

IQ Air AG

TEST REPORT

SCOPE OF WORK

RADIO TESTING – AIR PURIFIER [04]

REPORT NUMBER

2240389KAU-012

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TYPE: 04
DESCRIPTION: Air Purifier
SERIAL NO: N/A

All measurement results refer to the equipment which was tested

MANUFACTURER: IQAir AG
CUSTOMER NAME: IQAir AG
ADDRESS (CUSTOMER): Blumenfeldstrasse 10
9403 Goldach
Switzerland

REPORT NO: 2240389KAU-012

TEST RESULT: The equipment complies to 47 CFR Part 15, Subpart C, Intentional radiators, section 15.225 / RSS-210, Issue 10 and RSS-GEN, Issue 5 (Referring to the operating modes specified in this report) and the requirements are fulfilled.

TEST LABORATORY: Intertek Deutschland GmbH
Innovapark 20, 87600 Kaufbeuren
Germany

FCC DESIGNATION NUMBER: DE0014

FCC TEST FIRM REGISTRATION NUMBER: 359260

ISED CAB IDENTIFIER: DE0014
ISED #: 24854

TEST ENGINEER: M. Bensaid
Project Engineer

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Details about Accreditations/Acceptances

EMC / Radio National

	The Intertek Deutschland EMC-Lab is accredited by the Deutsche Akkreditierungsstelle GmbH (DAkkS) Registration Number (EMC general): D-PL-12085-01-01 Registration Number (EMC Med): D-PL-12085-01-03 Registration Number (EMC Canada): D-PL-12085-01-04 Registration Number (EMC FCC): D-PL-12085-01-05
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International

	The Intertek Deutschland EMC-Lab is accepted to participate in the IECEE (IEC Conformity assessment for Electrotechnical Equipment and Components) CB-Scheme CB Test Laboratory: TL118
	The Intertek Deutschland EMC-Lab is listed at the Federal Communications Commission (FCC) Designation Number: DE0014 Test Firm Registration Number: 359260
	The <i>Bundesnetzagentur</i> recognizes Intertek Deutschland GmbH as Conformity Assessment Body in the sector electromagnetic compatibility (EMC).
	The Intertek Deutschland EMC-Lab is accredited for Innovation, Science and Economic Development Canada (ISED) ISED CAB IDENTIFIER: DE0014 ISED #: 24854

Automotive

 Anerkennungsstelle Anerkannt unter KBA-P 00046-03	The Intertek Deutschland EMC-Lab is recognized as technical service of the Kraftfahrt-Bundesamt (KBA) Registration Number: KBA-P 00046-03
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SECTION 2

MEASUREMENT AND TEST SPECIFICATION

47 CFR Part 15, Subpart C, Intentional radiators, section 15.207 and section 15.225 /
RSS-210, Issue 10 and RSS-GEN, Issue 5

Test methods in:

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

No additions, deviations or exclusions have been made from standards and accreditation.

The test results detailed in this report apply only to the **04** with the test setup described.
Any modification such as a change, addition to or inclusion of another device into this
product will require an additional evaluation.

The support equipment listed as part of the emission tests is required to properly exercise
and test the device under test.

SECTION 3

GENERAL INFORMATION

Possible test case verdicts:

Test case does not apply to the test object: N/A (Not Applicable)

Test object does meet the requirement: P (Pass)

Test object does not meet the requirements: F (Fail)

Samples arrived: 2020-10-07 (EUT 1), 2021-01-28 (EUT 2) and 2021-09-07 (EUT 3)

Testing: 2020-11-12 to 2021-09-07

Decimal separator: ☒ Point ☐ Comma

Environmental conditions during testing:

Temperature:	15 °C - 35 °C
Humidity:	20 % - 60 %
Atmospheric pressure:	900 mbar - 1000 mbar

If explicitly required by a basic standard the measured climatic conditions are documented in the corresponding test section.

Test site:

Measurement Chamber	Type of chamber	IC Site filing #
ANECHOIC CHAMBER 1	Semi-anechoic 3 m	24854

SECTION 4

SUMMARY OF TESTING

4.1 General annotation

The tests were performed in the order of the right column in the “Test Results – Overview” table.

Professional judgement:

All measurement results exclusively refer to the equipment type **04** which was tested.

4.2 Identical types

N/A

4.3 Measurement uncertainty

For each test method, an uncertainty evaluation was carried out. The results of the evaluation can be provided upon request from Intertek Deutschland GmbH.

4.4 Document History

REVISION	DATE	REPORT	CHANGES	AUTHOR
Initial release	2022-01-18	2240389KAU-012	Initial issue	MBE

SECTION 5

TEST RESULTS – OVERVIEW

EMISSION	VERDICT	DATE	NO	TESTED WITH
Conducted emissions (0.15 MHz - 30 MHz)	P	2020-11-23 2021-01-05	3 4	EUT 1
Field strength (13.110 MHz – 14.010 MHz)	P	2021-03-18	5	EUT 1
Radiated emissions (< 30 MHz)	P	2021-03-18	6	EUT 1
Radiated emissions (30 MHz - 26 GHz)	P	2021-03-18 2021-03-19	7	EUT 2
Frequency Stability Test	P	2020-11-10 2020-11-23	2	EUT 1
20 dB bandwidth test	P	2021-09-07	8	EUT 3
Occupied bandwidth test	P	2020-11-12	1	EUT 1

SECTION 6

INFORMATION ABOUT THE EUT

6.1 Description of the EUT

Device tested as:

☒ table-top EUT

☐ floor-standing EUT

Dimensions:	Height:	Width:	Length:
	68.9 cm	64 cm	25.4 cm

Software version:	STM32: 90.4C, ESP32: 00.23
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Firmware version:	STM32: 90.4C, ESP32: 00.23
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Hardware version:	Preseries
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Operating temperature:	-20 – 50°C
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Description: The EUT is an air purifier for non-industrial spaces such as homes, offices, hospitality and retail spaces. In all cases the product is used to remove air pollutants from the surrounding environment. Operation is via a user interface on the purifier or via WLAN with a smart app. The EUT has a Bluetooth module, WLAN module and RFID module.

The RFID module reads out RFID-tags which are located on the air filter frame and can therefore determine the type of filters which are applied to the system.

A Bluetooth connection takes place as a background process, for connecting the purifier to a WLAN network. This Bluetooth connection allows for clear identification of the purifier to be connected.

Technical data of the RFID module

Transmitter frequency range: 13.56 MHz

Frequency agile or hopping: ☐ Yes ☒ No

Antenna: ☒ Internal antenna ☐ External antenna

Antenna connector: ☒ None, internal antenna ☐ Yes, type

Type of modulation: ISO/IEC 14443 Type A standard

Type of used TAG: NXP NTAG212

Temperature range: 0 – 50°C

Power rating: RFID Transceiver Power: 15.9 dBuA/m; RFID TAG: passive

Transmitter stand by mode supported: ☒ Yes ☐ No

6.1.1 Photo of the device and the rating plate

EUT:



Rating plate:

		FCC ID: 24MBQ-ATEMX04, IC: 22813-ATEMX04 Contain/Contient FCC ID: 24C72-ESPRH00M02 and IC: 21086-ESPRH00M02 This device complies with Part 15 of the FCC Rules and contains no user-serviceable parts that require field replacement. (1) This device may not cause interference. (2) This device must accept any interference, including interference that may cause improper operation of the device. Cet appareil respecte les normes de la Commission des normes, de l'équité, de la consommation et de l'énergie (CNEEC) de la Loi sur l'accès à l'information. (1) Cet appareil ne doit pas produire de brouillage. (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.		Atem[®] X	Serial number/ Numéro de série: 0420-L000-7000-0
Pairing Code/Code d'appariement: 123456 	Conforms to UL 916, 907 Conforme à la norme UL 907 CUL: 50-120V/1.6A CUL: 50-120V/1.6A Conforms to CAN/CSA C22.2 No. 115 Conforme à la norme CAN/CSA C22.2 No. 115	Model: Atem X Product: Air purifier Designed in Switzerland Made in Germany	Modèle: Atem X Produit: purificateur d'air Conçu en Suisse Fabriqué en Allemagne	Type: D4 Article number/numéro de l'article: 275-AA-10-F1 Ratings/cotes: 100-120V, 50-60Hz, 110W, 1.6A Production date/Date de production: 24 November/Novembre 2021	MAC Ethernet: 24:0A:C4:D4:50:03 MAC Wi-Fi: 24:0A:C4:D4:50:03 The purifier must be securely fixed when placed on a bench-top surface or table. Le purificateur doit être solidement fixé lorsqu'il est placé sur une surface de banc ou une table.
Manufacturer/Fabricant: Factory/Fabrique: Importer/Importateur:		IQAir AG, Blumenfeldstrasse 10, CH-9403 Goldach, Switzerland IQAir Germany GmbH, Karl-Maybach-Strasse 18, DE-88239 Wangen im Allgäu, Germany, EPA Establishment Registration No. 97566-DEU-1 IQAir North America, 14351 Firestone Blvd., La Mirada, CA 90638, USA, EPA Establishment Registration No. 97566-CA-1			

6.2 Power interface

MODE	VOLTAGE (V)	FREQUENCY (Hz)	COMMENT
Rated	100-120	50 / 60	For USA, Canada and Japan
1	120	60	-

6.3 Configuration mode

MODE	DESCRIPTION
1	The EUT was placed on the table and was directly connected to mains. The notebook and the USB cable were used for the setting the WLAN module and the RFID module (see section 6.10). The notebook was under the table.
2	The EUT was placed on the table and was directly connected to mains (see section 6.11).
3	The EUT was placed in the climatic chamber and was directly connected to mains. The loop antenna was placed in front of the RFID module (see section 6.12).

