RF Test Report

Standard(s): FCC Part 15 Subpart 15.247,
RSS-247 Issue 3:2023
Unlicensed Intentional Radiators

Issued To: Flosonics Medical Inc.
325 Front St W, 4th Floor
Toronto, ON, M5V 2Y1
Canada

Product Name: FloPatch FP120
Model: FP120
FCC ID: 2AUWSFP120V2
IC: 25612-FP120V2

Report No. ML300049-RF00
Date of Issue: August 8, 2023

Report Prepared By:

Amir Emami, Project Engineer

Reviewed By:

Raymond Au, Project Engineer

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1. Revision History

Project No. & Revision	Report Date	Initials	Description
ML300049-RF00	August 8, 2023	AE	Initial Release
-	-	-	-

NOTE:

- Latest reports marked as a revision replace any previous report and/or report revision issued under the same project number.

2. Summary of Test Results

2.1 Test Verdict

Unless otherwise stated, the test data and results in this test report relate only to the sample(s) tested.

Requirement		Test Type	Result	Remark
FCC	ISED			
15.203 15.247(b)(4)	RSS-247 5.4(d)	Antenna Gain and Requirement	Pass	Custom internal antenna with max 1.2dBi gain
15.247(a)(2)	RSS-247 5.2(a)	Emission Bandwidth	Pass	6dB Bandwidth > 500kHz
15.247(b)(3)	RSS-247 5.4(d)	Peak Conducted Output Power	Pass	< 1 Watt
15.247(d)	RSS-247 5.5	Spurious Out of Band Emissions	Pass	< 20dBc
15.247(d) 15.209	RSS-GEN 8.9 (Table 5 & 6)	Transmitter Spurious Radiated Emissions	Pass	---
15.205 15.209	RSS-GEN 8.10 (Table 7)	Lower and Upper Band Edges	Pass	Transmitter spurious radiated emissions which fall in the restricted bands
15.247(e)	RSS-247 5.2(b)	Power Spectral Density	Pass	< 8 dBm in 3kHz BW
15.207	RSS-GEN (Table 4)	Power Line Conducted Emissions	N/A	DUT is internally battery powered and does not connect to any mains network

2.1.1 Test Verdict Notes and Justifications

The DUT was mounted in three orthogonal axes and worst-case results were obtained in the Y-axis. Worst case results are presented. See the Test Setup Photos for axis details.

Antenna details obtained from client. As per FCC 15.203, the antenna is custom designed by the client and is sealed inside the enclosure. It uses a custom connection and has less than 6dBi gain.

2.2 Test Standards

Standard	Description
47 CFR FCC Part 15 Subpart C	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074:2019	Digital Transmission Systems, measurements and procedures
RSS-247 Issue 3:2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 5:2021	General Requirements for Compliance of Radio Apparatus
ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ISO 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

2.3 Test Facility

All tests were performed at Megalab Group Inc., located at 150 Addison Hall Circle, Aurora, ON, L4G 3X8, Canada.
The 10-meter semi-anechoic chamber for radiated emission and radiated immunity is designed to handle weights of up to 10,000lb and has power capability of over 100A. The turntable is capable of supporting test devices or systems either floor standing or table top of up to 4 meters wide and 3m tall. Conducted emissions, unless otherwise specified, are performed on a 2.44m x 2.48m ground plane and using a 2.44m x 2.48m vertical ground plane if applicable.

2.3.1 Accreditations

This report does not indicate any product endorsement by any government, accreditation agency, or Megalab Group Inc. Megalab Group Inc. shall have no liability for any deductions, interpretations or generalizations drawn by the client or others from the issued reports. If any opinions or interpretations are expressed in this report, they are outside Megalab Group Inc.'s scope of accreditation and do not necessarily reflect the opinions of Megalab Group Inc., unless otherwise specified.

A2LA (Certificate #5179.02)

Megalab Group Inc. is accredited to ISO/IEC 17025:2017 by the American Association for Laboratory Accreditation (A2LA) with Testing Certificate #5179.02. The laboratories current scope of accreditation can be found as listed on A2LA's website.

ISED

Megalab Group Inc. is registered with and recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.
Company Number: 28697

FCC

Megalab Group Inc. is registered with and recognized by the Federal Communications Commission (FCC) as an accredited testing laboratory.
Registration No. 200040

VCCI

The Semi-anechoic chamber of Megalab Group Inc. is registered with the Regulations for Voluntary Control Council for Interference (VCCI). Registration No.: R-20173, G-20174, C-20132, T-20133.

2.3.2 Measurement Uncertainty

As per ISO/IEC 17025 requirements, an evaluation of the measurement uncertainties associated with the emission test results should be included in the test report.

Where relevant, the following measurement uncertainty levels have been estimated for the tests performed on the DUT as specified in CISPR 16-4-2. The measurement uncertainties given below are based on a coverage factor k = 2 which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.

Measurement	Frequency Range	Uncertainty
Conducted Emissions at AC Mains Power Port	150kHz to 30MHz	2.27 dB
Radiated Emissions	30MHz to 1GHz	5.22 dB
	1GHz to 18GHz	4.76 dB

2.3.3 Sample Calculations

Radiated Emissions

Emission Level (dBµV/m) =	Read Level (dBµV)	+	Antenna Factor (dB/m)	+	Cable Loss (dB)	-	Pre-Amp Gain (dB)	
=	52.4	+	9.4	+	1.3	-	29.2	
=	33.9							

Margin (dB) =	Limit (dBµV/m)	-	Emission Level (dBµV/m)
=	50.0	-	33.9
=	16.1		

2.3.4 Terms, Definitions and Abbreviations

AE	Auxiliary Equipment
DUT	Device Under Test
DTS	Digital Transmission System
EMC	Electro-Magnetic Compatibility
FHSS	Frequency Hopping Spread Spectrum
ISM	Industrial, Scientific and Medical
LISN	Line Impedance Stabilization Network
N/A	Not Applicable
NCR	No Calibration Required
RF	Radio Frequency
RBW	Resolution Bandwidth
VBW	Video Bandwidth

Auxiliary Equipment/Support Equipment
Equipment needed to exercise and/or monitor the operation of the DUT.

Artificial Mains Network
Network that provides a defined impedance to the DUT at radio frequencies, couples the disturbance voltage to the measuring receiver and decouples the test circuit from the supply mains.

Class A Equipment
Equipment suitable for use in all locations other than those allocated in residential environments and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Class B Equipment
Equipment suitable for use in all locations, including in residential environments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Device Under Test
Device or system being evaluated for compliance with the requirements of the Test Standards listed in this report.

Electro-Magnetic Compatibility
Ability of equipment or system to function satisfactorily in its EM environment without introducing intolerable electromagnetic disturbances to anything in that environment.

Electromagnetic Disturbance
Any electromagnetic phenomenon which may degrade the performance of a device, equipment or system.

3. General Information

3.1 Client Information

Company	Flosonics Medical Inc.
Address	325 Front St W, 4th Floor Toronto, ON, M5V 2Y1 Canada
Contact	Pietro Verrecchia
Email	pietro@flosonicsmedical.com
Phone	437-882-5990

3.2 Device Under Test (DUT)

3.2.1 DUT Information

DUT Name	FloPatch FP120
DUT Model(s)	FP120
Serial Number	120-2300-0036
Power Source (AC / DC / Battery)	Battery Charger interface and power supply are out of scope of compliance testing (No customer use. Manufacturer only).
Input Voltage (V) or Range	Internal LiPo battery spans 3.0-4.2 Vdc
Frequency (Hz) or Range	N/A
Rated Current (A)	1
Software Version	Software version: Autodeploy 118. Firmware version: 1.9.2
Mode(s) of Operation	"Scanning" (everything ON – BLE, digital, and analog systems). and "sleep" (Some BLE and some digital). Sleep is a subset of scanning, so scanning is the worst case used for testing
Connectors Available on DUT	1 connector (comprised of insert-molded contacts in enclosure) used for battery charging.
DUT Dimensions (L x W x H)	54mm x 35mm x 15mm
Transmitter Information	
FCC ID	2AUWSFP120V2
IC	25612-FP120V2
Technology Used	BLE
Operating Frequency	2402MHz to 2480MHz
Modulation Type	GFSK
Number of Channels	40
Data Rate	2Mbps PHY radio
Antenna Manufacturer	Flosonics Medical
Antenna Model	FP120-XEC01-002
Antenna Type	Custom
Antenna Gain	1.2dBi (Theoretical)

Note: Antenna information is provided by the client. The characteristics and gain are obtained from the client's theoretical modeling.

3.2.2 DUT Description

The FloPatch FP120 is a wireless, battery operated, body-worn, non-invasive Doppler blood flow meter (no mains power or cables). The device is placed over the patient's vessel to evaluate blood flow velocity. The device transmits the data wirelessly to a mobile application.

3.3 Test Setup of DUT

3.3.1 Configuration

The DUT was configured in a direct test mode with the following parameters

- For all the tests, the DUT was set to transmit continuously with 100% duty cycle
- Output Power: +4dBm
- Channels:
  - 37 (low, 2402MHz),
  - 18 (Mid, 2442MHz),
  - 39 (High, 2480MHz)
- Packet Type: PRBS9
- Packet Length: 255 bytes

During all radiated emission measurements, the DUT was mounted in three orthogonal axes. See Test Setup Photos for axis details.

Description of I/O Cables			
Cable Function	**Length of Cable (m)**	**Shielded (Y/N)**	**Outdoor Use (Y/N)**
None	N/A	--	--

3.3.2 Support Equipment

Device	Manufacturer	Model	S/N
Laptop with nRF Connect Direct Test Mode software	N/A	N/A	N/A

3.4 Modifications for Compliance

No modifications were made to the device under test to comply with the testing requirements.

4. Test Results

4.1 Emission Bandwidth

Test Date:	June 23, 2023	Initials:	AE
Temperature (°C)	24.3		
Relative Humidity (%)	56.4		
Barometric Pressure (kPa)	97.6		

4.1.1 Limits

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.1.2 Test Procedure

Tested according to ANSI C63.10 Section 11.8 and 6.9.3.

For the 6dB (DTS) Bandwidth:

a) Set RBW = 100kHz and VBW ≥ [3 × RBW].
b) Detector = Peak and Trace Mode = Max Hold.
c) Sweep = Auto Couple.
d) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

For the 99% Bandwidth:

a) Set RBW in the range of 1% to 5% of the actual occupied bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Span set to 1.5 to 5 times the occupied bandwidth.
d) Use the 99% power bandwidth function of the instrument to measure bandwidth.

4.1.3 Test Results

6dB (DTS) Bandwidth				
Channel	**Frequency (MHz)**	**6dB Bandwidth (MHz)**	**Limit (MHz)**	**Test Result**
Low	2402	1.151	> 0.50	Pass
Mid	2442	1.150	> 0.50	Pass
High	2480	1.161	> 0.50	Pass

99% Bandwidth					
Channel	**Frequency (MHz)**	**F_{LOW} (MHz)**	**F_{HIGH} (MHz)**	**Occupied Bandwidth (MHz)**	**Test Result**
Low	2402	2.400962	2.403036	2.07	Pass
Mid	2442	2.440960	2.443038	2.08	Pass
High	2480	2.478958	2.481040	2.08	Pass

