FCC / ISED Test Report

For:
Praesidium Inc.

Model Name:
2001BIO1

Product Description:
Contactless vital sign detection sensor

FCC ID: 2A7ZX2001BIO1
IC ID: 28837-2001BIO1

Applied Rules and Standards:
47 CFR Part 15.255
RSS-210 Issue 10

REPORT #: EMC_PRAES-001-22001_15.255_Rev_1

DATE: 2023-02-16

A2LA Accredited

IC recognized #
3462B-2
CABID: US0187

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.255 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-210.

No deviations were ascertained.

Company	Description	Model #
Praesidium Inc.	Contactless vital sign detection sensor	2001BIO1

This test report EMC_PRAES-001-22001_15.255_Rev_1.docx dated on 2023-02-16 substitutes the report EMC_PRAES-001-22001_15.255 dated on 2023-02-09, which herewith gets invalid.

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2023-02-16	Compliance	Arndt Stoecker (EMC Lab Manager)	Arndt Stoecker Digitally signed by: Arndt Stoecker DN: CN = Arndt Stoecker email = arndt.stoecker@cetecom.com C = US O = CETECOM Inc Date: 2023.02.16 12:48:32 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2023-02-16	Compliance	Guangcheng Huang (EMC Engineer)	

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:	Arndt Stoecker
Responsible Project Leader:	Rami Saman

2.2 Identification of the Client

Client's Name:	Praesidium Inc.
Street Address:	150 N 200 E
City/Zip Code	St. George Utah 84770
Country	USA

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	2001BIO1
HW Version :	2001BIO1
SW Version :	V1.0.0
FCC-ID :	2A7ZX2001BIO1
IC-ID:	28837-2001BIO1
FWIN:	N/A
HVIN:	2001BIO1
PMN:	RemWave Sleep
Product Description:	Contactless vital sign detection sensor
Frequency Range / number of channels:	WiFi : 2400 MHz – 2483.5 MHz; Center to center: 2412 MHz (ch 1) – 2462 MHz (ch 11), 11 channels Radar: 60-64 GHz
Radio Information:	WLAN (WiFi Pre-certified) WIZnet H.K. LTD. Model: WIZFI360PA FCC ID: 2ATUB-WIZFI360PA ISED: 20560-WIZFI360PA Radar IWR6843 Chip
Modes of Operation:	1: normal operation mode (FMCW ca.1% duty cycle) 2: continuous transmission mode (FMCW ca. 100% duty cycle) 3: continuous wave transmission mode (CW)
Antenna Information as declared:	Main Antenna: PCB embedded 2.4 GHz Wi-Fi antenna gain 2 dBi gain PCB embedded 60-64 GHz Radar antenna, 15 dBi gain
Max. declared output Powers:	-10.2 dBm (Conducted output power)
Power Supply/ Rated Operating Voltage Range:	Vmin: 4.75 VDC/ Vnom: 5V VDC / Vmax: 5.25 VDC 5V 1A (5W) DC, USB-C input
Operating Temperature Range	32° to 104°F (0° to 40°C)
Other Radios included in the device:	-
Sample Revision	☐Prototype Unit; ☐Production Unit; ☒Pre-Production

EUT Dimensions	H x W x D (1.64in) x (4.25in) x (4.25in)

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	----------	2001BIO1	V1.0.0	----------

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	ACDC Charger	XSD-0501000NUSD	Shenzhen Sunshine Technological Co., Ltd.	----------

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	The radio of the EUT is configured according to requirement of each test case

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and continuous wave transmission.

For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.255 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 Issue 10 of ISED Canada.

This test report is to support a request for new equipment authorization under the:

- FCC ID: 2A7ZX2001BIO1
- IC ID: 28837-2001BIO1

Testing procedures are based on ANSI C63.10:2013 including chapter 9 for millimeter-wave systems.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.255(c)(3) RSS-210 J.2.1 (b)	Equivalent Isotropic Radiated Power and Conducted Output Power	Nominal	2	■	☐	☐	Complies
§15.255(e) RSS-210 J.4 (c)	6 dB Occupied Bandwidth	Nominal	2	■	☐	☐	Complies
RSS-Gen 6.7	99% Occupied Bandwidth	Nominal	2	☐	■	☐	For info only
§15.255(f) RSS-210 J.6	Frequency Stability	Nominal and extreme	2	■	☐	☐	Complies
§15.255(h) RSS-210 J.7	Group Installation	Nominal	-	☐	■ *	☐	Complies
§15.255(d) §15.209 (a) RSS-210 J.3	TX Spurious emissions-Radiated	Nominal	3	■	☐	☐	Complies
§15.207 RSS-Gen 8.8	AC Conducted Emissions	Nominal	2	■	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.
*): see manufacturer's product manual.

6 Measurements

6.1 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)
40-60 GHz	±3.95 dB (Horn Antenna)
60-90 GHz	±3.32 dB (External Mixer, Horn Antenna)
90-140 GHz	±4.94 dB (External Mixer, Horn Antenna)
140-225 GHz	±5.42 dB (External Mixer, Horn Antenna)

Conducted measurement

RF conducted measurement	±0.5 dB

6.2 Environmental Conditions During Testing:

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

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

6.3 Dates of Testing:

11/03/2022 – 12/09/2022

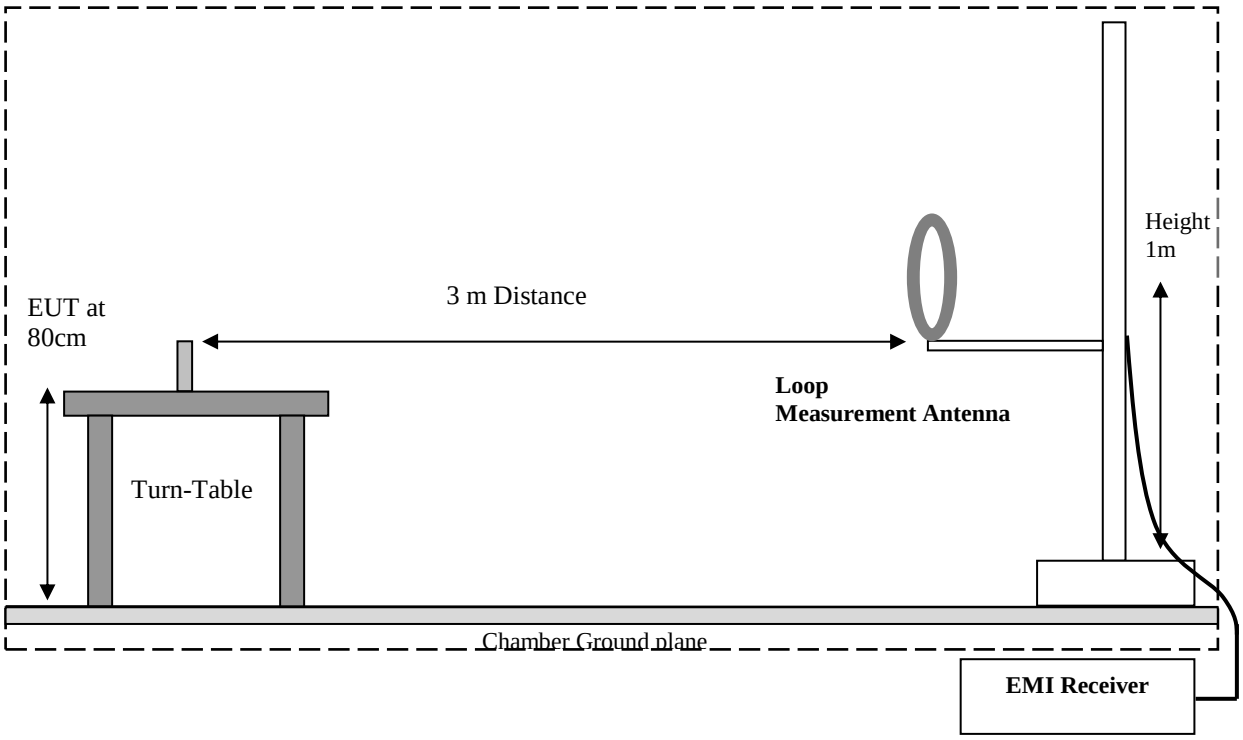
7 Measurement Procedures

7.1 Radiated Measurement

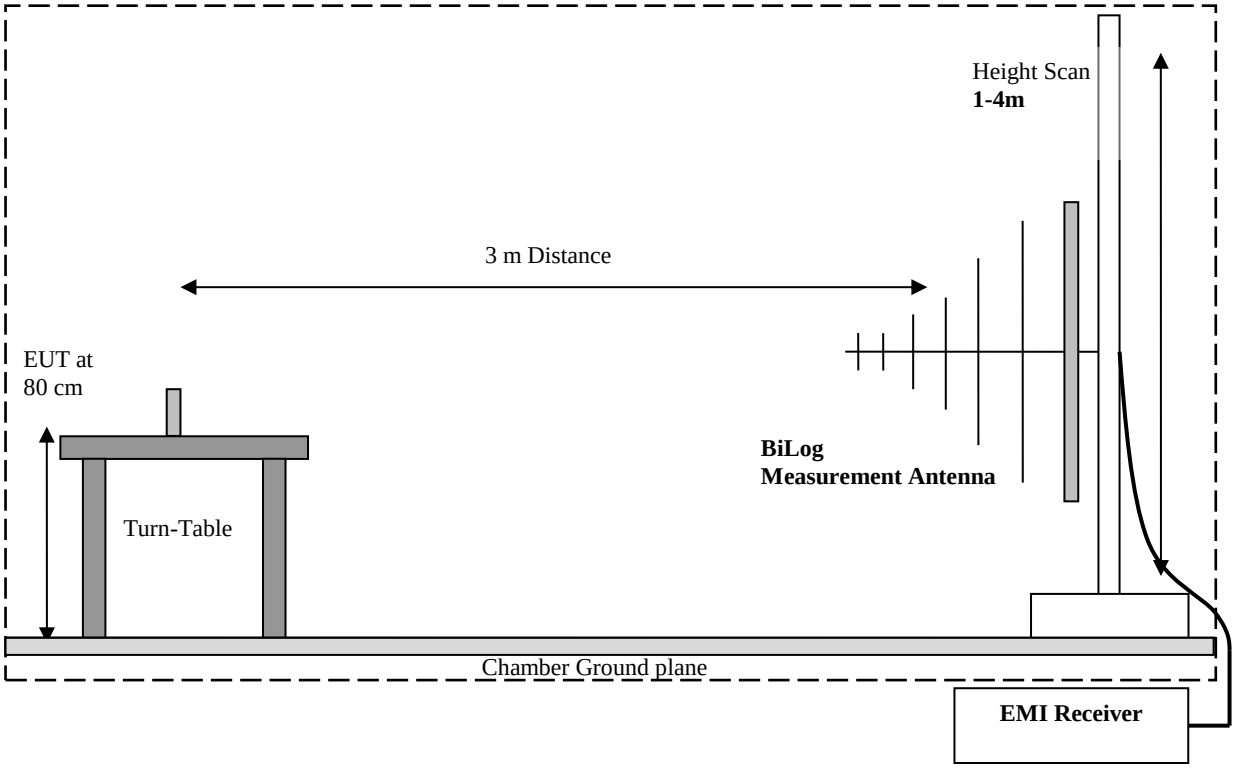
The radiated measurement is performed according to: ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

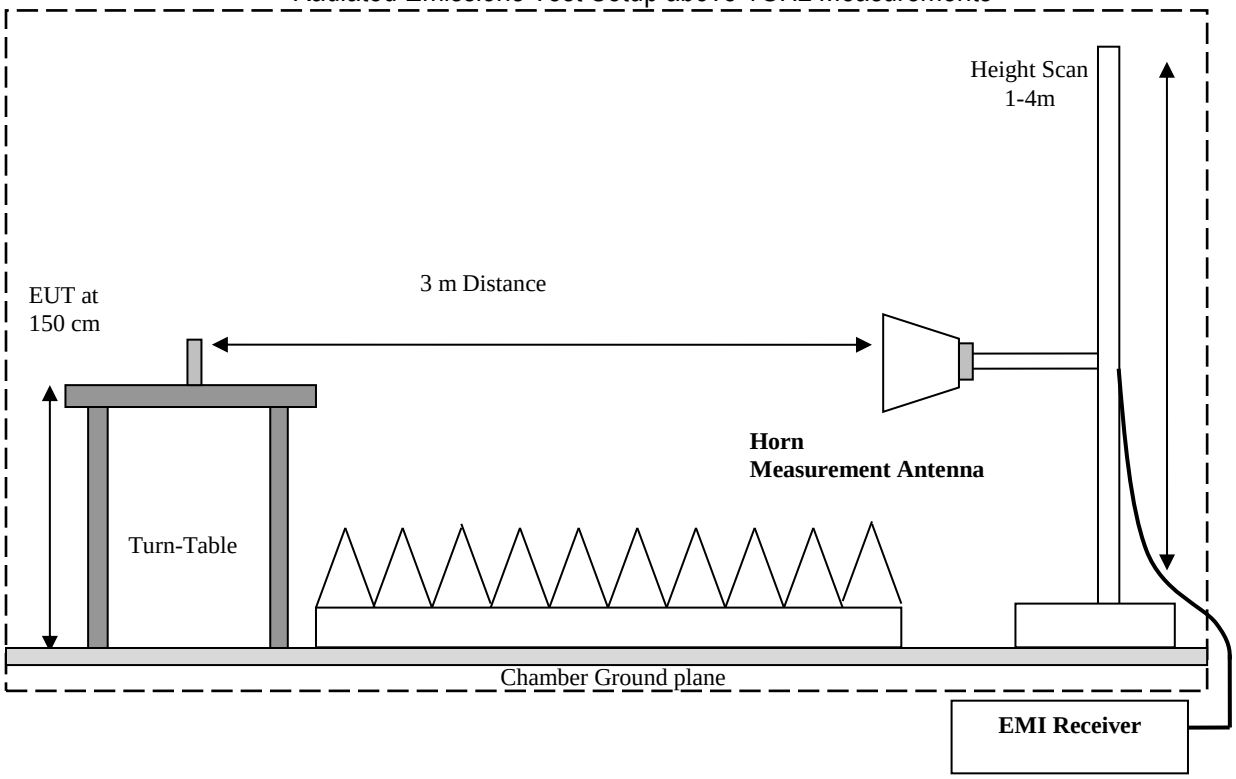
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

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

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. 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

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

8 Test Result Data

8.1 EIRP and Maximum Peak Conducted Output Power

8.1.1 Measurement according to ANSI C63.10 Section 9.11

1. An RF detector with a bandwidth encompassing the entire authorized frequency band is used. An appropriate test horn antenna is connected to it and put in the main beam of the EUT. The video output of the RF detector is feed to a DSO.
2. The EUT is set to transmission with max. power level. Frequent sweeps have been done on the DSO to capture the highest level of the video output.
3. Replace the EUT with a setup generating unmodulated mm-wave at the center frequency of the EUT frequency range. The setup includes a signal generator, a frequency multiplier, a variable attenuator and a horn antenna.
4. Adjust the level of the generated mm-wave till the DSO shows the same voltage level as the highest level captured measuring the EUT.
5. Without making any other change, disconnect the transmitting antenna on this signal generating setup and measure the output level of the setup with a wideband mm-wave power meter with a thermocouple detector in the conducted way.
6. Applying the equations in ANCI C63.10 to calculate the EIRP and conducted output of the EUT

8.1.2 Limits:

Maximum Peak Output Power:

FCC §15.255 (c):

- (3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed −10 dBm and the peak EIRP level shall not exceed 10 dBm.

IC RSS-210 J.2.1:

- (b) For fixed field disturbance sensors other than those operating under the provisions of (a) above and for interactive motion sensors, the peak transmitter output power shall not exceed -10 dBm, and the peak e.i.r.p. shall not exceed 10 dBm.

8.1.3 Test conditions and setup:

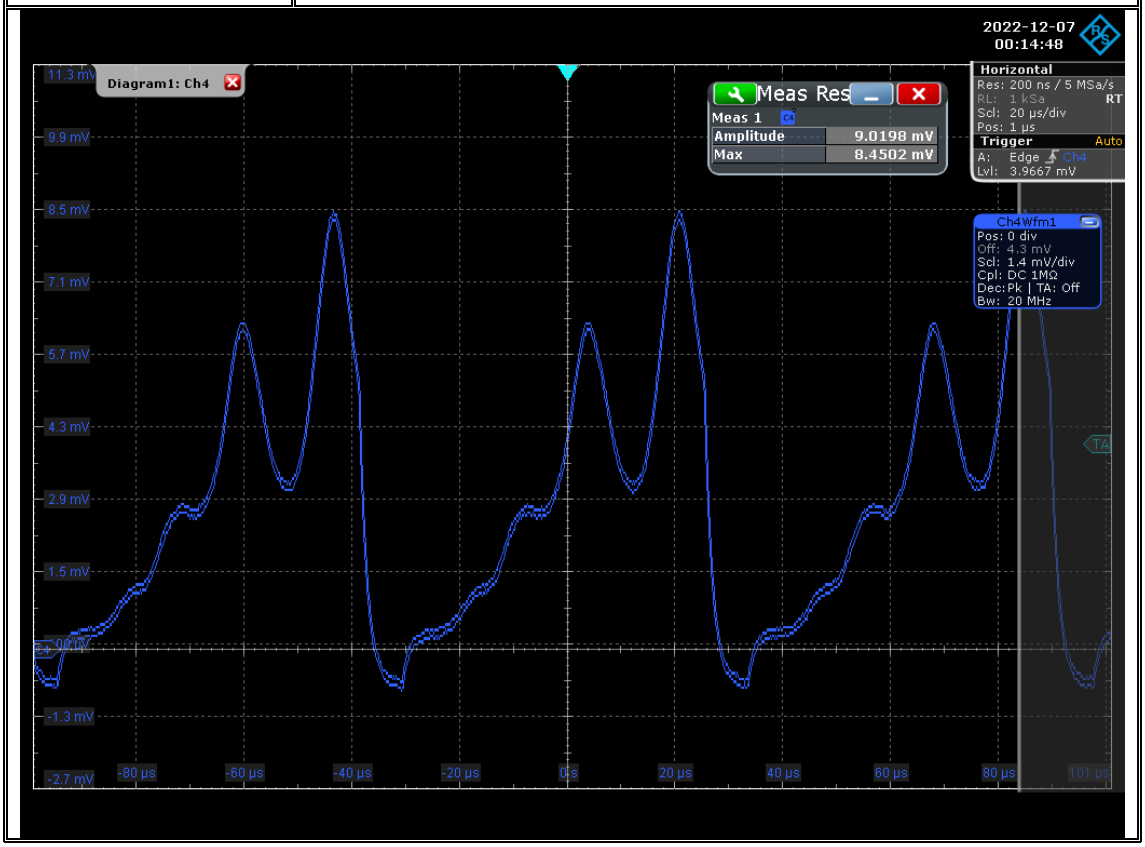
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23 °C	1	2	5 VDC	15 dBi

8.1.4 Measurement result:

Plot #	Frequency (GHz)	EUT operating mode	Maximum Peak Conducted Output Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
1-3	60-64	2	-10.2	4.8	-10 (conducted) / 10 (EIRP)	Complies

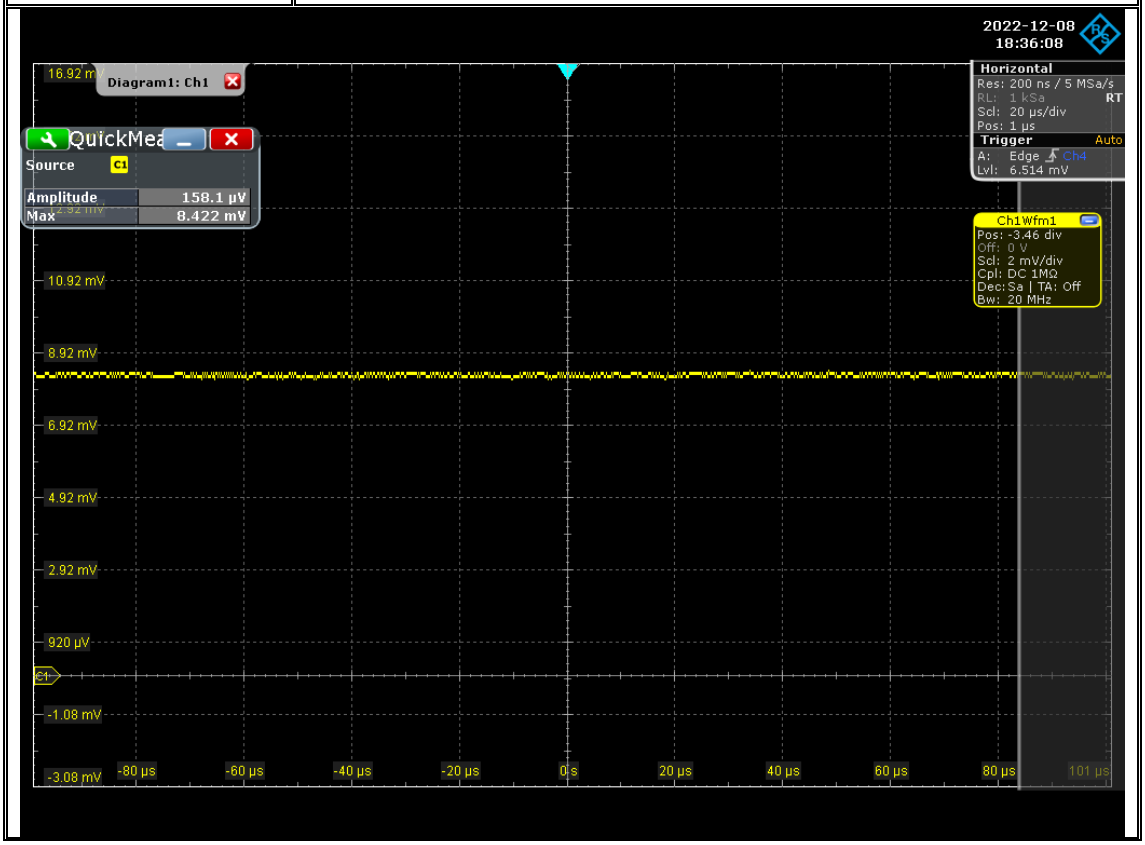
8.1.5 Measurement Plots:

Plot #1



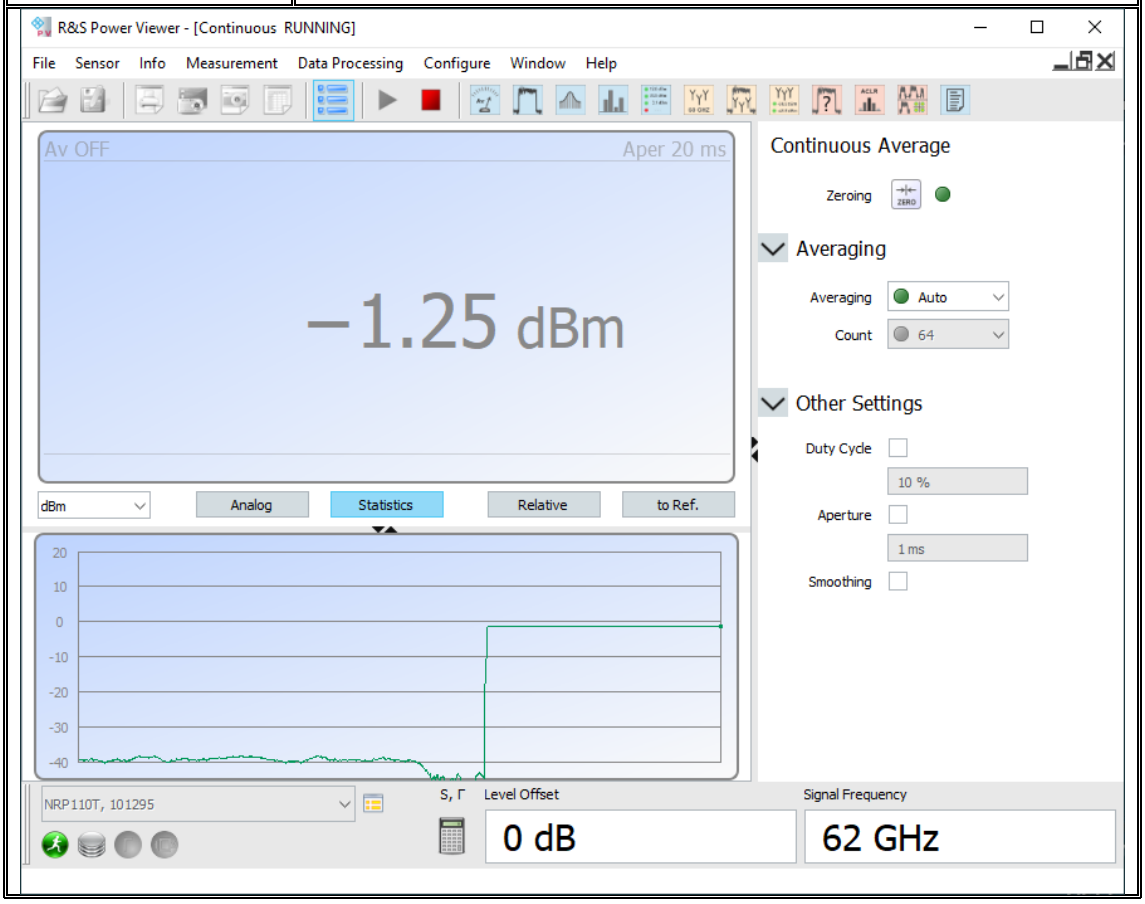
Note: measured with the DSO, shows max. voltage = 8.45 mV at a distance of 7 cm to EUT.

Plot #2



Note: reproduce the max. voltage level of 8.42 mV with a signal generator and transmitting antenna at a distance of 62 cm.

Plot #3



Note: measured the conducted power from the signal generator of -1.25 dBm.

Antenna gain of the antenna, which is attached to the signal generator: 25 dBi,
Free space loss of a signal at 62 GHz at a distance of 7 cm: 45.25 dB,
Free space loss of a signal at 62 GHz at a distance of 62 cm: 64.20 dB,
Thus the equivalent radiated power the EUT calculates:

EIRP = -1.25 dBm + 25 dB + 45.25 dB - 64.20 dB = 4.8 dBm
Conducted power = EIRP – AG (15 dBi) = -10.2 dBm

8.2 6 dB Bandwidth

8.2.1 Measurement according to ANSI C63.10 Section 6.9.2

Spectrum Analyzer settings:

- Span: approximately 2 to 3 times the emission bandwidth, centered on the carrier frequency
- RBW = as specified in the requirement
- VBW = as specified in the requirement
- Sweep Time = Auto couple
- Detector = Peak
- Trace = Max hold

8.2.2 Limits: FCC §15.255(e)(1), RSS-210 J.4 (c)

FCC §15.255(e)(1):
For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

RSS-210 J.4 (c):
For the purpose of this standard, emission bandwidth is defined as the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density shall be 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency must be stationary during the measurement interval, even if not stationary during normal operation.

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	2		5 VDC

8.2.4 Measurement result:

Plot #	EUT operating mode	6 dB Bandwidth (GHz)
1	2	3.35834

8.2.5 Measurement Plots:

Plot #1 6 dB Bandwidth

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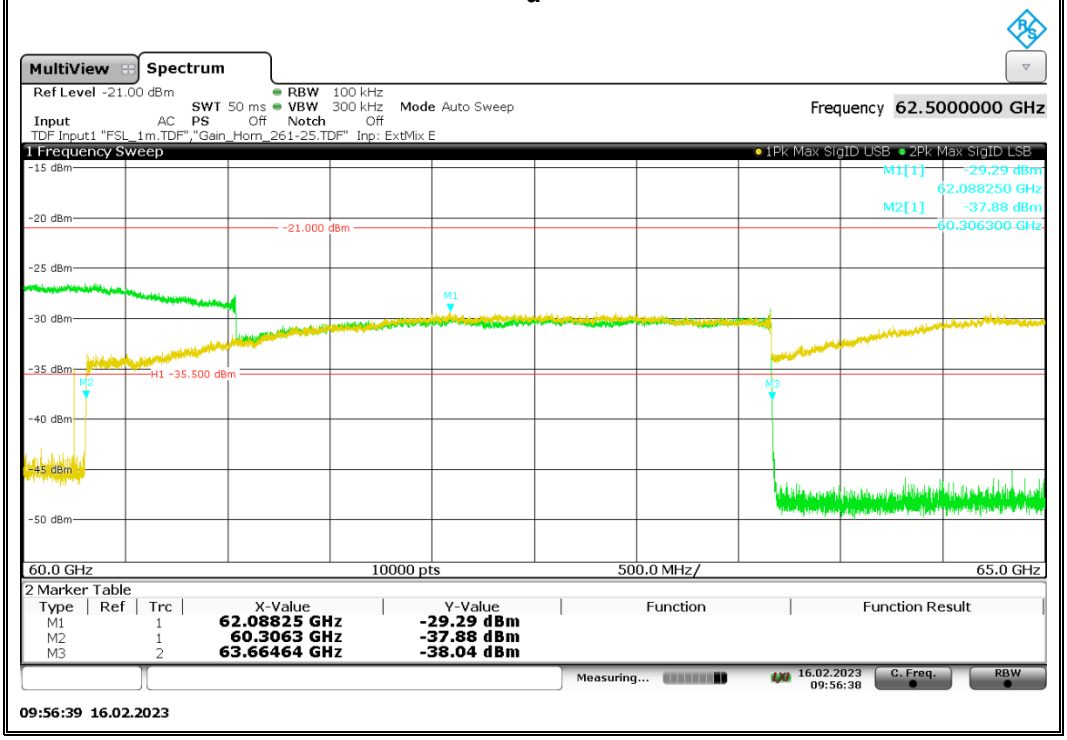


8.3 99% Occupied Bandwidth

8.3.1 Measurement according to RSS-Gen 6.7

Spectrum Analyzer settings:

- Span: approximately 2 to 3 times the emission bandwidth, around the carrier frequency
- RBW = 1% to 5% of the actual occupied bandwidth
- VBW = not smaller than three times the RBW
- Sweep Time = Auto couple
- Detector = Sample or Peak
- Trace = Max hold

8.3.2 Limits: - (for information only)

8.3.3 Test conditions and setup:

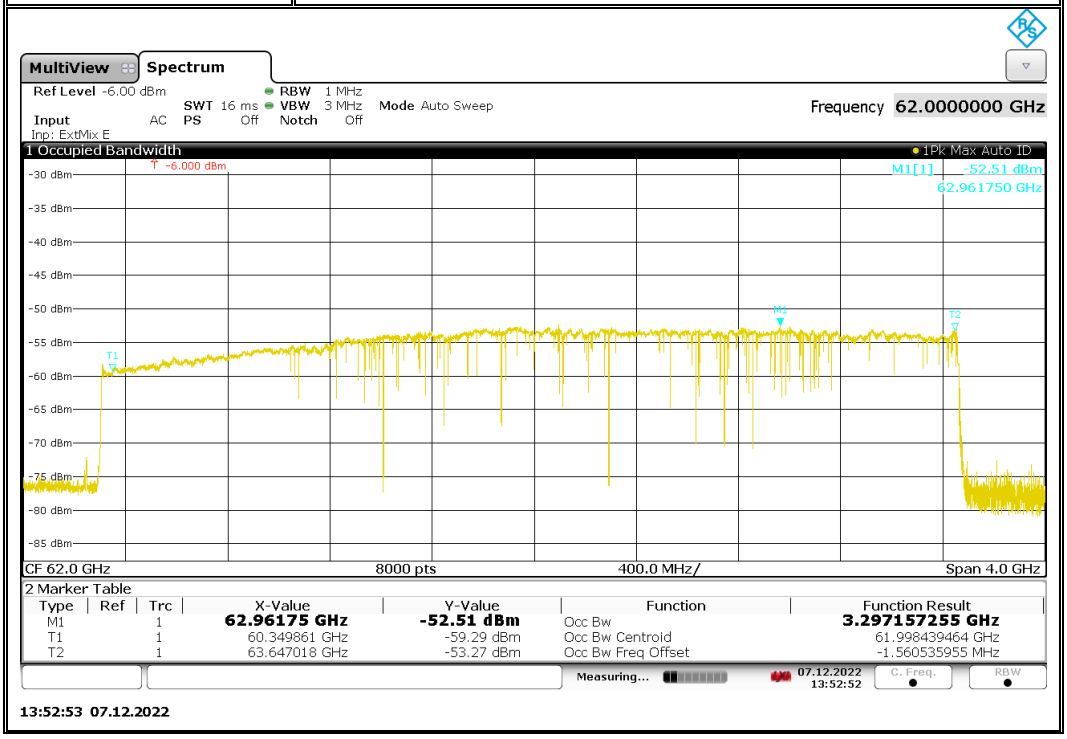
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22 °C	1	2	5 VDC

8.3.4 Measurement result:

Plot #	EUT operating mode	99% Occupied Bandwidth (GHz)
1	2	3.2972

8.3.5 Measurement Plots:

Plot #1 99% Occupied Bandwidth



8.4 Frequency Stability

8.4.1 Measurement according to ANSI C63.10 Section 9.14

Spectrum Analyzer settings:

- Span: approximately 2 to 3 times the emission bandwidth, around the carrier frequency
- RBW = 1% to 5% of the actual occupied bandwidth
- VBW = not smaller than three times the RBW
- Sweep Time = Auto couple
- Detector = Sample or Peak
- Trace = Max hold

8.4.2 Limits: FCC §15.255(f), RSS-210 J.6

FCC §15.255(f):
Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

RSS-210 J.6:
Fundamental emissions shall be contained within the 57-71 GHz frequency band during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.

8.4.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
20 °C	1	2	5 VDC

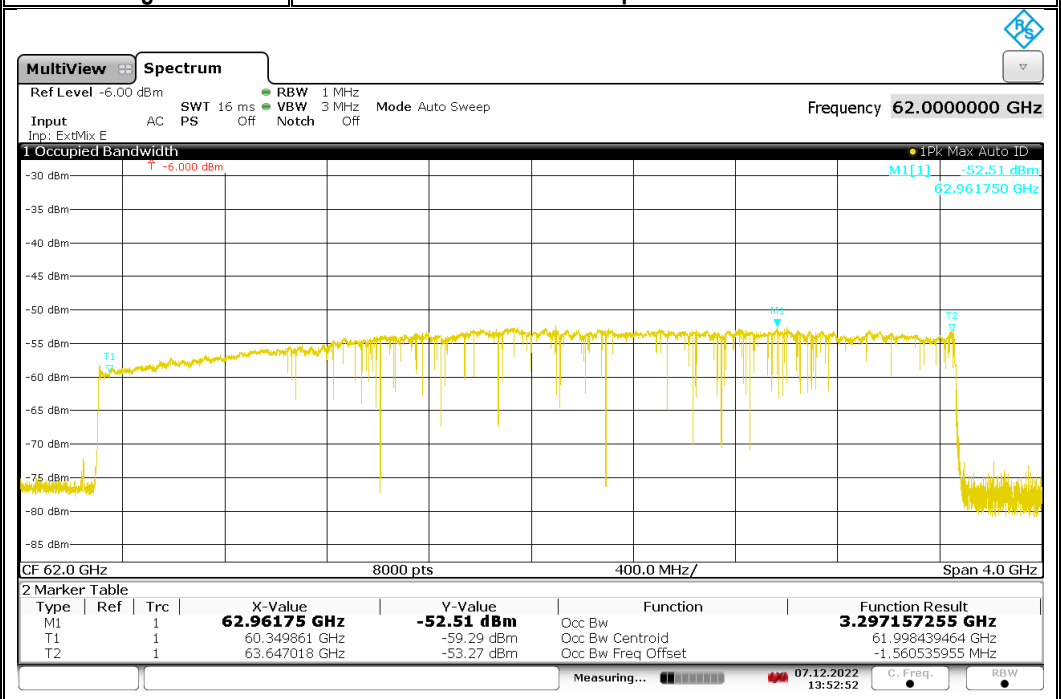
8.4.4 Measurement result:

Plot #	Voltage (V)	Temperature (°C)	F_low (GHz)	F_high (GHz)	Limit (GHz)	Verdict
1	5	20	60.349861	63.647018	57-71	Complies
2	4.25	20	60.35293	63.650734	57-71	Complies
3	5.75	20	60.348942	63.649839	57-71	Complies
4	5	0	60.360457	63.652241	57-71	Complies
5	5	10	60.362321	63.65203	57-71	Complies
6	5	30	60.353384	63.649538	57-71	Complies
7	5	40	60.346361	63.647303	57-71	Complies

8.4.5 Measurement Plots:

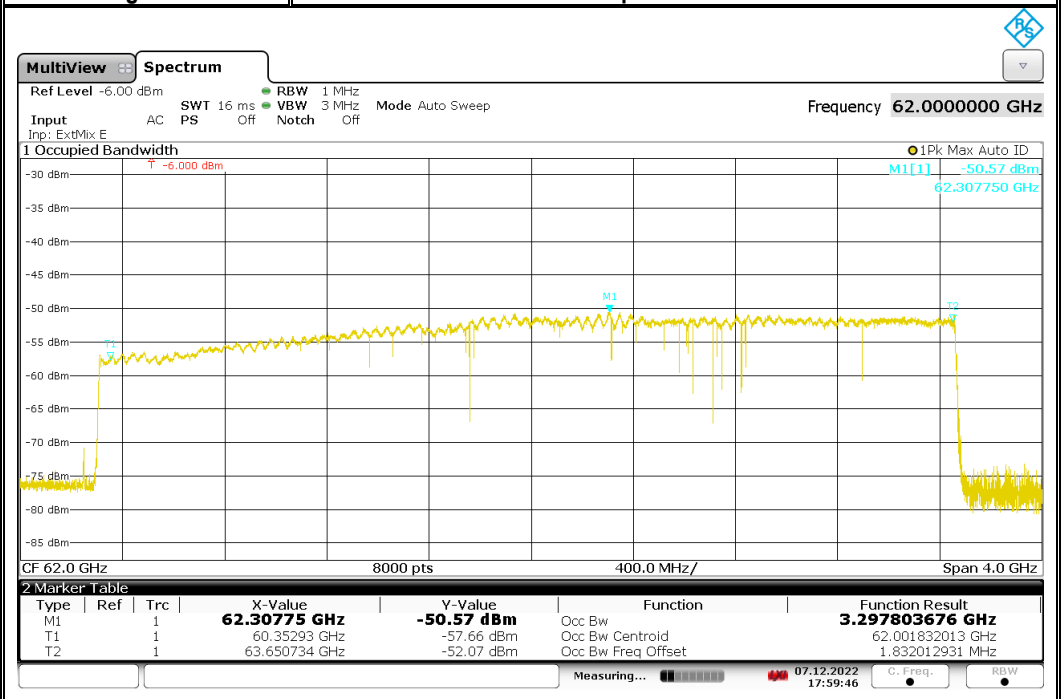
Plot # 1. 99% OBW

Voltage 5 V	Temperature 20 °C



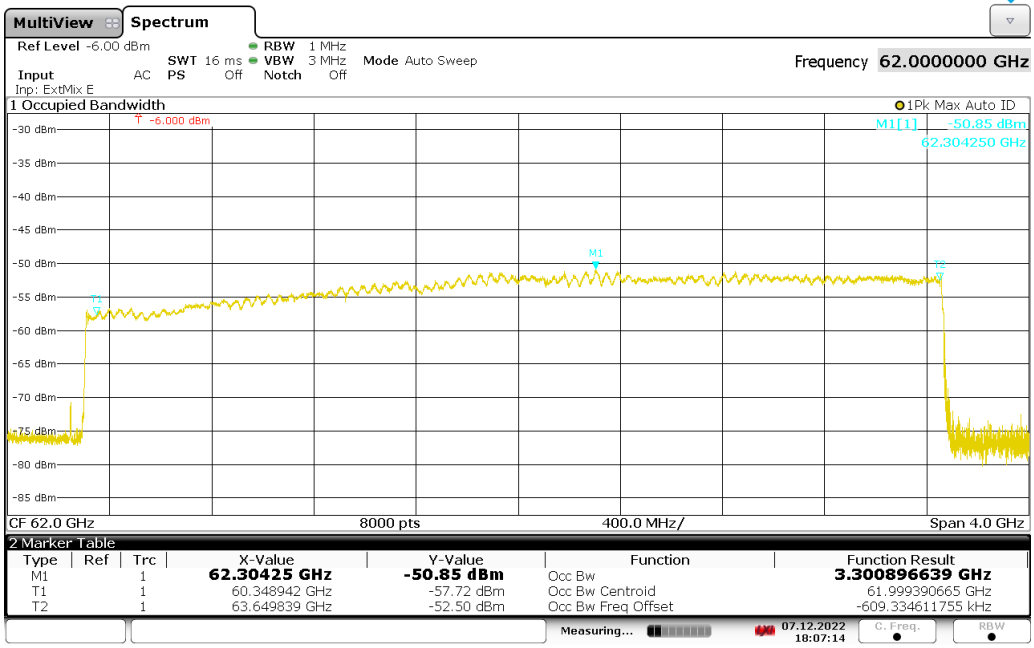
Plot # 2. 99% OBW

Voltage 4.25 V	Temperature 20 °C



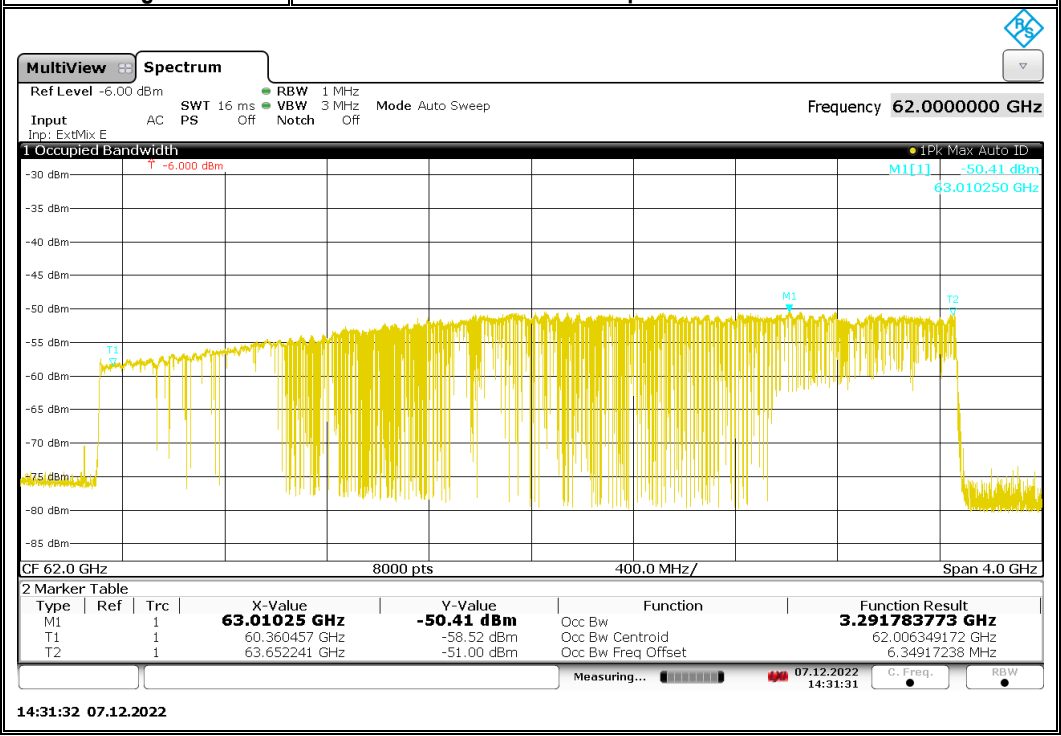
Plot # 3. 99% OBW

Voltage 5.75 V	Temperature 20 °C



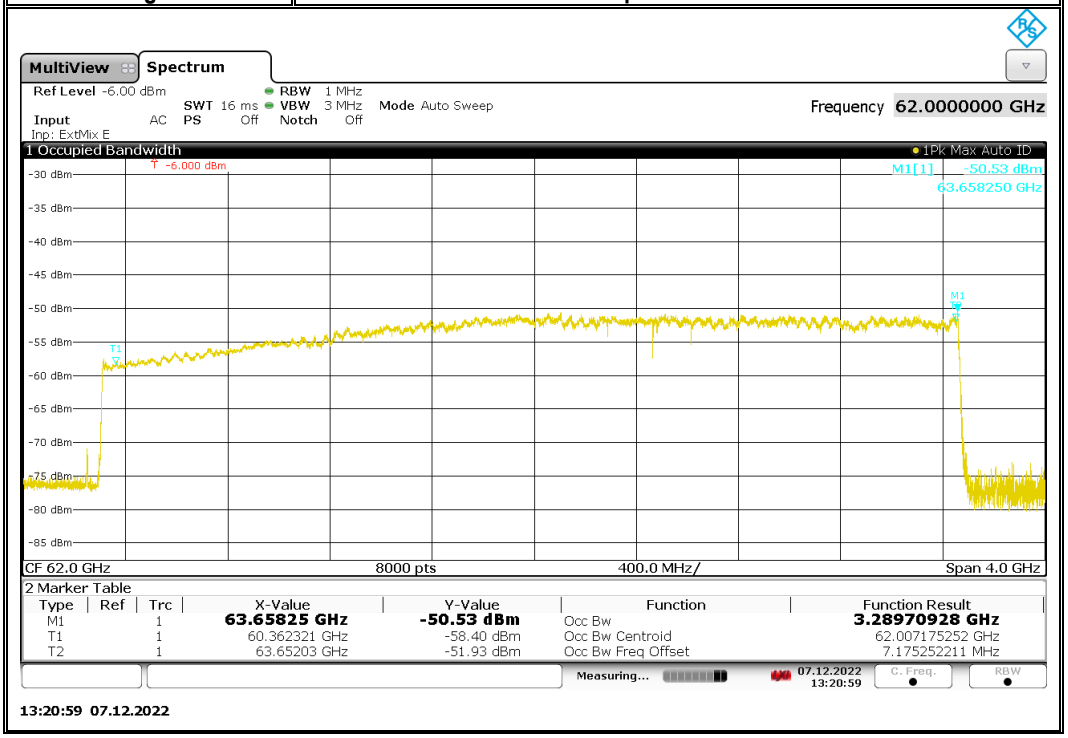
Plot # 4. 99% OBW

Voltage 5 V	Temperature 0 °C



Plot # 5. 99% OBW

Voltage 5 V	Temperature 10 °C



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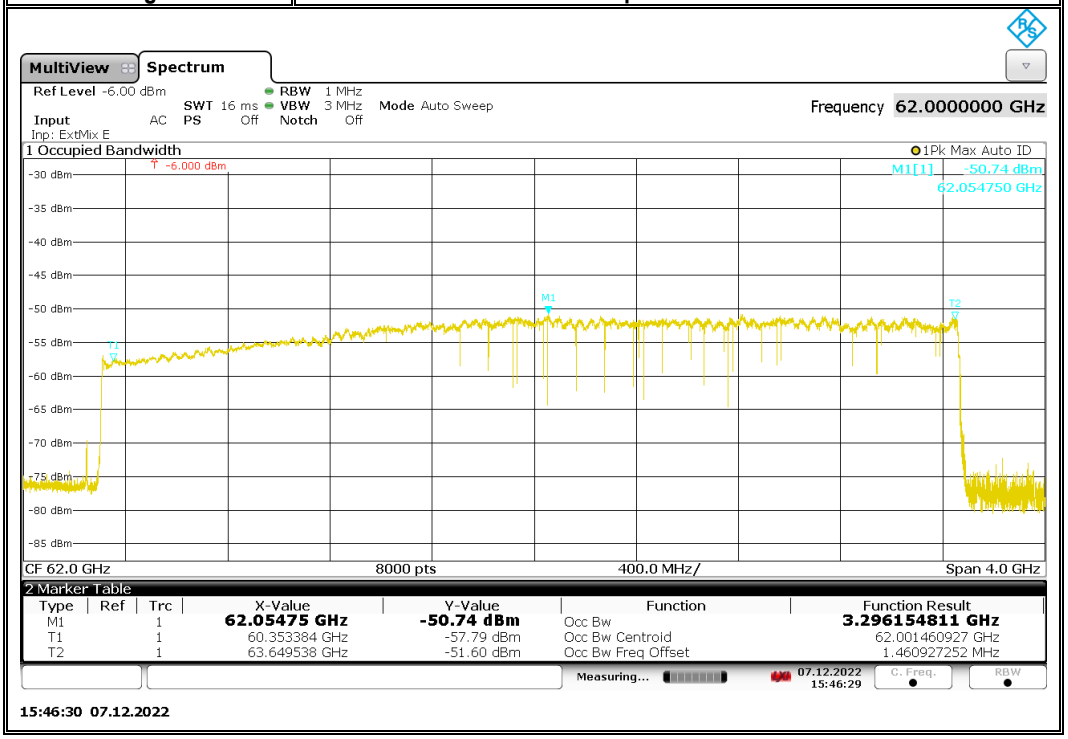
Plot # 6. 99% OBW

Voltage 5 V	Temperature 30 °C



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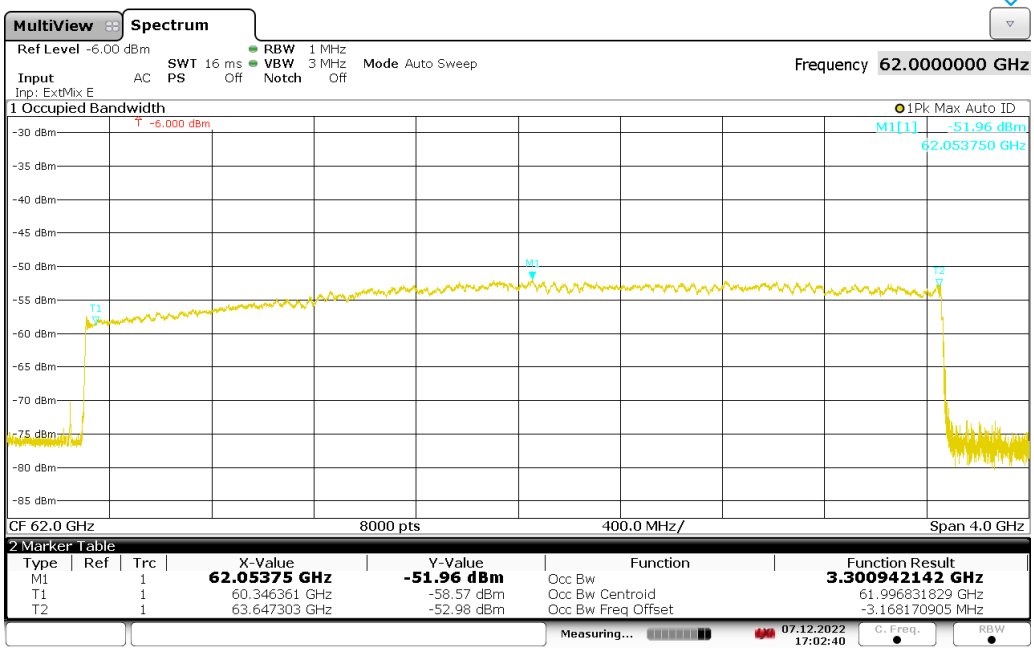
Plot # 7. 99% OBW

Voltage 5 V	Temperature 40 °C



8.5 Transmitter Spurious Emissions and Restricted Bands

8.5.1 Measurement according to ANSI C63.10

Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector = Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW = 120 KHz (<1 GHz)

- Frequency > 1 GHz
- Detector = Peak / Power Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) emission level shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.
- For test frequencies above 40 GHz external harmonic mixers are applied to down-convert the signal for the spectrum analyzer. The lack of tracking preselector for the external mixer can result in image frequencies, which requires confirmation. The spectrum analyzer applies the signal ID function to identify the image frequencies.

Measuring distance:

All measurements in the frequency range 40-200 GHz are done in far-field of the measurement antenna. The far-field boundary $d_{far\text{-}field}$ is

$$d_{far-field} = {D^2}/{\lambda}$$

Where
D is the max. dimension size of the measurement antenna
λ is the wavelength of the measured emission.

The following table illustrates the far-field boundary for the setup of each test frequency range:

Frequency range	Min. Wavelength	Max. dimension size of the meas. ant.	Far-field boundary
GHz	m	m	m
40-60	0.0050	0.049	0.96
60-90	0.0033	0.036	0.78
90-140	0.0021	0.021	0.41
140-200	0.0015	0.014	0.26

In order to conduct measurements in the far-field and acquire adequate dynamic, the measurement antenna is set at 1 m to the EUT for test frequencies above 40 GHz.

8.5.2 Limits: FCC 15.255(d) / 15.209(a) / RSS-210 J.3 / RSS-Gen 6.13

Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
- PEAK LIMIT = 74 dBµV/m
- AVG. LIMIT = 54 dBµV/m

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters, as defined in §15.255(d), which is equivalent to -9.92 dBm EIRP. A sample calculation of the limit conversion is according to ANSI C63.10 formula (25):

$$PD = \frac{EIRP_{Linear}}{4\pi d^2}$$

Where

PD is the power density at the distance specified by the limit, in W/m2
EIRP$_{Linear}$ is the equivalent isotropic radiated power, in watts
D is the distance at which the power density limit is specified, in m

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
20 °C	1	1	5 VDC

8.5.4 Measurement result:

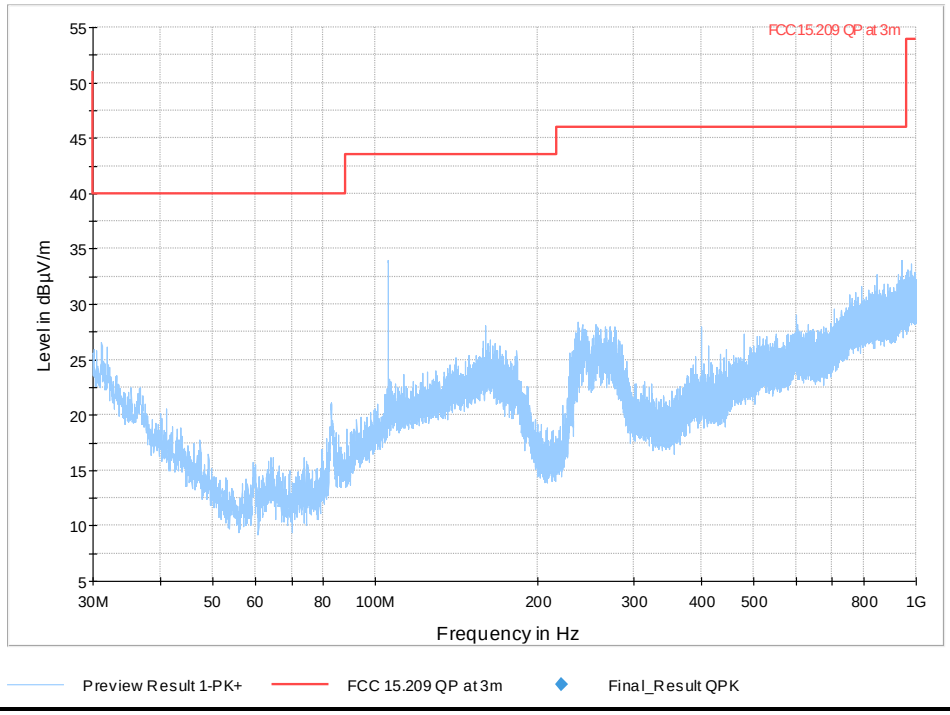
Plot #	Channel #	Scan Frequency	Limit	Result
1-20	Low	30 MHz – 200 GHz	See section 8.5.2	Complies
21-31	Mid	9 kHz – 200 GHz	See section 8.5.2	Complies
32-39	High	30 MHz – 200 GHz	See section 8.5.2	Complies

8.5.5 Measurement Plots:

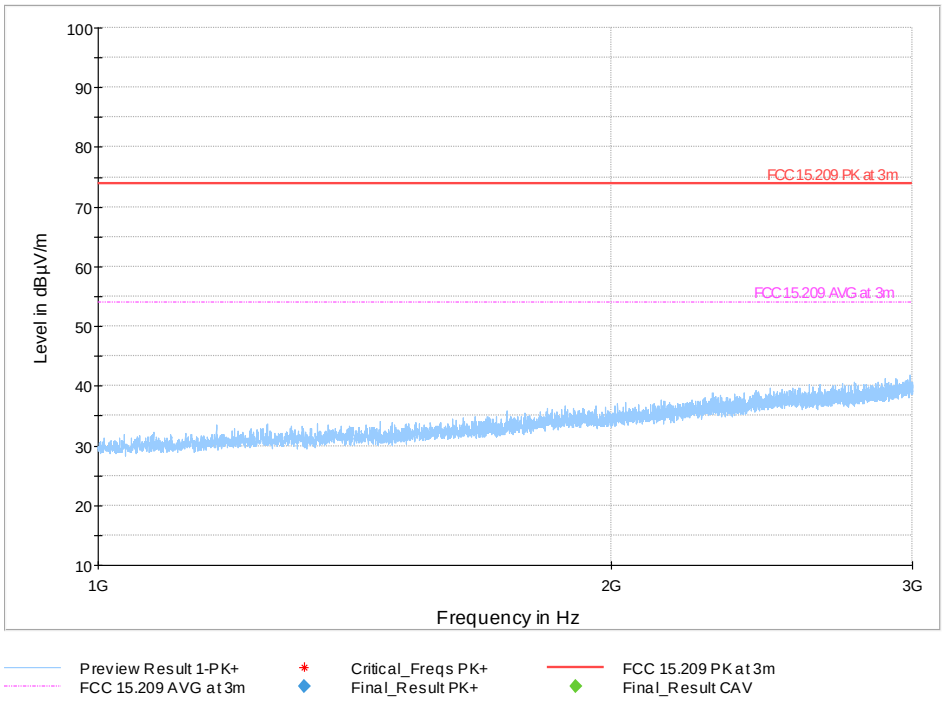
In the frequency range above 40GHz external mixers were used. External mixers can produce image signals. These image signals are identified by the lab and are not taken into account for the evaluation of the device under test.

8.5.5.1 Frequency low

Plot # 8. Radiated Emissions: 30 MHz – 1GHz

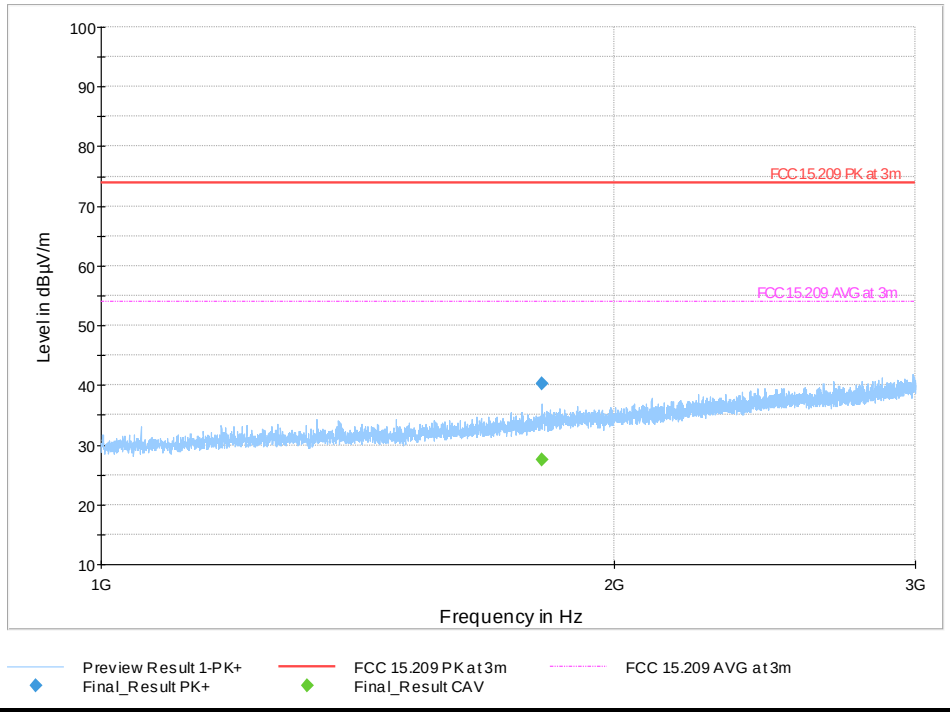


Plot # 9. Radiated Emissions: 1-3 GHz



Note: The EUT is at the lying position.

Plot # 10. Radiated Emissions: 1-3 GHz

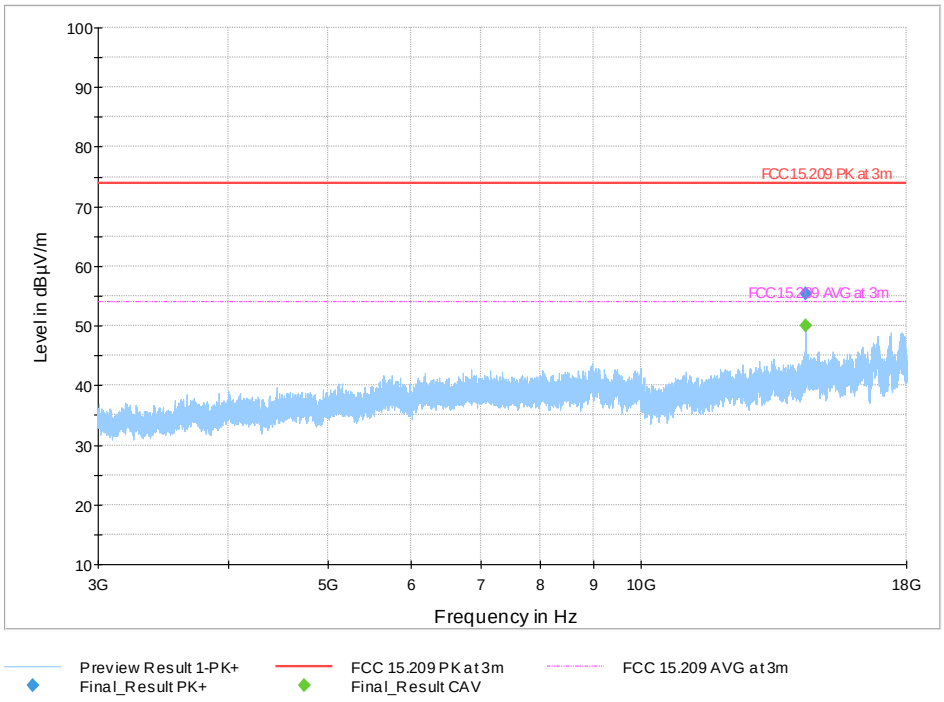


Note: The EUT is at the standing position, which is the worst case position.

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)
1813.00	---	27.51	53.98	26.47	500.0	1000.0	299.0	V	66.0	30.5
1813.00	40.31	---	73.98	33.67	500.0	1000.0	299.0	V	66.0	30.5

Plot # 11. Radiated Emissions: 3-18 GHz

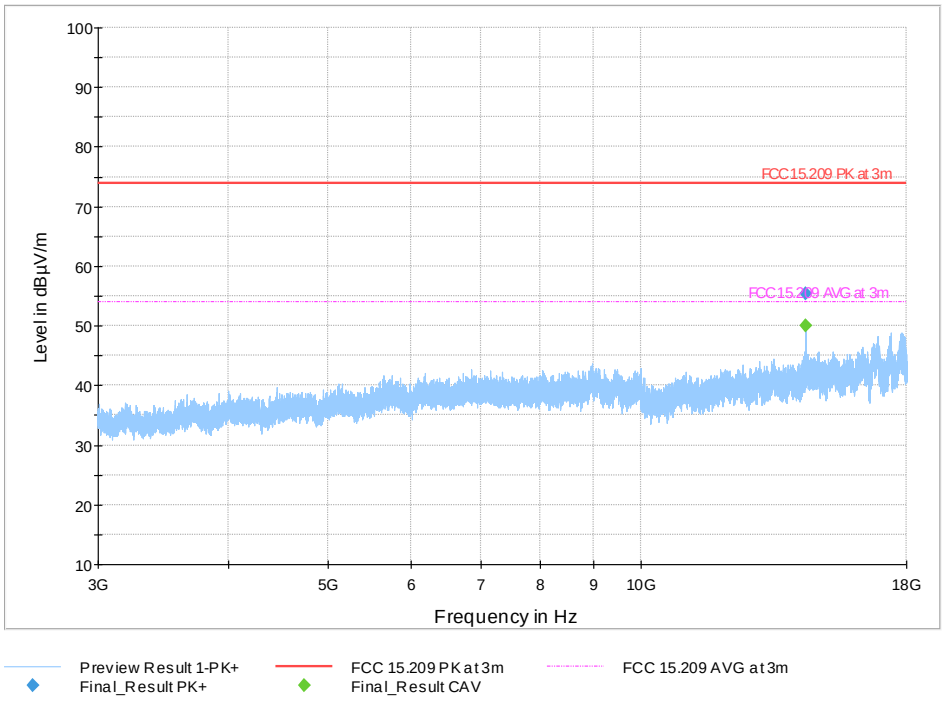


Final_Result

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)
14399.18	---	49.98	53.98	4.00	500.0	1000.0	214.0	V	133.0	9.3
14399.18	55.34	---	73.98	18.64	500.0	1000.0	214.0	V	133.0	9.3

Note: The EUT is at the lying position.

Plot # 12. Radiated Emissions: 3-18 GHz



Final_Result

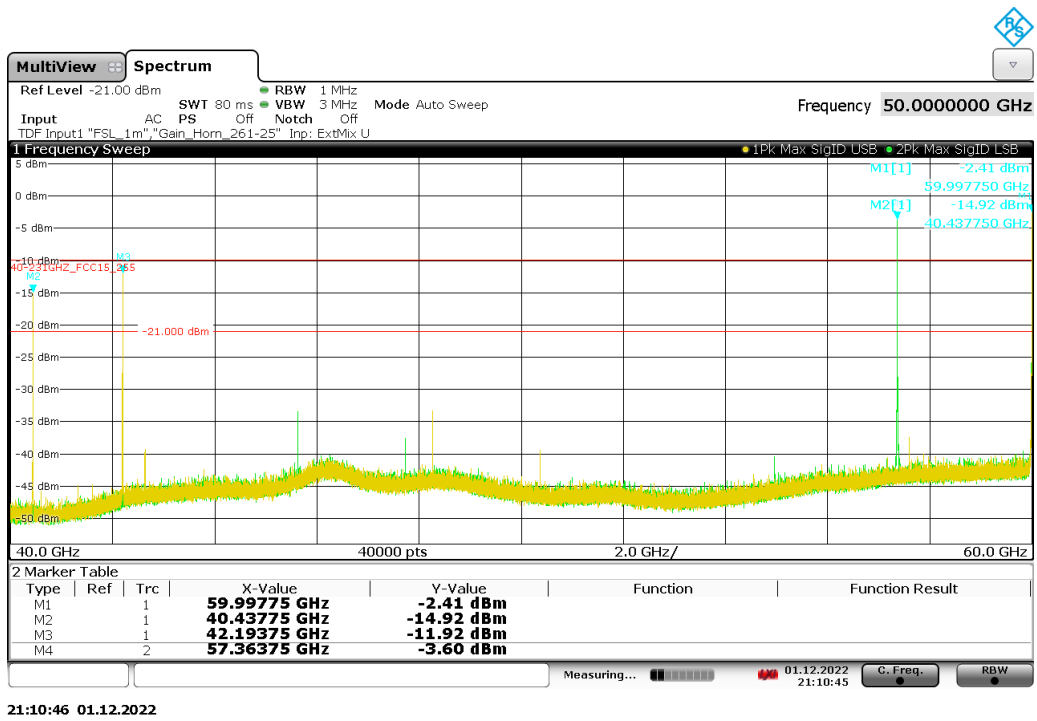
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
14398.93	---	50.49	53.98	3.49	500.0	1000.0	135.0	H
14398.93	55.54	---	73.98	18.44	500.0	1000.0	135.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
14398.93	298.0	9.3	
14398.93	298.0	9.3	

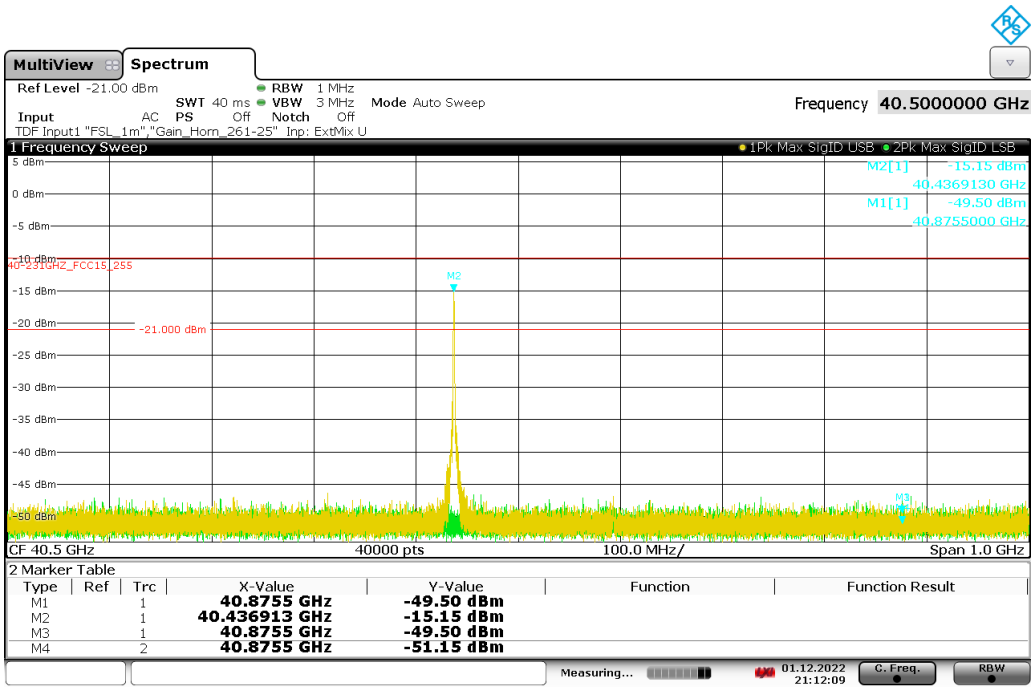
Note: The EUT is at the standing position, which is the worst case position.

Plot # 13. Radiated Emissions: 40-60 GHz

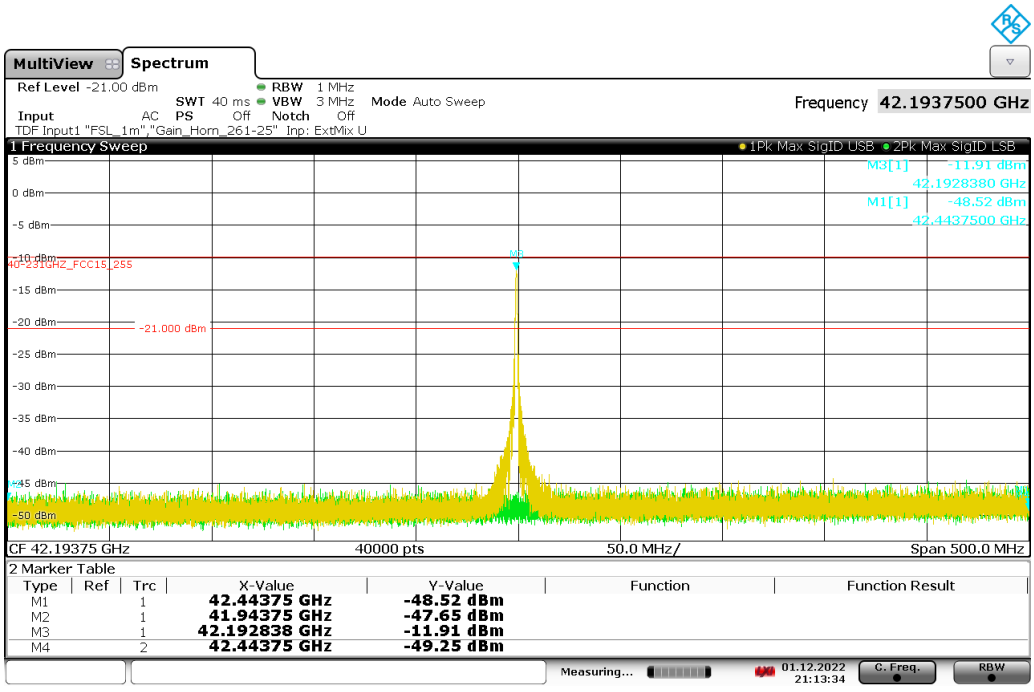


Note: The emission marked by marker 1 is the wanted emission. The ones at marker 2 and 3 are investigated in the following diagrams. The emission at marker 4 shows no trace-overlapping, thus image signal.
Note: The peak signal above is the transmit channel.

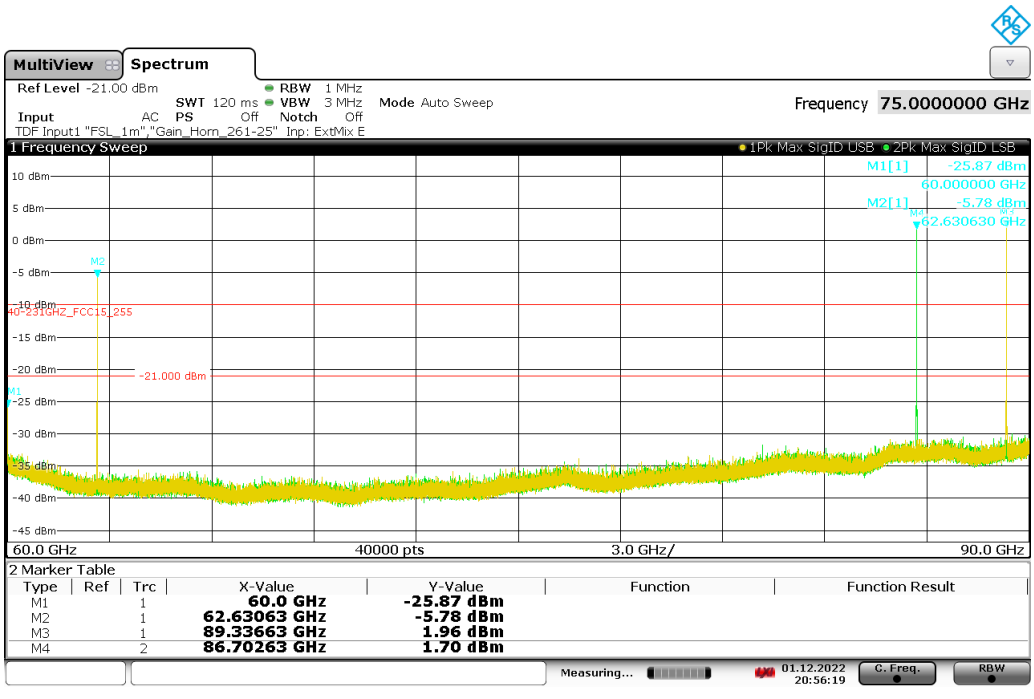
Plot # 14. Radiated Emissions: 40-60 GHz (marker 2)



Plot # 15. Radiated Emissions: 40-60 GHz (marker 3)

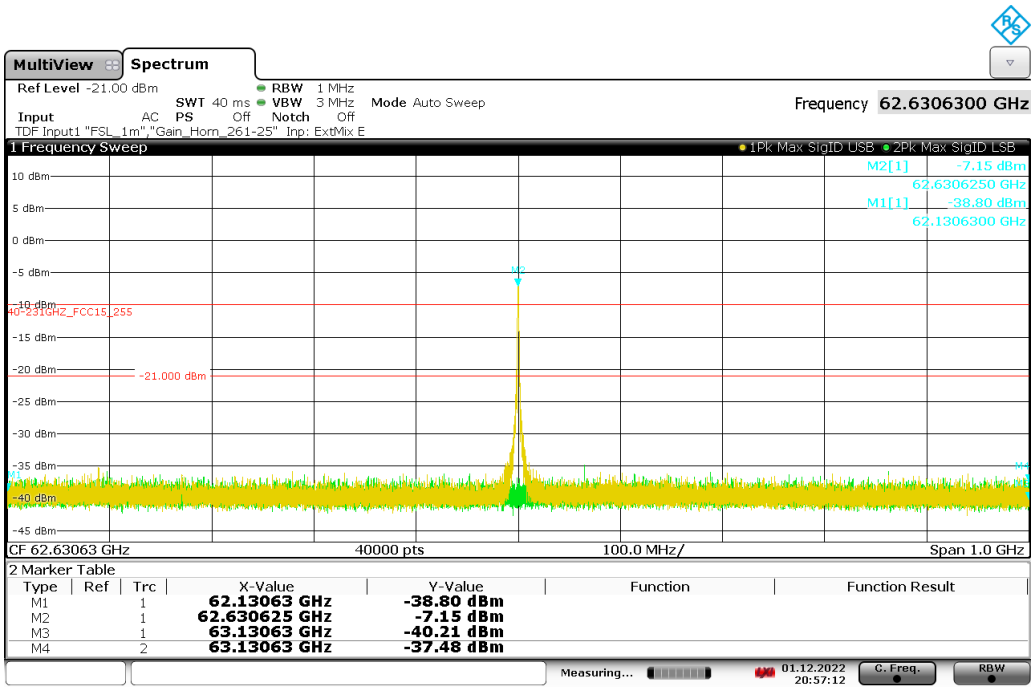


Plot # 16. Radiated Emissions: 60-90 GHz

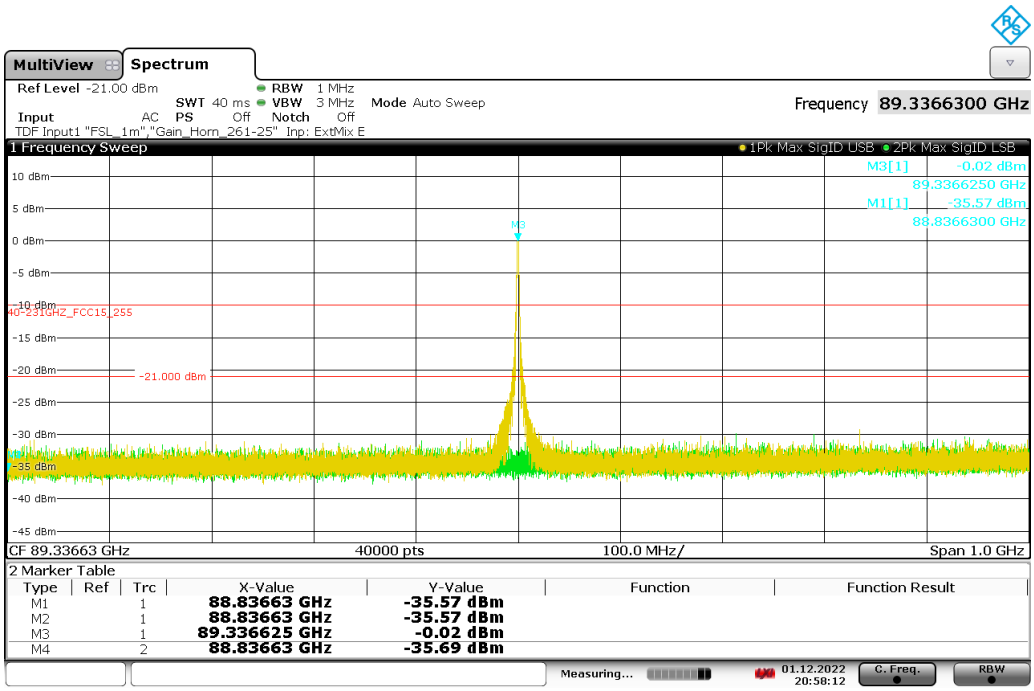


Note: The emission marked by marker 1 is the wanted emission. The ones at marker 2 and 3 are investigated in the following diagrams. The emission at marker 4 shows no trace-overlapping, thus image signal.

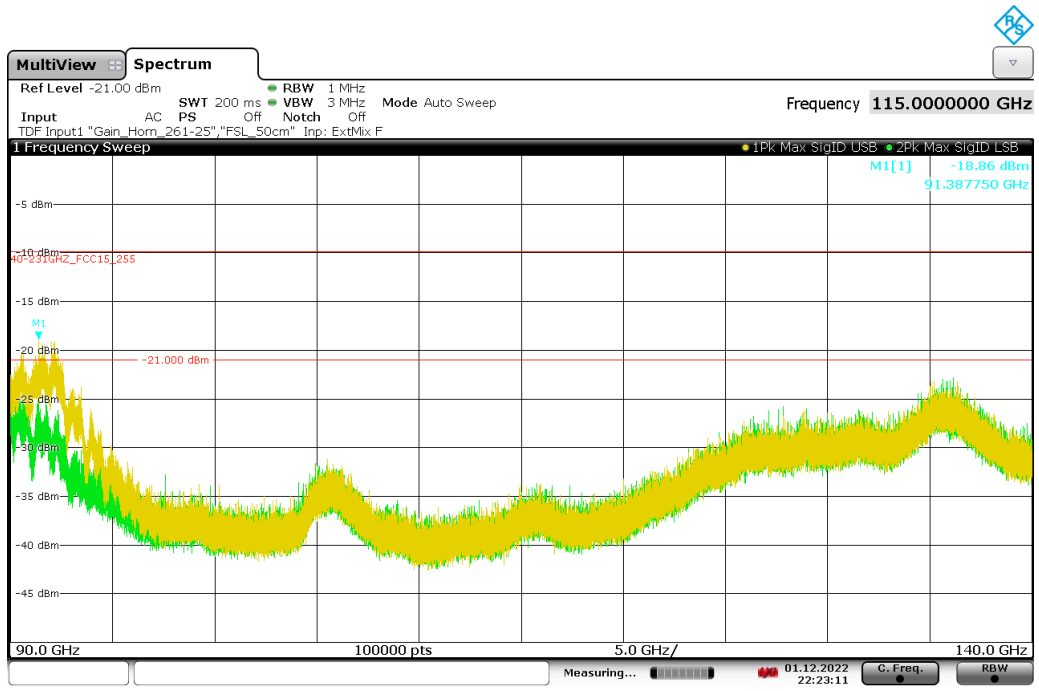
Plot # 17. Radiated Emissions: 60-90 GHz (marker 2)



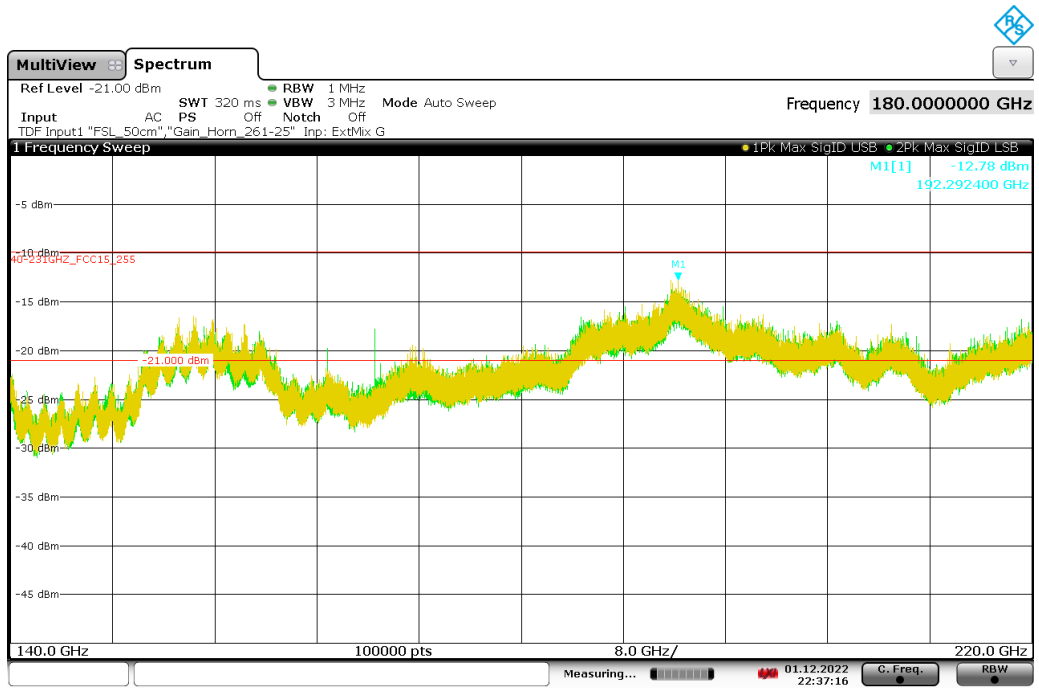
Plot # 18. Radiated Emissions: 60-90 GHz (marker 3)



Plot # 19. Radiated Emissions: 90-140 GHz

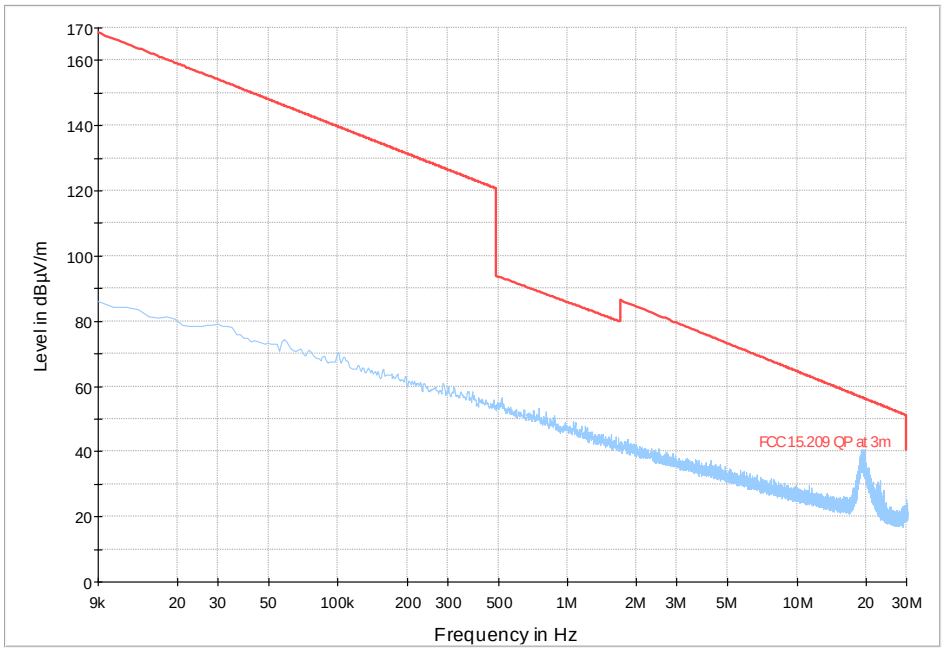


Plot # 20. Radiated Emissions: 140-200 GHz

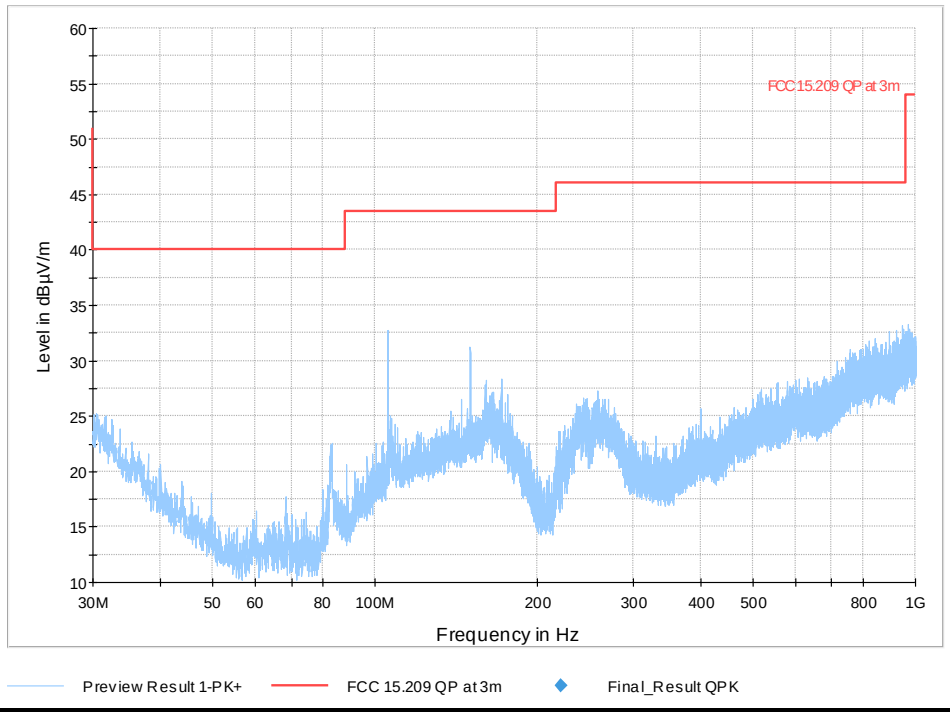


8.5.5.2 Frequency middle

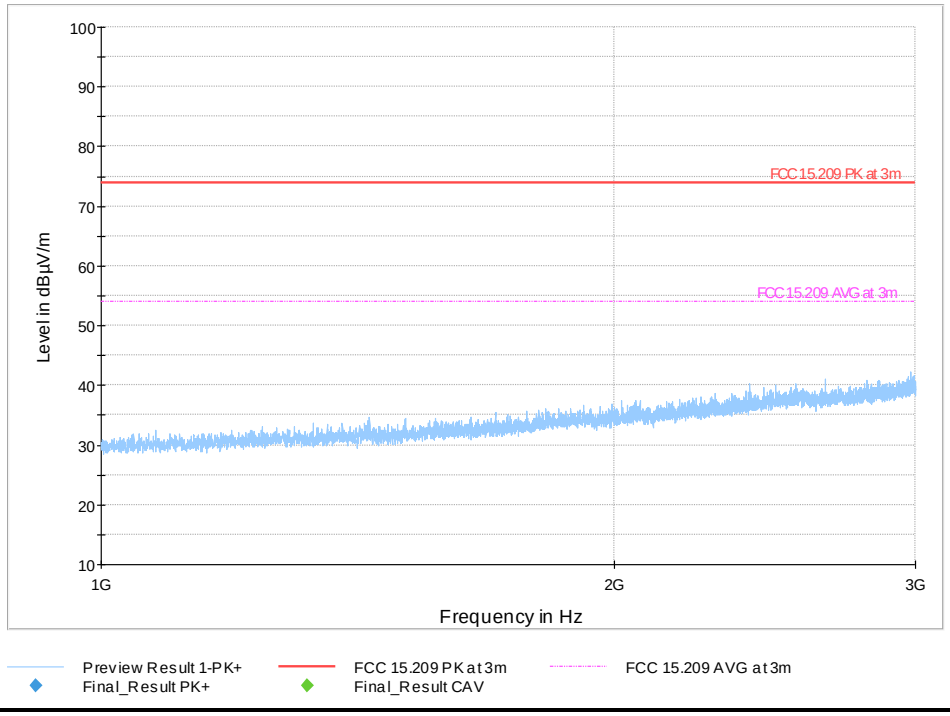
Plot # 21. Radiated Emissions: 9 KHz - 30 MHz



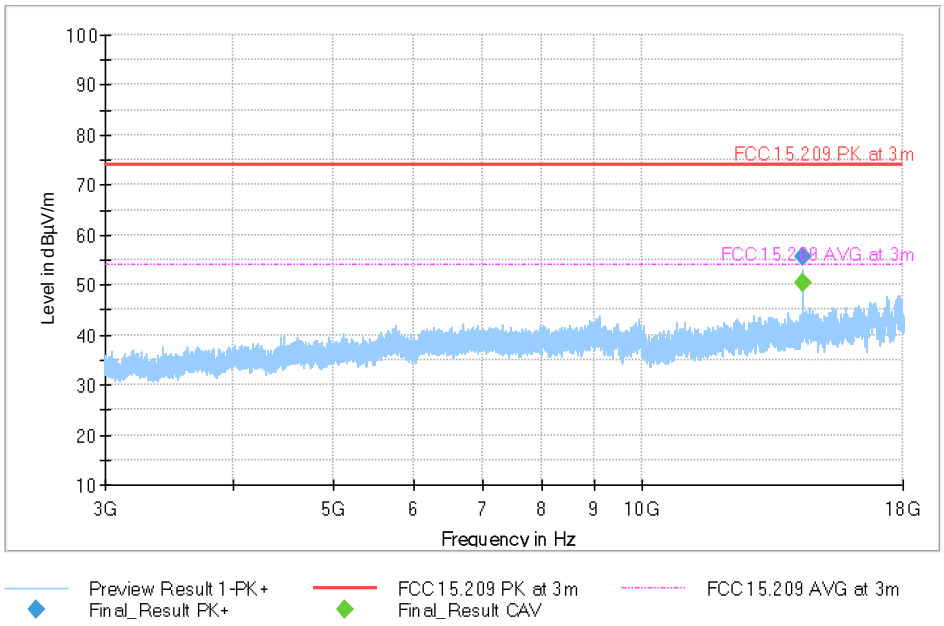
Plot # 22. Radiated Emissions: 30 MHz – 1GHz



Plot # 23. Radiated Emissions: 1-3 GHz



Plot # 24. Radiated Emissions: 3-18 GHz



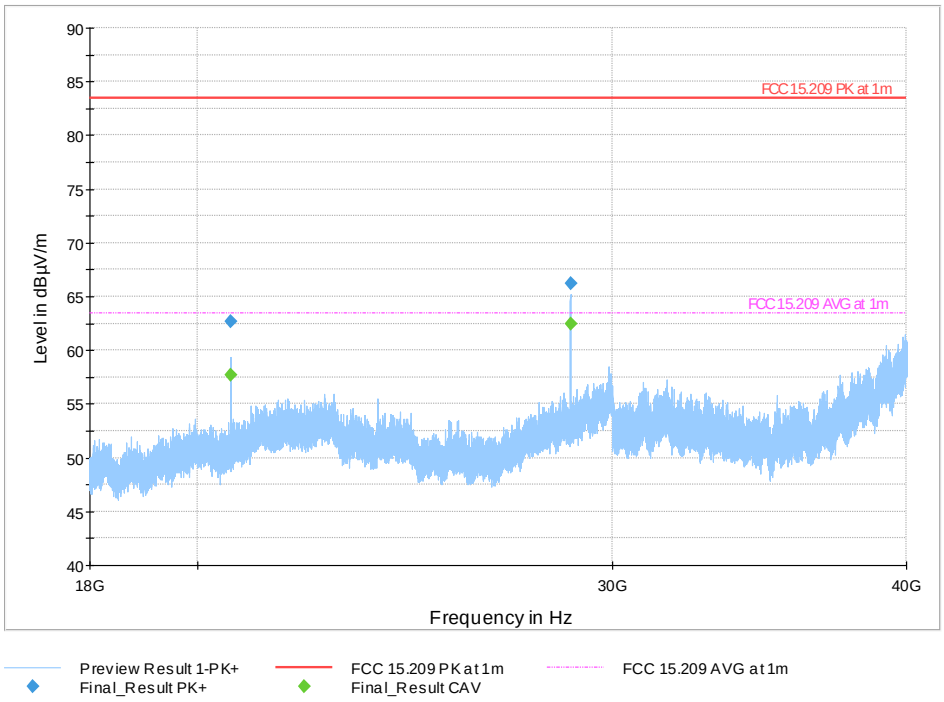
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
14398.93	---	50.56	53.98	3.42	500.0	1000.0	151.0	H
14398.93	55.50	---	73.98	18.48	500.0	1000.0	151.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
14398.93	295.0	9.3	
14398.93	295.0	9.3	

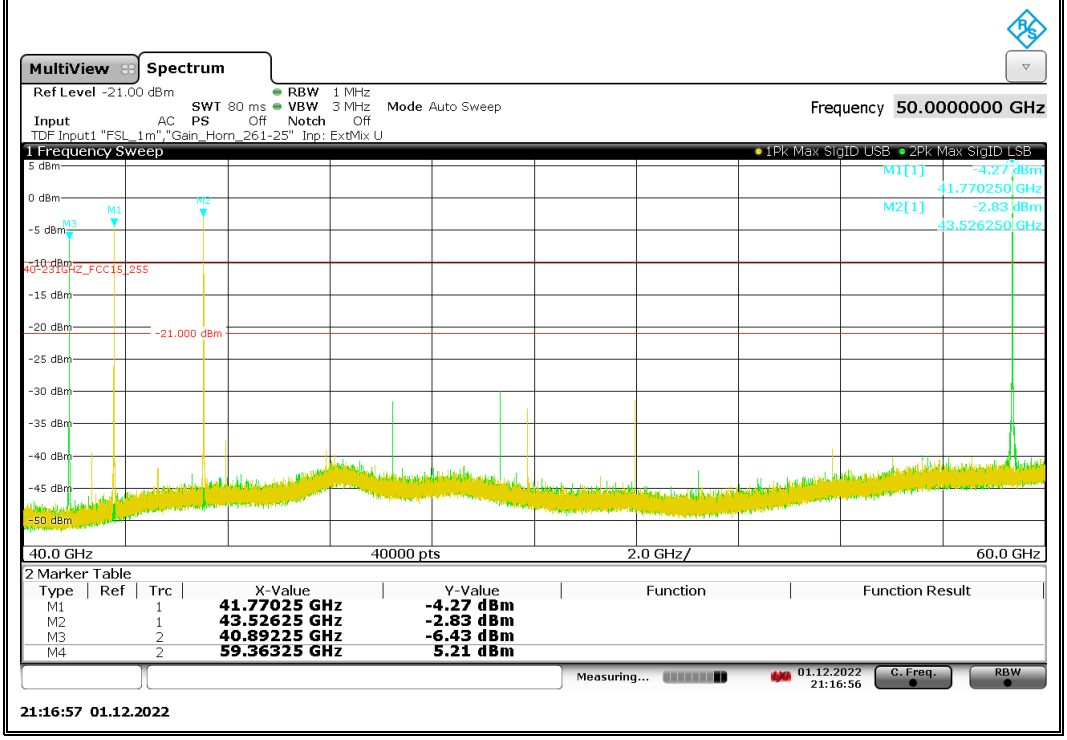
Plot # 25. Radiated Emissions: 18-40 GHz



Final_Result

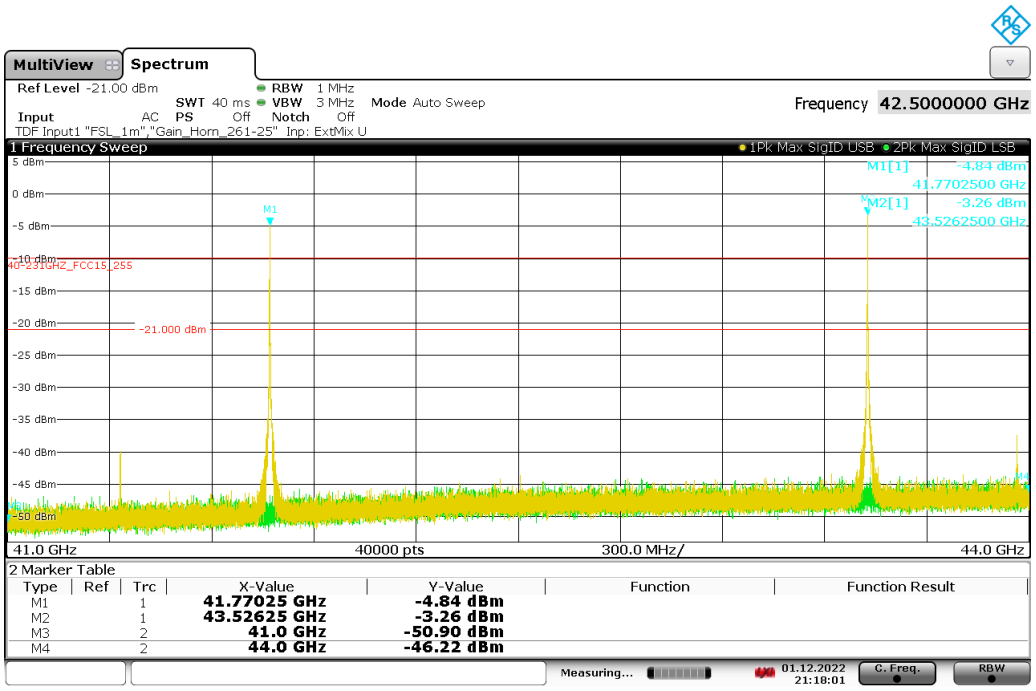
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20665.50	62.70	---	83.50	20.80	500.0	1000.0	150.0	H	74.0	16.9
20665.50	---	57.72	63.50	5.78	500.0	1000.0	150.0	H	74.0	16.9
28798.50	66.24	---	83.50	17.26	500.0	1000.0	150.0	H	37.0	20.4
28798.50	---	62.50	63.50	1.00	500.0	1000.0	150.0	H	37.0	20.4

Plot # 26. Radiated Emissions: 40-60 GHz

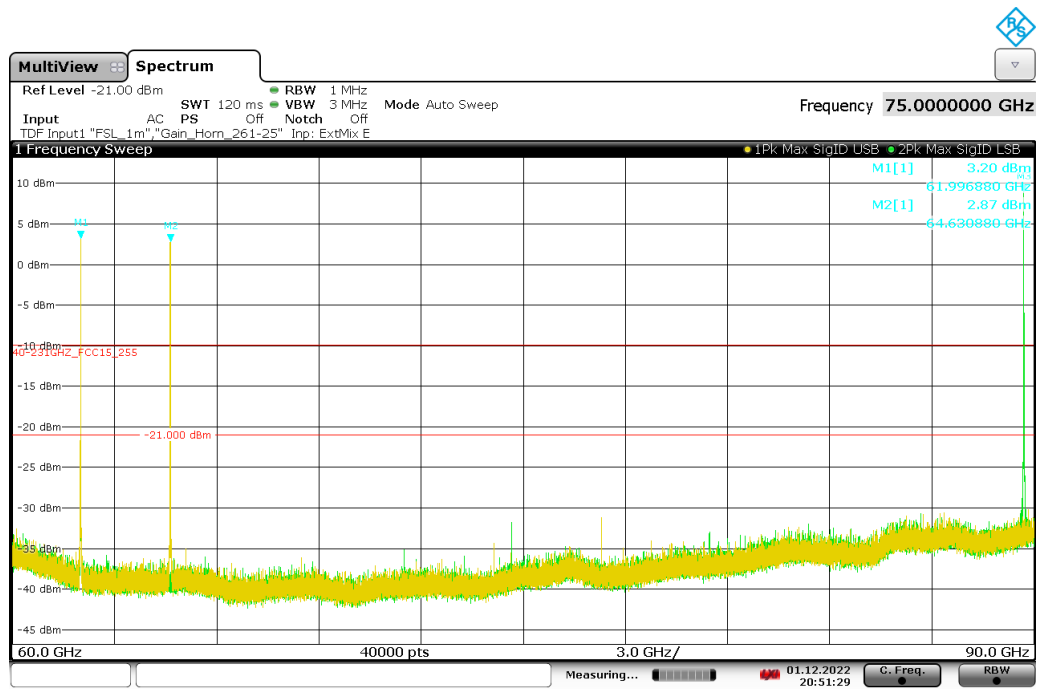


Note: The ones at marker 1 and 2 are investigated in the following diagrams. The emissions at marker 3 and 4 show no trace-overlapping, thus image signal.

Plot # 27. Radiated Emissions: 40-60 GHz (marker 1 and 2)



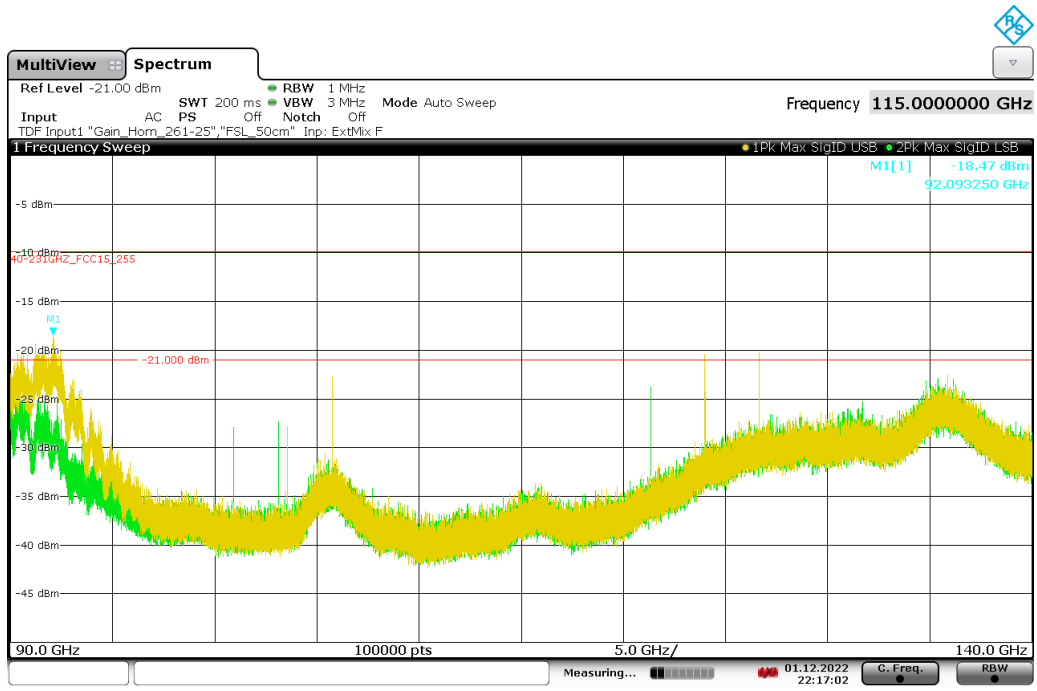
Plot # 28. Radiated Emissions: 60-90 GHz



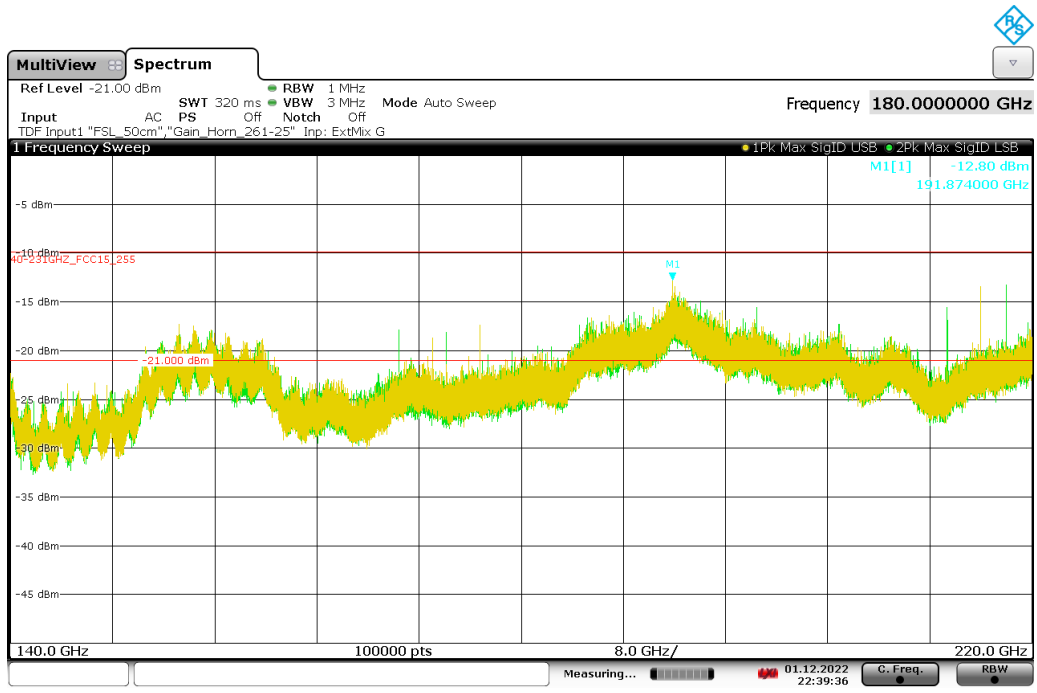
Note: The emission marked by marker 1 is the wanted emission. The emissions at marker 2 and 3 shows no trace-overlapping, thus image signal.

Note: The peak signal above is the transmit channel.

Plot # 29. Radiated Emissions: 90-140 GHz

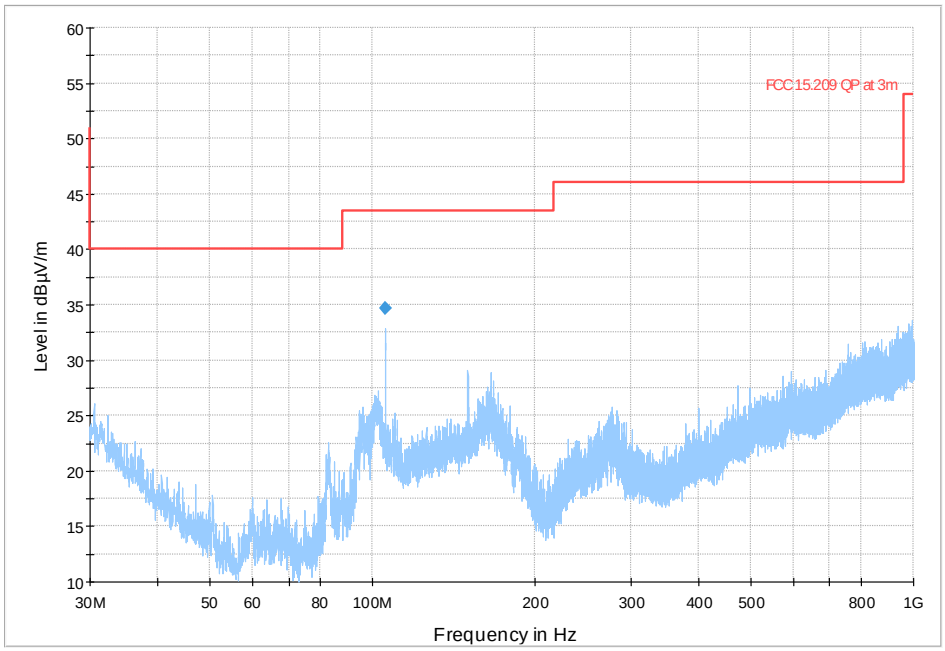


Plot # 30. Radiated Emissions: 140-200 GHz



8.5.5.3 Frequency high

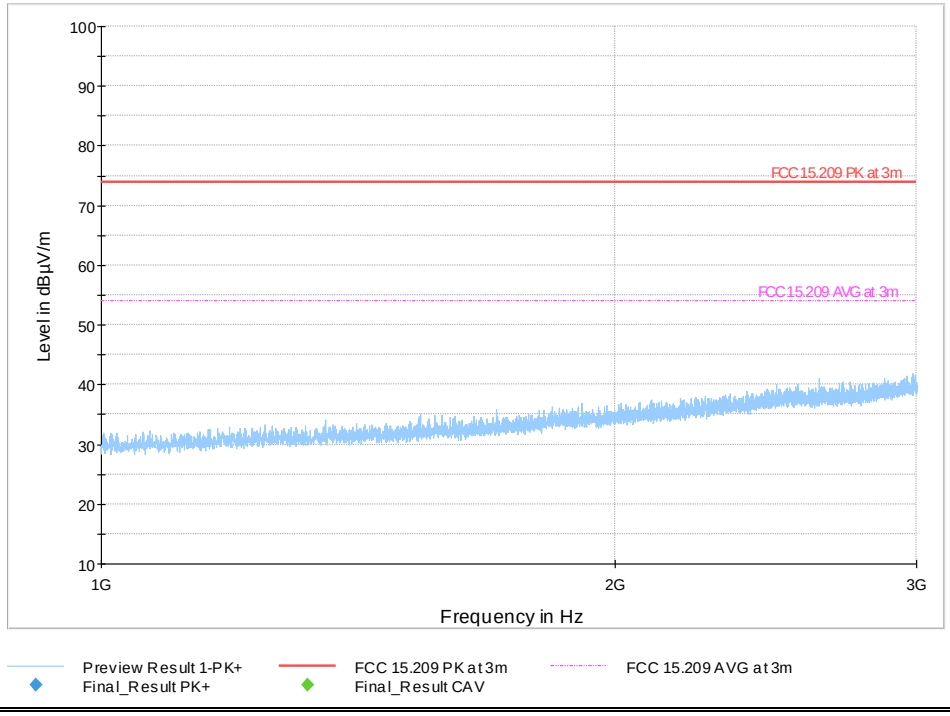
Plot # 31. Radiated Emissions: 30 MHz – 1GHz



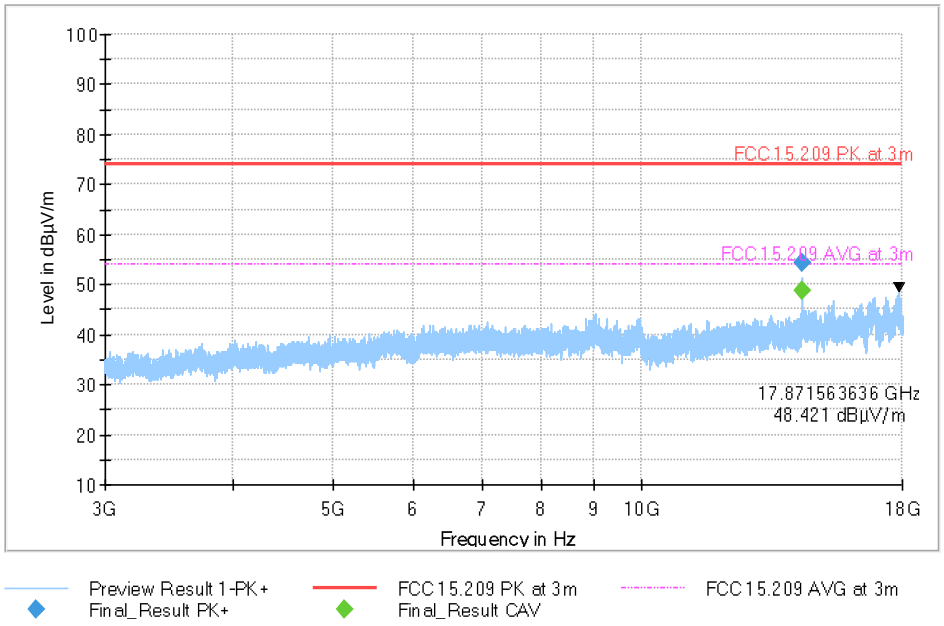
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
105.74	34.69	43.50	8.81	500.0	120.0	176.0	V	-39.0	22.0	

Plot # 32. Radiated Emissions: 1-3 GHz and Restricted Bands



Plot # 33. Radiated Emissions: 3-18 GHz



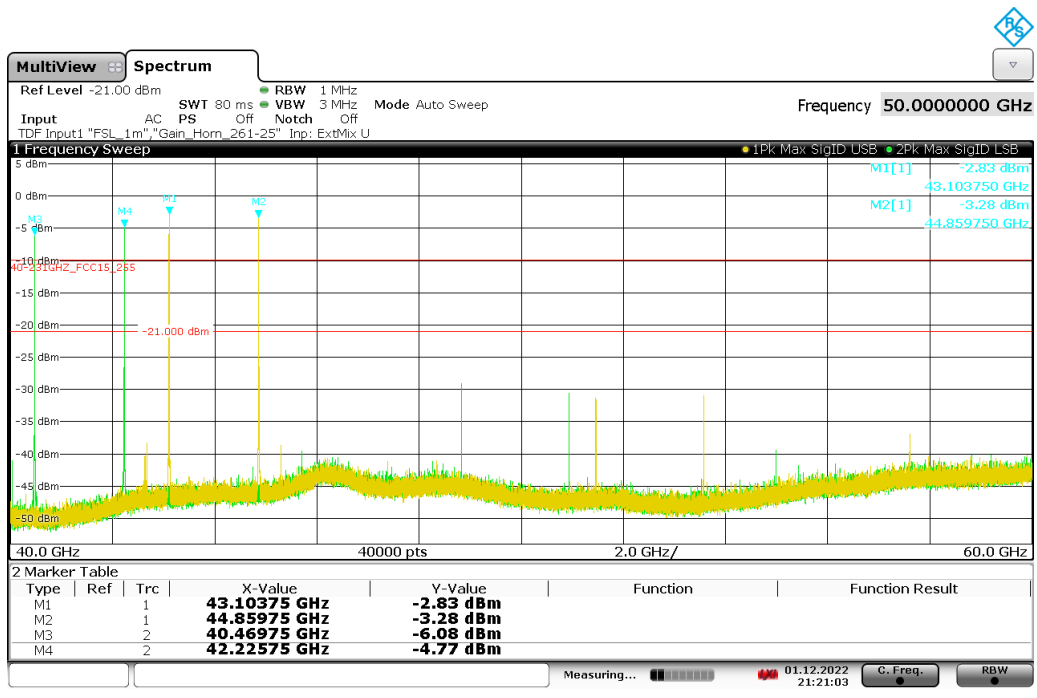
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
14398.93	---	48.83	53.98	5.15	500.0	1000.0	160.0	H
14398.93	54.34	---	73.98	19.64	500.0	1000.0	160.0	H

(continuation of the "Final_Result" table from column 14 ...)

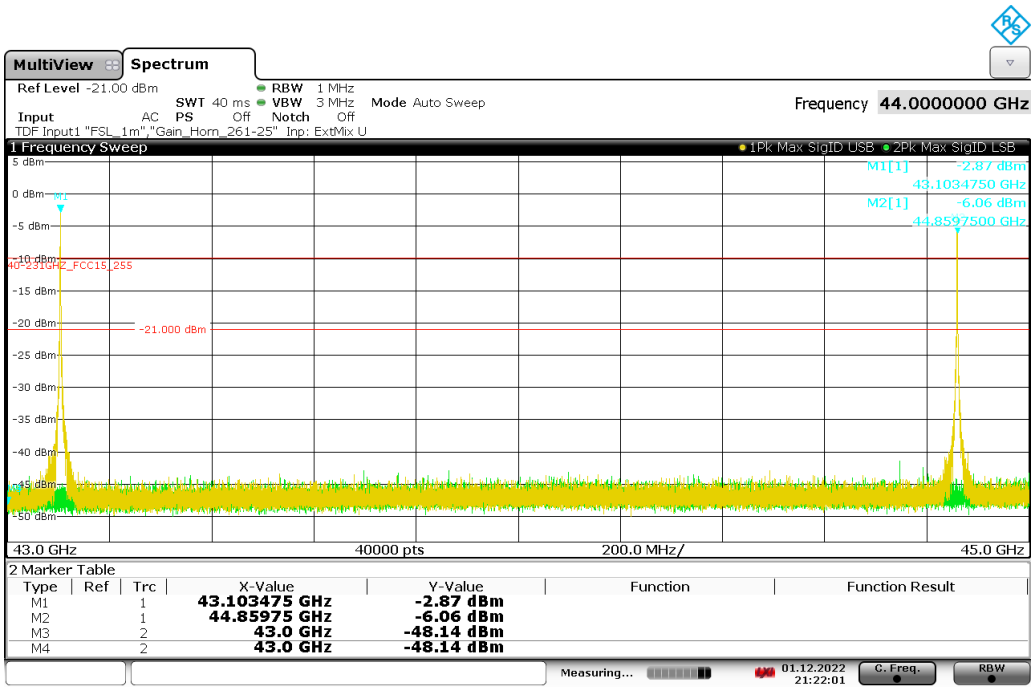
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
14398.93	285.0	9.3	
14398.93	285.0	9.3	

Plot # 34. Radiated Emissions: 40-60 GHz

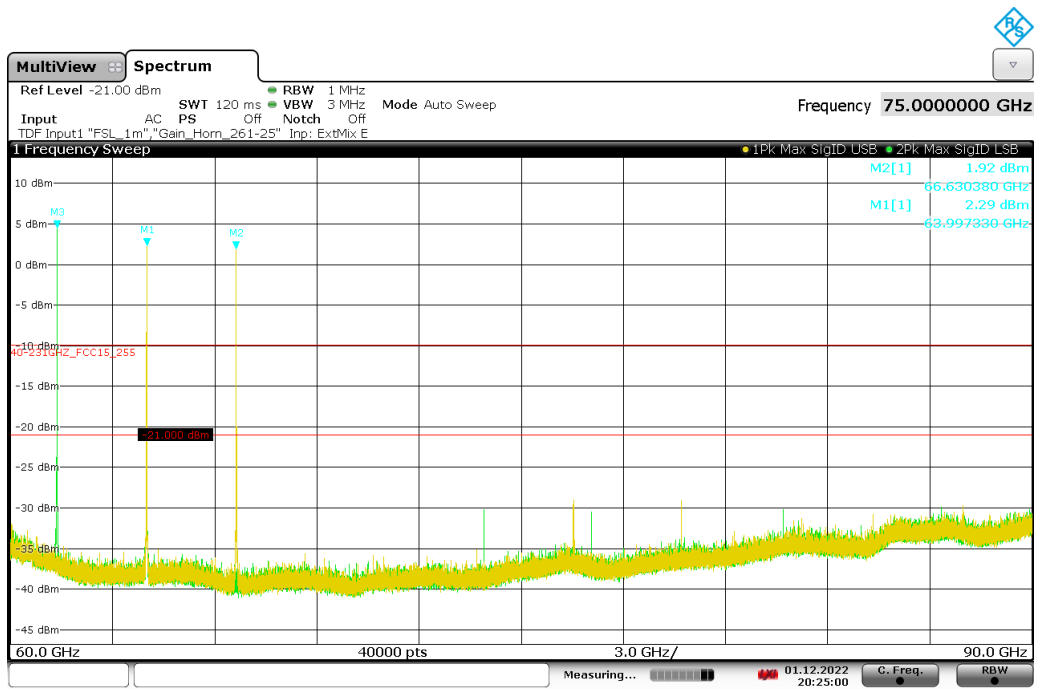


Note: The ones at marker 1 and 2 are investigated in the following diagrams. The emissions at marker 3 and 4 show no trace-overlapping, thus image signal.

Plot # 35. Radiated Emissions: 40-60 GHz (marker 1 and 2)

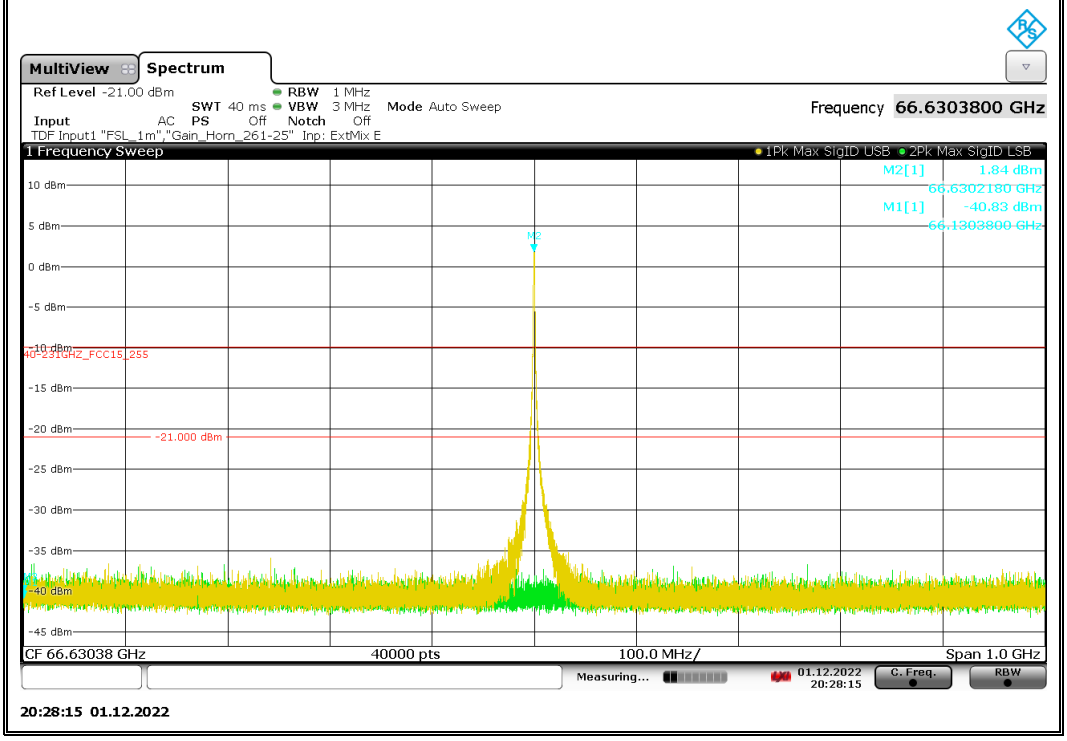


Plot # 36. Radiated Emissions: 60-90 GHz

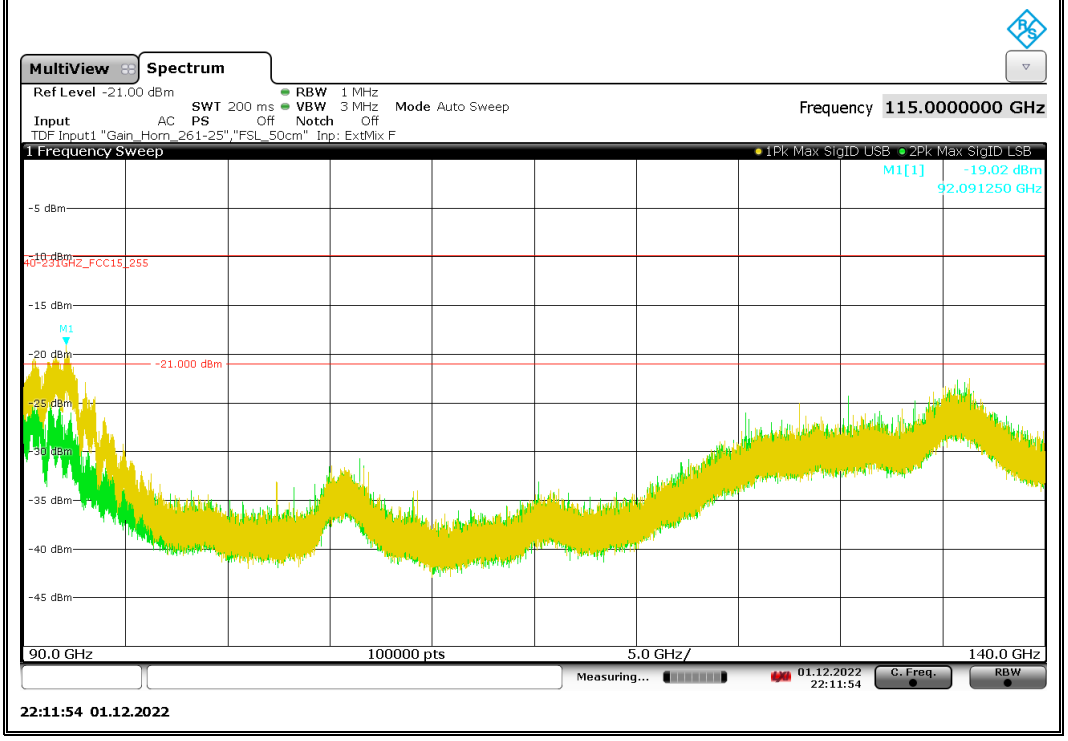


Note: The emission marked by marker 1 is the wanted emission. The one at marker 2 is investigated in the following diagram. The emission at marker 3 shows no trace-overlapping, thus image signal.
Note: The peak signal above is the transmit channel.

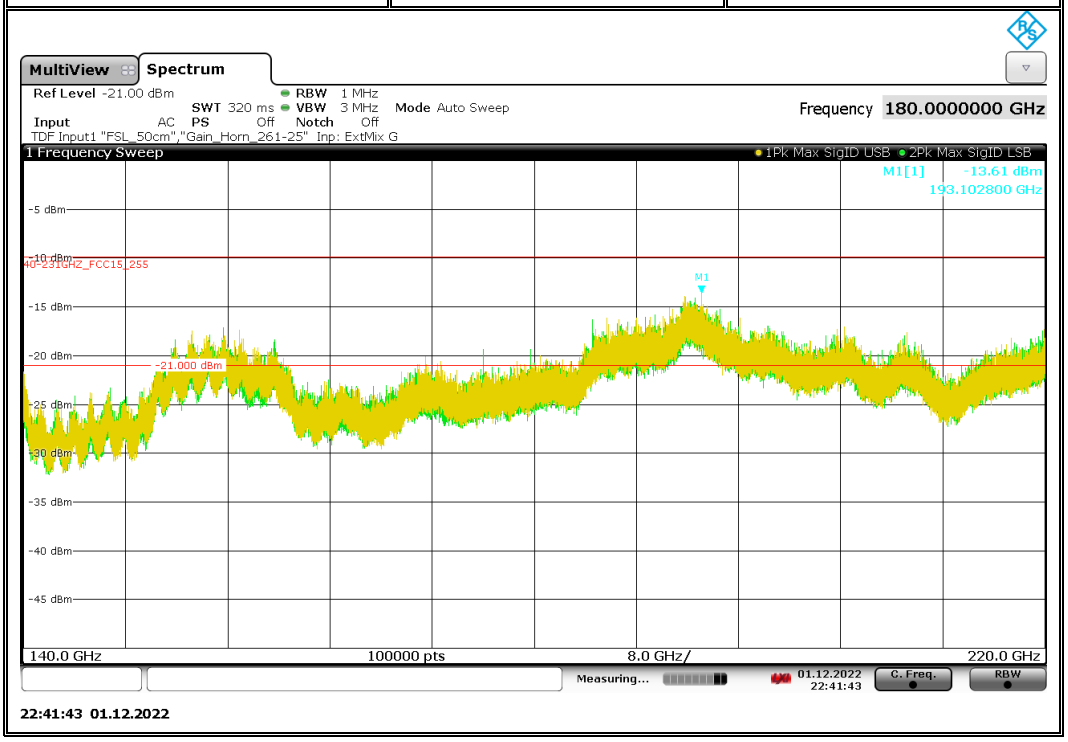
Plot # 37. Radiated Emissions: 60-90 GHz



Plot # 38. Radiated Emissions: 90-140 GHz



Plot # 39. Radiated Emissions: 140-200 GHz



8.1 AC Conducted Emissions

8.1.1 Measurement according to ANSI C63.4

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Pre-scan Detector = Peak / Average for
- Final Measurements Detector = Quasi-Peak / Average

8.1.2 Limits: FCC 15.207 & RSS-Gen 8.8

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

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.

8.1.3 Test conditions and setup:

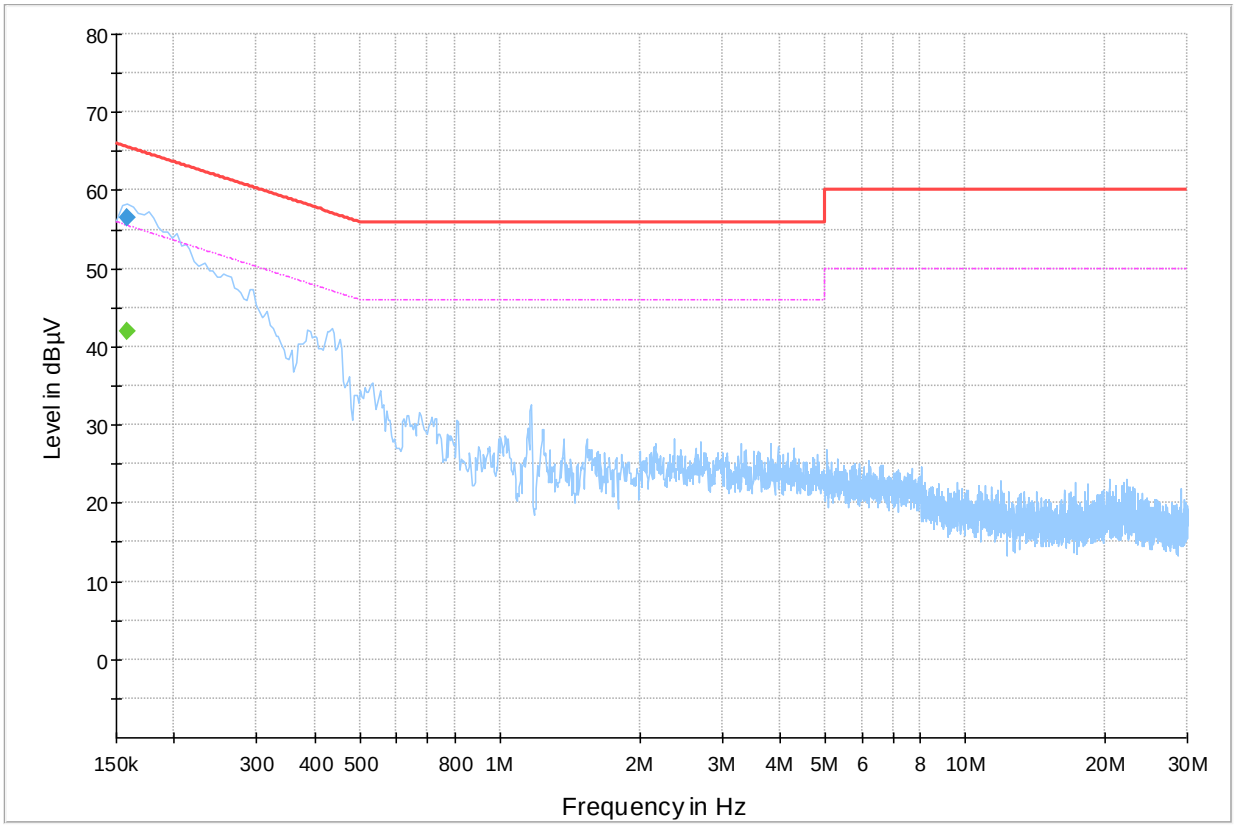
Ambient Temperature (°C)	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
20	1	2	Line & Neutral	110 V / 60 Hz

8.1.4 Measurement Result:

Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	1	2	150 kHz – 30 MHz	See section 8.1.2	Complies

8.1.5 Measurement Plots:

Plot # 1



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV	Margin	Meas. Time (ms)	Bandwidth	Line	PE	Corr. (dB)
0.16	---	42.01	55.53	13.52	500.0	9.0	L1	GND	10.45
0.16	56.57	---	65.53	8.96	500.0	9.0	L1	GND	10.45

9 Test setup photos

Setup photos are included in supporting file name: "EMC_PRAES-001-22001_15.255_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Biconilog BiLA2G	Biconlog Antenna	ETS Lindgren	BiLA2G	00164698	3 years	8/14/2020
Active Loop 6507	Loop Antenna	ETS Lindgren	6507	00161344	3 years	10/30/2020
Antenna Horn 3115	Horn Antenna	EMCO	3115	35111	3 years	9/28/2021
Antenna Horn 3117	Horn Antenna	ETS Lindgren	3117-PA	169547	3 years	9/1/2020
Antenna Horn 3117	Horn Antenna	ETS Lindgren	3116C-PA	191872028	3 years	9/23/2020
Horn antenna 40-60 GHz	Standard Gain Horn	MI-WAVE	261U-25/383	2021	-	-
Horn antenna 60-90 GHz	Standard Gain Horn	MI-WAVE	261E-25/387	2021	-	-
Horn antenna 90-140 GHz	Standard Gain Horn	MI-WAVE	261F-25/387	2021	-	-
Horn antenna 140-220 GHz	Standard Gain Horn	MI-WAVE	261G-25/387	-	-	-
External Mixer 40-60 GHz	External Mixer	R&S	FS-Z60	101025	3 Years	01/22/2020
External Mixer 50-75 GHz	External Mixer	R&S	FS-Z75	102261	3 Years	10/11/2022
External Mixer 60-90 GHz	External Mixer	R&S	FS-Z90	102088	3 Years	02/19/2020-
External Mixer 90-140 GHz	External Mixer	R&S	FS-Z140	101145	3 Years-	02/24/2020
External Mixer 140-220 GHz	External Mixer	R&S	FS-Z220	101037	3 Years	03/23/2020
EMI Test Receiver	Test Receiver	R&S	ESW 44	101715	3 Years	09/14/2021
V Band Amplitude Detector	RF Detector	ERAVANT	SFD-503753-15SF-P1	18541-02	-	-
Horn antenna 49.9-75.8 GHz	Standard Gain Horn	FLANN MICROWAVE	25240-20	273463	-	-
RTO 1014 Oscilloscope	Oscilloscope	R&S	RTO 1014	1316.1000K14 -300087-rf	3 Years	09/16/2021
SMF 100A	Signal Generator	R&S	SMF 100A	105358	3 Year	08/24/2021
Frequency Multiplier	Frequency Multiplier	MI-WAVE	936EF-10/387	192	-	-
WR-12 Level Setting Attenuator	Level Setting Attenuator	ERAVANT	STA-30-12-M2	04778-01	-	-
NRP110T	Thermal Power Sensor	R&S	NRP110T	1424.6215K02 -101295-xJ	3 years	11/25/2022
DIGITAL THERMOMETER	DIGITAL THERMOMETER	CONTROL COMPANY	36934-164	191871986	3 YEARS	10/20/2021
EMI Receiver	EMI Receiver	R&S	ESU40	100251	3 YEARS	9/13/2021
LISN	LISN	FCC	FCC-LISN-50-25-2-08	8014	3 YEARS	8/31/2021
Pule limiter 0-30 MHz	Pule limiter 0-30 MHz	R&S	ESH-Z2	102473	-	-

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	Template Revision	Changes to report	Prepared by	Approved by
2023-02-09	Initial version	-	Guangcheng Huang	Arndt Stoecker
2023-02-16	Rev_1	Update measurement 6 dB bandwidth. Update the list of test equipment. Specify measurement procedure above 40 GHz.	Guangcheng Huang	Arndt Stoecker

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