

Test Report

HELEM2301000056-2



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

Equipment Under Test: PTT Voice Responder

Model: APTT2

Type: APTT2-0001-00

Trademark: AINA

Manufacturer/Customer: AINA Wireless Finland Oy
Joensuunkatu 7 G
FI-24100, Salo
Finland

FCC Rule Part: §15.247
IC Rule Part: RSS-247, Issue 2, 2017
RSS-GEN Issue 5 Amendment 2, 2021

KDB: 558074 D01 15.247 Meas Guidance v05r02
Guidance for Compliance Measurements on Digital Transmission
Systems, Frequency Hopping Spread Spectrum System, and Hybrid
System Devices Operating Under §15.247 of the FCC rules (April 2, 2019)

Date: 28 March 2023

Issued by:

A handwritten signature in blue ink, appearing to read 'Henri Mäki'.

Henri Mäki
Testing Engineer

Date: 28 March 2023

Checked by:

A handwritten signature in blue ink, appearing to read 'Rauno Repo'.

Rauno Repo
Senior EMC Specialist

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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	28 March 2023

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test:	PTT Voice Responder
Trademark:	AINA
Model:	APTT2
Type:	APTT2-0001-00
Serial no:	Sample 1: AW8230400038 Sample 2: AW8230400014
FCC ID:	-
IC:	-
Radio module or chip:	Qualcomm QCC3044 (Dual-Mode Bluetooth, version 5.2)

General Description

The equipment under test is a push-to-talk voice responder. The equipment includes Bluetooth radio and a passive NFC tag, USB-C port and proprietary charging pins for charging, and 3.5 mm audio jack for headset. This test report contains the results for Bluetooth Low Energy.

Classification

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

Samples and Modifications

No.	Name	Description
1	APTT19A44F	Normal sample. Used for radiated tests.
2	APTT19A47D	Temporary antenna connector was soldered to replace original antenna. Used for conducted tests.

Ratings and declarations

Operating frequency range:	2402-2480 MHz
Nominal channel bandwidth:	2 MHz
Number of channels:	40
Channel separation:	2 MHz
Transmission technique:	DSSS
Modulation:	GFSK
Data rate:	0.125, 0.5, 1, 2 Mbps
Antenna type:	Integral ceramic chip
Antenna gain:	+0.5 dBi
Antenna count:	1
EUT dimensions:	Height: 88 mm Width: 77 mm Length: 22 mm
Power requirements:	3.7 VDC (rechargeable lithium-ion battery)
Operating temperature range:	-30...+60 °C

Ports and Cables

Cable / Port	Description
USB-C	Used for charging and configuring the EUT during testing.
Charging pins	Not used during testing.
3.5 mm audio jack	Connected to the peripheral headset during testing.

Peripherals

Peripheral	Description / Usage
Charger	Celly SPT-104 (TC1USBC20WWH). Used for charging the EUT during AC Power-Line Conducted Emissions testing.
Headset	Connected to the audio jack of the EUT during testing.
Laptop	Lenovo ThinkPad T470p. Configuring and charging the EUT.

The peripherals were provided by the customer.

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)(2) / RSS-247 5.2 a)	6 dB Bandwidth	PASS
RSS-Gen 6.7	Occupied Bandwidth 99 %	PASS
§15.247(b)(3) / RSS-247 5.4 d)	Maximum Peak Conducted Output Power	PASS
§15.247(d) / RSS-247 5.5	Unwanted Emissions	PASS
§15.247(e) / RSS-247 5.2 b)	Power Spectral Density	PASS

The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.10-2013.

EUT Test Conditions during Testing

The radio was configured with a software provided by the customer (CSR BlueTest3). Normal modulation and maximum transmit power was used during the tests.

Conducted RF tests were performed with an automated Rohde & Schwarz TS8997 measurement system. The EUT was connected to the measurement system with a coaxial cable and was configured and charged with the peripheral laptop via USB-C port.

Radiated tests were performed in a semi-anechoic chamber with a measurement distance of 3 meters. During measurements above 1 GHz absorbers were placed on the floor. The EUT was connected to the peripheral headset and was configured and charged with the peripheral laptop via USB-C port. Radiated tests were performed only using the 1 Mbps data rate.

During AC Power-Line Conducted Emissions test the EUT was connected to the peripheral headset and was charged with the peripheral charger. Normal Bluetooth connection was established with the peripheral laptop.



Figure 1: Test setup block diagram (conducted RF tests)

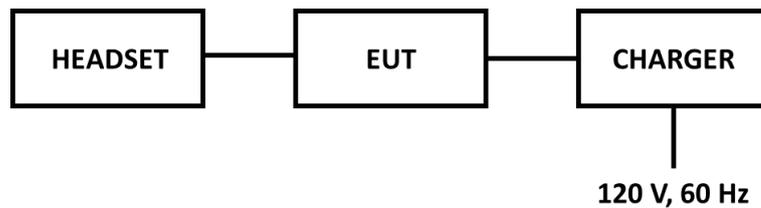


Figure 2: Test setup block diagram (AC Power-Line Conducted Emissions)



Figure 3: Test setup block diagram (radiated tests)

Table 1: Test frequencies and settings

Data rate	Channel	Frequency [MHz]
1 Mbps (LE 1M PHY)	37	2402
	17	2440
	39	2480
2 Mbps (LE 2M PHY)	0	2404
	17	2440
	36	2478

Note: channels 0 and 36 are the lowest and highest supported by LE 2M PHY.

Test Facility

<p>Testing Laboratory / address: FCC designation number: FI0002 ISED CAB identifier: T004</p>	<p>SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND</p>
<p>Test Site:</p>	<p><input type="checkbox"/> K10LAB, ISED Canada registration number: 8708A-1 <input checked="" type="checkbox"/> K5LAB, ISED Canada registration number: 8708A-2 <input type="checkbox"/> T10LAB</p>

TEST RESULTS

Antenna Requirement

Standard: FCC Rule §15.203
Tested by: HEM
Date: 9 March 2023

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.

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 1 is used	

AC Power-Line Conducted Emissions

Standard:	ANSI C63.10-2013
Tested by:	HEM
Date:	3 March 2023
Temperature:	23 °C
Humidity:	33 %RH
Measurement uncertainty:	± 2.9 dB, level of confidence 95 % (k = 2)
Test result:	PASS

FCC §15.207**RSS-Gen clause 8.8**

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 §15.207(a) and RSS-Gen clause 8.8, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

For equipment that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the equipment.

The emissions are measured with a LISN from 150 kHz to 30 MHz with a resolution bandwidth of 9 kHz using peak and average detectors.

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

Test results

Full Spectrum

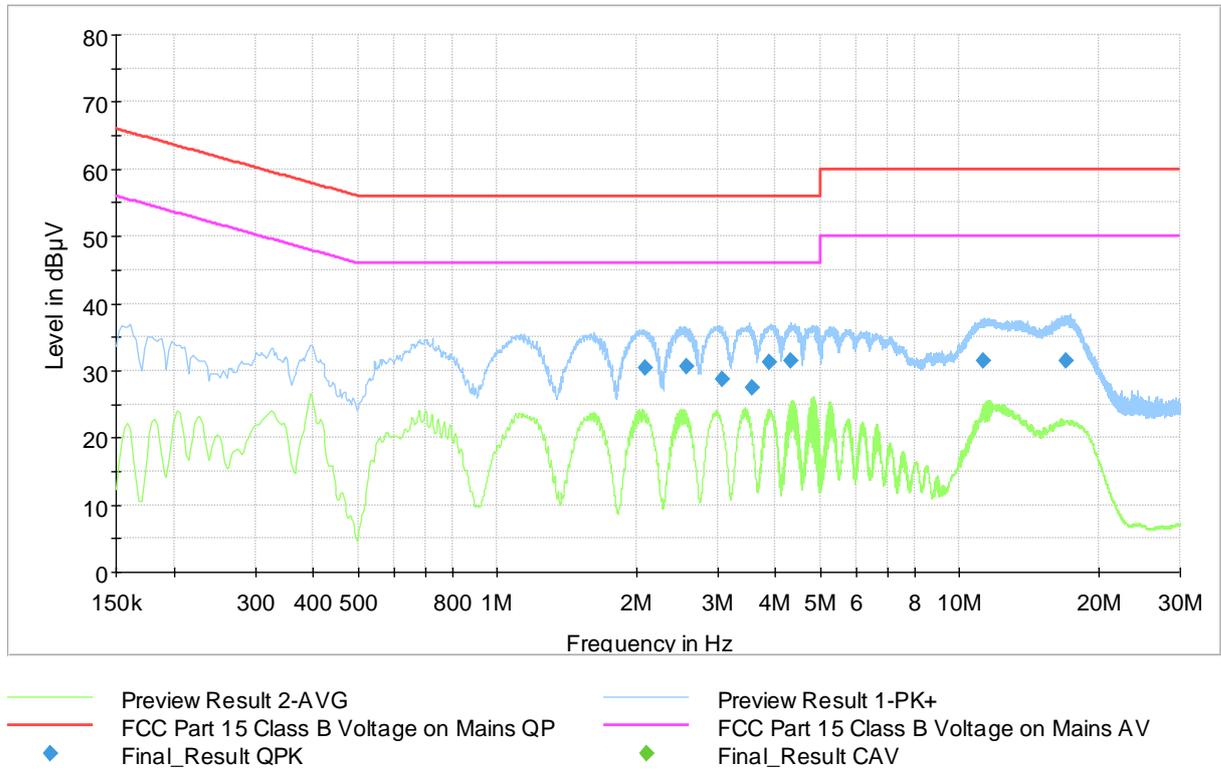


Figure 4: AC Power-Line Conducted Emissions

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)
2.098750	30.48	---	56.00	25.52	15 x 1000.0	9.000	L1	9.9
2.572750	30.51	---	56.00	25.49	15 x 1000.0	9.000	L1	9.9
3.063500	28.73	---	56.00	27.27	15 x 1000.0	9.000	L1	9.9
3.553750	27.39	---	56.00	28.61	15 x 1000.0	9.000	L1	9.9
3.888250	31.17	---	56.00	24.83	15 x 1000.0	9.000	L1	9.9
4.328500	31.50	---	56.00	24.50	15 x 1000.0	9.000	L1	10.0
11.295000	31.49	---	60.00	28.51	15 x 1000.0	9.000	N	10.3
17.032250	31.36	---	60.00	28.64	15 x 1000.0	9.000	L1	10.4

6 dB Bandwidth

Standard: ANSI C63.10-2013
Tested by: HEM
Date: 9 March 2023
Temperature: 22 °C
Humidity: 16 %RH
Test result: **PASS**

FCC §15.247(a)(2) RSS-247 clause 5.2 a)

The 6 dB bandwidth is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emissions is attenuated 6 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emissions.

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test results

Table 3: Test results for 6 dB Bandwidth

Data Rate	Frequency [MHz]	6 dB BW [kHz]	Limit [kHz]	Result
1 Mbps	2402	792.080	≥ 500	PASS
	2440	792.080		PASS
	2480	792.080		PASS
2 Mbps	2404	1584.158		PASS
	2440	1544.554		PASS
	2478	1584.158		PASS

The conducted measurement was performed with a spectrum analyzer using the following settings:

Setting	Value
Span	4.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
Sweep Points	101
Sweep Time	18.938 μs
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
Filter	3 dB
Trace Mode	Max Hold
Sweep Type	FFT
Preamp	off

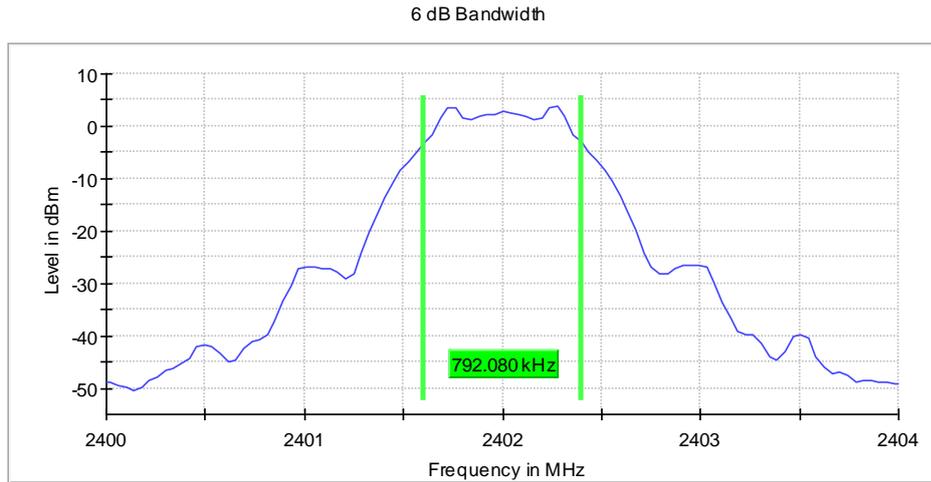


Figure 5: 6 dB Bandwidth (1 Mbps, TX 2402 MHz)

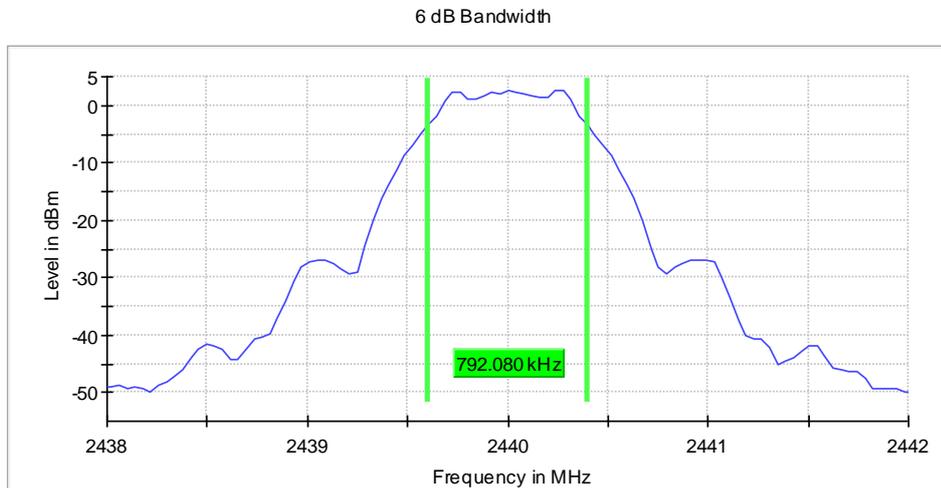


Figure 6: 6 dB Bandwidth (1 Mbps, TX 2440 MHz)

