



BNetzA-CAB-21/21-21

Partial Test Report

Test report no.: 21086128-23001-1

Date of issue: 2021-12-08

Test result: The test item - **passed** - and complies with the listed standards.

Applicant

Mitsubishi Electric Corporation Sanda Works

Manufacturer

Mitsubishi Electric Corporation

Test Item

R1LOW-R

RF-Spectrum Testing according to:

FCC 47 CFR Part 15

Radio Frequency Devices (Subpart C)

RSS-247 Issue 2

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5

General Requirements for Compliance of Radio Apparatus

Tested by

(name, function, signature)

Piotr Sardyko

Deputy Head of Laboratory RF

signature

Approved by

(name, function, signature)

Dr.-Ing. Harald Ansorge

Managing Director

signature

Applicant and Test item details

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Test item description	Automotive Display Audio
Model/Type reference	R1LOW-R
Standard specific information	
FCC ID	UJH-R1LOW-R
IC	662K-R1LOWR
PMN	R1LOW-R
HVIN variant ID#35	35
HVIN variant ID#36	36
HVIN variant ID#38	38
HVIN variant ID#40	40
HVIN variant ID#50	50
HVIN variant ID#52	52
HVIN variant ID#54	54
HVIN variant ID#56	56
HVIN variant ID#57	57
HVIN variant ID#62	62
FVIN	N/A
HMN	N/A
Frequency	2.4 GHz ISM band (2400 – 2483.5 MHz)
Technology	Bluetooth Basic Data Rate (BDR), Enhanced Data Rate (EDR)
Antenna	Sheet metal antenna
Power supply	9 – 16.5 V DC Battery
Temperature range	-40 °C to +75 °C

Disclaimer and Notes

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Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjoined to its use.

IBL-Lab GmbH does not take test samples. The sample used for testing is provided by the applicant.

Decision rule: Binary Statement for Simple Acceptance Rule according ILAC-G8:09/2019

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2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: - Electronics D-PL-21375-01-01 - Electromagnetic Compatibility D-PL-21375-01-02 - Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-03 - Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-04 - ISED Company Number 27156 - Testing Laboratory CAB Identifier DE0020 - Telekommunikation (TK) D-PL-21375-01-05 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to ILAC Mutual Recognition Arrangement
Testing location	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2021-09-30
Start – End of tests	2021-10-04 – 2021-10-29

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and Interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision History

-0 Initial Version

-1 Revision: administrative modification/correction

Page 168, Plot 92: replacement of wrong test plot / test protocol by the right one; no impact on test verdict
Change of HVIN

This test report 21086128-23001-1 replaces the previous test report 21086128-23001-0.

Utilisation, publication and control of previous report editions is under responsibility of the applicant.

2.6 Further documents

List of further applicable documents belonging to the present test report:

- TR-21086128-23001-1 (test report).pdf (latest available version)
- TR-21086128-23001-1_AnnexA (test results EUT).pdf
- TR-21086128-23001-1_AnnexB (external photos EUT).pdf
- TR-21086128-23001-1_AnnexC (internal photos EUT).pdf
- TR-21086128-23001-1_AnnexD (test setup FCC - IC).pdf

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75 % r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V / 50 Hz

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-/-	+25 °C	-/-
Relative humidity	-/-	50 % r.h.	-/-
Power supply	-/-	12.6 V DC	-/-

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)
RSS-247 Issue 2	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus

Test standard (not accredited)	Description
none	---

Reference	Description
ANSI C63.4-2014	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
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 15.247 Meas Guide v05r02	Guidance for compliance measurements on digital transmission systems, frequency hopping spread spectrum systems and hybrid system devices operating under section 15.247 of the FCC rules

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description

Automotive Display Audio

*: as declared by applicant

5.2 Test Item Description

Model name*	R1LOW-R		
EUT status*	PrePV		
Serial number*	ID#35: mechanical variant ASW, electrical variant 10 (lead model) ID#36: mechanical variant ASW, electrical variant 20 ID#38: mechanical variant ASW, electrical variant 50 ID#40: mechanical variant 8F, electrical variant 22 ID#50: mechanical variant 8TR, electrical variant 10 ID#52: mechanical variant 8TR, electrical variant 20 ID#54: mechanical variant 7WB, electrical variant 10 ID#56: mechanical variant 7ICS, electrical variant 10 ID#57: mechanical variant 7ICS, electrical variant 20 ID#62: mechanical variant 8NF, electrical variant 20		
Serial number of EUT test samples*	ID#35:	radiated EUT:	65804, 65805
		conducted EUT:	-
	ID#36:	radiated EUT:	66204, 66205
		conducted EUT:	-
	ID#38:	radiated EUT:	65251
		conducted EUT:	-
	ID#40:	radiated EUT:	66404, 66405
		conducted EUT:	66403
	ID#50:	radiated EUT:	65008
		conducted EUT:	65016
	ID#52:	radiated EUT:	66104, 66105
		conducted EUT:	-
	ID#54:	radiated EUT:	65702, 65705
		conducted EUT:	65703
	ID#56:	radiated EUT:	65602, 65604
		conducted EUT:	65603
	ID#57:	radiated EUT:	65903
		conducted EUT:	-
	ID#62:	radiated EUT:	66304, 66305
		conducted EUT:	66303
PCB identifier*	NJ00193612		
Hardware status*	NR-0C-R-PrePV		
Software status*	Android 10		

*: as declared by applicant; please see TR-21086128-23001-1_AnnexB , TR-21086128-23001-1_AnnexC for EUT photographs.

5.3 Technical Data of Equipment

Operational frequency band*	2.4 GHz ISM band (2400 – 2483.5 MHz)
Transmitter*	Chip QCA6574AU with 48 MHz TCXO (Module UGKZ5A3006A)
Technology*	Bluetooth Basic Data Rate (BDR), Enhanced Data Rate (EDR)
Modulation type*	GFSK, π/4-DQPSK, 8DPSK
Data rate*	1 Mbps, 2 Mbps, 3 Mbps
Number of channels*	79
Channel bandwidth*	1 MHz
Channel spacing*	1 MHz
Antenna*	Sheet metal antenna
Antenna gain*	-3.55
Rated RF Output Power*	< 2.5 mW (+4 dBm); Power Class: Class2
Power supply*	9 – 16.5 V DC Battery
Temperature range*	-40 °C to +75 °C

*: as declared by applicant

5.4 Additional Information

Model variant differences*

- R1LOW-R DV model with integrated sheet metal antenna and associated display, PCB ID NJ00193611
- R1LOW-R PrePV model with integrated sheet metal antenna and associated display, PCB ID NJ00193612

Applicant declares that transmitter modul with chip and sheet metal antenna are identical in R1LOW-R DV model (see IBL-Lab test report TR-21086128-23001-1) and R1LOW-R PrePV model.

Mechanical variants of R1LOW-R PrePV model listed in section 5.2 refer to different dimensions of associated display.

Electrical variants of R1LOW-R PrePV model listed in section 5.2 refer to different memory chipsets and multimedia chipsets and interfaces.

Test results of R1LOW-R DV model are used for following test cases (see IBL-Lab test report TR-21086128-23001-1):

- Carrier frequency separation
- Number of frequency hopping channels
- Time of channel occupancy
- Minimum emission bandwidth 6dB, emission bandwidth 20 dB
- Occupied Channel Bandwidth (99%)
- Band edge compliance (BEC), conducted
- Conducted spurious emissions (CSE)

Conducted R1LOW-R PrePV test samples of model variants #40, #50, #54, #56, #62 are used for following test cases:

- RF output power (conducted peak power)

Radiated R1LOW-R PrePV test samples of model variants #40, #50, #54, #56, #62 are used for following test cases:

- Antenna gain (calculated)

Radiated R1LOW-R PrePV test samples of all model variants are used for following test cases:

- Band edge compliance (BEC), radiated
- Radiated spurious emissions (RSE) – worst case from R1LOW-R DV tests (see IBL-Lab test report TR-21086128-23001-1)

Ancillaries tested with

None

Additional equipment used for testing

Notebook with test tool

*: as declared by applicant

5.5 Test modes

Mode 1	GFSK, 1 Mbps
Mode 2	π/4-DQPSK, 2 Mbps
Mode 3	8DPSK, 3 Mbps
Low Channel	2402 MHz
Mid Channel	2441 MHz
High Channel	2480 MHz

6 SUMMARY OF TEST RESULTS

Test specification

FCC 47 CFR Part 15
RSS-247 Issue 2 / RSS-Gen Issue 5

Clause	Requirement / Test Case	Result - Remark	Verdict
15.247(a)(1) RSS-247, 5.1 (b)	Carrier frequency separation	KDB 558074, clause: 9	- N/P - *)
15.247(a)(1)(iii), (g) RSS-247, 5.1 (d)	Number of frequency hopping channels	KDB 558074, clause: 9	- N/P - *)
15.247(a)(1)(iii) RSS-247, 5.1 (d)	Time of channel occupancy	KDB 558074, clause: 9	- N/P - *)
§15.247(a)(1) RSS-247, 5.1 (a)	Minimum emission bandwidth 6dB, emission bandwidth 20 dB	KDB 558074, clause: 2.2	- N/P - *)
RSS Gen, 6.7	Occupied channel bandwidth (99%)	-/-	- N/P - *)
§15.247(b)(1) RSS-247, 5.4 (b)	RF output power (conducted peak power)	KDB 558074, clause: 9	- PASS -
§15.247(b)(4) RSS-247, 5.4 (b)	Antenna gain (calculated)	-/-	- PASS -
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), conducted	KDB 558074, clause: 9	- N/P - *)
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), radiated	KDB 558074, clause: 9	- PASS -
§15.247(d) RSS-247, 5.5	Conducted spurious emissions (CSE)	KDB 558074, clause: 9	- N/P - *)
15.247(d) / §15.209 RSS-247, 5.5 / RSS-Gen, 8.9	Radiated spurious emissions (RSE)	-/-	- PASS -
§15.207 RSS-Gen, 8.8	AC conducted emissions	EUT is battery powered	- N/A -

*) see IBL-Lab test report TR-21086128-23001-1

Comments and observations

Following pages show requirements and references of FCC Part 15.247, ANSI C63.10 and KDB 558074 only. Same tests are also applicable and valid for RSS-247, with clauses given in table above.

7 TEST RESULTS

7.1 RF Output Power (Conducted Peak Power)

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The RF Output Power is defined as the conducted peak output power.

Limit

§15.247

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test procedure

ANSI C63.10, 11.9.2.3.2

Method AVGPM-G is a measurement using a gated RF average power meter.

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Gate triggering can be implemented in such a way that the sweep of the instrument is only active during the burst period of the device. Any Gate triggering shall be performed on the full power portion of the pulses and care must be taken to ensure that static portions of the pulse are not included in the measurement (ensuring that the trace is averaged over the entire symbol range). All Gate triggered measurements shall be accompanied by a Gate setup plot in the test report.

Test setup: 8.4 with conducted test sample (see section 5.2); test setup photographs see TR-21086128-23001-1_AnnexD

Test Results				
EUT, EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
EUT ID#40, Mode 1	-0.2	-0.1	0.3	≤ 21
EUT ID#50, Mode 1	-4.6	-4.2	-4.6	≤ 21
EUT ID#54, Mode 1	-3.5	-3.0	-2.8	≤ 21
EUT ID#56, Mode 1	-5.0	-4.3	-4.3	≤ 21
EUT ID#62, Mode 1	-3.8	-3.3	-3.2	≤ 21

Test Results				
EUT, EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
EUT ID#40, Mode 2	-0.5	-0.5	0.0	≤ 21
EUT ID#50, Mode 2	-5.3	-4.8	-5.1	≤ 21
EUT ID#54, Mode 2	-4.1	-3.5	-3.4	≤ 21
EUT ID#56, Mode 2	-5.6	-5.0	-5.0	≤ 21
EUT ID#62, Mode 2	-4.4	-3.9	-3.9	≤ 21

Test Results				
EUT, EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
EUT ID#40, Mode 3	-3.9	-3.2	-2.9	≤ 21
EUT ID#50, Mode 3	-5.3	-4.8	-5.1	≤ 21
EUT ID#54, Mode 3	-4.1	-3.5	-3.4	≤ 21
EUT ID#56, Mode 3	-5.7	-5.0	-5.0	≤ 21
EUT ID#62, Mode 3	-4.4	-3.9	-3.8	≤ 21

Comment:	---
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Verdict	- PASS -	plots see TR-21086128-23001-1_AnnexA
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7.2 Antenna Gain (calculated)

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The antenna gain is defined as the difference between radiated peak power (Peak EIRP) subtracted by the conducted peak power of the module, given in dBi.

Limit

§15.247

(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test setup: 8.2 with radiated test sample (see section 5.2), 8.4 with conducted test sample (see section 5.2); test setup photographs see TR-21086128-23001-1_AnnexD

Test Results

EUT ID #40, Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-1.4	-1.7	-2.2	≤ 36
Conducted peak power [dBm]	-0.2	-0.1	0.3	≤ 30
Calculated antenna gain [dBi]	-1.2	-1.6	-1.9	≤ 6

EUT ID #50, Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-2.0	-3.5	-3.4	≤ 36
Conducted peak power [dBm]	-4.6	-4.2	-4.6	≤ 30
Calculated antenna gain [dBi]	2.6	0.7	1.2	≤ 6

EUT ID #54, Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-4.2	-2.4	-1.9	≤ 36
Conducted peak power [dBm]	-3.5	-3.0	-2.8	≤ 30
Calculated antenna gain [dBi]	-0.7	0.6	0.9	≤ 6

EUT ID #56, Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-9.2	-8.3	-5.9	≤ 36
Conducted peak power [dBm]	-5.0	-4.3	-4.3	≤ 30
Calculated antenna gain [dBi]	-4.2	-4.0	-1.6	≤ 6

EUT ID #62, Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-1.1	-0.9	-1.2	≤ 36
Conducted peak power [dBm]	-3.8	-3.3	-3.2	≤ 30
Calculated antenna gain [dBi]	2.7	2.2	2.0	≤ 6

Comment:	---
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Verdict	- PASS -	plots see TR-21086128-23001-1_AnnexA
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7.3 Band Edge Compliance (BEC), radiated

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test procedure

The marker-delta method as described in ANSI C63.10, 6.10.6 or the integration method as described in ANSI C63.10, 11.13.3 can be used to perform measurements of the unwanted emissions level at the band edges.

Test setup: 8.2 with radiated test sample (see section 5.2); test setup photographs see TR-21086128-23001-1_AnnexD

Test results

BEC	low channel AVG / Peak [dμV/m @3m]	high channel AVG / Peak [dμV/m @3m]	Limit AVG / Peak [dμV/m @3m]
EUT ID#35	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#36	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#38	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#40	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#50	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#52	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#54	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#56	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#57	≤ 45 AVG / ≤ 48 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK
EUT ID#62	≤ 48 AVG / ≤ 50 PK	≤ 45 AVG / ≤ 48 PK	≤ 54 AVG / ≤ 74 PK

Comment:

Verdict**- PASS -**

TR-21086128-23001-1_AnnexA *

* description of traces for radiated Bend Edge Compliance (BEC) measurements:

 positive Peak (Max Hold) trace
 average Peak (Max Hold) trace

7.4 Radiated Spurious Emissions (RSE)

Applicability

This requirement applies to all types of DTS and FHS equipment.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products. Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency [MHz]	Field Strength [μV/m] / [dBμV/m]	Measurement distance [m]
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30.0 / 29.5	30
30 – 88	100 / 40.0	3
88 – 216	150 / 43.5	3
216 – 960	200 / 46.0	3
960 – 40 000	500 / 54.0	3

Note: Radiated Spurious Emissions (RSE) are performed for mode 2 low / mid / high channel.

