REP041455D

Test Report

Product	Animal Monitoring Device
Name and address of the applicant	DeLaval International AB Gustav De Lavals väg 15 SE-14147 Tumba, Sweden
Name and address of the manufacturer	DeLaval International AB Gustav De Lavals väg 15 SE-14147 Tumba, Sweden
Model	AM2
Rating	3.0V_{DC} (Primary Battery Fuji CR8LHC)
Trademark	DeLaval
Additional information	418MHz
Tested according to	**FCC Part 15.231** Periodic operation in the band 40.66-40.70 MHz and above 70 MHz **ISED Canada RSS-210, Issue 11** Licence-Exempt Radio Apparatus: Category I Equipment
Order number	PRJ0039211
Tested in period	2024-01-24 to 2024-04-17
Issue date	2024-09-12
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: A

Revision history

Revision	Date	Comment	Sign
A	2024-05-27	First edition	FS
B	2024-06-10	Corrected Duty-Cycle Calculation	FS
C	2024-07-26	Added 20 dB BW	FS
D	2024-09-12	Added Duty-Cycle Plots	FS

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.

1 INFORMATION

1.1 Tested Item

Name	**DeLaval**
Model name	**AM2**
FCC ID	**UCS2150043281**
ISED Canada ID	**6576A-2150043281**
Serial number	**Radiated Sample: 418M_TXM_S02** **Conducted Sample: 4XXM_COAX_S14**
Hardware version	**00**
Software version	**1.1.0.5967**
Frequency Range	**417.33 – 418.32 MHz**
Number of Channels	**4**
Type of Modulation	**2-GFSK**
Output Power	**0.20 mW (Peak, Radiated)**
Antenna Connector	**None (Integral Antenna)**
Power Source	**Primary Battery (Fuji CR8LHC)**

1.2 Description of Tested Device

The EUT is an animal monitoring device.

1.3 Test Environment

Temperature	**20.0 – 23.3 °C**
Relative humidity	**20.0 – 44.0 %**
Normal test voltage	**3.0 V DC (Nominal Battery Voltage)**

The values are the limit registered during the test period.

All tests have been performed with the EUT powered from a fresh battery.

1.4 Test Engineers

Frode Sveinsen

1.5 Antenna Requirement

Does the EUT have detachable antennas?	**☐ YES**	**☒ NO**
The EUT have an internal antenna		

Requirement: FCC 15.203, 15.204

1.6 Power Levels

Operation Mode	Power Level
2-GFSK	Default

EUT was transmitting continuously in test-mode during all tests.

2 TEST REPORT SUMMARY

2.1 General

The tests were conducted on a sample of the equipment for demonstrating compliance with one or more of the following standards:

Standard	Description
FCC CFR 47 Part 15.231	Periodic Operation in the band 40.66-40.70 MHz and above 70 MHz
ISED RSS-210, Issue 11	Licence-Exempt Radio Apparatus: Category I Equipment
ISED RSS-GEN Issue 5	General Requirements for Compliance of Radio Apparatus

The following standards and documents were used for one or more measurements:

Standard	Description
ANSI C63.4-2014	Unintentional Radiators
ANSI C63.10-2013	Intentional Radiators
FCC KDB 412172 D01	Determining ERP and EIRP

All measurements are traceable to national standards.

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

Information about type of EUT	
☒ **New Submission**	☐ **Production Unit**
☐ **Class II Permissive Change**	☒ **Pre-production Unit**
Equipment Class **DSC**	☐ **Family Listing**

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-210 Issue 11, RSS-GEN Issue 5 reference	ANSI C63.10-2013 reference	Verdict
Field Strength of Fundamental	**15.231 (b)**	**Annex A**	**6.5**	**Complies**
Occupied Bandwidth (99% BW)	**N/A**	**6.7 (RSS-GEN)**	**6.9.3**	**Complies**
Spurious Emissions (Radiated)	**15.231(b)** **15.209(a)**	**Annex A (RSS-210)** **7.3 (RSS-GEN)** **8.9 (RSS-GEN)**	**6.3, 6.5, 6.6**	**Complies**

3 TEST RESULTS

3.1 Field Strength of Fundamental

Operating Mode	**Continuous TX**
Modulation / Bitrate	**2-GFSK**
Test Standards	**FCC Part 15.231 (a)(b) RSS-210 Issue 11, Annex A**
Measurement Procedure	**ANSI C63.10-2013 Clause 6.5**
Test Engineer and Test Date	**Frode Sveinsen, 2024-01-24**
Test Verdict	**Complies**

Measurement Data:

Modulation Type	Carrier Frequency	Maximum Peak Field Strength @3m	Maximum Average Field Strength @3m	Limit @3m
FSK	**417.99 MHz**	**88.3 dBµV/m**	**78.5 dBµV/m**	**80.3 dBµV/m**

Measurement was performed with Peak Detector and Max Hold.

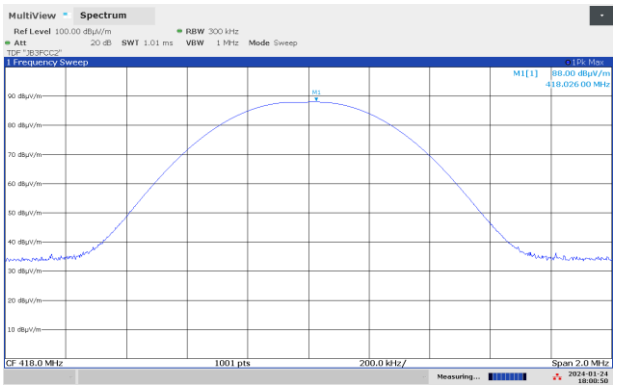
Duty Cycle value is declared by the manufacturer. Maximum transmit time over any 100ms period is 32.3ms.

