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Wireless test report – 438241TRFWL

Applicant:

B. Thermal Solutions Srl

Product name:

Radio Module

Model:

UWB DWM100

FCC ID:

2A2D3-UWBDWM

Specifications:

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

Date of issue: June 10, 2021

Tested by (name, function and signature)	**D. Guarnone**	(project handler)	Signature:
Reviewed by (name, function and signature)	**P. Barbieri**	(verifier)	Signature:

Test location(s)

Company name	Nemko Spa
Address	Via del Carroccio, 4
City	Biassono
Province	MB
Postal code	20853
Country	Italy
Telephone	+39 039 220 12 01
Facsimile	+39 039 220 12 21
Website	www.nemko.com
Site number	FCC: 682159 (10 m semi anechoic chamber)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report. This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Spa ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	B. Thermal Solutions Srl
Address	Via Marconi, 100, 60015 Falconara M.ma AN - 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
ANSI C63.4 v2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

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
438241TRFWL	June 10, 2021	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	Not applicable
§15.209, §15.519(c), §15.521(d)(e)	Radiated emission	Pass
§15.519(d)	Radiated emission in GPS band	Pass
§15.519(a)(1)	Operational limitations	Pass
§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

NOTE: --

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	June 10, 2021
Nemko sample ID number	4382300004

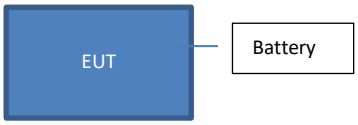
3.2 EUT information

Product name	Radio Module
Model	UWB DWM100
Model variant	--
Serial number	--

3.3 Technical information

Frequency band	3744 to 4243.2 MHz (UWB channel 2)
Frequency Min (MHz)	3744 MHz
Frequency Max (MHz)	4243.2 MHz
RF power Max (dBm), Units @ distance	-24.8 dBm @ 3 m with RBW of 3 MHz
Field strength, Units @ distance	70.5 dBµV/m @ 3 m
Measured BW (MHz) (10 dB)	603.6 MHz
Measured BW (MHz) (99%)	808.1 MHz
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	--
Emission classification (F1D, G1D, D1D)	604MP0N
Transmitter spurious @3 m	-58.0 dBm @ 7987.419 MHz
Power requirements	3 V_{DC}
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator

3.4 EUT setup diagram



Product description and theory of operation:

The UWB Anchor communicate with the Filippetti Group's Gateways and Routers, through the Smart Network proprietary protocol and the UHF wireless protocol in LoRa/FSK modulation

The device generates a radiofrequency signal with a range of about 150 m (in the absence of obstacles), which is converted into spatial distance.

Through the trilateration (with three or more distances detected by as many devices), it is possible to calculate with submetric accuracy (≈ 50 cm) the position of the SaveMENOW or the PPE equipped with appropriate tags. The data exchanged between the anchors and the mobile tags are sent to the RTLS server to estimate the position.

The device is supplied with 4 batteries (each of type D, nominal voltage of 3.6V, from 19 Ah)

3.5 EUT sub assemblies

None

3.6 EUT exercise details

During the tests, the EUT was set in transmit mode and connected to the battery, by the client.

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	01/2021	01/2023
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	01/2021	01/2023
Barometer	Castle	GPB 3300	072015	12/2020	12/2021

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)

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Receiver	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)
		Sensitivity measurement	1 MHz ÷ 18 GHz	6.0 dB	(1)
	Conducted	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)

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. Testing data

7.1 Frequency range

7.1.1 Definitions and limits

FCC 15.521

(h) 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/(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.

7.1.2 Test date

Start date	June 9, 2021

7.1.3 Observations, settings and special notes

None

7.1.4 Test data

F_c (MHz) = (F_{high} + F_{low})/2	3993 (MHz) channel 2

Note: For F_{high} and F_{low} see §3.3

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	June 10, 2021

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 Operational limitations

7.3.1 Definitions and limits

§ 15.519 Technical requirements for hand held UWB systems.

(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.

(1) 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

7.3.2 Test date

Start date	July 9, 2021

7.3.3 Observations, settings and special notes

Time domain, zero span

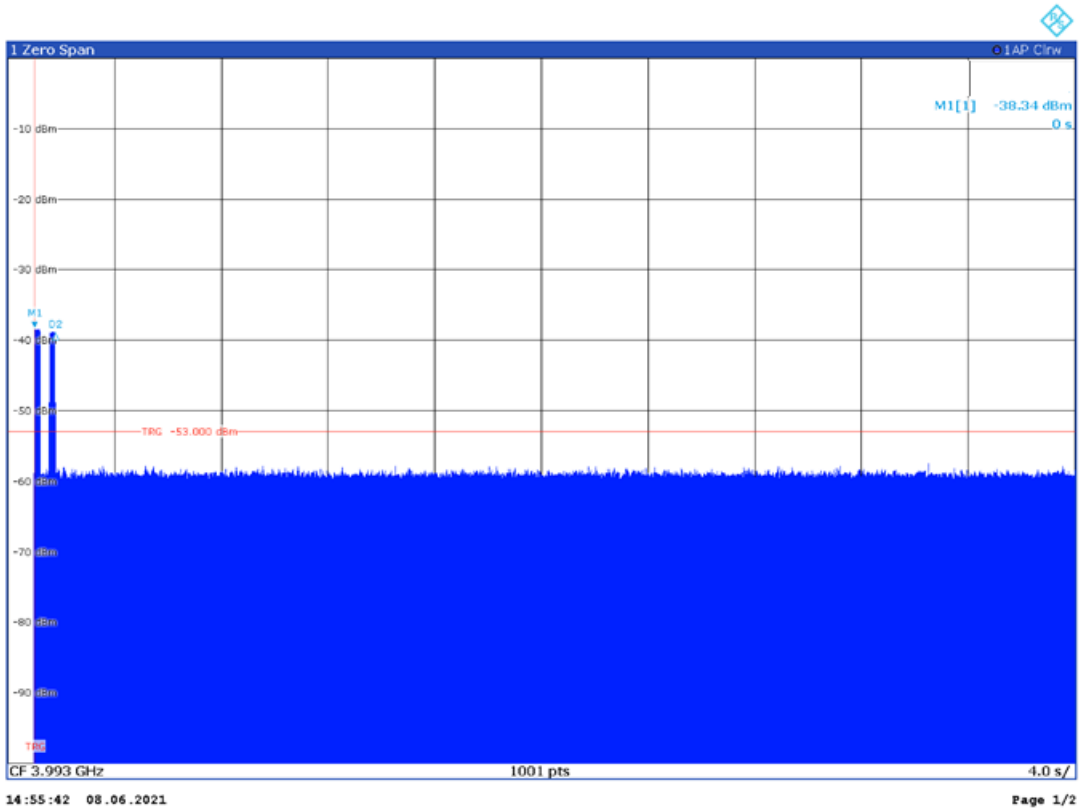
7.3.4 Test equipment list

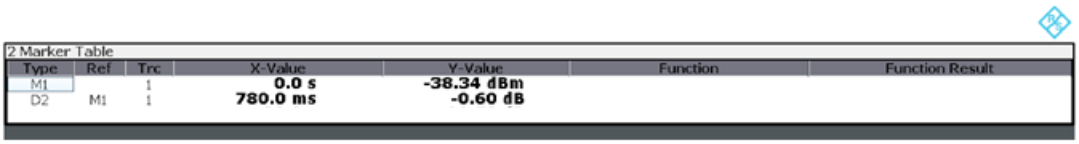
Table 7.3-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	09/2020	09/2021
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2018	07/2021
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	07/2020	07/2021
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	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

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

7.3.5 Test data





7.4 10 dB Bandwidth

7.4.1 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.

7.4.2 Test date

Start date	July 9, 2021

7.4.3 Observations, settings and special notes

RBW = 1 MHz, VBW = 3 MHz, SPAN = 2.5 GHz
E field strength (dBµV/m) = EIRP (dBm) + 95.3

7.4.4 Test equipment list

Table 7.4-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	09/2020	09/2021
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2018	07/2021
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	07/2020	07/2021
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	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

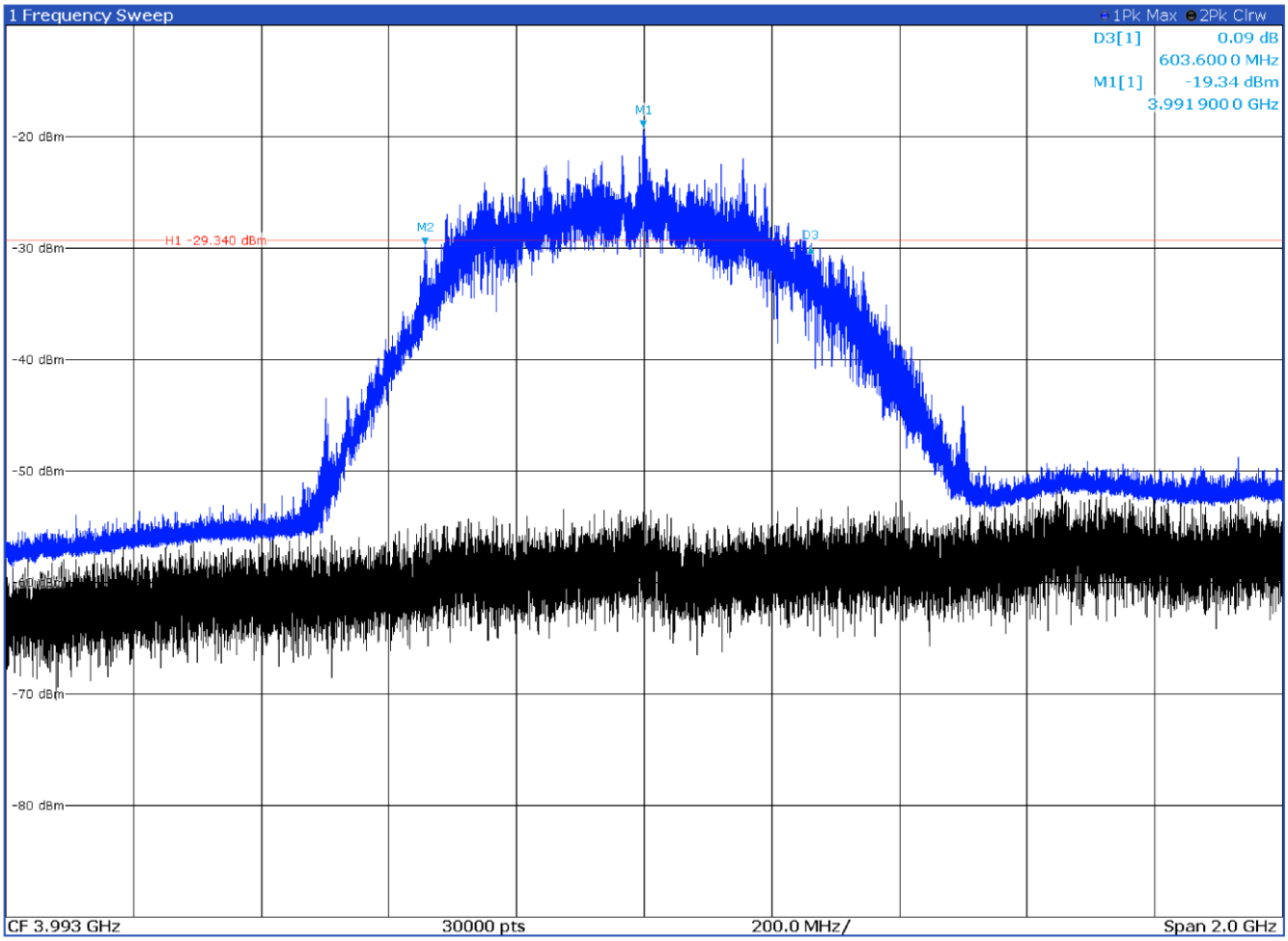
Note: NCR - no calibration required, VOU - verify on use

