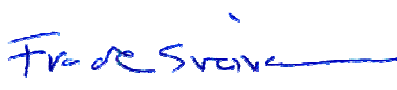


Test Report

Product	Hearing Protection with Bluetooth Low Energy
Name and address of the applicant	Swedsafe AB Nordanväg 7 282 35 Tyninge, Sweden
Name and address of the manufacturer	Swedsafe AB Nordanväg 7 282 35 Tyninge, Sweden
Model	Swedfit
Rating	3V _{DC} (2x AA cells)
Trademark	Swedsafe
Serial number	See page 3
Additional information	Bluetooth Low Energy
Tested according to	FCC Part 15.247 Digital Transmission Systems Industry Canada RSS-247, Issue 2 Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	449455
Tested in period	2021-11-18 to 2022-01-19
Issue date	2022-07-13
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470   An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Frode Sveinsen]  Approved by [G.Suhantakumar]	
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Revision history

Revision	Date	Comment	Sign
00	2022-01-19	First edition	FS



THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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1 INFORMATION

1.1 Test Item

Name	Swedsafe
Model/version	Swedfit
FCC ID	2A4BRSWEDFIT
ISED ID	28161-SWEDFIT
Serial number	Radiated sample: TEST2 Conducted Sample: TEST3
Hardware identity and/or version	0.1
Software identity and/or version	1.0a
Frequency Range	2402 – 2480 MHz
Number of Channels	40
Operating Modes	Bluetooth Low Energy, 1 Mbit
Type of Modulation	GFSK
Conducted Output Power	0.75 mW
Antenna Connector	None
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Primary Batteries (2x AA cells)
Desktop Charger	None

Description of Test Item

The EUT is a hearing protection with Bluetooth Low Energy. A head strap with a sensor connected to the forehead is an optional accessory. The EUT contains a Nordic nrf52840 BLE chip that is used only for configuration purposes.

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.

The EUT was powered from fresh batteries during all tests.

1.3 Test Engineer(s)

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 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	The EUT was programmed from a UART interface.
Additional information	All tests were performed with the EUT transmitting continuously with ~50% duty cycle Output Power: 0dBm (Maximum) Bit rate: 1 Mbit (only supported mode) Modulation: GFSK

1.6 Comments

All ports were populated during spurious emission measurements.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and ISSED RSS-247 Issue 2 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 ISSED.

☒ 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 2, 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	N/A
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)	5.5 (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:

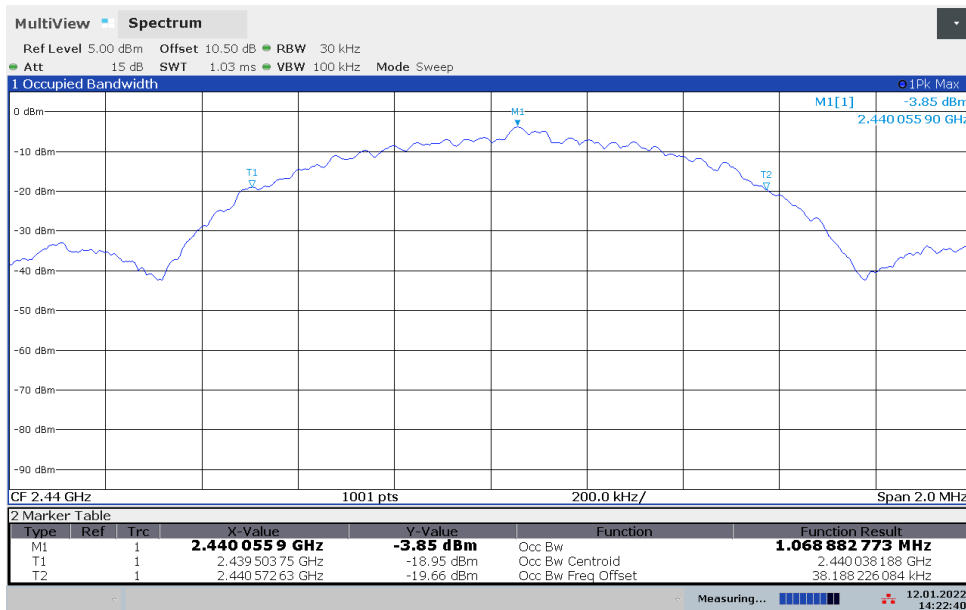
Carrier Frequency, Modulation and Data Rate	Occupied Bandwidth (99% BW)
2440 MHz, 1Mb	1069 kHz

Occupied Bandwidth is the same for all channels

See attached plots

Requirements:

No requirements for Digital Transmission Systems.



99% Occupied BW, 2440 MHz, 1Mbit

3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

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

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

Measurement Data:

Modulation and Bitrate	Measured DTS Bandwidth (kHz)		
	2402 MHz	2440 MHz	2480 MHz
GFSK 1Mb	709	723	707

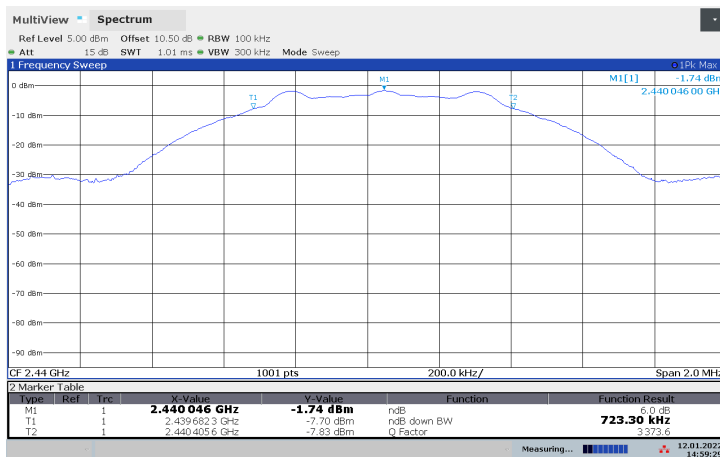
Power supply variation within 85 % to 115% of nominal value has no influence on measured value.

