Choose Scandinavian trust

Wireless test report – 444569TRFWL

Type of assessment:

Transmitters co-location

Applicant:

Tokinomo Marketing SA
121D Gheorghe Titeica, 6th floor, 2nd district
PO 020295 – Romania

Product:

LTE/GNSS MODULE

Model:

Tokinomo V4

Model variant:

--

FCC ID:

2ASEI-TOKIV4

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.209
  Radiated emission limits; general requirements.

Date of issue: August 31, 2021

P. Barbieri	
Tested by	Signature
D. Guarnone	
Reviewed by	Signature

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Doc. n. TRF001; Rev. 0; Date: 2020-11-30

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	682159 (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.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Tokinomo Marketing SA
Address	121D Gheorghe Titeica, 6th floor, 2nd district PO 020295 – Romania

1.2 Test specifications

FCC 47 CFR Part 15 Subpart C, §15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 Subpart C, §15.203	Antenna requirement

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.26 V2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

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
444569TRFWL	August 31, 2021	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.203	Antenna requirement	Pass
§15.209	Radiated emission limits; general requirements.	Pass
--	ERP / EIRP measurement	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	July 8, 2021
Nemko sample ID number	444569

3.2 EUT information

Product name	LTE/GNSS MODULE
Model	Tokinomo V4
Serial number	4445690001 (Number assigned by Nemko)

3.3 Technical information

Frequency band	BT/WI-FI:2400–2483.5 MHz band and LTE B2, B4, B5, B12, B13, B41 and B66
EUT power requirements	100 – 240 V ac 50 / 60 Hz with AC/DC adapter
Antenna information	EUT is designed so that the end user may replace a broken antenna. (The EUT has a non-standard antenna jack or electrical connector.)

3.4 EUT setup diagram

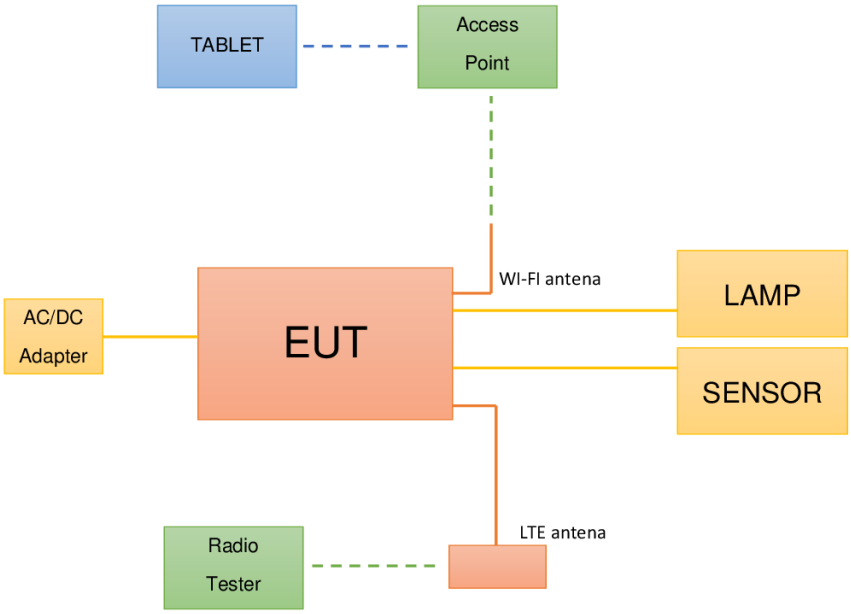


Figure 3.4-1: *Setup diagram*

3.5 Product description and theory of operation

The EUT is a robotic device for in-store advertising solution provided with two already certified radio modules.

3.6 EUT exercise details

The EUT has been tested forced in TX mode by a radio communication tester R&S CMW290 and an accesso point Linksys WRT54G.

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

WI-FI and LTE TX frequency is chosen to be the representative worst-case.

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

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

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	2020-12	2022-12
Thermo-hygrometer data loggers	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:

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)

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	2020-08	2021-08
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	2020-09	2021-09
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	2021-07	2024-07
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	2021-06	2024-06
Horn Antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	2020-04	2023-04
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718C	00121	2021-01	2022-01
Preamplifier (18 ÷ 40 GHz)	Sage	STB-1834034030-KFKF-L1	18490-01	2021-04	2022-04
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

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

Section 8. Testing data

8.1 FCC 15.209 Radiated emission limits; general requirements

8.1.1 Definitions and limits

(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.

Table 8.1-1: *FCC §15.209 – 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: *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

Test start date	August 26, 2021
Test engineer	P. Barbieri

8.1.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 27 GHz.
EUT's LTE and WIFI transmitters were set to transmit continuously, 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.

Spectrum analyzer settings for frequencies below 30 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	100 ms

Spectrum analyser settings for radiated measurements within restricted bands 30 MHz to 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

8.1.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	2020-08	2021-08
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	2020-09	2021-09
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	2021-07	2024-07
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	2021-06	2024-06
Horn Antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	2020-04	2023-04
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718C	00121	2021-01	2022-01
Preamplifier (18 ÷ 40 GHz)	Sage	STB-1834034030-KFKF-L1	18490-01	2021-04	2022-04
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

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

8.1.5 Test data

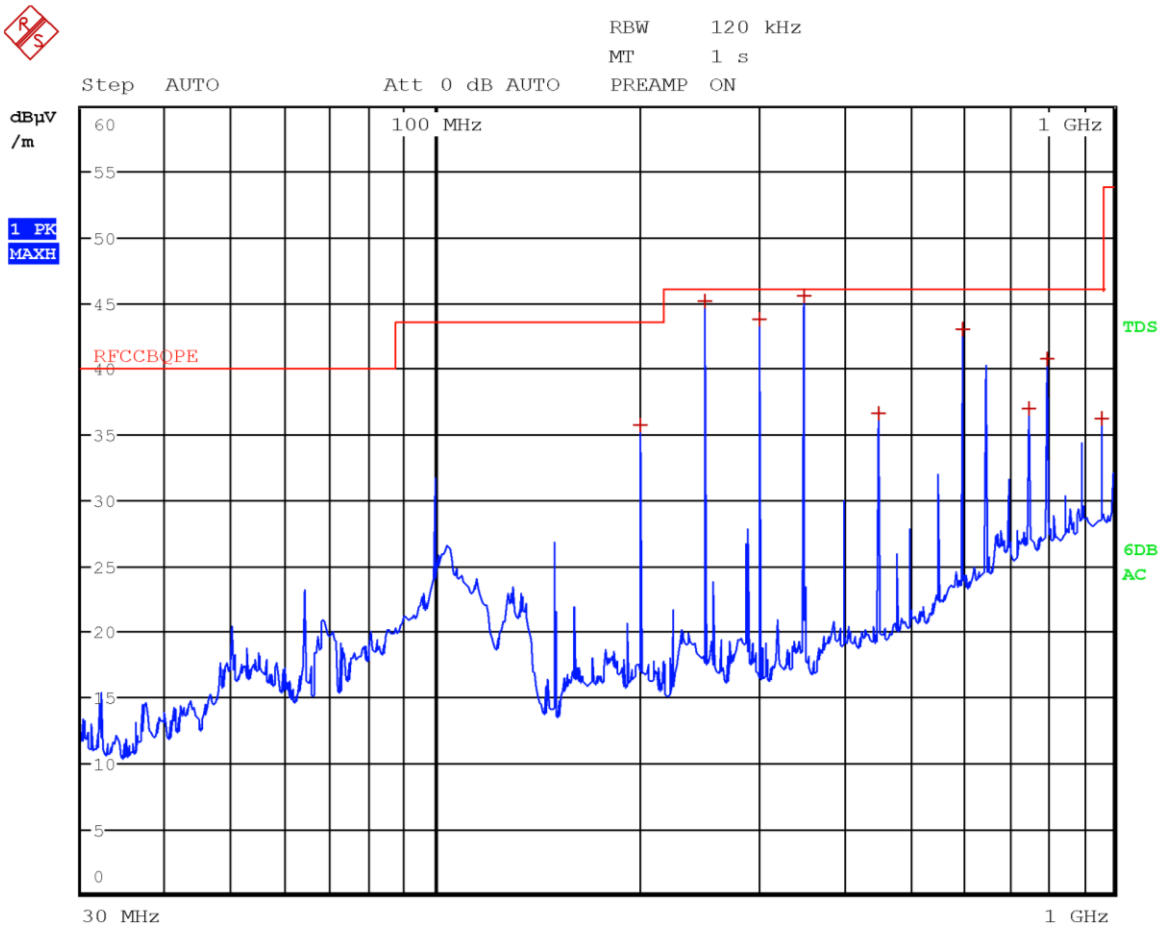


Figure 8.1-1: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
200.0100	35.8	43.5	-7.7	QP
249.9900	45.2	46.0	-0.8	QP
300.0000	43.9	46.0	-2.1	QP
350.0100	45.6	46.0	-0.4	QP
450.0000	36.7	46.0	-9.3	QP
600.0000	43.1	46.0	-2.9	QP
750.0000	37.0	46.0	-9.0	QP
799.9800	40.8	46.0	-5.2	QP
959.9700	36.2	46.0	-9.8	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

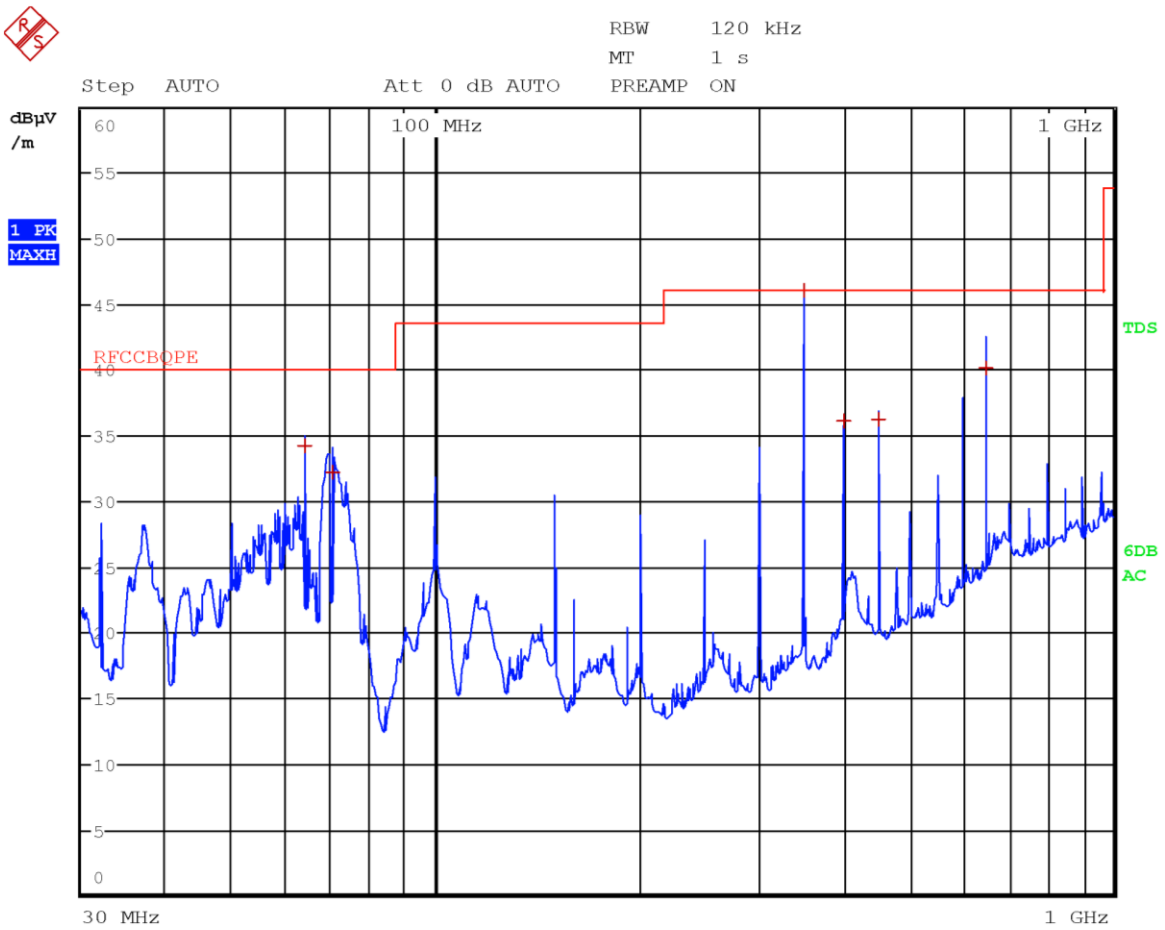


Figure 8.1-2: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
63.9900	34.3	40.0	-5.7	QP
70.3800	32.3	40.0	-7.7	QP
349.9800	45.9	46.0	-0.1	QP
399.9900	36.1	46.0	-9.9	QP
450.0000	36.3	46.0	-9.7	QP
649.9800	40.2	46.0	-5.8	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