7.4.5 Test data

Table 7.4-2: *Bandwidth measurements results*

Frequency, (MHz)	10 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Detector
3993	603.6	808.09	500	PK

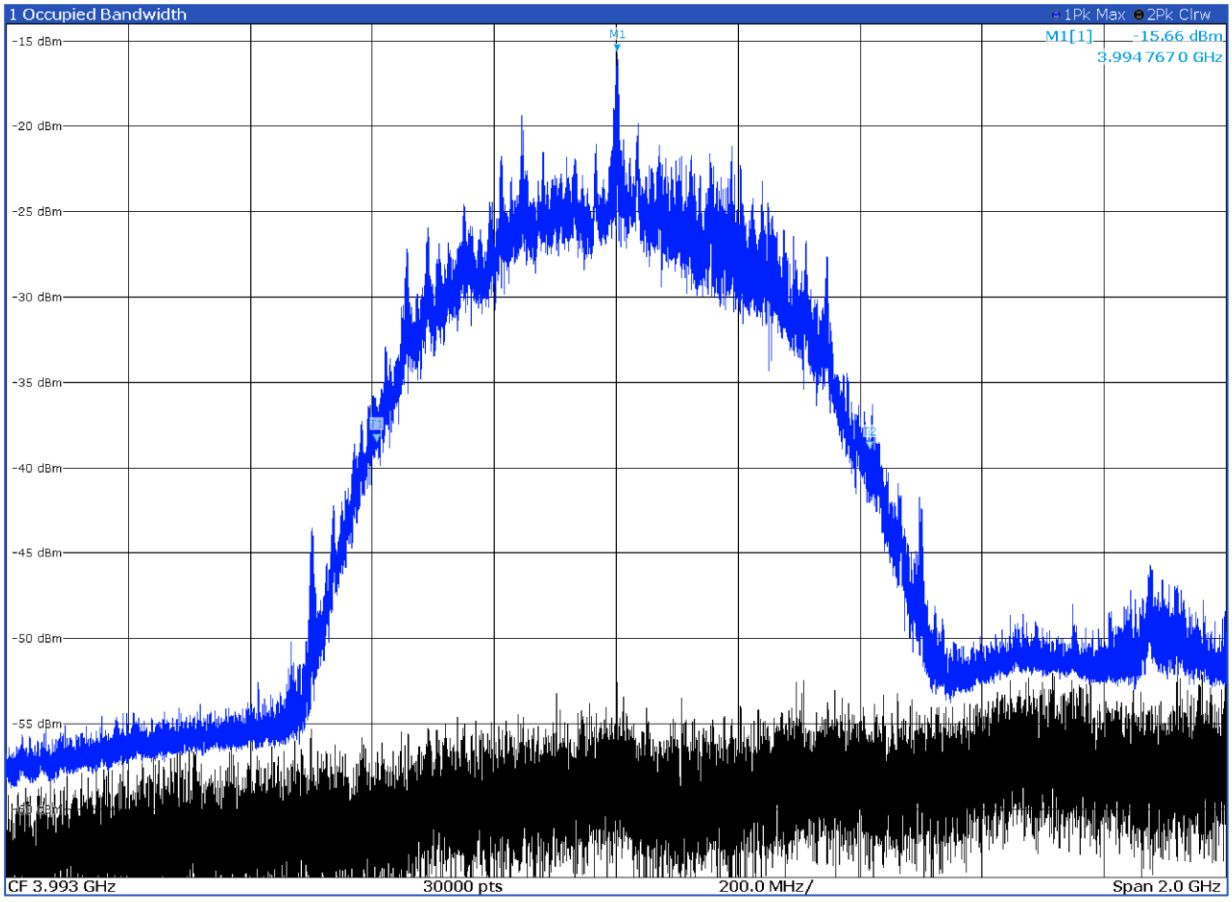
Frequency (MHz)	Lower Frequency (MHz)	Limit (MHz) Lower frequency	Upper frequency (MHz)	Limit (MHz) Upper frequency
3993	3649.633	3100	8485.8000	10600



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**3.991 9 GHz**	**-19.34 dBm**		
M2		1	**3.649 633 GHz**	**-29.84 dBm**		
D3	M2	1	**603.6 MHz**	**0.09 dB**		

10 dB Bandwidth



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**3.994 767 GHz**	**-15.66 dBm**	Occ Bw	**808.094 507 154 MHz**
T1		1	3.600 633 7 GHz	-38.51 dBm	Occ Bw Centroid	4.004 680 923 GHz
T2		1	4.408 728 2 GHz	-38.95 dBm	Occ Bw Freq Offset	11.680 923 049 MHz

99 % Bandwidth

7.5 EIRP

7.5.1 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 (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(dBuV/m) = P(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.

7.5.2 Test date

Start date	June 9, 2021

7.5.3 Observations, settings and special notes

RBW = 3 MHz, VBW = 10 MHz, so the EIRP limit is 20 log (3/50) = - 24.44 dBm
E field strength (dBµV/m) = EIRP (dBm) + 95.3

7.5.4 Test equipment list

Table 7.5-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	09/2020	09/2021
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2018	07/2021
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	07/2020	07/2021
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	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

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

7.5.5 Test data

Table 7.5-2: *Eirp measurements results*

Frequency, GHz	Antenna Polarization	Measure Level dBm	Limit dBm	Margin dB	Detector
3993	V	-24.77	-24.44	-0.33	PK
3993	H	-25.62	-24.44	-1.18	PK

E field strength (dBµV/m) = EIRP (dBm) + 95.3 → -24.8 dBm + 95.3 = 70.5 dBµV/m

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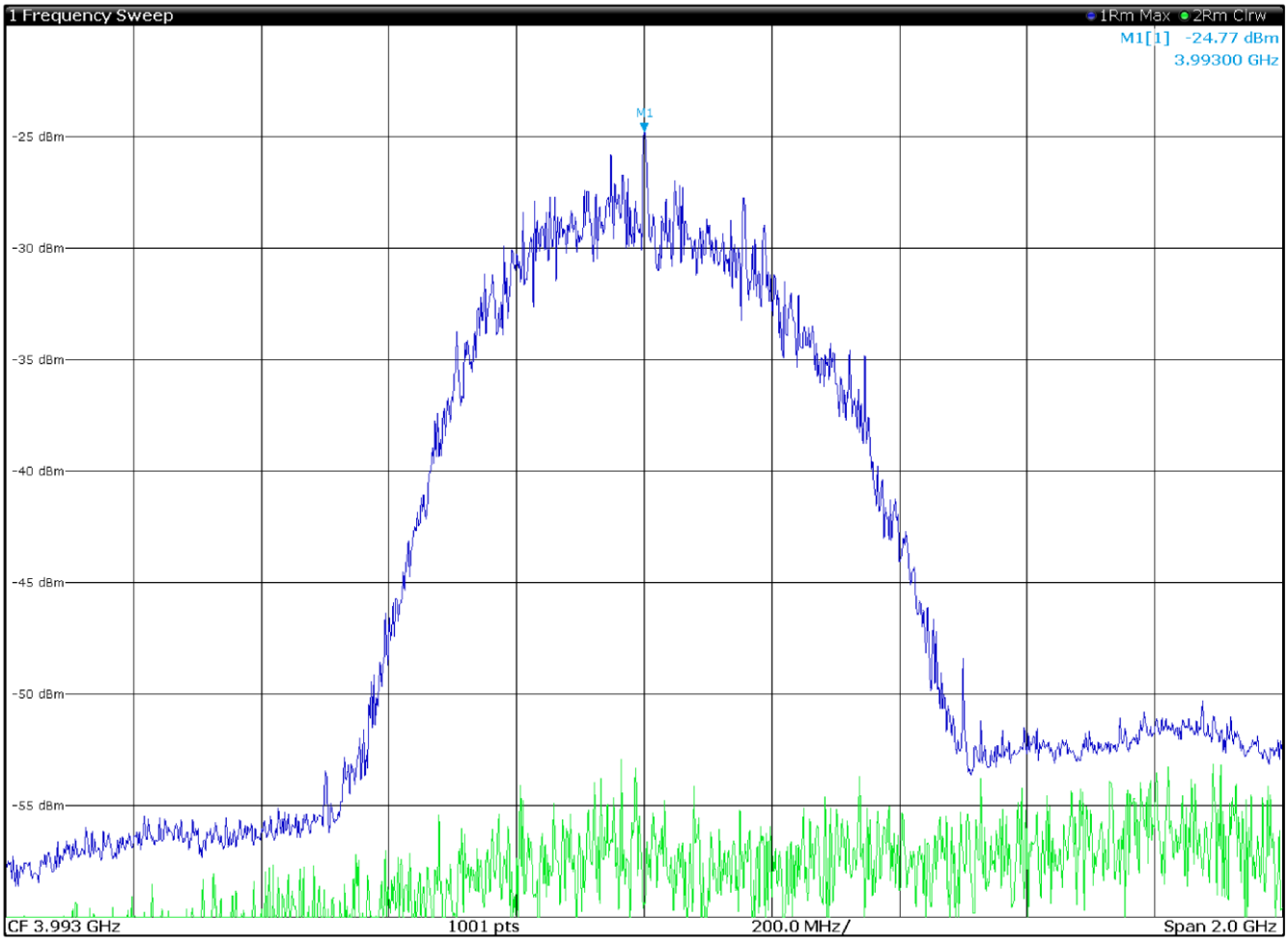
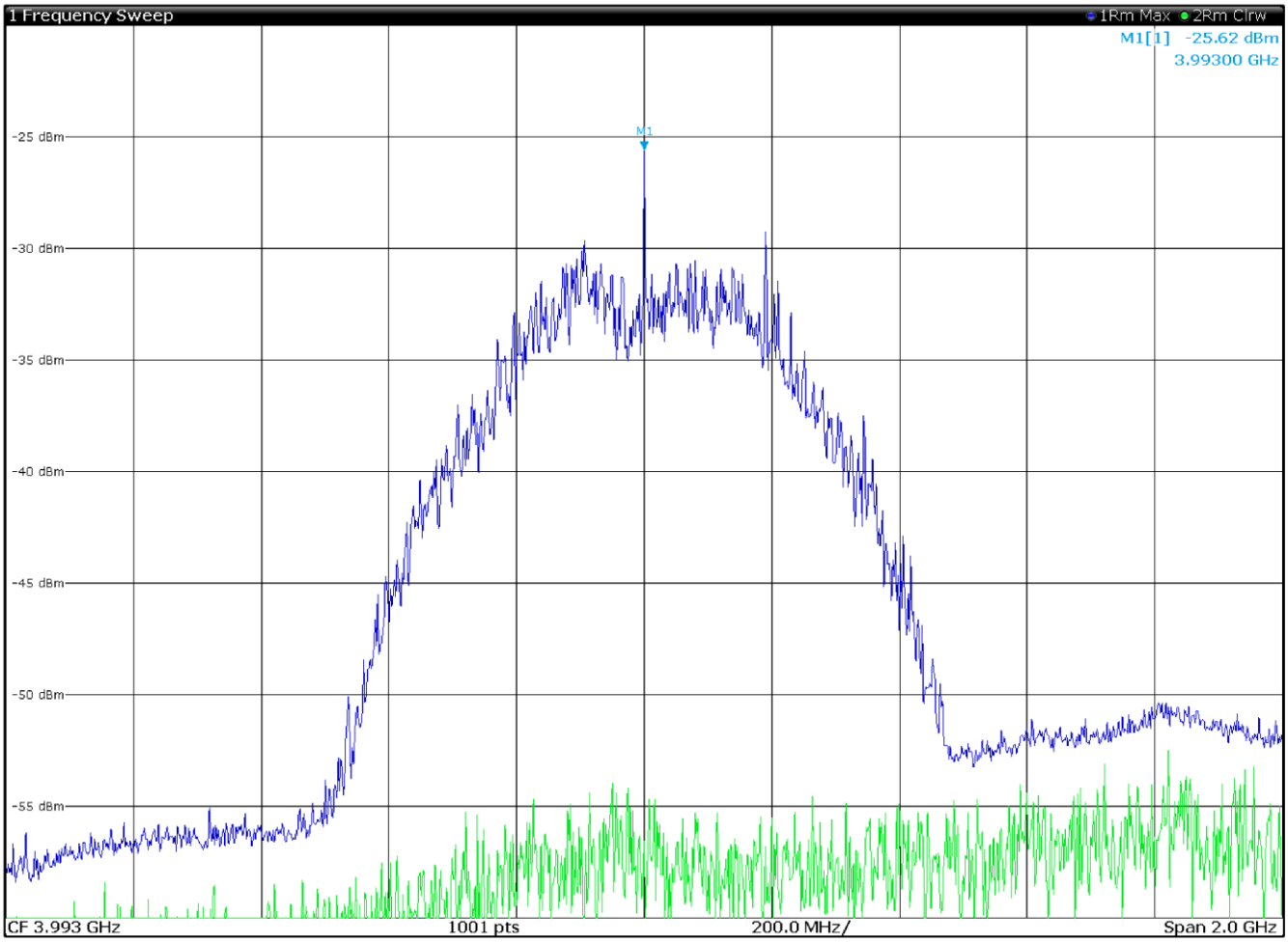


