

RADIO TEST REPORT – 485181-6TRFWL

Type of assessment:

Transmitters co-location

Applicant:

Advanced Microwave Engineering Srl
Via Lucca, 50/54 – 50142 Firenze (FI) – Italy

Product name:

UWB positioning sensor

Model:

LPS UWB 002

FCC ID:

UKOLPSUWB-BT

Specifications:

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

Date of issue: 2022-11-18

P. Barbieri

Tested by



Signature

D. Guarnone

Reviewed by



Signature

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Test location(s)

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Country	Italy
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Site number	682159

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 contained 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	Advanced Microwave Engineering Srl
Address	Via Lucca, 50/54 – 50142 Firenze (FI) – Italy

1.2 Test specifications

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

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
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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
485181-6TRFWL	2022-11-18	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

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	2022-11-09
Nemko sample ID number	4851810011

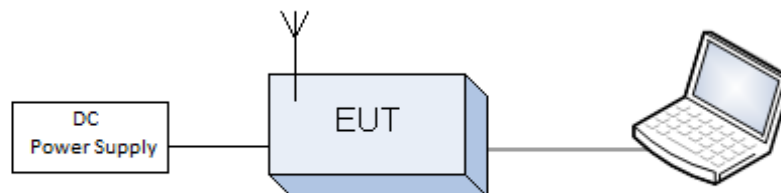
3.2 EUT information

Model	LPS UWB 002
Serial number	4851810011 (Number assigned by Nemko Spa)

3.3 Technical information

Frequency band	UWB at 4 GHz and 6.5 GHz Bluetooth at 2400 to 2483.5 MHz
Type of modulation	UWB
Emission classification	W7D
EUT power requirements	12 / 24 V DC
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 EUT setup diagram

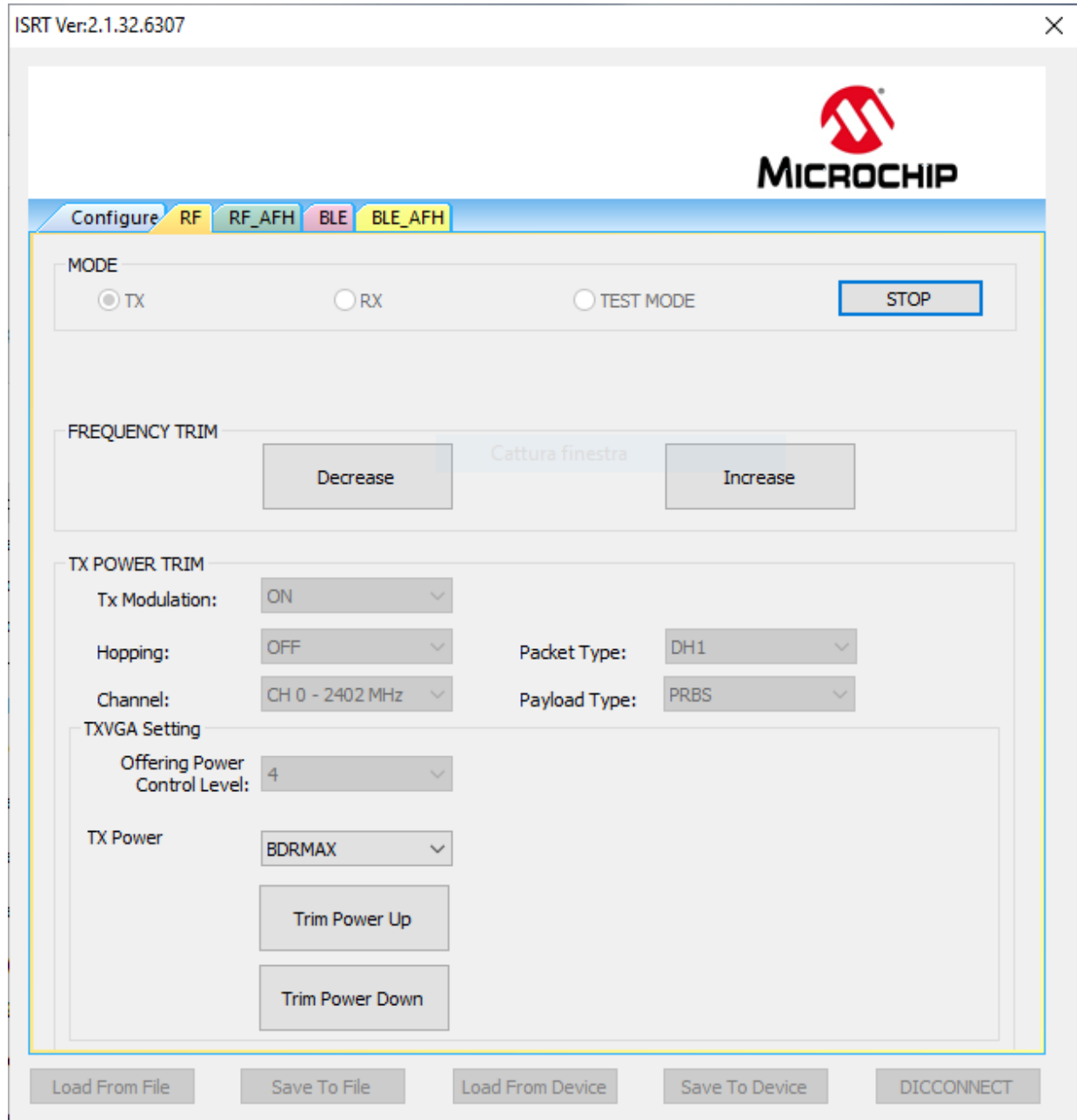


3.5 Product description and theory of operation

The LPSUWB system is a radio frequency sensor that uses UWB type signals to detect the spatial position of a nearby tag. The device is typically used on mobile means such as lift trucks but can also be installed in a fixed position near static machines. The power supply is in low voltage 12 / 24V in direct current but it also has a battery version that allows it to operate even without any electrical connection. Even if the battery is installed, recharging takes place by powering the system at 12/24 V. The LPSUWB system is also equipped with a Bluetooth interface with which it connects to other devices, typically a tablet or other portable devices.

3.6 EUT exercise details

The command TEST 254 sent to the EUT with Tera terminal software has been used to force the EUT in continuous UWB TX mode. For the Bluetooth radio module, the following software has been used:



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

No technical judgment

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	2022-09	2024-09

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 $\pm 5\%$, 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	2022-08	2023-08
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07	2024-07
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	Comtest	SAC-3	1711-150	2022-09	2024-09
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 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			

Test summary

Verdict	Pass
Tested by	P. Barbieri

8.1.2 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 intermodulation product found at 694 MHz fall outside the restricted frequency bands so the limits of -13 dBm applied ($82.2 \text{ dB}\mu\text{V/m} = -13 \text{ dBm} + 95.23 \text{ dB}$). The same limits apply to the spurious emissions of the 2G/3G/4G radio module.

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:

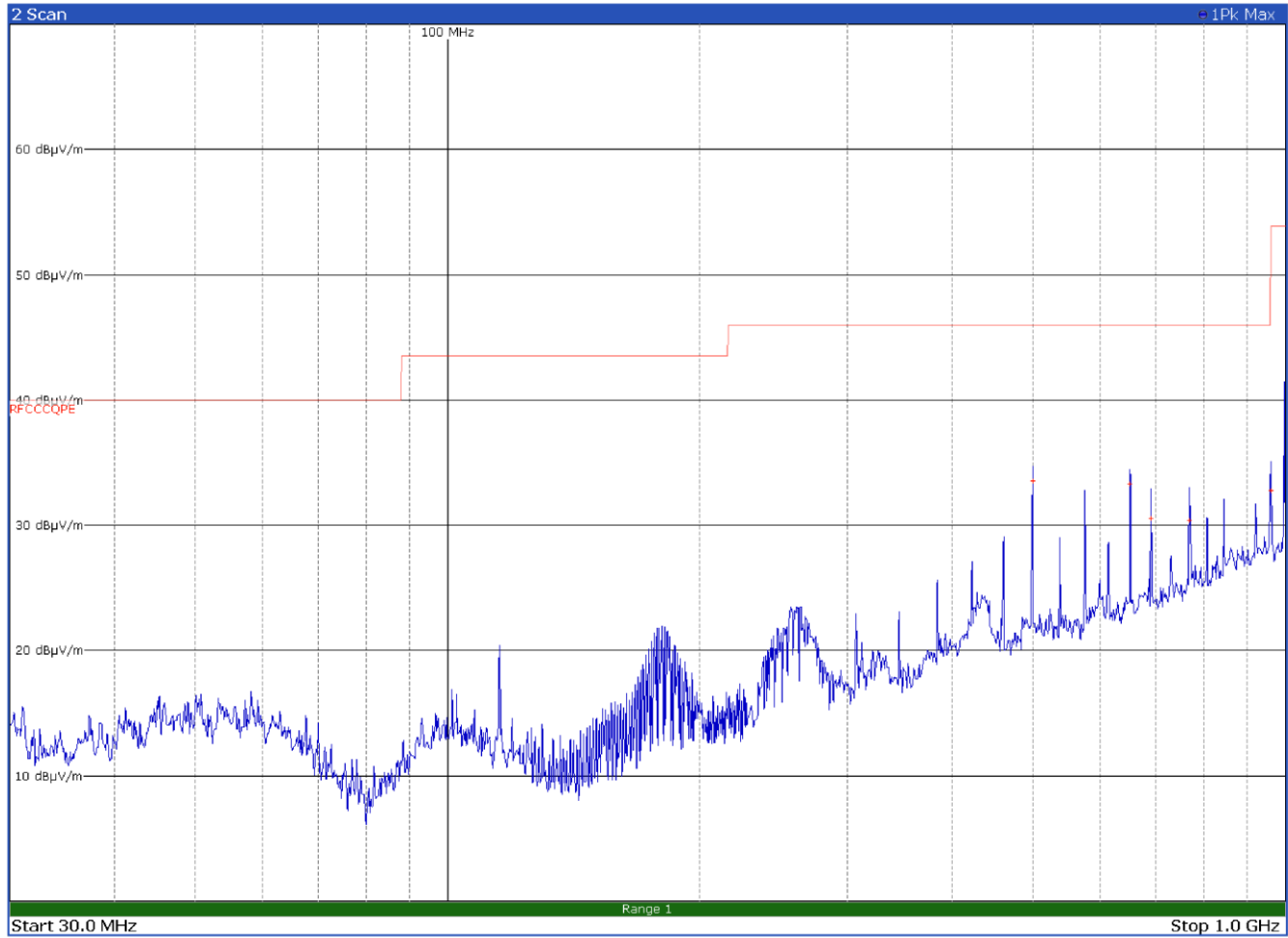
Resolution bandwidth:	1 MHz
Detector mode:	Peak

