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Wireless test report – 392986-2TRFWL

Applicant:

Eurotech SpA

Product name:

DYGATE-20-30

Model:

DynaGATE-20-30-22

Model variant:

DynaGATE-20-30-00, DynaGATE-20-30-10, DynaGATE-20-30-20

FCC ID:

UKMDG2030

IC Registration number:

21442-DG2030

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247 (Partial test)

  Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz

- RSS-247, Issue 2, Feb 2017, Section 5 (Partial test)

  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

  5) Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz

Date of issue: July 07, 2020

Tested by (name, function and signature)	D. Guarnone	(project handler)	Signature:	Daniele Guarnone
Reviewed by (name, function and signature)	P. Barbieri	(verifier)	Signature:	Barbieri

Test location(s)

Company name	Nemko Spa
Address	Via del Carroccio, 4
City	Biassono
Province	MB
Postal code	20853
Country	Italy
Telephone	+39 039 220 12 01
Facsimile	+39 039 220 12 21
Website	www.nemko.com
Site number	FCC: 682159; IC: 9109A (10 m semi anechoic chamber)

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 contain in this report are within Nemko Spa ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Eurotech SpA
Address	Via Fratelli Solari 3/a 33020 Amaro, UD, Italy

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
RSS-247, Issue 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the fcc rules
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, Mar 2019, Amendment 1	General Requirements for Compliance of Radio Apparatus

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 1.5 below. 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 Exclusions

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
392986-2TRFWL	July 7, 2020	

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Table 2.1-1: FCC general requirements results

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

Notes: EUT is an AC powered device.

2.2 FCC Part 15 Subpart C, intentional radiators test results for frequency hopping spread spectrum systems

Table 2.2-1: FCC 15.247 results for FHSS

Part	Test description	Verdict
§15.247(a)(1)(i)	Requirements for operation in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Requirements for operation in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Requirements for operation in the 2400–2483.5 MHz band	Not applicable
§15.247(b)(1)	Maximum peak output power in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power in the 902–928 MHz band	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 FCC Part 15 Subpart C, intentional radiators test results for digital transmission systems (DTS)

Table 2.3-1: FCC 15.247 results for DTS

Part	Test description	Verdict
§15.247(a)(2)	Minimum 6 dB bandwidth	Not performed
§15.247(b)(3)	Maximum peak output power in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density	Not performed
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.4 ISED RSS-Gen, Issue 5, Amendment 1, test results

Table 2.4-1: RSS-Gen results

Part	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
8.8	AC power-line conducted emissions limits	Pass

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

2.5 ISED RSS-247, Issue 2, test results for frequency hopping spread spectrum systems (FHSS)

Table 2.5-1: RSS-247 results for FHSS

Part	Test description	Verdict
5.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
5.1 (b)	Minimum channel spacing	Not applicable
5.1 (c)	Systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (e)	Systems operating in the 5725–5850 MHz band	Not applicable
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (a)	Systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (c)	Systems operating in the 5725–5850 MHz	Not applicable
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Not applicable

Notes: None

2.6 ISED RSS-247, Issue 2, test results for digital transmission systems (DTS)

Table 2.6-1: RSS-247 results for DTS

Part	Test description	Verdict
5.2 (a)	Minimum 6 dB bandwidth	Not performed
5.2 (b)	Maximum power spectral density	Not performed
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (d)	Systems employing digital modulation techniques	Pass
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Pass
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	May 18, 2020
Nemko sample ID number	392986 sample 1/12 and sample 1/1

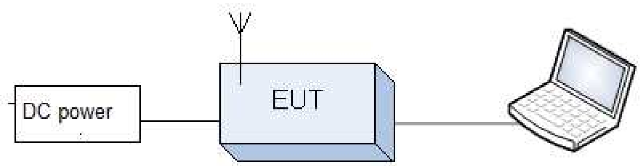
3.2 EUT information

Product name	DYGATE-20-30
Model	DynaGATE-20-30-22
Model variant	DynaGATE-20-30-00, DynaGATE-20-30-10, DynaGATE-20-30-20
Serial number	H120CRA0003, H120CRA0005

3.3 Technical information

RSS number and Issue number	RSS-247 Issue 2, Feb 2017
Frequency band	2400 to 2483.5 MHz
Frequency Min (MHz)	2412 (2402 BT)
Frequency Max (MHz)	2462 (2480 (BT)
RF power Min (W), Conducted	N/A
RF power Max (W), Conducted/ERP/EIRP	77.6 mW (18.9 dBm, measured @802.11n HT20, 2462 MHz, ch.1)
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	--
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	802.11 a/b/g/n
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, dBµV/m @3 m	63.88 (@17964 MHz)
Power requirements	24 $V_{DC,}$
Antenna information	The EUT uses a unique antenna coupling, peak gain = 1.7 dBi

3.4 EUT setup diagram



3.5 Product description and theory of operation

The DynaGATE 20-30 is an IoT Edge Gateway, E-Mark certified, that addresses the challenges of the next-generation applications for smart transportation and fleet management. It combines hardware, software and connectivity to bridge the vehicle with leading Cloud services. Based on the Intel® Atom™ x5 and x7 (E39xx) processor, with up to 8GB of ECC RAM and 32GB of eMMC, the DynaGATE 20-30 is a fanless, compact unit designed to exceed the requirements of automotive applications: it features extended operating temperature range, IP54 ingress protection, a wide range automotive power supply and a 6-axis sensor (accelerometer + gyroscope). It provides protected USB 2.0 and 3.0, one configurable RS-232/422/485, DI/DOs, and dual CAN bus interfaces - plus, a wide range of connectivity capabilities including two Gigabit Ethernet on M12, up to two LTE Cat 4/6 cellular modem, Wi-Fi, Bluetooth Low Energy, and a GPS with Untethered Dead Reckoning; two mPCIe and one M.2 slots can be reconfigured to host custom expansions and peripherals (Factory Option). Sophisticated power saving and management capabilities include: power monitoring, Wake-On-Ring/SMS and Wake-On-RTC.
Radio modules:

WiFi-Bluetooth module Eurotech DG2030

GPS module, U45 U-BLOX, NEO-M8U-0-10

LTE module: QUECTEL, EG25-G

3.6 EUT sub assemblies

Table 3.6-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number

3.7 EUT exercise details

EUT was set to continuously transmit mode during tests, by test software provided by client.
The EUT runs a Linux operating system which allows for the testing to be performed using engineering test tools and scripts. Communication with the EUT is via a serial console or Ethernet connection which provides a Linux command line interface for execution of the test tools/scripts. These tools/scripts configure the radio modules to enable continuous transmission with the ability to adjust modulation, frequency and output power as required.

Linux operating system version: 4.9.57-eurotech-ti.

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

The EUT has three WIFI 2.4 GHz standard; 802.11b standard is chosen to be the representative worst-case due to higher output power.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

In the laboratory, the following ambient conditions are respected for each test reported below:

Temperature	18 – 33 °C
Relative humidity	25 – 70 %
Air pressure	860 – 1060 mbar

The following instruments are used to monitor the environmental conditions:

Equipment	Manufacturer	Model no.	Asset no.	Cal date	Next cal.
Thermo-hygrometer data loggers	Testo	175-H2	20012380/305	2019-01	2021-01
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	2019-01	2021-01
Barometer	Castle	GPB 3300	072015	2019-12	2020-12

5.2 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 6. Measurement uncertainty

6.1 Uncertainty of measurement

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002.

The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:

P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.

F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.

Hereafter Nemko's measurement uncertainties are reported:

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001 MHz ÷ 40 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	0.009 MHz ÷ 30 MHz	1.1 dB	(1)
			30 MHz ÷ 18 GHz	1.5 dB	(1)
			18 MHz ÷ 40 GHz	3.0 dB	(1)
			40 MHz ÷ 140 GHz	5.0 dB	(1)
		Adjacent channel power	1 MHz ÷ 18 GHz	1.4 dB	(1)
		Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)
		Intermodulation attenuation	1 MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1 MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1 MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001 MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001 MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01 MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Effective radiated power transmitter	10 kHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Receiver	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Sensitivity measurement	1 MHz ÷ 18 GHz	6.0 dB	(1)
	Conducted	Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)

NOTES:
(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %

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.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	2020-01	2021-01
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESW44	101620	2019-08	2020-08
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	2018-07	2021-07
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	2018-07	2021-07
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	2019-09	2020-09
Horn antenna (18 ÷ 40 GHz)	A.H. System	SAS-574	558	2020-01	2023-01
Preamplifier (18 ÷ 40 GHz)	Miteq	JS44-18004000-35-8P-R	1.627	2019-09	2020-09
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	2019-09	2021-09
Shielded room	Siemens	10m control room	1947	NCR	NCR
LISN three phase (9 kHz ÷30 MHz)	Rohde & Schwarz	ESH2-Z5	872 460/041	2019-09	2020-09
Shielded room	Siemens	Conducted emission test room	1862	NCR	NCR

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.31(e) Variation of power source

8.1.1 Definitions and limits

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 date

Start date	April 9, 2020

8.1.3 Observations, settings and special notes

None

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 FCC 15.31(m) and RSS-Gen 6.9 Number of frequencies

8.2.1 Definitions and limits

FCC:
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.

ISED:
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

Note: “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 date

Start date	April 9, 2020

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

Table 8.2-1: Test channels selection

Modulation	Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
BT	2400	2483.5	83.5	2402	2441	2480
BLE	2400	2483.5	83.5	2402	2441	2480

Table 8.2-2: Test channels selection

Modulation	Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
wifi 802.11 a/b/g/n	2400	2483.5	83.5	2412	2437	2462
wifi 802.11 anHT40	2400	2483.5	83.5	2422	2437	2452

8.3 FCC 15.203 and RSS-Gen, section 6.8 Antenna requirement

8.3.1 Definitions and limits

FCC:
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.

ISED:
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 date

Start date	April 9, 2020

8.3.3 Observations, settings and special notes

None

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

8.4 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.4.1 Definitions and limits

FCC:
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.

IC:
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 8.4-1: 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.

8.4.2 Test date

Start date	June 04, 2020

8.4.3 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.

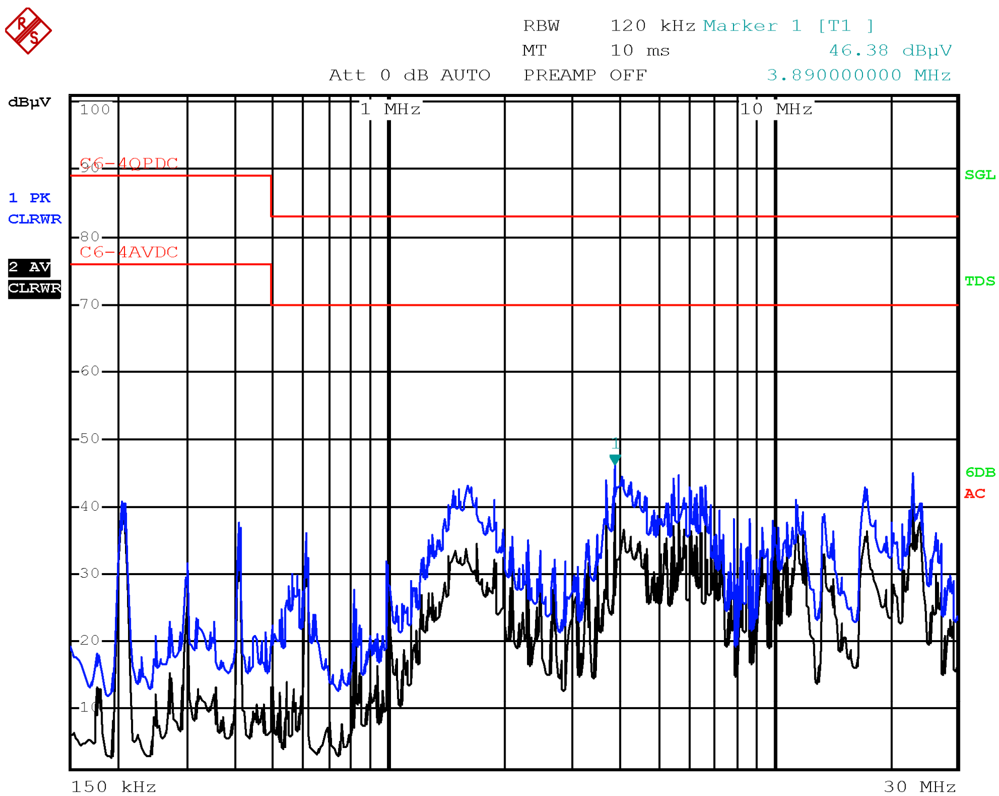
Receiver settings for preview measurements:

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

8.4.4 Test data



Plot 8.4-1: Conducted emissions on phase line

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
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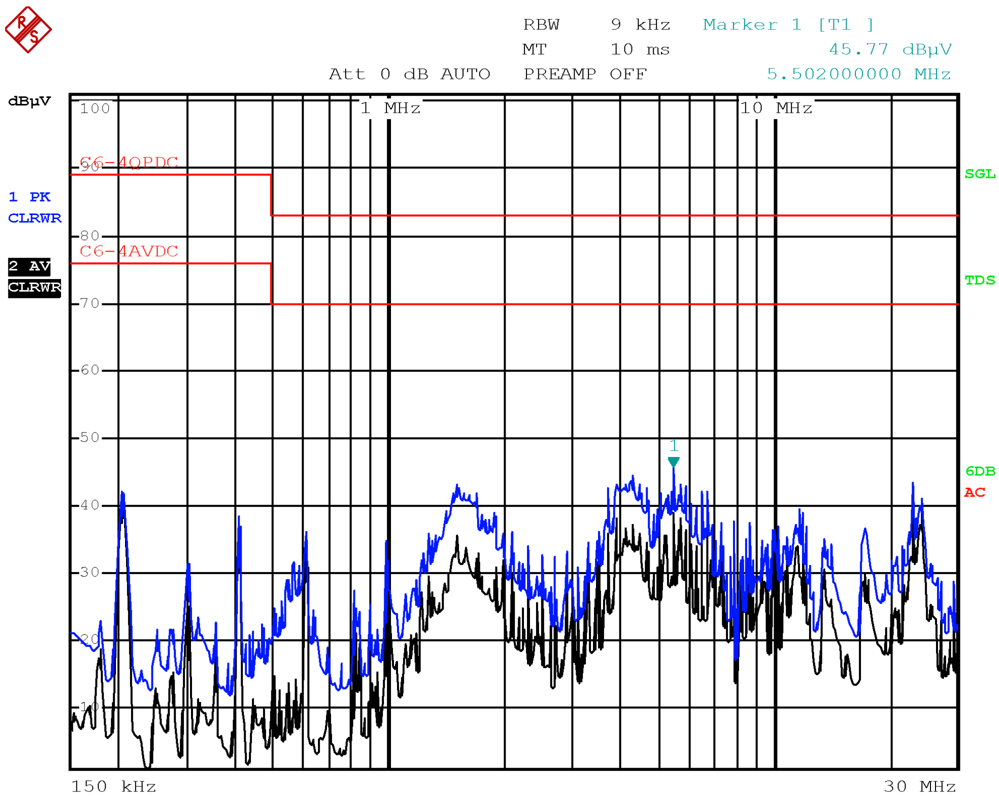

Plot 8.4-2: Conducted emissions on neutral line

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
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8.5 FCC 15.247(b) and RSS-247 5.4 (d) Transmitter output power and e.i.r.p. requirements for DTS in 2.4 GHz

8.5.1 Definitions and limits

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 2400–2483.5 MHz band: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.
(1) Fixed point-to-point operation:
(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.
(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.
(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:
(i) Different information must be transmitted to each receiver.
(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:
(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.
(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.
(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.
(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

ISED:
d. For DTSs employing digital modulation techniques operating in the 2400–2483.5 MHz band, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.
e. Fixed point-to-point systems in the 2400–2483.5 MHz band are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.
f. Transmitters operating in the band 2400–2483.5 MHz, may employ antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i Different information must be transmitted to each receiver.
ii If the transmitter employs an antenna system that emits multiple directional beams, but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc., and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4(b) and 5.4(d). However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.
iii If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4(b) and 5.4(d). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4(b) and 5.4(d). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4(b) and 5.4(d) by more than 8 dB.
iv Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4(b), 5.4(d) and 5.4(e).

8.5.1 Test date

Start date	June 03, 2020

8.5.2 Observations, settings and special notes

The test was performed using Integrated band power method. Tests were performed with highest and lowest data rates, only the worst cases were presented.

8.5.3 Test data

Output power measurements results SINGLE CHAIN

Modulation	Frequency,	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP,	EIRP limit,	EIRP margin, dB
	MHz	Measured	Limit			dBm	dBm	
802.11b, 1 Mbps, single chain	2412	17.48	30	-12.52	1.7	19.18	36	-16.82
	2437	16.99	30	-13.01	1.7	18.69	36	-17.31
	2462	17.77	30	-12.23	1.7	19.47	36	-16.53

Modulation	Frequency,	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP,	EIRP limit,	EIRP margin, dB
	MHz	Measured	Limit			dBm	dBm	
802.11g, 6 Mbps, single chain	2412	16.33	30	-13.67	1.7	18.03	36	-17.97
	2437	16.33	30	-13.67	1.7	18.03	36	-17.97
	2462	17.16	30	-12.84	1.7	18.86	36	-17.14

Output power measurements results Multiple chain

Calculation:

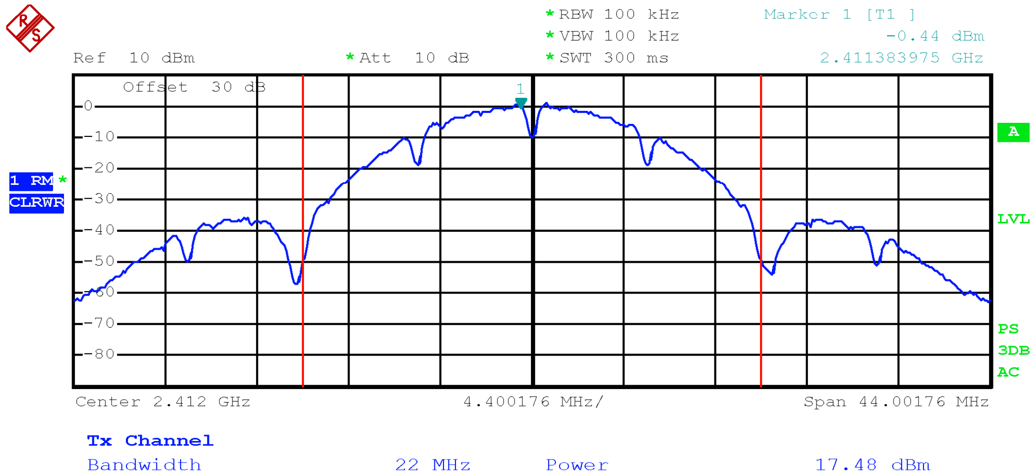
- Measured ch.0: 16.5 dBm = 44.7 mW
- Measured ch.1: 18.7 dBm = 74.1 mW
- Sum ch.0 + ch.1 = 44.7 mW + 74.1 mW = 118.8 mW → 20.7 dBm

Modulation	Frequency, MHz	Conducted output power, dBm				Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured ch 0	Measured ch1	Sum ch0 + ch1	Limit					
802.11b, 1 Mbps	2412	16.5	18.7	20.7	30.0	-9.3	1.7	22.4	36.0	-13.6
multiple chain	2437	16.7	18.0	20.4	30.0	-9.6	1.7	22.1	37.0	-14.9
	2462	17.0	18.8	21.0	30.0	-9.0	1.7	22.7	38.0	-15.3

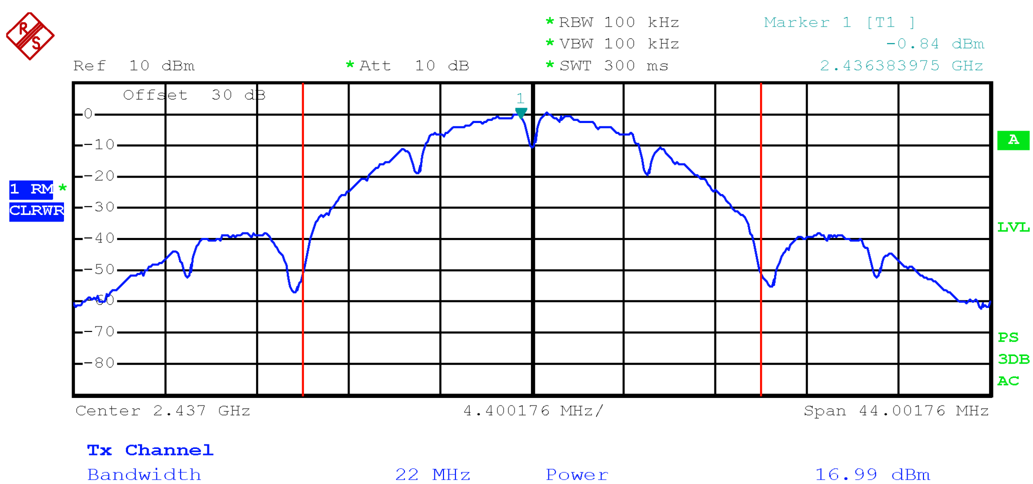
Modulation	Frequency, MHz	Conducted output power, dBm				Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured ch 0	Measured ch1	Sum ch0 + ch1	Limit					
802.11g, 6 Mbps	2412	16.7	17.7	20.2	30.0	-9.8	1.7	21.9	36.0	-14.1
multiple chain	2437	15.4	17.9	19.8	30.0	-10.2	1.7	21.5	37.0	-15.5
	2462	17.0	17.7	20.4	30.0	-9.6	1.7	22.1	38.0	-15.9

Modulation	Frequency, MHz	Conducted output power, dBm				Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured ch 0	Measured ch1	Sum ch0 + ch1	Limit					
802.11 Nht20	2412	16.9	18.3	20.7	30.0	-9.3	1.7	22.4	36.0	-13.6
multiple chain	2437	16.2	18.5	20.5	30.0	-9.5	1.7	22.2	37.0	-14.8
	2462	17.2	18.9	21.1	30.0	-8.9	1.7	22.8	38.0	-15.2

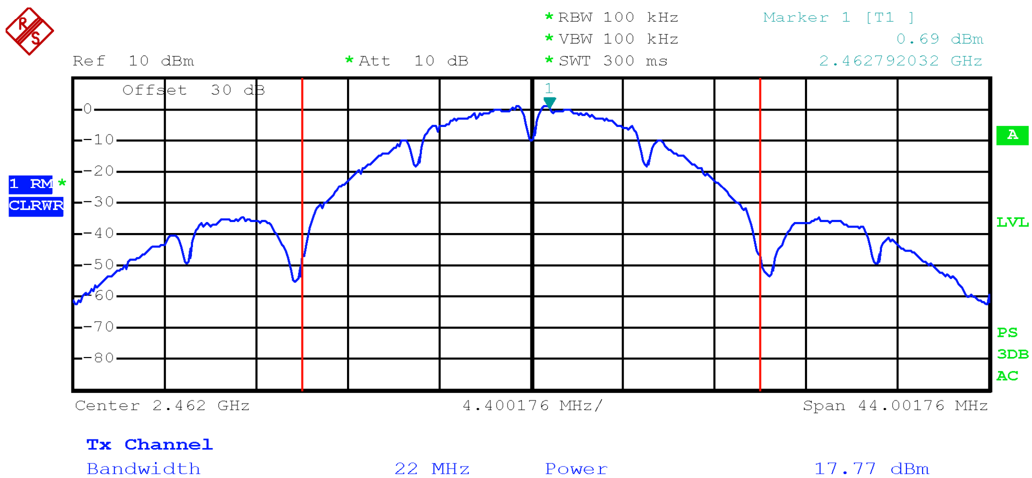
Modulation	Frequency, MHz	Conducted output power, dBm				Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured ch 0	Measured ch1	Sum ch0 + ch1	Limit					
802.11 nHT40	2422	16.4	15.5	19.0	30.0	-11.0	1.7	20.7	36.0	-15.3
multiple chain	2437	16.4	18.1	20.4	30.0	-9.6	1.7	22.1	37.0	-14.9
	2452	17.2	18.5	20.9	30.0	-9.1	1.7	22.6	38.0	-15.4



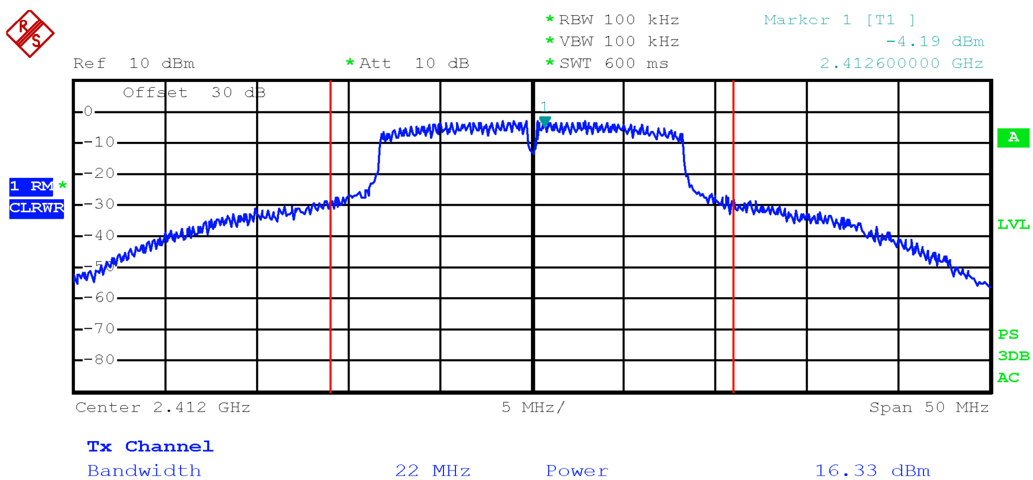
Output power TX 2412 MHz, 802.11b, 1 Mbps, single chain



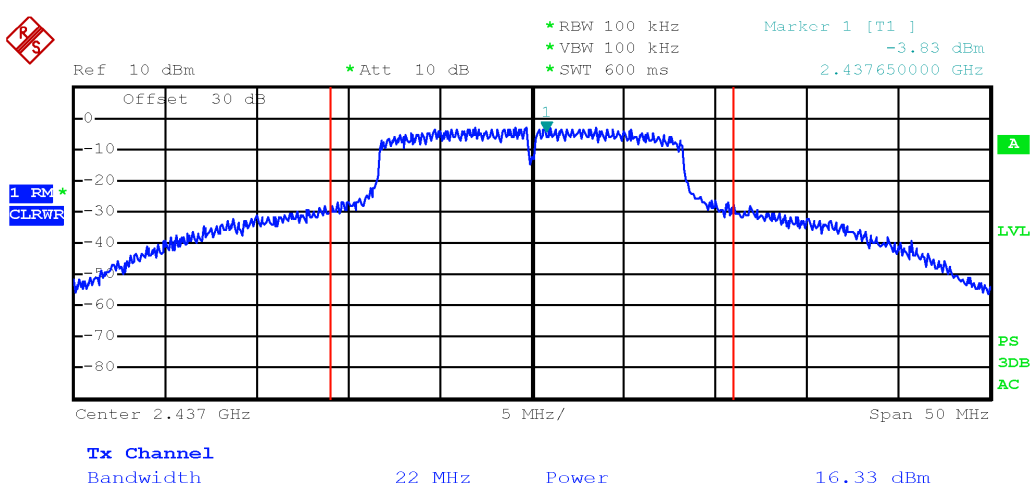
Output power TX 2437 MHz, 802.11b, 1 Mbps, single chain



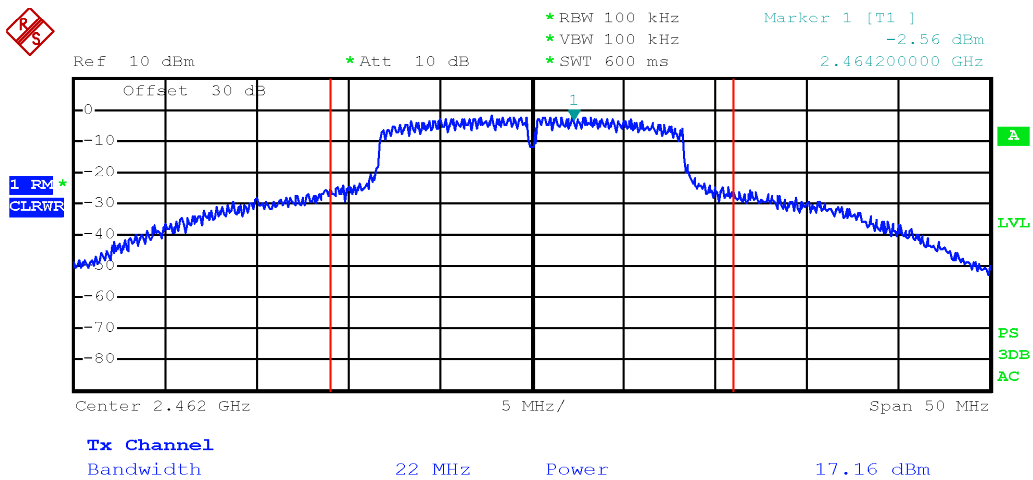
Output power TX 2462 MHz, 802.11b, 1 Mbps, single chain



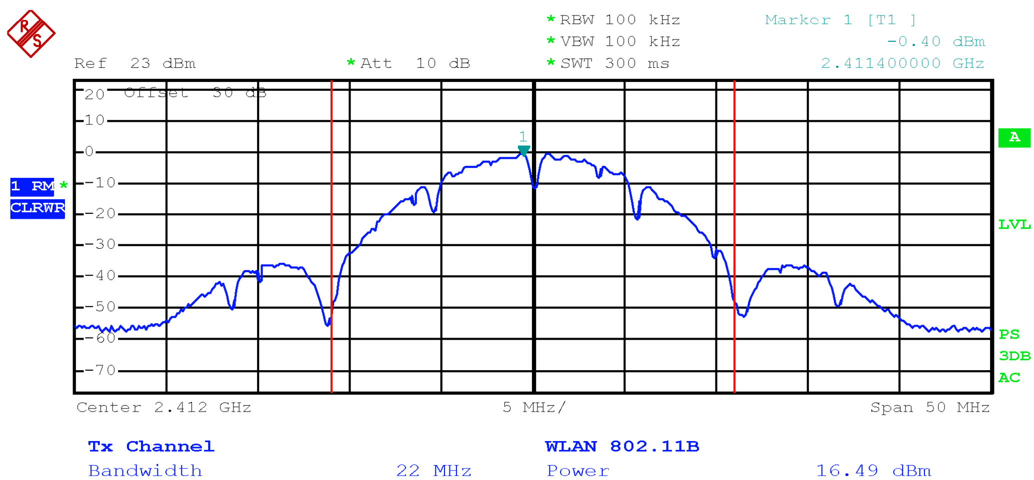
Output power TX 2412 MHz, 802.11g, 6 Mbps, single chain



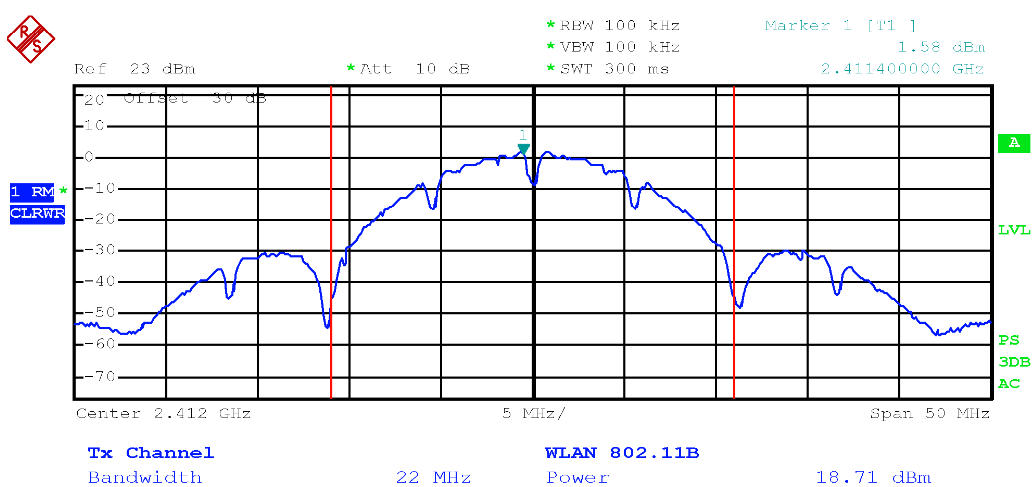
Output power TX 2437MHz, 802.11g, 6 Mbps, single chain



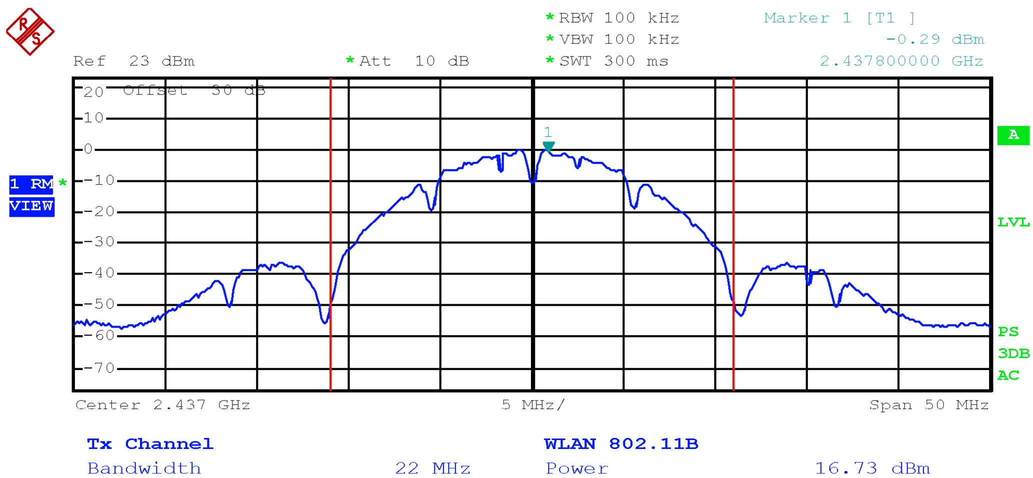
Output power TX 2462MHz, 802.11g, 6 Mbps, single chain



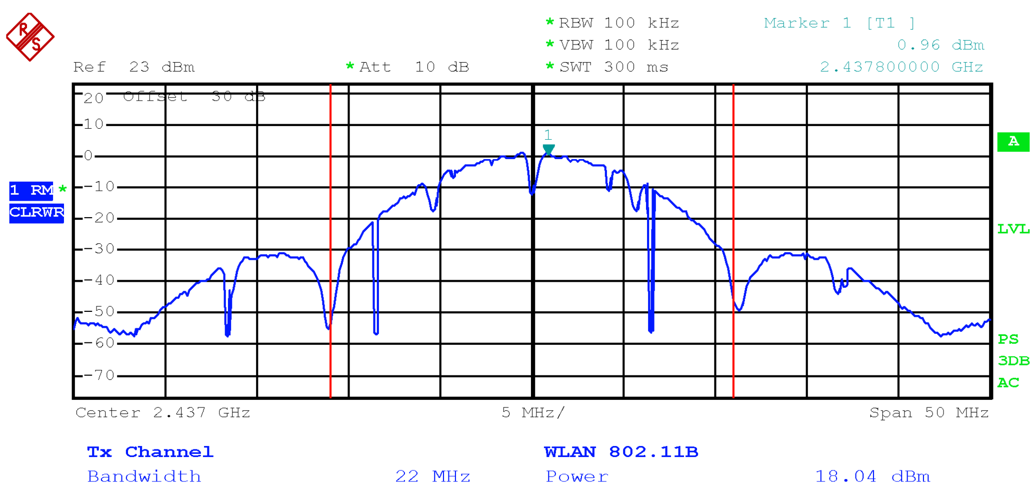
Output power TX 2412 MHz, 802.11b, 1 Mbps, multiple chain, chain 0



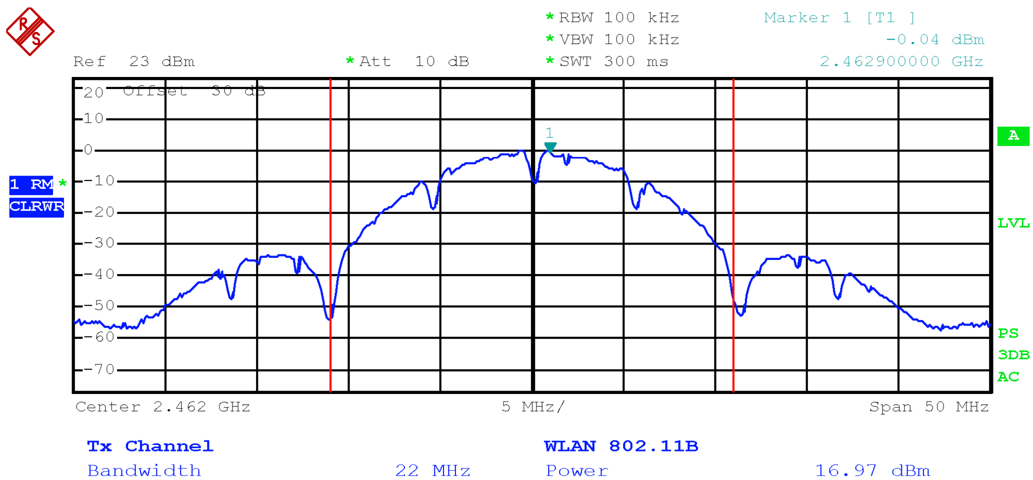
Output power TX 2412 MHz, 802.11b, 1 Mbps, multiple chain, chain 1



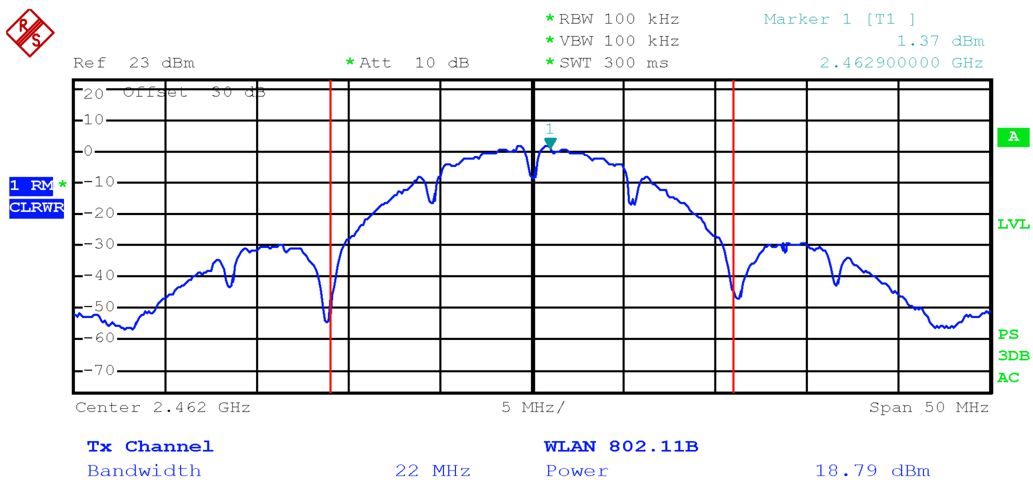
Output power TX 2437MHz, 802.11b, 1 Mbps, multiple chain, chain 0



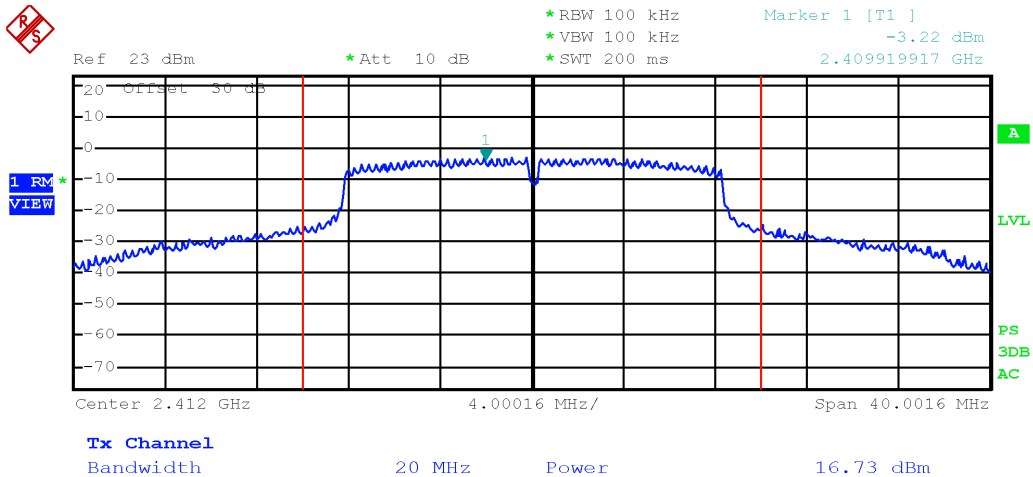
Output power TX 2437MHz, 802.11b, 1 Mbps, multiple chain, chain 1



