

Test Report

Product	Tag-M50X
Name and address of the applicant	Sonitor Technologies AS Drammensveien 288 0273 Oslo, Norway
Name and address of the manufacturer	Sonitor Technologies AS Drammensveien 288 0273 Oslo, Norway
Model	Tag-M50X
Rating	Internal battery: 3V
Trademark	Sonitor
Additional information	Bluetooth Low Energy 2402-2480 MHz
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Industry Canada RSS-247, Issue 4 Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz and 5470-5875 MHz bands
Order number	PRJ0072858
Tested in period	2025-03-06 – 2025-06-05
Issue date	2025-09-16
Name and address of the testing laboratory	 Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470 ISED No: 2040D-1   An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Jan G Eriksen]  Approved by [Frode Sveinsen]	
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Revision history

Revision	Date	Comment	Sign
A	2025-08-07	First edition	JGER
B	2025-09-16	Updated and corrected standards references	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.

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1 INFORMATION

1.1 Test Item

Name	Tag-M50X
Model/version	/
FCC ID	2AD7T11124102301
ISED ID	20330-11124102301
Serial number	/
Hardware identity and/or version	/
Software identity and/or version	/
Frequency Range	2402 – 2480 MHz
Number of Channels	40
Operating Modes	Bluetooth Low Energy ☒ 1Mb ☐ 2Mb
Type of Modulation	GFSK
Conducted Output Power	< 10 mW
Antenna Connector	None
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Internal battery
Desktop Charger	N/A

Description of Test Item

Tag-M50X is a tag used in real time location systems to know the position of an object in real time.

The tag listens to ultrasound and/or LF messages from ultraBeacons and advertises messages over Bluetooth Low Energy to nearby gateways or access points.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3 V DC

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Jan G Eriksen

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 only integral antennas. Conducted tests were performed with a temporary antenna connector.		

Requirement: FCC 15.203, 15.204

1.5 EUT Operating Modes

Description of operating modes	Radiated Emissions EUT set to transmit at three channels 2402, 2440, and 2480 MHz.
Additional information	The device was powered from a fully charged battery.

1.6 Comments

All measurements were done with the EUT powered by a fully charged battery.

All ports were populated during spurious emission measurements.

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 15.247	Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
ISED RSS-247, Issue 4	Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands
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 C63.10-2020 (FCC)	Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.10-2020 (ISED Canada) +cor.1-2023 +ANSI C63.10a-2024 +Errata to C63.10a-2024	Procedures for Compliance Testing of Unlicensed Wireless Devices +Corrigendum 1 +Amendment 1 +Errata to Amendment 1
FCC KDB 558074 D01	15.247 Measurement Guidance for DTS and Frequency Hopping Systems

All measurements are traceable to national standards.

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

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

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 4, RSS-GEN Issue 5 reference	ANSI C63.10-2020 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	Pass
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Pass
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	Pass
DTS Bandwidth	15.247(a)(2)	6.3 (RSS-247)	11.8 Option 2	Pass
Peak Power Output	15.247(b)	6.3.2 (RSS-247)	11.9.1.1	Pass
Power Spectral Density	15.247(d)	6.3.1 (RSS-247)	11.10.2 PKPSD (DTS)	Pass
Spurious Emissions (Antenna Conducted)	15.247(c)	6.6 (RSS-247)	6.7 11.11 (DTS)	Pass
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	3.3 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.5, 6.6, 6.10 11.12 (DTS)	Pass

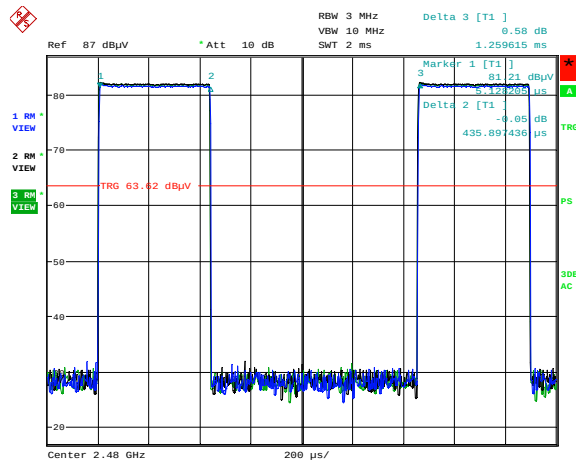
3 TEST RESULTS

3.1 Duty-Cycle measurement

The duty cycle of the device has been measured on three frequencies – 2402, 2440, and 2480 MHz.

The marker values have been taken on trace1 which was used at 2402 MHz.

The Duty Cycle is $(435.9 - 5.1) / (1259.6 - 5.1) = 0.3434$, i.e. 34.34 – corresponding to an average detector and average trace mode giving a reading which is 4.6 dB below the actual value.



Date: 5.JUN.2025 07:45:04

3.2 Occupied Bandwidth (99% BW)

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2020 Clause 6.9.2

Test Results: **Complies**

Measurement Data:

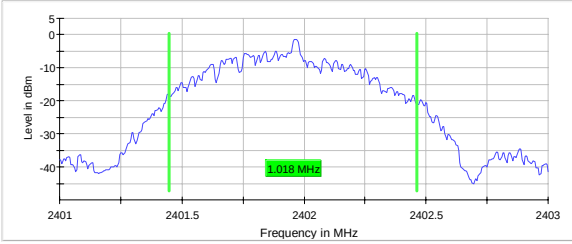
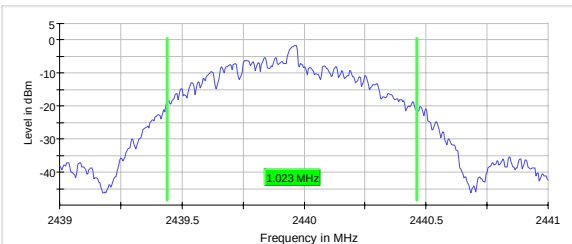
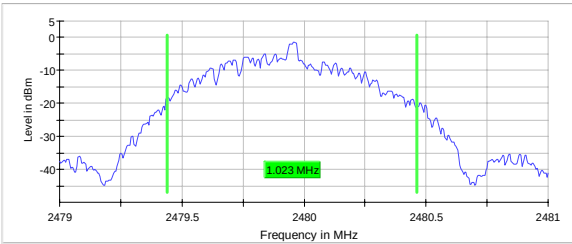
Carrier Frequency, Data Rate	Occupied Bandwidth (99% BW)
2402 MHz, 1Mb	1018 kHz
2440 MHz, 1Mb	1023 kHz
2480 MHz, 1 Mb	1023 kHz

Occupied Bandwidth is the same for all channels

See attached plots

Requirements:

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

99 % Bandwidth 	
99% Occupied BW, 2402 MHz, 1Mb 99 % Bandwidth 	
99% Occupied BW, 2440 MHz, 1Mb 99 % Bandwidth 	
99% Occupied BW, 2480 MHz, 1Mb	

3.3 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 4, Clause 6.3

Measurement procedure: ANSI C63.10-2020 Clause 11.8

Test Results: Complies

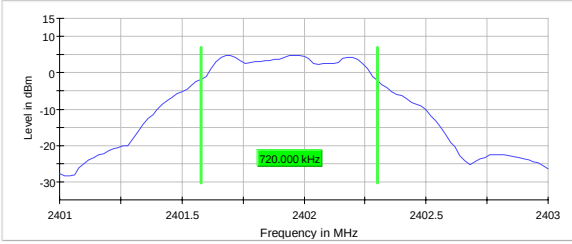
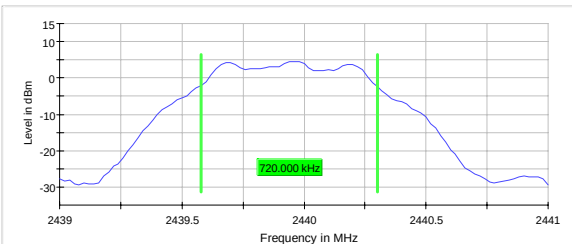
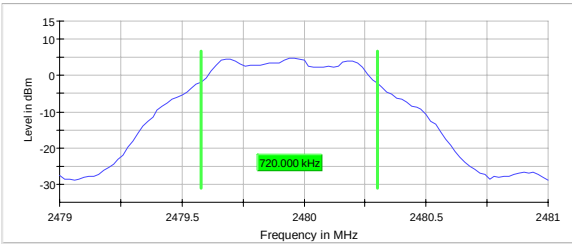
Measurement Data:

Modulation type and bitrate	Measured DTS Bandwidth (MHz)		
	2402 MHz	2440 MHz	2480 MHz
GFSK 1 Mbps	720 kHz	720 kHz	720 kHz
GFSK 2 Mbps	/	/	/

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.

6 dB Bandwidth 	
DTS BW, 2402 MHz, 1Mb 6 dB Bandwidth 	
DTS BW, 2440 MHz, 1Mb 6 dB Bandwidth 	
DTS BW, 2480 MHz, 1Mb	

3.4 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 4, Clause 6.3.2

Measurement procedure: ANSI C63.10-2020 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

Carrier Frequency	Peak Conducted Power, dBm	Peak EIRP measured, dBm		Antenna gain calculated dB
	GFSK 1Mb	GFSK 1Mb	GFSK 1Mb	
2402 MHz	4.9	96.6	1.4	-3.5
2440 MHz	4.6	98.8	3.6	-1.0
2480 MHz	4.7	97.5	2.3	-2.4

Output Power reported is Maximum Peak Power.

