FCC Test Report

For:
Rohde & Schwarz

Model:
QAR

Product Description:
Quality Automotive Radome Tester

FCC ID: KVW-QAR

Applied Rules and Standards:
47 CFR Parts: 18

REPORT #: EMC_ROHDE-001-20001_FCC_18

DATE: 2021-05-27

A2LA Accredited

IC recognized #
3462B

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following device as further described in section 3 of this report was evaluated against the applicable criteria specified in the Code of Federal Regulations Title 47 part 18

No deficiencies were ascertained.

Company	Description	Model #
Rohde & Schwarz	QAR Quality Automotive Radome Tester	QAR

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2021-05-27	Compliance	Kevin Wang (EMC Lab Manager)	kevin.wang@cetecom.com Digitally signed by: kevin.wang@cetecom.com DN: CN = kevin.wang@cetecom.com Date: 2021.05.27 17:42:04 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2021-05-27	Compliance	Yuchan Lu (EMC Engineer)	Yuchan Lu Digitally signed by: Yuchan Lu DN: CN = Yuchan Lu email = Yuchan.Lu@cetecom.com C = US O = CETECOM Inc. OU = EMC Date: 2021.05.27 17:43:36 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Kevin Wang
Responsible Project Leader:	Yuchan Lu

2.2 Identification of the Client

Client Firm/Name:	Rohde & Schwarz USA, Inc.
Street Address:	6821 Benjamin Frankline Drive
City/Zip Code	Columbia MD / 21046
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	----------
City/Zip Code	----------
Country	----------

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No	QAR
HW Version	02
SW Version	5.07.34
FCC-ID	KVW-QAR
Operating Voltage Range	200 – 240VAC
Operating Temperature Range	Tmin: 10 ºC / Tmax: 38 ºC
Radios included in the device	Operation frequency range depends on the operation modes listed as below: K10 option: 74-79GHz, 64 frequencies, 92.16us tx time on single frequency K60 option: 76-81GHz, 64 frequencies, 92.16us tx time on single frequency K100 option: 71-81GHz, 128 frequencies, 92.16us tx time on single frequency Z10 option: 72-82GHz, 64 frequencies, 251us tx time on single frequency
Sample Revision	☐Prototype ■Production ☐ Pre-Production
EUT Dimensions	QAR Panel: 60 * 52 *32 in QAR-Z10 Transmitter module: 14 * 14 * 8 in QAR- Z20 Platform: 60 * 13 * 50 in QAR- Z21 Platform horizontal: 60 * 12 * 32 in
Weight	QAR Panel: 390 lb QAR-Z10 Transmitter module: 13 lb QAR- Z20 Platform: 225 lb QAR- Z21 Platform horizontal: 199 lb

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Comments
1	100656	02	5.07.34	----------

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	-	-	-	-

3.4 Support Equipment (SE) details

SE #	Type	Model	Manufacturer	Serial Number
1	-	-	-	-

3.5 Test Sample Configuration

Set-up #	EUT / AE used for set-up	Comments
1	K100 option	K100 option is chosen as worst case within K10, K60 and k100 options, since K100 option has the widest operating frequency range and maximum operating frequency points
2	Z10 option	-

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to evaluate the compliance of the EUT against the relevant requirements specified in the Code of Federal Regulations Title 47 parts 18.

5 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)
RF conducted measurement	±0.5 dB

5.1 Environmental Conditions during Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

Deviating test conditions are indicated at individual test description where applicable.

5.2 Date of Testing:

02/08/2021 – 03/15/2021

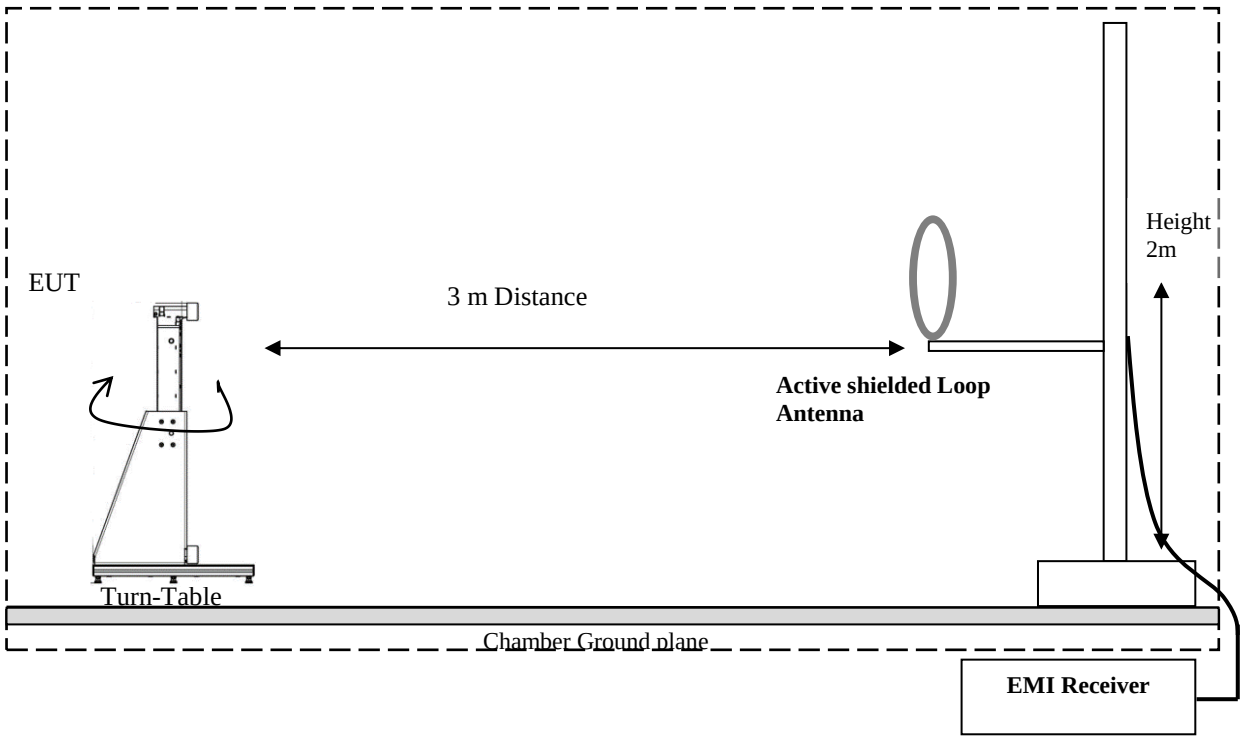
6 Measurement Procedures

Testing is performed according to the guidelines provided in FCC MP-5, "FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical equipment"

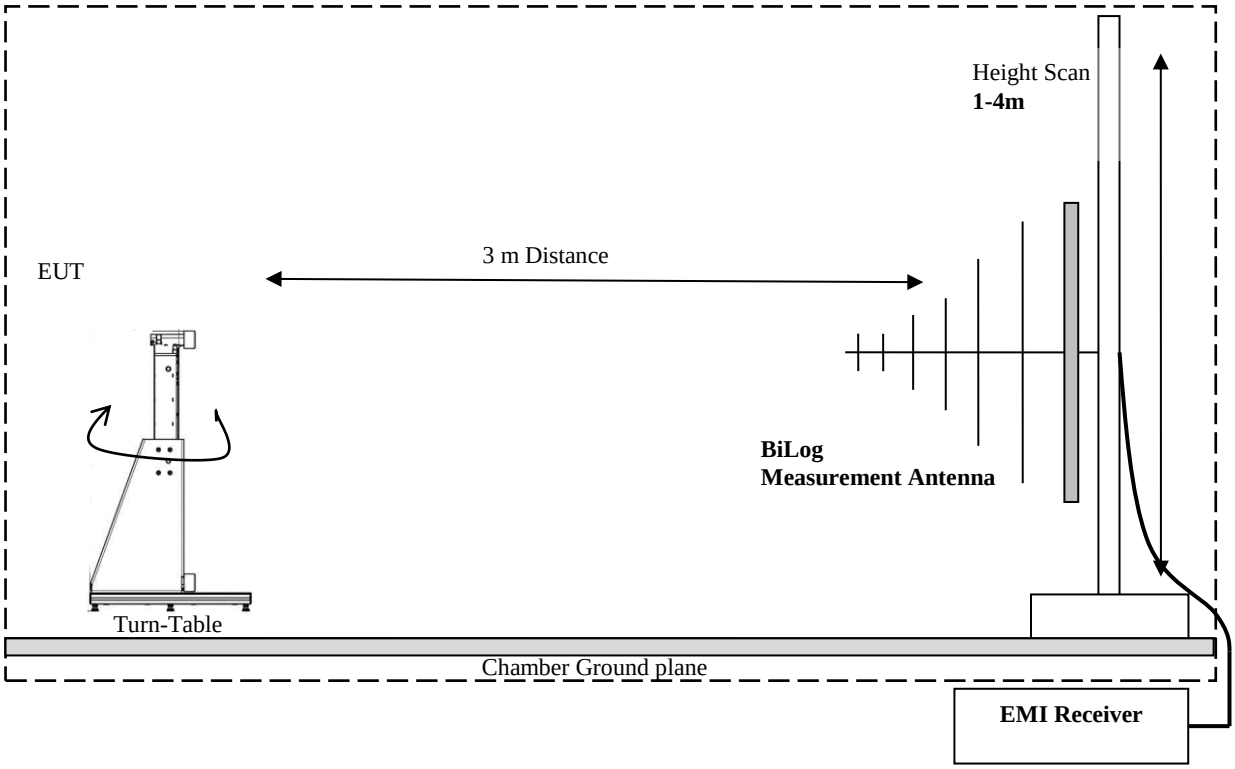
6.1 Radiated Measurement of below 40GHz

- Measurements below 40 GHz are split to five frequency ranges using appropriate antennas and EUT configuration. Active shielded loop antenna is used for up to 30 MHz measurement; Biconilog antenna is used from 30 MHz to 1 GHz; and three different horn antennas are used to cover frequencies up to 40 GHz.
- Exploratory measurements are performed with the EUT rotated from 0° to 360°, the loop antenna is set at around 2 meters, the other antennas height are varied from 1 and 4 meters, the height scans apply fro both horizontal and vertical polarization.
- Using the orientation and equipment arrangement of the EUT, based on the measurement results found during the exploratory measurement, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit are selected for the final measurement.
- In case there are no emissions above noise floor, only the maximum trace is reported as described above.
- Measuring distance between the measuring set antenna and EUT is measured from the closest point of the EUT, and determined by the boundary defined by an imaginary straight line periphery describing a simple geometric configuration enclosing the EUT system

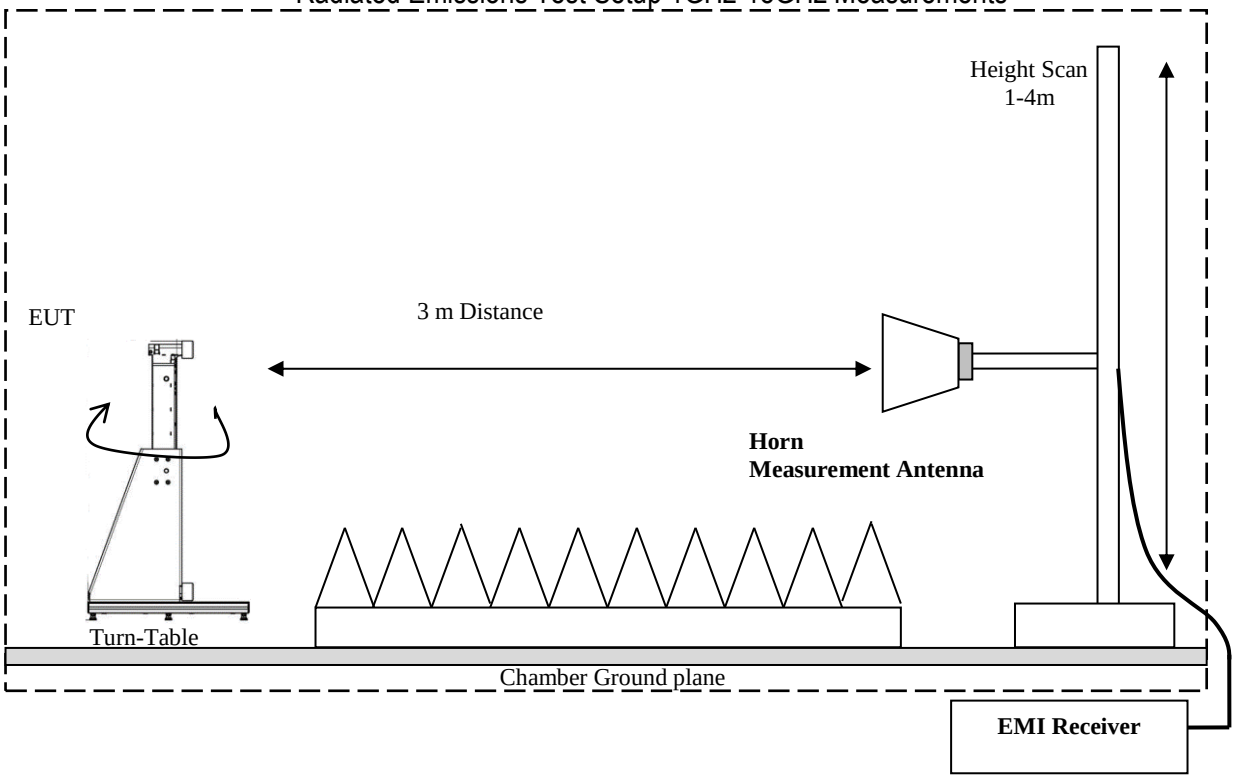
Radiated Emissions Test Setup below 30MHz Measurements



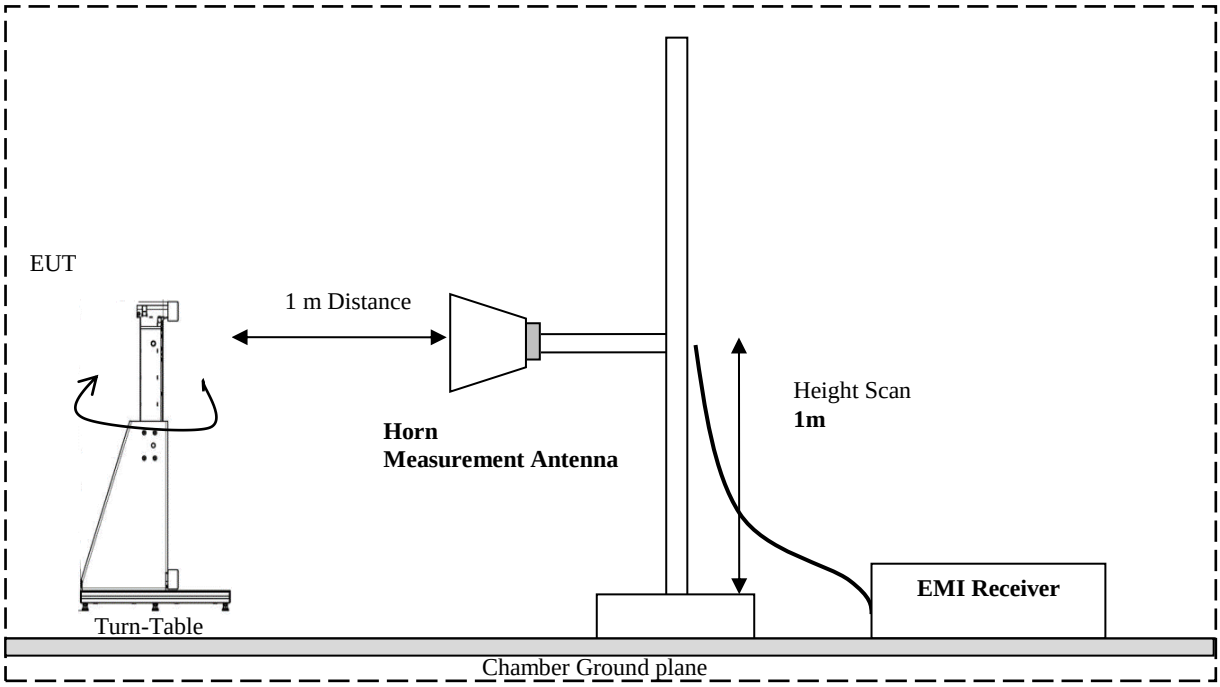
Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup 1GHz-18GHz Measurements



Radiated Emissions Test Setup 18GHz-40GHz Measurements



6.2 Radiated Measurement of above 40GHz

- Measurements above 40 GHz are split to 5 frequency ranges using R&S external mixers and appropriate antennas as follow:

40-60 GHz	FS-Z60 + 261U-25
60-90 GHz	FS-Z90 + 261E-23
90-140 GHz	FS-Z140 + 261F-25
140-220 GHz	FS-Z220 + 261G-25
220-325 GHz	FS-Z325 + 32240-20

- Exploratory measurements are performed with the EUT rotated from 0° to 360°, measuring set antennas are moved around the EUT to find the position produces highest emissions. The exploratory measurements are repeated with horizontal and vertical antenna polarization.
- Final measurement is performed on the certain position where the maximum emission was found during exploratory measurement.
- Measuring distance between the measuring set antenna and EUT is measured from the closest point of the EUT, and determined by the boundary defined by an imaginary straight line periphery describing a simple geometric configuration enclosing the EUT system.
- The largest diameter of the transmit antenna on the panel of K100 mode is 5mm, the largest diameter of the horn antenna of Z10 mode is 3cm, the far field distance is determined as below:

Far field boundary Calculation:
R far field = (2*D^2)/λ
Where: D = largest antenna dimension
λ = wavelength in meters