Test setup: 8.1, 8.2, 8.3 8.2 with radiated test sample (see section 5.2); test setup photographs see TR-21086128-23001-1_AnnexD

Test results					
EUT ID / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
EUT ID#35, 0	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#35, 78	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#36, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#36, 78	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#38, 0	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#38, 78	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#40, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#40, 78	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#50, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#50, 78	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#52, 0	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#52, 78	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#54, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#54, 78	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#56, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#56, 78	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#57, 0	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#57, 78	see plots	MaxPeak	see plots*	see plots	- PASS -
EUT ID#62, 0	see plots	MaxPeak	see plots	see plots	- PASS -
EUT ID#62, 78	see plots	MaxPeak	see plots	see plots	- PASS -

* all detected peaks are more than 6 dB below the limit

Comment:	---
----------	-----

Verdict	- PASS -	plots see TR-21086128-23001-1_AnnexA **
---------	----------	---

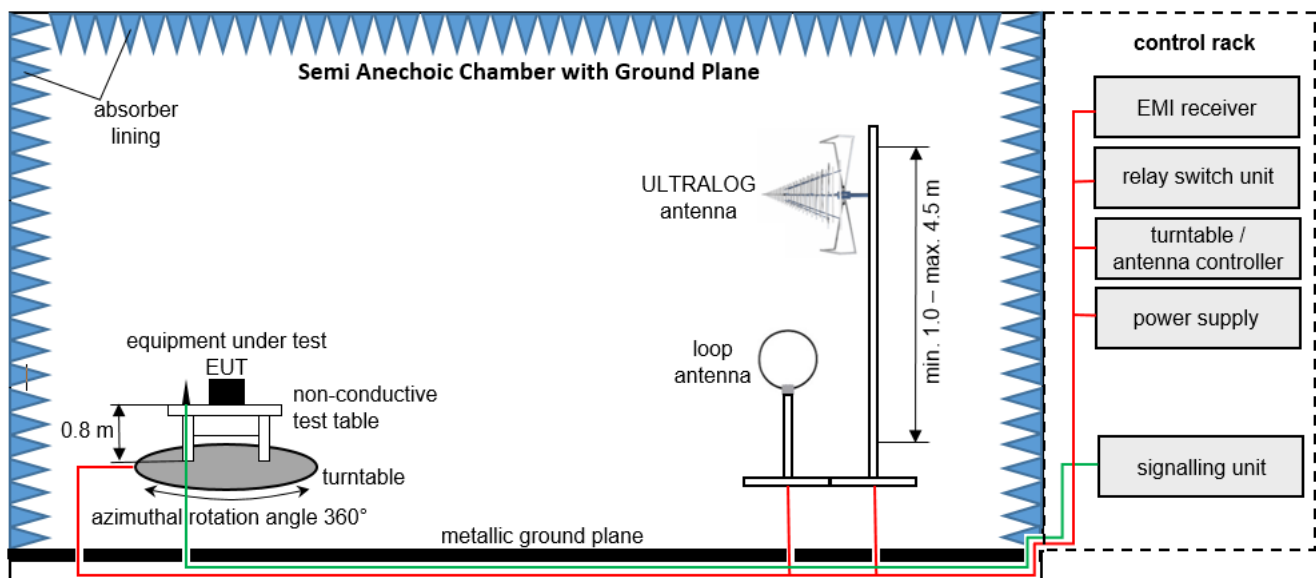
** description of line and marker for all radiated spurious emission (RSE) measurements:

-  positive Peak (Max Hold) trace during pre-scan
-  Max Peak value
-  final Quasi Peak value

8 TEST SETUP DESCRIPTION

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: loop antenna 3 m, ULTRALOG antenna 3 m
EMC32 software version: 11.10.00

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

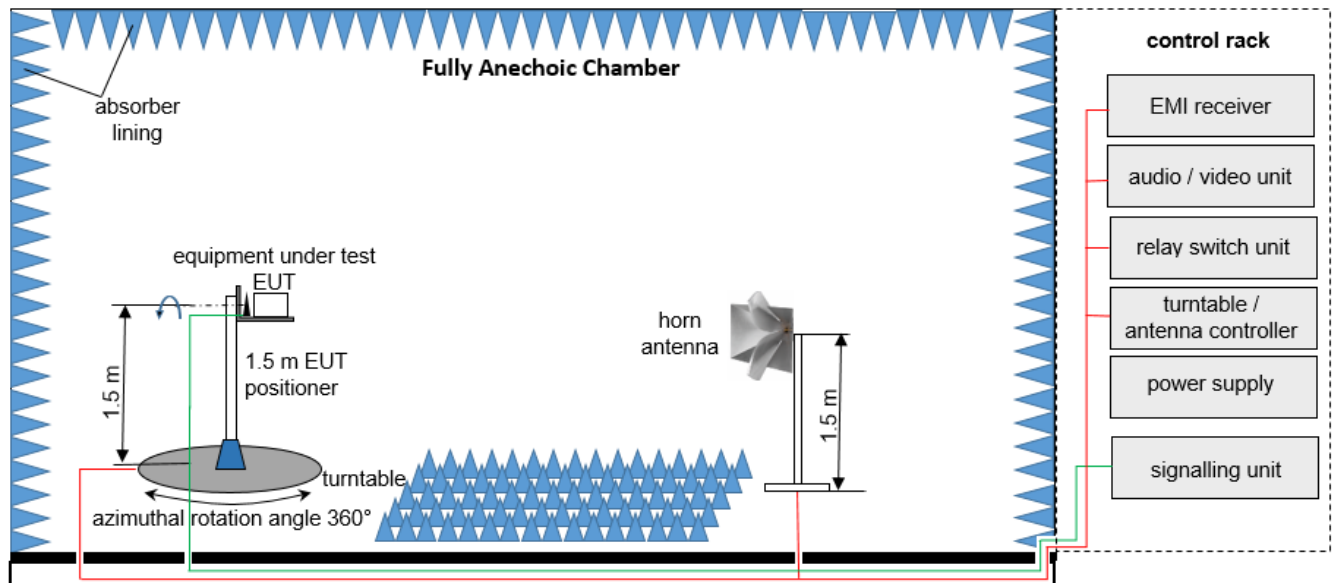
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	–
4	Positioner	matur GmbH	TD 1.5-10KG		LAB000258	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	2021-02-05 → 2022-02-05
7	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PR.B	LAB000235	2020-08-24 → 2021-08-24
8	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	–
10	Antenna Mast	matur GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	–
11	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	–
12	Controller	matur GmbH	FCU 3.0	10082	LAB000222	–
13	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	–
14	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	–
15	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	–
16	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	2020-07-05 → 2023-07-05
17	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	2020-03-25 → 2023-03-25

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 meter

EMC32 software version: 11.10.00

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

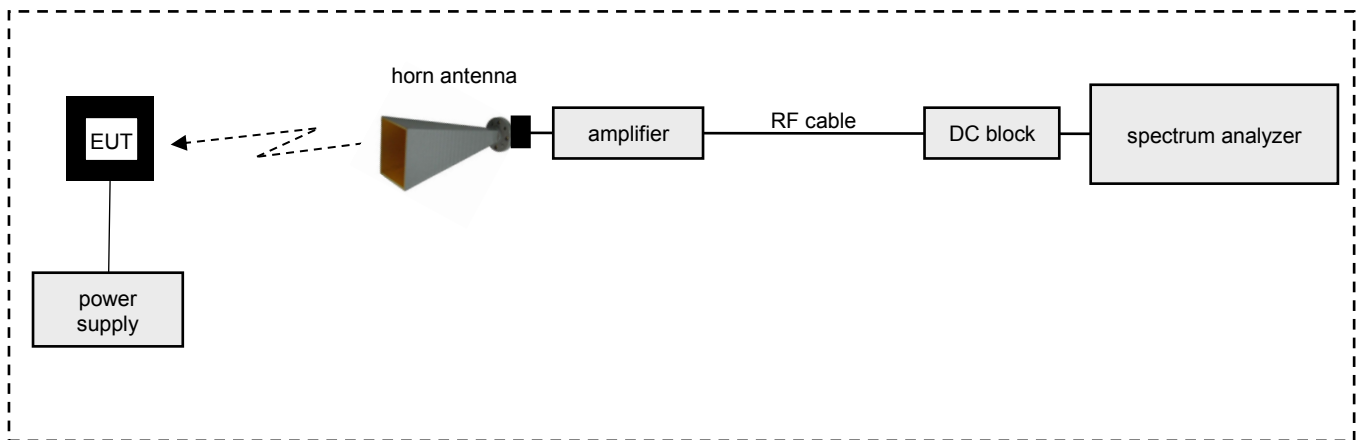
Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 \mu W)$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	–
4	Positioner	matur GmbH	TD 1.5-10KG	–	LAB000258	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	2021-02-05 → 2022-02-05
7	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PR.B	LAB000235	2020-08-24 → 2021-08-24
8	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10	–	LAB000226	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	–
10	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	–
11	Controller	matur GmbH	FCU 3.0	10082	LAB000222	–
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	–
13	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	–
14	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	–
15	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	2020-04-23 → 2023-04-23
16	HP-filter	AtlantRF	–	–	LAB000382	–

8.3 Radiated measurements > 18 GHz

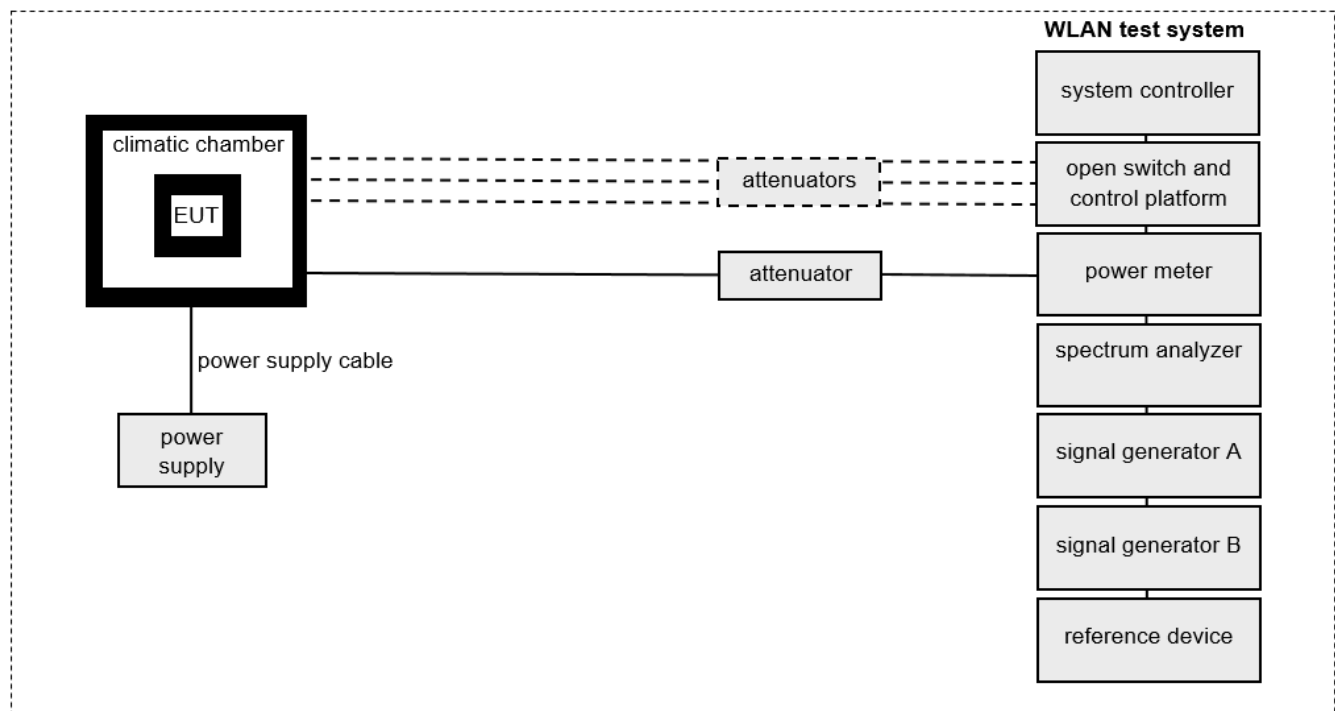


List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Test table	innco systems GmbH	PT0707-RH light	-	LAB000303	–
2	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273374	LAB000181	–
3	Coaxial Cable	Huber & Suhner	SF101/1.5m	503987/1	LAB000165	–
4	Antenna	Flann Microwave Ltd	20240-20	266403	LAB000128	2020-06-29 → 2023-06-29
5	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	2021-07-02 → 2022-07-02

8.4 Conducted measurements WLAN test system R&S TS 8997

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The losses for all signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



EMC32/WMS32 software version: 11.00.00

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	TS8997-Rack	Rohde & Schwarz	TS8997-Rack	100829	LAB000322	–
2	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157WX	101247	LAB000280	–
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157W8	100982	LAB000279	–
4	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	2021-06-15 → 2022-06-15
5	Signal Generator	Rohde & Schwarz	SMBV100A	258240	LAB000277	2021-06-02 → 2022-06-02
6	Signal Generator	Rohde & Schwarz	SMB100A-20	178175	LAB000276	2021-05-27 → 2022-05-27
7	Radio Communication Tester	Rohde & Schwarz	CMW270	101479	LAB000275	–
8	Controller	Hewlett Packard	ATS-Z230	101379	LAB000274	–
9	Power Supply	EA	PS 2042-10 B	2878350263	LAB000190	–

9 MEASUREMENT UNCERTAINTIES

Radio frequency	$\leq \pm 1 \times 10^{-7}$
RF power, conducted	$\leq \pm 0.75 \text{ dB}$
Power spectral density	$\leq \pm 3 \text{ dB}$
Maximum frequency deviation	$\leq \pm 5 \%$
Deviation limitation Duty Cycle, Tx-sequence, Tx-gap	$\leq \pm 5 \%$
Occupied channel bandwidth	$\leq \pm 5 \%$
Conducted spurious emission of transmitter	$\leq \pm 4 \text{ dB}$
Conducted emission of receivers	$\leq \pm 4 \text{ dB}$
Radiated emission of transmitter	$\leq \pm 6 \text{ dB}$
Radiated emission of receiver	$\leq \pm 6 \text{ dB}$
Temperature	$\leq \pm 2.5 \text{ }^{\circ}\text{C}$
Humidity	$\leq \pm 10 \%$

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor $k = 2$. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.

End of Test Report

Annex A

Test results of EUT

part of / in addition to

Test report no.: 21086128-23001-1

Tested by
(name, function, signature) *Piotr Sardyko*
Deputy Head of Laboratory RF



signature

Approved by
(name, function, signature) *Dr.-Ing. Harald Ansorge*
Managing Director



signature

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2 TEST RESULTS

2.1 Variant ID #35

DUT Information

DUT Name:	prePV 35
Manufacturer:	Mitsubishi Electric Corporation
Serial Number:	65804

2.1.1 RF Output Power (Conducted Peak Power)

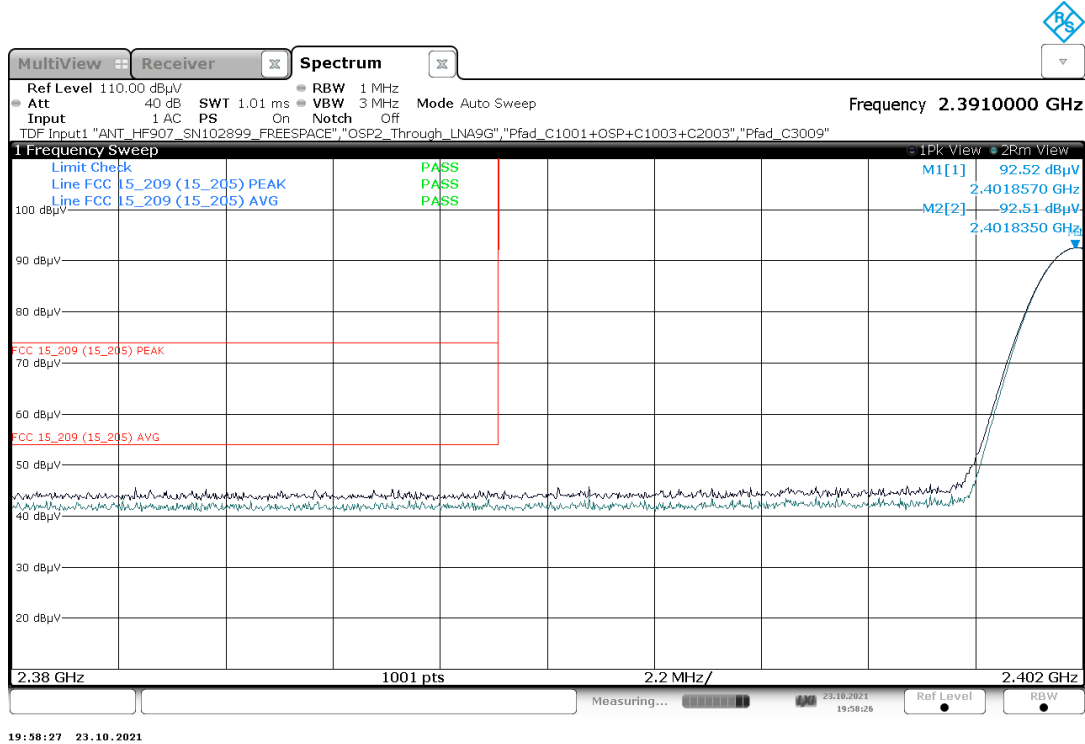
See test results of R1LOW-R DV model (see IBL-Lab test report TR-21065784-20819)