Duty Cycle = 32.3ms / 100ms => -20*log(0.323) = 9.8 dB

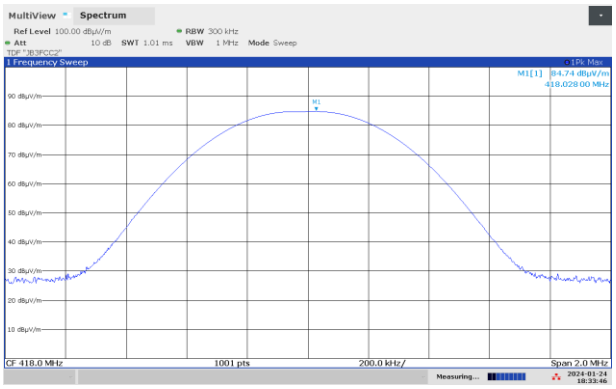
Each packet is 32.3 ms, and the transmitter is deactivated after the packet is sent.
Packet rate is 4 packets per hour, not included RFID triggered packets.

Limit:

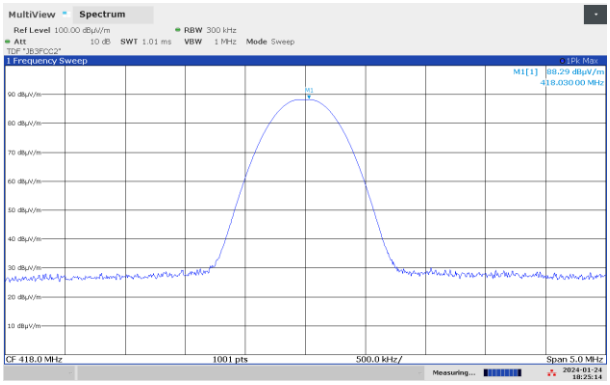
FCC ISED	Part 15.231 (b) RSS-210 Issue 11, Annex A	
Fundamental Frequency	**Field Strength of Fundamental Limit (dBµV/m @3m)**	**Field Strength of Spurious Emissions Limit (dBµV/m @3m)**
40.66-40.70 MHz	**67.0**	**47.0**
70-130 MHz	**61.9**	**41.9**
130-174 MHz	**61.9 to 71.5 [1]**	**41.9 to 51.5 [1]**
174-260 MHz	**71.5**	**51.5**
260-470 MHz	**71.5 to 81.9 [1]**	**51.5 to 61.9 [1]**
418 MHz	**80.3**	**60.3**
Above 470 MHz	**81.9**	**61.9**
	Limits above are with Average Detector	
	[1] Linear Interpolation	



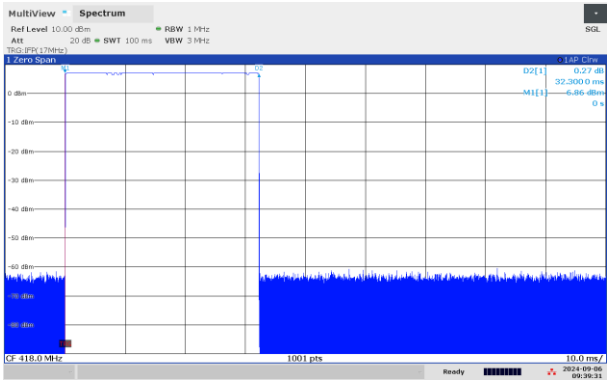
Peak Power, 417.99 MHz, XY, Max: HP



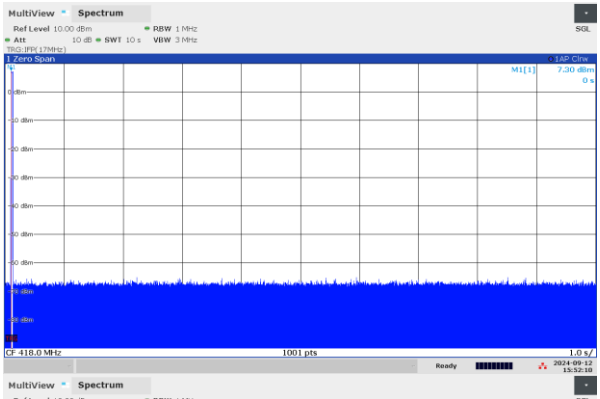
Peak Power, 417.99 MHz, YZ, Max: HP

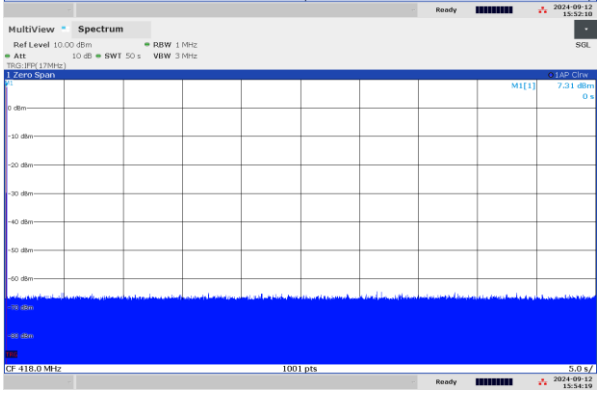


Peak Power, 417.99 MHz, ZX, Max: VP



Duty-Cycle, 32.3ms per 100ms





3.2 20dB Bandwidth

Operating Mode	**Continuous TX**
Modulation / Bitrate	**2-GFSK**
Test Standards	**FCC Part 15.231 (c)** **RSS-210 Issue 11, Annex A**
Measurement Procedure	**ANSI C63.10-2013 Clause 6.9.2**
Test Engineer and Test Date	**Frode Sveinsen, 2024-04-17**
Test Verdict	**Complies**

