FCC / ISED Test Report

For:
EM Microelectronic

Model:
EMBC3

Marketing Name:
EMBC3

Product Description:
EM Beacon – Coin – Gen 3

FCC ID: 2ACQR-EMBC3
IC: 12155A-EMBC3

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 3 (DTS) & RSS-Gen Issue 5

REPORT #: EMC_EMMIC_003_24001_FCC_15_247

DATE: 2025-02-27

A2LA Accredited

IC recognized # 3462B

***CETECOM* Inc.**
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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company Name	Product Description	Model
EM Microelectronic	EM Beacon – Coin – Gen 3	EMBC3

Responsible for Testing Laboratory:

Date	Section	Name	
2025-02-27	Compliance	Alvin Ilarina (Senior Manager Regulatory Services)	Alvin ILARINA Digitally signed by Alvin ILARINA Date: 2025.07.10 11:37:13 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2025-02-27	Compliance	Cheng Song (EMC Engineer)	Cheng Song CN = Cheng Song email = cheng.song@cetecom.com C = AD 2025.02.27 17:50:54 -08'00'

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
Senior Manager Regulatory Services:	Alvin Ilarina
Responsible Project Leader:	Shane Hao

2.2 Identification of the Client

Applicant's Name:	EM Microelectronic
Street Address:	Rue des Sors 3
City/Zip Code	Marin-Epagnier - 2074
Country	Switzerland

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Product Description:	EM Beacon – Coin – Gen 3
Model:	EMBC3
Marketing Name:	EMBC3
HW Version:	1.0
SW Version:	1.0
FCC-ID:	2ACQR-EMBC3
IC:	12155A-EMBC3
Radio Information as declared:	**Bluetooth Low Energy:** Nominal band: 2400 MHz – 2483.5 MHz; Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 channels
Antenna Information as declared:	max gain 1.5 dBi
Power Supply/ Rated Operating Voltage Range	3VDC
Operating Temperature Range	Low : 0 °C Norm 25 °C High 60 °C
Sample Revision	☒Production ☐ Pre-Production
EUT Dimensions	26mm x 26mm x 2.7mm
Weight	7 grams
EUT Diameter	☒< 60 cm ☐ Other _____
Note: The EUT specifications listed in the table above were provided by the client.	

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	00034	1.0	1.0	Radiated Emissions
2	00029	1.0	1.0	Conducted RF

3.3 Accessory Equipment (AE) details

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

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#2	The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#1	The internal antenna of the EUT was connected.

3.5 Mode of Operation details

Operating Mode	Description of Operating modes	Additional Information
Op. 1	BLE 2 Mbps PHY	The Bluetooth Low Energy radio of the EUT was configured for fixed-channel transmission at the maximum possible duty cycle using software inaccessible to the end user.

3.6 Justification for Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and highest possible duty cycle. 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 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1) RSS-247 5.2(a)	Emission Bandwidth	Nominal	Op. 1	■	☐	☐	Complies
§15.247(e) RSS-247 5.2(b)	Power Spectral Density	Nominal	Op. 1	■	☐	☐	Complies
§15.247(b)(1) RSS-247 5.4(d)	Maximum Conducted Output Power and EIRP	Nominal	Op. 1	■	☐	☐	Complies
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	Op. 1	■	☐	☐	Complies
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	Op. 1	■	☐	☐	Complies
§15.247(d); §15.209 RSS-Gen 6.13	TX Radiated Spurious Emissions	Nominal	Op. 1	■	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	-	☐	■	☐	Note 1 Note 2

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: The EUT does not draw power from AC public mains; therefore, this test case is not applicable.

6 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.

Radiated measurement

Measurement System		EMC 1	EMC 2
Conducted emissions (mains port)	150 kHz – 30 MHz	2.47 dB	N/A
Radiated emissions	9 kHz – 30 MHz	2.68 dB	2.53 dB
	30 – 100 MHz	4.39 dB	3.85 dB
	100 MHz – 1 GHz	5.65 dB	5.24 dB
	1 – 6 GHz	5.0 dB	4.88 dB
	6 – 18 GHz	4.76 dB	4.58 dB
	18 – 40 GHz	4.65 dB	4.61 dB

RF conducted measurement ±0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: http://physics.nist.gov/cuu/Uncertainty/typeb.html. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3dB to the limit.

6.1 Environmental Conditions During Testing:

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

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

6.2 Dates of Testing:

2024-11-13 – 2024-11-26

6.3 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.

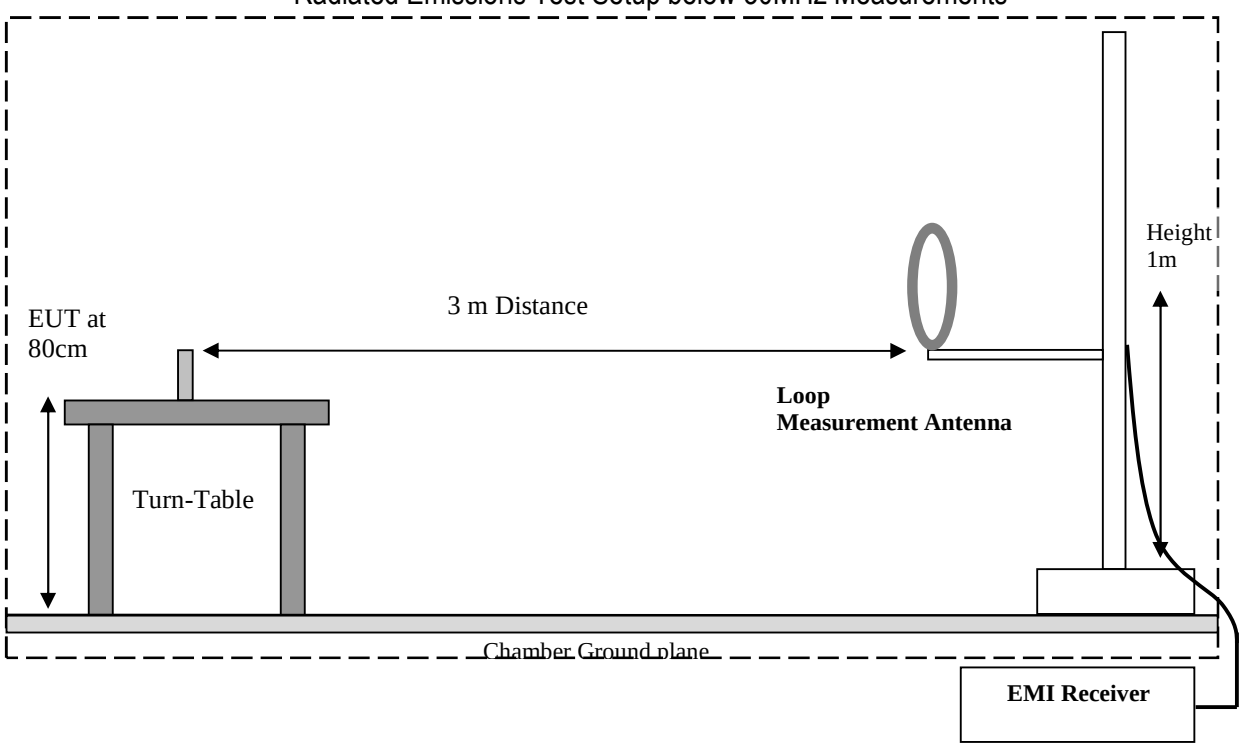
7 Measurement Procedures

7.1 Radiated Measurement

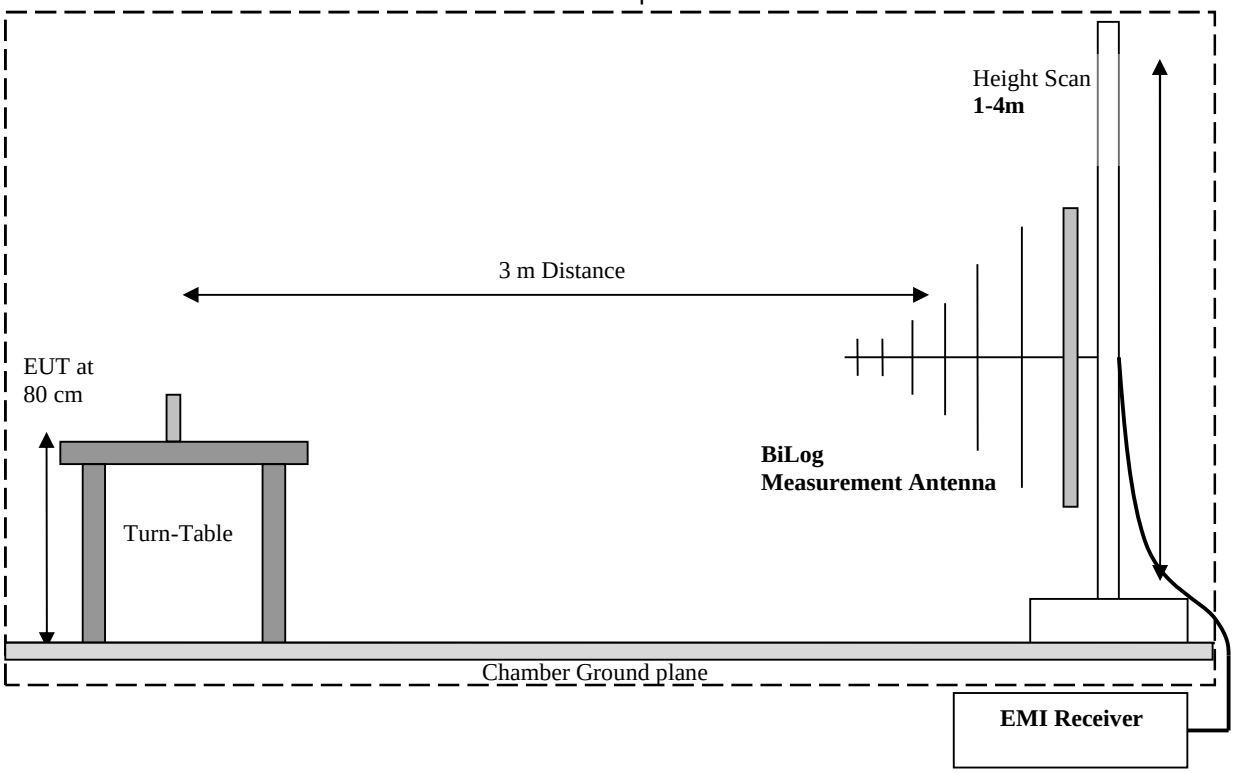
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

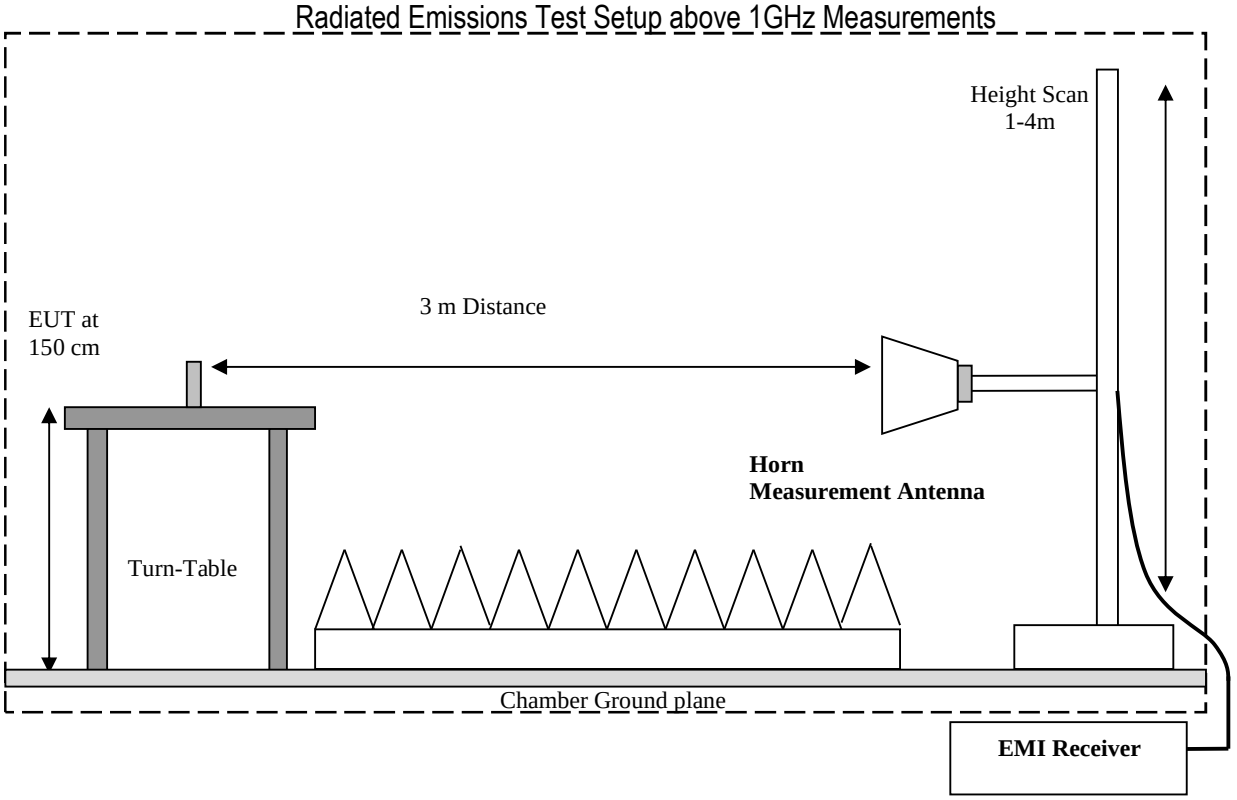
Radiated Emissions Test Setup below 30MHz Measurements