2.1.2 Radiated Peak Power (Peak EIRP)

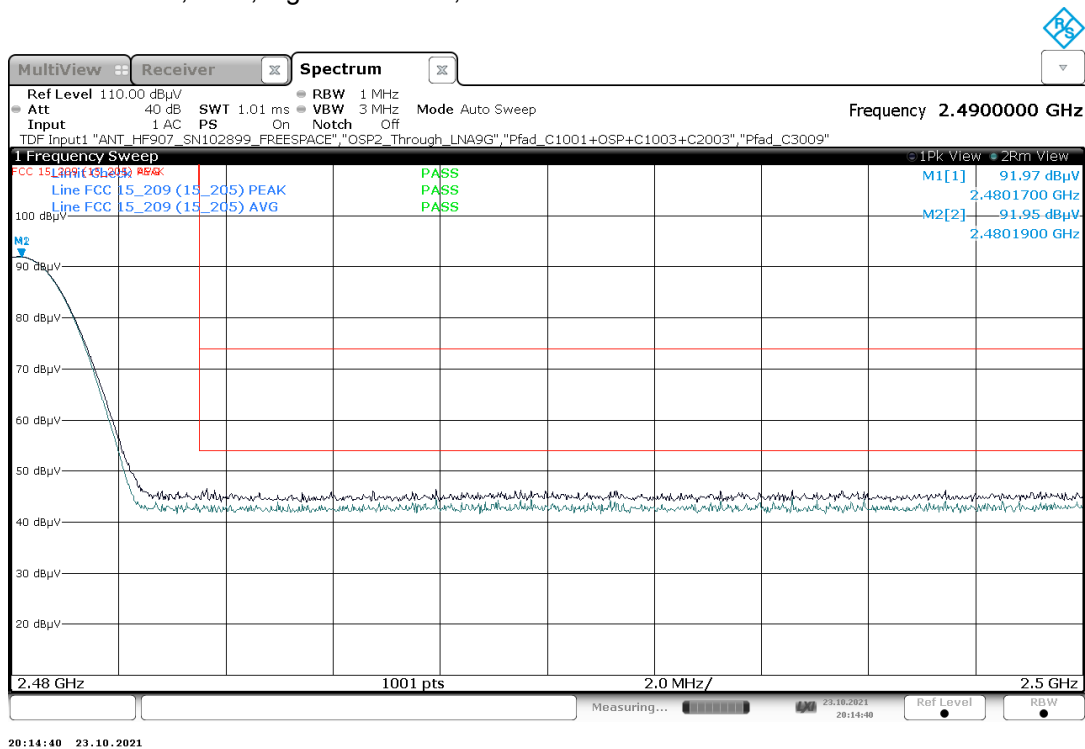
See test results of variant ID #36

2.1.3 Band Edge Compliance (BEC), radiated

Plot 1: Mode 1, BEC, low channel 0, 2402 MHz

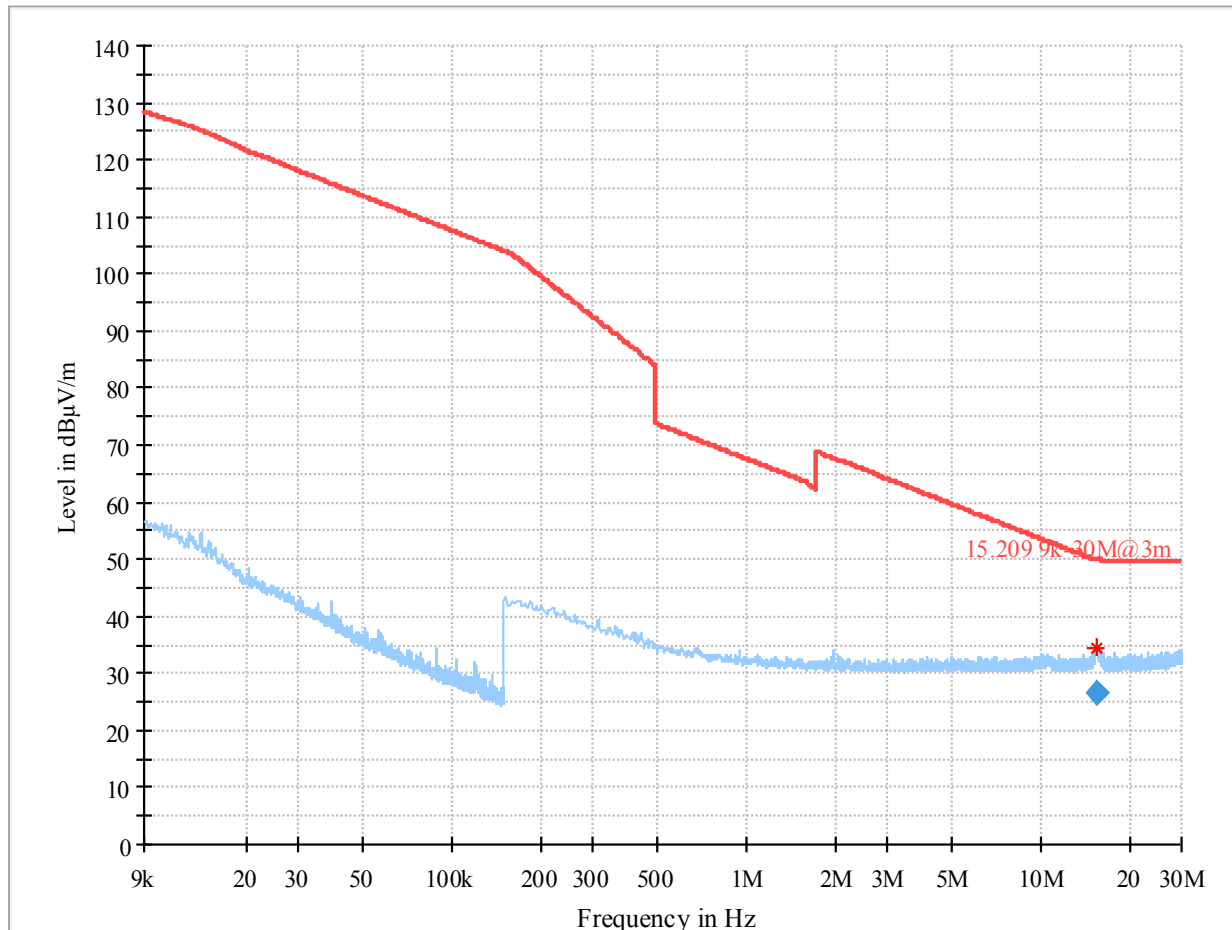


Plot 2: Mode 1, BEC, high channel 78, 2480 MHz



2.1.4 Radiated Spurious Emissions (RSE)

Plot 3: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna



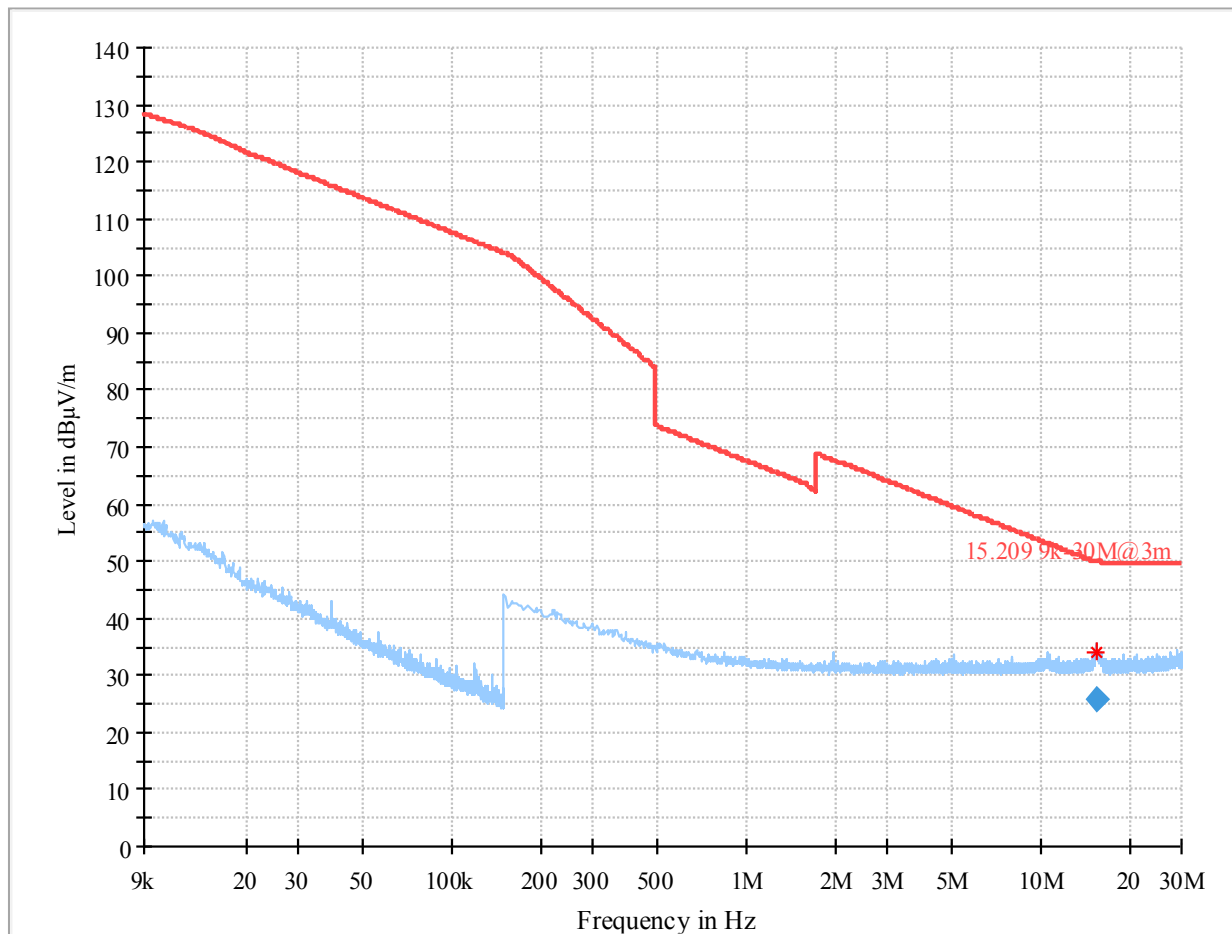
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
15.436500	26.77	50.03	23.26	100.0	9.000	H	240.0	20.5

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Comment
15.436500	23:38:29 - 29.10.2021

Plot 4: Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna



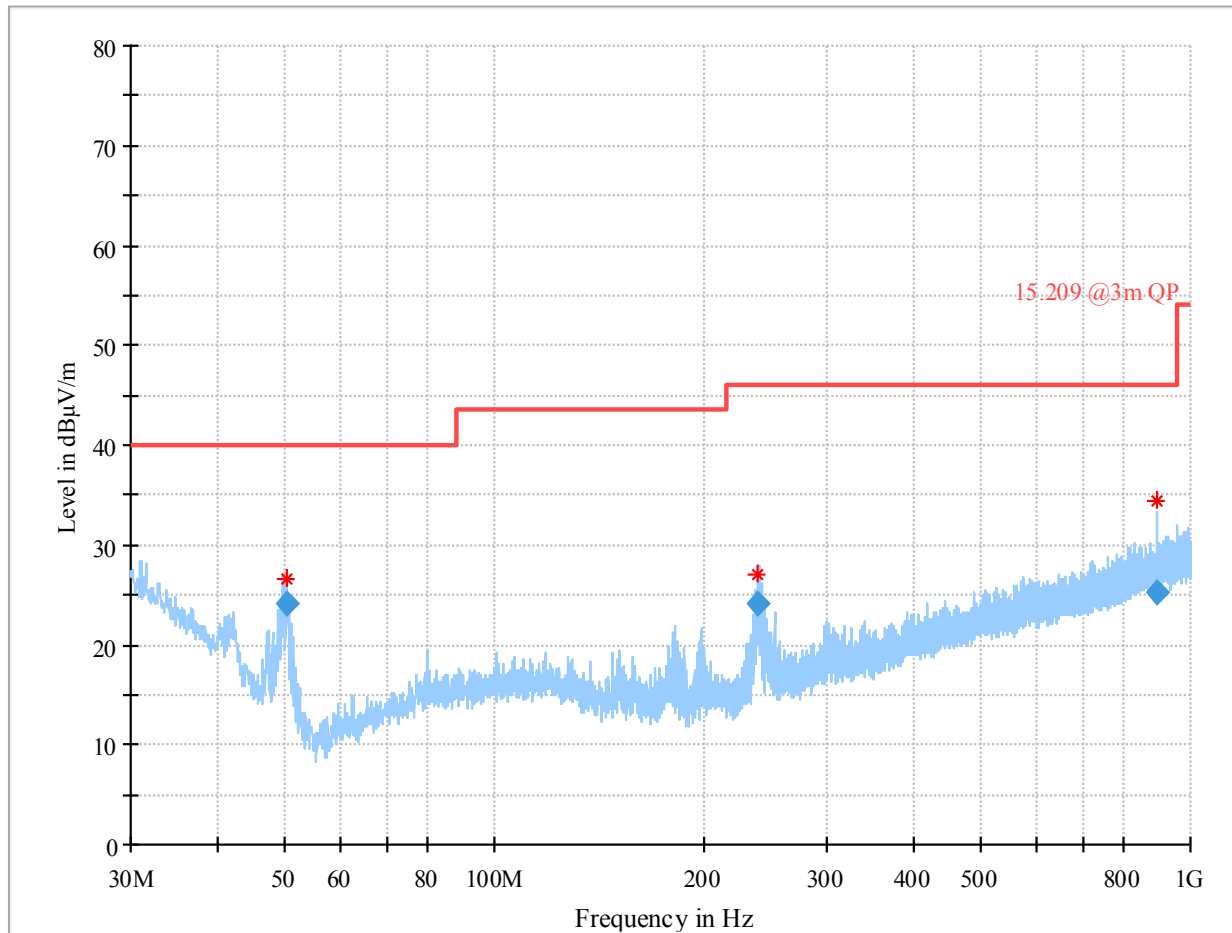
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
15.513000	25.77	50.03	24.26	100.0	9.000	V	240.0	20.5

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Comment
15.513000	23:52:29 - 29.10.2021

Plot 5: Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation



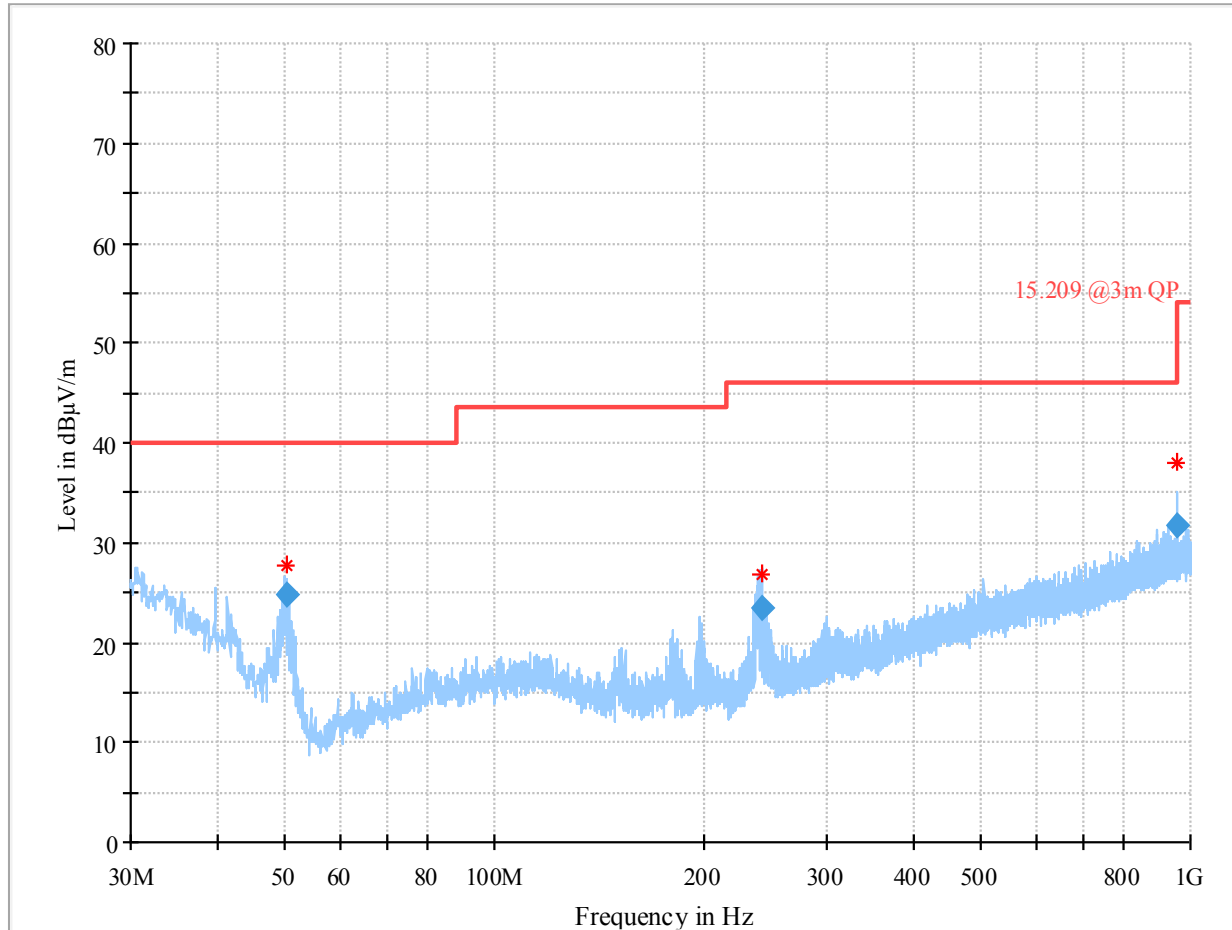
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
50.239500	24.04	40.00	15.96	100.0	120.000	100.0	V	17.0
239.214000	24.19	46.00	21.81	100.0	120.000	104.0	V	327.0
897.956000	25.32	46.00	20.68	100.0	120.000	146.0	V	0.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
50.239500	8.0	00:29:24 - 30.10.2021
239.214000	11.8	00:33:34 - 30.10.2021
897.956000	23.1	00:31:09 - 30.10.2021

Plot 6: Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation



Final_Result

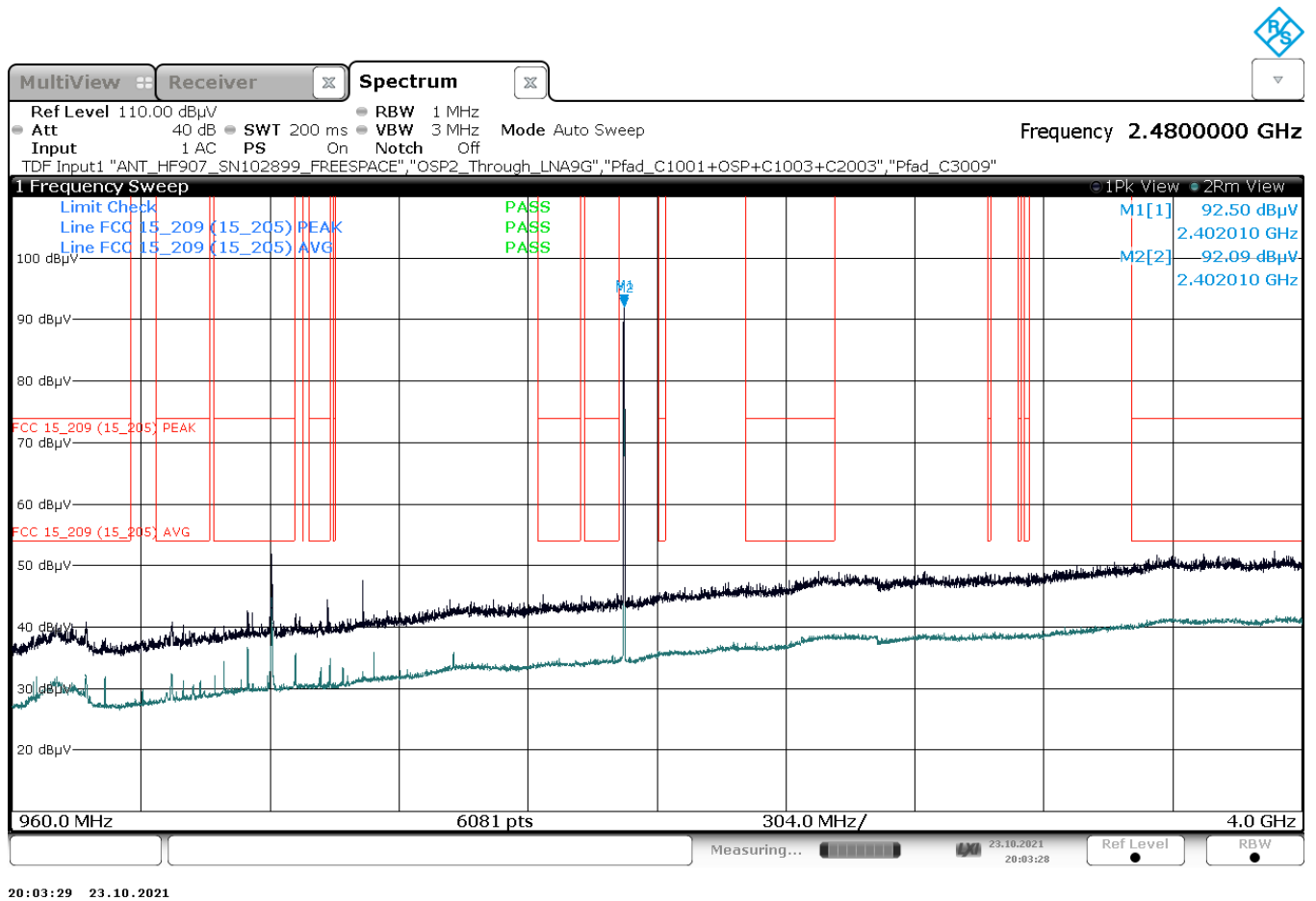
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
50.232000	24.73	40.00	15.27	100.0	120.000	103.0	V	64.0
241.676000	23.50	46.00	22.50	100.0	120.000	100.0	V	-1.0
954.069000	31.75	46.00	14.25	100.0	120.000	103.0	V	134.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
50.232000	8.0	00:12:31 - 30.10.2021
241.676000	11.8	00:10:44 - 30.10.2021
954.069000	23.5	00:14:29 - 30.10.2021

