

Test Report

Product	Maritime Broadband Radio		
Name and address of the applicant	Kongsberg Seatex AS Havnegata 9 N-7010 Trondheim, Norway		
Name and address of the manufacturer	Kongsberg Seatex AS Havnegata 9 N-7010 Trondheim, Norway		
Model	MBR 189 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) Industry Canada RSS-247, Issue 2 Licence-Exempt Local Area Network (LE-LAN) Devices		
Order number	466874		
Tested in period	2022-06-29 to 2022-11-25		
Issue date	2022-11-28		
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 [Jan G. Eriksen]		
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Revision history

Revision	Date	Comment	Sign
00	2022-11-28	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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2 INFORMATION

2.1 Test Item

Name	Kongsberg
Model	MBR 189 MK2
FCC ID	Q8IM189MK2
Serial number	2641
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
Conducted Output Power	1.05 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 Antenna		

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 and ISSED RSS-247 Issue 2.

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	RSS-247 Issue 2 RSS-GEN Issue 5 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	Complies
Power Line Conducted Emissions	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	N/A
Maximum Output Power	15.407(a)	6.2	Complies
Power Spectral Density	15.407(a)	6.2	Complies
Emission Bandwidth	15.407(a)(2)	6.2	Complies
Unwanted Emissions	15.407(b)	6.2	Complies
6 dB Bandwidth	15.407(e)	6.2.4	Complies
Radiated Emissions	15.205 15.209	7.3 (RSS-GEN) 8.9 (RSS-GEN)	Complies

4 TEST RESULTS

4.1 Maximum Output Power, EIRP

FCC 15.407 (a)

ISED RSS-247, Issue 2, Clause 6.2

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 (dBμV/m @3m)	Maximum e.i.r.p. (dBm)
147	5735	125.2	29.9
154	5770	125.4	30.2
168	5840	124.0	29.8

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

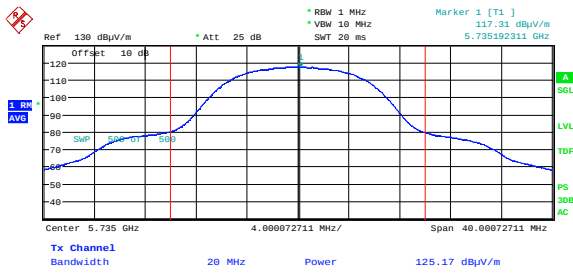
Measured radiated at 3m.

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

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

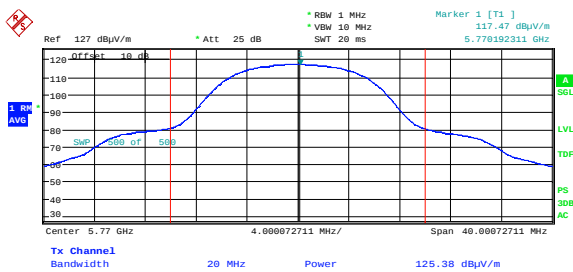
Limits for Indoor Device:

Frequency Band	FCC 15.407(a)	ISED RSS-247 Issue 2
5725 – 5825 MHz	Less than 1 Watt	Less than 1 Watt If Antenna Gain is more than 6 dBi the Power Limit is reduced by the amount exceeding 6 dBi
	If Antenna Gain is more than 6 dBi the Power Limit is reduced by the amount exceeding 6 dBi	



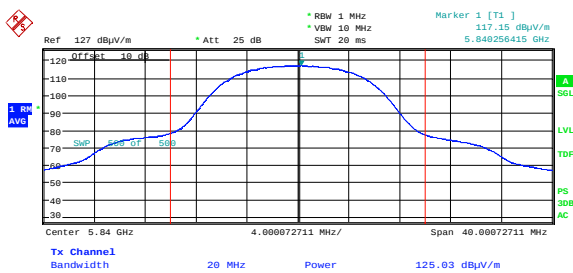
Date: 24.NOV.2022 17:42:12

RMS Field Strength, 5735 MHz



Date: 24.NOV.2022 17:17:52

RMS Field Strength, 5770 MHz



Date: 24.NOV.2022 17:06:18

RMS Field Strength, 5840 MHz

4.2 Emission Bandwidth / Occupied BW (99%)

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

ISED RSS-247, Issue 2, Clause 6.2

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

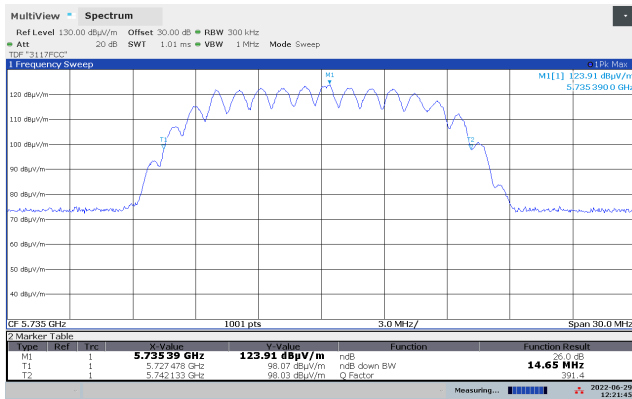
Test Results: Complies

Measurement Data:

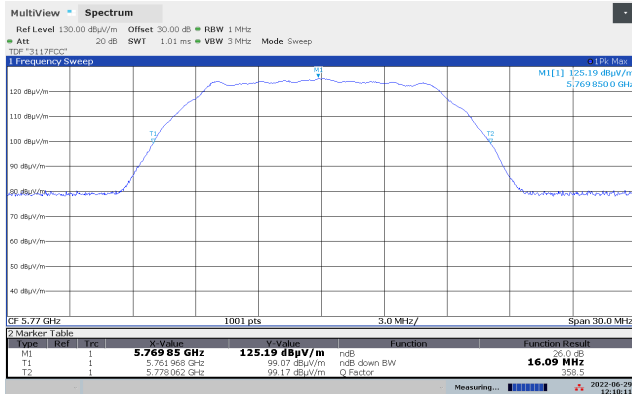
Ch. No.	Nominal Frequency	Emission BW B (26dB BW)	Occupied BW (99%)
147	5735 MHz	14.7 MHz	12.8 MHz
154	5770 MHz	16.1 MHz	12.8 MHz
168	5840 MHz	14.6 MHz	12.8 MHz

Limit:

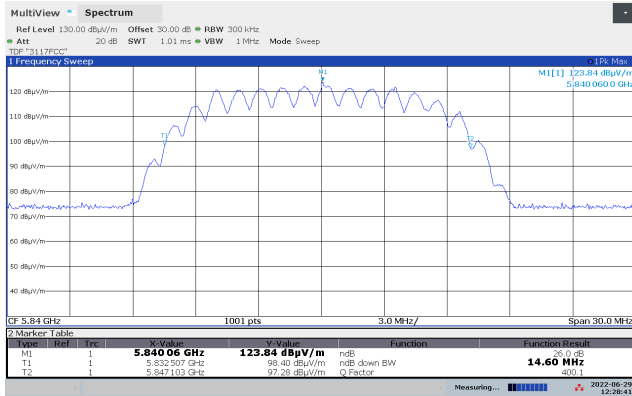
No requirements as long as the emissions are within the band-edges.