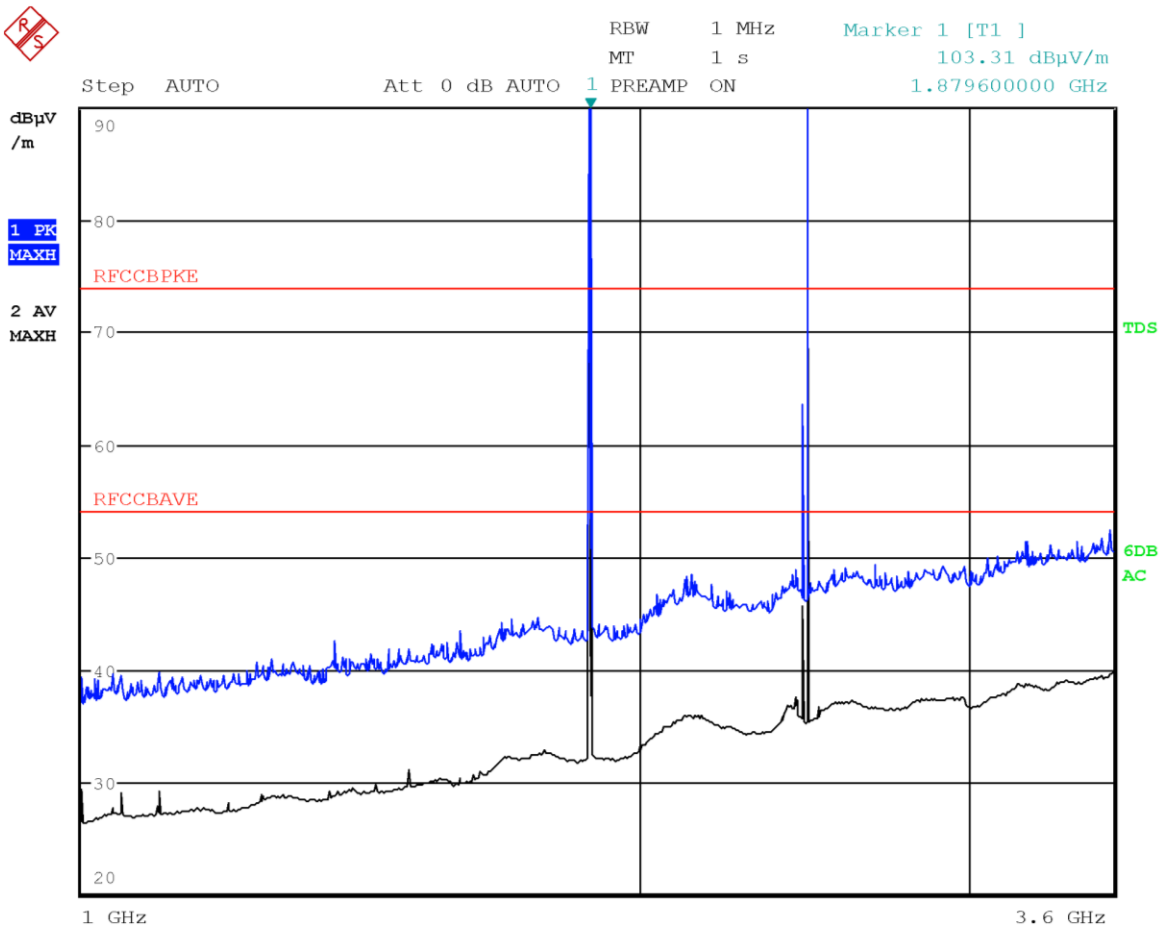


Figure 8.1-3: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

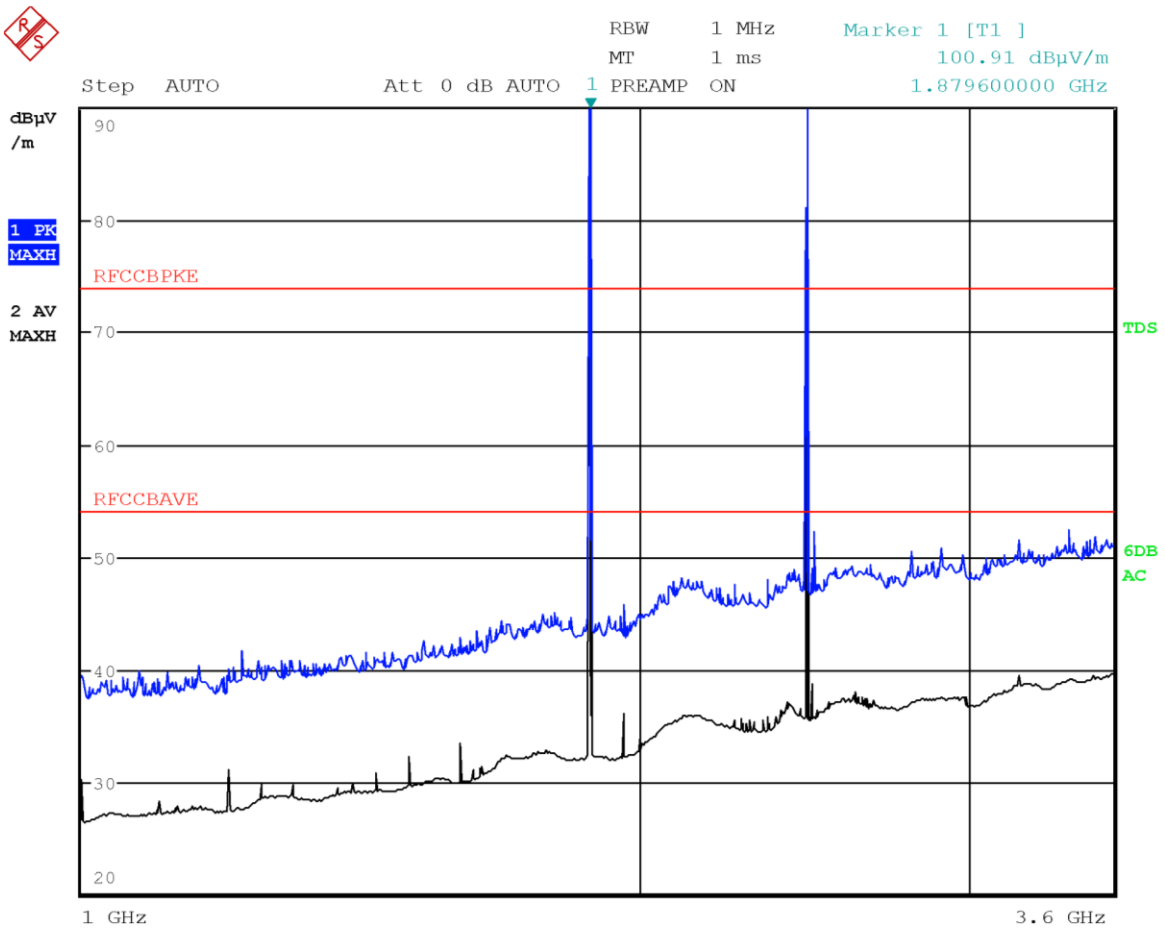


Figure 8.1-4: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

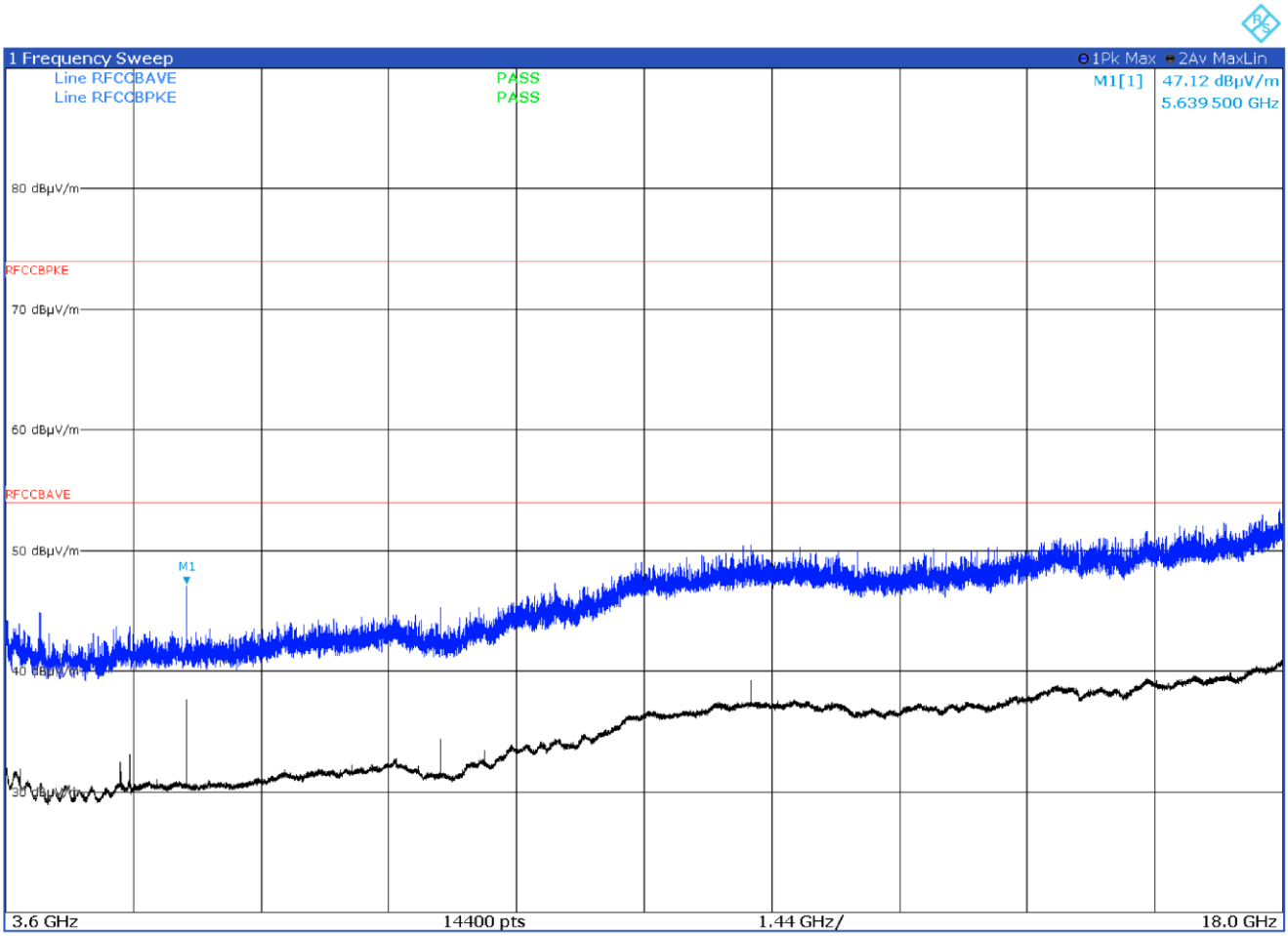


Figure 8.1-5: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

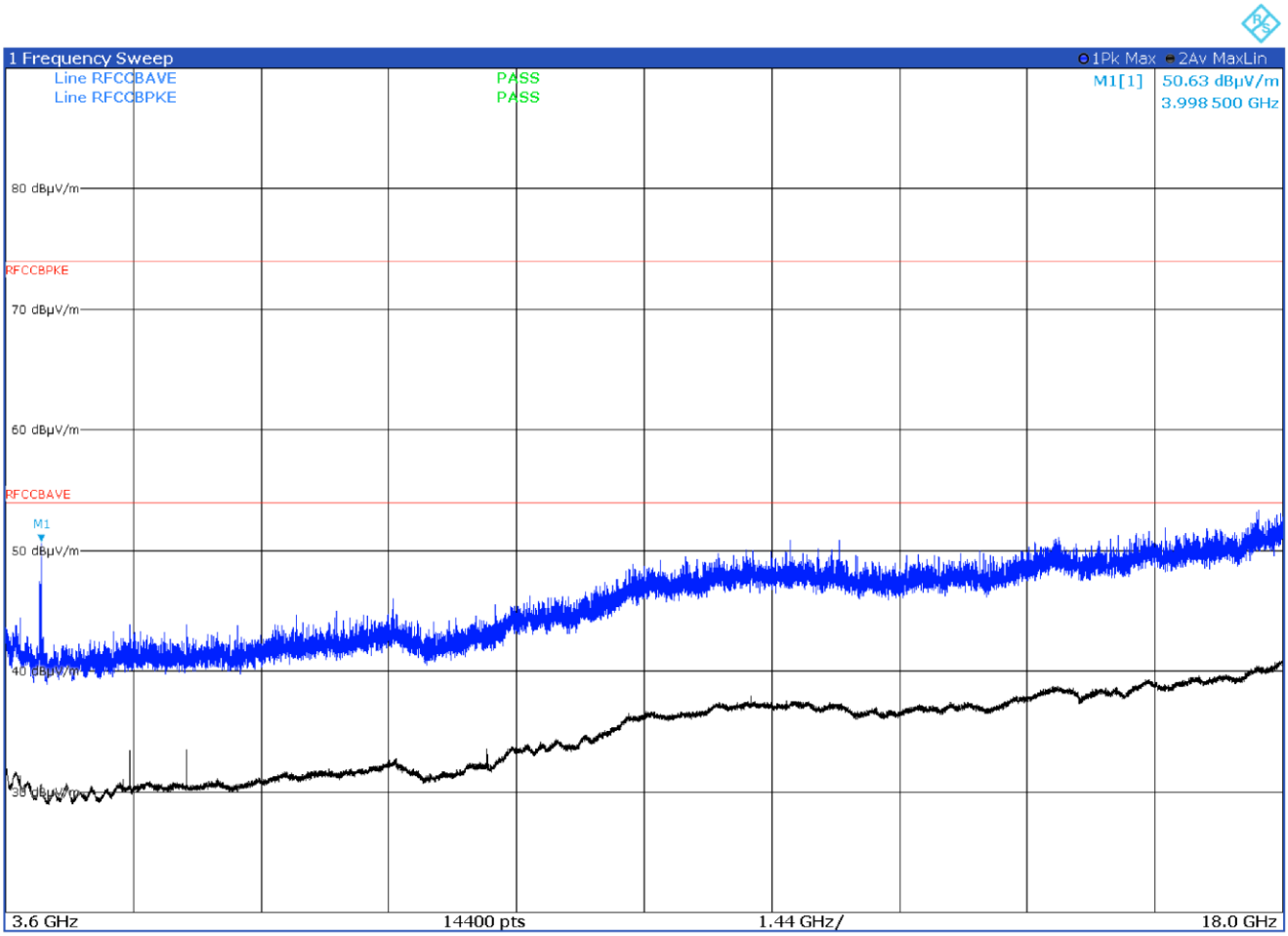


Figure 8.1-6: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

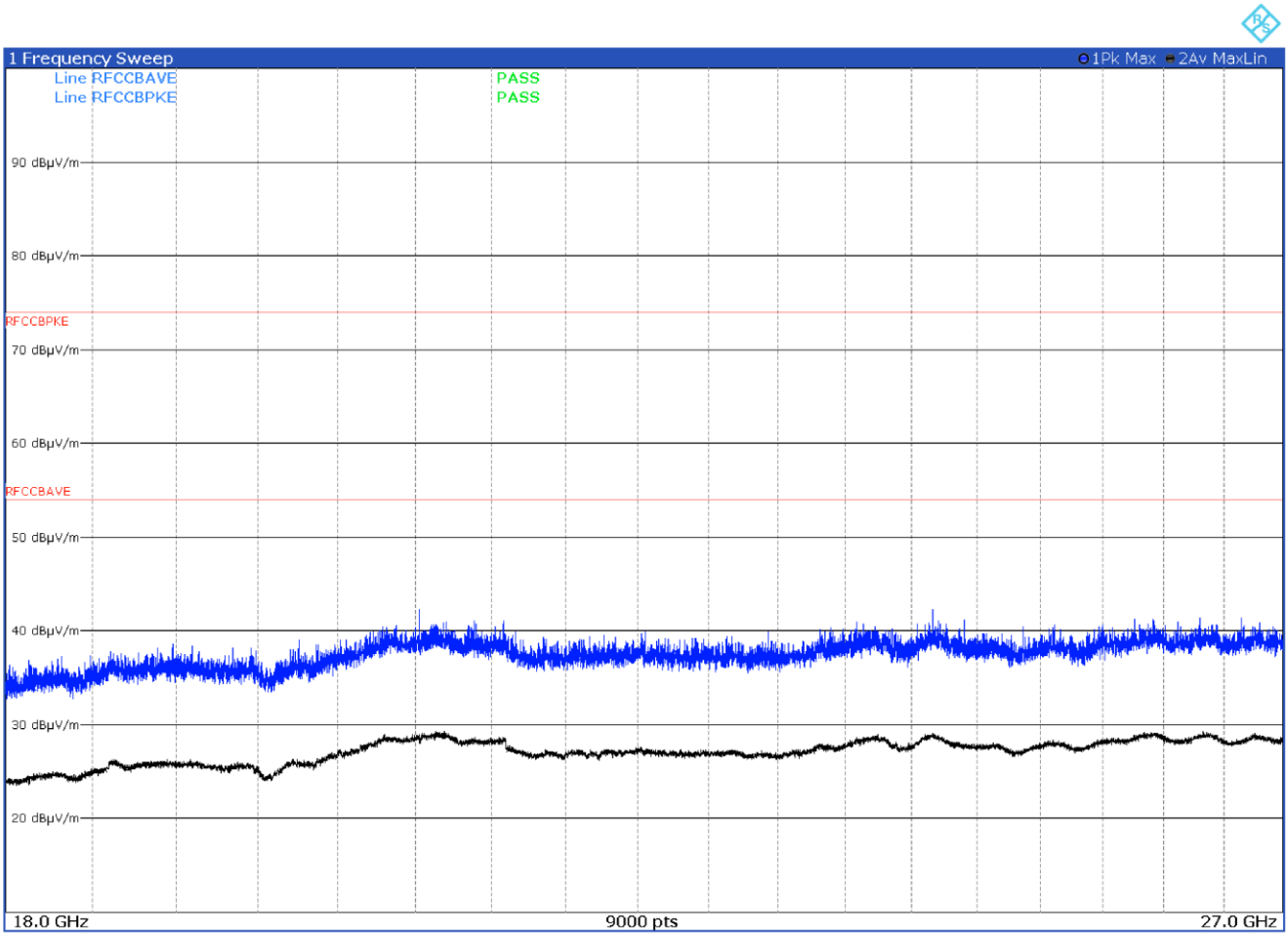


Figure 8.1-7: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

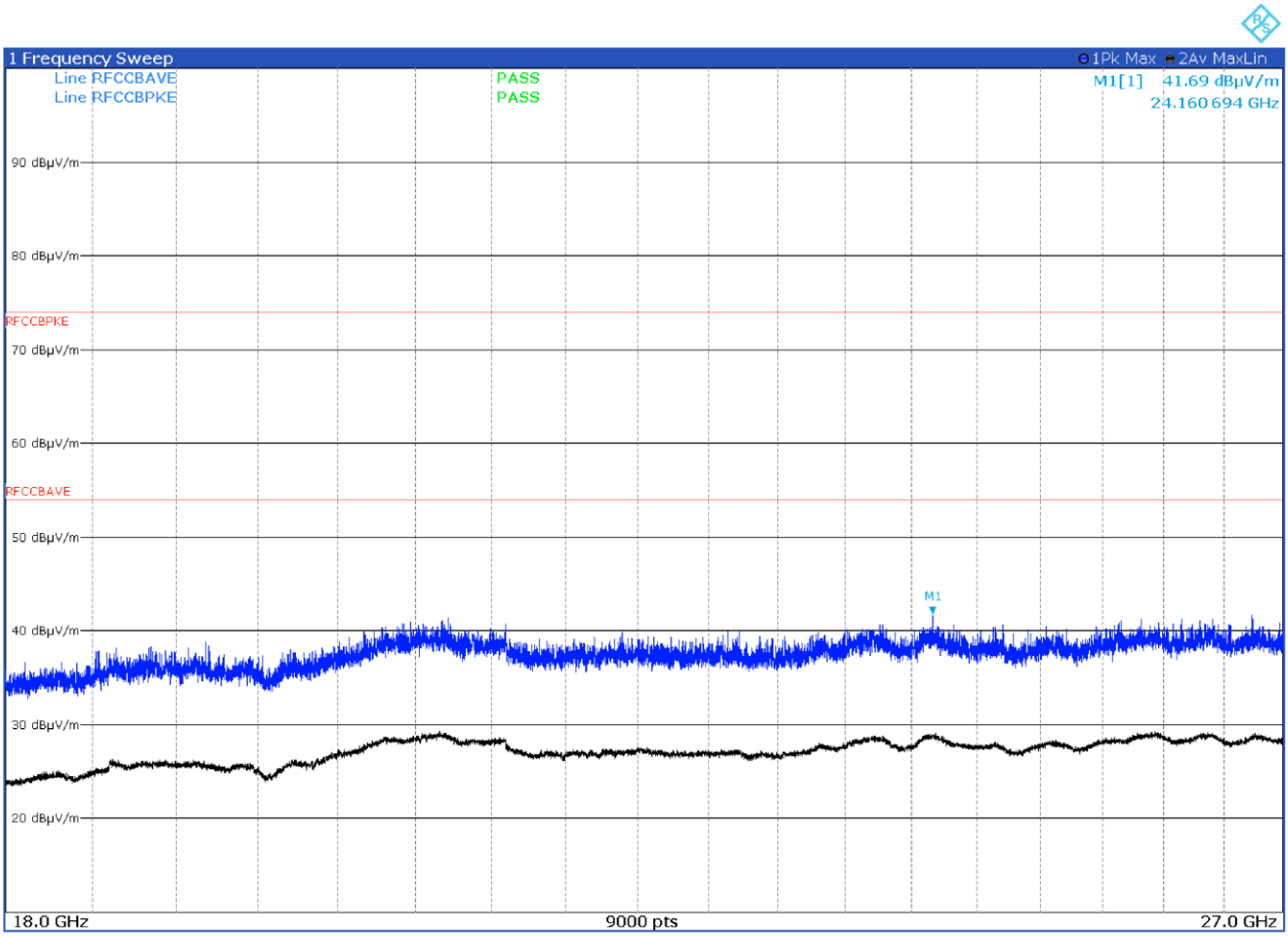


Figure 8.1-8: *Radiated spurious emissions with LTE B2 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