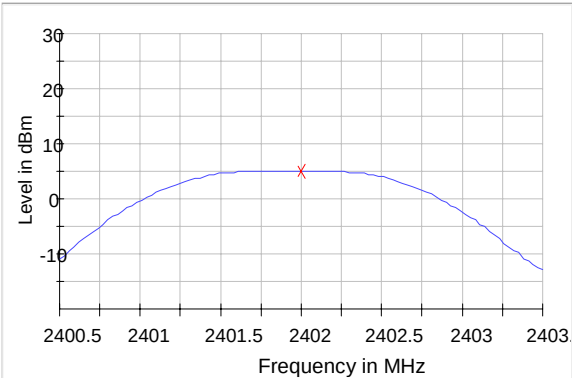
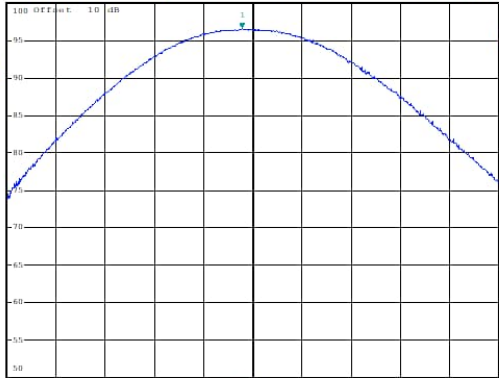
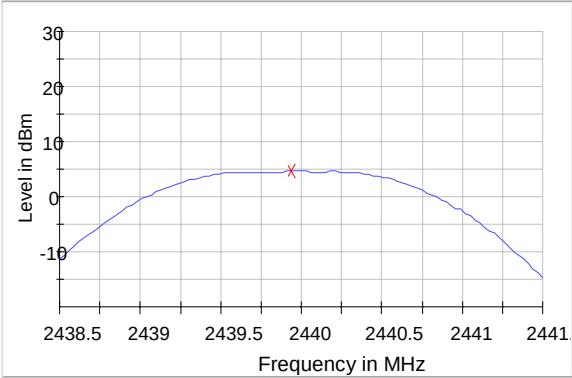
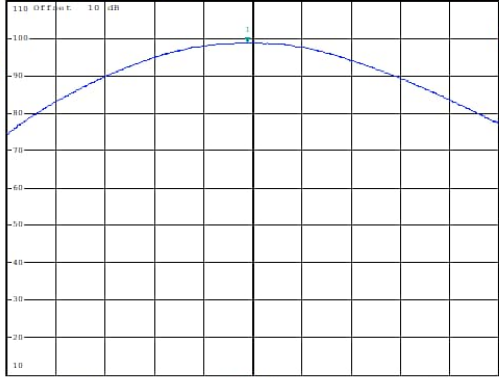
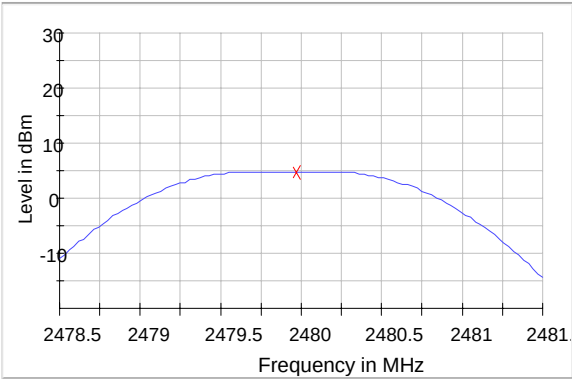
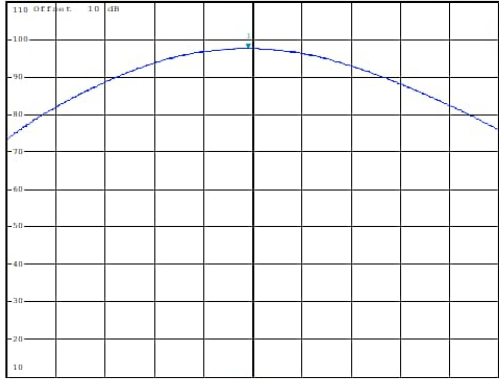
The Integrated Band Power Method was used to measure Output Power

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01 and in ANSI C63.10-2013 Annex G – with a distance of **3 meters**.

Antenna Gain is less than 6 dBi.

See attached plots.

Frequency Band	Requirements for Frequency Hopping systems
902-928 MHz	For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels
2400-2483.5 MHz	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
5725-5850 MHz	For all frequency hopping systems in the 5725-5850 MHz band: 1 watt
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 <i>maximum conducted output power</i> 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  — Connector 1 X Peak Connector 1	 Date: 24.MAR.2025 13:07:08
Peak Power, 2402 MHz, 1Mb Peak Power  — Connector 1 X Peak Connector 1	 Date: 24.MAR.2025 13:33:27
Peak Power, 2440 MHz, 1Mb Peak Power  — Connector 1 X Peak Connector 1	 Date: 24.MAR.2025 13:51:15
Peak Power, 2480 MHz, 1Mb	Peak Power signal strength, 2480 MHz, 1Mb

3.5 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 4, Clause 6.6

Measurement procedure: ANSI C63.10-2020 Clause 11.11

Test Results: Complies

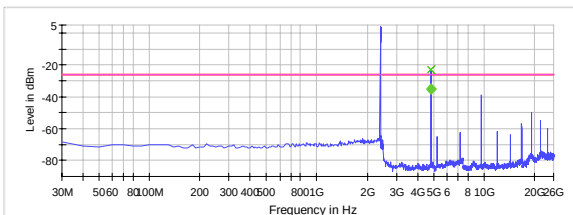
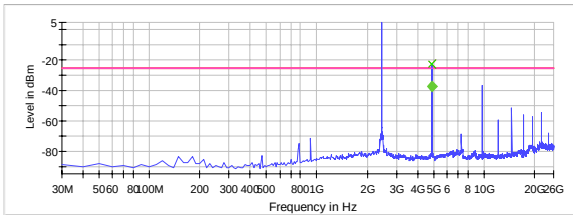
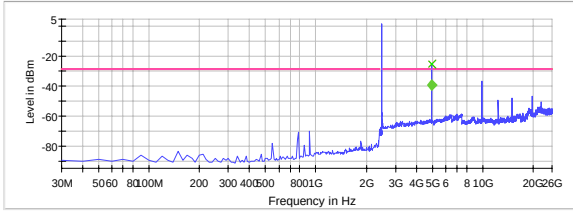
Measurement Data:

Carrier Frequency	Inband value (dBm)	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	3.8	-27.7	7.7	Pass
2440 MHz	4.9	-27.3	7.3	Pass
2480 MHz	1.3	26.3	6.3	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.	

Spurious  Level in dBm Frequency in Hz Limit Final Critical Sum Level Fail Threshold Pass Critical	
Conducted Emissions 30-26000 MHz, 2402 MHz, 1Mb Spurious  Level in dBm Frequency in Hz Limit Final Critical Sum Level Fail Threshold Pass Critical	
Conducted Emissions 30-26000 MHz, 2440 MHz, 1Mb Spurious  Level in dBm Frequency in Hz Limit Final Critical Sum Level Fail Threshold Pass Critical	
Conducted Emissions 30-26000 MHz, 2480 MHz, 1Mb	

3.6 Restricted Bands of operation

Restricted Bands of operation for FCC and ISSED are defined in FCC Part 15.205 and ISSED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		3.6-4.4	3.5-4.4
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 123-138	108-138	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISSED, all other frequencies are common.

3.7 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

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

Measurement procedure: ANSI C63.10-2020 Clause 11.12

Test Results: Complies

Measurement Data:

Peak Detector					
Modulation and Bitrate	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
GFSK, 1Mb	51.5	51.3	74	23.5	23.7
GFSK, 2Mb	/	/	74	/	/

Average Detector					
Modulation and Bitrate	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB *)	
GFSK, 1Mb (avg 500 swp)	39.0	39.4	54	/	/
Duty cycle correction	4.6	4.6	54	/	/
GFSK, 1Mb corrected	43.6	44.0	54	25.8	25.4
GFSK, 2Mb	/	/	54	/	/

Note: *) The margin of the Average Detector measurement has been corrected with the factor calculated from clause 3.1 "Duty Cycle measurement" (-4.6 dB).

$$54 \text{ dBuV/m} - 43.6 - 4.6 \text{ dB} = 5.8 \text{ dBuV/m}$$

$$54 \text{ dBuV/m} - 44.0 - 4.6 \text{ dB} = 5.4 \text{ dBuV/m}$$

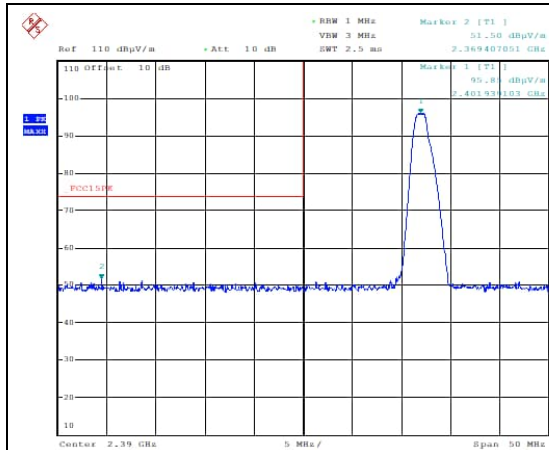
In addition, the manufacturer states that the signal during normal operation will have a maximum transmission duty cycle of less than 1% during any 100 ms period giving an additional 20 dB margin.

$$5.8 \text{ dBuV/m} + 20 \text{ dB} = \mathbf{25.8 \text{ dBuV/m}}$$

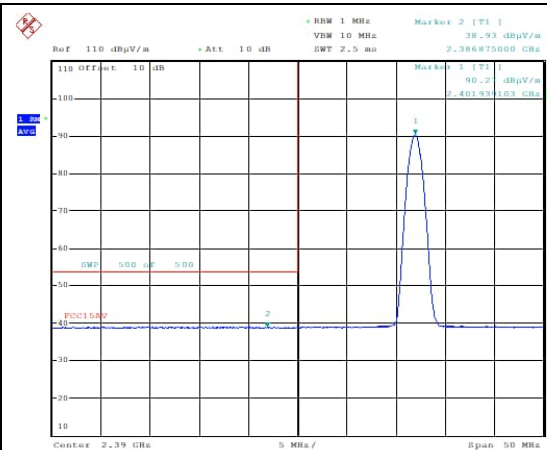
$$5.4 \text{ dBuV/m} + 20 \text{ dB} = \mathbf{25.4 \text{ dBuV/m}}$$

Average values were measured using trace averaging as described in ANSI C63.10-2013 clause 11.12.2.5.1 (Duty Cycle ≈100%).

See attached plots.



