

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

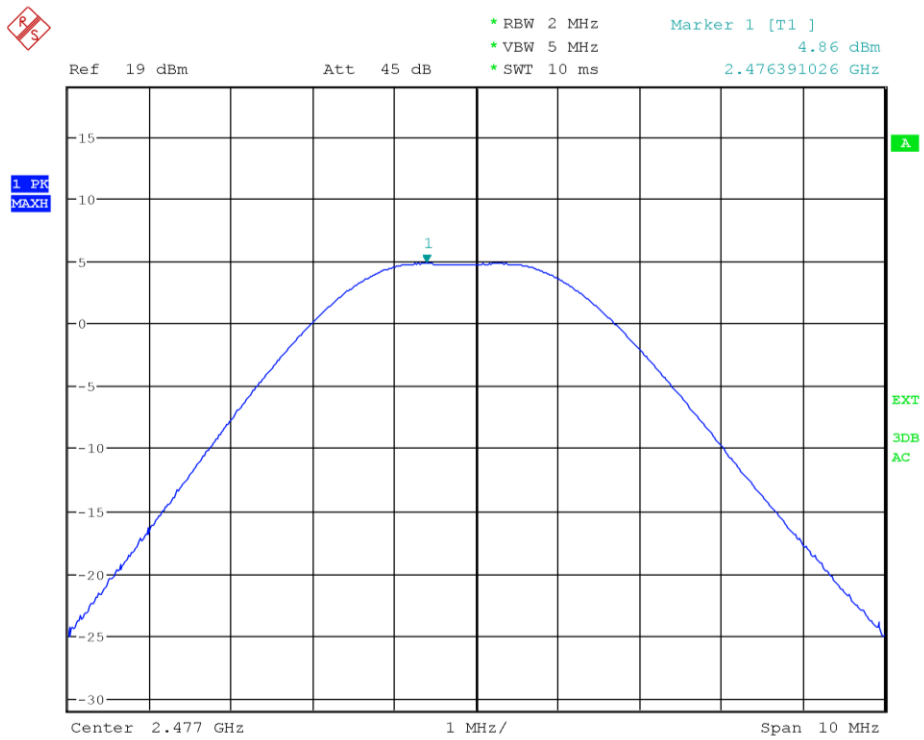


Figure 8.4-12: Output power on high channel – Antenna port 4

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

| Frequency, MHz | Field strength of emissions | | Measurement distance, m |
|----------------|-----------------------------|---------------------------------|-------------------------|
| | μV/m | dBμV/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 8.5-2: ISSED 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

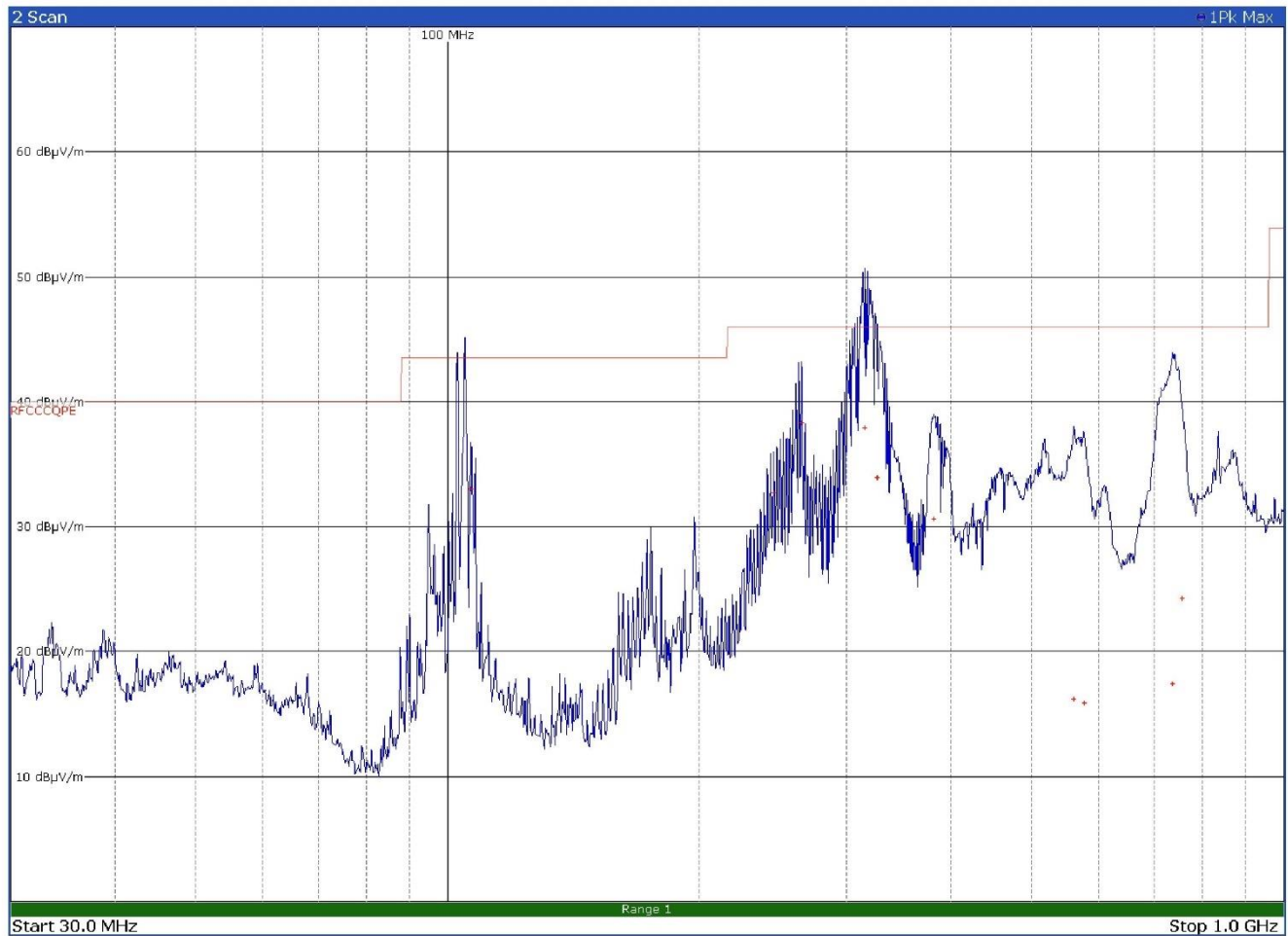


Figure 8.5-1: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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 |