Vertical Polarization



Horizontal Polarization

7.6 Radiated emissions

7.6.1 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:**

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

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 7.6-1: *FCC §15.209 – Radiated emission limits below 1 GHz*

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.

7.6.1 Test date

Start date	June 11, 2021

7.6.2 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz according to §15.33(a)(1).
E field strength (dBµV/m) = EIRP (dBm) + 95.3

Spectrum analyzer settings for radiated measurements below 1 GHz 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 960 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

7.6.3 Test equipment list

Table 7.6-2: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	08/2020	08/2021
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	09/2020	09/2021
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	07/2018	07/2021
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2018	07/2021
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	07/2020	07/2021
Horn antenna (3 ÷ 40 GHz)	RFSpin	DRH40	061106A40	04/2020	04/2023
Preamplifier (18 ÷ 40 GHz)	Sage	STB-1834034030-KFKF-L1	18490-01	03/2021	03/2024
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	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

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

7.6.4 Test data

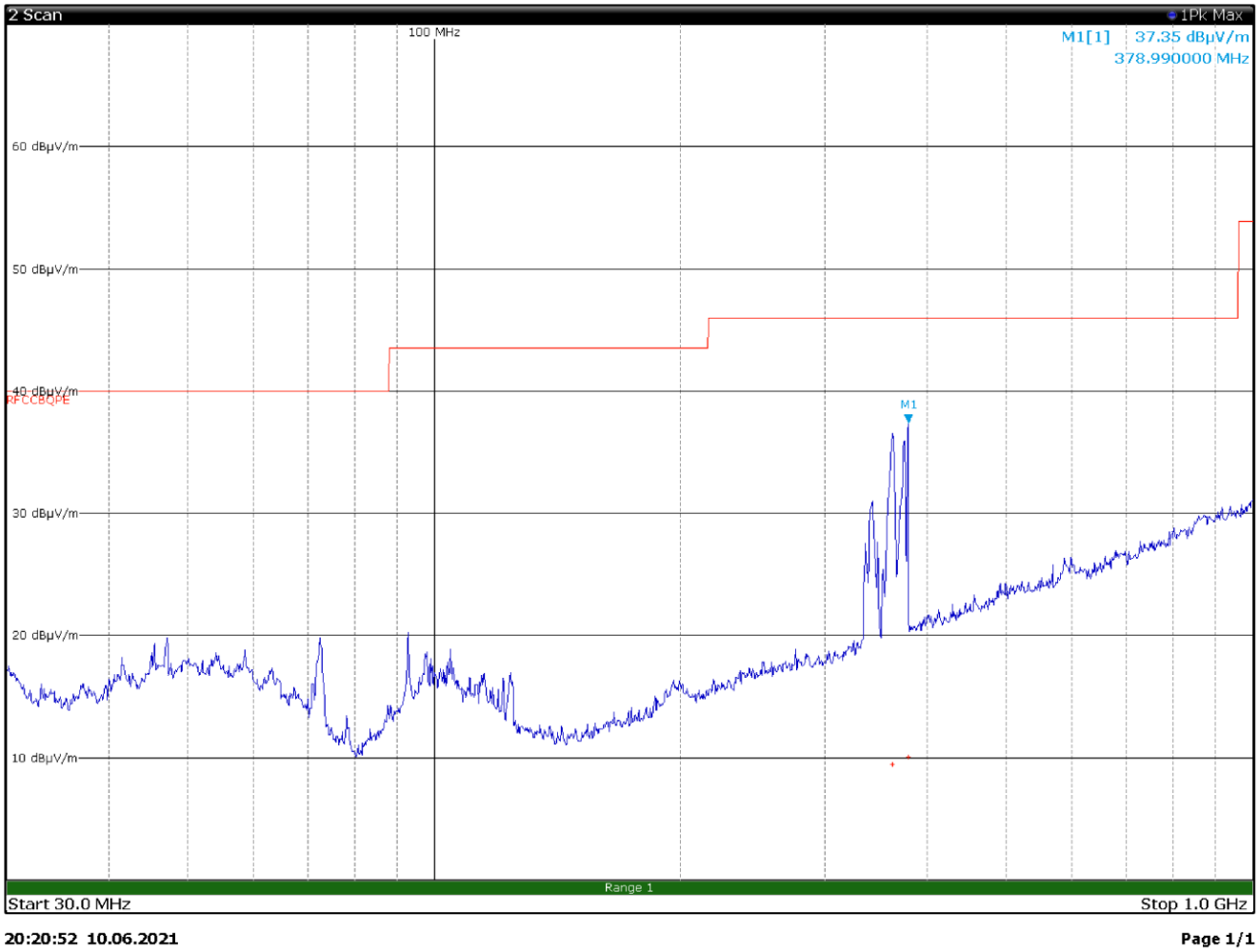


Figure 7.6-1: *Radiated spurious emissions 30 to 1000 MHz, antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
363.0000	9.5	46.0	-36.5	QP
378.9900	10.1	46.0	-35.9	QP