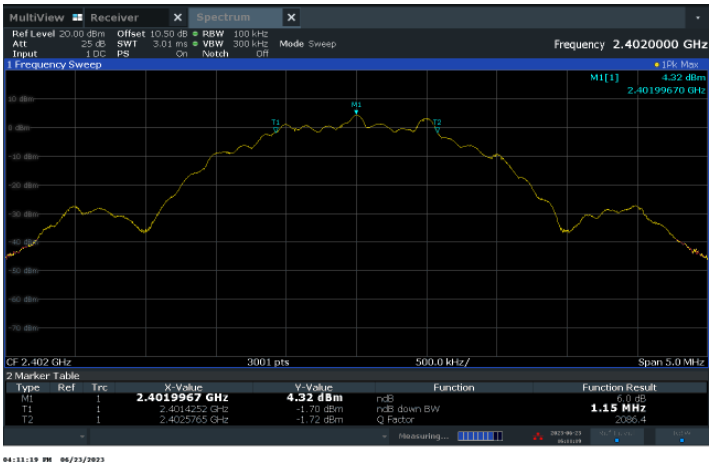


Figure 1 – 6dB Bandwidth - Low Channel

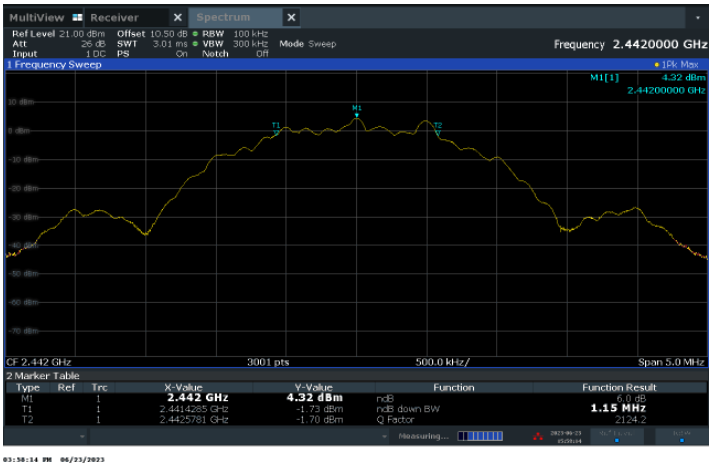


Figure 2 – 6dB Bandwidth - Mid Channel

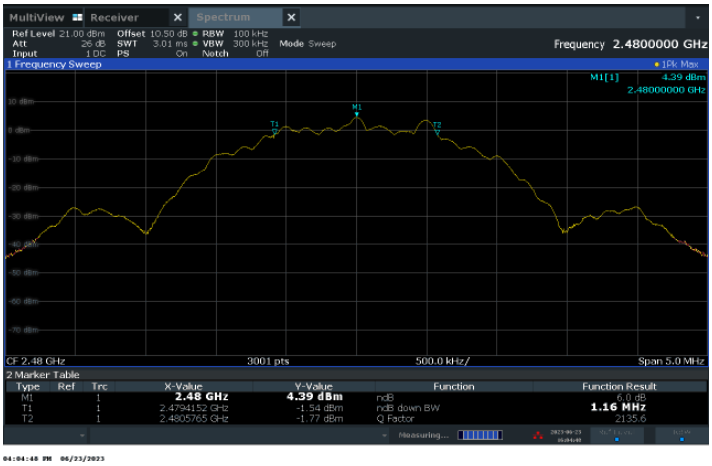


Figure 3 – 6dB Bandwidth - High Channel

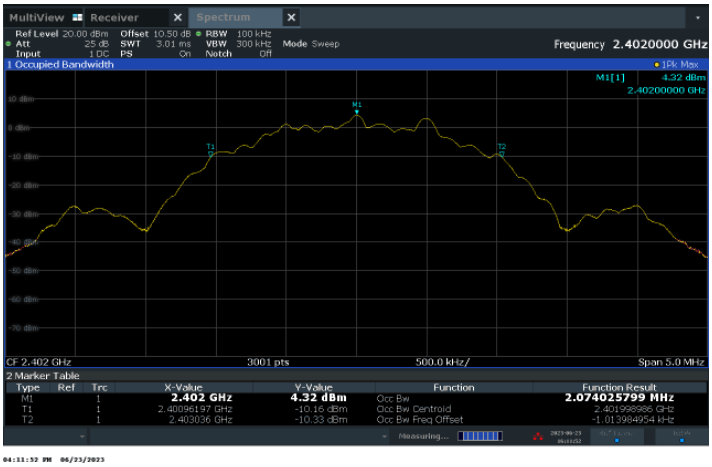


Figure 4 – 99% Bandwidth - Low Channel

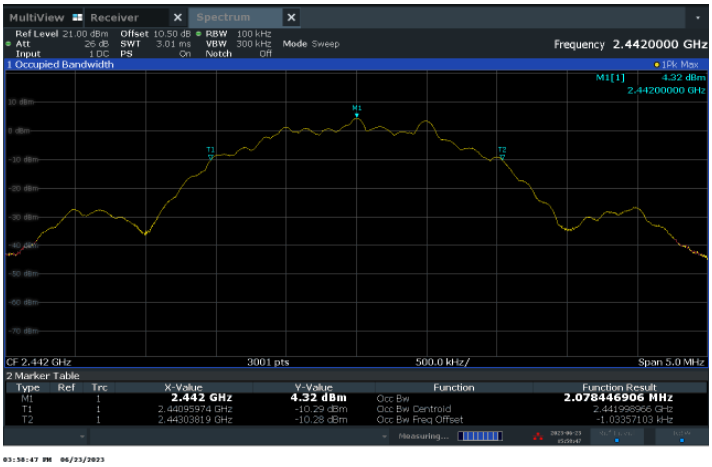


Figure 5 – 99% Bandwidth - Mid Channel

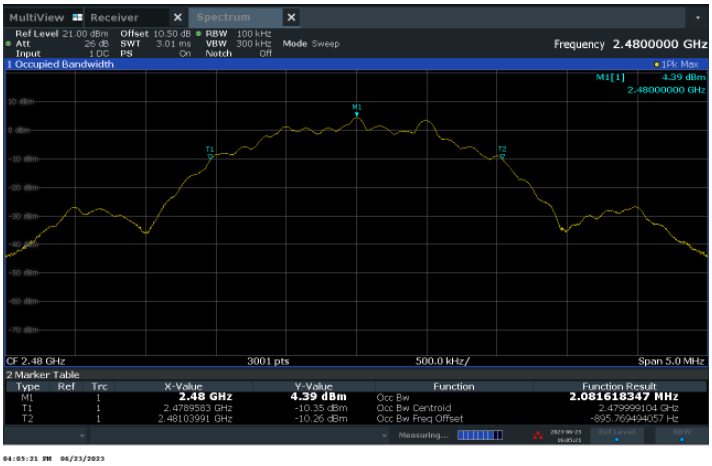


Figure 6 – 99% Bandwidth - High Channel

4.1.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_115	10dB Attenuator	Fairview Microwave	SA18E-10	NCR	NCR

4.2 Peak Conducted Output Power

Test Date:	June 23, 2023	Initials:	AE
Temperature (°C)	24.3		
Relative Humidity (%)	56.4		
Barometric Pressure (kPa)	97.6		

4.2.1 Limits

The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt (+30dBm) for systems using digital modulation in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands. The maximum conducted output power is the highest total transmit power occurring in any mode.

4.2.2 Test Procedure

Tested according to ANSI C63.10 Section 11.9.1.

The test was performed using a spectrum analyzer with a resolution bandwidth greater than the DTS bandwidth.

The RF output of the DUT was connected to the spectrum analyzer with sufficient attenuation in front and the total path loss was set as reference offset to correct the final reading.

4.2.3 Test Results

Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)	Limit (dBm)	Test Result
Low	2402	4.41	2.76	30	Pass
Mid	2442	4.35	2.72	30	Pass
High	2480	4.43	2.77	30	Pass

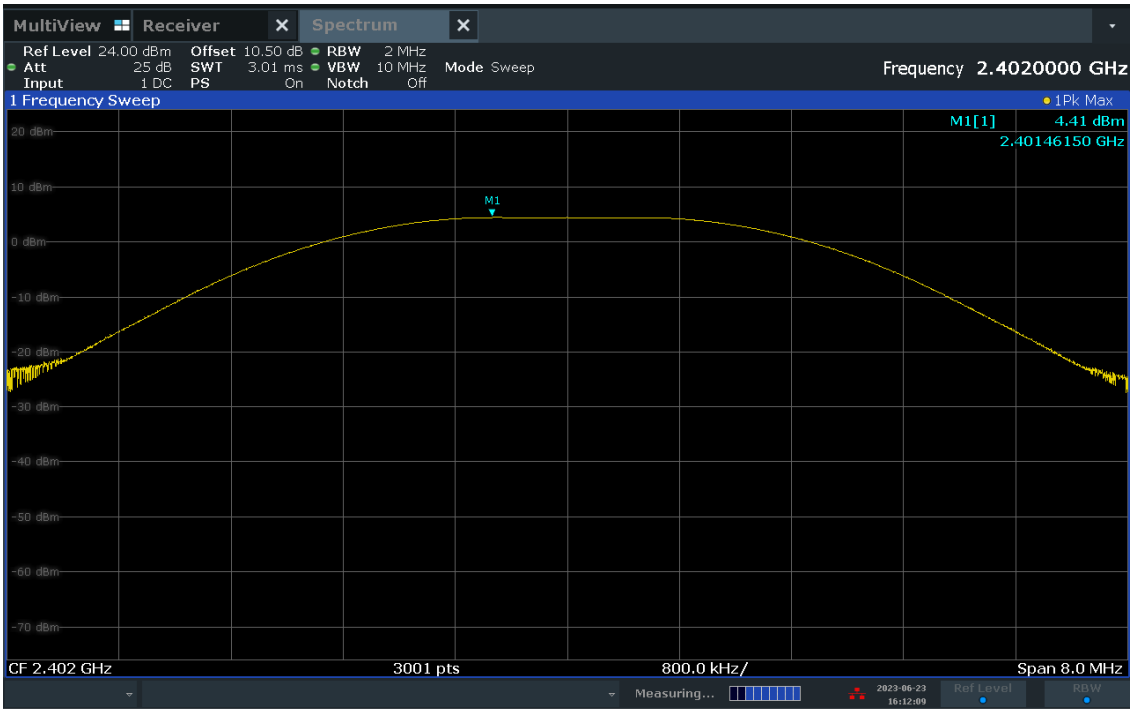


Figure 7 – Peak Power - Low Channel

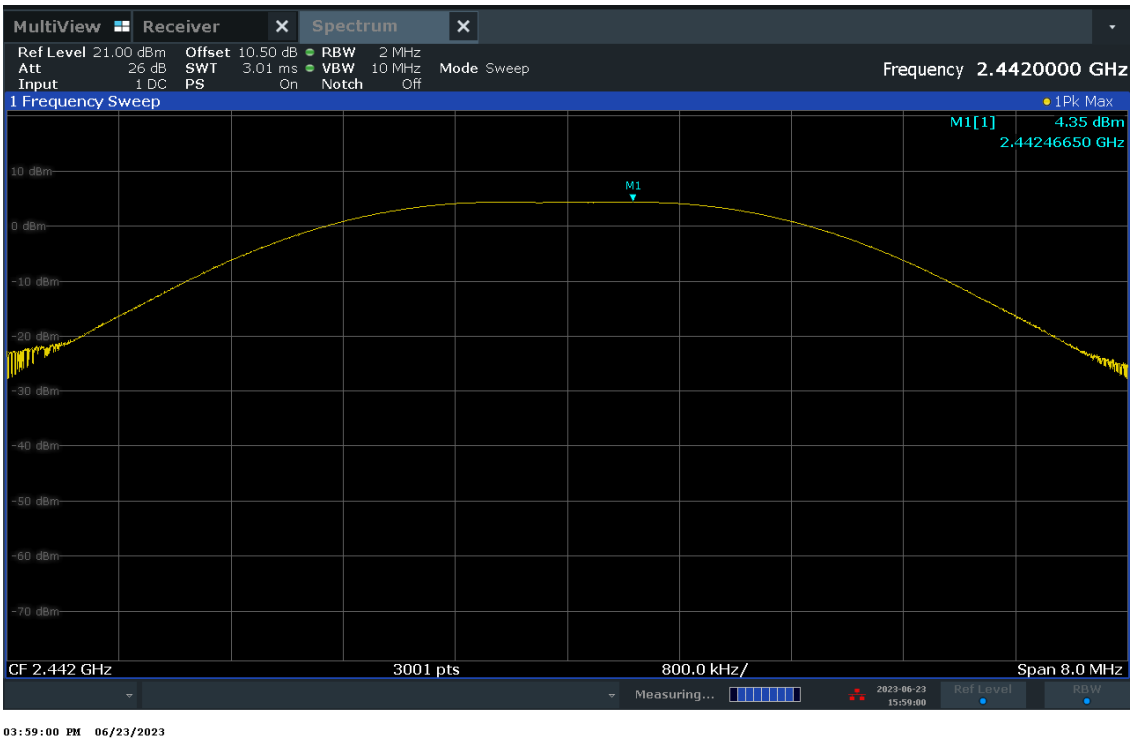


Figure 8 – Peak Power - Mid Channel

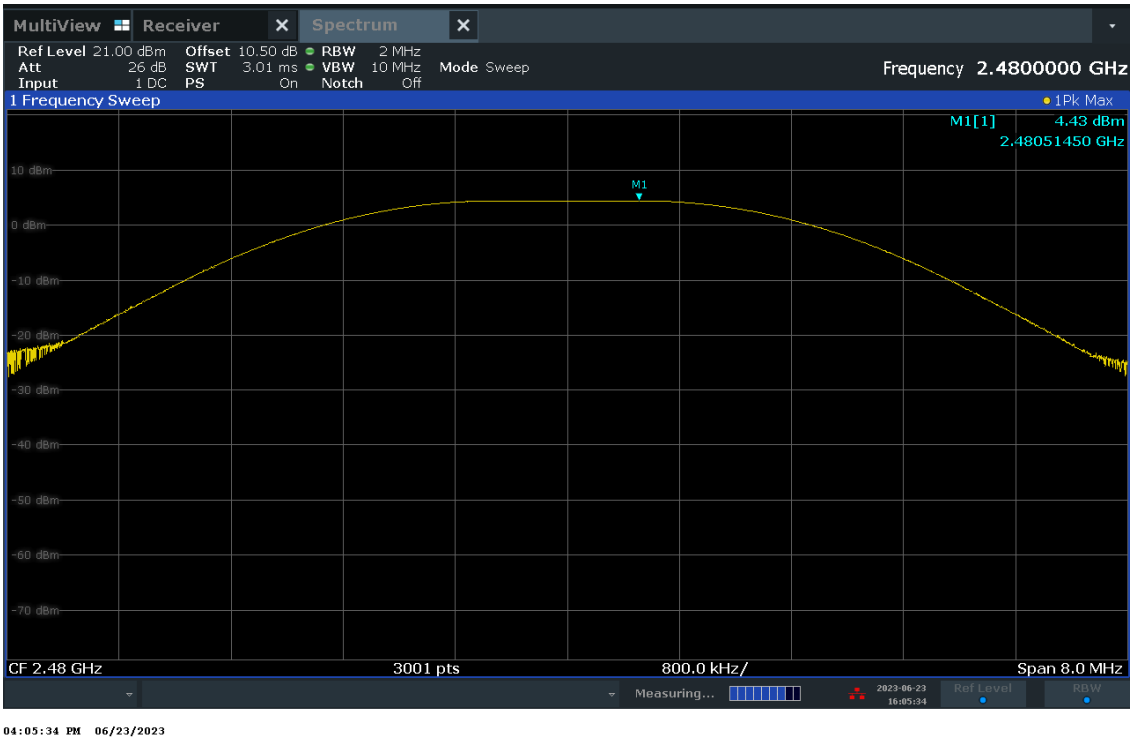


Figure 9 – Peak Power - High Channel

4.2.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_115	10dB Attenuator	Fairview Microwave	SA18E-10	NCR	NCR

4.3 Spurious Out of Band Emissions (-20dBc)

Test Date:	June 23, 2023	Initials:	AE
Temperature (°C)	24.3		
Relative Humidity (%)	56.4		
Barometric Pressure (kPa)	97.6		

4.3.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30dB instead of 20dB.

4.3.2 Test Procedure

Tested according to ANSI C63.10 Section 11.11

For the reference level measurement:

a) Set RBW = 100kHz and VBW ≥ [3 × RBW].
b) Detector = Peak and Trace Mode = Max Hold.
c) Sweep = Auto Couple.
d) Span set to ≥1.5 DTS bandwidth.
e) Use the peak marker function to determine the maximum level.

For the out of band emission measurement

a) Set the start and stop frequency to encompass the frequency range to be measured.
b) Set RBW = 100kHz and VBW ≥ [3 × RBW].
c) Detector = Peak and Trace Mode = Max Hold.
d) Sweep = Auto Couple.
e) Use the peak marker function to determine the maximum level.

The RF output of the DUT was connected to the spectrum analyzer with sufficient attenuation in front and the total path loss was set as reference offset to correct the final reading.

4.3.3 Test Results

The DUT met the 20dB below carrier requirement for out of band emissions.

