REP016409

Test Report

Product	Wireless Sensor
Name and address of the applicant	Disruptive Technologies, Inc Strandveien 17 1366 Lysaker, Norway
Name and address of the manufacturer	Disruptive Technologies Research AS Strandveien 17 1366 Lysaker, Norway
Model	102737
Rating	3.0 V_{DC} (1x BR1632A Lithium Battery)
Trademark	DISRUPTIVE
Additional information	/
Tested according to	**FCC Part 15.247** Frequency Hopping Transmitters / Digital Transmission Systems **Industry Canada RSS-247, Issue 3** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	PRJ0039553
Tested in period	2023-12-14 to 2024-01-03
Issue date	2024-01-12
Name and address of the testing laboratory	Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO470 ISED No: 2040D-1 **An accredited technical test executed under the Norwegian accreditation scheme**

Prepared by [Frode Sveinsen]	Approved by [Jan G Eriksen]

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Template version: C

Revision history

Revision	Date	Comment	Sign
A	2024-01-12	First edition	

GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to ensure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is solely responsible for any modifications to the product that could result in non-compliance with the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither are opinions expressed regarding model variants covered by the testing of this report.

CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence, that the instruments remain within the calibrated levels.

MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests. Uncertainty figures are found in a separate clause in this report.

CONTENTS

1 INFORMATION

1.1 Test Item

Name	**Door and Window Sensor**
Model/version	**102737**
FCC ID	**2ATFX-102737**
ISED ID	**25087-102737**
Serial number	**Radiated Sample: CONT_US3** **Conducted Sample: CONT_US1**
Hardware identity and/or version	**Rev. 0.5**
Software identity and/or version	**1.6.3**
Frequency Range	**903.25 – 926.75 MHz**
Type of Modulation	**FSK**
Conducted Output Power	**18.1 mW**
Antenna Connector	**None**
Number of Antennas	**1**
Diversity or Smart Antennas	**No**
Power Supply	**Primary Battery (1x BR1632A Lithium Battery)**

Description of Test Item

The tested item is a wireless Door/Window Sensor.

1.2 Normal test condition

Temperature:	**20 - 24 °C**
Relative humidity:	**20 - 50 %**
Normal test voltage:	**3.0 V_{DC} (Nominal Battery Voltage)**

The values are the limit registered during the test period.

1.3 Test Engineer

Frode Sveinsen

1.4 Antenna Requirement

Does the EUT have detachable antenna(s)?	☐ **YES**	☒ **NO**
If detachable, is the antenna connector(s) non-standard?	☒ **YES**	☐ **NO**
The tested equipment has an integral antenna, and an internal U-FL connector.		

Requirement: FCC 15.203, 15.204

1.5 EUT Operating Modes

Description of operating modes	Radiated Emissions were performed with the EUT set to transmit at a single channel with normal modulation enabled. Output Power was preprogrammed and was not selectable

1.6 Comments

All radiated measurements were performed with the EUT powered by a new battery. Conducted measurements were performed with the EUT powered from a regulated Power Supply.

2 TEST REPORT SUMMARY

2.1 General

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and ISED RSS-247 Issue 3 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were performed in a semi-anechoic chamber at measuring distances of 3m.

A description of the test facility is on file with the FCC and ISED.

☒ **New Submission**	☒ **Production Unit**
☐ **Class II Permissive Change**	☐ **Pre-production Unit**
DTS Equipment Code	☐ **Family Listing**

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 3, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	Complies
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 2	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	11.10.2 PKPSD (DTS)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 11.11 (DTS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	3.3 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

3 TEST RESULTS

3.1 Occupied Bandwidth (99% BW)

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.2

Test Results: Complies

Measurement Data:

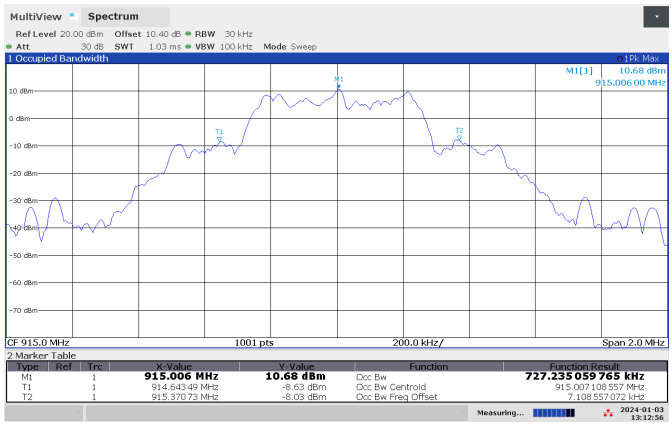
Carrier Frequency, Data Rate	Occupied Bandwidth (99% BW)
903.25 MHz	0.701 MHz
915.00 MHz	0.737 MHz
926.75 MHz	0.730 MHz

See attached plots

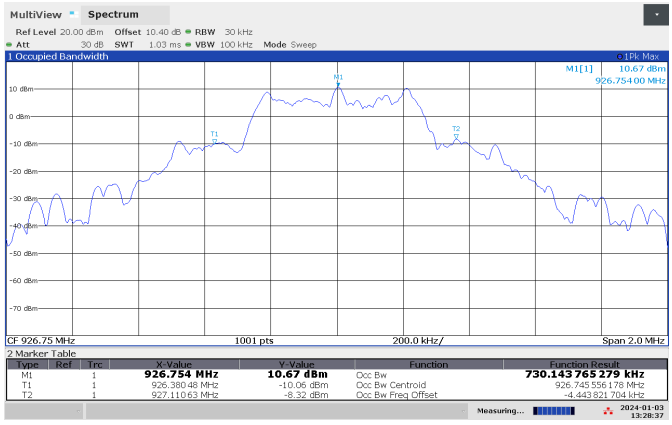
Requirements:

No requirement for 99% BW, reported for information only.

99% Occupied BW, 903.25 MHz



99% Occupied BW, 915.00 MHz



99% Occupied BW, 926.75 MHz

3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 3, Clause 5.2 (a)

Measurement procedure: **ANSI C63.10-2013 Clause 11.8**

Test Results: **Complies**

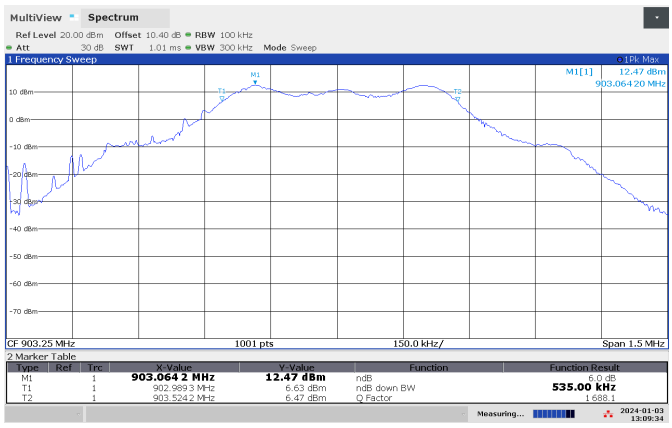
Measurement Data:

Modulation type and bitrate	Measured DTS Bandwidth (kHz)		
	903.25 MHz	915.00 MHz	926.75 MHz
GFSK	535	537	538

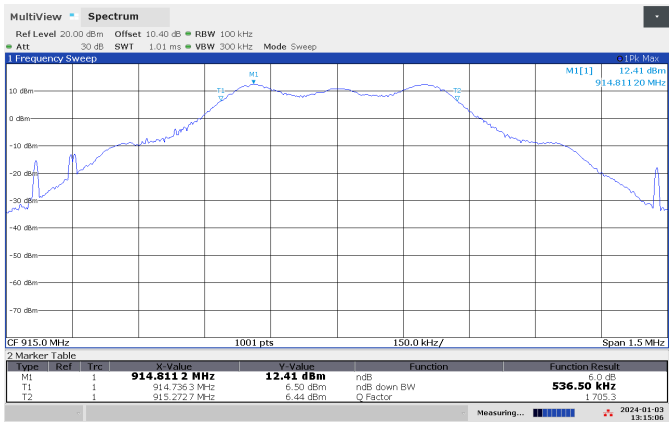
Power supply variation within 85 % to 115% of nominal value has no influence on measured value.

Frequency Band	Requirement for systems using Digital Modulation
902-928 MHz	The minimum 6 dB bandwidth shall be at least 500 kHz.
2400-2483.5 MHz	
5725-5850 MHz	

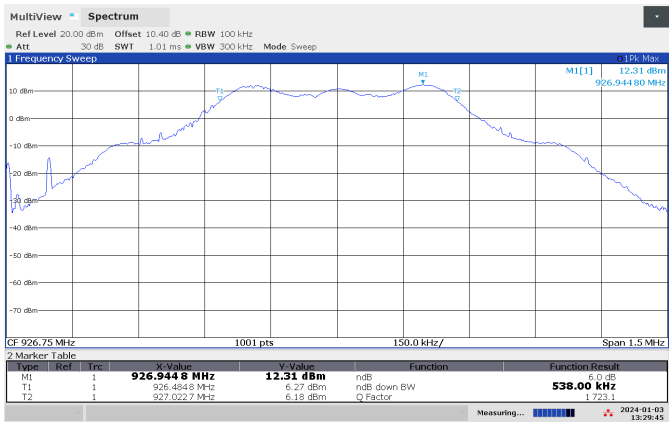
No requirements for Frequency Hopping Systems.