Test data, continued

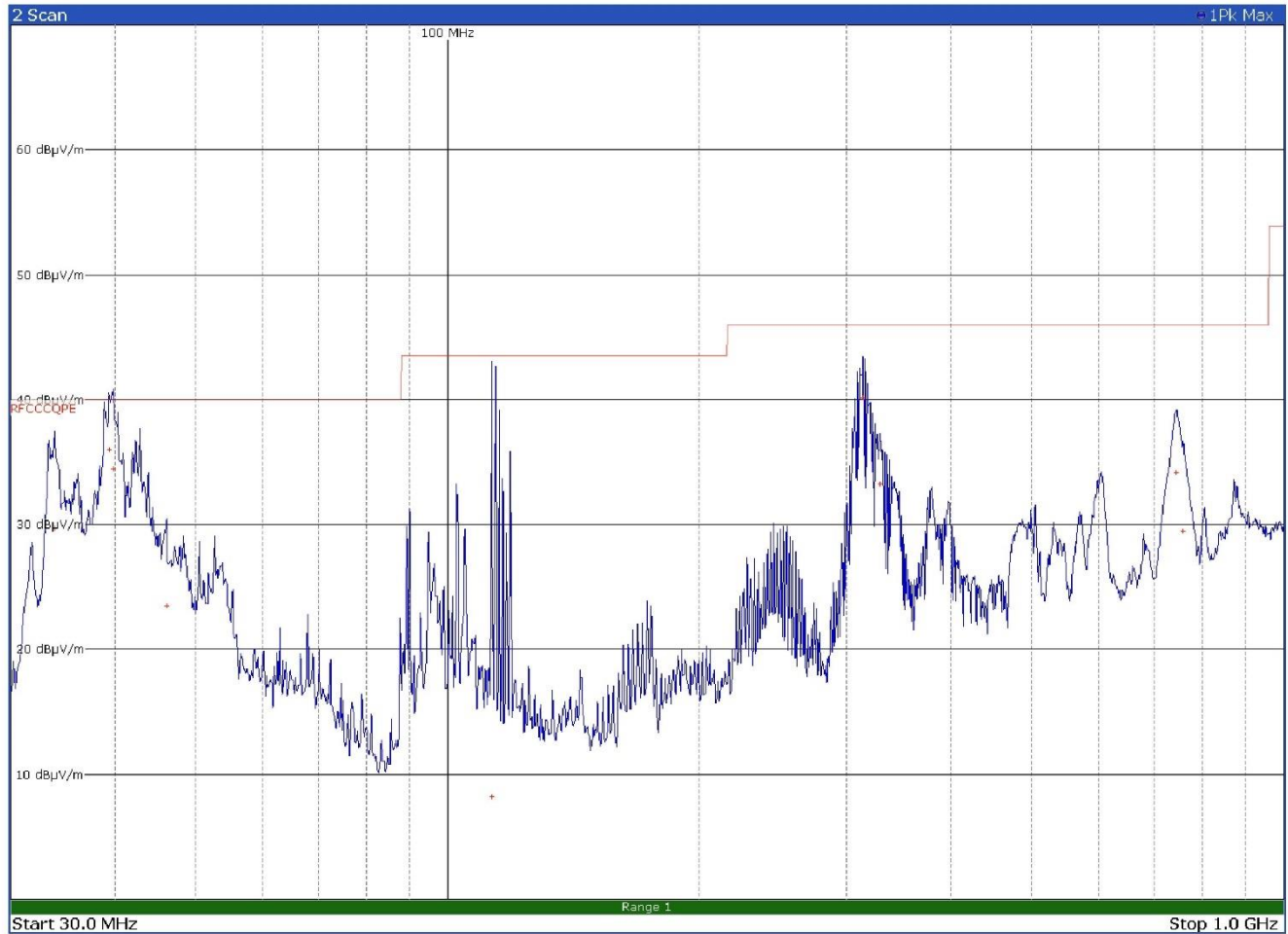


Figure 8.5-2: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

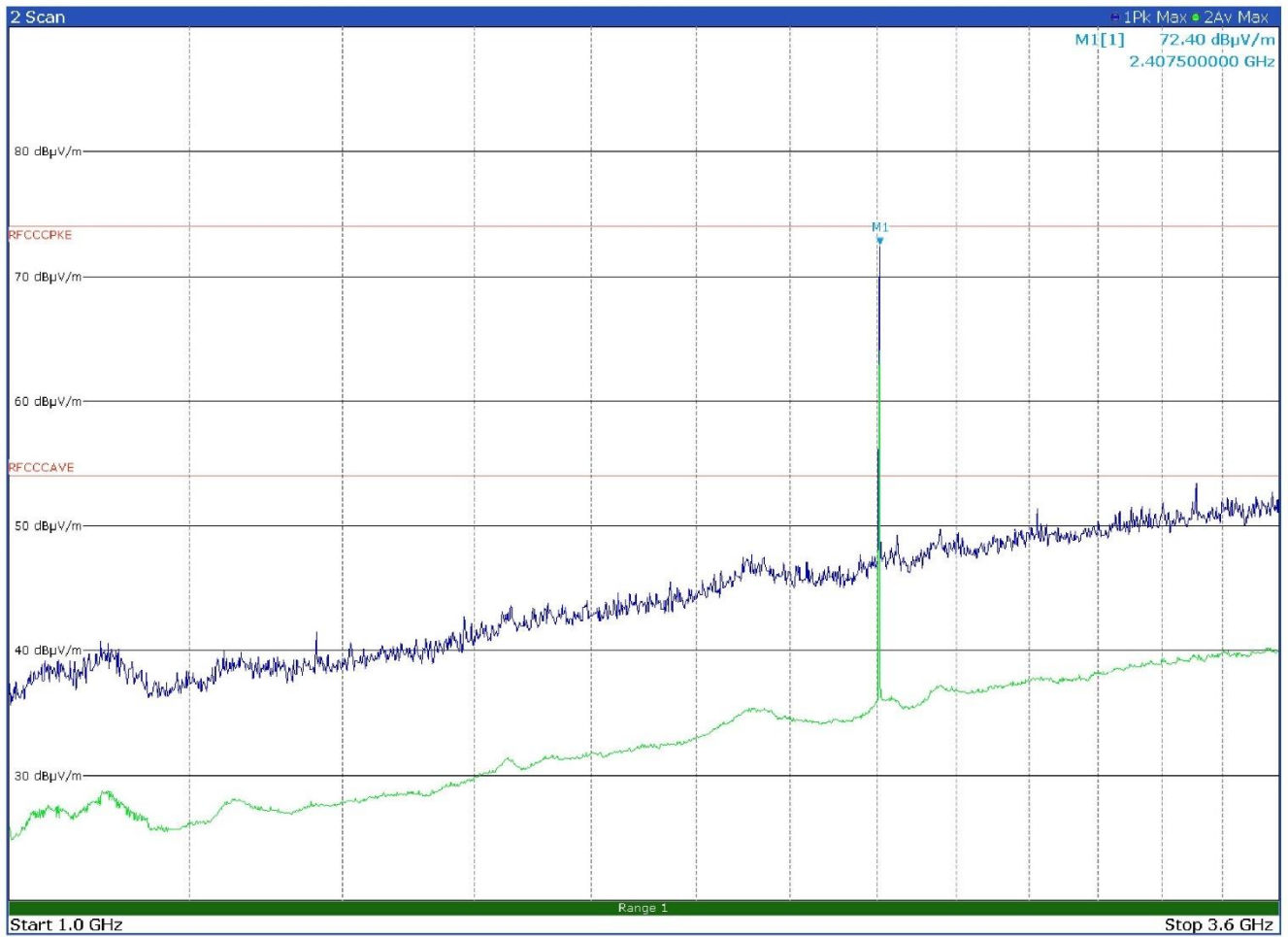


Figure 8.5-3: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

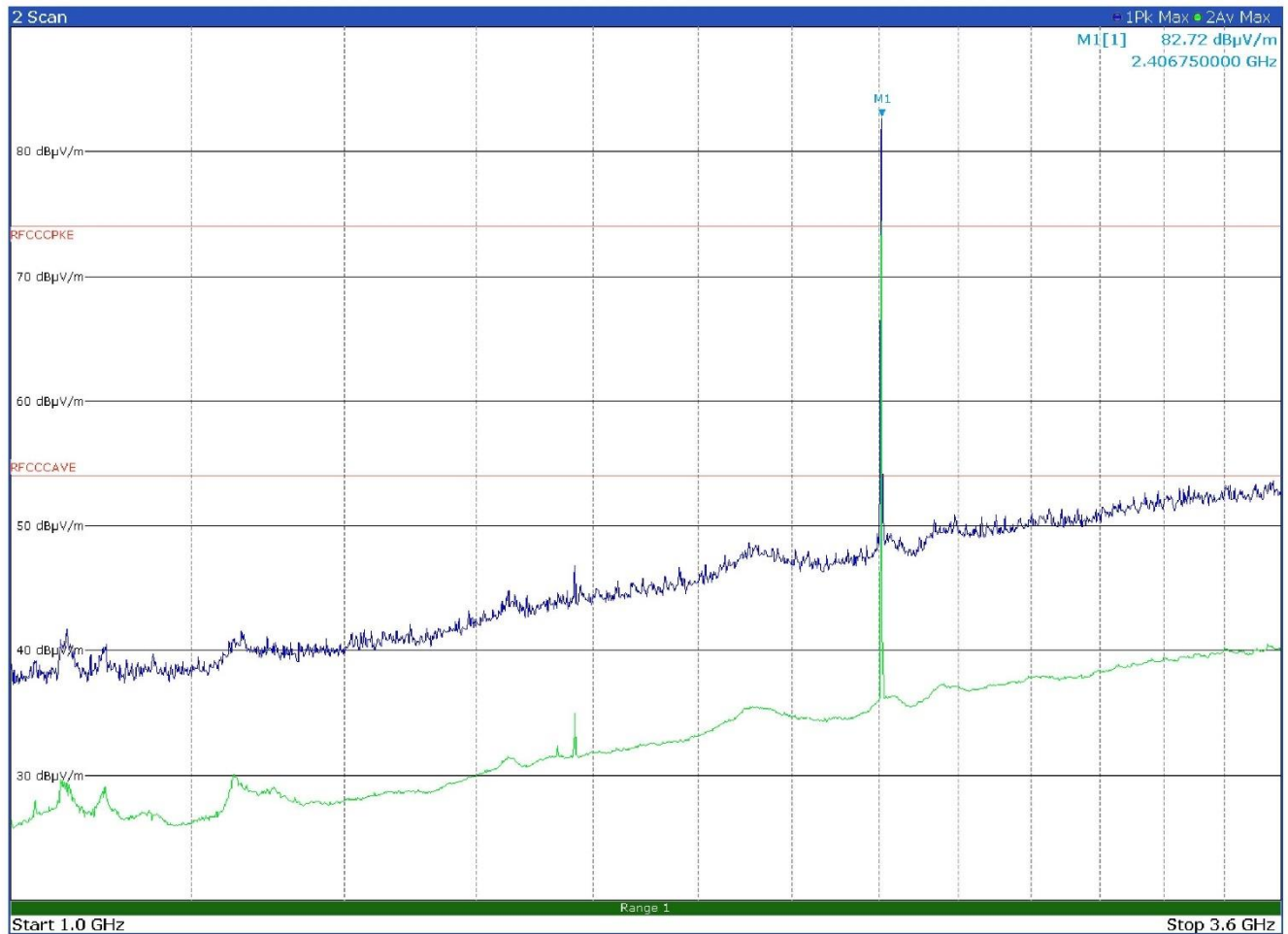


Figure 8.5-4: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

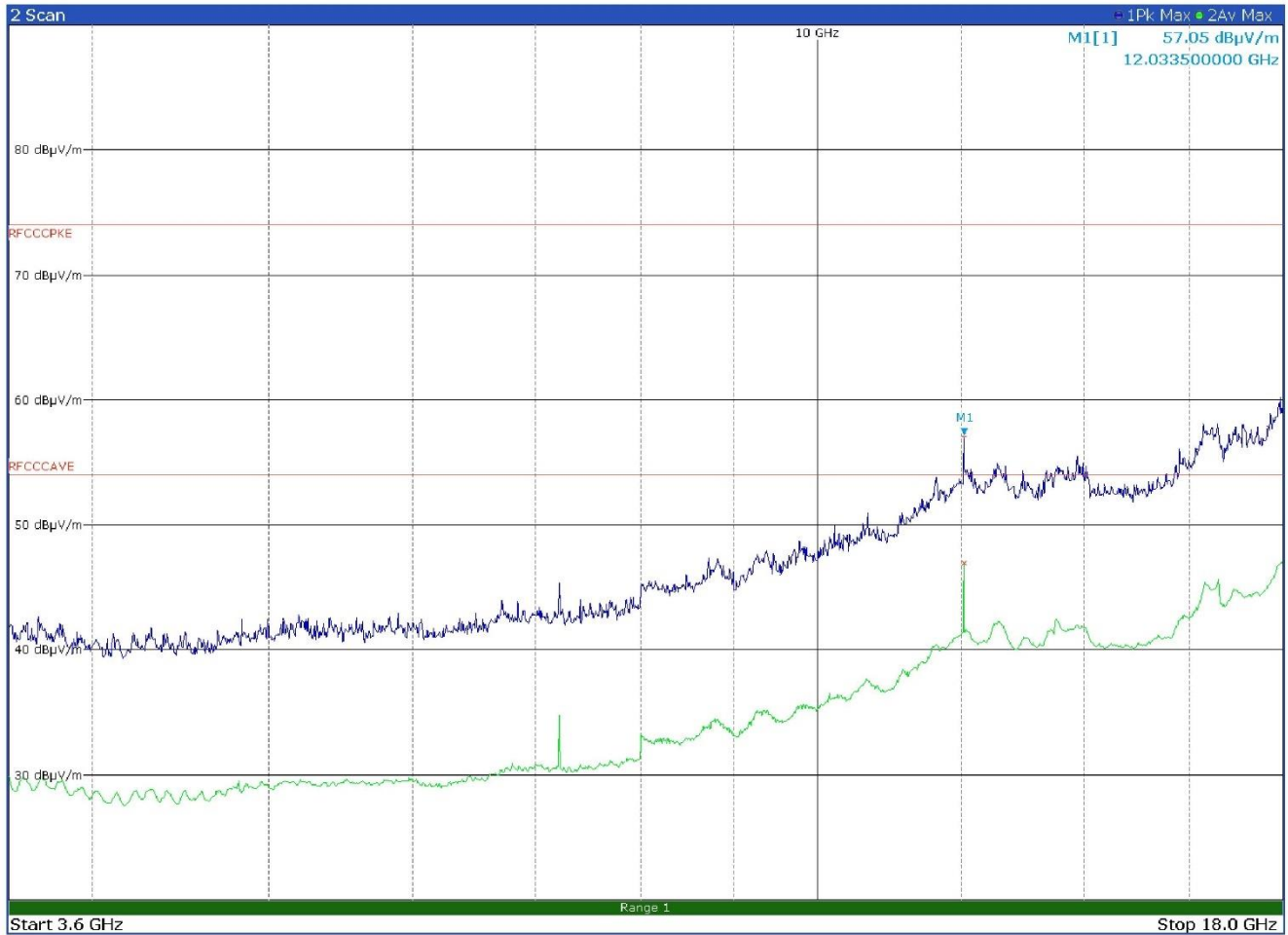


Figure 8.5-5: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

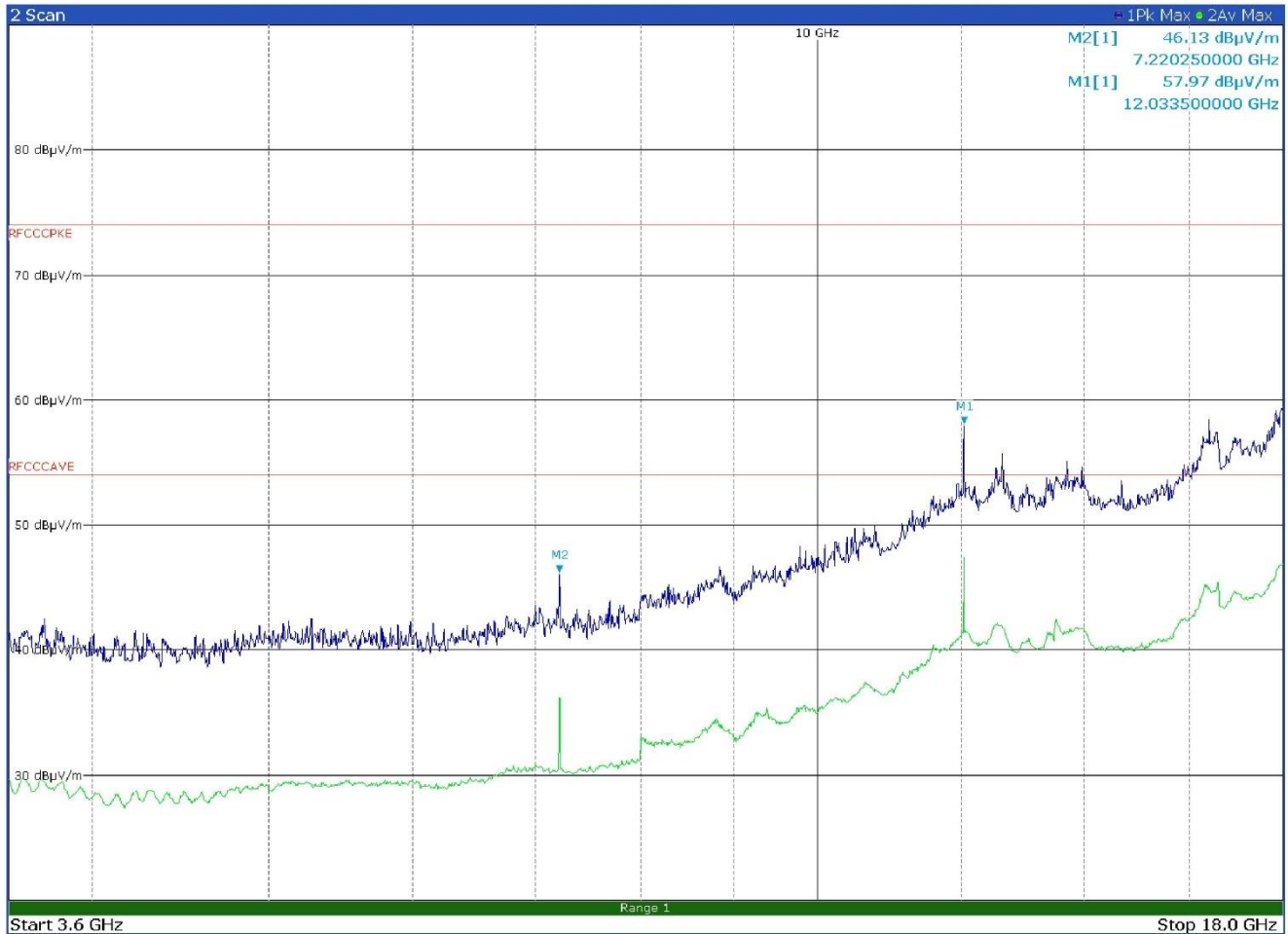


Figure 8.5-6: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

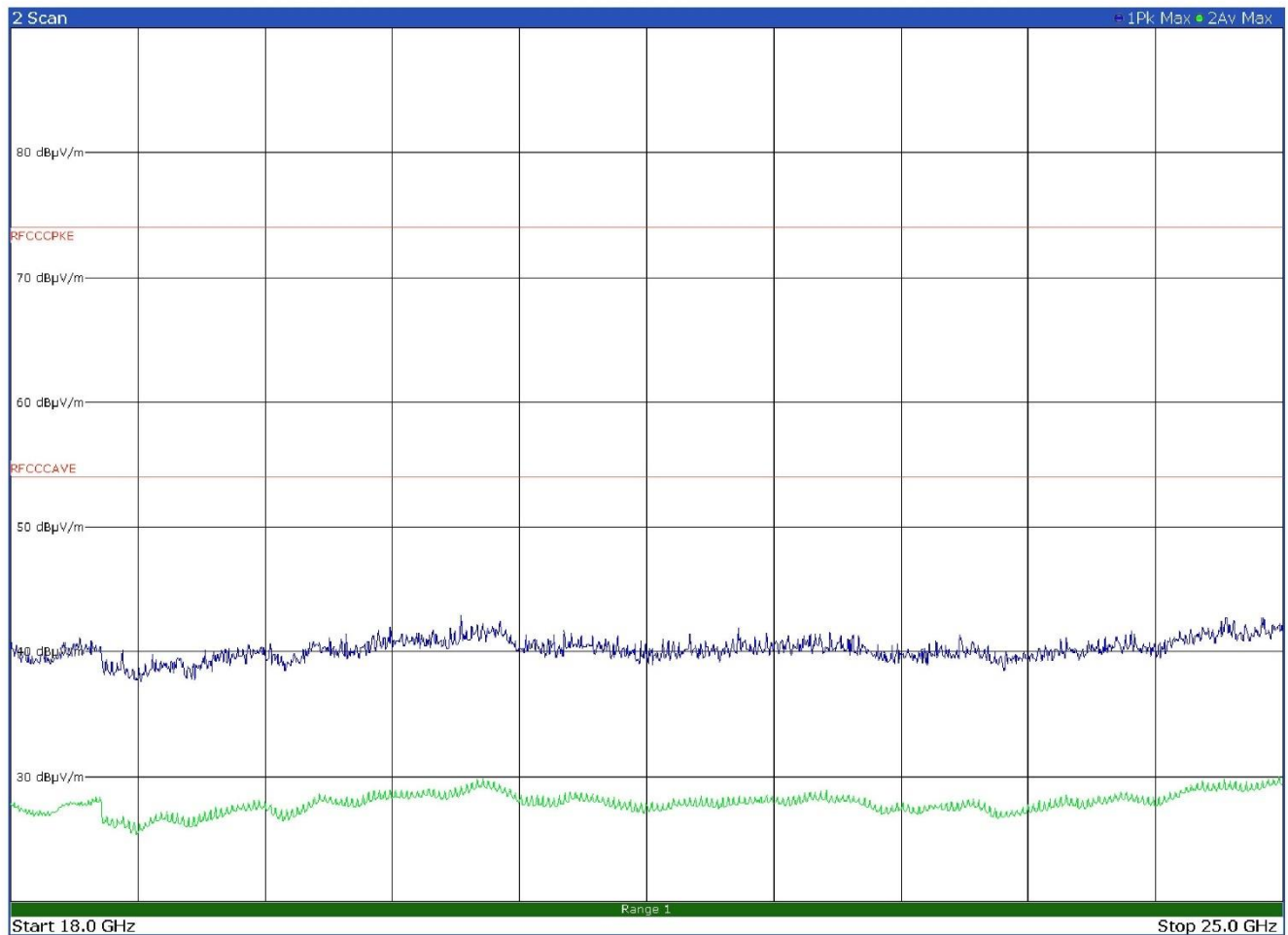


