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RADIO TEST REPORT – 454155-3TRFWL

Type of assessment:

Final product testing

Applicant:

Redline Communications

Product:

Outdoor Wireless TCP/IP Transport

Model:

RDL-3211 XC

FCC ID:

QC8-RDL3211XC

IC Registration number:

4310A-RDL3211XC

Specifications:

- FCC 47 CFR Part 15 Subpart E, §15.407
- RSS-247, Issue 2, Feb 2017, Section 6

Date of issue: March 24, 2022

Mark Libbrecht, EMC/RF Specialist
Tested by

Signature

Andrey Adelberg, Senior EMC/RF Specialist
Reviewed by

Signature

Lab locations

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Test site identifier	**Organization**	**Ottawa/Almonte**	**Montreal**	**Cambridge**
	FCC:	CA2040	CA2041	**CA0101**
	ISED:	2040A-4	2040G-5	**24676**
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart E, Clause 15.407	Unlicensed National Information Infrastructure Devises
RSS-247, Issue 2, Feb 2017, Section 6	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices. Technical requirements for licence-exempt local area network devices and digital transmission systems operating in the 5 GHz band

1.2 Test methods

789033 D02 General U-NII Test Procedures New Rules v02r01 (December 14, 2017)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
662911 D02 MIMO with Cross Polarized Antenna v01 (October 25, 2011)	Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies In full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
TRF	March 24, 2022	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

2.2 Technical judgment

It was verified that the worst-case results were observed when EUT was operating with BPSK modulation (MCS: 0), therefore all the measurement results in this report are based on this modulation.

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Table 4.1-1: *Measurement uncertainty calculations*

Test name	Measurement uncertainty, ±dB
All antenna port measurements	0.55
Occupied bandwidth	4.45
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78

Section 5 Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Applicant name	Redline Communications
Applicant address	302 Town Center Blvd., Markham, Ontario L3R 0E8, Canada
Manufacturer name	Same as applicant
Manufacturer address	Same as applicant

5.3 EUT information

Product name	Outdoor Wireless TCP/IP Transport
Model	RDL-3211 XC
Serial number	477RM21450003
Part Number	13-00509-50
Power supply requirements	PoE 48 V_{DC} 0.280 A (via external 100–240 V_{AC}, 50/60 Hz Adapter)
Product description and theory of operation	The EUT is a 2×2 MIMO point-to-multipoint (PMP), and point-to-point (PTP) carrier grade broadband wireless infrastructure product, designed to operate in the U-NII-3 WLAN band.

5.4 Radio technical information

Device type	☒	Outdoor access point
	☐	Indoor access point
	☒	Fixed point-to-point access point
	☐	Client device
	☐	Device installed in vehicles
Frequency band	5725–5850 MHz (U-NII-3)	
Channel sizes (MHz)	0.875, 5, 10, 20, 40, 45	
Type of modulation	OFDM using 256-QAM, 128-QAM, 64-QAM, 16-QAM, QPSK and BPSK modulation for sub-carriers	
Antenna information	2×2 MIMO: 25 dBi Dual Polarization Antenna 4.9–6.1 GHz, Redline 30-00399-00	

Radio technical information, continued

Point to multi-point operation (Point to Multi Point)

Channel sizes:	0.875 MHz	5 MHz	10 MHz	20 MHz	40 MHz	45 MHz
Frequency Min (MHz)	5725.5	5727.5	5730.0	5735.0	5745.0	5747.5
Frequency Max (MHz)	5849.5	5847.5	5845.0	5840.0	5830.0	5827.5
RF power Max (W), Conducted	0.013 (11.19 dBm)	0.013 (11.19 dBm)	0.013 (11.15 dBm)	0.014 (11.40 dBm)	0.014 (11.40 dBm)	0.013 (11.02 dBm)
Measured BW (MHz), 99% OBW	0.725	4.148	8.297	16.688	33.369	41.496
Emission classification	725KW7D	4M15W7D	8M30W7D	16M7W7D	33M4W7D	41M5W7D
Transmitter spurious, dBµV/m @ 3 m	42.92	42.78	43.75	43.61	43.32	43.67

Point to point operation (Point to Point)

Channel sizes:	0.875 MHz	5 MHz	10 MHz	20 MHz	40 MHz	45 MHz
Frequency Min (MHz)	5725.5	5727.5	5730.0	5735.0	5745.0	5747.5
Frequency Max (MHz)	5849.5	5847.5	5845.0	5840.0	5830.0	5827.5
RF power Max (W), Conducted	0.080 (19.03 dBm)	0.121 (20.81 dBm)	0.270 (24.31 dBm)	0.279 (24.46 dBm)	0.203 (23.08 dBm)	0.097 (19.88 dBm)
Measured BW (MHz), 99% OBW	0.735	4.137	8.270	16.620	33.385	41.389
Emission classification	735KW7D	4M14W7D	8M27W7D	16M6W7D	33M4W7D	41M4W7D
Transmitter spurious, dBµV/m @ 3 m	42.92	42.78	43.75	43.61	43.32	43.67

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	Test software: 1.90.0-106
Transmitter state	The EUT was controlled to transmit at desired frequency and modulation from laptop using web interface at IP address: 192.168.25.2. In addition, Telnet session was used to force 95% duty cycle with the following command: *dbg txloop 1 0 95* Power settings are made to attain output power table measurements shown in section 8.6

Table 5.5-1: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
PoE	Microsemi	PN: PD-9501GR/AC, SN: C19296230000004019

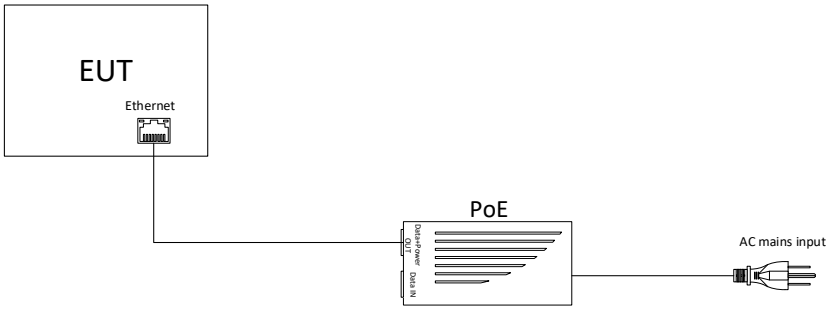


Figure 5.5-1: *Setup block diagram*

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Cambridge

6.2 Testing period

Test start date	January 13, 2022	Test end date	March 3, 2022

6.3 Sample information

Receipt date	December 17, 2021	Nemko sample ID number(s)	1

6.4 FCC Part 15 Subpart A and C, general requirements test results

Table 6.4-1: *FCC general requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31I	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass

Notes: Only limited subset of testing was performed

6.5 FCC Part §15.407 test results

Table 6.5-1: *FCC §15.407 requirements results*

Part	Test description	Verdict
§15.403(i)	Emission bandwidth	Pass
§15.407(a)(3)	Power and density limits within 5.725–5.85 GHz band	Pass
§15.407(b)(4)	Undesirable emission limits for 5.725–5.85 GHz band	Pass
§15.407(b)(6)	Conducted limits for U-NII devices using an AC power line	Pass
§15.407(e)	Minimum 6 dB bandwidth of U-NII devices within the 5.725-5.85 GHz band	Pass
§15.407(g)	Frequency stability	Pass
§15.407(h)(1)[1]	Transmit power control (TPC)	Not applicable
§15.407(h)(2)[1]	Dynamic Frequency Selection (DFS)	Not applicable

Notes [1]DFS and TPC requirements are only applicable to 5.25–5.35 GHz and 5.47–5.725 GHz bands

6.6 ISED RSS-Gen, Issue 5, test results

Table 6.6-1: *RSS-Gen requirements results*

Clause	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.11	Frequency stability	Pass
8.8	AC power-line conducted emissions limits	Pass

Notes: [1]According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

6.7 ISED RSS-247, Issue 2, test results

Table 6.7-1: *ISED RSS-247 requirements results*

Section	Test description	Verdict
6.1[1]	Types of Modulation	Pass
6.2.4.1	Power limits for 5725–5850 MHz band	Pass
6.2.4.1	Minimum 6 dB bandwidth for 5725–5850 MHz band	Pass
6.2.4.2	Unwanted emission limits for 5725–5850 MHz band	Pass
6.3	Dynamic Frequency Selection (DFS) for devices operating in the bands 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz	Not applicable

Notes: [1] The EUT employs digital modulations, such as: BPSK up to 256-QAM

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	November 30, 2022
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	November 30, 2022
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	April 12, 2022
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	April 28, 2022
Horn antenna (1–18 GHz)	ETS-Lindgren	3117	FA002911	1 year	April 21, 2022
Preamp (1–18 GHz)	ETS-Lindgren	124334	FA002956	1 year	April 5, 2022
50 Ω coax cable	Huber + Suhner	None	FA003043	1 year	July 13, 2022
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	July 13, 2022
Horn antenna (18–40 GHz)	EMCO	3116B	FA002948	1 year	January 23, 2022
Preamp 18-40 GHz	None	None	FA003323	1 year	April 5, 2022
Notch filter 2400-2483.5 MHz	Microwave Circuits	N0324413	FA001921	—	VOU
Notch filter 5725 - 5850 MHz	Microwave Circuits	N0257881	FA003027	—	VOU

Notes: NCR - no calibration required
VOU- verify on use

Section 8 Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

FCC §15.31 (e):

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.1.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

a) Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.
b) For devices, where operating at a supply voltage deviating ±15% from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.
c) For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.
d) For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

8.1.4 Test data

EUT Power requirements:	☐ AC	☒ DC	☐ Battery
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☒ NO	☐ N/A
If EUT is battery operated, was the testing performed using fresh batteries?	☐ YES	☐ NO	☒ N/A
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☐ YES	☐ NO	☒ N/A

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.2.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

a) For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.
b) For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.
c) If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).
b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).
c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

8.2.4 Test data

Table 8.2-2: *Test channels selection*

Channel bandwidth, MHz	Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
0.875	5725	5850	125	5725.5	5790.0	5849.5
5	5725	5850	125	5727.5	5790.0	5847.5
10	5725	5850	125	5730.0	5790.0	5845.0
20	5725	5850	125	5735.0	5790.0	5840.0
40	5725	5850	125	5745.0	5790.0	5830.0
45	5725	5850	125	5747.5	5790.0	5827.5

8.3 Antenna requirement

8.3.1 References, definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.3.3 Observations, settings and special notes

EUT utilizes 2 × 2 MIMO antenna configuration, which are cross polarized in orientation.

8.3.4 Test data

Must the EUT be professionally installed?	☒ YES	☐ NO	
Does the EUT have detachable antenna(s)?	☒ YES	☐ NO	
If detachable, is the antenna connector(s) non-standard?	☐ YES	☒ NO	☐ N/A

Table 8.3-1: *Antenna information*

Antenna type	Manufacturer	Model number	Maximum gain	Connector type
Dual Polarization	Redline	30-00399-00	25 dBi	MCX

8.4 Emission bandwidth and 6 dB BW

8.4.1 References, definitions and limits

FCC §15.403:

(i) For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

FCC §15.407:

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

RSS-247, Clause 2.6.4:

Frequency band 5725-5850 MHz:

6.2.4.1 Power limits

For equipment operating in the band 5725–5850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz.

8.4.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.4.3 Observations, settings and special notes

The emission bandwidth was tested per ANSI C63.10, Clause 12.4 and KDB 789033 D02, Clause II(C)(1). Spectrum analyser settings:

Resolution bandwidth	approximately 1% of the emission bandwidth
Video bandwidth	> RBW
Detector mode	Peak
Trace mode	Max Hold

The 6 dB bandwidth was tested per ANSI C63.10, Clause 11.8 and KDB 789033 D02, Clause II(C)(2). Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥3 × RBW
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: *26 dB bandwidth results, PMP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	26 dB bandwidth at ch0, MHz	26 dB bandwidth at ch1, MHz
0.875	BPSK	5725.5	0.843	0.847
0.875	BPSK	5790.0	0.829	0.839
0.875	BPSK	5849.5	0.847	0.853
5	BPSK	5727.5	4.70	4.75
5	BPSK	5790.0	4.71	4.71
5	BPSK	5847.5	4.68	4.79
10	BPSK	5730.0	9.35	9.47
10	BPSK	5790.0	9.39	9.45
10	BPSK	5845.0	9.39	9.47
20	BPSK	5735.0	18.58	18.66
20	BPSK	5790.0	18.58	18.74
20	BPSK	5840.0	18.58	18.78
40	BPSK	5745.0	37.62	37.90
40	BPSK	5790.0	37.55	37.90
40	BPSK	5830.0	37.62	37.90
45	BPSK	5747.5	46.35	46.99
45	BPSK	5790.0	46.51	47.07
45	BPSK	5827.5	46.67	46.83

Table 8.4-2: *26 dB bandwidth results, PTP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	26 dB bandwidth at ch0, MHz	26 dB bandwidth at ch1, MHz
0.875	BPSK	5725.5	0.823	0.843
0.875	BPSK	5790.0	0.823	0.825
0.875	BPSK	5849.5	0.821	0.829
5	BPSK	5727.5	4.67	4.71
5	BPSK	5790.0	4.71	4.71
5	BPSK	5847.5	4.71	4.71
10	BPSK	5730.0	9.43	9.43
10	BPSK	5790.0	9.35	9.45
10	BPSK	5845.0	9.37	9.49
20	BPSK	5735.0	18.54	18.62
20	BPSK	5790.0	18.58	18.58
20	BPSK	5840.0	18.66	18.66
40	BPSK	5745.0	37.72	37.96
40	BPSK	5790.0	37.56	37.72
40	BPSK	5830.0	37.72	37.96
45	BPSK	5747.5	46.83	46.91
45	BPSK	5790.0	46.59	47.15
45	BPSK	5827.5	46.59	46.67