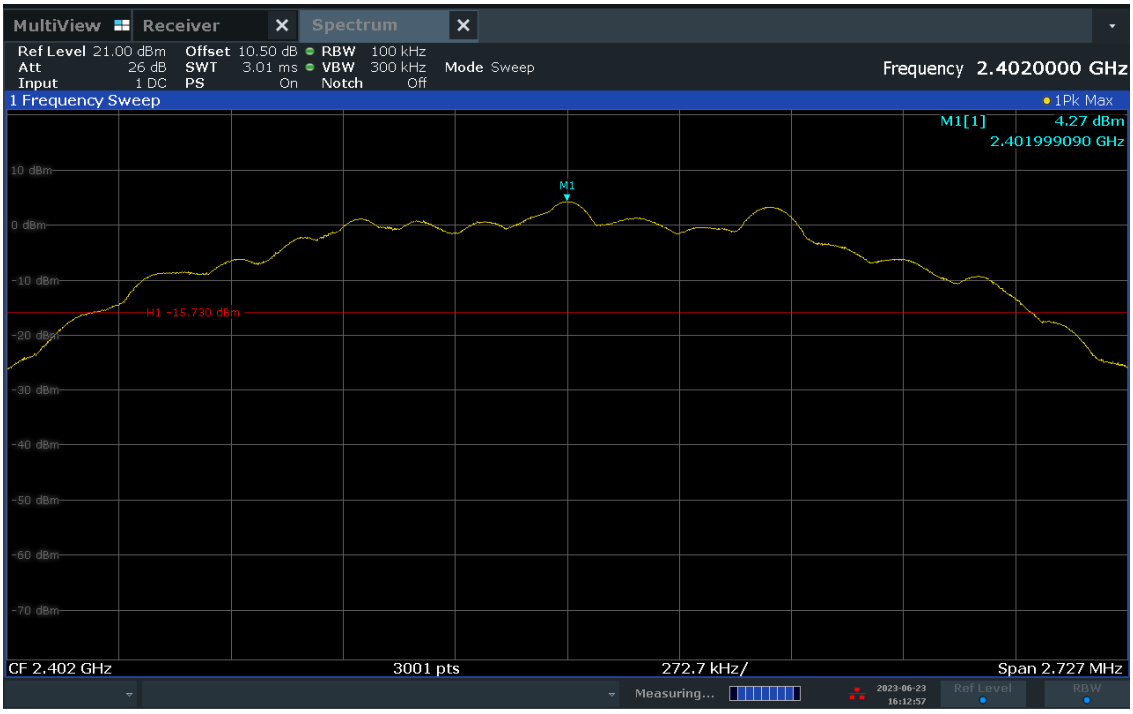


Figure 10 – -20dBc Reference Level - Low Channel

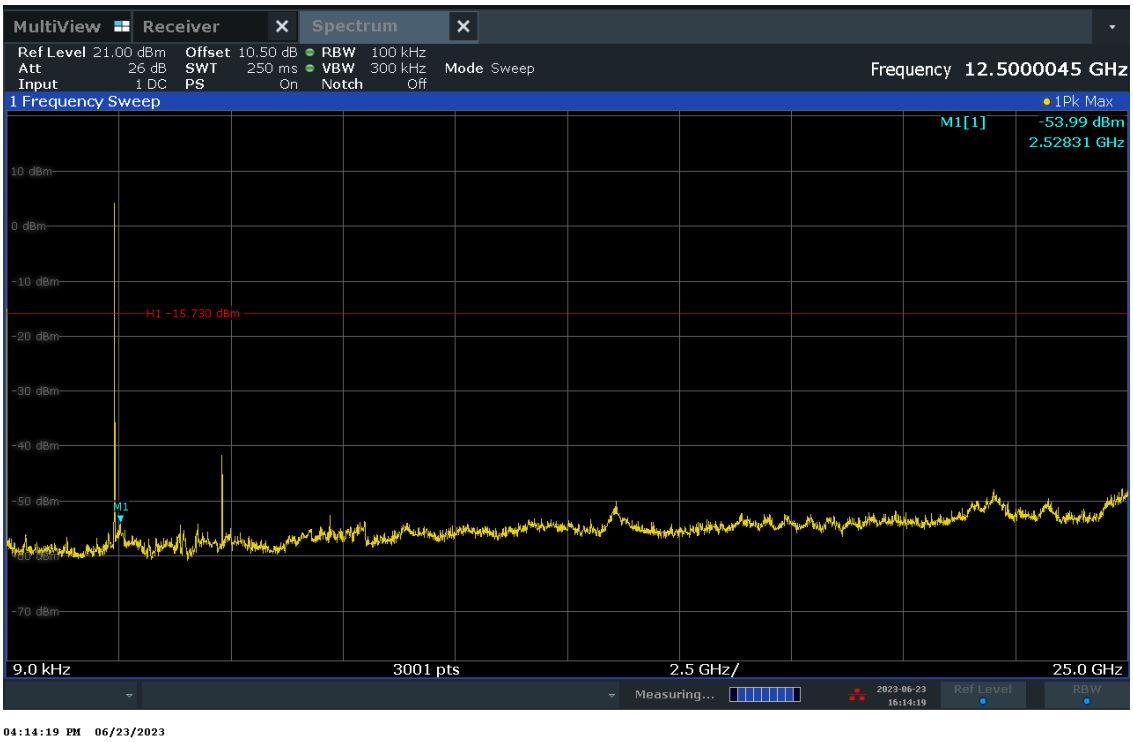


Figure 11 – -20dBc - Low Channel

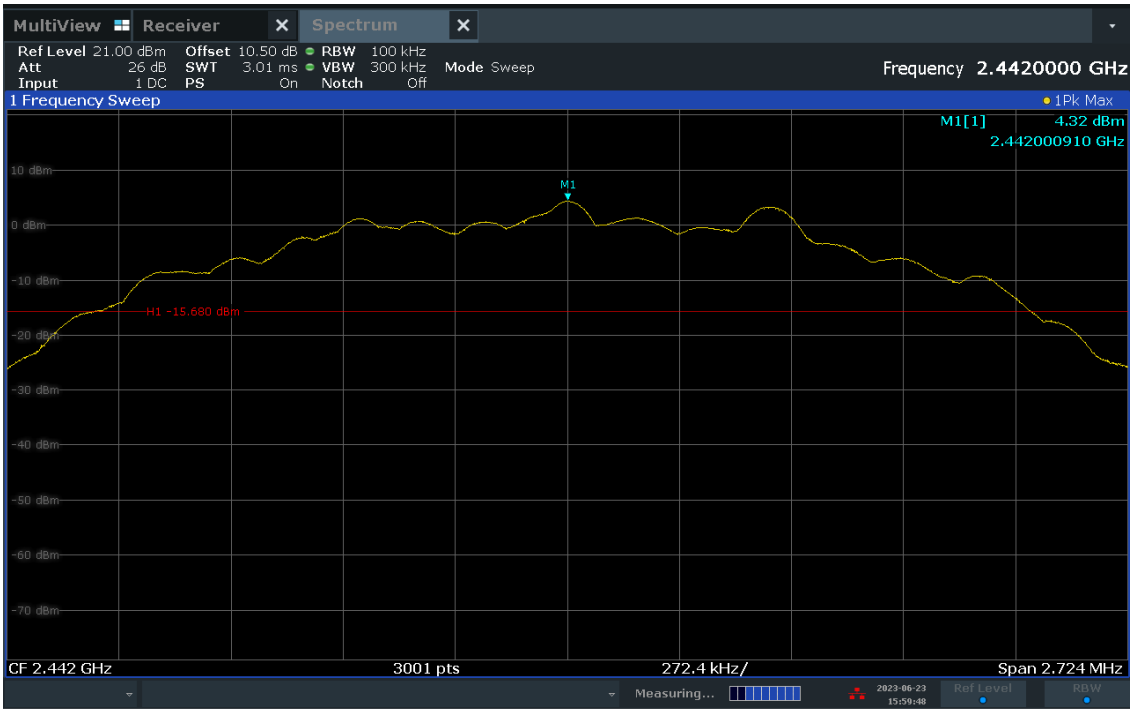


Figure 12 – -20dBc Reference Level - Mid Channel

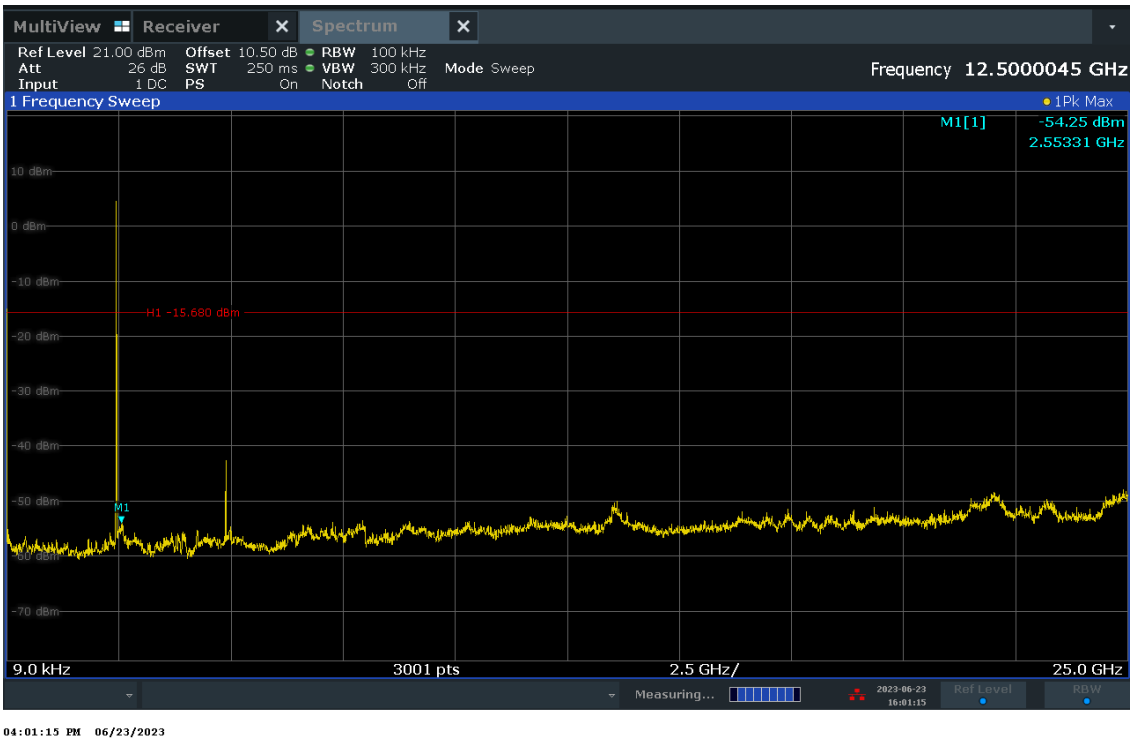


Figure 13 – -20dBc - Mid Channel

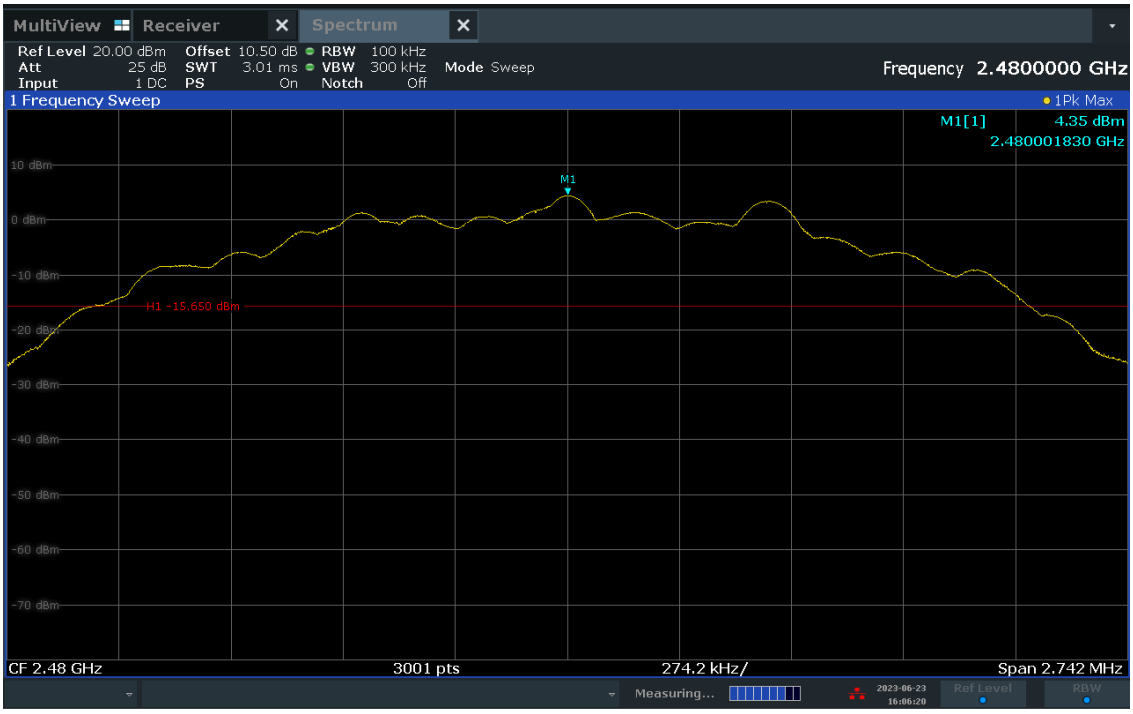


Figure 14 – -20dBc Reference Level - High Channel

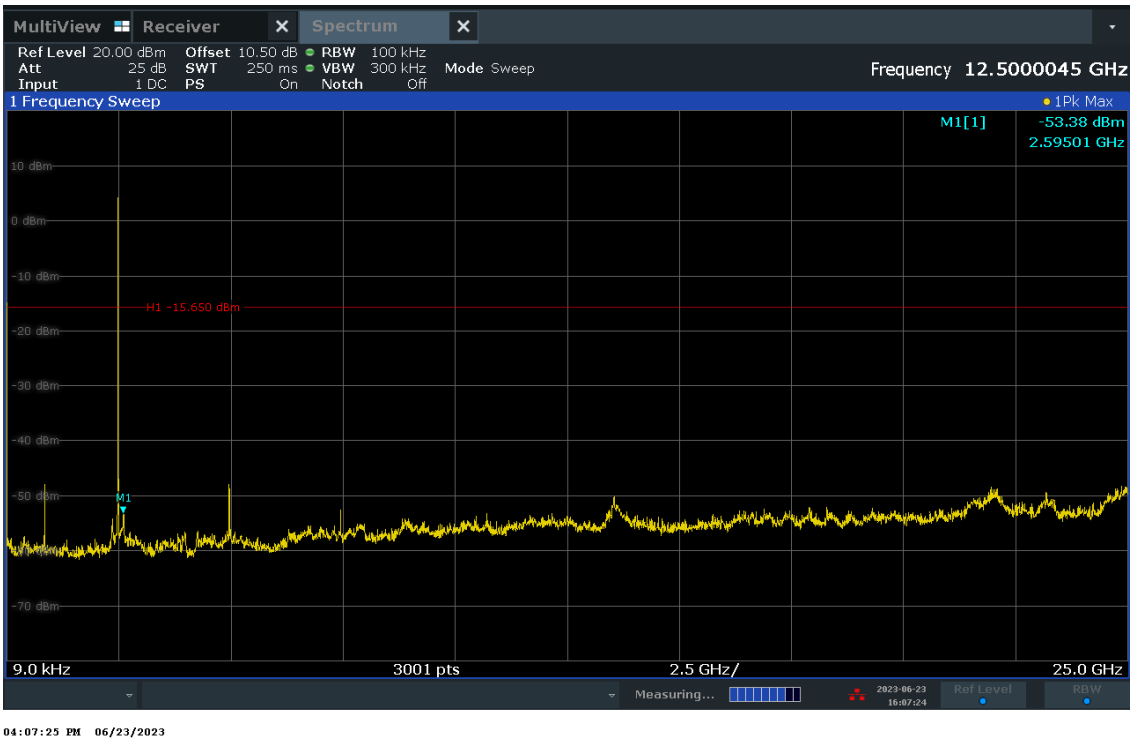


Figure 15 – -20dBc - High Channel

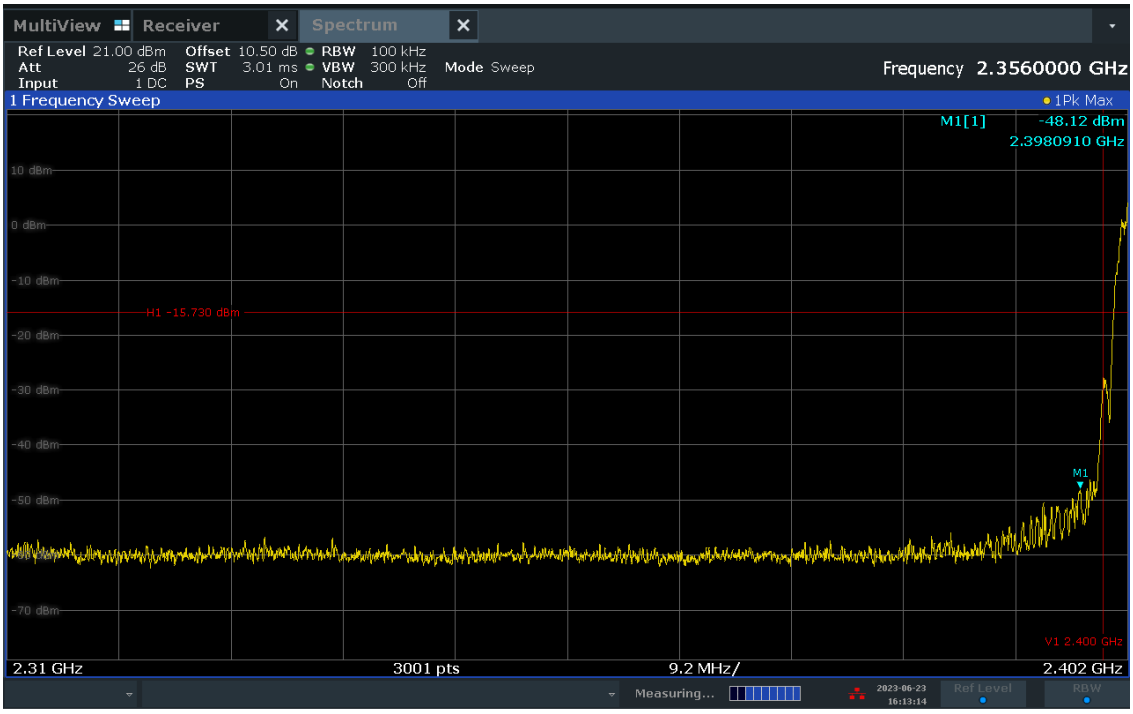


Figure 16 – -20dBc Band Edge - Low Channel

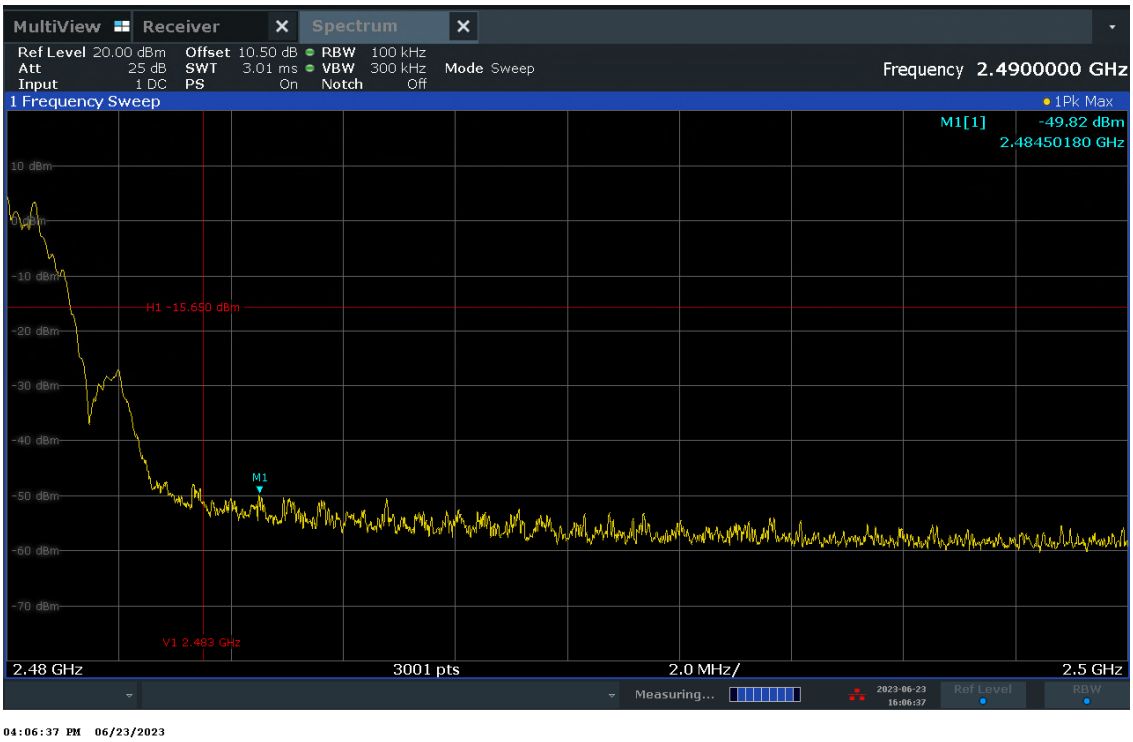


Figure 17 – -20dBc Band Edge - High Channel

4.3.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_115	10dB Attenuator	Fairview Microwave	SA18E-10	NCR	NCR

4.4 Transmitter Spurious Radiated Emissions

Test Date:	April 21, 2023	Initials:	AE
Temperature (°C)	19.7		
Relative Humidity (%)	26.8		
Barometric Pressure (kPa)	98.5		

4.4.1 Limits

Any radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the general radiated emission limits specified in FCC 15.209(a). Other emissions shall be at least 20dB below the highest level of the intentional transmitter.

Base Standard(s): FCC Subpart C 15.209 and RSS-Gen Section 8.9.

Frequency Range (MHz)	Field Strength Limit		Field Strength at 3m (dBµV/m)	Detector Type / Measurement Bandwidth
	µV/m	Distance		
0.009 – 0.150	2400/F(kHz)	300	128.5 – 104.1	Quasi-Peak‡ / 200Hz
0.150 – 0.490	2400/F(kHz)	300	104.1 – 93.8	Quasi-Peak‡ / 9kHz
0.490 – 1.705	24000/F(kHz)	30	73.8 – 63.0	Quasi-Peak / 9kHz
1.705 – 30	30	30	69.5	Quasi-Peak / 9kHz
30 – 88	100	3	40.0	Quasi-Peak / 120kHz
88 – 216	150	3	43.5	Quasi-Peak / 120kHz
216 – 960	200	3	46.0	Quasi-Peak / 120kHz
960 – 1000	500	3	54.0	Quasi-Peak / 120kHz
Above 1000	500	3	54.0	Average / 1MHz
Above 1000	5000	3	74.0	Peak / 1MHz

‡The emission limits below 1GHz shown in the above table are based on measurements employing a CISPR Quasi-Peak detector except for the frequency bands 9-90 kHz and 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