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

Resolution bandwidth:	1 MHz
Detector mode:	Average

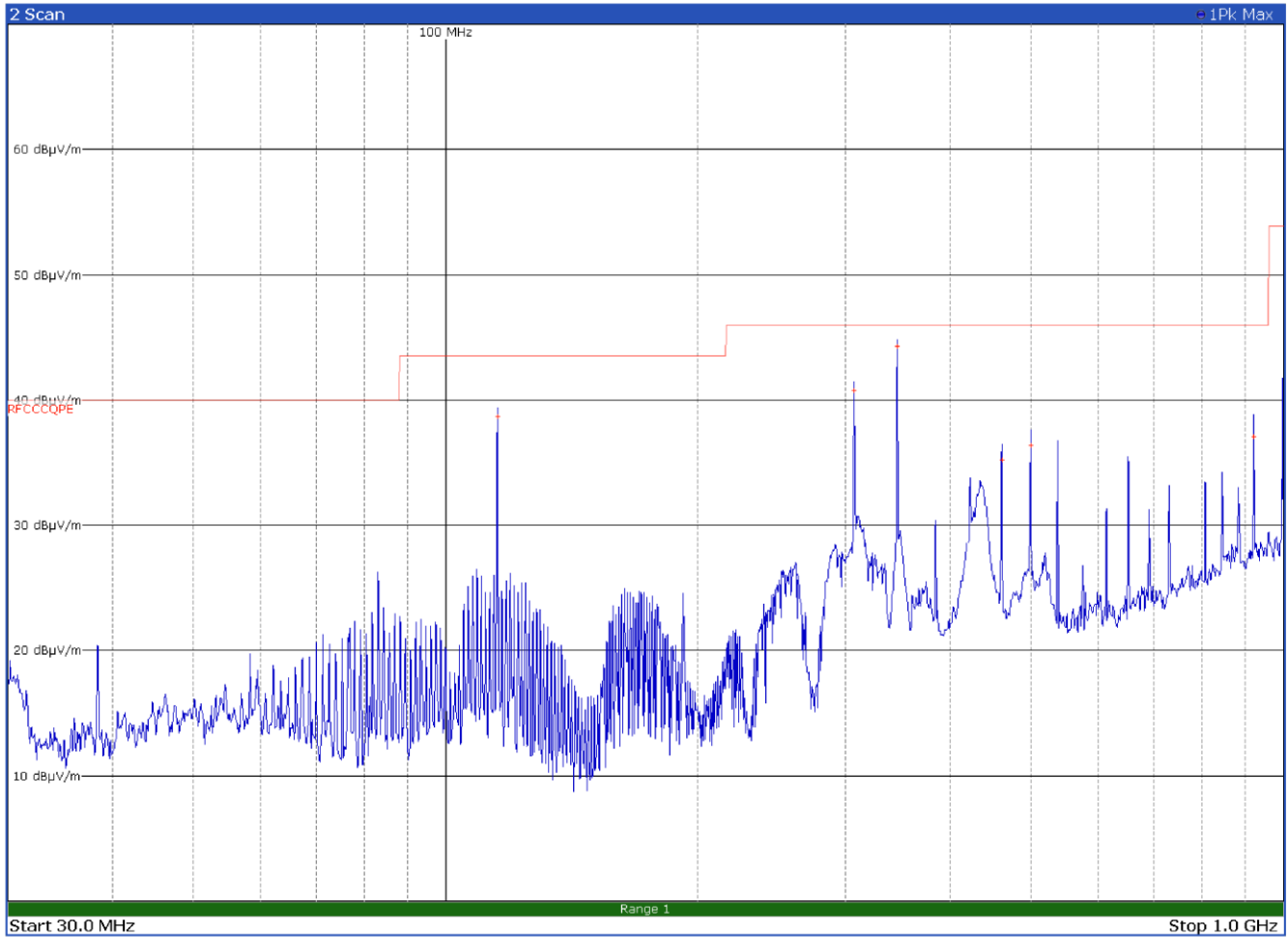
8.1.3 Test data

Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	30 to 1000 MHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



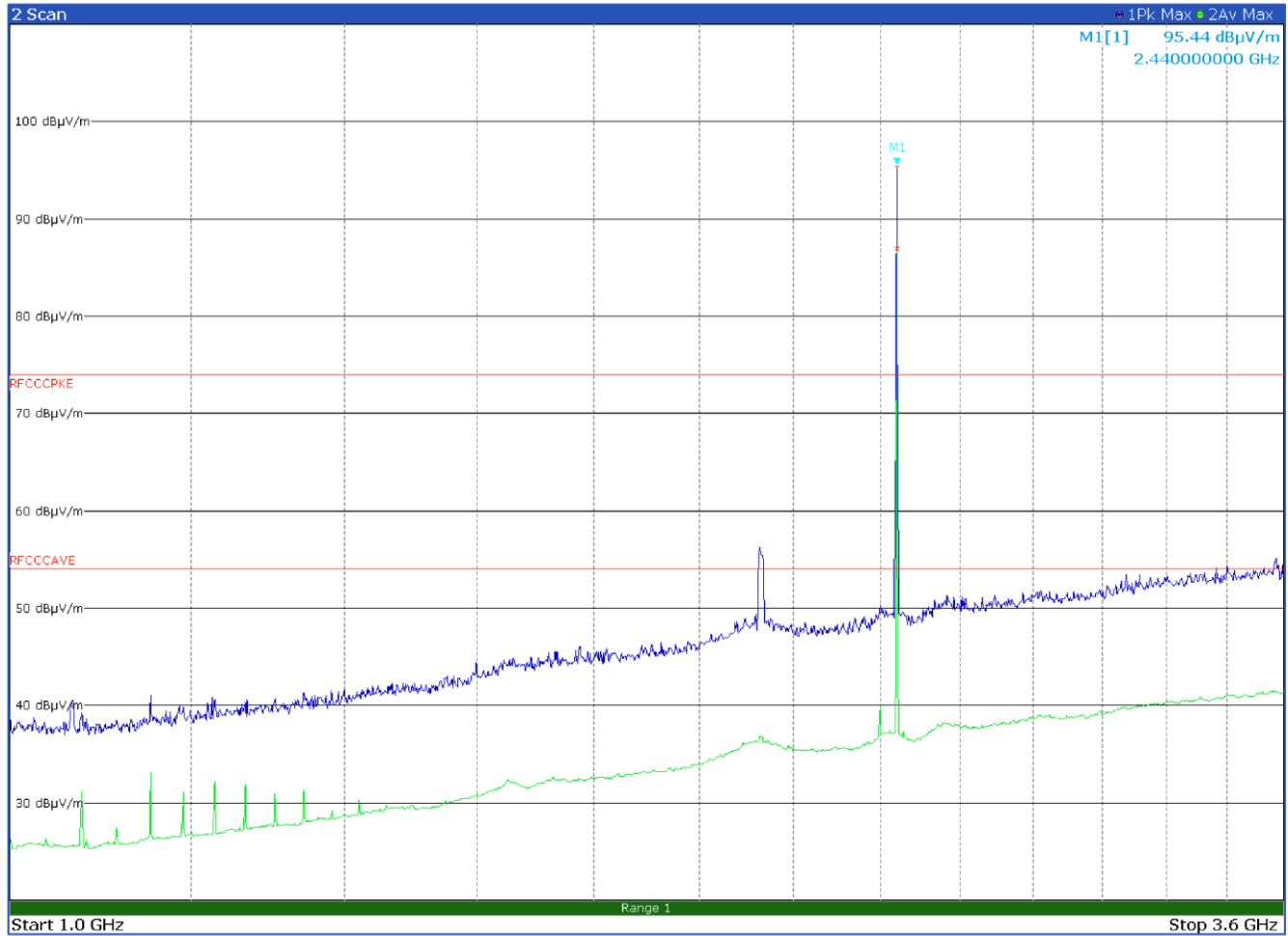
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
499.2000	33.6	46.0	-12.4	QP
652.8000	33.4	46.0	-12.6	QP
691.2000	30.6	46.0	-15.4	QP
768.0000	30.5	46.0	-15.5	QP
960.0000	32.8	53.9	-21.1	QP

Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	30 to 1000 MHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



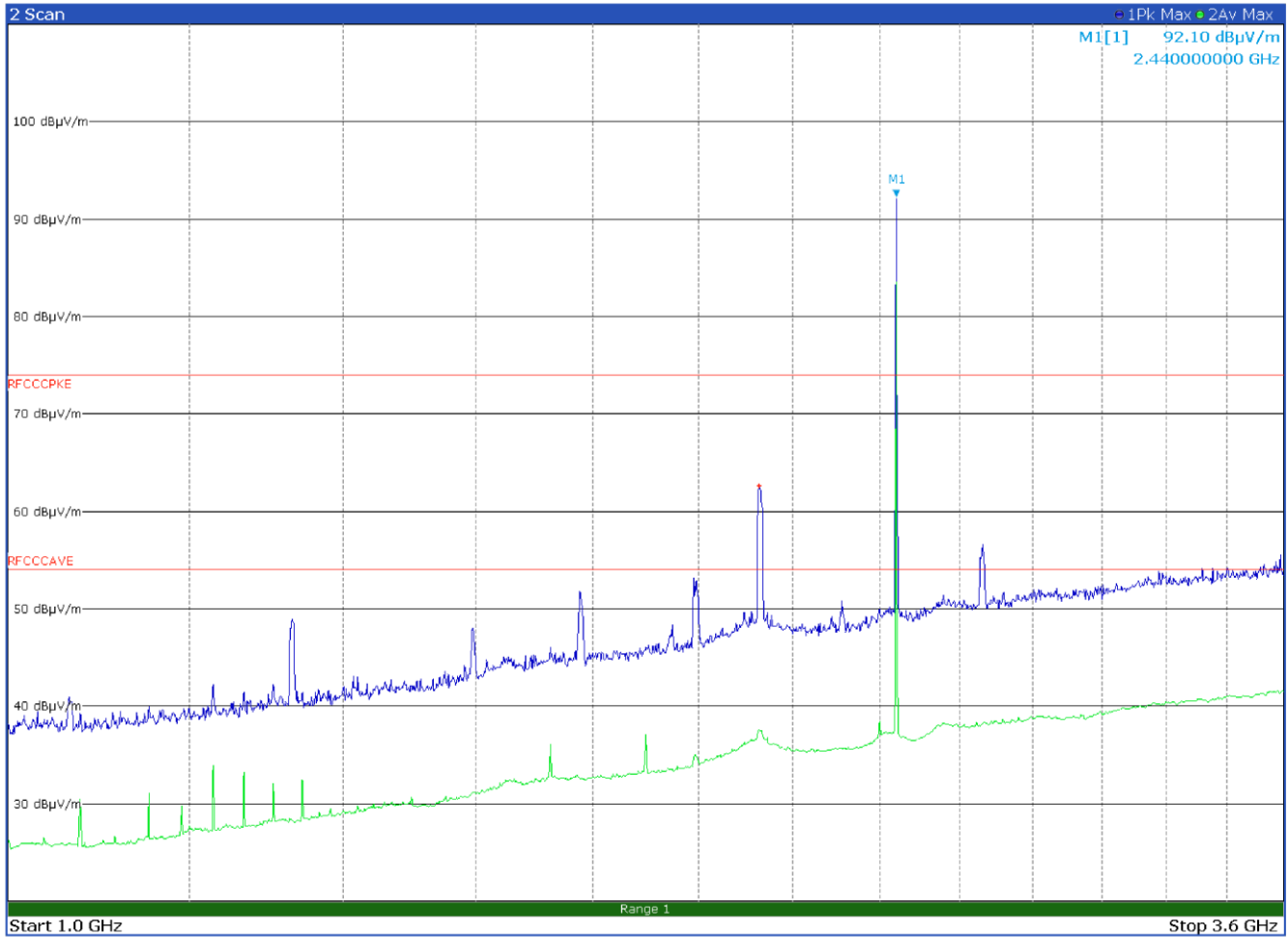
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
115.2000	38.7	43.5	-4.8	QP
307.2000	40.8	46.0	-5.2	QP
345.6000	44.4	46.0	-1.6	QP
460.8000	35.2	46.0	-10.8	QP
499.2000	36.4	46.0	-9.6	QP
921.6000	37.1	46.0	-8.9	QP

Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1000 to 3600 MHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



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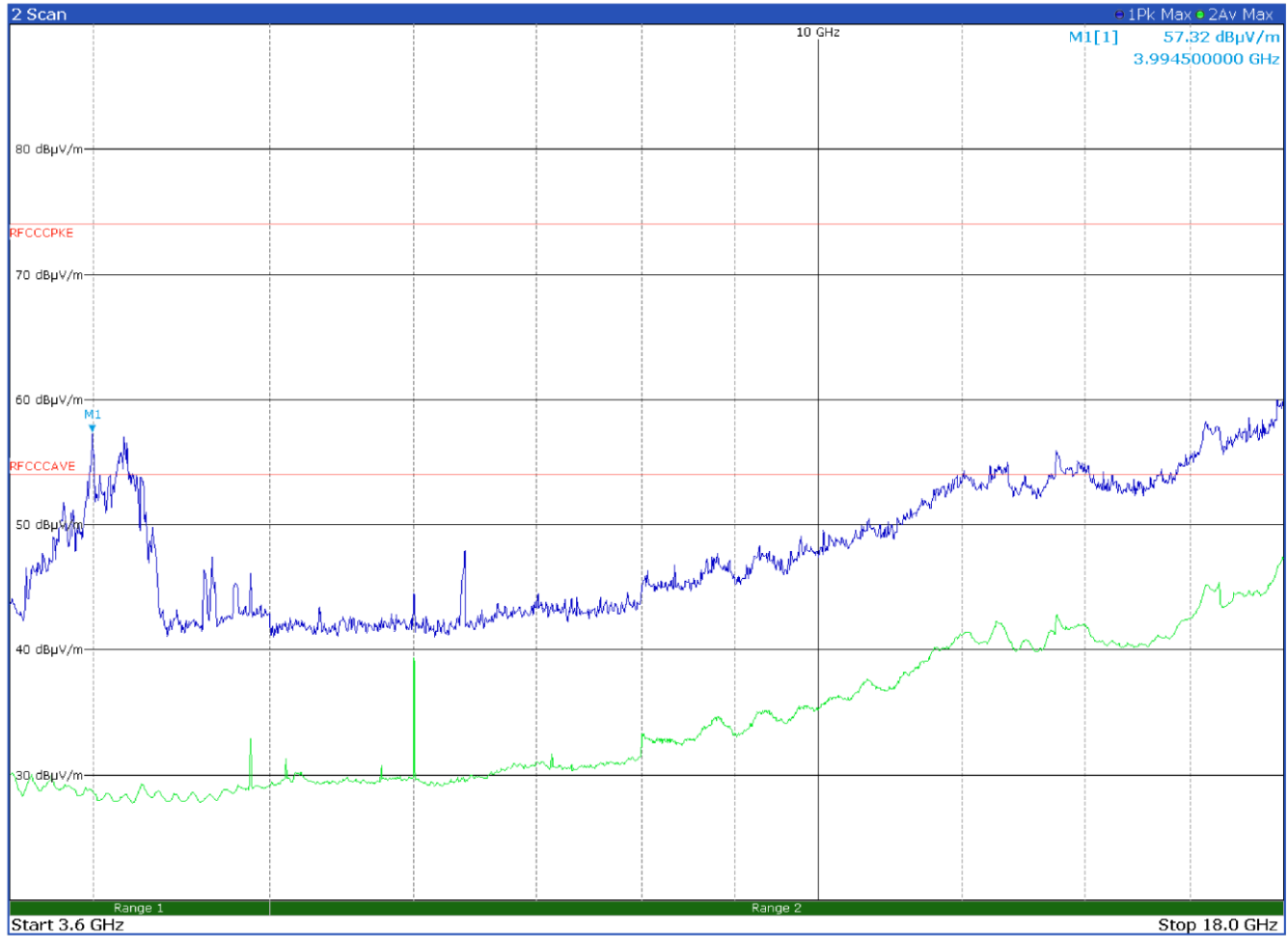
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1000 to 3600 MHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