Test data, continued

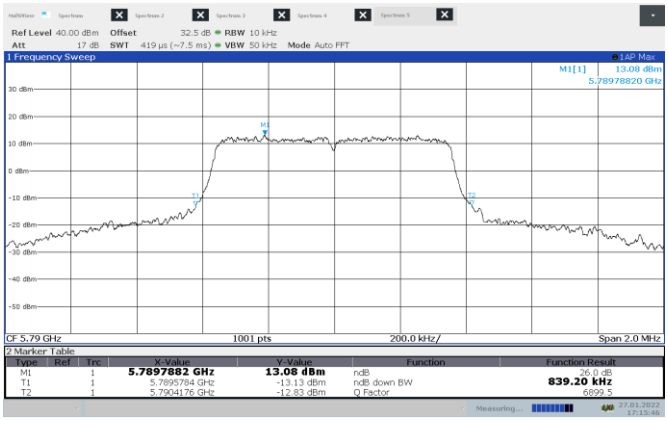


Figure 8.4-1: *26 dB bandwidth on 0.875 MHz channel, sample plot*

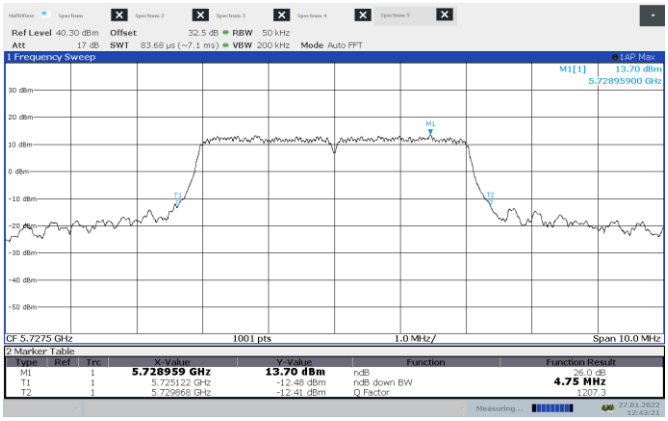


Figure 8.4-2: *26 dB bandwidth on 5 MHz channel, sample plot*

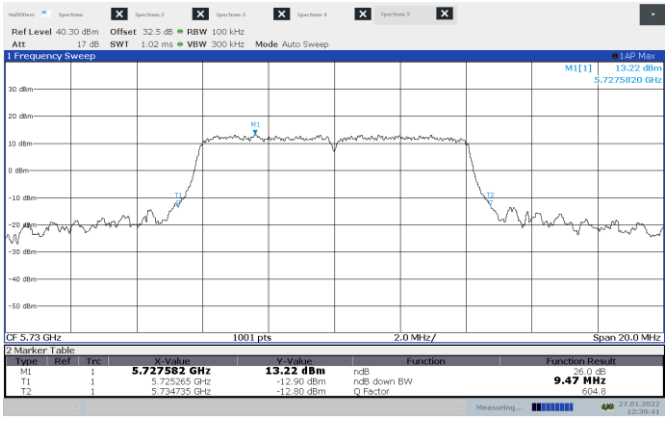


Figure 8.4-3: *26 dB bandwidth on 10 MHz channel, sample plot*

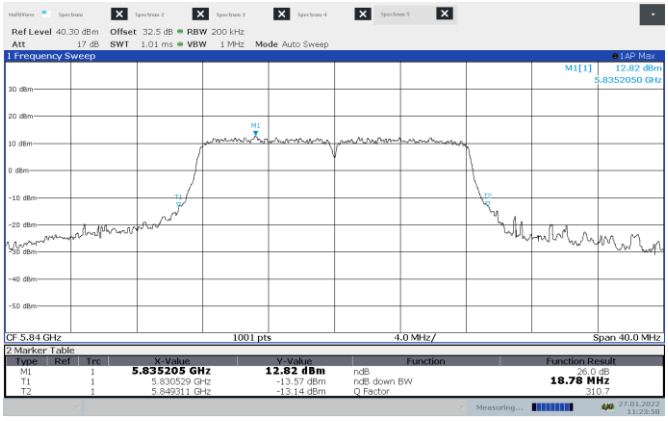


Figure 8.4-4: *26 dB bandwidth on 20 MHz channel, sample plot*

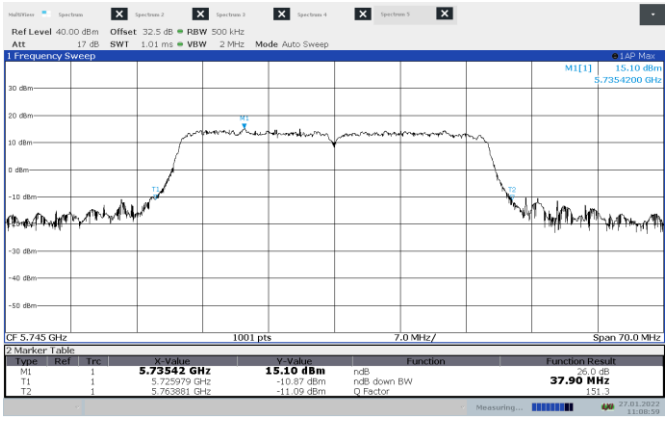


Figure 8.4-5: *26 dB bandwidth on 40 MHz channel, sample plot*

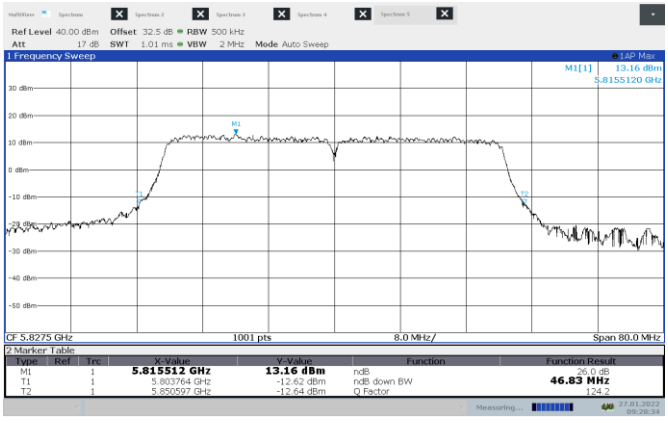


Figure 8.4-6: *26 dB bandwidth on 45 MHz channel, sample plot*

Test data, continued

Table 8.4-3: *6 dB bandwidth results, PMP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	6 dB bandwidth at ch0, MHz	6 dB bandwidth at ch1, MHz	Minimum limit, MHz	Minimum margin, MHz
0.875	BPSK	5725.5	0.731	0.751	0.500	0.23
0.875	BPSK	5790.0	0.757	0.735	0.500	0.24
0.875	BPSK	5849.5	0.721	0.737	0.500	0.22
5	BPSK	5727.5	4.11	4.11	0.500	3.61
5	BPSK	5790.0	4.11	4.11	0.500	3.61
5	BPSK	5847.5	4.11	4.11	0.500	3.61
10	BPSK	5730.0	8.23	8.25	0.500	7.73
10	BPSK	5790.0	8.25	8.23	0.500	7.73
10	BPSK	5845.0	8.25	8.25	0.500	7.75
20	BPSK	5735.0	16.66	16.66	0.500	16.16
20	BPSK	5790.0	16.66	16.66	0.500	16.16
20	BPSK	5840.0	16.66	16.66	0.500	16.16
40	BPSK	5745.0	33.31	33.26	0.500	32.76
40	BPSK	5790.0	33.29	33.28	0.500	32.78
40	BPSK	5830.0	33.30	33.28	0.500	32.78
45	BPSK	5747.5	41.64	41.60	0.500	41.10
45	BPSK	5790.0	41.62	41.60	0.500	41.10
45	BPSK	5827.5	41.68	41.57	0.500	41.07

Table 8.4-4: *6 dB bandwidth results, PTP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	6 dB bandwidth at ch0, MHz	6 dB bandwidth at ch1, MHz	Minimum limit, MHz	Minimum margin, MHz
0.875	BPSK	5725.5	0.741	0.743	0.500	0.24
0.875	BPSK	5790.0	0.737	0.755	0.500	0.24
0.875	BPSK	5849.5	0.745	0.749	0.500	0.25
5	BPSK	5727.5	4.11	4.11	0.500	3.61
5	BPSK	5790.0	4.12	4.11	0.500	3.61
5	BPSK	5847.5	4.09	4.11	0.500	3.59
10	BPSK	5730.0	8.21	8.25	0.500	7.71
10	BPSK	5790.0	8.23	8.25	0.500	7.73
10	BPSK	5845.0	8.25	8.29	0.500	7.75
20	BPSK	5735.0	16.66	16.66	0.500	16.16
20	BPSK	5790.0	16.66	16.66	0.500	16.16
20	BPSK	5840.0	16.66	16.66	0.500	16.16
40	BPSK	5745.0	33.32	33.30	0.500	32.80
40	BPSK	5790.0	33.34	33.27	0.500	32.77
40	BPSK	5830.0	33.28	33.29	0.500	32.78
45	BPSK	5747.5	41.68	41.61	0.500	41.11
45	BPSK	5790.0	41.66	41.56	0.500	41.06
45	BPSK	5827.5	41.64	41.66	0.500	41.14

Test data, continued

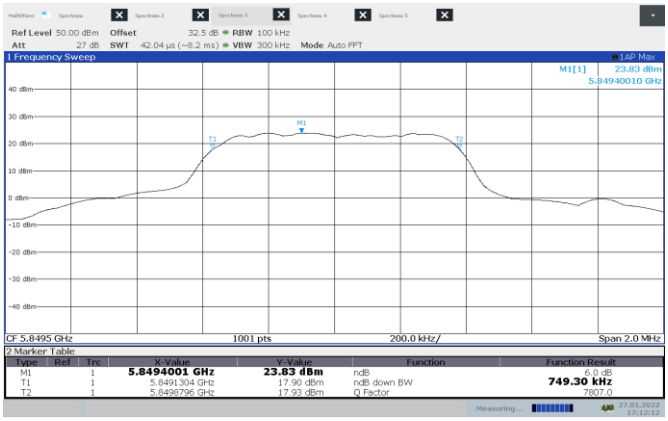


Figure 8.4-7: *6 dB bandwidth on 0.875 MHz channel, sample plot*

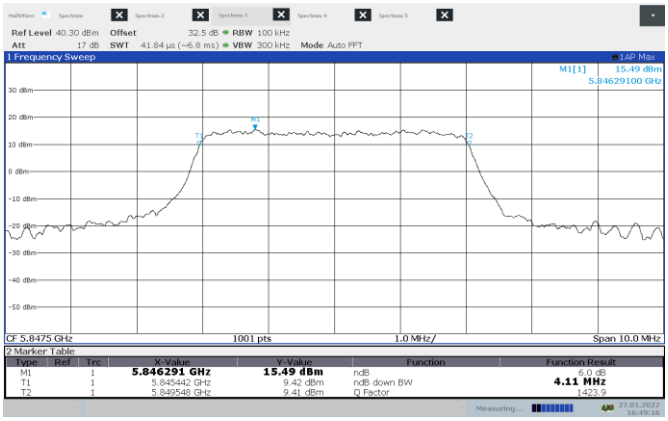


Figure 8.4-8: *6 dB bandwidth on 5 MHz channel, sample plot*

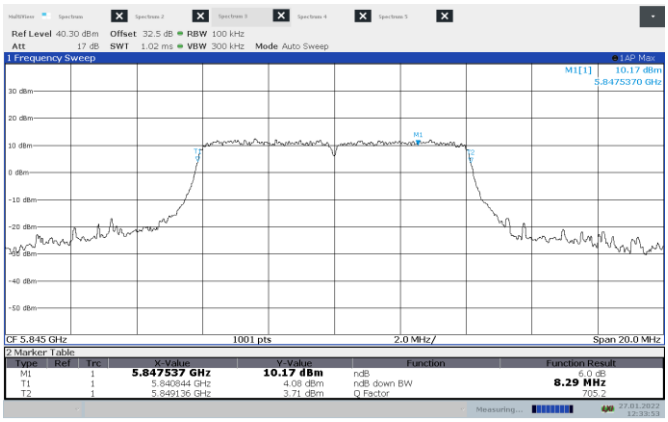


Figure 8.4-9: *6 dB bandwidth on 10 MHz channel, sample plot*

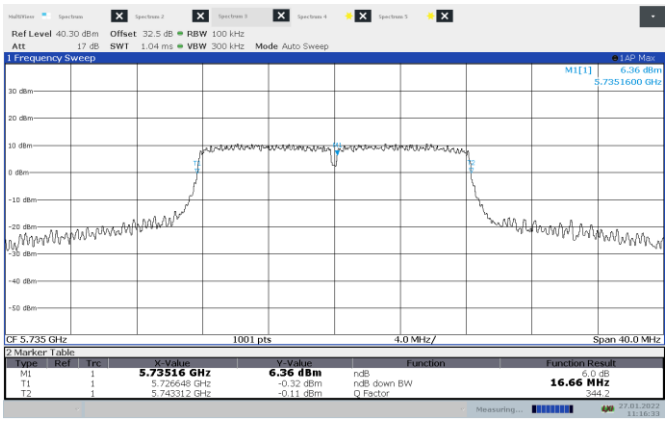


Figure 8.4-10: *6 dB bandwidth on 20 MHz channel, sample plot*

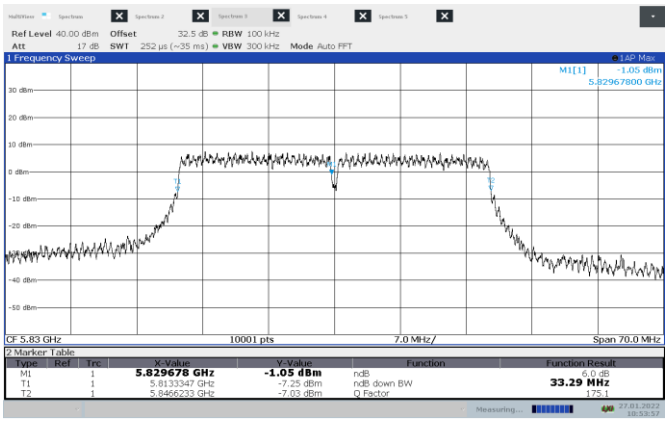


Figure 8.4-11: *6 dB bandwidth on 40 MHz channel, sample plot*

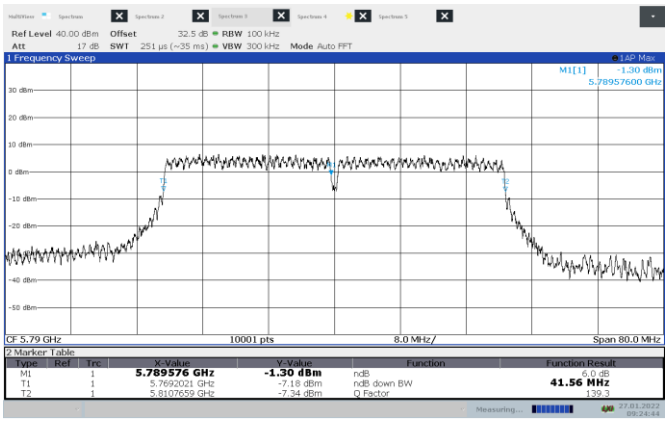


Figure 8.4-12: *6 dB bandwidth on 45 MHz channel, sample plot*

8.5 Occupied bandwidth

8.5.1 References, definitions and limits

ANSI C63.10-2013, Clause 6.9.3:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

RSS-Gen, Clause 6.7:

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

8.5.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.5.3 Observations, settings and special notes

The emission bandwidth was tested per ANSI C63.10, Clause 6.9.3 and KDB 789033 D02, Clause II(D). Spectrum analyser settings:

Resolution bandwidth:	≥ 1 % of span
Video bandwidth:	≥3 × RBW
Detector mode:	Peak
Trace mode:	Max Hold

8.5.4 Test data

Table 8.5-1: *99% bandwidth results, PMP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	99% bandwidth at ch0, MHz	99% bandwidth at ch1, MHz
0.875	BPSK	5725.5	0.739	0.742
0.875	BPSK	5790.0	0.737	0.741
0.875	BPSK	5849.5	0.742	0.752
5	BPSK	5727.5	4.136	4.144
5	BPSK	5790.0	4.140	4.129
5	BPSK	5847.5	4.127	4.148
10	BPSK	5730.0	8.266	8.297
10	BPSK	5790.0	8.252	8.273
10	BPSK	5845.0	8.253	8.282
20	BPSK	5735.0	16.644	16.688
20	BPSK	5790.0	16.615	16.617
20	BPSK	5840.0	16.628	16.615
40	BPSK	5745.0	33.361	33.369
40	BPSK	5790.0	33.312	33.230
40	BPSK	5830.0	33.273	33.286
45	BPSK	5747.5	41.382	41.496
45	BPSK	5790.0	41.330	41.364
45	BPSK	5827.5	41.333	41.341

Table 8.5-2: *99% bandwidth results, PTP operation*

Channel bandwidth, MHz	Modulation	Frequency, MHz	99% bandwidth at ch0, MHz	99% bandwidth at ch1, MHz
0.875	BPSK	5725.5	0.733	0.734
0.875	BPSK	5790.0	0.735	0.730
0.875	BPSK	5849.5	0.734	0.734
5	BPSK	5727.5	4.122	4.128
5	BPSK	5790.0	4.123	4.136
5	BPSK	5847.5	4.120	4.137
10	BPSK	5730.0	8.253	8.259
10	BPSK	5790.0	8.258	8.264
10	BPSK	5845.0	8.255	8.270
20	BPSK	5735.0	16.612	16.560
20	BPSK	5790.0	16.608	16.584
20	BPSK	5840.0	16.620	16.600
40	BPSK	5745.0	33.265	33.209
40	BPSK	5790.0	33.230	33.228
40	BPSK	5830.0	33.385	33.280
45	BPSK	5747.5	41.307	41.297
45	BPSK	5790.0	41.213	41.271
45	BPSK	5827.5	41.389	41.291