Requirements:

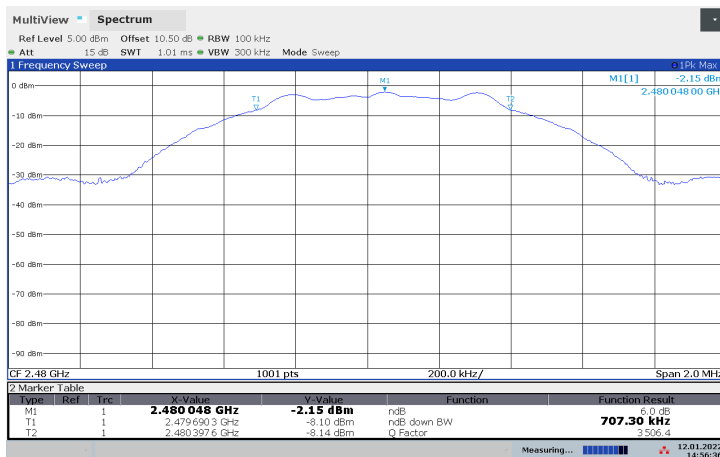
For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.



DTS BW, 2402 MHz, GFSK 1Mb



DTS BW, 2440 MHz, GFSK 1Mb



DTS BW, 2480 MHz, GFSK 1Mb

3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

Carrier Frequency	Peak Conducted Power, dBm	Peak EIRP, dBm	Antenna Gain, dBi
2402 MHz	-1.27	-15.7	-14.4
2440 MHz	-1.53	-14.7	-13.1
2480 MHz	-1.98	-14.6	-12.6

Output Power reported is Maximum Peak Power.

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

Antenna Gain is less than 6 dBi.

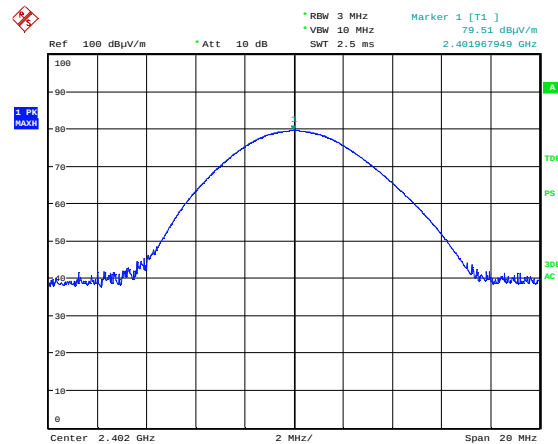
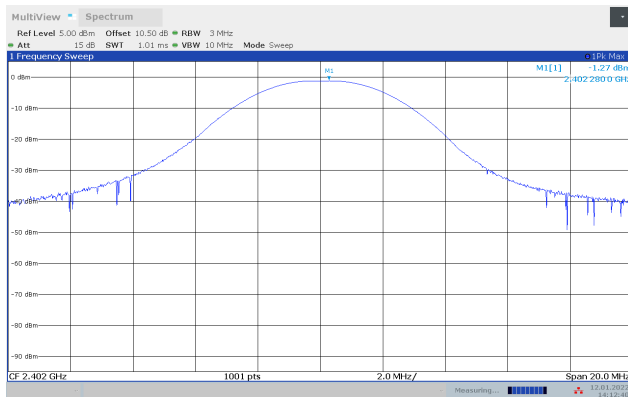
See attached plots.

Requirements:

The maximum peak output power shall not exceed the following limits:

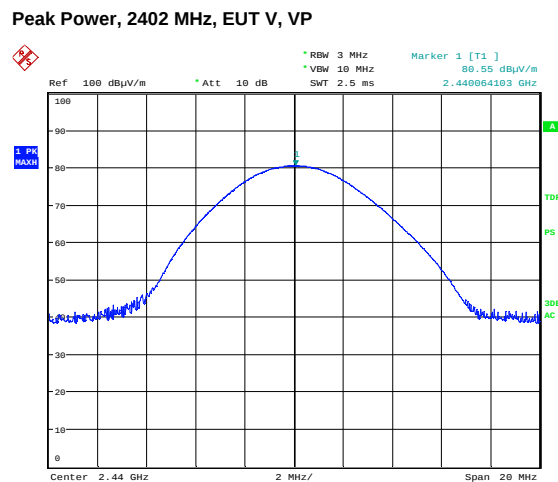
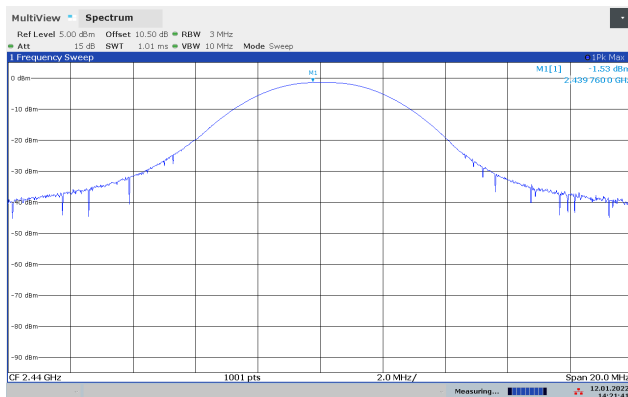
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

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.



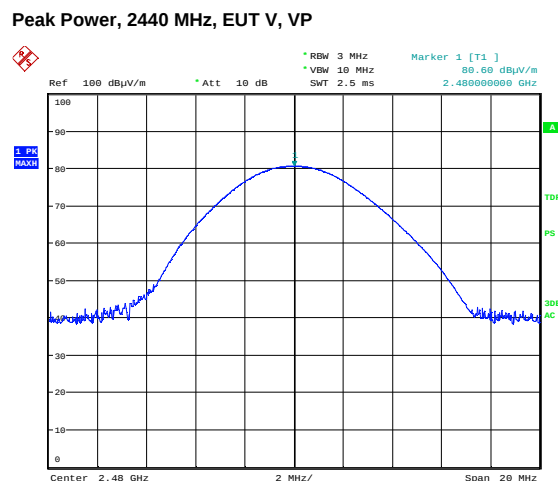
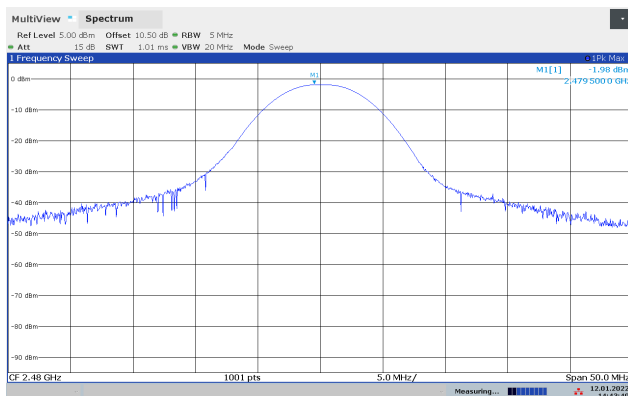
Date: 18.NOV.2021 11:15:23