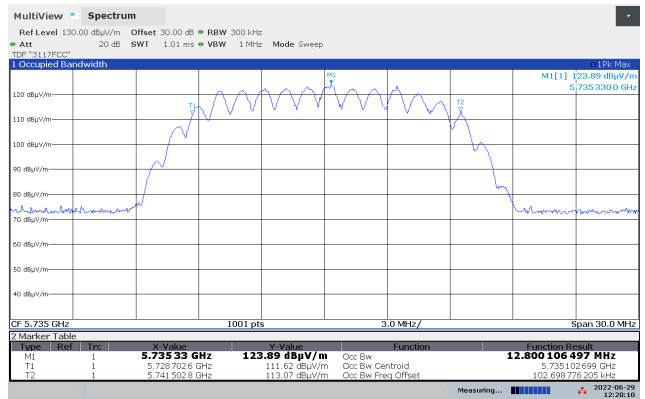
Emission Bandwidth B, 5735 MHz



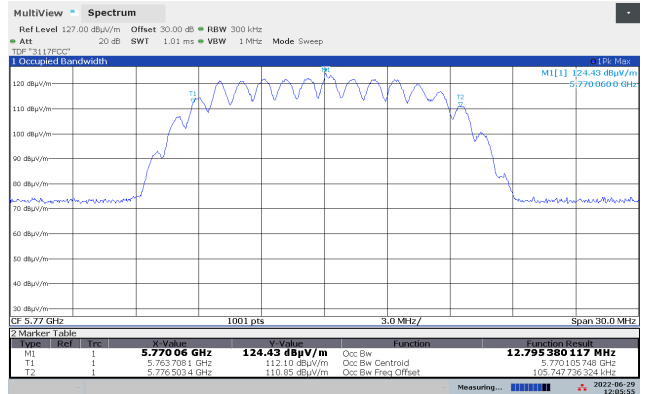
Emission Bandwidth B, 5770 MHz



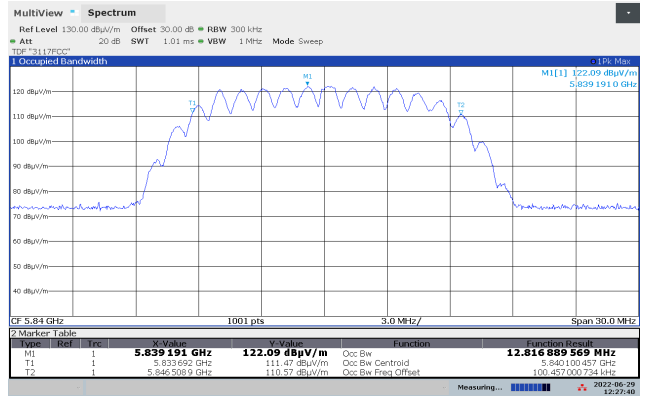
Emission Bandwidth B, 5840 MHz



99% Occupied Bandwidth, 5735 MHz



99% Occupied Bandwidth, 5770 MHz



99% Occupied Bandwidth, 5840 MHz

4.3 DTS Bandwidth

Para. No.: 15.407(e)

ISED RSS-247, Issue 2, Clause 6.2.4

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

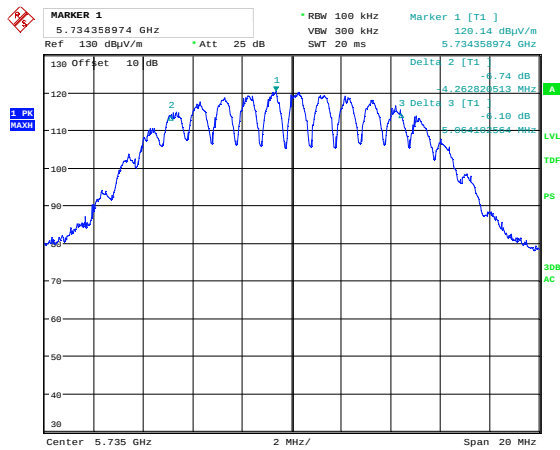
Test Results: Complies

Measurement Data:

Ch. No.	Nominal Frequency	DTS Bandwidth (6 dB)
147	5735 MHz	9.3 MHz
154	5770 MHz	9.5 MHz
168	5840 MHz	8.1 MHz

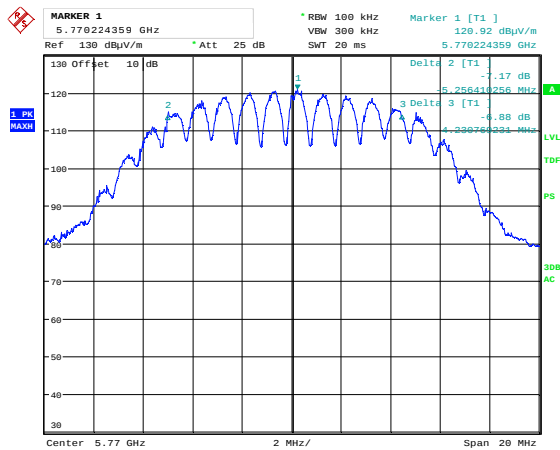
Limit:

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



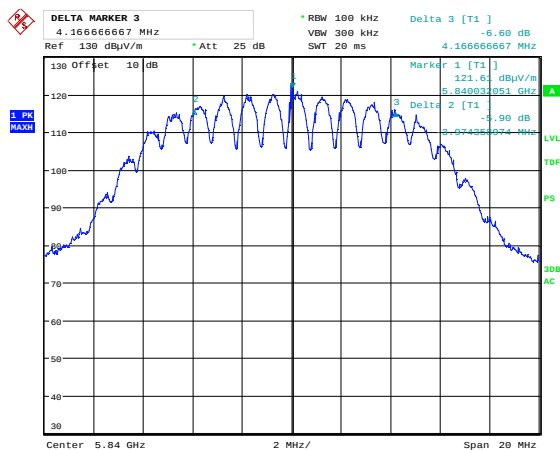
Date: 24.NOV.2022 17:46:06

DTS BW, 5735 MHz



Date: 24.NOV.2022 17:20:08

DTS BW, 5770 MHz



Date: 24.NOV.2022 17:10:20

DTS BW, 5840 MHz

4.4 Peak Power Spectral Density

FCC 15.407(a)

ISED RSS-247, Issue 2, Clause 6.2

Measurement procedure: ANSI C63.10-2013 Clause 12.5

Test Results: Complies

Measurement Data:

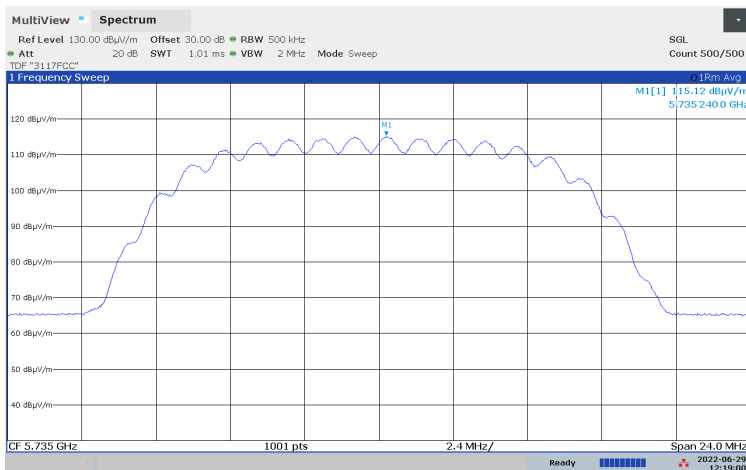
Ch. No.	Nominal Frequency	Peak PSD (dBμV/m / 500kHz @3m)	Peak PSD (dBm / 500kHz)
147	5735 MHz	115.1	19.9
154	5770 MHz	115.0	19.7
168	5840 MHz	114.1	18.9

Field Strength was converted to EIRP using the method described in KDB 412172.

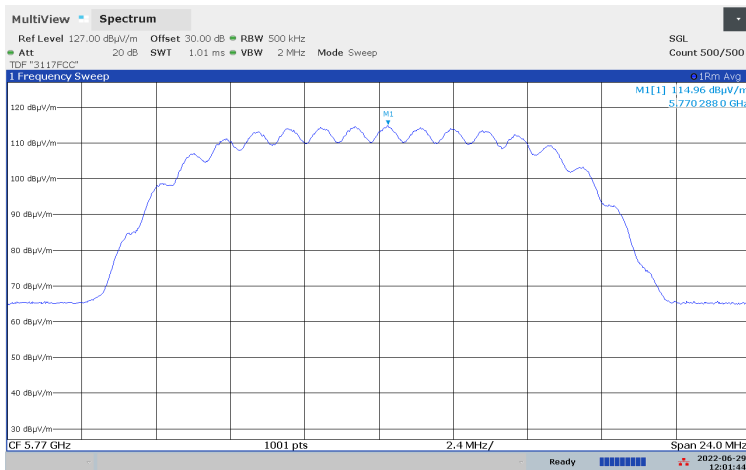
Antenna Gain is less than 6 dBi for all frequencies above.

Limits:

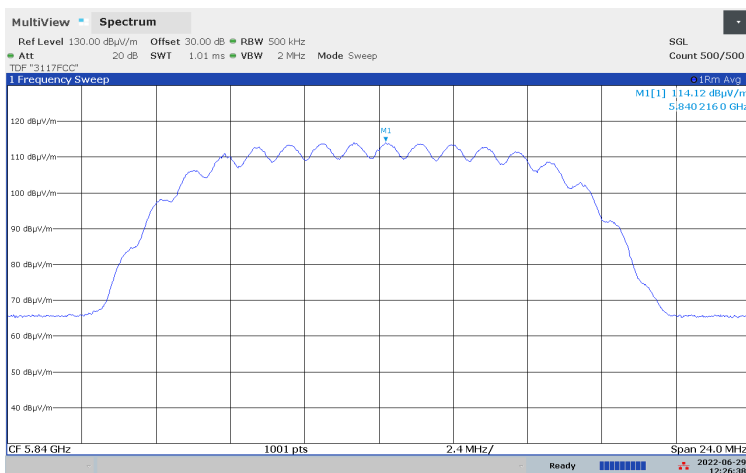
Frequency Band	FCC 15.407(a)	RSS-247, Issue 2
5725 – 5825 MHz	Less than 30 dBm/500kHz	Less than 30 dBm/500kHz
	If Antenna Gain is more than 6 dBi the limit above is reduced by the amount exceeding 6 dBi	



PSD, 5735 MHz



PSD, 5770 MHz



PSD, 5840 MHz

4.5 Unwanted Emissions

FCC 15.407 (b)

ISED RSS-247, Issue 2, clause 6.2

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
149	5735	5650	< -40
149	5735	5700	< -45
165	5840	5875	< -45
165	5840	5925	< -40

The measurement was performed radiated.

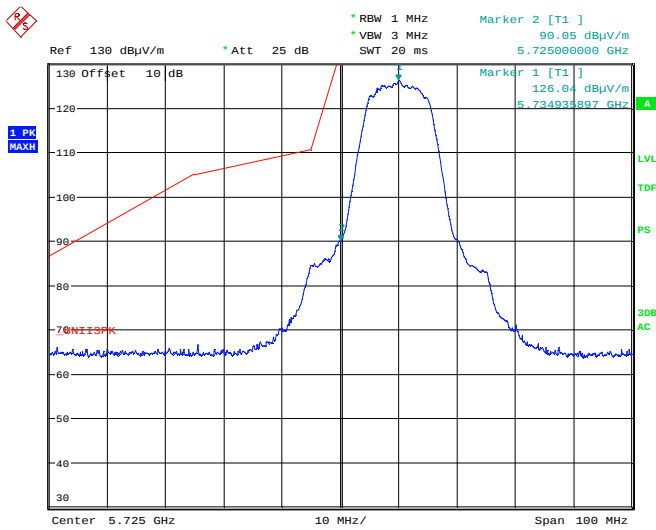
EIRP values were calculated from field strength using the method in KDB 412172 D01.