Test data, continued

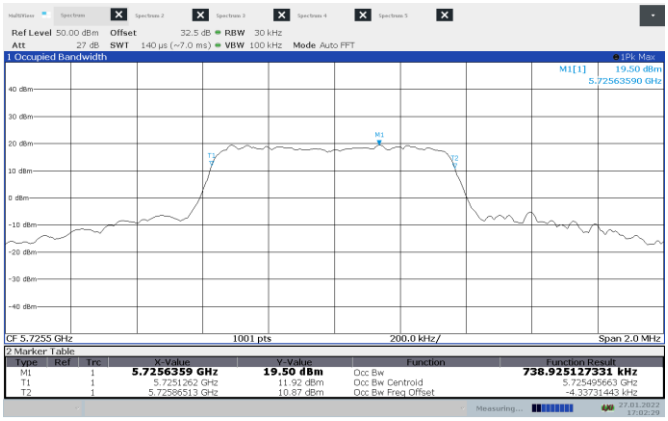


Figure 8.5-1: *99% bandwidth on 0.875 MHz channel, sample plot*

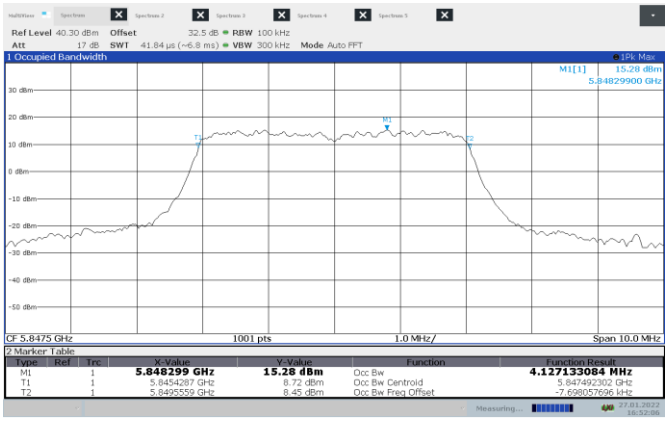


Figure 8.5-2: *99% bandwidth on 5 MHz channel, sample plot*

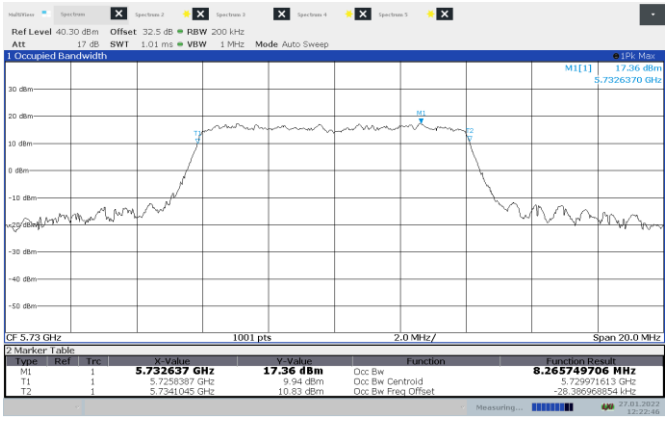


Figure 8.5-3: *99% bandwidth on 10 MHz channel, sample plot*

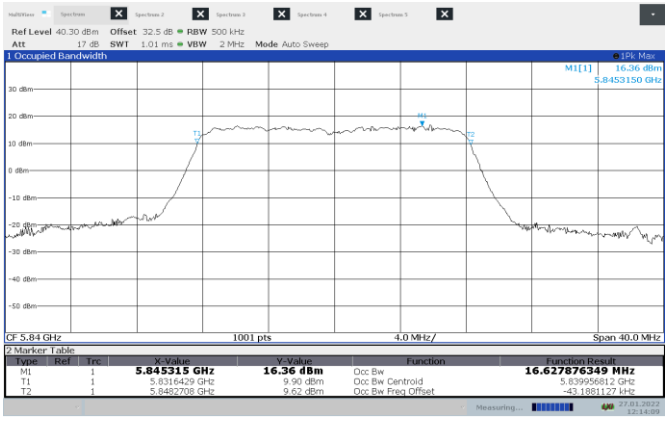


Figure 8.5-4: *99% bandwidth on 20 MHz channel, sample plot*

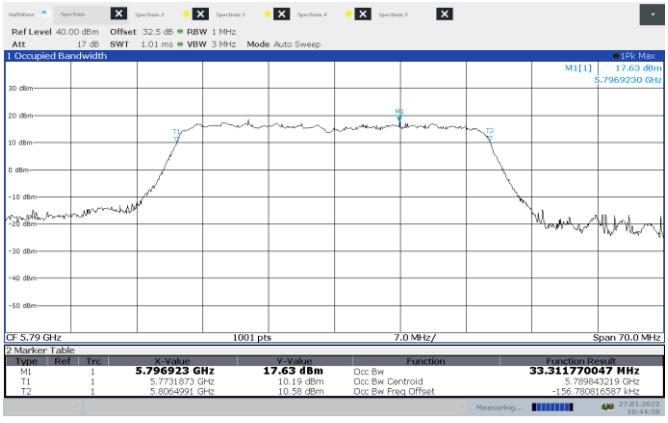


Figure 8.5-5: *99% bandwidth on 40 MHz channel, sample plot*

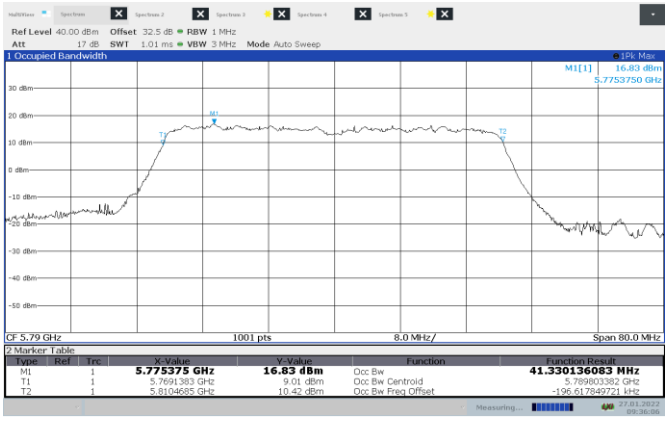


Figure 8.5-6: *99% bandwidth on 45 MHz channel, sample plot*

8.6 Transmitter output power and e.i.r.p. requirements for 5725–5850 MHz band

8.6.1 References, definitions and limits

FCC §15.407:

(a) Power limits:

(3) For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(11) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(12) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725–5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

RSS-247, Clause 6.2:

Power and unwanted emissions limits

The output power and e.i.r.p. of the equipment wanted emission shall be measured in terms of average value.

6.2.4 Frequency band 5725–5850 MHz

6.2.4.1 Power limits

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

8.6.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	January 13, 2022

8.6.3 Observations, settings and special notes

Combined average output power was calculated as follows: $P_{combined} = 10 \times log_{10}\left(\left(10^{P_{ch0}/10}\right) + \left(10^{P_{ch1}/10}\right)\right)$

EIRP was calculated as follows: $EIRP = P_{combined} + antenna\ gain$

Combined PPSD was calculated as follows: $PPSD_{combined} = 10 \times log_{10}\left(\left(10^{PSD_{ch0}/10}\right) + \left(10^{PSD_{ch1}/10}\right)\right)$

No summation of directional gain is needed for cross-polarized antennas as per manufacturer's definition of the cross-polarized MIMO type.

The EUT is also a fixed point-to-point device; therefore it may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

For point-to-multi point operations antennas with the directional gain greater than 6 dBi, the maximum output power limit was calculated as follows:
30 dBm – (Peak antenna gain – 6 dBi)
For 25 dBi antenna with 0.7 dB cable loss: Limit = 30 dBm – (24.3 dBi – 6 dBi) = 11.7 dBm

For point-to-multi point operations antennas with the directional gain greater than 6 dBi, the maximum power spectral density limit was calculated as follows:
30 dBm/500 kHz – (Maximum antenna gain – 6 dBi)
For 25 dBi antenna with 0.7 dB cable loss: Limit = 30 dBm/500 kHz – (24.3 dBi – 6 dBi) = 11.7 dBm/500 kHz

Power spectral density was tested per ANSI C63.10, Clause 12.5 and 789033 D02, Clause II(F).
Spectrum analyser settings:

Resolution bandwidth	500 kHz
Video bandwidth	≥ 3 × RBW
Frequency span	Enough to encompass the entire 26 dB EBW or 99% OBW of the signal
Detector mode	RMS
Trace mode	Average Power
Average Sweeps	≥ 100

Conducted output power was tested per ANSI C63.10, Clause 12.3 and 789033 D02, Clause II(E) using method SA-1 or SA-1 Alternative (averaging with the EUT transmitting at full power throughout each sweep).
Spectrum analyser settings:

Resolution bandwidth	>1% of BW
Video bandwidth	≥ 3 × RBW
Frequency span	Enough to encompass the entire 26 dB EBW or 99% OBW of the signal
Detector mode	RMS
Trace mode	Average Power
Power integration	Over 26 dB EBW or 99% OBW
Average Sweeps	≥ 100

8.6.4 Test data, Point-to-multipoint operation

Table 8.6-1: *Output power measurements results for 0.875 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5725.5	8.32	8.03	11.19	11.70	0.51	24.30	35.49	36.00	35.49
BPSK	5790.0	8.28	7.68	11.00	11.70	0.70	24.30	35.30	36.00	35.30
BPSK	5849.5	7.50	7.89	10.71	11.70	0.99	24.30	35.01	36.00	35.01

Table 8.6-2: *PSD measurements results for 0.875 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5725.5	6.49	6.34	9.43	11.7	2.27
BPSK	5790.0	6.66	6.08	9.39	11.7	2.31
BPSK	5849.5	5.74	6.10	8.93	11.7	2.77

Table 8.6-3: *Output power measurements results for 5 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5727.5	8.30	8.05	11.19	11.70	0.51	24.30	35.49	36.00	0.51
BPSK	5790.0	8.24	7.68	10.98	11.70	0.72	24.30	35.28	36.00	0.72
BPSK	5847.5	7.62	7.94	10.79	11.70	0.91	24.30	35.09	36.00	0.91

Table 8.6-4: *PSD measurements results for 5 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5727.5	-0.71	-1.05	2.13	11.7	9.57
BPSK	5790.0	-0.66	-1.36	2.01	11.7	9.69
BPSK	5847.5	-1.49	-0.90	1.83	11.7	9.87

Test data continued, Point-to-multipoint operation

Table 8.6-5: *Output power measurements results for 10 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5730.0	8.19	8.09	11.15	11.70	0.55	24.30	35.45	36.00	0.55
BPSK	5790.0	8.03	7.72	10.89	11.70	0.81	24.30	35.19	36.00	0.81
BPSK	5845.0	7.39	7.79	10.60	11.70	1.10	24.30	34.90	36.00	1.10

Table 8.6-6: *PSD measurements results for 10 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5730.0	-3.21	-3.55	-0.37	11.7	12.07
BPSK	5790.0	-3.17	-4.02	-0.56	11.7	12.26
BPSK	5845.0	-4.37	-3.59	-0.95	11.7	12.65

Table 8.6-7: *Output power measurements results for 20 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5735.0	8.44	8.33	11.40	11.70	0.30	24.30	35.70	36.00	0.30
BPSK	5790.0	8.46	7.88	11.19	11.70	0.51	24.30	35.49	36.00	0.51
BPSK	5840.0	7.65	7.81	10.74	11.70	0.96	24.30	35.04	36.00	0.96

Table 8.6-8: *PSD measurements results for 20 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5735.0	-5.84	-6.05	-2.93	11.7	14.63
BPSK	5790.0	-5.94	-6.39	-3.15	11.7	14.85
BPSK	5840.0	-6.79	-6.83	-3.80	11.7	15.50

Test data continued, Point-to-multipoint operation

Table 8.6-9: *Output power measurements results for 40 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5745.0	8.53	8.25	11.40	11.70	0.30	24.30	35.70	36.00	0.30
BPSK	5790.0	8.47	7.61	11.07	11.70	0.63	24.30	35.37	36.00	0.63
BPSK	5830.0	7.66	7.16	10.43	11.70	1.27	24.30	34.73	36.00	1.27

Table 8.6-10: *PSD measurements results for 40 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5745.0	-8.60	-6.23	-4.24	11.7	15.94
BPSK	5790.0	-8.61	-6.89	-4.66	11.7	16.36
BPSK	5830.0	-6.80	-7.29	-4.03	11.7	15.73

Table 8.6-11: *Output power measurements results for 45 MHz channel for PMP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dBm
BPSK	5747.5	8.48	7.48	11.02	11.70	0.68	24.30	35.32	36.00	0.68
BPSK	5790.0	8.24	7.25	10.78	11.70	0.92	24.30	35.08	36.00	0.92
BPSK	5827.5	7.67	7.50	10.60	11.70	1.1	24.30	34.90	36.00	1.10

Table 8.6-12: *PSD measurements results for 45 MHz channel for PMP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5747.5	-9.55	-10.66	-7.06	11.7	18.76
BPSK	5790.0	-9.65	-10.66	-7.12	11.7	18.82
BPSK	5827.5	-10.34	-10.62	-7.47	11.7	19.17

8.6.5 Test data, Point-to-point operation

Table 8.6-13: *Output power measurements results for 0.875 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5725.5	15.53	15.30	18.43	30.0	11.57
BPSK	5790.0	16.23	15.80	19.03	30.0	10.97
BPSK	5849.5	15.02	15.24	18.14	30.0	11.86

Table 8.6-14: *PSD measurements results for 0.875 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5725.5	13.91	13.21	16.58	30.0	13.42
BPSK	5790.0	14.29	13.49	16.92	30.0	13.08
BPSK	5849.5	13.90	13.95	16.94	30.0	13.06

Table 8.6-15: *Output power measurements results for 5 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5727.5	17.50	17.24	20.38	30.0	9.62
BPSK	5790.0	18.08	17.51	20.81	30.0	9.19
BPSK	5847.5	16.94	17.36	20.17	30.0	9.83

Table 8.6-16: *PSD measurements results for 5 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5727.5	8.62	7.87	11.27	30.0	18.73
BPSK	5790.0	8.65	8.56	11.62	30.0	18.38
BPSK	5847.5	8.02	8.27	11.16	30.0	18.84

Test data continued, Point-to-point operation

Table 8.6-17: *Output power measurements results for 10 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5730.0	21.22	21.19	24.22	30.0	5.78
BPSK	5790.0	21.42	21.18	24.31	30.0	5.69
BPSK	5845.0	20.67	21.04	23.87	30.0	6.13

Table 8.6-18: *PSD measurements results for 10 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5730.0	9.53	9.69	12.62	30.0	17.38
BPSK	5790.0	9.63	9.49	12.57	30.0	17.43
BPSK	5845.0	9.44	9.42	12.44	30.0	17.56

Table 8.6-19: *Output power measurements results for 20 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5735.0	21.56	21.28	24.43	30.0	5.57
BPSK	5790.0	21.62	21.27	24.46	30.0	5.54
BPSK	5840.0	21.04	21.32	24.19	30.0	5.81

Table 8.6-20: *PSD measurements results for 20 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5735.0	6.48	6.45	9.48	30.0	20.52
BPSK	5790.0	6.80	6.80	9.81	30.0	20.19
BPSK	5840.0	6.69	7.20	9.96	30.0	20.04

Test data continued, Point-to-point operation

Table 8.6-21: *Output power measurements results for 40 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5745.0	19.63	19.49	22.57	30.0	7.43
BPSK	5790.0	20.14	20.00	23.08	30.0	6.92
BPSK	5830.0	18.96	19.30	22.14	30.0	7.86

Table 8.6-22: *PSD measurements results for 40 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5745.0	2.22	1.75	5.00	30.0	25.00
BPSK	5790.0	3.14	2.20	5.71	30.0	24.29
BPSK	5830.0	2.37	2.47	5.43	30.0	24.57

Table 8.6-23: *Output power measurements results for 45 MHz channel for PTP operation*

Modulation	Frequency, MHz	Conducted output power at ch0, dBm	Conducted output power at ch1, dBm	Combined output power, dBm	Power limit, dBm	Power margin, dB
BPSK	5747.5	16.72	16.49	19.62	30.0	10.38
BPSK	5790.0	17.30	16.40	19.88	30.0	10.12
BPSK	5827.5	16.51	16.65	19.59	30.0	10.41

Table 8.6-24: *PSD measurements results for 45 MHz channel for PTP operation*

Modulation	Frequency, MHz	PSD at ch0, dBm/0.5 MHz	PSD at ch1, dBm/0.5 MHz	Combined PPSD, dBm/0.5 MHz	PPSD limit, dBm/0.5 MHz	PSD margin, dB
BPSK	5747.5	-1.68	-2.12	1.12	30.0	28.88
BPSK	5790.0	-0.36	-2.05	1.89	30.0	28.11
BPSK	5827.5	-1.18	-1.64	1.61	30.0	28.39

