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RADIO TEST REPORT – 460693-6TRFWL

Type of assessment:

Transmitters co-location

Applicant:

Eurotech Spa

Via Fratelli Solari, 3/A – 33020 Amaro (UD) – Italy

Model:

BTGPU1031

FCC ID:

UKMBGP1031

IC Registration number:

21442-BGP1031

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.209
  Radiated emission limits; general requirements.
- RSS-GEN, Issue 5, Apr. 2018, section 8.9
  Transmitter Emission Limits

Date of issue: 2022-05-20

P. Barbieri
Tested by

Signature

D. Guarnone
Reviewed by

Signature

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

Table of contents

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, §15.209	Radiated emission limits; general requirements.
RSS-GEN, Issue 5, section 8.9	Transmitter Emission Limits for Licence-Exempt Radio Apparatus

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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

As per quote, the purpose of this report is verification of transmitters colocation. Only inter-modulation products within restricted bands were assessed, other requirements were excluded from the scope of this report.

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
460693-6TRFWL	2022-05-20	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.209	Radiated emission limits; general requirements.	Pass

2.2 ISED RSS-GEN, Issue 5, test results

Part	Test description	Verdict
8.9	Transmitter Emission Limits for Licence-Exempt Radio Apparatus	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	2022-04-29
Nemko sample ID number	4606930004

3.2 EUT information

Model	BTGPU1031
Serial number	A122AT50098

3.3 Technical information

Frequency band	WIFI: 2400 – 2483.5 MHz band WIFI: 5150 – 5725 MHz band WCDMA / LTE North America Bands		
Type of modulation	802.11a/b/g/n/ac, WCDMA and LTE standard		
Emission classification (F1D, G1D, D1D)	F1D, W7D		
EUT power requirements	24 – 110 V DC, 25 W		
Antenna information	The EUT uses five dedicated antennas, as following:		
	Modem antenna	2J-Antennas	2JW0124-C8868B
	Modem antenna	2J-Antennas	2JW0124z-C8868B
	WIFI antenna	Linx Technologies	ANT-DB1-RAF-RPS
	WIFI antenna	Linx Technologies	ANT-DB1-RAF-RPS
	GNSS antenna	2J-Antennas	2J4301MPCF-300LL100-C20NBST

3.4 EUT setup diagram

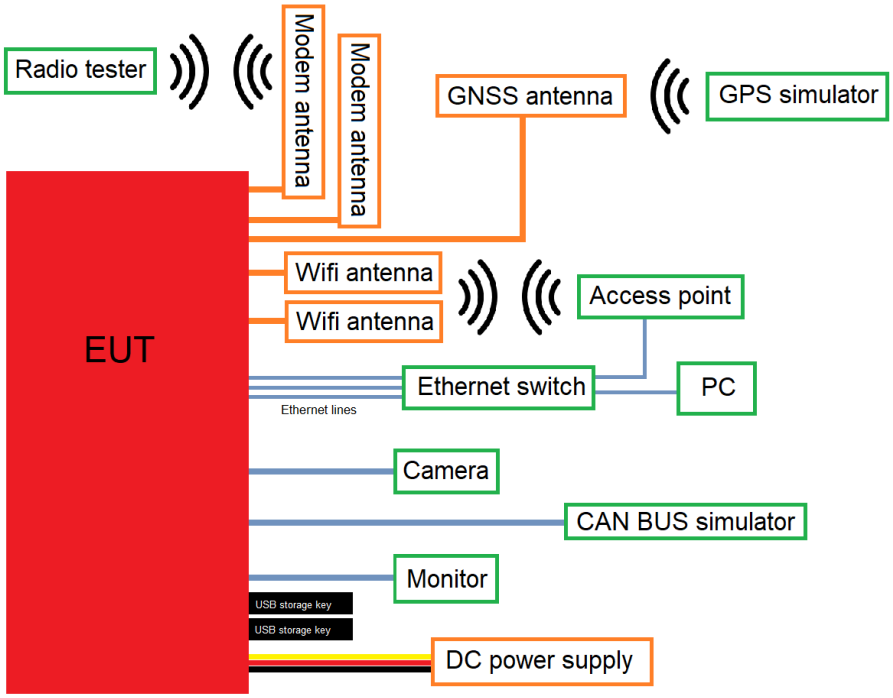


Figure 3.4-1: *Setup diagram*

3.5 Product description and theory of operation

The EUT is a rugged subsystem that has been designed to deliver GPU acceleration to Rolling Stock and Automotive applications. Based on NVIDIA Jetson Xavier NX, it combines a 6-core, high-performance ARM CPU with a 384-core GPU and 48 Tensor Cores, offering exceptional power efficiency and up to 21 TOPS of accelerated computing. The EUT can be used to process multiple video streams from high speed, high frame rate cameras: it provides 3x GbE, 4x GMSL and 3x USB3.1 Gen 2 ports (noise and surge protected) that can be used to connect sensors and to create sophisticated networking architectures. Wireless connectivity is also cutting edge, thanks to Wi-Fi 6 and support for LTE modems. The EUT offers plenty of storage capacity for video and other data via an internal NVME unit; removable storage is also supported via a microSD interface. On-vehicle features include isolated CAN-FD and opto-isolated DIO, a GNSS with Untethered Dead Reckoning (optionally RTK), and rugged M12 connectors. The EUT use a Linux kernel version 4.9.253-tegra.

3.6 EUT exercise details

The EUT has been forced in transmission mode using an access point supplied by the applicant and a radio communication tester R&S CM290.

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 WIFI and Bluetooth in 2.4 GHz band, WIFI 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.
Data logger con diagnosi in campo	Testo	175-H2	20012380/305	2020-12	2022-12
Data logger con diagnosi in campo	Testo	175-H2	38203337/703	2020-12	2022-12
Barometer	Castle	GPB 3300	072015	2021-07	2022-07

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:

Test	Range	Measurement Uncertainty	Notes
Radiated Disturbance	Antenna distance 1 m, 3 m, 10 m 0.009 ÷ 200 MHz	5.0 dB	(1)
	Antenna distance 1 m, 3 m, 10 m 200 ÷ 1000 MHz	5.2 dB	(1)
	Antenna distance 1 m, 3 m, 10 m 1 ÷ 6 GHz	5.2 dB	(1)
	Antenna distance 1 m, 3 m 6 ÷ 18 GHz	5.5 dB	(1)
	Antenna distance 1 m, 3 m 18 ÷ 40 GHz	7.2 dB	(1)
Radiated Disturbance with large loop antenna system (LLAS)	0.009 ÷ 30 MHz	3.3 dB	(1)
Conducted Disturbance	0.02 ÷ 150 kHz with AMN	3.8 dB	(1)
	150 kHz ÷ 30 MHz with AMN	3.4 dB	(1)
	150 kHz ÷ 30 MHz with AAN	4.6 dB	(1)
	9 kHz ÷ 30 MHz with voltage probe	2.9 dB	(1)
	150 kHz ÷ 30 MHz with current probe	2.9 dB	(1)
Frequency	10 Hz ÷ 1 kHz	0.2 %	(1)
	1 kHz ÷ 40 GHz	10^{-6}	(1)
Electromagnetic fields (EMF)	Magnetic, Electric and Electromagnetic fields: 0 Hz ÷ 40 GHz	25 %	(1)
Electrical quantities (voltage, current, resistance)	AC/DC Voltage 10 mV ÷ 1000 V 0÷100 kHz AC/DC Current 0.1 mA ÷ 400 A 0÷1 kHz Resistance 100 mΩ ÷ 10 MΩ	2.5 %	(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 %

(2) The instruments used for this immunity test is according to the tolerances requested by the applicable standard

(3) The reported expanded uncertainty of measurement is related to the stimulus quantity

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Description	Manufacturer	Model	Identifier	Cal Date	Due Date
EMI Receiver	Rohde & Schwarz	ESW44	101620	2021-08	2022-08
Antenna Trilog 25-2000 MHz	Schwarzbeck Mess-Elektronik	VULB9168	9168-242	2021-06	2024-06
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09	2024-09
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2020-04	2023-04
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2022-03	2023-03
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2022-05	2023-05
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2021-09	2023-09

Section 8. Testing data

8.1 FCC 15.209 and RSS-GEN section 8.9 Radiated emission limits; general requirements

8.1.1 Definitions and limits

FCC:

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

ISED:

Except when the requirements applicable to a given device state otherwise, emissions from licence‑exempt transmitters shall comply with the field strength limits shown in Table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 8.1-1: *FCC §15.209 and 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 8.1-2: *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 8.1-2 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 8.1-3: *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			

8.1.2 Test summary

Verdict	Pass
Tested by	P. Barbieri

8.1.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz.
Different channel setting has been investigated as per provided by client's setup, only the worst-case is presented. Radiated measurements were performed at a distance of 3 m.
The limits apply to the spurious emissions of the 3G/4G radio module is -13 dBm (82.2 dBµV/m = -13 dBm + 95.23 dB)..

Receiver settings for radiated measurements within restricted bands 30 MHz to 1 GHz:

Resolution bandwidth:	120 kHz
Detector mode:	Quasi-Peak

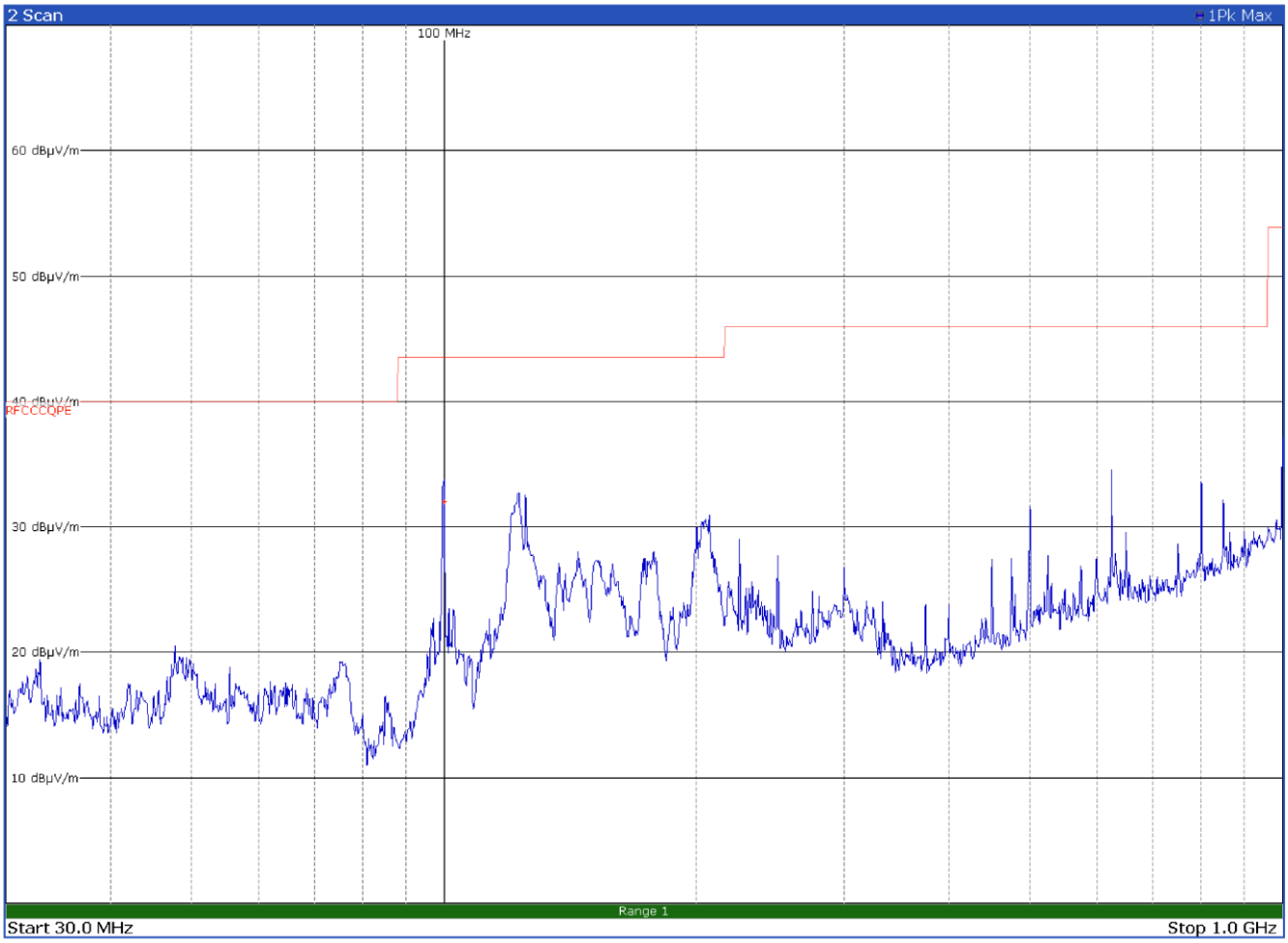
Receiver settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Detector mode:	Peak

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

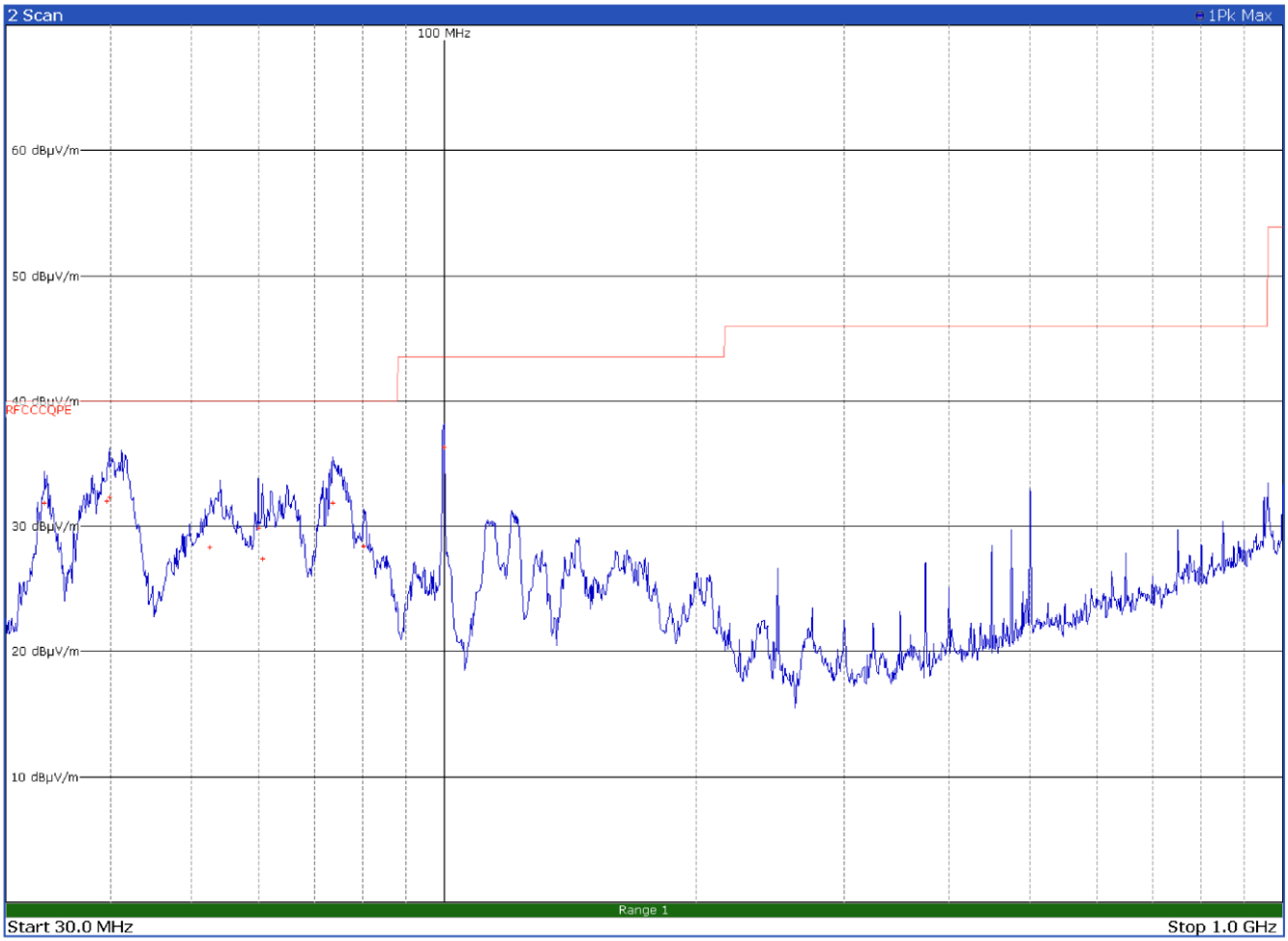
Resolution bandwidth:	1 MHz
Detector mode:	Average