DTS BW, 903.25 MHz



DTS BW, 915.00 MHz



DTS BW, 926.75 MHz

3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 3, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

Carrier Frequency	Peak Conducted Power	Peak ERP	Antenna Gain
	dBm	dBm	dBd
903.25 MHz	12.6	3.5	-9.1
915.00 MHz	12.5	6.5	-5.9
926.75 MHz	12.4	8.2	-4.2

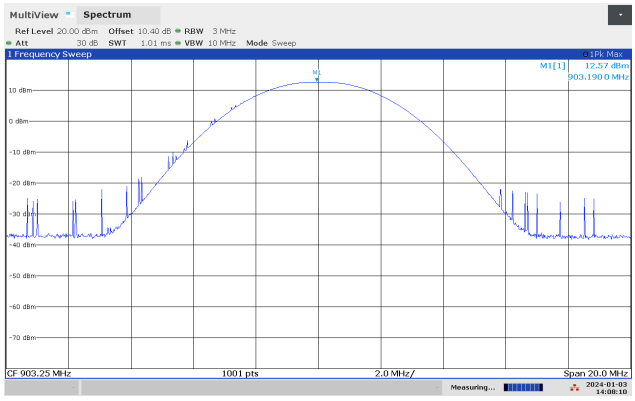
Output Power reported is Maximum Peak Power.

Peak ERP is calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

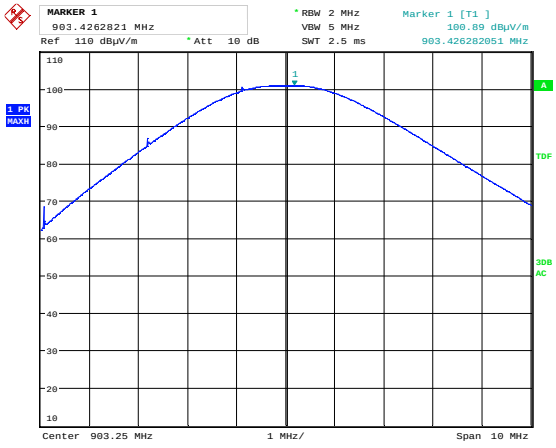
Antenna Gain is less than 6 dBi.

See attached plots.

Requirements for Digital Modulation systems
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.
Maximum allowed Antenna Gain
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Peak Power, 903.25 MHz



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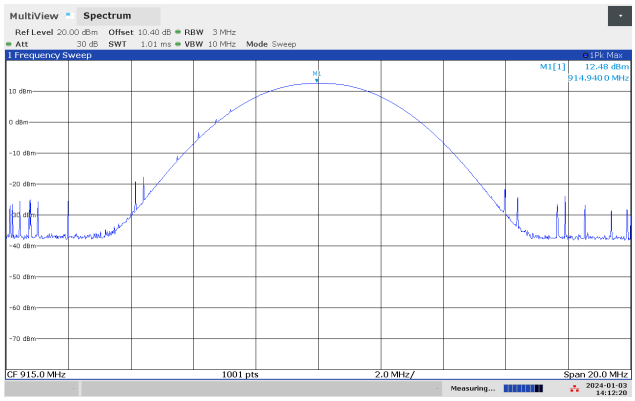
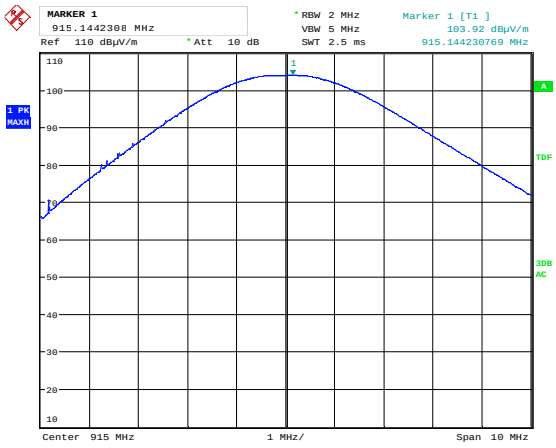
Peak ERP, 903.25 MHz



Peak Power, 915.00 MHz



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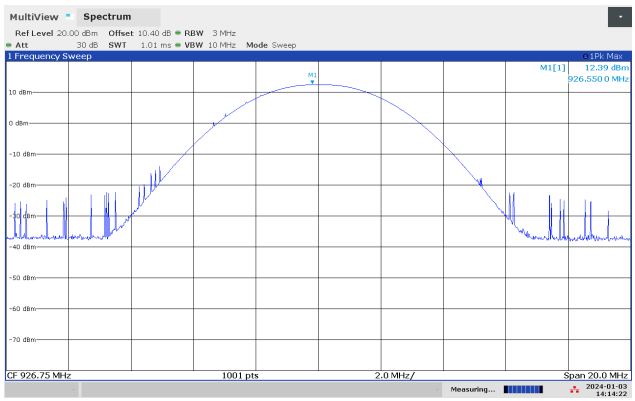
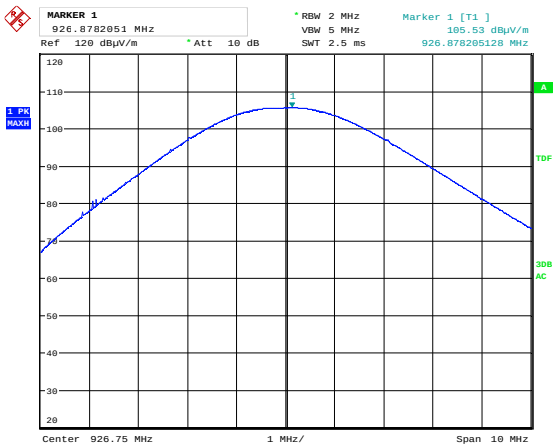
Peak ERP, 915.00 MHz



Peak Power, 926.75 MHz



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Peak ERP, 926.75 MHz

3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 3, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

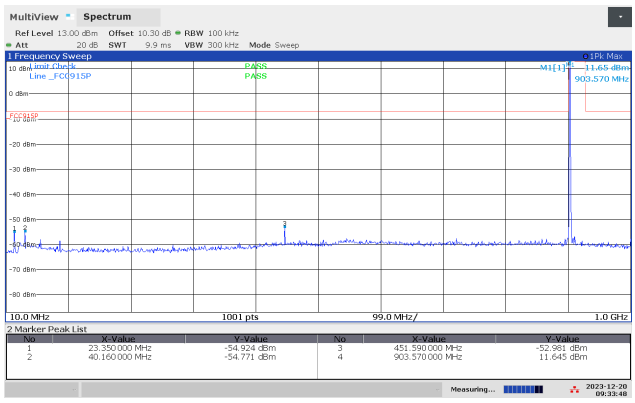
Measurement Data:

Carrier Frequency	Highest Value (dBm)	Margin (dB)	Verdict
903.25 MHz	-24.8	> 10	Pass
915.00 MHz	-23.5	> 10	Pass
926.75 MHz	-24.2	> 10	Pass

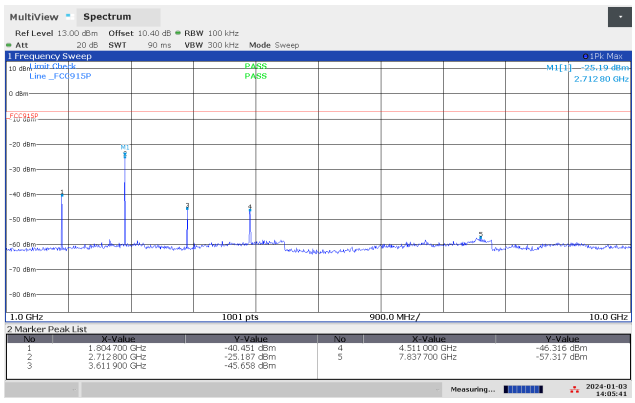
Measured with Peak Detector

RF conducted power to 25 GHz: see attached plots.

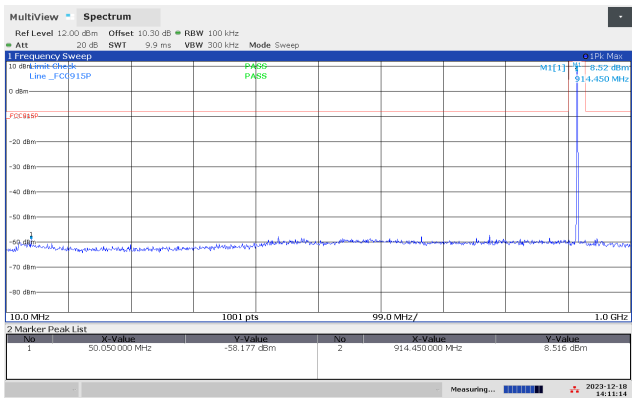
Requirements for all systems	
Peak measurement	**RMS averaging (alternative measurement)**
20 dB or more below carrier measured in 100 kHz bandwidth	30 dB or more below carrier measured in 100 kHz bandwidth
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required.	