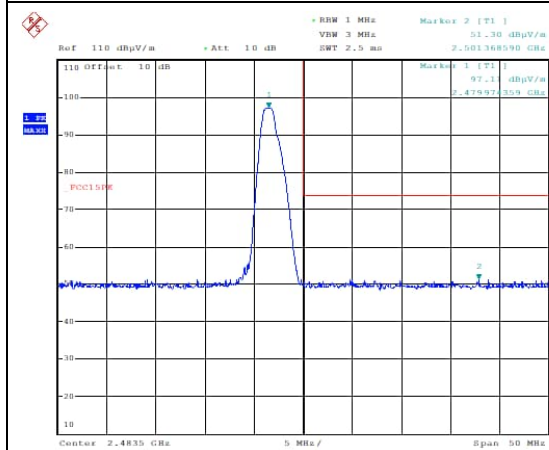
Date: 24.MAR.2025 14:20:24



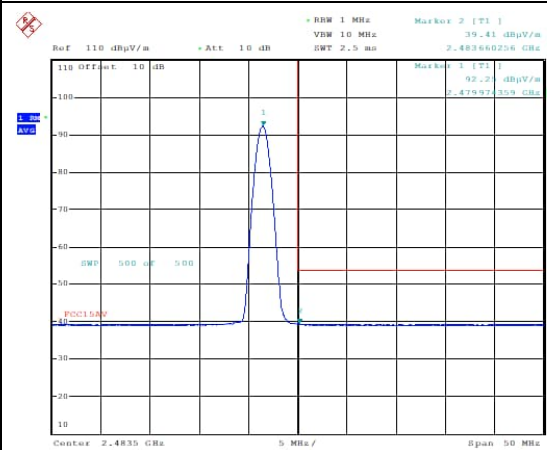
Date: 24.MAR.2025 14:22:48

Lower Band Edge, 2402 MHz, 1Mb, Peak

Lower Band Edge, 2402 MHz, 1Mb, Average



Date: 24.MAR.2025 19:54:57



Date: 24.MAR.2025 19:55:57

Upper Band Edge, 2480 MHz, 1Mb, Peak

Upper Band Edge, 2480 MHz, 1Mb, Average

3.8 Radiated Emissions, 30 – 1000 MHz

FCC Part 15.209 (a)

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

Measurement procedure: ANSI C63.10-2020 Clause 11.12

Test Results: Complies

Measurement Data:

Detector: Quasi-Peak

Measuring distance 3 m

Tested in test mode with EUT transmitting on ch19

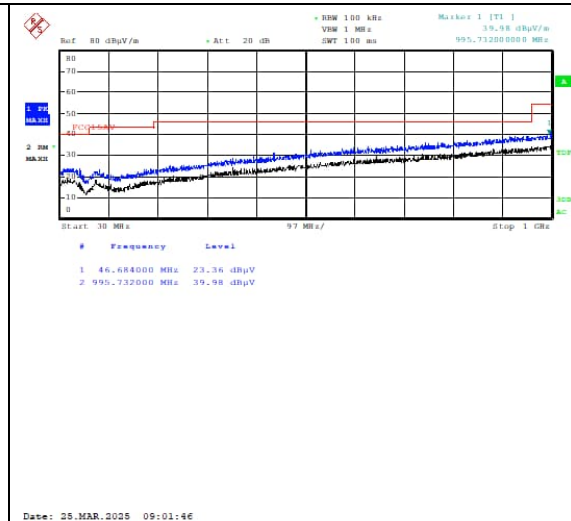
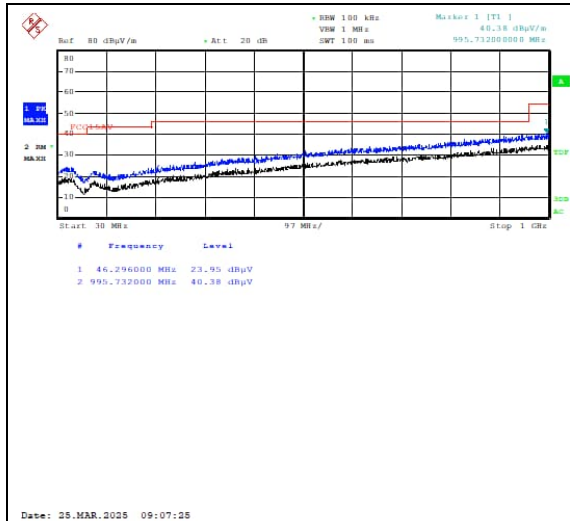
Measured Frequency (MHz)	Carrier Frequency (MHz)	Modulation	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30 – 88	2402 / 2440 / 2480	GFSK	< 30	40.0	> 10 *)
88 – 216	2402 / 2440 / 2480	GFSK	< 30	43.5	> 13.5 *)
216 – 960	2402 / 2440 / 2480	GFSK	< 40	46.0	> 6 *)
960 – 1000	2402 / 2440 / 2480	GFSK	< 44	54.0	> 10 *)

Note: *) The measurements do not include specific data on the frequency, so the exact measured level (Peak detector) is not given. However, the plots show that no Peak detector measurements are above the 40 dBμV/m line.

See attached plots

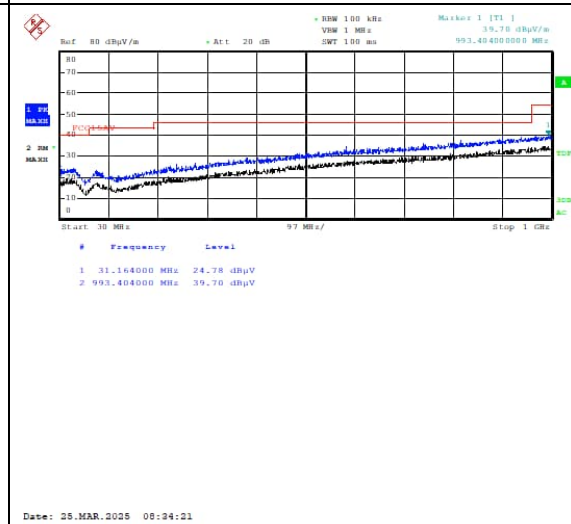
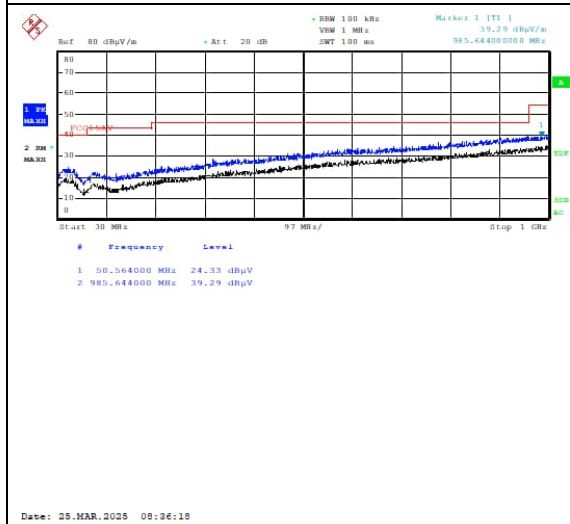
Requirements/Limit

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	



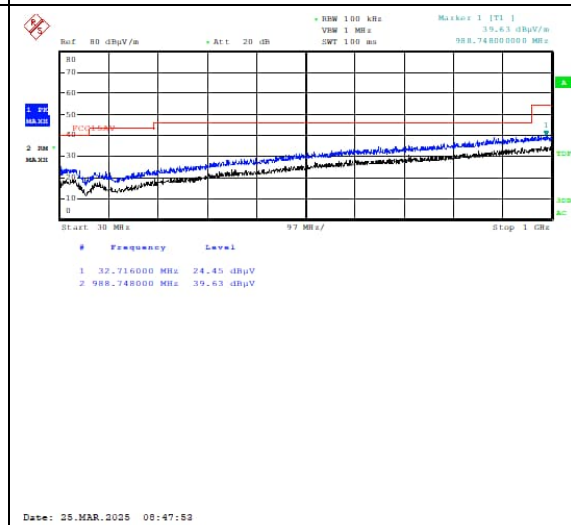
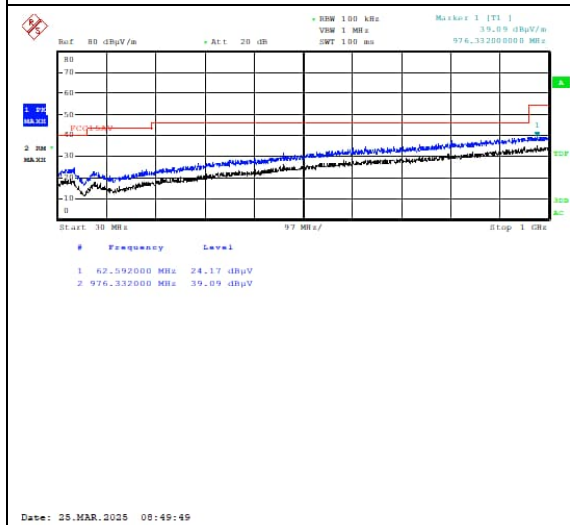
Radiated Emissions 30 - 1000 MHz, 2402 MHz, 1Mb, HP

Radiated Emissions 30 - 1000 MHz, 2402 MHz, 1Mb, VP



Radiated Emissions 30 - 1000 MHz, 2440 MHz, 1Mb, HP

Radiated Emissions 30 - 1000 MHz, 2440 MHz, 1Mb, VP



Radiated Emissions 30 - 1000 MHz, 2480 MHz, 1Mb, HP

Radiated Emissions 30 - 1000 MHz, 2480 MHz, 1Mb, VP

3.9 Radiated Emissions, 1 – 26 GHz

FCC Part 15.209 (a)

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

Measurement procedure: ANSI C63.10-2020 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz) and 1m (18 – 26 GHz)

RBW=1 MHz

Carrier Frequency (MHz)	Measured Frequency (GHz)	Pol HP / VP	Measured Emissions (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
			Peak	Average *)	Pk	Av	Pk	Av *)
2402	4804	HP	58.9	38.9	74	54	15.1	15.1
2440	4880	HP	57.8	37.8	74	54	16.2	16.2
2480	4960	HP	55.9	35.8	74	54	18.1	18.1
2440	7320	HP	59.8	39.8	74	54	14.2	14.2
2480	7440	HP	61.5	41.5	74	54	12.5	12.5
2402	12010	VP	62.4	42.5	74	54	11.6	11.6
2440	12200	VP	65.6	45.6	74	54	8.4	8.4
2480	12400	VP	61.5	41.5	74	54	12.5	12.5
2402	19216	VP	65.2	45.2	74	54	18.3 **)	18.3 **)
2440	19520	VP	65.6	45.6	74	54	17.9 **)	17.9 **)
2480	19840	VP	65.5	45.5	74	54	18.0 **)	18.0 **)

NOTE: *) The manufacturer states that the signal will during normal operation have a maximum transmission duty cycle of less than 1% during any 100 ms period giving an average value which is 20 dB (maximum allowed correction factor) below the peak value.

***) An additional 9.5 dB has been added to the margin because measurement was taken at 1 meter distance and limit is given at 3 meters.