8.1.4 Test data for WCDMA B2 at 1880 MHz and WIFI at 2437 MHz



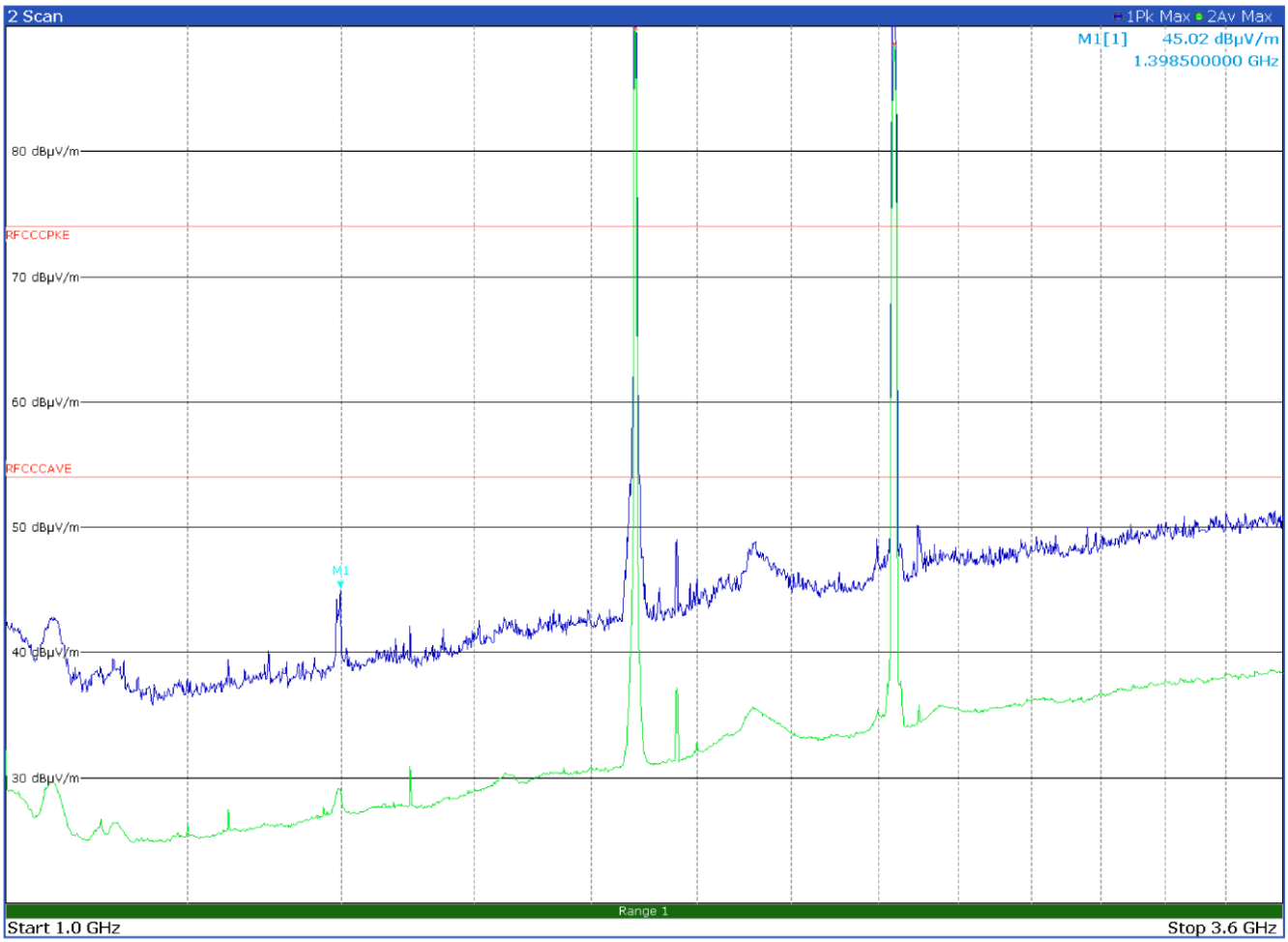
Antenna in horizontal polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
99.9300	32.0	43.5	-11.5	QP



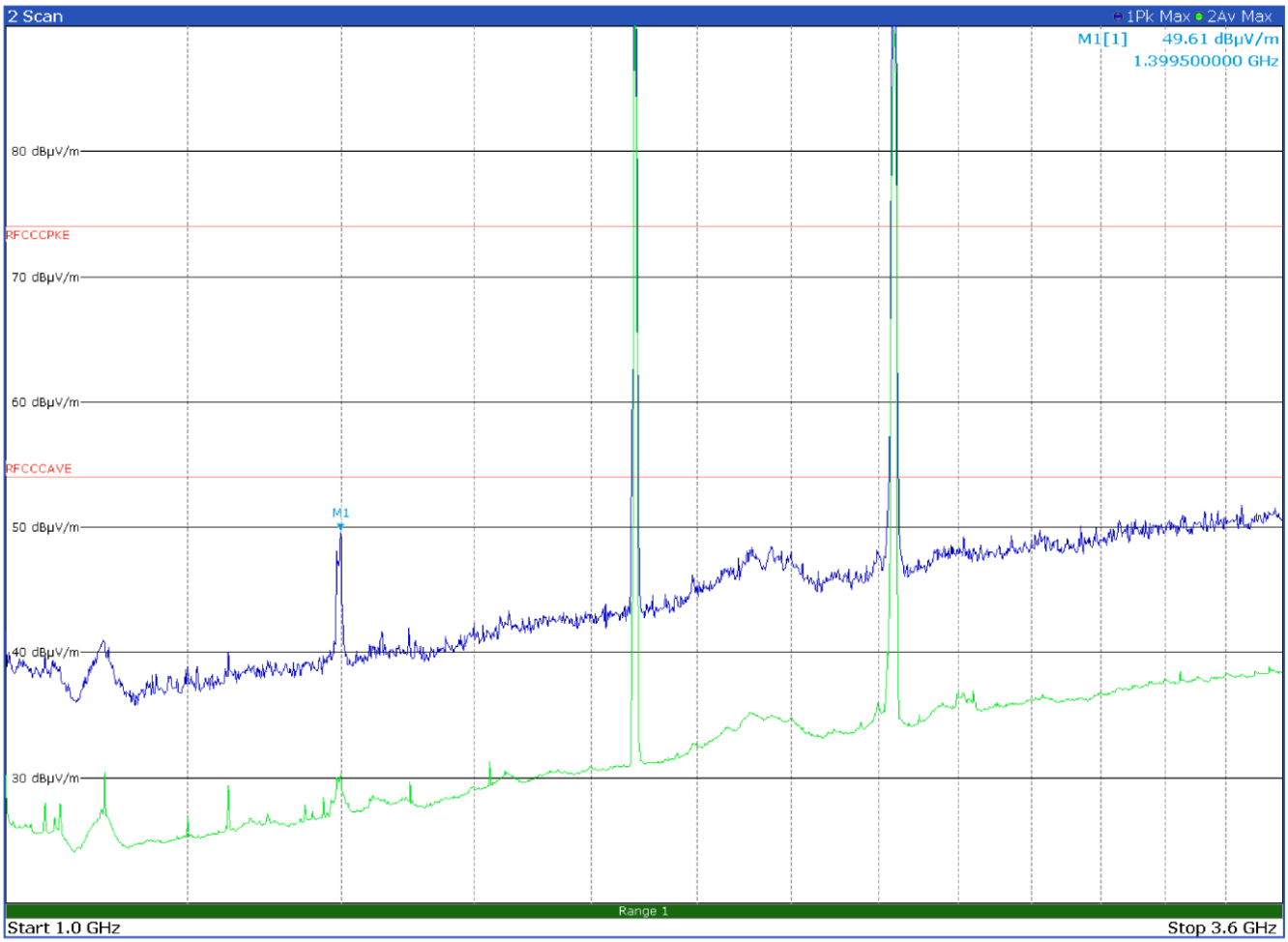
Antenna in vertical polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
33.3600	31.9	40.0	-8.1	QP
39.6300	32.1	40.0	-7.9	QP
39.8700	32.3	40.0	-7.7	QP
52.5600	28.4	40.0	-11.6	QP
60.0000	29.9	40.0	-10.1	QP
60.6900	27.4	40.0	-12.6	QP
73.6200	31.9	40.0	-8.1	QP
80.1300	28.4	40.0	-11.6	QP
99.9300	36.3	43.5	-7.2	QP



