FCC / ISED Test Report

For:
LENNOX Industries Inc.

Brand:
Lennox

Marketing Name:
Lennox S40 Smart Thermostat

Model #:
Lennox S40 Smart Thermostat

Product Description:
S40 Thermostat is an electronic communicating thermostat. This module shall be the user interface, sensor data aggregator and internet gateway for residential air conditioning system.

FCC ID: 2A6F9-S4022A
IC ID: 28687-S4022A

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

REPORT #: EMC_LENNX_007_21001_FCC_15.247_ISED_BTLE_DTS

DATE: 7/1/2022

A2LA Accredited

IC recognized # 3462B

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

TABLE OF CONTENTS

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.

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

Company	Description	Model #
LENNOX Industries Inc.	S40 Thermostat is an electronic communicating thermostat. This module shall be the user interface, sensor data aggregator and internet gateway for residential air conditioning system.	Lennox S40 Smart Thermostat

Responsible for Testing Laboratory:

Date	Section	Name	Signature
7/1/2022	Compliance	Wang, Kevin (EMC Lab Manager)	kevin.wang@cetecom.com Digitally signed by: kevin.wang@cetecom.com DN: CN = kevin.wang@cetecom.com Date: 2022.07.01 14:16:38 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
7/1/2022	Compliance	Ghanma, Issa [CETECOM] (EMC Engineer)	Digitally signed by: Issa W Ghanma DN: CN = Issa W Ghanma email = issa.ghanma@cetecom.com C = US O = CETECOM Inc. OU = EMC Date: 2022.07.01 13:35:06 -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:	Wang, Kevin
Responsible Project Leader:	Baskaran, Akanksha

2.2 Identification of the Client

Applicant's Name:	LENNOX Industries Inc.
Street Address:	1600 Metrocrest Dr.
City/Zip Code	Carrollton, TX 75006
Country	USA

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	Lennox S40 Smart Thermostat
Contains FCC-IDs:	2A6F9-S4022A
Contains IC-IDs:	28687-S4022A
HW Version :	EQ1
SW Version :	04.00.0275.lii - SW Bundle No: 316
Product Description:	S40 Thermostat is an electronic communicating thermostat. This module shall be the user interface, sensor data aggregator and internet gateway for residential air conditioning system.
Module:	❖ Bluetooth: Silicon Labs • FCC ID: QOQGM210P • IC ID: 5123A-GM210P • Part Number: BGM210PA32JIA2 • Technology/Modes: BLE 5.0; GFSK; 1Mb/s • Channels 0-39: 2402 – 2480 MHz • Tune-up tolerance: ±1.5 dB • Antenna: Laird ▪ Flex PIFA ▪ Part Number: 001-0014 o Peak Gain: +2 dBi • Wi-Fi (Disabled)
Max. Conducted Output Power:	16.65 dBm
Power Supply/ Rated Operating Voltage Range:	18V (Low) / 24V (Nominal) / 32V (Max), AC
Operating Temperature Range	T min: 4 ºF / T max: 158 ºF
Sample Revision	■ Prototype Unit; ☐ Production Unit; ☐ Pre-Production
EUT Dimensions[Inch]:	L 7.047” x W 4.469” x Thickness ~1.1”
EUT Diameter:	■ < 60 cm ☐ Other _____

Other Radios included in the device:	❖ Wi-Fi: Texas Instruments WL1807MOD • FCC ID: Z64-WL18DBMOD • IC ID: 451I-WL18DBMOD • Part Number: WL1807MODGIMOCR • Technology/Modes: ▪ 802.11 b/g/n: Channels 1-11→2412 – 2462 MHz ▪ 802.11 a/b/g/n: UNII-1 Channels 36-48→5180 – 5240 MHz • Bandwidth: 20 MHz • Mode: SISO only • Tune-up tolerance: +1 dB; -3 dB • Antenna: Laird ▪ Flex PIFA ▪ Dual band: 2.4 GHz and 5 GHz ▪ Part Number: 001-0016 ▪ Peak Gain: 2.4 GHz:+2.5 dBi; 5 GHz: +3 dBi
Note: The information of the EUT specifications in the table above are provided by the client.	

