

Test Report

Product	Maritime Broadband Radio		
Name and address of the applicant	Kongsberg Discovery AS, Seatex Havnegata 9 N-7010 Trondheim, Norway		
Name and address of the manufacturer	Kongsberg Discovery AS, Seatex Havnegata 9 N-7010 Trondheim, Norway		
Model	MBR 179 MK2		
Rating	300W (24-48 V _{DC})		
Trademark	 KONGSBERG		
Additional information	Operates in U-NII-3 band		
Tested according to	FCC Part 15.407 Unlicensed National Information Infrastructure Devices (U-NII)		
Order number	PRJ0034517		
Tested in period	2023-05-15 to 2023-07-14		
Issue date	2023-09-20		
Name and address of the testing laboratory	 Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001   An accredited technical test executed under the Norwegian accreditation scheme		
	 Prepared by [Frode Sveinsen]  Approved by [Roy Uggerud]		
This report was originally distributed electronically with digital signatures. For more information, please contact Nemko Scandinavia AS.			

Revision history

Revision	Date	Comment	Sign
A	2023-09-20	First Edition	FS
B	2023-11-16	Company Name changed	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.

This report shall not be reproduced, except in full, without the written approval of Nemko.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Group accepts no responsibility for damage suffered by any third party because of decisions made or actions based on this report.

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

CALIBRATION

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

MEASUREMENT UNCERTAINTY

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

CONTENTS

2	INFORMATION	4
2.1	Test Item	4
2.3	Normal test conditions	5
2.4	Test Engineer(s)	5
2.5	Antenna Requirement	5
2.6	EUT Operating Modes	5
2.7	Comments	5
3	TEST REPORT SUMMARY	6
3.1	General	6
3.2	Test Summary	6
4	TEST RESULTS	7
4.1	Maximum Output Power, EIRP	7
4.3	Spectrum Mask	9
4.4	Emission Bandwidth / Occupied Bandwidth (99%)	12
4.5	DTS Bandwidth	14
4.6	Peak Power Spectral Density	16
4.7	Unwanted Emissions	18
4.8	Restricted Bands of operation	20
4.9	Radiated Emissions, 30 – 1000 MHz	21
4.10	Radiated Emissions, 1 – 40 GHz	23
5	Measurement Uncertainty	26
6	LIST OF TEST EQUIPMENT	27
7	BLOCK DIAGRAM	28
7.1	Test Site Radiated Emission	28

2 INFORMATION

2.1 Test Item

Name	Kongsberg
Model	MBR 179 MK2
FCC ID	Q8IMBR179MK2
Serial number	2645
Hardware identity and/or version	Rev1
Software identity and/or version	2.20
Frequency Ranges	5735 – 5840 MHz (U-NII-3)
Type of Modulation	GMSK
RMS Output Power	255 W (EIRP)
Antenna Connector	None
Description of Antennas	Phased Array with 60 antenna elements
Antenna Diversity Supported	No
MIMO Supported	No
TPC Supported	Not required in U-NII-3 Band
DFS Supported	Not required in U-NII-3 Band
Ad-hoc Mode	N/A
Hotspot Mode	N/A
Power Supply	External DC Supply (24-48 V _{DC})

Description of Test Item

The EUT is a Maritime Broadband Radio for fixed installations.

2.3 Normal test conditions

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	48 V DC

The values are the limit registered during the test period.

2.4 Test Engineer(s)

Frode Sveinsen

2.5 Antenna Requirement

Is the antenna detachable?	☐ Yes	☒ No
If detachable, is the antenna connector non-standard?	☐ Yes	☐ No
Type of antenna connector: N/A, Integral Antennas		

2.6 EUT Operating Modes

Description of operating modes	Continuous TX
Additional information	The test was performed with the EUT transmitting continuously on highest and lowest channel and on one channel in the middle of the band

2.7 Comments

All ports were populated during spurious emission measurements.

3 TEST REPORT SUMMARY

3.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.407.

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 1m and 3m.

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

3.2 Test Summary

Name of test	FCC Part 15 reference	Result
Supply Voltage Variations	15.31(e)	Complies
Antenna Requirement	15.203	Complies
Power Line Conducted Emissions	15.107(a) 15.207(a)	N/A
Maximum Output Power	15.407(a)	Complies
Power Spectral Density	15.407(a)	Complies
Emission Bandwidth	15.407(a)(2)	Complies
Unwanted Emissions	15.407(b)	Complies
6 dB Bandwidth	15.407(e)	Complies
Radiated Emissions	15.205 15.209	Complies

4 TEST RESULTS

4.1 Maximum Output Power, EIRP

FCC 15.407 (a)

Measurement procedure: ANSI C63.10-2013 Clause 12.3, method SA-1

Test Results: Complies

Measurement Data:

Ch. No.	Nominal Frequency (MHz)	Maximum Field Strength RMS, (dB μ V/m)	Maximum e.i.r.p. RMS, (dBm)	Maximum e.i.r.p. RMS, (Watts)
147	5735	149.3	54.1	255
154	5770	148.8	53.6	228
168	5840	149.2	54.0	250

The EUT operates continuously; therefore, method SA-1 of ANSI C63.10-2013 clause 12.3 was used.

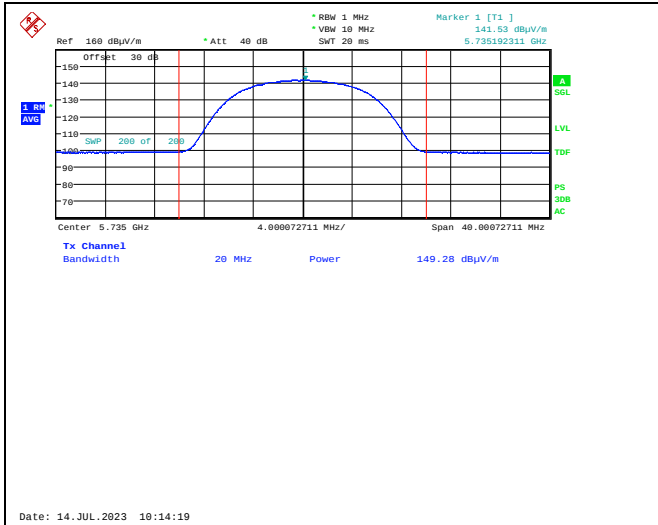
Measured radiated at 3m.

EIRP values were calculated from Field Strength values using the method described in KDB 412172 D01.

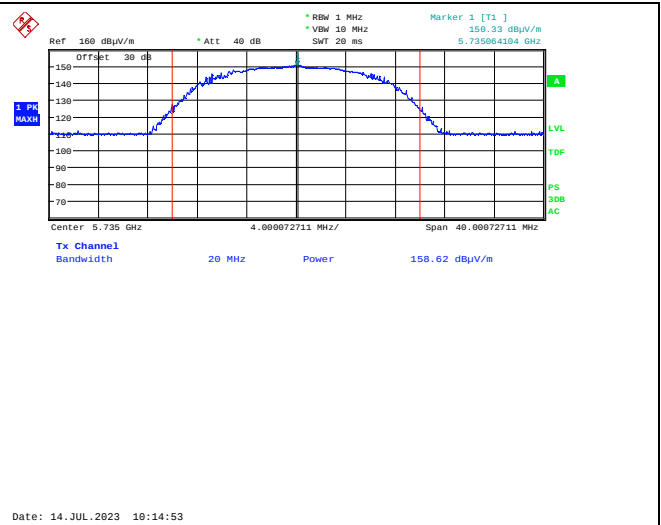
This is an outdoor device with smart antennas; no antenna connector was available.