Figure 8.5-7: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization

No spurious emissions found

Test data, continued

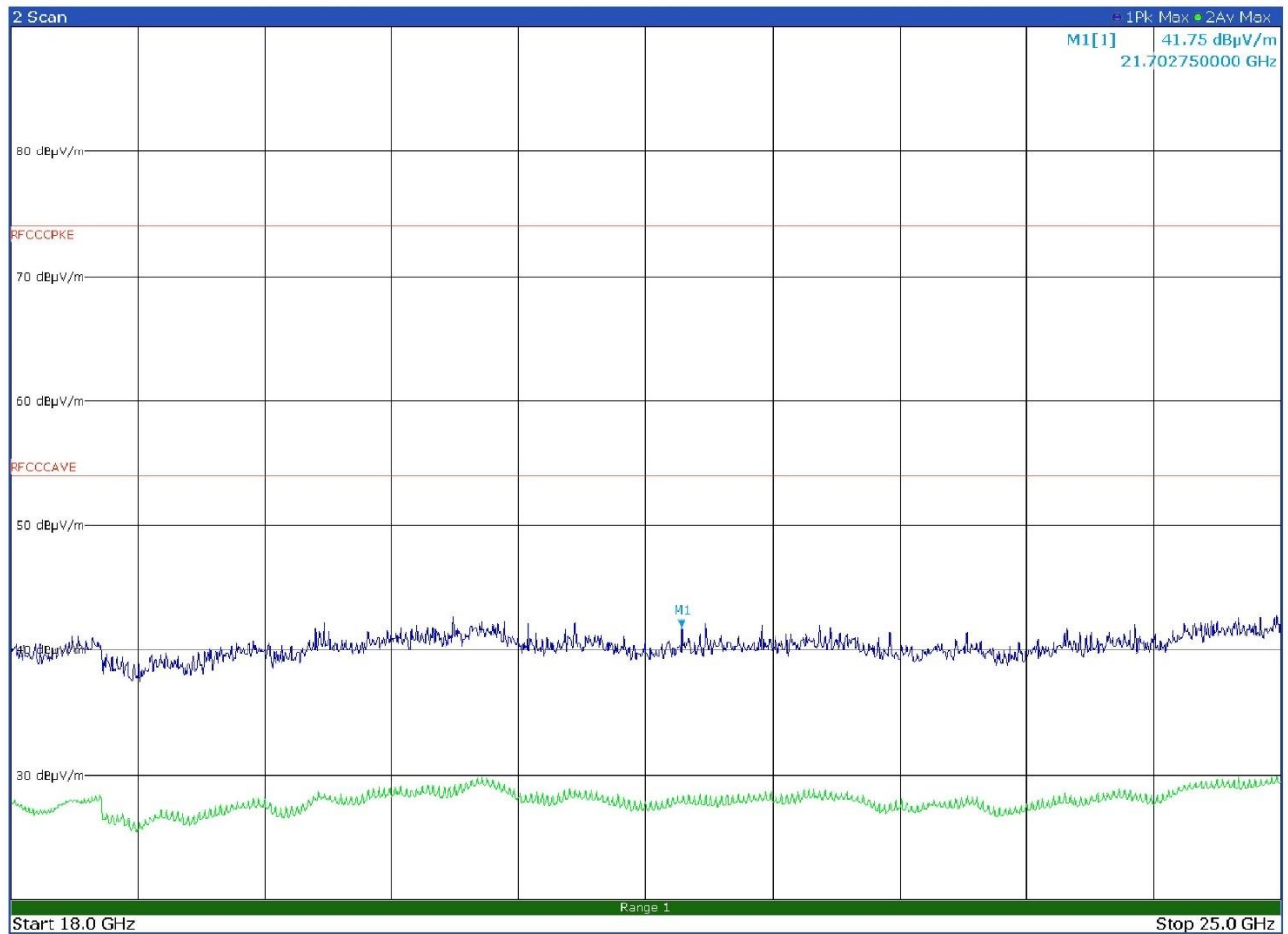


Figure 8.5-8: Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization

Test data, continued

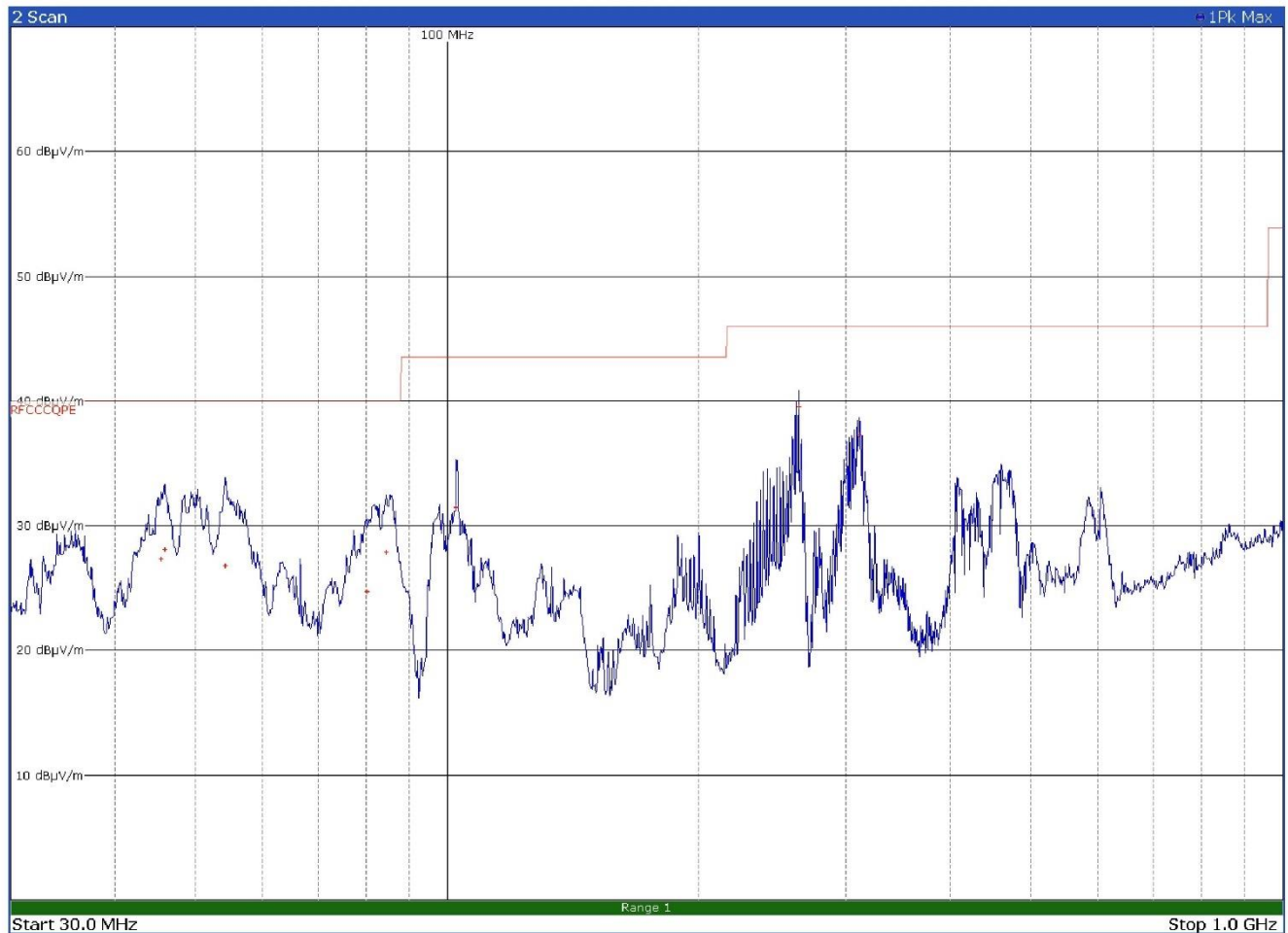


Figure 8.5-9: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

| 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

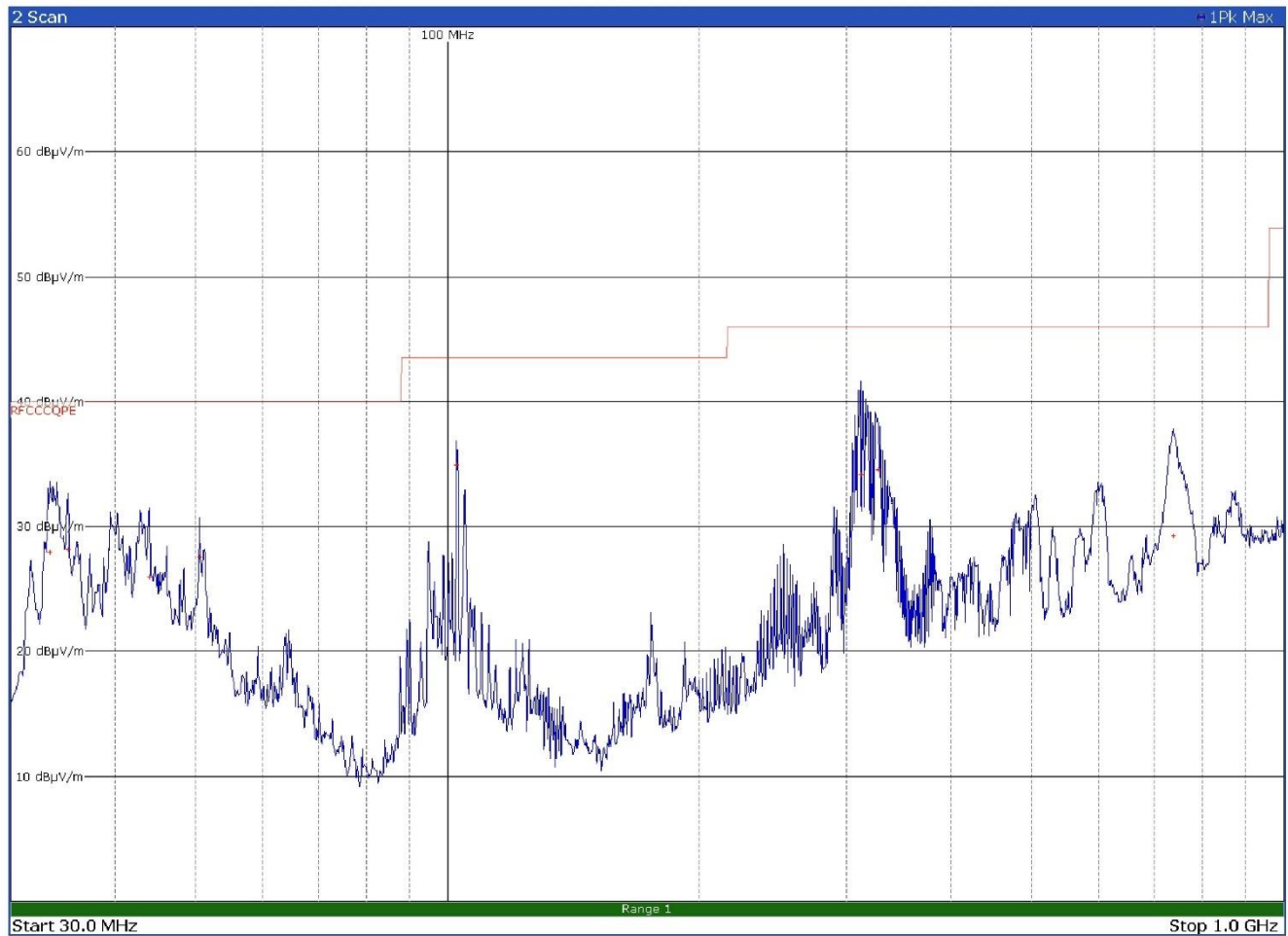


Figure 8.5-10: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

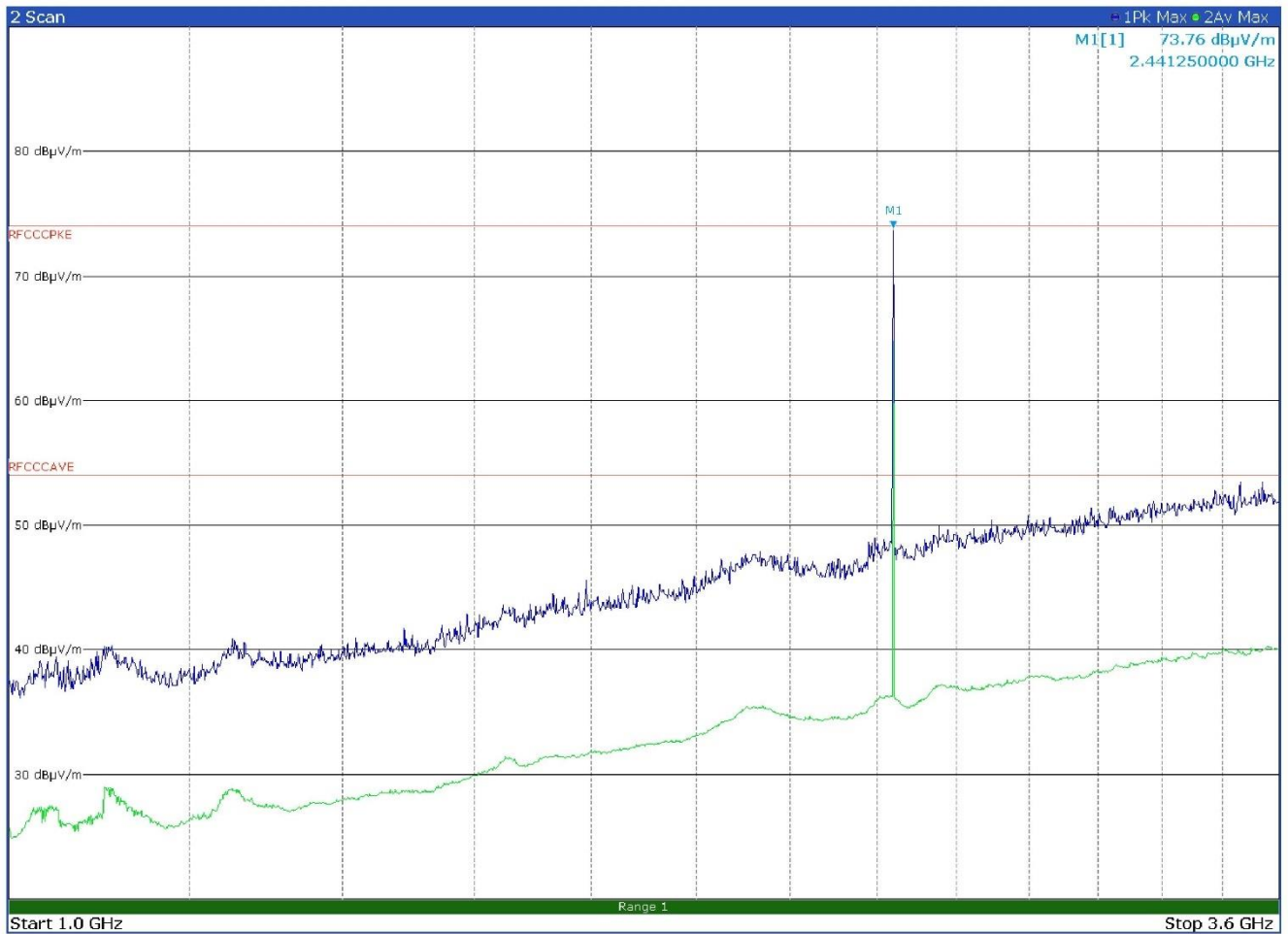


Figure 8.5-11: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

