

Wireless test report – 485181-8TRFWL

Applicant:

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

Product name:

Sensor for detection ad localization

Model:

LPS UWB 002

FCC ID:

UKOLPSUWB-BT

Specifications:

- ◆ FCC 47 CFR Part 15 Subpart F
Ultra-Wideband operation
- ◆ FCC 47 CFR Part 15 Subpart C
Intentional radiator

Date of issue: November 18, 2022

Tested by P. Barbieri

Signature:



Reviewed by D. Guarnone

Signature:



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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 F	Ultra-Wideband operation
FCC 47 CFR Part 15, Subpart C	Intentional Radiators

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

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
485181-8TRFWL	November 18, 2022	Original report issued



Section 2. Summary of test results

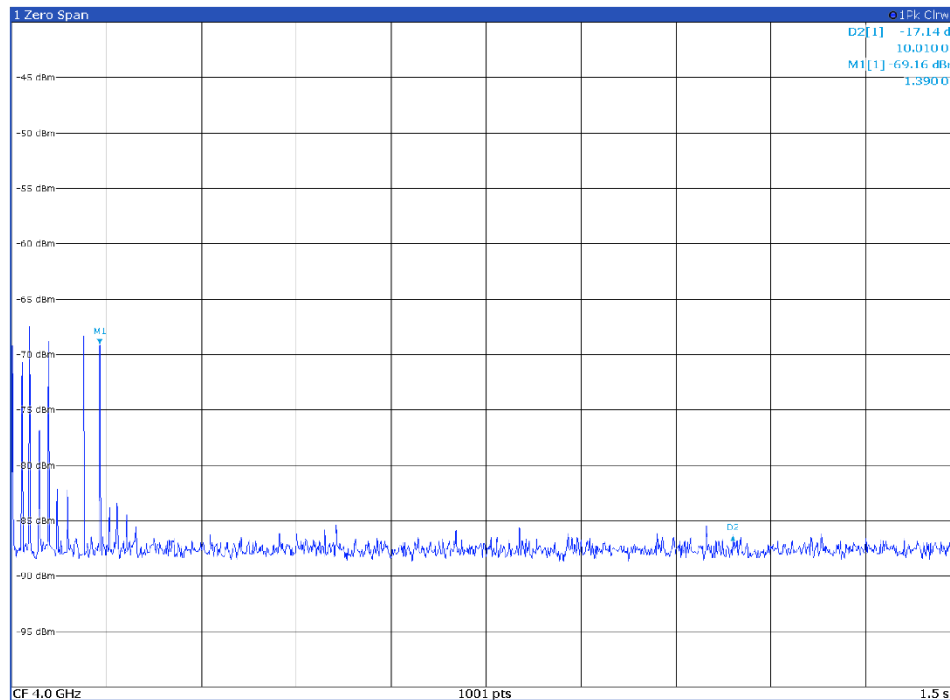
2.1 FCC Part 15 Subpart F and Subpart C, general requirements test results

Table 2.1-1: FCC test results

Part	Test description	Verdict
§15.207	Conducted emission	Pass
§15.209, §15.519(c), §15.521(d)	Radiated emission	Pass
§15.519(d)	Radiated emission in GPS band	Pass
§15.519(a)(1)	Operational limitations	Pass2
§15.503(a), §15.519(b)	10 dB Bandwidth	Pass
§15.521(g), §15.519(e)	EIRP	Pass
§15.519(a)(2), §15.203	Antenna Requirement	Pass
§15.521(h)	Frequency range	Pass ¹

Note 1: The highest frequency employed in §15.33 to determine the frequency range over which radiated measurements are made shall be based on the center frequency, f_C , unless a higher frequency is generated within the UWB device. For measuring emission levels, the spectrum shall be investigated from the lowest frequency generated in the UWB transmitter, without going below 9 kHz, up to the frequency range shown in §15.33(a) or up to $f_C + 3/(\text{pulse width in seconds})$, whichever is higher. There is no requirement to measure emissions beyond 40 GHz provided f_C is less than 10 GHz; beyond 100 GHz if f_C is at or above 10 GHz and below 30 GHz; or beyond 200 GHz if f_C is at or above 30 GHz. The center frequency of the EUT is 4 GHz. Spectrum investigated from 30 MHz to 40 GHz.

Note 2: A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting. After TAG switch off the EUT stop to transmit immediately as show in the following graphics.



Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 9, 2022
Nemko sample ID number	4851810001

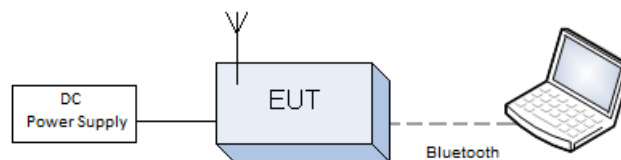
3.2 EUT information

Product name	LPS UWB 002
Model	040005

3.3 Technical information

Frequency	4 GHz
RF power Max (dBm), Units @ distance	-0.2 dBm @ 3 m with RBW of 50 MHz
Measured BW (MHz) (10 dB)	592.0 MHz
Measured BW (MHz) (99%)	839.2 MHz
Type of modulation	UWB
Emission classification (F1D, G1D, D1D)	W7D
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 TX mode

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.
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	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. Testing data

7.1 AC power line conducted emissions limits

7.1.1 Definitions and limits

FCC §15.207:

- (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Table 7.1-1: Conducted emissions limit

Frequency of emission, MHz	Conducted emissions limit, dB μ V	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Notes: * - The level decreases linearly with the logarithm of the frequency.
 ** - A linear average detector is required.

7.1.2 Test date

Start date November 16, 2022

7.1.3 Observations, settings and special notes

Port under test – Coupling device	AC Mains - Artificial Mains Network (AMN)
EUT power input during test	12 V DC Powered by a commercial AC/DC adapter model F24W2-120200SPAV
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.
Additional notes:	<ul style="list-style-type: none"> – The EUT was set up as tabletop configuration per ANSI C63.10-2013 measurement procedure. – The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance. Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB) – Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview), Quasi-peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms (Preview), 160 ms (Final)

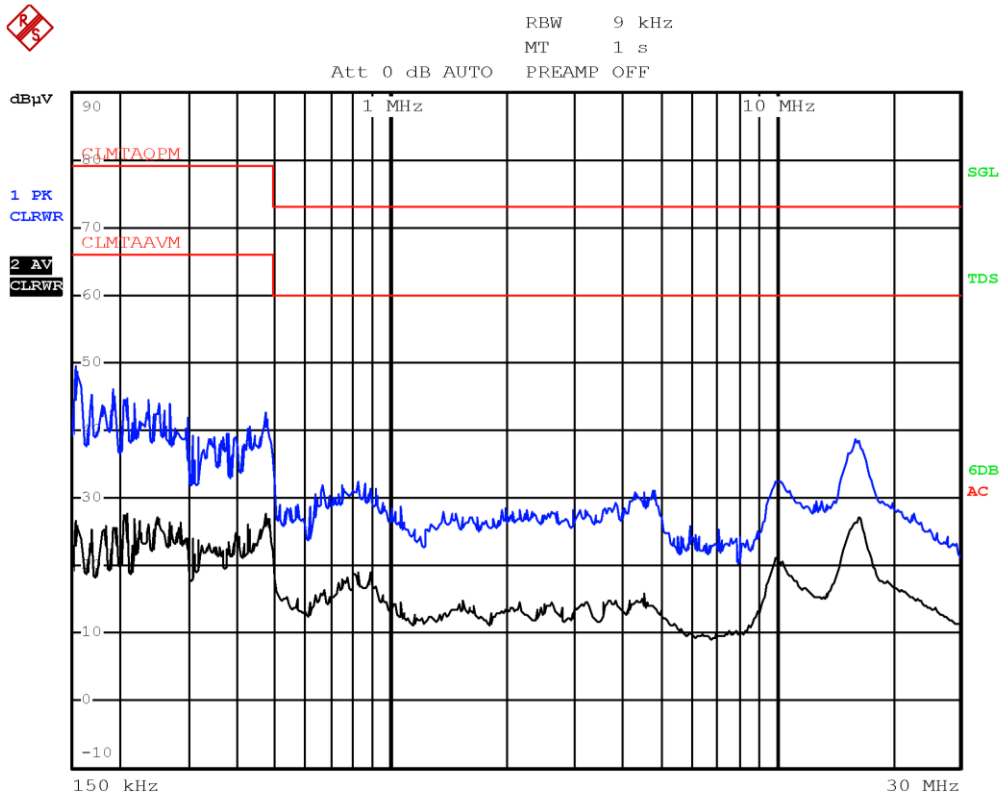
7.1.4 Test equipment list

Table 7.1-2: Equipment list

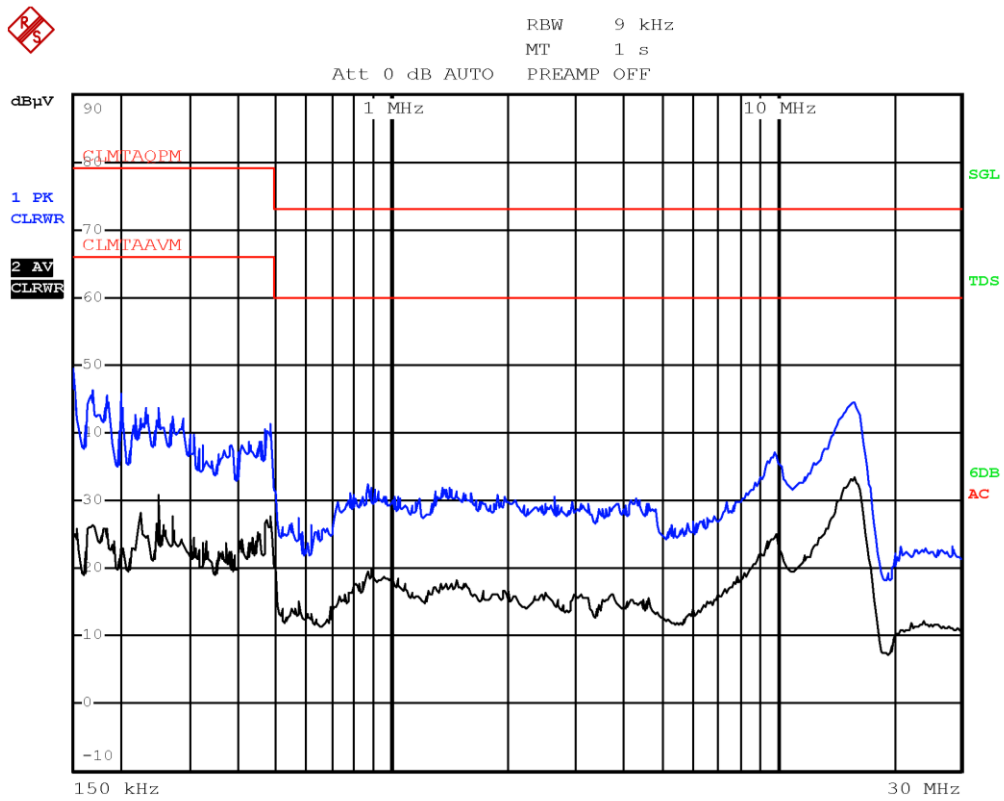
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Receiver	Rohde & Schwarz	ESU8	100202	2022-09	2023-09
LISN	Rohde & Schwarz	ENV432	101714	2022-08	2023-08
Attenuator	Aeroflex / Weinschel	2	CC8577	2022-08	2023-08
Shielded room	Siemens	Conducted emission test room	1862	NCR	NCR

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

7.1.5 Test data



Plot 7.1-1: Conducted emissions on phase line



Plot 7.1-2: Conducted emissions on neutral line

7.2 Antenna requirement

7.2.1 Definitions and limits

FCC 15.203

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 carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, 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.

FCC 15.519

(a) UWB devices operating under the provisions of this section must be hand held, i.e., they are relatively small devices that are primarily hand held while being operated and do not employ a fixed infrastructure.

(2) The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

7.2.2 Test date

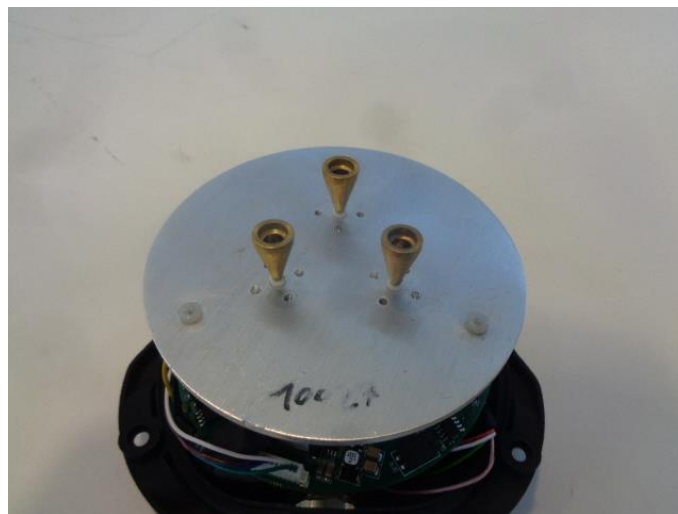
Start date November 16, 2022

7.2.3 Observations, settings and special notes

The EUT use permanently attached antenna.

7.2.4 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



7.3 10 dB Bandwidth

7.3.1 Definitions and limits

FCC 15.503

(a) UWB bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L . The frequency at which the highest radiated emission occurs is designated f_M .

(d) Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

FCC 15.519

(b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10.600 MHz.

7.3.1 Test date

Start date November 16, 2022

7.3.2 Observations, settings and special notes

Spectrum analyzer settings:

Resolution bandwidth: 1 MHz

Video bandwidth: 3 MHz

Span: 1.5 GHz

Detector mode: Peak

7.3.3 Test equipment list

Table 7.3-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-153	2021-09	2024-09
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV9718C	00121	2022-03	2023-03
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	Comtest	SAC-3	1711-150	2022-09	2024-09

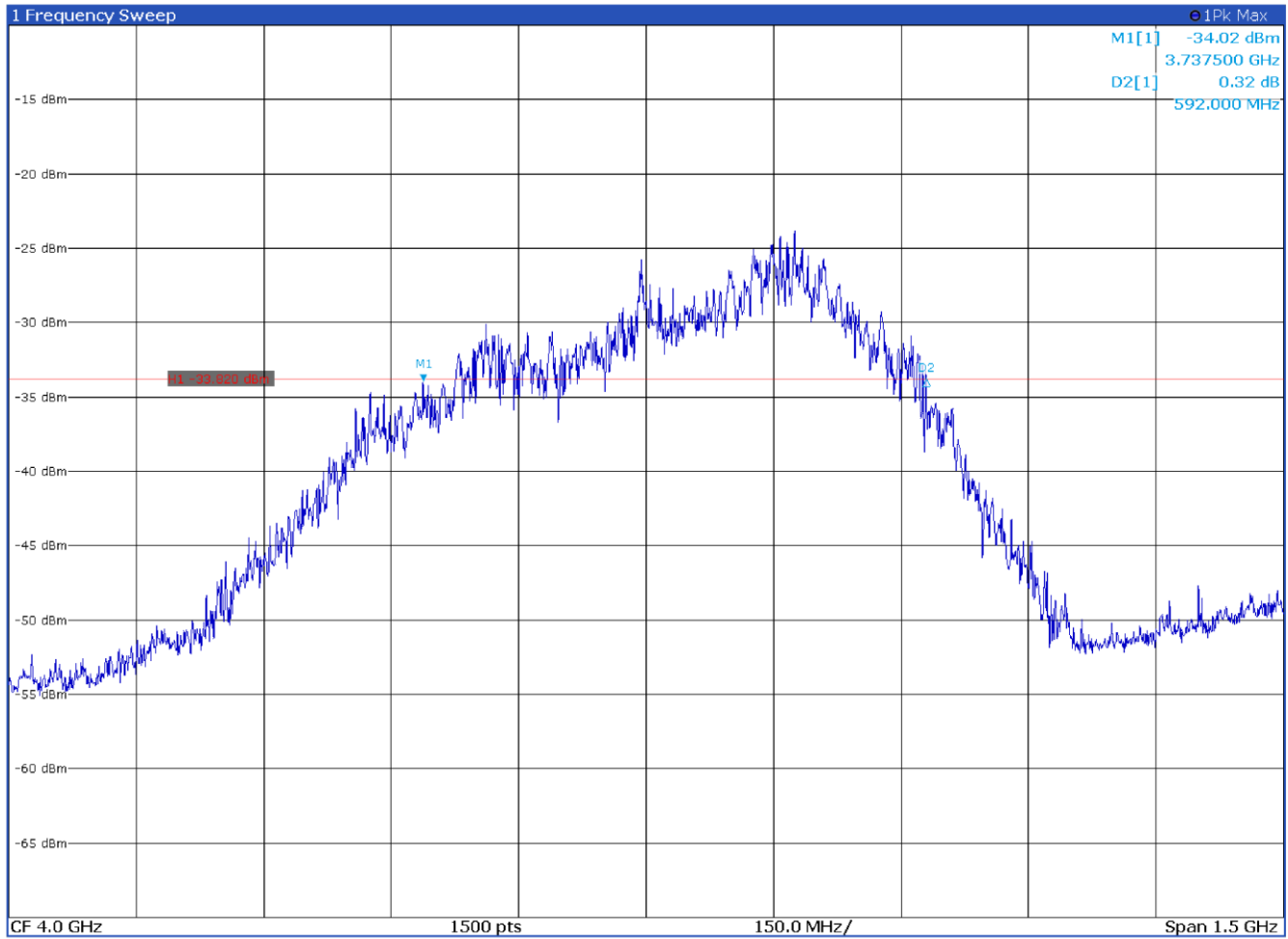
Note: NCR - no calibration required, VOU - verify on use

7.3.4 Test data

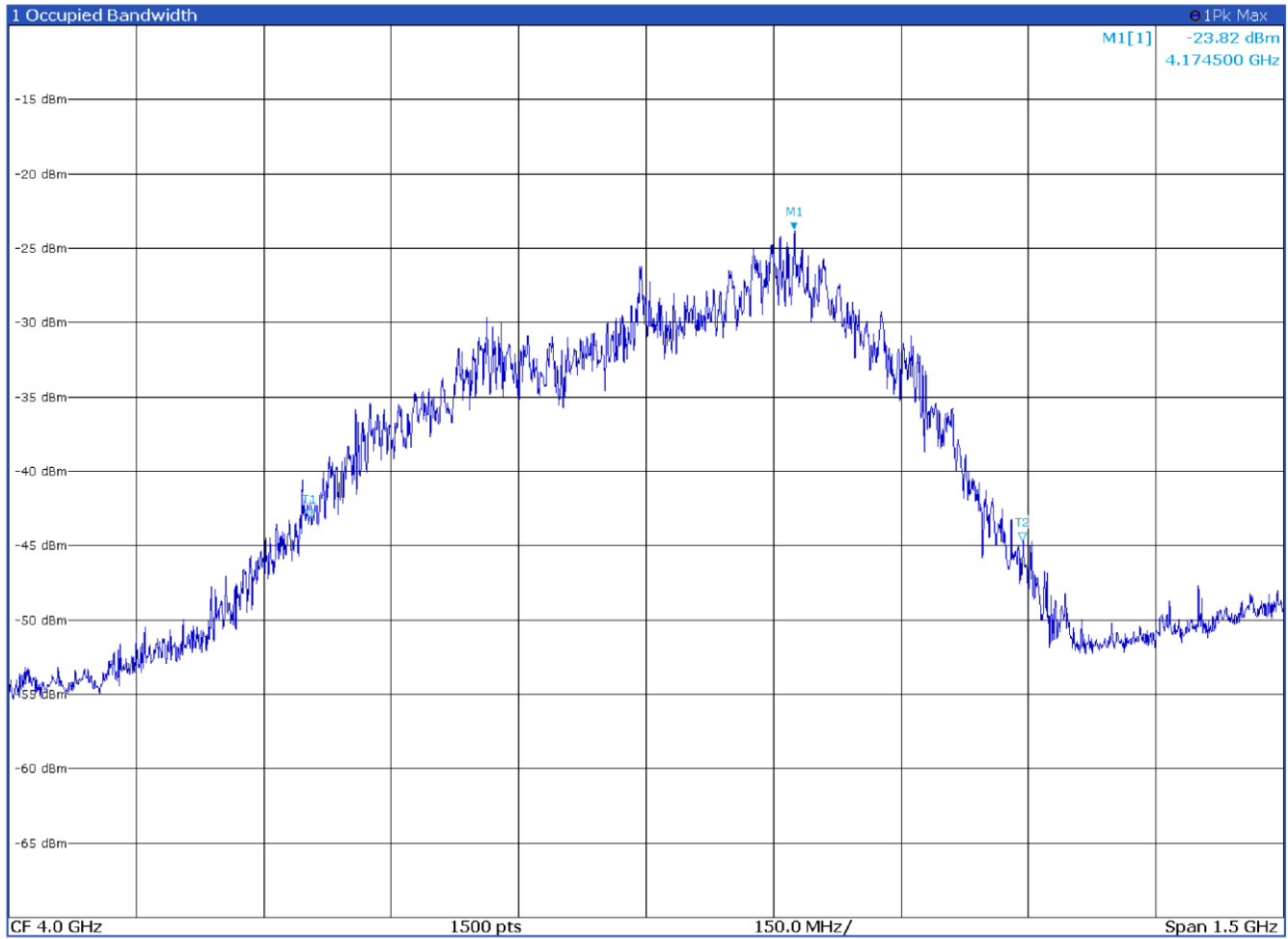
Table 7.3-2: Bandwidth measurements results

Frequency, (MHz)	10 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Margin (MHz)
4000	592.0	839.2	500	92.0

Frequency (MHz)	Lower Frequency (MHz)	Limit (MHz) Lower frequency	Upper frequency (MHz)	Limit (MHz) Upper frequency
4000	3737.5	3100	4329.5	10600



Plot 7.3-1: 10 dB Bandwidth



2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.1745 GHz	-23.82 dBm	Occ Bw	839.200839925 MHz
T1		1	3.60382 GHz	-43.17 dBm	Occ Bw Centroid	4.023421003 GHz
T2		1	4.44302 GHz	-44.71 dBm	Occ Bw Freq Offset	23.421002694 MHz

Plot 7.3-2: 99 % Bandwidth



7.4 EIRP

7.4.1 Definitions and limits

FCC 15.521

(g) When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, f_m . If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be $20 \log(\text{RBW}/50)$ dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using $E(\text{dBuV/m}) = P(\text{dBm EIRP}) + 95.2$. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

FCC 15.519

(e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_m . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