6.4 Operation mode

MODE	DESCRIPTION
1	The WLAN module and the RFID module of the EUT were in continuous wave mode.
2	The RFID module of the EUT was in continuous transmitting mode (continuous reading the RFID-tags).
3	Full load operation and the antenna of the RFID module was replaced by a terminating resistor. The RFID module of the EUT was on

6.5 Supply and interconnecting cables used for testing

LINE	LENGTH (cm)	SHIELDING
AC cable	180	N
USB cable	100	N

6.6 System components

DEVICE	MANUFACTURER	TYPE	MODEL
-	-	-	-

6.7 Peripheral devices used for testing

PRODUCT TYPE	MANUFACTURER/TYPE
Notebook	ThinkPad / 20FN-003LMZ

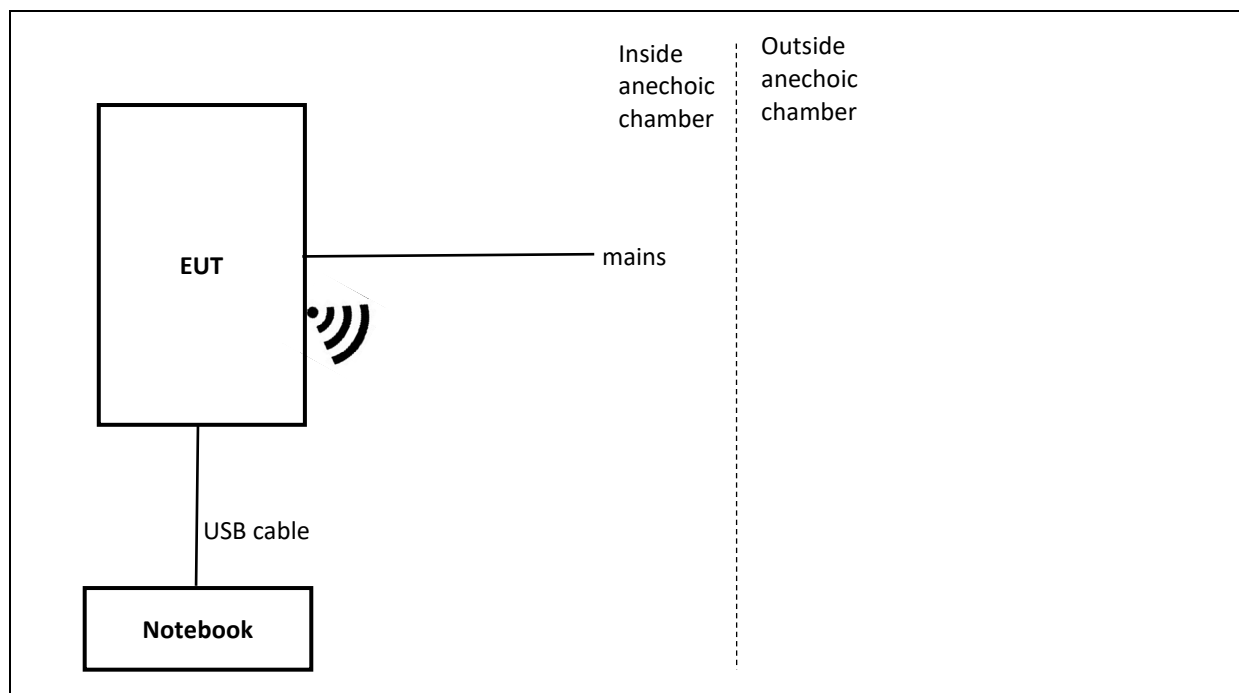
6.8 Antenna configuration

DESCRIPTION
☐ Equipment with an external antenna connector
☒ Equipment without an external antenna connector (integral antenna)
☐ Equipment with more than one antenna

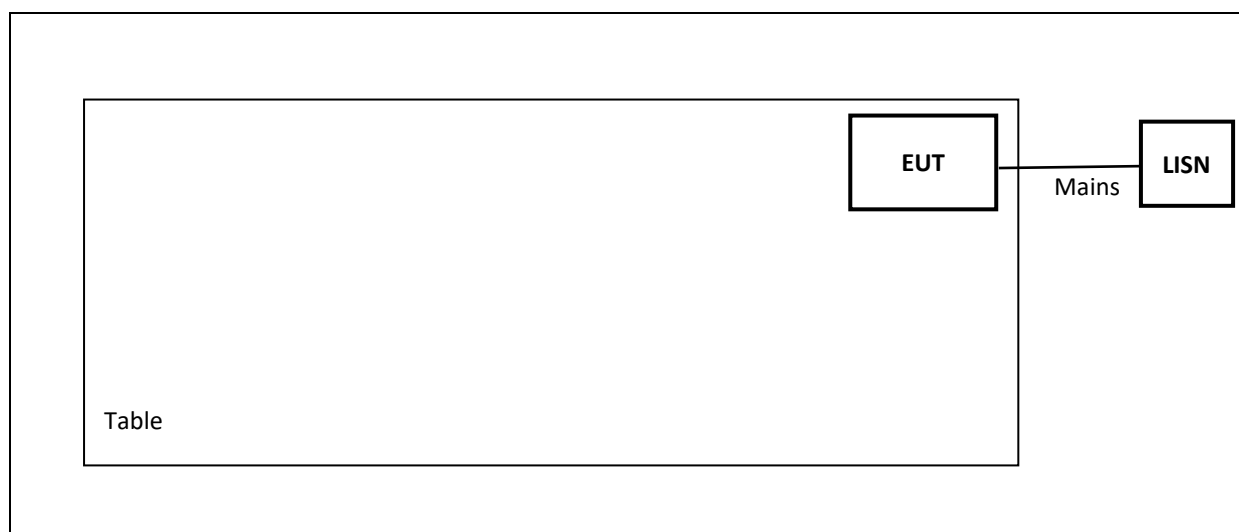
6.9 Clock frequencies of the EUT

SOURCE	FREQUENCY (MHz)
Bluetooth	2402 – 2480
WLAN	2412 – 2462
Crystal Oscillator MCU	16.0
Real Time Crystal Clock Oscillator MCU	0.032768
Crystal Oscillator RFID Transceiver	27.12
Crystal Oscillator WLAN Module	40.0
RFID	13.56

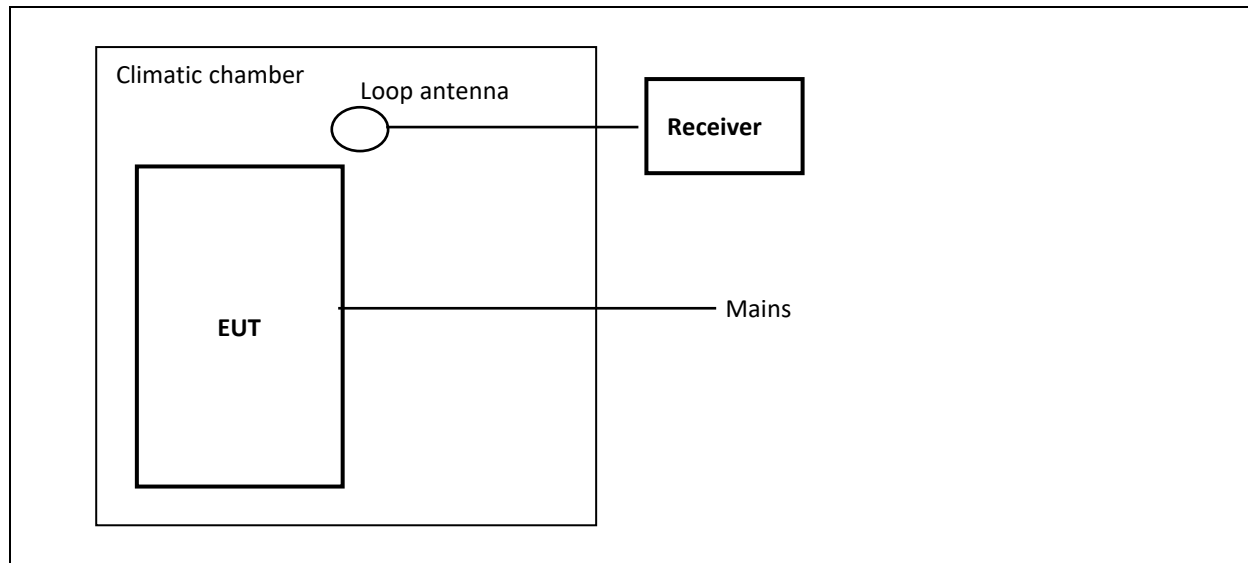
6.10 Block diagram of the test setup for anechoic chamber



6.11 Block diagram of the test setup for conducted emissions



6.12 Block diagram of the test setup for 20 dB bandwidth-, Occupied bandwidth- and Frequency Stability-test



SECTION 7

7.1 Conducted emissions

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.207 RSS-210, Issue 10		P
Methods of measurement according to:	ANSI C63.10 RSS-Gen, Issue 5		
Equipment mode	Power interface	1	
	EUT configuration mode	2	
	Operation mode	2 and 3	
Test requirements	Frequency range	150 kHz - 30 MHz	

