

Figure 8.4-11: Output power on mid channel – Antenna port 4

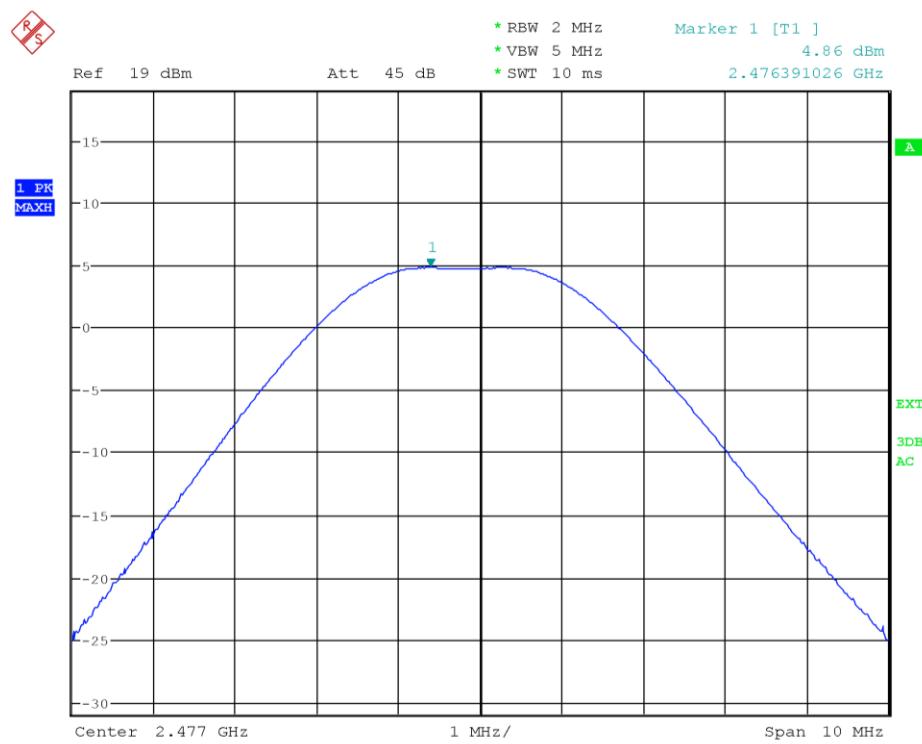


Figure 8.4-12: Output power on high channel – Antenna port 4

8.5 Spurious (out-of-band) unwanted emissions

8.5.1 References, definitions and limits

RSS-247, Clause 5.5:

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 8.5-1: RSS-Gen – Radiated emission limits

Field strength of emissions			
Frequency, MHz	µV/m	dBµV/m	Measurement distance, m
0.009–0.490	2400/F	67.6 – 20 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × 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 8.5-2: 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	
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	Above 38.6
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.5-2 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.

8.5.2 Test summary

Verdict	Pass
Tested by	O. Frau
Test date	March 26, 2024

8.5.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 100 % duty cycle.
- 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 analyser 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 analyser 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 analyser 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

8.5.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	3m semi-anechoic chamber	1711-150

8.5.5 Test data

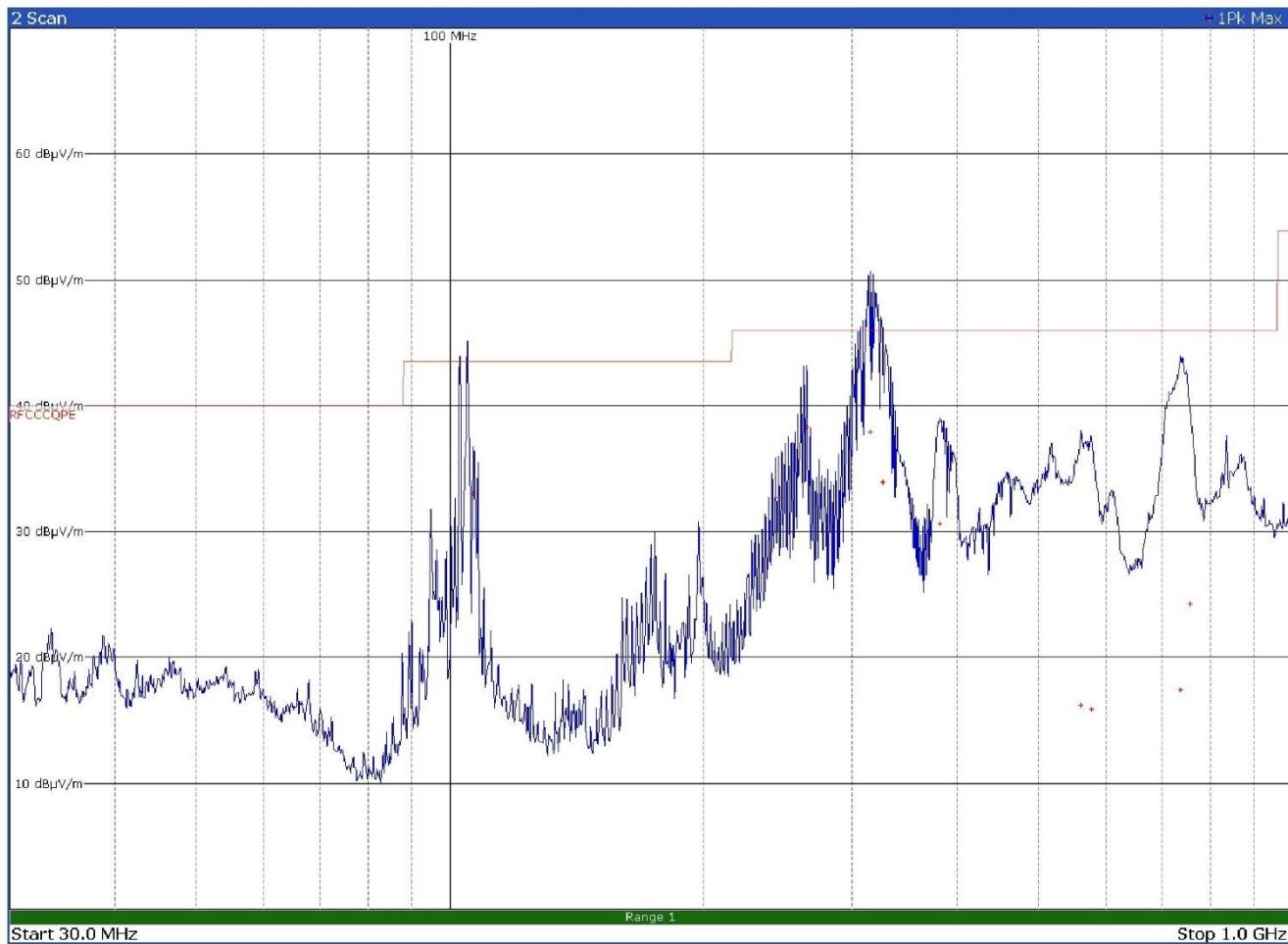


Figure 8.5-1: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
106.6800	33.0	43.5	-10.5	QP
245.5500	32.7	46.0	-13.3	QP
265.2000	38.3	46.0	-7.70	QP
315.6600	37.9	46.0	-8.10	QP
326.5800	34.0	46.1	-12.1	QP
381.4200	30.6	46.0	-15.4	QP
561.2400	16.2	46.0	-29.8	QP
576.6600	15.9	46.0	-30.1	QP
736.5900	17.5	46.0	-28.5	QP
756.3000	24.3	46.0	-21.7	QP

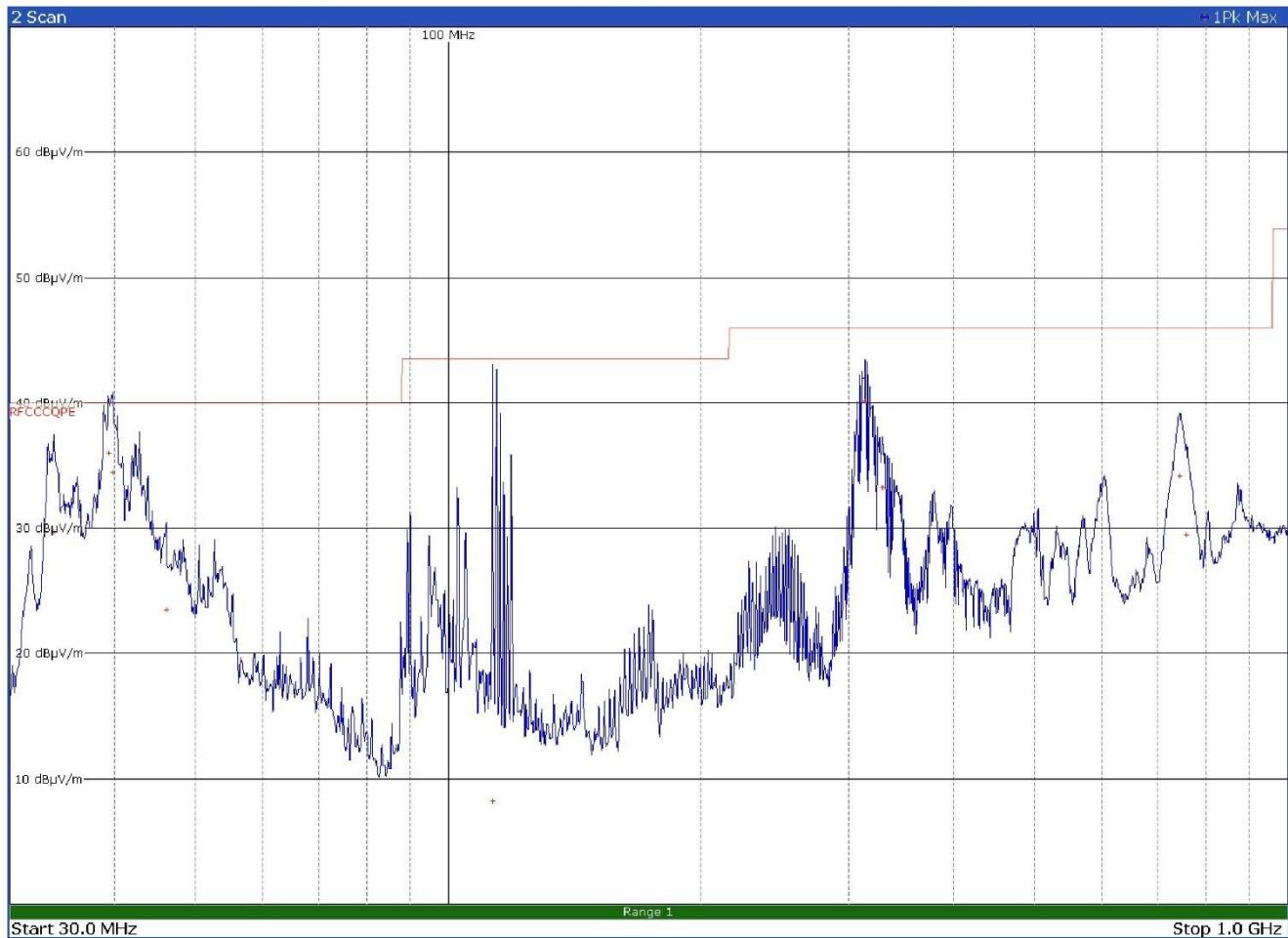


Figure 8.5-2: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
33.8700	29.7	40.0	-10.3	QP
39.3300	36.0	40.0	-4.0	QP
39.7800	34.5	40.0	-5.5	QP
46.0800	23.5	40.0	-16.5	QP
112.9800	8.20	43.5	-35.3	QP
313.5600	40.1	46.0	-5.90	QP
328.9500	33.3	46.0	-12.7	QP
743.3400	34.2	46.0	-11.8	QP
758.4300	29.5	46.0	-16.5	QP