7.4.2 Test date

Start date November 11, 2022

7.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Resolution bandwidth: 50 MHz
 Video bandwidth: 50 MHz
 Detector mode: Peak

7.4.4 Test equipment list

Table 7.4-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-153	2021-09	2024-09
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV9718C	00121	2022-03	2023-03
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	Comtest	SAC-3	1711-150	2022-09	2024-09

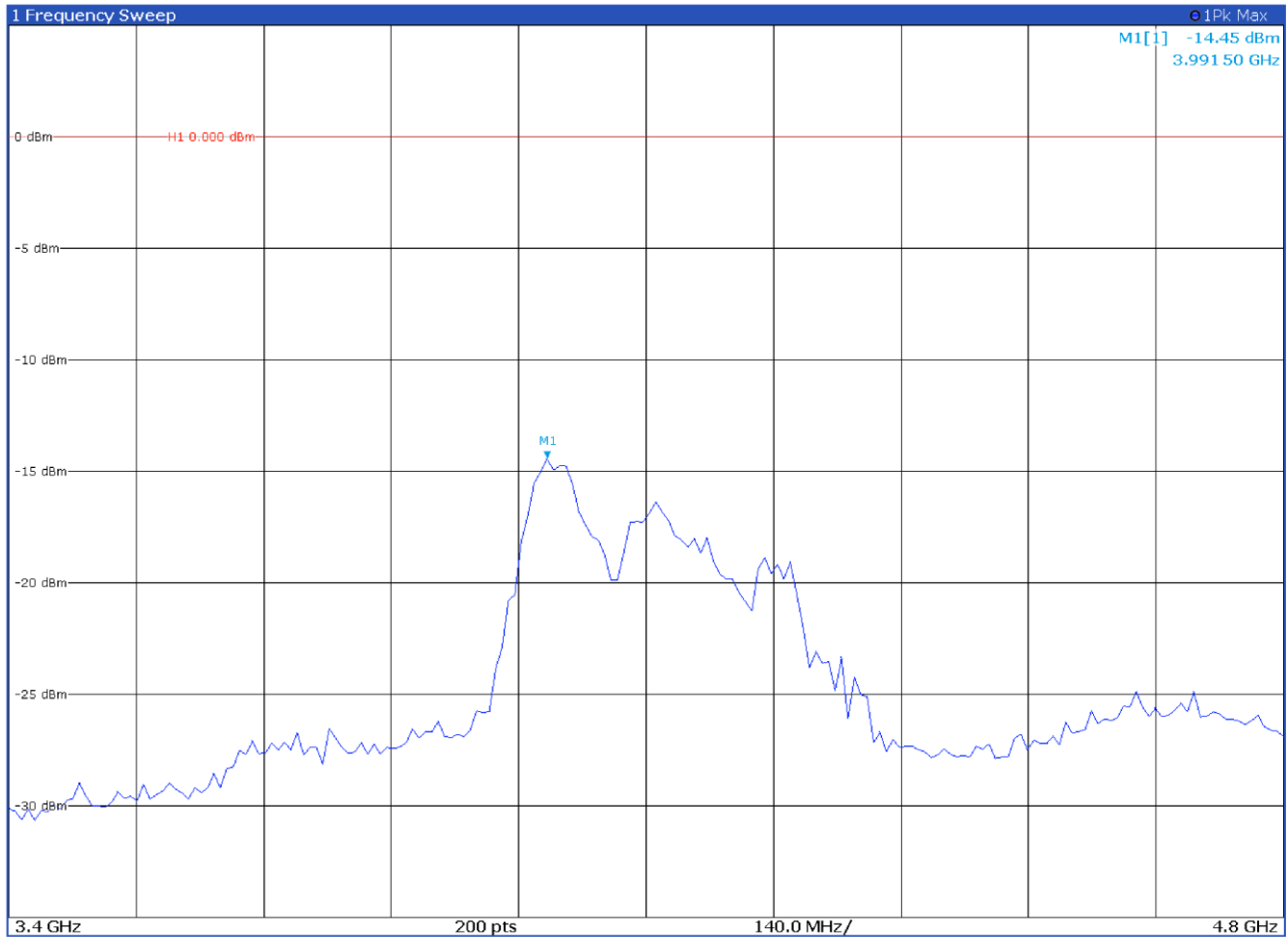
Note: NCR - no calibration required, VOU - verify on use



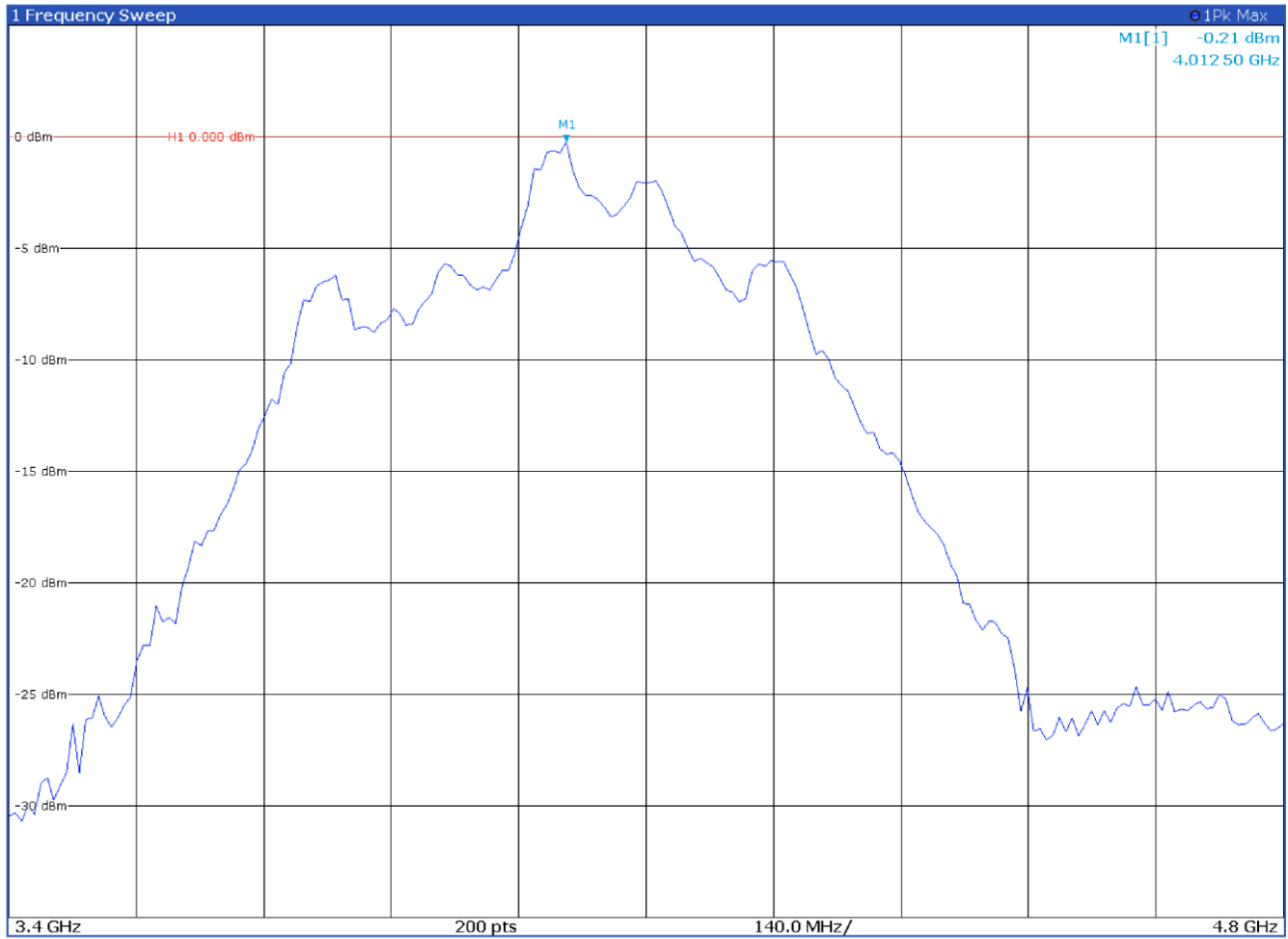
7.4.5 Test data

Table 7.4-2: Eirp measurements results

Frequency, GHz	Antenna Polarization	Measure Level dBm	Limit dBm	Margin dB	Detector
3.9915	H	-14.4	0	-14.4	PK
4.0125	V	-0.2	0	-0.2	PK



Plot 7.4-1: Peak power with antenna in horizontal polarization



Plot 7.4-2: Peak power with antenna in horizontal polarization

7.5 Radiated emissions

7.5.1 Definitions and limits

FCC 15.519

(c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 7.5-1: Average limits

Frequency in MHz	EIRP in dBm
960 – 1610	-75.3
1610 – 1990	-63.3
1990 – 3100	-61.3
3100 – 10600	-41.3
Above 10600	-61.3

Notes: --

FCC 15.521

(d) Within the tables in §§15.509, 15.511, 15.513, 15.515, 15.517, and 15.519, the tighter emission limit applies at the band edges. Radiated emission levels at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Radiated emission levels above 960 MHz are based on RMS average measurements over a 1 MHz resolution bandwidth. The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time. Unless otherwise stated, if pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on. Alternative measurement procedures may be considered by the Commission.

(e) The frequency at which the highest radiated emission occurs, f_m , must be contained within the UWB bandwidth.

Table 7.5-2: FCC §15.209 – Radiated emission limits below 1 GHz

Frequency, MHz	Field strength of emissions		Measurement distance, m
	$\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m}$	
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.

7.5.2 Test date

Start date November 11, 2022

7.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz according to §15.33(a)(1)

Spectrum analyzer settings for peak radiated measurements below 1000 MHz pre-scan

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyzer settings for peak radiated measurements above 1000 MHz pre-scan

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyzer settings for average radiated measurements above 960 MHz pre-scan

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	RMS
Trace mode:	Max Hold

7.5.4 Test equipment list

Table 7.5-3: Equipment list

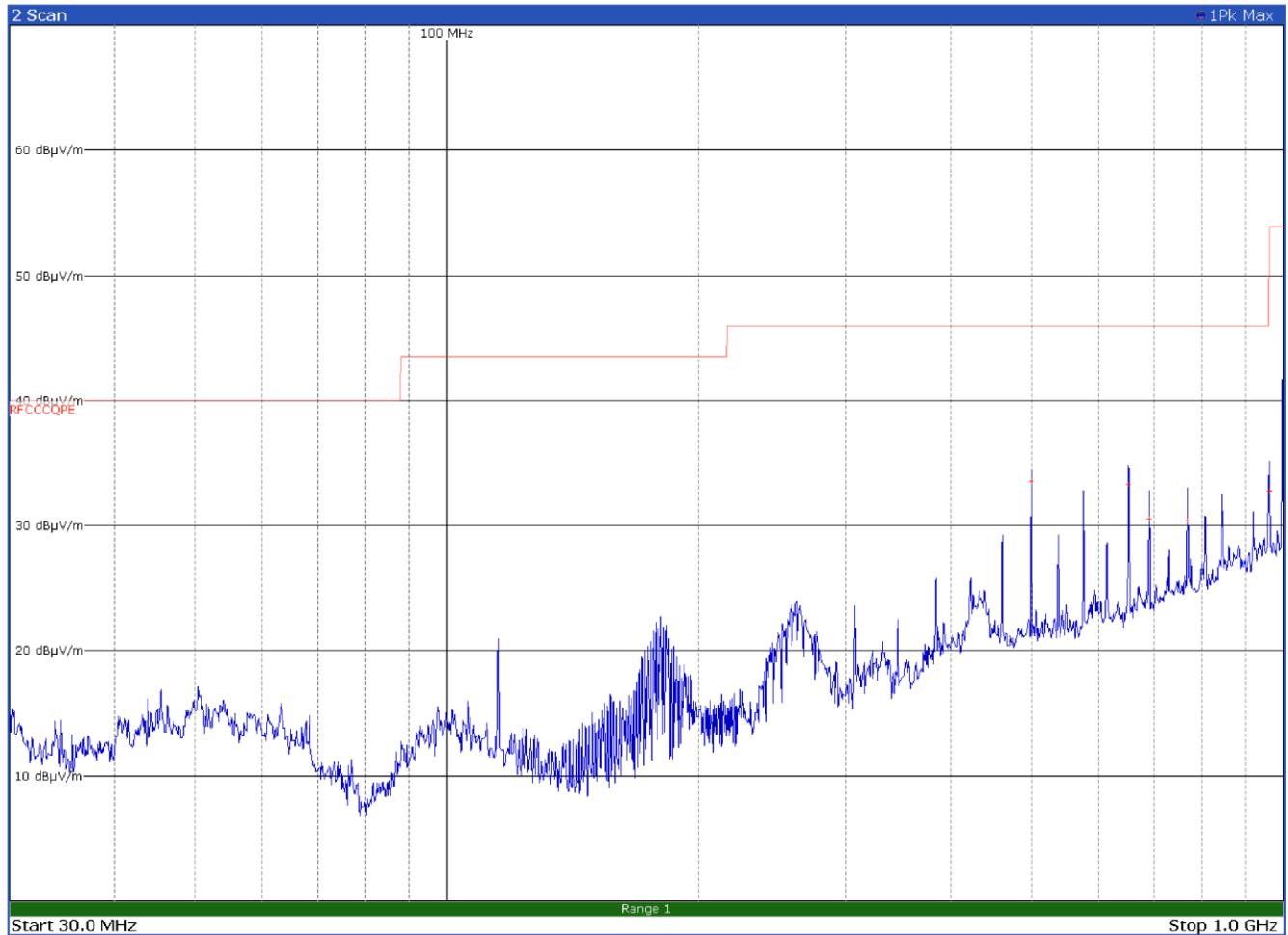
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07	2024-07
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09	2024-09
Double 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
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

Note: NCR - no calibration required, VOI - verify on use



7.5.5 Test data

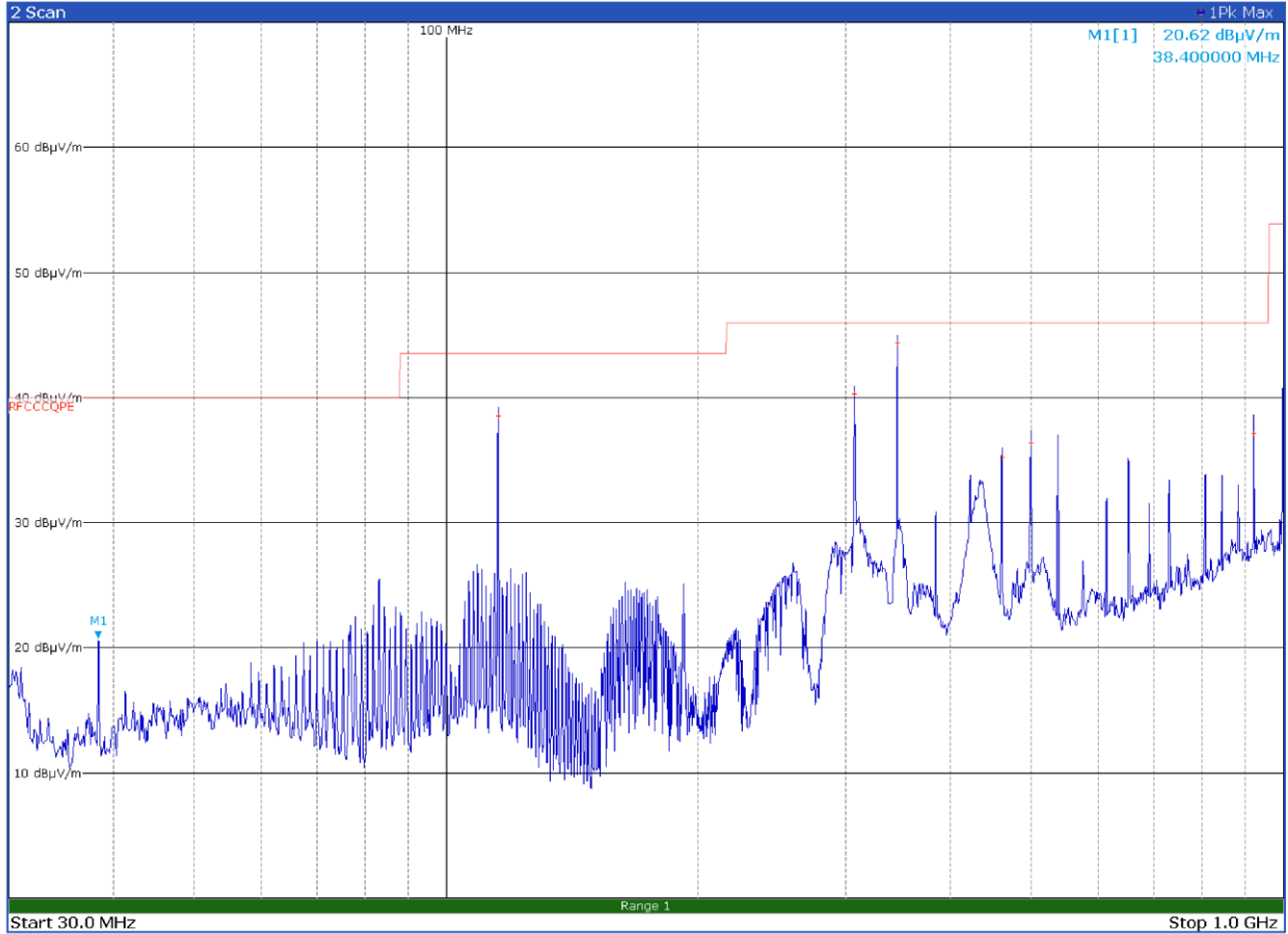
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	30 to 1000 MHz	FCC §15.209 with UWB ON	P



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



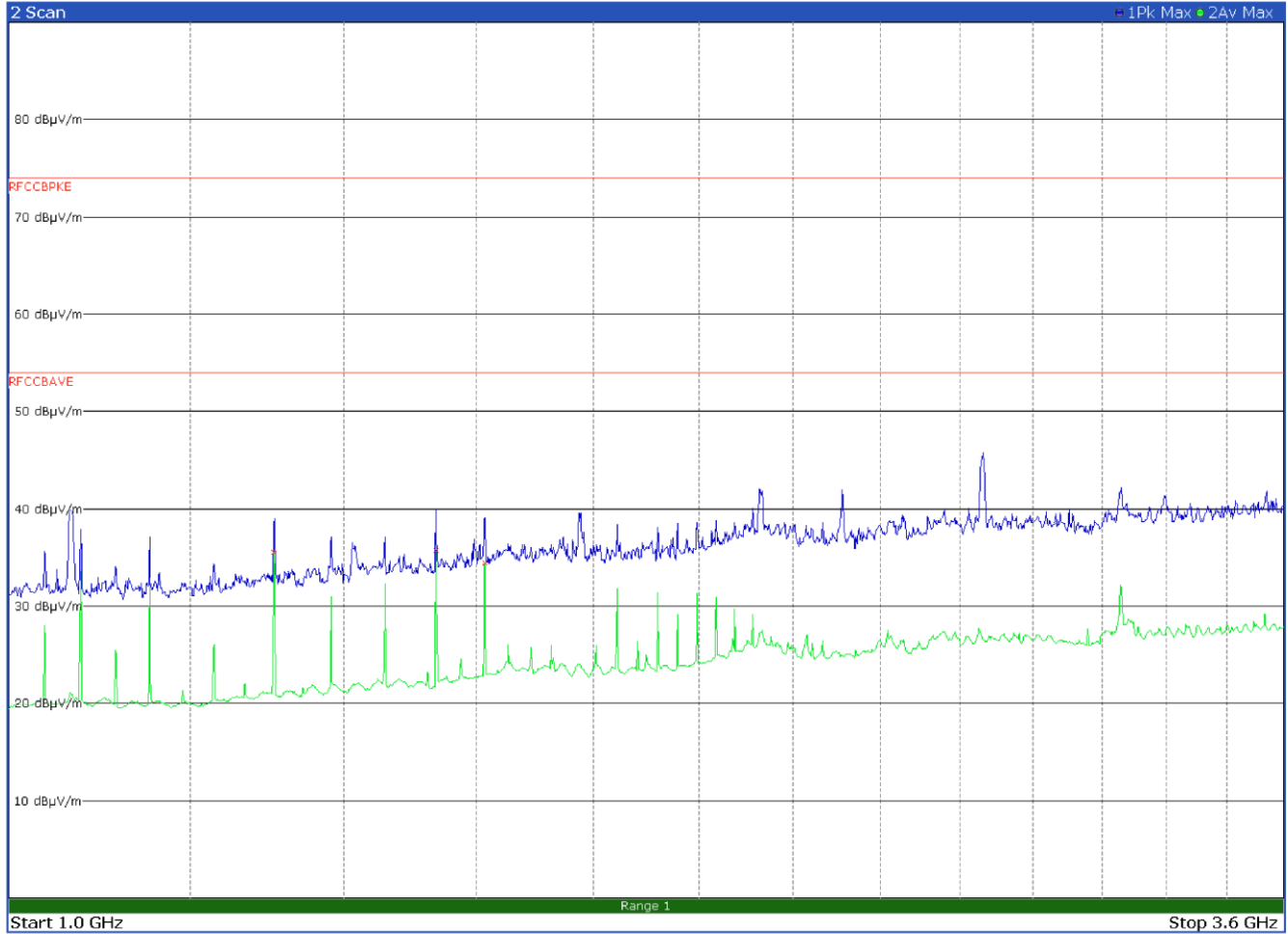
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	30 to 1000 MHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
115.2000	38.6	43.5	-4.9	QP
307.2000	40.3	46.0	-5.7	QP
345.6000	44.4	46.0	-1.6	QP
460.8000	35.3	46.0	-10.7	QP
499.2000	36.5	46.0	-9.5	QP
921.6000	37.2	46.0	-8.8	QP



