FCC / ISED Test Report

For:
Rivian Automotive, LLC

Brand:
Rivian

Marketing Name:
Vehicle Access System

Model Number:
VAS-BLE 1.5

Product Description:
Vehicle Access Modules based upon Bluetooth Low Energy Technology (VAS BLE)

FCC ID: 2AW3A-1NAG20VAS
IC: 26958-1NAG20VAS

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 2 (DTSs) & RSS-Gen Issue 5

REPORT #: EMC_RIVIA_042_22001_FCC_15.247_ISED_BLE_DTS

DATE: 4/15/2023

A2LA Accredited

IC recognized #
3462B

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1 Assessment

The following equipment (as identified in section 3 of this test report) 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.

According to section 5 of this report, the overall result is Pass.

Company	Description	Model #
Rivian Automotive, LLC	Vehicle Access Modules based upon Bluetooth Low Energy Technology (VAS BLE)	VAS-BLE 1.5

Responsible for Testing Laboratory:

Date	Section	Name	Signature
4/15/2023	Compliance	Stoecker, Arndt (Director of Regulatory Services)	

Responsible for the Report:

Date	Section	Name	Signature
4/15/2023	Compliance	Ghanma, Issa (Deputy Lab Manager)	Issa Ghanma Digitally signed by: Issa Ghanma DN: CN = Issa Ghanma email = Issa.Ghanma@cetecom.com C = US O = CETECOM, Inc. OU = EMC Date: 2023.04.15 17:39:21 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

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

2.2 Identification of the Client

Applicant's Name:	Rivian Automotive, LLC
Street Address:	14600 Myford Road
City/Zip Code	Irvine, CA 92606
Country	USA

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Brand:	Rivian
Model No:	VAS-BLE 1.5
Marketing name:	Vehicle Access System
FCC-ID :	2AW3A-1NAG20VAS
IC:	26958-1NAG20VAS
HW Version :	PT00039251 (Fir Tree – internal antenna): Rev B PT00039253 (Screw Mount – External antenna): Rev G
SW Version :	2.2
HVIN:	VAS-BLE 1.5
PMN:	VAS (Vehicle Access System)
Product Description:	Vehicle Access Modules based upon Bluetooth Low Energy Technology (VAS BLE)
Frequency Range/number of channels:	Nominal band: 2400 MHz – 2483.5 MHz Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 Channels
Radio information:	Bluetooth Low Energy Texas Instrument • Chipset name/number: C2642R SOC BLE • Technology: BLE Version 5.2 • Supported data rate: 1Mb/s, 2Mb/s, 125kb/s (S8 LE Coded), and 500kb/s (S2 LE Coded)
Max. Measured Conducted Output Power:	PT00039251: +3.03 dBm PT00039253: +4.09 dBm
Power Supply/ Rated Operating Voltage Range:	9.8V (Low) / 13.5 V (Nominal) / 16.0V (Max), DC
Operating Temperature Range:	T min: -40 ºC / T Nom: 20 ºC / T max: +105 ºC
Other Radios included in the device:	N/A
Antenna Information as declared:	❖ PT00039251 (Fir Tree – internal antenna) o VAS 1.5 Module Integrated Antenna o Single Band Circularly Polarized Dual PCB monopole Antenna o Part number: PT00781678 Rev A o Frequency (MHz): 2400 – 2485 o Max gain (dBi): 7.04 @ 2410 MHz ❖ PT00039253 (Screw Mount – External antenna) o EDV VAS Circular Ground Plane Antenna o Single Band Ceramic Microstrip Patch Antenna o Part number: PT00891429 Rev A o Frequency (MHz): 2400 – 2485 o Max gain (dBi): 6.7 @ 2414 MHz
Sample Revision:	☑ Production Unit; ☐ Pre-Production
Product dimensions [mm]:	❖ PT00039251 (Fir Tree – internal antenna): 1.5” x 1.5” x 1” ❖ PT00039253 (Screw Mount – External antenna) 2” x 1.5” x 1”
Note: The information of the EUT specifications in the table above is provided by the applicant.	

3.2 EUT Sample details

EUT #	S/N	Device Number	HW Version	SW Version	Notes/Comments
1	004	PT00039251	Rev B	2.2	Conducted measurement
2	005	PT00039251	Rev B	2.2	Radiated measurement
3	002	PT00039253	Rev G	2.2	Conducted measurement
4	001	PT00039253	Rev G	2.2	Radiated measurement with PT00891429 antenna

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	S/N	Notes/Comments
N/A	-	-	-	-	-

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test setup	Comments
1	EUT # 1	The measurement equipment was connected to the 50-ohm RF port of the EUT.
2	EUT # 2	The internal antenna was connected. PT00781678 antenna
3	EUT # 3	The measurement equipment was connected to the 50-ohm RF port of the EUT.
4	EUT # 4	The external antenna was connected. PT00891429 antenna

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
Op. 1	Bluetooth LE	❖ A CANBUS adaptor to USB provided by the client used to communicate with the device and send commands, that will not be available to the end-user to configure the BLE radio to: • Maximum output power setting → 5 dBm • Continuous transmission • Modulated signal • Switch between supported data rates: 1Mb/s, 2Mb/s, 125kb/s (S8 LE Coded), and 500kb/s (S2 LE Coded) • Select TX channel(s) o Low channel → 2402 MHz
Op. 2	Bluetooth LE	❖ A CANBUS adaptor to USB provided by the client used to communicate with the device and send commands, that will not be available to the end-user to configure the BLE radio to: • Maximum output power setting → 5 dBm • Continuous transmission • Modulated signal • Select data rate: o 1Mb/s PT00039251 (worst case) o 2Mb/s PT00039253 (worst case) • Select TX channel(s) o Low channel → 2402 MHz o Mid channel → 2440 MHz o High channel → 2480 MHz

3.6 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid, and high channels and the highest possible duty cycle (99.9%) and output power.

For conducted measurements;

- All data in this report show the worst case of BLE radio transmitting at the highest output power representing the worst case of BLE transmission mode.

For radiated measurements;

- All data in this report show the worst case of BLE radio transmitting at the highest output power representing the worst case of BLE transmission mode.
- All data in this report show the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

According to the Electrical behavior declaration letter provided by the client: '*VAS-BLE 1.5_PT00781678 REV B FIR TREE PT00781677 REV B SCREW MOUNT - Internal antenna_PT0039253 REV G External antenna options Electrical Behavior Declaration Letter 3_30_2023*':

"*Both PT00781678 (Fir Tree – internal antenna) & PT00781677 (Screw Mount – internal antenna) use the same PCBA, the same material of enclosure with similar distances, dimensions, gaps, etc. and they behave the same electrically.*

The only difference between the PT00781678 & PT00781677 modules is the mounting strategy, where the PT00781678 (Fir Tree – internal antenna) – internal antenna is mounted with the plastic/nylon FIR TREE on the back of the module where PT00781677 (Screw Mount – internal antenna) is mounted with external plastic/nylon screws to secure the modules on the vehicle.

PT00039253 (Screw Mount – External antenna) can be used with PT00891429 6.7 dBi peak gain patch antenna & PT00891430 3.26 dBi peak gain patch antenna, & WPC.25D.82. 0835E.e -1.5 dBi peak gain patch antenna.

The enclosures are all made of plastic/nylon."

Based on the similarity and differences declared by the client between PT00781678 (Fir Tree – internal antenna) & PT00781677 (Screw Mount – internal antenna), one model/Type number: **PT00781678 (Fir Tree – internal antenna)** was tested, and **PT00039253 (Screw Mount – External antenna) with the highest gain antenna PT00891429** was tested.

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.

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

- FCC ID: 2AW3A-1NAG20VAS
- IC: 26958-1NAG20VAS

4.1 Test methodology of applied standards

- FCC part 15, Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- RSS-247 issue 2 Feb. 2017
- RSS-Gen issue 5 April 2018
- ANSI C63.10:2013

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	-	☐	☐	☑	Note 1
§15.247(e) RSS-247 5.2(b)	Power Spectral Density	Nominal	-	☐	☐	☑	Note 1
§15.247(b)(1) RSS-247 5.4(d)	Maximum Conducted Output Power and EIRP	Nominal	Op.1	☑	☐	☐	Complies Note 2
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	-	☐	☐	☑	Note 1
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	-	☐	☐	☑	Note 1
§2.1055 ISED RSS-Gen 6.11	Frequency Stability	Extreme temperature	-	☑	☐	☐	Note 1
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	Op.2	☑	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	-	☑	☐	☐	Note 3

Note 1: Leverage from report # '*FCC_IC_RF_SL21021001-RIVIAN-005_BLE_Rev2.0*'
Note 2: Spot check for power level verification.
Note 3: The EUT is a vehicular device powered by DC mains (battery); hence this test is not applicable.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with a 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

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 3 dB 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:

2/14/2023 – 3/21/2023

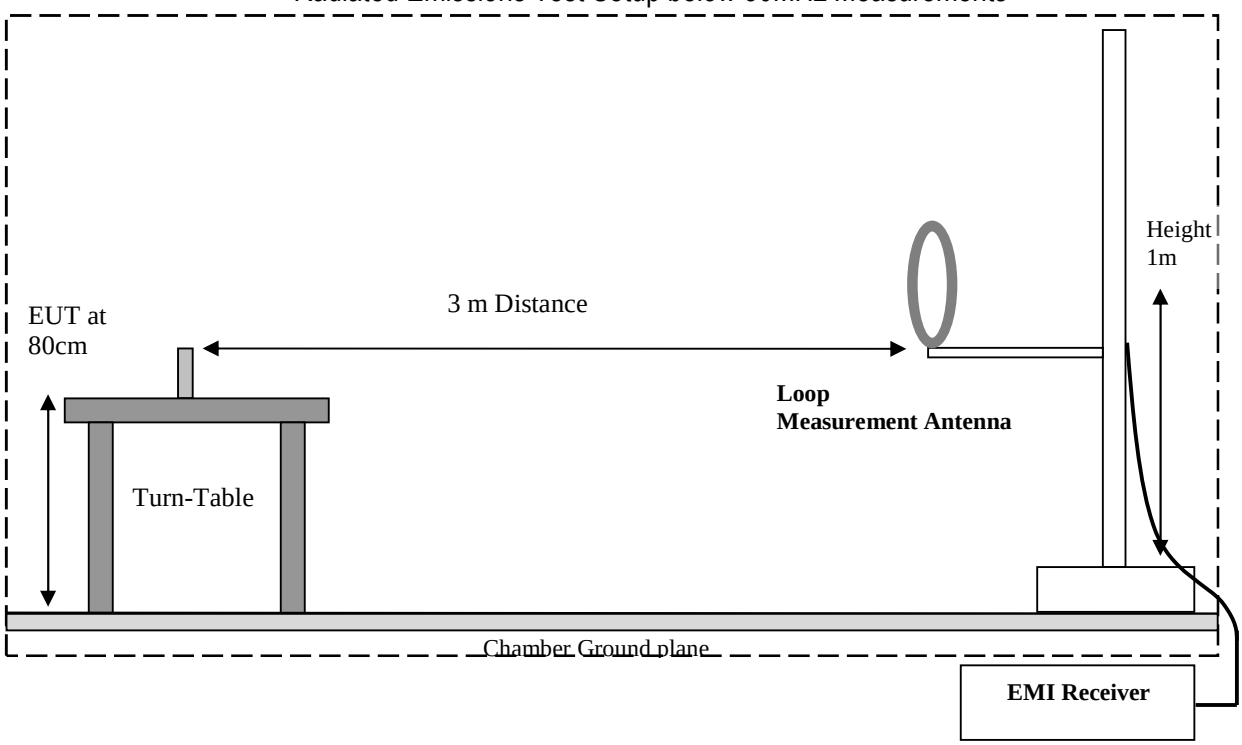
7 Measurement Procedures

7.1 Radiated Measurement

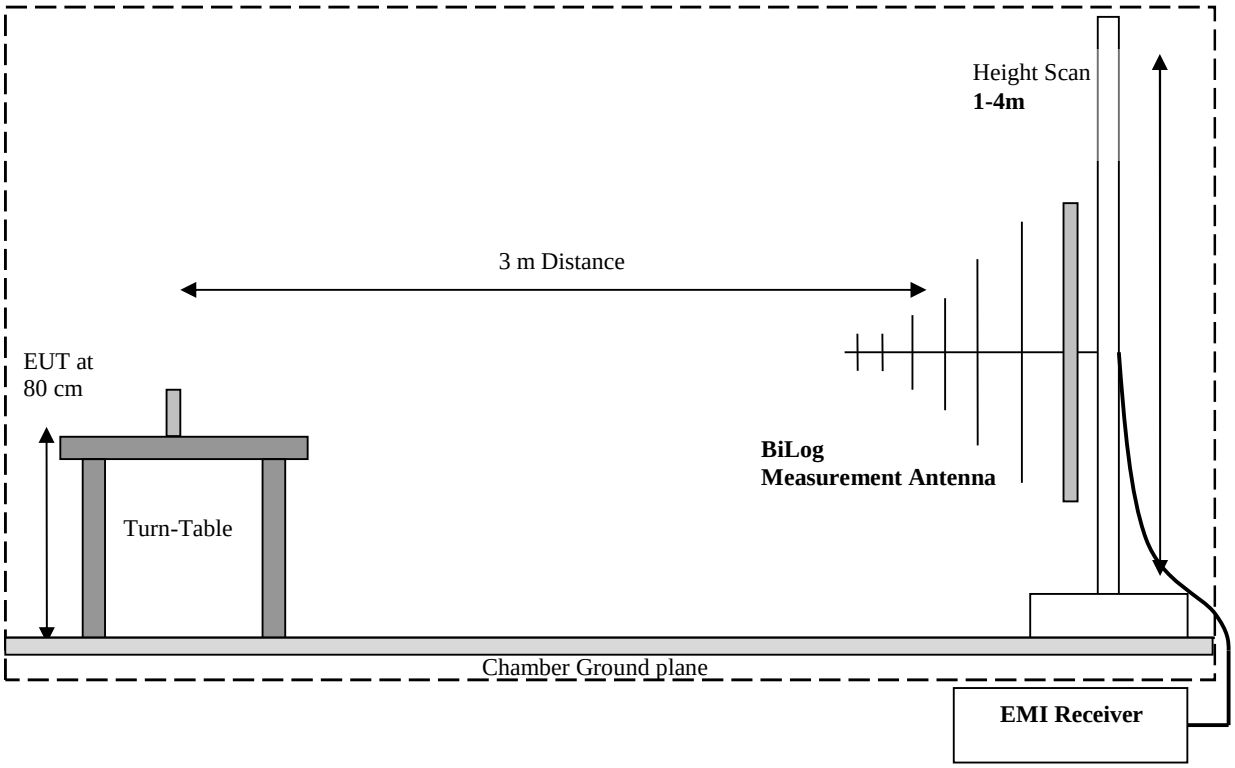
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 360º continuous measurement 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 highest six 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 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.