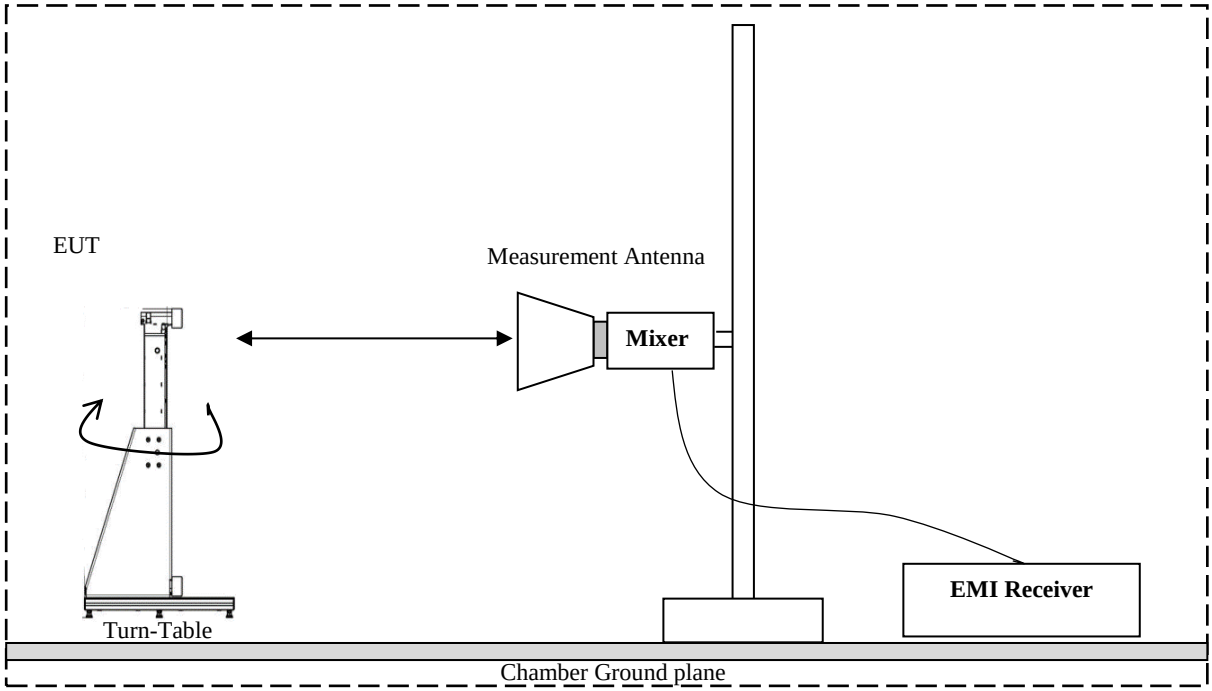
Frequency Range (GHz)	Far field distance of K100 mode (m)	Far field distance of Z10 mode (m)

40-60	0.01	0.36
60-90	0.015	0.54
90-140	0.023	0.84
140-220	0.037	1.32
220-325	0.054	1.94

Note: The far field distance is the distance from the aperture of the transmitter antenna to the measurement antenna
Far field distance = measuring distance + distance from the transmitter antenna to the imaginary boundary of EUT

To ensure far field test condition are met, as well as there are enough margin between noise floor and the emission limits, 0.5m measuring distance is used from 40GHz to 90GHz, 0.2m measuring distance is used from 90GHz to 140GHz, 0.1m measuring distance is used for above 140GHz;

Radiated Emissions Test Setup above 40 GHz



For the K100 mode, the emission close to the maximum image project (MIP) area is checked primarily as potentially highest emission area (MIP area shows as below). No radome was placed in the imaging area as worst case during test

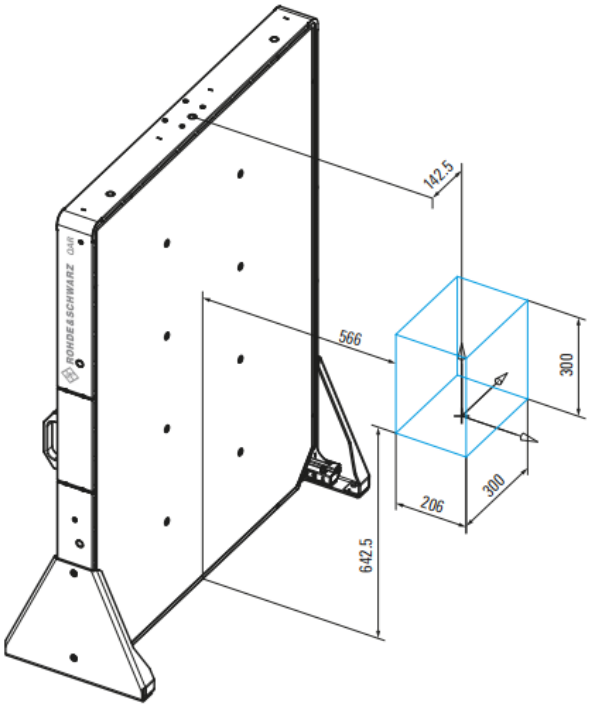


Fig. 16: Dimensions and position of the MIP area of the R&S®QAR

For Z10 mode, the high directional horn antenna point directly to QAR panel (radiation pattern of the horn antenna shows as below), emission was measured outside of the imaginary boundary of QAR. No radome was placed in the imaging area as worst case during testing

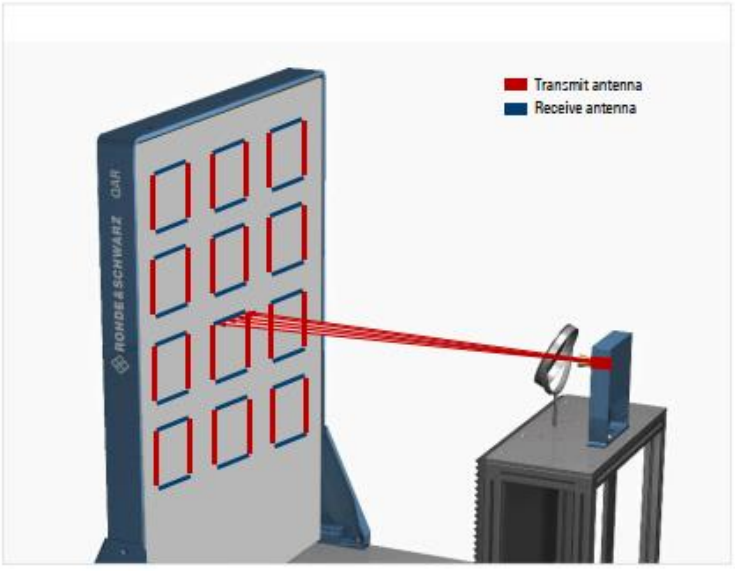


Fig. 10: Measurement of transmission loss using the R&S®QAR

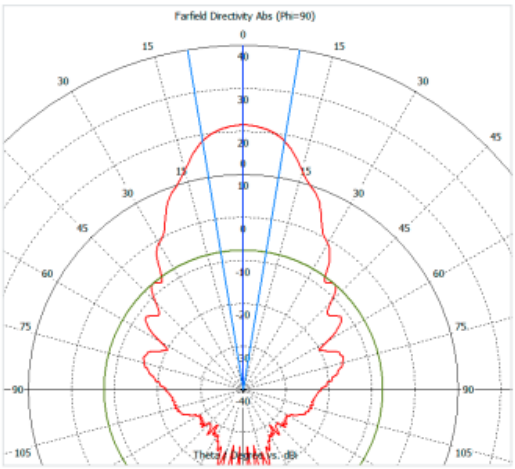


Fig. 11: Antenna pattern of the R&S®QAR-Z10 external transmit

6.3 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

- Measured reading in dBµV
- Cable Loss between the receiving antenna and SA in dB and
- Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV) + Cable Loss (dB) + Antenna Factor (dB/m)

Example:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Set-up #	Pass	Fail	NA	NP	Result
FCC §18.305	Radiated Emissions	Nominal	1&2	■	☐	☐	☐	Complies
FCC §18.307	AC power line Conducted Emissions	Nominal	1&2	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.

8 Test Result Data

8.1 Radiated Emissions Measurement according to CFR 47 Part 18.305

Spectrum Analyzer settings		
Sweep Frequency Range	30 MHz – 1 GHz	>1 GHz
Resolution Bandwidth	100 kHz	1 MHz
Detector (Exploratory Measurements)	Peak	Peak
Detector (Final Measurements)	Average	Average
Trace Mode	Max Hold	Max Hold
Step Size	40 kHz	500 kHz
Measurement Time (Exploratory Measurements)	2 ms	2 ms
Measurement Time (Final Measurements)	100 ms	100 ms

8.1.1 Limits:

Equipment	Operating frequency	RF Power generated by equipment (watts)	Field strength limit (uV/m)	Distance (meters)
Any type unless otherwise specified (miscellaneous)	Any ISM frequency	Below 500 500 or more	25 25 × SQRT(power/500)	300 [1]300
	Any non-ISM frequency	Below 500 500 or more	15 15 × SQRT(power/500)	300 [1]300
Industrial heaters and RF stabilized arc welders	On or below 5,725 MHz Above 5,725 MHz	Any Any	10 ([2])	1,600 ([2])
Medical diathermy	Any ISM frequency Any non-ISM frequency	Any Any	25 15	300 300
Ultrasonic	Below 490 kHz	Below 500 500 or more	2,400/F(kHz) 2,400/F(kHz) × SQRT(power/500)	300 [3]300
	490 to 1,600 kHz Above 1,600 kHz	Any Any	24,000/F(kHz) 15	30 30
Induction cooking ranges	Below 90 kHz On or above 90 kHz	Any Any	1,500 300	[4]30 [4]30

Note1: EUT belong to miscellaneous equipment with non-ISM frequency
Note2: Limit 3m(dBuV/m) = Limit 300m(dBuV/m) + 40*log(300/3) for below 30MHz
Note3: Limit 3m(dBuV/m) = Limit 300m(dBuV/m) + 20*log(300/3) for above 30MHz

Limit Calculation:
Field Strength Limit @ 3m(dBuV/m) = 63.52dBuV/m
➔ EIRP Limit = -31.71dBm
40-220 GHz limit on SA is based on the following formula:
$Limit_{SA} = Limit_{actual}$ + Ant Gain – FSPL
For 40-60GHz, the measurement distance is 50cm.
For 60-90GHz, the measurement distance is 45.5cm.
For 90-140GHz, the measurement distance is 20cm.
For 140-325GHz, the measurement distance is 10cm.

Then the EIRP limit on the SA will be the following table.

Freq/GHz	limit on SA	Freq/GHz	limit on SA	Freq/GHz	limit on SA	Freq/GHz	limit on SA
40	-65.17	93	-64.54	146	-62.44	199	-65.13
41	-65.39	94	-64.63	147	-62.50	200	-65.17
42	-65.59	95	-64.73	148	-62.56	201	-65.21
43	-65.80	96	-64.82	149	-62.61	202	-65.26
44	-66.00	97	-64.91	150	-62.67	203	-65.30
45	-66.19	98	-65.00	151	-62.73	204	-65.34
46	-66.38	99	-65.08	152	-62.79	205	-65.39
47	-66.57	100	-65.17	153	-62.84	206	-65.43
48	-66.75	101	-65.26	154	-62.90	207	-65.47
49	-66.93	102	-65.34	155	-62.96	208	-65.51
50	-67.11	103	-65.43	156	-63.01	209	-65.55
51	-67.28	104	-65.51	157	-63.07	210	-65.59
52	-67.45	105	-65.59	158	-63.12	211	-65.64
53	-67.61	106	-65.68	159	-63.18	212	-65.68
54	-67.78	107	-65.76	160	-63.23	213	-65.72
55	-67.94	108	-65.84	161	-63.29	214	-65.76
56	-68.09	109	-65.92	162	-63.34	215	-65.80
57	-68.25	110	-66.00	163	-63.39	216	-65.84
58	-68.40	111	-66.08	164	-63.45	217	-65.88
59	-68.55	112	-66.15	165	-63.50	218	-65.92
60	-67.87	113	-66.23	166	-63.55	219	-65.96
61	-68.02	114	-66.31	167	-63.60	220	-66.00
62	-68.16	115	-66.38	168	-63.66	224	-71.15
63	-68.30	116	-66.46	169	-63.71	228	-71.31
64	-68.43	117	-66.53	170	-63.76	232	-71.46
65	-68.57	118	-66.61	171	-63.81	236	-71.61
66	-68.70	119	-66.68	172	-63.86	240	-71.75
67	-68.83	120	-66.75	173	-63.91	244	-71.90
68	-68.96	121	-66.83	174	-63.96	248	-72.04
69	-69.09	122	-66.90	175	-64.01	252	-72.18
70	-69.21	123	-66.97	176	-64.06	256	-72.31
71	-69.34	124	-67.04	177	-64.11	260	-72.45
72	-69.46	125	-67.11	178	-64.16	264	-72.58
73	-69.58	126	-67.18	179	-64.21	268	-72.71
74	-69.69	127	-67.25	180	-64.26	272	-72.84
75	-69.81	128	-67.31	181	-64.30	276	-72.97
76	-69.93	129	-67.38	182	-64.35	280	-73.09
77	-70.04	130	-67.45	183	-64.40	284	-73.22
78	-70.15	131	-67.52	184	-64.45	288	-73.34

79	-70.26	132	-67.58	185	-64.49	292	-73.46
80	-70.37	133	-67.65	186	-64.54	296	-73.58
81	-70.48	134	-67.71	187	-64.59	300	-73.69
82	-70.59	135	-67.78	188	-64.63	304	-73.81
83	-70.69	136	-67.84	189	-64.68	308	-73.92
84	-70.80	137	-67.91	190	-64.73	312	-74.03
85	-70.90	138	-67.97	191	-64.77	316	-74.14
86	-71.00	139	-68.03	192	-64.82	320	-74.25
87	-71.10	140	-68.09	193	-64.86	324	-74.36
88	-71.20	141	-62.13	194	-64.91		
89	-71.30	142	-62.20	195	-64.95		
90	-71.40	143	-62.26	196	-65.00		
91	-64.35	144	-62.32	197	-65.04		
92	-64.45	145	-62.38	198	-65.08		

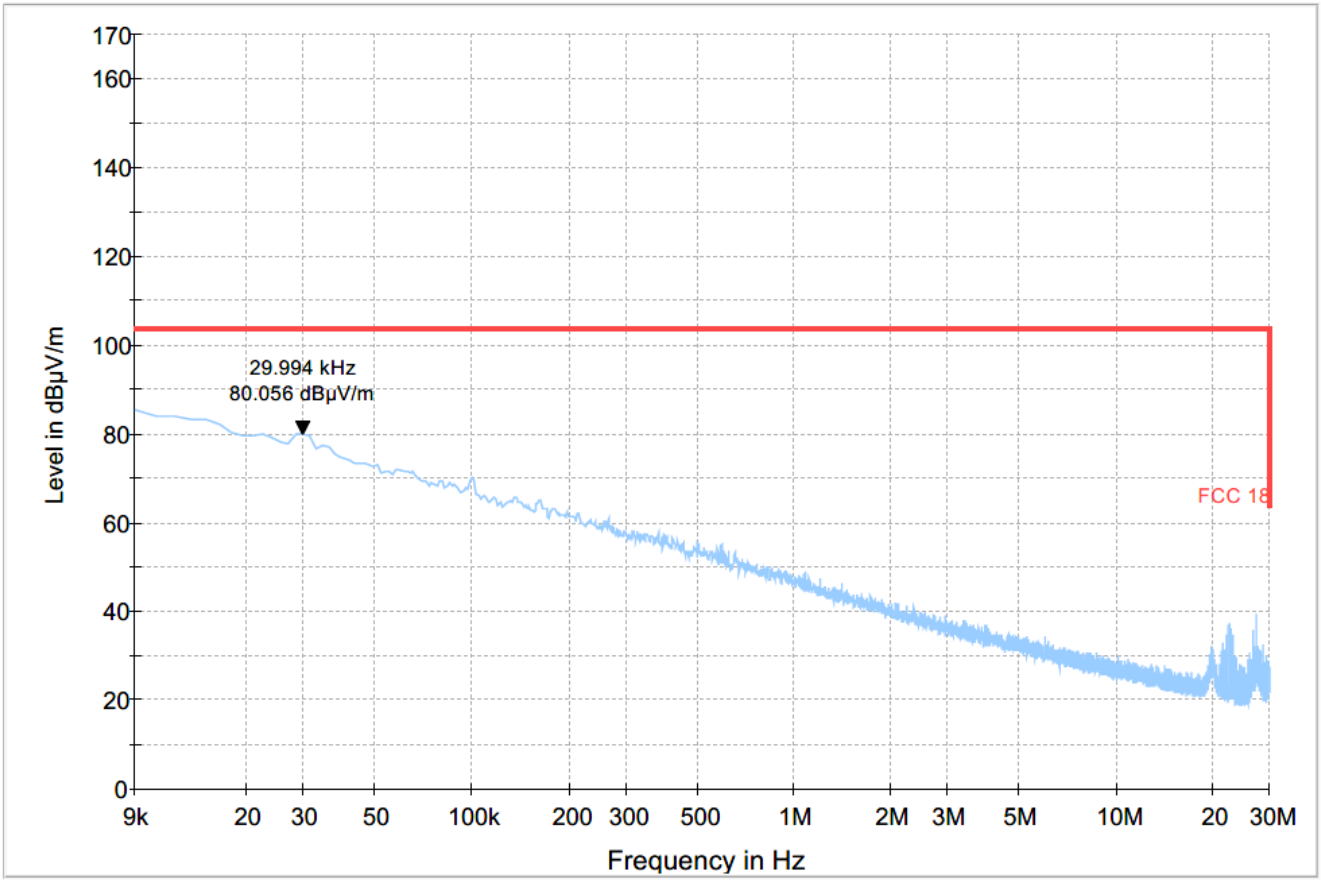
8.1.2 Test Summary:

Environmental Conditions	
Ambient Temperature:	24.6°C
Relative Humidity:	45.1%
Atmospheric Pressure:	1010 mbar

Test Results						
Plot #	EUT Set-Up #	EUT operating mode	Scan Frequency	Power Supply Input	Comments	Result
1 – 12	1	K100 mode	9kHz – 325 GHz	230V AC	Final measurement	Pass
13 - 24	2	Z10 mode	9kHz – 325 GHz	230V AC	Final measurement	Pass