As per ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, or Average limits where defined, then the DUT is considered to have passed the requirements.

4.4.2 Test Procedure

Tested according to ANSI C63.10 Section 6.3.

The device under test was setup inside a semi-anechoic chamber with remotely controlled turntable and antenna positioner at a 3m test distance. The DUT was placed on top of a 0.8m high non-conductive table above the reference ground plane for frequencies below 1GHz and 1.5m high for frequencies above 1GHz.

To determine the emission characteristics of the DUT, exploratory radiated emission scans were made while rotating the turntable 0° to 360° and using a Peak detector. The results were recorded in graphical form.

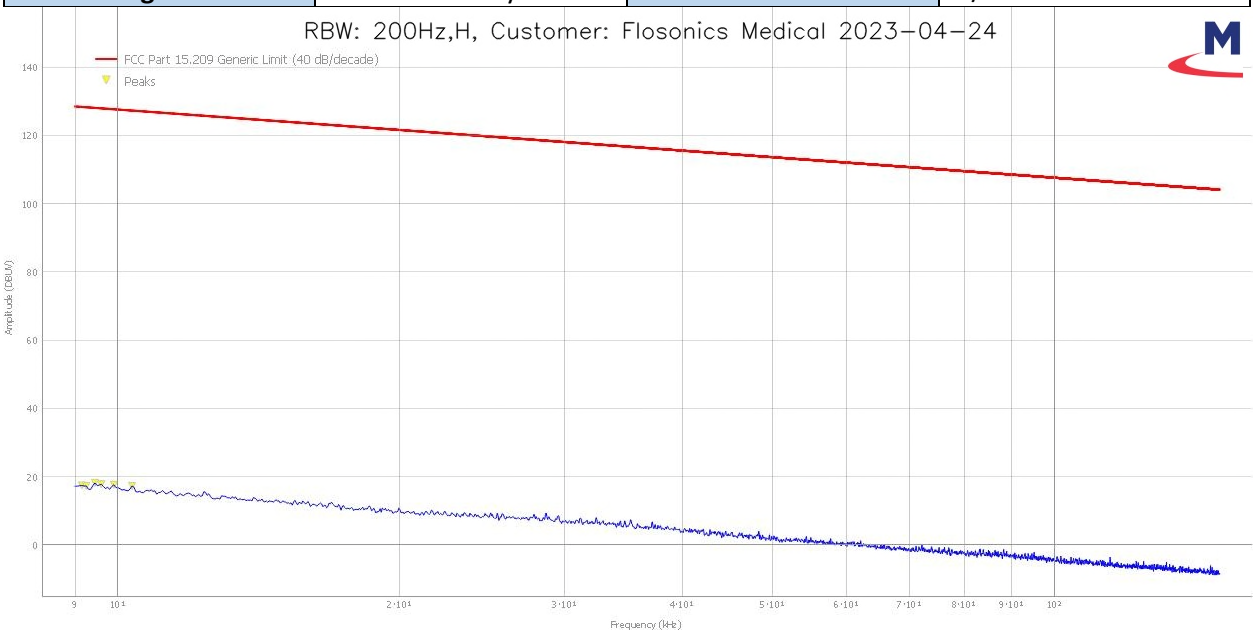
For each suspected emission, final measurements of the DUT radiated emissions with the Quasi-Peak, Average or Peak detector, as defined in the limit tables above, were made with the turntable azimuth rotated 0° to 360° and antenna height varied from 1m to 4m. The antenna was positioned to receive emissions in the vertical and horizontal polarizations such that the maximum radiated emission levels were detected.

As per FCC Part 15.33(a), the DUT was scanned to the 10th harmonic of the highest fundamental frequency.

Peak output power for low, mid and high channels, each in three orthogonal axes, were verified. The worst case was used for the spurious emissions which was on the low channel and in the Y-axis.

4.4.3 Test Results

Range:	9kHz to 150kHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	N/A

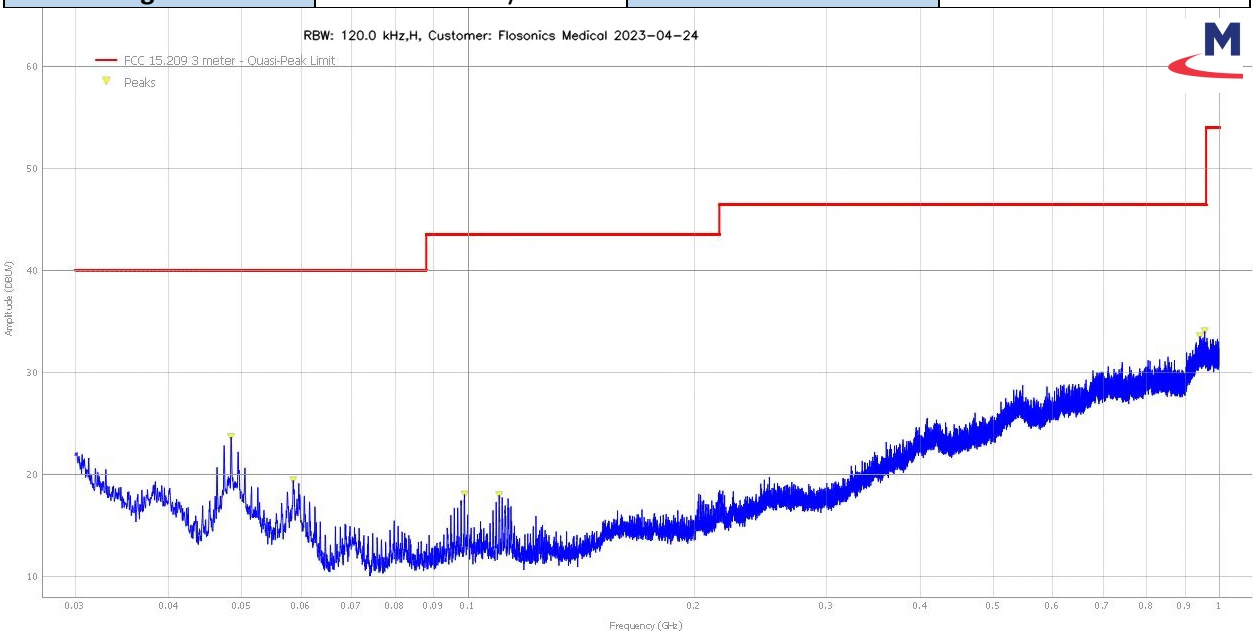


Remark: Peak Emission Plot

Range:	150kHz to 30MHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	N/A

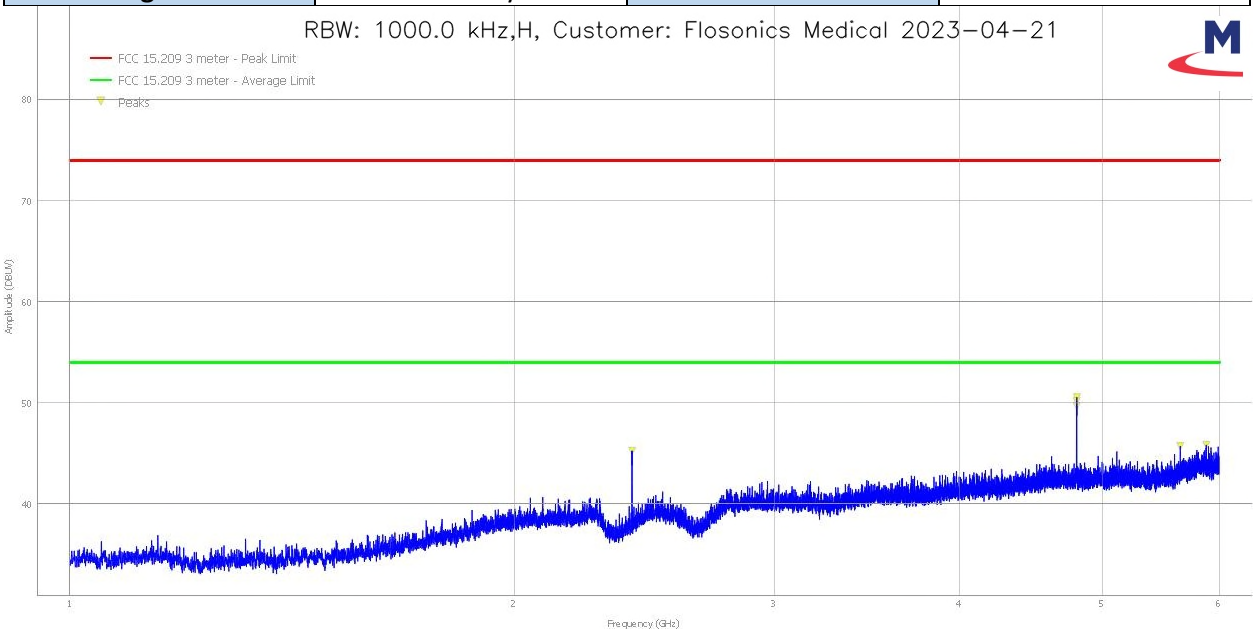
Remark: Peak Emission Plot

Range:	30MHz to 1GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Horizontal