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	0001	EQ1	04.00.0275.lii - SW Bundle No: 316	-

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
N/A	-	-	-	-

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	The radio of the EUT was configured to a fixed channel transmission with dynamic 100% duty cycle using Windows command prompt to configure the EUT. The measurement instrument was connected to the 50 ohm RF port of the EUT.
2	EUT#1	The radio of the EUT was configured to a fixed channel transmission with dynamic 100% duty cycle using Windows command prompt to configure the EUT. The external antenna was connected.

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
Op. 1	Bluetooth LE	❖ The Bluetooth LE radio was configured to: ▪ Mode: GFSK ▪ Transmit mode: Continuous TX ▪ Duty cycle: 100% ▪ Max Power settings: 19 ▪ Hopping: No ▪ Hopping Type: Single Frequency ▪ Channel: Low: Ch 0; Mid: Ch 19; High: Ch 39 ▪ Data rate: 1 Mbps
Op.2	Op. 1 + Wi-Fi 2.4	❖ The Wi-Fi radio was transmitting simultaneously and configured to: ▪ Mode: 801.11g ▪ Transmit mode: Continuous TX ▪ Duty cycle: 100% ▪ Max Power settings: 19 ▪ Hopping: No ▪ Hopping Type: Single Frequency ▪ Channel: Low: Ch 1; Mid: Ch 6; High: Ch 11 ▪ Data rate: 6 Mbps
Op.3	Idle	❖ All radios not transmitting, and EUT in fully functional mode.

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 channel(s), and highest possible duty cycle and output power simultaneously with Wi-Fi 2.4 GHz 802.11g representing the worst case mode of operation.

For radiated measurements;

- All data in this report show the worst case of Bluetooth LE radio, transmitting at the highest output power band
- 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

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 host equipment authorization that contains FCC IDs: 2A6F9-S4022A; and IC IDs: 28687-S4022A

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.

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	-	☐	☐	■	See note1 See note 2
§15.247(e) RSS-247 5.2(b)	Power Spectral Density	Nominal	-	☐	☐	■	See note1 See note 2
§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	-	☐	☐	■	See note1 See note 2
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	-	☐	☐	■	See note1 See note 2
§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	Op. 3	■	☐	☐	Complies

Note1: NA= Not Applicable; NP= Not Performed.
Note2: Leveraged from module certification report(s) # RF190408C21-2, under FCC ID: QOQGM210P and report(s) # IC190408A21-2, under IC ID: 5123A-GM210P

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=1.

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:

6/8/2022 – 6/18/2022

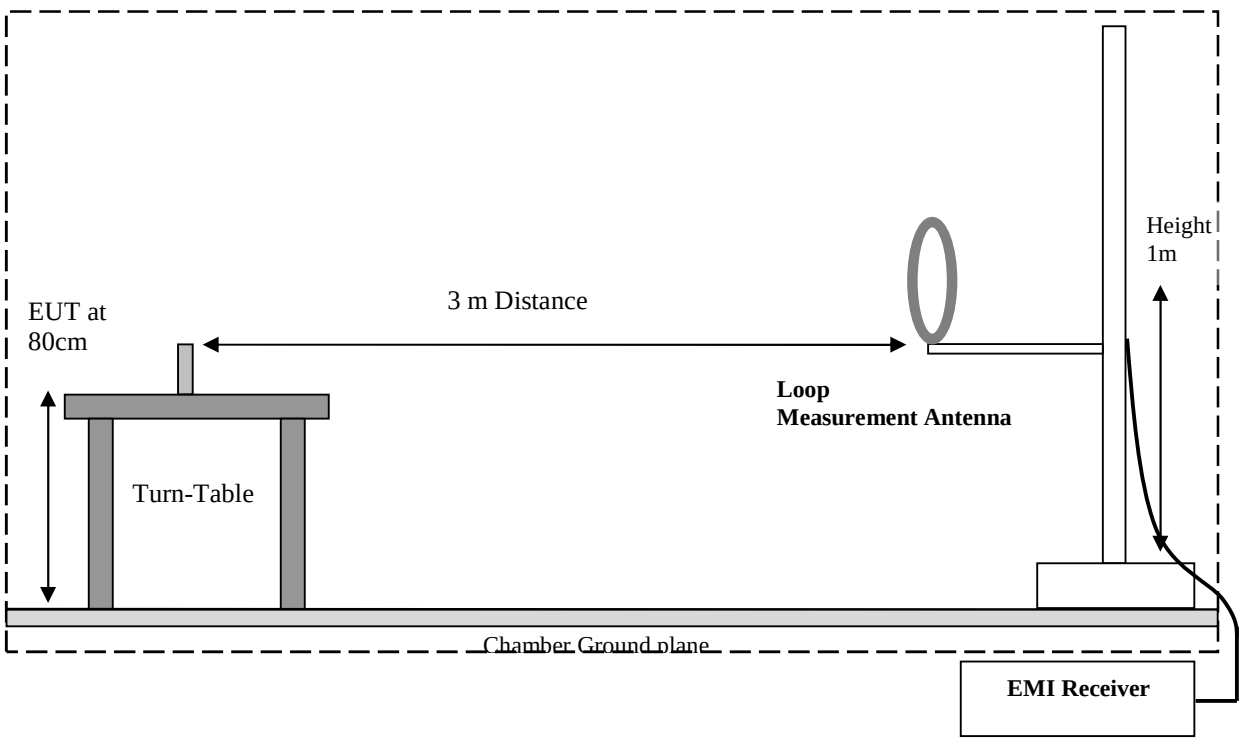
7 Measurement Procedures

7.1 Radiated Measurement

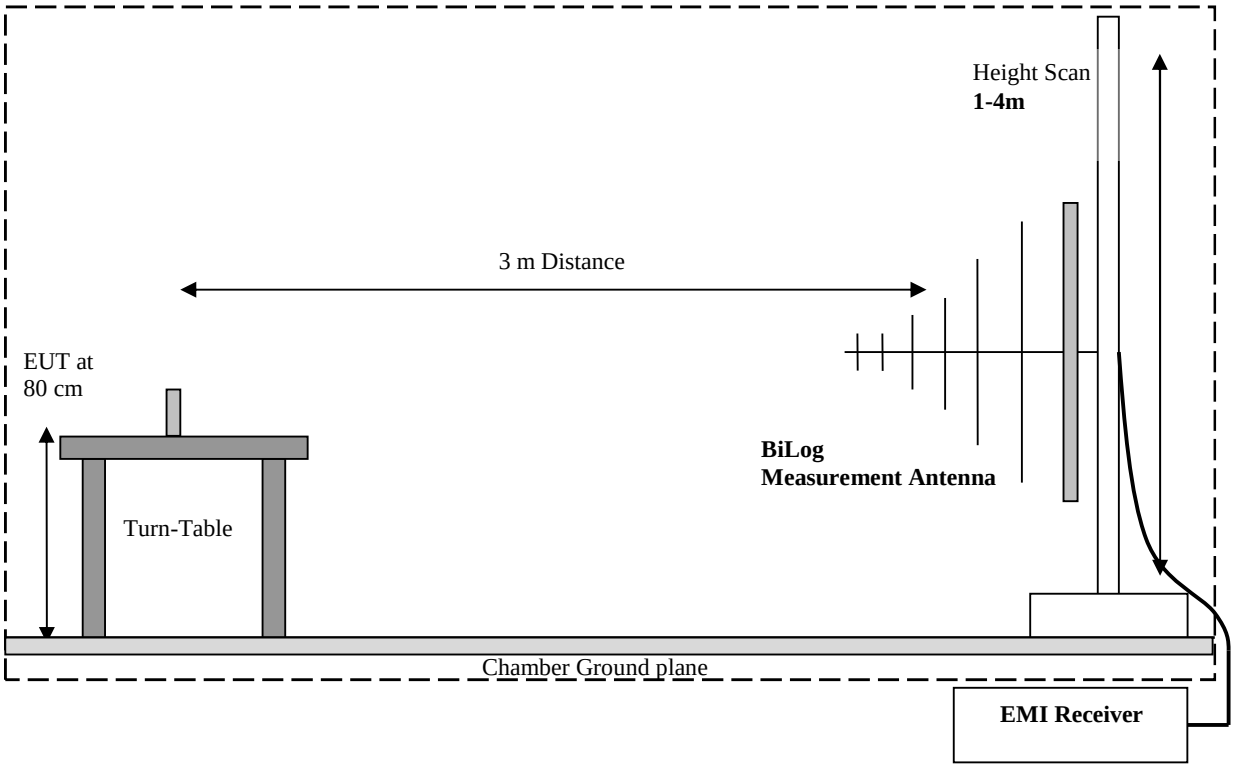
The radiated measurement is performed according to ANSI C63.10 (2013)