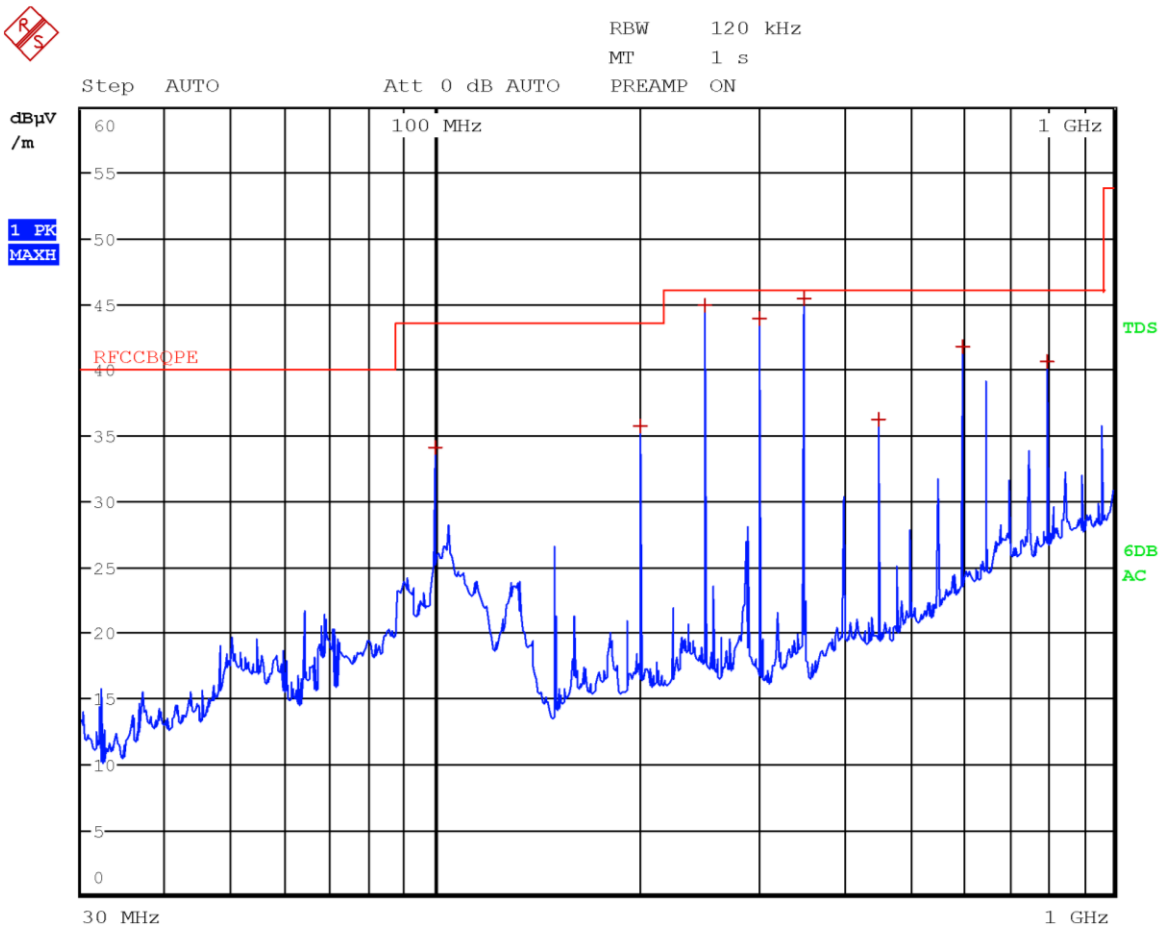


Figure 8.1-9: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
99.9900	34.1	43.5	-9.4	QP
200.0100	35.8	43.5	-7.7	QP
249.9900	45.0	46.0	-1.0	QP
300.0000	43.9	46.0	-2.1	QP
350.0100	45.4	46.0	-0.6	QP
450.0000	36.3	46.0	-9.7	QP
600.0000	41.9	46.0	-4.1	QP
799.9800	40.7	46.0	-5.3	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

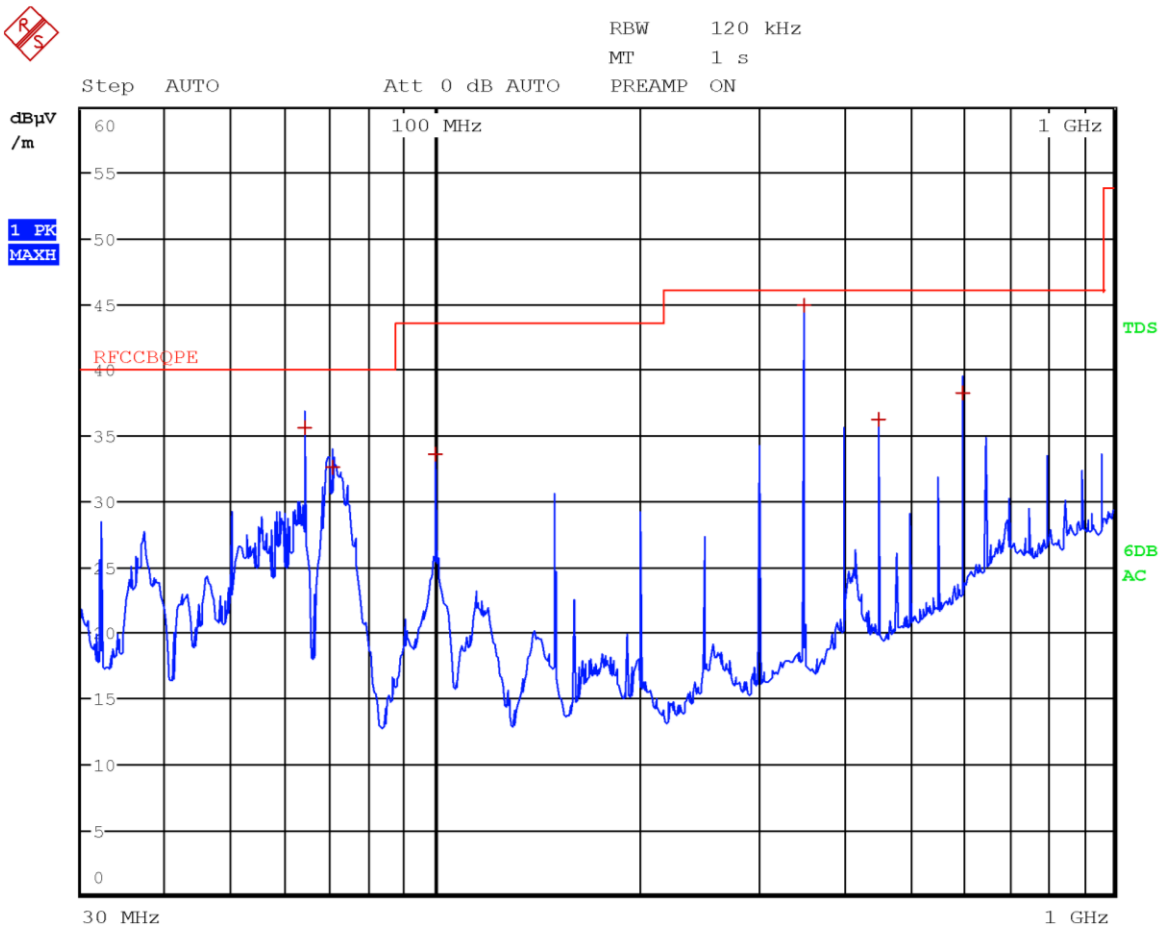


Figure 8.1-10: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
64.0200	35.6	40.0	-4.4	QP
70.2900	32.7	40.0	-7.3	QP
99.9900	33.7	43.5	-9.8	QP
350.0100	45.0	46.0	-1.0	QP
450.0000	36.3	46.0	-9.7	QP
600.0000	38.3	46.0	-7.7	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