Peak: $74 \text{ dBuV/m} - 65.2 + 9.5 = 18.3 \text{ dBuV/m}$,
Avg: $54 \text{ dBuV/m} - 45.2 + 9.5 = 18.3 \text{ dBuV/m}$

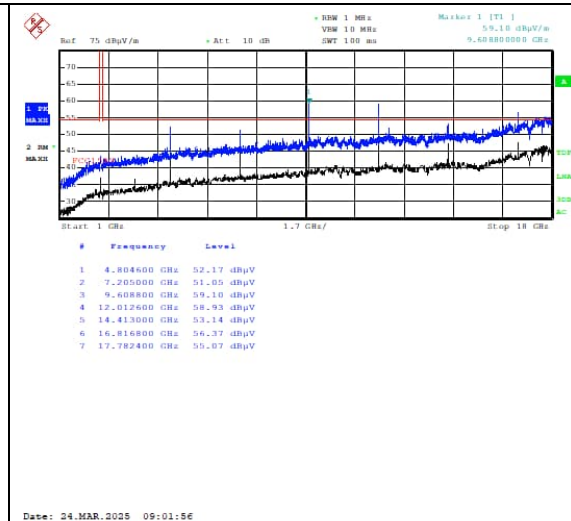
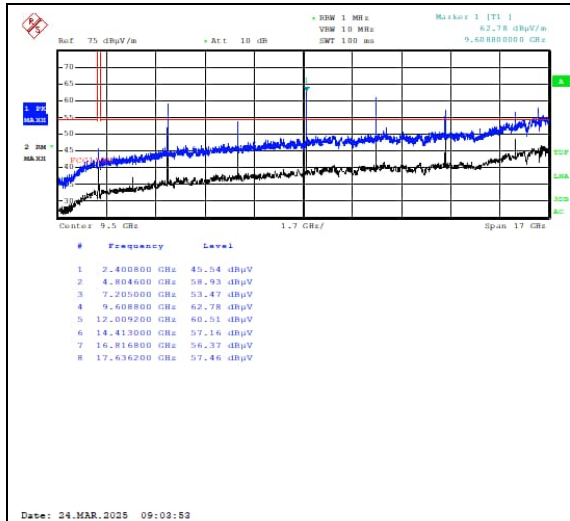
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

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

See plots.

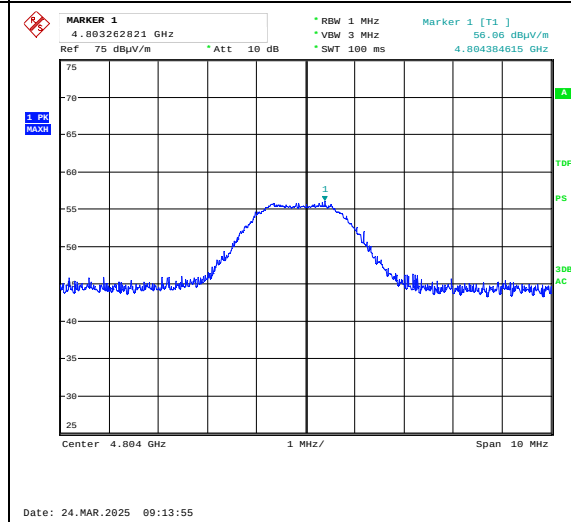
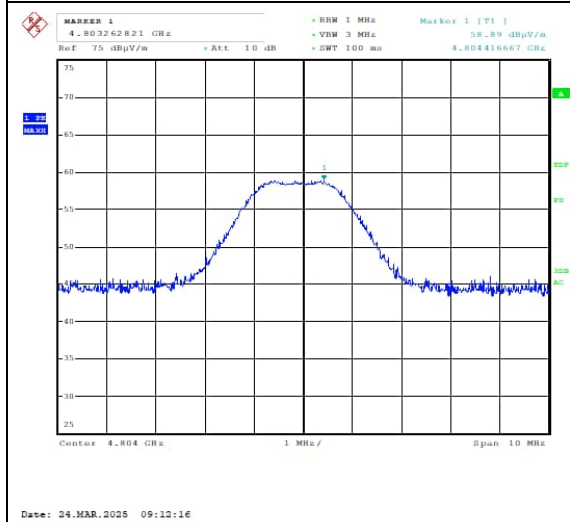
Requirements/Limit

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 – 26 GHz	54.0 dBμV/m	74.0 dBμV/m



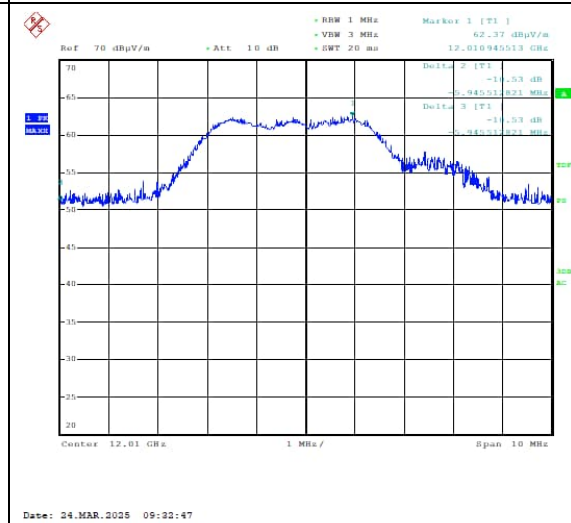
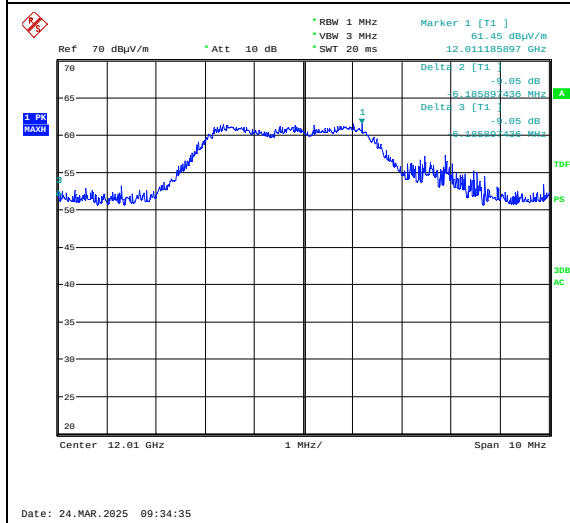
Radiated Emissions 1 - 18 GHz, 2402 MHz, 1M, HP

Radiated Emissions 1 - 18 GHz, 2402 MHz, 1M, VP



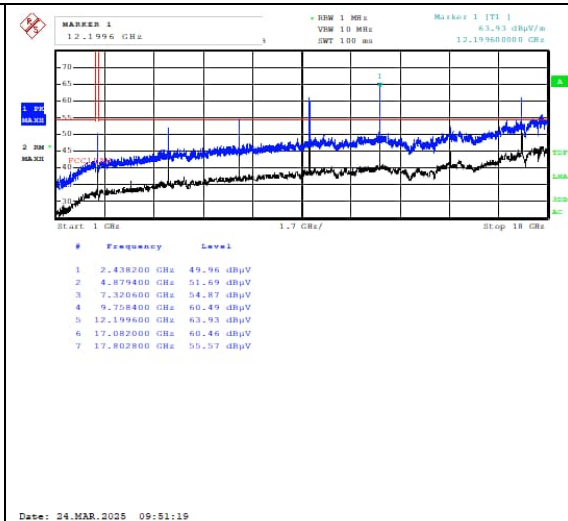
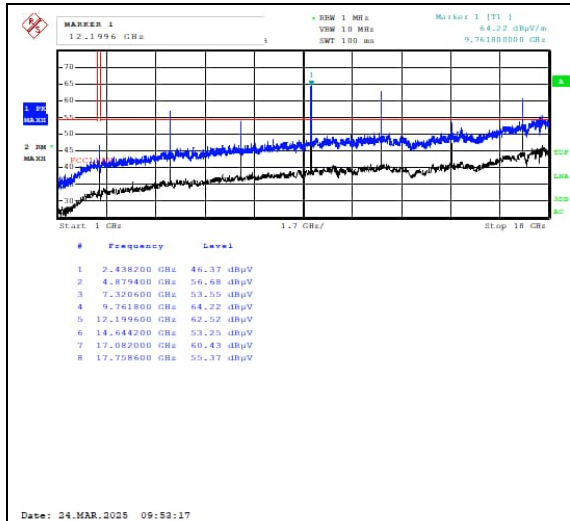
Radiated Emissions 4804 MHz, 2402 MHz, 1M, HP

Radiated Emissions 4804 MHz, 2402 MHz, 1M, VP



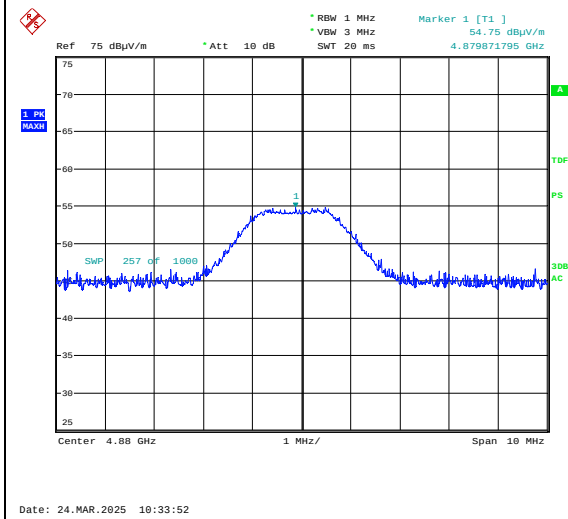
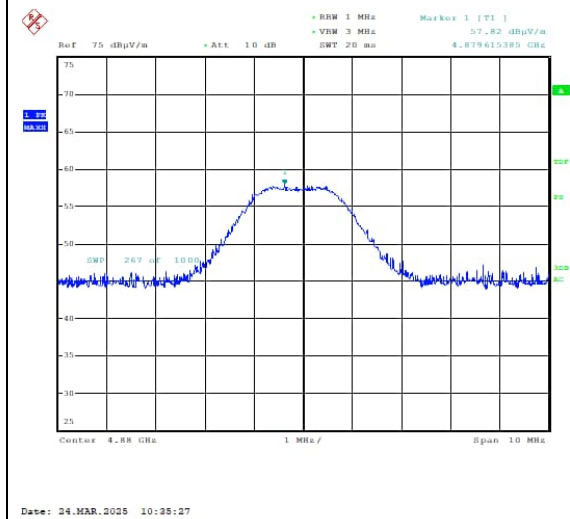
Radiated Emissions 12010 MHz, 2402 MHz, 1M, HP