Test data, continued

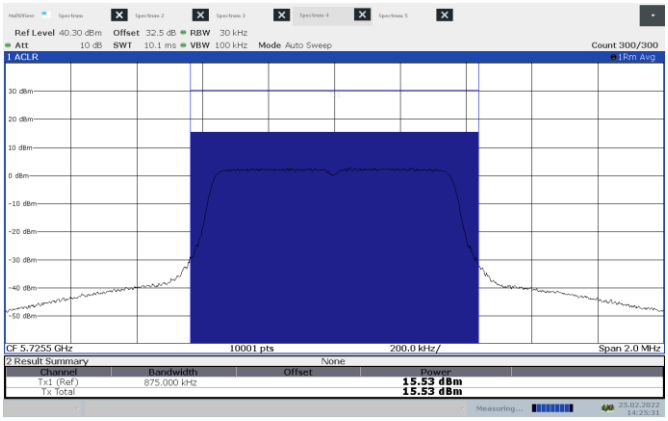


Figure 8.6-1: *Sample plot for output power on 0.875 MHz channel*

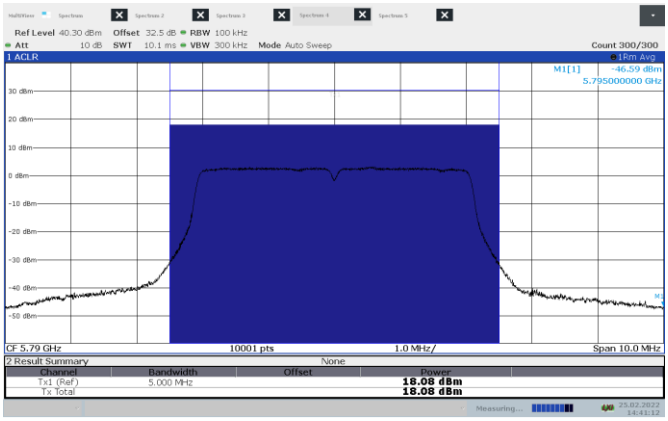


Figure 8.6-2: *Sample plot for output power on 5 MHz channel*

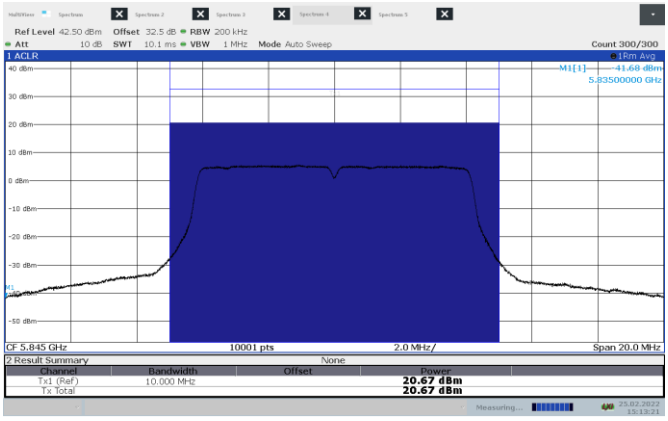


Figure 8.6-3: *Sample plot for output power on 10 MHz channel*

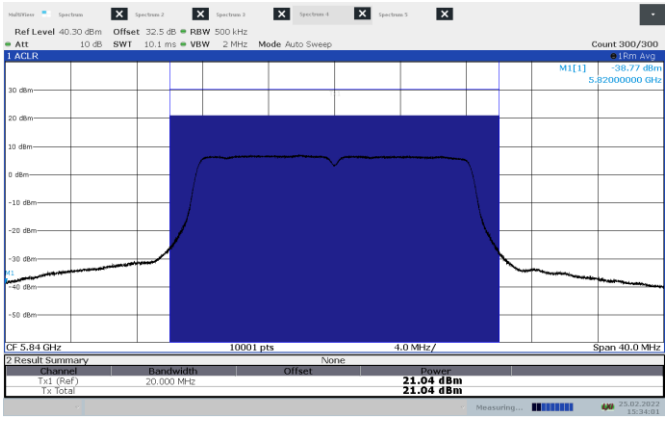


Figure 8.6-4: *Sample plot for output power on 20 MHz channel*

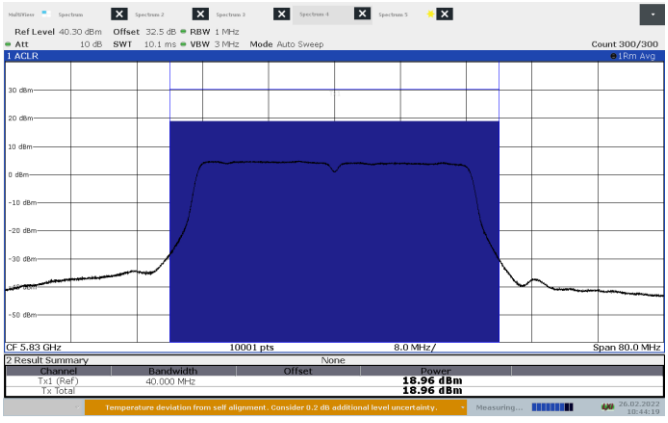


Figure 8.6-5: *Sample plot for output power on 40 MHz channel*

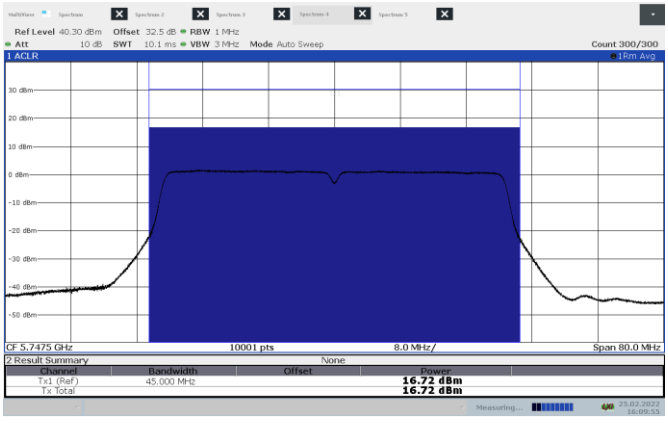


Figure 8.6-6: *Sample plot for output power on 45 MHz channel*

Test data, continued

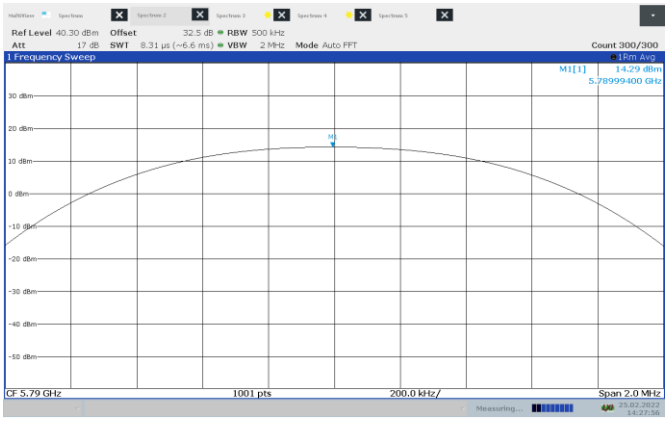


Figure 8.6-7: *Sample plot for PSD on 0.875 MHz channel, PTP*

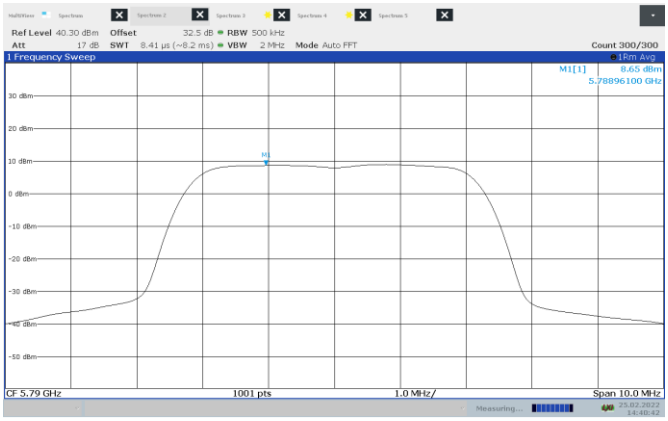


Figure 8.6-8: *Sample plot for PSD on 5 MHz channel, PTP*

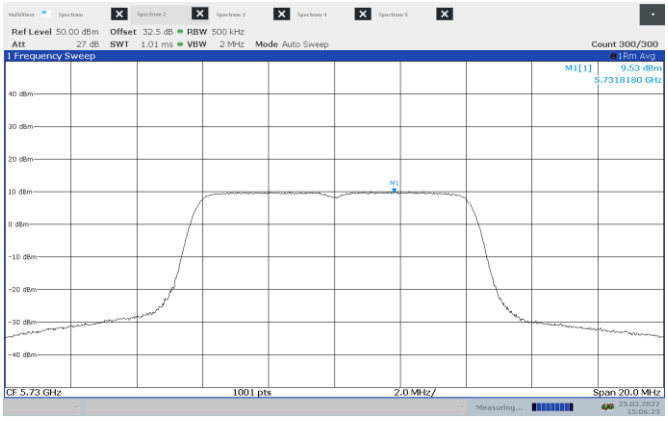


Figure 8.6-9: *Sample plot for PSD on 10 MHz channel, PTP*

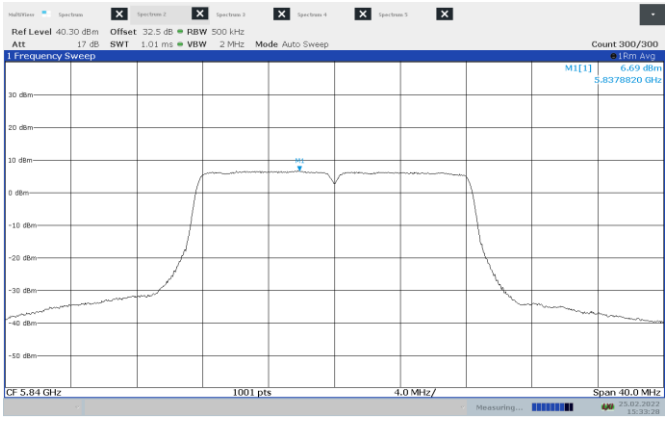


Figure 8.6-10: *Sample plot for PSD on 20 MHz channel, PTP*

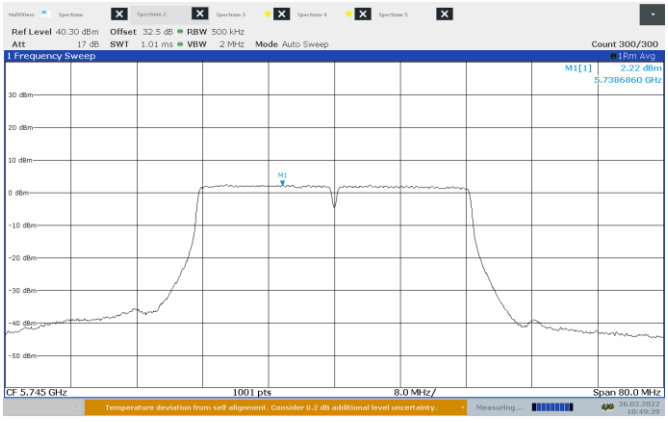


Figure 8.6-11: *Sample plot for PSD on 40 MHz channel, PTP*

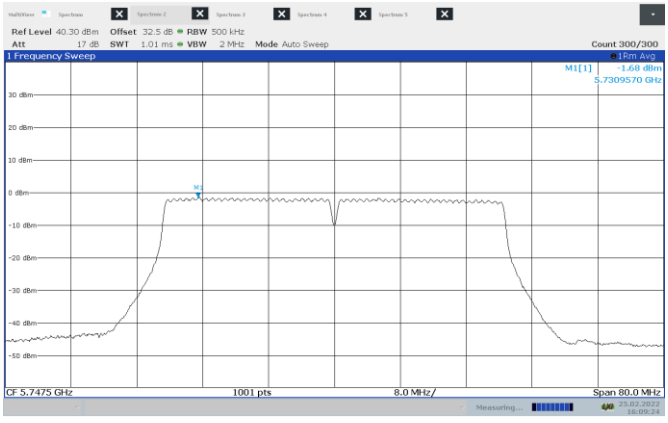


Figure 8.6-12: *Sample plot for PSD on 45 MHz channel, PTP*

8.7 Spurious unwanted (undesirable) emissions

8.7.1 References, definitions and limits

FCC §15.407:

(b) Undesirable emission limits.
Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(4) For transmitters operating in the 5.725–5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(8) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(9) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

(10) The provisions of §15.205 apply to intentional radiators operating under this section.

(11) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

RSS-247, Clause 6.2:

Power and unwanted emissions limits
The power and e.i.r.p. of the equipment unwanted emission shall be measured in peak value. However, the equipment is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands which are listed in the same standard.
If the transmission is in bursts, the provisions of RSS-Gen for pulsed operation shall apply.
The outermost carrier frequencies or channels shall be used when measuring unwanted emissions. Such carrier or channel center frequencies are to be indicated in the test report.

6.2.4 Frequency band 5725–5850 MHz

6.2.4.2 Unwanted emission limits
Devices operating in the band 5725–5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:

a. 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;
b. 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
c. 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to −27 dBm/MHz at 75 MHz above or below the band edges; and
d. −27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

Table 8.7-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

	Field strength of emissions		
Frequency, MHz	**µV/m**	**dBµV/m**	**Measurement distance, m**
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

References, definitions and limits, continued

Table 8.7-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.7-2 and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Table 8.7-3: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.7.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	February 24, 2022

8.7.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 40 GHz has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 95 % duty cycle. The EUT was transmitting on both MIMO chains simultaneously using BPSK modulation
- Radiated measurements were performed at a distance of 3 m up to 18 GHz, at 1 m above 18 GHz (with added distance correction factor).
- The spurious emission was tested per ANSI C63.10, Clause 12.7 and 789033 D02, Clause II(G).
- EUT transmit ports loaded during radiated cabinet emissions measurements
- MIMO Antenna is cross polarized

Spectrum analyser for peak conducted measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser for peak conducted measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

Spectrum analyser for peak conducted measurements outside restricted bands:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.7.4 Test data