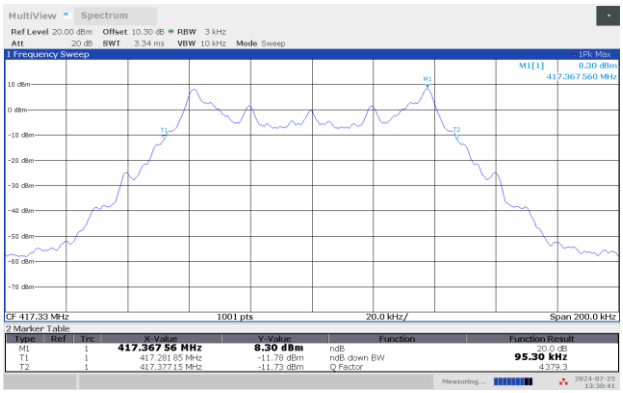
Measurement Data:

Carrier Frequency	Occupied Bandwidth (99% BW)	Limit
417.33 MHz	95.3 kHz	1043 kHz
417.66 MHz	95.3 kHz	1044 kHz
417.99 MHz	95.3 kHz	1045 kHz
418.32 MHz	95.3 kHz	1046 kHz

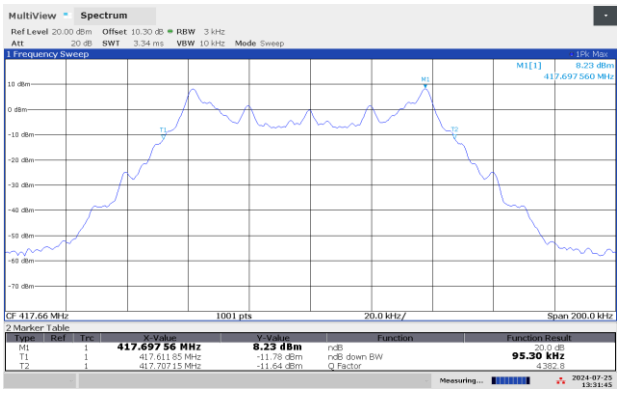
See attached plots.

Requirements:

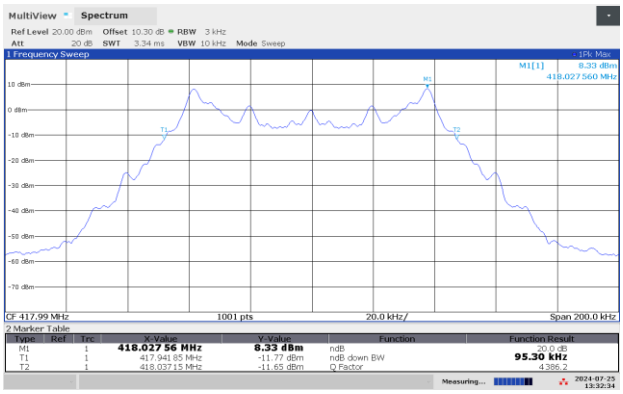
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.



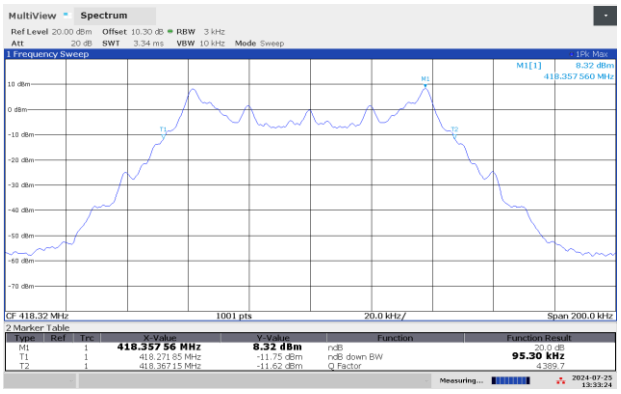
20 dB Bandwidth, 417.33 MHz



20 dB Bandwidth, 417.66 MHz



20 dB Bandwidth, 417.99 MHz



20 dB Bandwidth, 418.32 MHz

3.3 Occupied Bandwidth (99% BW) and Emission Bandwidth

Operating Mode	**Continuous TX**
Modulation / Bitrate	**2-GFSK**
Test Standards	**ISED RSS-GEN Issue 5, Clause 6.7**
Measurement Procedure	**ANSI C63.10-2013 Clause 6.9.3**
Test Engineer and Test Date	**Frode Sveinsen, 2024-04-17**
Test Verdict	**Complies**

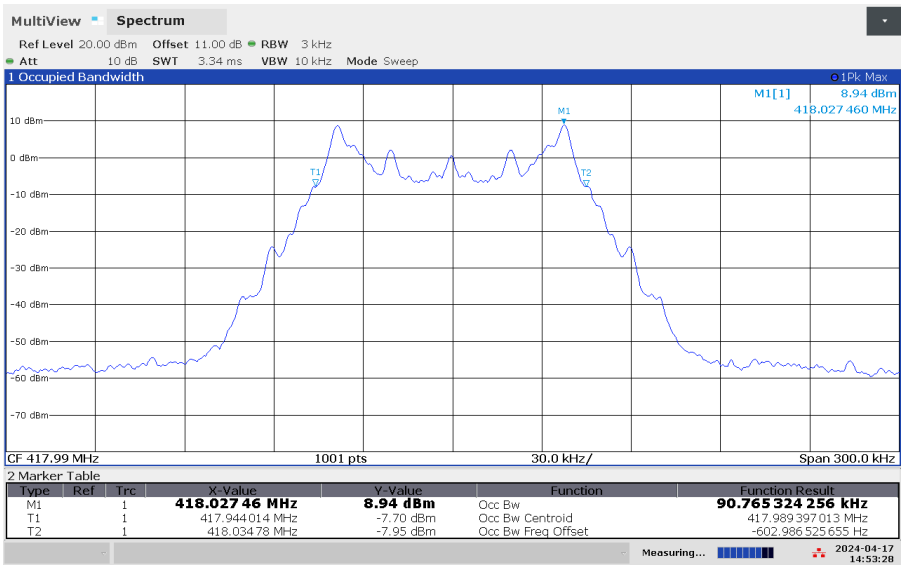
Measurement Data:

Carrier Frequency	Occupied Bandwidth (99% BW)
417.99 MHz	**90.8 kHz**

See attached plots.

Requirements:

No limit specified for 99% BW, reported for information only.



99% Occupied Bandwidth, 417.99 MHz

3.4 Radiated Emissions, 30 – 1000 MHz

Operating Mode	**Continuous TX**
Modulation / Bitrate	**2-GFSK**
Test Standards	**FCC Part 15.209 (a), 15.231 (b)** **ISED RSS-Gen Issue 5, Clause 7.3/8.9; RSS-210 Issue 11, Annex A**
Measurement Procedure	**ANSI C63.10-2013 Clause 11.12**
Test Engineer and Test Date	**Frode Sveinsen, 2024-0**
Test Verdict	**Complies**

Measurement Data:

Detector: Peak

Measuring distance: 3m

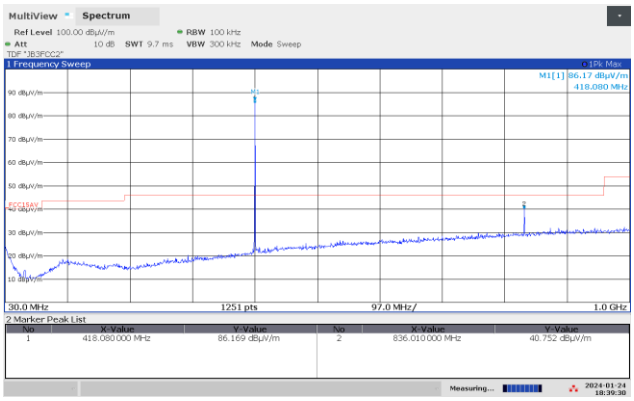
Tested in test mode with EUT transmitting continuously during this test

Measured Frequency (MHz)	Carrier Frequency (MHz)	Mode	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 – 88	418.32	FSK	< 25	40.0	>15
88 – 216	418.32	FSK	< 20	43.5	>23.5
216 – 960	418.32	FSK	< 34	46.0	>12
960 – 1000	418.32	FSK	< 34	54.0	>20
836.64	418.32	FSK	43.4	61.9	18.5

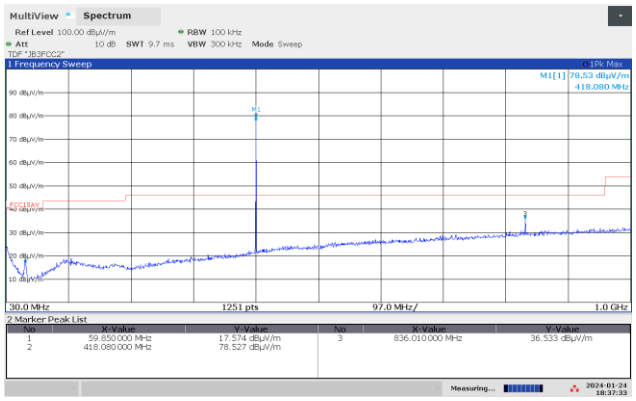
See attached plots

Limit

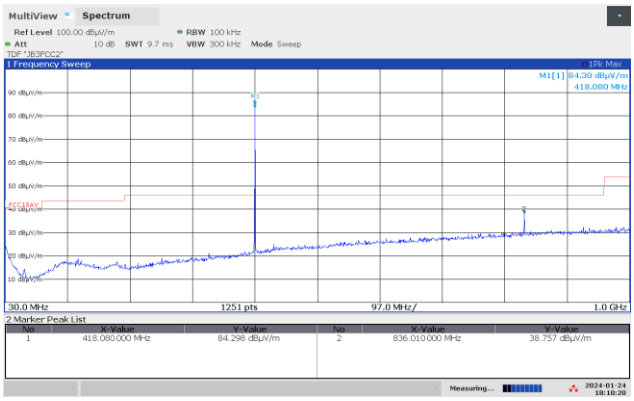
FCC	**Part 15.209 @ frequencies defined in §15.205**	
ISED	**RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10**	
Frequency	**Radiated emission limit @3 meters**	
30 – 88 MHz	**100 µV/m**	**40.0 dBµV/m**
88 – 216 MHz	**150 µV/m**	**43.5 dBµV/m**
216 – 960 MHz	**200 µV/m**	**46.0 dBµV/m**
960 – 1000 MHz	**500 µV/m**	**54.0 dBµV/m**
	Limits above are with Quasi-Peak Detector	
FCC **ISED**	**Part 15.231 (b)** **RSS-210 Issue 11, Annex A**	
Fundamental Frequency	**Field Strength of Fundamental Limit (dBµV/m @3m)**	**Field Strength of Spurious Emissions Limit (dBµV/m @3m)**
40.66-40.70 MHz	**67.0**	**47.0**
70-130 MHz	**61.9**	**41.9**
130-174 MHz	**61.9 to 71.5 [1]**	**41.9 to 51.5 [1]**
174-260 MHz	**71.5**	**51.5**
260-470 MHz	**71.5 to 81.9 [1]**	**51.5 to 61.9 [1]**
Above 470 MHz	**81.9**	**61.9**
	Limits above are with Average Detector	
	[1] Linear Interpolation	