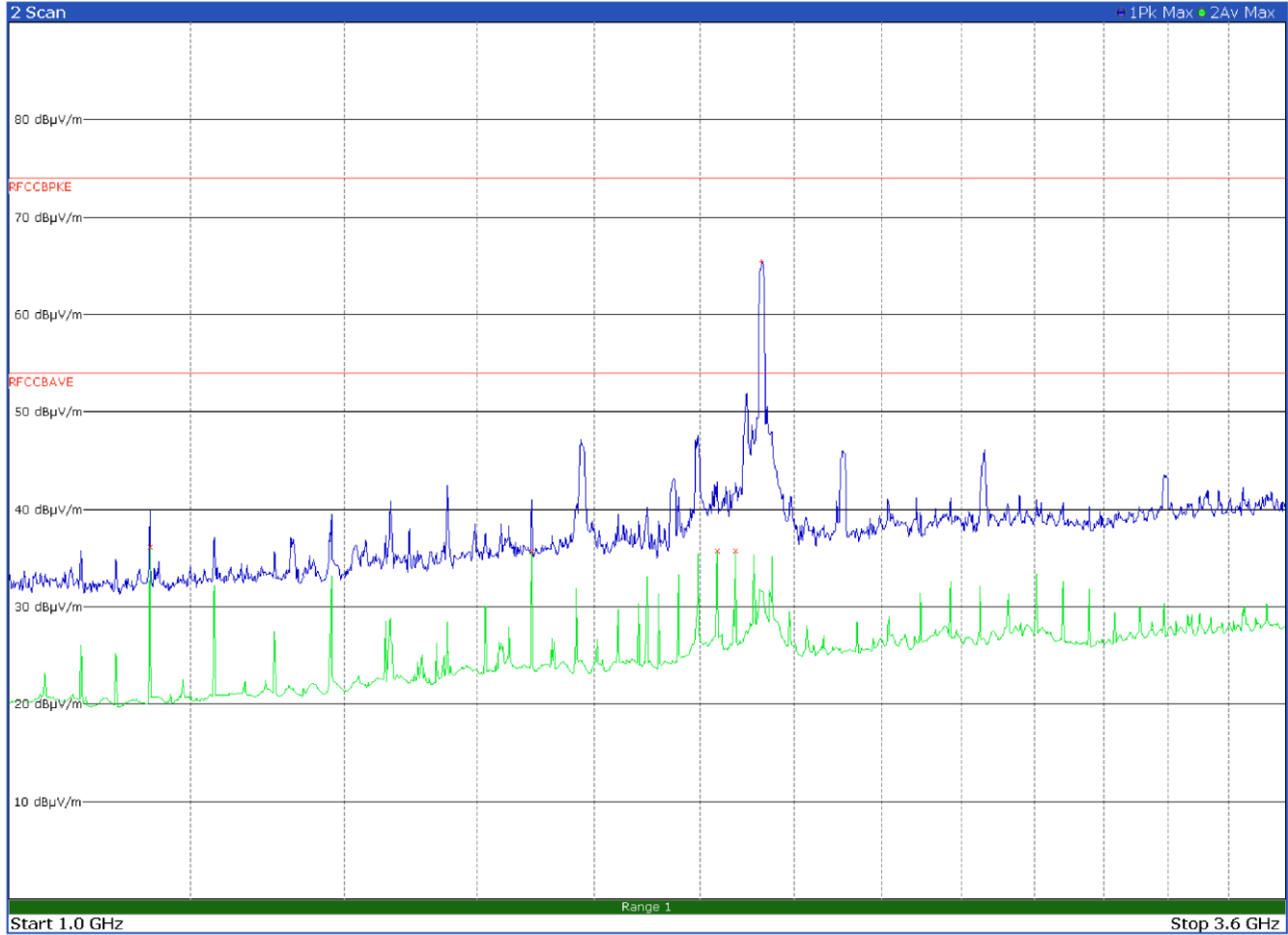
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1 to 3.6 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1305.5000	35.6	54.0	-18.4	Av
1536.0000	35.8	54.0	-18.2	Av
1612.7500	34.5	54.0	-19.5	Av



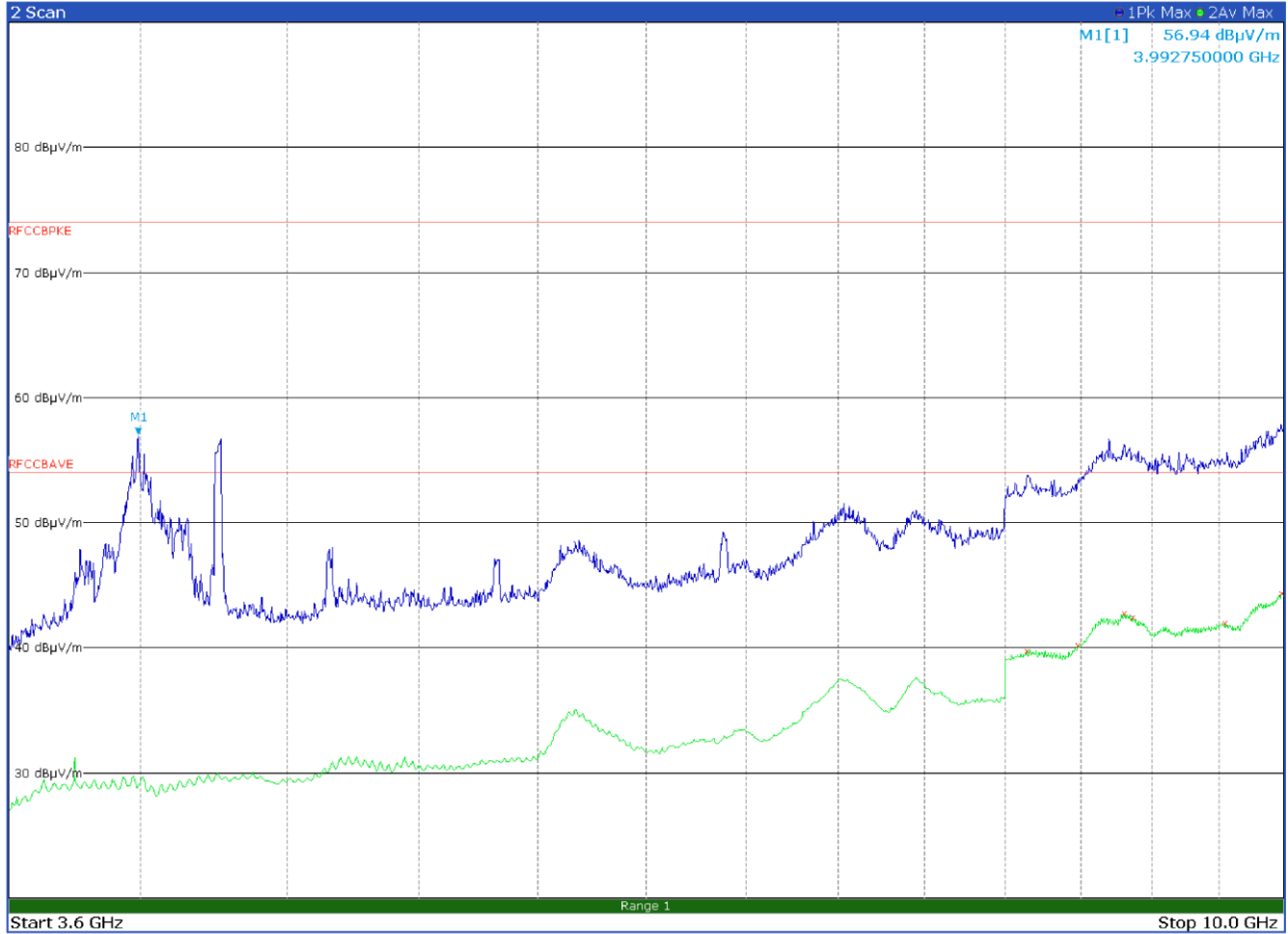
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1 to 3.6 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1152.0000	36.1	54.0	-17.9	Av
1689.5000	35.6	54.0	-18.4	Av
2035.2500	35.7	54.0	-18.3	Av
2073.5000	35.8	54.0	-18.2	Av
2129.0000	65.4	74.0	-8.6	Pk



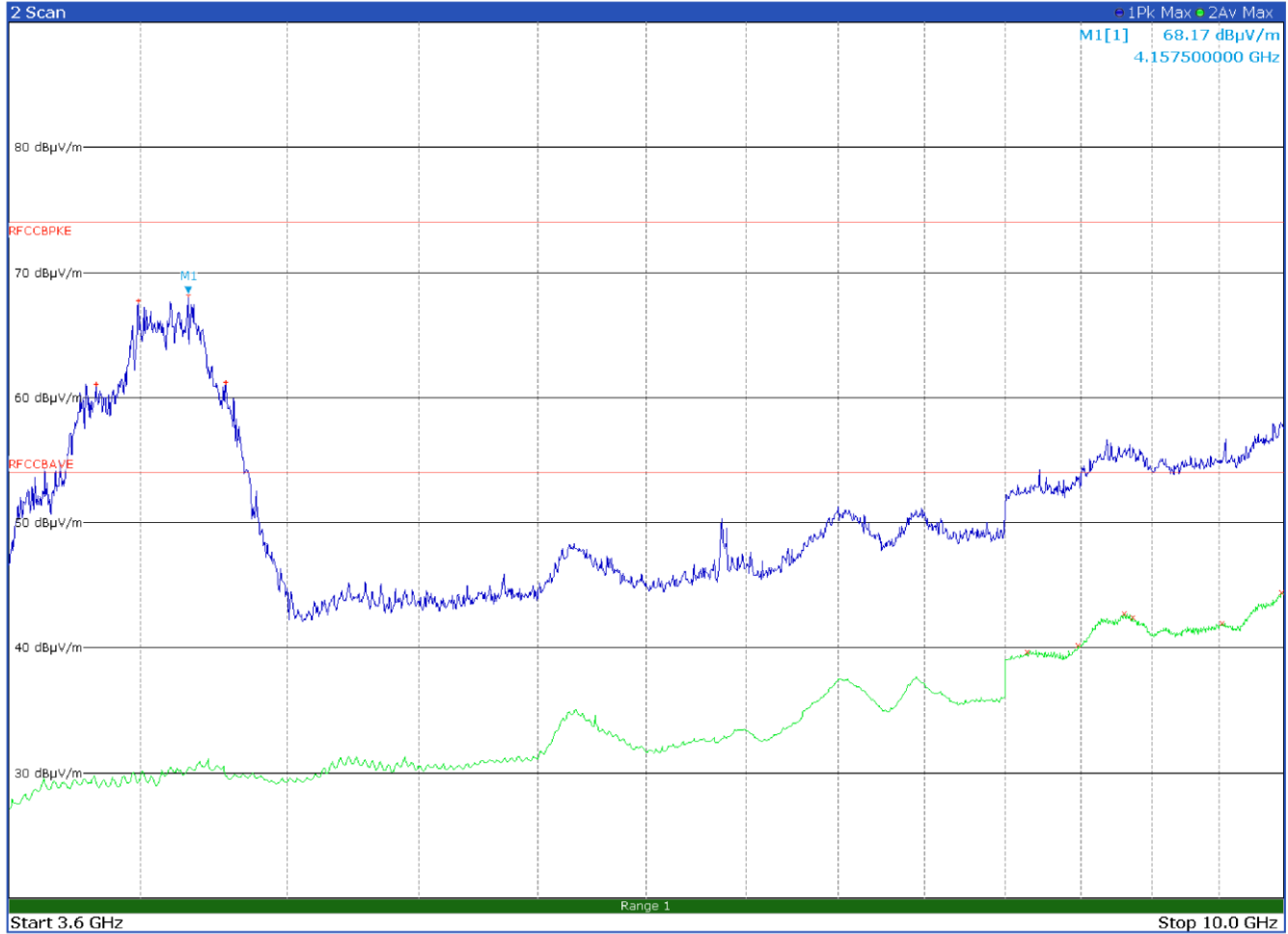
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	3.6 to 10 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
8140.2500	39.7	54.0	-14.3	Av
8480.5000	40.2	54.0	-13.8	Av
8801.0000	42.8	54.0	-11.2	Av
8860.2500	42.5	54.0	-11.5	Av
9541.0000	42.0	54.0	-12.0	Av
9981.2500	44.4	54.0	-9.6	Av



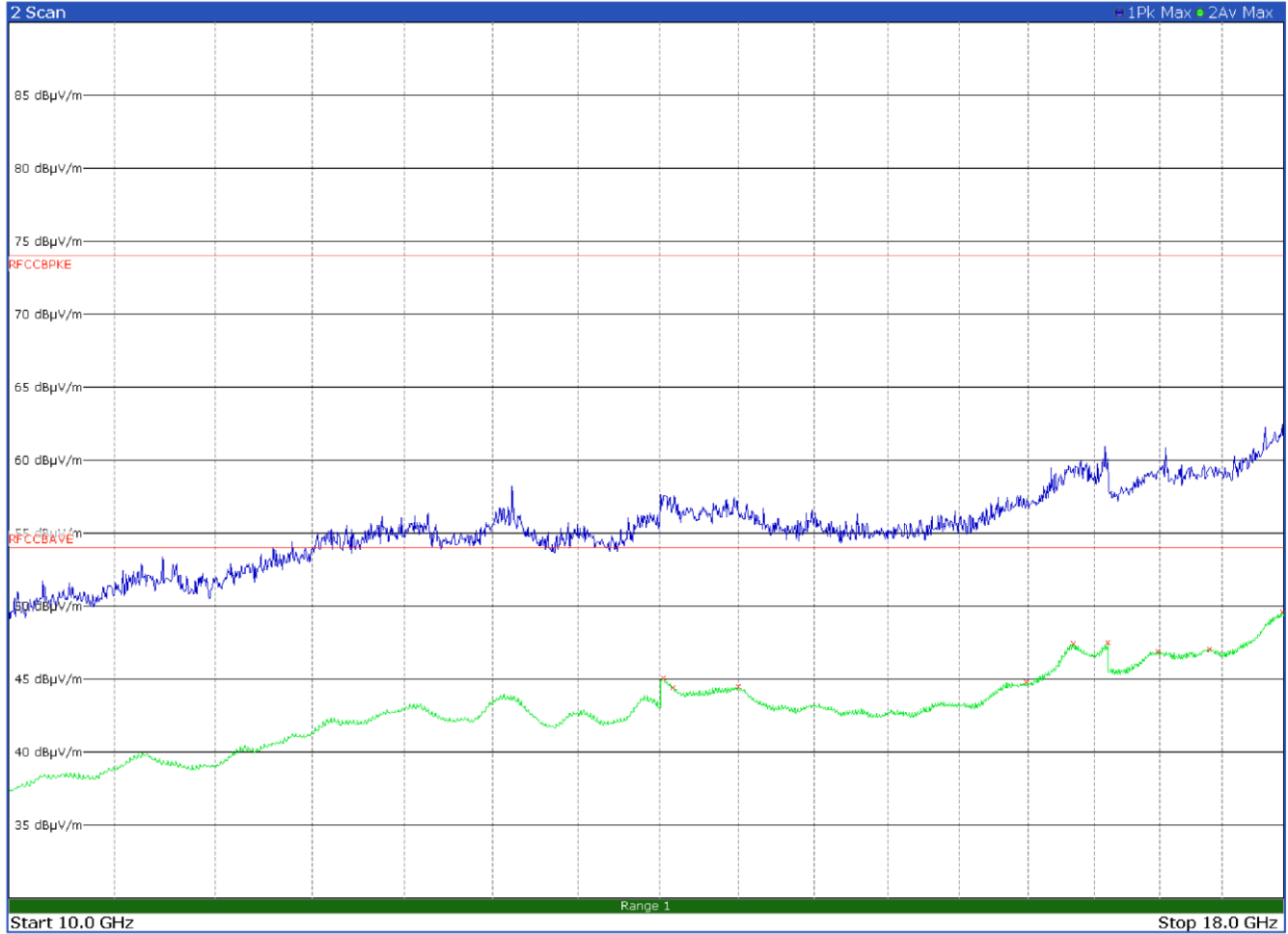
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	3.6 to 10 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
3860.7500	61.1	74.0	-12.9	Pk
3994.5000	67.8	74.0	-6.2	Pk
4157.5000	68.2	74.0	-5.8	Pk
4282.2500	61.2	74.0	-12.8	Pk
8141.0000	39.7	54.0	-14.3	Av
8481.0000	40.2	54.0	-13.8	Av
8800.2500	42.8	54.0	-11.2	Av
8860.2500	42.5	54.0	-11.5	Av
9520.2500	42.0	54.0	-12.0	Av
9981.0000	44.4	54.0	-9.6	Av



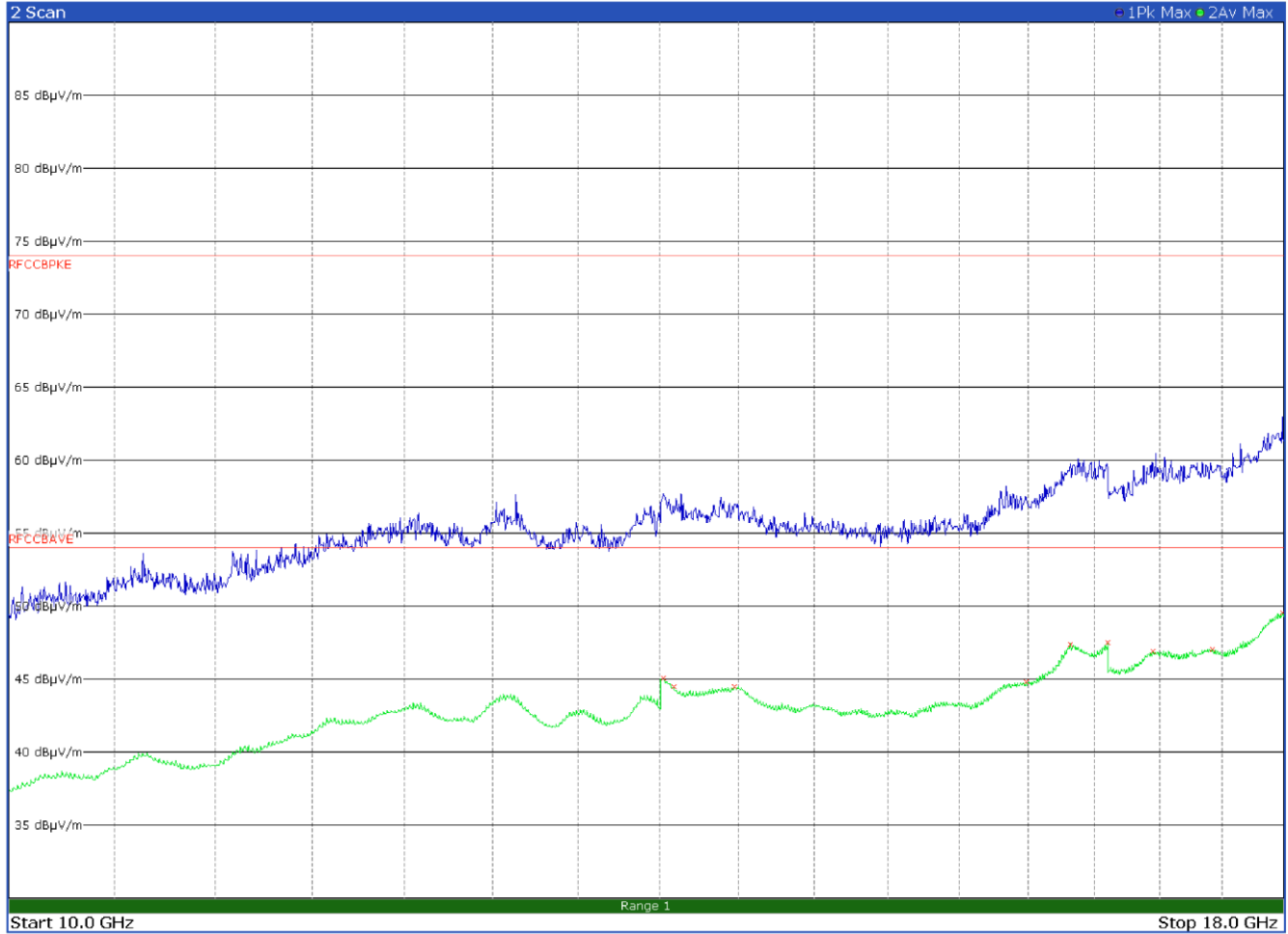
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	10 to 18 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
13524.0000	45.1	54.0	-8.9	Av
13586.2500	44.5	54.0	-9.5	Av
13996.2500	44.5	54.0	-9.5	Av
15985.7500	44.8	54.0	-9.2	Av
16334.2500	47.5	54.0	-6.5	Av
16599.5000	47.5	54.0	-6.5	Av
16988.7500	46.9	54.0	-7.1	Av
17400.2500	47.1	54.0	-6.9	Av
17994.5000	49.7	54.0	-4.3	Av



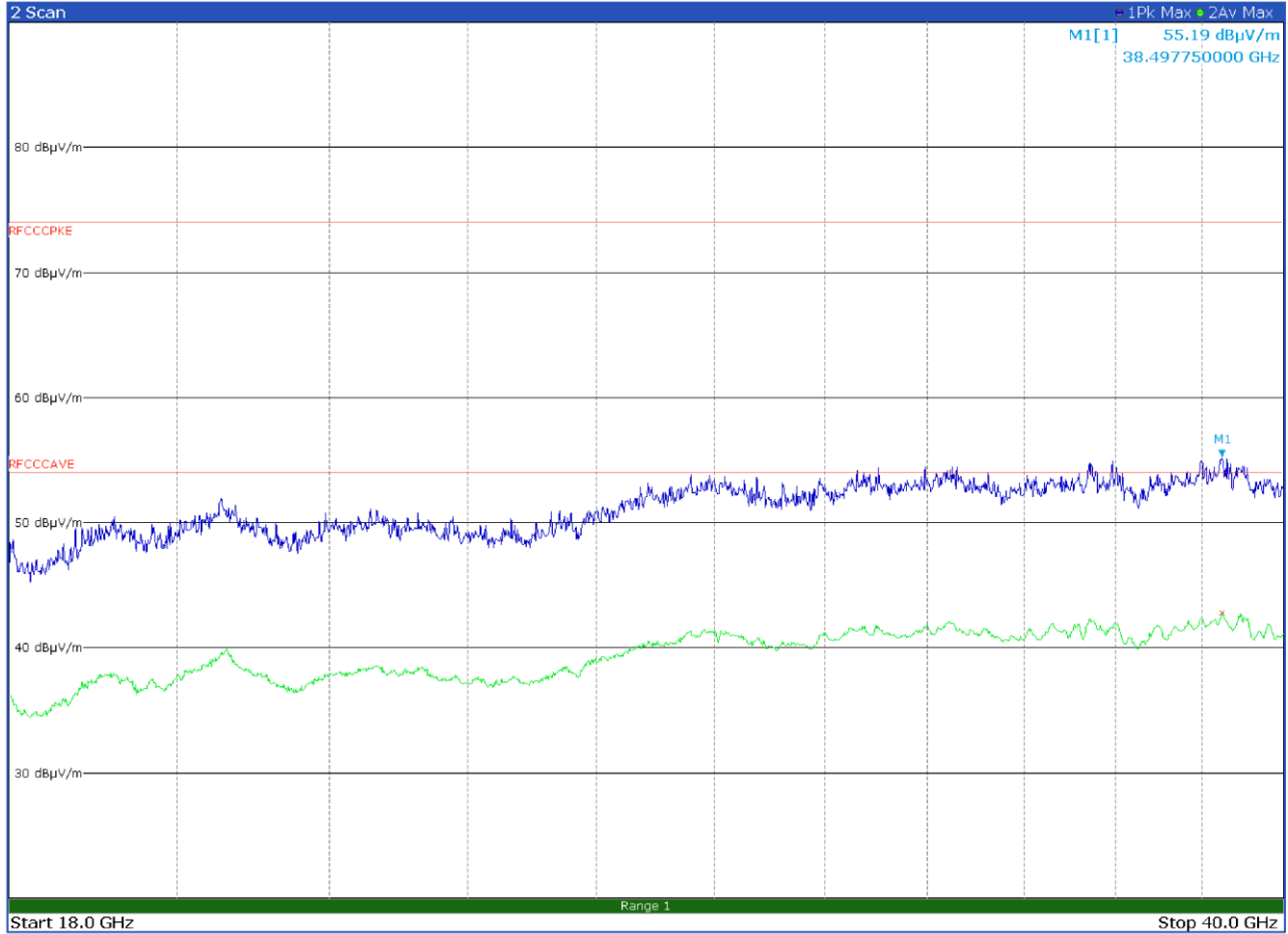
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	10 to 18 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
13524.7500	45.1	54.0	-8.9	Av
13587.0000	44.5	54.0	-9.5	Av
13976.0000	44.5	54.0	-9.5	Av
15985.7500	44.8	54.0	-9.2	Av
16313.7500	47.4	54.0	-6.6	Av
16600.7500	47.6	54.0	-6.4	Av
16949.2500	47.0	54.0	-7.0	Av
17419.5000	47.1	54.0	-6.9	Av
17994.7500	49.6	54.0	-4.4	Av