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:

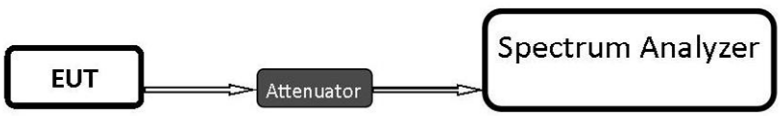
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

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

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES" - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Maximum Peak Conducted Output Power

8.1.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.11.9

Spectrum Analyzer settings:

- RBW ≥ DTS bandwidth
- VBW ≥ 3 x RBW
- Span ≥ 3 x RBW
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

Maximum Peak Output Power:

- FCC §15.247 (b)(1): 1 W
- IC RSS-247: 1 W

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
22° C	2	Op. 1	Battery	1.5 dBi

8.1.4 Measurement result:

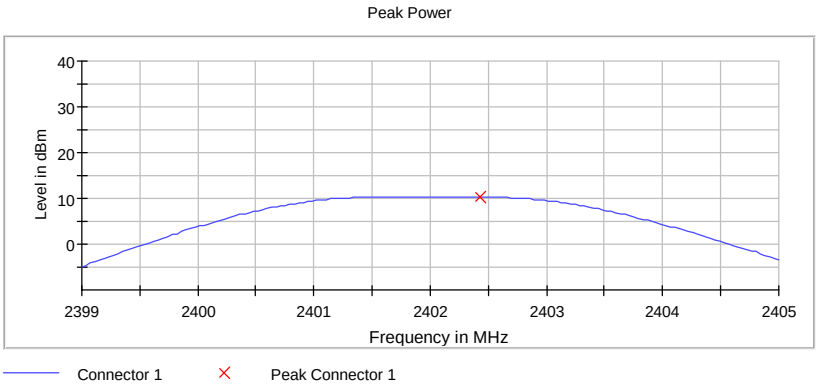
Test #	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
1	2402	10.3	11.8	30 (Pk) / 36 (EIRP)	Pass
2	2440	10	11.5	30 (Pk) / 36 (EIRP)	Pass
3	2480	10.1	11.6	30 (Pk) / 36 (EIRP)	Pass

8.1.5 Measurement Plots:

Peak output power (Sweep) (2402 MHz; 10.000 dBm; 2 MHz)

Result

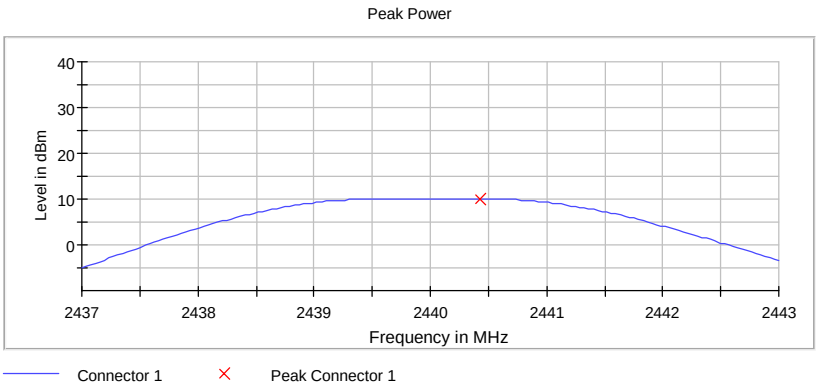
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	10.3	30.0	PASS



Peak output power (Sweep) (2440 MHz; 10.000 dBm; 2 MHz)

Result

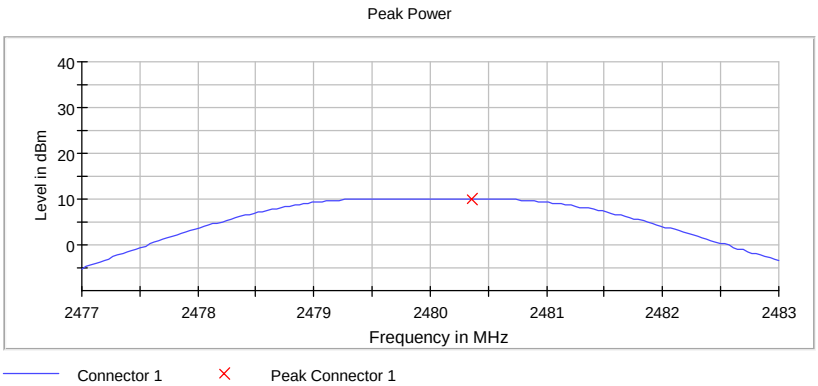
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	10.0	30.0	PASS



Peak output power (Sweep) (2480 MHz; 10.000 dBm; 2 MHz)

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	10.1	30.0	PASS



8.2 Power Spectral Density

8.2.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz
- Set the VBW ≥ 3 x RBW
- Detector = Peak
- Sweep time = Auto couple
- Trace mode = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level within the RBW
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(b)

- For digitally modulated systems, the peak power spectral density 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.

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
22° C	2	Op. 1	Battery	1.5 dBi

8.2.4 Measurement result:

Test #	Frequency (MHz)	Maximum Power Spectral Density (dBm/3 kHz)	Limit (dBm / 3 kHz)	Result
1	2402	-3.47	8	Pass
2	2440	-3.714	8	Pass
3	2480	-3.564	8	Pass

8.2.5 Measurement Plots:

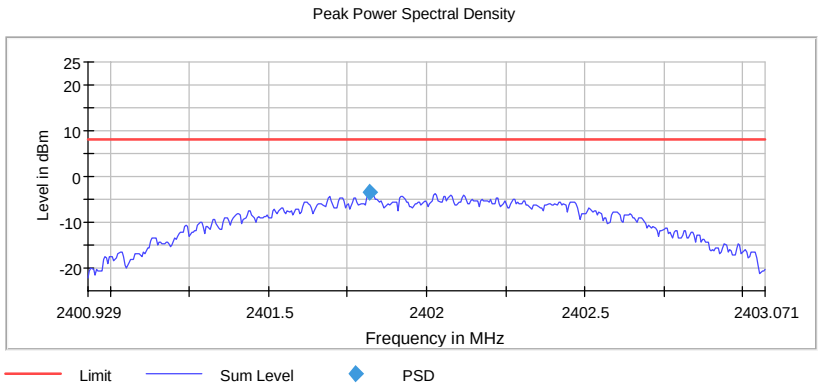
Peak Power Spectral Density (2402 MHz; 10.000 dBm; 2 MHz)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2401.817857	-3.470	8.0	PASS

Ports

Port	State
1	used



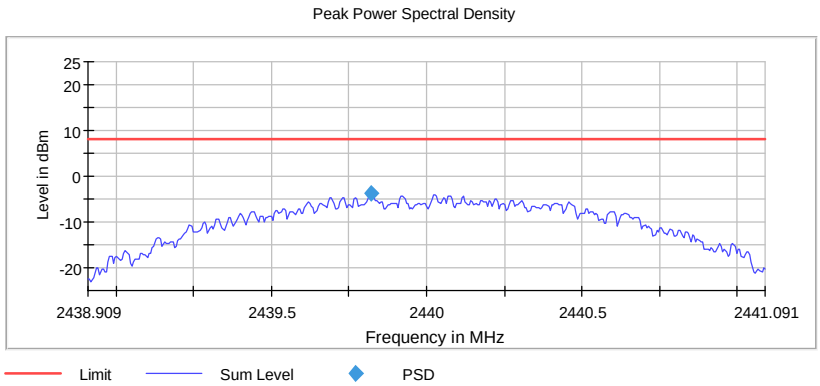
Peak Power Spectral Density (2440 MHz; 10.000 dBm; 2 MHz)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2439.820000	-3.714	8.0	PASS

Ports

Port	State
1	used



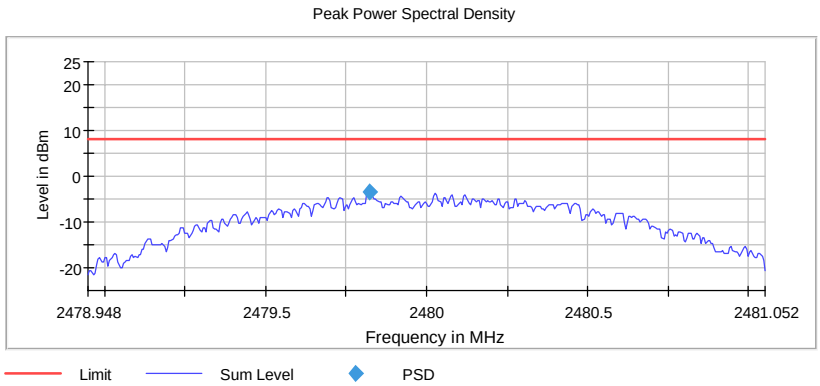
Peak Power Spectral Density (2480 MHz; 10.000 dBm; 2 MHz)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.821169	-3.564	8.0	PASS

Ports

Port	State
1	used



8.3 Band Edge Compliance

8.3.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

8.3.2 Limits non restricted band:

FCC§15.247 (d)

- 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 20 dB below that in the 100 kHz 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

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- 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 20 dB below that in the 100 kHz 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

8.3.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

- *PEAK LIMIT= 74 dBµV/m @3m =-21.23 dBm
- *AVG. LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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			

8.3.4 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
22° C	2	Op. 1	Battery	1.5 dBi

8.3.5 Measurement result:

Test #	EUT Set-Up #	Band Edge	Band Edge Delta (dBc)	Limit (dBc)	Result
1	2	Lower, Non-restricted	31.8	> 20	Pass
2	2	Upper, Non-restricted	52.7	> 20	Pass

8.3.6 Measurement Plots:

Band Edge low (2402 MHz; 10.000 dBm; 2 MHz)

Result

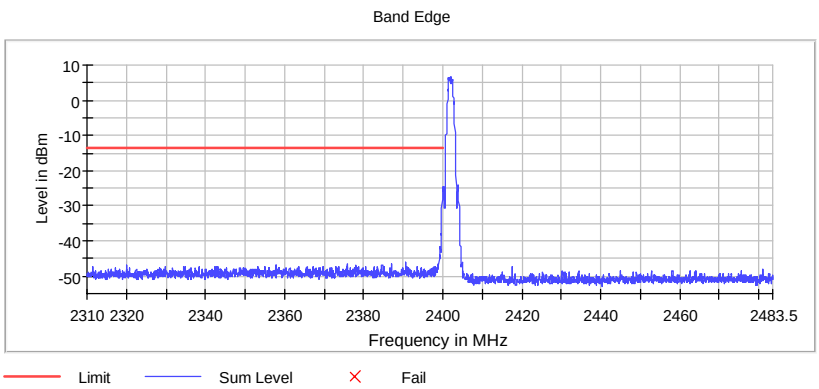
DUT Frequency (MHz)	Result
2402.000000	PASS

Inband Peak

Frequency (MHz)	Level (dBm)
2402.013824	6.6

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.950000	-25.1	11.8	-13.4	PASS
2399.900000	-26.5	13.1	-13.4	PASS
2399.850000	-28.2	14.8	-13.4	PASS
2399.800000	-30.5	17.1	-13.4	PASS
2399.750000	-34.4	21.0	-13.4	PASS
2399.700000	-35.4	22.0	-13.4	PASS
2399.650000	-36.6	23.2	-13.4	PASS
2399.550000	-37.9	24.6	-13.4	PASS
2399.600000	-38.2	24.8	-13.4	PASS
2399.500000	-40.1	26.8	-13.4	PASS
2399.400000	-41.4	28.0	-13.4	PASS
2399.350000	-43.1	29.7	-13.4	PASS
2399.450000	-43.3	29.9	-13.4	PASS
2399.200000	-44.0	30.7	-13.4	PASS
2399.150000	-44.3	30.9	-13.4	PASS



Band Edge high (2480 MHz; 10.000 dBm; 2 MHz)