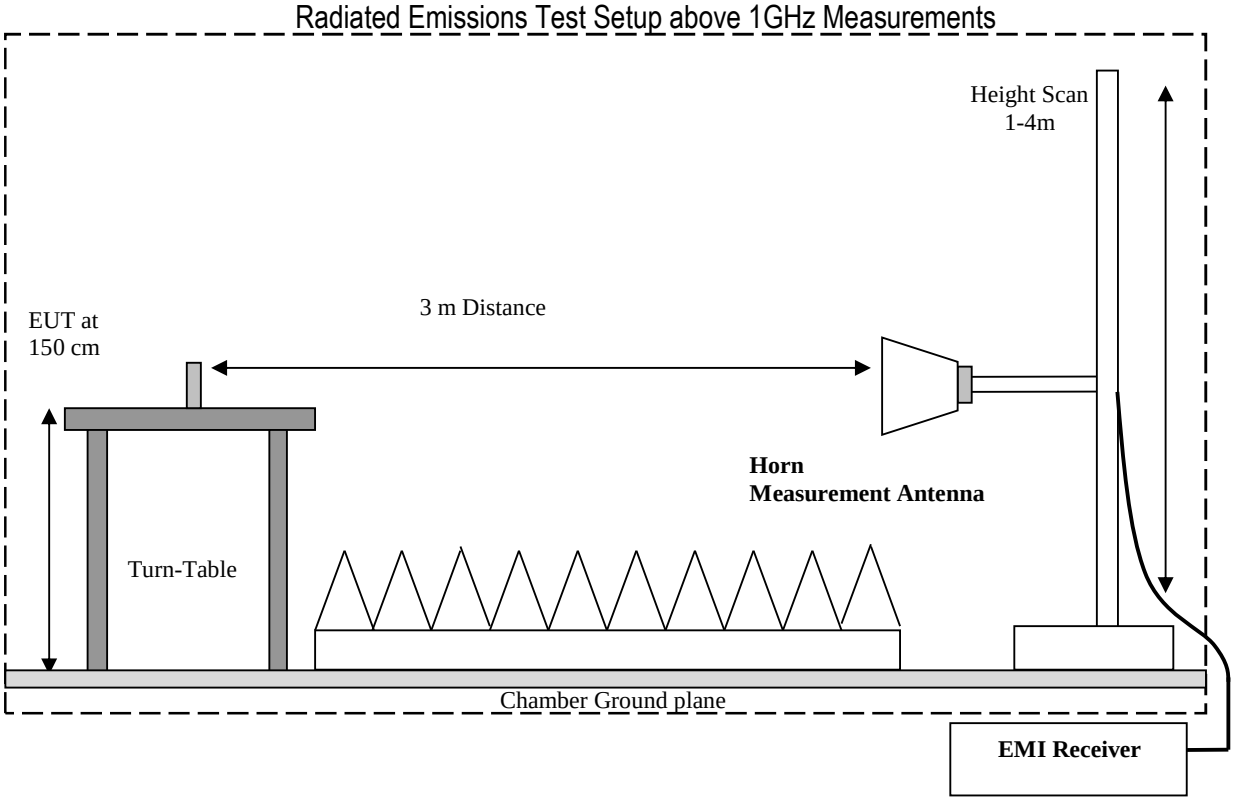
Radiated Emissions Test Setup below 30MHz Measurements



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:

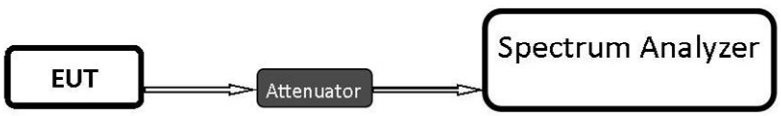
FS (dBµV/m) = Measured Value on SA (dBµV) + Cable Loss (dB) + Antenna Factor (dB/m)

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 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

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)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
- IC RSS-247 5.4 d: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

8.1.3 Test conditions and setup:

Ambient Temperature	EUT operating mode	Power Input	Antenna Gain
23° C	Op. 1	13.8V DC	PT00781678: +7.04 dBi PT00891429: +6.7 dBi

8.1.4 Measurement result:

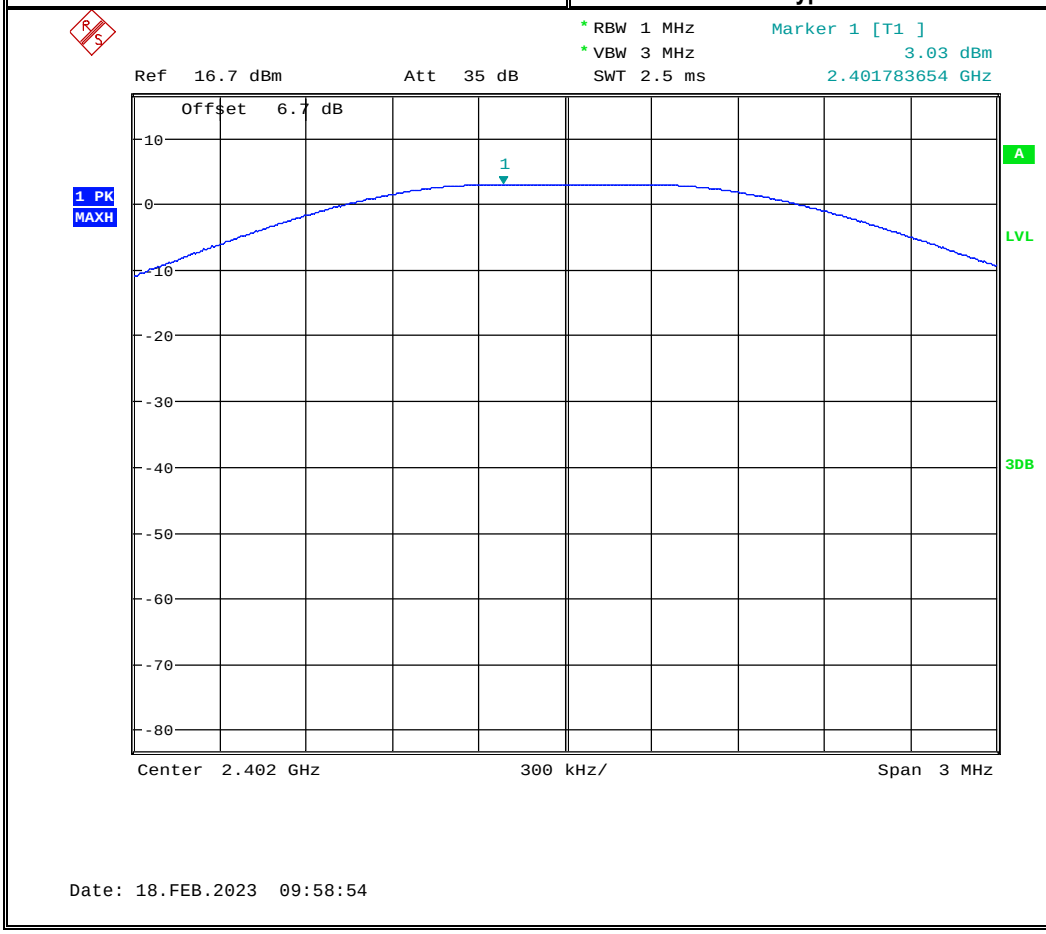
EUT Set-Up #	Plot #	Frequency (MHz)	Mode	Maximum Peak Conducted Output Power (dBm)	EIRP*1 (dBm)	Limit*2 (dBm)	Result
1	1	2402	**1M**	**3.03**	**10.07**	28.96 (Pk) / 34.96 (EIRP)	Pass
	2	2402	2M	3.02	10.06	28.96 (Pk) / 34.96 (EIRP)	Pass
	3	2402	S8	3.01	10.05	28.96 (Pk) / 34.96 (EIRP)	Pass
	4	2402	S2	3.02	10.06	28.96 (Pk) / 34.96 (EIRP)	Pass
3	5	2402	1M	3.95	10.65	29.3 (Pk) / 35.3 (EIRP)	Pass
	6	2402	**2M**	**4.09**	**10.79**	29.3 (Pk) / 35.3 (EIRP)	Pass
	7	2402	S8	3.94	10.64	29.3 (Pk) / 35.3 (EIRP)	Pass
	8	2402	S2	3.95	10.65	29.3 (Pk) / 35.3 (EIRP)	Pass

1: EIRP= Maximum peak conducted output power + Antenna gain
2: The limit is corrected by the amount in dB that the directional gain of the antenna exceeds 6 dBi

8.1.5 Measurement Plots:

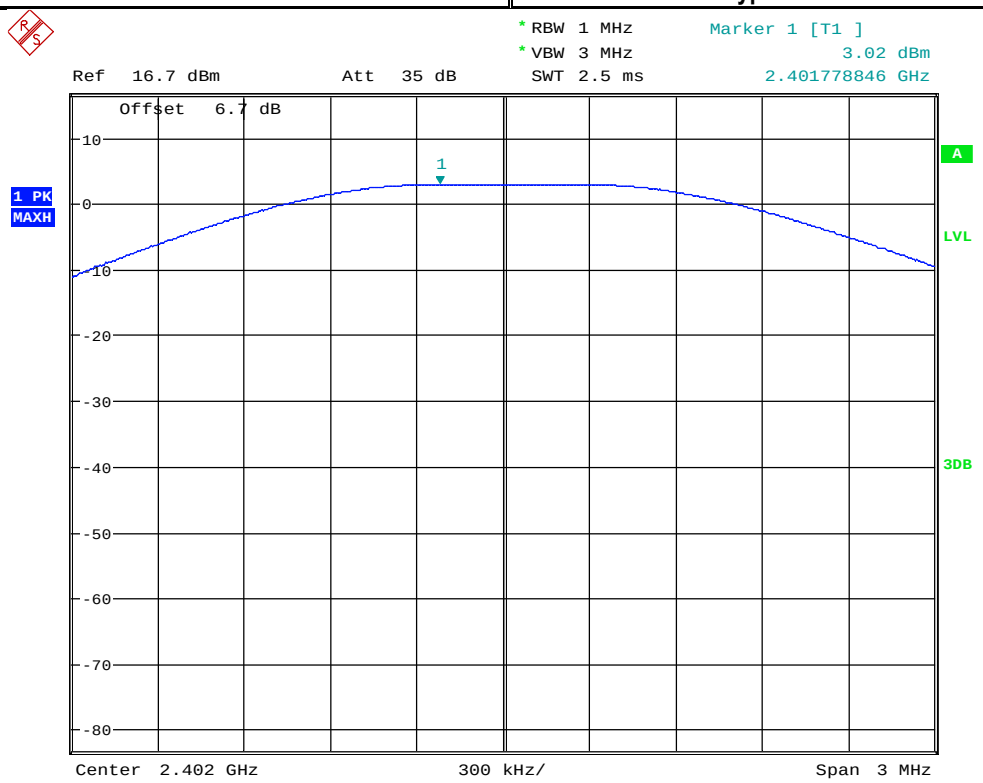
Plot # 1

Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK 1M



Plot # 2

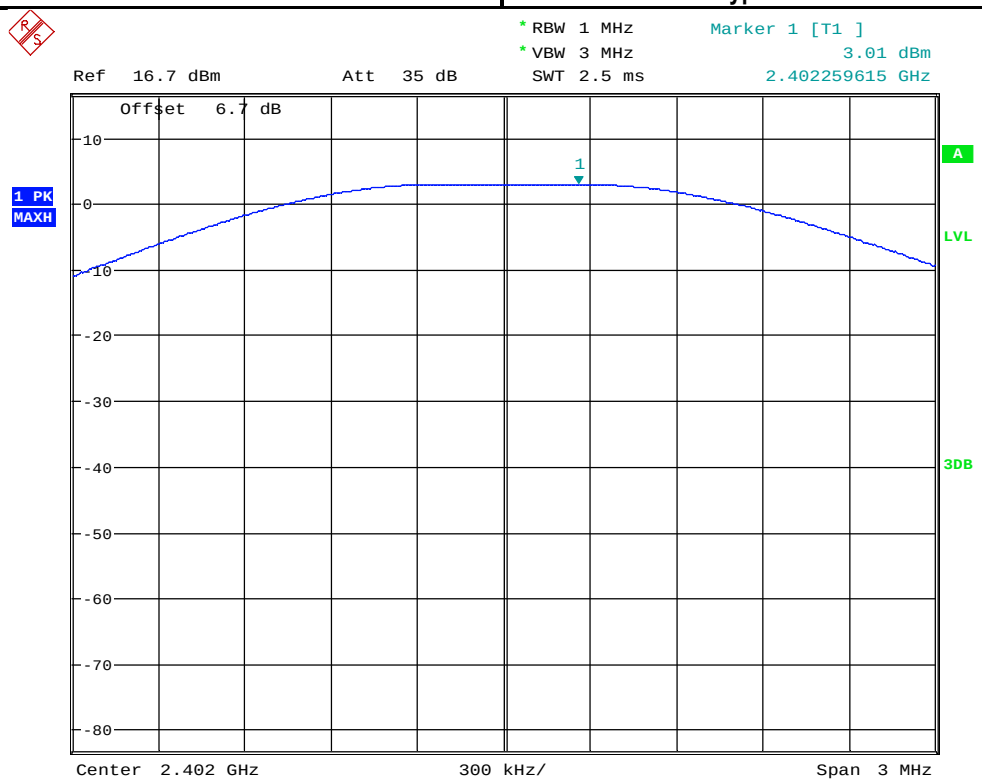
Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK 2M



Date: 18.FEB.2023 09:57:55

Plot # 3

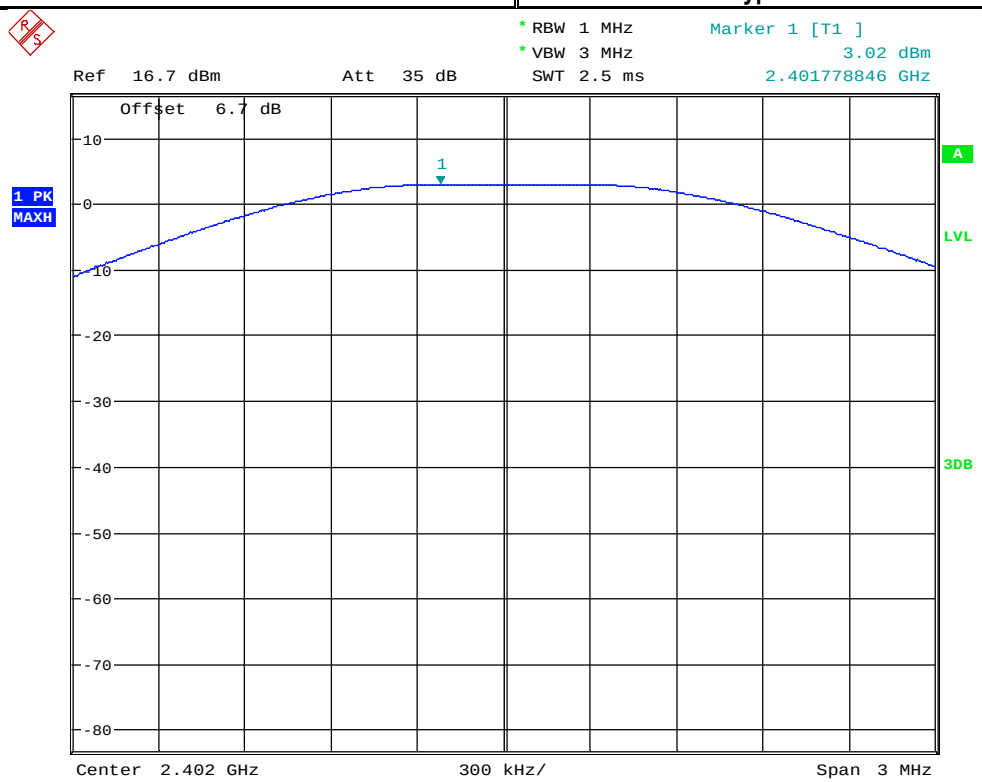
Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK S8