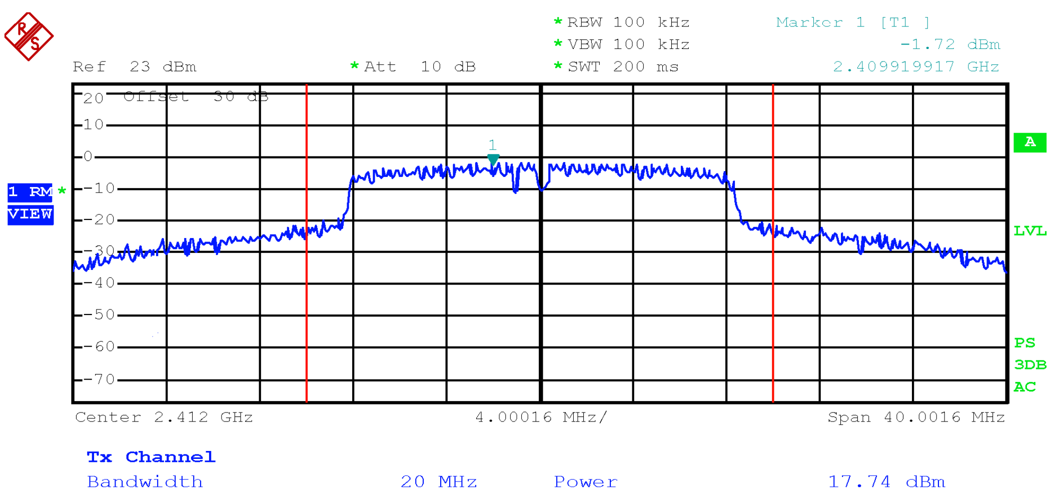
Output power TX 2462 MHz, 802.11b, 1 Mbps, multiple chain, chain 0



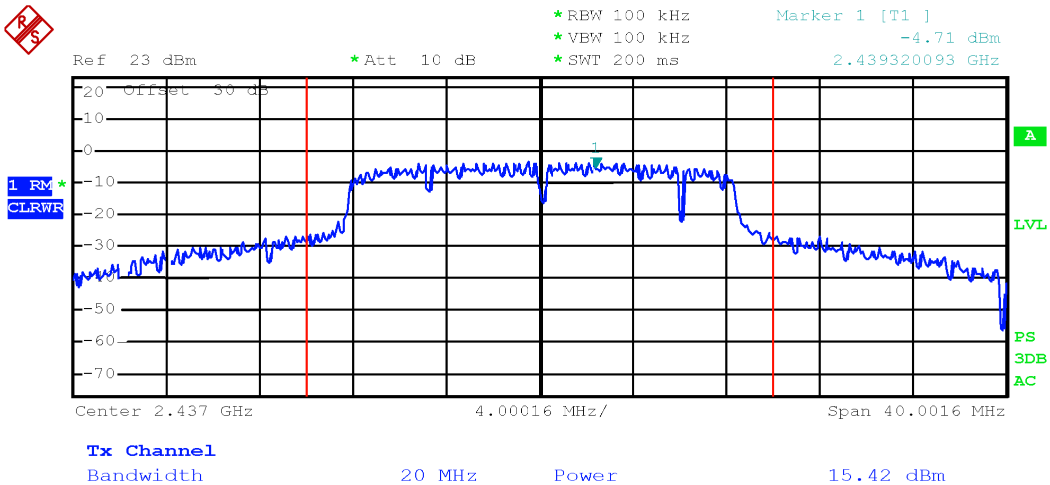
Output power TX 2462 MHz, 802.11b, 1 Mbps, multiple chain, chain 1



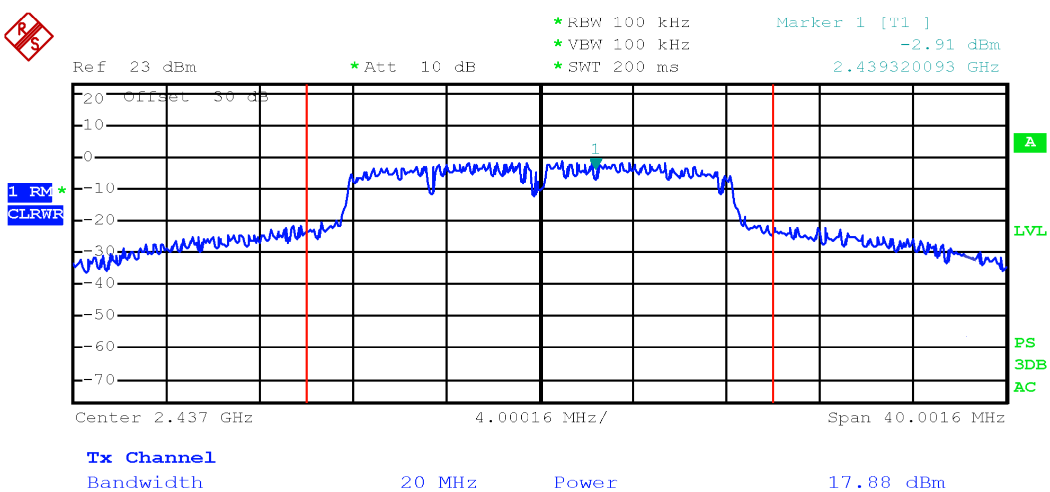
Output power TX 2412 MHz, 802.11g, 6 Mbps, multiple chain, chain 0



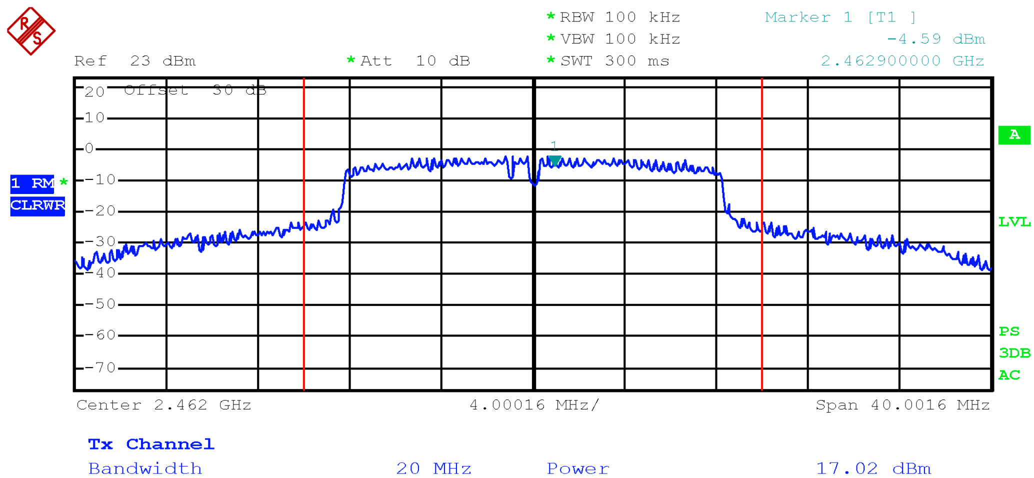
Output power TX 2412 MHz, 802.11g, 6 Mbps, multiple chain, chain 1



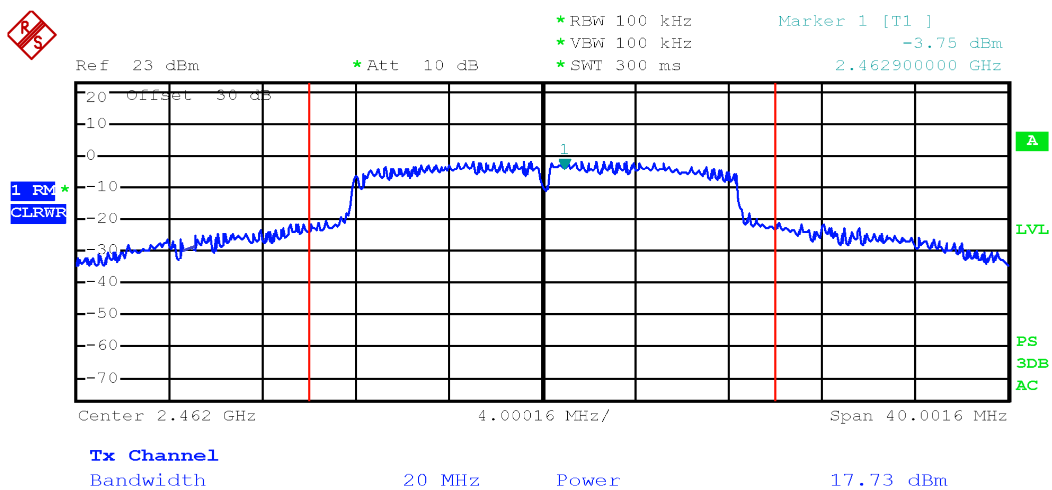
Output power TX 2437MHz, 802.11g, 6 Mbps, multiple chain, chain 0



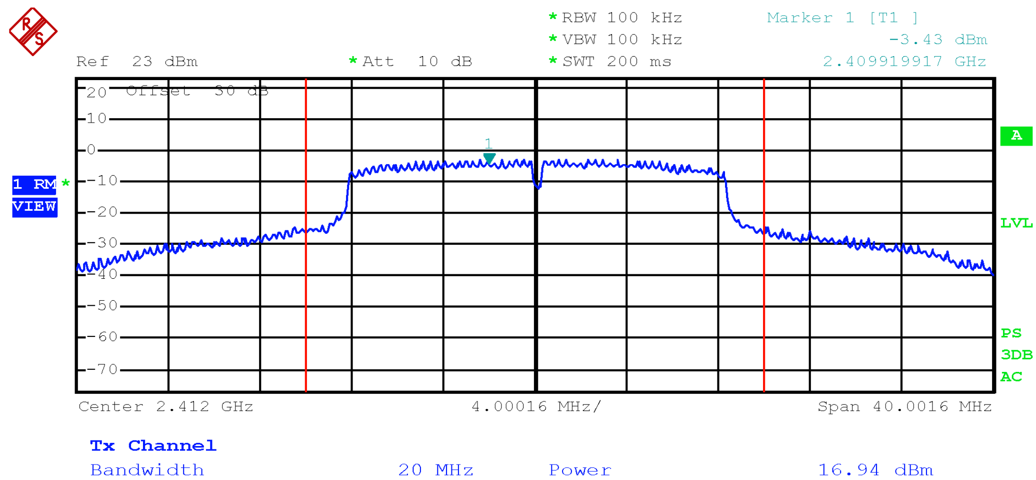
Output power TX 2437MHz, 802.11g, 6 Mbps, multiple chain, chain 1



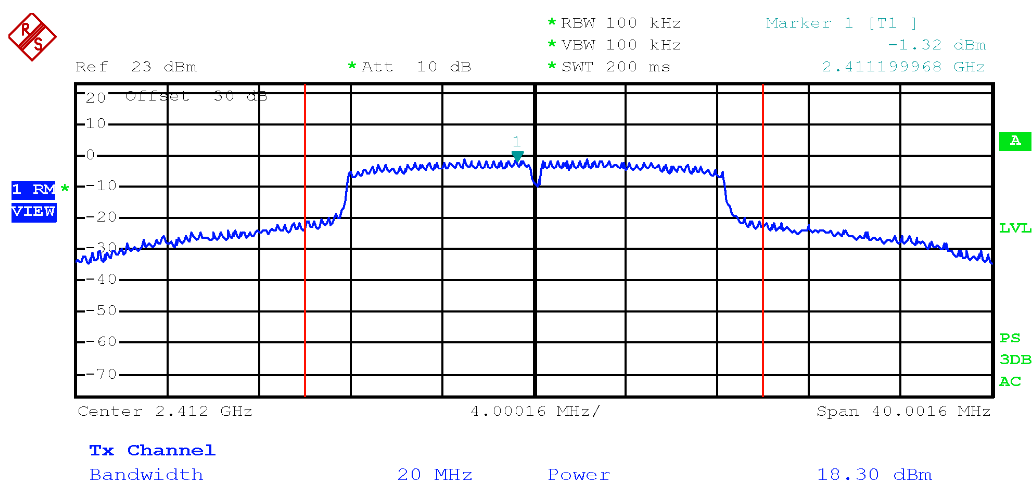
Output power TX 2462 MHz, 802.11g, 6 Mbps, multiple chain, chain 0



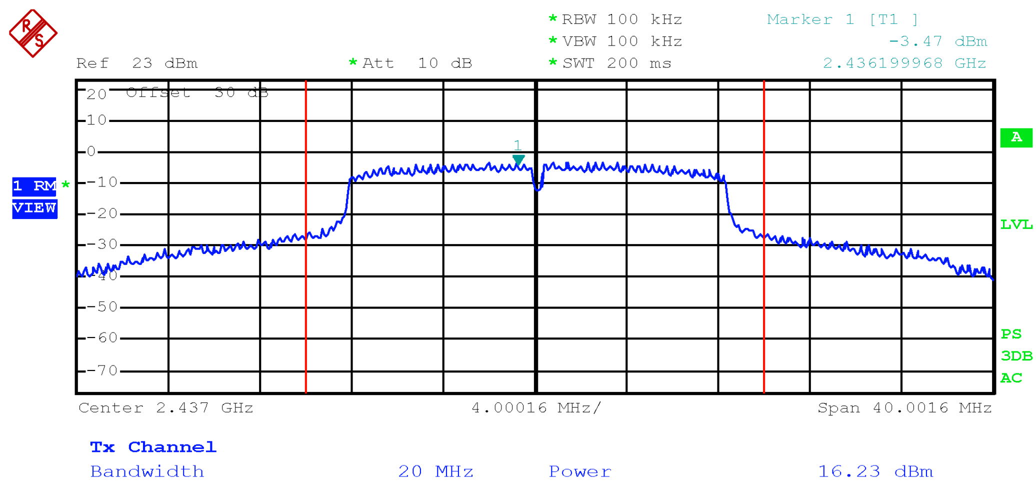
Output power TX 2462 MHz, 802.11g, 6 Mbps, multiple chain, chain 1



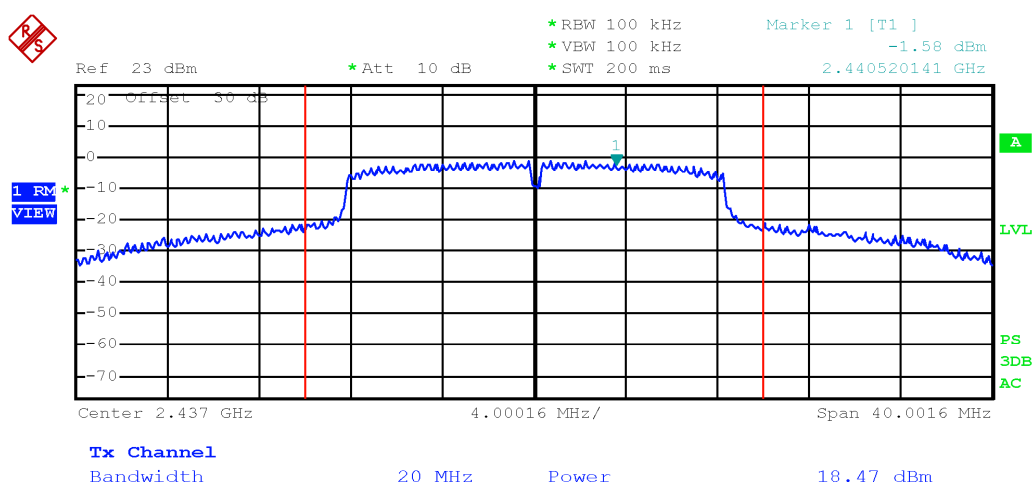
Output power TX 2412 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 0



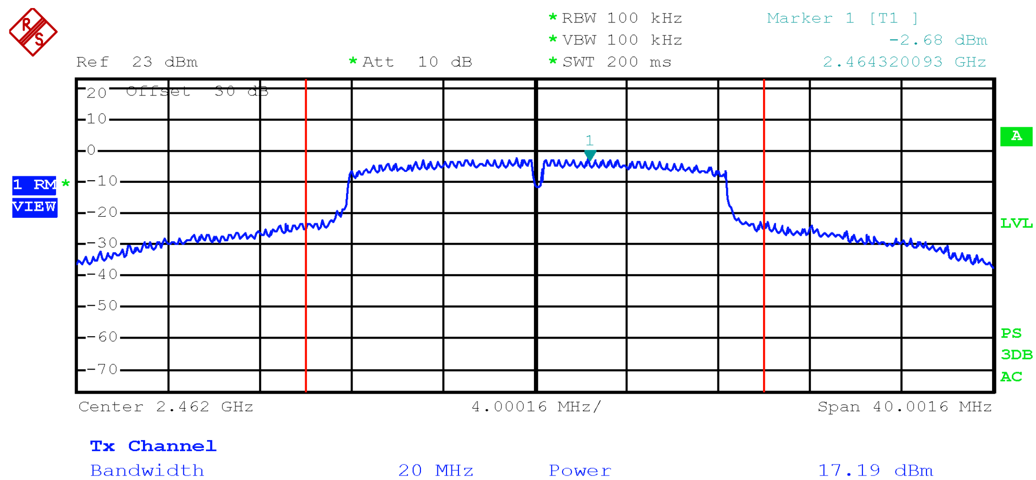
Output power TX 2412 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 1



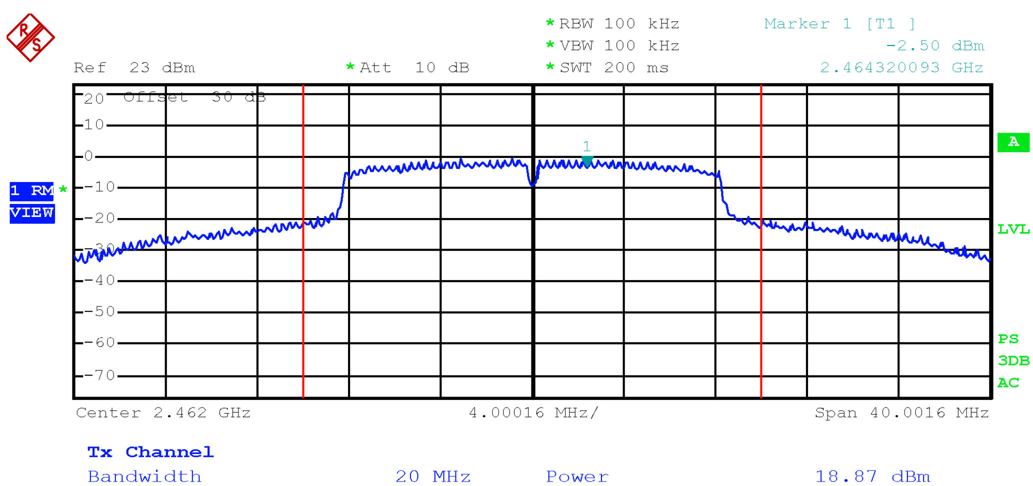
Output power TX 2437 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 0



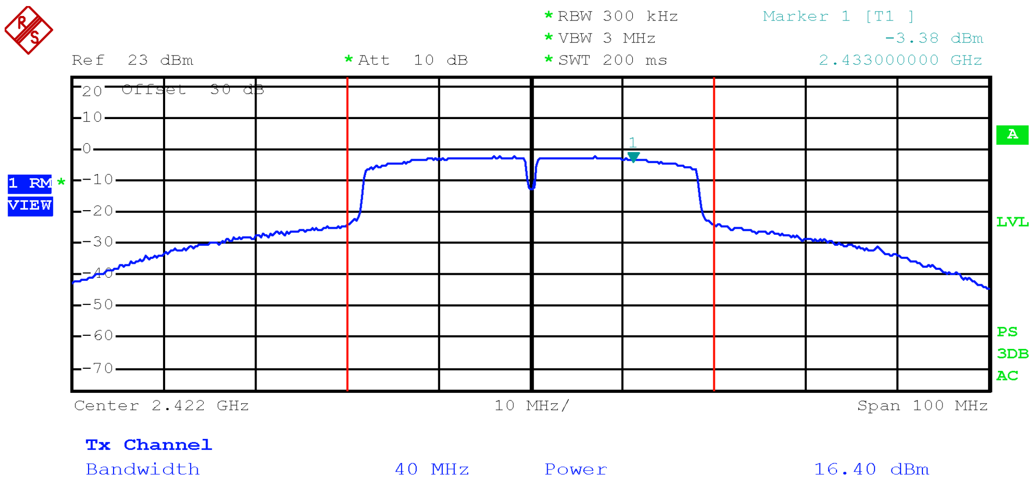
Output power TX 2437 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 1



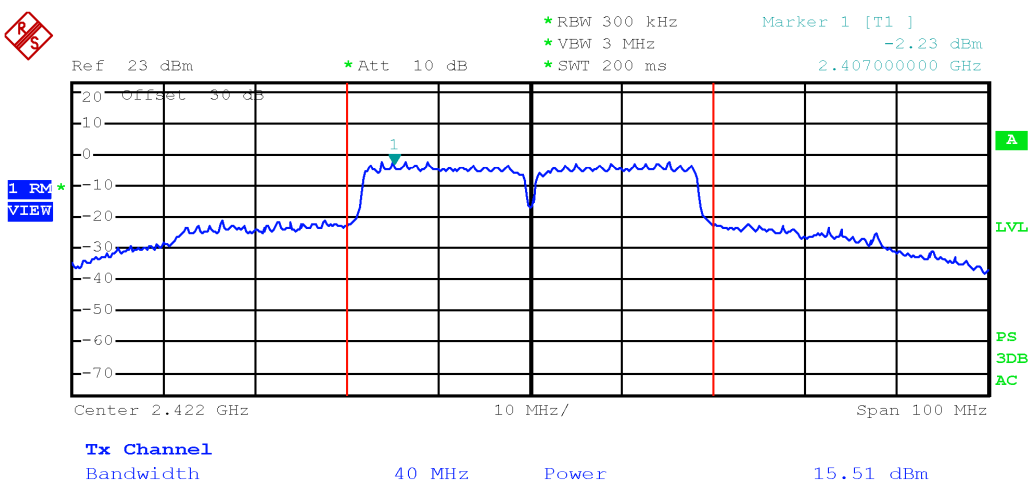
Output power TX 2462 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 0



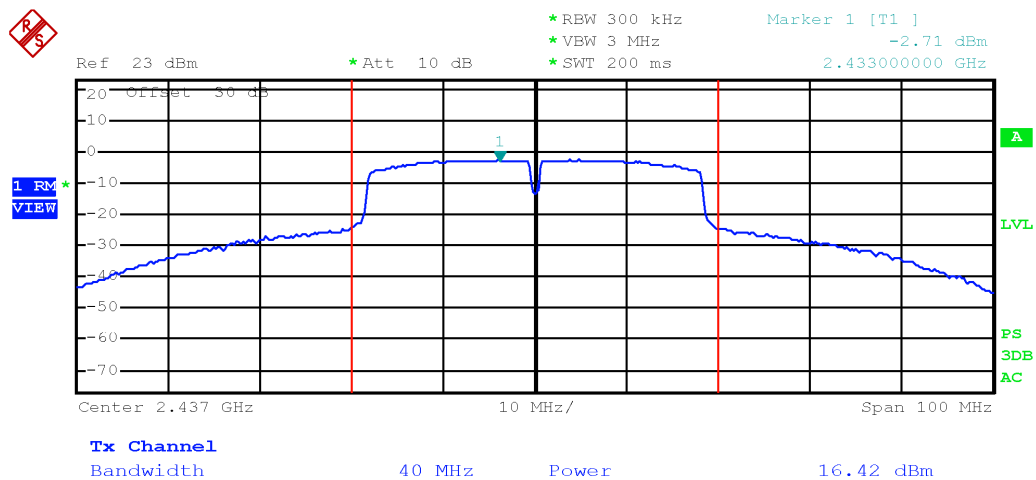
Output power TX 2462 MHz, 802.11 nHT20 6.5 Mbps, multiple chain, chain 1



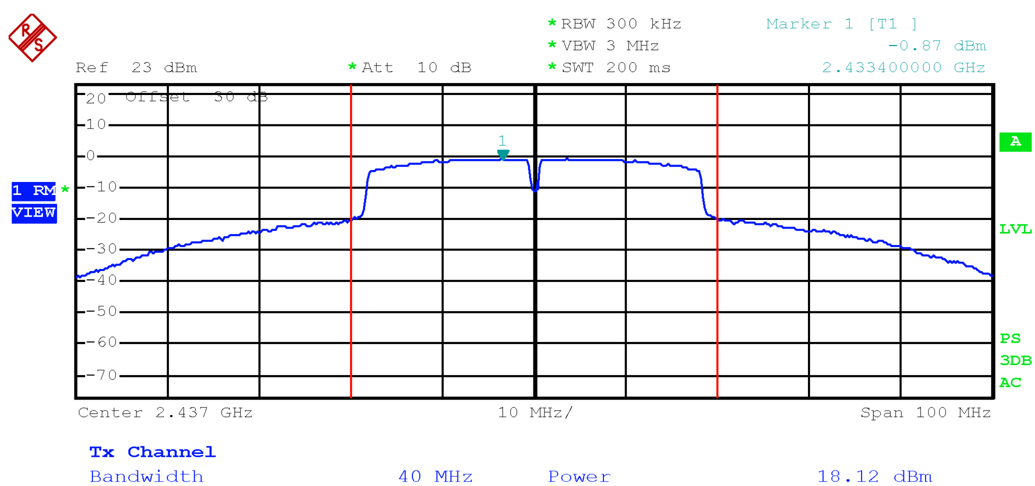
Output power TX 2422 MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 0



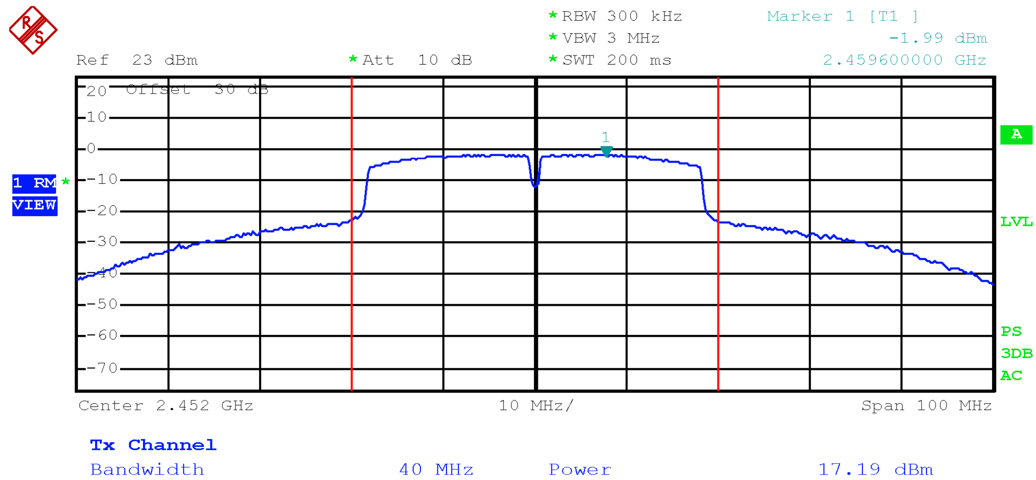
Output power TX 2422 MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 1



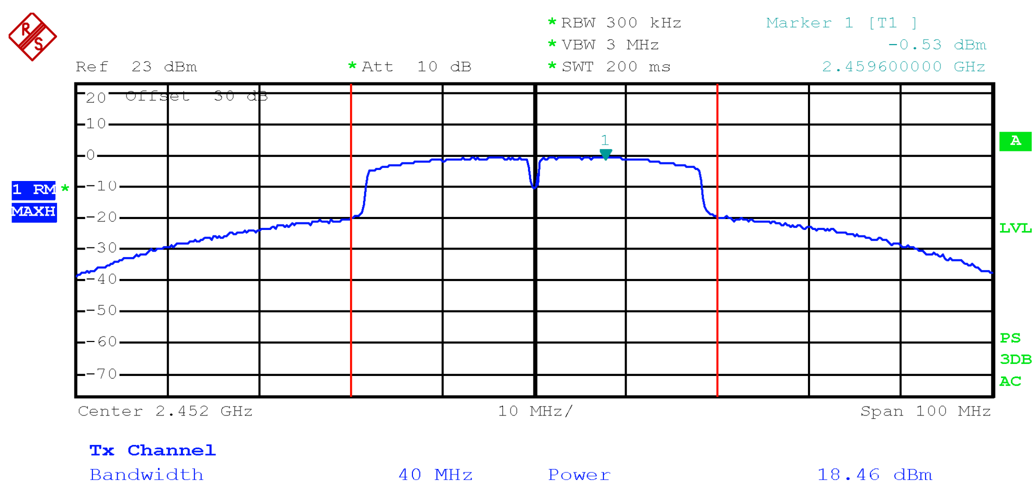
Output power TX 2437MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 0



Output power TX 2437 MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 1



Output power TX 2452MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 0



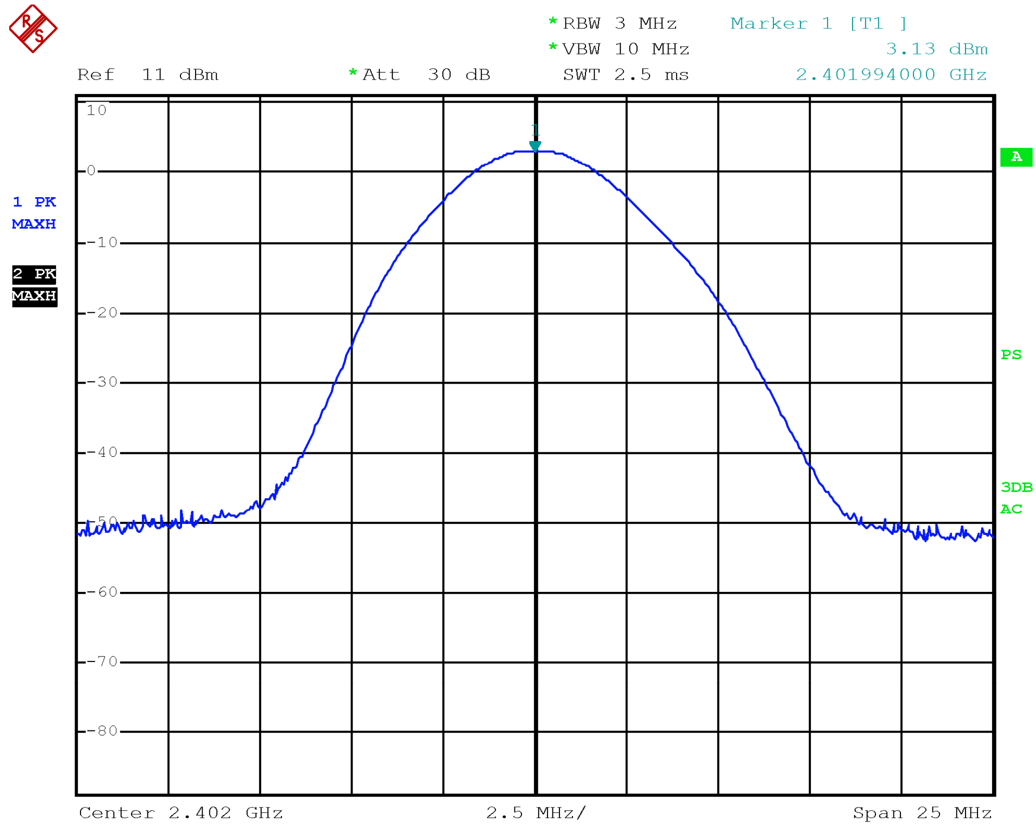
Output power TX 2452 MHz, 802.11 nHT40 13.5 Mbps, multiple chain, chain 1

Bluetooth output power

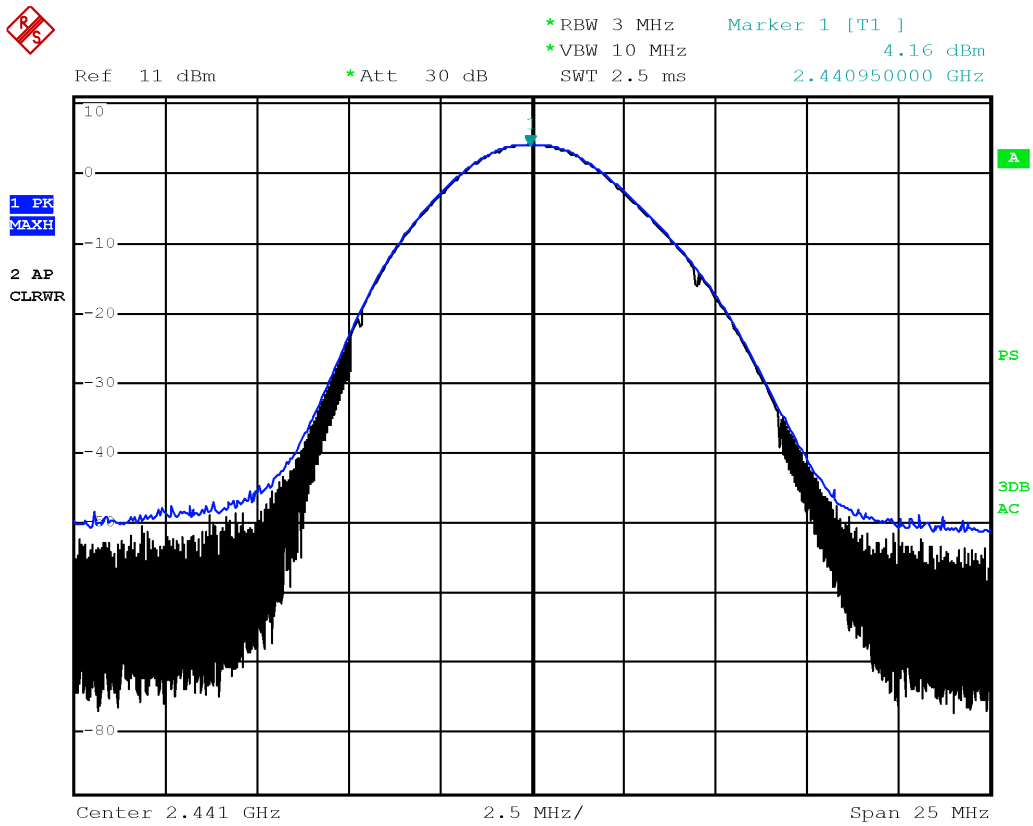
Standard	Channel	RF measured	Limit	MARGIN	Antenna gain	eirp	eirp limit	Margin
		(dBm)	dBm	dB	dBi	dBm	dBm	dB
GFSK LE	LOW	3.2	30	-26.8	1.7	4.9	36	-31.1
GFSK LE	MDDLE	4.2	30	-25.8	1.7	5.9	36	-30.1
GFSK LE	HIGH	4.6	30	-25.4	1.7	6.3	36	-29.7

Standard	Channel	RF measured	Limit	MARGIN	Antenna gain	eirp	eirp limit	Margin
		(dBm)	dBm	dB	dBi	dBm	dBm	dB
BT GFSK	LOW	3.1	30	-26.9	1.7	4.8	36	-31.2
BT GFSK	MDDLE	4.2	30	-25.8	1.7	5.9	36	-31.1
BT GFSK	HIGH	4.7	30	-25.3	1.7	6.4	36	-29.6

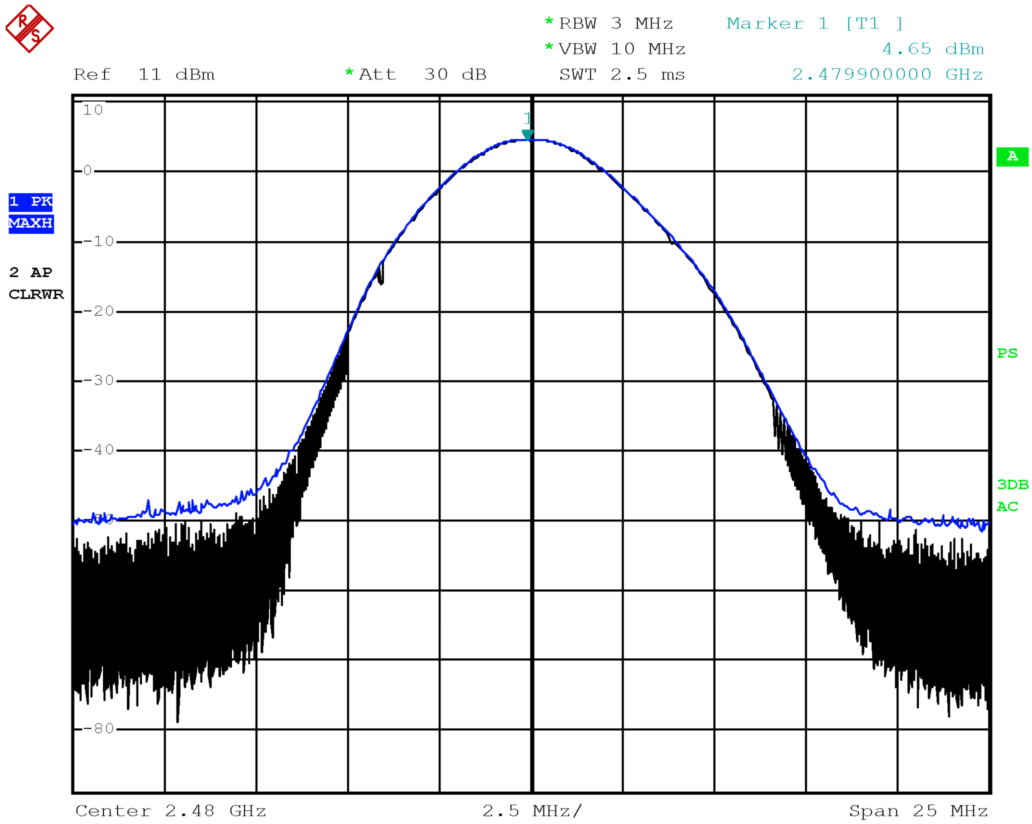
Standard	Channel	RF measured	Limit	MARGIN	Antenna gain	eirp	eirp limit	Margin
		(dBm)	dBm	dB	dBi	dBm	dBm	dB
8PSK	LOW	5.1	30	-24.9	1.7	6.8	36	-29.2
8PSK	MDDLE	5.9	30	-24.1	1.7	7.6	36	-28.4
8PSK	HIGH	4.7	30	-25.3	1.7	6.4	36	-29.6