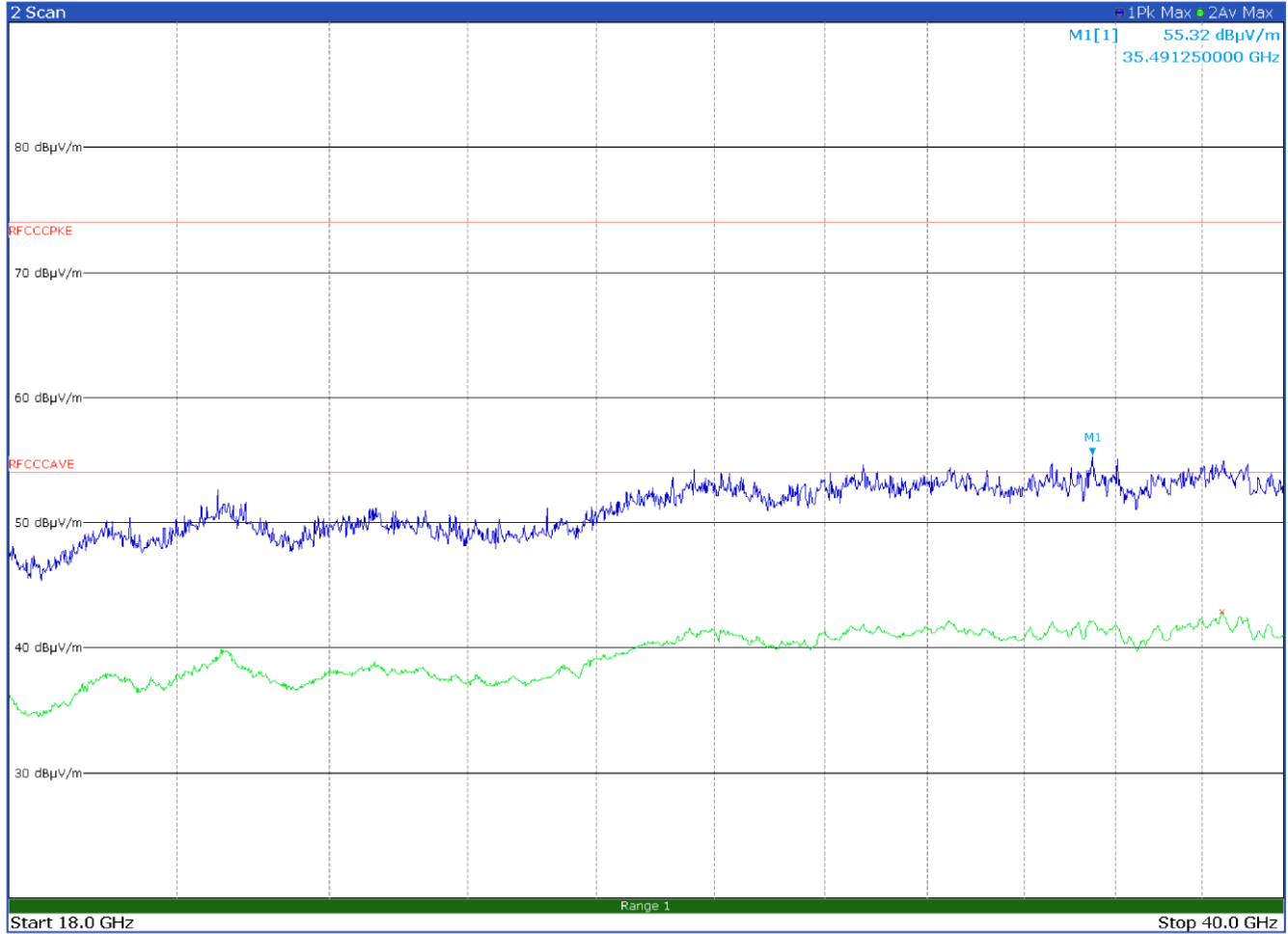
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	18 to 40 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
38498.7500	42.8	54.0	-11.2	Av



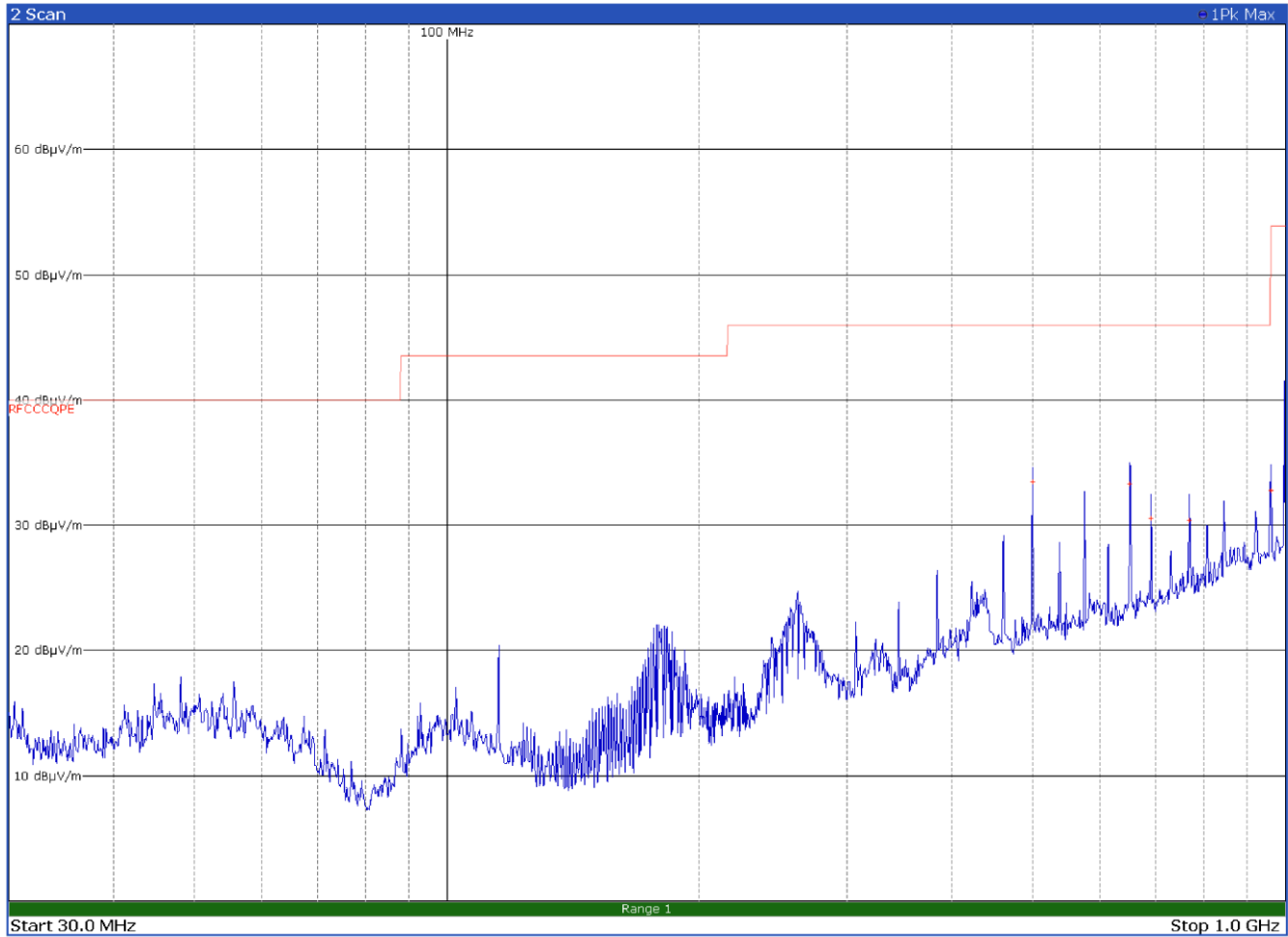
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	18 to 40 GHz	FCC §15.209 with UWB ON	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
38495.2500	42.9	54.0	-11.1	Av



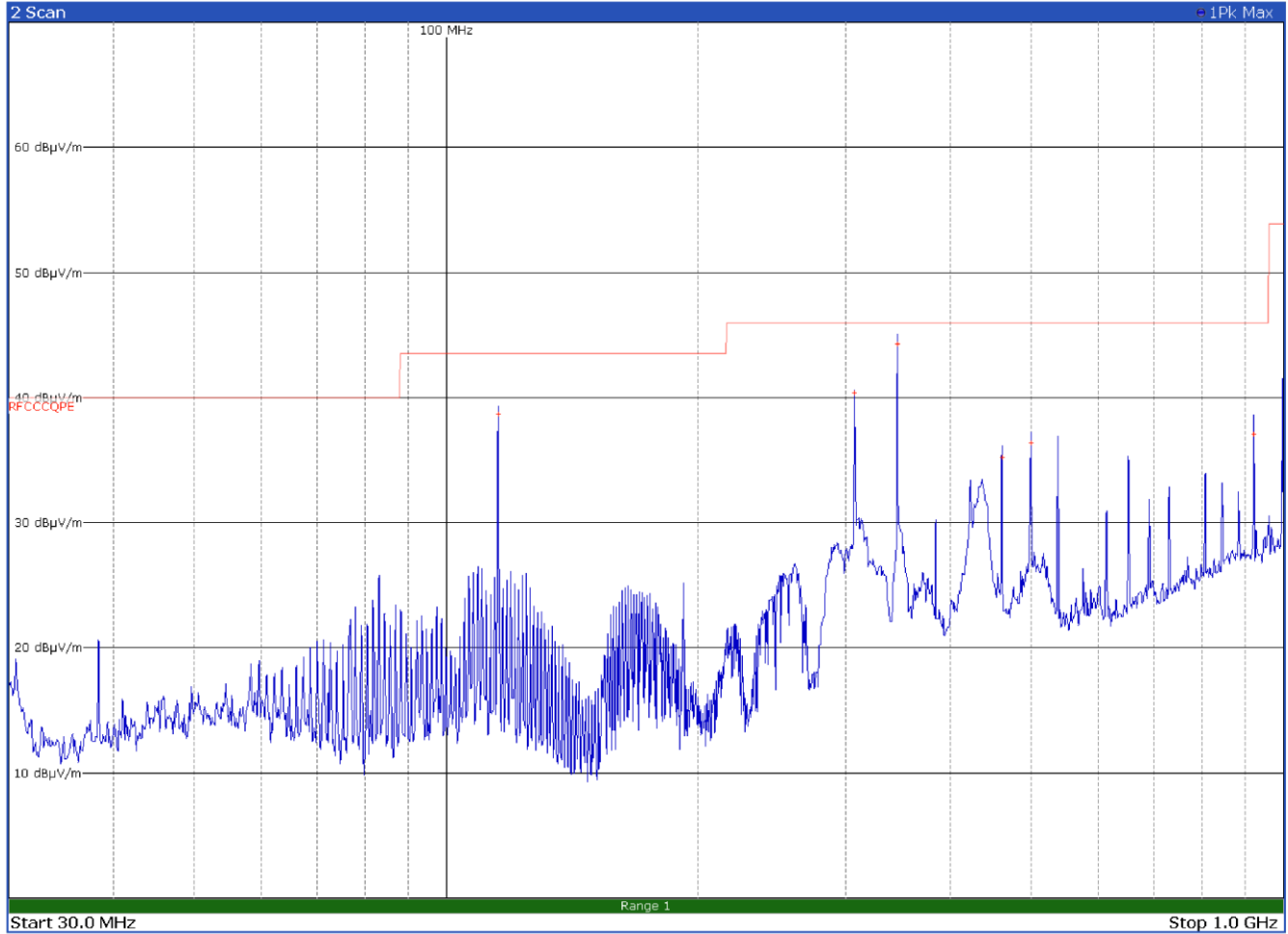
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	30 to 1000 MHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
499.2000	33.5	46.0	-12.5	QP
652.8000	33.3	46.0	-12.7	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



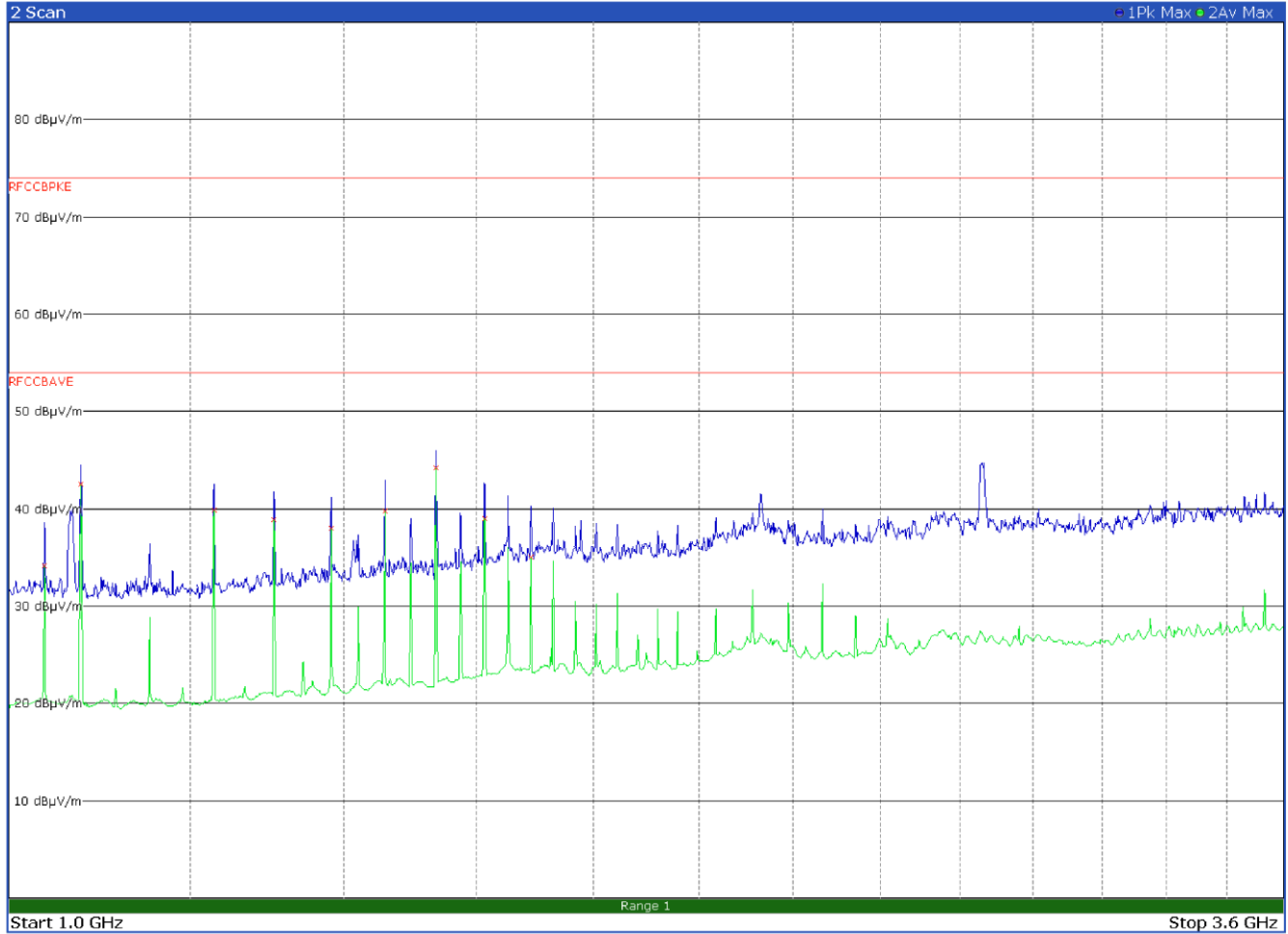
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	30 to 1000 MHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
115.2000	38.7	43.5	-4.8	QP
307.2000	40.4	46.0	-5.6	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



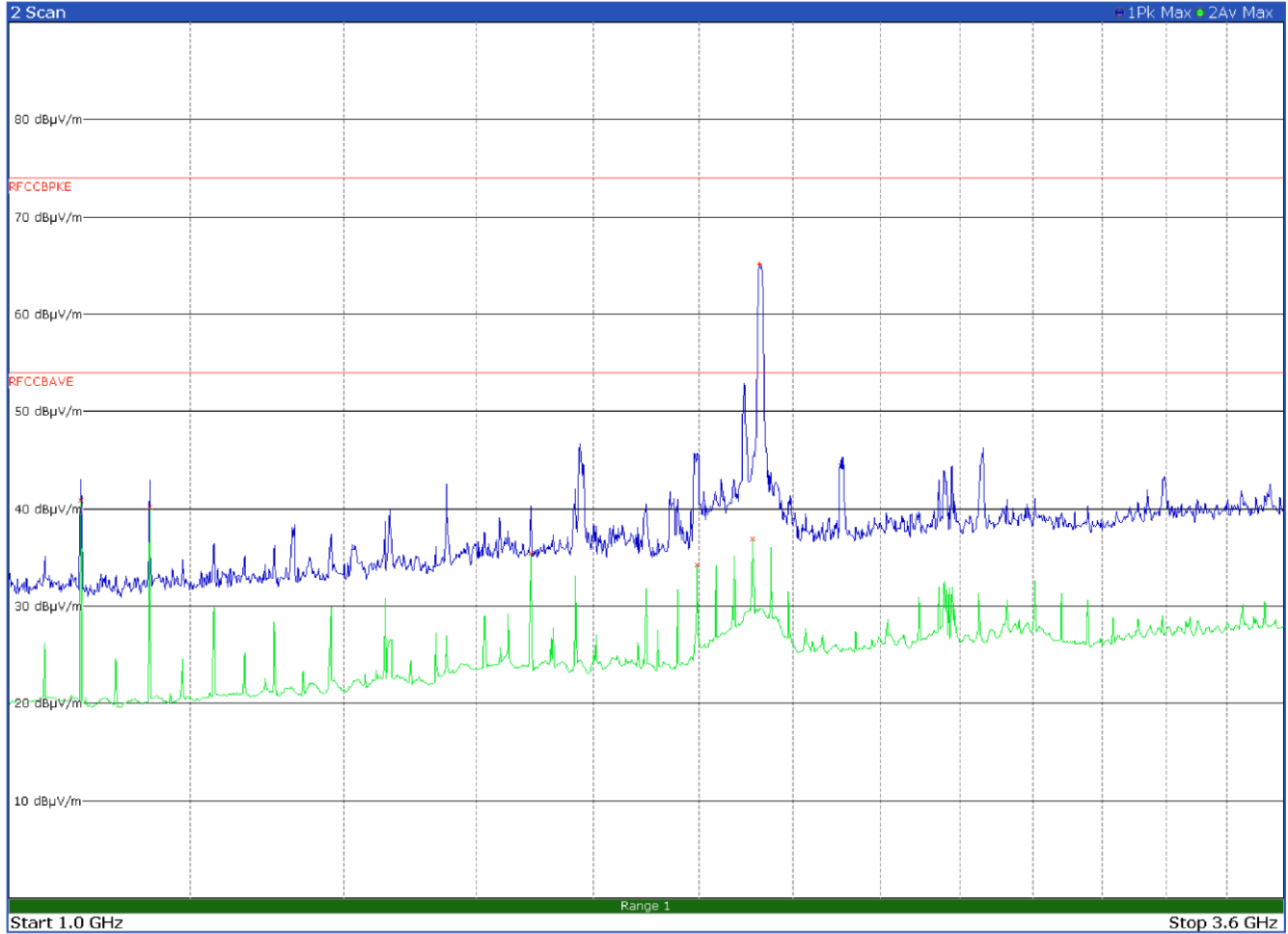
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1 to 3.6 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1036.7500	34.2	54.0	-19.8	Av
1075.2500	42.6	54.0	-11.4	Av
1228.7500	39.9	54.0	-14.1	Av
1305.5000	38.9	54.0	-15.1	Av
1382.5000	38.1	54.0	-15.9	Av
1459.2500	39.8	54.0	-14.2	Av
1536.0000	44.3	54.0	-9.7	Av
1612.7500	39.0	54.0	-15.0	Av
1689.5000	35.1	54.0	-18.9	Av



