

Test Report

HELEM2412000414-1 v1.1



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS

Equipment Under Test:	Radio modem module
Trademark:	SATEL
Model:	SATEL-TR49
Type:	SATEL-TA37
Customer / Manufacturer:	Satel Oy Meriniitynkatu 17 FI-24100, Salo Finland
FCC Rule Part:	§15.247
IC Rule Part:	RSS-Gen Issue 5, Amendment 1, Amendment 2 RSS-247 Issue 3
KDB:	558074 D01 15.247 Meas Guidance v05r02

Date: 19 December 2025

Issued by:


Lauri Sippola
Testing Engineer

Date: 19 December 2025

Checked by:


Pekka Kälviäinen
Testing Engineer

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GENERAL REMARKS

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

RELEASE HISTORY

Version	Changes	Issued
1.0	Initial release	11 February 2025
1.1	Updated Samples and Modifications. Updated Maximum Peak Conducted Output Power results.	19 December 2025

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test: Radio modem module
 Trademark: SATEL
 Model: SATEL-TR49
 Type: SATEL-TA37
 Hardware version: SPL0073f, 11.1
 Firmware version: 07.44.2.5.2.37
 Serial no: 2432000430
 FCC ID: MRBSATEL-TA37
 IC: 2422A-SATELTA37

General Description

The equipment under test is a radio modem module operating at frequency ranges 410-475 MHz and 902-928 MHz.

Classification

Fixed device ☐
 Mobile Device (Human body distance > 20cm) ☒
 Portable Device (Human body distance < 20cm) ☐

Samples and Modifications

No.	Name	Description
1	EUT	Normal sample
2	EUT	Updated version of Sample 1 used for Maximum Peak Conducted Output Power test on 18 December 2025. - Radio compatibility mode selection made easier. - Internal 1 W transmit power slightly reduced.

Specifications

Type of equipment:	FHSS		
Operating frequency range:	Option 9 mode:	902.2 – 927.8 MHz	
	Option 10 mode:	902.2464 – 927.8208 MHz	
Number of hopping frequencies:	Option 9 mode:	128	
	Option 10 mode:	50-110	
Channel separation:	Option 9 mode:	200.0 kHz	
	Option 10 mode:	230.4 kHz	
Maximum nominal RF output power:	1.0 W		
Antenna type:	External, antenna gain max. 6 dBi		
EUT dimensions:	Width: 36 mm	Height: 7 mm	Length: 57 mm
Power requirements:	EUT: 3.7 – 5.5 VDC Evaluation board: 9 – 32 VDC (12 V used during testing)		

Note: “Option 9” and “Option 10” are the names of test modes declared by the manufacturer.

Ports and Cables

Cable / Port	Description
DC input	Two-wire (+/-), connected from evaluation board to power supply
D9 connector	Connected from evaluation board to laptop with an RS232 – USB adapter
Antenna port	TNC 50 Ω female, connected from evaluation board to spectrum analyzer/antenna

Peripherals

Peripheral	Description / Usage
AC/DC power supply	Nokia AC-10E, used during AC Power-Line Conducted Emissions test. Provided by the laboratory.
Evaluation board	SATEL M3-TR3 Evaluation kit, sn.2015337762. Used for all tests except AC Power-Line Conducted Emissions test.
Evaluation board	SATEL M3-TR3 Evaluation kit, sn.145289999. Used during AC/DC Power-Line Conducted Emissions test (input voltage fed directly to the module).
Yagi antenna	CompeTech CA930Y-TNC (nominal gain 6 dBi), reference antenna for radiated tests.
Whip antenna	McGill Microwave Systems MM-ANT-NM-915-6DBI (nominal gain 6 dBi), reference antenna for radiated tests.

The peripherals were provided by the customer, unless otherwise noted.

SUMMARY OF TESTING

Test specification	Description of test	Result
§15.203	Antenna Requirement	PASS
§15.207 / RSS-Gen 8.8	AC Power-Line Conducted Emissions	PASS
§15.247(a)(1) / RSS-247 5.1 a)	20 dB Bandwidth	PASS
RSS-Gen 6.7	99 % Occupied Bandwidth	PASS
§15.247(a)(1) / RSS-247 5.1 b)	Carrier Frequency Separation	PASS
§15.247(a)(1)(i) / RSS-247 5.1 c)	Number of Hopping Frequencies	PASS
§15.247(a)(1)(i) / RSS-247 5.1 c)	Time of Occupancy	PASS
§15.247(b)(2) / RSS-247 5.4 a)	Maximum Peak Conducted Output Power	PASS
§15.247(d) / RSS-247 5.5	Unwanted Emissions (conducted)	PASS
§15.247(d) / RSS-247 5.5	Unwanted Emissions (radiated)	PASS

The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.4 of ANSI C63.10-2020.

EUT Test Conditions during Testing

During testing the EUT was mounted on an evaluation board. The radio was configured with a software provided by the manufacturer (TypeApproval_TR49_UI_V023_05062019). Normal modulation and maximum transmit power was used during the tests, and hopping was either enabled or disabled depending on the test.

Table 1: Test frequencies and settings

Test mode	Channel	Frequency [MHz]
Option 9	Bottom	902.2
	Middle	915.0
	Top	927.8
Option 10 (Hop table setting 50 or 112)	Bottom	902.2464
	Middle	914.9184
	Top	927.8208

The antenna port was connected to a spectrum analyzer with a coaxial cable and attenuators/filters (conducted RF tests) or to an antenna provided by the manufacturer (radiated tests). The RS232-port was connected to a laptop with an RS232-USB adapter cable. DC input voltage to the evaluation board was 12 VDC.

During AC Power-Line Conducted Emissions test an evaluation board without voltage regulation was used (voltage fed directly to the module). The EUT was powered with a peripheral AC/DC power supply (input 120 V/60 Hz, output 5 VDC).

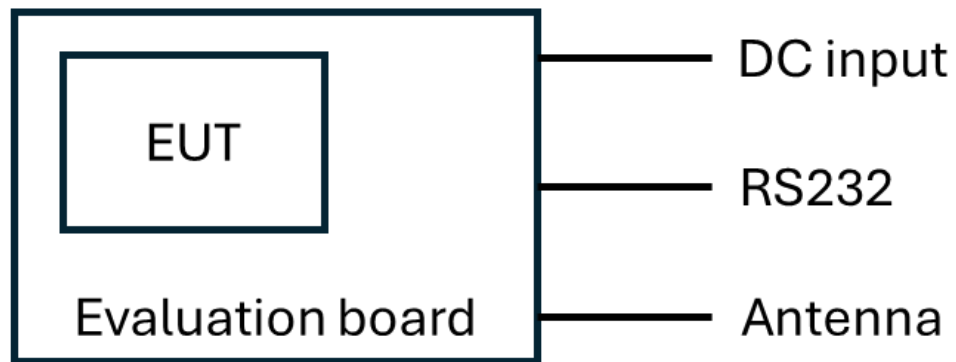


Figure 1: The EUT block diagram

Test Facility

Testing Laboratory / address: FCC designation number: FI0002 ISED CAB identifier: T004	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	☐ K10LAB, ISED Canada registration number: 8708A-1 ☒ K5LAB, ISED Canada registration number: 8708A-2 ☐ T10LAB

TEST RESULTS

Antenna Requirement

Standard: FCC Rule §15.203
Tested by: HEM
Date: 20 January 2025

FCC Rule: §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. This requirement does not apply to intentional radiators that must be professionally installed. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits are not exceeded.

Specification	Requirement (at least one of the following shall be applied)	Conclusion
§15.203	1. Permanently attached antenna 2. Unique coupling to the intentional radiator 3. Professionally installed radio. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.	PASS
Note	Option 2 is used	

AC Power-Line Conducted Emissions

Standard: ANSI C63.10-2020 clause 6.2
Tested by: LAS
Date: 22 January 2025
Temperature: 23 °C
Humidity: 23 %RH
Measurement uncertainty: ± 2.9 dB, level of confidence 95 % ($k = 2$)
Test result: **PASS**

FCC Rule: §15.207
RSS-Gen clause 8.8

For radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in the table below, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

Frequency of emission [MHz]	Conducted limit [dB μ V]	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

The correction factor in the final result table contains the sum of the transducers (transient limiter + cables). The result value is the measured value corrected with the correction factor.

AC Power-Line Conducted Emissions

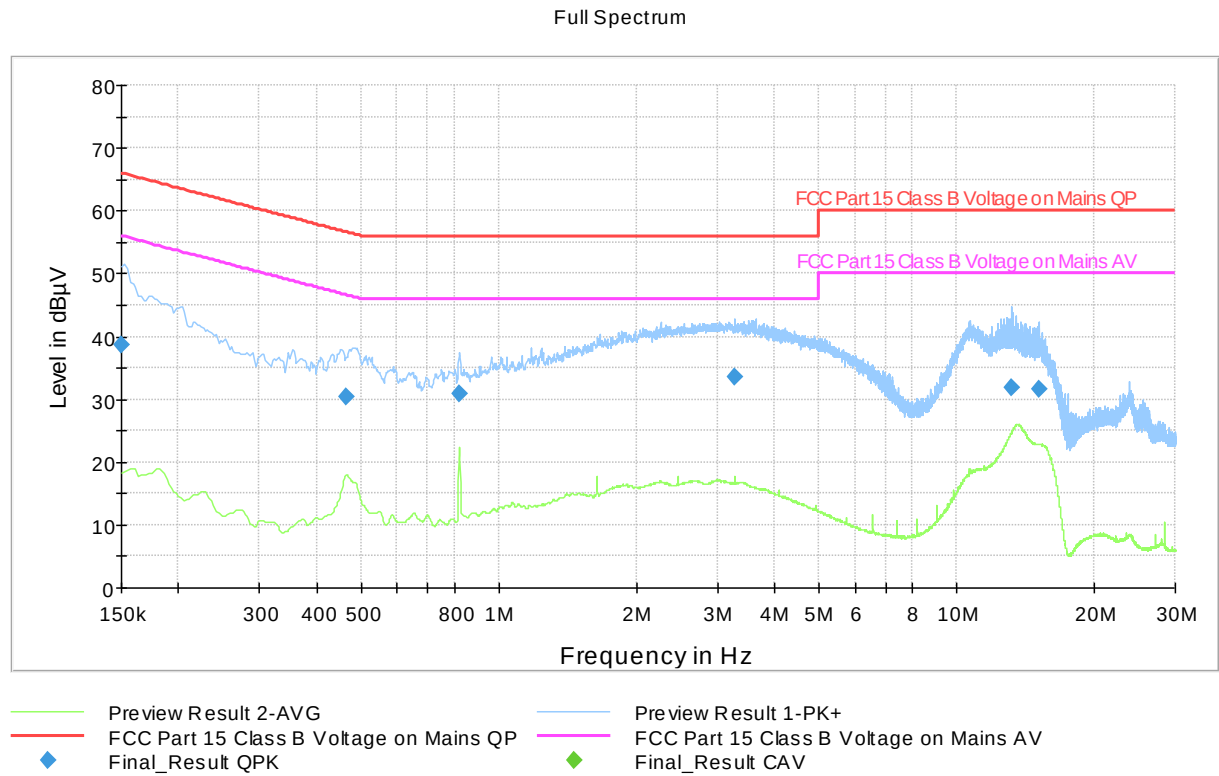


Figure 2: AC Power-Line Conducted Emissions

Table 2: Test results for AC Power-Line Conducted Emissions

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	38.68	---	66.00	27.32	15 x 1000.0	9.000	N	9.7
0.463000	30.33	---	56.64	26.31	15 x 1000.0	9.000	N	9.7
0.819500	30.93	---	56.00	25.07	15 x 1000.0	9.000	N	9.8
3.280500	33.59	---	56.00	22.41	15 x 1000.0	9.000	N	9.9
13.151000	31.93	---	60.00	28.07	15 x 1000.0	9.000	N	10.4
15.088250	31.68	---	60.00	28.32	15 x 1000.0	9.000	N	10.4

20 dB Bandwidth

Standard:	ANSI C63.10-2020 clause 6.9.2	
Tested by:	HEM	
Date:	20 January 2025	30 January 2025
Temperature:	22 °C	23 °C
Humidity:	23 %RH	31 %RH
Test result:	PASS	

FCC Rule: §15.247(a)(1) RSS-247 clause 5.1 a)

The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

The conducted measurement is performed with a spectrum analyser on bottom, middle, and top channels with the hopping function disabled.

Test results

Table 3: Test results for 20 dB Bandwidth

Test Mode	Channel	20 dB BW [kHz]	Limit [kHz]
Option 9	Bottom	144.8	≤ 500
	Middle	144.8	
	Top	144.8	
Option 10	Bottom	133.8	
	Middle	133.8	
	Top	133.8	

The spectrum analyzer figures with bottom channel are presented.

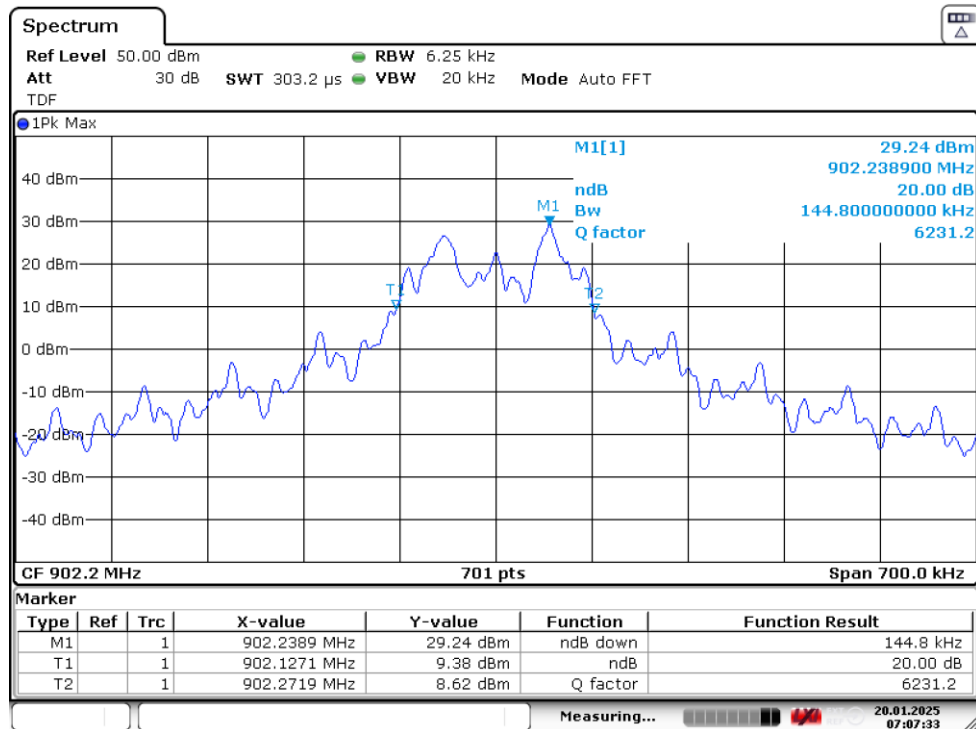


Figure 3: 20 dB Bandwidth (Option 9, bottom ch.)

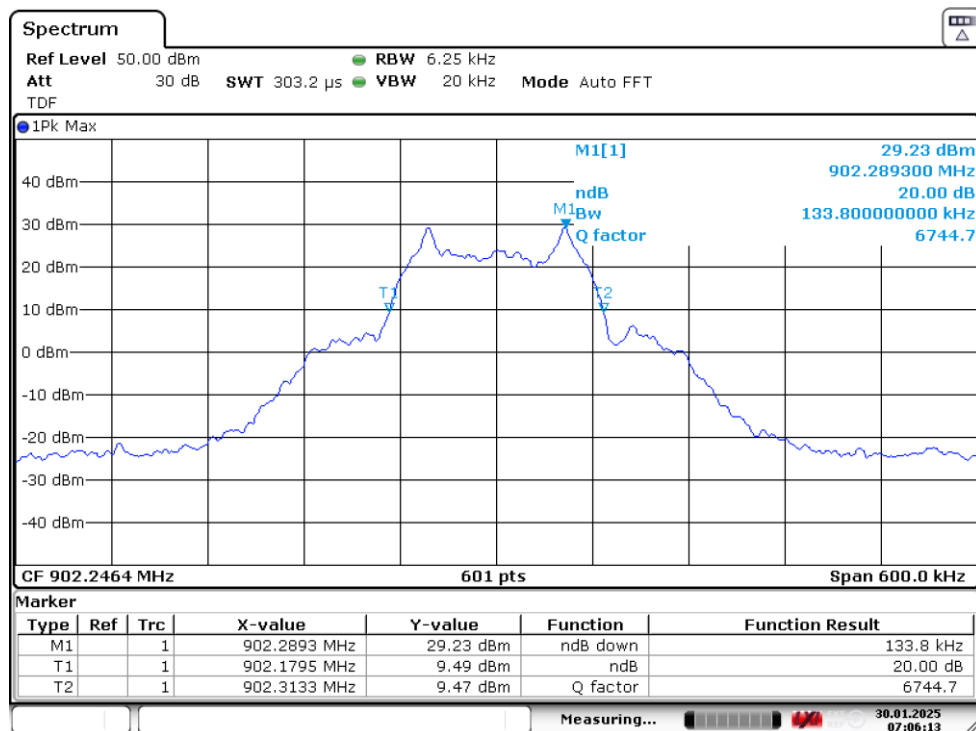


Figure 4: 20 dB Bandwidth (Option 10, bottom ch.)

99 % Occupied Bandwidth

Standard:	RSS-Gen clause 6.7	
Tested by:	HEM	
Date:	20 January 2025	30 January 2025
Temperature:	22 °C	23 °C
Humidity:	23 %RH	31 %RH
Test result:	PASS	

RSS-Gen clause 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

The conducted measurement is performed with a spectrum analyser on bottom, middle, and top channels with the hopping function disabled.

Test results

Table 4: Test results for 99 % Occupied Bandwidth

Test Mode	Channel	99 % OBW [kHz]
Option 9	Bottom	151.783
	Middle	150.785
	Top	150.785
Option 10	Bottom	127.787
	Middle	127.787
	Top	129.784

The spectrum analyzer figures with bottom channel (Option 9) and top channel (Option 10) are presented.

99 % Occupied Bandwidth

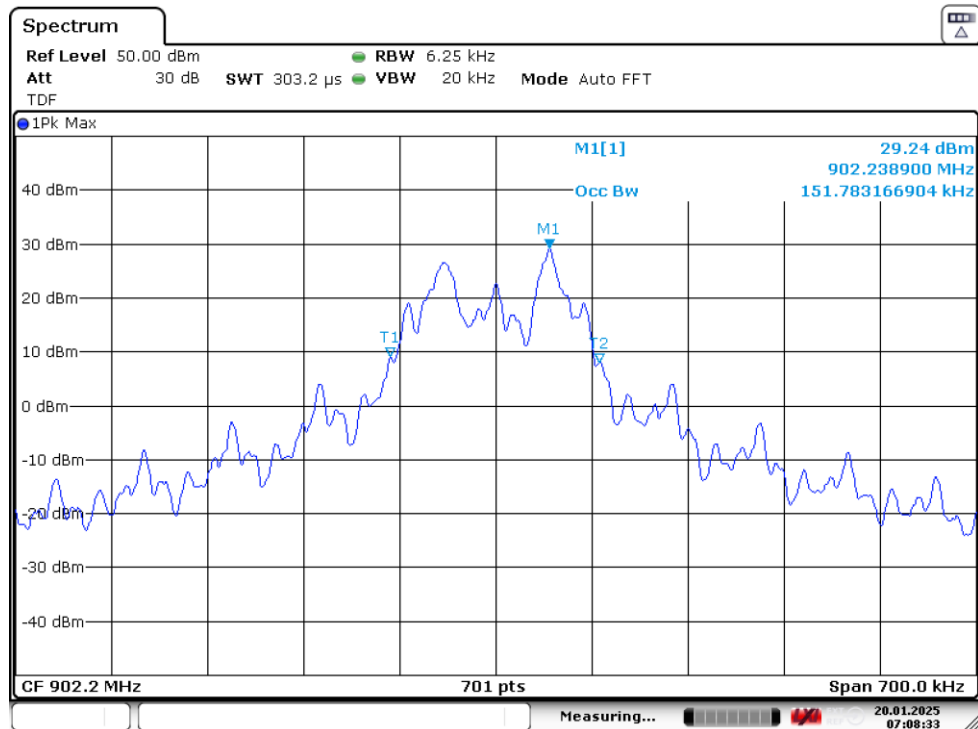


Figure 5: 99 % Occupied Bandwidth (Option 9, bottom ch.)

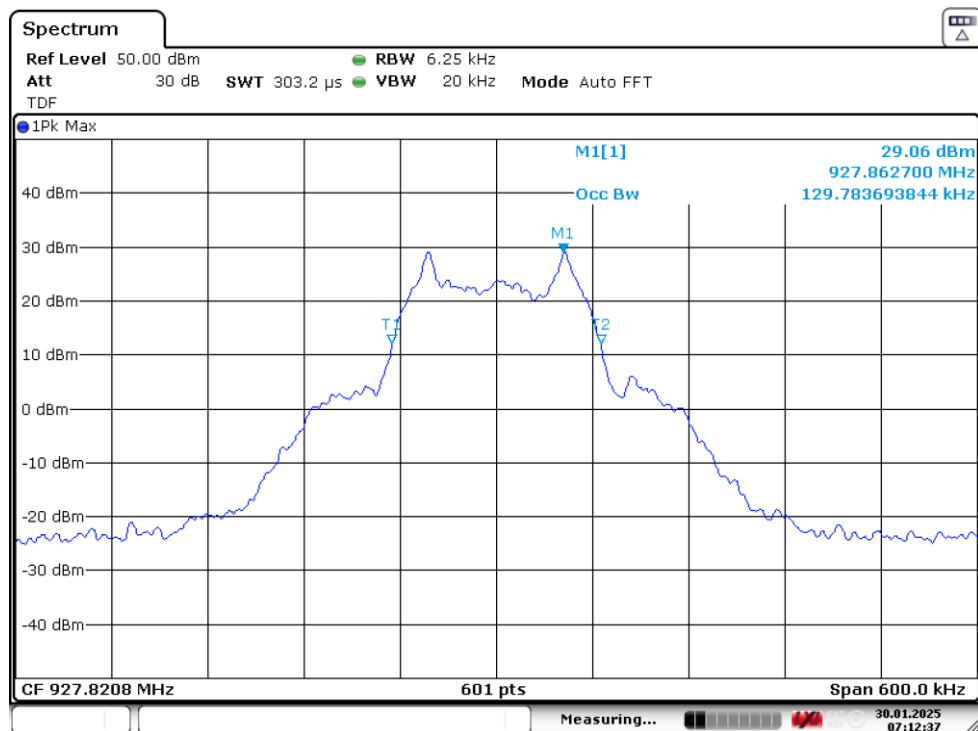


Figure 6: 99 % Occupied Bandwidth (Option 10, top ch.)

Carrier Frequency Separation

Standard: ANSI C63.10-2020 clause 7.8.2
Tested by: HEM
Date: 20 January 2025 30 January 2025
Temperature: 22 °C 23 °C
Humidity: 23 %RH 31 %RH
Test result: **PASS**

FCC Rule: §15.247(a)(1)
RSS-247 clause 5.1 b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

The conducted measurement is performed with a spectrum analyser with the hopping function enabled.

Test results

Table 5: Test results for Carrier Frequency Separation

Test Mode	Separation [kHz]	Limit [kHz]
Option 9	200.0	≥ 144.8
Option 10	230.4	≥ 133.8

Carrier Frequency Separation

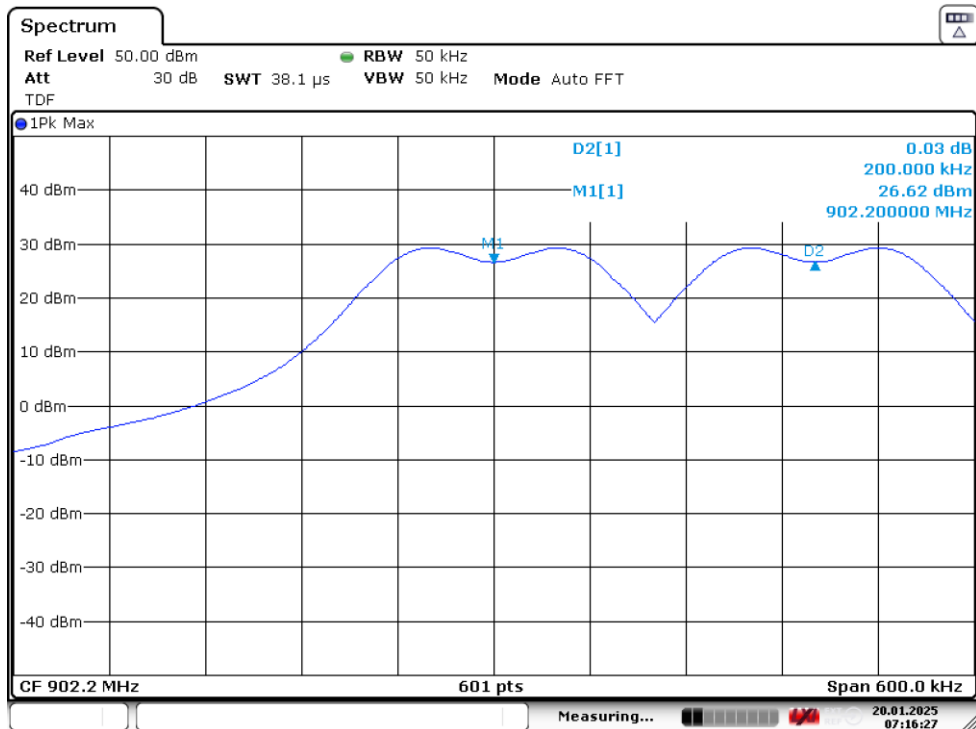


Figure 7: Carrier Frequency Separation (Option 9)

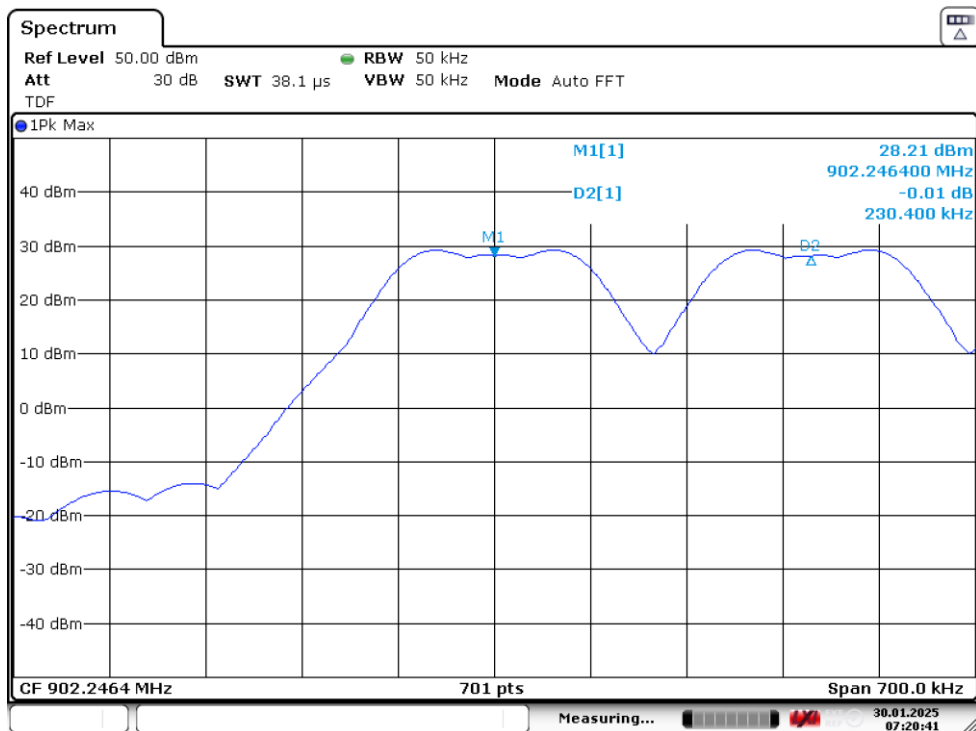


Figure 8: Carrier Frequency Separation (Option 10)

Number of Hopping Frequencies

Number of Hopping Frequencies

Standard: ANSI C63.10-2020 clause 7.8.3
Tested by: HEM
Date: 20 January 2025 30 January 2025
Temperature: 22 °C 23 °C
Humidity: 23 %RH 31 %RH
Test result: **PASS**

FCC Rule: §15.247(a)(1)(i)
RSS-247 clause 5.1 c)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

The conducted measurement is performed with a spectrum analyser with the hopping function enabled.