The tested equipment is for indoor use only, no band-edge requirements apply at 5250 MHz.

Limits:

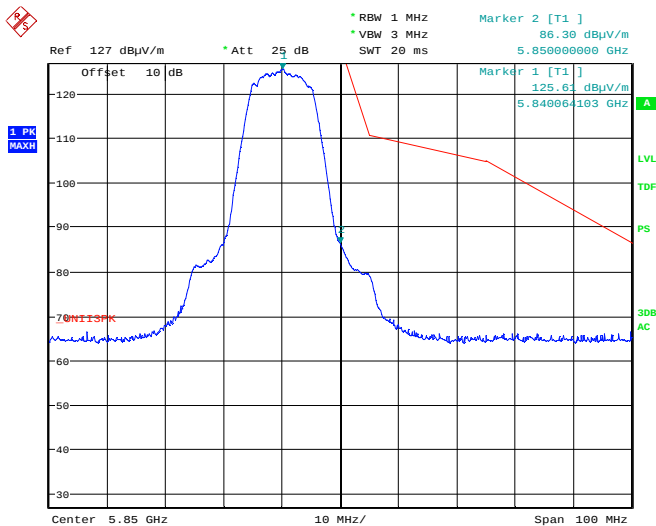
Operating Frequency band	Limit for Emissions Outside Operating Frequency Band
5725 – 5825 MHz	See FCC 15.407(b)(4)(i) or 15.407(b)(4)(ii)

Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.



Date: 24.NOV.2022 17:43:19

Band Edge 5725 MHz, ch147, Radiated, Max



Date: 25.NOV.2022 13:05:34

Band Edge 5850 MHz, ch168, Radiated, Max

4.6 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.

4.7 Radiated Emissions, 30 – 1000 MHz

FCC 15.205, 15.209, 15.407

ISED RSS-GEN, Issue 5, Clause 8.9

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Detector: QuasiPeak (Prescan with Peak Detector)

Measuring distance 3m

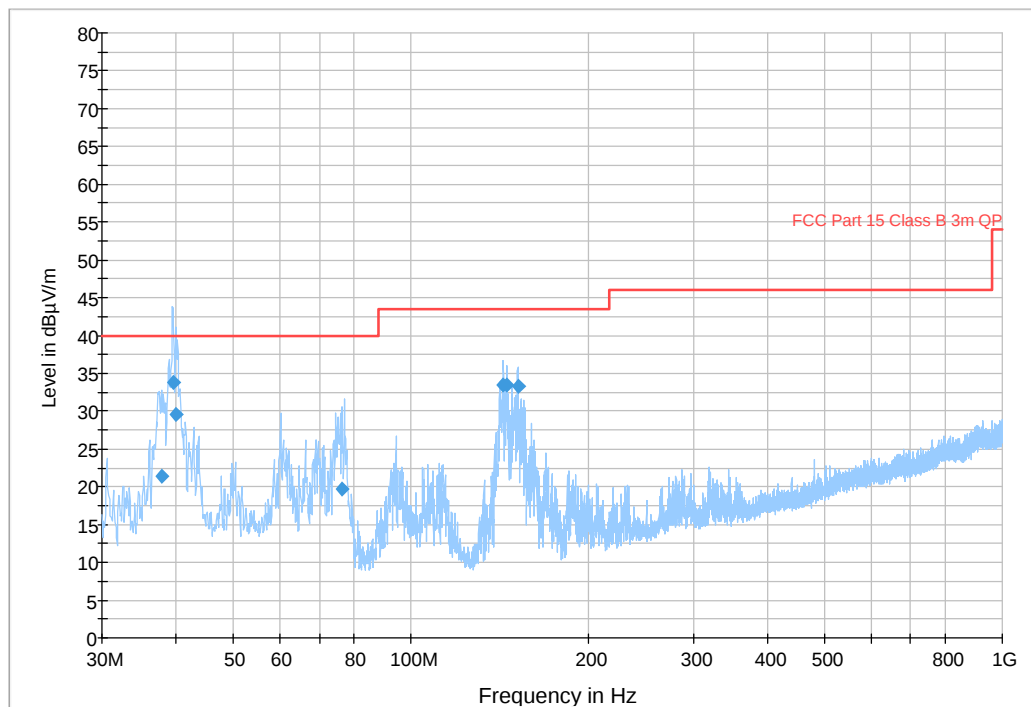
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.781690	21.46	40.00	18.54	15000.0	120.000	150.0	V	194.0	-14.0
39.554924	33.74	40.00	6.26	15000.0	120.000	109.0	V	204.0	-13.5
40.103768	29.51	40.00	10.49	15000.0	120.000	144.0	V	52.0	-13.4
76.526682	19.62	40.00	20.38	15000.0	120.000	300.0	V	164.0	-17.9
143.239050	33.43	43.50	10.07	15000.0	120.000	106.0	V	89.0	-17.5
145.254018	33.53	43.50	9.97	15000.0	120.000	115.0	V	93.0	-17.4
151.605440	33.32	43.50	10.18	15000.0	120.000	107.0	V	88.0	-17.2