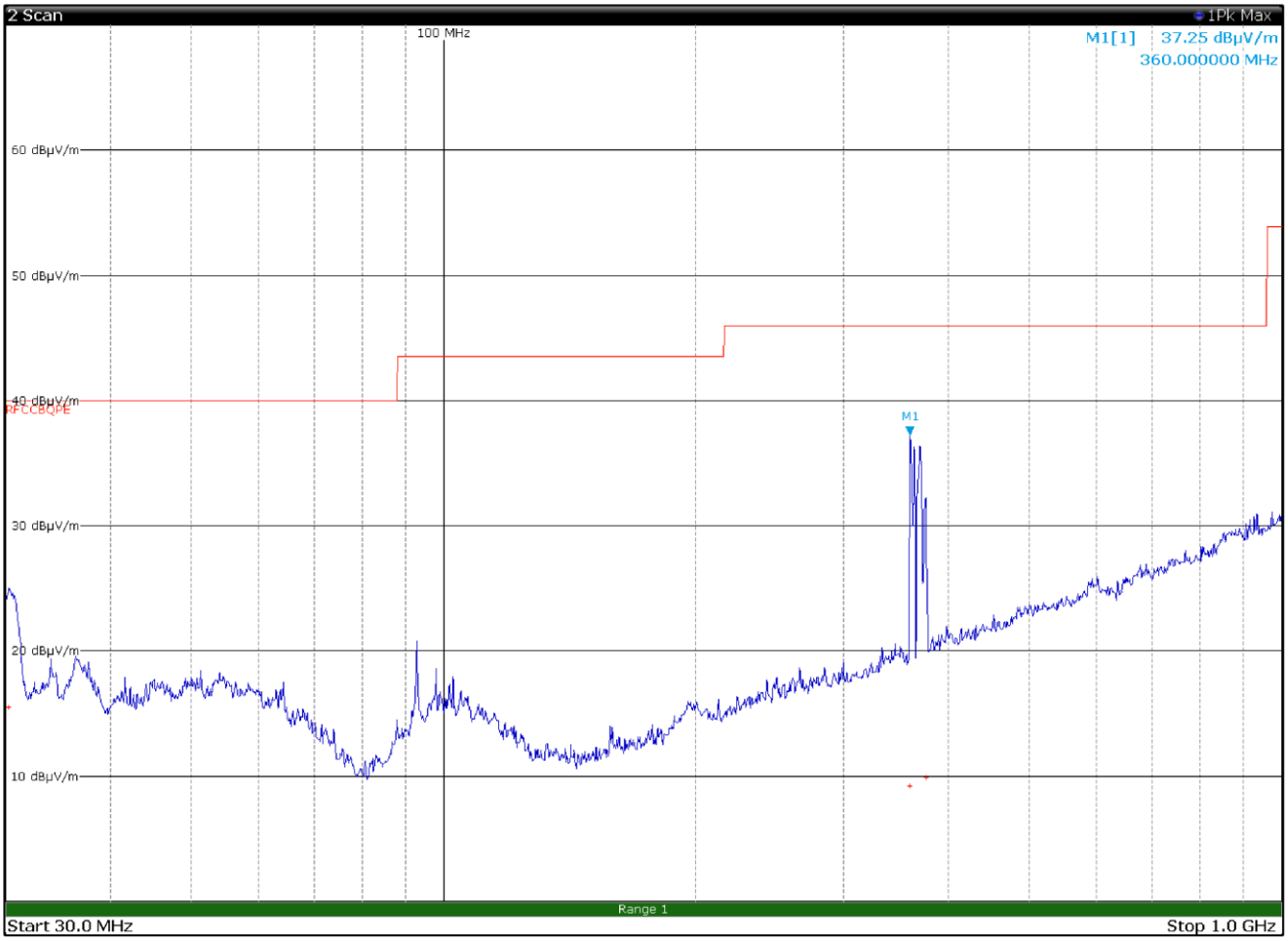


Figure 7.6-2: *Radiated spurious emissions 30 to 1000 MHz, antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
30.2700	15.6	40.0	-24.4	QP
360.0000	9.2	46.0	-36.8	QP
375.9900	10.0	46.0	-36.0	QP

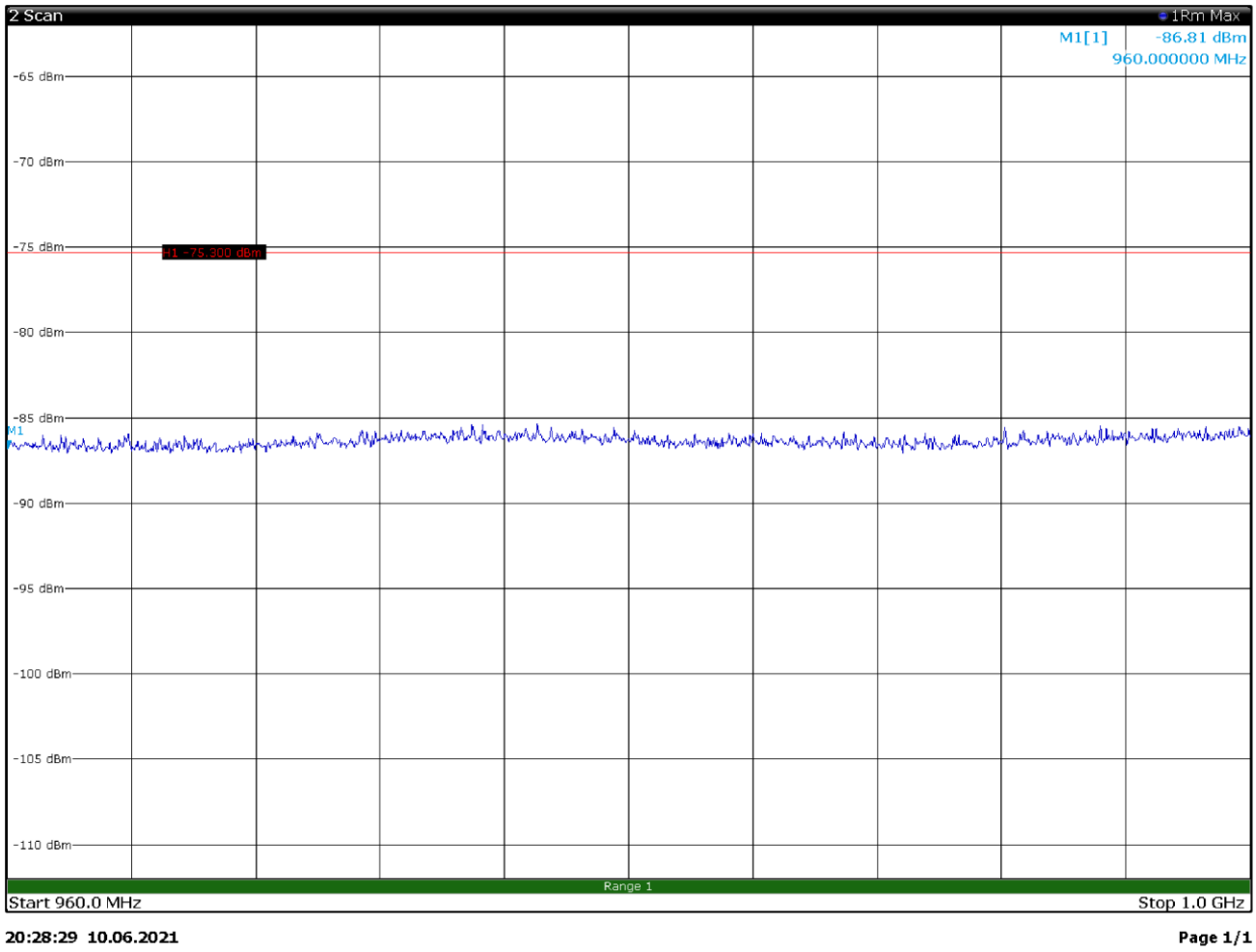


Figure 7.6-3: *Radiated spurious emissions 960 to 1000 MHz, antenna in horizontal polarization*

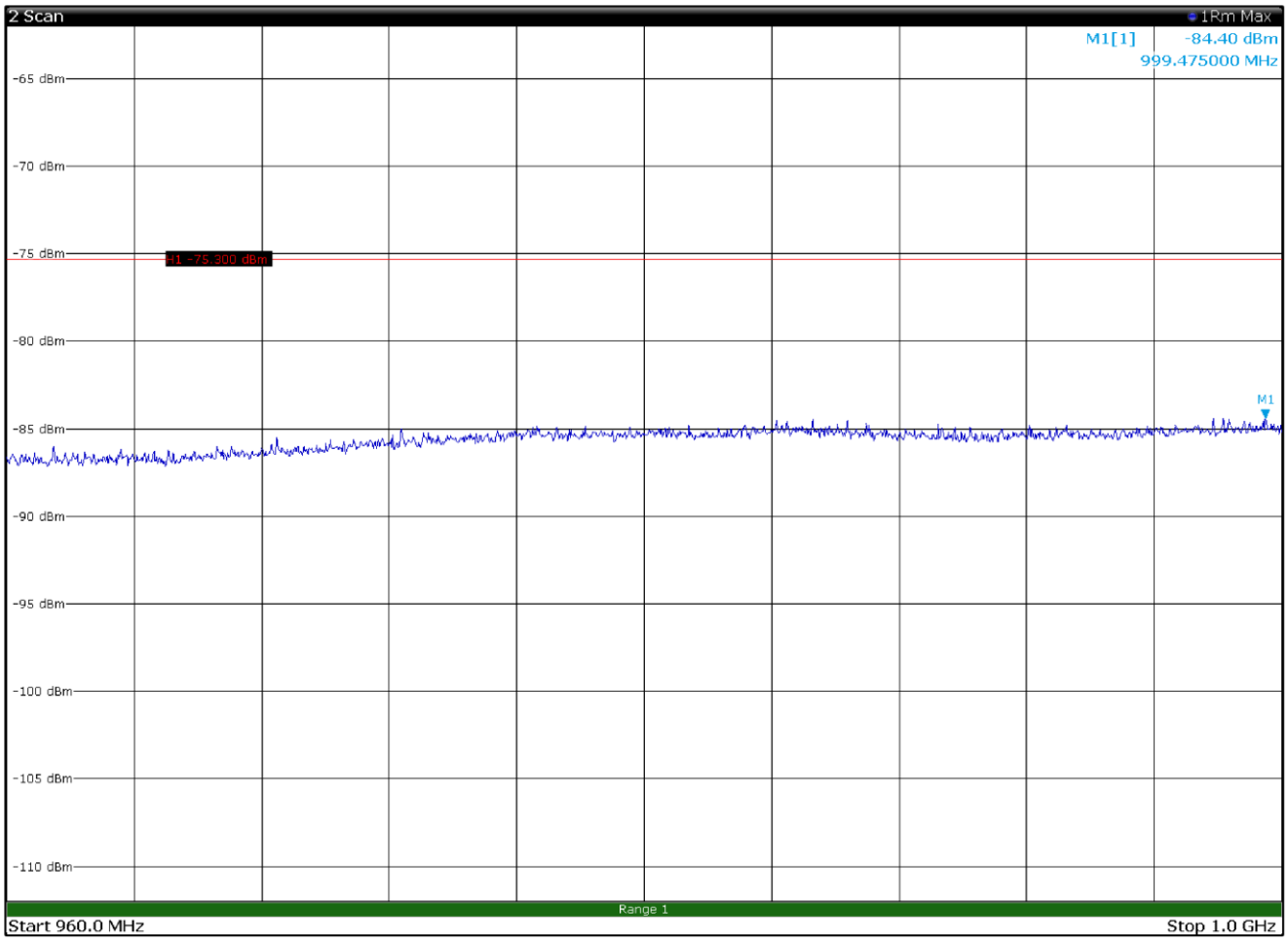
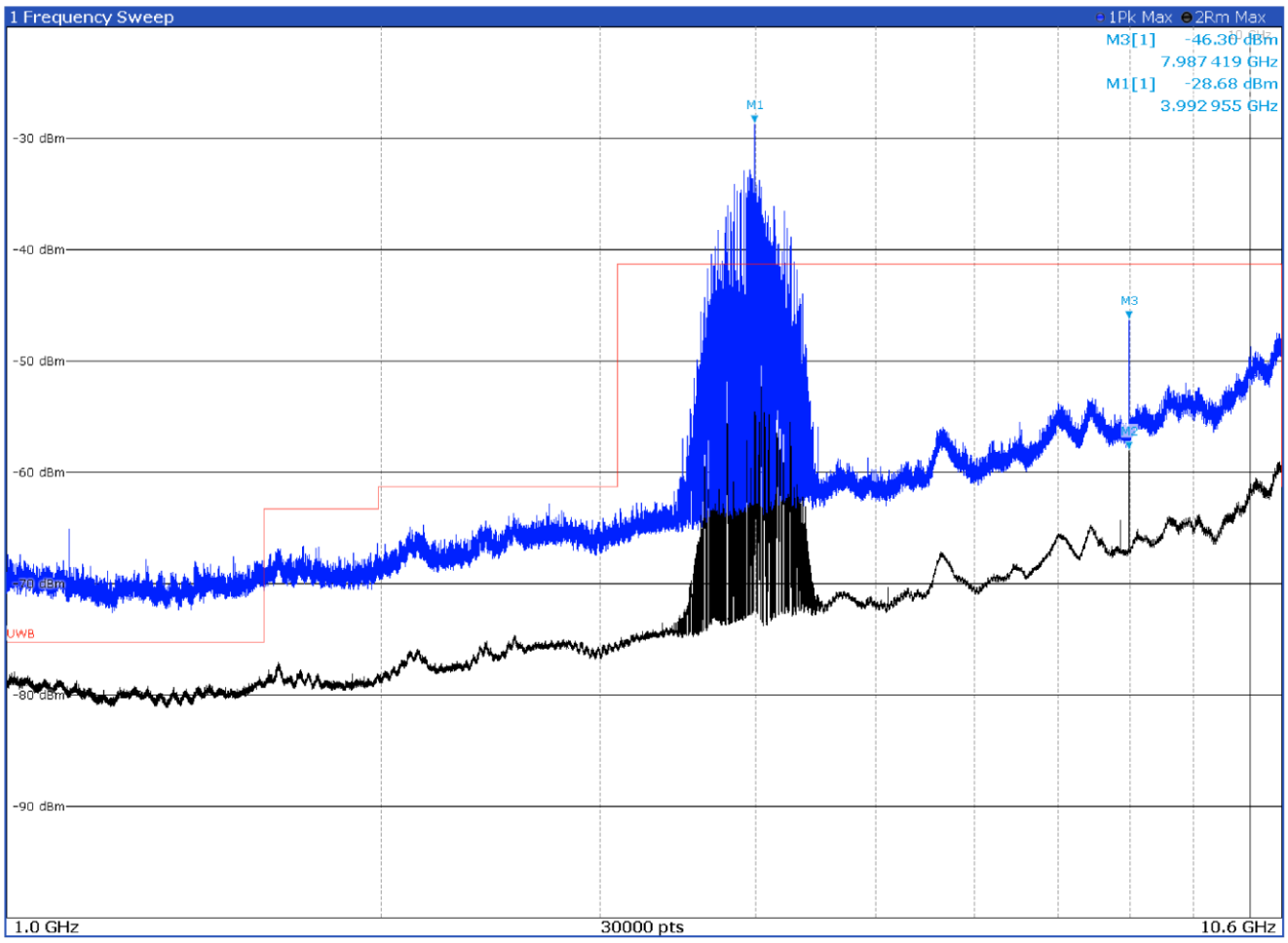