Limits:

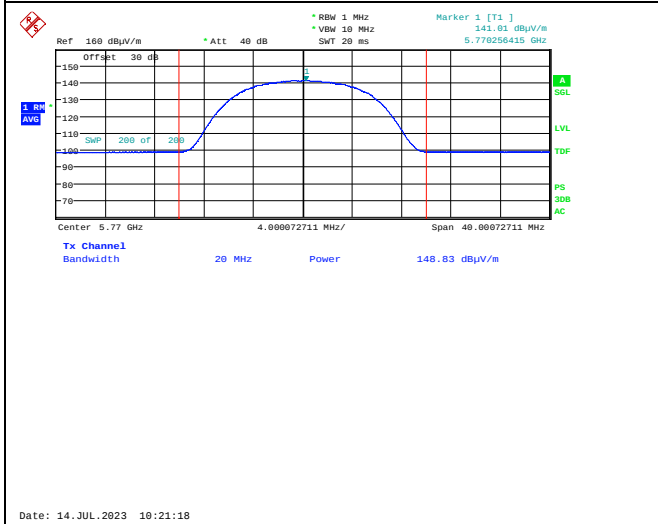
Frequency Band	FCC 15.407(a)
5725 – 5825 MHz	Less than 1 Watt
	If Antenna Gain is more than 6 dBi the Power Limit is reduced by the amount exceeding 6 dBi



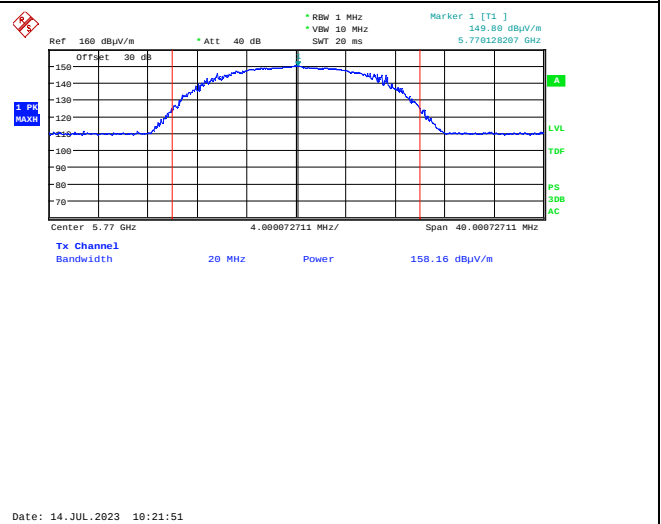
RMS Field Strength, 5735 MHz



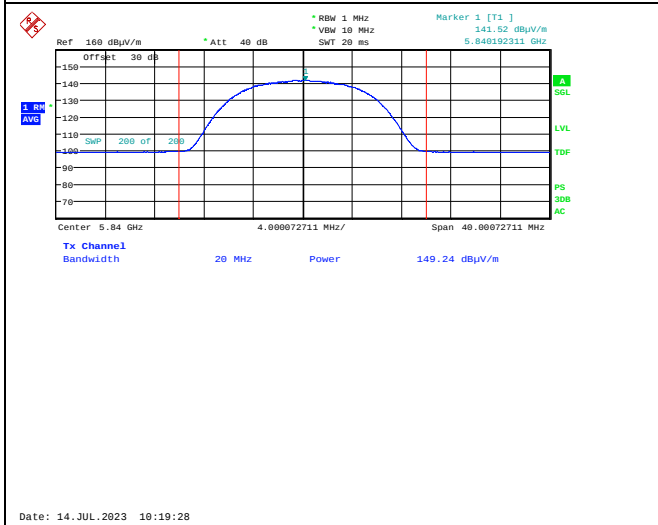
Peak Field Strength, 5735 MHz



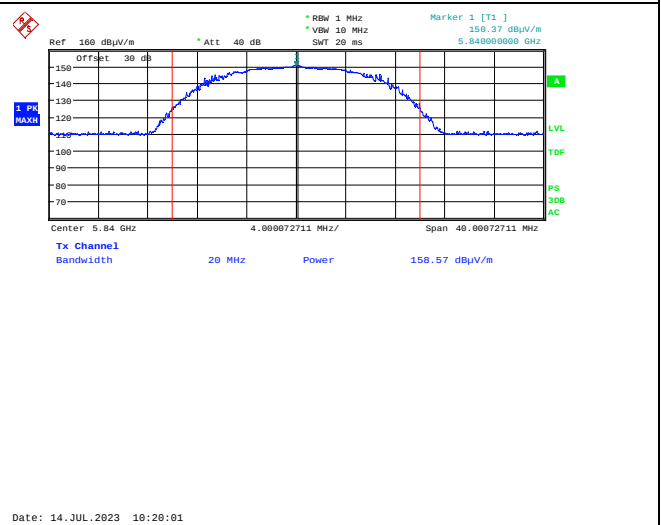
RMS Field Strength, 5770 MHz



Peak Field Strength, 5770 MHz



RMS Field Strength, 5840 MHz



Peak Field Strength, 5840 MHz

4.3 Spectrum Mask

Para. No.: ETSI EN 303 276 V1.2.1 (2021-01)

Measurement procedure: ETSI EN 303 276 V1.2.1, clause 4.3.4

Test Results: Complies

Since the dynamic range of the spectrum analyzer is not large enough to measure down to -80 dBc, as required, the measurement had to be performed in two steps. The first step measured the carrier directly without filter, in the second step a tuned band-stop filter was used to measure the levels below -70 dBc.

Limit:

Output Power must be within the mask below, but does not need to be below the general spurious limit.

The measurement is performed with Max Hold and Resolution Bandwidth 1 MHz.

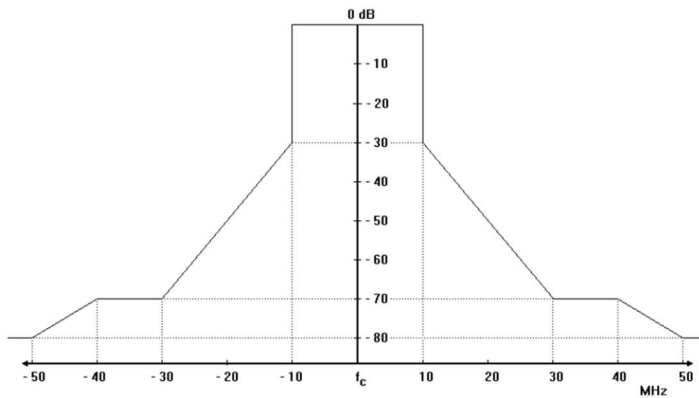
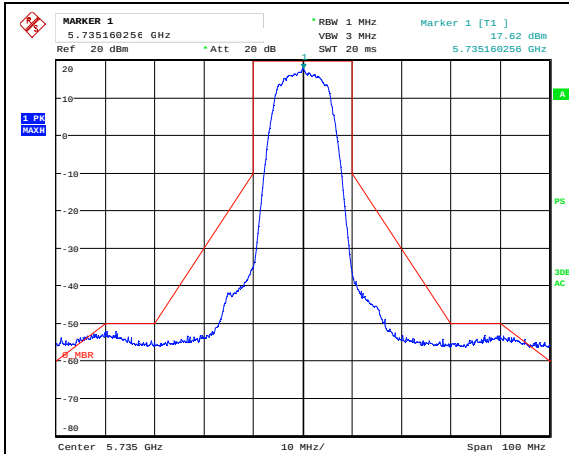
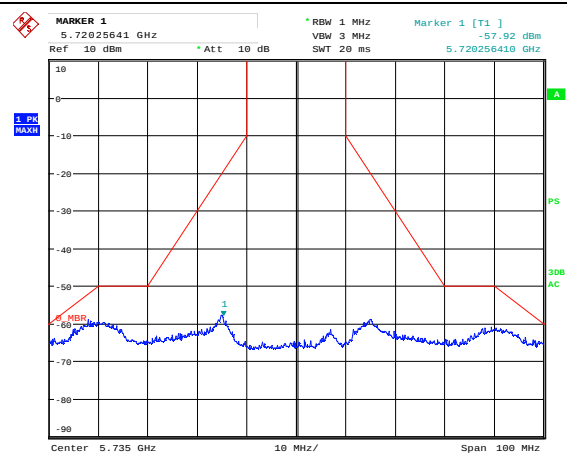