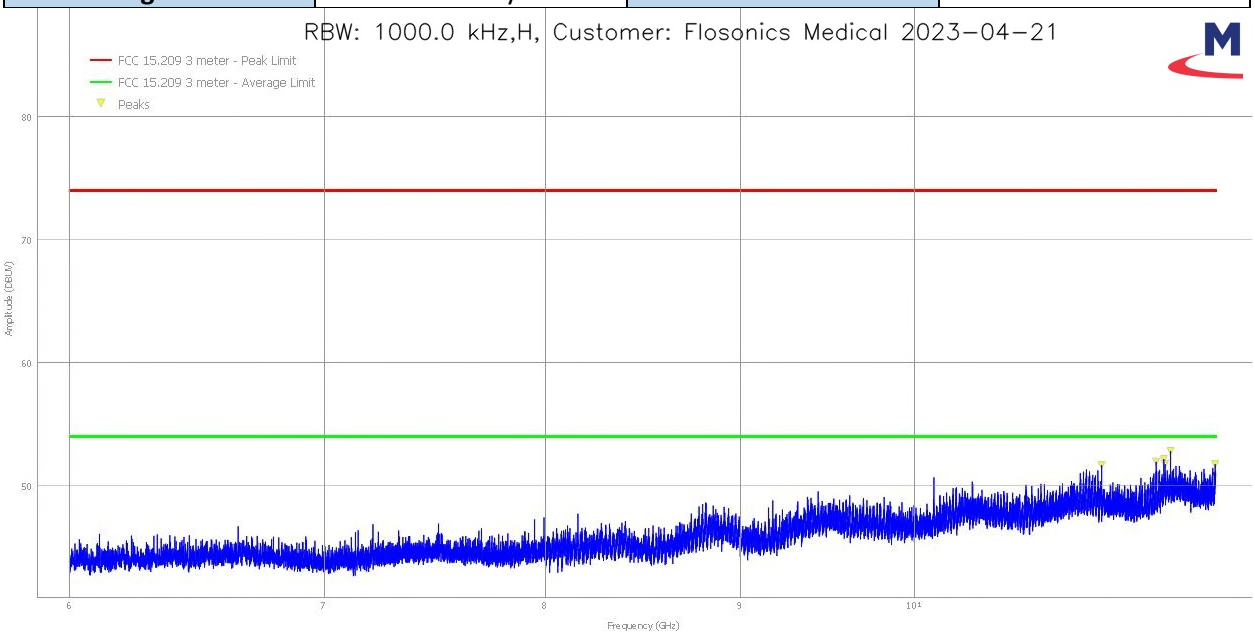
Remark: - Peak Emission Plot

Range:	1GHz to 6GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Horizontal



Remark: - Peak Emission Plot
- A Notch filter was used to filter out the fundamental

Range:	6GHz to 12GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Horizontal

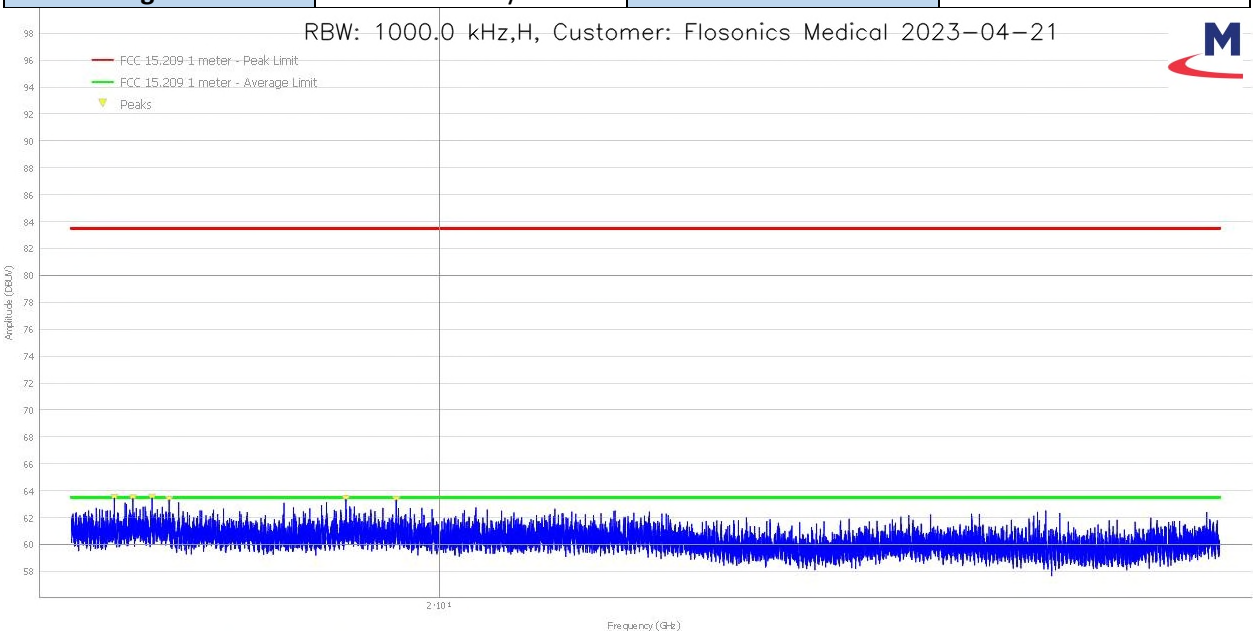


Remark: Peak Emission Plot

Range:	12GHz to 18GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Horizontal

Remark: Peak Emission Plot

Range:	18GHz to 25GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Horizontal



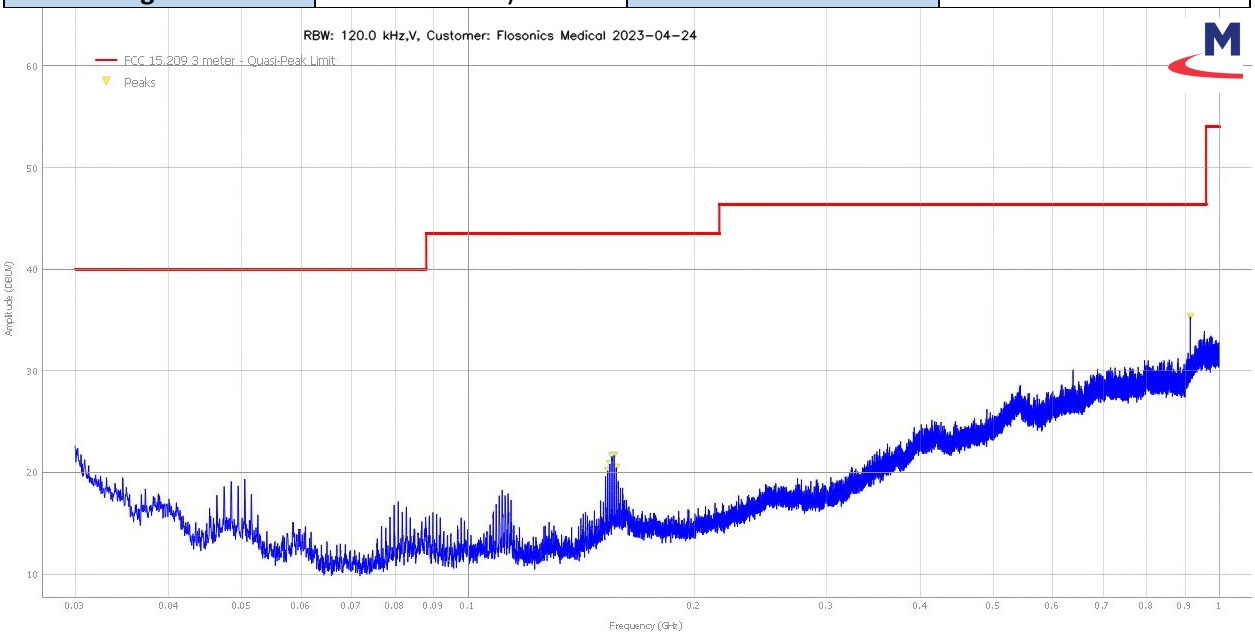
Remark: Peak Emission Plot

Horizontal Antenna Polarization							
Frequency (MHz)	**Detector**	**Reading (dBµV)**	**Correction Factor (dB)**	**Emission Level (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Test Result**
955.80	PEAK	29.2	4.8	34.0	46.4	12.4	Pass
941.97	PEAK	28.5	5.0	33.5	46.4	12.9	Pass
48.39	PEAK	37.4	-13.8	23.6	40.0	16.4	Pass
58.53	PEAK	35.0	-15.6	19.4	40.0	20.6	Pass
98.94	PEAK	32.5	-14.5	18.0	43.5	25.5	Pass
11677.00	AVG	31.0	7.4	38.4	54.0	15.6	Pass
18419.50	AVG	36.6	13.3	49.9	63.5	13.6	Pass
18221.75	AVG	35.8	13.5	49.3	63.5	14.2	Pass
18318.50	AVG	36.4	13.4	49.8	63.5	13.7	Pass
19470.25	AVG	37.4	12.3	49.7	63.5	13.8	Pass
18509.75	AVG	36.6	13.3	49.9	63.5	13.7	Pass
19752.75	AVG	37.7	12.0	49.7	63.5	13.8	Pass

Worst case position: Angle: 0 Deg
Height: 155 cm

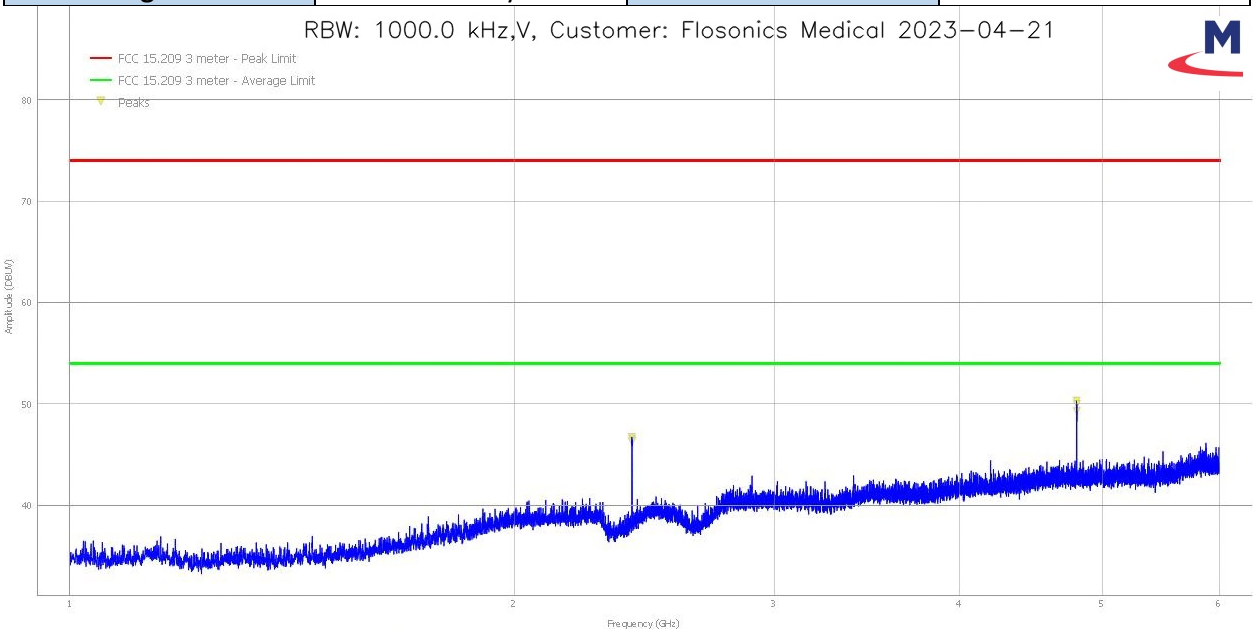
See the Lower and Upper Band Edges Section below for the harmonic measurements.