Radiated Emissions 12010 MHz, 2402 MHz, 1M, VP



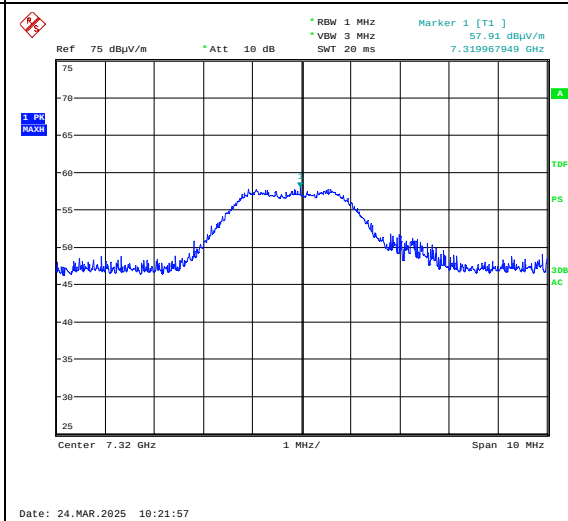
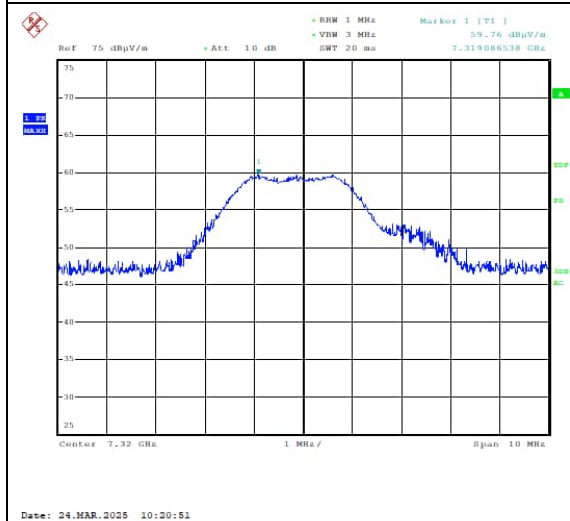
Radiated Emissions 1 - 18 GHz, 2440 MHz, 1M, HP

Radiated Emissions 1 - 18 GHz, 2440 MHz, 1M, VP



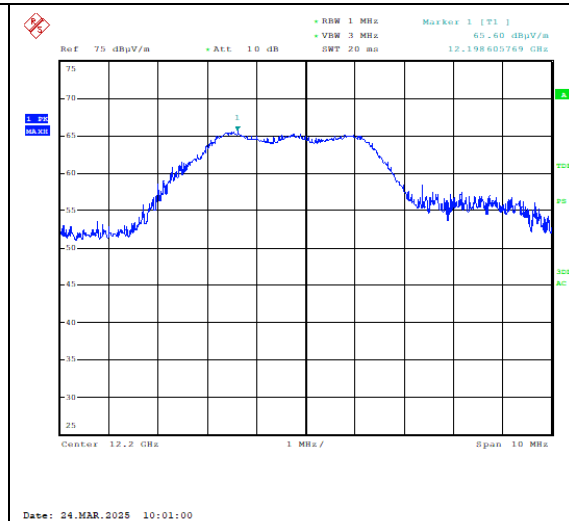
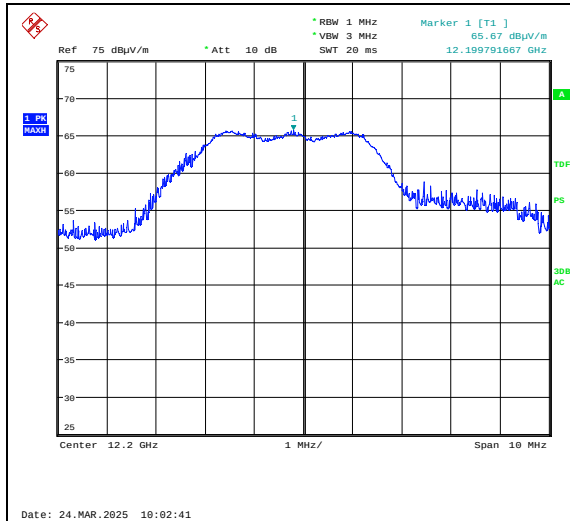
Radiated Emissions 4880 MHz, 2440 MHz, 1M, HP

Radiated Emissions 4880 MHz, 2440 MHz, 1M, VP



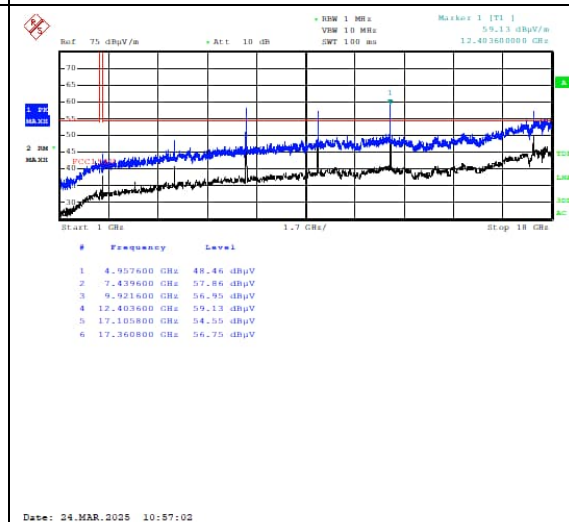
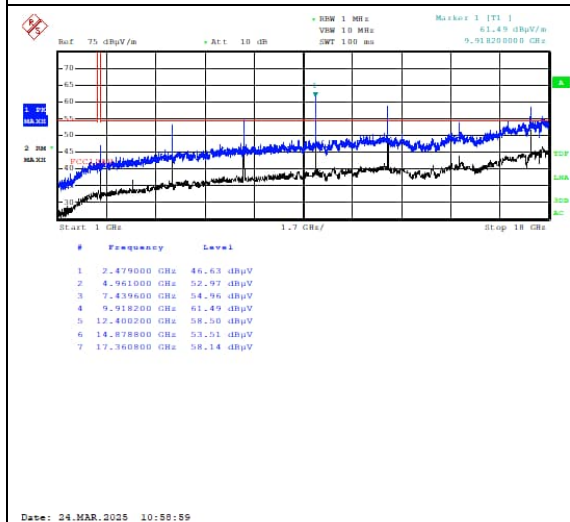
Radiated Emissions 7320 MHz, 2440 MHz, 1M, HP

Radiated Emissions 7320 MHz, 2440 MHz, 1M, VP



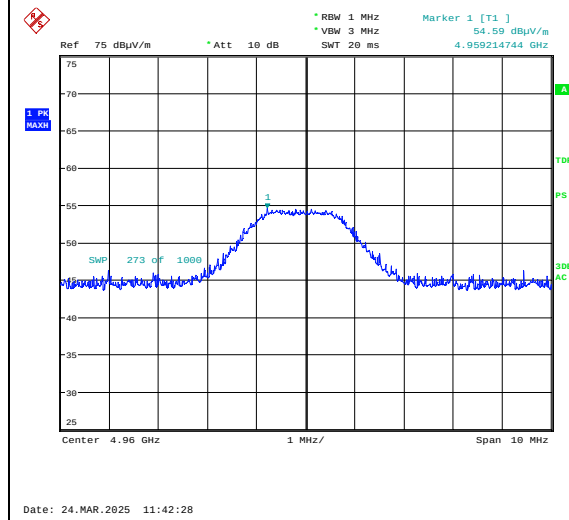
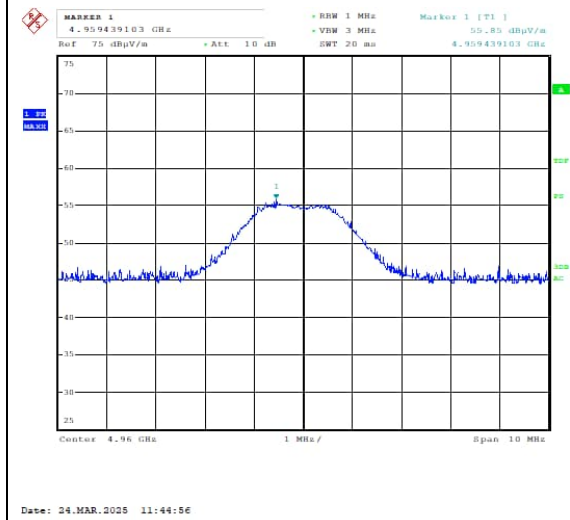
Radiated Emissions 12200 MHz, 2440 MHz, 1M, HP

Radiated Emissions 12200 MHz, 2440 MHz, 1M, VP



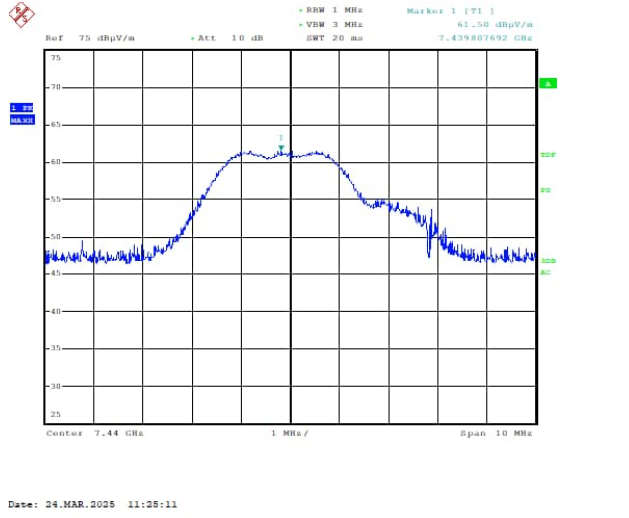
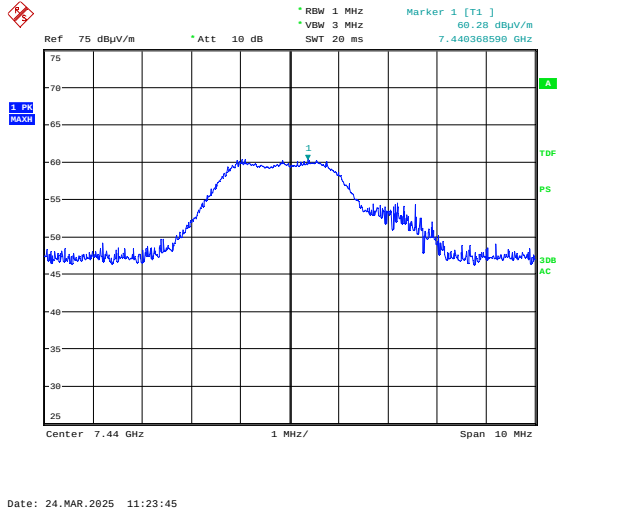
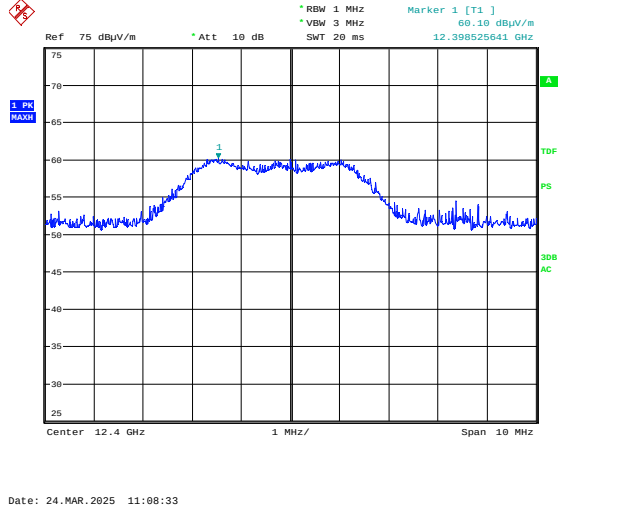
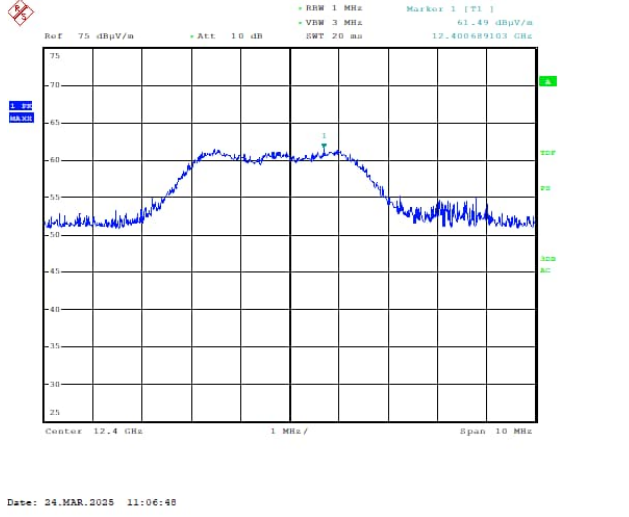
Radiated Emissions 1 - 18 GHz, 2480 MHz, 1M, HP