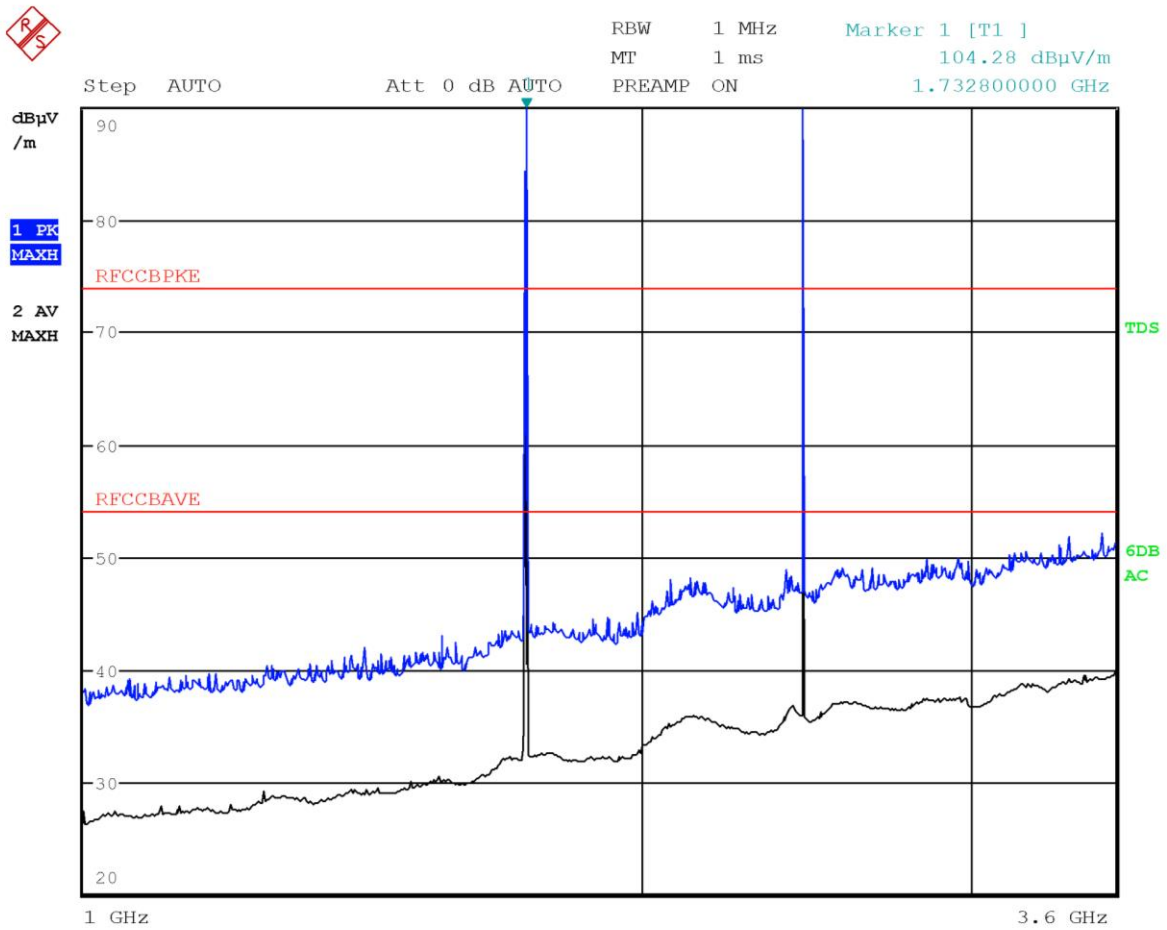


Figure 8.1-11: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

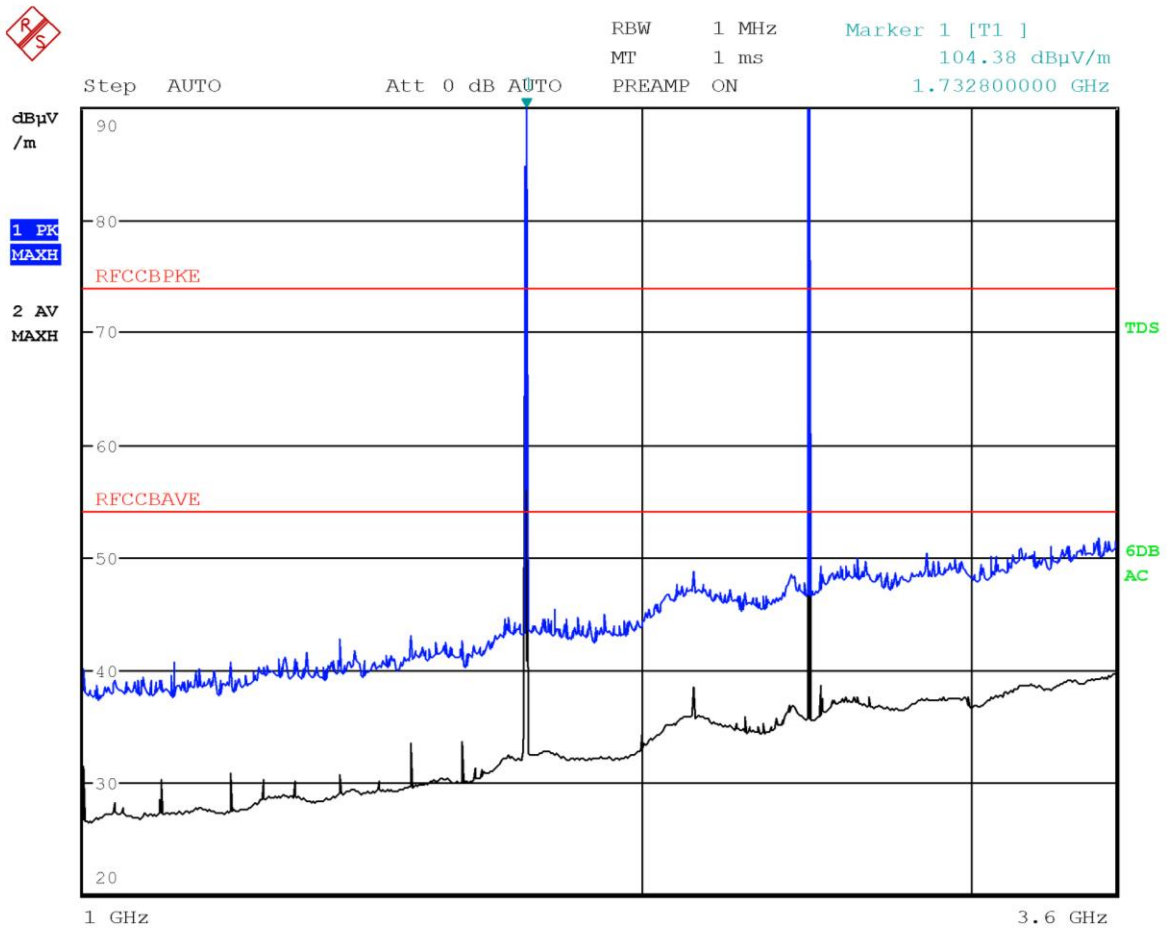


Figure 8.1-12: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

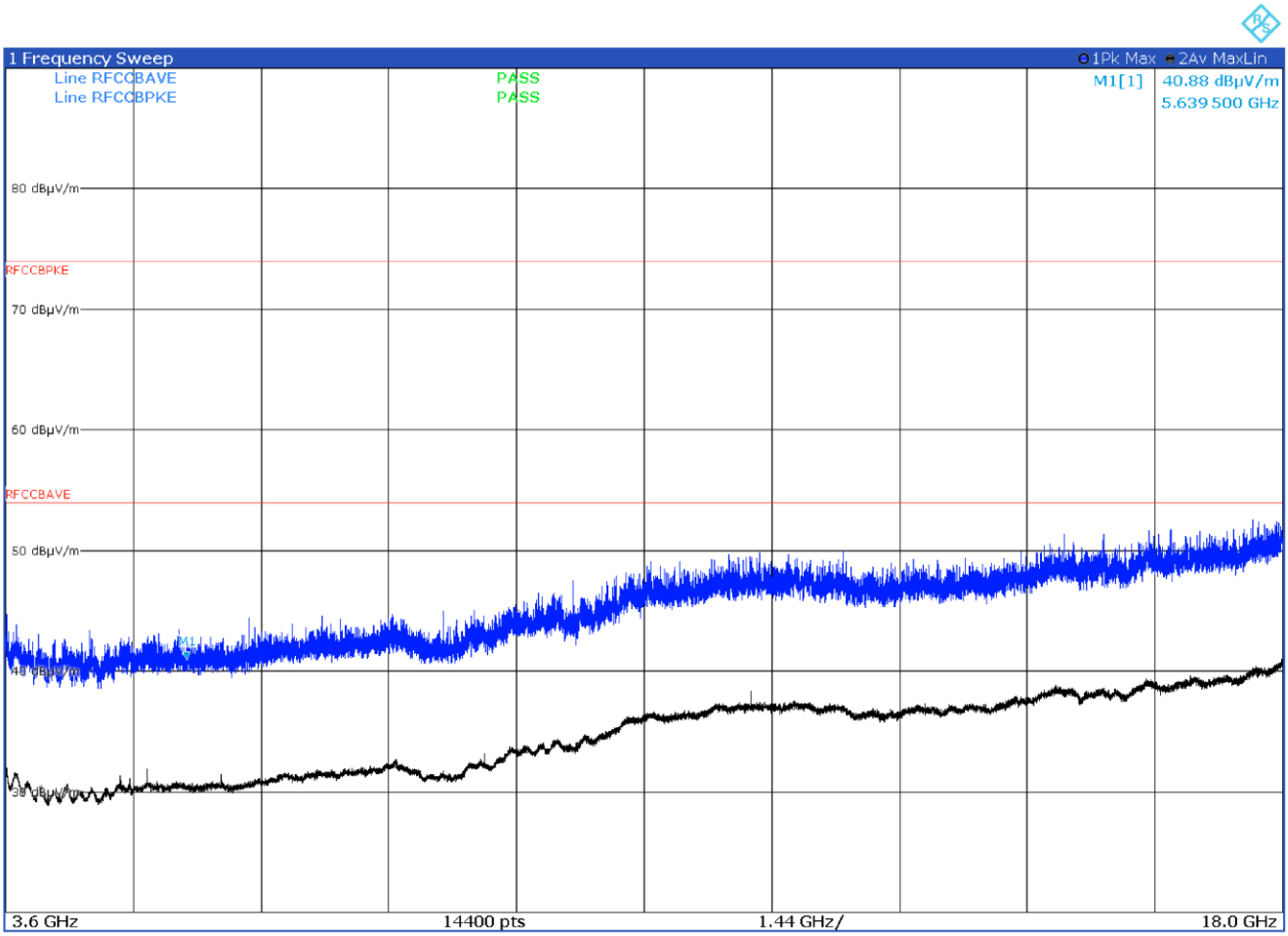


Figure 8.1-13: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

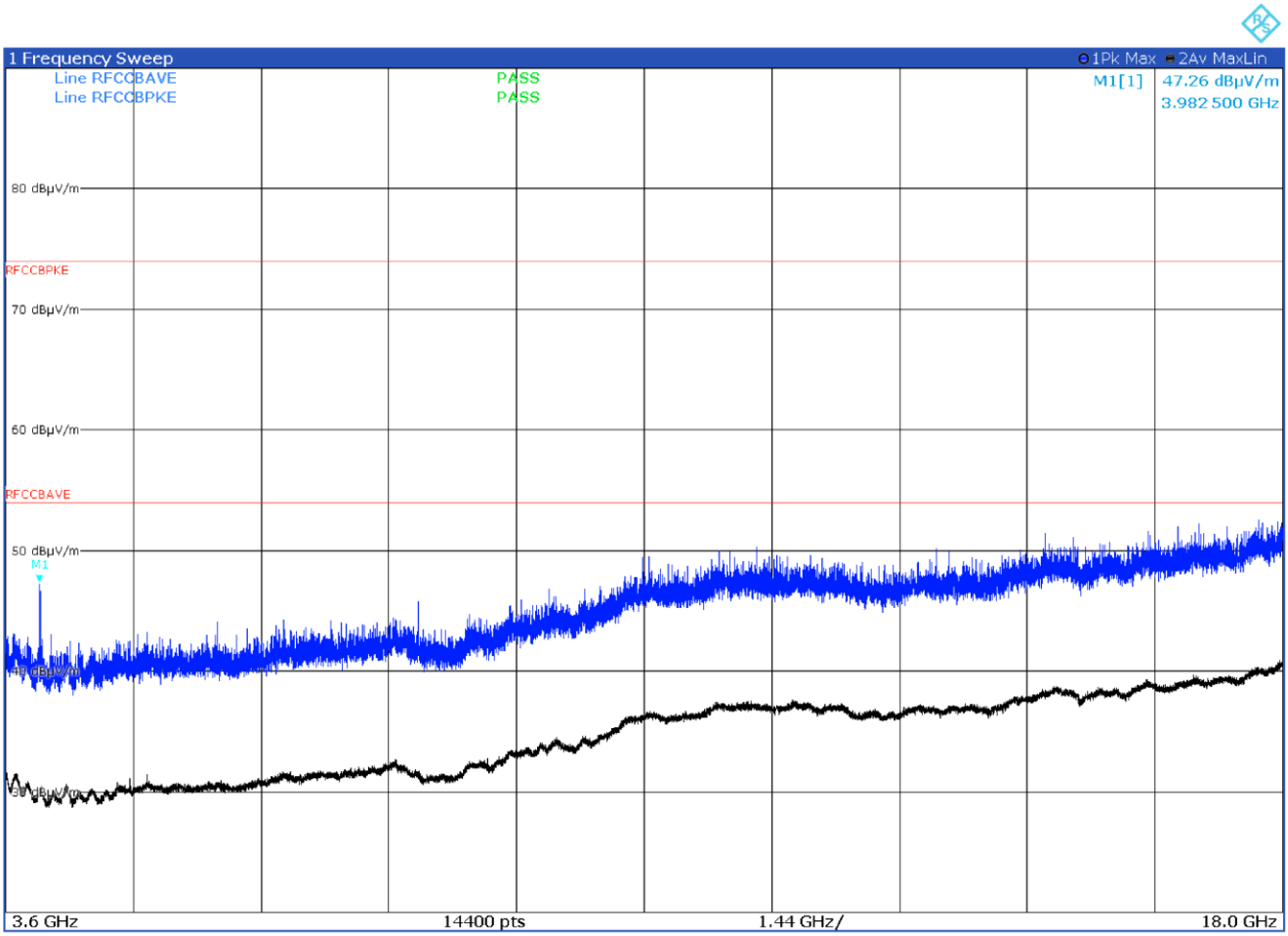


Figure 8.1-14: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

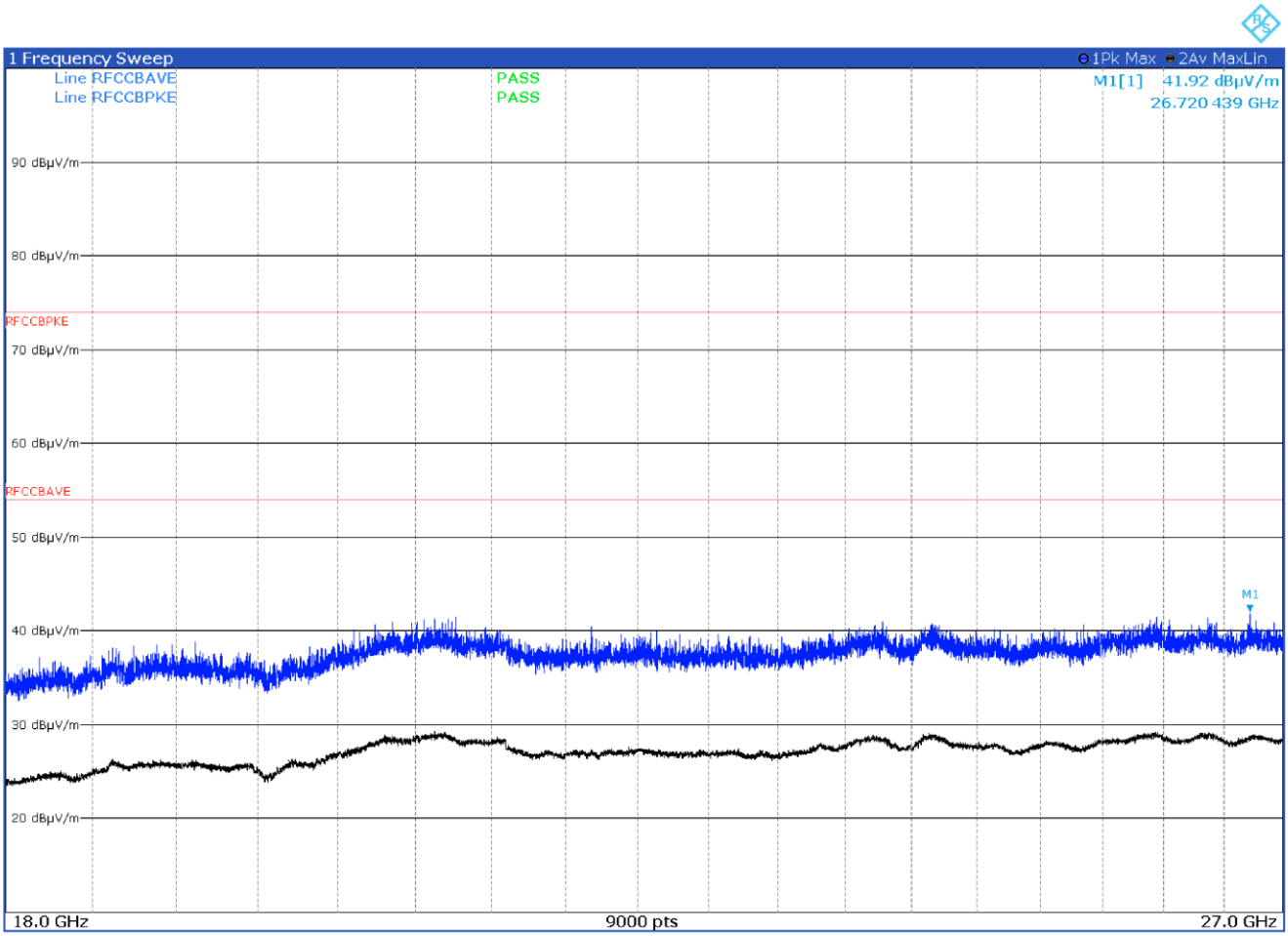


Figure 8.1-15: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

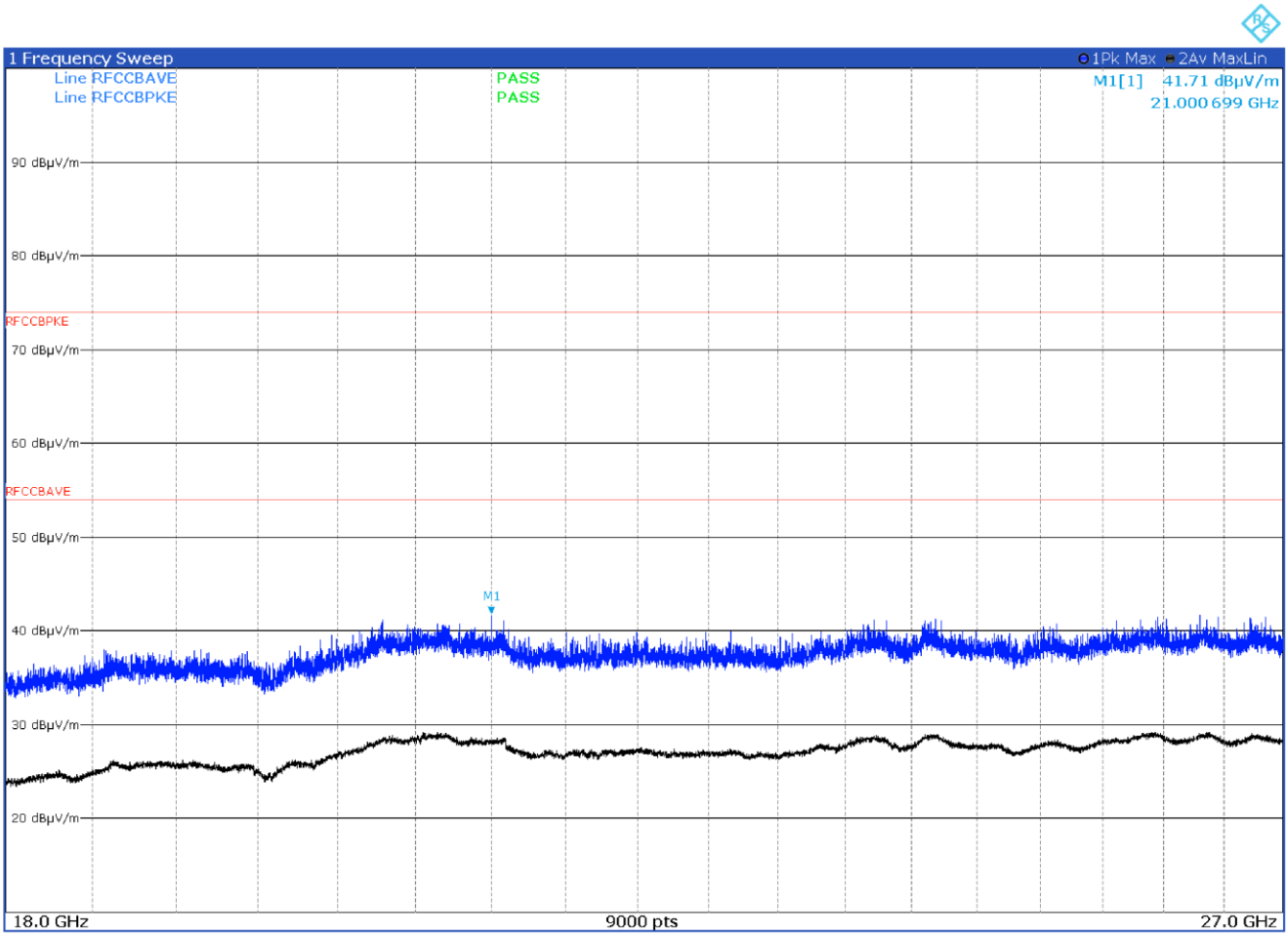


Figure 8.1-16: *Radiated spurious emissions with LTE B4 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

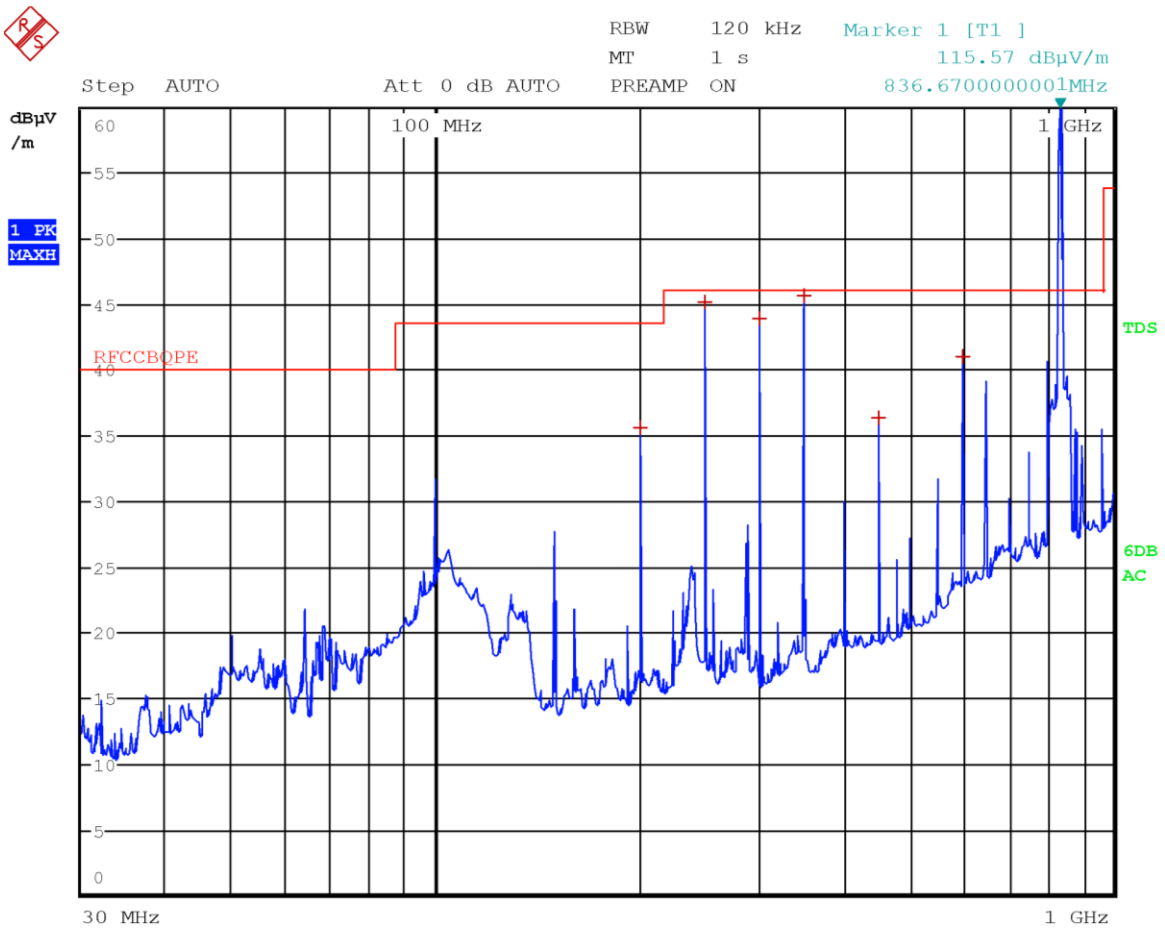


Figure 8.1-17: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
200.0100	35.6	43.5	-7.9	QP
249.9900	45.2	46.0	-0.8	QP
300.0000	44.0	46.0	-2.0	QP
350.0100	45.7	46.0	-0.3	QP
450.0000	36.4	46.0	-9.6	QP
600.0000	41.0	46.0	-5.0	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