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

4.8 Radiated Emissions, 1 – 40 GHz

FCC 15.205, 15.209, 15.407

ISED RSS-GEN, Issue 5, Clause 8.9

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	< 60	< 50	74	54	/	/

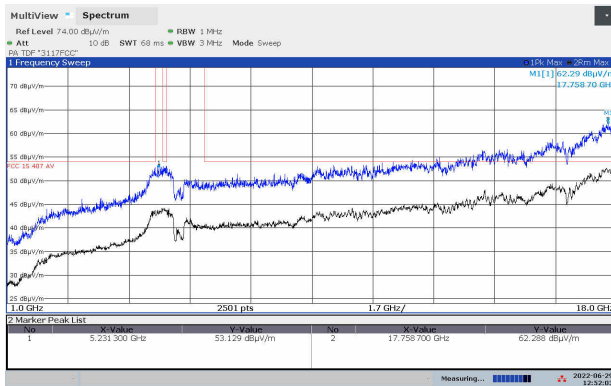
No spurious emissions were detected.

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

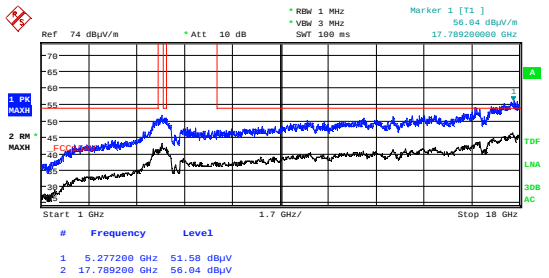
See attached plots.

Requirements/Limit

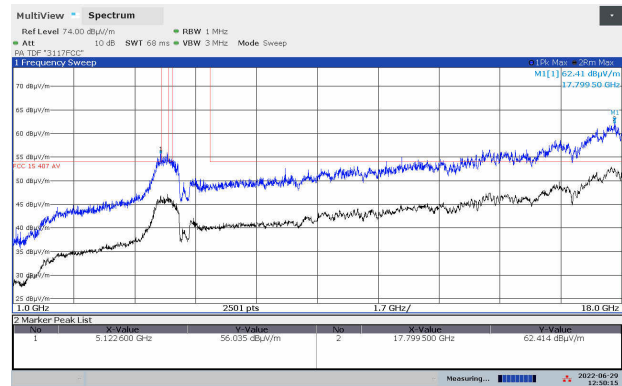
FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector (dBµV/m)	Peak Detector (dBµV/m)
1 – 40 GHz	54	74



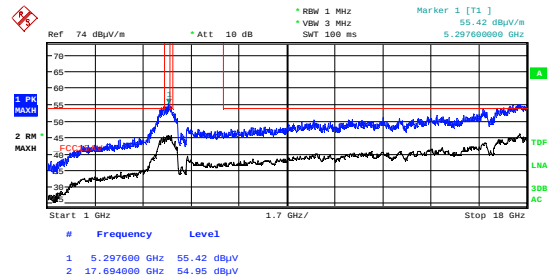
Radiated Emissions 1-18 GHz, 5735 MHz, HP



