

Report on the FCC and IC Testing of the
GWF MessSysteme AG
Radio transceiver for water-/gas-meter
Model: RCM-H200
In accordance with FCC 47 CFR Part
15 C and ISED RSS-247 and ISED RSS-
GEN



Product Service

Add value.
Inspire trust.

Prepared for: GWF MessSysteme AG
Obergrundstrasse 119
CH-6002 Lucerne
Switzerland

FCC ID: 2A4F7-RCMH200
IC: 28165-RCMH200

COMMERCIAL-IN-CONFIDENCE

Date: 2022-04-29

Document Number: TR-713237652-03 (Revision 1)

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Martin Steindl	2022-05-12	 SIGN-ID 648997
Authorised Signatory	Matthias Stumpe	2022-05-12	 SIGN-ID 638970

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

Engineering Statement:

This measurement 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 15 C and ISED RSS-247 and RSS-GEN.

The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Martin Steindl	2022-05-12	 SIGN-ID 648998

Laboratory Accreditation
DAkkS Reg. No. D-PL-11321-11-02
DAkkS Reg. No. D-PL-11321-11-03

Laboratory recognition
Registration No. BNetzA-CAB-16/21-15

Industry Canada test site registration
3050A-2

Executive Statement:

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15 C:2021 and ISED RSS-247:2017 and RSS-GEN:2021

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1 Report Summary

1.1 Modification Report

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

Issue	Description of changes	Date of Issue
1	First Issue	2022-04-22
2	Added additional measurement for band edge requirement	2022-05-11

Table 1: Report of Modifications

1.2 Introduction

Applicant	GWF MessSysteme AG Obergrundstrasse 119 CH-6002 Lucerne Switzerland
Manufacturer	ESCATEC Mechatronics Sd. Bhd. 8 Jalan Firma 1/2 Kawasan Perindustrian Tebrau 1 81100 Johor Bahru Johor Malaysia
Model Number(s)	RCM-H200
Serial Number(s)	94
Hardware Version(s)	HW V11
Software Version(s)	FW V1.0
Number of Samples Tested	1
Test Specification(s) / Issue / Date	FCC 47 CFR Part 15 C : 2021 ISED RSS-247, Issue 2 : 2017 ISED RSS-GEN, Issue 5, Amd. 1, Amd. 2 : February 2021
Test Plan/Issue/Date	N/A
Order Number	PO- 000003448-2
Date	2021-12-17
Date of Receipt of EUT	2022-04-19; 2022-05-11
Start of Test	2022-04-19
Finish of Test	2022-05-11
Name of Engineer(s)	M. Steindl
Related Document(s)	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 558074 D01 V05R02



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15 C, ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result
2.1	15.203, 15.247(b)	Antenna requirement	Pass
2.2	15.247(a)(1)(i)	Emission Bandwidth	Pass
2.3	15.247(a)(1)	Hopping Channel Separation	Pass
2.4	15.247(a)(1)(i)	Number of Hopping Channels	Pass
2.5	15.247(a)(1)(i)	Time Occupancy on any Channel	Pass
2.6	15.247(b)(3)	Output Power	Pass
2.7	15.247(d)	Frequency Band Edge	Pass
2.8	15.209, 15.247(d)	Restricted Bands of operation	Pass
2.9	15.247(d), 15.205, 15.209	Spurious Emissions	Pass
---	15.207	Conducted Emissions on Mains Terminals	Not Applicable

Table 2: Results according to FCC 47 CFR Part 15 C

Section	Specification Clause	Test Description	Result
2.2	5.1.c	Emission Bandwidth	Pass
2.3	5.1.b	Hopping Channel Separation	Pass
2.4	5.1.c	Number of Hopping Channels	Pass
2.5	5.1.c	Time Occupancy on any Channel	Pass
2.6	5.4 d.	Output Power	Pass
2.7	5.5	Frequency Band Edge	Pass
2.8	5.5	Restricted Bands of operation	Pass
2.9	5.5	Spurious Emissions	Pass

Table 3: Results according to ISED RSS-247

Section	Specification Clause	Test Description	Result
2.2	6.7	Emission Bandwidth	Pass
2.8	8.10	Restricted Bands of operation	Pass
2.9	8.9, 8.10	Spurious Emissions	Pass
2.10	8.11	Frequency Stability	Pass
--	8.8	Conducted Emissions on Mains Terminals	Not applicable

Table 4: Results according to RSS-Gen



1.4 Product Information

1.4.1 Technical Description

The RCM-H200 is an external LoRaWAN radio module for water and gas meters.

<i>Frequency Band</i>	902 – 928 MHz
<i>Frequency range</i>	902.3 MHz to 914.9 MHz
<i>Number of frequency channels:</i>	64
<i>Emission designator:</i>	230KF1D
<i>Modulation type:</i>	FSK
<i>Frequency deviation:</i>	90 kHz
<i>Data rate:</i>	100 kbps
<i>Power supply:</i>	Lithium Ion Battery
<i>Supply Voltage:</i>	3 V
<i>Supply Frequency:</i>	0 Hz

1.4.2 EUT Ports / Cables identification

Port	Usage	Cable length	Screened
Meter interface	Signal/Control Port	1.2 m	Shielded

Table 5 Ports and Cables identification

1.5 Test Configuration

The EUT was configured as stand alone device

1.6 Modes of Operation

The EUT was operated on lowest, middle and highest frequency



1.7 EUT Modifications 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	Not Applicable	Not Applicable

Table 6

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing test laboratory:

Test Name	Name of Engineer(s)
Antenna requirement	M. Steindl
Emission Bandwidth	M. Steindl
Hopping Channel Separation	M. Steindl
Number of Hopping Channel	M. Steindl
Output Power	M. Steindl
Frequency Band Edge	M. Steindl
Restricted Bands of Operation	M. Steindl
Spurious emissions	M. Steindl
Temperature Stability	M. Steindl

Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany



2 Test Details

2.1 Antenna requirement

2.1.1 Specification Reference

FCC 47 CFR Part 15 C, Clauses 15.203, 15.247(b)

2.1.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.1.3 Date of Test

2022-04-21

2.1.4 Specification Limits

FCC 47 CFR 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. The use of a permanently attached antenna or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some fields disturbance sensors, or to other intentional radiators which must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits are not exceeded.

FCC 47 CFR 15.247(b)

Except for point-to-point operation and multiple directional beams, if the transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2.1.5 Test Results

Pass: The EUT uses integrated antenna on the PCB.



2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(a)(1)(i)
ISED RSS-247, Clause 5.1 c.
ISED RSS-Gen, Clause 6.7

2.2.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.2.3 Date of Test

2022-04-19

2.2.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	31 %

2.2.5 Specification Limits

The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

ISED RSS-GEN:

The occupied (99 %) bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSS.

2.2.6 Test Method

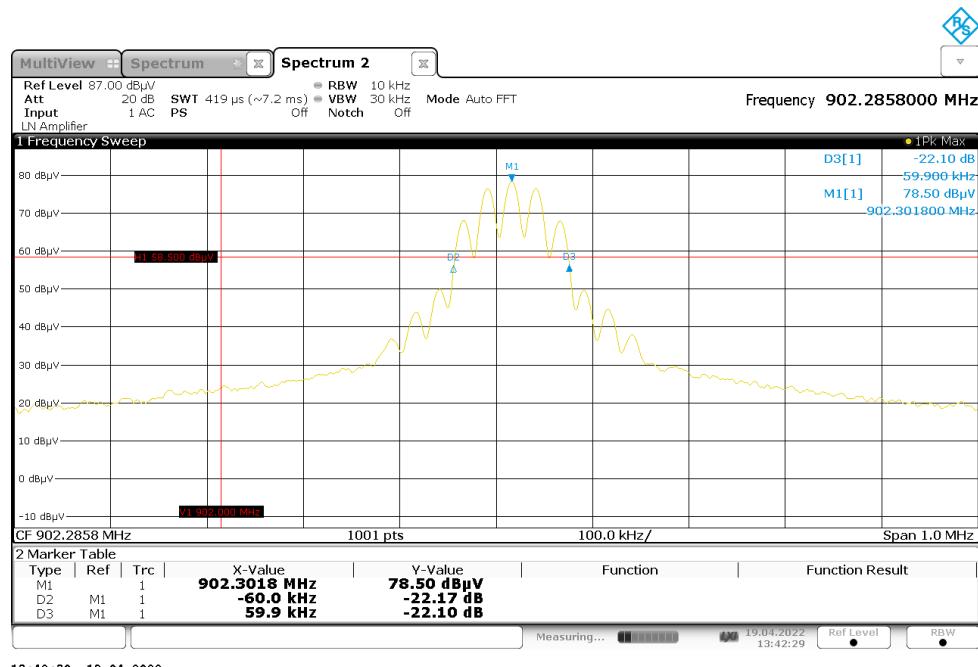
The test was performed according to ANSI C63.10, clauses 6.9.3 and 11.8.1

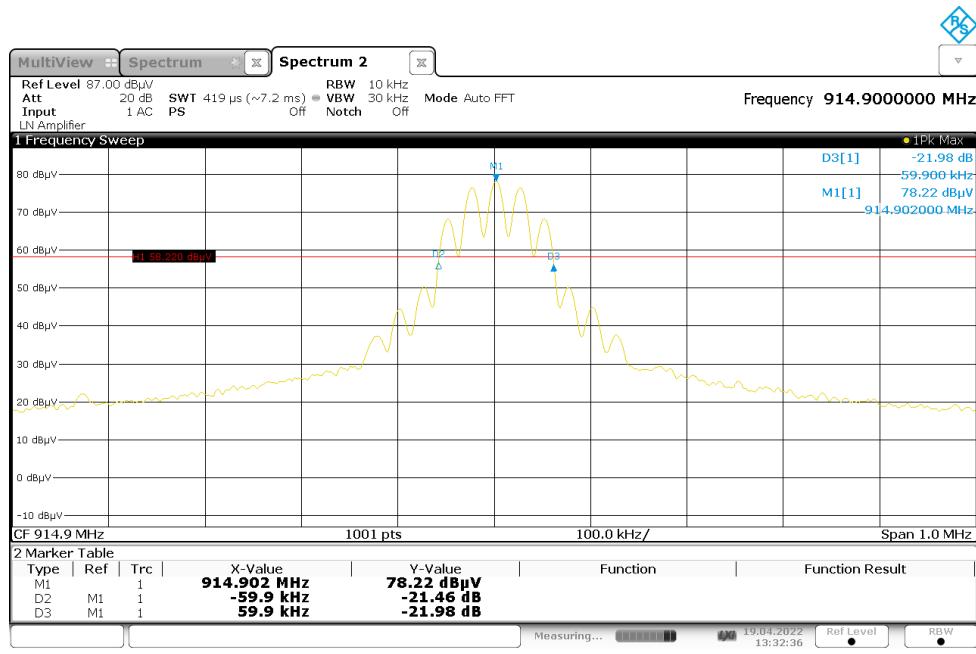
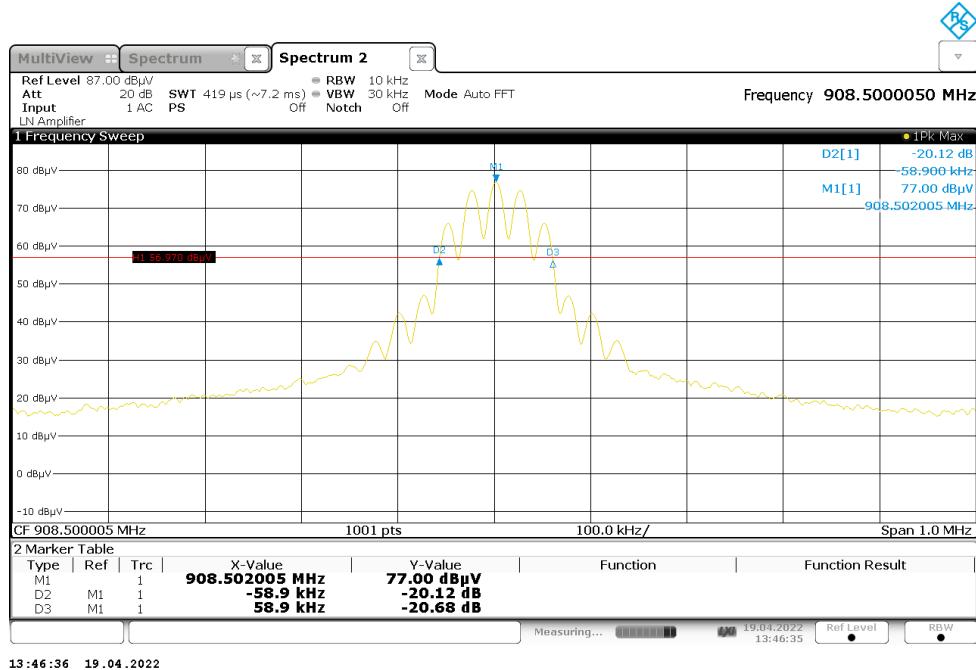