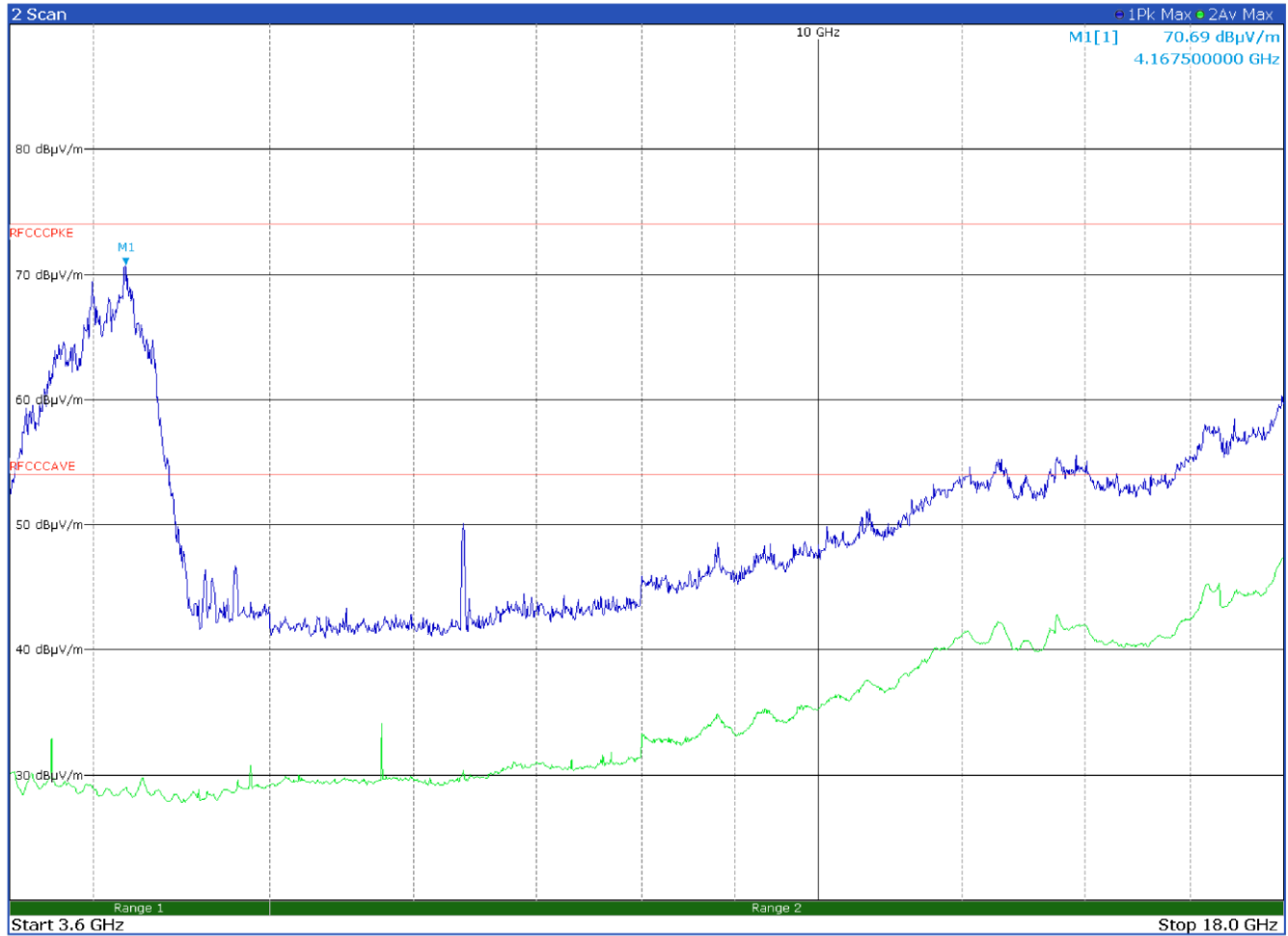
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
2126.2500	62.7	74.0	-11.3	Pk

Limit exceeded by the carrier

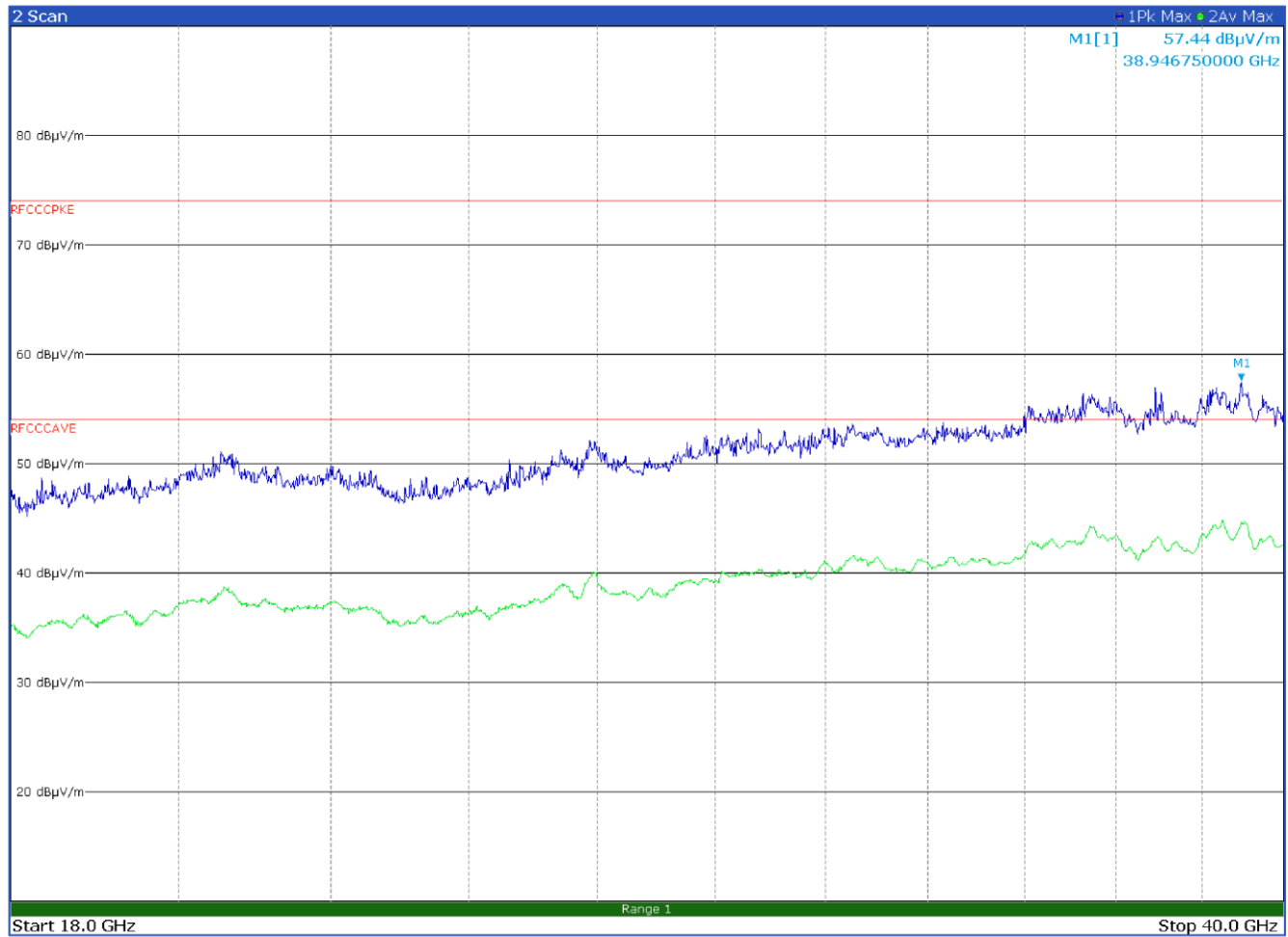
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	3.6 to 18 GHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



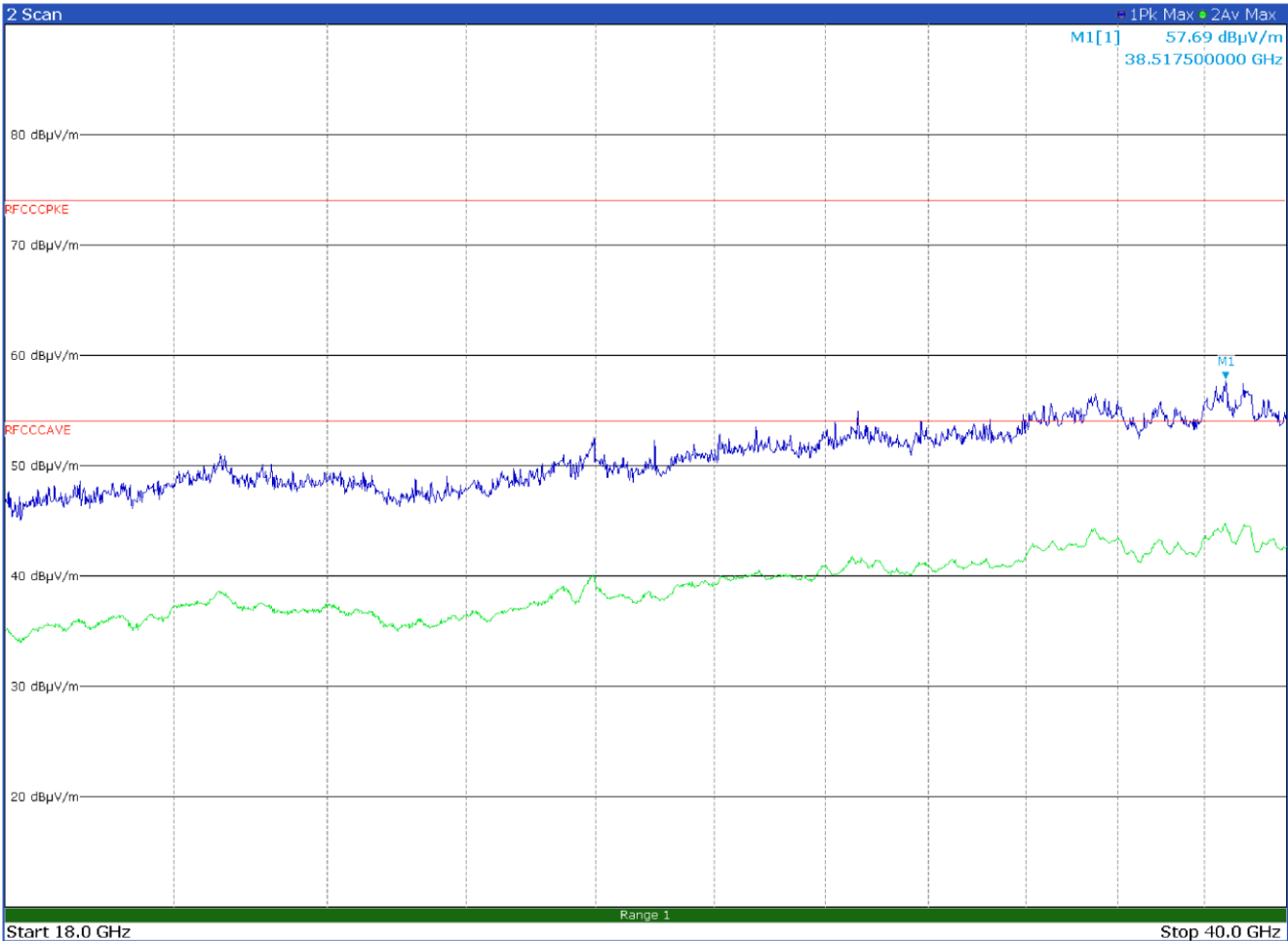
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	3.6 to 18 GHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