Date: 18.FEB.2023 09:56:59

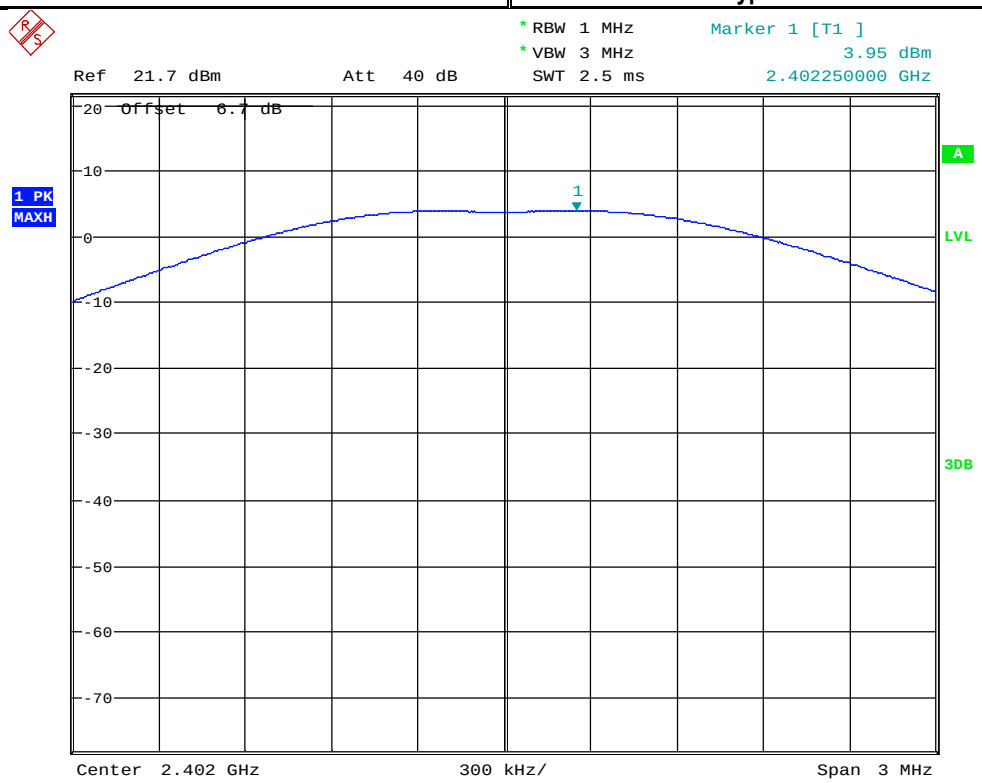
Plot # 4

Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK S2



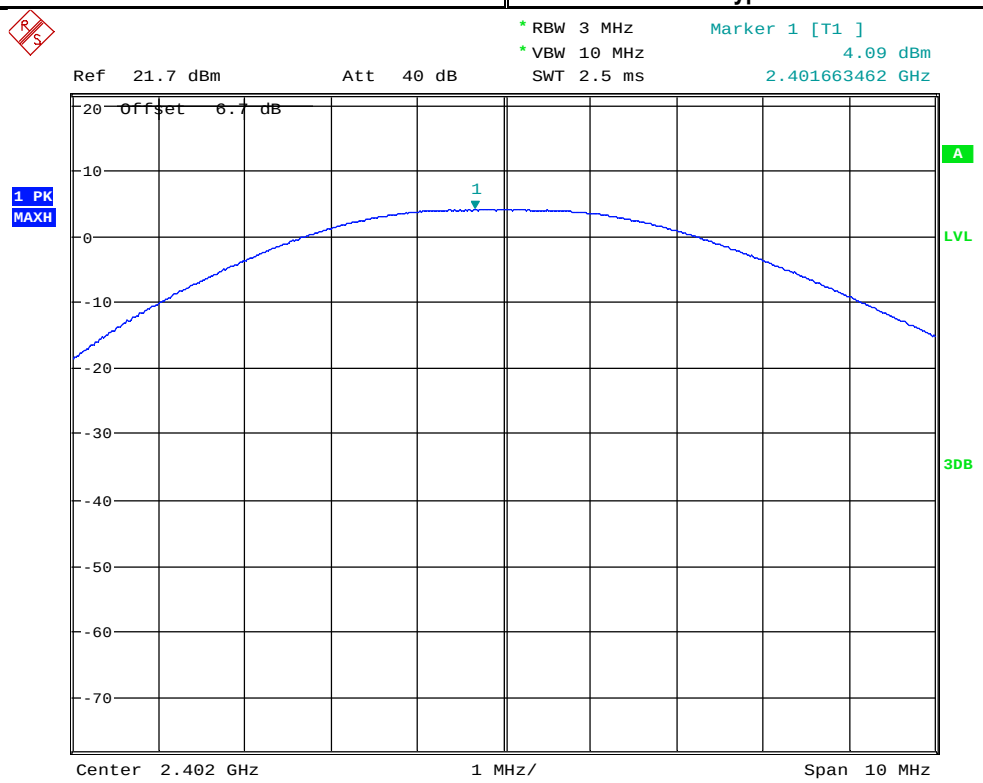
Plot # 5

Low channel / 2402 MHz | **Modulation/Packet Type: BTLE GFSK 1M**



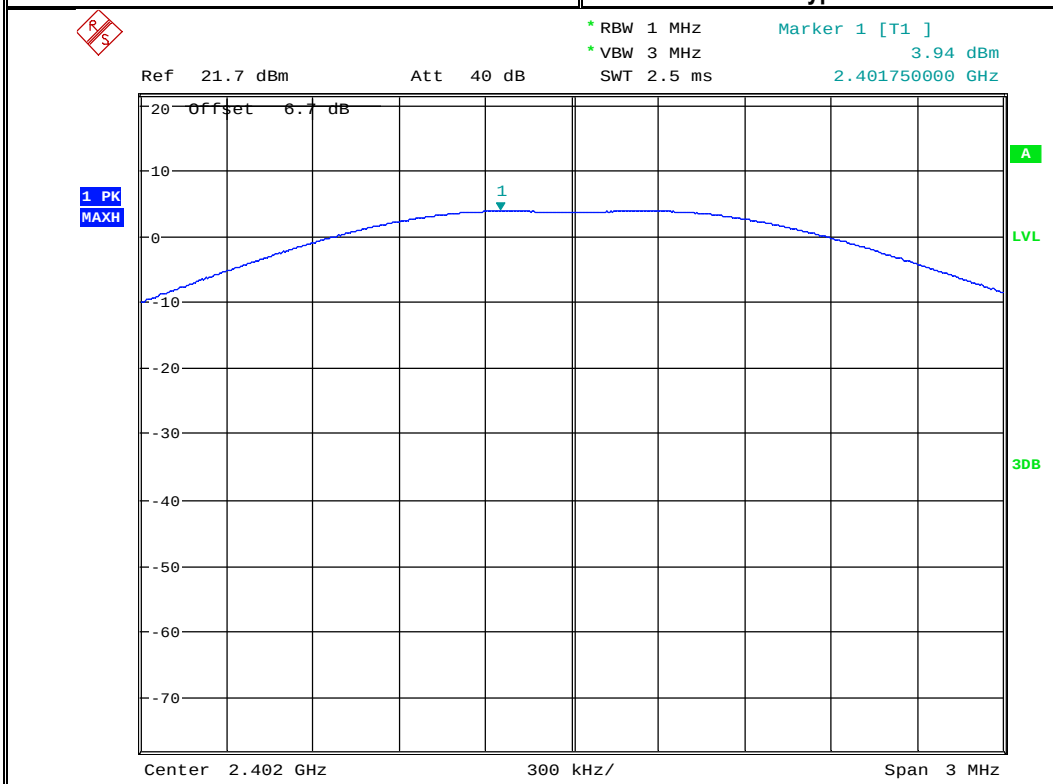
Plot # 6

Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK 2M



Plot # 7

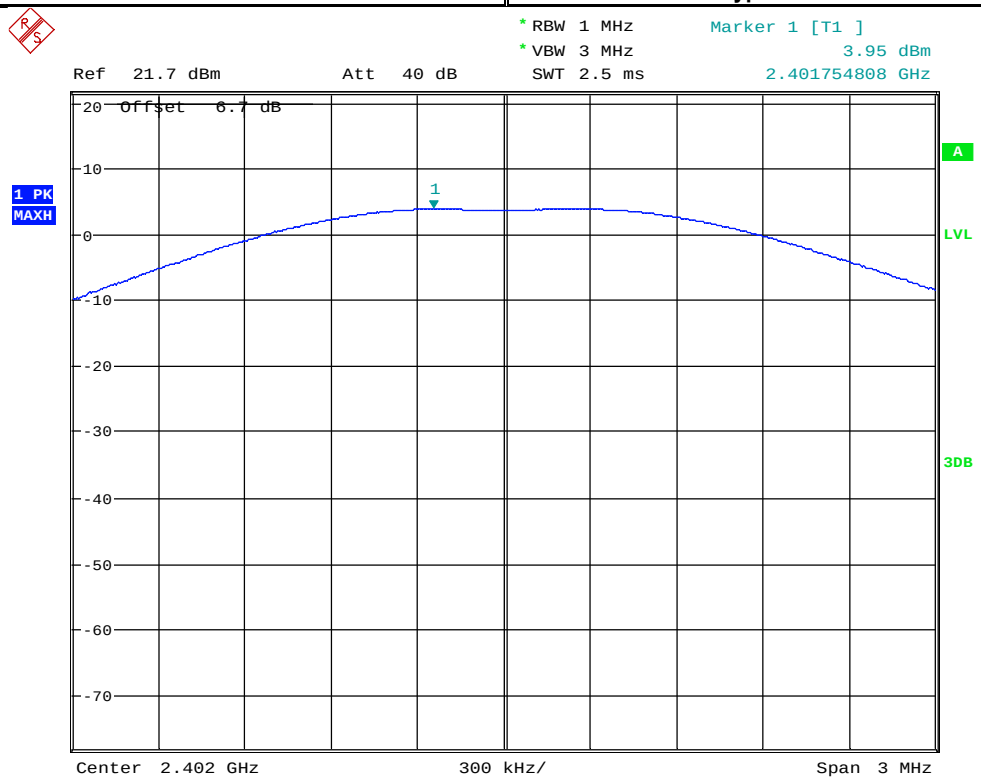
Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK S8



Date: 14.FEB.2023 11:10:23

Plot # 8

Low channel / 2402 MHz	Modulation/Packet Type: BTLE GFSK S2



8.2 Radiated Transmitter Spurious Emissions and Restricted Bands

8.2.1 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 at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.2.2 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

8.2.3 Test conditions and setup:

Ambient Temperature	EUT operating mode	Power supply	Antenna Gain
23°C	Op.2	13.8V DC	PT00781678: +7.04 dBi PT00891429: +6.7 dBi

8.2.4 Measurement result:

EUT Set-Up #	Plot #	Channel #	Scan Frequency	Lowest margin emission [dBµV/m] @ 3m	Limit	Result
2	9 – 11	Low	30 MHz – 18 GHz	43.90	See section 8.2.2	Pass
	12 – 16	Mid	9 kHz – 26 GHz	30.72	See section 8.2.2	Pass
	17 – 19	High	30 MHz – 18 GHz	26.78	See section 8.2.2	Pass
4	20 – 22	Low	30 MHz – 18 GHz	42.17	See section 8.2.2	Pass
	23 – 27	Mid	9 kHz – 26 GHz	40.51	See section 8.2.2	Pass
	28 – 30	High	30 MHz – 18 GHz	47.64	See section 8.2.2	Pass

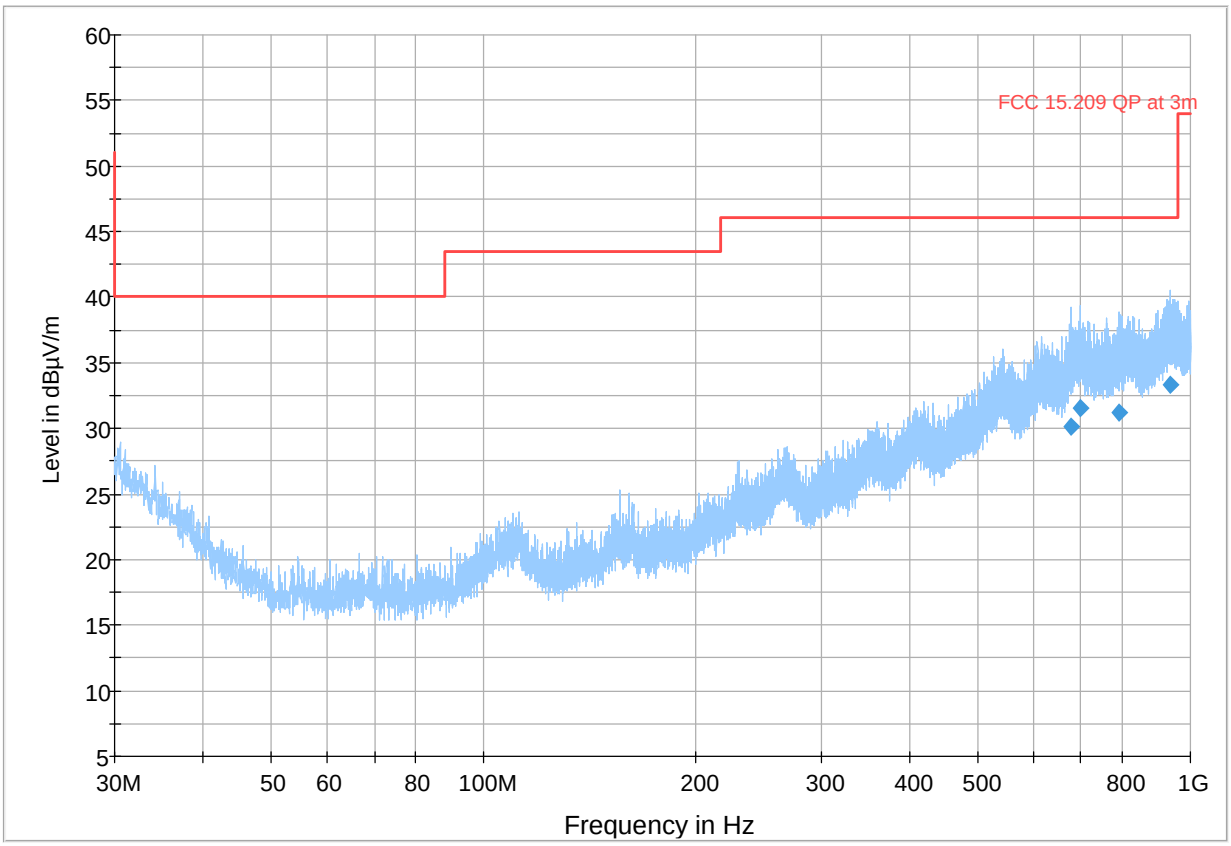
8.2.5 Measurement Plots:

Plot # 9 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2402 MHz	PHY: 1M

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
677.80	30.13	46.02	15.89	500.0	120.0	232.0	V	241.0	30.55
696.94	31.51	46.02	14.51	500.0	120.0	325.0	H	41.0	32.02
791.13	31.17	46.02	14.85	500.0	120.0	325.0	H	-26.0	31.52
936.11	33.29	46.02	12.73	500.0	120.0	277.0	H	178.0	33.66

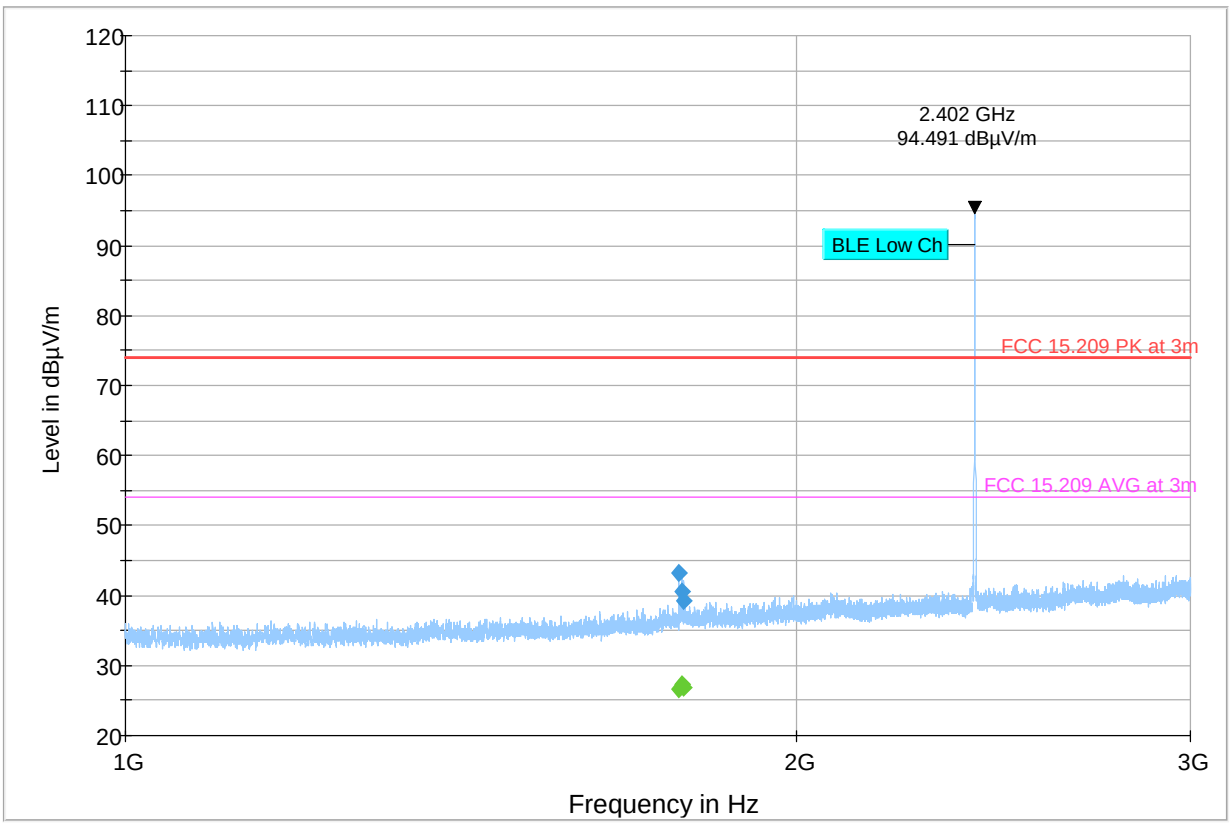


Plot # 10 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2402 MHz | **PHY: 1M**