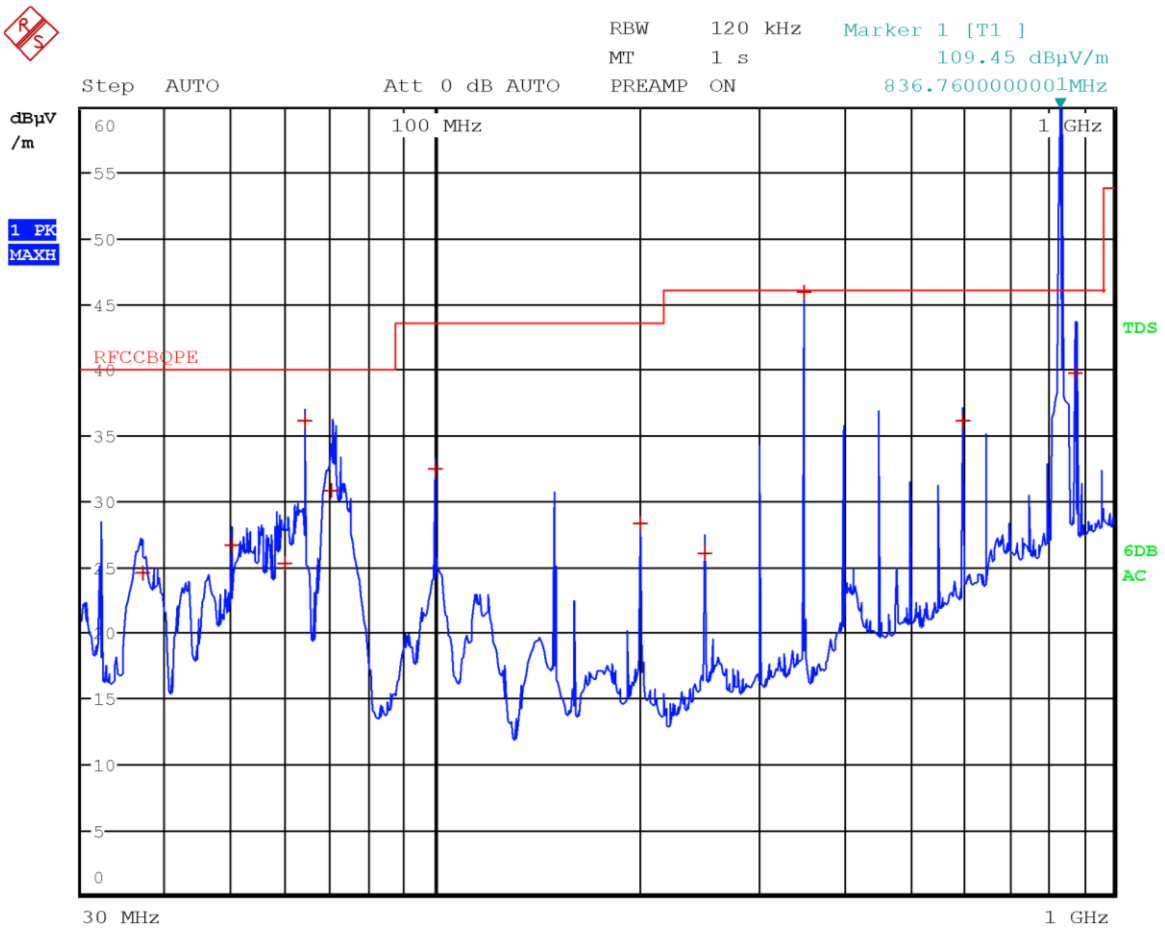


Figure 8.1-18: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
36.9300	24.6	40.0	-15.4	QP
49.9800	26.7	40.0	-13.3	QP
59.8200	25.4	40.0	-14.6	QP
63.9900	36.1	40.0	-3.9	QP
70.2300	30.9	40.0	-9.1	QP
99.9900	32.5	43.5	-11.0	QP
200.0100	28.4	43.5	-15.1	QP
249.9900	26.1	46.0	-19.9	QP
349.9800	45.9	46.0	-0.1	QP
600.0000	36.2	46.0	-9.8	QP
881.4000	39.8	46.0	-6.2	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