Peak Power, 2402 MHz



Date: 18.NOV.2021 11:06:00

Peak Power, 2440 MHz



Date: 18.NOV.2021 10:23:26

Peak Power, 2480 MHz

Peak Power, 2480 MHz, EUT H, HP

3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	>50	>30	Pass
2440 MHz	>50	>30	Pass
2480 MHz	>50	>30	Pass

Measured with Peak Detector

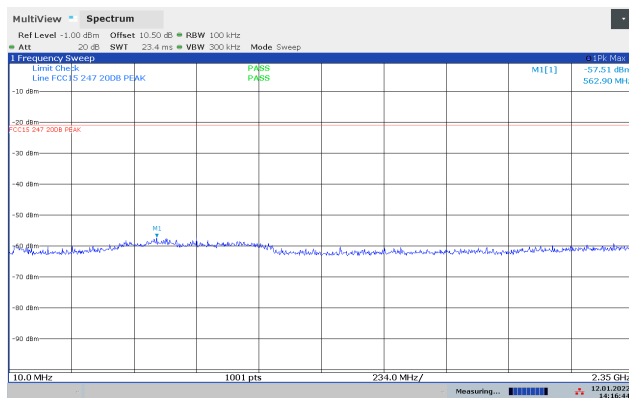
RF conducted power to 26 GHz: see attached plots.

Limit

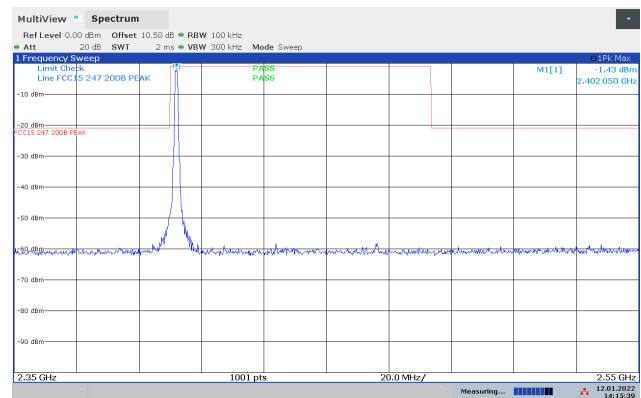
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

Detector type shall be the same as used for measuring Output Power.

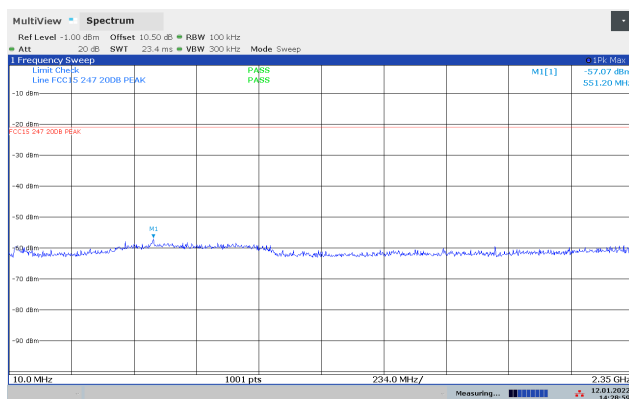
Attenuation below the general limits specified in part 15.209(a) is not required.



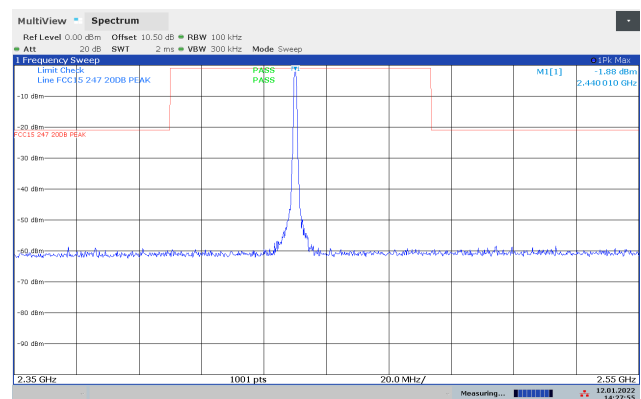
Conducted Emissions 10-2350 MHz, 2402 MHz



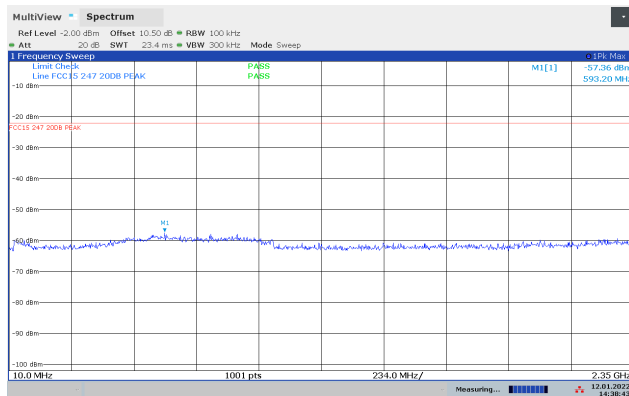
Conducted Emissions 2350-2550 MHz, 2402 MHz



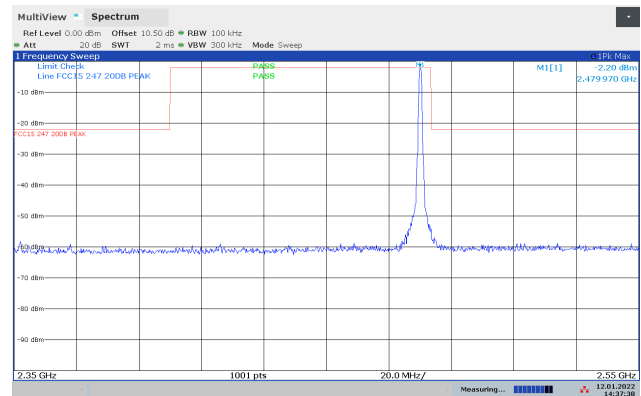
Conducted Emissions 10-2350 MHz, 2440 MHz



