

Test Report

Product	Zigbee Module
Name and address of the applicant	ASSA ABLOY Global Solutions Norway AS Anolitveien 1-3, 1400 Ski, Norway
Name and address of the manufacturer	ASSA ABLOY Global Solutions Norway AS Anolitveien 1-3, 1400 Ski, Norway
Model	PCBA 1731
Rating	4.5 V _{DC}
Trademark	ASSA ABLOY
Additional information	Zigbee Module for use in door locks
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / 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	PRJ0012784
Tested in period	2023-04-19 to 2023-04-27
Issue date	2023-09-29
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 [Frode Sveinsen]  Approved by [G.Suhanthakumar]	
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Revision history

Revision	Date	Comment	Sign
A	2023-05-12	First edition	FS
B	2023-09-07	Removed Antenna Gain values	FS
C	2023-09-29	Added EIRP values and 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.

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1 INFORMATION

1.1 Test Item

Name	ASSA ABLOY
Model/version	PCBA 1731
FCC ID	Y7V-PCBA1731C1
ISED ID	9514A-PCBA1731C1
Serial number	2223 HAN 00358
Hardware identity and/or version	PCBA1731C1
Software identity and/or version	1.1
Frequency Range	2405 – 2475 MHz
Number of Channels	40
Operating Modes	Zigbee
Type of Modulation	GFSK
Conducted Output Power	0.0127 mW
Antenna Connector	U-FL
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	Primary Batteries (4.5 V _{DC} , 0.3 W)

Description of Test Item

The EUT is a Zigbee Module for use in door locks.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	4.5 V DC (Nominal battery voltage)

The values are the limit registered during the test period.

The EUT was powered from new batteries during all tests.

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 Integral Antenna		

Requirement: FCC 15.203, 15.204

1.5 EUT Operating Modes

Description of operating modes	Continuous transmission in test mode
Additional information	The EUT was programmed over a USB interface from a computer located outside the test chamber.

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 and 1m.

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	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)	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:

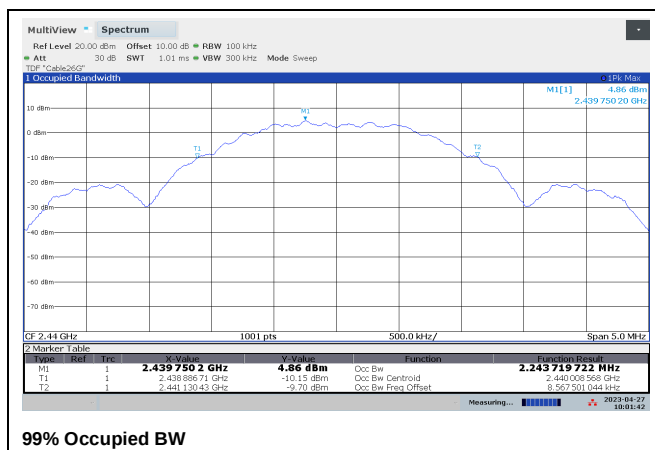
Carrier Frequency	Occupied Bandwidth (99% BW)
2440 MHz	2.24 MHz

Occupied Bandwidth is the same for all channels.

See attached plots.

Requirements:

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



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

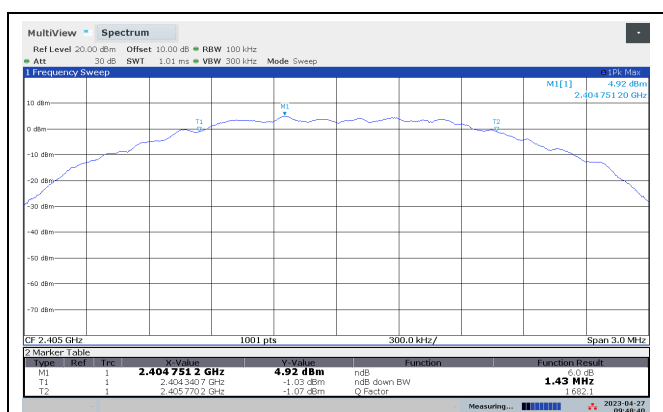
Test Results: Complies

Measurement Data:

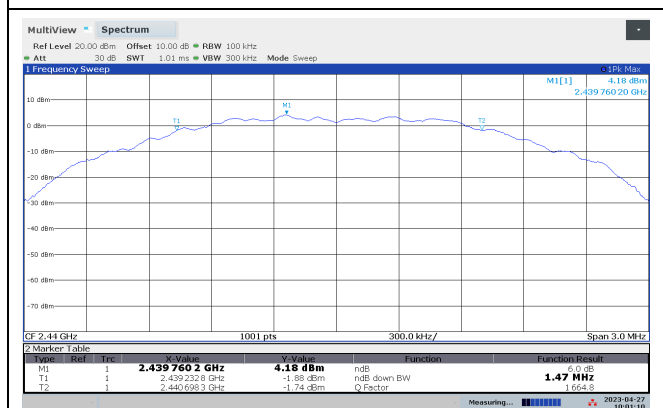
Modulation type and bitrate	Measured DTS Bandwidth		
	2402 MHz	2440 MHz	2480 MHz
GFSK	1.43 MHz	1.47 MHz	1.47 MHz

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

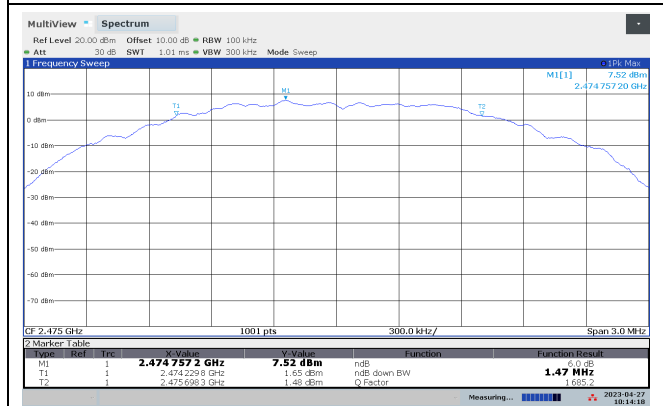
Frequency Band	Requirement for systems using Digital Modulation
902-928 MHz	The minimum 6 dB bandwidth shall be at least 500 kHz.
2400-2483.5 MHz	
5725-5850 MHz	



DTS BW, 2405 MHz



DTS BW, 2440 MHz



DTS BW, 2475 MHz

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 Conducted Power, mW	Peak EIRP, mW
2405 MHz	8.9	7.76	33.88
2440 MHz	7.5	5.62	48.98
2475 MHz	11.0	12.59	63.10

Output Power reported is Maximum Peak Power.

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

See attached plots.

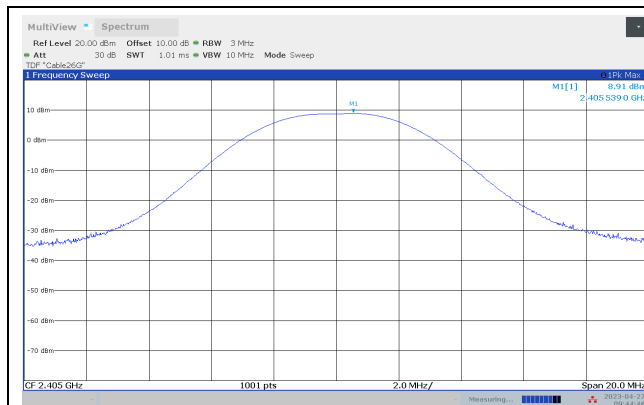
Requirements for Digital Modulation systems

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

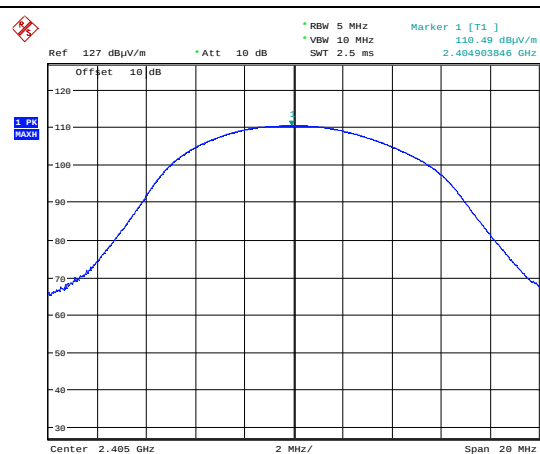
As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the 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.