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

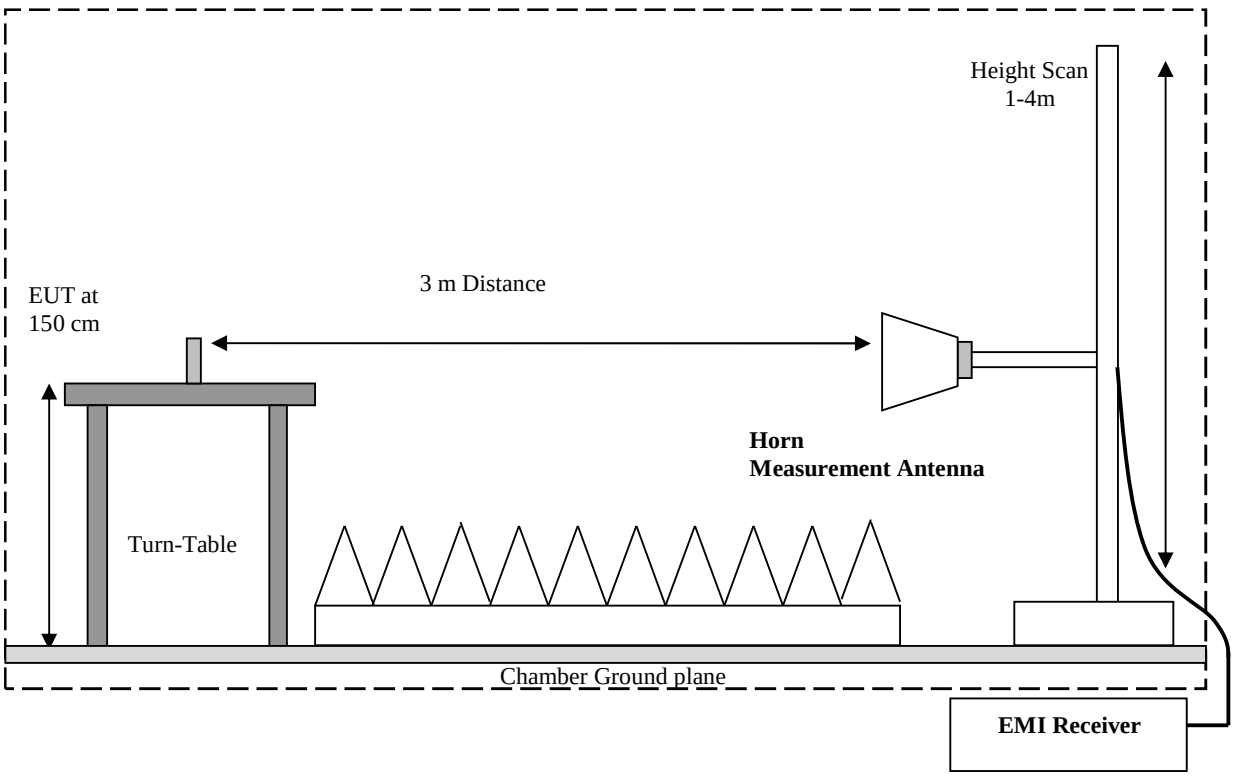
Radiated Emissions Test Setup below 30MHz Measurements



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:

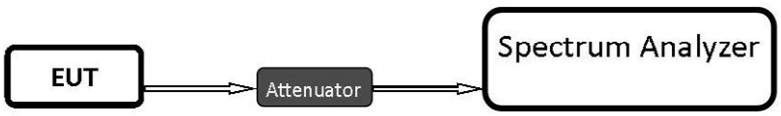
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

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

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
23° C	1	Op. 1	24V AC	+2.5 dBi