Test results

Table 6: Test results for Number of Hopping Frequencies

Test Mode	Frequency range [MHz]	Hopping Channels	Total Number of Channels
Option 9	902.0 – 908.5	32	128
	908.5 – 914.9	32	
	914.9 – 921.3	31	
	921.3 – 928.0	33	
Option 10 (Hop table setting 50)	902.0000 – 908.5824	14	50
	908.5824 – 915.0336	12	
	915.0336 – 921.4848	11	
	921.4848 – 928.0000	13	
Option 10 (Hop table setting 112)	902.0000 – 908.5824	28	110
	908.5824 – 915.0336	26	
	915.0336 – 921.4848	28	
	921.4848 – 928.0000	28	

Number of Hopping Frequencies

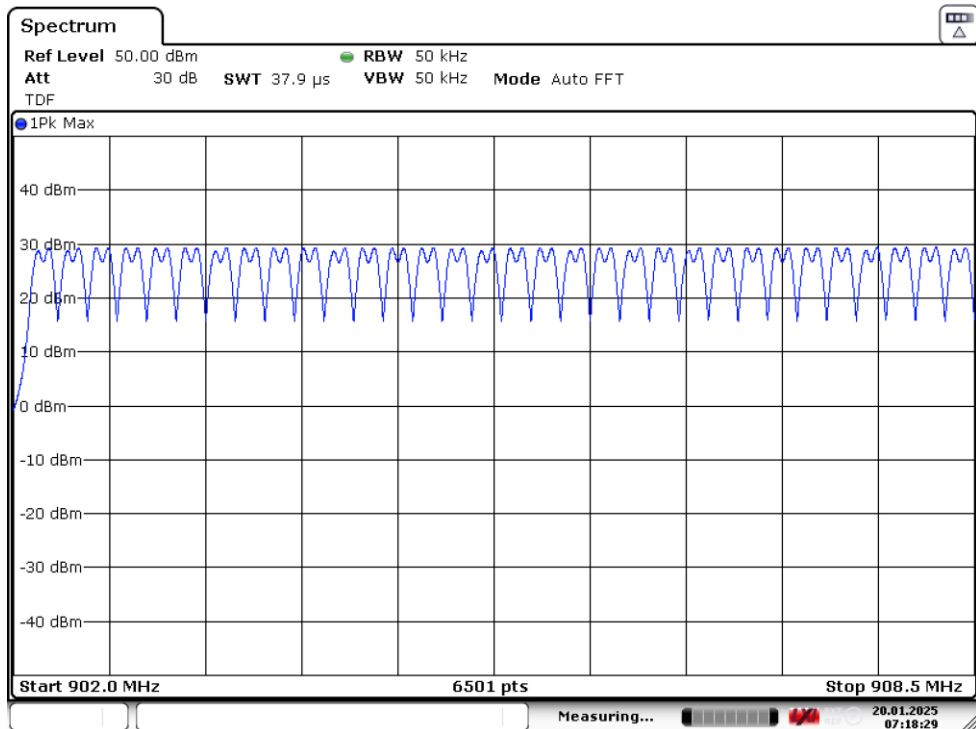


Figure 9: Number of Hopping Frequencies (Option 9, 902.0 – 908.5 MHz)

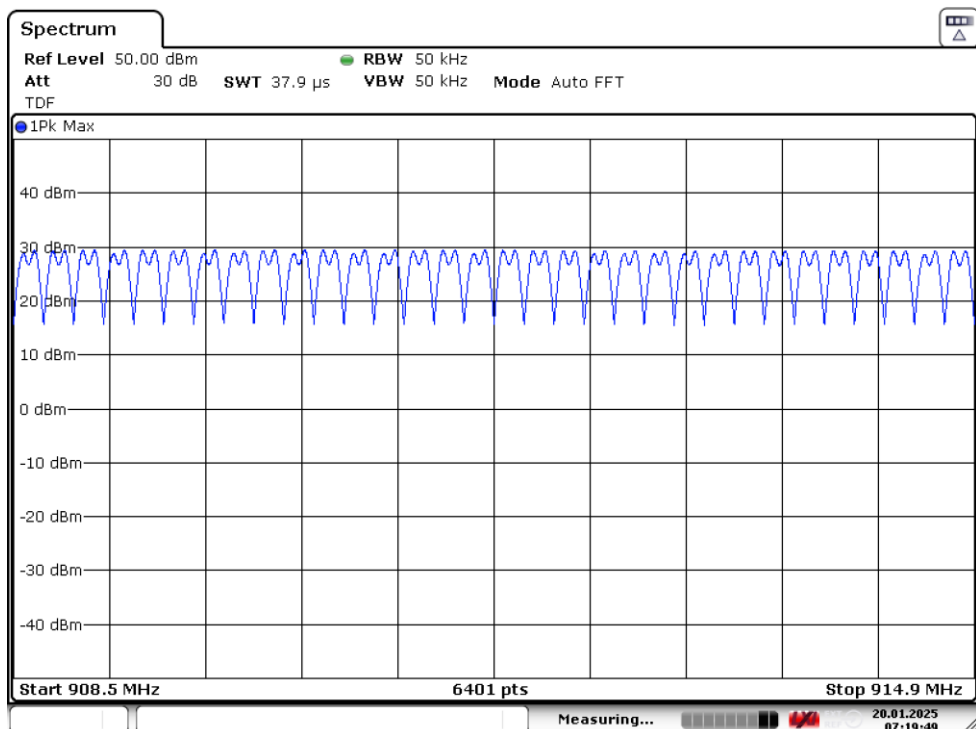


Figure 10: Number of Hopping Frequencies (Option 9, 908.5 – 914.9 MHz)

Number of Hopping Frequencies

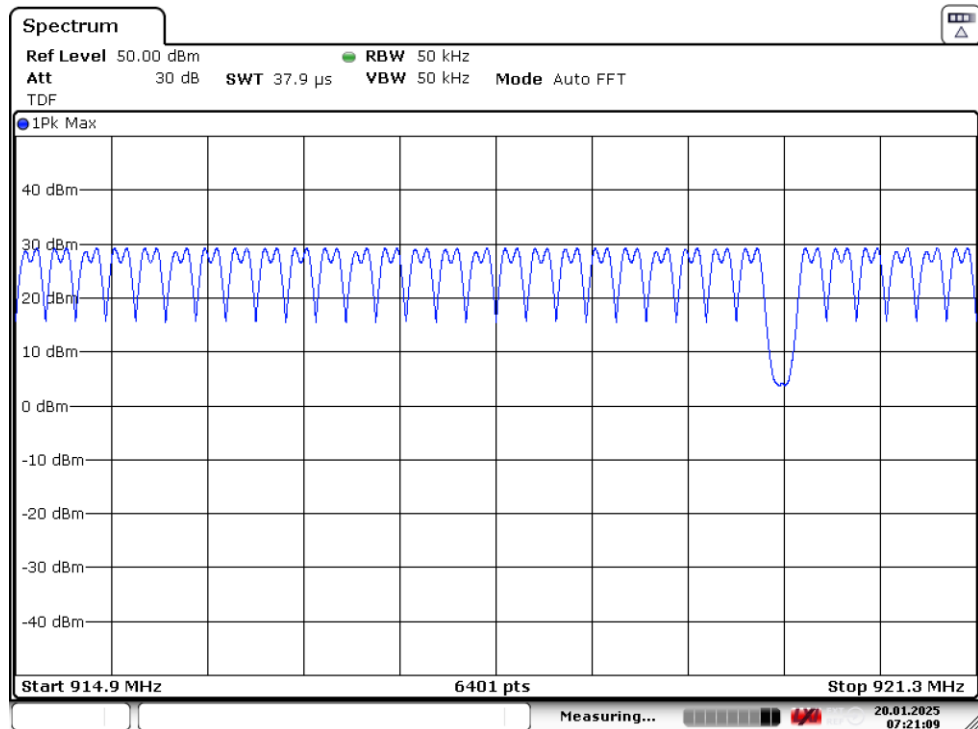


Figure 11: Number of Hopping Frequencies (Option 9, 914.9 – 921.3 MHz)

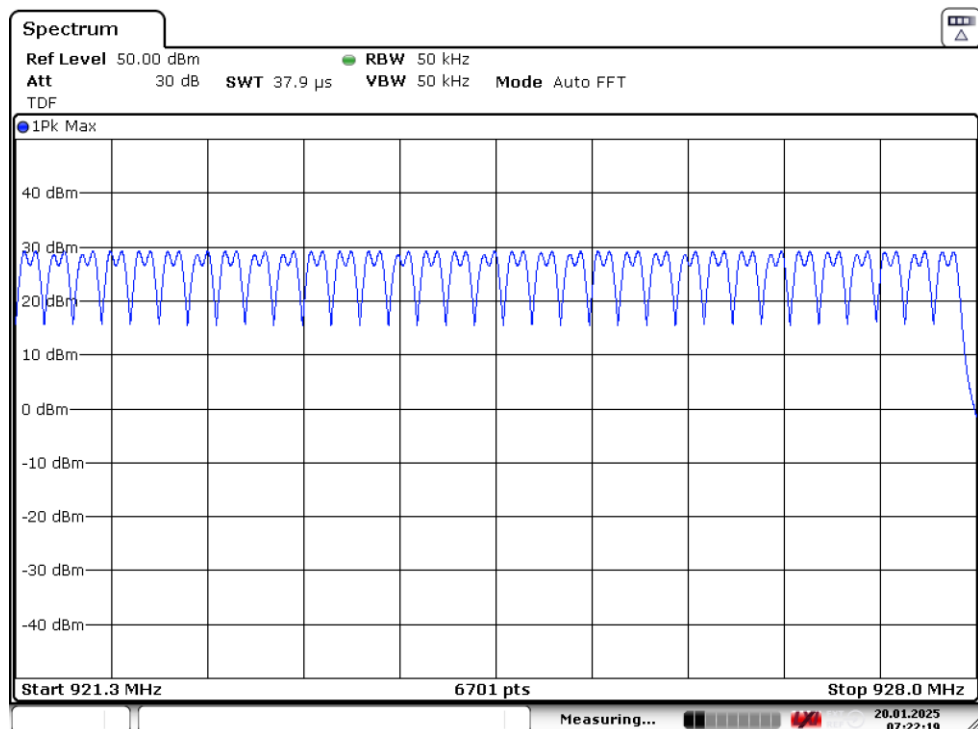


Figure 12: Number of Hopping Frequencies (Option 9, 921.3 – 928.0 MHz)

Number of Hopping Frequencies

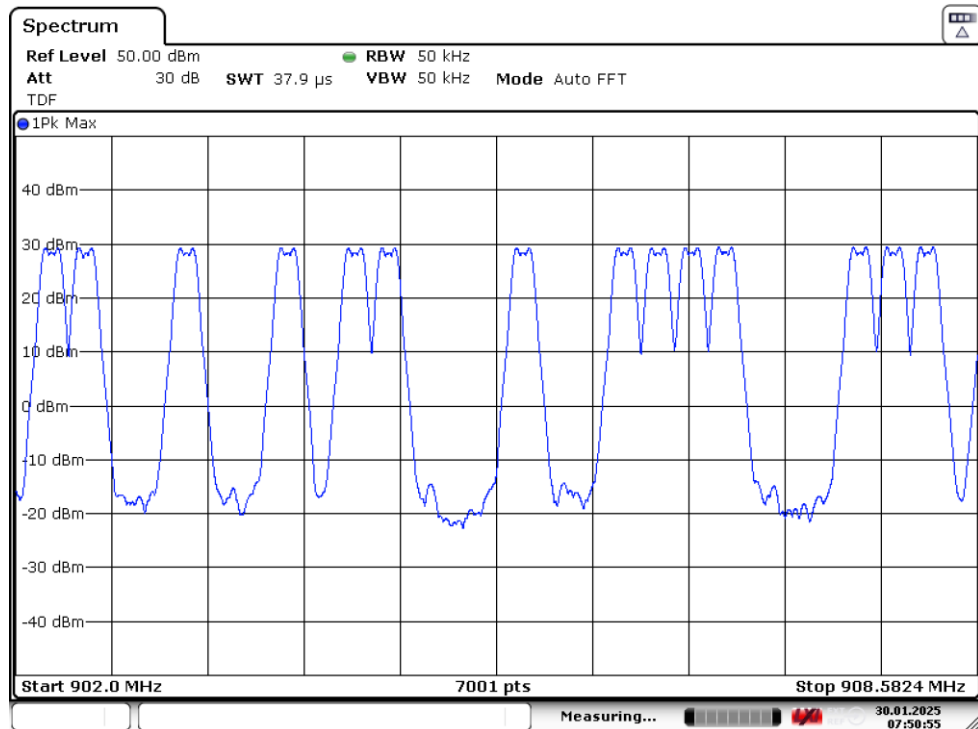


Figure 13: Number of Hopping Frequencies (Option 10 hop table 50, 902.0000 – 908.5824 MHz)

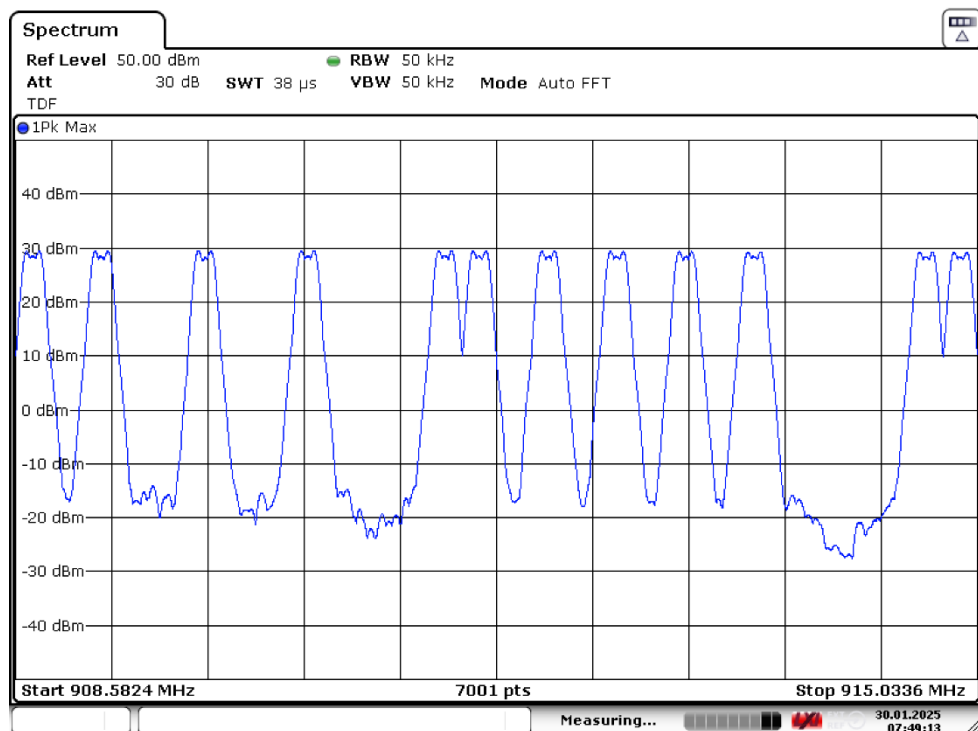


Figure 14: Number of Hopping Frequencies (Option 10 hop table 50, 908.5824 – 915.0336 MHz)

Number of Hopping Frequencies

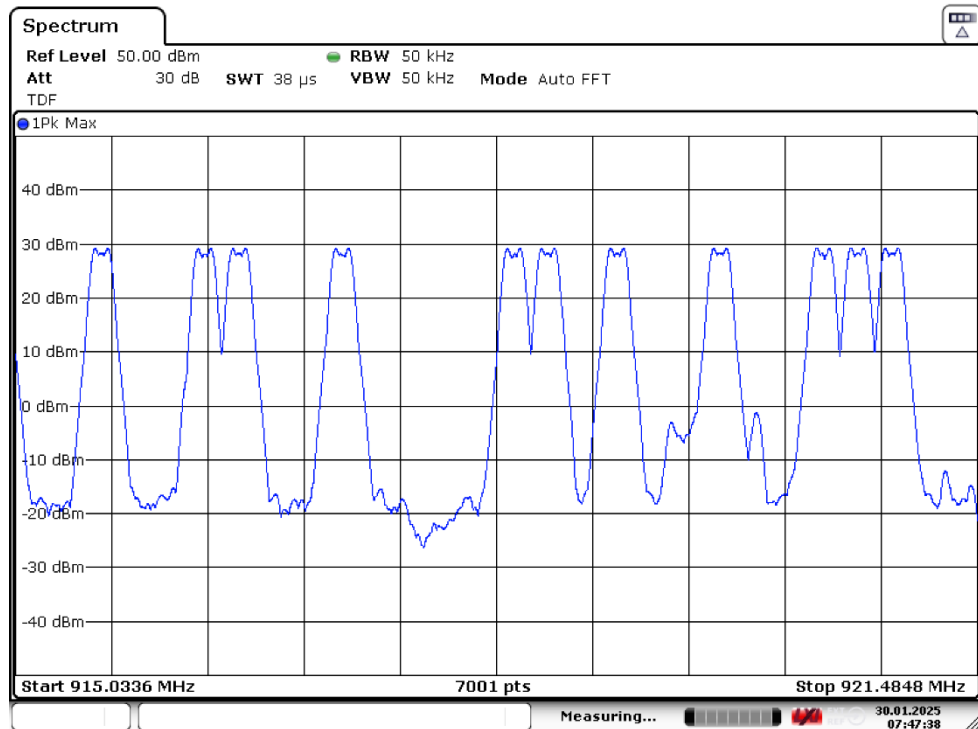


Figure 15: Number of Hopping Frequencies (Option 10 hop table 50, 915.0336 – 921.4848 MHz)

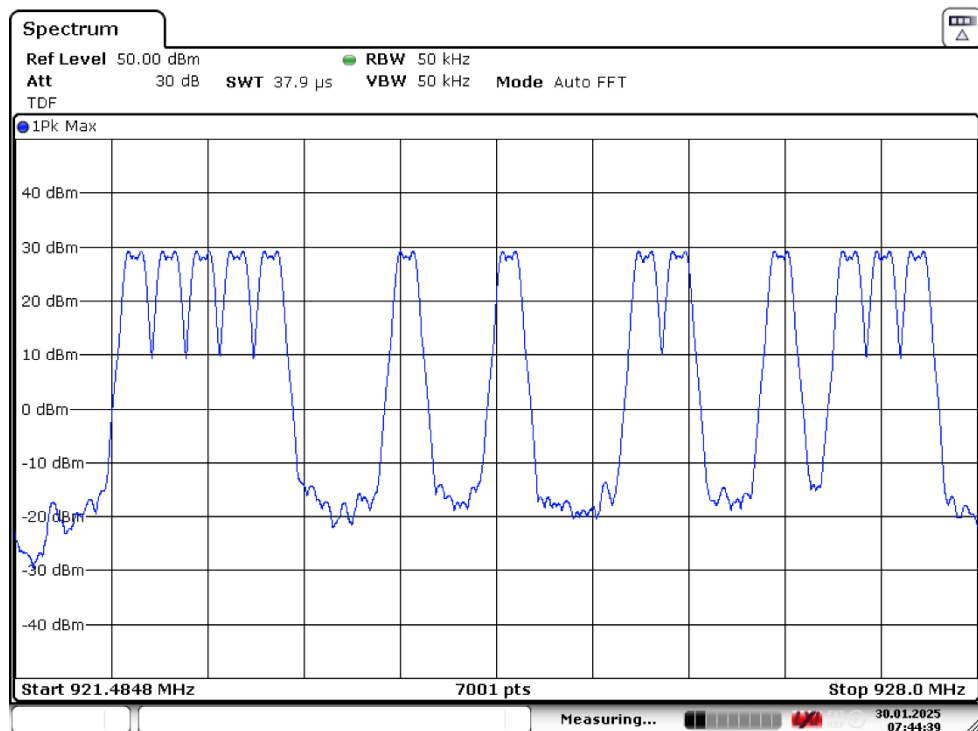


Figure 16: Number of Hopping Frequencies (Option 10 hop table 50, 921.4848 – 928.0000 MHz)

Number of Hopping Frequencies

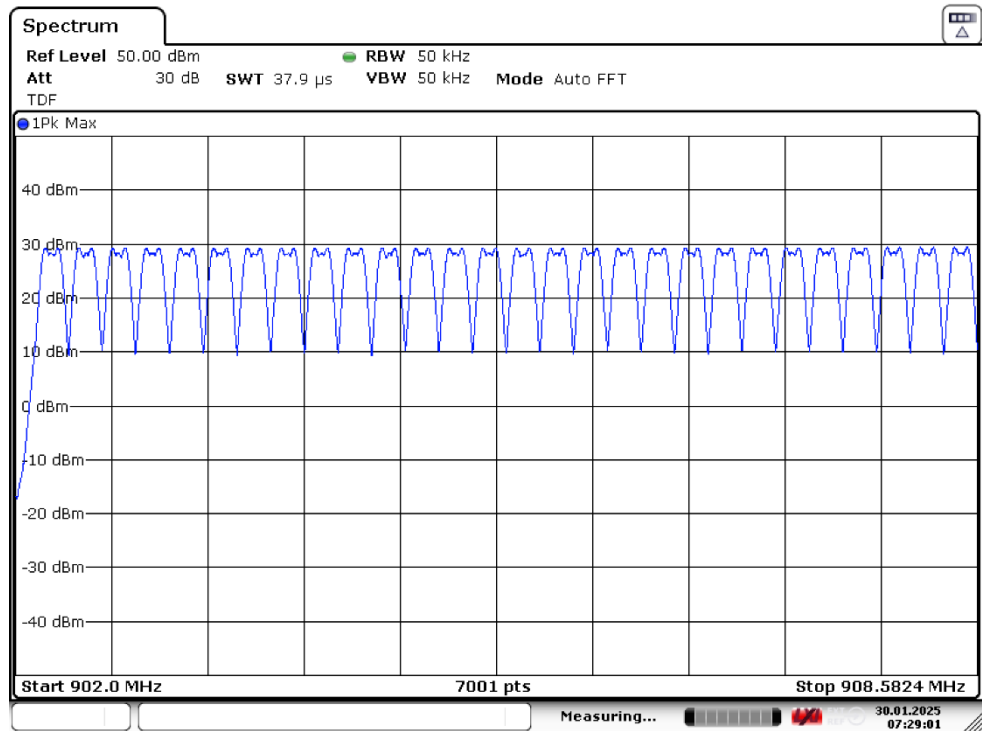


Figure 17: Number of Hopping Frequencies (Option 10 hop table 112, 902.0000 – 908.5824 MHz)

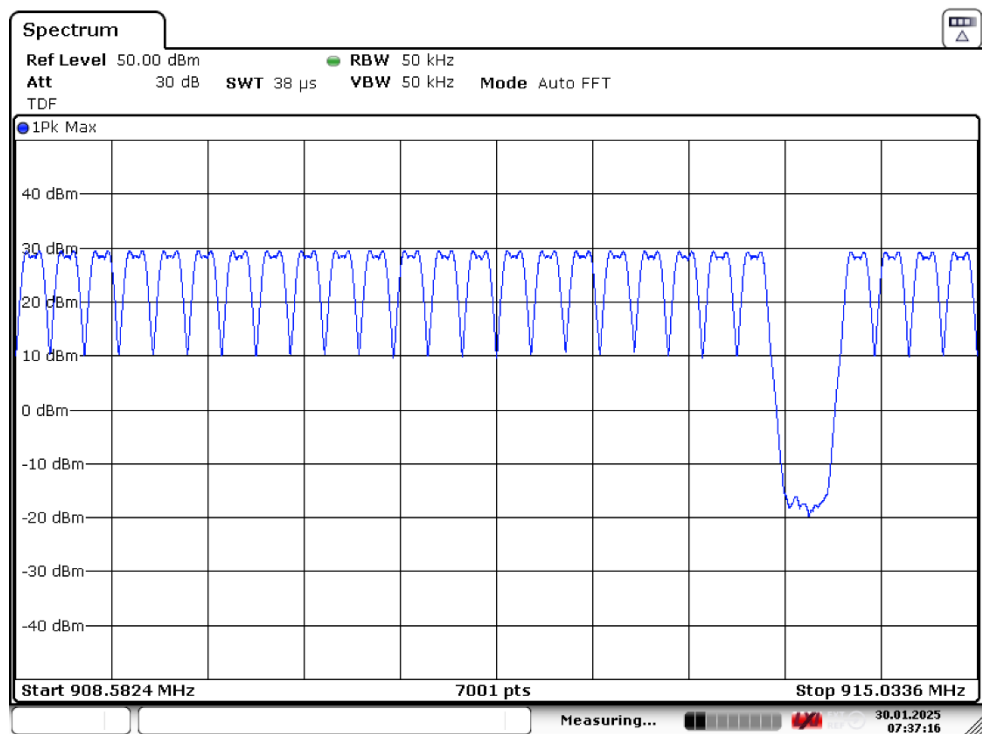


Figure 18: Number of Hopping Frequencies (Option 10 hop table 112, 908.5824 – 915.0336 MHz)

Number of Hopping Frequencies

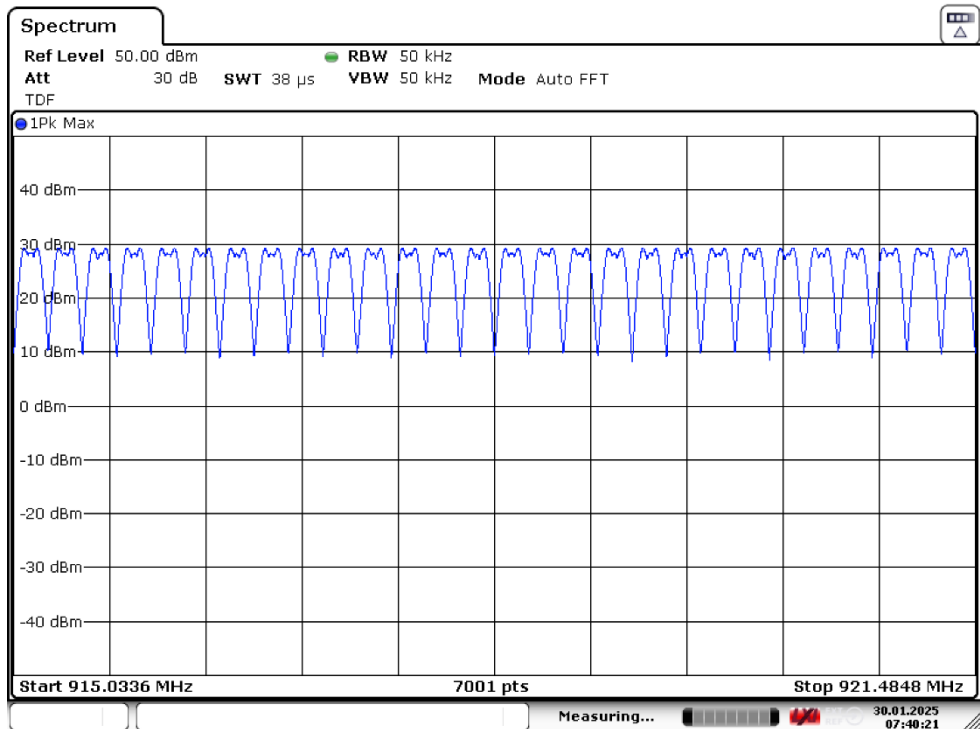


Figure 19: Number of Hopping Frequencies (Option 10 hop table 112, 915.0336 – 921.4848 MHz)

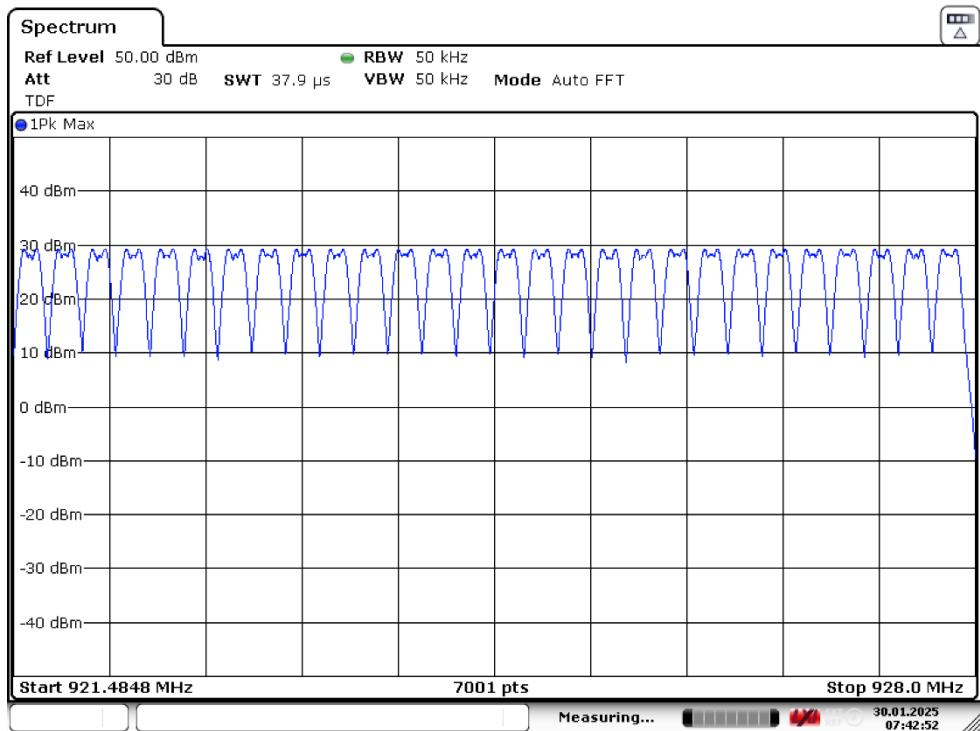


Figure 20: Number of Hopping Frequencies (Option 10 hop table 112, 921.4848 – 928.0000 MHz)

Time of Occupancy

Standard: ANSI C63.10-2020 clause 7.8.4
Tested by: HEM
Date: 20 January 2025 30 January 2025
Temperature: 22 °C 23 °C
Humidity: 23 %RH 31 %RH
Test result: **PASS**

FCC Rule: §15.247(a)(1)(i)
RSS-247 clause 5.1 c)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

The conducted measurement is performed with a spectrum analyser with the hopping function enabled.

