRIGHT	WHKX1.0/15G-10SS	inv. 8267	2021-01-29	2023-01-29
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2022-02-02	2023-02-02
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	NCR
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2021-10-05	2022-10-05
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv. 9093	2021-12-06	2022-12-06
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 EMC	inv. 10516	2021-10-22	2022-10-22
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2021-10-22	2022-10-22
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	NCR

NCR = No Calibration Required

END OF REPORT