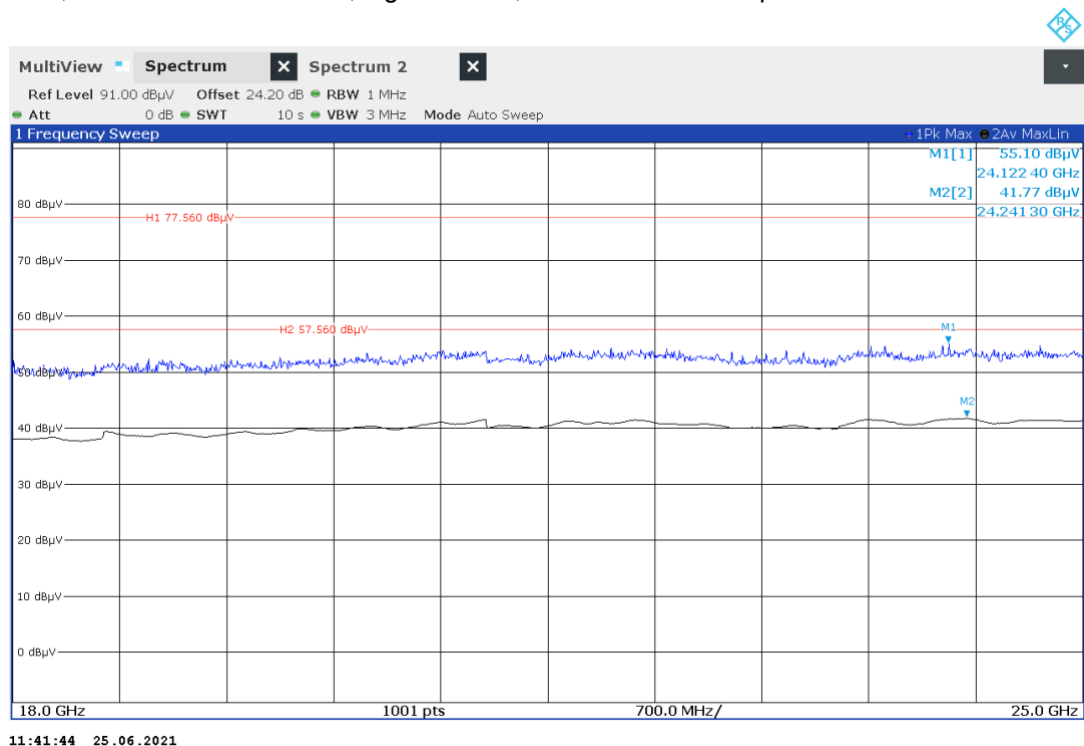
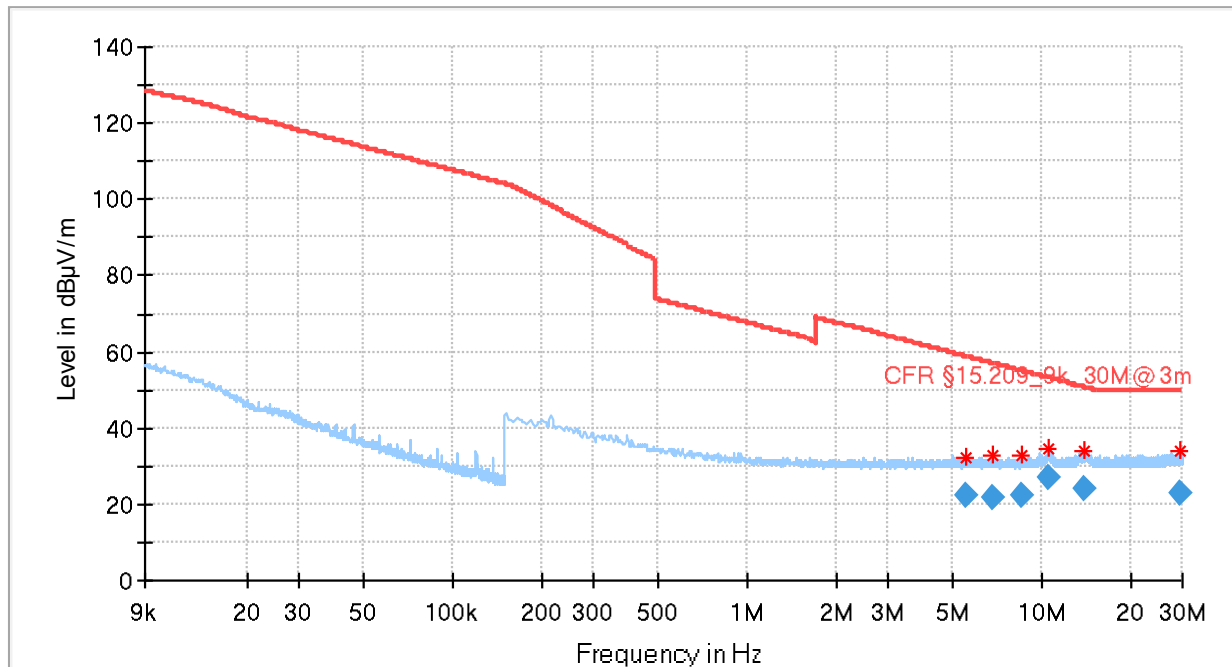


Plot 69: Mode 1, RSE 18 GHz – 25 GHz, high channel, horizontal / vertical polarisation



Plot 70: Mode 4, RSE 9 kHz – 30 MHz, low channel, loop antenna

Full Spectrum

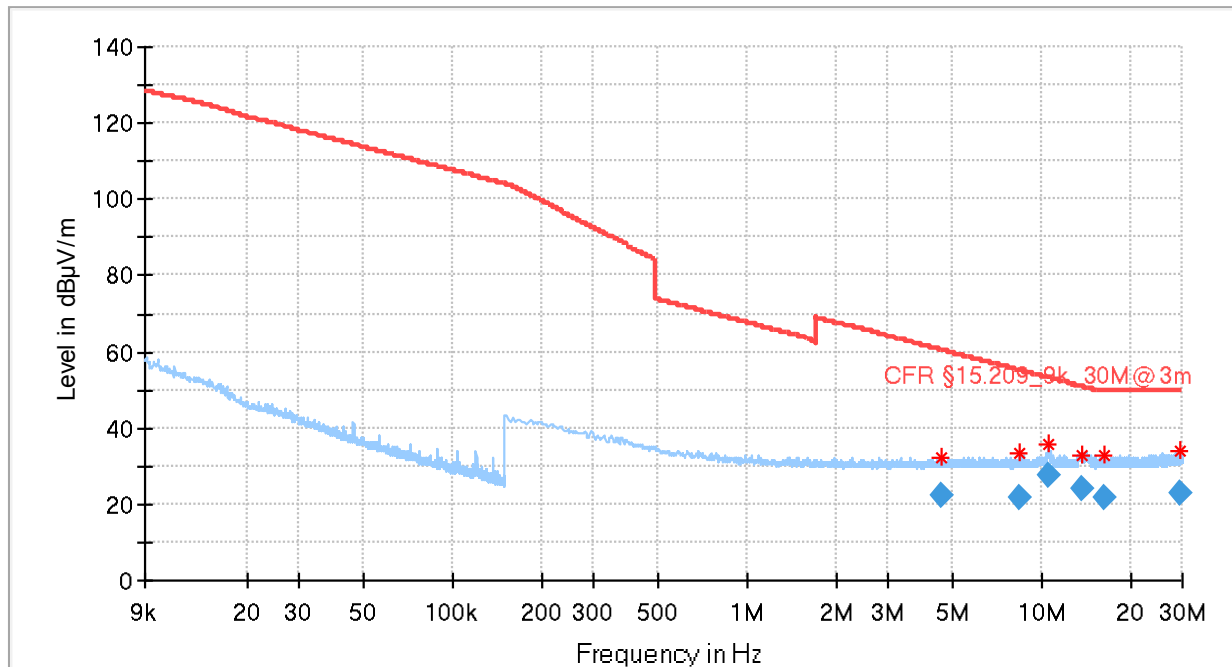


Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)
5.541000	22.17	58.75	36.58	15000.0	9.000	60.0	20.4
6.785250	21.93	56.97	35.04	15000.0	9.000	120.0	20.4
8.614500	22.07	54.89	32.82	15000.0	9.000	240.0	20.5
10.560750	26.79	53.12	26.33	15000.0	9.000	240.0	20.5
13.854750	23.99	50.75	26.77	15000.0	9.000	0.0	20.5
29.467500	22.79	49.54	26.75	15000.0	9.000	60.0	20.8

Plot 71: Mode 4, RSE 9 kHz – 30 MHz, mid channel, loop antenna

Full Spectrum

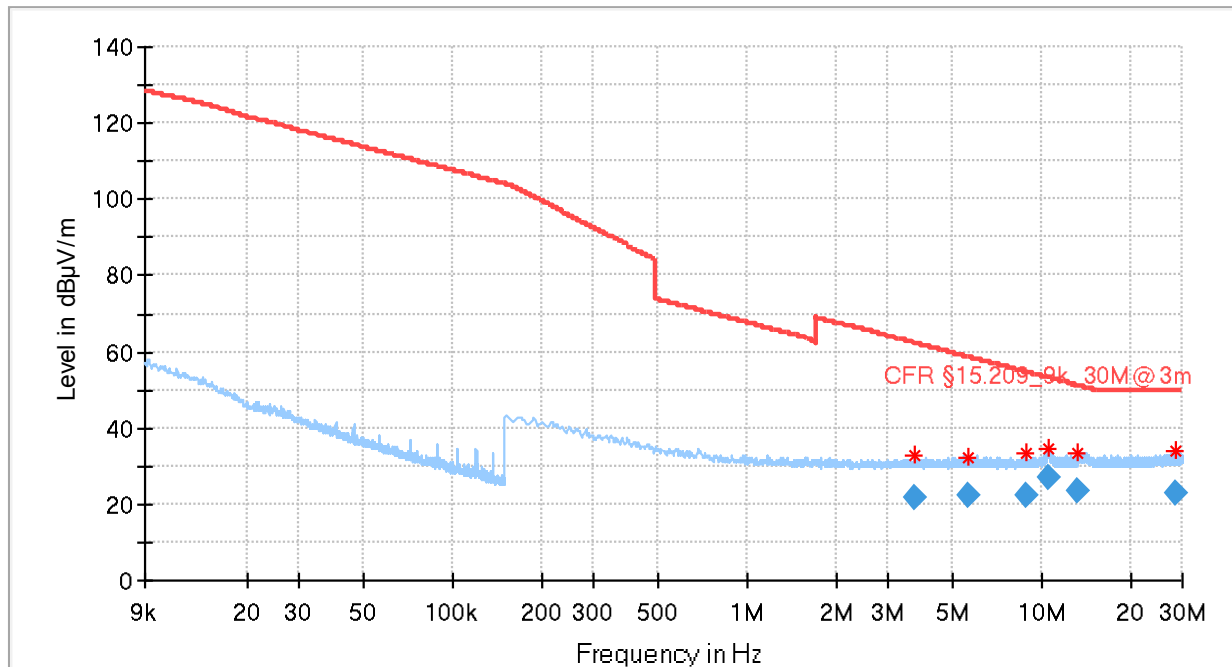


Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)
4.528500	21.98	60.52	38.53	15000.0	9.000	120.0	20.3
8.349000	21.96	55.16	33.20	15000.0	9.000	60.0	20.4
10.536000	27.32	53.14	25.82	15000.0	9.000	120.0	20.5
13.647750	24.07	50.89	26.82	15000.0	9.000	240.0	20.5
16.428750	21.83	49.54	27.71	15000.0	9.000	180.0	20.5
29.361750	22.86	49.54	26.68	15000.0	9.000	180.0	20.8

Plot 72: Mode 4, RSE 9 kHz – 30 MHz, high channel, loop antenna

Full Spectrum

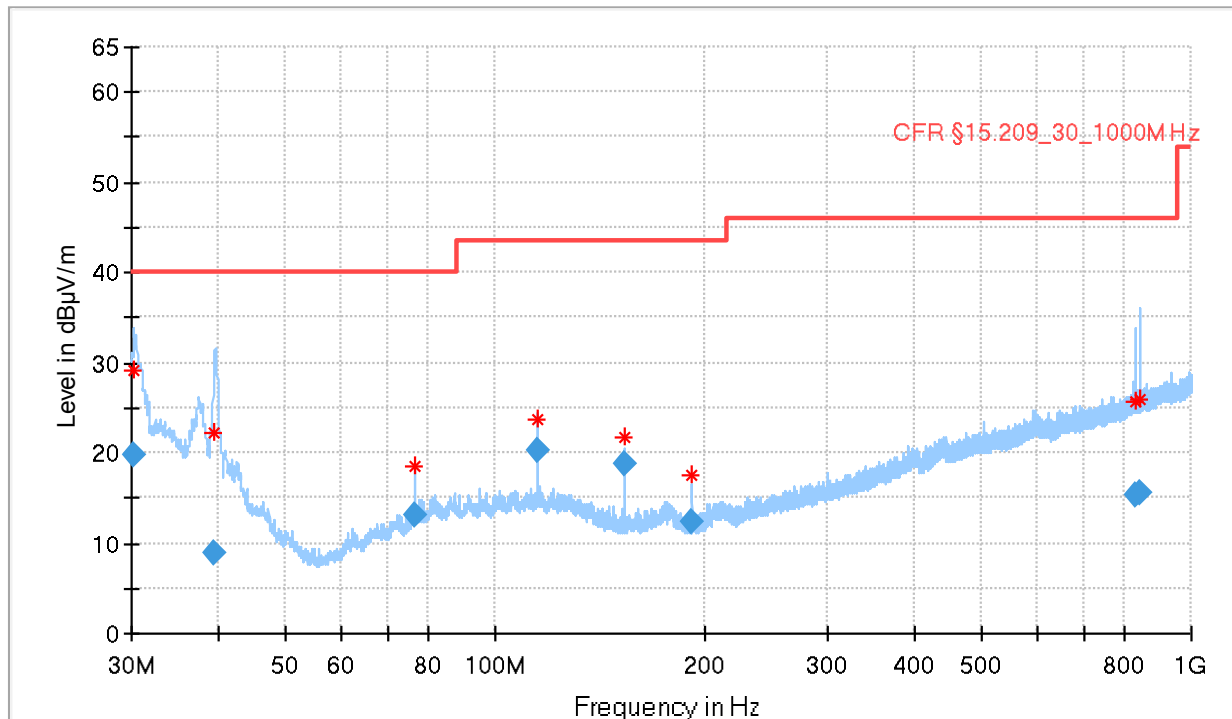


Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)
3.709500	21.66	62.27	40.60	15000.0	9.000	240.0	20.3
5.637750	22.04	58.59	36.56	15000.0	9.000	180.0	20.4
8.812500	22.07	54.68	32.61	15000.0	9.000	0.0	20.5
10.558500	26.99	53.12	26.13	15000.0	9.000	300.0	20.5
13.285500	23.49	51.12	27.63	15000.0	9.000	0.0	20.5
28.563000	22.86	49.54	26.68	15000.0	9.000	120.0	20.8

Plot 73: Mode 4, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation

Full Spectrum

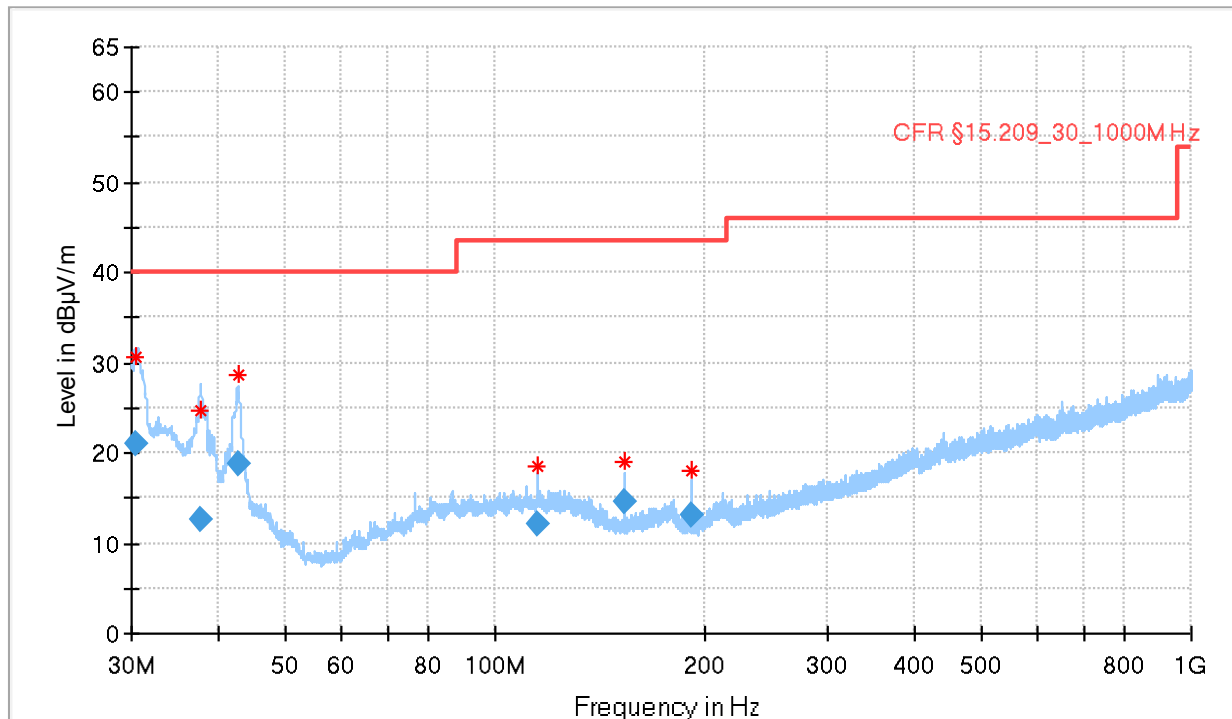


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.330000	19.76	40.00	20.24	15000.0	120.000	103.0	V	-29.0	20.4
39.510000	8.89	40.00	31.11	15000.0	120.000	122.0	V	17.0	15.3
76.800000	13.17	40.00	26.83	15000.0	120.000	122.0	V	162.0	10.9
115.200000	20.19	43.50	23.31	15000.0	120.000	130.0	V	57.0	13.1
153.600000	18.68	43.50	24.82	15000.0	120.000	124.0	H	-18.0	10.4
192.000000	12.34	43.50	31.16	15000.0	120.000	121.0	H	17.0	10.5
832.950000	15.22	46.00	30.78	15000.0	120.000	400.0	V	188.0	23.4
840.960000	15.55	46.00	30.45	15000.0	120.000	370.0	V	182.0	23.4

Plot 74: Mode 4, RSE 30 MHz – 1 GHz, mid channel, horizontal / vertical polarisation

Full Spectrum

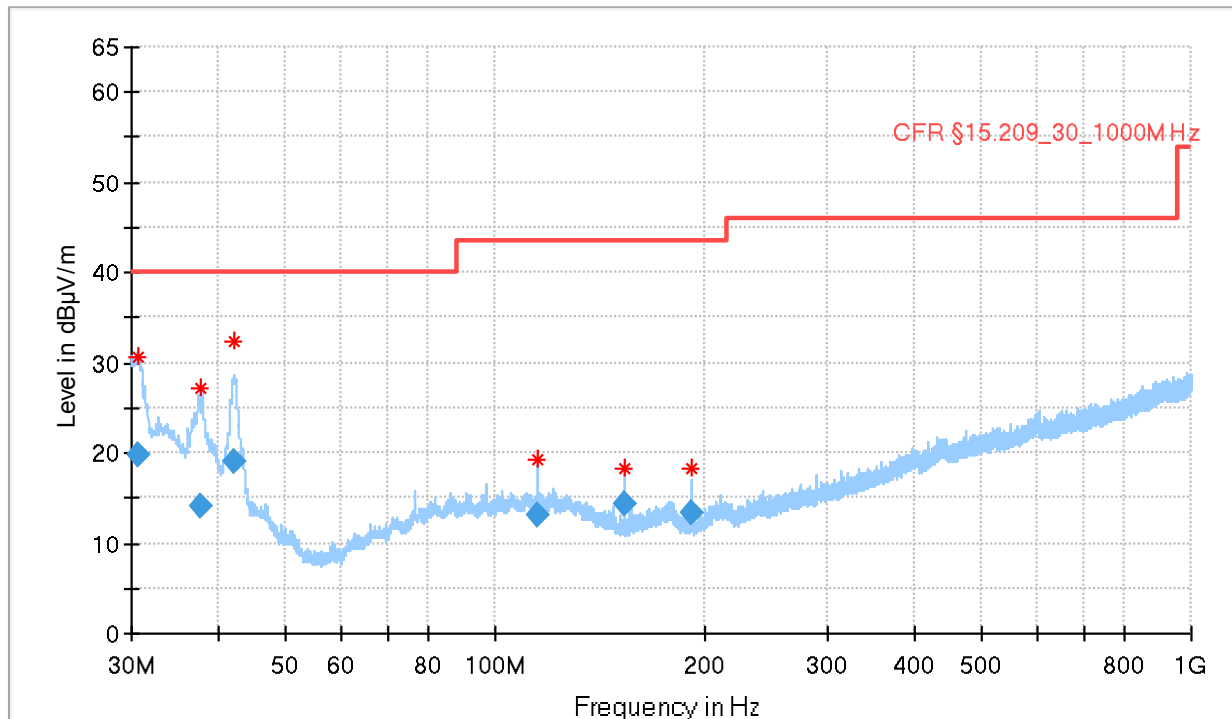


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.390000	20.89	40.00	19.11	15000.0	120.000	100.0	V	21.0	20.4
37.680000	12.72	40.00	27.28	15000.0	120.000	100.0	V	77.0	16.4
42.600000	18.85	40.00	21.15	15000.0	120.000	103.0	V	283.0	13.3
115.200000	12.03	43.50	31.47	15000.0	120.000	100.0	V	257.0	13.1
153.600000	14.59	43.50	28.91	15000.0	120.000	100.0	V	167.0	10.4
192.000000	13.07	43.50	30.43	15000.0	120.000	103.0	H	9.0	10.5

Plot 75: Mode 4, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation

Full Spectrum

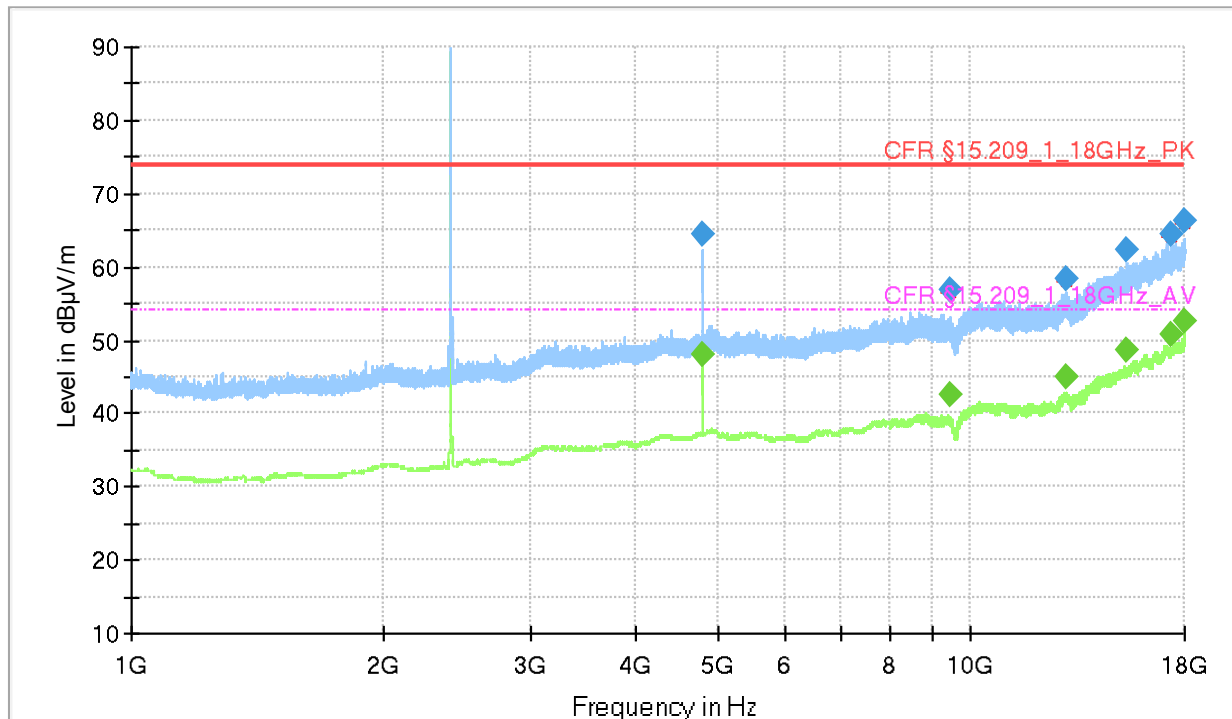


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.660000	19.70	40.00	20.30	15000.0	120.000	100.0	V	-28.0	20.2
37.830000	14.19	40.00	25.81	15000.0	120.000	100.0	V	17.0	16.3
42.060000	19.03	40.00	20.97	15000.0	120.000	122.0	V	236.0	13.7
115.200000	13.00	43.50	30.50	15000.0	120.000	130.0	V	37.0	13.1
153.600000	14.46	43.50	29.04	15000.0	120.000	100.0	V	178.0	10.4
192.000000	13.46	43.50	30.04	15000.0	120.000	130.0	H	-17.0	10.5

Plot 76: Mode 4, RSE 1 GHz – 18 GHz, low channel, horizontal / vertical polarisation

Full Spectrum

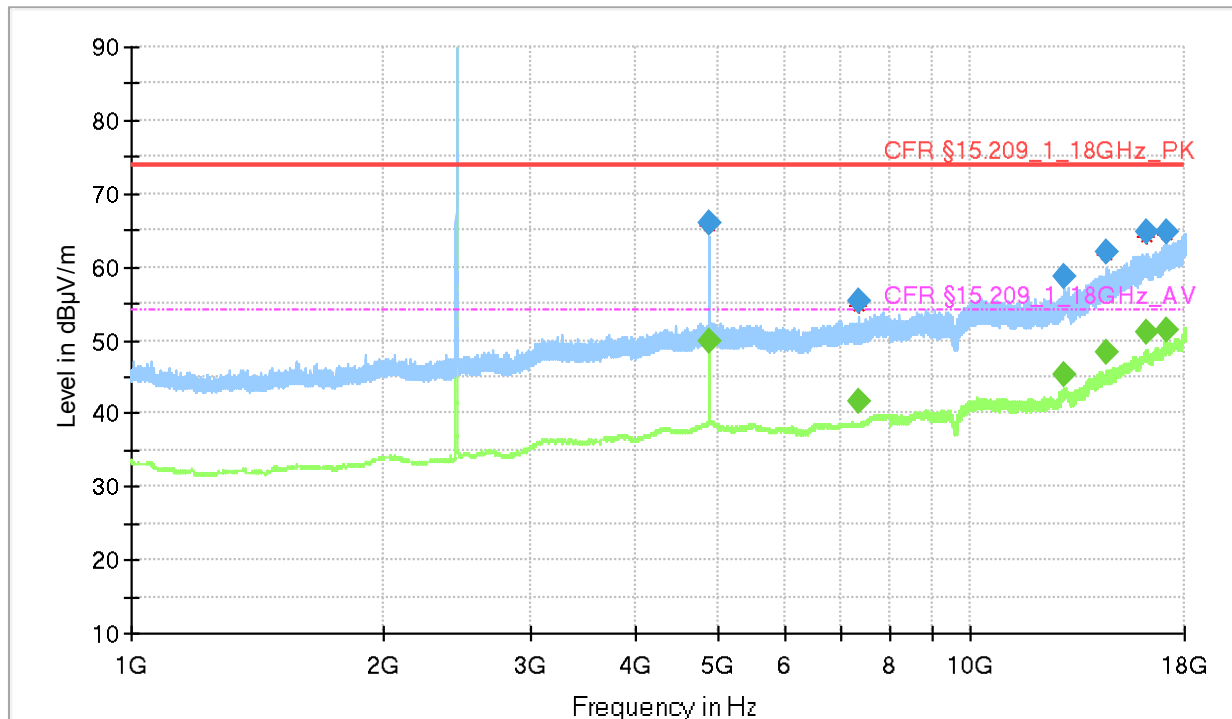


Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
4803.925000	64.32	---	74.00	9.68	15000.0	1000.000	V	229.0	20.4
4803.925000	---	48.14	54.00	5.86	15000.0	1000.000	V	229.0	20.4
9434.875000	56.89	---	74.00	17.11	15000.0	1000.000	H	300.0	26.2
9434.875000	---	42.63	54.00	11.37	15000.0	1000.000	H	300.0	26.2
12987.000000	58.46	---	74.00	15.54	15000.0	1000.000	H	249.0	29.3
12987.000000	---	45.07	54.00	8.93	15000.0	1000.000	H	249.0	29.3
15361.200000	62.25	---	74.00	11.75	15000.0	1000.000	V	2.0	33.1
15361.200000	---	48.74	54.00	5.26	15000.0	1000.000	V	2.0	33.1
17344.900000	---	50.91	54.00	3.09	15000.0	1000.000	H	217.0	35.8
17344.900000	64.50	---	74.00	9.50	15000.0	1000.000	H	217.0	35.8
17947.870000	66.30	---	74.00	7.70	15000.0	1000.000	H	295.0	37.3
17947.870000	---	52.64	54.00	1.36	15000.0	1000.000	H	295.0	37.3

Plot 77: Mode 4, RSE 1 GHz – 18 GHz, mid channel, horizontal / vertical polarisation

Full Spectrum

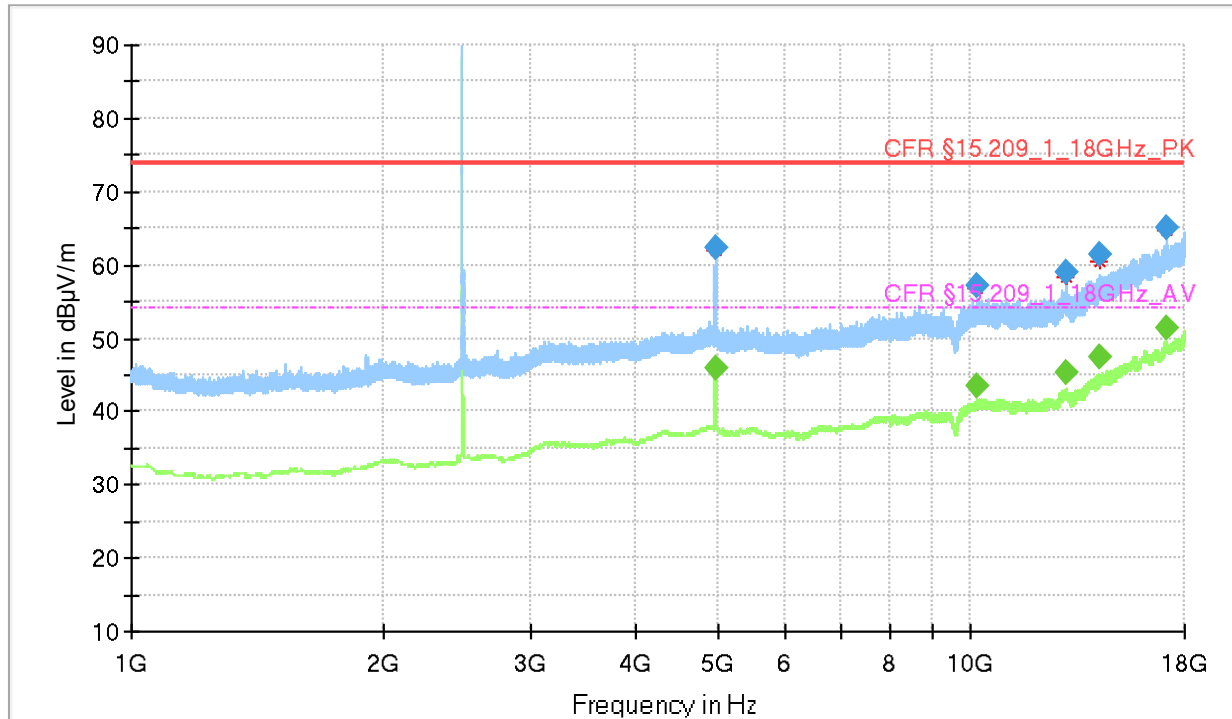


Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
4879.900000	66.11	---	74.00	7.89	15000.0	1000.000	V	282.0	20.6
4879.900000	---	49.84	54.00	4.16	15000.0	1000.000	V	282.0	20.6
7383.950000	---	41.52	54.00	12.48	15000.0	1000.000	V	269.0	23.5
7383.950000	55.24	---	74.00	18.76	15000.0	1000.000	V	269.0	23.5
12926.47500	58.63	---	74.00	15.37	15000.0	1000.000	H	133.0	29.2
12926.47500	---	45.29	54.00	8.71	15000.0	1000.000	H	133.0	29.2
14566.47500	62.05	---	74.00	11.95	15000.0	1000.000	V	52.0	32.5
14566.47500	---	48.18	54.00	5.82	15000.0	1000.000	V	52.0	32.5
16236.35000	64.88	---	74.00	9.12	15000.0	1000.000	H	11.0	34.0
16236.35000	---	50.96	54.00	3.04	15000.0	1000.000	H	11.0	34.0
17147.00000	64.89	---	74.00	9.11	15000.0	1000.000	V	249.0	35.5
17147.00000	---	51.27	54.00	2.73	15000.0	1000.000	V	249.0	35.5

Plot 78: Mode 4, RSE 1 GHz – 18 GHz, high channel, horizontal / vertical polarisation

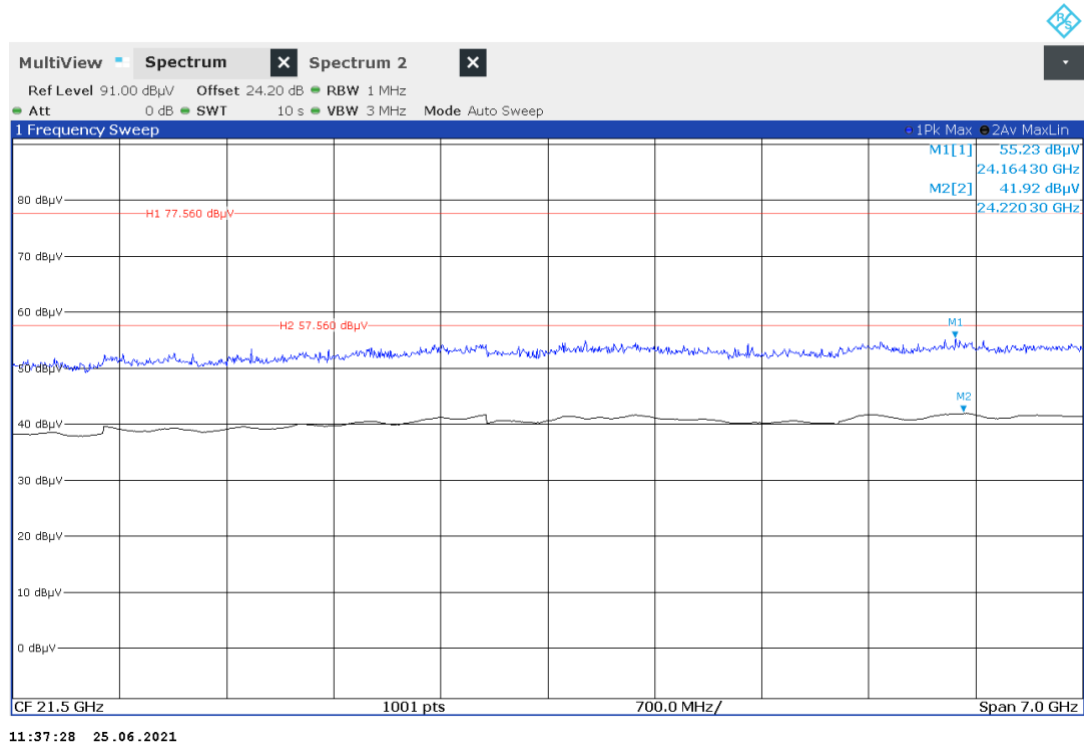
Full Spectrum



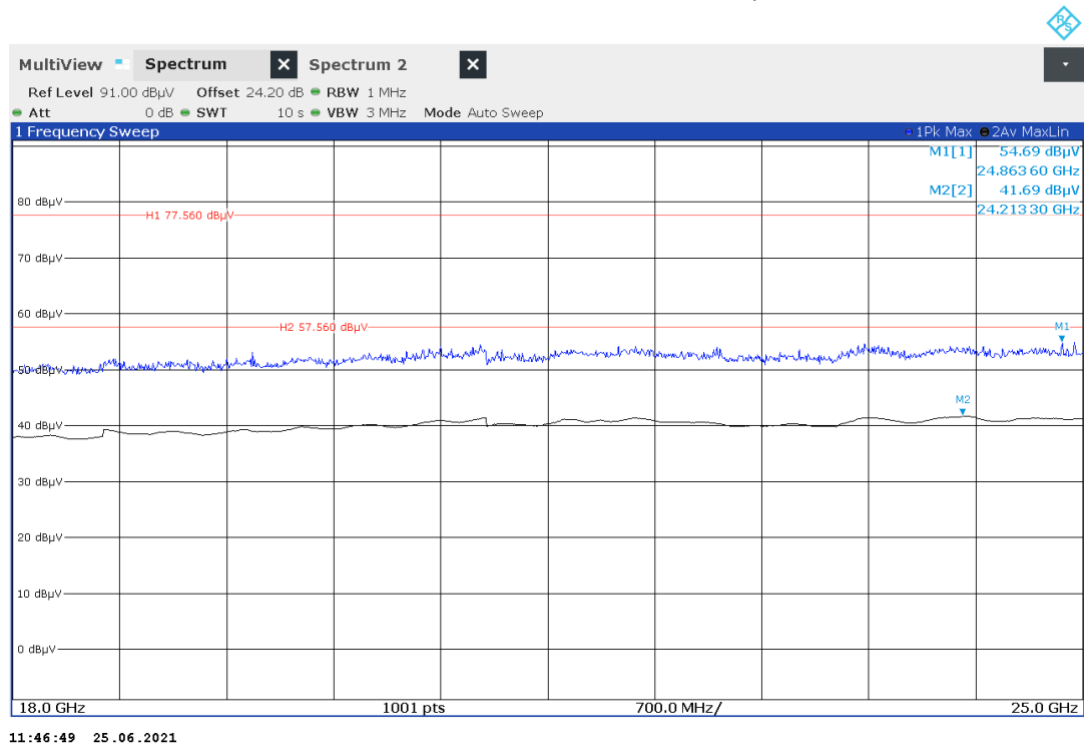
Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
4960.975000	62.26	---	74.00	11.74	15000.0	1000.000	V	333.0	20.8
4960.975000	---	46.00	54.00	8.00	15000.0	1000.000	V	333.0	20.8
10207.57500	57.01	---	74.00	16.99	15000.0	1000.000	H	341.0	26.9
10207.57500	---	43.53	54.00	10.47	15000.0	1000.000	H	341.0	26.9
12972.12500	58.88	---	74.00	15.12	15000.0	1000.000	H	244.0	29.2
12972.12500	---	45.14	54.00	8.86	15000.0	1000.000	H	244.0	29.2
14286.47500	---	47.33	54.00	6.67	15000.0	1000.000	V	51.0	32.0
14286.47500	61.52	---	74.00	12.48	15000.0	1000.000	V	51.0	32.0
17095.50000	---	51.36	54.00	2.64	15000.0	1000.000	H	58.0	35.4
17095.50000	65.19	---	74.00	8.81	15000.0	1000.000	H	58.0	35.4

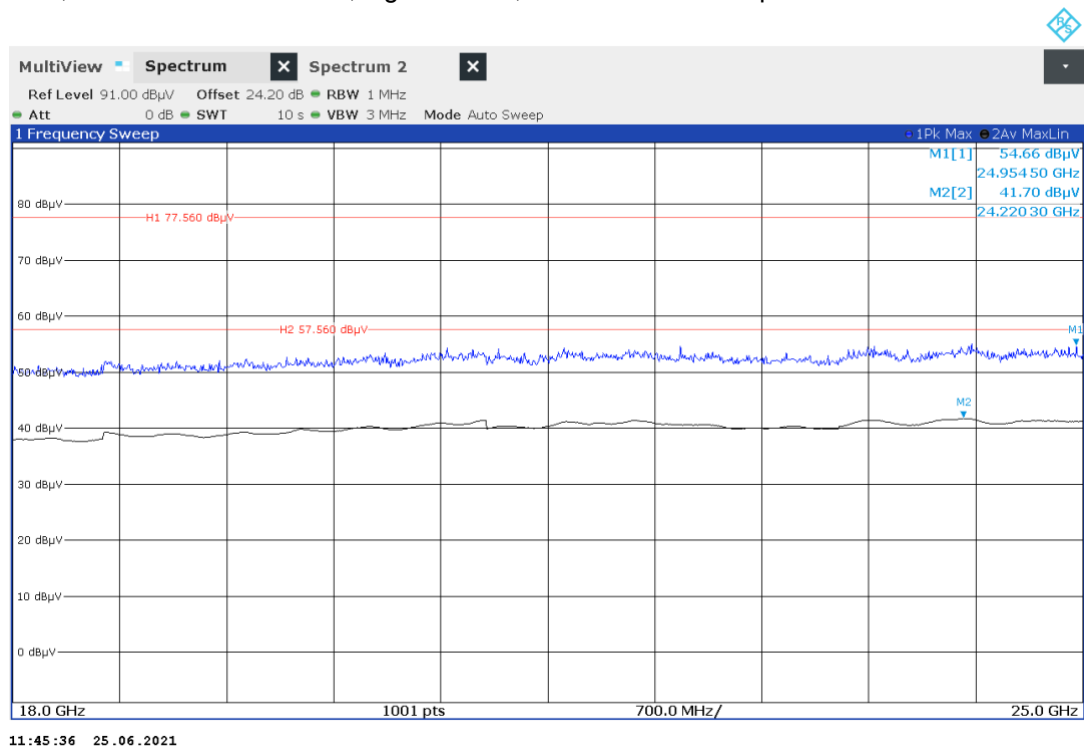
Plot 79: Mode 4, RSE 18 GHz – 25 GHz, low channel, horizontal / vertical polarisation



Plot 80: Mode 4, RSE 18 GHz – 25 GHz, mid channel, horizontal / vertical polarisation



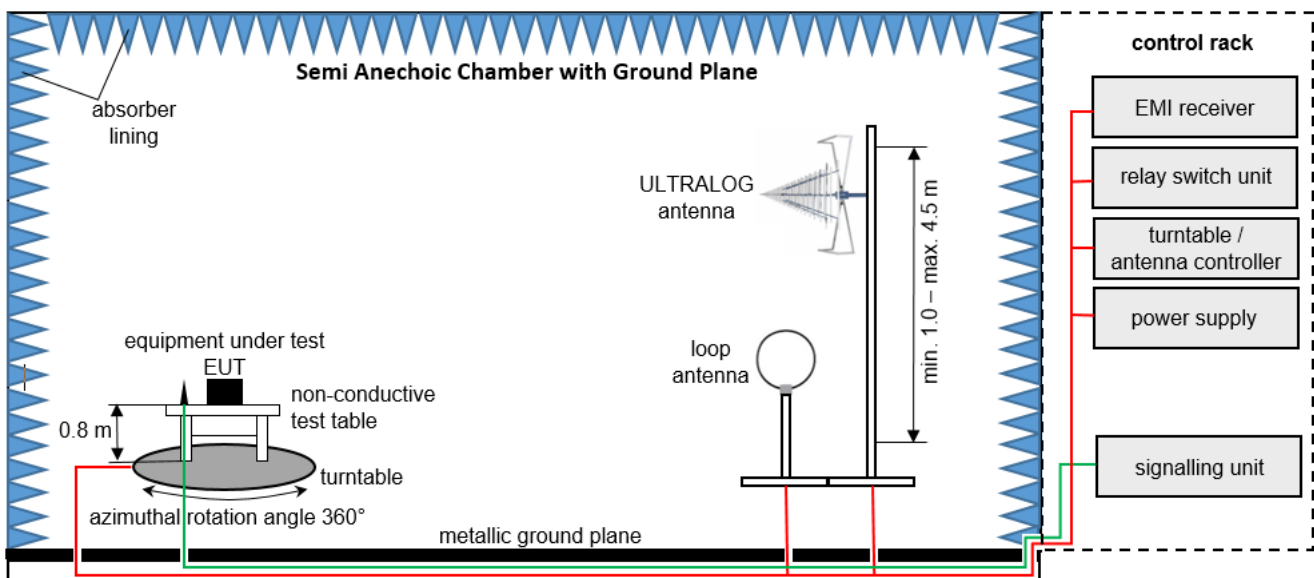
Plot 81: Mode 4, RSE 18 GHz – 25 GHz, high channel, horizontal / vertical polarisation



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)

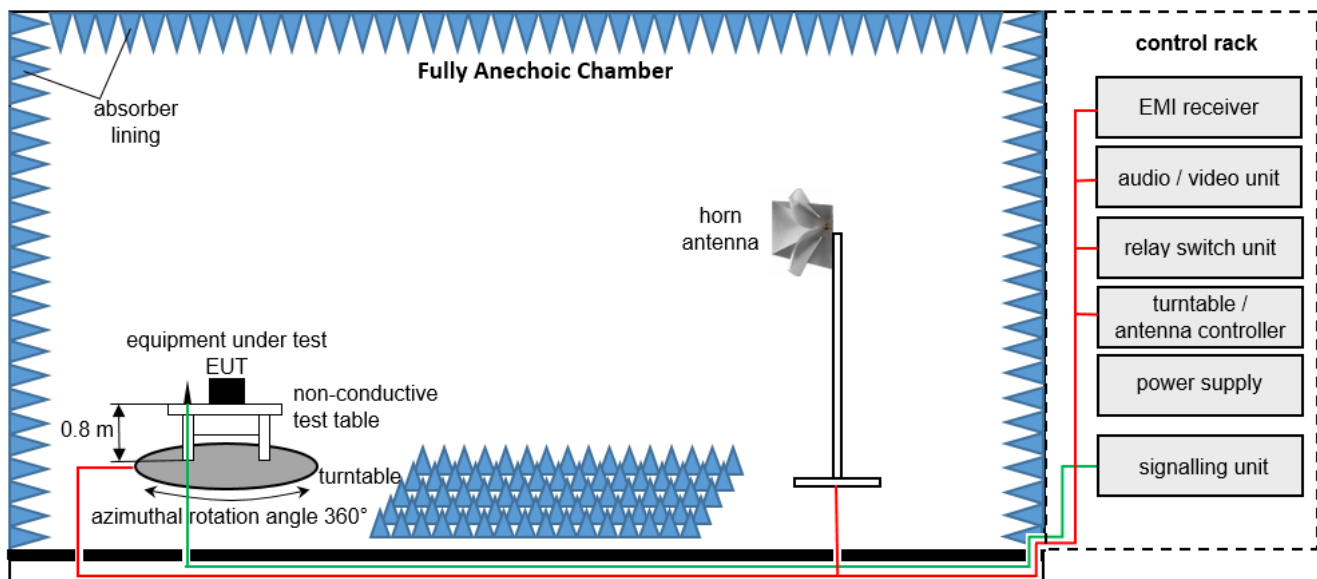
Example calculation:

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

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	101481	LAB000236	2020-06-03 → 2021-06-03
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	2020-07-07 → 2021-07-07
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
18	EMI Test Receiver	Rohde & Schwarz	ESW26	101512	LAB000363	2021-02-05 → 2022-02-05

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)

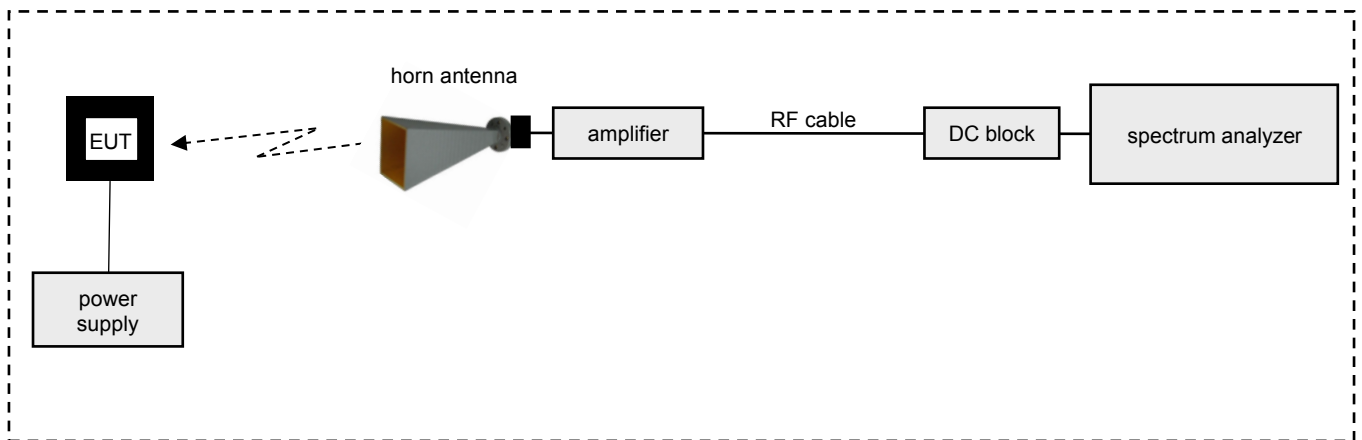
Example calculation:

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

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	mature GmbH	TD 1.5-10KG		LAB000258	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	2020-06-03 → 2021-06-03
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	mature GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	–
10	Antenna Mast	mature GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	–
11	Controller	mature 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	2020-07-07 → 2021-07-07
15	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	2020-04-23 → 2023-04-23
16	EMI Test Receiver	Rohde & Schwarz	ESW26	101512	LAB000363	2021-02-05 → 2022-02-05

8.3 Radiated measurements > 18 GHz

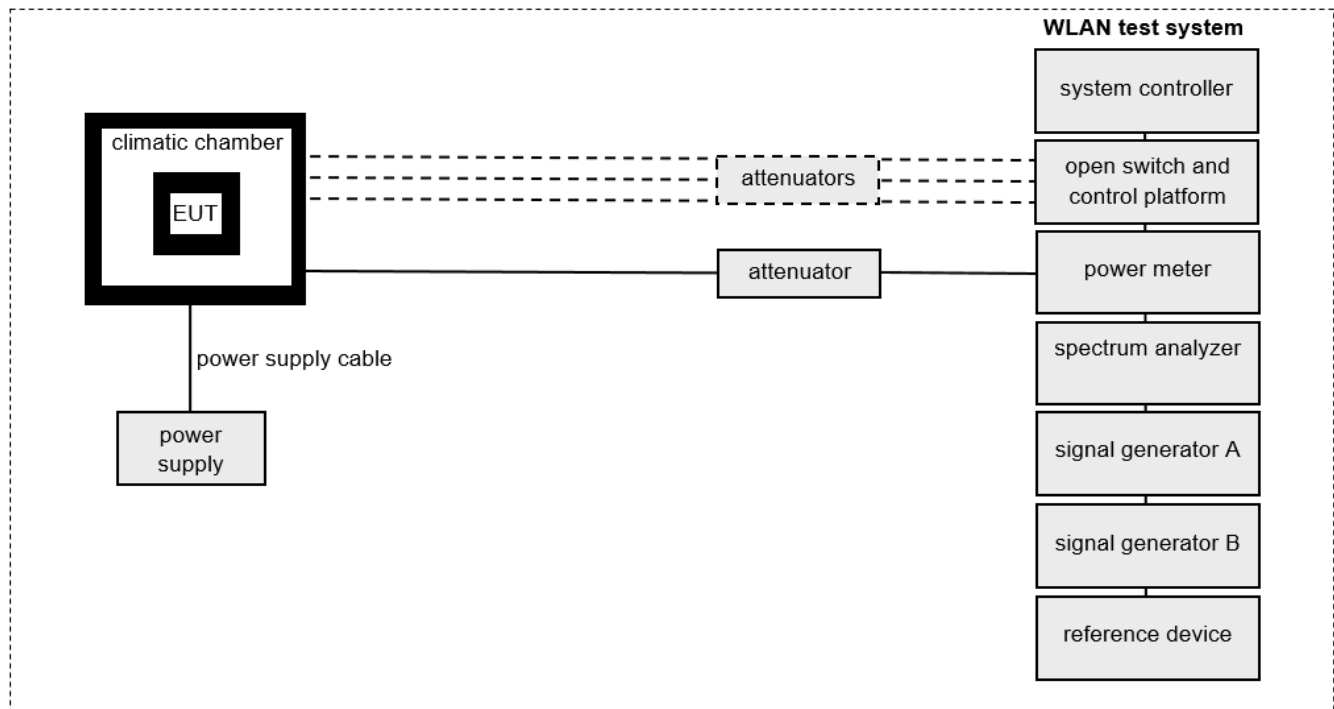


List of test equipment used:

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	2020-07-01 → 2021-07-01
3	Coaxial Cable	Huber & Suhner	SF101/1.5m	503987/1	LAB000165	2020-06-05 → 2022-06-05
4	Antenna	Flann Microwave Ltd	20240-20	266403	LAB000128	2020-06-29 → 2021-06-29
5	Spectrum Analyser	Rohde & Schwarz	FSW50	101450	LAB000111	2020-05-05 → 2022-05-05

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 Verification
1	TS8997-Rack	Rohde & Schwarz	TS8997-Rack	100829	LAB000322	–
2	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157WX	101247	LAB000280	2021-01-11
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157W8	100982	LAB000279	2021-01-11
4	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	2021-01-11
5	Signal Generator	Rohde & Schwarz	SMBV100A	258240	LAB000277	2021-01-11
6	Signal Generator	Rohde & Schwarz	SMB100A-20	178175	LAB000276	2021-01-11
7	Radio Communication Tester	Rohde & Schwarz	CMW270	101479	LAB000275	2021-01-11
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	$\leq \pm 2.5 \text{ °C}$
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 %.

Annex A EUT Photographs, external

Photo No. 1:



Photo No. 2:



Photo No. 3:



Photo No. 4:



Photo No. 5:

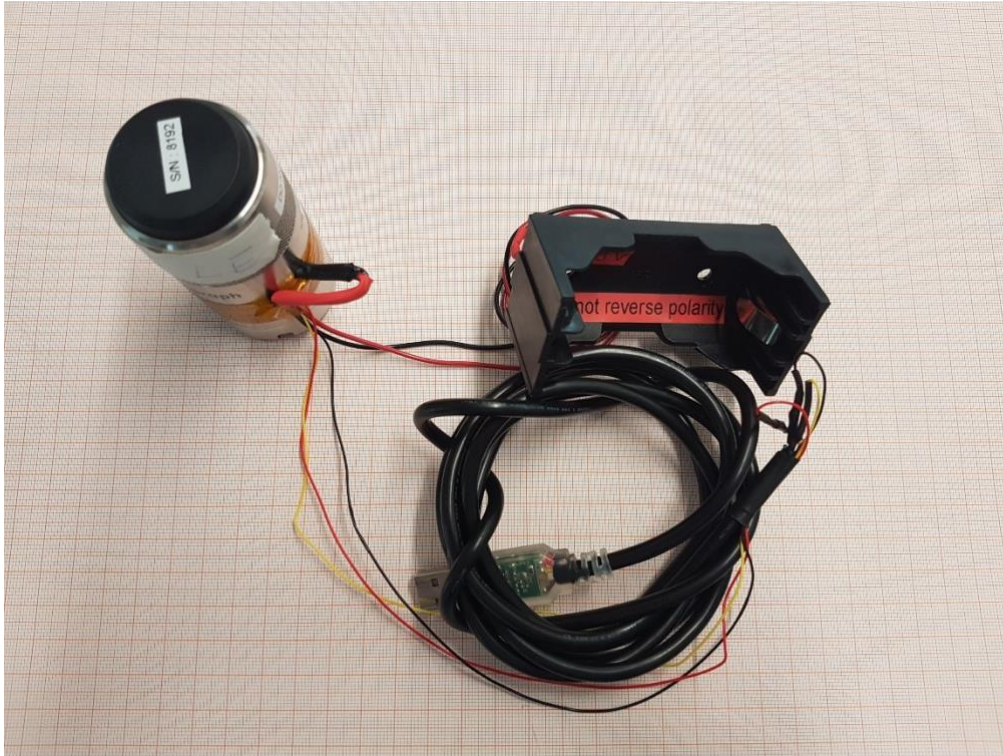


Photo No. 6:



Photo No. 7:



Photo No. 8:



Photo No. 9:



Photo No. 10:



Photo No. 11:



Annex B EUT Photographs, internal

Photo No. 12:

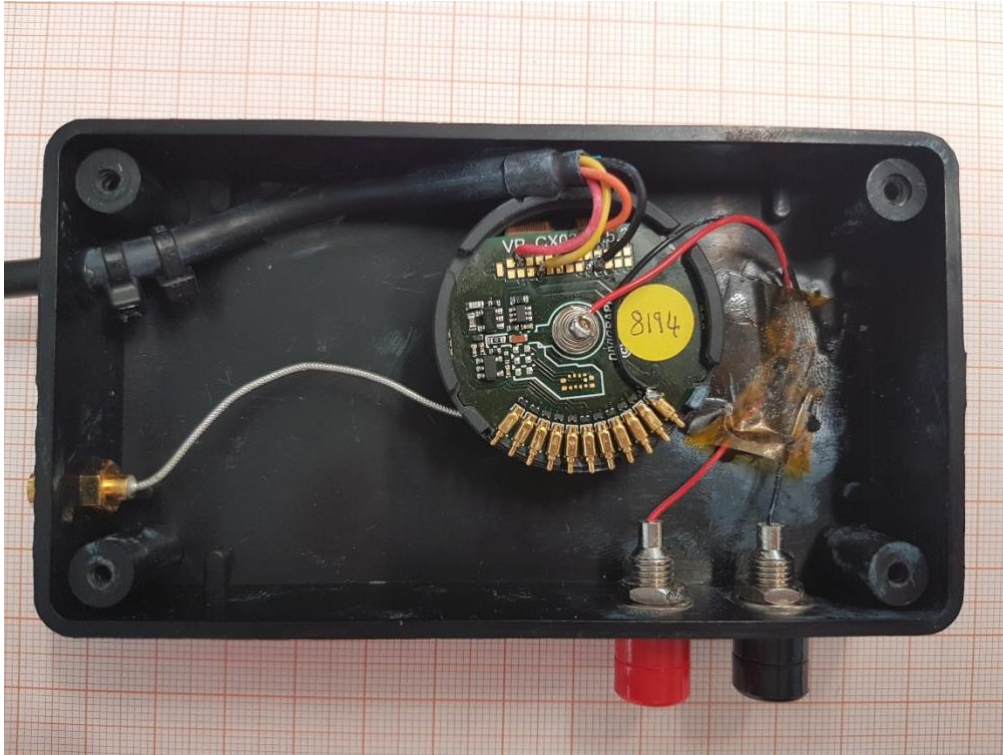


Photo No. 13:



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2021-07-29

Photo No. 14:

Photo No. 15:

Annex C Test Setup Photographs

Photo No. 16:

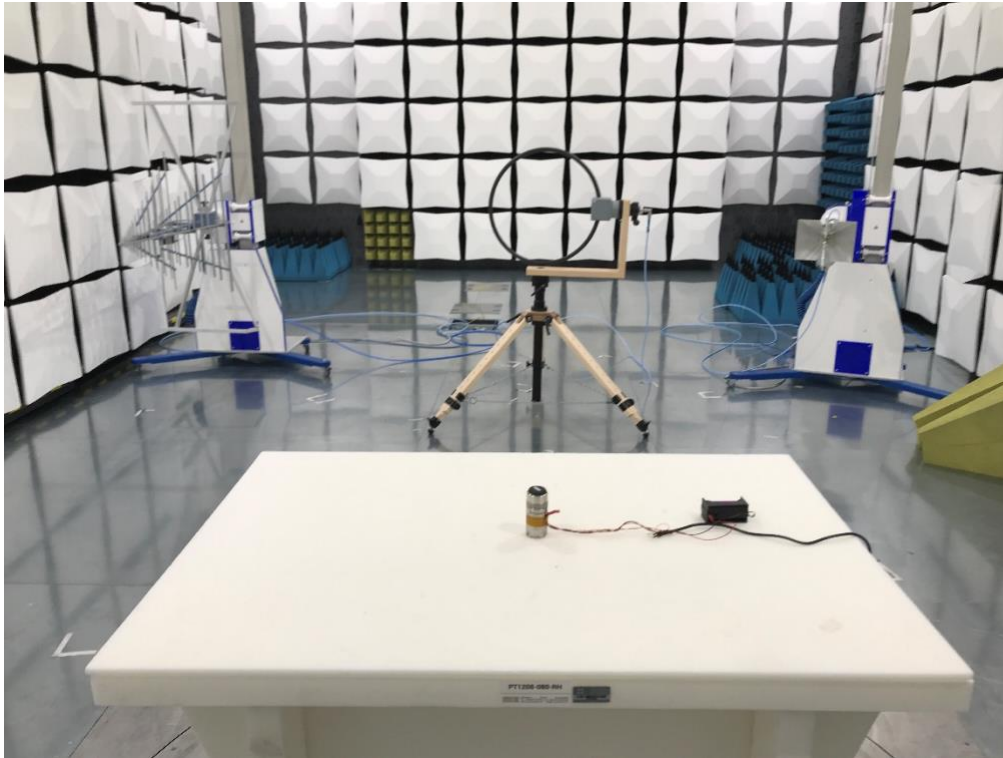


Photo No. 17:

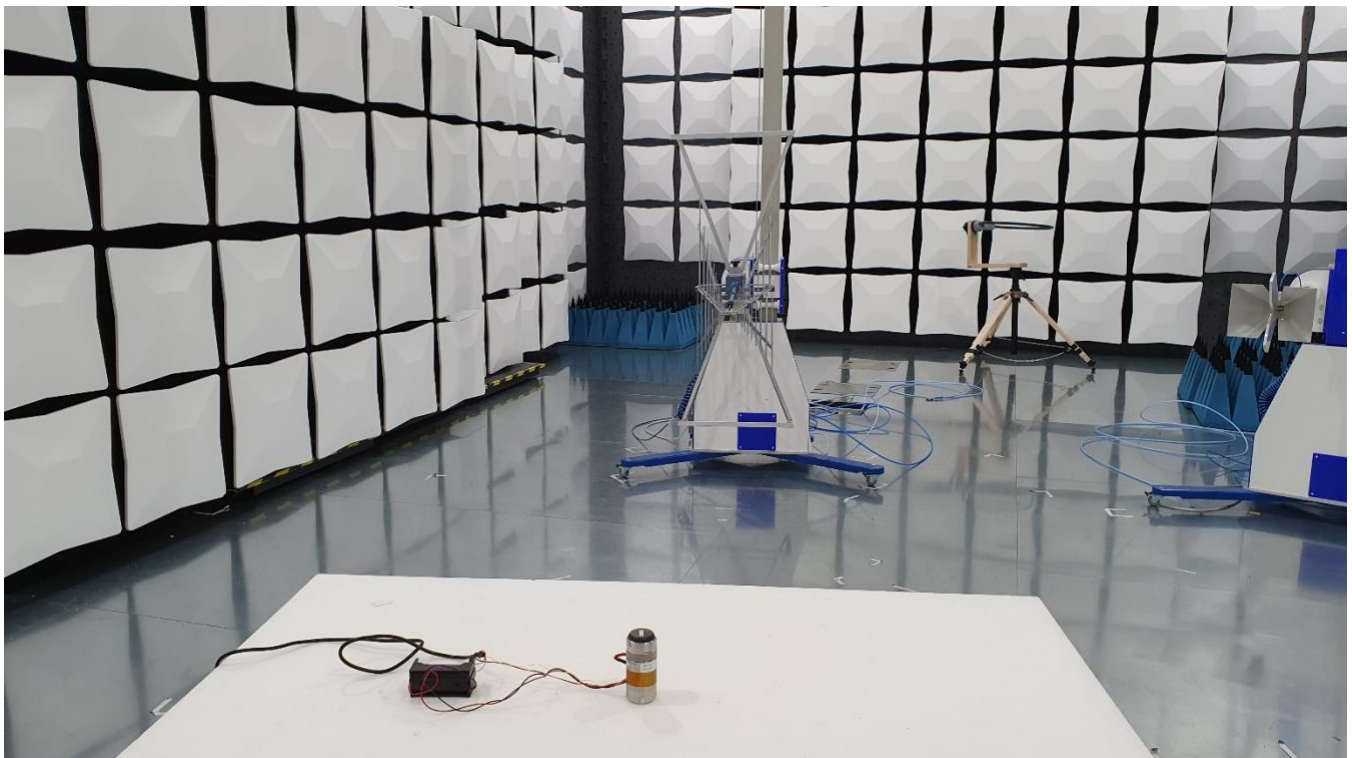


Photo No. 18:

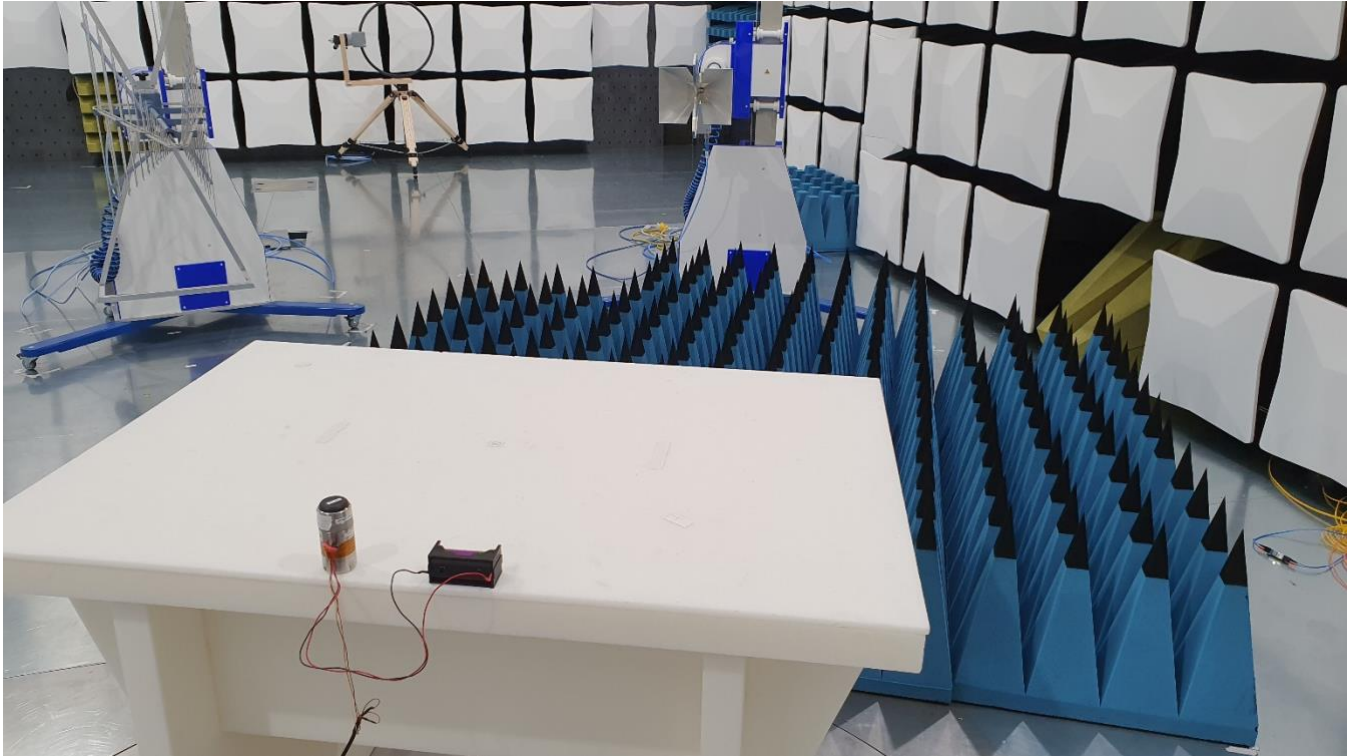


Photo No. 19:

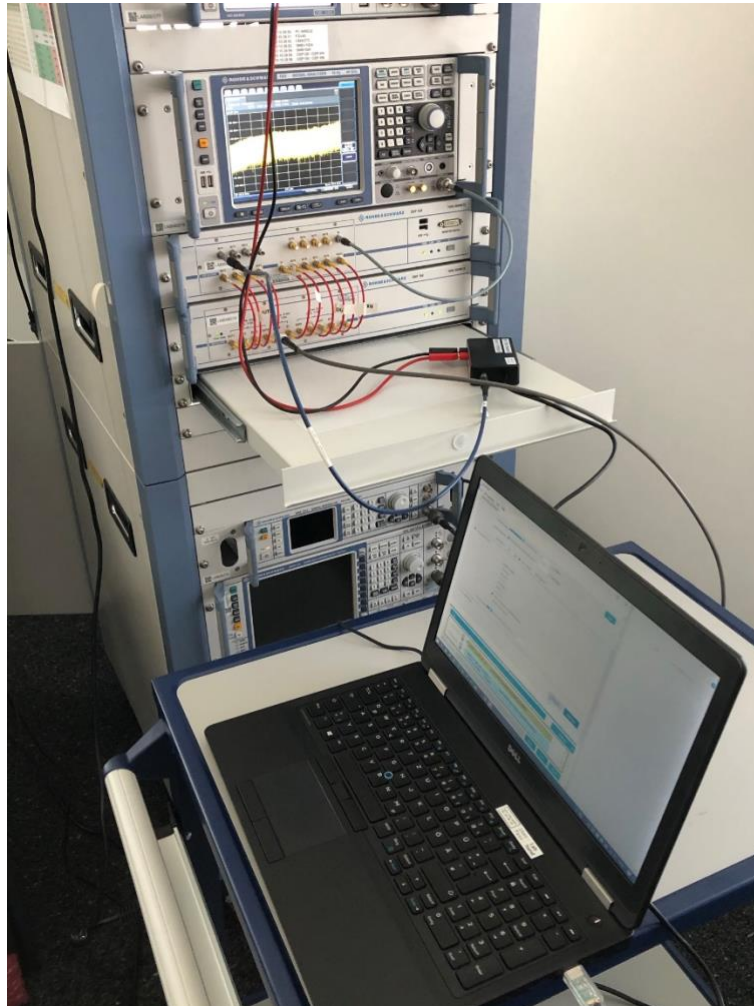


Photo No. 20:

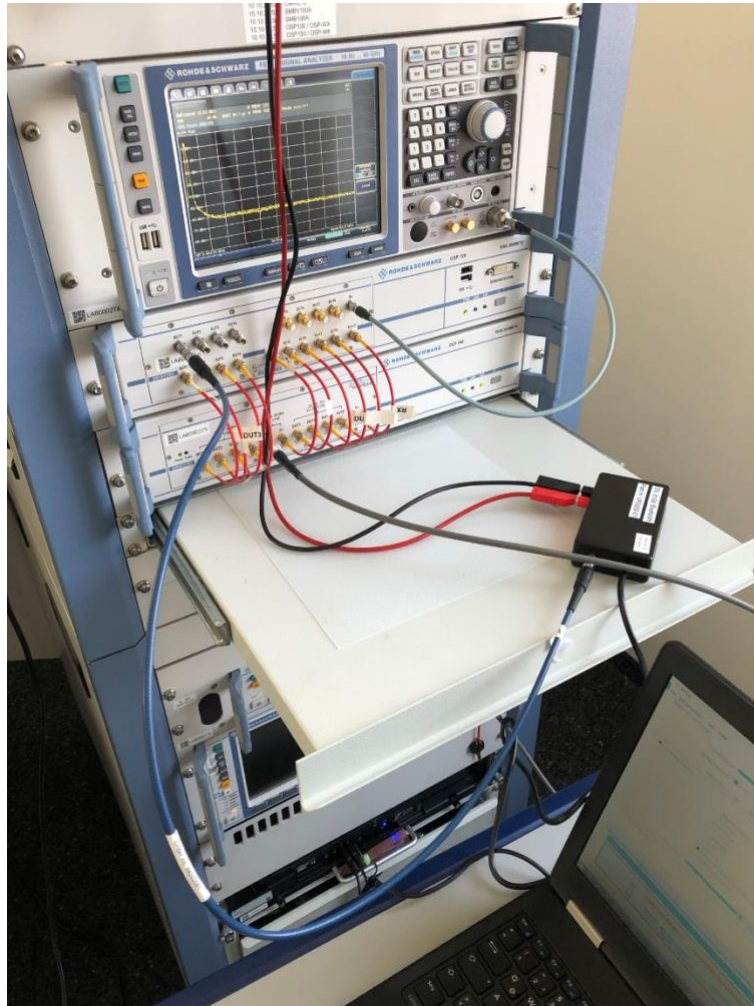


Photo No. 21:



End of Test Report