8.1.3 Measurement Plots:

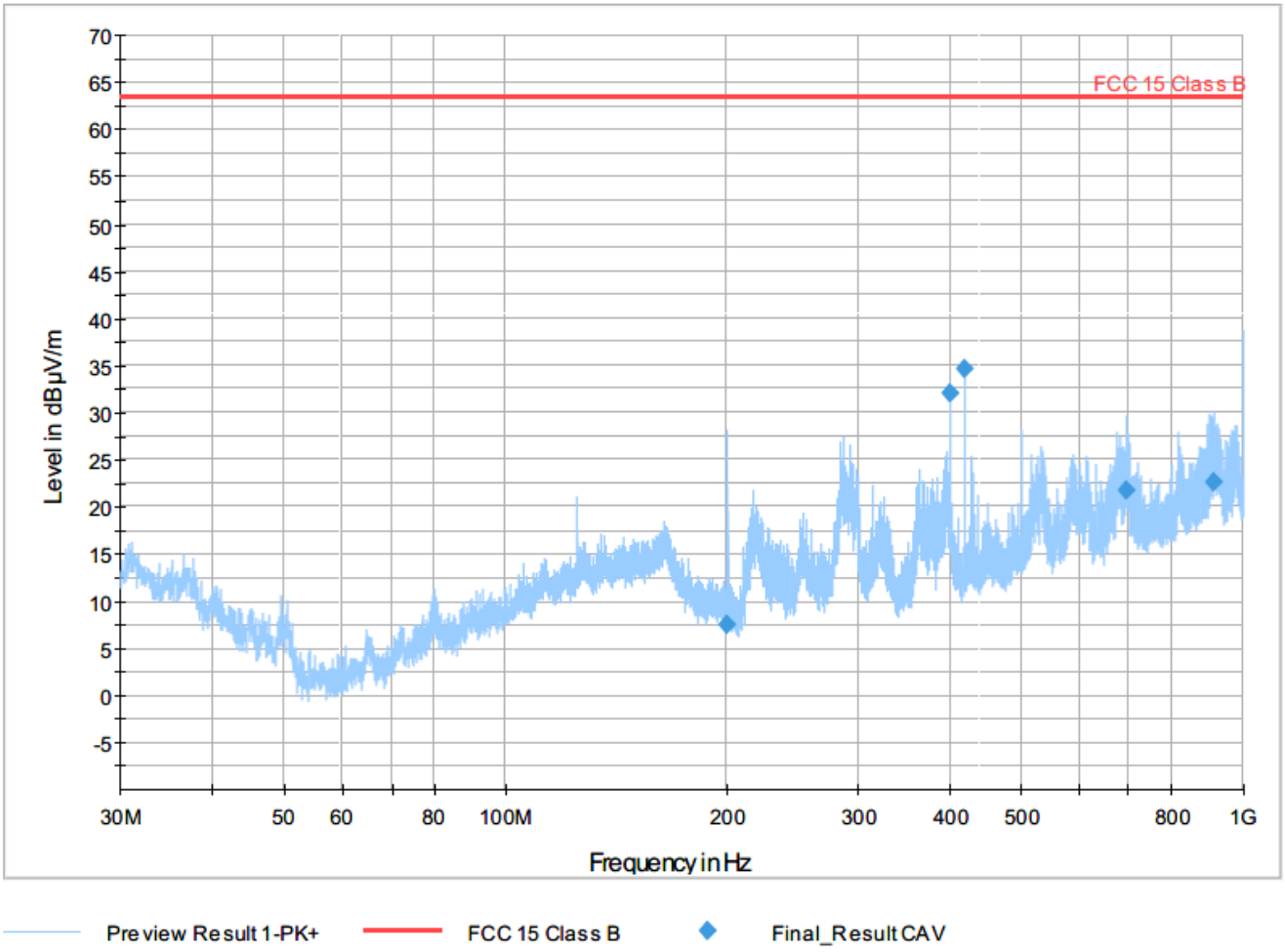
Plot # 1 Unwanted Emissions: 9 kHz - 30 MHz



Plot # 2 Unwanted Emissions 30 MHz – 1GHz

Final_Result

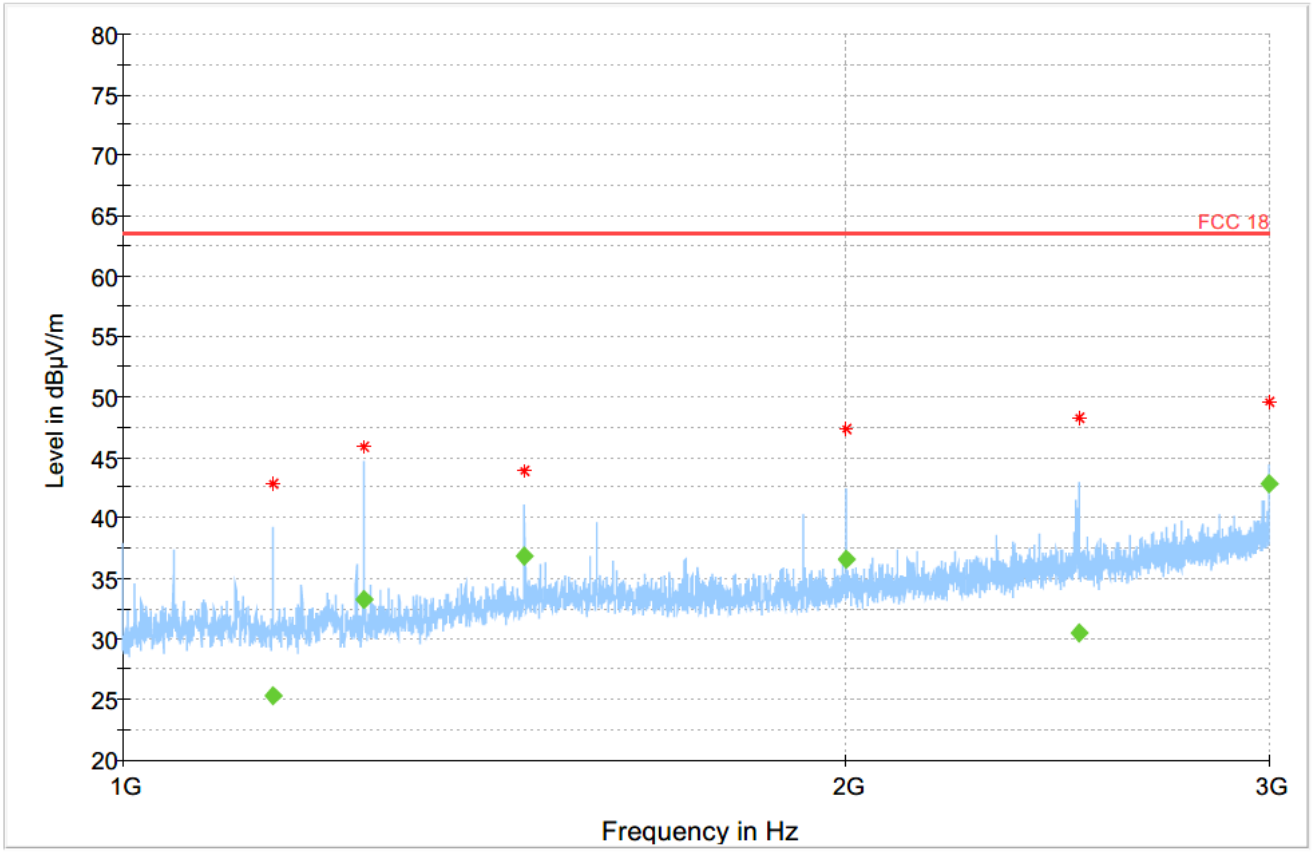
Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
199.968	7.54	63.52	55.98	500.0	120.000	117.0	H	65.0	12.9	
399.982	31.99	63.52	31.53	500.0	120.000	154.0	H	82.0	18.0	
419.989	34.64	63.52	28.88	500.0	120.000	133.0	H	90.0	18.5	
695.711	21.76	63.52	41.76	500.0	120.000	100.0	H	86.0	22.9	
913.743	22.62	63.52	40.9	500.0	120.000	125.0	H	152.0	25.5	



Plot # 3 Unwanted Emissions: 1-3 GHz

Final_Result

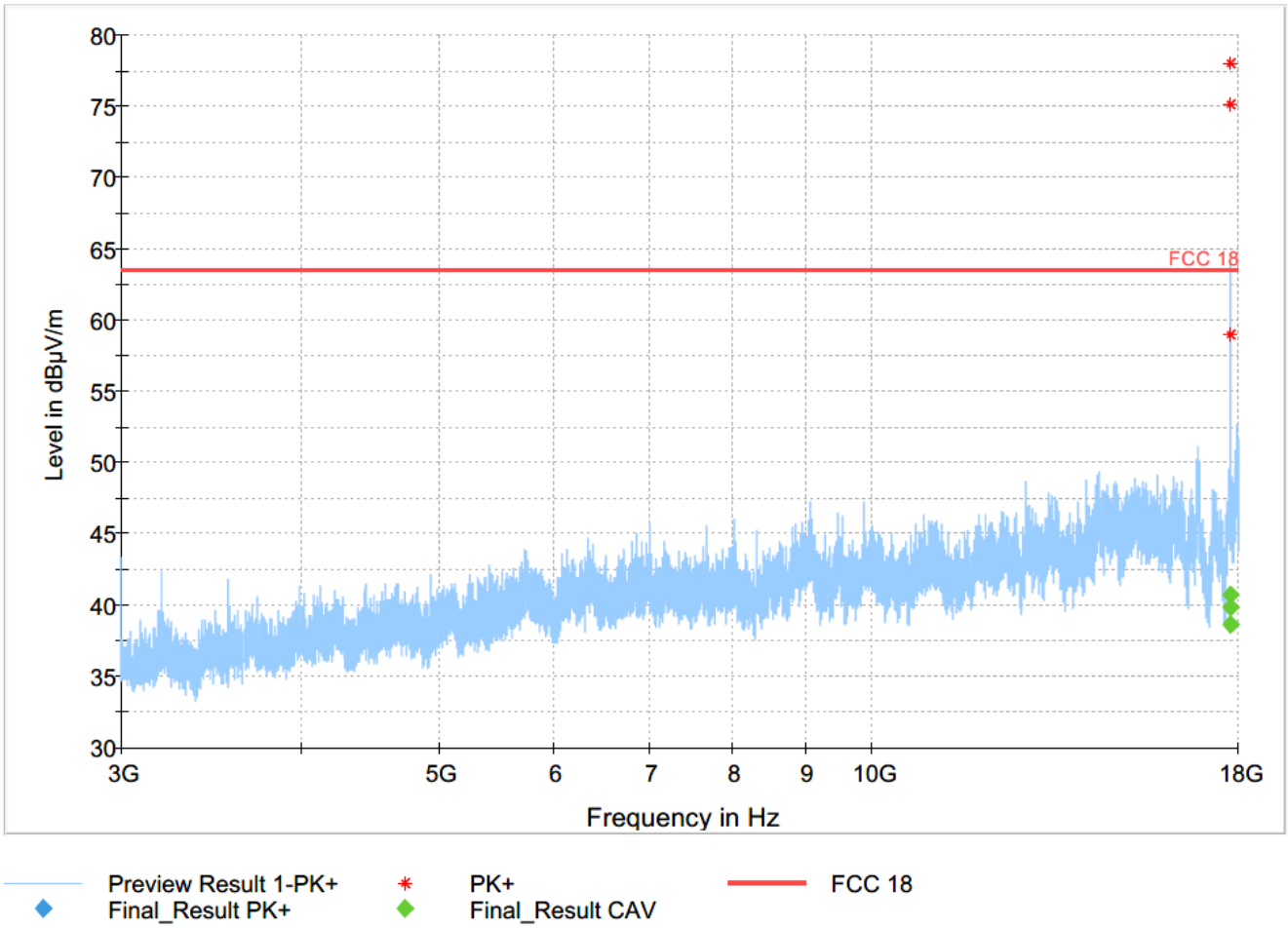
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1154.750	---	25.35	63.52	38.17	500.0	1000.000	265.0	H	329.0	-5.6	
1259.750	---	33.32	63.52	30.20	500.0	1000.000	130.0	H	330.0	-5.1	
1470.250	---	36.83	63.52	26.69	500.0	1000.000	121.0	H	239.0	-2.6	
2000.000	---	36.59	63.52	26.93	500.0	1000.000	121.0	H	56.0	-1.5	
2500.000	---	30.43	63.52	33.09	500.0	1000.000	185.0	V	133.0	0.2	
3000.000	---	42.80	63.52	20.72	500.0	1000.000	211.0	H	200.0	3.4	



Plot # 4 Unwanted Emissions: 3 - 18 GHz

Final_Result

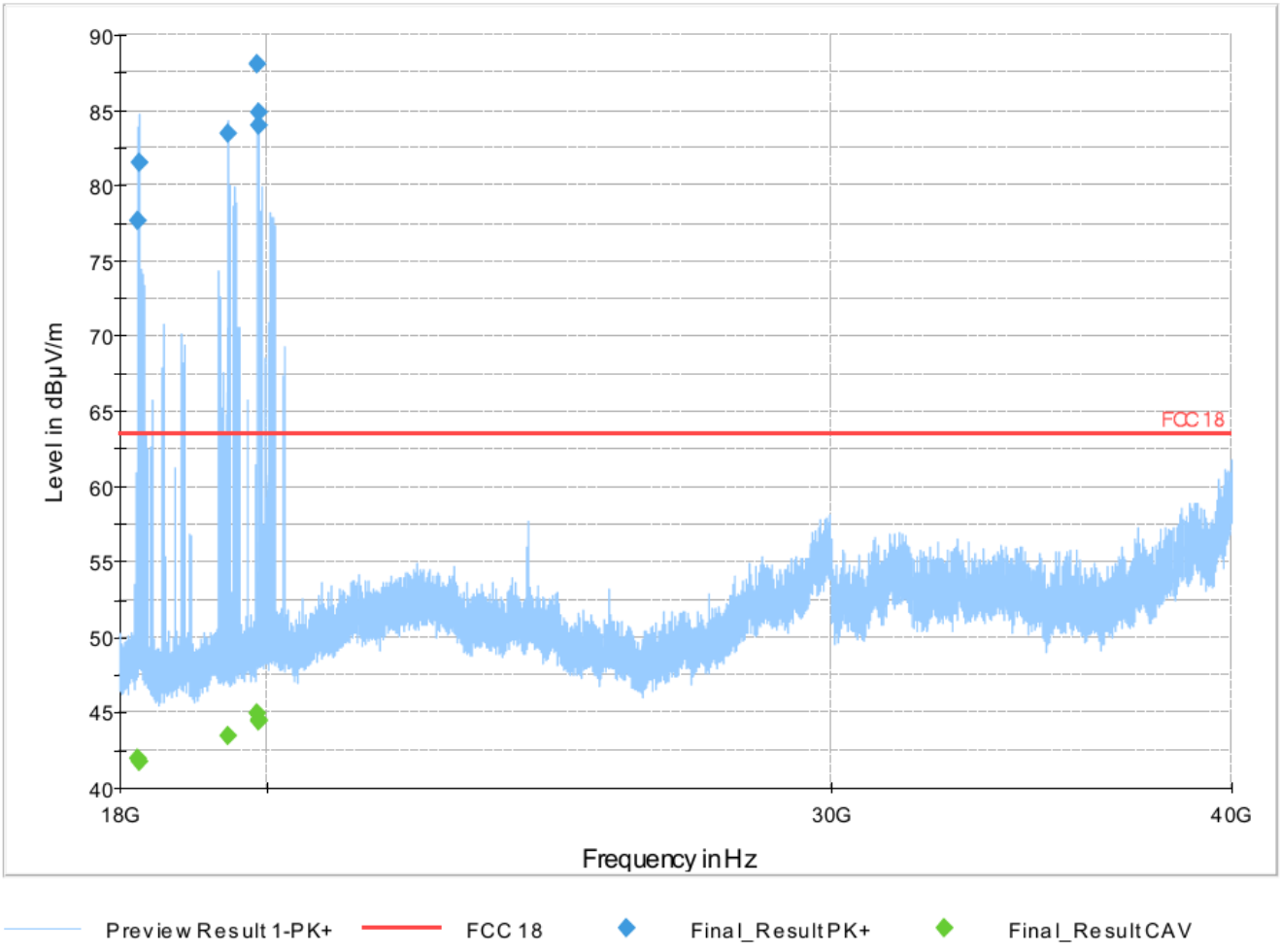
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
17750.000	---	40.78	63.52	22.74	500.0	1000.000	184.0	V	86.0	-8.8	
17763.500	---	38.58	63.52	24.94	500.0	1000.000	270.0	V	76.0	-8.5	
17769.750	---	39.84	63.52	23.68	500.0	1000.000	155.0	V	1.0	-8.3	



Plot # 5 Unwanted Emissions: 18-40 GHz

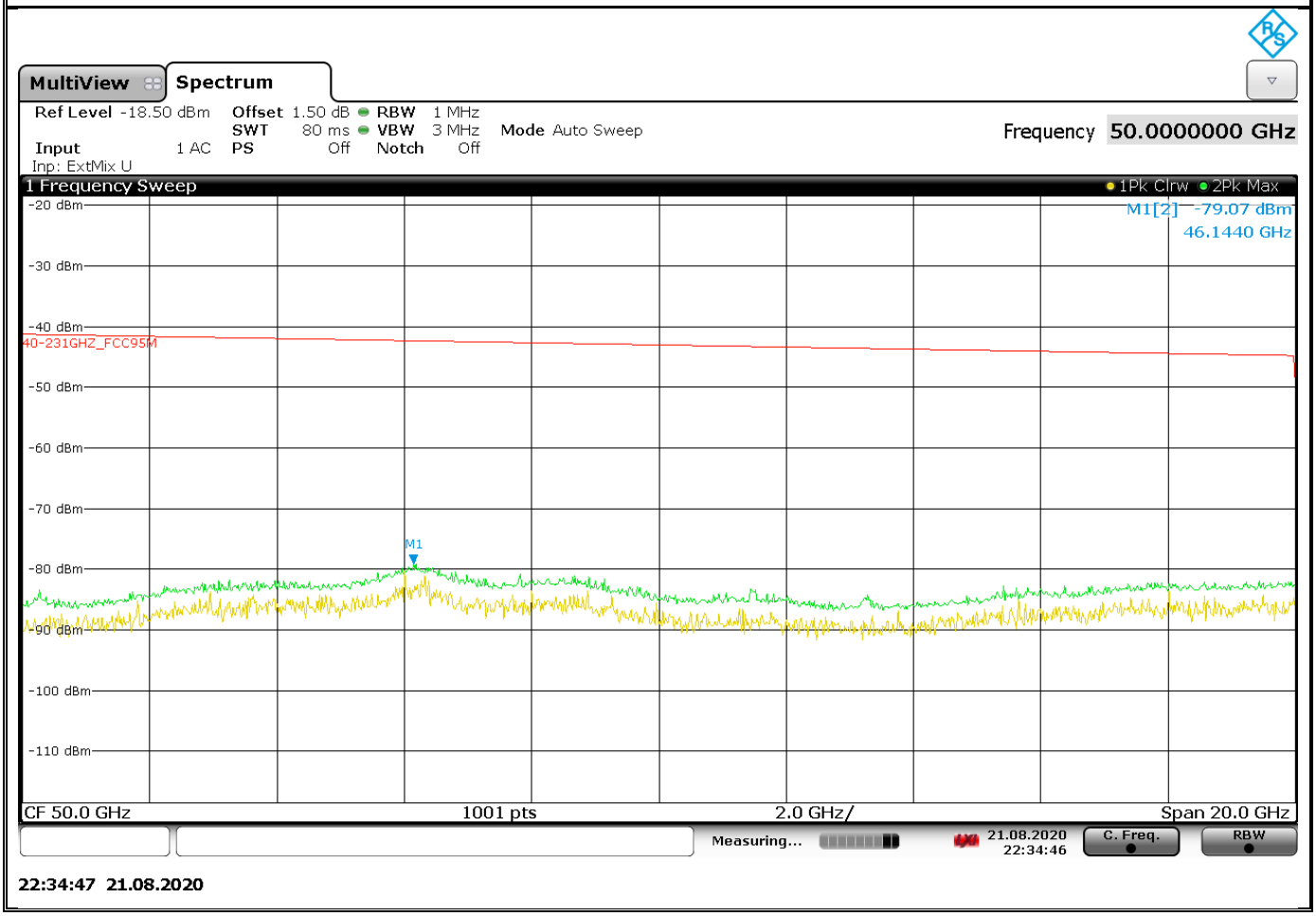
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
18222.375	---	41.94	63.52	21.58	500.0	1000.000	100.0	V	185.0	12.2	
18241.875	---	41.69	63.52	21.83	500.0	1000.000	100.0	V	164.0	12.2	
19443.000	---	43.42	63.52	20.10	500.0	1000.000	150.0	H	247.0	13.8	
19856.250	---	44.98	63.52	18.54	500.0	1000.000	100.0	H	267.0	14.7	
19875.750	---	44.53	63.52	18.99	500.0	1000.000	150.0	H	248.0	14.8	
19895.625	---	44.36	63.52	19.16	500.0	1000.000	100.0	H	266.0	14.8	