Date: 24.NOV.2022 18:17:07

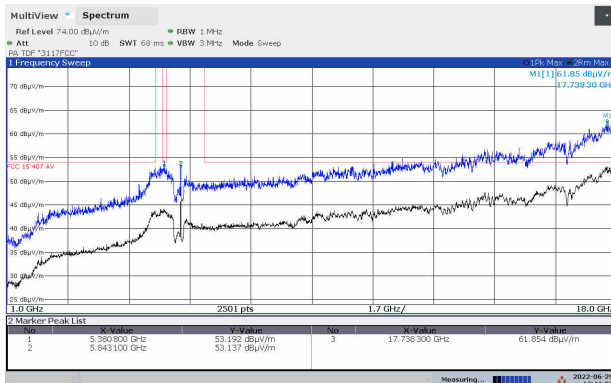


VP

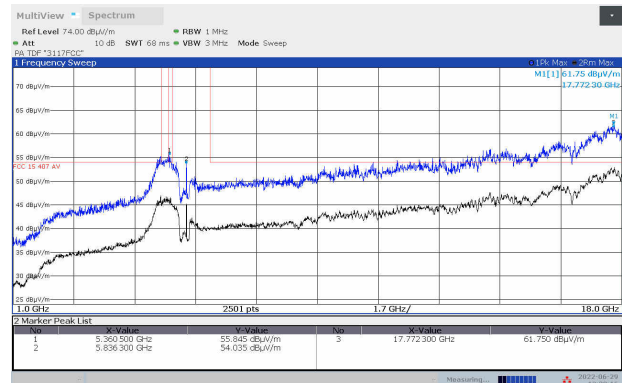


Date: 24.NOV.2022 18:15:12

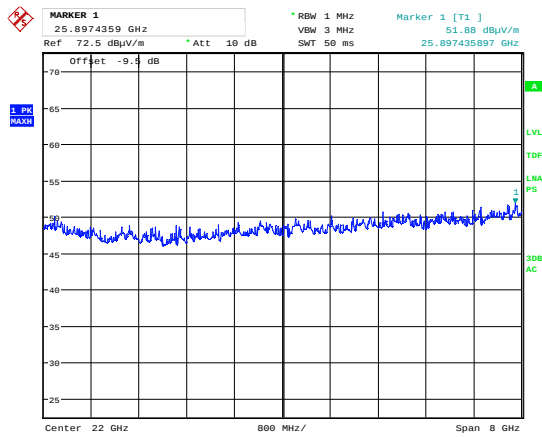
Radiated Emissions 1-18 GHz, 5770 MHz, HP



Radiated Emissions 1-18 GHz, 5840 MHz, HP

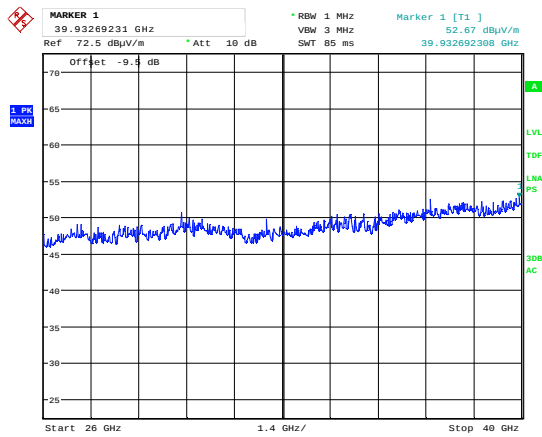


VP



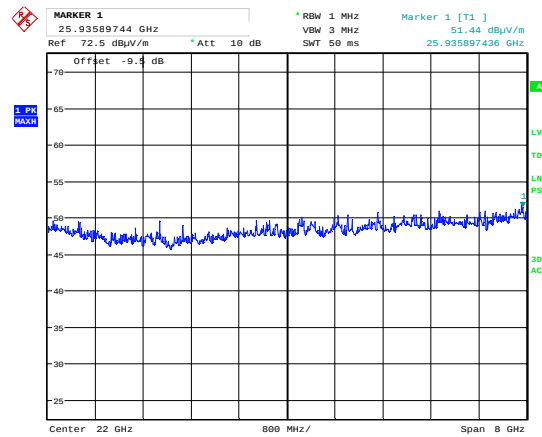
Date: 25.NOV.2022 15:31:41

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



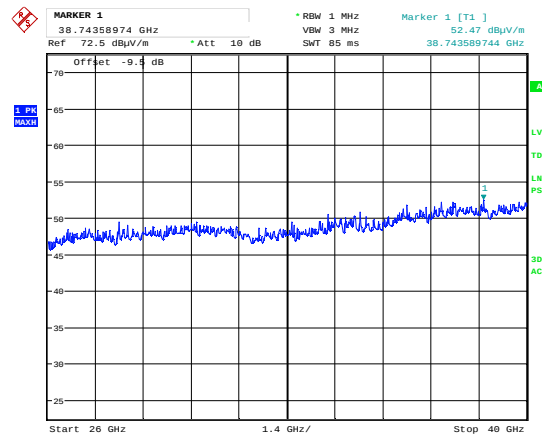
Date: 25.NOV.2022 15:41:00

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



Date: 25.NOV.2022 15:29:34

VP



Date: 25.NOV.2022 15:39:58

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	2022-01	2023-01
2	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2022-08	2023-08
3	6810-17B	Attenuator	Suhner	LR 1669	COU	
4	N0257881	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