Figure 5: Transmitter power spectrum mask



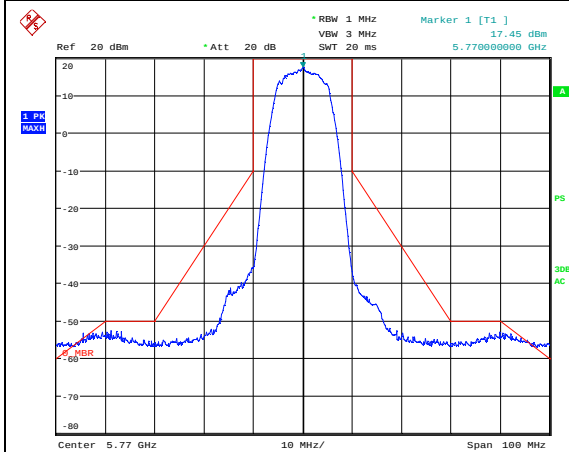
Date: 29.JUN.2023 16:11:43

Spectrum Mask, 5735 MHz



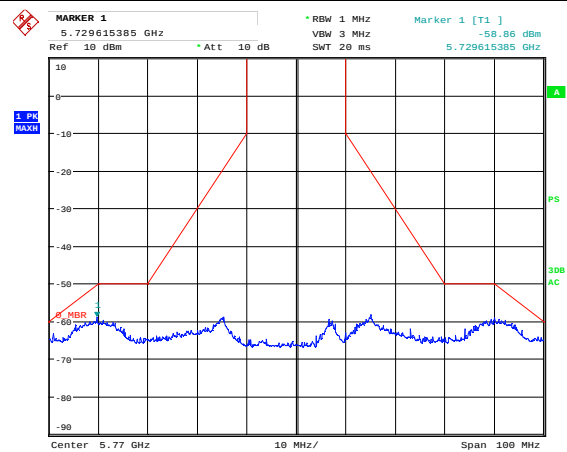
Date: 29.JUN.2023 16:13:03

Carrier with Filter, 5735 MHz



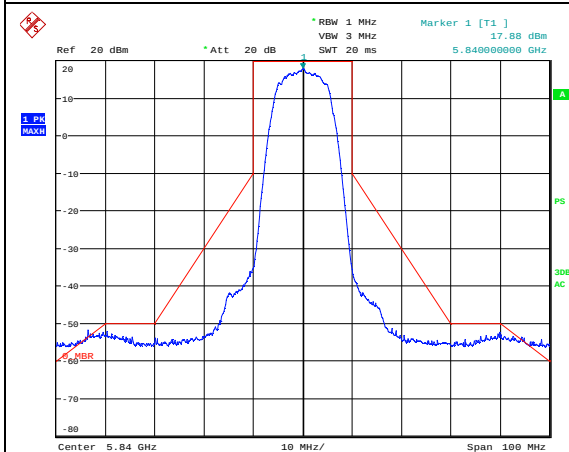
Date: 29.JUN.2023 15:58:20

Spectrum Mask, 5770 MHz



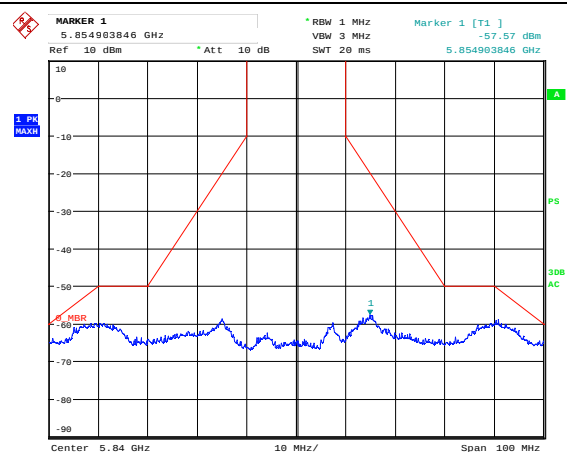
Date: 29.JUN.2023 15:59:37

Carrier with Filter, 5770 MHz



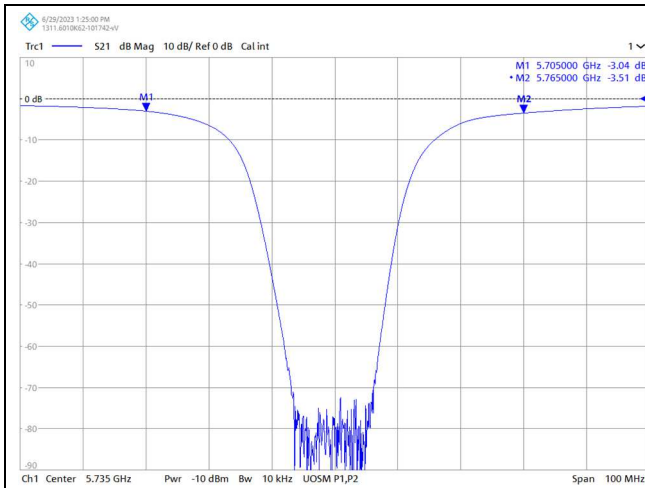
Date: 29.JUN.2023 15:58:29

Spectrum Mask, 5840 MHz

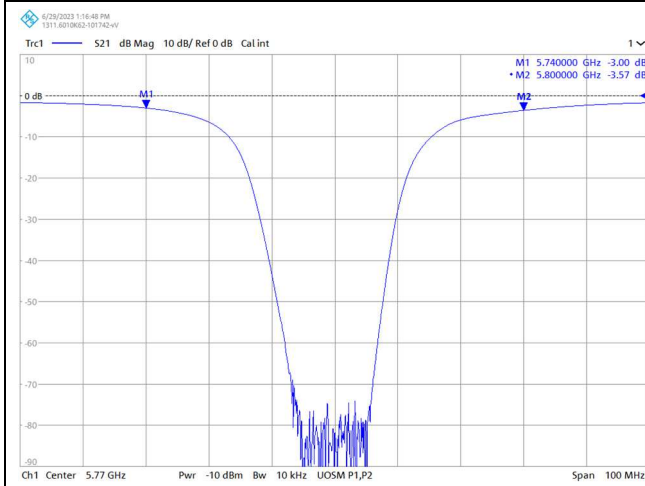


Date: 29.JUN.2023 15:51:35

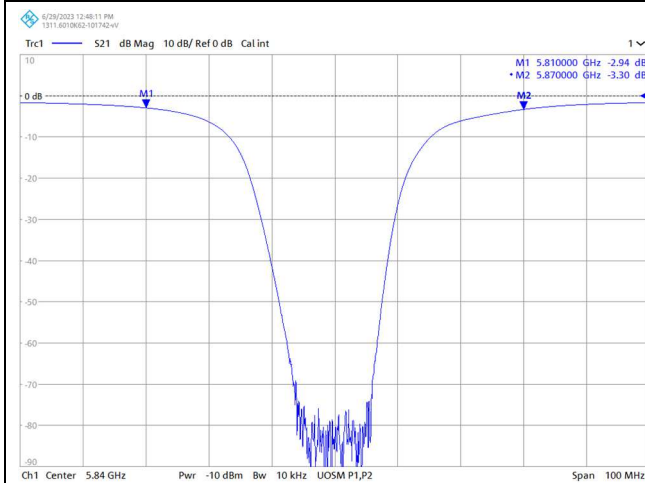
Carrier with Filter, 5840 MHz



Filter response, 5735 MHz



Filter response, 5770 MHz



Filter response, 5840 MHz

4.4 Emission Bandwidth / Occupied Bandwidth (99%)

Para. No.: 15.407(a)(2)