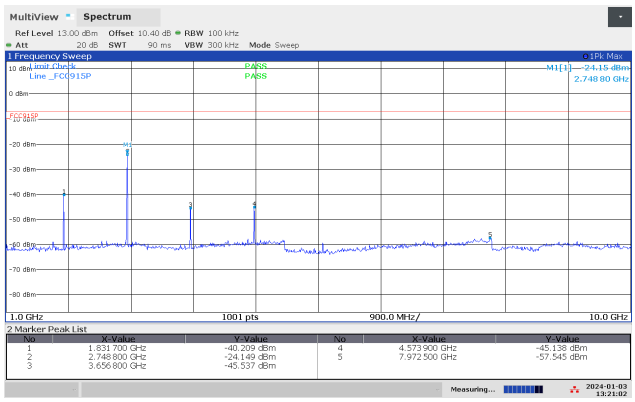
Conducted Emissions 10-1000 MHz, 903.25 MHz



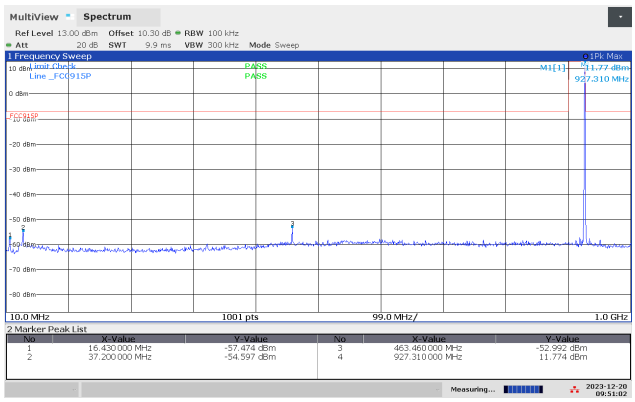
Conducted Emissions 1000-10000 MHz, 903.25 MHz



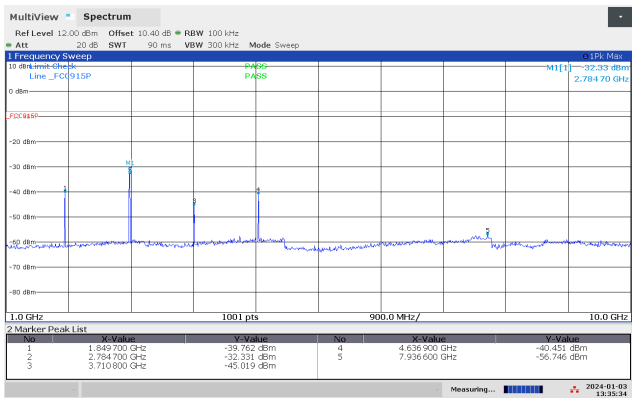
Conducted Emissions 10-1000 MHz, 915.00 MHz



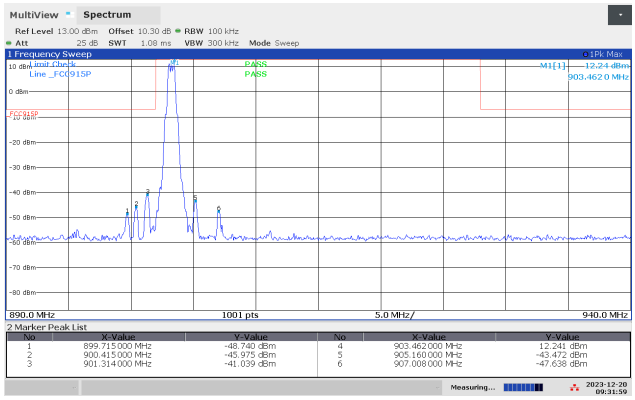
Conducted Emissions 1000-10000 MHz, 915.00 MHz



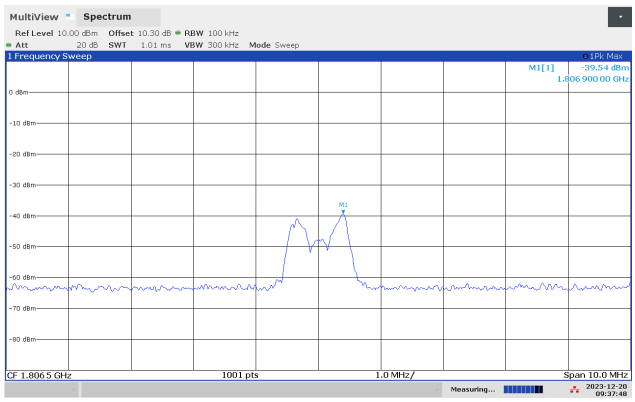
Conducted Emissions 10-1000 MHz, 926.75 MHz



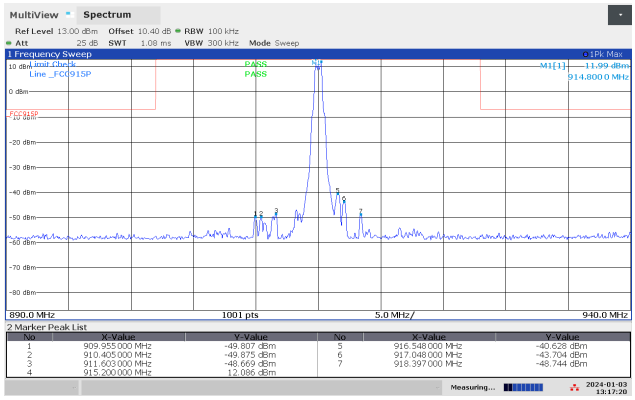
Conducted Emissions 1000-10000 MHz, 926.75 MHz



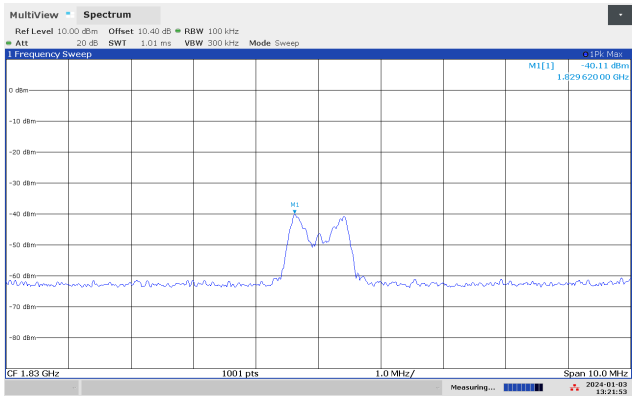
Conducted Emissions 890-940 MHz, 903.25 MHz



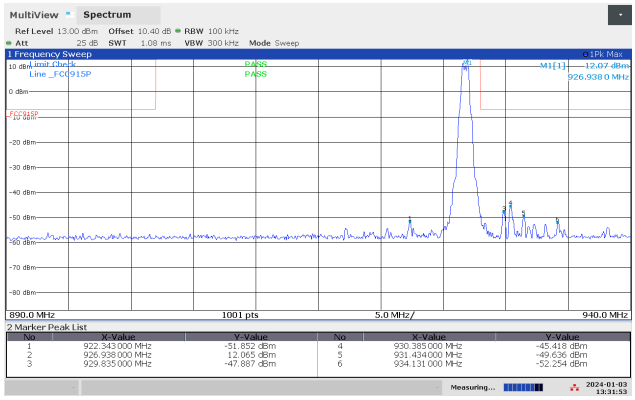
Conducted Emissions 1806.5 MHz, 903.25 MHz



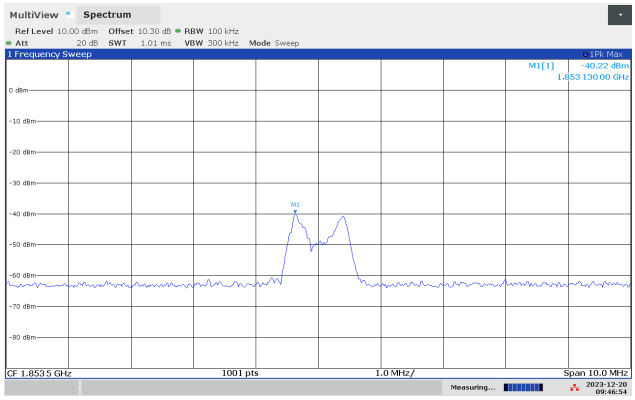
Conducted Emissions 890-940 MHz, 915.00 MHz



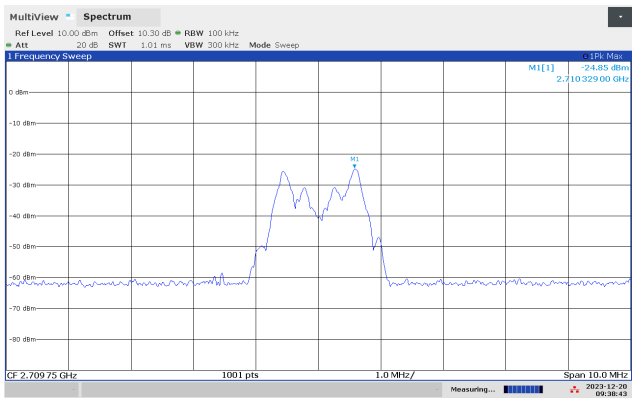
Conducted Emissions 1830.0 MHz, 915.00 MHz