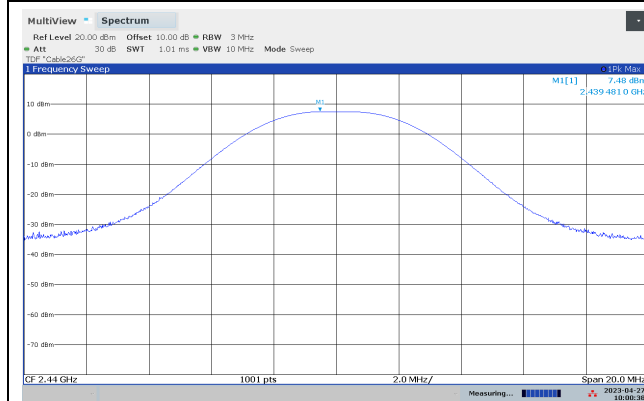


Peak Power, 2405 MHz

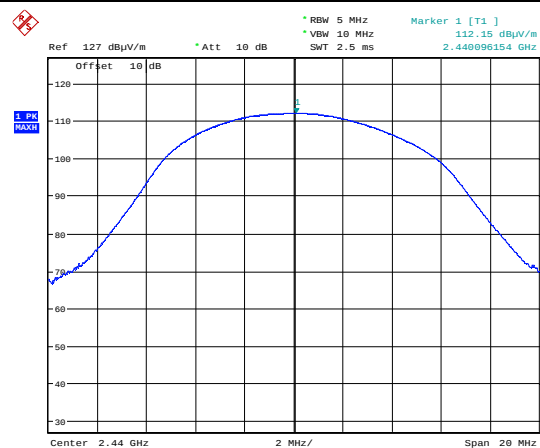


Date: 19. APR. 2023 12:15:13

Maximum Field Strength, 2405 MHz

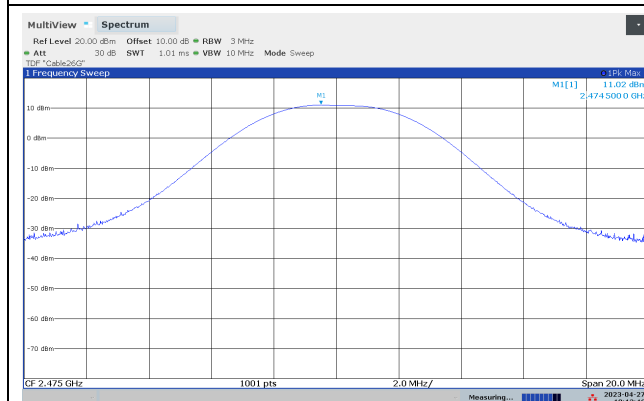


Peak Power, 2440 MHz

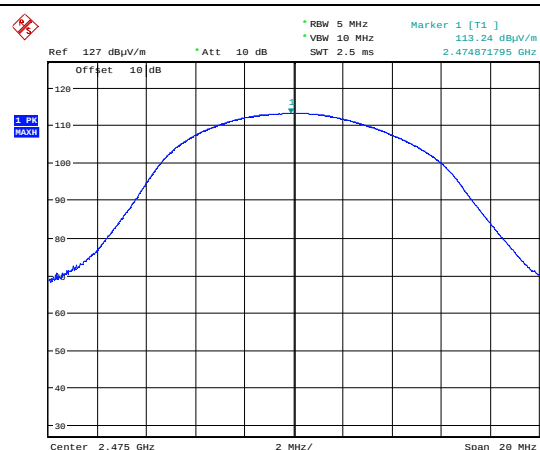


Date: 19. APR. 2023 12:08:43

Maximum Field Strength, 2440 MHz



Peak Power, 2475 MHz



Date: 19. APR. 2023 11:59:48

Maximum Field Strength, 2475 MHz

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

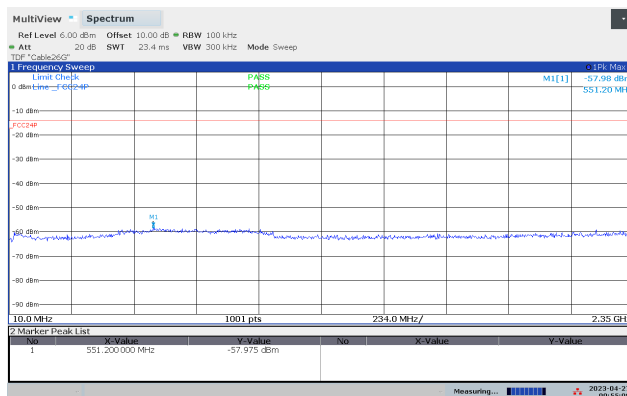
Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2405 MHz	> 40	> 20	Pass
2440 MHz	> 40	> 20	Pass
2475 MHz	> 40	> 20	Pass

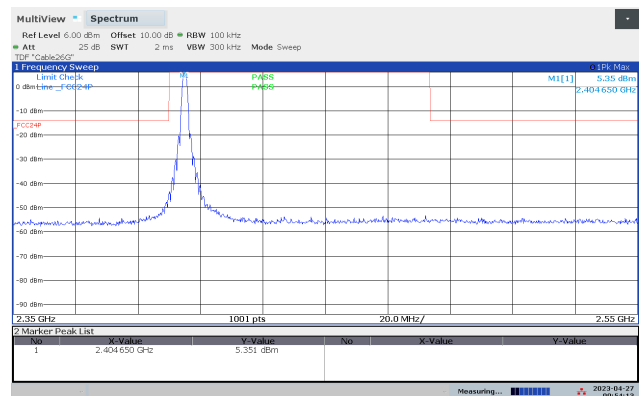
Measured with Peak Detector

RF conducted power to 25 GHz: see attached plots.

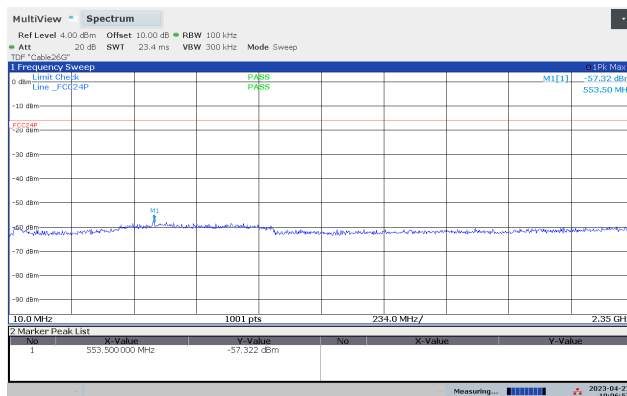
Requirements for all systems	
Peak measurement	RMS averaging (alternative measurement)
20 dB or more below carrier measured in 100 kHz bandwidth	30 dB or more below carrier measured in 100 kHz bandwidth
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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.	