Test results

Table 7: Test results for Time of Occupancy

Test Mode	Channel	Dwell Time per Hop [ms]	Hops during 20 s	Time of Occupancy [ms]
Option 9	Bottom	45.96	2	91.92
	Middle	45.96	2	91.92
	Top	45.95	2	91.90
Option 10 (Hop table 50)	Bottom	1.65	10	16.5
	Middle	1.65	10	16.5
	Top	1.65	10	16.5
Option 10 (Hop table 112)	Bottom	1.65	5	8.25
	Middle	1.65	5	8.25
	Top	1.65	5	8.25

The spectrum analyzer figures with bottom channel are presented.

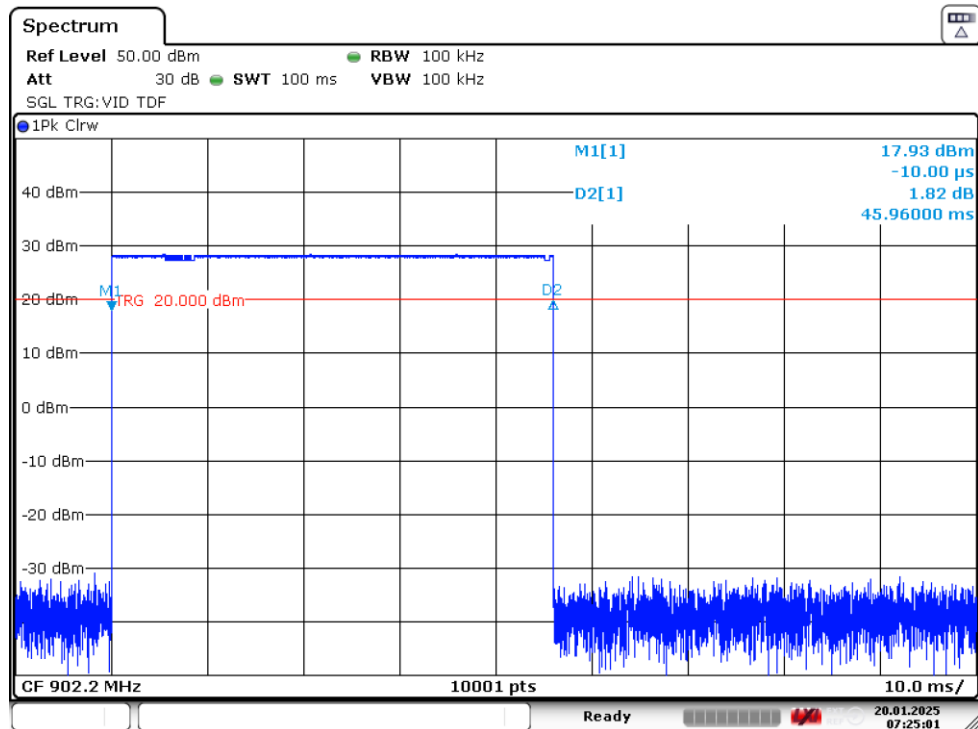


Figure 21: Dwell Time per Hop (Option 9, bottom ch.)

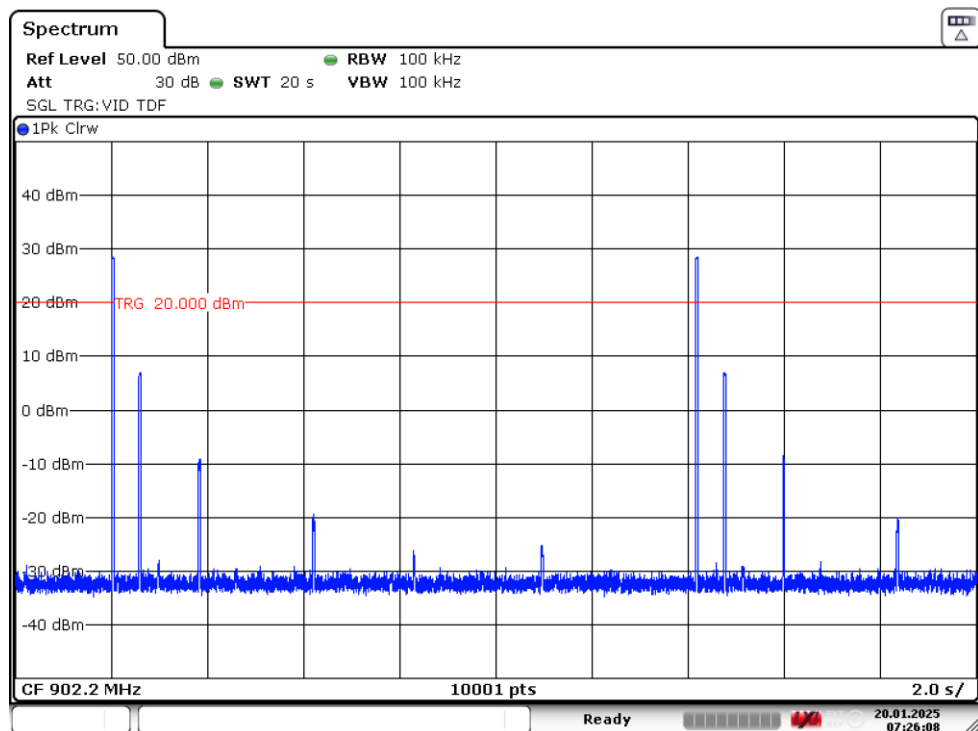


Figure 22: Hops during 20 s (Option 9, bottom ch.)

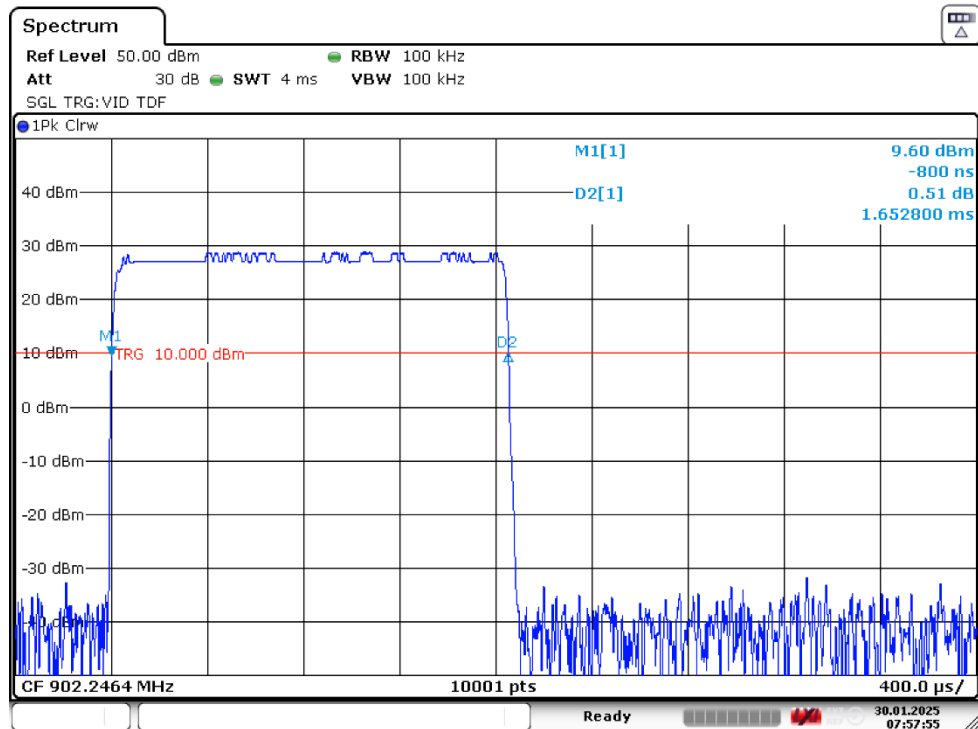


Figure 23: Dwell Time per Hop (Option 10 hop table 50, bottom ch.)

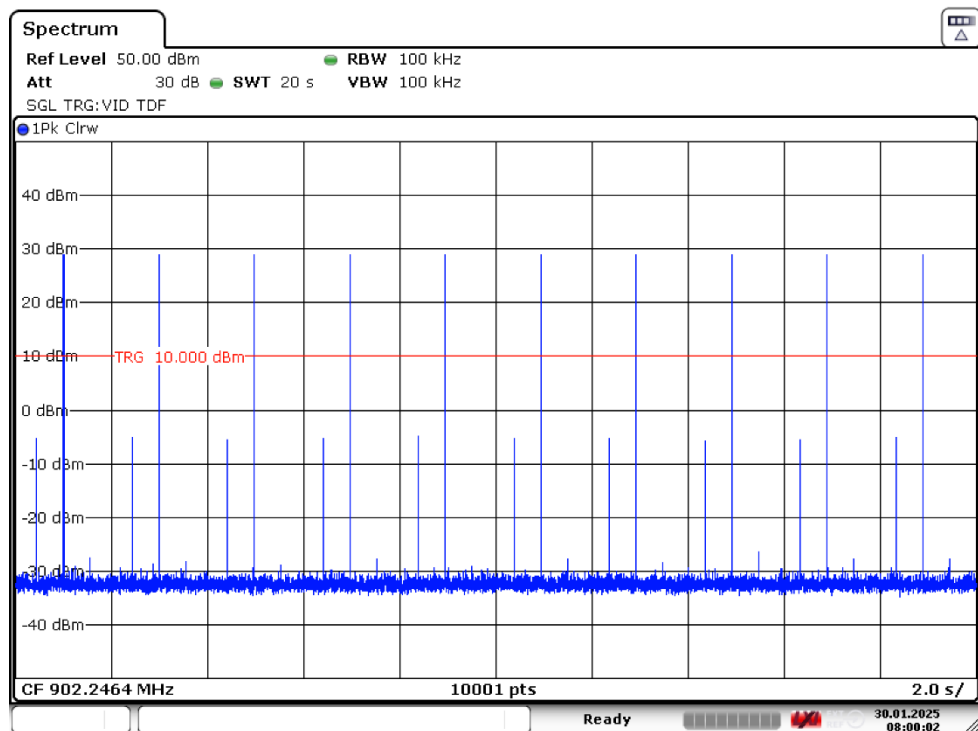


Figure 24: Hops during 20 s (Option 10 hop table 50, bottom ch.)

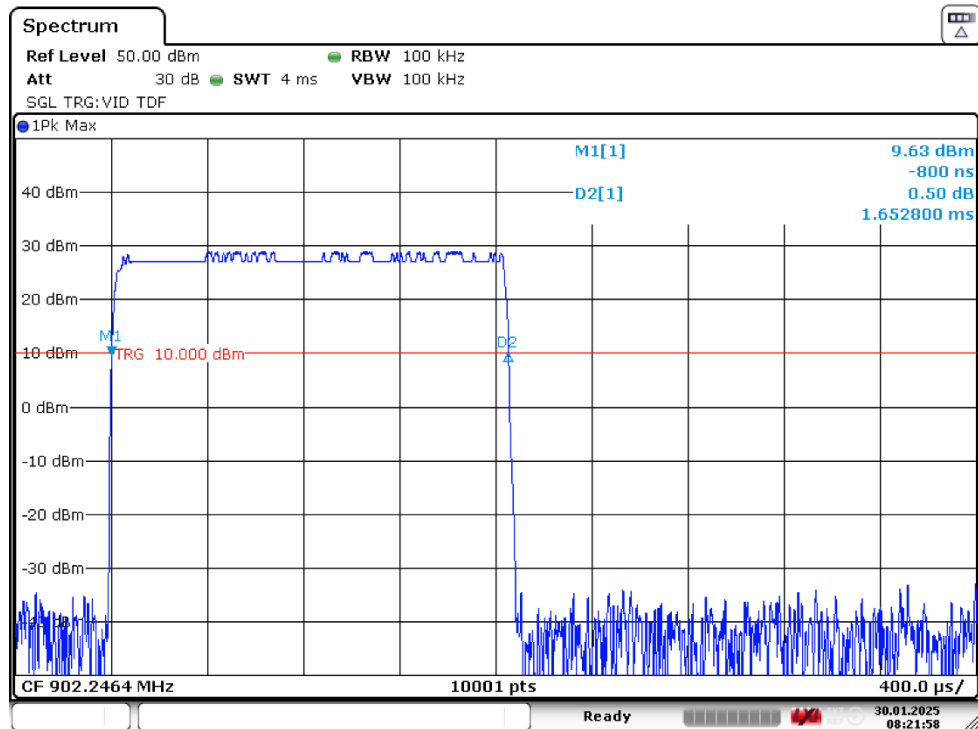


Figure 25: Dwell Time per Hop (Option 10 hop table 112, bottom ch.)

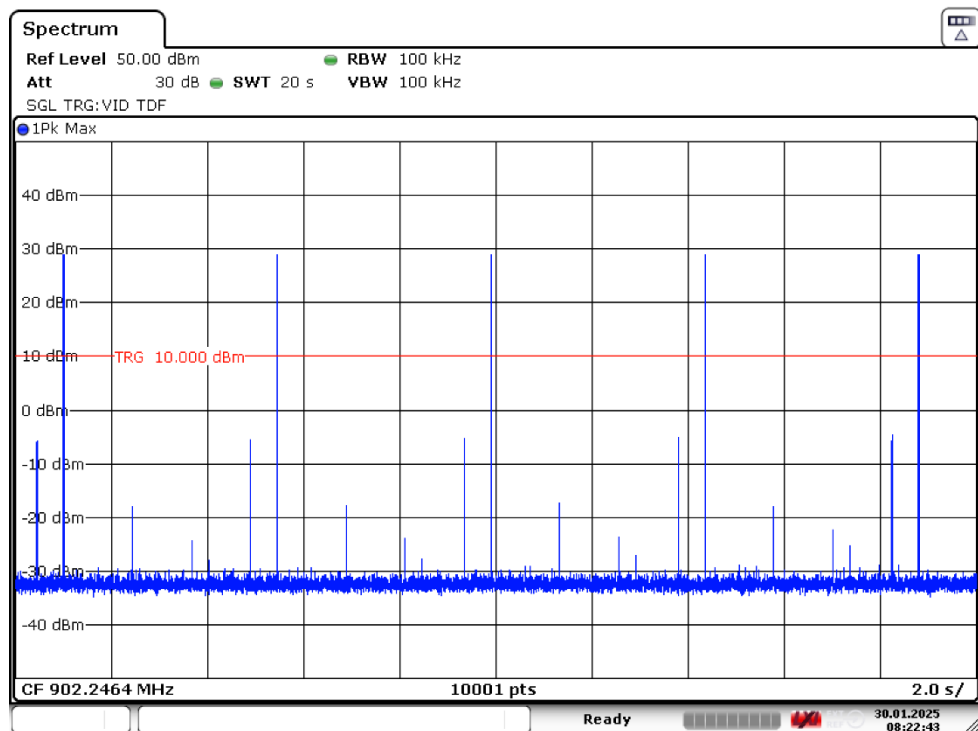


Figure 26: Hops during 20 s (Option 10 hop table 112, bottom ch.)

Maximum Peak Conducted Output Power

Standard: ANSI C63.10-2020 clause 7.8.5
Tested by: LAS
Date: 18 December 2025
Temperature: 22 °C
Humidity: 34 %RH
Measurement uncertainty: ± 2.87 dB, level of confidence 95 % ($k = 2$)
Test result: **PASS**

FCC Rule: §15.247(b)(2)
RSS-247 clause 5.4 a)

The maximum peak conducted output power shall not exceed 1.0 W (30 dBm), and the e.i.r.p. shall not exceed 4 W (36 dBm) if the hopset uses 50 or more hopping channels.

The conducted measurement is performed with a spectrum analyser on bottom, middle, and top channels with the hopping function disabled.

Tested with sample 2.

Test results

Table 8: Test results for Maximum Peak Conducted Output Power

Test Mode	Channel	Conducted Power [dBm]	e.i.r.p. [dBm]
Option 9	Bottom	27.88	33.88
	Middle	27.90	33.90
	Top	27.90	33.90
Option 10	Bottom	27.88	33.88
	Middle	27.85	33.85
	Top	27.83	33.83

Note: the e.i.r.p. result is calculated with an external antenna gain 6 dBi.

The spectrum analyzer figures with worst channels are presented.

Maximum Peak Conducted Output Power

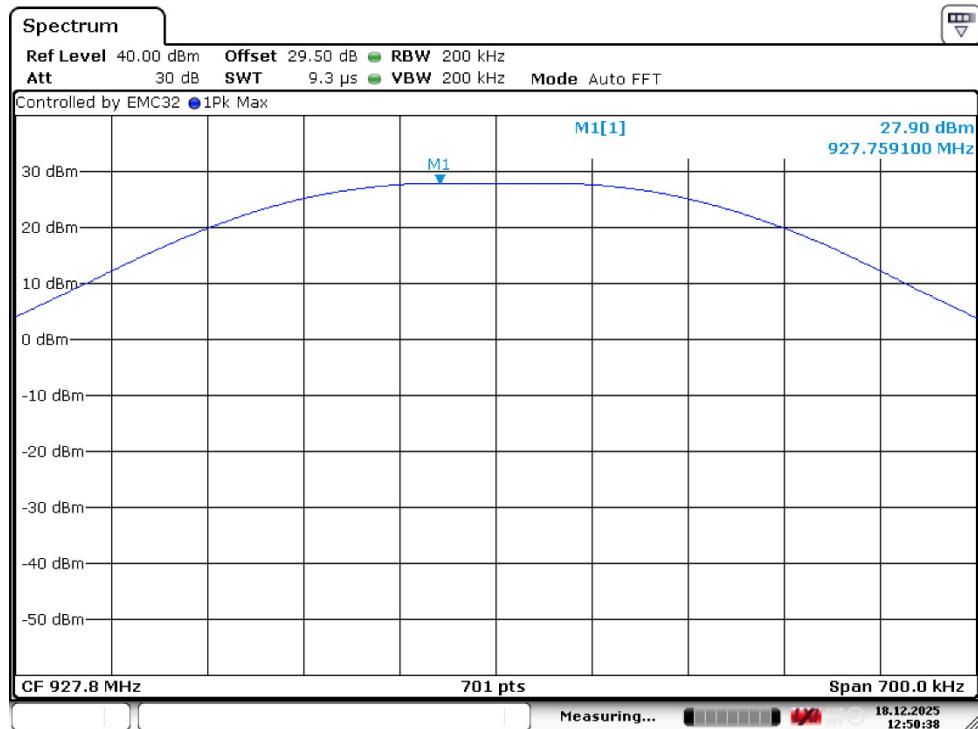


Figure 27: Maximum Peak Conducted Output Power (Option 9, top ch.)

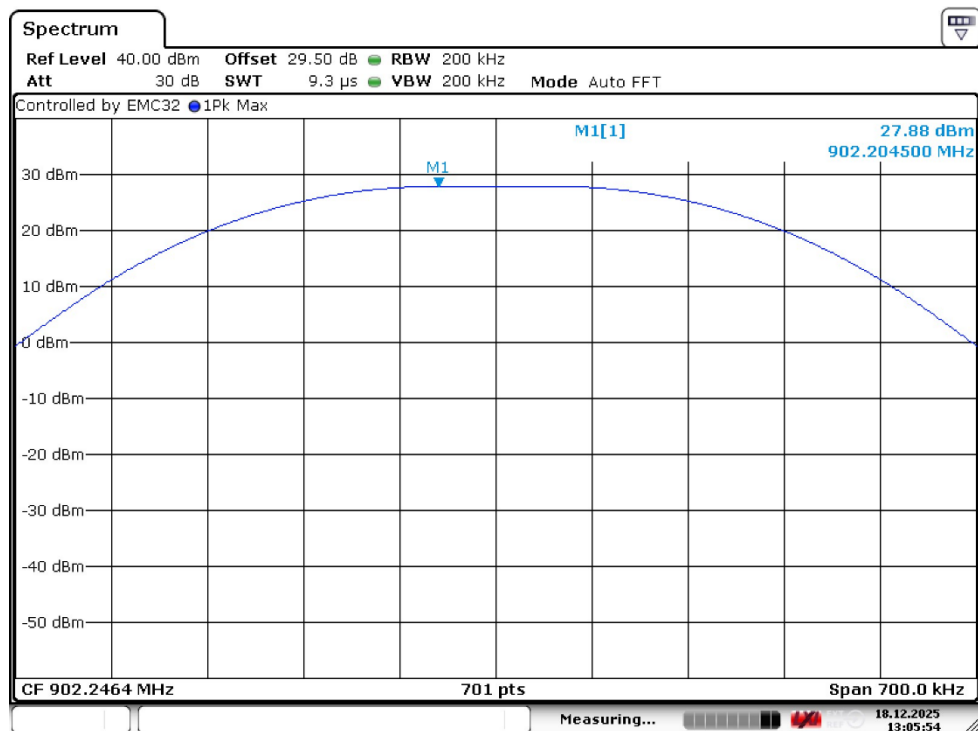


Figure 28: Maximum Peak Conducted Output Power (Option 10, bottom ch.)

Unwanted Emissions (conducted)

Unwanted Emissions (conducted)

Standard:	ANSI C63.10-2020 clause 7.8.7	
Tested by:	HEM	
Date:	20 January 2025	30 January 2025
Temperature:	22 °C	23 °C
Humidity:	23 %RH	31 %RH
Measurement uncertainty:	± 2.87 dB, level of confidence 95 % (k = 2)	
Test result:	PASS	

FCC Rule: §15.247(d) RSS-247 clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on an RF conducted measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

The conducted measurement is performed with a spectrum analyser on bottom, middle, and top channels with the hopping function disabled. The band-edge measurement is repeated with the hopping enabled.

Test results

No spurious emissions within 20 dB of the limit were observed. The spectrum analyser figures with Option 10, bottom channel are presented.

Band-edge measurement results are presented with Option 9 and Option 10 test modes, and with bottom and top channels.

Table 9: Test results for Band-Edge measurement

Test mode	Channel	Lower Band-Edge [dBc]	Upper Band-Edge [dBc]	Limit [dBc]
Option 9	Bottom	-21.76	-	≤ -20.00
	Top	-	-21.81	
	Hopping mode	-22.28	-21.72	
Option 10	Bottom	-39.55	-	
	Top	-	-22.02	
	Hopping mode	-42.76	-23.08	

Unwanted Emissions (conducted)

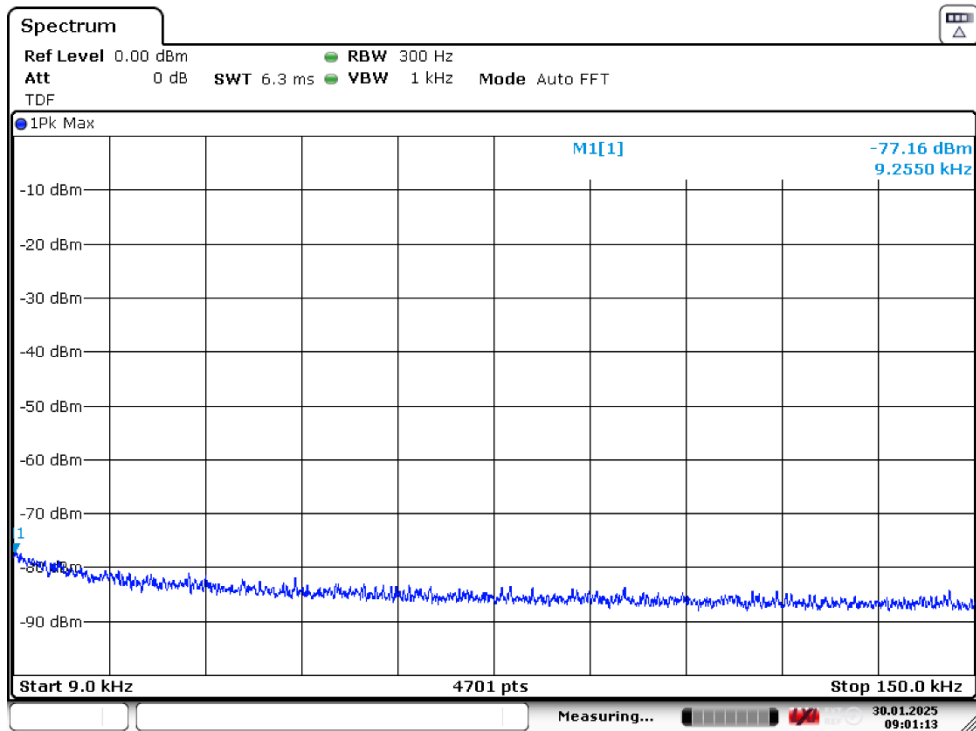


Figure 29: Unwanted emissions 9 – 150 kHz (Option 10, bottom ch.)