8.1.4 Measurement result:

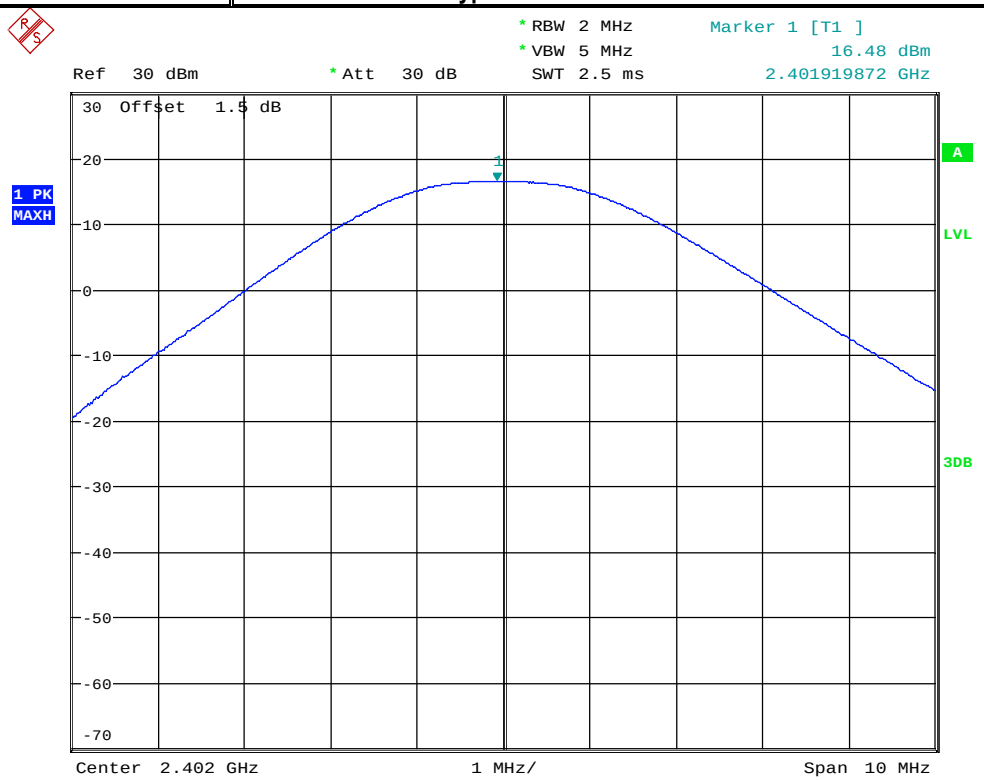
Plot #	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	EIRP*1 (dBm)	Limit (dBm)	Result
1	2402	16.48	19.95	30 (Pk) / 36 (EIRP)	Pass
2	2441	16.53	20.03	30 (Pk) / 36 (EIRP)	Pass
3	2480	16.65	20.15	30 (Pk) / 36 (EIRP)	Pass

1: EIRP= Maximum peak conducted output power + Antenna gain + Tune-up tolerance.