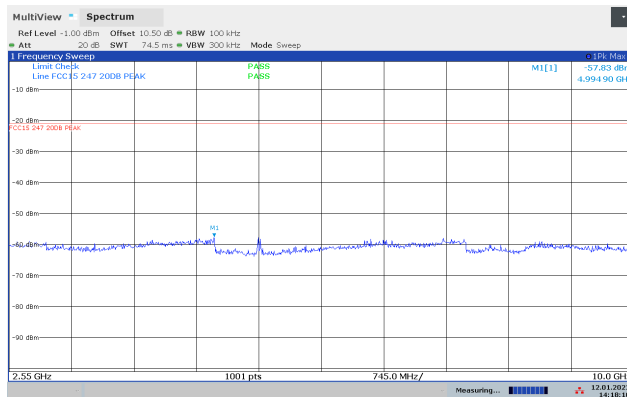
Conducted Emissions 2350-2550 MHz, 2440 MHz



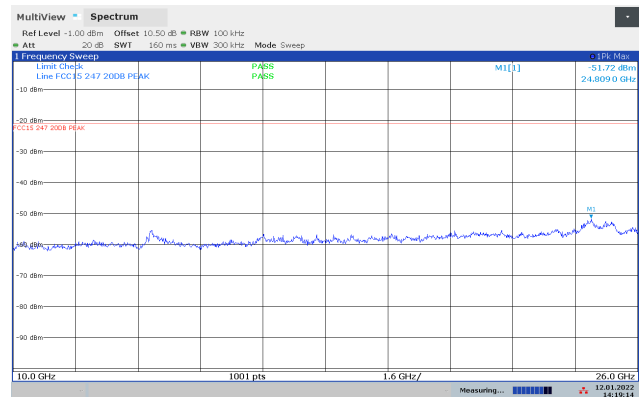
Conducted Emissions 10-2350 MHz, 2480 MHz



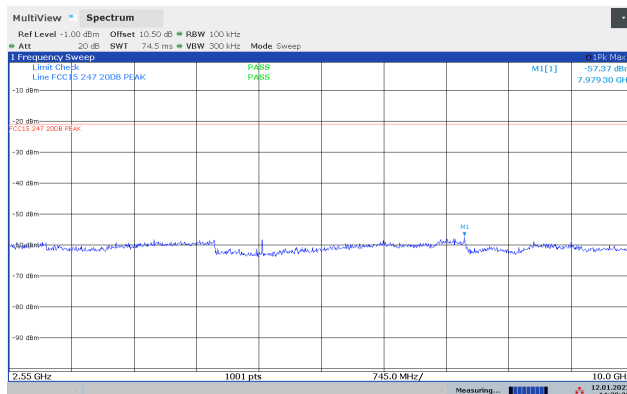
Conducted Emissions 2350-2550 MHz, 2480 MHz



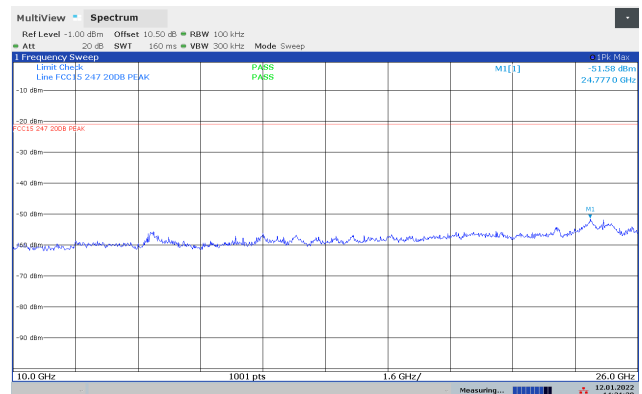
Conducted Emissions 2.55-10 GHz, 2402 MHz



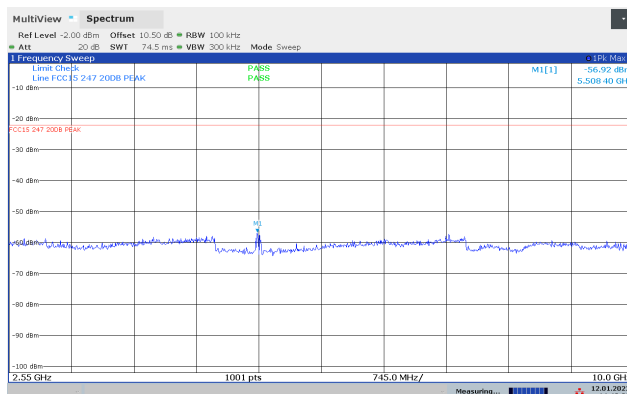
Conducted Emissions 10-26 GHz, 2402 MHz



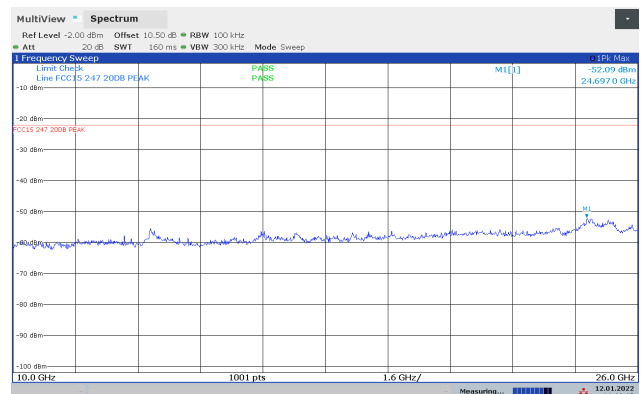
Conducted Emissions 2.55-10 GHz, 2440 MHz



Conducted Emissions 10-26 GHz, 2440 MHz



Conducted Emissions 2.55-10 GHz, 2480 MHz



Conducted Emissions 10-26 GHz, 2480 MHz

3.5 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)	ISSED (MHz)	FCC (GHz)	ISSED (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.

