Report on the FCC and IC Testing of the dormakaba EAD GmbH Model: 9230-K7 In accordance with FCC 47 CFR Part 15C and ISED Canada RSS-210 and ISED Canada RSS-GEN

Prepared for: dormakaba EAD GmbH
Albertistr. 3
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Germany

FCC ID: NVI-DKAM9230K7
IC: 11038A-DKAM9230K7

Product Service

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Date: 2020-09-21
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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Matthias Stumpe	2020-09-22	SIGN-ID 402855
Authorised Signatory	Alex Fink	2020-09-22	SIGN-ID 402861

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C and ISED Canada RSS-210, ISED Canada RSS-247 and ISED Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthias Stumpe	2020-09-22	SIGN-ID 402855

Laboratory Accreditation	Laboratory recognition	ISED Canada test site registration
DAkkS Reg. No. D-PL-11321-11-02 DAkkS Reg. No. D-PL-11321-11-03	Registration No. BNetzA-CAB-16/21-15	3050A-2

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C, ISED RSS-210, Issue 10 (12-2019) and ISED Canada RSS-GEN:2016, Issue 5 (2019-03).

Trade Register Munich
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VAT ID No. DE129484267
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www.tuev-sued.com/imprint

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2020-08-11
2	Model number corrected	2020-08-27
3	Model changed from “dormakaba access manager 92 30 Serie K7 MRD” to “9230-K7”. EUT Marking Plate added to test report.	2020-09-21

Table 1

1.2 Introduction

Applicant	dormakaba EAD GmbH
Manufacturer	dormakaba EAD GmbH
Model Number(s)	9230-K7
Serial Number(s)	---
Hardware Version(s)	Prototype
Software Version(s)	Prototype
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C, ISED Canada RSS-210, Issue 10 (12-2019) and ISED Canada RSS-GEN:2016, Issue 5 (2019-03)
Test Plan/Issue/Date	---
Order Number Date	203029 2020-05-20
Date of Receipt of EUT	2020-05-22
Start of Test	2020-06-24
Finish of Test	2020-07-22
Name of Engineer(s)	Martin Steindl
Related Document(s)	ANSI C63.10 (2013)

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1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and ISED Canada RSS-210 and ISED Canada RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: Continuously reading RFID card				
3.1	15.207, N/A and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2013)
3.2	15.215 (c); --- and 6.7	Occupied Bandwidth	Pass	ANSI C63.10 (2013)
3.3	15.225 (a)(b)(c)(d); B.6; 6.13	Field Strength of any Emission	Pass	ANSI C63.10 (2013)
3.4	15.225 (e); B.6; ---	Frequency Tolerance Under Temperature Variations	Pass	ANSI C63.10 (2013)
3.5	---; --- and 3.2	Exposure of Humans to RF Fields	Pass	IC RSS-102, Issue 5, section 2.5 KDB 447498 D01 General RF Exposure Guidance v06, chapter 4.3.1

Table 2

Product Service

1.4 Basic information of EUT

The device is used as an access control center in an access control system.
The access control system is controlled by a system software. Access rights are assigned in the system software and the connected devices are configured. The access rights are saved in the device.
Additional devices are connected to the device. The connected registration units / readers read data from media. The device checks the authorization of the media.
The device supports mobile access. With Mobile Access, smartphones with the dormakaba mobile access app become media.
If a media is authorized, the device grants access.
The door states are recognized and evaluated via the digital inputs of the device.

1.5 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer, S/N: N/A	Not Applicable	Not Applicable

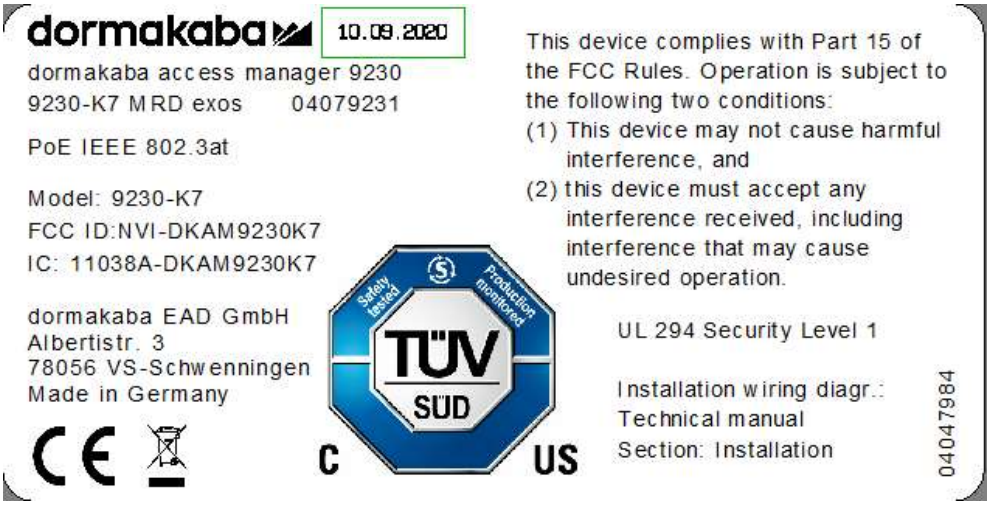
Table 3

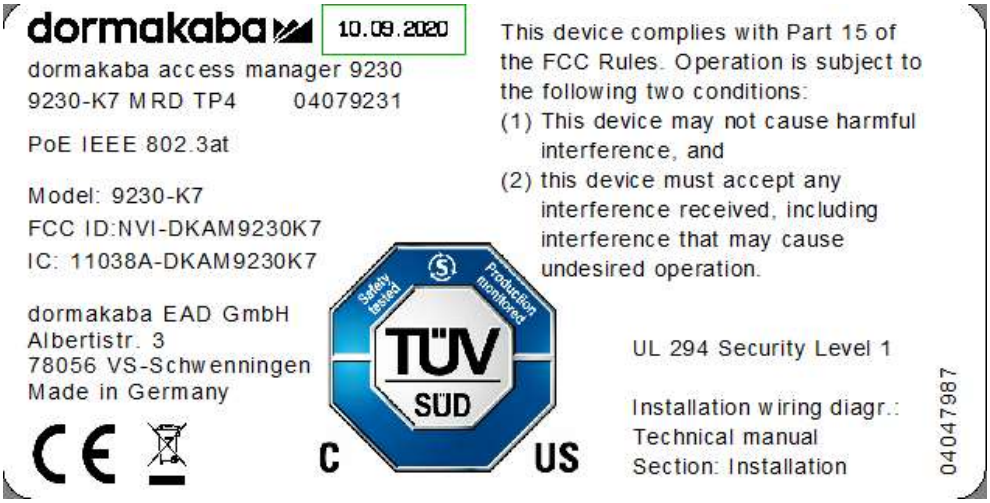
Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer, S/N: 04079231 (antenna port replaced with resistor)	Not Applicable	Not Applicable