8.1.5 Measurement Plots:

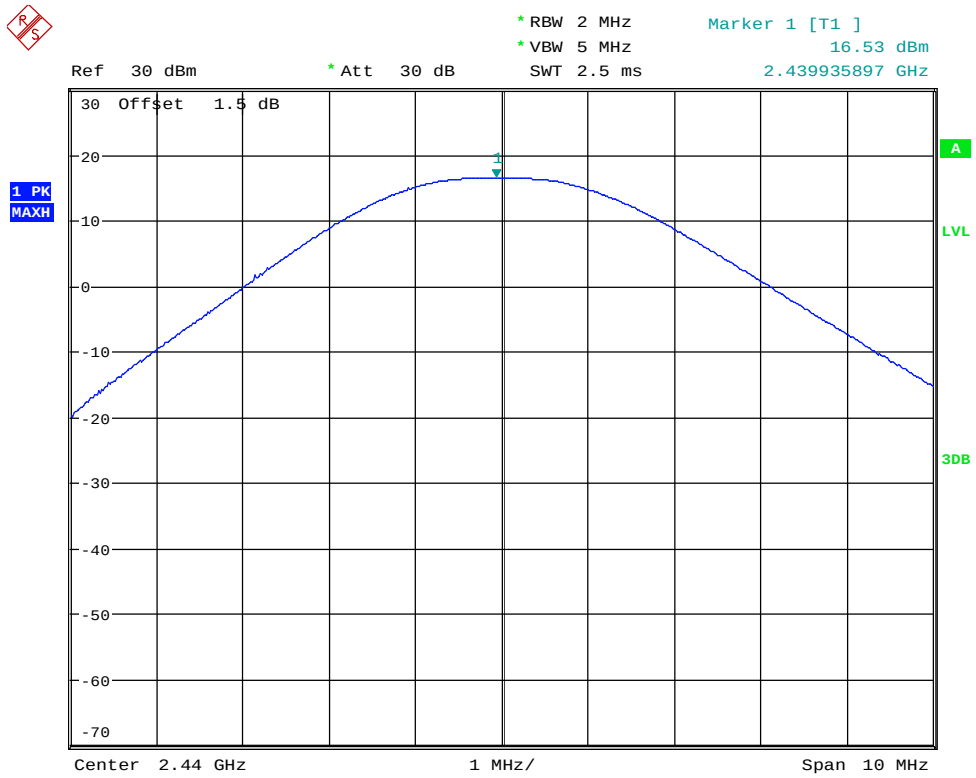
Plot #1

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



Plot #2

Mid channel / 2440 MHz | **Modulation/Packet Type: BTLE**



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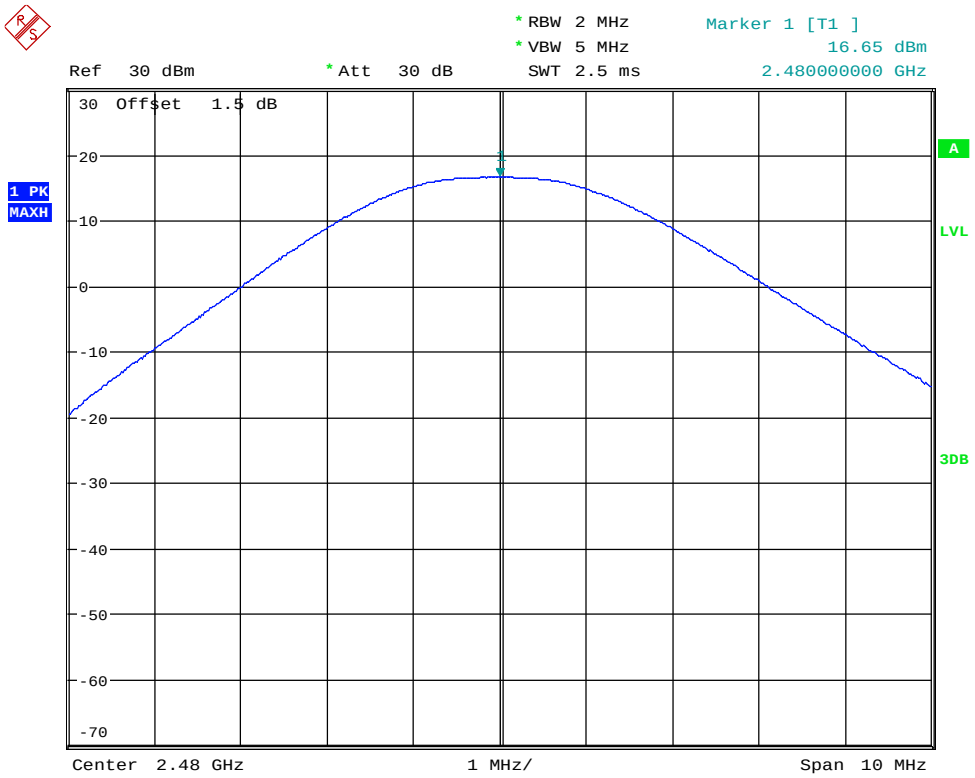
Plot #3

High channel / 2480 MHz | **Modulation/Packet Type: BTLE**



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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 Set-Up #	EUT operating mode	Power Input
23.8°C	2	Op. 2	24V AC

8.2.4 Measurement result:

Plot #	Channel #	Scan Frequency	Lowest margin emission (dBµV/m)	Limit	Result
1 – 3	0	30 MHz – 18 GHz	45.15	See section 8.2.2	Pass
4 – 8	19	30 MHz – 18 GHz	45.30	See section 8.2.2	Pass
9 – 11	39	30 MHz – 18 GHz	37.67	See section 8.2.2	Pass