3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

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

Measurement procedure: ANSI C63.10-2013 Clause 11.12

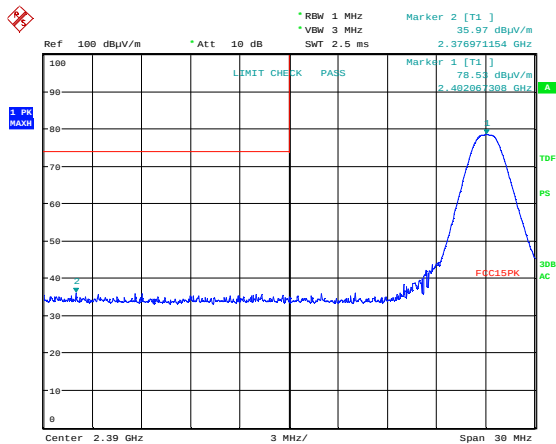
Test Results: Complies

Measurement Data:

Detector	Measured field strength (dB μ V/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
Peak	36.0	41.6	74	38.0	32.4
Average	/	/	54	/	/

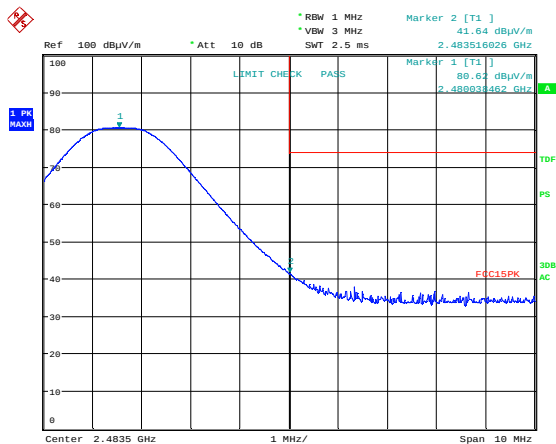
Peak values are below Average Limit.

See attached plots.



Date: 18. NOV. 2021 10:32:33

Lower Band Edge, 2402 MHz, EUT H, HP, Peak



Date: 18. NOV. 2021 10:24:25

Upper Band Edge, 2480 MHz, EUT H, HP, Peak

3.7 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: Quasi-Peak

Measuring distance 3m

Tested in with BLE active on 2440 MHz

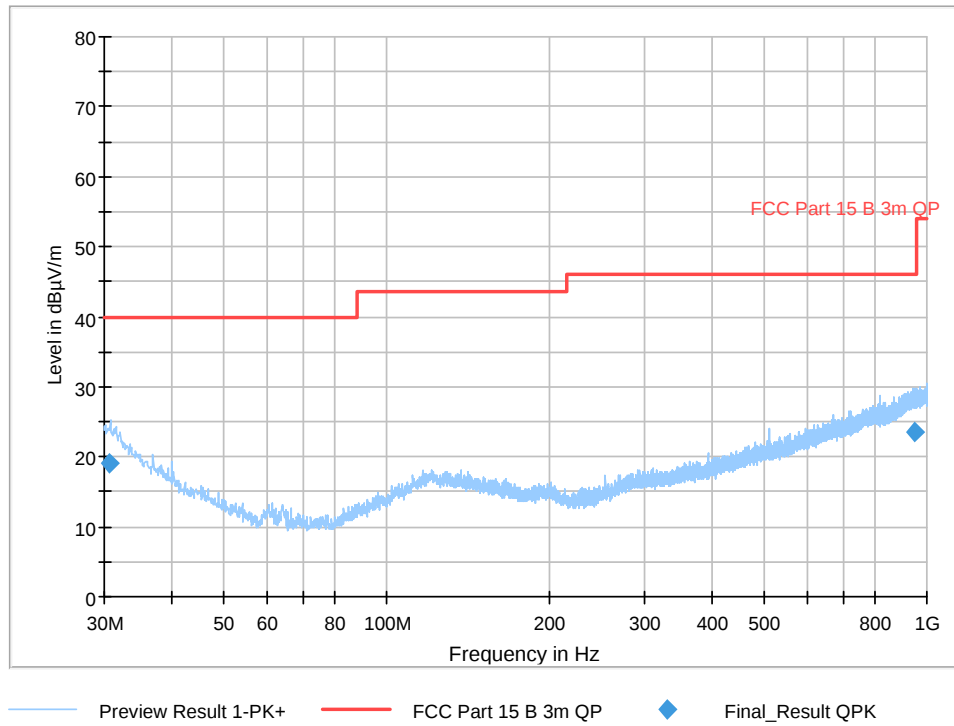
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.784350	19.18	40.00	20.82	1000.0	120.000	140.0	V	325.0
951.303800	23.45	46.00	22.55	1000.0	120.000	324.0	H	0.0

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	

Full Spectrum



Radiated Emissions 30 - 1000 MHz, 2440 MHz

3.8 Radiated Emissions, 1 – 26 GHz

FCC Part 15.209 (a)

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

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector, RBW=1 MHz

Carrier Frequency (MHz)	Measured Frequency (GHz)	Measured Emission (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
		Peak	Average	Pk	Av	Pk	Av
2402	7206	55.5	48.7	74	54	18.5	5.3
2440	7320	57.9	50.8	74	54	16.1	3.2
2480	7440	57.9	50.9	74	54	16.1	3.1
Any	Any	< 56	< 46	74	54	>18	>8

Average values have been corrected 6.0 dB for Duty Cycle.

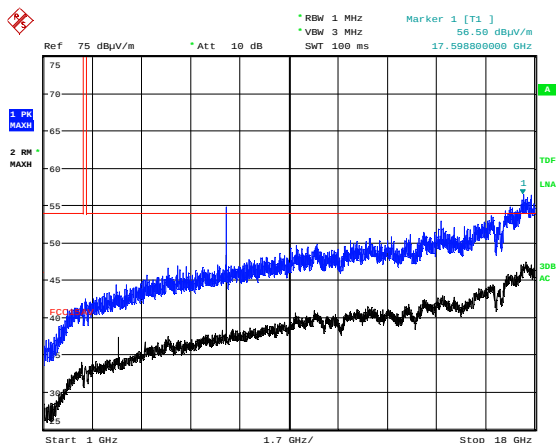
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

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

See plots.