Result

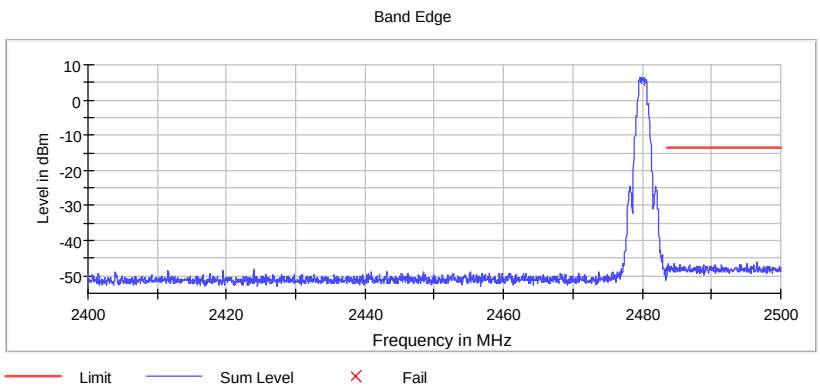
DUT Frequency (MHz)	Result
2480.000000	PASS

Inband Peak

Frequency (MHz)	Level (dBm)
2480.061765	6.5

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2496.562500	-46.2	32.7	-13.5	PASS
2484.557692	-46.3	32.8	-13.5	PASS
2483.711538	-46.4	33.0	-13.5	PASS
2495.134615	-46.5	33.0	-13.5	PASS
2496.033654	-46.7	33.2	-13.5	PASS
2488.841346	-46.7	33.3	-13.5	PASS
2494.288462	-46.9	33.4	-13.5	PASS
2486.778846	-46.9	33.4	-13.5	PASS
2485.456731	-46.9	33.5	-13.5	PASS
2491.432692	-47.0	33.5	-13.5	PASS
2494.076923	-47.0	33.6	-13.5	PASS
2490.480769	-47.1	33.6	-13.5	PASS
2497.461538	-47.1	33.6	-13.5	PASS
2489.899038	-47.1	33.6	-13.5	PASS
2499.841346	-47.1	33.6	-13.5	PASS



8.4 Emission Bandwidth 6dB and 99% Occupied Bandwidth

8.4.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

6dB (DTS) Bandwidth:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) ≥ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- 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 6 dB relative to the maximum level measured in the fundamental emission.

99% Occupied Bandwidth:

- Set frequency = nominal EUT channel center frequency
- Set Span = 1.5 x to 5.0 x OBW
- Set RBW = 1% to 5% of OBW
- Set the video bandwidth (VBW) ≈ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

8.4.2 Limits:

FCC §15.247(a)(2) and RSS-247 5.2(a)

- 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.

8.4.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	2	Op. 1	Battery

8.4.4 Measurement result:

Test #	Frequency (MHz)	6dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
1	2402	1.428572	> 0.5	Pass
2	2440	1.454546	> 0.5	Pass
3	2480	1.402598	> 0.5	Pass

Test #	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
4	2402	2.040000	NA	Pass
5	2440	2.040000	NA	Pass
6	2480	2.020000	NA	Pass

8.4.5 Measurement Plots:

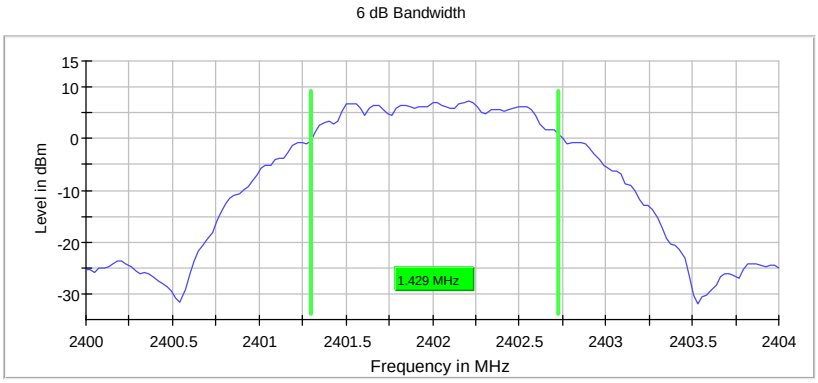
Minimum Emission Bandwidth 6 dB (2402 MHz; 10.000 dBm; 2 MHz)

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.428572	0.500000	---	2401.298701	2402.727273

(continuation of the "6 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	7.2	PASS



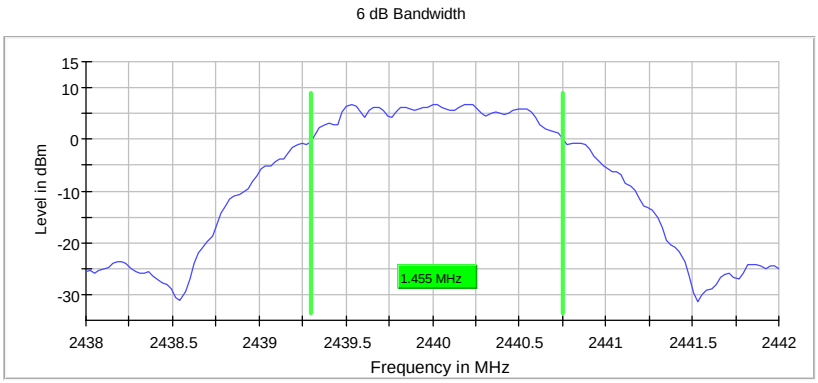
Minimum Emission Bandwidth 6 dB (2440 MHz; 10.000 dBm; 2 MHz)

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2440.000000	1.454546	0.500000	---	2439.298701	2440.753247

(continuation of the "6 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2440.000000	6.8	PASS



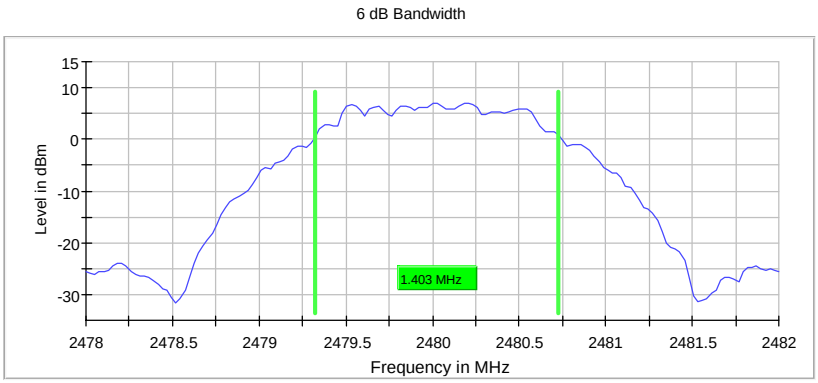
Minimum Emission Bandwidth 6 dB (2480 MHz; 10.000 dBm; 2 MHz)

6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.402598	0.500000	---	2479.324675	2480.727273

(continuation of the "6 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2480.000000	7.1	PASS



Occupied Channel Bandwidth 99% (2402 MHz; 10.000 dBm; 2 MHz)

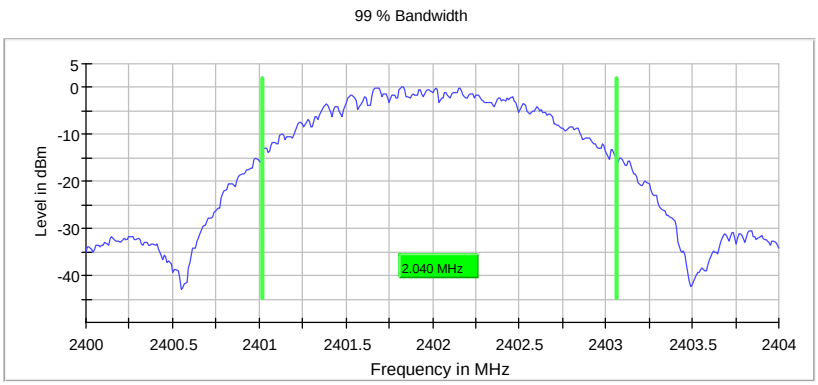
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10-

99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	2.040000	---	---	2401.020000	2403.060000

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2402.000000	PASS



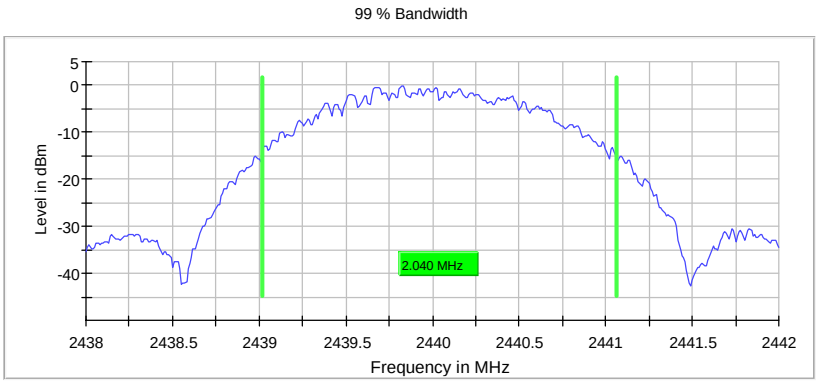
Occupied Channel Bandwidth 99% (2440 MHz; 10.000 dBm; 2 MHz)

99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2440.000000	2.040000	---	---	2439.020000	2441.060000

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2440.000000	PASS



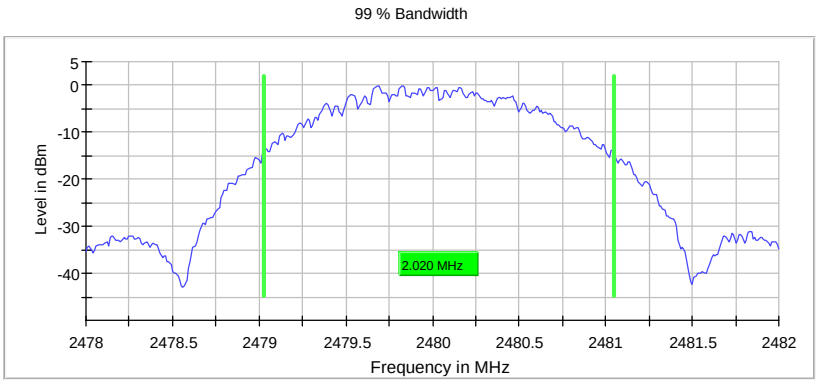
Occupied Channel Bandwidth 99% (2480 MHz; 10.000 dBm; 2 MHz)

99 % Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	2.020000	---	---	2479.030000	2481.050000

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2480.000000	PASS



8.5 Radiated Transmitter Spurious Emissions and Restricted Bands

8.5.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

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

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

- Frequency > 1 GHz
- Detector = Peak / 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) data rate 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.

8.5.2 Limits:

FCC §15.247

- 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 20 dB below that in the 100 kHz 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	Op. 1	Battery

8.5.4 Measurement result:

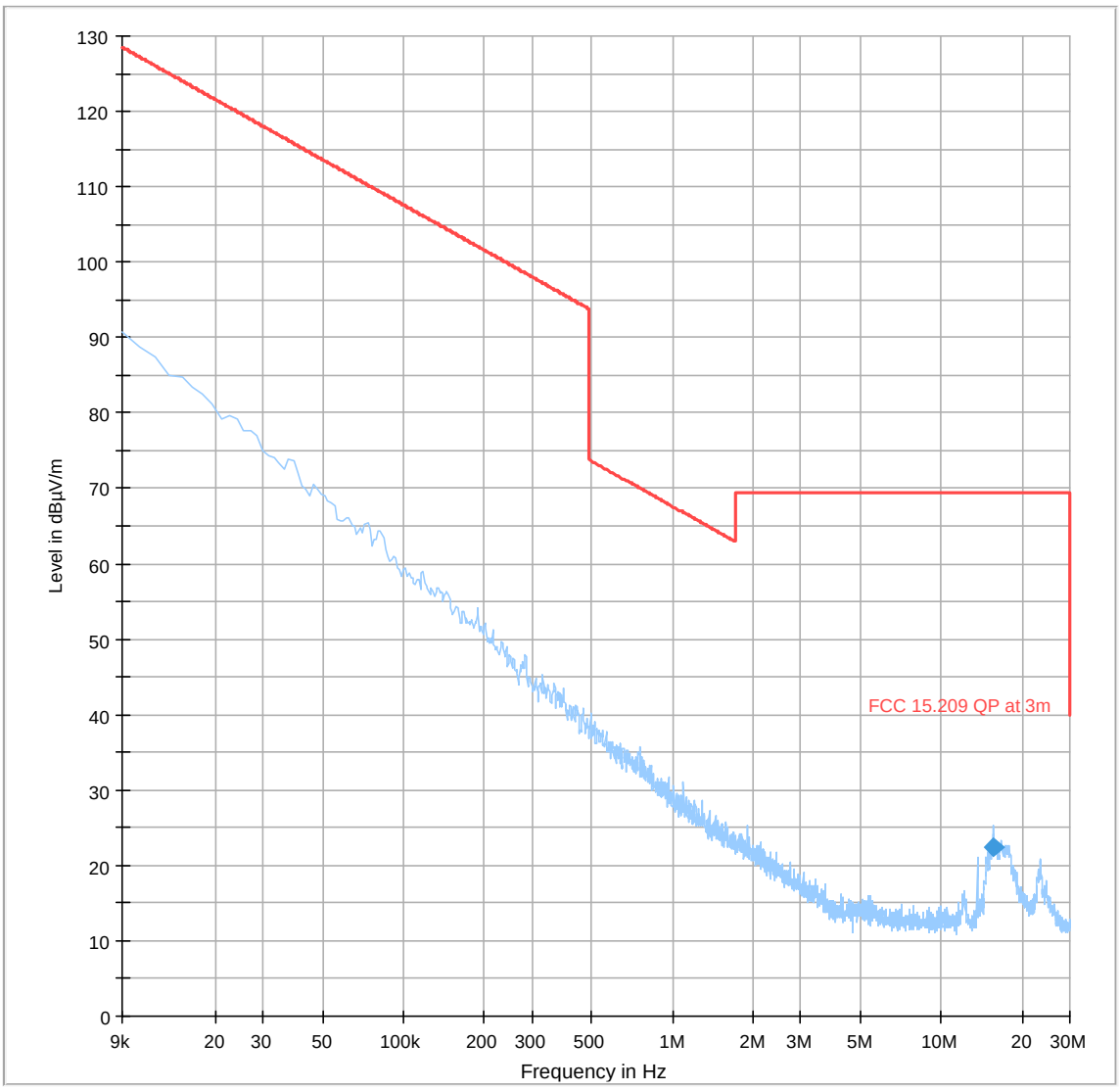
Plot #	Channel #	Scan Frequency	Limit	Result
1-5	Low	9 kHz – 26 GHz	See section 8.5.2	Pass
6-10	Mid	9 kHz – 26 GHz	See section 8.5.2	Pass
11-16	High	9 kHz – 26 GHz	See section 8.5.2	Pass