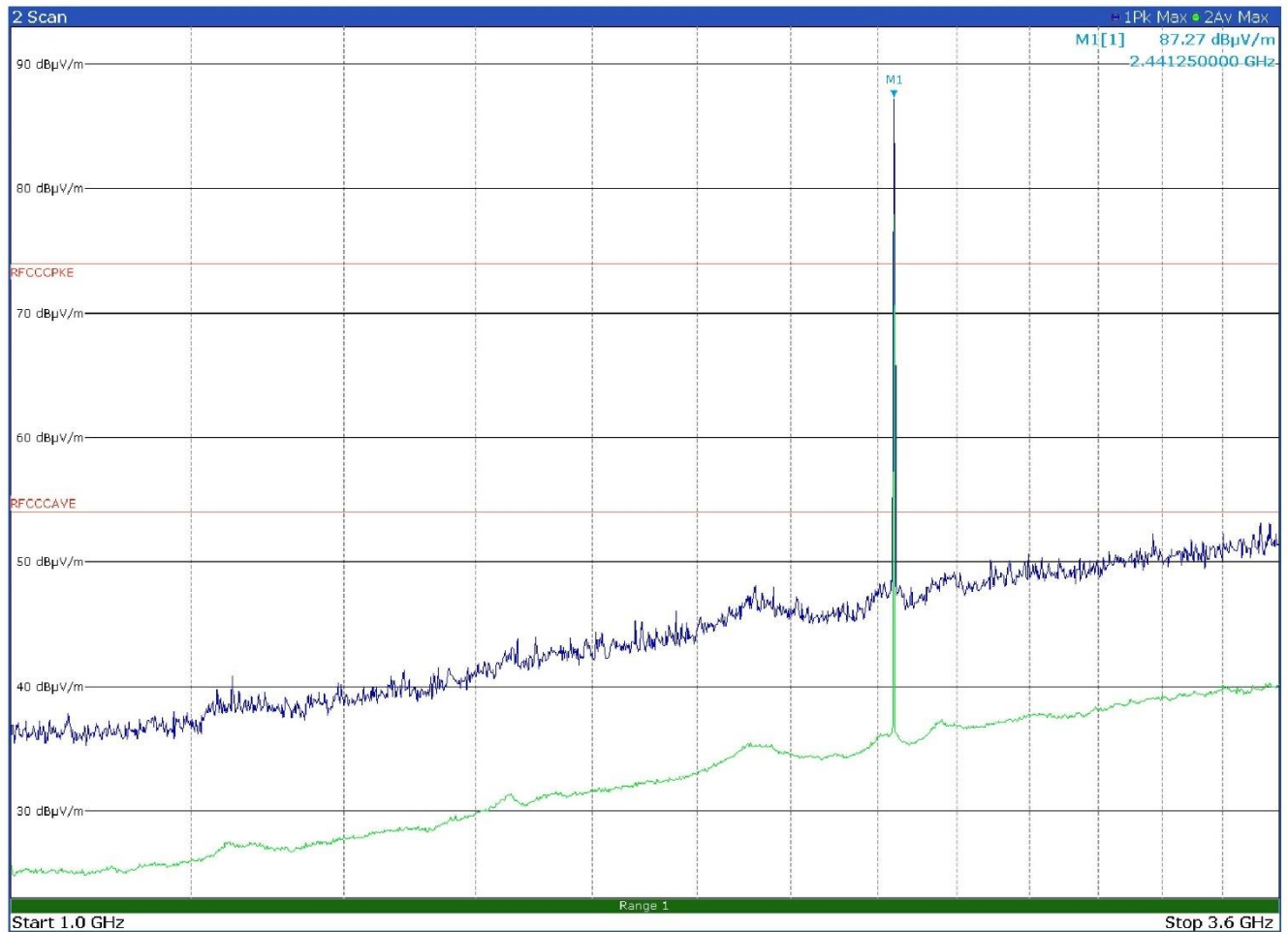


Figure 8.5-12: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

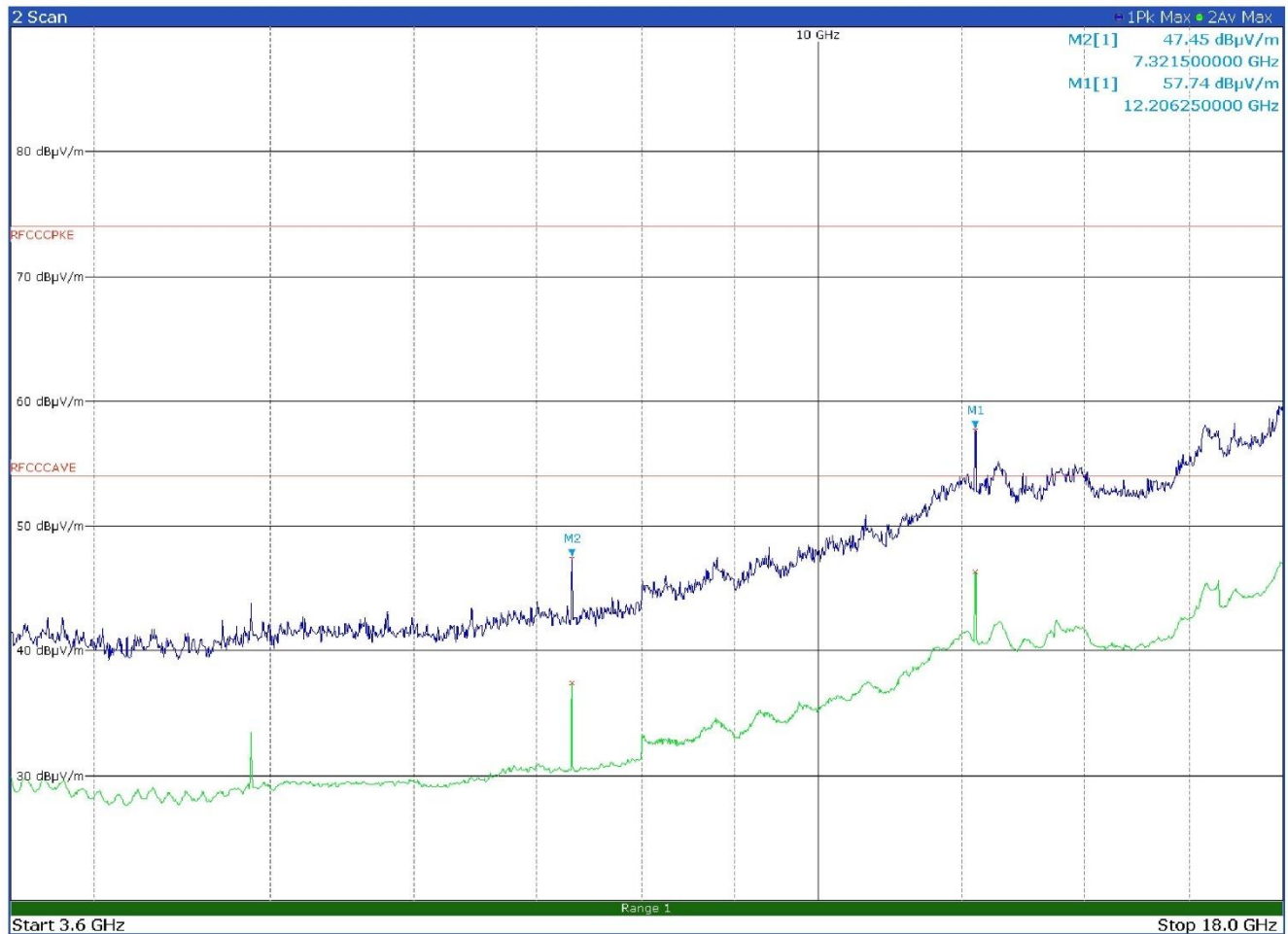


Figure 8.5-13: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

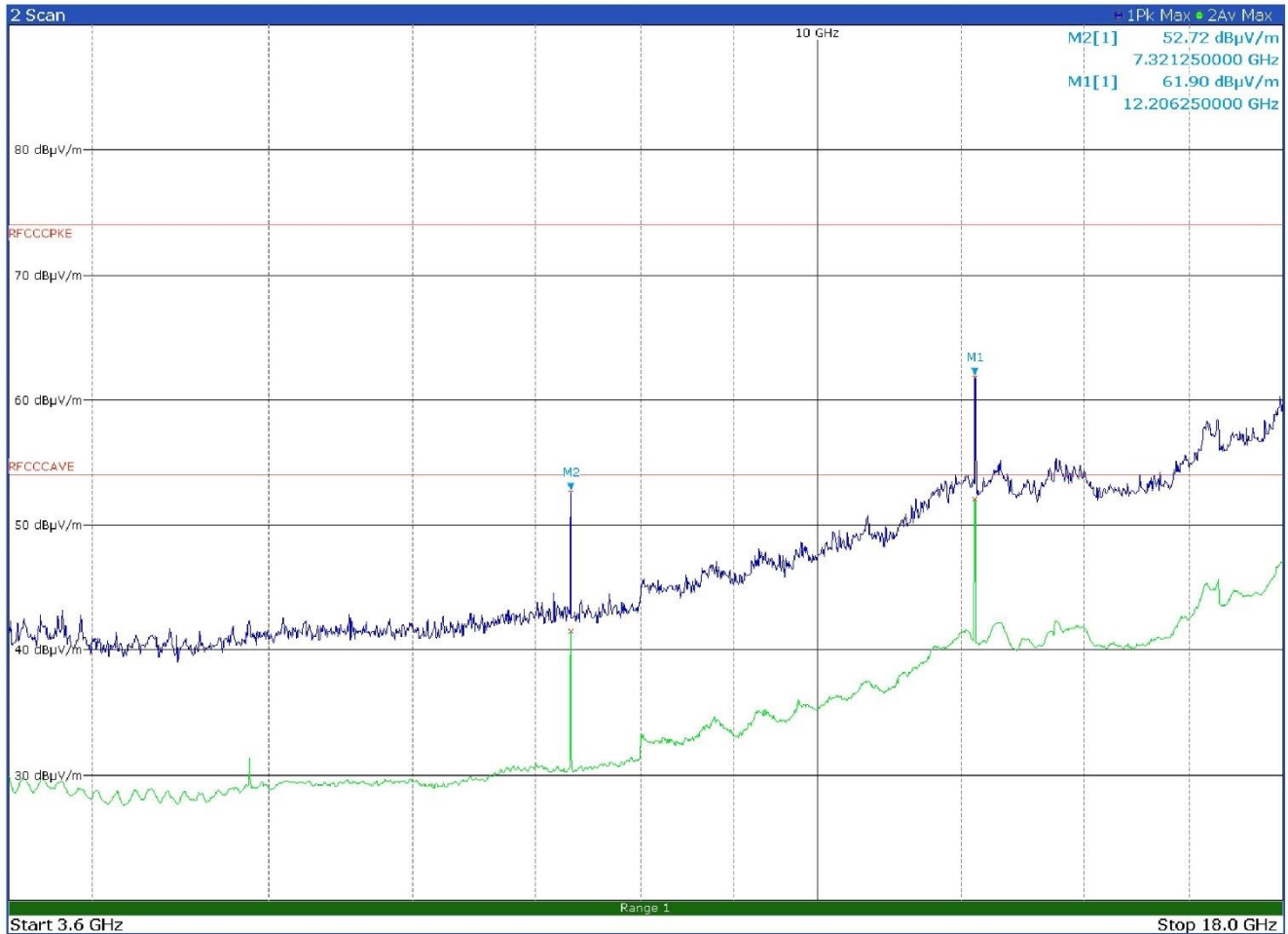


Figure 8.5-14: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

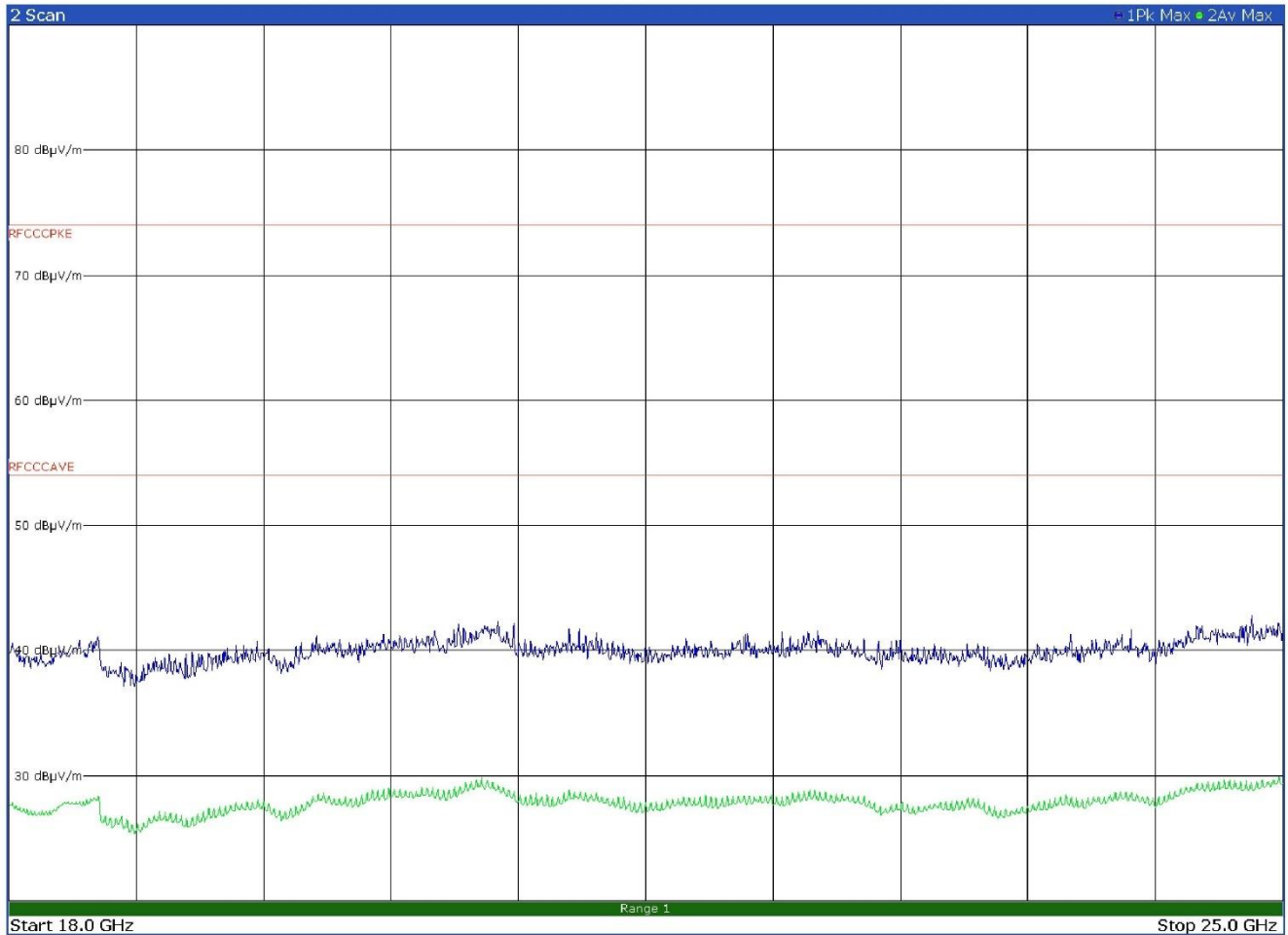


Figure 8.5-15: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization

No spurious emissions found

Test data, continued

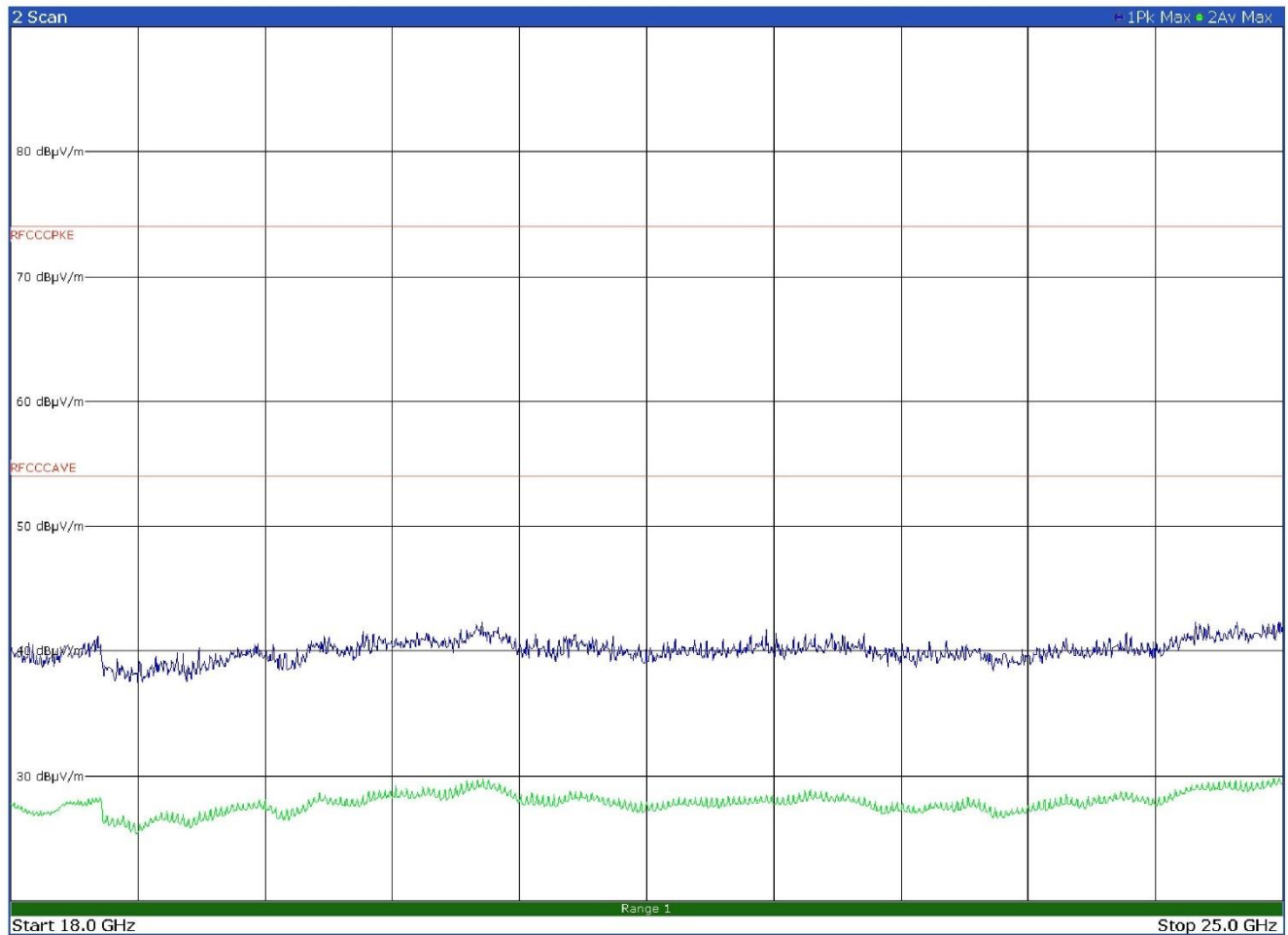


Figure 8.5-16: Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization

No spurious emissions found

Test data, continued

