Annex 201: Measurement diagrams 22-1-0057101T021-TR1-A201-R01

Number of pages:	32	**Date of Report:**	2024-Jul-09
Testing company:	cetecom advanced GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	**Applicant:**	Zigpos GmbH
Product:	**RTLS anchor**		
Model:	**CorivaSat**		
FCC ID:	2AHHJ-ZP-OXSAT1	**IC:**	32087-ZPOXSAT1
Contains FCC-ID:	Z64-CC3135MOD	**Contains IC:**	451I-CC3135MOD

Testing has been carried out in accordance with:

FCC Regulations
Title 47 CFR, Chapter I, Subchapter A, Part 15
Subpart C Intentional Radiators
§ 15.203 Antenna requirement
§ 15.205 Restricted bands of operation.
§ 15.209 Radiated emission limits; general requirements
Subpart F Ultra-Wideband Operation
§ 15.517 Technical requirements for indoor UWB systems
§ 15.521 Technical requirements applicable to all UWB devices

ISED-Regulations
Radio Standards Specifications
RSS-Gen, Issue 5
General Requirements for Compliance of Radio Apparatus
RSS-220, Issue 1 + Amendment 1 (July 2018)
Devices Using Ultra-Wideband (UWB) Technology

Test technology UWB (RF-Path A)

Table of Contents

1 Measurement diagrams for RF-Path A

1.1 Magnetic field strength (9kHz ≤ f ≤ 150kHz)

Diagram 2.01

Common Information

Test description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test Site Location:	Ref.-Nr. 441 Semi Anechoic Chamber (SAC1) with 3 m measurement distance
Version of Testsoftware:	EMC32 V10.50.0
Distance correction:	used accord. table, pls. see test report
Technical Data:	Please see page 2 for detailed data of measurement setup
Rec. antenna (pre-scan):	height 1.00 m, parallel and 90° to EUT polarisation
Used filter:	bypass
Test Standard:	FCC 15.205 § 15.209; RSS-Gen: Issue 5
Operator:	LKnopp
Operating Mode:	UWB
Power during tests:	24V DC by Battery
Comment 1:	Antenna standing / RF-Path A
Comment 2:	
Environmental Conditions:	Humidity : 41%rH; Temperature: 21°C
EUT Setup:	1
Verdict:	Passed

EUT Information

PMT number:	22-1-00571S38_C01
Power supply:	24V DC

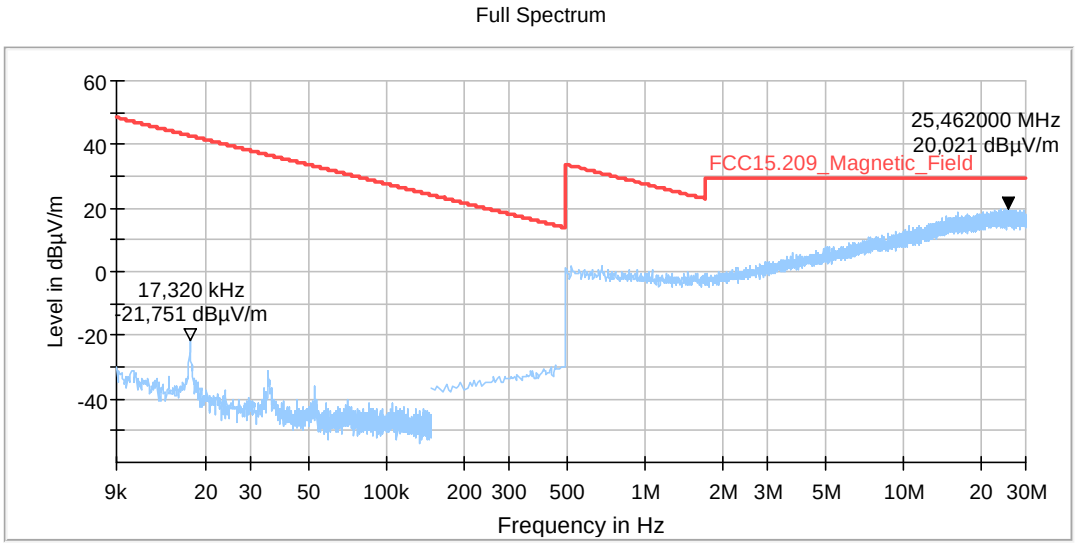


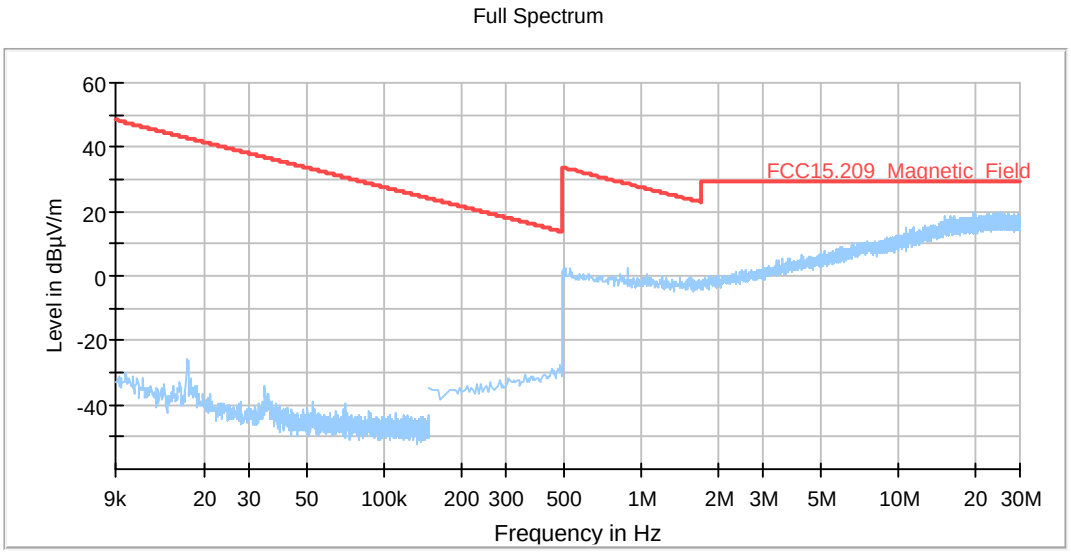
Diagram 2.02

Common Information

Test description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test Site Location:	Ref.-Nr. 441 Semi Anechoic Chamber (SAC1) with 3 m measurement distance CETECOM ADVANCED GmbH / Location Essen
Version of Testsoftware:	EMC32 V10.50.0
Distance correction:	used accord. table, pls. see test report
Technical Data:	Please see page 2 for detailed data of measurement setup
Rec. antenna (pre-scan):	height 1.00 m, parallel and 90° to EUT polarisation
Used filter:	bypass
Test Standard:	FCC 15.205 § 15.209; RSS-Gen: Issue 5
Operator:	LKnopp
Operating Mode:	TX-on
Power during tests:	24V DC Battery
Comment 1:	Antenna lying / RF-Path A
Comment 2:	
Environmental Conditions:	Humidity : 41%rH; Temperature: 21°C
EUT Setup:	1
Verdict:	Passed

EUT Information

PMT number:	22-1-00571S38_C01
Power supply:	24V DC

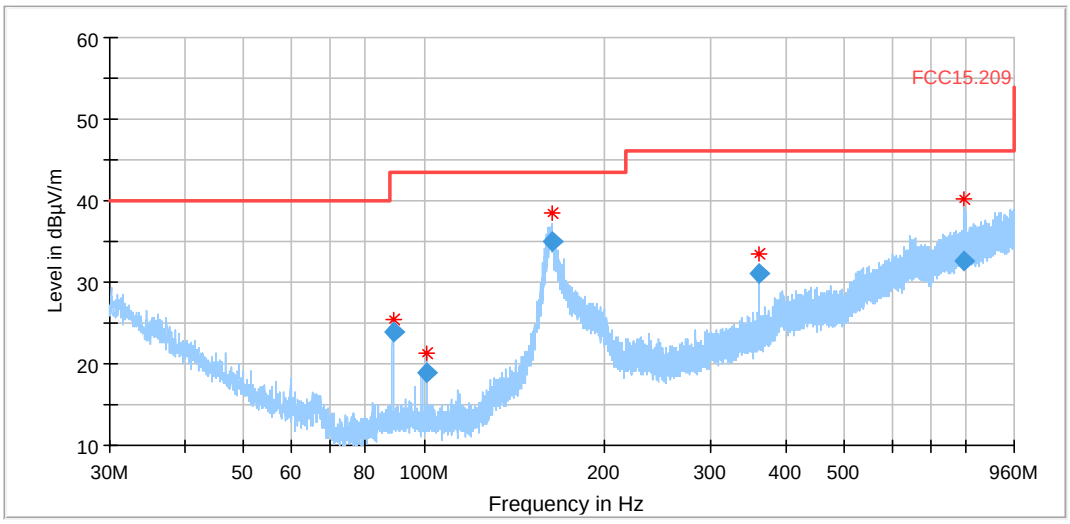


1.2 Electric field strength (30MHz < f < 960MHz)

Diagram 3.01

Common Information

Test Description:	Radiated field strength emission in 3m distance
Test Site:	Ref.-Nr. 441 Semi Anechoic Chamber (SAC1) with 3 m measurement distance CETECOM ADVANCED GmbH / Location Essen
Test Standard:	FCC 15.205&15.209 & RSS Gen. Issue 5
Antenna polarisation:	horizontal/vertical
Environmental Conditions:	Humidity : 41%rH; Temperature: 20°C
Operator Name:	LKnopp
EUT:	
Operating Mode:	UWB/ RF-Path A
Power supply:	24V DC
Comment:	Standing / RF-Path A
Verdict:	Passed



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)
88.790000	23.88	43.50	19.62	120.000	218.0	H	82.0	7.8	0.0	0.9
101.310000	18.95	43.50	24.55	120.000	105.0	V	354.0	7.7	0.0	0.9
163.310000	34.94	43.50	8.56	120.000	130.0	H	98.0	9.3	0.0	1.3
359.990000	31.13	46.00	14.87	120.000	100.0	H	0.0	16.5	0.0	2.0
793.510000	32.54	46.00	13.46	120.000	221.0	H	97.0	25.6	0.0	3.1

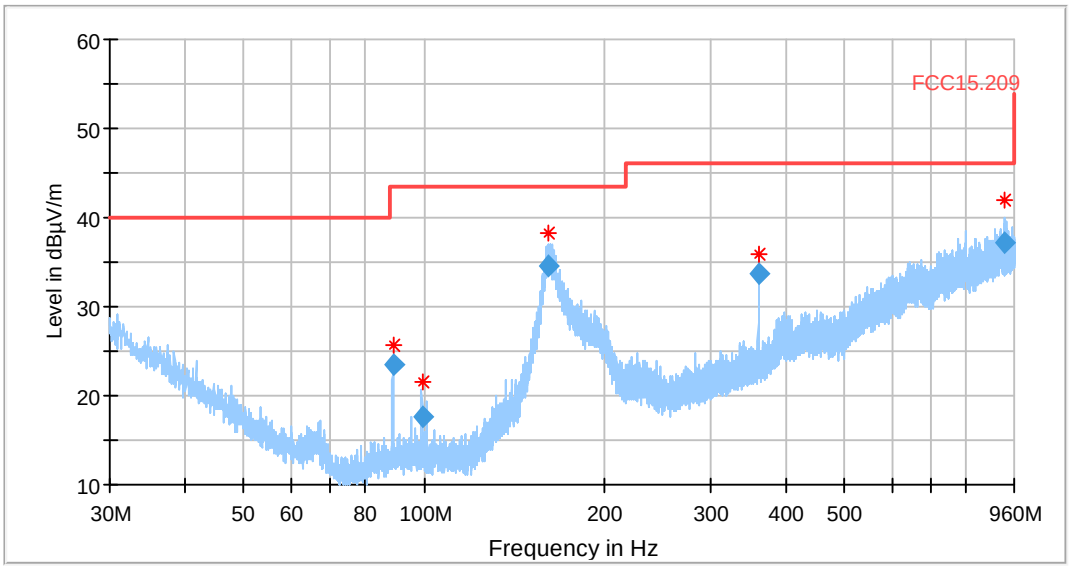
(continuation of the "Final_Result" table from column 18 ...)

Frequency (MHz)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
88.790000	6.9	16.1	11:09:18 - 14.06.2023
101.310000	6.8	11.2	11:18:52 - 14.06.2023
163.310000	8.0	25.6	11:14:23 - 14.06.2023
359.990000	14.5	14.7	10:59:23 - 14.06.2023
793.510000	22.5	7.0	11:04:18 - 14.06.2023

Diagram 3.02

Common Information

Test Description:	Radiated field strength emission in 3m distance
Test Site:	CETECOM GmbH Essen
Test Standard:	FCC 15.205&15.209 & RSS Gen. Issue 5
Antenna polarisation:	horizontal/vertical
Environmental Conditions:	Humidity : 41%rH; Temperature: 20°C
Operator Name:	LKnopp
EUT:	
Operating Mode:	UWB
Power supply:	24V DC
Comment:	Lying / RF-Path A
Verdict:	Passed



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)
88.790000	23.56	43.50	19.94	120.000	223.0	H	111.0	7.8	0.0	0.9
99.230000	17.66	43.50	25.84	120.000	105.0	V	199.0	7.7	0.0	0.9
160.690000	34.51	43.50	8.99	120.000	175.0	H	84.0	9.1	0.0	1.3
359.990000	33.75	46.00	12.25	120.000	100.0	H	129.0	16.5	0.0	2.0
926.390000	37.13	46.00	8.87	120.000	360.0	V	176.0	27.0	0.0	3.4

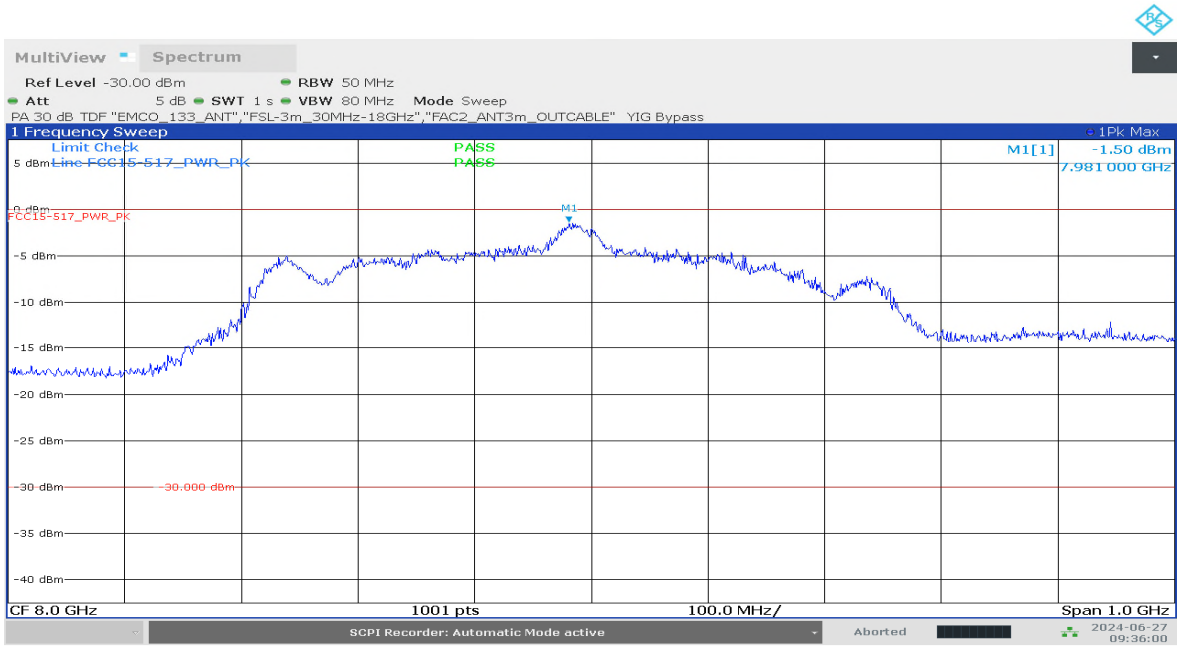
(continuation of the "Final_Result" table from column 18 ...)

Frequency (MHz)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
88.790000	6.9	15.8	11:49:34 - 14.06.2023
99.230000	6.8	10.0	11:54:28 - 14.06.2023
160.690000	7.8	25.5	11:44:01 - 14.06.2023
359.990000	14.5	17.3	11:38:49 - 14.06.2023
926.390000	23.6	10.1	11:58:37 - 14.06.2023

1.3 Measurements according FCC Part 15.517(c) and RSS-220 (§5.2.1(d))

1.3.1 Peak power / RF-Path A

Diagram no.: TID501a_PWR_PK_Sample38_PathA_Ch9_Value_0x8686868686_EUT_laying_AntH.PNG



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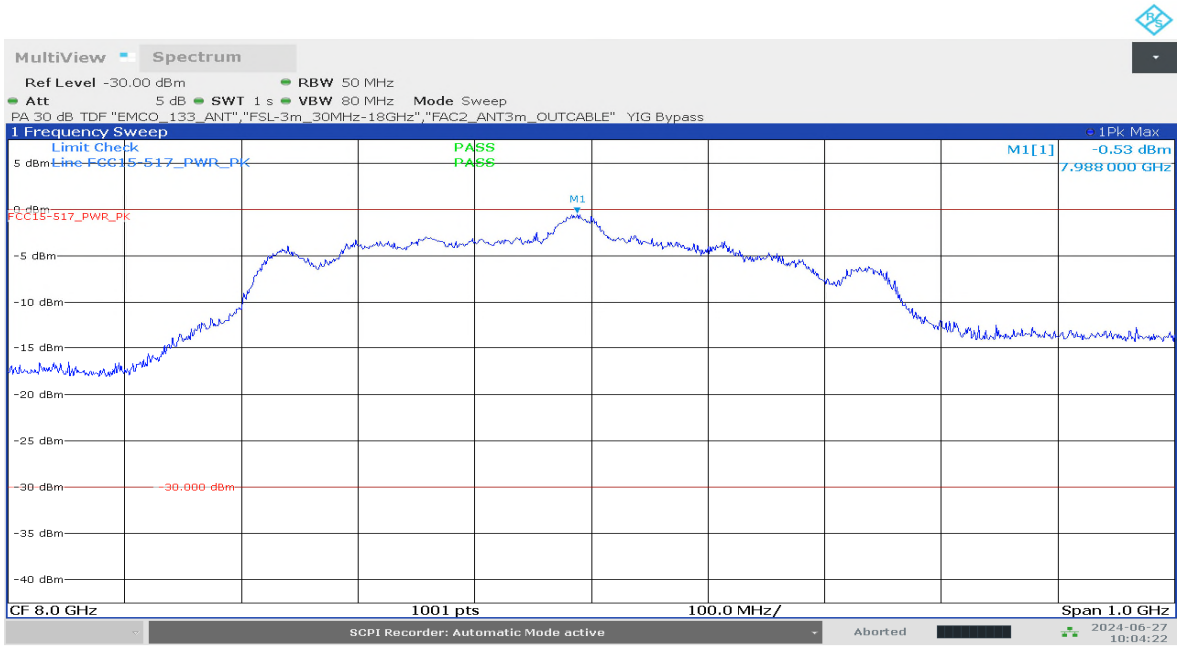

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Worst-Case search antenna polarisation horizontal

Diagram no.: TID501a_PWR_PK_Sample38_PathA_Ch9_Value_0x8686868686_EUT_standing_AntH.PNG

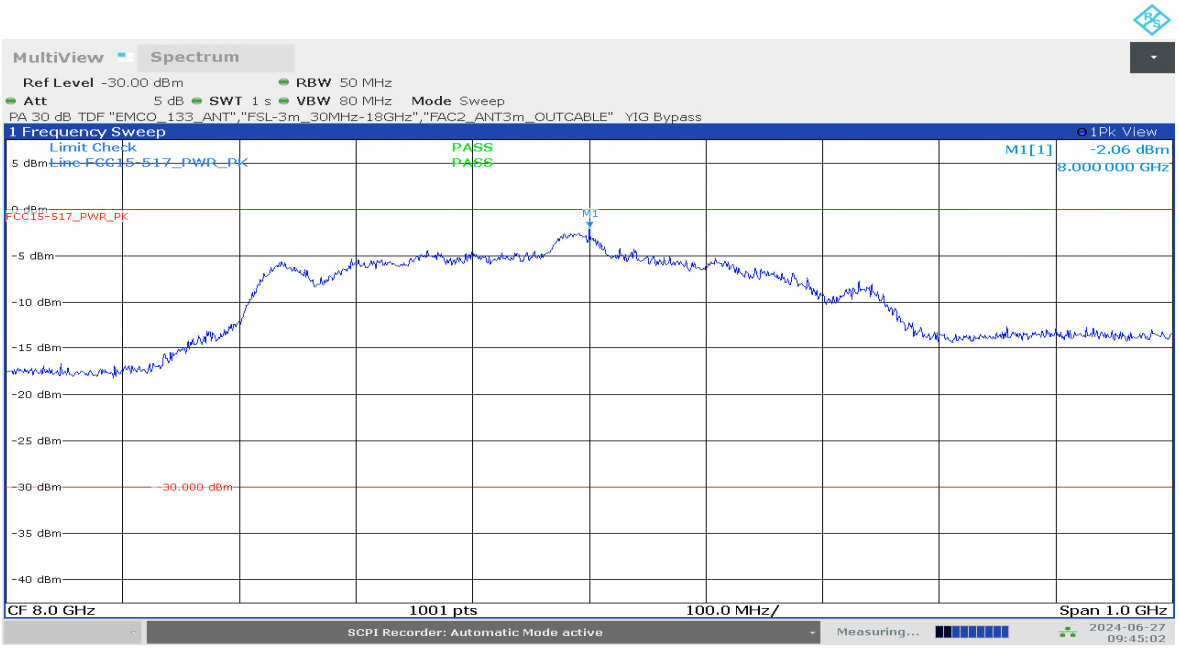

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Diagram no.: TID501b_PWR_PK_Sample38_PathA_Ch9_Value_0x8686868686_EUT_standing_AntV.PNG

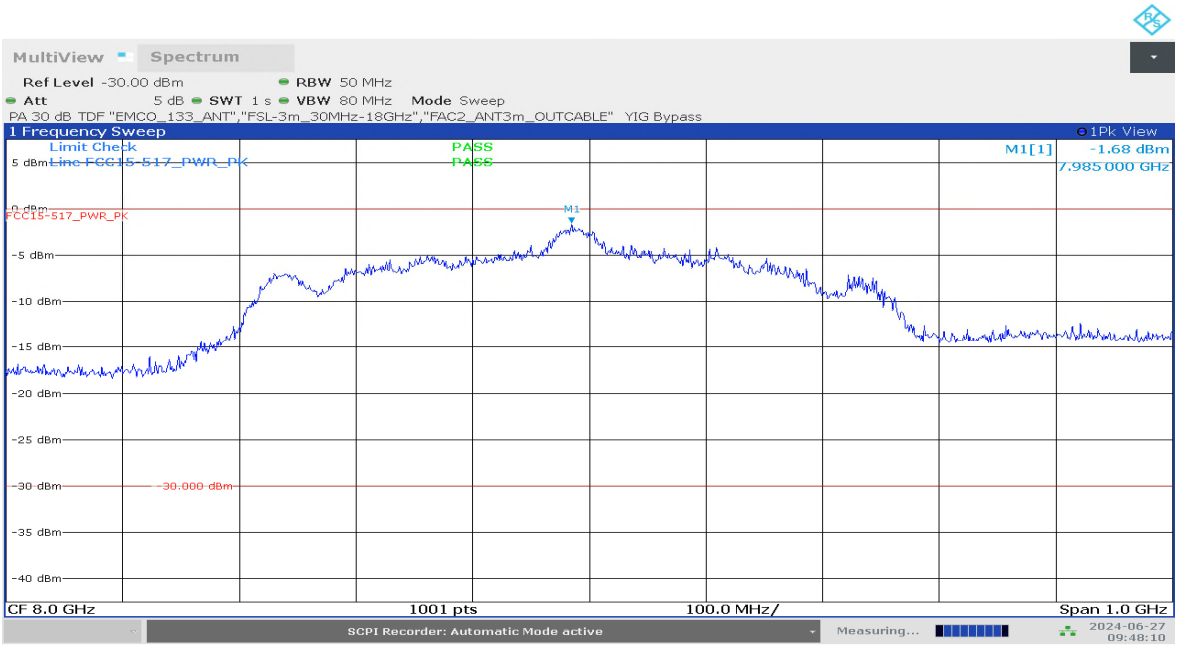

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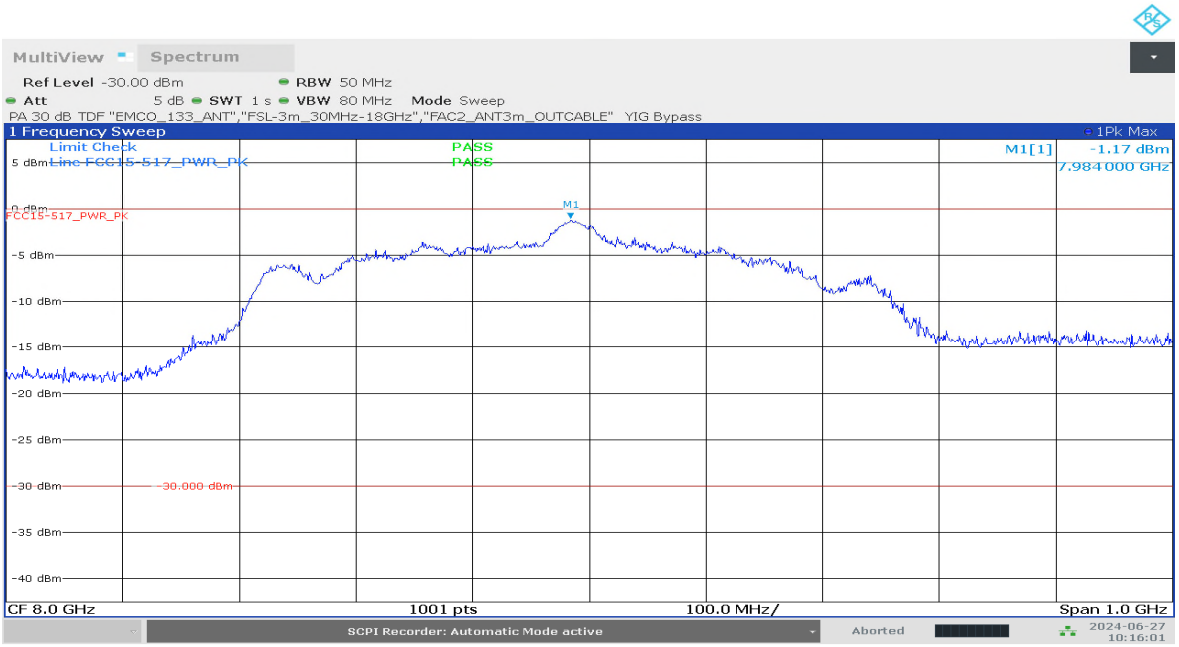
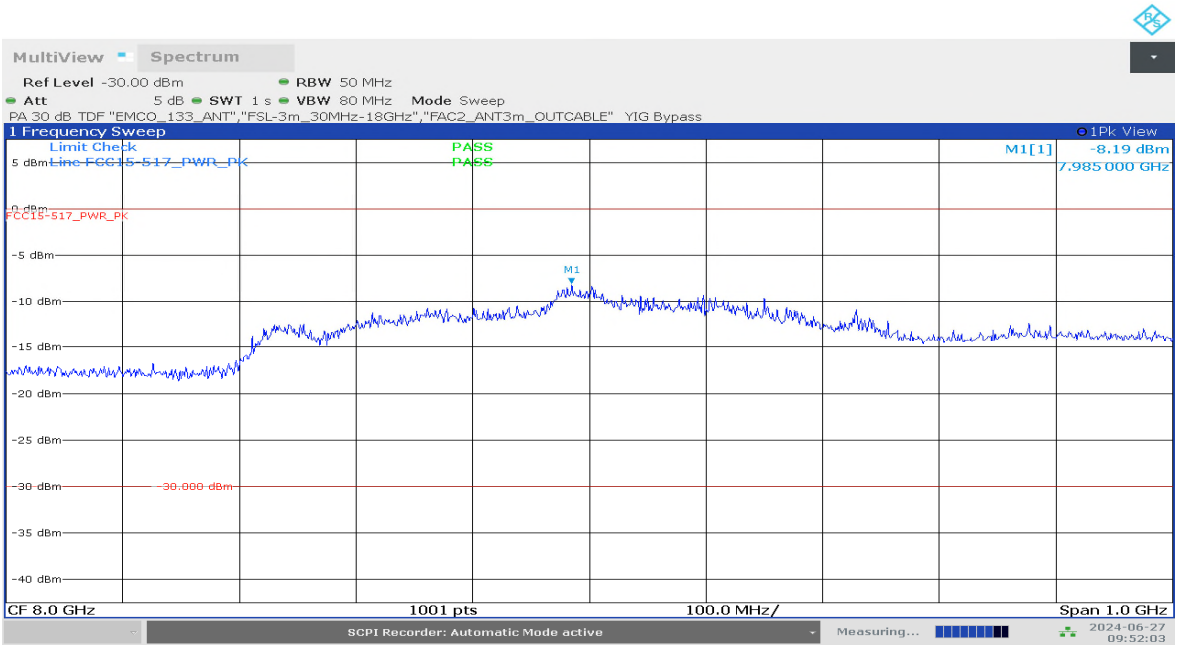
Diagram no.: TID501b_01_PWR_PK_Sample38_PathA_Ch9_Value_0x8686868686__TT_155deg_Azim_100deg__AntV.PNG



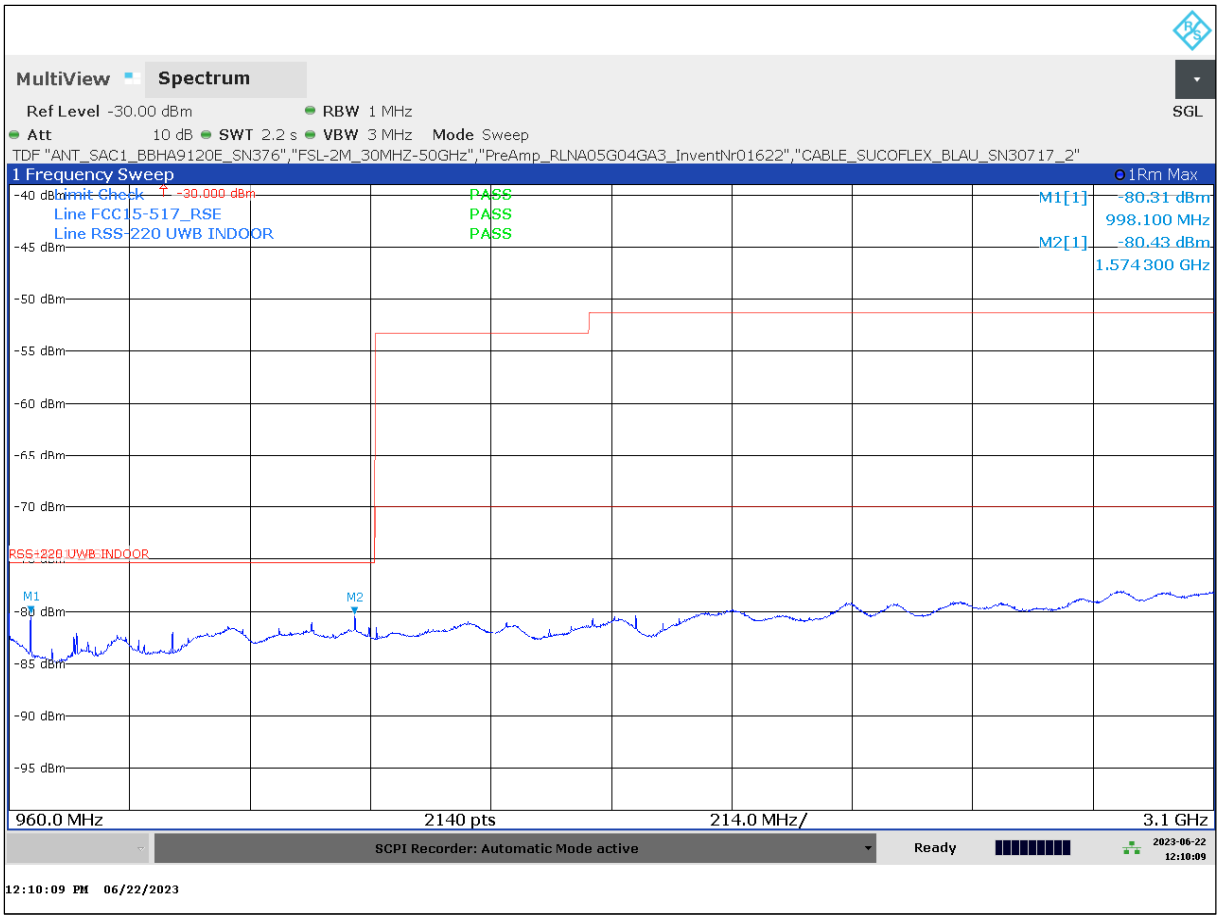
Worst-Case search antenna polarisation vertical

Diagram no.: TID501b_PWR_PK_Sample38_PathA_Ch9_Value_0x8686868686_EUT_laying_AntV.PNG

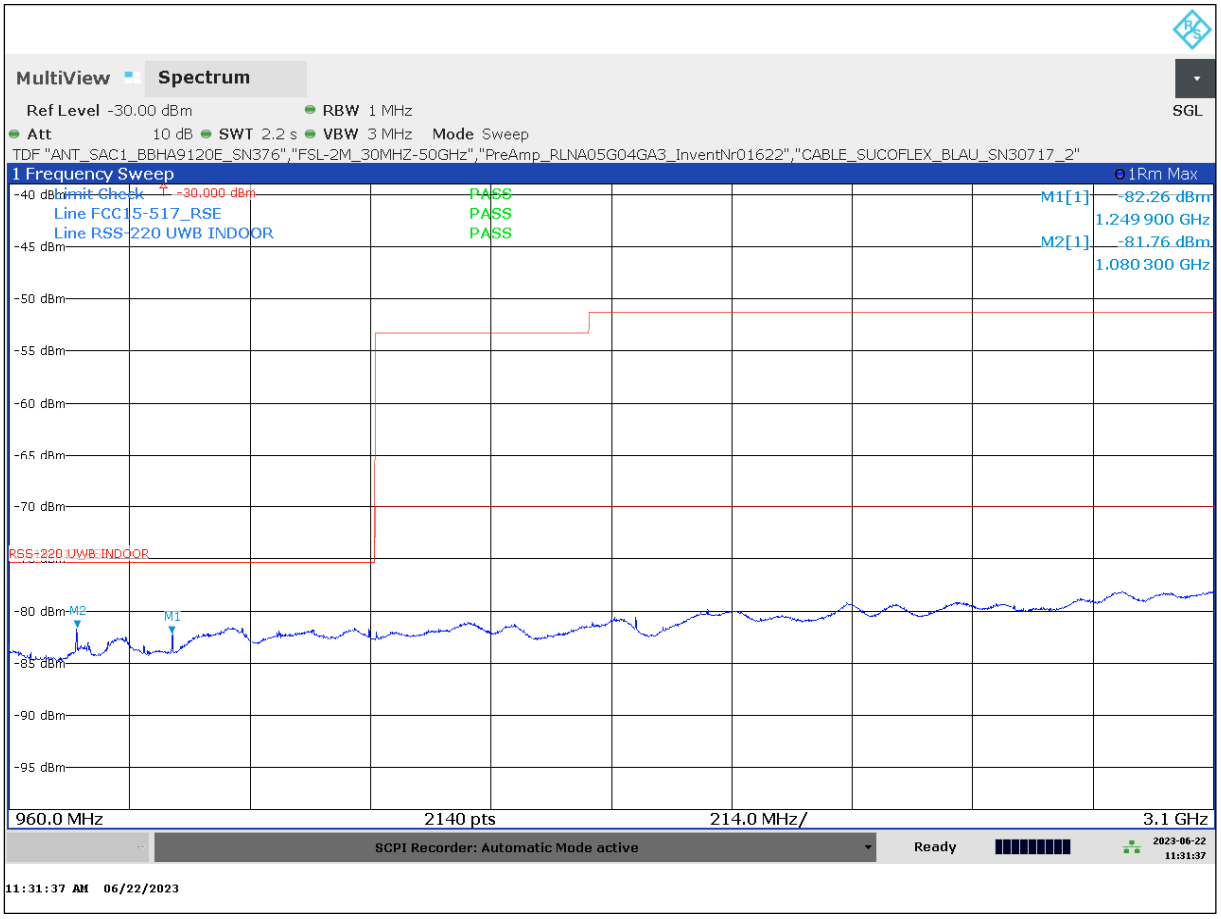


1.3.2 Measurements in range: 960MHz < f < 3.1GHz (§15.517(c) & RSS-220)

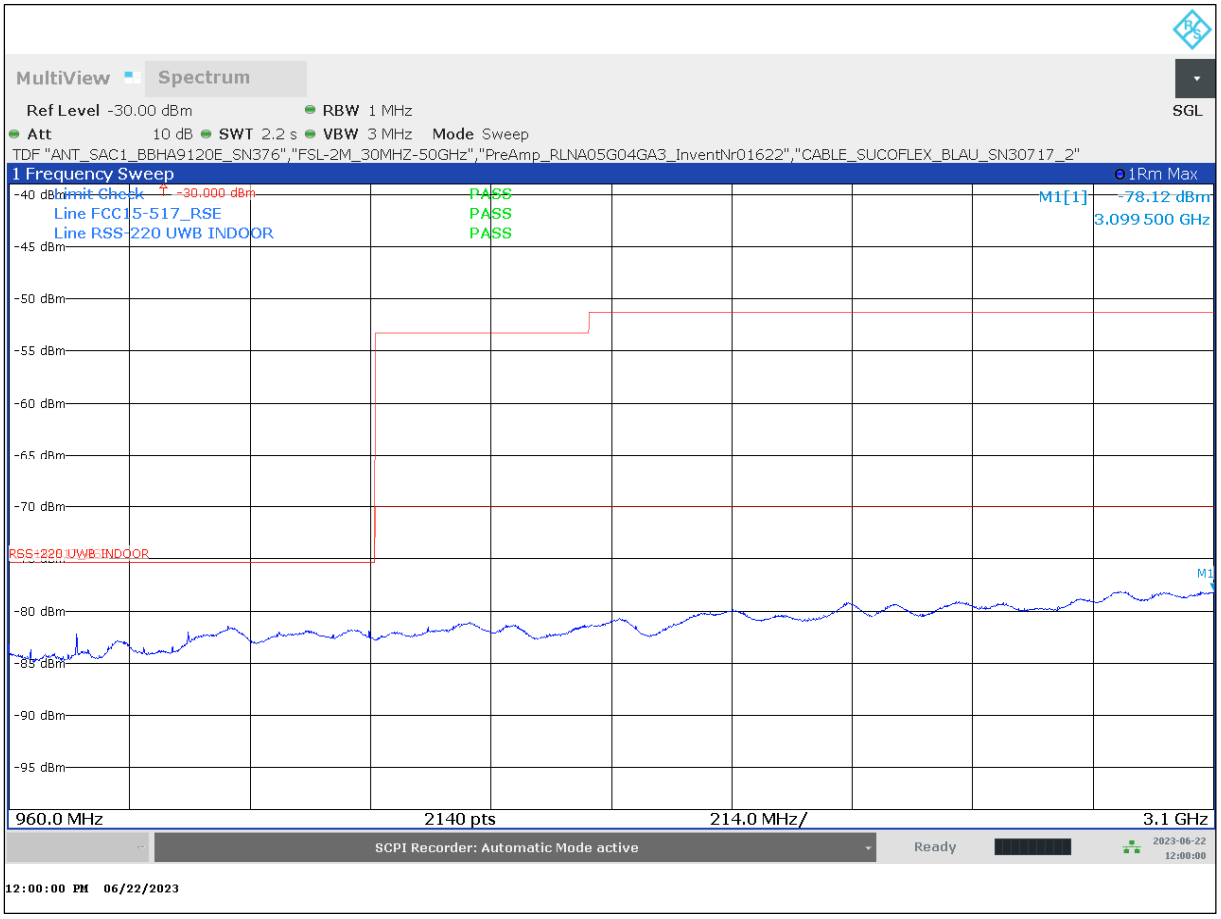
T021_D007a_RSE_TX_Ch9_Value_0x86868686_EUT_laying_AntH



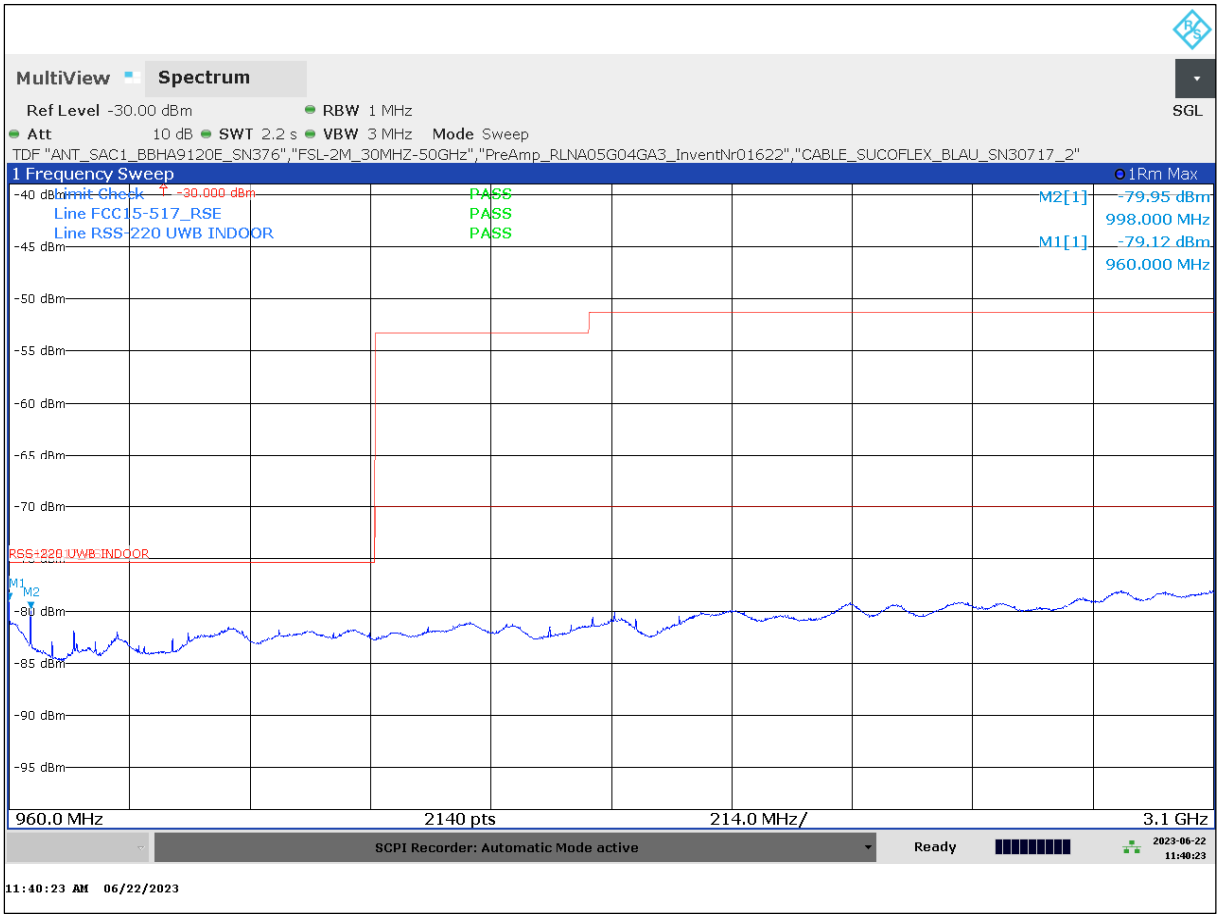
T021_D007a_RSE_TX_Ch9_Value_0x86868686_EUT_standing_AntH



T021_D007b_RSE_TX_Ch9_Value_0x86868686_EUT_laying_AntV

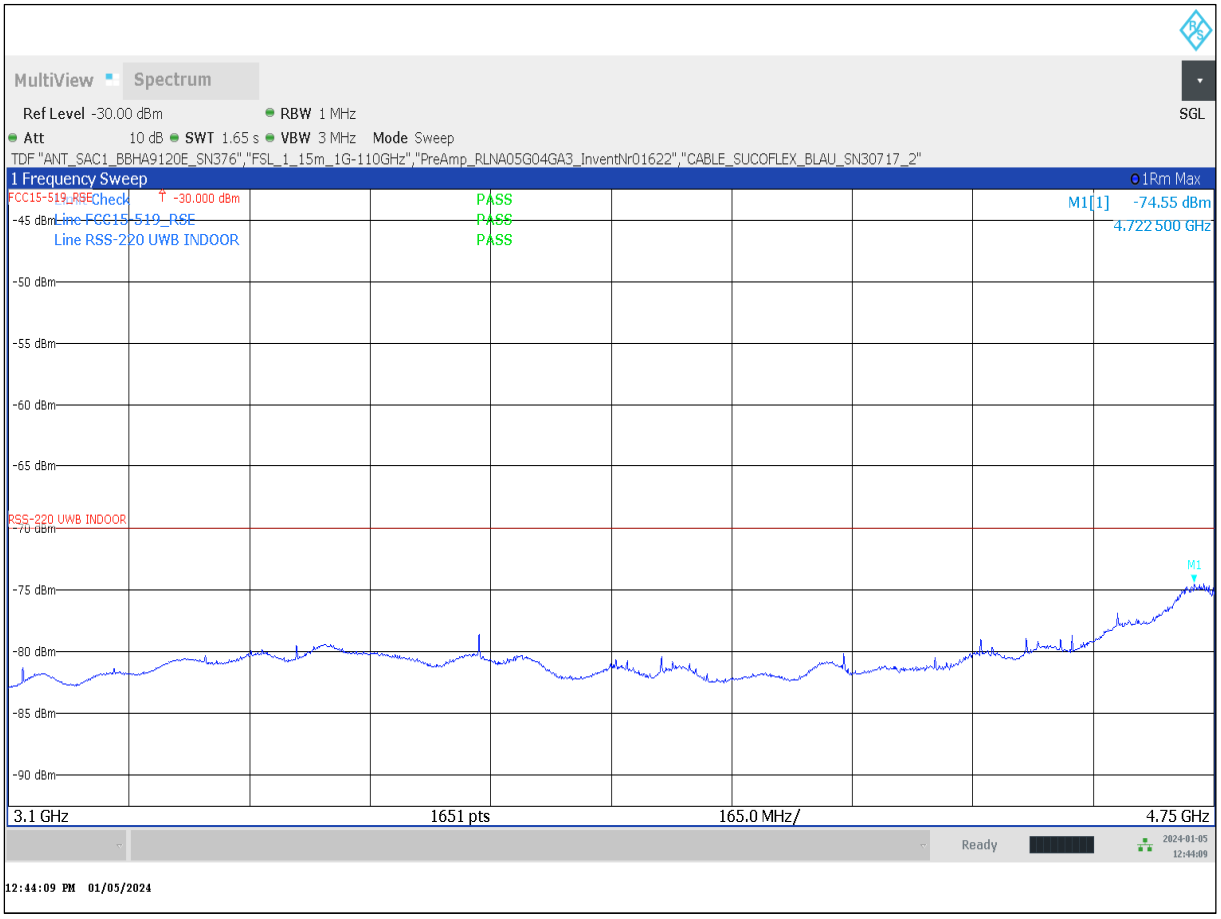


T021_D007b_RSE_TX_Ch9_Value_0x86868686_EUT_standing_AntV



1.3.3 Measurements in range: 3.1GHz < f < 4.75GHz (RSS-220, §5.2.1 (d))

T021_D008a_RSE_TX_S38_Ch9_Value_0x86868686_EUT_laying__AntH



T021_D008a_RSE_TX_S38_Ch9_Value_0x86868686_EUT_standing__AntH

T021_D008b_RSE_TX_S38_Ch9_Value_0x86868686_EUT_laying__AntV

T021_D008b_RSE_TX_S38_Ch9_Value_0x86868686_EUT_standing__AntV

1.3.4 Measurements in range: 3.1GHz < f < 10.6GHz

Diagram no.: TID502a_PSD_Sample38_PathA_Ch9_Value_0x8686868686_AntH.PNG

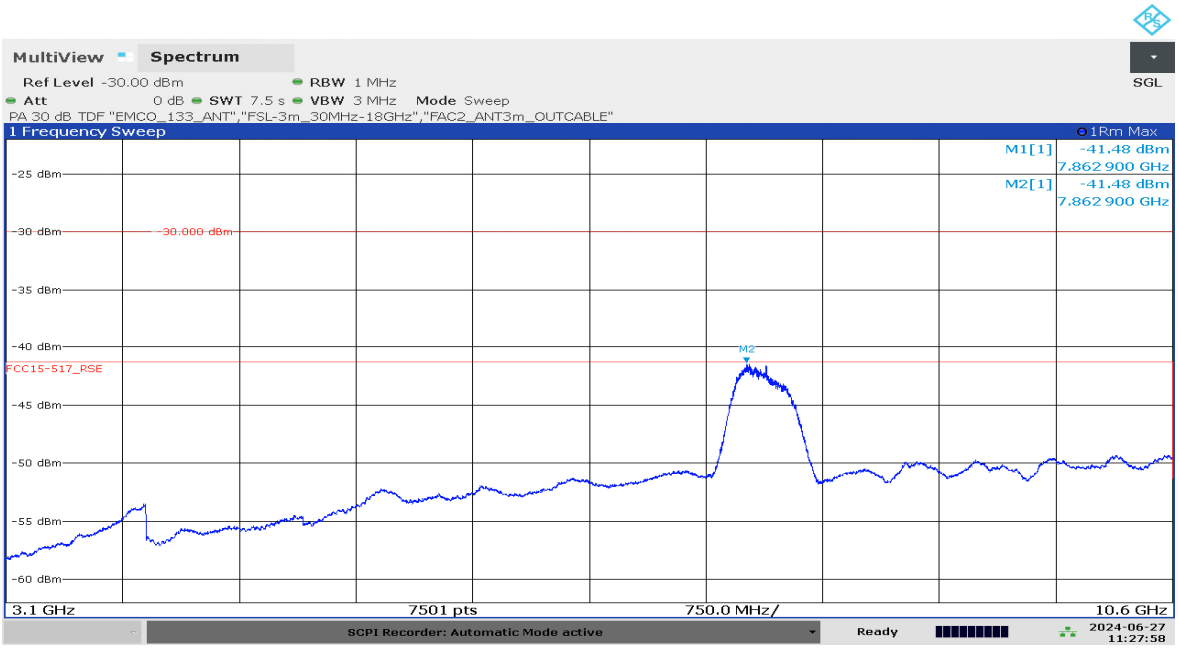


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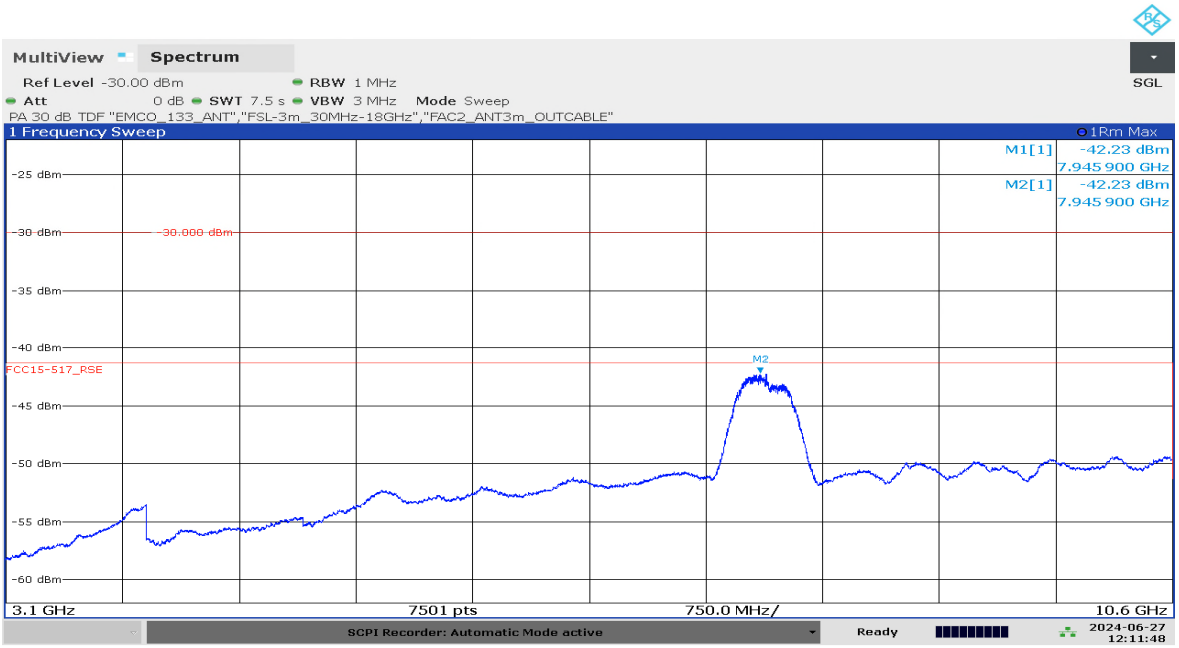
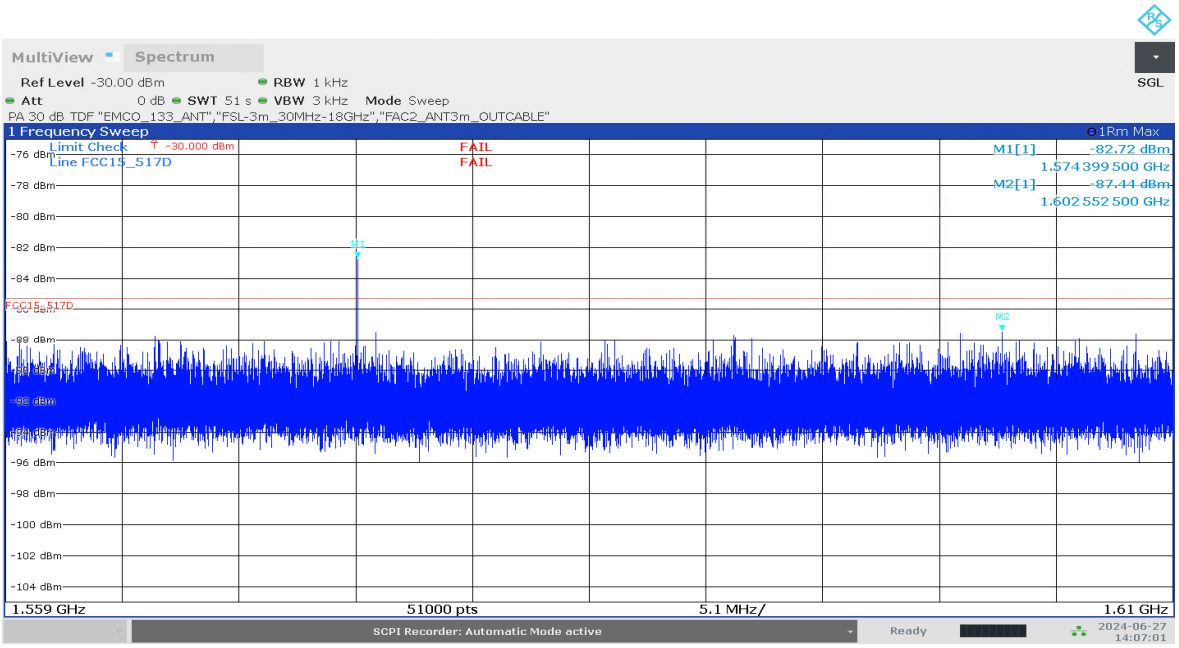
Diagram no.: TID502b_PSD_Sample38_PathA_Ch9_Value_0x8686868686_AntV.PNG



12:11:48 06/27/2024

1.3.5 Measurements in range: 1.559GHz < f < 1.61GHz, UWB-on

Diagram no.: TID505a_RSE_GPS2_SampleS38_PathA_Ch9_Value_0x8686868686_AntH.PNG



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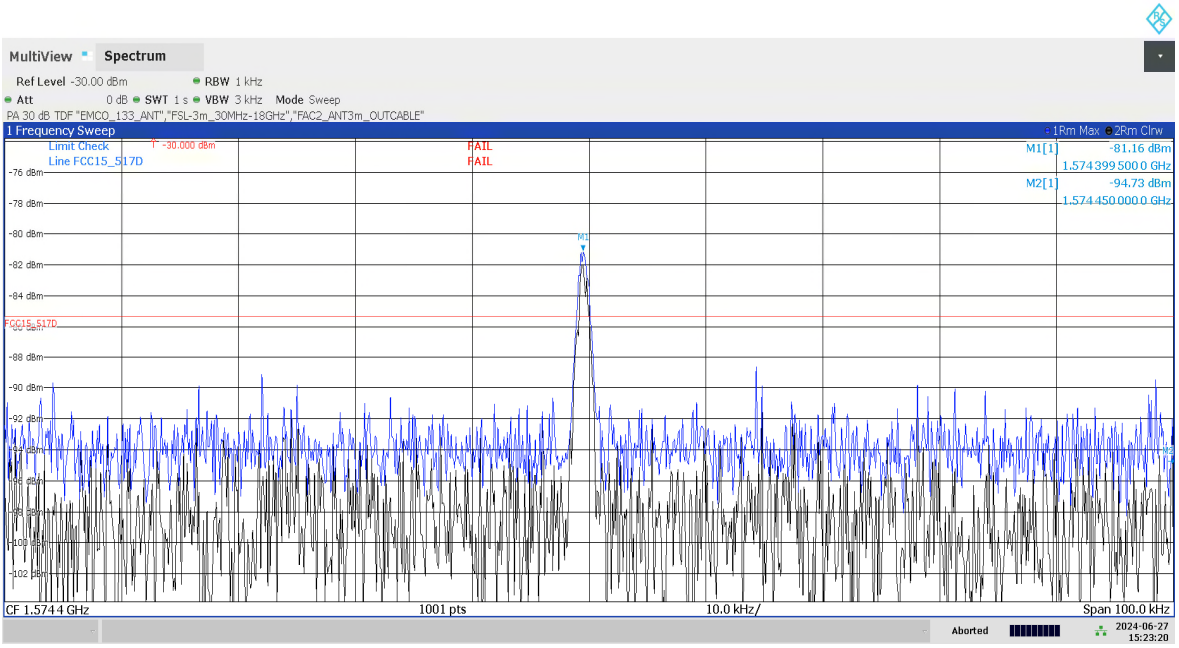
Critical emission: 1574.3995MHz

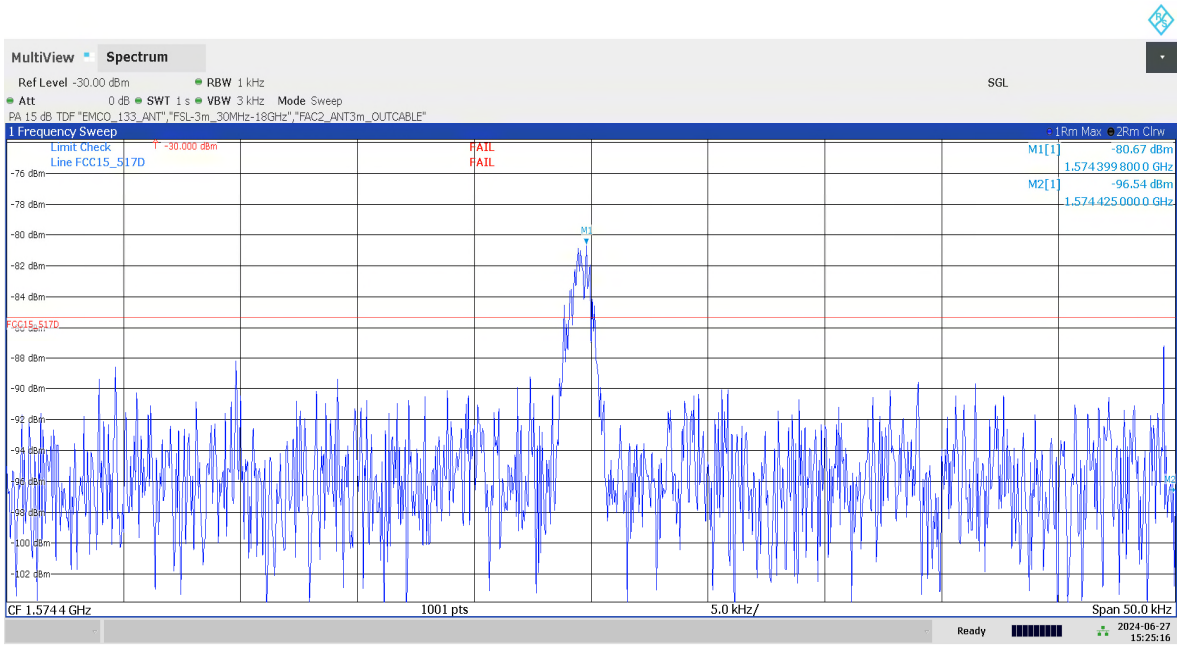
Diagram no.: TID505a_01_RSE_GPS2_SampleS38_PathA_Ch9_Value_0x8686868686_TT_55deg_A_0deg__AntH.PNG



03:23:20 06/27/2024

Critical emission with better resolution

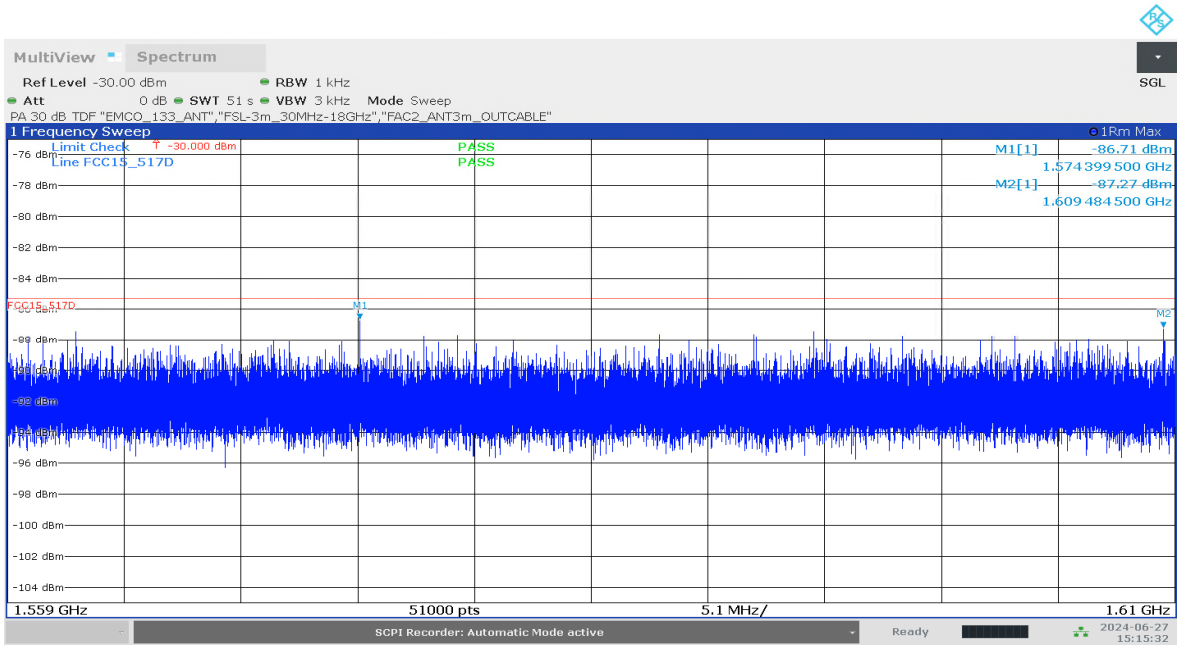
Diagram no.: TID505a_02_RSE_GPS2_SampleS38_PathA_Ch9_Value_0x8686868686_TT_55deg_A_0deg__AntH.PNG



03:25:17 06/27/2024

Maximization of critical emission: Azimuth: 55deg, Elevation: 0deg
See below chapter for further investigation.

Diagram no.: TID505b_RSE_GPS2_SampleS38_PathA_Ch9_Value_0x8686868686_AntV.PNG

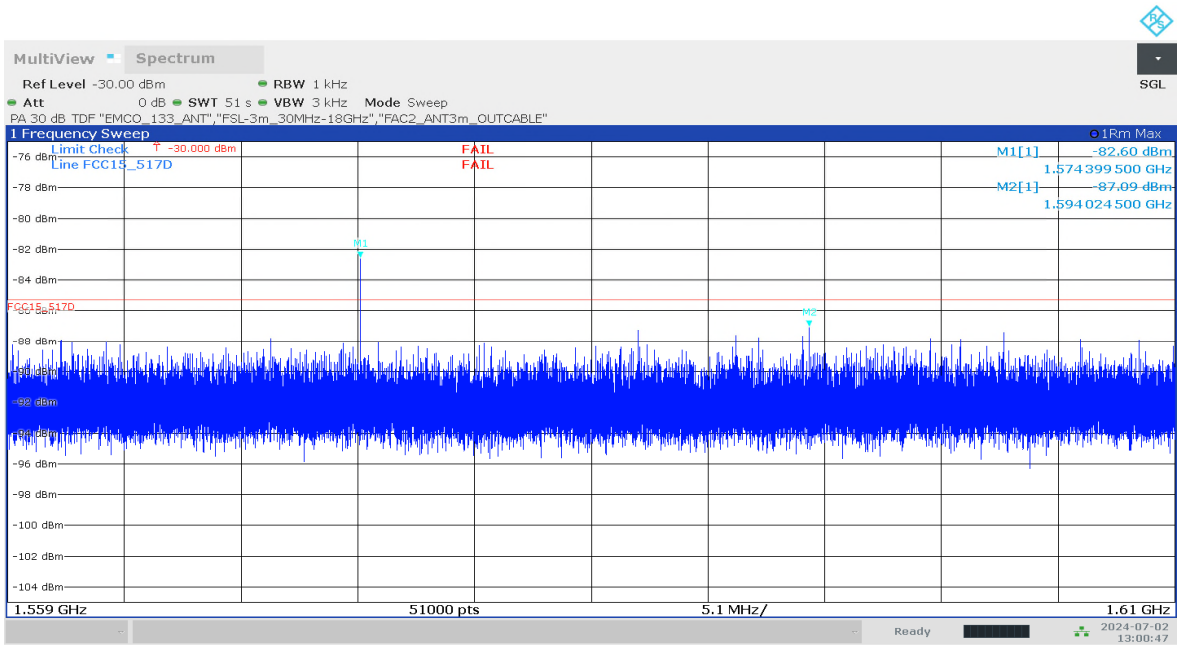


03:15:33 06/27/2024

1.3.6 Measurements in range: 1.559GHz < f < 1.61GHz, UWB-off

EUT transmitter or chip is switched-off:

Diagram no.: TID505a_03_RSE_GPS2_EUT_powered_on_UWB_off_AntH.PNG



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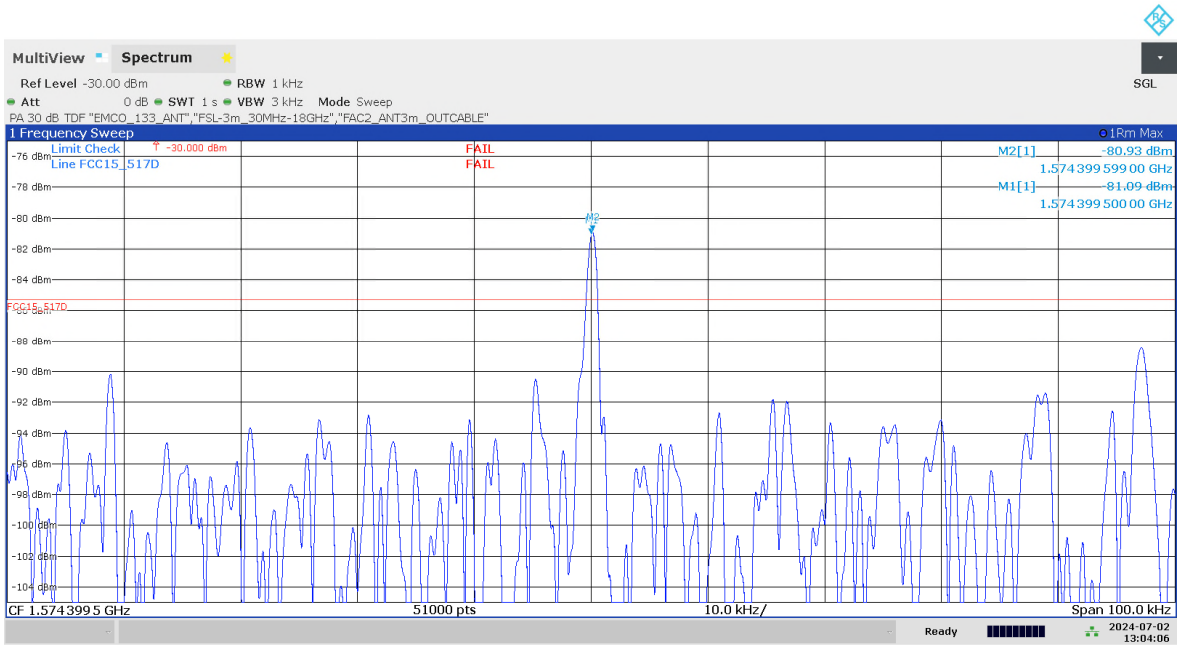
Current consumption: 22mA, EUT just powered.

Diagram no.: TID505a_04_RSE_GPS2_EUT_powered_on_UWB_off_AntH.PNG



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Better resolution of emission

Verdict: Emission still present, generated by other electronics not involved with UWB technology.

1.3.7 Measurements in range: 1.164GHz < f < 1.24GHz

Diagram no.: TID504a_RSE_GPS1_SampleS38_PathA_Ch9_Value_0x8686868686_AntH.PNG

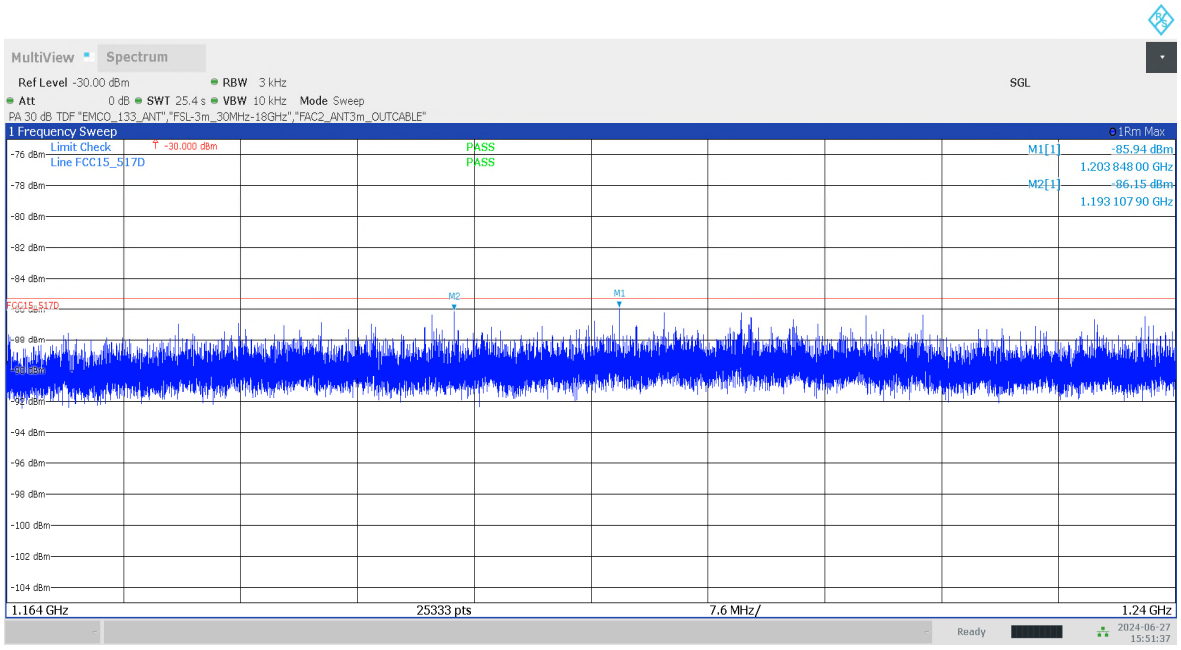
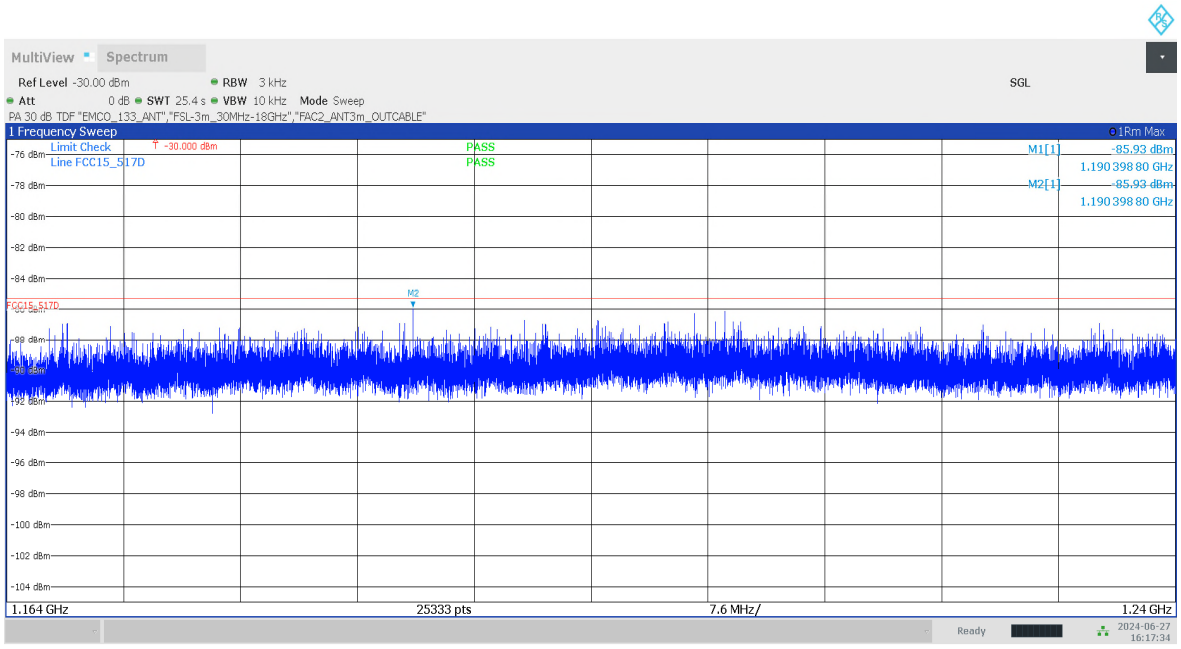


Diagram no.: TID504b_RSE_GPS1_SampleS38_PathA_Ch9_Value_0x8686868686_AntV.PNG



1.3.8 Measurements in range: 10.6GHz < f < 12.4GHz

Diagram no.: TID509a_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntH.PNG

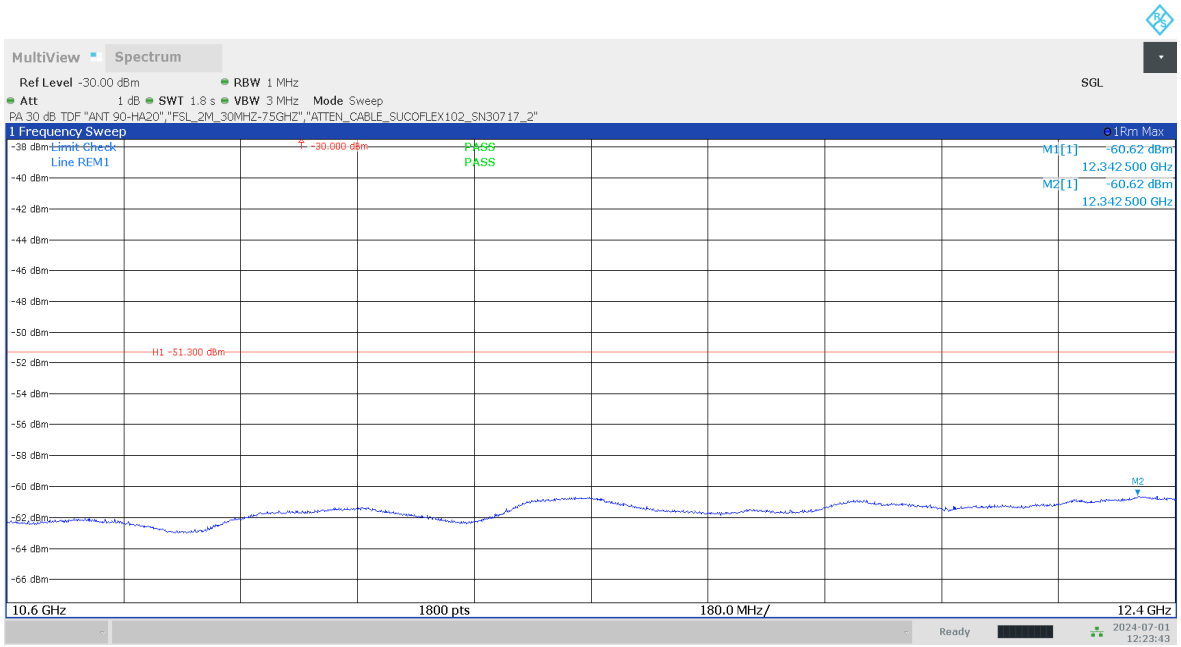
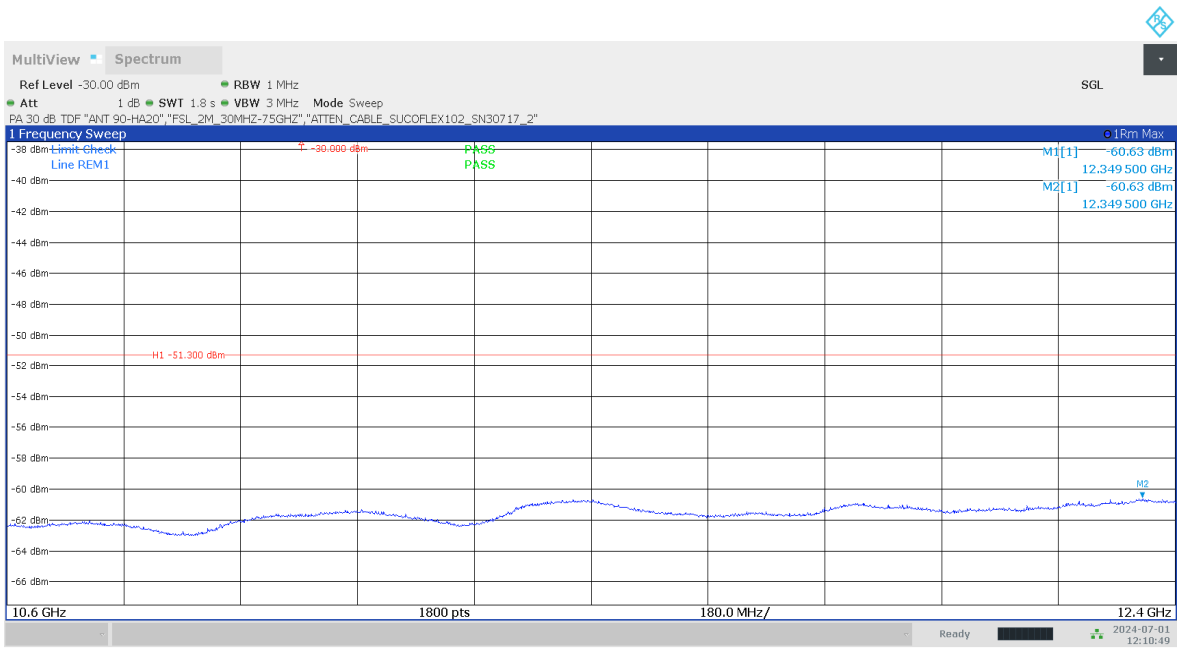


Diagram no.: TID509b_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntV.PNG



1.3.9 Measurements in range: 12.4GHz < f < 18GHz

Diagram no.: TID508a_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntH.PNG

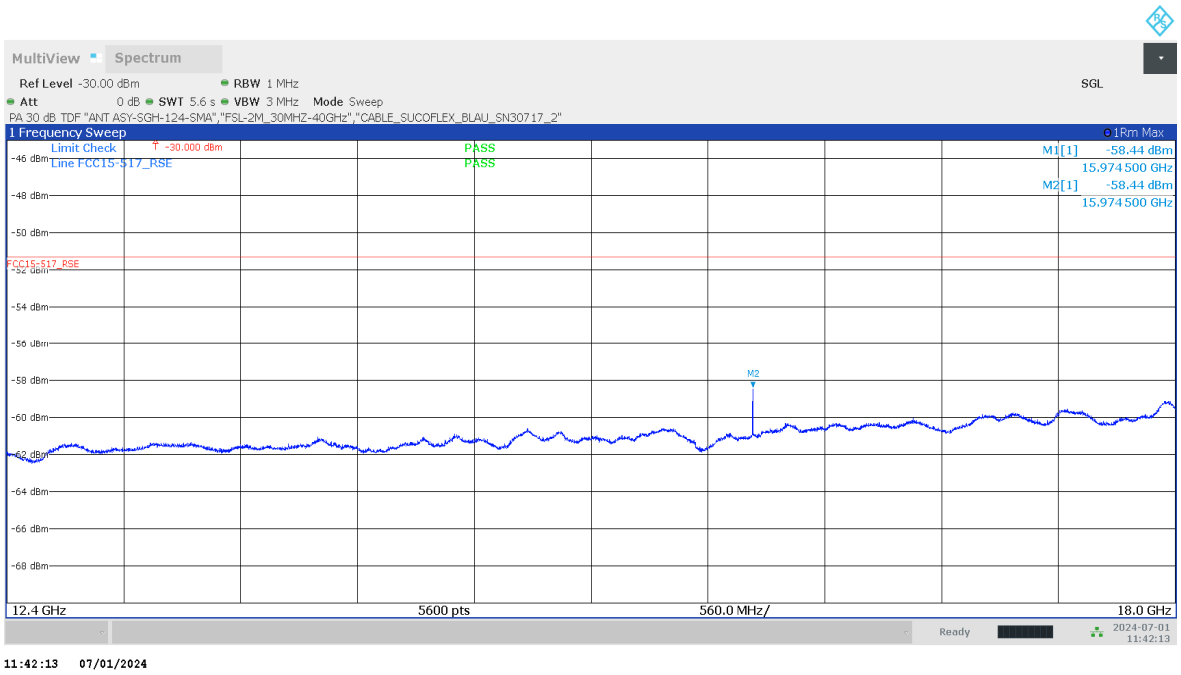
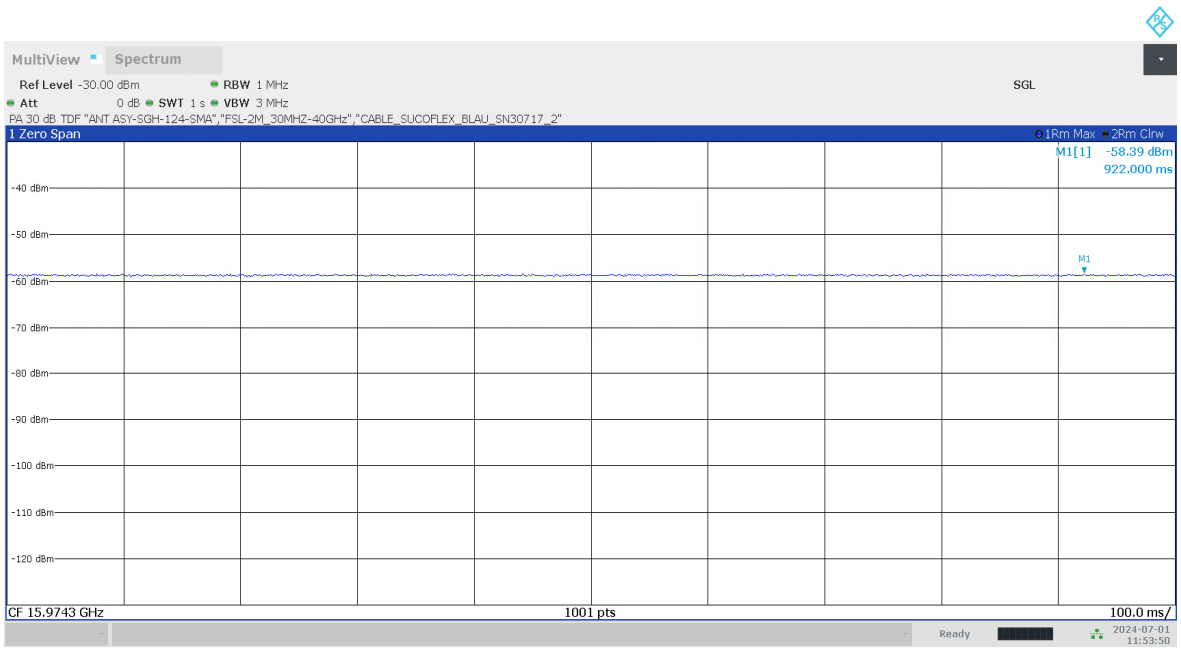
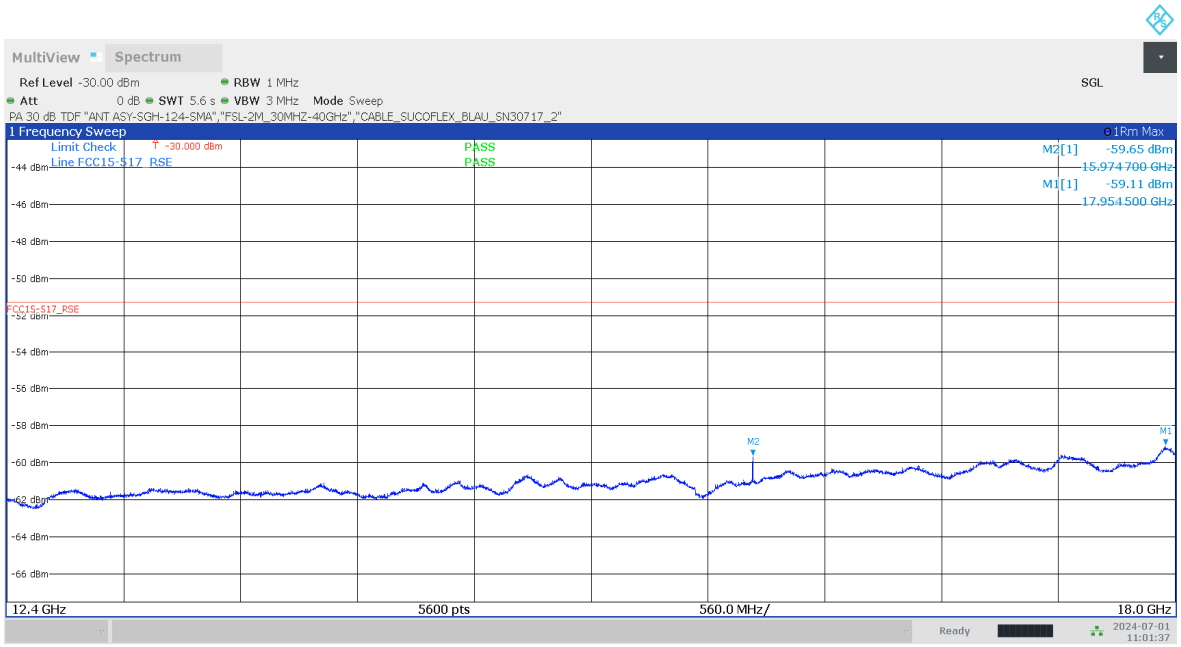


Diagram no.: TID508a_01_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_Az_0_7deg_E_45deg_AntH.PNG



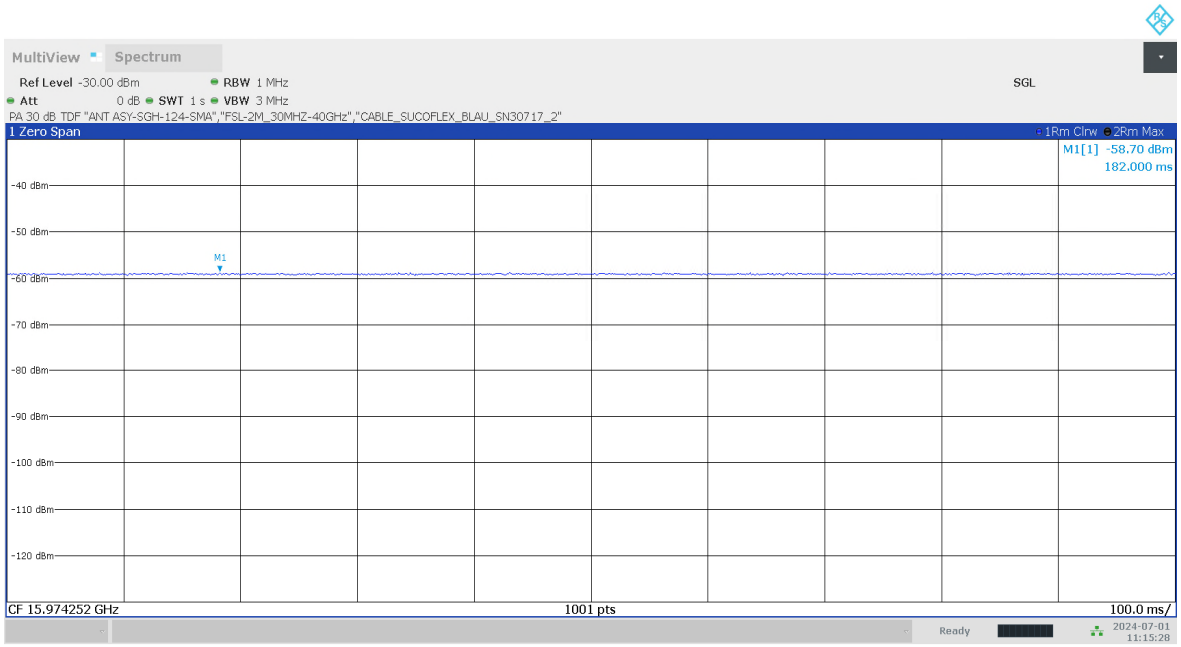
Max-Value: -58.39dBm

Diagram no.: TID508b_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntV.PNG



11:01:37 07/01/2024

Diagram no.: TID508b_01_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_Az_326deg_E_90_4deg_AntV.PNG

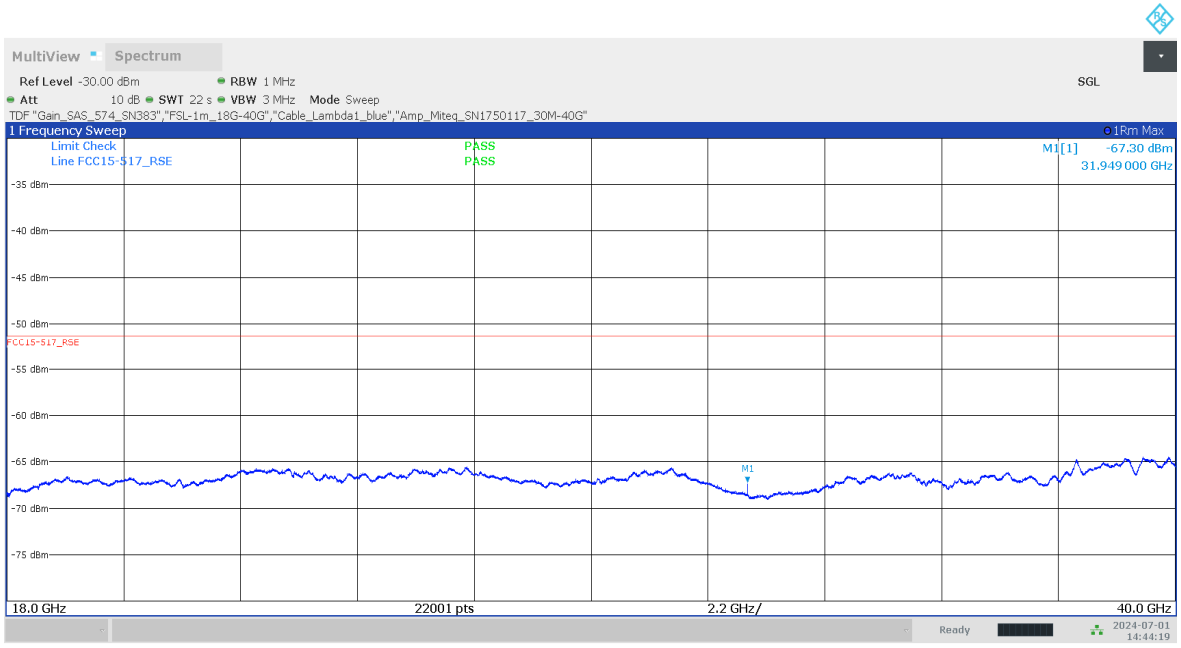


11:15:28 07/01/2024

Max-Value: -58.70dBm

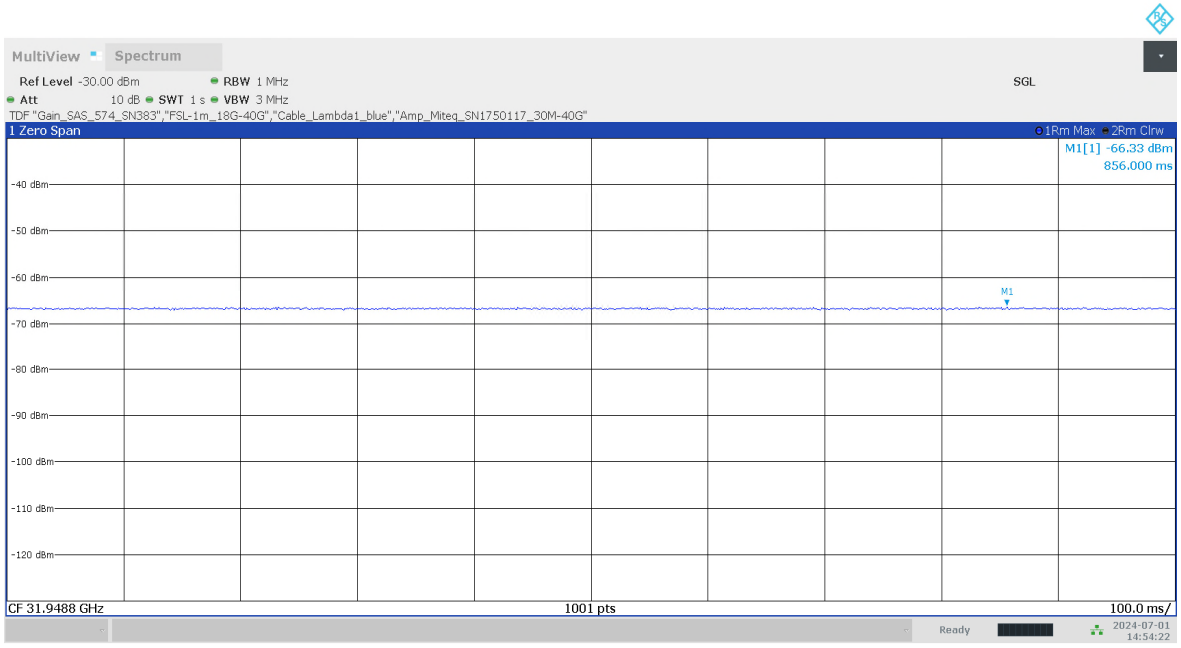
1.3.10 Measurements in range: 18GHz < f < 40GHz

Diagram no.: TID510a_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntH.PNG



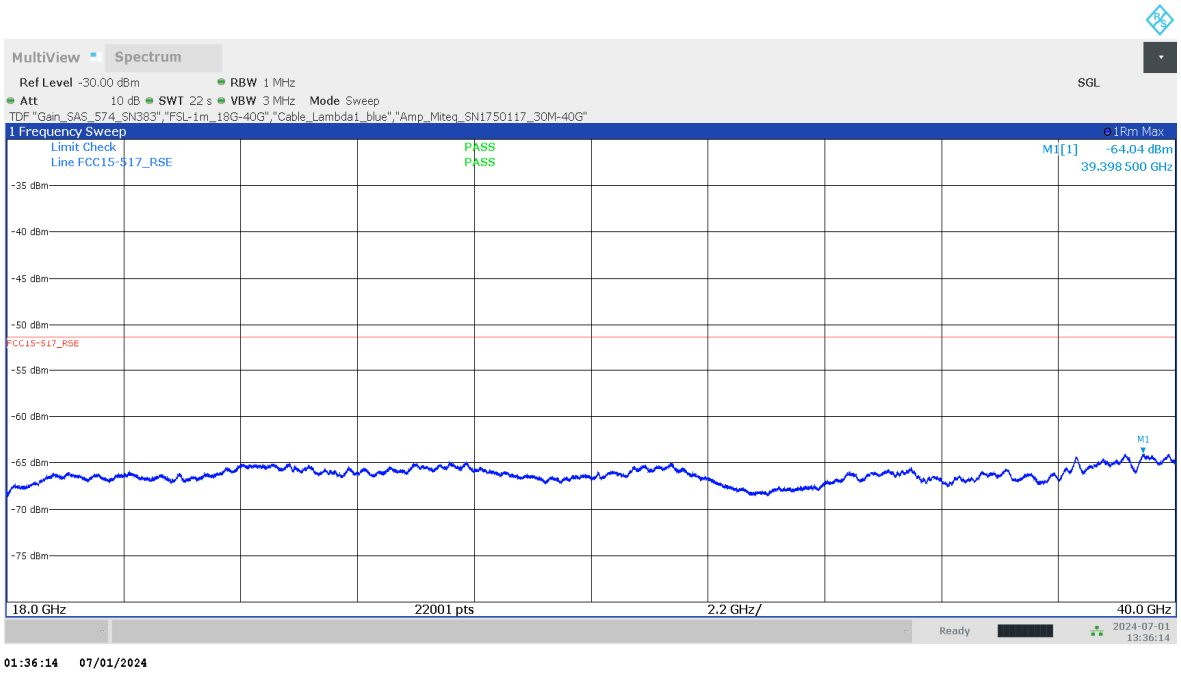
02:44:20 07/01/2024

Diagram no.: TID510a_01_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_A359deg_E90deg_AntH.PNG



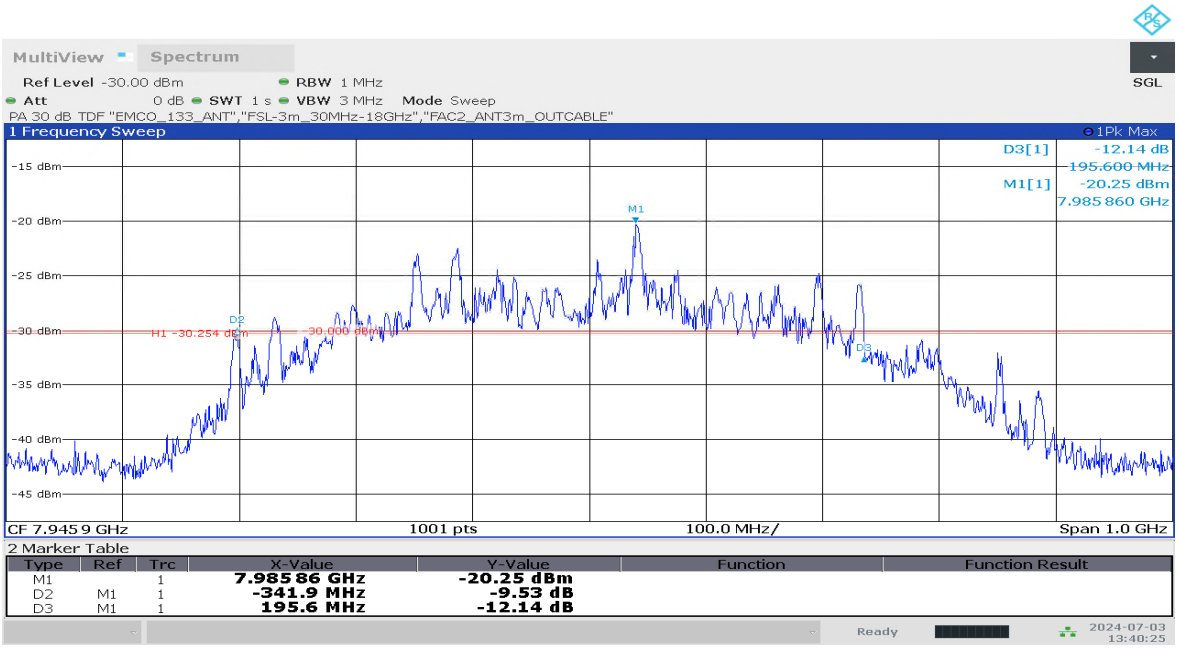
02:54:22 07/01/2024

Diagram no.: TID510b_RSE_SampleS38_PathA_Ch9_Value_0x8686868686_AntV.PNG



1.3.11 10dBc bandwidth, RF-Path A

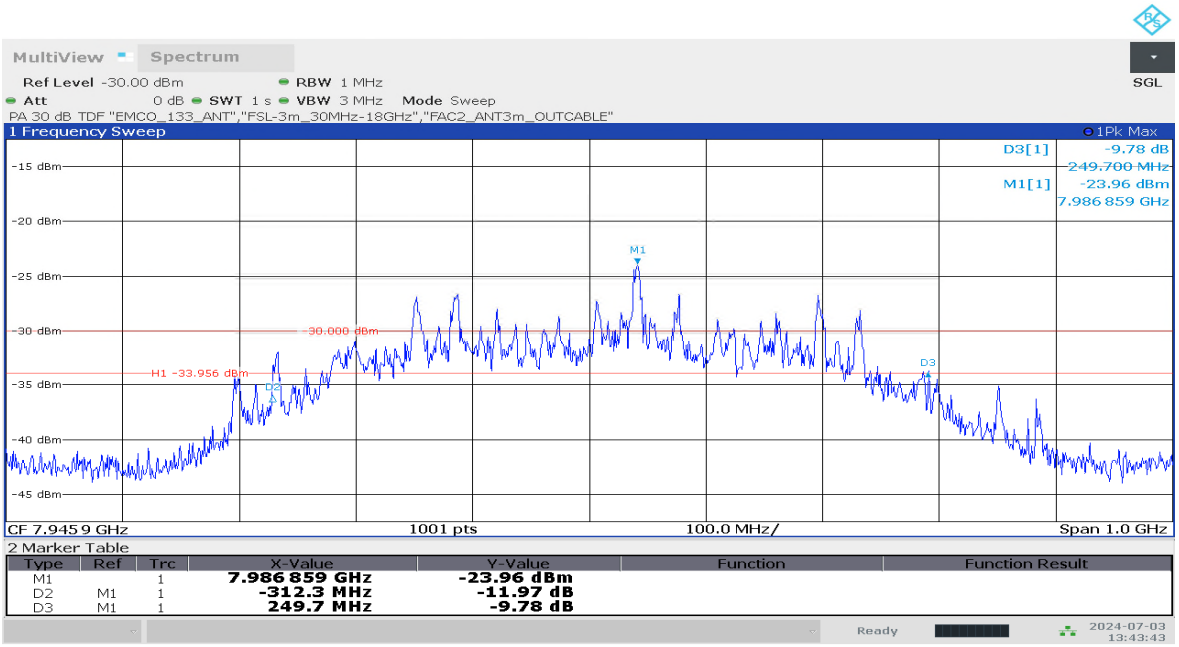
Diagram no.: TID514a_10dB_BW_SampleS38_PathA_Ch9_Value_0x8686868686_bw_set_0x2E_AntH.PNG



01:40:26 07/03/2024

Resulting bandwidth: 537.5 MHz

Diagram no.: TID514b_10dB_BW_SampleS38_PathA_Ch9_Value_0x8686868686_bw_set_0x2E_AntV.PNG



01:43:44 07/03/2024

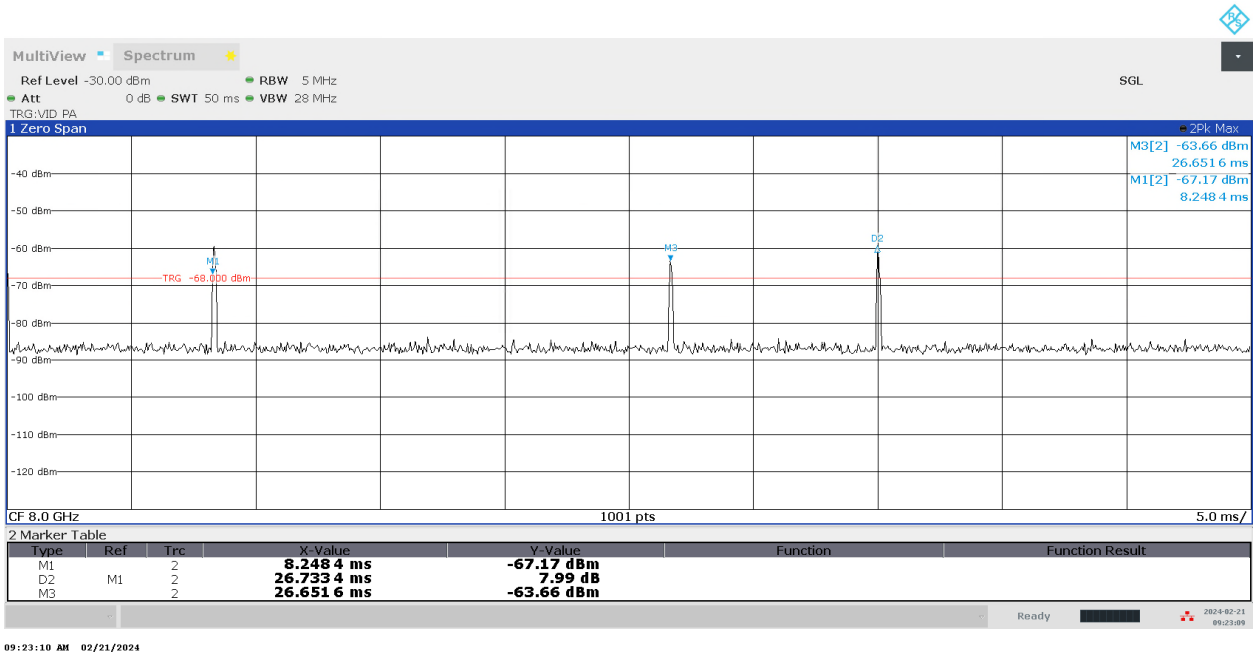
Resulting bandwidth: 562.0 MHz

1.3.12 Transmit timing (§FCC15.517 (a)(5))

According applicants information, different samples of the CorivaSat devices communicate each other under the control of a central unit (AE3).
As the unit AE3 can determine and monitor the presence of available devices, it also instructs the EUT to stop communications in case no associated receiver is available. Following diagrams shows the time behaviour for both simulated cases.

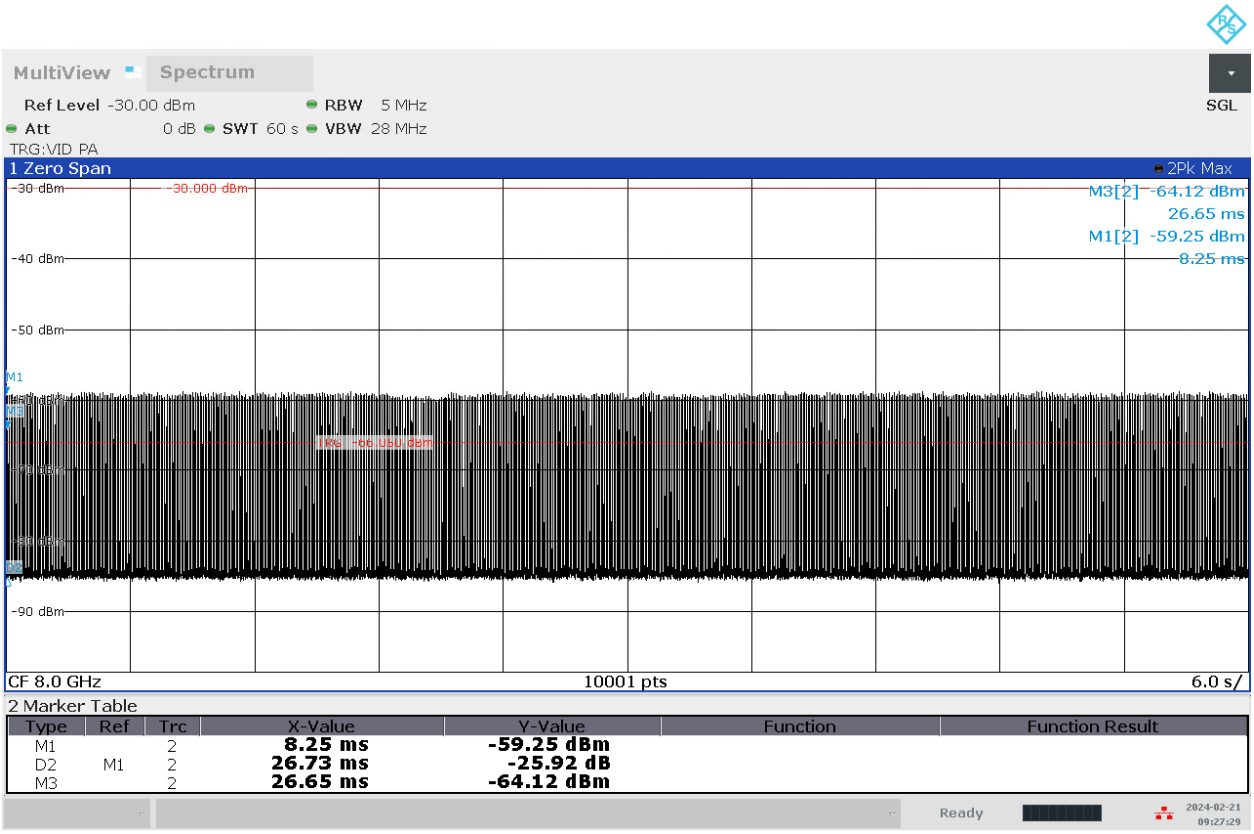
Set-up 3 with EUT 3 was used during the tests.

TID009_04_Timing_Sattelite_Master#EMV2_to_Slave#EMV1_Communication



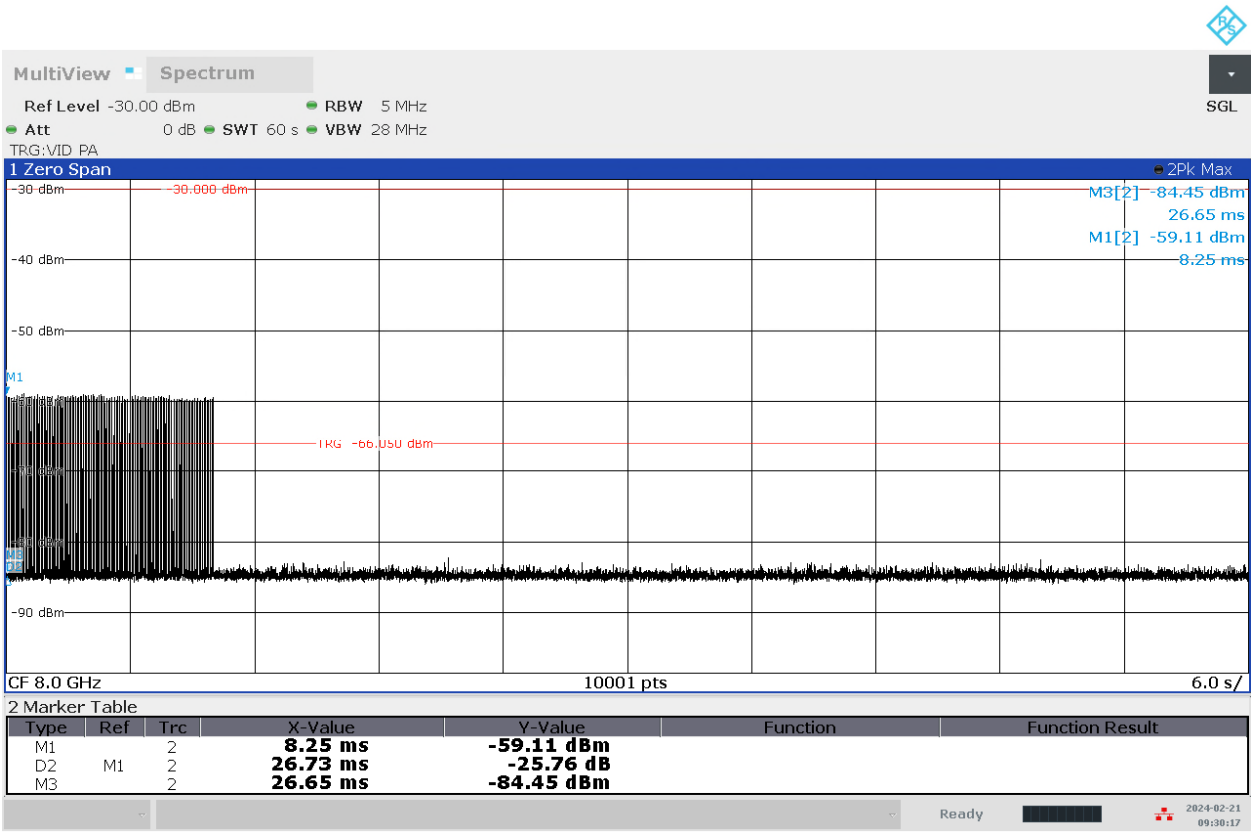
Communication to an associated receiver (AE4) during a 50ms period: two packet transmissions

TID009_05_Timing_Sattelite_Master#EMV2_to_Slave#EMV1_Communication_1Minute_Screenshot



Communication to an associated receiver (AE4) during a 1 minute period: continuous transmissions

TID009_06_Timing_Sattelite_Master#EMV2_no_Slave#EMV1_1Minute_Screenshot



Communication to an associated receiver (AE4) **during** a 1 minute period: continuous transmissions when AE4 disconnnects from control unit (AE3)
Communication is stopped after recognition of no receiver presence.

End Of Annex 1