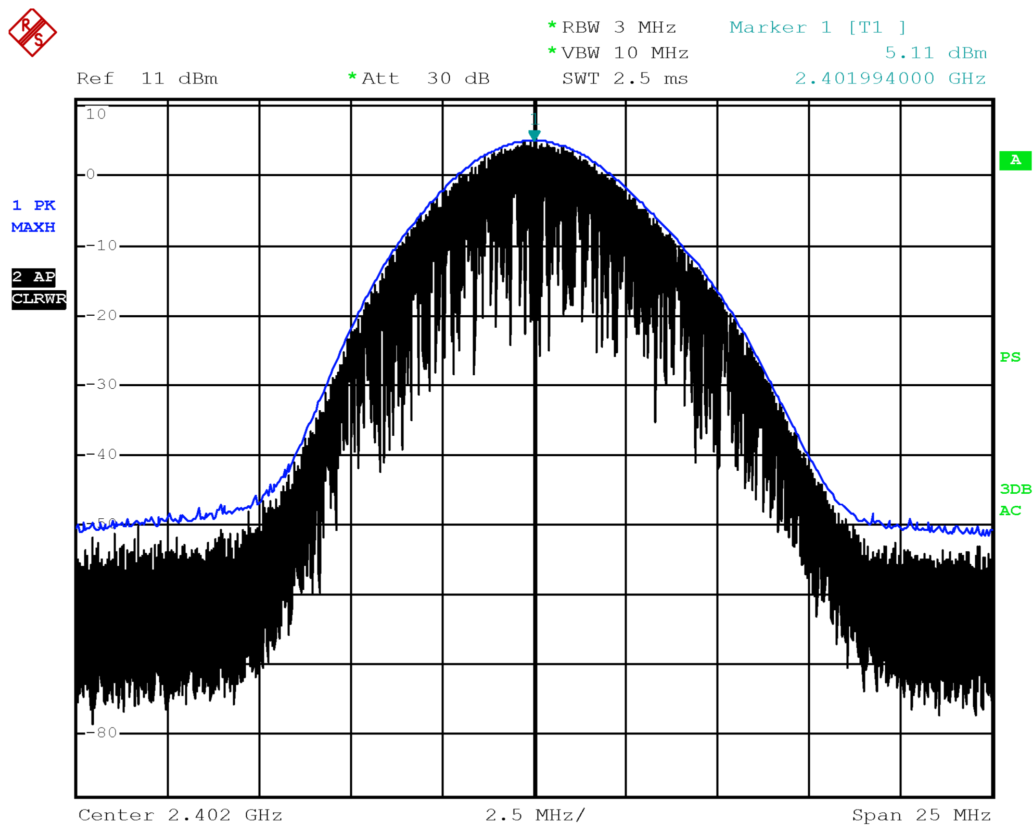
Output power TX 2402MHz, BT GFSK



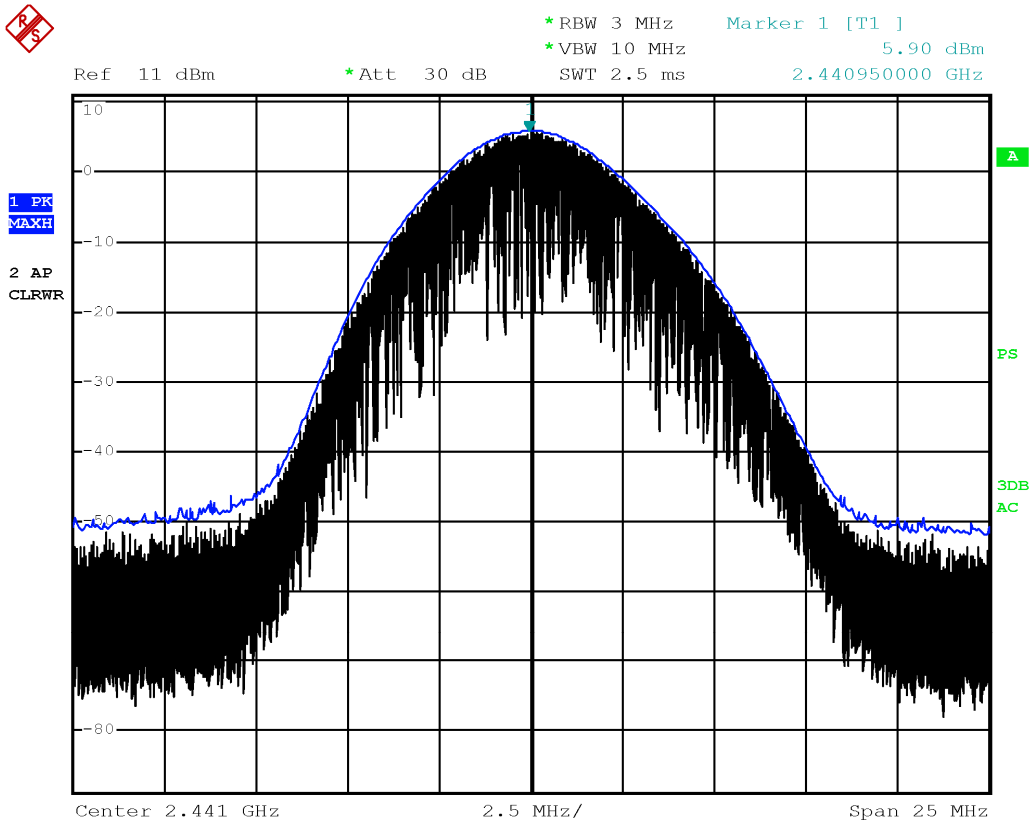
Output power TX 2441MHz, BT GFSK



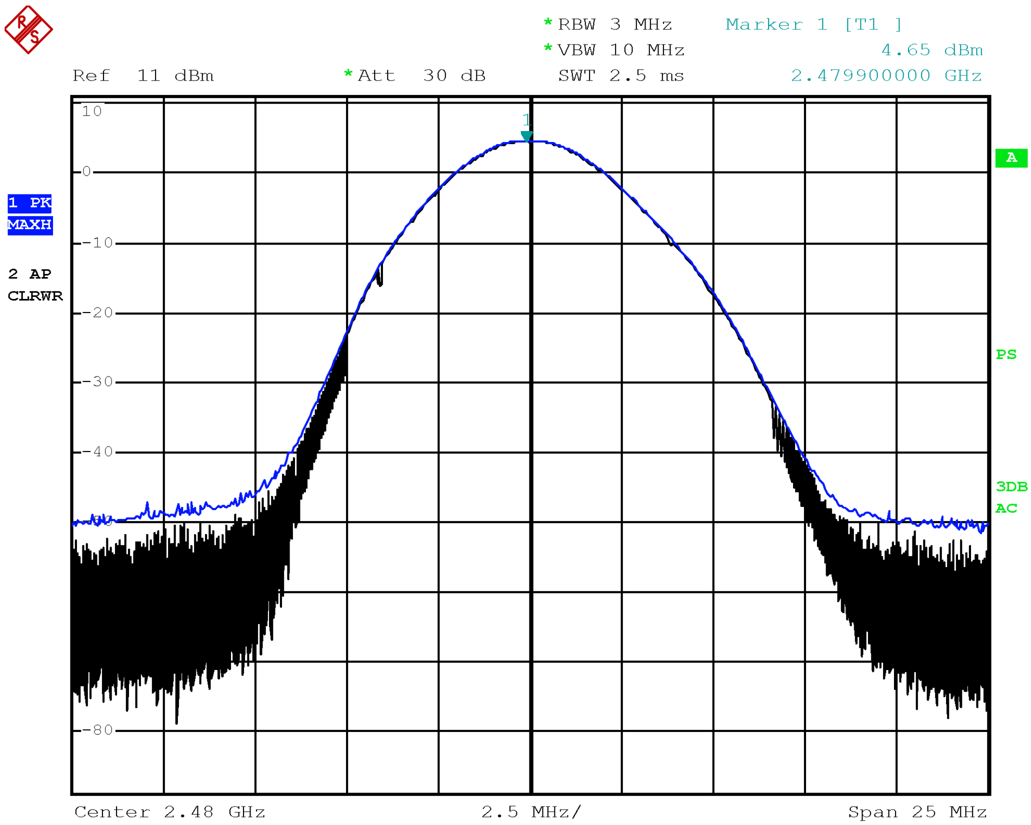
Output power TX 2480MHz, BT GFSK



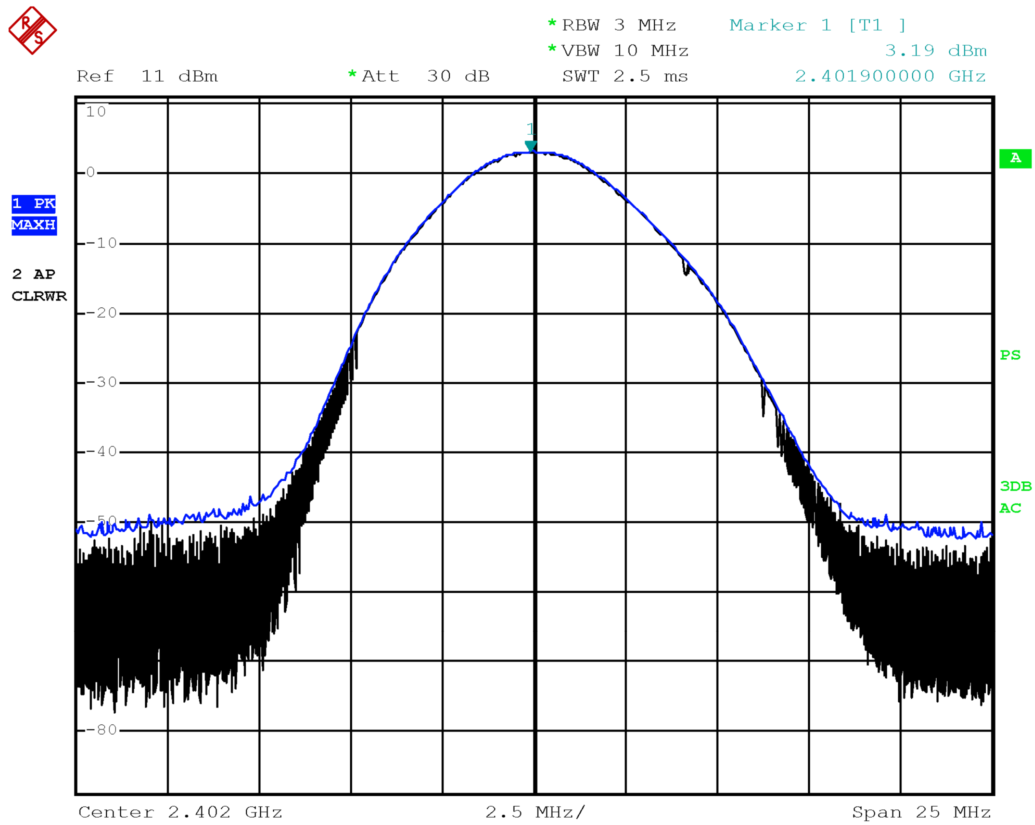
Output power TX 2402MHz, BT 8DPSK



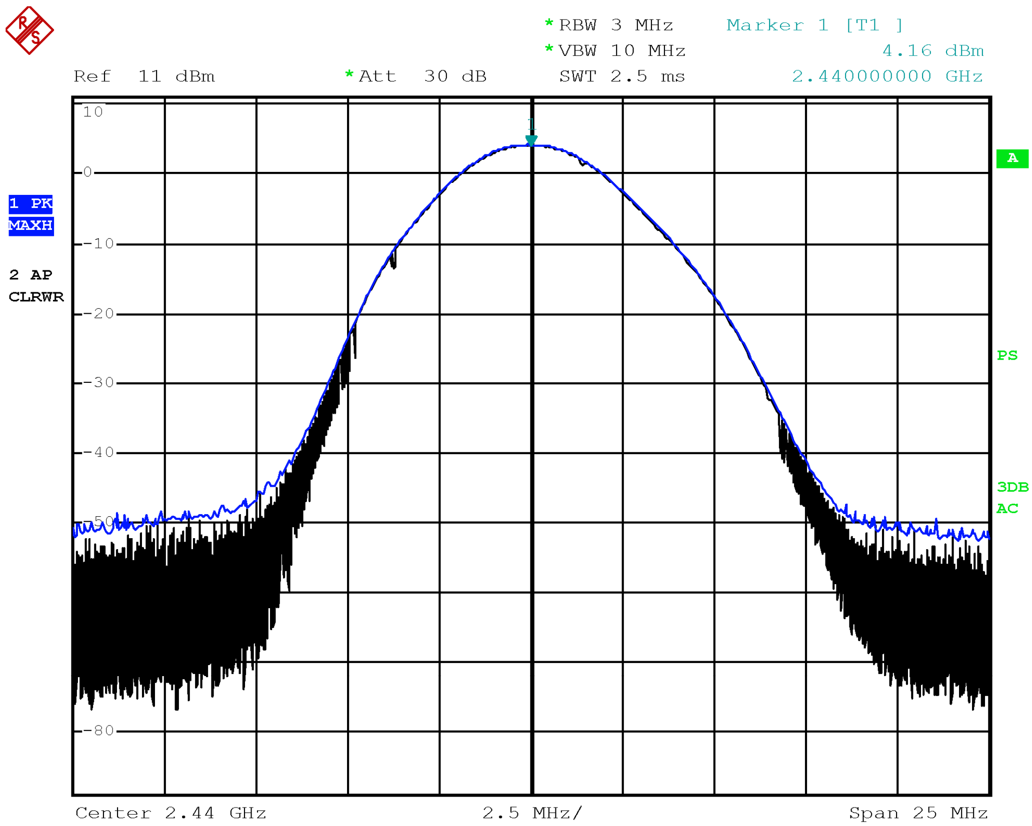
Output power TX 2441MHz, BT 8DPSK



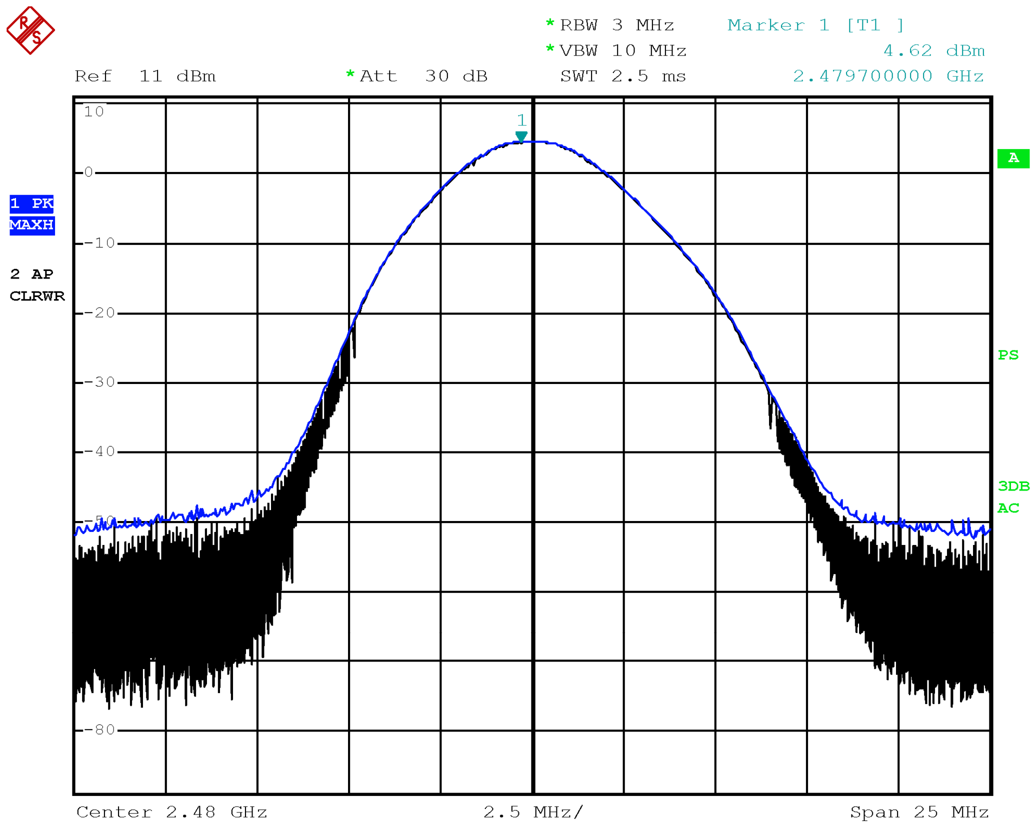
Output power TX 2480MHz, BT 8DPSK



Output power TX 2402MHz, GFSK(LE mode)



Output power TX 2441MHz, GFSK(LE mode)



Output power TX 2480MHz, GFSK(LE mode)

8.6 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.6.1 Definitions and limits

FCC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

ISED:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.6-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions µV/m	Field strength of emissions 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

Table 8.6-2: 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 8.6-2 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 8.6-3: 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			

8.6.1 Test date

Start date	April 14, 2020

8.6.2 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
EUT was set to transmit continuously. Tests were performed with EUT set to highest and lowest data rate, different antenna configurations and modulation schemes were investigated, only the worst case are presented. Radiated measurements were performed at a distance of 3 m. Since fundamental power was tested using the maximum peak conducted output power procedure to demonstrate compliance, the spurious emissions limit is −20 dBc/100 kHz.

Spectrum analyzer settings for conducted spurious emissions measurements:

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

Spectrum analyzer settings for radiated measurements within restricted bands below 1 GHz:

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

Spectrum analyzer settings for peak radiated measurements within restricted bands above 1 GHz:

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

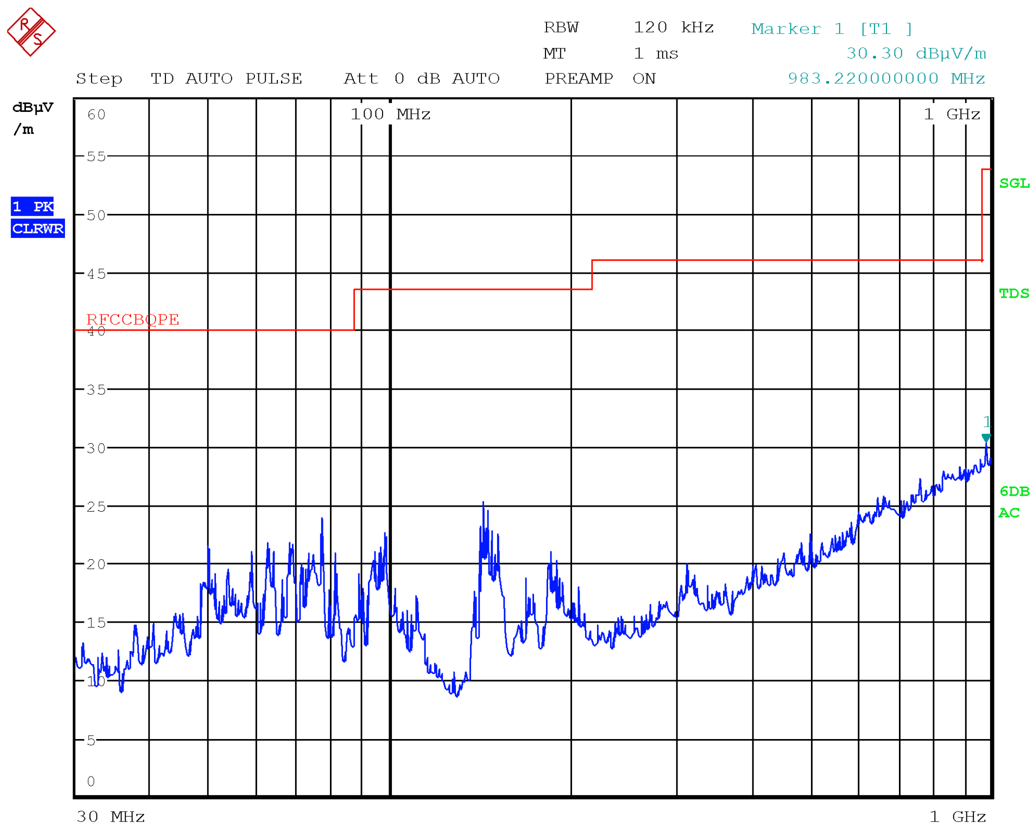
Spectrum analyzer settings for average conducted measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	power averaging (RMS)
Trace mode:	averaging (RMS)

Spectrum analyzer settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.6.4 Test data



Radiated spurious emissions 30 to 1000 MHz, Mid channel with antenna in horizontal polarization

TX 2437 MHz CH 06, 802.11g, 6Mbps, single chain configuration

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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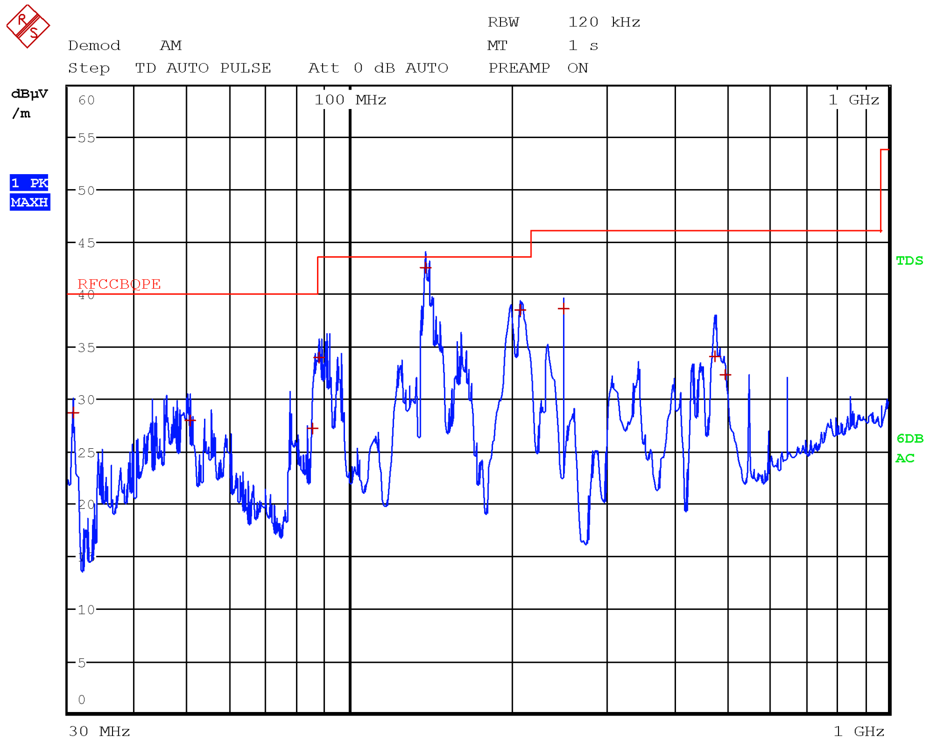
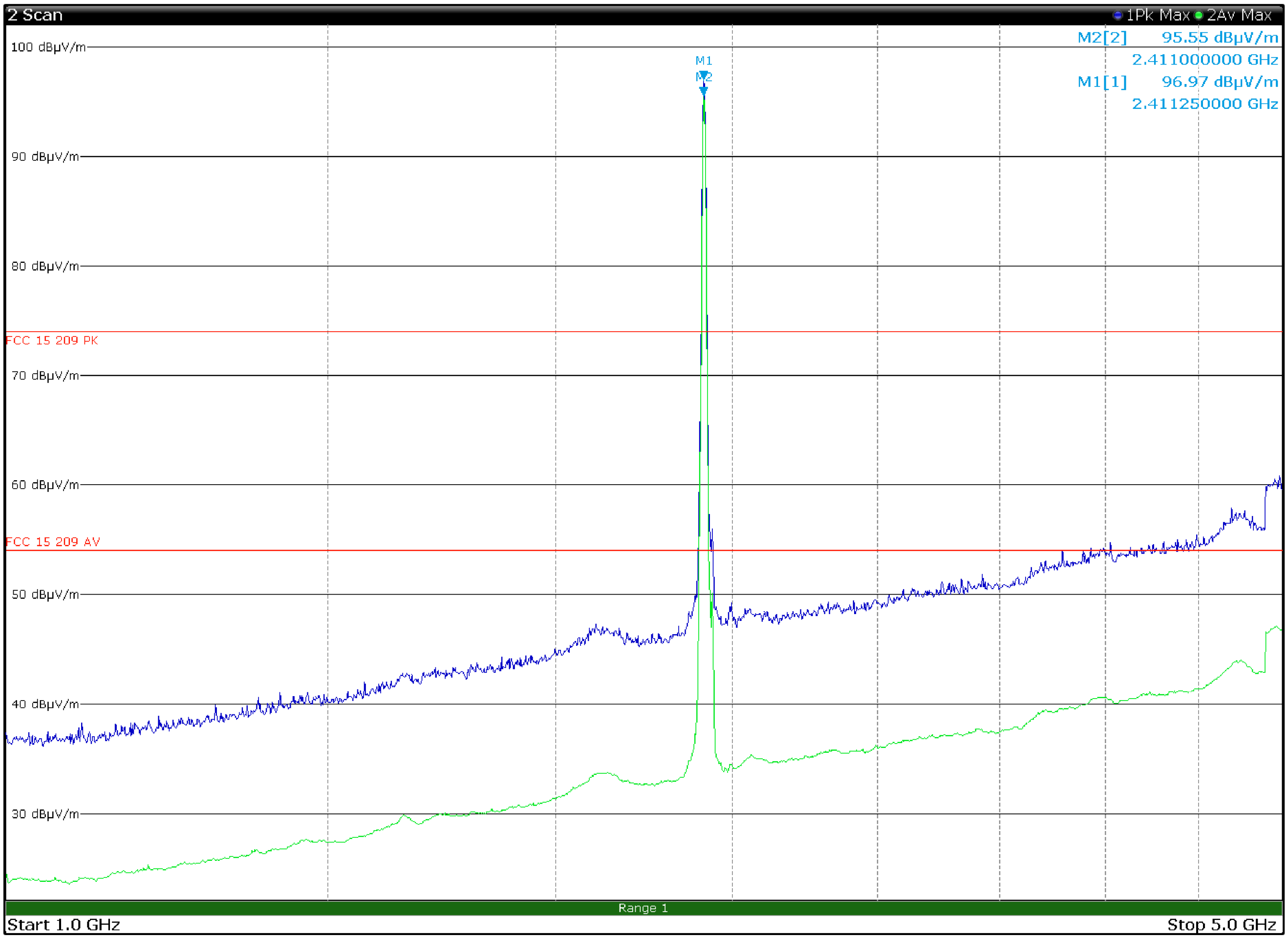


Radiated spurious emissions 30 to 1000 MHz, Mid channel with antenna in vertical polarization

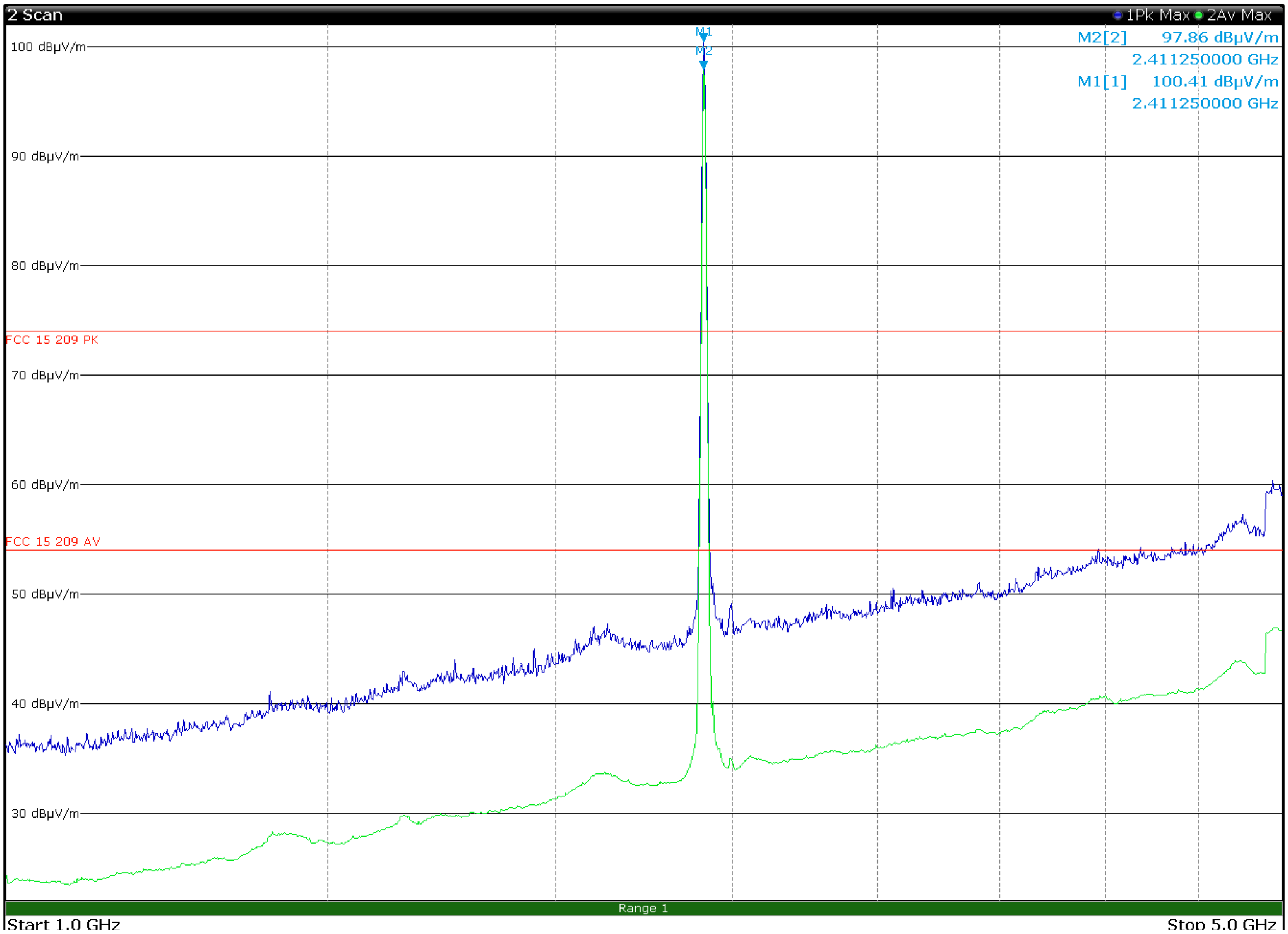
TX 2437 MHz CH 06, 802.11g, 6Mbps, single chain configuration

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
30.6000	30.3	40.0	-9.7	QP
39.4800	31.2	40.0	-8.8	QP
40.1100	29.4	40.0	-10.6	QP
50.4300	27.4	40.0	-12.6	QP
58.7100	30.9	40.0	-9.1	QP
68.9700	31.0	40.0	-9.0	QP
77.1900	36.3	40.0	-3.7	QP
81.2100	32.6	40.0	-7.4	QP
98.4900	27.0	43.5	-16.5	QP
106.7100	23.6	43.5	-19.9	QP
138.3900	27.0	43.5	-16.5	QP
151.5600	30.9	43.5	-12.6	QP
500.0100	29.1	46.0	-16.9	QP
706.8300	20.8	46.0	-25.2	QP
817.4400	22.2	46.0	-23.8	QP
904.8600	23.5	46.0	-22.5	QP



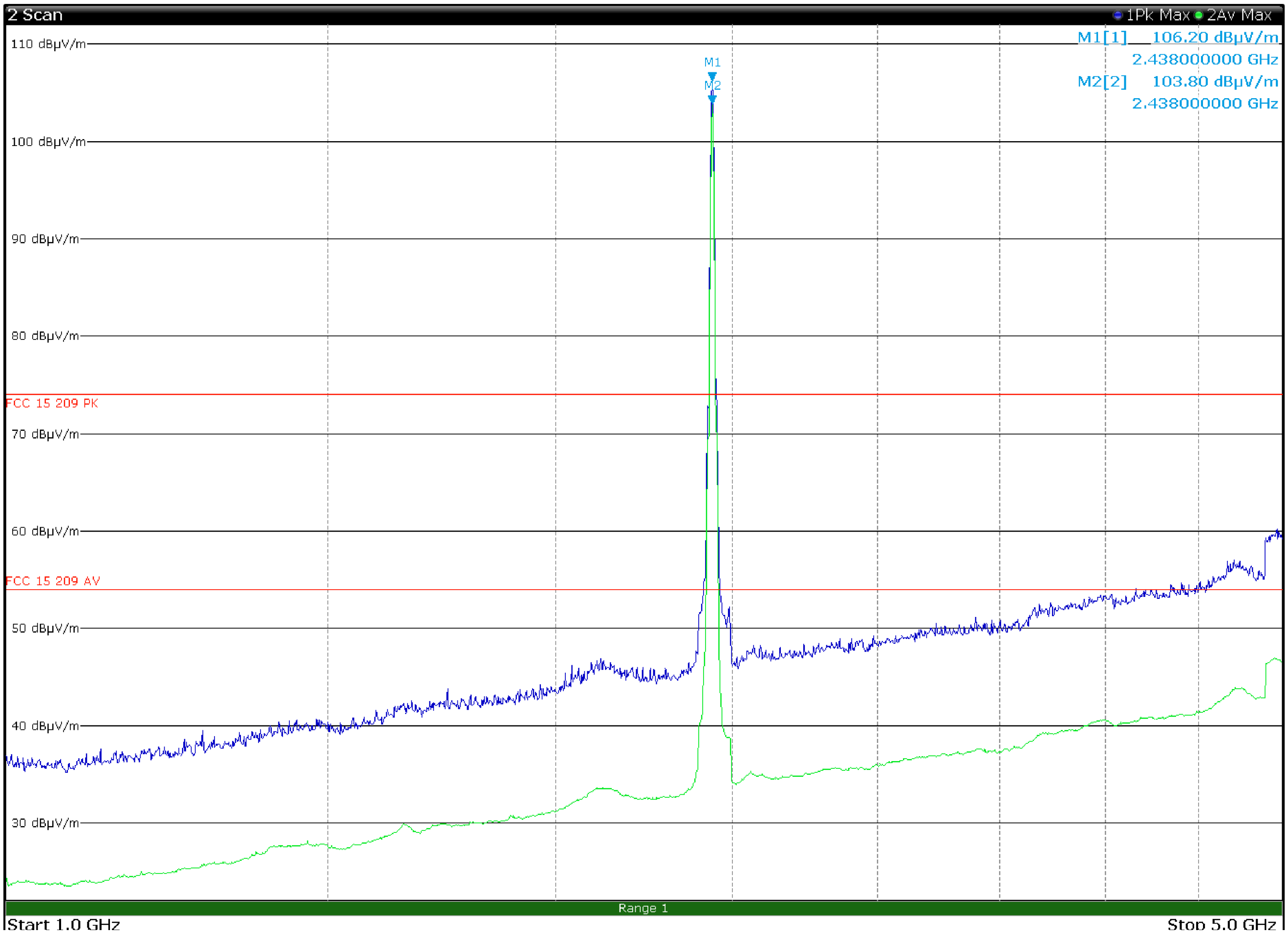
Radiated spurious emissions 1 to 5 GHz, Low channel with antenna in horizontal polarization, TX 2412 MHz, CH01, 802.11b, 1Mbps, multiple chain

Limit exceeded by the carrier



: Radiated spurious emissions 1 to 5 GHz, Low channel with antenna in vertical polarization, TX 2412 MHz, CH01, 802.11b, 1Mbps, multiple chain

Limit exceeded by the carrier



Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11b, 1Mbps, multiple chain with antenna in horizontal polarization,

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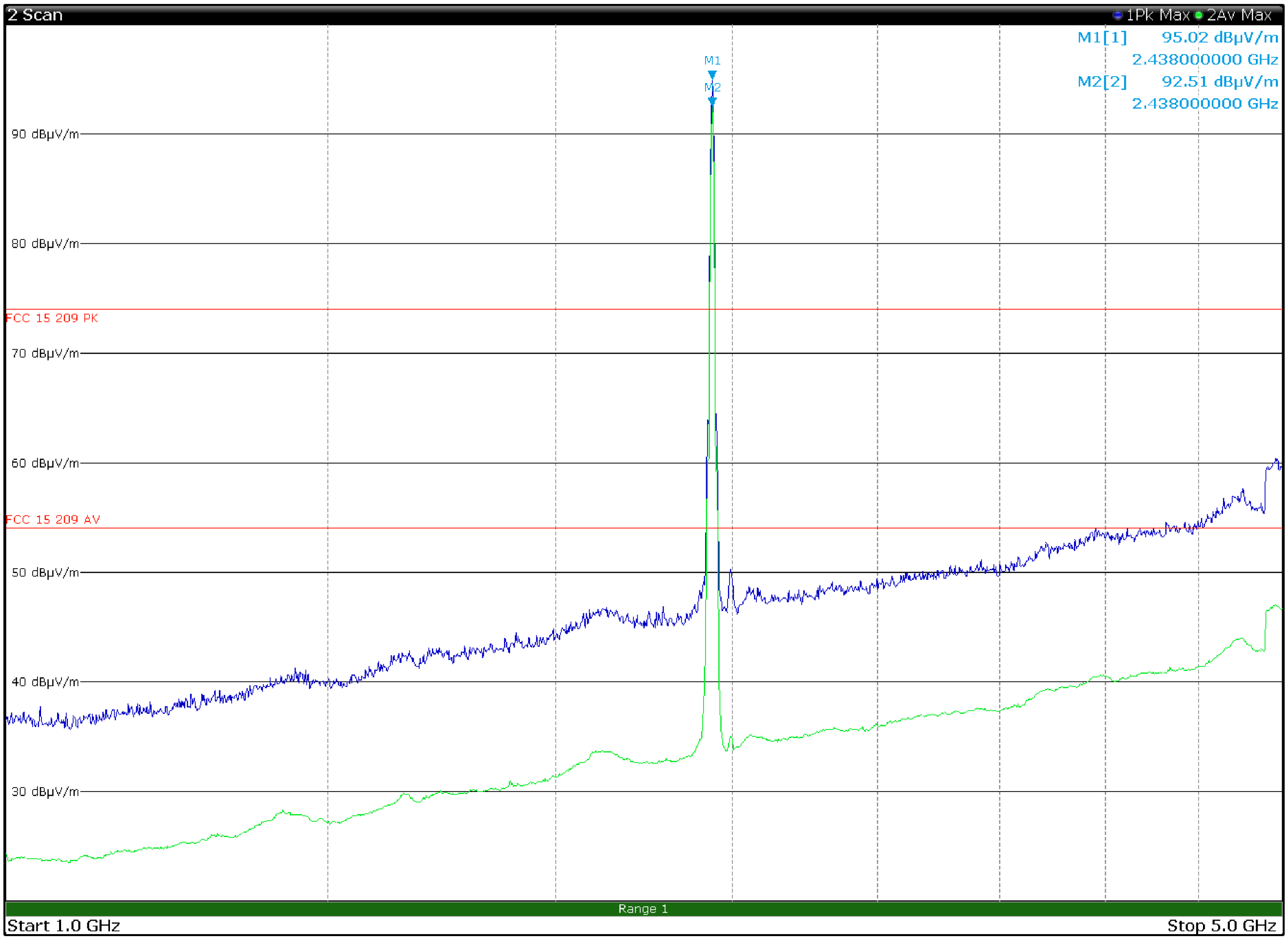
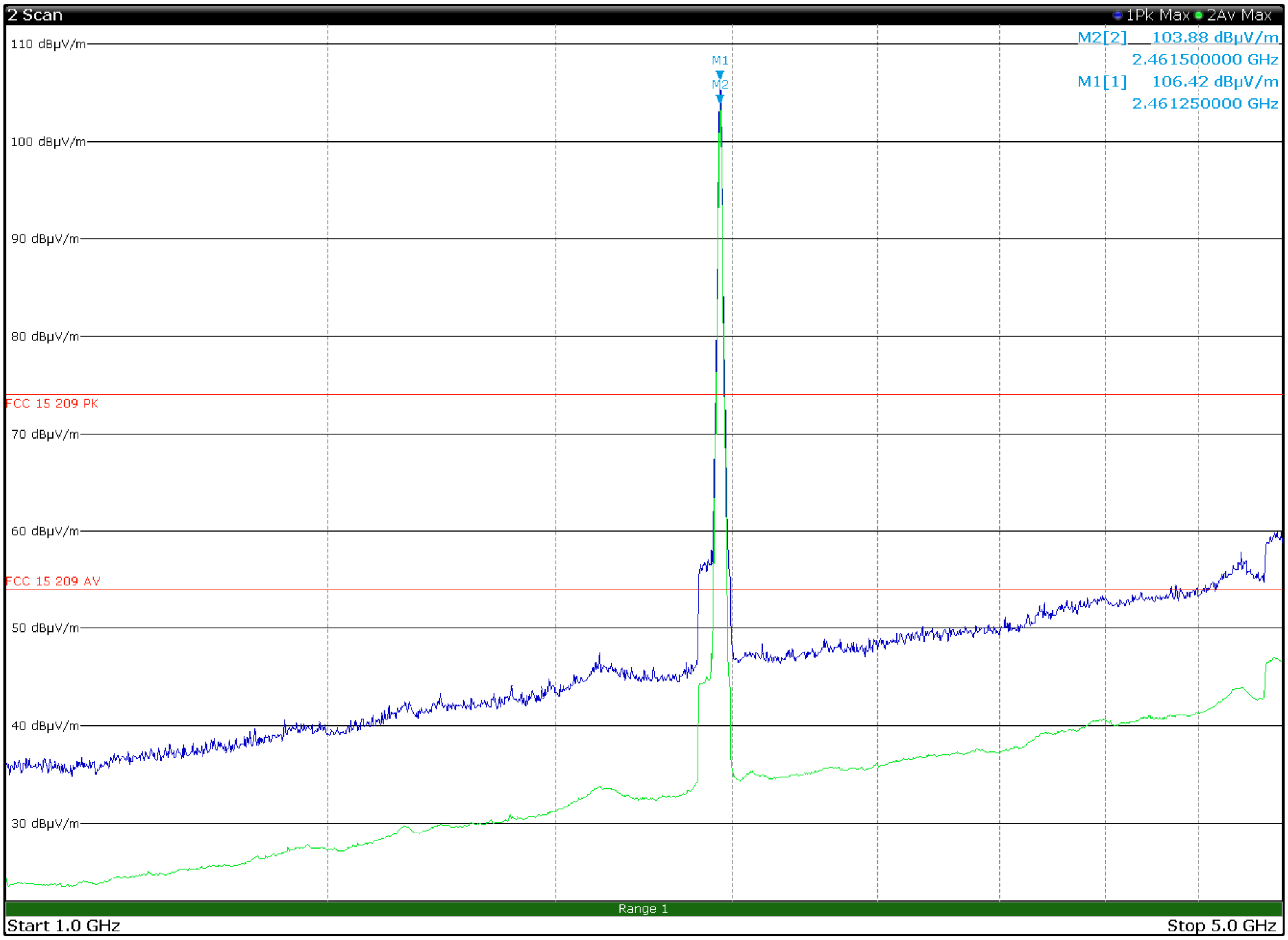
Limit exceeded by the carrier



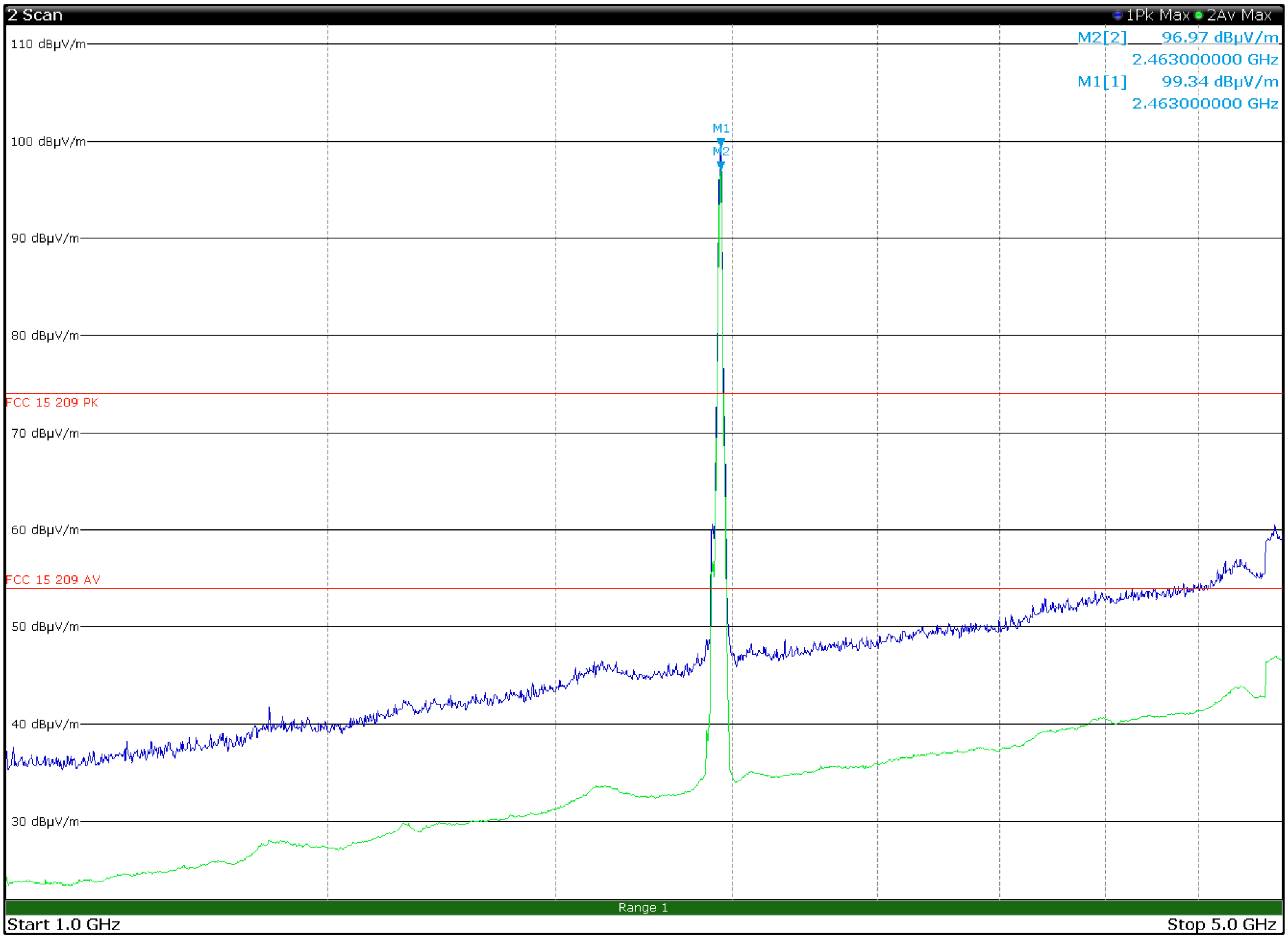
Radiated spurious emissions 1 to 3.6 GHz, TX 2437 MHz, CH06, 802.11b, 1Mbps, multiple chain in vertical polarization