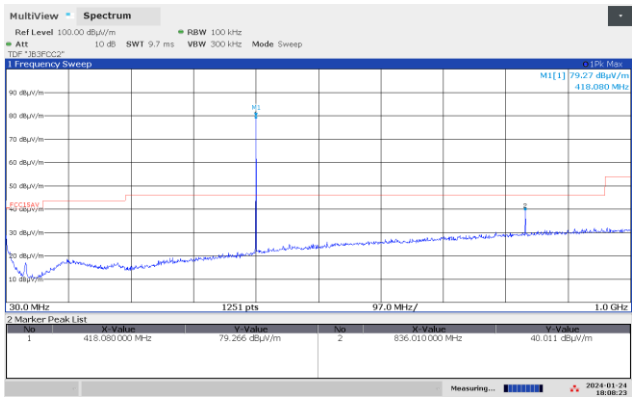
Radiated Emissions 30 - 1000 MHz, XY, HP



VP



Radiated Emissions 30 - 1000 MHz, YZ, HP



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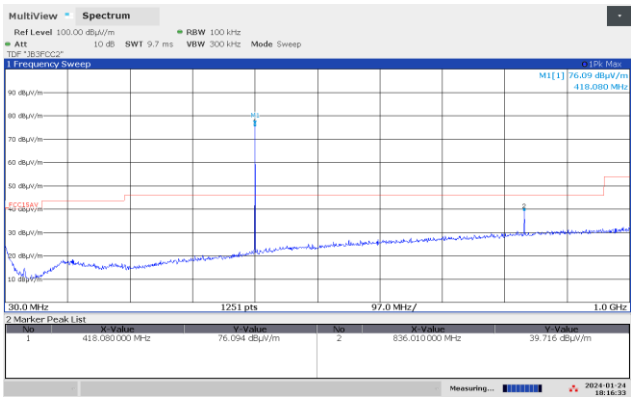
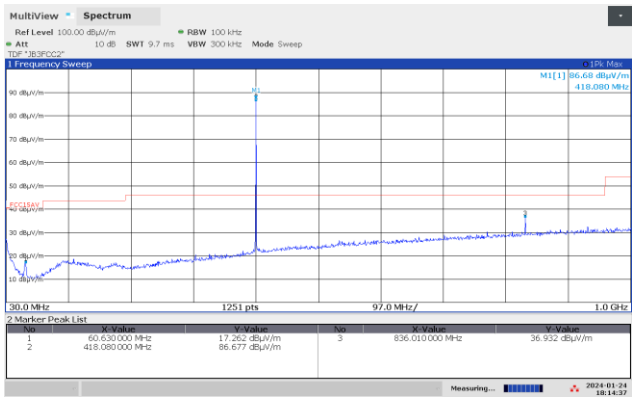


Radiated Emissions 30 - 1000 MHz, ZX, HP



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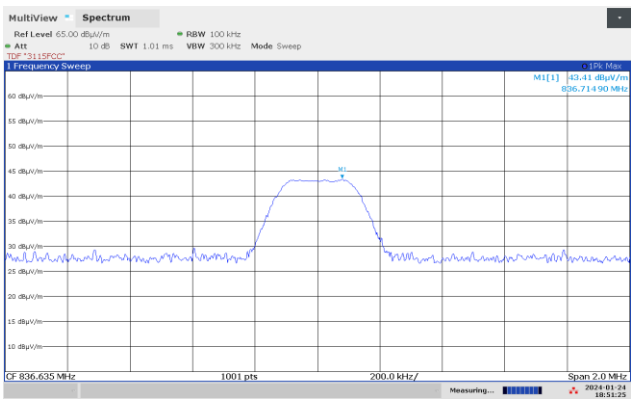


Spurious 836.6 MHz, 418.3 MHz, Max: HP, ZX

3.5 Radiated Emissions, 1 – 5 GHz

Operating Mode	**Continuous TX**
Modulation / Bitrate	**2-GFSK**
Test Standards	**FCC Part 15.209 (a), 15.231 (b)** **ISED RSS-Gen Issue 5, Clause 7.3/8.9; RSS-210 Issue 11, Annex A**
Measurement Procedure	**ANSI C63.10-2013 Clause 11.12**
Test Engineer and Test Date	**Frode Sveinsen, 2024-0**
Test Verdict	**Complies**

Measurement Data:

Measuring distance: 3m (1 – 5 GHz)

RBW=1 MHz

Measured Freq. (GHz)	Mode	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak	Average	Pk	Av	Pk	Av
2086.65*	FSK	-	54.3	N/A	61.9	-	7.6
2504.0*	FSK	-	53.7	N/A	61.9	-	8.2
2928.2*	FSK	-	47.1	N/A	61.9	-	14.8
4173.3	FSK	53.5	48.3	74	54	20.5	5.7
4590.6	FSK	51.2	-	74	54	22.8	-

*Not Restricted Band

The EUT was transmitting continuously in test-mode during all tests. Average values are NOT corrected for duty-cycle.