Table 4

Product Service

1.6 EUT Marking Plate





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1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: Continuously reading RFID card	
AC Power Line Conducted Emissions	Martin Steindl, M. Stumpe
Occupied Bandwidth	Martin Steindl
Field Strength of any Emission	Martin Steindl
Frequency Tolerance Under Temperature Variations	Martin Steindl
Exposure of Humans to RF Fields	Martin Steindl

Table 5

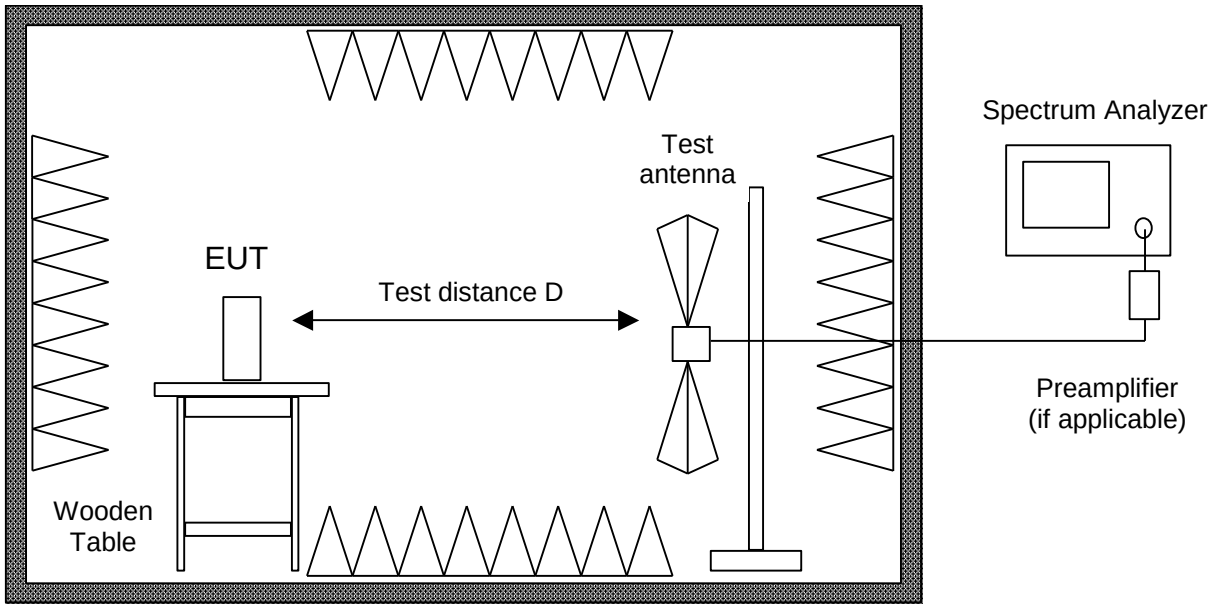
Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

2 Test Setup

2.1 Radiated Emission in Fully or Semi Anechoic Room



Fully or semi anechoic room

Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 for alternative test sites is used (see 2.2). If prescans are recorded in fully anechoic room they are indicated appropriately.

Product Service

According to section 13 of KDB558074 the requirement for radiated emissions on the band edges was performed with a reduced bandwidth of 100 kHz instead of 1 MHz.

Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

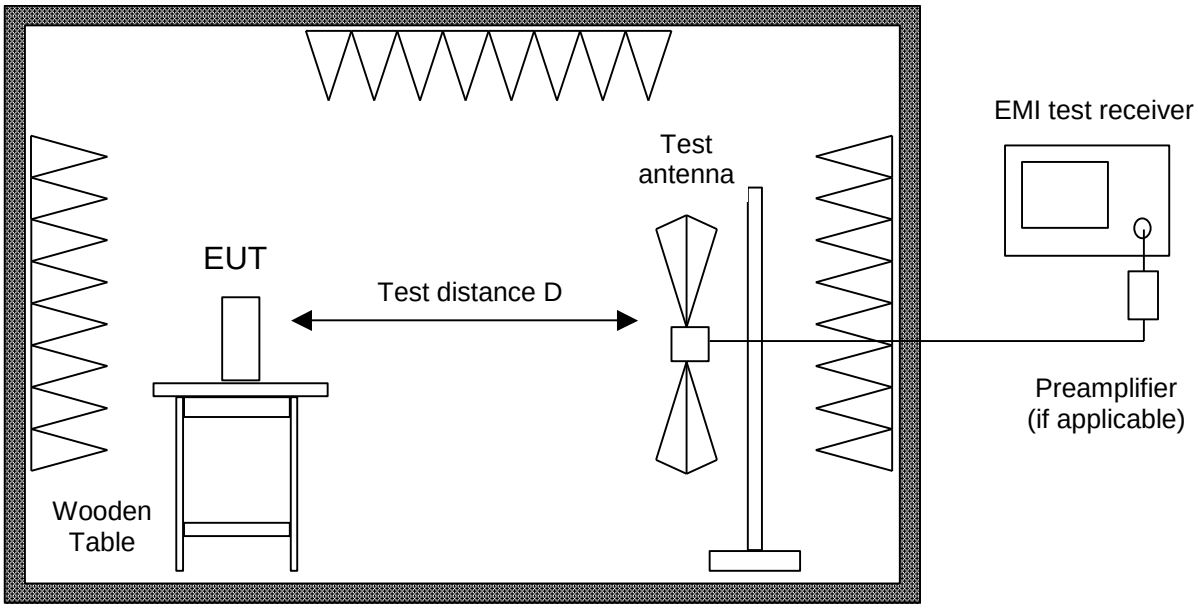
EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.
If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where, for non-pulsed operation, average detector is employed.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Product Service

2.2 Radiated Emission at Alternative Test Site



Alternate test site (semi anechoic room)

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels. Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is dircharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

Product Service

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.