Limit exceeded by the carrier



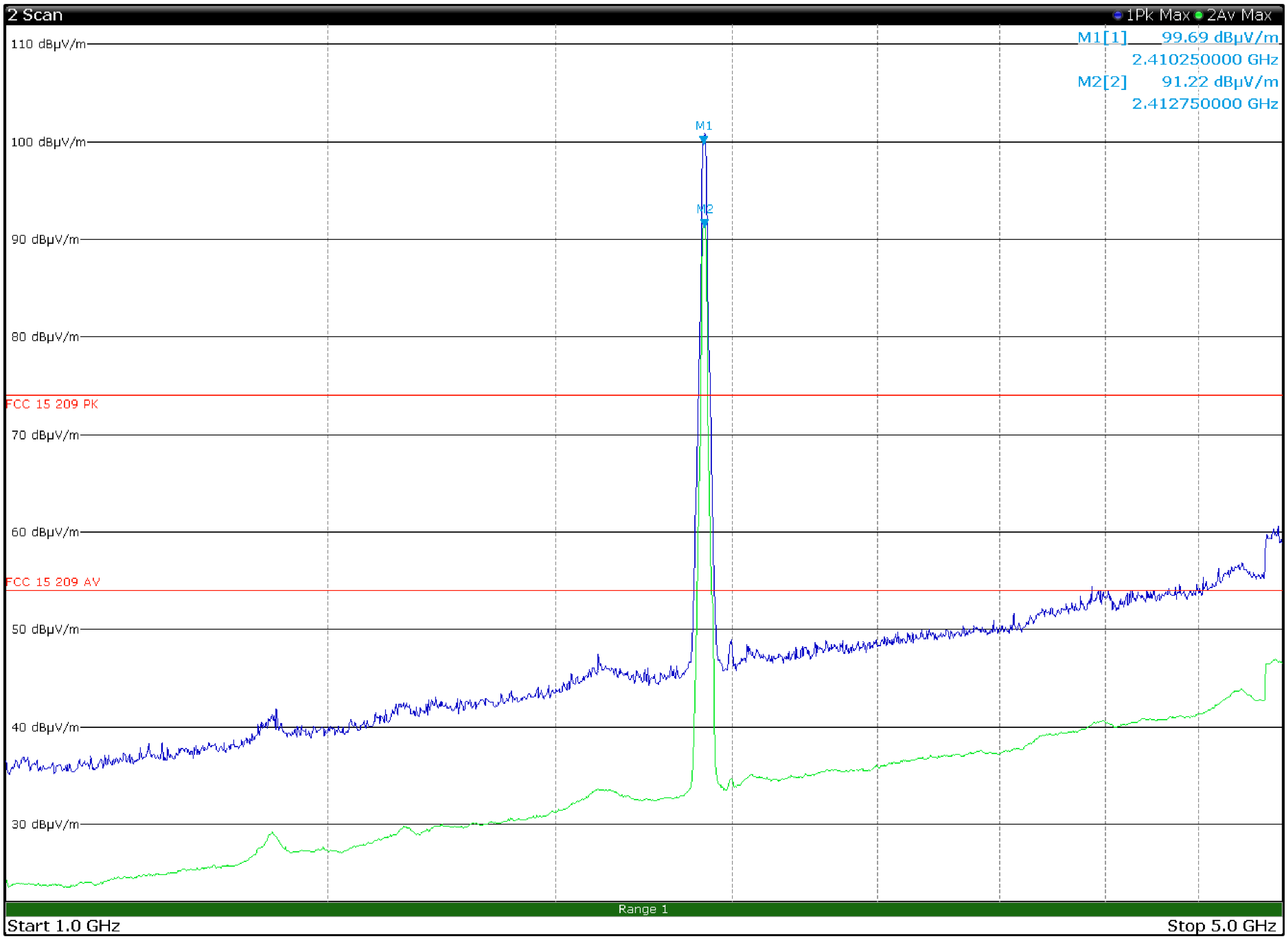
Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11b, 1Mbps, multiple chain High channel with antenna in horizontal polarization

Limit exceeded by the carrier

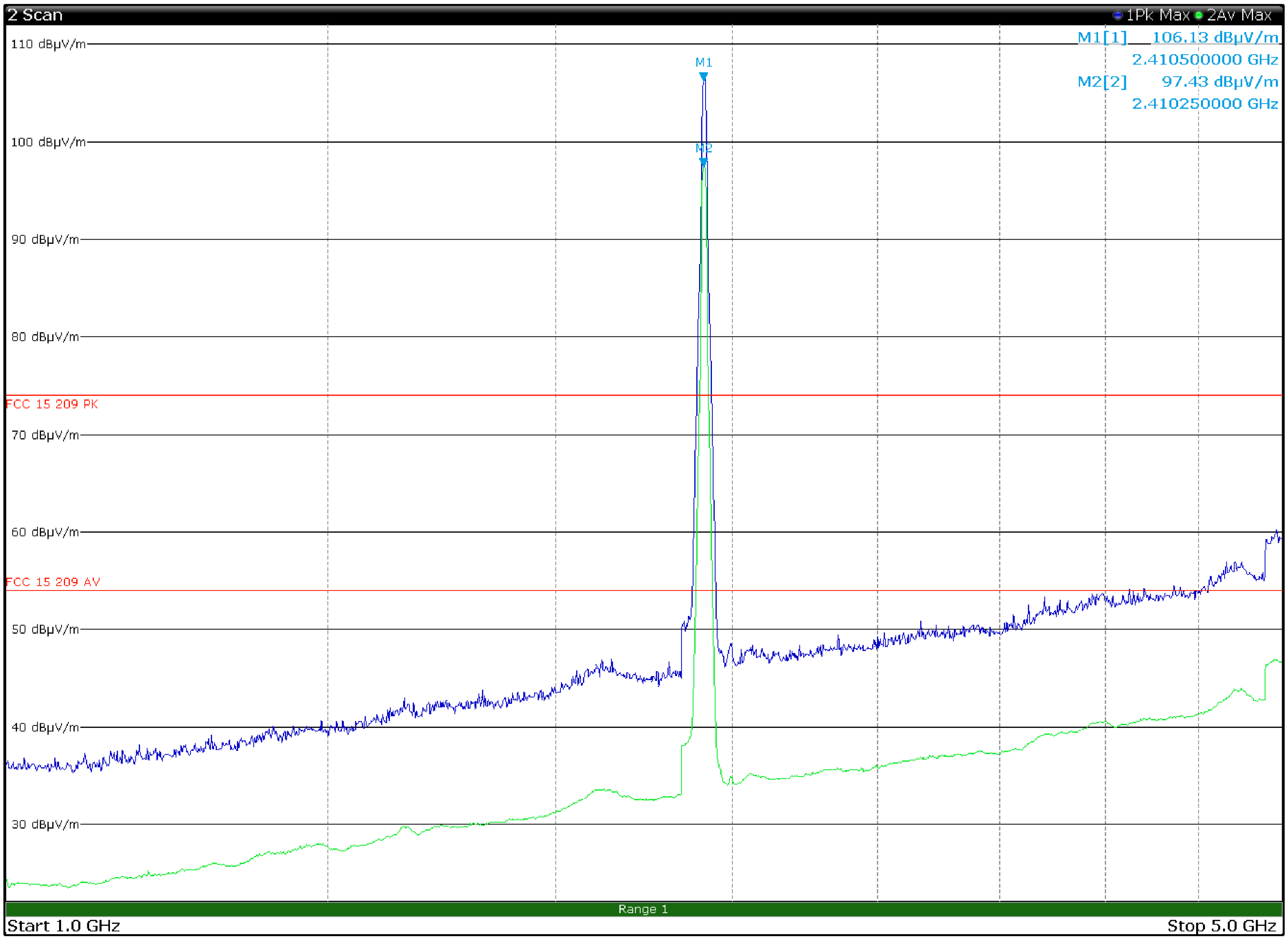


Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11b, 1Mbps, multiple chain High channel with antenna with antenna in vertical polarization

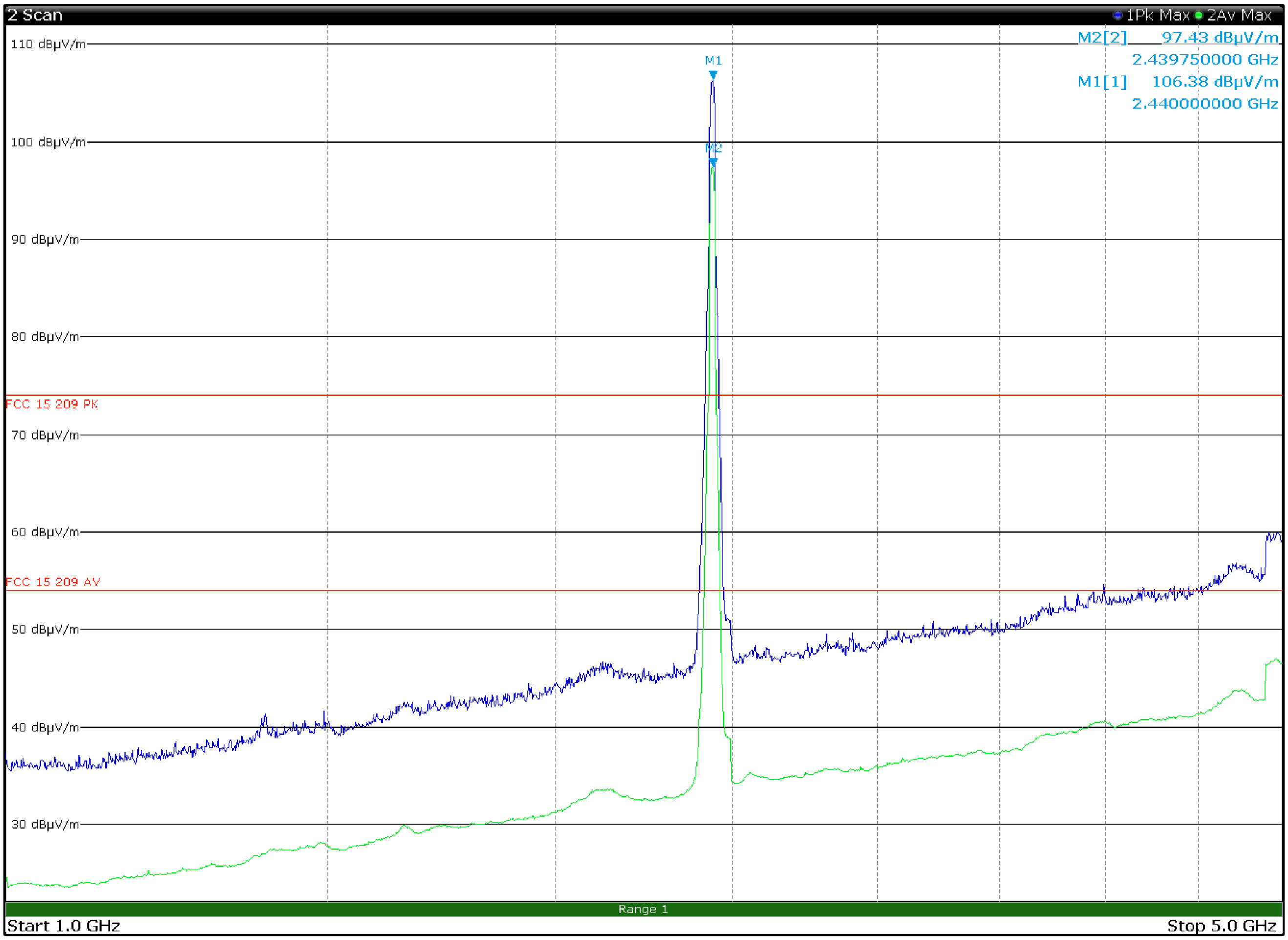
Limit exceeded by the carrier



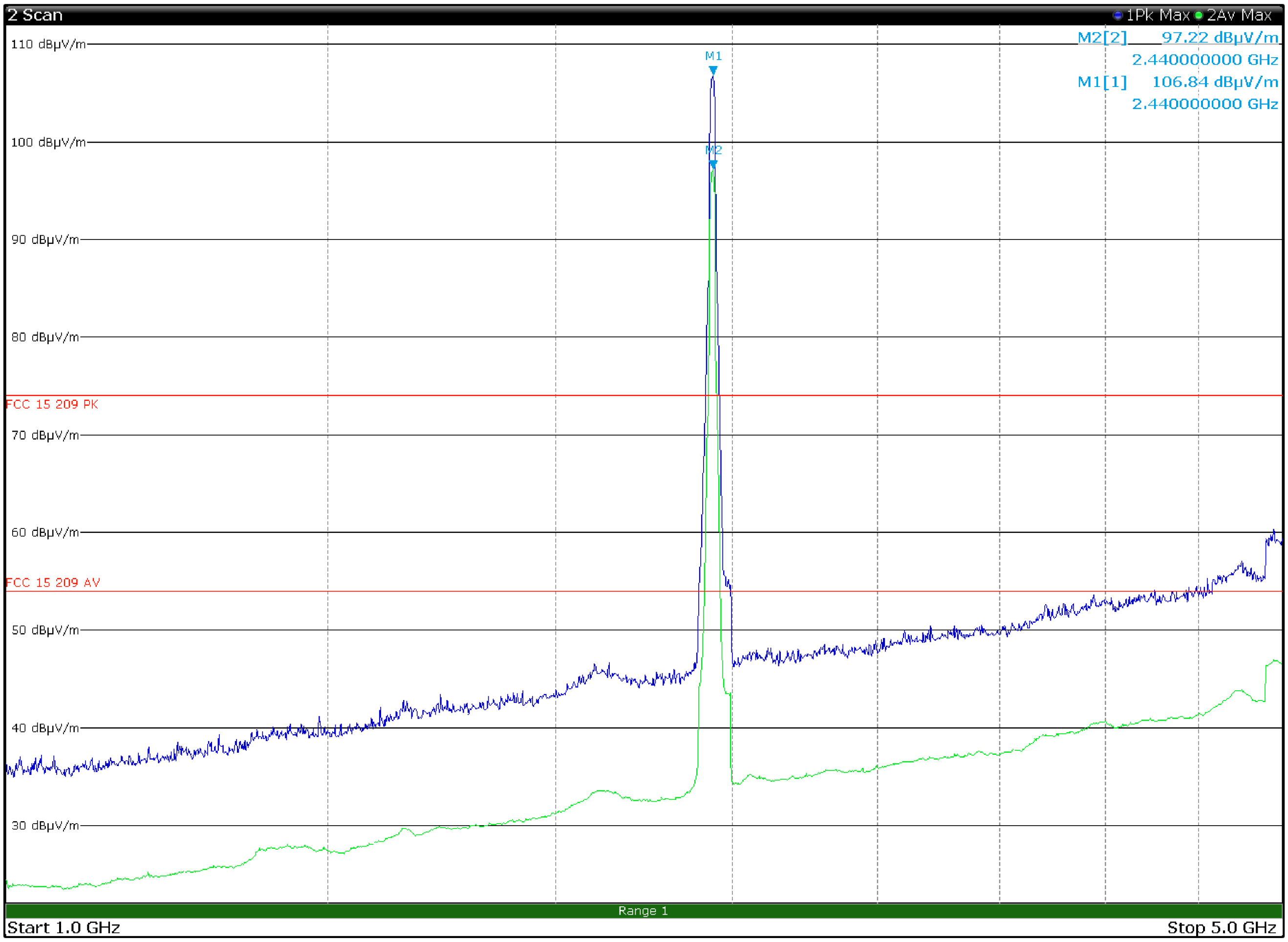
Radiated spurious emissions 1 to 5 GHz, X 2412 MHz, CH01, 802.11g, 6Mbps, multiple chain with antenna in vertical polarization



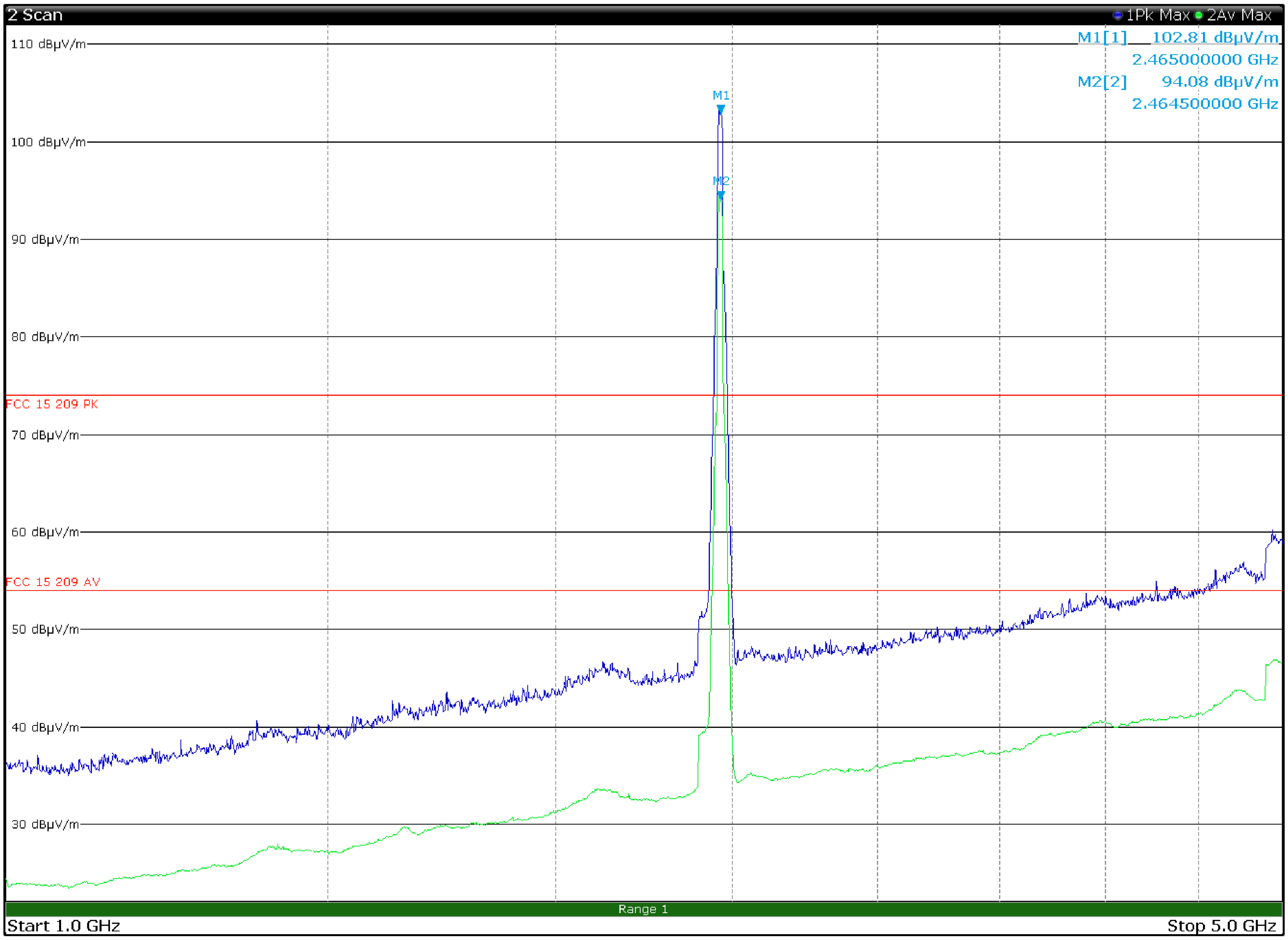
Radiated spurious emissions 1 to 5 GHz, TX 2412 MHz, CH01, 802.11g, 6Mbps, multiple chain with antenna in horizontal polarization



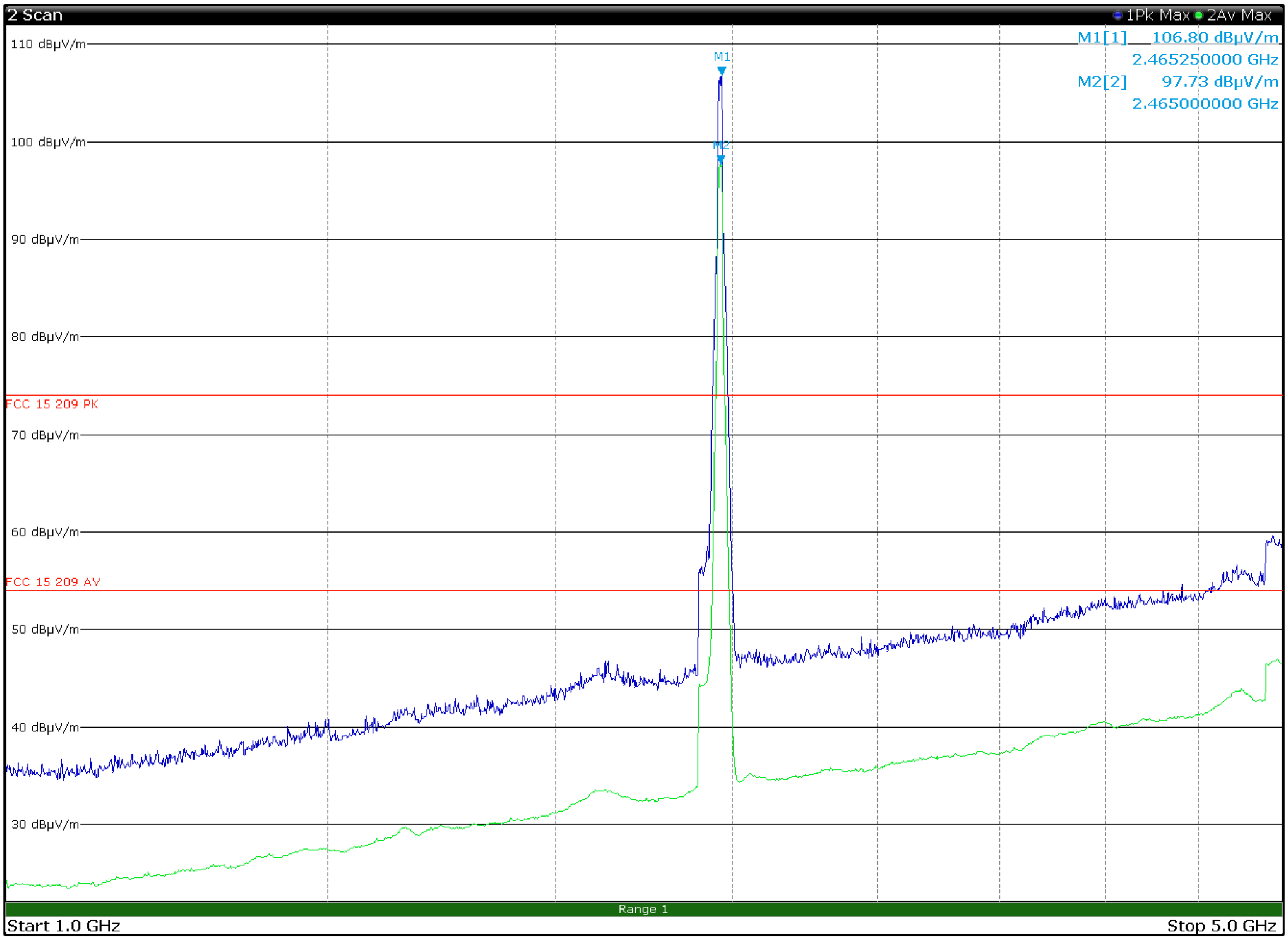
Radiated spurious emissions 1 to 5 GHz, TX 2437MHz, CH06, 802.11g, 6Mbps, multiple chain with antenna in horizontal polarization



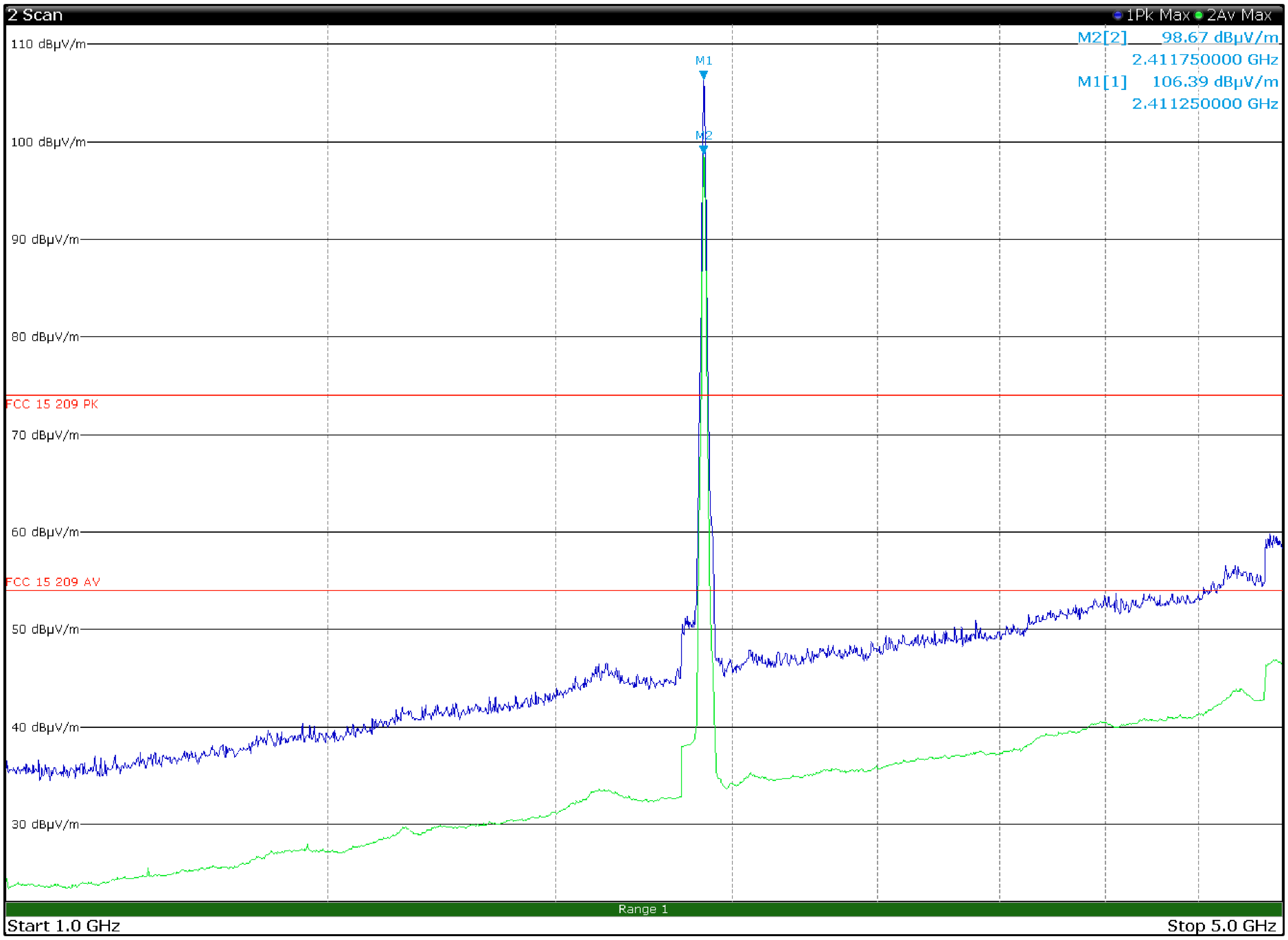
Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11g, 6Mbps, multiple chain with antenna in vertical polarization



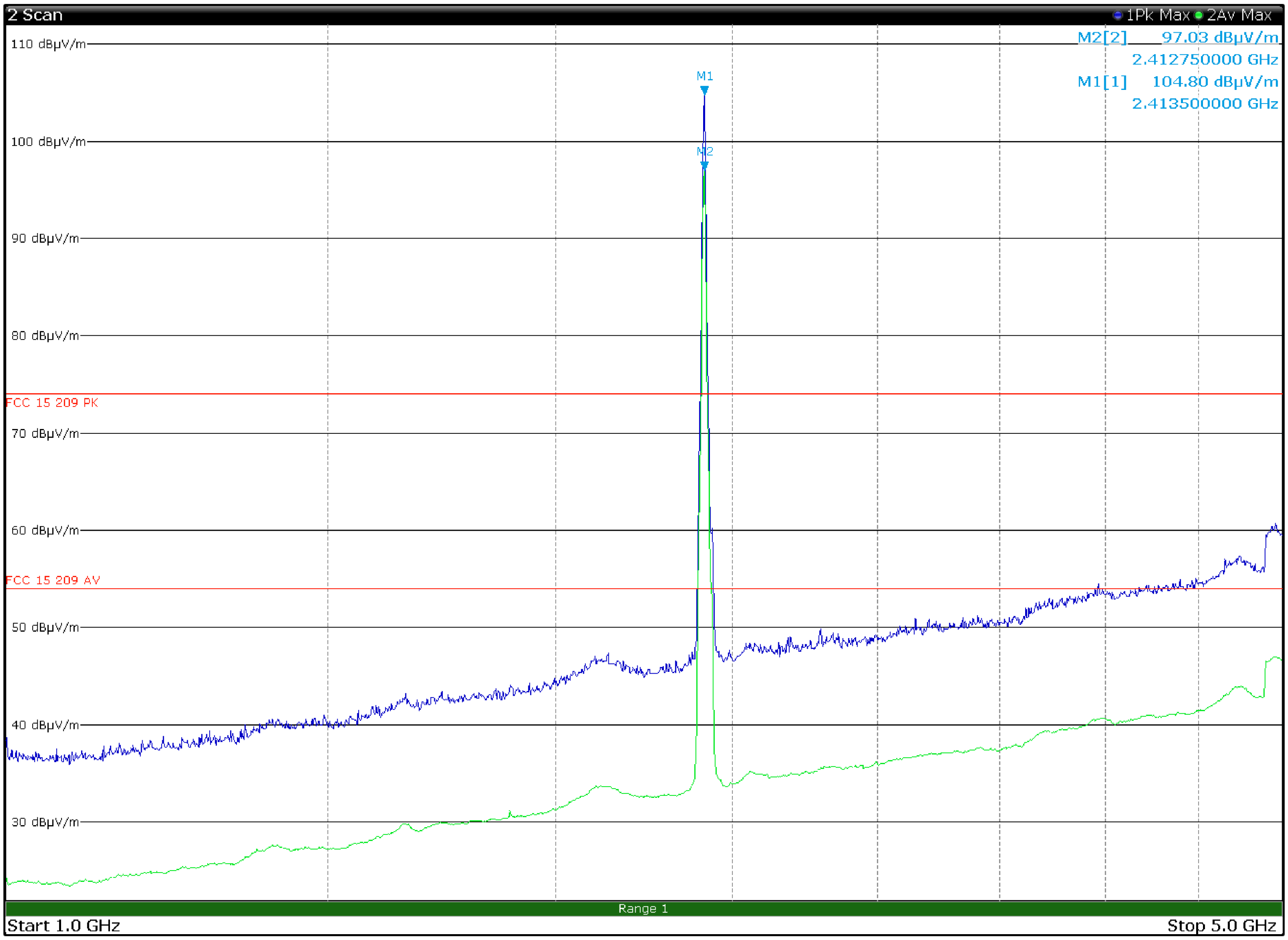
Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11g, 6Mbps, multiple chain with antenna in vertical polarization



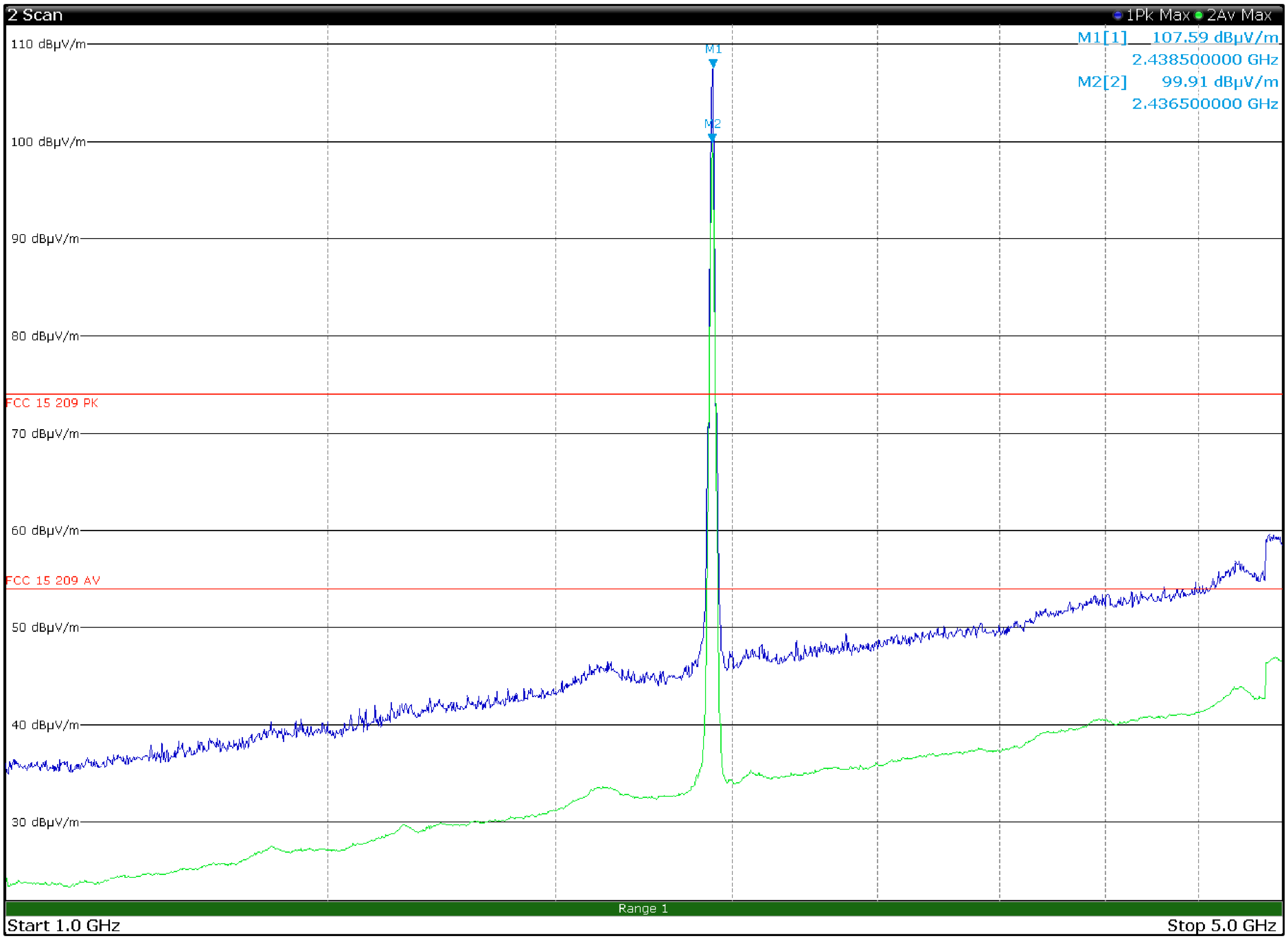
Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11g, 6Mbps, multiple chain with antenna in horizontal polarization



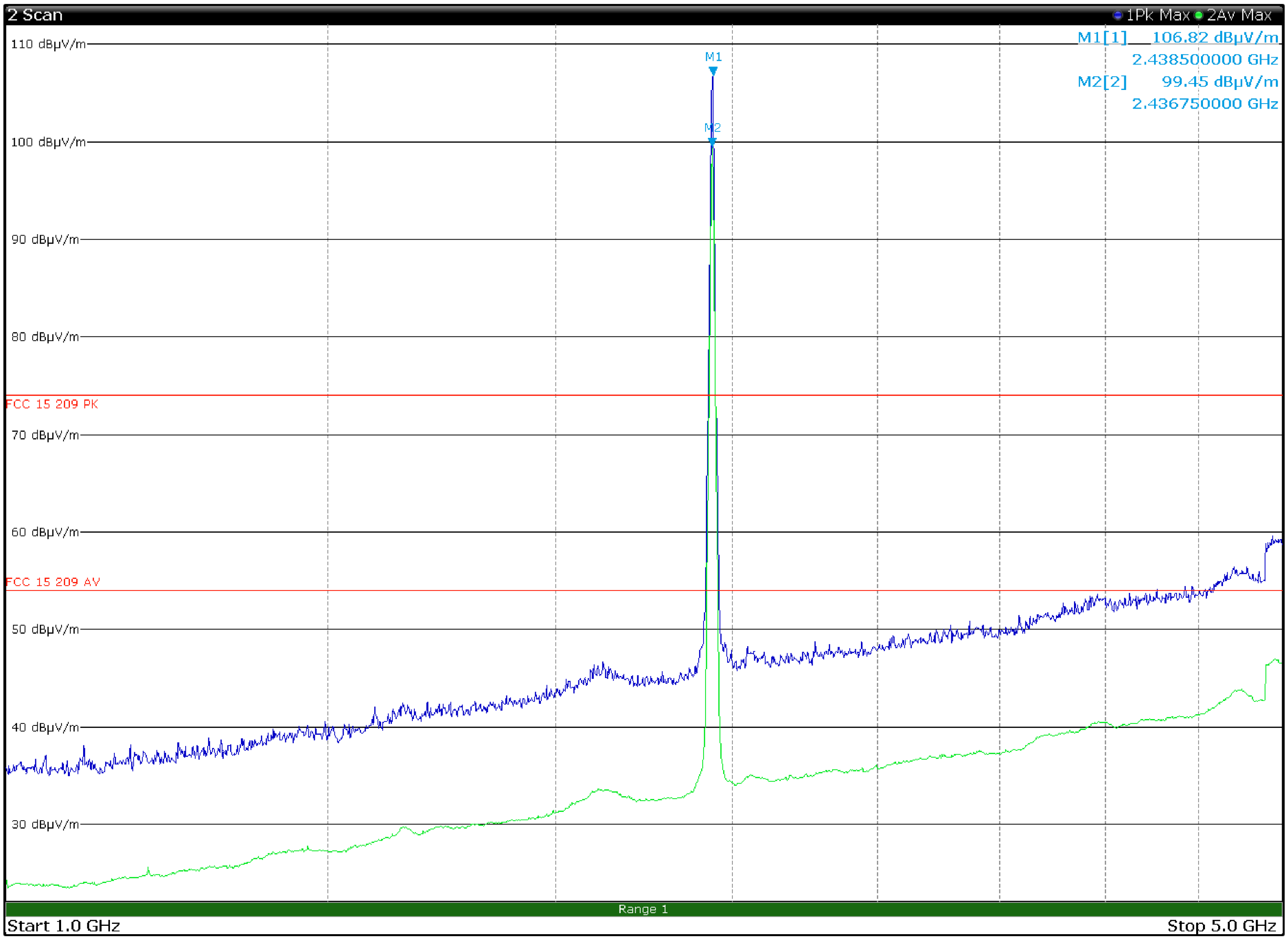
Radiated spurious emissions 1 to 5 GHz, TX 2412 MHz, CH01, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in horizontal polarization



