



Deutscher
Akreditierungsdienst
D-PL 21375-01-02
D-PL 21375-01-03



Wahl-GAR 01/01/23

Test Report

Test report no.: 23058741-34055-1

Date of issue: 2023-10-18

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

Applicant

Hella Aglaia Mobile Vision GmbH

Manufacturer

SynchronicIT BV

Test Item

UWB Dongle

Radio Frequency Testing according to:

Title 47
FCC Regulations Subpart 15F
§15.517

Tested by
(name, function, signature)

Piotr Sardyko
Labor Manager RF

signature

Approved by
(name, function, signature)

Karsten Gerald
Senior Lab Manager RF

signature

Applicant and Test item details

Applicant	Hella Aglaia Mobile Vision GmbH Ullsteinstraße 140, 12109 Berlin Germany
Manufacturer	SynchronicIT BV Spoonstraat 155, Room 413 6591 GT Gennep, The Netherlands
Test item description	UWB dongle & UWB wearable with wireless charge
Model/Type reference	UWB Dongle
FCC ID	2ASWU-PS11

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.

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, EMC, Radio D-PL-21375-01-01 - Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-02 - Testing Laboratory Designation Number DE0024 - Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-03 - ISED Company Number 27156 - Testing Laboratory CAB Identifier DE0020 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement
Date of receipt of test samples	2023-08-07
Start – End of tests	2023-08-07 – 2023-08-11

2.2 Possible verdicts of the results

Test sample meets the requirements	P (PASS) – the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) – the measured value is above the acceptance limit, AL = TL
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:

- Indoor operation chapter was added to test report. Correspondent tests were done.

This test report 23058741-34055-1 replaces the previous test report 23058741-34055-0.

2.6 Further documents

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

Measurement plots: 23058741-34055-1_Annex A

EUT photographs: 23058741-34055-1_Annex B

Test setup photographs: 23058741-34055-1_Annex C

2.7 Formula for determination of correction values (E_c)

$$E_c = E_R + AF + C_L + D_F - G_A \quad (1)$$

E_c = Electrical field – corrected value

E_R = Receiver reading

$$M = L_T - E_c \quad (2)$$

M = Margin

L_T = Limit

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

2.8 Software/Firmware used for measurements

All measurements were done directly with spectrum analyzer or SW R&S EMC32.

In some measurements (please see test equipment list for each test) R&S ESW 26 was used (please see chapter 8).

(Instrument) Firmware Version: **1.70**

In some measurements (please see test equipment list for each test) R&S FSW 50 was used (please see chapter 8).

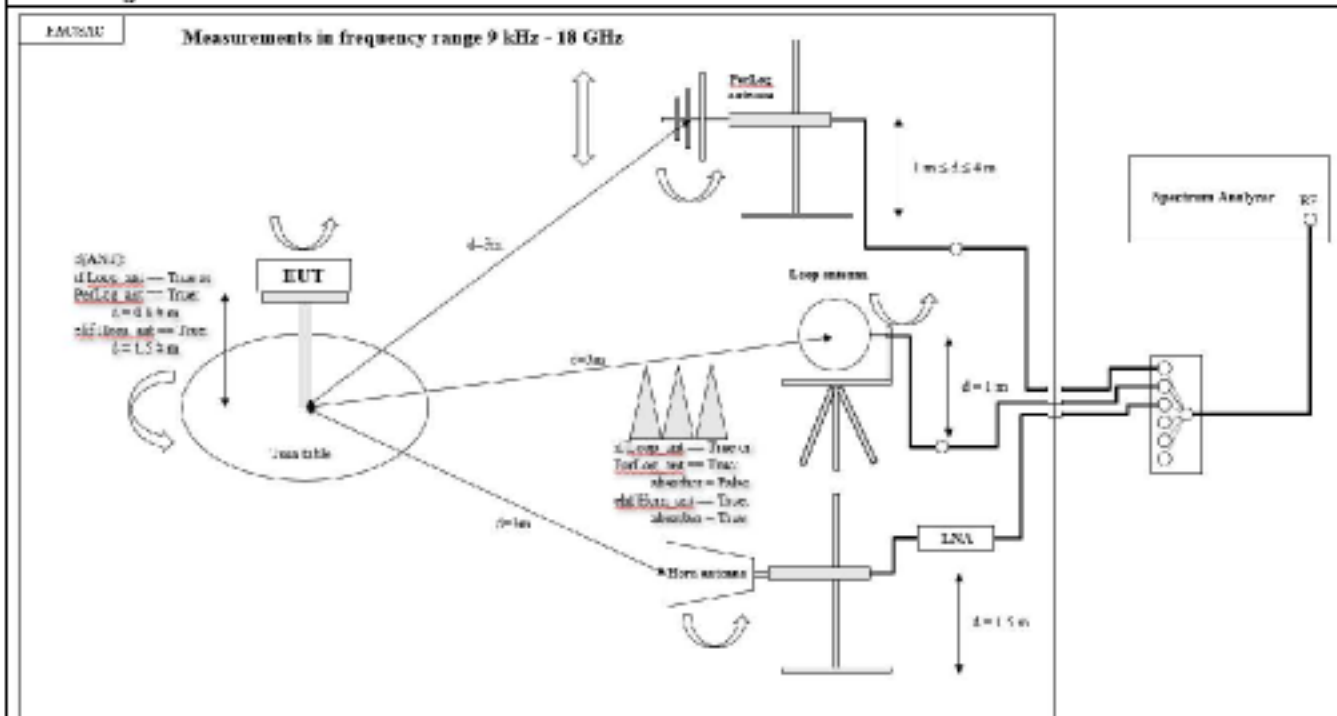
(Instrument) Firmware Version: **4.61**

In some measurements SW R&S EMC32 was used.

Version: **11.10.00**

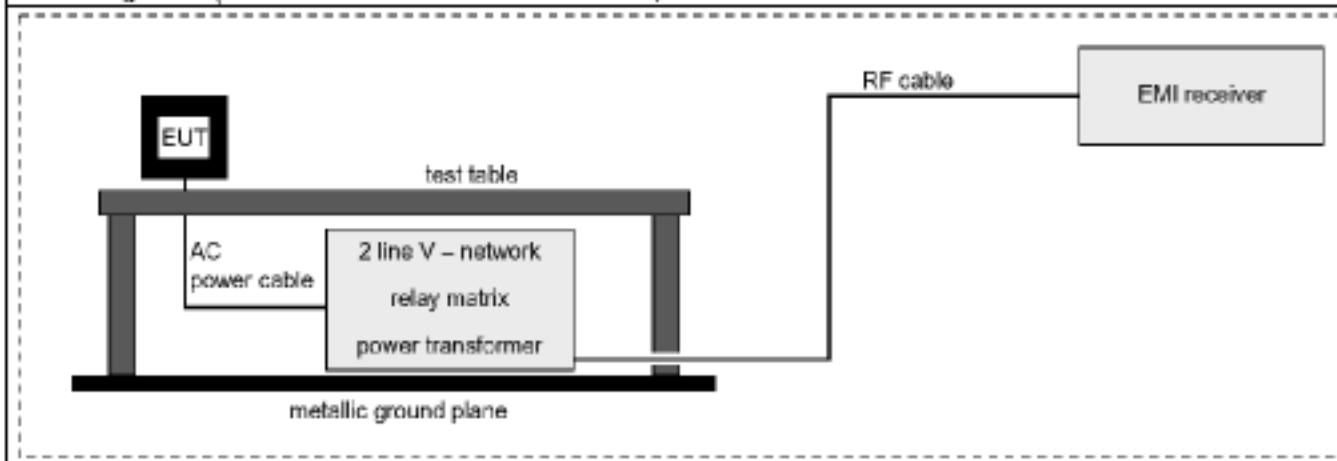
2.9 Block diagrams

Block diagram 1*:



* depending on limit line different horn antennas, correspondingly different measurement distances, can be used. If the case here, please see the annex C with test set-up photos.

Block diagram 2 (conducted emissions measurements):



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	5 V USB

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)

FCC CFR Title 47 Part 15 Subpart F	---
ANSI C63.10: 2013	---

Test standard (not accredited)

None

Reference	Description
none	---

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description*

UWB dongle & UWB wearable with wireless charge. According to customers information the test item is intended to be used only indoors in the retail market.

*: declared by the applicant

5.2 Technical Data of Equipment*

Number of channel:	1
Channel tested:	f_{cent} : 6489.6 MHz
Device type:	Indoor UWB system
Number of channels:	1
Emission designator(s):	IEEE 802.15.4-2011 UWB
RF mode:	Tx / Rx
Antenna Type:	Internal (Johansson 7000AT18A1600)
Max radiated emissions:	< -41.3 dBm
Antenna connector:	None
Equipment type:	Production model
Temperature range:	Tmin: 0 °C, Tmax: 40 °C
Type of power source:	Power supply through USB (5 V)

*: declared by the applicant

5.3 Test Item (Equipment Under Test) Description*

Short designation	EUT Model	EUT Description	ID	Hardware status	Software status
EUT A	UWB Dongle	Tx	N/A	NH201	N/A
EUT B	UWB Dongle	Normal sample	N/A	NH201	N/A

*: declared by the applicant

5.4 Auxiliary Equipment (AE) Description*

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE1	Normal sample	UWB Tag	-	-

*: declared by the applicant

5.5 Test Item Operating Modes Description*

EUT operating mode no.	Description of operating modes	Additional information
op. 1	Continuous modulated	-
op. 2	Normal mode	-

*: declared by the applicant

5.6 Test Item Set-ups Description

set. 1	EUT A
set. 2	EUT B + AE 1

5.7 Test Conditions

Temperatur, [°C]		Voltage, [V]	
Tnom	20 ± 5	Vnom	5

5.8 Additional Information

Test items differences	-
Additional application considerations to test a component or sub-assembly	The power was set with the following command in the script: <pre>config.txPower = 33;</pre>

6 SUMMARY OF TEST RESULTS

Test specification

FCC 15.517

FCC part	Requirement / Test Case	Test Conditions	Set-up	Operating mode	Result / Remark	Verdict
15.517 (a)(5)	Indoor operation	Nominal	2	2	None	Pass
15.517(b)	10 dB bandwidth	Nominal	1	1	None	Pass
15.209 15.517(c)	Radiated emissions	Nominal	1	1	None	Pass
15.517(d)	Radiated emissions in the GPS bands	Nominal	1	1	None	Pass
15.517(e)	Fundamental emission peak power	Nominal	1	1	None	Pass
15.203	Antenna requirement	-	-	-	-	Pass
15.207(a)	Conducted emissions	Normal	1	1	None	Pass

Notes

None

Comments and observations

None

7 TEST RESULTS

7.1 Indoor operation

Test equipment (Please see Chapter 8 for exact information of test equipment)

Radiated: R3, A3, C1, Amp2

Description

The Applicant provided following information to functionality of the EUT and AE:

1 OVERVIEW

HELLA Aglaia Mobile Vision GmbH provides solutions for people counting in the retail market and for public transport. The solution is based on stereoscopic cameras which can give detailed information about the people being counted.

For their retail solution, UWB dongles and tags are used to differentiate between customers and employees. Each camera is equipped with an UWB dongle. Each employee carries an UWB tag with them and the distance to each camera is measured. Based on these measurements, employees can be marked by the camera, leaving them out of the customer count.

2 SOLUTION

The dongles are connected to the cameras using the USB Port. They contain a SFM10 module (based on NXP QL23D0) from SynchronicIT. The SFM10 will listen for and communicate with the tags. As part of the communication, the distance towards this dongle is measured. Both the tag and the dongle will know the distance, so it can be used to optimize the power usage vs. response time in case there are several dongles within each others range of UWB, they will align the communication, so all distances are known at every camera

The tag also contain a SFM10 module. The tags are powered by a rechargeable lithium polymer battery. To optimize battery life a movement sensor detects if the sensor is at rest.

The solution is for indoor use only. Neither dongle, tag nor camera are waterproof.

3 COMMUNICATION

3.1 DONGLE

Initially the dongle is deactivated and will not transmit any ultra-wideband signals. When the camera detects a person in the field of view, it will activate the dongle. The dongle will then transmit wake-up calls for tags and listen for signals by any tag to establish the communication.

The dongles will deactivate themselves when there is no person in the field of view of the camera and no signal by any tag was received for 10 seconds.

3.2 TAG

Initially the tags are in passive mode and will not transmit any ultra-wideband signals. They will listen once a second for a wake-up call by a dongle in range. After receiving a wake-up call, the tag will send out poll signals and listen for replies to establish the communication.

When a tag has not received any reply to its poll signal for 10 seconds it will switch back to passive mode and wait for a new wake-up call.

To minimize the power drain the tags will deactivate themselves when they are at rest. In this case they will neither receive nor transmit any ultra-wideband signals. Any movement will activate the tag again. It will then start again in passive mode.

Additional measurements were done to check the description above*:

Plot 1.1.: No trigger signal -> EUT B is not transmitting.

Plot 1.2.: Trigger signal at M1. EUT B starts to transmit at M1. No movement. -> AE 1 is not **responding**. EUT B stops to transmit at D2.

Plot 1.3.: Trigger signal at M1. EUT B starts to transmit at M1. Movement from 0 s up to M3. -> AE 1 starts to transmit at M2 and stops at M4. EUT B stops to transmit at M5.

Limits

FCC 15.517(a):

(a) Operation under the provisions of this section is limited to UWB transmitters employed solely for indoor operation.

(1) Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

(2) The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.

(3) The use of outdoor mounted antennas, e.g., antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

(4) Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.

(5) A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

Results*

(1) The EUT has no waterproof housing. The EUT is using USB connection for power supply. The EUT can function only together with a camera (after getting a trigger signal from camera). Thus, the EUT is capable to work only indoors.

(2)(3) The antenna, used in the EUT, is a ceramic antenna (Johansson 7000AT18A1600), which is covered with a housing. What doesn't allow to use the EUT antenna as a directional antenna. What, on his part, doesn't give a possibility intentionally to direct the emissions in one direction or another e.g. outside.

(5) The EUT (Dongle) is transmitting only when it is sending information to an associated receiver (Tag). The EUT (Dongle) stops transmitting in less then 10 s if the AE (Tag) stops to respond.

Pass.

* Please see measurement plots in Annex A.

7.2 Occupied Bandwidth

Test equipment (Please see Chapter 8 for exact information of test equipment)

Radiated: R3, A3, C1, Amp2

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013, Chapter 10.1.

Please see test set-up photos in Annex C and block diagram in Chapter 2.9.

Please see Plots in Annex A for spectrum analyzer settings.

Measurement was done radiated.

Limits

The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10600 MHz.

Results*

Plot No	Set-up / Op.	f_{low} [MHz]	f_{high} [MHz]	Measured value (10 dB BW), [MHz]	Limit, [GHz]	Result
2.1.	1 / 1	6201.1	6773.2	572.1	3.1 – 10.6	Pass

* Please see measurement plots in Annex A.

7.3 Radiated field strength / emissions

Test equipment

Frequency range 9 kHz – 30 MHz

Measurement in a semianechoic room with the distance between the EUT and the reference point of the antenna 3 m (see photos in Annex B). The measurement was done with software R&S EMC 32 V11.00.

Radiated: A1, C1, R1, SW2

Frequency range 30 MHz – 1 GHz

Measurement in a semianechoic room with the distance between the EUT and the reference point of the antenna 3 m (see photos in Annex B). The measurement was done with software R&S EMC 32 V11.00.

Radiated: A2, C1, R1, SW2

Frequency range 1 GHz – 40 GHz

The measurement was done directly with spectrum analyzer.