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3 and 12.4.1

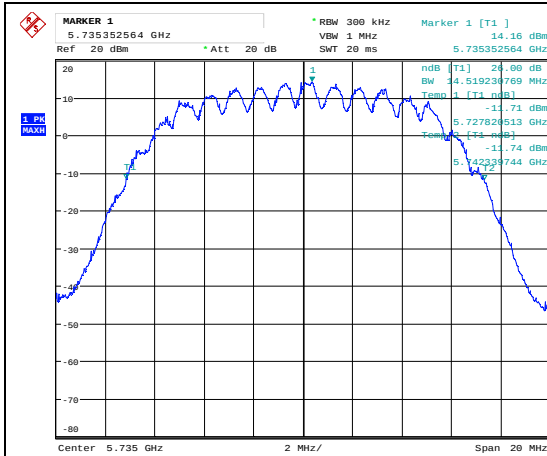
Test Results: Complies

Measurement Data:

Nominal Frequency	Emission BW B (26 dB) (MHz)	Occupied BW (99%) (MHz)
5735 MHz	14.5	12.0
5770 MHz	13.9	12.0
5840 MHz	14.5	12.0

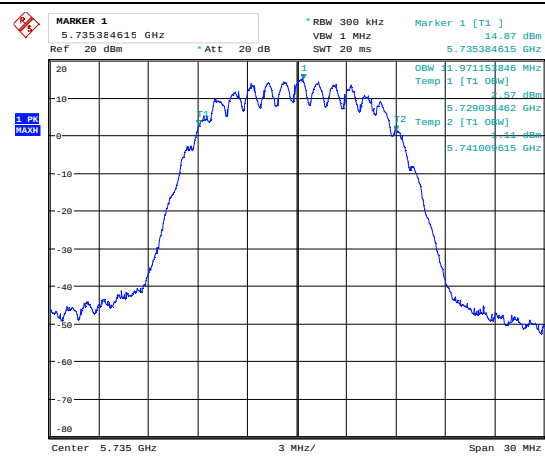
Limit:

No requirements as long as the emissions are within the band edges.



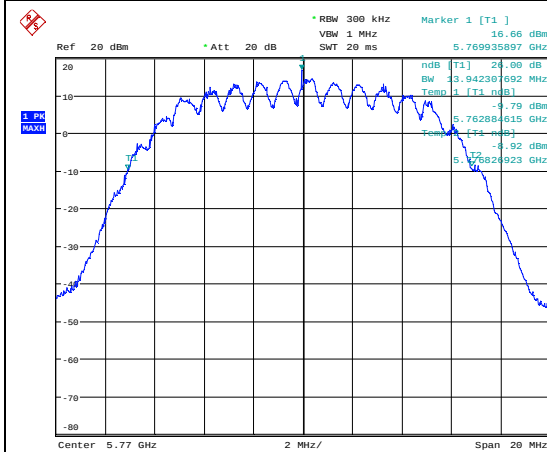
Date: 29.JUN.2023 16:33:11

Emission Bandwidth B, 5735 MHz



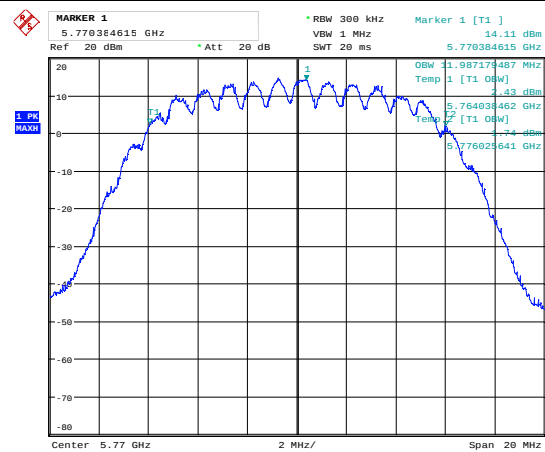
Date: 29.JUN.2023 16:16:03

99% Occupied Bandwidth, 5735 MHz



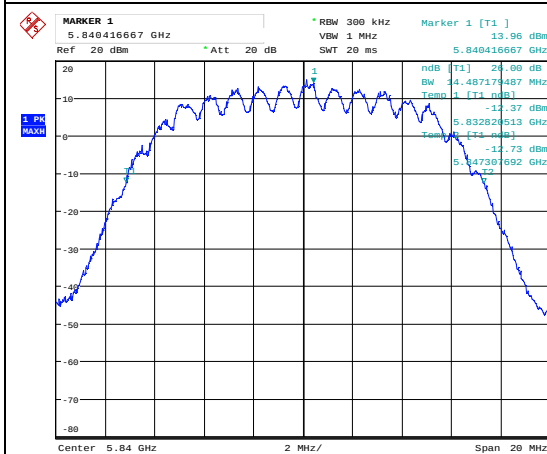
Date: 29.JUN.2023 16:23:55

Emission Bandwidth B, 5770 MHz



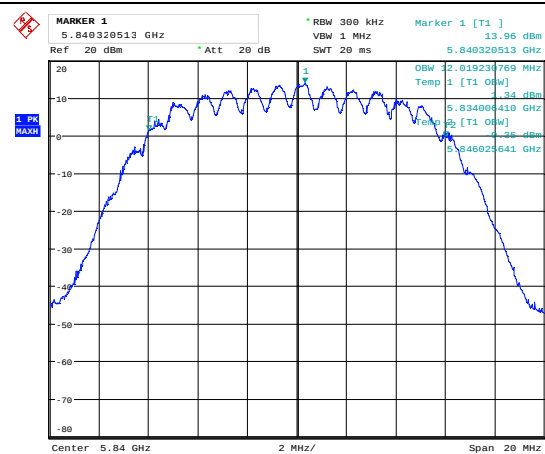
Date: 29.JUN.2023 16:17:55

99% Occupied Bandwidth, 5770 MHz



Date: 29.JUN.2023 16:36:22

Emission Bandwidth B, 5840 MHz



Date: 29.JUN.2023 16:35:39

99% Occupied Bandwidth, 5840 MHz

4.5 DTS Bandwidth

Para. No.: 15.407(e)

Measurement procedure: ANSI C63.10-2013 Clause 11.8, Option 1

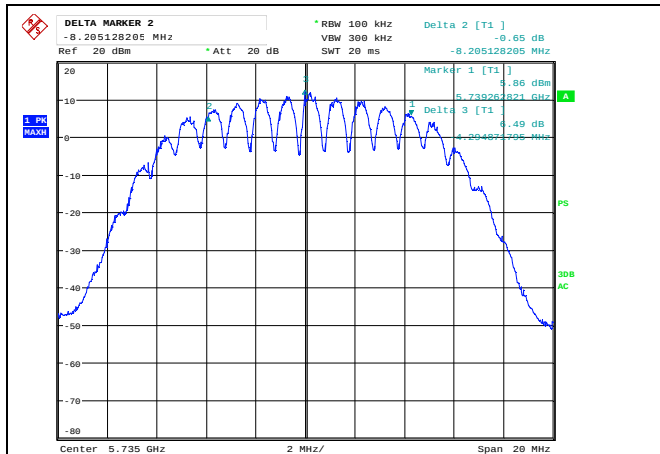
Test Results: Complies

Measurement Data:

Ch. No.	Nominal Frequency (MHz)	DTS Bandwidth, Measured Values (MHz)
147	5735	8.2
154	5770	8.4
168	5840	8.6

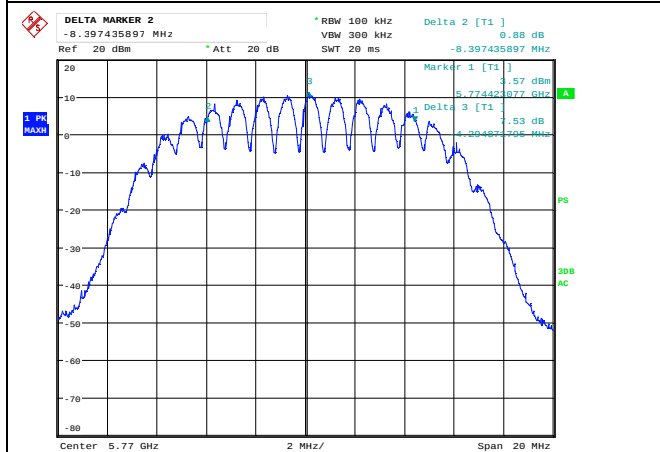
Limit:

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.



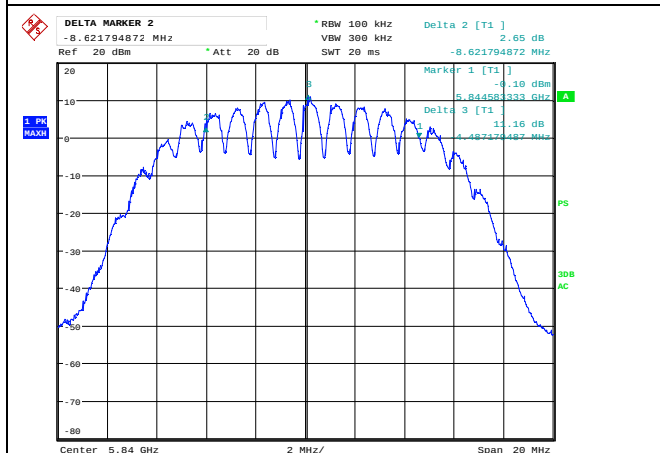
Date: 29. JUN. 2023 16:32:29

DTS BW, 5735 MHz



Date: 29. JUN. 2023 16:26:34

DTS BW, 5770 MHz



Date: 29. JUN. 2023 16:39:41

DTS BW, 5840 MHz

4.6 Peak Power Spectral Density

FCC 15.407(a)

Measurement procedure: ANSI C63.10-2013 Clause 12.5

Test Results: Complies

Measurement Data:

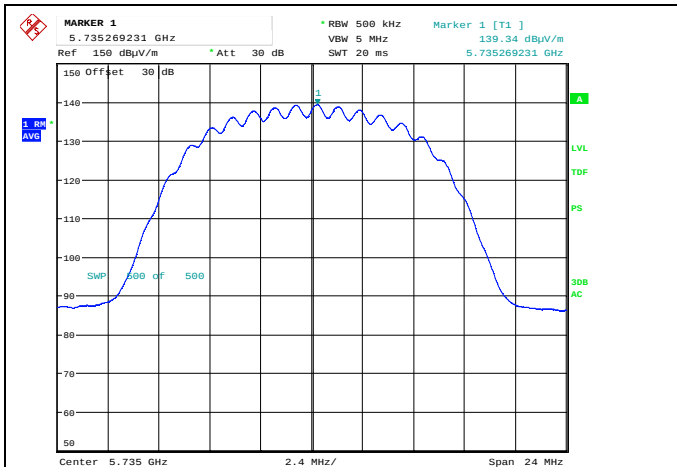
Ch. No.	Nominal Frequency	Peak PSD (dBμV/m / 500kHz)	Peak PSD (dBm/500kHz)
147	5735 MHz	139.3	44.1
154	5770 MHz	139.5	44.3
168	5840 MHz	139.8	44.6

Measured radiated at 3m.

Values above were converted from Field Strength to EIRP using the free field formula, as described in KDB 412172.

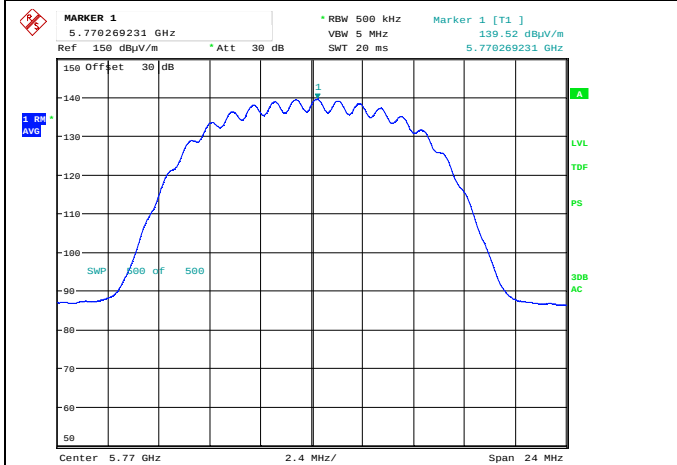
Limits:

Frequency Band	FCC 15.407(a)
5725 – 5825 MHz	Less than 30 dBm/500kHz
	If Antenna Gain is more than 6 dBi the limit above is reduced by the amount exceeding 6 dBi



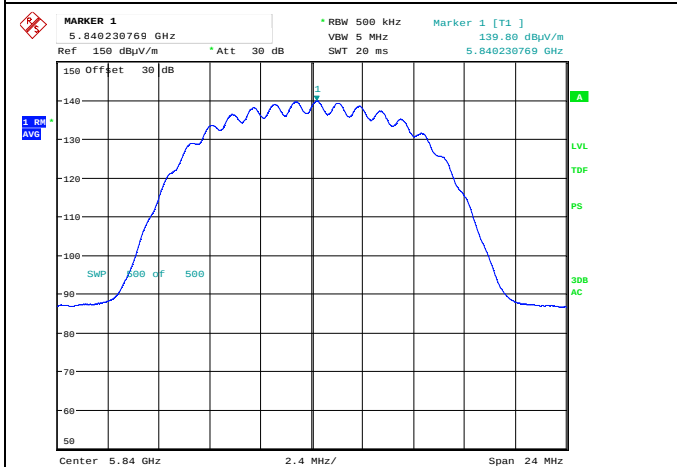
Date: 14.JUL.2023 10:16:12

PSD, 5735 MHz



Date: 14.JUL.2023 10:17:28

PSD, 5770 MHz



Date: 14.JUL.2023 10:18:44

PSD, 5840 MHz

4.7 Unwanted Emissions

FCC 15.407 (b)

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Band Edge Emissions:

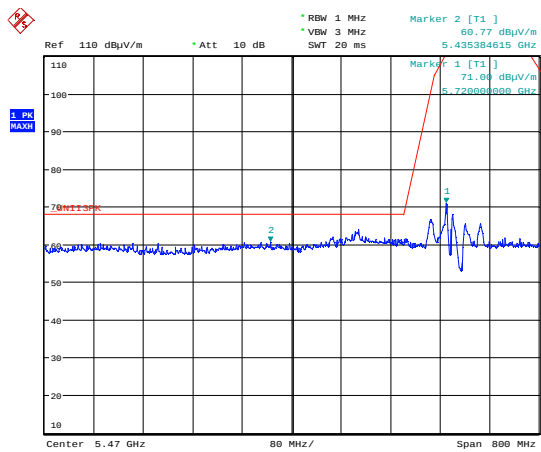
Ch. No.	Carrier Frequency (MHz)	Band Edge Frequency (MHz)	Measured Values (dBm/MHz e.i.r.p.)
			802.11a 6Mb
147	5735	5650	< 65
168	5840	5925	< 65

The measurement was performed radiated.