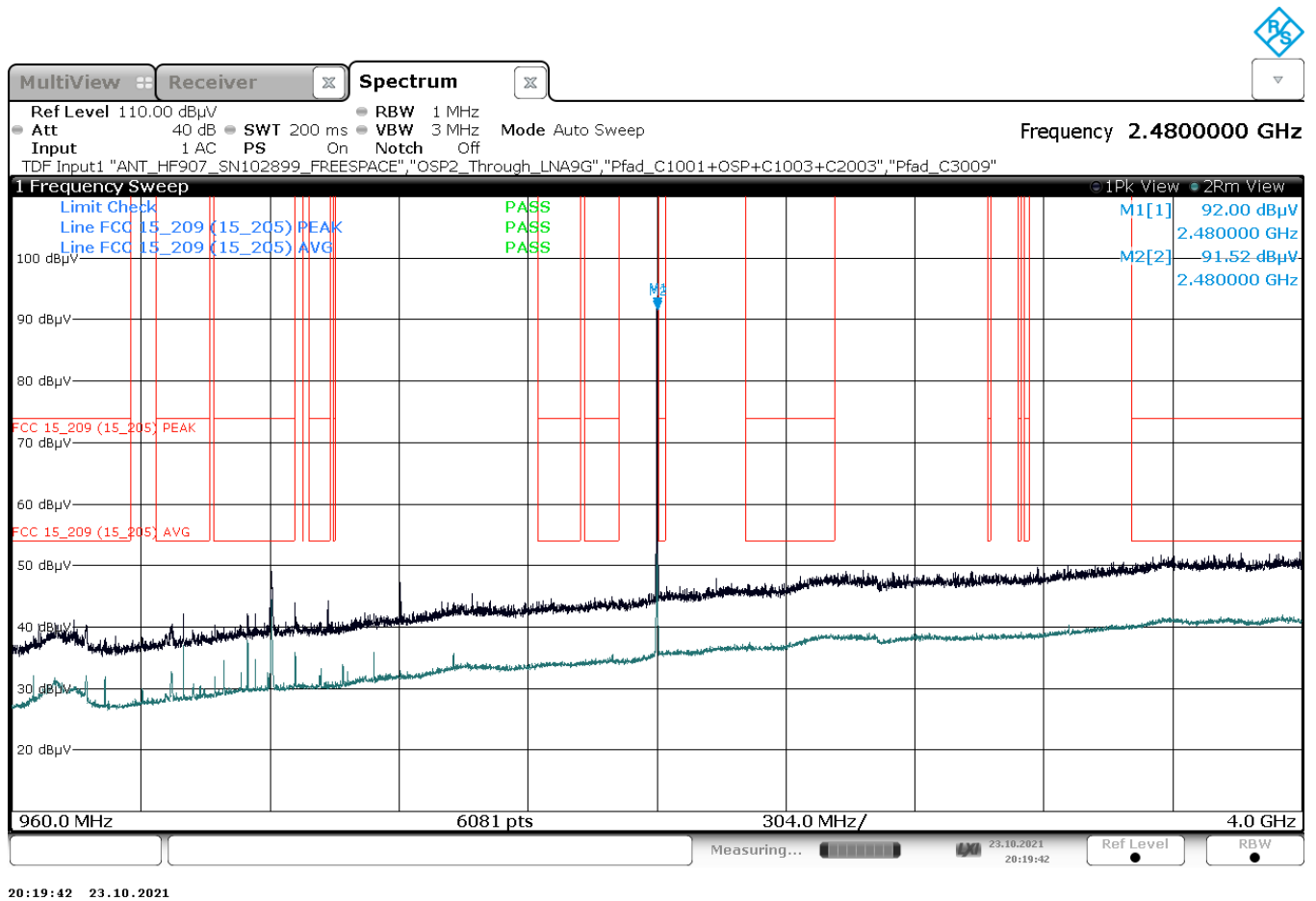
Annex A of TR no.: 21086128-23001-1

Plot 7: Mode 1, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



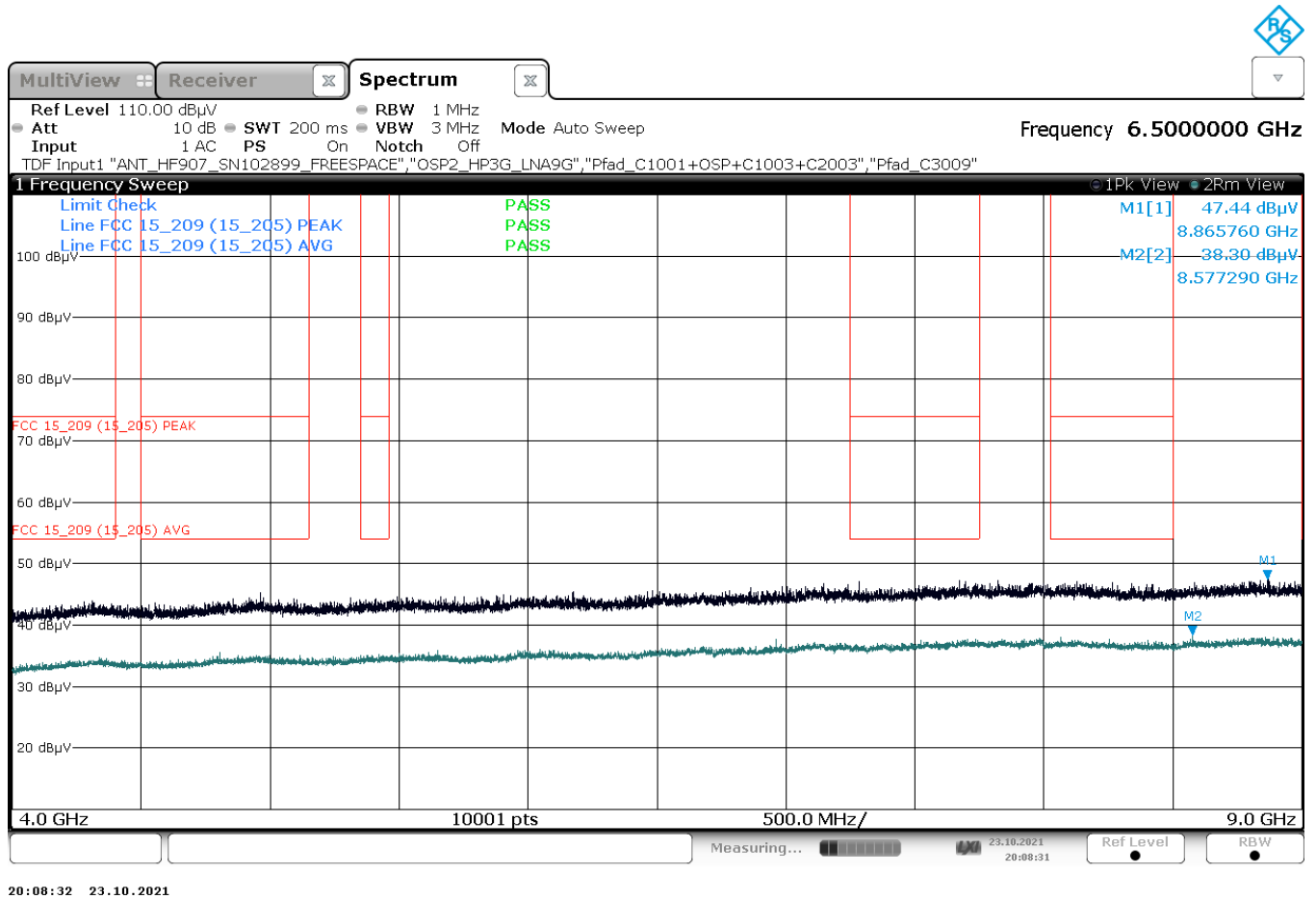
Annex A of TR no.: 21086128-23001-1

Plot 8: Mode 1, RSE 1 GHz – 4 GHz, high channel, horizontal / vertical polarisation



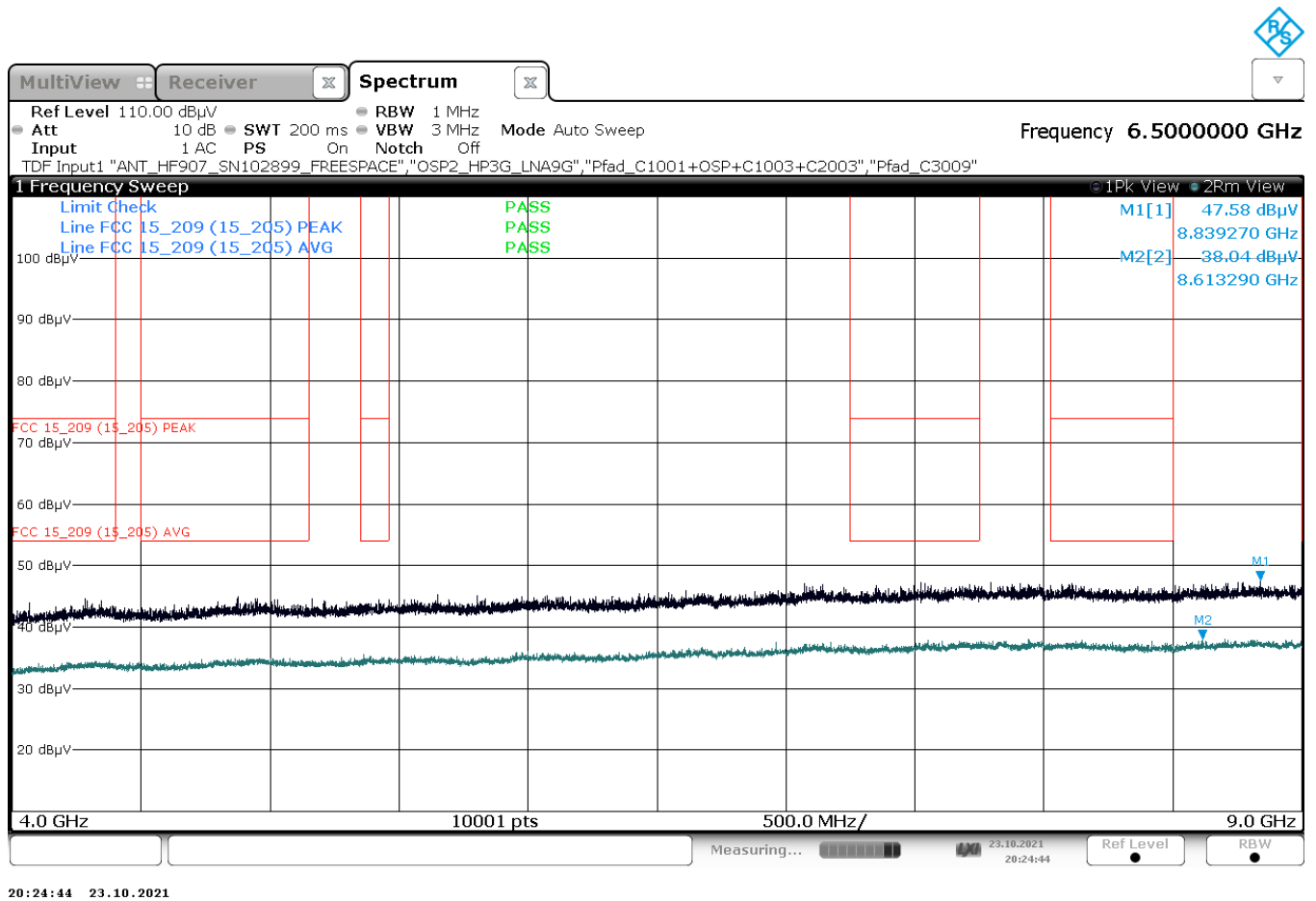
Annex A of TR no.: 21086128-23001-1

Plot 9: Mode 1, RSE 4 GHz – 9 GHz, low channel, horizontal / vertical polarisation



Annex A of TR no.: 21086128-23001-1

Plot 10: Mode 1, RSE 4 GHz – 9 GHz, high channel, horizontal / vertical polarisation



2.2 Variant ID #36

DUT Information

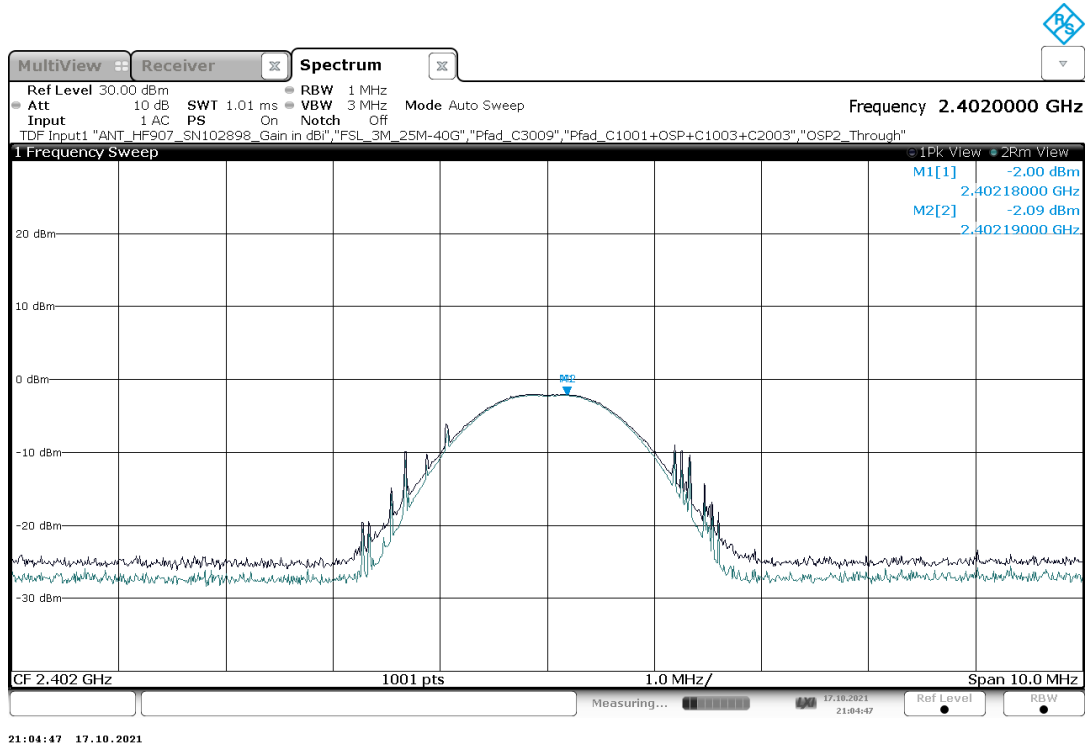
DUT Name:	prePV 36
Manufacturer:	Mitsubishi Electric Corporation
Serial Number:	66204

2.2.1 RF Output Power (Conducted Peak Power)

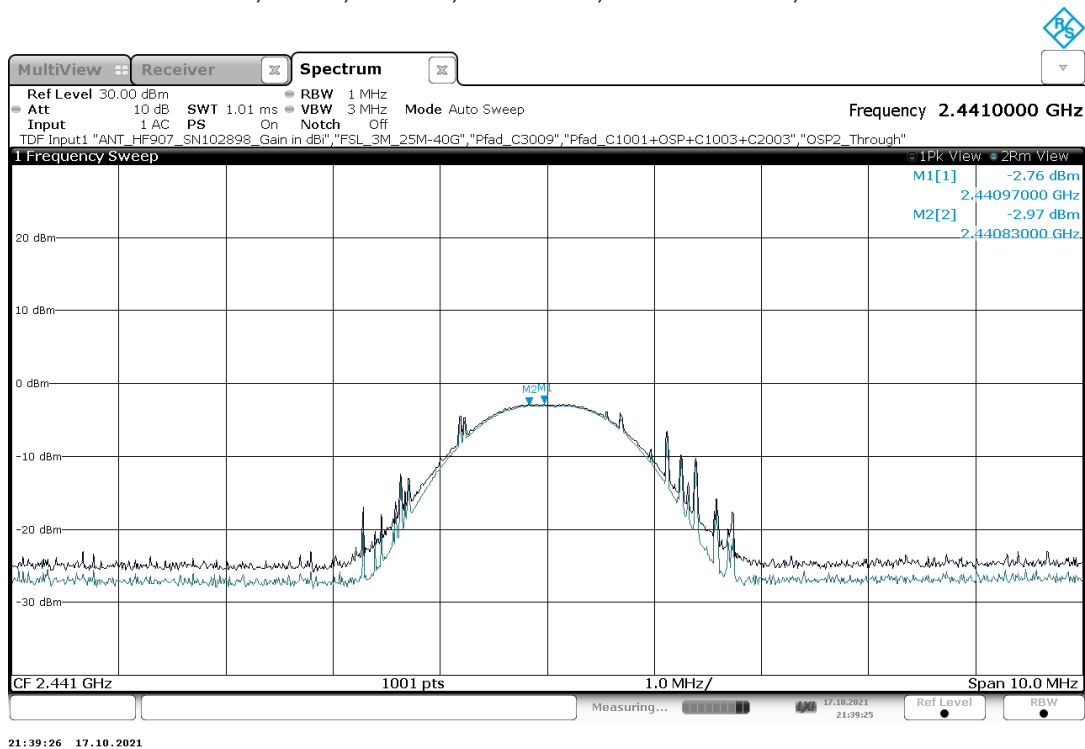
See test results of R1LOW-R DV model (see IBL-Lab test report TR-21065784-20819)