8.5.5 Measurement Plots:

Plot # 1

Final_Result

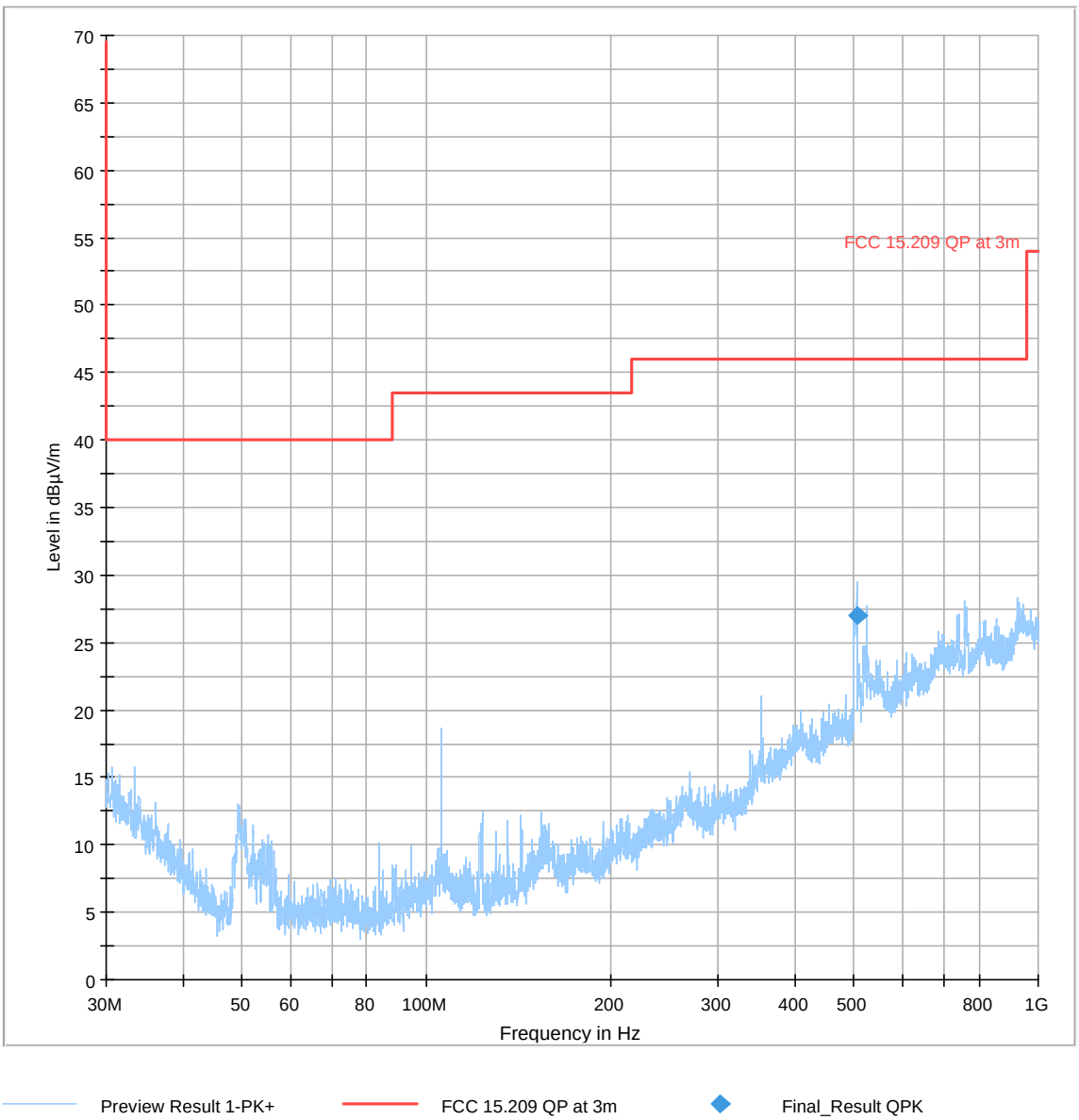
Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
15.556	22.42	---	69.50	47.08	500.0	9.0	120.0	H	9.0	5.2	



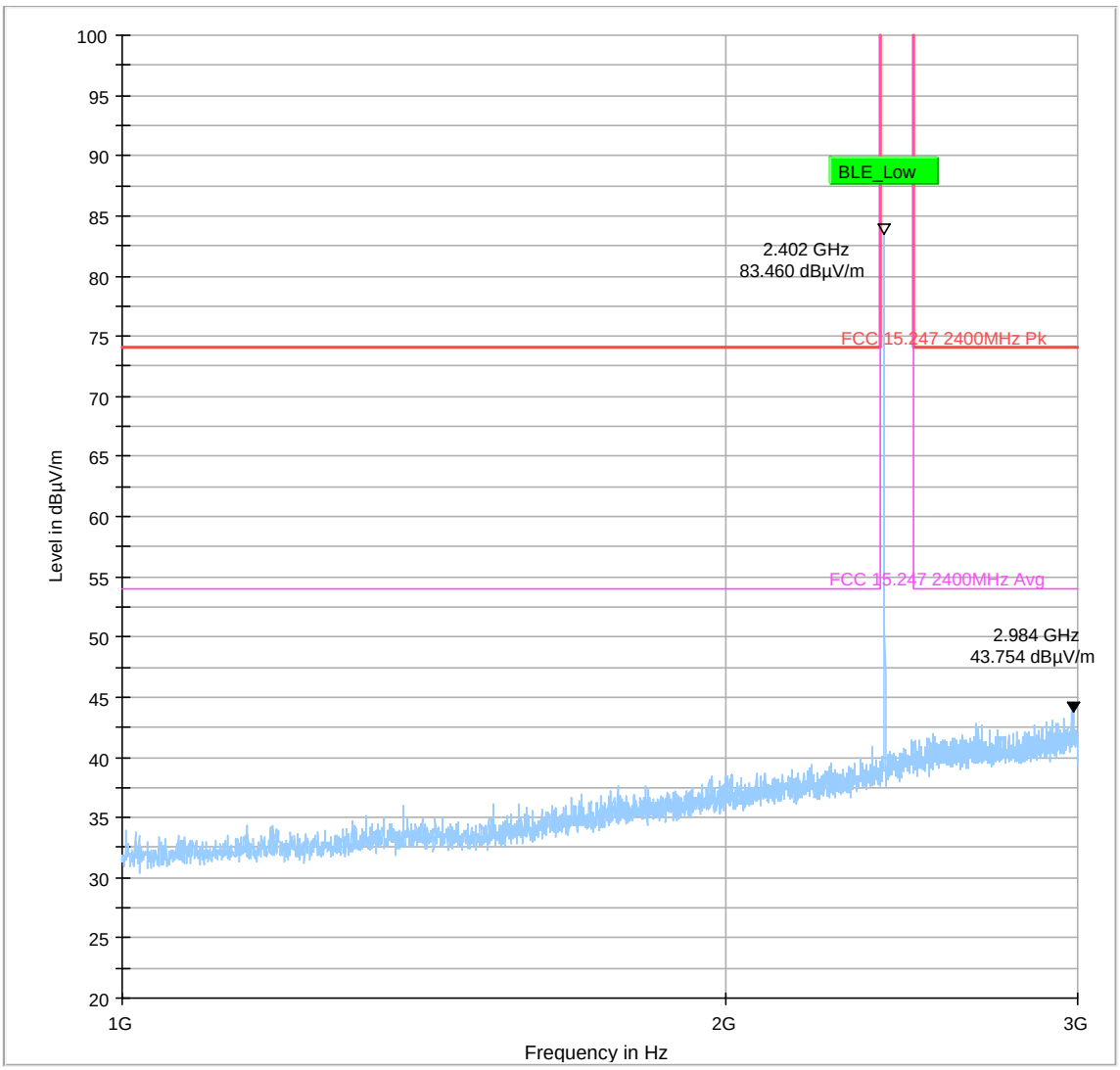
Plot # 2

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
504.912	27.04	---	46.02	18.98	500.0	120.0	145.0	H	97.0	-7.5	



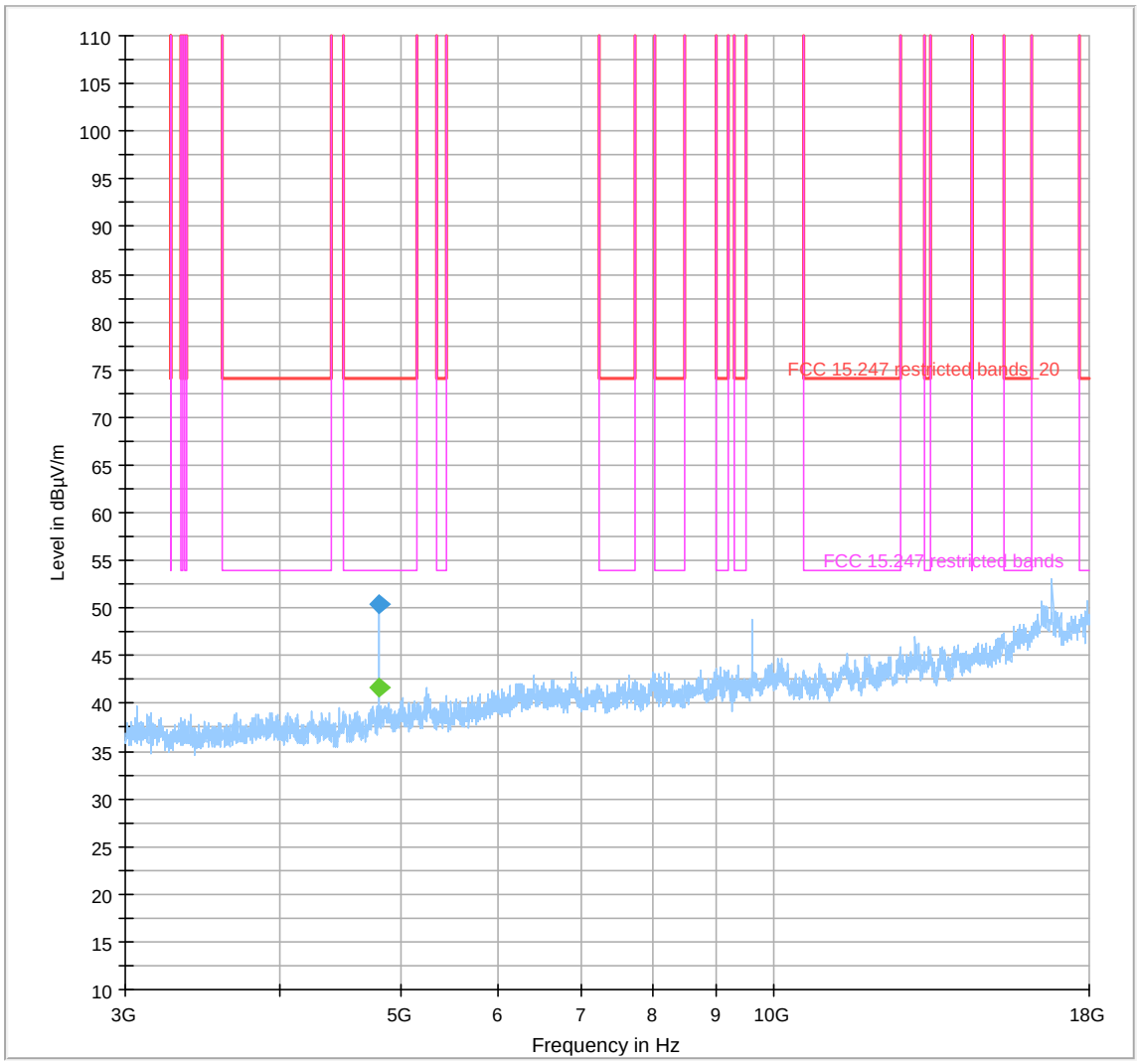
Plot # 3


100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
Level in dBµV/m
1G
2G
3G
Frequency in Hz
BLE_Low
2.402 GHz
83.460 dBµV/m
FCC 15.247 2400MHz Pk
FCC 15.247 2400MHz Avg
2.984 GHz
43.754 dBµV/m
Preview Result 1-PK+
FCC 15.247 2400MHz Avg
Critical_Freqs PK+
Final_Result PK+
FCC 15.247 2400MHz Pk
Final_Result CAV