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)
1770.71	---	26.56	53.98	27.42	500.0	1000.0	296.0	V	70.0	6.22
1770.71	43.27	---	73.98	30.71	500.0	1000.0	296.0	V	70.0	6.22
1775.14	40.64	---	73.98	33.34	500.0	1000.0	282.0	H	76.0	6.63
1775.14	---	27.39	53.98	26.59	500.0	1000.0	282.0	H	76.0	6.63
1779.14	39.26	---	73.98	34.72	500.0	1000.0	226.0	V	32.0	6.25
1779.14	---	26.90	53.98	27.08	500.0	1000.0	226.0	V	32.0	6.25

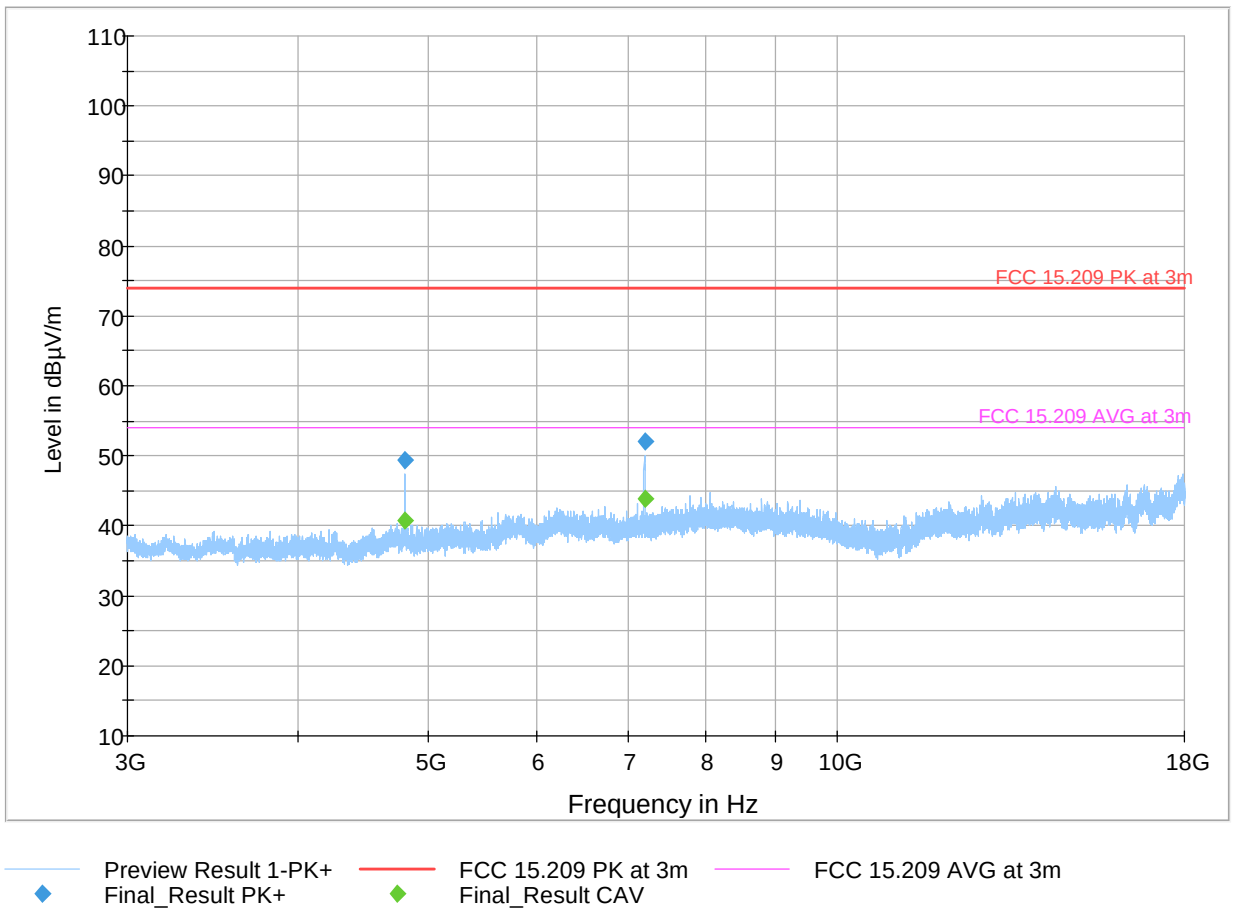


Plot # 11 Radiated Emissions: 3 – 18 GHz

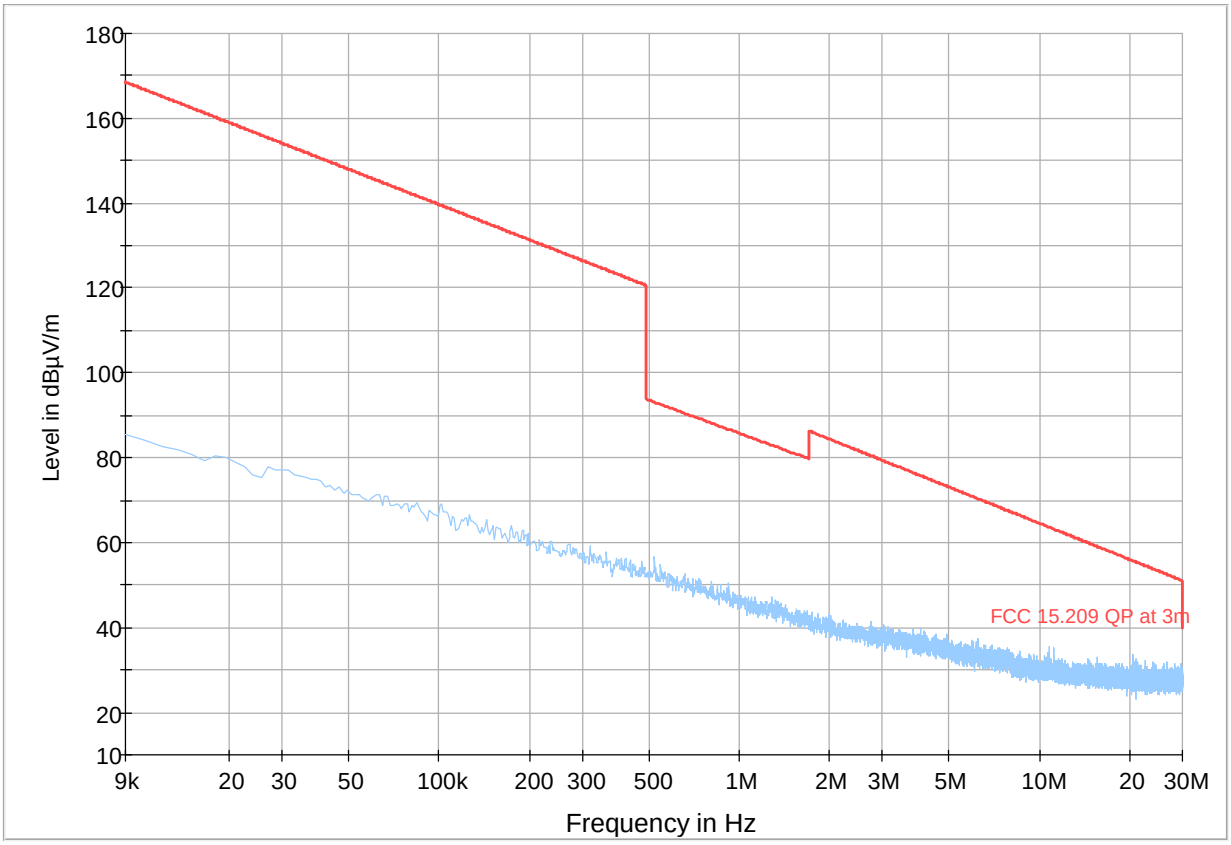
Tx Frequency: 2402 MHz | **PHY: 1M**

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)
4803.50	49.38	---	73.98	24.60	500.0	1000.0	252.0	V	92.0	-3.92
4803.50	---	40.72	53.98	13.26	500.0	1000.0	252.0	V	92.0	-3.92
7205.50	52.03	---	73.98	21.95	500.0	1000.0	150.0	H	113.0	0.83
7205.50	---	43.90	53.98	10.08	500.0	1000.0	150.0	H	113.0	0.83



Plot # 12 Radiated Emissions: 9 KHz – 30 MHz	
Tx Frequency: 2440 MHz	**PHY: 1M**

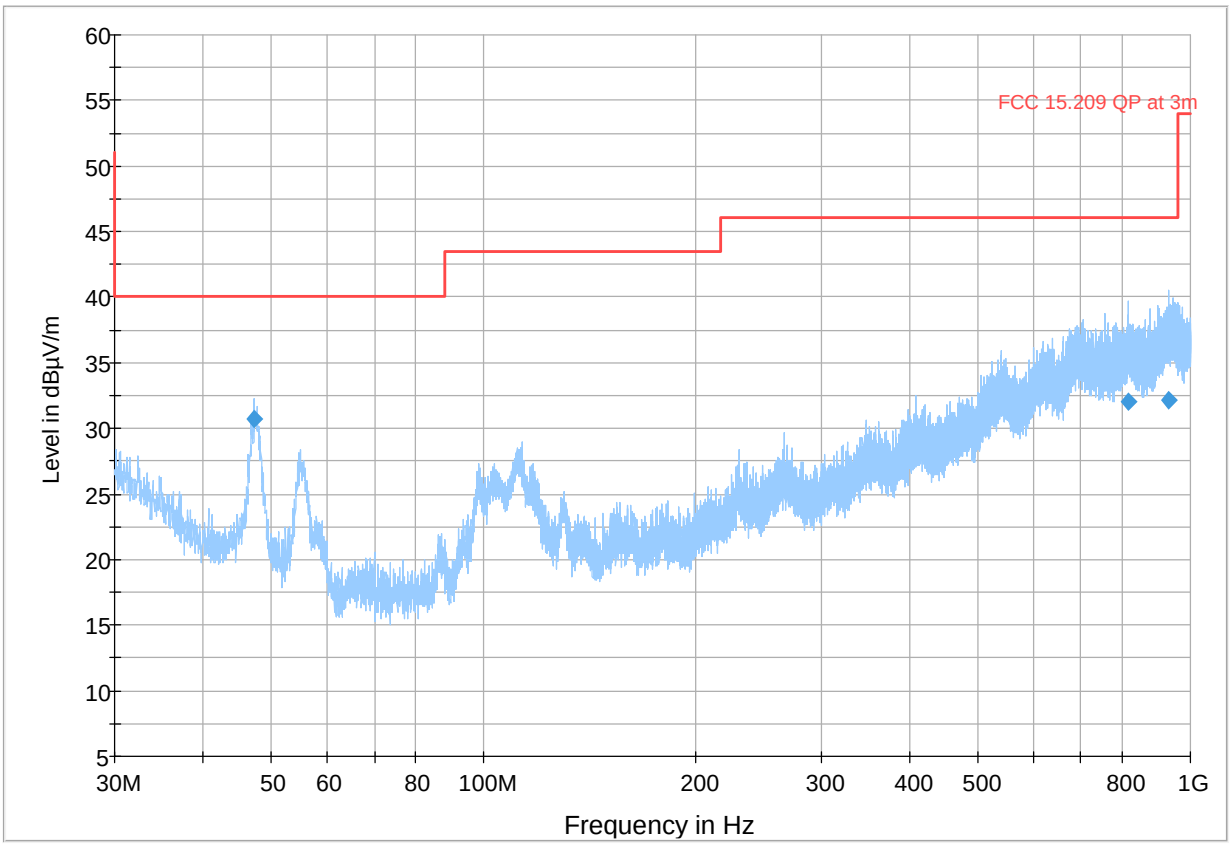


Plot # 13 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2440 MHz | **PHY: 1M**

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.33	30.72	40.00	9.28	500.0	120.0	150.0	V	207.0	13.92
817.58	32.00	46.02	14.02	500.0	120.0	285.0	H	-23.0	32.44
929.48	32.10	46.02	13.92	500.0	120.0	287.0	V	4.0	32.45

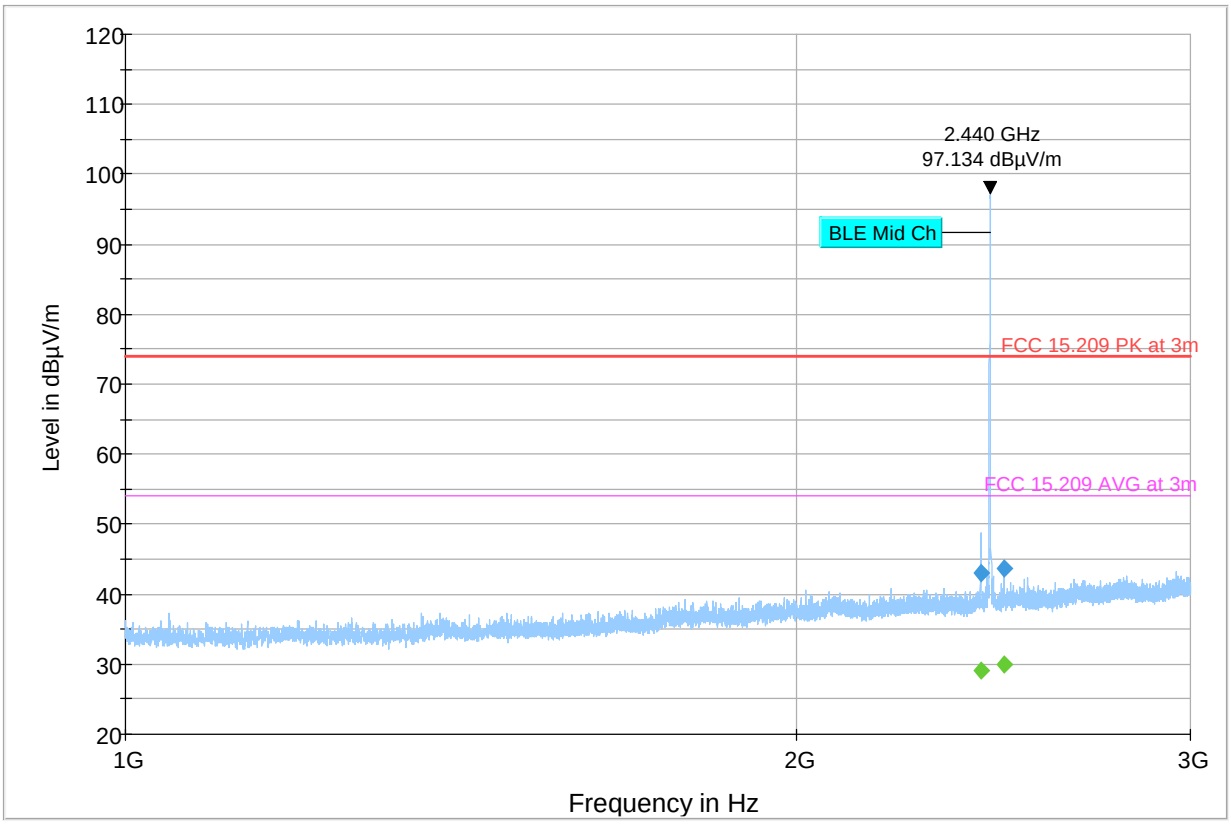


Plot # 14 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2440 MHz | **PHY: 1M**