2.2.7 Test Results

Frequency Channel	20 dB Bandwidth	Limit	Band Edge Left	Band Edge Right	Result
902.3 MHz	119.9 kHz	500 kHz	902.241800 MHz	902.361700 MHz	Pass
908.5 MHz	119.8 kHz	500 kHz	908.443105 MHz	908.560905 MHz	Pass
914.9 MHz	119.8 kHz	500 kHz	914.842100 MHz	914.961900 MHz	Pass

Table 7: 20 dB bandwidth

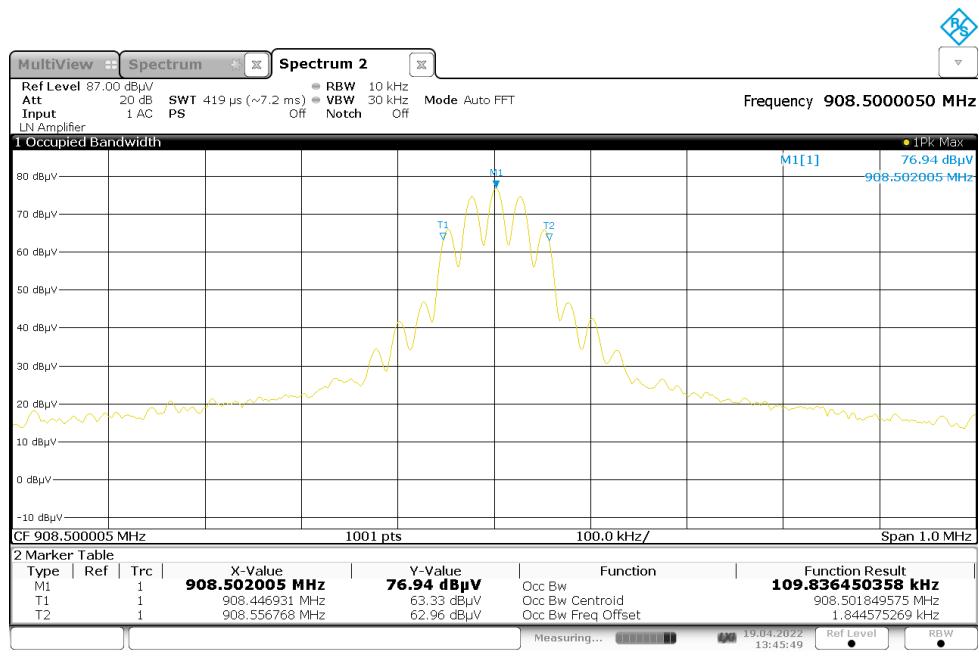
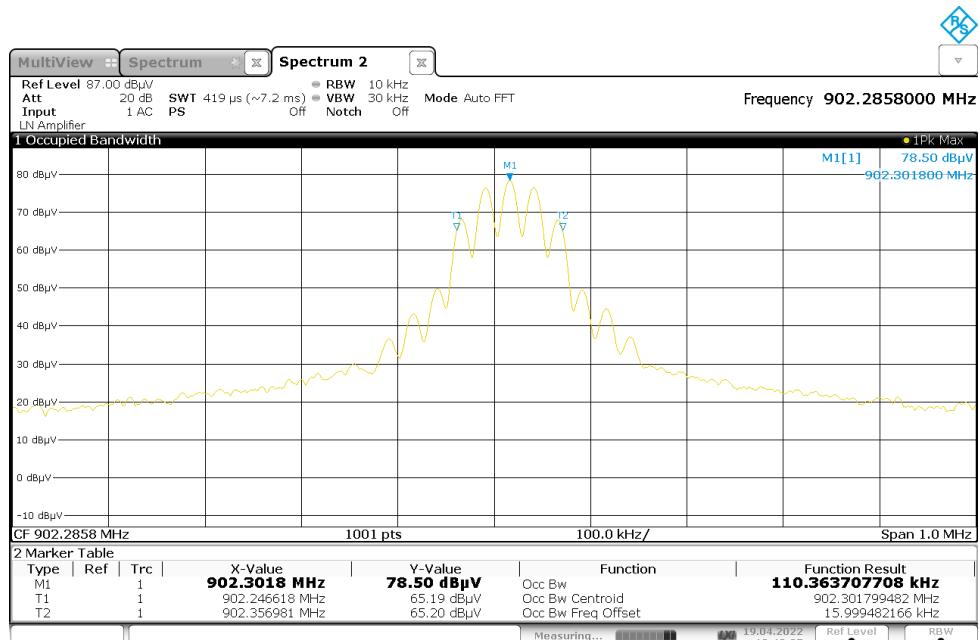


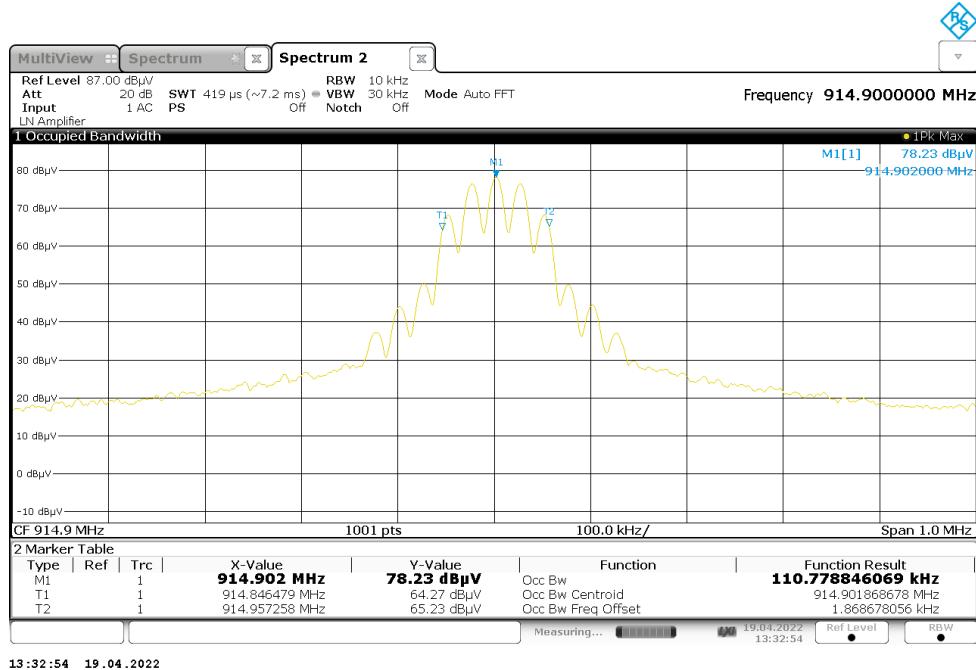


Frequency Channel	99% Bandwidth	Band Edge Left	Band Edge Right
902.3 MHz	110.3637 kHz	902.246618 MHz	902.456981 MHz
908.5 MHz	109.8365 kHz	908.446931 MHz	908.556768 MHz
914.9 MHz	110.7788 kHz	914.846479 MHz	914.957258 MHz



Table 8: 99% bandwidth





2.2.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 9



2.3 Hopping Channel Separation

2.3.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(a)(1)
ISED RSS-247, Clause 5.1.b.

2.3.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.3.3 Date of Test

2022-04-21

2.3.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	29 %

2.3.5 Specification Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

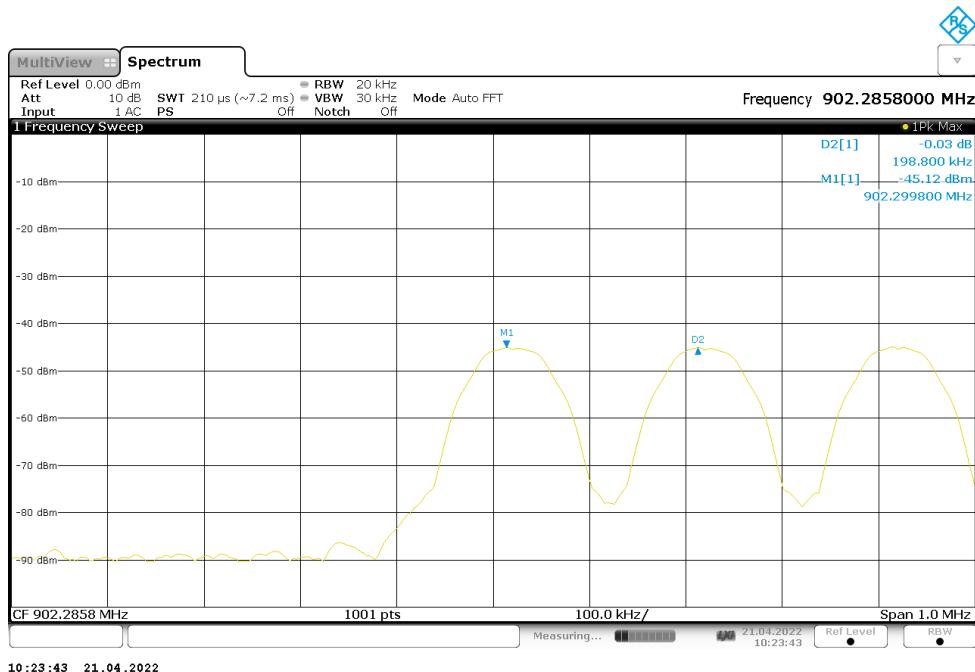
2.3.6 Test Method

The test was performed according to ANSI C63.10, clauses 6.9.3 and 11.8.1

2.3.7 Test Results

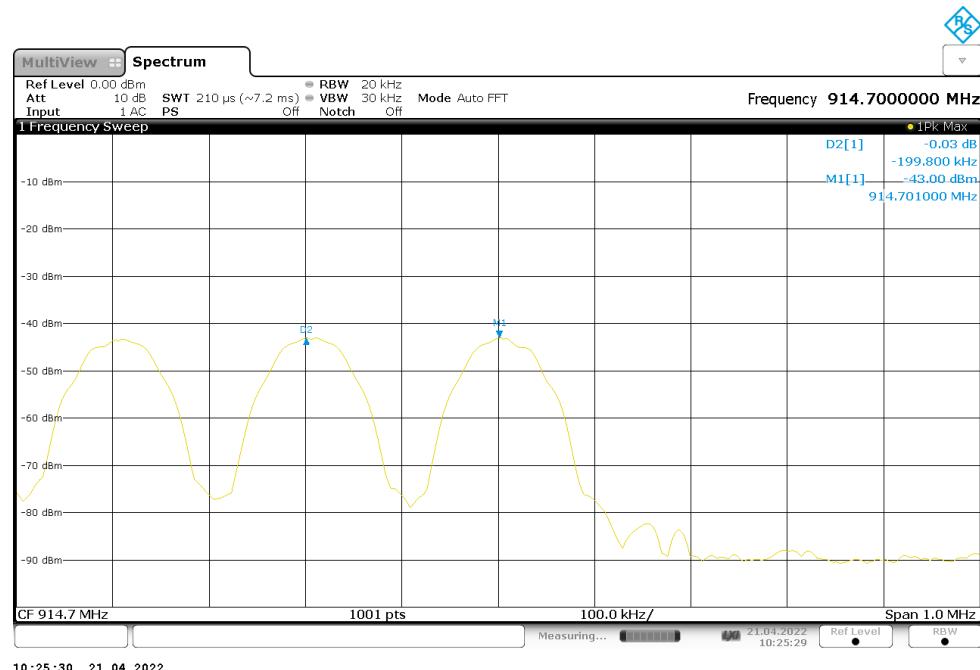
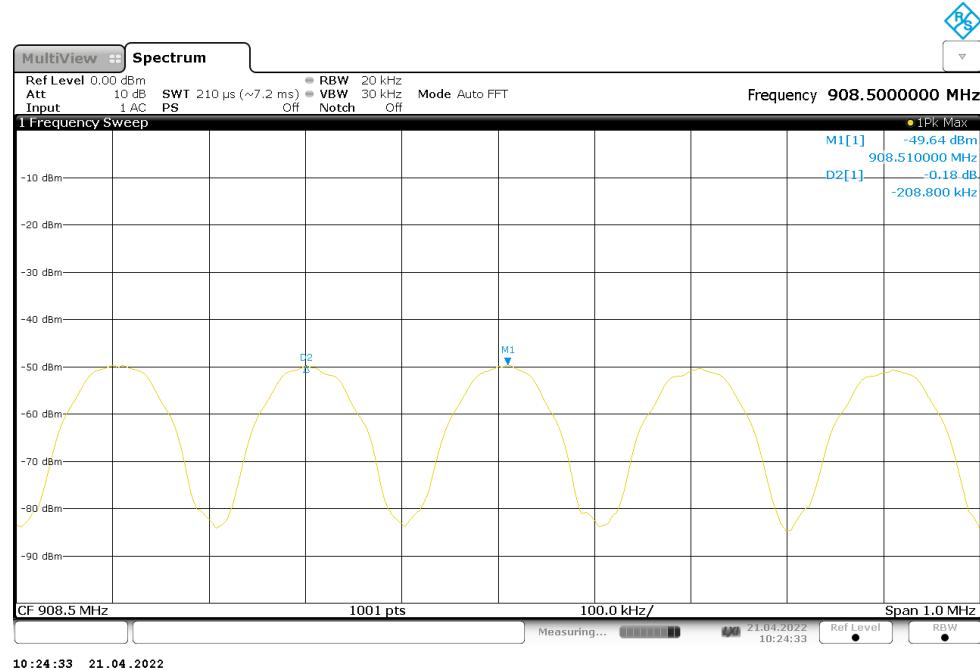
Frequency Channel	Band Separation	Limit	Result
902.3 MHz	198.8 kHz	≥ 119.9 kHz	Pass
908.5 MHz	208.8 kHz	≥ 119.8 kHz	Pass
914.9 MHz	199.8 kHz	≥ 119.8 kHz	Pass