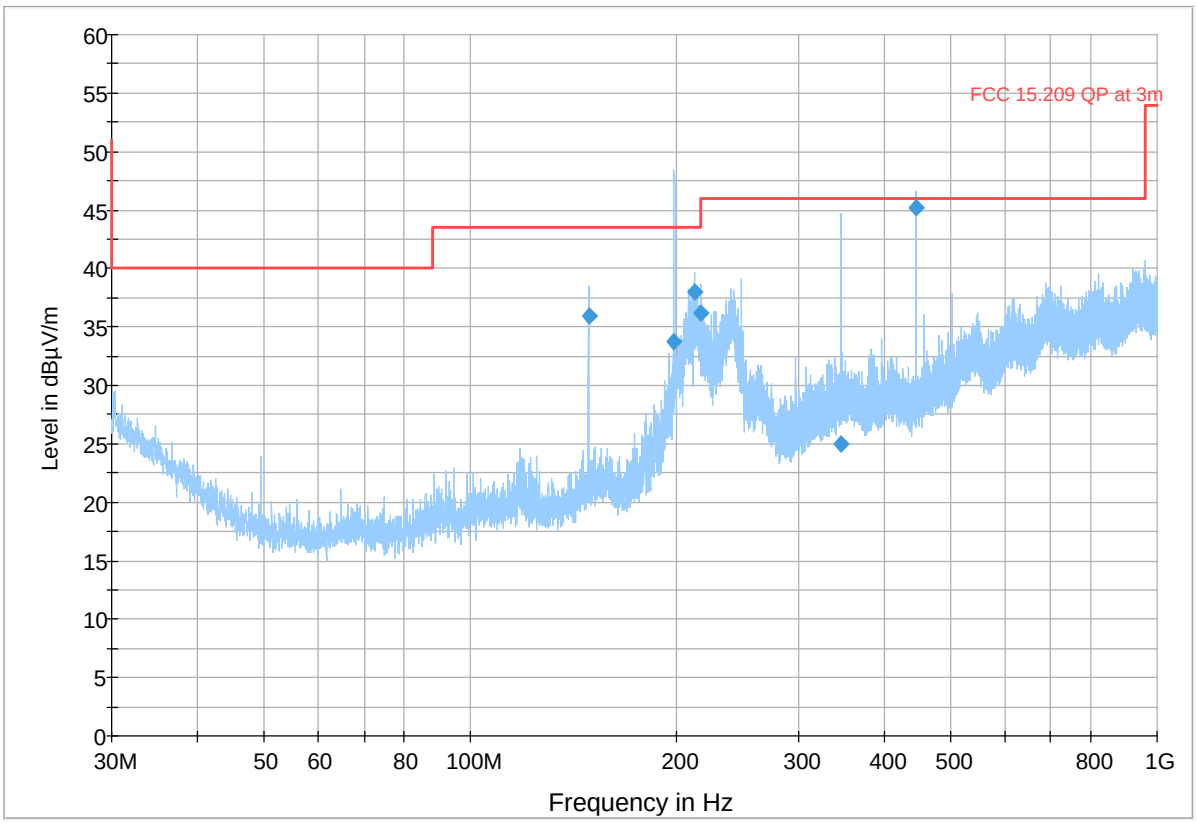
8.2.5 Measurement Plots:

Plot # 1 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2402 MHz	Mode: GFSK 1 Mbps

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)
148.502	35.90	43.50	7.60	500.0	120.000	186.0	V	146.0	17.2
198.004	33.76	43.50	9.74	500.0	120.000	174.0	H	-36.0	18.1
211.487	37.97	43.50	5.53	500.0	120.000	150.0	H	312.0	19.5
215.917	36.16	43.50	7.34	500.0	120.000	174.0	H	166.0	19.5
346.511	25.03	46.02	20.99	500.0	120.000	299.0	V	20.0	24.2
445.516	45.15	46.02	0.87	500.0	120.000	210.0	V	219.0	25.1