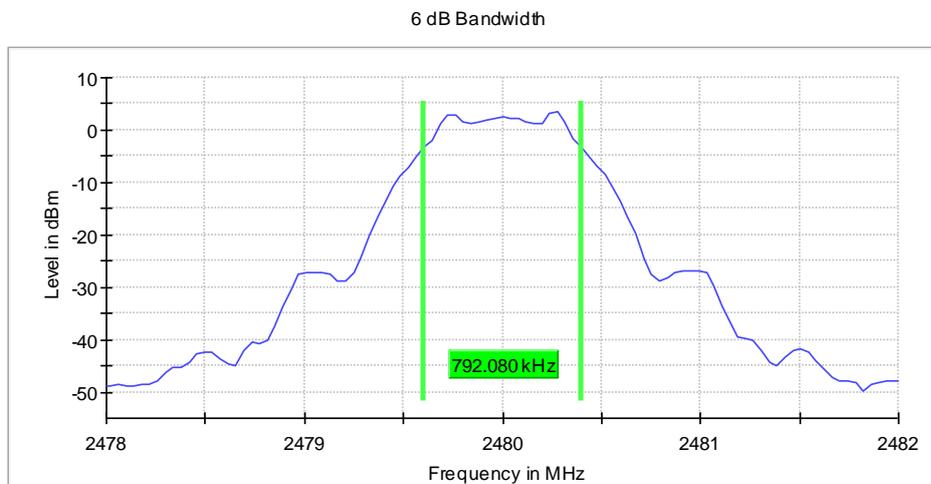


Figure 7: 6 dB Bandwidth (1 Mbps, TX 2480 MHz)

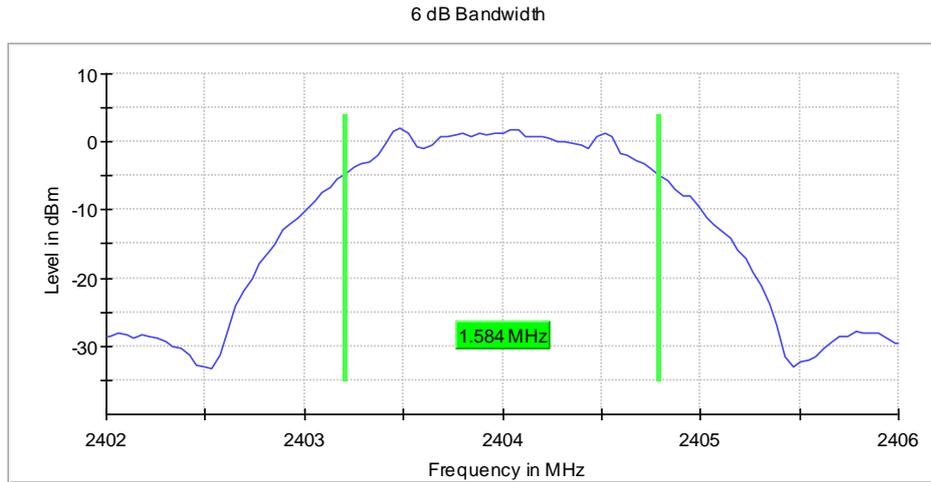


Figure 8: 6 dB Bandwidth (2 Mbps, TX 2404 MHz)

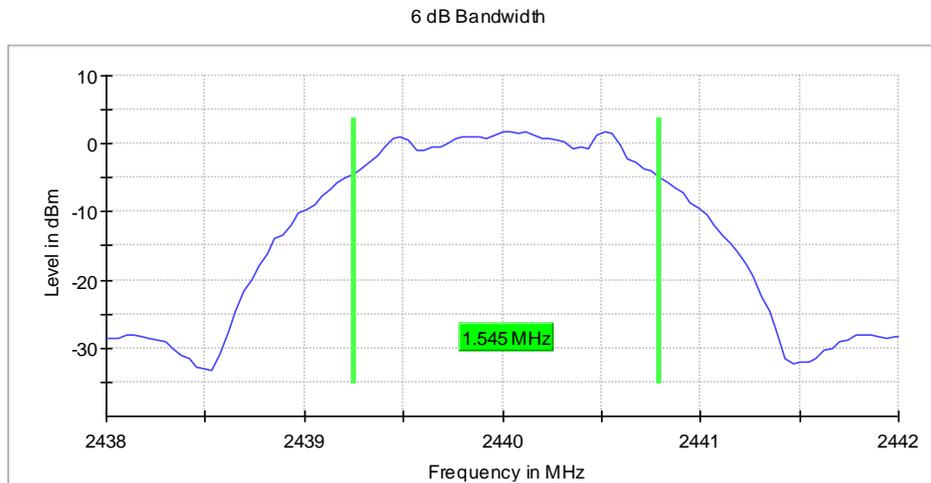


Figure 9: 6 dB Bandwidth (2 Mbps, TX 2440 MHz)

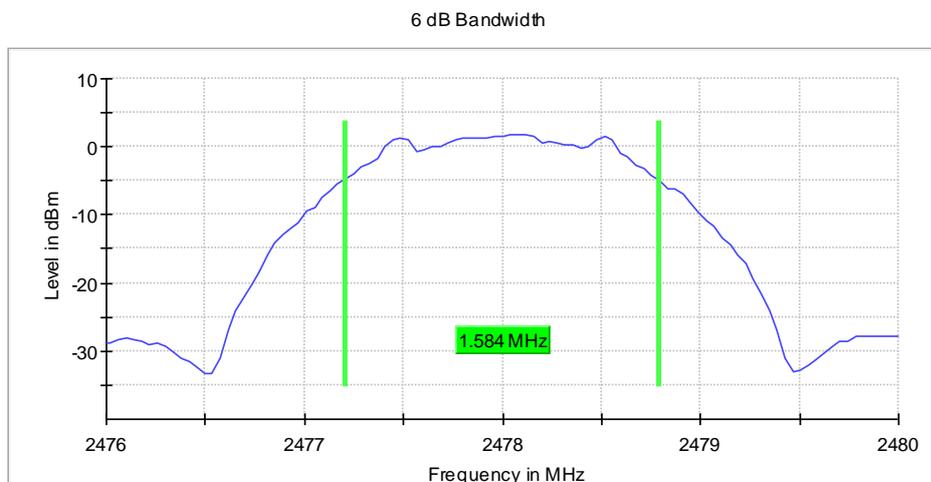


Figure 10: 6 dB Bandwidth (2 Mbps, TX 2478 MHz)

Occupied Bandwidth 99%

Standard: RSS-Gen
Tested by: HEM
Date: 9 March 2023
Temperature: 22 °C
Humidity: 16 %RH
Test result: **PASS**

RSS-Gen clause 6.7

The occupied 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 emission is contained.

Test results

Table 4: Test results for Occupied Bandwidth 99%

Data Rate	Frequency [MHz]	OBW 99% [MHz]	Limit [MHz]	Result
1 Mbps	2402	1.050000	-	PASS
	2440	1.050000		PASS
	2480	1.050000		PASS
2 Mbps	2404	2.090000		PASS
	2440	2.090000		PASS
	2478	2.090000		PASS

The conducted measurement was performed with a spectrum analyzer using the following settings:

Setting	Value
Span	4.000 MHz
RBW	20.000 kHz
VBW	100.000 kHz
Sweep Points	400
Sweep Time	94.824 µs
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
Filter	3 dB
Trace Mode	Max Hold
Sweep Type	FFT
Preamp	off

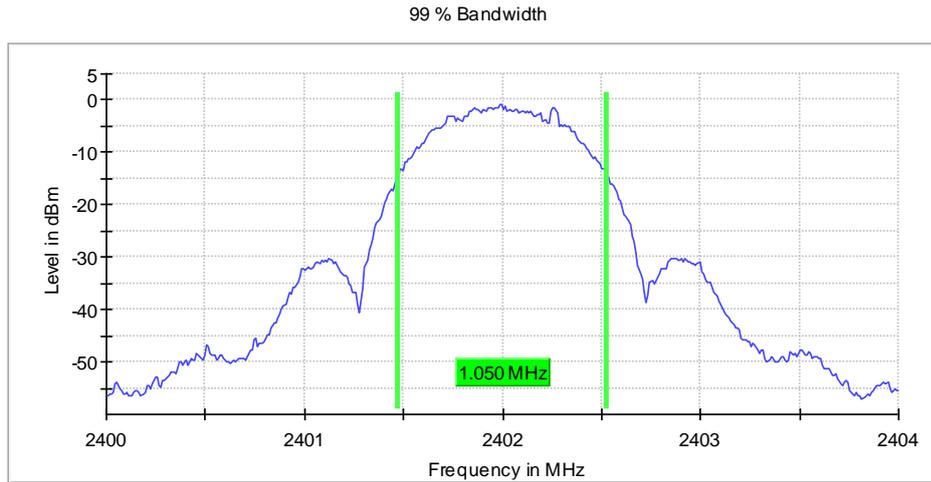


Figure 11: Occupied Bandwidth 99% (1 Mbps, TX 2402 MHz)

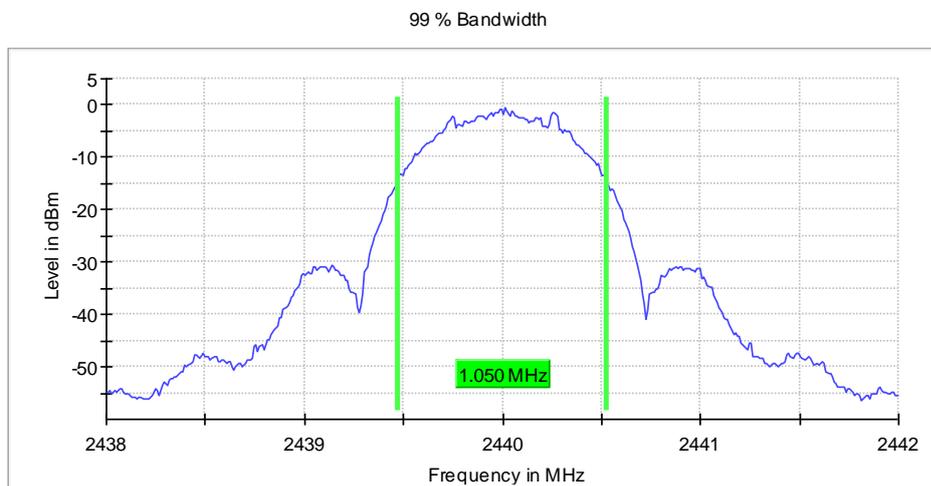


Figure 12: Occupied Bandwidth 99% (1 Mbps, TX 2440 MHz)

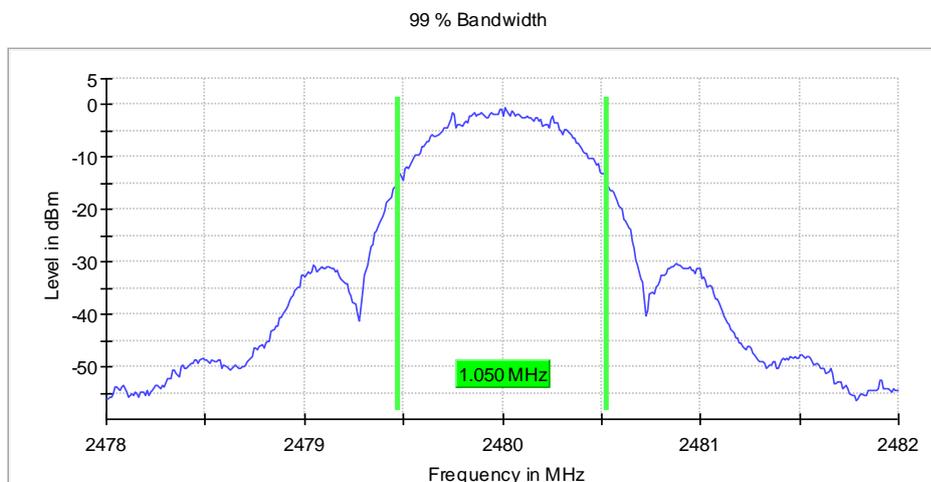


Figure 13: Occupied Bandwidth 99% (1 Mbps, TX 2480 MHz)

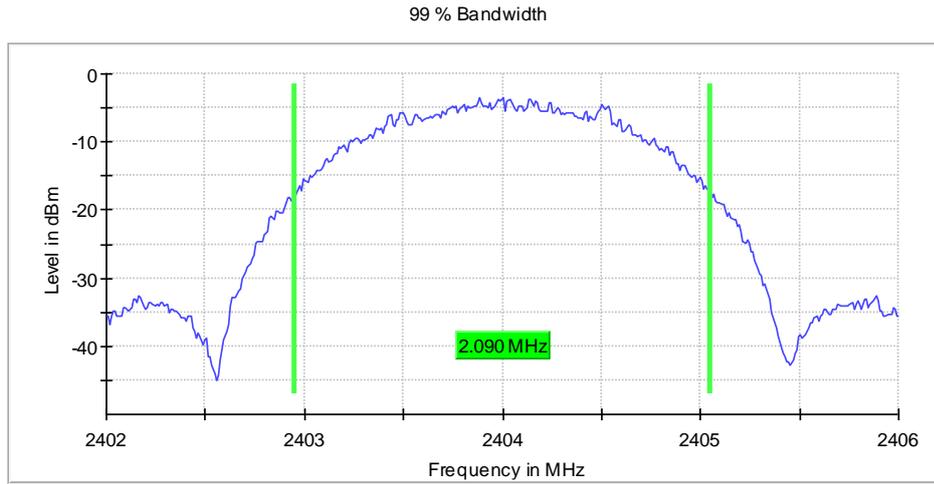


Figure 14: Occupied Bandwidth 99% (2 Mbps, TX 2404 MHz)

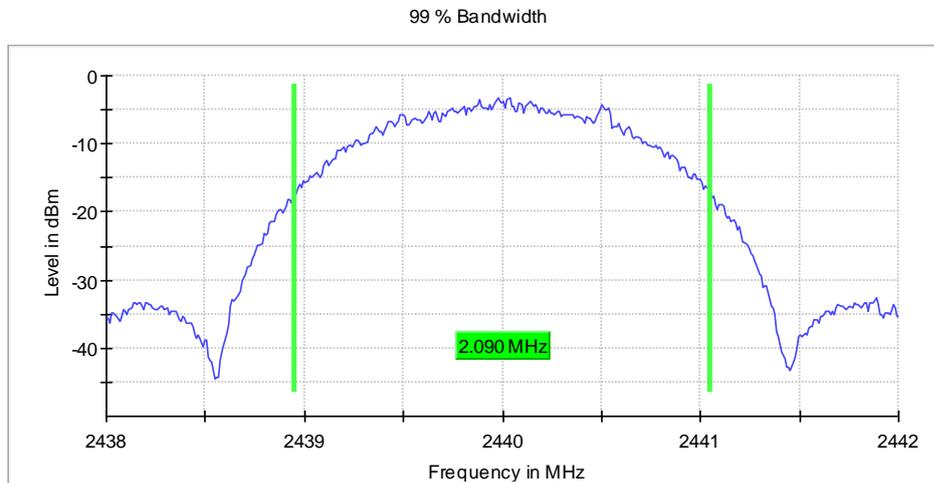


Figure 15: Occupied Bandwidth 99% (2 Mbps, TX 2440 MHz)