Radiated: Amp2, C1, R3

Frequency range, [MHz]	Antenna	Measurement distance, [m]	Min Rayleigh (far-field) distance, [m]	Amplifier used	Is the measurement distance in m equal to or greater than the Rayleigh distance
960-1610	A3	1	0.99	Amp2	Yes
1610-3100	A3	2	1.59	Amp2	Yes
3100-10600	A3	3	3	Amp2	Yes
10600-15000	A7	1	0.97	Amp3	Yes
15000-18000	A8	1	0.62	Amp3	Yes
18000-26500	A9	0.5	0.48	Amp4	Yes
26500-40000	A10	0.32	0.31	Amp4	Yes

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013.

RBW for frequency range 9 kHz- 30 MHz: 200 Hz, 9 kHz.

RBW for frequency range 30 MHz- 1 GHz: 120 kHz.

RBW for frequency range 1 GHz- 40 GHz: 1 MHz.

See photos in Annex C for test Set-up and block diagram in Chapter 2.9.

Limits

According to FCC 15.209(a):

Frequency (MHz)	Magnetic field strength (HField) (μA/m)*	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	6.37/F (F in kHz)	2400/F(kHz)	300
0.490-1.705	63.7/F (F in kHz)	24000/F(kHz)	30
1.705-30.0	0.08	30	30
30-88	-	100	3
88-216	-	150	3
216-930	-	200	3

* the measurement was done with dBuV/m units. Please see the appropriate dBuV/m limits in the same table

Limits

According to FCC 15.517(c) Radiated emissions:

Frequency [MHz]	EIRP in dBm	Measurement distance [meters]	Remarks
950-1810	-75.3	3	-
1810-1990	-53.3		
1990-3100	-51.3		
3100-10600	-41.3		
Above 10600	-51.3		

Test Results

Set-up / Op.	Frequency	Verdict
1 / 1	9 kHz – 40 GHz	Pass

All Readings below 1 GHz are Quasi-Peak or Peak detector, above 1 GHz with RMS detector.

Comment:	---
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Verdict	- PASS -	For plots please see Annex A to current report
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7.4 Radiated emissions in the GPS bands

Test equipment (Please see Chapter 8 for exact information of test equipment)

Radiated: R3, A3, C1, Amp2

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013, Chapter 10.3.10.

Please see test set-up photos in Annex C and block diagram in Chapter 2.9.

Please see Plots in Annex A for spectrum analyzer settings.

Measurement was done radiated.

Measurement distance: 3 m.

Limits

-85.3 dBm for frequency range 1164 MHz – 1240 MHz and 1559 MHz – 1610 MHz.

Test Results

Set-up / Op.	Frequency range, [MHz]	Verdict
1 / 1	1164-1240	Pass
1 / 1	1559-1610	Pass

All Readings were done with RMS detector.

Comment:

Verdict

- PASS -

For plots please see Annex A to current report

7.5 Fundamental emission peak power

Test equipment (Please see Chapter 8 for exact information of test equipment)

Radiated: R3, A3, C1, Amp2

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013, Chapter 10.3.6.

Please see test set-up photos in Annex C and block diagram in Chapter 2.9.

Please see Plots in Annex A for spectrum analyzer settings.

Measurement was done radiated.

Measurement distance: 3 m.

Limits

0 dBm

Results*

Plot No	Set-up / Op.	f _c , [MHz]	f _{max} , [MHz]	P _{max} , [dBm]	Limit, [dBm]	Result
5.1.	1 / 1	6489.6	6495.23	-2.3	0	Pass

* Please see measurement plots in Annex A.

7.6 Antenna requirement according to FCC 15.203

The antenna is permanently affixed to the module.

Verdict	- PASS -	Please see internal photos of the EUT
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7.7 Conducted emissions

Test equipment (Please see Chapter 8 for exact information of test equipment)

Radiated: R1, L1, C5, SW2

Description

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- The EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

Please see test set-up photos in Annex C and block diagram 2 in Chapter 2.9.

Limits

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

Please see FCC Title 47 § 15.207 for more details.

Test Results

Set-up / Op.	Line	Verdict
1 / 1	L1	Pass
1 / 1	N	Pass

All Readings were done with Quasi-Peak and Average detector.

Comment:	---
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Verdict	- PASS -	For plots please see Annex A to current report
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8 MEASUREMENT EQUIPMENT

No	Equipment	Type	Manufacturer	Serial No.	Int. No.	Last Calibration	Next Calibration
Antennas (A):							
1.	Active Loop Antenna	HFH2-Z2E	Rohde & Schwarz	100108	LAB000108	2023-05-05	2026-05-05
2.	Ultrabroadband antenna	HL562E	Rohde & Schwarz	102005	LAB000150	2022-12-22	2025-12-22
3.	Double-Ridged Waveguide Horn Antenna	HF-907	Rohde & Schwarz	102899	LAB000151	2023-05-05	2026-05-05
4.	Rod Antenna	-	-	-	LAB000280	-	-
5.	Horn Antenna (2.6 GHz – 3.95 GHz)	PE9863/S F-10	Pasternack	-	LAB000312	2021-01-13	-
6.	Horn Antenna (3.95 GHz – 5.85 GHz)	PE9861/S F-10	Pasternack	-	LAB000264	2020-09-29	-
7.	Horn Antenna (10 GHz – 15 GHz)	PE9855 S F-20	Pasternack	-	LAB000263	2020-09-29	-
8.	Horn Antenna (12.4 GHz – 18 GHz)	62-HA20-A-5MF	TTE Europe	-	LAB000282	2020-09-29	-
9.	Horn Antenna (17.6 GHz – 26.7 GHz)	20240-20	Rann Microwave Ltd	268402	LAB000127	2020-06-29	-
10.	Horn Antenna (26.4 GHz – 40.1 GHz)	22240-20	Rann Microwave Ltd	270447	LAB000129	2020-06-29	-
11.	Horn Antenna (33 GHz – 50.1 GHz)	23240-20	Rann Microwave Ltd	273430	LAB000132	2020-07-01	-
12.	Horn Antenna (49.9 GHz – 75.8 GHz)	25240-20	Rann Microwave Ltd	272860	LAB000133	2020-07-01	-
13.	Horn Antenna (80.5 GHz – 91.5 GHz)	26240-20	Rann Microwave Ltd	273417	LAB000135	2020-07-01	-
14.	Horn Antenna (73.8 GHz – 114 GHz)	27240-20	Rann Microwave Ltd	273388	LAB000138	2020-07-01	-
15.	Horn Antenna (114 GHz – 173 GHz)	28240-20	Rann Microwave Ltd	273382	LAB000139	2020-07-01	-
16.	Horn Antenna (145 GHz – 220 GHz)	30240-20	Rann Microwave Ltd	273390	LAB000178	2020-08-01	-
17.	Horn Antenna (217 GHz – 330 GHz)	32240-20	Rann Microwave Ltd	273469	LAB000152	2020-08-01	-
18.	Horn Antenna (49.9 GHz – 75.8 GHz)	25240-20	Rann Microwave Ltd	272861	LAB000134	2020-07-01	-
19.	Horn Antenna (80.5 GHz – 91.5 GHz)	26240-20	Rann Microwave Ltd	273418	LAB000136	2020-08-01	-
Amplifiers (Amp)*:							
1.	Pre-Amplifier	BBV 9718 C	Schwarzbeck Mess-Elektronik OHG	84	LAB000189	-	-
2.	Low noise amplifier	BZ-01000900-111550-202320	B&Z Technologies	24336	LAB000296	-	-
3.	Low noise amplifier	BZ-08001800-180855-202020	B&Z Technologies	22105	LAB000297	-	-
4.	Low noise amplifier	BZ-18004000-270845-252525	B&Z Technologies	22449	LAB000298	-	-
Attenuator (Att)*:							
1.	Attenuator	25081-20 (49.9 GHz – 75.8 GHz)	Rann Microwave Ltd	234411	LAB000229	-	-

2.	Attenuator	270B1-20 (73.8 GHz – 112 GHz)	Rann Microwave Ltd	270004	LAB000230	-	-
RF Cables (Cab):							
1.	Coaxial cable	LU7-022-1000	Rosenberger	33	LAB000153	-	-
2.	Coaxial cable	LU7-022-1000	Rosenberger	34	LAB000153	-	-
3.	Coaxial cable	SF101/1.5m	Huber & Suhner	503987/1	LAB000185	-	-
Chambers (C):							
1.	Semi/Fully Anechoic Chamber	SAC5	Albatross Projects GmbH	20168.PRB	LAB000235	2022-01-31	2025-01-31
2.	Climatic chamber	T-65/50	CTS GmbH	204002	LAB000110	2023-05-11	2024-05-11
3.	Shielding Cover	CMU-Z11	Rohde & Schwarz	100876	LAB000039	-	-
4.	Climatic chamber	T-70/350	CTS GmbH	194027	LAB000098	2023-06-30	2024-06-30
5.	Shielded room	Sputnik 1 (Schirmkabine)	Albatross Projects GmbH	-	LAB000257	-	-
Corner Reflector (CR):							
1.	Trihedral Corner Reflector	SAJ-080-S1	ERAVANT	04756-01	LAB000201	-	-
Directional coupler (DC):							
1.	Directional coupler	CPL-5230-10-SMA-79	Midwest Microwave	-	LAB000672	-	-
Distance meter (DM):							
1.	Laser distance meter	GLM 50 C	Bosch	-	-	-	-
2.	Laser distance meter	GLM 120 C	Bosch	-	-	-	-
Filter (F):							
1.	High-pass filter (84 GHz – 110 GHz)	10-WHPF-84.5-UG387	TTE	-	LAB000299	-	-
2.	High-pass filter (7 GHz – 23 GHz)	HPF 7-23	AtlantRF	-	LAB000444	-	-
3.	High-pass filter (3.3 GHz – 12.75 GHz)	HPF 3.3-11	AtlantRF	-	LAB000382	-	-
4.	High-pass filter (1.3 GHz – 12.75 GHz)	H1G713G1	Microwave Circuits Inc	48291	LAB000443	-	-
5.	High-pass filter (1.3 GHz – 12.75 GHz)	H1G713G1	Microwave Circuits Inc	1898-01	LAB000670	-	-
6.	Bandstop filter (30MHz – 3GHz for 900 MHz Band)	WRG876/960- 847/989-50/8SS	Wainwright Instruments GmbH	-	LAB000671	-	-
Harmonic mixers (H):							
1.	Harmonic Mixer	FS-Z60	Rohde & Schwarz	101350	LAB000375	2023-04-13	2024-04-13
2.	Harmonic Mixer	FS-Z75	Rohde & Schwarz	102015	LAB000112	2023-05-03	2024-05-03
3.	Harmonic Mixer	FS-Z90	Rohde & Schwarz	102020	LAB000113	2023-04-06	2024-04-06
4.	Harmonic Mixer	FS-Z110	Rohde & Schwarz	102000	LAB000114	2023-05-02	2024-05-02
5.	Harmonic Mixer	FS-Z170	Rohde & Schwarz	100996	LAB000126	2023-04-26	2024-04-26
6.	Harmonic Mixer	FS-Z220	Rohde & Schwarz	101039	LAB000116	2023-04-16	2024-04-06
7.	Harmonic Mixer	FS-Z325	Rohde & Schwarz	101015	LAB000117	2023-04-11	2024-04-11
LISN (L):							
1.	Two-line V-Network	ENV216	Rohde & Schwarz	102597	LAB000220	2022-09-27	2023-09-27
2.	Two-line V-Network	ENV216	Rohde & Schwarz	102598	LAB000217	2023-06-01	2024-06-01
Multimeters (M):							
1.	Multimeter	U1242B	Keysight	MY59240021	LAB000187	2022-08-20	2024-08-20
2.	Multimeter	U1242B	Keysight	MY59160026	LAB000018	2021-08-30	2023-08-30
Multipliers (Mp):							
1.	Multiplier	SMZ75	Rohde & Schwarz	101307	-	2018-03-15	-
2.	Multiplier	SMZ110	Rohde & Schwarz	100001	-	2020-05-09	-
Power Supply (P):							
1.	Power Supply	PS 2042-10 B	Elektro-Automatis GmbH	2878350263	LAB000190	-	-

2.	Power Supply	PS 2042-10 B	Elektro-Automatik GmbH	2878350322	LAB000192	-	-
3.	Power Supply	E3640A	Agilent	MY40005893	LAB000036	-	-
Power meters (PM):							
1.	Power meter	NRP-ZB1	Rohde & Schwarz	105194	LAB000120	2023-05-10	2024-05-10
2.	Power meter	NRP110T	Rohde & Schwarz	101151	LAB000119	2023-06-05	2024-06-05
Receivers and Spectrum analyzers (R):							
1.	Test Receiver, SAC5	ESW-26	Rohde & Schwarz	101517	LAB000363	2023-01-31	2024-01-30
2.	Test Receiver	ESW-26	Rohde & Schwarz	101481	LAB000236	-	-
3.	Spectrum Analyzer 1 Hz = 50 GHz	FSW-50	Rohde & Schwarz	101450	LAB000111	2023-07-26	2024-07-26
4.	Spectrum Analyzer 2 Hz = 43 GHz	FSW-43	Rohde & Schwarz	101391	LAB000289	2023-06-02	2024-06-02
Signal Generators (SG):							
1.	Signal generator 8 kHz – 50 GHz	SMA100B	Rohde & Schwarz	103838	LAB000118	2021-06-30	2024-06-30
2.	Vector Signal Generator	SMW200A	Rohde & Schwarz	108822	LAB000288	-	-
Software (SW):							
No	Type	Name	Manufacturer	Version	Int. No.	Build	Rev
1.	Software	R&S Power Viewer	Rohde & Schwarz	11.3, 3.2.2020	-	7338	3230
2.	Software	R&S EMC32	Rohde & Schwarz	11.20	-	-	-

* The gain values of Amp and attenuation values of Cab and Att are remeasured annually internal.

9 MEASUREMENT UNCERTAINTIES

Test case	Measurement uncertainty*
Radiated field strength	$\leq \pm 6$ dB
Occupied bandwidth	± 100 kHz
Time domain measurement	± 2.32 ms
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %

*) The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %.