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)
2415.86	---	29.14	53.98	24.84	500.0	1000.0	325.0	H	21.0	8.66
2415.86	43.06	---	73.98	30.92	500.0	1000.0	325.0	H	21.0	8.66
2476.57	---	29.96	53.98	24.02	500.0	1000.0	318.0	V	343.0	8.64
2476.57	43.73	---	73.98	30.25	500.0	1000.0	318.0	V	343.0	8.64

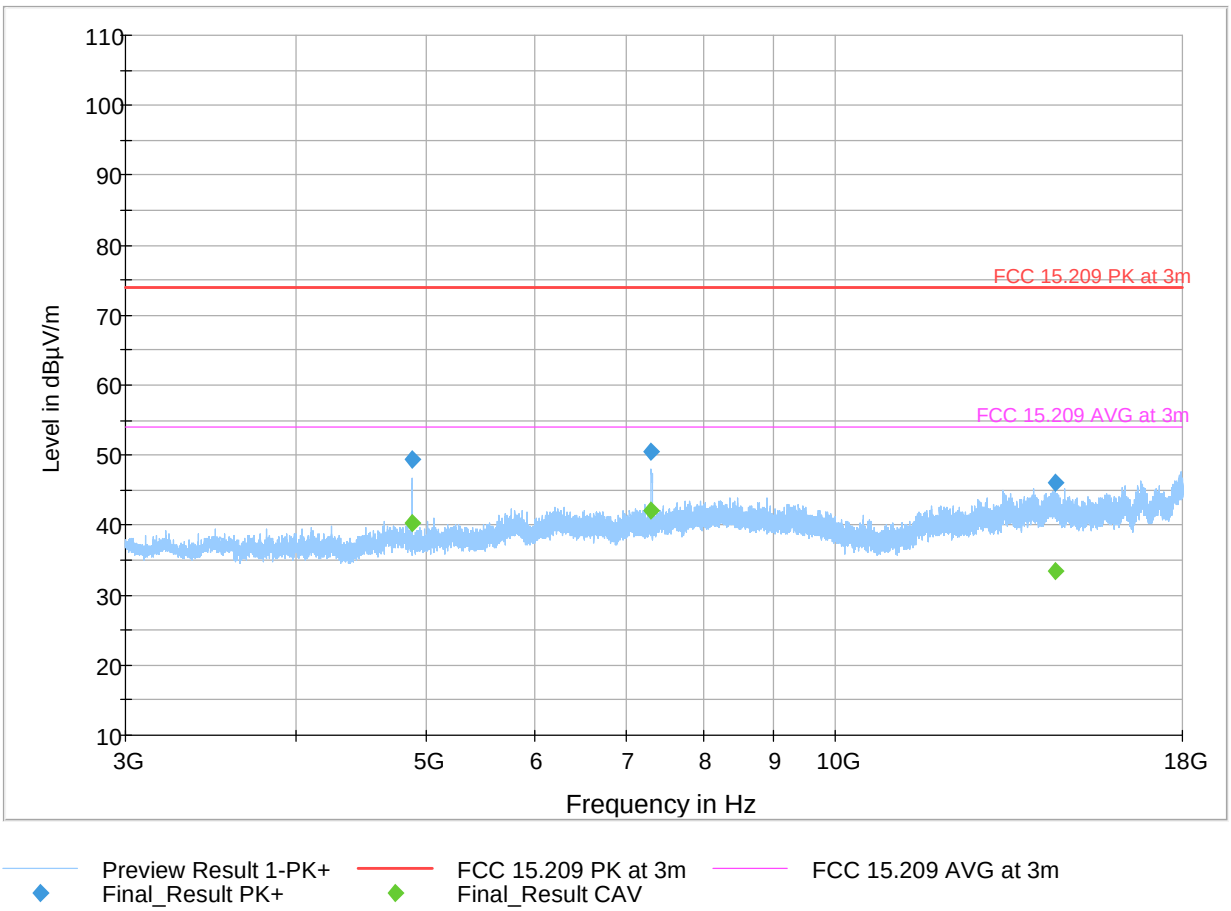


Plot # 15 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2440 MHz | **PHY: 1M**

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)
4879.50	---	40.23	53.98	13.75	500.0	1000.0	219.0	V	79.0	-4.43
4879.50	49.39	---	73.98	24.59	500.0	1000.0	219.0	V	79.0	-4.43
7319.50	50.59	---	73.98	23.39	500.0	1000.0	150.0	H	119.0	0.72
7319.50	---	42.09	53.98	11.88	500.0	1000.0	150.0	H	119.0	0.72
14517.50	46.09	---	73.98	27.89	500.0	1000.0	232.0	H	145.0	5.46
14517.50	---	33.55	53.98	20.43	500.0	1000.0	232.0	H	145.0	5.46

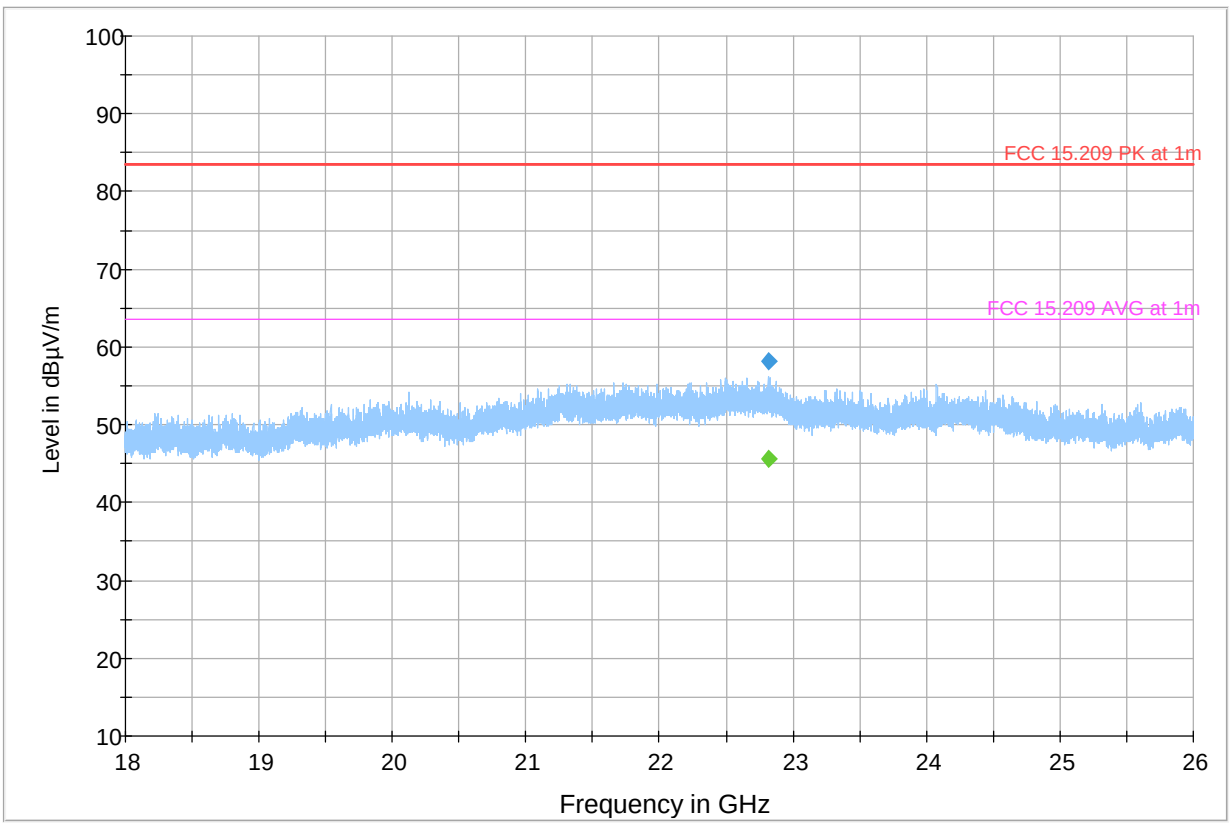


Plot # 16 Radiated Emissions: 18 – 26 GHz

Tx Frequency: 2440 MHz | **PHY: 1M**

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)
22813.00	---	45.58	63.50	17.92	500.0	1000.0	140.0	V	97.0	19.84
22813.00	58.24	---	83.50	25.26	500.0	1000.0	140.0	V	97.0	19.84

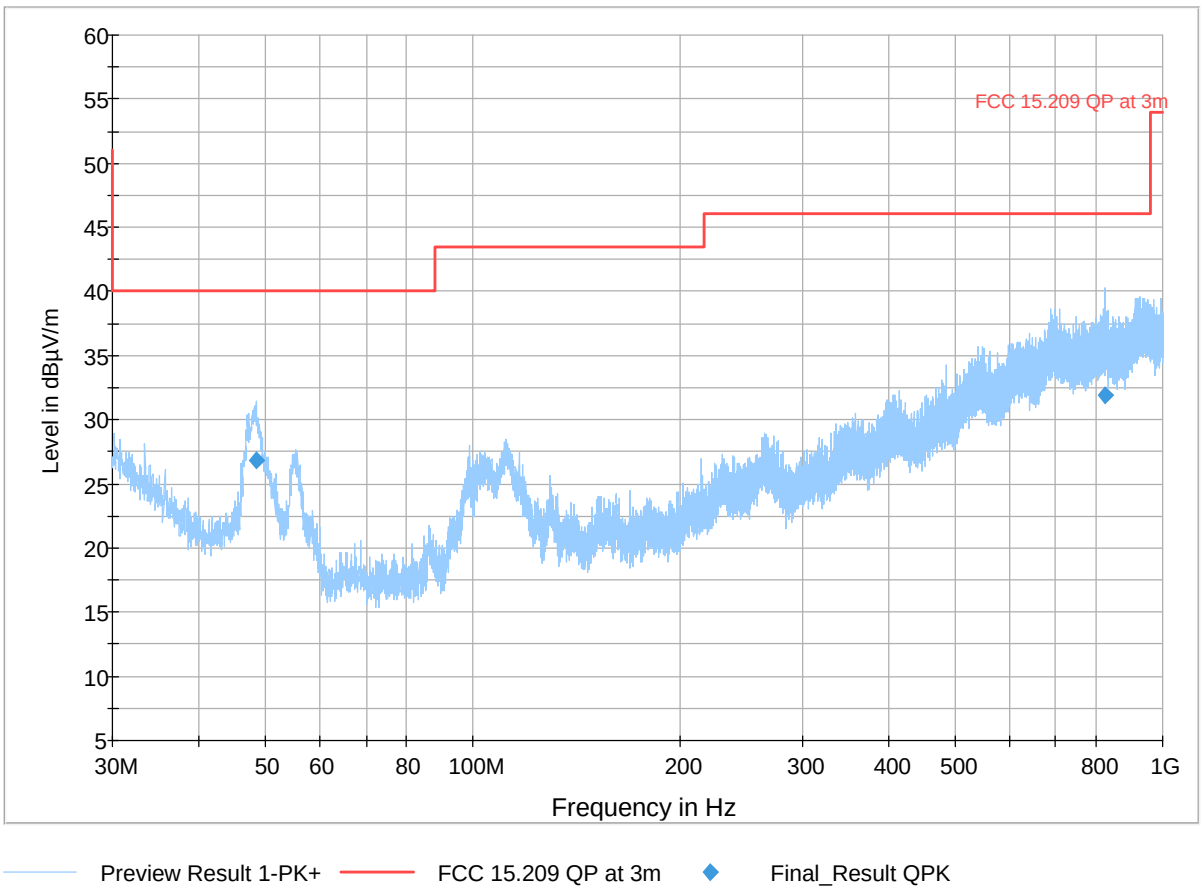


Plot # 17 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2480 MHz	PHY: 1M

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.43	26.78	40.00	13.22	500.0	120.0	174.0	V	165.0	13.78
825.95	31.89	46.02	14.13	500.0	120.0	240.0	H	1.0	32.38

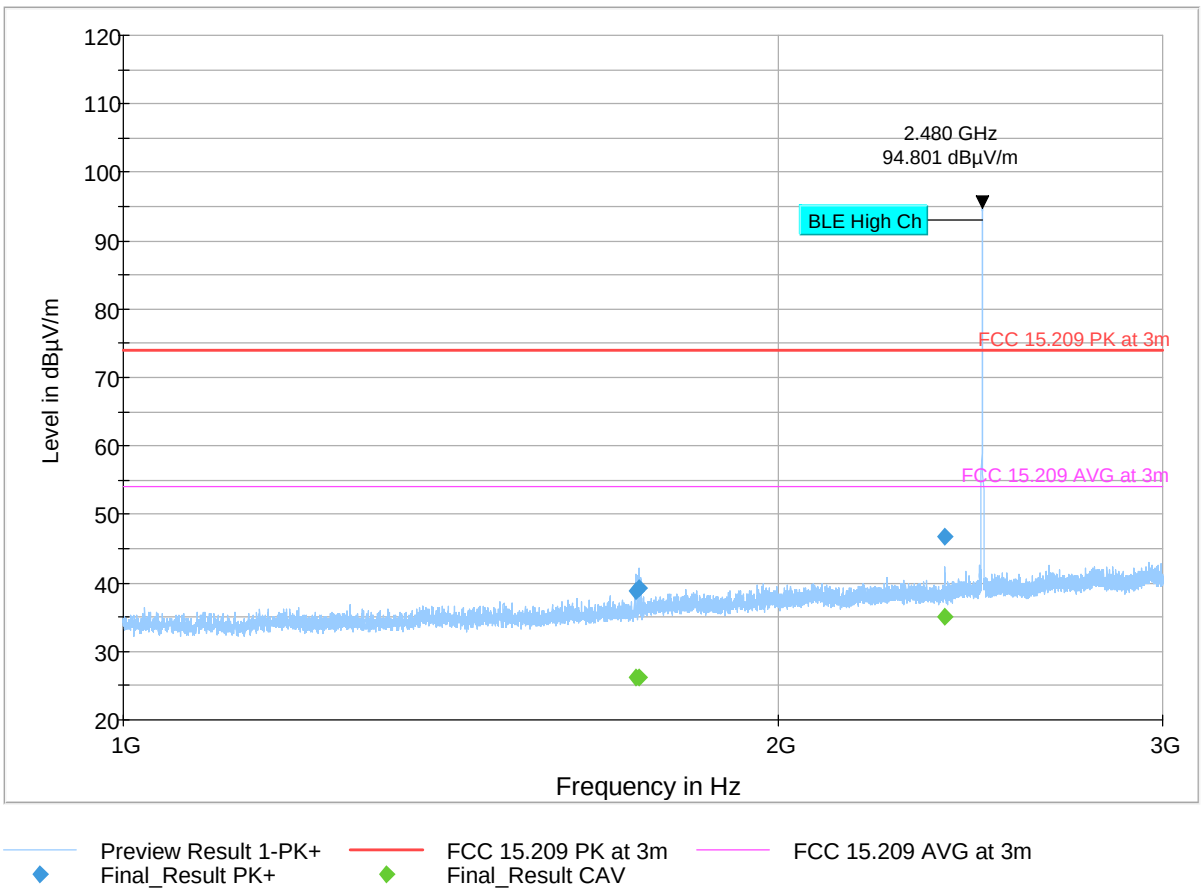


Plot # 18 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2480 MHz | **PHY: 1M**