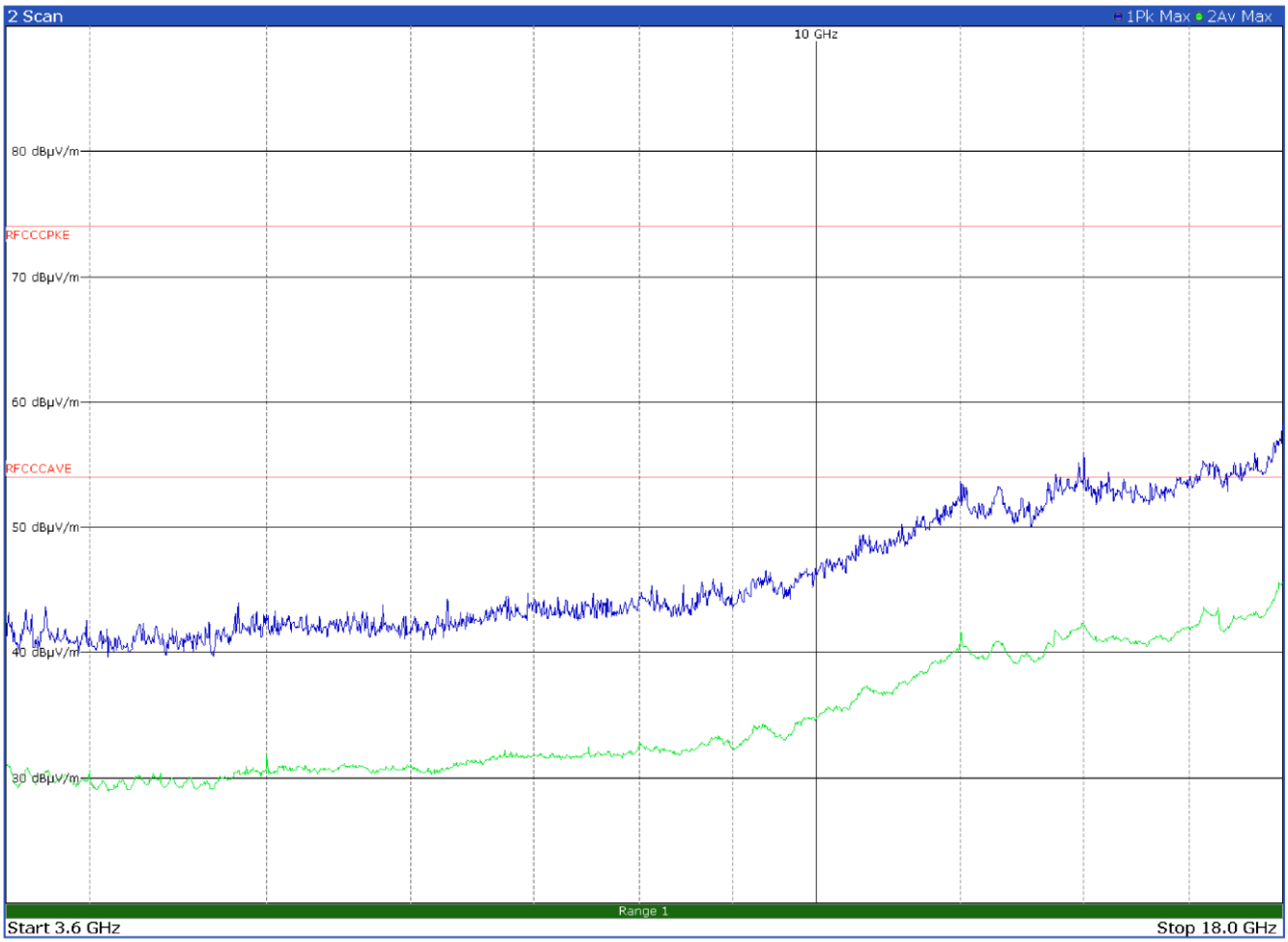
Antenna in horizontal polarization

Limit exceeded by carriers – No inter-modulation product founds

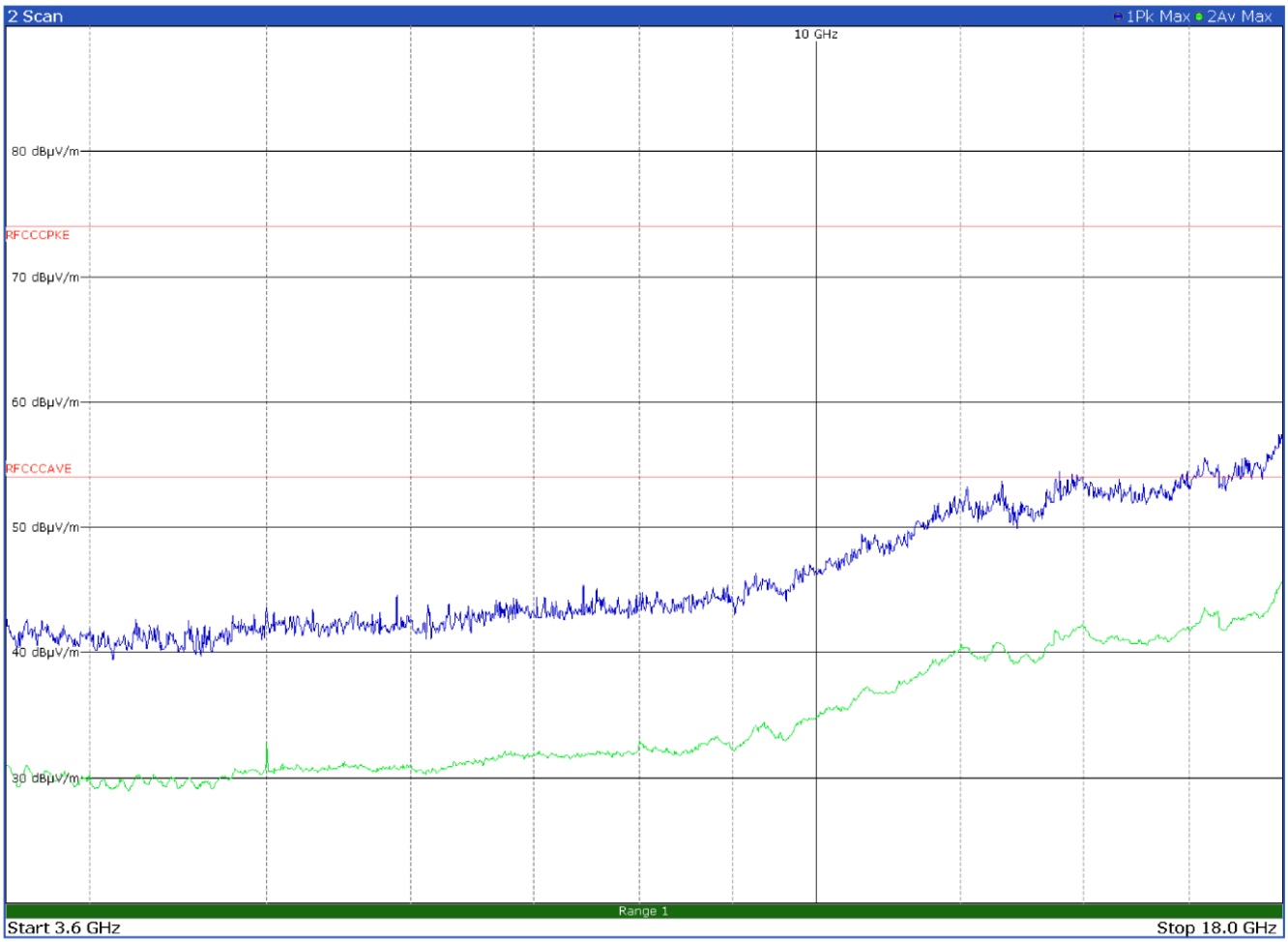


Antenna in vertical polarization

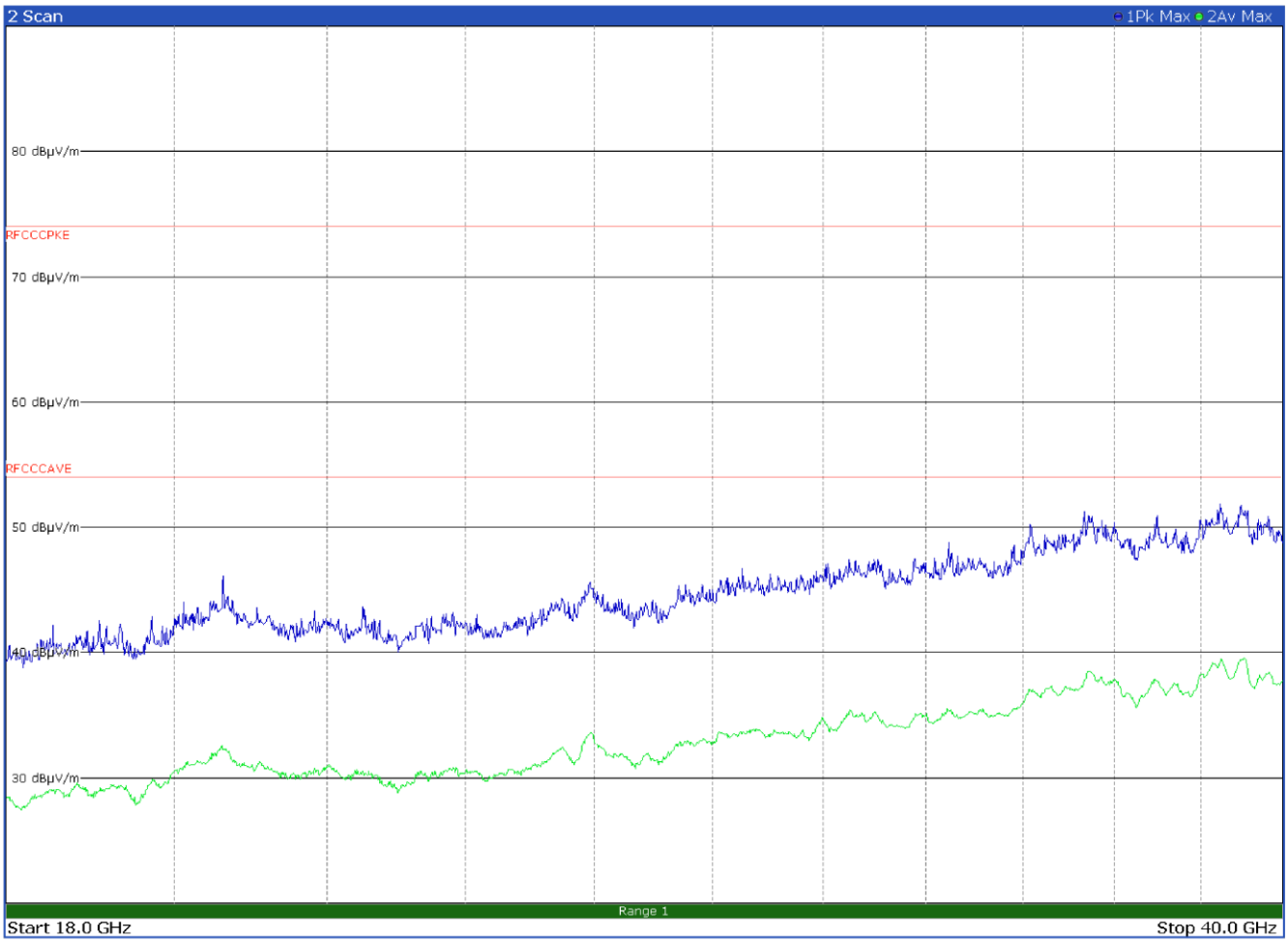
Limit exceeded by carriers – No inter-modulation product founds



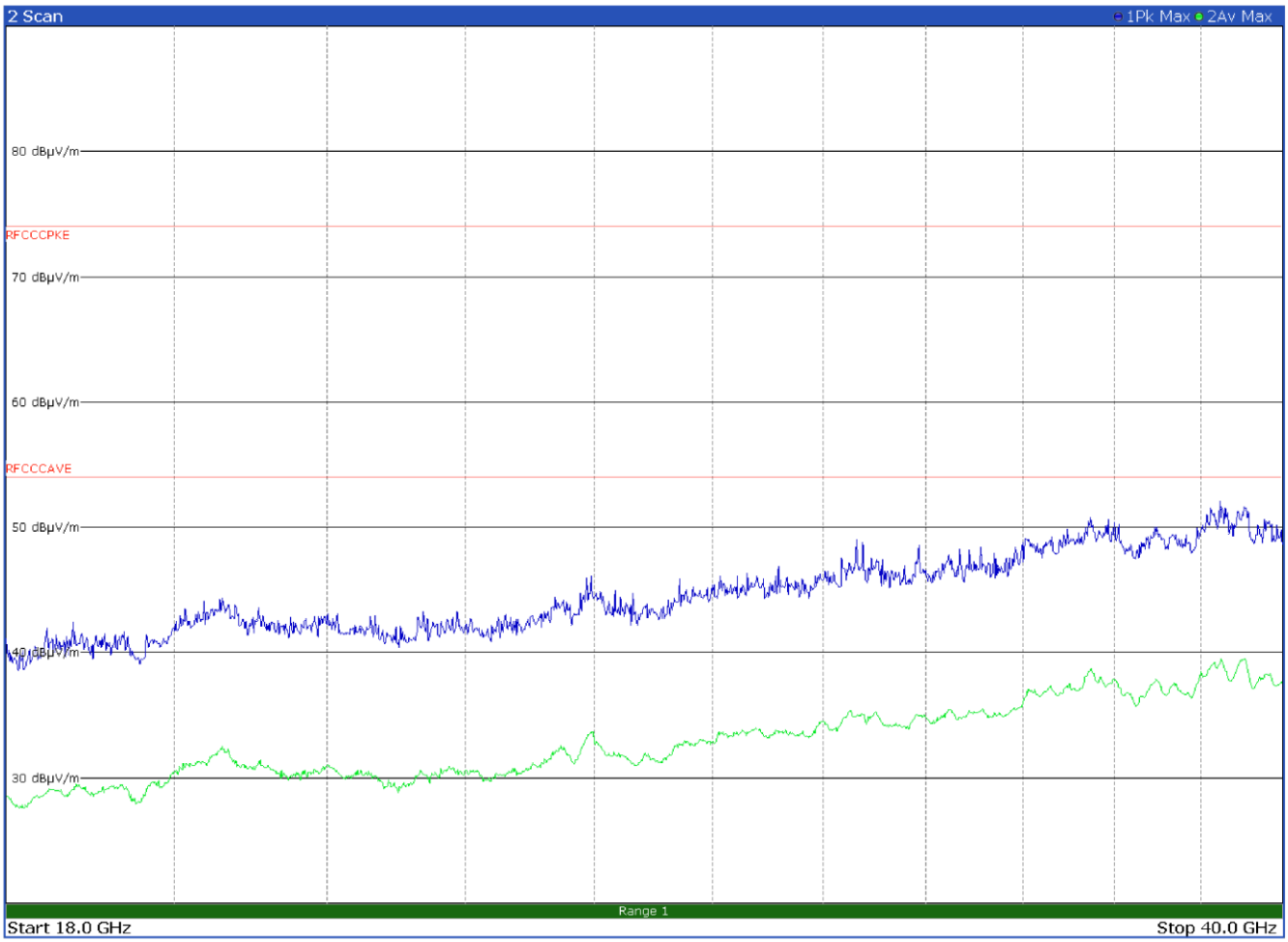
Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds

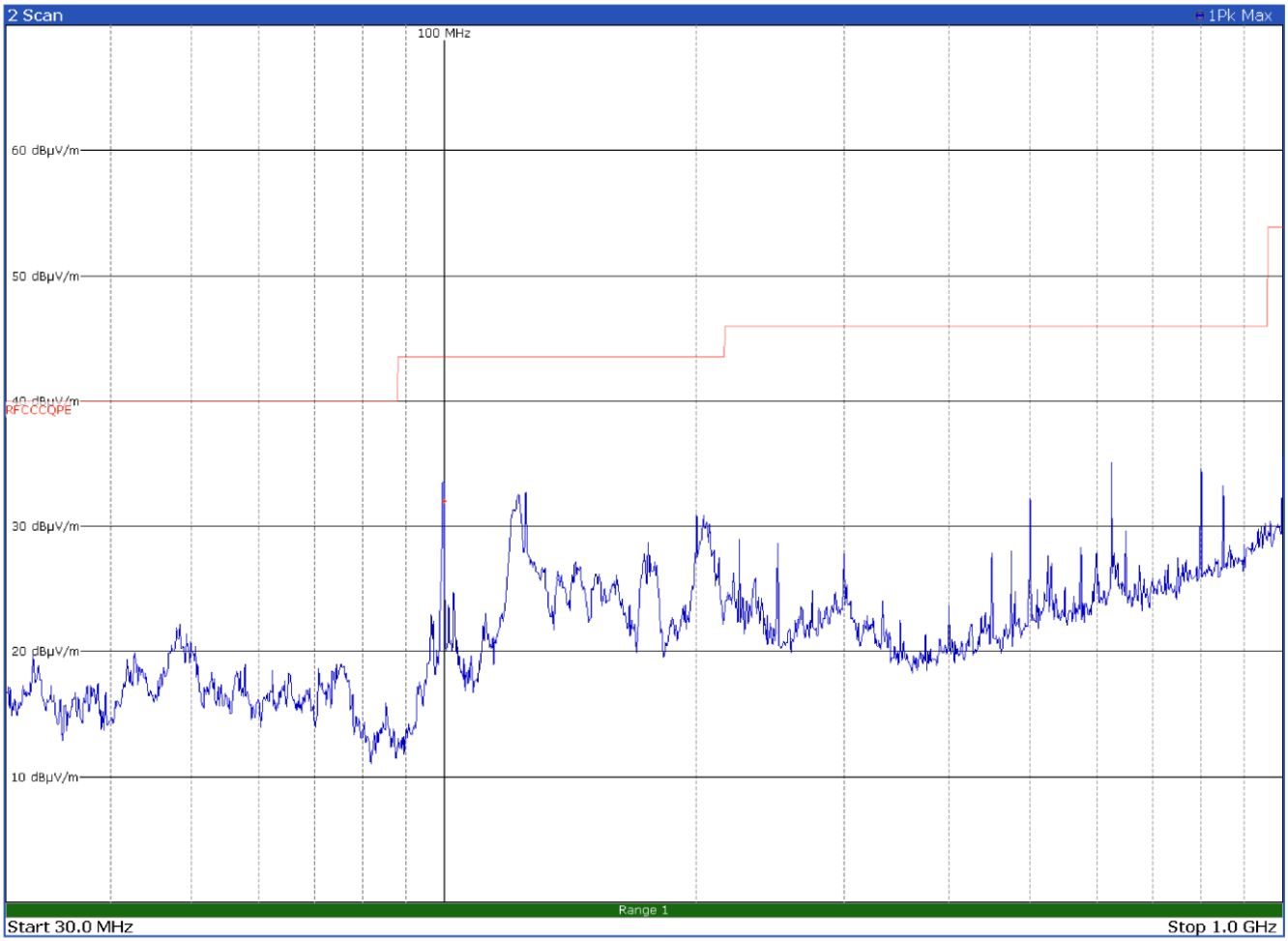


Antenna in horizontal polarization – No inter-modulation product founds



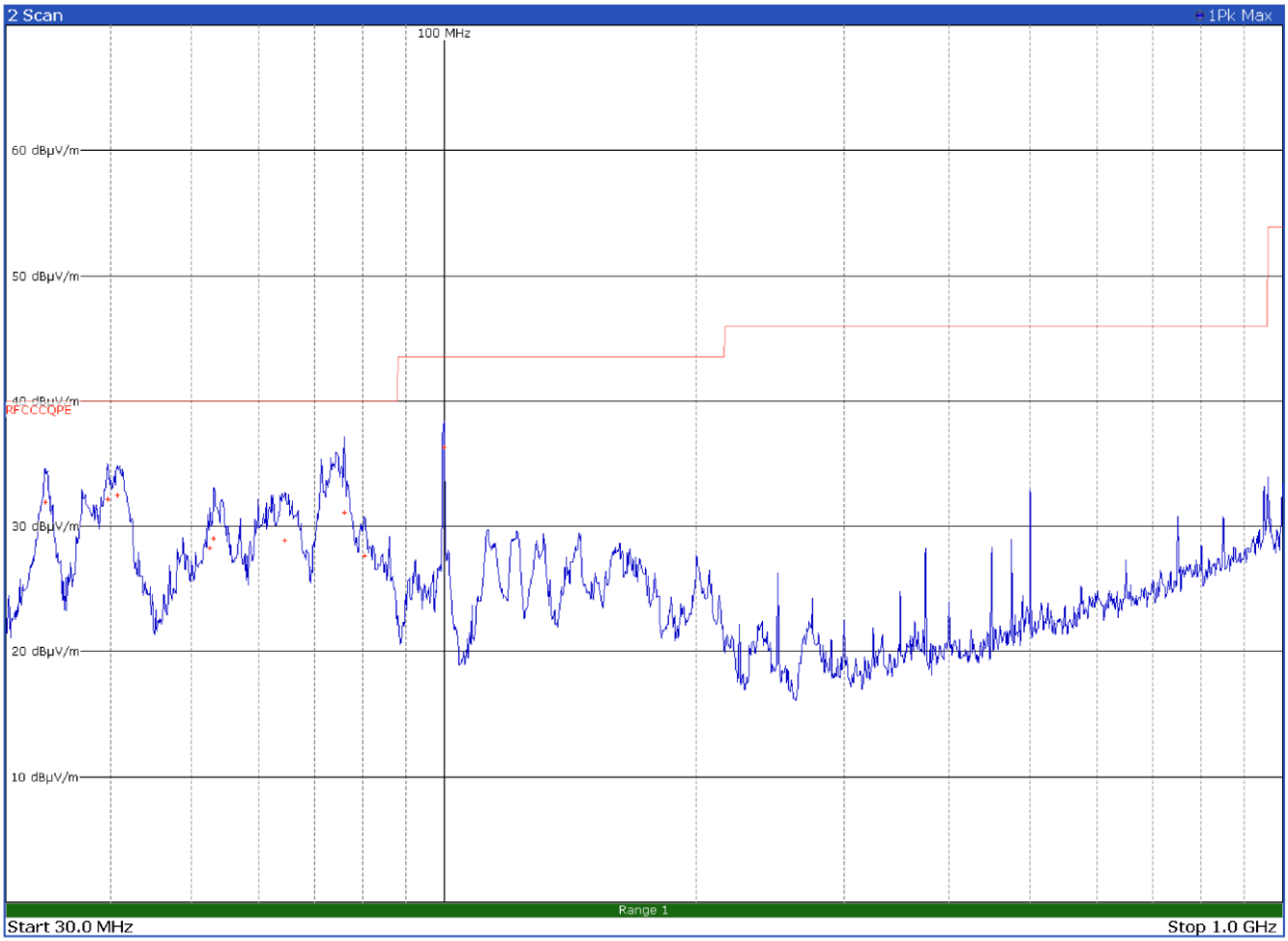
Antenna in vertical polarization – No inter-modulation product founds

8.1.5 Test data for LTE B4 at 1730 MHz and WIFI at 2437 MHz



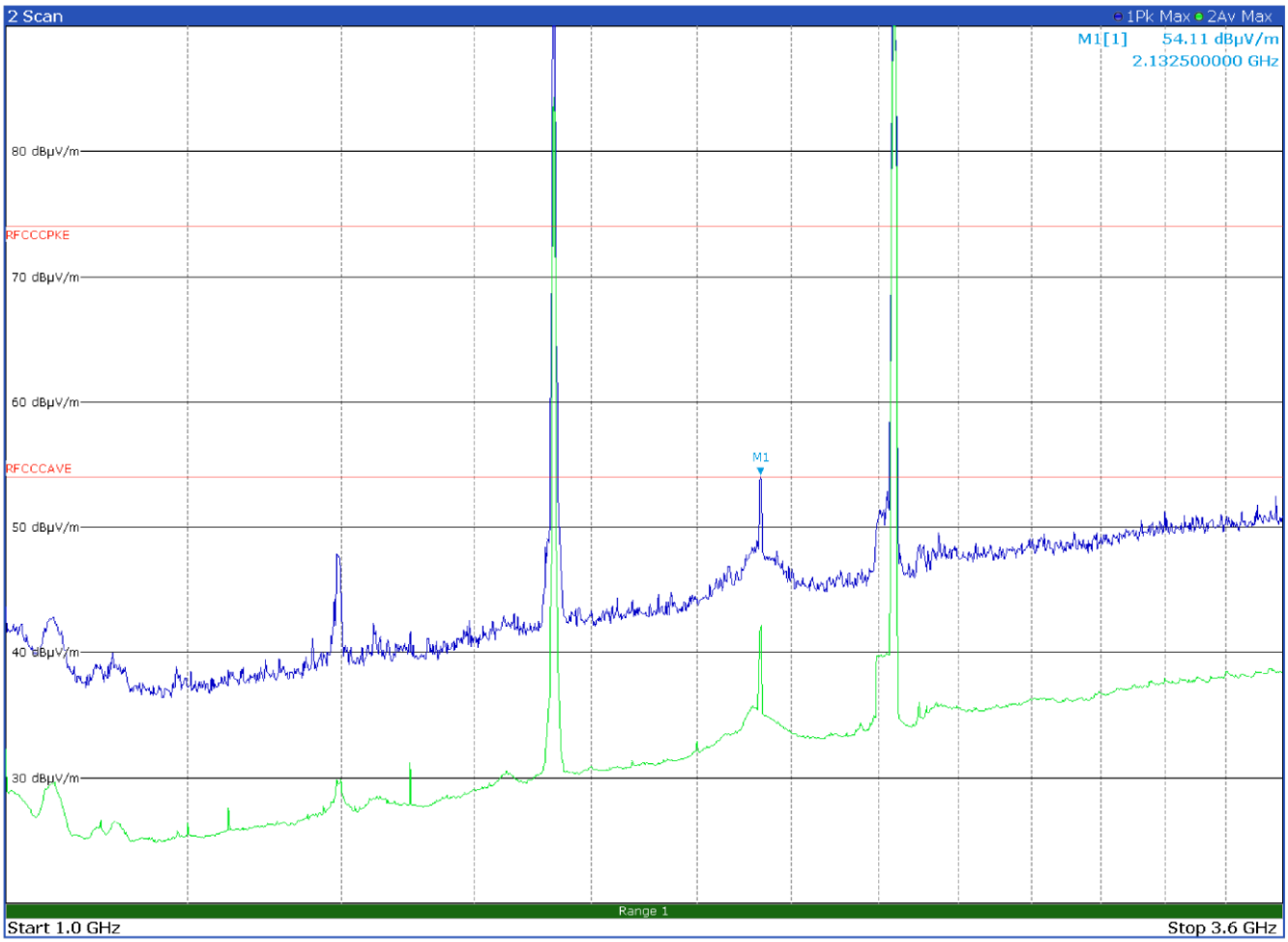
Antenna in horizontal polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
99.9300	32.1	43.5	-11.4	QP