Test data, continued

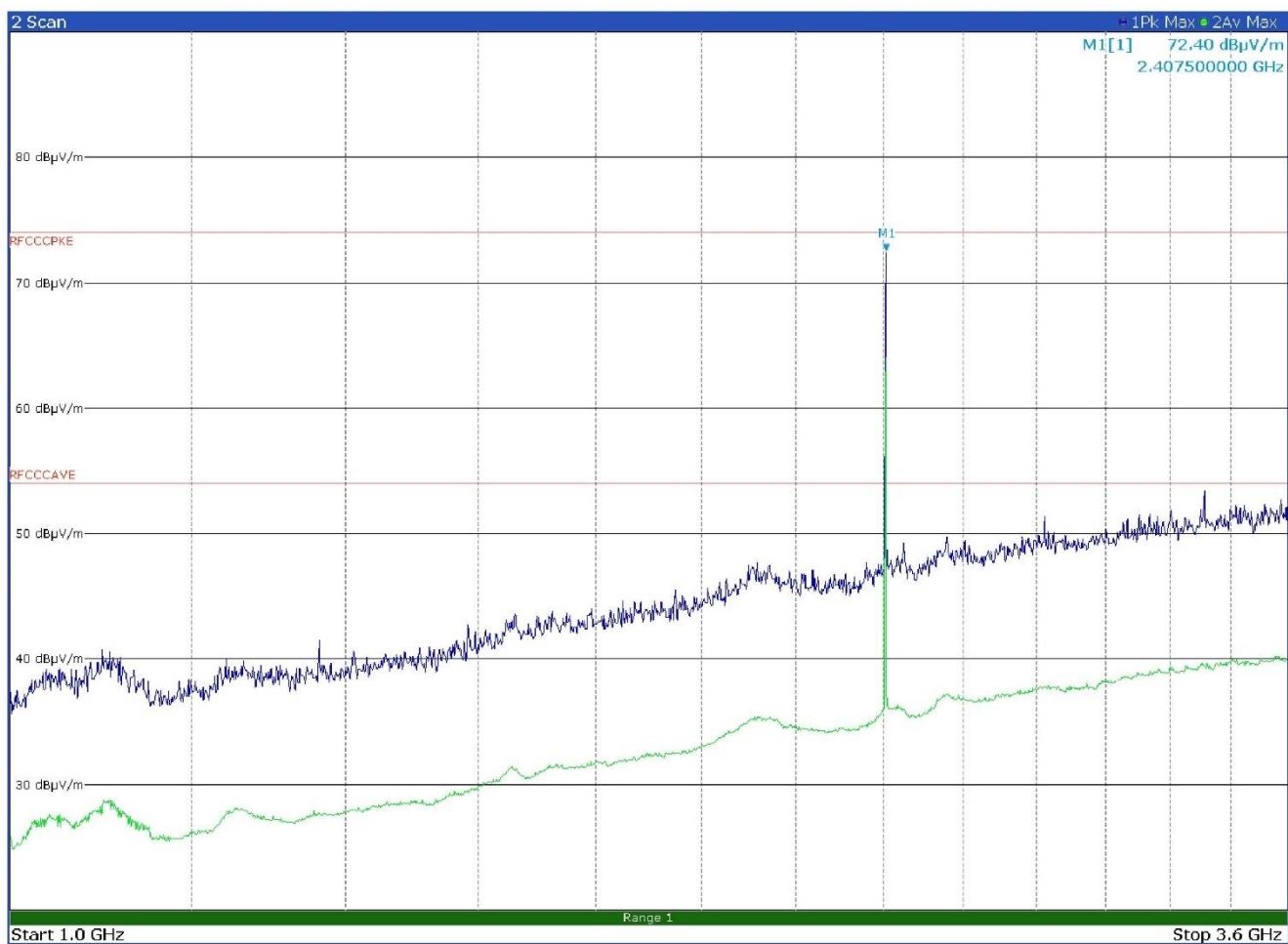


Figure 8.5-3: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

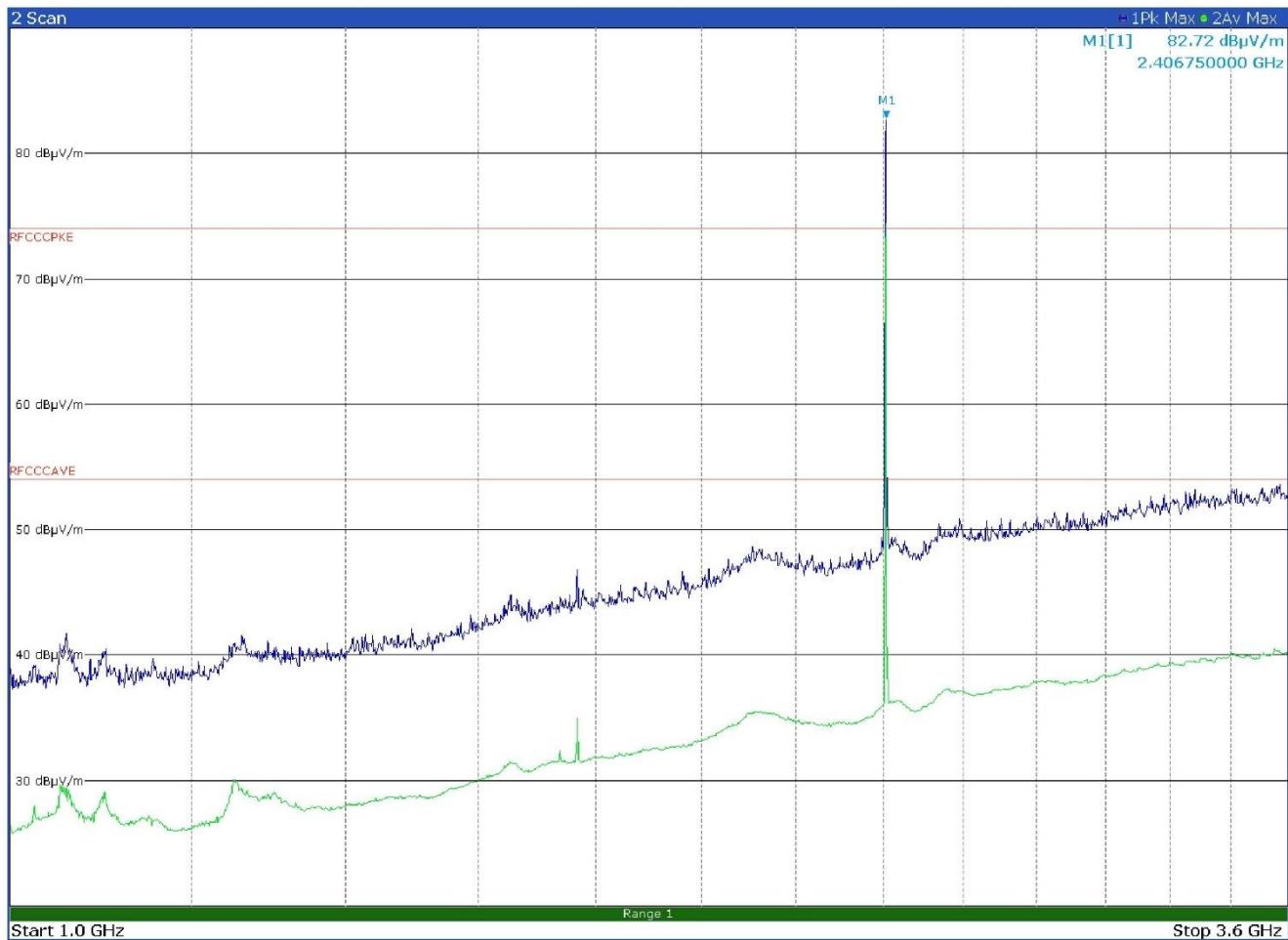


Figure 8.5-4: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

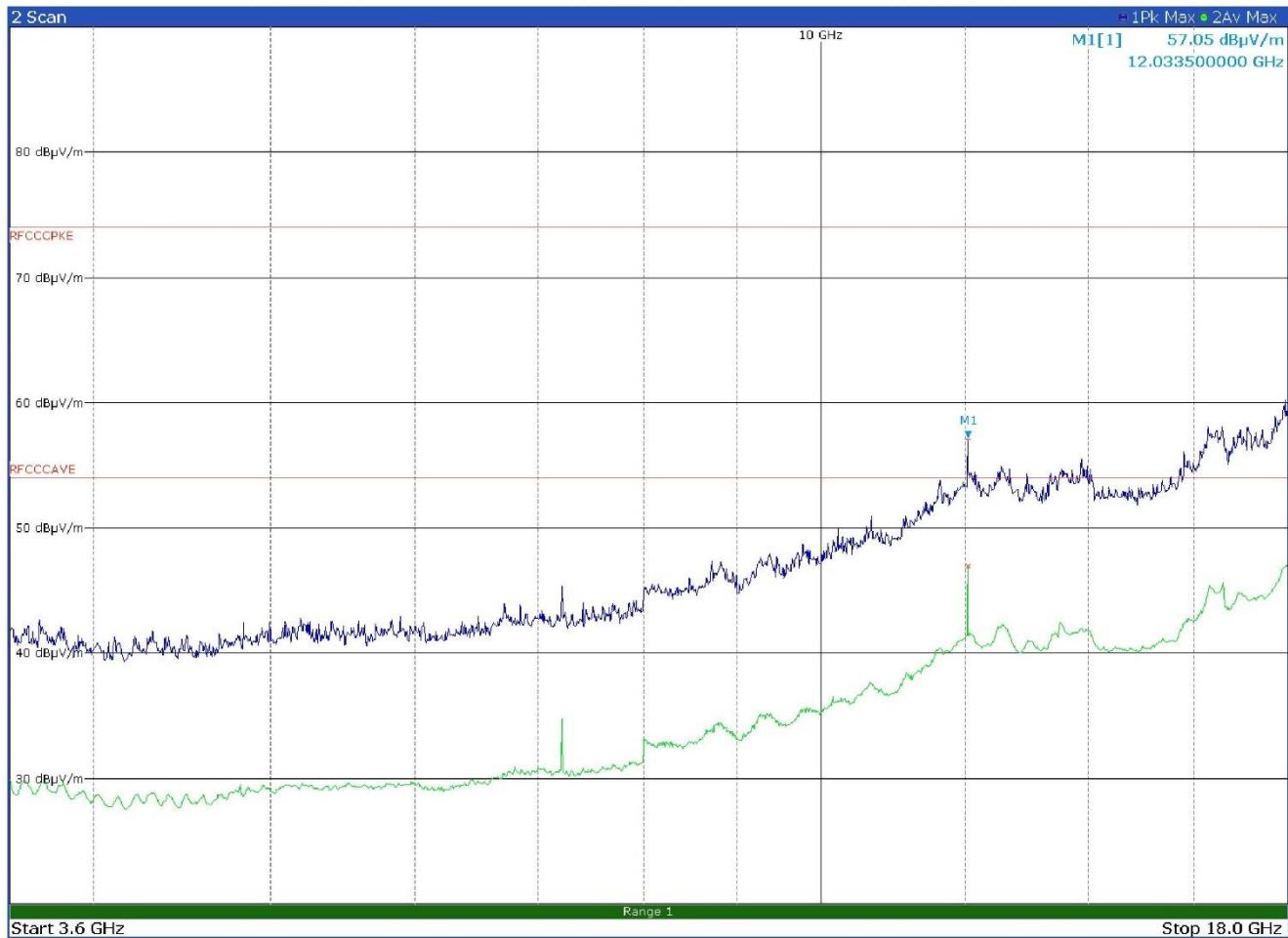


Figure 8.5-5: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
12033.5000	57.1	74.1	-17.0	Pk
12033.5000	47.0	54.0	-7.0	Av

Test data, continued

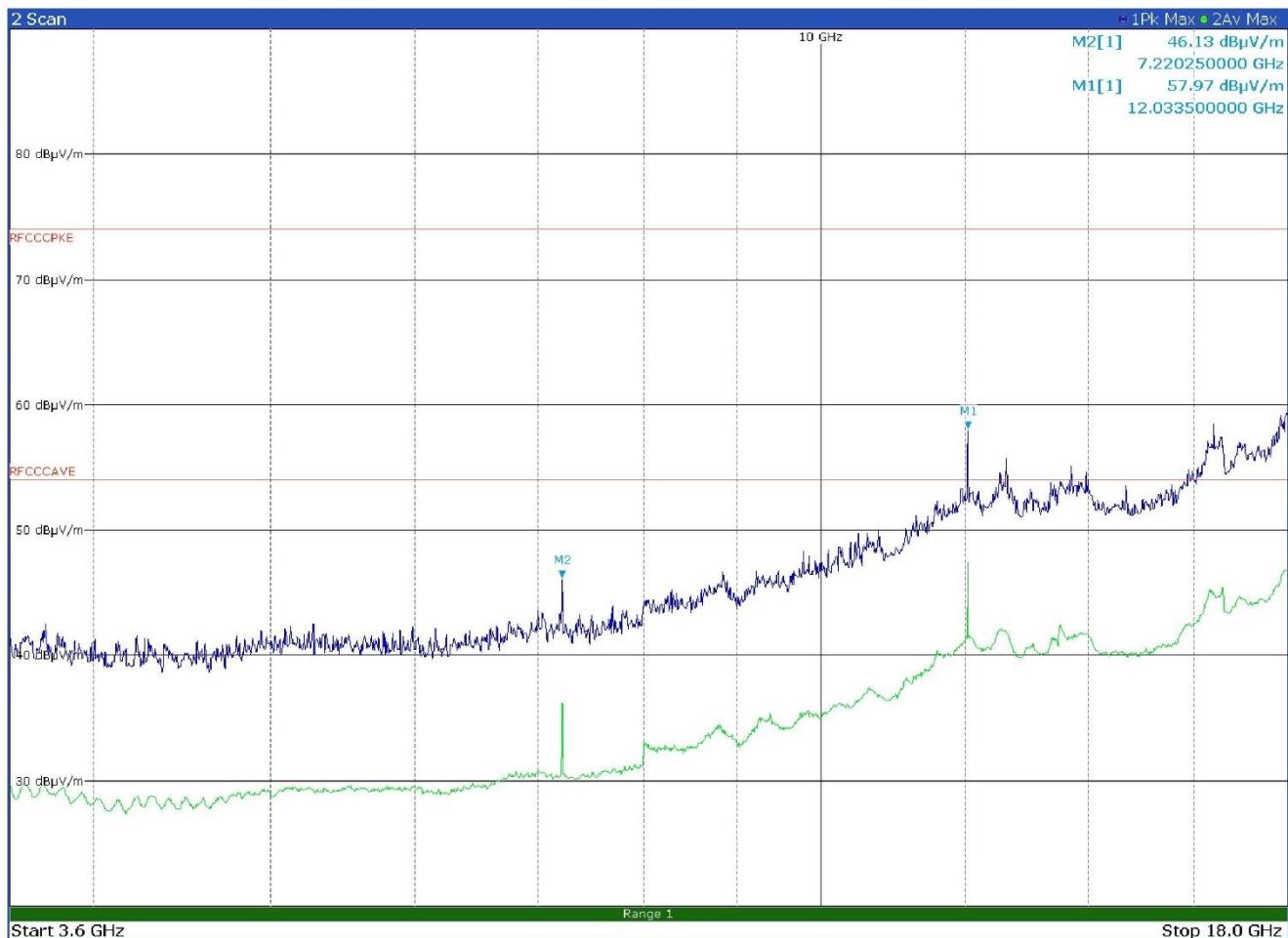


Figure 8.5-6: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
7220.2500	46.1	74.0	-27.9	Pk
7222.5000	36.2	54.0	-17.8	Av
12033.5000	58.0	74.0	-16.0	Pk
12033.5000	47.2	54.0	-6.80	Av

Test data, continued

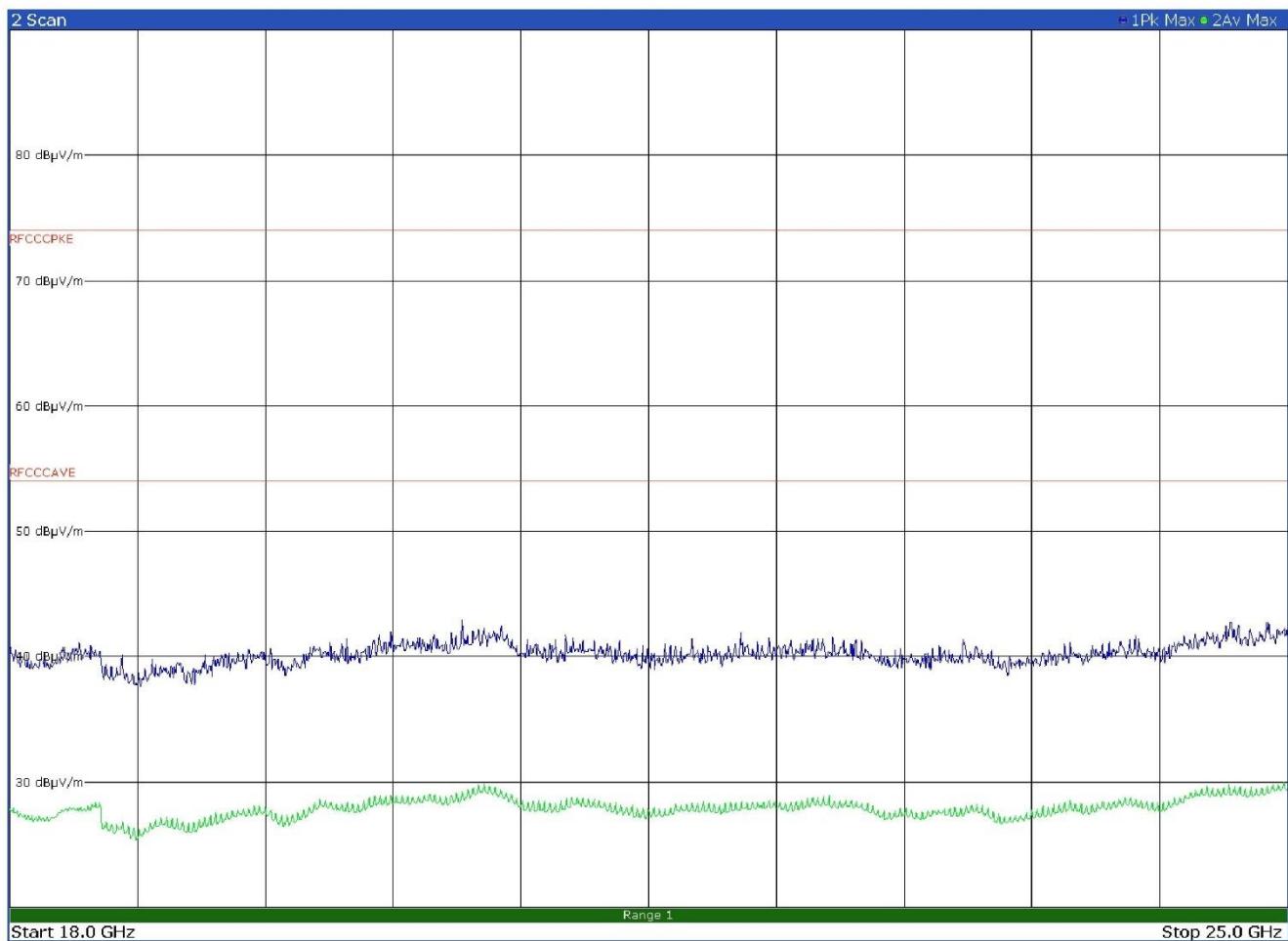


Figure 8.5-7: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

No spurious emissions found

Test data, continued

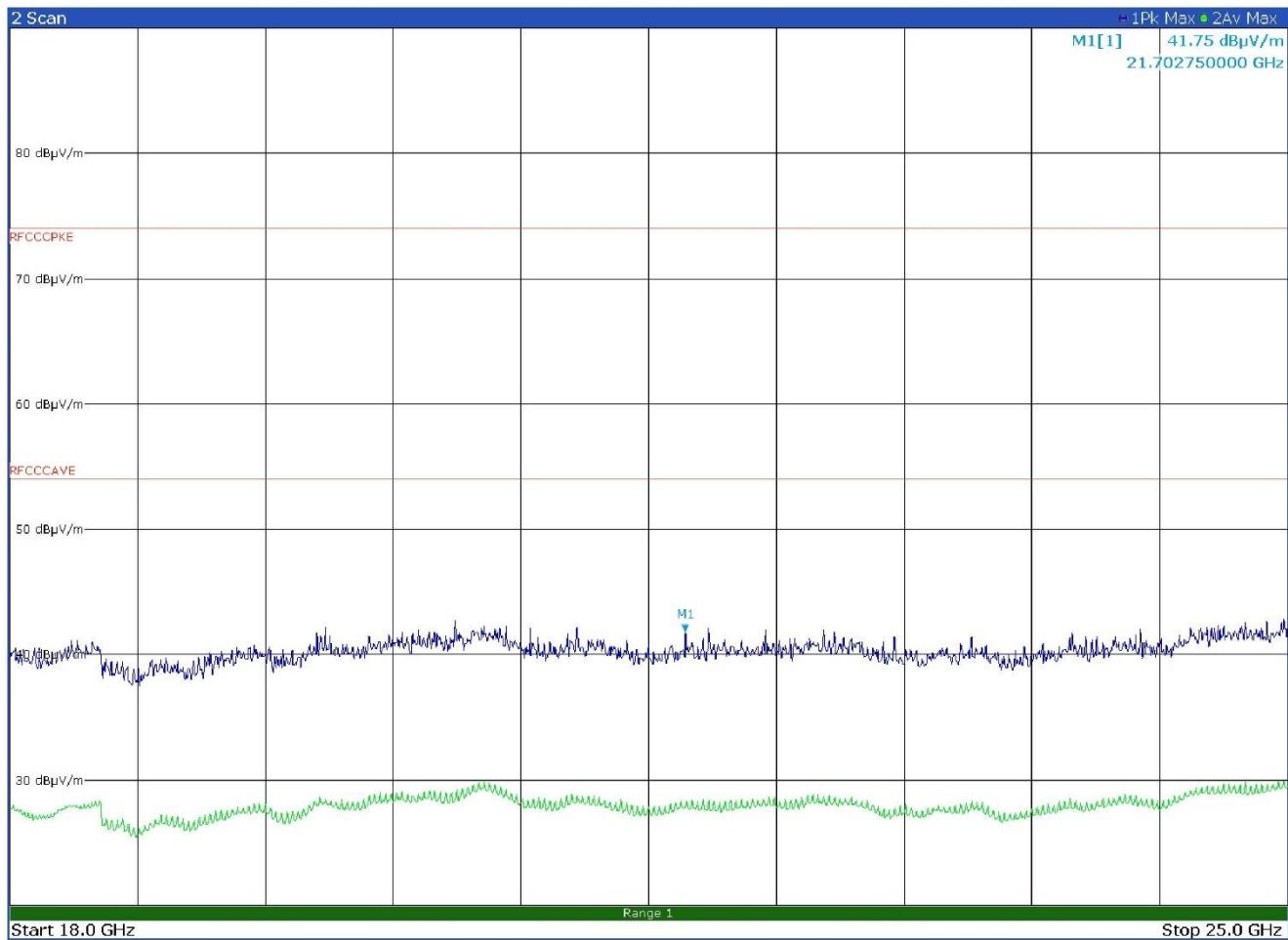


Figure 8.5-8: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Test data, continued