END OF THE REPORT

Annex A

Measurement plots

part of / in addition to

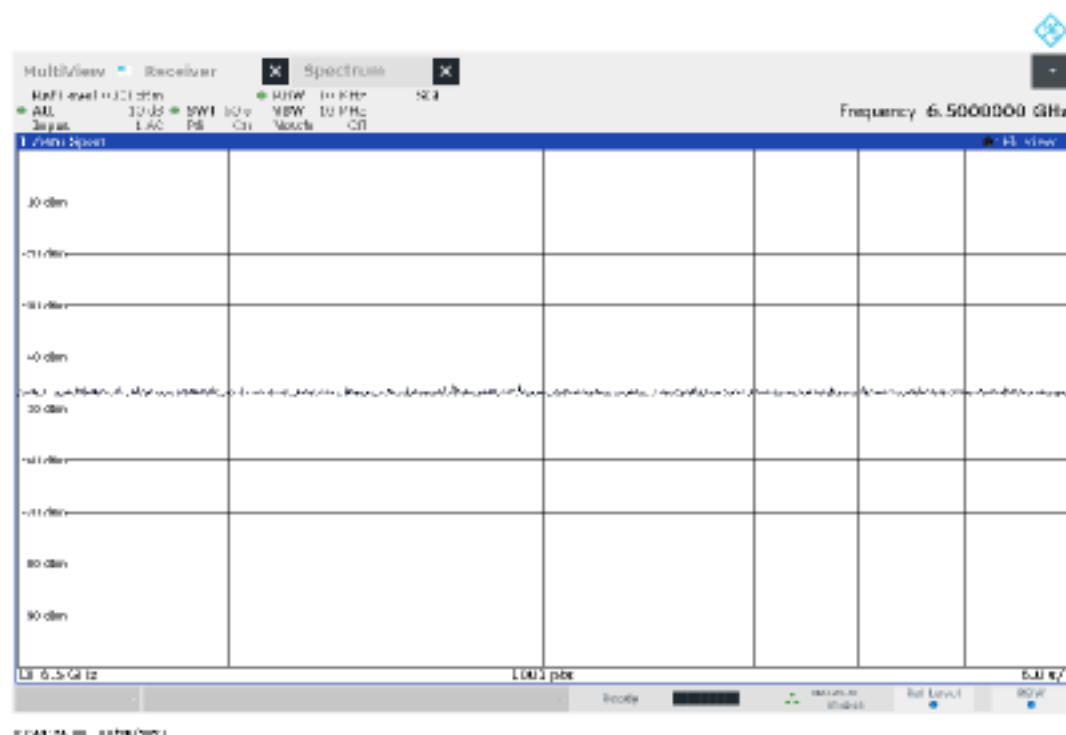
Test report no.: 23058741-34055-1

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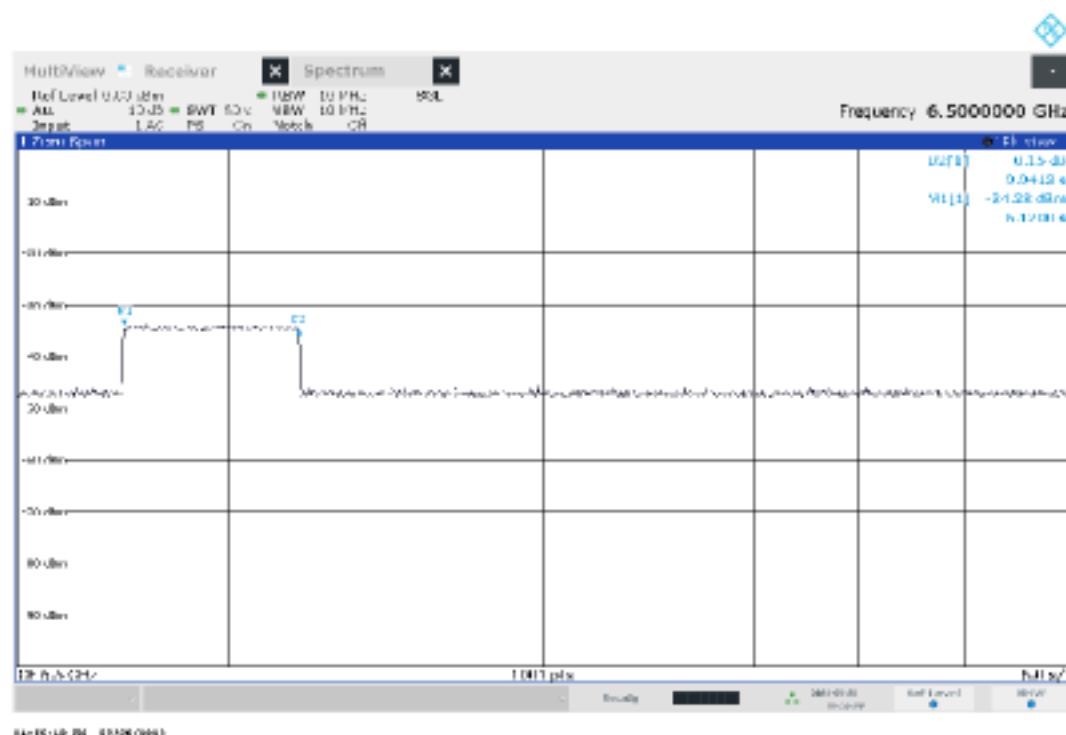
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1 INDOOR OPERATION

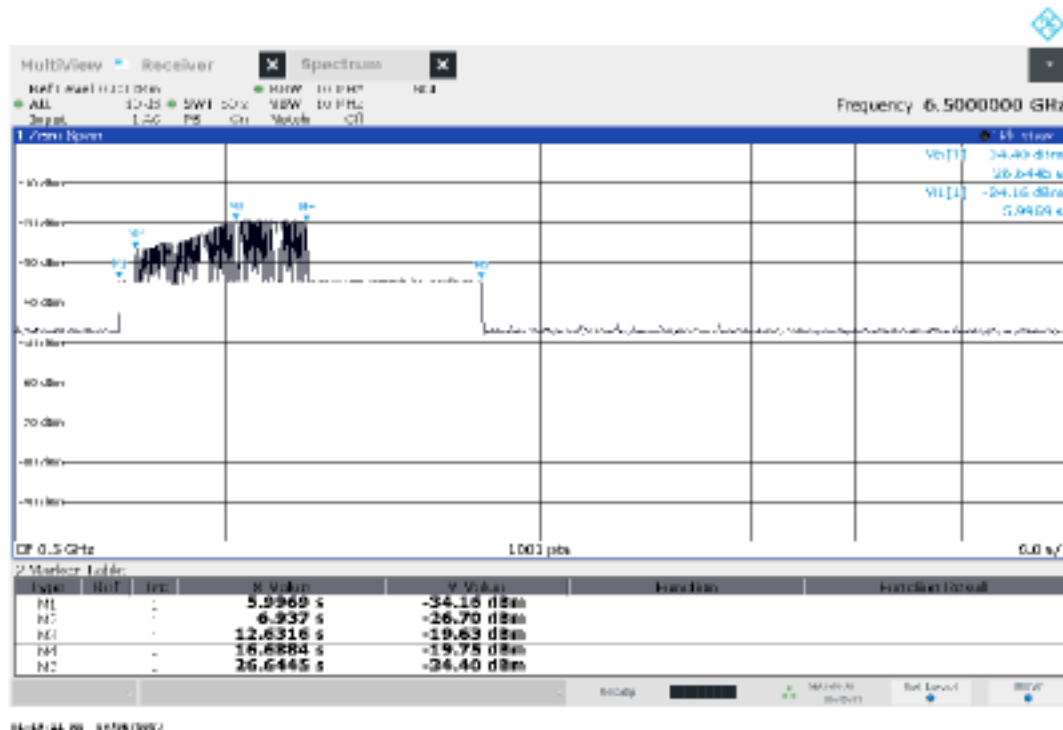
1.1 Measurement 1: No trigger signal -> EUT B is not transmitting.



1.2 Measurement 2: Trigger signal at M1. EUT B starts to transmit at M1. No movement. -> AE 1 is not responding. EUT B stops to transmit at D2.

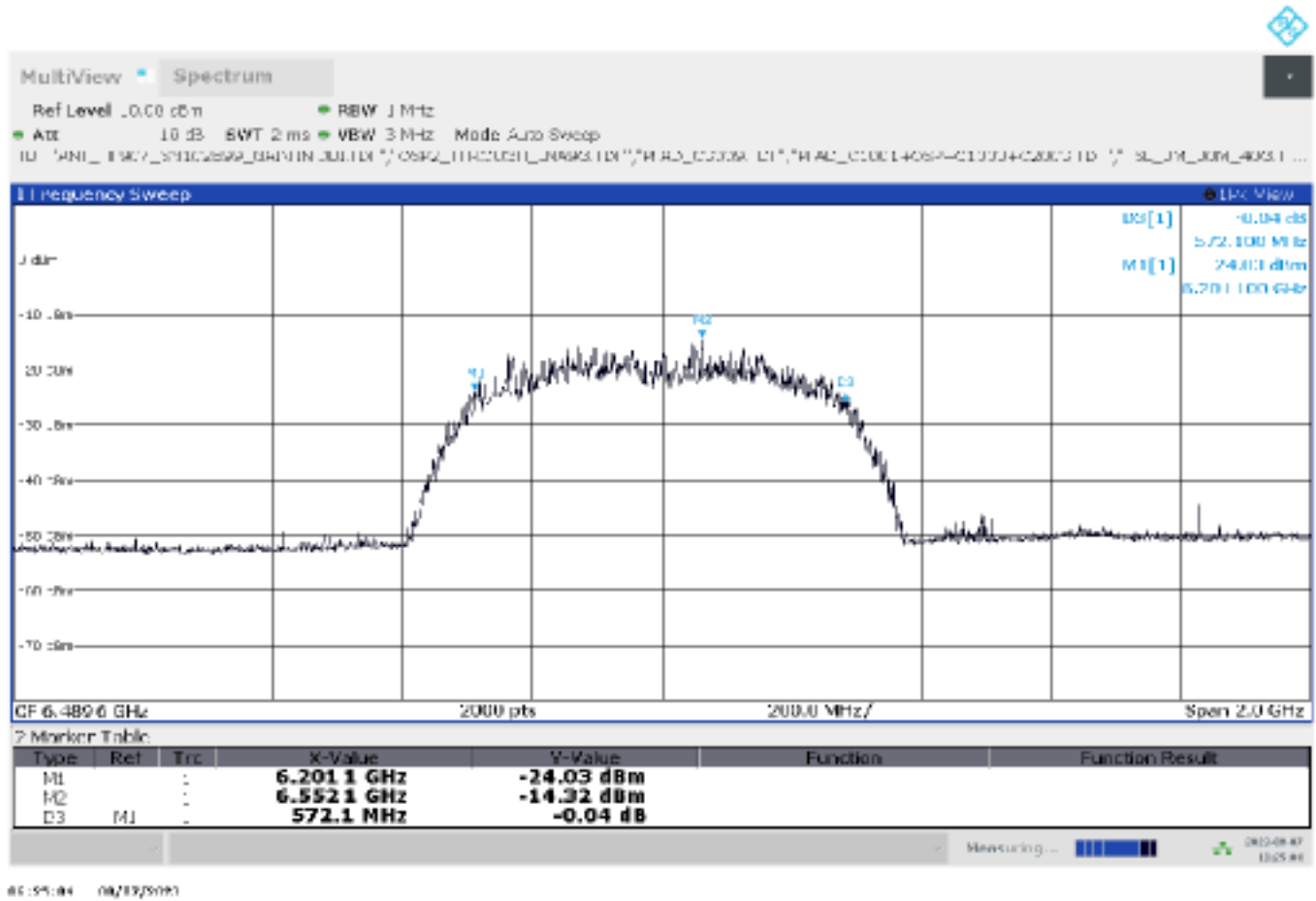


- 1.3 Measurement 3:** Trigger signal at M1. EUT B starts to transmit at M1. Movement from 0 s up to M3. -> AE 1 starts to transmit at M2 and stops at M4. EUT B stops to transmit at M5.



2 OCCUPIED BANDWIDTH

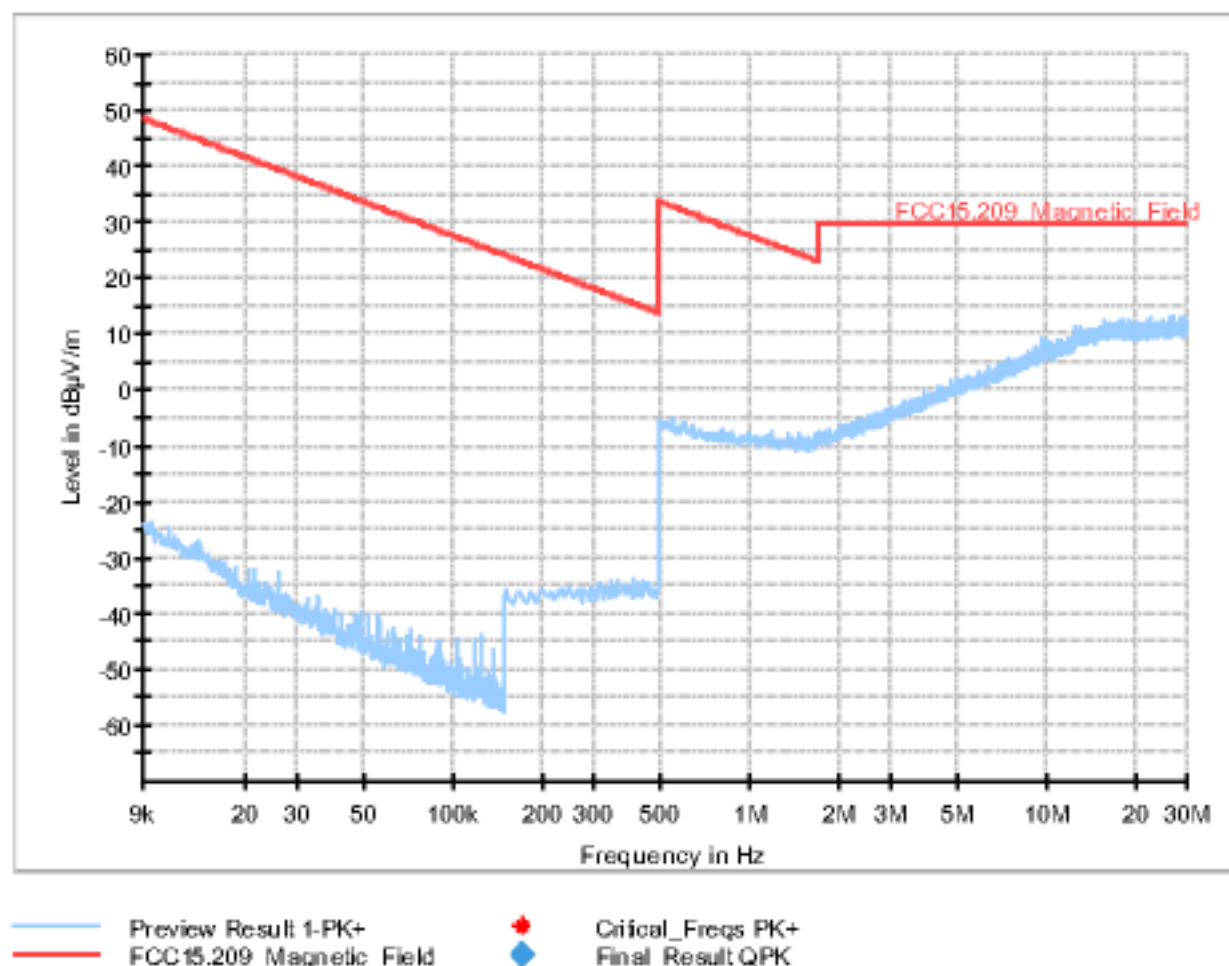
2.1 10 dB bandwidth, set-up 1, op. 1



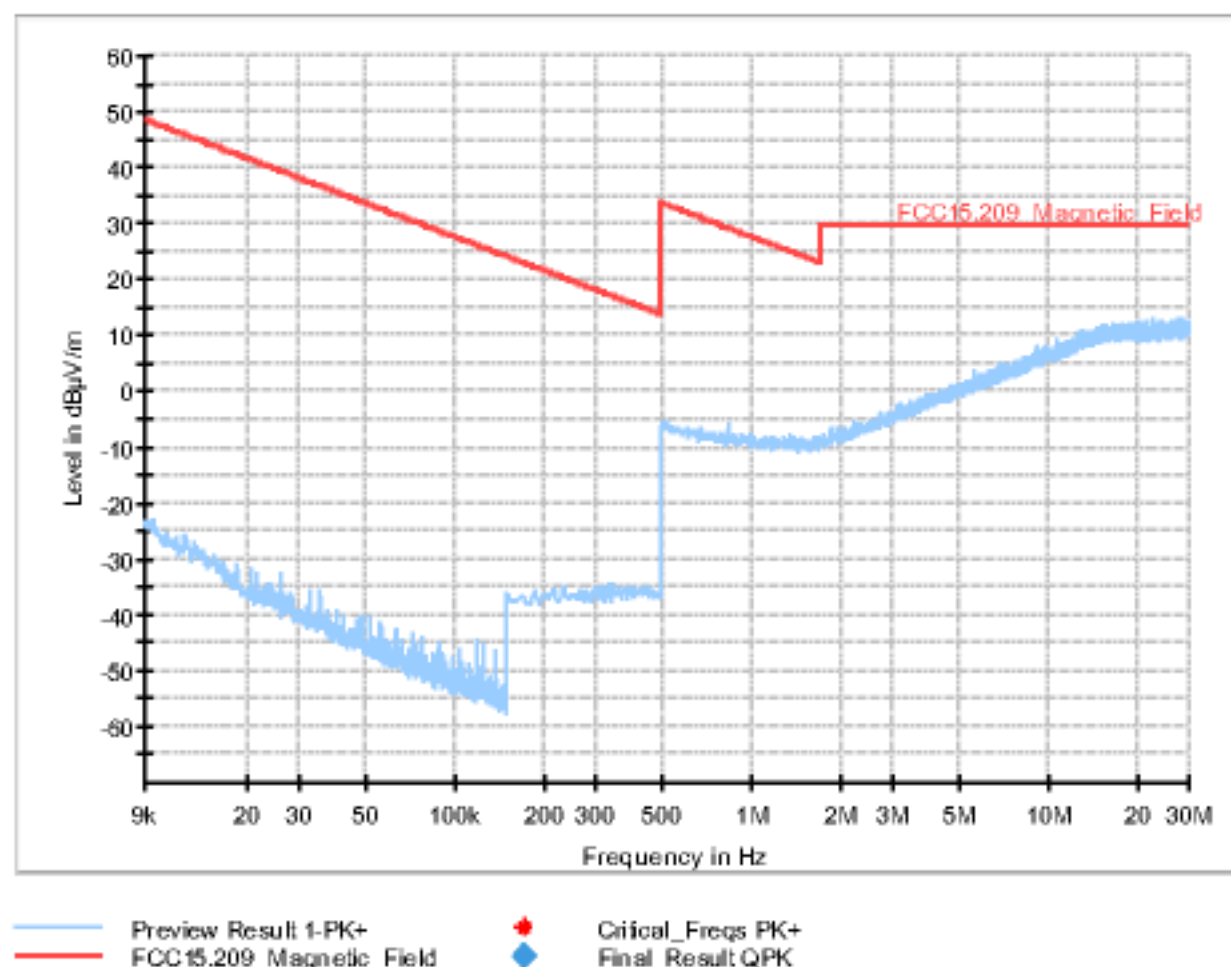
3 GENERAL LIMIT - RADIATED FIELD STRENGTH EMISSIONS, 9 kHz – 5 GHz