Product Service

3 Test Details

3.1 AC Power Line Conducted Emissions

3.1.1 Specification Reference

FCC 47 CFR Part 15C and ISED Canada RSS-GEN, Clause 15.207 and 8.8

3.1.2 Equipment Under Test and Modification State

9230-K7, S/N: N/A - Modification State 0
9230-K7, S/N: 04079231 - Modification State 0

3.1.3 Date of Test

2020-06-23 and 2020-07-22

3.1.4 Test Method

The EUT was placed on a non-conductive table 0.8m above a reference ground plane and 0.4m away from a vertical coupling plane. All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted disturbance voltage measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.

3.1.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	33.0 %

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3.1.6 Test Results

Results for Configuration and Mode: normal operation mode - continuously reading RFID card.

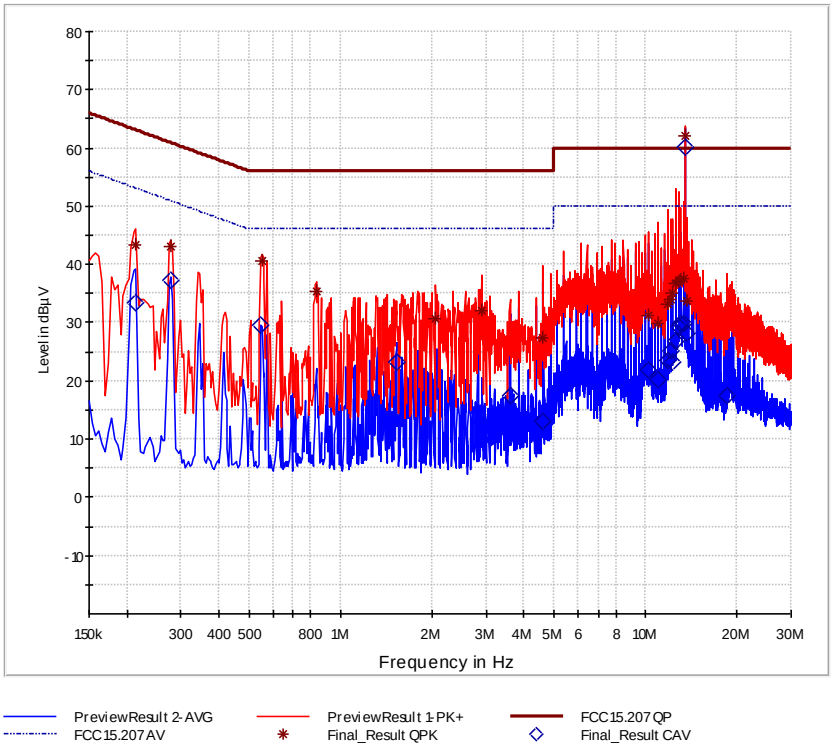
Power supplied by PoE Injector “POE36U-1AT-R” manufactured by PHIHONG.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Product Service

Line Under Test: AC Mains – L

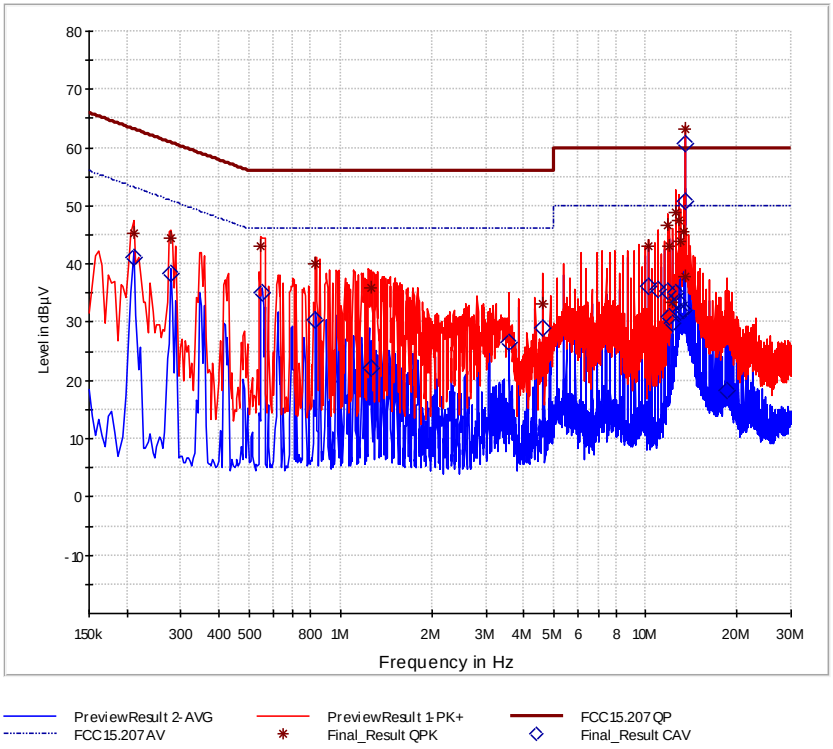


Final Results :

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Line*	*Filter*	*Corr. dB*
0.214000	---	33.52	53.05	19.53	1000.0	9.000	L1	OFF	10.0
0.214000	43.24	---	63.05	19.81	1000.0	9.000	L1	OFF	10.0
0.278000	---	37.22	50.88	13.66	1000.0	9.000	L1	OFF	10.0
0.278000	43.18	---	60.88	17.70	1000.0	9.000	L1	OFF	10.0
0.550000	---	29.49	46.00	16.51	1000.0	9.000	L1	OFF	10.0
0.554000	40.49	---	56.00	15.51	1000.0	9.000	L1	OFF	10.0
0.834000	35.43	---	56.00	20.57	1000.0	9.000	L1	OFF	10.1
1.526000	---	23.15	46.00	22.85	1000.0	9.000	L1	OFF	10.1
2.058000	30.61	---	56.00	25.39	1000.0	9.000	L1	OFF	10.1
2.906000	32.02	---	56.00	23.98	1000.0	9.000	L1	OFF	10.1
3.594000	---	17.53	46.00	28.47	1000.0	9.000	L1	OFF	10.1
4.622000	---	13.10	46.00	32.90	1000.0	9.000	L1	OFF	10.2
4.622000	27.36	---	56.00	28.64	1000.0	9.000	L1	OFF	10.2
10.266000	31.33	---	60.00	28.67	1000.0	9.000	L1	OFF	10.2
10.270000	---	21.76	50.00	28.24	1000.0	9.000	L1	OFF	10.2
11.038000	---	20.29	50.00	29.71	1000.0	9.000	L1	OFF	10.2
11.038000	29.77	---	60.00	30.23	1000.0	9.000	L1	OFF	10.2
11.810000	33.16	---	60.00	26.84	1000.0	9.000	L1	OFF	10.2
11.810000	---	23.42	50.00	26.58	1000.0	9.000	L1	OFF	10.2
12.066000	34.04	---	60.00	25.96	1000.0	9.000	L1	OFF	10.2
12.066000	---	25.28	50.00	24.72	1000.0	9.000	L1	OFF	10.2
12.322000	35.04	---	60.00	24.96	1000.0	9.000	L1	OFF	10.2
12.322000	---	23.38	50.00	26.62	1000.0	9.000	L1	OFF	10.2
12.578000	36.87	---	60.00	23.13	1000.0	9.000	L1	OFF	10.2
12.578000	---	26.74	50.00	23.26	1000.0	9.000	L1	OFF	10.2
12.834000	37.16	---	60.00	22.84	1000.0	9.000	L1	OFF	10.2
12.834000	---	29.24	50.00	20.76	1000.0	9.000	L1	OFF	10.2
13.090000	37.18	---	60.00	22.82	1000.0	9.000	L1	OFF	10.2