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)
1718.86	---	26.27	53.98	27.71	500.0	1000.0	149.0	H	51.0	6.33
1718.86	38.87	---	73.98	35.11	500.0	1000.0	149.0	H	51.0	6.33
1725.71	---	26.29	53.98	27.69	500.0	1000.0	285.0	H	60.0	6.44
1725.71	39.22	---	73.98	34.76	500.0	1000.0	285.0	H	60.0	6.44
2384.00	---	35.04	53.98	18.94	500.0	1000.0	277.0	V	343.0	8.37
2384.00	46.75	---	73.98	27.23	500.0	1000.0	277.0	V	343.0	8.37

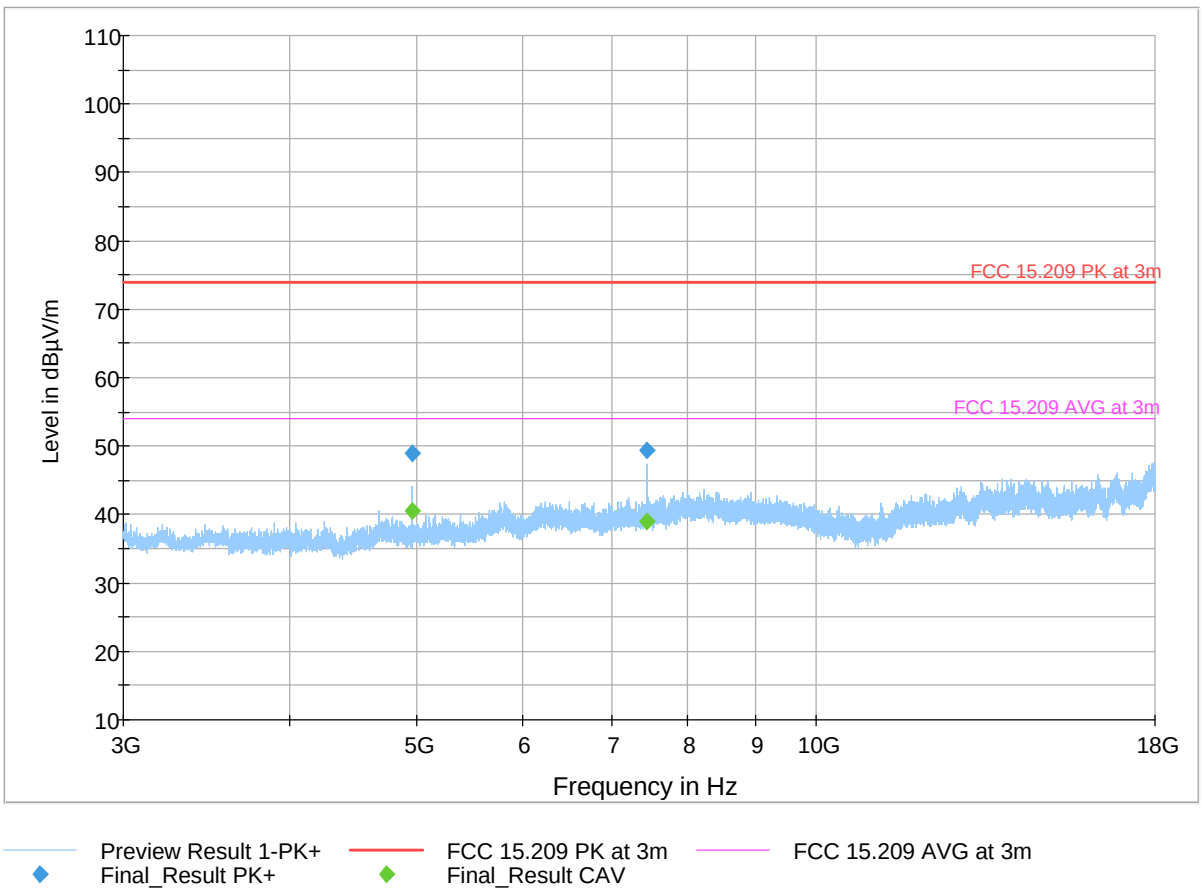


Plot # 19 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2480 MHz	PHY: 1M

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)
4960.50	48.86	---	73.98	25.12	500.0	1000.0	219.0	V	76.0	-4.42
4960.50	---	40.42	53.98	13.56	500.0	1000.0	219.0	V	76.0	-4.42
7441.00	49.38	---	73.98	24.60	500.0	1000.0	164.0	H	123.0	1.01
7441.00	---	39.03	53.98	14.95	500.0	1000.0	164.0	H	123.0	1.01

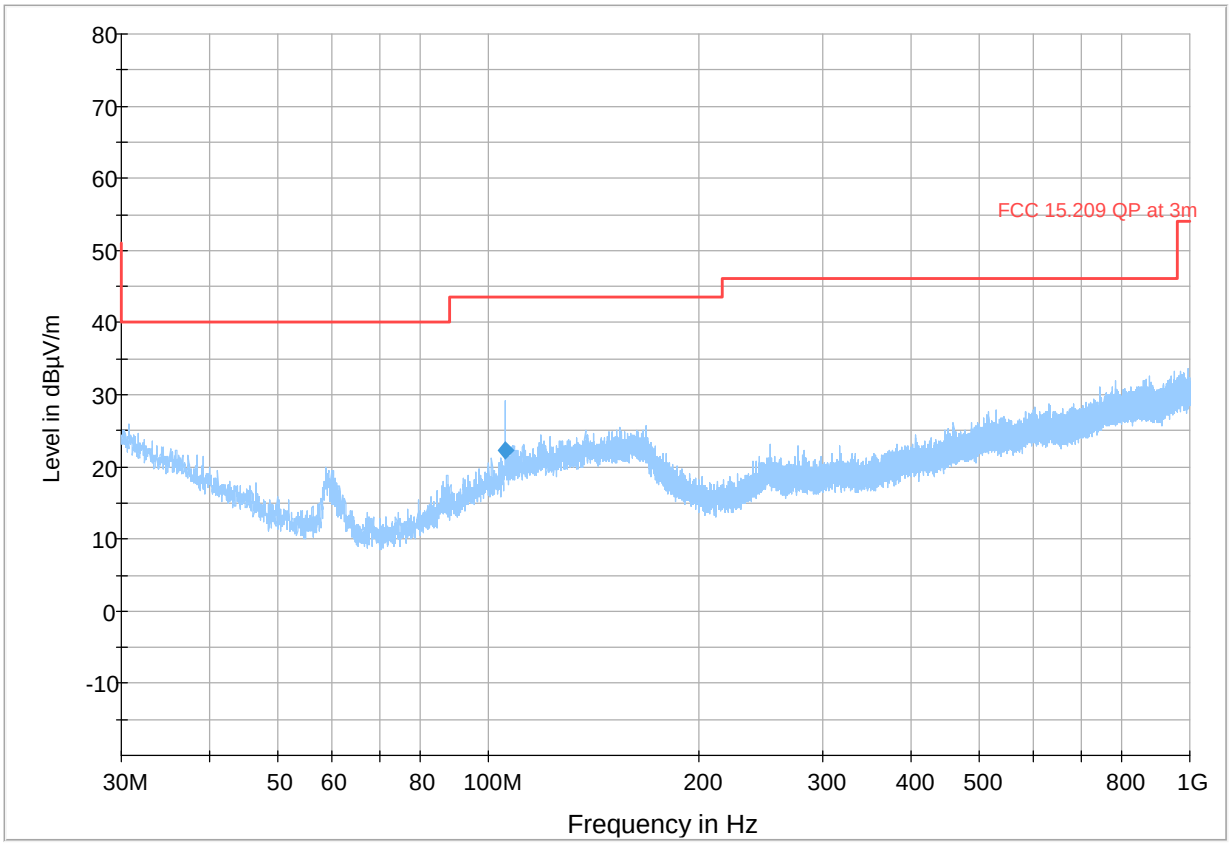


Plot # 20 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2402 MHz | **PHY: 2M**

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
105.66	22.22	43.50	21.28	500.0	120.0	100.0	V	52.0	21.9

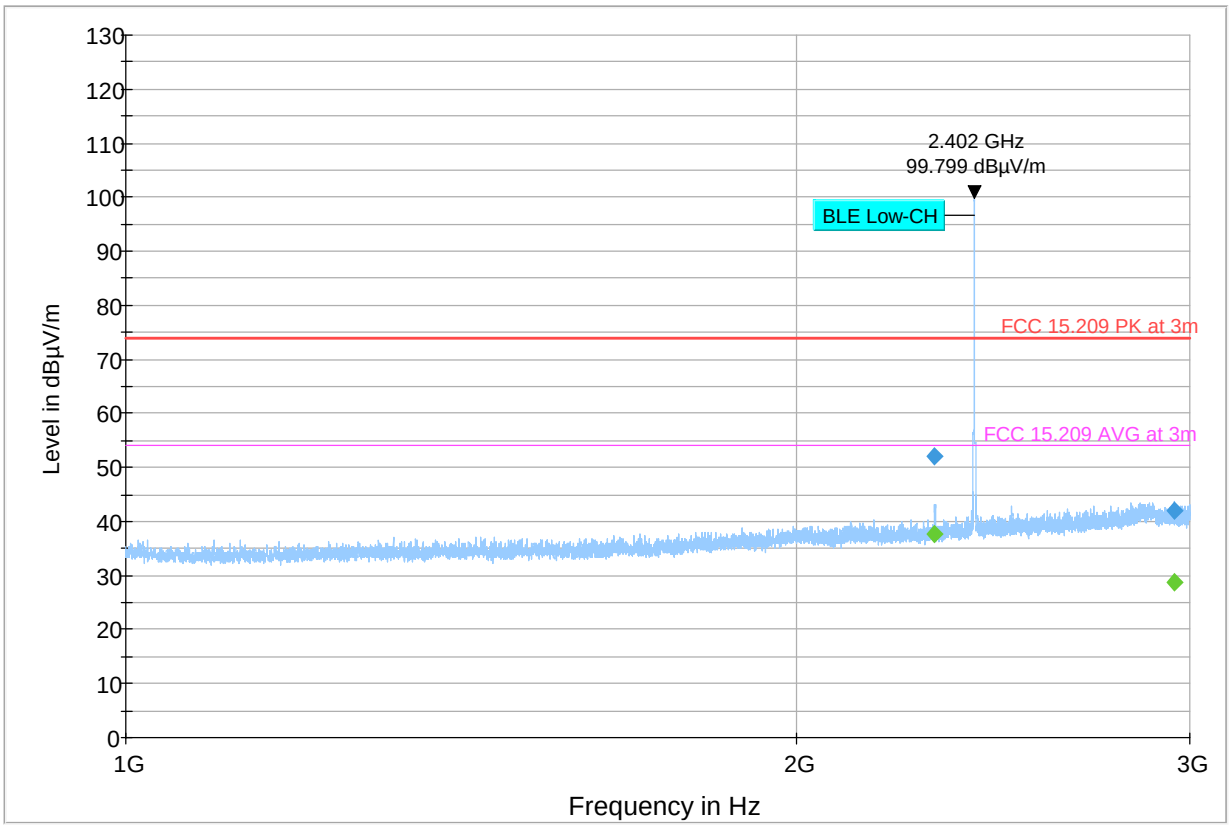


Plot # 21 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2402 MHz | **PHY: 2M**

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)
2305.86	51.94	---	73.98	22.04	500.0	1000.0	142.0	H	170.0	5.9
2305.86	---	37.77	53.98	16.21	500.0	1000.0	142.0	H	170.0	5.9
2951.43	42.09	---	73.98	31.89	500.0	1000.0	277.0	V	309.0	8.4
2951.43	---	28.88	53.98	25.10	500.0	1000.0	277.0	V	309.0	8.4

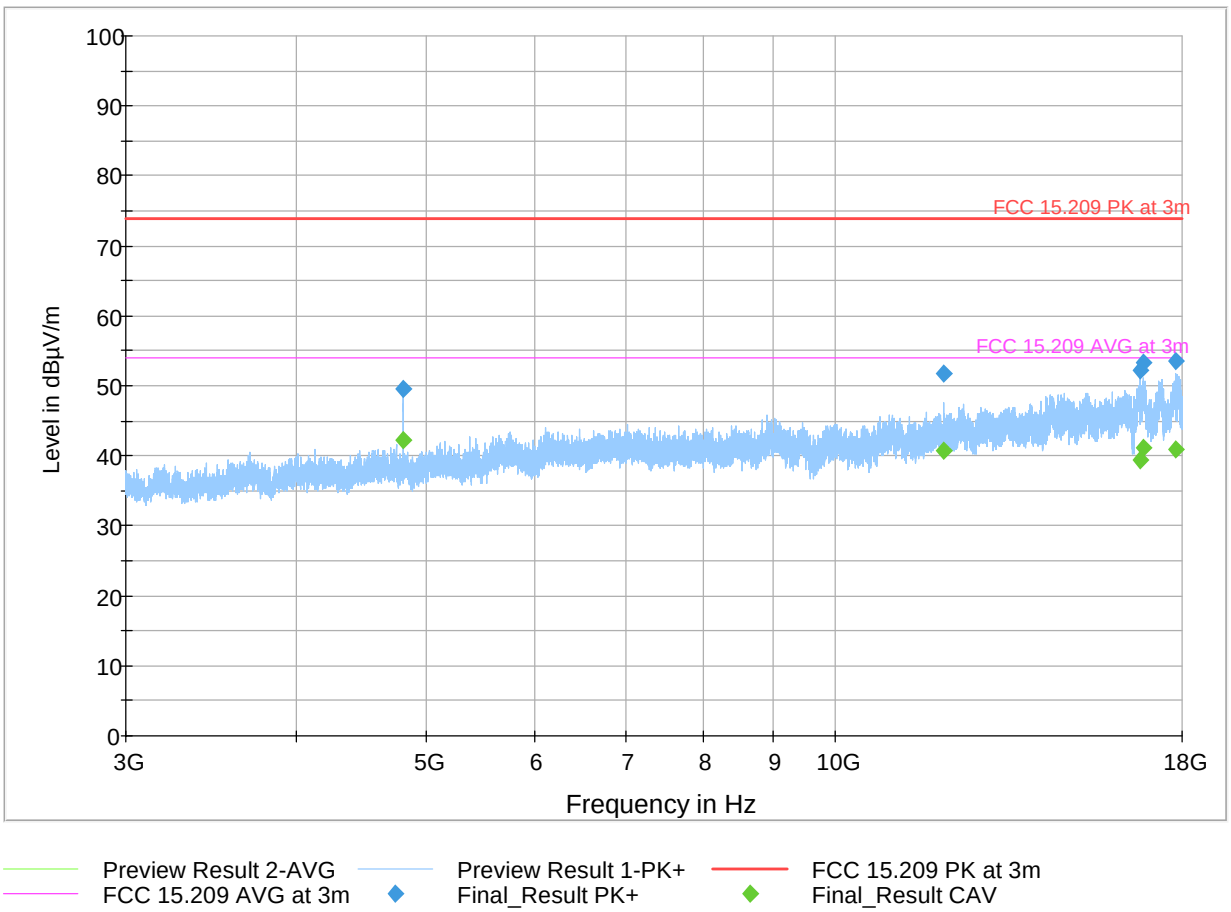


Plot # 22 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2402 MHz | **PHY: 2M**

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)
4804.25	---	42.17	53.98	11.81	500.0	1000.0	196.0	H	193.0	-3.3
4804.25	49.56	---	73.98	24.42	500.0	1000.0	196.0	H	193.0	-3.3
12011.00	51.83	---	73.98	22.15	500.0	1000.0	107.0	V	165.0	4.9
12011.00	---	40.70	53.98	13.28	500.0	1000.0	107.0	V	165.0	4.9
16748.75	52.11	---	73.98	21.87	500.0	1000.0	167.0	H	-90.0	13.7
16748.75	---	39.29	53.98	14.69	500.0	1000.0	167.0	H	-90.0	13.7
16856.75	53.40	---	73.98	20.58	500.0	1000.0	126.0	H	71.0	14.3
16856.75	---	41.05	53.98	12.93	500.0	1000.0	126.0	H	71.0	14.3
17802.25	53.44	---	73.98	20.54	500.0	1000.0	154.0	H	87.0	17.8
17802.25	---	40.86	53.98	13.12	500.0	1000.0	154.0	H	87.0	17.8