2.2.2 Radiated Peak Power (Peak EIRP)

Plot 11: Test Mode 1, GFSK, 1 Mbit/s, Peak EIRP, low channel 0, 2402 MHz

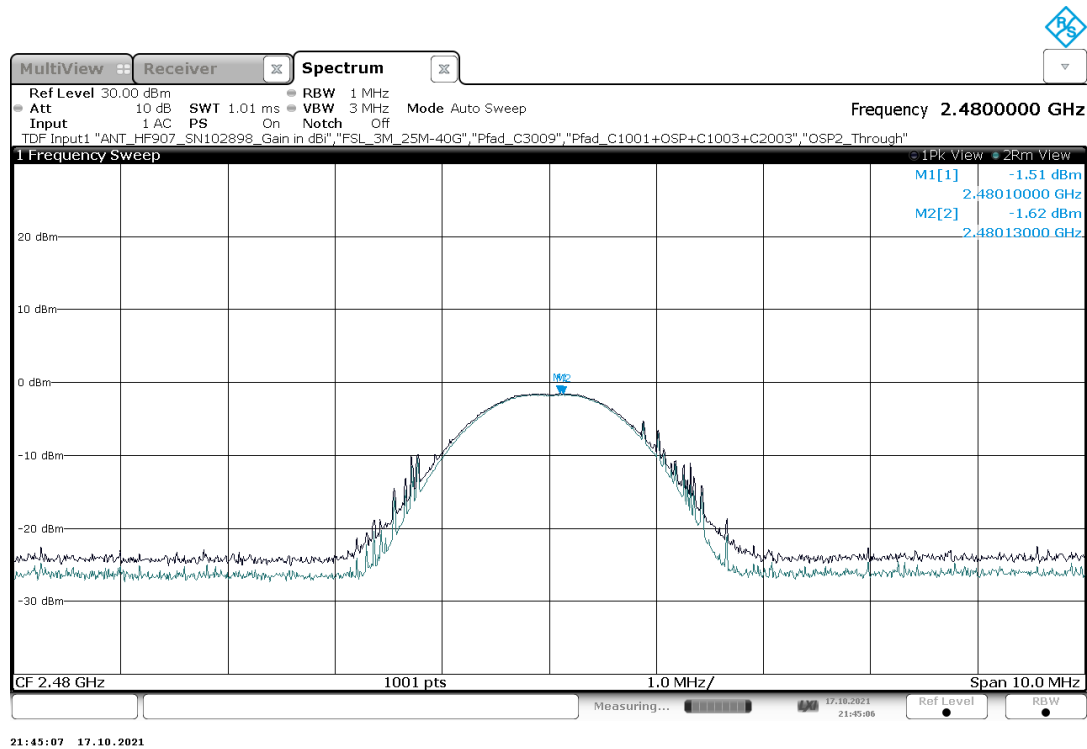


Plot 12: Test Mode 1, GFSK, 1 Mbit/s, Peak EIRP, mid channel 39, 2440 MHz



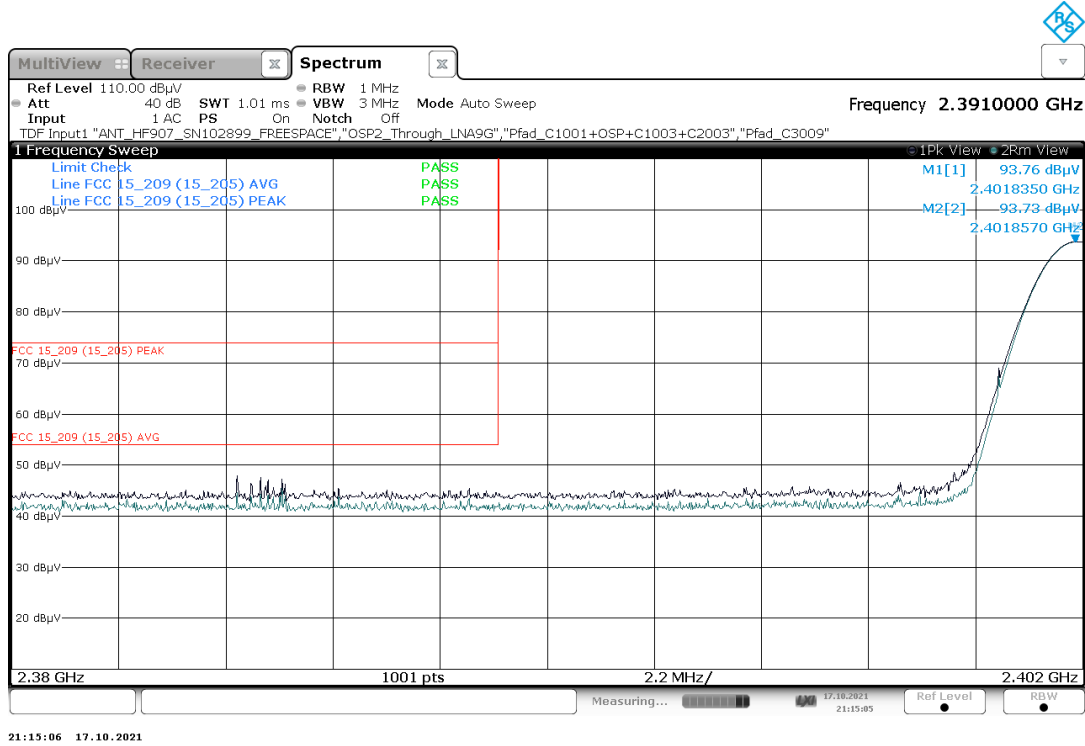
Annex A of TR no.: 21086128-23001-1

Plot 13: Test Mode 1, GFSK, 1 Mbit/s, Peak EIRP, high channel 78, 2480 MHz

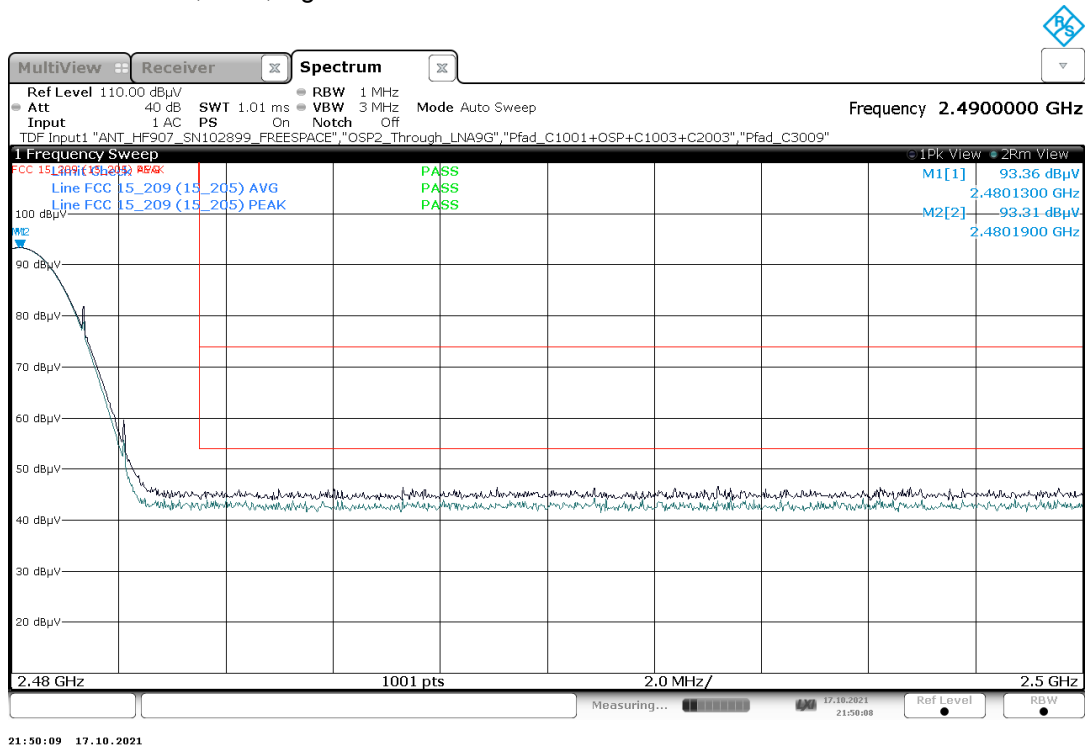


2.2.3 Band Edge Compliance (BEC), radiated

Plot 14: Mode 1, BEC, low channel 0

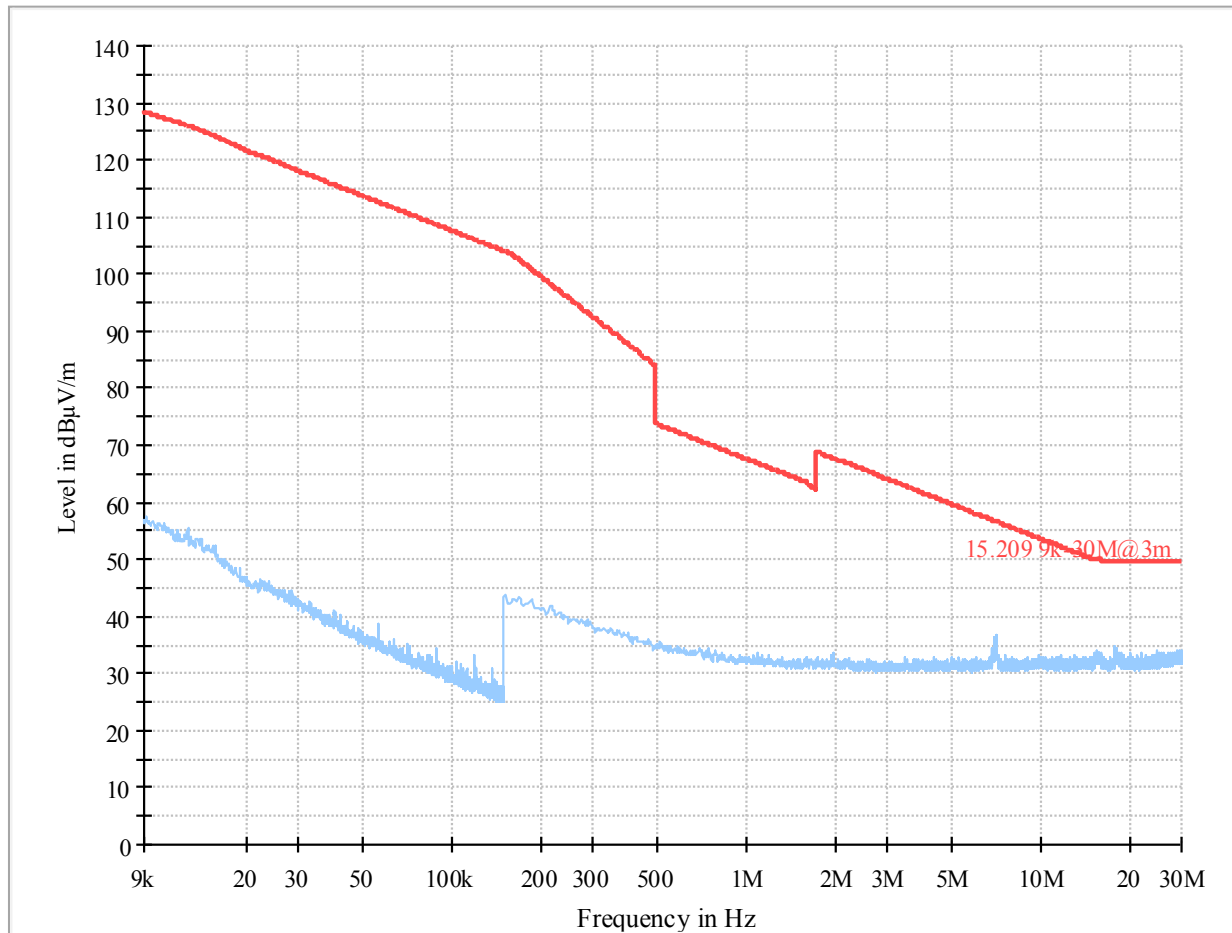


Plot 15: Mode 1, BEC, high channel 78

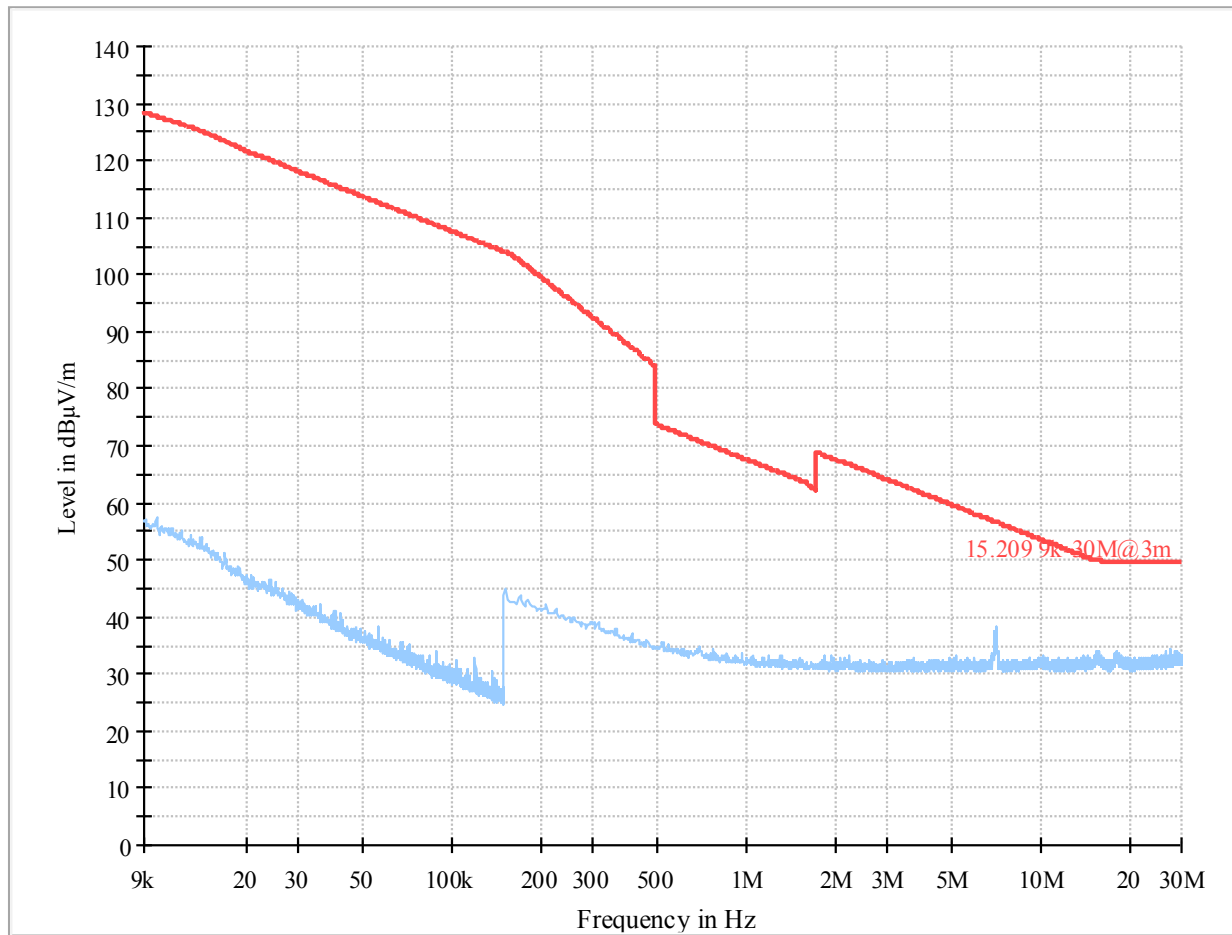


2.2.4 Radiated Spurious Emissions (RSE)

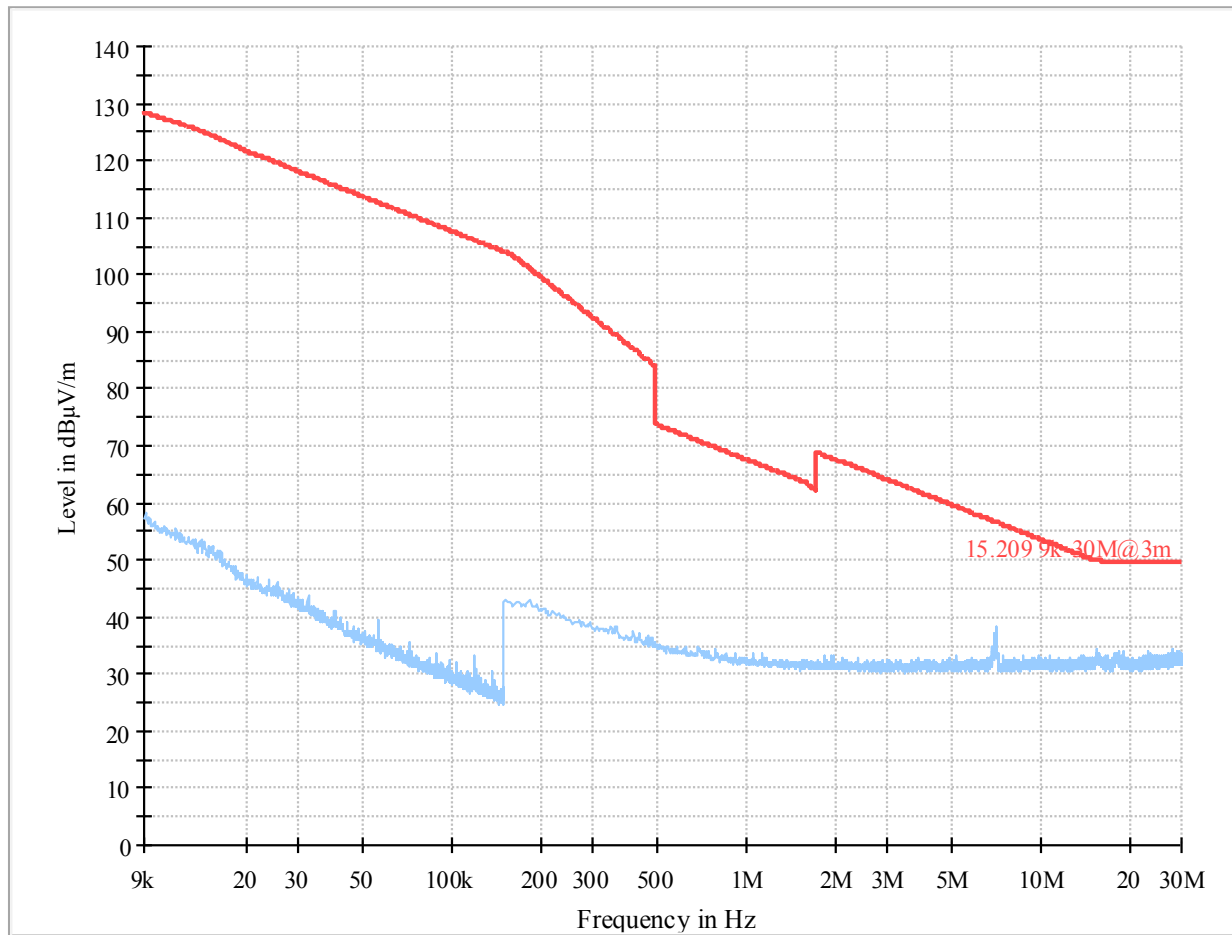
Plot 16: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna, EUT laying