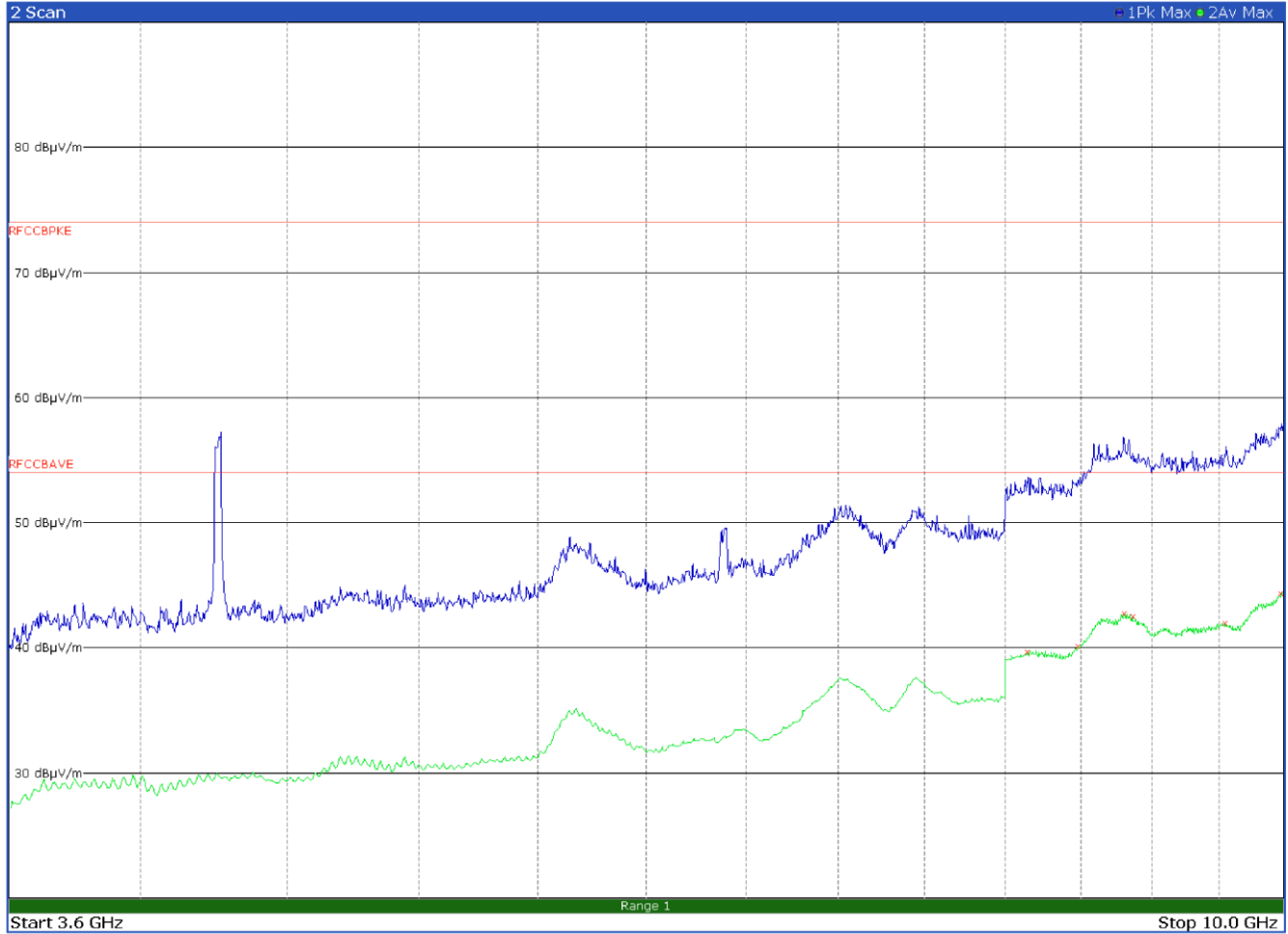
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1 to 3.6 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1075.2500	40.9	54.0	-13.1	Av
1152.0000	40.2	54.0	-13.8	Av
1689.5000	35.5	54.0	-18.5	Av
1996.7500	34.3	54.0	-19.7	Av
2112.0000	36.9	54.0	-17.1	Av
2125.5000	65.2	74.0	-8.8	Pk



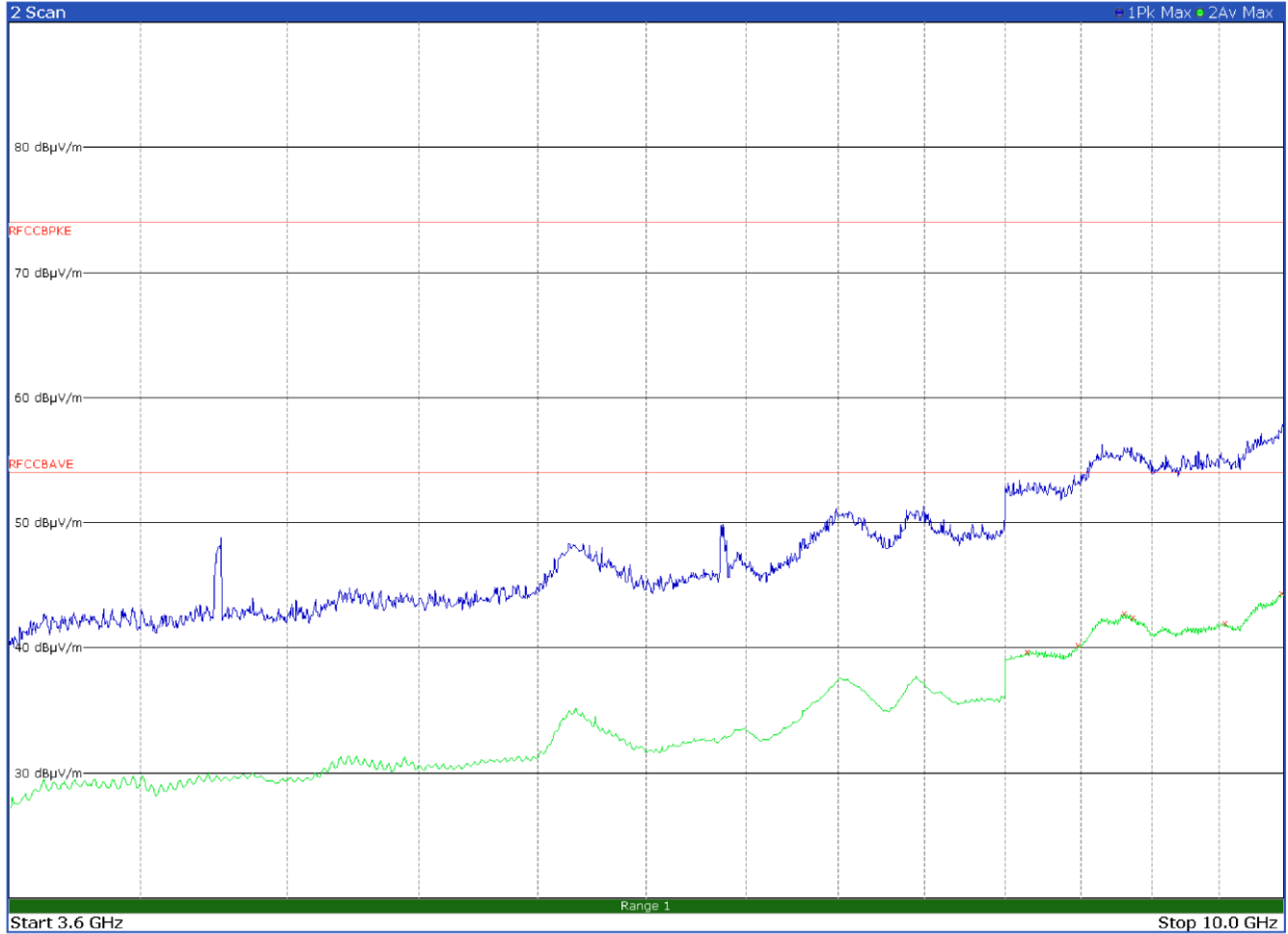
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	3.6 to 10 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
8141.0000	39.7	54.0	-14.3	Av
8481.2500	40.2	54.0	-13.8	Av
8800.2500	42.8	54.0	-11.2	Av
8860.5000	42.5	54.0	-11.5	Av
9541.0000	42.0	54.0	-12.0	Av
9980.2500	44.4	54.0	-9.6	Av



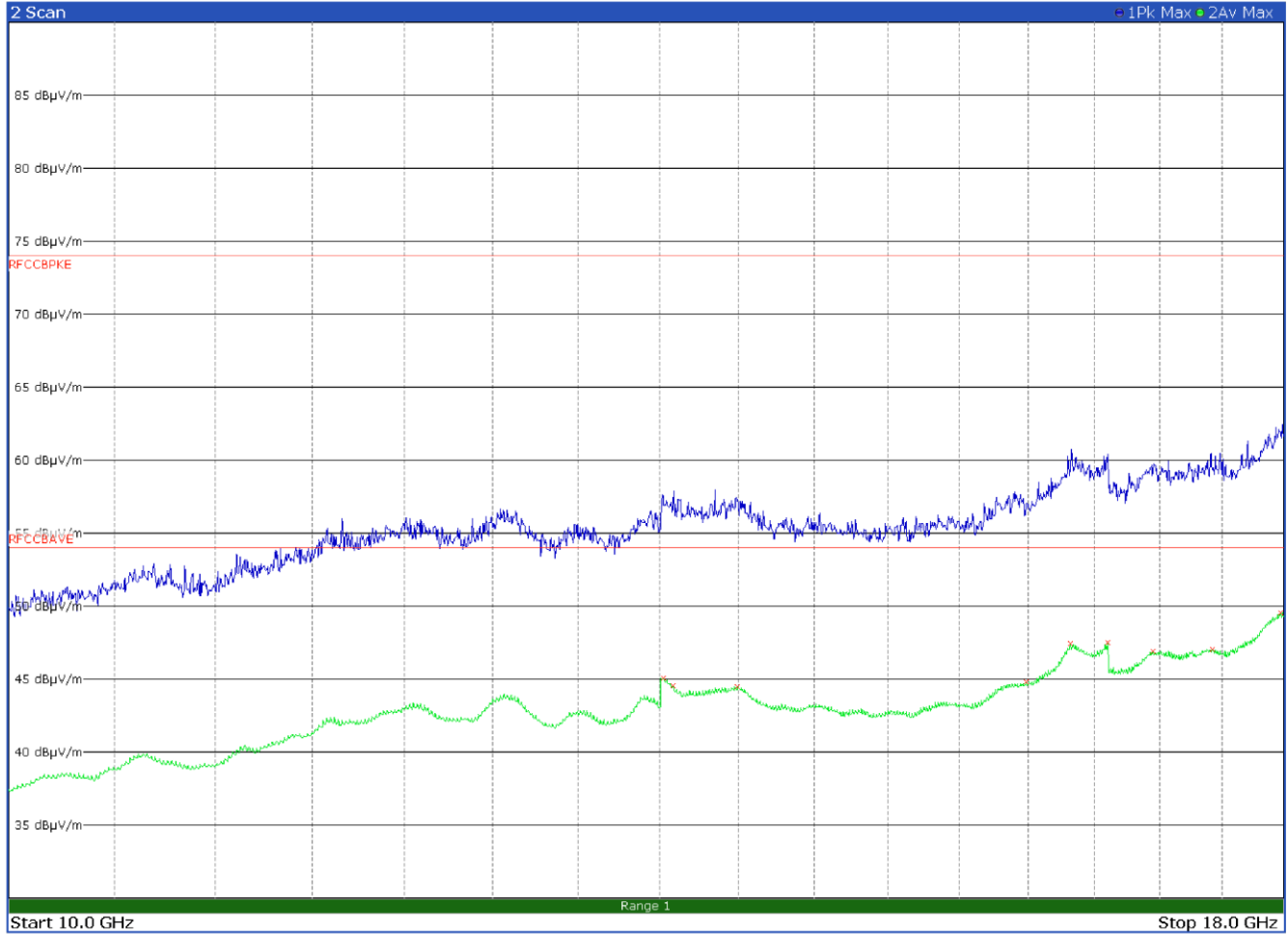
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	3.6 to 10 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
8141.0000	39.7	54.0	-14.3	Av
8480.7500	40.2	54.0	-13.8	Av
8800.2500	42.8	54.0	-11.2	Av
8861.0000	42.5	54.0	-11.5	Av
9540.2500	42.0	54.0	-12.0	Av
9981.5000	44.4	54.0	-9.6	Av



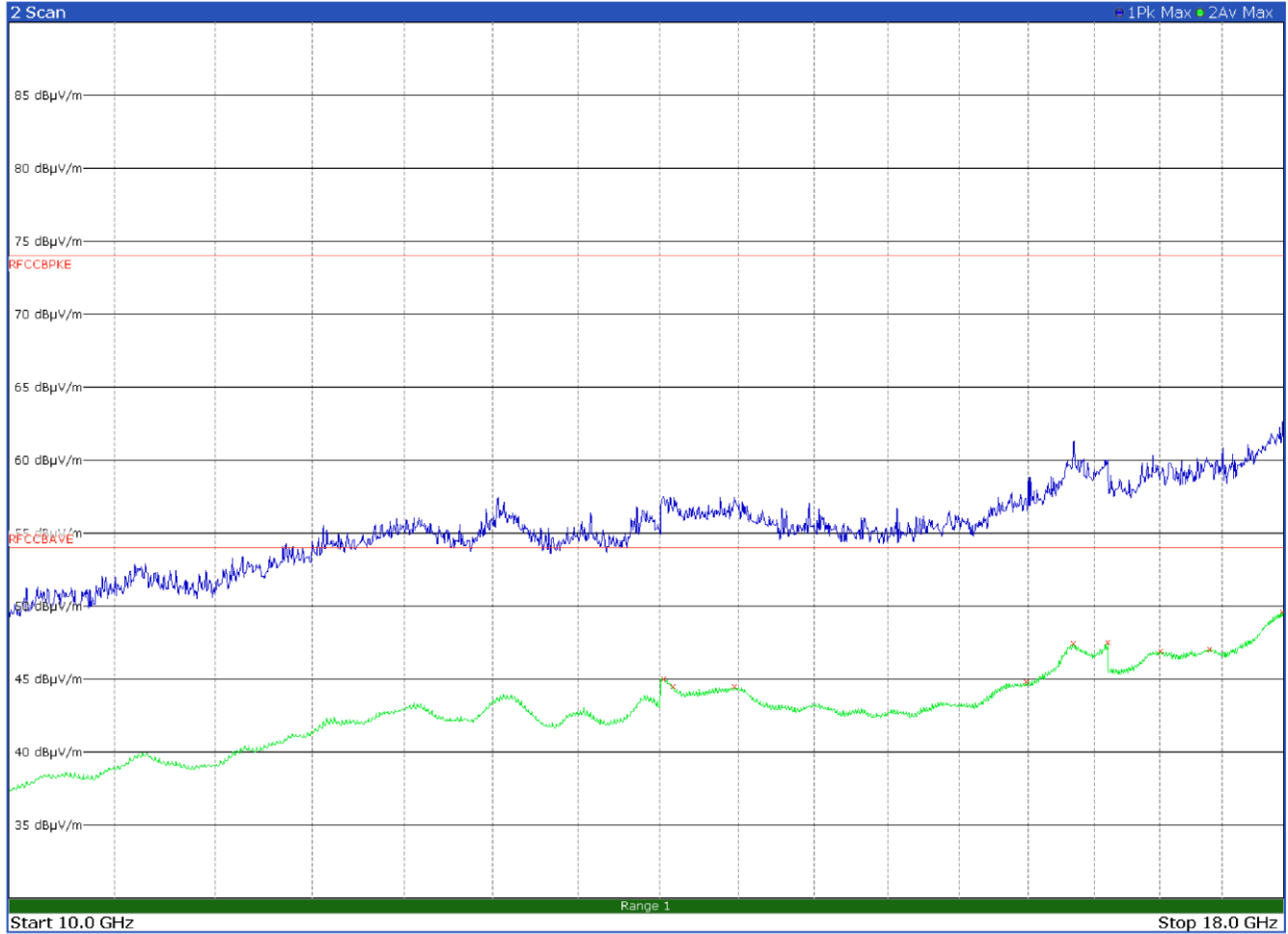
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	10 to 18 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
13525.7500	45.1	54.0	-8.9	Av
13586.5000	44.6	54.0	-9.4	Av
13995.5000	44.5	54.0	-9.5	Av
15985.7500	44.8	54.0	-9.2	Av
16313.0000	47.5	54.0	-6.5	Av
16599.5000	47.5	54.0	-6.5	Av
16948.7500	47.0	54.0	-7.0	Av
17420.7500	47.1	54.0	-6.9	Av
17974.2500	49.6	54.0	-4.4	Av



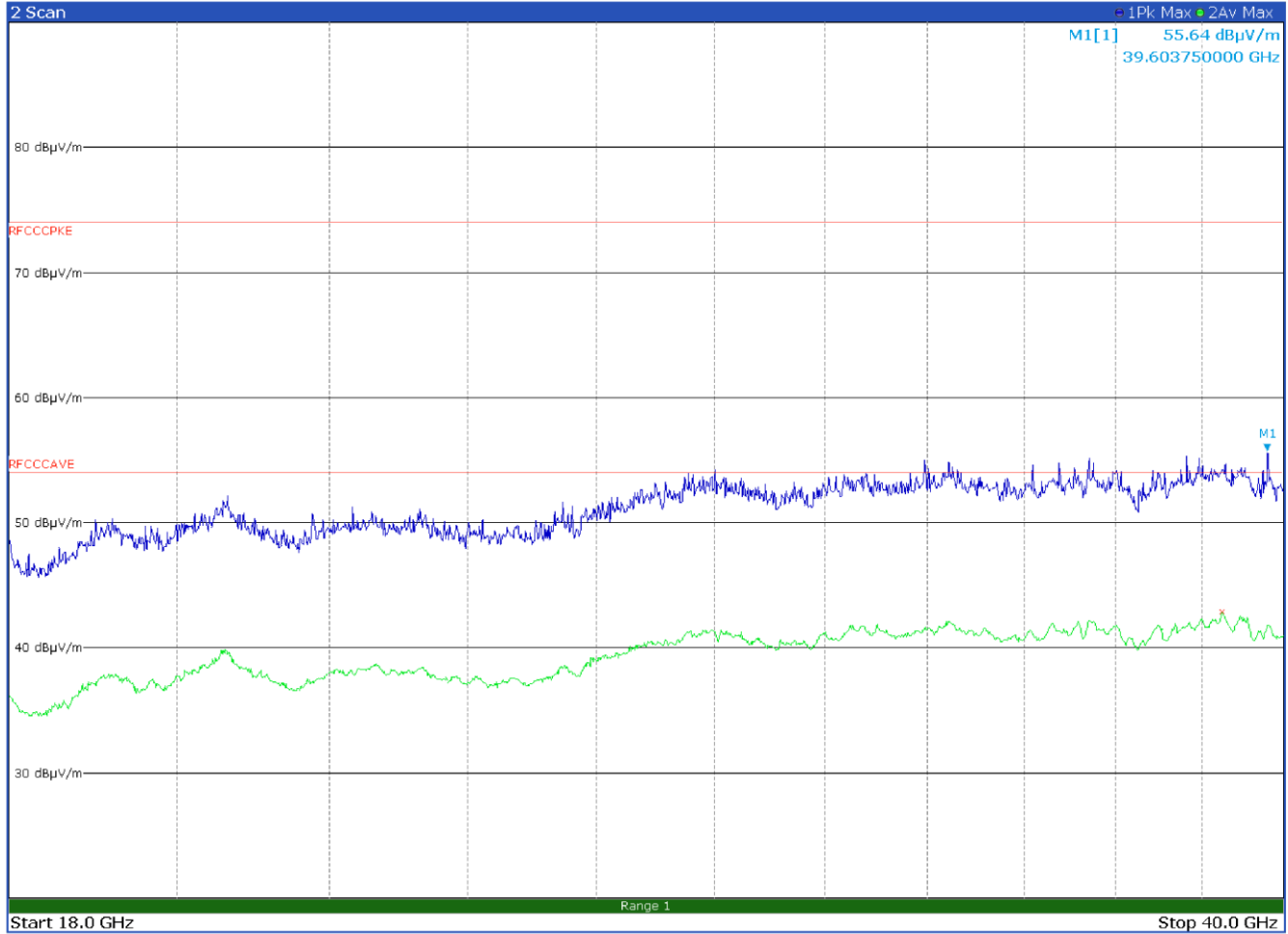
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	10 to 18 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
13525.7500	45.1	54.0	-8.9	Av
13585.2500	44.5	54.0	-9.5	Av
13976.0000	44.5	54.0	-9.5	Av
15985.7500	44.9	54.0	-9.1	Av
16334.2500	47.5	54.0	-6.5	Av
16600.2500	47.6	54.0	-6.4	Av
17010.0000	46.9	54.0	-7.1	Av
17399.7500	47.1	54.0	-6.9	Av
17994.5000	49.6	54.0	-4.4	Av



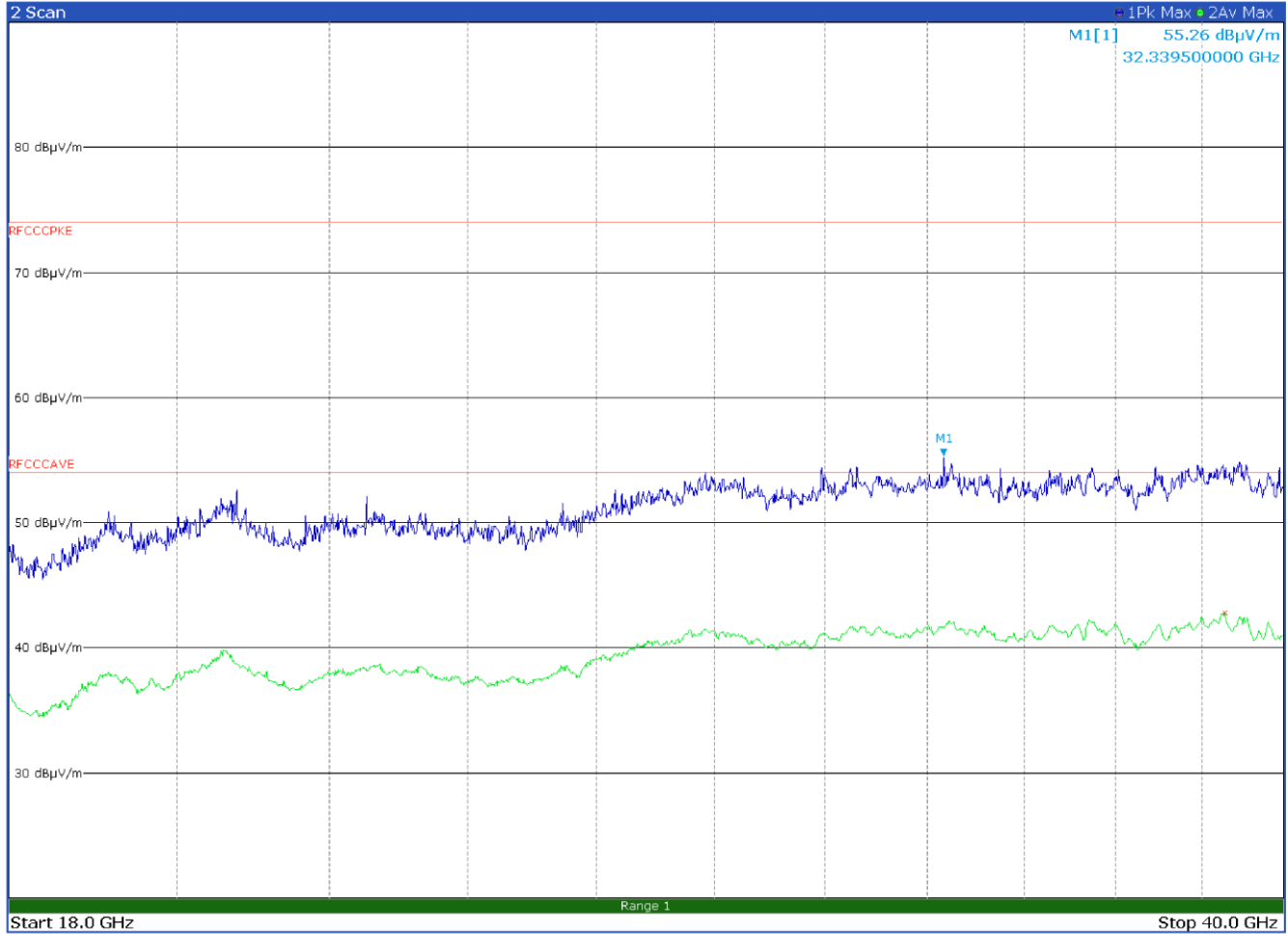
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	18 to 40 GHz	FCC §15.209 with UWB OFF	P