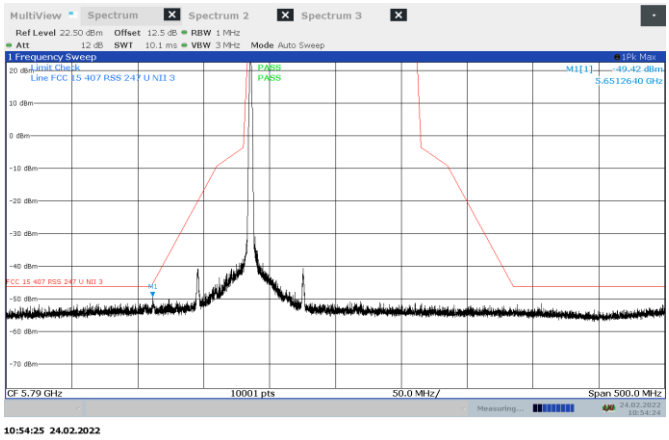


Figure 8.7-1: *Conducted spurious emissions mask, 0.875 MHz low channel at ch0*

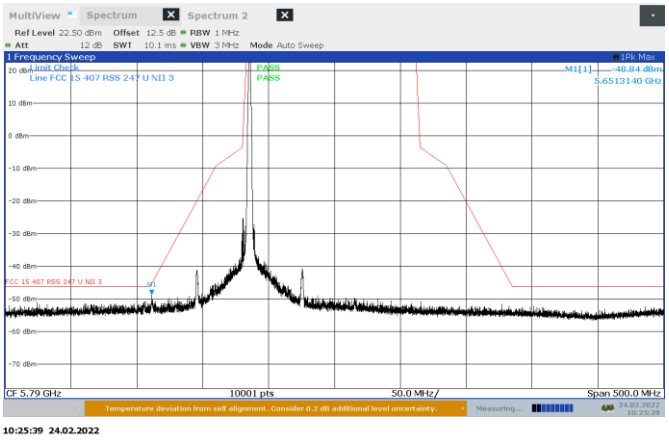


Figure 8.7-2: *Conducted spurious emissions mask, 0.875 MHz low channel at ch1*

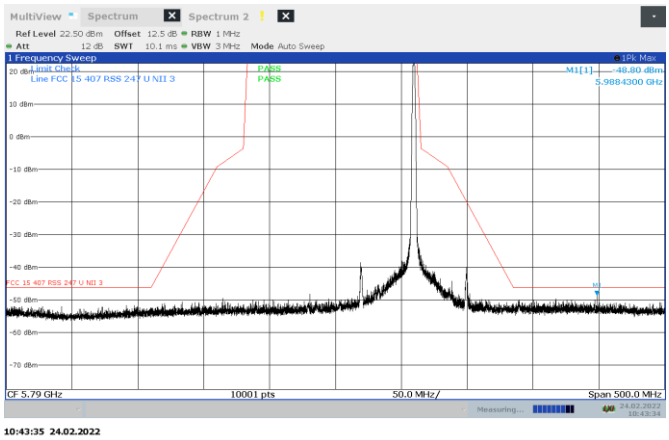


Figure 8.7-3: *Conducted spurious emissions mask, 0.875 MHz high channel at ch0*

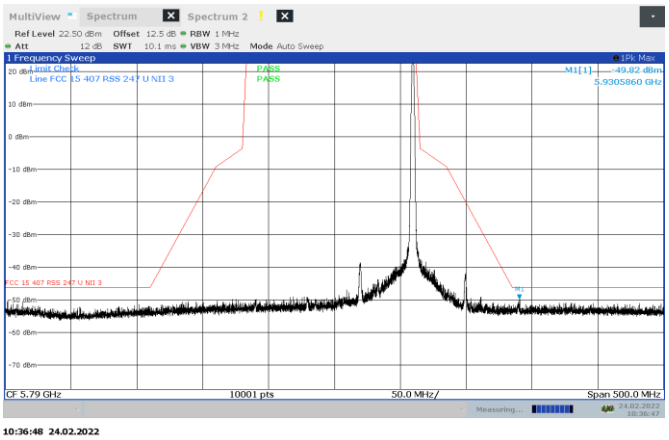


Figure 8.7-4: *Conducted spurious emissions mask, 0.875 MHz high channel at ch1*

Test data, continued

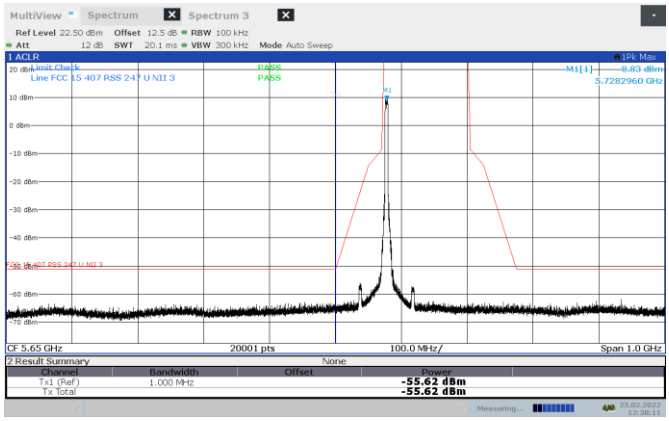


Figure 8.7-5: *Conducted spurious emissions mask, 5 MHz low channel at ch0*

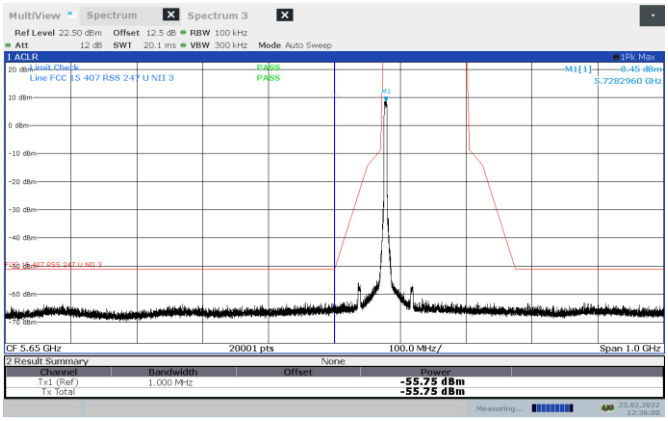


Figure 8.7-6: *Conducted spurious emissions mask, 5 MHz low channel at ch1*

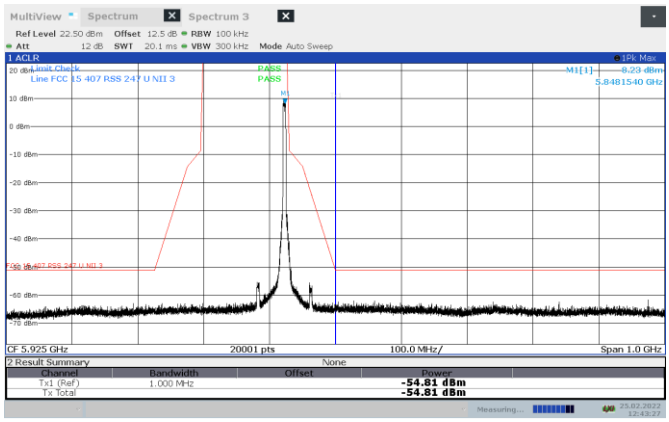


Figure 8.7-7: *Conducted spurious emissions mask, 5 MHz high channel at ch0*

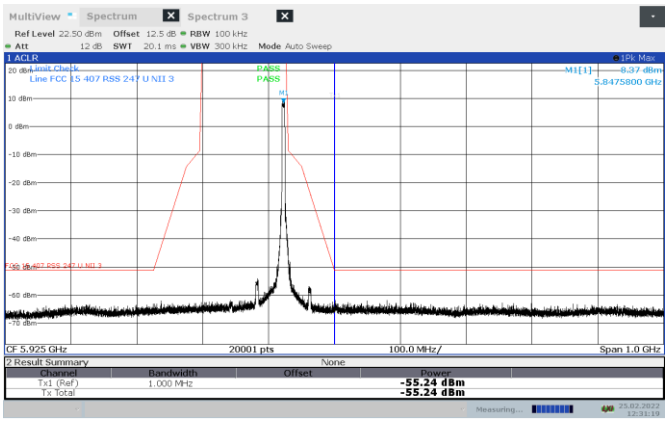


Figure 8.7-8: *Conducted spurious emissions mask, 5 MHz high channel at ch1*

Test data, continued

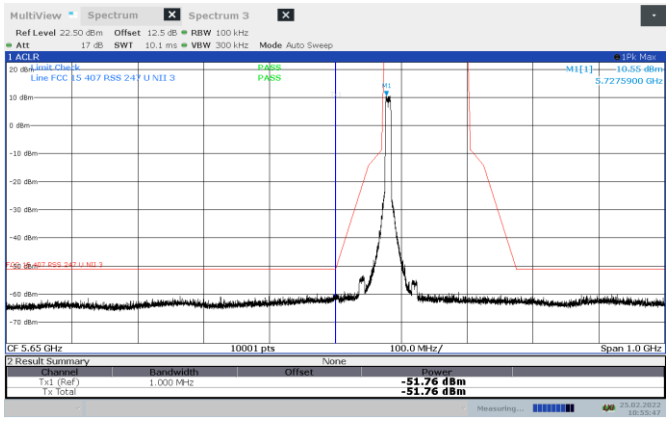


Figure 8.7-9: *Conducted spurious emissions mask, 10 MHz low channel at ch0*

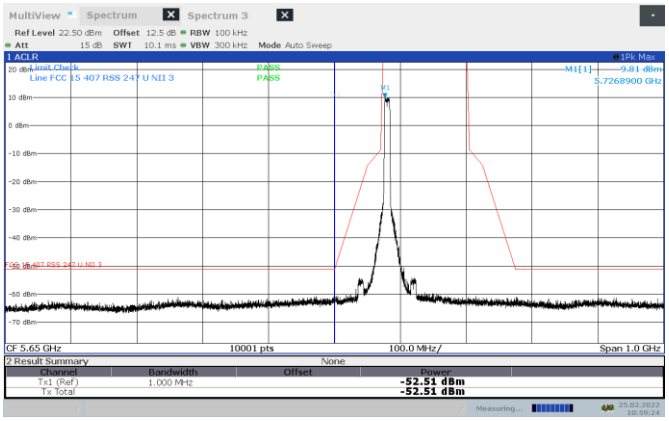


Figure 8.7-10: *Conducted spurious emissions mask, 10 MHz low channel at ch1*

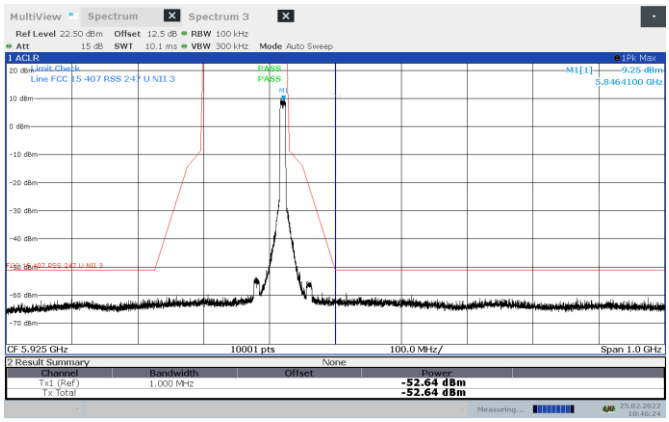


Figure 8.7-11: *Conducted spurious emissions mask, 10 MHz high channel at ch0*

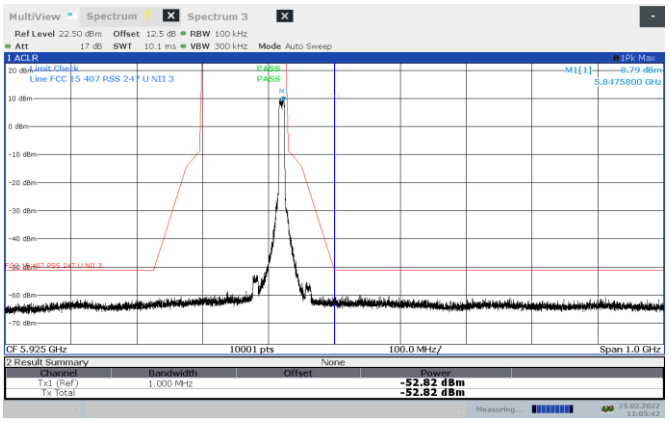


Figure 8.7-12: *Conducted spurious emissions mask, 10 MHz high channel at ch1*

Test data, continued

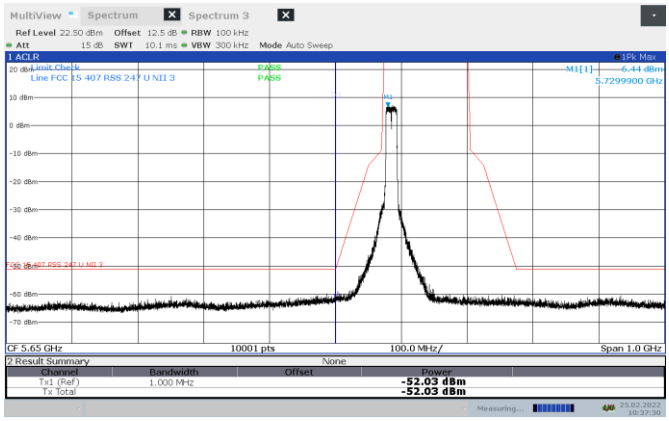


Figure 8.7-13: *Conducted spurious emissions mask, 20 MHz low channel at ch0*

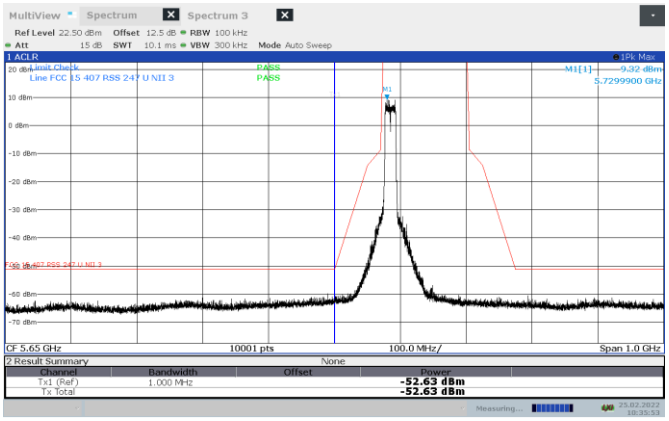


Figure 8.7-14: *Conducted spurious emissions mask, 20 MHz low channel at ch1*

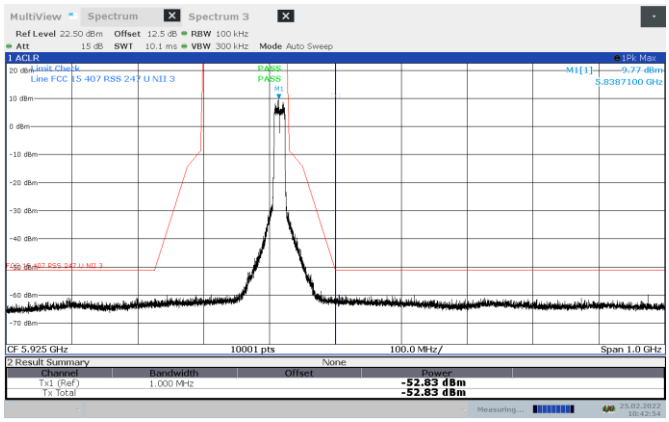


Figure 8.7-15: *Conducted spurious emissions mask, 20 MHz high channel at ch0*

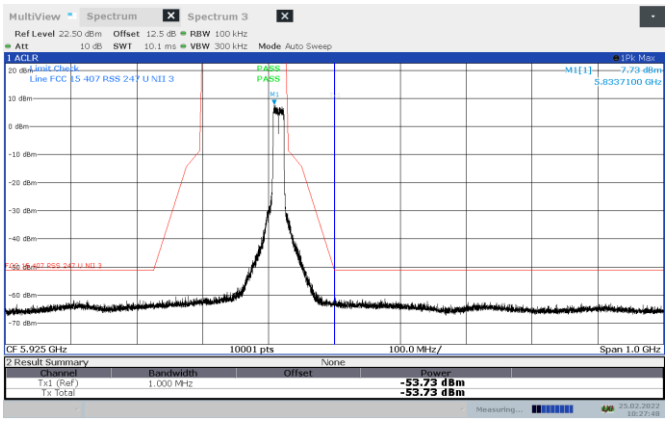


Figure 8.7-16: *Conducted spurious emissions mask, 20 MHz high channel at ch1*

Test data, continued

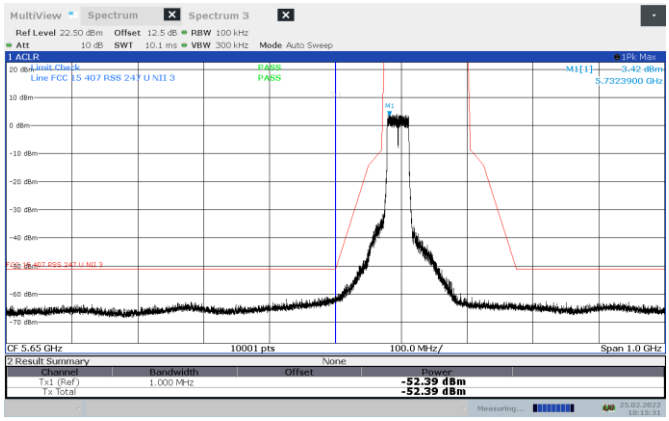


Figure 8.7-17: *Conducted spurious emissions mask, 40 MHz low channel at ch0*

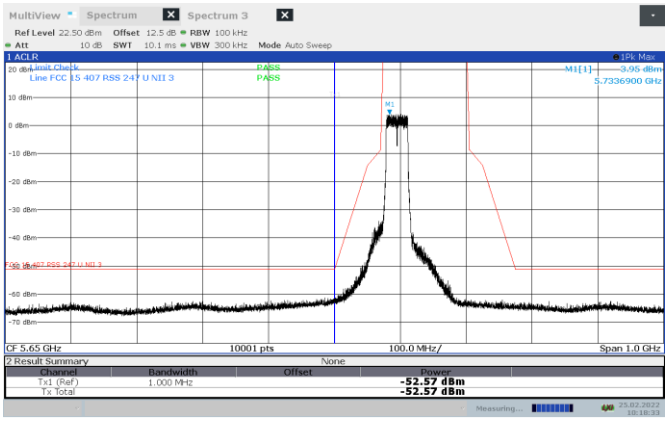


Figure 8.7-18: *Conducted spurious emissions mask, 40 MHz low channel at ch1*

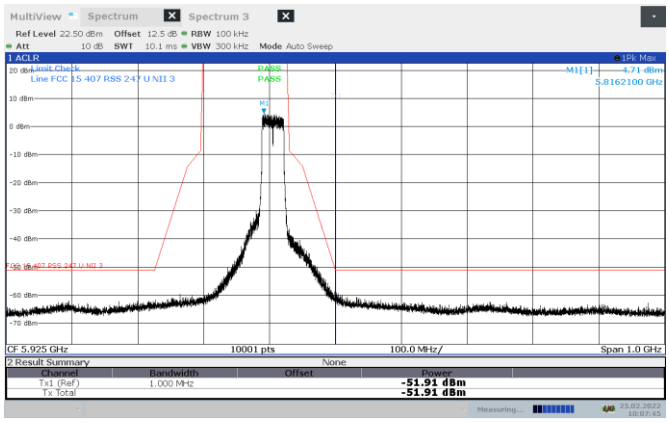


Figure 8.7-19: *Conducted spurious emissions mask, 40 MHz high channel at ch0*

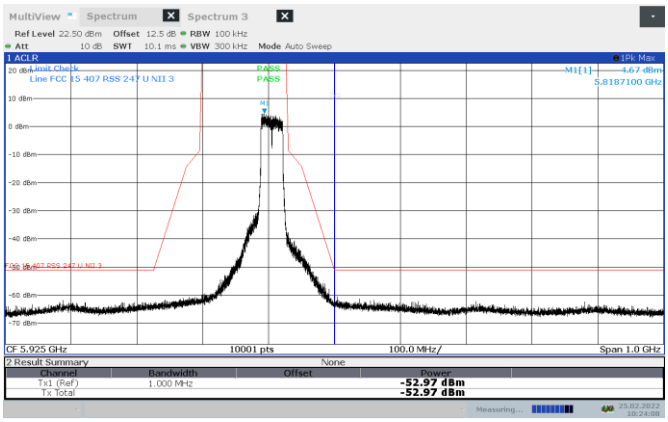


Figure 8.7-20: *Conducted spurious emissions mask, 40 MHz high channel at ch1*

Test data, continued

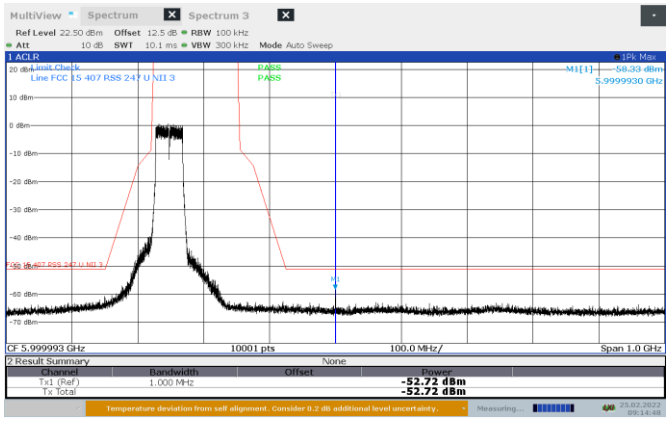


Figure 8.7-21: *Conducted spurious emissions mask, 45 MHz low channel at ch0*

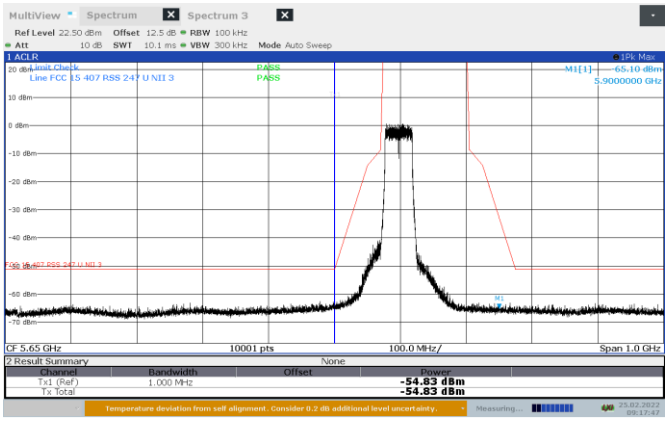


Figure 8.7-22: *Conducted spurious emissions mask, 45 MHz low channel at ch1*

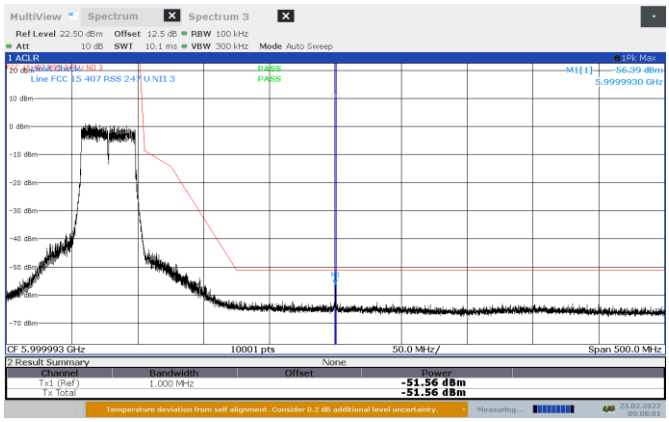


Figure 8.7-23: *Conducted spurious emissions mask, 45 MHz high channel at ch0*

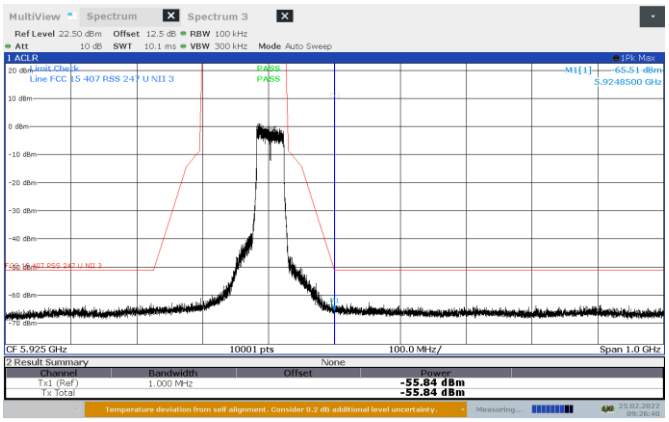


Figure 8.7-24: *Conducted spurious emissions mask, 45 MHz high channel at ch1*

Test data, continued

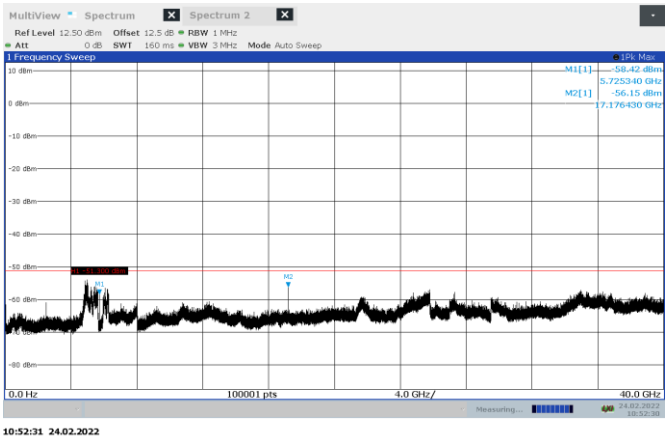


Figure 8.7-25: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW low channel at ch0*