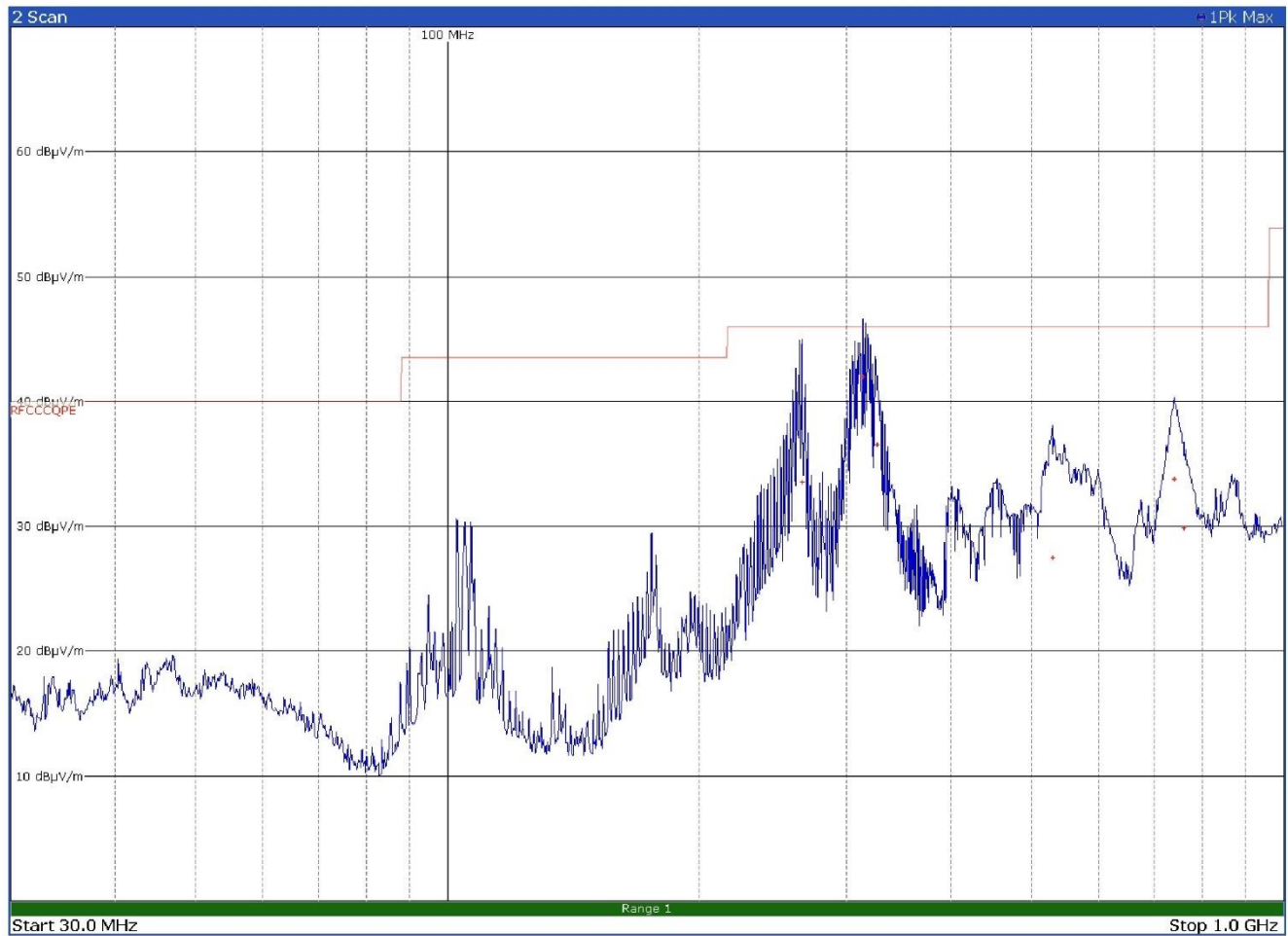


Figure 8.5-17: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/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

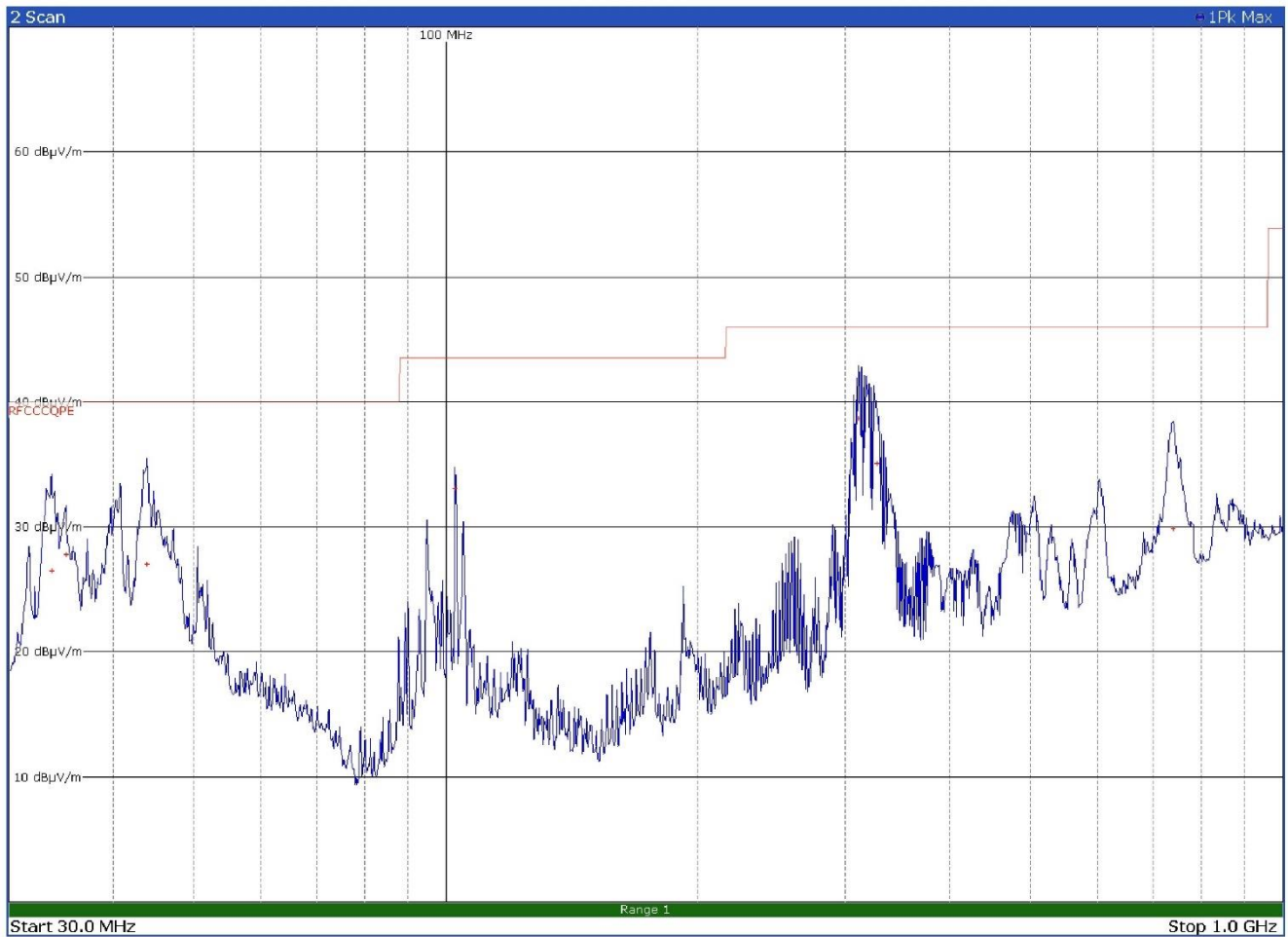


Figure 8.5-18: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

| 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

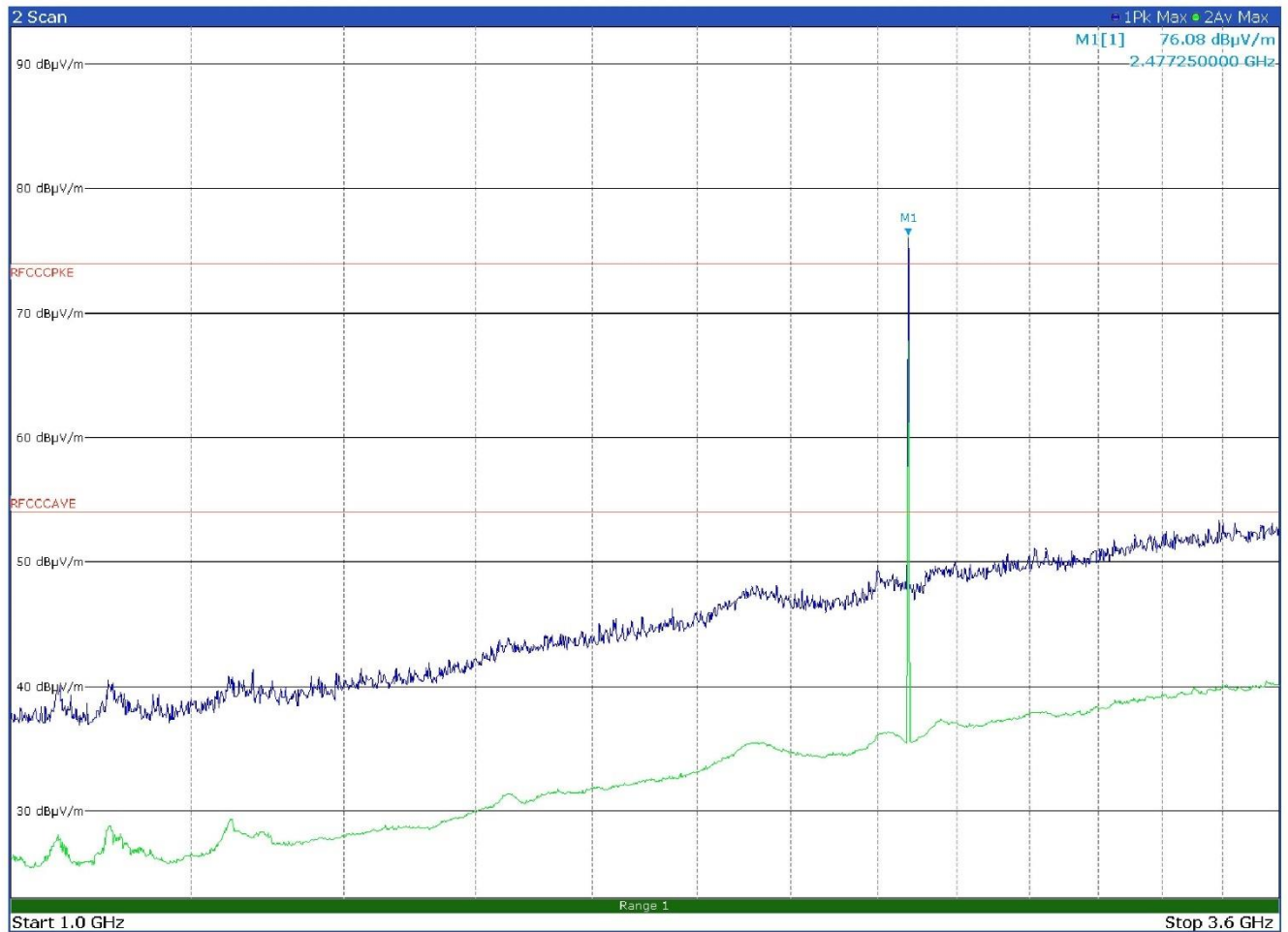


Figure 8.5-19: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Limit exceeded by the carrier

Test data, continued

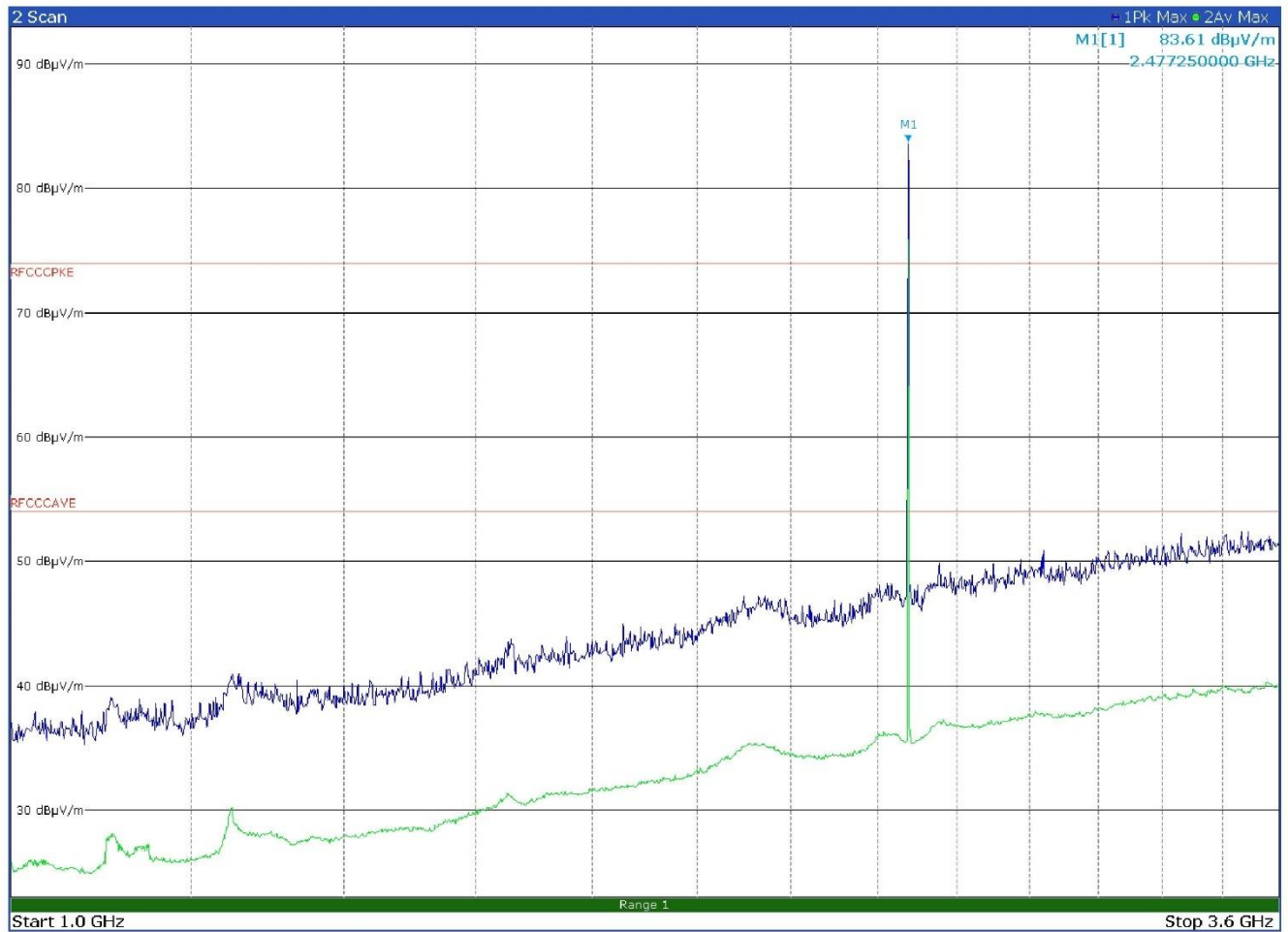


Figure 8.5-20: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Limit exceeded by the carrier