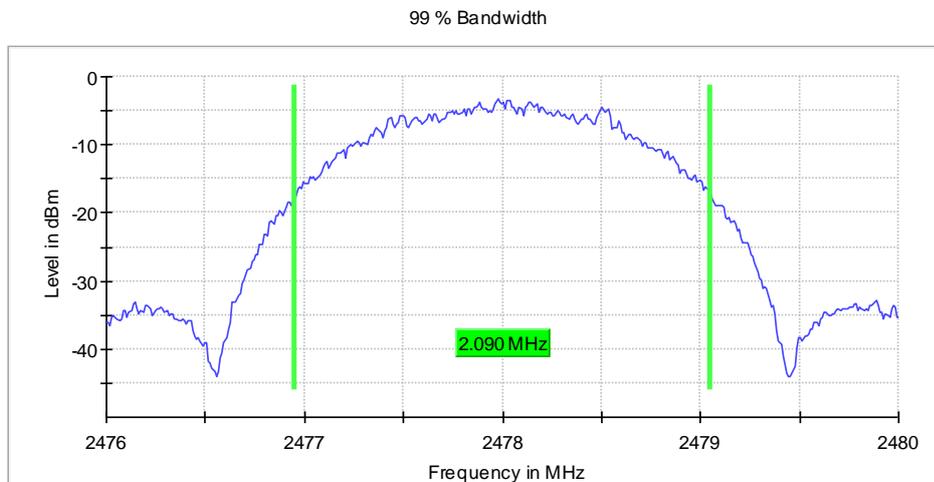


Figure 16: Occupied Bandwidth 99% (2 Mbps, TX 2478 MHz)

Maximum Peak Conducted Output Power
Maximum Peak Conducted Output Power

Standard:	ANSI C63.10-2013
Tested by:	HEM
Date:	23 March 2023
Temperature:	23 °C
Humidity:	22 %RH
Measurement uncertainty:	± 2.87dB, level of confidence 95 % (k = 2)
Test result:	PASS

**FCC §15.247(b)(3)
RSS-247 clause 5.4 d)**

For systems using digital modulation in the 2400-2483.5 MHz band the maximum peak conducted output power of the intentional radiated shall not exceed 1 W (30 dBm). The conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test results
Table 5: Test results for Maximum Peak Conducted Output Power

Data Rate	Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Result
1 Mbps	2402	3.9	30	PASS
	2440	3.7		PASS
	2480	3.7		PASS
2 Mbps	2404	3.8		PASS
	2440	3.7		PASS
	2478	3.7		PASS

The conducted measurement was performed with a spectrum analyzer using the following settings:

Setting	Value
Span	6.000 MHz
RBW	2.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	953.450 ns
Reference Level	10.000 dBm
Attenuation	30.000 dB
Detector	MaxPeak
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamp	off

Maximum Peak Conducted Output Power

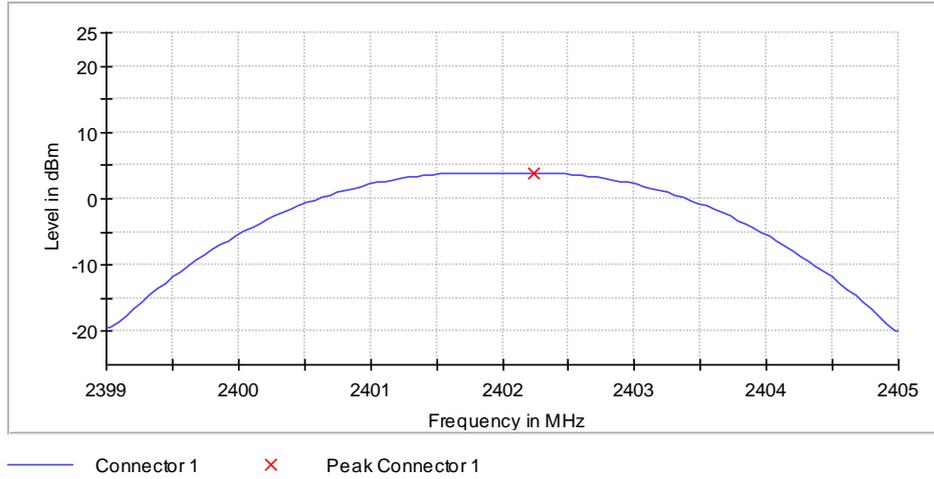


Figure 17: Maximum Peak Conducted Output Power (1 Mbps, TX 2402 MHz)

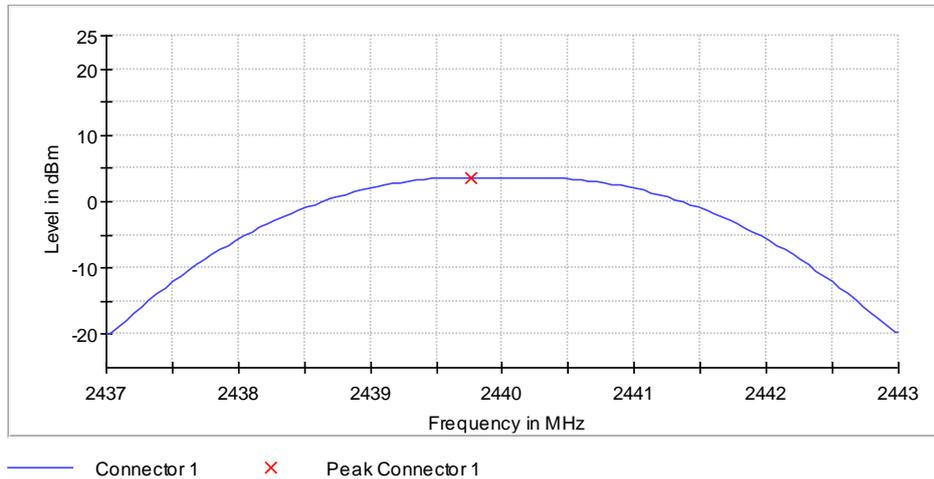


Figure 18: Maximum Peak Conducted Output Power (1 Mbps, TX 2440 MHz)

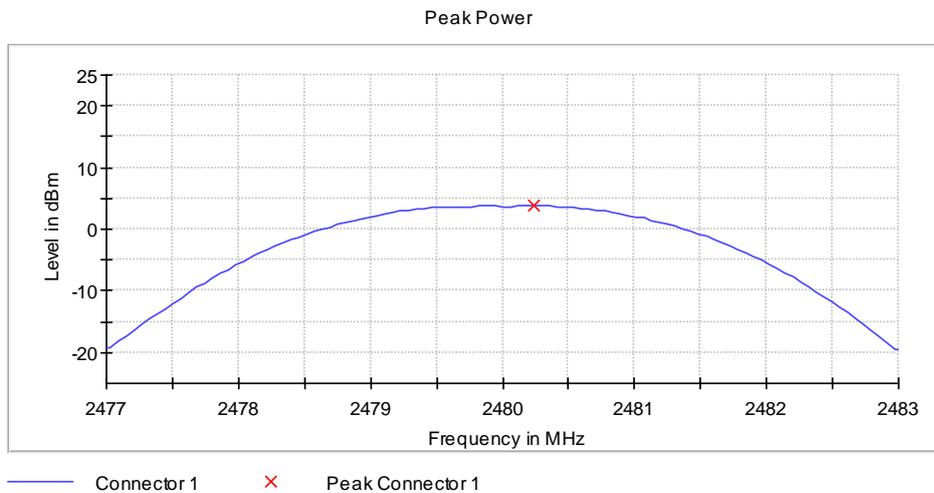


Figure 19: Maximum Peak Conducted Output Power (1 Mbps, TX 2480 MHz)

Maximum Peak Conducted Output Power

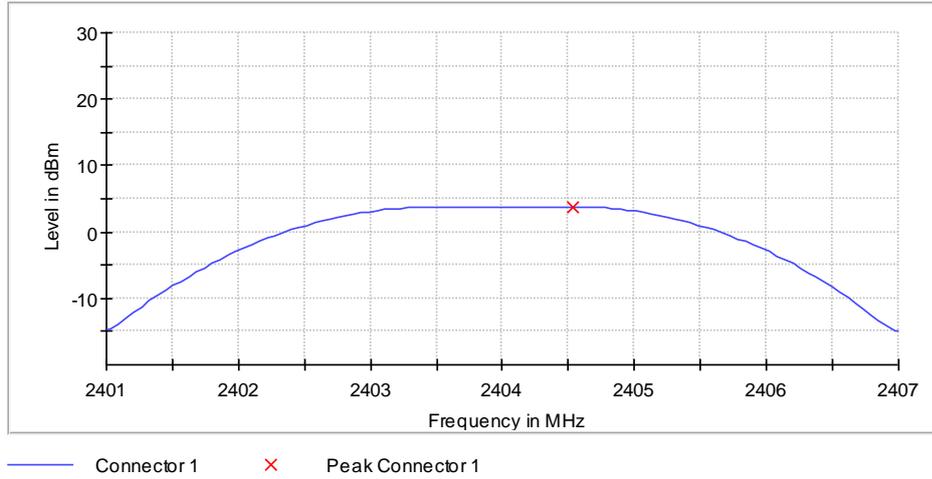


Figure 20: Maximum Peak Conducted Output Power (2 Mbps, TX 2404 MHz)

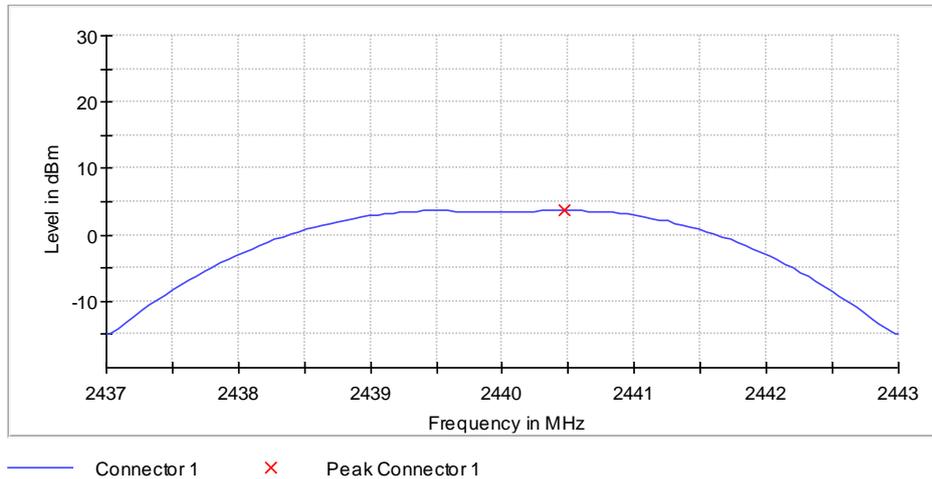


Figure 21: Maximum Peak Conducted Output Power (2 Mbps, TX 2440 MHz)

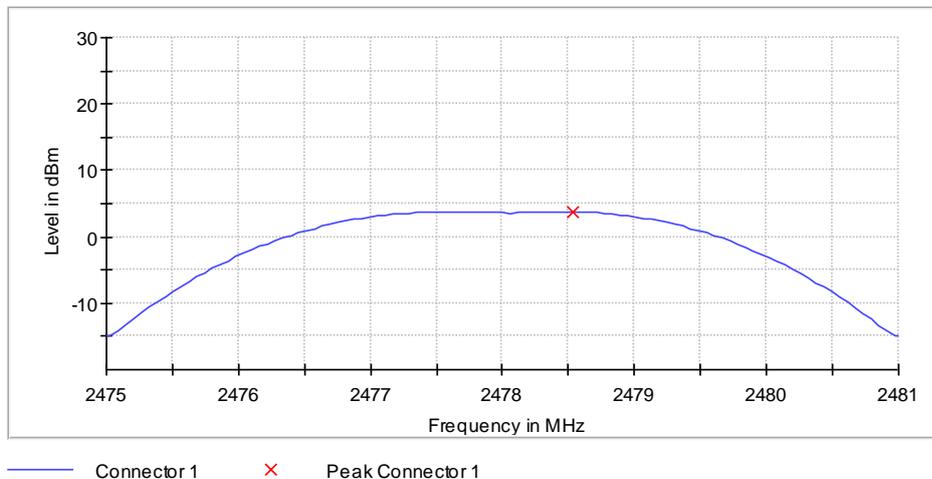


Figure 22: Maximum Peak Conducted Output Power (2 Mbps, TX 2478 MHz)

Unwanted Emissions (conducted)

Standard:	ANSI C63.10-2013
Tested by:	HEM
Date:	9 March 2023
Temperature:	22 °C
Humidity:	16 %RH
Measurement uncertainty:	± 2.87 dB, level of confidence 95 % (k = 2)
Test result:	PASS

**FCC §15.247(d)
RSS-247 clause 5.5**

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

Test results

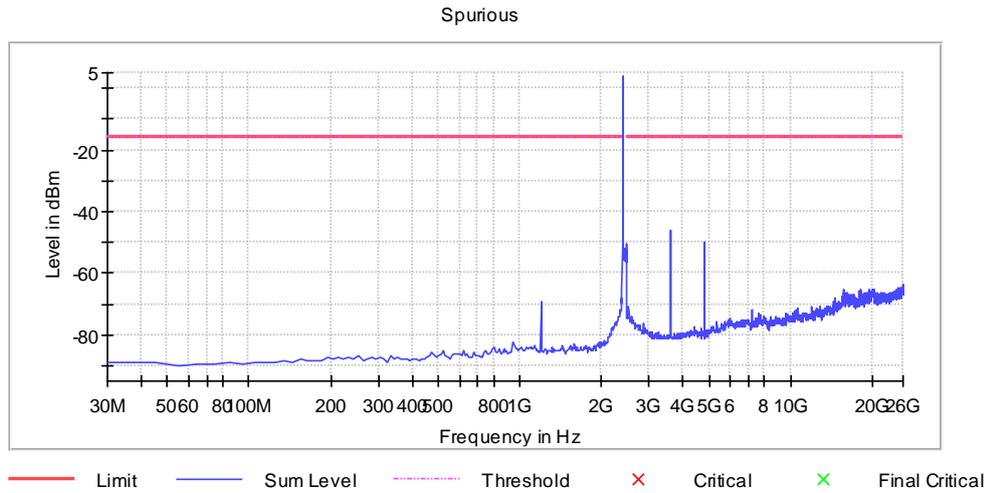


Figure 23: Unwanted Emissions, conducted (1 Mbps, TX 2402 MHz)