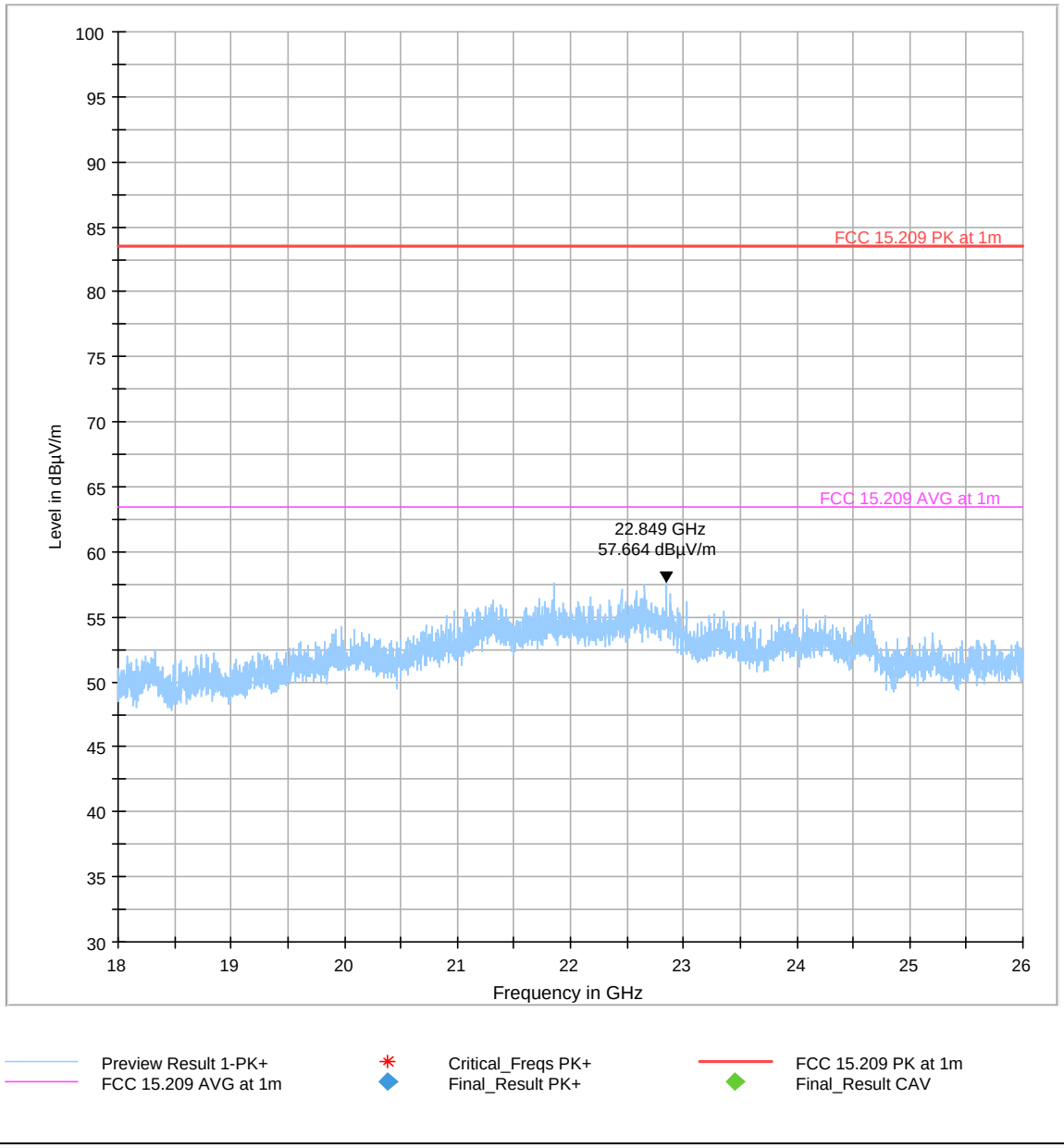
Plot # 4

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
4804.000	---	41.61	53.98	12.37	500.0	1000.0	115.0	V	114.0	-2.0	
4804.000	50.31	---	73.98	23.67	500.0	1000.0	115.0	V	114.0	-2.0	



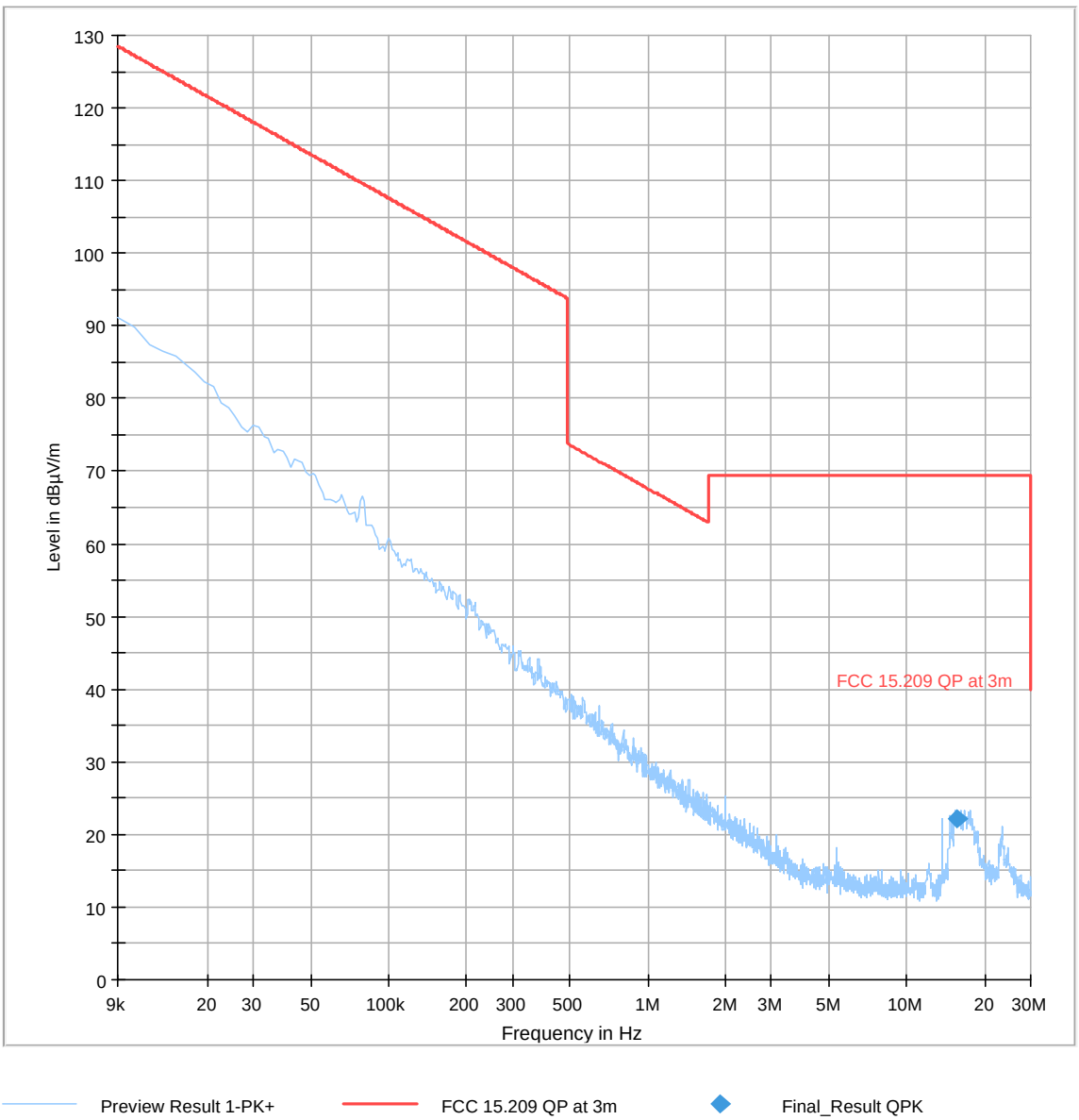
Plot # 5


100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
Level in dBµV/m
18
19
20
21
22
23
24
25
26
Frequency in GHz
FCC 15.209 PK at 1m
FCC 15.209 AVG at 1m
22.849 GHz
57.664 dBµV/m
Preview Result 1-PK+
FCC 15.209 AVG at 1m
Critical_Freqs PK+
Final_Result PK+
FCC 15.209 PK at 1m
Final_Result CAV

Plot # 6

Final_Result

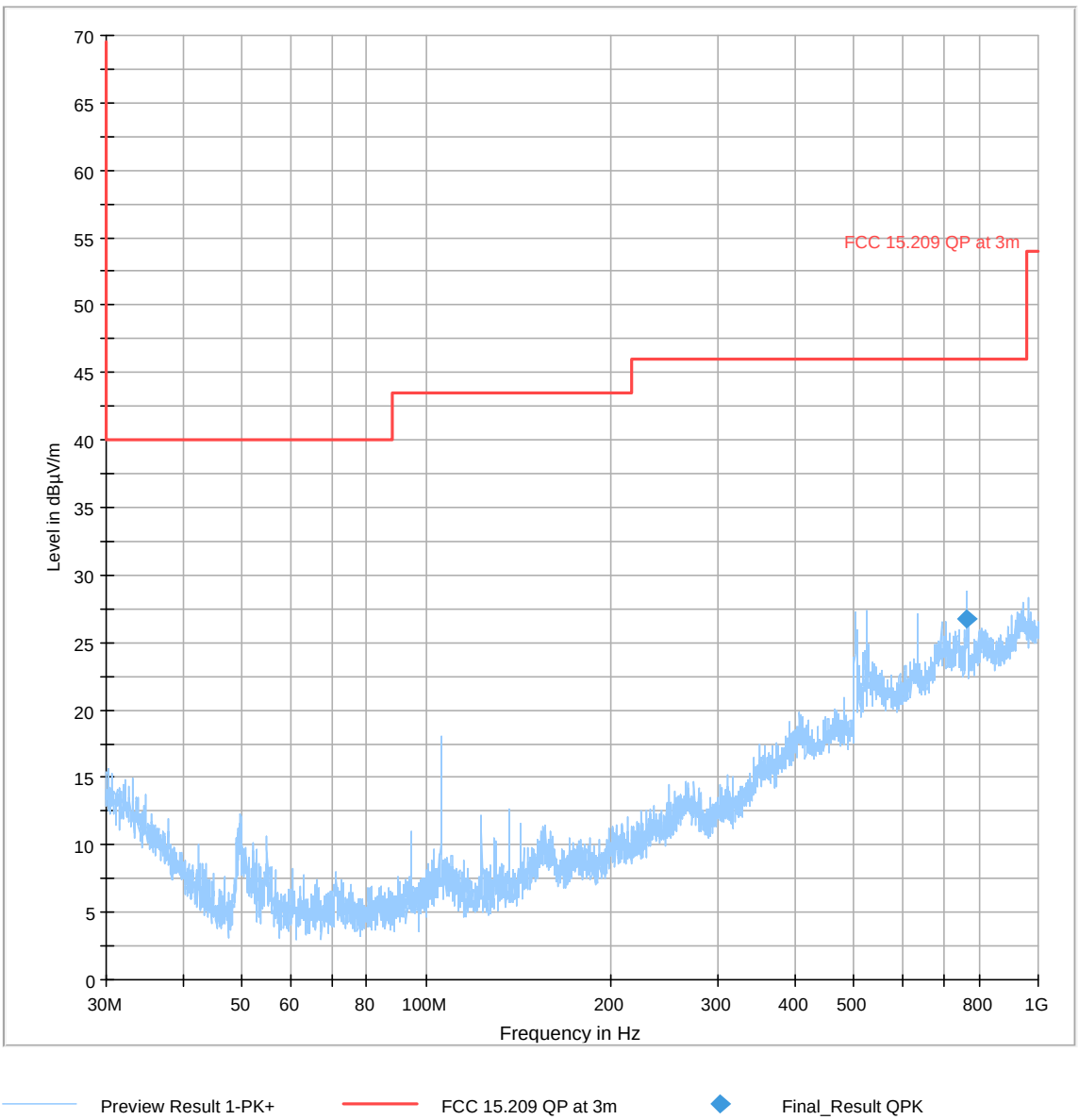
Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
15.619	22.26	---	69.50	47.24	500.0	9.0	120.0	H	98.0	5.2	