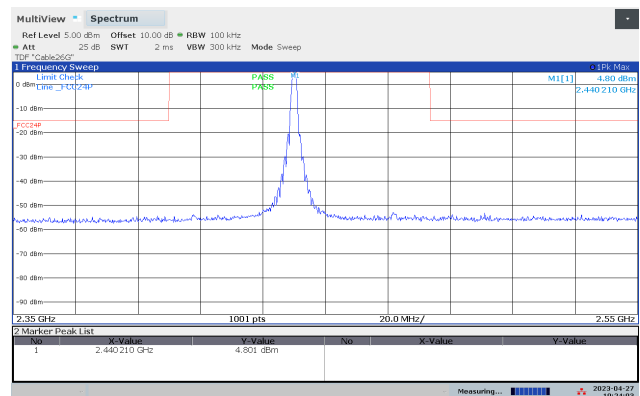
Conducted Emissions 10-2350 MHz, 2405 MHz, 1Mb



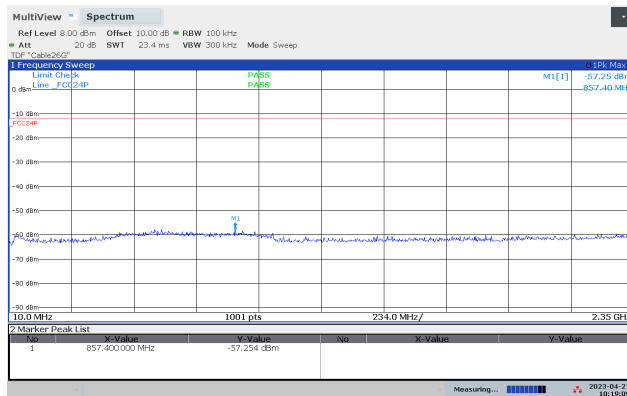
Conducted Emissions 2350-2550 MHz, 2405 MHz, 1Mb



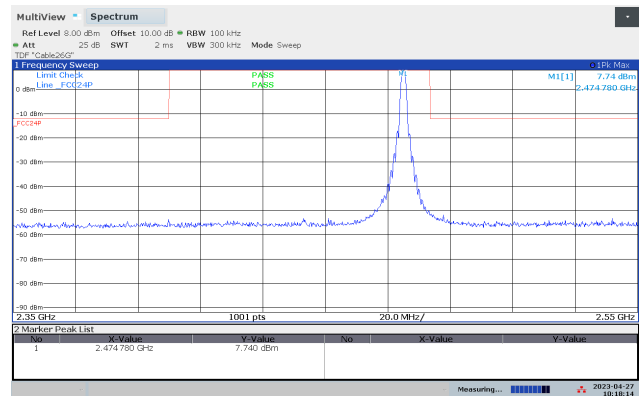
Conducted Emissions 10-2350 MHz, 2440 MHz, 1Mb



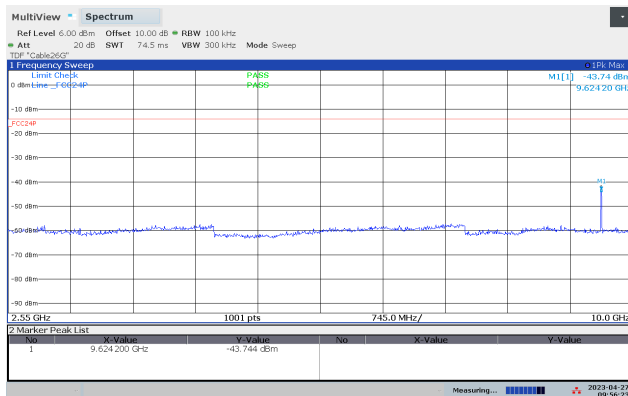
Conducted Emissions 2350-2550 MHz, 2440 MHz, 1Mb



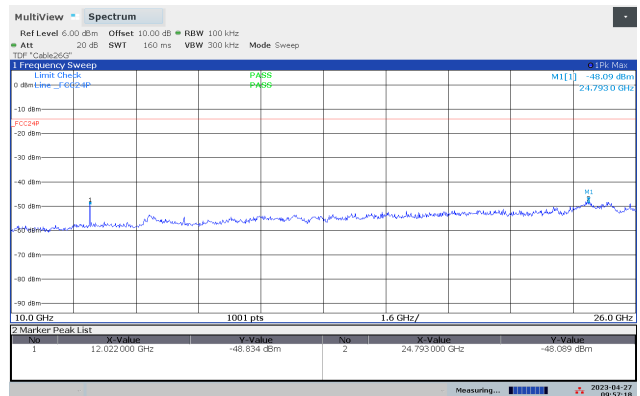
Conducted Emissions 10-2350 MHz, 2475 MHz, 1Mb



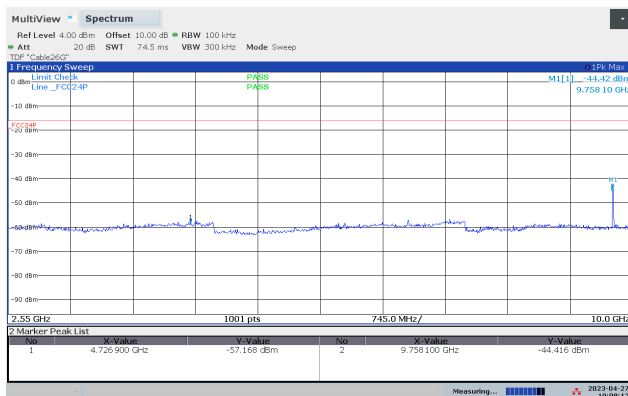
Conducted Emissions 2350-2550 MHz, 2475 MHz, 1Mb



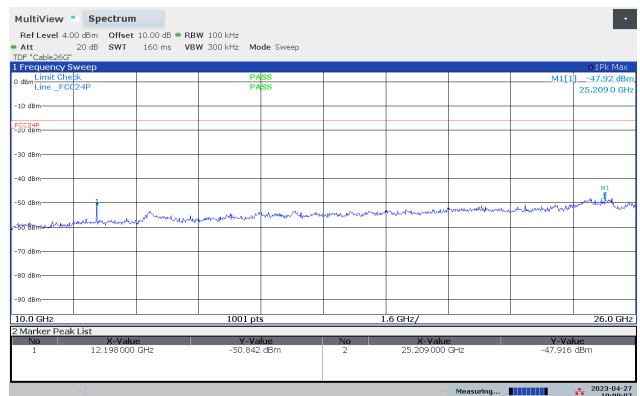
Conducted Emissions 2.55-10 GHz, 2405 MHz, 1Mb



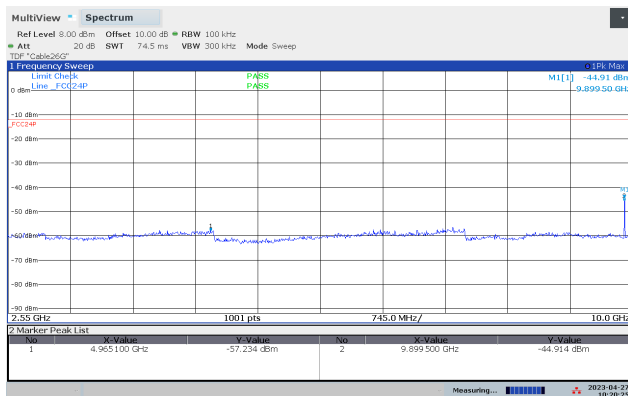
Conducted Emissions 10-26 GHz, 2405 MHz, 1Mb



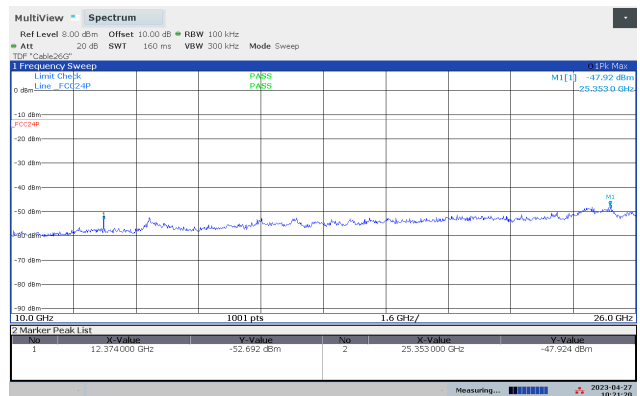
Conducted Emissions 2.55-10 GHz, 2440 MHz, 1Mb



Conducted Emissions 10-26 GHz, 2440 MHz, 1Mb



Conducted Emissions 2.55-10 GHz, 2475 MHz, 1Mb



Conducted Emissions 10-26 GHz, 2475 MHz, 1Mb

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

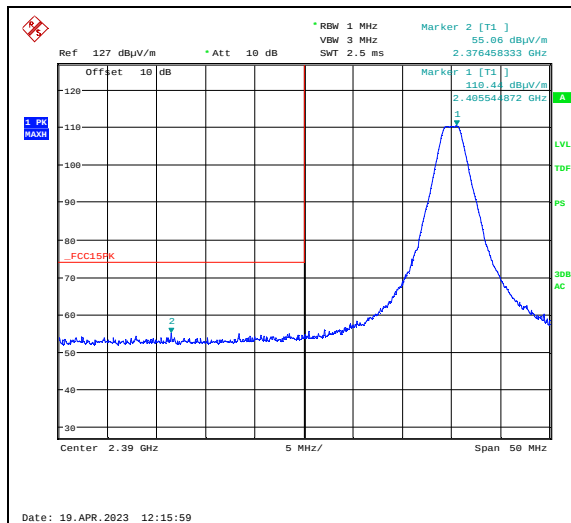
Test Results: Complies

Measurement Data:

Detector	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
Peak	55.1	61.5	74	18.9	12.5
Average	42.4	50.2	54	11.6	3.8

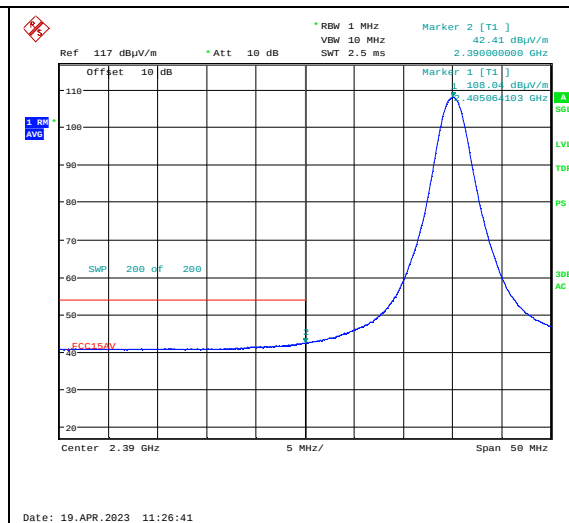
Duty Cycle was 100% during all measurements.

See attached plots.



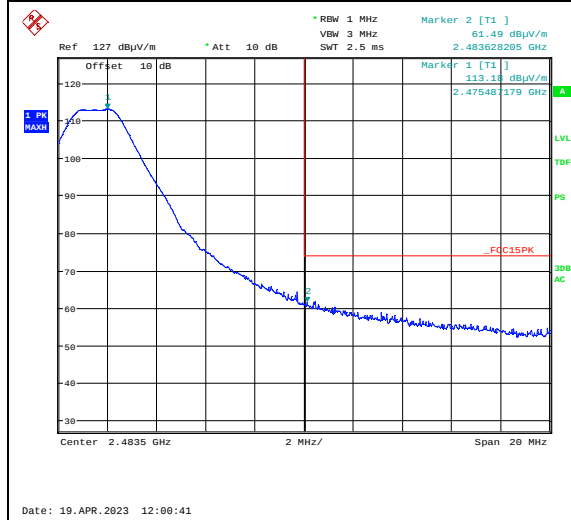
Date: 19. APR. 2023 12:15:59

Lower Band Edge, 2405 MHz, Peak



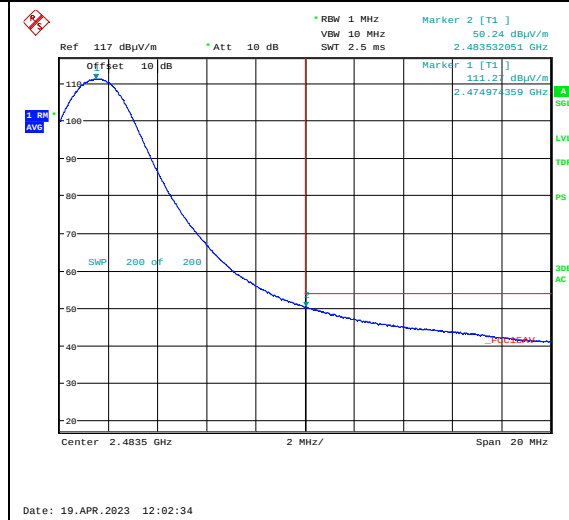
Date: 19. APR. 2023 11:26:41

Lower Band Edge, 2405 MHz, Average



Date: 19. APR. 2023 12:00:41

Upper Band Edge, 2475 MHz, Peak



Date: 19. APR. 2023 12:02:34

Upper Band Edge, 2475 MHz, Average

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 (Pre-scan with Peak Detector)

Measuring distance 3m.

Tested in test mode with EUT transmitting on 2440 MHz

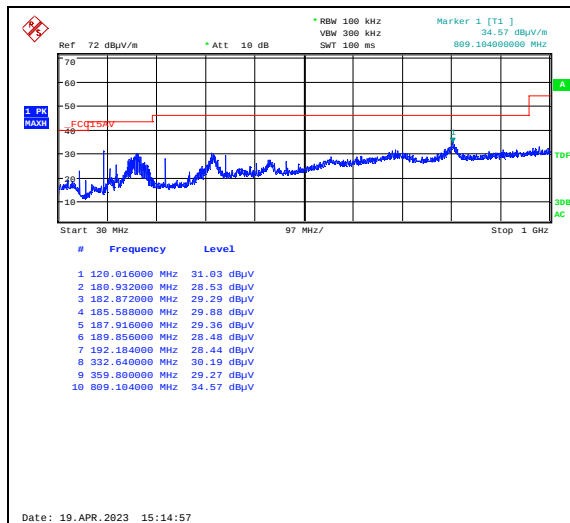
Measured Frequency (MHz)	Carrier Frequency (MHz)	Modulation	Measured Emissions (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 – 88	2440	GFSK	< 30	40.0	> 10
88 – 216	2440	GFSK	35.5	43.5	8.0
216 – 960	2440	GFSK	< 35	46.0	> 11
960 – 1000	2440	GFSK	< 34	54.0	> 20
120.020	2440	GFSK	35.5	43.5	8.0
240.025	2440	GFSK	31.5	43.5	12.0

The spurioues at 120 MHz and 240 Mhz are from the USB connection and are independent of the RF signal.

See attached plots.

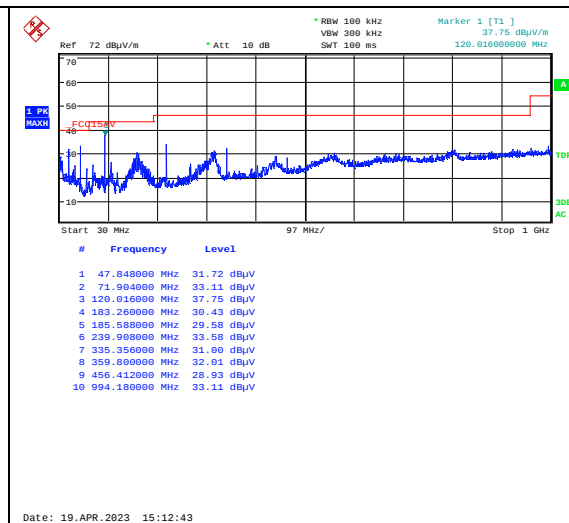
Requirements/Limit

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		



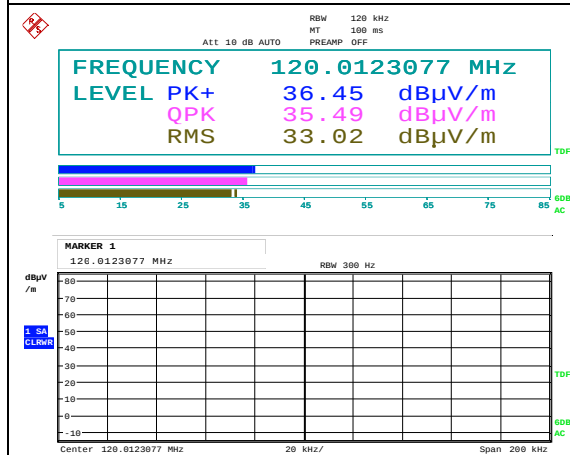
Date: 19. APR. 2023 15:14:57

Radiated Emissions 30 - 1000 MHz, 1Mb, HP



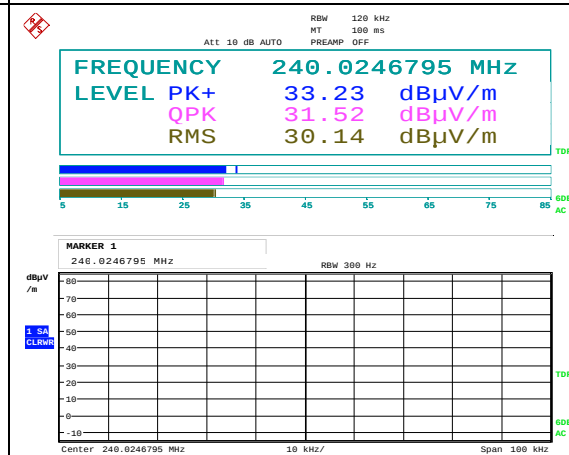
Date: 19. APR. 2023 15:12:43

VP



Date: 19. APR. 2023 15:28:53

Emission 120 MHz, 1Mb, Max: VP



Date: 19. APR. 2023 15:35:52

Emission 240 MHz, 1Mb, Max: VP

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)
1m (18 – 26 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
2405	7215	GFSK	52.3	44.3	74	54	21.7	9.7
	12025	GFSK	57.0	49.4	74	54	17.0	4.6
2440	7320	GFSK	51.9	43.8	74	54	22.1	10.2
	9760	GFSK	55.0	47.1	74	54	19.0	6.9
	12200	GFSK	57.6	51.6	74	54	16.4	2.4
2475	7425	GFSK	52.3	44.4	74	54	21.7	9.6
	12375	GFSK	60.3	53.7	74	54	13.7	0.3