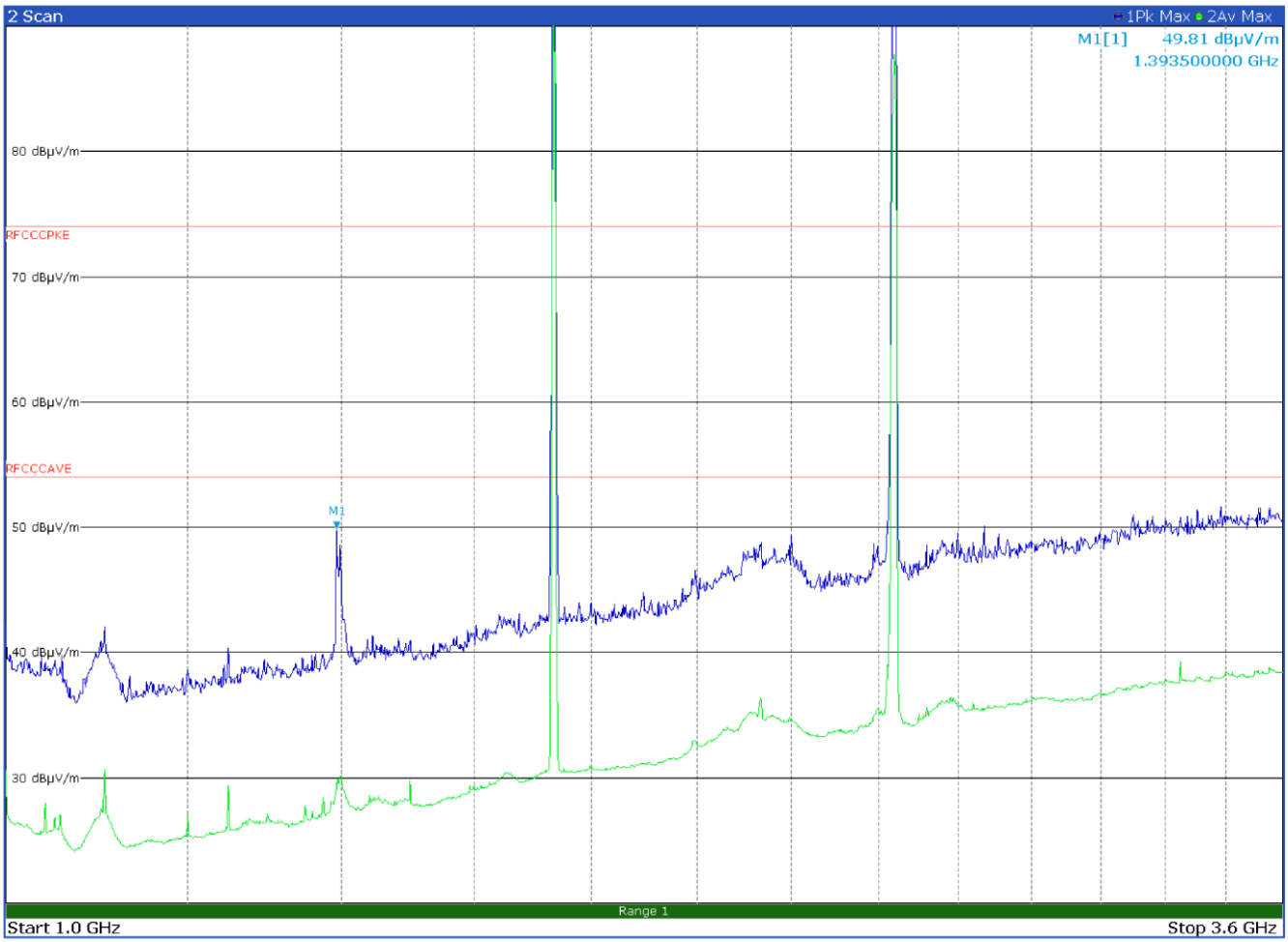
Antenna in vertical polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
33.3900	32.0	40.0	-8.0	QP
39.6600	32.2	40.0	-7.8	QP
40.7700	32.5	40.0	-7.5	QP
52.5600	28.3	40.0	-11.7	QP
53.1300	29.1	40.0	-10.9	QP
64.5900	28.9	40.0	-11.1	QP
75.9600	31.1	40.0	-8.9	QP
80.4000	27.7	40.0	-12.3	QP
99.9300	36.4	43.5	-7.1	QP



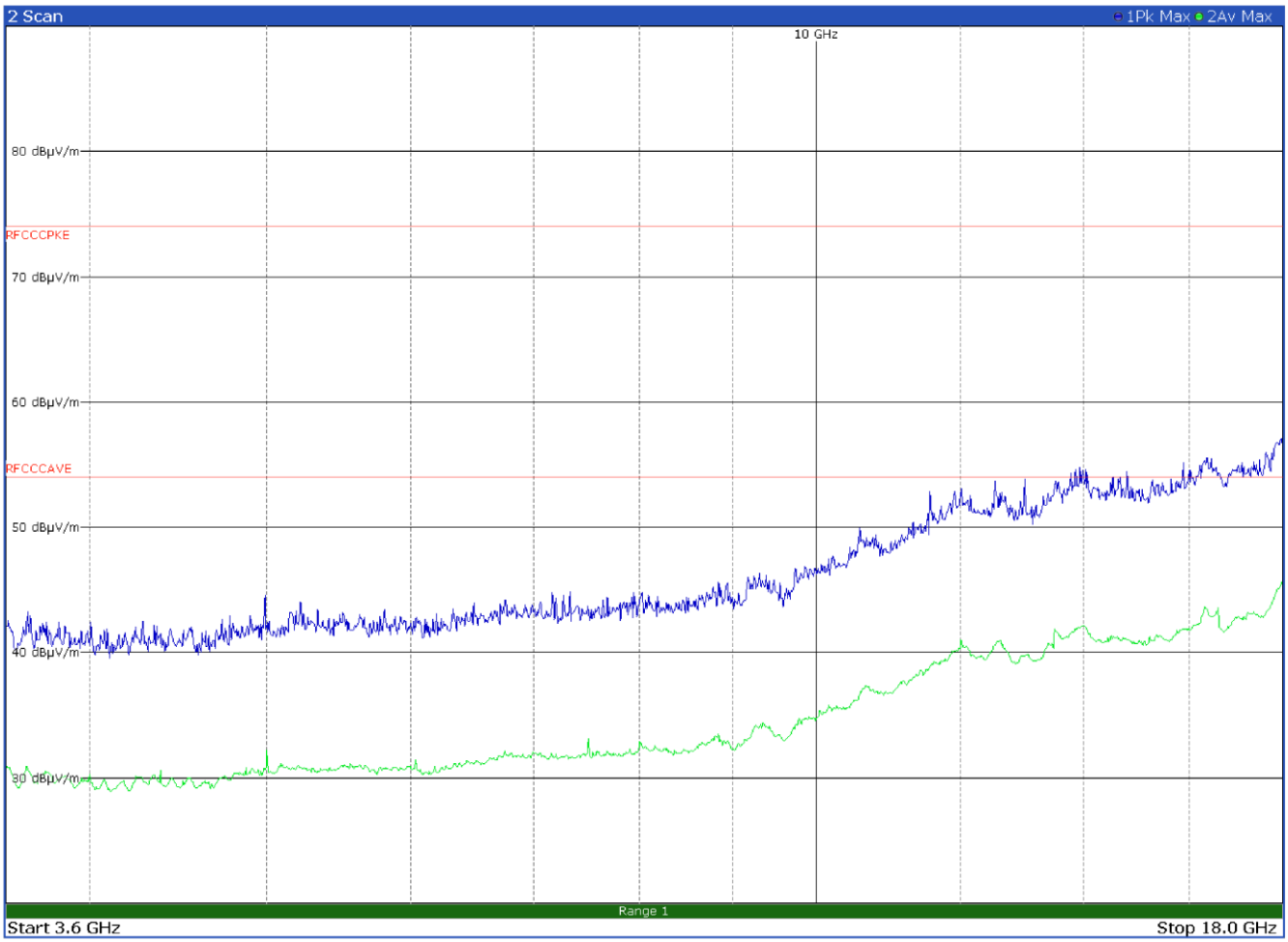
Antenna in horizontal polarization

Limit exceeded by carriers – No inter-modulation product founds

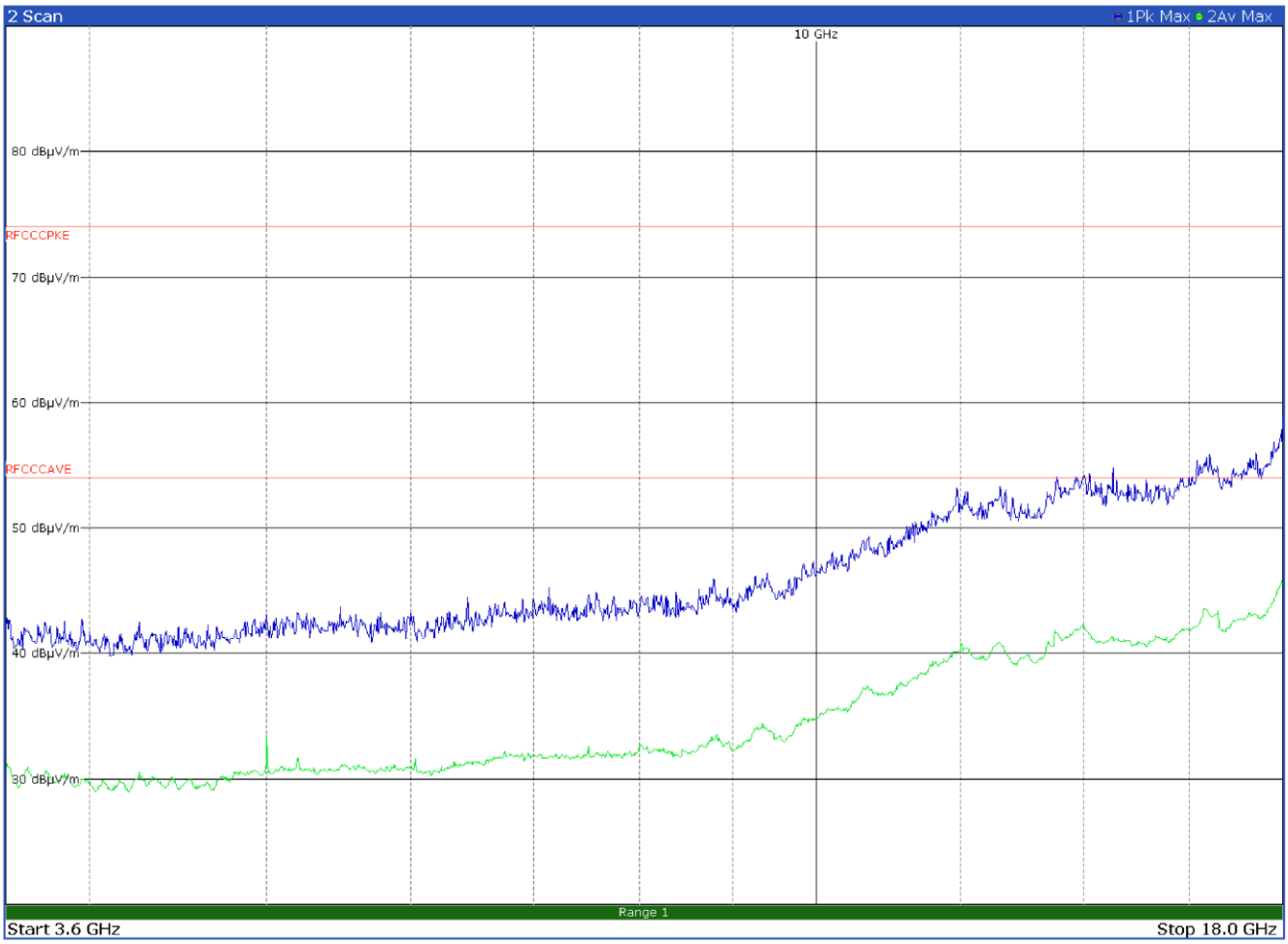


Antenna in horizontal polarization

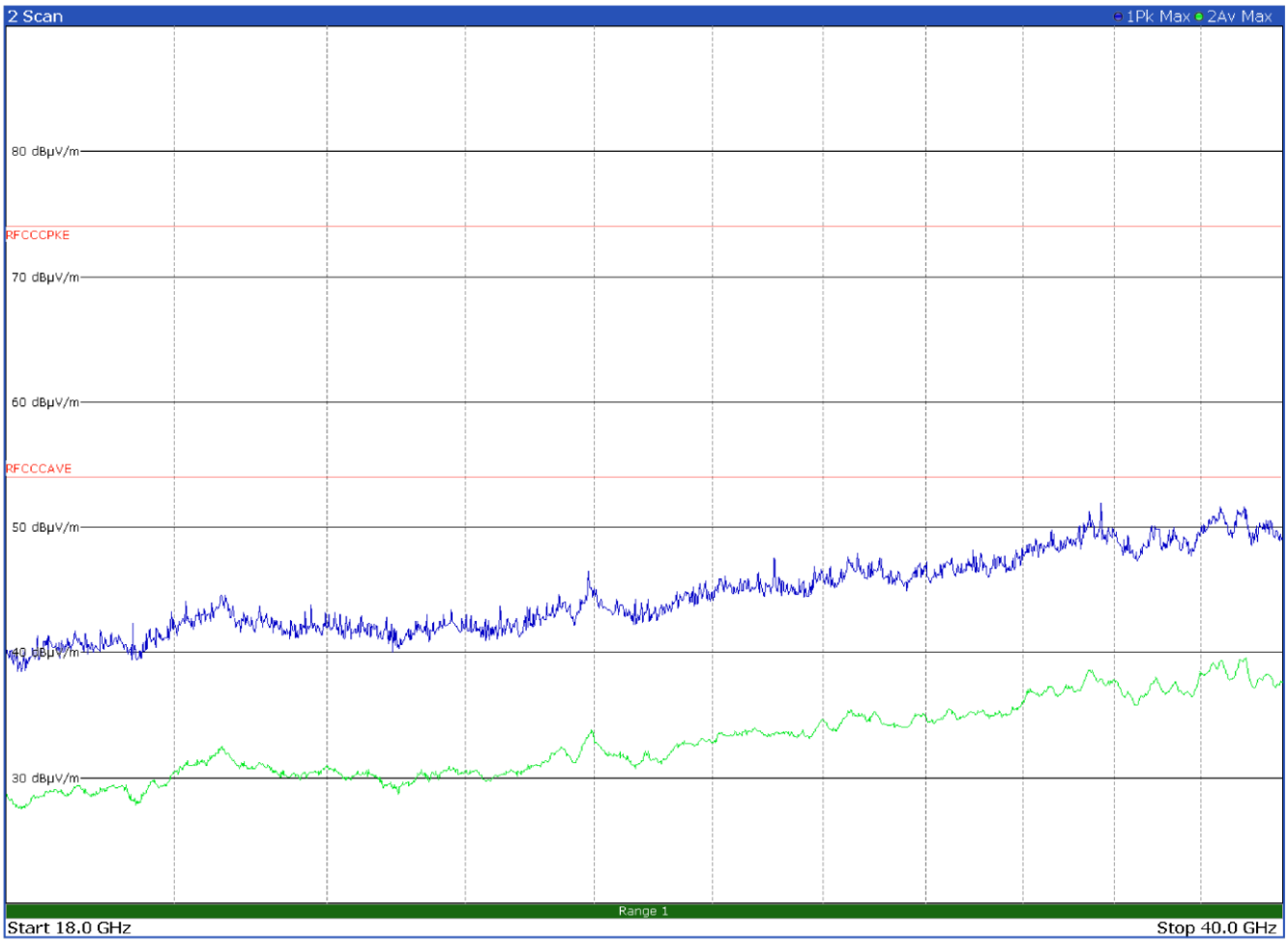
Limit exceeded by carriers – No inter-modulation product founds