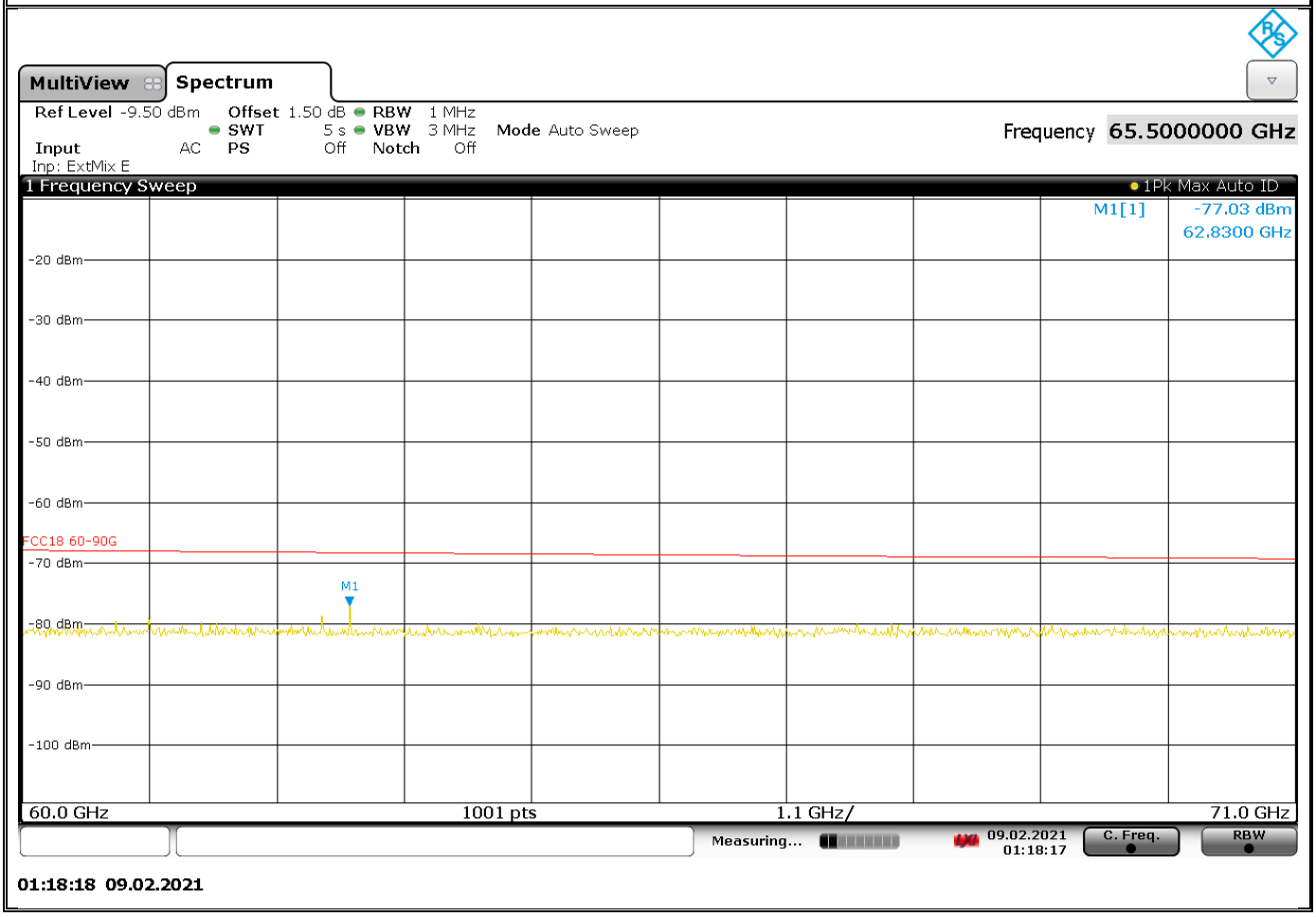
Plot # 6 Unwanted Emissions: 40 - 60 GHz

Measurement antenna orientation: Horizontal



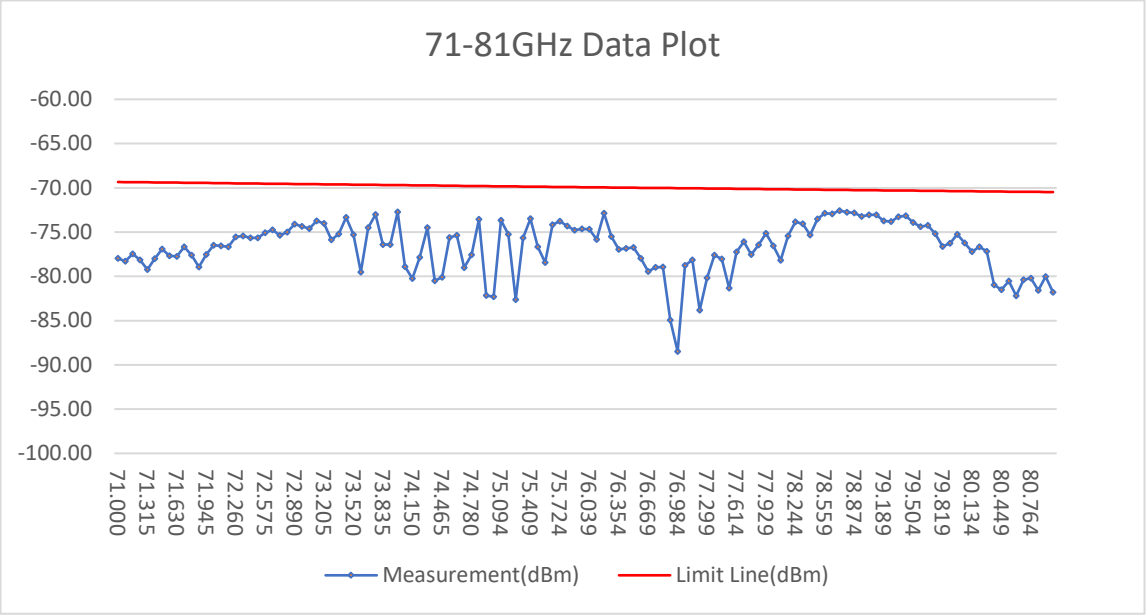
Plot # 7 Unwanted Emissions: 60 - 71 GHz

Measurement antenna orientation: Horizontal



Plot # 8 Unwanted Emissions: 71 - 81 GHz

Measurement antenna orientation: Horizontal



Note: the following frequency are measured.

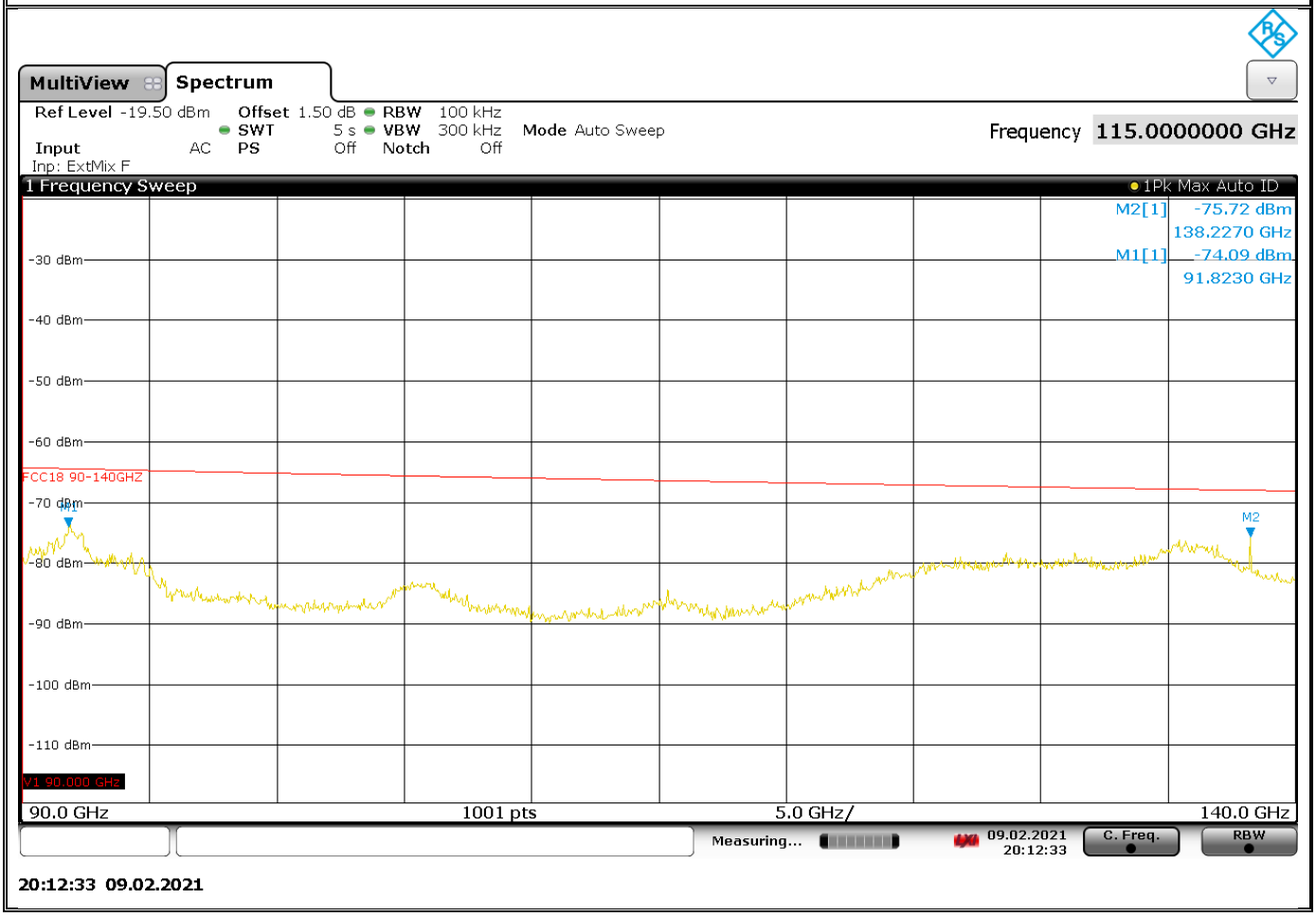
71000000000	71078740157	71157480314	71236220472	71314960629	71393700787	71472440944	71551181102
71629921259	71708661417	71787401574	71866141732	71944881889	72023622047	72102362204	72181102362
72259842519	72338582677	72417322834	72496062992	72574803149	72653543307	72732283464	72811023622
72889763779	72968503937	73047244094	73125984251	73204724409	73283464566	73362204724	73440944881
73519685039	73598425196	73677165354	73755905511	73834645669	73913385826	73992125984	74070866141
74149606299	74228346456	74307086614	74385826771	74464566929	74543307086	74622047244	74700787401
74779527559	74858267716	74937007874	75015748031	75094488188	75173228346	75251968503	75330708661
75409448818	75488188976	75566929133	75645669291	75724409448	75803149606	75881889763	75960629921
76039370078	76118110236	76196850393	76275590551	76354330708	76433070866	76511811023	76590551181
76669291338	76748031496	76826771653	76905511811	76984251968	77062992125	77141732283	77220472440
77299212598	77377952755	77456692913	77535433070	77614173228	77692913385	77771653543	77850393700
77929133858	78007874015	78086614173	78165354330	78244094488	78322834645	78401574803	78480314960
78559055118	78637795275	78716535433	78795275590	78874015748	78952755905	79031496062	79110236220
79188976377	79267716535	79346456692	79425196850	79503937007	79582677165	79661417322	79740157480
79818897637	79897637795	79976377952	80055118110	80133858267	80212598425	80291338582	80370078740
80448818897	80527559055	80606299212	80685039370	80763779527	80842519685	80921259842	81000000000

Plot # 9 Unwanted Emissions: 81 - 90 GHz

Measurement antenna orientation: Horizontal

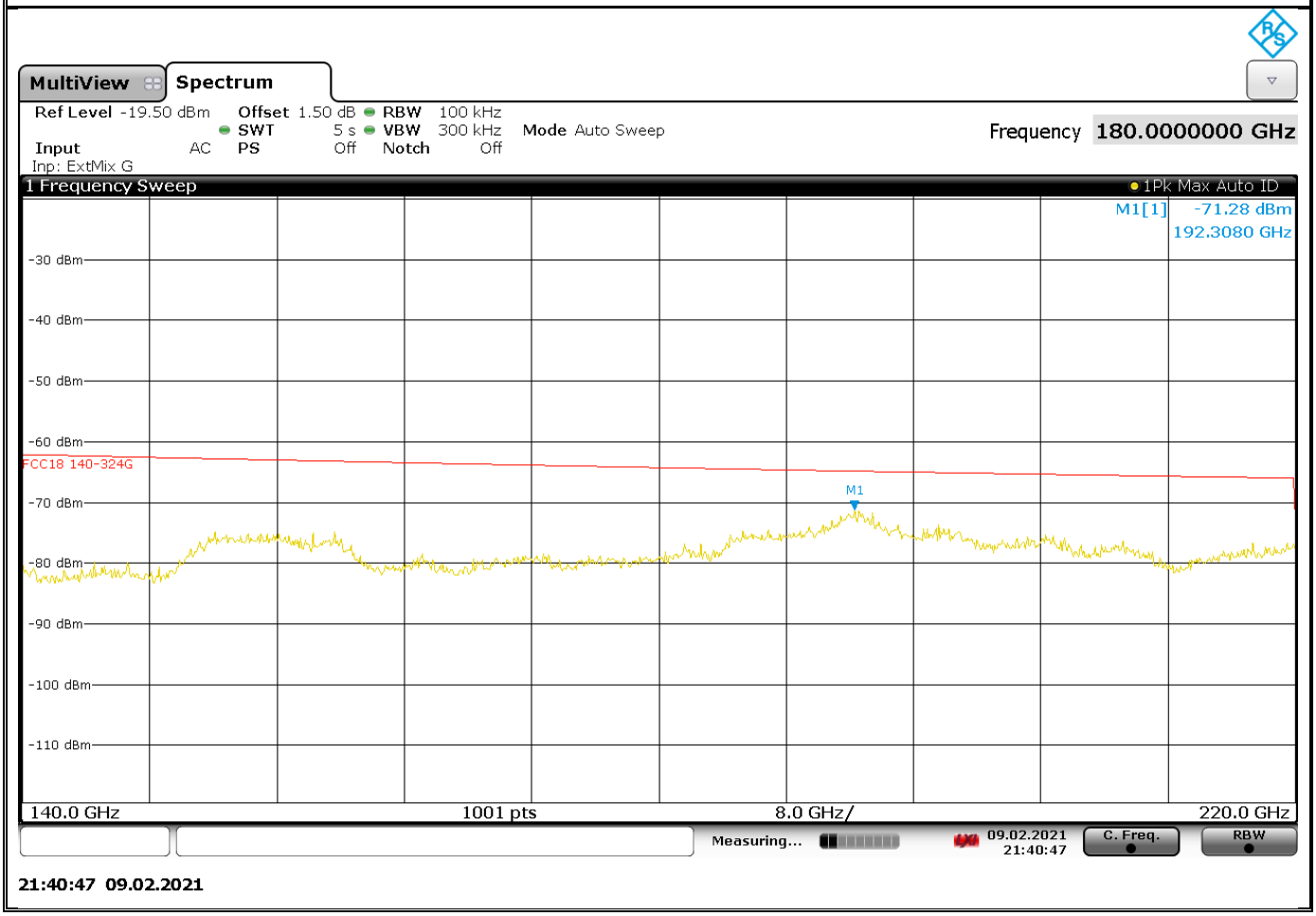
Plot # 10 Unwanted Emissions: 90 - 140 GHz