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Filter	Corr. dB
13.090000	---	29.86	50.00	20.14	1000.0	9.000	L1	OFF	10.2
13.350000	37.67	---	60.00	22.33	1000.0	9.000	L1	OFF	10.2
13.350000	---	29.77	50.00	20.23	1000.0	9.000	L1	OFF	10.2
13.562000	---	60.28	50.00	-10.28	1000.0	9.000	L1	OFF	10.2
13.562000	62.08	---	60.00	-2.08	1000.0	9.000	L1	OFF	10.2
13.606000	---	28.23	50.00	21.77	1000.0	9.000	L1	OFF	10.2
13.606000	33.85	---	60.00	26.15	1000.0	9.000	L1	OFF	10.2
18.482000	---	17.46	50.00	32.54	1000.0	9.000	L1	OFF	10.3

Line Under Test: AC Mains - N



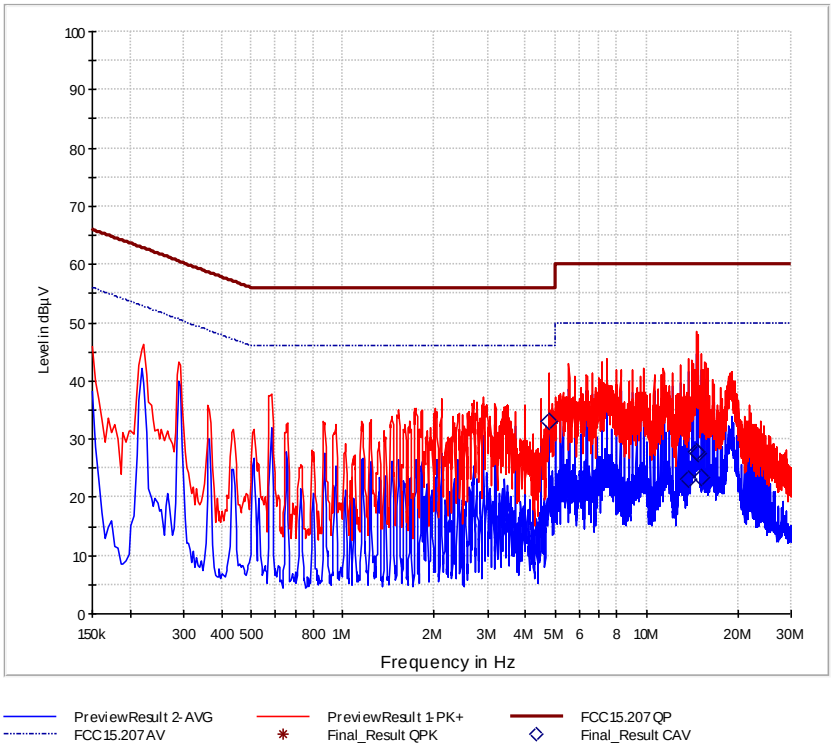
Final Results:

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Filter	Corr. dB
0.210000	---	41.27	53.21	11.94	1000.0	9.000	N	OFF	10.0
0.210000	45.33	---	63.21	17.88	1000.0	9.000	N	OFF	10.0
0.278000	---	38.31	50.88	12.57	1000.0	9.000	N	OFF	10.0
0.278000	44.40	---	60.88	16.48	1000.0	9.000	N	OFF	10.0
0.550000	43.19	---	56.00	12.81	1000.0	9.000	N	OFF	10.0
0.554000	---	35.13	46.00	10.87	1000.0	9.000	N	OFF	10.0
0.830000	40.01	---	56.00	15.99	1000.0	9.000	N	OFF	10.1
0.830000	---	30.44	46.00	15.56	1000.0	9.000	N	OFF	10.1
1.254000	35.95	---	56.00	20.05	1000.0	9.000	N	OFF	10.1
1.254000	---	22.24	46.00	23.76	1000.0	9.000	N	OFF	10.1
3.586000	---	26.49	46.00	19.51	1000.0	9.000	N	OFF	10.1
4.610000	33.25	---	56.00	22.75	1000.0	9.000	N	OFF	10.2
4.610000	---	29.11	46.00	16.89	1000.0	9.000	N	OFF	10.2
10.238000	43.16	---	60.00	16.84	1000.0	9.000	N	OFF	10.2
10.238000	---	36.10	50.00	13.90	1000.0	9.000	N	OFF	10.2
11.006000	---	35.57	50.00	14.43	1000.0	9.000	N	OFF	10.2
11.774000	46.63	---	60.00	13.37	1000.0	9.000	N	OFF	10.2
11.774000	---	35.40	50.00	14.60	1000.0	9.000	N	OFF	10.2
12.030000	---	30.90	50.00	19.10	1000.0	9.000	N	OFF	10.2
12.030000	43.22	---	60.00	16.78	1000.0	9.000	N	OFF	10.2
12.286000	---	29.88	50.00	20.12	1000.0	9.000	N	OFF	10.2
12.290000	33.55	---	60.00	26.45	1000.0	9.000	N	OFF	10.2
12.542000	---	35.02	50.00	14.98	1000.0	9.000	N	OFF	10.2
12.542000	48.88	---	60.00	11.12	1000.0	9.000	N	OFF	10.2
12.798000	47.38	---	60.00	12.62	1000.0	9.000	N	OFF	10.2
12.798000	---	33.43	50.00	16.57	1000.0	9.000	N	OFF	10.2
13.054000	---	31.80	50.00	18.20	1000.0	9.000	N	OFF	10.2