Duty Cycle was 100%.

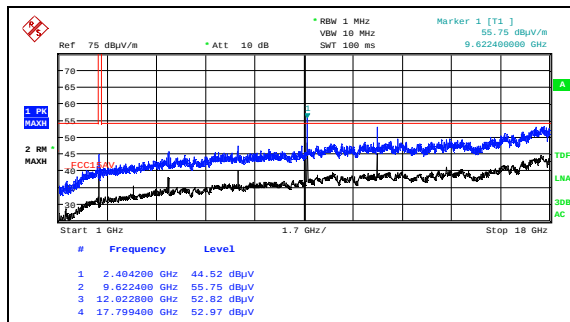
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz.

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

See plots.

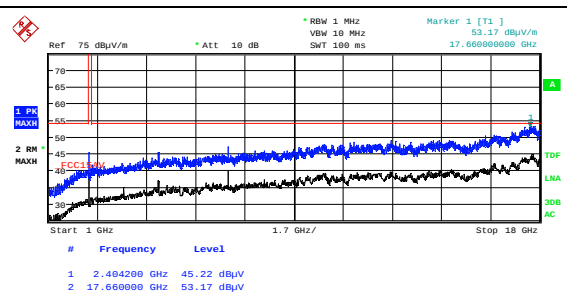
Requirements/Limit

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



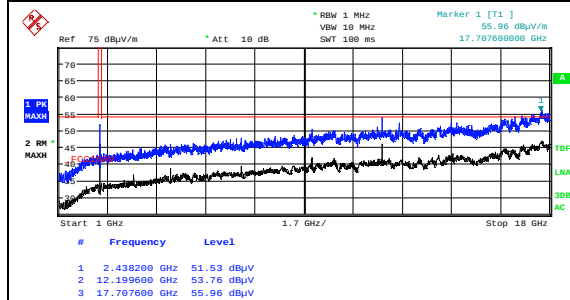
Date: 19. APR. 2023 14:26:56

Radiated Emissions 1 - 18 GHz, 2405 MHz, HP



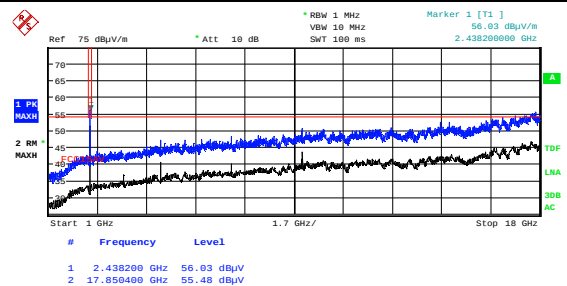
Date: 19. APR. 2023 14:24:59

VP



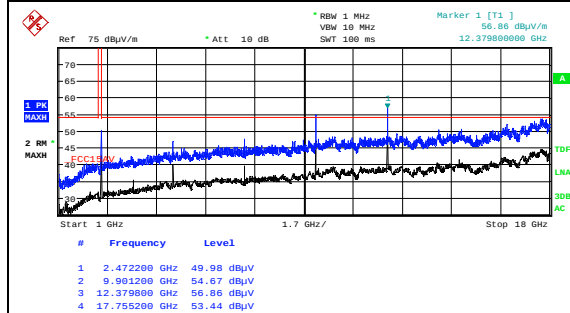
Date: 19. APR. 2023 13:04:47

Radiated Emissions 1 - 18 GHz, 2440 MHz, HP



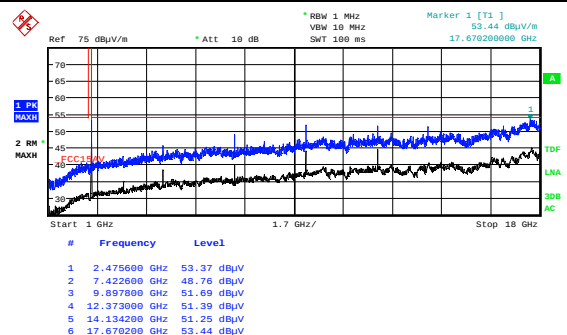
Date: 19. APR. 2023 13:02:33

VP



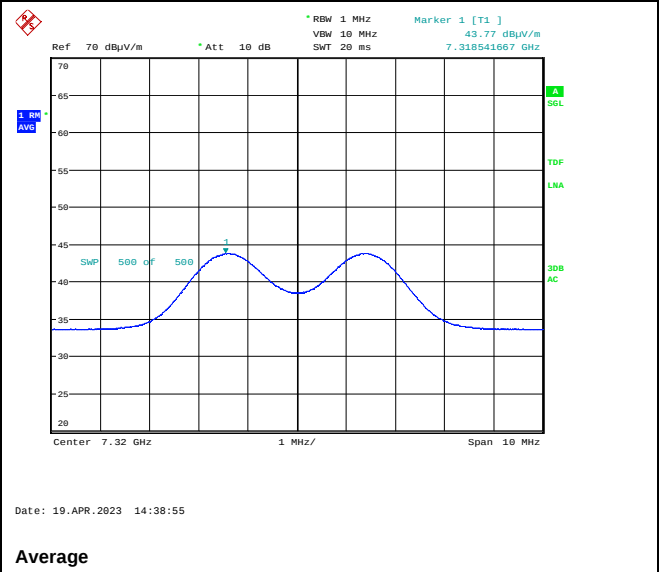
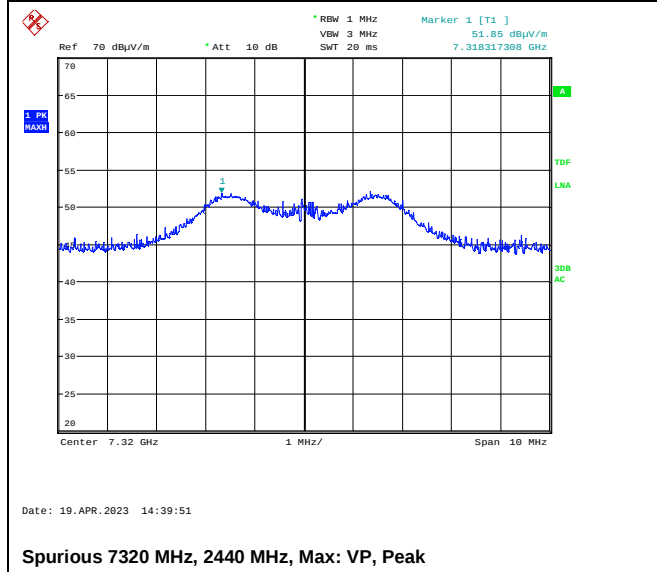
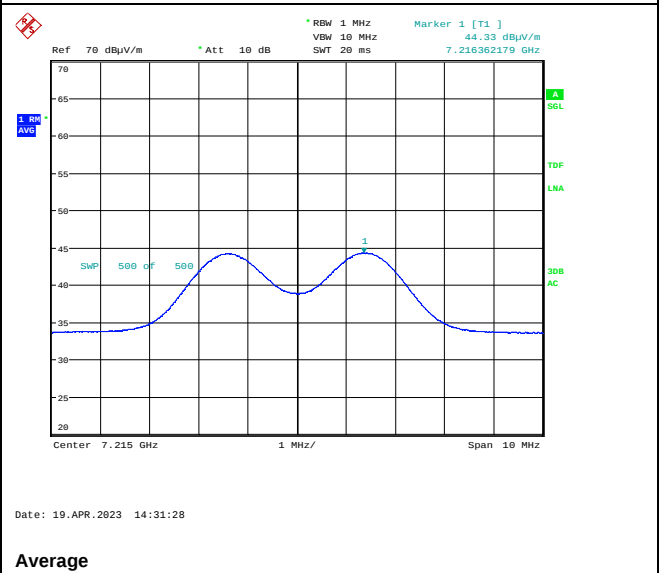
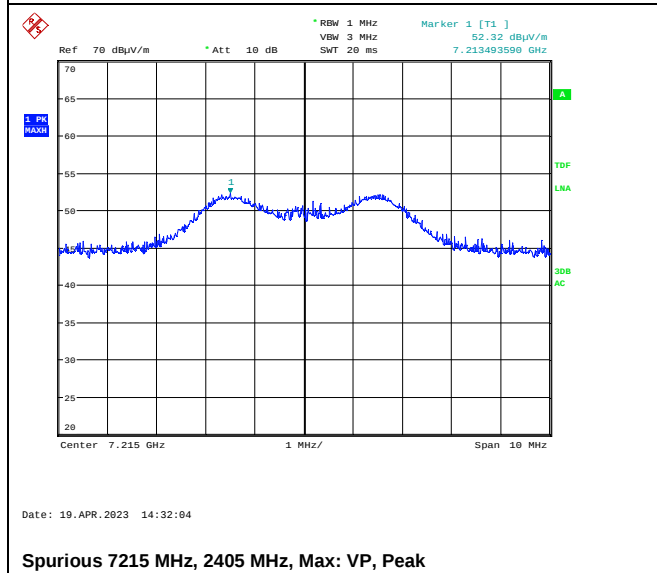
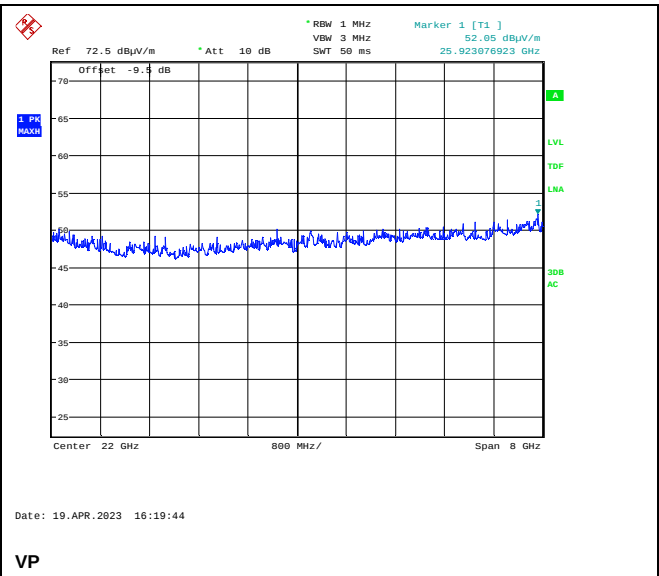
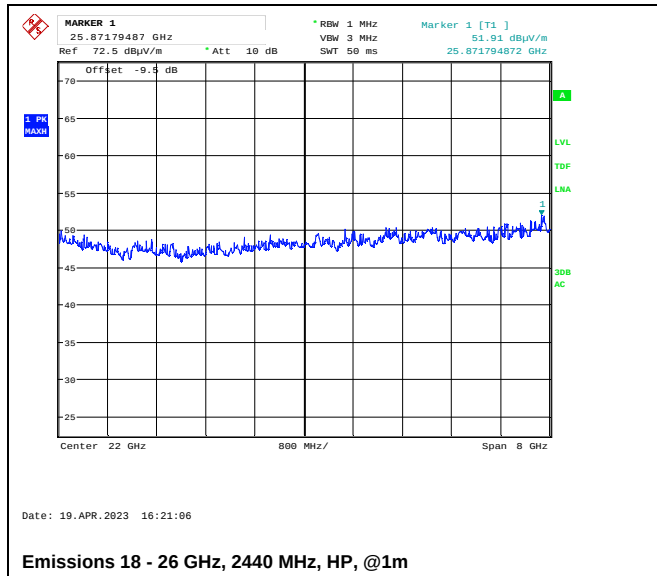
Date: 19. APR. 2023 14:09:31