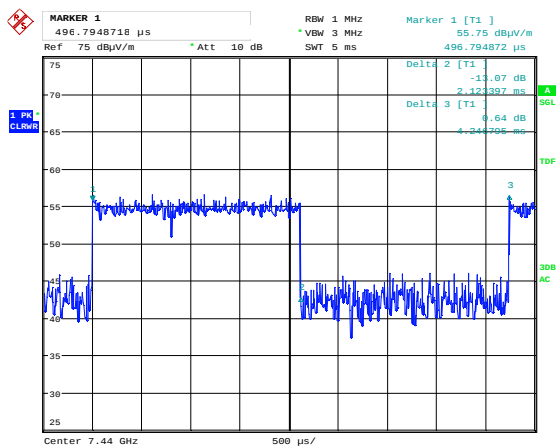
Requirements/Limit

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 dB μ V/m	74.0 dB μ V/m



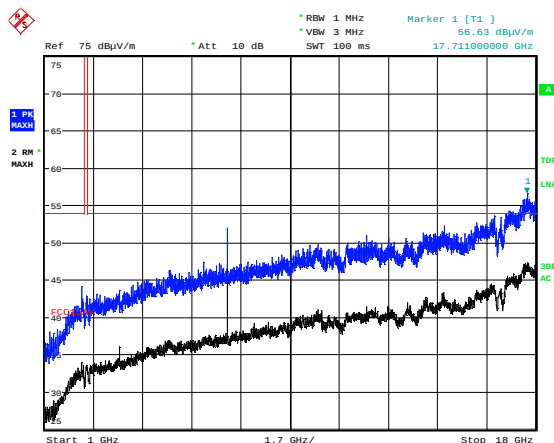
Date: 18.NOV.2021 12:13:57

Radiated Emissions 1 - 18 GHz, 2440 MHz, HP



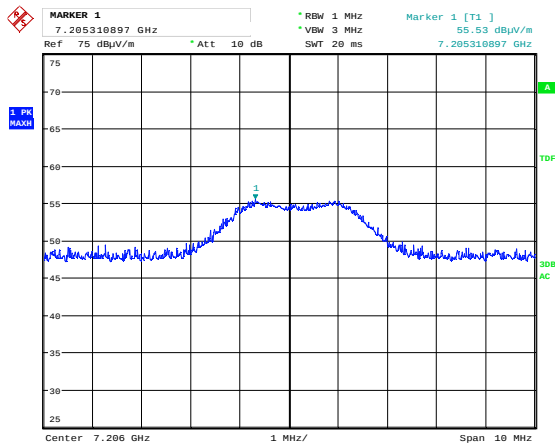
Date: 18.NOV.2021 12:44:20

Duty Cycle, 50%



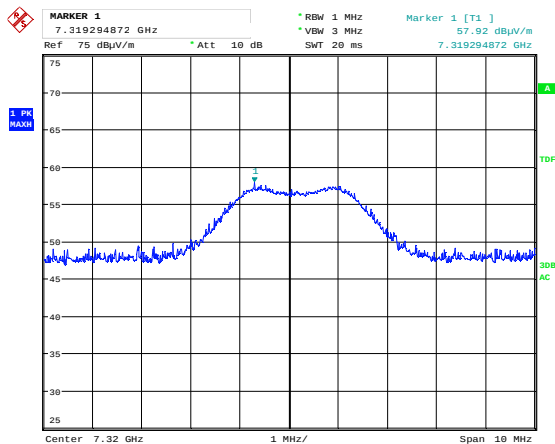
Date: 18.NOV.2021 12:16:05

Radiated Emissions 1 - 18 GHz, 2440 MHz, VP



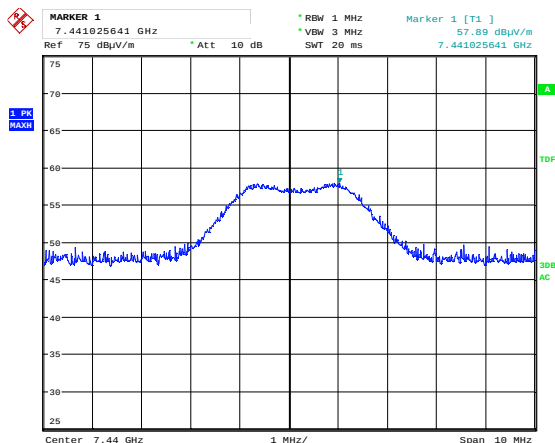
Date: 18.NOV.2021 12:58:11

Radiated Emissions 7206 MHz, 2402 MHz, Pk



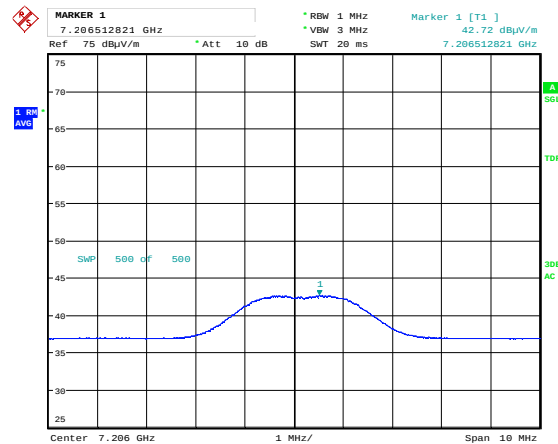
Date: 18.NOV.2021 12:38:41

Radiated Emissions 7320 MHz, 2440 MHz, Pk



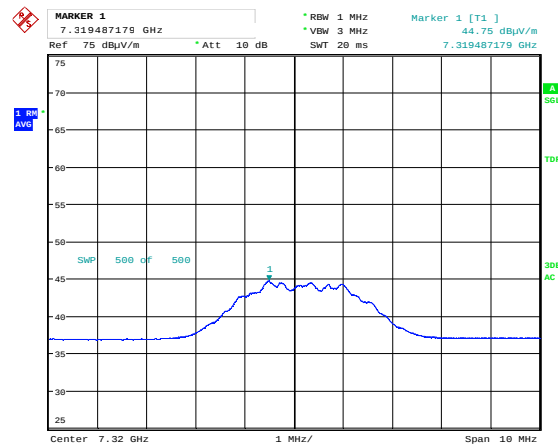
Date: 18.NOV.2021 12:41:30

Radiated Emissions 7440 MHz, 2480 MHz, Pk



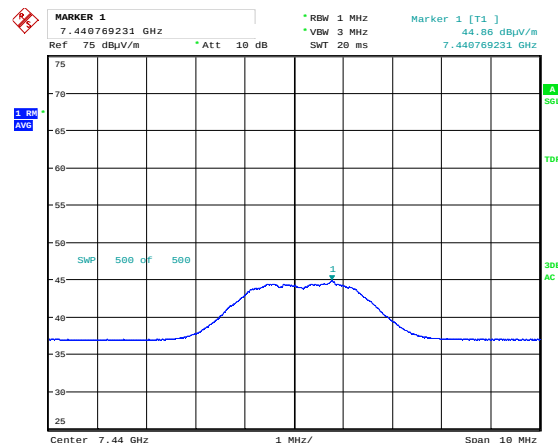
Date: 18.NOV.2021 12:51:43

Radiated Emissions 7206 MHz, 2402 MHz, Av