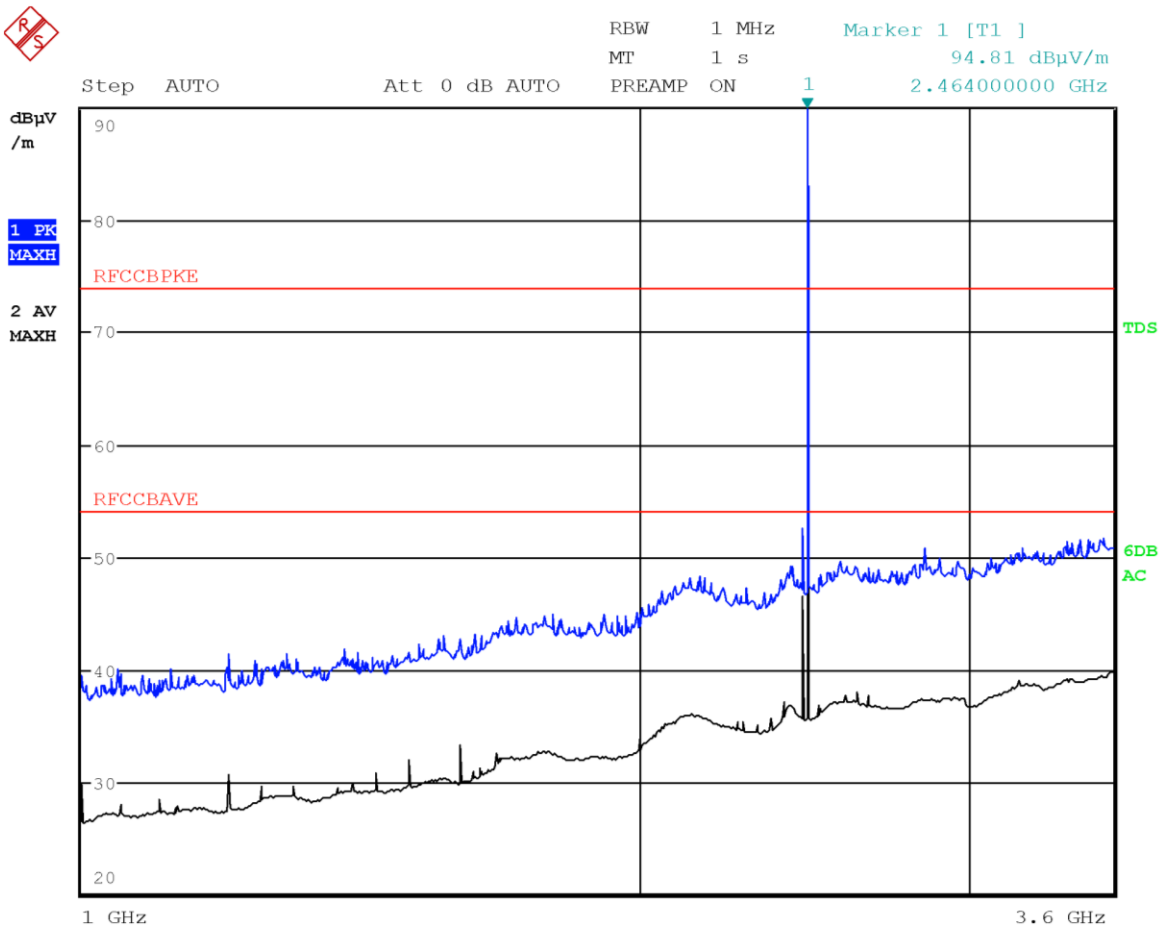


Figure 8.1-19: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

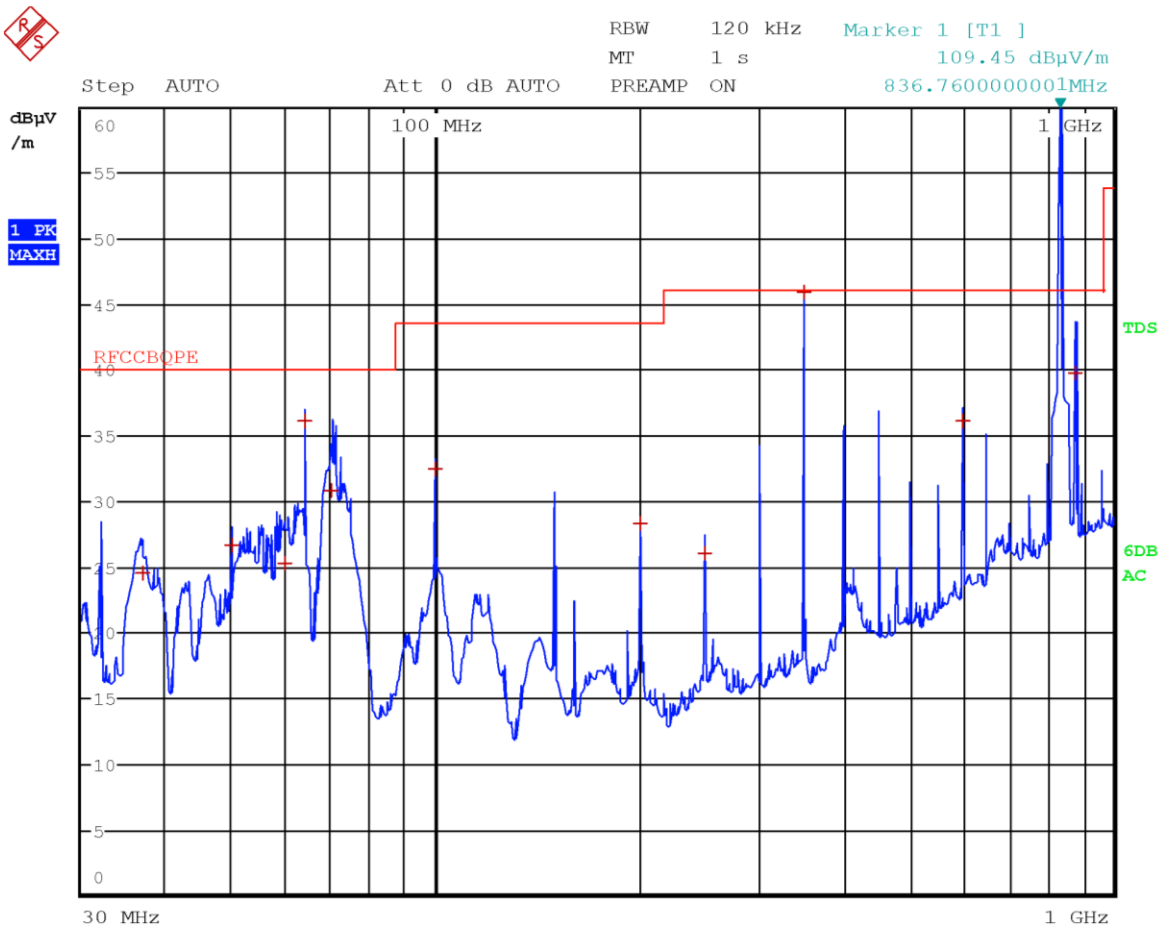


Figure 8.1-20: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

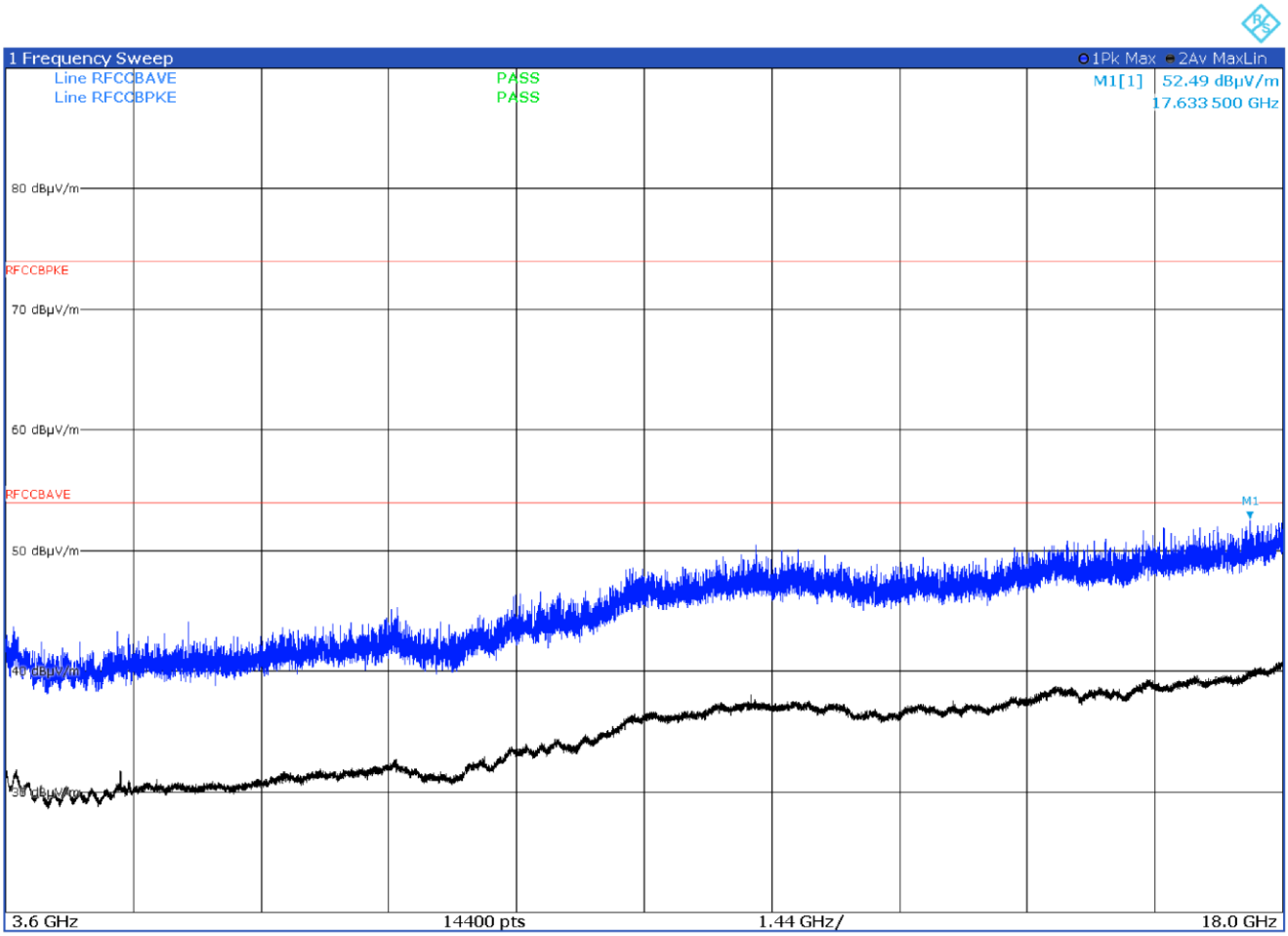


Figure 8.1-21: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

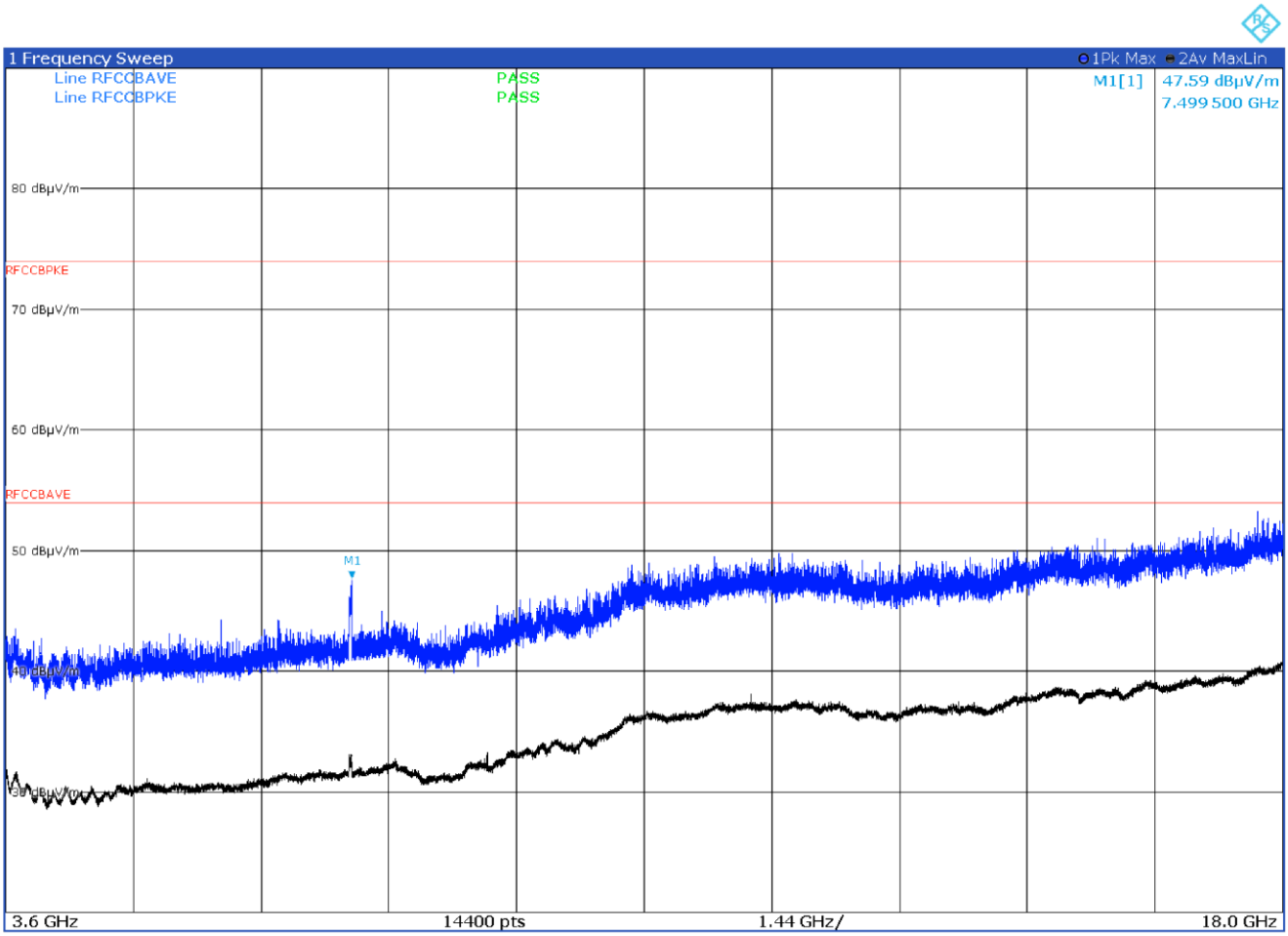


Figure 8.1-22: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

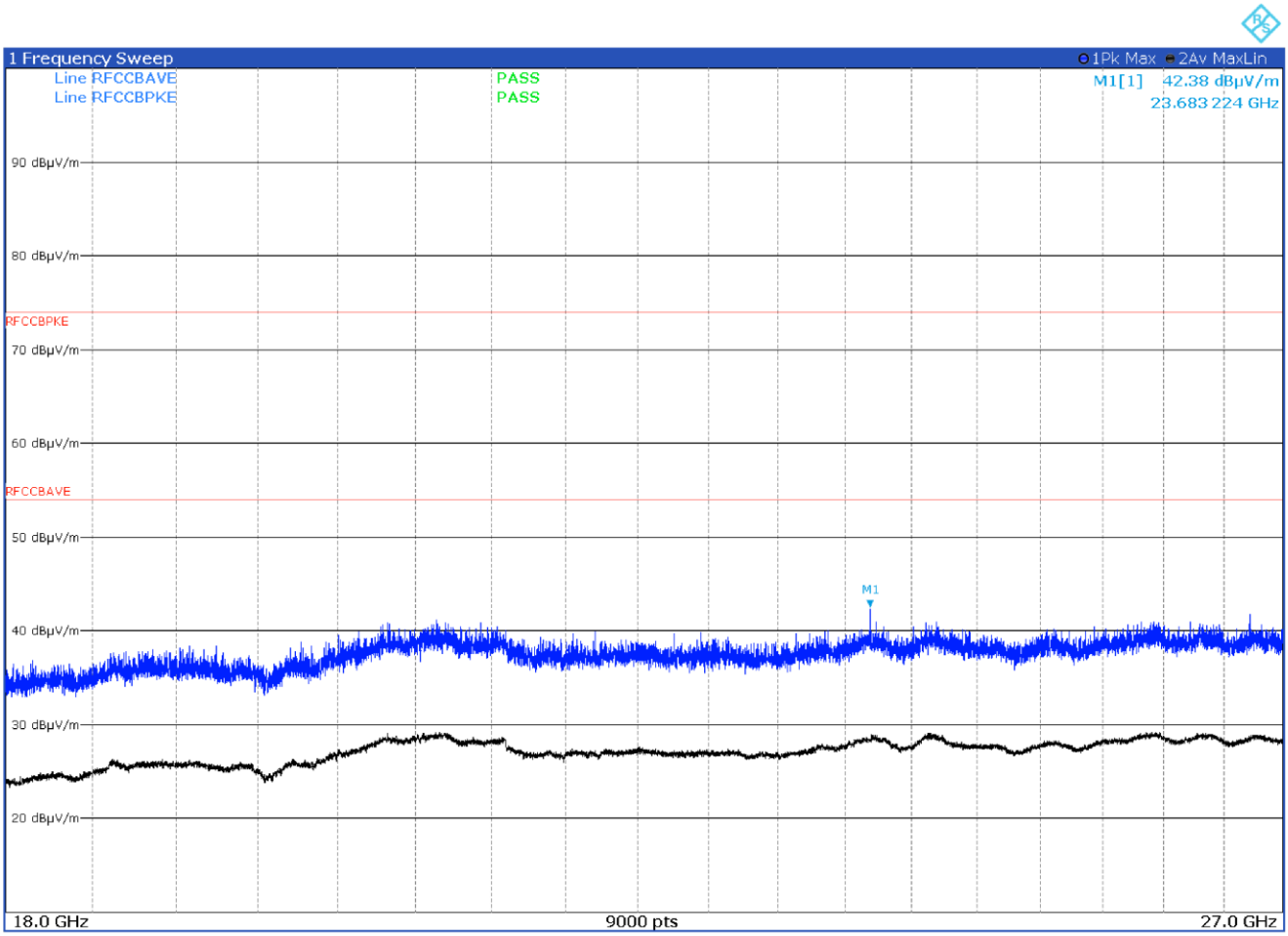


Figure 8.1-23: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

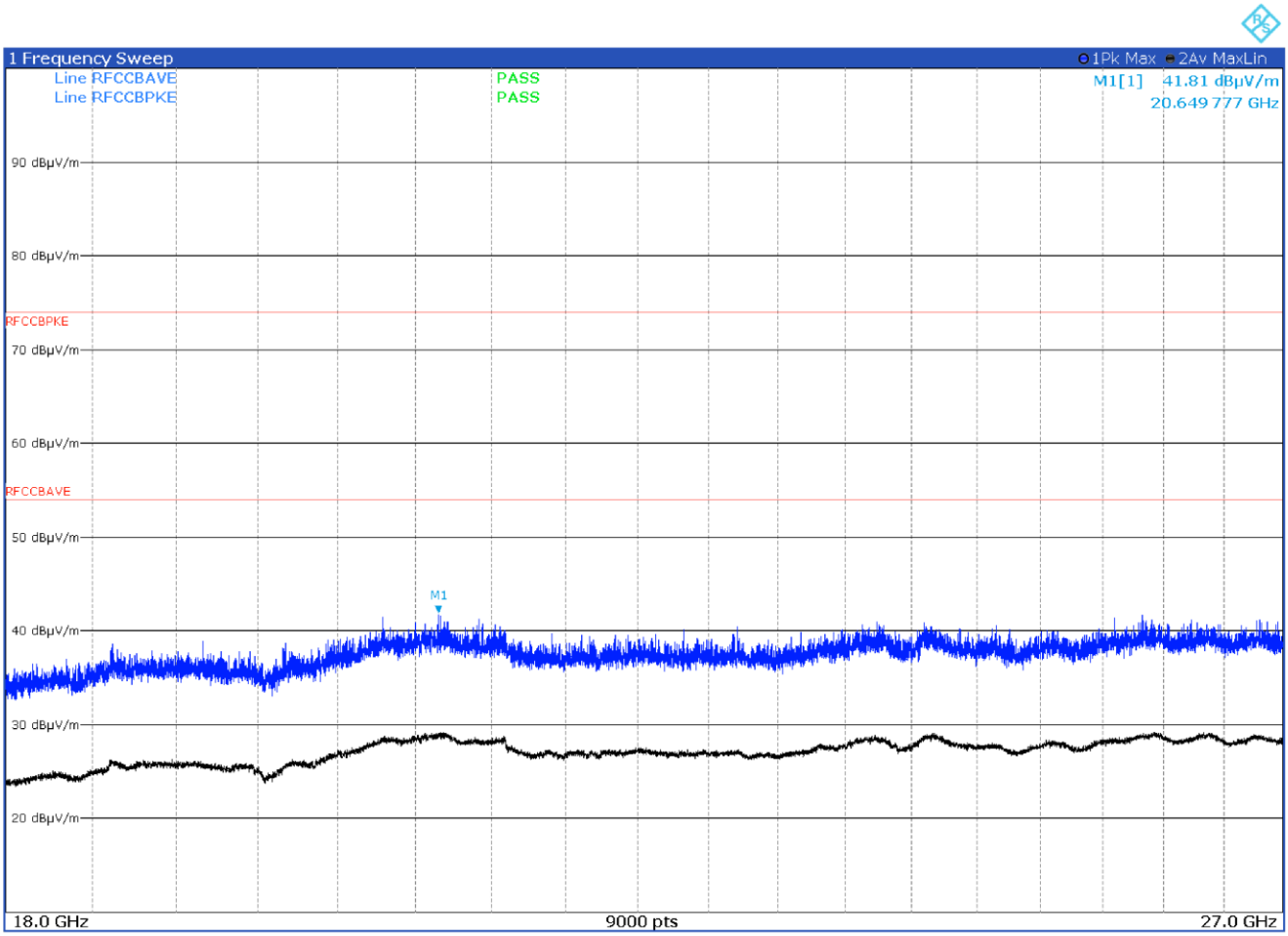


Figure 8.1-24: *Radiated spurious emissions with LTE B5 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

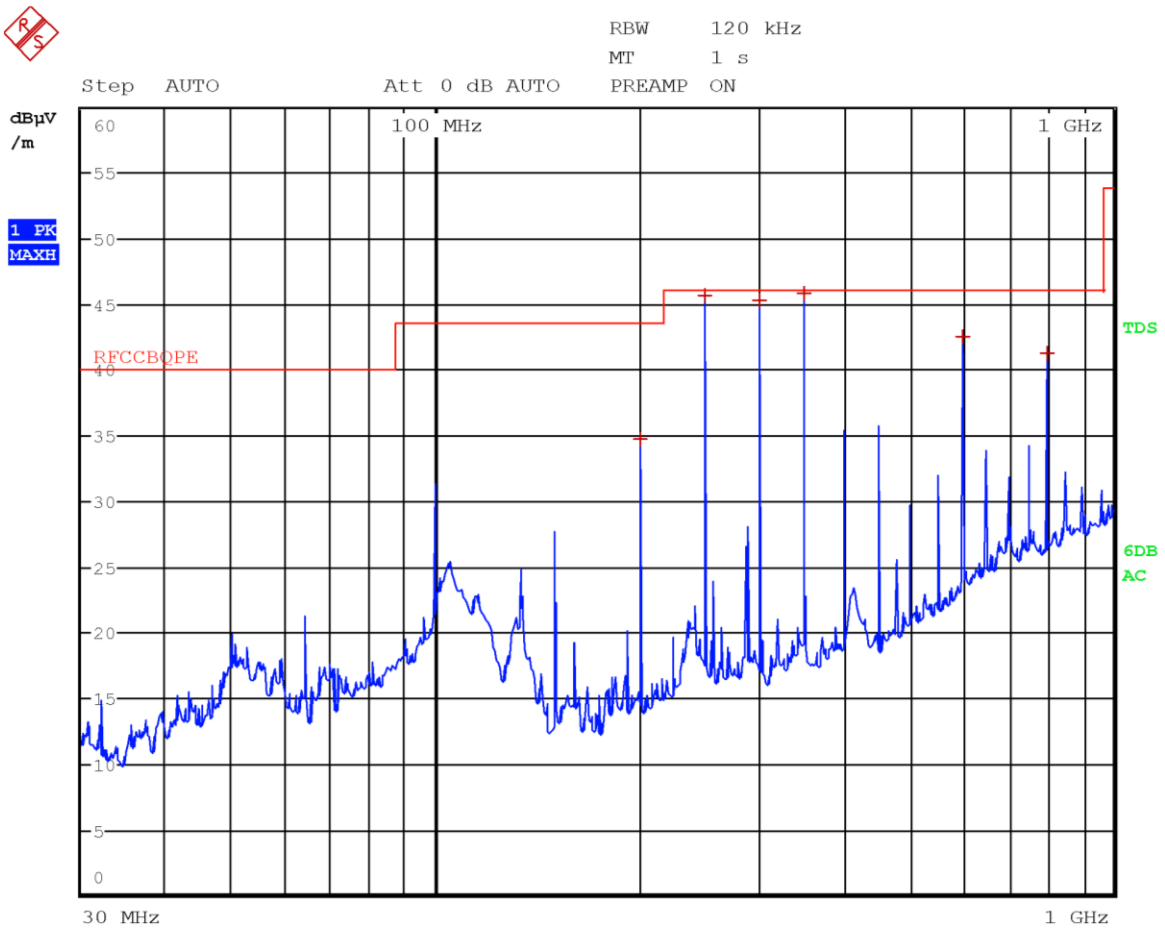


Figure 8.1-25: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
200.0100	34.7	43.5	-8.8	QP
249.9900	45.8	46.0	-0.2	QP
300.0000	45.3	46.0	-0.7	QP
349.9800	45.9	46.0	-0.1	QP
600.0000	42.6	46.0	-3.4	QP
799.9800	41.3	46.0	-4.7	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

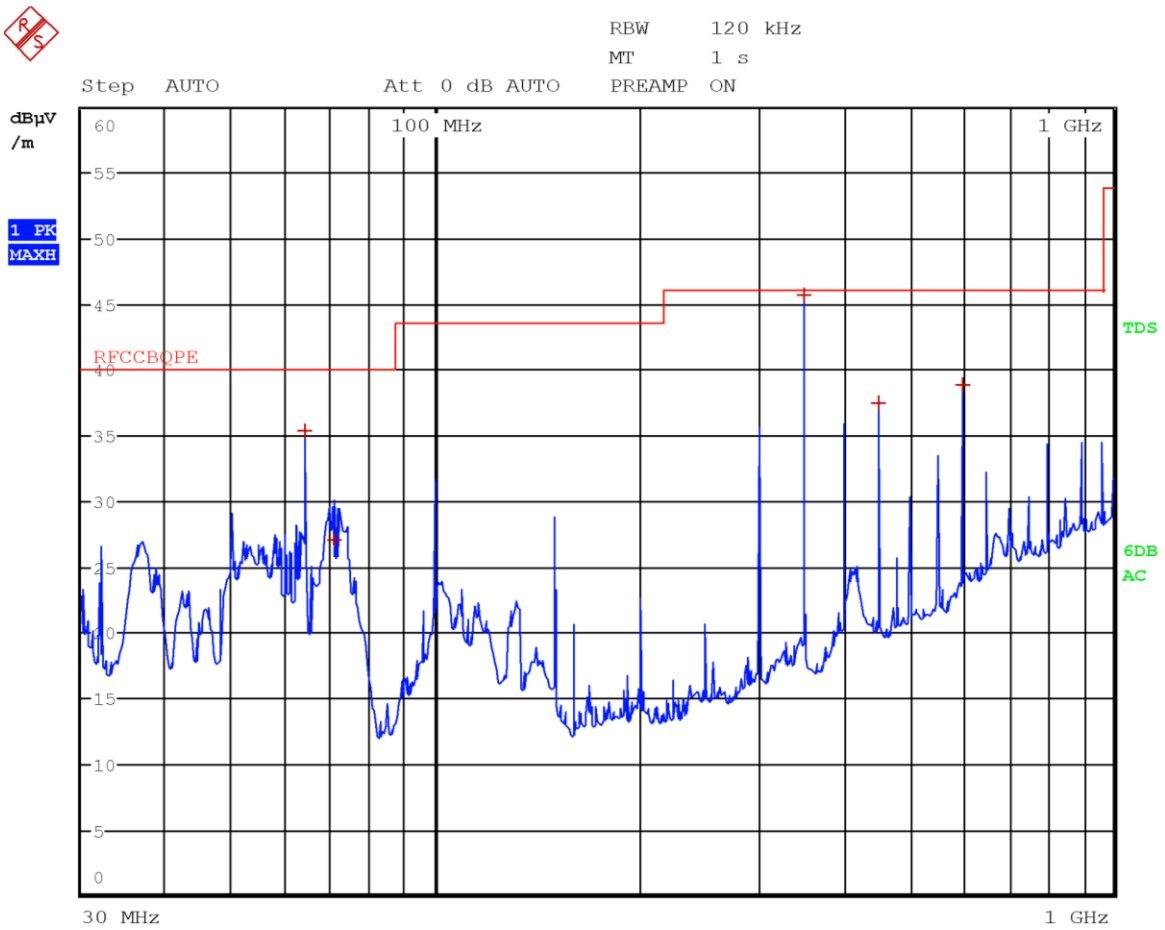


Figure 8.1-26: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
63.9900	35.4	40.0	-4.6	QP
71.0100	27.0	40.0	-13.0	QP
349.9800	45.8	46.0	-0.2	QP
450.0000	37.5	46.0	-8.5	QP
600.0000	38.9	46.0	-7.1	QP
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