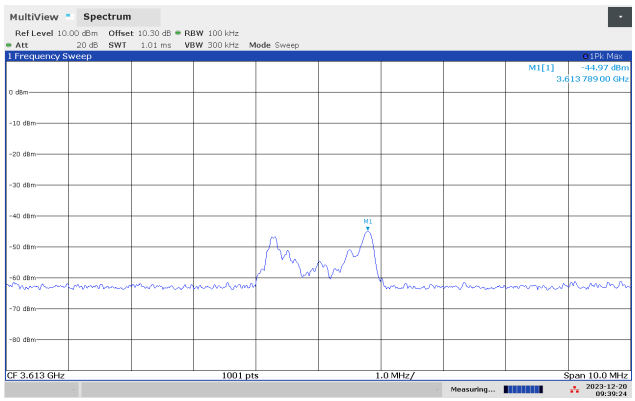
Conducted Emissions 890-940 MHz, 926.75 MHz



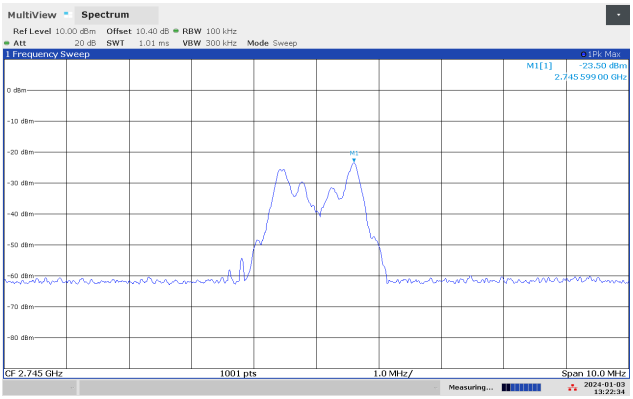
Conducted Emissions 1853.5 MHz, 926.75 MHz



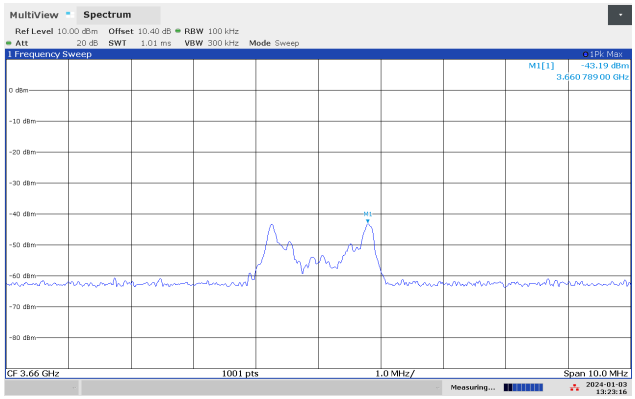
Conducted Emissions 2709.75 MHz, 903.25 MHz



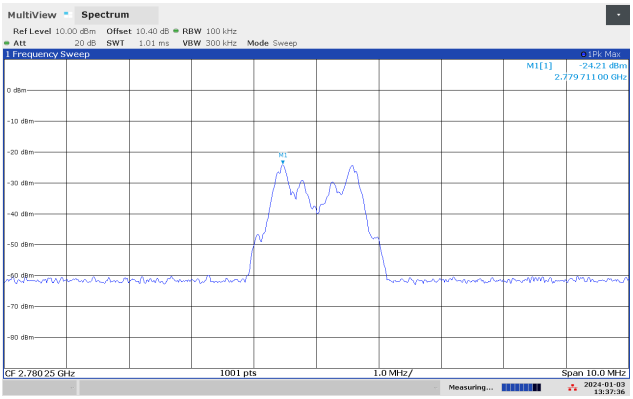
Conducted Emissions 3613 MHz, 903.25 MHz



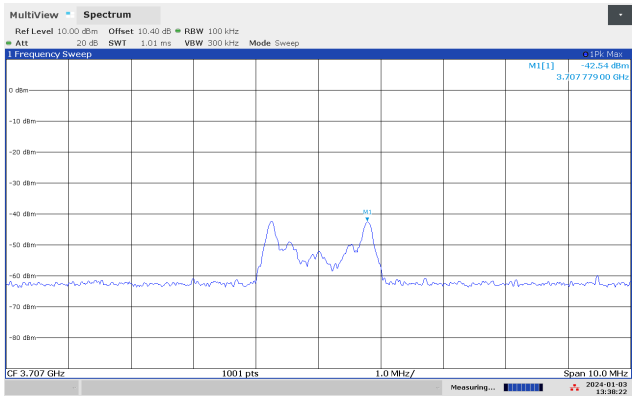
Conducted Emissions 2745.0 MHz, 915.00 MHz



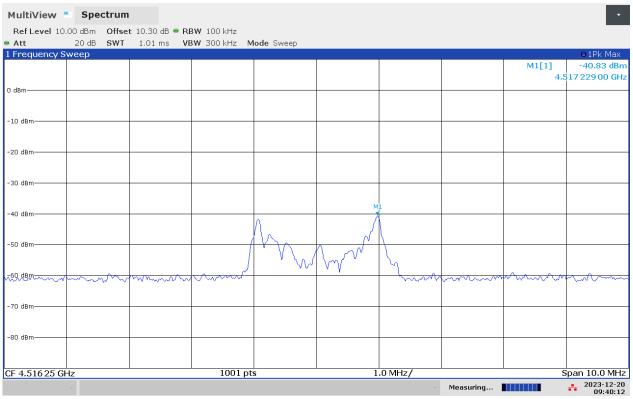
Conducted Emissions 3660 MHz, 915.00 MHz



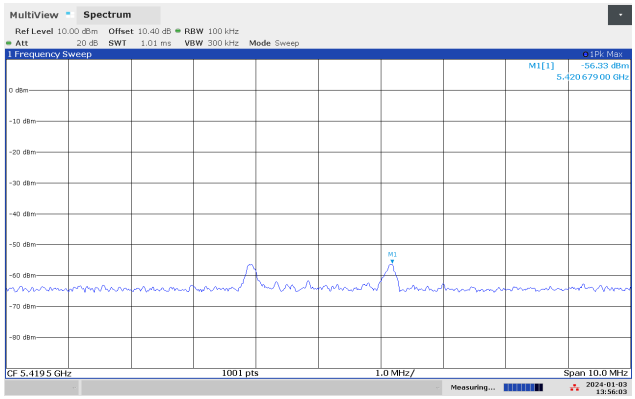
Conducted Emissions 2780.25 MHz, 926.75 MHz



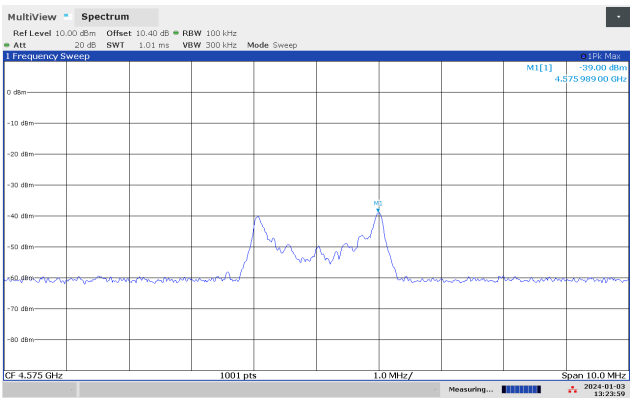
Conducted Emissions 3707 MHz, 926.75 MHz



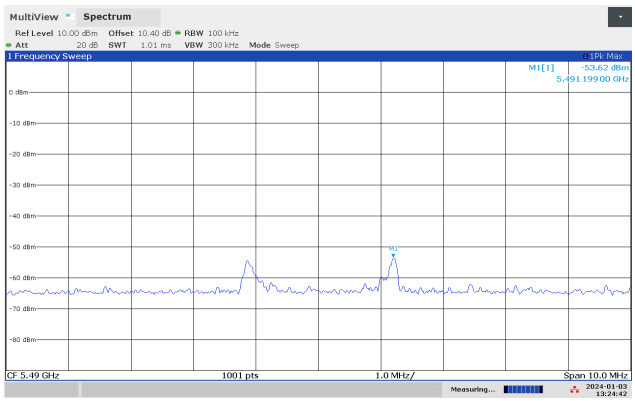
Conducted Emissions 4516.25 MHz, 903.25 MHz



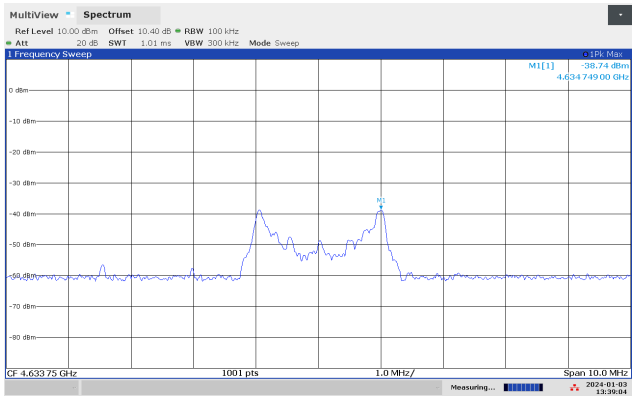
Conducted Emissions 5419.5 MHz, 903.25 MHz