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
38496.5000	42.9	54.0	-11.1	Av



Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	18 to 40 GHz	FCC §15.209 with UWB OFF	P



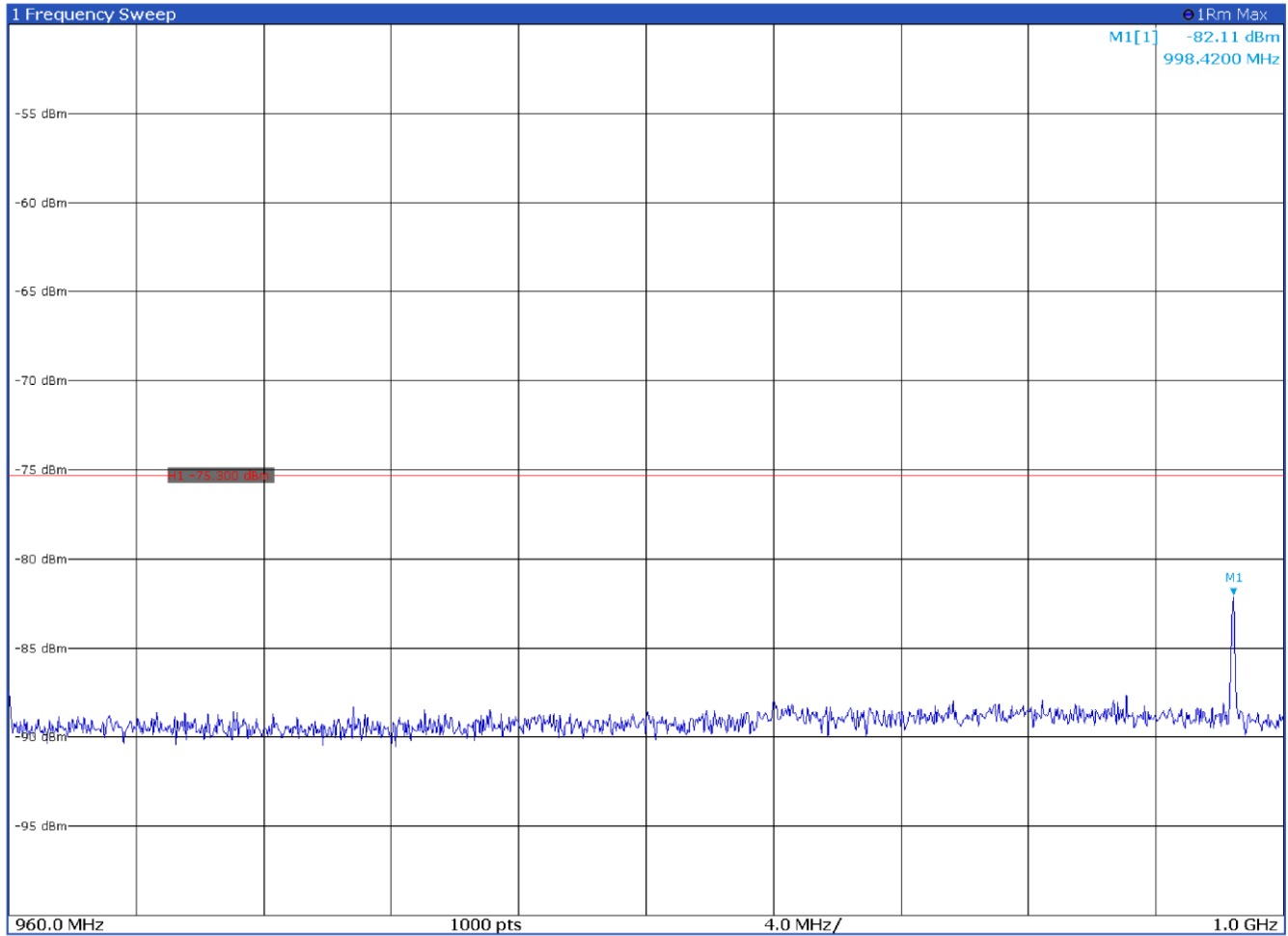
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
38548.0000	42.8	54.0	-11.2	Av

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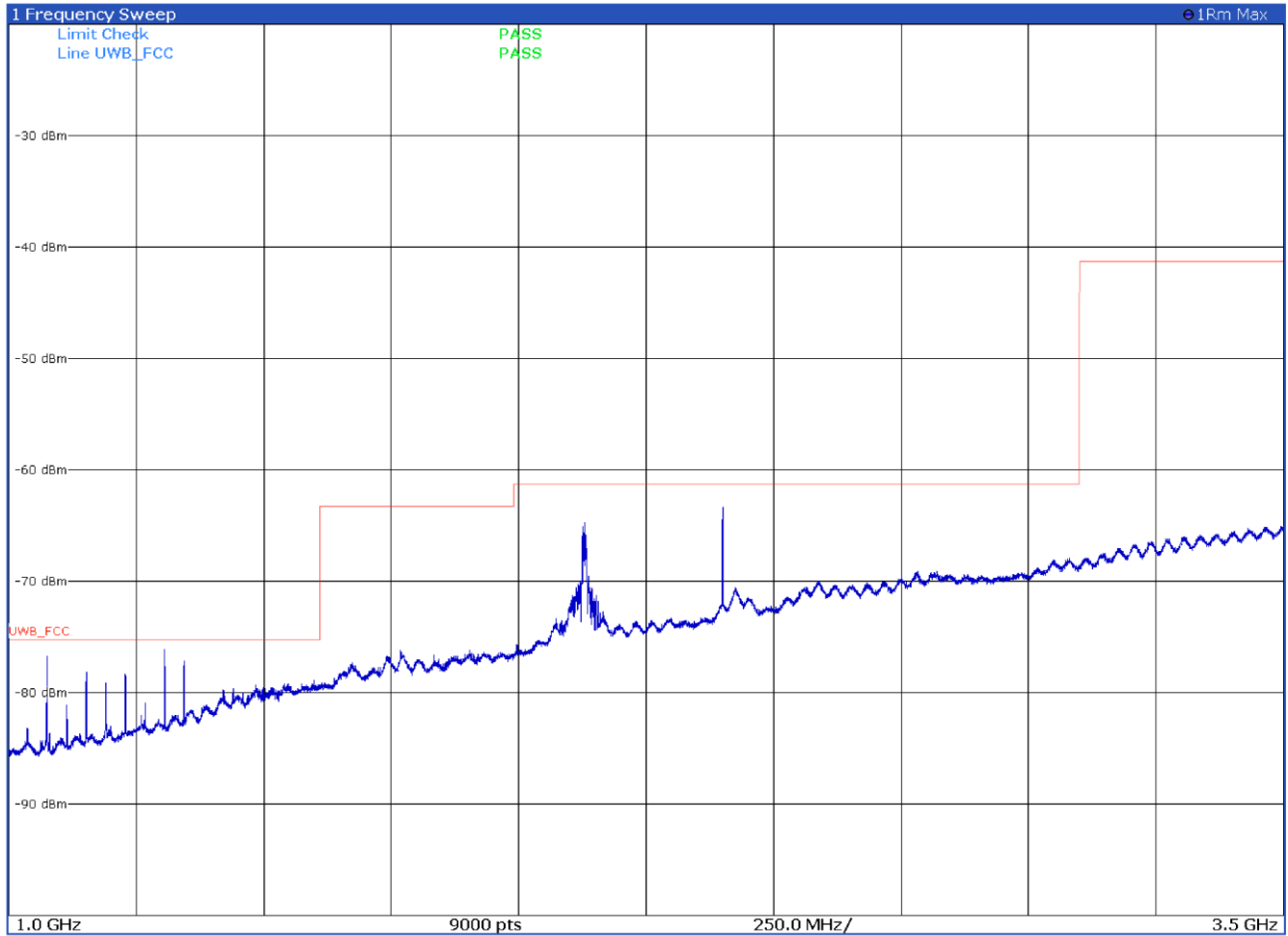
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	960 to 1000 MHz	UWB emission FCC §15.519 (average)	P



The radiated emissions found un this range are not generated by the UWB radio module



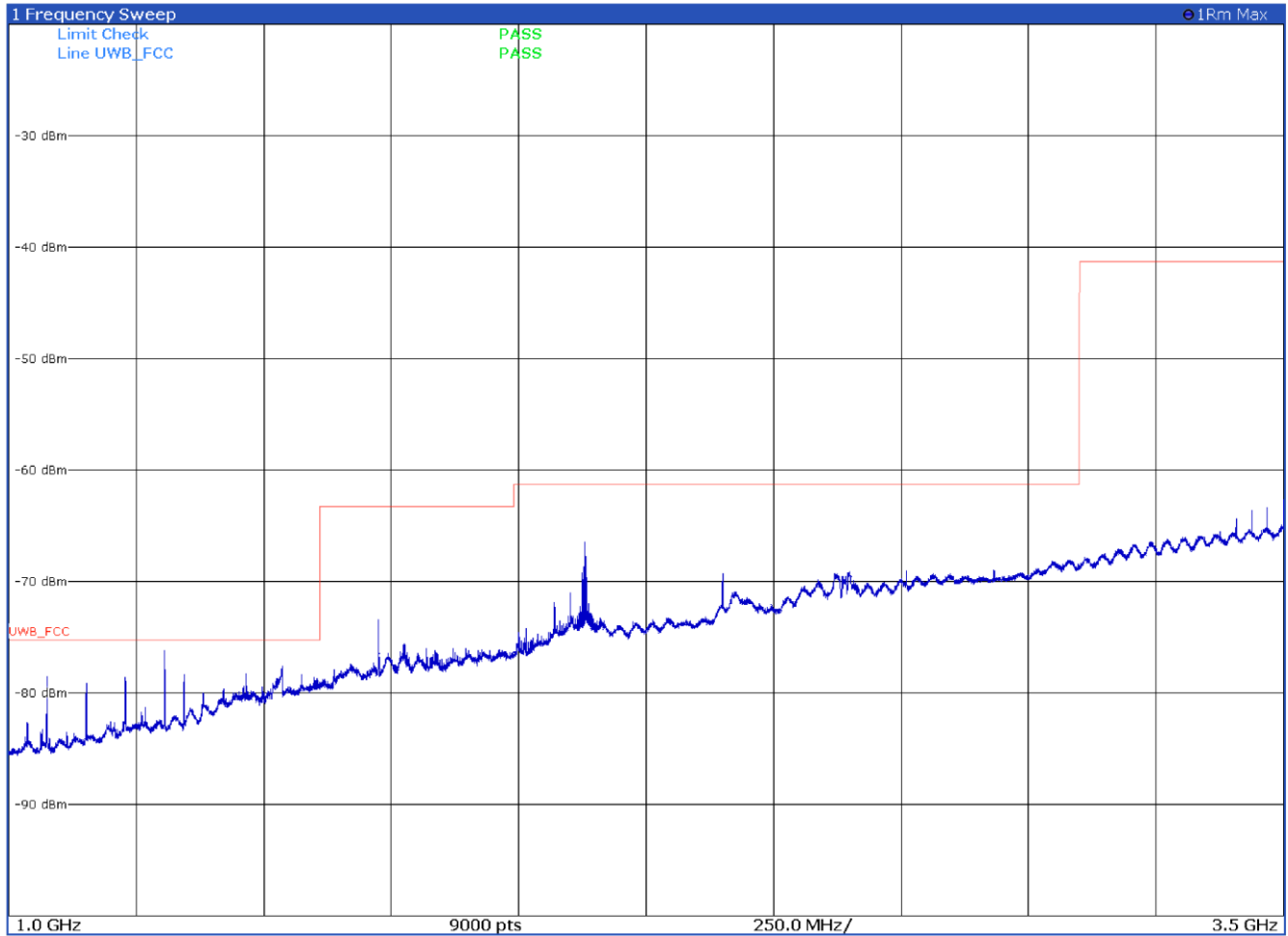
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1 to 3.5 GHz	UWB emission FCC §15.519 (average)	P



The radiated emissions found un this range are not generated by the UWB radio module



Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1 to 3.5 GHz	UWB emission FCC §15.519 (average)	P



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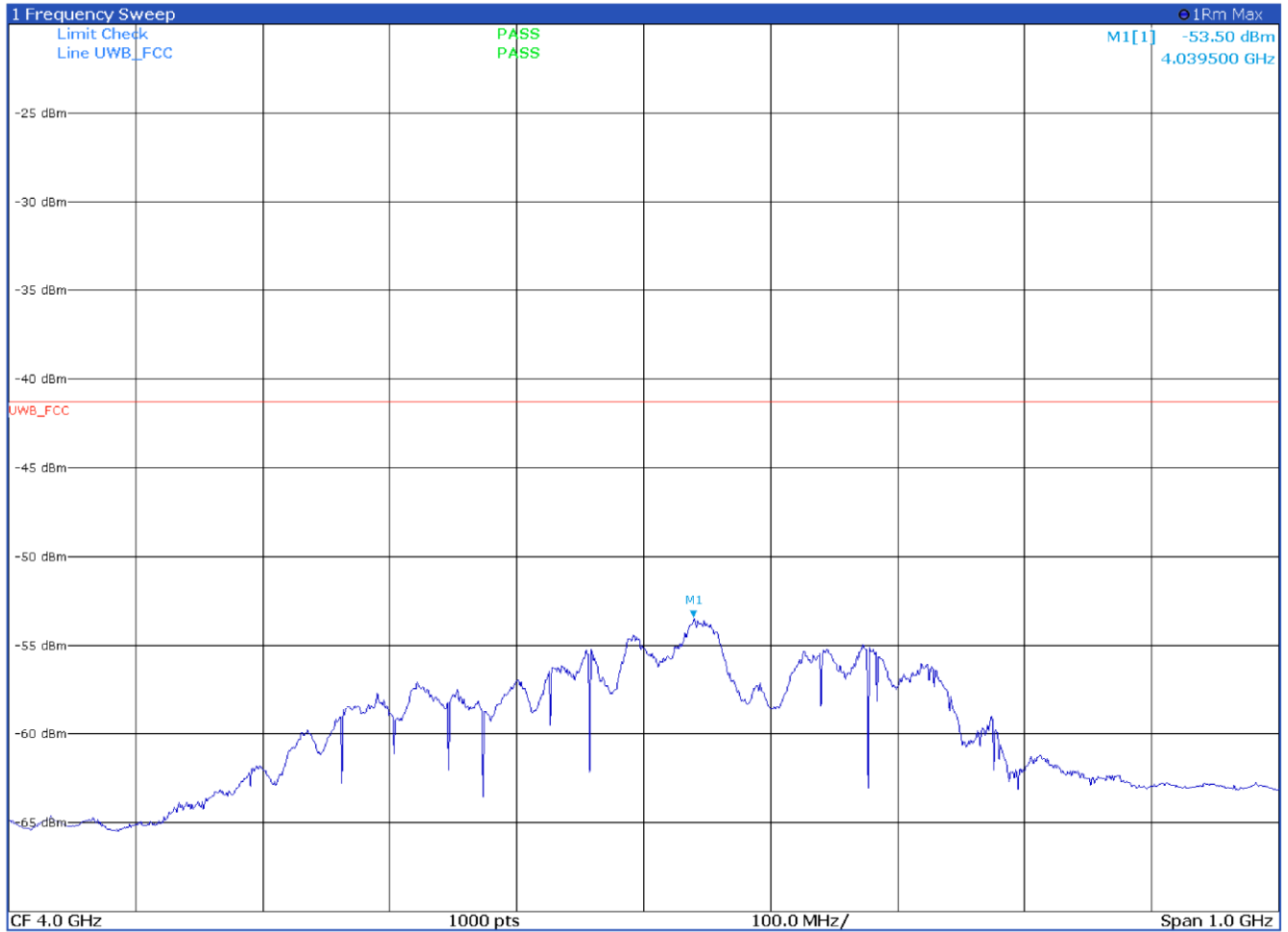
The radiated emissions found un this range are not generated by the UWB radio module

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Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	3.5 to 4.5 GHz	UWB emission FCC §15.519 (average)	P

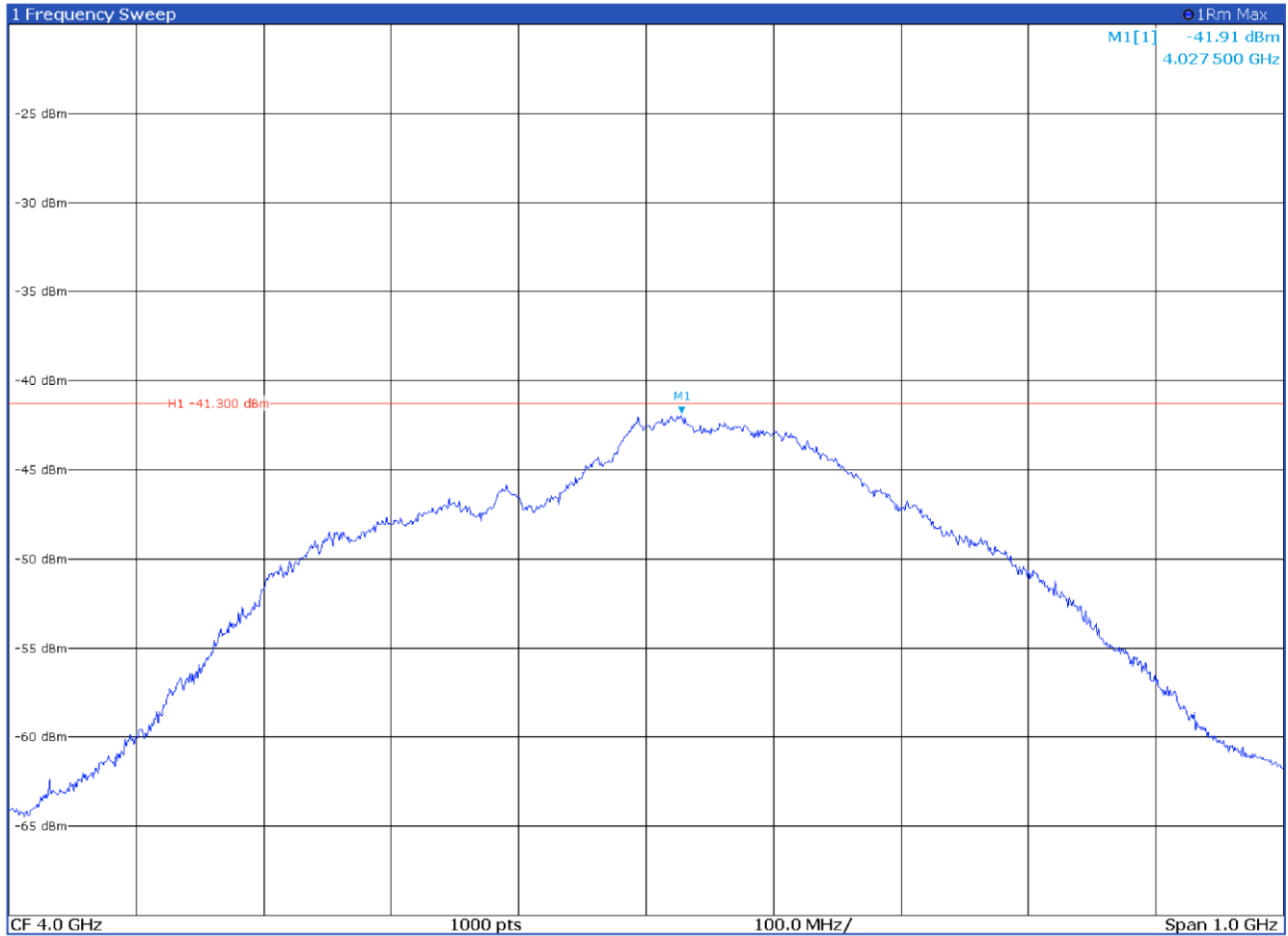


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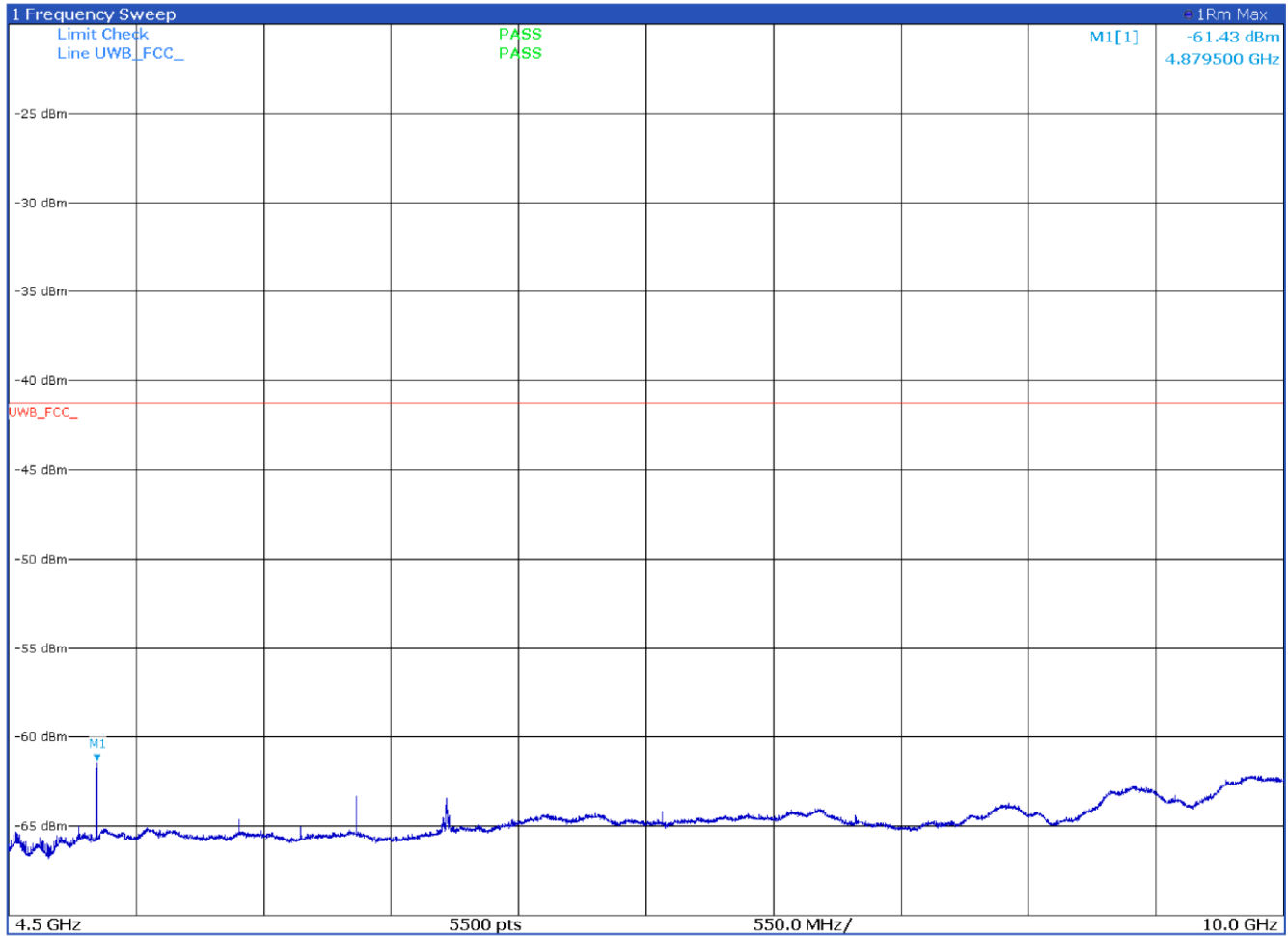


Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	3.5 to 4.5 GHz	UWB emission FCC §15.519 (average)	P





Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	4.5 to 10 GHz	UWB emission FCC §15.519 (average)	P



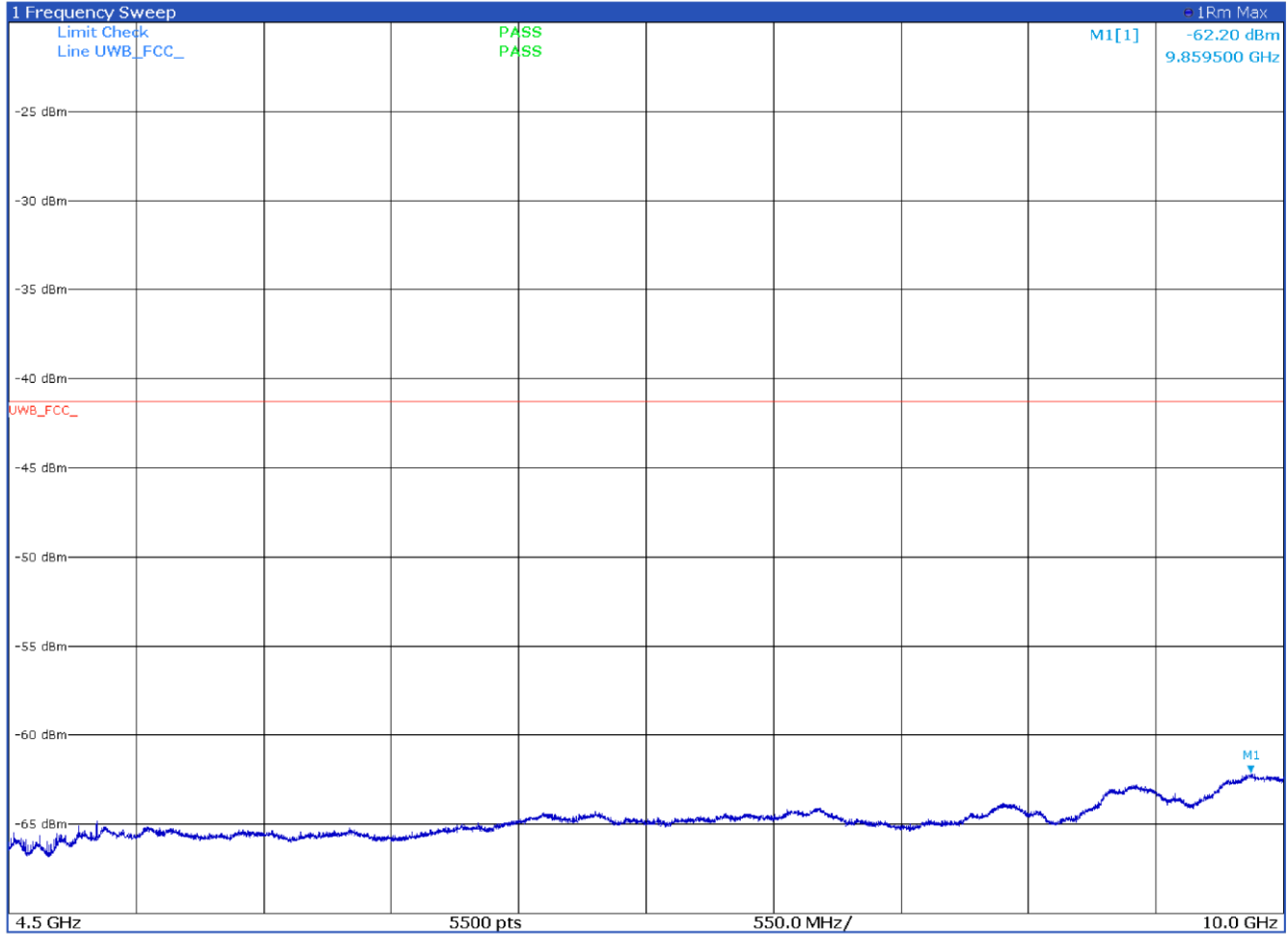
The radiated emissions found un this range are not generated by the UWB radio module

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Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	4.5 to 10 GHz	UWB emission FCC §15.519 (average)	P

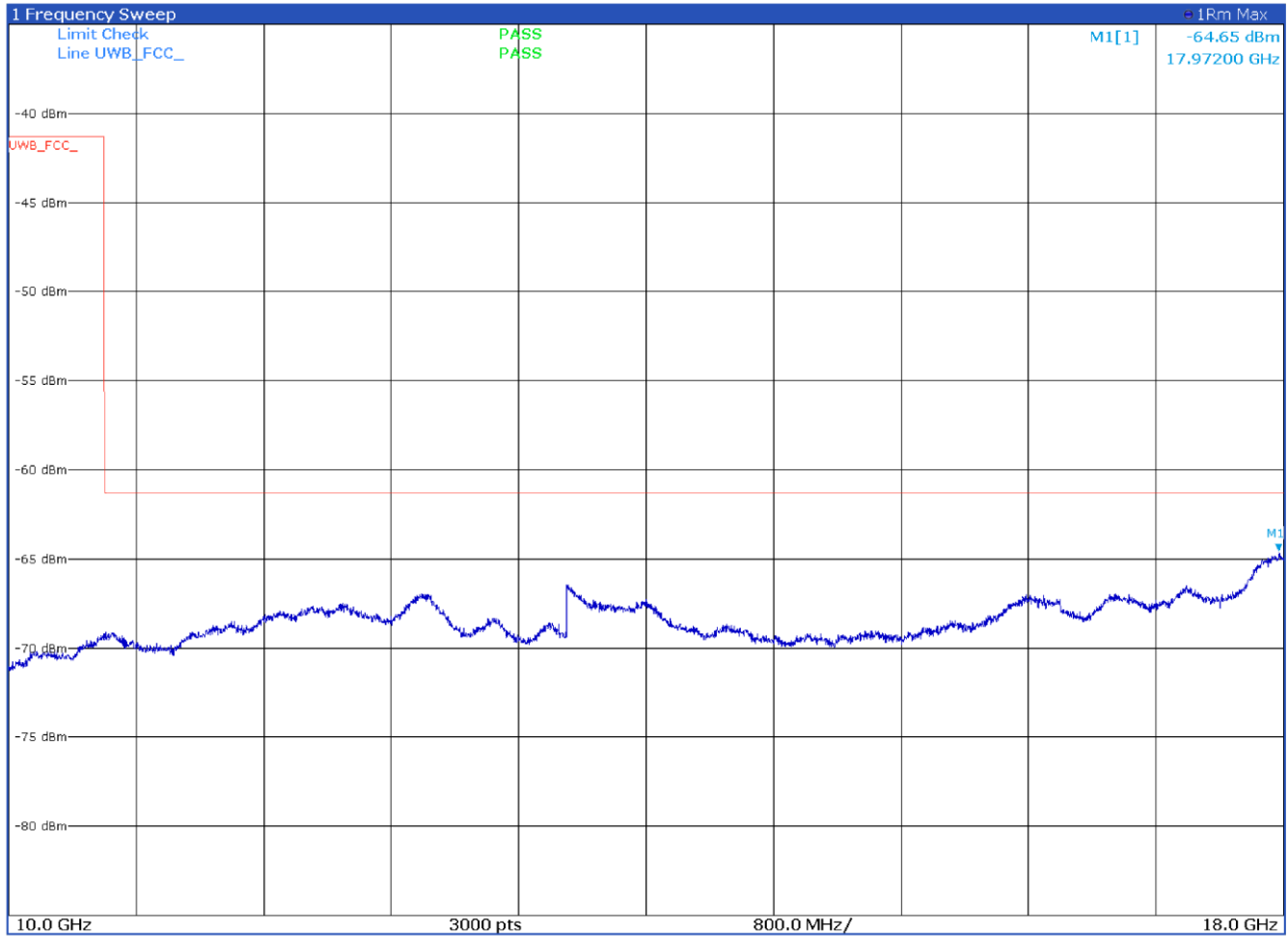


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Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	10 to 18 GHz	UWB emission FCC §15.519 (average)	P

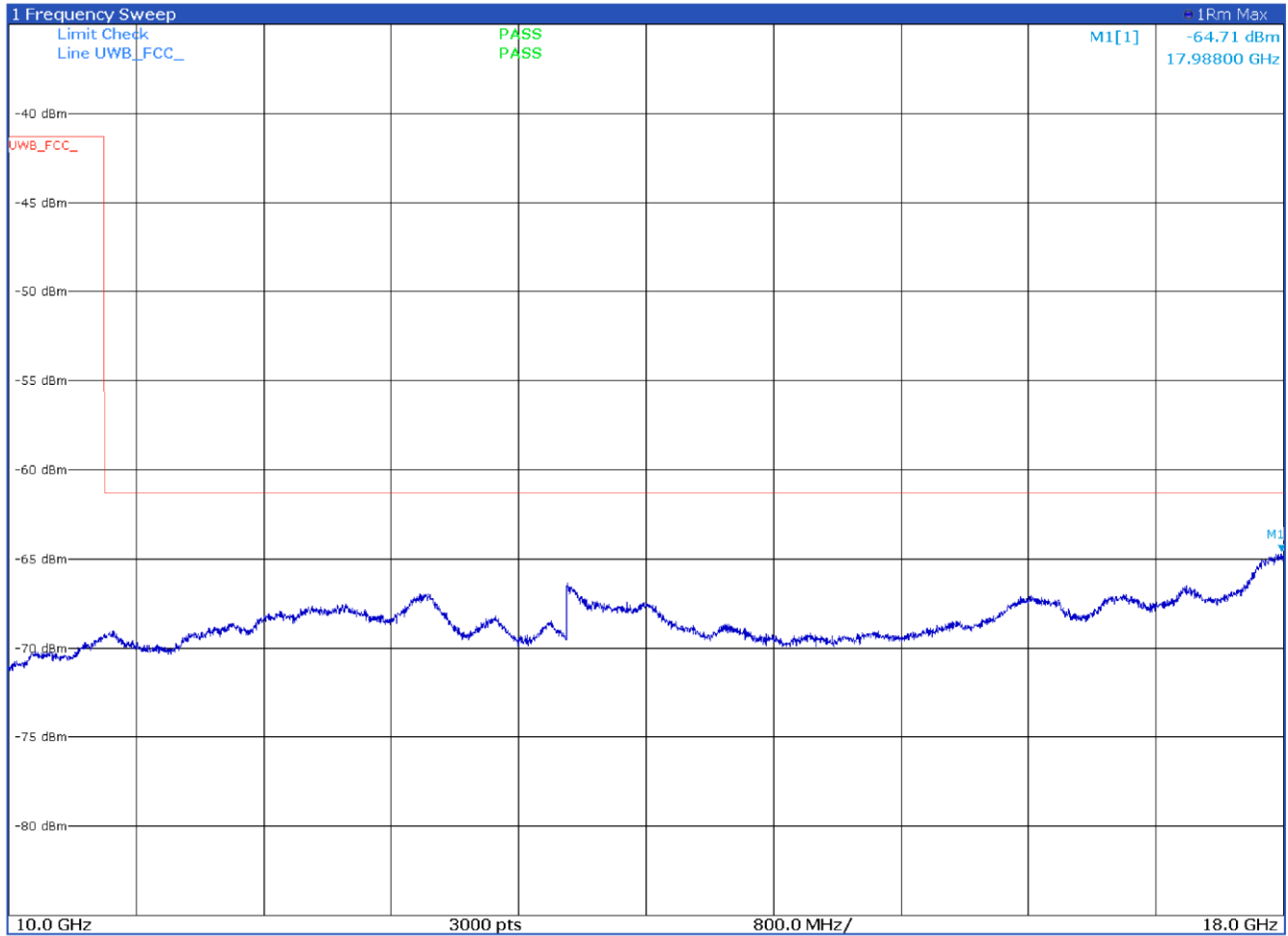


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Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	10 to 18 GHz	UWB emission FCC §15.519 (average)	P

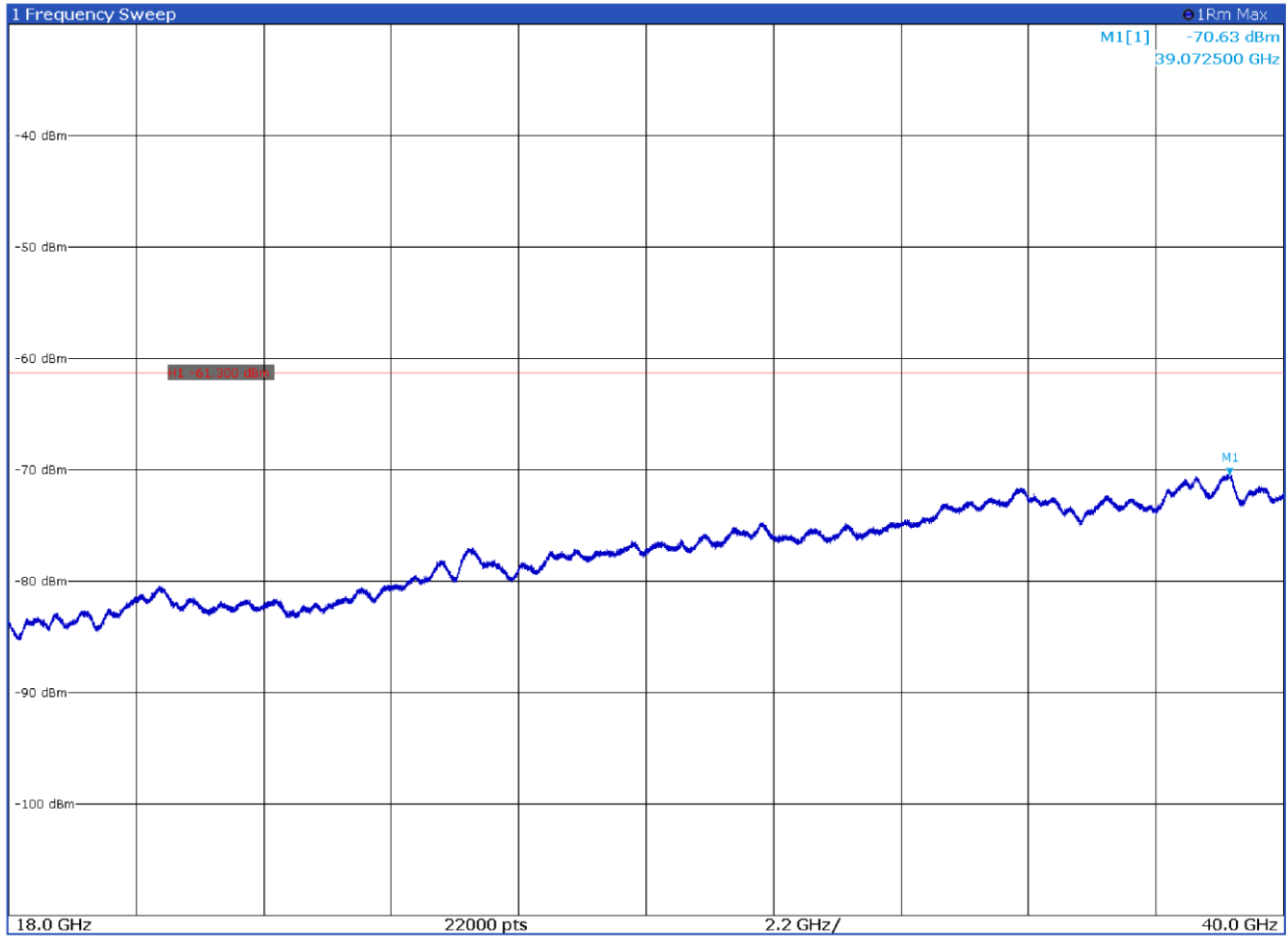


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Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	18 to 40 GHz	UWB emission FCC §15.519 (average)	P

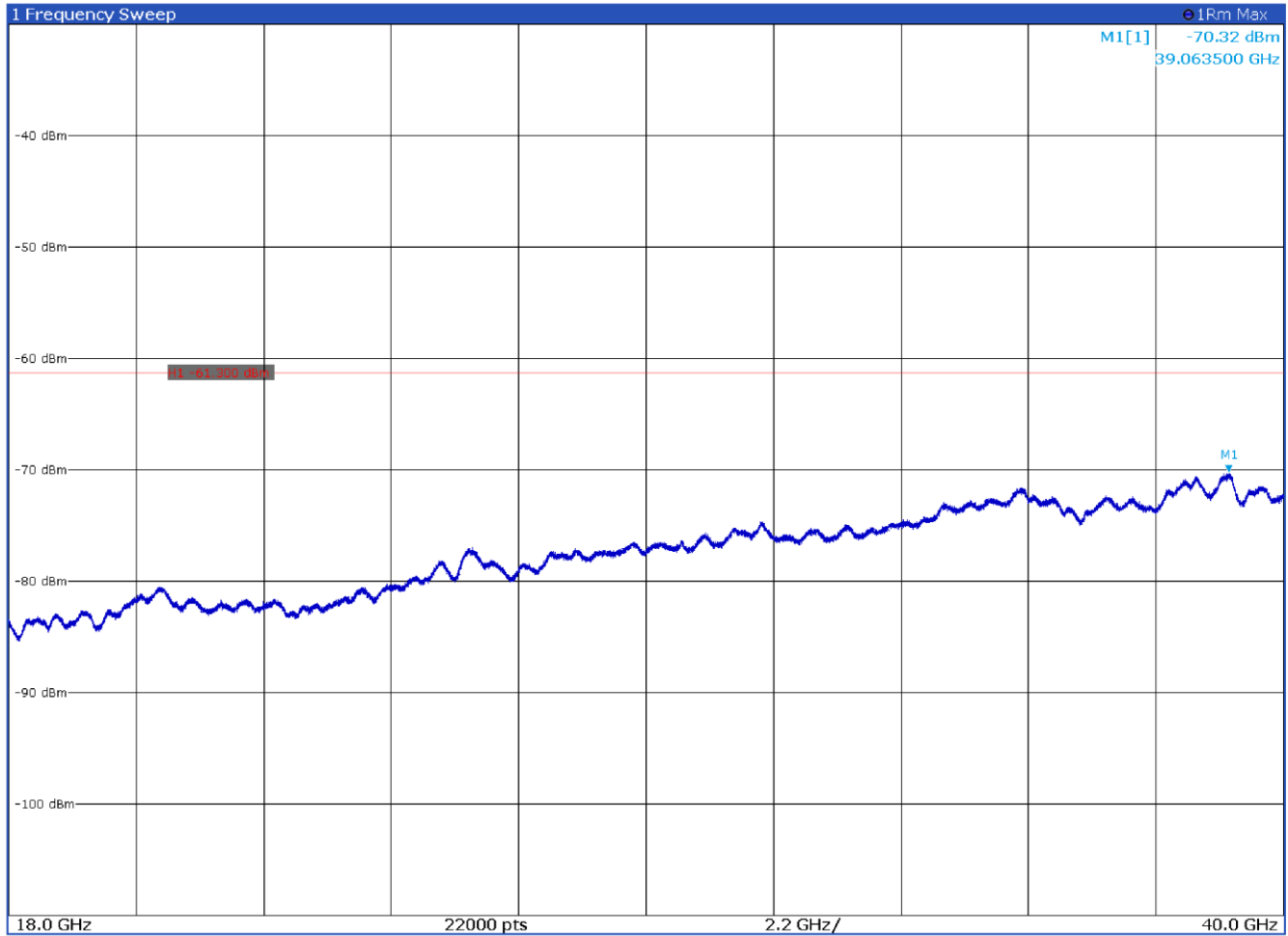


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Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	18 to 40 GHz	UWB emission FCC §15.519 (average)	P



7.6 Radiated Emissions in GPS band

7.6.1 Definitions and limits

FCC 15.519

(d) In addition to the radiated emission limits specified in the table in paragraph (c) of the section 15.519, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz.