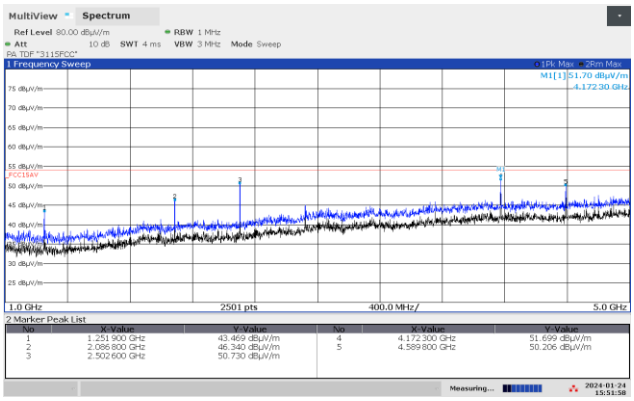
A High-Pass Filter was used for measurements above 1 GHz.

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

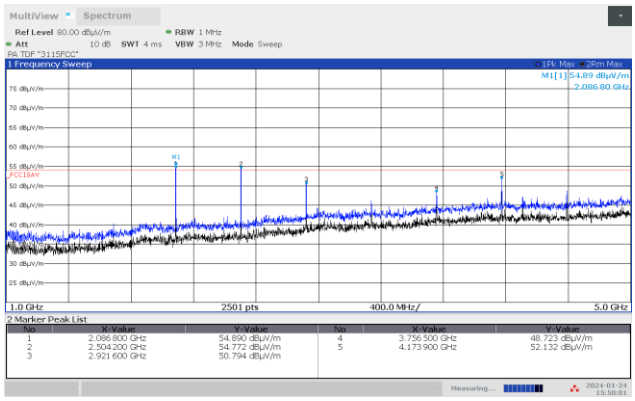
See plots.

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**
Above 1 GHz	**54.0 dBµV/m**	**74.0 dBµV/m**
FCC **ISED**	**Part 15.231 (b)** **RSS-210 Issue 11, Annex A**	
Fundamental Frequency	**Field Strength of Fundamental Limit (dBµV/m @3m)**	**Field Strength of Spurious Emissions Limit (dBµV/m @3m)**
Above 470 MHz	**81.9**	**61.9**
	Limits above are with Average Detector	
	[1] Linear Interpolation	



Radiated Emissions 1 - 5 GHz, XY, HP



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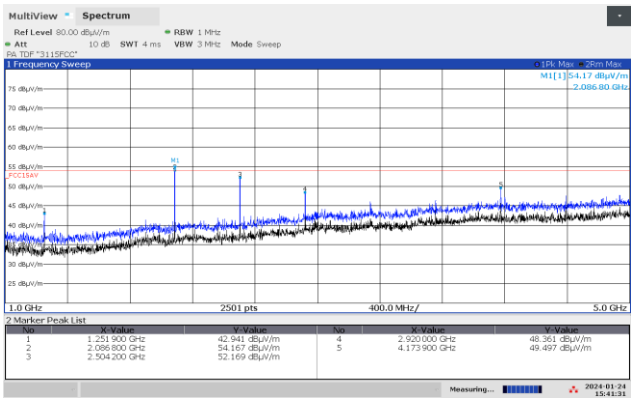
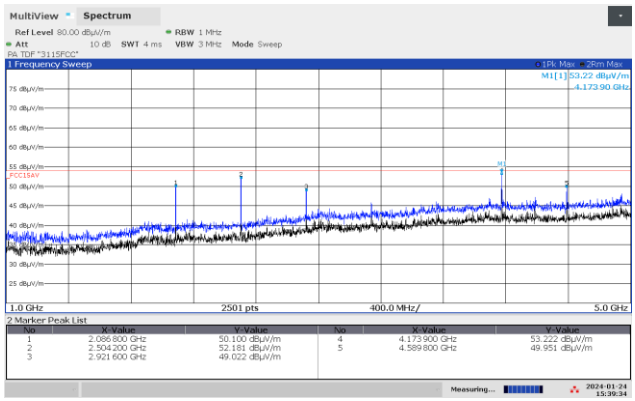


Radiated Emissions 1 - 5 GHz, YZ, HP



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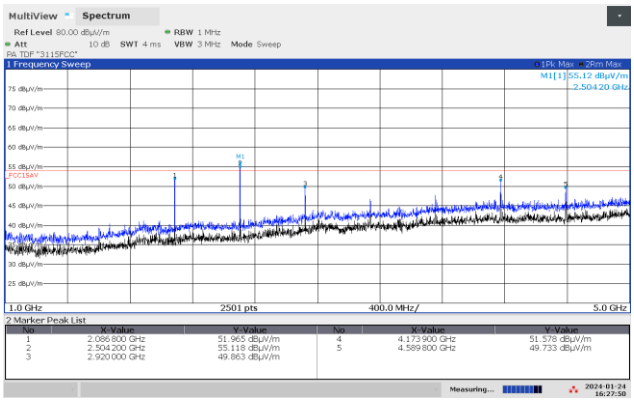
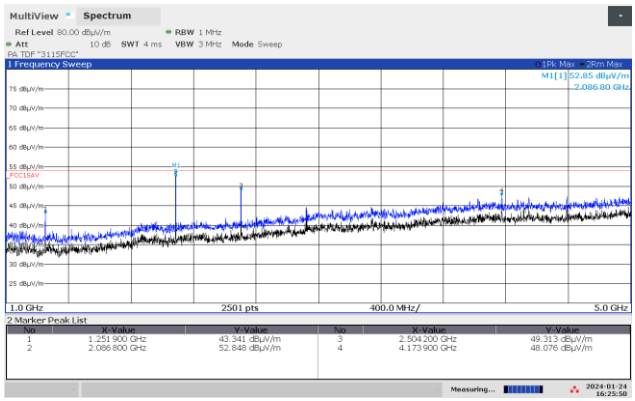