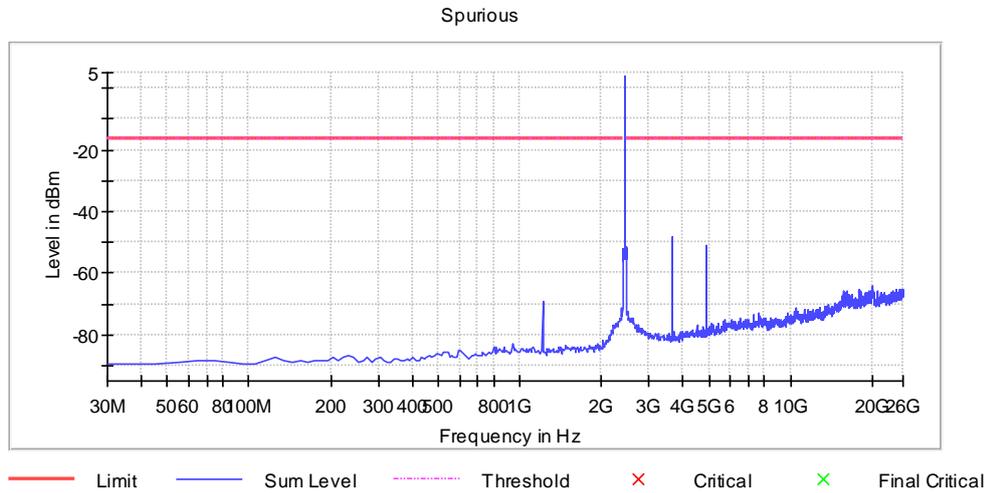


Figure 24: Unwanted Emissions, conducted (1 Mbps, TX 2440 MHz)

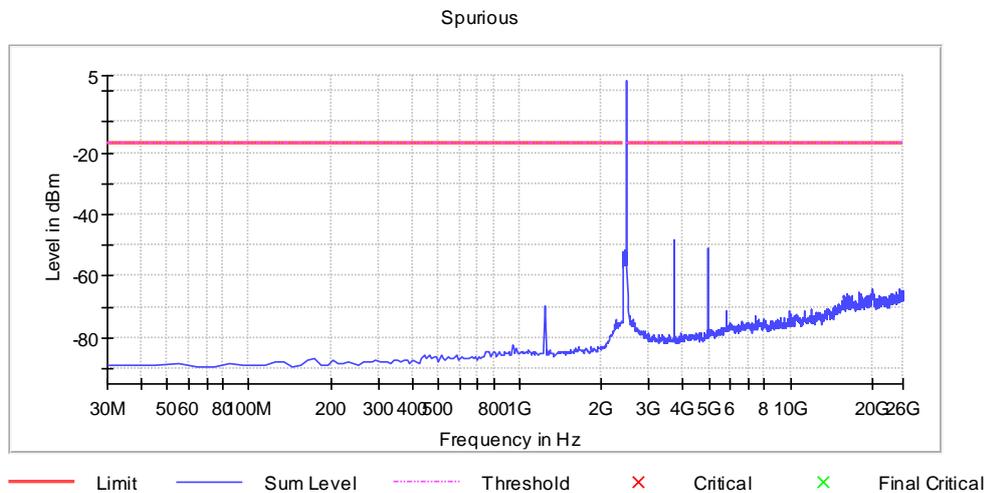


Figure 25: Unwanted Emissions, conducted (1 Mbps, TX 2480 MHz)

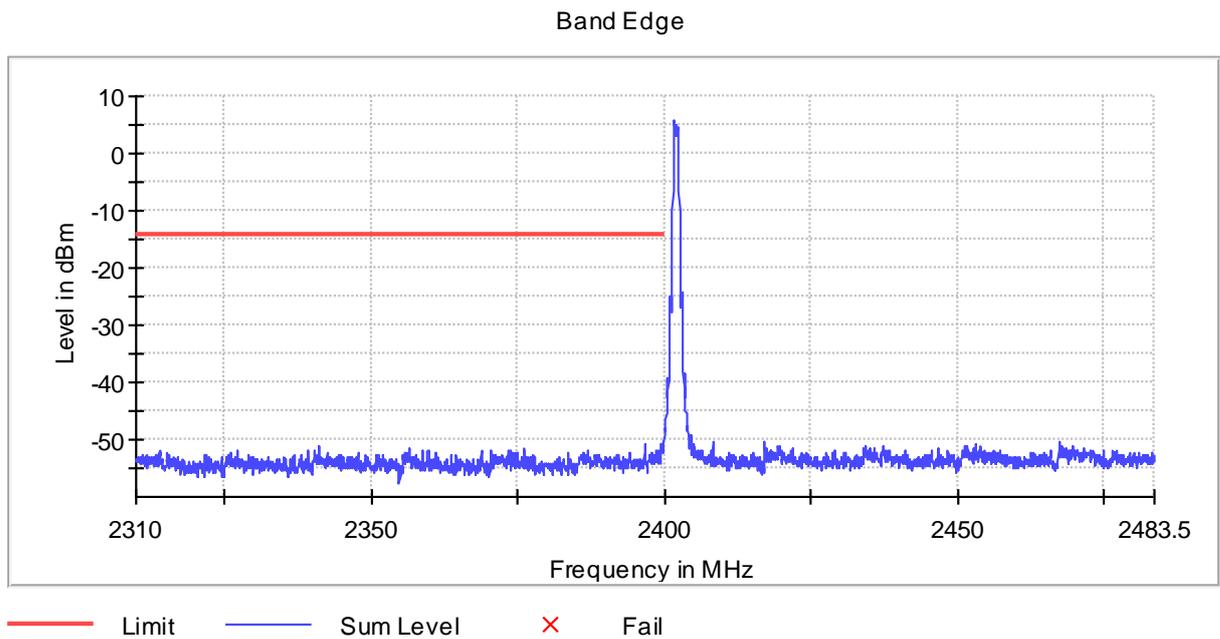


Figure 26: Lower Band-Edge, conducted (1 Mbps, TX 2402 MHz)

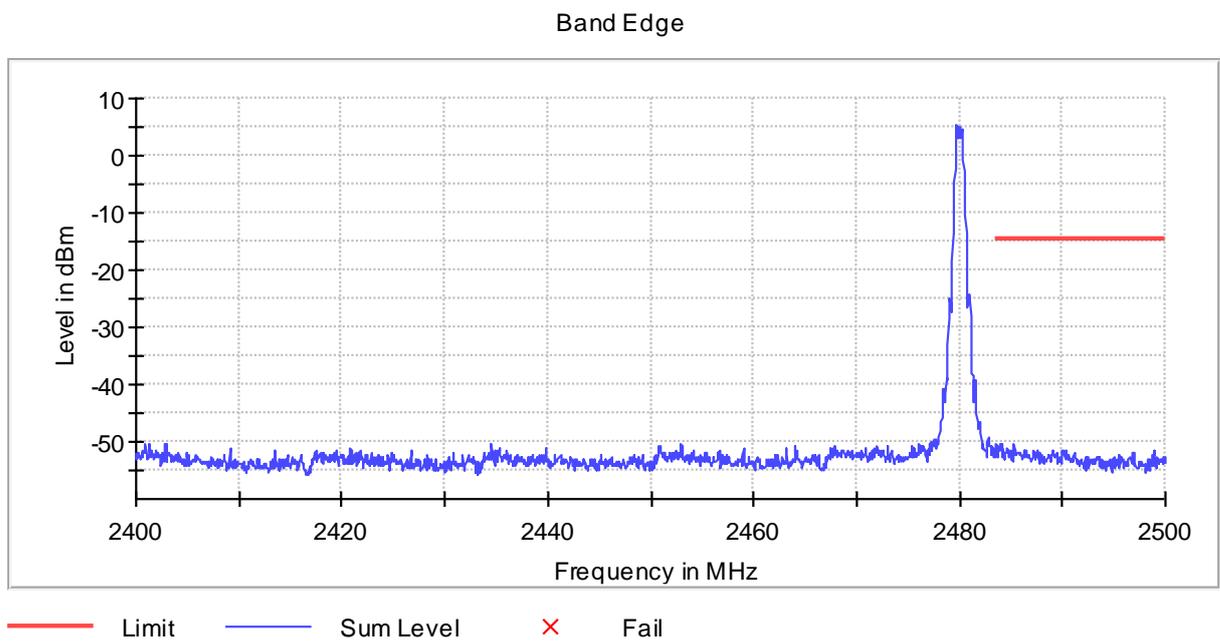


Figure 27: Upper Band-Edge (1 Mbps, TX 2480 MHz)

Unwanted Emissions (conducted)

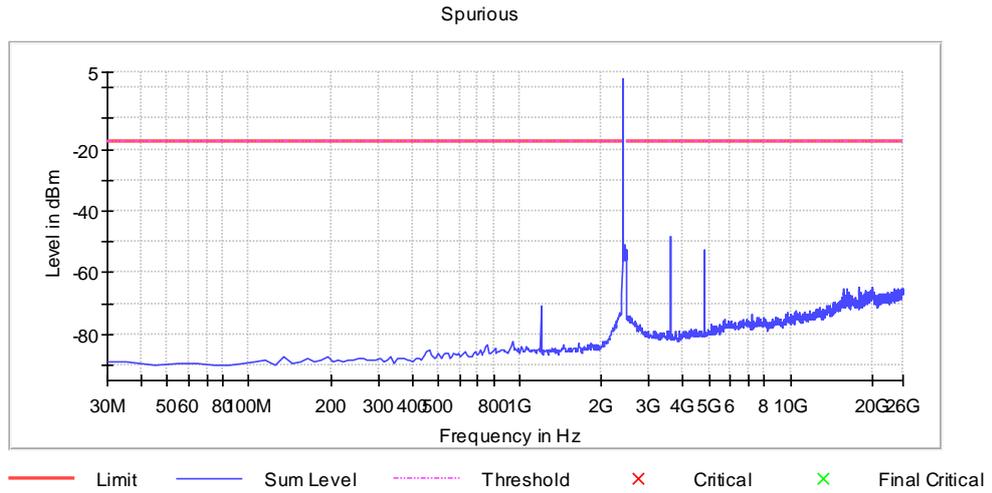


Figure 28: Unwanted Emissions, conducted (2 Mbps, TX 2404 MHz)

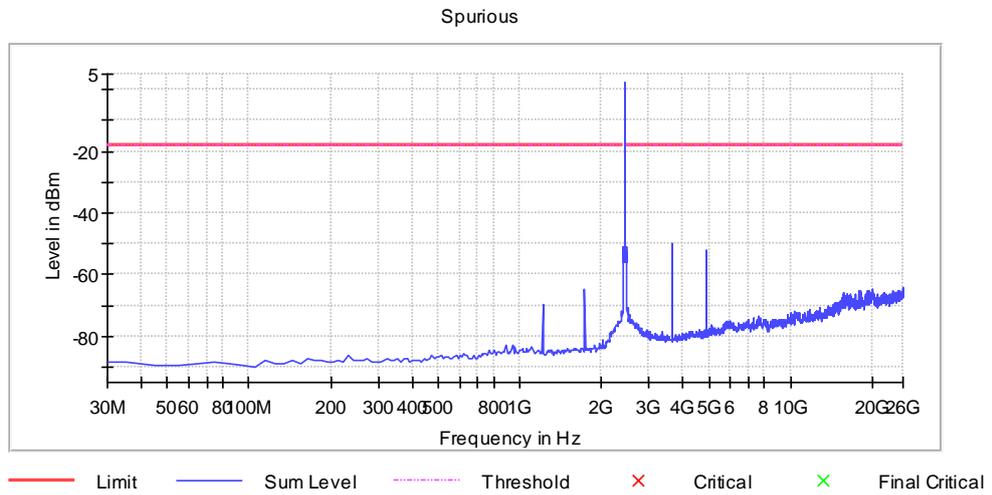


Figure 29: Unwanted Emissions, conducted (2 Mbps, TX 2440 MHz)

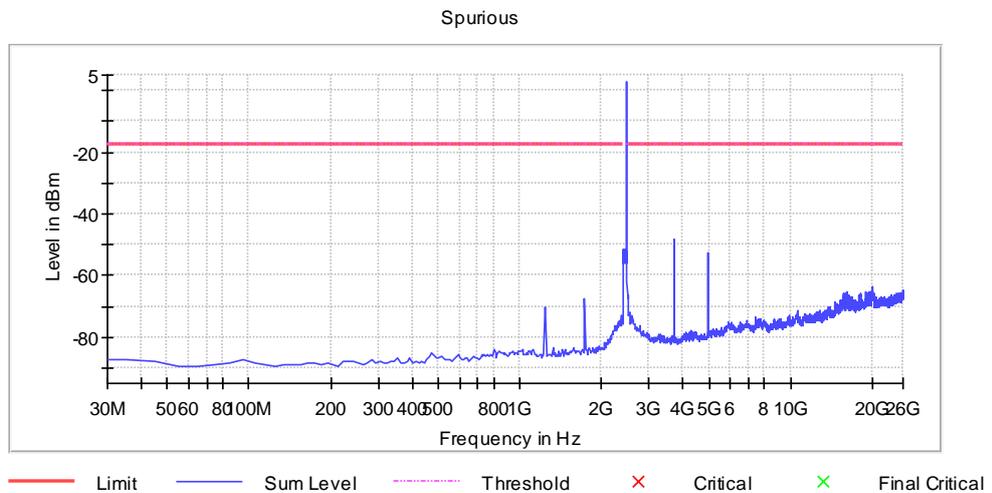


Figure 30: Unwanted Emissions, conducted (2 Mbps, TX 2478 MHz)

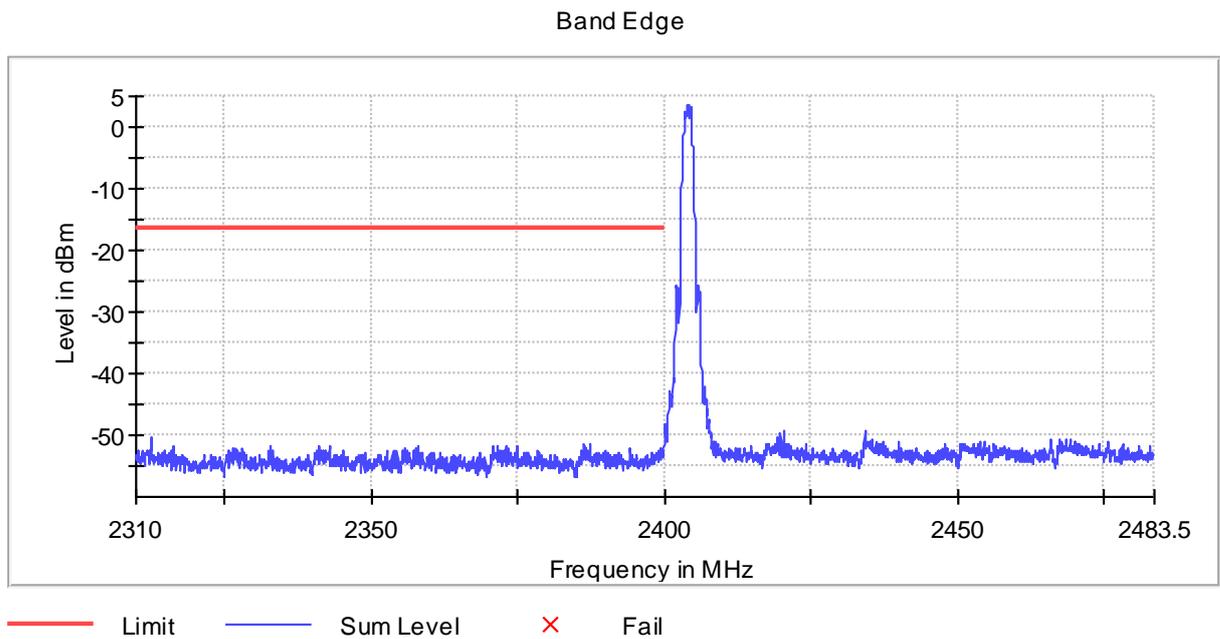


Figure 31: Lower Band-Edge, conducted (2 Mbps, TX 2404 MHz)