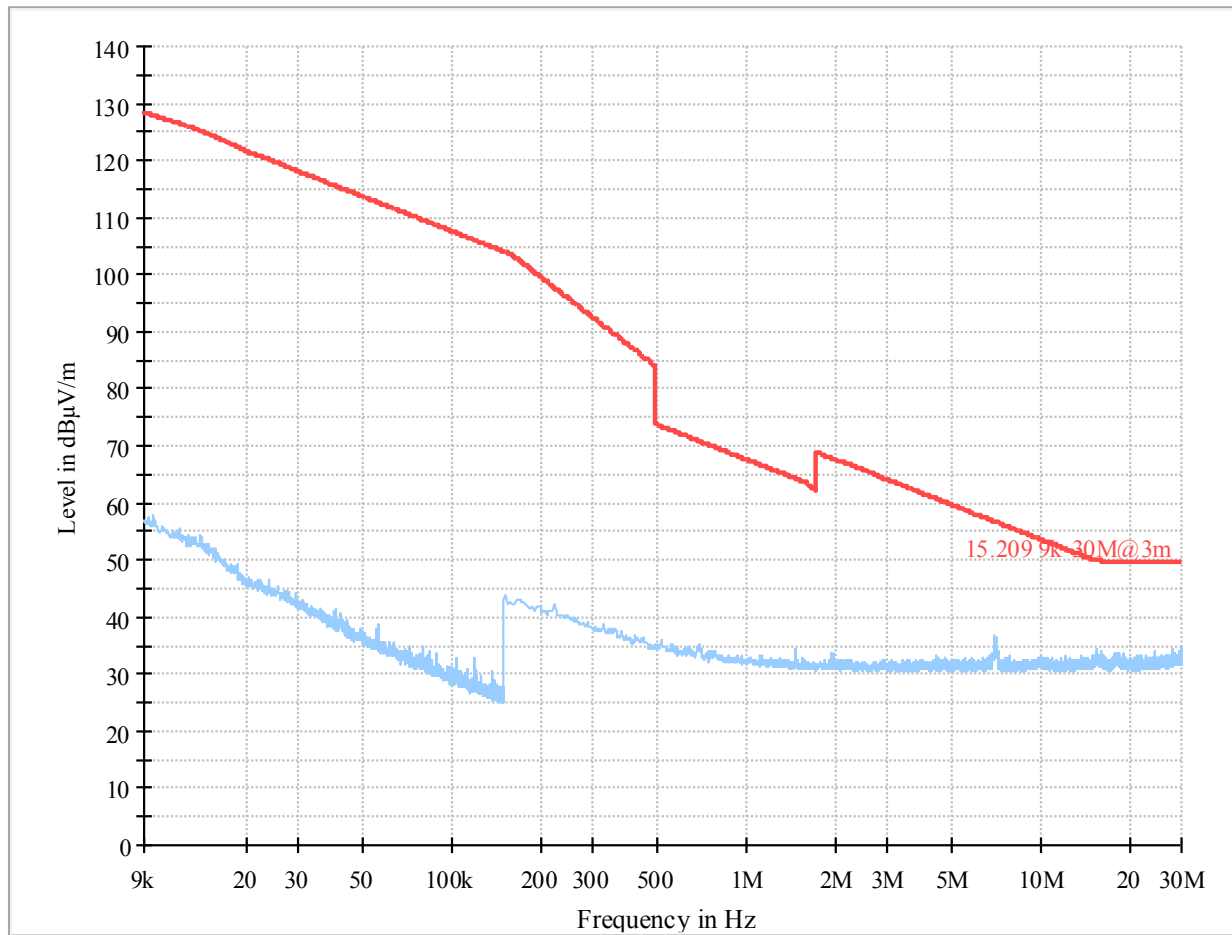
Plot 17: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna, EUT standing



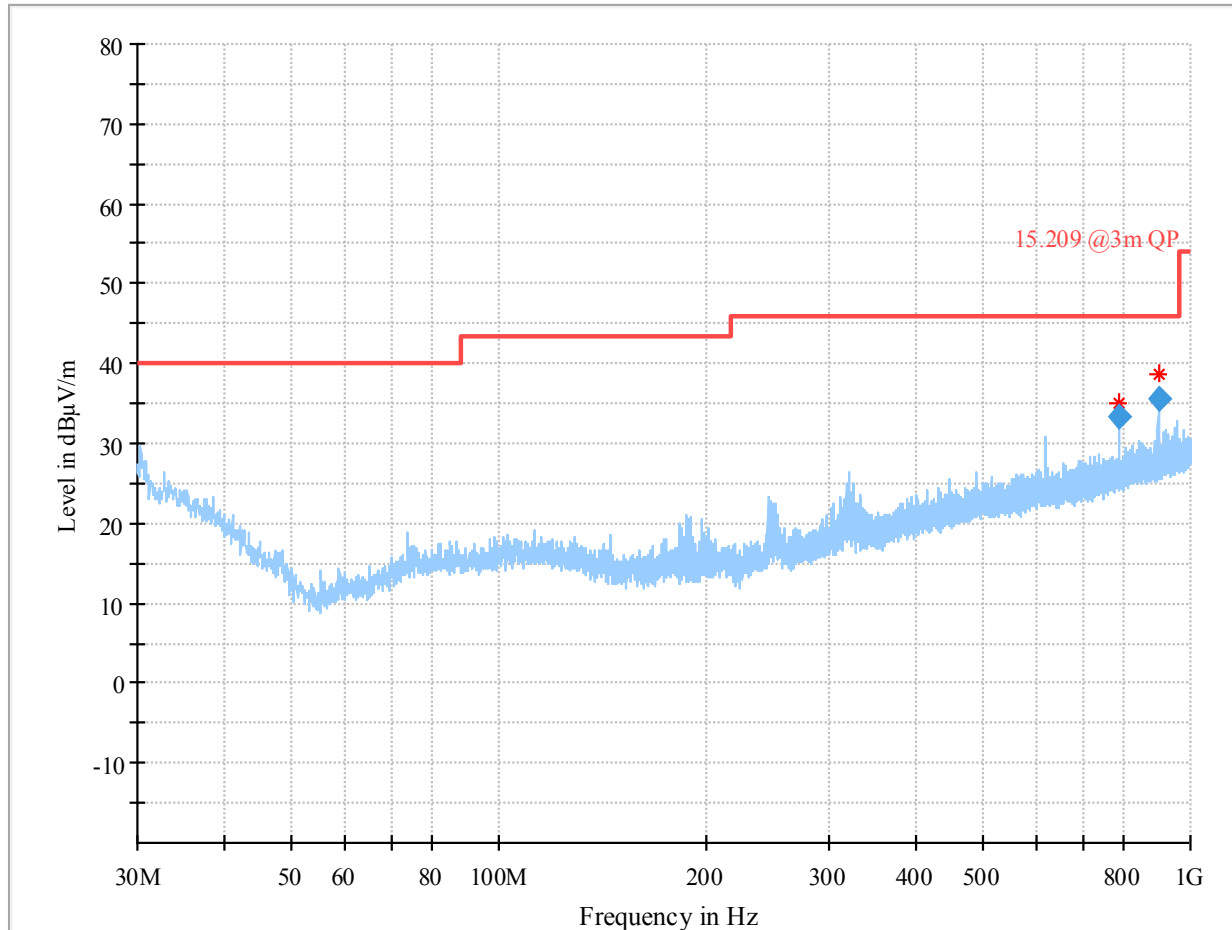
Plot 18: Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna, EUT laying



Plot 19: Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna, EUT standing



Plot 20: Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation, EUT laying



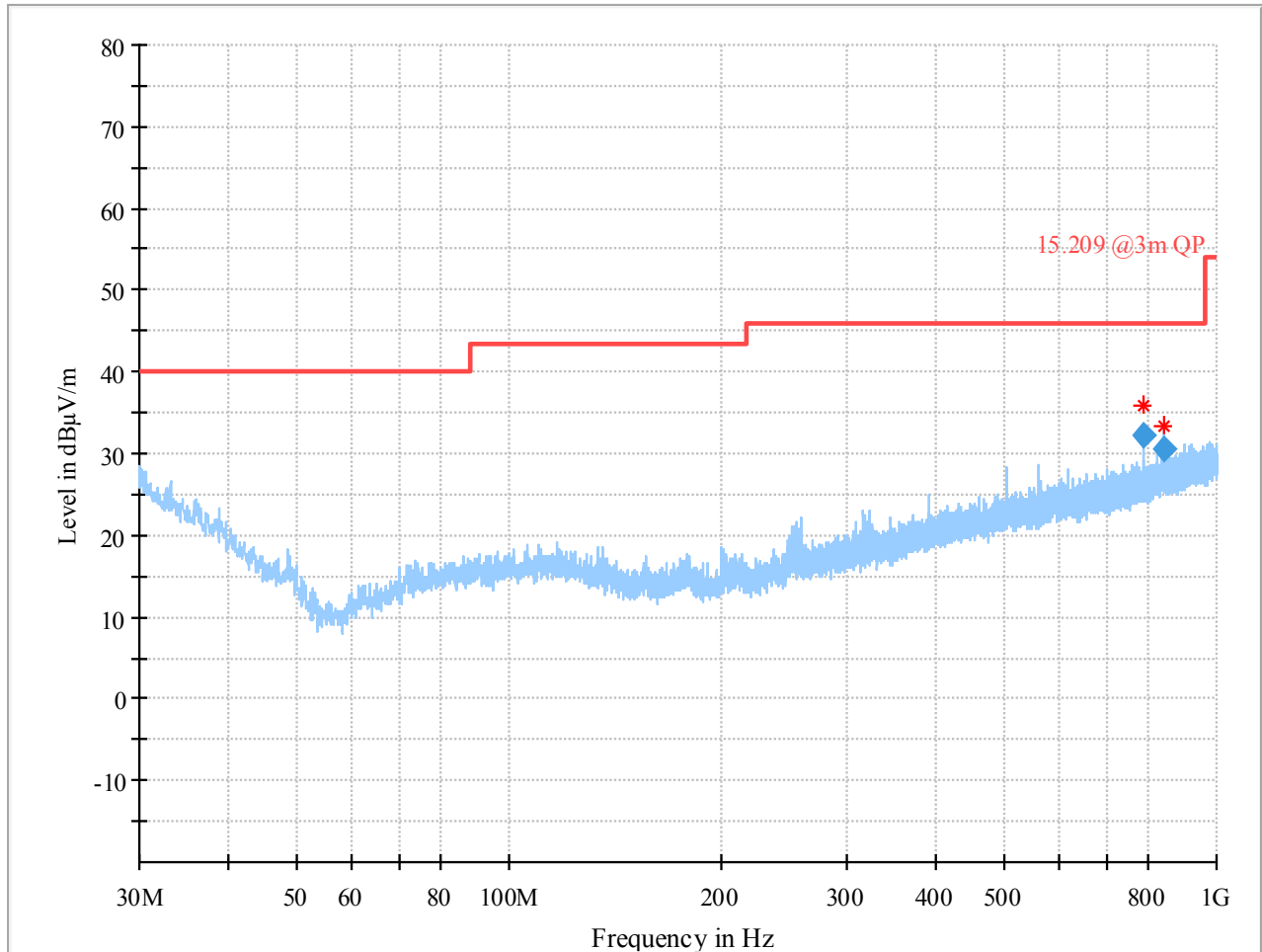
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
785.702000	33.31	46.00	12.69	100.0	120.000	100.0	V	-12.0
897.932500	35.52	46.00	10.48	100.0	120.000	125.0	V	184.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
785.702000	21.8	02:48:08 - 13.10.2021
897.932500	23.1	02:50:38 - 13.10.2021

Plot 21: Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation, EUT standing



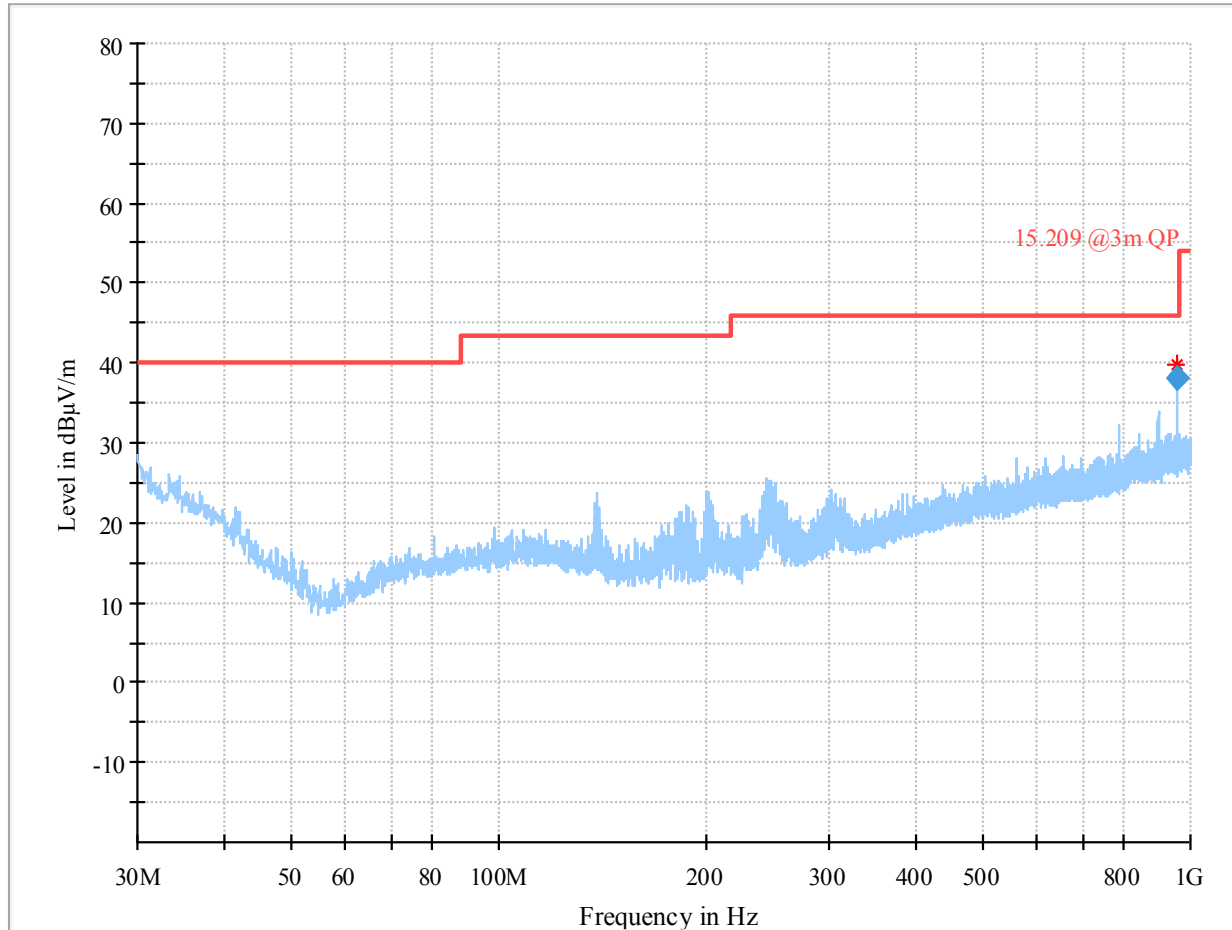
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
785.702000	32.33	46.00	13.67	100.0	120.000	138.0	V	330.0
841.815000	30.61	46.00	15.39	100.0	120.000	103.0	V	340.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
785.702000	21.8	03:03:42 - 13.10.2021
841.815000	22.5	03:06:02 - 13.10.2021