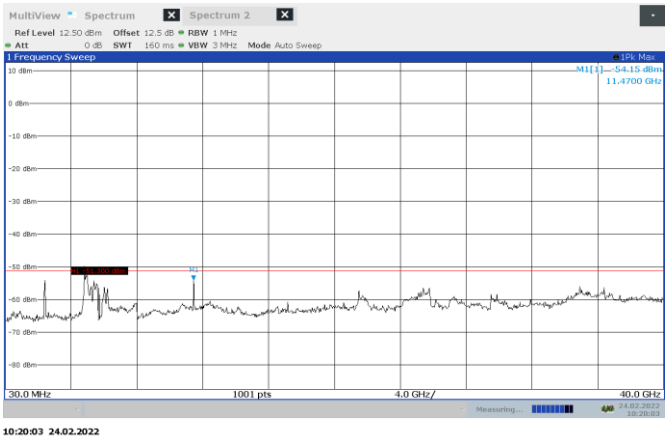


Figure 8.7-26: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW low channel at ch1*

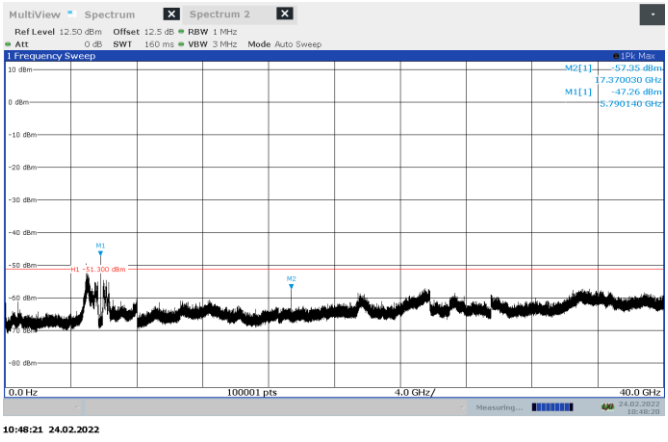


Figure 8.7-27: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW mid channel at ch0*

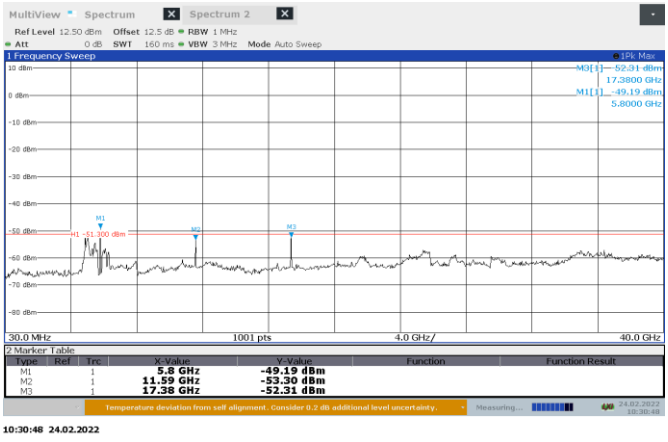


Figure 8.7-28: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW mid channel at ch1*

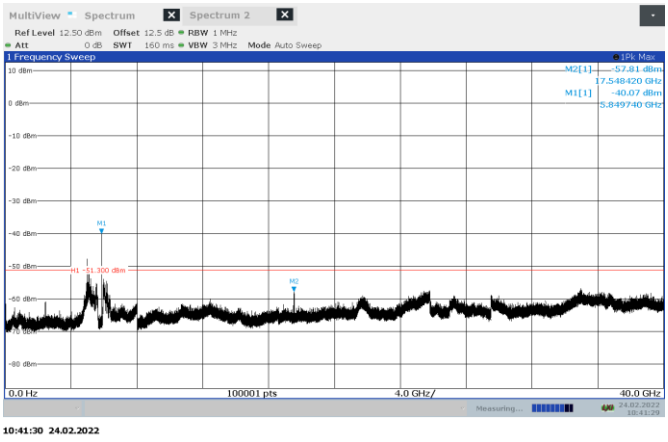


Figure 8.7-29: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW high channel at ch0*

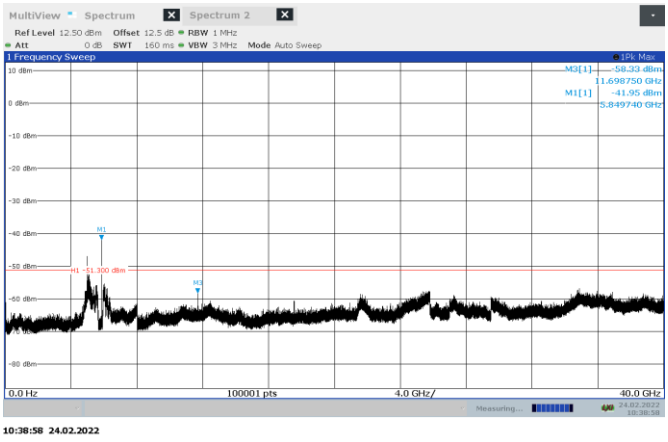


Figure 8.7-30: *Conducted spurious 30 MHz - 40 GHz, 0.875 MHz BW high channel at ch1*

Test data, continued

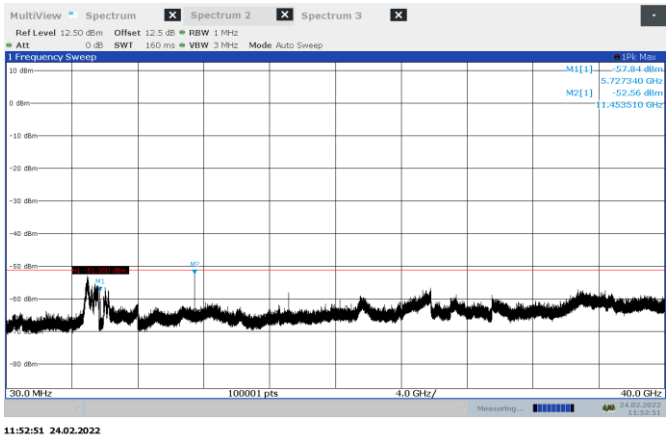


Figure 8.7-31: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW low channel at ch0*

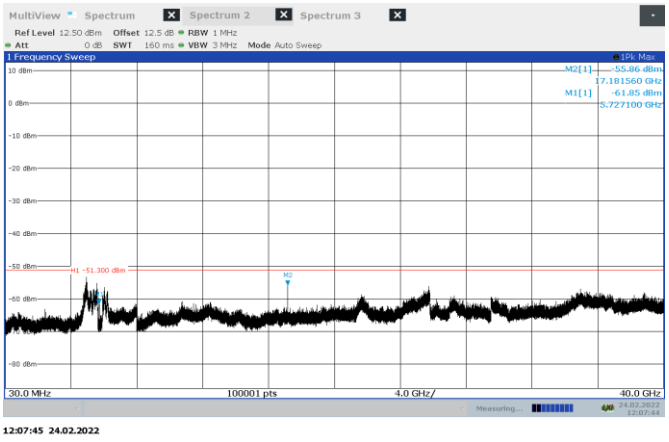


Figure 8.7-32: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW low channel at ch1*

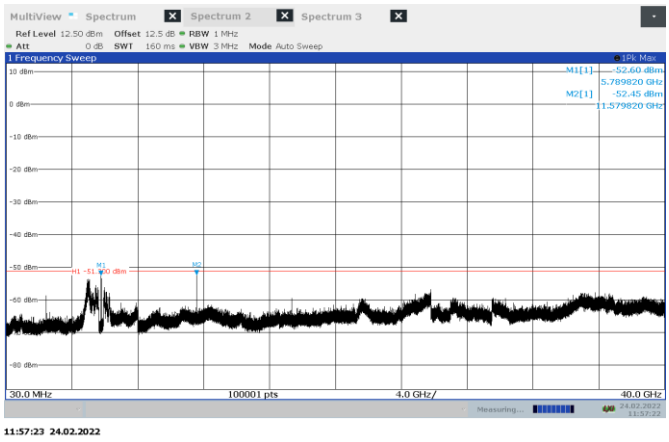


Figure 8.7-33: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW mid channel at ch0*

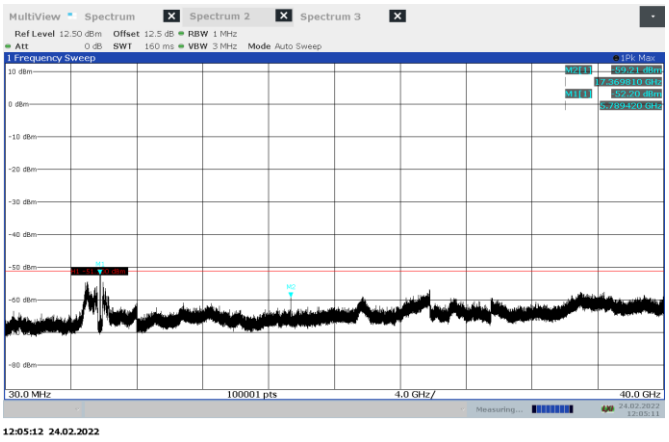


Figure 8.7-34: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW mid channel at ch1*

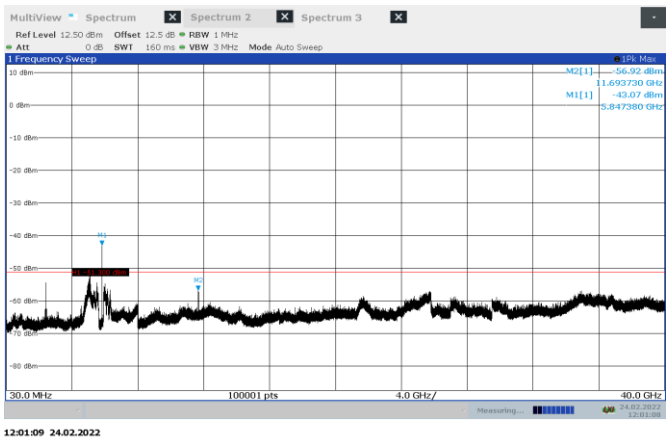


Figure 8.7-35: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW high channel at ch0*

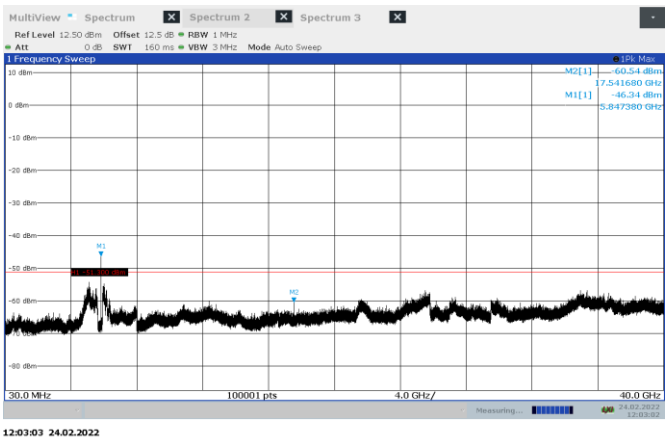
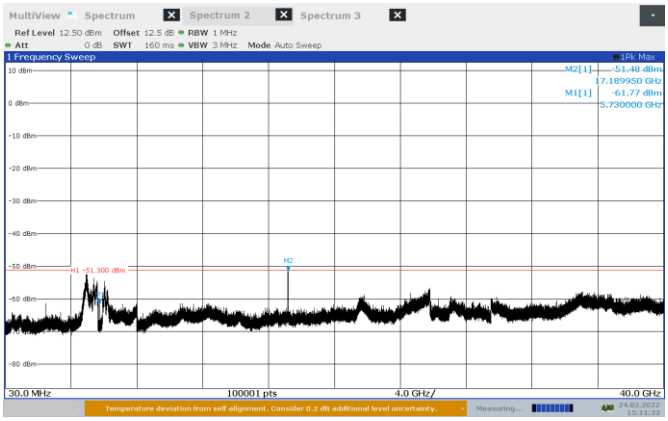


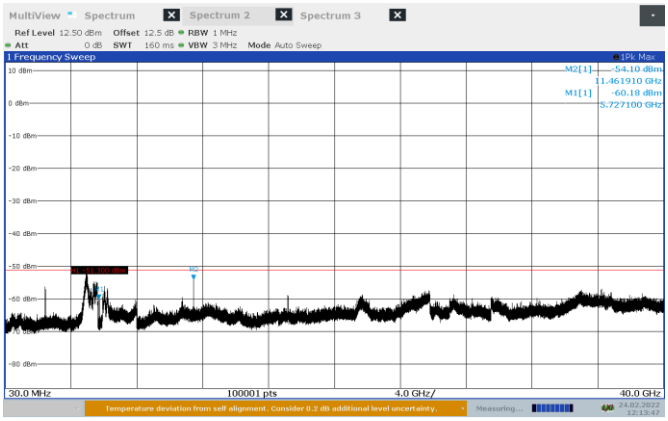
Figure 8.7-36: *Conducted spurious 30 MHz - 40 GHz, 5 MHz BW high channel at ch1*

Test data, continued



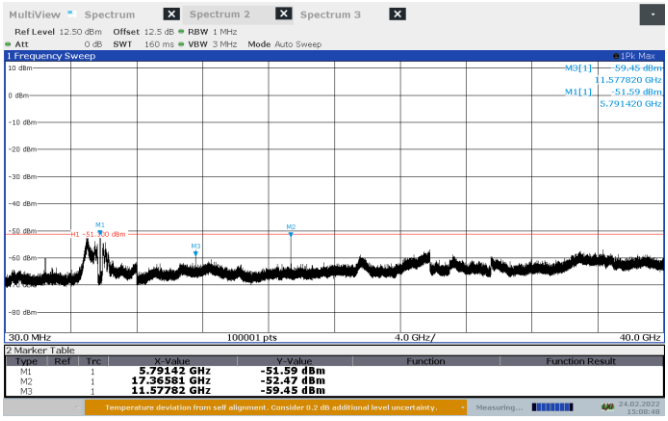
15:11:33 24.02.2022

Figure 8.7-37: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW low channel at ch0*



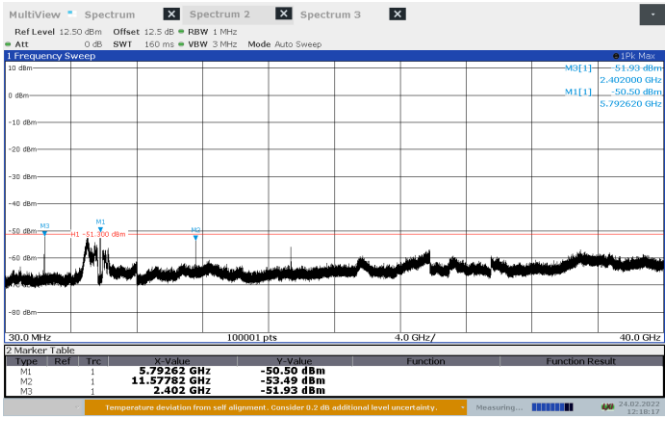
12:13:47 24.02.2022

Figure 8.7-38: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW low channel at ch1*