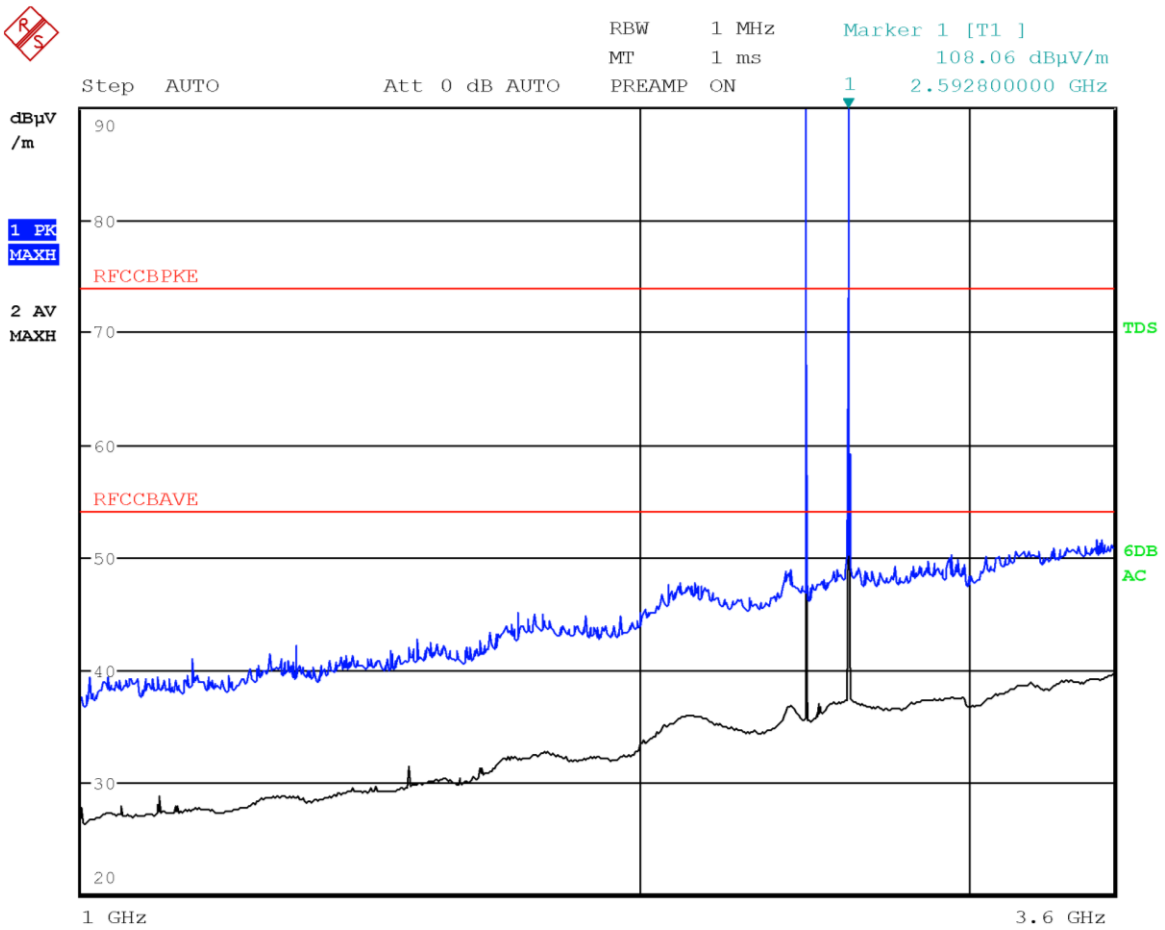


Figure 8.1-27: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

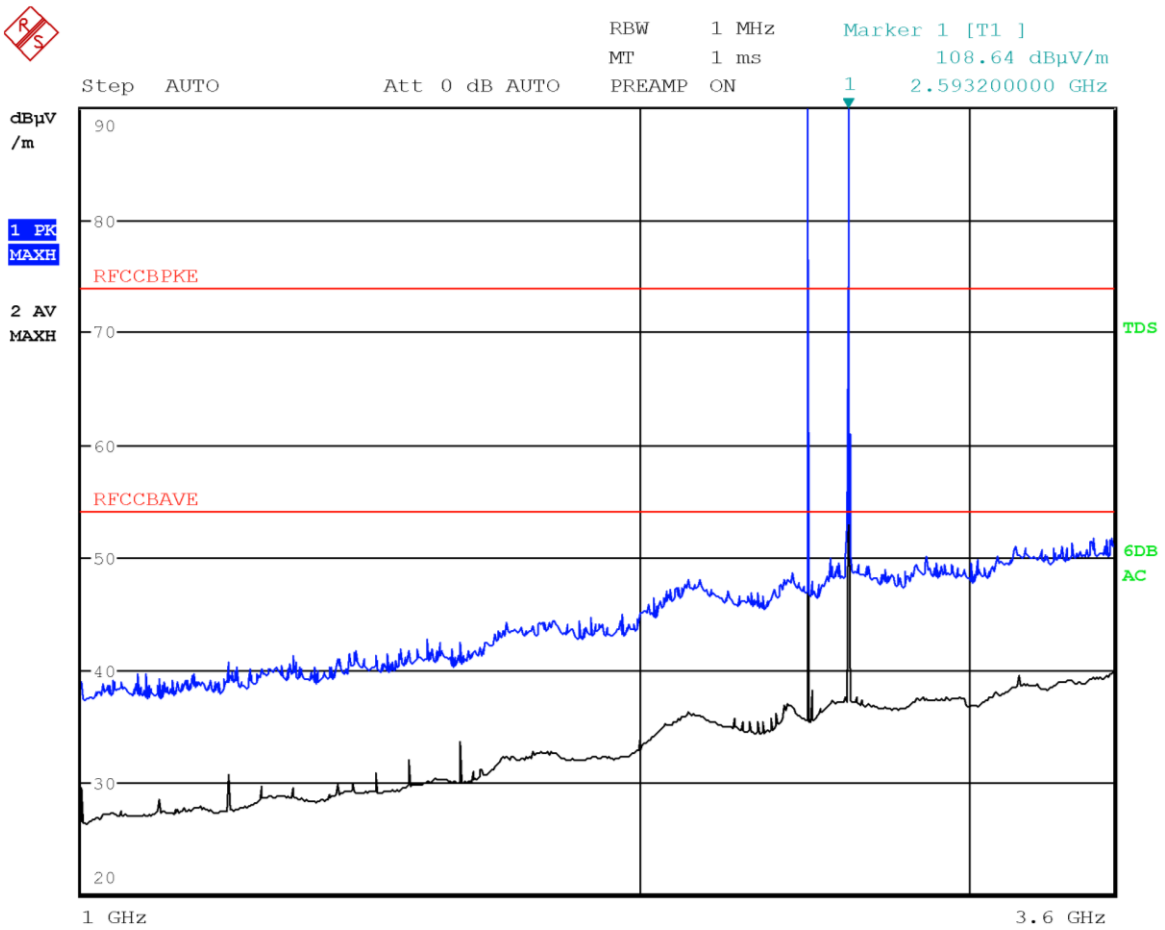


Figure 8.1-28: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: Emissions above the limit were from intentional emissions. No intermodulation emissions were detected

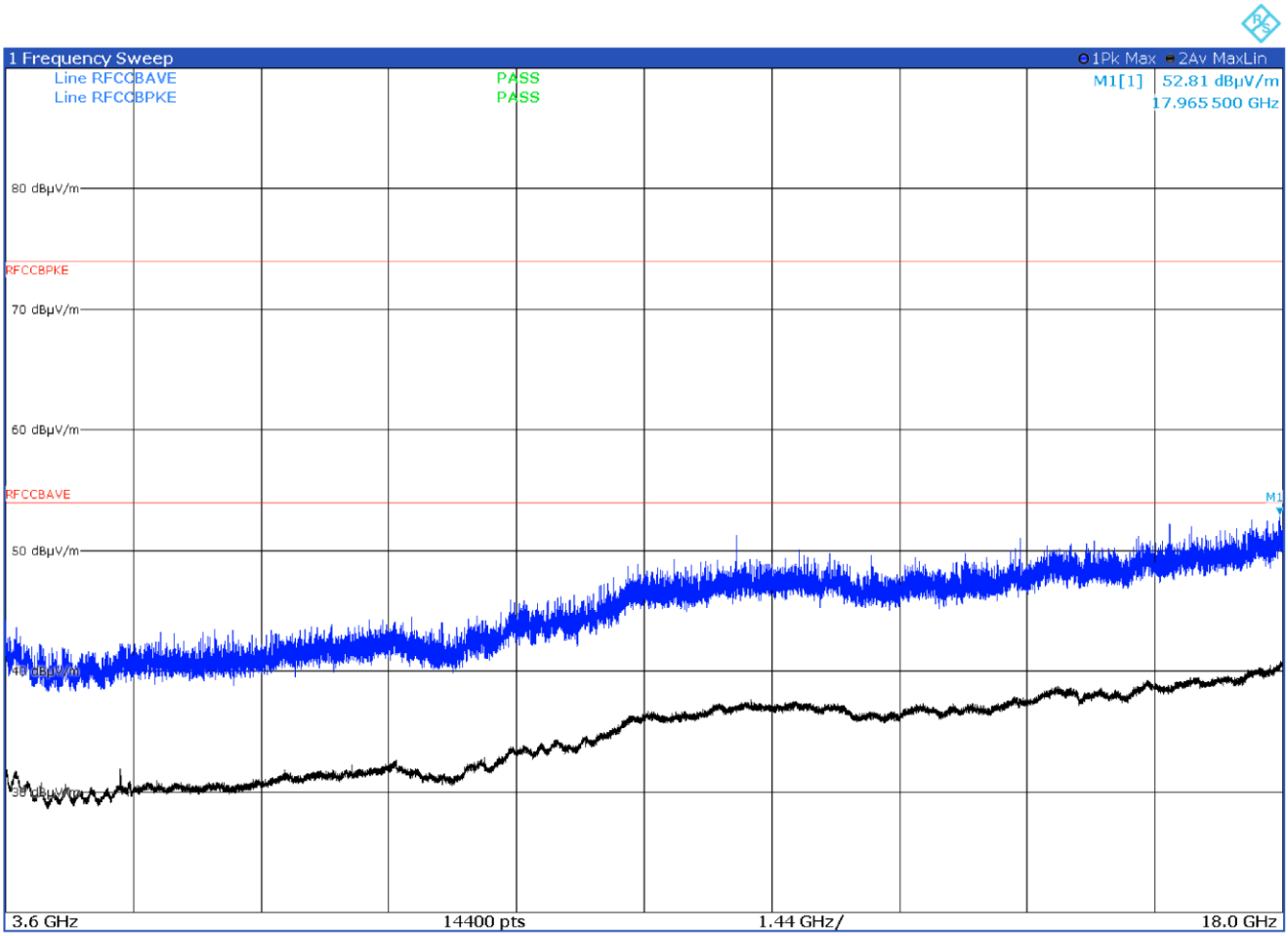


Figure 8.1-29: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

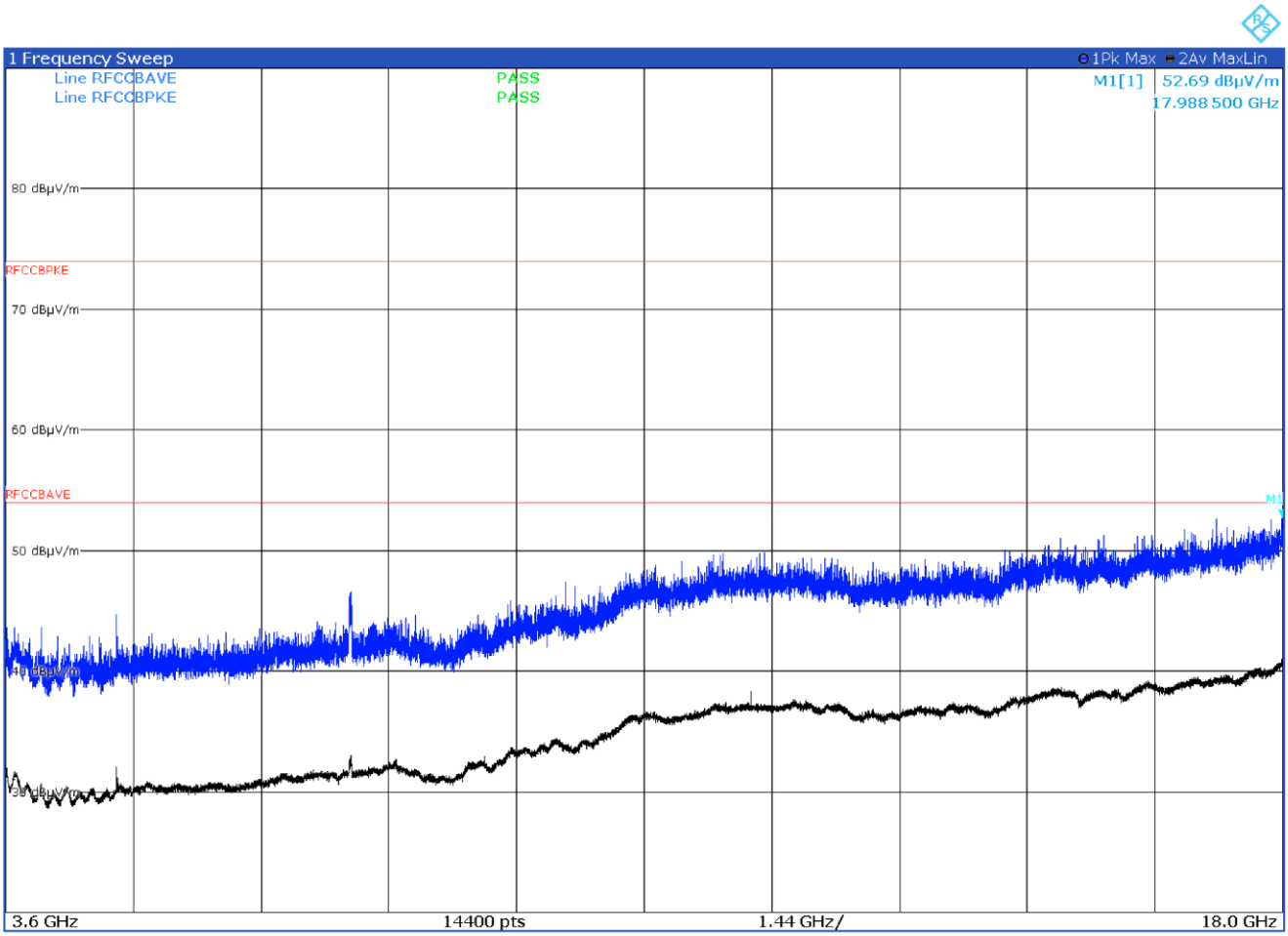


Figure 8.1-30: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

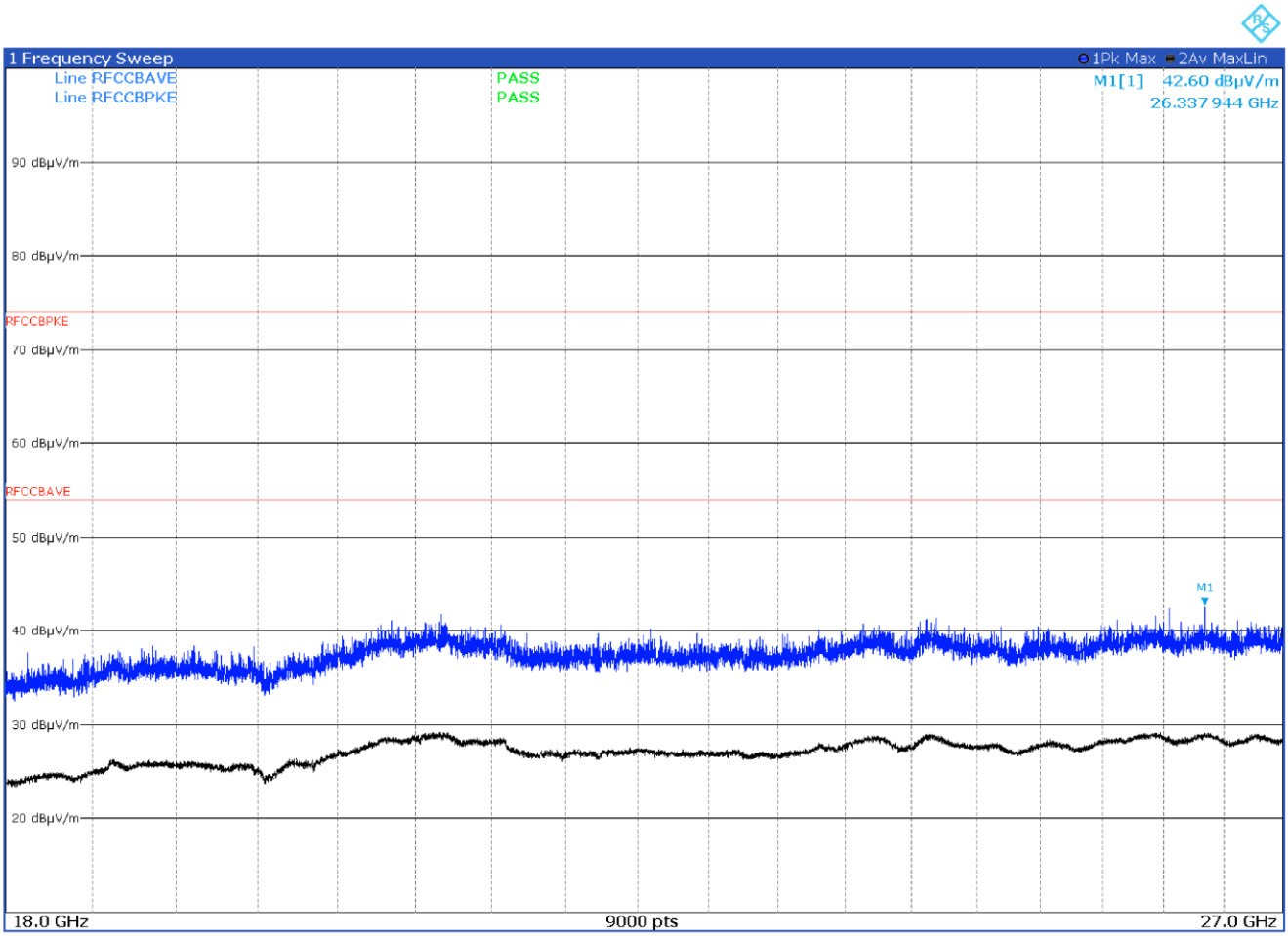


Figure 8.1-31: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in horizontal polarization*

Note: No intermodulation emissions were detected

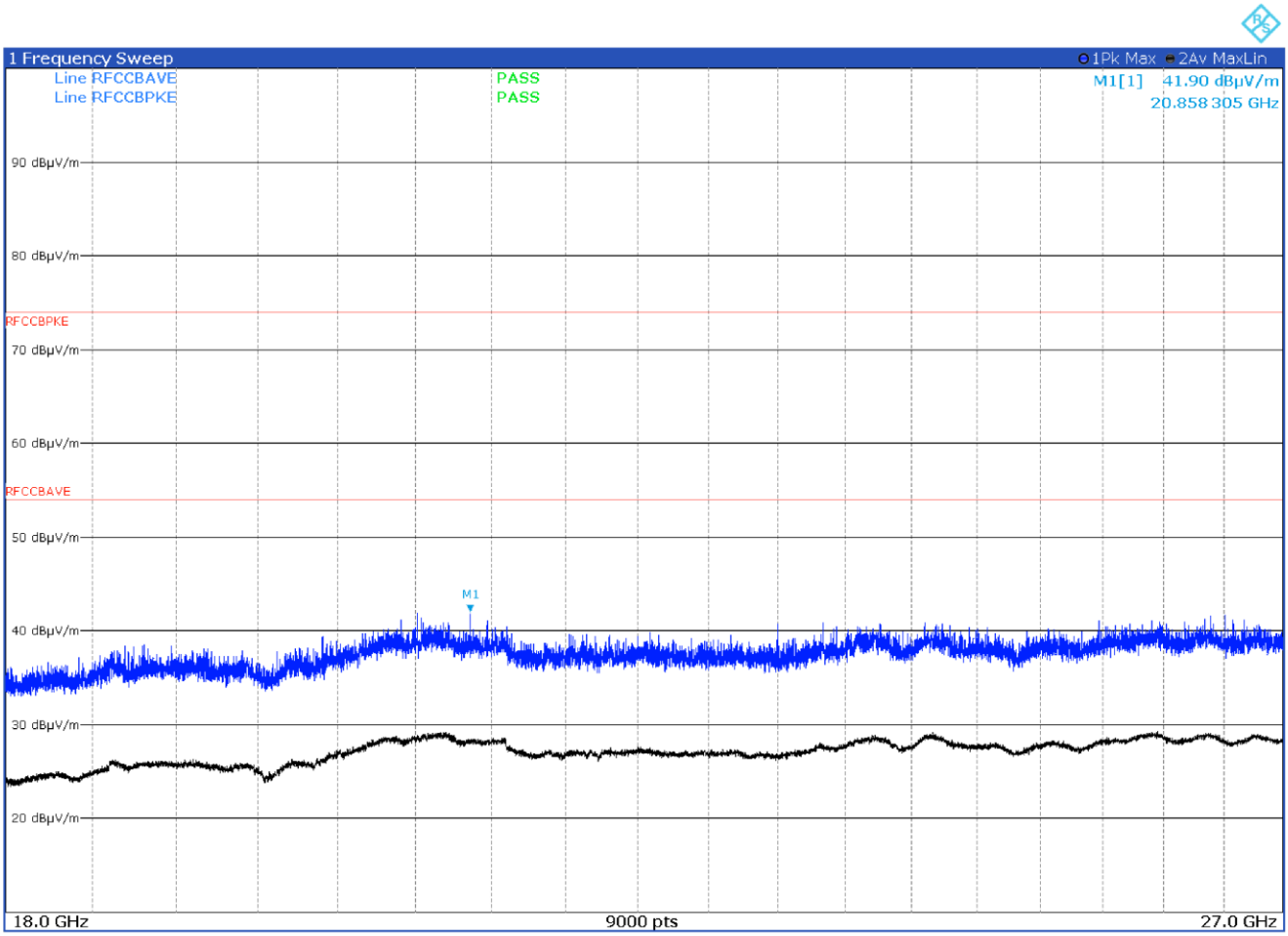


Figure 8.1-32: *Radiated spurious emissions with LTE B41 at mid channel and WIFI at high channel – antenna in vertical polarization*

Note: No intermodulation emissions were detected

8.2 Antenna requirement

8.2.1 References, definitions and limits

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.