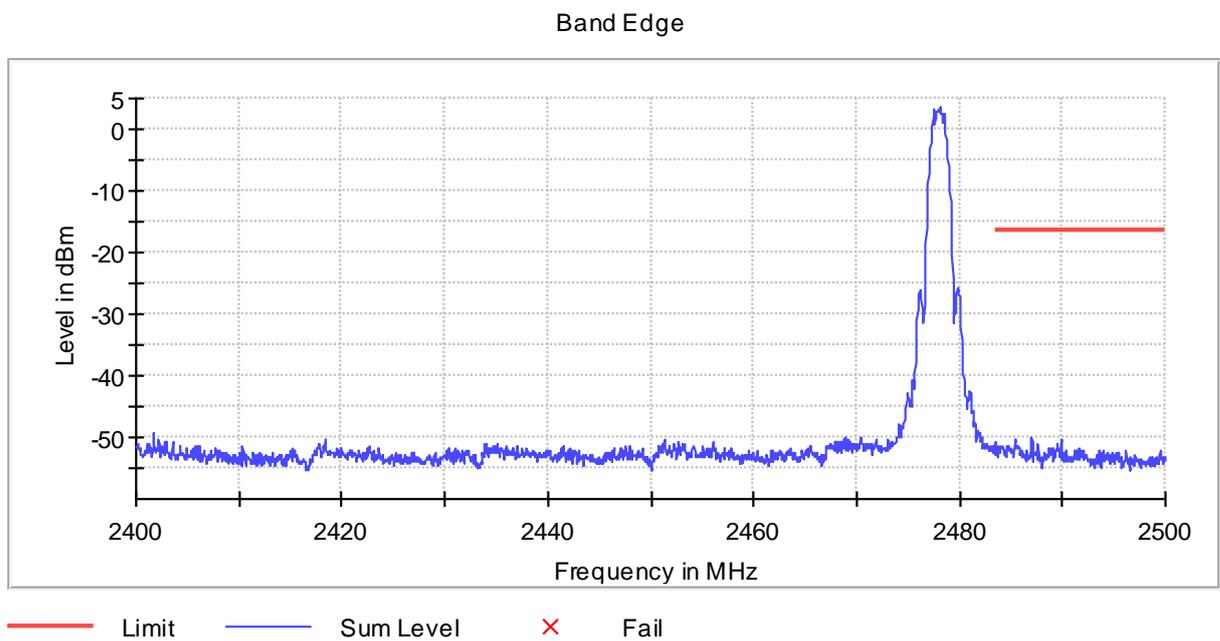


Figure 32: Upper Band-Edge, conducted (2 Mbps, TX 2478 MHz)

Unwanted Emissions (radiated)

Standard:	ANSI C63.10-2013	
Tested by:	HEM, HAM	
Date:	28 February 2023	1 March 2023
Temperature:	24 °C	23 °C
Humidity:	33 %RH	32 %RH
Measurement uncertainty:	± 4.51 dB, level of confidence 95 % (k = 2)	
Test result:	PASS	

**FCC §15.247(d)
RSS-247 clause 5.5**

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

Investigative measurements were performed in order to find the worst-case orientation for the EUT. The final measurements were performed in the worst-case orientation.

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

The measurements were performed using the 1 Mbps data rate.

Test results (1 Mbps, TX 2402 MHz)

Table 6: Test results with quasi-peak detector (1 Mbps, TX 2402 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
179.525000	20.54	43.50	22.96	15 x 1000.0	120.000	100.0	V	357.0	17.0
204.165000	22.04	43.50	21.46	15 x 1000.0	120.000	117.0	V	14.0	15.2
204.355000	21.68	43.50	21.82	15 x 1000.0	120.000	175.0	H	347.0	15.2
378.245000	18.75	46.00	27.25	15 x 1000.0	120.000	114.0	V	226.0	21.6
455.365000	16.46	46.00	29.54	15 x 1000.0	120.000	135.0	V	8.0	23.7
533.415000	17.32	46.00	28.68	15 x 1000.0	120.000	111.0	V	323.0	24.8

Table 7: Test results with peak detector (1 Mbps, TX 2402 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2400.000000	56.09	74.34 *)	18.25	15 x 1000.0	1000.000	146.0	V	252.0	13.7
2401.750000	94.34	---	---	15 x 1000.0	1000.000	146.0	V	249.0	13.7
4804.500000	46.53	73.98	27.45	15 x 1000.0	1000.000	276.0	H	254.0	7.4

*) -20 dBc

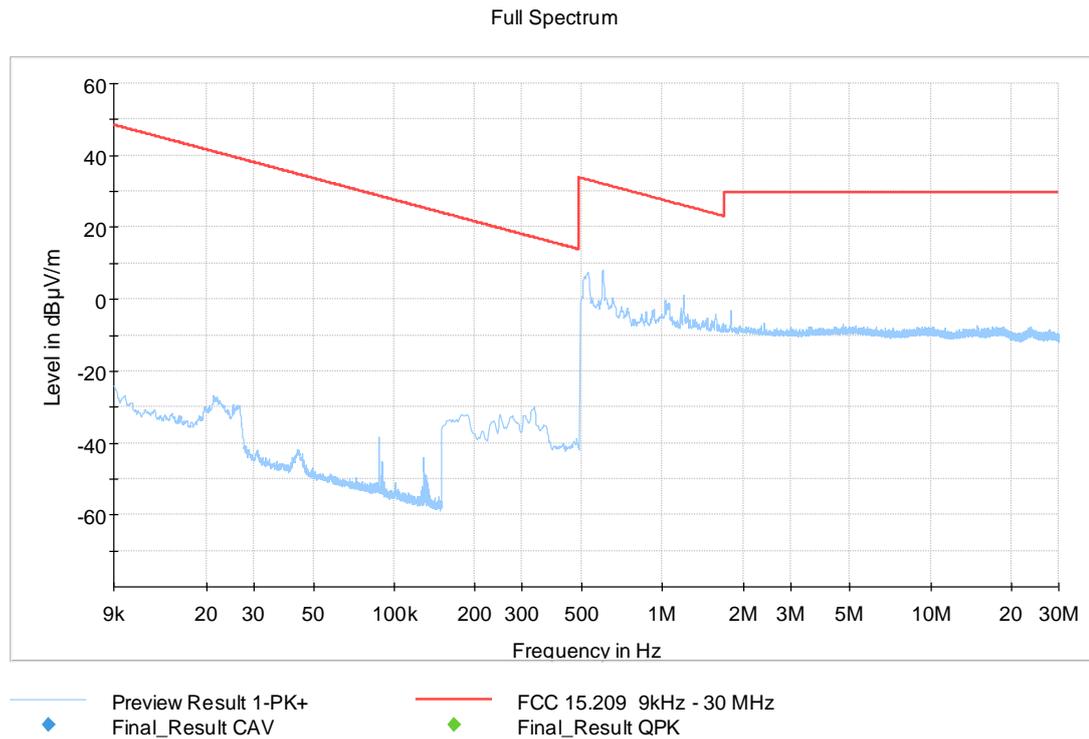


Figure 33: Unwanted Emissions, radiated 9 kHz – 30 MHz (1 Mbps, TX 2402 MHz)

Unwanted Emissions (radiated)

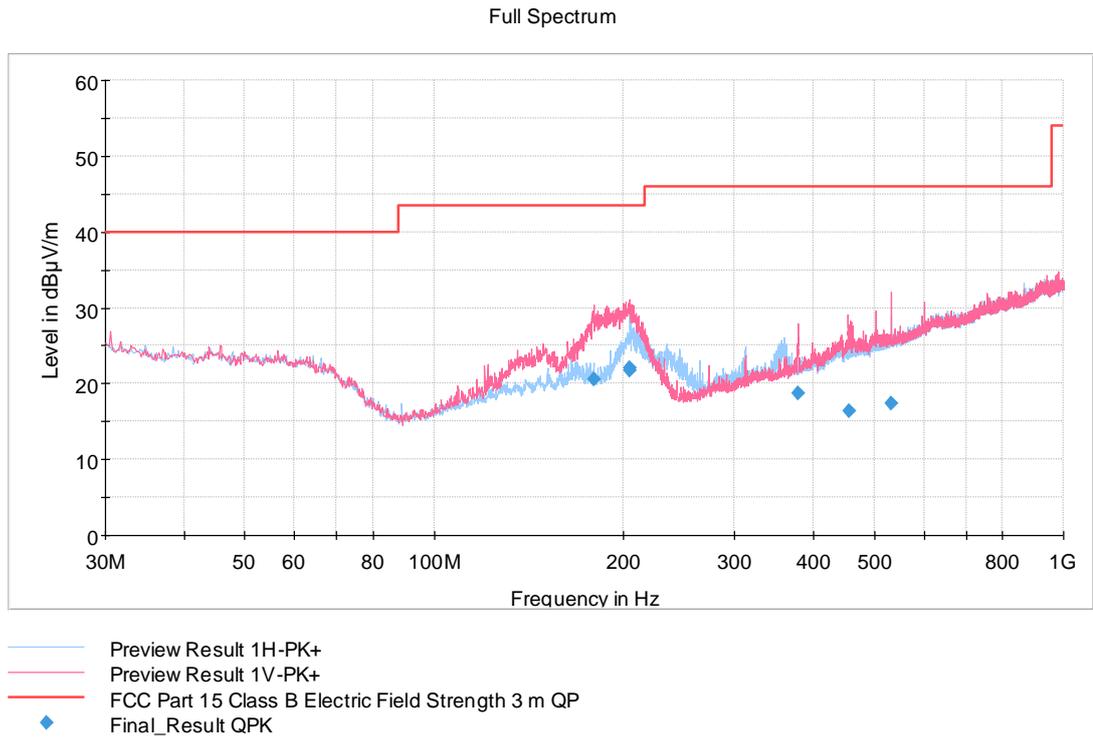


Figure 34: Unwanted Emissions, radiated 30 – 1000 MHz (1 Mbps, TX 2402 MHz)

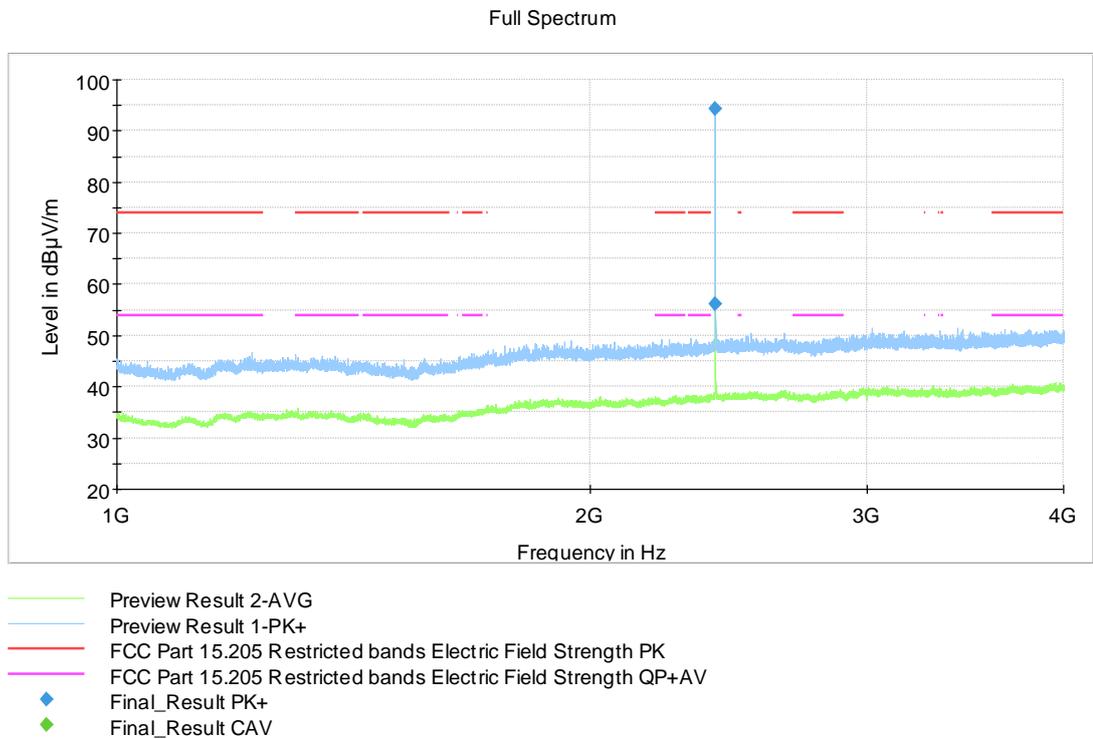


Figure 35: Unwanted Emissions, radiated 1 – 4 GHz (1 Mbps, TX 2402 MHz)

Unwanted Emissions (radiated)

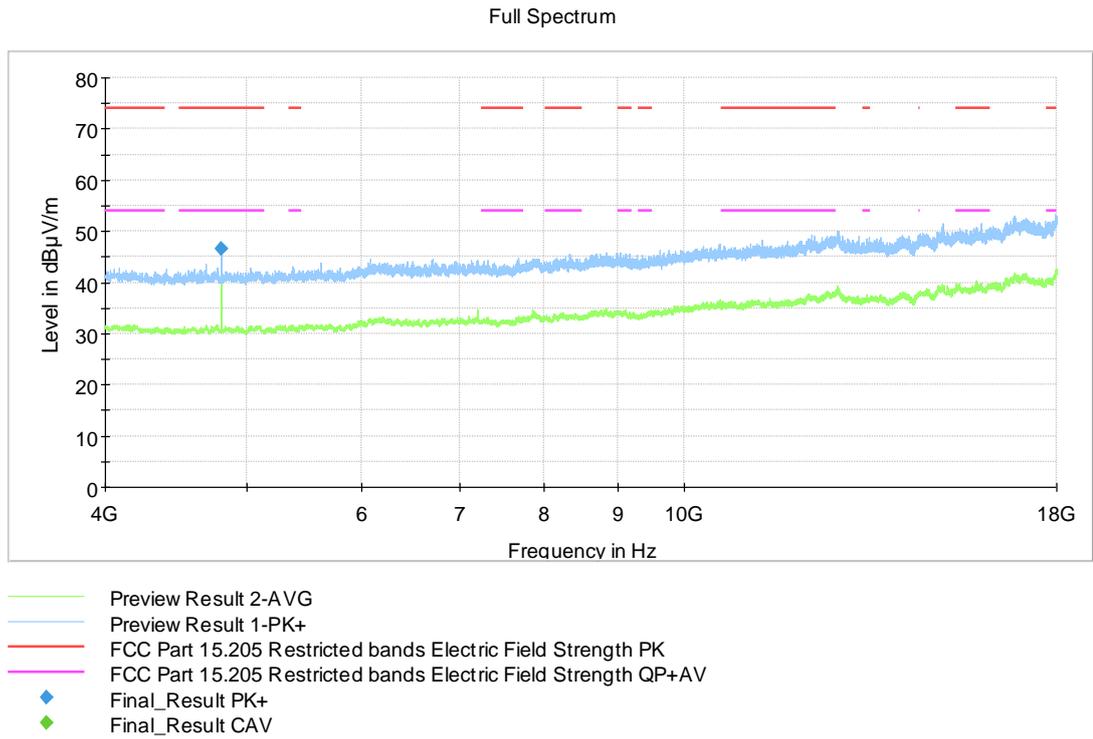


Figure 36: Unwanted Emissions, radiated 4 – 18 GHz (1 Mbps, TX 2402 MHz)