Range:	30MHz to 1GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Vertical



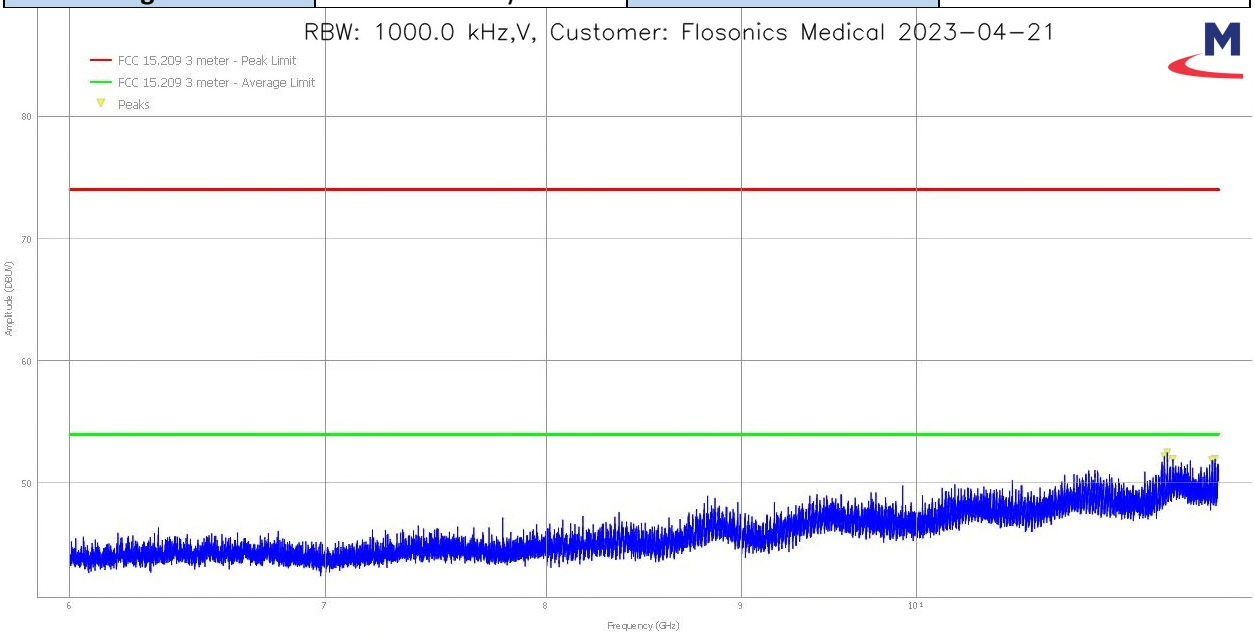
Remark: - Peak Emission Plot

Range:	1GHz to 6GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Vertical



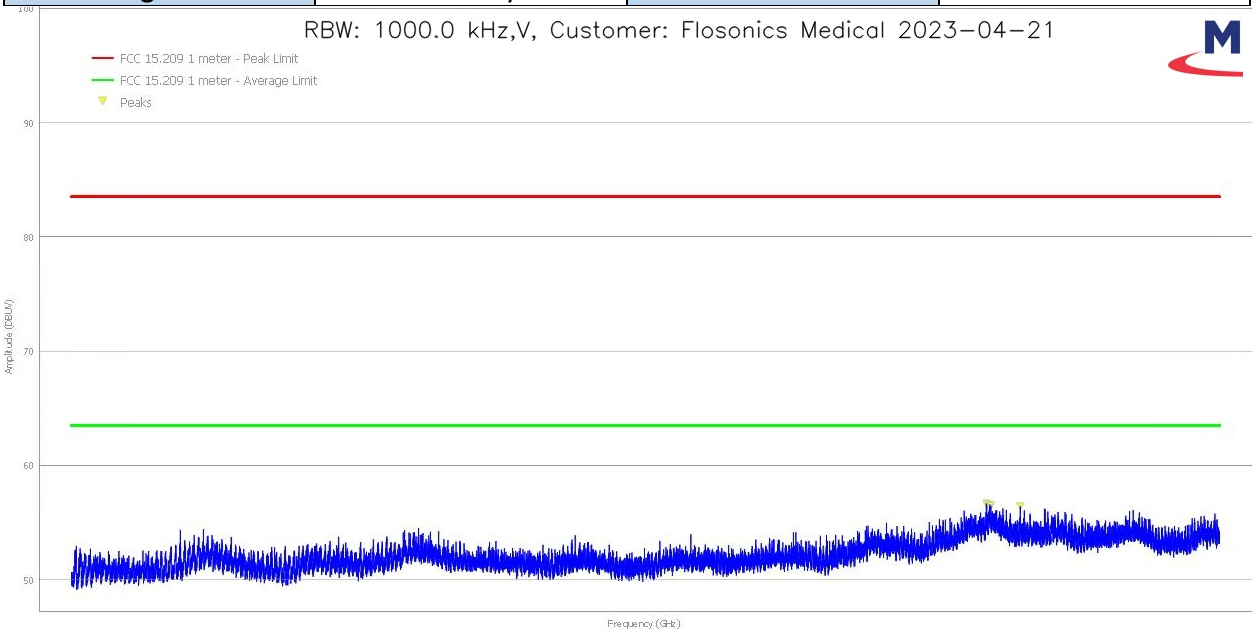
Remark: - Peak Emission Plot
- A Notch filter was used to filter out the fundamental

Range:	6GHz to 12GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Vertical



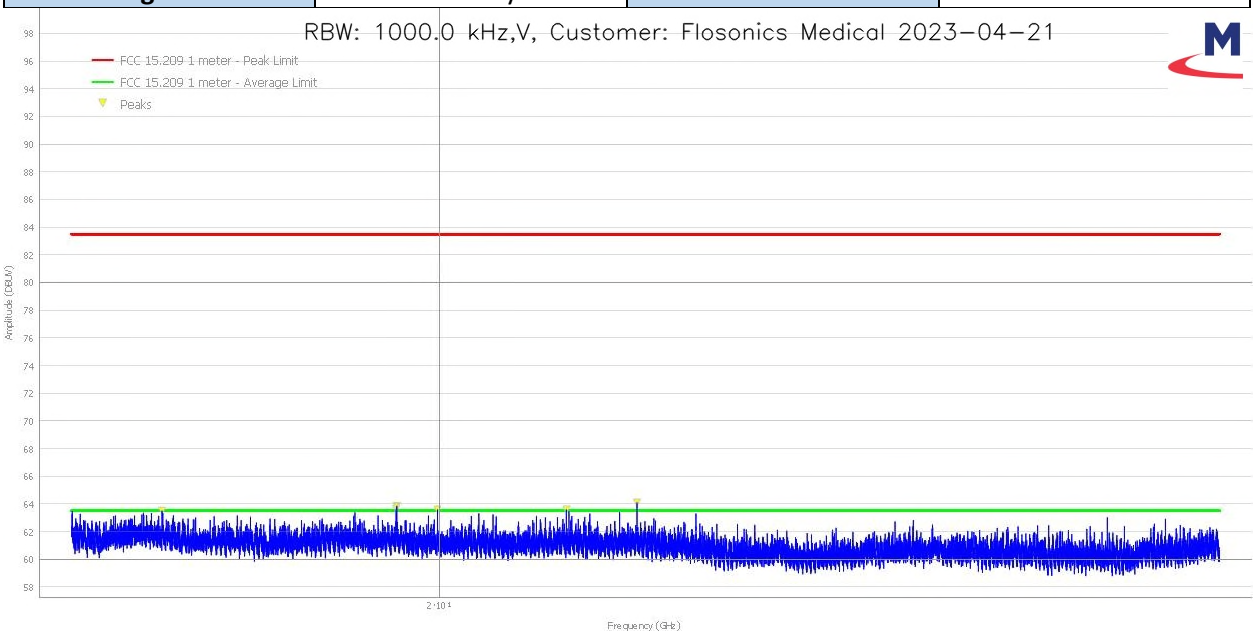
Remark: Peak Emission Plot

Range:	12GHz to 18GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Vertical



Remark: Peak Emission Plot

Range:	18GHz to 25GHz	**Tx Frequency**	Low Channel
Test Voltage:	Internal Battery	**Antenna Polarization**	Vertical



Remark: Peak Emission Plot

Vertical Antenna Polarization							
Frequency (MHz)	**Detector**	**Reading (dBµV)**	**Correction Factor (dB)**	**Emission Level (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Test Result**
914.70	PEAK	31.7	3.6	35.3	46.4	11.1	Pass
156.48	PEAK	34.0	-12.3	21.7	43.5	21.8	Pass
11636.25	PEAK	30.6	7.4	38.0	54.0	16.0	Pass
11977.25	PEAK	29.2	8.5	37.7	54.0	16.3	Pass
21162.00	AVG	38.4	11.0	49.5	63.5	14.0	Pass
19756.00	AVG	37.8	12.0	49.8	63.5	13.7	Pass
19752.75	AVG	37.6	12.0	49.6	63.5	13.9	Pass
20738.50	AVG	38.2	11.3	49.5	63.5	14.0	Pass
19987.50	AVG	37.4	11.8	49.2	63.5	14.3	Pass
18472.00	AVG	36.7	13.3	50.0	63.5	13.5	Pass

Worst case position: Angle: 0 Deg
Height: 155 cm

See the Lower and Upper Band Edges Section below for the harmonic measurements.

4.4.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_48	Loop Antenna	Com-Power	AL-130R	May 4, 2022	May 4, 2024
EQ_EMC_59	BiLog Antenna	ETS Lindgren	3142E	Feb 27, 2022	Feb 27, 2024
EQ_EMC_60	Horn Antenna	ETS Lindgren	3117	Mar 11, 2022	Mar 11, 2024
EQ_EMC_68	6dB Attenuator	Fairview Microwave	SA3NS-06	NCR	NCR
EQ_EMC_85	RF Cable <1GHz	Times Microwave	LMR-400	NCR	NCR
EQ_EMC_75	RF Cable >1GHz	MegaPhase	EMC2	NCR	NCR
EQ_EMC_89	Preamplifier 9kHz-1GHz	Teseq	LNA 6901	May 12, 2022	May 12, 2024
EQ_EMC_42	Preamplifier 1GHz-18GHz	Com-Power	PAM-118A	Mar 24, 2022	Mar 24, 2024
EQ_EMC_43	Preamplifier 18GHz-40GHz	Com-Power	PAM-840A	Mar 24, 2022	Mar 24, 2024
EQ_EMC_108	2400 - 2500MHz Notch Filter	Micro-Tronics	BRM50702	NCR	NCR
EQ_EMC_96	Emissions Software	Megalab Group	EMI V1.0	NCR	NCR

4.5 Lower and Upper Band Edges

Test Date:	April 20, 2023	Initials:	AE
Temperature (°C)	19.7		
Relative Humidity (%)	26.8		
Barometric Pressure (kPa)	98.5		

4.5.1 Limits

Any radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the general radiated emission limits specified in FCC 15.209(a).

4.5.2 Test Procedure

Tested according to ANSI C63.10 Section 11.12

The device under test was setup inside a semi-anechoic chamber with remotely controlled turntable and antenna positioner at a 3m test distance. The DUT was placed on top of a 0.8m high non-conductive table above the reference ground plane for frequencies below 1GHz and 1.5m high for frequencies above 1GHz.

For both the lower and upper radiated band edges, the radiated emission was first maximized on the center frequency of the low and high channels with the turntable azimuth rotated 0° to 360° and antenna height varied from 1m to 4m. Once maximized, the start and stop frequency were adjusted to capture that channel's lower and upper band edges inside the restricted bands.

The antenna was positioned to receive emissions in the vertical and horizontal polarizations such that the maximum radiated emission levels were detected.

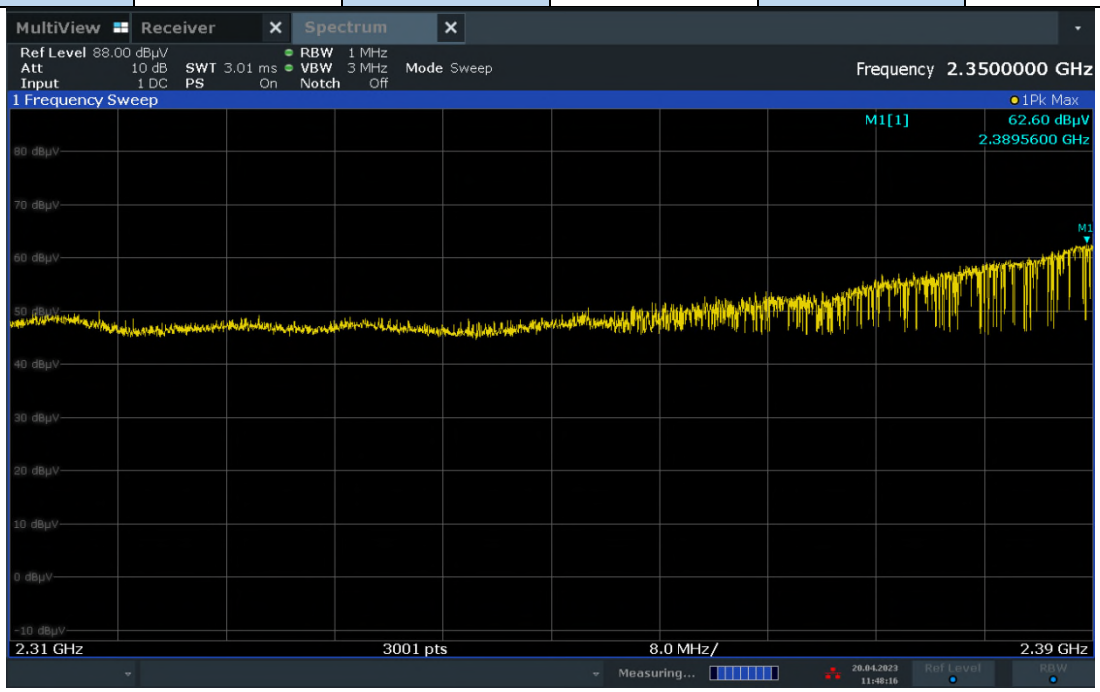
The radiated band edge measurements were made with the DUT in each of the three orthogonal axes.

4.5.3 Test Results

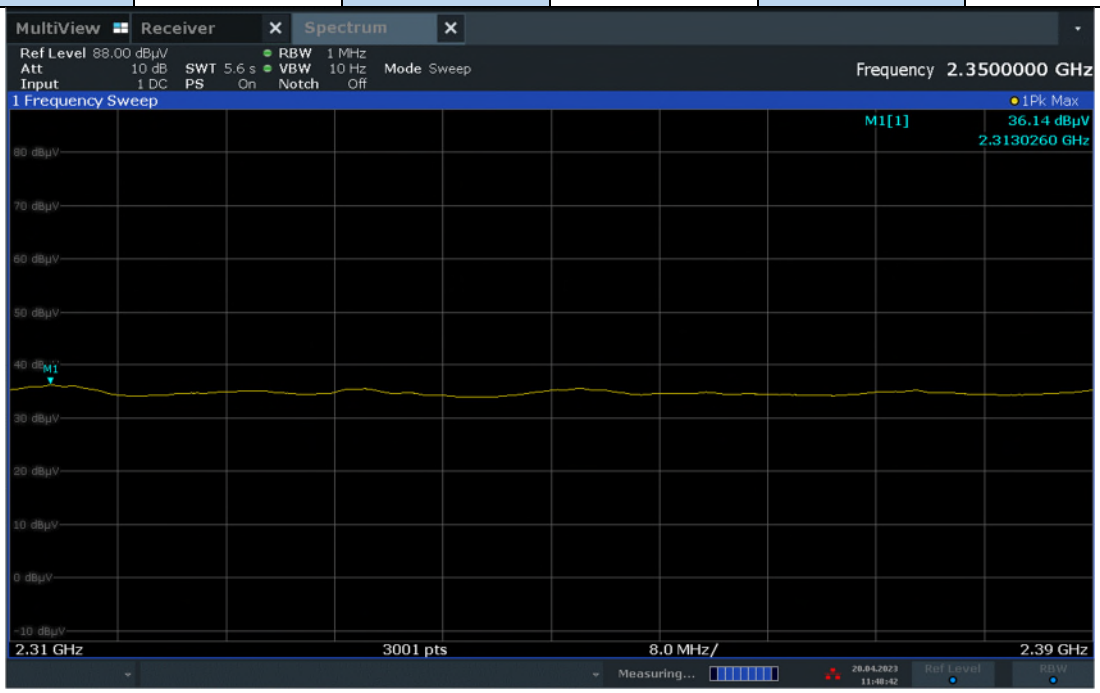
The DUT met the band edge requirements. Peak output power for low, mid and high channels, each in three orthogonal axes, were measured and the Plots Section below contains the maximum radiated emission levels captured on the spectrum analyzer at the band edges for the worst-case position which was in the Y-axis. The Final Measurements Section contains the final results with the correction factors added in.