Test data, continued

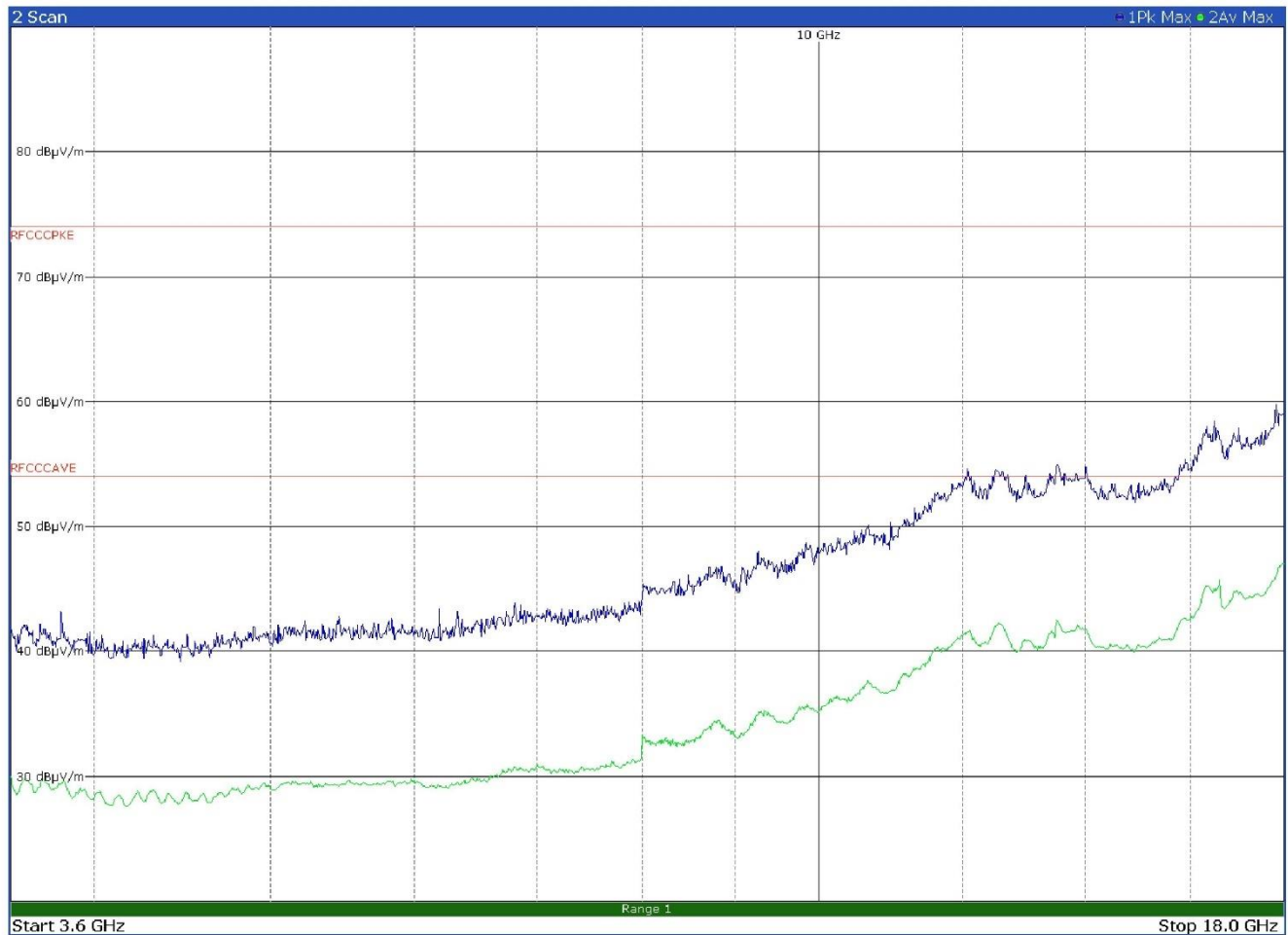


Figure 8.5-21: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Test data, continued