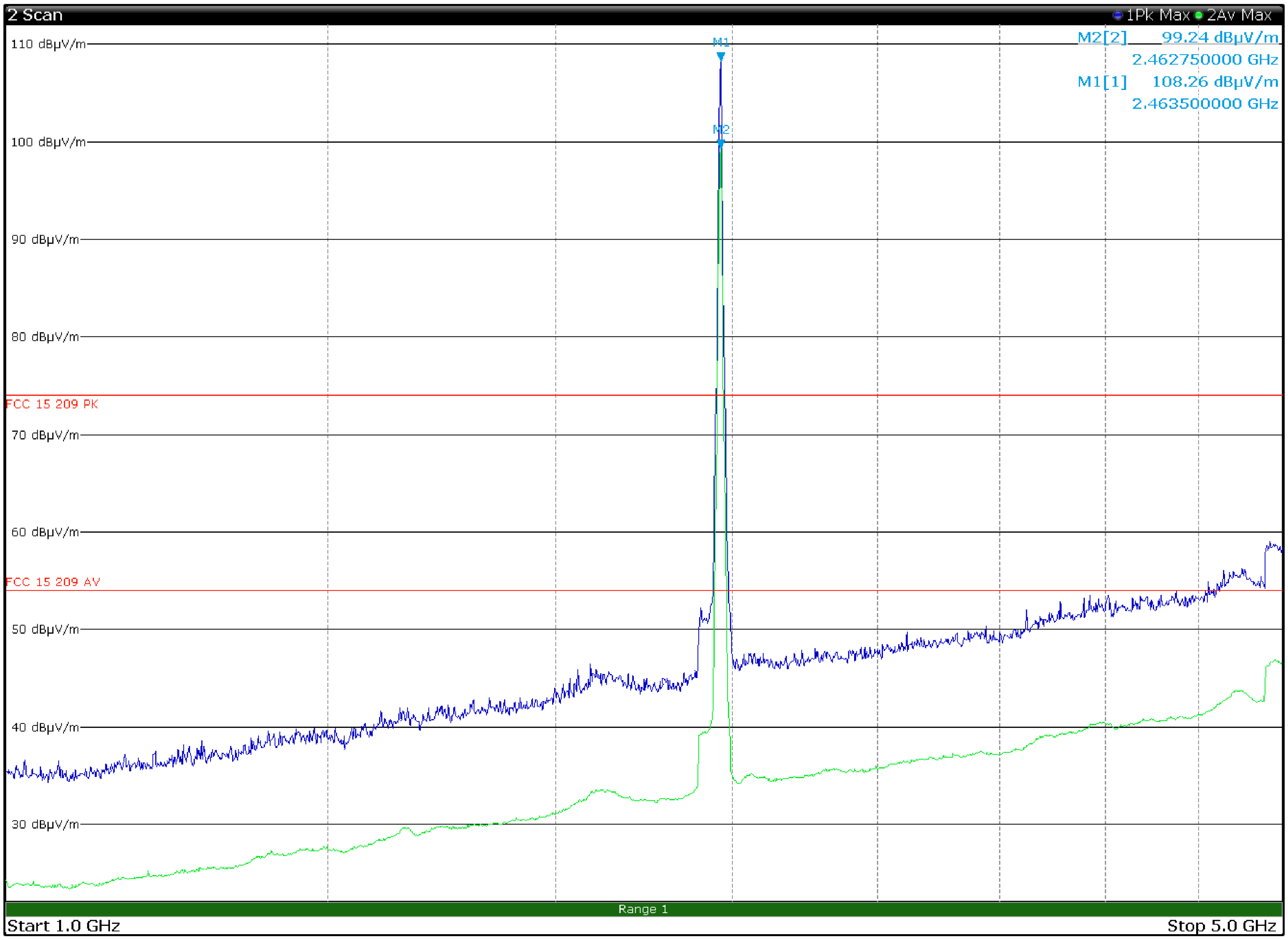
Radiated spurious emissions 1 to 5 GHz, TX 2412 MHz, CH01, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in vertical polarization



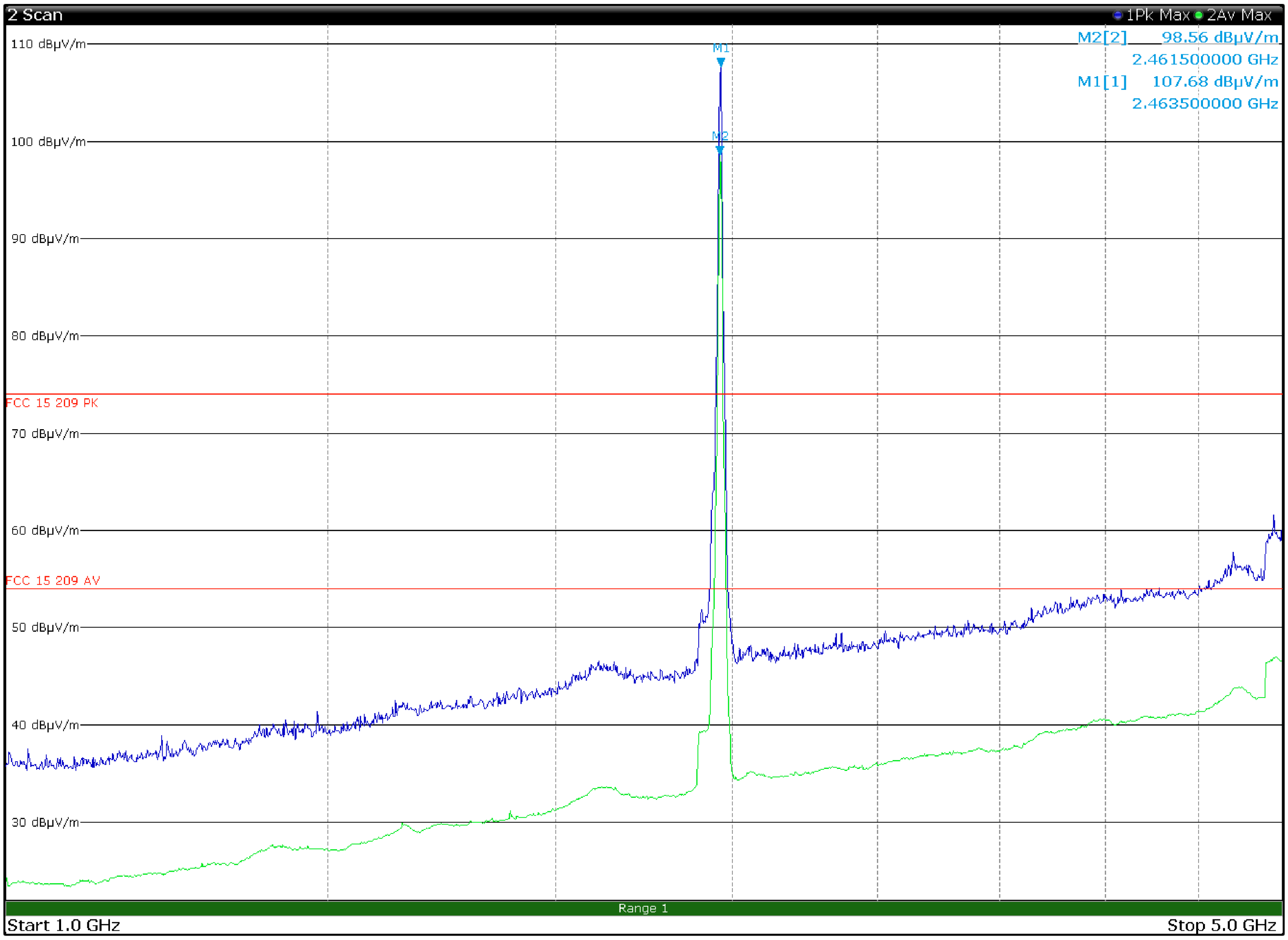
Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in vertical polarization



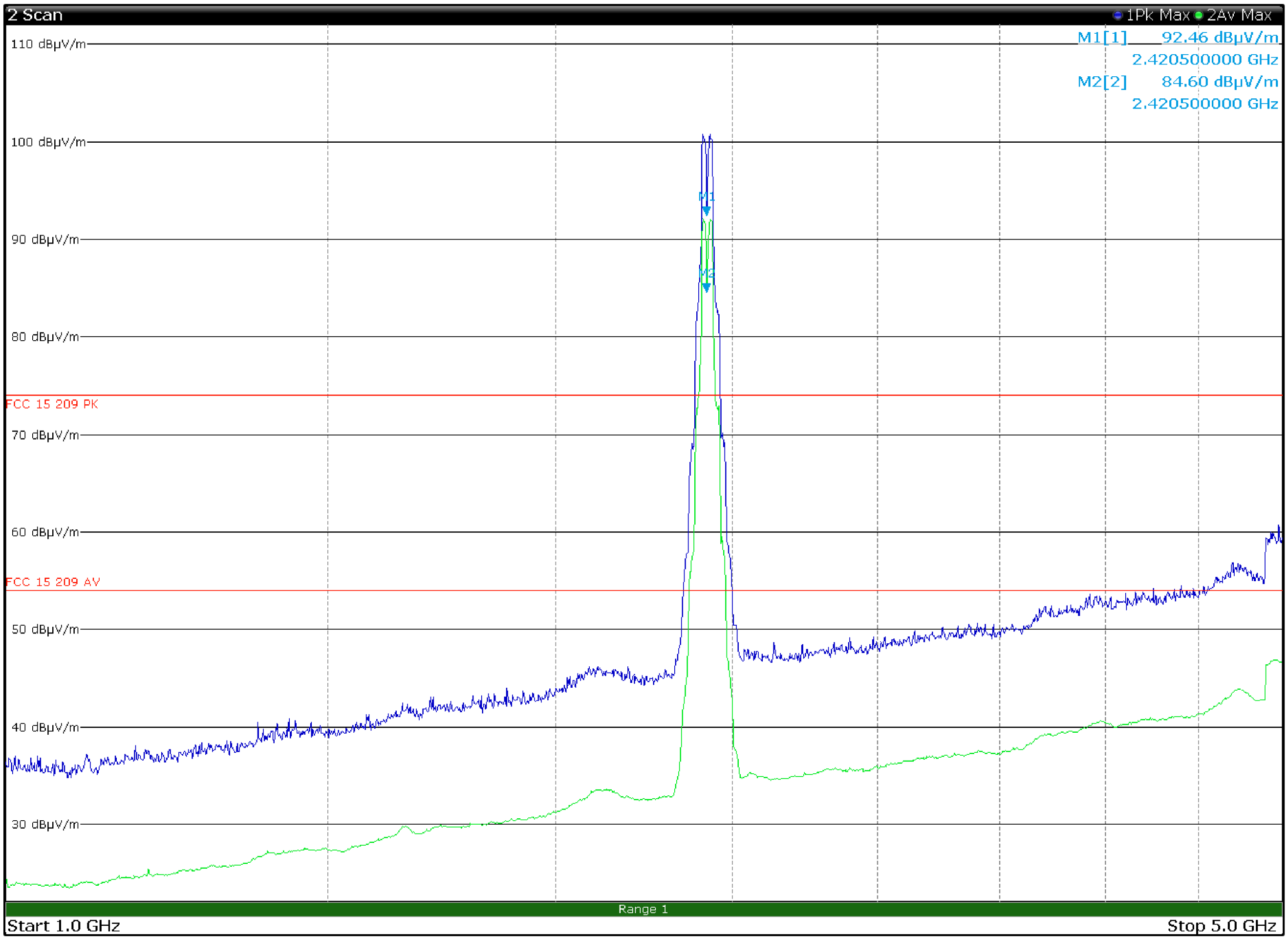
Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11n (20MHz), 6.5Mbps, multiple chainwith antenna in horizontal polarization



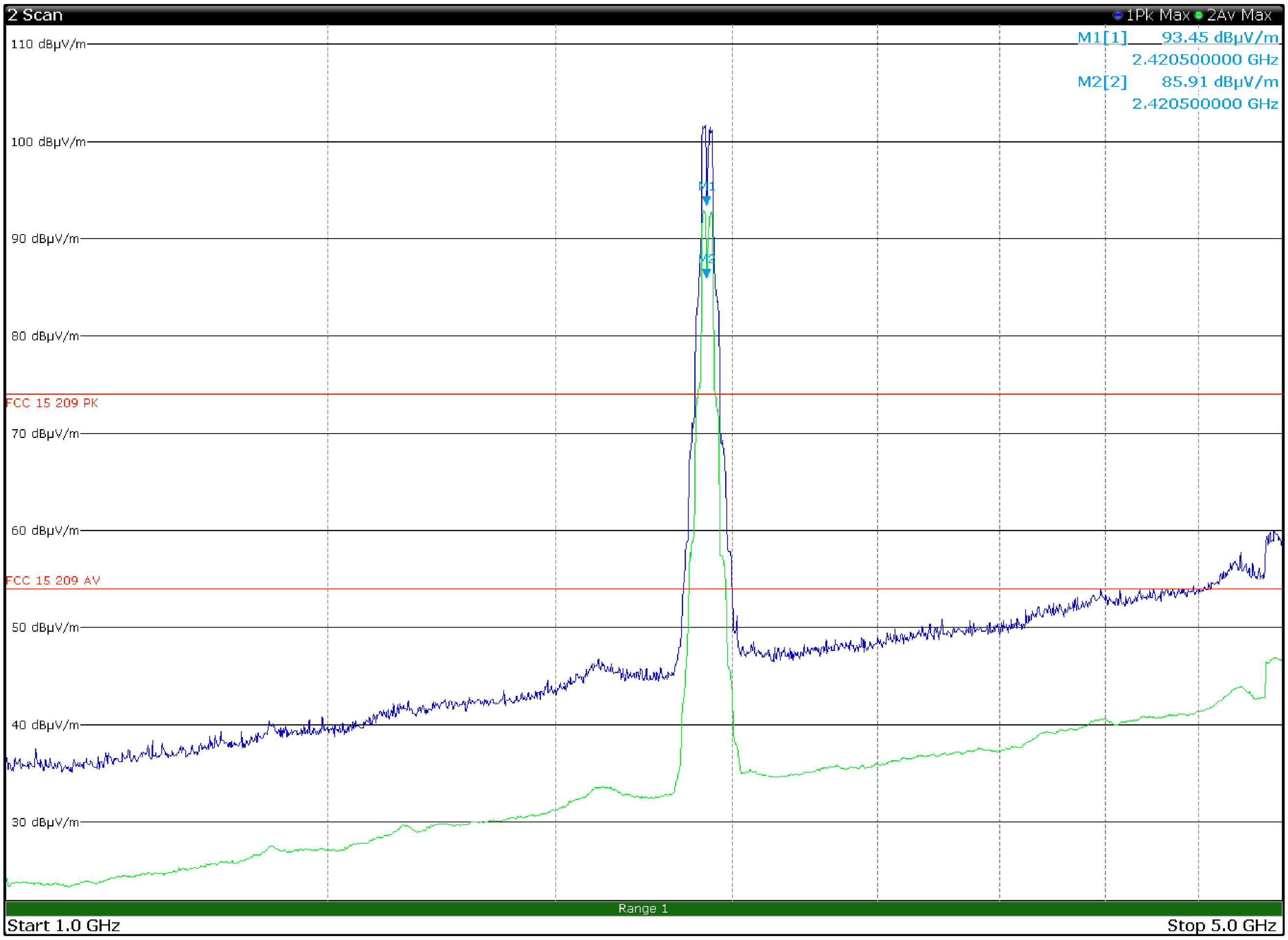
Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in horizontal polarization



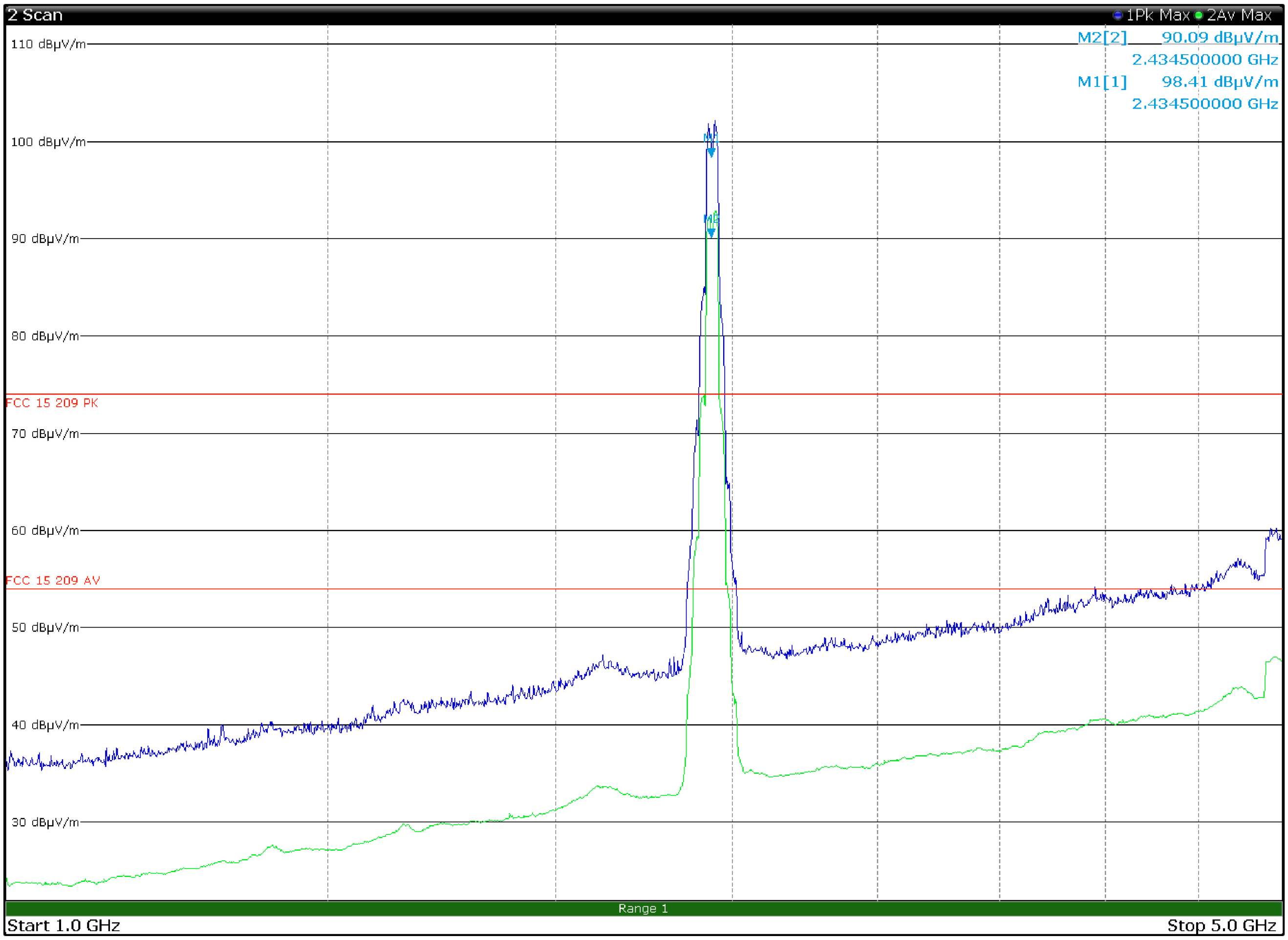
Radiated spurious emissions 1 to 5 GHz, TX 2462 MHz, CH11, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in vertical polarization



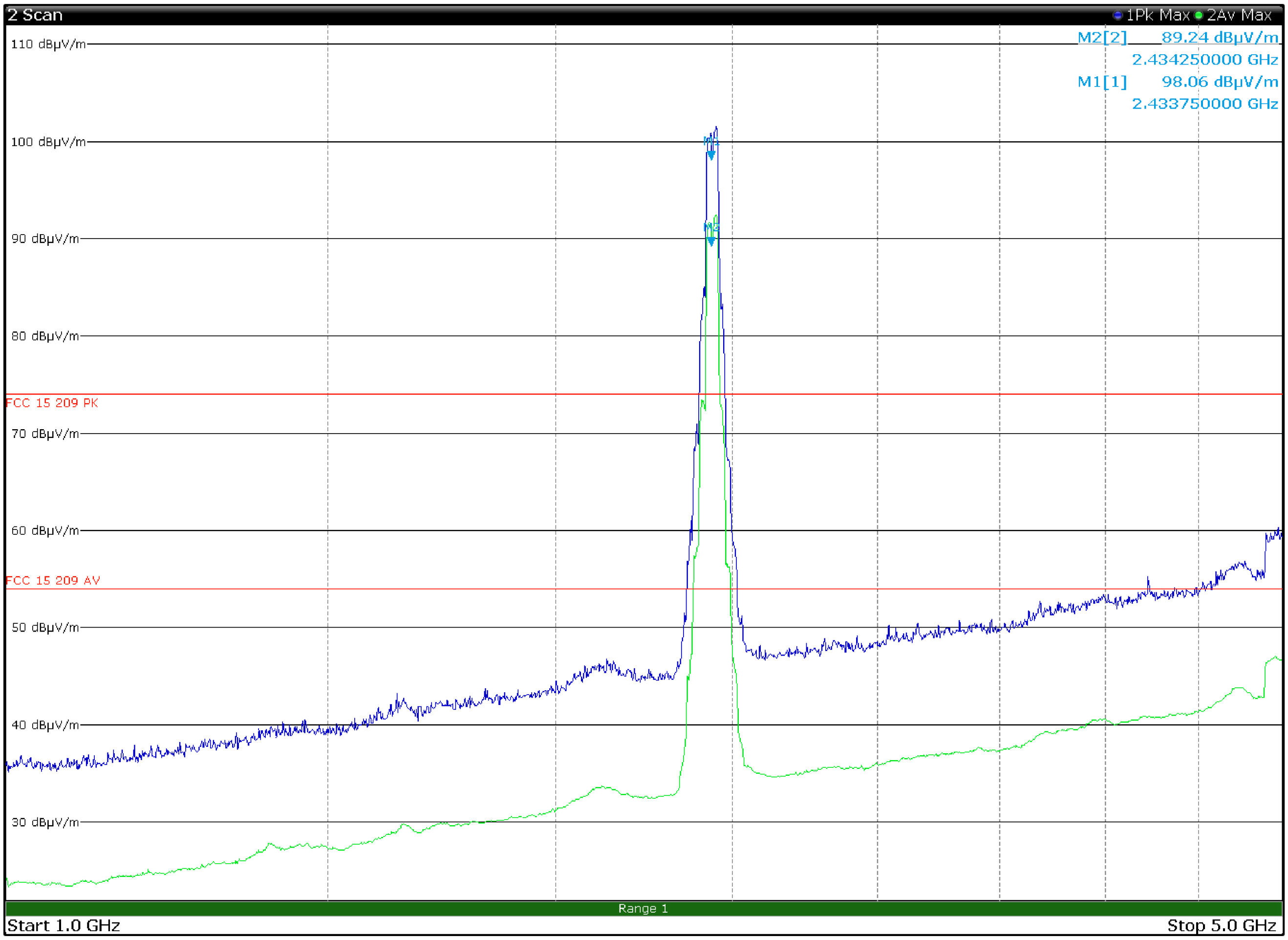
Radiated spurious emissions 1 to 5 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization



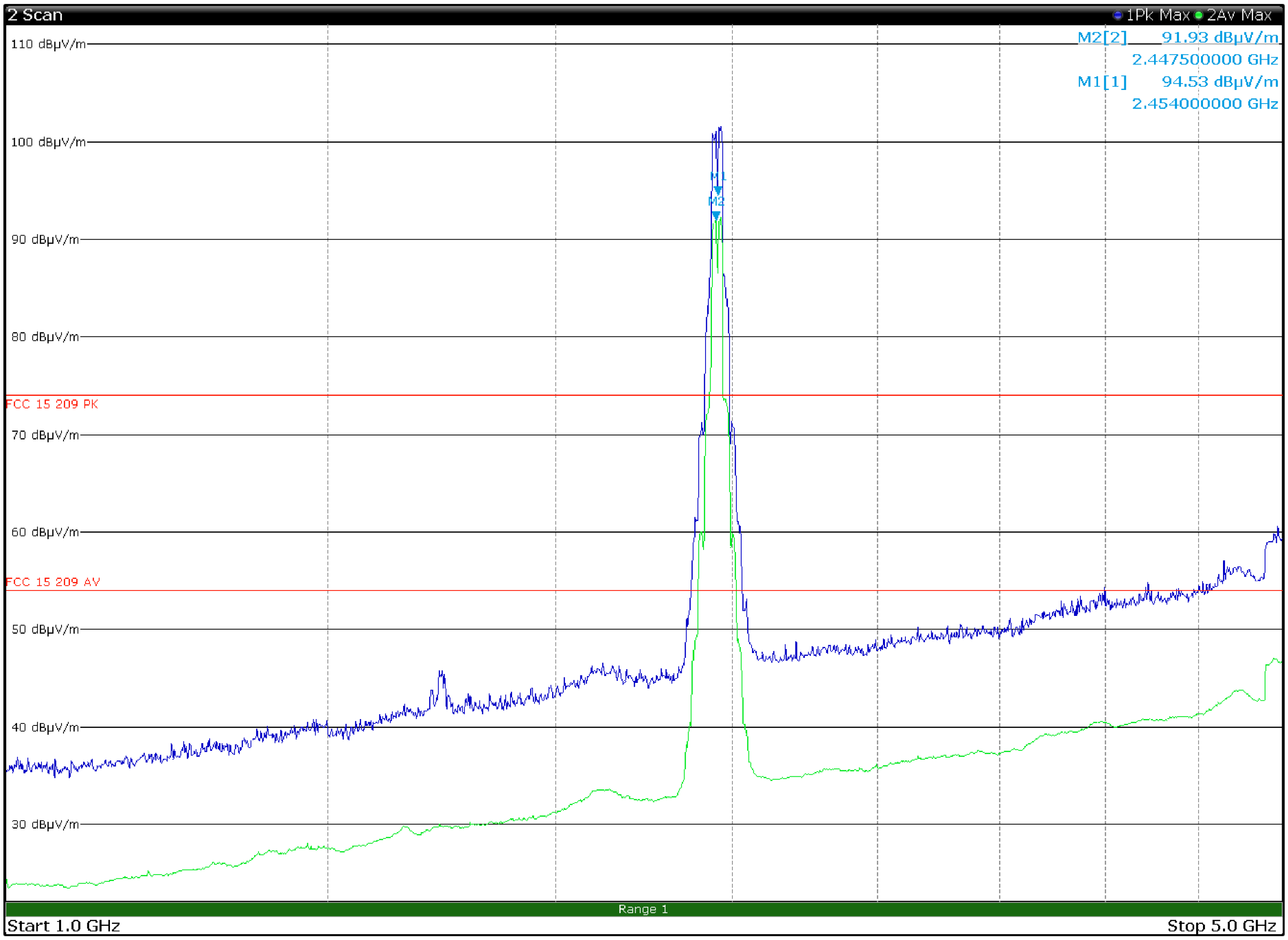
Radiated spurious emissions 1 to 5 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization



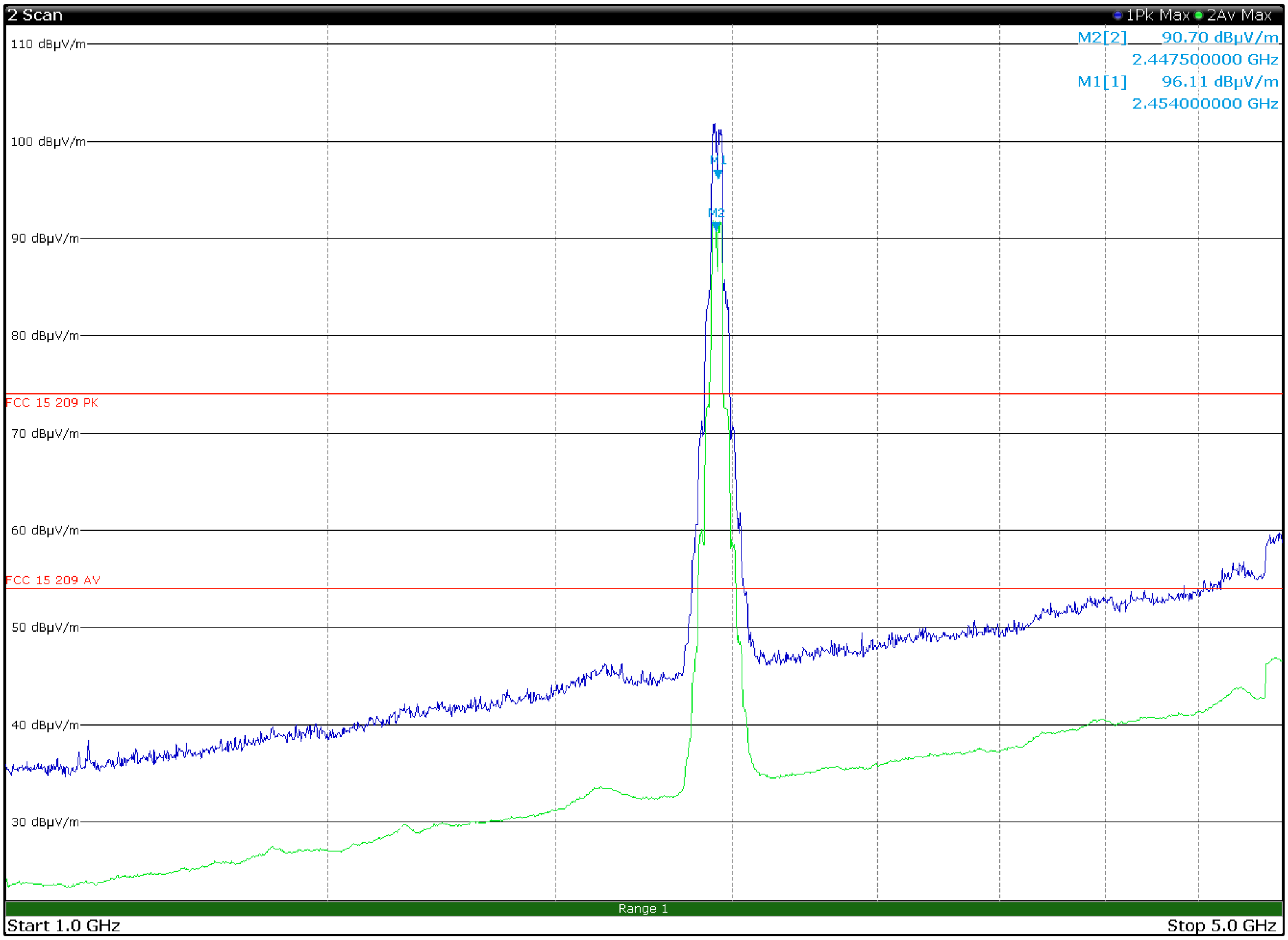
Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization



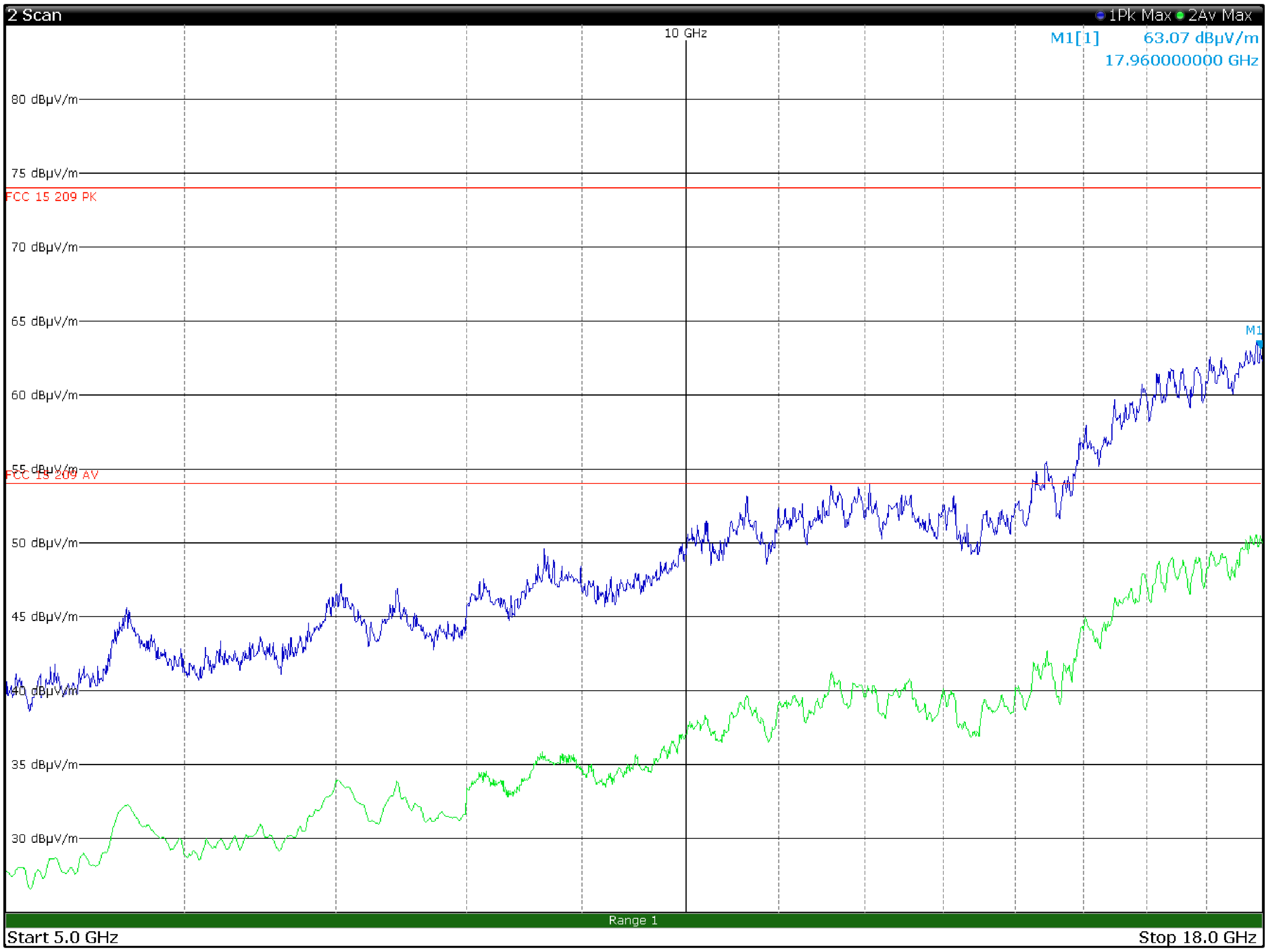
Radiated spurious emissions 1 to 5 GHz, TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization



Radiated spurious emissions 1 to 5 GHz, TX 2452 MHz, CH09, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization



Radiated spurious emissions 1 to 5 GHz, TX 2452 MHz, CH09, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization



Radiated spurious emissions 5 to 18 GHz, TX 2452 MHz, CH09, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization

Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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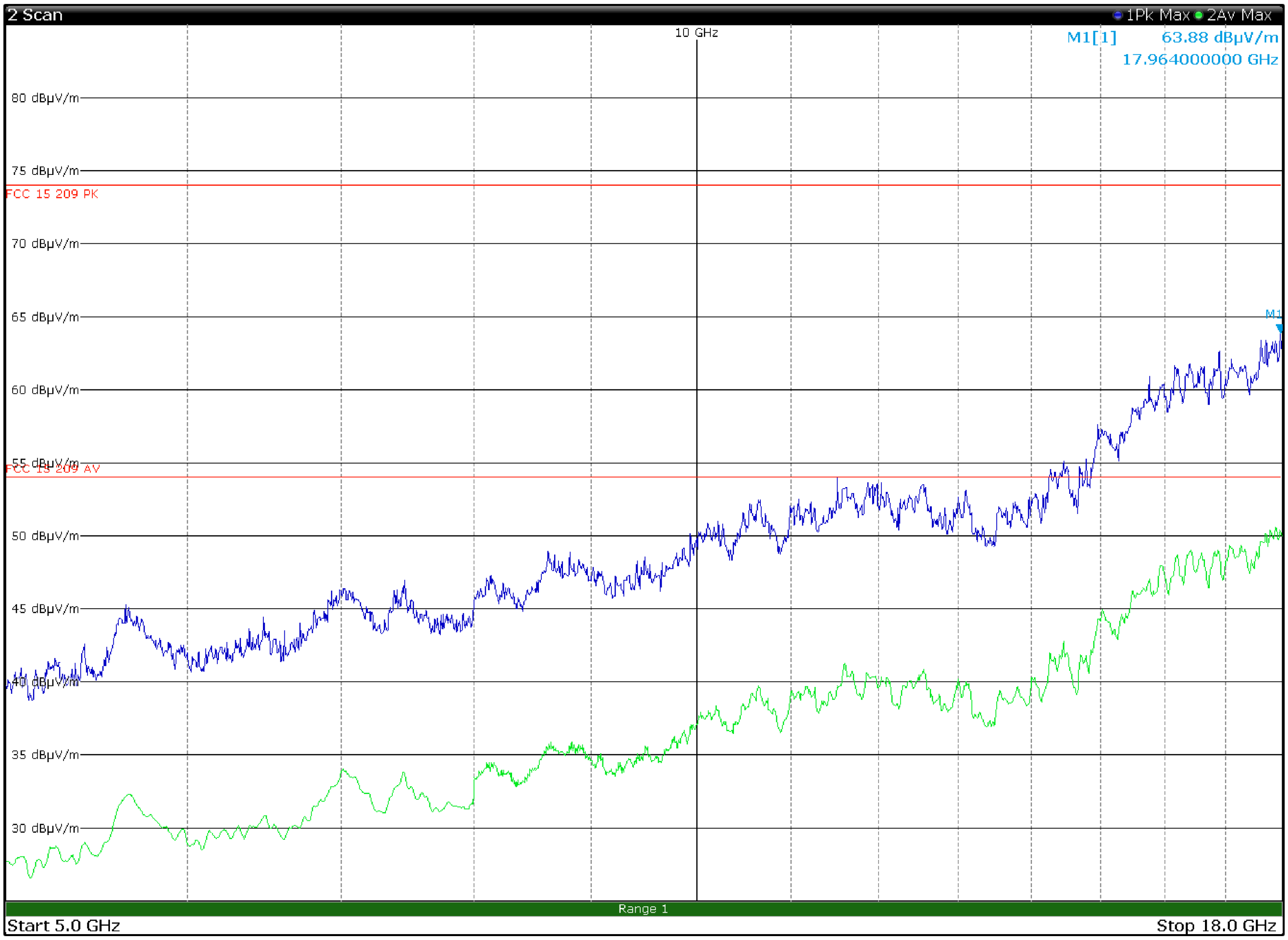

Radiated spurious emissions 3.6 to 18 GHz, TX 2452 MHz, CH09, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in in vertical polarization

Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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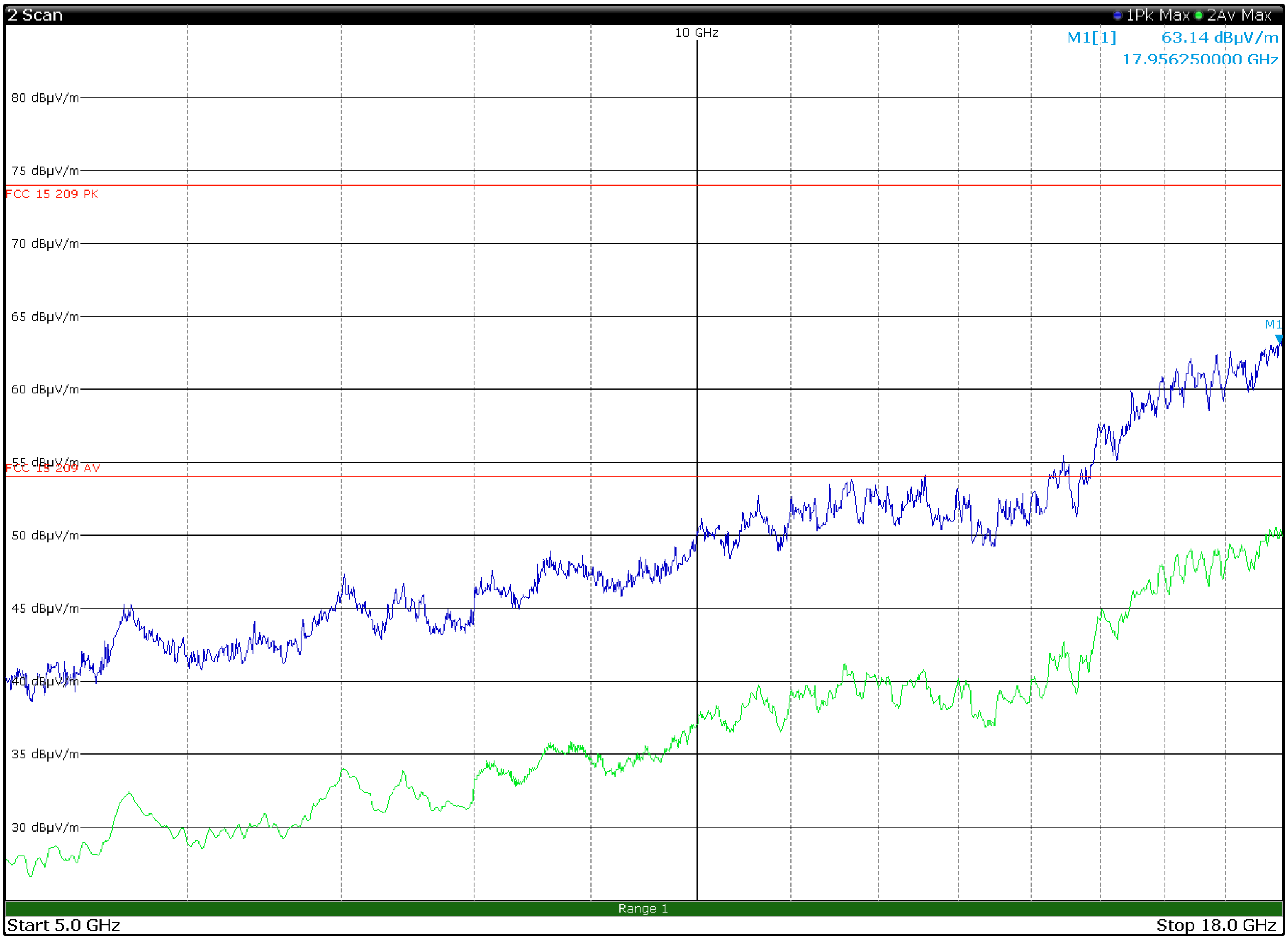

Radiated spurious emissions 5 to 18 GHz, , TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization

Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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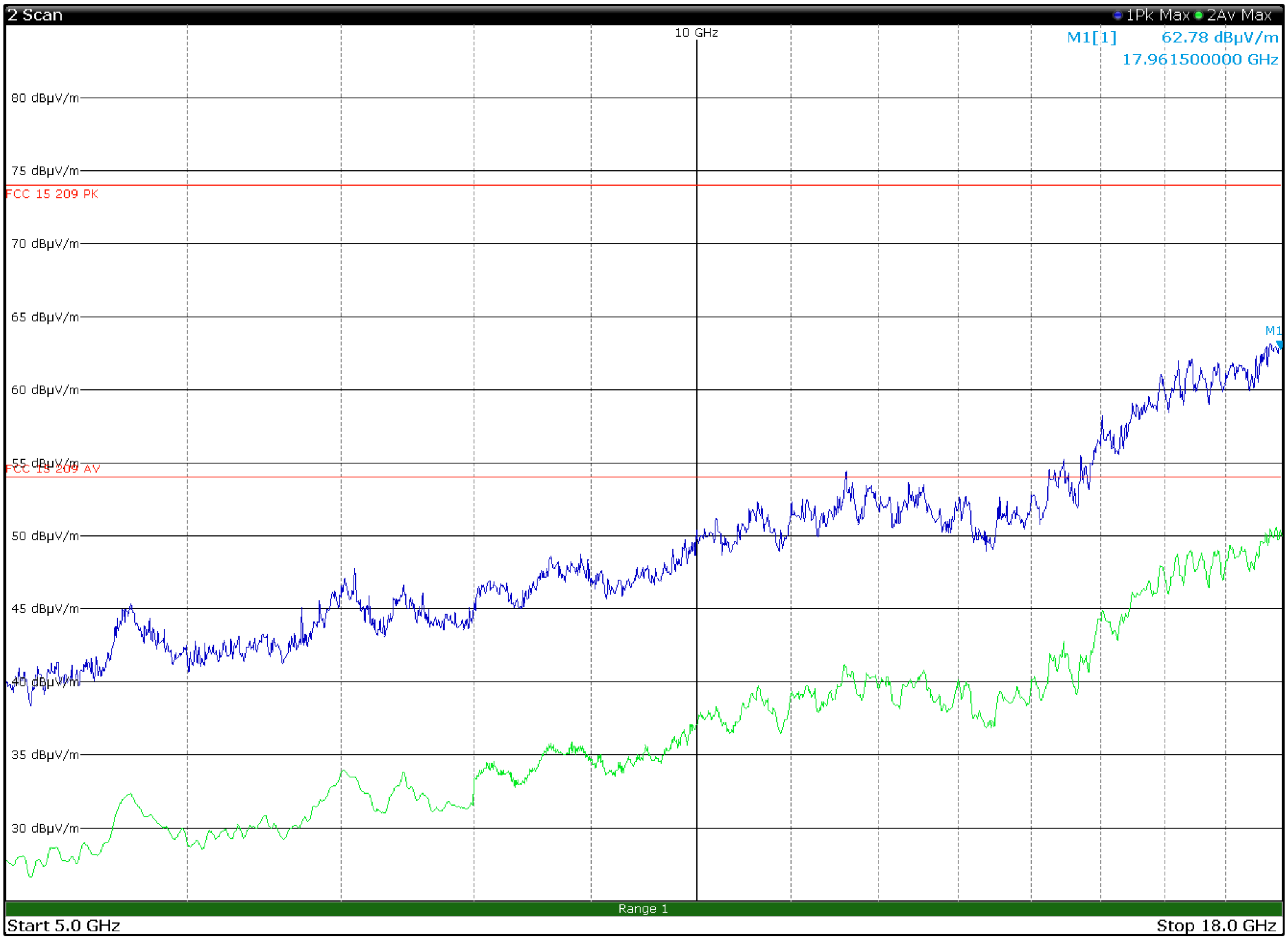

Radiated spurious emissions 5 to 18 GHz, , TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization

Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
--	--	--	--	--
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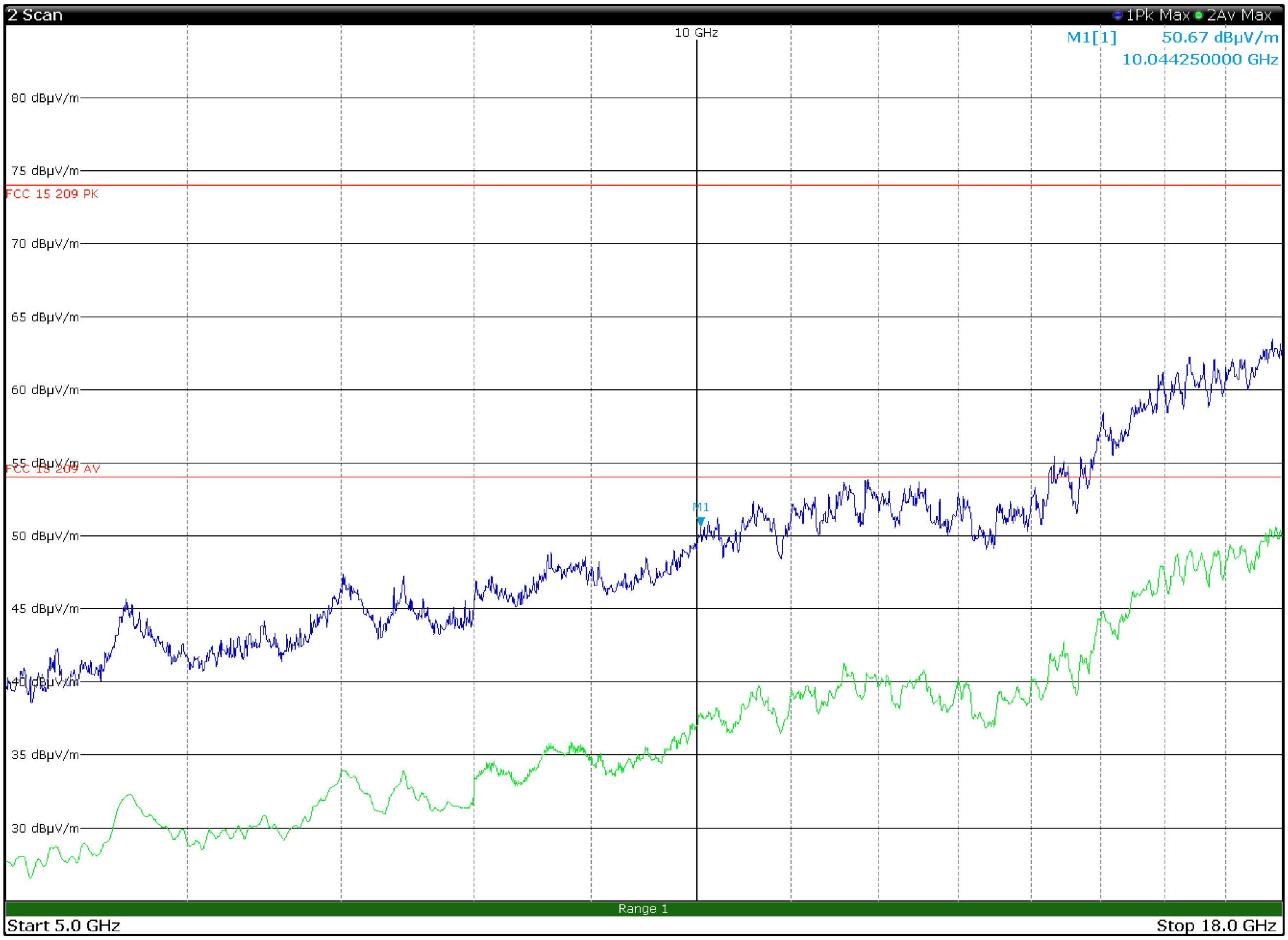

: Radiated spurious emissions 5 to 18 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization

Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
--	--	--	--	--
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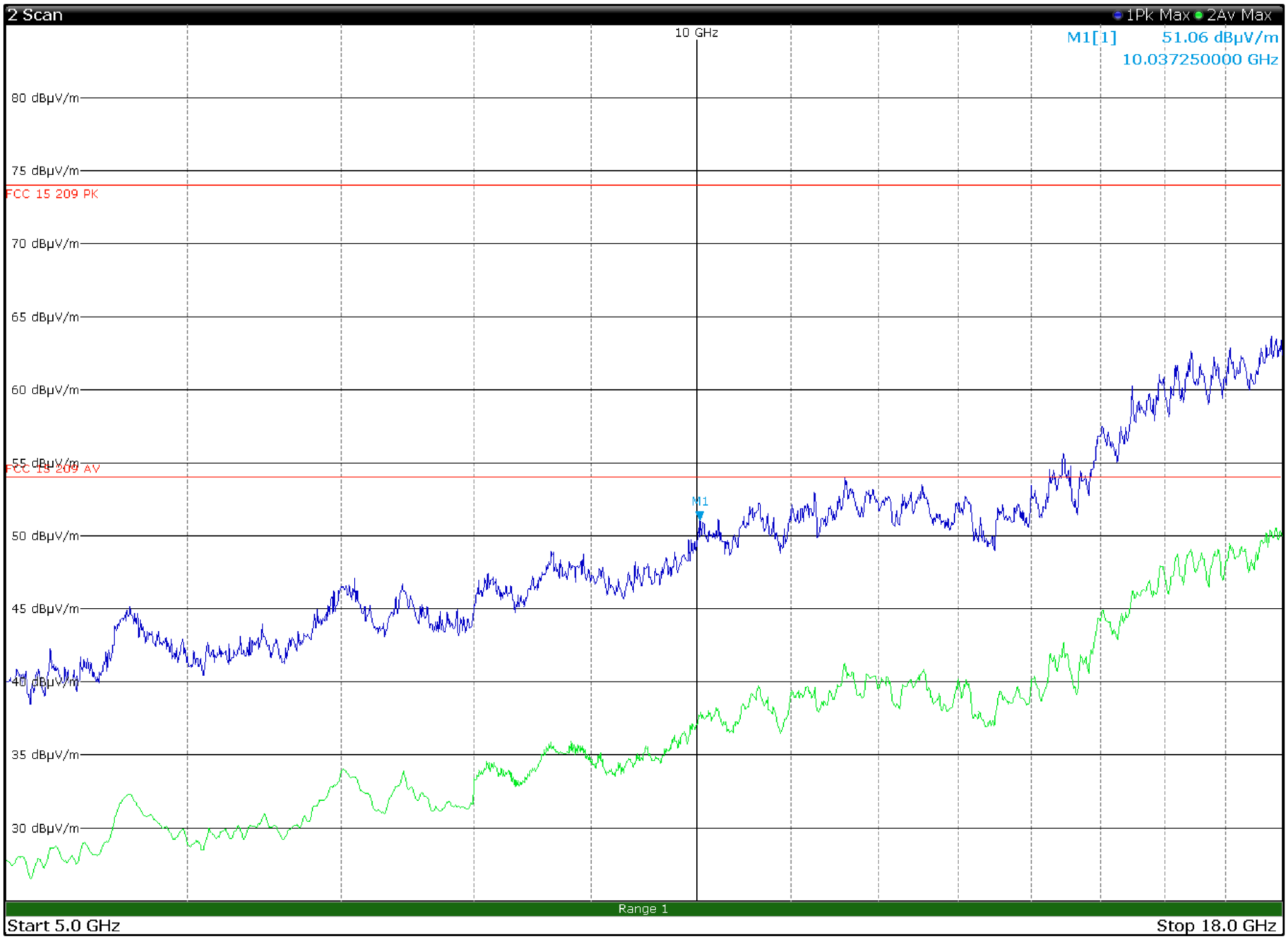
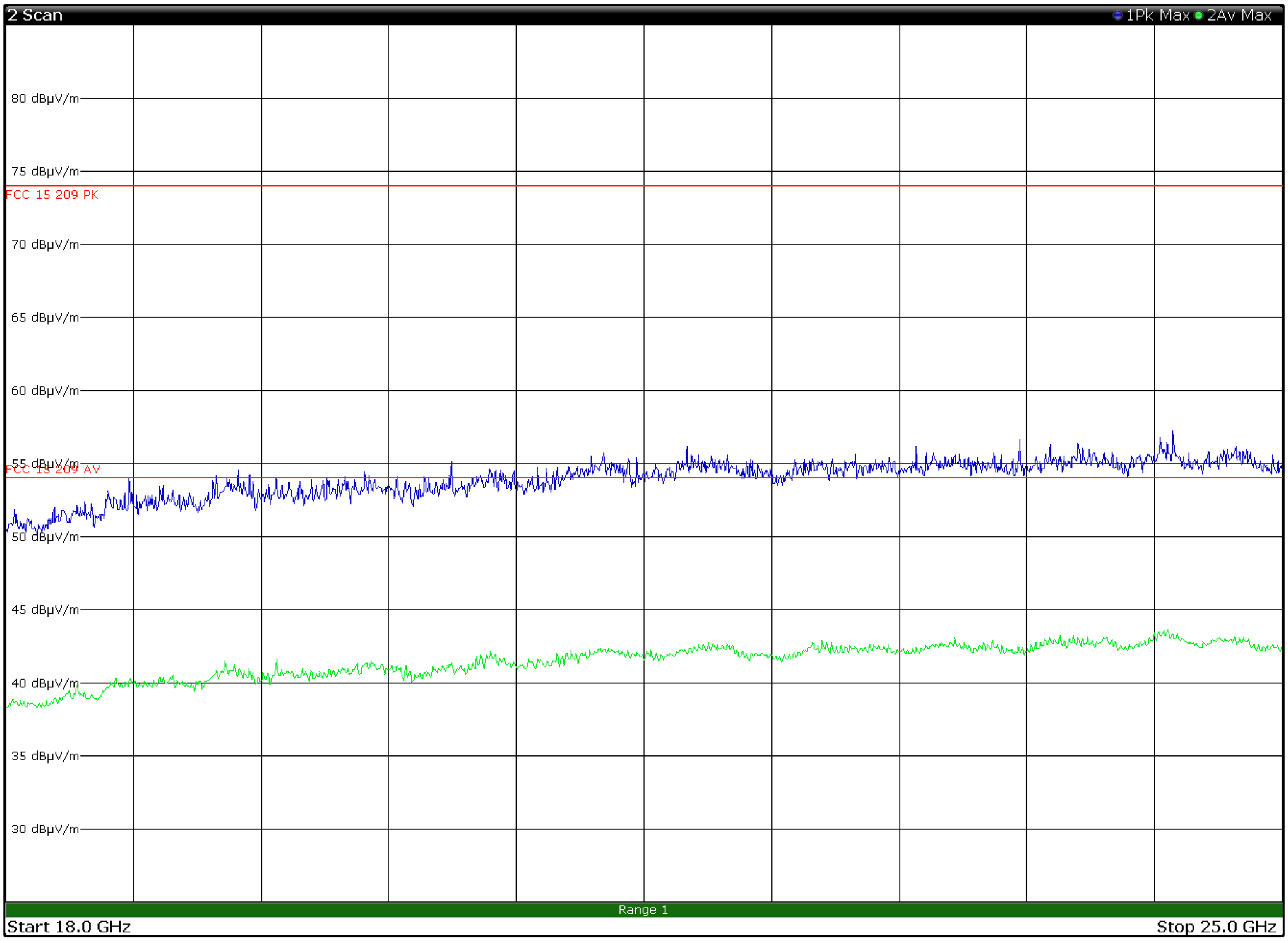
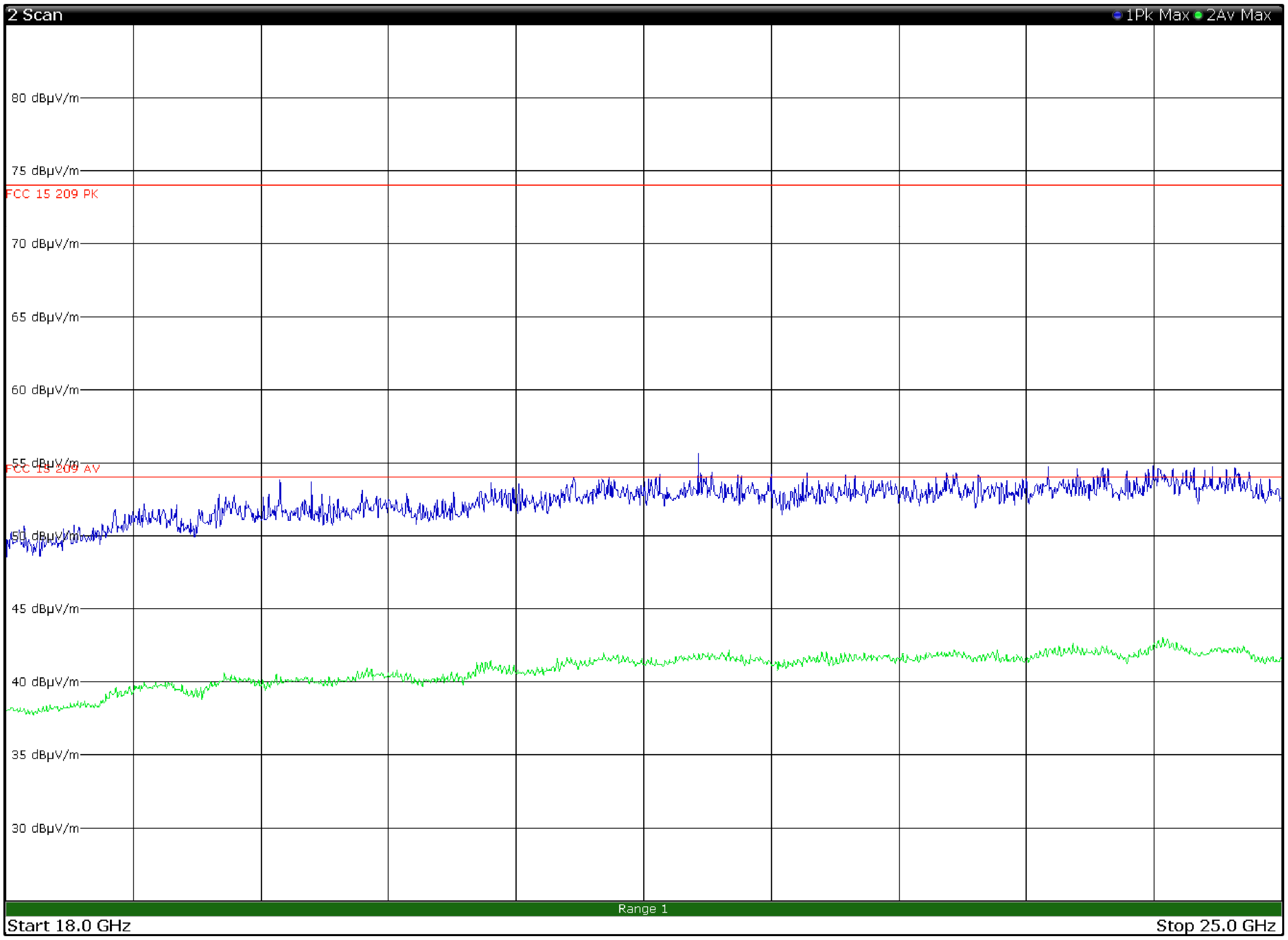


Radiated spurious emissions 5 to 18 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization

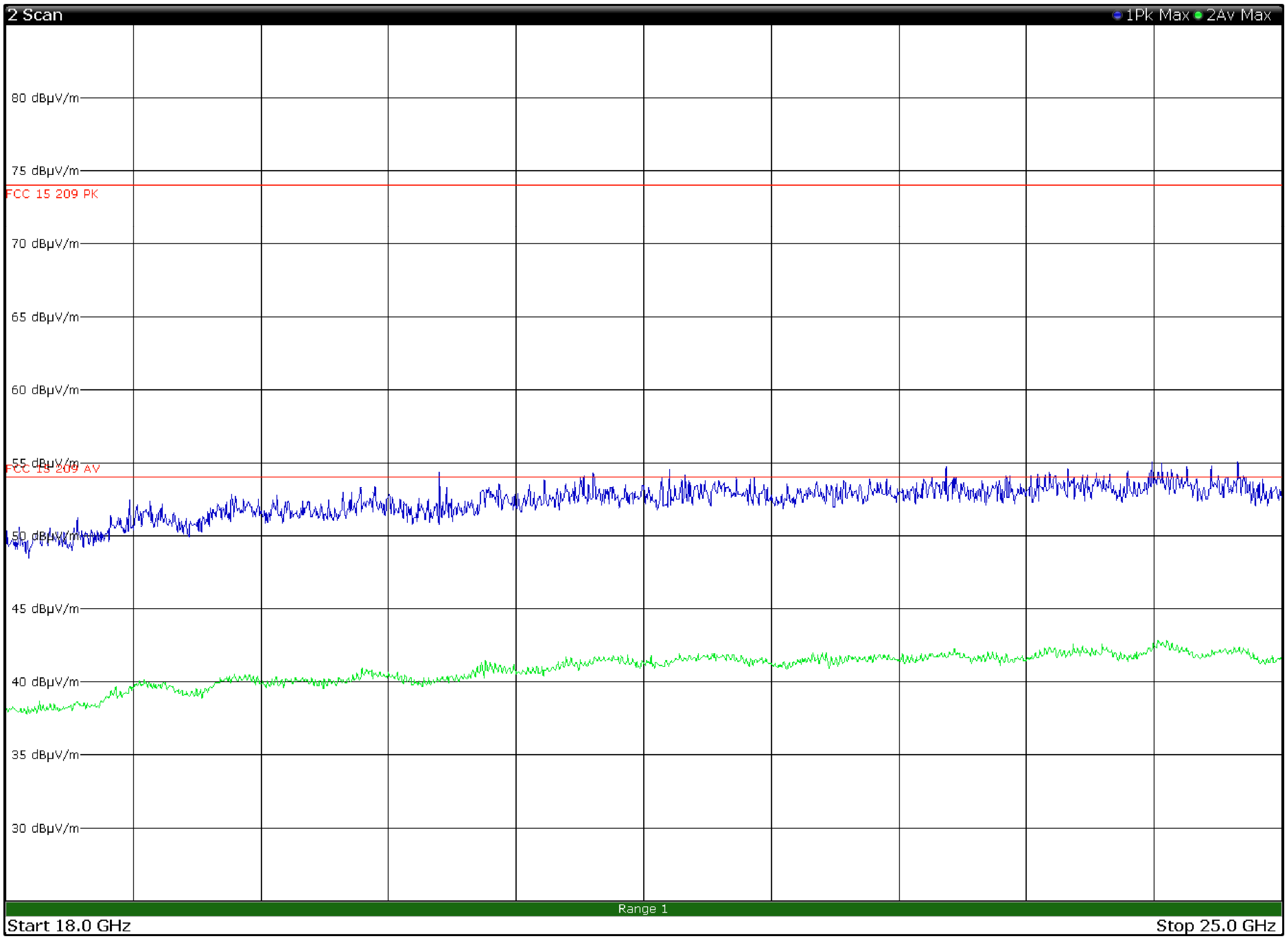
Frequency (GHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
--	--	--	--	--
--	--	--	--	--



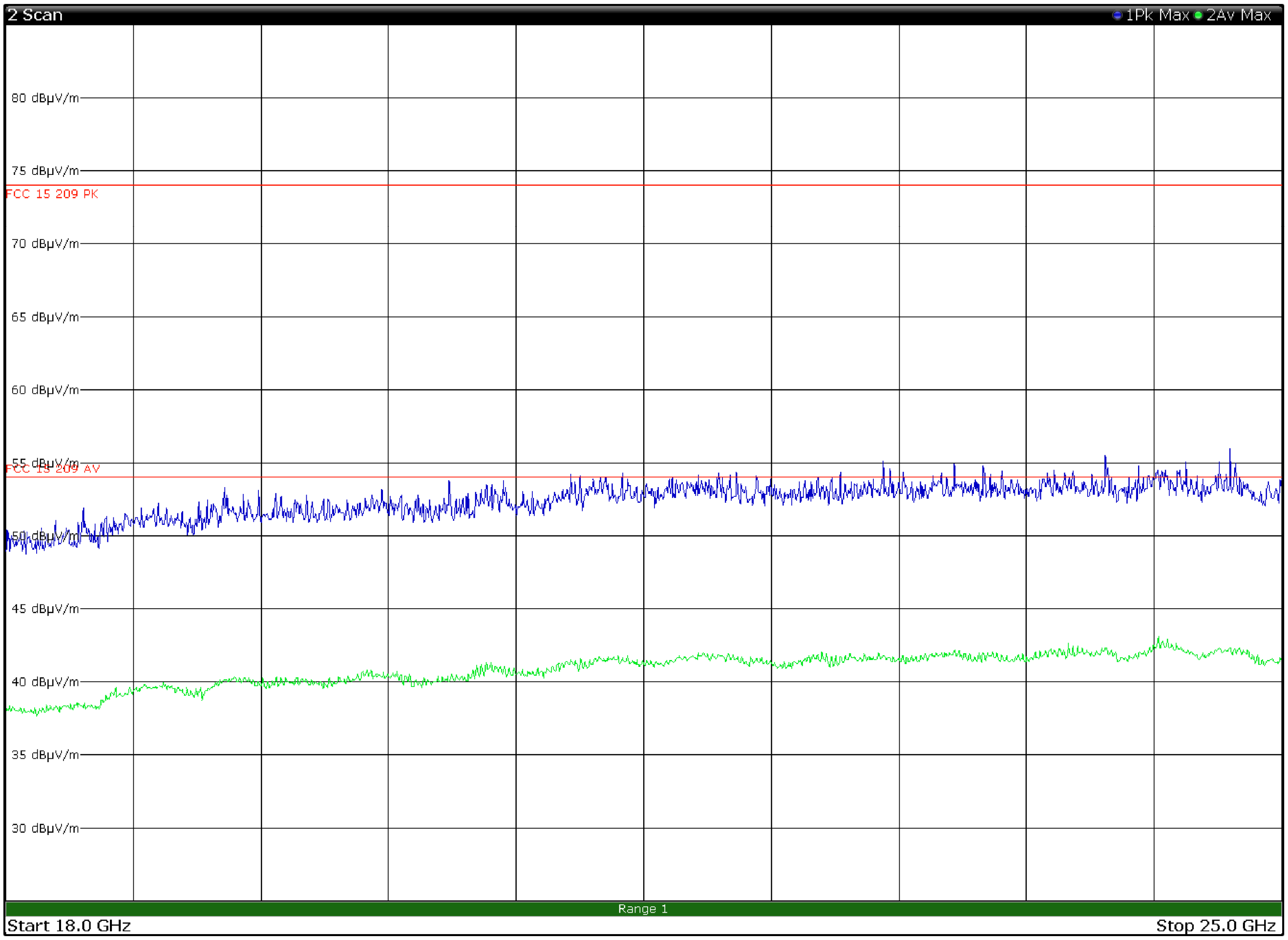
Radiated spurious emissions 18 to 25 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain in horizontal polarization



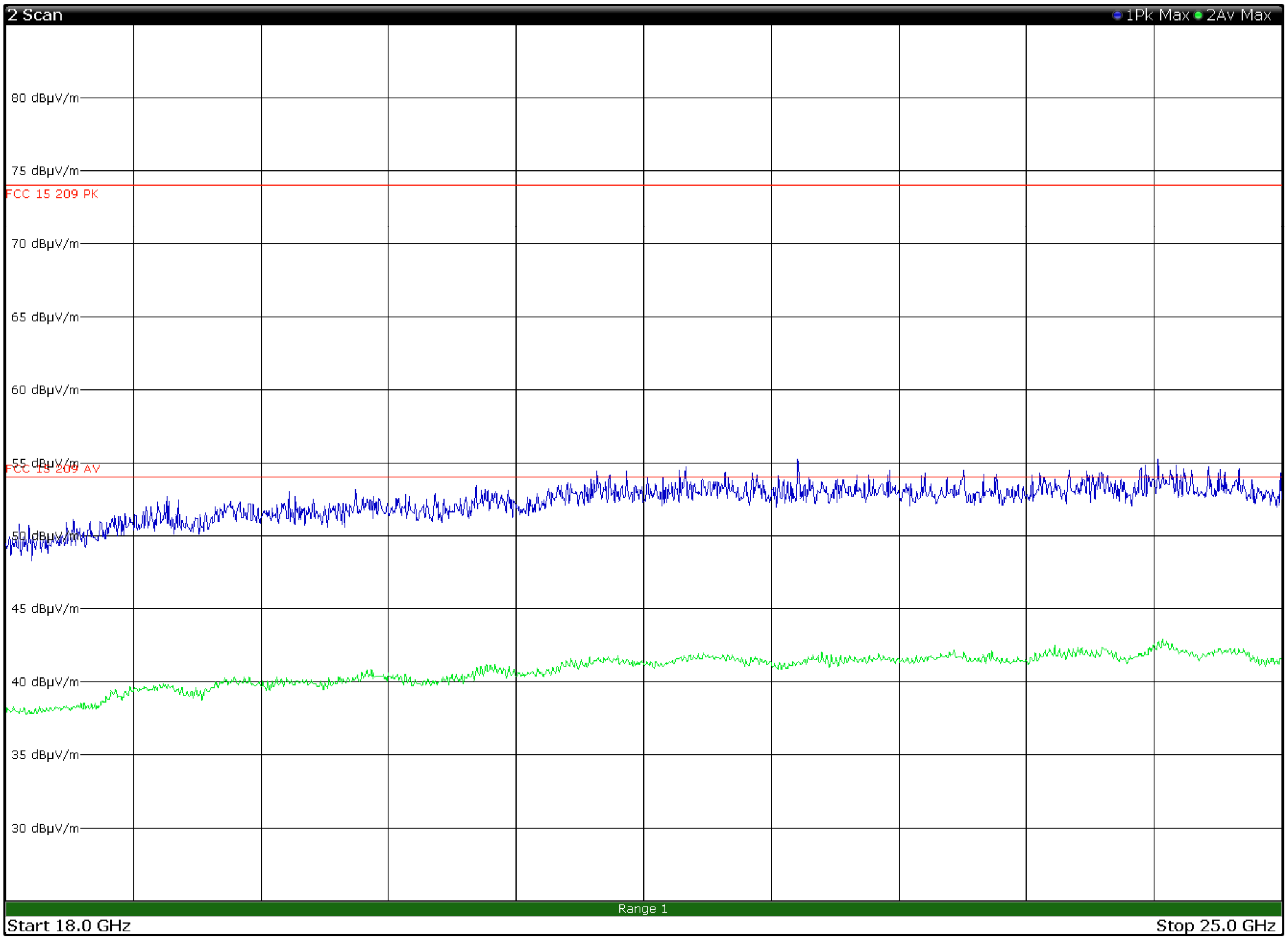
Radiated spurious emissions 18 to 25 GHz, TX 2422 MHz, CH03, 802.11n (40MHz), 13.5Mbps, multiple chain in vertical polarization



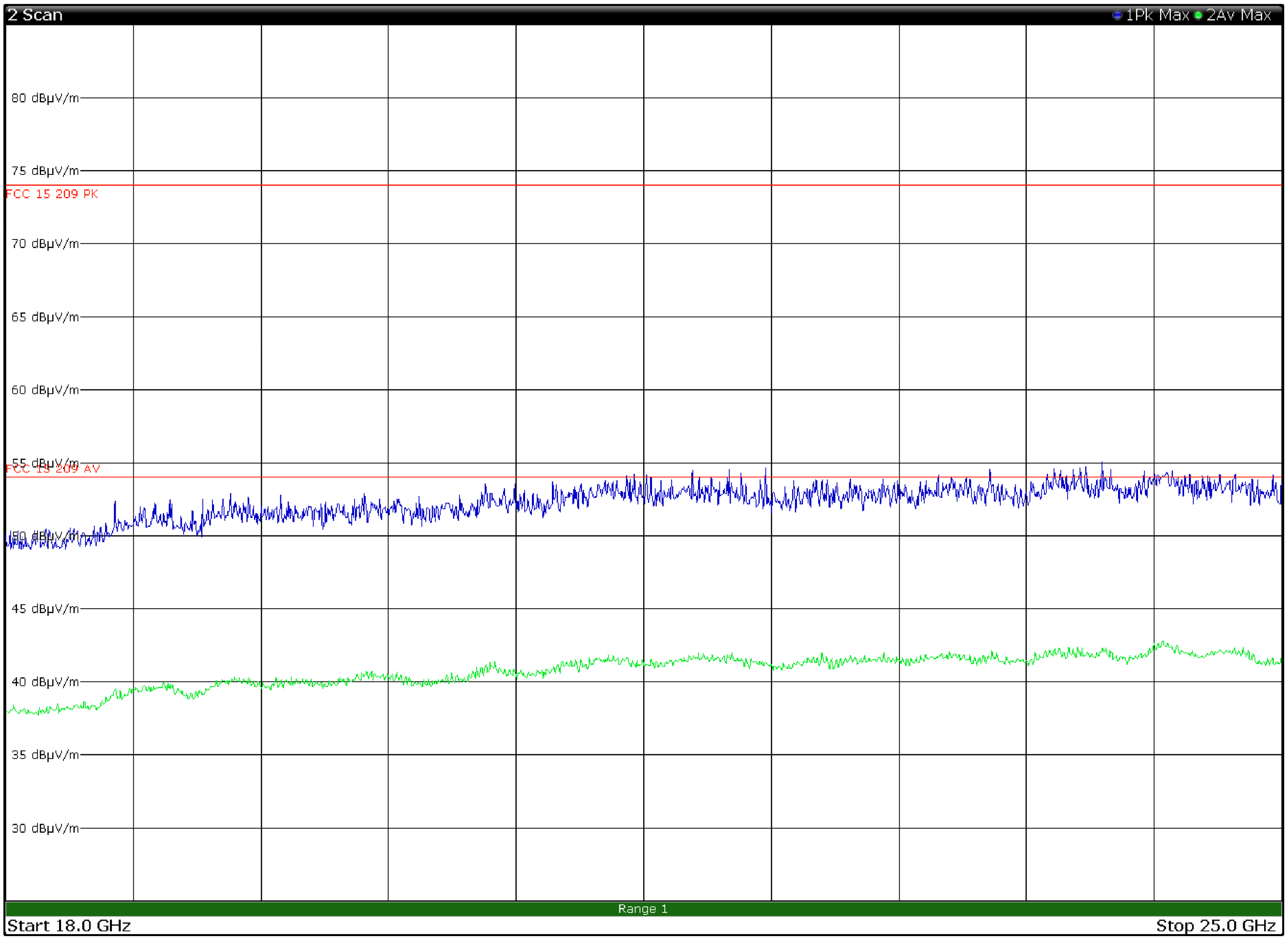
: Radiated spurious emissions 18 to 25 GHz, TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in horizontal polarization



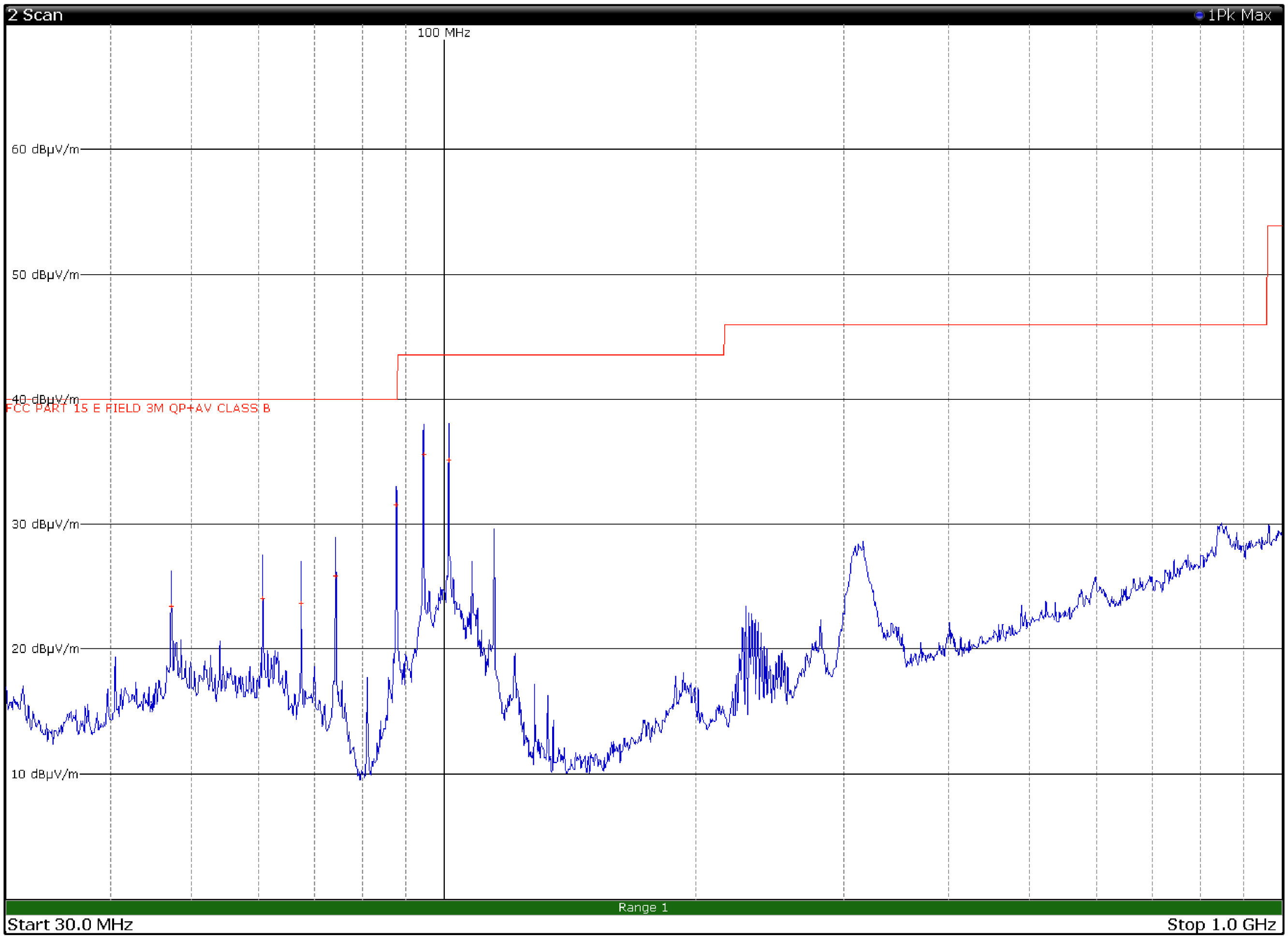
Radiated spurious emissions 18 to 25 GHz, TX 2437 MHz, CH06, 802.11n (40MHz), 13.5Mbps, multiple chain with antenna in vertical polarization



: Radiated spurious emissions 18 to 25 GHz, TX 2462 MHz, CH11, 802.11n (20MHz), 6.5Mbps, multiple chain with antenna in horizontal polarization

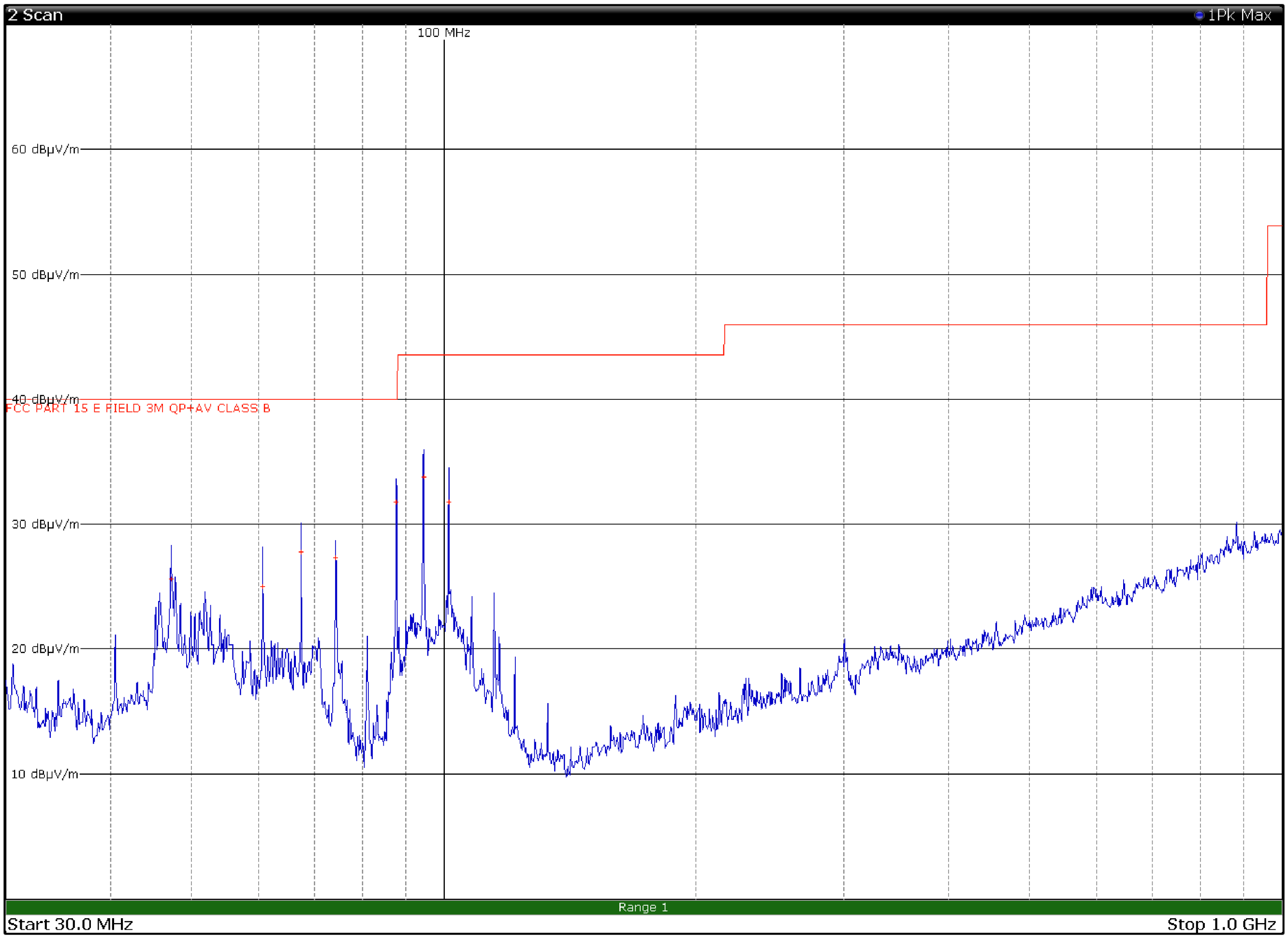


Radiated spurious emissions 18 to 25 GHz, TX 2462 MHz, CH11, 802.11n (20MHz), 6.5Mbps, multiple chain with with antenna in vertical polarization