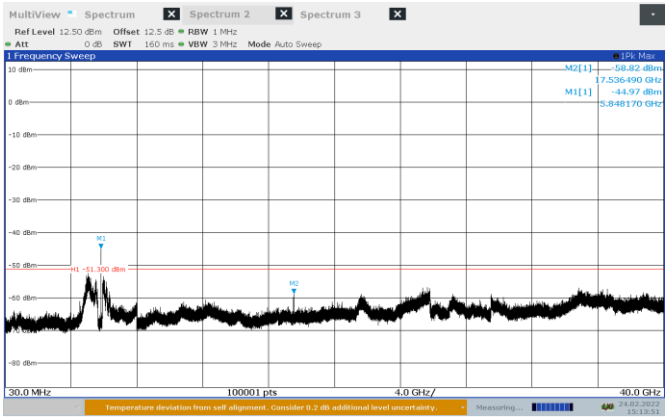
15:08:49 24.02.2022

Figure 8.7-39: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW mid channel at ch0*



12:18:18 24.02.2022

Figure 8.7-40: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW mid channel at ch1*



15:13:52 24.02.2022

Figure 8.7-41: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW high channel at ch0*

15:03:53 24.02.2022

Figure 8.7-42: *Conducted spurious 30 MHz - 40 GHz, 10 MHz BW high channel at ch1*

Test data, continued

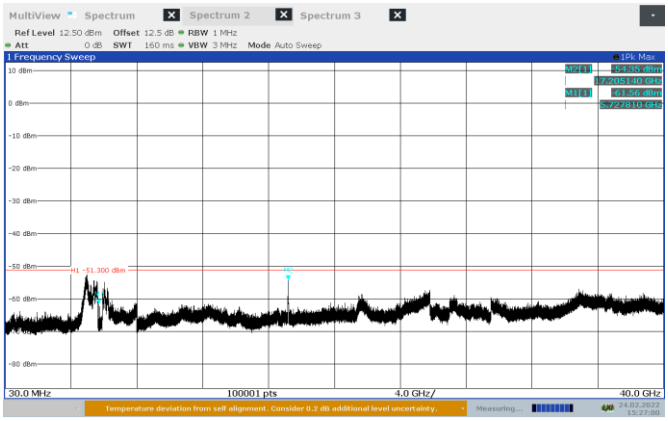


Figure 8.7-43: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW low channel at ch0*

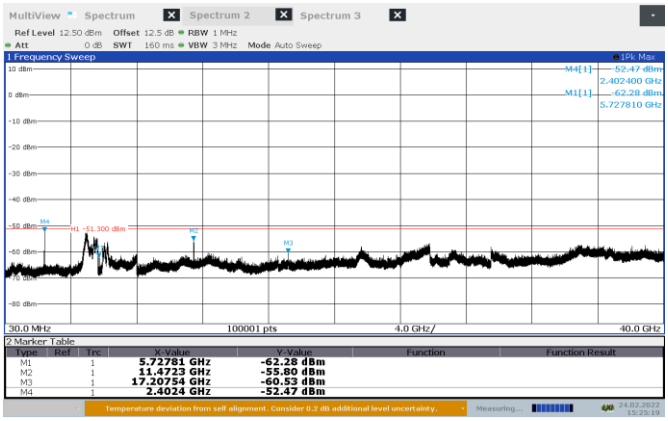


Figure 8.7-44: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW low channel at ch1*

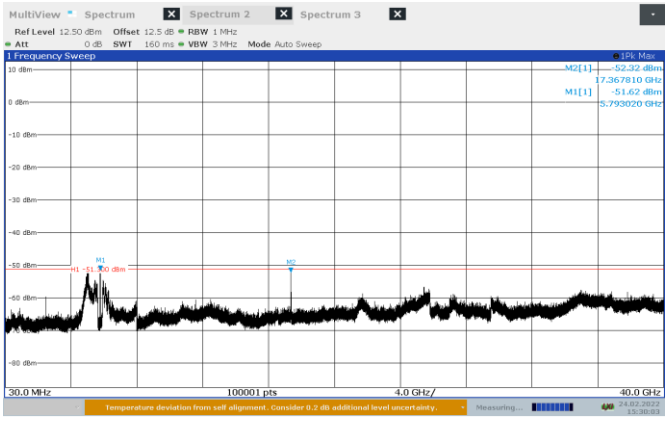


Figure 8.7-45: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW mid channel at ch0*

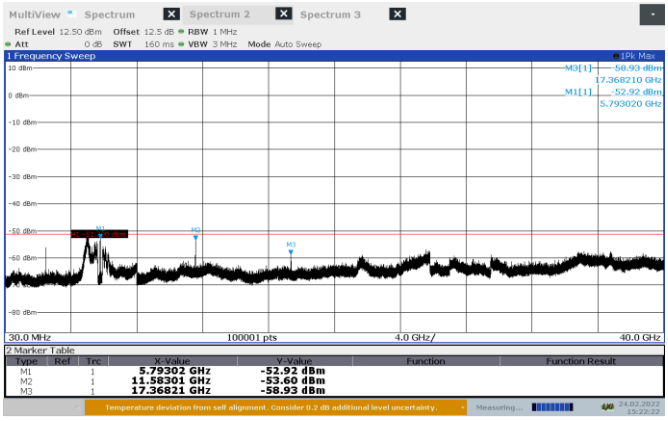


Figure 8.7-46: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW mid channel at ch1*

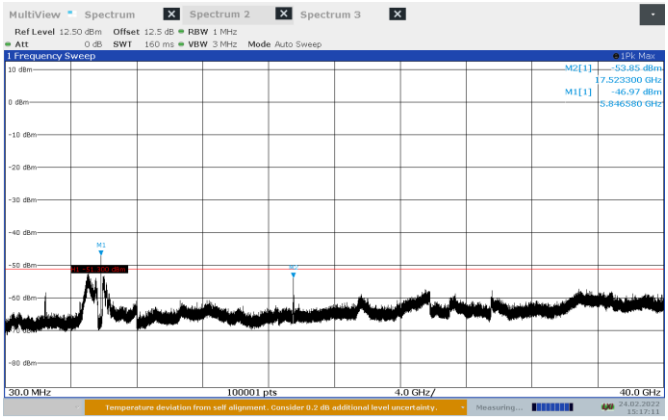


Figure 8.7-47: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW high channel at ch0*

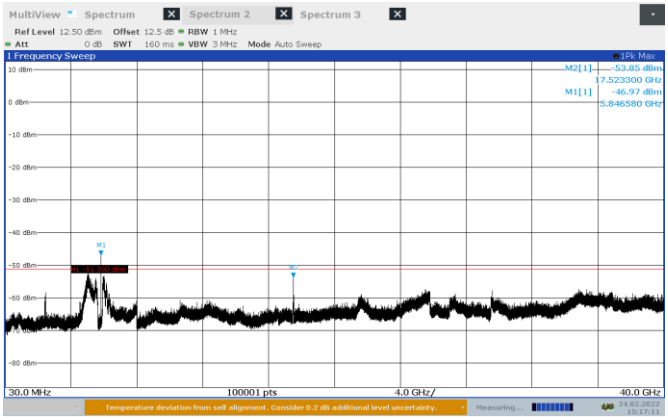


Figure 8.7-48: *Conducted spurious 30 MHz - 40 GHz, 20 MHz BW high channel at ch1*

Test data, continued

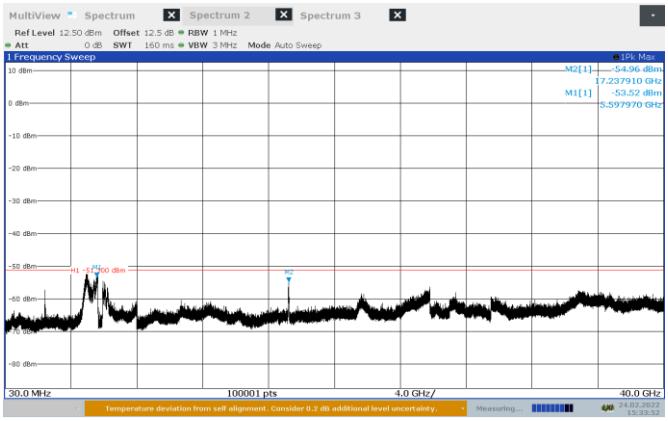


Figure 8.7-49: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW low channel at ch0*

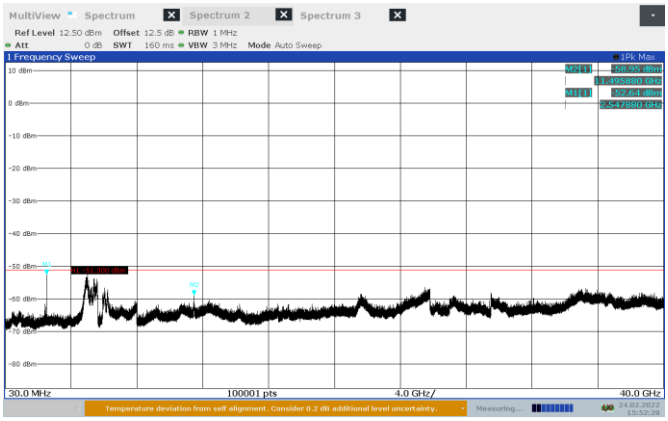


Figure 8.7-50: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW low channel at ch1*

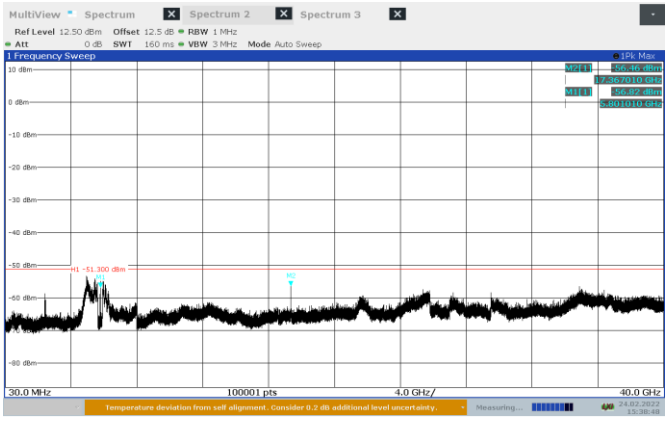


Figure 8.7-51: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW mid channel at ch0*

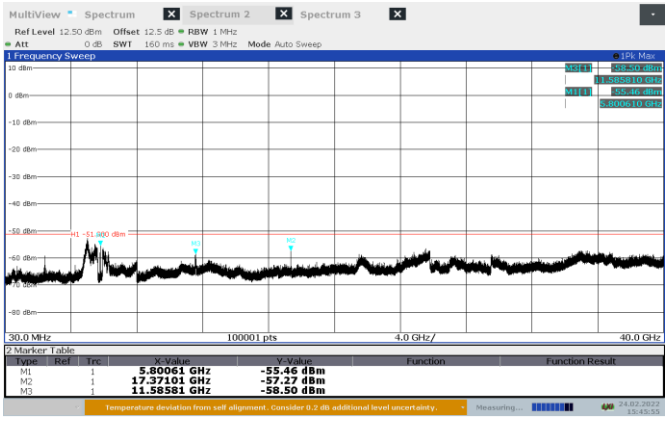


Figure 8.7-52: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW mid channel at ch1*

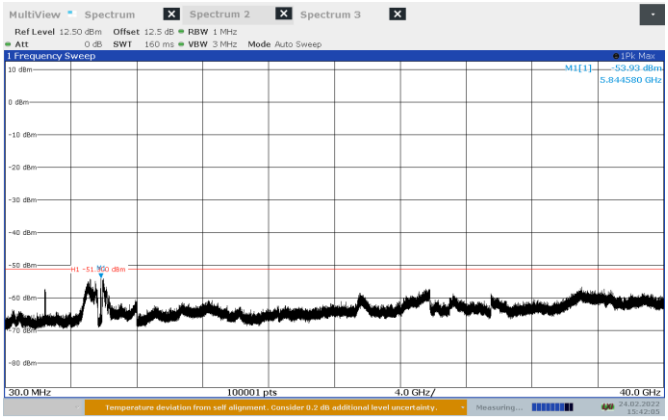


Figure 8.7-53: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW high channel at ch0*

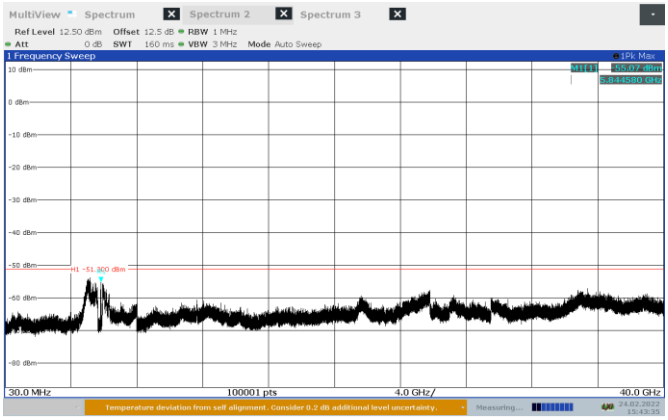


Figure 8.7-54: *Conducted spurious 30 MHz - 40 GHz, 40 MHz BW high channel at ch1*

Test data, continued

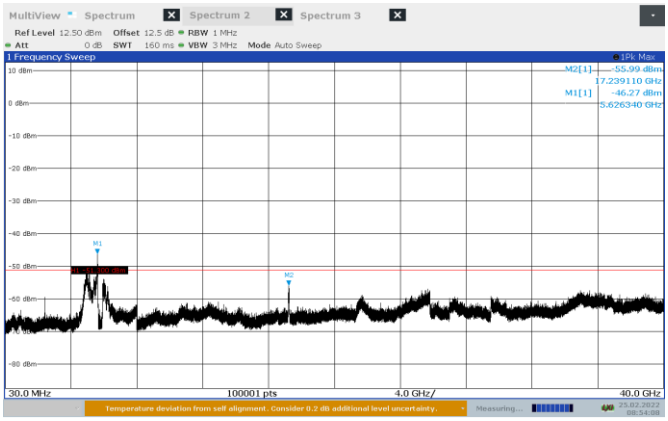


Figure 8.7-55: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW low channel at ch0*

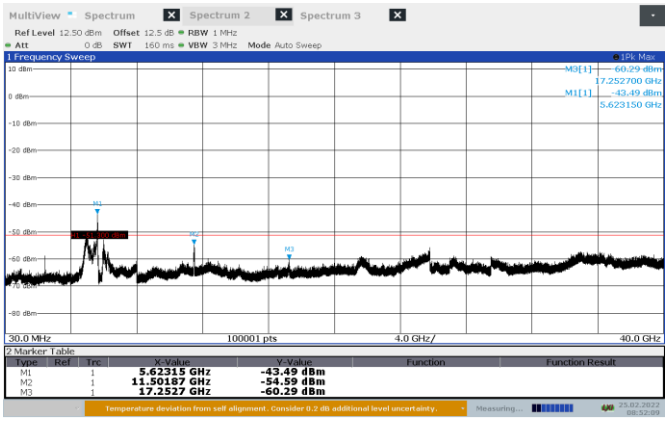


Figure 8.7-56: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW low channel at ch1*

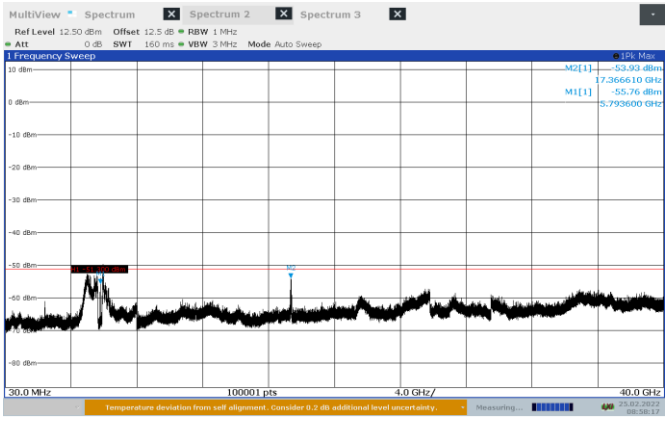


Figure 8.7-57: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW mid channel at ch0*

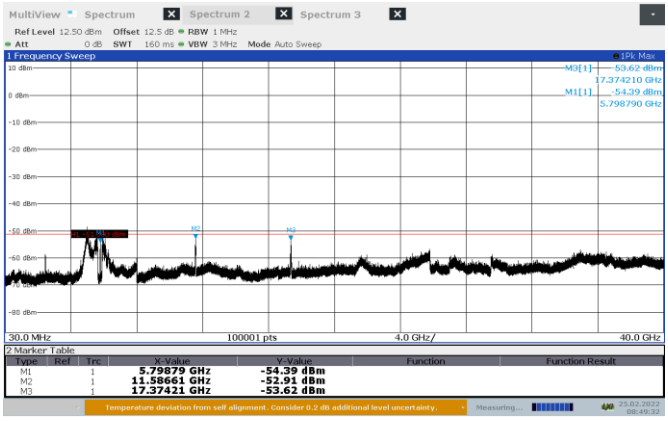


Figure 8.7-58: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW mid channel at ch1*