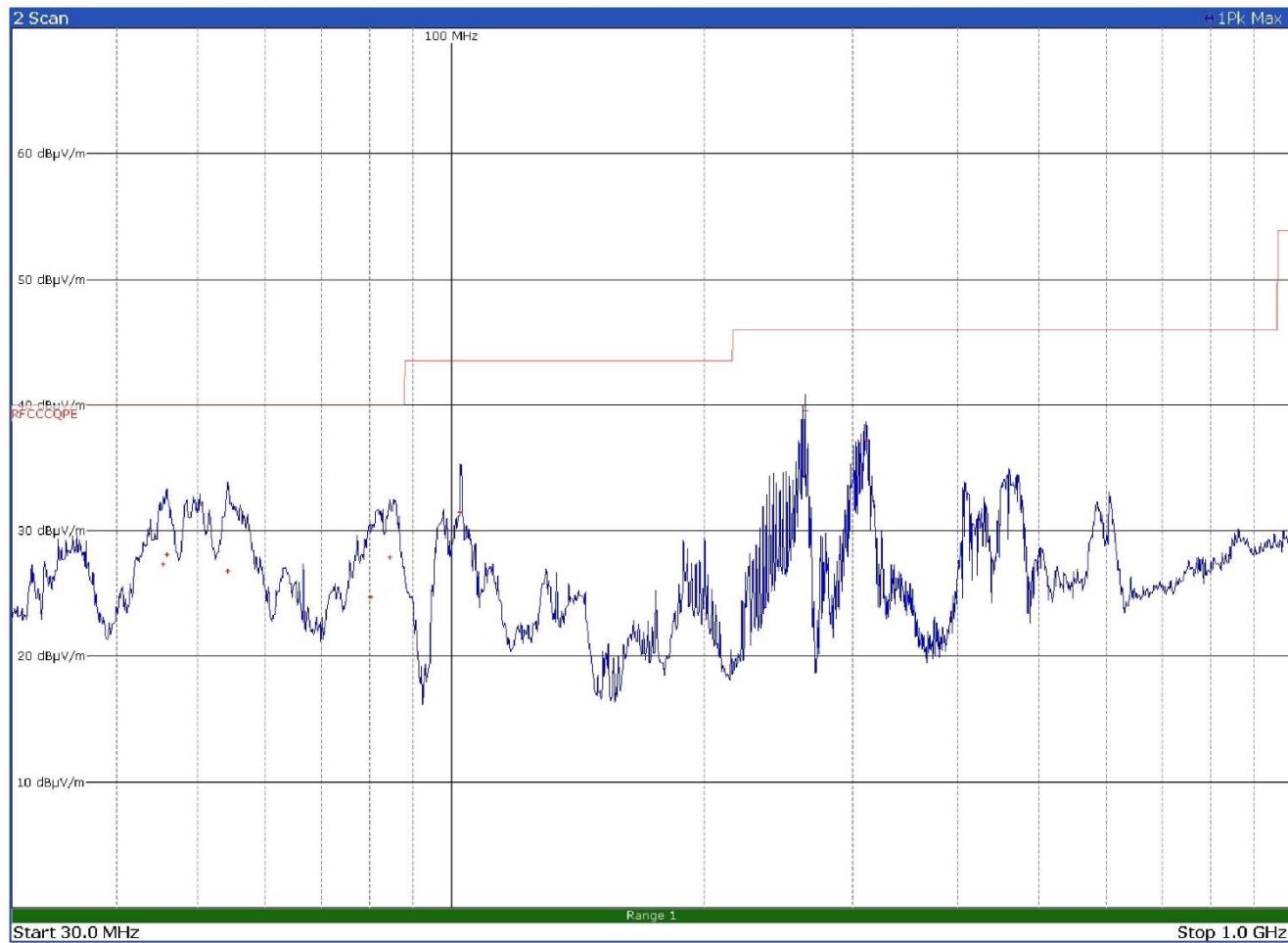


Figure 8.5-9: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
45.4200	27.3	40.0	-12.7	QP
45.8700	28.1	40.0	-11.9	QP
54.2100	26.8	40.0	-13.2	QP
80.0400	24.7	40.0	-15.3	QP
84.5100	27.9	40.0	-12.1	QP
102.5100	31.4	43.5	-12.1	QP
263.3400	39.5	46.0	-6.50	QP
311.5800	37.3	46.0	-8.70	QP

Test data, continued

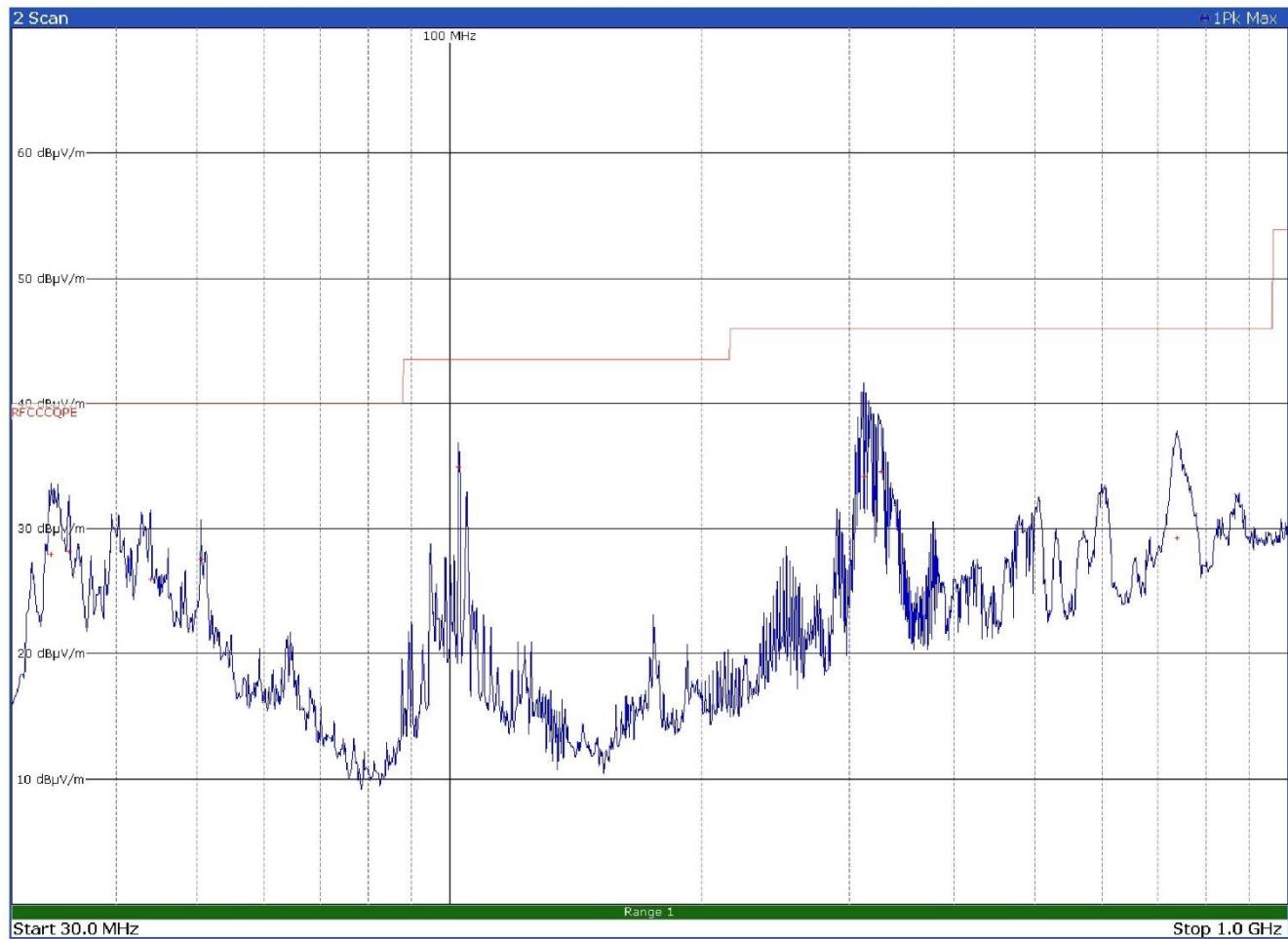


Figure 8.5-10: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
33.4500	27.9	40.0	-12.1	QP
35.1300	28.2	40.0	-11.8	QP
43.9500	25.9	40.0	-14.1	QP
50.4600	27.6	40.0	-12.4	QP
102.4500	35.0	43.6	-8.60	QP
311.7600	34.2	46.0	-11.8	QP
326.9100	34.5	46.0	-11.5	QP
737.6100	29.3	46.0	-16.7	QP