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line	Filter	Corr. dB
13.054000	44.00	---	60.00	16.00	1000.0	9.000	N	OFF	10.2
13.310000	45.55	---	60.00	14.45	1000.0	9.000	N	OFF	10.2
13.310000	---	32.16	50.00	17.84	1000.0	9.000	N	OFF	10.2
13.482000	37.98	---	60.00	22.02	1000.0	9.000	N	OFF	10.2
13.558000	---	60.65	50.00	-10.65	1000.0	9.000	N	OFF	10.2
13.558000	63.06	---	60.00	-3.06	1000.0	9.000	N	OFF	10.2
13.566000	---	50.73	50.00	-0.73	1000.0	9.000	N	OFF	10.2
18.430000	---	18.17	50.00	31.83	1000.0	9.000	N	OFF	10.3

Product Service

Line Under Test: AC Mains - L (antenna port replaced with resistor)

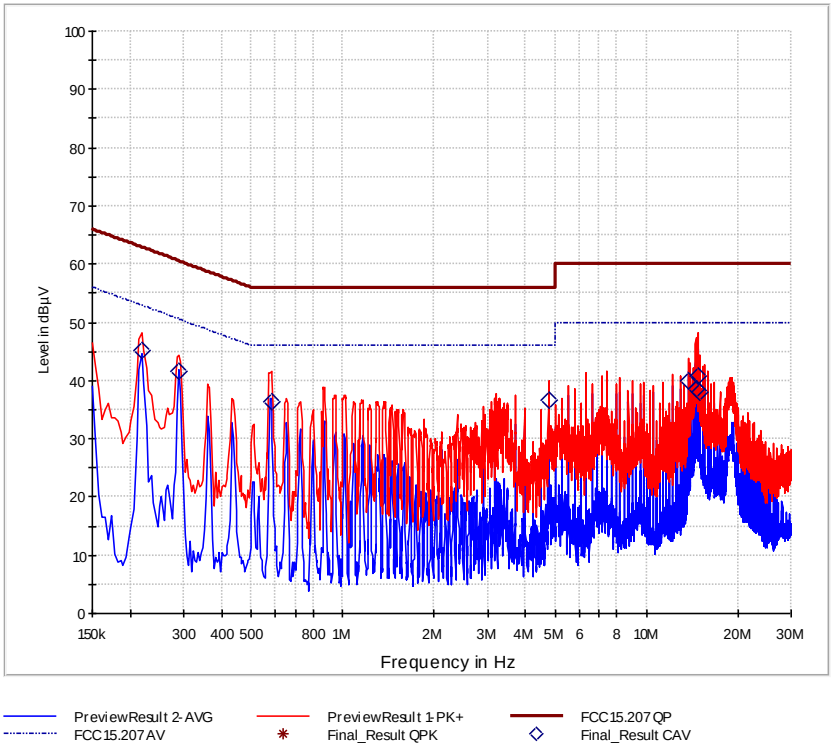


Final Results:

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Line*	*Filter*	*Corr. dB*
4.778000	---	33.00	46.00	13.00	1000.0	9.000	L1	ON	10.3
13.802000	---	23.13	50.00	26.87	1000.0	9.000	L1	ON	10.3
14.598000	---	27.95	50.00	22.05	1000.0	9.000	L1	ON	10.3
14.862000	---	27.62	50.00	22.38	1000.0	9.000	L1	ON	10.3
15.130000	---	23.47	50.00	26.53	1000.0	9.000	L1	ON	10.3

Product Service

Line Under Test: AC Mains - N (antenna port replaced with resistor)



Final Results:

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Line*	*Filter*	*Corr. dB*
0.218000	---	45.21	52.90	7.69	1000.0	9.000	N	ON	10.0
0.290000	---	41.62	50.52	8.91	1000.0	9.000	N	ON	10.0
0.582000	---	36.44	46.00	9.56	1000.0	9.000	N	ON	10.0
4.766000	---	36.66	46.00	9.34	1000.0	9.000	N	ON	10.3
13.766000	---	39.96	50.00	10.04	1000.0	9.000	N	ON	10.3
14.562000	---	38.65	50.00	11.35	1000.0	9.000	N	ON	10.3
14.826000	---	40.65	50.00	9.35	1000.0	9.000	N	ON	10.3
15.090000	---	37.94	50.00	12.06	1000.0	9.000	N	ON	10.3

Product Service

FCC 47 CFR Part 15, Limit Clause 15.207 and ISED Canada RSS-GEN, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Table 6

*Decreases with the logarithm of the frequency.

3.1.7 Test Location and Test Equipment Used

This test was carried out in Shielded room - cabin no. 4.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESU8	19904	12	2021-01-31
Artificial mains network	Rohde & Schwarz	ENV216	39910	12	2021-02-29
EMC measurement software	Rohde & Schwarz	EMC32 Emission K9 - V9.26.01	20090	---	---
Shielded room	Euroshield	Cabin no. 4	19314	---	---

Table 7

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

3.2 Occupied Bandwidth

3.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.215 (c),
ISED RSS-GEN, Issue 9, Section 6.7