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Shielded cabin	ETS LINDGREN	RFSD 100	3598	PM KF 2955-2	-
Pulse Limiter 10 dB 9 kHz - 200 MHz	Schwarzbeck	VTSD 9561-F N	9561-F N242	PM KF 3059	2020-12 (1 year) 2019-12 (1 year)
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
V-Artificial mains-network, 2 Line	Rohde & Schwarz	ESH3-Z5	863367/018	PM KF 0142	2019-10 (2 years)
Test software	Rohde & Schwarz	EMC 32 V.8.54	-	PM KF 2983	-

Comment

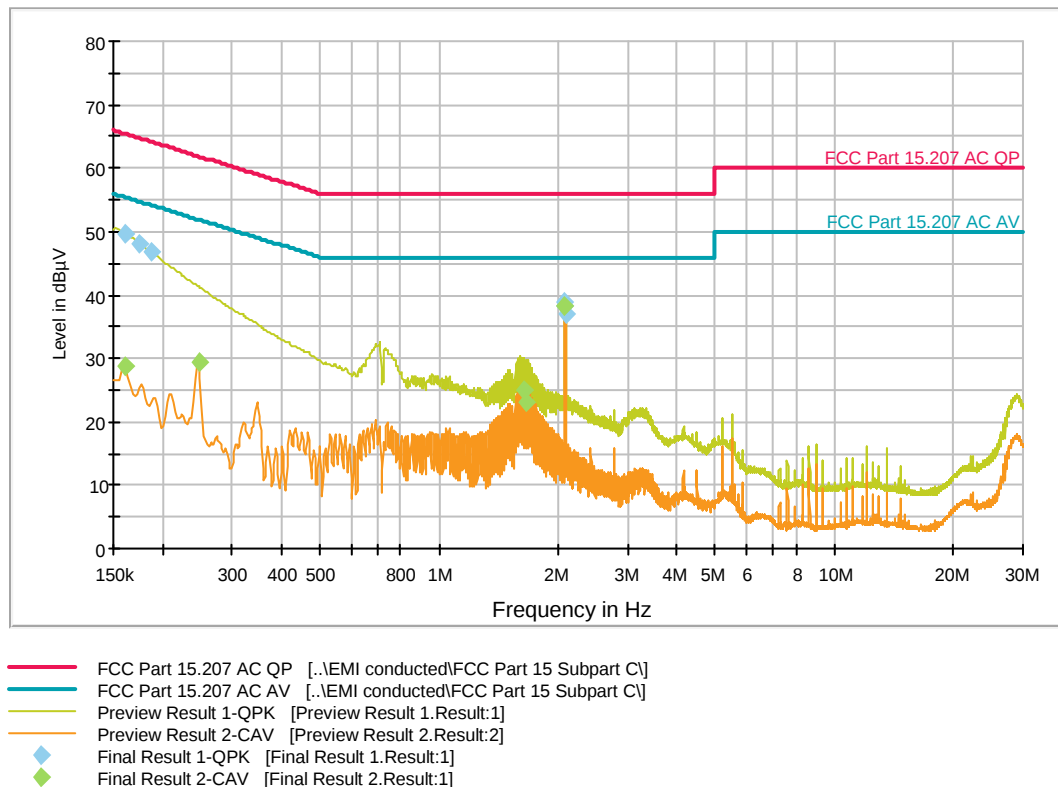
In the following diagram, the N and L line are merged.

Measurement results – Conducted emissions:

Common Information

EUT:	IQAir, model: Atem X, Type 04
Project No.:	40389
Test description:	Conducted Emissions
Test stand:	FCC 15 C / RSS-GEN - RSS-210
Tested port:	Mains
Test verdict:	Passed
Operating conditions:	Full load operation and the antenna of the RFID module was replaced by a terminating resistor.
Operator name:	MBE
Date of testing:	23.11.2020

EN-CE-R32-LN01



Final Result 1

Frequency (MHz)	QuasiPeak-ClearWrite (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.161250	49.8	GND	N	10.2	15.6	65.4	
0.174750	48.1	GND	N	10.2	16.6	64.7	
0.188250	46.7	GND	N	10.2	17.4	64.1	
2.080500	38.4	GND	N	10.2	17.6	56.0	
2.082750	38.8	GND	N	10.2	17.2	56.0	
2.085000	37.1	GND	N	10.2	18.9	56.0	

Final Result 2

Frequency (MHz)	CAverage-ClearWrite (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.161250	28.8	GND	N	10.2	26.6	55.4	
0.246750	29.4	GND	L1	10.2	22.4	51.9	
1.641750	25.0	GND	L1	10.2	21.0	46.0	
1.659750	22.9	GND	L1	10.2	23.1	46.0	
2.082750	38.2	GND	N	10.2	7.8	46.0	

EMI Auto Test Template: EN-CE-R32-LN01

Hardware Setup: EN-CE-R32-LN01
Measurement Type: 2 Line LISN
Frequency Range: 150 kHz - 30 MHz
Graphics Level Range: 0 dBμV - 80 dBμV

Preview Measurements:
Scan Test Template: EN-CE-R32-LN01_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	50 Hz	QPK; CAV	200 Hz	1 s	20 dB
150 kHz - 30 MHz	2.25 kHz	QPK; CAV	9 kHz	1 s	0 dB

Receiver: [ESR 7]

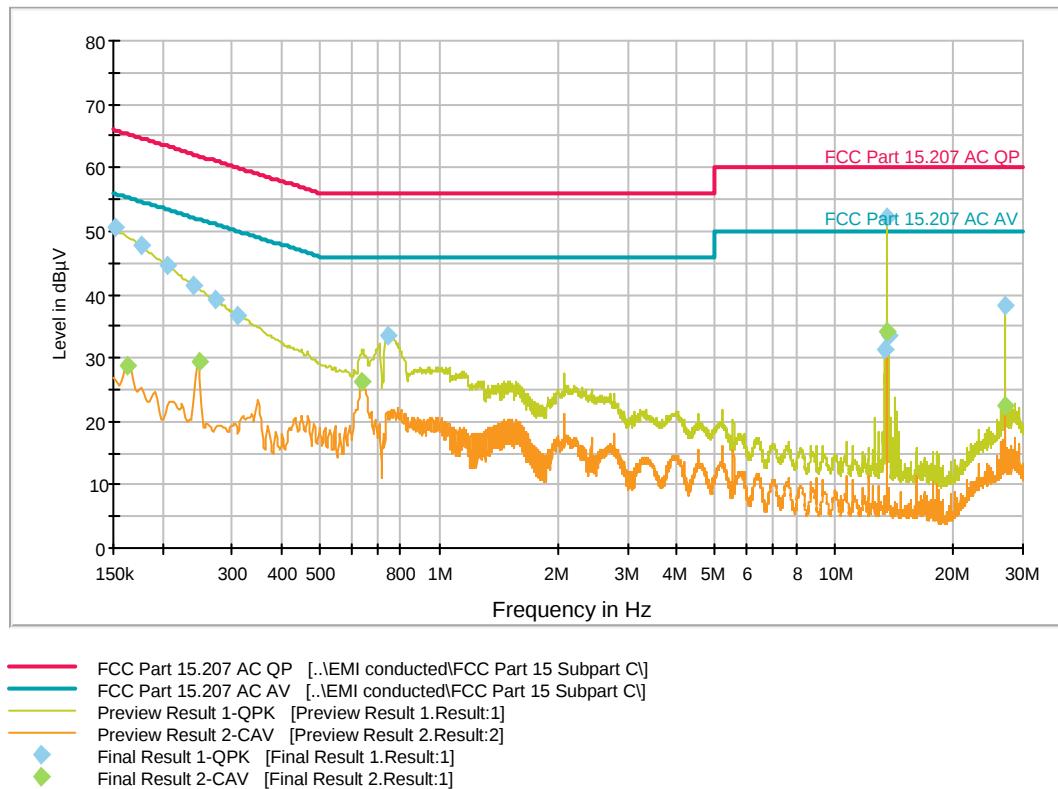
Data Reduction:
Limit Line #1: FCC Part 15.207 AC QP
Limit Line #2: FCC Part 15.207 AC AV
Peak Search: 6 dB , Maximum Results: 10
Subrange Maxima: 10 Subranges , Maxima per Subrange: 1
Acceptance Offset: -10 dB
Maximum Number of Results: 20
After Data Reduction: Interactive data reduction

Report Settings:
Report Template: Standard Report_EMC KF_Conducted Emission

Common Information

EUT: IQAir, model: Atem X, Type 04
Project No.: 40389
Test description: Conducted Emissions, 150 kHz - 30 MHz
Test standard: FCC part 15 subpart C
Tested port: Mains
Test verdict: Passed
Operating conditions: The RFID module of the EUT was in continuous transmitting mode
Operator name: SBE
Date of testing: 05.01.2021

EN-CE-R32-LN01



Final Result 1

Frequency (MHz)	QuasiPeak-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.152250	50.4	GN	N	10.2	15.4	65.9	
0.177000	47.6	GN	N	10.2	17.0	64.6	
0.206250	44.4	GN	N	10.2	18.9	63.4	
0.240000	41.4	GN	N	10.2	20.7	62.1	
0.271500	39.1	GN	L1	10.2	22.0	61.1	
0.307500	36.8	GN	N	10.2	23.2	60.0	
0.744000	33.5	GN	L1	10.2	22.5	56.0	
13.348500	31.2	GN	L1	10.8	28.8	60.0	
13.560000	52.1	GN	L1	10.9	7.9	60.0	
13.771500	33.5	GN	L1	10.9	26.5	60.0	
27.120750	38.2	GN	L1	11.3	21.8	60.0	