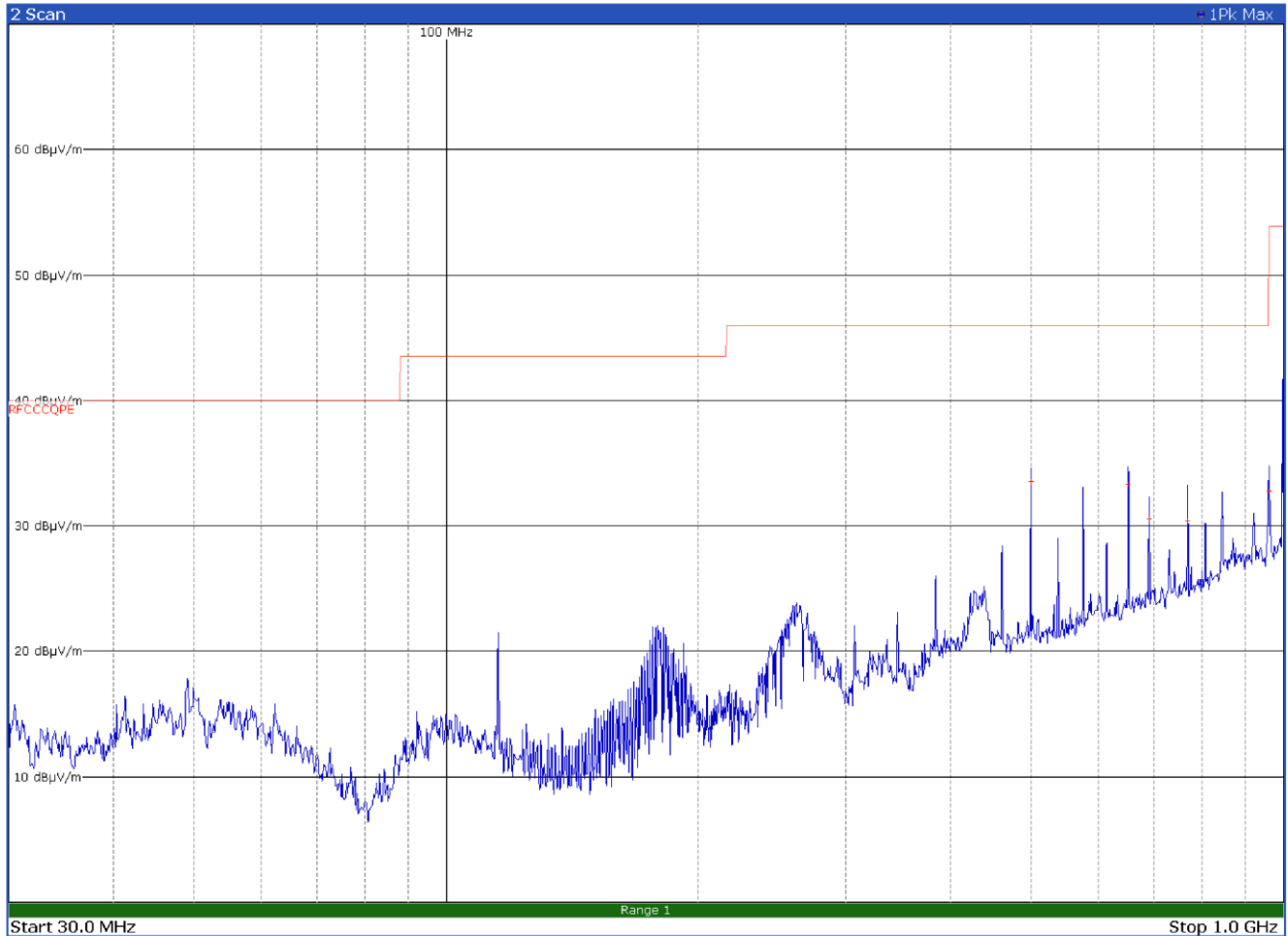
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	18 to 40 GHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P



Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	18 to 40 GHz	Bluetooth at 2440 MHz and UWB at 4 GHz	P

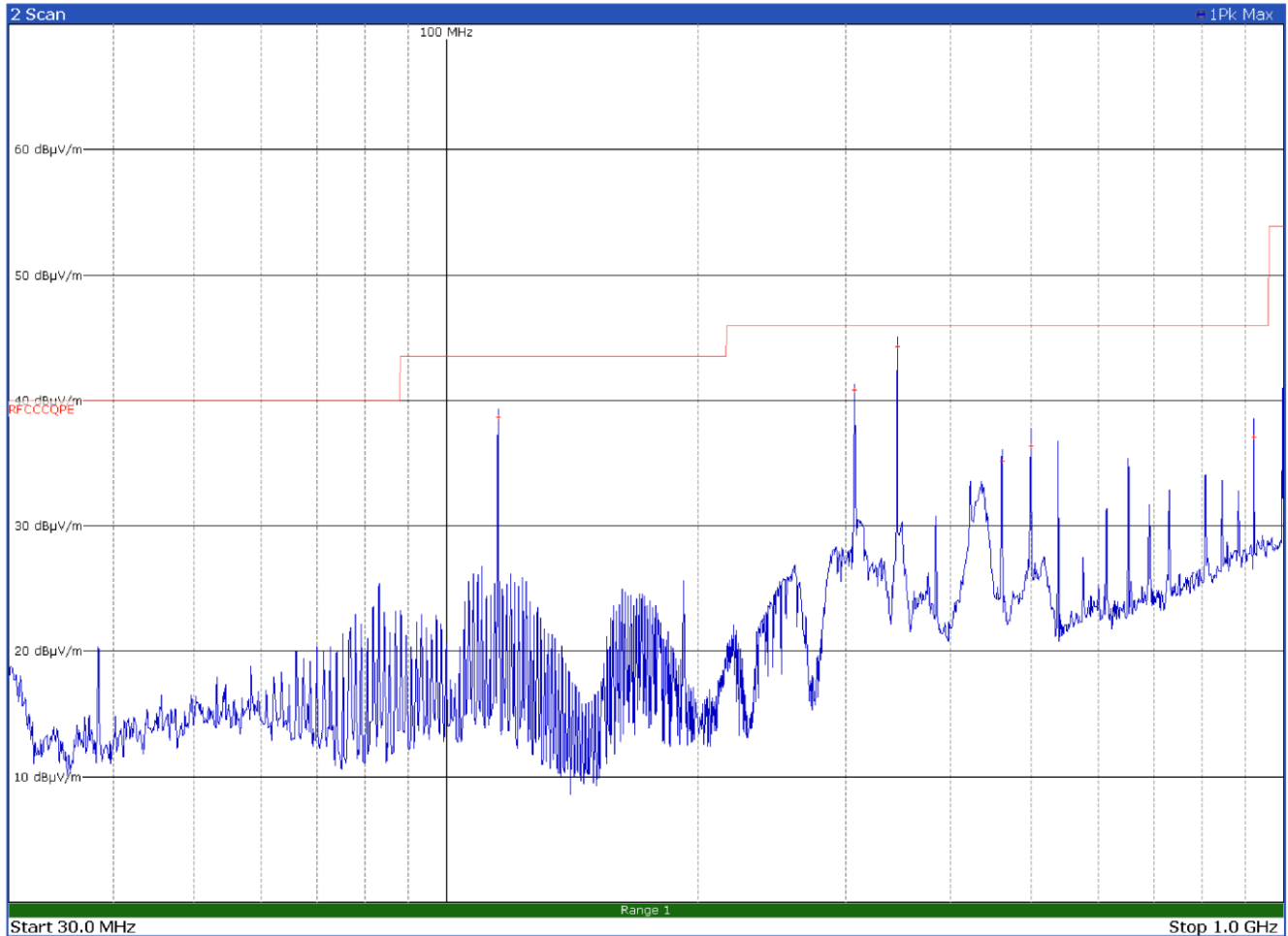


Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	30 to 1000 MHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P