Test data, continued

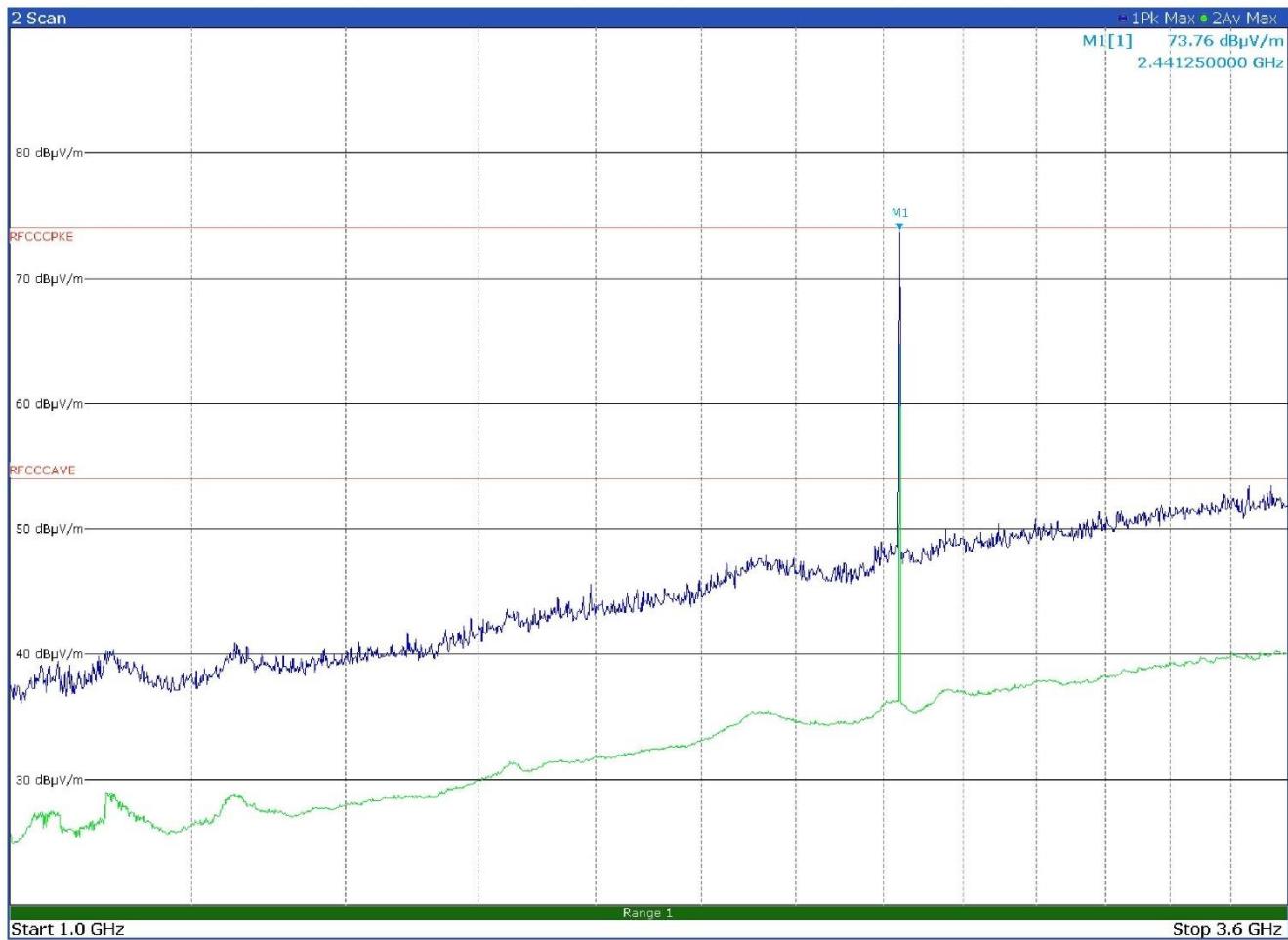


Figure 8.5-11: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

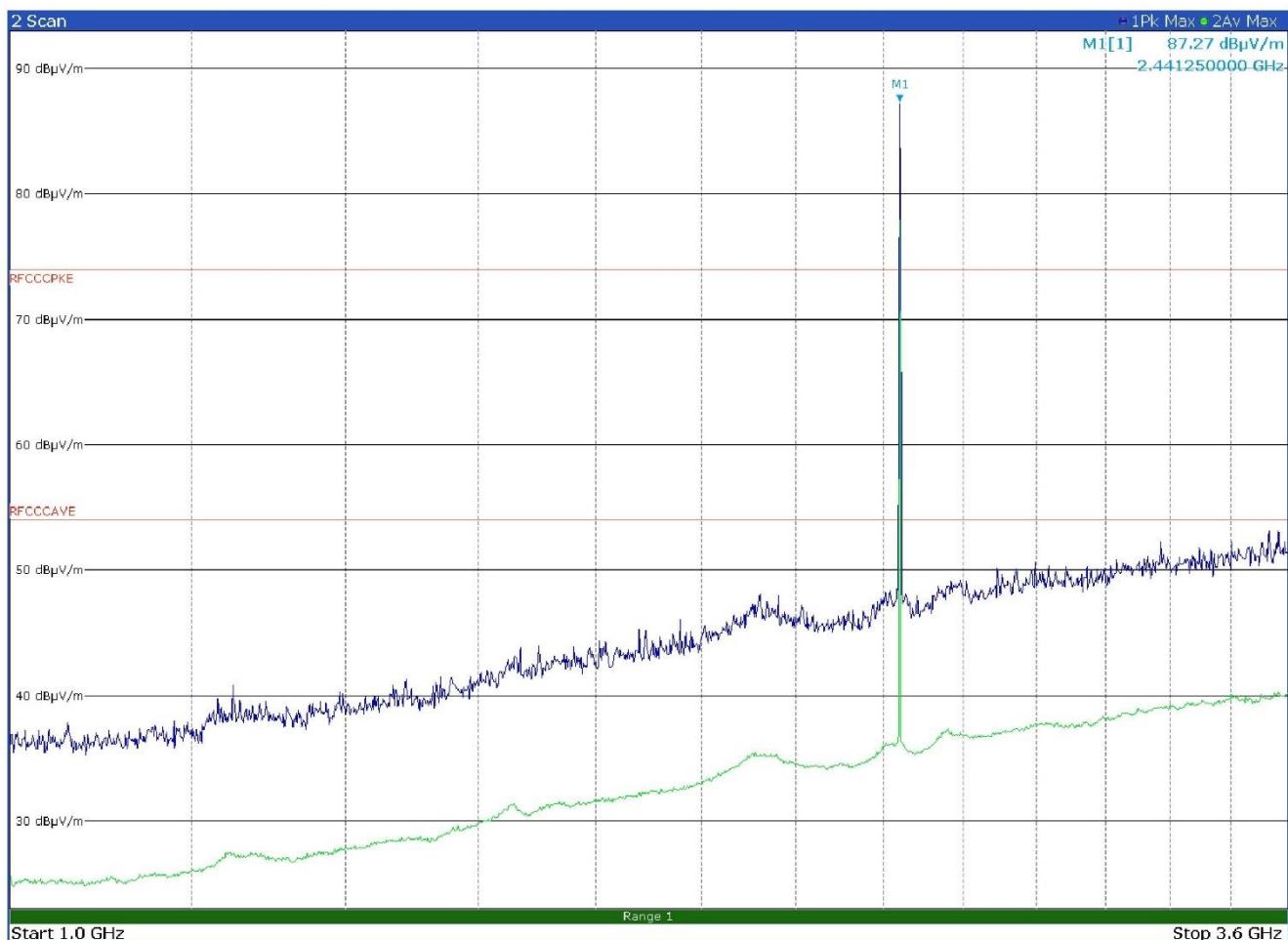


Figure 8.5-12: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

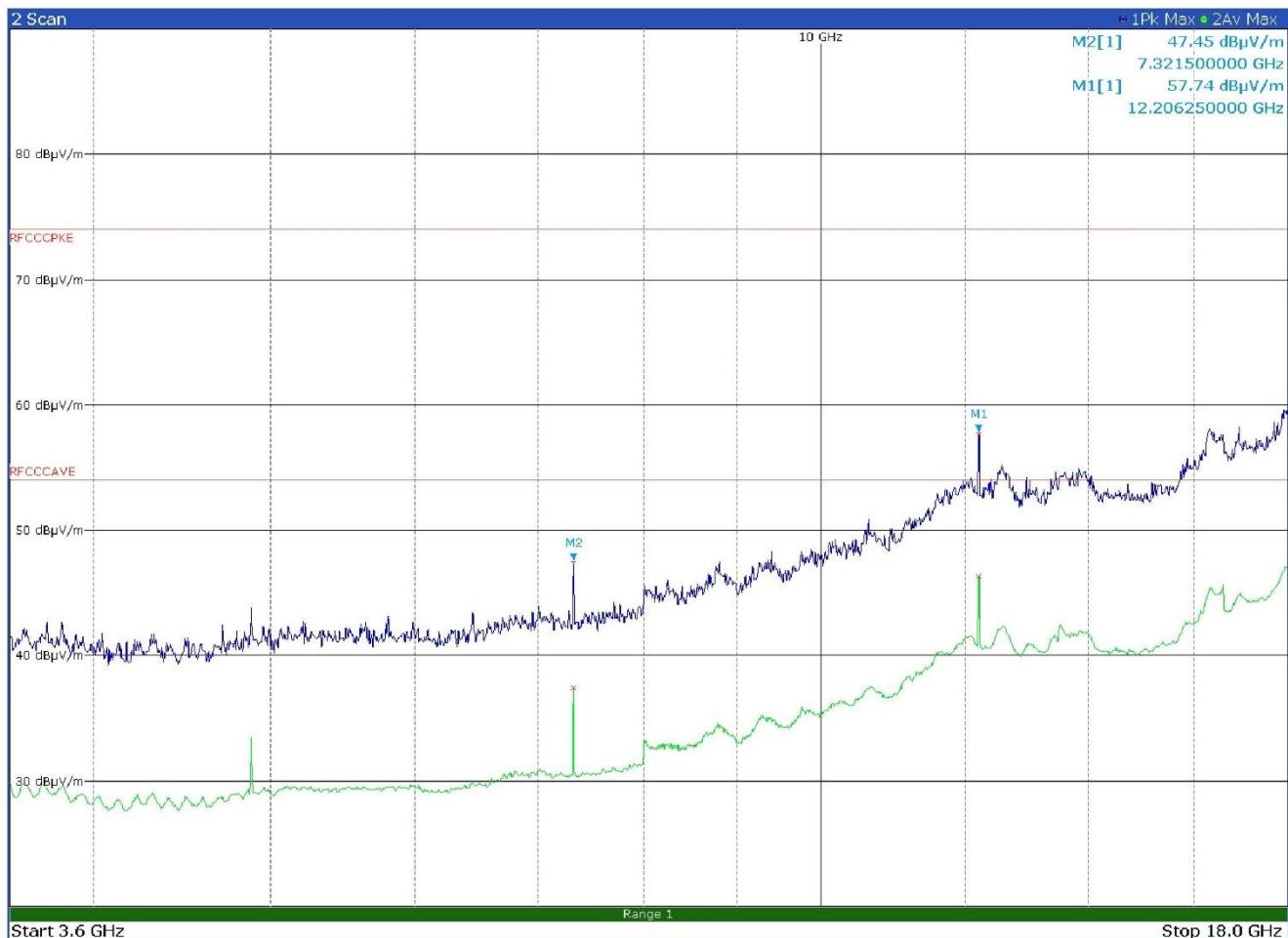


Figure 8.5-13: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
7321.2500	37.4	54.0	-16.6	Av
7321.5000	47.5	74.0	-26.5	Pk
12206.2500	57.7	74.0	-16.3	Pk
12206.2500	46.3	54.0	-7.70	Av

Test data, continued

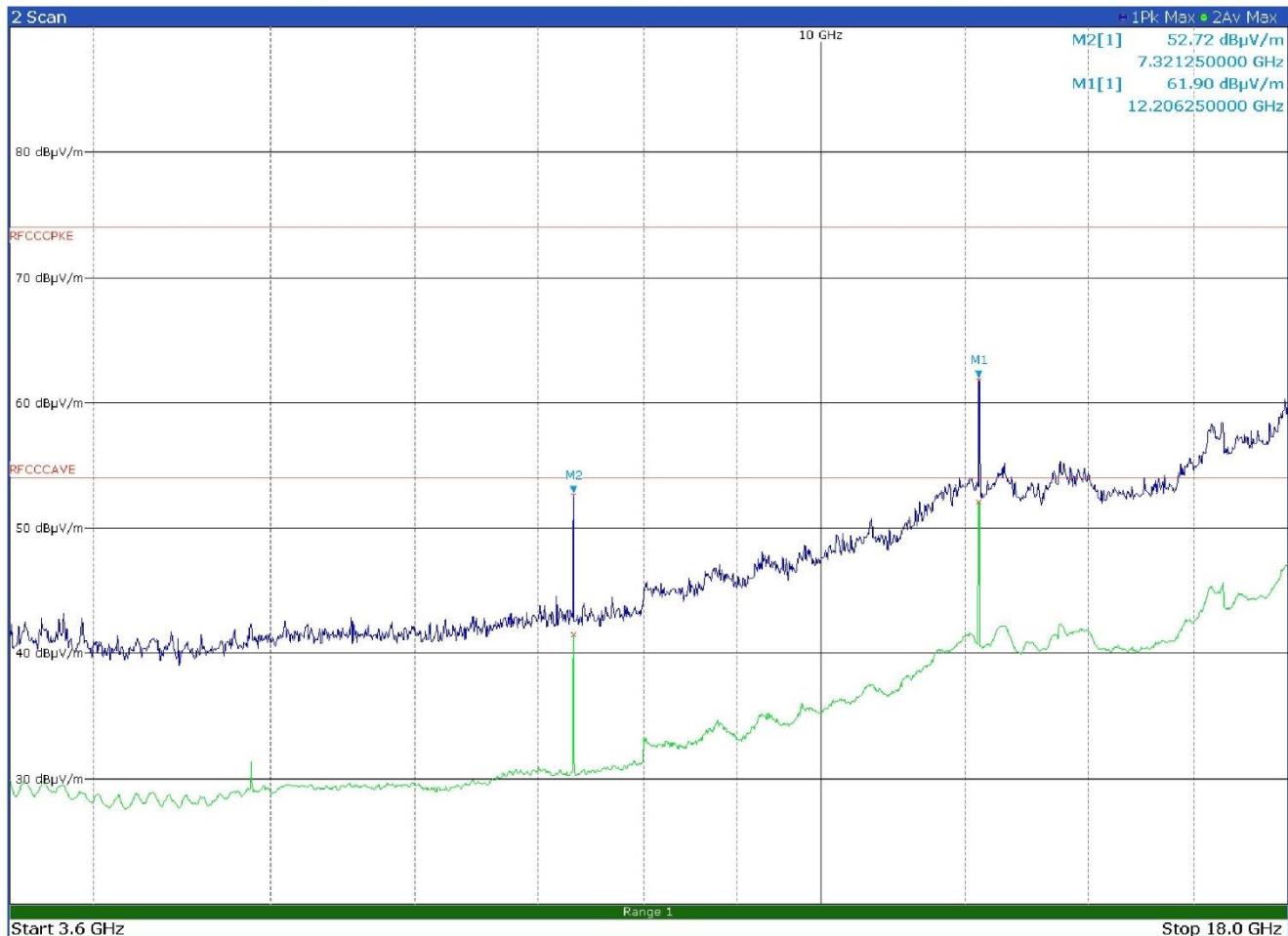


Figure 8.5-14: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
7321.2500	52.7	74.0	-21.3	Pk
7321.2500	41.5	54.0	-12.5	Av
12206.2500	61.9	74.0	-12.1	Pk
12206.2500	52.1	54.0	-1.90	Av