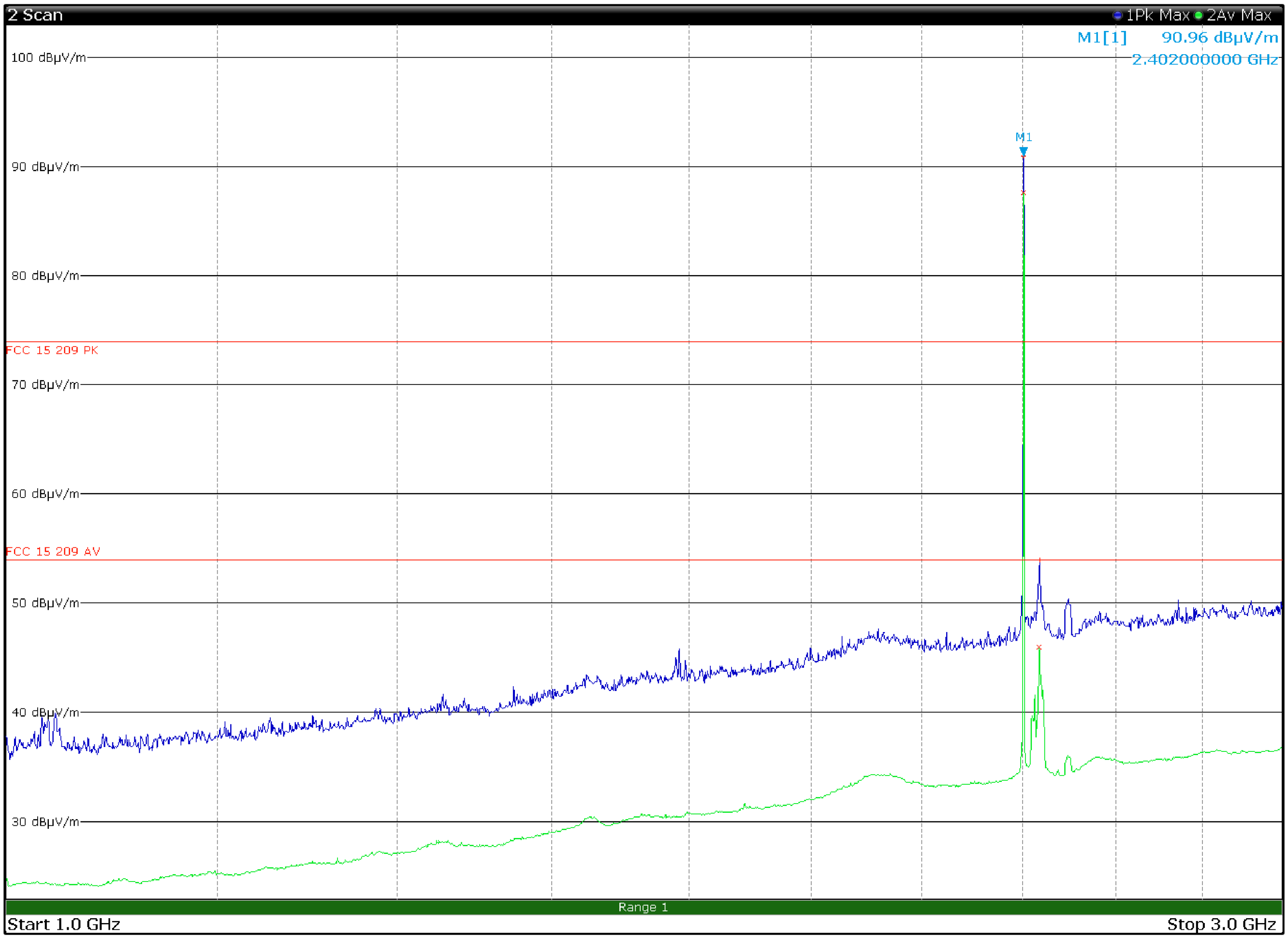
TX 2480 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
47.2500	23.5	40.0	-16.5	QP
60.7500	24.0	40.0	-16.0	QP
67.5000	23.7	40.0	-16.3	QP
74.2500	25.9	40.0	-14.1	QP
87.7500	31.6	40.0	-8.4	QP
94.5000	35.7	43.5	-7.8	QP
101.2500	35.2	43.5	-8.3	QP

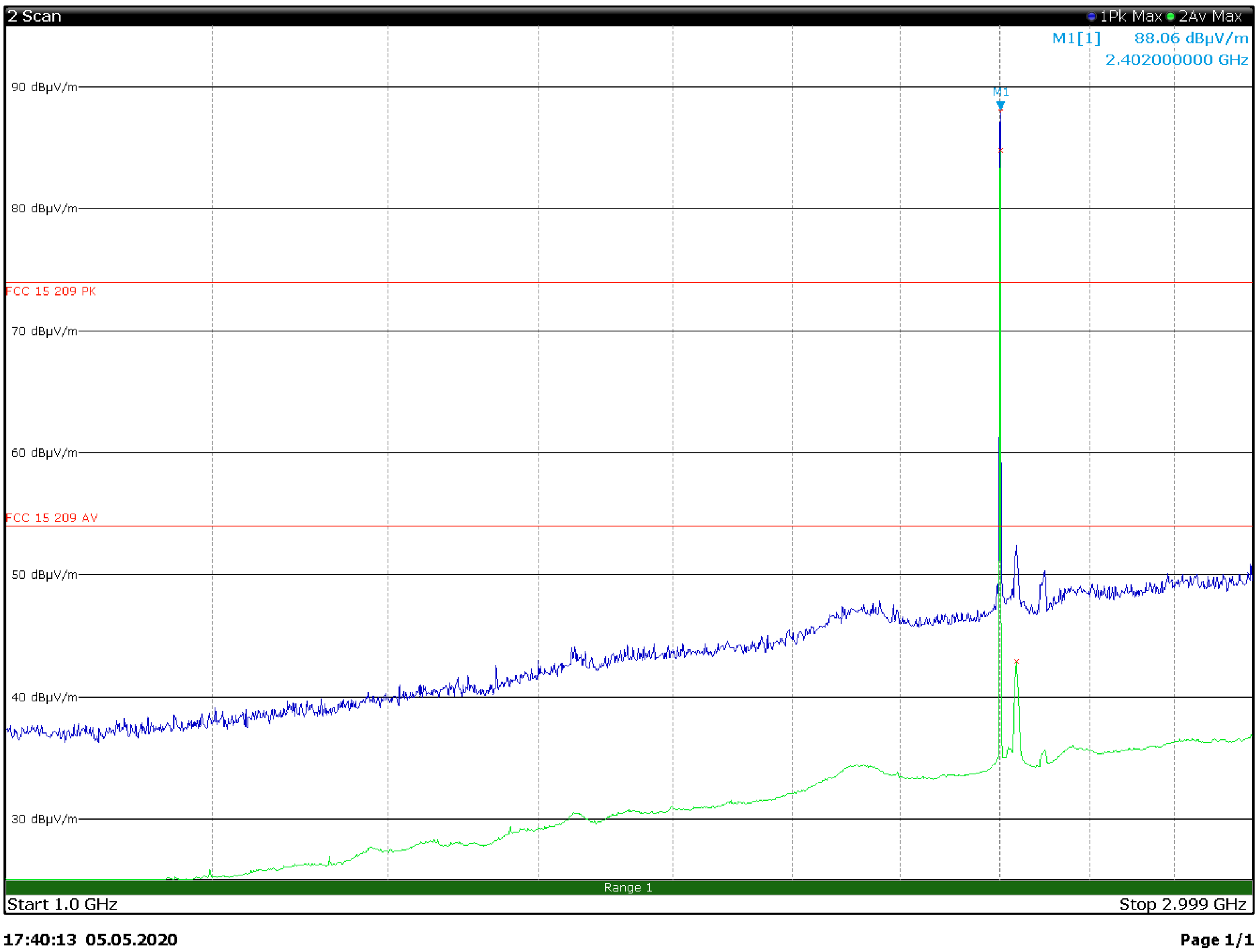


TX 2480 MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization

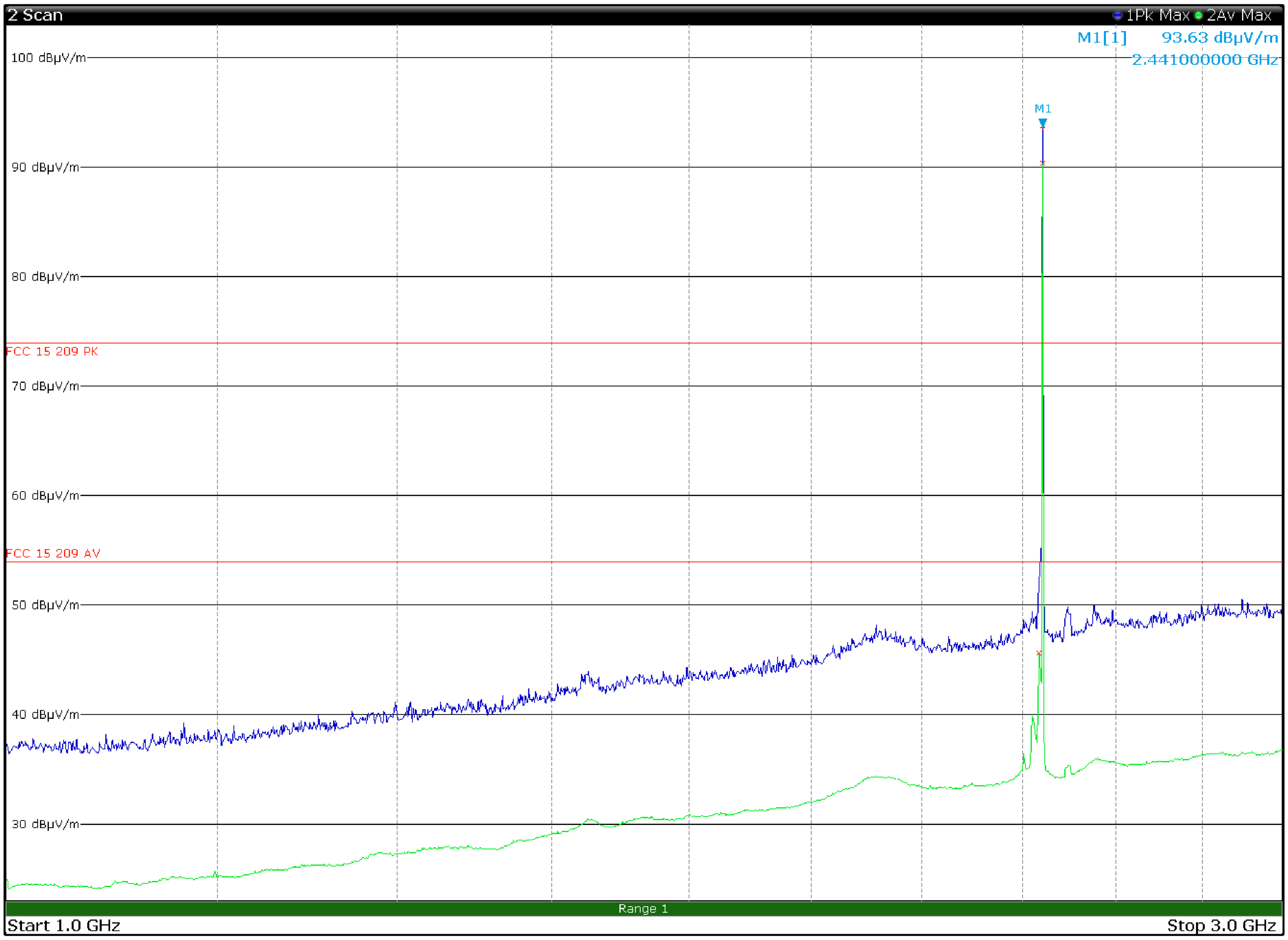
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
47.2500	25.6	40.0	-14.4	QP
60.7500	25.0	40.0	-15.0	QP
67.5000	27.8	40.0	-12.2	QP
74.2500	27.3	40.0	-12.7	QP
87.7500	31.8	40.0	-8.2	QP
94.5000	33.8	43.5	-9.7	QP
101.2500	31.8	43.5	-11.7	QP



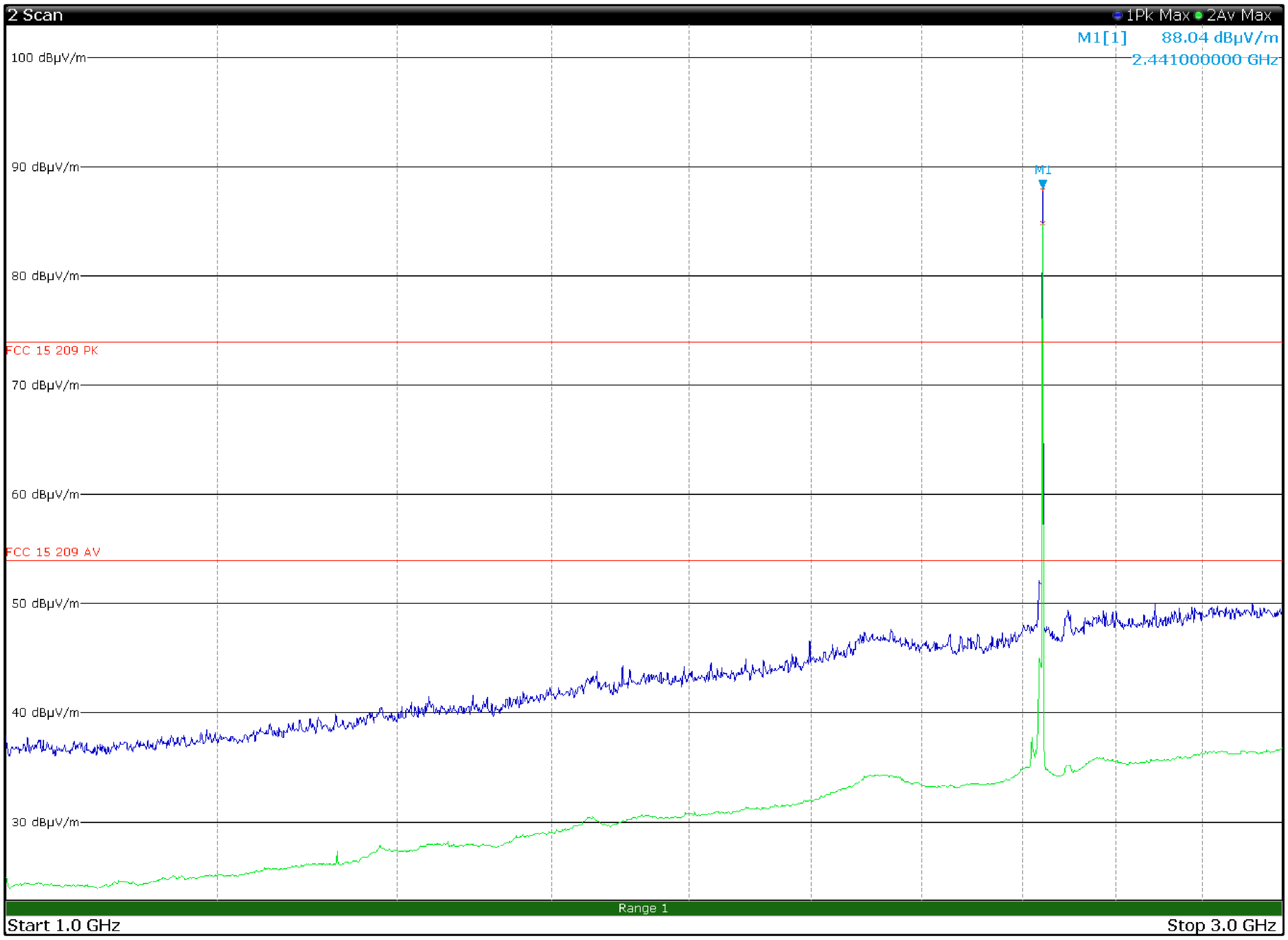
Radiated spurious emissions 1 to 3GHz, TX 2402 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



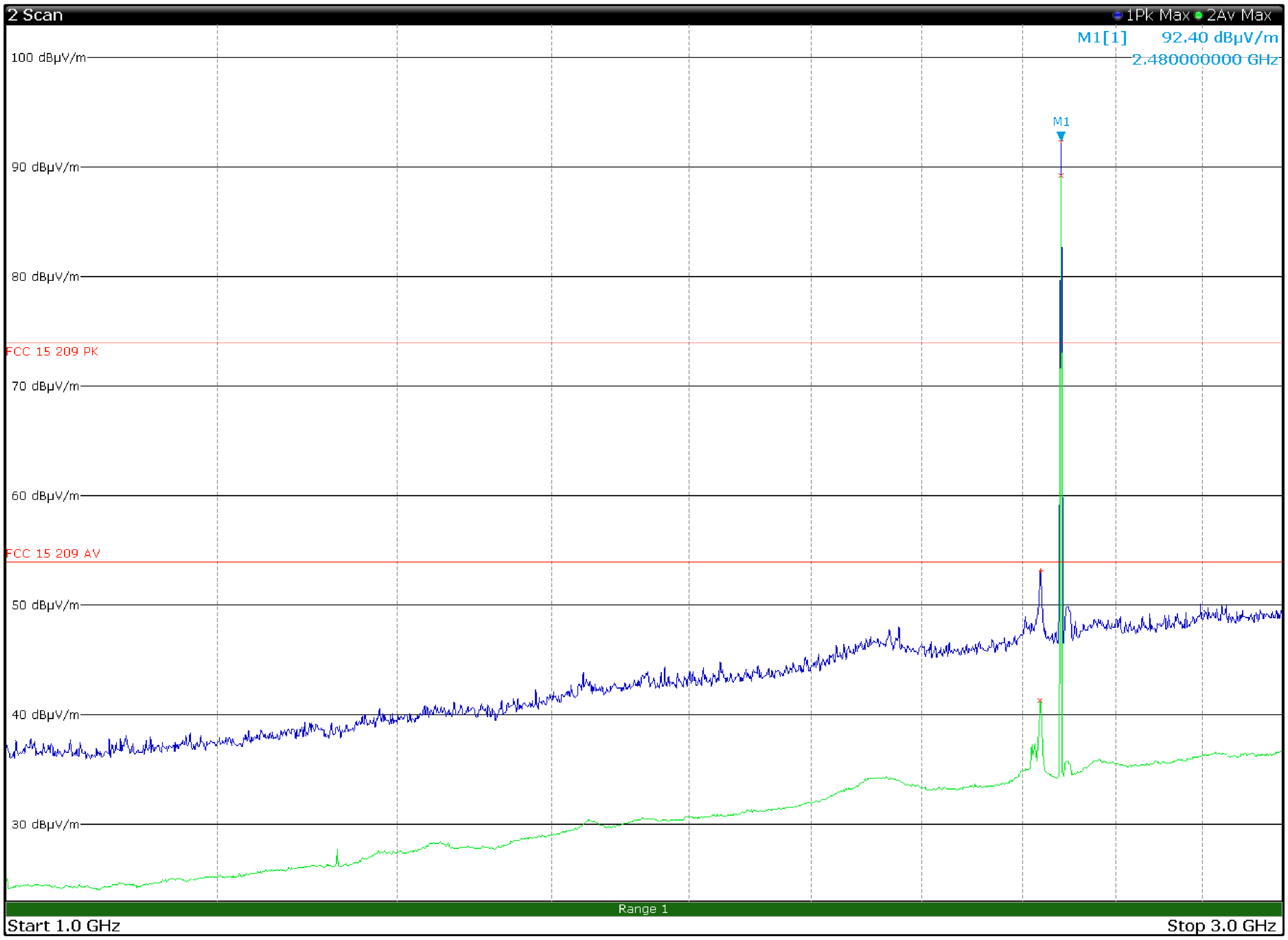
Radiated spurious emissions 1 to 3GHz, TX 2402 MHz, CH 00, 8DPSK MODULATION with antenna vertical polarization



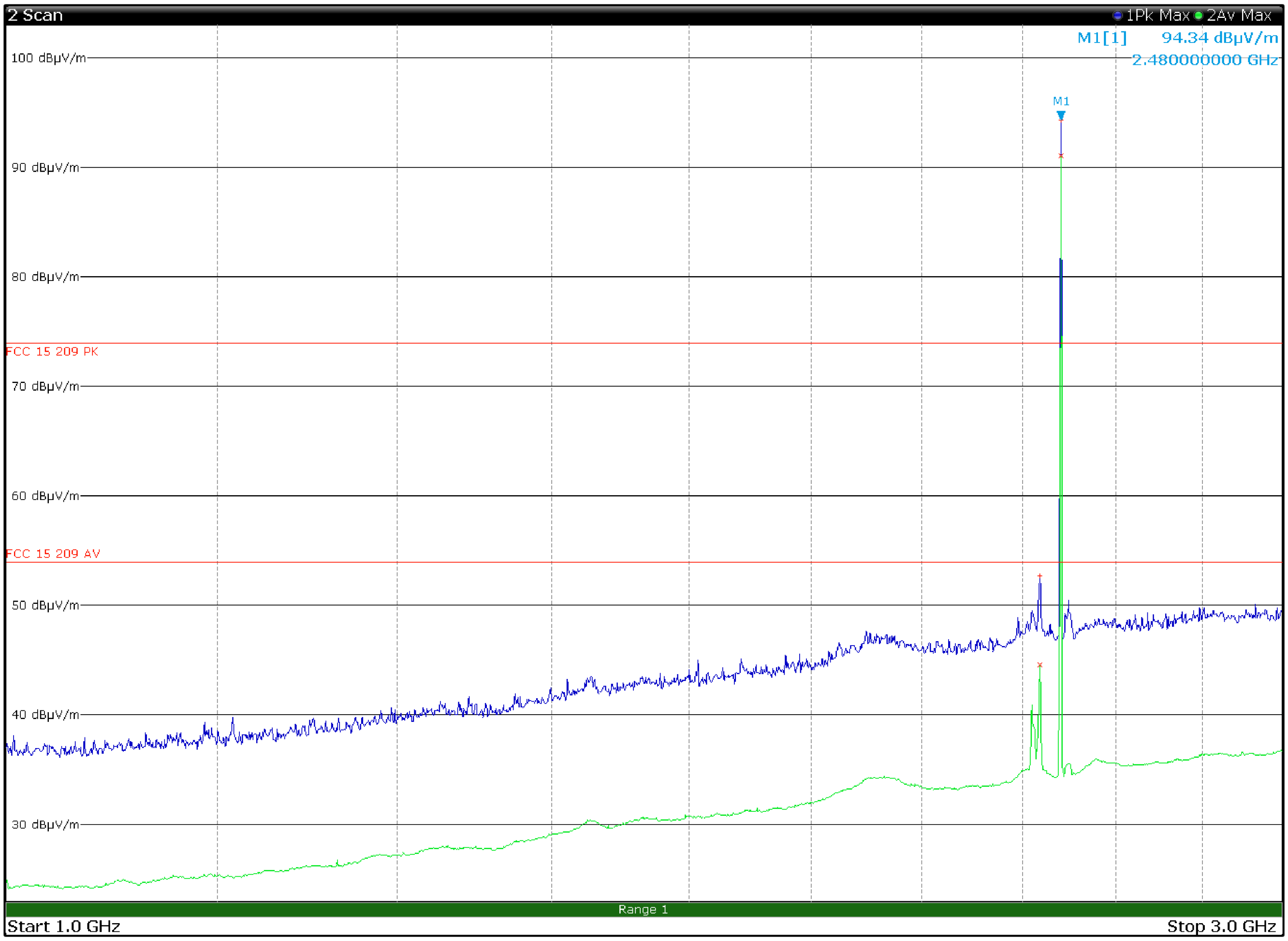
Radiated spurious emissions 1 to 3GHz, TX 2441 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



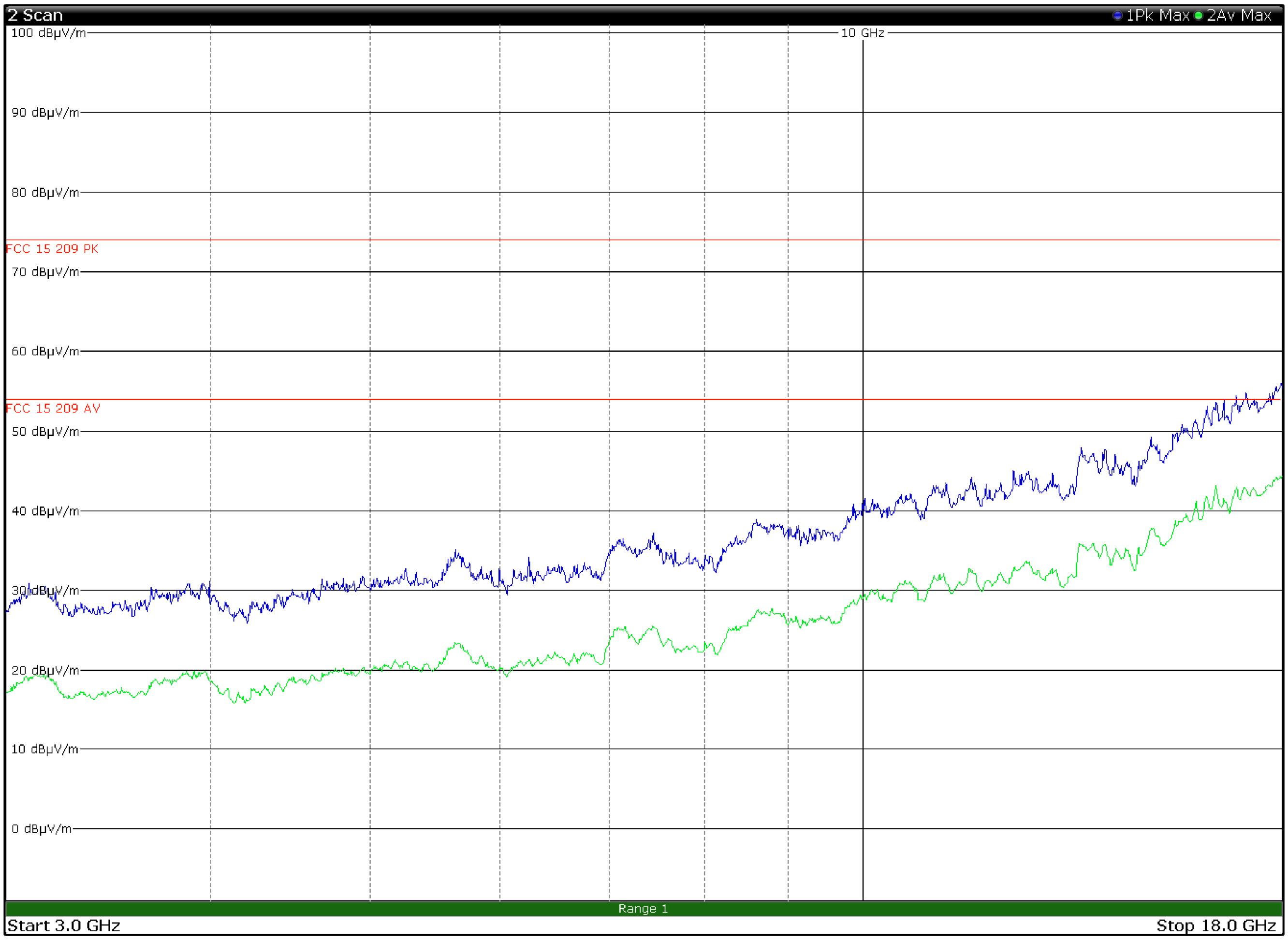
Radiated spurious emissions 1 to 3GHz, TX 2441 MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



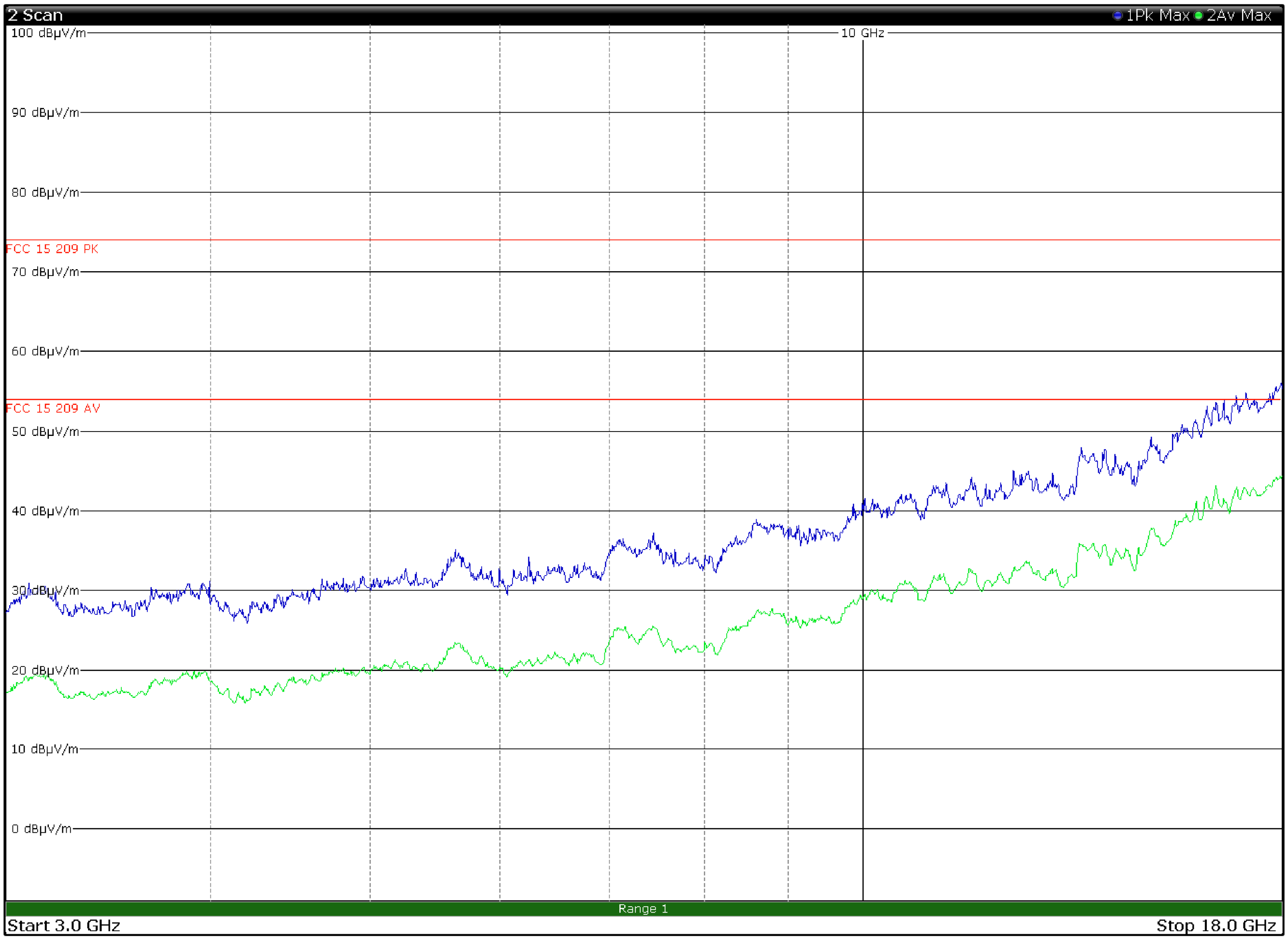
Radiated spurious emissions 1 to 3GHz, TX 2480 MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



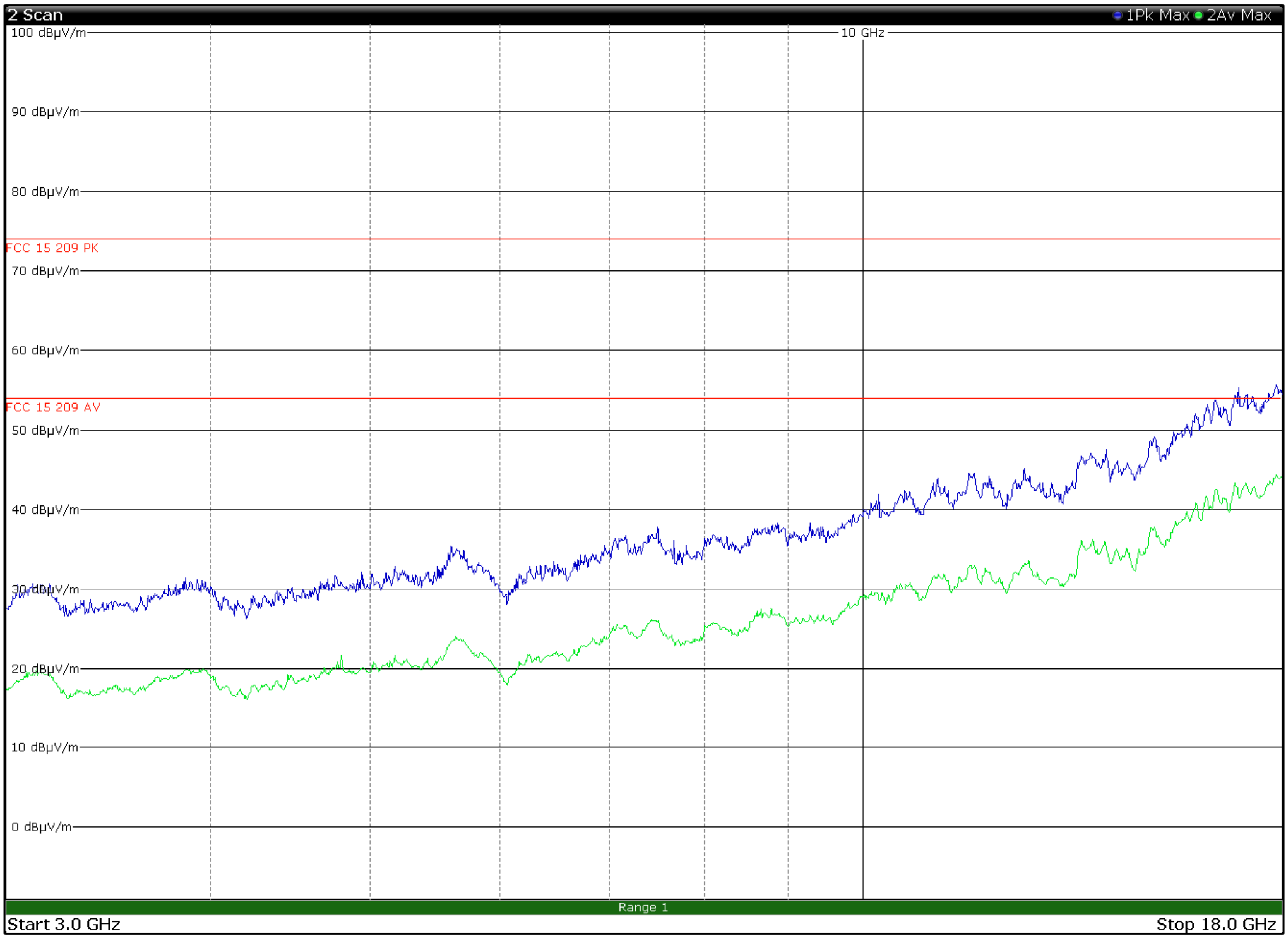
Radiated spurious emissions 1 to 3GHz, TX 2441 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



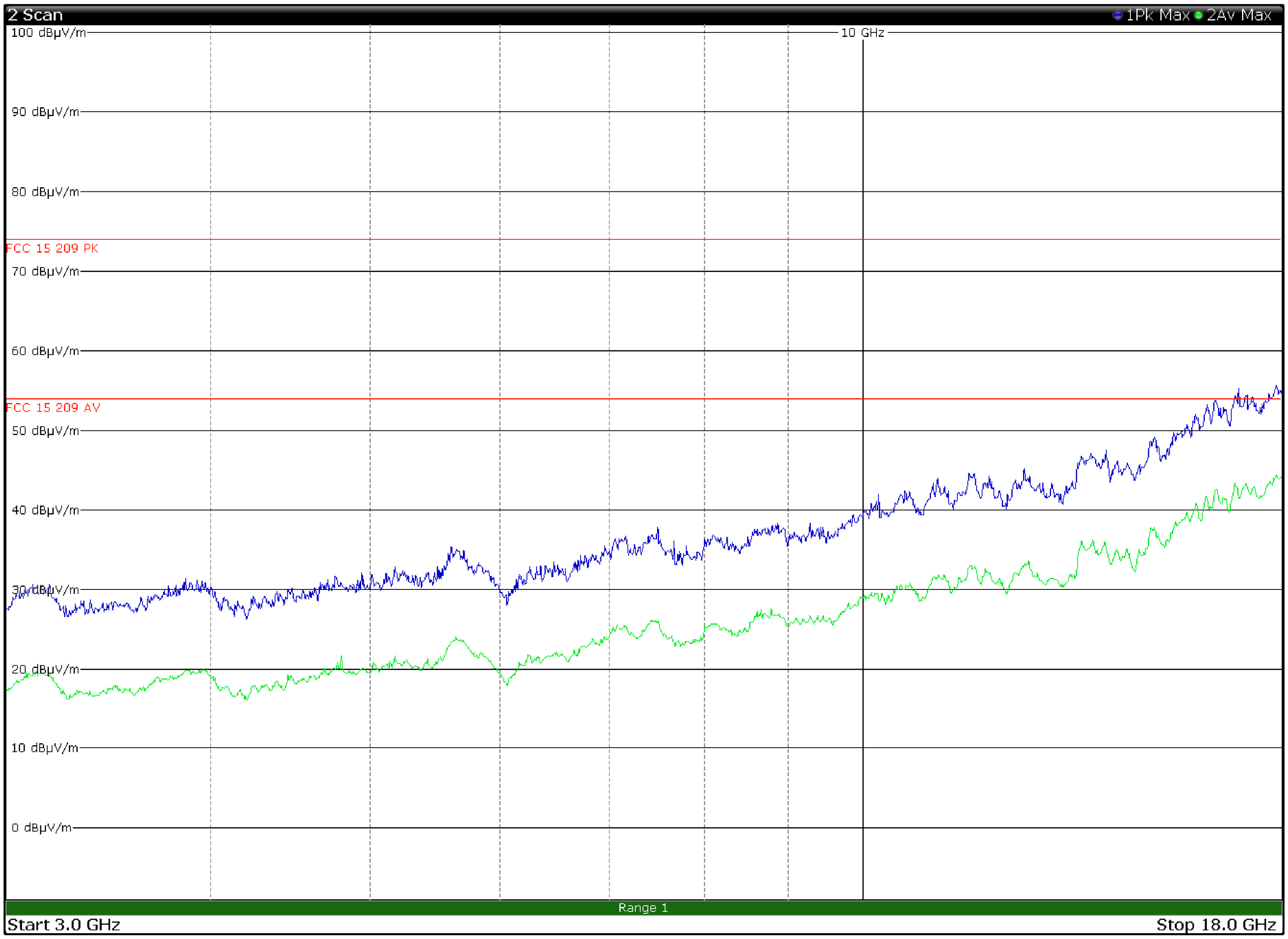
Radiated spurious emissions 3 to 18GHz, TX 2480 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



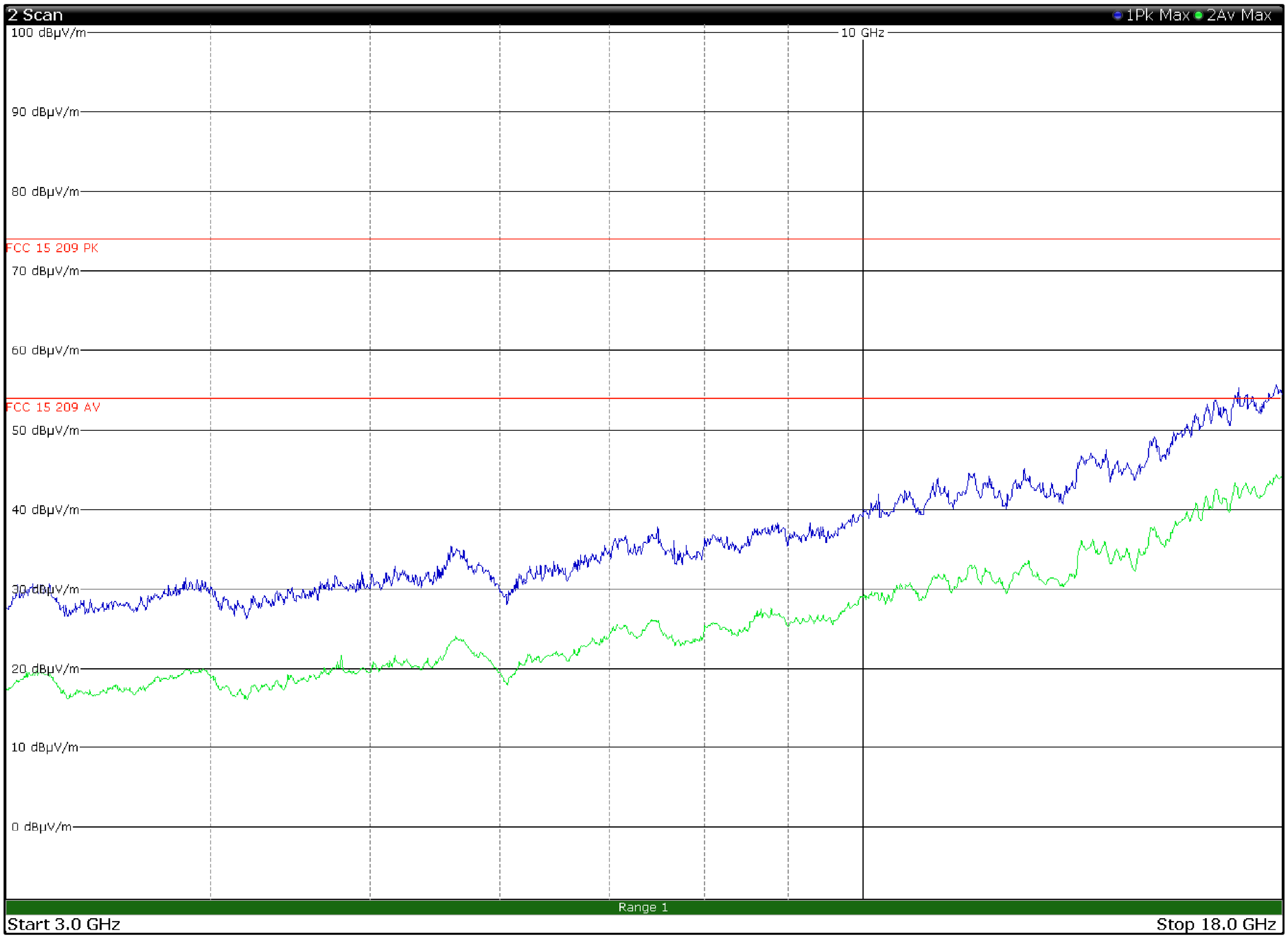
Radiated spurious emissions 3 to 18GHz, TX 2480 MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