EIRP values were calculated from field strength using the method in KDB 412172 D01.

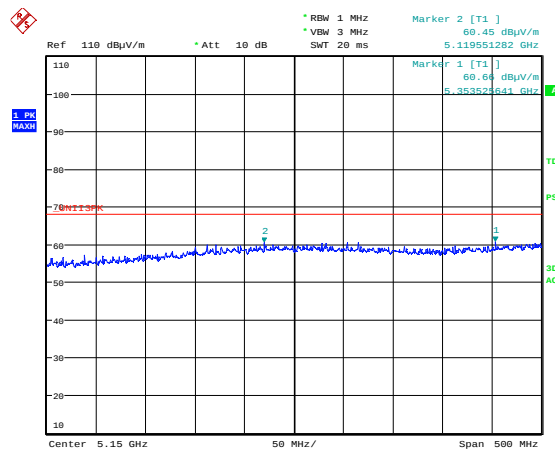
Limits:

Operating Frequency band	Limit for Emissions Outside Operating Frequency Band
5725 – 5825 MHz	See FCC 15.407(b)(4)(i) or 15.407(b)(4)(ii)



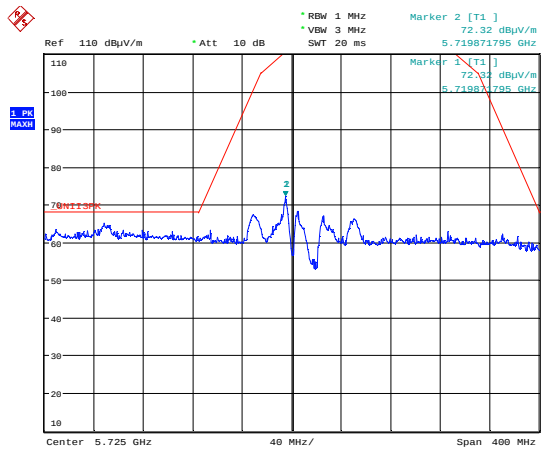
Date: 13. JUL. 2023 15:07:04

Lower Band Edge 5725 MHz, ch147, Radiated, Max, Pk



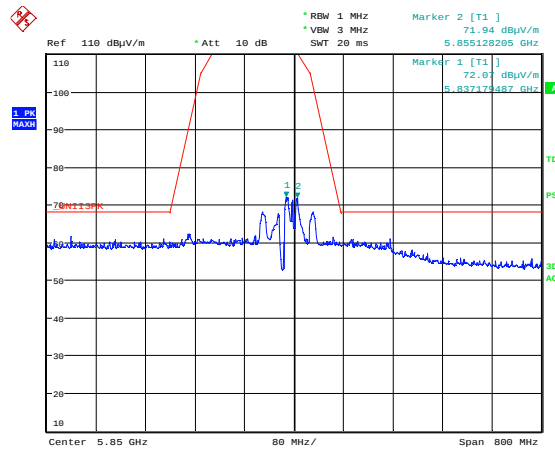
Date: 13. JUL. 2023 15:05:46

Lower Band Edge 5725 MHz, ch147, Radiated, Max, Pk



Date: 13. JUL. 2023 14:58:13

Lower Band Edge 5725 MHz, ch147, Radiated, Max, Pk



Date: 13. JUL. 2023 15:20:20

Upper Band Edge 5850 MHz, ch168, Radiated, Max, Pk

4.8 Restricted Bands of operation

Restricted Bands of operation for FCC are defined in FCC Part 15.205.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209.

FCC (MHz)	FCC (GHz)
0.090-0.110	0.96-1.24 1.3-1.427
0.495-0.505	1.435-1.6265
2.1735-2.1905	1.6455-1.6465
	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
	2.4835-2.5
6.215-6.218	2.69-2.9
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
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	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	

4.9 Radiated Emissions, 30 – 1000 MHz

FCC 15.205, 15.209, 15.407

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Detector: QuasiPeak (Prescan with Peak Detector)

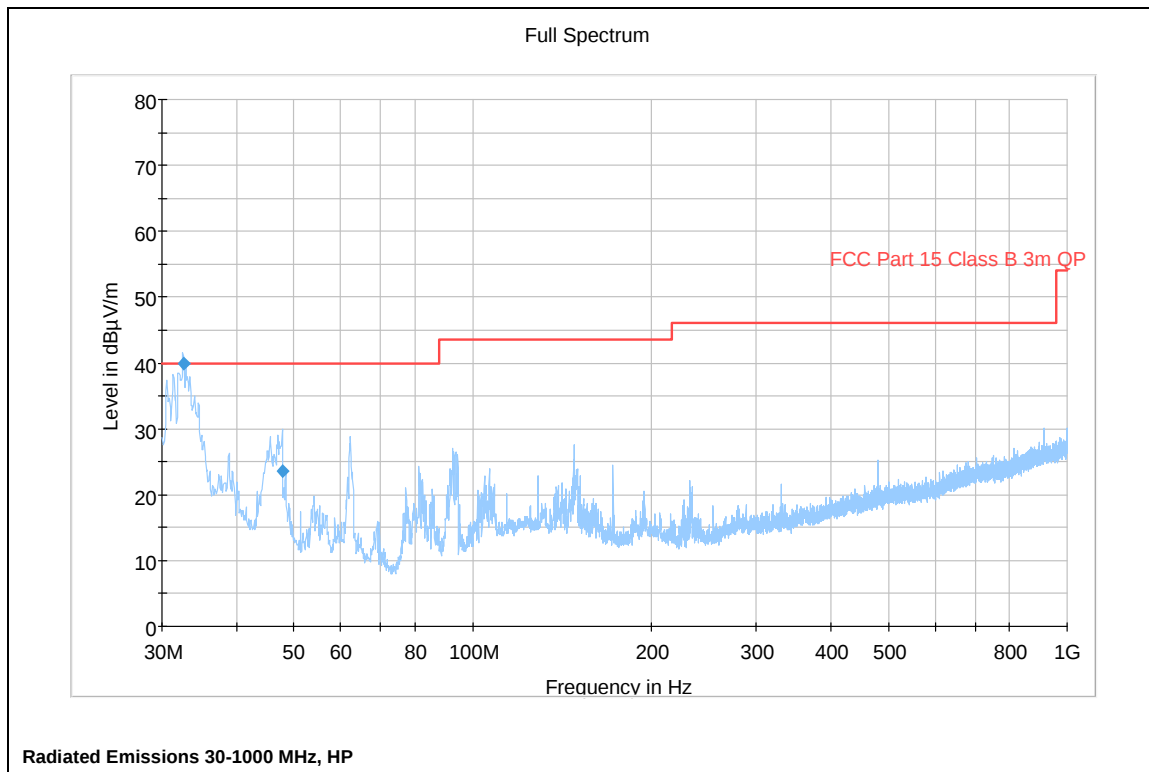
Measuring distance 3m

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.590058	39.96	40.00	0.04	15000.0	120.000	102.0	V	9.0	-6.3
47.798340	23.60	40.00	16.40	15000.0	120.000	150.0	V	22.0	-14.5

See attached plots.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
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		



4.10 Radiated Emissions, 1 – 40 GHz

FCC 15.205, 15.209, 15.407

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Measuring distance 3m up to 18 GHz.