3.2.2 Equipment Under Test and Modification State

9230-K7, S/N: N/A - Modification State 0

3.2.3 Date of Test

2020-06-24

3.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

3.2.5 Environmental Conditions

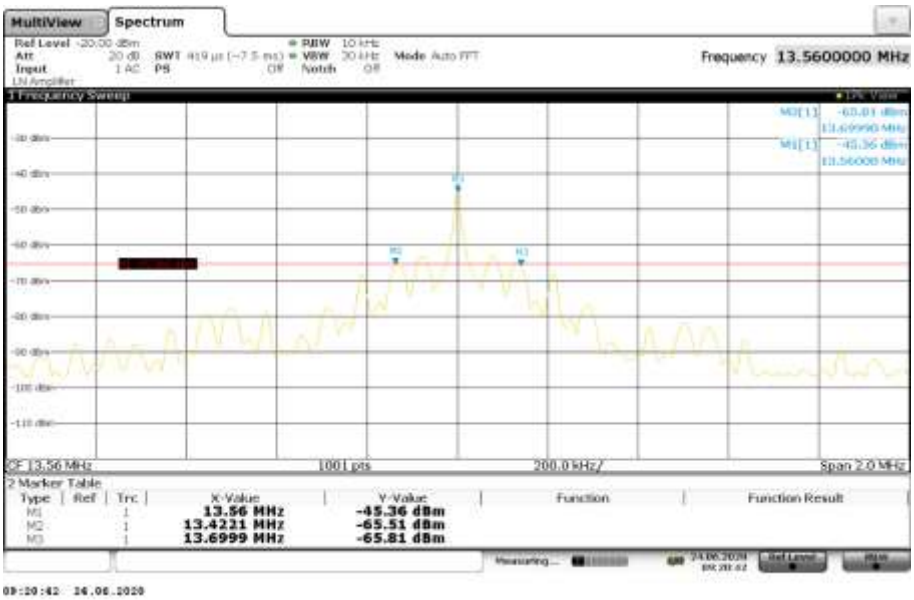
Ambient Temperature	23.0 °C
Relative Humidity	36.0 %

3.2.6 Test Results

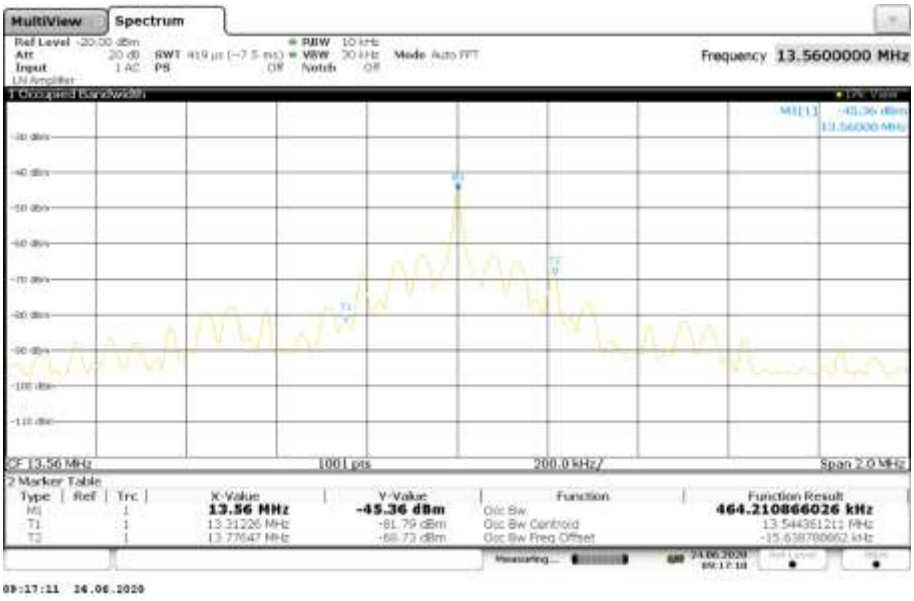
Frequency (MHz)	20 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)	F_{LOWER} (MHz)	F_{UPPER} (MHz)
13.56	277.8	464.21	13.4221	13.6999

Table 8

Product Service



20 dB Bandwidth



99 % Bandwidth

Product Service

FCC 47 CFR Part 15, Limit Clause 15.215 (c)

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.

ISED RSS 210 and ISED RSS GEN, Limit Clause

Not specified

3.2.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	ESW44	39387	12	2021-03-31

Table 9

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

3.3 Field Strength of any Emission

3.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 (a)(b)(c)(d); and
ISED RSS-210; Clause B.1 to B.9 and
ISED RSS-GEN, clause 6.4 and 6.5.

3.3.2 Equipment Under Test and Modification State

9230-K7, S/N: N/A - Modification State 0

3.3.3 Date of Test

2020-06-24

3.3.4 Test Method

See section 2.1 of this test report for details.

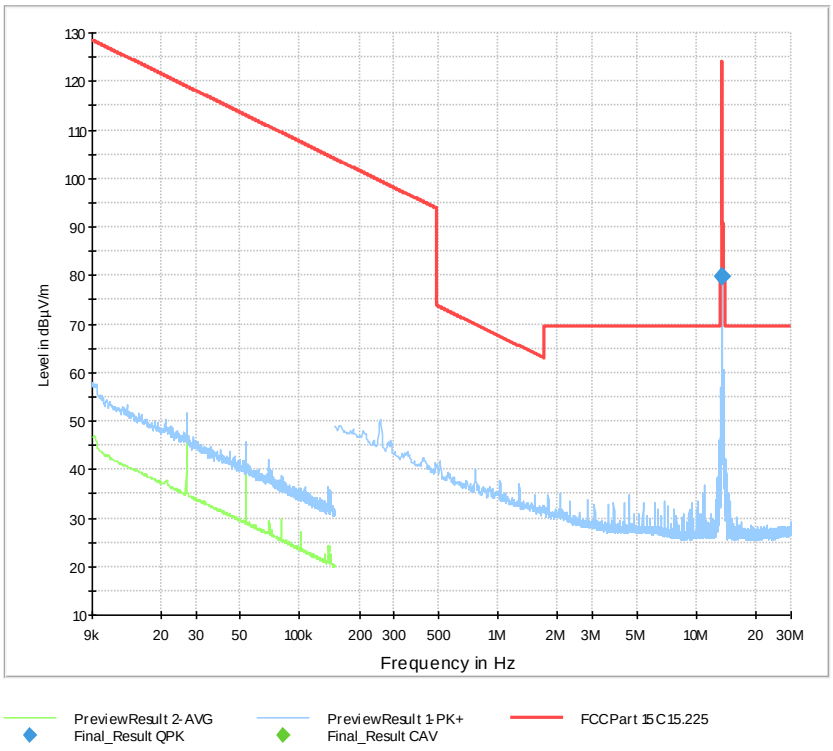
3.3.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	32.0 %

Product Service

3.3.6 Test Results

Continuously reading RFID card



Final Results:

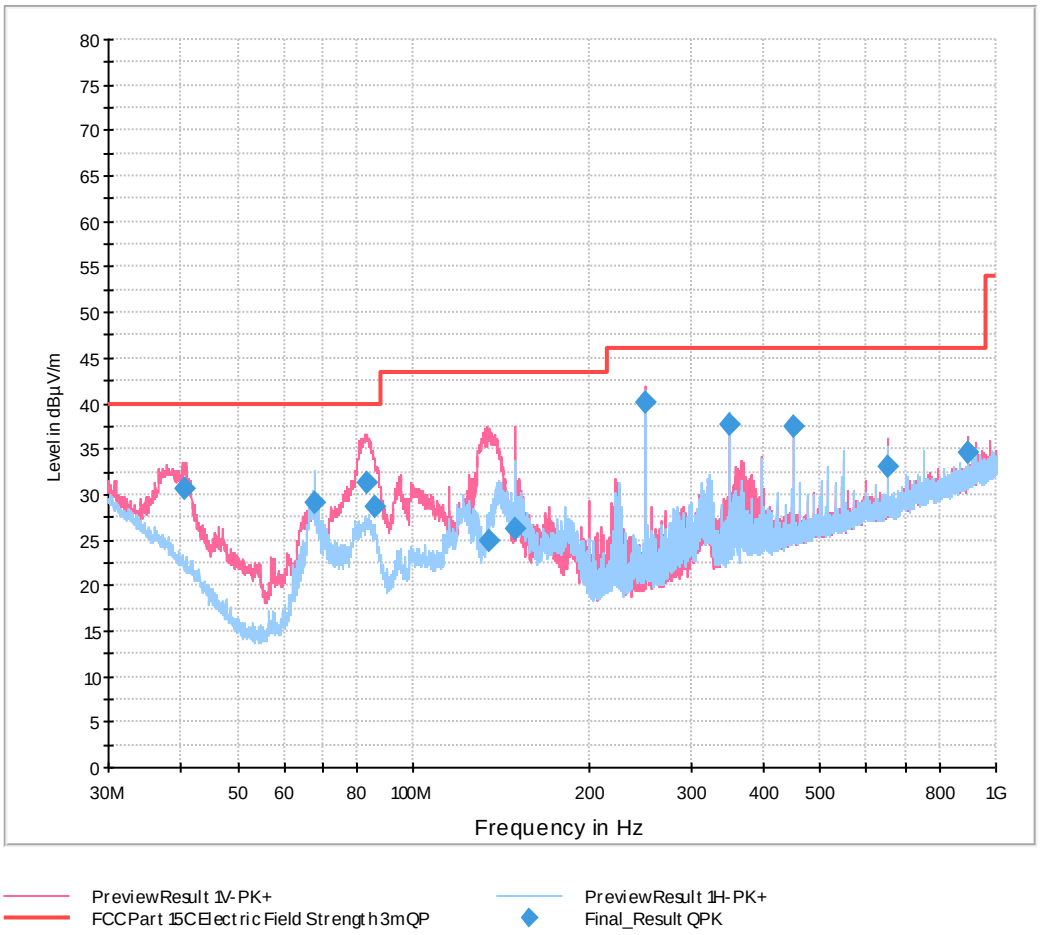
Frequency *MHz*	*QuasiPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
13.560000	79.68	---	124.00	44.32	1000.0	9.000	100.0	V	-99.0	18.8

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13,56000	Quasi-Peak	3	30	60,9	18,8	-40,0		39,7	84,0	**44,3**

Table 10 - Emissions Results – 9 kHz to 30 MHz

Final Value (dBµV/m) = Reading Value (dBµV) + Cable Correction Factor (dB)
+ Antenna Correction Factor (dB/m)
+ Pulse Train Correction (dB)

Product Service



Final Results:

Frequency *MHz*	*QuasiPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
40.680000	30.69	40.00	9.31	1000.0	120.000	100.0	V	-30.0	19.9
67.800000	29.02	40.00	10.98	1000.0	120.000	396.0	H	189.0	14.6
83.250000	31.20	40.00	8.80	1000.0	120.000	105.0	V	9.0	16.5
86.010000	28.54	40.00	11.46	1000.0	120.000	113.0	V	-180.0	16.7
135.390000	24.80	43.50	18.70	1000.0	120.000	135.0	V	240.0	16.9
149.970000	26.23	43.50	17.27	1000.0	120.000	128.0	V	62.0	16.0
249.990000	40.09	46.02	5.93	1000.0	120.000	111.0	V	180.0	17.7
349.980000	37.60	46.02	8.42	1000.0	120.000	102.0	H	133.0	20.5
449.970000	37.40	46.02	8.62	1000.0	120.000	128.0	V	37.0	22.7
649.980000	33.12	46.02	12.90	1000.0	120.000	153.0	V	9.0	26.1
894.960000	34.68	46.02	11.34	1000.0	120.000	112.0	V	-136.0	28.8

FCC 47 CFR Part 15, Limit Clause 15.225 (a)(b)(c)(d)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 m.
(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 m.
(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 m.
(d) 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.

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	5

Table 10 - FCC Radiated Emission Limit

ISED RSS-210, Limit Clause B.6

The field strength of any emission shall not exceed the following limits:

(a) 15.848 mW/m (84 dBµV/m) at 30 m, within the band 13.553 – 13.567 MHz.
(b) 334 µV/m (50.5 dBµV/m) at 30 m, withing the bands 13.410 – 13.553 MHz and 13.567 – 13.710 MHz.
(c) 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz.
(d) RSS-GEN general field strength limits for frequencies outside the band 13.110 – 14.010 MHz.

ISED RSS-GEN, Limit Clause

Frequency	Electric Field Strength (µV/m)	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (m)
9 - 490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490 - 1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705 kHz - 30 MHz	30	N/A	30

Table 11 - ISED Radiated Emission Limit - Less than 30 MHz

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 - 88	100
88 - 216	150
216 - 960	200
> 960	500

Table 12 - ISED Radiated Emission Limit - 30 MHz to 1 GHz

3.3.7 Test Location and Test Equipment Used

Radiated Tests were carried out in FAR No.11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2021-03-31
Loop antenna	Schwarzbeck	FMZB 1519 B	44334	36	2023-01-31
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2022-11-30
EMC measurement software	Rohde & Schwarz	EMC32 Emission K11 - V10.50.10	42986	---	---
Semi Anechoic Room	Frankonia	Cabin No. 11	42961	36	2022-08-31

Table 13

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

3.4 Frequency Tolerance Under Temperature and Voltage Variations

3.4.1 Specification Reference

FCC 47 CFR Part 15C, ISED RSS-210 and ISED RSS-GEN, Clause 15.225 (e), B.1 to B.9 and 6.11.