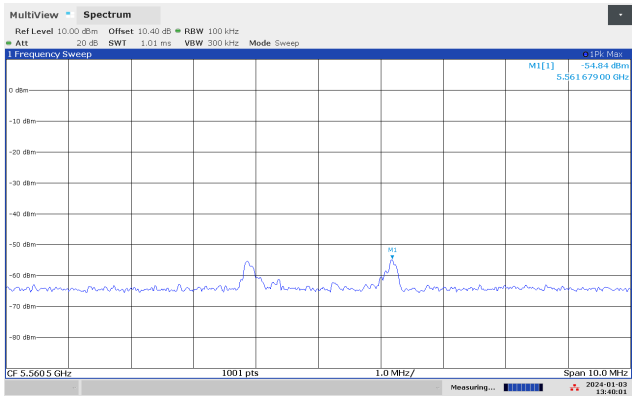
Conducted Emissions 4575 MHz, 915.00 MHz



Conducted Emissions 5490 MHz, 915.00 MHz



Conducted Emissions 4633.75 MHz, 926.75 MHz



Conducted Emissions 5660.5 MHz, 926.75 MHz

3.5 Radiated Emissions, 30 – 1000 MHz.

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Detector: Peak

Measuring distance 3 m

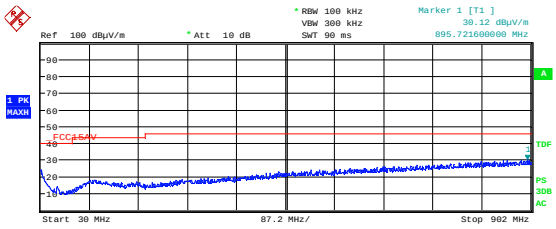
Tested in test mode with EUT transmitting

Measured Frequency (MHz)	Carrier Frequency (MHz)	Modulation	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 – 88	903.25 / 915 / 926.75	Modulated	< 26	40.0	> 14
88 – 216	903.25 / 915 / 926.75	Modulated	< 20	43.5	> 13.5
216 – 960	903.25 / 915 / 926.75	Modulated	< 32	46.0	> 14
960 – 1000	903.25 / 915 / 926.75	Modulated	< 34	54.0	> 20

See attached plots

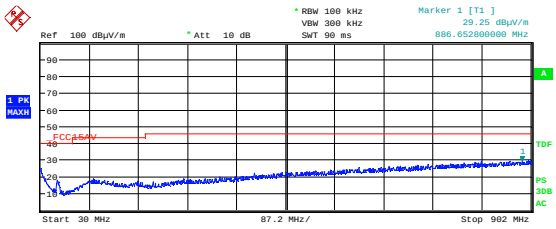
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 µV/m	40.0 dBµV/m
88 – 216 MHz	150 µV/m	43.5 dBµV/m
216 – 960 MHz	200 µV/m	46.0 dBµV/m
960 – 1000 MHz	500 µV/m	54.0 dBµV/m
	Limits above are with Quasi Peak Detector	



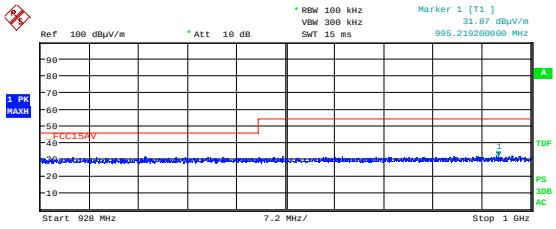
Date: 14.DEC.2023 14:50:50

Radiated Emissions 30 - 902 MHz, 903.25 MHz HP



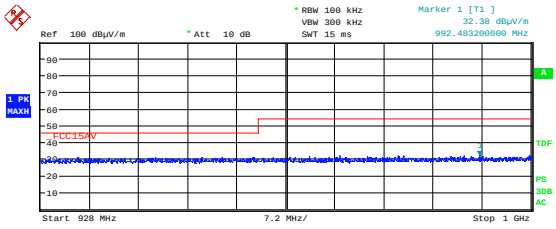
Date: 14.DEC.2023 14:48:55

VP



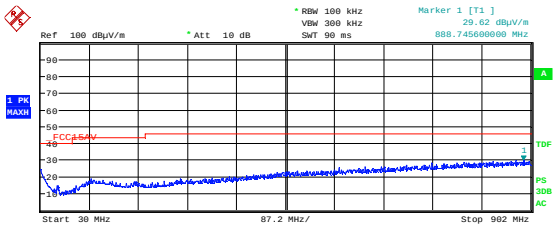
Date: 14.DEC.2023 14:55:20

Radiated Emissions 928 - 1000 MHz, 903.25 MHz HP



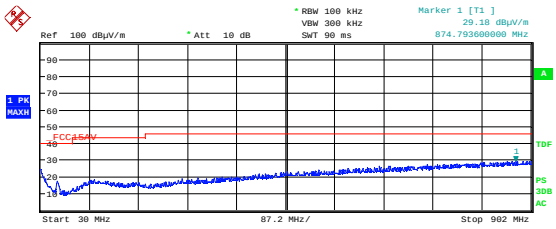
Date: 14.DEC.2023 14:53:25

VP



Date: 14.DEC.2023 15:16:49

Radiated Emissions 30 - 902 MHz, 915.00 MHz HP



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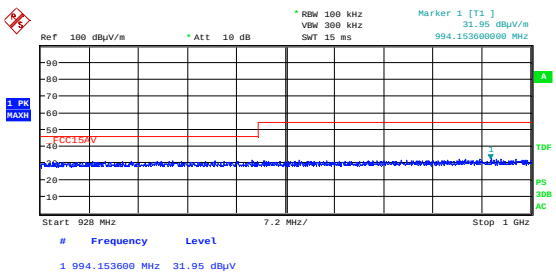
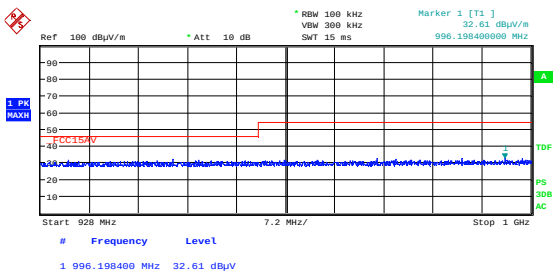
VP



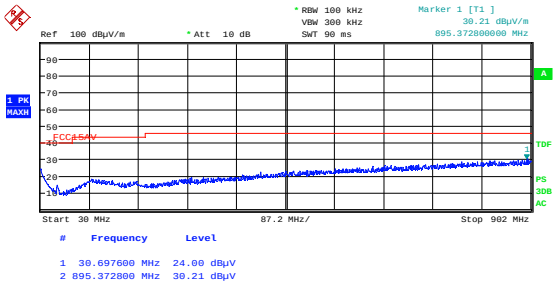
Date: 14.DEC.2023 15:21:20

Radiated Emissions 928 - 1000 MHz, 915.00 MHz HP



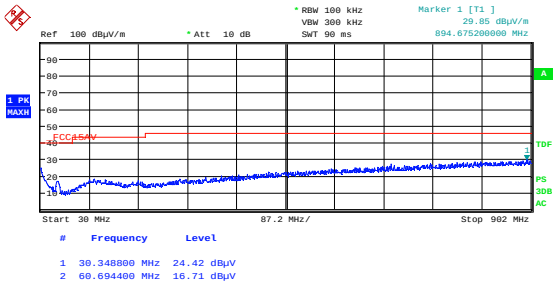
Date: 14.DEC.2023 15:19:24

VP



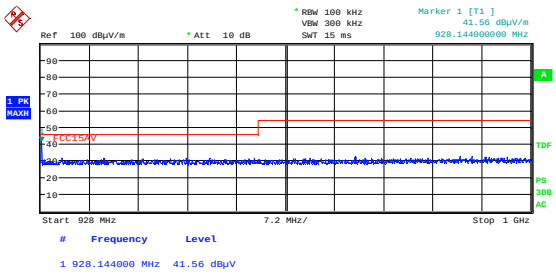
Date: 14.DEC.2023 14:13:39

Radiated Emissions 30 - 902 MHz, 926.75 MHz HP



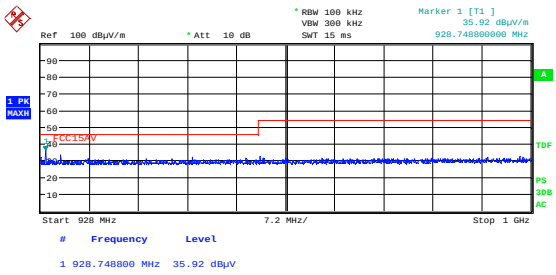
Date: 14.DEC.2023 14:11:43

VP



Date: 14.DEC.2023 14:24:01

Radiated Emissions 928 - 1000 MHz, 926.75 MHz HP



Date: 14.DEC.2023 14:22:05

VP

3.6 Radiated Emissions, 1 – 10 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: **ANSI C63.10-2013 Clause 11.12**

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 10 GHz)

RBW=1 MHz

Carrier Frequency (MHz)	Measured Frequency (GHz)	Mode	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Pk	Av	Pk	Av
903.25	2709.75	Modulated	60.5	40.5	74	54	13.5	13.5
	3613.00	Modulated	52.1	32.1	74	54	21.9	21.9
915.00	2745.00	Modulated	62.5	42.5	74	54	11.5	11.5
	3660.00	Modulated	54.0	34.0	74	54	20.0	20.0
926.75	2780.25	Modulated	66.4	46.4	74	54	7.6	7.6
	3707.00	Modulated	52.6	32.6	74	54	21.4	21.4

A High Pass Filter was used for measurements from 1.5 GHz to 10 GHz

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer “Transducer factor”.