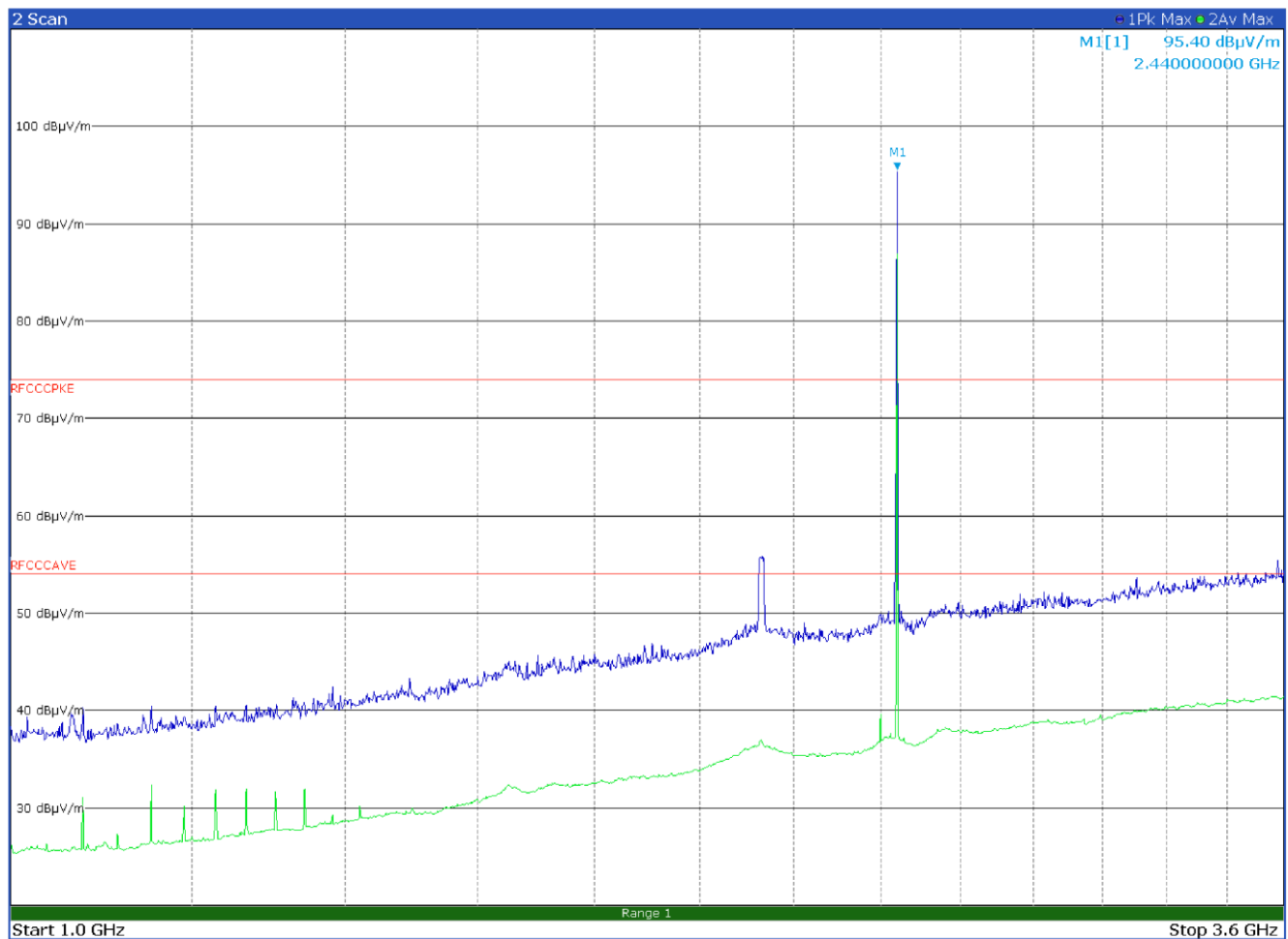
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
499.2000	33.6	46.0	-12.4	QP
652.8000	33.4	46.0	-12.6	QP
691.2000	30.6	46.0	-15.4	QP
768.0000	30.5	46.0	-15.5	QP
960.0000	32.8	53.9	-21.1	QP

Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	30 to 1000 MHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P



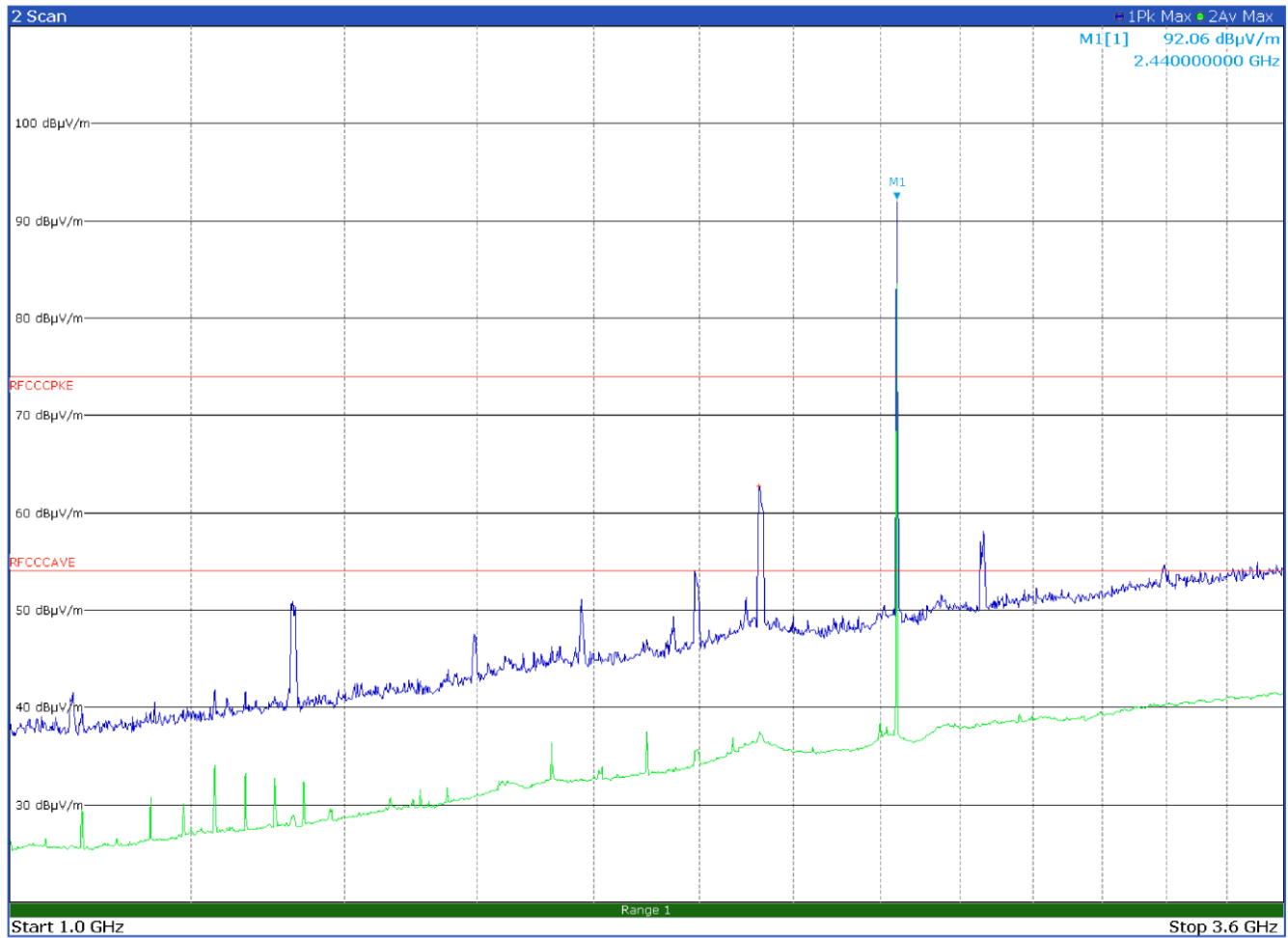
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
115.2000	38.8	43.5	-4.7	QP
307.2000	40.9	46.0	-5.1	QP
345.6000	44.3	46.0	-1.7	QP
460.8000	35.2	46.0	-10.8	QP
499.2000	36.4	46.0	-9.6	QP
921.6000	37.1	46.0	-8.9	QP

Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1000 to 3600 MHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P