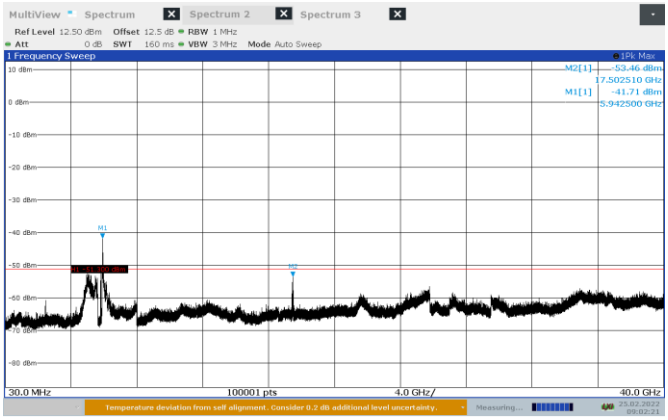


Figure 8.7-59: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW high channel at ch0*

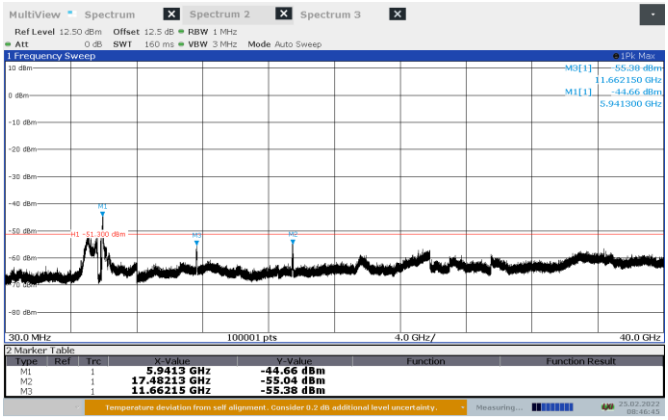
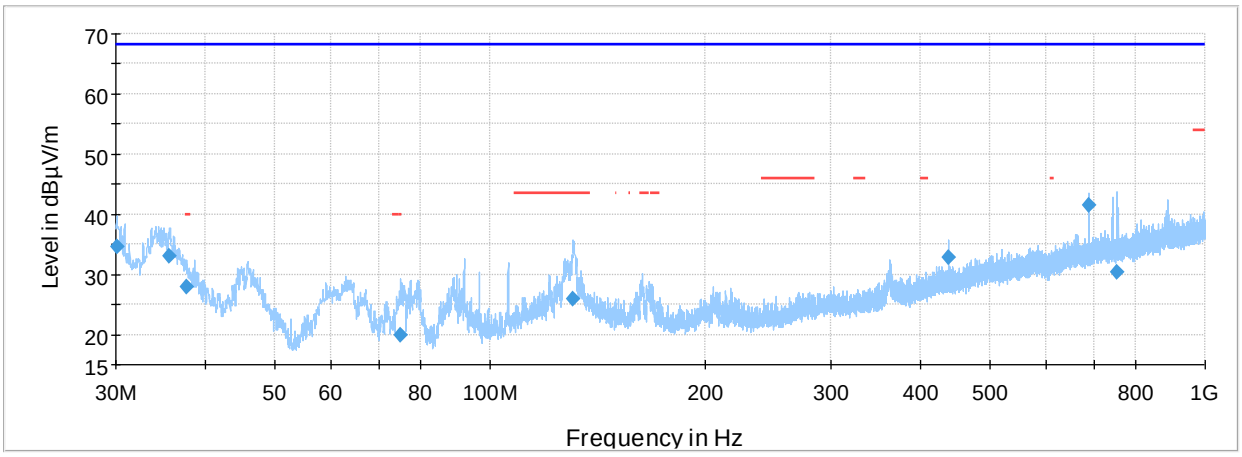


Figure 8.7-60: *Conducted spurious 30 MHz - 40 GHz, 45 MHz BW high channel at ch1*

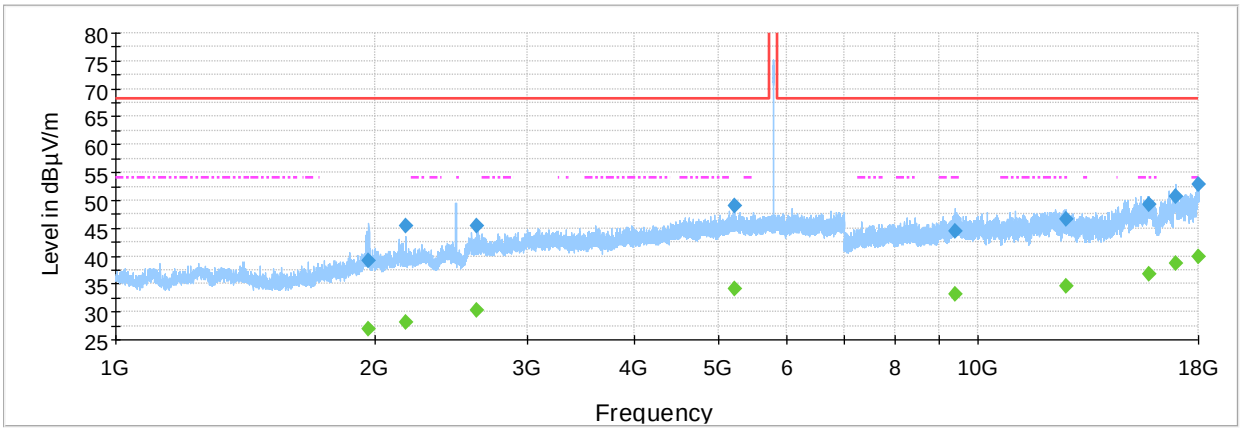
Test data, continued



NEX454155 RE 30 - 1000 MHz, 10MHz BW, 5790 MHz

Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands quasi-peak limits
Final_Result QPK
FCC 15.407 and RSS-210 A9 UNII-3

Figure 8.7-61: *Radiated cabinet spurious emissions 30-1000 MHz, 10 MHz BW mid channel*



NEX454155 RE 1-18 GHz, 10MHz BW, 5790 MHz

Preview Result 1-PK+
FCC 15.407 and RSS-210 A9 UNII-3
FCC 15.209 and RSS-Gen Restricted bands average limits
Final_Result PK+
Final_Result CAV

Figure 8.7-62: *Radiated cabinet spurious emissions 1-18 GHz, 10 MHz BW mid channel*

Test data, continued

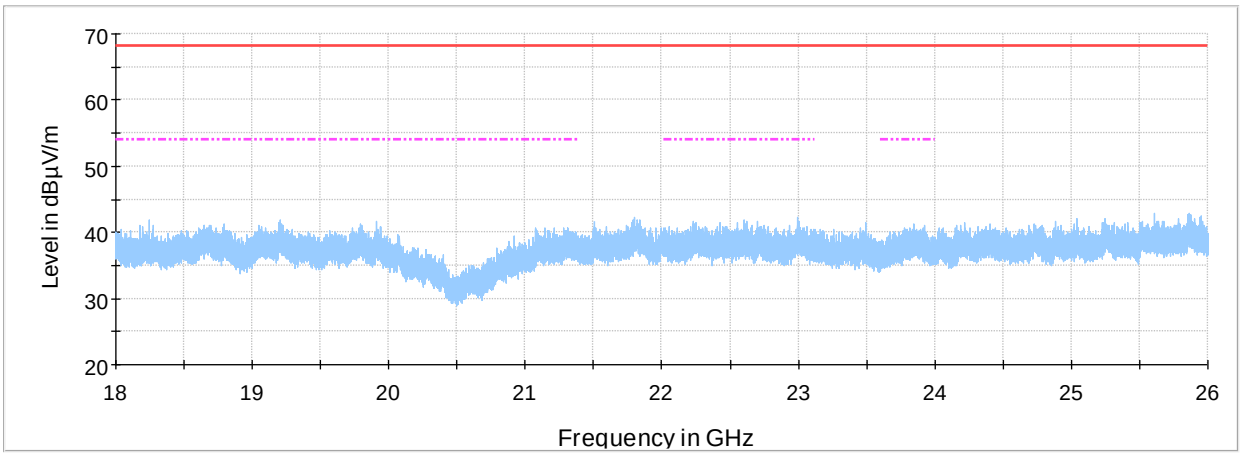


Figure 8.7-63: *Radiated cabinet spurious emissions 18-26 GHz, 10 MHz BW mid channel*

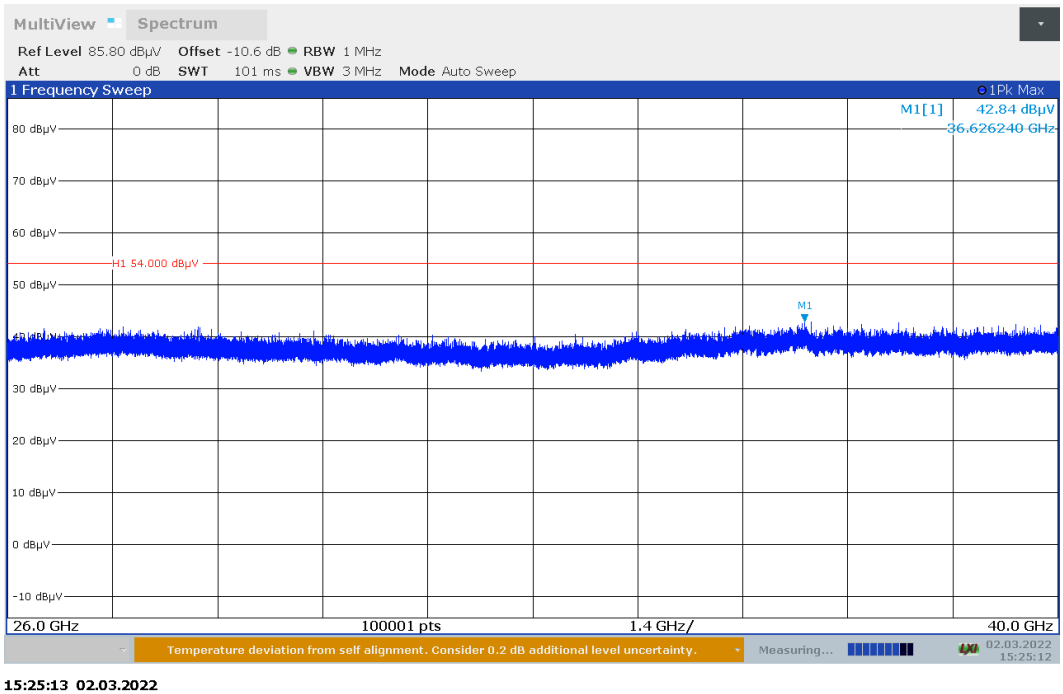


Figure 8.7-64: *Radiated cabinet spurious emissions 26-40 GHz, 10 MHz BW mid channel*

8.8 AC power line conducted emissions limits

8.8.1 Definitions and limits

FCC §15.407(6)(b):

Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207

FCC §15.207(a):
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

RSS-Gen, 8.8:
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.7-4: *Conducted emissions limit*

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.8.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	March 1, 2022

8.8.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

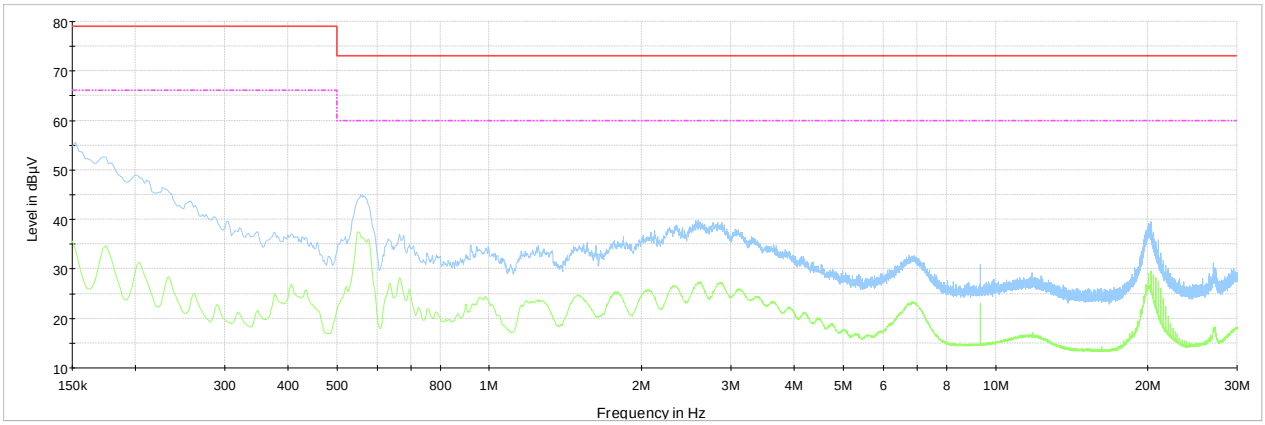
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	100 ms

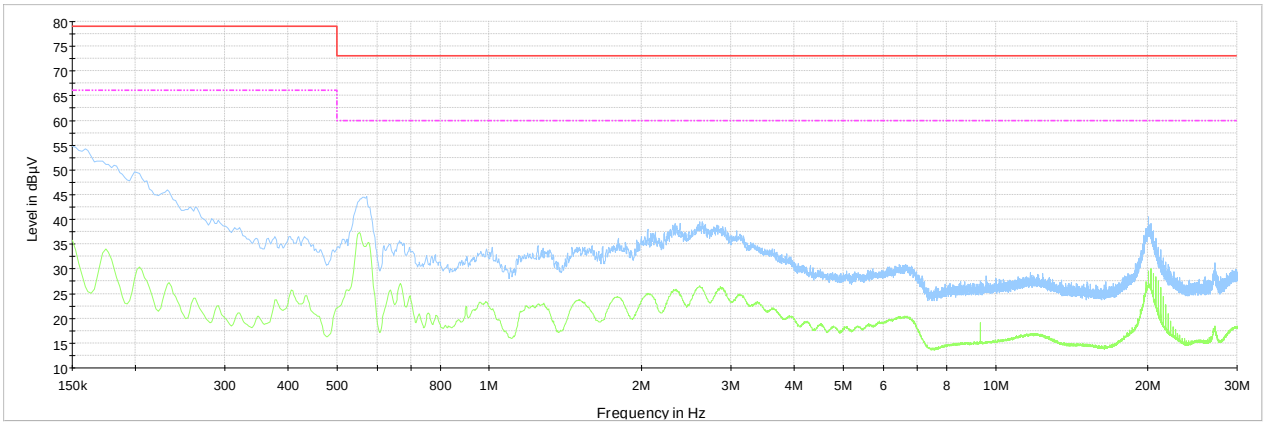
Receiver settings for final measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Quasi-Peak and Average
Trace mode	Max Hold
Measurement time	100 ms

8.8.4 Test data



Plot 8.7-65: *Conducted emissions on phase line*



Plot 8.7-66: *Conducted emissions on neutral line*

8.9 Frequency stability

8.9.1 Definitions and limits

FCC 15.407(g) and RSS-Gen, 8.11
Manufacturers of U-NII (ISED: LE-LAN) devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

8.9.2 Test summary

Verdict	Pass		
Tested by	Mark Libbrecht	Test date	March 1, 2022

8.9.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

8.9.4 Test data

Table 8.7-5: *Frequency drift measurement*

Test conditions	Frequency, GHz	Drift, Hz
+70 °C, Nominal	5.789977732	41567
+60 °C, Nominal	5.789983826	35473
+50 °C, Nominal	5.789986334	32965
+40 °C, Nominal	5.789977944	41355
+30 °C, Nominal	5.789967058	52241
+20 °C, +15 %	5.789993519	25780
+20 °C, Nominal	5.790019299	*Reference*
+20 °C, −15 %	5.789980055	39244
+10 °C, Nominal	5.789985183	34116
0 °C, Nominal	5.789974896	44403
−10 °C, Nominal	5.789982645	36654
−20 °C, Nominal	5.789964552	54747
−30 °C, Nominal	5.789986505	32794
−40 °C, Nominal	5.789989022	30277

Table 8.7-6: *Lower band edge drift calculation*

Bandwidth, MHz	99% OBW lower cross point, GHz	Max negative drift, Hz	Drifted lower cross point, GHz	Band edge, GHz	Margin, MHz
0.875	5.7251288	0	5.7251288	**5.725**	0.129
5	5.7254353	0	5.7254353	**5.725**	0.435
10	5.7258549	0	5.7258549	**5.725**	0.855
20	5.7266492	0	5.7266492	**5.725**	1.649
40	5.7282651	0	5.7282651	**5.725**	3.265
45	5.7267243	0	5.7267243	**5.725**	1.724

Notes: Drifted lower cross point = 99% OBW lower cross point – max negative drift.

Table 8.7-7: *Upper band edge drift calculation*

Bandwidth, MHz	99% OBW upper cross point, GHz	Max positive drift, Hz	Drifted upper cross point, GHz	Band edge, GHz	Margin, MHz
0.875	5.8498642	54747	5.849918947	**5.85**	0.081
5	5.8495538	54747	5.849608547	**5.85**	0.391
10	5.8491094	54747	5.849164147	**5.85**	0.836
20	5.8482481	54747	5.848302847	**5.85**	1.697
40	5.8465373	54747	5.846592047	**5.85**	3.408
45	5.8479974	54747	5.848052147	**5.85**	1.948

Notes: Drifted upper cross point = 99% OBW upper cross point + max positive drift.

End of the test report