Final Result 2

Frequency (MHz)	CAverage-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.163500	28.6	GN	N	10.2	26.7	55.3	
0.246750	29.4	GN	N	10.2	22.5	51.9	
0.636000	26.1	GN	N	10.2	19.9	46.0	
13.560000	34.3	GN	L1	10.9	15.7	50.0	
27.120750	22.6	GN	L1	11.3	27.4	50.0	

EMI Auto Test Template: EN-CE-R32-LN01

Hardware Setup: EN-CE-R32-LN01
Measurement Type: 2 Line LISN
Frequency Range: 150 kHz - 30 MHz
Graphics Level Range: 0 dB μ V - 80 dB μ V

Preview Measurements:
Scan Test Template: EN-CE-R32-LN01_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	50 Hz	QPK; CAV	200 Hz	1 s	20 dB
150 kHz - 30 MHz	2.25 kHz	QPK; CAV	9 kHz	1 s	0 dB

Receiver: [ESR 7]

Data Reduction:
Limit Line #1: FCC Part 15.107 AC QP, Class B
Limit Line #2: FCC Part 15.107 AC AV, Class B
Peak Search: 6 dB , Maximum Results: 10
Subrange Maxima: 10 Subranges , Maxima per Subrange: 1
Acceptance Offset: -10 dB
Maximum Number of Results: 20
After Data Reduction: Interactive data reduction

Report Settings:
Report Template: Standard Report_EMK KF_Conducted Emission

7.2 Field strength 13.110 MHz – 14.010 MHz (Emission Mask)

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (a) – (c) RSS-210, Issue 10, section B4		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.4 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	13.110 MHz – 14.010 MHz	
	Measurement time	1 s	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The limits below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)	Field strength (dBµV/m)	Measurement distance (m)
13.110 - 13.410	106	40.5	30	80.5	3
13.410 - 13.553	334	50.5	30	90.5	3
13.553 - 13.567	15848	84.0	30	124.0	3
13.567 - 13.710	334	50.5	30	90.5	3
13.710 - 14.010	106	40.5	30	80.5	3

Test setup details

Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth.

The test was carried out automatically by the test receiver.

The EUT is a table-top EUT and was standing on a table made of Styrodur on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

Test equipment

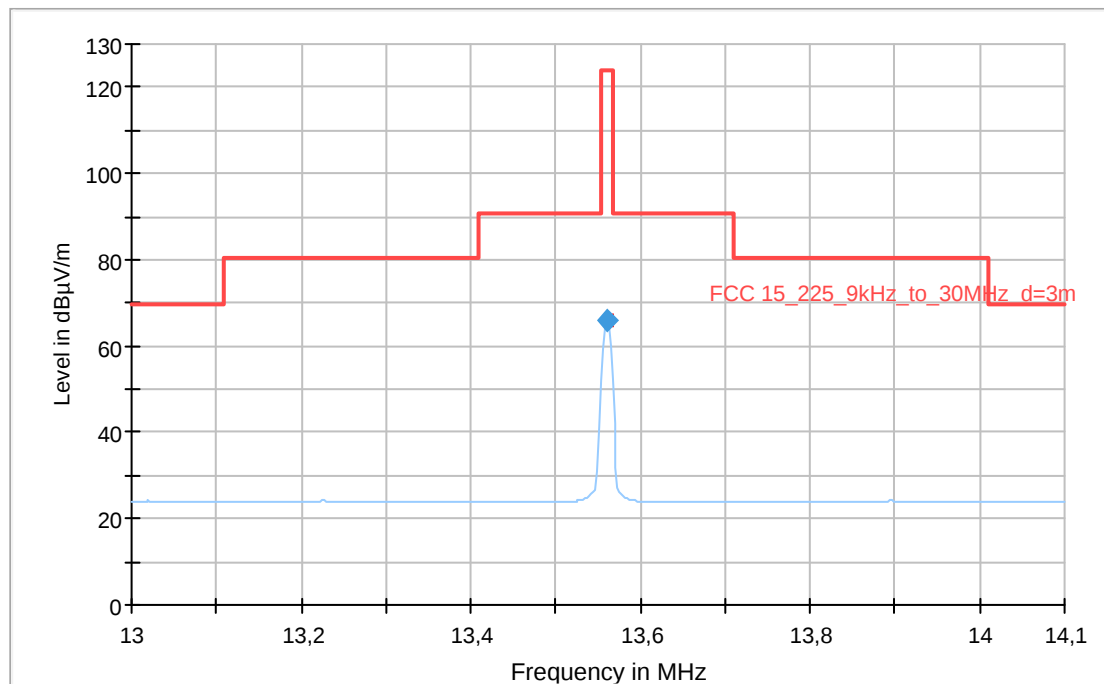
DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-02	2018-04 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Active loop antenna, 9 kHz-30 MHz	Rohde & Schwarz	HFH2-Z2	881058/48	PM KF 1401	2020-08 (1 year)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983-2	-

Measurement results – Field strength 13.110 MHz – 14.010 MHz (Emission Mask):

Radiated Emissions Test Report

Common Information

EUT:	IQAir, model: Atem X, Type 04
Test Verdict:	Passed
Test Description:	FCC Part 15C
Operating Conditions:	RFID and WLAN were in continuous wave mode
Operator Name:	UGR
Project Number:	40389
Date:	18.03.2021



Preview Result 1-QPK [Preview Result 1.Result:1]
 * Critical_Freqs AVG [Critical_Freqs.Result:5]
 * Critical_Freqs QPK [Critical_Freqs.Result:4]
 FCC 15_225_9kHz_to_30MHz_d=3m [..zF radiated\FCC Part 15C]
 ◆ Final_Result QPK [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	65.72	---	124.00	58.28	1000.0	9.000	H	198.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
13.560000	19.6	-

Comment

The 13.56 MHz RFID transmitter was operated in CW mode. Therefore, the bandwidth of the transmitting signal is smaller than the measuring bandwidth of the measuring receiver. Thus, a measurement with a larger measurement bandwidth was not necessary.

EMI Auto Test Template: FCC-RE-R17-AN23

Hardware Setup: EN-RE-R12-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: 0 dBμV/m - 130 dBμV/m

Preview Measurements:

Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN23_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamplifier
Receiver: [ESR 26]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz. It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.

To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation.

The calculations are performed automatically by the measurement software EMC 32.

As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

7.3 Radiated emissions < 30 MHz

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (d), §15.209 RSS-210, Issue 10, section B4		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.4 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	9 kHz - 30 MHz	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The limits below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
0.490 - 1.705	24000/F(kHz)	87.6 - 20 · log(F(kHz))	30
1.705 - 13.110	30	29.5	30
14.010 - 30.000	30	29.5	30
Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.			

Test setup details

Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth.

The test was carried out automatically by the test receiver.

The EUT is a table-top EUT and was standing on a table made of Styrodur on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

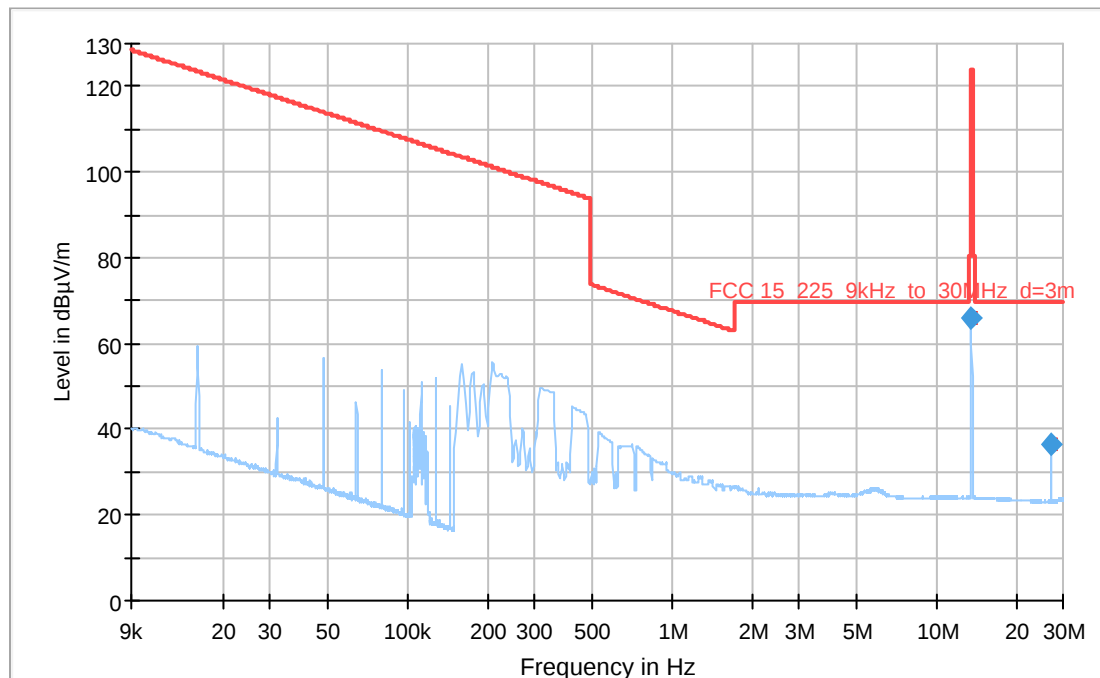
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-02	2018-04 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Active loop antenna, 9 kHz-30 MHz	Rohde & Schwarz	HFH2-Z2	881058/48	PM KF 1401	2020-08 (1 year)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983-2	-

Measurement results – Radiated emissions < 30 MHz:

Common Information

EUT:	IQAir, model: Atem X, Type 04
Test Verdict:	Passed
Test Description:	FCC Part 15C
Operating Conditions:	RFID and WLAN were in continuous wave mode
Operator Name:	UGR
Project Number:	40389
Date:	18.03.2021



Preview Result 1-QPK [Preview Result 1.Result:1]
 * Critical_Freqs AVG [Critical_Freqs.Result:5]
 * Critical_Freqs QPK [Critical_Freqs.Result:4]
 FCC 15_225_9kHz_to_30MHz_d=3m [.\zF radiated\FCC Part 15C]
 ◆ Final_Result QPK [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	65.72	---	124.00	58.28	1000.0	9.000	H	198.0
27.120750	36.50	---	69.54	33.04	1000.0	9.000	V	242.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
13.560000	19.6	-
27.120750	19.9	20:37:21 - 18.03.2021

Comment

The 13.56 MHz RFID transmitter was operated in CW mode. Therefore, the bandwidth of the transmitting signal is smaller than the measuring bandwidth of the measuring receiver. Thus, a measurement with a larger measurement bandwidth was not necessary.