Plot 22: Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation, EUT laying



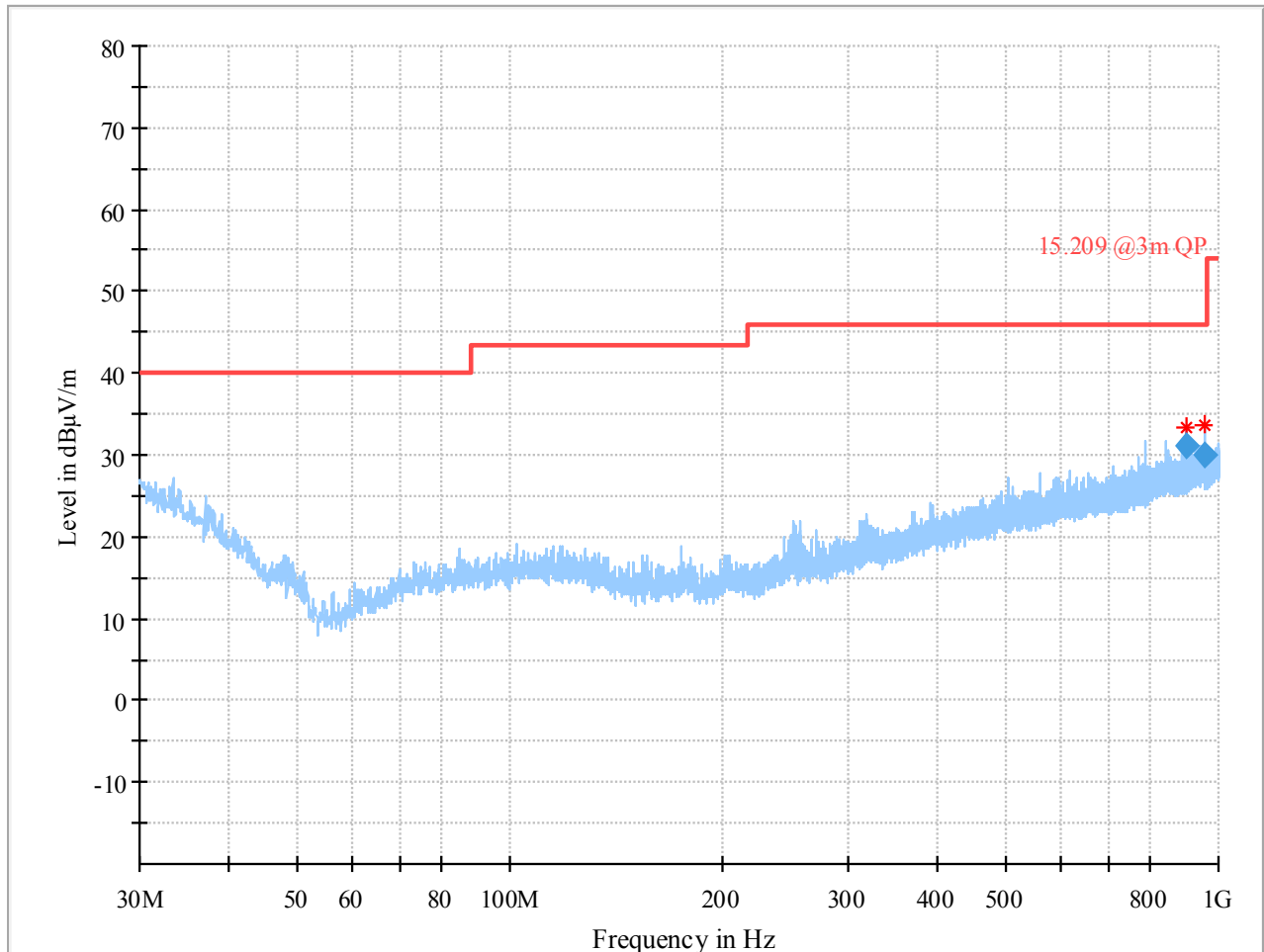
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
954.070500	38.03	46.00	7.97	100.0	120.000	104.0	V	108.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
954.070500	23.5	03:36:06 - 13.10.2021

Plot 23: Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation, EUT standing



Final_Result

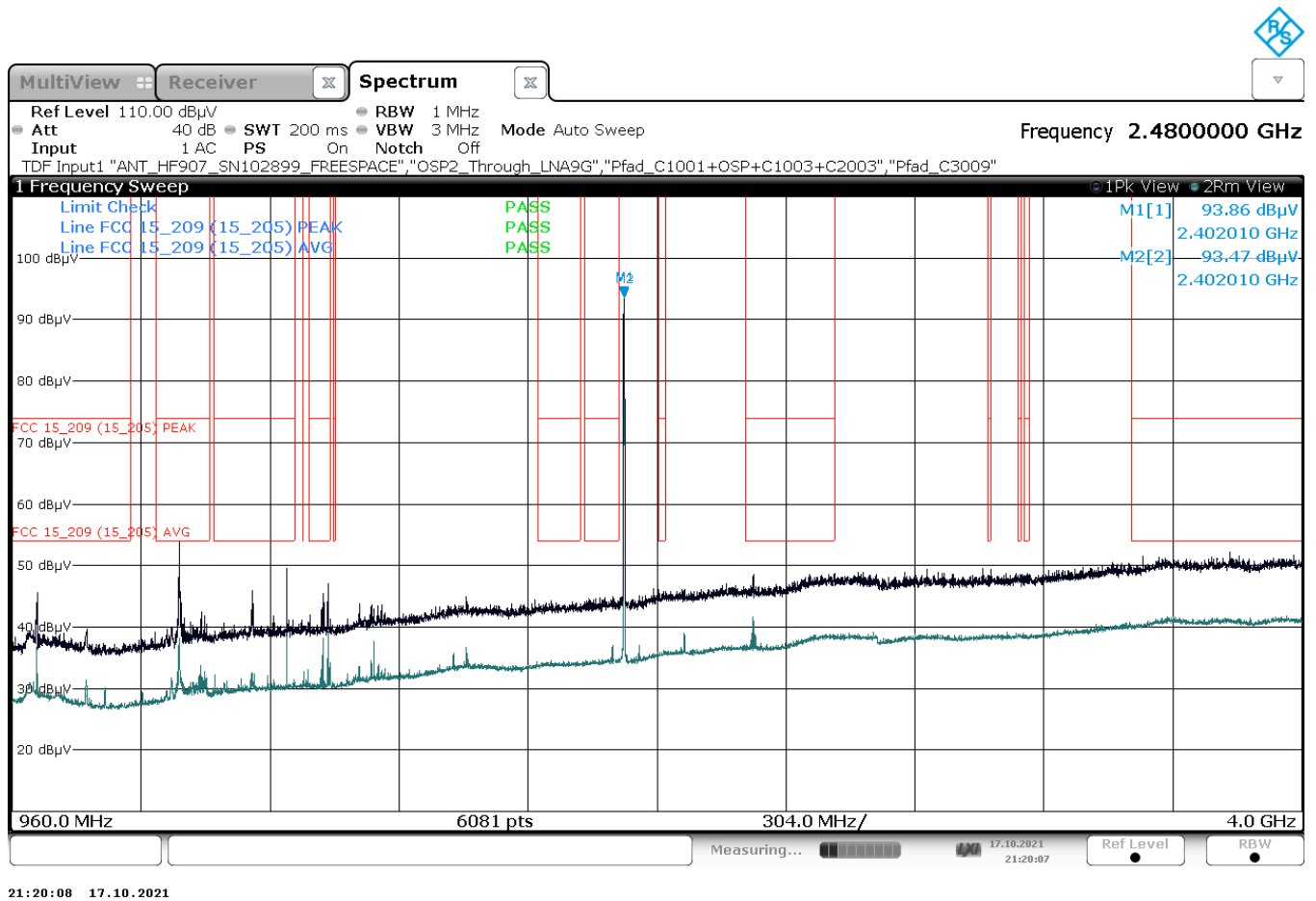
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
897.931000	31.23	46.00	14.77	100.0	120.000	100.0	H	49.0
954.070500	29.93	46.00	16.07	100.0	120.000	273.0	V	185.0

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Corr. (dB/m)	Comment
897.931000	23.1	03:20:52 - 13.10.2021
954.070500	23.5	03:23:46 - 13.10.2021

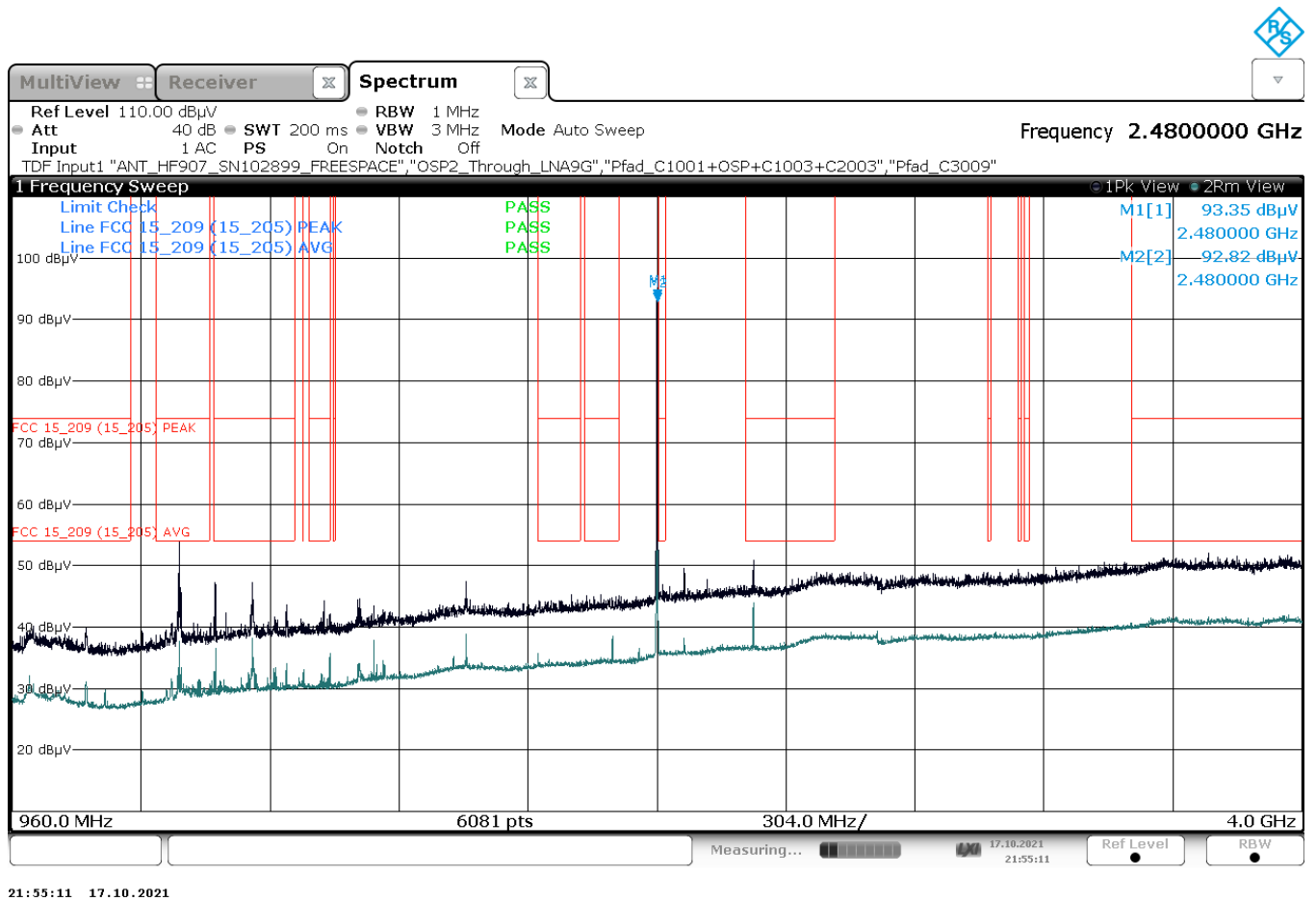
Annex A of TR no.: 21086128-23001-1

Plot 24: Mode 1, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



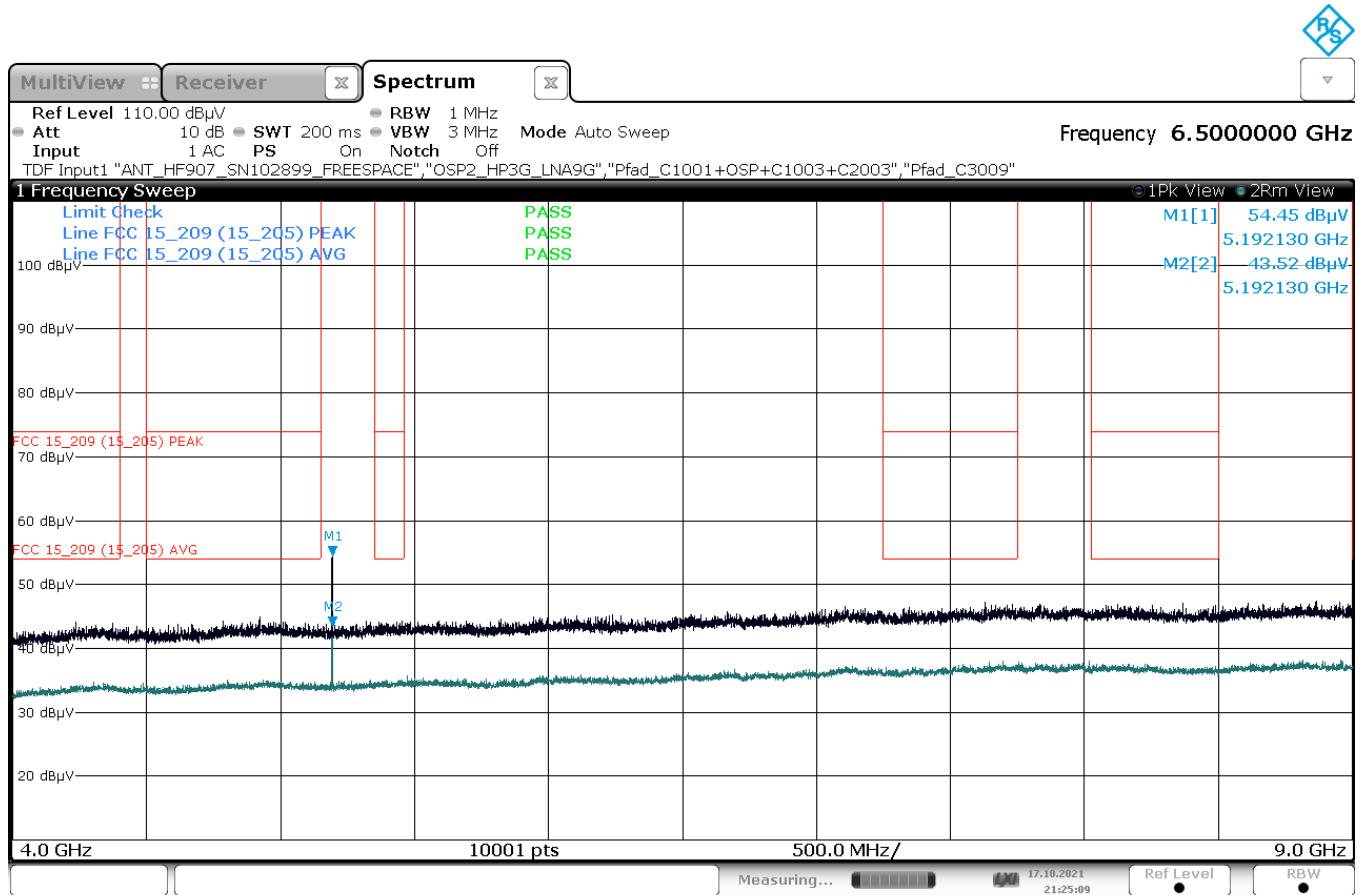
Annex A of TR no.: 21086128-23001-1

Plot 25: Mode 1, RSE 1 GHz – 4 GHz, high channel, horizontal / vertical polarisation



Annex A of TR no.: 21086128-23001-1

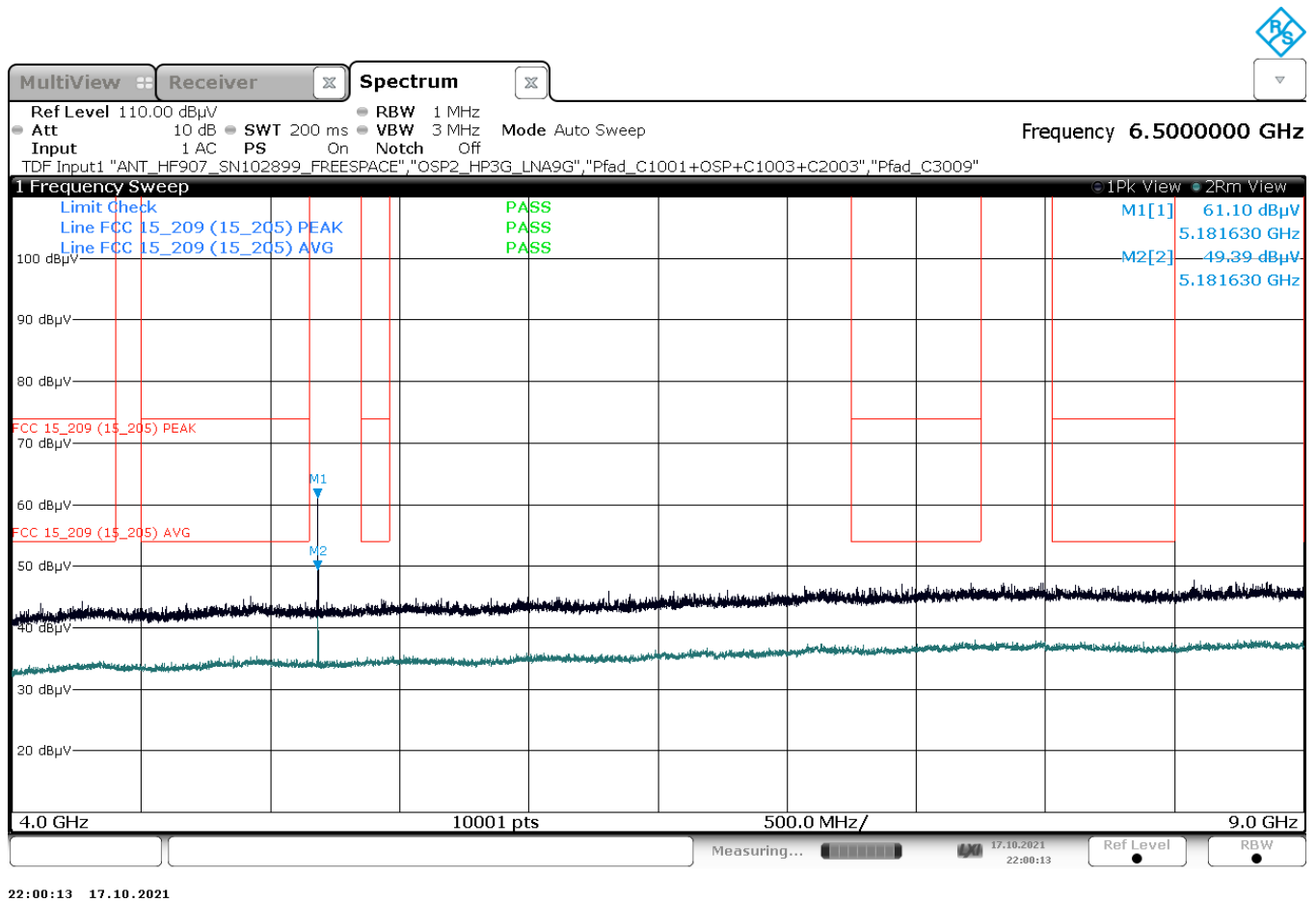
Plot 26: Mode 1, RSE 4 GHz – 9 GHz, low channel, horizontal / vertical polarisation