Measurement antenna orientation: Horizontal



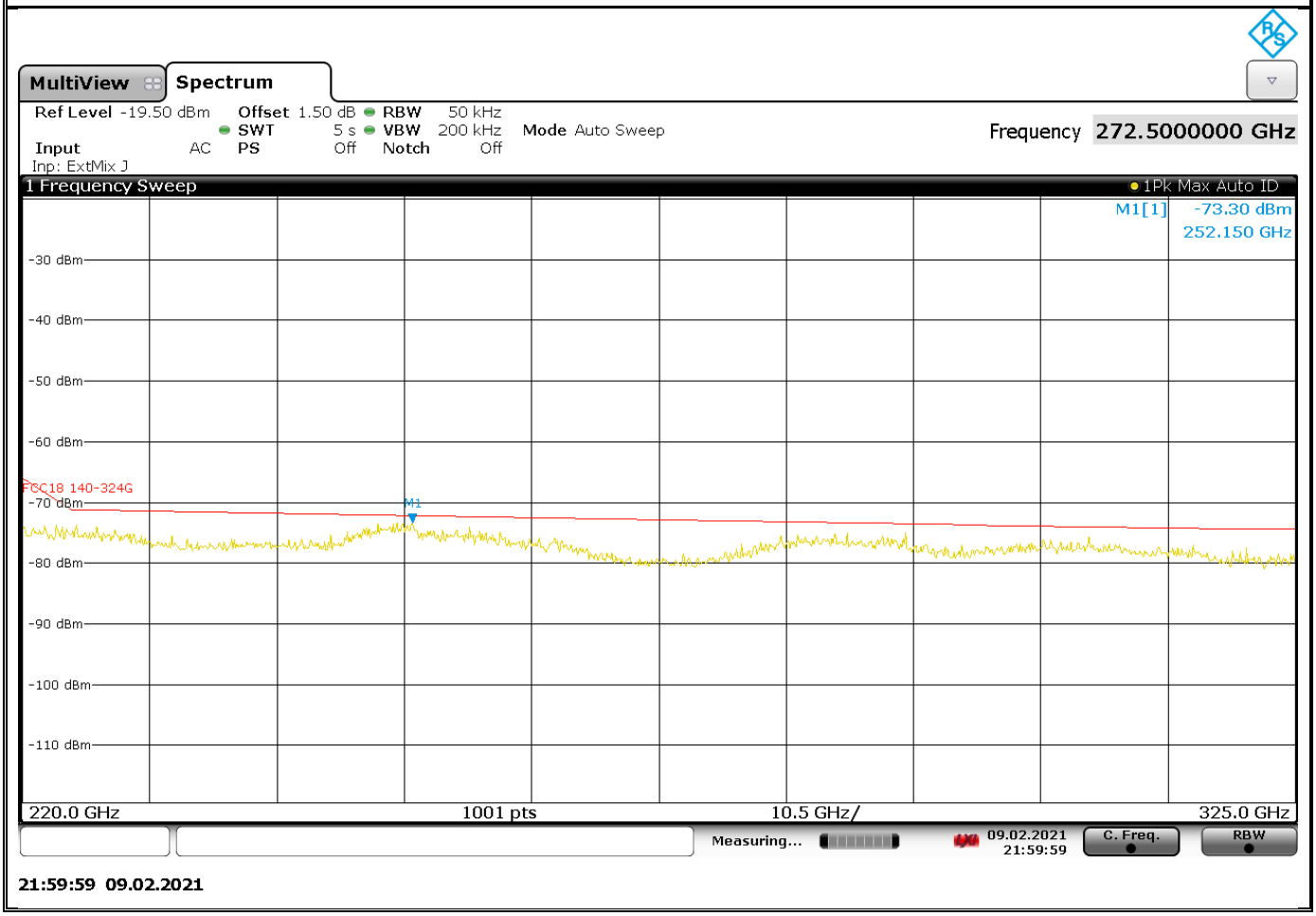
Plot # 11 Unwanted Emissions: 140 - 220 GHz

Measurement antenna orientation: Horizontal



Plot # 12 Unwanted Emissions: 220 - 325 GHz

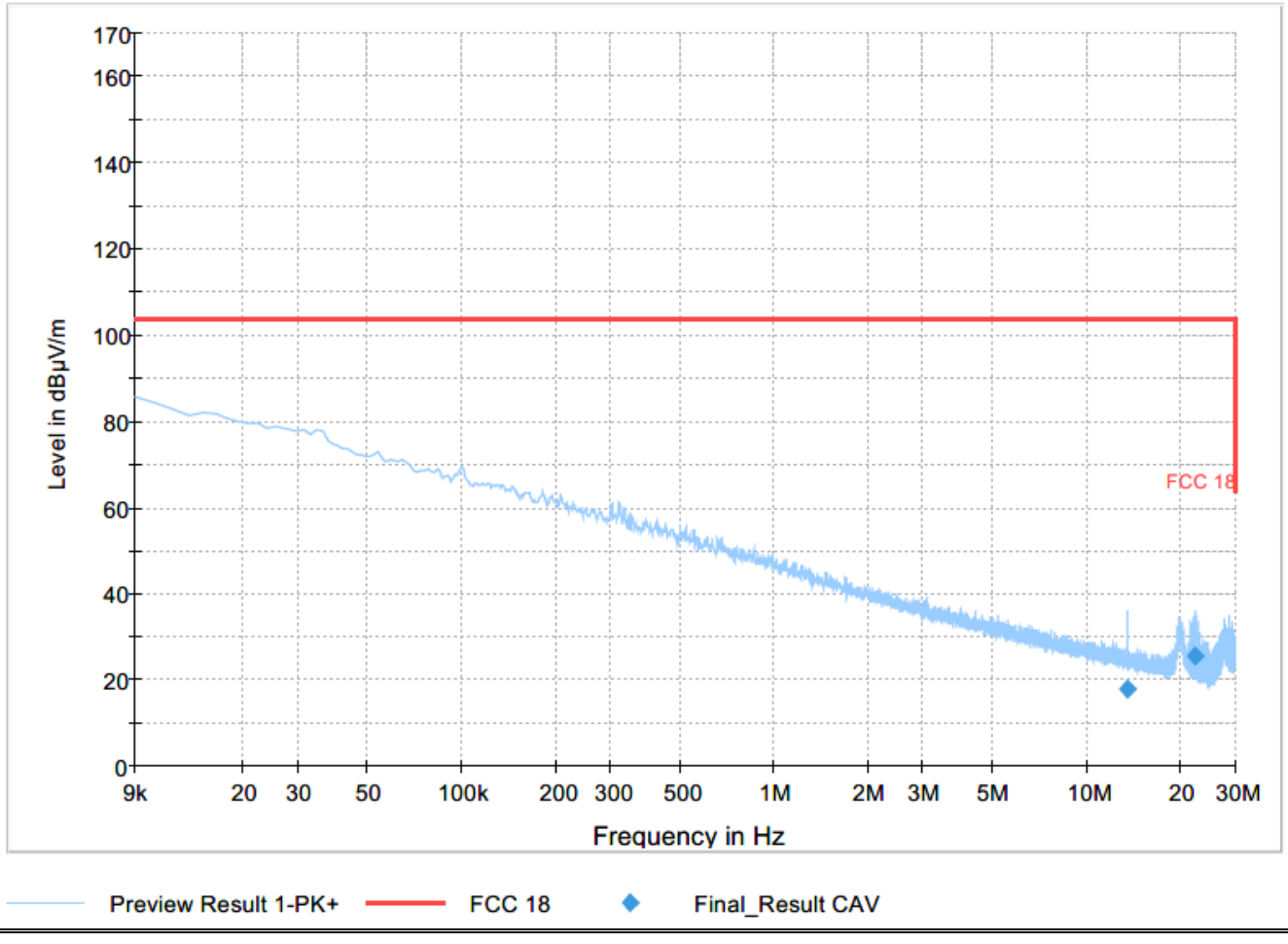
Measurement antenna orientation: Horizontal



Plot # 13 Unwanted Emissions: 9 kHz - 30 MHz

Final_Result

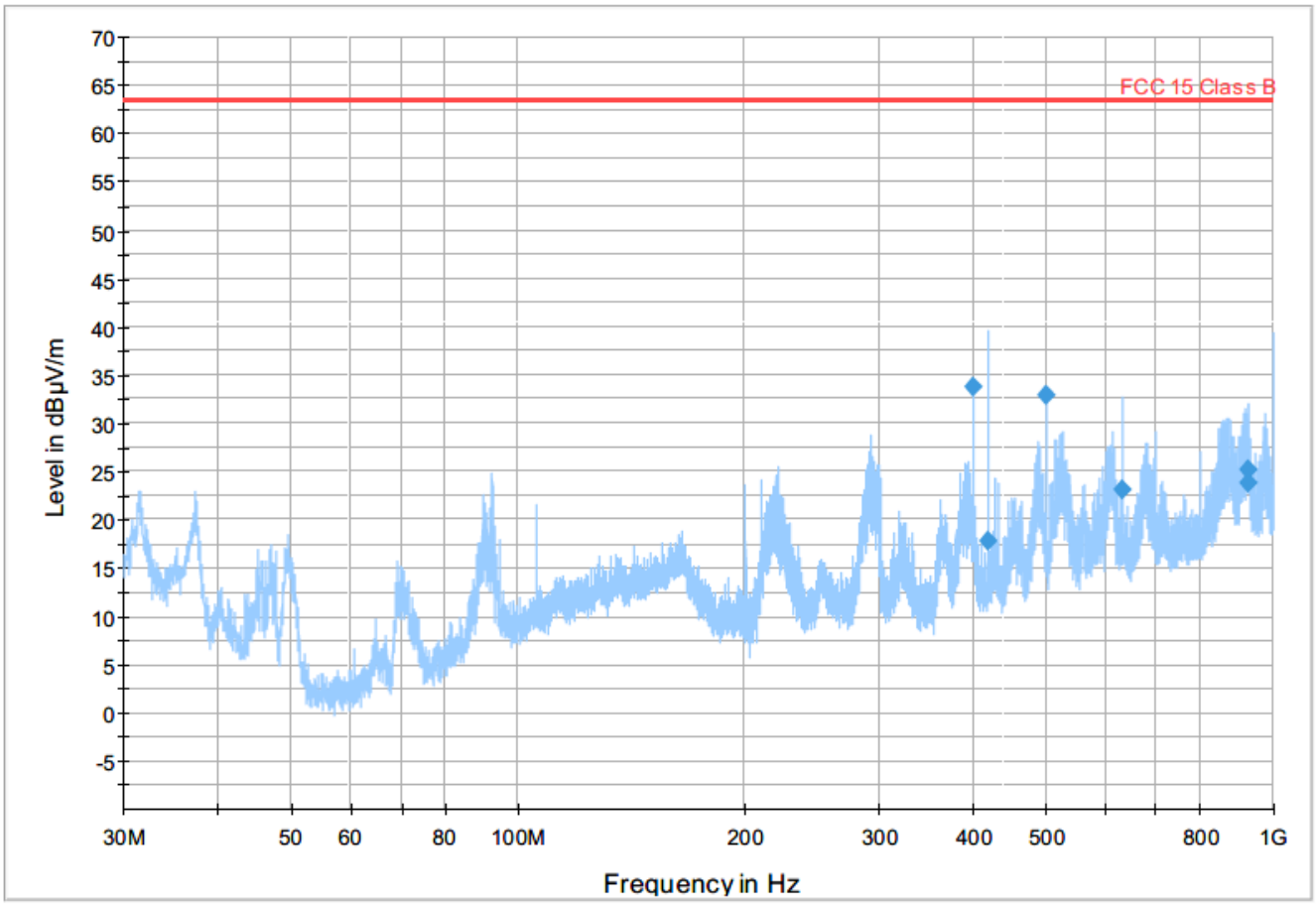
Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
13.560	17.84	103.52	85.68	500.0	9.000	233.0	H	-4.0	17.1	
22.354	25.53	103.52	77.99	500.0	9.000	120.0	V	203.0	16.8	



Plot # 14 Unwanted Emissions 30 MHz – 1GHz

Final_Result

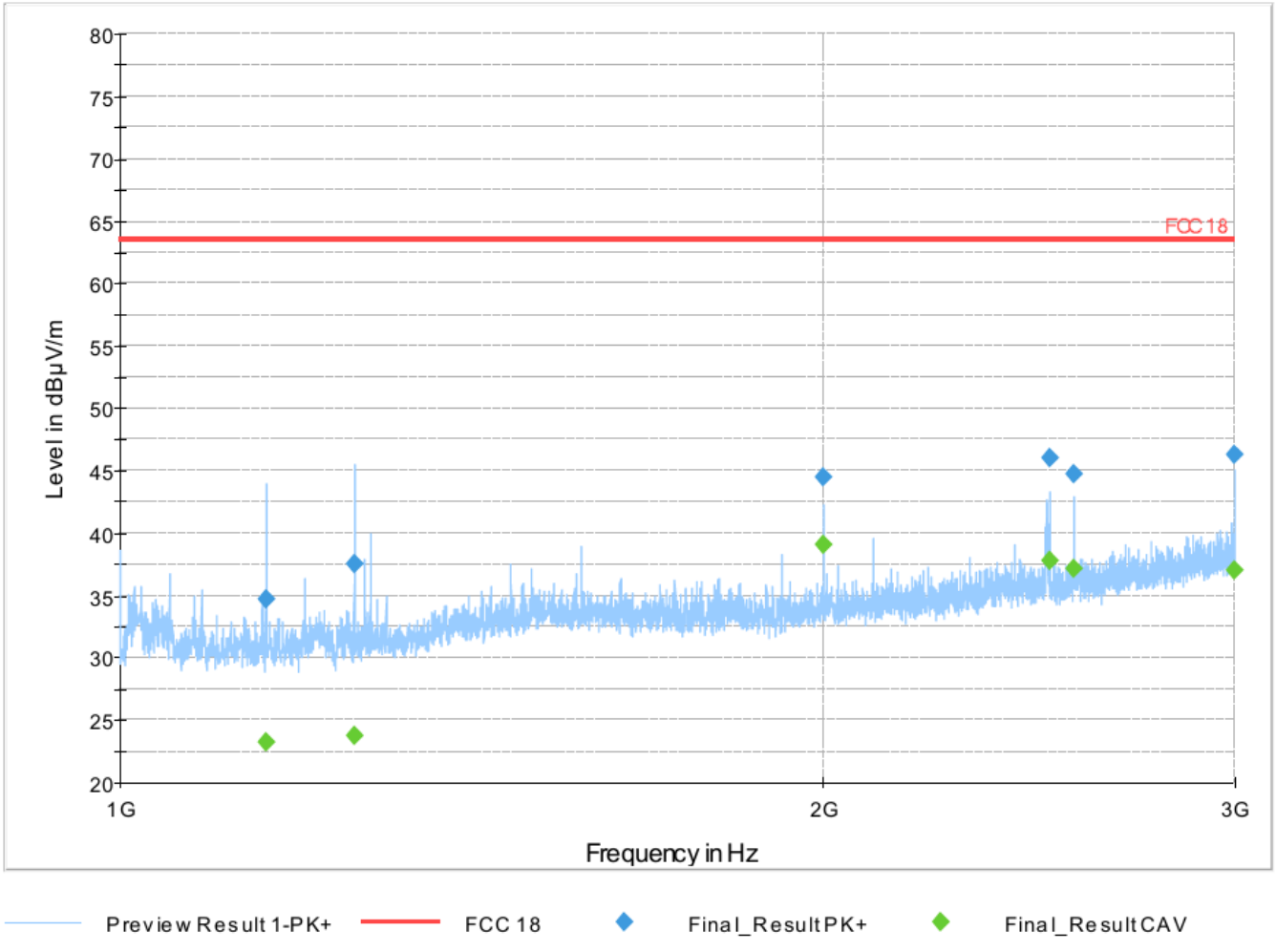
Frequency (MHz)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
399.982	33.72	63.52	29.8	500.0	120.000	116.0	H	142.0	18.0	
419.989	17.84	63.52	45.68	500.0	120.000	100.0	H	41.0	18.5	
499.989	32.94	63.52	30.58	500.0	120.000	100.0	H	59.0	19.9	
629.994	23.15	63.52	40.37	500.0	120.000	275.0	H	149.0	22.0	
925.456	25.12	63.52	38.4	500.0	120.000	107.0	H	58.0	25.8	
927.493	23.78	63.52	39.74	500.0	120.000	107.0	H	58.0	25.9	



Plot # 15 Unwanted Emissions: 1-3 GHz

Final_Result

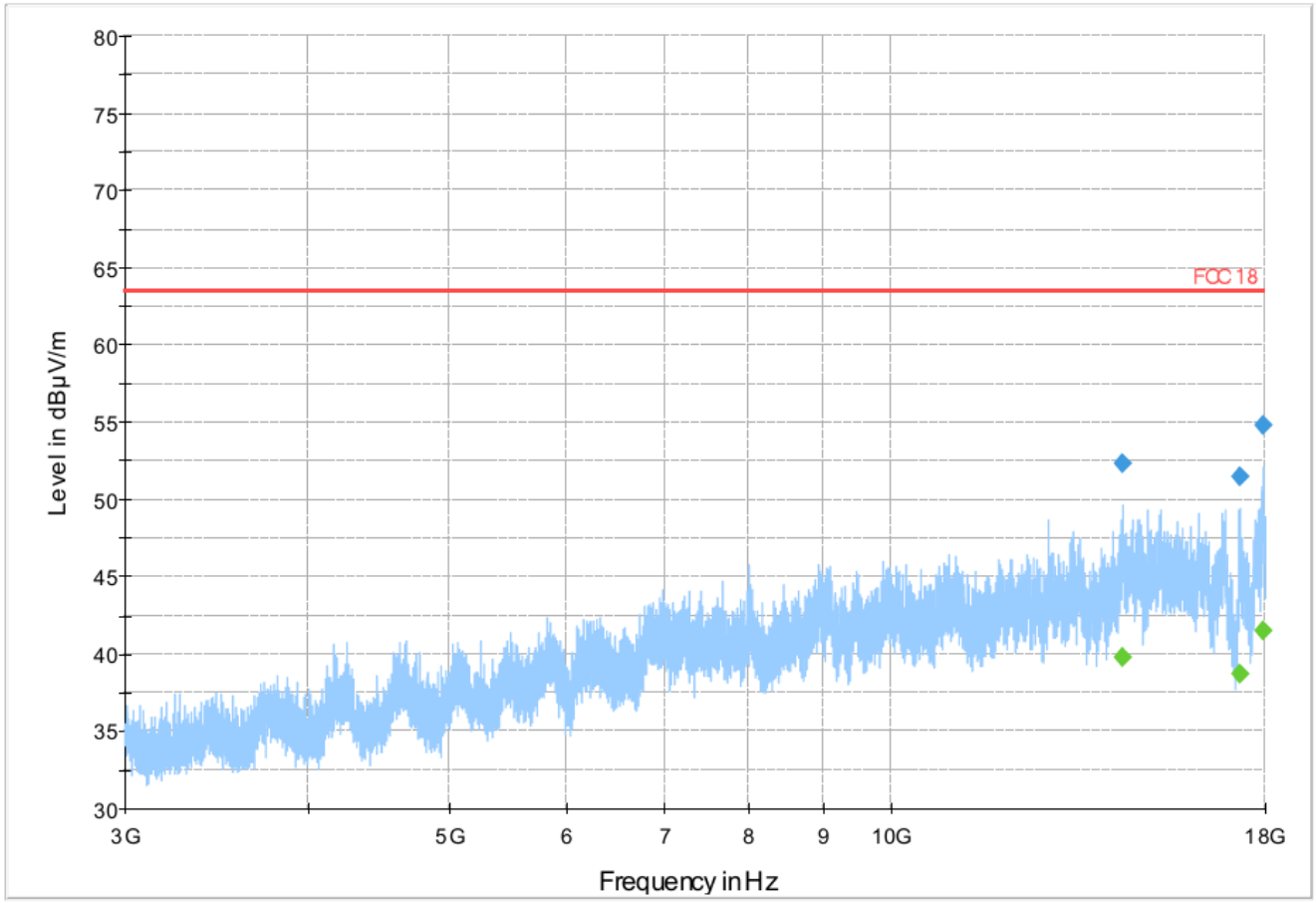
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1154.750	---	23.21	63.52	40.31	500.0	1000.000	162.0	H	227.0	-5.6	
1260.000	---	23.75	63.52	39.77	500.0	1000.000	266.0	H	192.0	-5.1	
2000.000	---	39.01	63.52	24.51	500.0	1000.000	193.0	H	136.0	-1.5	
2500.000	---	37.76	63.52	25.76	500.0	1000.000	121.0	V	63.0	0.2	
2560.000	---	37.11	63.52	26.41	500.0	1000.000	189.0	H	339.0	0.3	
3000.000	---	37.06	63.52	26.46	500.0	1000.000	100.0	V	93.0	3.4	