4.5.3.1. Plots

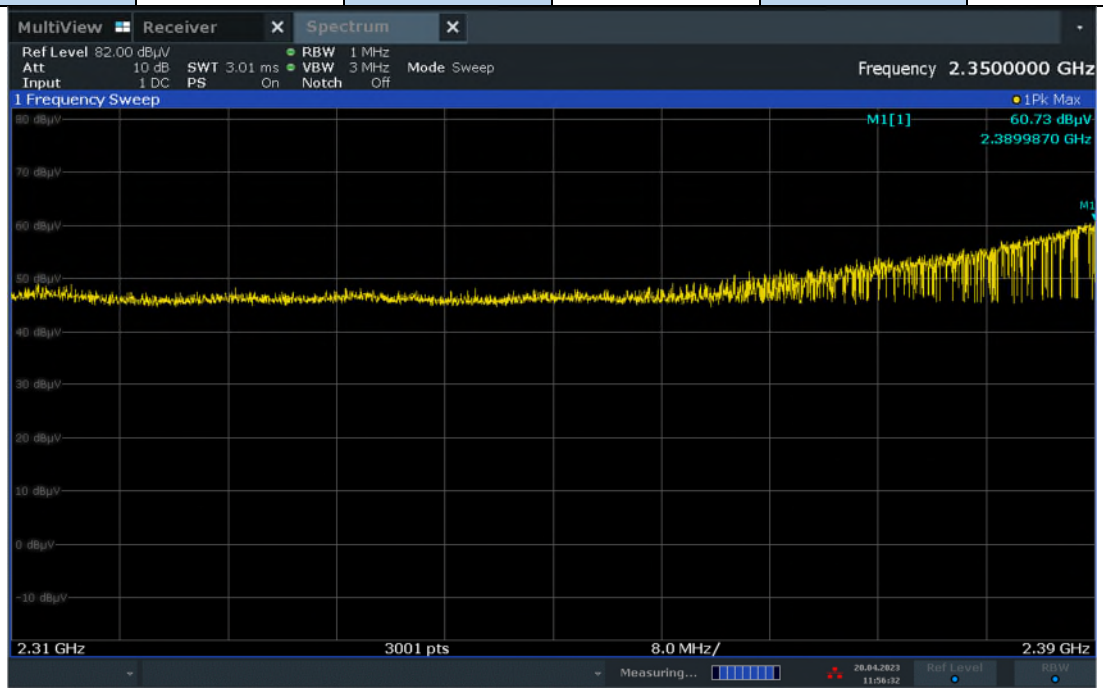
Tx Frequency	Low Channel	**Antenna Polarization**	Horizontal	**Emission**	Peak



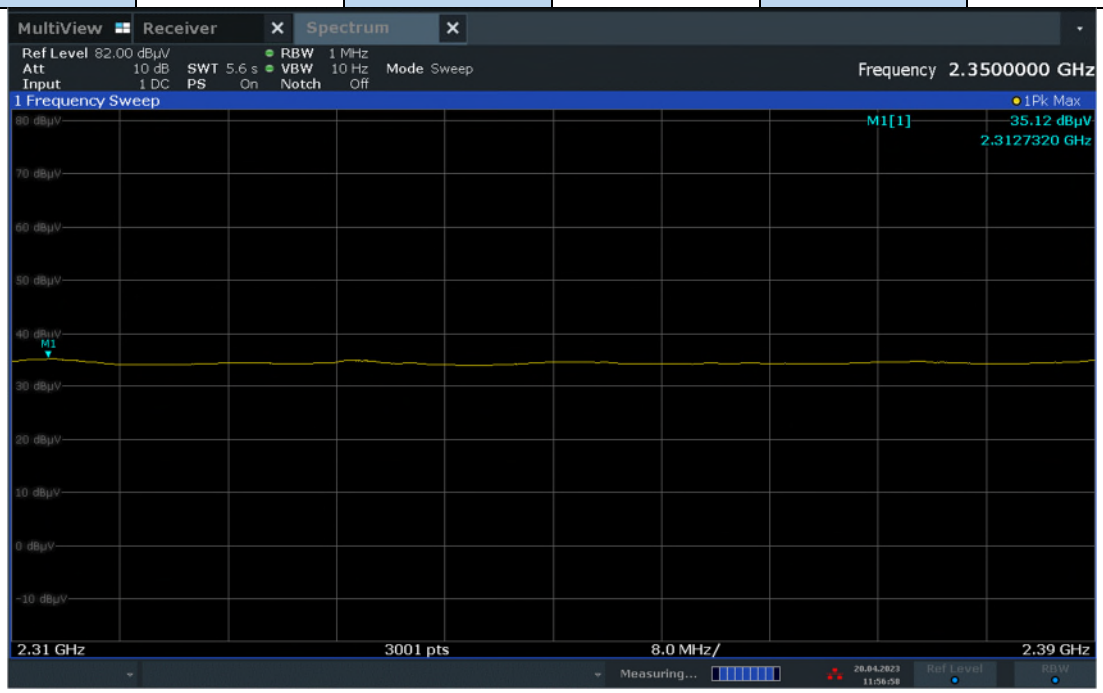
Tx Frequency	Low Channel	**Antenna Polarization**	Horizontal	**Emission**	Average



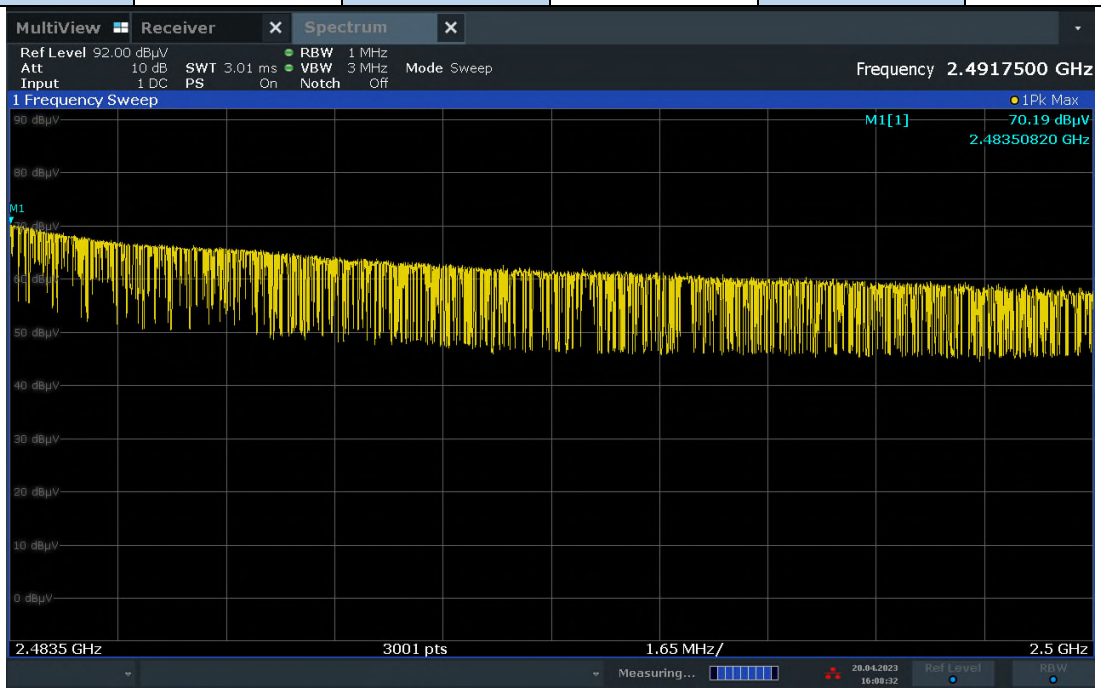
Tx Frequency	Low Channel	**Antenna Polarization**	Vertical	**Emission**	Peak



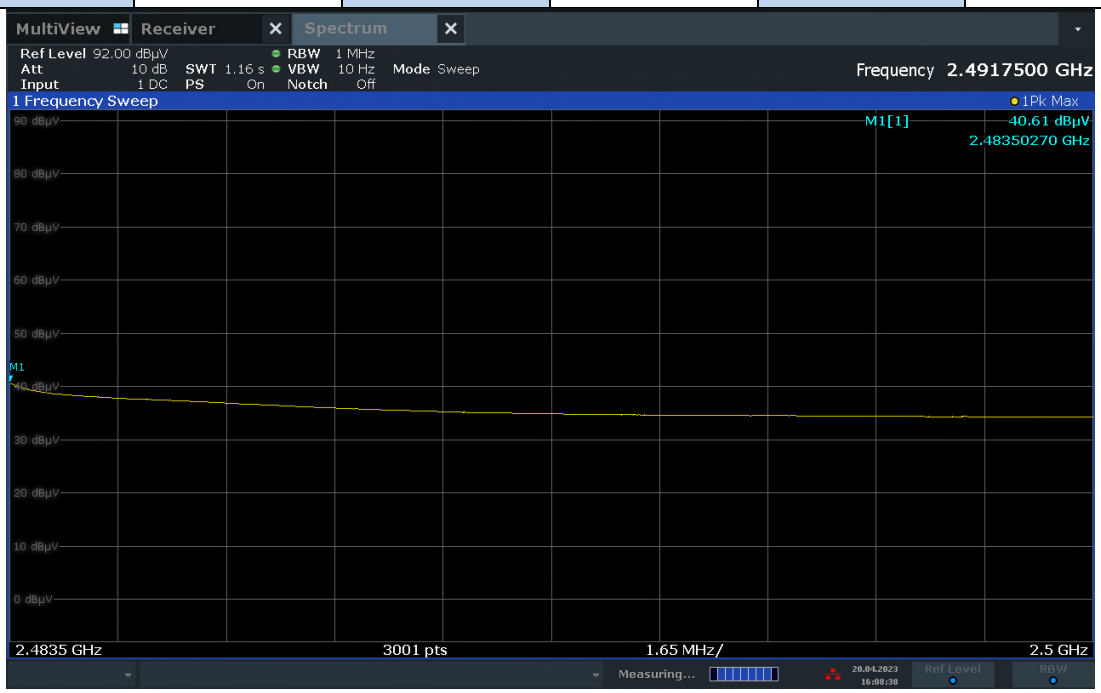
Tx Frequency	Low Channel	**Antenna Polarization**	Vertical	**Emission**	Average



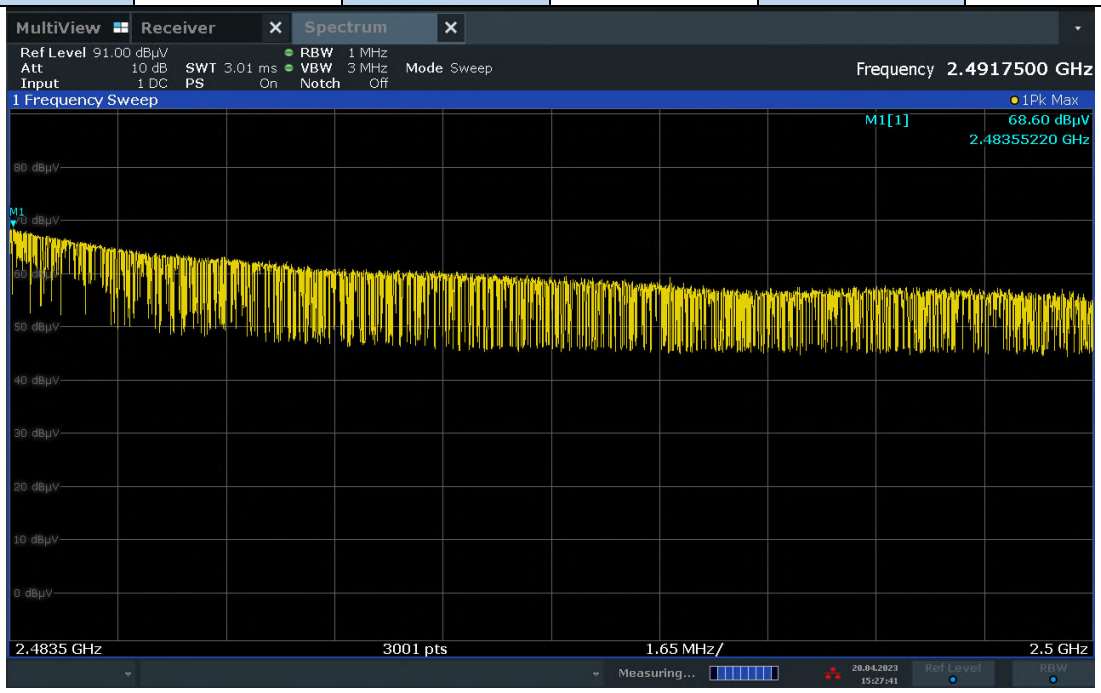
Tx Frequency	High Channel	**Antenna Polarization**	Horizontal	**Emission**	Peak



Tx Frequency	High Channel	**Antenna Polarization**	Horizontal	**Emission**	Average



Tx Frequency	High Channel	**Antenna Polarization**	Vertical	**Emission**	Peak



Tx Frequency	High Channel	**Antenna Polarization**	Vertical	**Emission**	Average

4.5.3.2. Final Measurements

Low Channel

Frequency (MHz)	Detector	Antenna Polarity	Reading (dBµV)	Correction Factor (dB)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Z-Axis								
2402.0	PEAK	Horz	104.2	-5.6	98.6	--	--	--
2402.0	AVG	Horz	77.0	-5.6	71.4	--	--	--
2402.0	PEAK	Vert	98.8	-5.6	93.3	--	--	--
2402.0	AVG	Vert	72.4	-5.6	66.8	--	--	--
2389.8	PEAK	Horz	63.9	-5.6	58.3	74.0	15.7	Pass
2313.1	AVG	Horz	36.0	-5.7	30.3	54.0	23.7	Pass
2389.5	PEAK	Vert	58.1	-5.6	52.5	74.0	21.5	Pass
2312.9	AVG	Vert	34.6	-5.7	29.0	54.0	25.0	Pass
2491.6	PEAK	Horz	50.2	-5.4	44.8	74.0	29.2	Pass
2490.9	AVG	Horz	36.5	-5.4	31.1	54.0	22.9	Pass
2492.6	PEAK	Vert	49.0	-5.4	43.6	74.0	30.4	Pass
2490.8	AVG	Vert	35.4	-5.4	30.0	54.0	24.0	Pass
X-Axis								
2402.0	PEAK	Horz	100.0	-5.6	94.4	--	--	--
2402.0	AVG	Horz	73.2	-5.6	67.6	--	--	--
2402.0	PEAK	Vert	102.8	-5.6	97.2	--	--	--
2402.0	AVG	Vert	75.7	-5.6	70.1	--	--	--
2389.5	PEAK	Horz	59.6	-5.6	54.0	74.0	20.0	Pass
2313.1	AVG	Horz	34.8	-5.7	29.2	54.0	24.8	Pass
2388.7	PEAK	Vert	60.1	-5.6	54.5	74.0	19.5	Pass
2312.9	AVG	Vert	35.5	-5.7	29.8	54.0	24.2	Pass
2489.2	PEAK	Horz	49.7	-5.4	44.3	74.0	29.7	Pass
2490.8	AVG	Horz	35.5	-5.4	30.1	54.0	23.9	Pass
2493.5	PEAK	Vert	50.3	-5.4	44.8	74.0	29.2	Pass
2490.9	AVG	Vert	36.0	-5.4	30.6	54.0	23.4	Pass
Y-Axis								
2402.0	PEAK	Horz	104.2	-5.6	98.6	--	--	--
2402.0	AVG	Horz	76.9	-5.6	71.3	--	--	--
2402.0	PEAK	Vert	101.7	-5.6	96.1	--	--	--
2402.0	AVG	Vert	74.9	-5.6	69.4	--	--	--
2389.6	PEAK	Horz	62.6	-5.6	57.0	74.0	17.0	Pass
2313.0	AVG	Horz	36.1	-5.7	30.5	54.0	23.5	Pass
2390.0	PEAK	Vert	60.7	-5.6	55.1	74.0	18.9	Pass
2312.7	AVG	Vert	35.1	-5.7	29.5	54.0	24.5	Pass
2492.9	PEAK	Horz	50.7	-5.4	45.3	74.0	28.7	Pass