Limit exceeded by the carrier

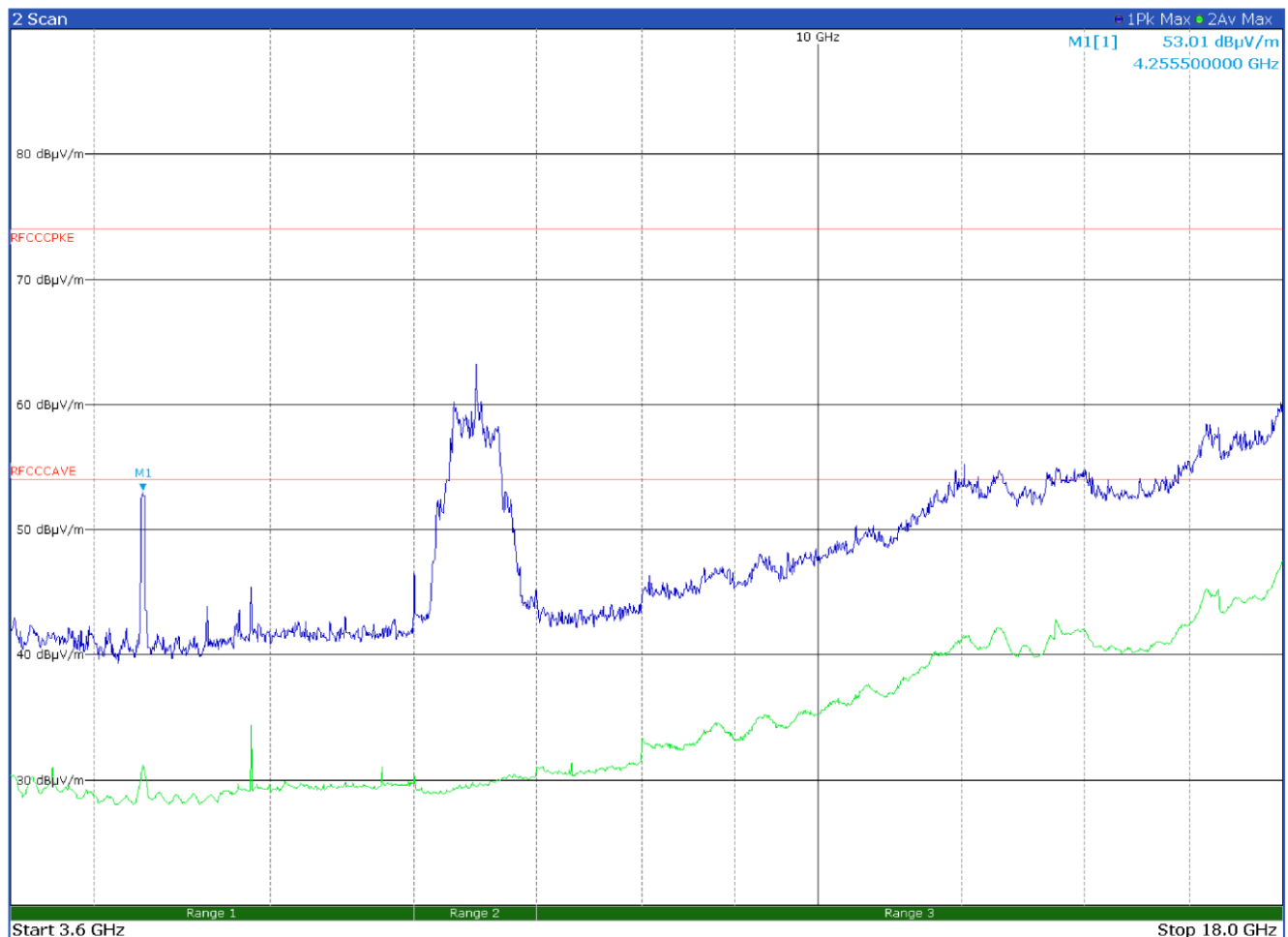
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1000 to 3600 MHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P



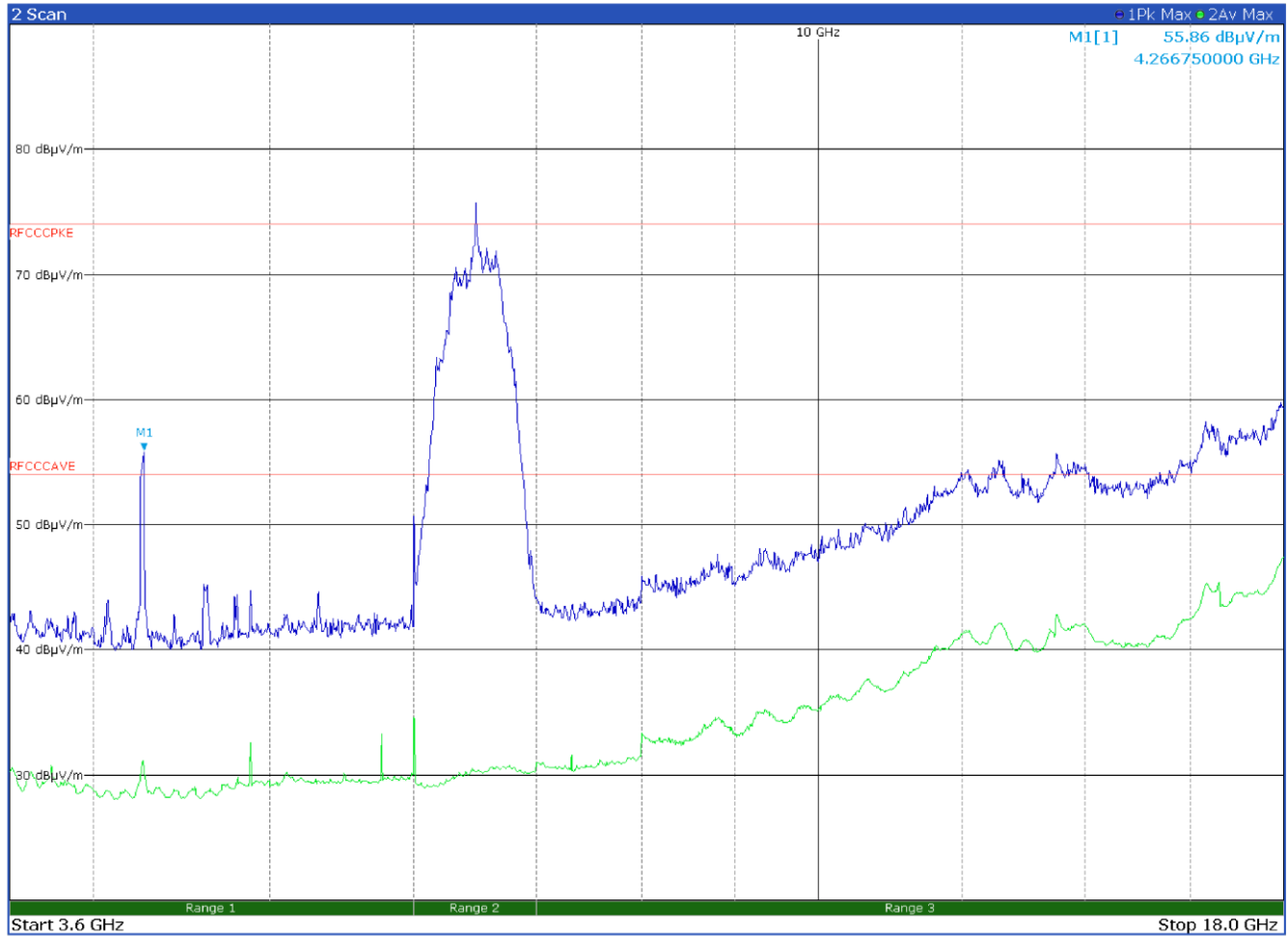
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
2125.0000	62.8	74.0	-11.2	Pk

Limit exceeded by the carrier

Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	3.6 to 18 GHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P

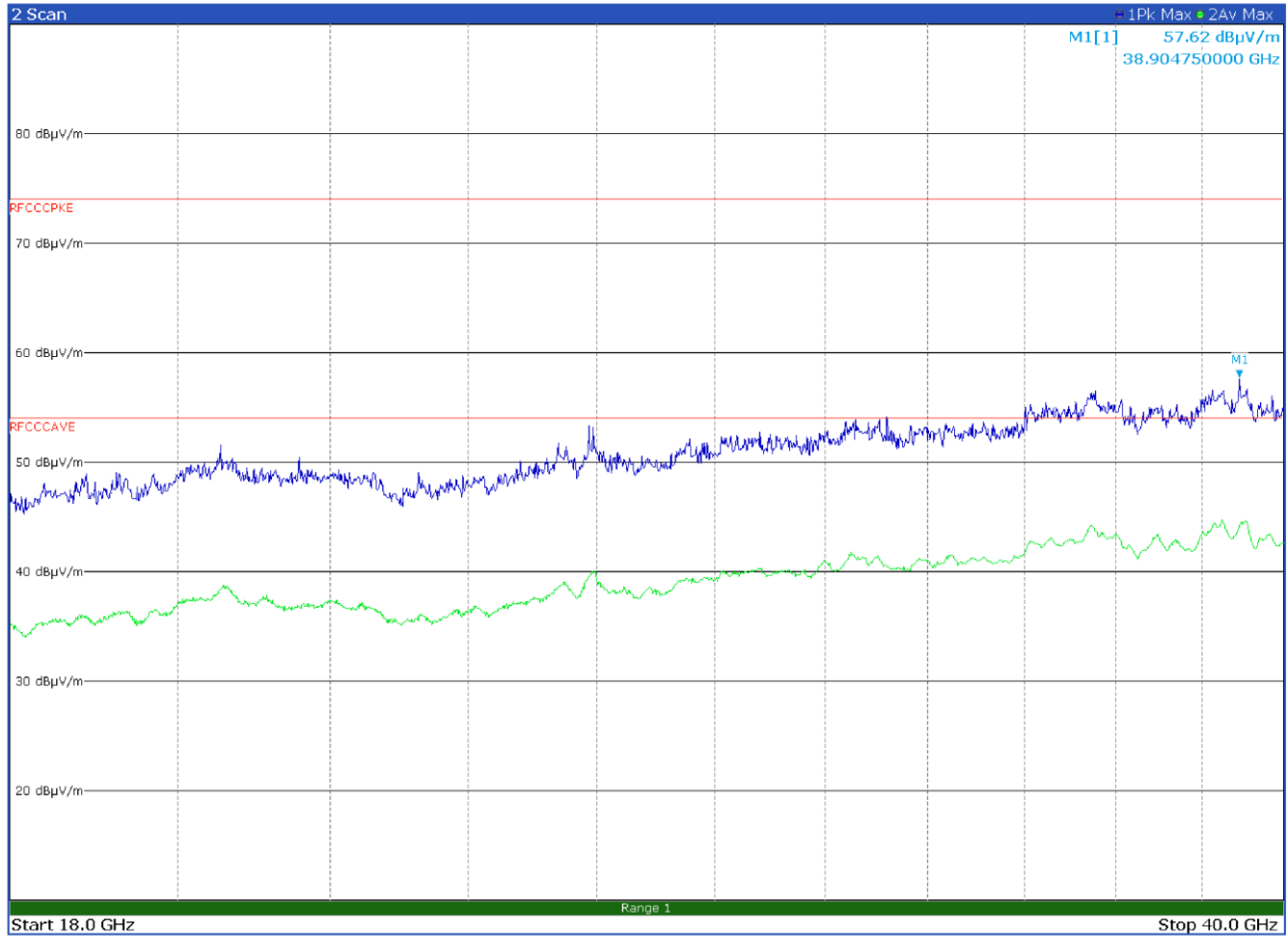


Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	3.6 to 18 GHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P