Figure 7.6-4: *Radiated spurious emissions 960 to 1000 MHz, antenna in vertical polarization*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**3.992 955 GHz**	**-28.68 dBm**		
M2		2	**7.987 419 GHz**	**-58.00 dBm**		
M3		1	**7.987 419 GHz**	**-46.30 dBm**		

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
7987.419	-46.3	--	-	PK
7987.419	-58.0	-43.0	-15.0	AV

Figure 7.6-5: *Radiated spurious emissions 1 to 10.61 GHz (FCC limits), with antenna in horizontal polarization*

The peak value are only informative

THE PE

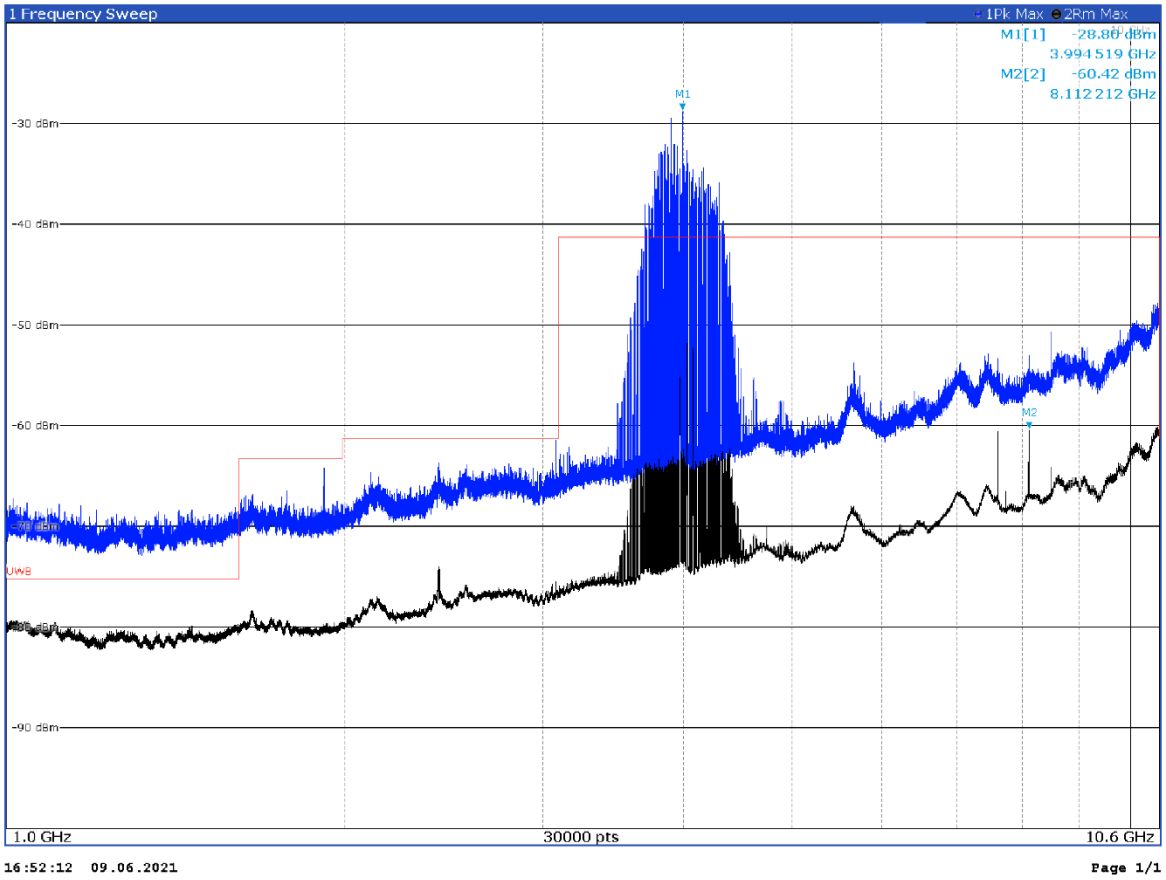


Figure 7.6-6: *Radiated spurious emissions 1 to 10.61 GHz (FCC Limits), with antenna in vertical polarization*

The peak value are only informative

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
8112.212	-60.4	-43.0	-17.4	AV

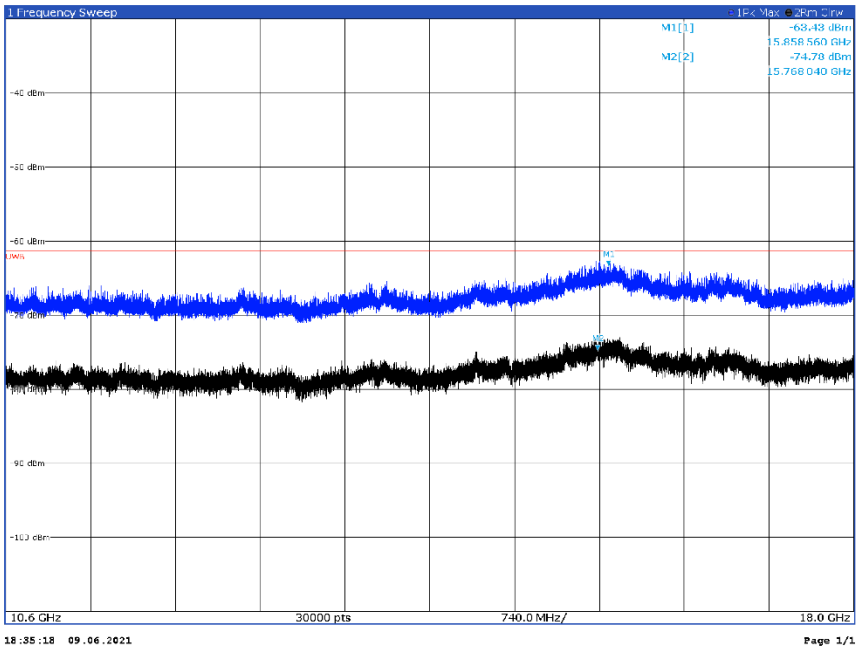


Figure 7.6-7: *Radiated spurious emissions 10.61 to 18 GHz, with antenna in horizontal polarization*

The peak value are only informative

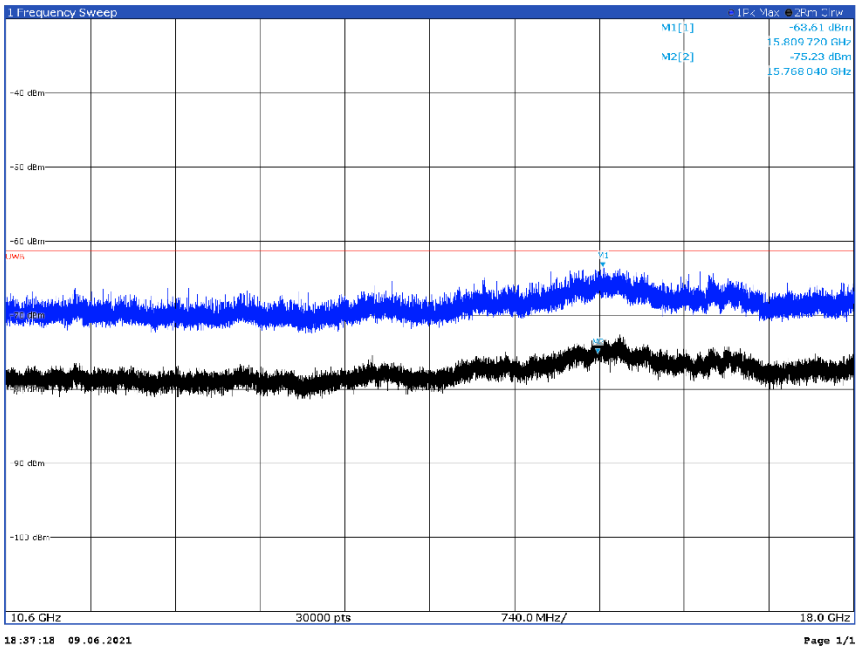


Figure 7.6-8: *Radiated spurious emissions 10.61 to 18 GHz, with antenna in vertical polarization*