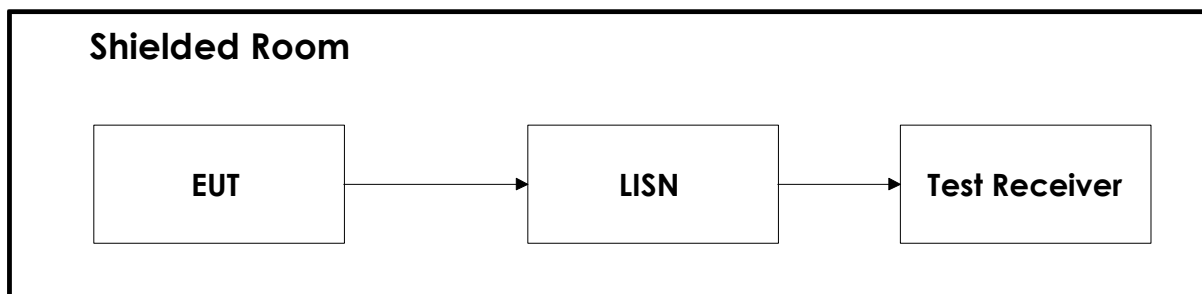
Note: COU – calibrate on use; N/A – Not Applicable

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

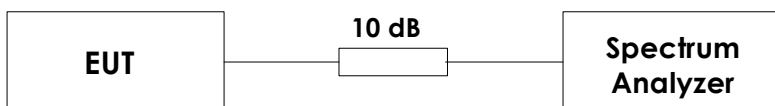
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.30	EMC test software
2	Rohde & Schwarz	GPBShot	2.7	Screenshots from R&S Spectrum Analyzers

7 BLOCK DIAGRAM

7.1 Power Line Conducted Emission

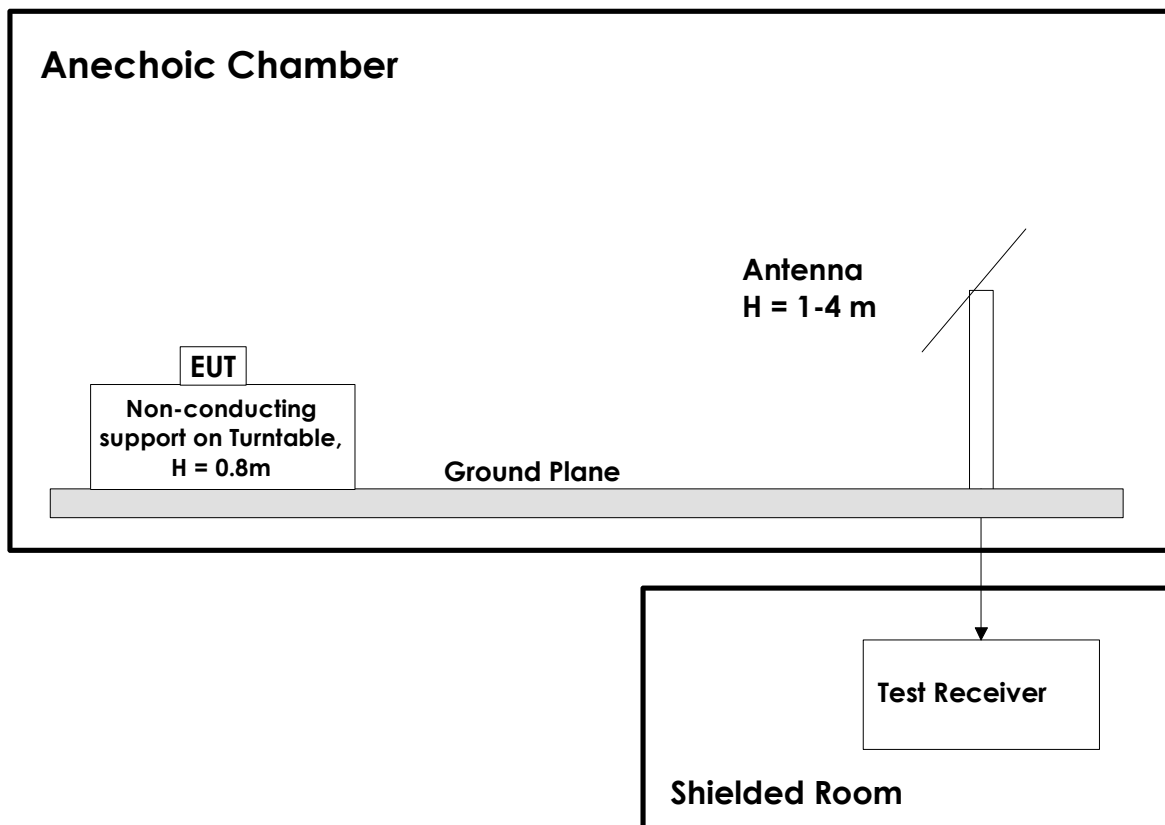


7.2 Conducted Tests



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

7.3 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 is used for all measurements, and High-Pass filter is used for all harmonics.