3.1 Radiated field strength measurements ($f < 30$ MHz)

3.1.1 Set-up 1, 9 kHz – 30 MHz, Op. 1, EUTs lying

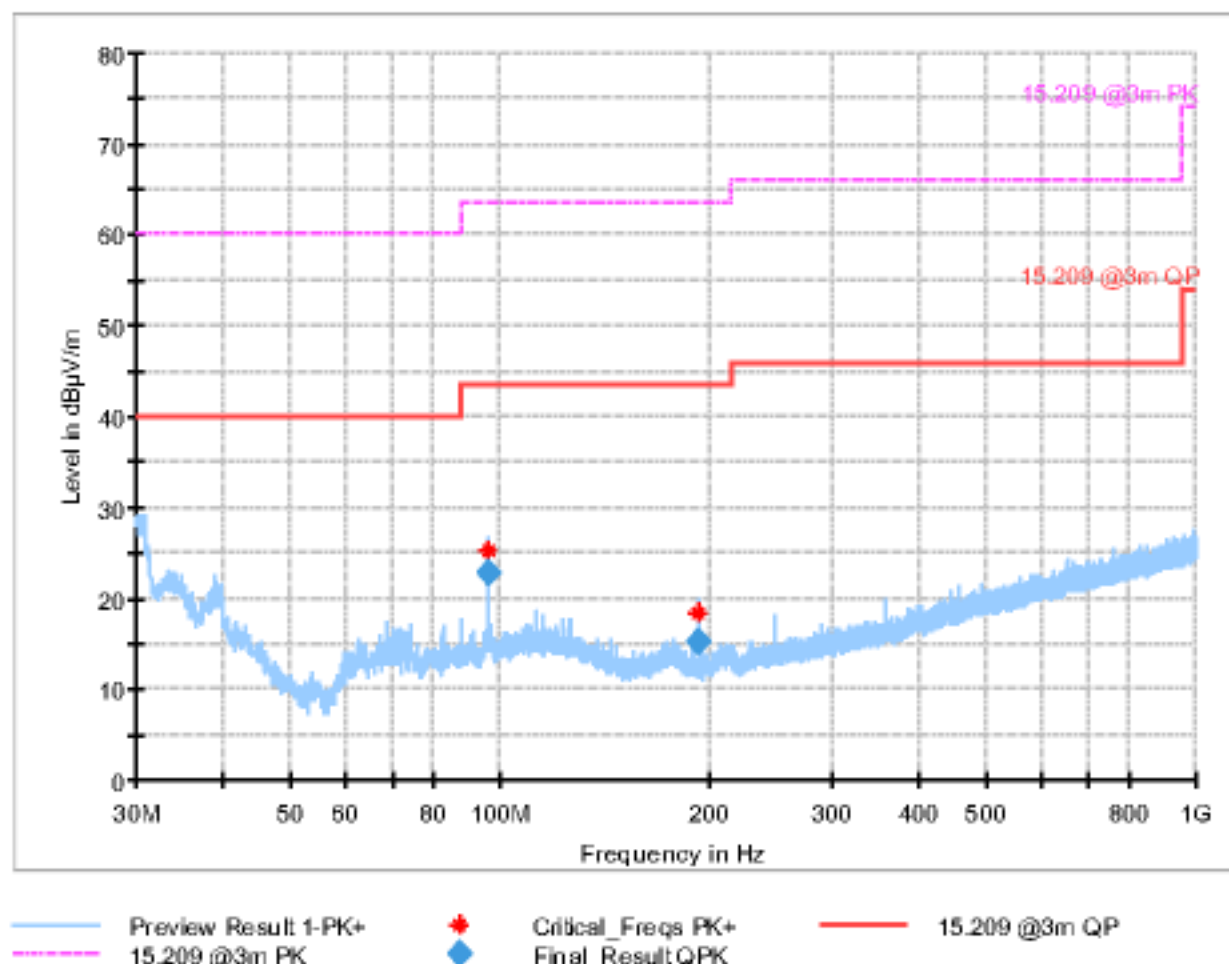


3.1.2 Set-up 1, 9 kHz – 30 MHz, Op. 1, EUTs staying



3.2 Radiated field strength measurements (30 MHz < f < 1000 MHz)

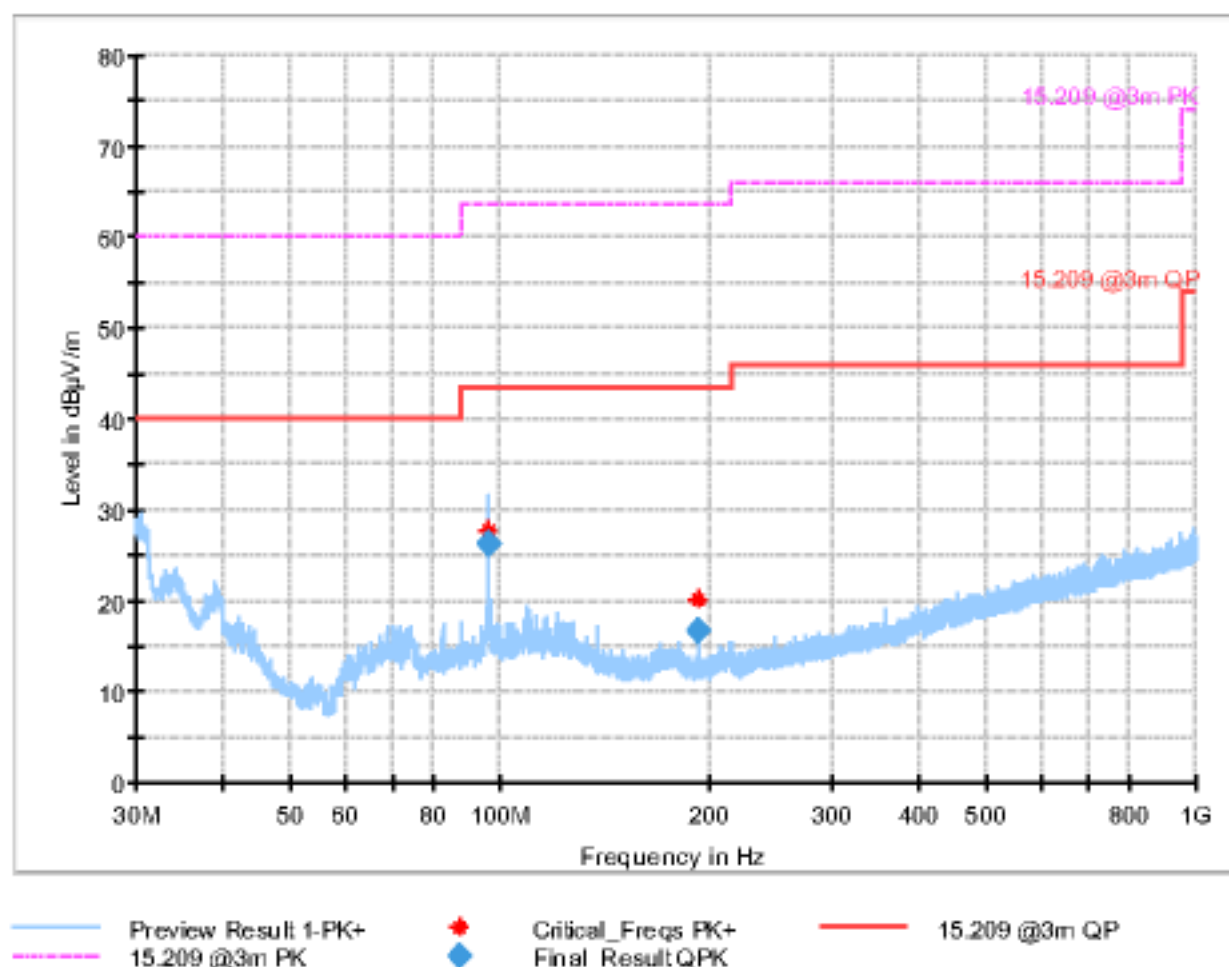
3.2.1 Lying, Set-up 1, Op. 1



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
95.400000	22.79	43.50	20.71	100.0	120.000	104.0	V	30.0
193.225000	15.18	43.50	28.32	100.0	120.000	100.0	V	60.0

3.2.2 Staying, Set-up 1, Op. 1



Final Result

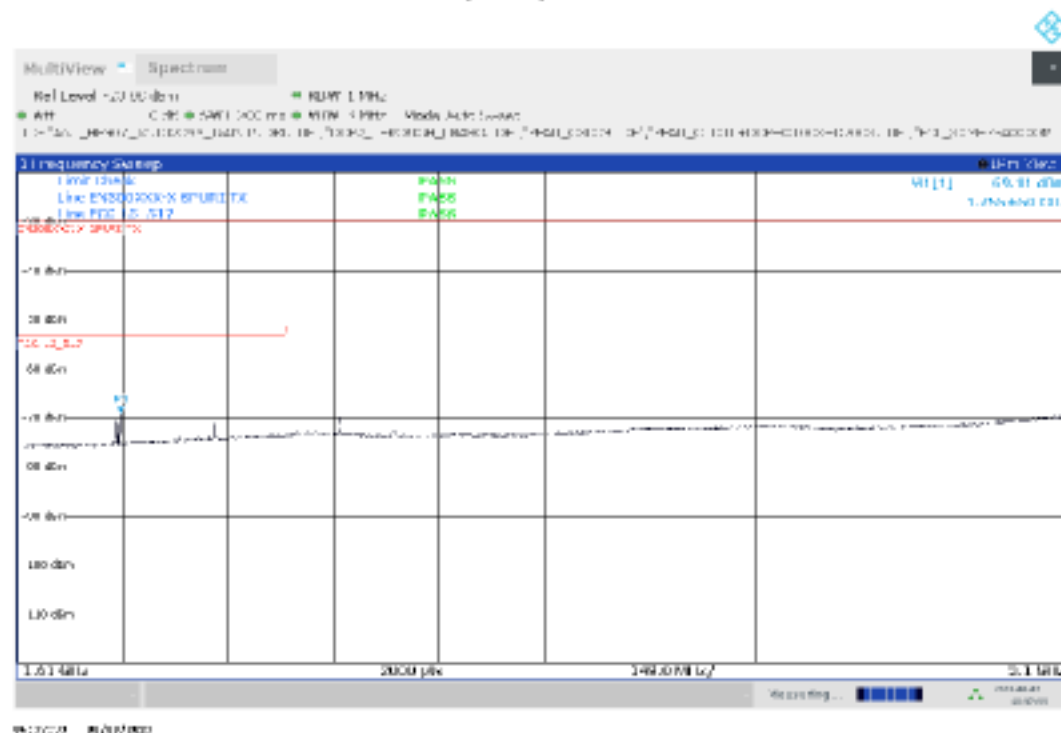
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
96.375000	26.16	43.50	17.34	100.0	120.000	115.0	V	198.0
193.200000	16.63	43.50	26.87	100.0	120.000	100.0	V	66.0

3.3 Radiated field strength measurements ($1\text{ GHz} < f < 40\text{ GHz}$)

3.3.1 960 MHz – 1610 MHz, Set-up 1, Op. 1

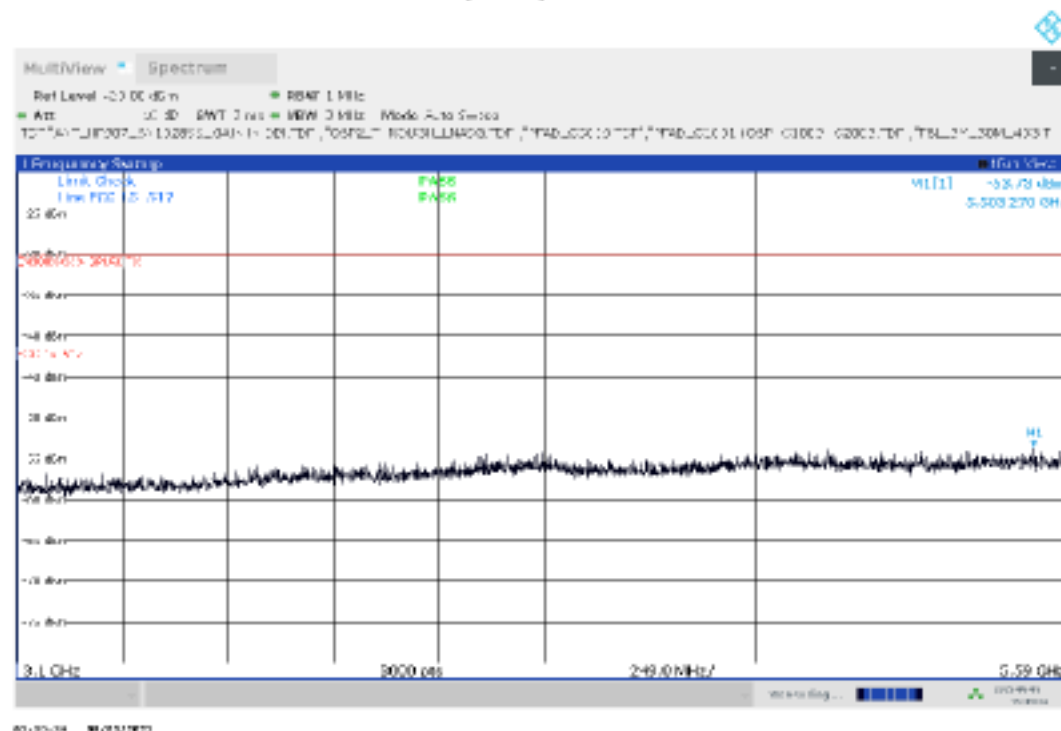


3.3.2 1610 MHz – 3100 MHz, Set-up 1, Op. 1



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3.3.3 3100 MHz – 5590 MHz, Set-up 1, Op. 1