Radiated Emissions 1 - 18 GHz, 2480 MHz, 1M, VP

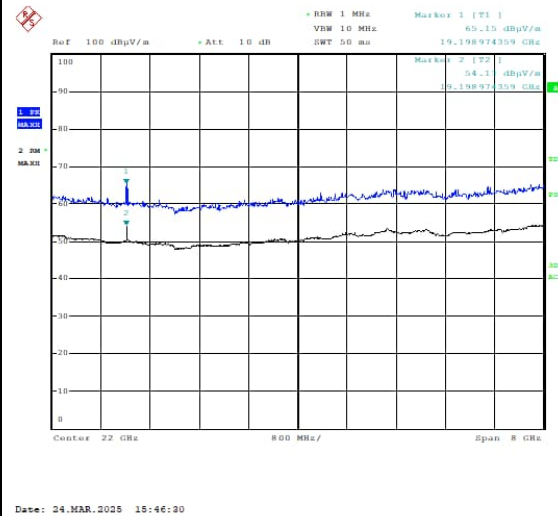
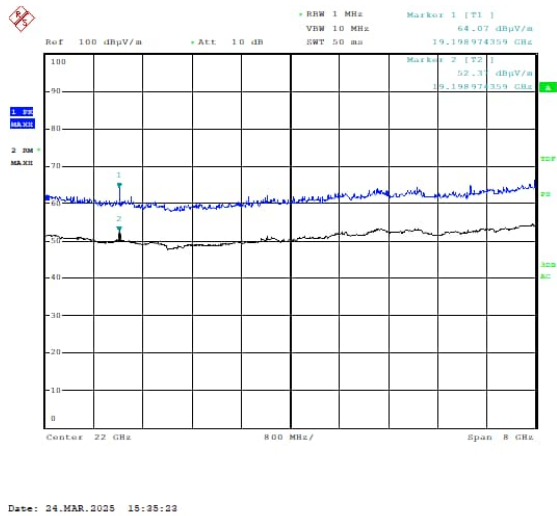


Radiated Emissions 4960 MHz, 2480 MHz, 1M, HP

Radiated Emissions 4960 MHz, 2480 MHz, 1M, VP

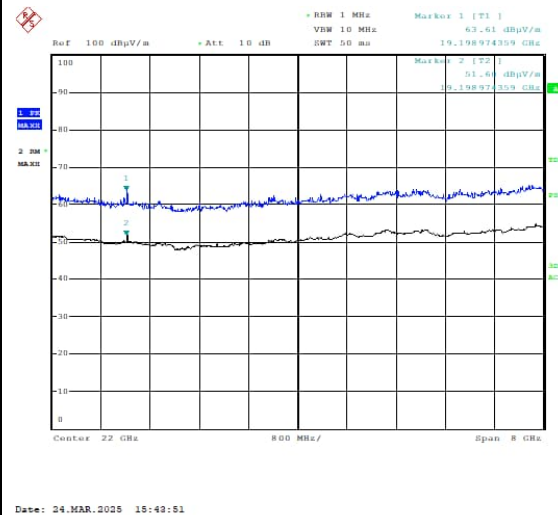
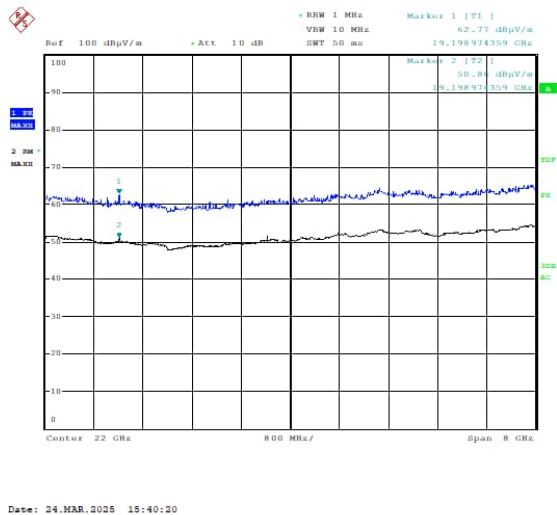
 Ref: 75 dBµV/m, Att: 10 dB, RBW: 1 MHz, VBW: 3 MHz, SMT: 20 ms, Marker 1 [T1]: 61.50 dBµV/m, 7.43987692 GHz Center: 7.44 GHz, 1 MHz, Span: 10 MHz Date: 24.MAR.2025 11:25:11	 Ref: 75 dBµV/m, Att: 10 dB, RBW: 1 MHz, VBW: 3 MHz, SMT: 20 ms, Marker 1 [T1]: 60.28 dBµV/m, 7.448368598 GHz Center: 7.44 GHz, 1 MHz, Span: 10 MHz Date: 24.MAR.2025 11:23:45
Radiated Emissions 7440 MHz, 2480 MHz, 1M, HP	Radiated Emissions 7440 MHz, 2480 MHz, 1M, VP
 Ref: 75 dBµV/m, Att: 10 dB, RBW: 1 MHz, VBW: 3 MHz, SMT: 20 ms, Marker 1 [T1]: 60.10 dBµV/m, 12.398525641 GHz Center: 12.4 GHz, 1 MHz, Span: 10 MHz Date: 24.MAR.2025 11:08:33	 Ref: 75 dBµV/m, Att: 10 dB, RBW: 1 MHz, VBW: 3 MHz, SMT: 20 ms, Marker 1 [T1]: 61.49 dBµV/m, 12.400689153 GHz Center: 12.4 GHz, 1 MHz, Span: 10 MHz Date: 24.MAR.2025 11:06:48
Radiated Emissions 12400 MHz, 2480 MHz, 1M, HP	Radiated Emissions 12400 MHz, 2480 MHz, 1M, VP

The measurements 18-26 GHz were performed at 1 meter distance with the device oriented in three orientations – lying flat “flat”, standing with its longest length horizontal “hor” and standing with its longest length vertical “vert”.



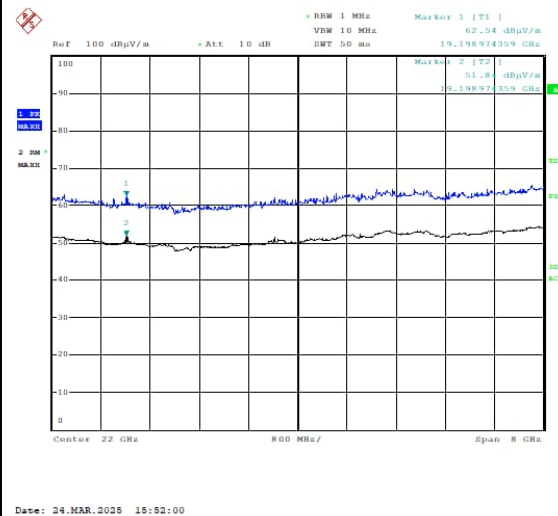
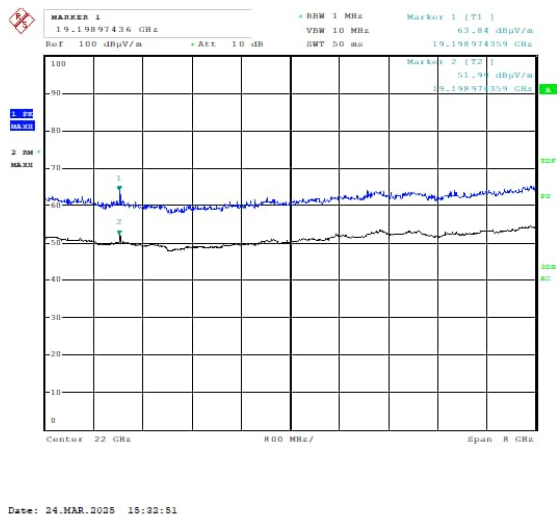
Radiated Emissions 18 - 26 GHz, flat 2402 MHz, 1M, HP