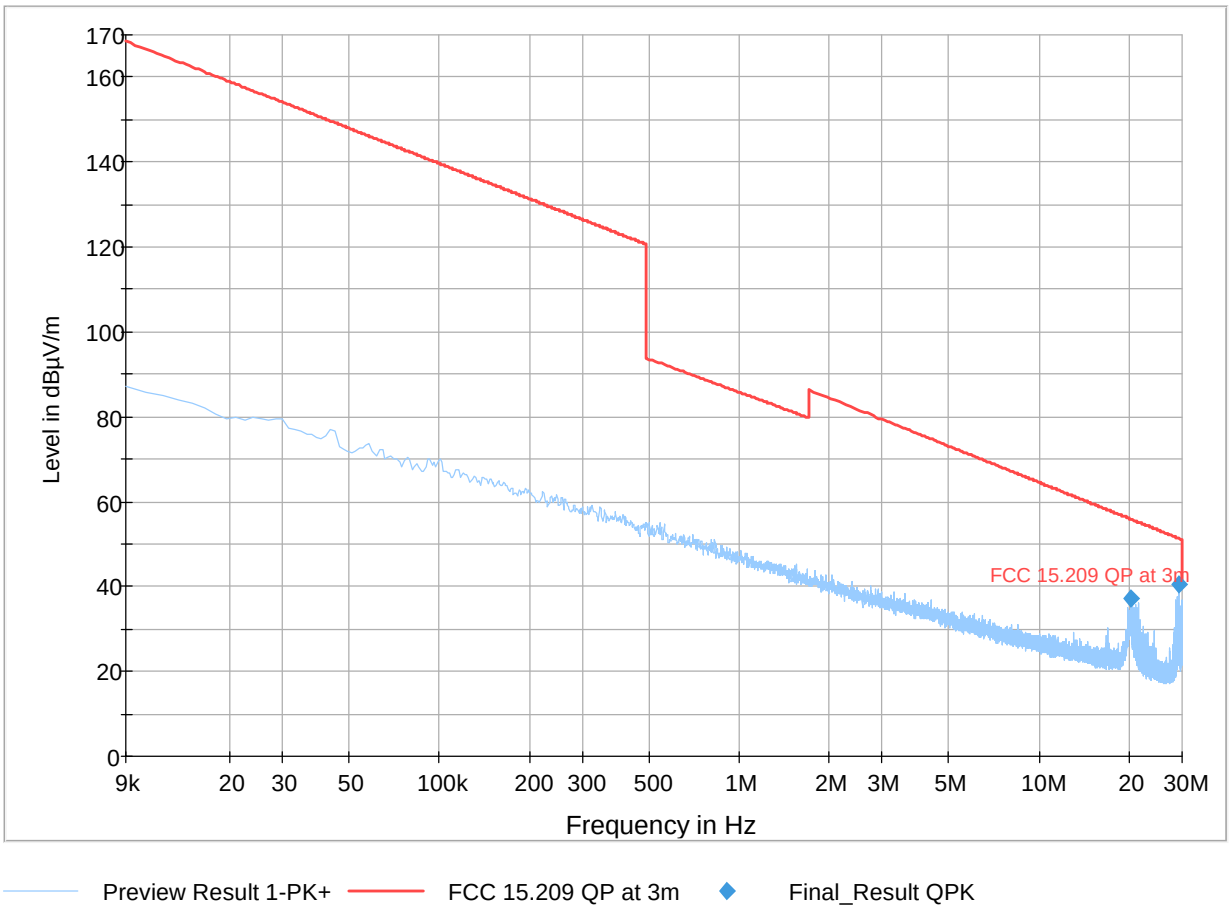


Plot # 23 Radiated Emissions: 9 KHz – 30 MHz

Tx Frequency: 2440 MHz | **PHY: 2M**

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20.20	37.26	55.91	18.65	500.0	9.0	100.0	H	-39.0	16.5
29.24	40.51	51.36	10.85	500.0	9.0	100.0	H	222.0	15.9

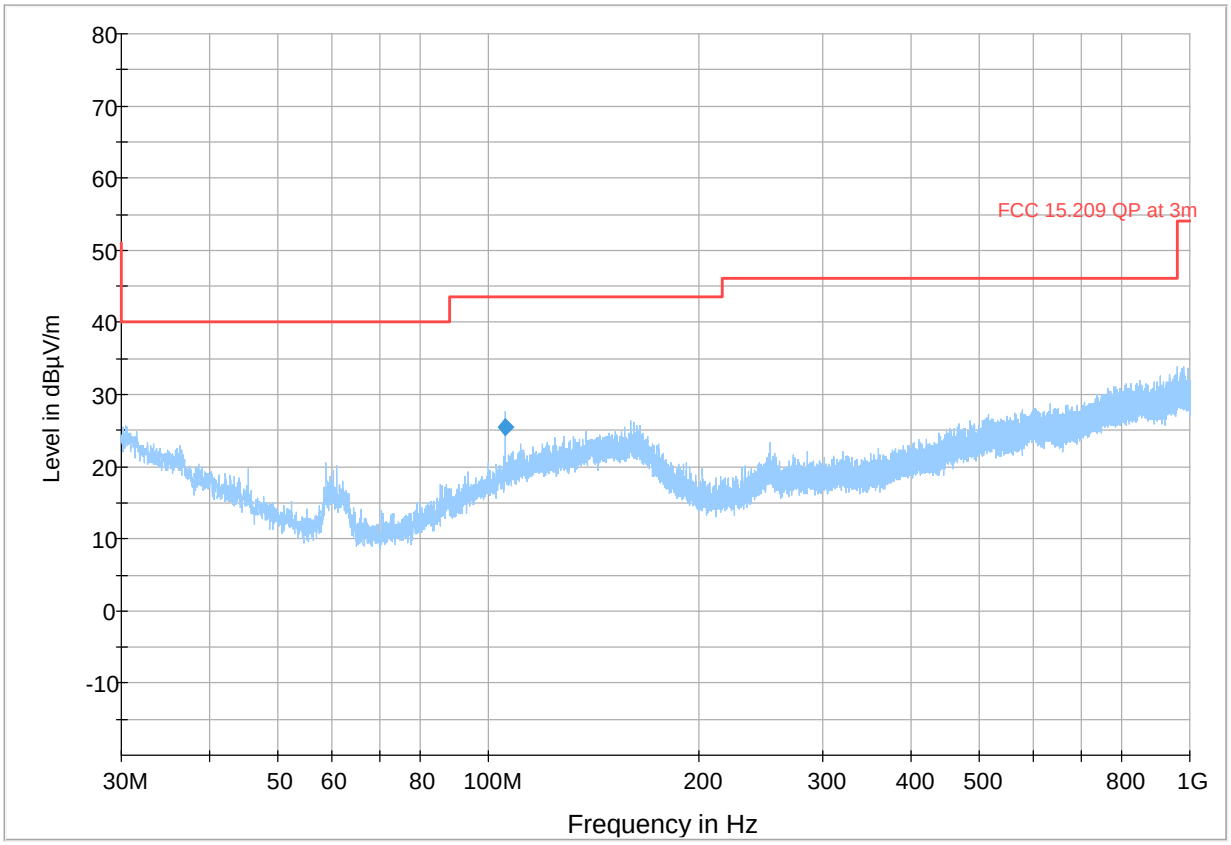


Plot # 24 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2440 MHz | **PHY: 2M**

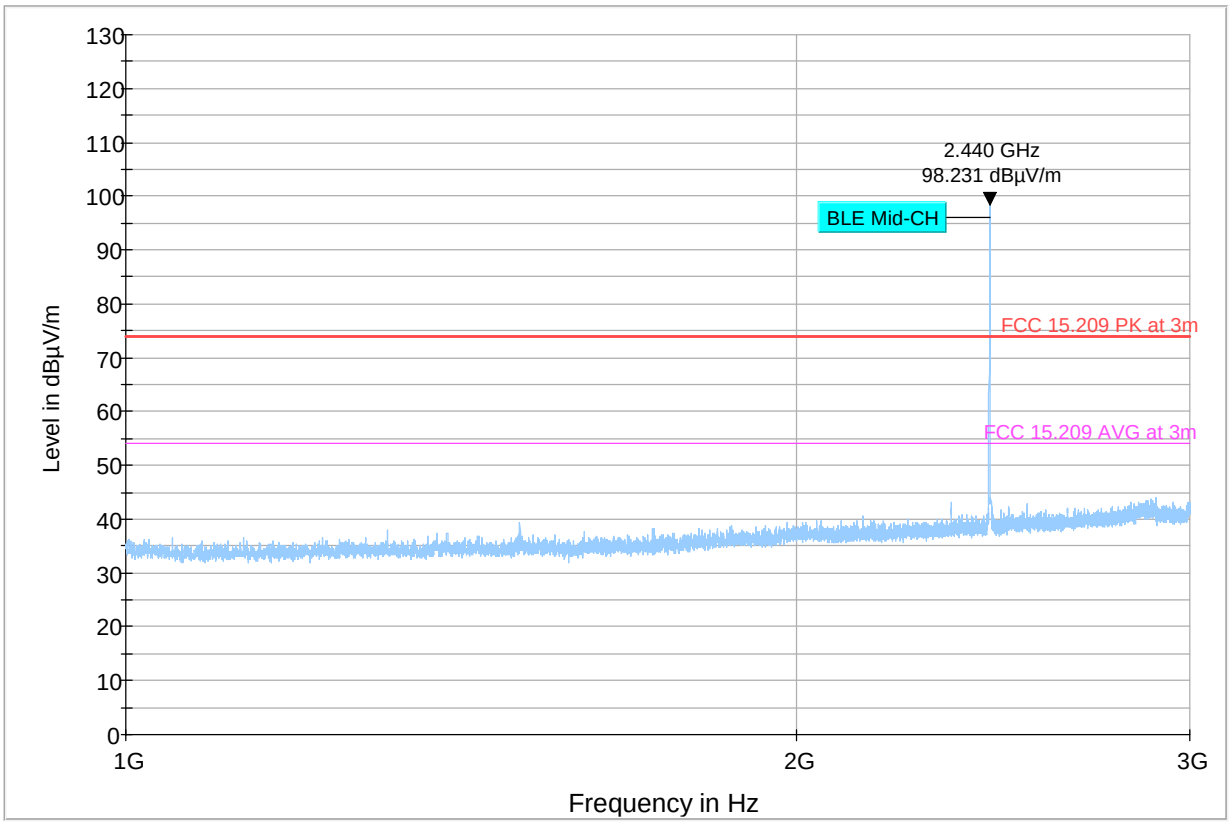
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
105.68	25.41	43.50	18.09	500.0	120.0	144.0	V	70.0	22.0



Plot # 25 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2440 MHz	PHY: 2M

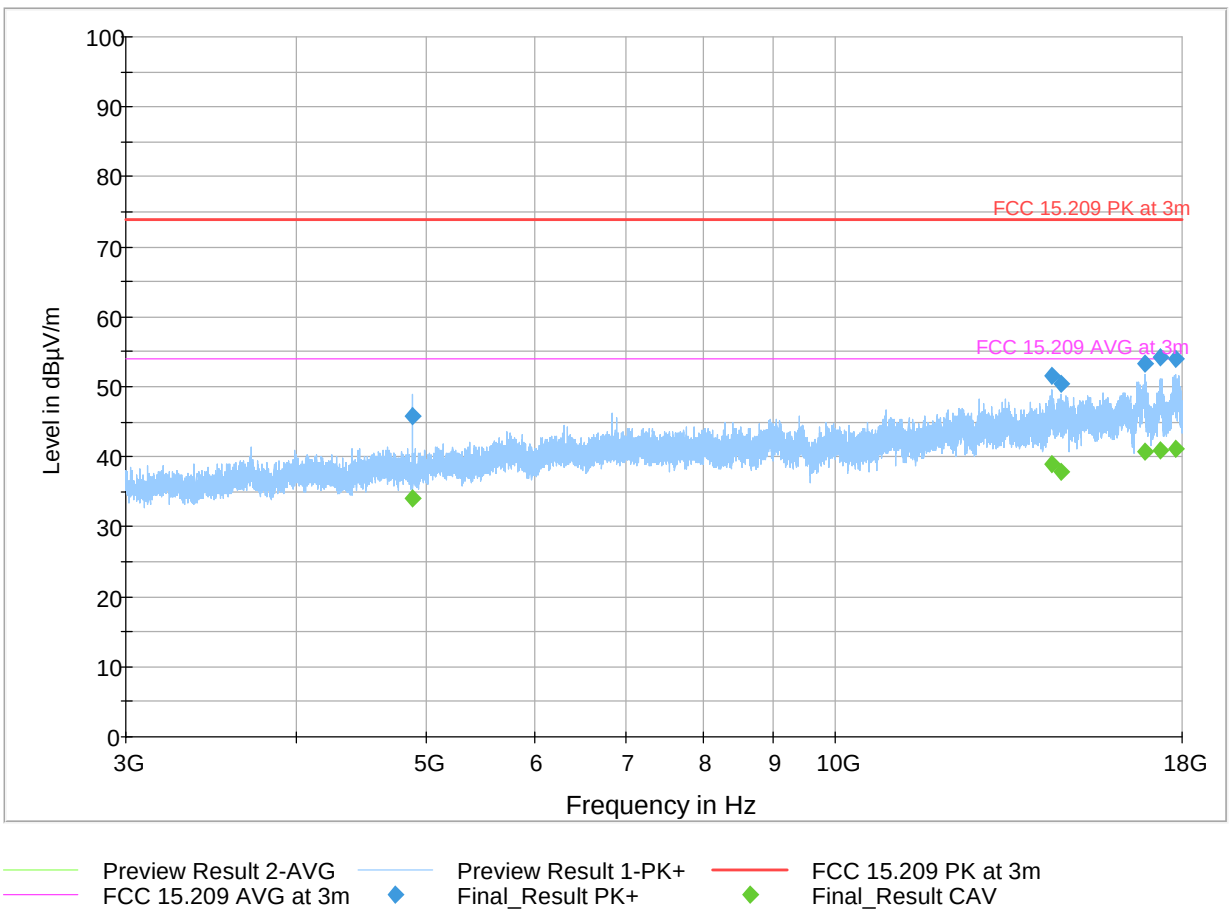


Plot # 26 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2440 MHz | **PHY: 2M**