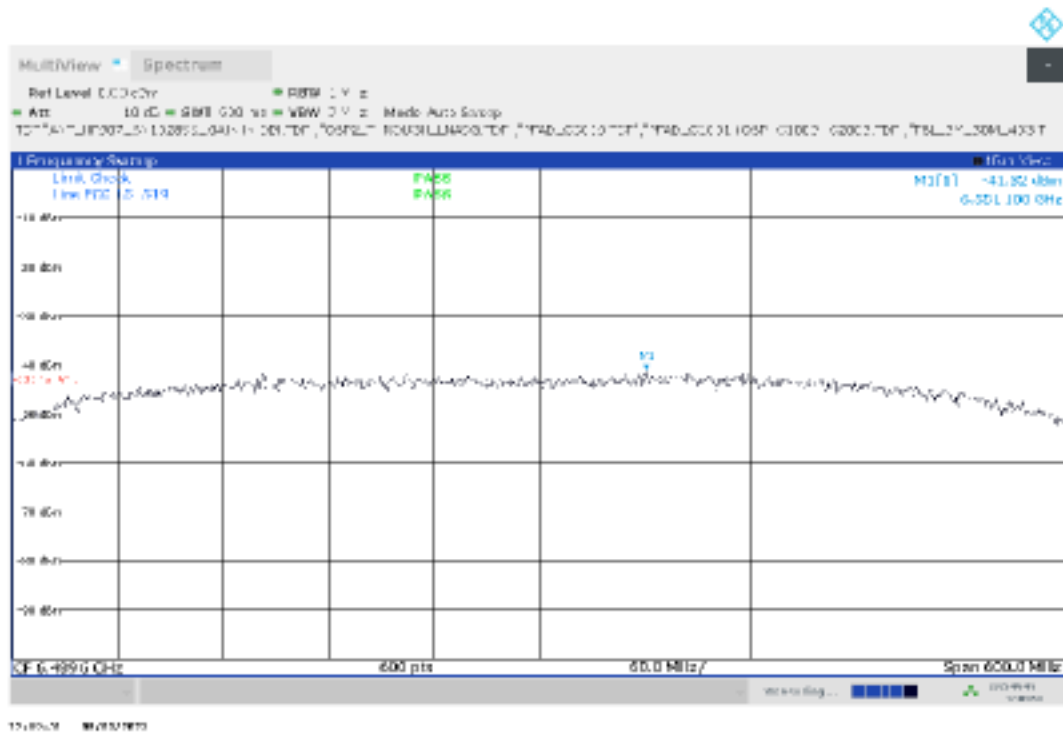


3.3.4 5590 MHz – 6190 MHz, Set-up 1, Op. 1

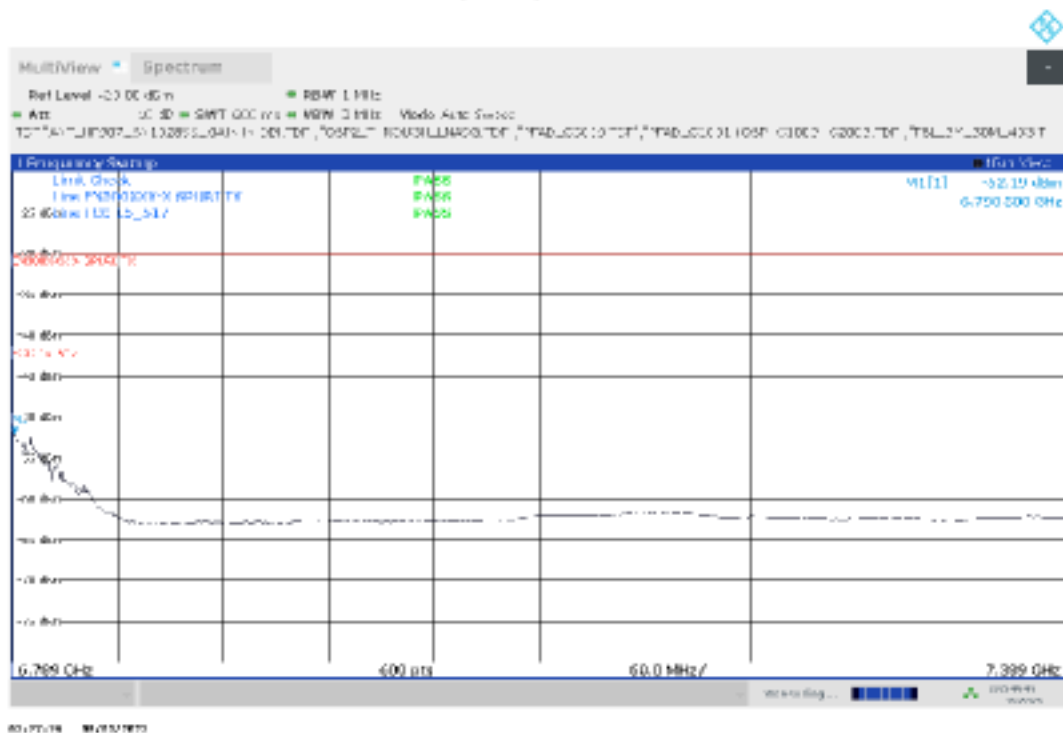


Annex A of TR no.: 23058741-34055-1

3.3.5 $f_c=6489.6$, span = 600 MHz, pts = 600, swt = 600 ms, Set-up 1, Op. 1

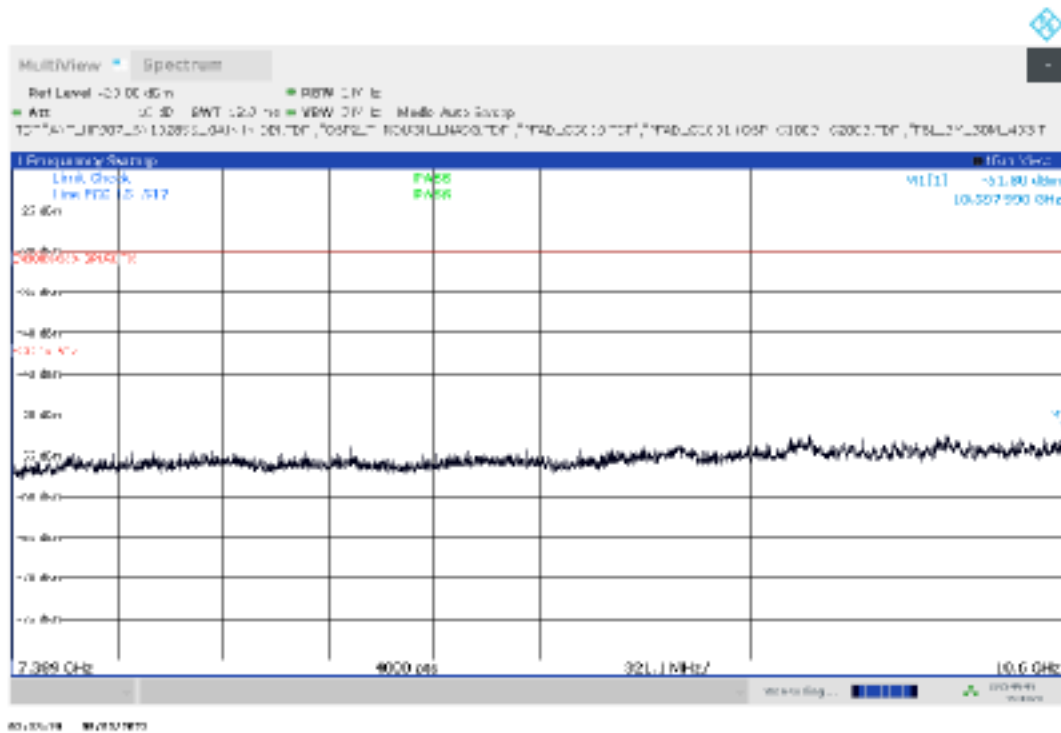


3.3.6 6789 MHz – 7389 MHz, Set-up 1, Op. 1



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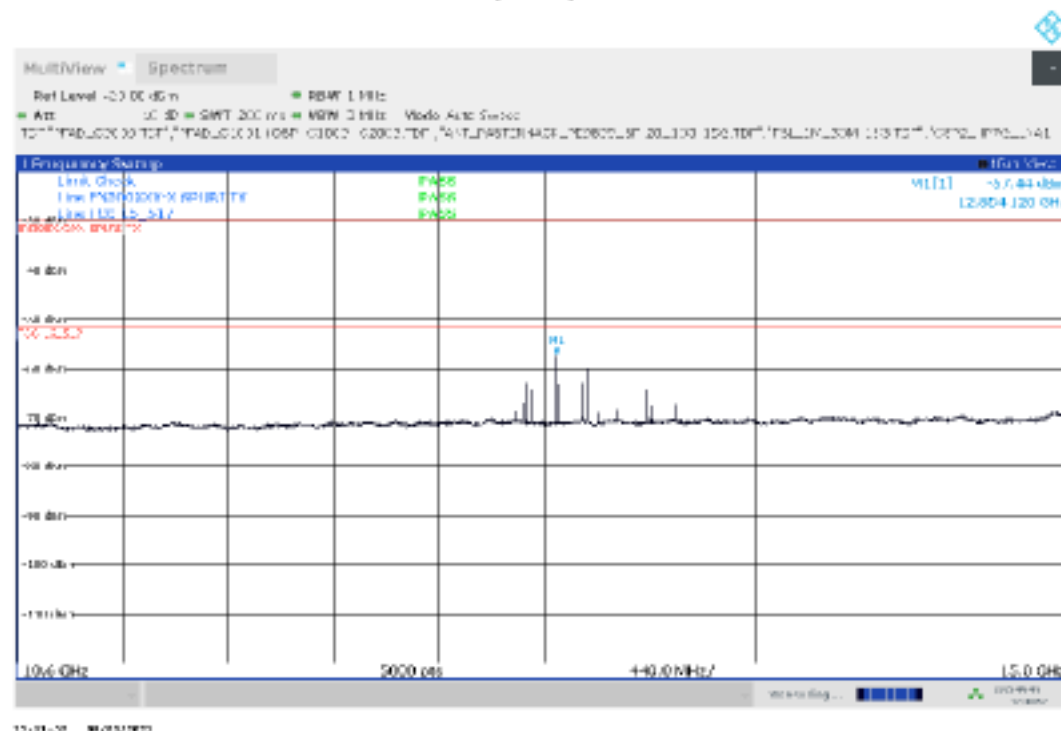
3.3.7 7389 MHz – 10600 MHz, Set-up 1, Op. 1



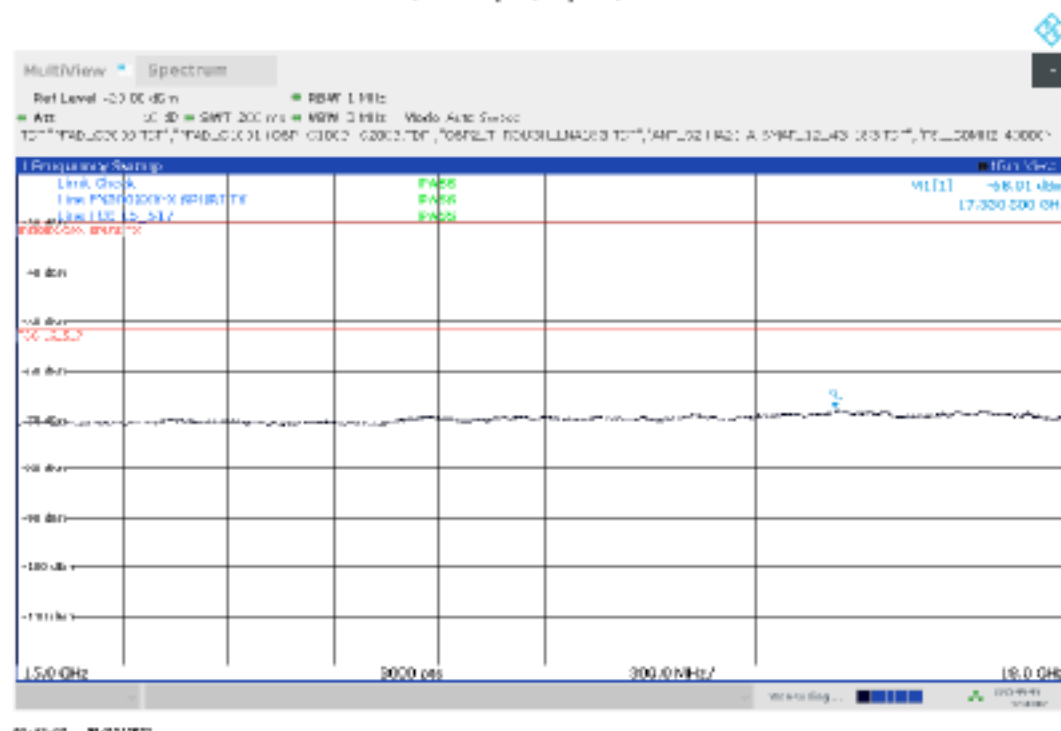
3.3.8 10600 MHz – 15000 MHz, Set-up 1, Op. 1, ANT HOR