Test data, continued

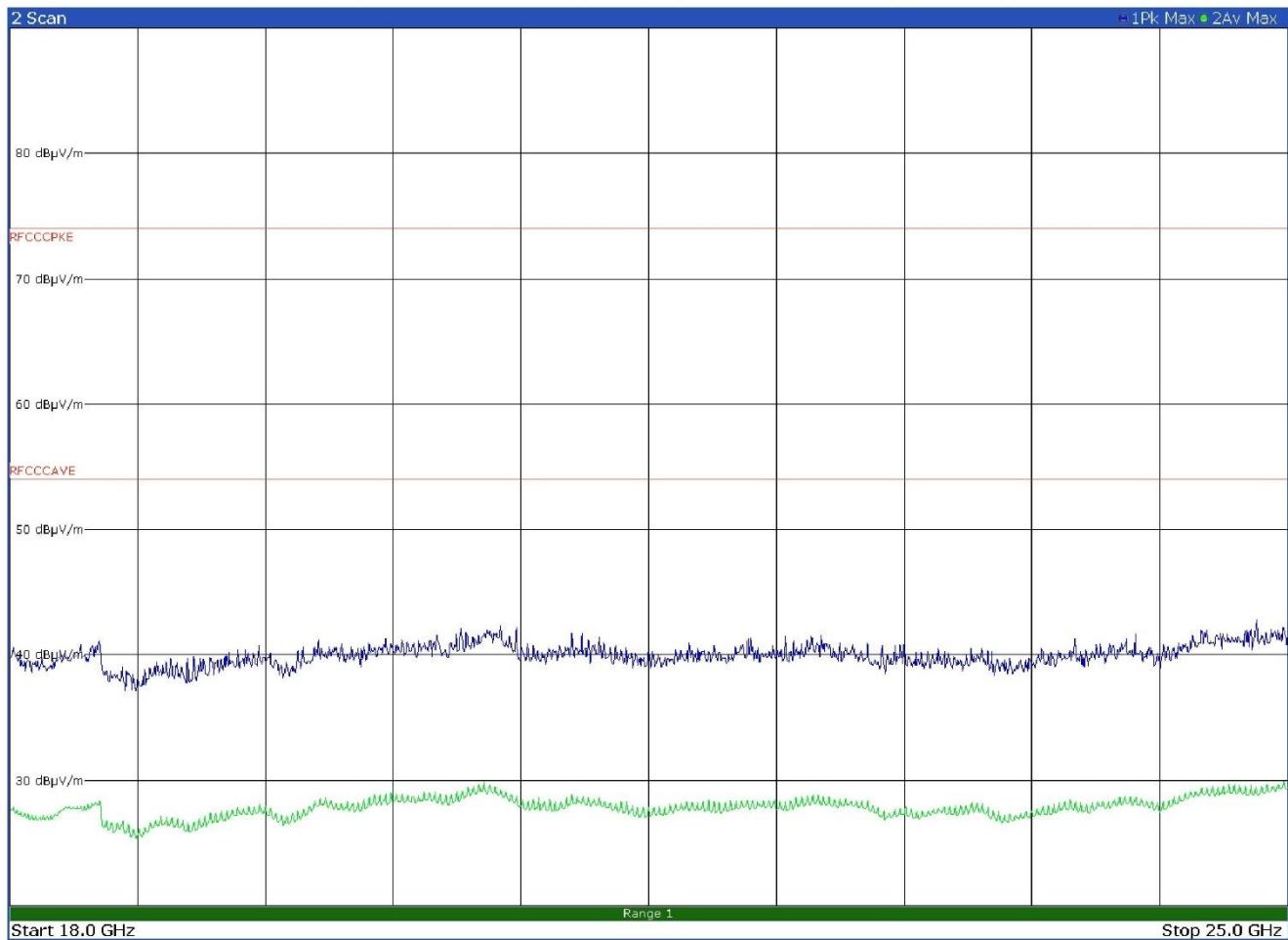


Figure 8.5-15: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

No spurious emissions found

Test data, continued

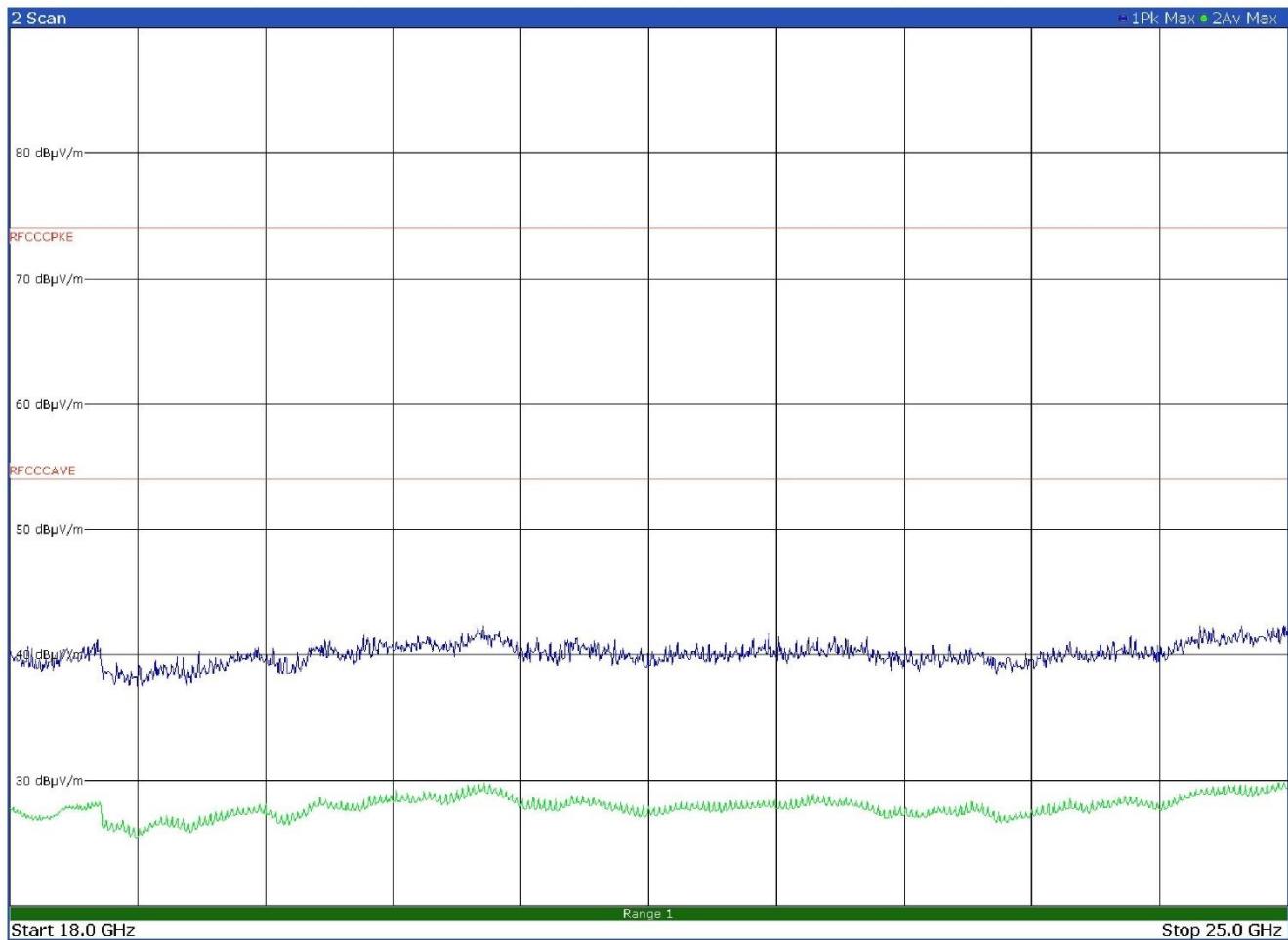


Figure 8.5-16: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

No spurious emissions found

Test data, continued

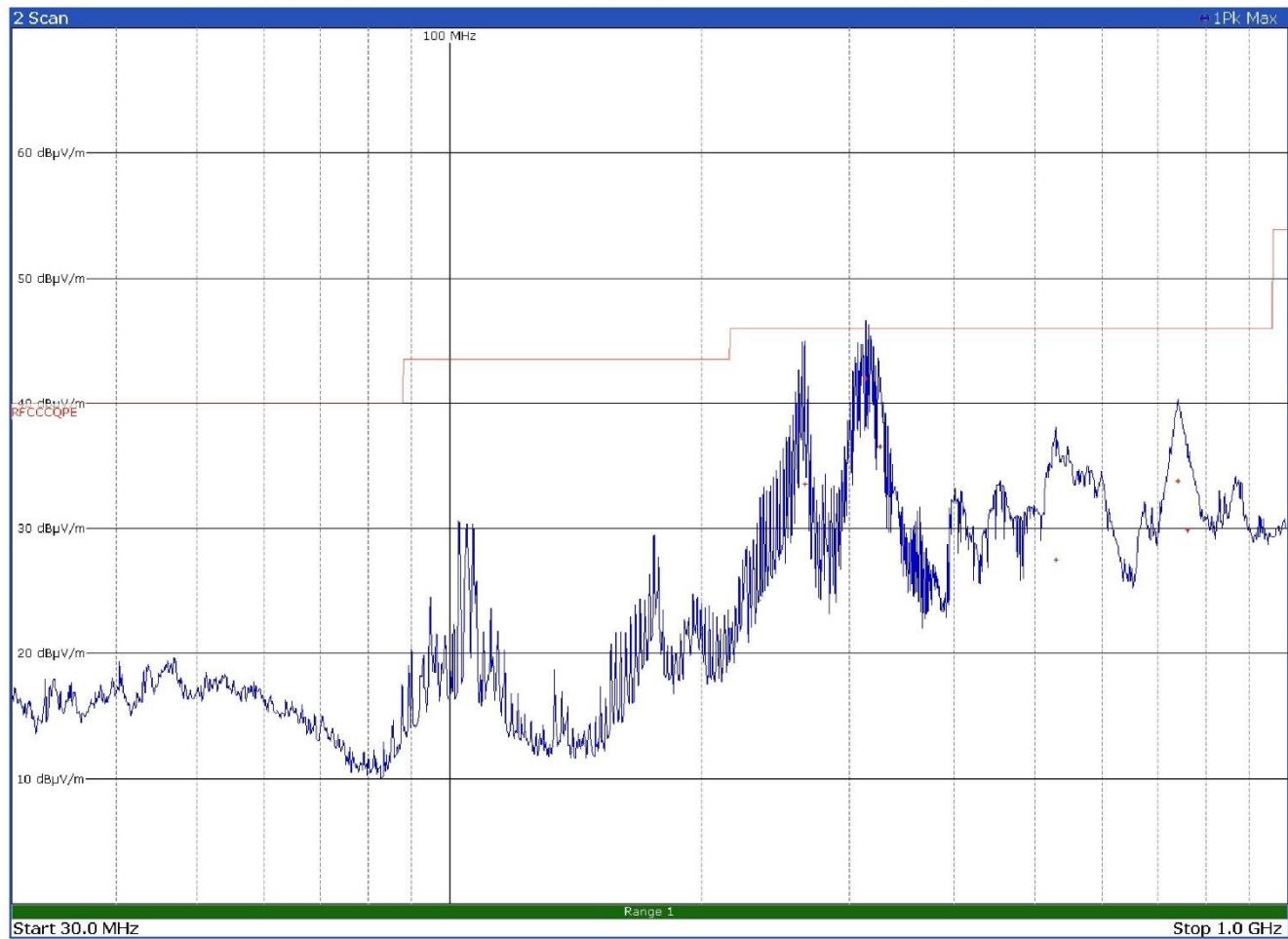


Figure 8.5-17: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
265.4700	33.5	46.0	-12.5	QP
313.6800	42.0	46.0	-4.0	QP
326.8500	36.6	46.0	-9.40	QP
528.8700	27.5	46.0	-18.5	QP
739.5900	33.8	46.0	-12.2	QP
759.0000	29.9	46.0	-16.1	QP

Test data, continued

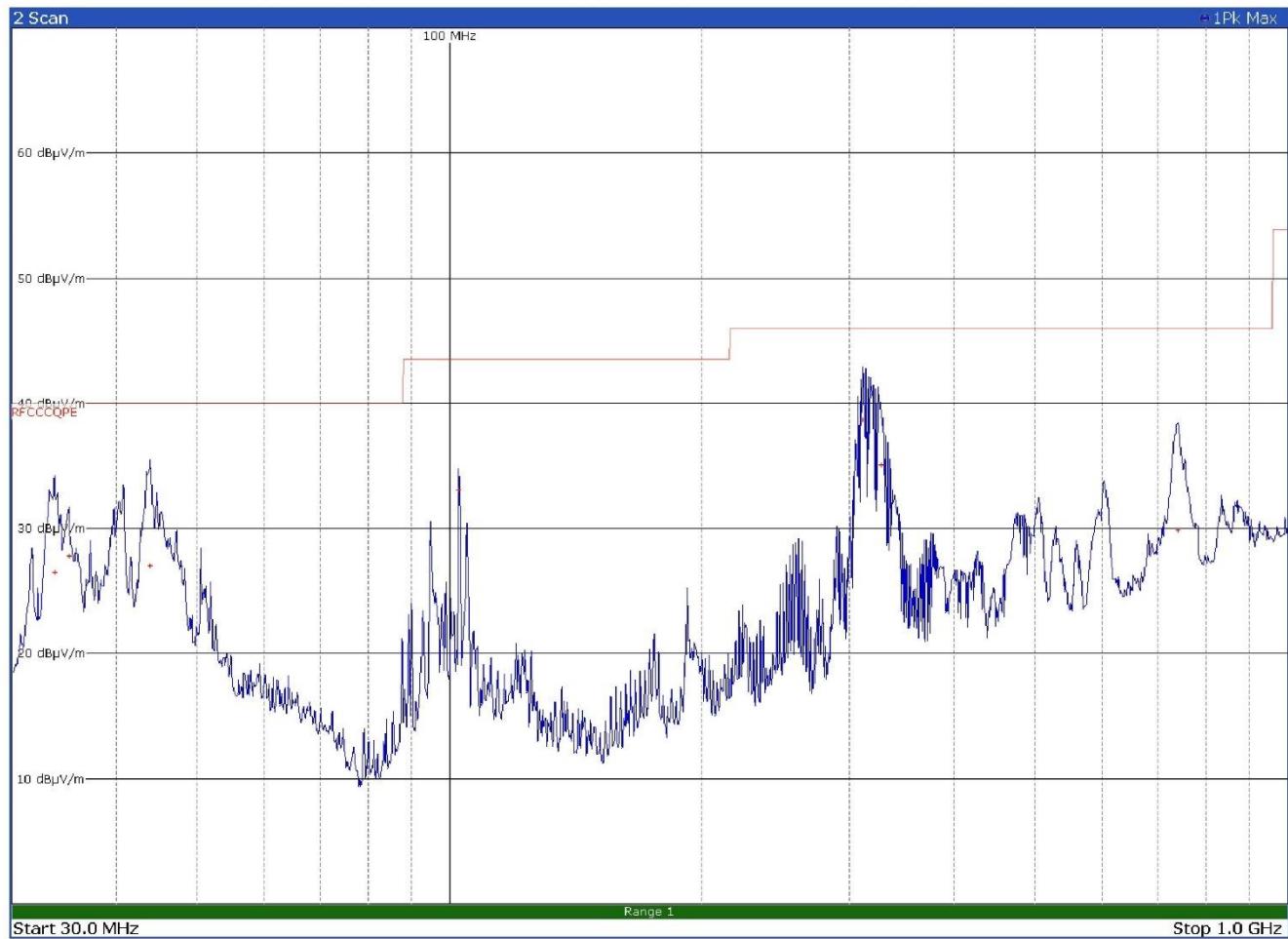


Figure 8.5-18: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
33.7500	26.5	40.0	-13.5	QP
35.1300	27.8	40.0	-12.2	QP
43.8600	27.0	40.0	-13.0	QP
102.4800	33.1	43.6	-10.5	QP
311.5200	38.7	46.0	-7.30	QP
326.9100	35.1	46.0	-10.9	QP
739.5900	29.8	46.0	-16.2	QP