3.4.2 Equipment Under Test and Modification State

9230-K7 S/N: N/A - Modification State 0

3.4.3 Date of Test

2020-06-25

3.4.4 Test Method

3.4.5 Environmental Conditions

Ambient Temperature	23.0 °C
Relative Humidity	33.0 %

3.4.6 Test Results

Temperature	Voltage	Measured Frequency (MHz)	Frequency Deviation (Hz)	Frequency Error (ppm)
-20.0 °C	120 V AC	13.56010710	52.1	3.84
-10.0 °C	120 V AC	13.56011290	57.9	4.27
0.0 °C	120 V AC	13.56009260	37.6	2.77
+10.0 °C	120 V AC	13.56005790	2.9	0.21
+20.0 °C	120 V AC	13.56005500	0.0	0.00
+30.0 °C	120 V AC	13.55995950	-95.5	-7.04
+40.0 °C	120 V AC	13.55991320	-141.8	-10.46
+50.0 °C	120 V AC	13.55987550	-179.5	-13.24

Table 14 - Frequency Tolerance Under Temperature Variation

Temperature	Voltage	Measured Frequency (MHz)	Frequency Deviation (Hz)	Frequency Error (ppm)
+20.0 °C	102 V AC	13.56005500	0.0	0.00
+20.0 °C	120 V AC	13.56005500	0.0	0.00
+20.0 °C	138 V AC	13.56005500	0.0	0.00

Table 15 - Frequency Tolerance Under Voltage Variation

Product Service

FCC 47 CFR Part 15, Limit Clause 15.225 (e)

The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency.

ISED RSS-210, Limit Clause B.6

Carrier frequency stability shall be maintained to ±0.01% (±100 ppm)

3.4.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2021-01-31
Climatic test chamber	Feutron	KPK200-2	19868	36	2021-08-31

Table 16

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

3.5 Exposure of Humans to RF Fields

3.5.1 Specification Reference

IC RSS-GEN Issue 5, section 3.2 and
IC RSS-102, Issue 5, section 2.5
KDB 447498 D01 General RF Exposure Guidance v06, chapter 4.3.1

3.5.2 Equipment Under Test and Modification State

9230-K7, S/N: N/A - Modification State 0

3.5.3 Date of Test

2020-03-20

Product Service

3.5.4 Test Results

acc. to KDB 447498 D01:

Maximum Radiated Power (EIRP) Pmax:	0.497 mW (see section 3.3 for measurement)
Compliance Boundary d:	5 mm
Frequency f:	13.56 MHz

Calculation according to Section 4.3.1

1. $\frac{1}{2}\left[1+\log\left(\frac{100}{100}\right)\right] * \left[\left((Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ step\ a)\right) + (50mm - 50mm) * \left(\frac{100}{150}\right)\right]$
2. $\frac{1}{2}[1+0] * \left[\left((Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ step\ a)\right) + 0 * \left(\frac{100}{150}\right)\right]$
3. $\frac{1}{2}[Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ step\ a]$
4. $\frac{\max power}{\min distance} * \sqrt{f} \leq 3.0$
5. $\max power \leq \frac{3.0 * \min distance}{\sqrt{f}}$
6. $\max power \leq \frac{3.0 * 50\ mm}{\sqrt{0{,}1GHz}} = 474\ mW$
7. $\frac{1}{2} * 474\ mW = 237\ mW$ → maximal allowed Power
8. 0.497 mW < 237 mW → criteria fulfilled

Product Service

IC RSS-GEN Issue 5, section 3.2 and IC RSS-102, Issue 5, section 2.5

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☐ detachable				
The conducted output power (CP in watts) is measured at the antenna connector: CP =			☐	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: G =		☐		
$EIRP = G \cdot CP \Rightarrow EIRP$ =				
☐ the field strength[1] in V/m: FS = ... V/m			☐	
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = mW				
with:				
Distance between the antennas in m: D = mm		☐		
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by:				
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = 0.497 mW				
with:				
Field strength in V/m: FS = 79.68 dBµV/m = 40.7 mV/m = 0.0407 V/m			☒	
Distance between the two antennas in m: D = 3 m			☒	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): TP = 0.497 mW				

[1] The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses.
If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Product Service

Exposure of Humans to RF Fields (continued)		Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is					
☒ less than or equal to 20 cm	☐ greater than 20 cm		☒		
Transmitting device is					
☐ in the vicinity of the human head	☐ body-worn		☐		

Product Service

SAR evaluation				
SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required. For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.				

Frequency (MHz)	Exemption limits (mW)[2] at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

Carrier frequency:	f	=	13.56 MHz	
Distance:	d	=	5 mm	☒
Transmitter output power:	TP	=	0.497 mW	
Limit:	TP_{limit}	=	52 mW	☒

[2] The excemption limit in the table are based on measurements and simulations on half-wave dipole antennas at separaton distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

Product Service

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Testing			
Test Name	kp	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	±1.14 %	2
RF-Frequency error	1.96	±1 · 10-7	7
RF-Power, conducted carrier	2	±0.079 dB	2
RF-Power uncertainty for given BER	1.96	+0.94 dB / -1.05	7
RF power, conducted, spurious emissions	1.96	+1.4 dB / -1.6 dB	7
RF power, radiated			
25 MHz – 4 GHz	1.96	+3.6 dB / -5.2 dB	8
1 GHz – 18 GHz	1.96	+3.8 dB / -5.6 dB	8
18 GHz – 26.5 GHz	1.96	+3.4 dB / -4.5 dB	8
40 GHz – 170 GHz	1.96	+4.2 dB / -7.1 dB	8
Spectral Power Density, conducted	2.0	±0.53 dB	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	±2,89 %	2
6 kHz – 25 kHz	2	±0.2 dB	2
Maximum frequency deviation for FM	2	±2,89 %	2
Adjacent channel power 25 MHz – 1 GHz	2	±2.31 %	2
Temperature	2	±0.39 K	4
(Relative) Humidity	2	±2.28 %	2
DC- and low frequency AC voltage			
DC voltage	2	±0.01 %	2
AC voltage up to 1 kHz	2	±1.2 %	2
Time	2	±0.6 %	2

Table 17

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Table 18

Immunity Testing			
Test Name	kp	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves		a	4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Table 19

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%
Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.
Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%
Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%