Table 10: Hopping Channel separation





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2.3.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 11



2.4 Number of Hopping Channel

2.4.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(a)(1)(i)
ISED RSS-247, Clause 5.1.c.

2.4.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.4.3 Date of Test

2022-04-21

2.4.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	29 %

2.4.5 Specification Limits

For frequency hopping systems operating in the 902 – 928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 s within a 20 s period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 s with a 10 s period.

2.4.6 Test Method

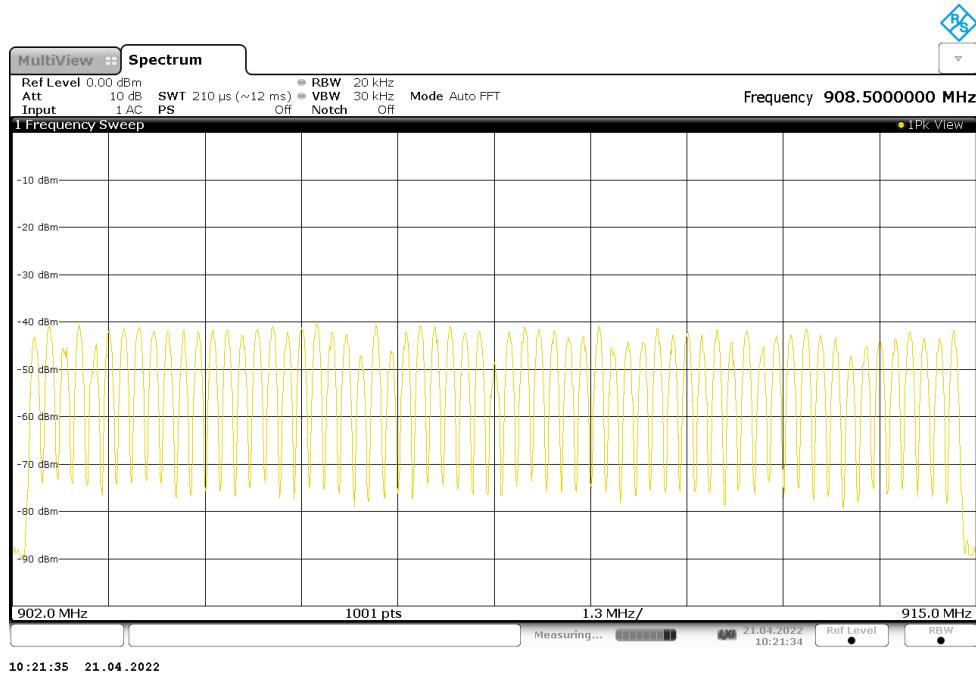
The test was performed according to ANSI C63.10, clauses 6.9.3 and 11.8.1



2.4.7 Test Results

Frequency Channel	Band Separation	Limit	Result
64	< 250 kHz	≥ 50	Pass

Table 12:



2.4.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 13



2.5 Time Occupancy on any Channel

2.5.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(a)(1)(i)
ISED RSS-247, Clause 5.1.c.

2.5.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.5.3 Date of Test

2022-04-21

2.5.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	29 %

2.5.5 Specification Limits

For frequency hopping systems operating in the 902 – 928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 s within a 20 s period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 s with a 10 s period.

2.5.6 Test Method

The test was performed according to ANSI C63.10, clauses 6.9.3 and 11.8.1

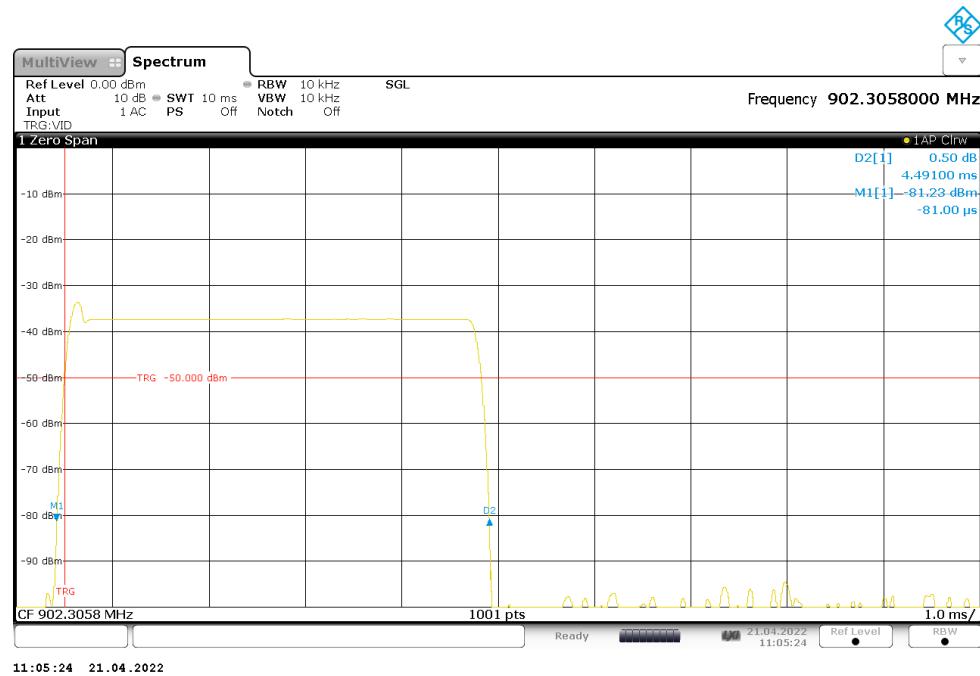
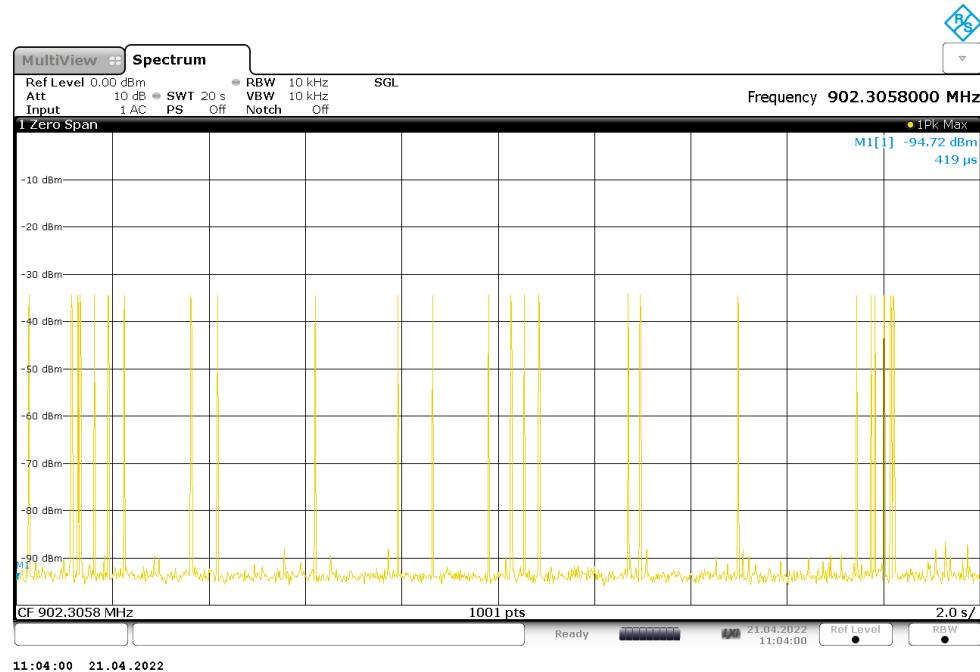
2.5.7 Test Results

Frequency Channel	Time occupancy	Limit	Result
902.3 MHz	25 x 4.491 ms = 112.275 ms	< 400 ms	Pass
908.5 MHz	23 x 4.491 ms = 103.293 ms	< 400 ms	Pass
914.9 MHz	25 x 4.500 ms = 112.500 ms	< 400 ms	Pass

Table 14: Time Occupancy

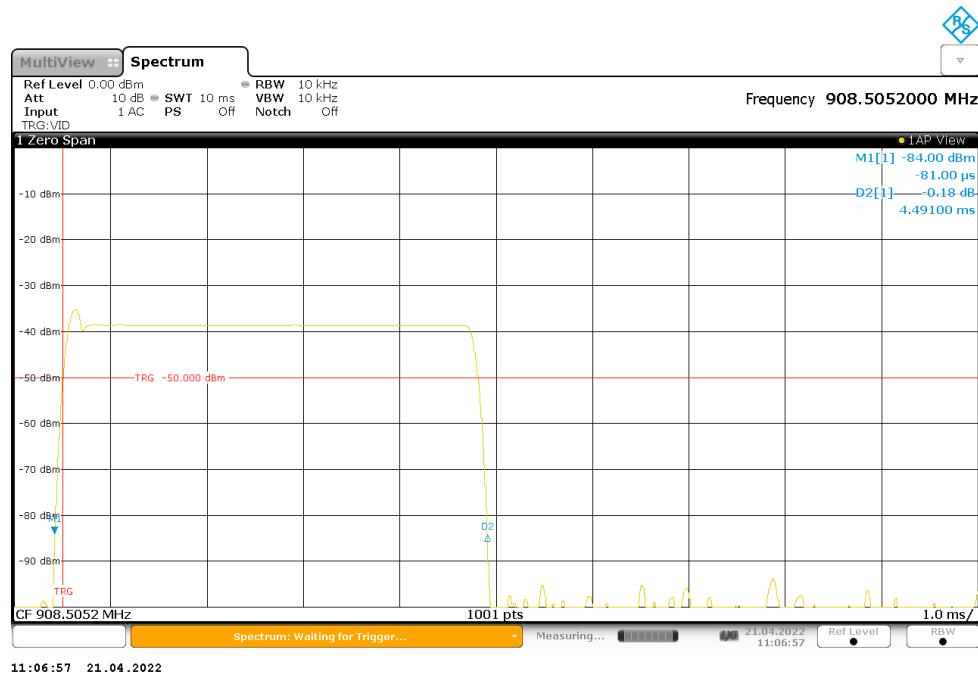
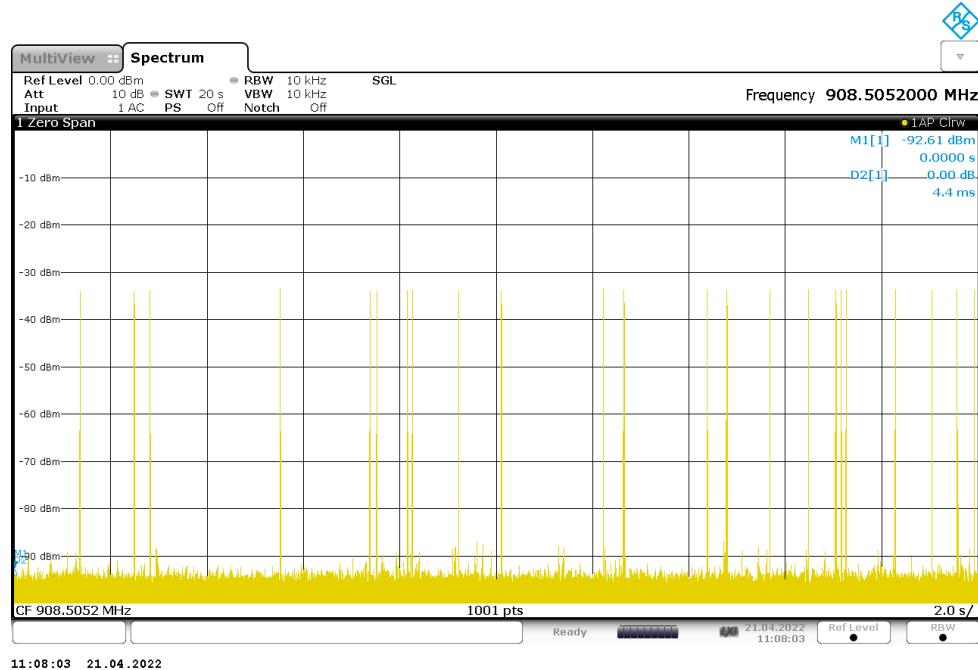