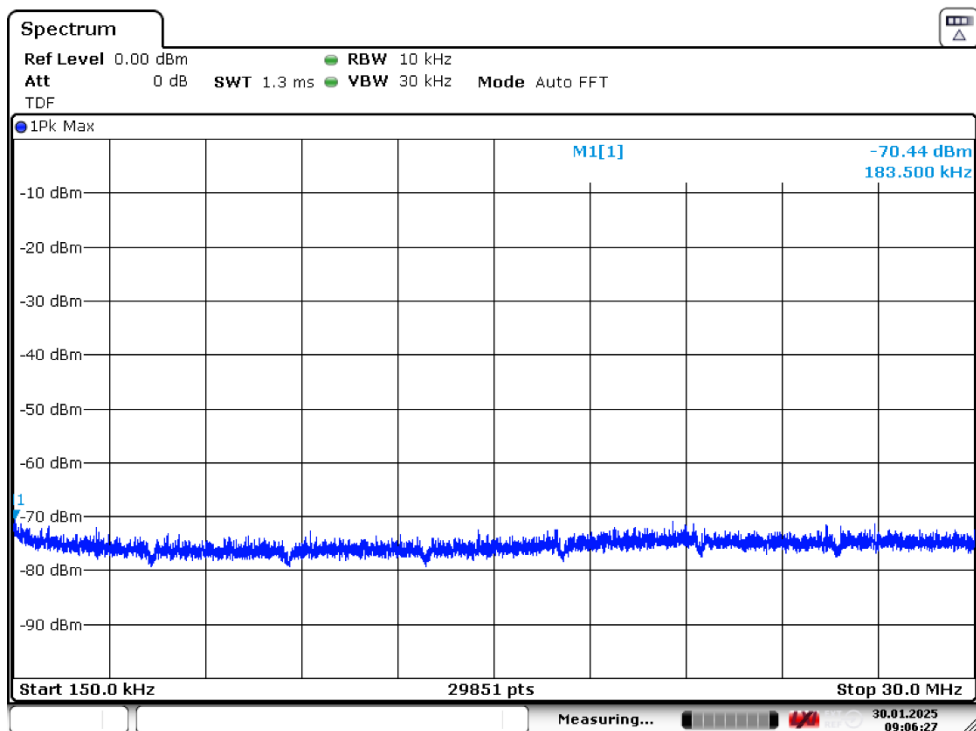


Figure 30: Unwanted emissions 150 kHz – 30 MHz (Option 10, bottom ch.)

Unwanted Emissions (conducted)

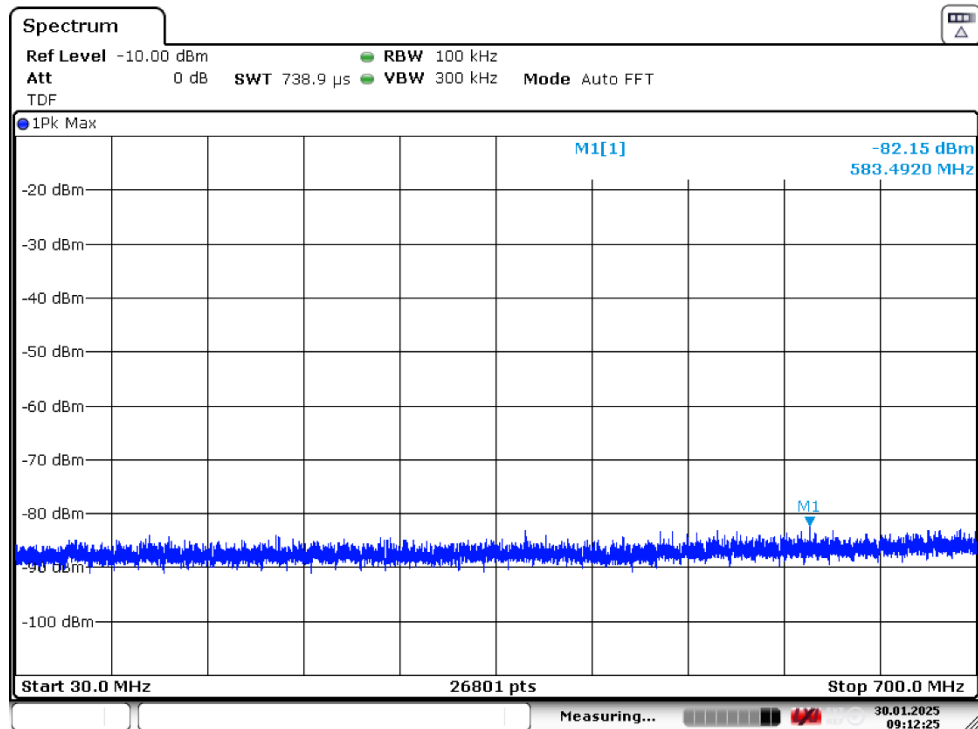


Figure 31: Unwanted emissions 30 – 700 MHz (Option 10, bottom ch.)

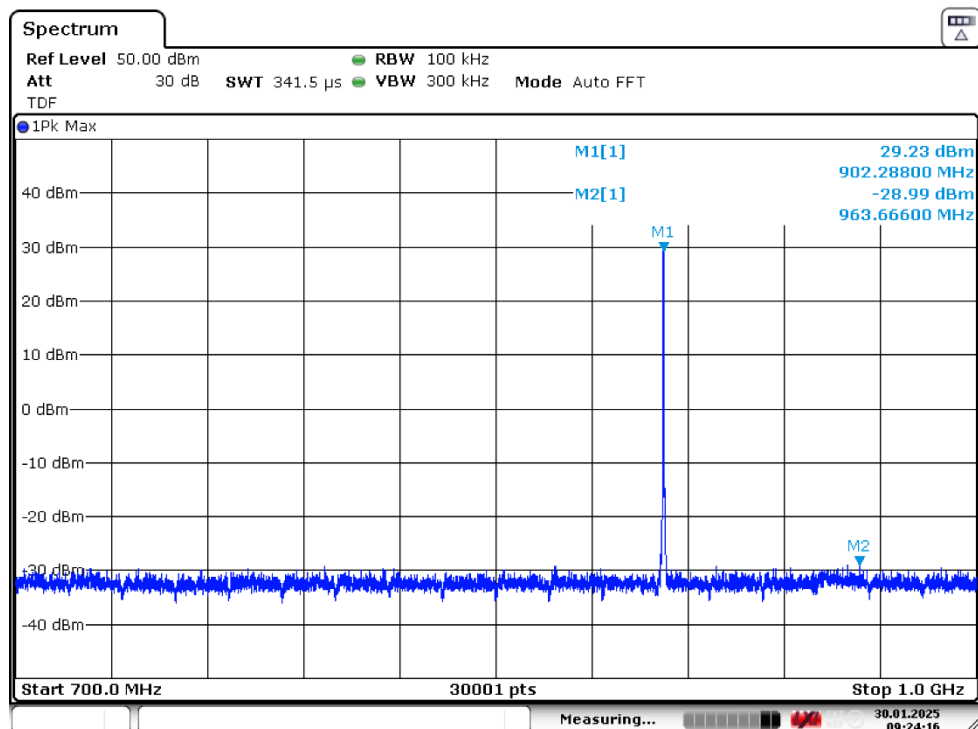


Figure 32: Unwanted emissions 700 – 1000 MHz (Option 10, bottom ch.)

Unwanted Emissions (conducted)

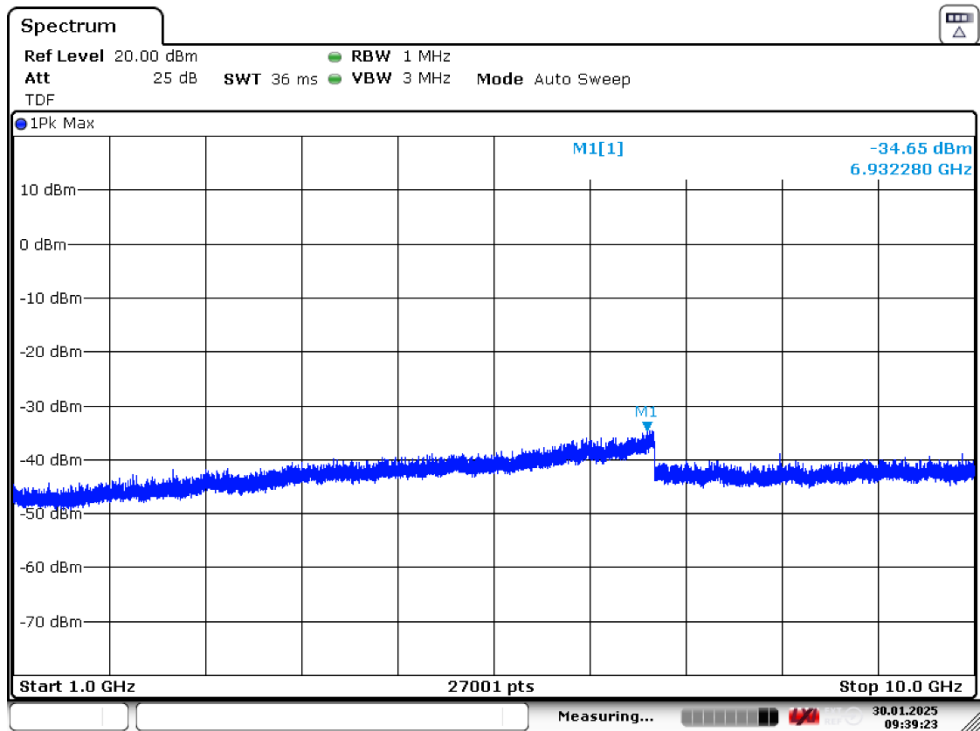


Figure 33: Unwanted emissions 1 – 10 GHz (Option 10, bottom ch.)

Unwanted Emissions (conducted)

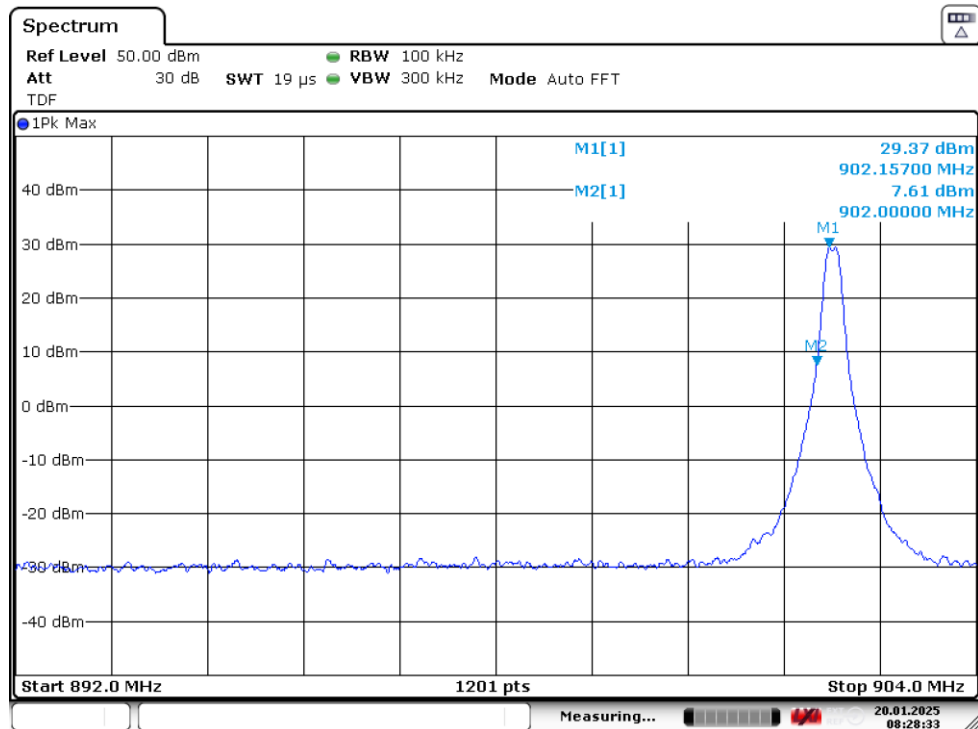


Figure 34: Lower band-edge (Option 9, bottom ch.)

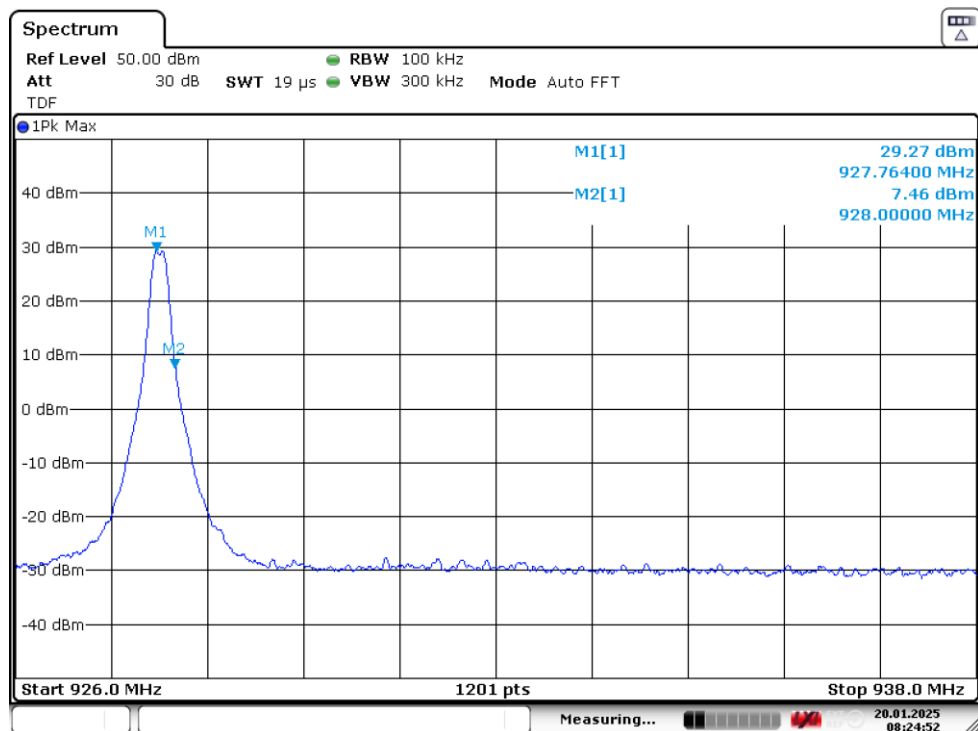


Figure 35: Upper band-edge (Option 9, top. ch)

Unwanted Emissions (conducted)

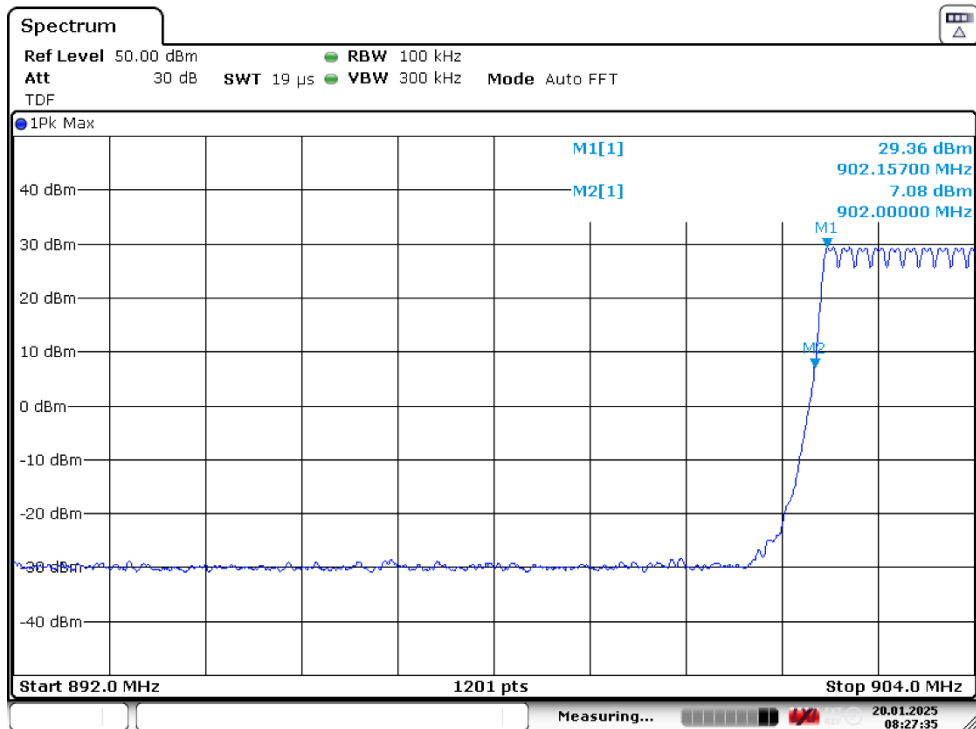


Figure 36: Lower band-edge (Option 9, hopping enabled)

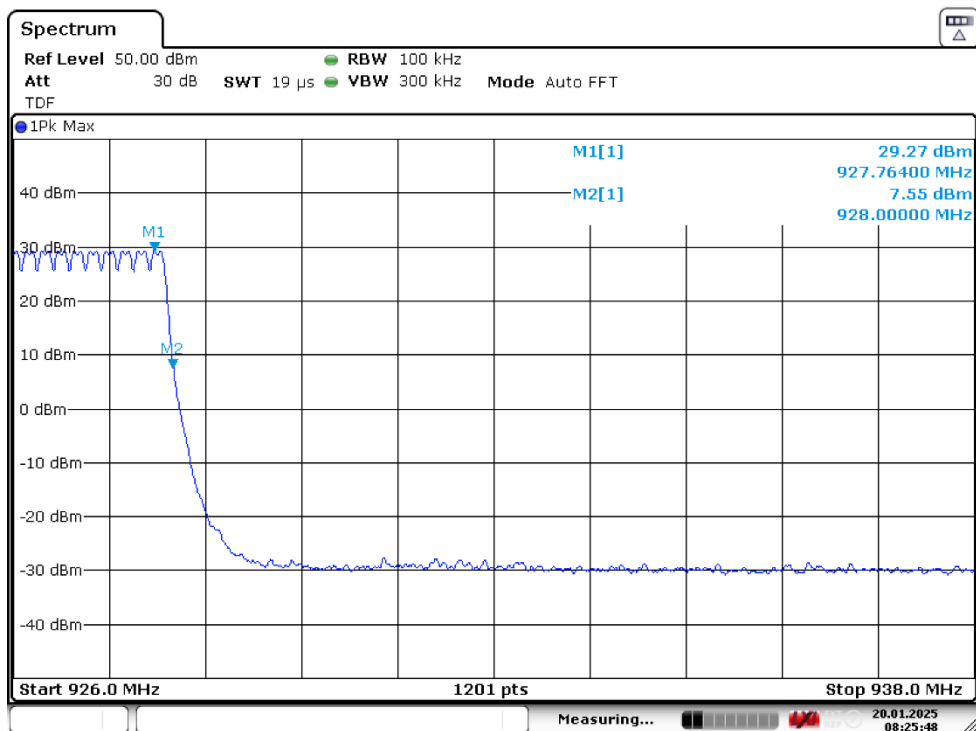


Figure 37: Upper band-edge (Option 9, hopping enabled)

Unwanted Emissions (conducted)

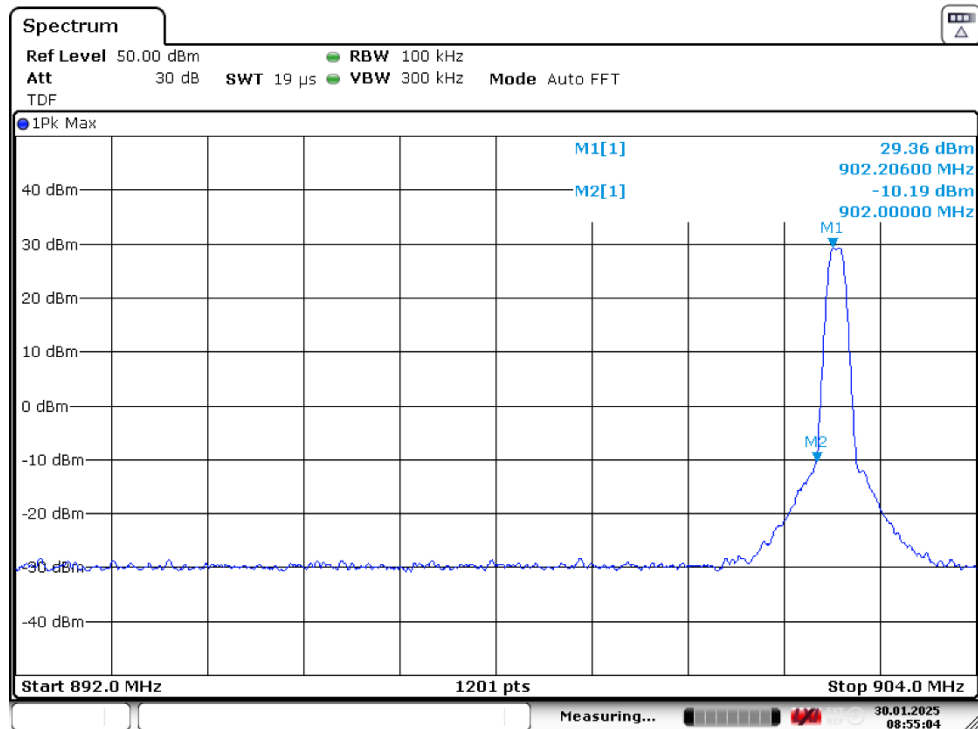


Figure 38: Lower band-edge (Option 10, bottom ch.)

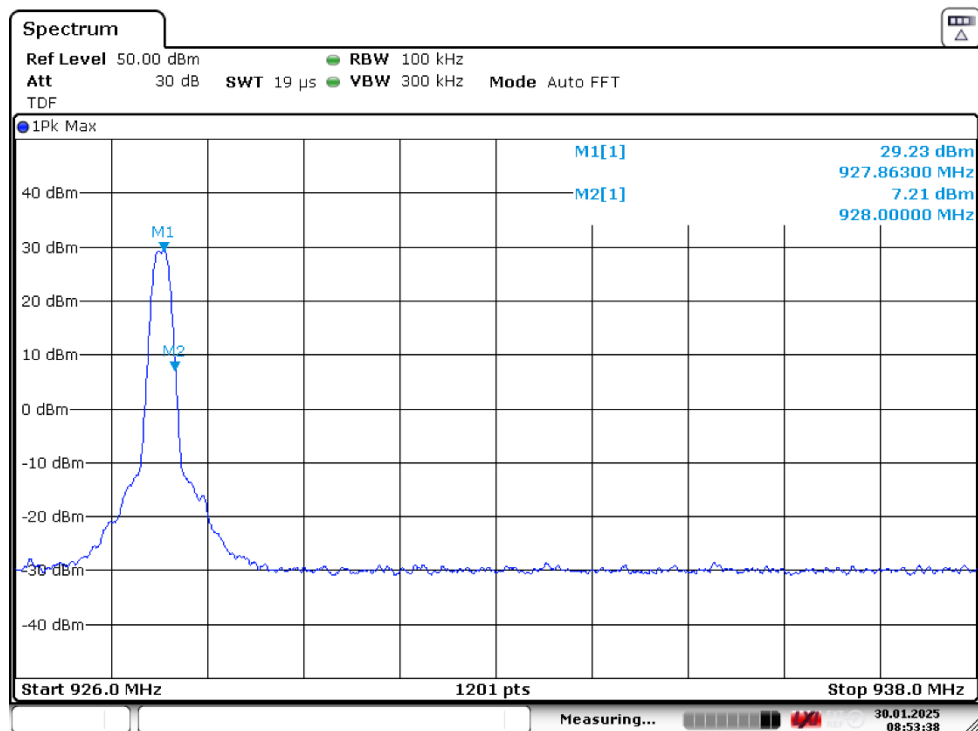


Figure 39: Upper band-edge (Option 10, top. ch)

Unwanted Emissions (conducted)

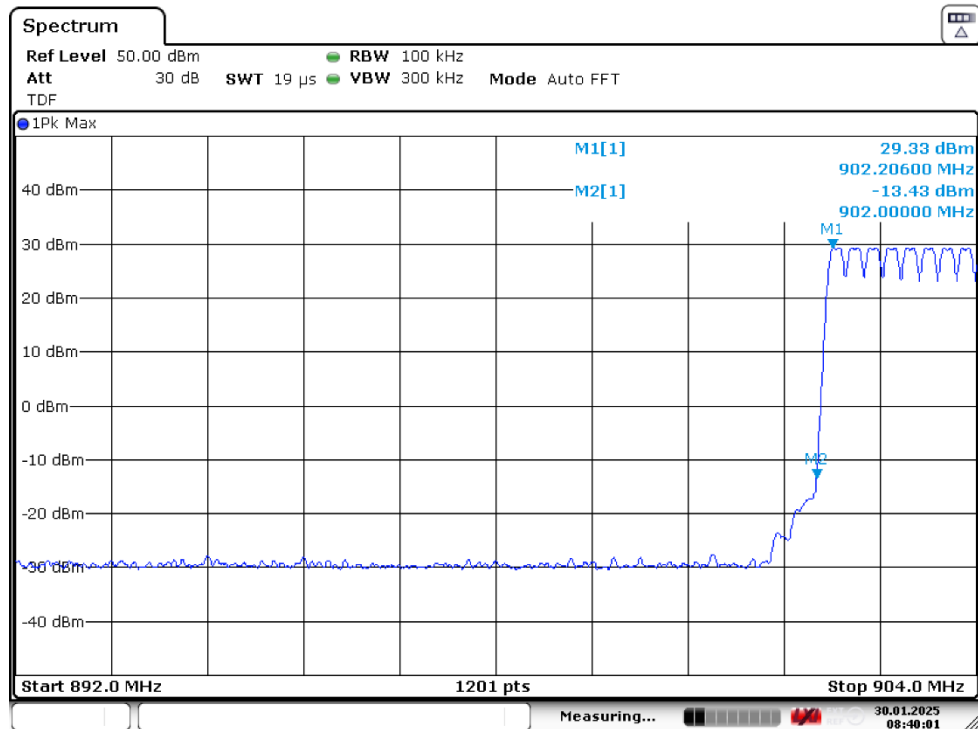


Figure 40: Lower band-edge (Option 10, hopping enabled)

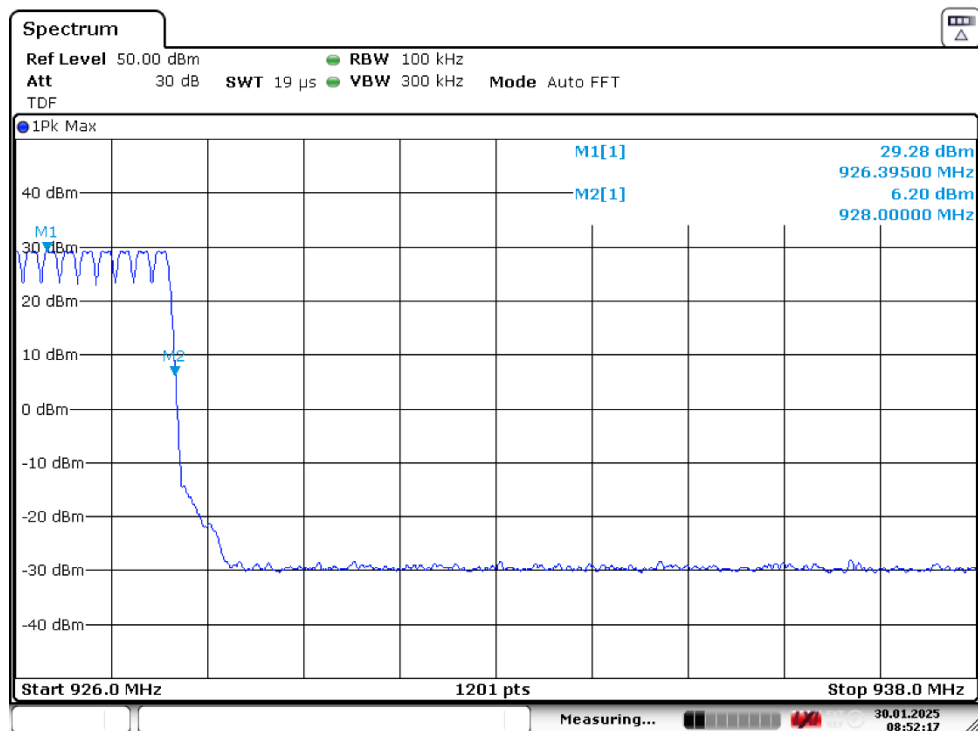


Figure 41: Upper band-edge (Option 10, hopping enabled)

Unwanted Emissions (radiated)

Unwanted Emissions (radiated)

Standard:	ANSI C63.10-2020 clause 7.8.8		
Tested by:	LAS	HEM, LAS	HEM, LAS
Date:	20 January 2025	21 January 2025	22 January 2025
Temperature:	24 °C	23 °C	23 °C
Humidity:	18 %RH	17 %RH	23 %RH
Measurement uncertainty:	± 4.51 dB, level of confidence 95 % (k = 2)		
Test result:	PASS		

FCC Rule: §15.247(d) RSS-247 clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on an RF radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) and RSS-Gen 8.9 is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen 8.10, must also comply with the radiated emission limits specified in §15.209(a) and RSS-Gen 8.9.