EMI Auto Test Template: FCC-RE-R17-AN23

Hardware Setup: EN-RE-R12-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: 0 dB μ V/m - 130 dB μ V/m

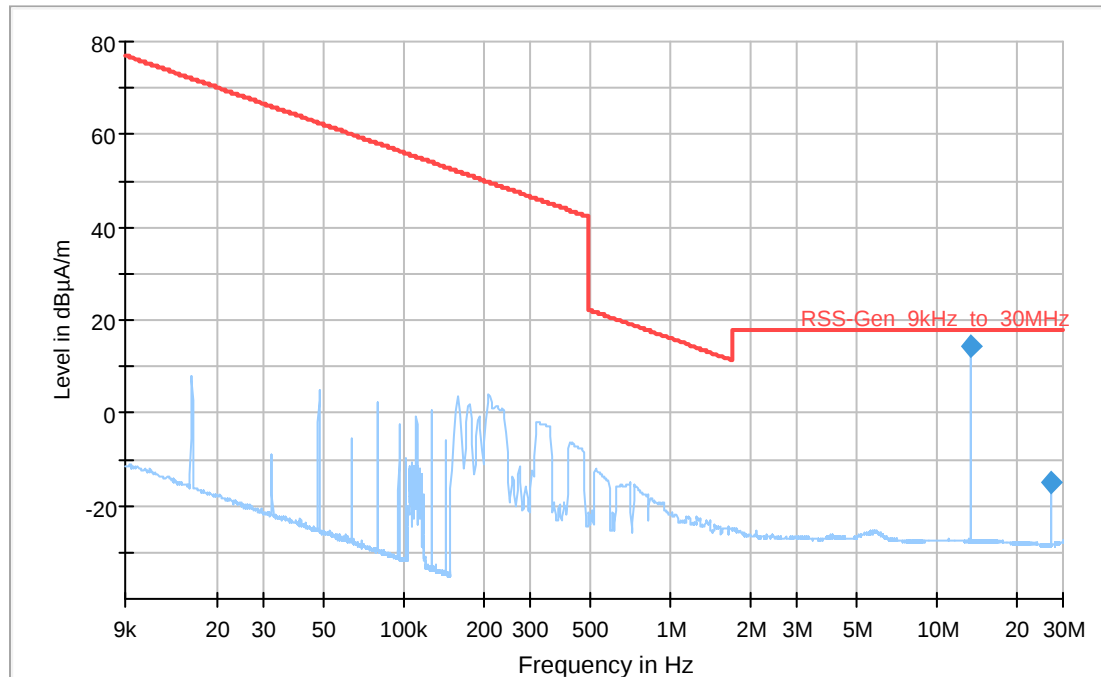
Preview Measurements:

Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN23_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Common Information

EUT:	IQAir, model: Atem X, Type 04
Test Verdict:	Passed
Test Description:	RSS-Gen, 9 kHz - 30 MHz
Operating Conditions:	RFID and WLAN were in continuous wave mode
Operator Name:	MBE
Project Number:	40389
Date:	18.03.2021



— Preview Result 1-QPK [Preview Result 1.Result:1]
 — RSS-Gen_9kHz_to_30MHz [..\zF radiated\RSS-Gen]
 * QPK [Critical_Freqs.Result:4]
 * AVG [Critical_Freqs.Result:5]
 ◆ Final_Result QPK [Final_Result.Result:4]
 ◆ Final_Result AVG [Final_Result.Result:5]

Final Result

Frequency (MHz)	QuasiPeak (dBμA/m)	Average (dBμA/m)	Limit (dBμA/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	14.22	---	18.04	3.82	1000.0	9.000	H	198.0
27.120750	-15.00	---	18.04	33.04	1000.0	9.000	V	242.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
13.560000	19.6	-
27.120750	19.9	-

EMI Auto Test Template: EN-RE-R17-AN24

Hardware Setup: EN-RE-R12-AN24
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: -40 dBμA/m - 80 dBμA/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN24_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz. It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.

To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation.

The calculations are performed automatically by the measurement software EMC 32.

As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

7.4 Radiated emissions 30 MHz to 26 GHz

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (d), §15.209 RSS-210, Issue 10, section B4		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.5 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	30 MHz - 26 GHz	

Limits

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

Test setup details

Overview sweeps performed with peak detectors and final measurement with quasi-peak detectors. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

The EUT is a table-top EUT and was standing on a table made of Styrodur on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).

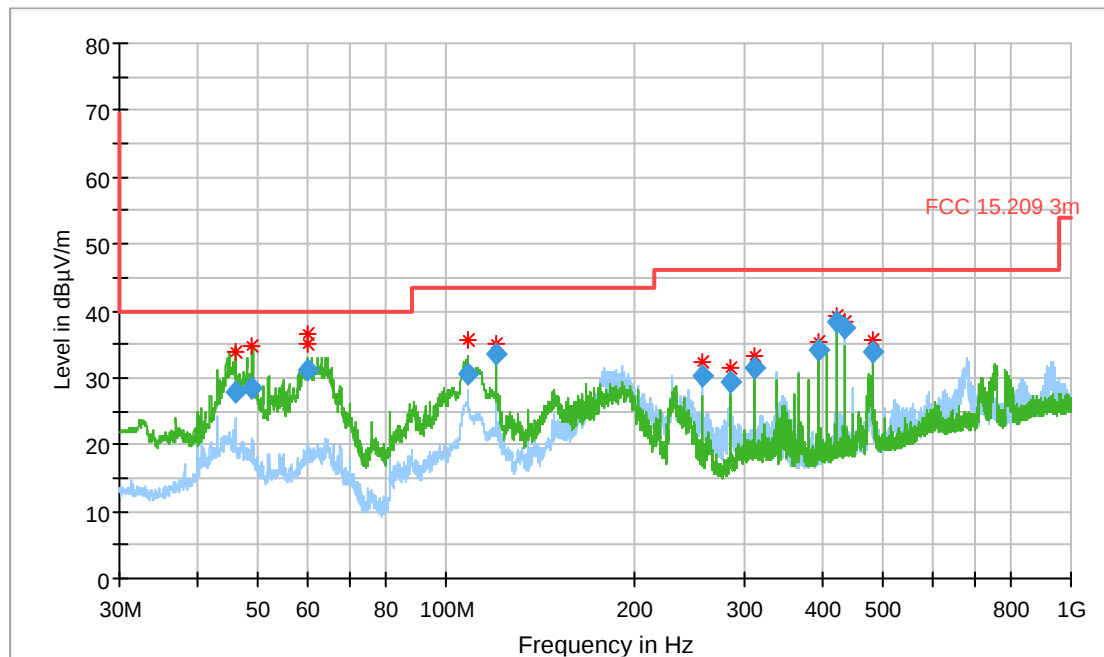
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-02	2018-04 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Tower	Inn-Co	MA4484-XPET	-	PM KF 2949-03	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Trilog broadband antenna	Schwarzbeck	VULB 9163	9163-974	PM KF 3196	2020-08 (1 year)
Spectrum analyzer	Rohde & Schwarz	FSV40	837356/012	PM KF 2783	2020-08 (1 year)
Horn antenna 1 - 18 GHz	Rohde & Schwarz	HF906	100331	PM KF 1047a	2019-05 (2 years)
Horn antenna 12 – 40 GHz	Schwarzbeck	BBHA 9170	BBHA917036 1	PM KF 1204	2020-09 (2 years)
Horn antenna preamp. 3 - 18 GHz	Bonn	BLMA 0118-BT	76609	PM KF 1047	2020-01 (2 years)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983-2	-

Measurement results – Radiated emissions

Common Information

EUT:	IQAir, model: Atem X, Type 04
Test Verdict:	Passed
Test Description:	FCC Part 15C
Operating Conditions:	RFID and WLAN were in continuous wave mode
Operator Name:	UGR
Project Number:	40389
Date:	18.03.2021



- Preview Result 1H-PK+ [Preview Result 1H.Result:2]
- Preview Result 1V-PK+ [Preview Result 1V.Result:2]
- * Critical_Freqs PK+ [Critical_Freqs.Result:4]
- FCC 15.209 3m [.\zF radiated\FCC Part 15C\]
- ◆ Final_Result QPK [Final_Result.Result:4]
- × MaxPeak-PK+ (Single) [Result Table_Single.Result:1]
- + QuasiPeak-QPK (Single) [Result Table_Single.Result:2]