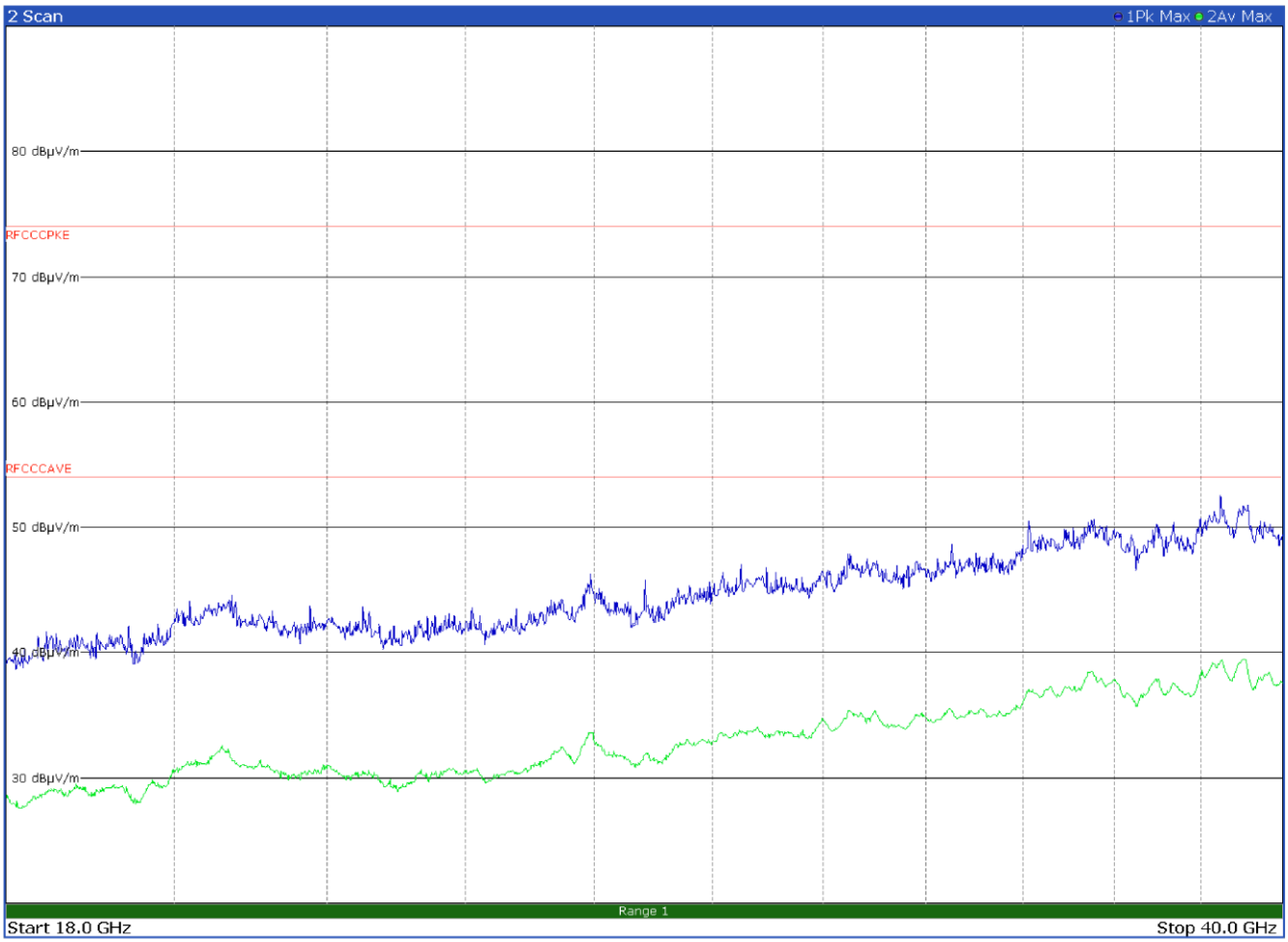
Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds

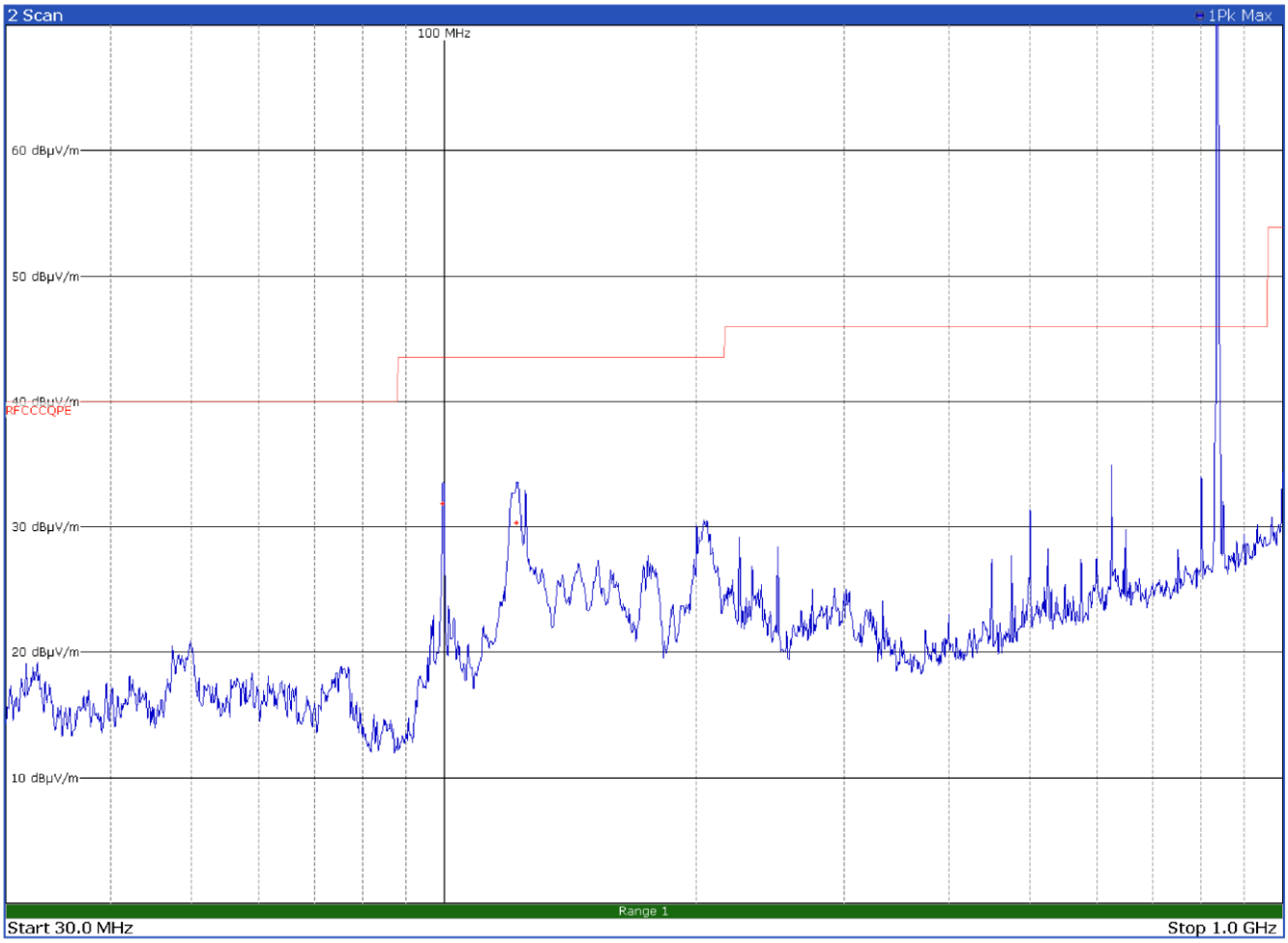


Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds

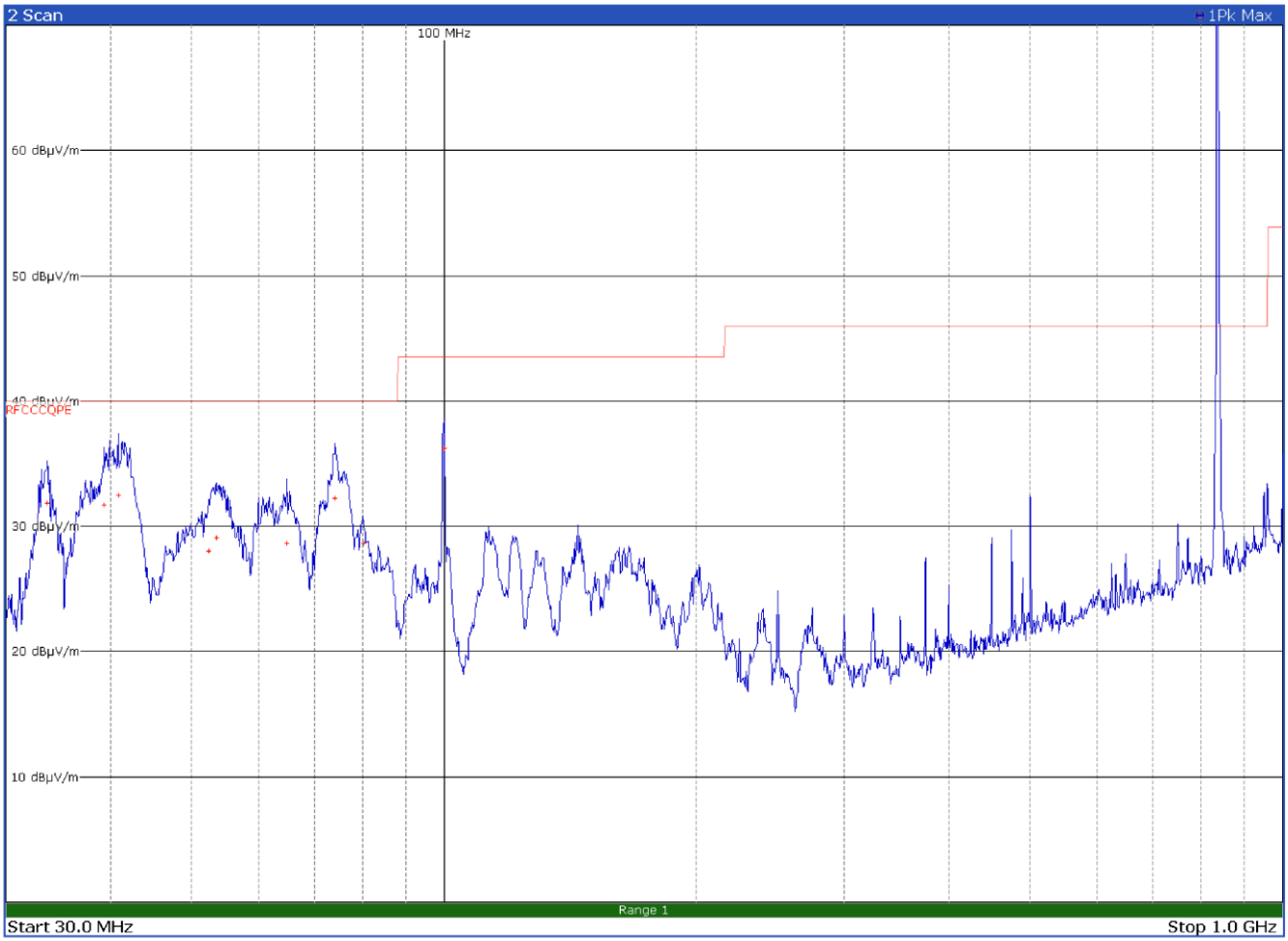
8.1.6 Test data for WCDMA B5 at 837 MHz and WIFI at 2437 MHz



Antenna in horizontal polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
99.6000	31.9	43.5	-11.6	QP
122.0100	30.3	43.5	-13.2	QP