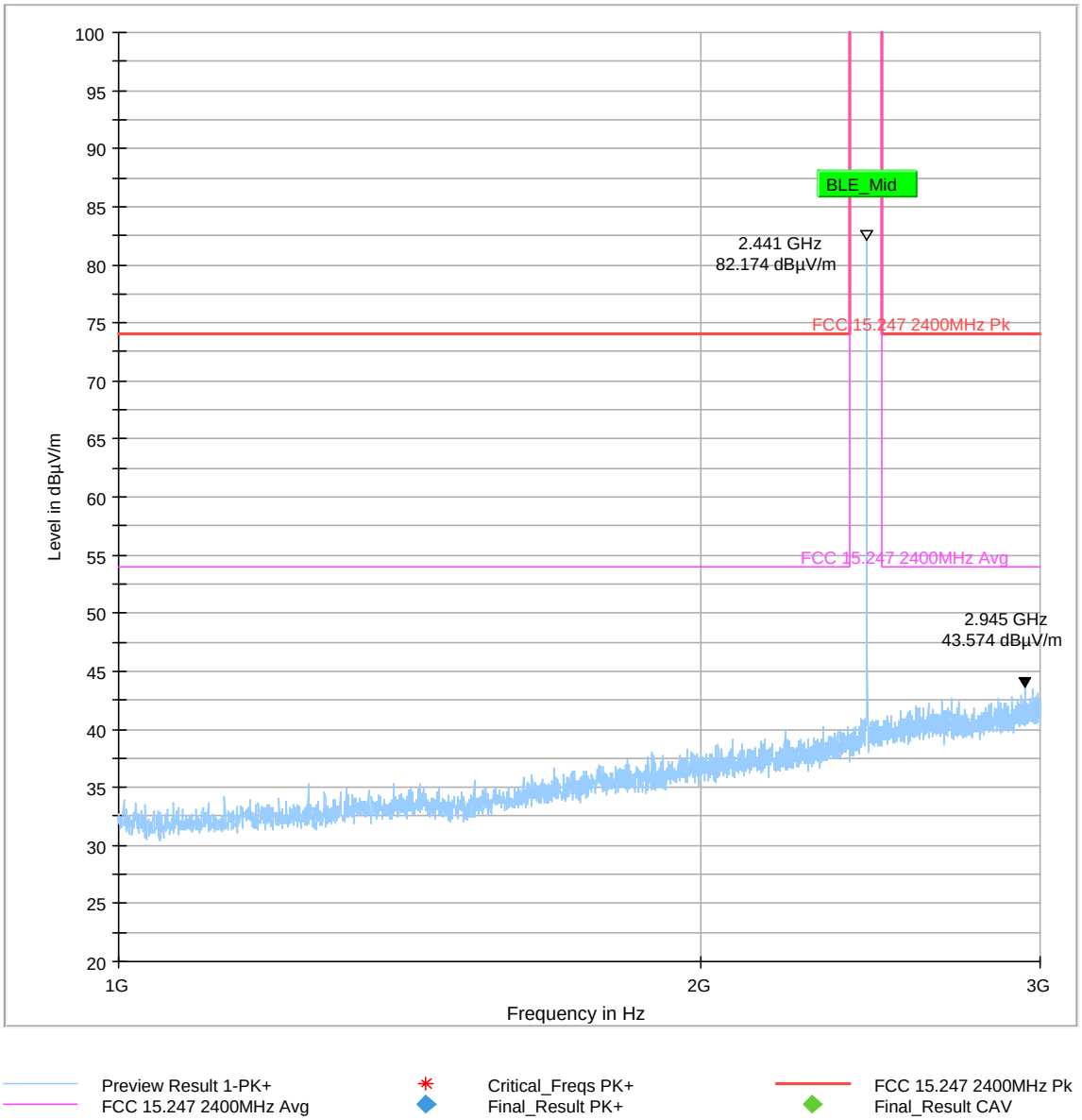
Plot # 7

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
762.374	26.71	---	46.02	19.31	500.0	120.0	205.0	H	348.0	-3.6	



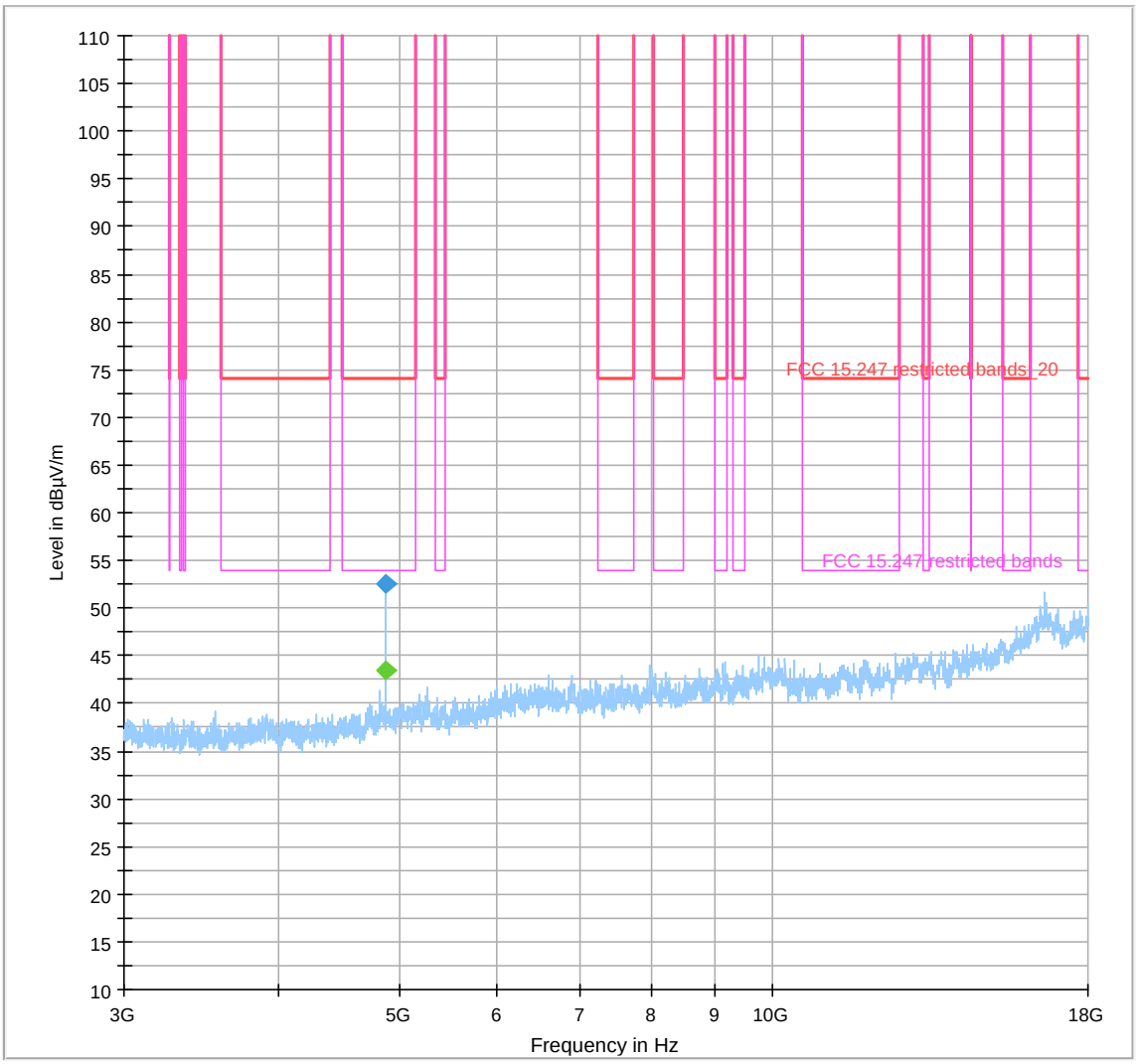
Plot # 8


BLE_Mid
2.441 GHz
82.174 dBµV/m
FCC 15.247 2400MHz Pk
FCC 15.247 2400MHz Avg
2.945 GHz
43.574 dBµV/m
Level in dBµV/m
Frequency in Hz
1G
2G
3G
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
Preview Result 1-PK+
FCC 15.247 2400MHz Avg
Critical_Freqs PK+
Final_Result PK+
FCC 15.247 2400MHz Pk
Final_Result CAV

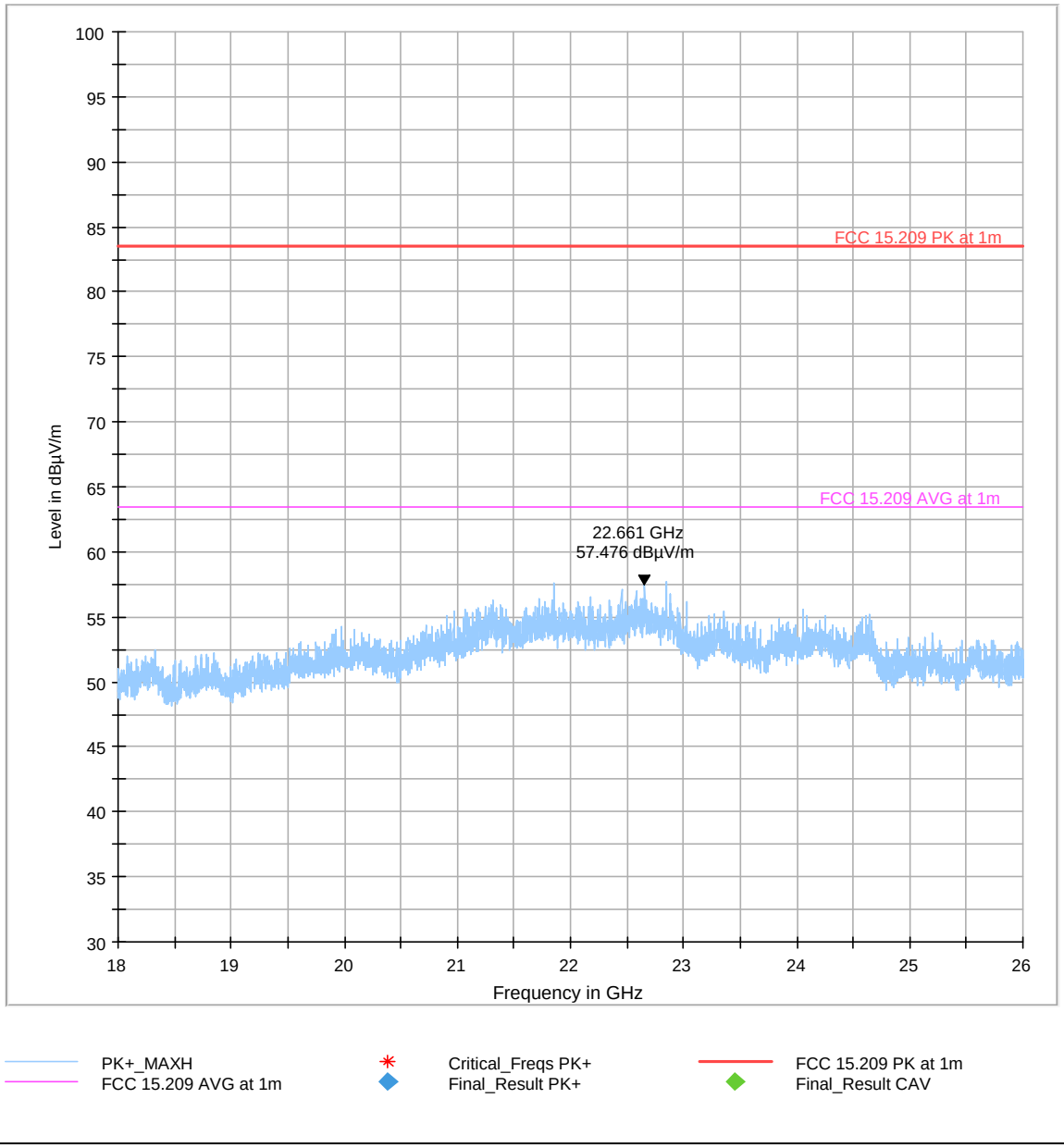
Plot # 9

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
4879.000	---	43.42	53.98	10.56	500.0	1000.0	136.0	V	258.0	-2.0	
4879.000	52.49	---	73.98	21.49	500.0	1000.0	136.0	V	258.0	-2.0	