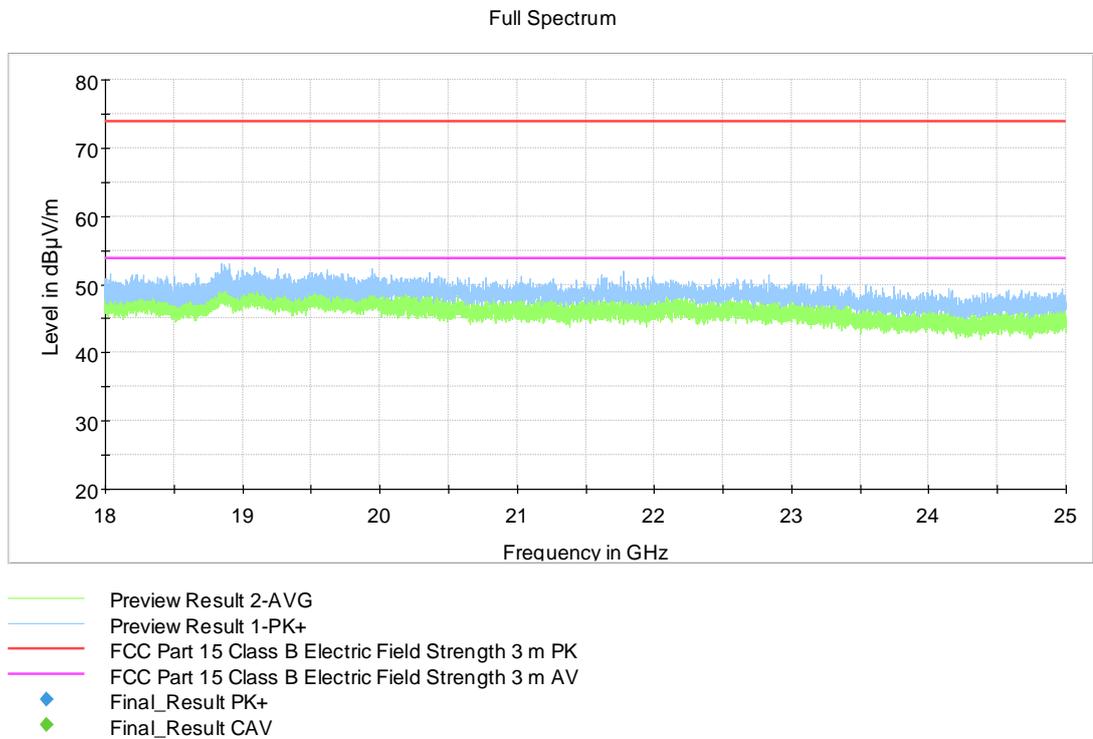


Figure 37: Unwanted Emissions, radiated 18 – 25 GHz (1 Mbps, TX 2402 MHz)

Test results (1 Mbps, TX 2440 MHz)

Table 8: Test results with quasi-peak detector (1 Mbps, TX 2440 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Angle *) (°)	Pol	Azimuth (deg)	Corr. (dB/m)
0.603000	-3.97	32.00	35.97	15 x 1000.0	9.000	90.0	V	205.0	-20.4

*) Measurement loop antenna angle

Table 9: Test results with peak detector (1 Mbps, TX 2440 MHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2439.700000	91.75	---	---	15 x 1000.0	1000.000	180.0	V	261.0	13.6
4879.400000	47.28	73.98	26.70	15 x 1000.0	1000.000	240.0	H	256.0	7.6
19640.200000	51.19	73.98	22.79	15 x 1000.0	1000.000	280.0	V	327.0	7.5

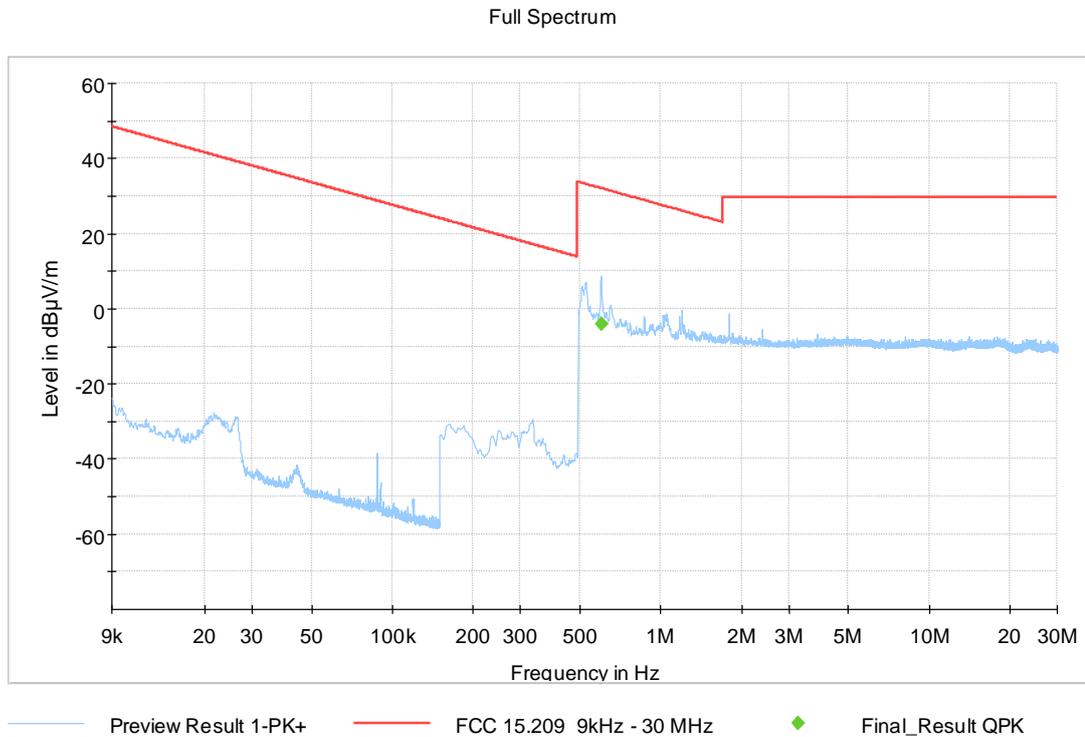


Figure 38: Unwanted Emissions, radiated 9 kHz – 30 MHz (1 Mbps, TX 2440 MHz)

Unwanted Emissions (radiated)

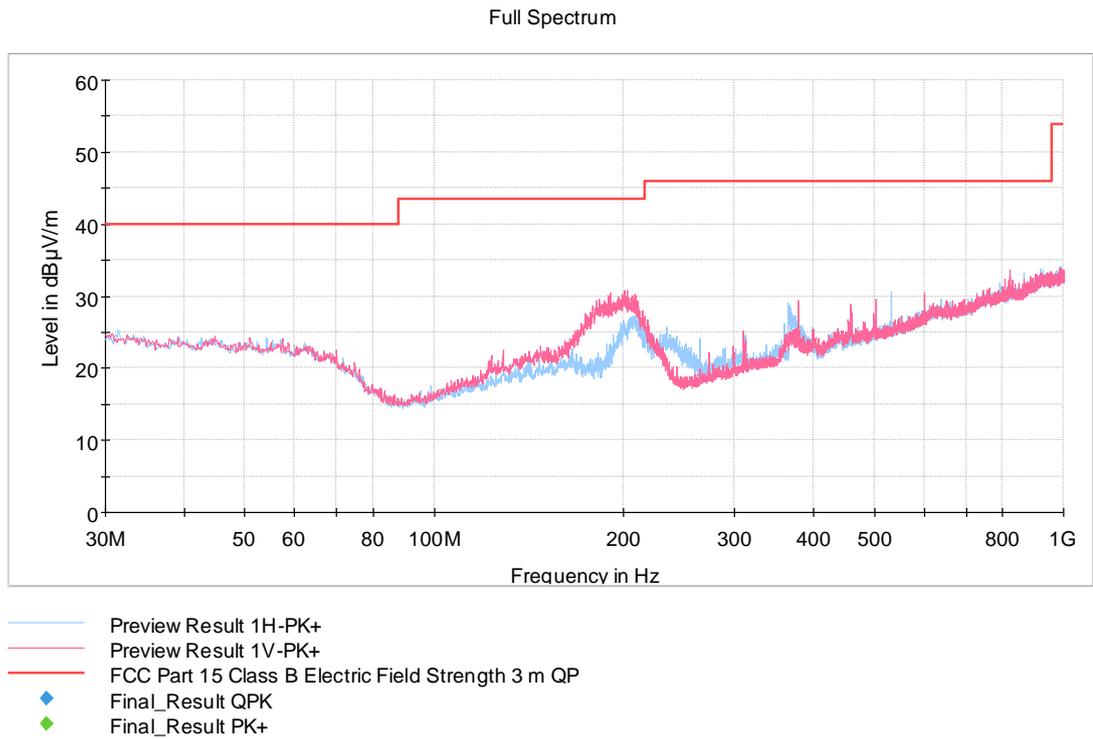


Figure 39: Unwanted Emissions, radiated 30 – 1000 MHz (1 Mbps, TX 2440 MHz)

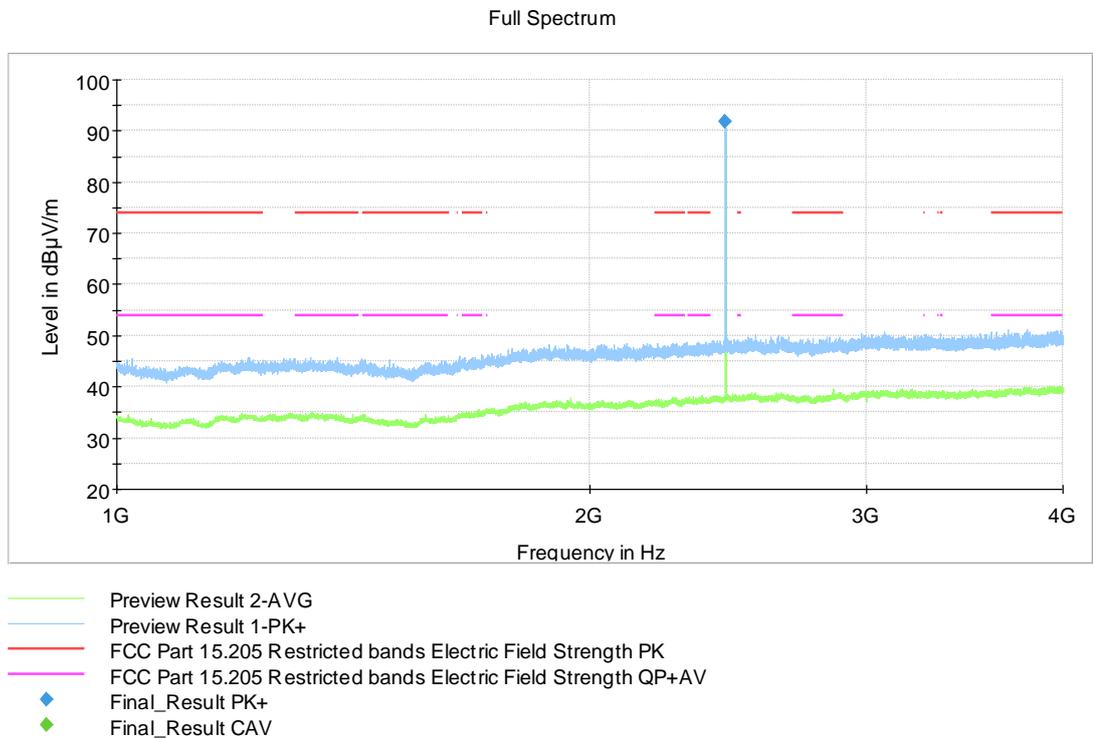


Figure 40: Unwanted Emissions, radiated 1 – 4 GHz (1 Mbps, TX 2440 MHz)

Unwanted Emissions (radiated)

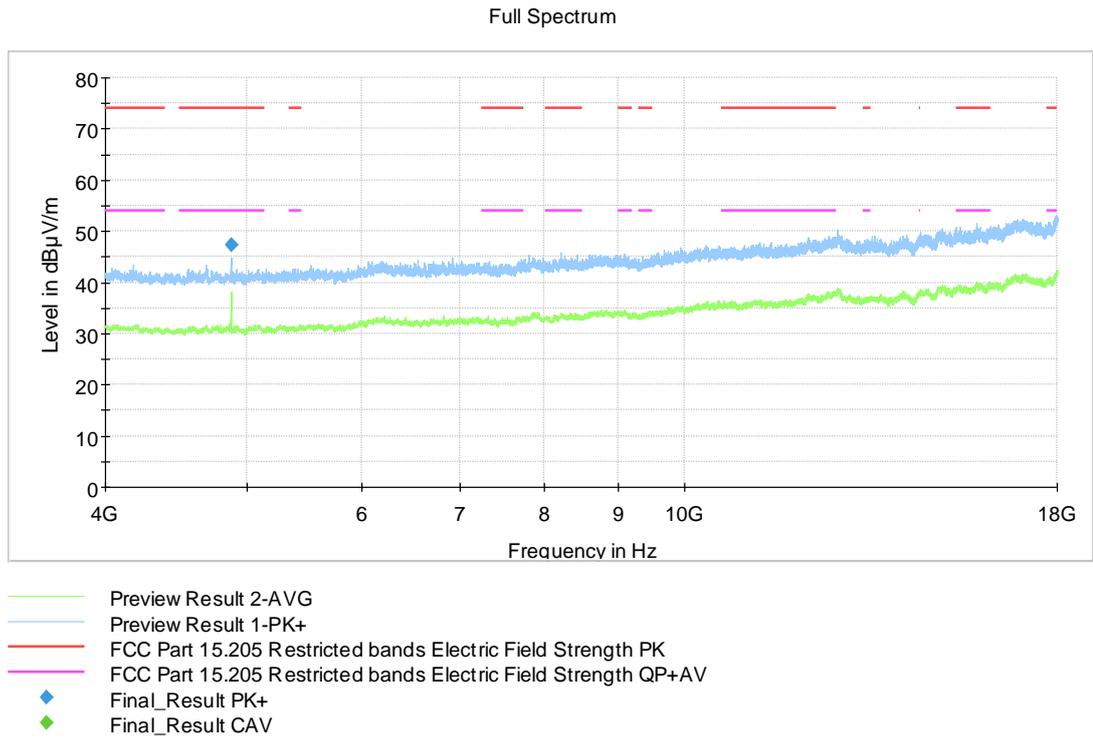


Figure 41: Unwanted Emissions, radiated 4 – 18 GHz (1 Mbps, TX 2440 MHz)