21:25:09 17.10.2021

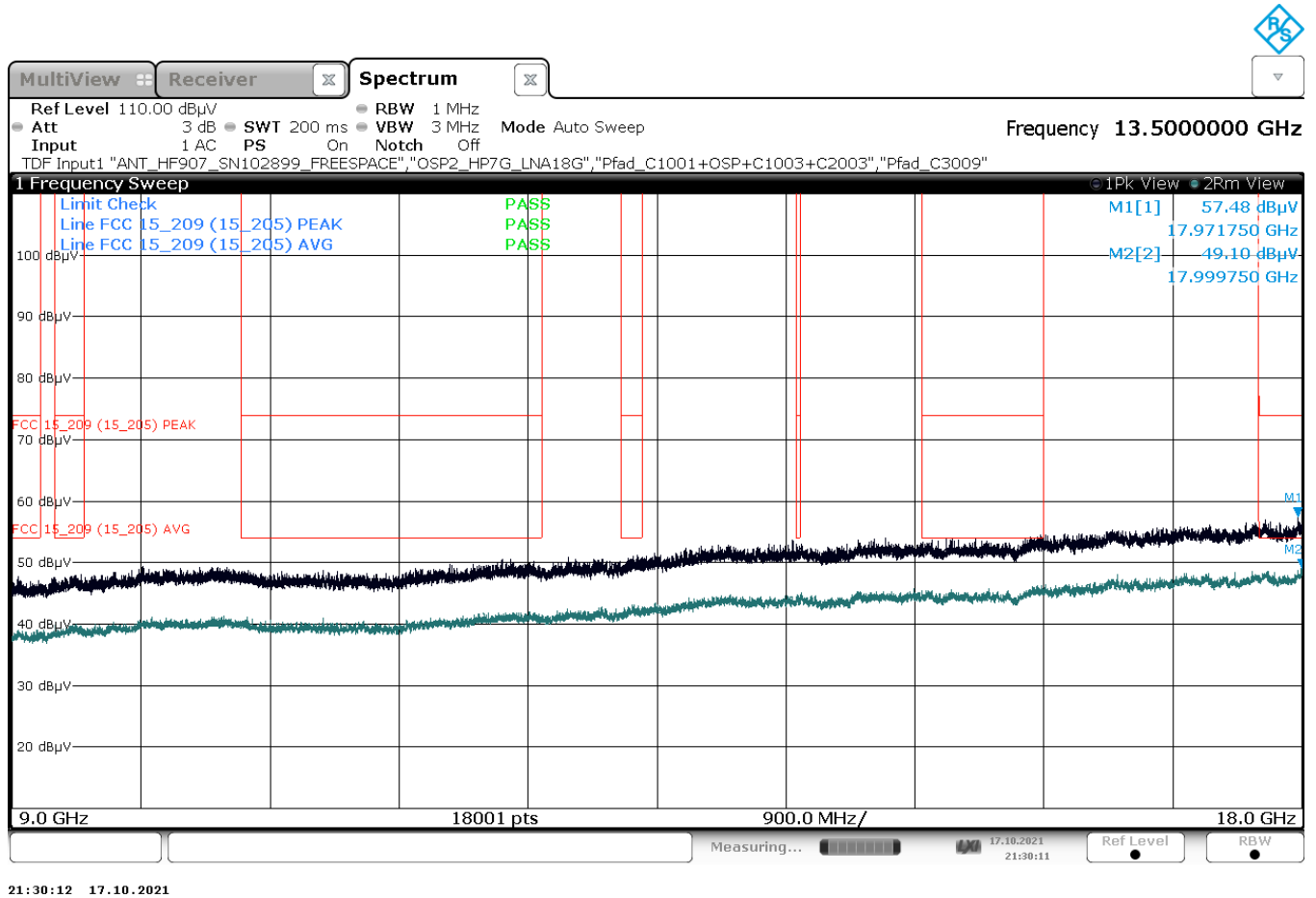
Annex A of TR no.: 21086128-23001-1

Plot 27: Mode 1, RSE 4 GHz – 9 GHz, high channel, horizontal / vertical polarisation



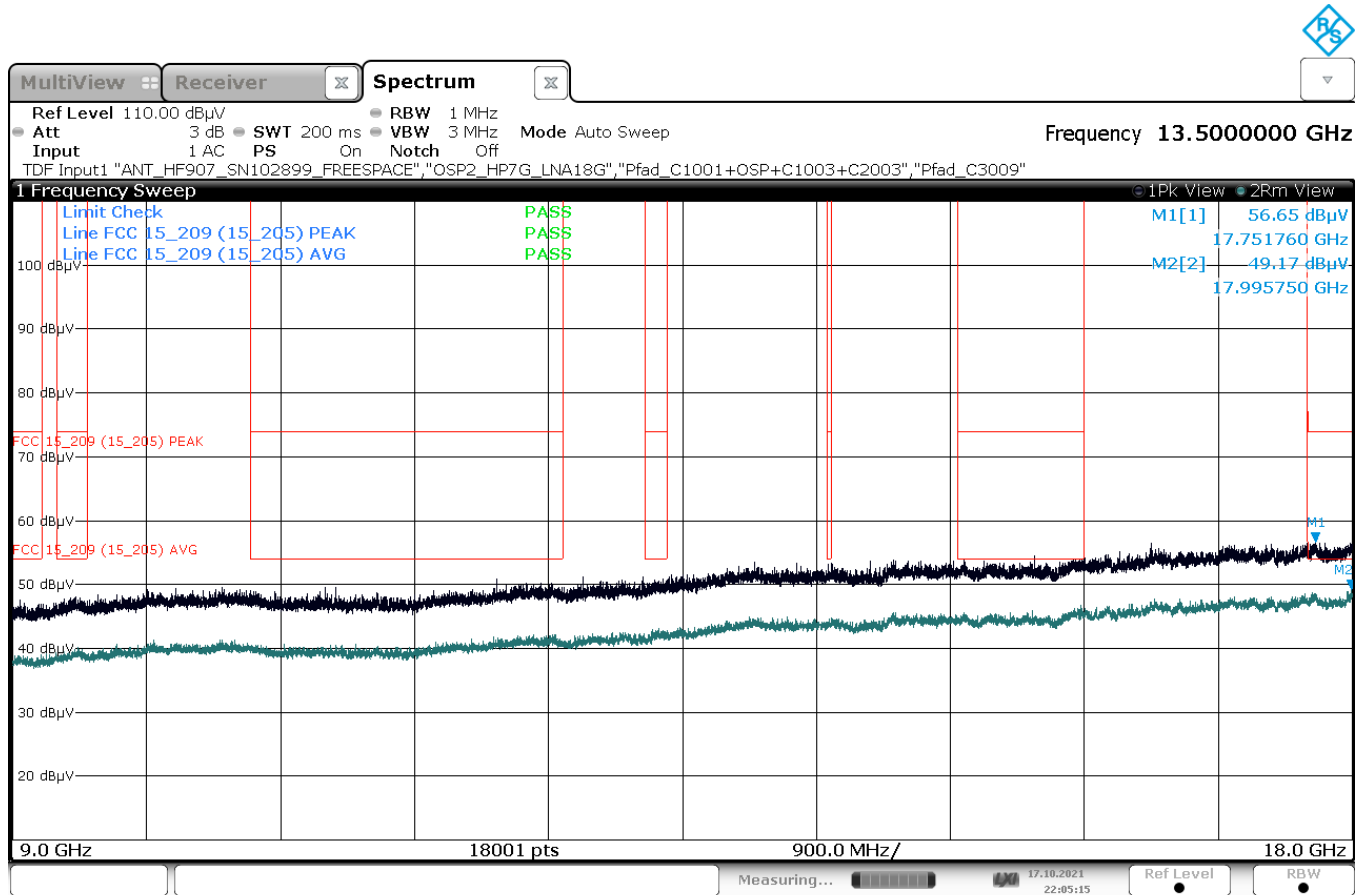
Annex A of TR no.: 21086128-23001-1

Plot 28: Mode 1, RSE 9 GHz – 18 GHz, low channel, horizontal / vertical polarisation



Annex A of TR no.: 21086128-23001-1

Plot 29: Mode 1, RSE 9 GHz – 18 GHz, high channel, horizontal / vertical polarisation



22:05:16 17.10.2021

2.3 Variant ID #38

DUT Information

DUT Name:	prePV 38
Manufacturer:	Mitsubishi Electric Corporation
Serial Number:	65251

2.3.1 RF Output Power (Conducted Peak Power)

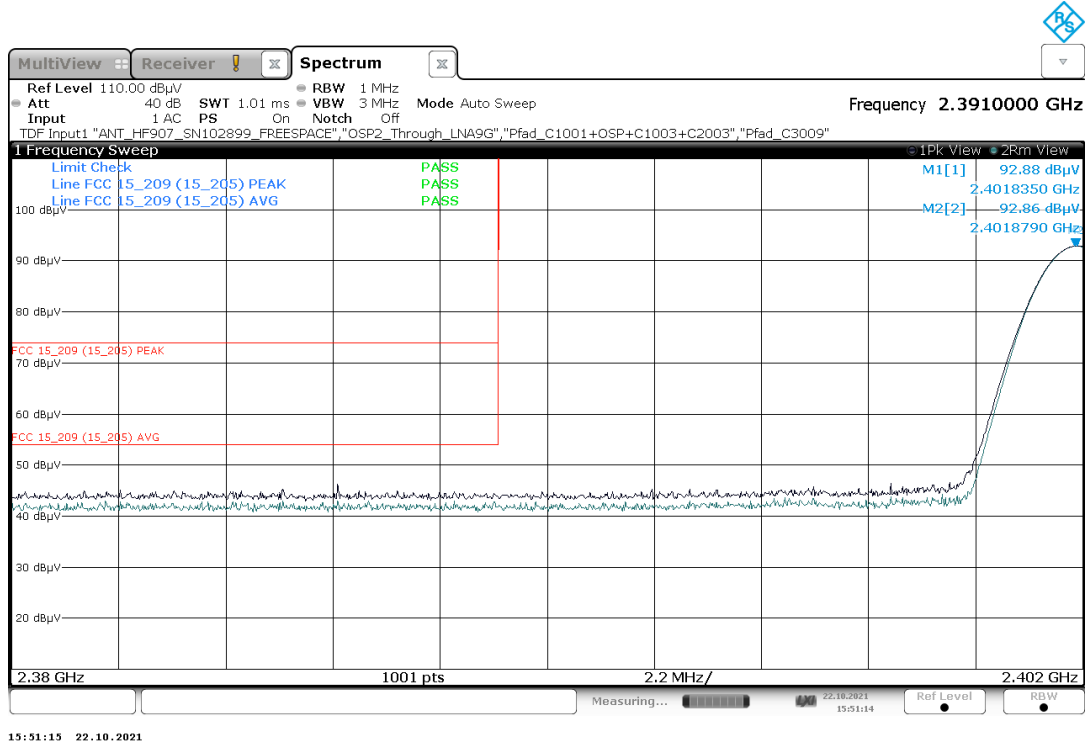
See test results of R1LOW-R DV model (see IBL-Lab test report TR-21065784-20819)

2.3.2 Radiated Peak Power (Peak EIRP)

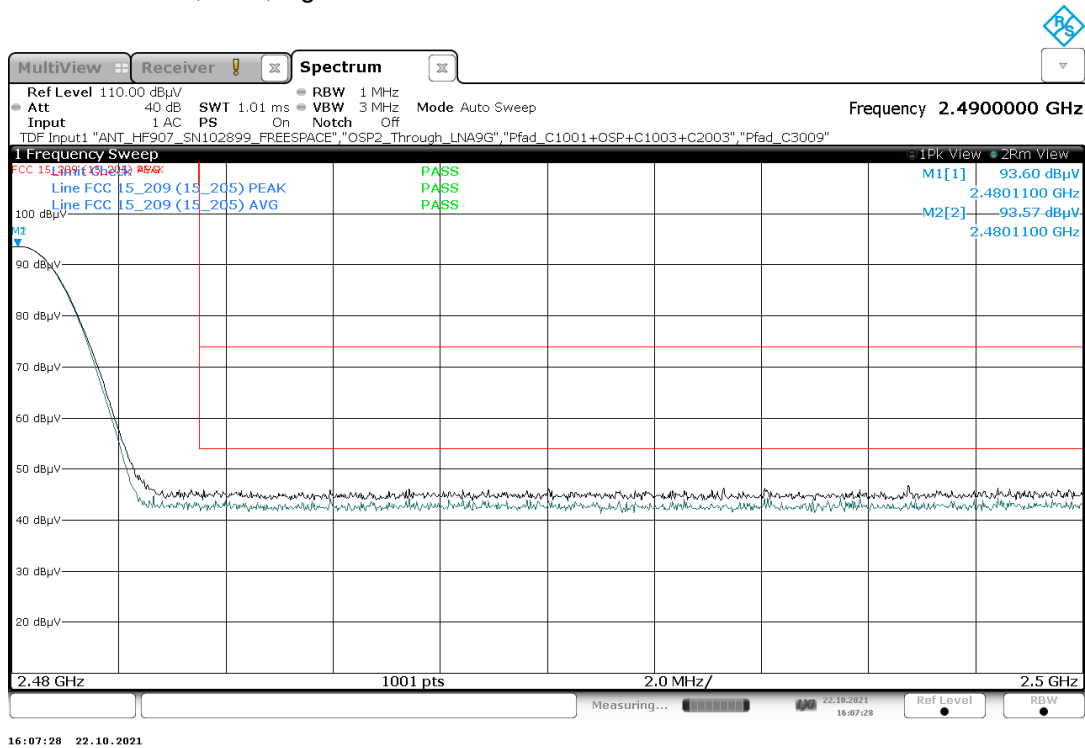
See test results of variant ID #36

2.3.3 Band Edge Compliance (BEC), radiated

Plot 30: Mode 1, BEC, low channel 0

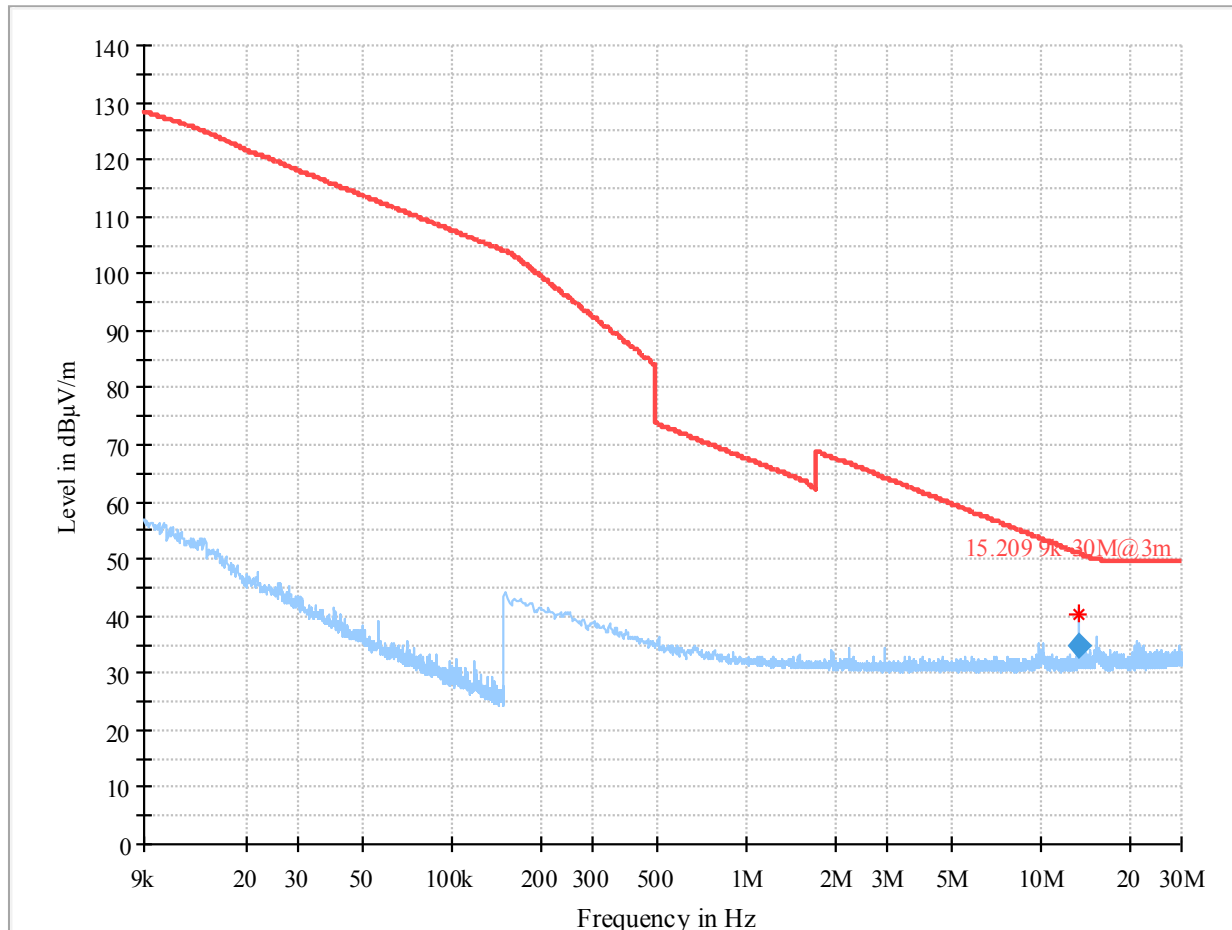


Plot 31: Mode 1, BEC, high channel 78



2.3.4 Radiated Spurious Emissions (RSE)

Plot 32: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna, EUT laying



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	34.64	50.94	16.30	100.0	9.000	V	30.0	20.5

(continuation of the "Final_Result" table from column above)

Frequency (MHz)	Comment
13.560000	01:04:32 - 16.10.2021