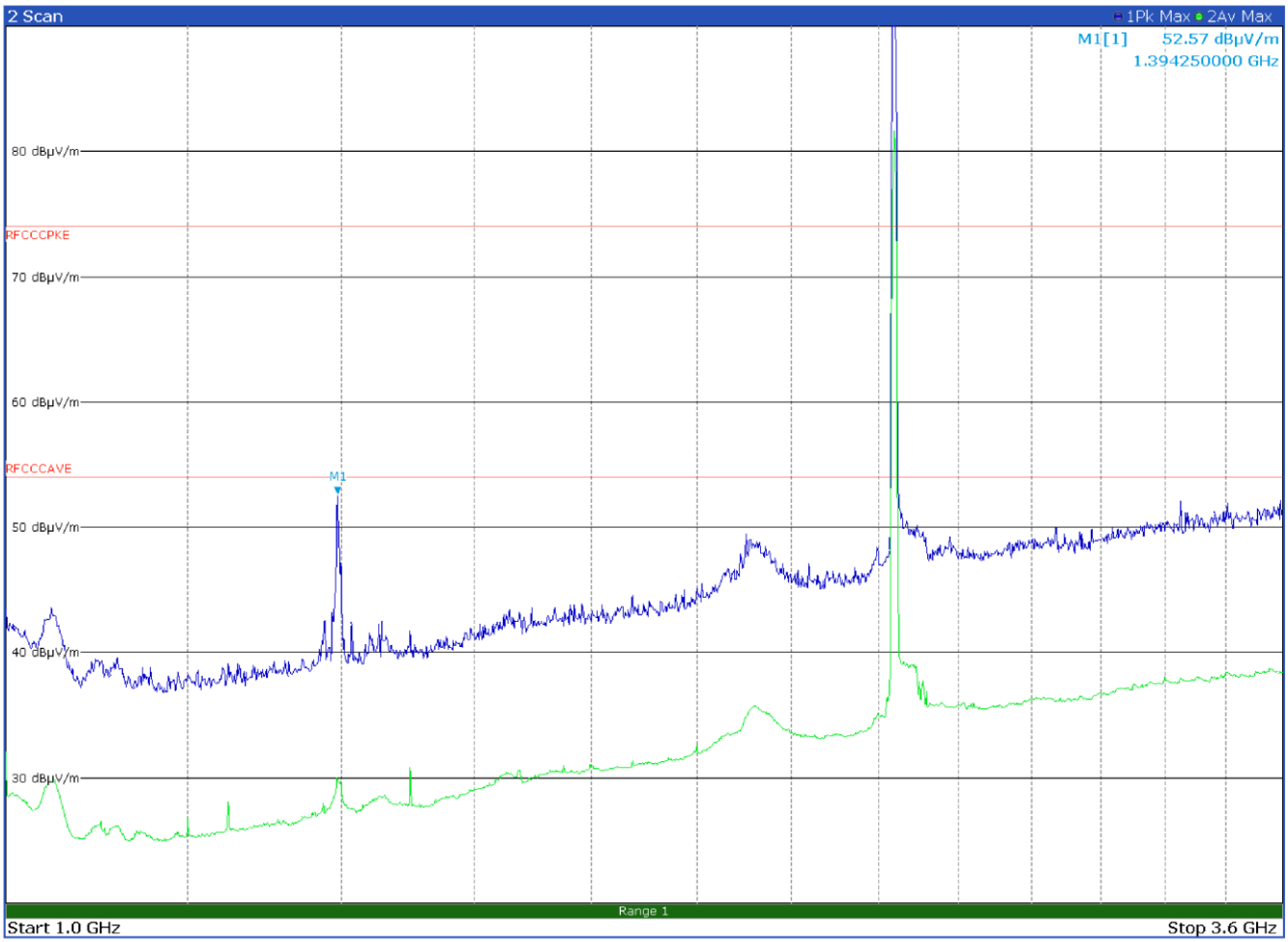
Limit exceeded by carriers



Antenna in vertical polarization

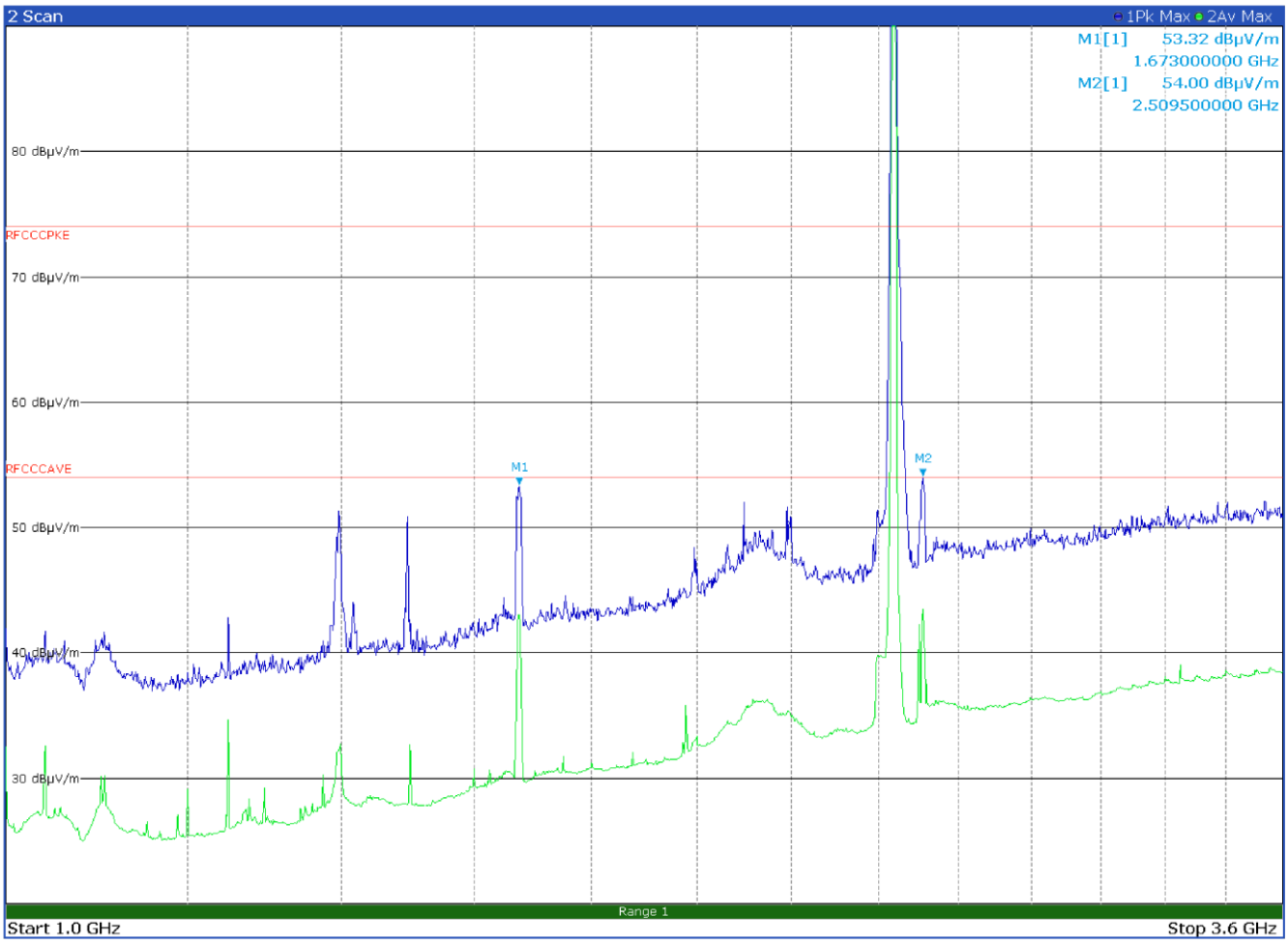
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
33.6300	31.9	40.0	-8.1	QP
39.2700	31.7	40.0	-8.3	QP
40.8600	32.5	40.0	-7.5	QP
52.3800	28.1	40.0	-11.9	QP
53.4300	29.1	40.0	-10.9	QP
64.8900	28.6	40.0	-11.4	QP
74.0400	32.3	40.0	-7.7	QP
80.1600	28.7	40.0	-11.3	QP
99.9300	36.3	43.5	-7.2	QP

Limit exceeded by carriers



Antenna in horizontal polarization – No inter-modulation product founds

Limit exceeded by carrier



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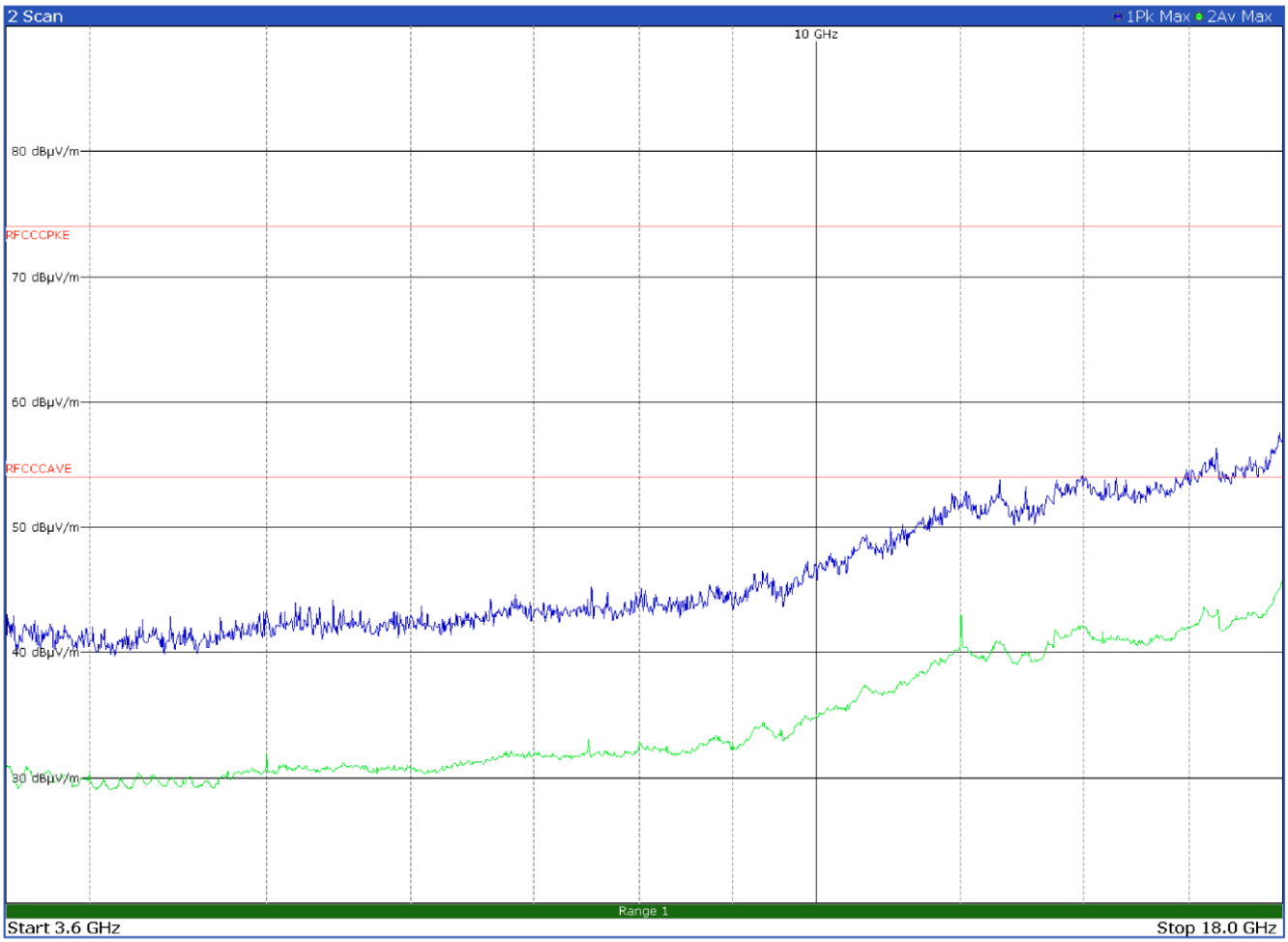
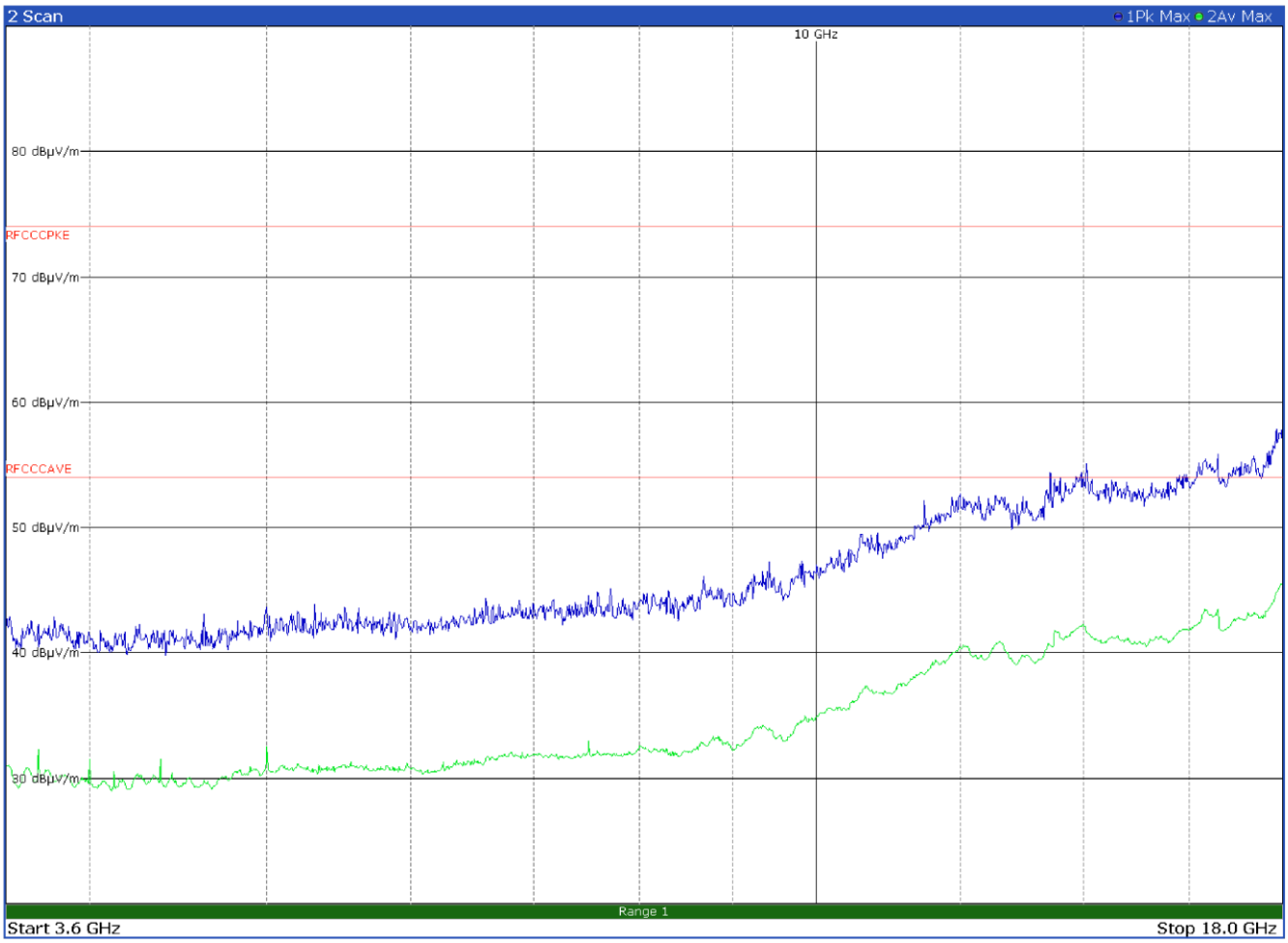
Antenna in vertical polarization – No inter-modulation product founds

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1673.0000	53.3	82.2	-28.9	Pk
2509.5000	54.0	82.2	-28.2	Pk

Limit exceeded by carrier



Antenna in horizontal polarization – No inter-modulation product founds



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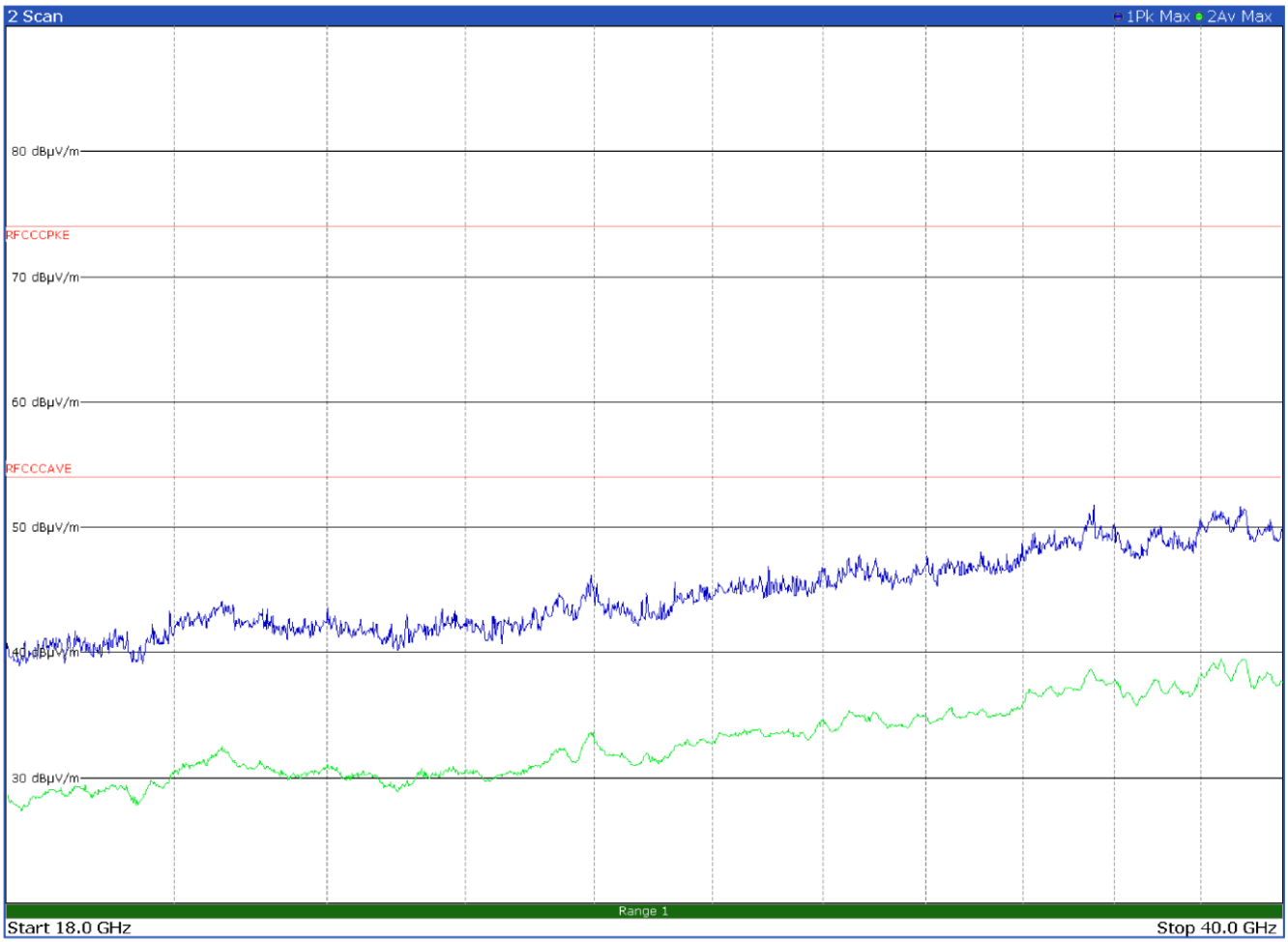
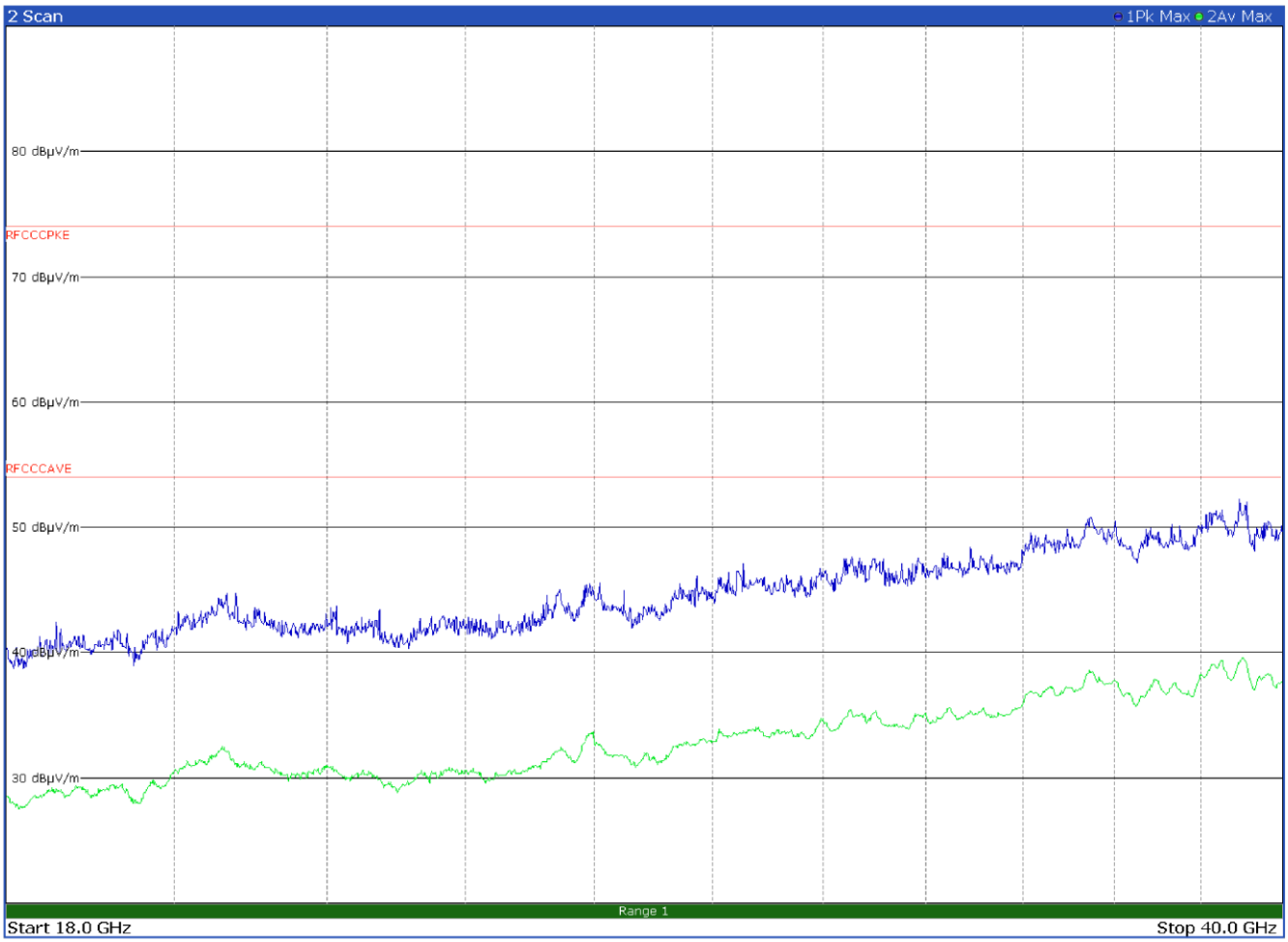
Antenna in vertical polarization – No inter-modulation product founds