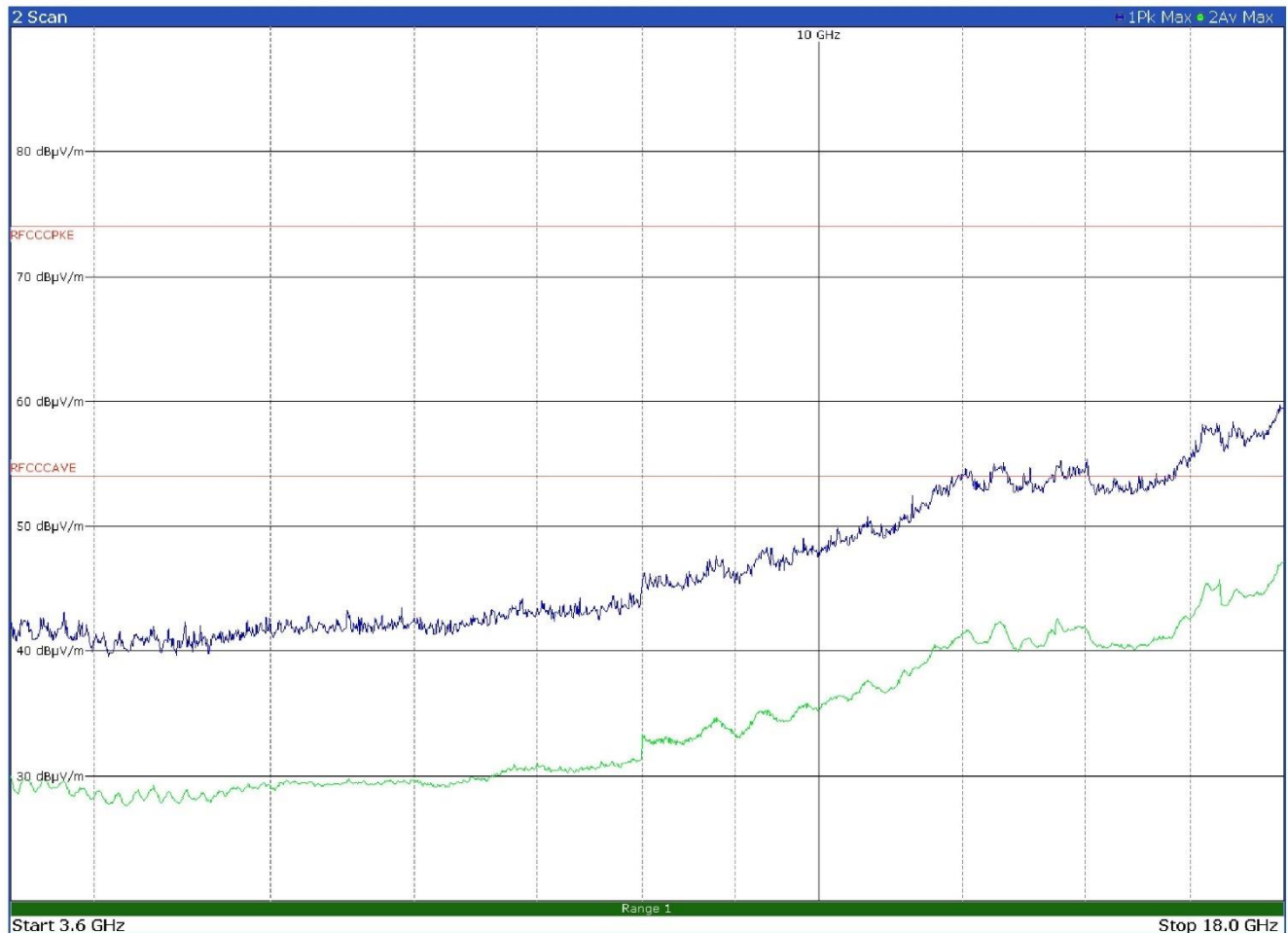


Figure 8.5-22: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

Test data, continued

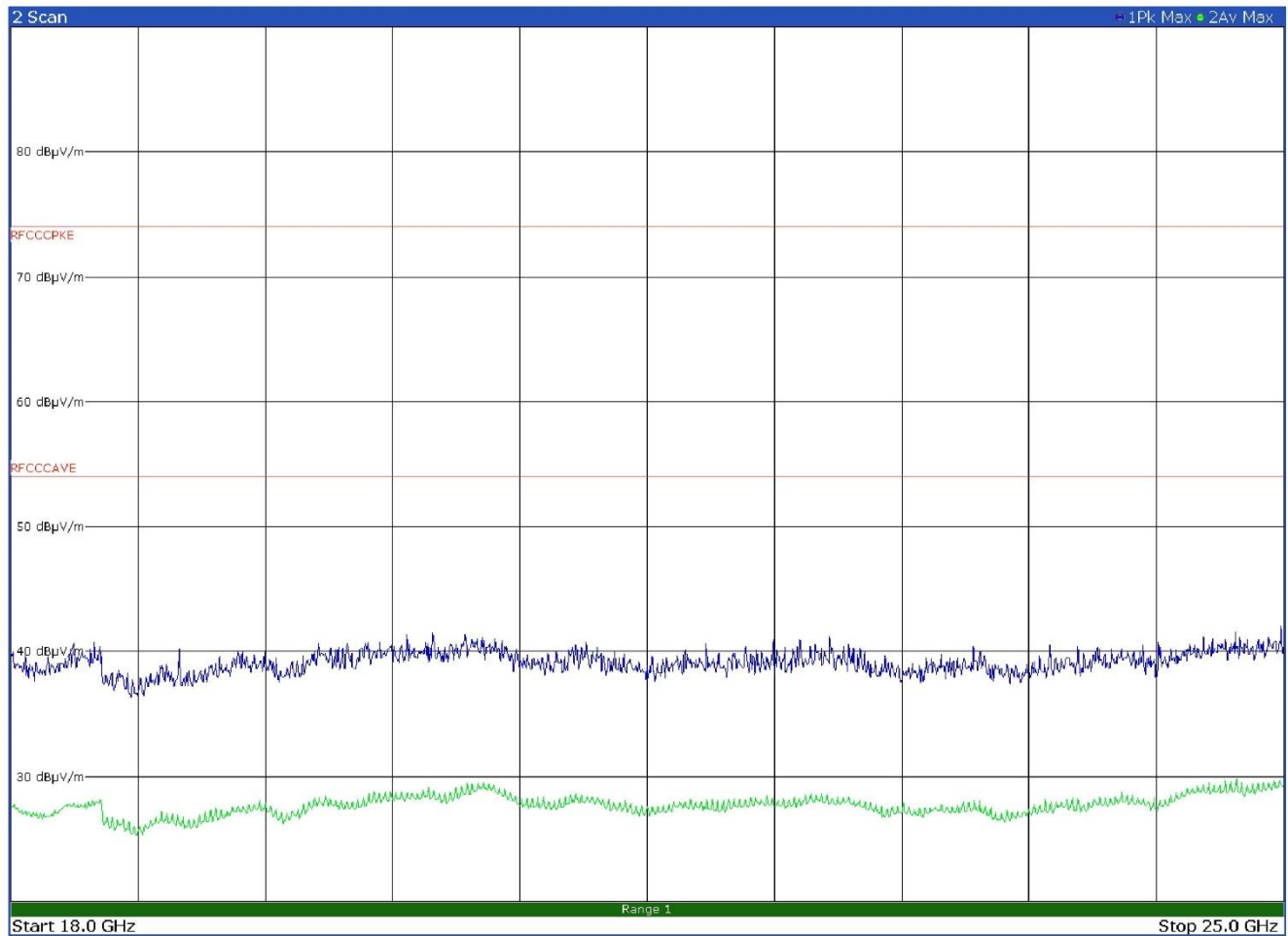


Figure 8.5-23: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization

Test data, continued

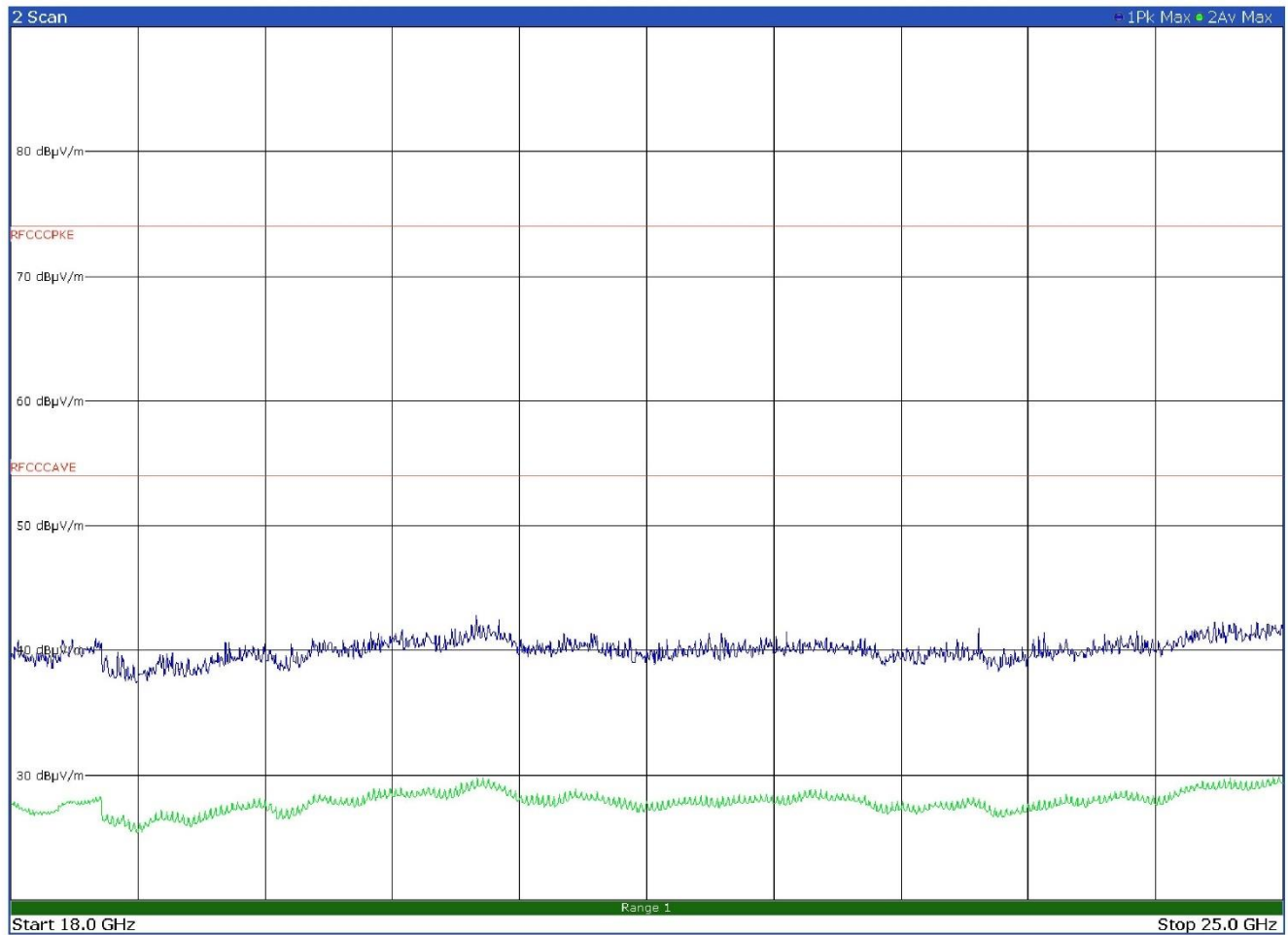


Figure 8.5-24: Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization

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

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

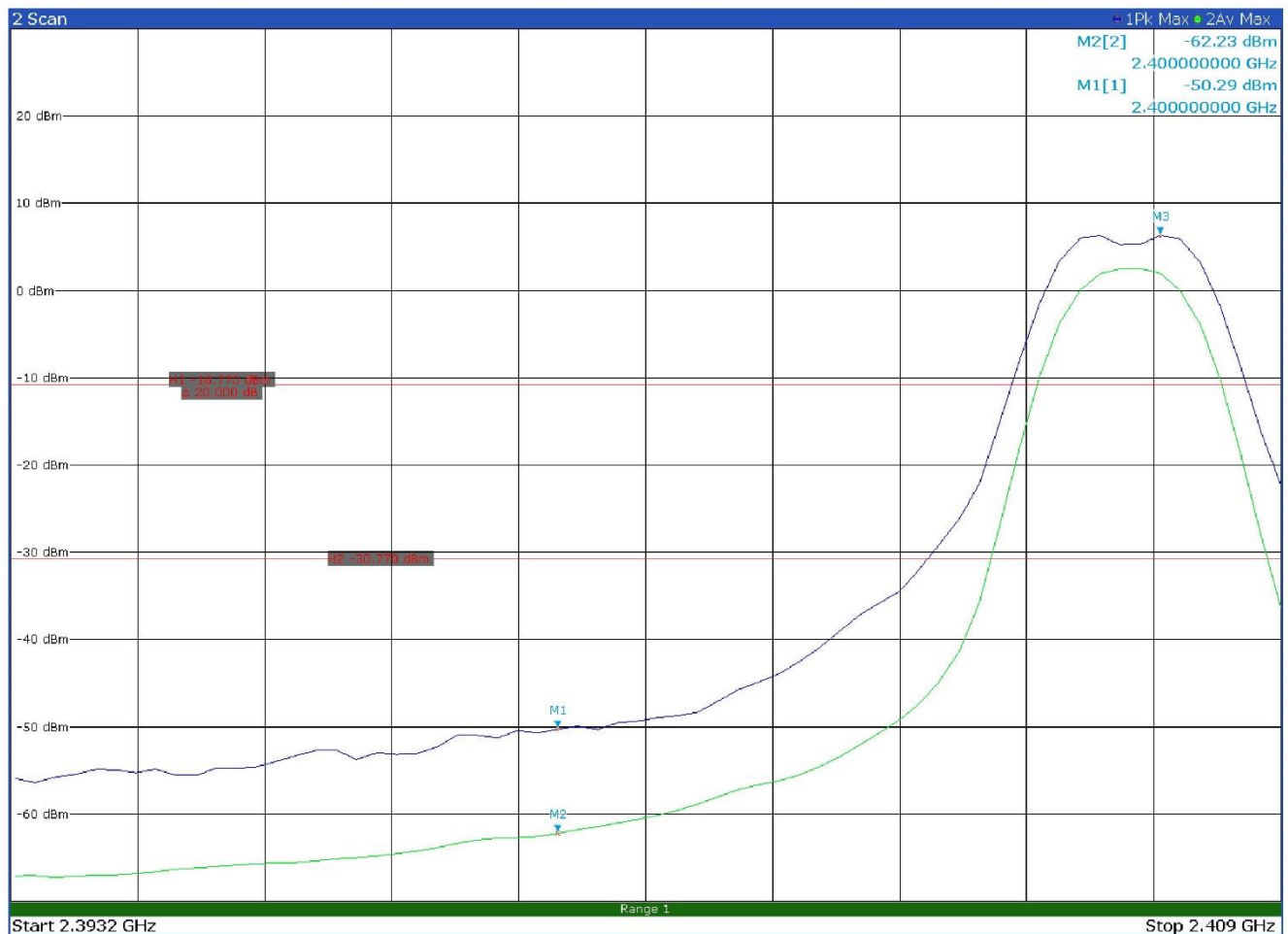


Figure 8.5-25: Band edge spurious emissions at 2400 MHz – Antenna port 1

Test data, continued

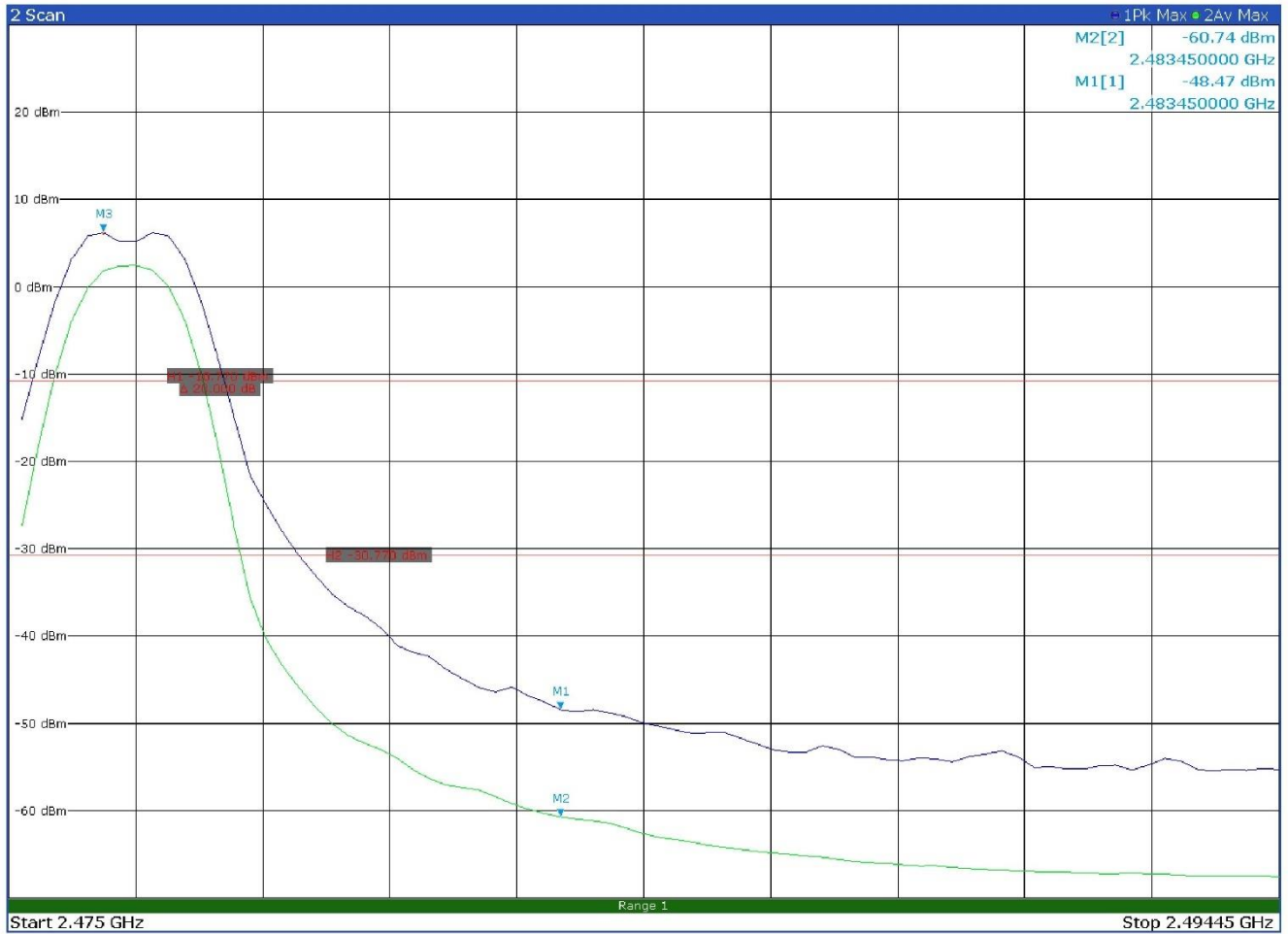


Figure 8.5-26: Band edge spurious emissions at 2483.5 MHz – Antenna port 1

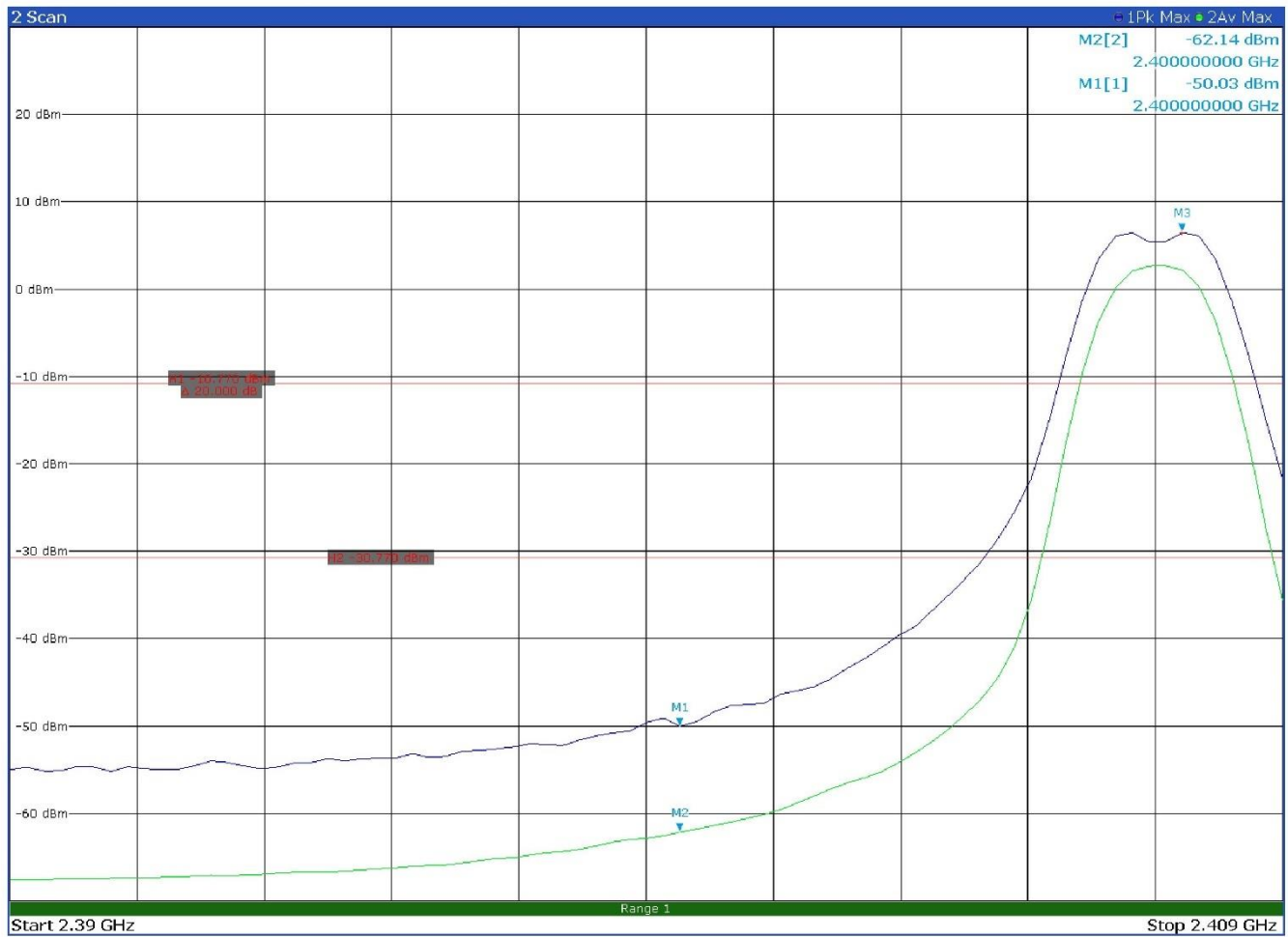


Figure 8.5-27: Band edge spurious emissions at 2400 MHz – Antenna port 2

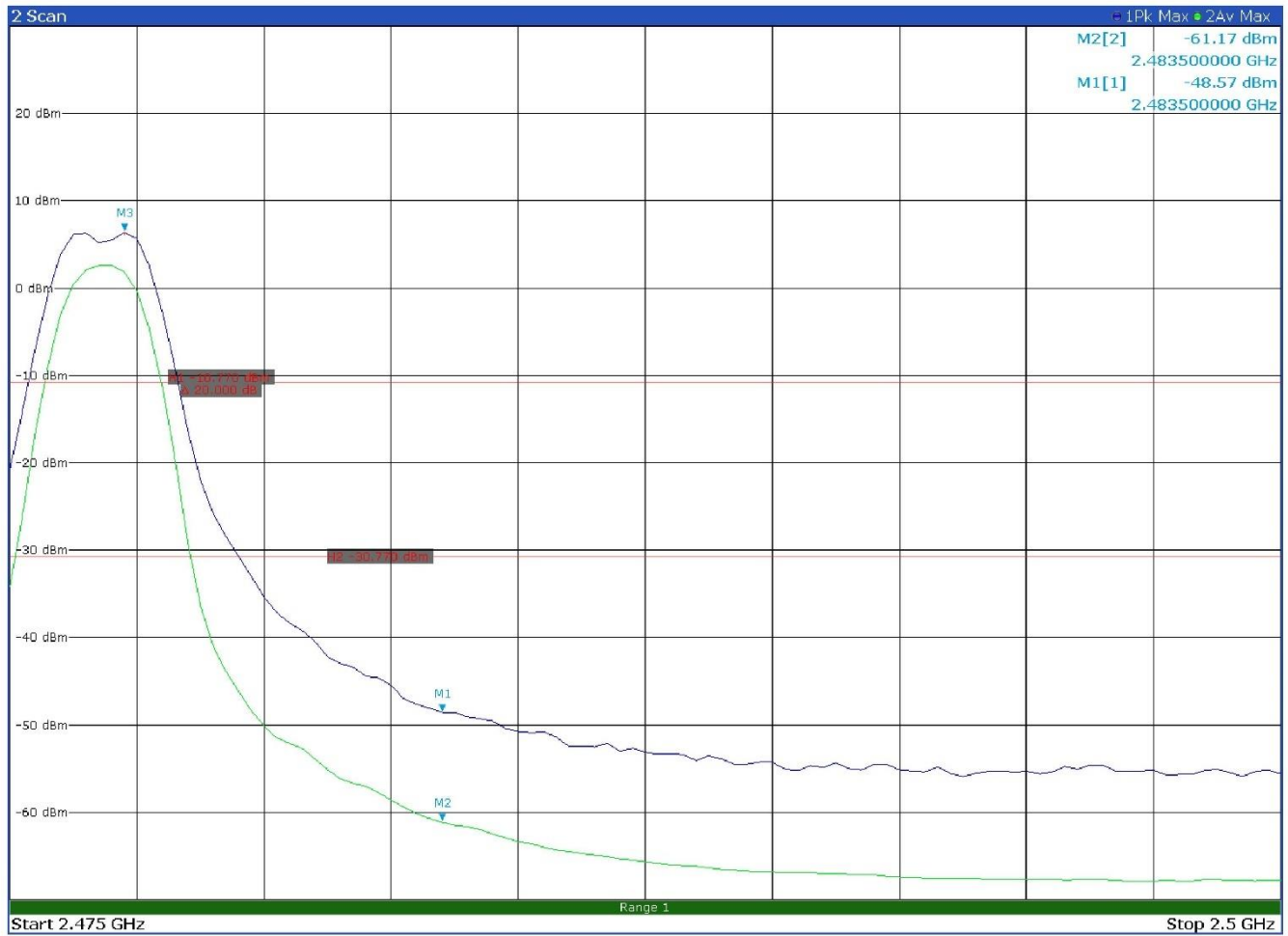


Figure 8.5-278: Band edge spurious emissions at 2483.5 MHz – Antenna port 2

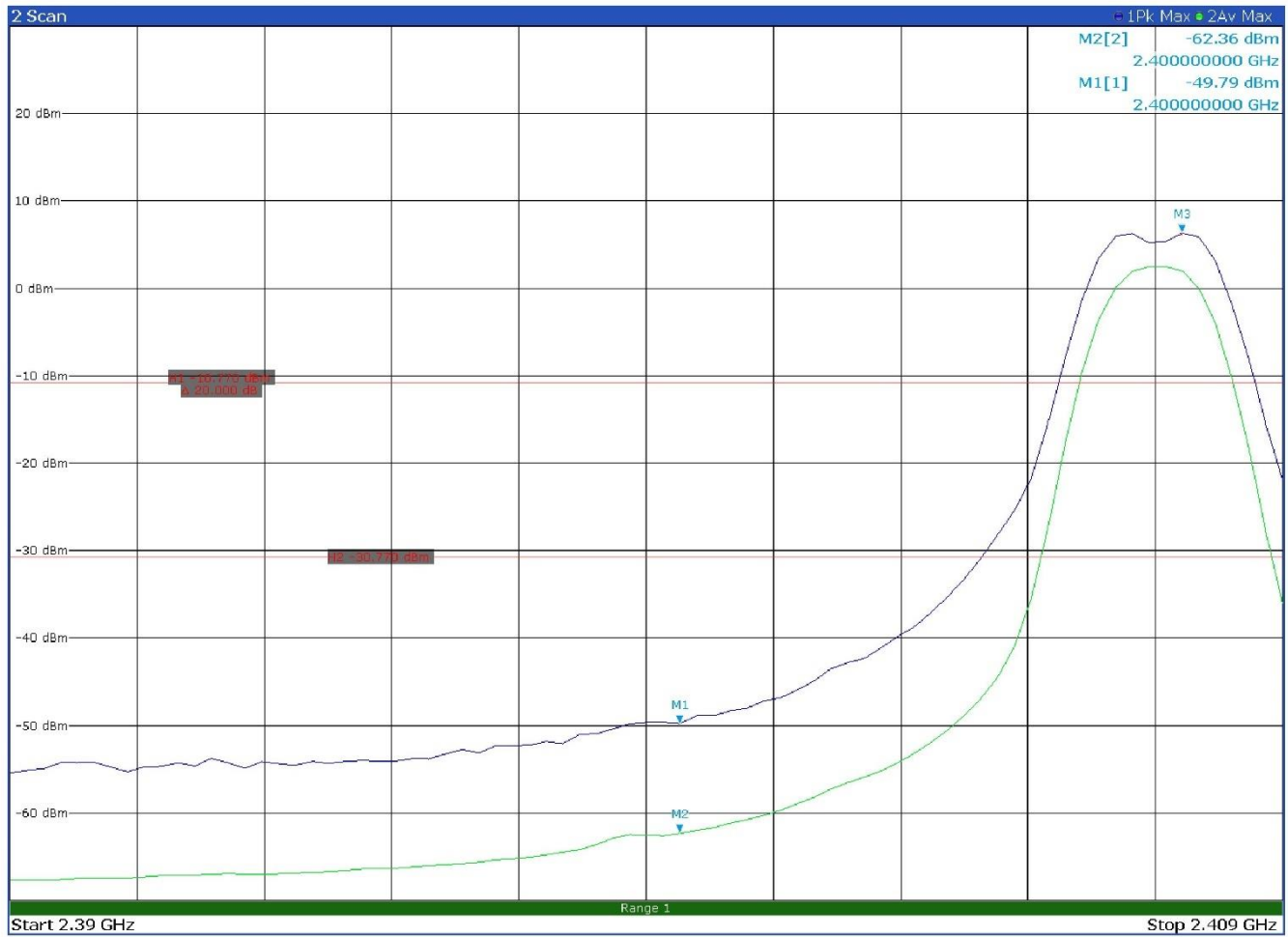


Figure 8.5-29: Band edge spurious emissions at 2400 MHz – Antenna port 3

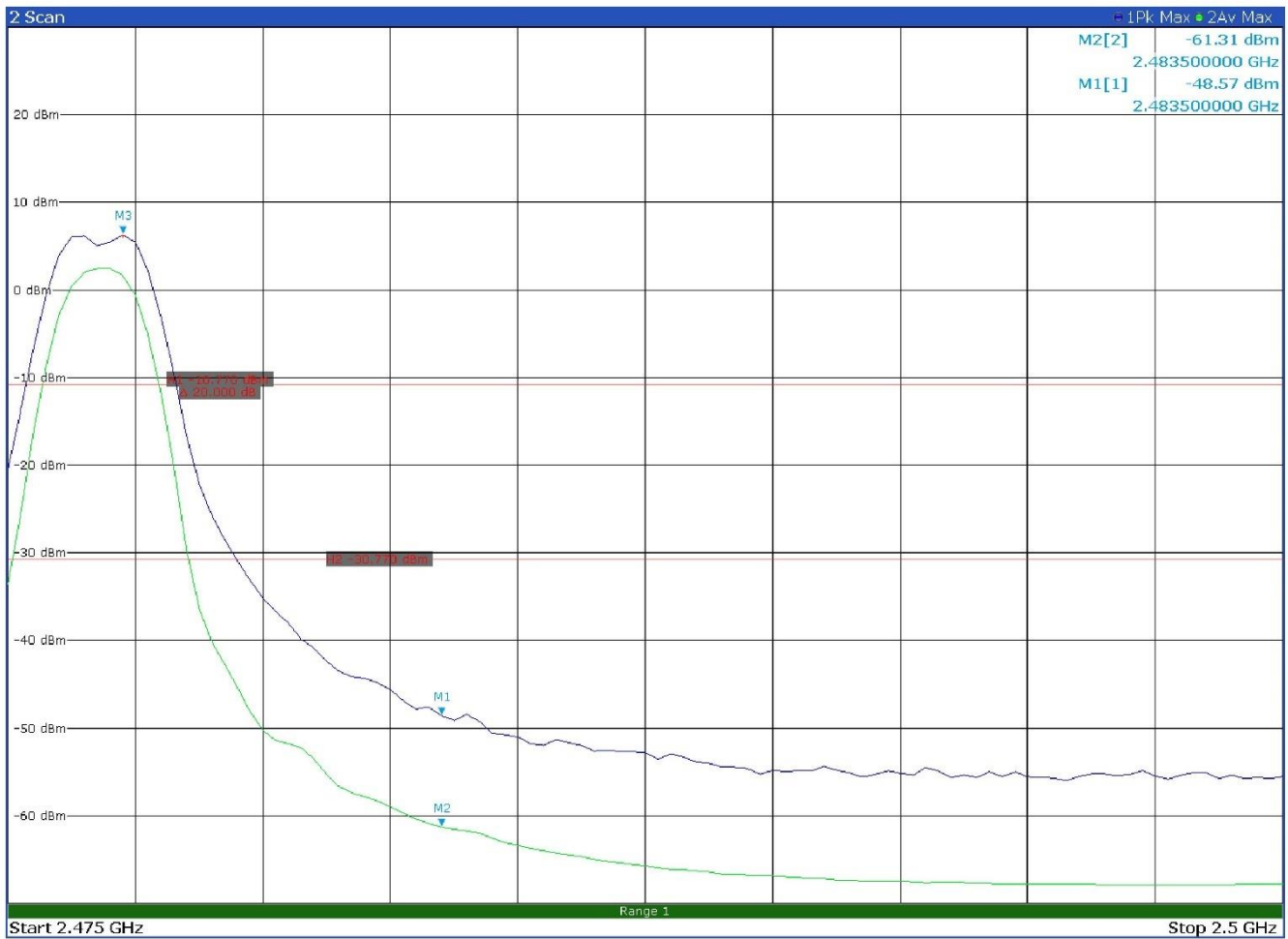