Radiated Emissions 1 - 5 GHz, ZX, HP



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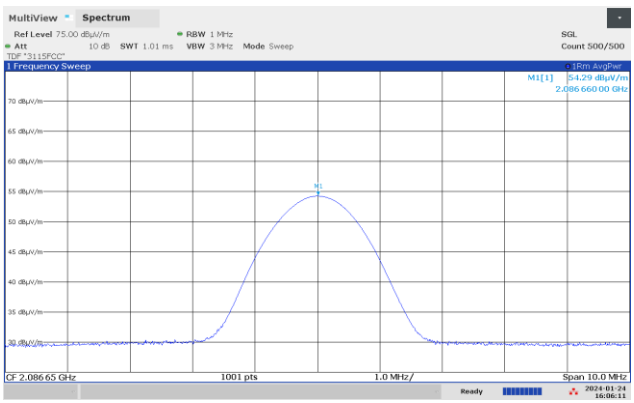
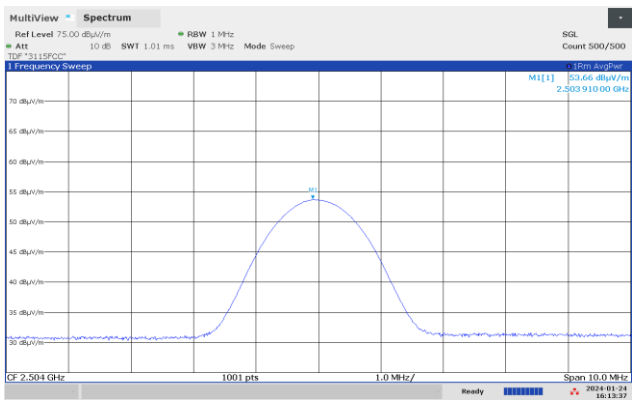
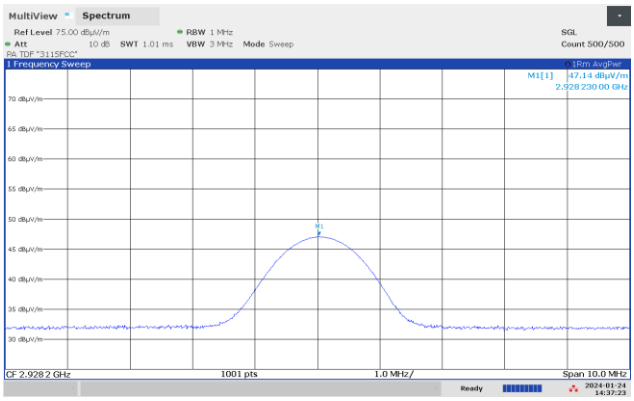


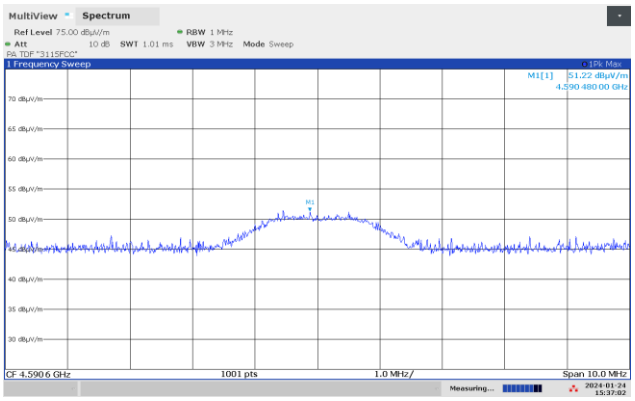
Emissions 2086.65 GHz, XY, Max: VP, Average



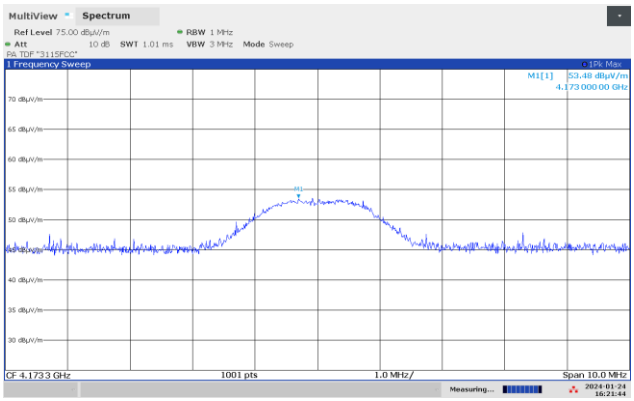
Emissions 2504 GHz, XY, Max: VP, Average



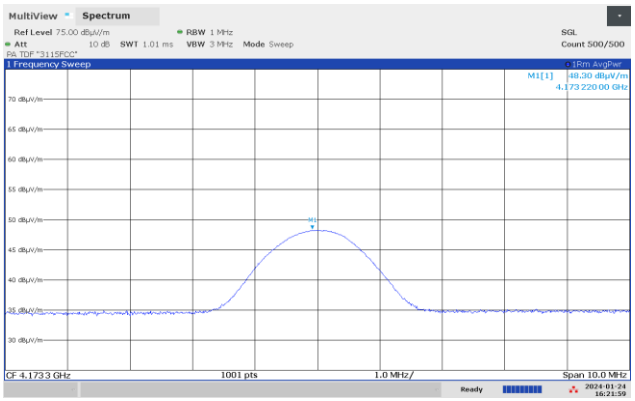
Emissions 2928.2 GHz, YZ, Max: VP, Average