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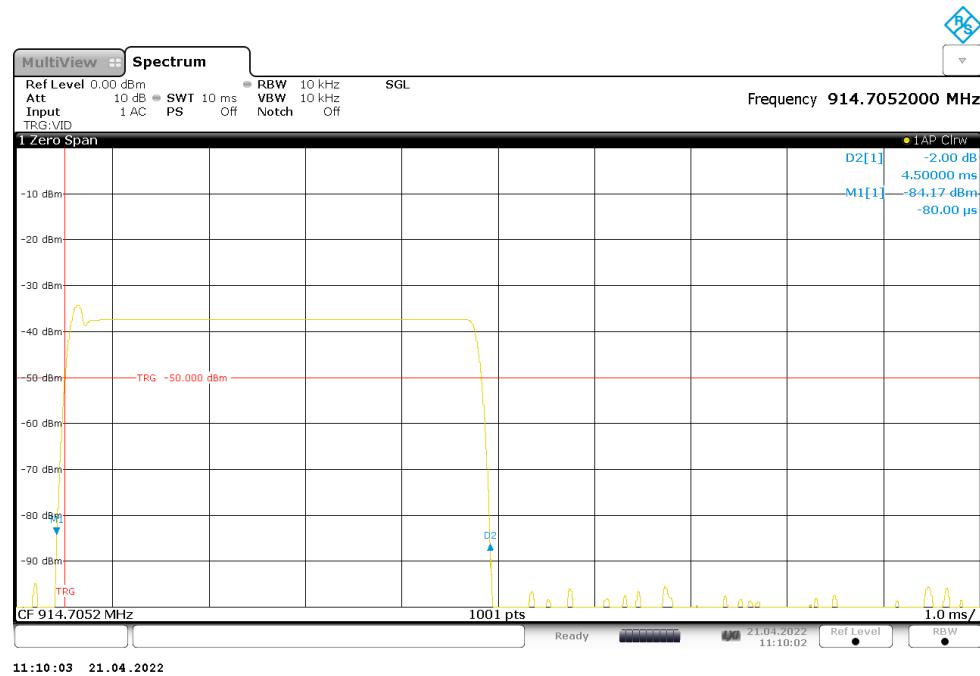
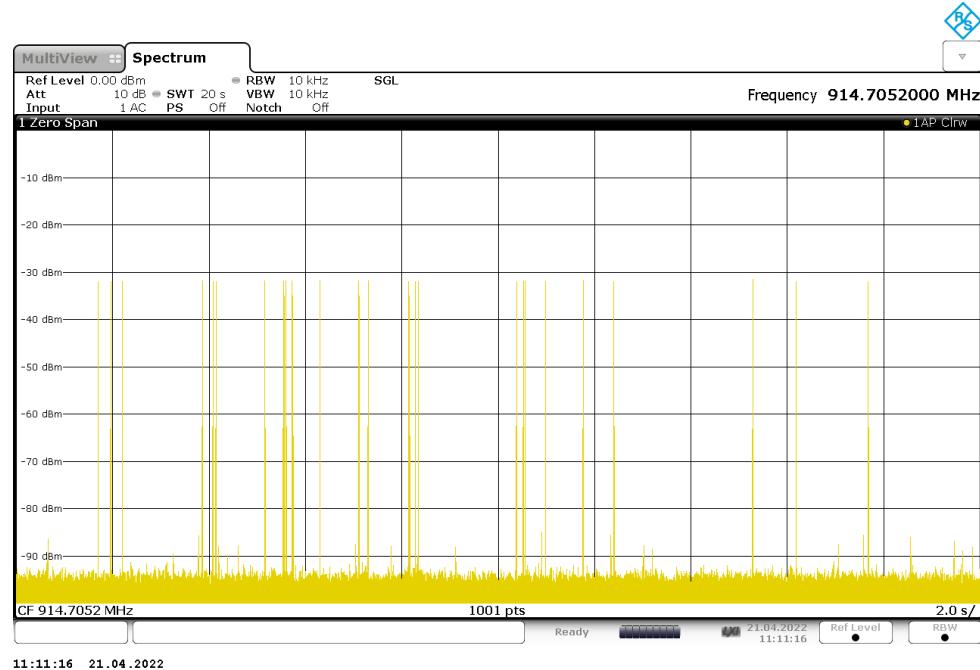


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2.5.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 15



2.6 Output Power

2.6.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(b)(3)
ISED RSS-247, Clause 5.4 d.

2.6.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.6.3 Date of Test

2022-04-19

2.6.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	31 %

2.6.5 Specification Limits

The maximum conducted output power shall not exceed 1 W (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm).

2.6.6 Test Method

The test was performed according to ANSI C63.10, section 11.9
EIRP value was calculated according to ANSI C63.10, section 9.5:

$$EIRP = E_{Meas} + 20 \log(d_{Meas}) - 104.7 \text{ dB}$$

For test method for radiated emissions, please refer to section 2.9.6.2 if this test report.



2.6.7 Test Results

Frequency Channel	3 m Fieldstrength	EIRP	Limit	Result
902.3 MHz	115.85 dB μ V/m	20.69 dBm	30.0 dBm	Pass
908.5 MHz	117.36 dB μ V/m	22.20 dBm	30.0 dBm	Pass
914.9 MHz	113.95 dB μ V/m	18.79 dBm	30.0 dBm	Pass

Table 16: Output Power

2.6.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 17



2.7 Frequency Band Edge

2.7.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(d)
ISED RSS-247, Clause 5.5

2.7.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0
RCM_H200; S/N Test-Board; Modification State 0

2.7.3 Date of Test

2022-05-6, 2022-05-11

2.7.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	31 %

2.7.5 Specification Limits

In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either conducted or radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

2.7.6 Test Method

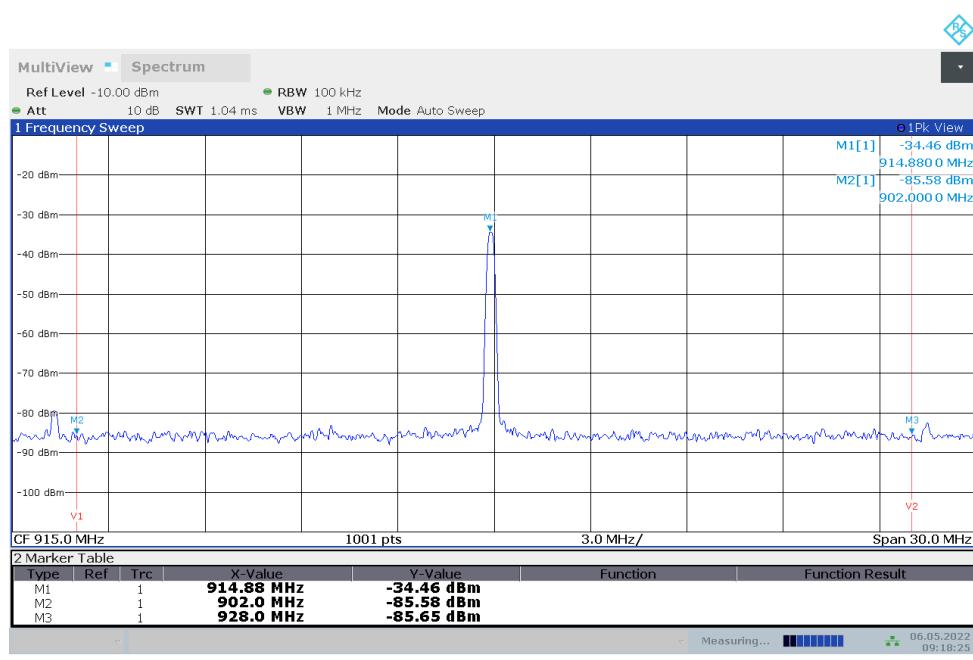
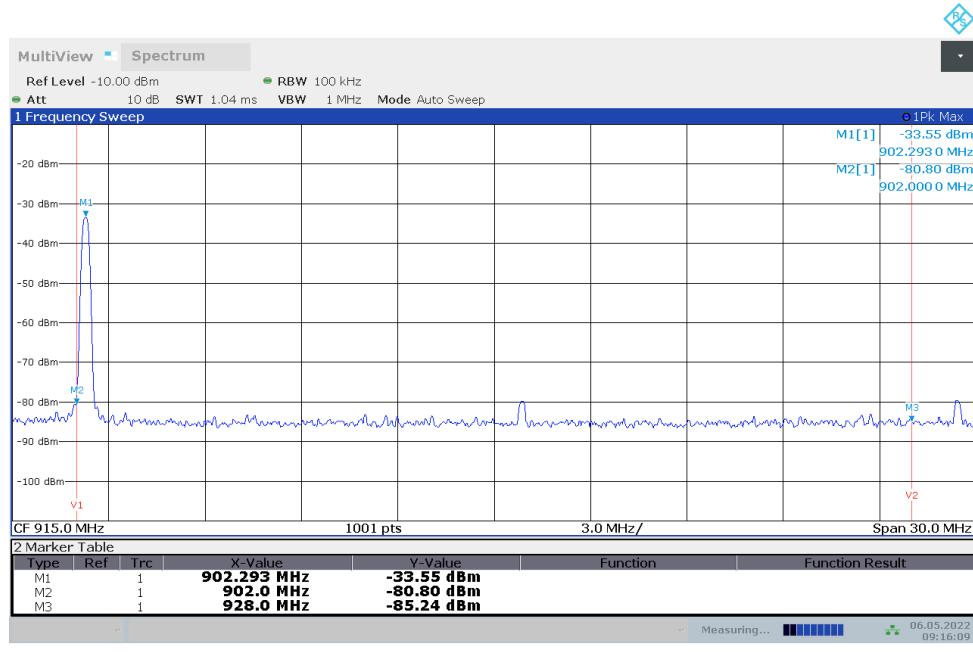
The test was performed according to ANSI C63.10, sections 11.11

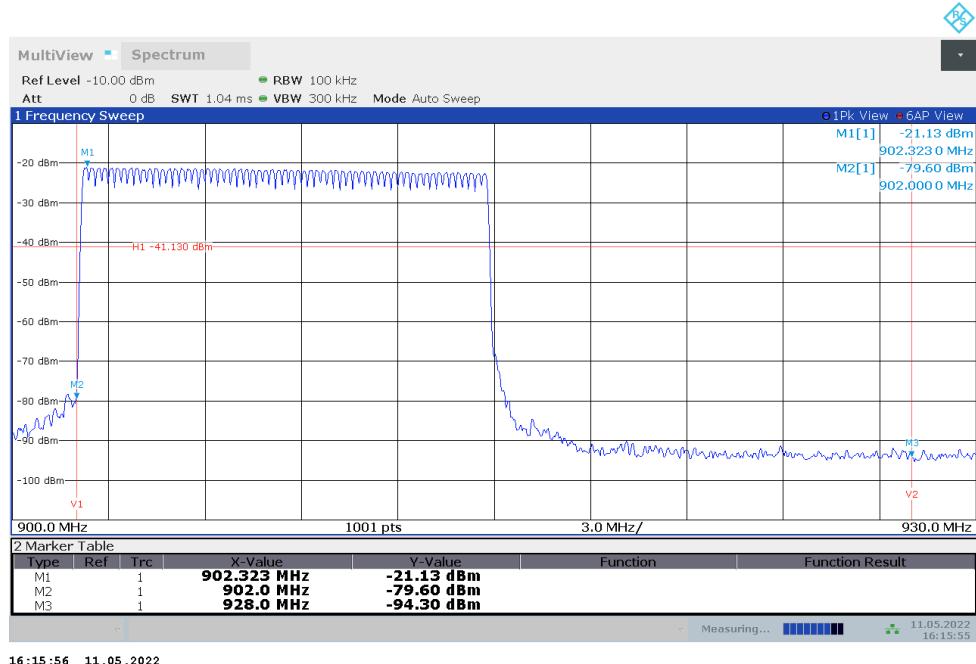


2.7.7 Test Results

See plots for restricted band for further details.