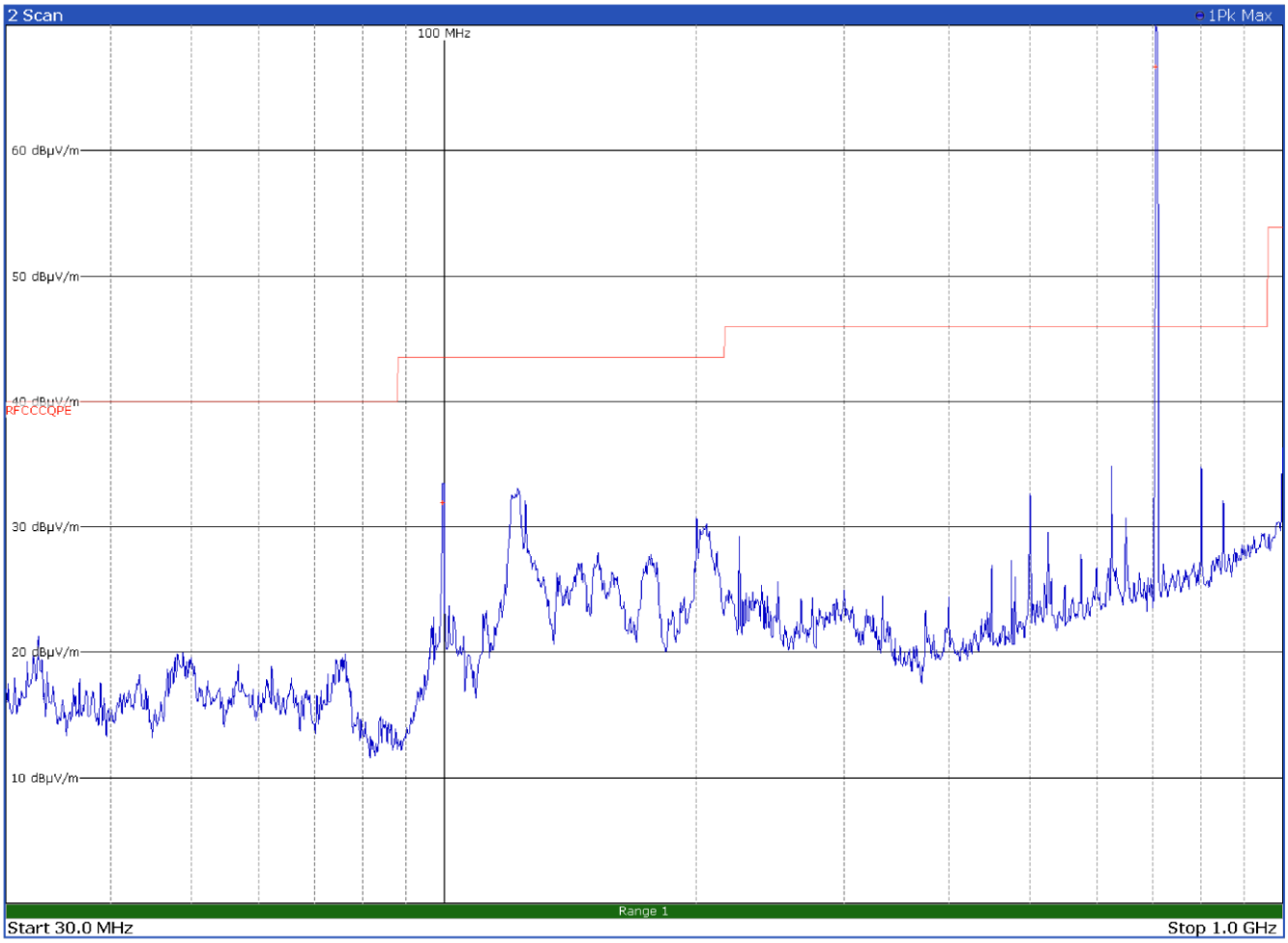


Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds

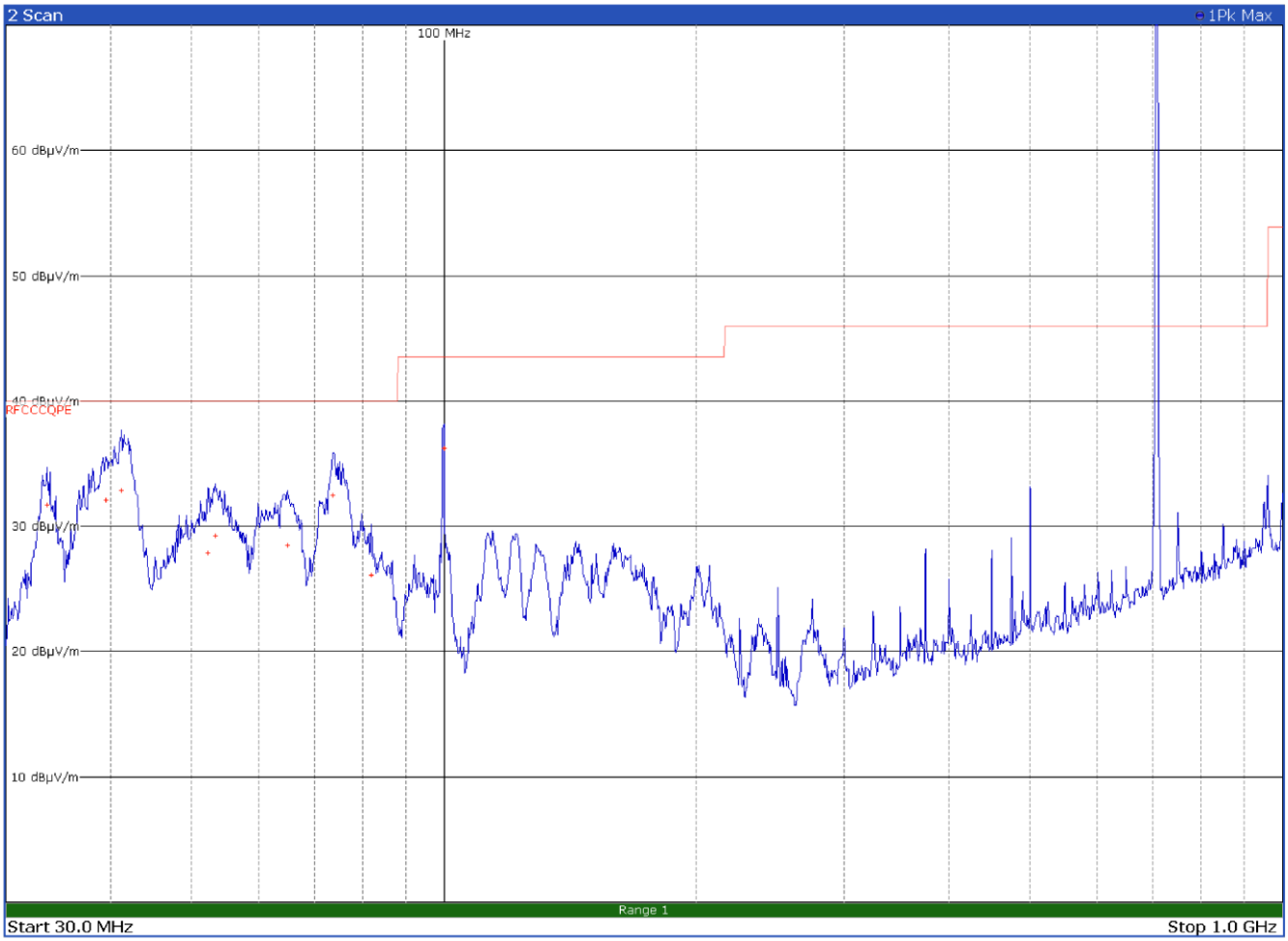
8.1.7 Test data for LTE B12 at 782 MHz and WIFI at 2437 MHz



Antenna in horizontal polarization

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
99.6000	32.0	43.5	-11.5	QP

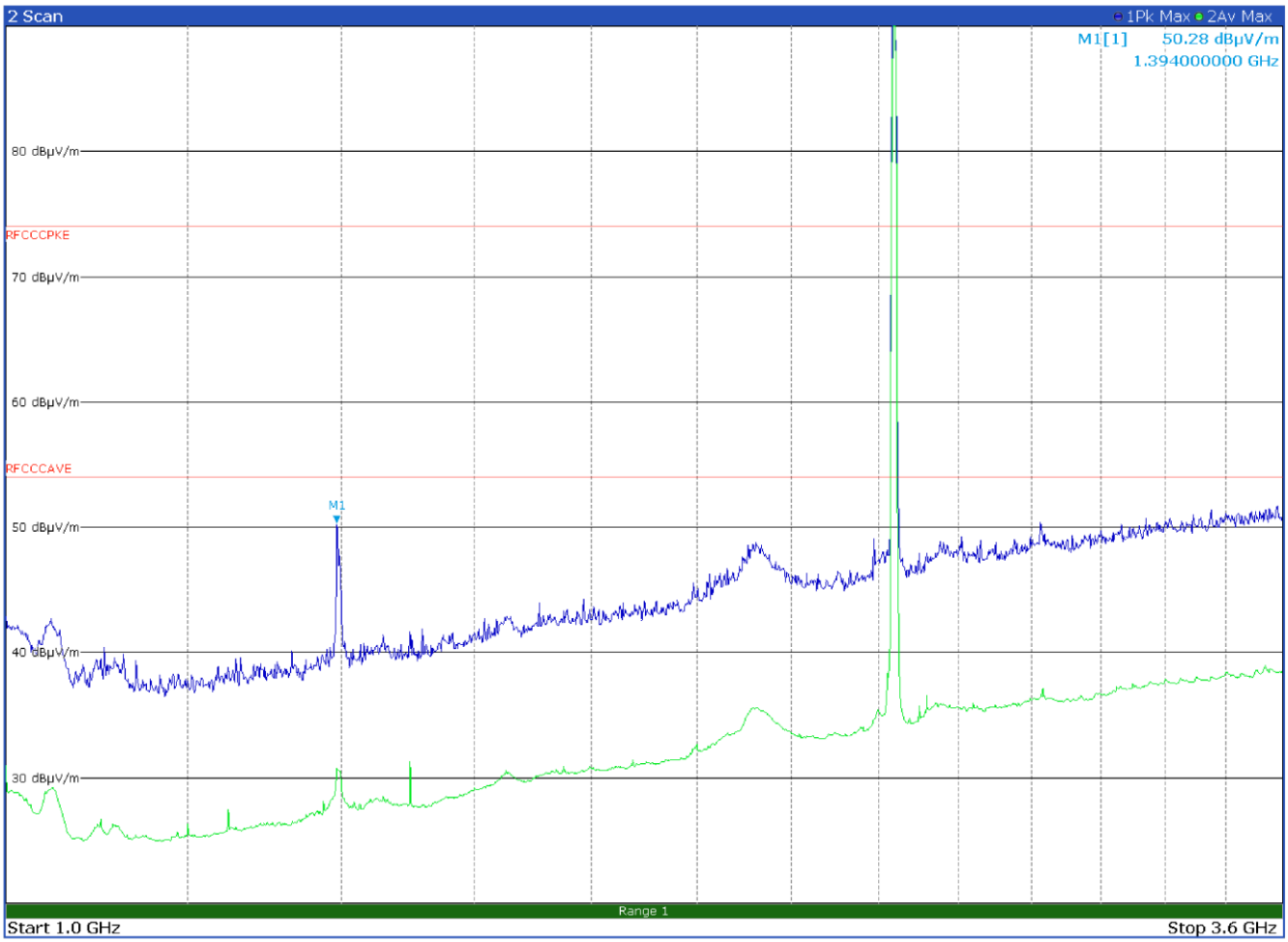
Limit exceeded by carriers



Antenna in vertical polarization

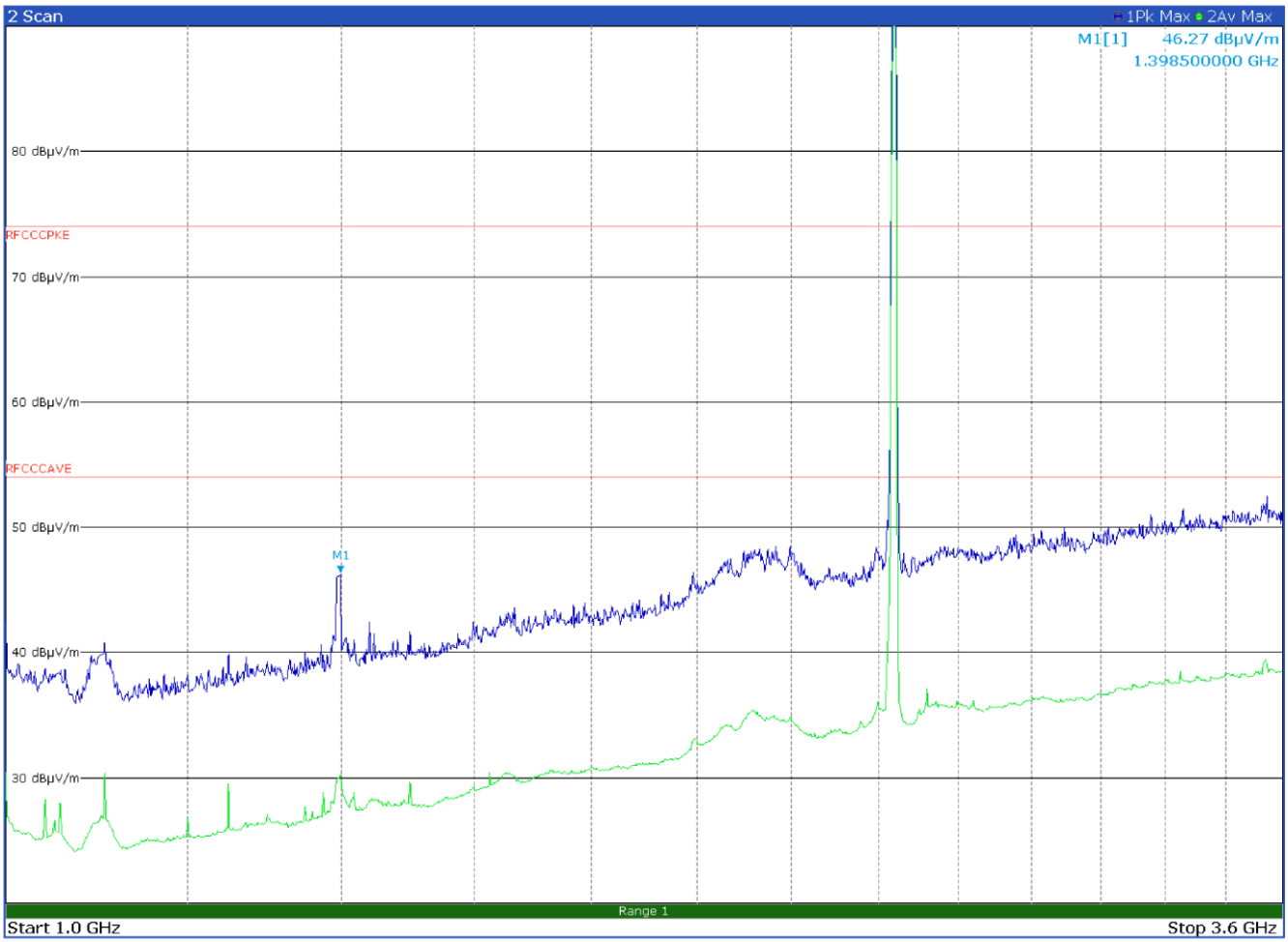
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
33.6000	31.8	40.0	-8.2	QP
39.4800	32.1	40.0	-7.9	QP
41.1900	32.9	40.0	-7.1	QP
52.2600	27.9	40.0	-12.1	QP
53.3400	29.3	40.0	-10.7	QP
64.9800	28.5	40.0	-11.5	QP
73.6800	32.5	40.0	-7.5	QP
81.8100	26.1	40.0	-13.9	QP
99.9300	36.3	43.5	-7.2	QP