Radiated Emissions 18 - 26 GHz, flat 2402 MHz, 2M, VP



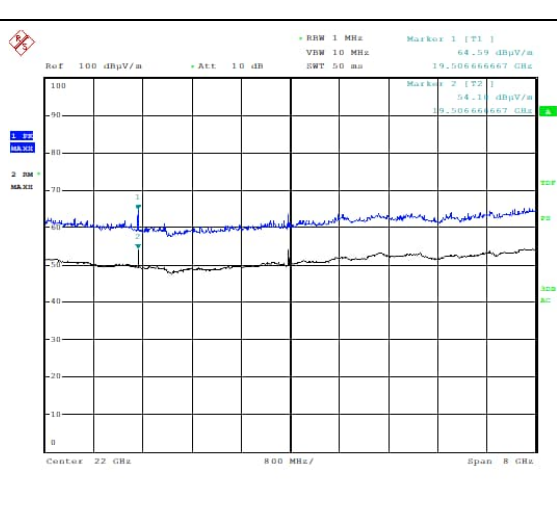
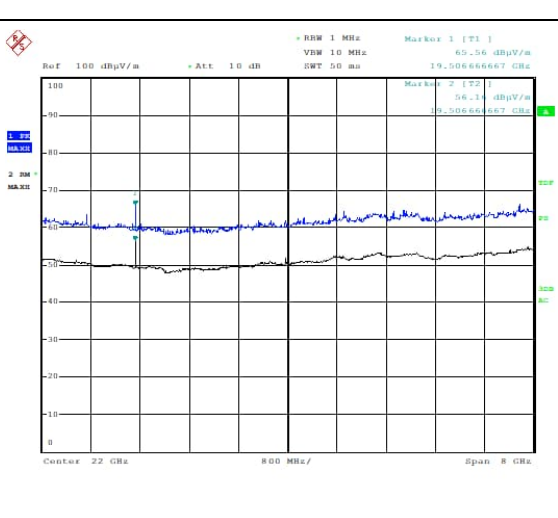
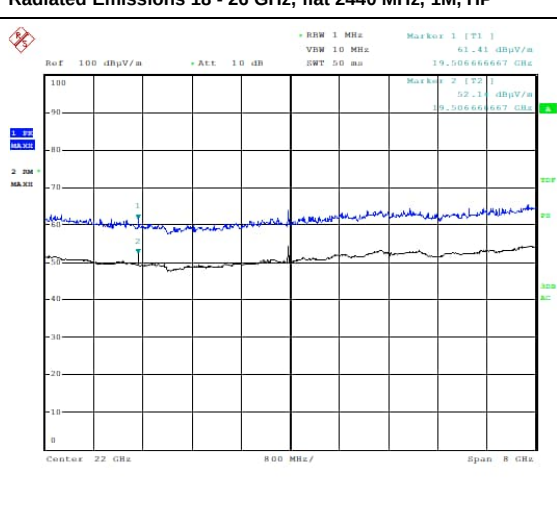
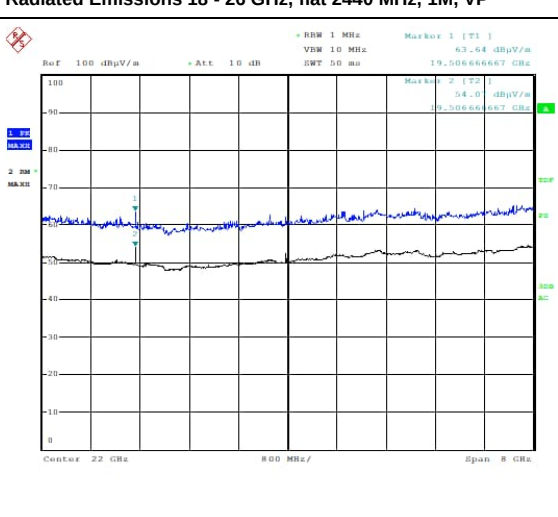
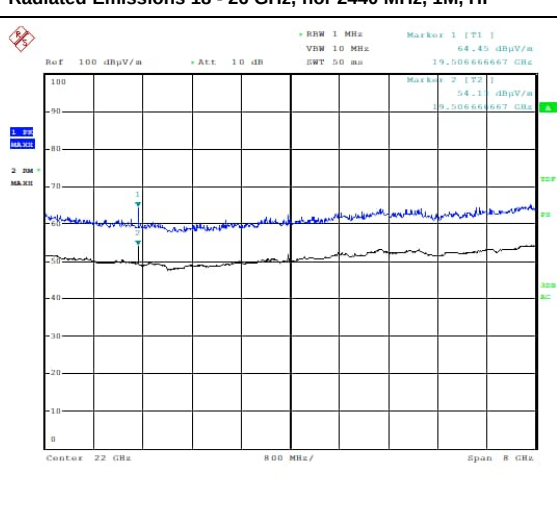
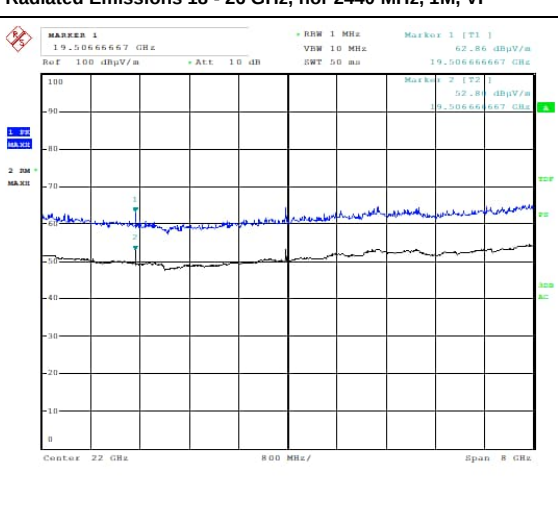
Radiated Emissions 18 - 26 GHz, hor 2402 MHz, 1M, HP

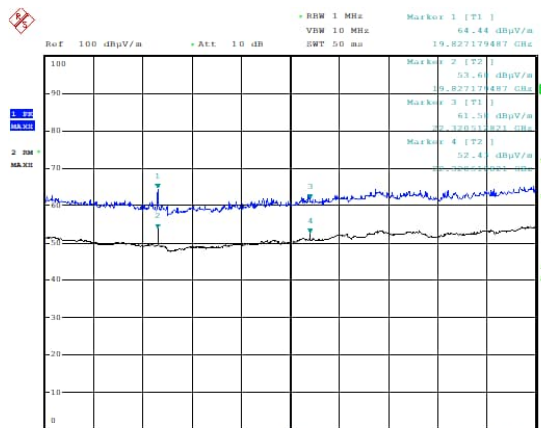
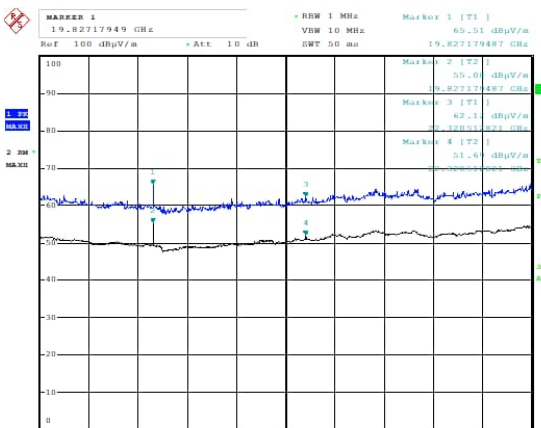
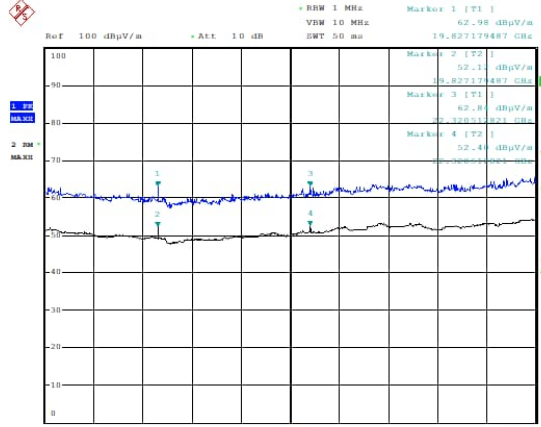
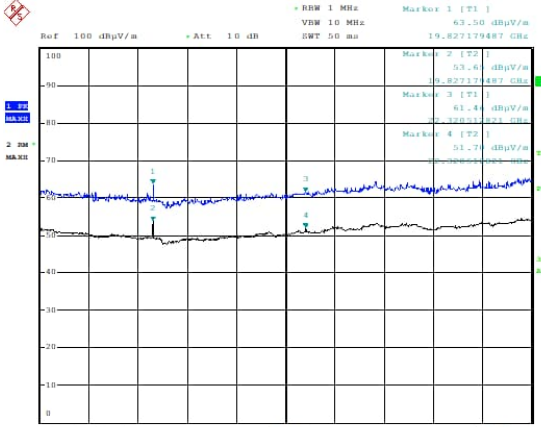
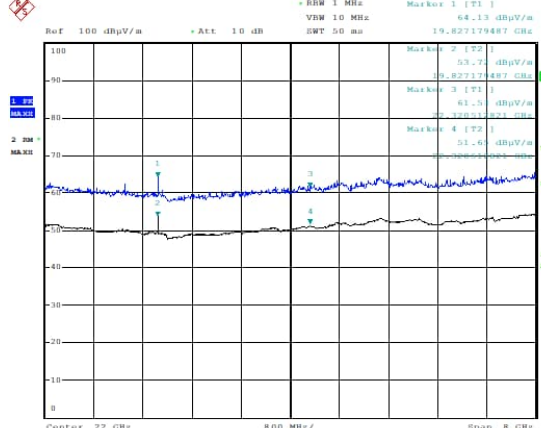
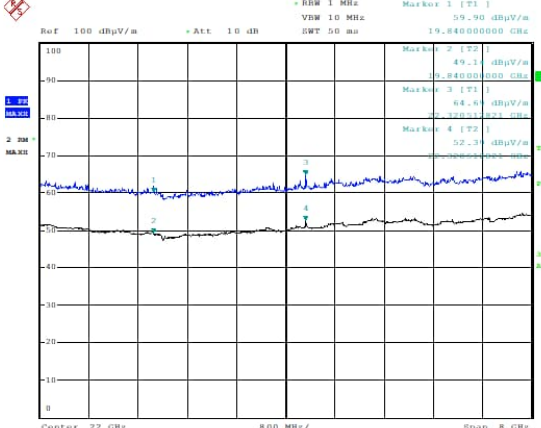
Radiated Emissions 18 - 26 GHz, hor 2402 MHz, 2M, VP