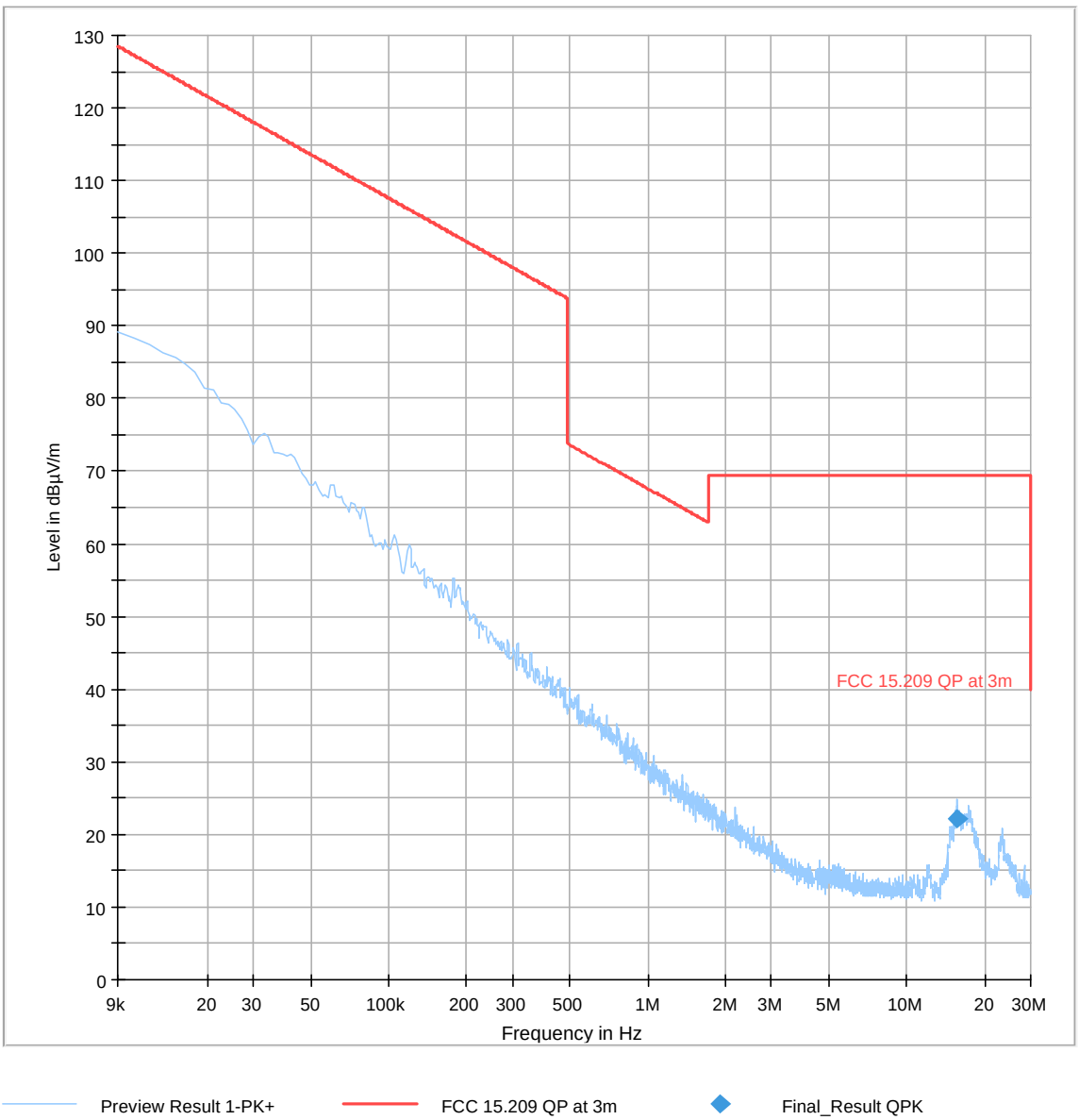
Plot # 10


100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
Level in dBµV/m
18
19
20
21
22
23
24
25
26
Frequency in GHz
FCC 15.209 PK at 1m
FCC 15.209 AVG at 1m
22.661 GHz
57.476 dBµV/m
PK+_MAXH
FCC 15.209 AVG at 1m
Critical_Freqs PK+
Final_Result PK+
FCC 15.209 PK at 1m
Final_Result CAV

Plot # 11

Final_Result

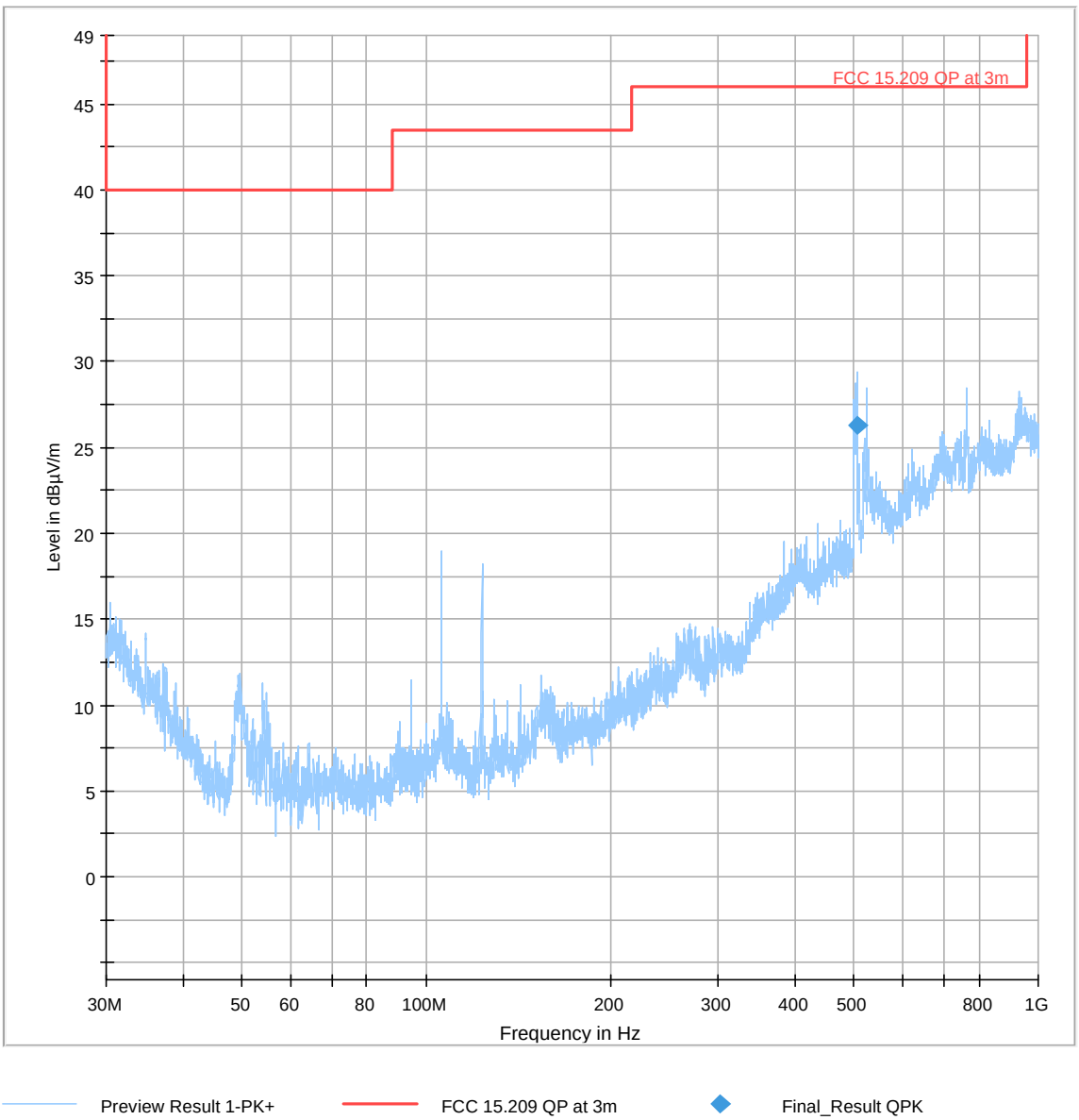
Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
15.555	22.28	---	69.50	47.22	500.0	9.0	120.0	H	326.0	5.2	



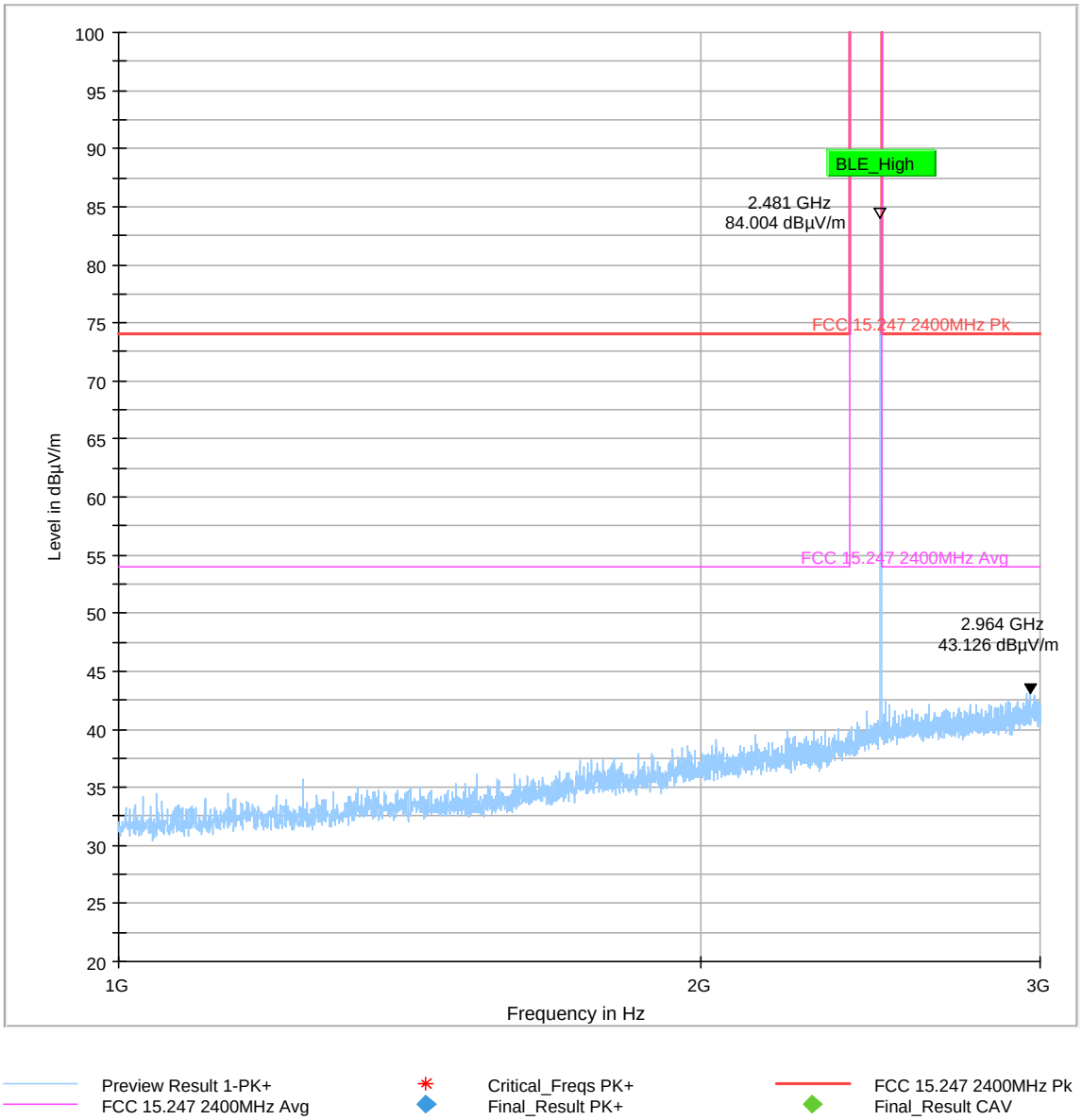
Plot # 12

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
506.294	26.29	---	46.02	19.73	500.0	120.0	144.0	H	347.0	-7.4	