Plot # 16 Unwanted Emissions: 3 - 18 GHz

Final_Result

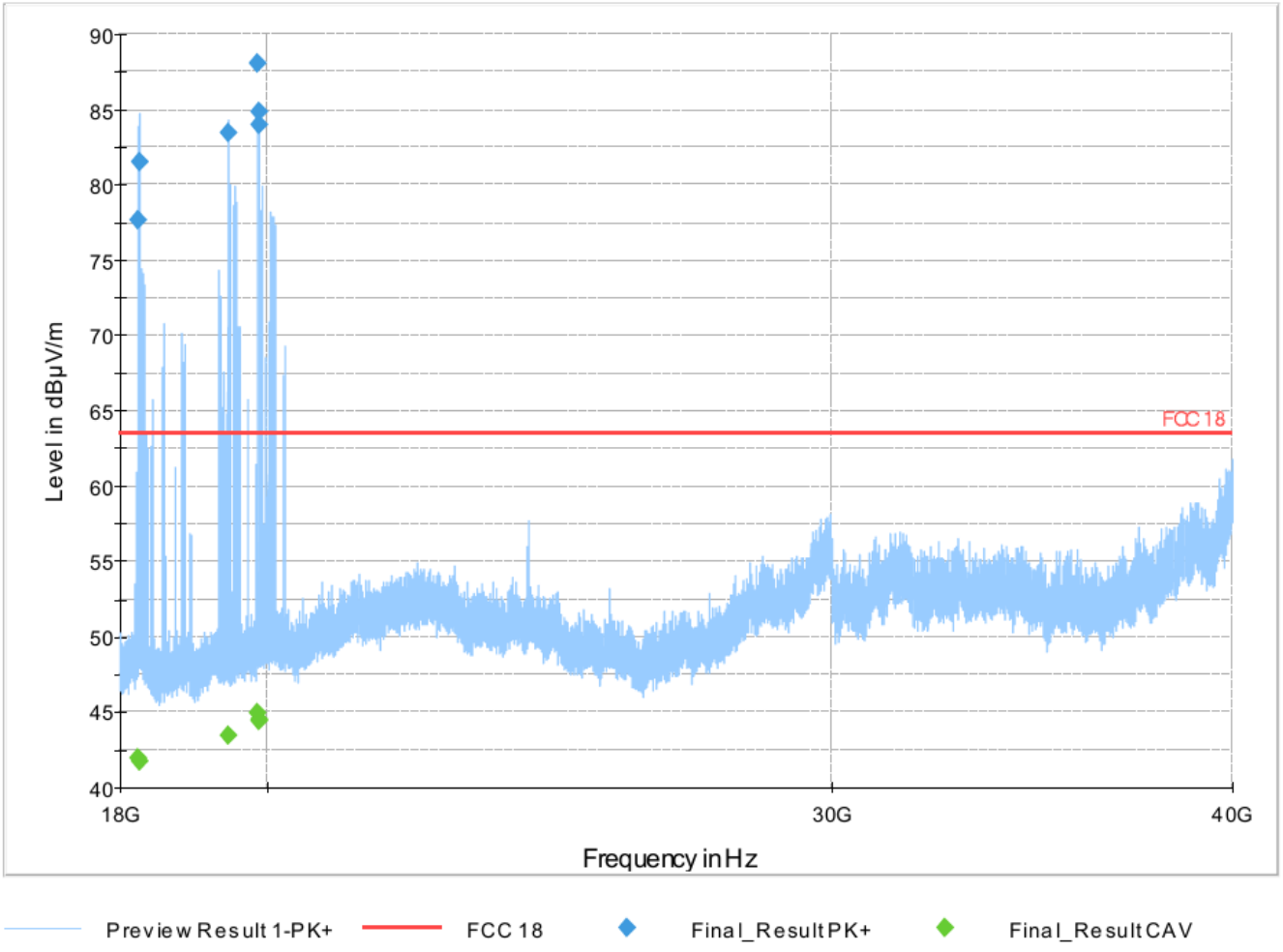
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
14375.500	---	39.76	63.52	23.76	500.0	1000.000	177.0	V	358.0	-16.5	
17312.250	---	38.66	63.52	24.86	500.0	1000.000	117.0	V	299.0	-10.4	
17934.750	---	41.45	63.52	22.07	500.0	1000.000	220.0	H	91.0	-7.4	



Plot # 17 Unwanted Emissions: 18-40 GHz

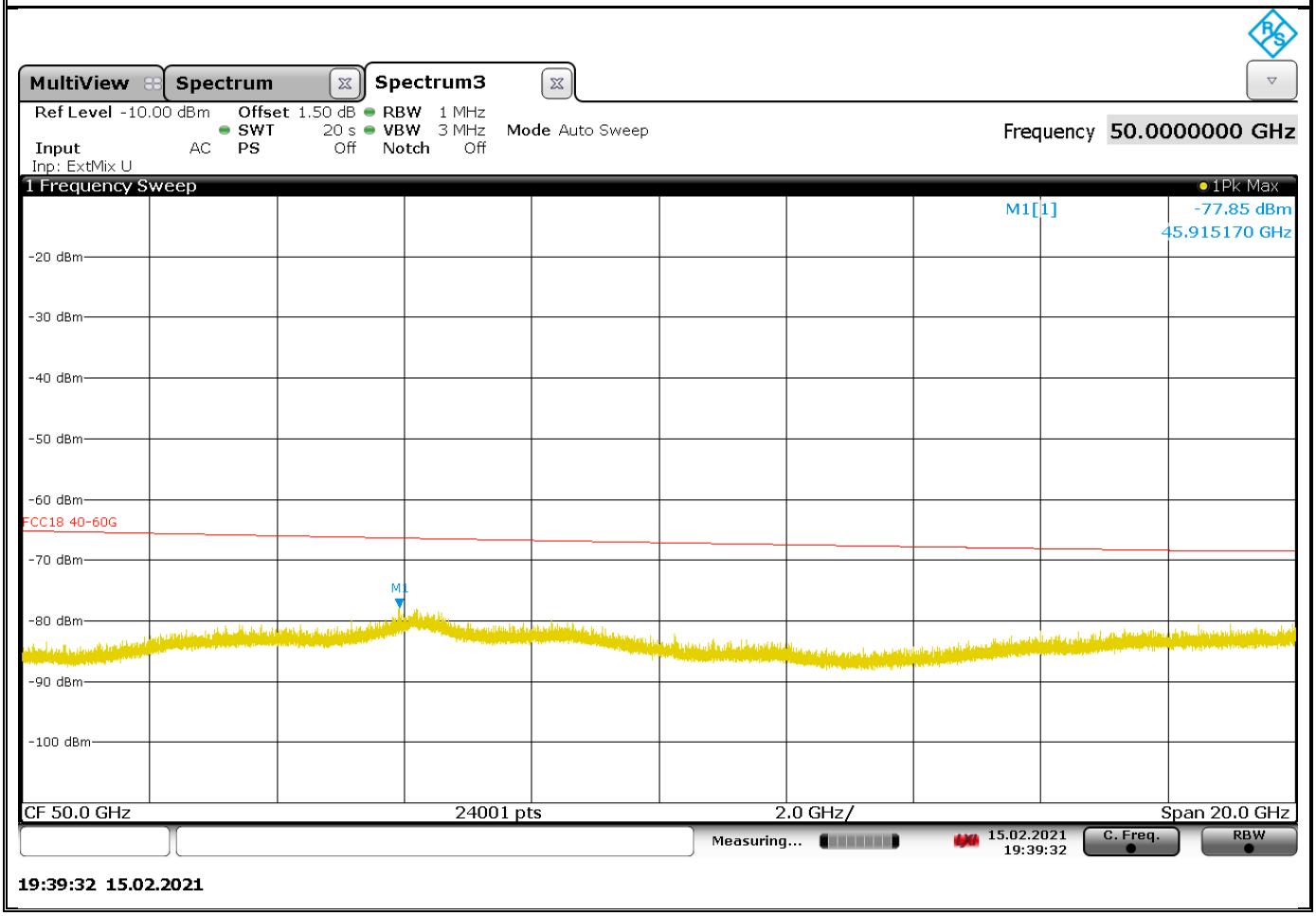
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
18222.375	---	41.94	63.52	21.58	500.0	1000.000	100.0	V	185.0	12.2	
18241.875	---	41.69	63.52	21.83	500.0	1000.000	100.0	V	164.0	12.2	
19443.000	---	43.42	63.52	20.10	500.0	1000.000	150.0	H	247.0	13.8	
19856.250	---	44.98	63.52	18.54	500.0	1000.000	100.0	H	267.0	14.7	
19875.750	---	44.53	63.52	18.99	500.0	1000.000	150.0	H	248.0	14.8	
19895.625	---	44.36	63.52	19.16	500.0	1000.000	100.0	H	266.0	14.8	



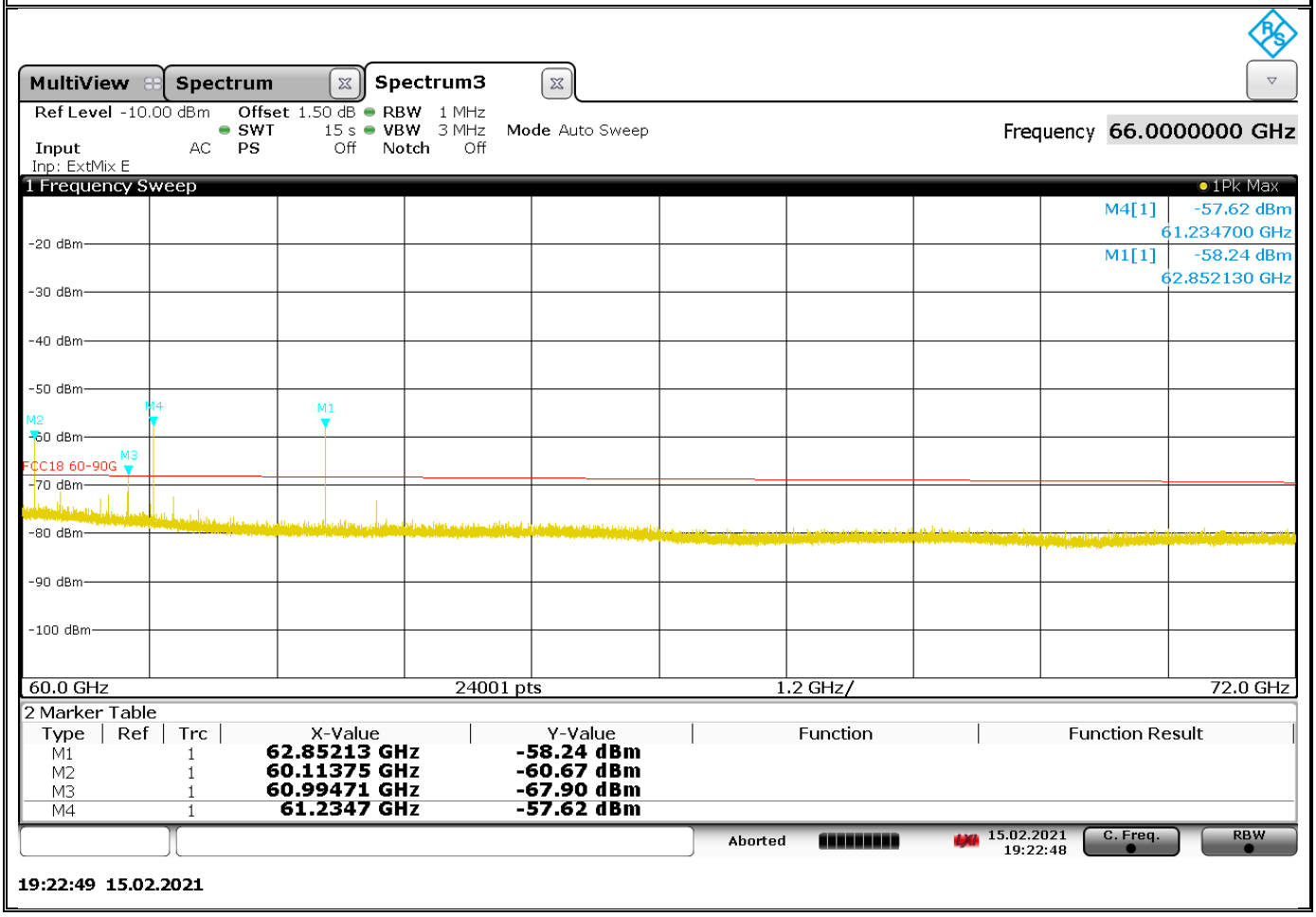
Plot # 18 Unwanted Emissions: 40 - 60 GHz

Measurement antenna orientation: Horizontal



Plot # 19 Unwanted Emissions: 60 - 72 GHz

Measurement antenna orientation: Horizontal

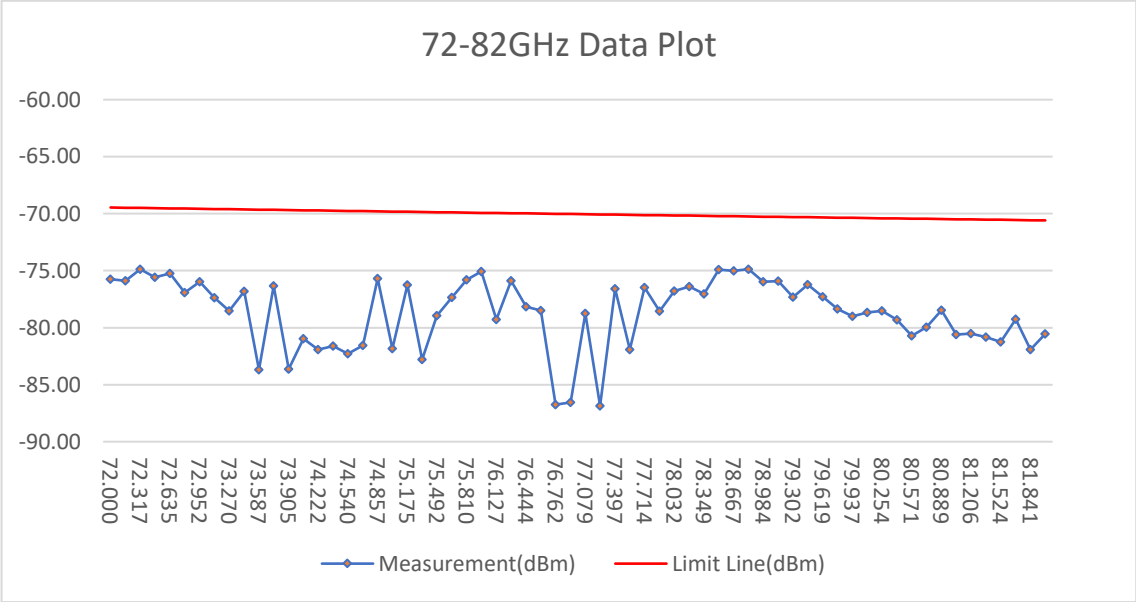


Note: Those four frequencies are measured using Peak detector and RMS detector.