A prescan at 1m was performed from 18 – 40 GHz

Carrier Freq. (MHz)	Measured Freq. (GHz)	Measured Emission (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
		Peak	Average	Pk	Av	Pk	Av
Any	Any	< 65	< 50	74	54	> 9	> 4

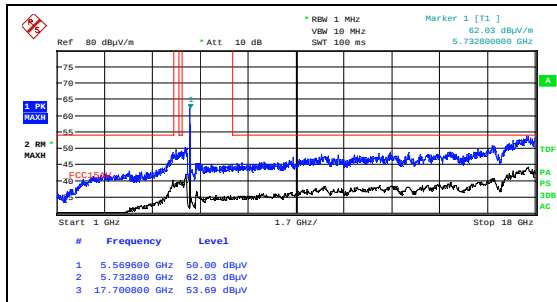
No Spurious were detected.

Antenna factor, amplifier gain, and cable loss are included in Spectrum Analyzer "Transducer factor".

See attached plots.

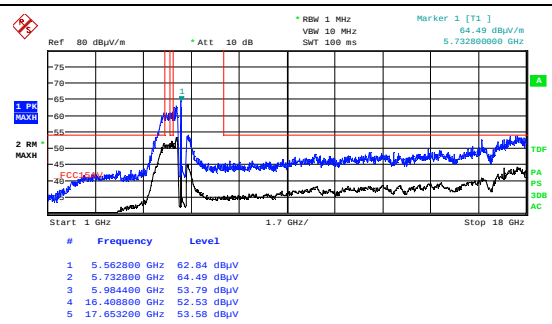
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
	Radiated emission limit @3 meters	
Frequency	Average Detector (dBμV/m)	Peak Detector (dBμV/m)
1 – 40 GHz	54	74