Test data, continued

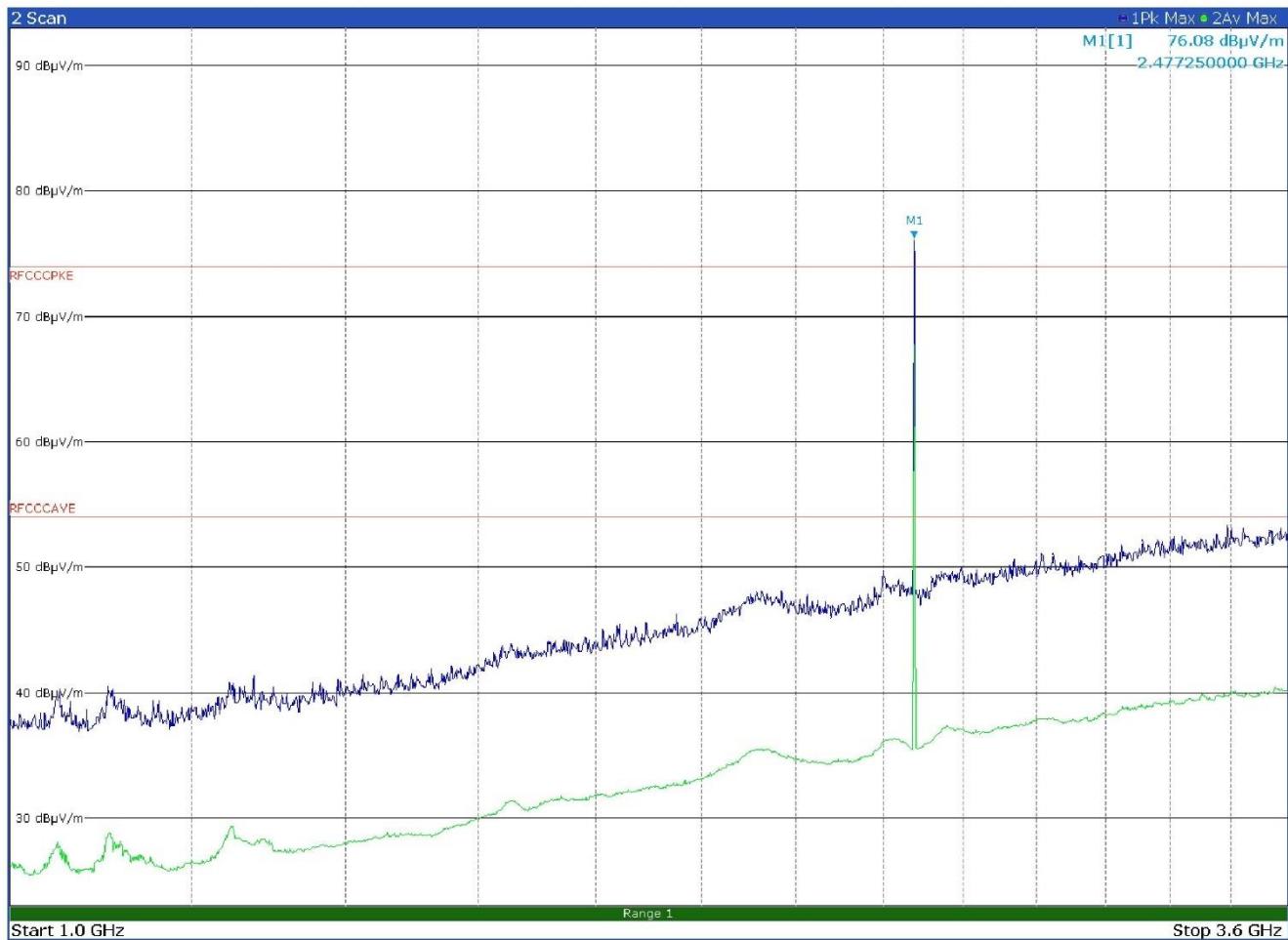


Figure 8.5-19: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

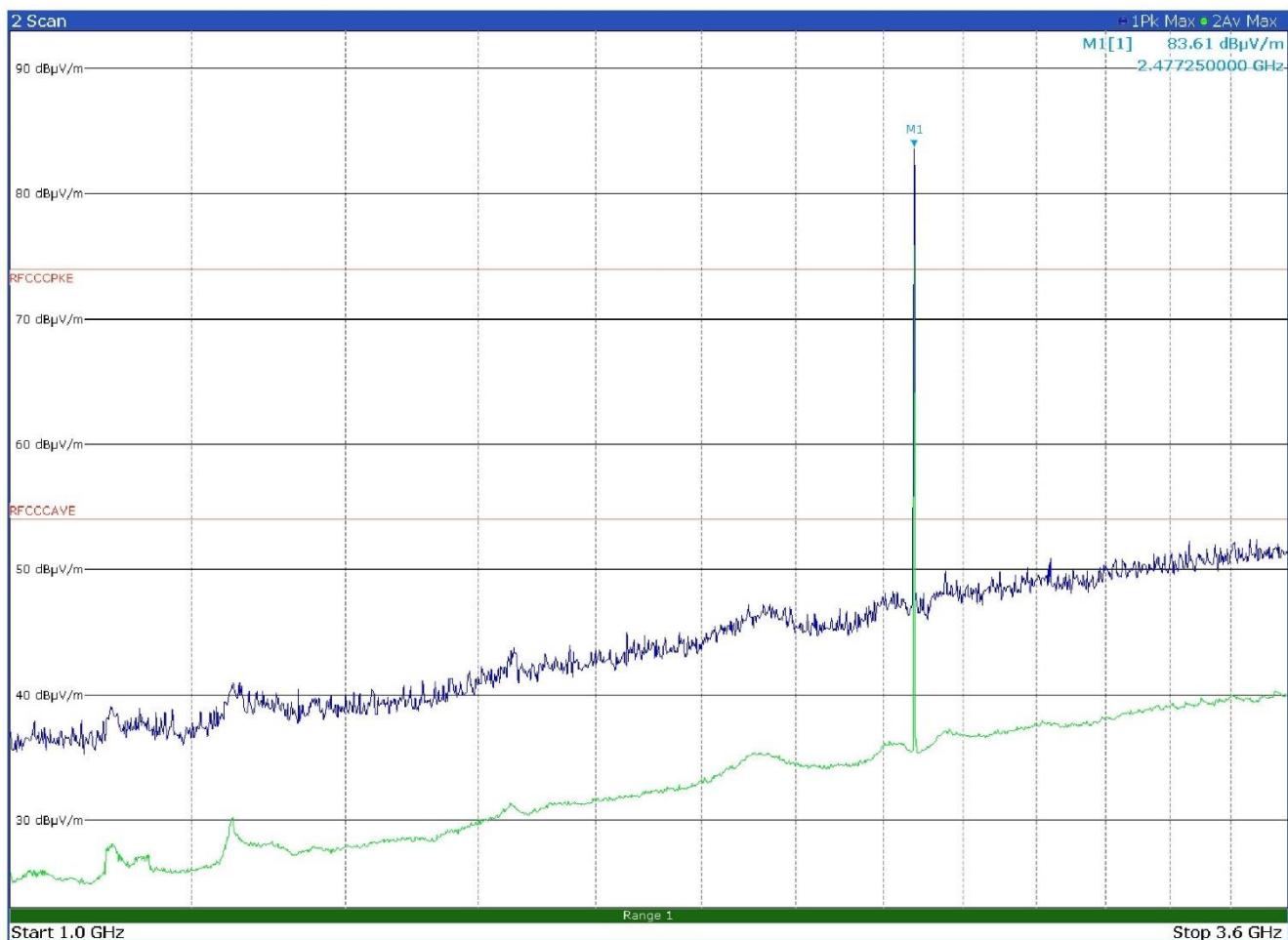


Figure 8.5-20: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

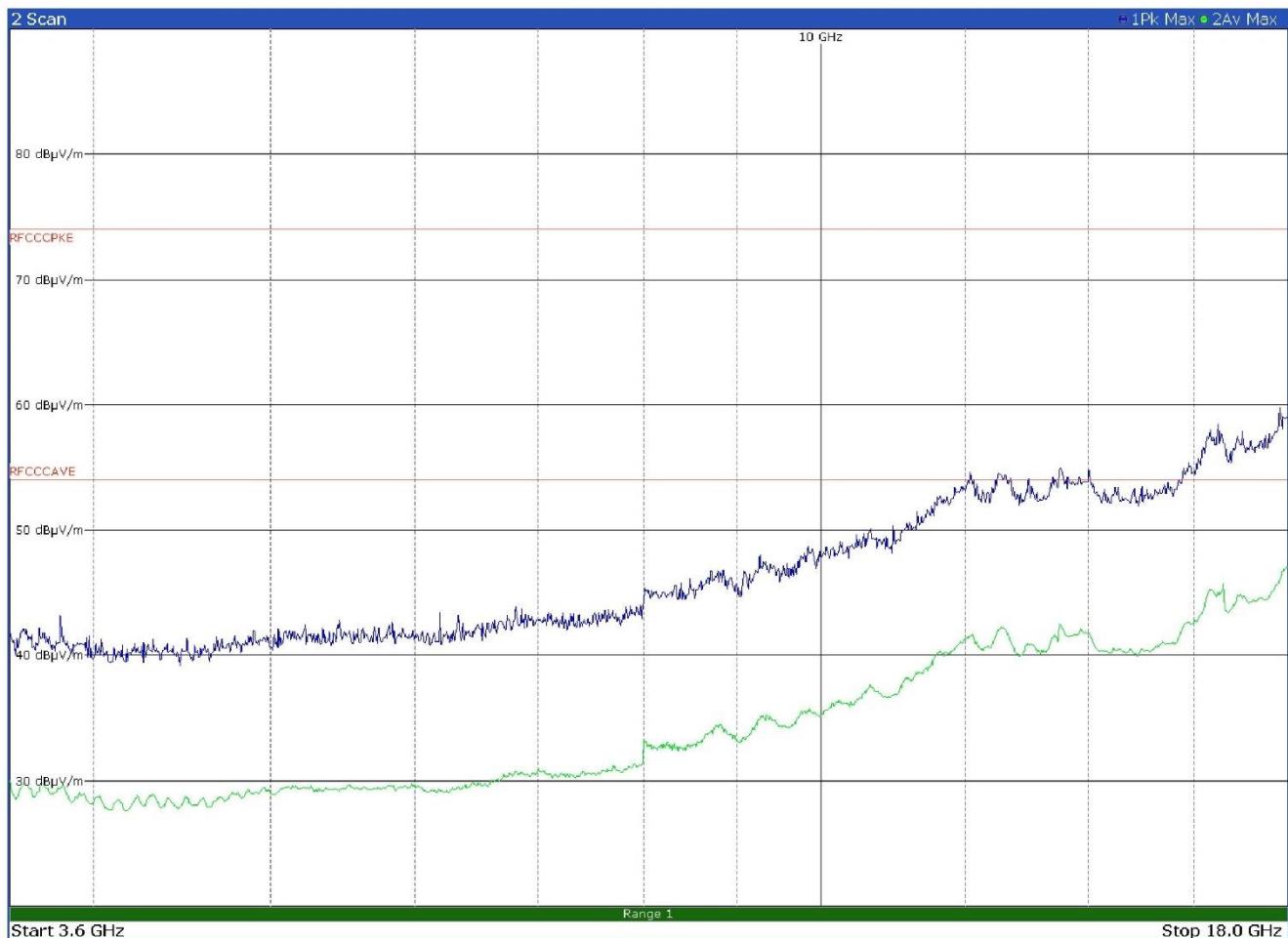


Figure 8.5-21: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Test data, continued

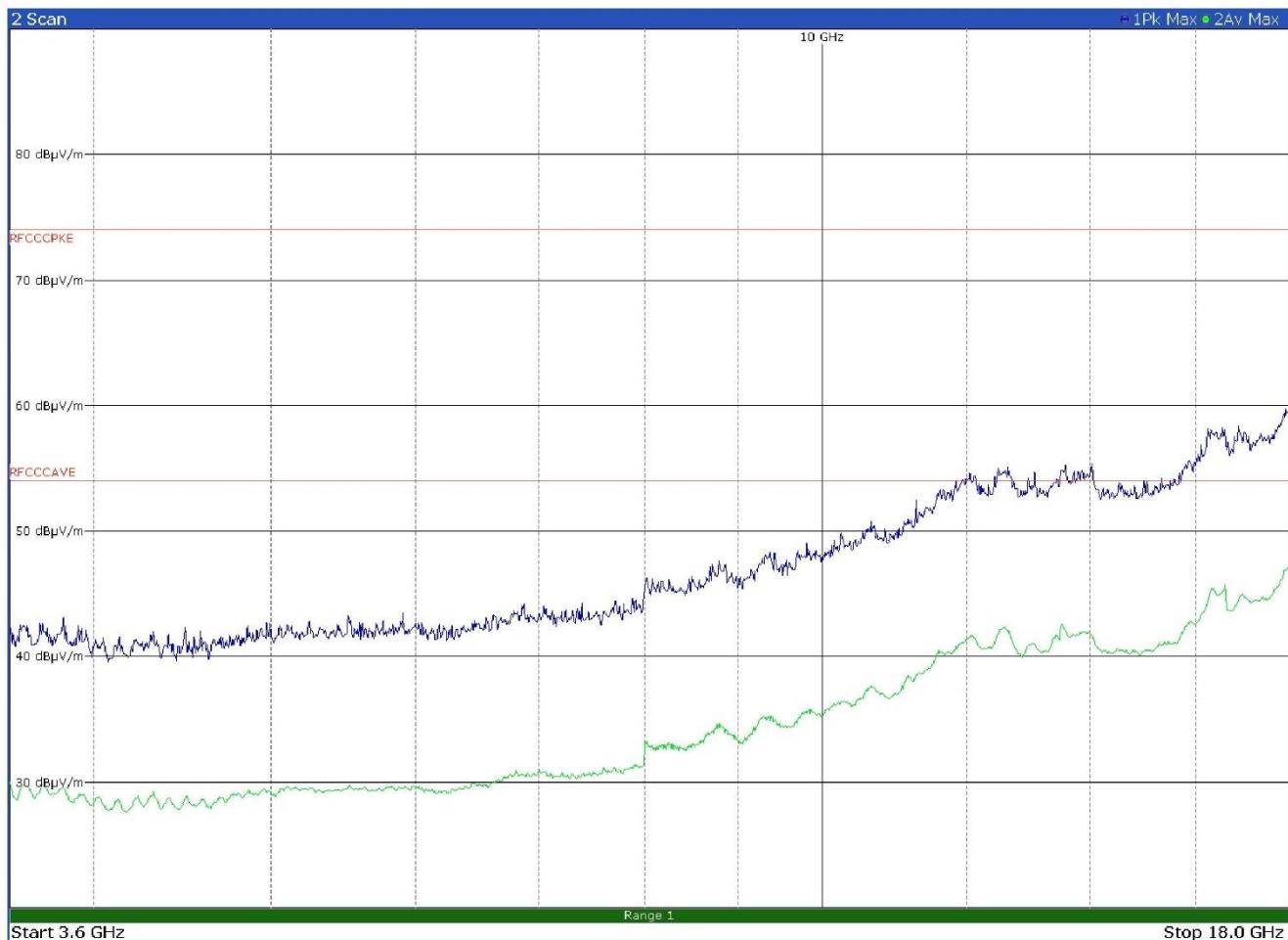


Figure 8.5-22: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Test data, continued

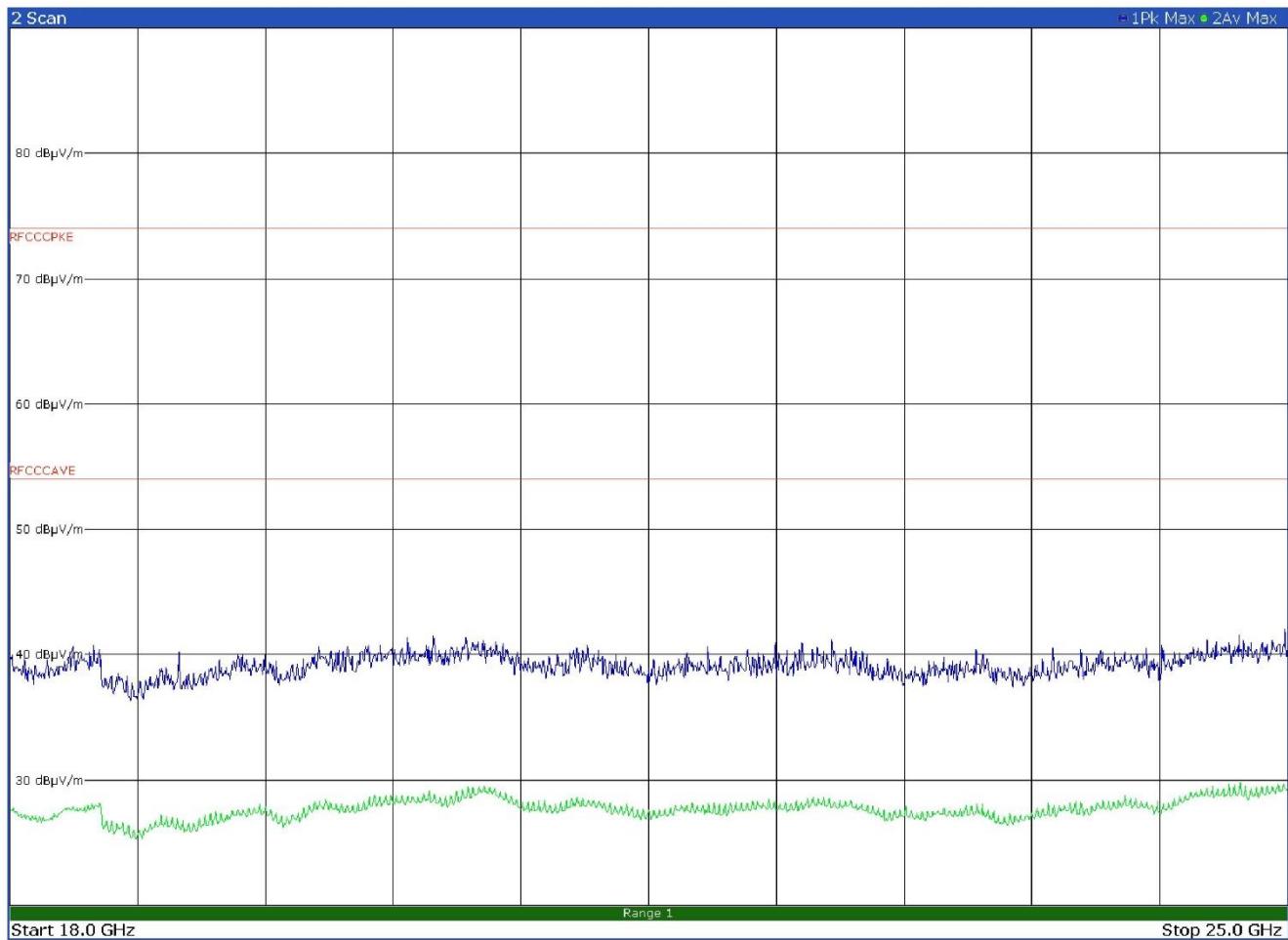


Figure 8.5-23: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Test data, continued

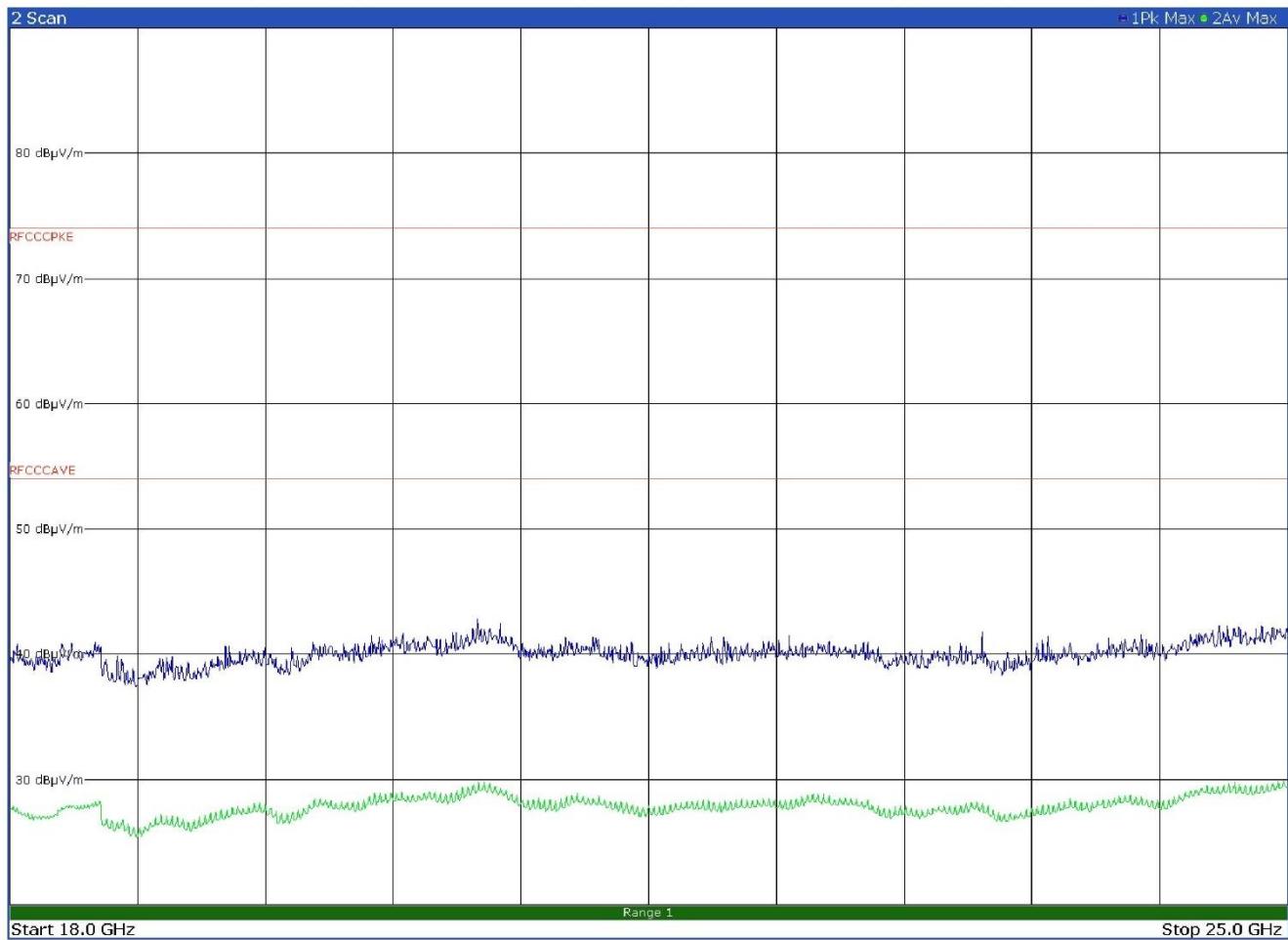


Figure 8.5-24: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Test data, continued

Limit for conducted measurement, according to ANSI C63.10 - 2013:

$$\text{EIRP[dBm]} = \text{E[dB}\mu\text{V/m]} + 20 \log (\text{d[m]}) - 104.77,$$

considering $\text{d[m]} = 0 \text{ m}$

$$\rightarrow 74 \text{ dB}\mu\text{V/m} + (20 - 104.77) [\text{dB}] = -10.77 \text{ dBm}$$