Frequency (MHz)	Detector	Antenna Polarity	Reading (dBµV)	Correction Factor (dB)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
2490.9	AVG	Horz	36.9	-5.4	31.4	54.0	22.6	Pass
2491.9	PEAK	Vert	50.0	-5.4	44.6	74.0	29.4	Pass
2490.9	AVG	Vert	36.0	-5.4	30.5	54.0	23.5	Pass
4804.0	PEAK	Horz	54.3	-1.6	52.7	74.0	21.3	Pass
4804.0	AVG	Horz	40.0	-1.6	38.4	54.0	15.6	Pass
4804.0	PEAK	Vert	53.6	-1.6	52.0	74.0	22.0	Pass
4804.0	AVG	Vert	38.8	-1.6	37.2	54.0	16.8	Pass
7206.0	PEAK	Horz	47.5	1.5	49.0	74.0	25.0	Pass
7206.0	AVG	Horz	33.2	1.5	34.7	54.0	19.3	Pass
7206.0	PEAK	Vert	46.9	1.5	48.4	74.0	25.6	Pass
7206.0	AVG	Vert	33.1	1.5	34.6	54.0	19.4	Pass
9608.0	PEAK	Horz	46.1	4.0	50.1	74.0	23.9	Pass
9608.0	AVG	Horz	31.6	4.0	35.6	54.0	18.4	Pass
9608.0	PEAK	Vert	46.0	4.0	50.0	74.0	24.0	Pass
9608.0	AVG	Vert	31.6	4.0	35.6	54.0	18.4	Pass
12010.0	PEAK	Horz	43.1	8.7	51.8	74.0	22.2	Pass
12010.0	AVG	Horz	29.0	8.7	37.6	54.0	16.4	Pass
12010.0	PEAK	Vert	42.5	8.7	51.2	74.0	22.8	Pass
12010.0	AVG	Vert	29.0	8.7	37.7	54.0	16.3	Pass

High Channel

Frequency (MHz)	Detector	Antenna Polarity	Reading (dBµV)	Correction Factor (dB)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Z-Axis								
2480.0	PEAK	Horz	102.8	-5.4	97.4	--	--	--
2480.0	AVG	Horz	76.4	-5.4	71.0	--	--	--
2480.0	PEAK	Vert	97.7	-5.4	92.3	--	--	--
2480.0	AVG	Vert	72.0	-5.4	66.6	--	--	--
2351.4	PEAK	Horz	52.9	-5.6	47.3	74.0	26.7	Pass
2352.0	AVG	Horz	38.3	-5.6	32.8	54.0	21.2	Pass
2364.6	PEAK	Vert	49.6	-5.6	44.0	74.0	30.0	Pass
2352.0	AVG	Vert	36.3	-5.6	30.7	54.0	23.3	Pass
2483.5	PEAK	Horz	70.9	-5.4	65.5	74.0	8.5	Pass
2483.5	AVG	Horz	41.1	-5.4	35.7	54.0	18.3	Pass
2483.5	PEAK	Vert	66.3	-5.4	60.8	74.0	13.2	Pass
2483.5	AVG	Vert	38.5	-5.4	33.1	54.0	20.9	Pass

Frequency (MHz)	Detector	Antenna Polarity	Reading (dBµV)	Correction Factor (dB)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
X-Axis								
2480.0	PEAK	Horz	98.4	-5.4	93.0	--	--	--
2480.0	AVG	Horz	72.5	-5.4	67.1	--	--	--
2480.0	PEAK	Vert	101.2	-5.4	95.8	--	--	--
2480.0	AVG	Vert	75.1	-5.4	69.6	--	--	--
2347.6	PEAK	Horz	49.1	-5.6	43.5	74.0	30.5	Pass
2352.1	AVG	Horz	35.2	-5.6	29.6	54.0	24.4	Pass
2326.5	PEAK	Vert	52.9	-5.6	47.3	74.0	26.7	Pass
2352.1	AVG	Vert	38.6	-5.6	33.0	54.0	21.0	Pass
2483.6	PEAK	Horz	66.4	-5.4	61.0	74.0	13.0	Pass
2483.5	AVG	Horz	38.8	-5.4	33.3	54.0	20.7	Pass
2483.6	PEAK	Vert	69.7	-5.4	64.3	74.0	9.7	Pass
2483.5	AVG	Vert	40.4	-5.4	35.0	54.0	19.0	Pass
Y-Axis								
2480.0	PEAK	Horz	102.3	-5.4	96.9	--	--	--
2480.0	AVG	Horz	76.0	-5.4	70.6	--	--	--
2480.0	PEAK	Vert	100.2	-5.4	94.8	--	--	--
2480.0	AVG	Vert	74.4	-5.4	68.9	--	--	--
2335.0	PEAK	Horz	53.6	-5.6	48.0	74.0	26.0	Pass
2359.2	AVG	Horz	39.0	-5.6	33.4	54.0	20.6	Pass
2316.0	PEAK	Vert	49.9	-5.6	44.3	74.0	29.7	Pass
2336.9	AVG	Vert	36.4	-5.6	30.8	54.0	23.2	Pass
2483.5	PEAK	Horz	70.2	-5.4	64.8	74.0	9.2	Pass
2483.5	AVG	Horz	40.6	-5.4	35.2	54.0	18.8	Pass
2483.6	PEAK	Vert	68.6	-5.4	63.2	74.0	10.8	Pass
2483.5	AVG	Vert	39.7	-5.4	34.2	54.0	19.8	Pass

4.5.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_60	Horn Antenna	ETS Lindgren	3117	Mar 11, 2022	Mar 11, 2024
EQ_EMC_75	RF Cable >1GHz	MegaPhase	EMC2	NCR	NCR
EQ_EMC_42	Preamplifier 1GHz-18GHz	Com-Power	PAM-118A	Mar 24, 2022	Mar 24, 2024

4.6 Power Spectral Density

Test Date:	June 23, 2023	Initials:	AE
Temperature (°C)	24.3		
Relative Humidity (%)	56.4		
Barometric Pressure (kPa)	97.6		

4.6.1 Limits

For digitally modulated systems, the power spectral density (PSD) conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.6.2 Test Procedure

Tested according to ANSI C63.10 Section 11.10

a) Set RBW = 3kHz and VBW ≥ [3 × RBW].
b) Set Span to 1.5 times the DTS Bandwidth.
c) Detector = Peak and Trace Mode = Max Hold.
d) Sweep = Auto Couple.
e) Use the peak marker function to determine the maximum level.

The RF output of the DUT was connected to the spectrum analyzer with sufficient attenuation in front and the total path loss was set as reference offset to correct the final reading.

4.6.3 Test Results

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Test Result
Low	2402	-13.49	8	Pass
Mid	2442	-13.48	8	Pass
High	2480	-13.43	8	Pass

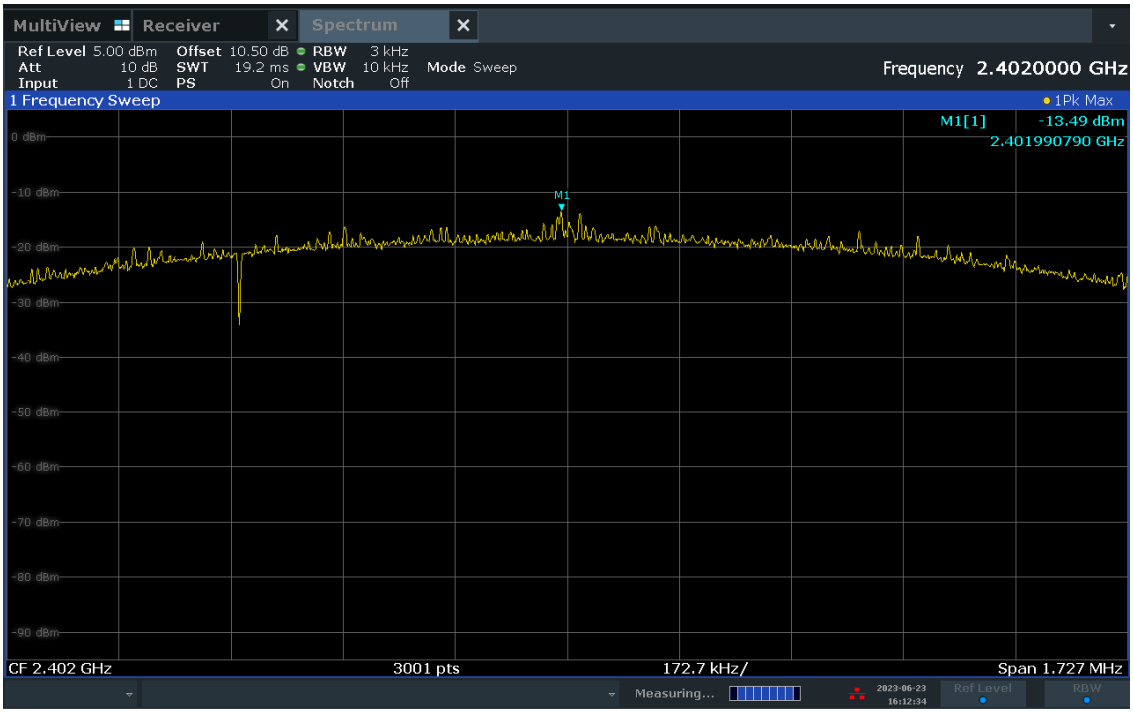


Figure 18 – PSD - Low Channel

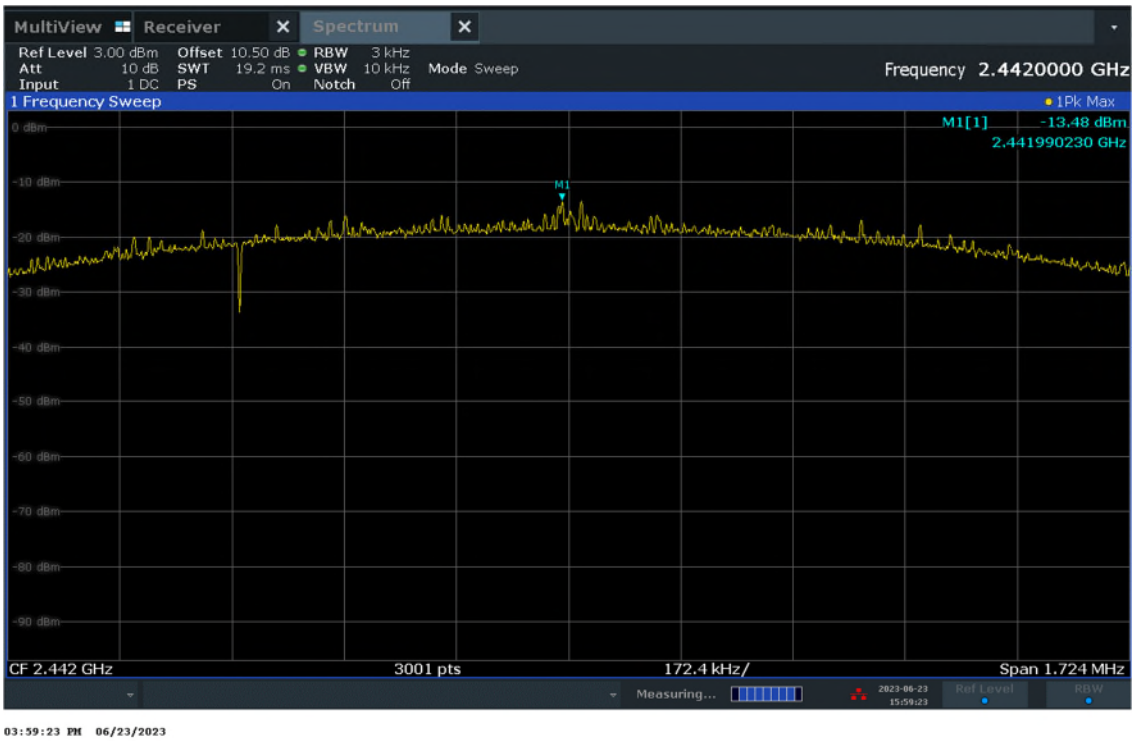


Figure 19 – PSD - Mid Channel

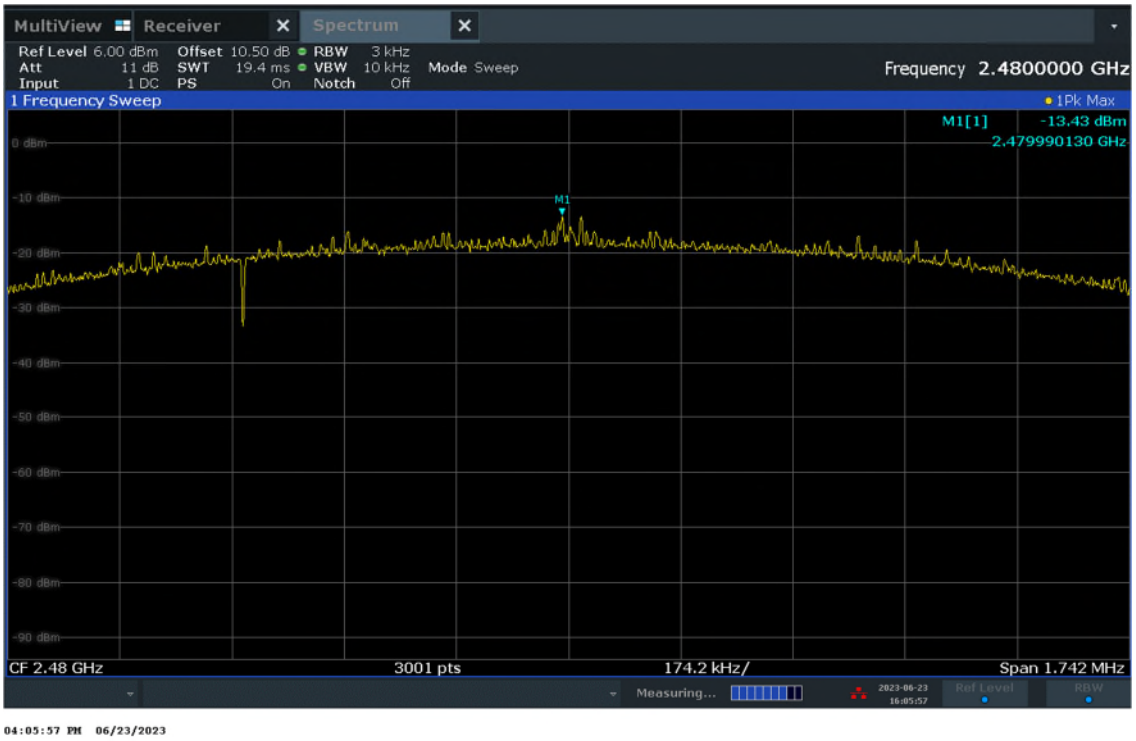


Figure 20 – PSD - High Channel

4.6.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_115	10dB Attenuator	Fairview Microwave	SA18E-10	NCR	NCR

---------- End of Test Report ----------