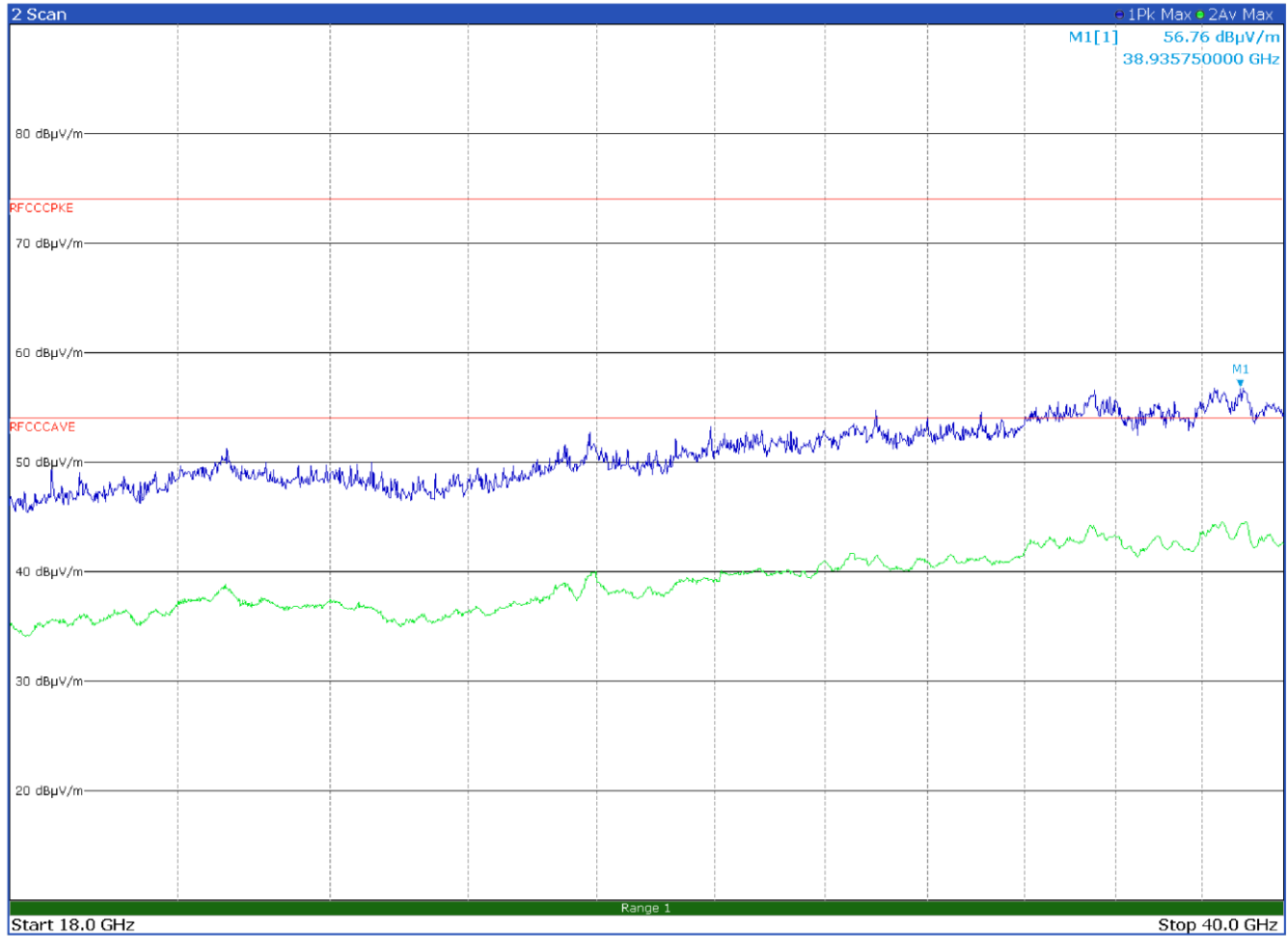


Limit exceeded by the carrier

Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	18 to 40 GHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P

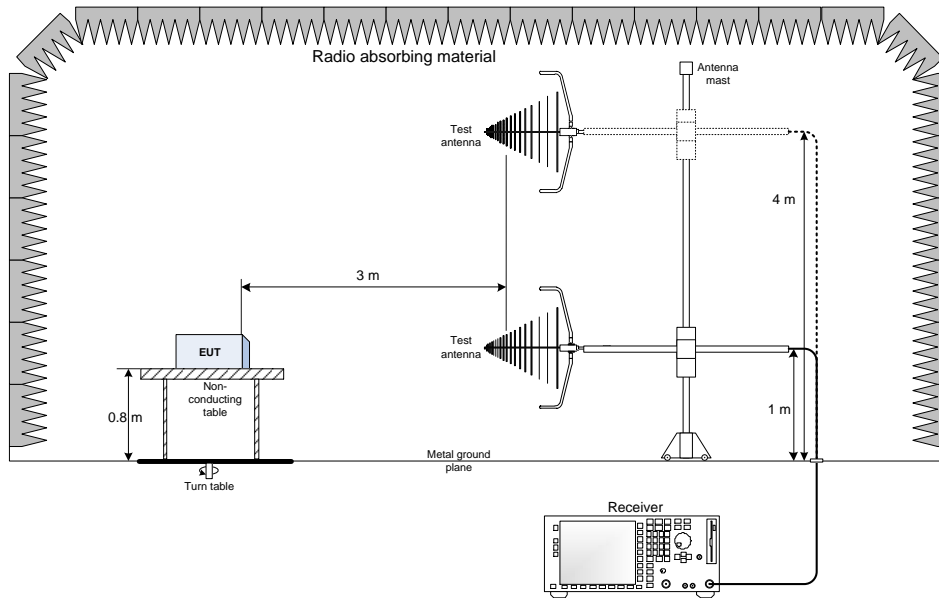


Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	18 to 40 GHz	Bluetooth at 2440 MHz and UWB at 6.5 GHz	P

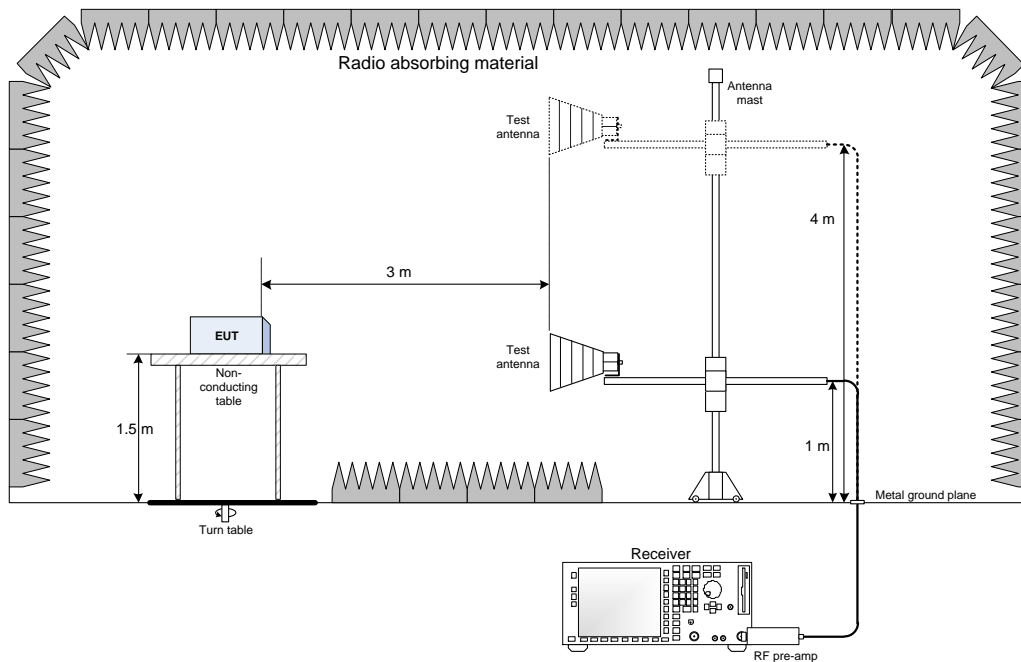


Section 9. Block diagrams of test set-ups

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



End of report