The peak value are only informative

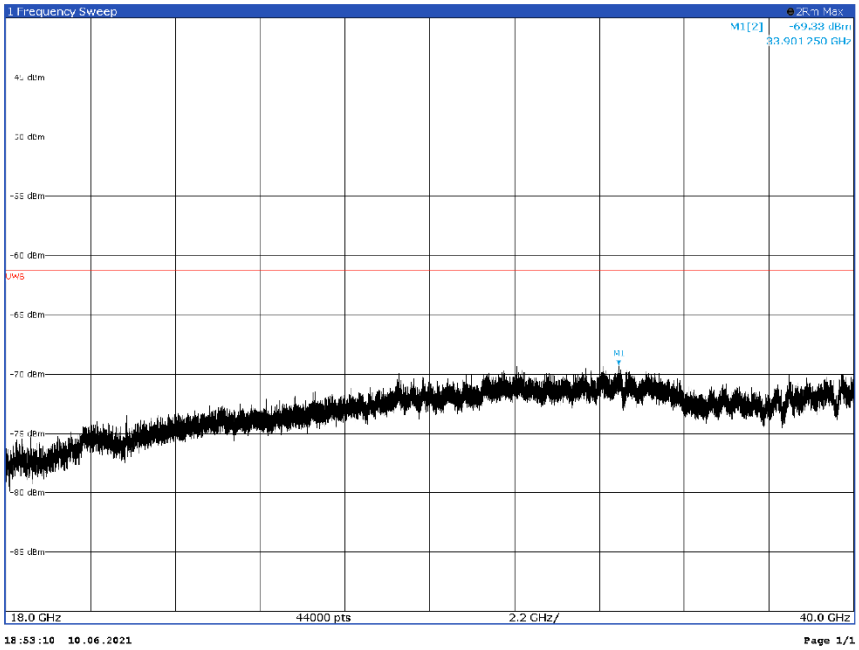


Figure 7.6-9: *Radiated spurious emissions 18 to 40 GHz, with antenna in horizontal polarization*

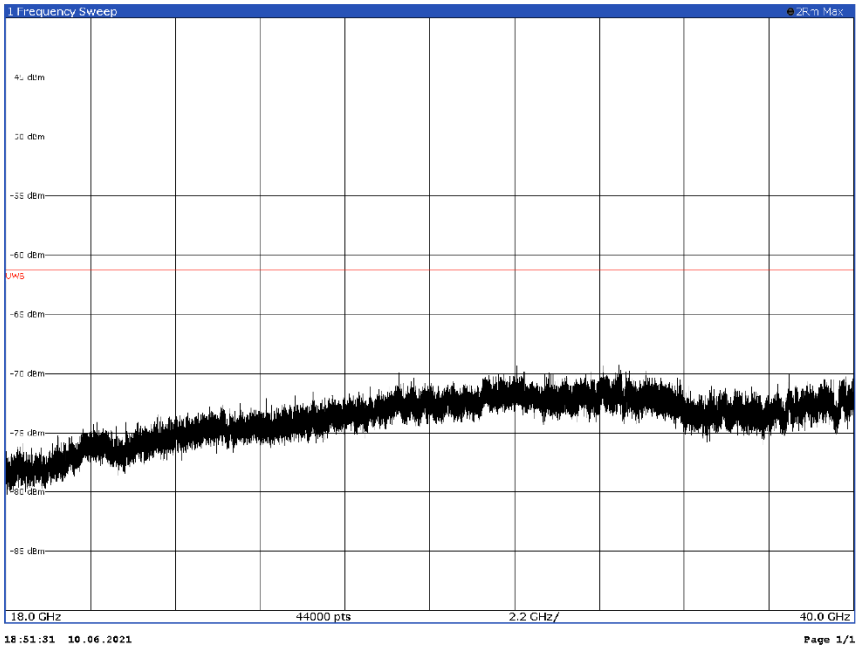


Figure 7.6-10: *Radiated spurious emissions 18 to 40 GHz, with antenna in vertical polarization*

7.7 Radiated Emissions in GPS band

7.7.1 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.

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

7.7.2 Test date

Start date	November 24, 2020

7.7.3 Observations, settings and special notes

E field strength (dBµV/m) = EIRP (dBm) + 95.3

Spectrum analyzer settings:

Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Detector mode Trace 1	Peak
Trace 1 mode :	Max Hold
Detector mode Trace 2	RMS
Trace 2 mode :	Max Hold

7.7.4 Test equipment list

Table 7.7-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	09/2020	09/2021
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2018	07/2021
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	07/2020	07/2021
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	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

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

7.7.5 Test data

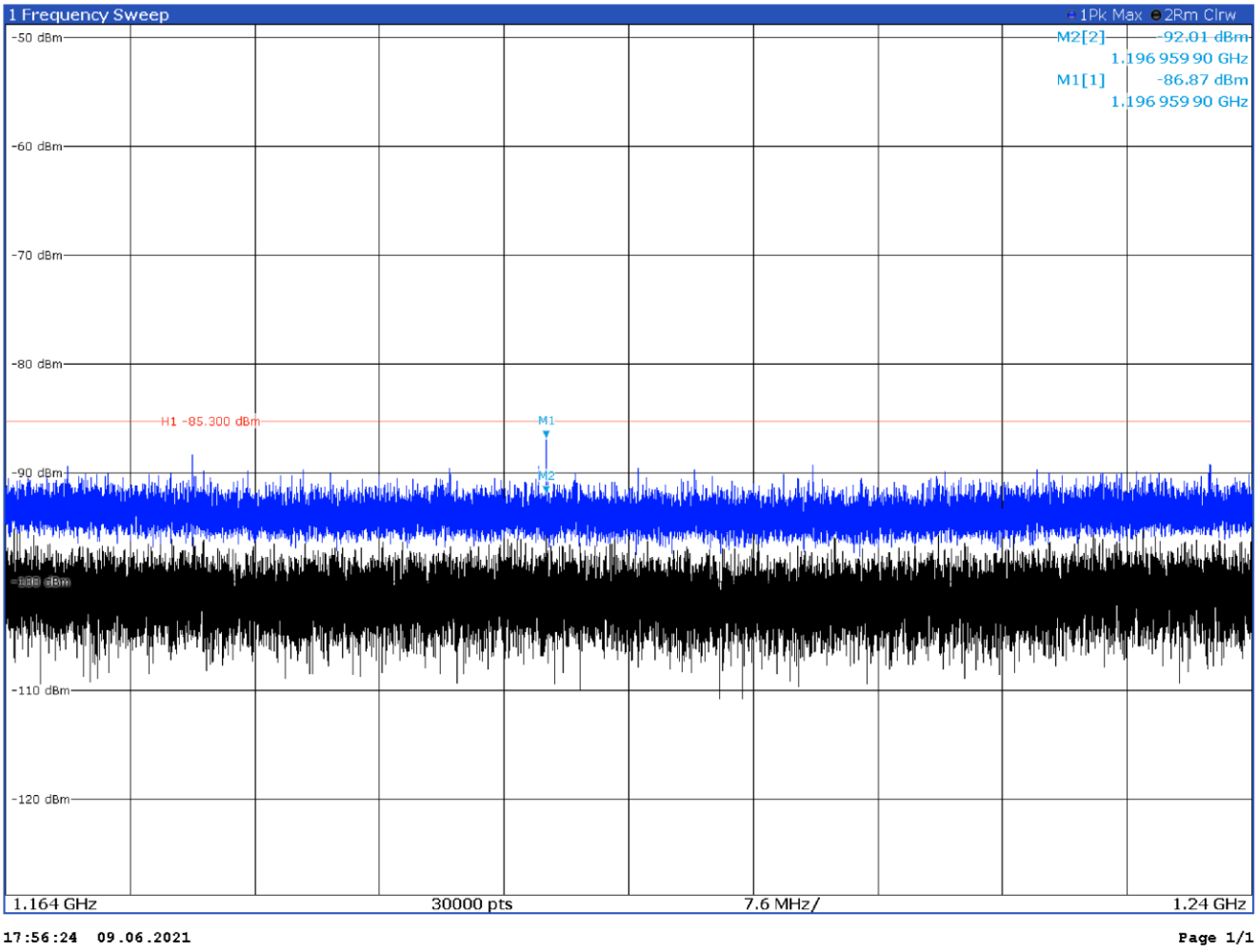


Figure 7.7-1: *Radiated spurious emissions 1164 - 1240 MHz, antenna in horizontal polarization*

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1196.9590	-86.9	-85.3	-	PK
1196.9590	-92.0	-85.3	-6.7	AV

Note:

1. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.
2. E field strength (dBµV/m) = EIRP (dBm) + 95.3