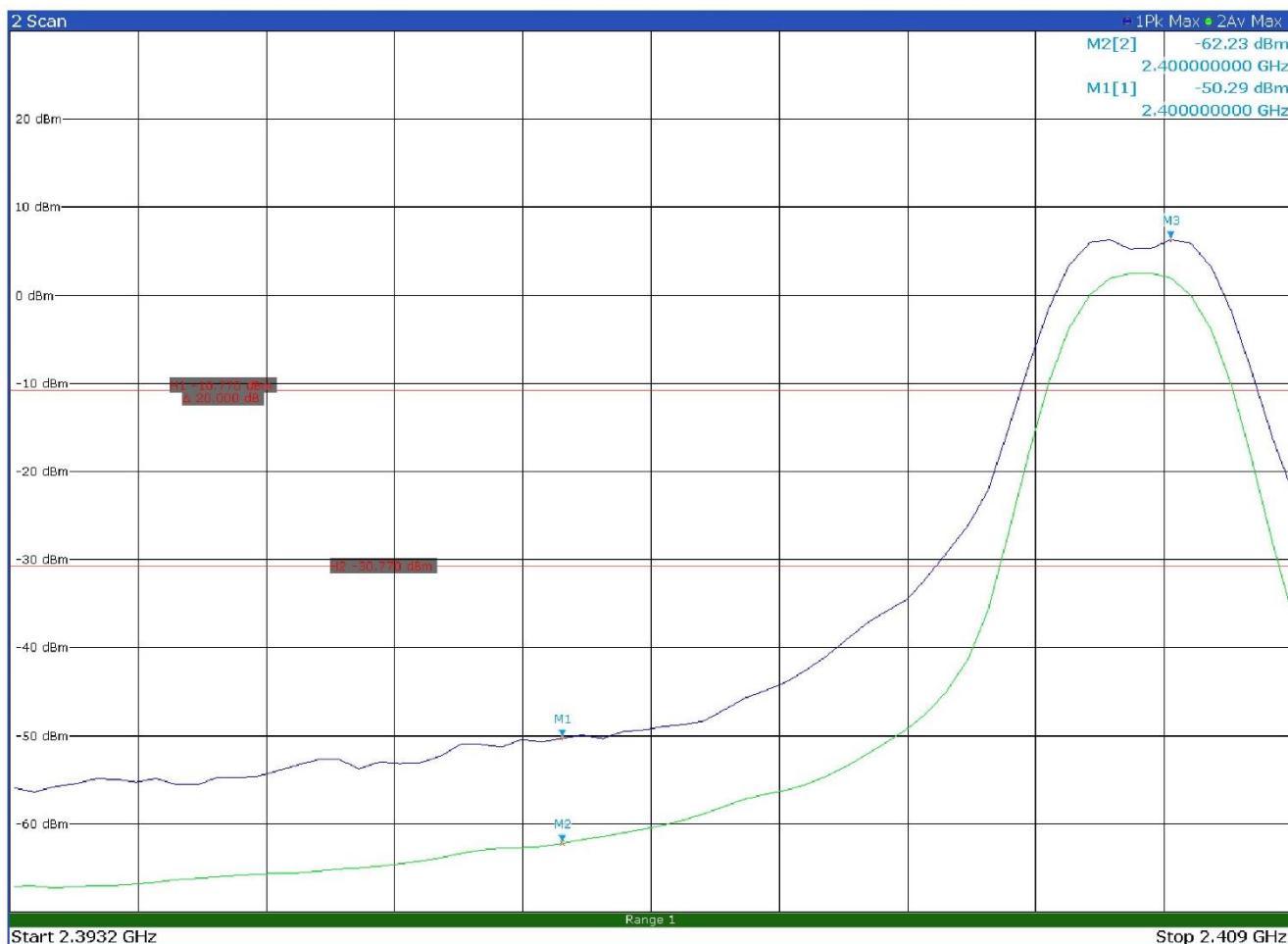


Figure 8.5-25: Band edge spurious emissions at 2400 MHz – Antenna port 1

Test data, continued

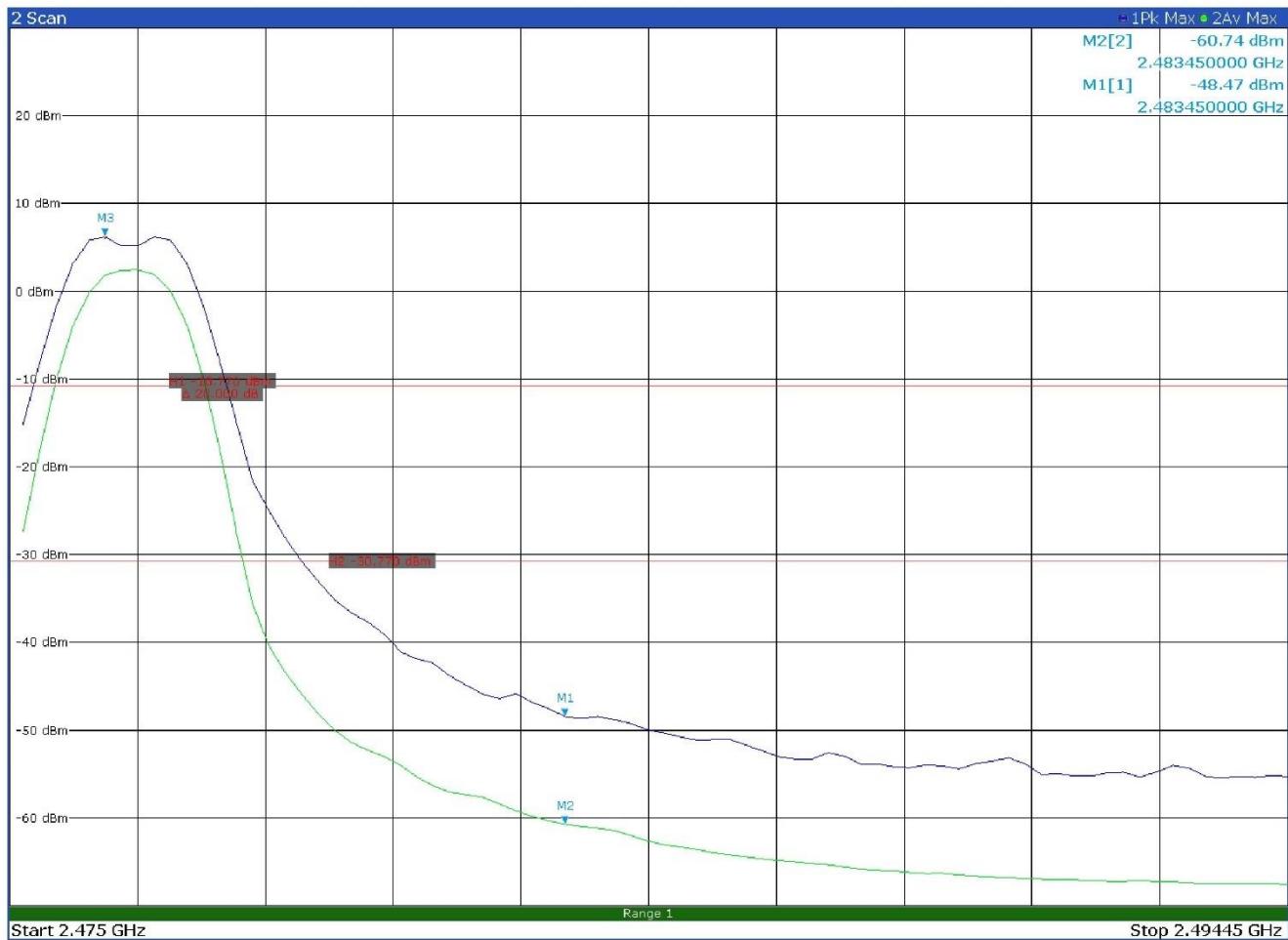


Figure 8.5-26: Band edge spurious emissions at 2483.5 MHz – Antenna port 1

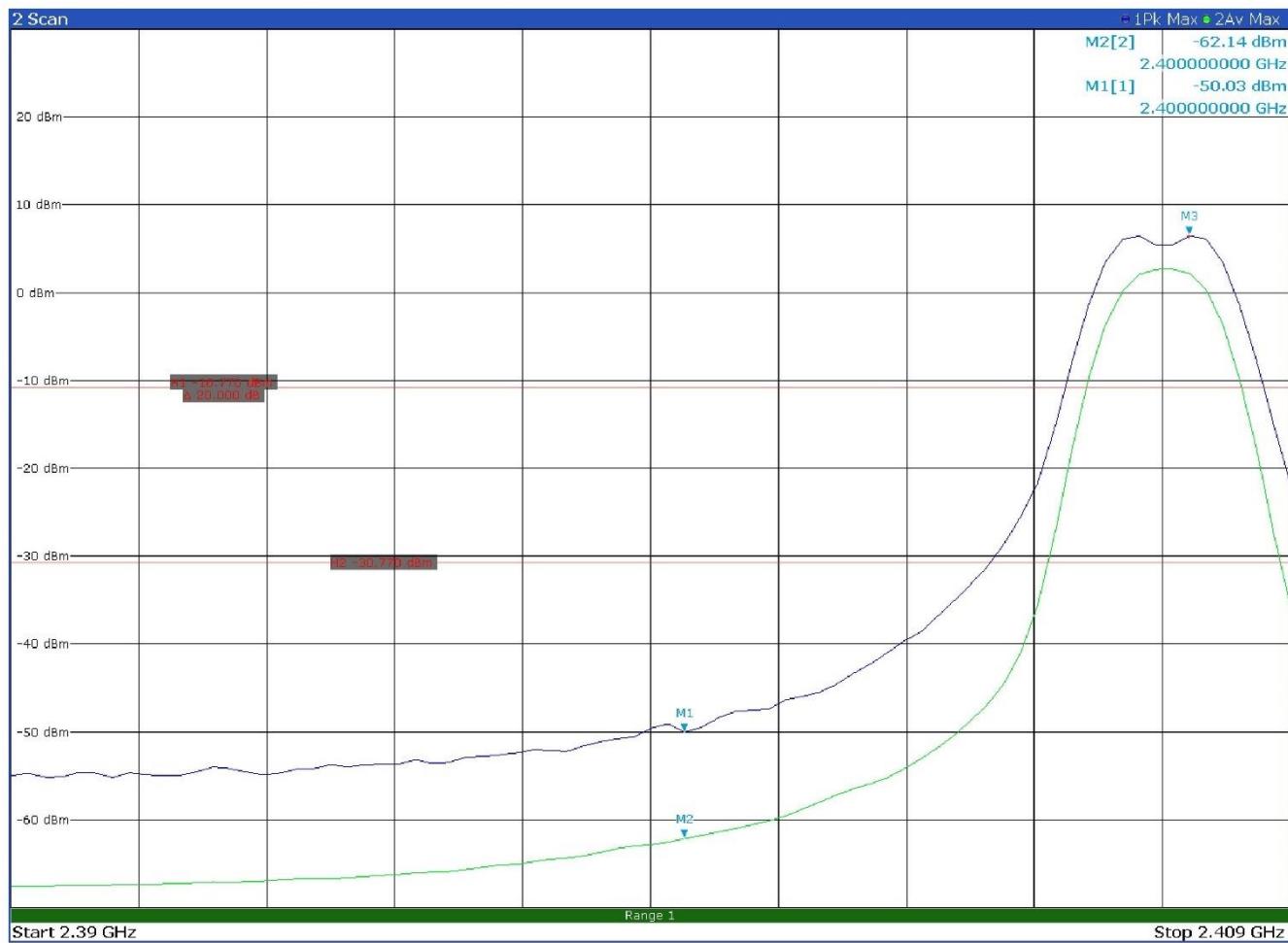


Figure 8.5-27: Band edge spurious emissions at 2400 MHz – Antenna port 2

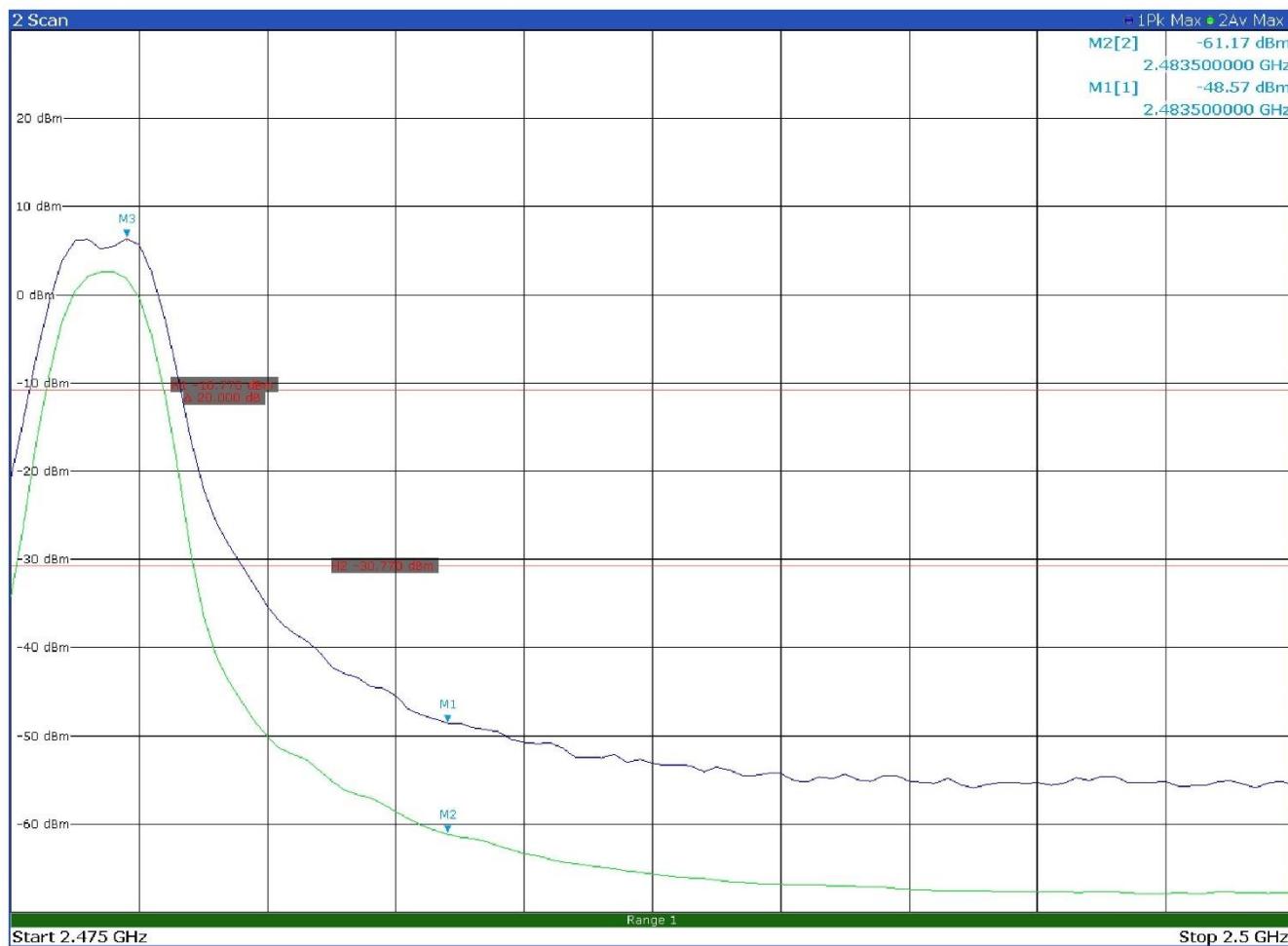


Figure 8.5-278: Band edge spurious emissions at 2483.5 MHz – Antenna port 2

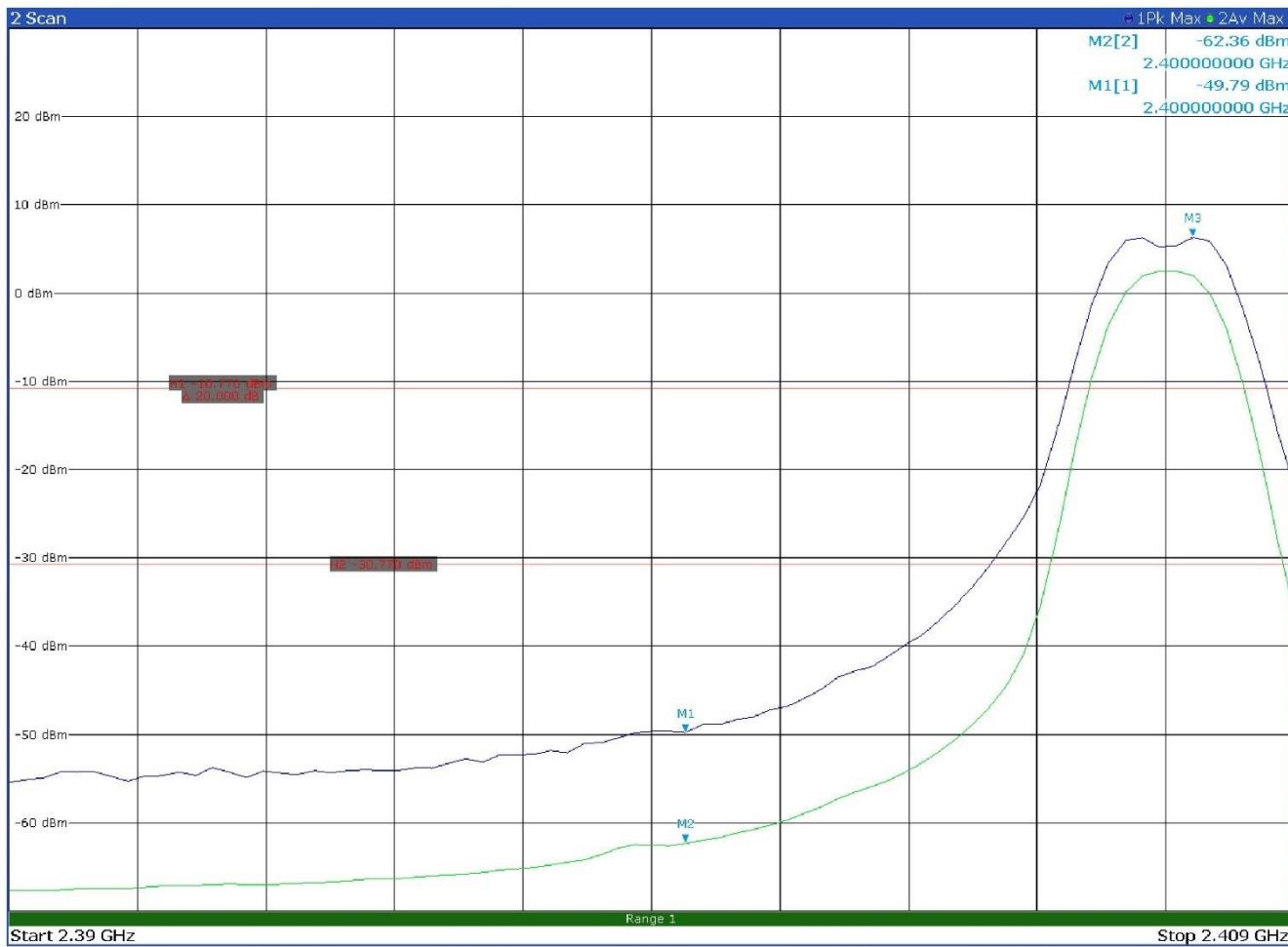


Figure 8.5-29: Band edge spurious emissions at 2400 MHz – Antenna port 3

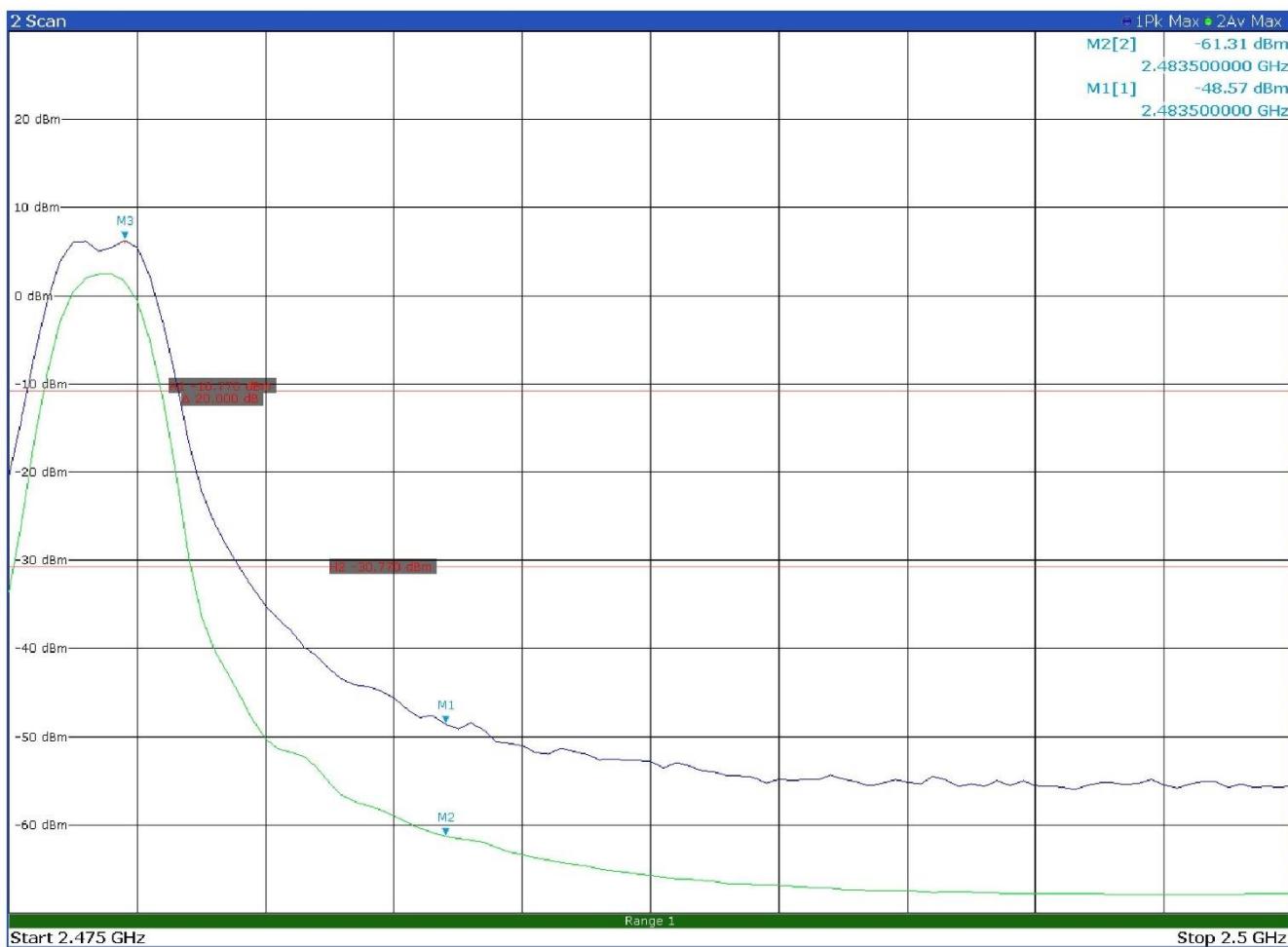


Figure 8.5-30: Band edge spurious emissions at 2483.5 MHz – Antenna port 3

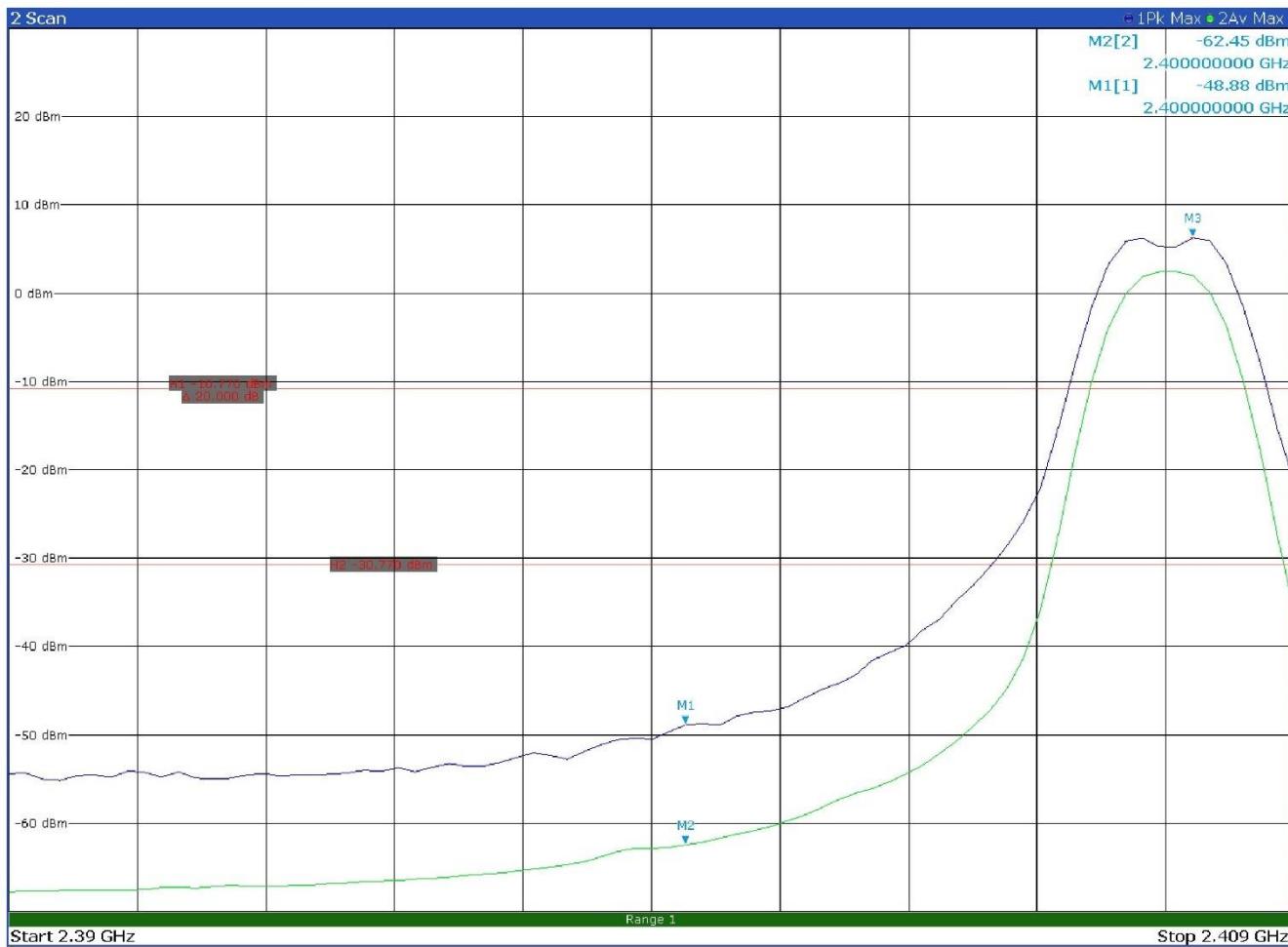


Figure 8.5-31: Band edge spurious emissions at 2400 MHz – Antenna port 4

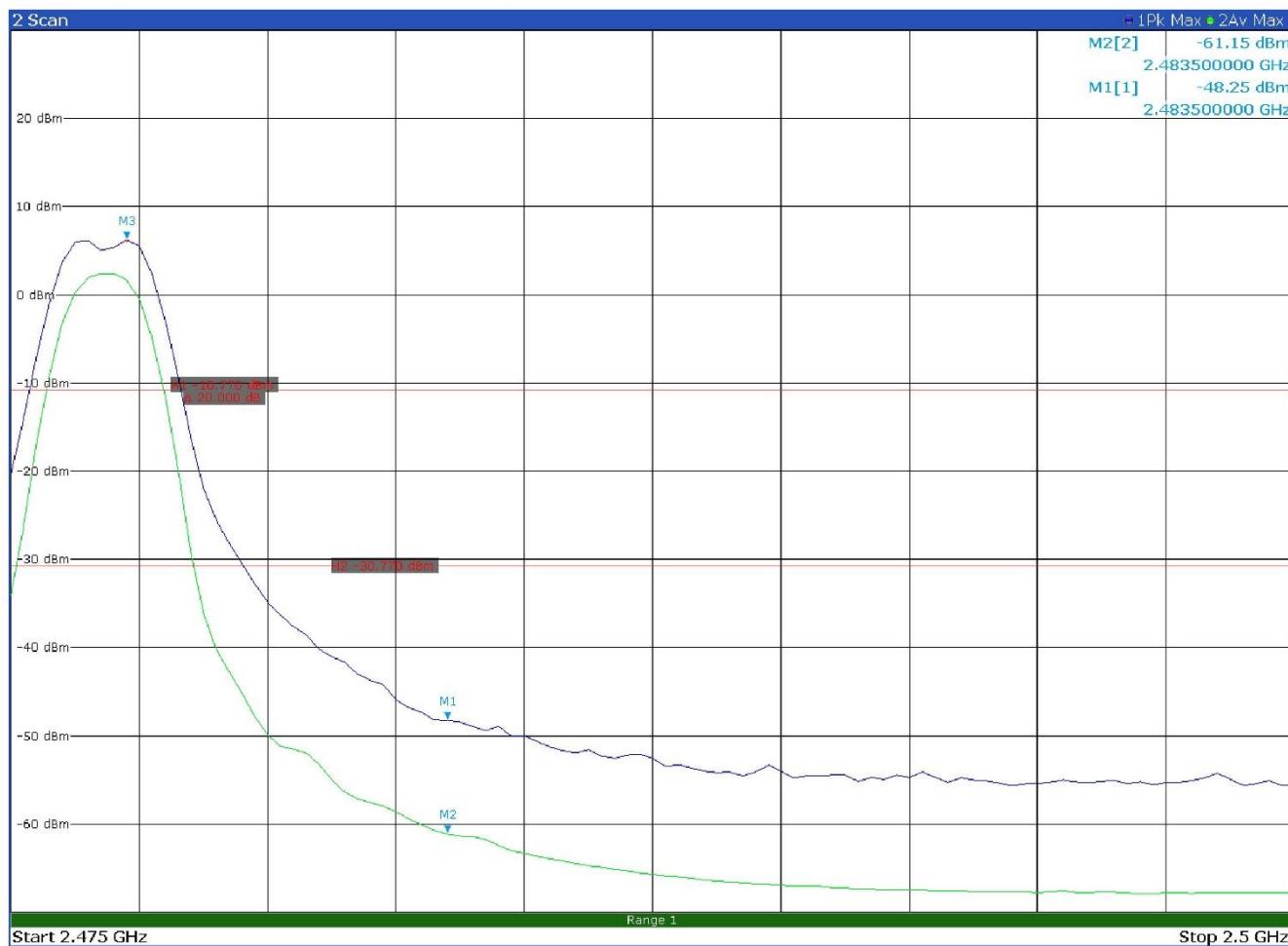


Figure 8.5-32: Band edge spurious emissions at 2483.5 MHz – Antenna port 4

8.6 Power spectral density for digitally modulated devices

8.6.1 References, definitions and limits

RSS-247, Clause 5.2:

DTs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:

b. The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

RSS-247, Clause 5.3:

Hybrid systems employ a combination of both frequency hopping and digital transmission techniques and shall comply with the following:

b. With the frequency hopping turned off, the digital transmission operation shall comply with the power spectral density requirements for digital modulation systems set out in of section 5.2(b) or section 6.2.4 for hybrid devices operating in the band 5725–5850 MHz.

8.6.2 Test summary

Verdict	Pass	Tested by	O. Frau	Test date	March 28, 2024
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8.6.3 Observations, settings and special notes

Power spectral density test was performed as per KDB 558074, section 8.4 with reference to ANSI C63.10 subclause 11.10.

The test was performed using method PKPSD (peak PSD).

Spectrum analyser settings:

Resolution bandwidth:	3 kHz \leq RBW \leq 100 kHz
Video bandwidth:	$\geq 3 \times$ RBW
Frequency span:	1.5 times the DTS BW (Peak)
Detector mode:	Peak
Trace mode:	Max hold

8.6.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620

8.6.5 Test data

Table 8.6-1: PSD results (conducted measurement) – Antenna port 1

Frequency, MHz	Field strength, dB μ V/m/3 kHz	EIRPSD, dBm/3 kHz	Antenna gain, dBi	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2406	82.26	-12.97	4.67	-17.64	8	-25.64
2441	81.89	-13.34	4.67	-18.01	8	-26.01
2476	81.57	-13.66	4.67	-18.33	8	-26.33

Note: EIRPSD [dBm/3 kHz] = PSD [dBm/3 kHz] + Antenna gain [dBi];
 Field Strength [dB μ V/m/3 kHz] = EIRPSD [dBm/3 kHz] + 95.23 [dB]

Table 8.6-2: PSD results (conducted measurement) – Antenna port 2

Frequency, MHz	Field strength, dB μ V/m/3 kHz	EIRPSD, dBm/3 kHz	Antenna gain, dBi	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2406	82.02	-13.21	4.67	-17.88	8	-25.88
2441	81.75	-13.48	4.67	-18.15	8	-26.15
2476	81.71	-13.52	4.67	-18.19	8	-26.19

Note: EIRPSD [dBm/3 kHz] = PSD [dBm/3 kHz] + Antenna gain [dBi];
 Field Strength [dB μ V/m/3 kHz] = EIRPSD [dBm/3 kHz] + 95.23 [dB]

Table 8.6-3: PSD results (conducted measurement) – Antenna port 3

Frequency, MHz	Field strength, dB μ V/m/3 kHz	EIRPSD, dBm/3 kHz	Antenna gain, dBi	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2406	81.95	-13.28	4.67	-17.95	8	-25.95
2441	81.75	-13.48	4.67	-18.15	8	-26.15
2476	81.45	-13.78	4.67	-18.45	8	-26.45

Note: EIRPSD [dBm/3 kHz] = PSD [dBm/3 kHz] + Antenna gain [dBi];
 Field Strength [dB μ V/m/3 kHz] = EIRPSD [dBm/3 kHz] + 95.23 [dB]

Table 8.6-4: PSD results (conducted measurement) – Antenna port 4

Frequency, MHz	Field strength, dB μ V/m/3 kHz	EIRPSD, dBm/3 kHz	Antenna gain, dBi	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2406	81.92	-13.31	4.67	-17.98	8	-25.98
2441	81.23	-14.00	4.67	-18.67	8	-26.67
2476	81.05	-14.18	4.67	-18.85	8	-26.85

Note: EIRPSD [dBm/3 kHz] = PSD [dBm/3 kHz] + Antenna gain [dBi];
 Field Strength [dB μ V/m/3 kHz] = EIRPSD [dBm/3 kHz] + 95.23 [dB]