8.2.2 Test summary

Test start date	August 26, 2021
Test engineer	P. Barbieri

8.2.3 Observations, settings and special notes

None

8.2.4 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

Table 8.2-1: *Antenna information*

Antenna type	Manufacturer	Model number	Maximum gain	Connector type
Wifi antenna	Shenzhen Sensewell Technology Co.,Ltd	SXW-WIFI-W10	2.5 dBi	SMA
4G/LTE FPC Antenna	Shenzhen Faycent Technology Co.,LTD	LY-P11-002-V1	5 dBi	SMA

To avoid the possibility of removing the antenna, the SMA connector has been blocked with a heat-shrinkable tube

8.3 ERP / EIRP measurement

8.3.1 References, definitions and limits

There are several choices available with respect to instrumentation that can be used to perform the measurement of EUT output power, whether it be the output power associated with the fundamental emission or the power contained within unwanted (out-of-band and/or spurious) emissions. Typical instruments used to perform power measurements include RF power meters, spectrum analyzers, EMI receivers, and vector signal analyzers. Most digital spectrum/signal analyzers and EMI receivers are equipped with a power averaging (rms) display detector that can provide near power meter accuracy while also offering the flexibility for use in collecting the data necessary to demonstrate compliance to most of the other regulatory requirements. Thus, spectrum analyzers, signal analyzers, and EMI receivers (with spectrum analyzer mode) have become the primary instruments of choice when performing compliance measurements, including RF output power measurements.

8.3.2 Test summary

Test start date	August 26, 2021
Test engineer	P. Barbieri

8.3.3 Observations, settings and special notes

Output power was measured with RMS power meter per ANSI C63.26 Paragraph 5.2.4.2.

Spectrum analyzer settings for PSD:

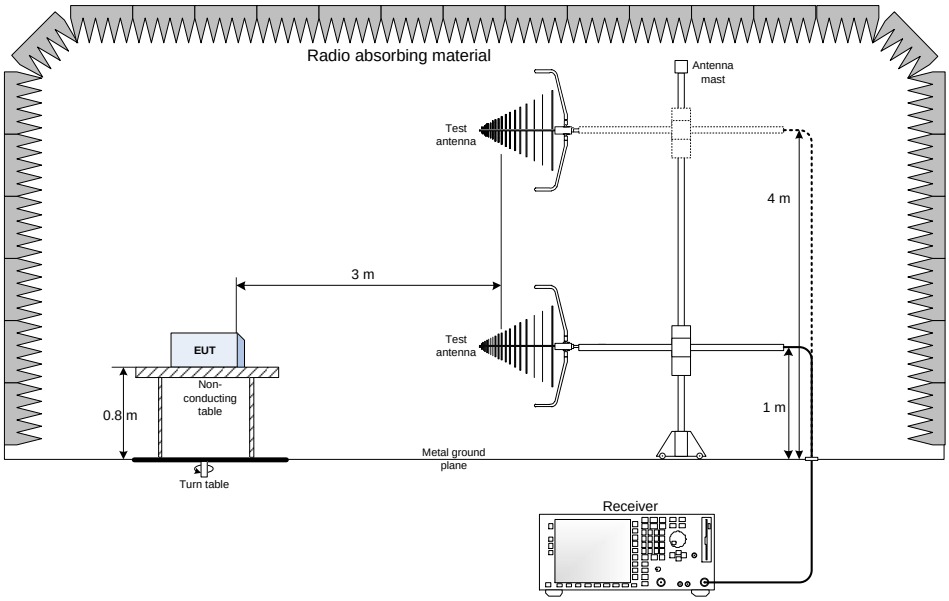
Detector mode	RMS
Resolution bandwidth	> OBW
Video bandwidth	> RBW
Measurement mode	Power over emission bandwidth
Trace mode	Averaging
Measurement time	Auto

8.3.4 Test data

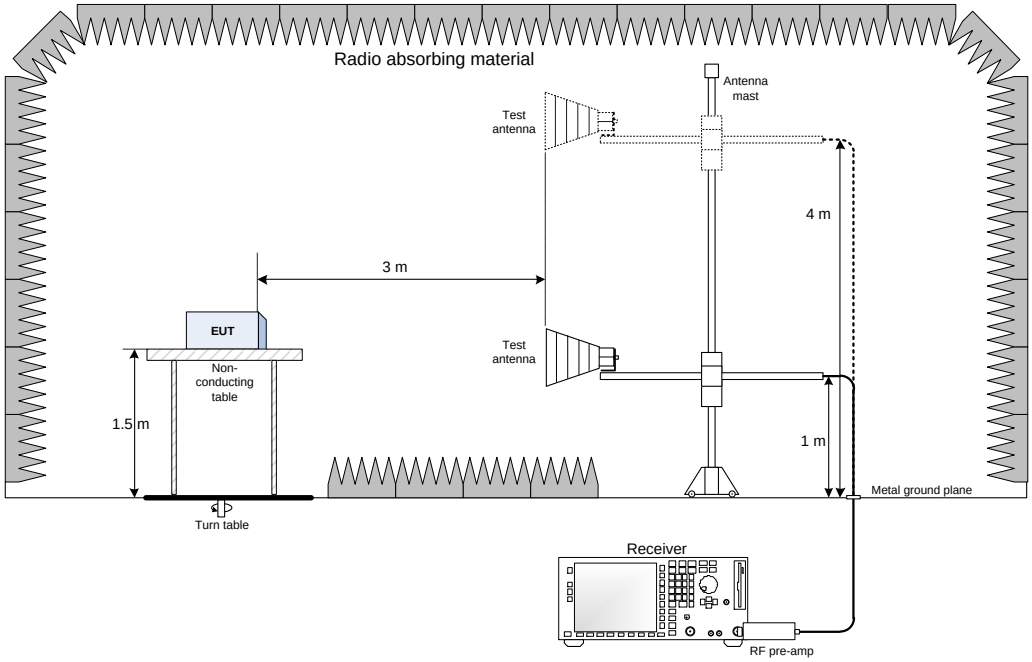
LTE Band	ERP/EIRP measured, dBm	ERP/EIRP measured, W	ERP/EIRP limit, W	Margin, W
2	17.4	0.0550	0.1637	-0.1087
4	22.8	0.1905	0.2000	-0.0095
5	10.9	0.0123	0.2388	-0.2265
41	15.9	0.0389	0.1312	-0.0923

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz

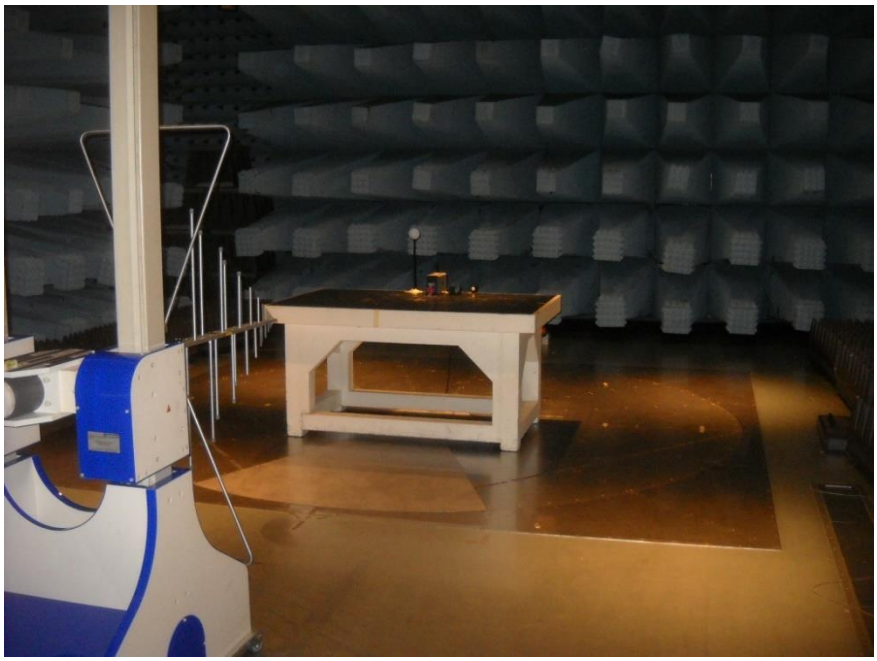


9.2 Radiated emissions set-up for frequencies above 1 GHz



Section 10. Photos

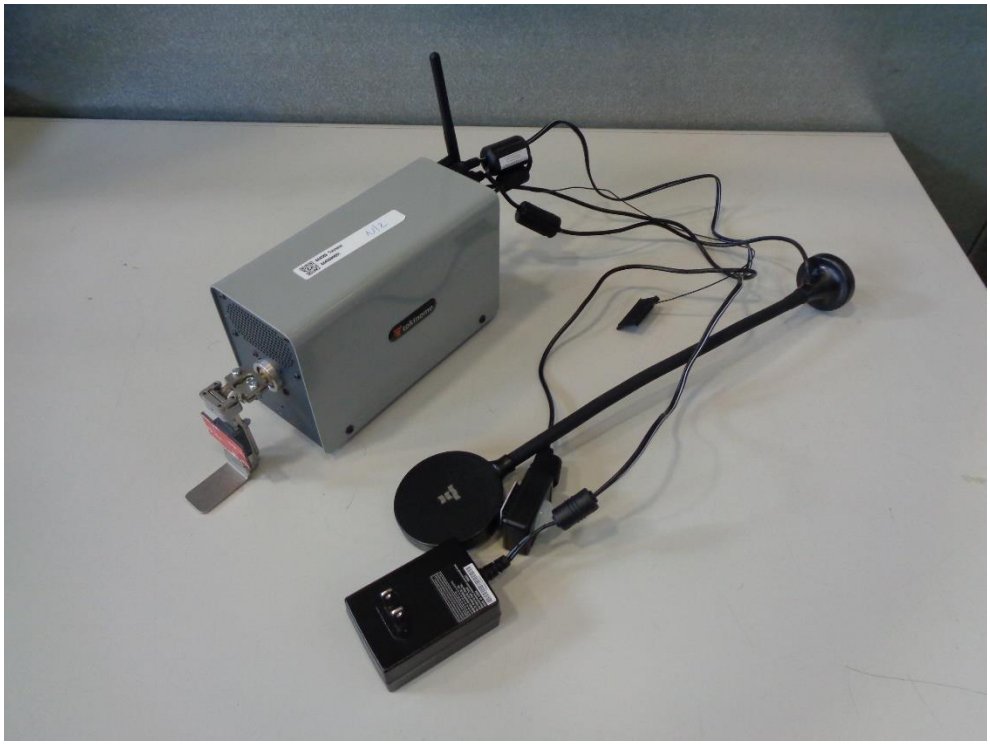
10.1 Photos of the test set-up

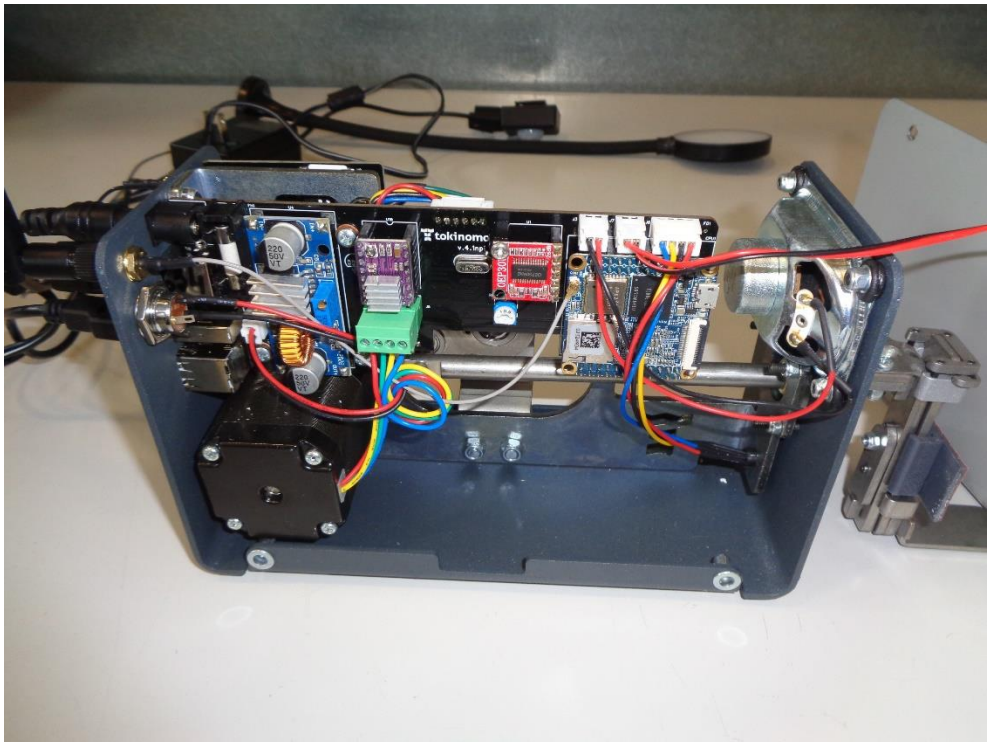


Radiated emission below 1 GHz

Radiated emission above 1 GHz

10.2 Photos of the EUT

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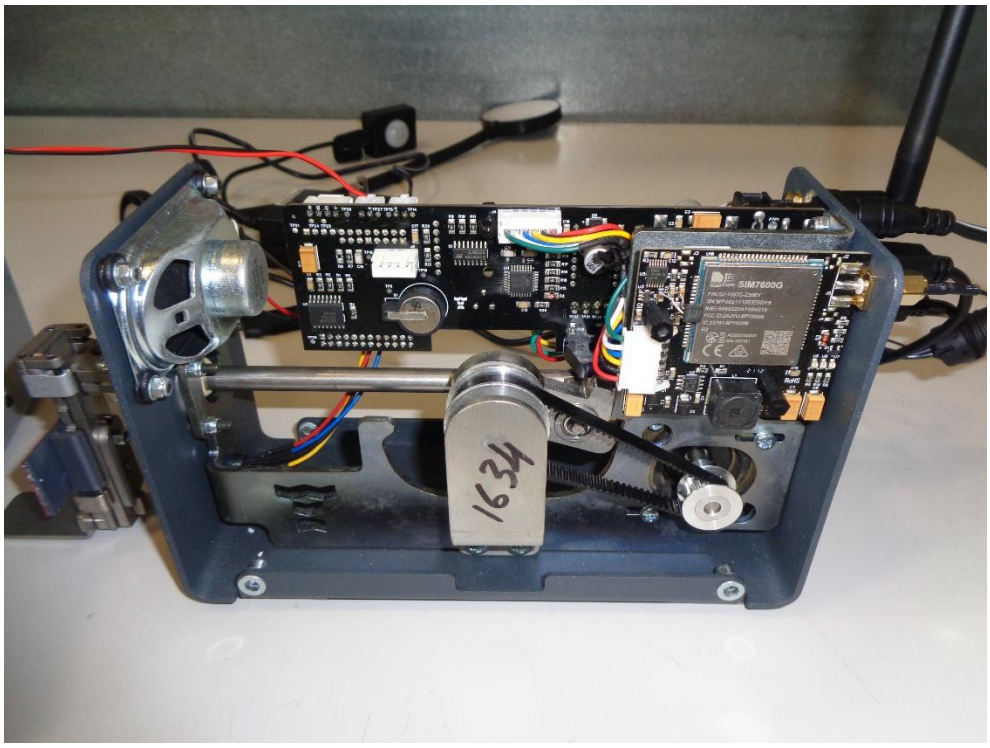
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