The peak value are only informative

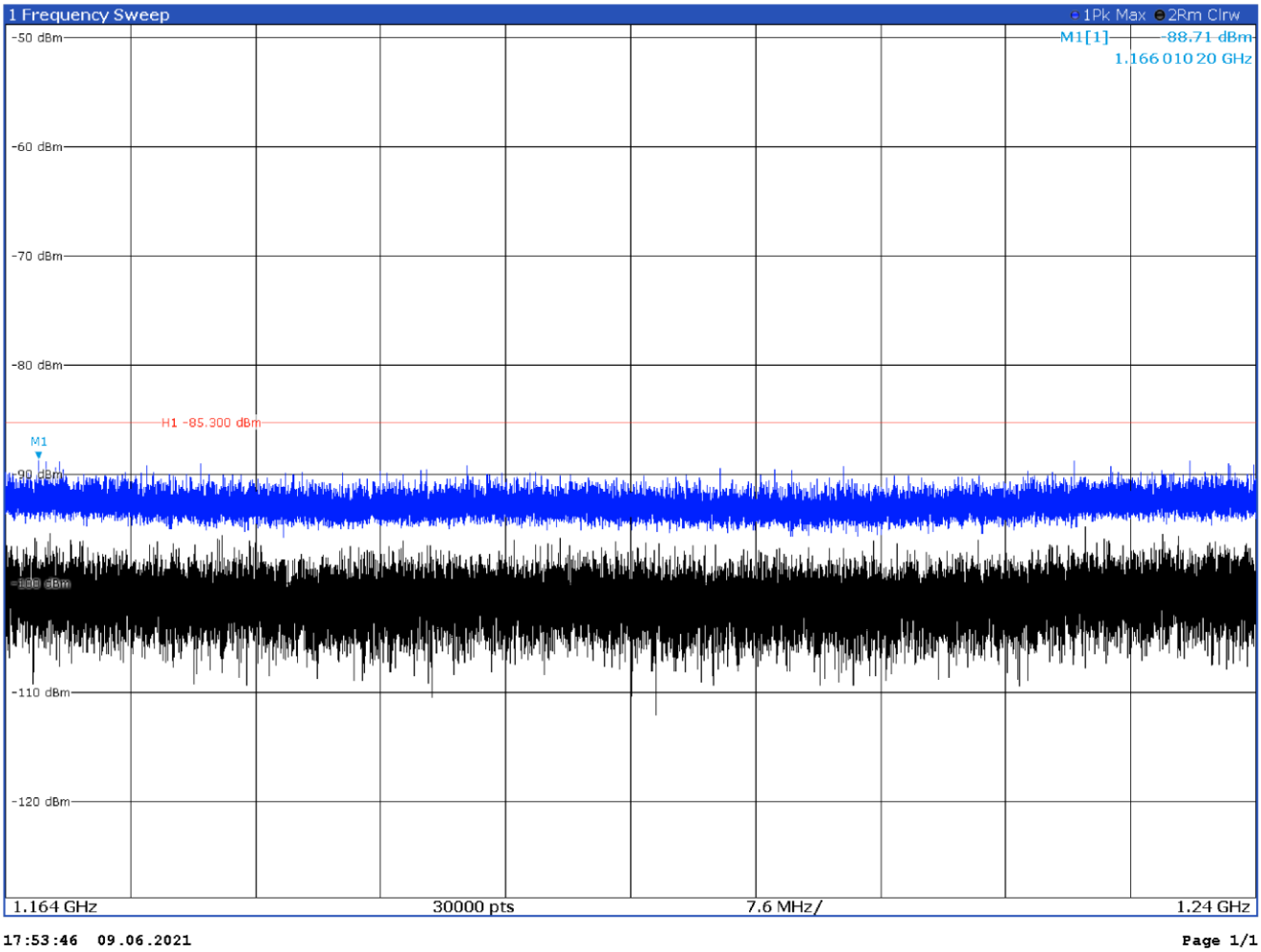


Figure 7.7-2: *Radiated spurious emissions 1164 - 1240 MHz, antenna in vertical polarization*

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1166.0102	-88.7	-85.3	-3.4	--

Note:

1. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.
2. E field strength (dBµV/m) = EIRP (dBm) + 95.3
3. The peak value are only informative

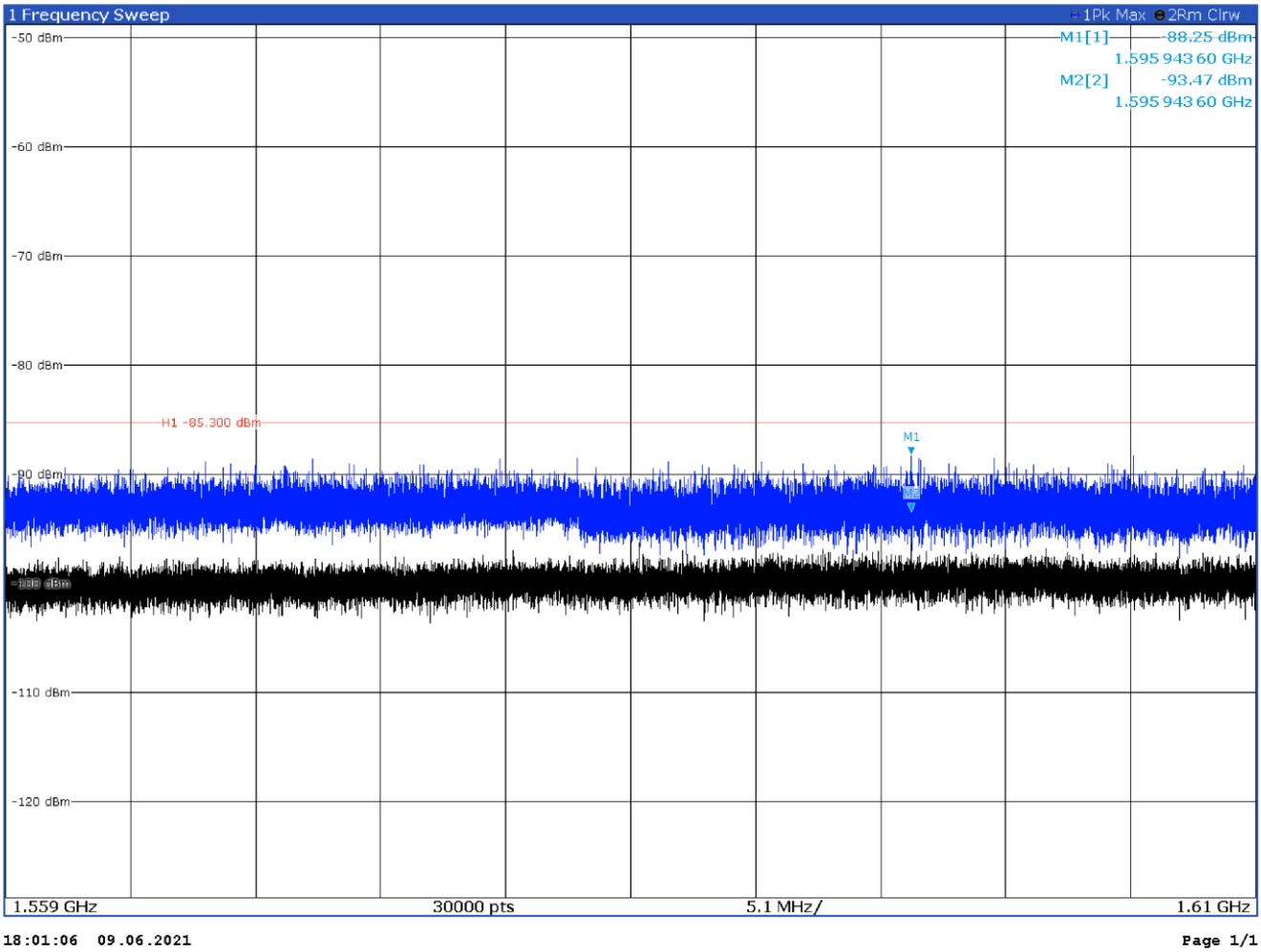


Figure 7.7-3: *Radiated spurious emissions 1559 to 1610 MHz, antenna in horizontal polarization*

The peak value are only informative

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1595.94360	-88.3	-85.3	-3.0	PK

Note:

1. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.
2. E field strength (dBµV/m) = EIRP (dBm) + 95.3

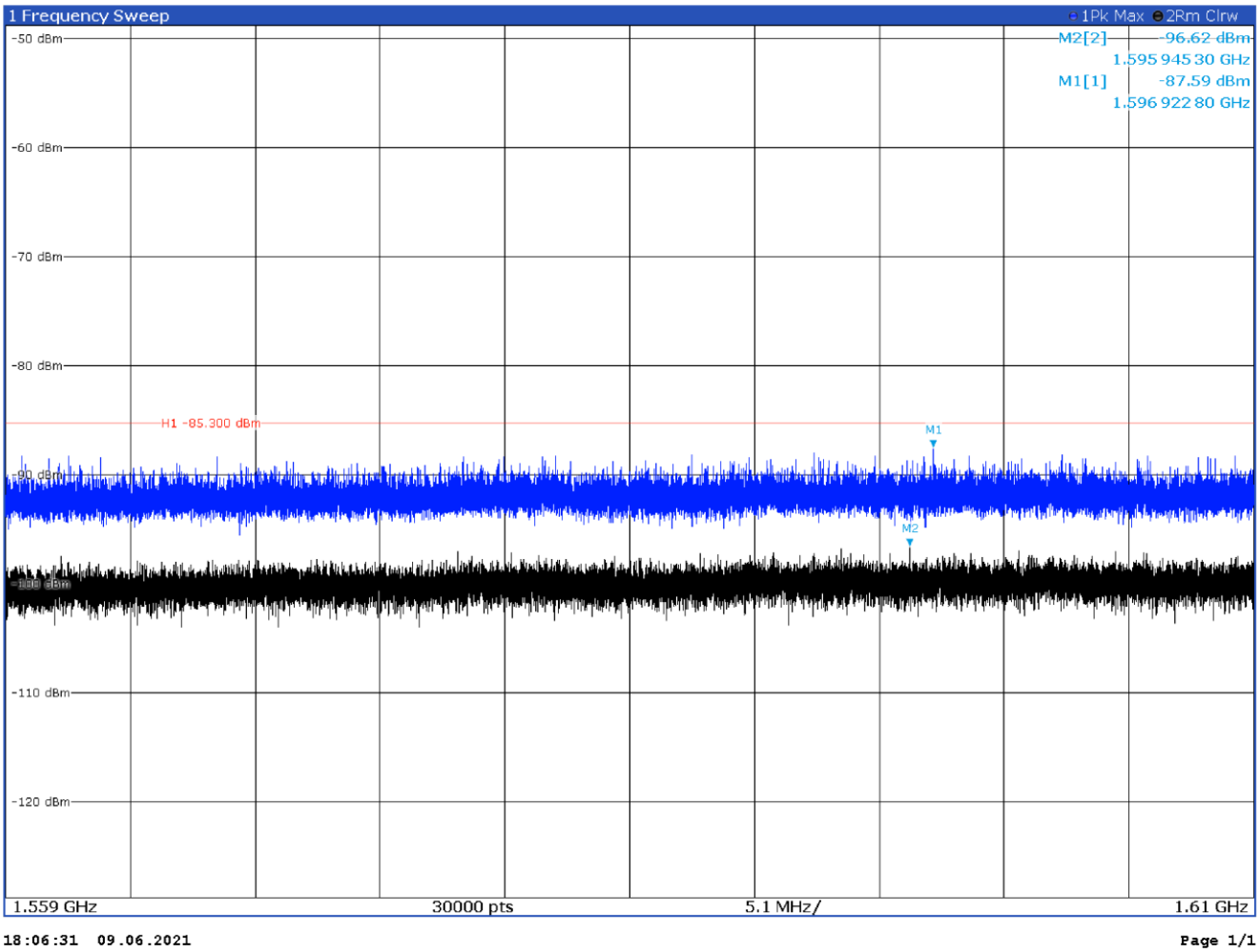


Figure 7.7-4: *Radiated spurious emissions 1559 to 1610 MHz, antenna in vertical polarization*