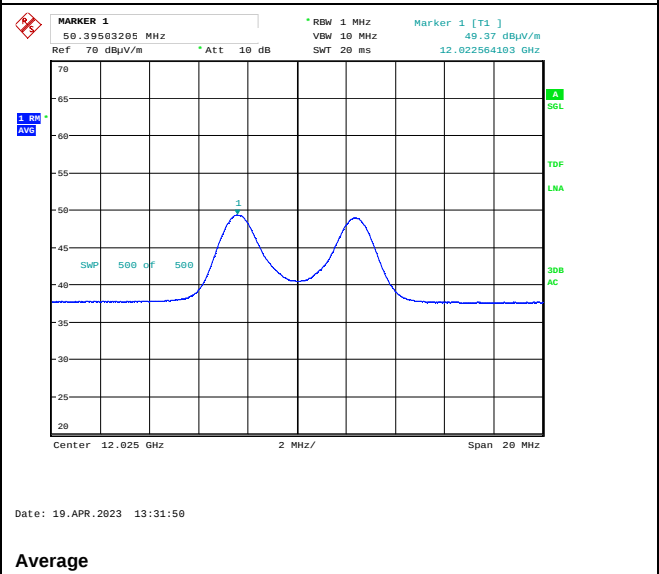
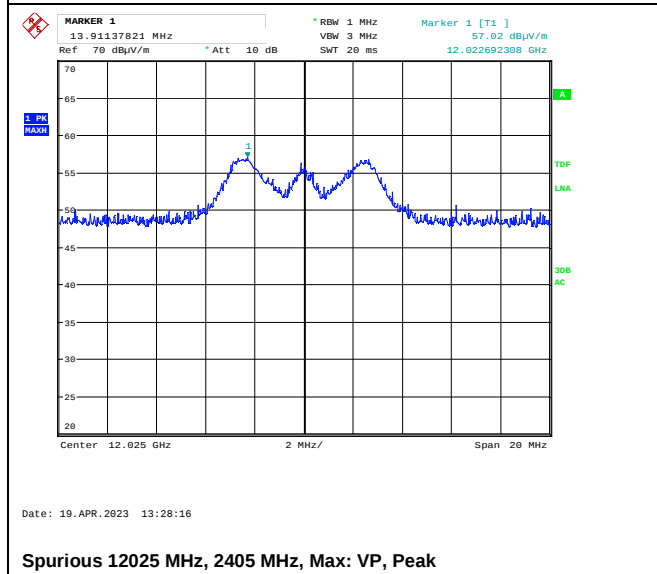
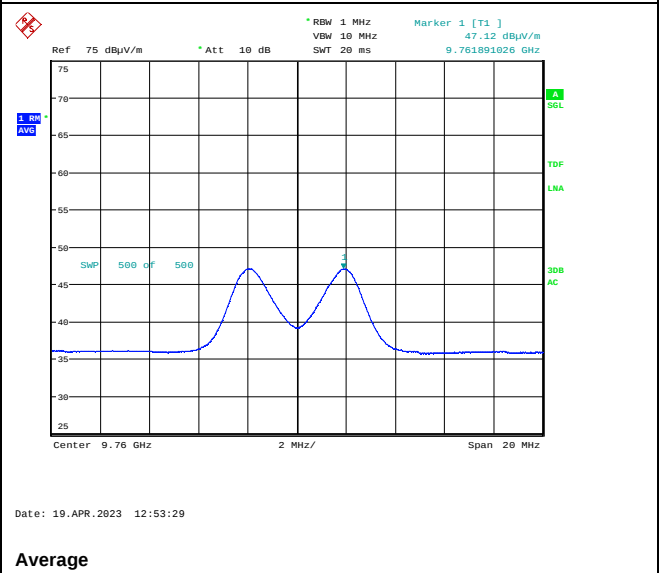
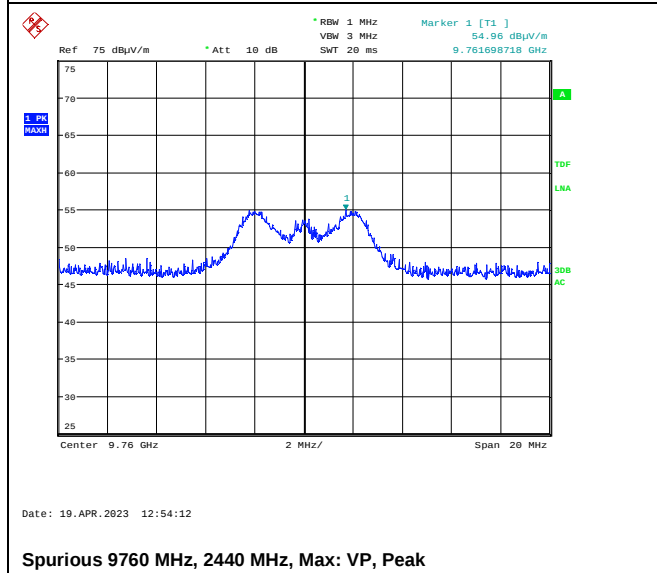
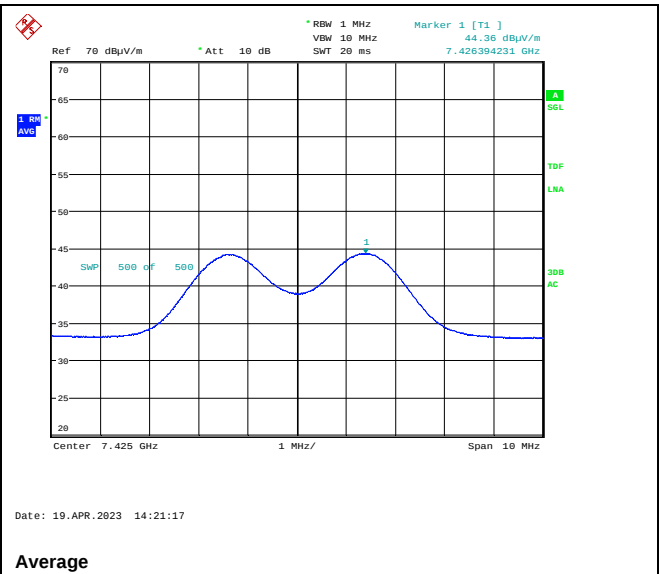
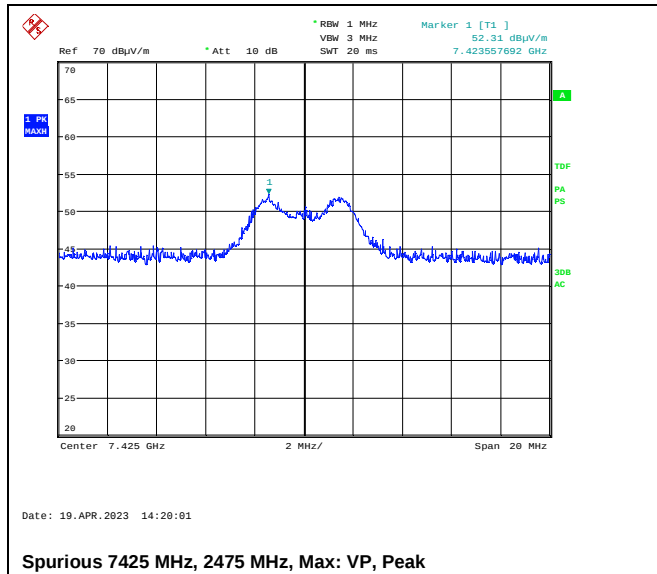
Radiated Emissions 1 - 18 GHz, 2475 MHz, HP

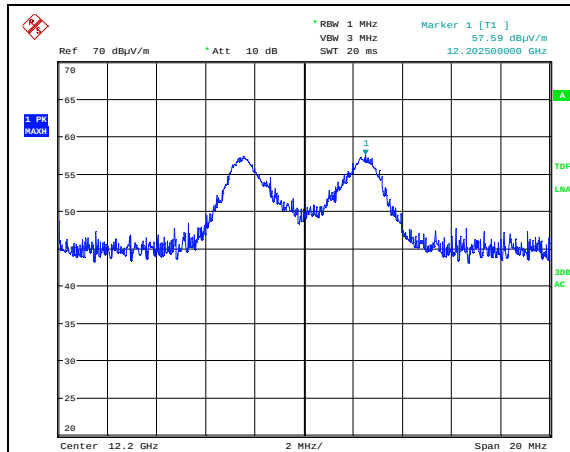


Date: 19. APR. 2023 14:07:34

VP

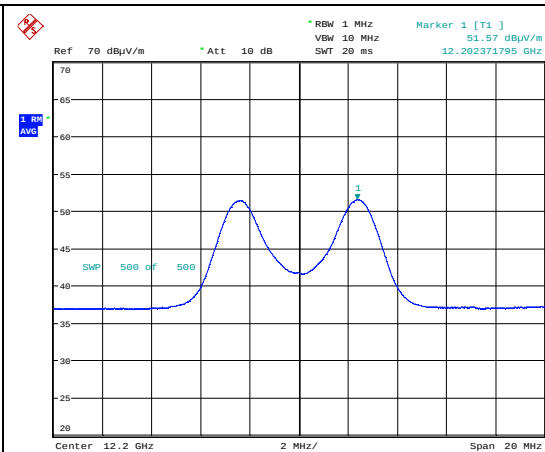