Figure 8.5-30: Band edge spurious emissions at 2483.5 MHz – Antenna port 3

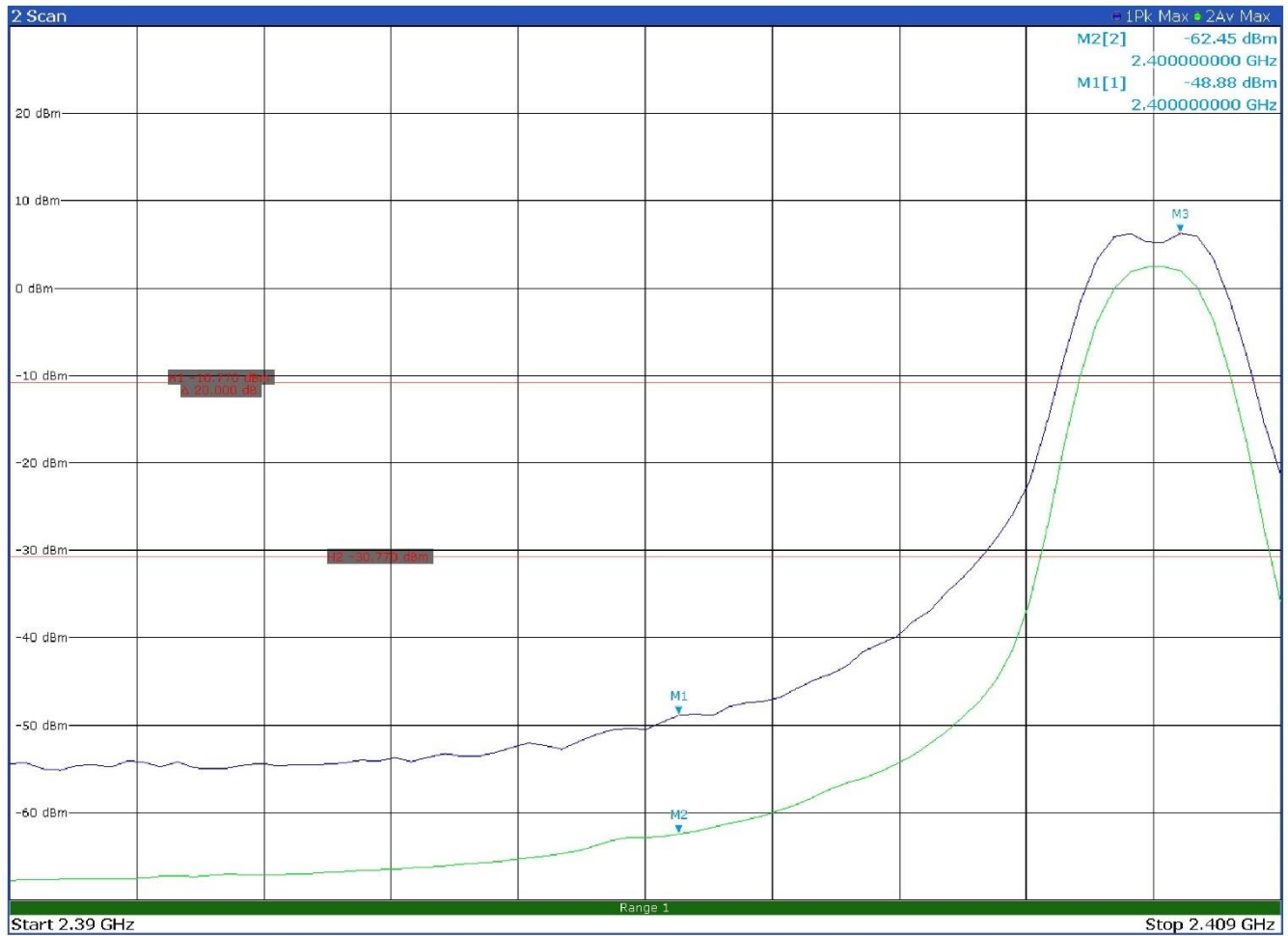


Figure 8.5-31: Band edge spurious emissions at 2400 MHz – Antenna port 4

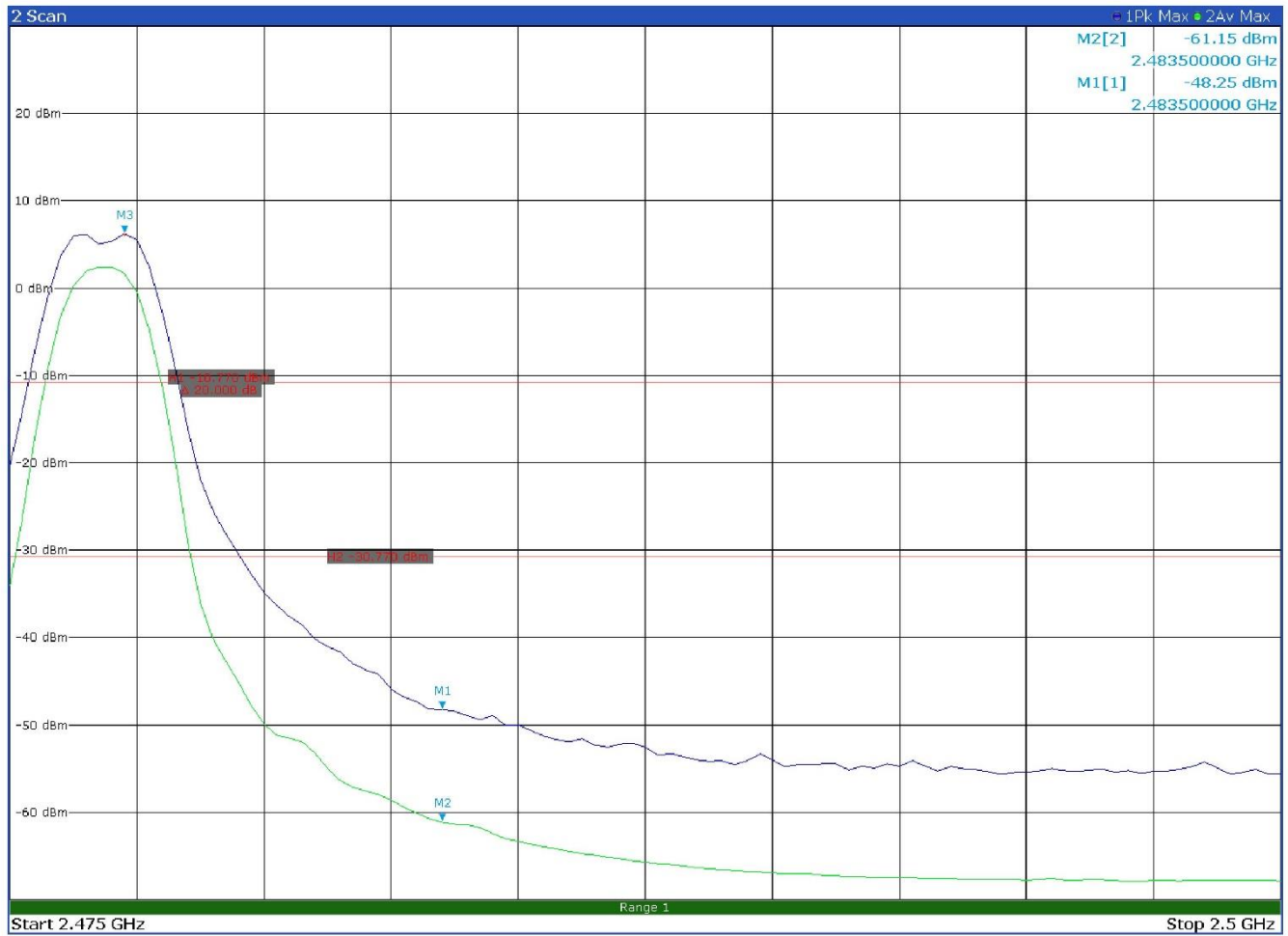


Figure 8.5-32: Band edge spurious emissions at 2483.5 MHz – Antenna port 4

8.6 Power spectral density for digitally modulated devices

8.6.1 References, definitions and limits

RSS-247, Clause 5.2:

DTSs 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 |

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: | $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ |
| Video bandwidth: | $\geq 3 \times \text{RBW}$ |
| 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, dBμV/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 [dBμV/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, dBμV/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 [dBμV/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, dBμV/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 [dBμV/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, dBμV/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 [dBμV/m/3 kHz] = EIRPSD [dBm/3 kHz] + 95.23 [dB]