Limit exceeded by carriers



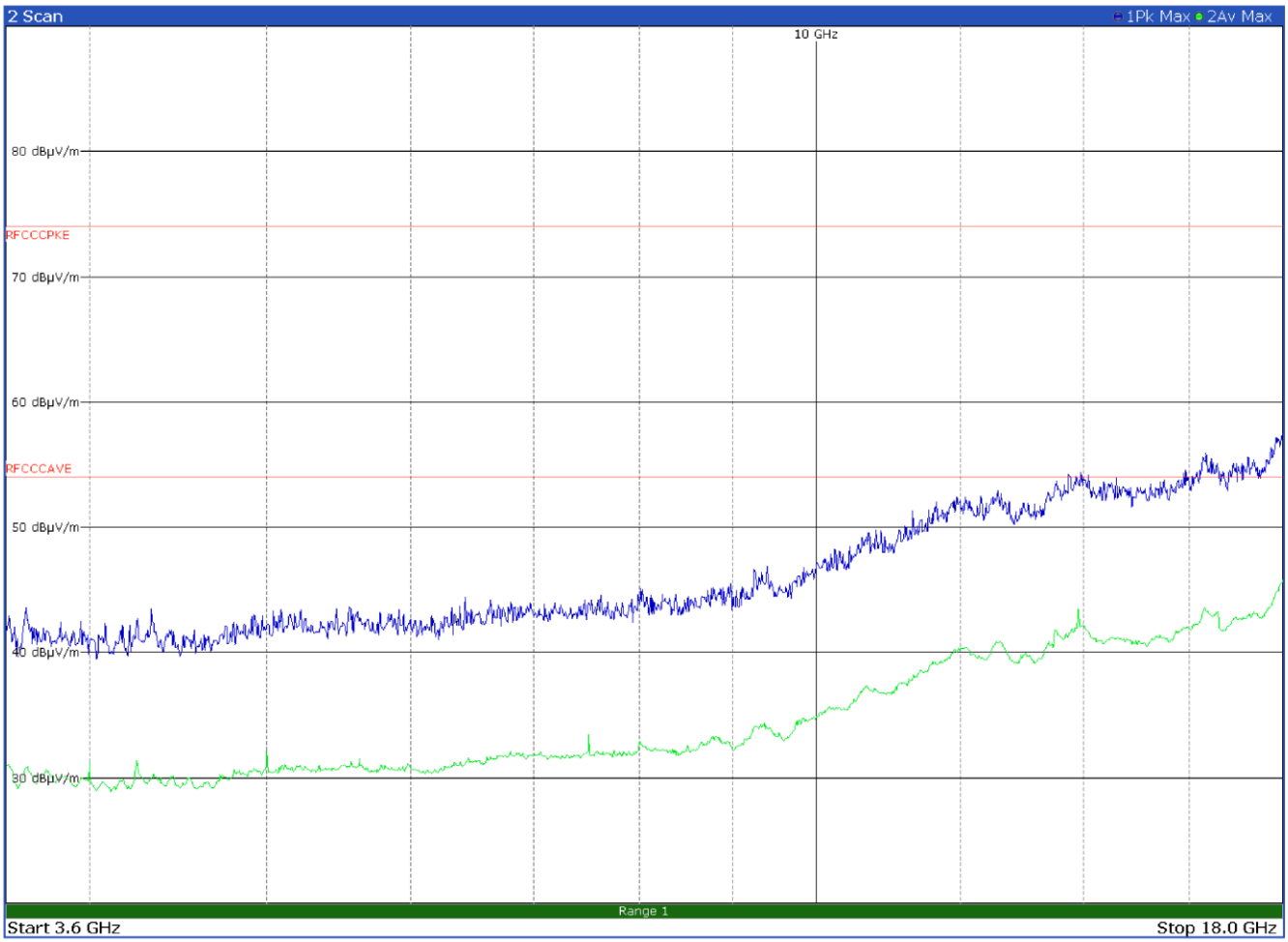
Antenna in horizontal polarization – No inter-modulation product founds

Limit exceeded by carrier

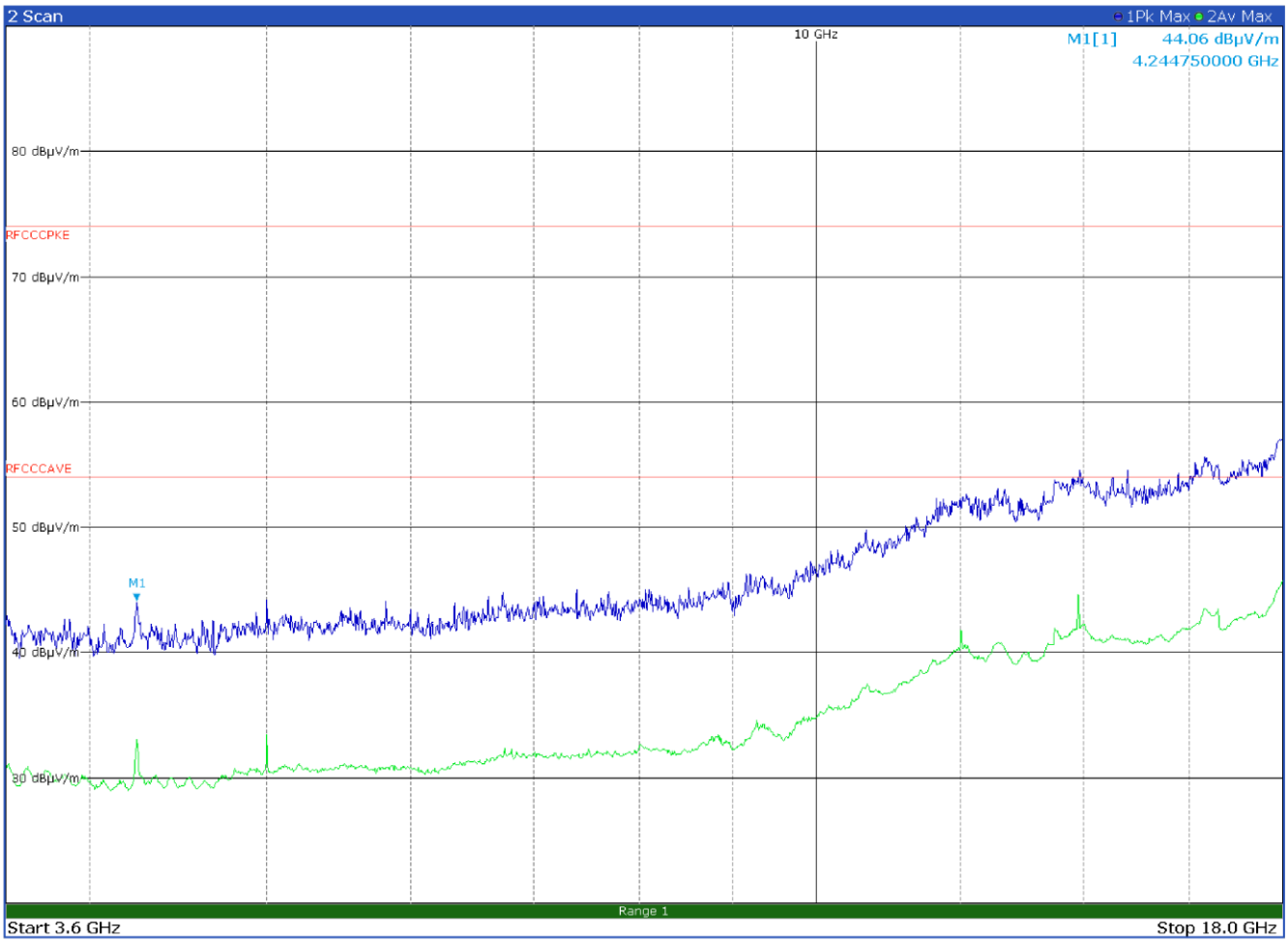


Antenna in vertical polarization – No inter-modulation product founds

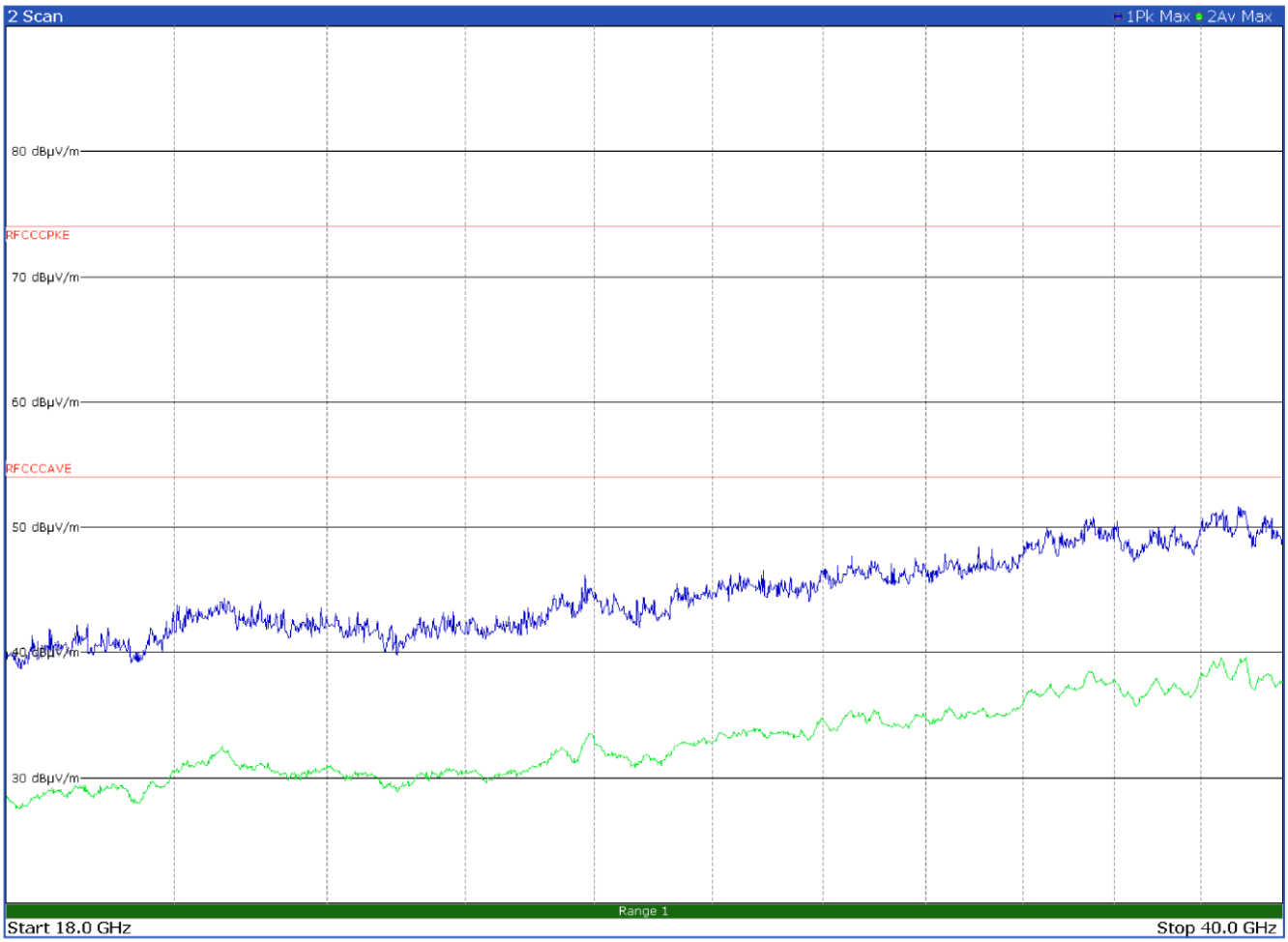
Limit exceeded by carrier



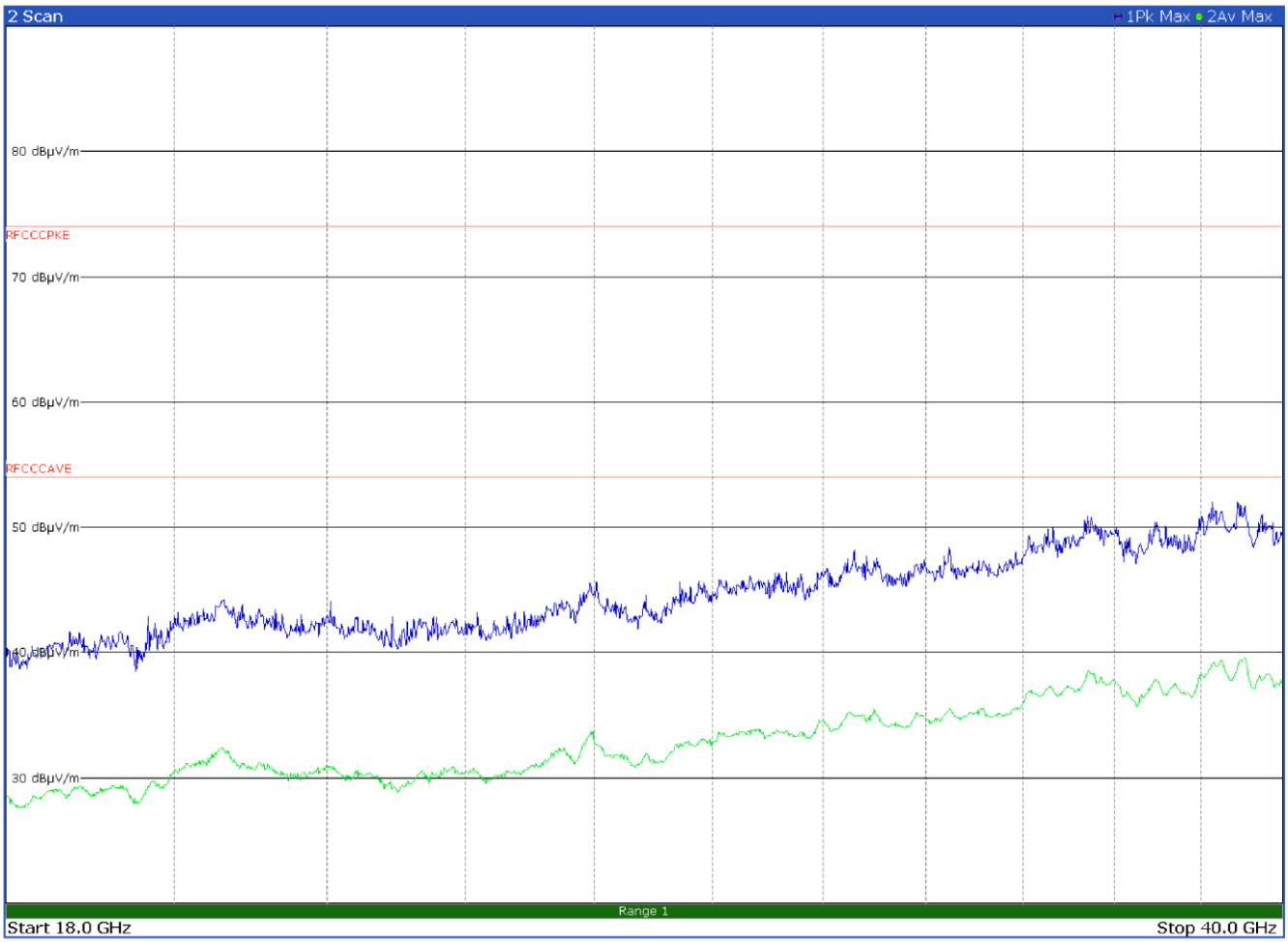
Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds



Antenna in horizontal polarization – No inter-modulation product founds



Antenna in vertical polarization – No inter-modulation product founds