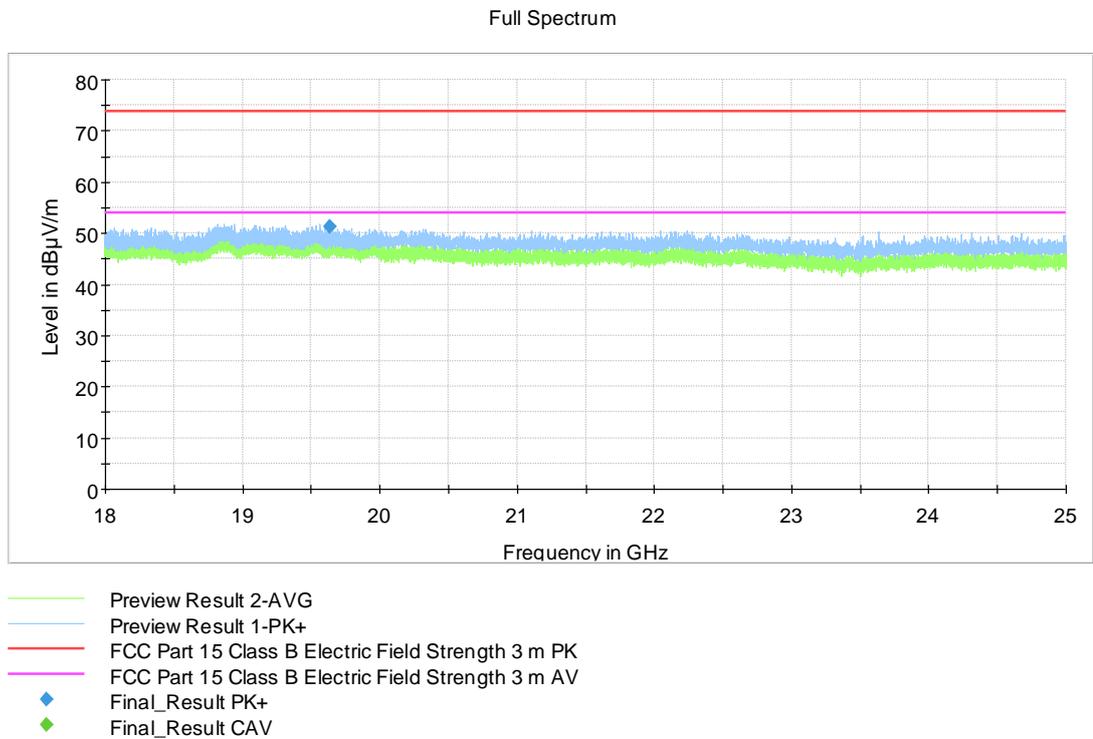


Figure 42: Unwanted Emissions, radiated 18 – 25 GHz (1 Mbps, TX 2440 MHz)

Unwanted Emissions (radiated)
Test results (1 Mbps, TX 2480 MHz)
Table 10: Test results with quasi-peak detector (1 Mbps, TX 2480 MHz)

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
202.395000	22.04	43.50	21.46	15 x 1000.0	120.000	105.0	V	3.0	15.2

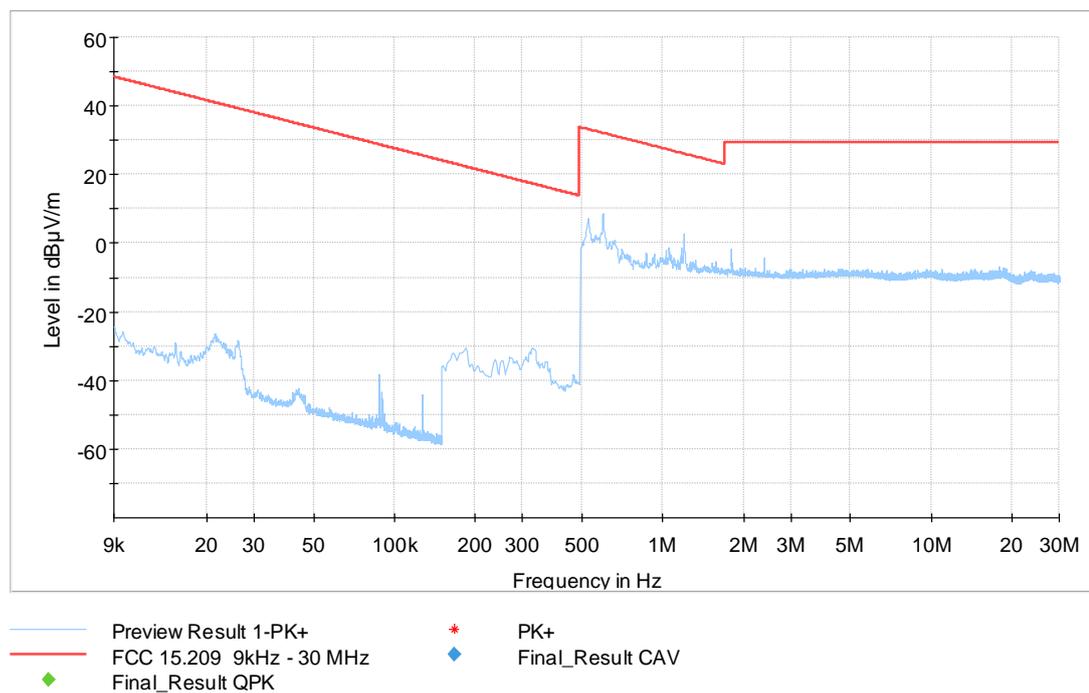
Table 11: Test results with average detector (1 Mbps, TX 2480 MHz)

Frequency (MHz)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19163.000000	38.82	53.98	15.16	15 x 1000.0	1000.000	400.0	H	24.0	7.9

Table 12: Test results with peak detector (1 Mbps, TX 2480 MHz)

Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2479.750000	90.42	---	---	15 x 1000.0	1000.000	228.0	V	92.0	13.7
2483.500000	50.28	73.98	23.70	15 x 1000.0	1000.000	320.0	V	94.0	13.8
4959.500000	48.32	73.98	25.66	15 x 1000.0	1000.000	263.0	H	256.0	7.4

Full Spectrum


Figure 43: Unwanted Emissions, radiated 9 kHz – 30 MHz (1 Mbps, TX 2480 MHz)

Unwanted Emissions (radiated)

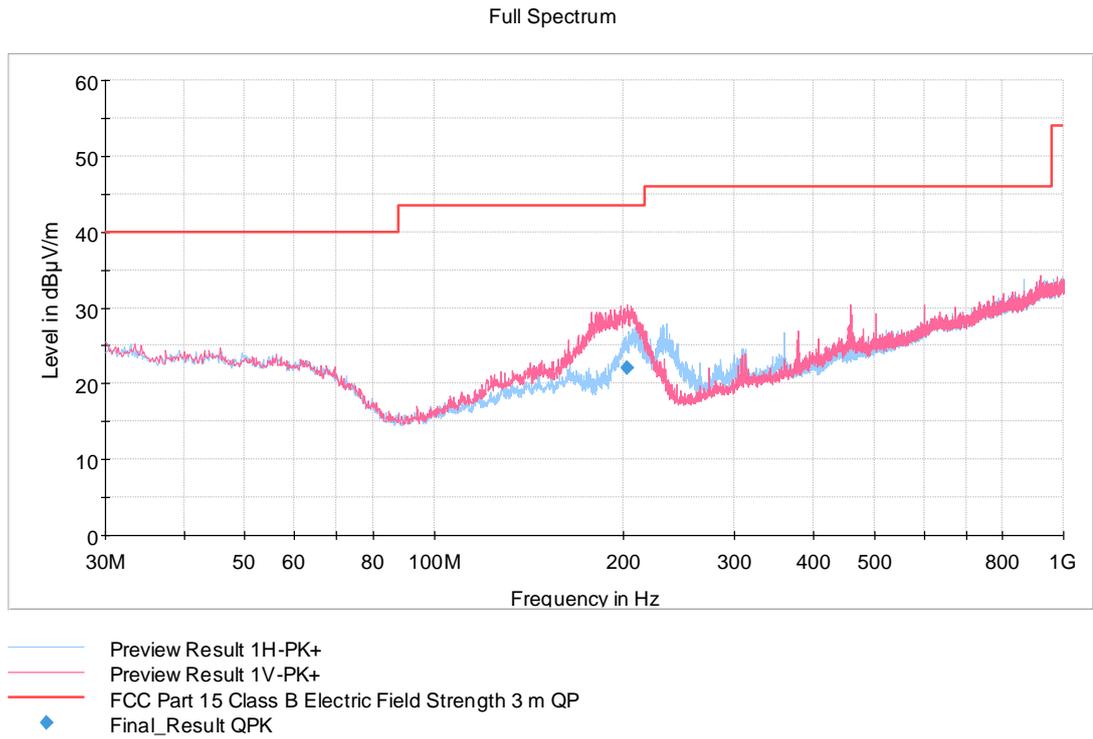


Figure 44: Unwanted Emissions, radiated 30 – 1000 MHz (1 Mbps, TX 2480 MHz)

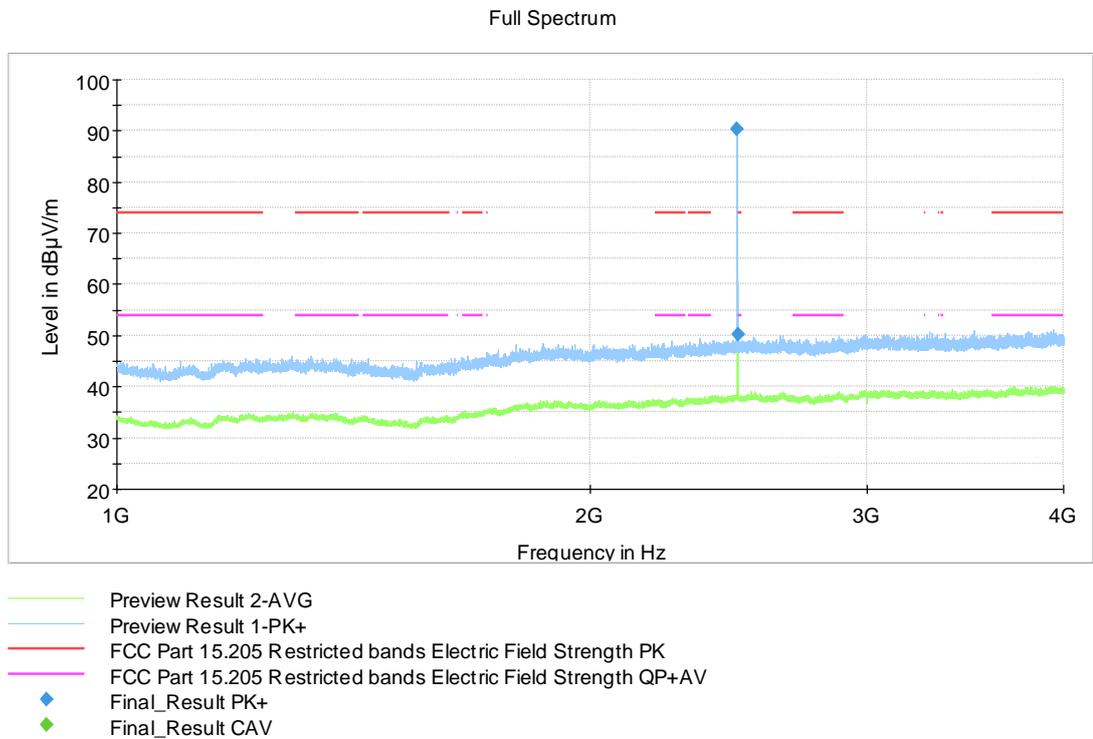


Figure 45: Unwanted Emissions, radiated 1 – 4 GHz (1 Mbps, TX 2480 MHz)

Unwanted Emissions (radiated)

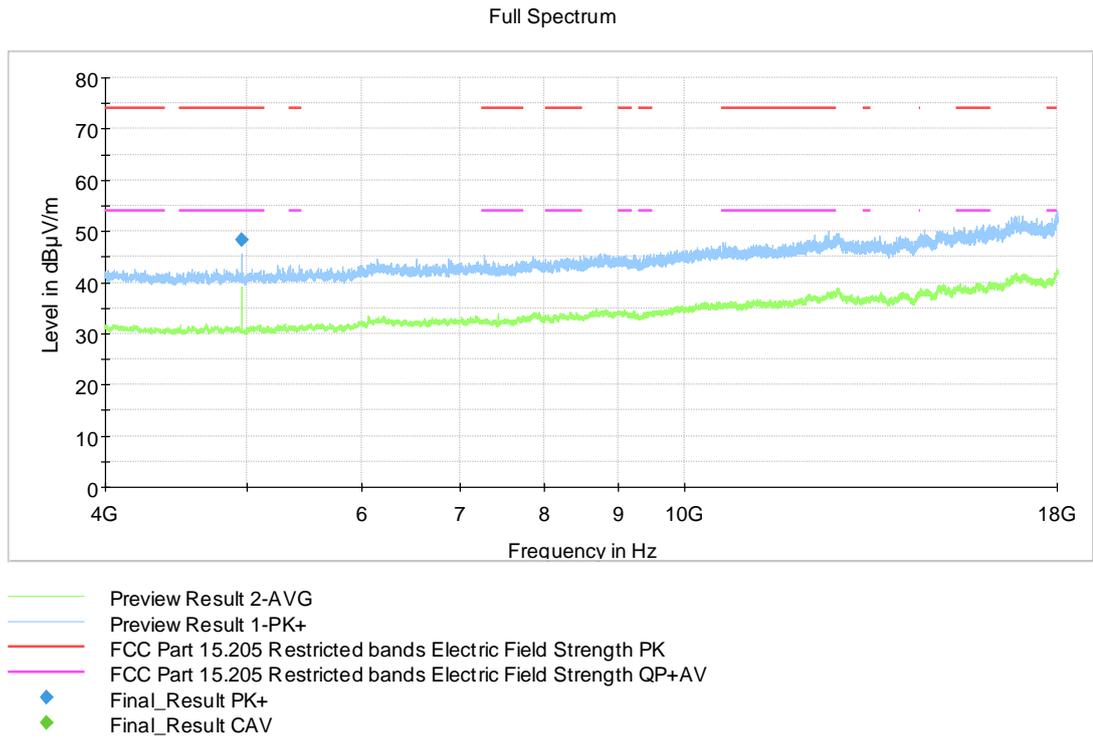


Figure 46: Unwanted Emissions, radiated 4 – 18 GHz (1 Mbps, TX 2480 MHz)