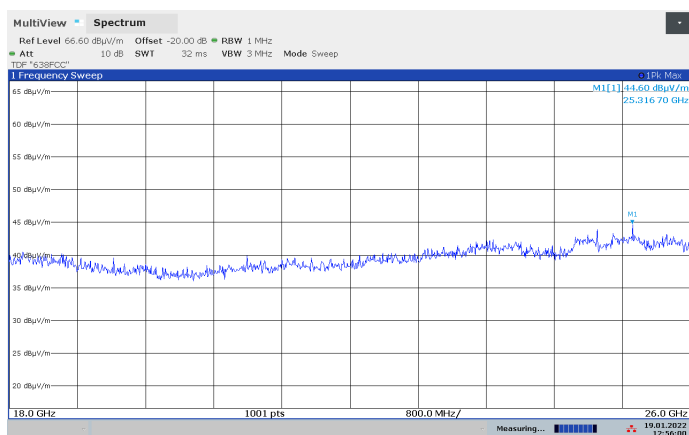
Date: 18.NOV.2021 12:37:37

Radiated Emissions 7320 MHz, 2440 MHz, Av

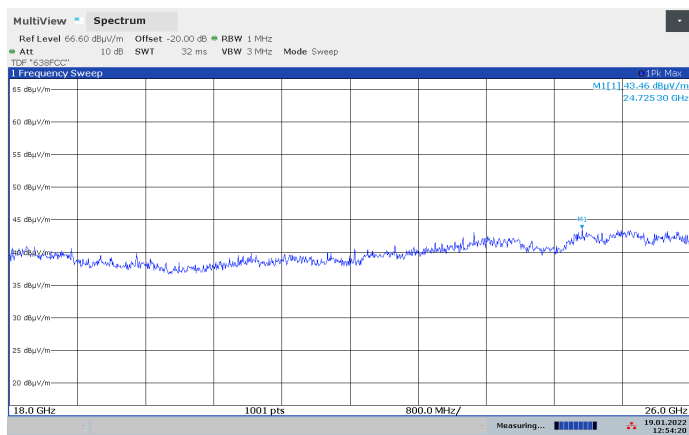


Date: 18.NOV.2021 12:42:33

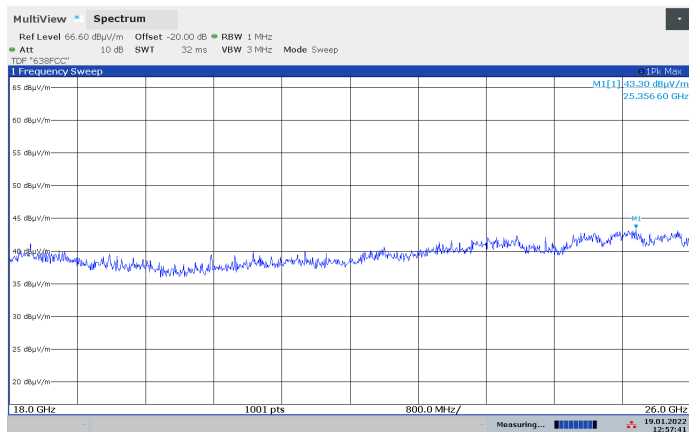
Radiated Emissions 7440 MHz, 2480 MHz, Av



Pre-scan 18 - 26 GHz, 2402 MHz



Pre-scan 18 - 26 GHz, 2440 MHz



Pre-scan 18 - 26 GHz, 2480 MHz

3.9 Power Spectral Density (PSD)

FCC part 15.247(d)

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

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

Measurement Data:

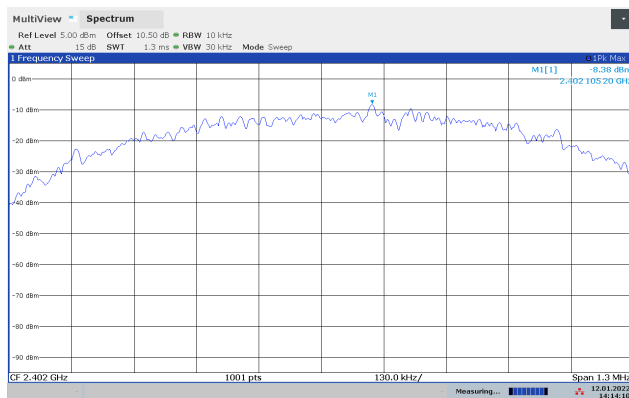
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

Carrier Frequency	Measured Power Spectral Density (dBm/3kHz)
2402 MHz	-13.6
2440 MHz	-13.8
2480 MHz	-14.5

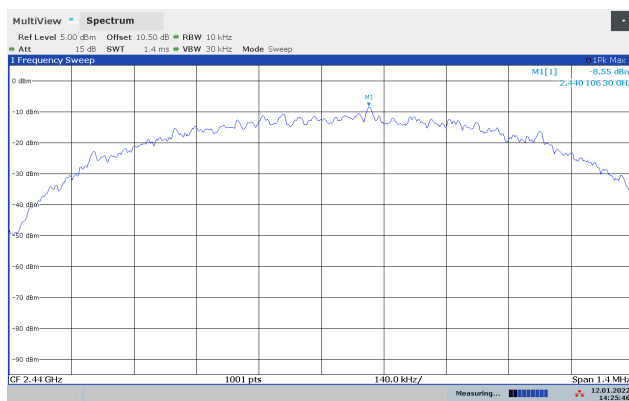
The measured values with 10kHz RBW are corrected by a Bandwidth Correction Factor of -10 dB.