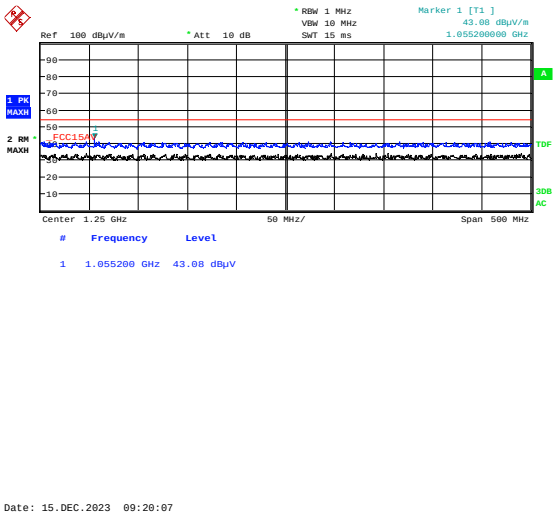
Average Detector Values are Measured by Peak Detector and Corrected for Duty Cycle.

Duty Cycle Correction Factor = 20 dB [-20*log(2.43ms/100ms) = 32.3 dB, Max allowed DC Corr is 20 dB]

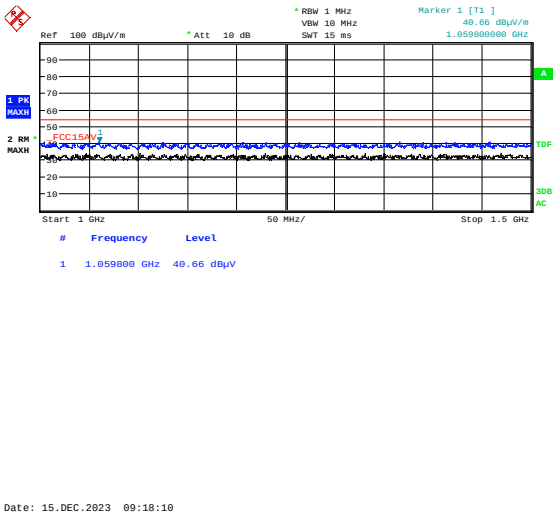
See plots.

Requirements/Limit

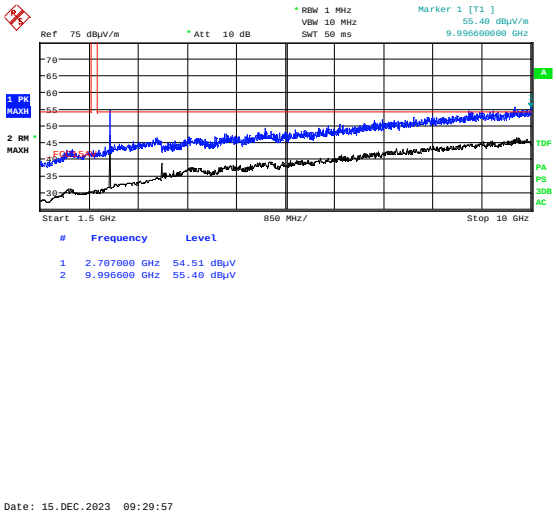
FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 10 GHz	54.0 dBµV/m	74.0 dBµV/m



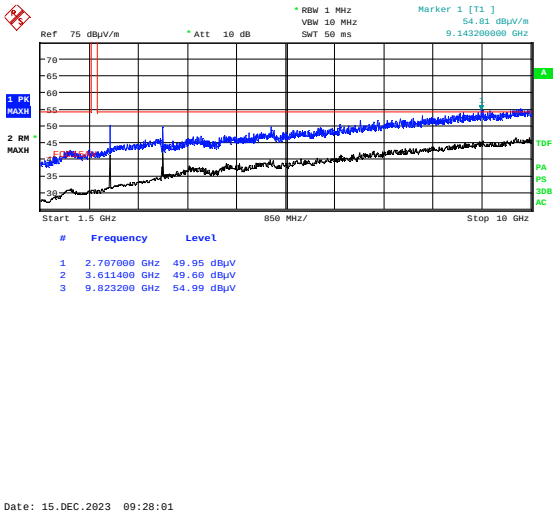
Radiated Emissions 1 – 1.5 GHz, 903.25 MHz, HP



VP



Radiated Emissions 1.5 – 10 GHz, 903.25 MHz, HP



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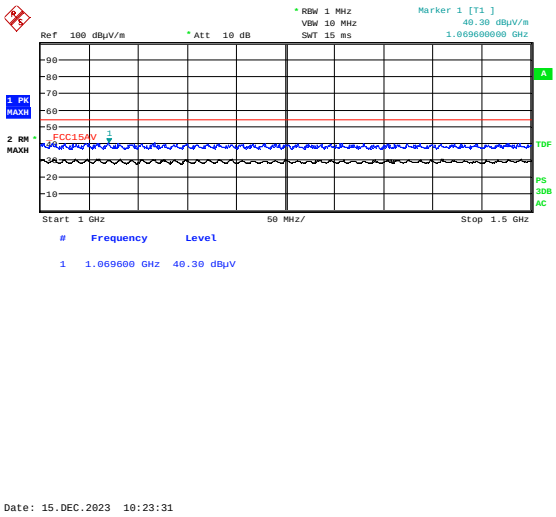
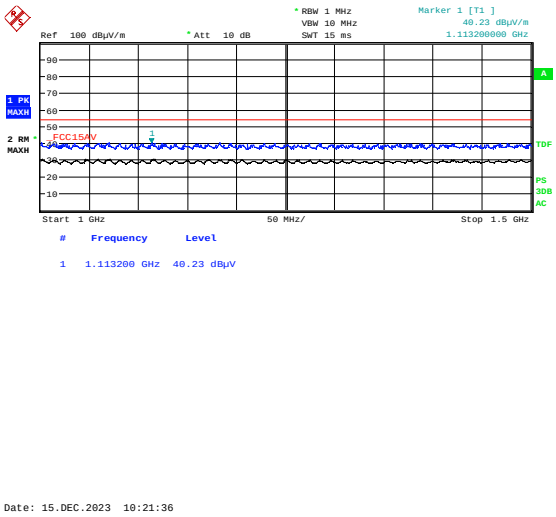


Radiated Emissions 1 – 1.5 GHz, 915.00 MHz, HP



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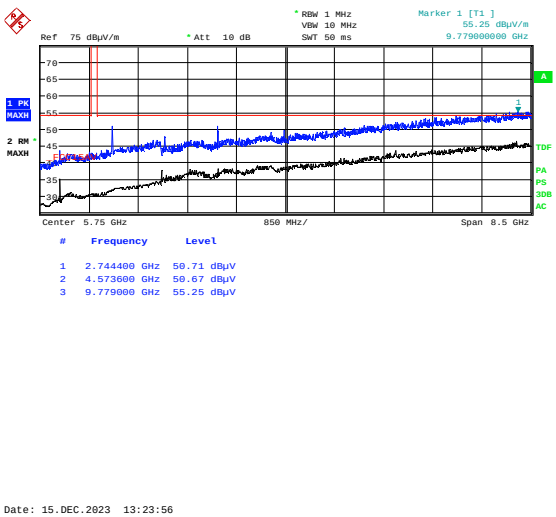
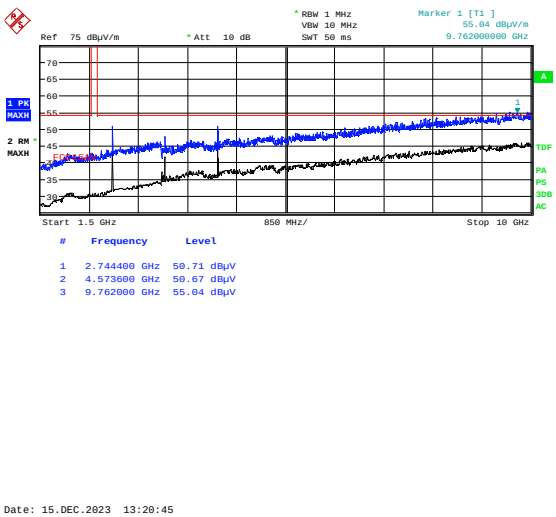