Frequency(GHz)	PK(dBm)	RMS(dBm)	Limit(dBm)
60.11375	-70.51	-84.93	-68.02
60.99471	-71.01	-86.15	-68.16
61.2347	-69.7	-86.31	-68.16
62.85213	-78.72	-88.21	-68.3

Plot # 20 Unwanted Emissions: 72 - 82 GHz

Measurement antenna orientation: Horizontal

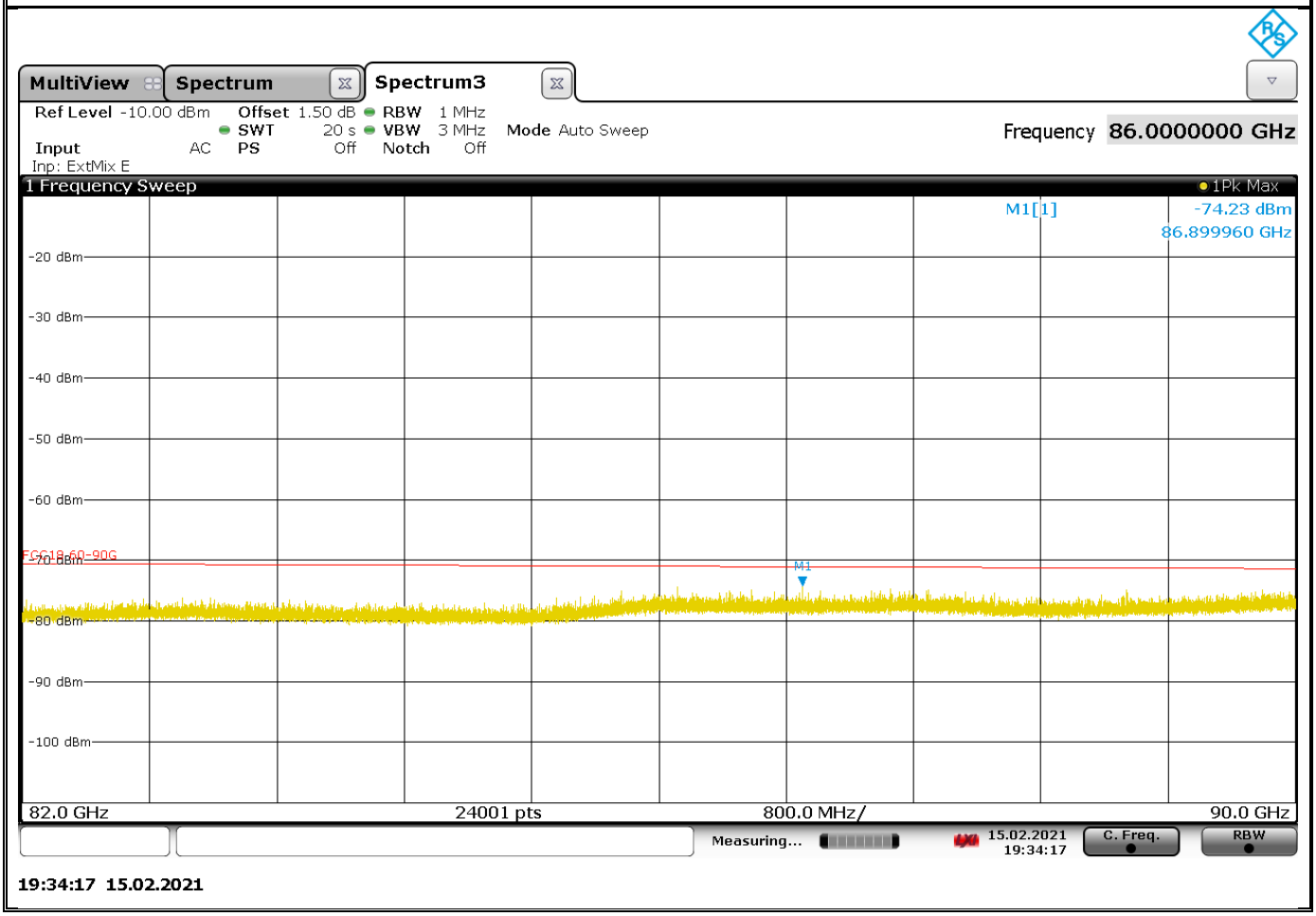


Note: the following frequency are measured.

72000000000	72158730158	72317460317	72476190476	72634920634	72793650793	72952380952	73111111111
73269841269	73428571428	73587301587	73746031746	73904761904	74063492063	74222222222	74380952380
74539682539	74698412698	74857142857	75015873015	75174603174	75333333333	75492063492	75650793650
75809523809	75968253968	76126984126	76285714285	76444444444	76603174603	76761904761	76920634920
77079365079	77238095238	77396825396	77555555555	77714285714	77873015873	78031746031	78190476190
78349206349	78507936507	78666666666	78825396825	78984126984	79142857142	79301587301	79460317460
79619047619	79777777777	79936507936	80095238095	80253968253	80412698412	80571428571	80730158730
80888888888	81047619047	81206349206	81365079365	81523809523	81682539682	81841269841	82000000000

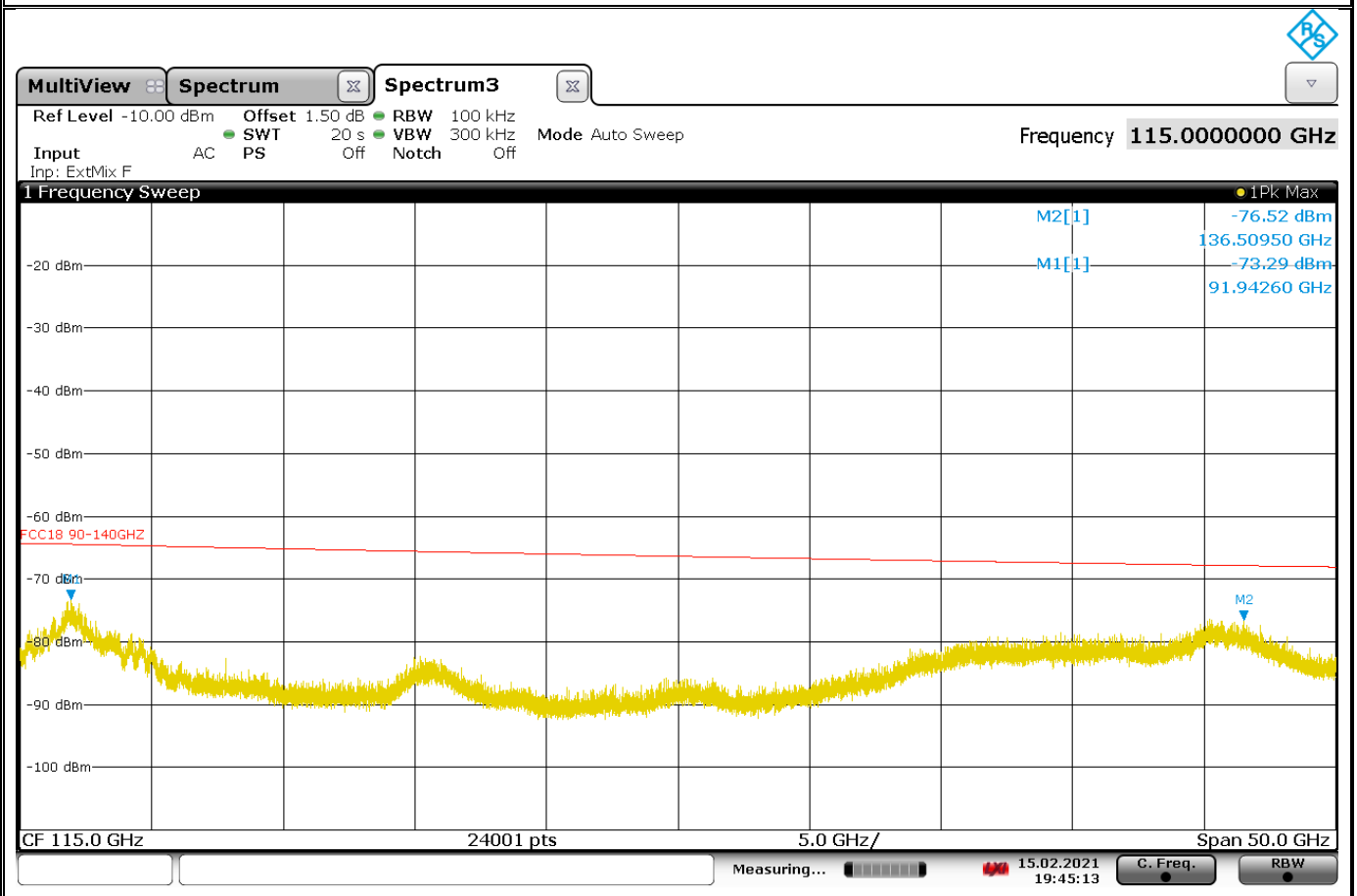
Plot # 21 Unwanted Emissions: 82 - 90 GHz

Measurement antenna orientation: Horizontal



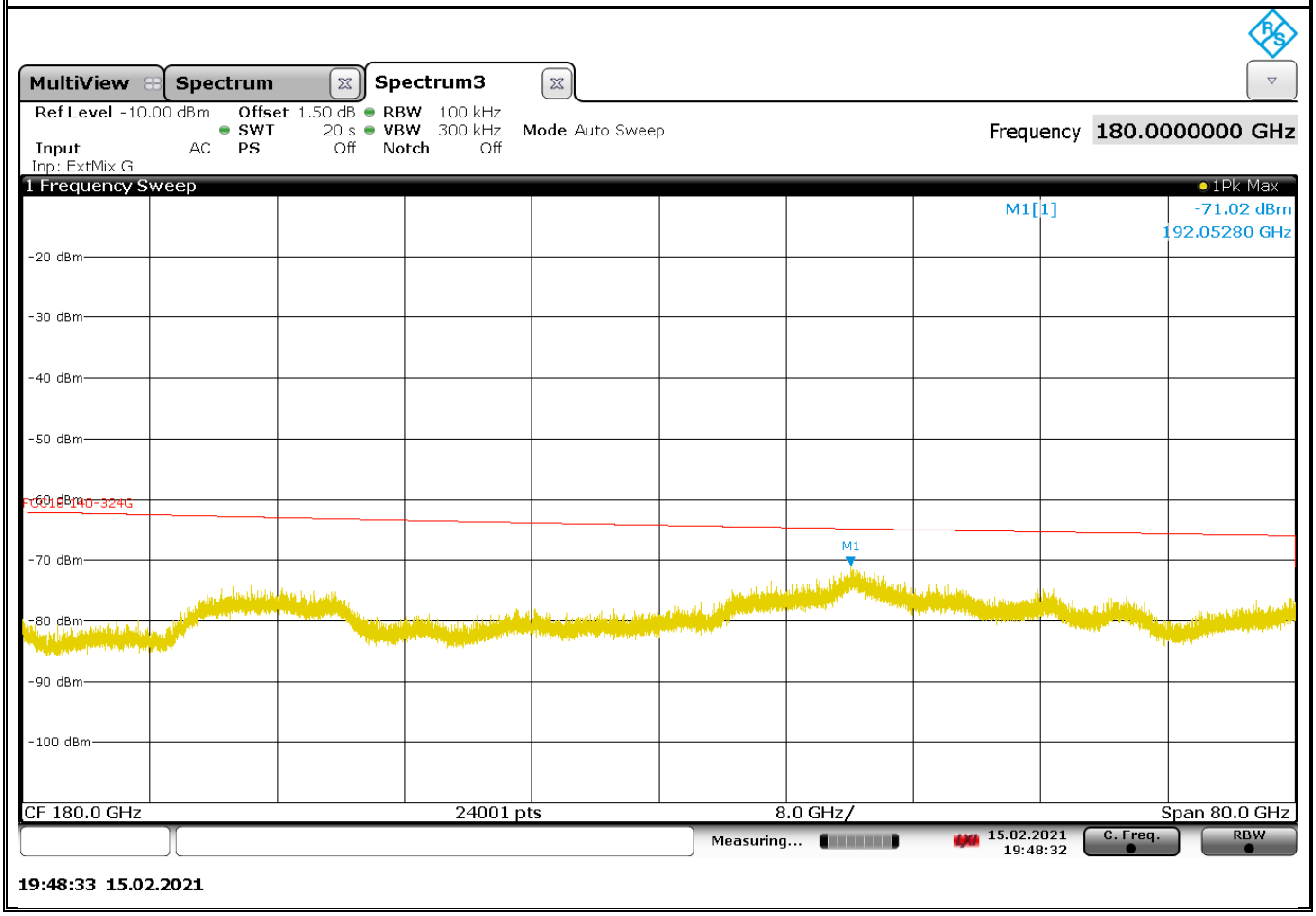
Plot # 22 Unwanted Emissions: 90 - 140 GHz

Measurement antenna orientation: Horizontal



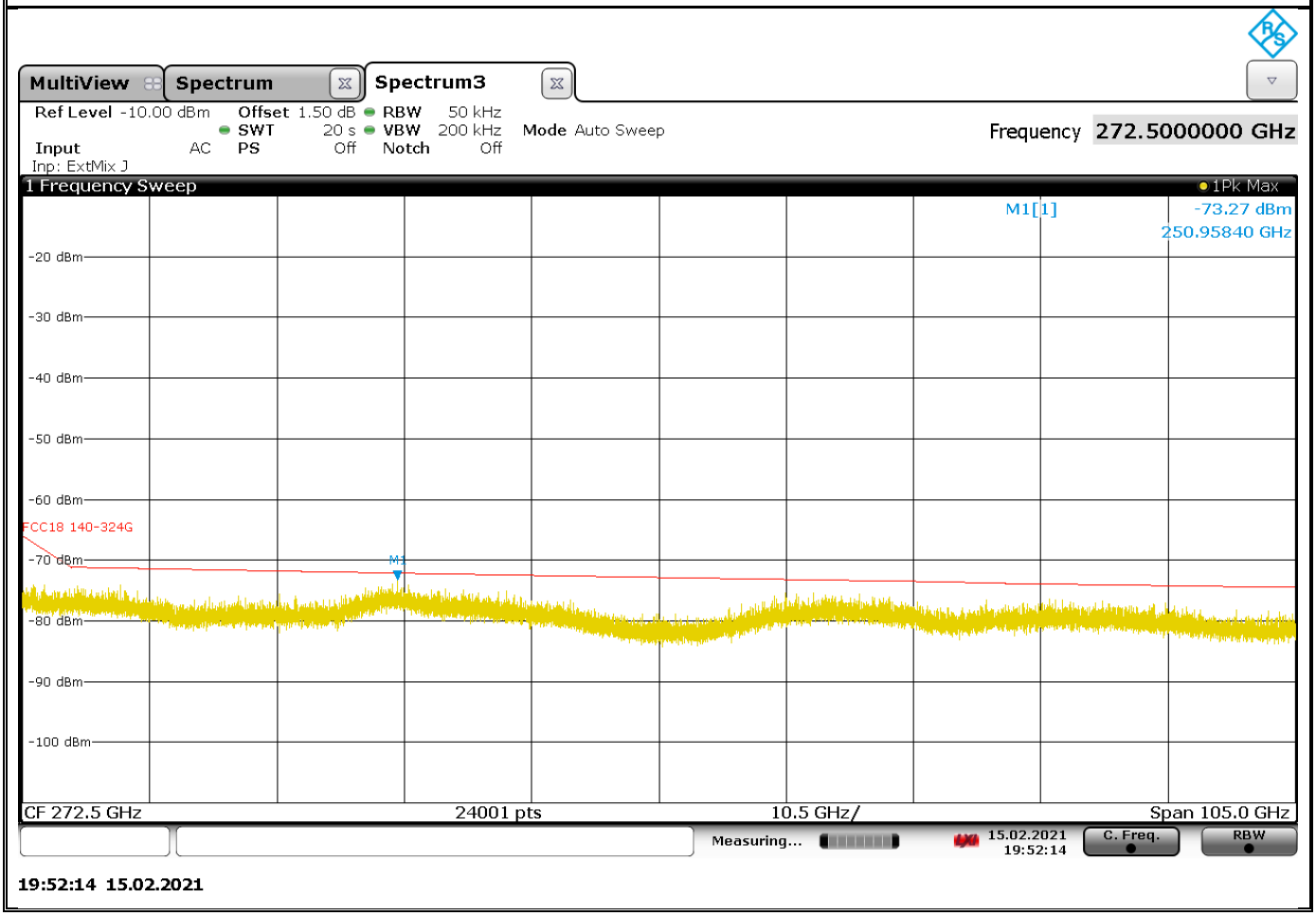
Plot # 23 Unwanted Emissions: 140 - 220 GHz

Measurement antenna orientation: Horizontal



Plot # 24 Unwanted Emissions: 220 - 325 GHz

Measurement antenna orientation: Horizontal



8.2 AC Power line Conducted Emissions according to CFR 47 Part 18.307

Spectrum Analyzer Setting	
Frequency band	150 kHz – 30 MHz
Resolution Bandwidth	9 kHz
Detector (Exploratory Measurements)	Peak, Average
Detector (Final Measurements)	Quasi-Peak, Average
Trace Mode	Max Hold
Step Size	4 kHz
Measurement Time	20 ms

8.2.1 Measurement Procedure:

- The EUT is placed on a horizontal ground plane and 40 cm from the vertical ground conducting surface.
- The length of the power lead in excess of the 80 cm separating the EUT from the LISN shall be folded back and forth so as to form a bundle not exceeding 30 to 40 cm in length
- The plug end of the power lead is connected to the 50Uh/50ohm LISN.
- The 6 highest emissions within 20 dB of the limit are noted.

8.2.2 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

8.2.3 Test Summary:

Environmental Conditions	
Ambient Temperature:	21.8° C
Relative Humidity:	40.4%
Atmospheric Pressure:	1010 mbar

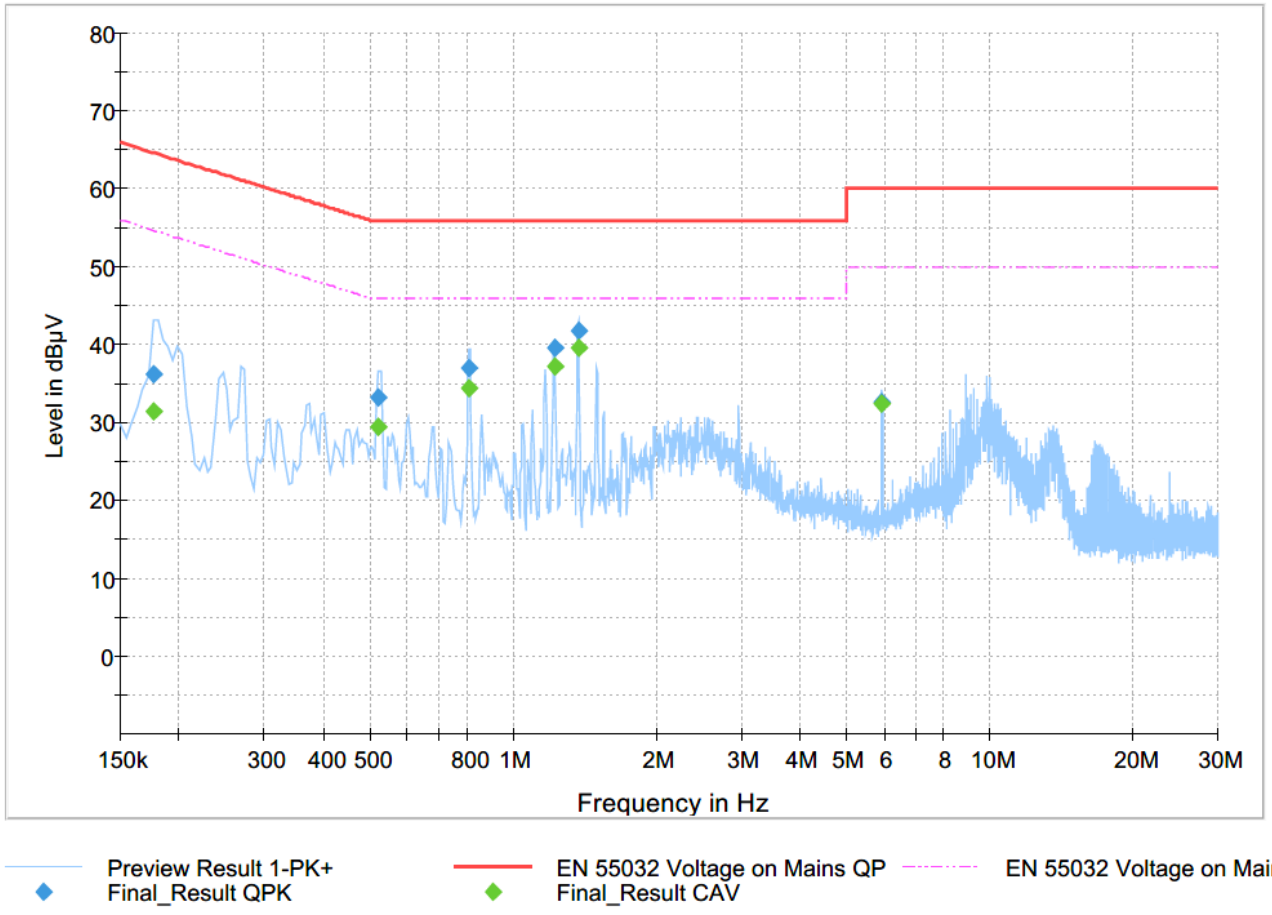
Test Results							
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Detector (Peak / AVG / QP)**	**Line Under Test**	**Power Supply Input**	**Comments**	**Result**
1	1	K100 Mode	Peak & AVG	Line	230V AC	Final measurement	Pass
2	1	K100 Mode	Peak & AVG	Neutral	230V AC	Final measurement	Pass
3	2	Z10 Mode	Peak & AVG	Line	230V AC	Final measurement	Pass
4	2	Z10 Mode	Peak & AVG	Neutral	230V AC	Final measurement	Pass

8.2.4 Measurement Plots:

Plot # 1

Final_Result

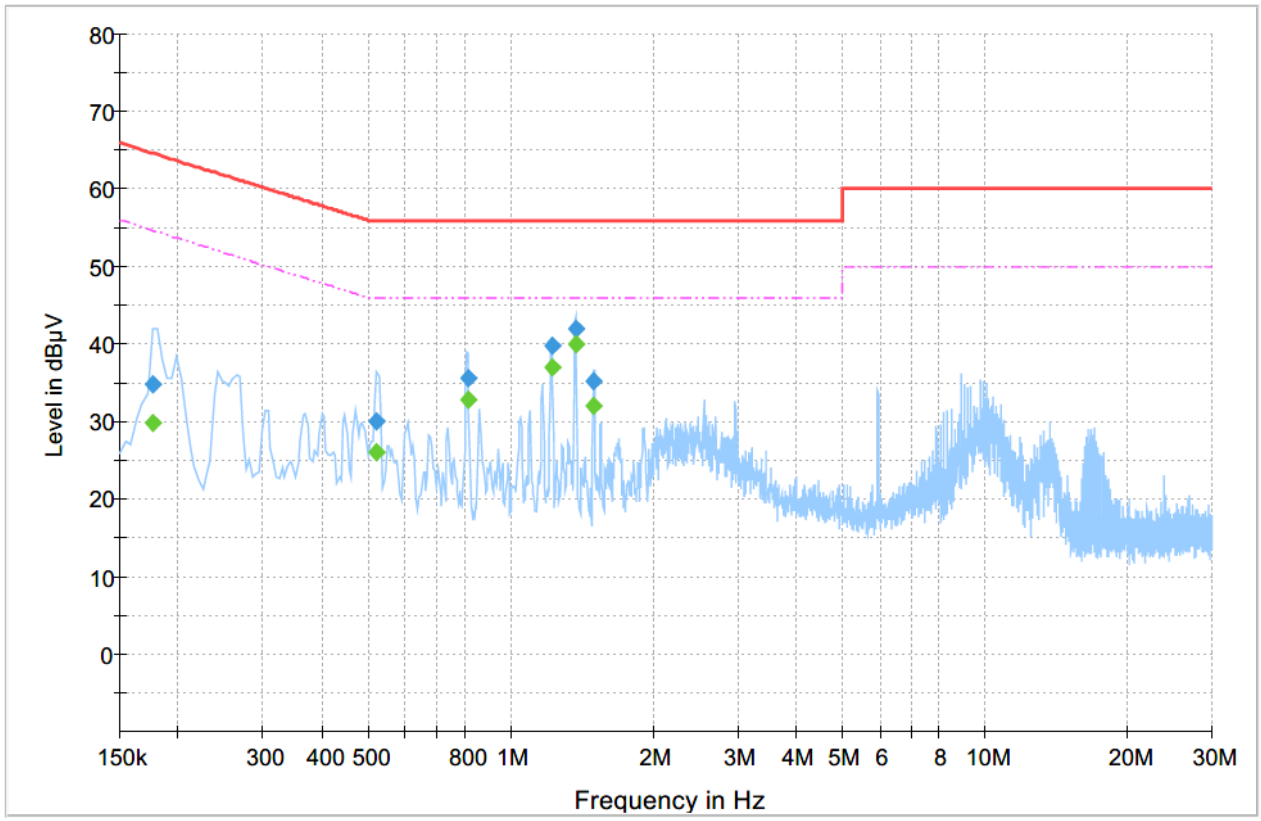
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.176	---	31.37	54.66	23.29	500.0	9.000	L1	GND	10.6	
0.176	36.13	---	64.66	28.53	500.0	9.000	L1	GND	10.6	
0.523	---	29.37	46.00	16.63	500.0	9.000	L1	GND	10.0	
0.523	33.14	---	56.00	22.86	500.0	9.000	L1	GND	10.0	
0.808	---	34.32	46.00	11.68	500.0	9.000	L1	GND	10.0	
0.808	36.96	---	56.00	19.04	500.0	9.000	L1	GND	10.0	
1.221	---	37.13	46.00	8.87	500.0	9.000	L1	GND	10.1	
1.221	39.49	---	56.00	16.51	500.0	9.000	L1	GND	10.1	
1.370	---	39.59	46.00	6.41	500.0	9.000	L1	GND	10.1	
1.370	41.85	---	56.00	14.15	500.0	9.000	L1	GND	10.1	
5.944	---	32.33	50.00	17.67	500.0	9.000	L1	GND	10.1	
5.944	32.70	---	60.00	27.30	500.0	9.000	L1	GND	10.1	



Plot # 2

Final_Result

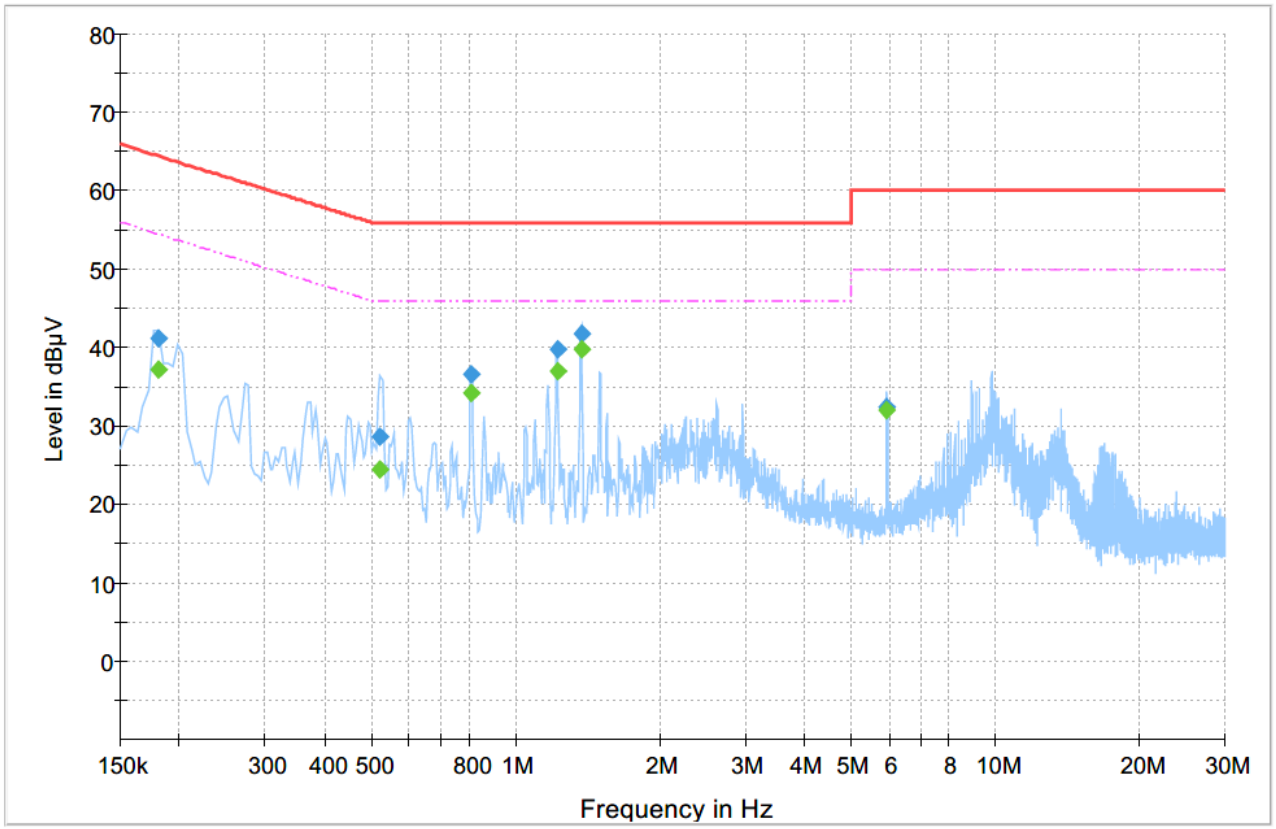
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.176	---	29.81	54.66	24.85	500.0	9.000	N	GND	10.3	
0.176	34.88	---	64.66	29.78	500.0	9.000	N	GND	10.3	
0.523	---	26.07	46.00	19.93	500.0	9.000	N	GND	10.0	
0.523	29.94	---	56.00	26.06	500.0	9.000	N	GND	10.0	
0.813	---	32.88	46.00	13.12	500.0	9.000	N	GND	10.0	
0.813	35.52	---	56.00	20.48	500.0	9.000	N	GND	10.0	
1.221	---	37.05	46.00	8.95	500.0	9.000	N	GND	10.1	
1.221	39.79	---	56.00	16.21	500.0	9.000	N	GND	10.1	
1.370	---	40.05	46.00	5.95	500.0	9.000	N	GND	10.1	
1.370	41.93	---	56.00	14.07	500.0	9.000	N	GND	10.1	
1.498	---	32.00	46.00	14.00	500.0	9.000	N	GND	10.1	
1.498	35.17	---	56.00	20.83	500.0	9.000	N	GND	10.1	



Plot # 3

Final_Result

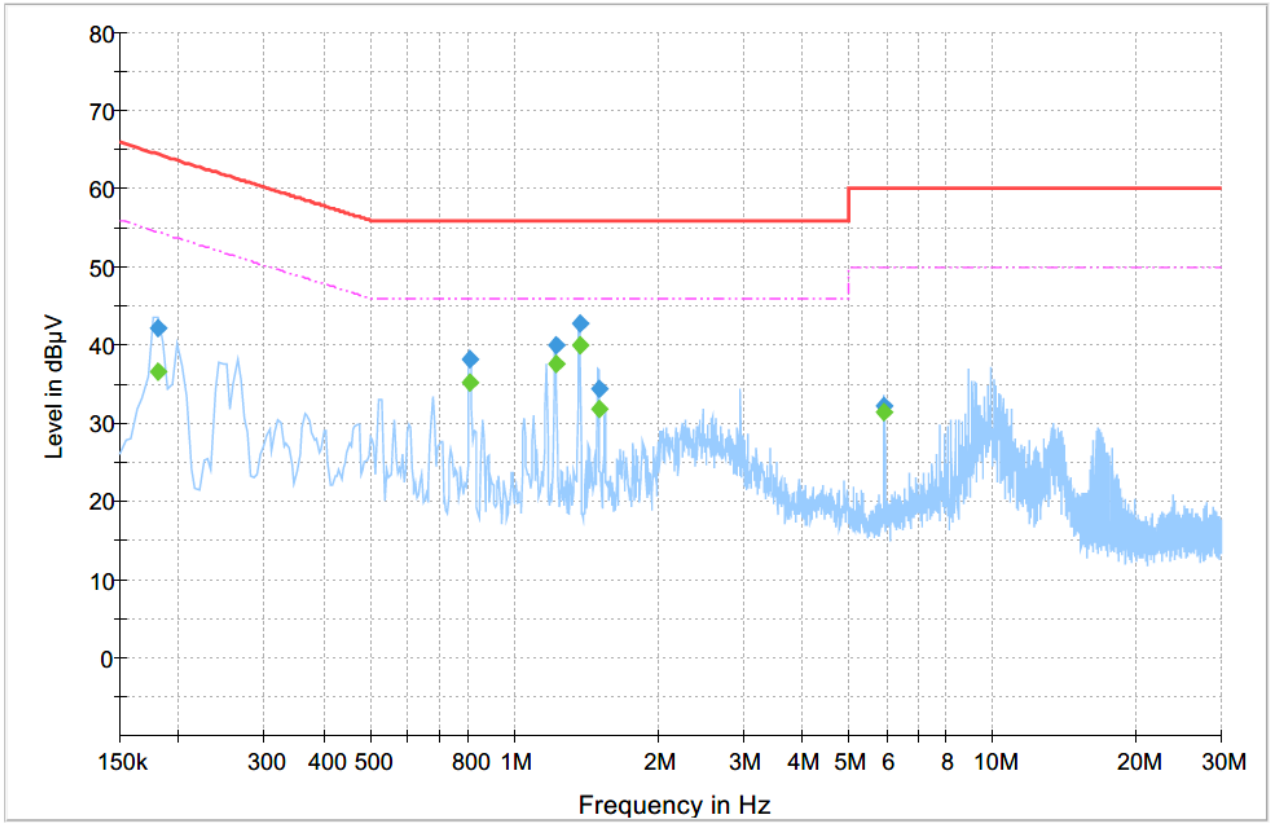
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.181	---	37.23	54.45	17.22	500.0	9.000	L1	GND	10.5	
0.181	41.23	---	64.45	23.22	500.0	9.000	L1	GND	10.5	
0.523	---	24.44	46.00	21.56	500.0	9.000	L1	GND	10.0	
0.523	28.57	---	56.00	27.43	500.0	9.000	L1	GND	10.0	
0.808	---	34.19	46.00	11.81	500.0	9.000	L1	GND	10.0	
0.808	36.67	---	56.00	19.33	500.0	9.000	L1	GND	10.0	
1.221	---	37.05	46.00	8.95	500.0	9.000	L1	GND	10.1	
1.221	39.81	---	56.00	16.19	500.0	9.000	L1	GND	10.1	
1.370	---	39.69	46.00	6.31	500.0	9.000	L1	GND	10.1	
1.370	41.81	---	56.00	14.19	500.0	9.000	L1	GND	10.1	
5.944	---	32.01	50.00	17.99	500.0	9.000	L1	GND	10.1	
5.944	32.44	---	60.00	27.56	500.0	9.000	L1	GND	10.1	



Plot # 4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.181	---	36.51	54.45	17.94	500.0	9.000	N	GND	10.3	
0.181	42.13	---	64.45	22.33	500.0	9.000	N	GND	10.3	
0.808	---	35.11	46.00	10.89	500.0	9.000	N	GND	10.0	
0.808	38.19	---	56.00	17.81	500.0	9.000	N	GND	10.0	
1.221	---	37.63	46.00	8.37	500.0	9.000	N	GND	10.1	
1.221	40.01	---	56.00	15.99	500.0	9.000	N	GND	10.1	
1.370	---	39.95	46.00	6.05	500.0	9.000	N	GND	10.1	
1.370	42.69	---	56.00	13.31	500.0	9.000	N	GND	10.1	
1.502	---	31.86	46.00	14.14	500.0	9.000	N	GND	10.1	
1.502	34.45	---	56.00	21.55	500.0	9.000	N	GND	10.1	
5.940	---	31.38	50.00	18.62	500.0	9.000	N	GND	10.1	
5.940	32.12	---	60.00	27.88	500.0	9.000	N	GND	10.1	



9 Test setup photos

Setup photos are included in supporting file name: "EMC_ROHDE-001-20001_FCC_18_Setup_Photos"

10 Test Equipment And Ancillaries Used For Testing

Item Name	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Biconlog Antenna	A.H. Systems	BiLA2G	569	3 years	12/01/2020
Horn Antenna	ETS Lindgren	3115	35111	3 years	04/17/2019
Horn Antenna	ETS Lindgren	3117-PA	169547	3 years	09/10/2020
EMI Test Receiver	R&S	ESW44	101715	3 years	01/06/2020
Thermometer Humidity Monitor	Control Company	36934-164	191871994	2 years	01/10/2019
Line Impedance Stabilization Network	FCC	FCC-LISN-50-25-2-08	08014	3 years	07/19/2019
Horn Antenna	MI-WAVE	261U-25/383	N/A	N/A	N/A
Horn Antenna	MI-WAVE	261E-25/387	N/A	N/A	N/A
Horn Antenna	MI-WAVE	261F-25/378	N/A	N/A	N/A
Horn Antenna	MI-WAVE	261G-25/387	N/A	N/A	N/A
Horn Antenna	Flann Microwave	32240-20	273388	N/A	N/A
Harmonic Mixer	Radiometer Physics	FS-Z60	101025	3 years	01/22/2020
Harmonic Mixer	Radiometer Physics	FS-Z90	102088	3 years	02/19/2020
Harmonic Mixer	Radiometer Physics	FS-Z140	101145	3 years	20/24/2020
Harmonic Mixer	Radiometer Physics	FS-Z220	101037	3 years	03/23/2020
Harmonic Mixer	Radiometer Physics	FS-Z325	100943	3 years	02/27/2020

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 Revision History

Date	Report Name	Changes to report	Report prepared by
2021-05-27	EMC_ROHDE-001-20001_FCC_18	Initial Version	Yuchan Lu

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