The radiated measurements are performed on bottom, middle, and top channels with the hopping function disabled. Two different external reference antennas are used with the EUT, provided by the manufacturer (Yagi and whip antennas). "Option 9" test mode was used during testing.

The radiated measurements are performed in a semi-anechoic chamber. During measurements below 1 GHz the EUT is placed on a table 80 cm above the ground plane. Above 1 GHz the EUT is placed 150 cm above the ground plane, and absorbers are placed on the floor between the EUT and measurement antenna.

The correction factor in the final result tables contains the sum of the transducers (antenna + amplifier + cables). The result value is the measured value corrected with the correction factor.

Unwanted Emissions (radiated)

Test results (Yagi antenna)

Table 10: Unwanted radiated emissions (quasi-peak detector)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
0.511250	-0.75	33.43	34.18	15 x 1000.0	9.000	coax. *)	V	170.0	-20.4	Middle
0.513000	-3.74	33.40	37.14	15 x 1000.0	9.000	coax. *)	V	171.0	-20.4	Bottom
0.513000	-12.99	33.40	46.39	15 x 1000.0	9.000	copl. *)	V	5.0	-20.4	Top
10.001250	-11.15	29.50	40.65	15 x 1000.0	9.000	100.0	V	140.0	-20.3	Top
30.380000	15.29	40.00	24.71	15 x 1000.0	120.000	151.0	V	173.0	16.9	Middle
40.854000	25.16	40.00	14.84	15 x 1000.0	120.000	100.0	V	95.0	17.3	Middle
52.844000	13.56	40.00	26.44	15 x 1000.0	120.000	317.0	V	74.0	17.9	Middle
154.772000	22.44	43.50	21.06	15 x 1000.0	120.000	100.0	V	136.0	18.7	Middle
618.159000	18.45	46.00	27.55	15 x 1000.0	120.000	100.0	H	215.0	27.8	Middle
674.728000	19.59	46.00	26.41	15 x 1000.0	120.000	100.0	V	227.0	28.4	Middle

*) coax. / copl. = measurement loop antenna in coaxial/coplanar orientation.

Table 11: Unwanted radiated emissions (average detector)

Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
2706.575000	30.95	54.00	23.05	15 x 1000.0	1000.000	212.0	H	49.0	4.6	Bottom
2783.475000	31.35	54.00	22.65	15 x 1000.0	1000.000	107.0	H	46.0	5.0	Top
3608.850000	31.69	54.00	22.31	15 x 1000.0	1000.000	217.0	V	175.0	6.0	Bottom
3660.050000	31.82	54.00	22.18	15 x 1000.0	1000.000	186.0	V	179.0	6.3	Middle
4510.925000	35.10	54.00	18.90	15 x 1000.0	1000.000	263.0	V	348.0	7.3	Bottom
4639.050000	32.86	54.00	21.14	15 x 1000.0	1000.000	184.0	V	345.0	7.8	Top
5413.375000	32.97	54.00	21.03	15 x 1000.0	1000.000	107.0	H	106.0	8.4	Bottom
8120.025000	35.49	54.00	18.51	15 x 1000.0	1000.000	107.0	V	63.0	12.0	Bottom
8235.000000	34.42	54.00	19.58	15 x 1000.0	1000.000	107.0	V	63.0	12.2	Middle

Table 12: Unwanted radiated emissions (peak detector)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
902.000000	99.46	105.58	6.12	15 x 1000.0	120.000	270.0	V	38.0	47.5	Bottom
902.170000	125.58	---	---	15 x 1000.0	120.000	100.0	H	133.0	47.5	Bottom
914.960000	130.62	---	---	15 x 1000.0	120.000	100.0	H	315.0	47.8	Middle
927.760000	131.76	---	---	15 x 1000.0	120.000	100.0	H	15.0	48.1	Top
928.000000	98.43	111.76	13.33	15 x 1000.0	120.000	252.0	V	20.0	48.1	Top
1042.600000	46.09	74.00	27.91	15 x 1000.0	1000.000	299.0	H	117.0	9.6	Bottom
2744.825000	45.14	74.00	28.86	15 x 1000.0	1000.000	184.0	H	48.0	5.2	Middle
4574.675000	45.92	74.00	28.08	15 x 1000.0	1000.000	190.0	V	338.0	7.8	Middle
6315.675000	51.79	105.58	53.79	15 x 1000.0	1000.000	244.0	V	189.0	10.6	Bottom
6405.150000	50.88	110.62	59.74	15 x 1000.0	1000.000	185.0	V	195.0	10.3	Middle
6494.825000	50.79	111.76	60.97	15 x 1000.0	1000.000	190.0	V	193.0	10.5	Top
8349.975000	49.28	74.00	24.72	15 x 1000.0	1000.000	100.0	H	92.0	12.7	Top
9149.775000	50.70	74.00	23.30	15 x 1000.0	1000.000	151.0	V	138.0	14.3	Middle
9923.725000	61.10	105.58	44.48	15 x 1000.0	1000.000	177.0	V	133.0	15.5	Bottom

Unwanted Emissions (radiated)

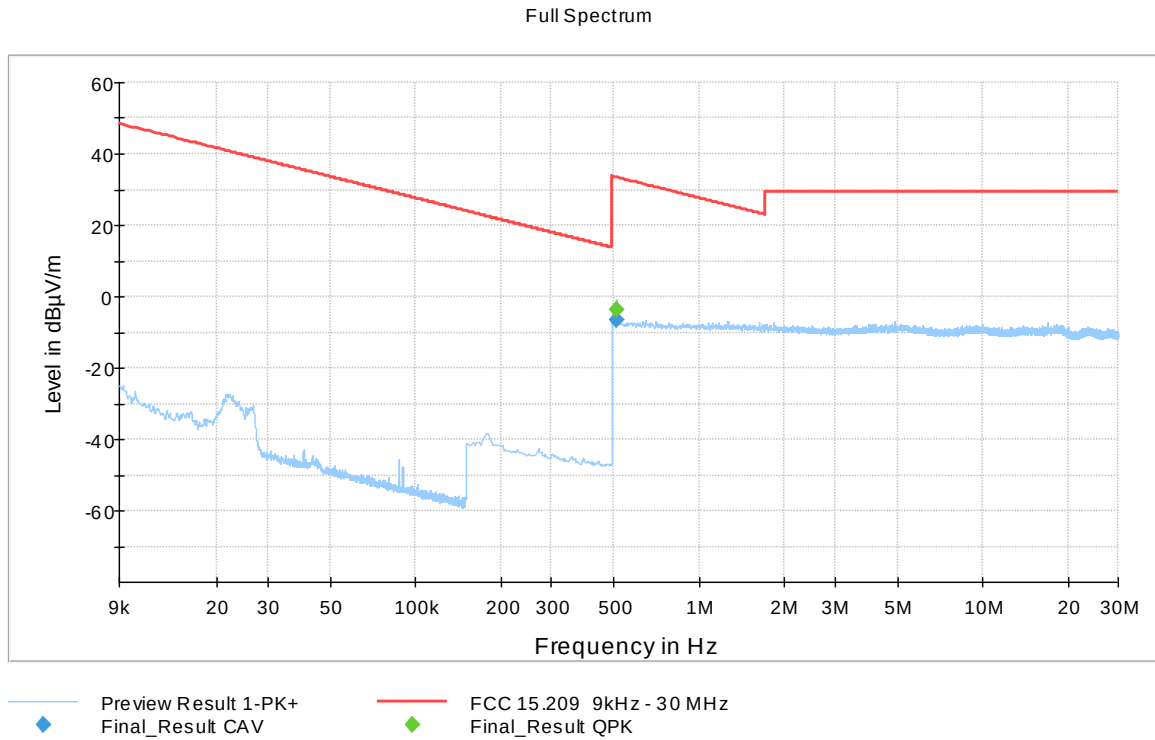


Figure 42: Unwanted emissions 9 kHz – 30 MHz (Yagi antenna, bottom ch.)

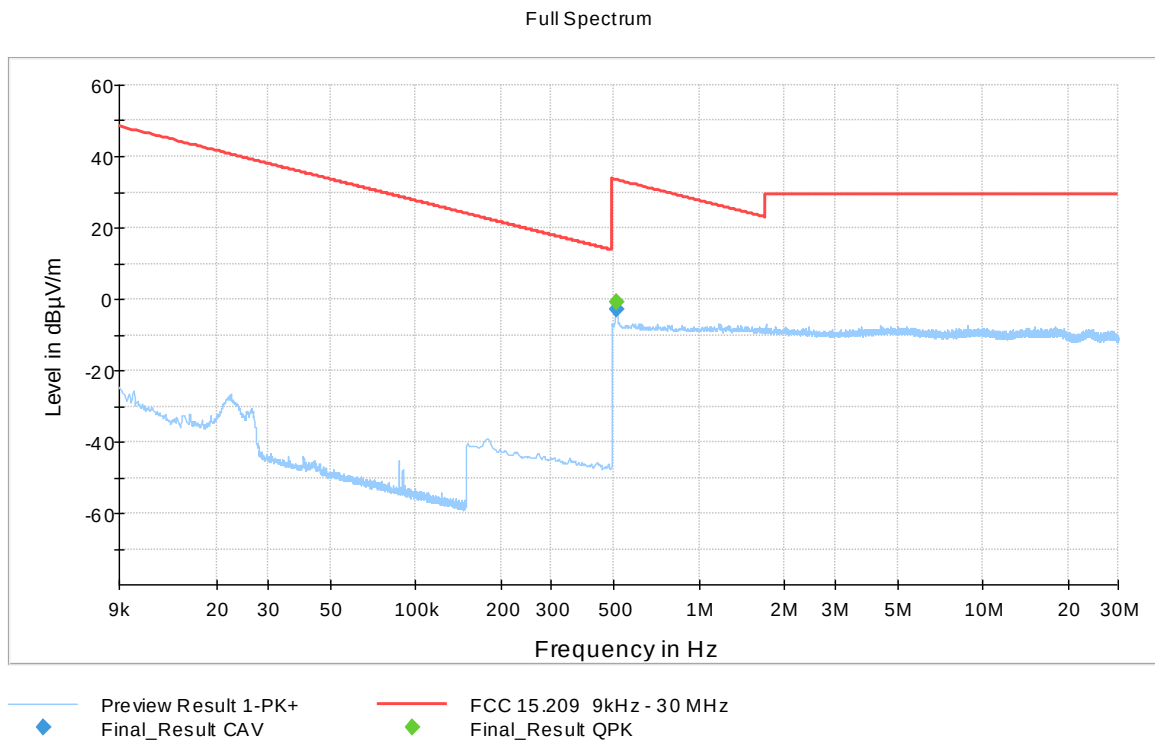


Figure 43: Unwanted emissions 9 kHz – 30 MHz (Yagi antenna, middle ch.)

Unwanted Emissions (radiated)

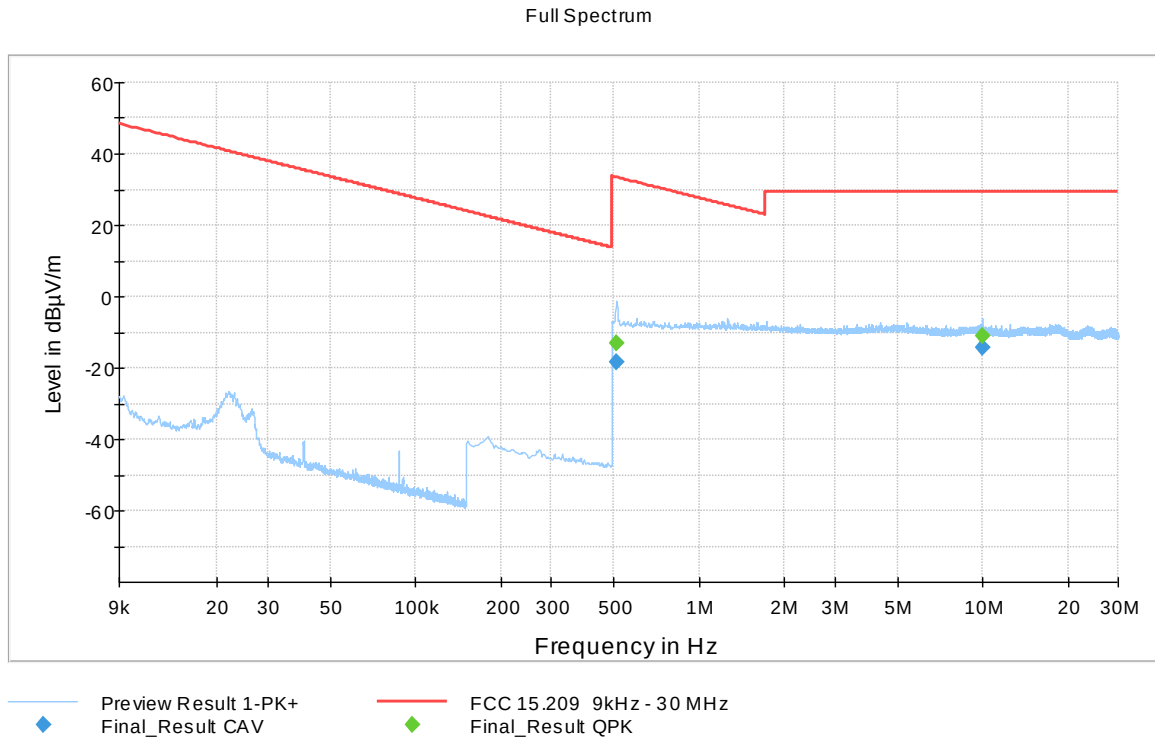


Figure 44: Unwanted emissions 9 kHz – 30 MHz (Yagi antenna, top ch.)

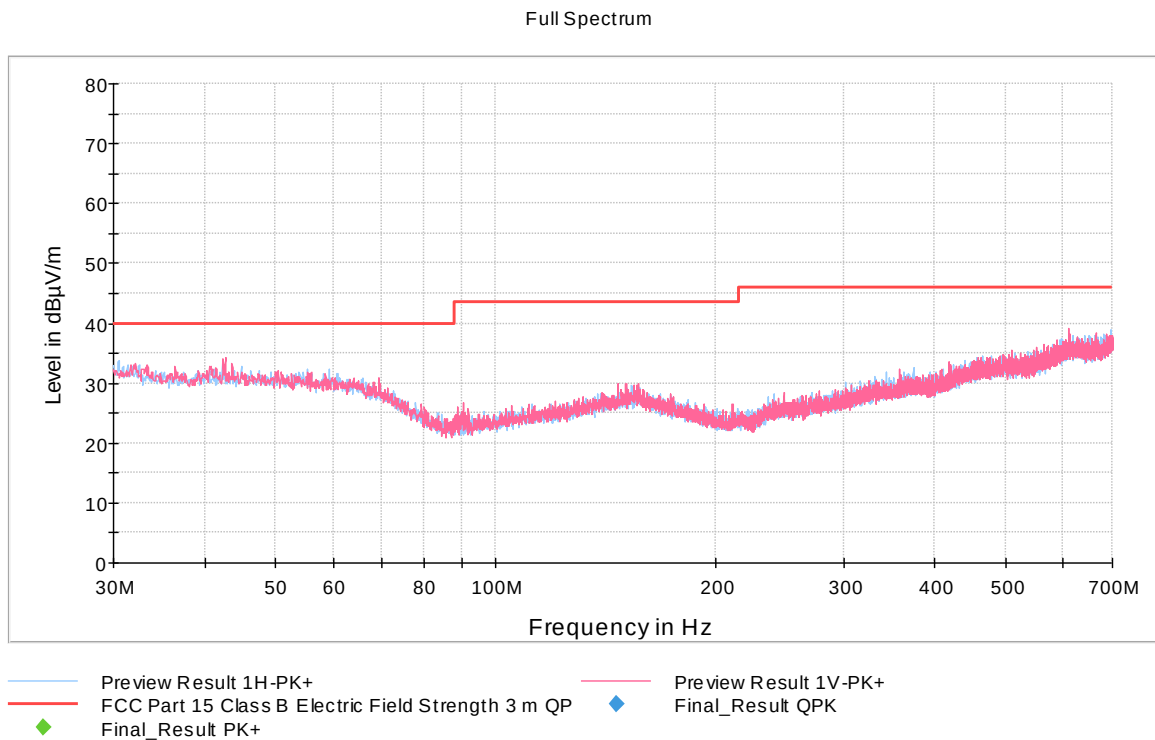


Figure 45: Unwanted emissions 30 – 700 MHz (Yagi antenna, bottom ch.)

Unwanted Emissions (radiated)

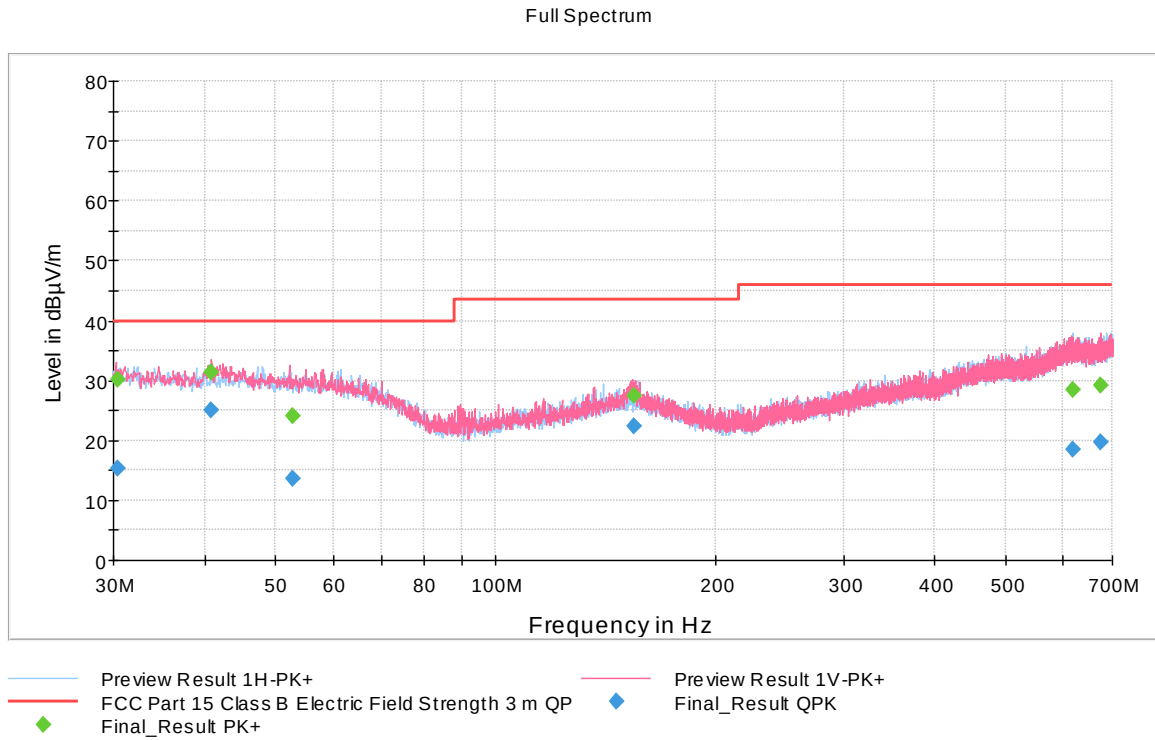


Figure 46: Unwanted emissions 30 – 700 MHz (Yagi antenna, middle ch.)

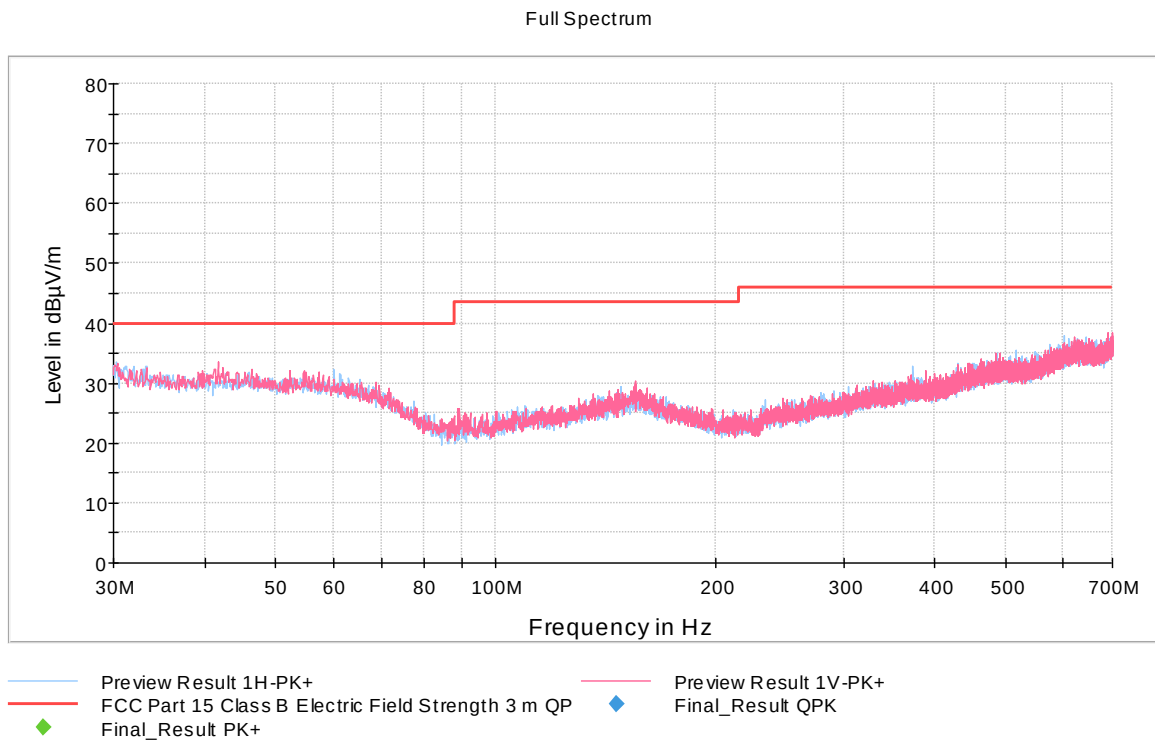


Figure 47: Unwanted emissions 30 – 700 MHz (Yagi antenna, top ch.)

Unwanted Emissions (radiated)

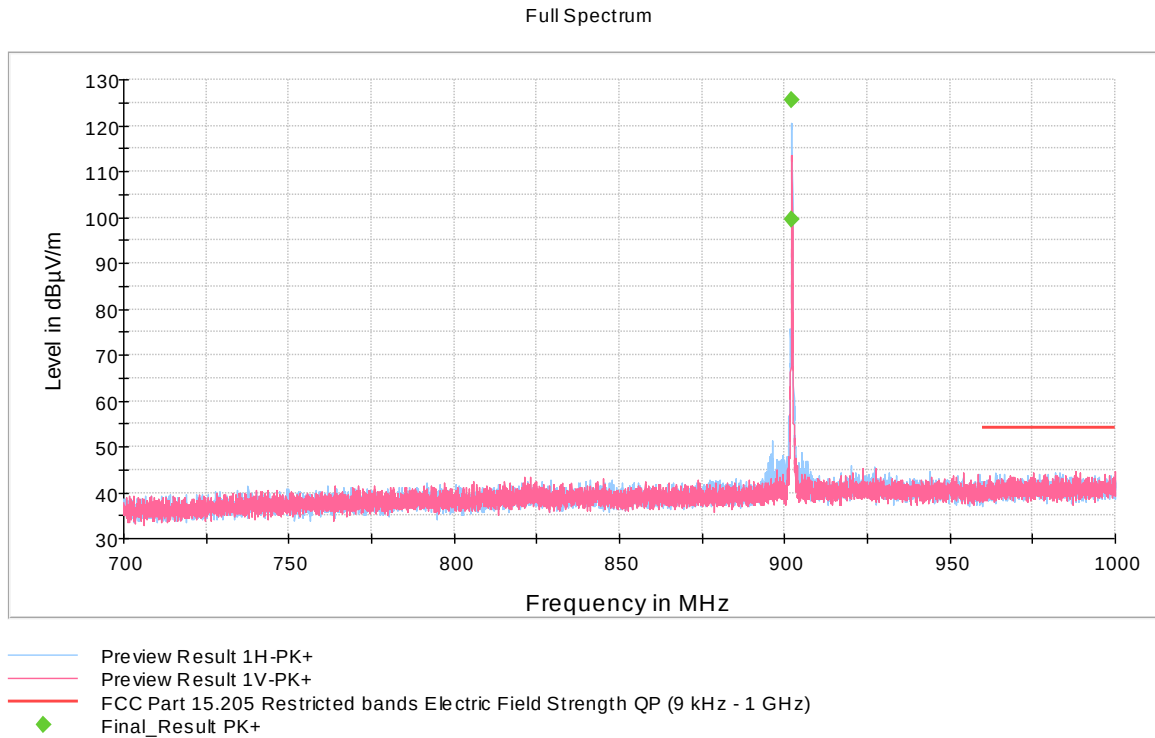


Figure 48: Unwanted emissions 700 – 1000 MHz (Yagi antenna, bottom ch.)