Emissions 4590.6 GHz, YZ, Max: VP, Peak



Emissions 4173.3 GHz, XY, Max: VP, Peak



Average

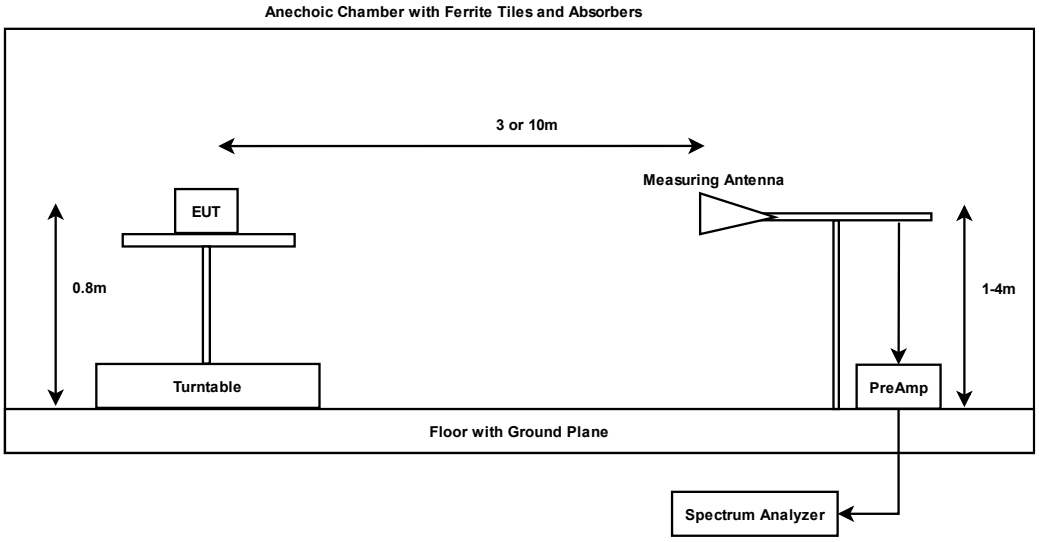
4 Measurement Uncertainty

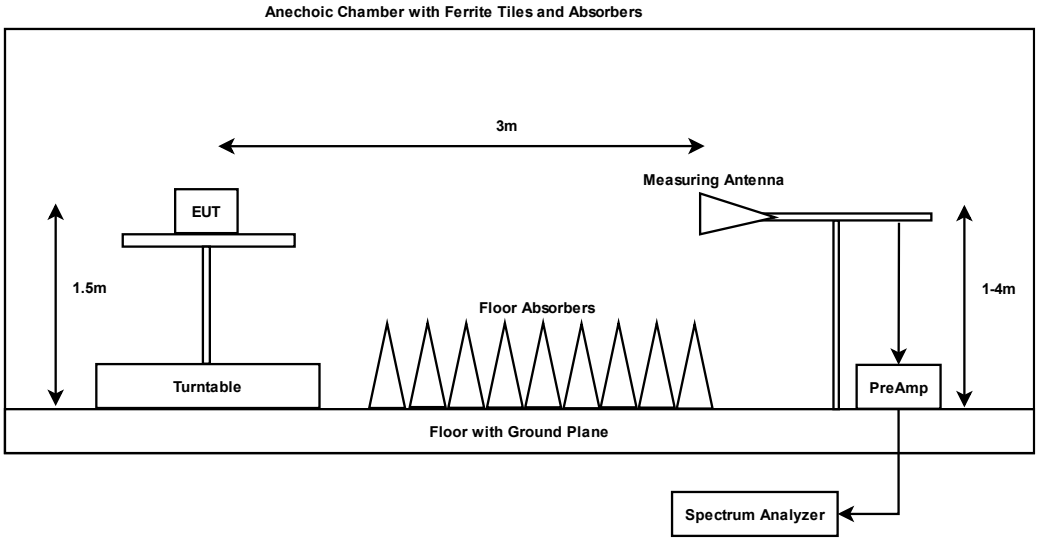
Measurement Uncertainty Values		
Test Item		**Uncertainty**
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted (RBW < 100 kHz)	**< 3.6 GHz**	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	**< 1 GHz**	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	**Frequency**	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Timing and Jitter Measurements		±2.0 ns
Frame Timing Measurements		±1.4 ppm
Receiver Blocking Levels		±1.0 dB
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 Test Setups

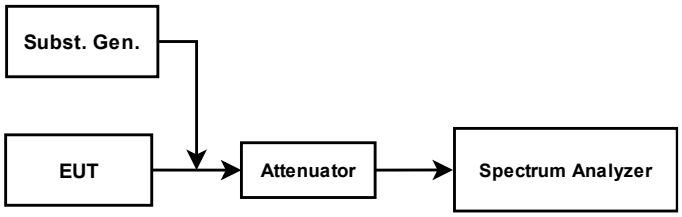
5.1 Radiated Emissions Test, Semi-Anechoic Chamber





Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna.
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 measuring harmonics.

5.2 Conducted Tests



This test set-up was used for measuring Occupied Bandwidth.

6 Test Equipment Used

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 Testhouse.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2024-01	2025-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2024-01	2025-01
3	SMB100A	Subst Generator	Rohde & Schwarz	LR 1790	2023-01	2025-01
4	WKH6-790-1000-7000-40SS	HighPass Filter (1 GHz)	Wainwrigth Instr.	LR 1781	COU	
5	JB3	BiLog Antenna	Sunol Sciences	N-4525	2023-04	2026-04
6	310	Preamplifier	Sonoma Inst.	LR 1686	2023-08	2024-08
7	3115	Horn Antenna	EMCO	LR 1226	2022-12	2027-12
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2023-08	2024-08
9	CPX400S	DC Power Supply 420W	AimTTi	LR 1745	N/A	
10	Model 45	Multimeter	Fluke	LT 5218	2024-04	2025-04

COU = Calibrate on Use

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 AS	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers