FCC / ISED Test Report

For:
Praesidium

Brand:
Praesidium

Model:
2001BIO1A
Product Description:
Contactless Vital Sign Detection Sensor

FCC ID: 2A7ZX2001BIO1
IC: 28837-2001BIO1
Contains FCC ID: 2ATUB-WIZFI360PA
Contains ISED: 20560-WIZFI360CON

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

REPORT #: EMC_PRAES-003-23001_FCC15.255

DATE: 2023-08-24

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A2LA Accredited

IC recognized #
3462B
CABID: US0187

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

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	2002BIO1A

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2023-08-24	Compliance	Arndt Stoecker (Director of Regulatory Services)	Arndt Stoecker Digitally signed by: Arndt Stoecker DN: CN = Arndt Stoecker email = arndt.stoecker@cetecom.com C = US O = CETECOM Inc Date: 2023.08.24 16:45:53 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2023-08-24	Compliance	Art Thammanavarat (Senior EMC Engineer)	art. thammanavarat@cetecom.com Digitally signed by: art. thammanavarat@cetecom.com DN: CN = art. thammanavarat@cetecom.com Date: 2023.08.24 15:12:30 -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
Director of Regulatory Services:	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

Brand:	Praesidium
Marketing Name:	BioFi
Product Description:	Contactless Vital Sign Detection Sensor
Model Name :	2001BIO1
Contains FCC-ID :	217ZX2001BIO1
Contains IC:	28837-2001BIO1
HW Version :	2001BIO1A
SW Version :	V1.0.0
FVIN	N/A
HVIN	2001BIO1A
PMN	RemWave Sleep
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
Other Radios included in the device	WLAN (WiFi Pre-certified) WIZnet H.K. LTD. Model: WizFi360CON FCC ID: 2ATUB-WIZFI360PA ISED: 20560-WIZFI360CON -Radar IWR6843 Chip
Antenna Information as declared	Main Antenna: 2.4 GHz Wi-Fi antenna Flexible Planar Antenna, Laird Connectivity MPN: EMF2471A3S-10MHF1 Gain (2.45 GHz): 2.4 dBi PCB embedded 60-64 GHz Radar antenna, 15 dBi gain
Power Supply/ Rated Operating Voltage Range	Vmin: 4.75 VDC/ Vnom: 5V VDC / Vmax: 5.25
Operating Temperature Range	0ºC to 40ºC
Sample Revision	☐Production ☒ Pre-Production
EUT Dimensions	1.64in x 4.25in x 4.25in
Weight	450g
EUT Diameter	■ < 60 cm ☐ Other _____

3.2 EUT Sample details

EUT #	Model Number	HW Version	SW Version	Notes/Comments
1	2001BIO1A	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

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.

The integrated Wi-Fi module in this product underwent a C2PC.
This report is to demonstrate that the performance of the radar transmitter was not affected by the change.

Testing procedures are based on ANSI C63.10:2013.

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	3	■	☐	☐	Complies 1)
§15.255(e) RSS-210 J.4 (c)	6 dB Occupied Bandwidth	Nominal	2	☐	☐	■	
RSS-Gen 6.7	99% Occupied Bandwidth	Nominal	2	☐	■	☐	
§15.255(f) RSS-210 J.6	Frequency Stability	Nominal and extreme	2	☐	☐	■	
§15.255(h) RSS-210 J.7	Group Installation	Nominal	-	☐	☐ *	■	
§15.255(d) §15.209 (a) RSS-210 J.3	TX Spurious emissions-Radiated	Nominal	3	■	☐	☐	Complies 2)
§15.207 RSS-Gen 8.8	AC Conducted Emissions	Nominal	2	☐	☐	■	

Note: NA= Not Applicable; NP= Not Performed.
1): A radiated verification with a CW signal was performed to ensure the radar signal output power did not increase.
2): Performed above 60GHz to verify that the spurious emissions of the radar transmitter is not impacted.
Please referee to the CETECOM test report EMC_PRAES_001_23001_FCC15_255_Rev1 for all results.

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=2.

Measurement System		EMC 1	EMC 2
Conducted emissions (mains port)		1.12 dB	0.46 dB
Radiated emissions	(< 30 MHz)	3.66 dB	3.88 dB
	(30 MHz – 1GHz)	3.17 dB	3.34 dB
	(1 GHz – 3 GHz)	5.01 dB	4.45 dB
	(>3 GHz)	4.0 dB	4.79 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%

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

6.3 Date of Testing:

2023-04-26 – 2023-06-05

6.4 Decision Rule:

Cetecom advanced follows ILAC G8:2019 chapter 4.2.1 (Simple Acceptance Rule).

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3. The measurement uncertainty is mentioned in this test report, See chapter 9, but is not taken into account – neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong.

7 Measurement Procedures

7.1 EIRP and Maximum Peak Conducted Output Power

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.

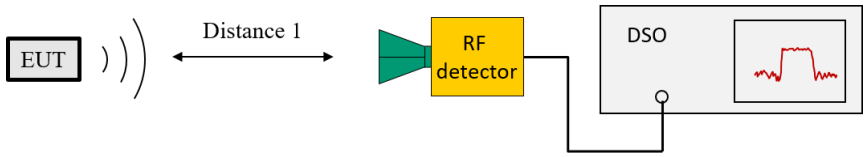


Fig. 1: Test setup 1. $EIRP_{EUT} - FSL_1 + AG_{meas} = P_{detector}$

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.

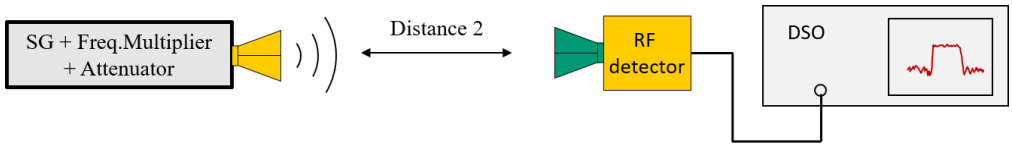


Fig. 2: Test setup 2. $P_{SG} + AG_{TX} - FSL_2 + AG_{meas} = P_{detector}$

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.

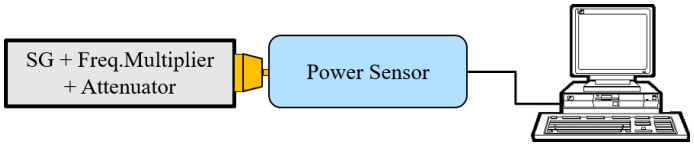


Fig. 3: Test setup 3. $P_{SG} = P_{sensor}$

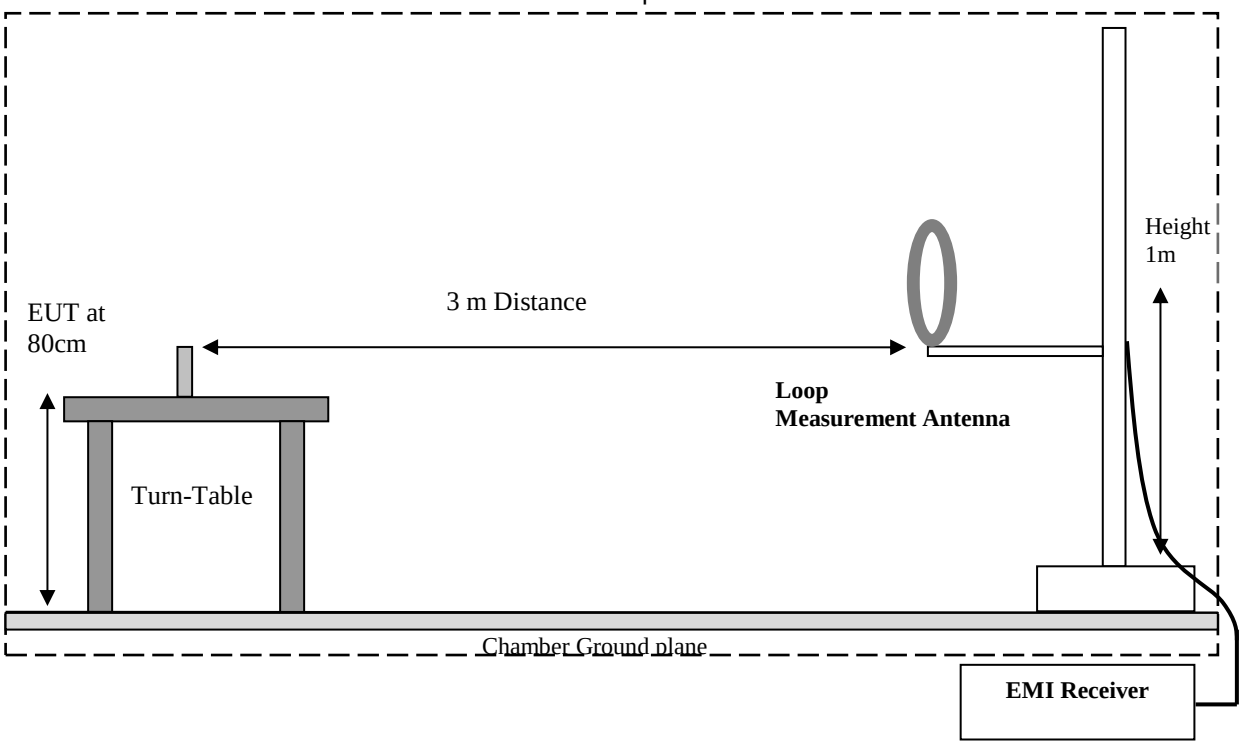
6. Applying the equations in ANCI C63.10 to calculate the EIRP and conducted output of the EUT

7.2 Radiated Measurement

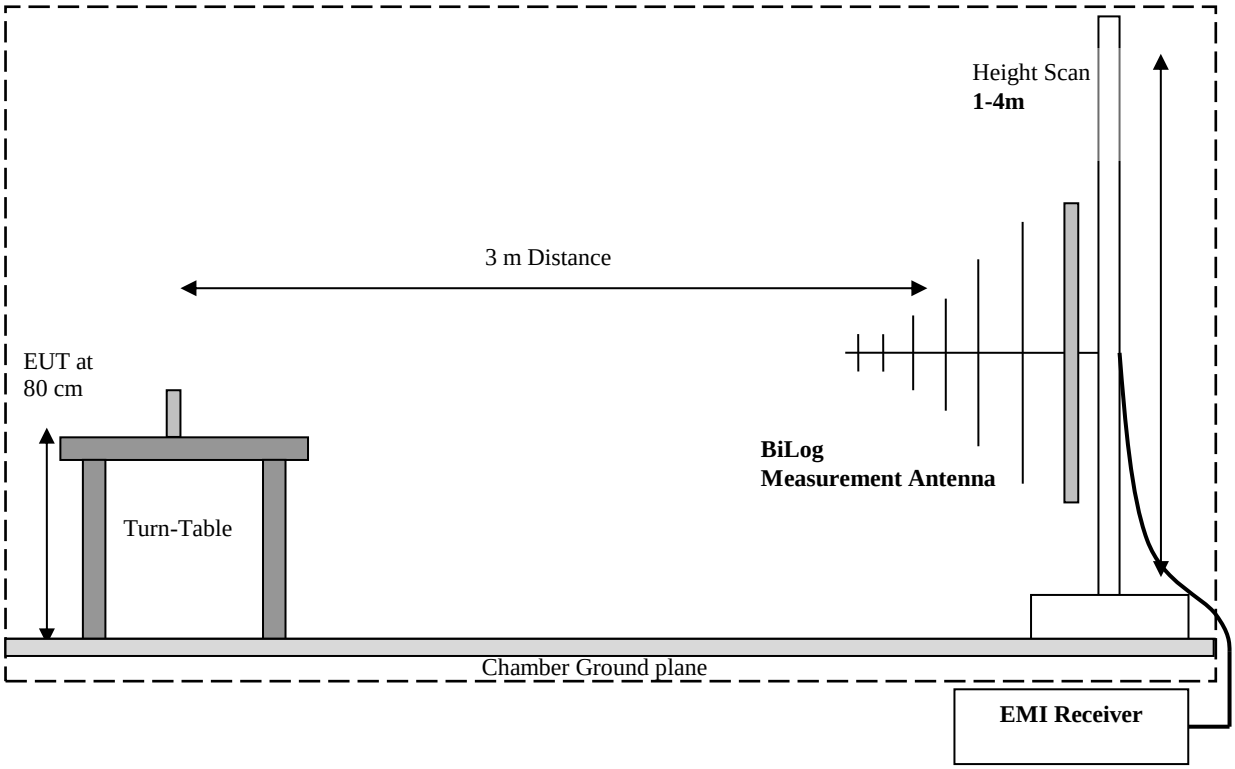
The radiated measurement is performed according to: ANSI C63.10 (2013)

- 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.

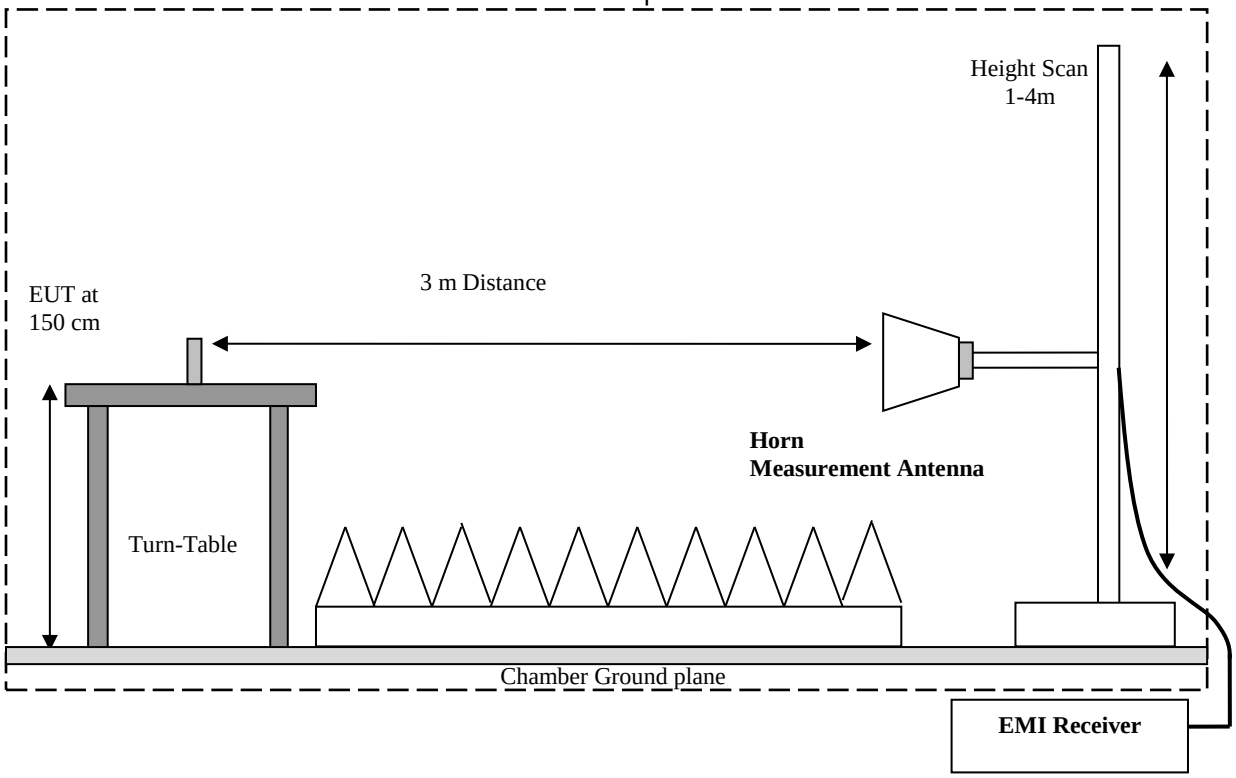
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.2.1 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/m)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.3 Power Line Conducted Measurement Procedure

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

8 Test Result Data

8.1 Verification of maximum output power after a C2PC on the Wi-Fi module

8.1.1 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.

8.1.2 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23 °C	1	CW on 62GHz 100% duty cycle	5 VDC	15 dBi

To verify that the max output power is not effected by the change on the Wi-Fi module, the following test procedure was used.
Rotating the EUT and Antenna to find the maximum EiRP
Measure the EIRP in 1m distance with a standard gain horn with 20dBi Gain

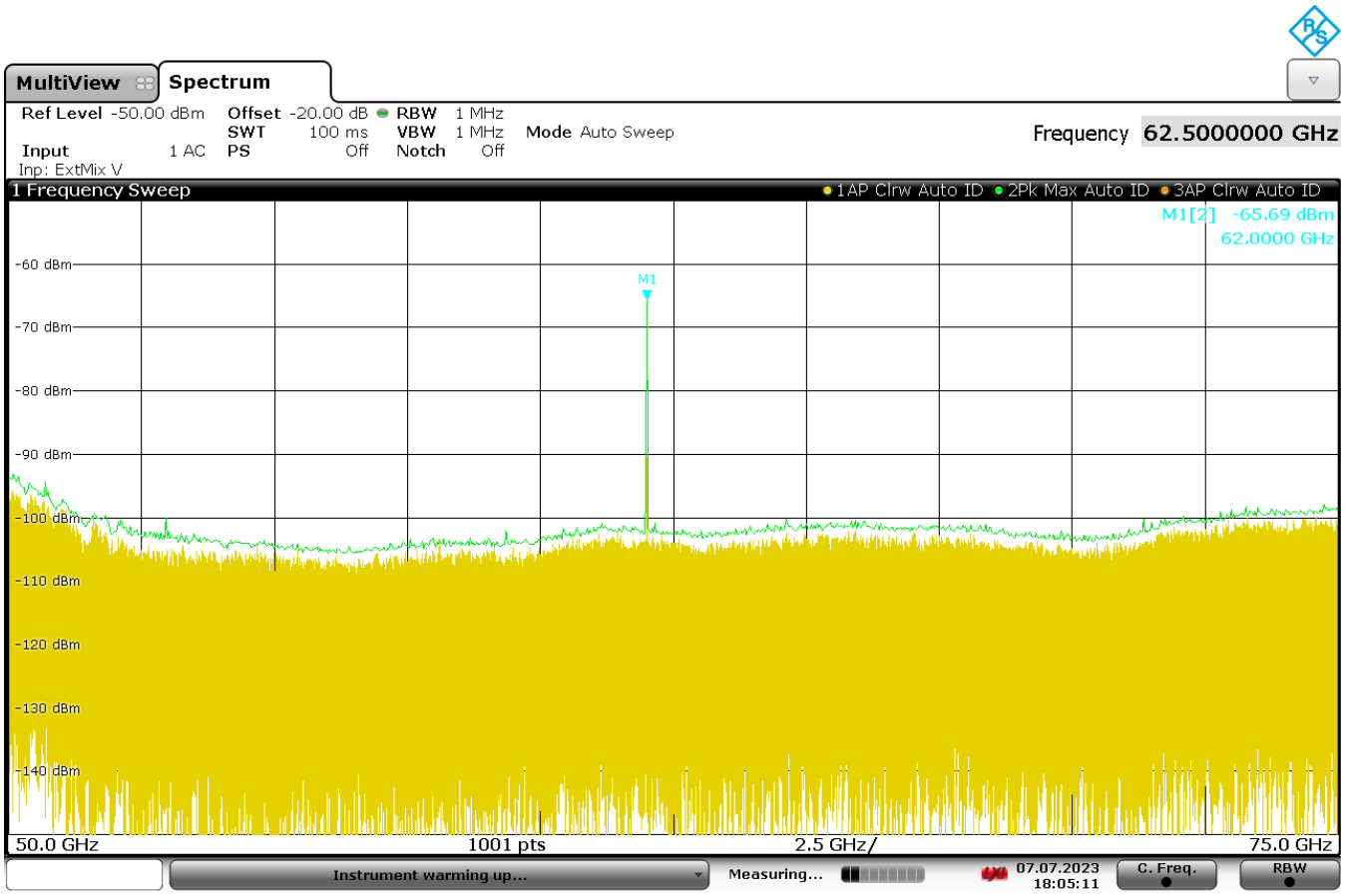
Measurement Value = - 65.7dBm (including – 20dB offset for antenna gain
Free space path loss at 1m and 61.9GHz = 68.3dB

Calculation:
EiRP = Measurement Value - Antenna gain + Free space path loss
EiRP = 65.7dBm (antenna gain included) + 68.3dB = 2.6dBm

8.1.3 Measurement result:

Plot #	Frequency (GHz)	EUT operating mode	EIRP before (dBm)	EIRP after (dBm)	Result
1	62	CW on 62GHz 100% duty cycle	4.4	2.6	Within expectation considering MU and different test setup

8.1.4 Measurement Plot:



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8.2 Transmitter Spurious Emissions and Restricted Bands

8.2.1 Measurement according to ANSI C63.10

To verify the influence of the C2PC on Wi-Fi module Transmitter Spurious Emissions in the range of 60GHz to 220GHz were performed

Analyzer Settings:

- 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 testing 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 (and suppress) 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 $d_{\text{far-field}}$ 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.

8.2.2 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. 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/m^2
EIRP$_{Linear}$ is the equivalent isotropic radiated power, in watts
D is the distance at which the power density limit is specified, in m

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
20 °C	1	CW on 62GHz 100% duty cycle	5 VDC

8.2.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-12	Mid	60GHz – 220 GHz	See section 8.2.2	Complies

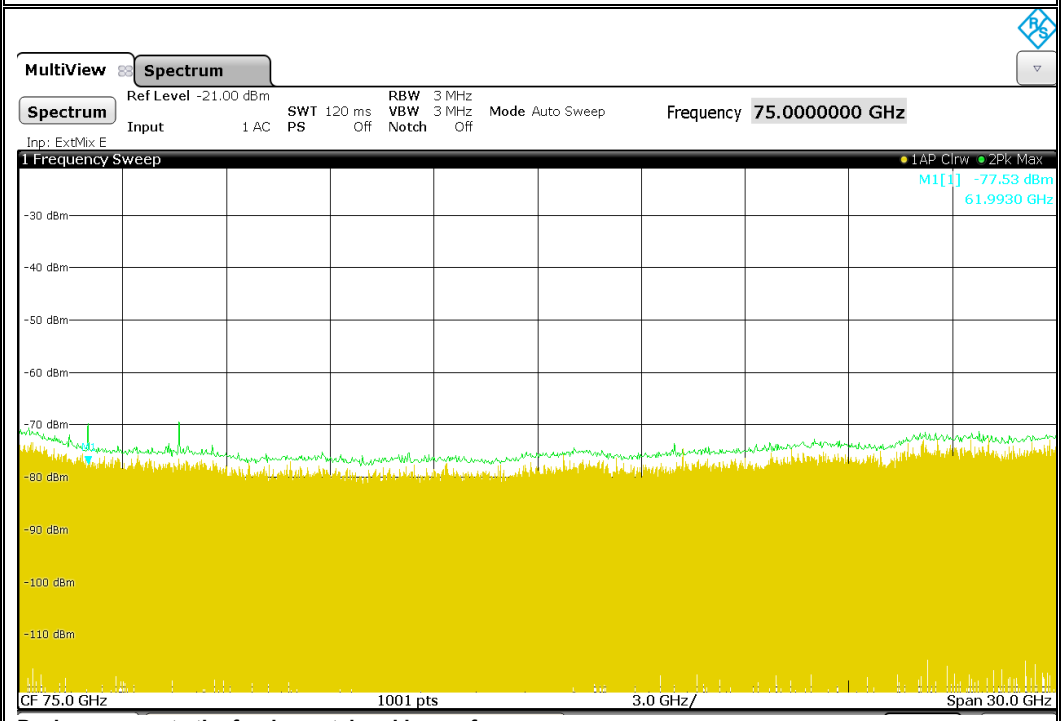
8.2.5 Measurement Plots:

The exploratory measurements are carried out by slowly rotating the turn table while constantly sweeping through the spectrum using a max hold function.
The exploratory measurements are carried out with horizontal and vertical antenna orientation and horizontal and vertical EUT orientation.

- Antenna Horizontal: EUT vertical and EUT horizontal
- Antenna Vertical: EUT vertical and EUT horizontal

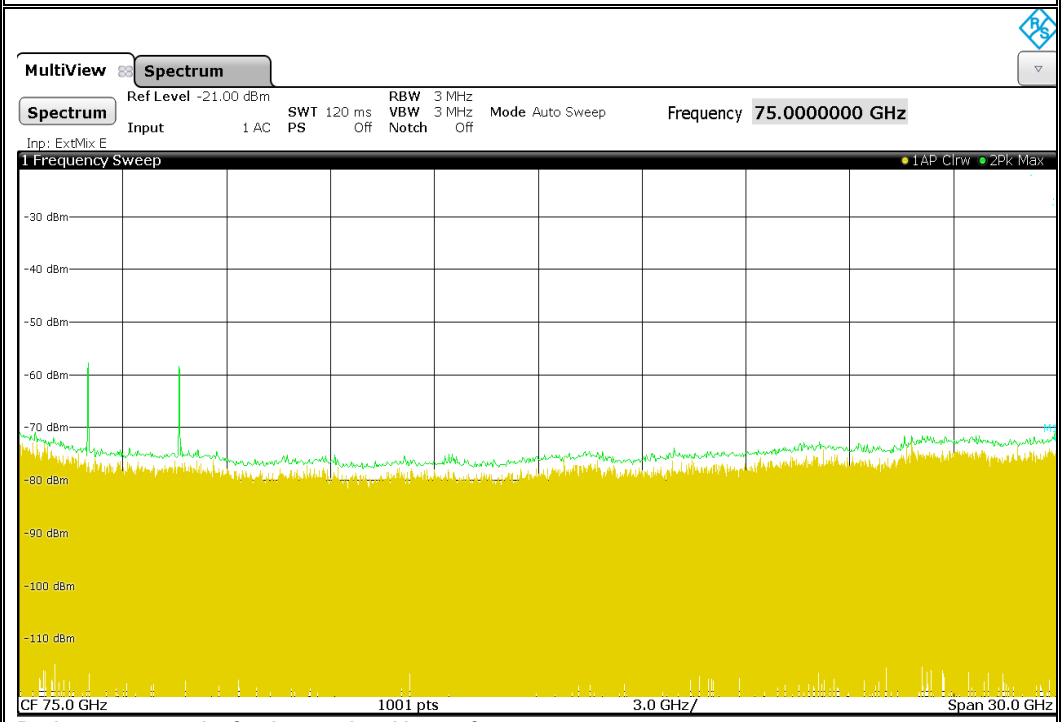
The exploratory measurements did not show any emissions above the noise flor so no further measurements were performed

Plot # 1. Radiated Emissions: 60-90 GHz; antenna H; EUT H



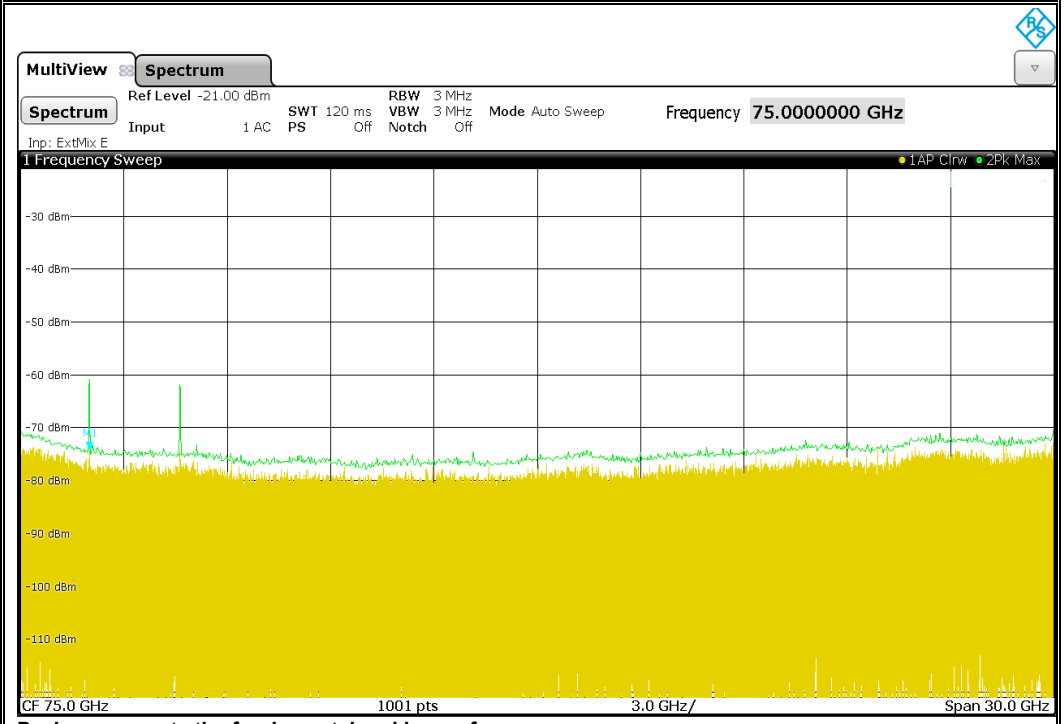
Peaks represents the fundamental and image frequency

Plot # 2. Radiated Emissions: 60-90 GHz; antenna H; EUT V



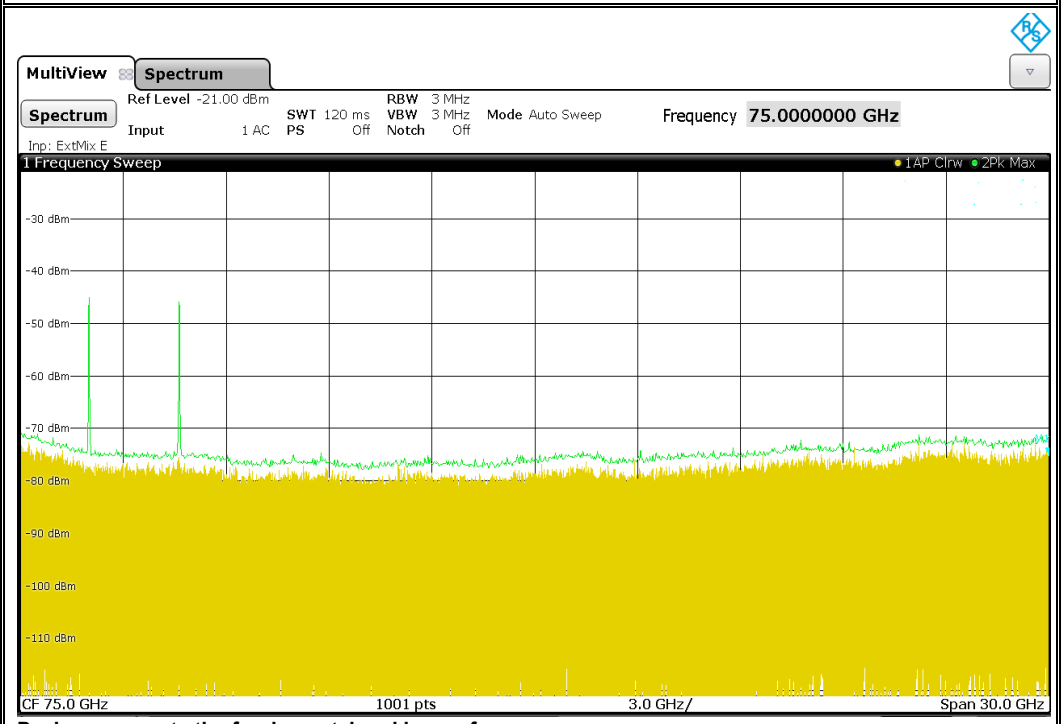
Peaks represents the fundamental and image frequency

Plot # 3. Radiated Emissions: 60-90 GHz; antenna V; EUT H



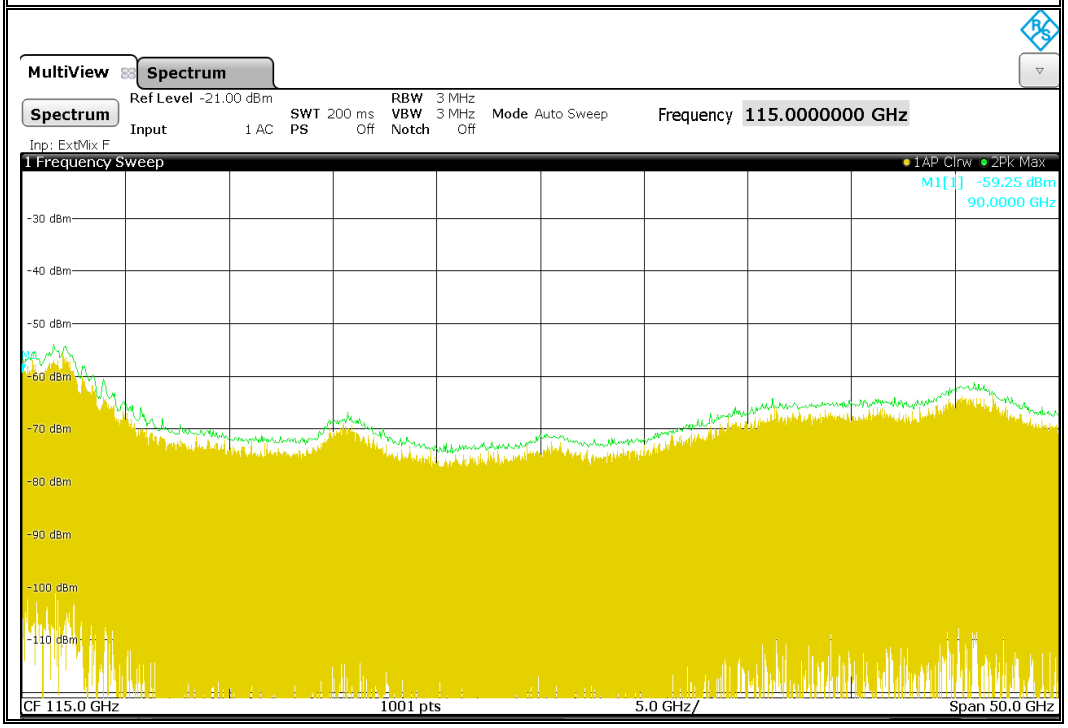
Peaks represents the fundamental and image frequency

Plot # 4. Radiated Emissions: 60-90 GHz; antenna V; EUT V

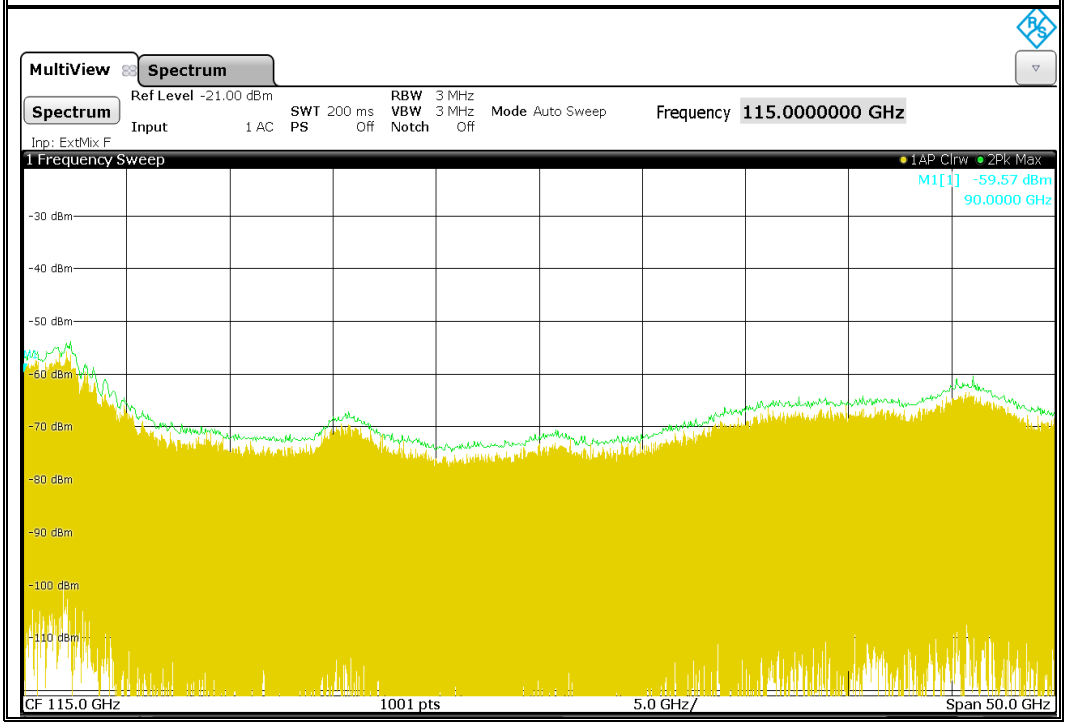


Peaks represents the fundamental and image frequency

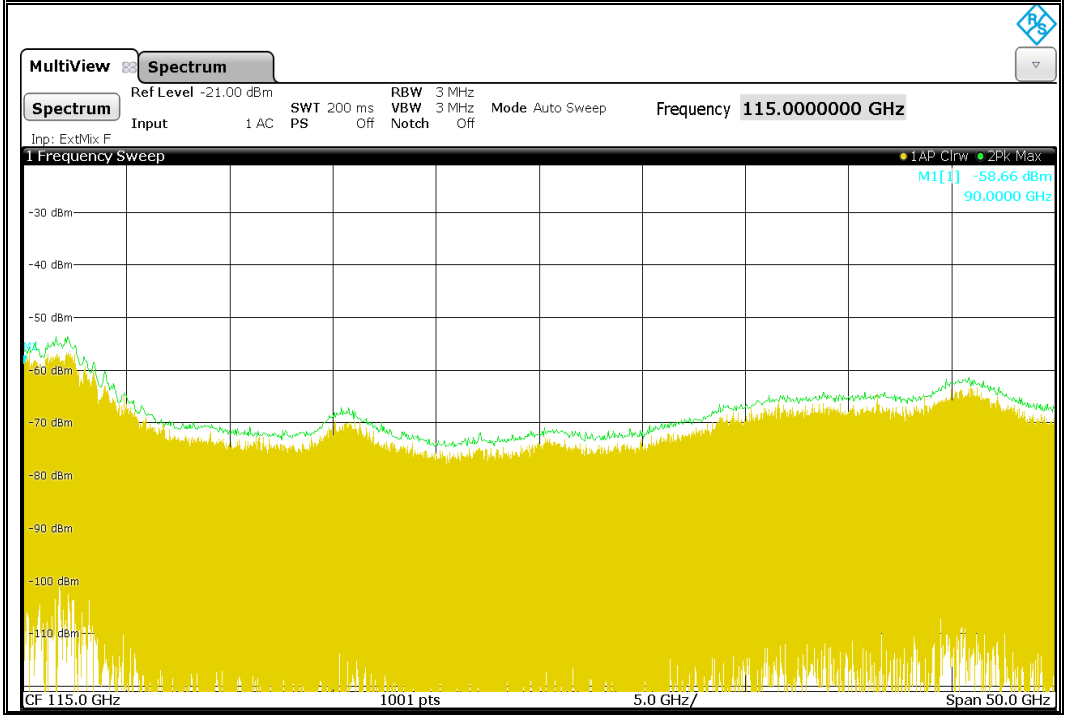
Plot # 5. Radiated Emissions: 90-140 GHz; antenna H; EUT H



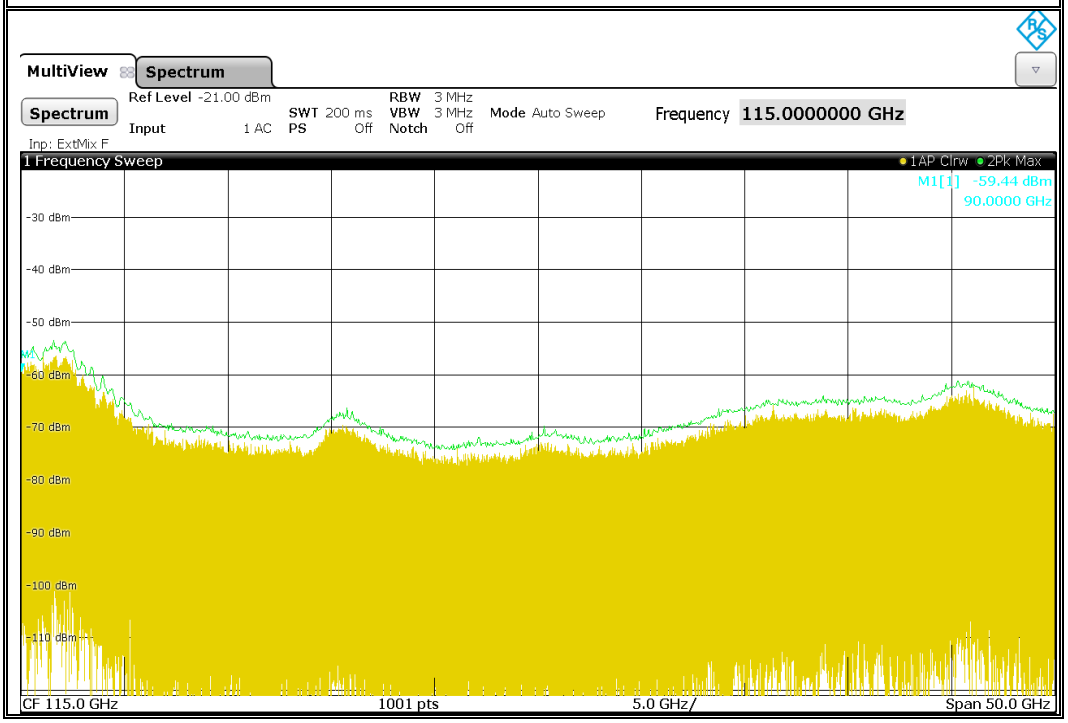
Plot # 6. Radiated Emissions: 90-140 GHz; antenna H; EUT V



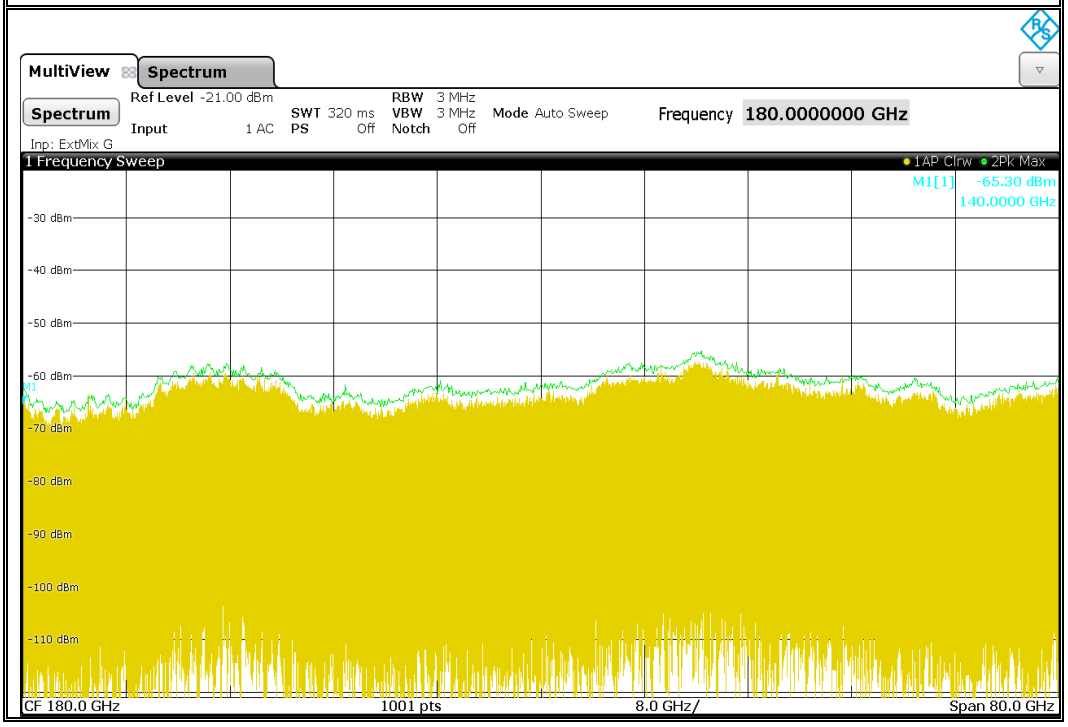
Plot # 7. Radiated Emissions: 90-140 GHz; antenna V; EUT H



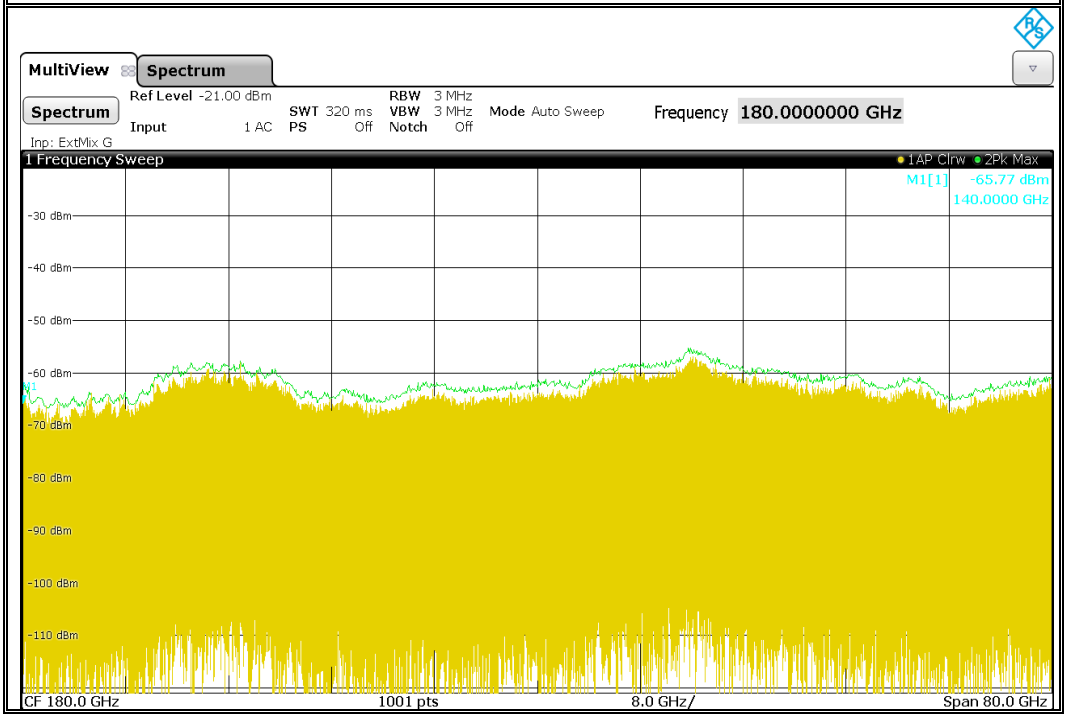
Plot # 8. Radiated Emissions: 90-140 GHz; antenna V; EUT V



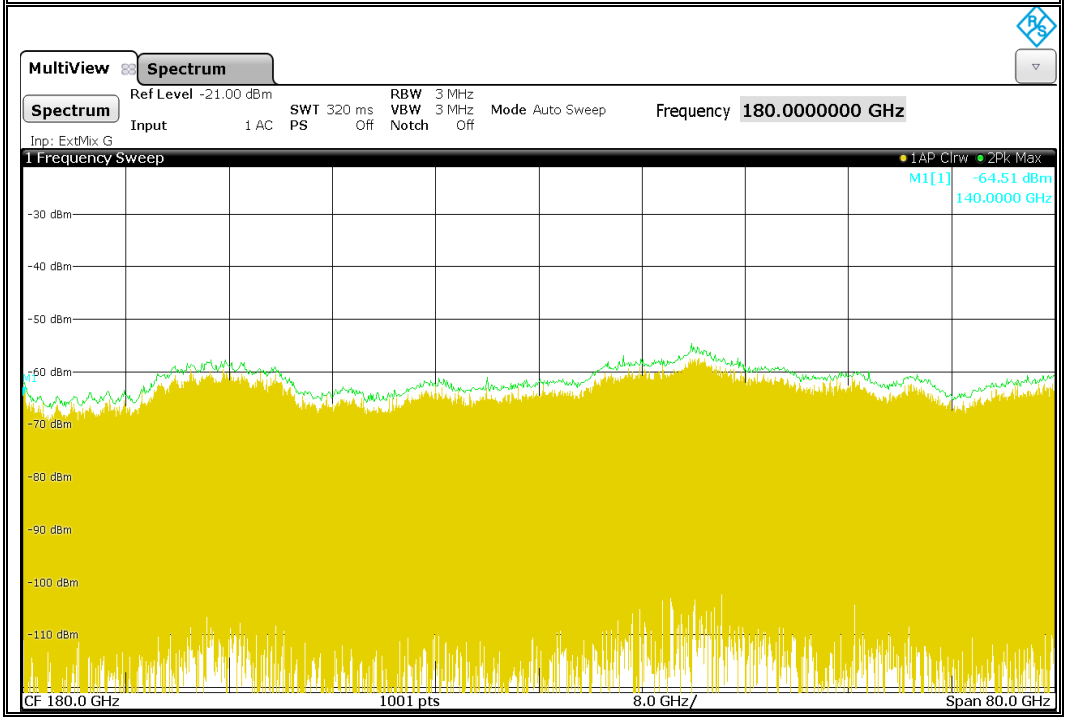
Plot # 9. Radiated Emissions: 140-220 GHz; antenna H; EUT H



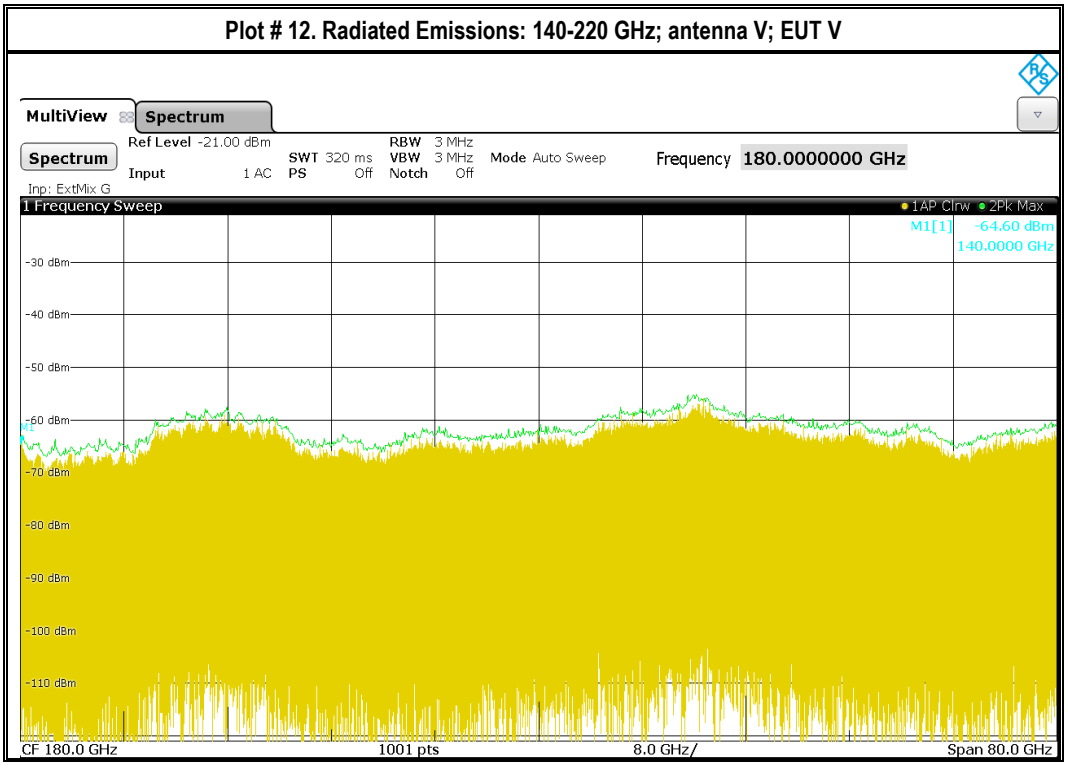
Plot # 10. Radiated Emissions: 140-220 GHz; antenna H; EUT V



Plot # 11. Radiated Emissions: 140-220 GHz; antenna V; EUT H



Plot # 12. Radiated Emissions: 140-220 GHz; antenna V; EUT V



9 Test setup photos

Setup photos are included in supporting file name: "EMC_PRAES-003-23001_FCC15.255_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 3116	Horn Antenna	ETS Lindgren	3116C-PA	00169535	3 years	9/23/2020
Horn antenna 40-60 GHz	Standard Gain Horn	MI-WAVE	261U-25/383	-	NA	-
Horn antenna 60-90 GHz	Standard Gain Horn	MI-WAVE	261E-25/387	-	NA	-
Horn antenna 90-140 GHz	Standard Gain Horn	MI-WAVE	261F-25/387	-	NA	-
Horn antenna 140-220 GHz	Standard Gain Horn	MI-WAVE	261G-25/387	-	NA	-
External Mixer 40-60 GHz	External Mixer	R&S	FS-Z60	101025	3 Years	02/20/2022 1)
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	02/20/2022 1)
External Mixer 90-140 GHz	External Mixer	R&S	FS-Z140	101145	3 Years-	02/20/2022 1)
External Mixer 140-220 GHz	External Mixer	R&S	FS-Z220	101037	3 Years	03/20/2022 1)
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	NA	-
Horn antenna 49.9-75.8 GHz	Standard Gain Horn	FLANN MICROWAVE	25240-20	273463	NA	-
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	NA	-
WR-12 Level Setting Attenuator	Level Setting Attenuator	ERAVANT	STA-30-12-M2	04778-01	NA	-
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 1): in service date
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	Changes to report	Prepared by
2023-08-24	Initial version-	Art Thammanavarat

<<< The End >>>