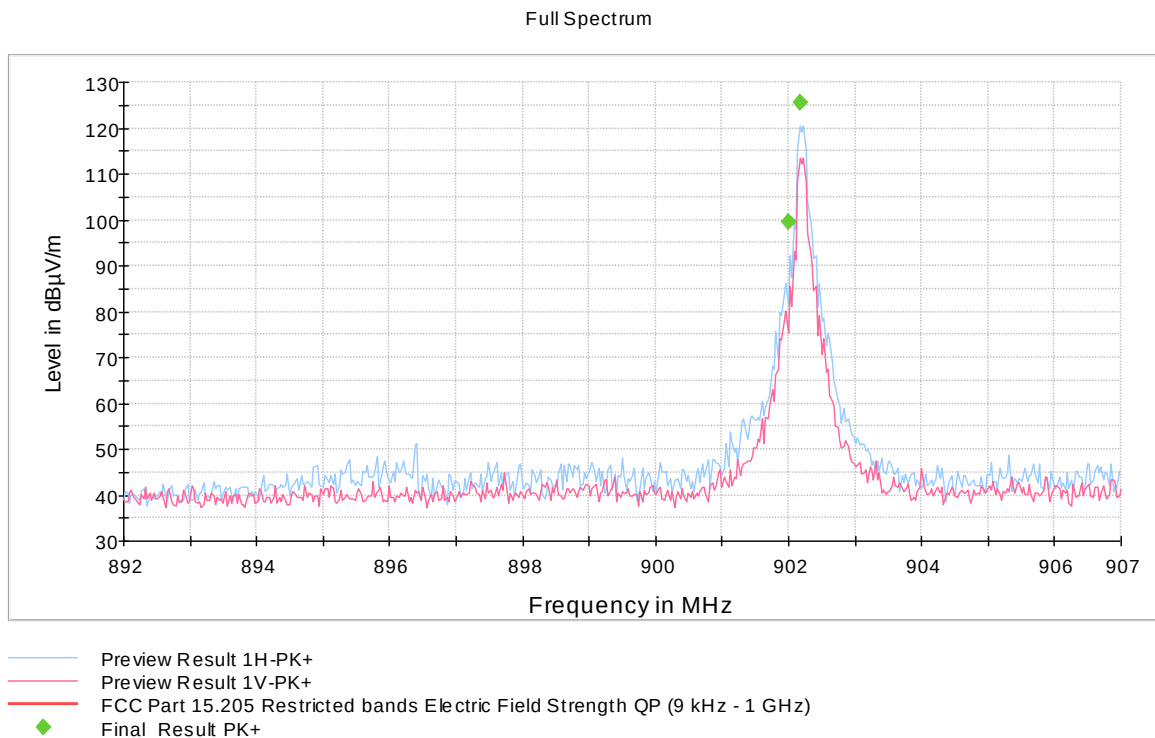


Figure 49: Lower Band-Edge (Yagi antenna, bottom ch.)

Unwanted Emissions (radiated)

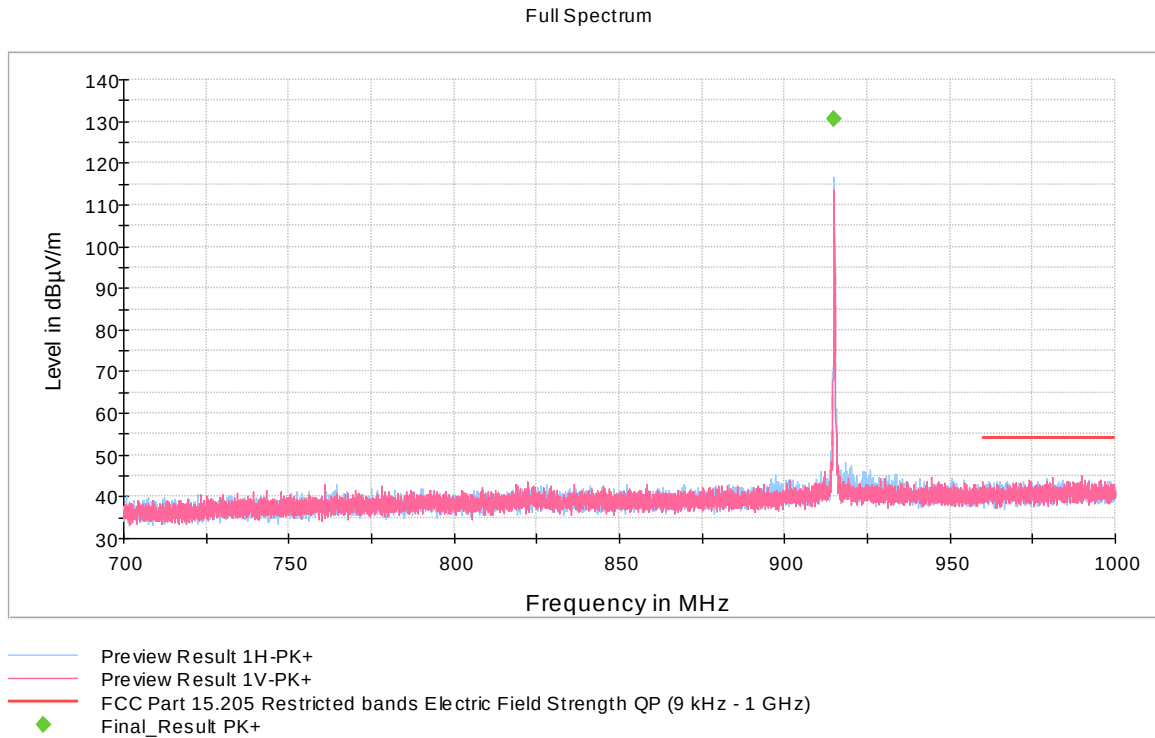


Figure 50: Unwanted emissions 700 – 1000 MHz (Yagi antenna, middle ch.)

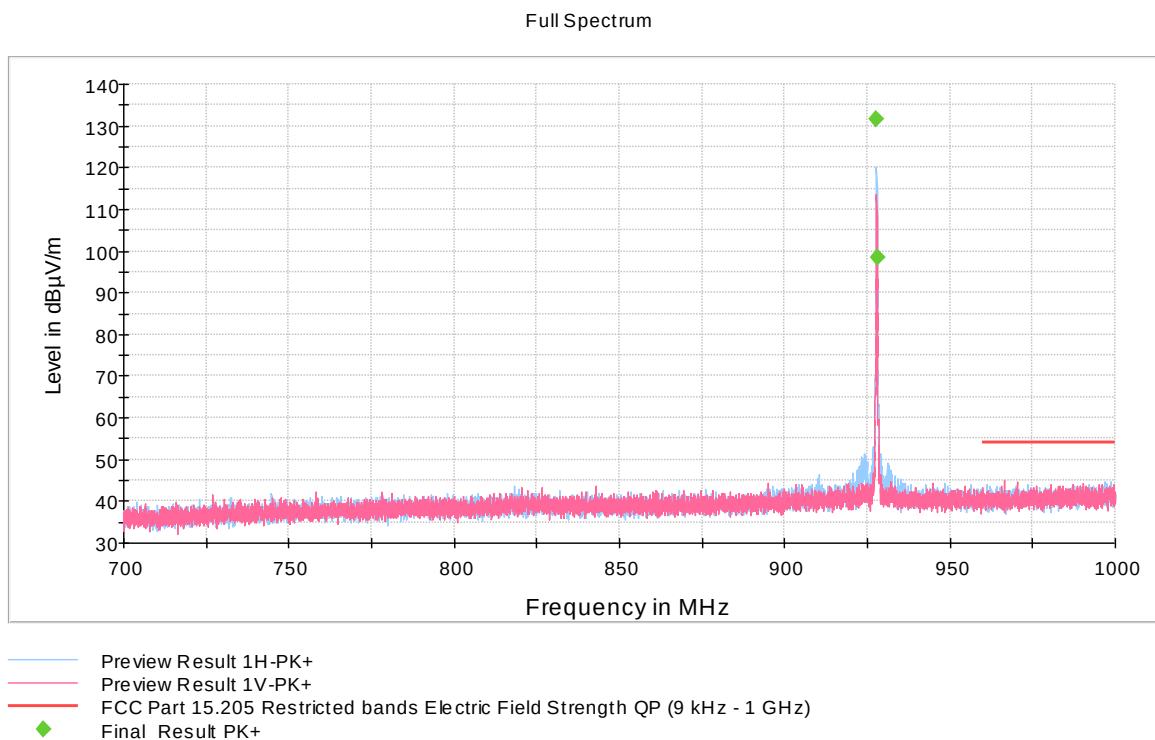


Figure 51: Unwanted emissions 700 – 1000 MHz (Yagi antenna, top ch.)

Unwanted Emissions (radiated)

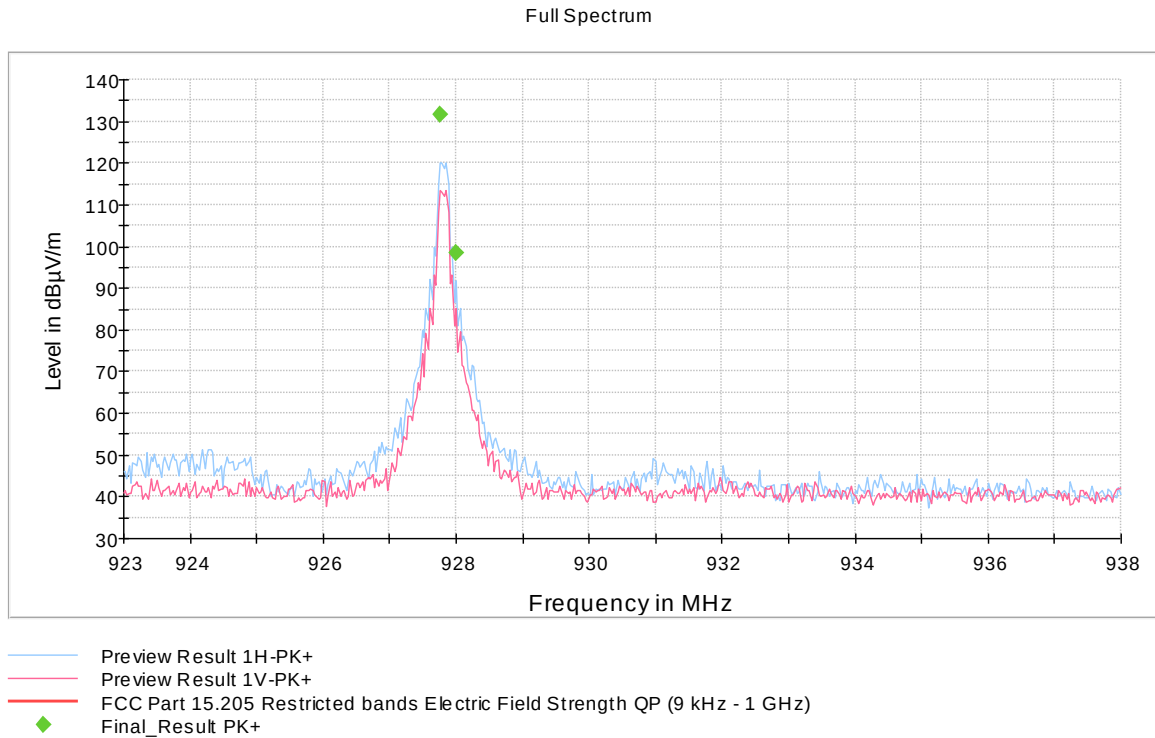


Figure 52: Upper band-edge (Yagi antenna, top ch.)

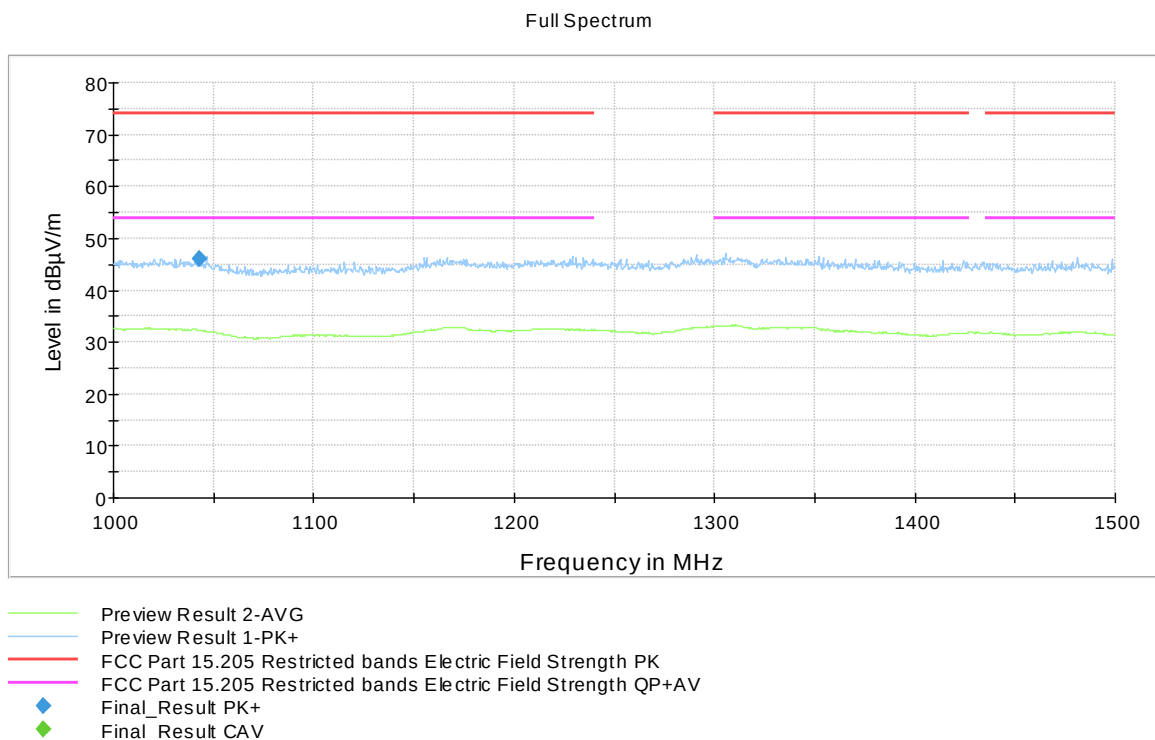


Figure 53: Unwanted emissions 1.0 – 1.5 GHz (Yagi antenna, bottom ch.)

Unwanted Emissions (radiated)

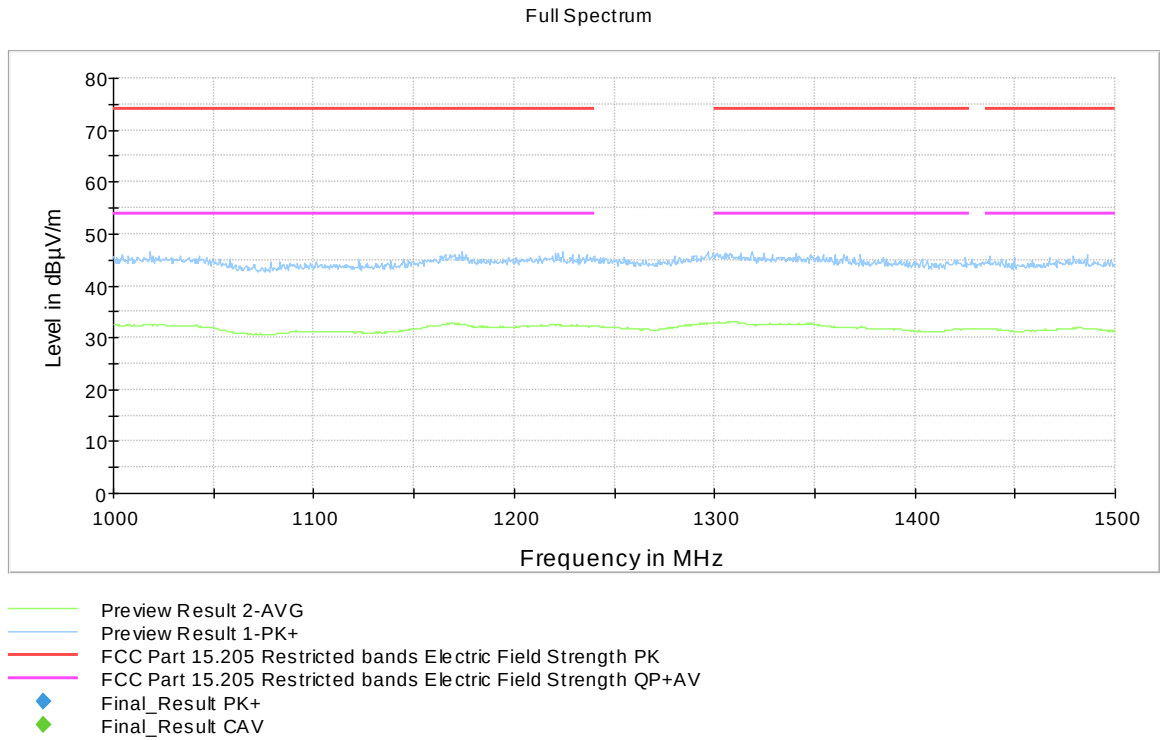


Figure 54: Unwanted emissions 1.0 – 1.5 GHz (Yagi antenna, middle ch.)

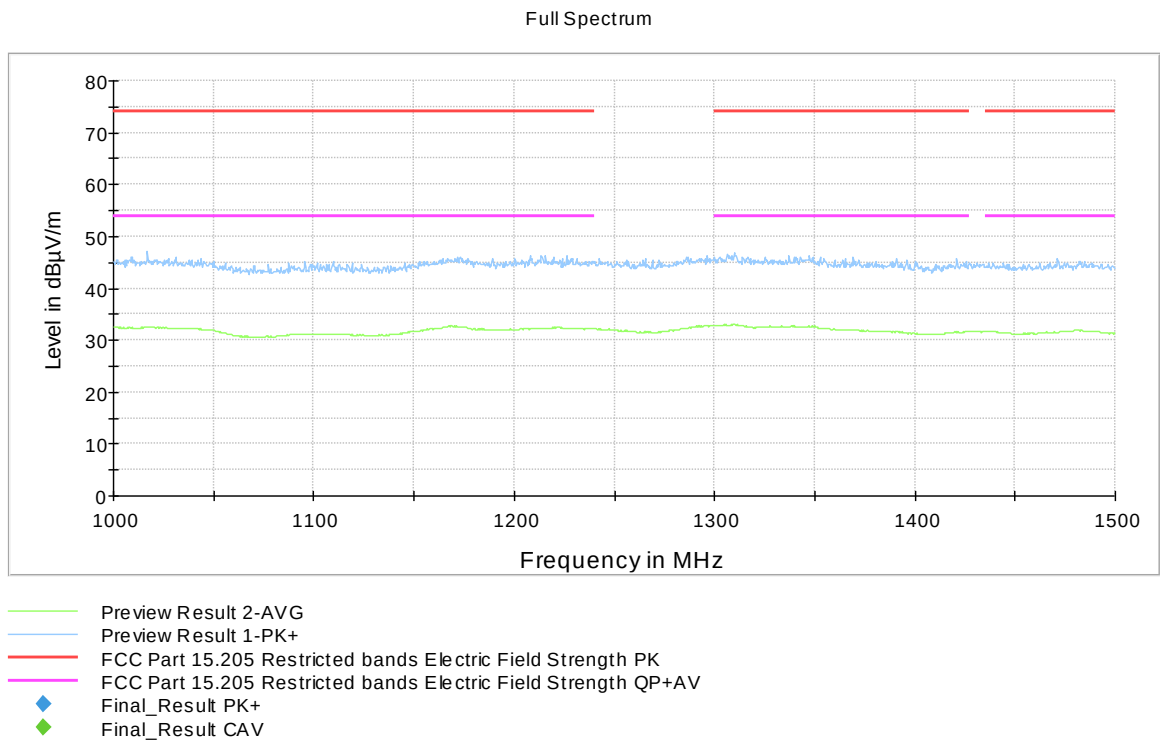


Figure 55: Unwanted emissions 1.0 – 1.5 GHz (Yagi antenna, top ch.)

Unwanted Emissions (radiated)

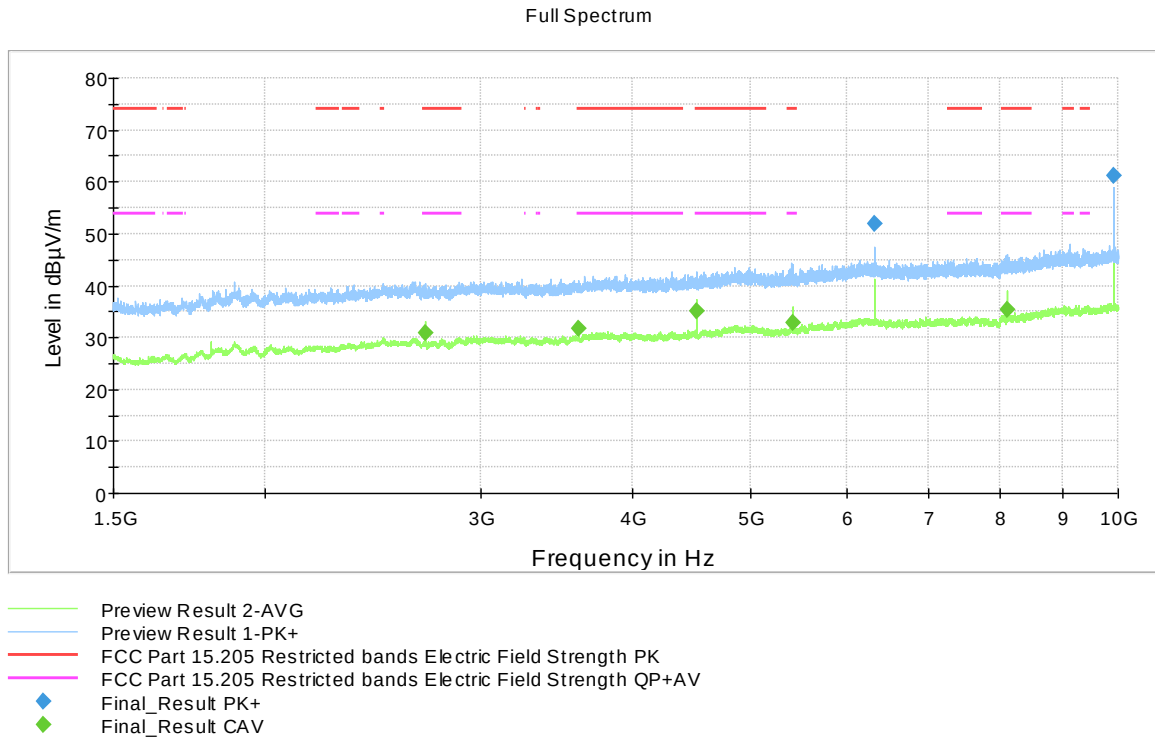


Figure 56: Unwanted emissions 1.5 – 10 GHz (Yagi antenna, bottom ch.)

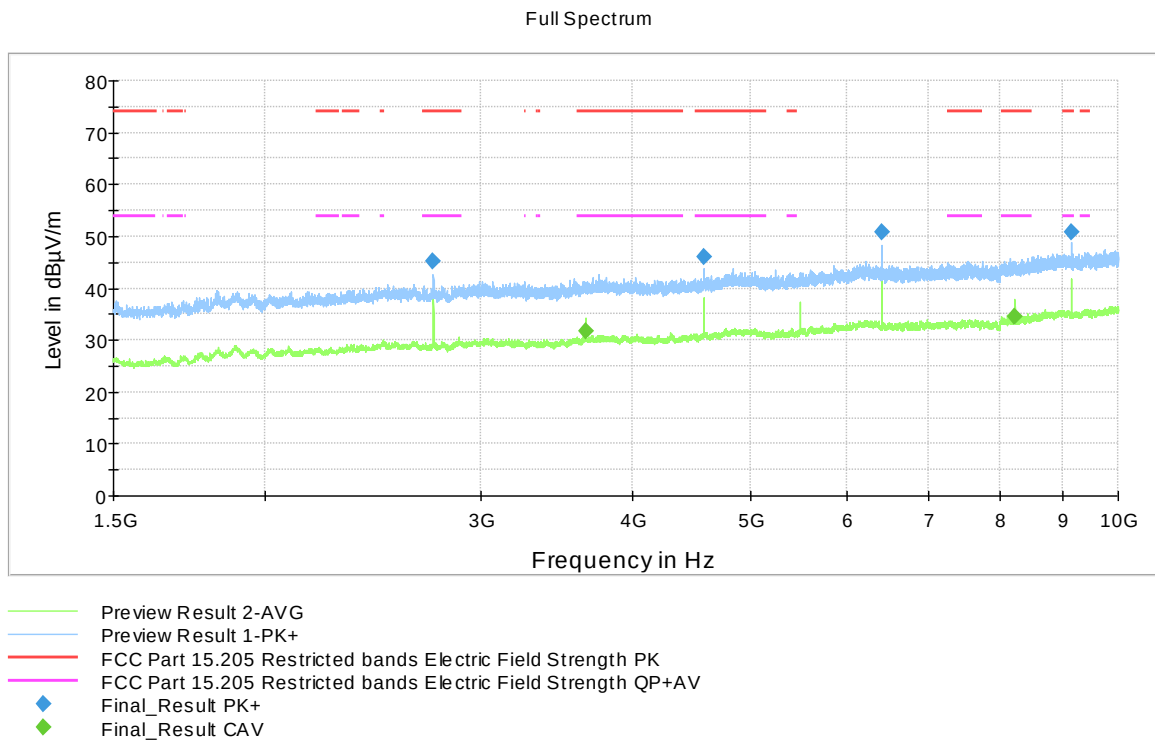


Figure 57: Unwanted emissions 1.5 – 10 GHz (Yagi antenna, middle ch.)

Unwanted Emissions (radiated)

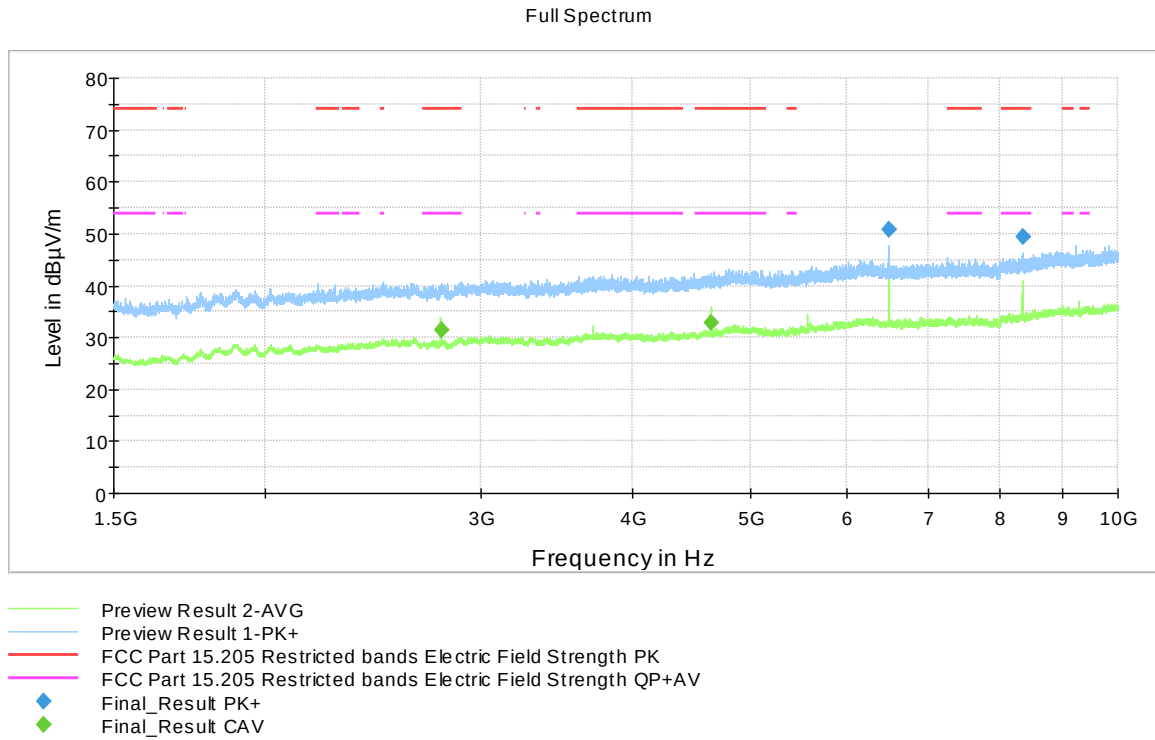


Figure 58: Unwanted emissions 1.5 – 10 GHz (Yagi antenna, top ch.)