3.3.9 10600 MHz – 15000 MHz, Set-up 1, Op. 1, ANT VER

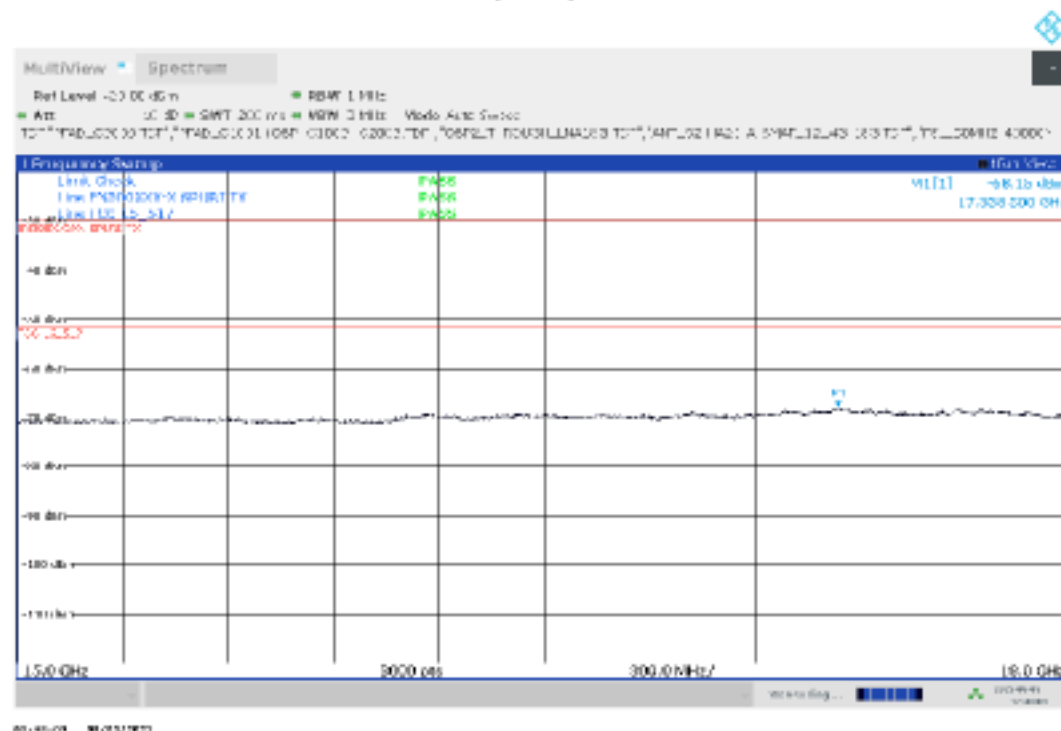


3.3.10 15000 MHz – 18000 MHz, Set-up 1, Op. 1, ANT HOR

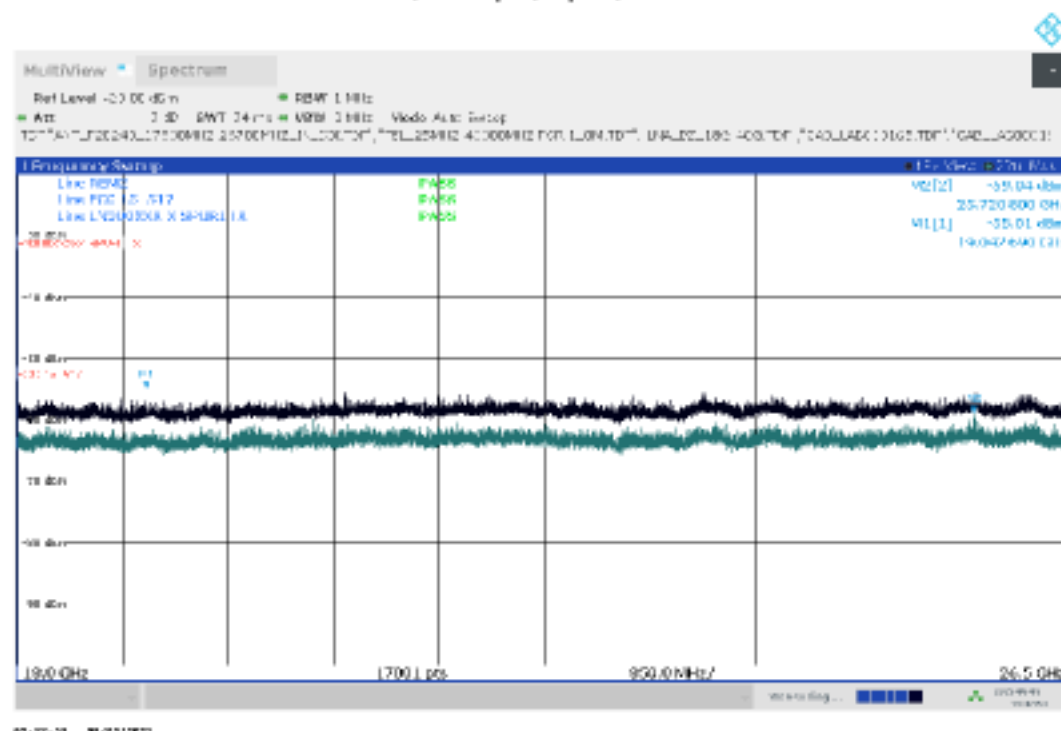


Annex A of TR no.: 23058741-34055-1

3.3.11 15000 MHz – 18000 MHz, Set-up 1, Op. 1, ANT VER

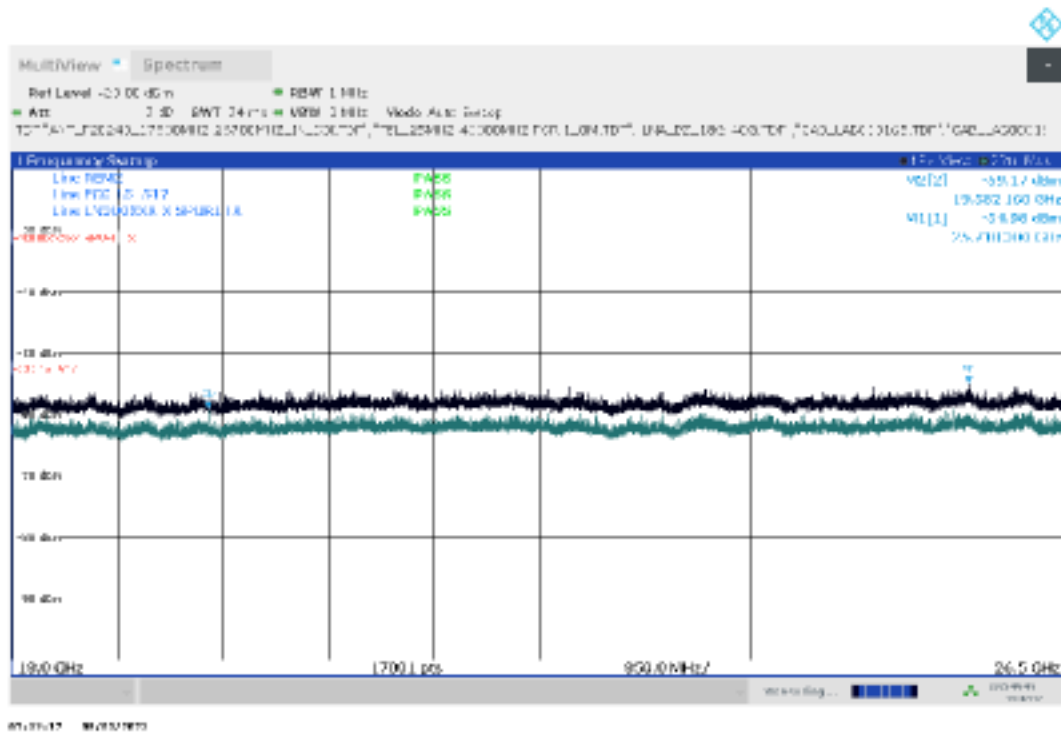


3.3.12 18000 MHz – 26500 MHz, Set-up 1, Op. 1, ANT HOR

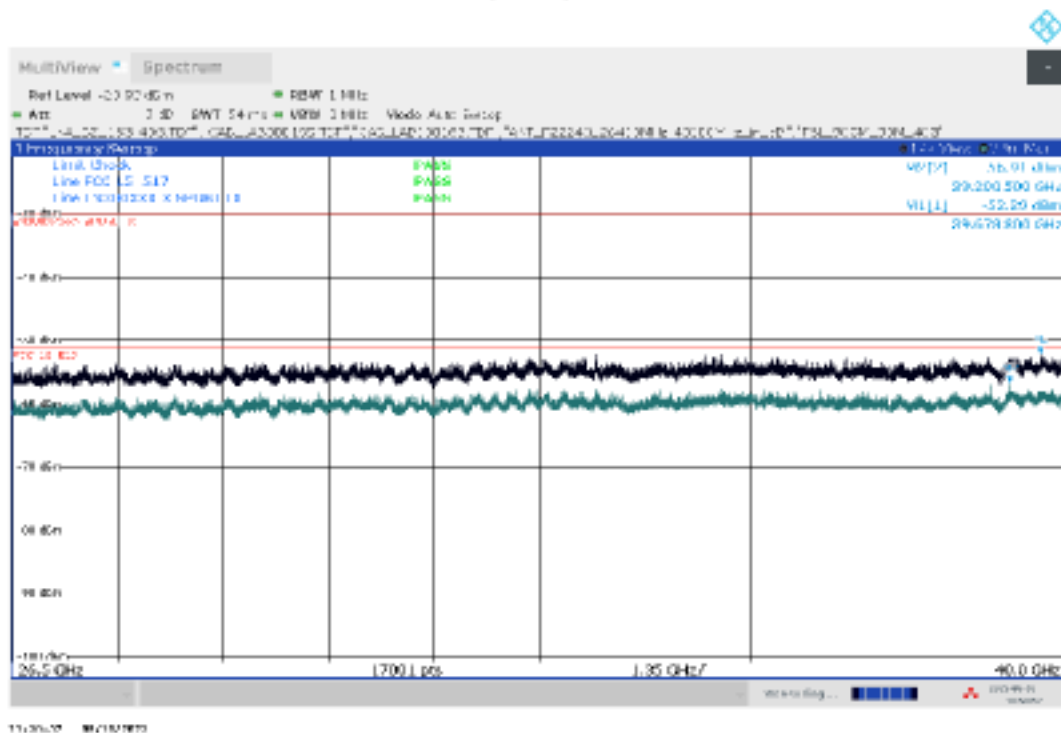


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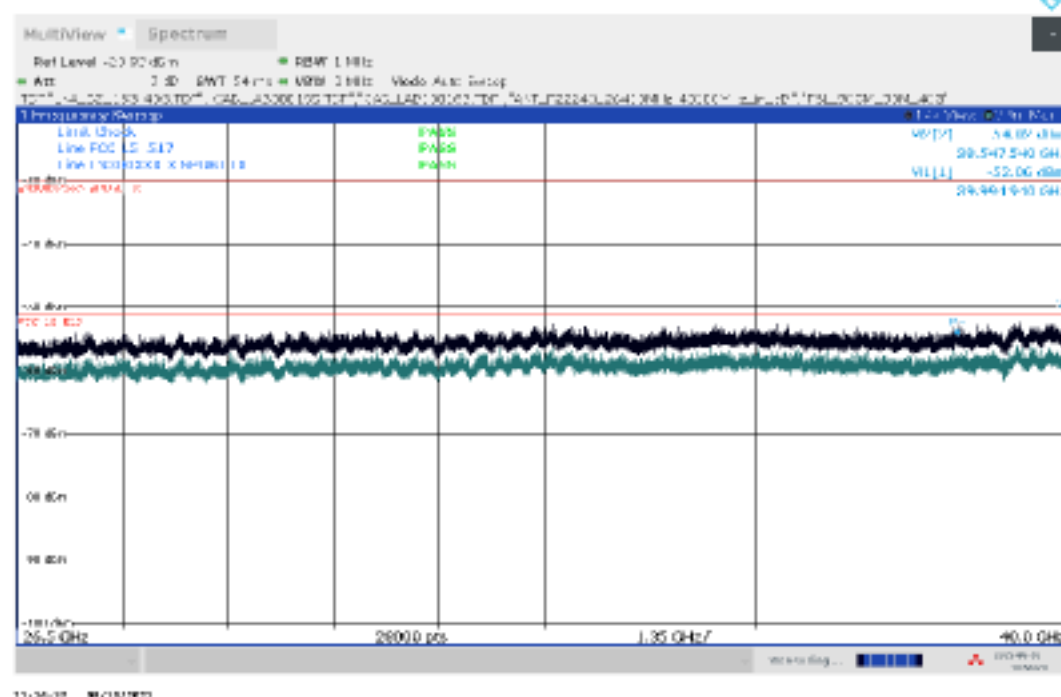
3.3.13 18000 MHz – 26500 MHz, Set-up 1, Op. 1, ANT VER