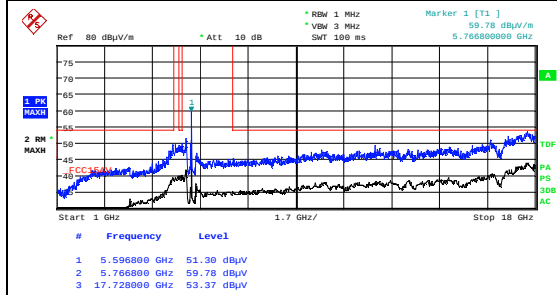
Date: 15.MAY.2023 16:21:03

Radiated Emissions 1-18 GHz, 5735 MHz, HP



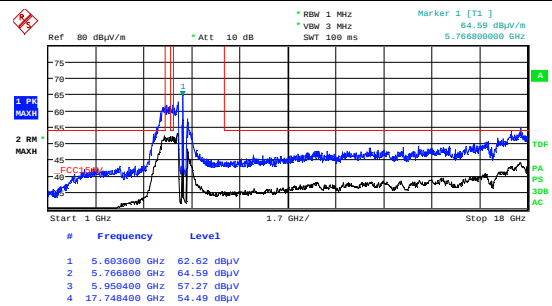
Date: 15.MAY.2023 16:19:07

VP



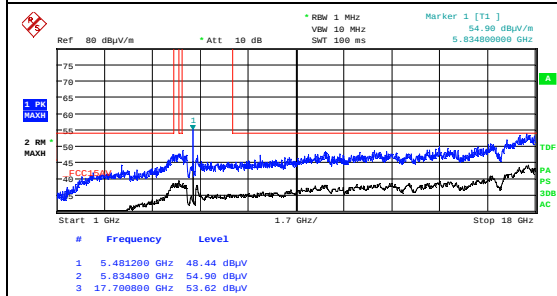
Date: 15.MAY.2023 16:12:54

Radiated Emissions 1-18 GHz, 5770 MHz, HP



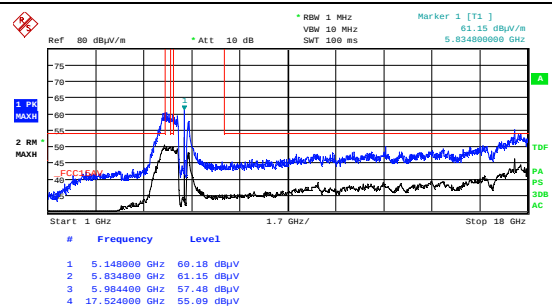
Date: 15.MAY.2023 16:10:59

VP



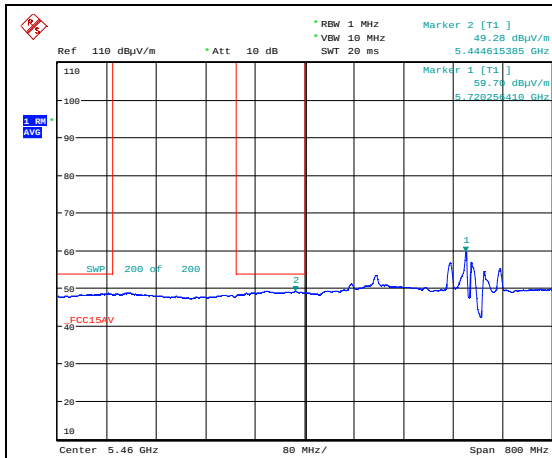
Date: 15.MAY.2023 16:29:24

Radiated Emissions 1-18 GHz, 5840 MHz, HP



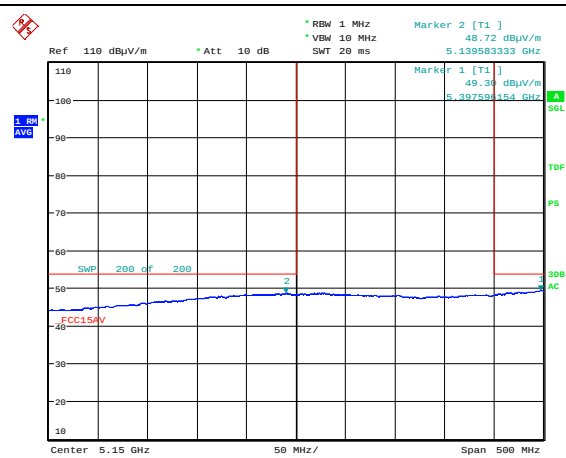
Date: 15.MAY.2023 16:27:27

VP



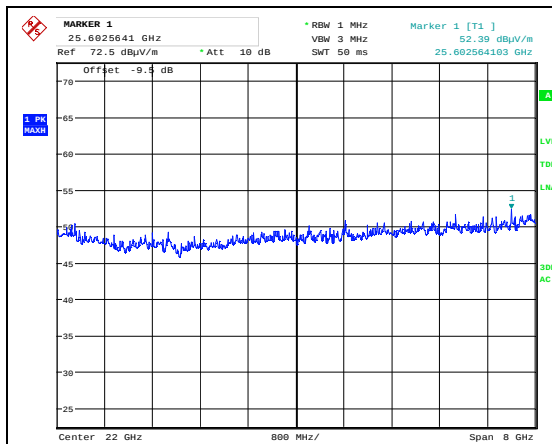
Date: 13.JUL.2023 15:08:38

Lower Band Edge 5725 MHz, ch147, Radiated, Max, Av



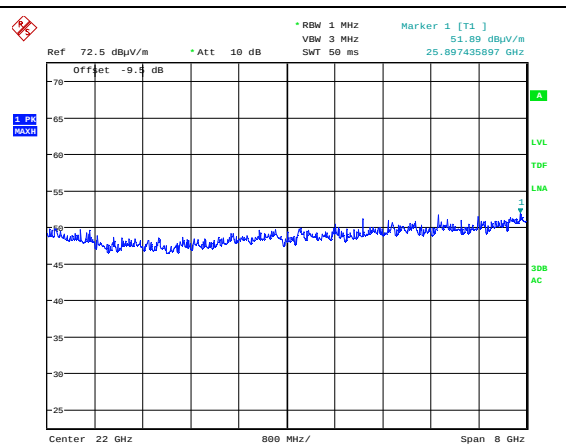
Date: 13.JUL.2023 15:04:56

Lower Band Edge 5725 MHz, ch147, Radiated, Max, Av



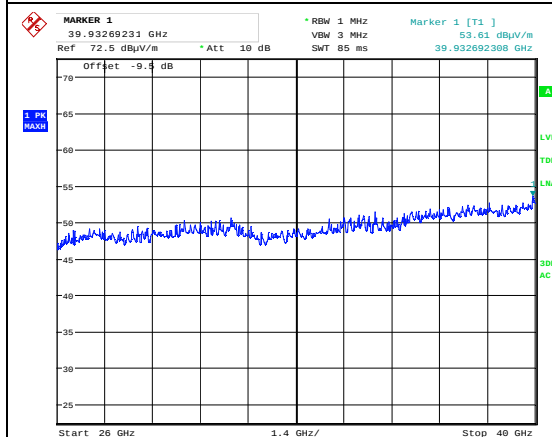
Date: 29.JUN.2023 13:05:00

Pre-scan @1m, 18-26 GHz, 5770 MHz, HP



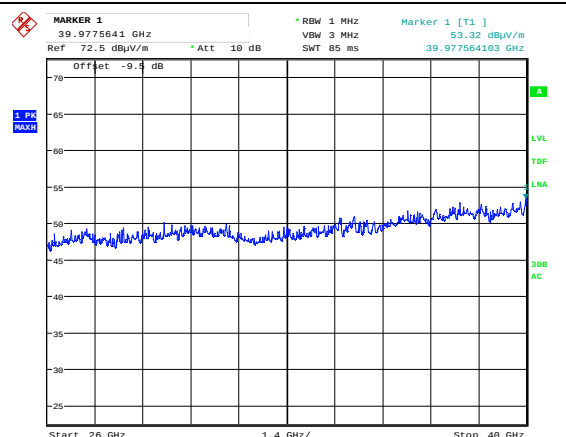
Date: 29.JUN.2023 13:02:48

VP



Date: 29.JUN.2023 13:21:28

Pre-scan @1m, 26-40 GHz, 5770 MHz, HP



Date: 29.JUN.2023 13:16:17

VP

5 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

6 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	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
2	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2022-08	2023-08
3	6810-17B	Attenuator	Suhner	LR 1669	COU	
4	N0257881	Tunable BandStop Filter (5.8 GHz)	Wainwright Inst.	LR 1764	COU	
5	L01G18G1	LowPass Filter (1 GHz)	Microwave Circuits	LR 1768	COU	
6	VULB 9163	Hybrid Antenna	Schwarzbeck	LR 1616	2021-05	2024-05
7	310	Preamplifier	Sonoma Inst.	LR 1686	2022-08	2023-08
8	Model 638	Antenna Horn	Narda	LR 1480	N/A	
9	Model V637	Horn Antenna	Narda	LR 099	N/A	
10	JS4-20004000	Preamplifier	Miteq	LR 1591	2022-08	2023-08
11	Model 87 V	Multimeter	Fluke	LR 1600	2022-03	2024-03

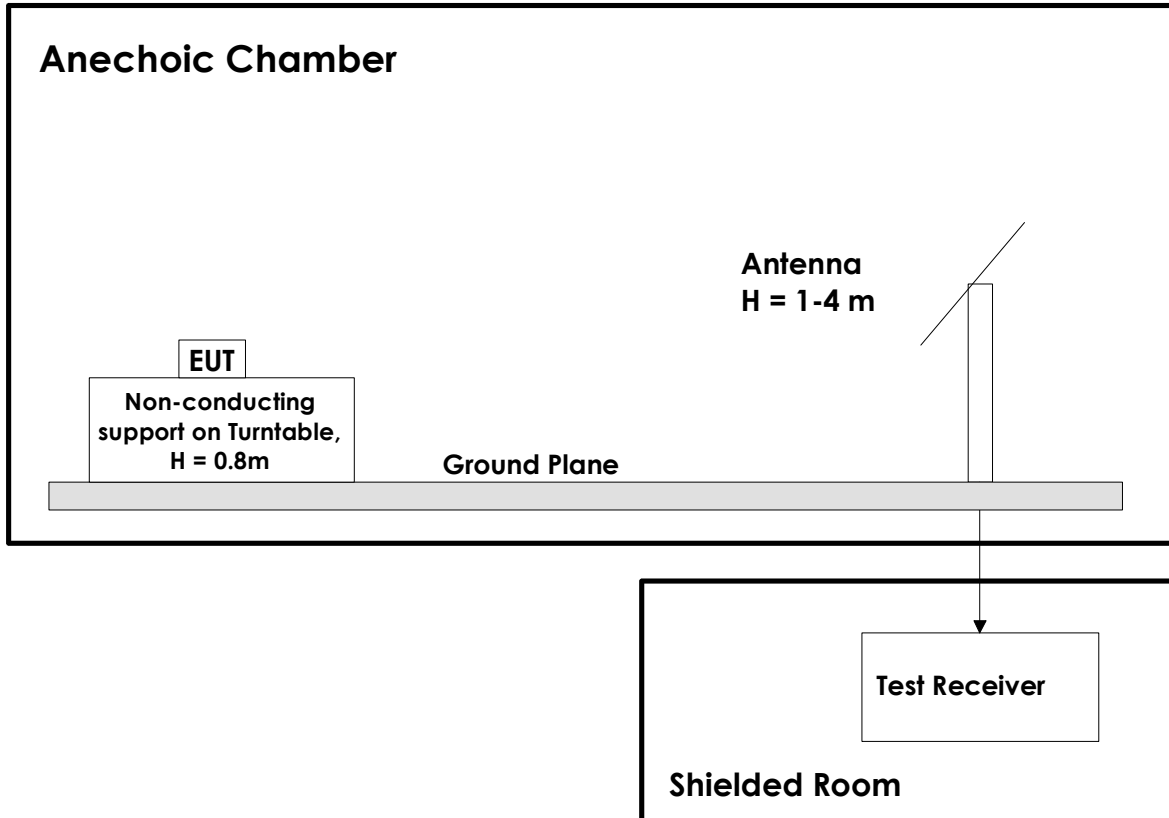
Note: COU – calibrate on use; N/A – Not Applicable

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

No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.30	EMC test software
2	Rohde & Schwarz	GPBShot	2.7	Screenshots from R&S Spectrum Analyzers

7 BLOCK DIAGRAM

7.1 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. Measuring distance is 3m for all frequencies.

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

All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers.

A pre-amplifier was used for all measurements.

For carrier measurements, up to 30 dB attenuation was used to avoid overloading the preamp.

A Band-Stop filter was used for Spurious Emissions and Band Edge measurements below 18 GHz.

A Low-Pass Filter was used below 1 GHz.