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
45.990000	27.72	40.00	12.28	1000.0	120.000	130.0	V	28.0
48.990000	28.36	40.00	11.64	1000.0	120.000	100.0	V	30.0
60.000000	31.14	40.00	8.86	1000.0	120.000	100.0	V	308.0
108.510000	30.51	43.52	13.01	1000.0	120.000	100.0	V	129.0
120.000000	33.66	43.52	9.86	1000.0	120.000	212.0	H	267.0
257.640000	30.13	46.02	15.89	1000.0	120.000	258.0	H	298.0
284.760000	29.48	46.02	16.54	1000.0	120.000	100.0	H	161.0
311.880000	31.43	46.02	14.59	1000.0	120.000	194.0	H	251.0
393.240000	34.26	46.02	11.76	1000.0	120.000	103.0	V	-3.0
420.360000	38.44	46.02	7.58	1000.0	120.000	250.0	H	252.0
433.920000	37.40	46.02	8.62	1000.0	120.000	231.0	H	264.0
480.000000	33.92	46.02	12.10	1000.0	120.000	103.0	V	268.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB)	Comment
45.990000	14.1	18:43:37 - 18.03.2021
48.990000	14.2	18:42:03 - 18.03.2021
60.000000	12.8	18:52:13 - 18.03.2021
108.510000	12.6	18:47:09 - 18.03.2021
120.000000	11.9	18:31:15 - 18.03.2021
257.640000	14.4	18:39:40 - 18.03.2021
284.760000	14.6	18:29:00 - 18.03.2021
311.880000	15.1	18:33:21 - 18.03.2021
393.240000	17.1	18:45:23 - 18.03.2021
420.360000	17.9	18:35:30 - 18.03.2021
433.920000	18.0	18:37:36 - 18.03.2021
480.000000	18.5	18:49:00 - 18.03.2021

EMI Auto Test Template: FCC-RE-R17-AN34

Hardware Setup: EN-RE-R17-AN34
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 30 MHz - 1 GHz
Graphics Level Range: 0 dBµV/m - 80 dBµV/m

Preview Measurements:
Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Graphics Display: Show separate traces for horizontal and vertical polarization
Scan Test Template: EN-RE-R17-AN34_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 1 GHz	30 kHz	PK+	120 kHz	0,02 s	20 dB
1 GHz - 3 GHz	250 kHz	PK+	1 MHz	0,1 s	20 dB

Frequency Zoom:
Zoom Scan Template: EN-RE-R17-AN34_ZOOM

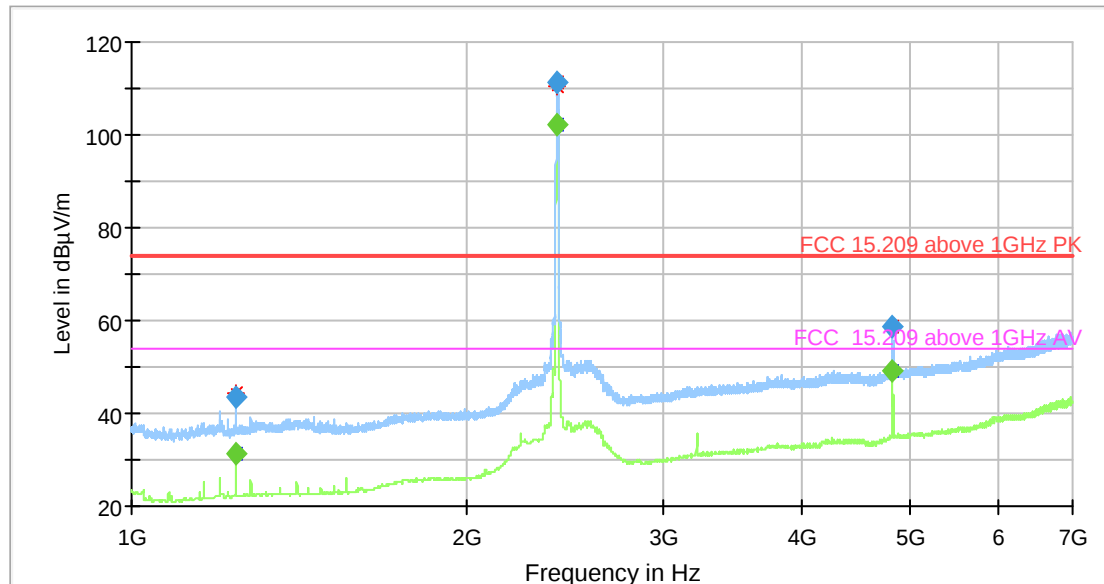
Adjustment:
Antenna height: Range = 180 cm , Measuring Speed = 2
Turntable position: Range = 60 deg , Measuring Speed = 3
Template for Single Meas.: EN-RE-R17-AN34_ADJ

Final Measurements:
Template for Single Meas.: EN-RE-R17-AN34_FIN_15s

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 200 MHz	40 kHz	QPK	120 kHz	1 s	20 dB
200 MHz - 1 GHz	40 kHz	QPK	120 kHz	1 s	20 dB
1 GHz - 3 GHz	400 kHz	QPK	1 MHz	1 s	20 dB

Common Information (1 GHz – 7 GHz)

EUT: IQAir, model: Atem X, Type 04
Test Verdict: Passed
Test Description: FCC Part 15C
Operating Conditions: RFID and WLAN were in continuous wave mode
Operator Name: UGR
Project Number: 40389
Date: 18.03.2021



Preview Result 2-AVG [Preview Result 2.Result:2]
 Preview Result 1-PK+ [Preview Result 1.Result:1]
 Critical_Freqs AVG [Critical_Freqs.Result:5]
 Critical_Freqs PK+ [Critical_Freqs.Result:4]
 FCC 15.209 above 1GHz PK [.\EMI radiated\FCC Part 15C]
 FCC 15.209 above 1GHz AV [.\EMI radiated\FCC Part 15C]
 Final_Result PK+ [Final_Result.Result:4]
 Final_Result AVG [Final_Result.Result:5]
 MaxPeak-PK+ (Single) [Result Table_Single.Result:1]
 Average-AVG (Single) [Result Table_Single.Result:3]

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1240.000000	43.64	---	74.00	30.36	1000.0	1000.000	258.0	V
1240.000000	---	31.14	54.00	22.86	1000.0	1000.000	263.0	V
2412.500000	111.31	---	---	---	1000.0	1000.000	238.0	V
2412.750000	---	102.03	---	---	1000.0	1000.000	238.0	V
4824.000000	58.51	---	74.00	15.49	1000.0	1000.000	204.0	V
4824.750000	---	49.05	54.00	4.95	1000.0	1000.000	210.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
1240.000000	111.0	26	12:18:01 - 19.03.2021
1240.000000	31.0	26	12:25:36 - 19.03.2021
2412.500000	286.0	30	WLAN
2412.750000	286.0	30	WLAN
4824.000000	275.0	35	12:15:23 - 19.03.2021
4824.750000	275.0	35	12:22:53 - 19.03.2021

The WLAN frequency band above the limit was not considered at the test according to FCC part 15 C.

EMI Auto Test Template: xF-RE-R17-AN20

Hardware Setup: xF-RE-R17-AN20
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 1 GHz - 7 GHz
Graphics Level Range: 10 dB μ V/m - 110 dB μ V/m

Preview Measurements:
Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: xF-RE-R17-AN20_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 26] 1 GHz - 7 GHz	250 kHz	PK+ ; AVG	1 MHz	0,05 s	20 dB

Frequency Zoom:
Zoom Scan Template: xF-RE-R17-AN20_MAX

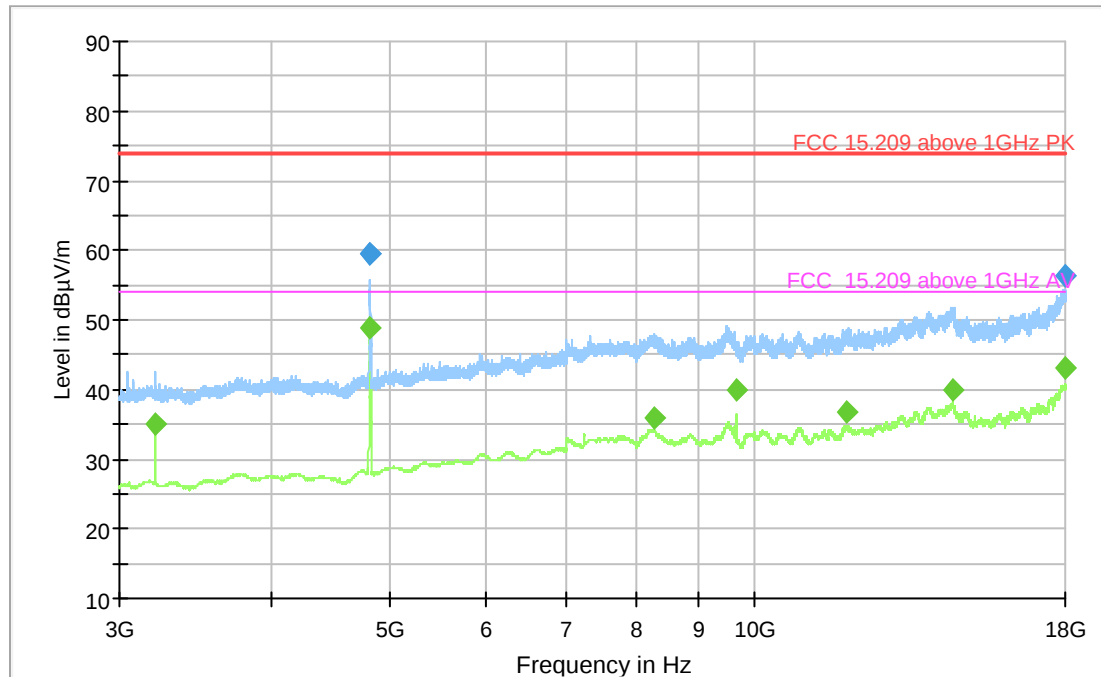
Adjustment:
Antenna height: Range = 180 cm , Measuring Speed = 2
Turntable position: Range = 60 deg , Measuring Speed = 2
Template for Single Meas.: xF-RE-R17-AN20_MAX