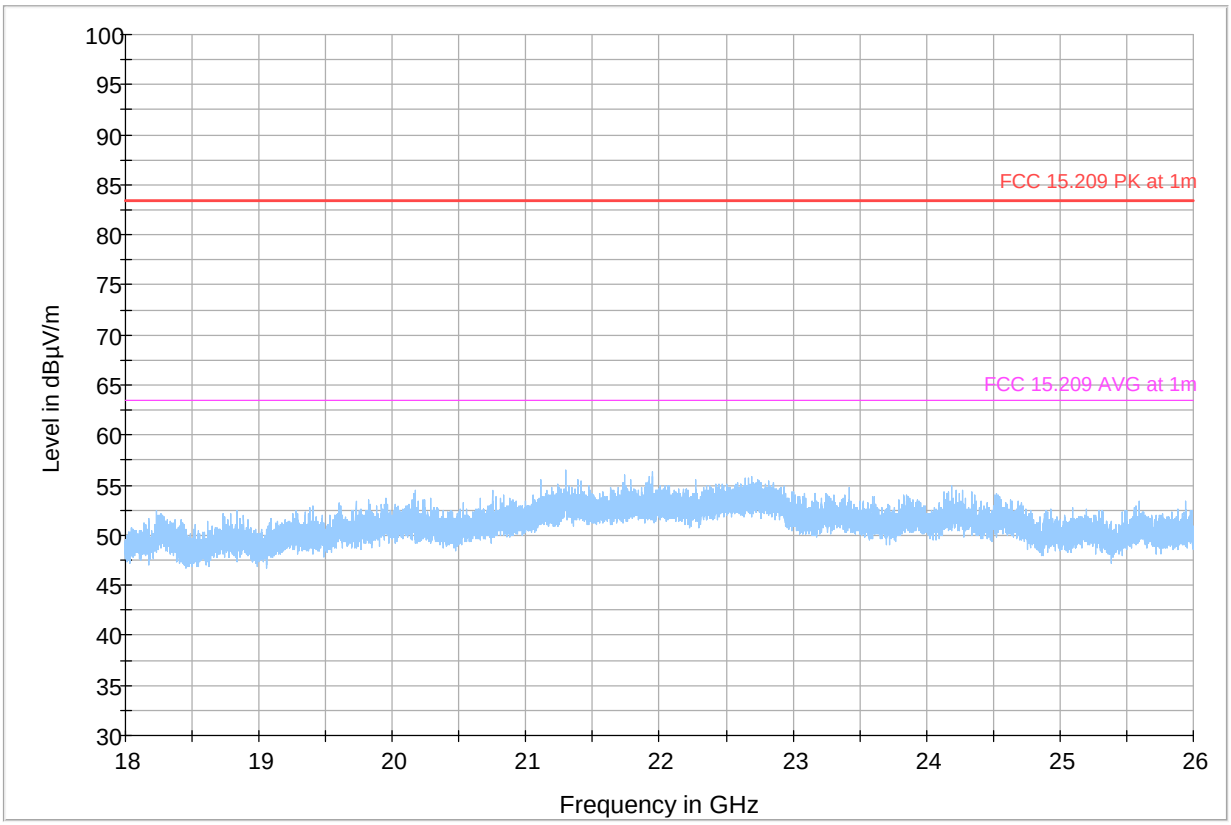
Final_Result

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)
4879.25	45.81	---	73.98	28.17	500.0	1000.0	303.0	H	192.0	-3.8
4879.25	---	34.13	53.98	19.85	500.0	1000.0	303.0	H	192.0	-3.8
14441.75	---	39.02	53.98	14.96	500.0	1000.0	151.0	H	113.0	9.2
14441.75	51.55	---	73.98	22.43	500.0	1000.0	151.0	H	113.0	9.2
14683.50	---	37.79	53.98	16.18	500.0	1000.0	160.0	V	-89.0	8.9
14683.50	50.44	---	73.98	23.54	500.0	1000.0	160.0	V	-89.0	8.9
16913.50	---	40.77	53.98	13.21	500.0	1000.0	159.0	H	-81.0	14.0
16913.50	53.33	---	73.98	20.65	500.0	1000.0	159.0	H	-81.0	14.0
17372.50	---	40.93	53.98	13.05	500.0	1000.0	284.0	V	170.0	15.9
17372.50	54.18	---	73.98	19.80	500.0	1000.0	284.0	V	170.0	15.9
17791.25	54.06	---	73.98	19.91	500.0	1000.0	134.0	H	3.0	17.6
17791.25	---	41.22	53.98	12.76	500.0	1000.0	134.0	H	3.0	17.6



Plot # 27 Radiated Emissions: 18 – 26 GHz

Tx Frequency: 2440 MHz	PHY: 2M

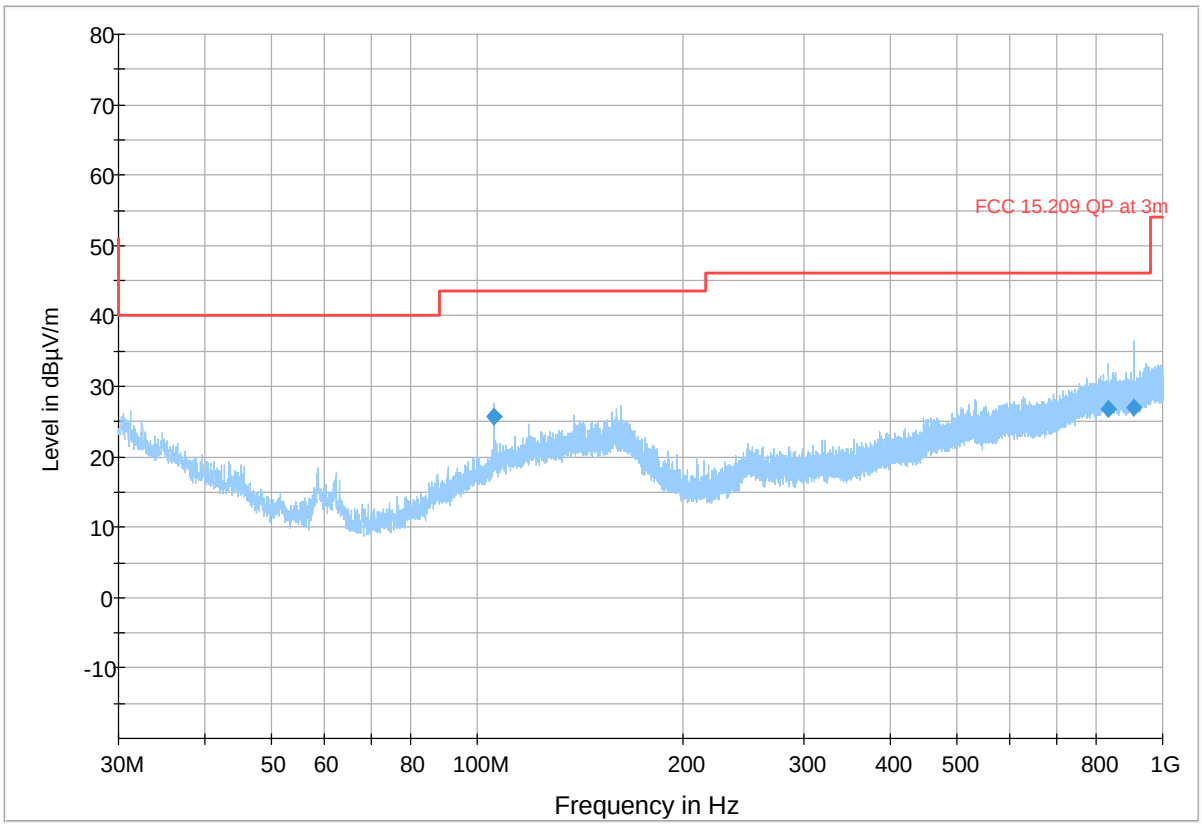


Plot # 28 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2480 MHz	PHY: 2M

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
105.66	25.76	43.50	17.74	500.0	120.0	152.0	V	90.0	21.9
834.88	26.71	46.02	19.31	500.0	120.0	175.0	H	77.0	31.0
908.63	27.03	46.02	18.99	500.0	120.0	125.0	V	291.0	31.5

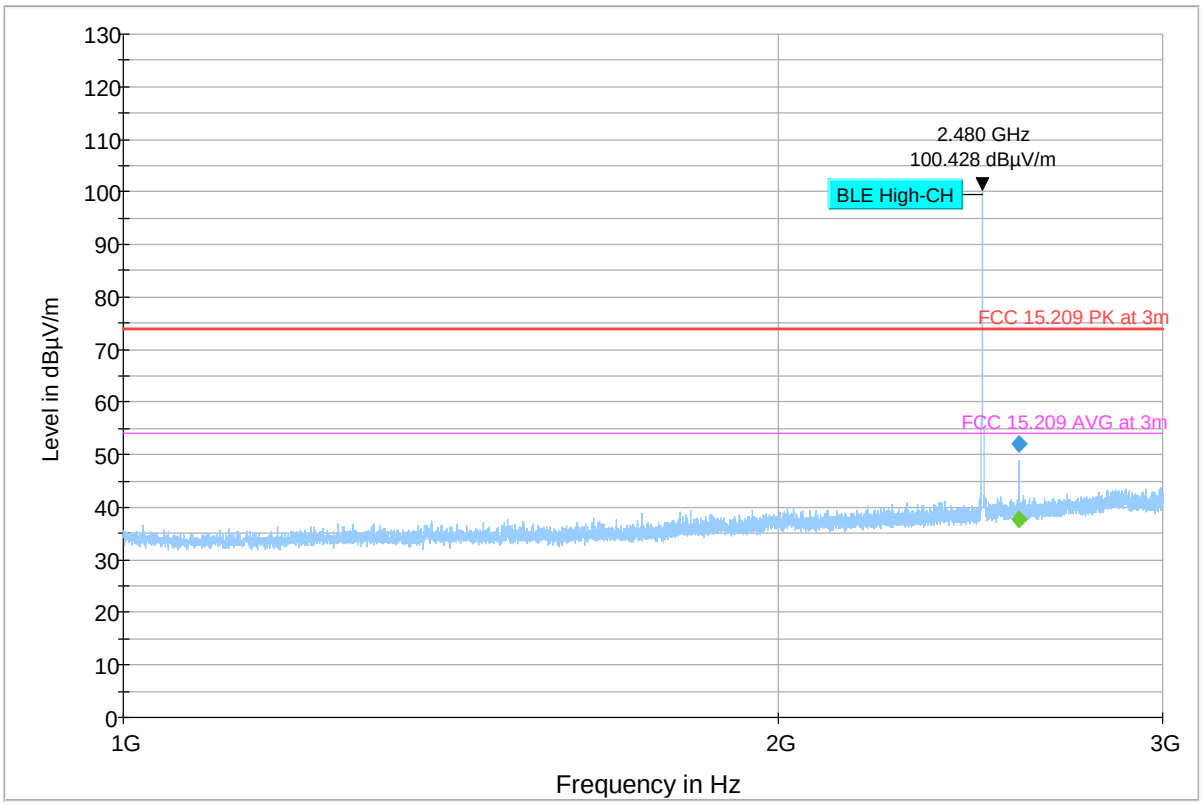


Plot # 29 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2480 MHz	PHY: 2M

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)
2576.14	---	37.57	53.98	16.41	500.0	1000.0	168.0	V	180.0	6.8
2576.14	51.93	---	73.98	22.04	500.0	1000.0	168.0	V	180.0	6.8

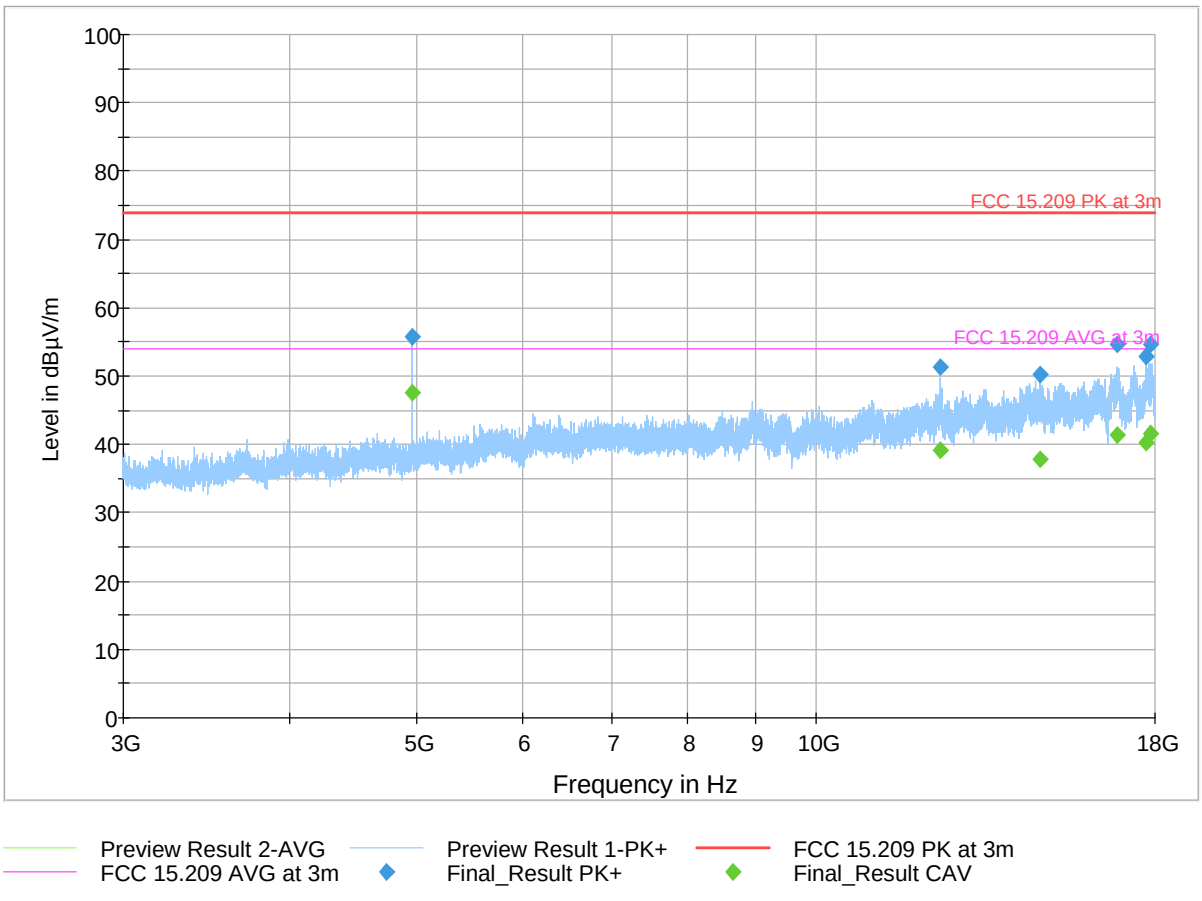


Plot # 30 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2480 MHz | **PHY: 2M**

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)
4959.25	---	47.64	53.98	6.34	500.0	1000.0	100.0	H	127.0	-3.2
4959.25	55.79	---	73.98	18.19	500.0	1000.0	100.0	H	127.0	-3.2
12398.75	---	39.20	53.98	14.78	500.0	1000.0	218.0	V	171.0	7.0
12398.75	51.29	---	73.98	22.69	500.0	1000.0	218.0	V	171.0	7.0
14756.00	50.33	---	73.98	23.65	500.0	1000.0	134.0	H	191.0	9.1
14756.00	---	37.76	53.98	16.22	500.0	1000.0	134.0	H	191.0	9.1
16852.50	54.64	---	73.98	19.34	500.0	1000.0	129.0	V	208.0	14.4
16852.50	---	41.41	53.98	12.57	500.0	1000.0	129.0	V	208.0	14.4
17730.25	52.84	---	73.98	21.14	500.0	1000.0	311.0	V	133.0	16.0
17730.25	---	40.16	53.98	13.82	500.0	1000.0	311.0	V	133.0	16.0
17882.00	54.71	---	73.98	19.27	500.0	1000.0	194.0	V	-17.0	18.2
17882.00	---	41.70	53.98	12.28	500.0	1000.0	194.0	V	-17.0	18.2



9 Test setup photos

Setup photos are included in supporting file name: "EMC_RIVIA_042_22001_FCC_ISED_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
ACTIVE LOOP ANTENNA	ETS LINDGREN	6507	00161344	3 YEARS	10/30/2020
BICONILOG ANTENNA	ETS Lindgren	3142E	00166067	3 YEARS	6/8/2022
HORN ANTENNA	EMCO	3115	00035114	3 YEARS	8/10/2020
HORN ANTENNA	ETS LINDGREN	3117-PA	00215984	3 YEARS	1/31/2021
HORN ANTENNA	ETS LINDGREN	3116C-PA	00169535	3 YEARS	9/23/2020
EMI RECEIVER	R&S	ESU40	100251	3 YEARS	9/13/2021
SPECTRUM ANALYZER	R&S	FSU26	200065	3 YEARS	8/25/2021
DIGITAL THERMOMETER	CONTROL COMPANY	36934-164	191871986	3 YEARS	10/20/2021

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

11 History

Date	Report Name	Changes to report	Report prepared by
4/15/2023	EMC_RIVIA_042_22001_FCC_15.247_ISED_BLE_DTS	Initial Version	Issa Ghanma

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