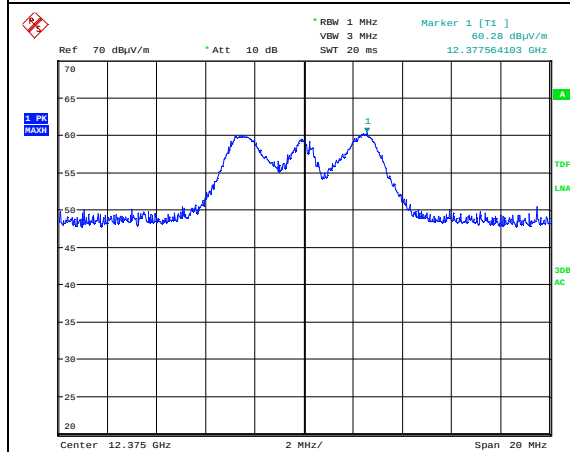
Date: 19. APR. 2023 13:17:11

Spurious 12200 MHz, 2440 MHz, Max: VP, Peak



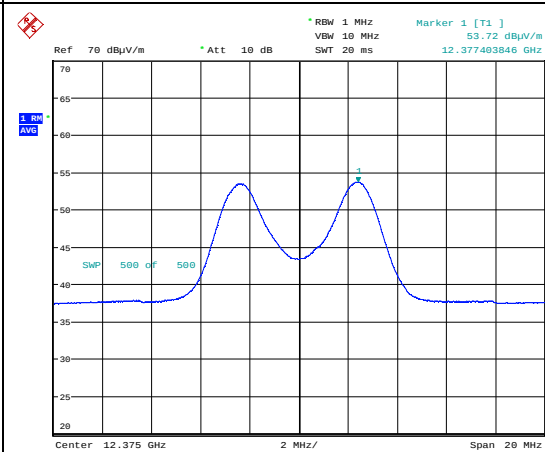
Date: 19. APR. 2023 13:19:20

Average



Date: 19. APR. 2023 13:40:21

Spurious 12375 MHz, 2475 MHz, Max: VP, Peak



Date: 19. APR. 2023 13:41:06

Average

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

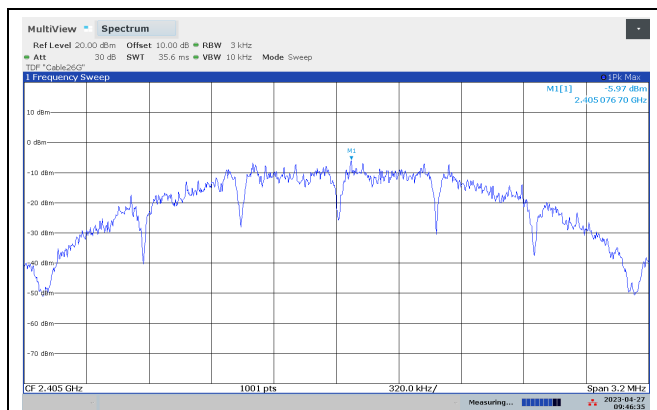
Measurement Data:

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

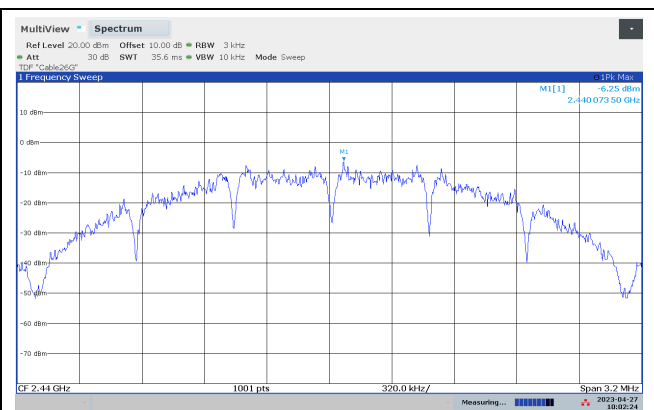
Modulation Type	Measured Power Spectral Density (dBm/3kHz)		
	2405 MHz	2440 MHz	2475 MHz
GFSK	-6.0	-6.2	-2.8

Requirement for systems using Digital Modulation

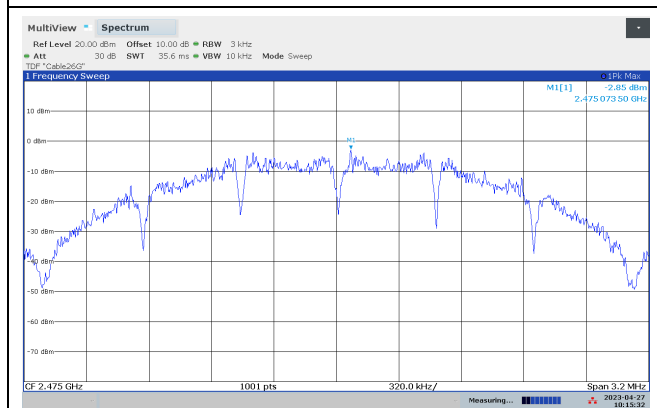
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



PSD, 2405 MHz, 1Mb



PSD, 2440 MHz, 1Mb



PSD, 2475 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 Test Laboratory.

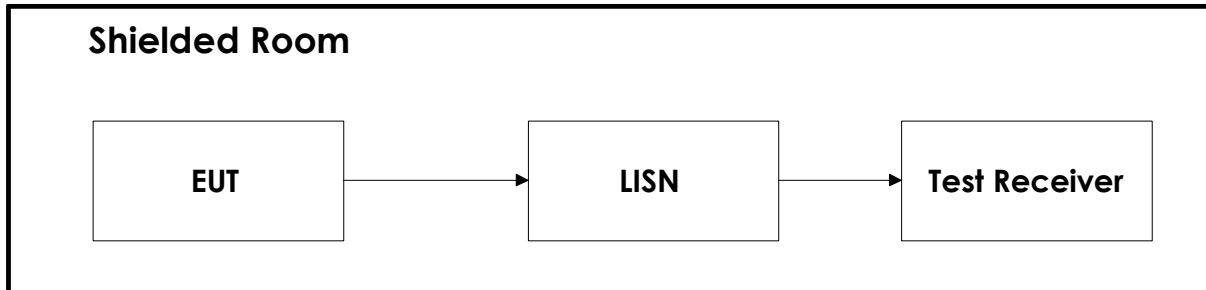
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2023-01	2024-01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
3	6810.17B	Attenuator	Suhner	LR 1669	2022-05	2023-05
4	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	COU	
5	VULB 9163	BiLog Antenna	Schwarzbech	LR 1616	2021-05	2024-05
6	310	Preamplifier	Sonoma Inst.	LR 1686	2022-08	2023-08
7	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2022-08	2023-08
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2022-08	2023-08
9	WLK5-1100-1485- 7000-40SS	Low Pass Filter	Wainwright Inst.	LR 1761	COU	
10	638	Antenna Horn	Narda	LR 1480	N/A	
16	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

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

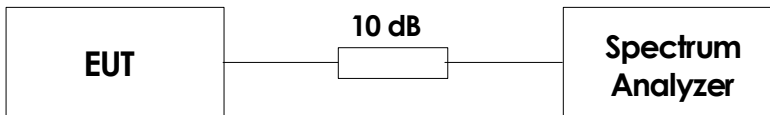
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.40	EMC test software
2	Nemko	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission

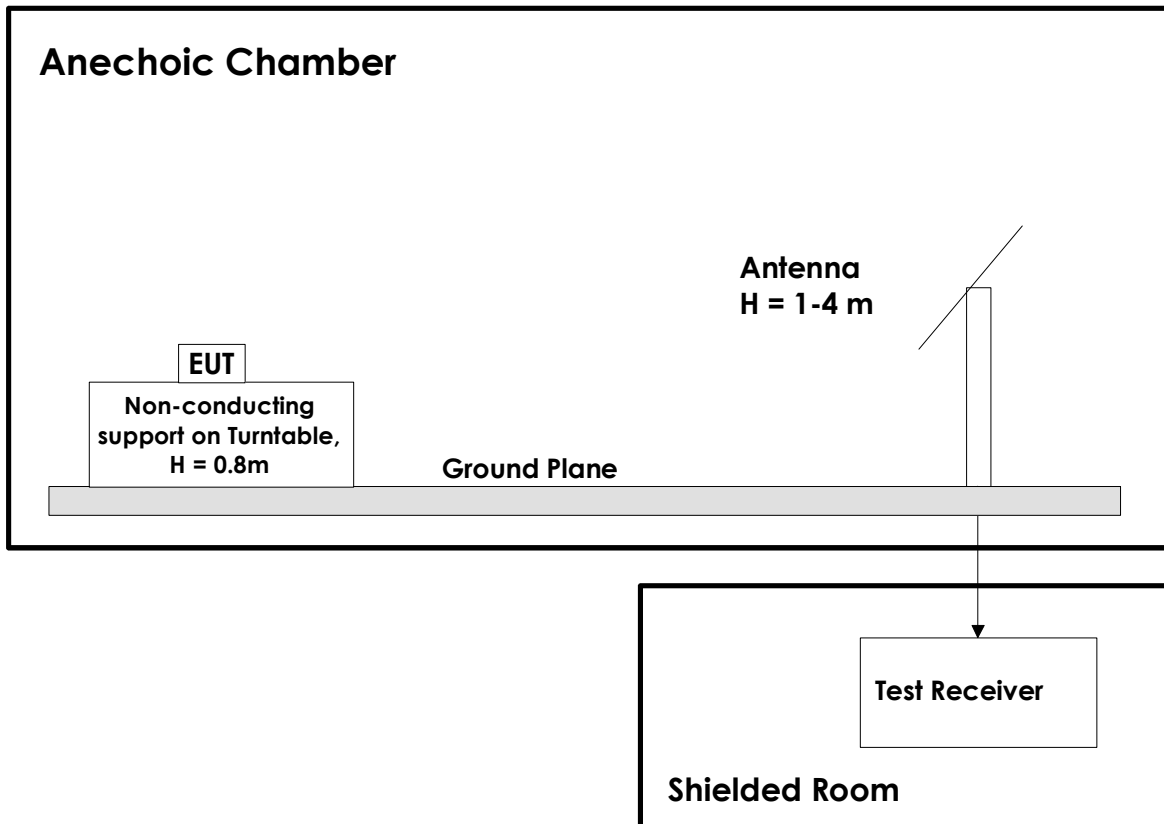


6.2 Conducted Tests



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. 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.