Pass





2.7.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
Signal and Spectrum Analysator	Rohde & Schwarz	FSW43	53496	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 18



2.8 Restricted Bands of operation

2.8.1 Specification Reference

FCC 47 CFR Part 15 C, Clauses 15.209 and 15.247(d)

ISED RSS-247, Clause 5.5

ISED RSS-GEN, Clause 8.10

2.8.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.8.3 Date of Test

2022-04-19

2.8.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	31 %

2.8.5 Specification Limits

In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either conducted or radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

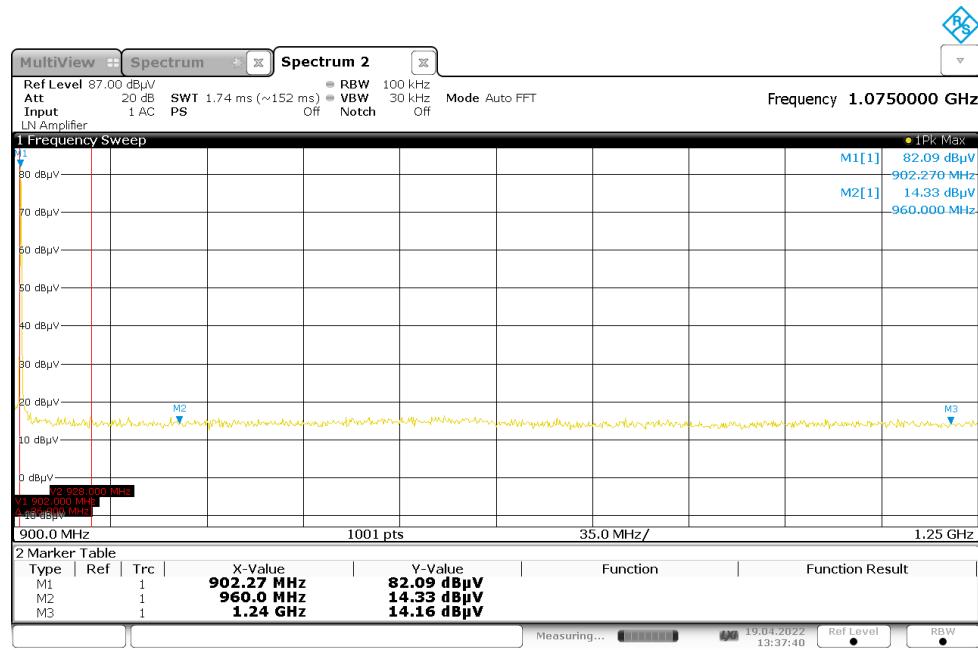
In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

2.8.6 Test Method

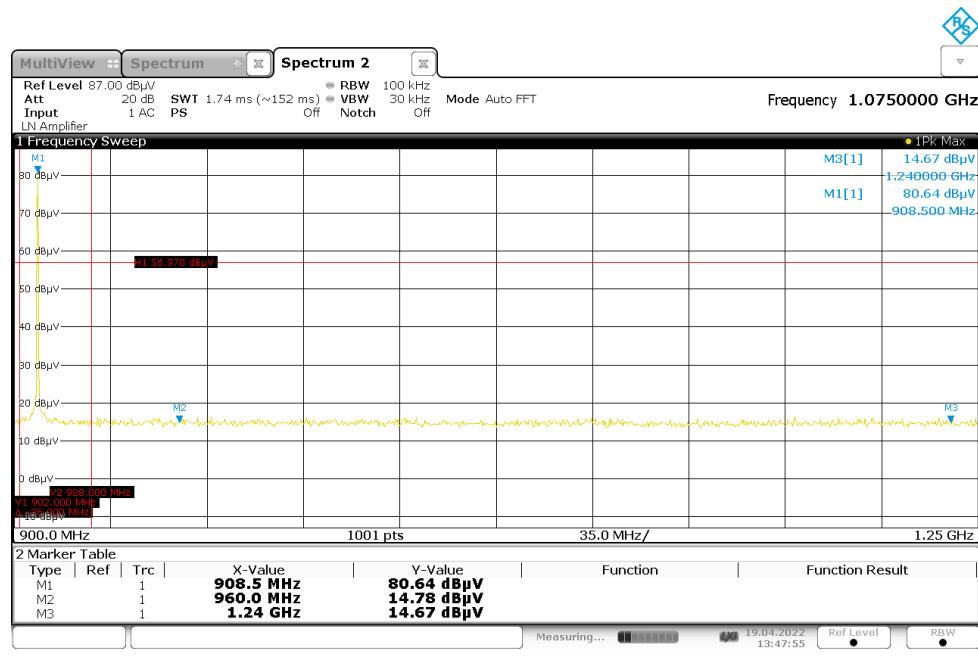
The test was performed according to ANSI C63.10, sections 11.11



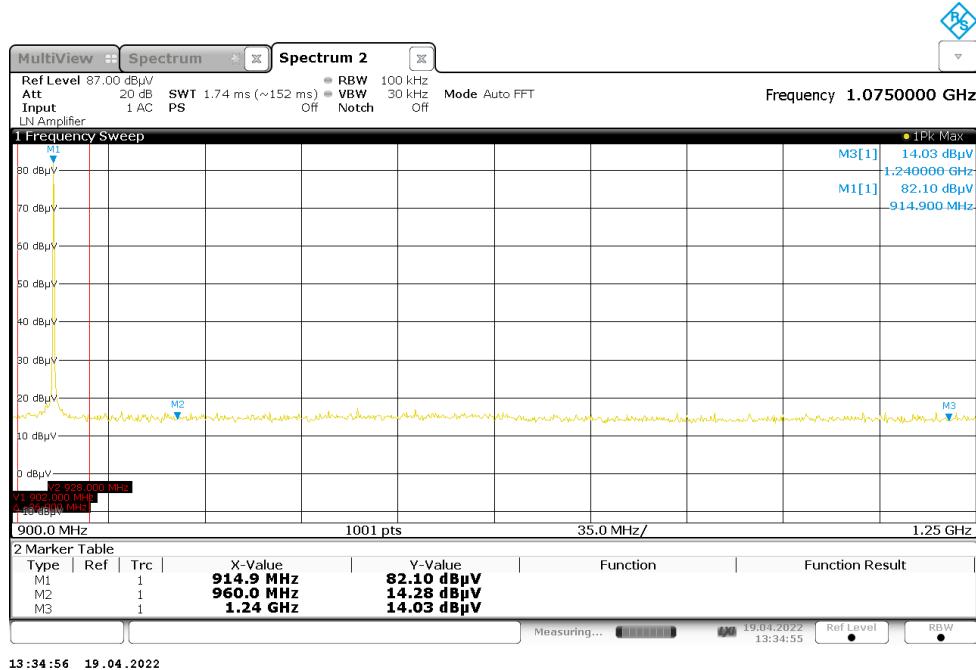
2.8.7 Test Results



Lowest channel: Pass



Middle channel: Pass



Highest channel: Pass

2.8.8 Test Location and Test Equipment

The test was carried out in semi anechoic room No. 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Fixed attenuator	Aeroflex	Model 1: 6 dB	39632	36	2025-03-31
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 19



2.9 Spurious emissions

2.9.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.205, 15.209, 15.247(d)

ISED RSS-247, Clause 5.5

ISED RSS-Gen, Clauses 8.9 and 8.10

2.9.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.9.3 Date of Test

2022-04-19 and 2022-04-20

2.9.4 Environmental Conditions

Ambient Temperature	21 °C
Relative Humidity	31 %



2.9.5 Specification Limits

In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either conducted or radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

General radiated emission limits:					
Frequency Range (MHz)	Test distance (m)	Field strength ($\mu A/m$)	Field strength ($dB\mu A/m$)	Field strength ($\mu V/m$)	Field strength ($dB\mu V/m$)
0.009 – 0.49	300	6.37 / f	20*lg(6.37 / f)	2400 / f	20*lg(2400 / f)
0.49 – 1.705	30	63.7 / f	20*lg(63.7 / f)	24000 / f	20*lg(24000 / f)
1.705 – 30	30	0.08	20*lg(0.08 / f)	30	20*lg(30 / f)
30 – 88	3	---	--	100	40
88 – 216	3	--	--	150	43.5
126 – 960	3	--	--	200	46
above 960	3	--	--	500	54

Note 1: f in kHz

Table 20 General radiated emission limits

2.9.6 Test Method

The test was performed according to ANSI C63.10, sections 11.11 and 11.12

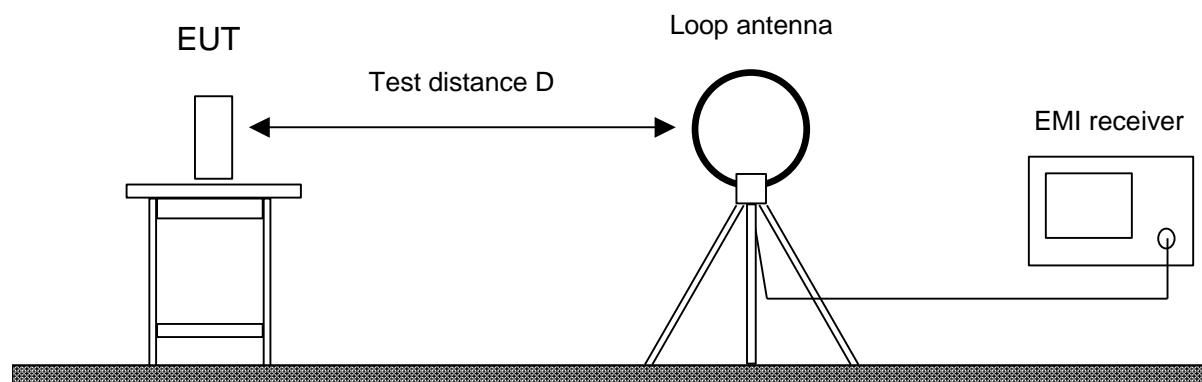
Prescans are performed in six positions of the EUT to get the full spectrum of emission caused by the EUT with the measuring antenna raised and lowered from 1 m to 4 m with vertical and horizontal polarisation to find the combination of table position, antenna height and antenna polarisation for the maximum emission levels.

Data reduction is applied to these results to select those levels having less margin than 10 dB or exceeding the limit using subranges and limited number of maximums.

Further maximisation for adjusting the maximum position is following.

Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

2.9.6.1 Frequency range 9 kHz – 30 MHz

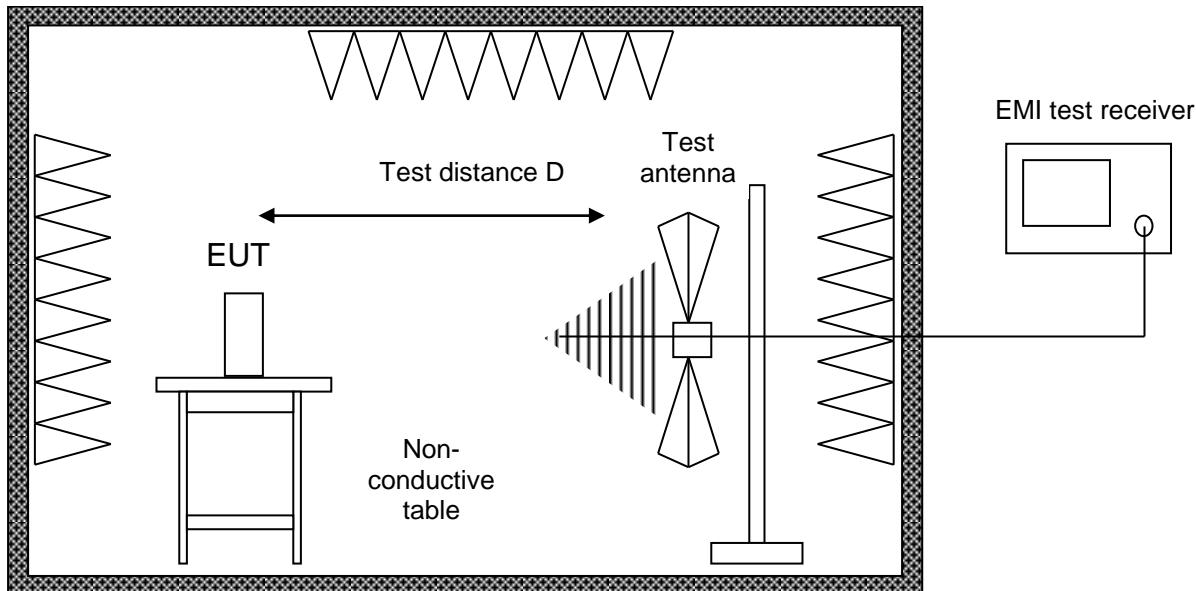


The EUT was placed on a non-conductive table, 0.8 m above the ground.

Radiated emissions in the frequency 9 kHz – 30 MHz is measured within a semi-anechoic room with an active loop antenna with the measurement detector set to peak. In addition in the frequency range 9 kHz to 490 kHz also an average detector was used. The measurement bandwidth of the receiver was set to 300 Hz in the frequency range 9 kHz to 150 kHz and 10 kHz in the frequency range 150 kHz to 30 MHz. Prescans were performed in six positions of the EUT.

For final measurements the detector was set to CISPR quasi-peak and in addition to CISPR average in the frequency range 9 kHz to 490 kHz with a resolution bandwidth 200 Hz in the frequency range 9 kHz to 150 kHz and 9 kHz in the frequency range 150 kHz to 30 MHz. Final tests were performed immediately after a final frequency and zoom (for drifting disturbances) and maximum adjustment.

2.9.6.2 Frequency range 30 MHz – 1 GHz

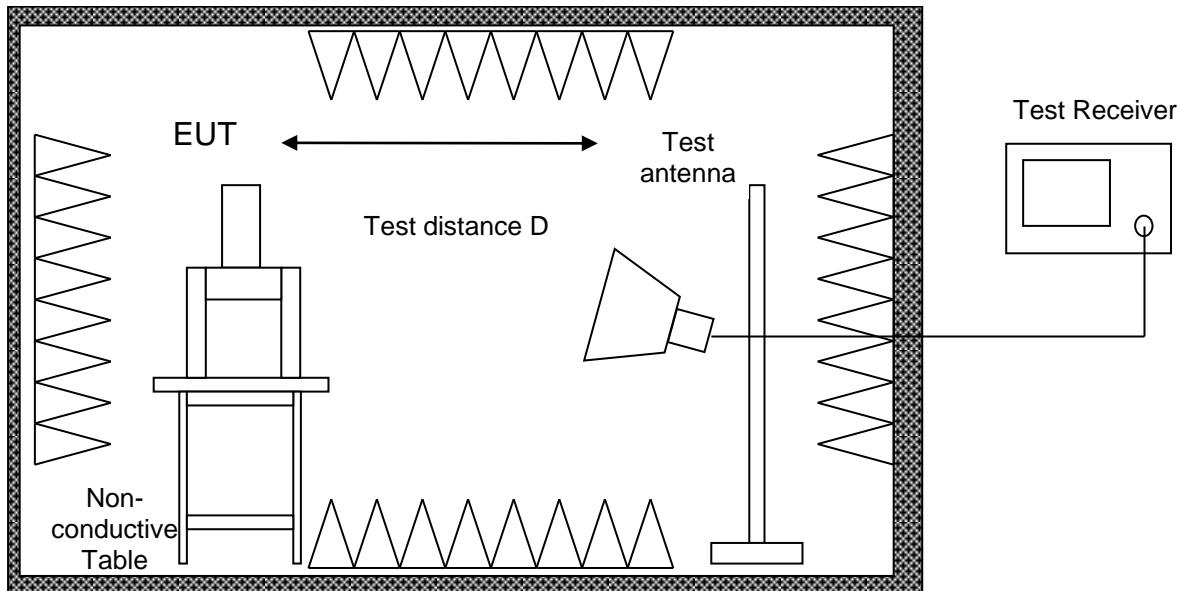


Alternate test site (semi anechoic room)

The EUT was placed on a non-conductive table, 0.8 m above the ground plane. Radiated emissions in the frequency range 30 MHz – 1 GHz are measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4. for alternative test sites. A linear polarised logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used.

For prescan tests the test receiver is set to peak-detector with a bandwidth of 120 kHz. With the measurement bandwidth of the test receiver set to 120 kHz CISPR quasi-peak detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.

2.9.6.3 Frequency range above 1 GHz



Fully anechoic room

The EUT was placed on a non-conductive table, 1.5 m above the ground plane. Radiated emission tests above 1 GHz are performed in a fully anechoic room with the S_{VSWR} requirements of ANSI C63.4. Measurements are performed both in the horizontal and vertical planes of polarisation using a test receiver with the detector function set to peak and average and the resolution bandwidth set to 1 MHz. Testing above 1 GHz is performed with horn antennas with the EUT in boresight of the antenna.

For prescan tests the test receiver is set to peak- and average-detector with a bandwidth of 1 MHz. With the measurement bandwidth of the test receiver set to 1 MHz and peak- and CISPR average-detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.



2.9.7 Test Results

<i>Frequency range</i>	<i>Limit applied</i>	<i>Test distance</i>	<i>Test site</i>
9 kHz – 30 MHz	15.209	10 m	Cabin No. 8
30 MHz – 1 GHz	15.209, 15.247	3 m	Cabin No. 11
1 GHz – 9.5 GHz	15.209, 15.247	1 m	Cabin No. 11

Table 21: Description of performed tests

Sample calculation:

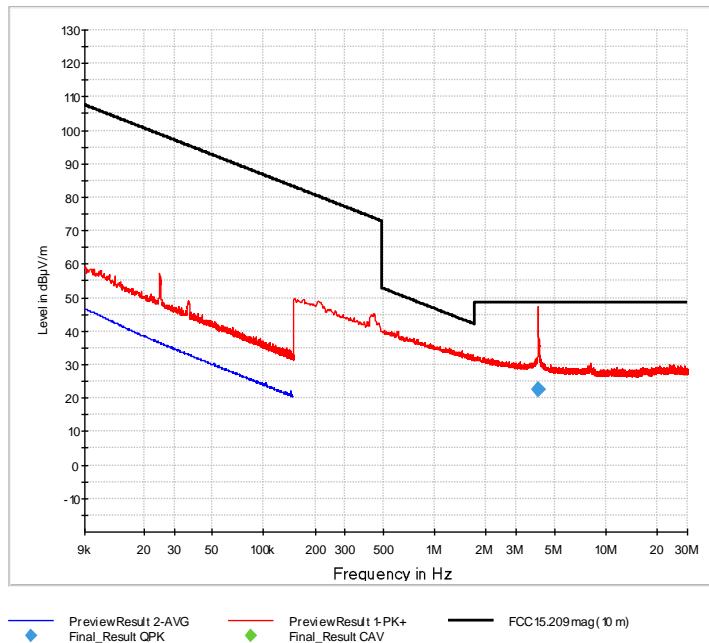
Final Value (dB μ V/m) = Reading Value (dB μ V) + (Cable attenuation (dB)
+ Antenna Transducer (dB(1/m)))

2.9.7.1 Transmitting on lowest frequency

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
32.220	vertical	Quasi-Peak	2.4	24.1		26.5	95.9	69.4
187.380	vertical	Quasi-Peak	16.6	15.1		31.7	95.9	64.2
650.460	vertical	Quasi-Peak	7.5	27.7		35.2	95.9	60.7
741.120	vertical	Quasi-Peak	10.1	28.9		39.0	95.9	56.9
838.290	vertical	Quasi-Peak	8.6	30.1		38.7	95.9	57.2
902.300	horizontal	Quasi-Peak	85.1	30.8		115.9		
5413.750	vertical	Average	21.0	33.0		54.0	54.0	0.0
8120.750	vertical	Average	11.2	36.7		47.9	54.0	6.1
9023.000	vertical	Average	11.2	37.8		49.0	54.0	5.1

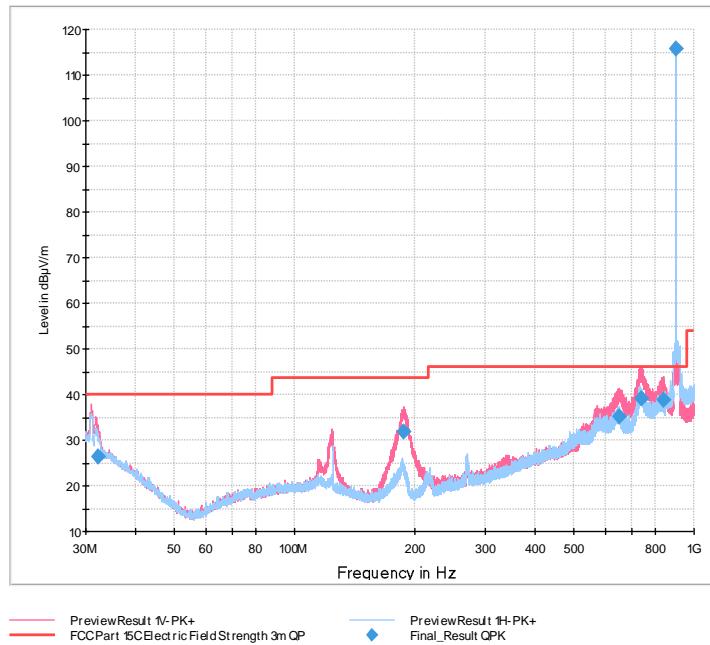
Final results corrected to 3 m distance

Frequency range 9 kHz – 30 MHz:



Frequency MHz	QuasiPeak dB μ V/m	CAverage dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Pol	Azi-muth deg	Corr. dB/m
3.999750	22.74		48.60	25.86	1000	9	V	68.0	19.6

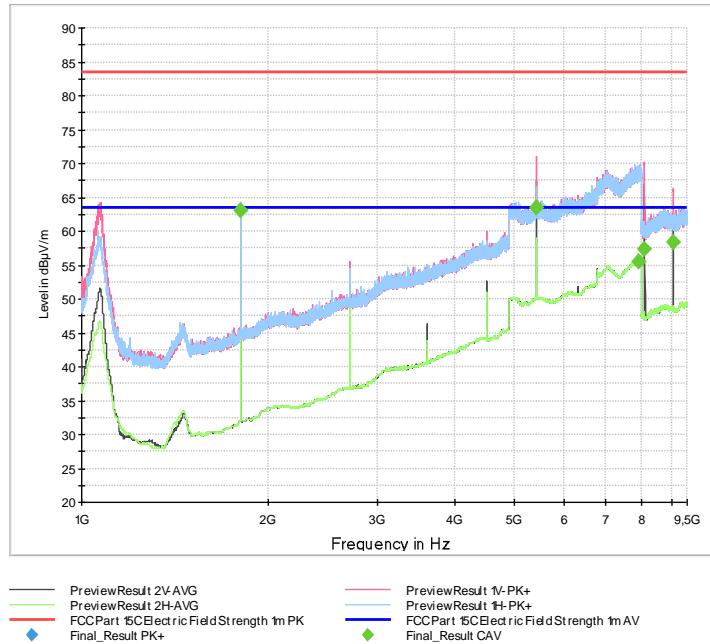
Frequency range 30 MHz – 1 GHz:



Frequency MHz	QuasiPeak dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azi-muth deg	Corr. dB
32.220000	26.47	40.00	13.53	1000	120	100.0	V	-139.0	24.1
187.380000	31.70	43.50	11.80	1000	120	100.0	V	62.0	15.1
650.460000	35.18	46.02	10.84	1000	120	212.0	V	-19.0	27.7
741.120000	39.00	46.02	7.02	1000	120	100.0	V	109.0	28.9
838.290000	38.66	46.02	7.36	1000	120	125.0	V	-71.0	30.1
902.280000	115.85	*	*	1000	120	100.0	H	192.0	30.8

*: Carrier frequency, no limit applys

Frequency range 1 GHz – 9.5 GHz:



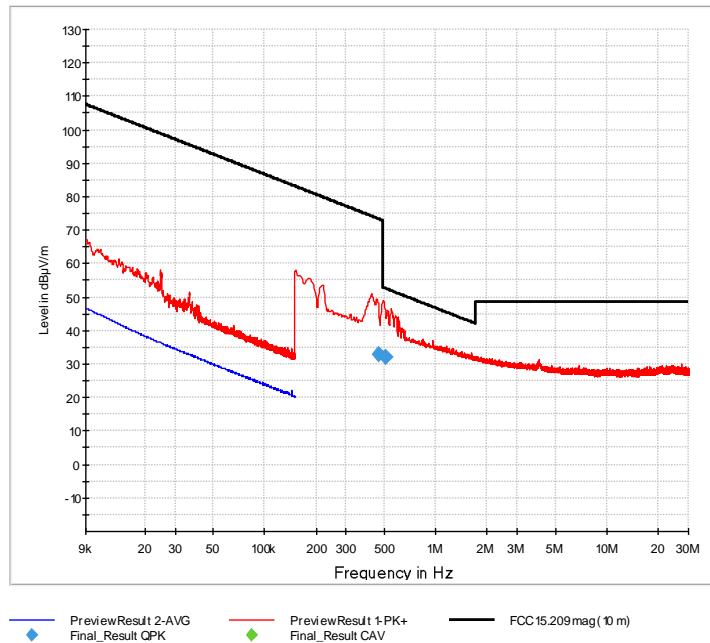
Frequency MHz	Max- Peak dB μ V/m	CAver- age dB μ V/m	Limit dB μ V/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Po l	Azi- muth deg	Corr. dB/m
1804.500		63.08	63.50	0.42	1000	1000	200.0	H	-30.0	31.2
5413.750		63.48	63.50	0.02	1000	1000	100.0	V	-150.0	42.5
7951.000		55.50	63.50	8.00	1000	1000	100.0	V	30.0	46.0
8120.750		57.43	63.50	6.07	1000	1000	150.0	V	-150.0	46.2
9023.000		58.45	63.50	5.05	1000	1000	150.0	V	-150.0	47.3

2.9.7.2 Transmitting on middle frequency

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
31.200	vertical	Quasi-Peak	6.6	24.7		31.3	97.4	66.0
182.940	vertical	Quasi-Peak	13.9	15.4		29.3	97.4	68.1
642.570	vertical	Quasi-Peak	3.5	27.3		30.8	97.4	66.5
741.090	vertical	Quasi-Peak	13.2	28.9		42.1	97.4	55.3
831.720	vertical	Quasi-Peak	7.1	30.1		37.2	97.4	60.2
908.500	horizontal	Quasi-Peak	86.5	30.9		117.4		
1076.000	vertical	Peak	14.8	37.3		52.1	74.0	21.9
1076.000	vertical	Average	1.4	37.3		38.7	54.0	15.3
1817.000	horizontal	Peak	13.8	40.8		54.6	97.4	42.8
2725.500	vertical	Peak	2.3	44.8		47.1	74.0	26.9
2725.500	vertical	Average	-2.9	44.8		41.9	54.0	12.1
5451.250	vertical	Peak	7.7	52.1		59.8	74.0	14.2
5451.250	vertical	Average	1.1	52.1		53.2	54.0	0.8
7902.000	horizontal	Peak	3.0	55.5		58.5	97.4	38.8
8176.750	vertical	Peak	0.2	55.9		56.1	74.0	17.9
8176.750	vertical	Average	-12.5	55.9		43.4	54.0	10.6
9085.000	vertical	Peak	0.5	56.7		57.2	74.0	16.8
9085.000	vertical	Average	-12.8	56.7		43.9	54.0	10.1

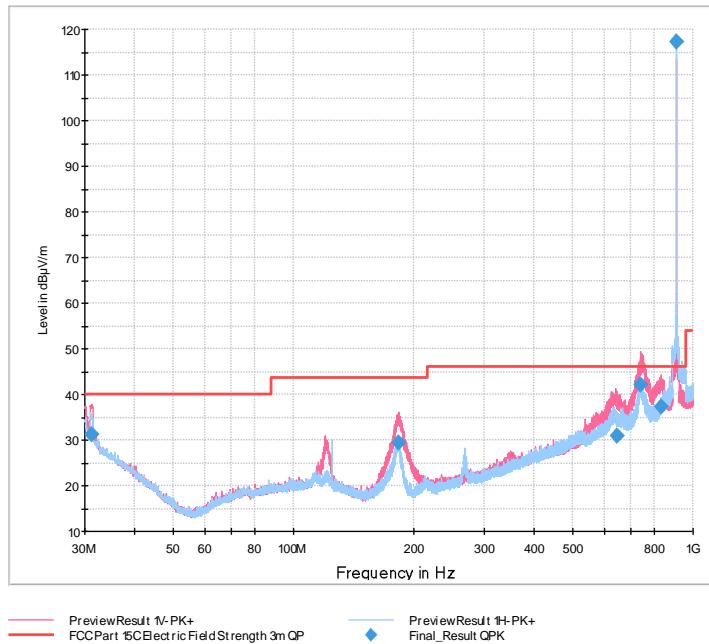
Final results corrected to 3 m distance

Frequency range 9 kHz – 30 MHz:



Frequency MHz	Qua- siPeak dB μ V/m	CAverage dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Band- width kHz	Pol	Azi- muth deg	Corr. dB/m
0.467250	32.84		73.31	40.47	1000	9	V	49.0	19.7
0.514500	31.88		52.48	20.60	1000	9	V	-198.0	19.7

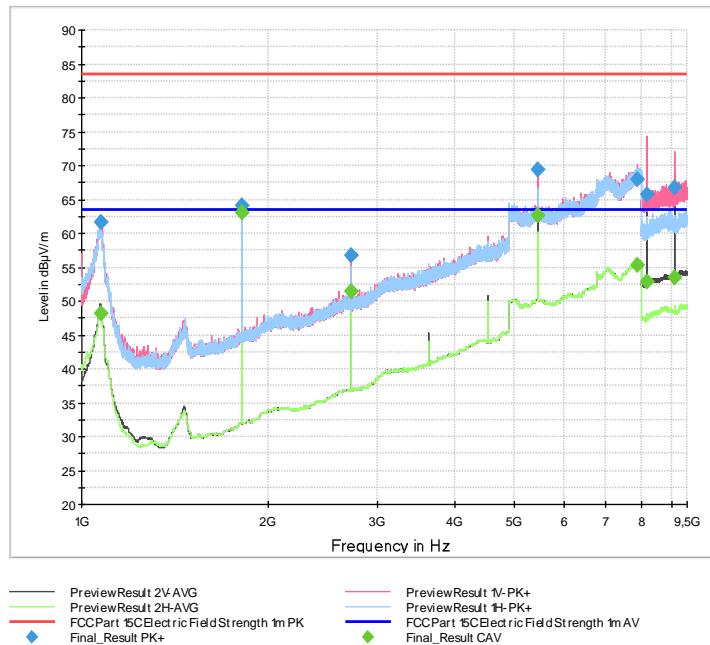
Frequency range 30 MHz – 1 GHz:



Frequency MHz	Qua- siPeak dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
31.200000	31.32	40.00	8.68	1000	120	100.0	V	140.0	24.7
182.940000	29.26	43.50	14.24	1000	120	100.0	V	-91.0	15.4
642.570000	30.83	46.02	15.19	1000	120	100.0	V	-71.0	27.3
741.090000	42.08	46.02	3.94	1000	120	154.0	V	-84.0	28.9
831.720000	37.15	46.02	8.87	1000	120	144.0	V	-82.0	30.1
908.520000	117.36	*		1000	120	100.0	H	186.0	30.9

*: Carrier, no limit applies

Frequency range 1 GHz – 10 GHz:



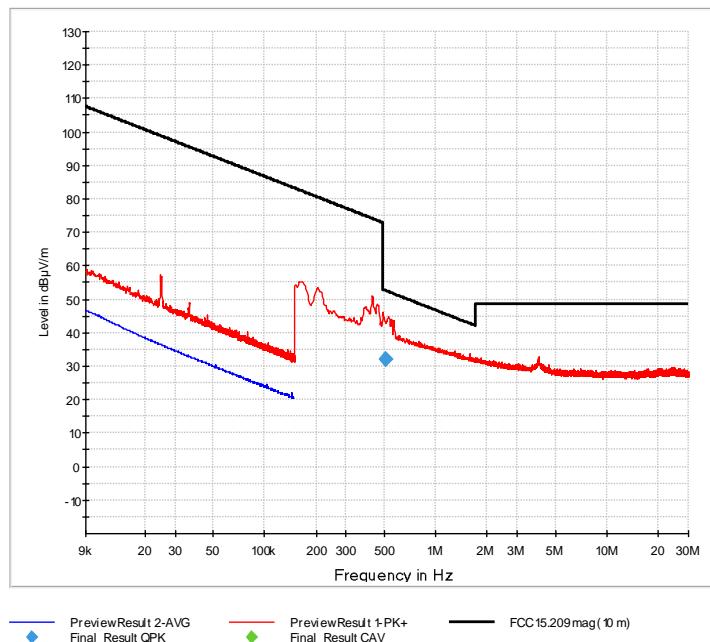
Frequency MHz	Max- Peak dB μ V/m	CAver- age dB μ V/m	Limit dB μ V/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
1076.000000		48.19	63.50	15.31	1000	1000	155.0	V	-35.0	27.8
1076.000000	61.61		83.50	21.89	1000	1000	155.0	V	-35.0	27.8
1817.000000	64.08		83.50	19.42	1000	1000	171.0	H	151.0	31.3
1817.000000		63.06	63.50	0.44	1000	1000	171.0	H	151.0	31.3
2725.500000	56.64		83.50	26.86	1000	1000	125.0	V	136.0	35.3
2725.500000		51.44	63.50	12.06	1000	1000	125.0	V	136.0	35.3
5451.250000	69.33		83.50	14.17	1000	1000	216.0	V	2.0	42.6
5451.250000		62.67	63.50	0.83	1000	1000	216.0	V	2.0	42.6
7902.000000		55.34	63.50	8.16	1000	1000	125.0	H	210.0	46.0
7902.000000	68.02		83.50	15.48	1000	1000	125.0	H	210.0	46.0
8176.750000		52.87	63.50	10.63	1000	1000	125.0	V	4.0	46.4
8176.750000	65.63		83.50	17.87	1000	1000	125.0	V	4.0	46.4
9085.000000	66.70		83.50	16.80	1000	1000	125.0	V	5.0	47.2
9085.000000		53.38	63.50	10.12	1000	1000	125.0	V	5.0	47.2

2.9.7.3 Transmitting on highest frequency

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dB μ V)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
32.550	vertical	Quasi-Peak	-5.2	23.9		18.7	94.0	75.3
125.880	vertical	Quasi-Peak	7.3	17.1		24.4	43.5	19.1
186.120	vertical	Quasi-Peak	16.2	15.1		31.3	94.0	62.7
656.340	vertical	Quasi-Peak	6.6	27.9		34.5	94.0	59.4
754.890	vertical	Quasi-Peak	16.8	28.9		45.7	94.0	48.3
882.900	vertical	Quasi-Peak	11.0	30.5		41.5	94.0	52.4
914.900	horizontal	Quasi-Peak	83.0	31.0		114.0		
2744.750	horizontal	Average	-0.7	44.7		44.0	54.0	10.0
7949.750	horizontal	Peak	-6.0	55.5		49.6	94.0	44.4
8234.000	horizontal	Average	-7.7	56.1		48.4	54.0	5.6
9149.000	horizontal	Average	-7.5	56.7		49.2	54.0	4.8