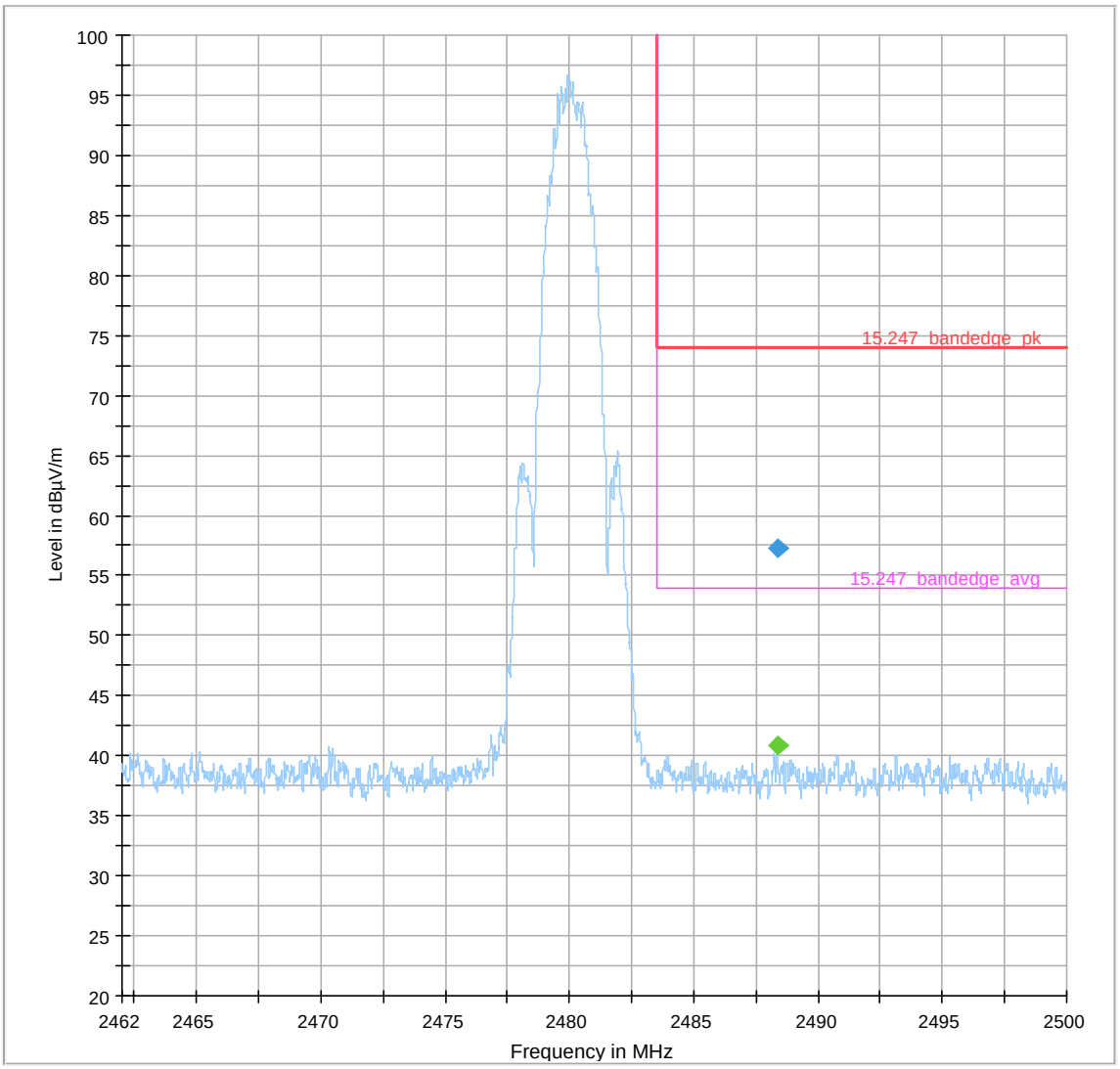
Plot # 13


BLE_High
2.481 GHz
84.004 dBµV/m
FCC 15.247 2400MHz Pk
FCC 15.247 2400MHz Avg
2.964 GHz
43.126 dBµV/m
Level in dBµV/m
Frequency in Hz
1G
2G
3G
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
Preview Result 1-PK+
FCC 15.247 2400MHz Avg
Critical_Freqs PK+
Final_Result PK+
FCC 15.247 2400MHz Pk
Final_Result CAV

Plot # 14

Final_Result

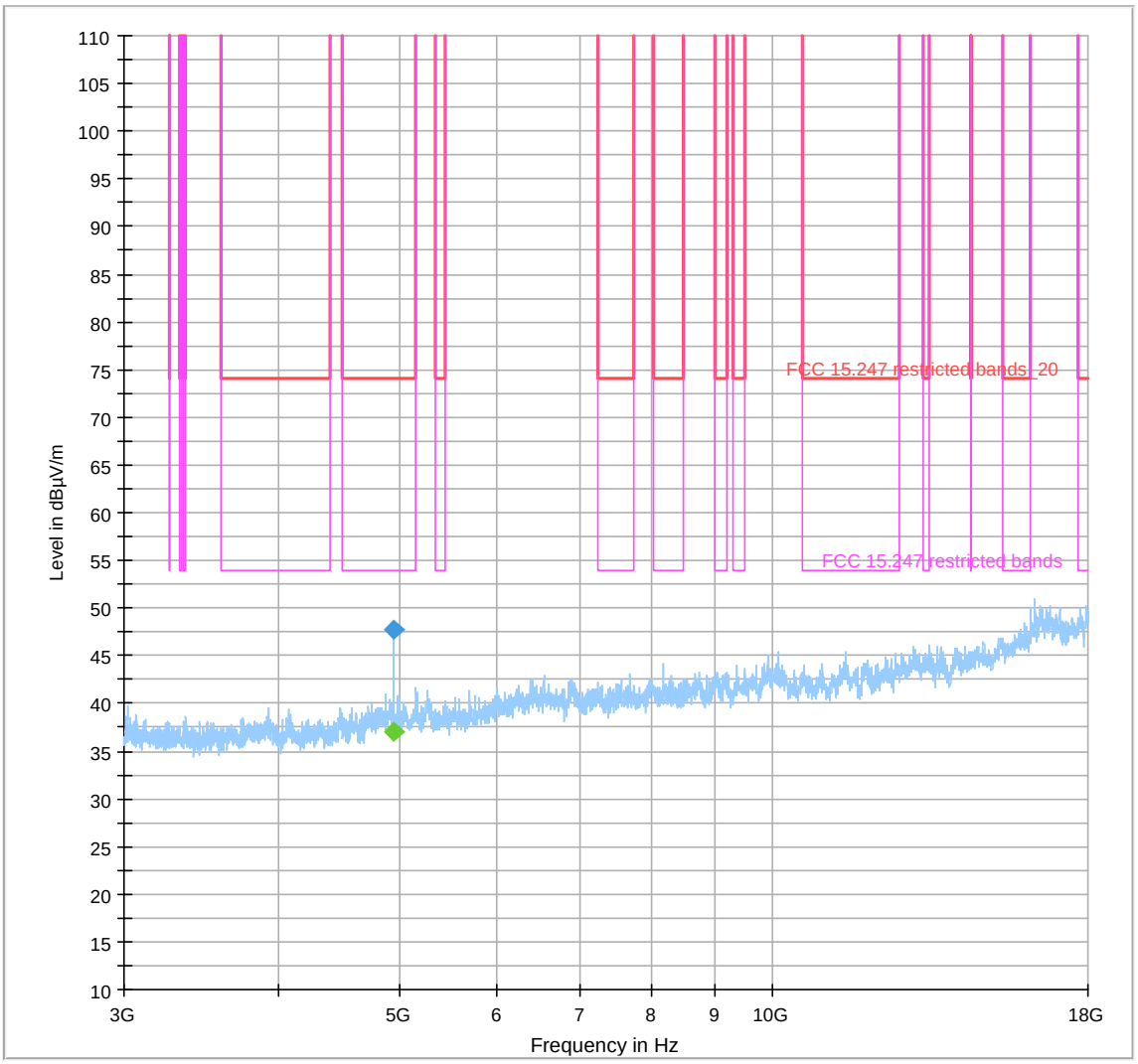
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
2488.353	---	40.86	54.00	13.14	500.0	1000.0	118.0	H	251.0	33.9	
2488.353	57.24	---	74.00	16.76	500.0	1000.0	118.0	H	251.0	33.9	



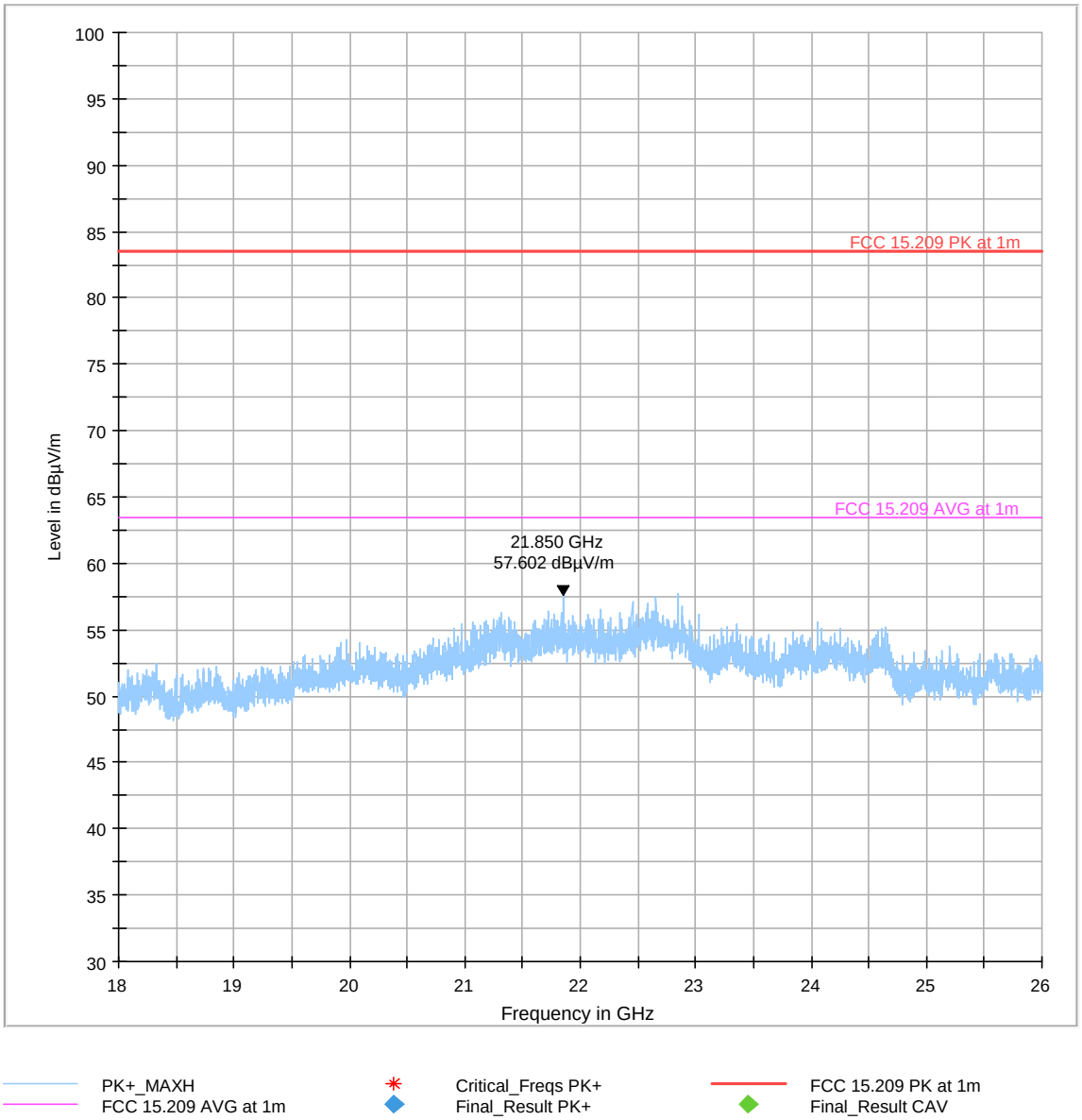
Plot # 15

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
4959.000	---	37.00	53.98	16.98	500.0	1000.0	115.0	V	149.0	-2.5	
4959.000	47.75	---	73.98	26.23	500.0	1000.0	115.0	V	149.0	-2.5	



Plot # 16


100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
Level in dBµV/m
FCC 15.209 PK at 1m
FCC 15.209 AVG at 1m
21.850 GHz
57.602 dBµV/m
18
19
20
21
22
23
24
25
26
Frequency in GHz
PK+_MAXH
FCC 15.209 AVG at 1m
Critical_Freqs PK+
Final_Result PK+
FCC 15.209 PK at 1m
Final_Result CAV

9 Test setup photos

Setup photos are included in supporting file name: “EMC_EMMIC_003_24001_FCC_15_247_Setup_Photos”

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
LOOP ANTENNA	ETS LINDGREN	6512	00049838	3 Years	09/06/2023
BILOG ANTENNA	A.H. SYSTEMS	BiLA2G	569	3 Years	10/30/2023
HORN ANTENNA	EMCO	3115	00035111	3 Years	10/26/2023
HORN ANTENNA	ETS LINDGREN	3117-PA	00167061	3 Years	9/25/2023
HORN ANTENNA	ETS LINDGREN	3116C-PA	00166821	3 Years	10/26/2023
ESW.EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101715	3 Years	10/24/2023
DIGITAL THERMOMETER	Control Company	4410,90080-03	230712972	3 Years	10/18/2023
Signal Analyzer	R&S	FSV40	101022	3 Years	09/25/2023
Multimeter	Fluke	115	56090717MV	3 Years	09/26/2023
Software	EMC32	Version 10.50.40	-	-	-

11 History

Date	Report Name	Changes to report	Prepared by
2025-02-27	EMC_EMMIC_003_24001_FCC_15_247	Initial Version	Cheng Song

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