3.3.14 26500 MHz – 40000 MHz, Set-up 1, Op. 1, ANT HOR

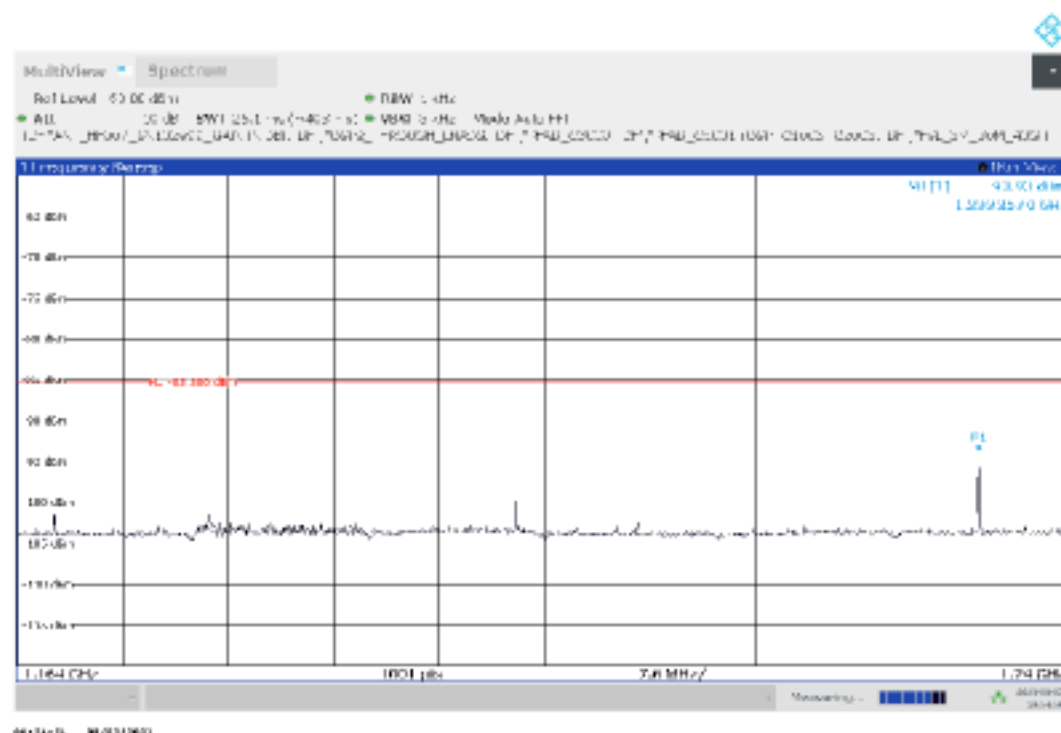


3.3.15 26500 MHz – 40000 MHz, Set-up 1, Op. 1, ANT VER

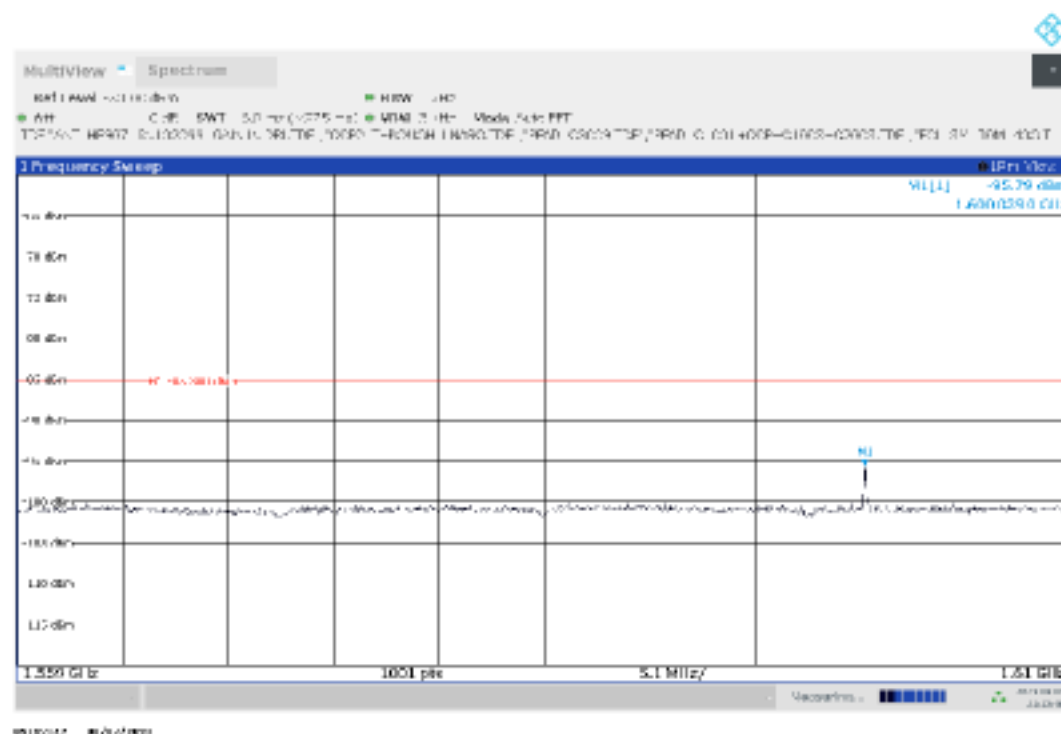


4 FUNDAMENTAL EMISSIONS IN THE GPS BAND

4.1 Frequency range 1164 MHz – 1240 MHz, Set-up 1, Op. 1

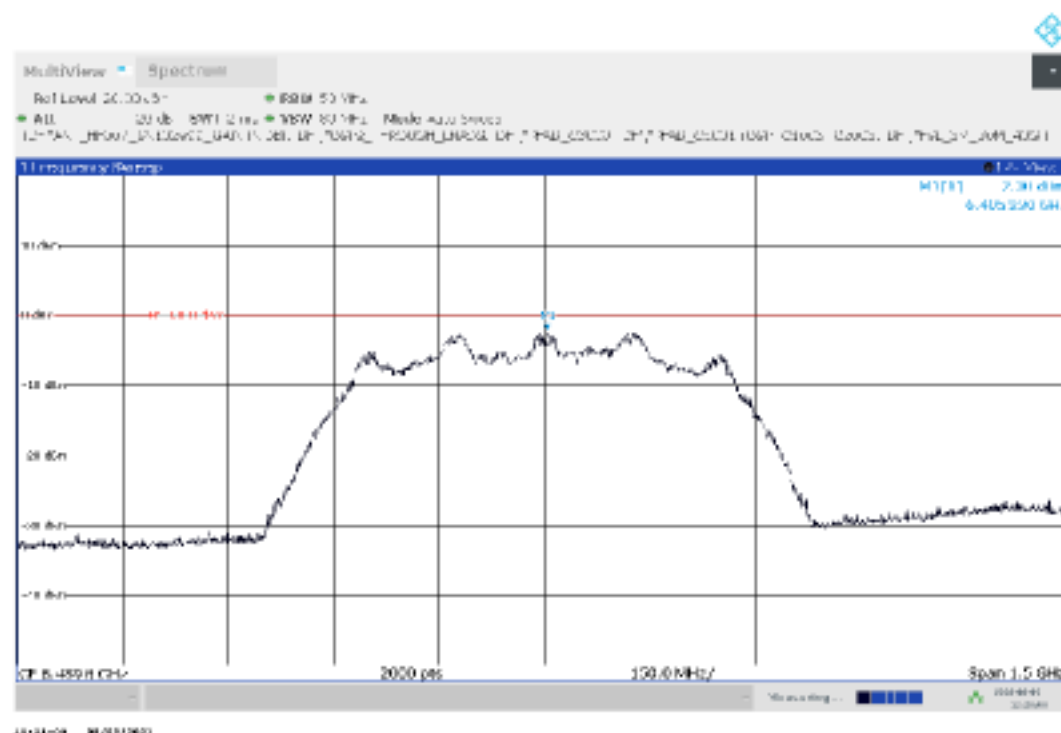


4.2 Frequency range 1559 MHz – 1610 MHz, Set-up 1, Op. 1



5 FUNDAMENTAL EMISSION PEAK POWER

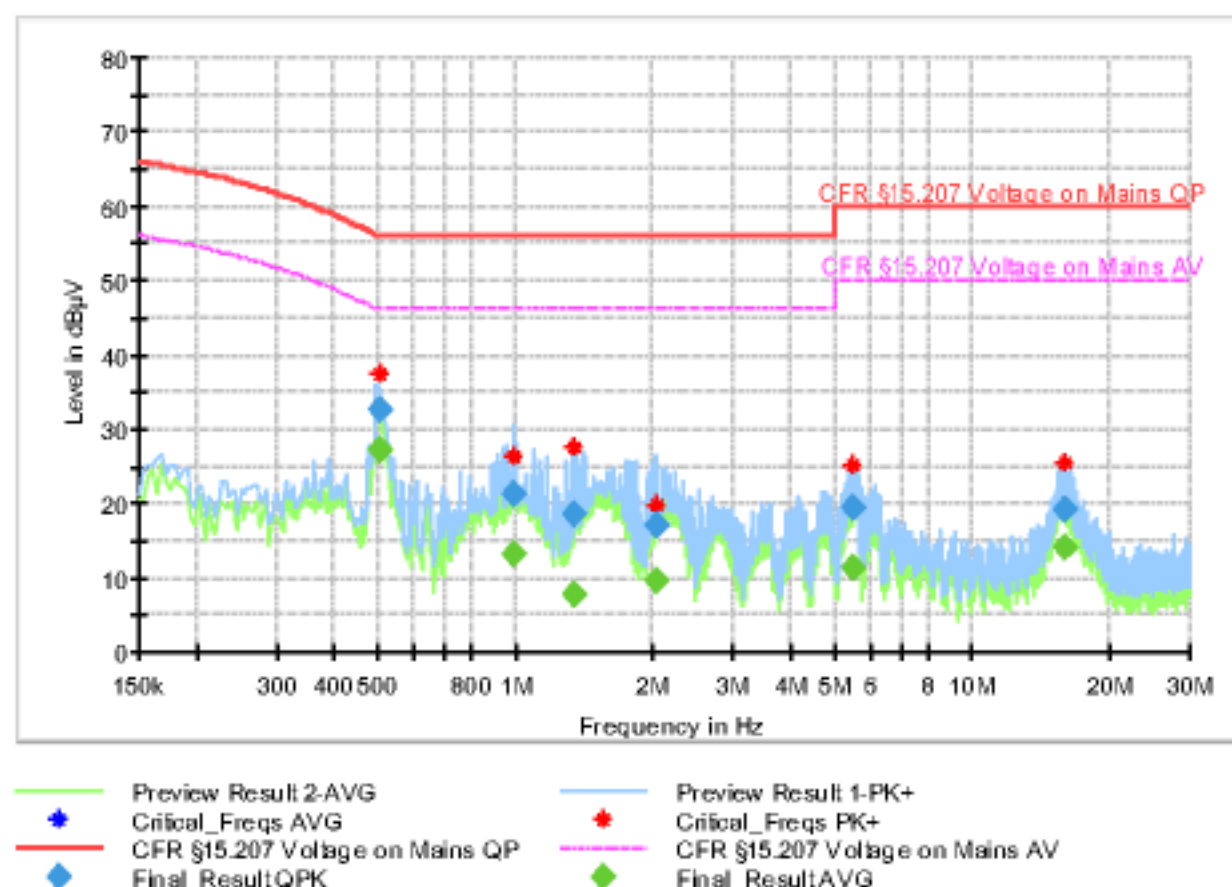
5.1 Set-up 1, Op. 1



6 Conducted emissions

6.1 Set-up 1, Op. 1, L1

Full Spectrum

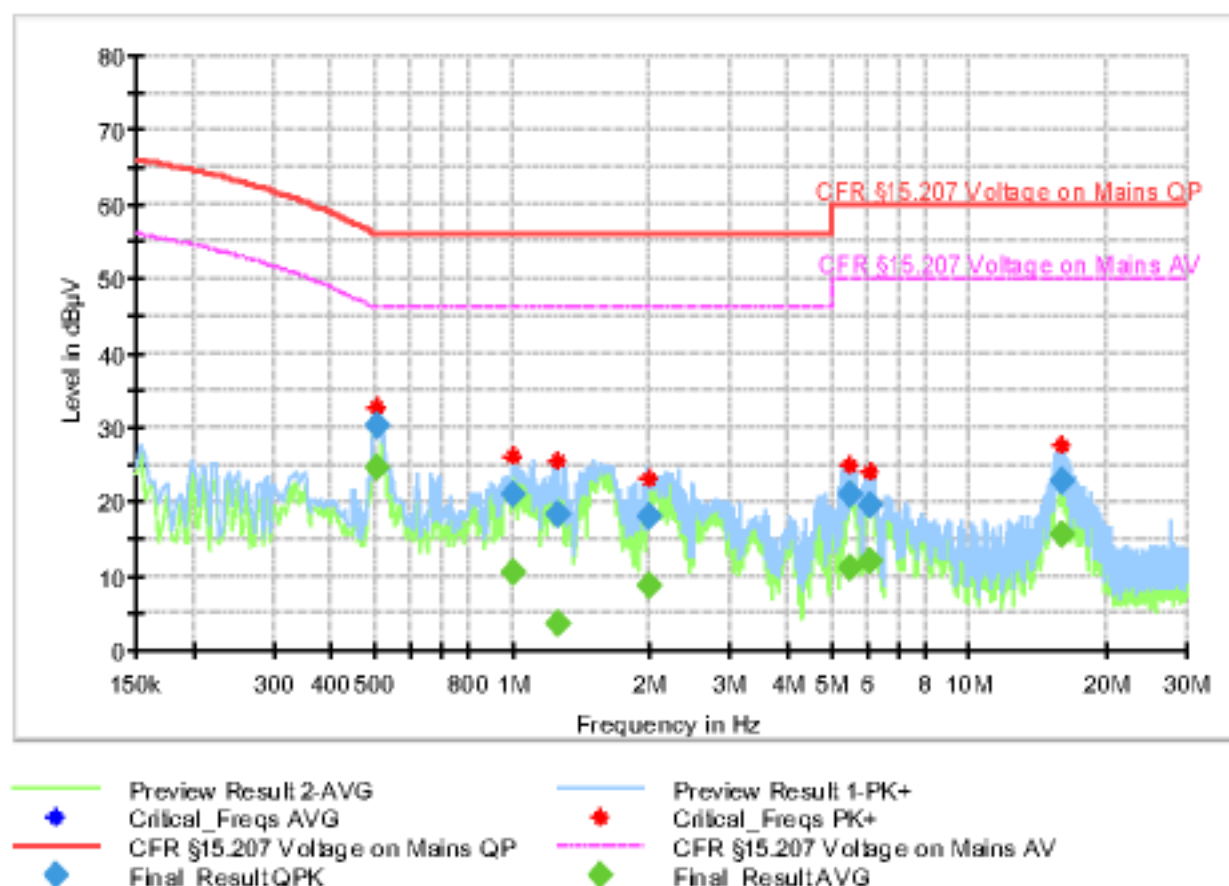


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Mess. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.504237	---	27.19	46.00	18.81	15000.0	9.000	L1	10.1
0.904237	32.67	---	56.00	23.33	15000.0	9.000	L1	10.1
0.996762	---	13.06	46.00	32.94	15000.0	9.000	L1	9.9
0.996762	21.15	---	56.00	34.85	15000.0	9.000	L1	9.9
1.341038	---	7.77	46.00	38.23	15000.0	9.000	L1	9.9
1.341038	18.68	---	56.00	37.32	15000.0	9.000	L1	9.9
2.030050	---	9.60	46.00	36.40	15000.0	9.000	L1	9.9
2.030050	17.03	---	56.00	38.97	15000.0	9.000	L1	9.9
5.500381	---	11.28	50.00	38.72	15000.0	9.000	L1	10.0
5.500381	19.58	---	60.00	40.42	15000.0	9.000	L1	10.0
15.891375	---	14.05	50.00	35.95	15000.0	9.000	L1	10.4
15.891375	19.14	---	60.00	40.86	15000.0	9.000	L1	10.4

6.2 Set-up 1, Op. 1, N

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Mess. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.505237	---	24.67	46.00	21.33	15000.0	9.000	N	10.1
0.505237	30.28	---	56.00	25.72	15000.0	9.000	N	10.1
1.004225	---	10.57	46.00	35.43	15000.0	9.000	N	9.9
1.004225	21.05	---	56.00	34.95	15000.0	9.000	N	9.9
1.261681	---	3.70	46.00	42.30	15000.0	9.000	N	9.9
1.261681	18.20	---	56.00	37.80	15000.0	9.000	N	9.9
1.986544	---	8.60	46.00	37.40	15000.0	9.000	N	9.9
1.986544	17.94	---	56.00	38.06	15000.0	9.000	N	9.9
5.493919	---	11.19	50.00	38.81	15000.0	9.000	N	10.0
5.493919	20.83	---	60.00	39.17	15000.0	9.000	N	10.0
6.079725	---	12.11	50.00	37.89	15000.0	9.000	N	10.0
6.079725	19.34	---	60.00	40.66	15000.0	9.000	N	10.0
15.936688	---	15.57	50.00	34.43	15000.0	9.000	N	10.4
15.936688	22.81	---	60.00	37.19	15000.0	9.000	N	10.4

Annex B

External photographs of EUT

part of / in addition to

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1. EUT external photographs

Photograph 1: EUT A, view 1



Photograph 2: EUT A, view 2



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Photograph 3: EUT B, view 1



Photograph 4: EUT B, view 2



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Photograph 5: AE 1, view 1

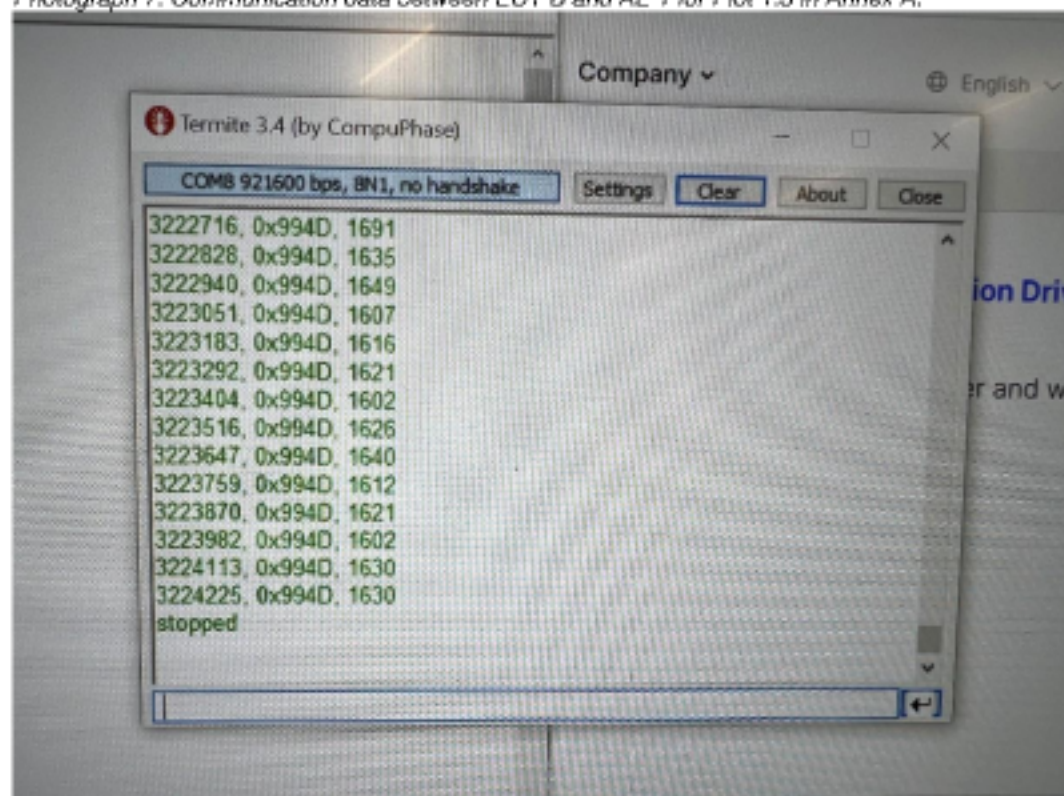


Photograph 6: AE 1, view 2



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Photograph 7: Communication data between EUT B and AE 1 for Plot 1.3 in Annex A.



Annex C

Test setup photographs

part of / in addition to

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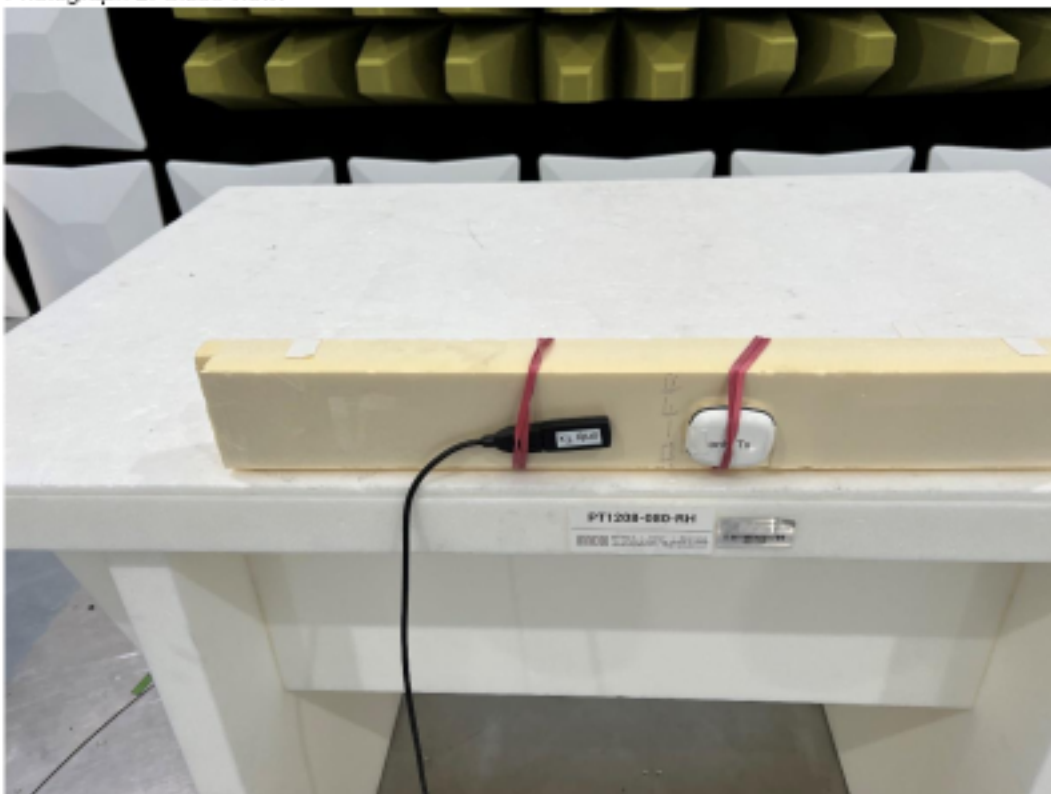
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2. Measurements in frequency range $30 \text{ MHz} < f < 1000 \text{ MHz}$	4
3. Measurements in frequency range $1 \text{ GHz} < f < 40 \text{ GHz}$	5
4. Conducted emissions	6
5. Indoor operation.....	9

1. Measurements in frequency range $f < 30$ MHz

Photograph 1: Overall view.



Photograph 2: Close view.

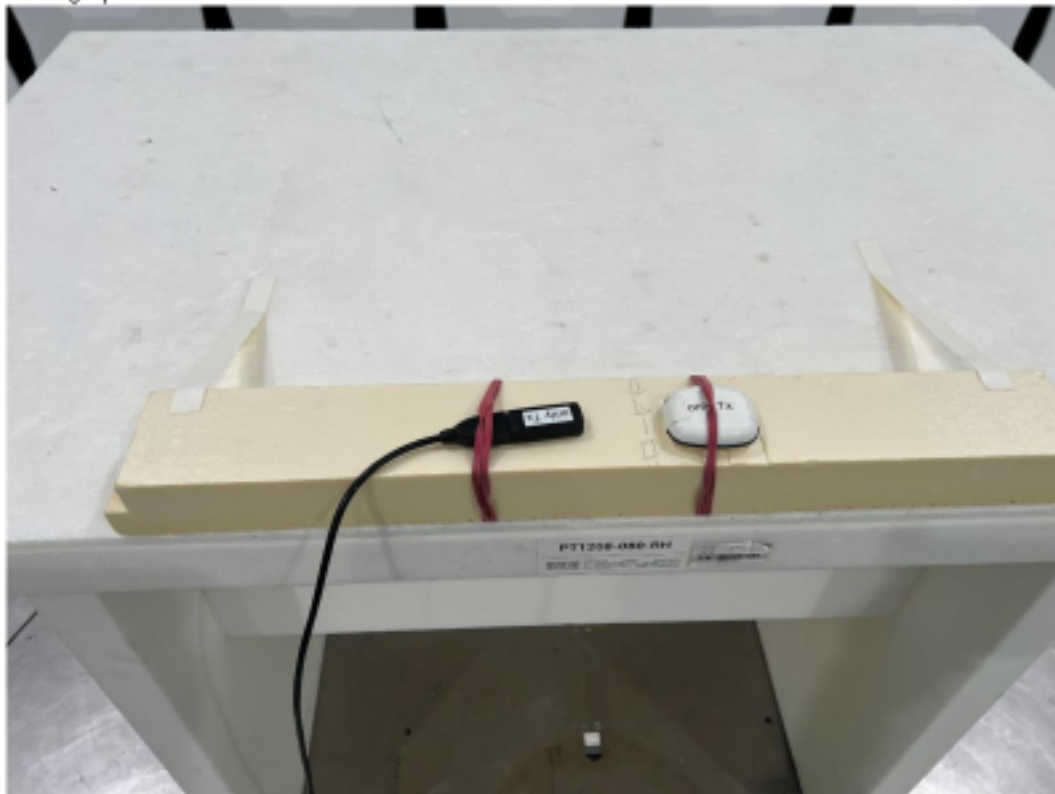


2. Measurements in frequency range $30 \text{ MHz} < f < 1000 \text{ MHz}$

Photograph 3: Overall view.

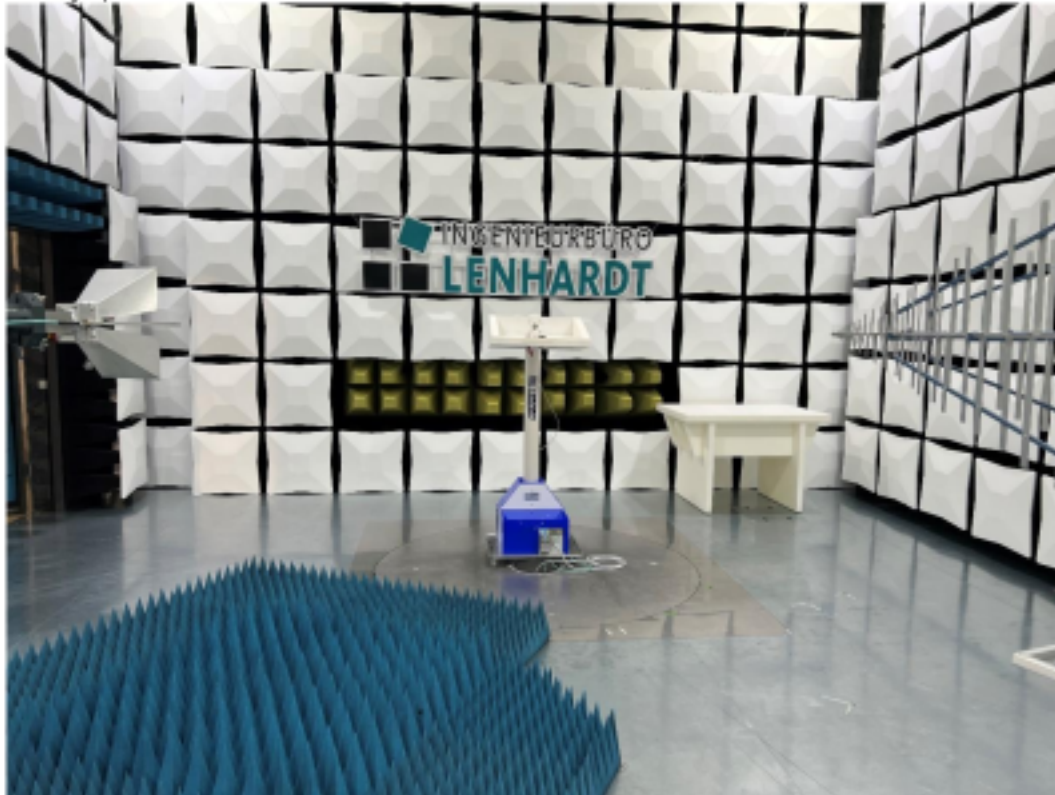


Photograph 4: Close view 1.

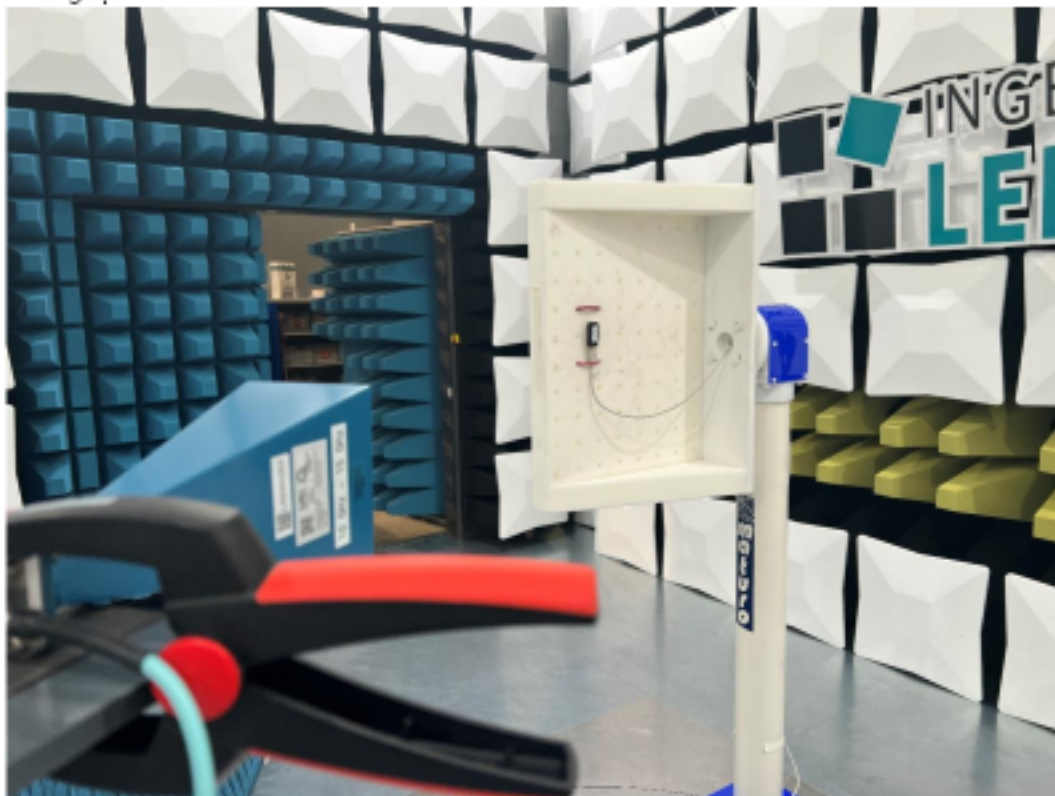


3. Measurements in frequency range $1 \text{ GHz} < f < 40 \text{ GHz}$

Photograph 5: Overall view 1.

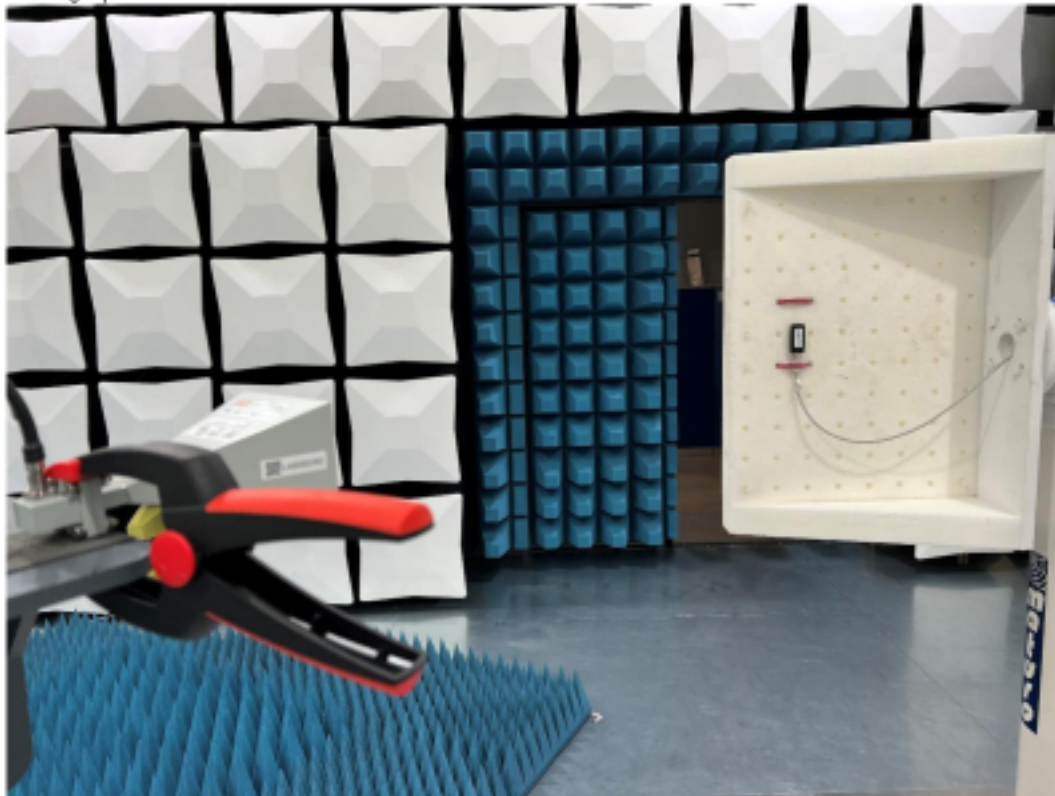


Photograph 6: Overall view 2.



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Photograph 7: Overall view 3.

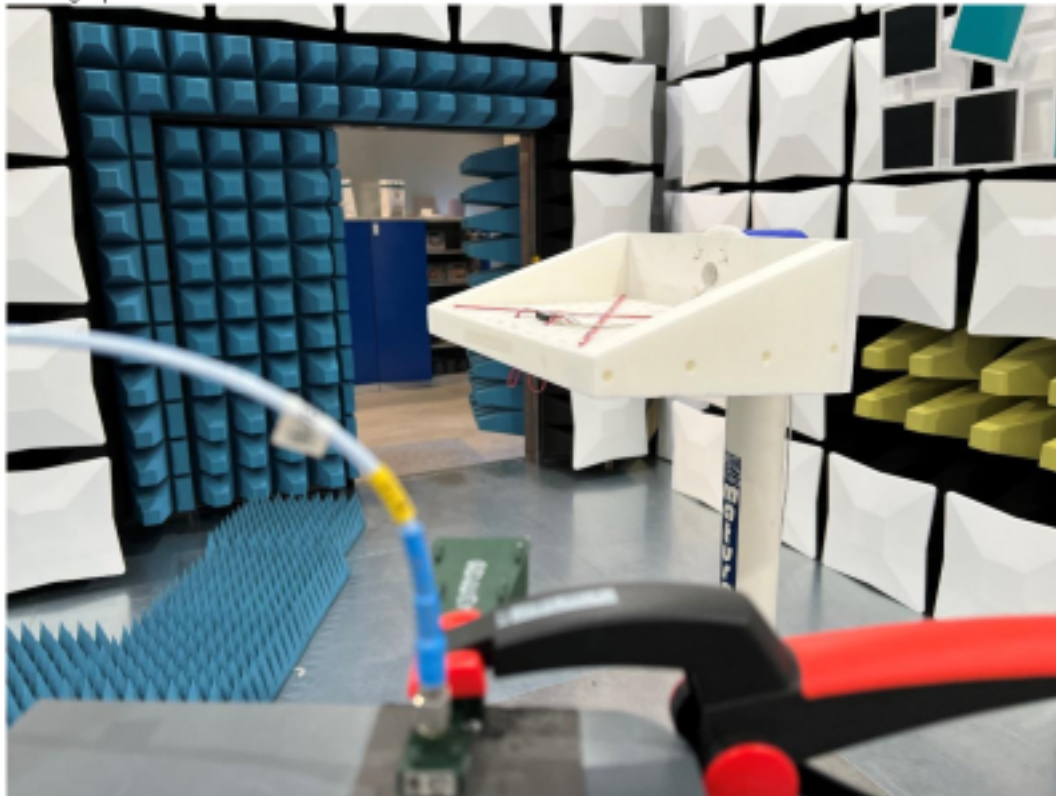


Photograph 8: Overall view 4.



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Photograph 9: Overall view 5.



Photograph 10: Close view.