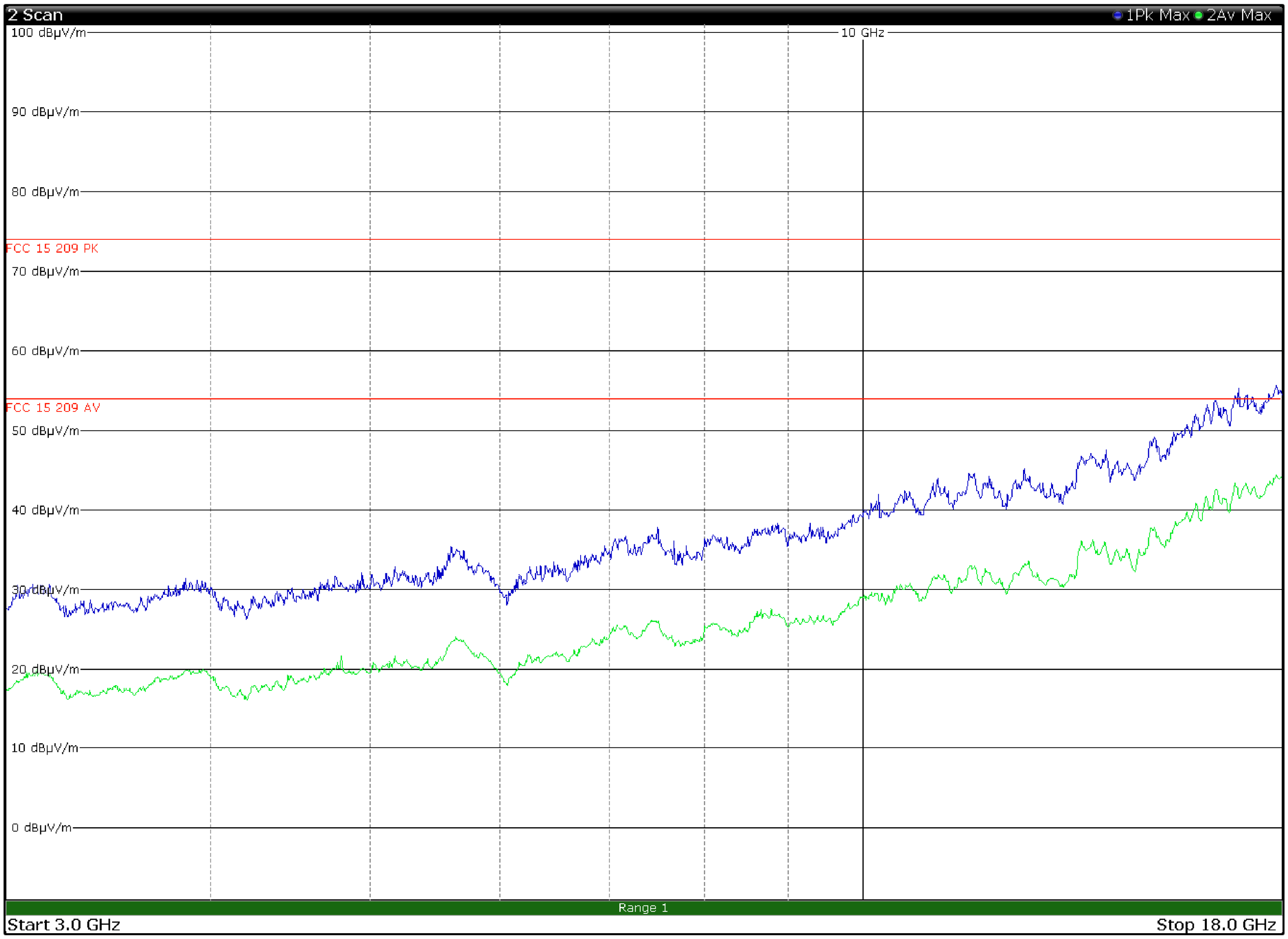
Radiated spurious emissions 3 to 18GHz, TX 2402 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



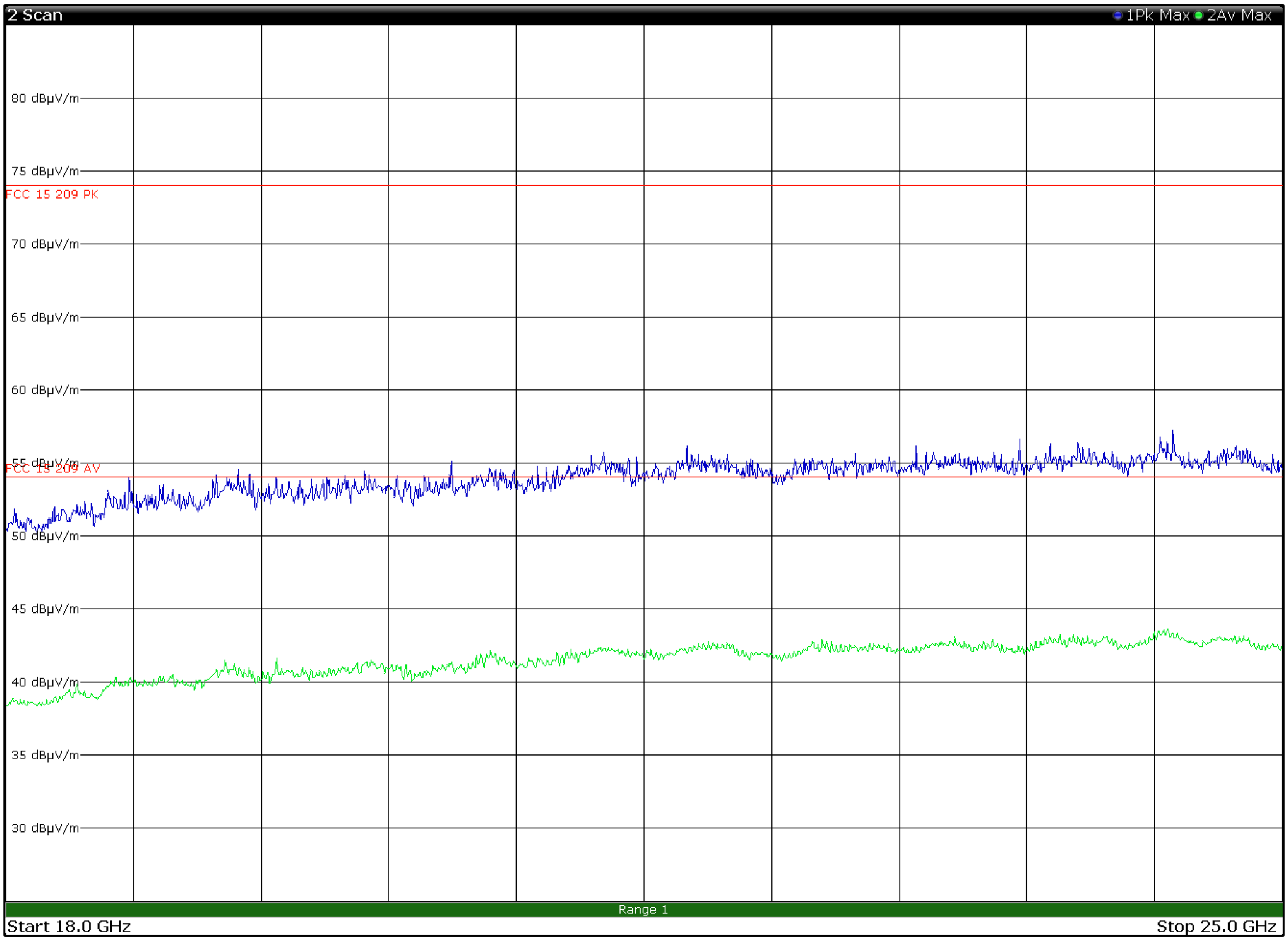
Radiated spurious emissions 3 to 18GHz, TX 2402MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



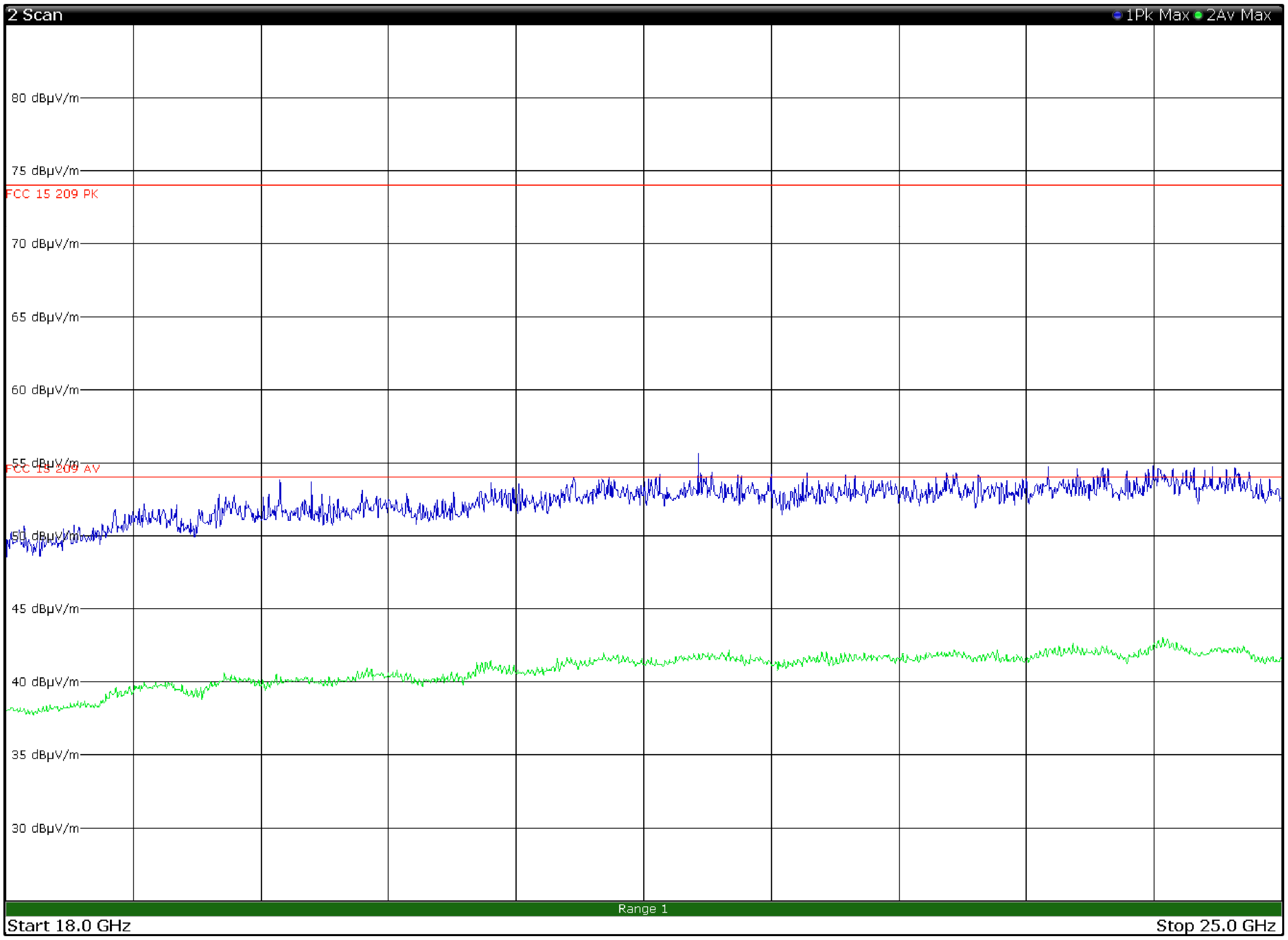
Radiated spurious emissions 3 to 18GHz, TX 2441 MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



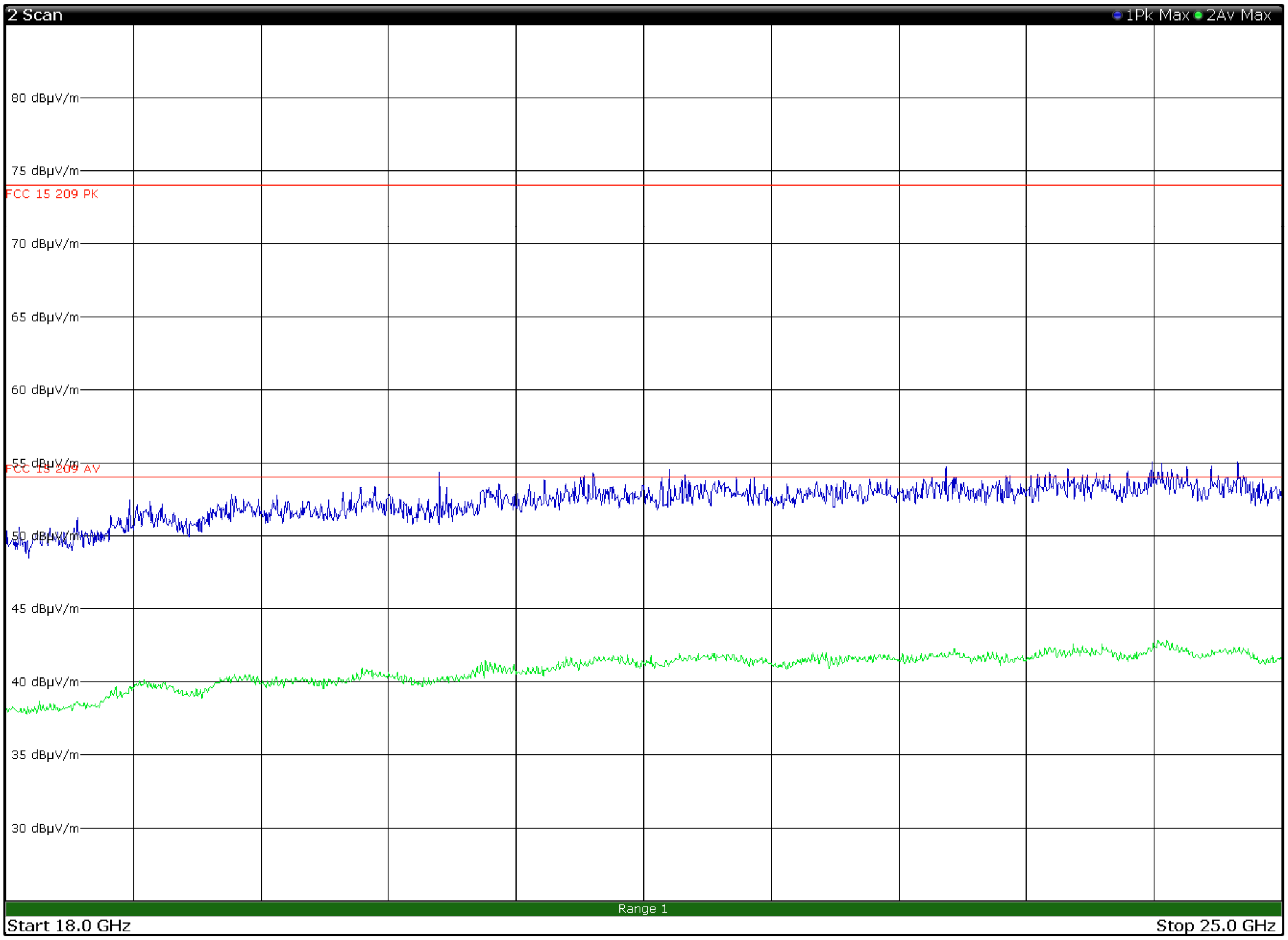
Radiated spurious emissions 3 to 18GHz, TX 2441MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



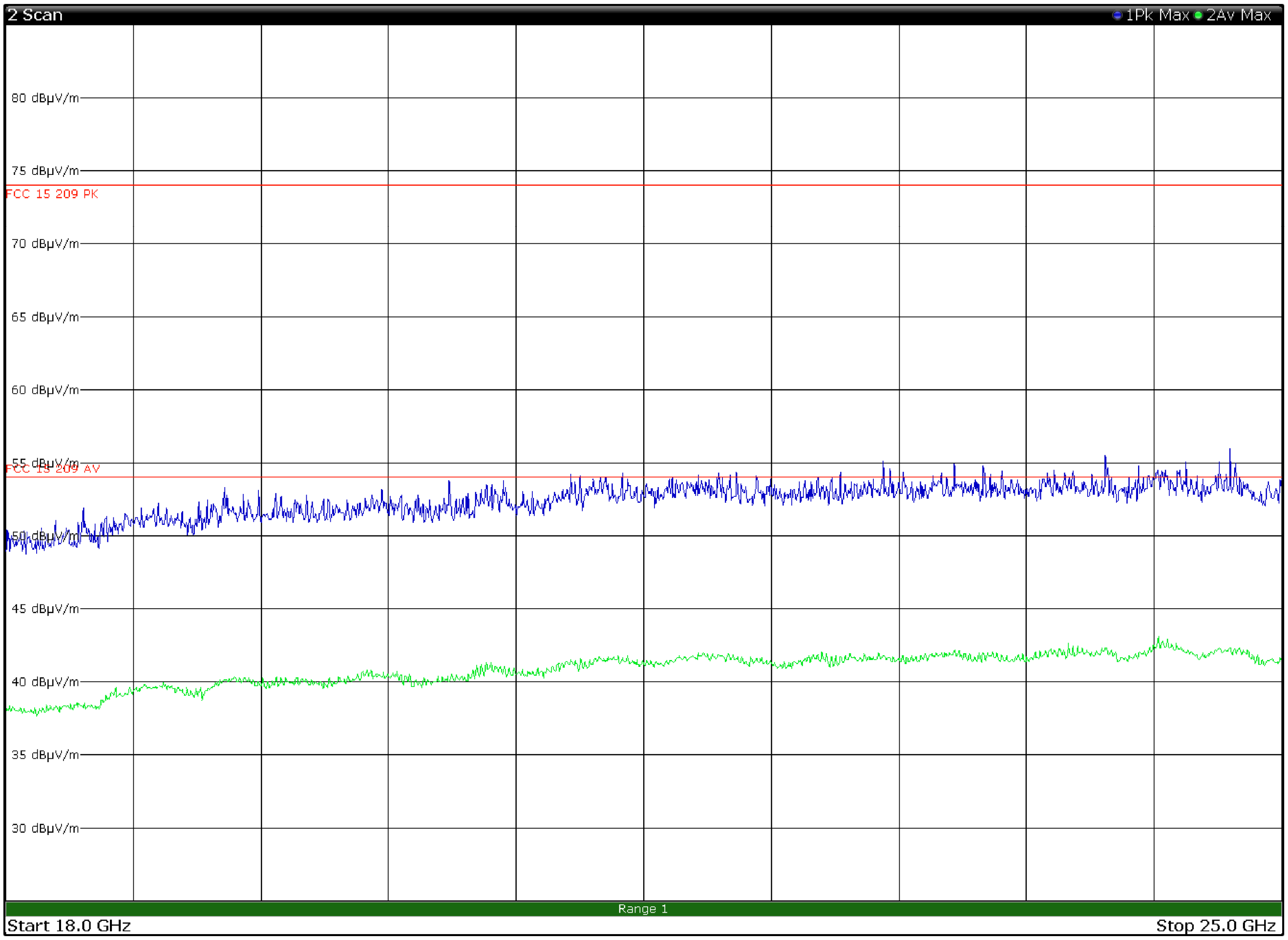
Radiated spurious emissions 18 to 25 GHz, TX 2402MHz, CH 00, 8DPSK MODULATION with antenna in horizontal polarization



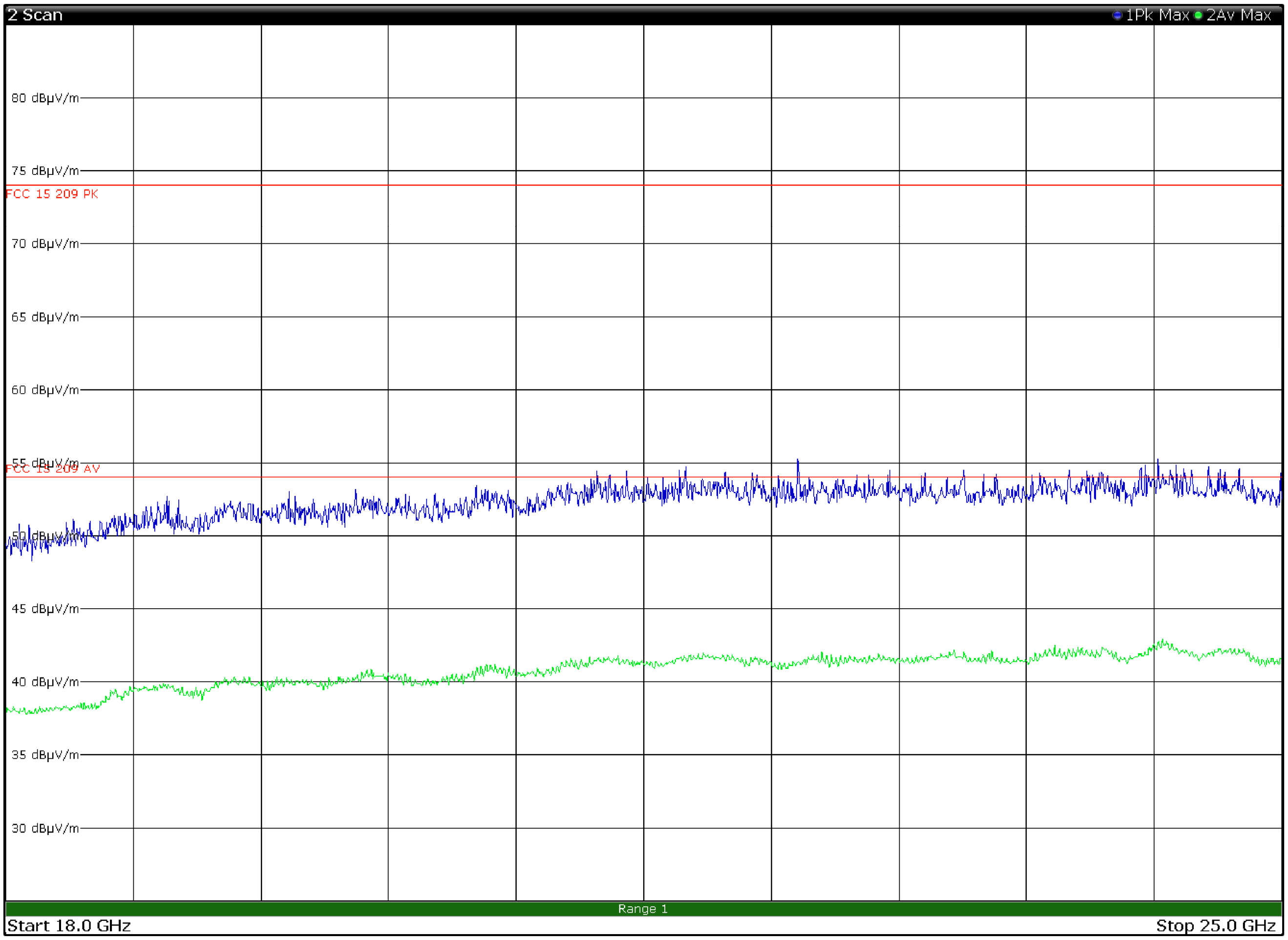
Radiated spurious emissions 18 to 25 GHz, TX 2402MHz, CH 00, 8DPSK MODULATION with antenna in vertical polarization



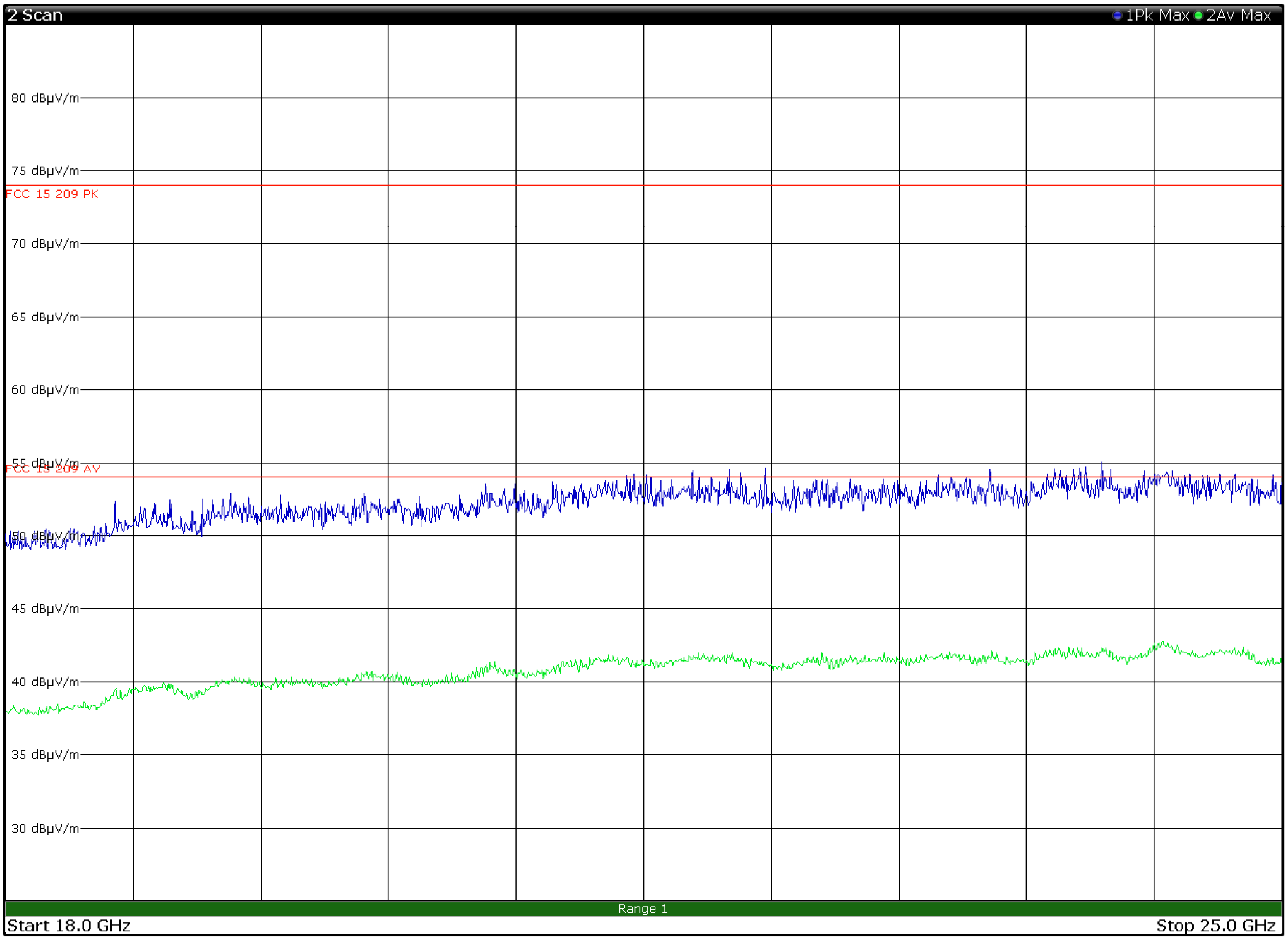
Radiated spurious emissions 18 to 25 GHz TX 2441MHz, 8DPSK MODULATION with antenna in horizontal polarization



Radiated spurious emissions 18 to 25 GHz, TX 2441MHz, 8DPSK MODULATION with antenna in vertical polarization



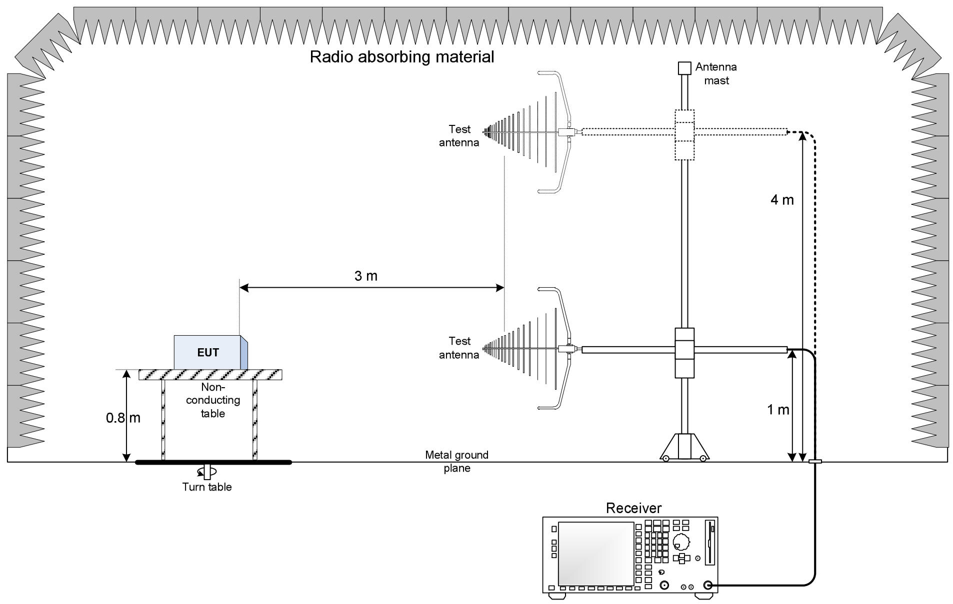
Radiated spurious emissions 18 to 25 GHz, TX 2480MHz,8DPSK MODULATION with antenna in horizontal polarization



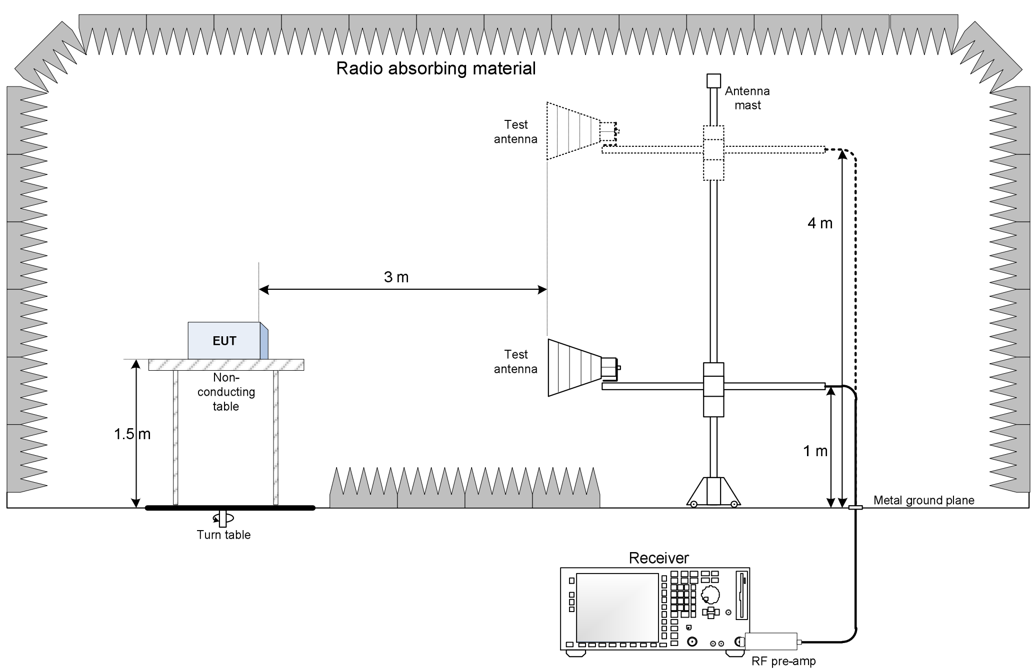
Radiated spurious emissions 18 to 25 GHz, TX 2480MHz,8DPSK MODULATION with antenna in vertical polarization

Section 9. Block diagrams of test set-ups

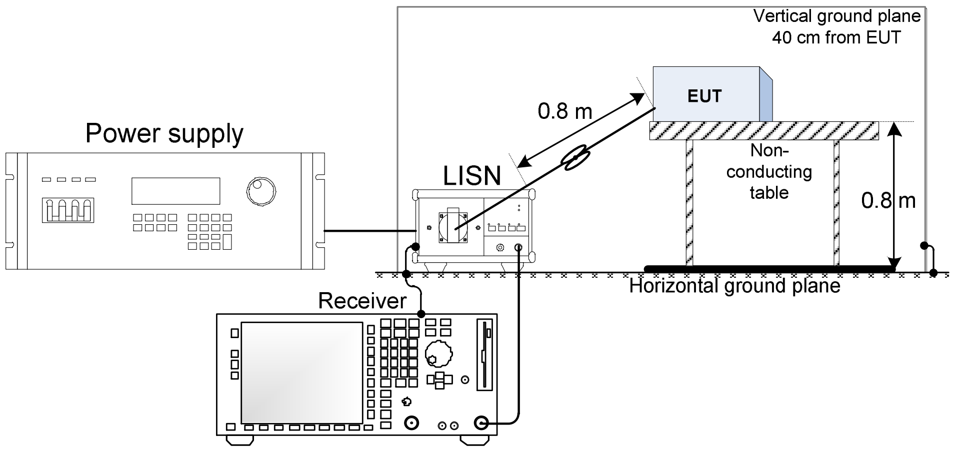
9.1 Radiated emissions set-up for frequencies below 1 GHz



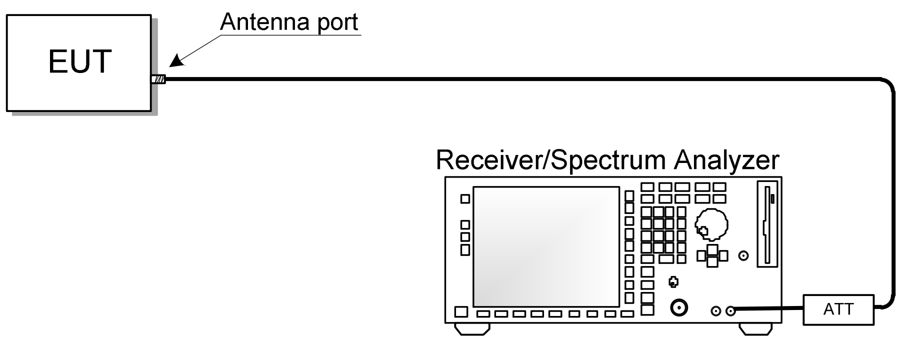
9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

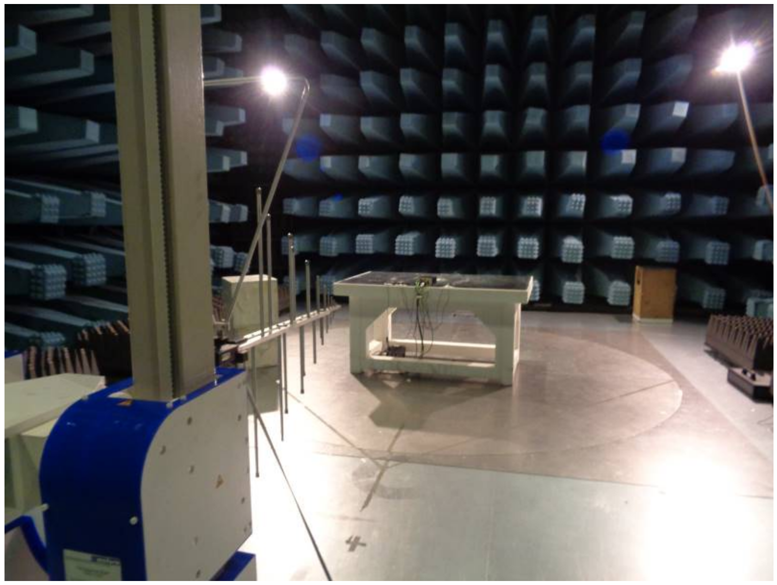


9.4 Antenna port set-up

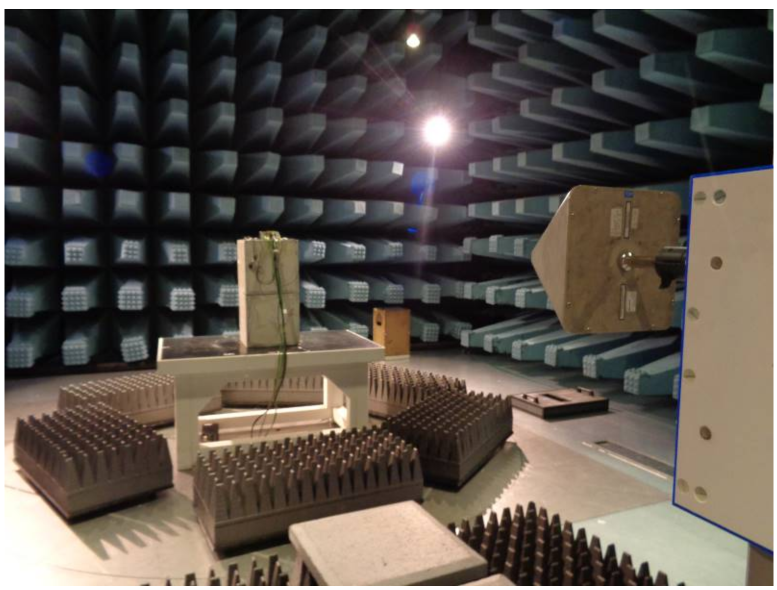


Section 10. Photos

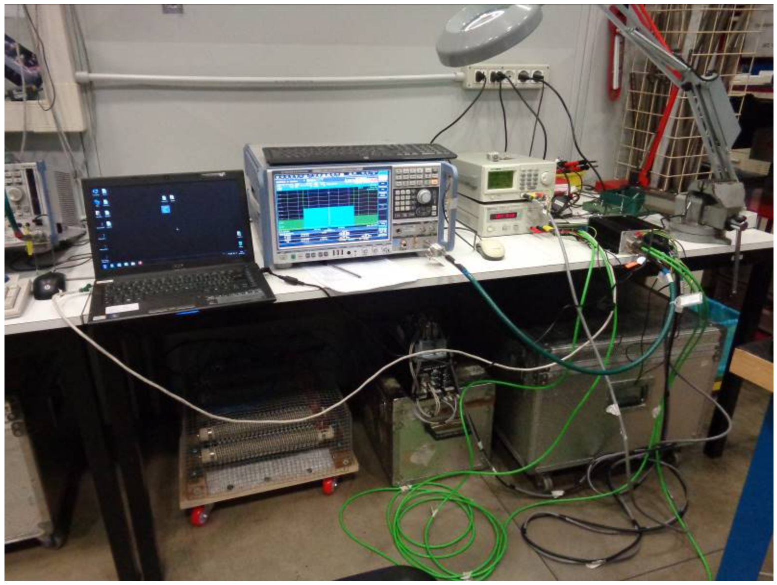
10.1 Photos of the test set-up



Radiated emission below 1 GHz



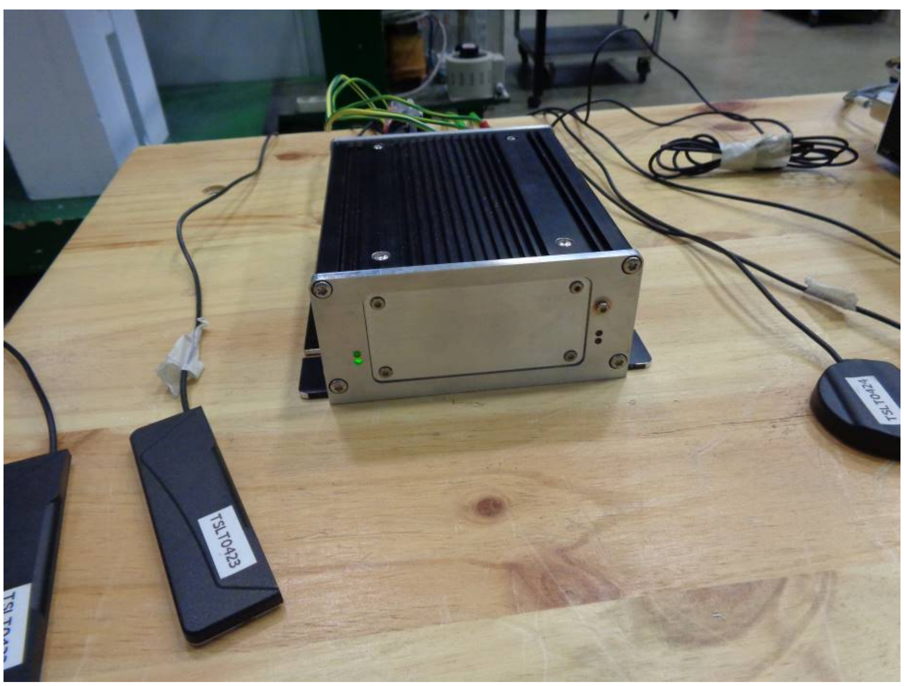
Radiated emission above 1 GHz



Conducted emission on the antenna port

Conducted emission on the AC Mains

10.2 Photos of the EUT



(End of report)