Radiated Emissions 1.5 – 10 GHz, 915.00 MHz, HP



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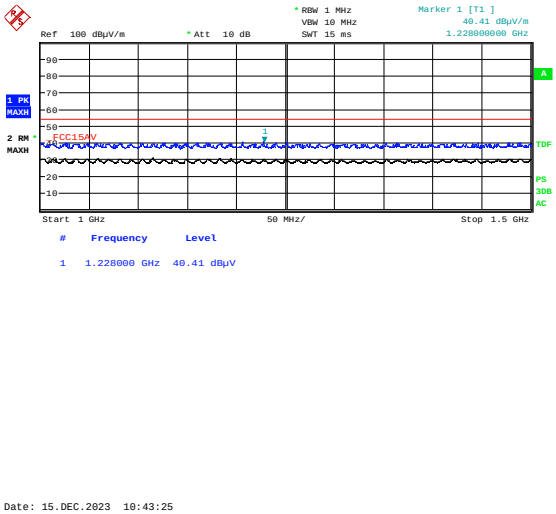
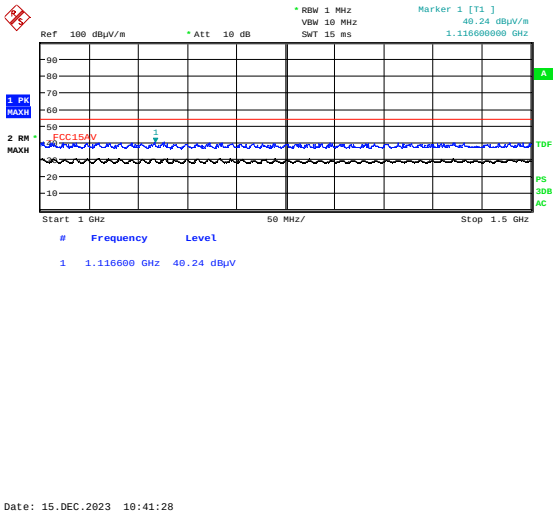


Radiated Emissions 1 – 1.5 GHz, 926.75 MHz, HP



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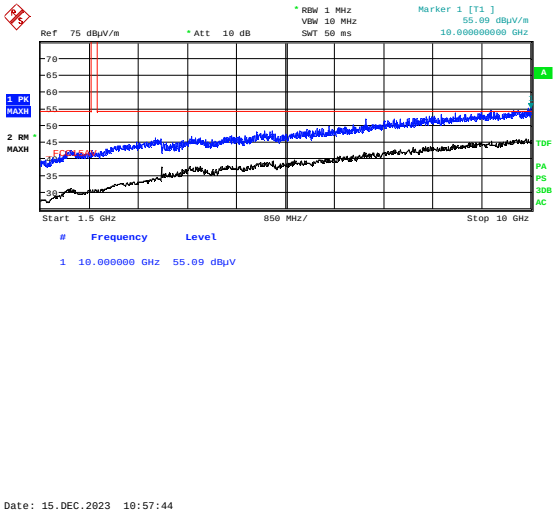
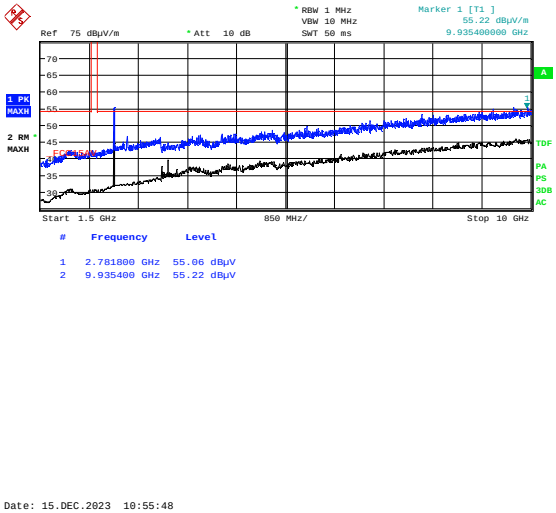
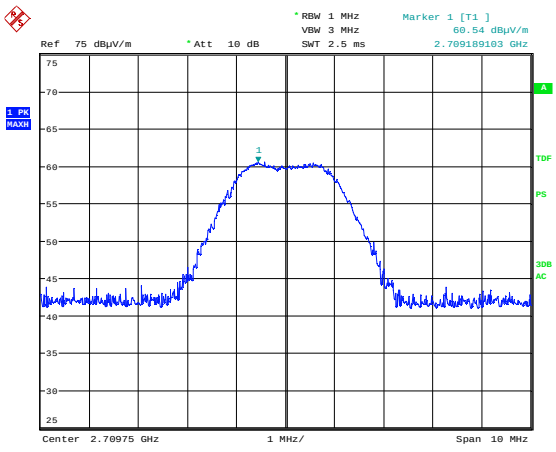


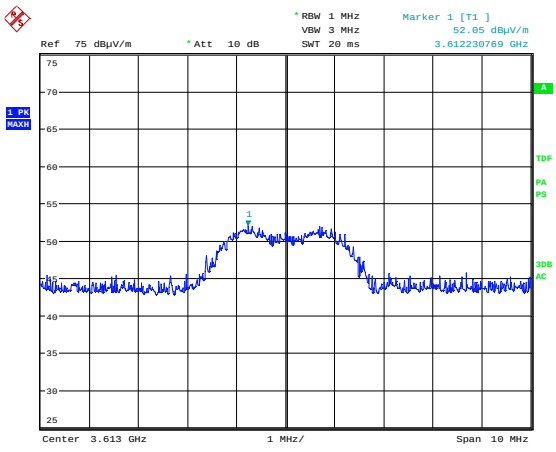
Radiated Emissions 1.5 – 10 GHz, 926.75 MHz, HP



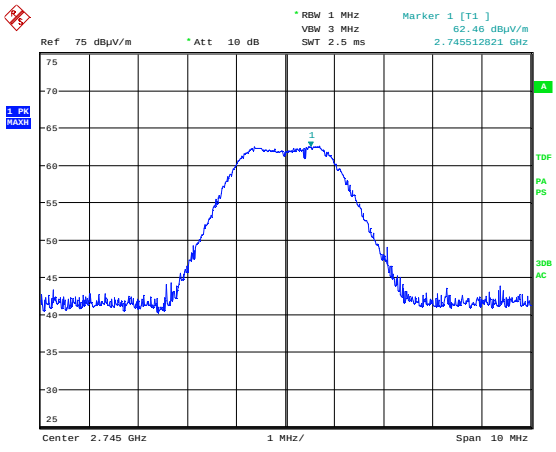
VP



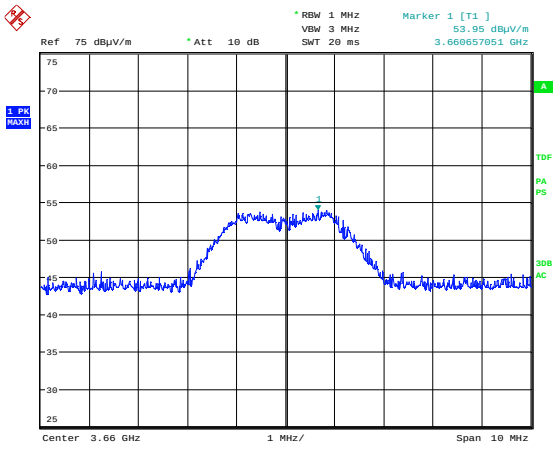
Emissions 2709.75 MHz, 903.25 MHz, Max: HP



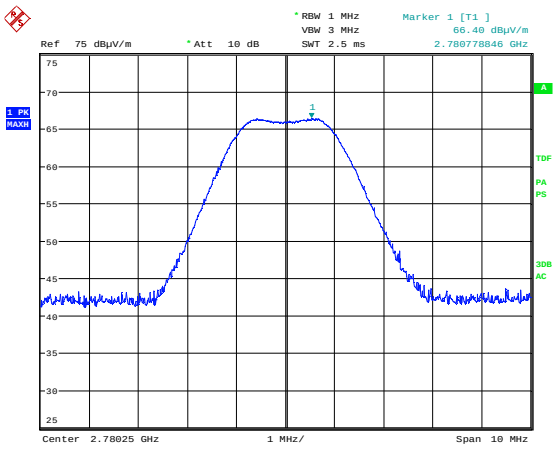
Emissions 3613.00 MHz, 903.25 MHz, Max: VP



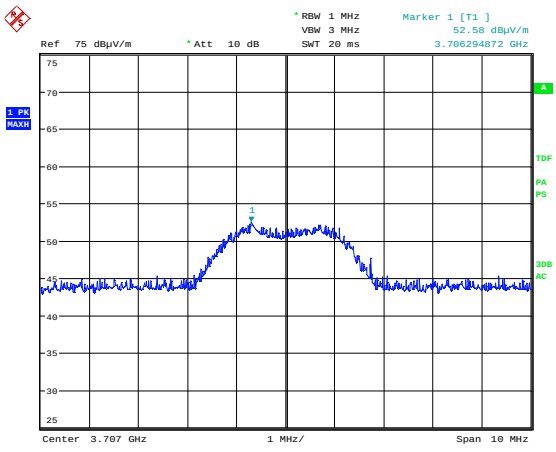
Emissions 2745.00 MHz, 915.00 MHz, Max: HP



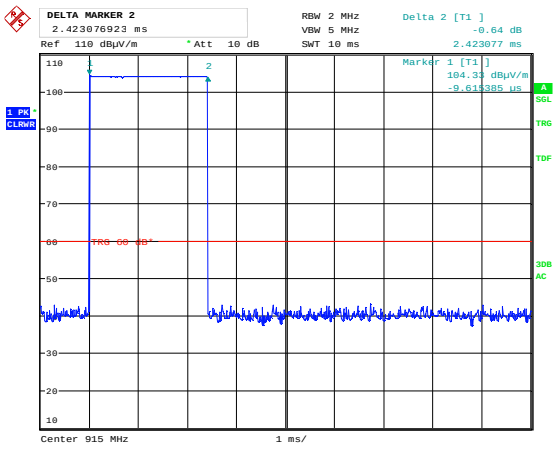
Emissions 3660.00 MHz, 915.00 MHz, Max: VP