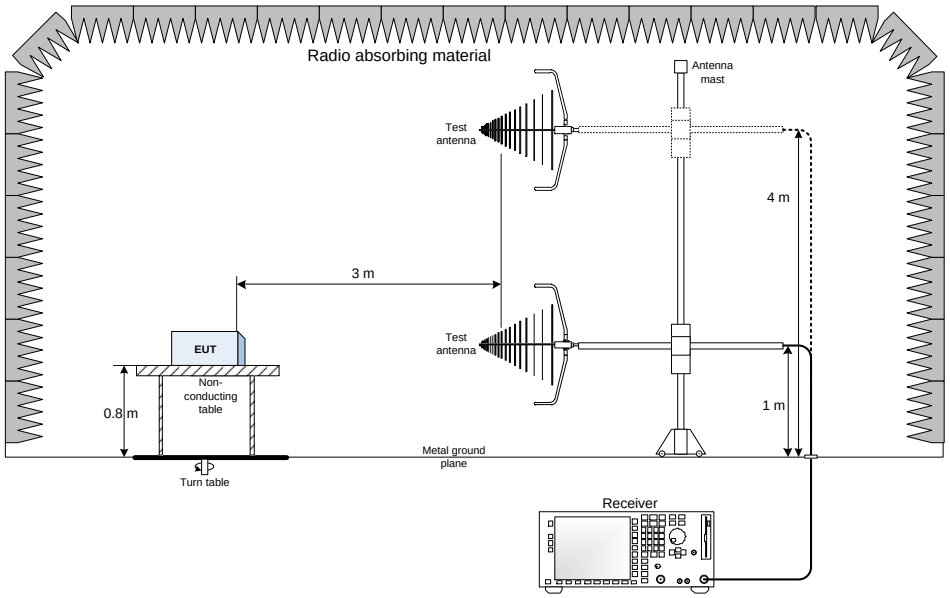
Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
1596.9228	-87.6	-85.3	-	PK
1595.94530	-96.6	-85.3	-11.3	AV

Note:

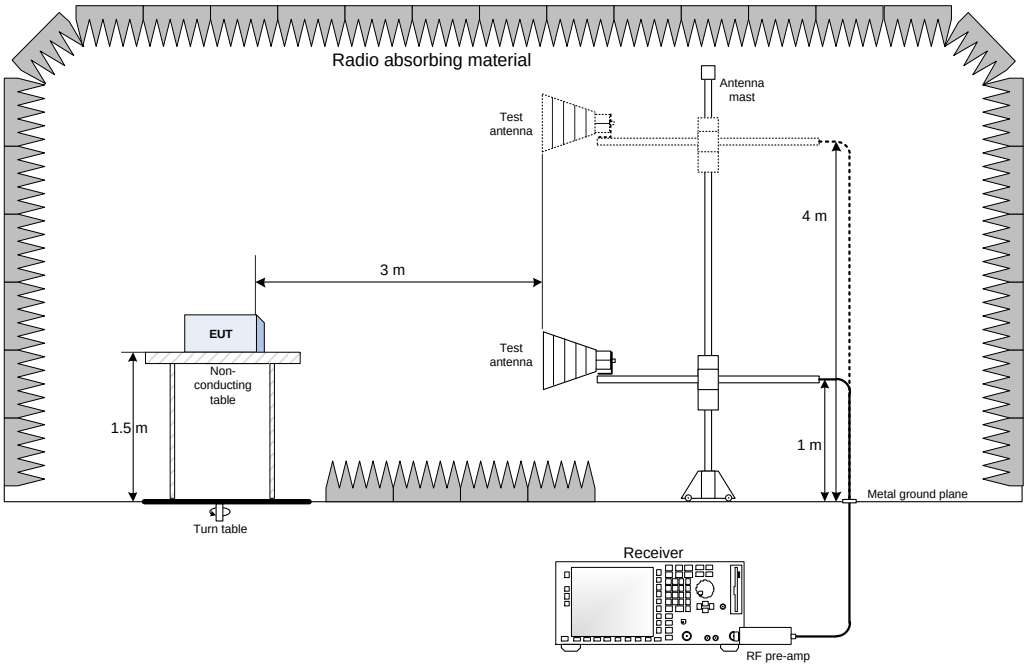
1. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.
2. E field strength (dBµV/m) = EIRP (dBm) + 95.3
3. The peak value are only informative

Section 9 Block diagrams of test set-ups

7.8 Radiated emissions set-up for frequencies below 1 GHz

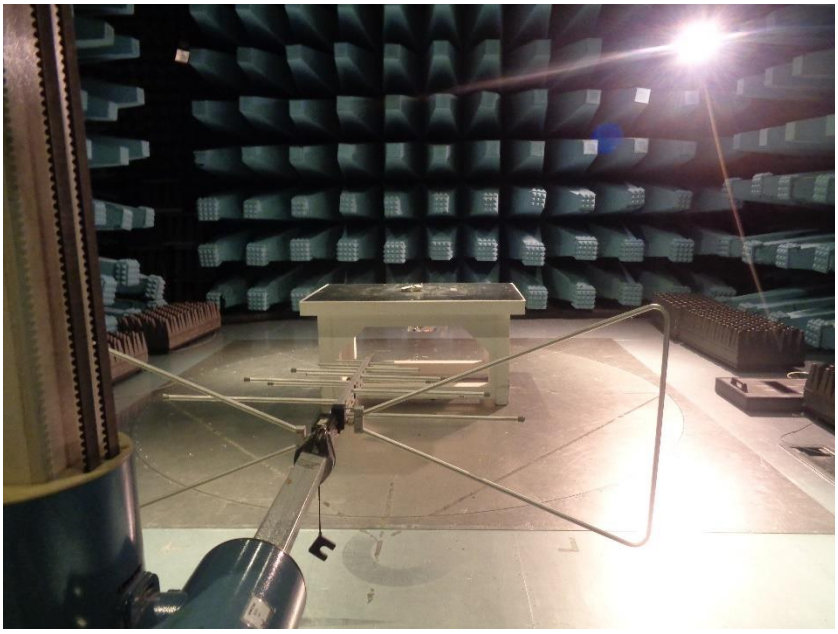


7.9 Radiated emissions set-up for frequencies above 1 GHz

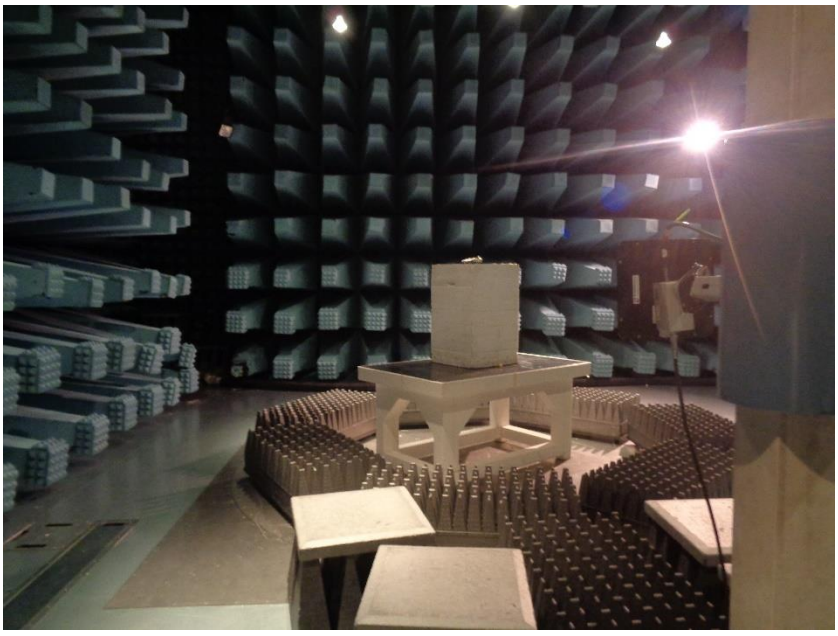


Section 10 Photos

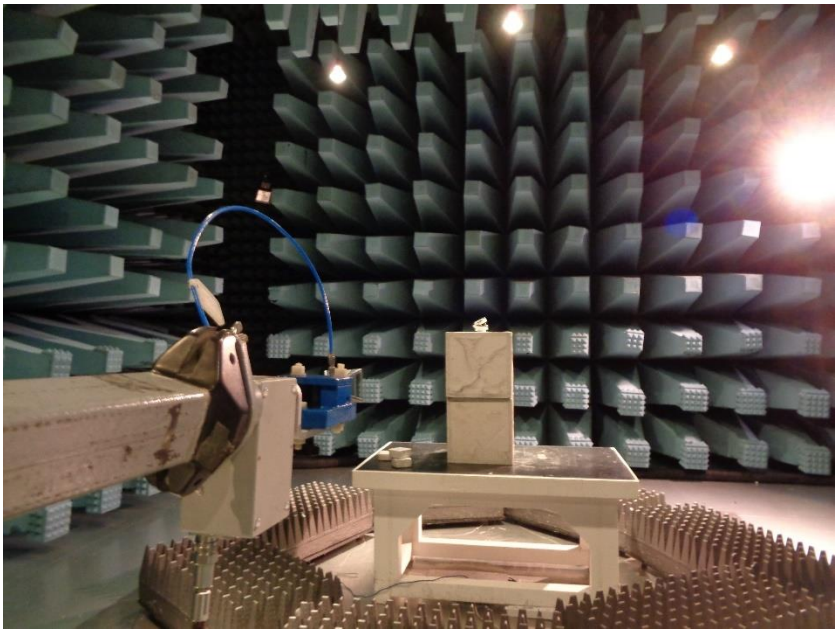
7.10 Photos of the test set-up



Radiated emission below 1 GHz

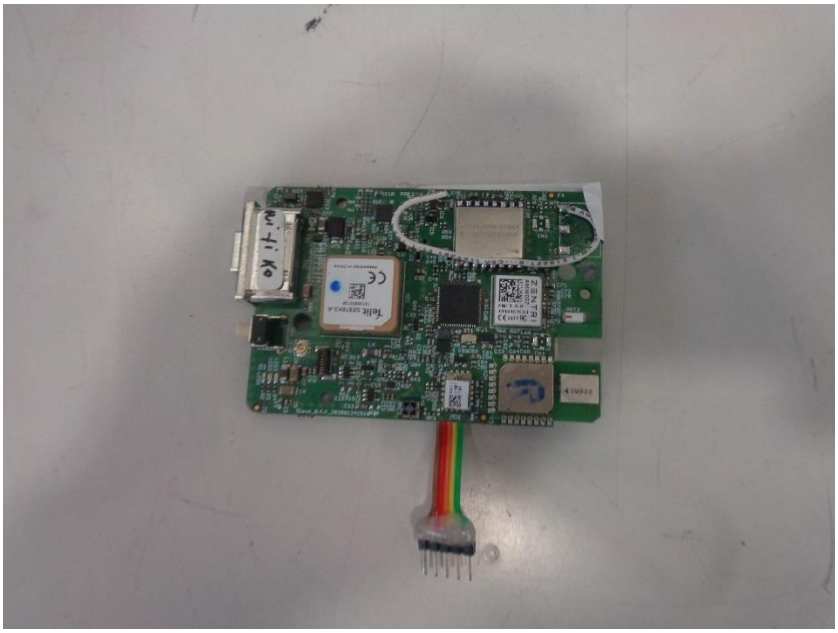


Radiated emission above 1 GHz and below 10 GHz



Radiated emission above 10 GHz and below 40 GHz

7.11 Photos of the EUT



(End of report)