Unwanted Emissions (radiated)

Test results (Whip antenna)

Table 13: Unwanted radiated emissions (quasi-peak detector)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
0.513000	-3.64	33.40	37.04	15 x 1000.0	9.000	coax. *)	V	165.0	-20.4	Bottom
0.513000	-3.90	33.40	37.30	15 x 1000.0	9.000	coax. *)	V	163.0	-20.4	Middle
0.513000	-5.23	33.40	38.63	15 x 1000.0	9.000	coax. *)	V	167.0	-20.4	Top
33.680000	18.81	40.00	21.19	15 x 1000.0	120.000	109.0	V	2.0	16.6	Middle
39.846000	24.50	40.00	15.50	15 x 1000.0	120.000	109.0	V	327.0	17.2	Middle
156.842000	15.23	43.50	28.27	15 x 1000.0	120.000	109.0	V	318.0	18.7	Middle
693.713000	19.22	46.00	26.78	15 x 1000.0	120.000	316.0	V	87.0	28.8	Middle
902.000000	103.34	108.81	5.47	15 x 1000.0	120.000	150.0	V	285.0	47.5	Bottom
902.160000	128.81	---	---	15 x 1000.0	120.000	137.0	V	144.0	47.5	Bottom
914.960000	129.16	---	---	15 x 1000.0	120.000	147.0	V	165.0	47.8	Middle
927.760000	128.54	---	---	15 x 1000.0	120.000	148.0	V	2.0	48.1	Top
928.000000	103.00	108.54	5.54	15 x 1000.0	120.000	146.0	V	205.0	48.1	Top

*) coax. / copl. = measurement loop antenna in coaxial/coplanar orientation.

Table 14: Unwanted radiated emissions (average detector)

Frequency (MHz)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
4575.075000	31.53	54.00	22.47	15 x 1000.0	1000.000	178.0	V	341.0	7.8	Middle
8235.375000	33.39	54.00	20.61	15 x 1000.0	1000.000	185.0	V	314.0	12.2	Middle
9150.400000	34.09	54.00	19.91	15 x 1000.0	1000.000	147.0	V	129.0	14.3	Middle
9440.225000	33.13	54.00	20.87	15 x 1000.0	1000.000	100.0	V	118.0	15.3	Middle
9924.400000	48.03	---	---	15 x 1000.0	1000.000	105.0	V	97.0	15.5	Bottom

Table 15: Unwanted radiated emissions (peak detector)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Channel
2783.675000	48.95	74.00	32.29	15 x 1000.0	1000.000	107.0	V	213.0	5.0	Top
4639.225000	45.73	74.00	28.27	15 x 1000.0	1000.000	177.0	V	343.0	7.8	Top
5566.600000	46.67	108.54	61.87	15 x 1000.0	1000.000	185.0	V	189.0	8.7	Top
6494.375000	54.75	108.54	53.79	15 x 1000.0	1000.000	217.0	V	57.0	10.5	Top
9278.100000	51.35	108.54	57.01	15 x 1000.0	1000.000	171.0	V	138.0	14.7	Top
9923.800000	61.18	108.81	47.63	15 x 1000.0	1000.000	213.0	V	127.0	15.5	Bottom

Unwanted Emissions (radiated)

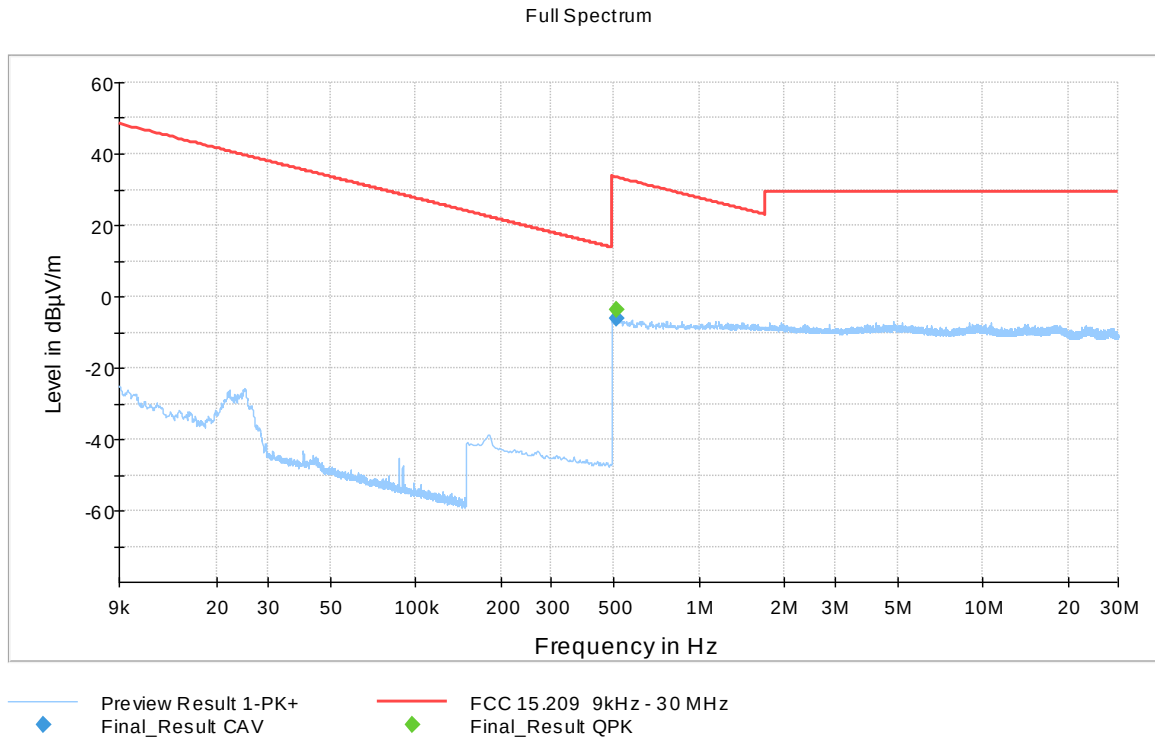


Figure 59: Unwanted emissions 9 kHz – 30 MHz (Whip antenna, bottom ch.)

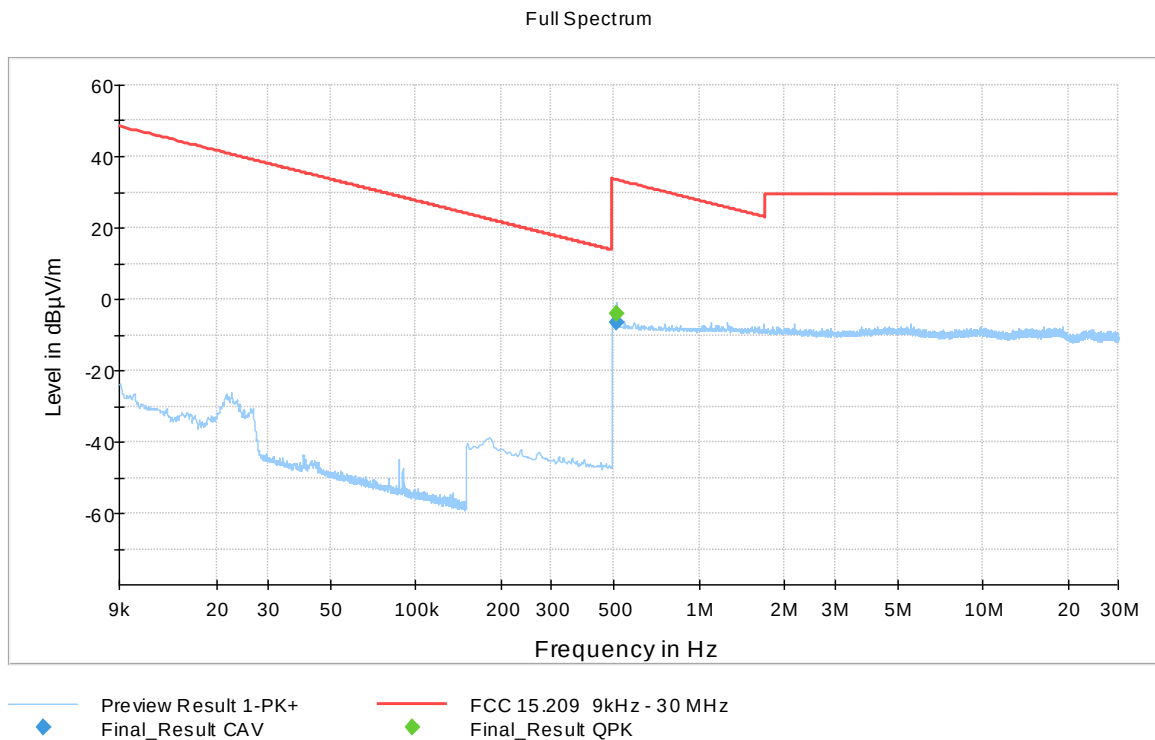


Figure 60: Unwanted emissions 9 kHz – 30 MHz (Whip antenna, middle ch.)

Unwanted Emissions (radiated)

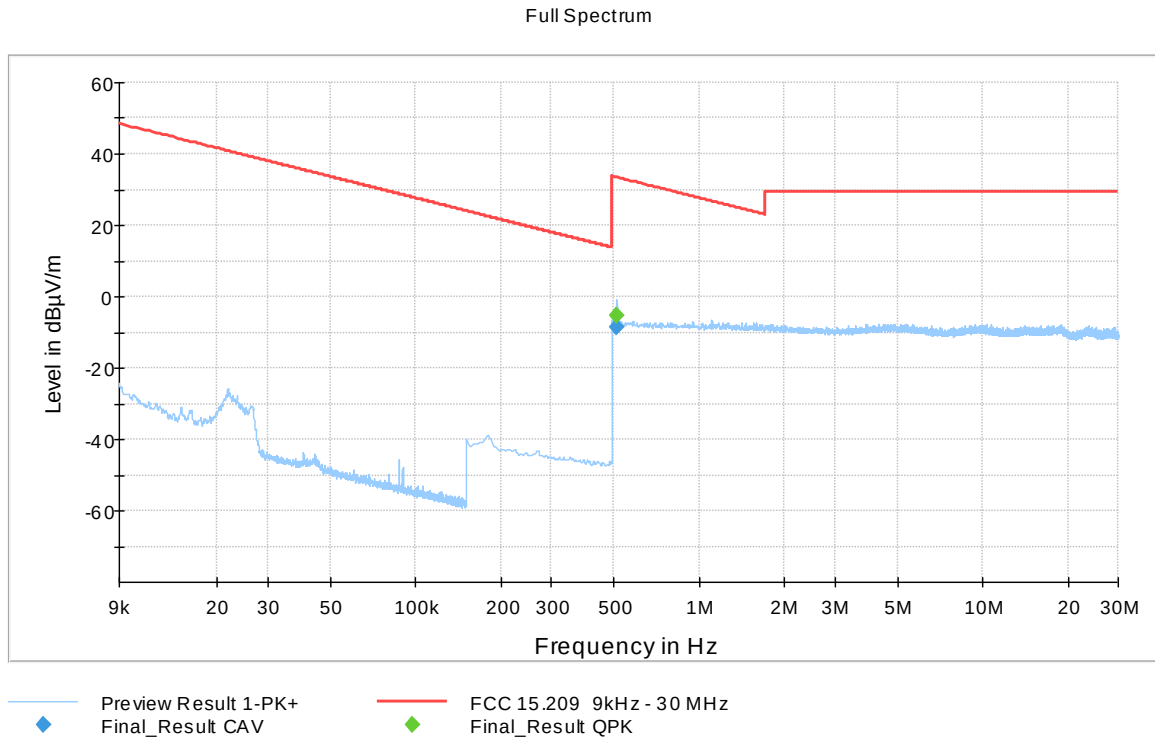


Figure 61: Unwanted emissions 9 kHz – 30 MHz (Whip antenna, top ch.)

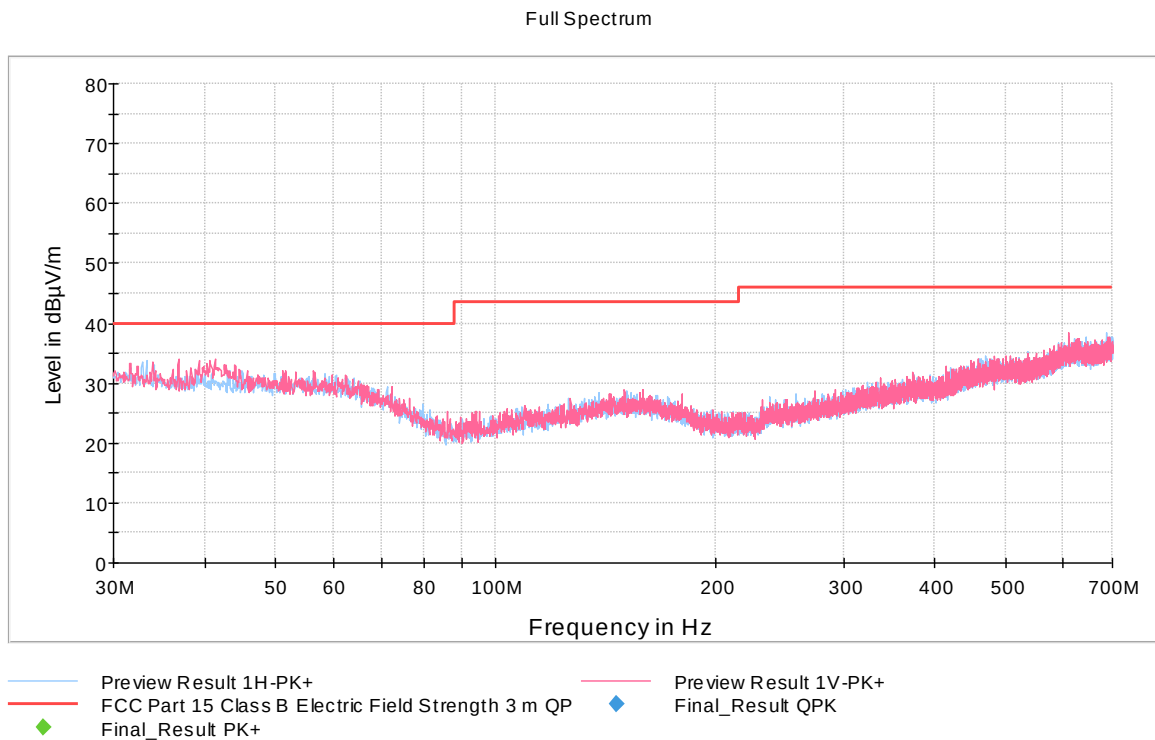


Figure 62: Unwanted emissions 30 – 700 MHz (Whip antenna, bottom ch.)

Unwanted Emissions (radiated)

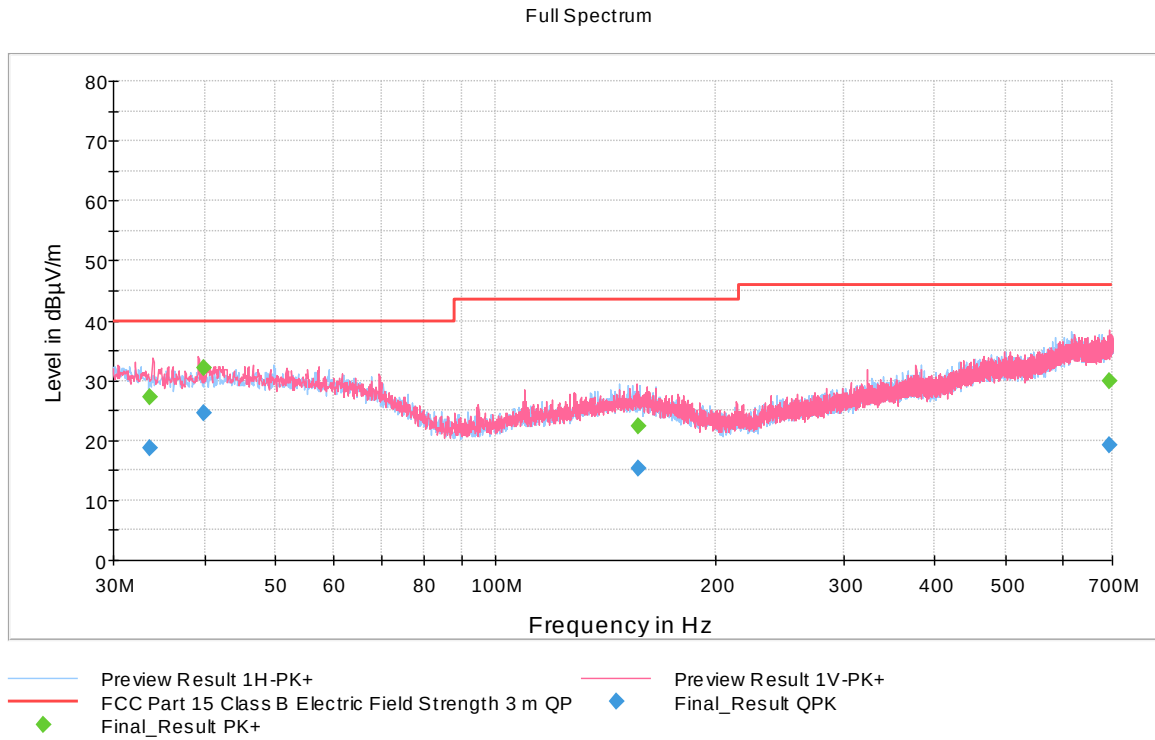


Figure 63: Unwanted emissions 30 – 700 MHz (Whip antenna, middle ch.)

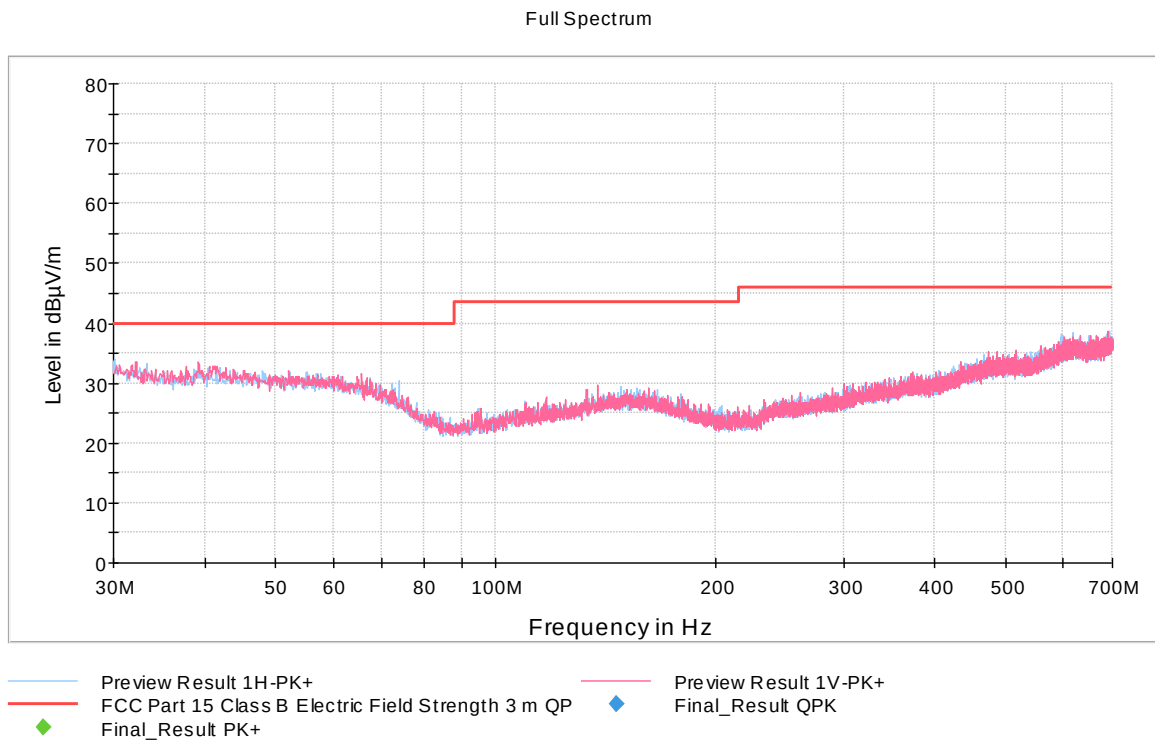


Figure 64: Unwanted emissions 30 – 700 MHz (Whip antenna, top ch.)

Unwanted Emissions (radiated)

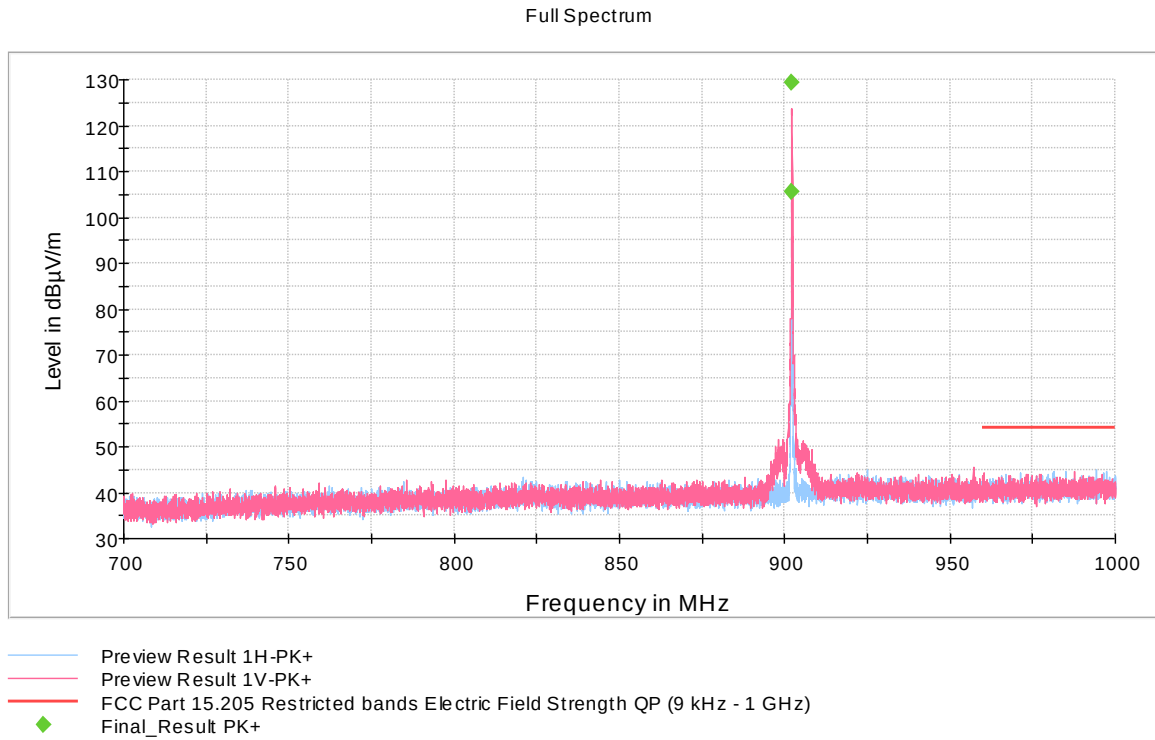


Figure 65: Unwanted emissions 700 – 1000 MHz (Whip antenna, bottom ch.)

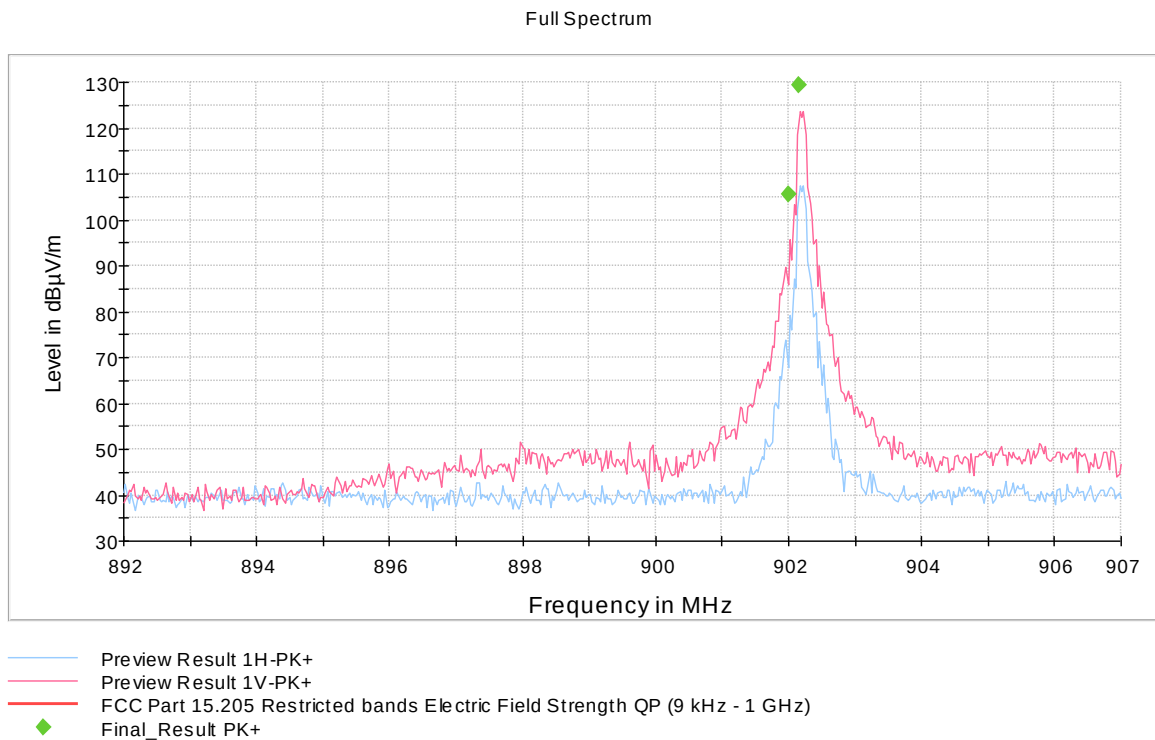


Figure 66: Lower Band-Edge (Whip antenna, bottom ch.)