Emissions 2780.25 MHz, 926.75 MHz, Max: HP

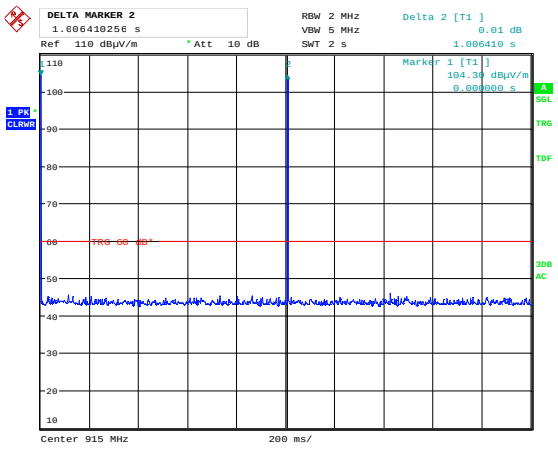


Emissions 3707.00 MHz, 926.75 MHz, Max: VP



Date: 14.DEC.2023 15:08:39

Burst length



Date: 14.DEC.2023 15:10:34

Time between Bursts (Measured in Test Mode, Actual Time is longer)

3.7 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 3, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

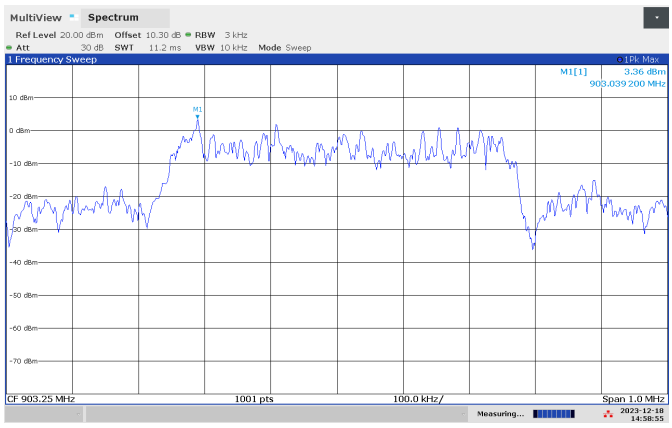
Test Results: Complies

Measurement Data:

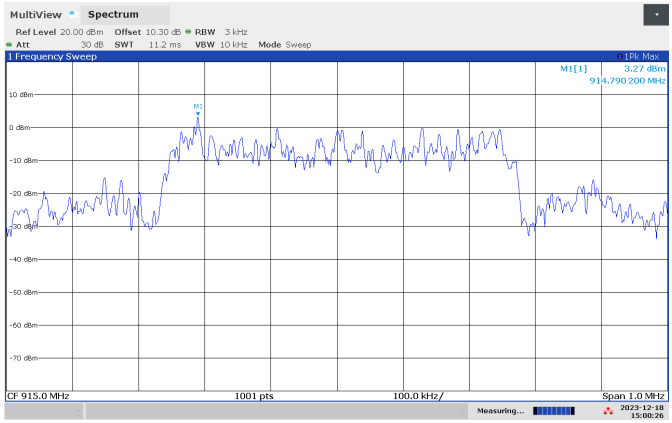
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

Modulation Type and Bitrate	Measured Power Spectral Density (dBm/3kHz)		
	903.25 MHz	915.00 MHz	926.75 MHz
GFSK	3.4	3.3	3.0

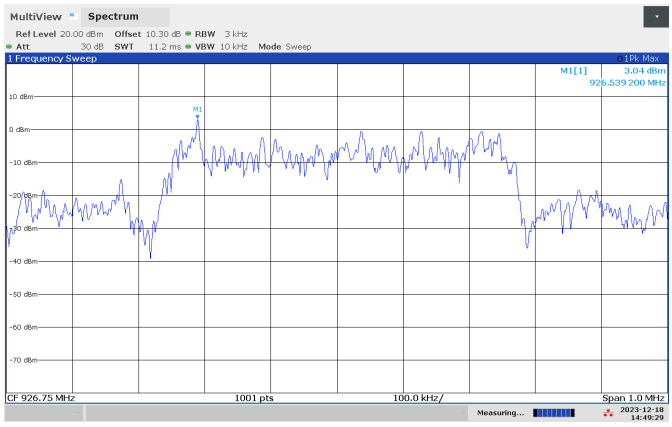
Requirement for systems using Digital Modulation
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



PSD, 903.25 MHz



PSD, 915.00 MHz



PSD, 926.75 MHz

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		**Uncertainty**
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	**< 3.6 GHz**	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	**< 1 GHz**	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	**Frequency**	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

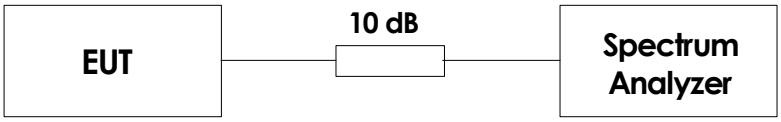
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2023-01	2024-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
3	6810.17B	Attenuator	Suhner	LR 1830	2023-05	2024-05
4	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	COU	
5	JB3	BiLog Antenna	Sunol	N-4525	2023-04	2026-04
6	3115	Horn Antenna	EMCO	LR 1226	2022-12	2027-12
7	310	Preamplifier	Sonoma Inst.	LR 1686	2023-08	2024-08
8	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2023-08	2024-08
9	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2023-08	2024-08
10	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

The software listed below has been used for one or more tests.

No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Nemko	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

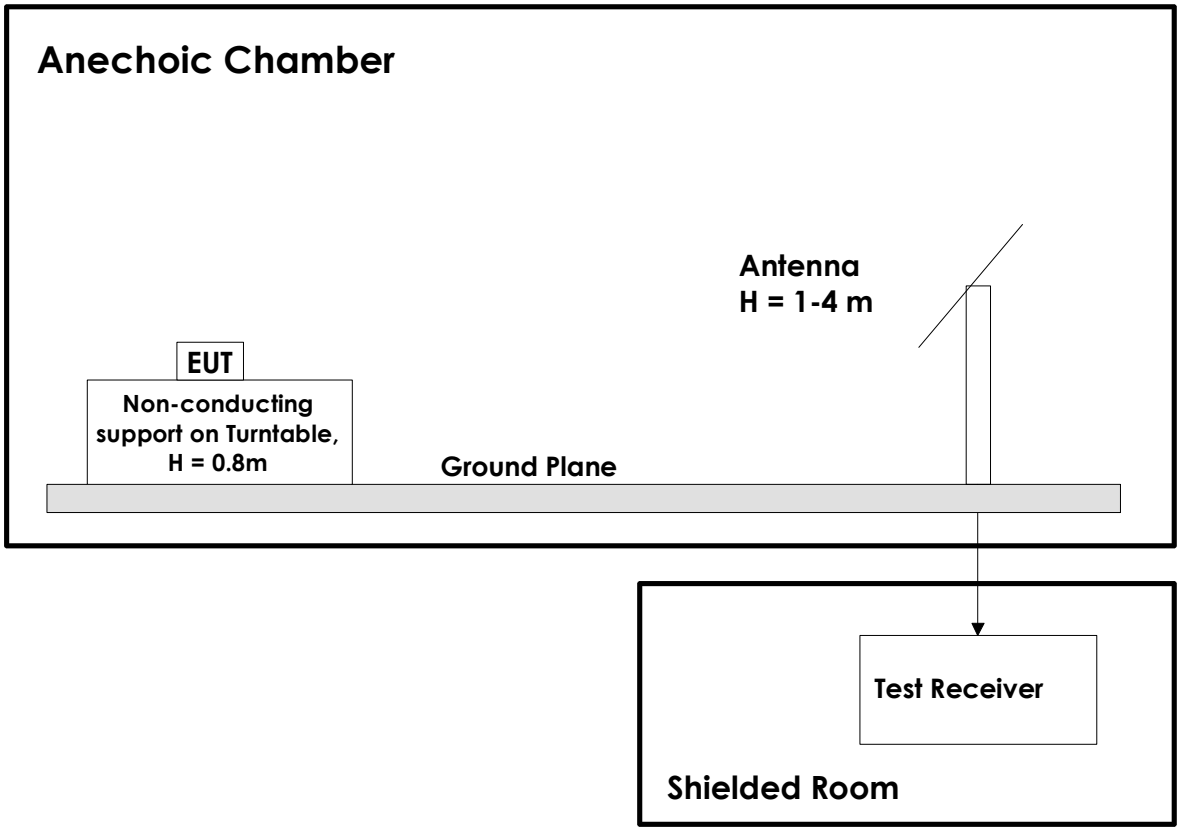
6 BLOCK DIAGRAM

6.1 Conducted Tests



This test set-up is used for all Conducted tests.
For Frequency Stability test the EUT was placed in a climatic chamber.

6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.