Final Measurements:
Template for Single Meas.: xF-RE-R17-AN20_FIN

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 26] 1 GHz - 7 GHz	400 kHz	PK+ ; AVG	1 MHz	1 s	20 dB

Common Information (3 GHz – 18 GHz)

EUT: IQAir, model: Atem X, Type 04
Test Verdict: Passed
Test Description: FCC Part 15C
Operating Conditions: RFID and WLAN were in continuous wave mode
Operator Name: UGR
Project Number: 40389
Date: 18.03.2021



Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC 15.209 above 1GHz PK [..\EMI radiated\FCC Part 15C\
FCC 15.209 above 1GHz AV [..\EMI radiated\FCC Part 15C\
Final_Result PK+ [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
3216.023750	---	35.11	54.00	18.89	1000.0	1000.000	181.0	H
4823.166875	---	48.81	54.00	5.19	1000.0	1000.000	211.0	V
4823.963125	59.62	---	74.00	14.38	1000.0	1000.000	204.0	V
4824.041875	59.44	---	74.00	14.56	1000.0	1000.000	209.0	V
8252.998750	---	35.86	54.00	18.14	1000.0	1000.000	352.0	H
9647.973750	---	40.05	54.00	13.95	1000.0	1000.000	150.0	V
11883.815630	---	36.76	54.00	17.24	1000.0	1000.000	372.0	H
14552.385000	---	39.80	54.00	14.20	1000.0	1000.000	354.0	H
17988.097570	56.42	---	74.00	17.58	1000.0	1000.000	210.0	H
17989.223730	---	43.04	54.00	10.96	1000.0	1000.000	373.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
3216.023750	20.0	-13.52	19.03.2021 07:42
4823.166875	274.0	-12.30	19.03.2021 07:48
4823.963125	272.0	-12.30	19.03.2021 07:33
4824.041875	275.0	-12.30	19.03.2021 07:35
8252.998750	89.0	-6.91	19.03.2021 07:51
9647.973750	260.0	-6.30	19.03.2021 07:38
11883.815630	354.0	-4.88	19.03.2021 07:57
14552.385000	263.0	-1.09	19.03.2021 07:54
17988.097570	300.0	3.15	19.03.2021 07:29
17989.223730	172.0	3.16	19.03.2021 08:00

EMI Auto Test Template: xF-RE-R15-PAM03-AN20

Hardware Setup: xF-RE-R15-PAM03-AN20
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 3 GHz - 18 GHz
Graphics Level Range: 10 dBμV/m - 90 dBμV/m

Preview Measurements:
Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Sweep Test Template: xF-RE-R15-PAM03_AN20_PRE

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40] 1 GHz - 18 GHz	531,25 kHz	PK+ ; AVG	1 MHz	200 s	0 dB

Frequency Zoom:
Zoom Sweep Template: xF-RE-R15-PAM03_AN20_MAX

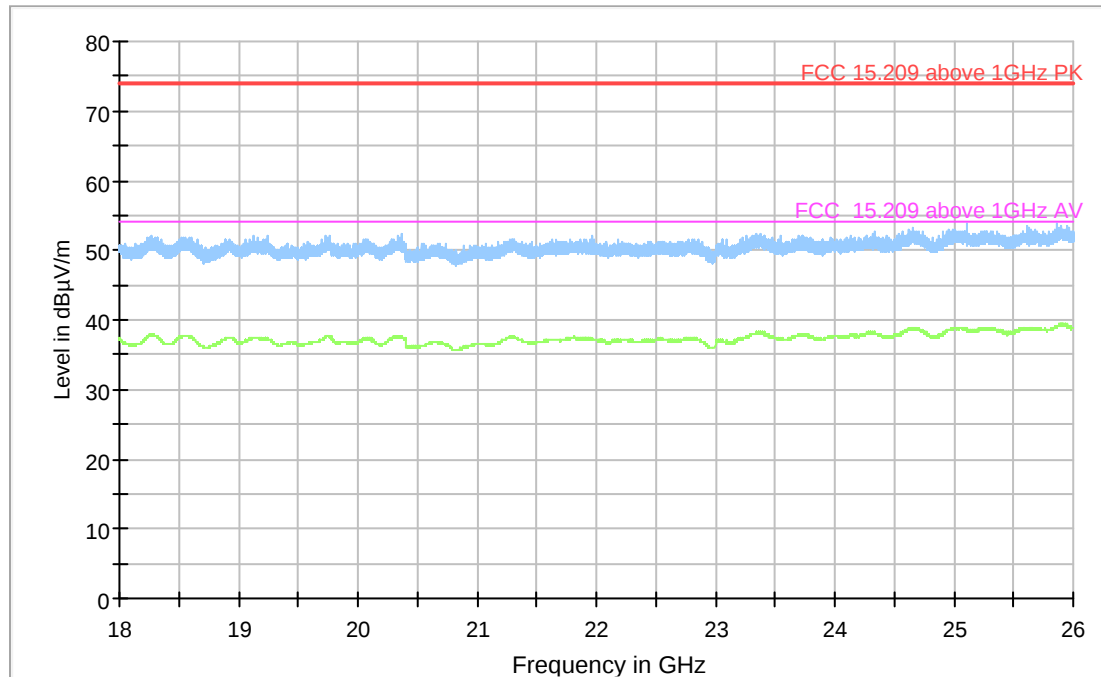
Adjustment:
Antenna height: Range = 180 cm , Measuring Speed = 2
Turntable position: Range = 60 deg , Measuring Speed = 2
Template for Single Meas.: xF-RE-R15-PAM03-AN20_ADJ

Final Measurements:
Template for Single Meas.: xF-RE-R15-PAM03-AN20_FIN

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [FSV 40] 1 GHz - 18 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Common Information (18 GHz – 26 GHz)

EUT:	IQAir, model: Atem X, Type 04
Test Verdict:	Passed
Test Description:	FCC Part 15C
Operating Conditions:	RFID and WLAN were in continuous wave mode
Operator Name:	UGR
Project Number:	40389
Date:	19.03.2021



—	Preview Result 2-AVG [Preview Result 2.Result:2]
—	Preview Result 1-PK+ [Preview Result 1.Result:1]
—	FCC 15.209 above 1GHz PK [.\EMI radiated\FCC Part 15C\]
—	FCC 15.209 above 1GHz AV [.\EMI radiated\FCC Part 15C\]
◆	Final_Result PK+ [Final_Result.Result:4]
◆	Final_Result AVG [Final_Result.Result:5]

EMI Auto Test Template: xF-RE-R15-AN06

Hardware Setup: xF-RE-R15-AN06
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 18 GHz - 26 GHz
Graphics Level Range: 0 dB μ V/m - 80 dB μ V/m

Preview Measurements:
Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Sweep Test Template: xF-RE-R15-AN06_PRE

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40] 18 GHz - 40 GHz	687,5 kHz	PK+ ; AVG	1 MHz	200 s	0 dB

Frequency Zoom:
Zoom Sweep Template: xF-RE-R15-AN06_MAX

Adjustment:
Antenna height: Range = 180 cm , Measuring Speed = 2
Turntable position: Range = 60 deg , Measuring Speed = 2
Template for Single Meas.: xF-RE-R15-AN06_ADJ

Final Measurements:
Template for Single Meas.: xF-RE-R15-AN06_FIN

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [FSV 40] 18 GHz - 40 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 30 MHz – 18 GHz (40 GHz). It includes automatic antenna mast of height 4 m and turntable of radius 2 m. It enables both manual and fully automatic measurements. To find the highest level of radiation

- the height of the antenna is scanned in range 1m to 4 m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation. The calculations are performed automatically by the measurement software EMC 32. As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

7.5 Frequency stability measurement

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (e) RSS-210, Issue 10, section B4 RSS-Gen Issue 5, section 6.11		P
Methods of measurement according to:	ANSI C63.10, section 9.14		
Equipment mode	Power interface	1	
	EUT configuration mode	3	
	Operation mode	2	

Limits

Limit:	The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ (± 100 ppm) of the carrier frequency under nominal conditions.
Temperature range:	- 20 degree to + 60 degree
Voltage range:	0.85 x 120 V and 1.15*120 V

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2020-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 years)
Temperature Chamber	Feutron	3836/16	098/06	PM KF 1299	2020-09 (1 year)

Measurement results – Frequency stability measurement:

Temperature °C	Carrier at 20°C MHz	Upper limit:	13.561356 MHz
		Lower limit:	13.558644 MHz
		Measured frequency under temperature influence:	
+60	13.56013	13.56004	
+50		13.56005	
+40		13.56007	
+30		13.56010	
+20		13.56013	
+10		13.56018	
0		13.56020	
-10		13.56018	
-20		13.56017	

Comment

The frequency stability under temperature influence remains in the tolerance of $\pm 0.01\%$ (± 100 ppm).