Unwanted Emissions (radiated)

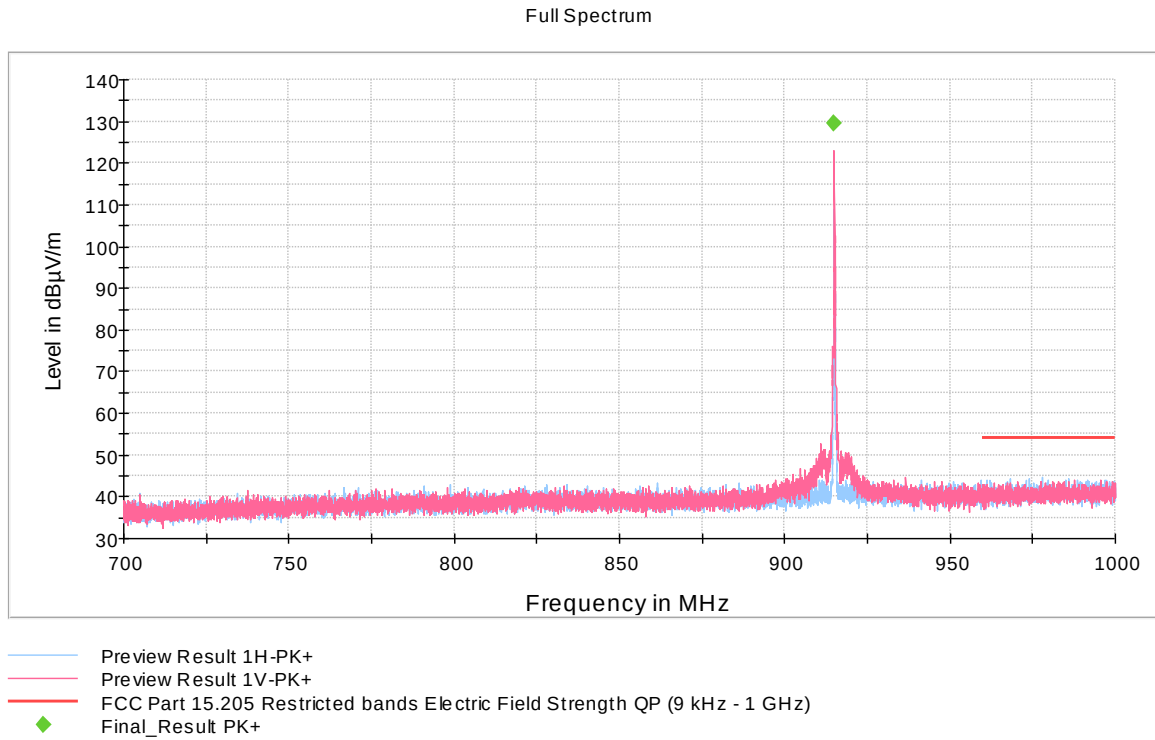


Figure 67: Unwanted emissions 700 – 1000 MHz (Whip antenna, middle ch.)

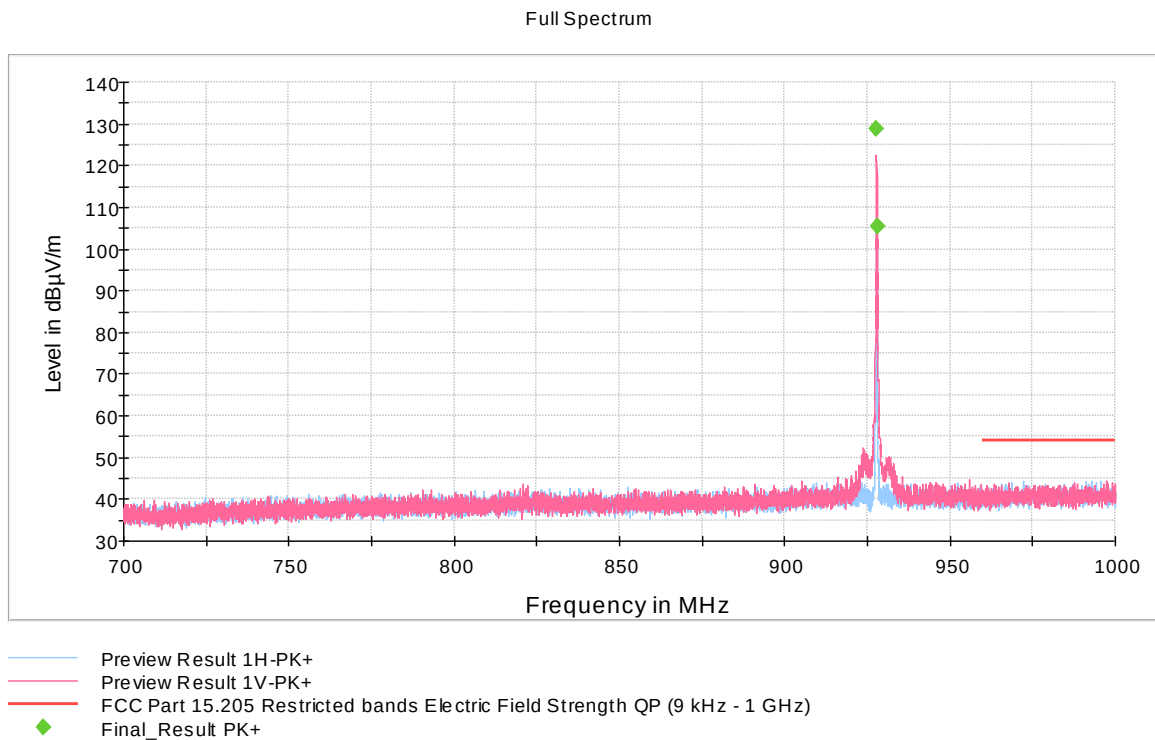


Figure 68: Unwanted emissions 700 – 1000 MHz (Whip antenna, top ch.)

Unwanted Emissions (radiated)

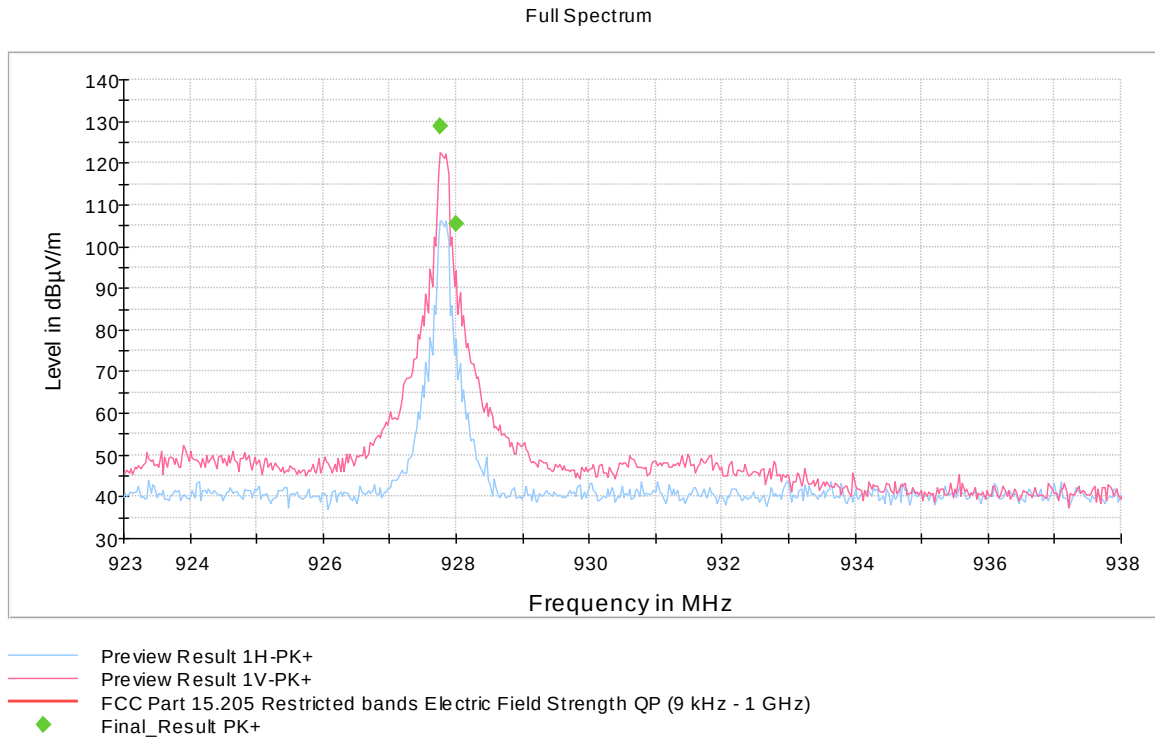


Figure 69: Upper band-edge (Whip antenna, top ch.)

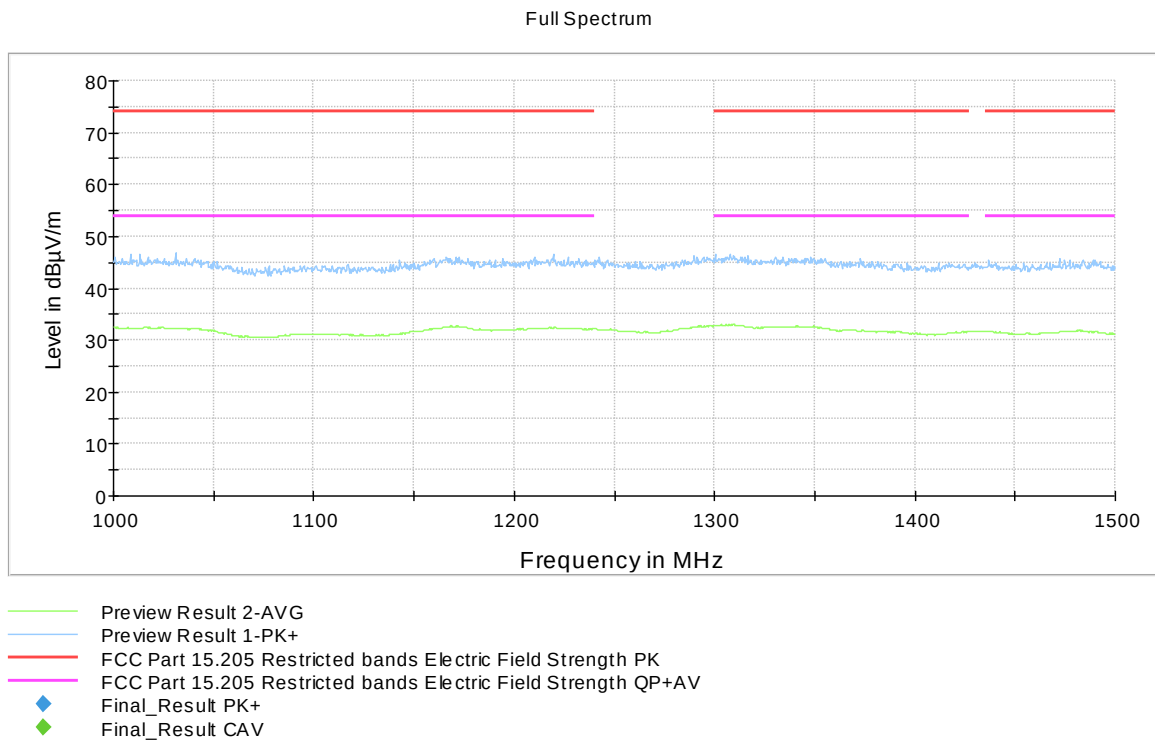


Figure 70: Unwanted emissions 1.0 – 1.5 GHz (Whip antenna, bottom ch.)

Unwanted Emissions (radiated)

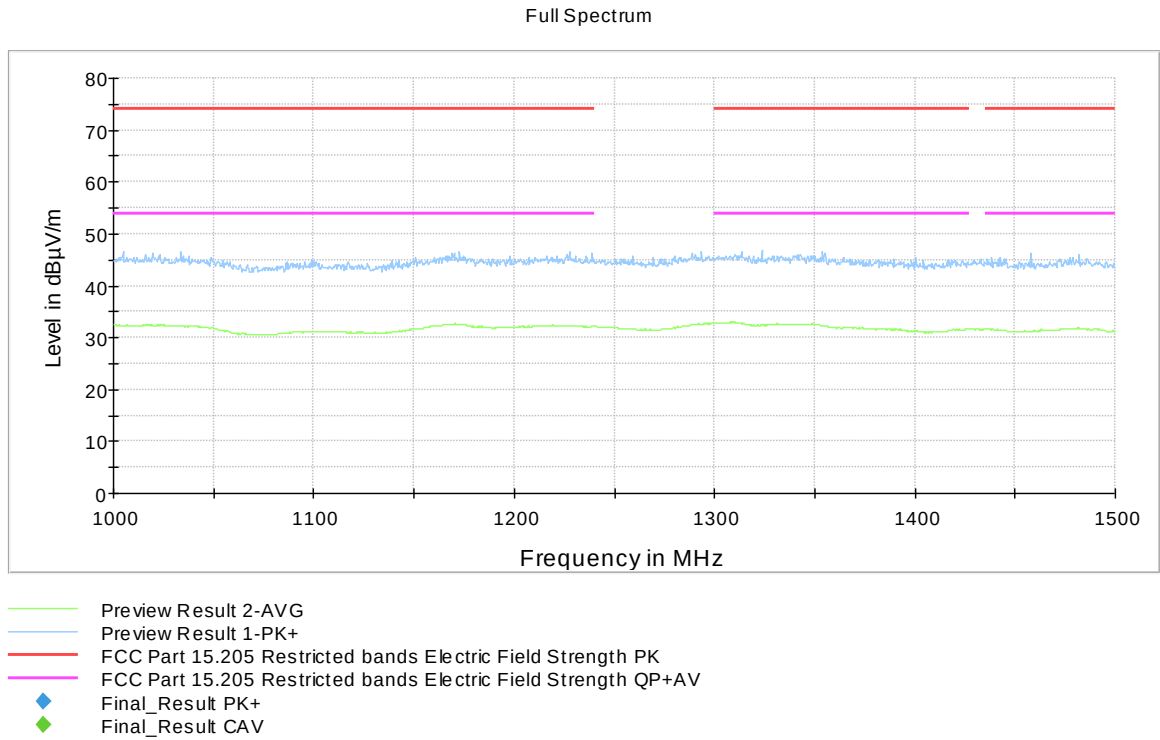


Figure 71: Unwanted emissions 1.0 – 1.5 GHz (Whip antenna, middle ch.)

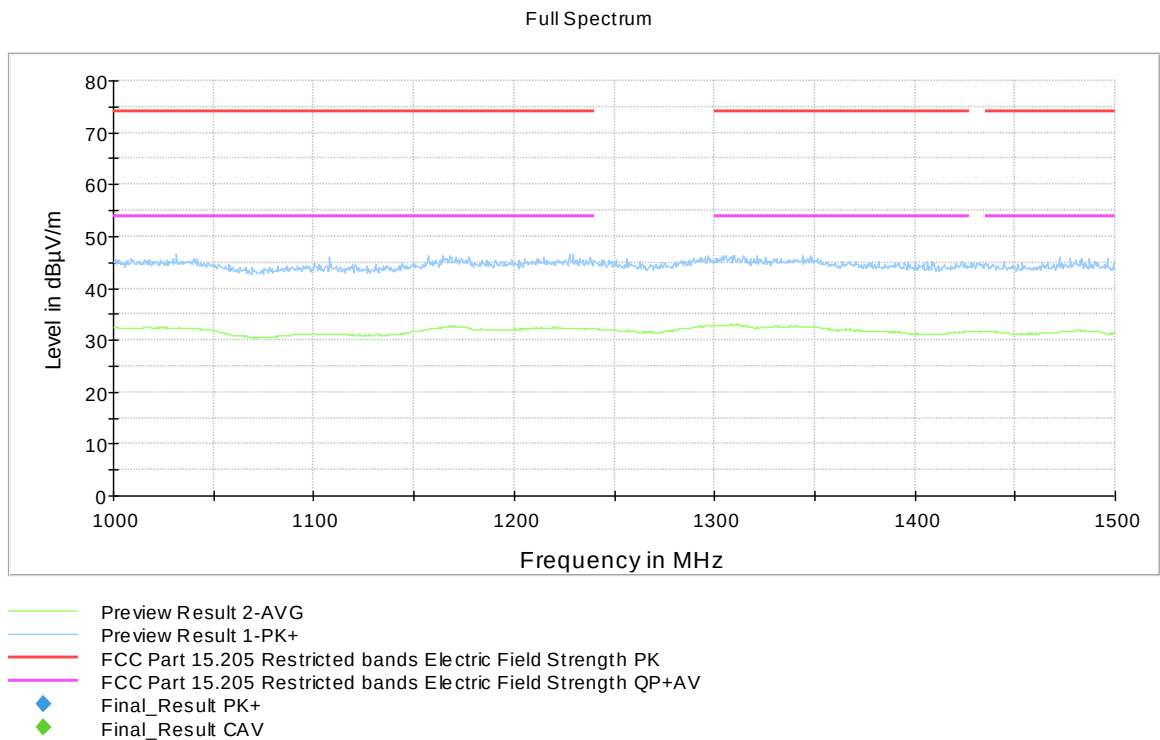


Figure 72: Unwanted emissions 1.0 – 1.5 GHz (Whip antenna, top ch.)

Unwanted Emissions (radiated)

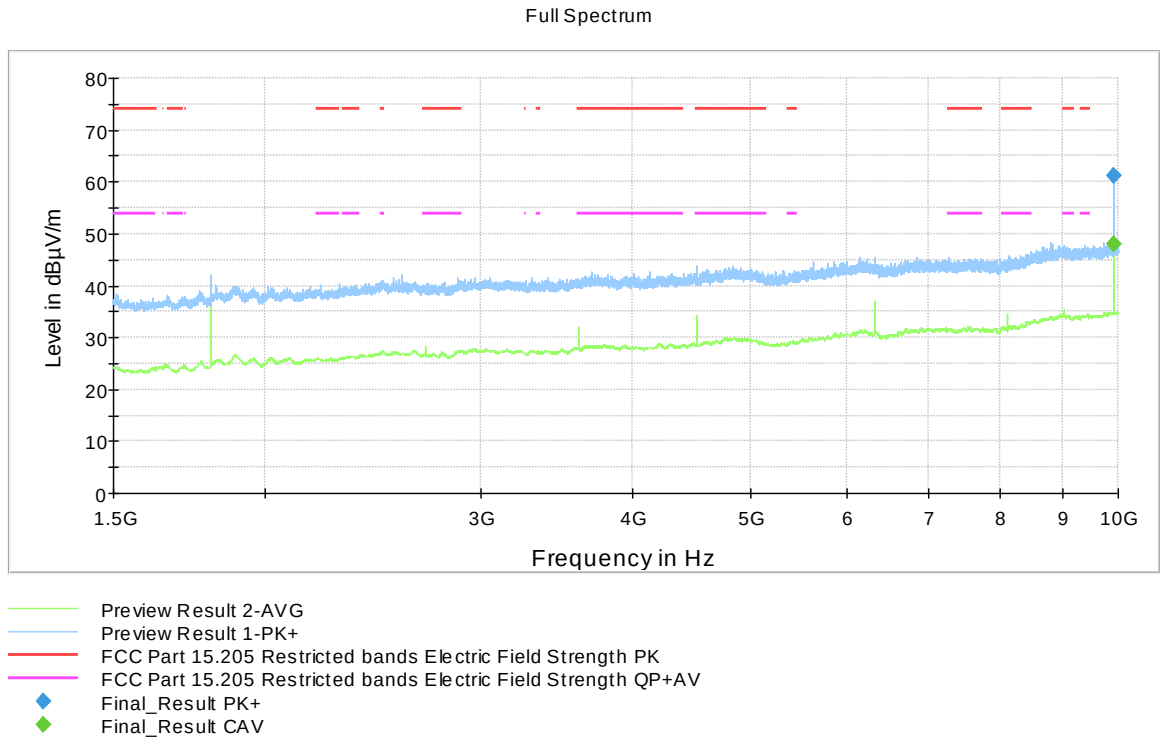


Figure 73: Unwanted emissions 1.5 – 10 GHz (Whip antenna, bottom ch.)

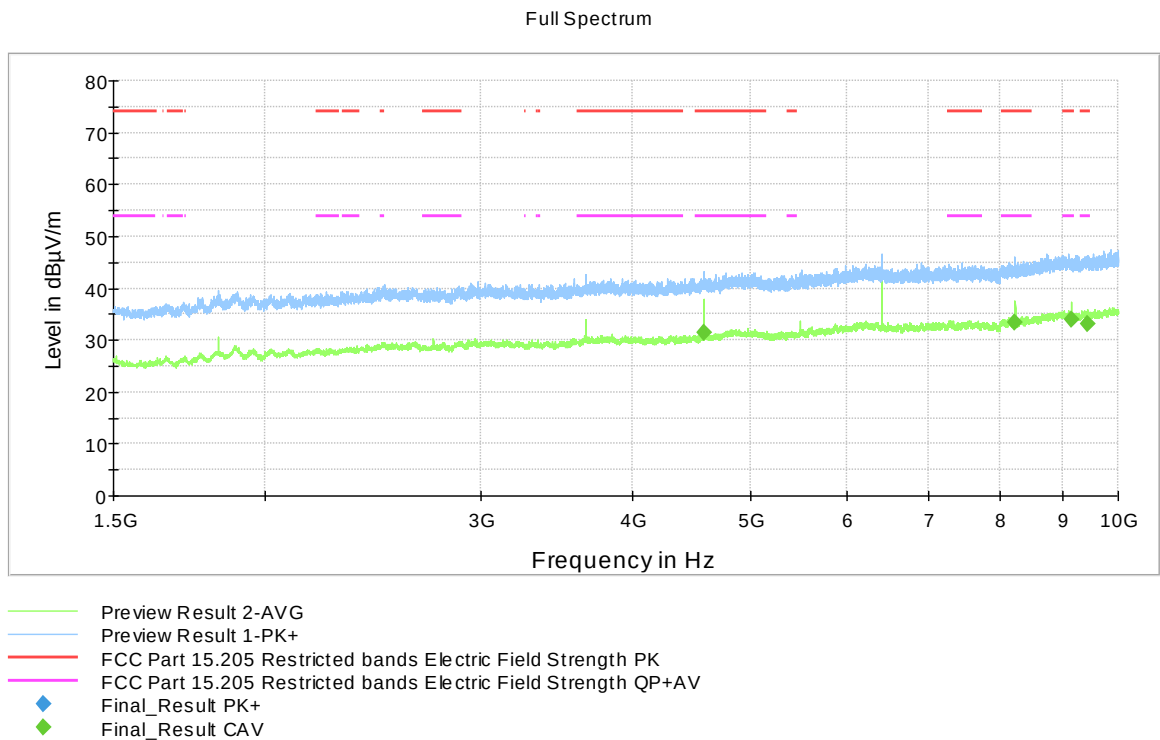


Figure 74: Unwanted emissions 1.5 – 10 GHz (Whip antenna, middle ch.)

Unwanted Emissions (radiated)

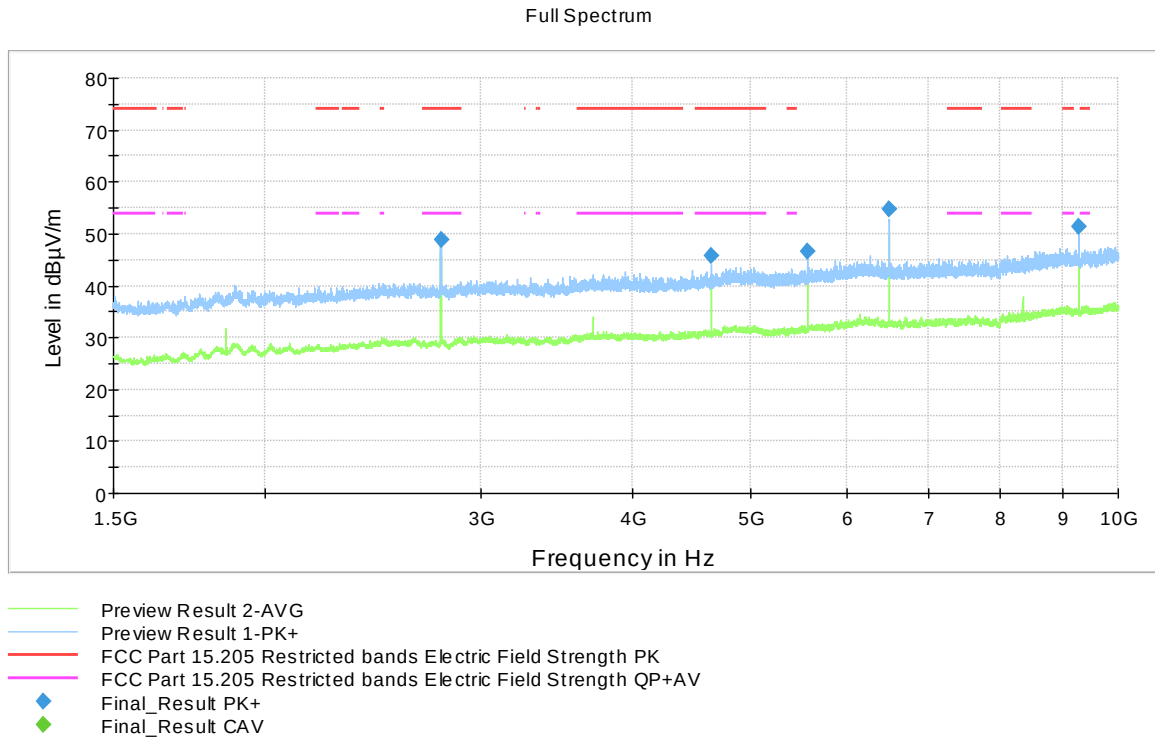


Figure 75: Unwanted emissions 1.5 – 10 GHz (Whip antenna, top ch.)

TEST EQUIPMENT**AC Power-Line Conducted Emissions**

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
COAX CHAIN K5 EMI CE 9kHz-30MHz	-	C054+FP1SF+C153	-	2024-03-28	2025-03-28
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2024-06-12	2025-06-11
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2024-02-05	2025-02-05
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	NCR
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2024-11-02	2025-11-02
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-

Conducted RF tests

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ATTENUATOR	HUBER&SUHNER	6810.17.B (10dB)	inv. A102	2024-12-11	2026-12-11
ATTENUATOR	NARDA	757 C - 20 dB	inv. A111	2024-12-11	2026-12-11
ATTENUATOR	NARDA	771 C - 6 dB	inv. A115	2024-12-11	2026-12-11
CABLE	SUHNER	sucotest	inv. C120	2024-07-14	2025-07-14
FILTER	WAINWRIGHT	HP, WHKX1.0/15G-10SS	inv. 8267	2024-07-14	2025-07-14
FILTER	WAINWRIGHT	LP, WLKS700-9SS	inv. 10606	2024-12-10	2026-12-10
PRECISION DC POWER SUPPLY	THANDAR	TS3021S	inv. 3484	NCR	NCR
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv. 9093	2024-06-13	2025-06-12
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 EMC	inv. 10516	2024-11-02	2025-11-02

Unwanted Emissions (radiated)

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv. 8013	2024-11-18	2025-11-18
ANTENNA	EMCO	3117, emi 1-18GHz	inv. 7293	2024-06-28	2026-06-28
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2024-12-11	2026-12-11
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	HUBER&SUHNER	6610.19.AA (10dB)	inv. A3	2024-12-11	2026-12-11
ATTENUATOR	HUBER&SUHNER	6806.17.B (6dB)	inv. A101	2024-12-11	2026-12-11
ATTENUATOR	HUBER&SUHNER	6810.17.B (10dB)	inv. A102	2024-12-11	2026-12-11
ATTENUATOR	PASTERNAK	PE 7004-4 (4dB)	inv. 10126	2024-12-11	2026-12-11
CABLE	SUHNER	SUCOFLEX 126E 1-18GHz	inv. C137	2024-04-05	2025-04-05
COAX CHAIN K5 EMI < 1GHz	-	C053+FP3AirC+C138	-	2024-03-28	2025-03-28
COAX CHAIN K5 EMI 1GHz-26.5GHz	-	C135+C149	-	2024-03-28	2025-03-28
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2024-06-12	2025-06-11
FILTER	WAINWRIGHT	HP, WHKX1.0/15G-10SS	inv. 8267	2024-12-10	2026-12-10
FILTER	WAINWRIGHT	HP, WHKX1.5/15G-12SS	inv. 10608	2024-12-10	2026-12-10
FILTER	WAINWRIGHT	LP, WLKS700-9SS	inv. 10606	2024-12-10	2026-12-10
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
POWER SUPPLY	DELTA	SM 130-25D	inv. 10406	NCR	NCR
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2024-09-10	2025-09-10
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv. 10517	2024-11-02	2025-11-02
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	NCR

NCR = No Calibration Required

END OF REPORT