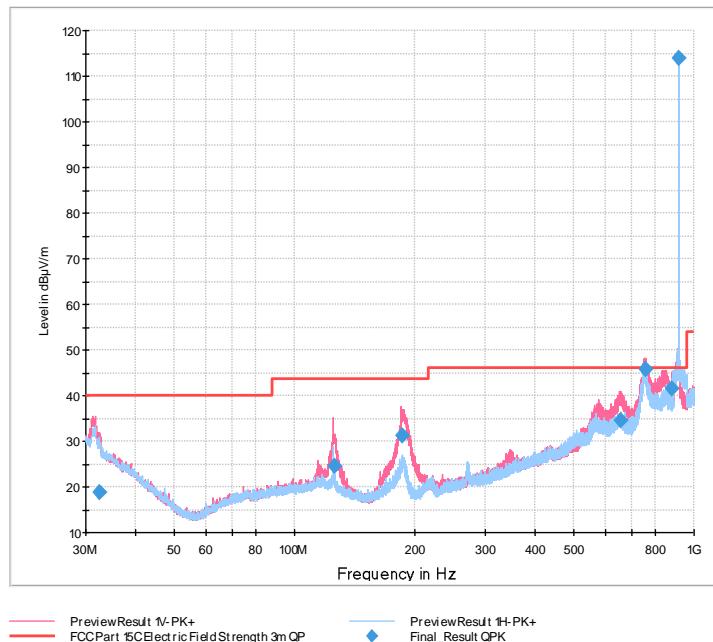
Final results corrected to 3 m distance

Frequency range 9 kHz – 30 MHz:



Frequency MHz	QuasiPeak dB μ V/m	CAverage dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Bandwidth kHz	Pol	Azi-muth deg	Corr. dB/m
0.512250	31.98		52.52	20.54	1000	9	V	-110.0	19.7

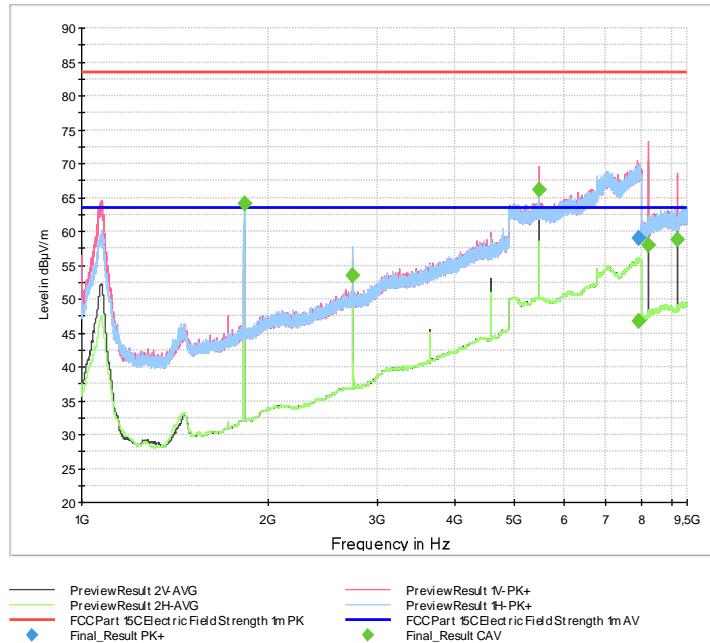
Frequency range 30 MHz – 1 GHz:



Frequency MHz	QuasiPeak dB μ V/m	Limit dB μ V/m	Margin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB
32.550000	18.68	40.00	21.32	1000	120	130.0	V	-99.0	23.9
125.880000	24.41	43.50	19.09	1000	120	128.0	V	0.0	17.1
186.120000	31.27	43.50	12.23	1000	120	100.0	V	126.0	15.1
656.340000	34.51	46.02	11.51	1000	120	196.0	V	58.0	27.9
754.890000	45.70	46.02	0.32	1000	120	134.0	V	106.0	28.9
882.900000	41.54	46.02	4.48	1000	120	100.0	V	59.0	30.5
914.880000	113.95	*		1000	120	100.0	H	72.0	31.0

*: Carrier, no limit applies

Frequency range 1 GHz – 9.5 GHz:



Frequency MHz	Max- Peak dB μ V/m	CAver- age dB μ V/m	Limit dB μ V/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
1829.750000		63.04	63.50	0.46	1000	1000	100.0	H	30.0	31.4
2744.750000		53.48	63.50	10.02	1000	1000	100.0	H	-150.0	35.2
5489.500000		57.31	63.50	6.19	1000	1000	100.0	V	-150.0	42.8
7949.750000		46.65	63.50	16.87	1000	1000	175.0	H	53.0	46.0
7949.750000	59.05		83.50	24.45	1000	1000	175.0	H	53.0	46.0
8234.000000		57.91	63.50	5.59	1000	1000	150.0	V	-150.0	46.6
9149.000000		58.74	63.50	4.76	1000	1000	150.0	V	-150.0	47.2

2.9.8 Test Location and Test Equipment

The test was carried out in semi anechoic rooms No. 8 and 11

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Loop Antenna	Schwarzbeck	FMZB 1519B	44334	36	2023-01-31
EMI test receiver	Rohde & Schwarz	ESW 26	28268	12	2022-10-31
EMI measurement software	Rohde & Schwarz	EMC32 Emission V10.60.20	19927		
Semi anechoic room	Albatross Projects	Cabin No. 8	19917	36	2022-10-31
ULTRALOG antenna	Rohde & Schwarz	HL562E	39969	36	2025-03-31
Double ridged horn antenna	Rohde & Schwarz	HF907	40089	24	2023-02-28
EMI test receiver	Rohde & Schwarz	ESW 44	19897	12	2023-30
EMI measurement software	Rohde & Schwarz	EMC32 Emission V10.60.20	42986		
Semi anechoic room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 22



2.10 Temperature Stability

2.10.1 Specification Reference

ISED RSS-Gen, Clause 6.11, 8.11

2.10.2 Equipment under Test and Modification State

RCM_H200; S/N 94; Modification State 0

2.10.3 Date of Test

2022-04-21

2.10.4 Environmental Conditions

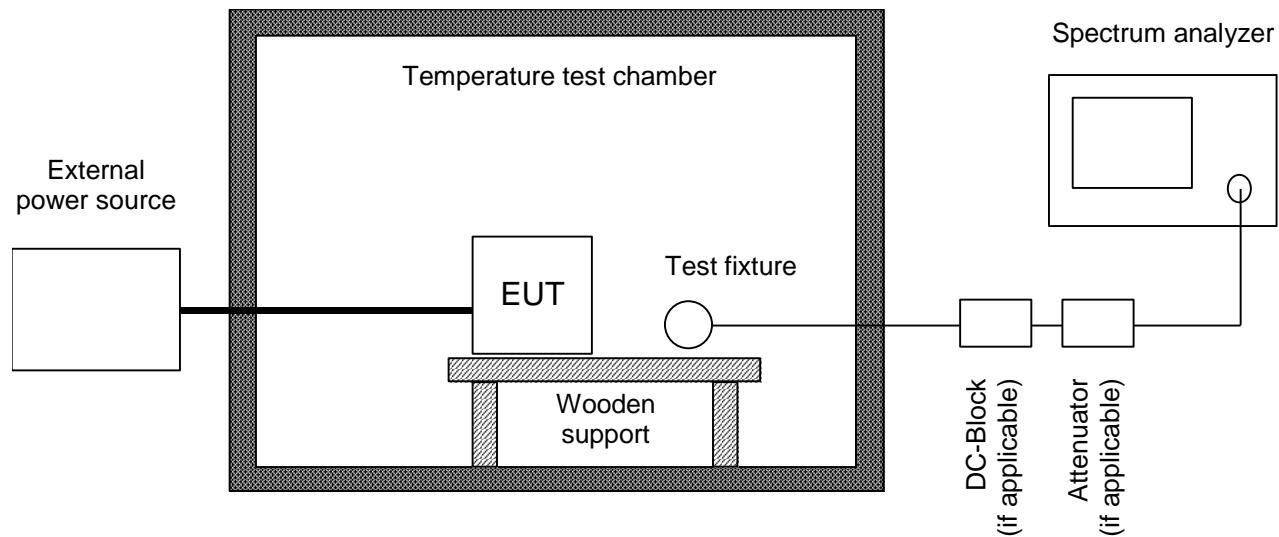
Ambient Temperature	22 °C
Relative Humidity	28 %

2.10.5 Specification Limits

If the stability of the license-exempt radio apparatus is not specified in the applicable RSS, the fundamental emissions of the radio apparatus should be kept within at least the central 80 % of its permitted operating frequency band in order to minimize the possibility of out-of-band operation. In addition, its occupied bandwidth shall be entirely outside the restricted bands and the prohibited TV bands of 85 MHz – 72 MHz, 76 MHz – 88 MHz, 174 MHz – 216 MHz, and 470 MHz – 602 MHz, unless otherwise indicated.

2.10.6 Test Method

The test was performed according to ANSI C63.10, section 6.8.



The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. Temperature and voltage range may vary if the manufacturer states another temperature or voltage range.

If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as a DC block and appropriate (50 Ω) attenuators. In case where the EUT does not provide an antenna connector or a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- The maximum battery voltage as delivered by a new battery or 115 % of the battery nominal voltage;
- The battery nominal voltage
- 85 % of the battery nominal voltage
- The battery operating end point voltage which shall be specified by the equipment manufacturer.

The EUT is operating providing an unmodulated carrier for frequency error tests. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.

If an unmodulated carrier is not available a significant and stable point of the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1 % of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance is larger than the uncertainty of the measured frequency tolerance.

The test was performed with an unmodulated carrier signal



2.10.7 Test Results

Temperature	Supply Voltage	Frequency	Frequency drift
-15 °C	3.0 V	914.9024301 MHz	2.7669 ppm
20 °C	2.2 V	914.8995031 MHz	-0.4324 ppm
20 °C	3.0 V	914.8998987 MHz	0.000 ppm
55 °C	3.0 V	914.8968290 MHz	-3.3552 ppm

Table 23

2.10.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analysator	Rohde & Schwarz	FSV40	20219	24	2024-02-29
Temperature test chamber	Feutron	KPK200-2	19868	24	2023-02-28

Table 24

3 Measurement Uncertainty

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

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (U_{CISPR}). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

<i>Radio Interference Emission Testing</i>		<i>kp</i>	<i>Expanded Uncertainty</i>
Test Name			
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	
Radiated Emission			
30 MHz to 300 MHz	2	± 4.9 dB	
300 MHz to 1 GHz	2	± 5.0 dB	
1 GHz to 6 GHz	2	± 4.6 dB	
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	
300 MHz to 1 GHz	2	± 4.9 dB	
The expanded uncertainty reported according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 is based on a standard uncertainty multiplied by a coverage factor of $kp = 2$, providing a level of confidence of $p = 95.45\%$			

Table 25 Measurement uncertainty based on CISPR 16-4-2



<i>Radio Interference Emission Testing</i>		
<i>Test Name</i>	<i>kp</i>	<i>Expanded Uncertainty</i>
Occupied Bandwidth	2	$\pm 5\%$
Conducted Power		
9 kHz \leq f < 30 MHz	2	± 1.0 dB
30 MHz \leq f < 1 GHz	2	± 1.5 dB
1 GHz \leq f \leq 40 GHz	2	± 2.5 dB
1 MS/s power sensor (TS8997)	2	± 1.5 dB
Occupied Bandwidth	2	$\pm 5\%$
Power Spectral Density	2	± 3.0 dB
Radiated Power		
9 kHz \leq f < 26.5 GHz	2	± 6.5 dB
26.5 GHz \leq f < 60 GHz	2	± 8.0 dB
60 GHz \leq f < 325 GHz	2	± 10 dB
Conducted Spurious Emissions	2	± 3.0 dB
Radiated Spurious Emissions	2	± 6.0 dB
Voltage		
DC	2	$\pm 1.0\%$
AC	2	$\pm 2.0\%$
Time (automatic)	2	$\pm 5\%$
Frequency	2	$\pm 10^{-7}$

The expanded uncertainty reported according to ETSI TR 100 028:2001 is based on a standard uncertainty multiplied by a coverage factor of $kp = 2$, providing a level of confidence of $p = 95.45\%$

Table 26 Measurement uncertainty based on ETSI TR 100 028