Radiated Emissions 18 - 26 GHz, vert 2402 MHz, 1M, HP

Radiated Emissions 18 - 26 GHz, vert 2402 MHz, 2M, VP

 Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 64.59 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 54.19 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:23:09	 Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 65.56 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 54.14 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:14:41
Radiated Emissions 18 - 26 GHz, flat 2440 MHz, 1M, HP  Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 61.41 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 52.19 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:20:17	Radiated Emissions 18 - 26 GHz, flat 2440 MHz, 1M, VP  Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 63.64 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 54.07 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:17:02
Radiated Emissions 18 - 26 GHz, hor 2440 MHz, 1M, HP  Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 64.45 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 54.19 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:25:26	Radiated Emissions 18 - 26 GHz, hor 2440 MHz, 1M, VP  MARKER 1 19.50666667 GHz Ref 100 dBuV/m + Att 10 dB RBW 1 MHz Marker 1 [T1] VSW 10 MHz 62.86 dBuV/m SWT 50 ms 19.50666667 GHz Marker 2 [T2] 52.84 dBuV/m 19.50666667 GHz Center 22 GHz 800 MHz/ Span 8 GHz Date: 24.MAR.2025 16:10:08
Radiated Emissions 18 - 26 GHz, vert 2440 MHz, 1M, HP	Radiated Emissions 18 - 26 GHz, vert 2440 MHz, 1M, VP

 Date: 24.MAR.2025 15:24:06	 Date: 24.MAR.2025 15:16:01
Radiated Emissions 18 - 26 GHz, flat 2480 MHz, 1M, HP  Date: 24.MAR.2025 15:21:20	Radiated Emissions 18 - 26 GHz, flat 2480 MHz, 1M, VP  Date: 24.MAR.2025 15:18:42
Radiated Emissions 18 - 26 GHz, hor 2480 MHz, 1M, HP  Date: 24.MAR.2025 15:26:30	Radiated Emissions 18 - 26 GHz, hor 2480 MHz, 1M, VP  Date: 24.MAR.2025 15:10:29
Radiated Emissions 18 - 26 GHz, vert 2480 MHz, 1M, HP	Radiated Emissions 18 - 26 GHz, vert 2480 MHz, 1M, VP

3.10 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 4, Clause 6.3.1

Measurement procedure: ANSI C63.10-2020 Clause 11.10

Test Results: Complies

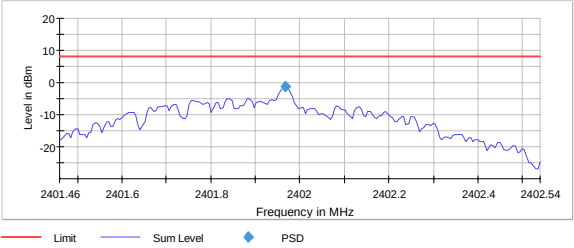
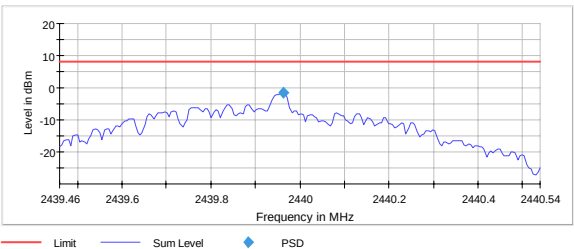
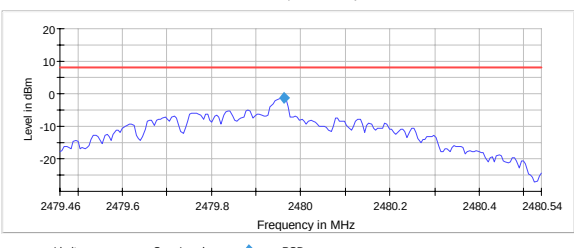
Measurement Data:

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

Modulation Type and Bitrate	Measured Power Spectral Density (dBm/3kHz)		
	2402 MHz	2440 MHz	2480 MHz
GFSK 1Mb (RBW 10kHz)	-1.3	-1.7	-1.3
GFSK 1Mb (RBW 3kHz)	-6.5	-6.9	-6.5
GFSK 2Mb	/	/	/

The second row shows the measured values (RBW 10 kHz) decreased with a factor of $10 \cdot \log(10/3)$ dB [6.53 dB].

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.

Peak Power Spectral Density  — Limit — Sum Level ◆ PSD	
PSD, 2402 MHz, 1Mb	
Peak Power Spectral Density  — Limit — Sum Level ◆ PSD	
PSD, 2440 MHz, 1Mb	
Peak Power Spectral Density  — Limit — Sum Level ◆ PSD	
PSD, 2480 MHz, 1Mb	

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 testhouse.

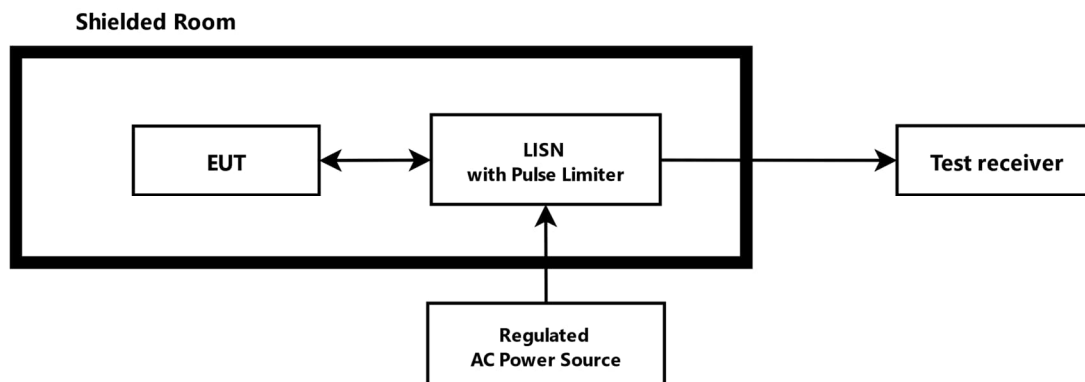
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2025-02	2026-02
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2025-01	2026-01
3	6810.17B	Attenuator	Suhner	LR 1669	COU	
4	NO324415	Band Reject Filter (2.4 GHz)	Microwave Circuits	LR 1760	COU	
5	JB3	BiLog Antenna	Sunol	N-4525	2023-04	2026-04
6	310	Preamplifier	Sonoma Inst.	LR 1686	2024-09	2025-09
7	3115	Horn Antenna	EMCO	LR 1330	2022-11	2027-11
8	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2024-09	2025-09
9	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2024-09	2025-09
10	WLK5-1100-1485-7000-40SS	Low Pass Filter (1 GHz)	Wainwright Inst.	LR 1761	COU	
11	638	Antenna Horn	Narda	LR 1480	N/A	
12	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

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

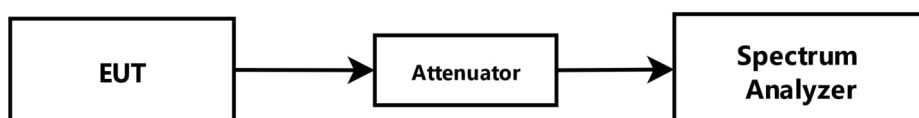
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Nemko	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission

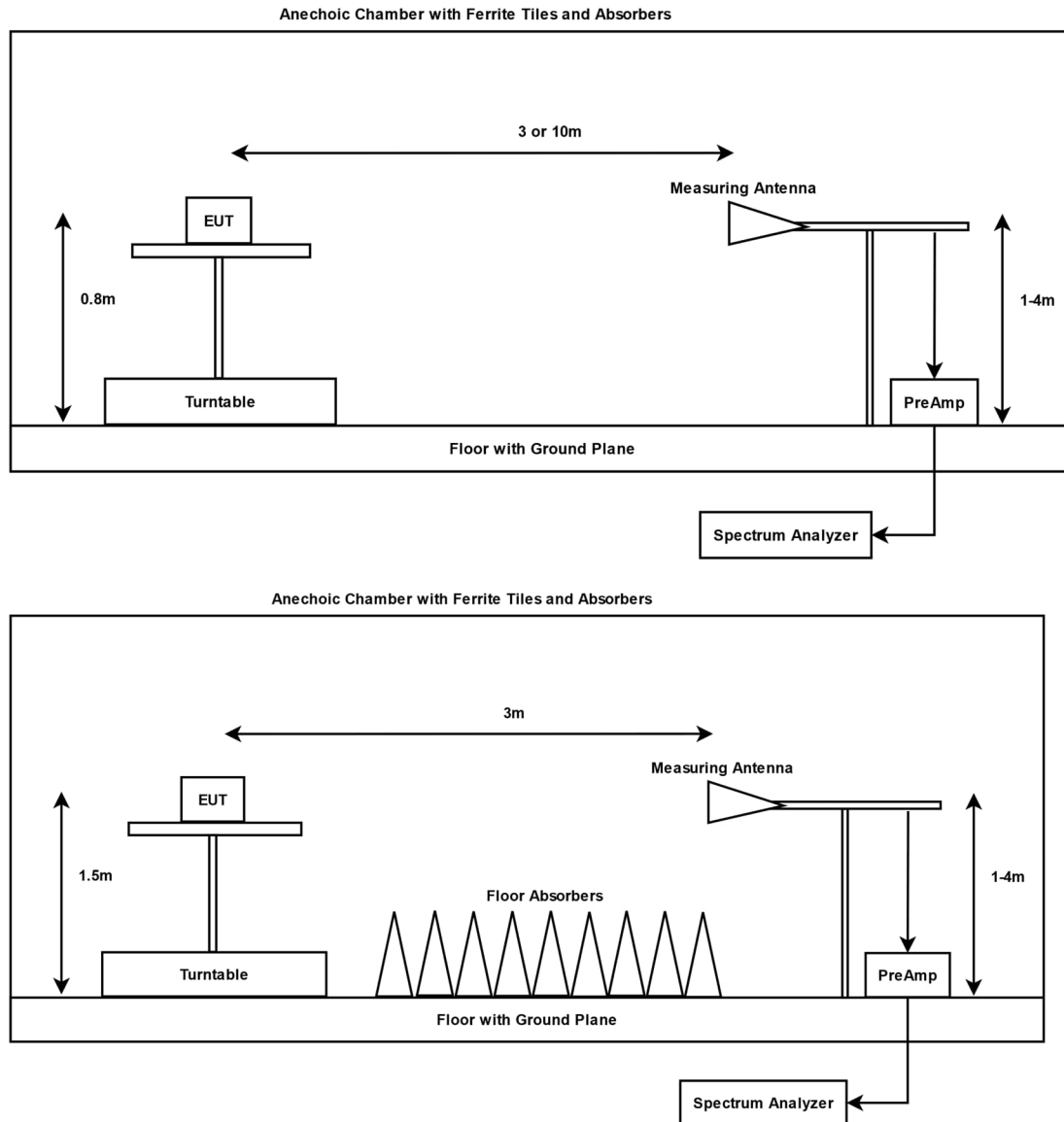


6.2 Conducted Tests



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

6.3 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. Measuring distance is 3m. 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. A Band-Stop filter is used for all measurements from 1 to 18 GHz and a Low-Pass filter is used below 1 GHz.