The AC supply voltage was varied from 102 to 138 V.

The voltage variations had no influence on the transmission level.

7.6 20 dB bandwidth

NORMATIVE REFERENCES		RESULT
Limits according to:	FCC §15.215 (c)	P
Methods of measurement according to:	RSS-Gen, Issue 5, 6.7	
Equipment mode	Power interface	1
	EUT configuration mode	3
	Operation mode	2

Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

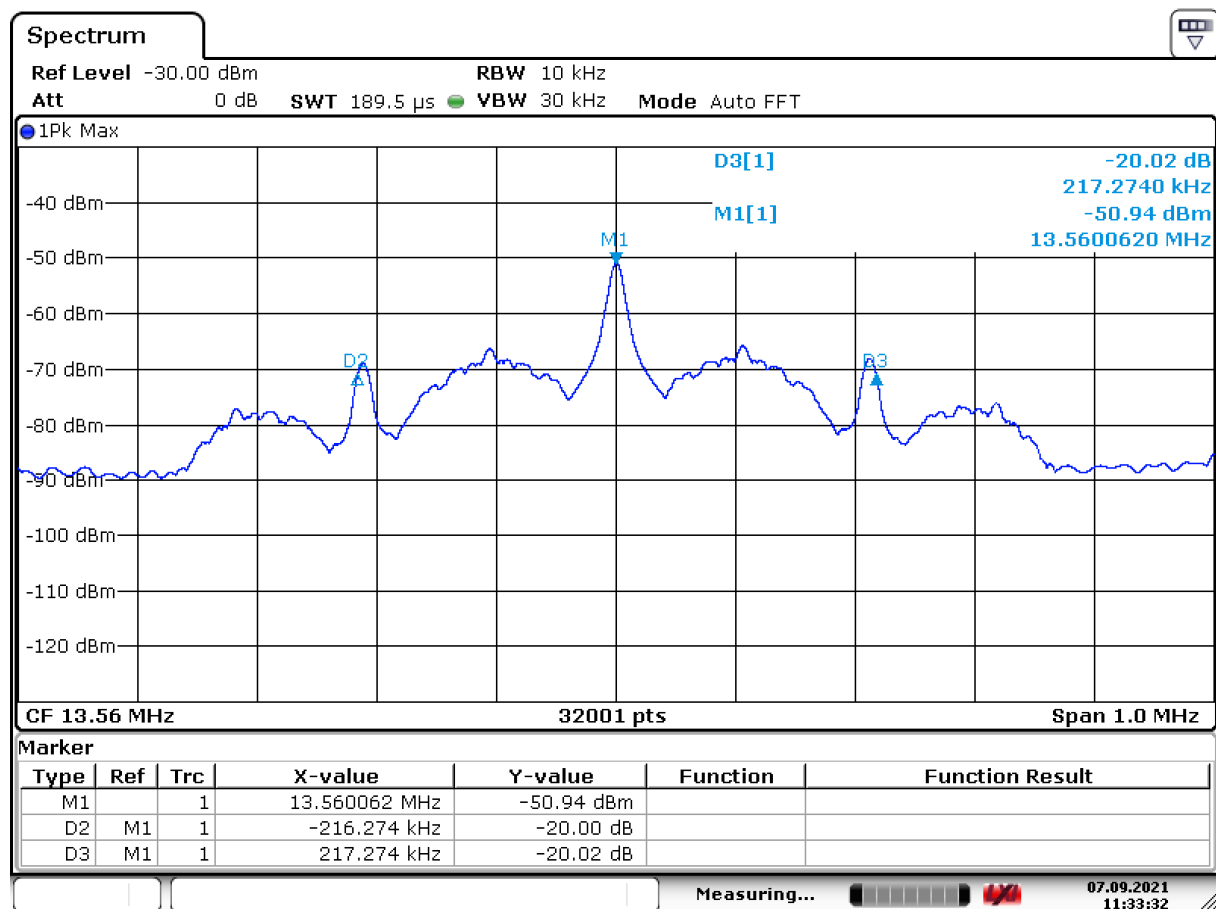
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2021-08 (1 year)
Temperature Chamber	Feutron	3836/16	098/06	PM KF 1299	2020-09 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

Comment

The 20-bandwidth is 53.959 kHz.

Measurement results – 20 dB bandwidth:



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7.7 Occupied bandwidth

NORMATIVE REFERENCES			RESULT
Limits according to:	RSS-Gen, Issue 5, 6.7		P
Methods of measurement according to:	RSS-Gen, Issue 5, 6.7		
Equipment mode	Power interface	1	
	EUT configuration mode	3	
	Operation mode	2	

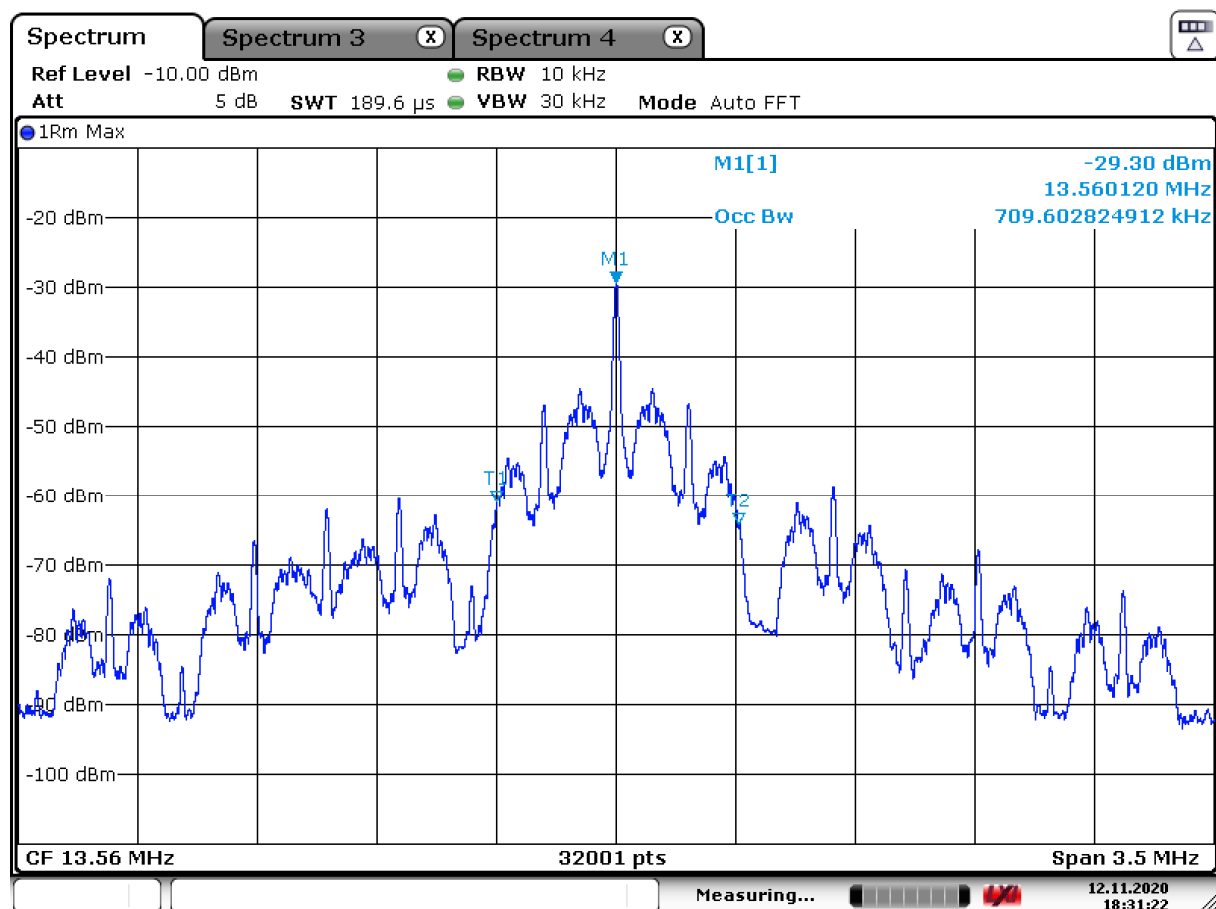
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2020-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 years)
Temperature Chamber	Feutron	3836/16	098/06	PM KF 1299	2020-09 (1 year)

Comment

The 99% occupied bandwidth is 709.6 kHz.

Measurement results – 99% occupied bandwidth:



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7.8 Measurement uncertainty evaluation

Measurement uncertainty for radiated magnetic field, 9 kHz – 30 MHz	± 3.2 dB
Measurement uncertainty for radiated emission, 30 MHz - 1000 MHz	
Uncertainty for the frequency range 30 to 300 MHz using a biconical or a combination antenna at 3 m	± 4.9 dB
Uncertainty for the frequency range 300 to 1000 MHz using a logperiodic or a combination antenna at 3 m	± 4.7 dB
Measurement uncertainty for Frequency error	± 1 x 10 ⁻⁸
Measurement uncertainty for humidity	± 4 %
Measurement uncertainty for temperature	± 0.5 °C
Measurement uncertainty for voltage	
DC	± 0.1 %
AC up to 10 kHz	± 1.8 %
Measurement uncertainty for time	± 0.058 %
Measurement uncertainty for conducted emissions, LISN, 150 kHz -30 MHz	± 2.3 dB
Measurement uncertainty for OBW	± 4.3 %
601 points resolution (Spectrum analyzer)	± 0.83 %
30000 points resolution (Spectrum analyzer)	± 0.016 %

End of test report