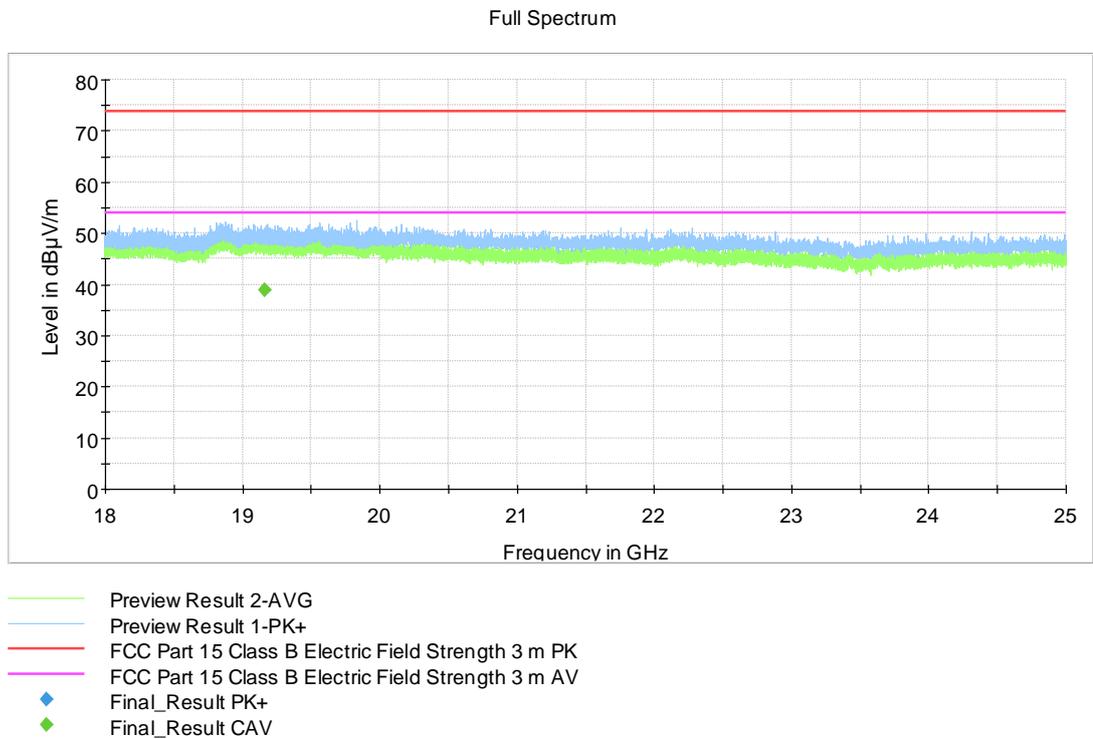


Figure 47: Unwanted Emissions, radiated 18 – 25 GHz (1 Mbps, TX 2480 MHz)

Power Spectral Density

Standard: ANSI C63.10-2013
Tested by: HEM
Date: 9 March 2023
Temperature: 22 °C
Humidity: 16 %RH
Test result: **PASS**

FCC §15.247(e) RSS-247 clause 5.2 b)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test results

Table 13: Test results for Power Spectral Density

Data rate	Frequency [MHz]	PSD [dBm/10 kHz]	Limit [dBm/3 kHz]	Result
1 Mbps	2402	-3.534	≤ 8	PASS
	2440	-3.202		PASS
	2480	-3.256		PASS
2 Mbps	2404	-6.383		PASS
	2440	-5.588		PASS
	2478	-5.686		PASS

Note: Compliance was determined in a 10 kHz band.

The conducted measurement was performed with a spectrum analyzer using the following settings:

Setting	Value
Span	3.000 MHz
RBW	10.000 kHz
VBW	30.000 kHz
Sweep Points	600
Sweep Time	3.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
Filter	3 dB
Trace Mode	Max Hold
Sweep Type	Sweep
Preamp	off

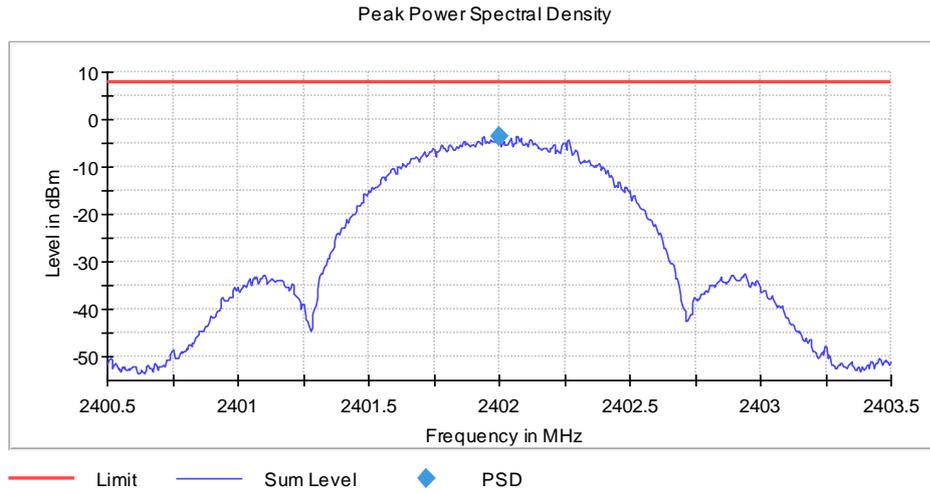


Figure 48: Power Spectral Density (1 Mbps, TX 2402 MHz)

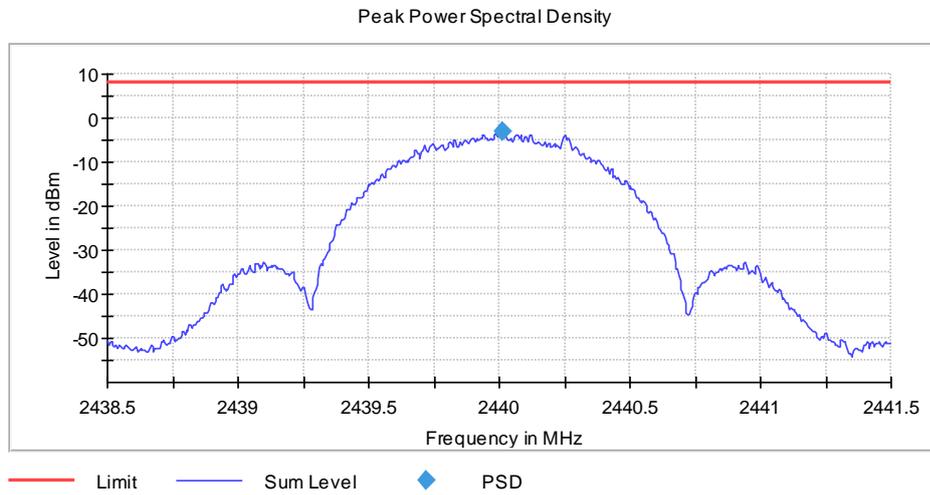


Figure 49: Power Spectral Density (1 Mbps, TX 2440 MHz)

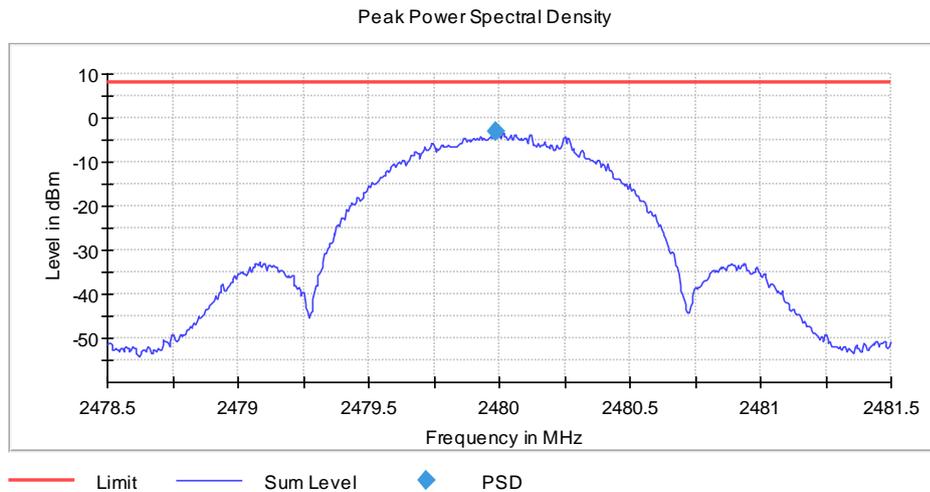


Figure 50: Power Spectral Density (1 Mbps, TX 2480 MHz)

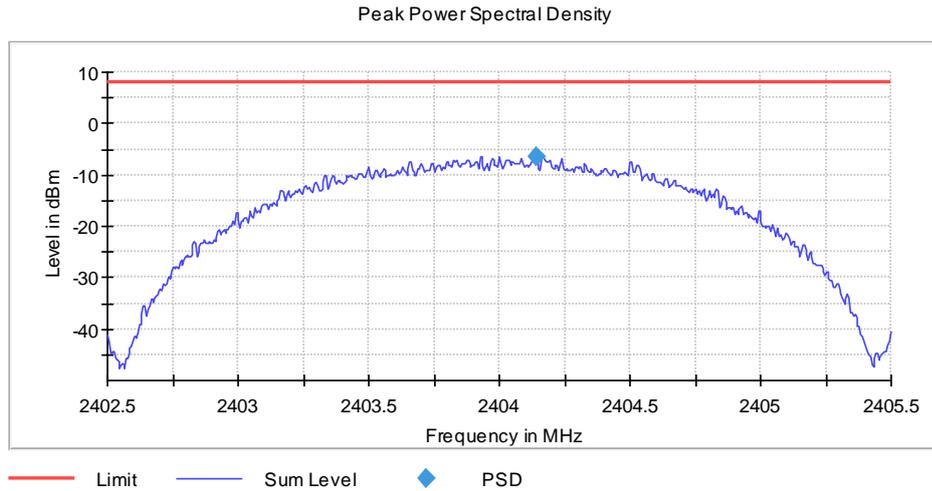


Figure 51: Power Spectral Density (2 Mbps, TX 2404 MHz)

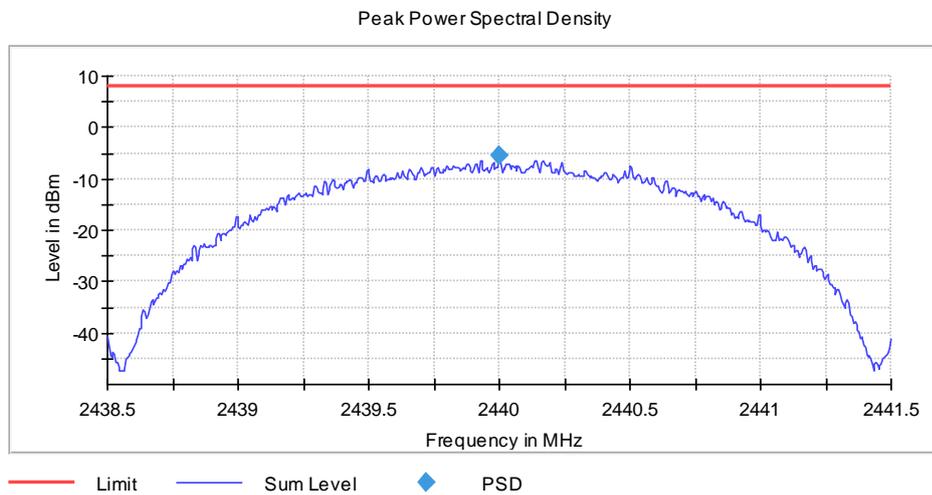


Figure 52: Power Spectral Density (2 Mbps, TX 2440 MHz)

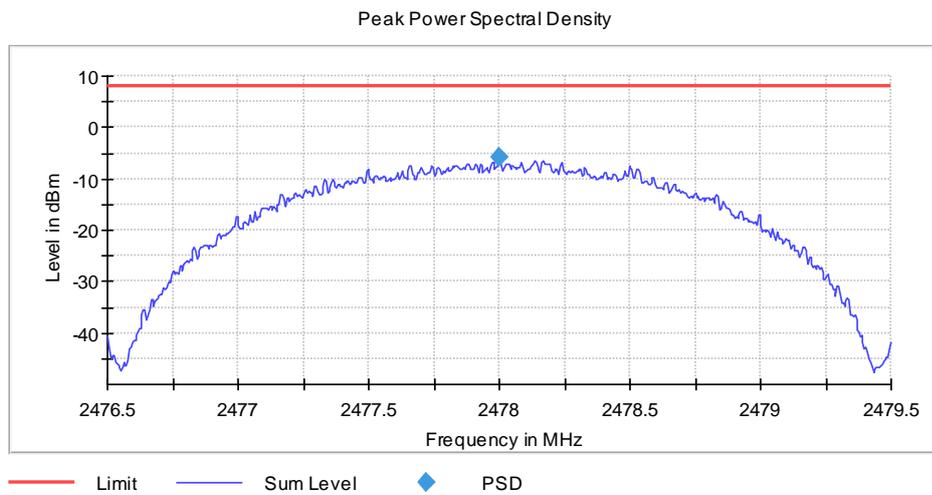


Figure 53: Power Spectral Density (2 Mbps, TX 2478 MHz)

TEST EQUIPMENT
AC Power-Line Conducted Emissions

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2022-06-20	2023-06-20
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2023-02-01	2024-02-01
POWER SUPPLY	CALIFORNIA INSTR.	15003i-400/3	inv. 9486	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-

Conducted RF Tests

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
OSP-B157W 8 PORT	ROHDE & SCHWARZ	OSP-B157W8	inv. 10883	2022-06-17	2023-06-17
OSP BASE UNIT	ROHDE & SCHWARZ	OSP 120	inv. 10882	2022-06-20	2023-06-20
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv. 10881	2022-06-21	2023-06-21
TEST SOFTWARE	ROHDE & SCHWARZ	WMS32	-	-	-

Unwanted Emissions (radiated)

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
ANTENNA	EMCO	3160-09	inv. 7294	2023-02-23	2024-02-23
ANTENNA	EMCO	3117	inv. 7293	2022-06-16	2024-06-16
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv. 8013	2022-10-25	2024-10-25
ANTENNA	SCHWARZBECK	VULB 9168	inv. 8911	2022-11-29	2024-11-29
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	NCR
ATTENUATOR	PASTERNAK	10 dB, DC-40 GHz	sn. A1	2021-04-20	2023-04-20
ATTENUATOR	PASTERNAK	PE 7004-4 (4dB)	inv. 10126	2021-03-30	2023-03-30
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2022-06-20	2023-06-20
FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv. 10403	2023-01-09	2025-01-09
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	NCR
RF PREAMPLIFIER	CIAO	CA1840-5019	inv. 10593	2022-09-21	2023-09-21
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2022-09-21	2023-09-21
TEST SOFTWARE	ROHDE & SCHWARZ	EMC32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	NCR

NCR = No Calibration Required

END OF REPORT