Requirements:

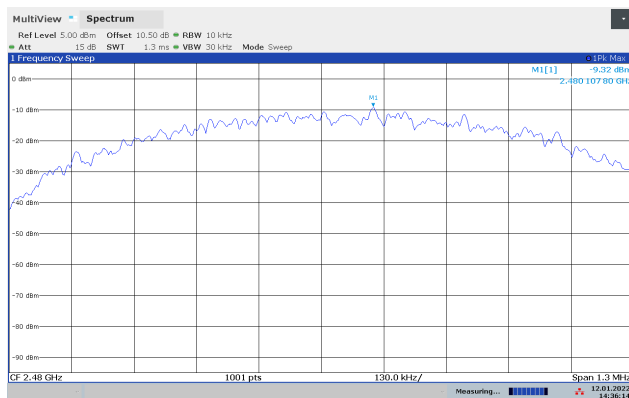
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band



PSD, 2402 MHz



PSD, 2440 MHz



PSD, 2480 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.

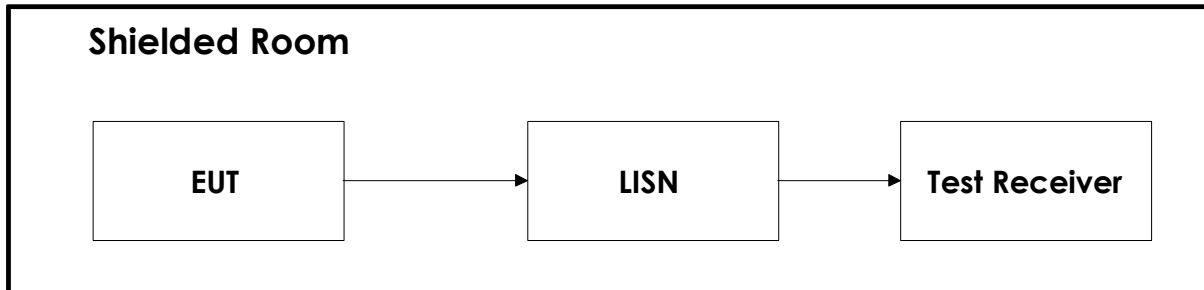
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2022-01	2023-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2021-02	2022-02
3	6810.17B	Attenuator	Suhner	LR 1669	2021-08	2022-08
4	NO324415	Band Reject Filter (2.4)	Microwave Circuits	LR 1760	COU	
5	JB3	BiLog Antenna	Sunol Sciences	N-4525	2020-03	2023-03
6	310	Preamplifier	Sonoma Inst.	LR 1686	2021-08	2022-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2021-08	2022-08
8	3115	Horn Antenna	EMCO	LR 1330	2016-10	2026-10
9	638	Antenna Horn	Narda	LR 1480	N/A	
10	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2021-08	2022-08
11	WLK5-1100-1485-7000-40SS	Low Pass Filter	Wainwright Inst.	LR 1761	COU	
12	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

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

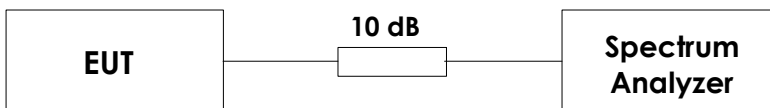
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.30.10	Radiated Emission test software
2	Nemko	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission

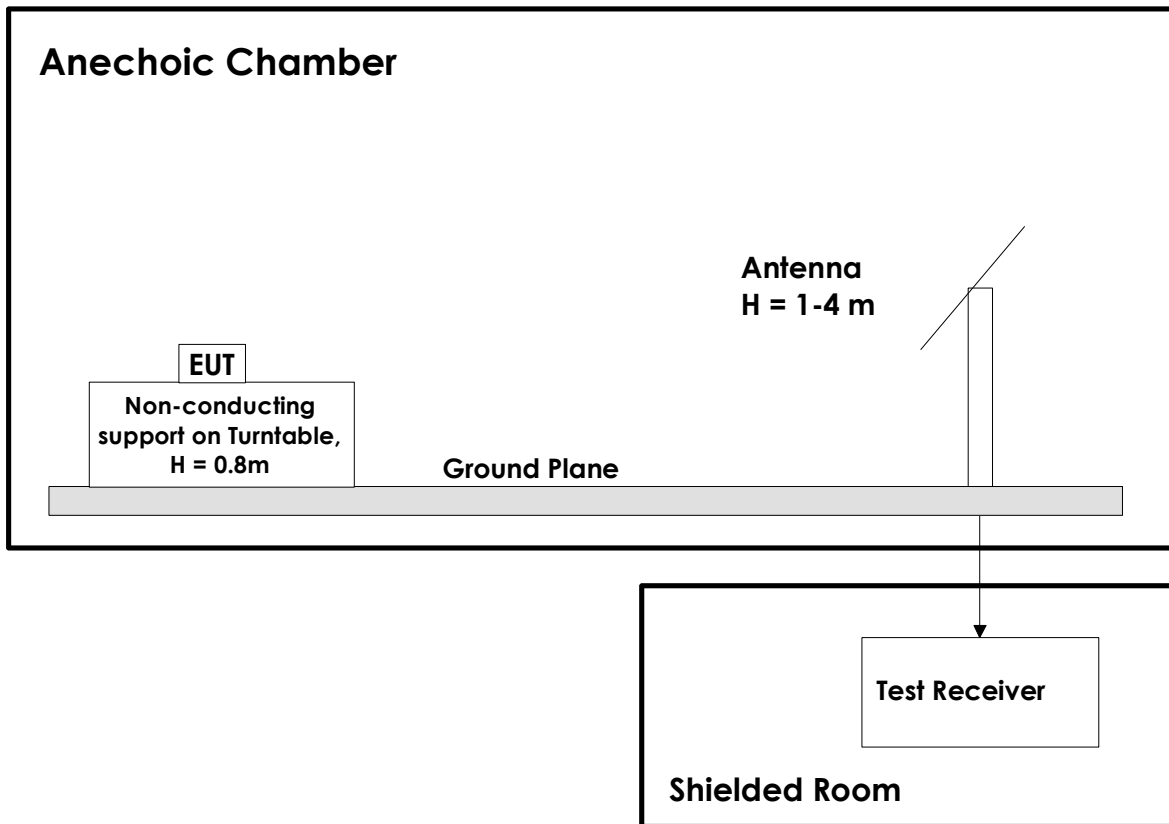


6.2 Conducted Tests



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. 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.