Table 7.6-1: Average limits

Frequency in MHz	EIRP in dBm
1164 – 1240	-85.3
1559 – 1610	-85.3

Notes: --

7.6.2 Test date

Start date November 11, 2022

7.6.3 Observations, settings and special notes

Spectrum analyzer settings:

Resolution bandwidth:	1 kHz
Video bandwidth:	3 kHz
Detector mode Trace 2	RMS
Trace 2 mode :	Max Hold

7.6.4 Test equipment list

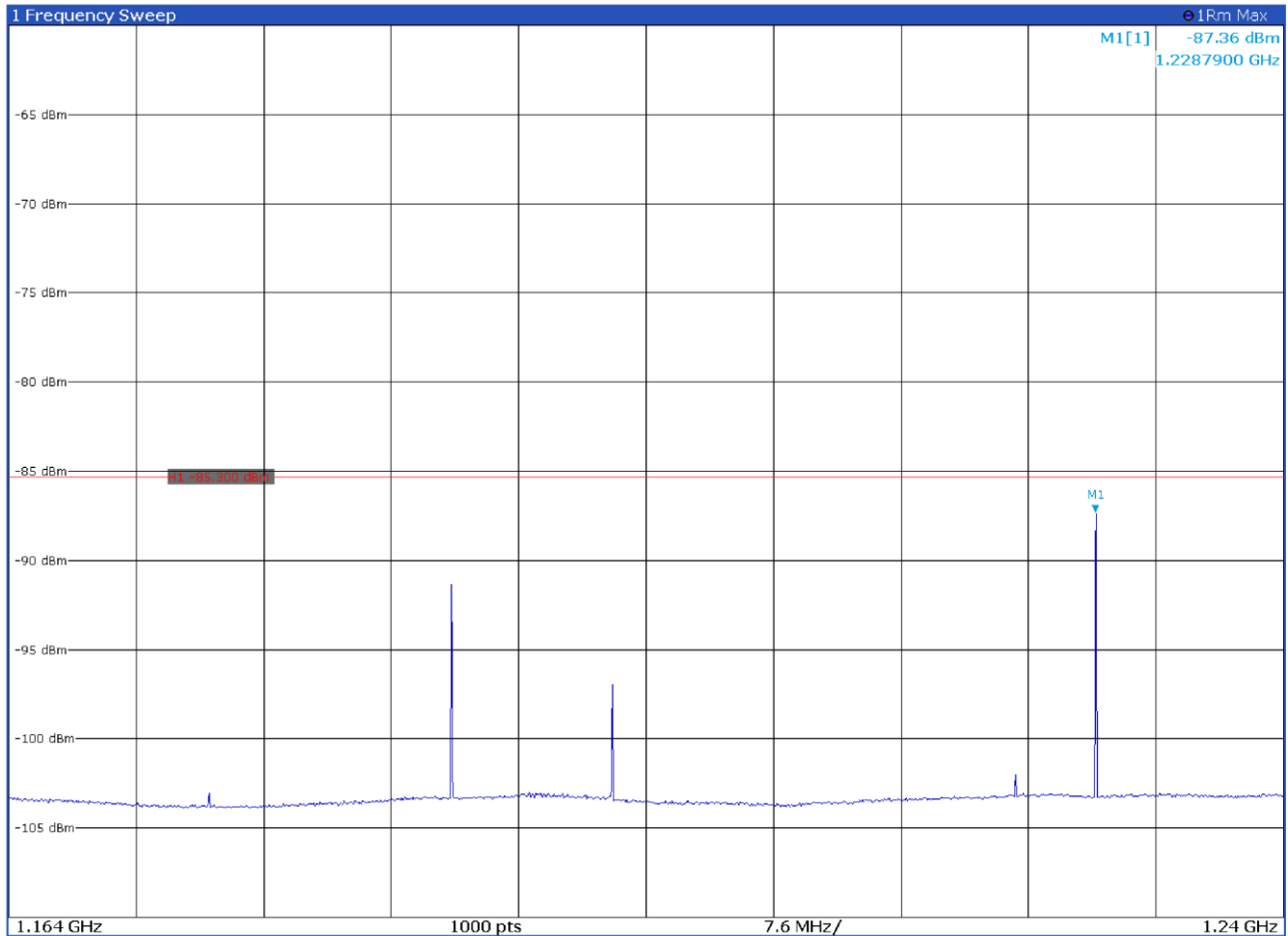
Table 7.6-2: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-153	2021-09	2024-09
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV9718C	00121	2022-03	2023-03
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	Comtest	SAC-3	1711-150	2022-09	2024-09

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

7.6.5 Test data

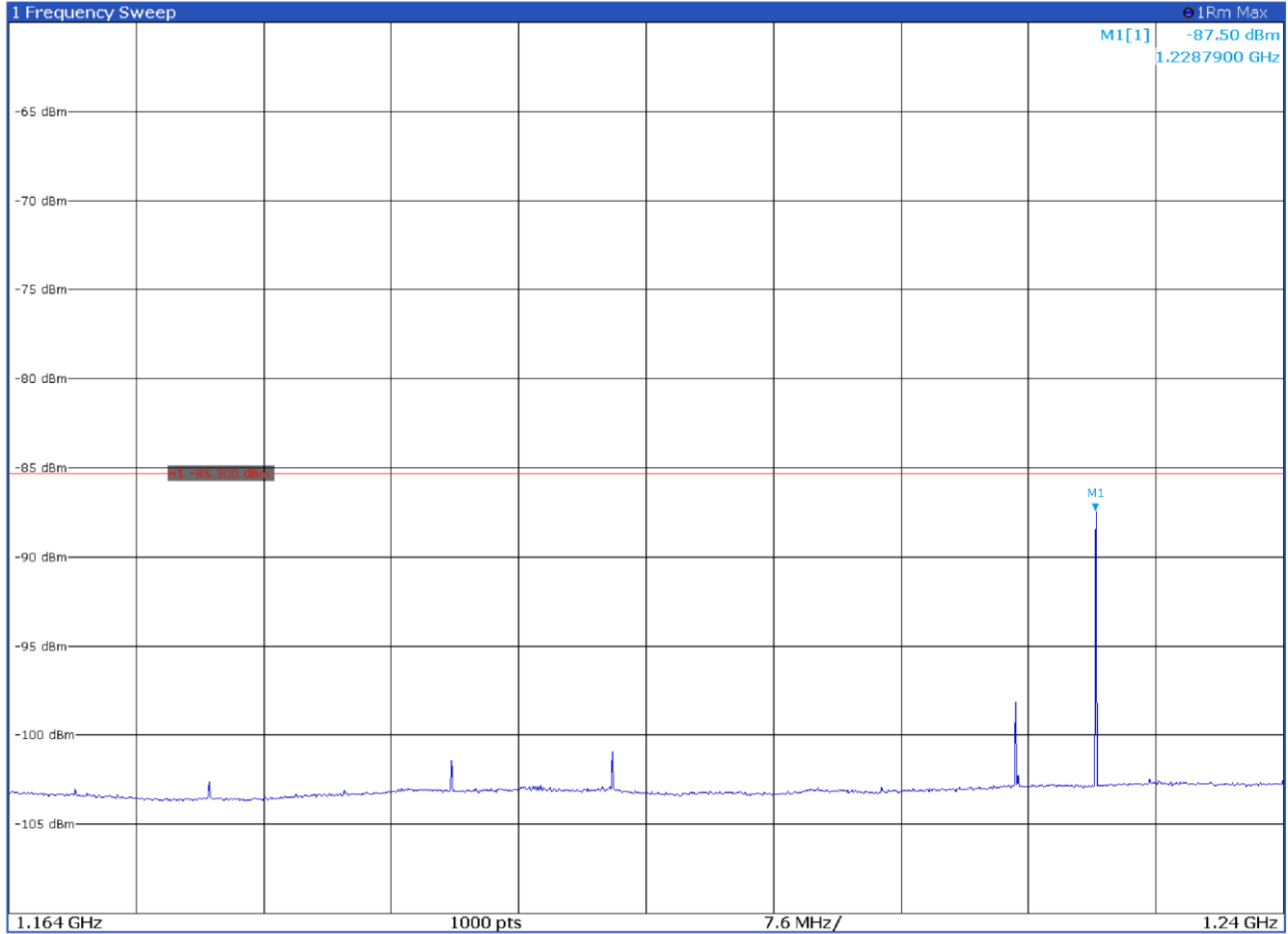
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1164 to 1240 MHz	UWB emission FCC §15.519 (average)	P



The radiated emissions found un this range are not generated by the UWB radio module



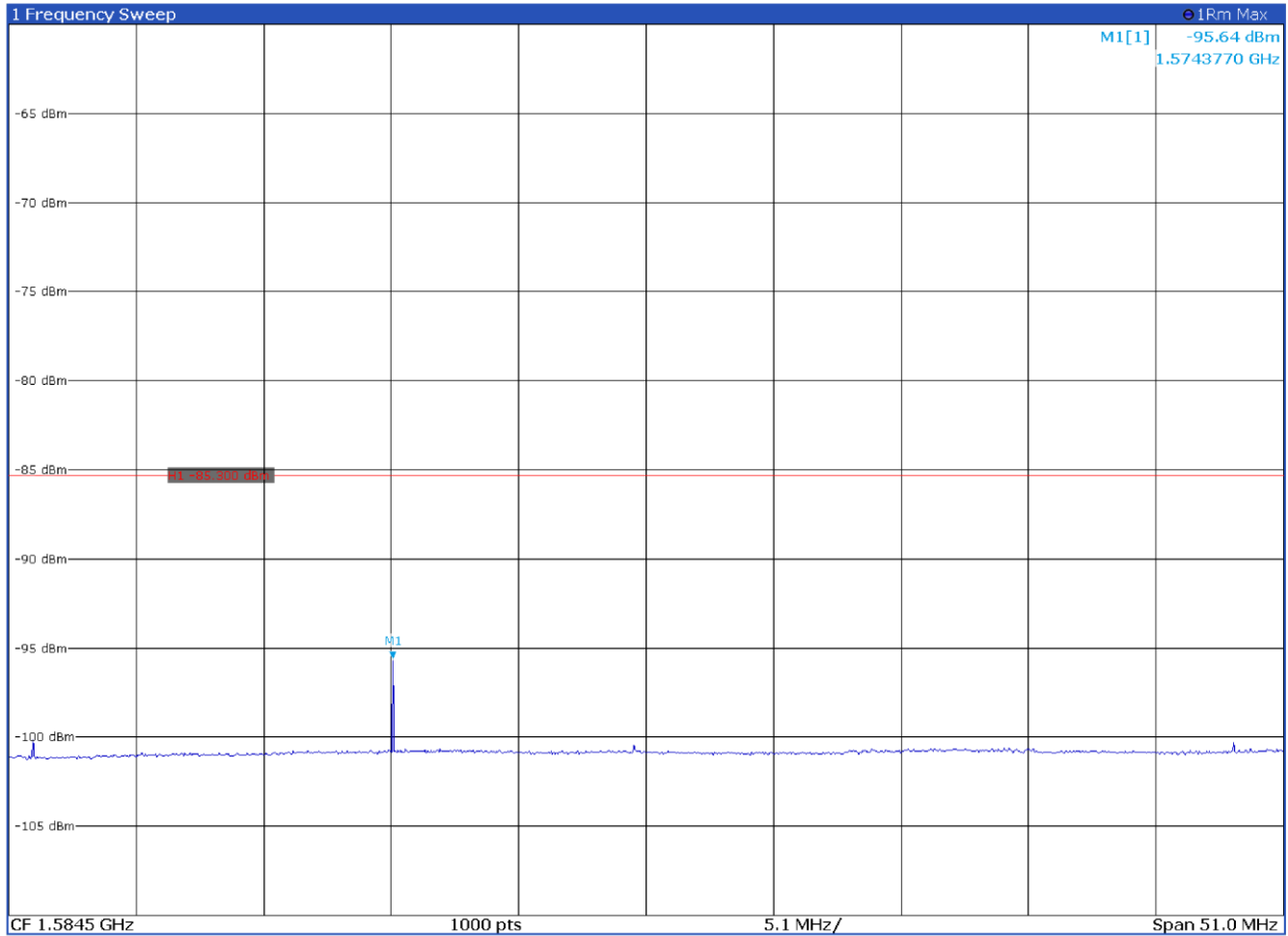
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1164 to 1240 MHz	UWB emission FCC §15.519 (average)	P



The radiated emissions found un this range are not generated by the UWB radio module



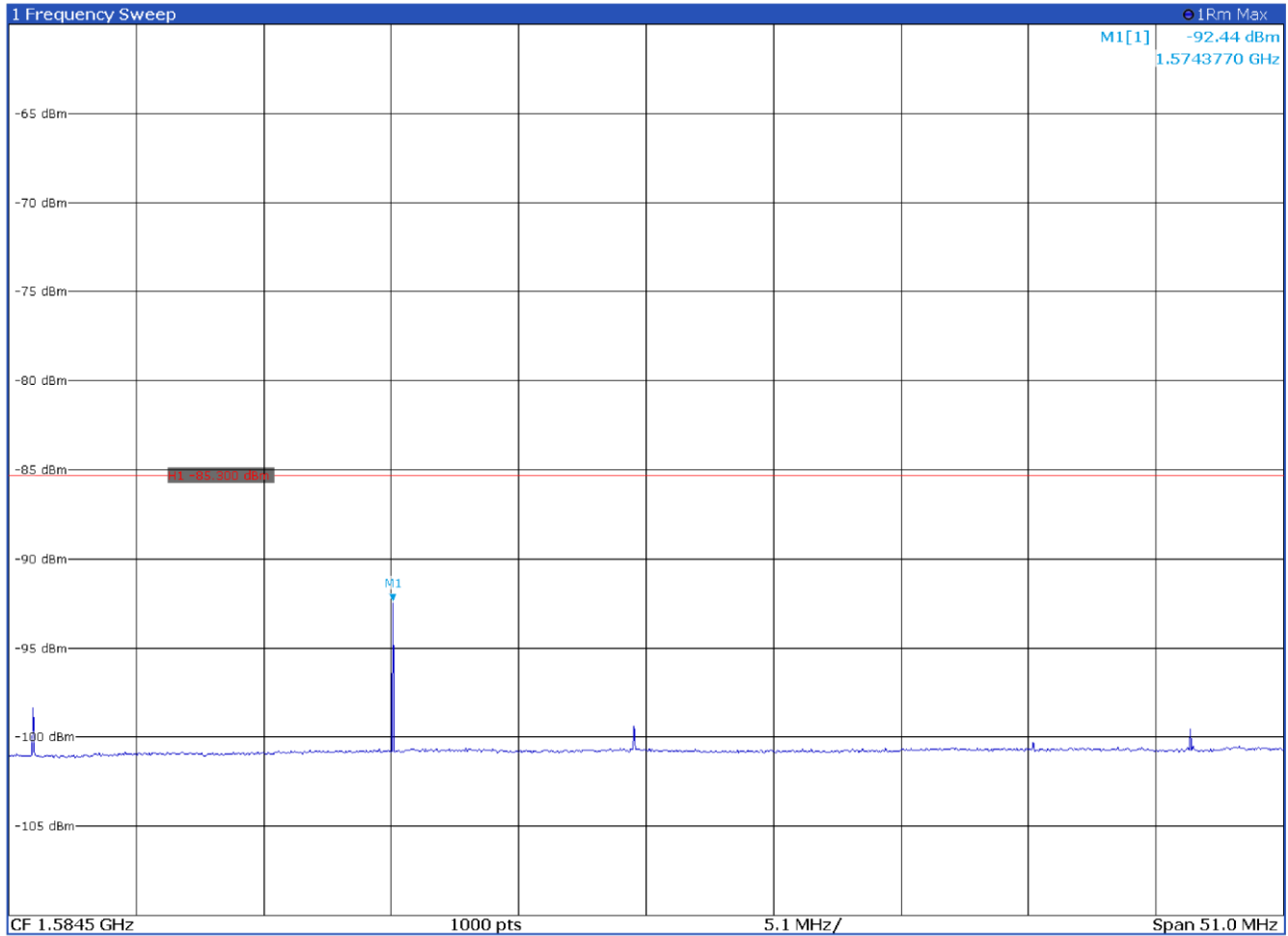
Antenna Polarization	Frequency range	Remarks	Verdict
Horizontal	1559 to 1610 MHz	UWB emission FCC §15.519 (average)	P



The radiated emissions found un this range are not generated by the UWB radio module



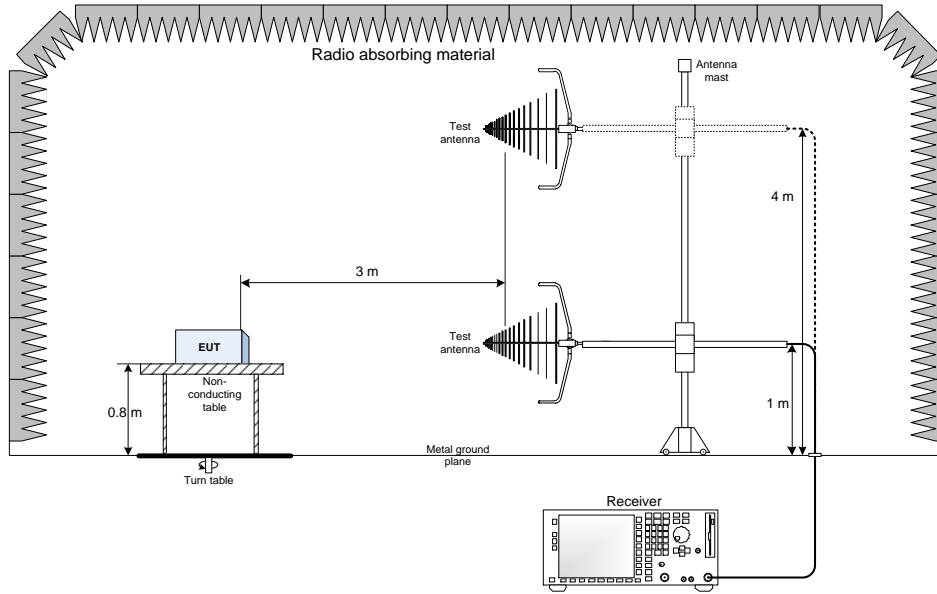
Antenna Polarization	Frequency range	Remarks	Verdict
Vertical	1559 to 1610 MHz	UWB emission FCC §15.519 (average)	P



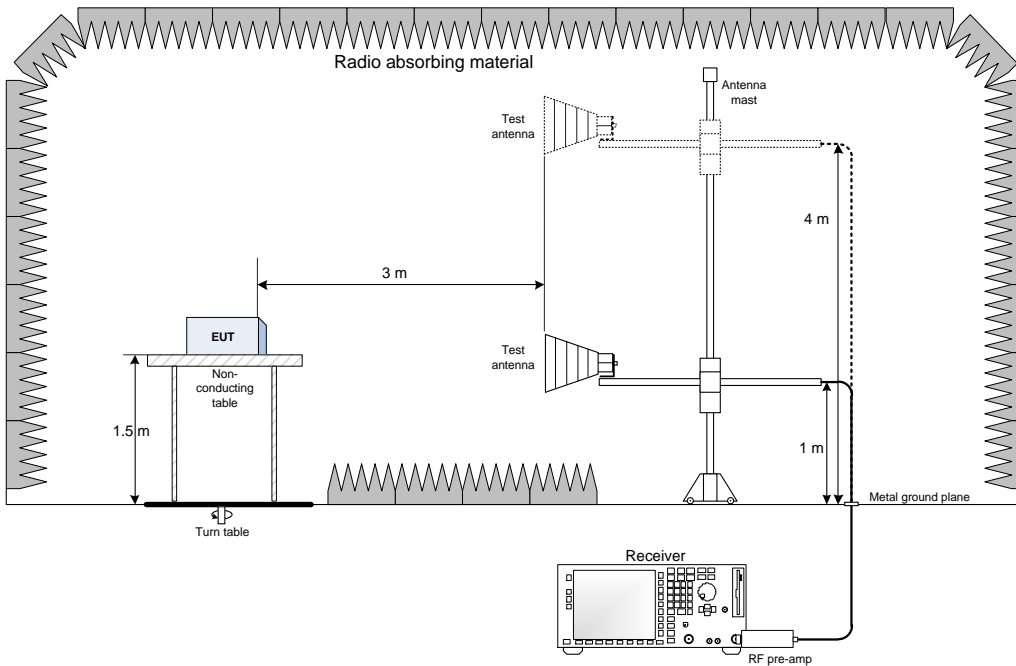
The radiated emissions found un this range are not generated by the UWB radio module

Section 8. Block diagrams of test set-ups

8.1 Radiated emissions set-up for frequencies below 1 GHz



8.2 Radiated emissions set-up for frequencies above 1 GHz



Section 9. Photos

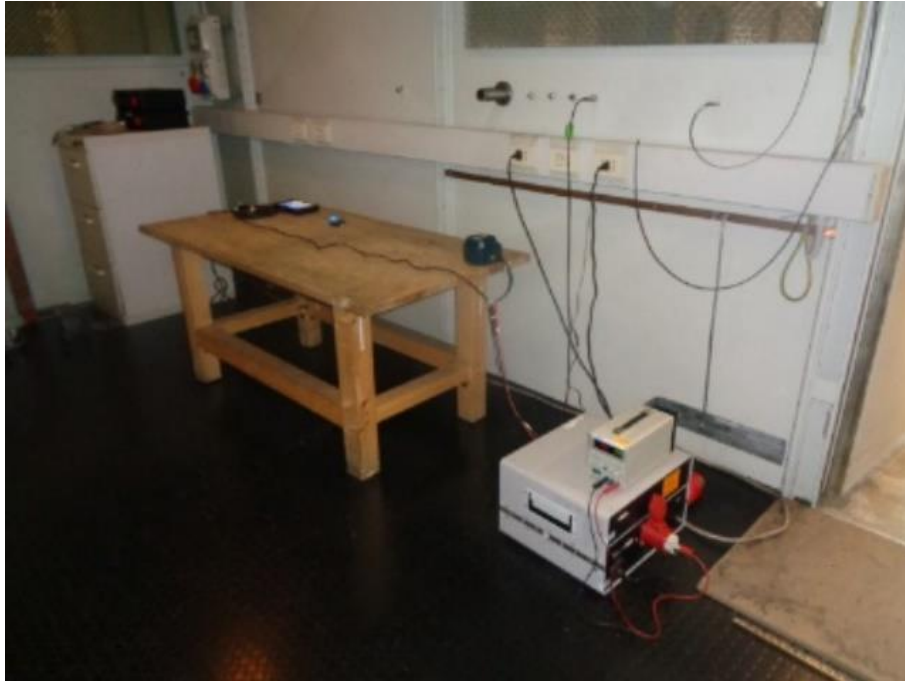
9.1 Photos of the test set-up



Radiated emission below 1 GHz



Radiated emission above 1 GHz



Conducted emission

9.2 Photos of the EUT



End of report