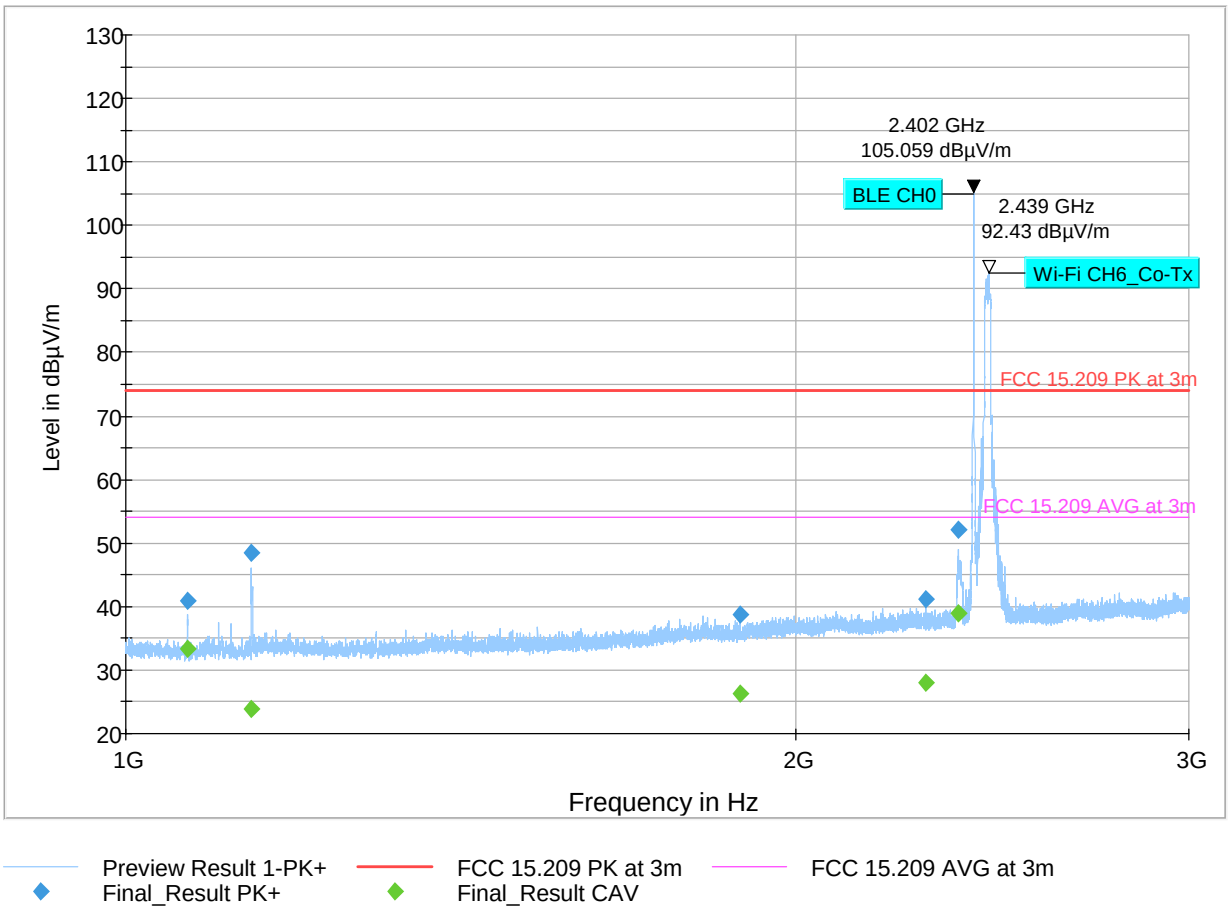


Plot # 2 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2402 MHz	Mode: GFSK 1 Mbps

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)
1066.286	---	33.27	53.98	20.71	500.0	1000.000	150.0	V	170.0	2.9
1066.286	40.87	---	73.98	33.11	500.0	1000.000	150.0	V	170.0	2.9
1138.571	---	23.97	53.98	30.01	500.0	1000.000	217.0	H	133.0	4.2
1138.571	48.43	---	73.98	25.55	500.0	1000.000	217.0	H	133.0	4.2
1885.571	38.73	---	73.98	35.25	500.0	1000.000	216.0	H	-75.0	7.2
1885.571	---	26.44	53.98	27.54	500.0	1000.000	216.0	H	-75.0	7.2
2287.143	---	27.93	53.98	26.05	500.0	1000.000	220.0	H	242.0	8.8
2287.143	41.26	---	73.98	32.72	500.0	1000.000	220.0	H	242.0	8.8
2363.714	52.08	---	73.98	21.89	500.0	1000.000	150.0	H	266.0	8.5
2363.714	---	38.87	53.98	15.11	500.0	1000.000	150.0	H	266.0	8.5

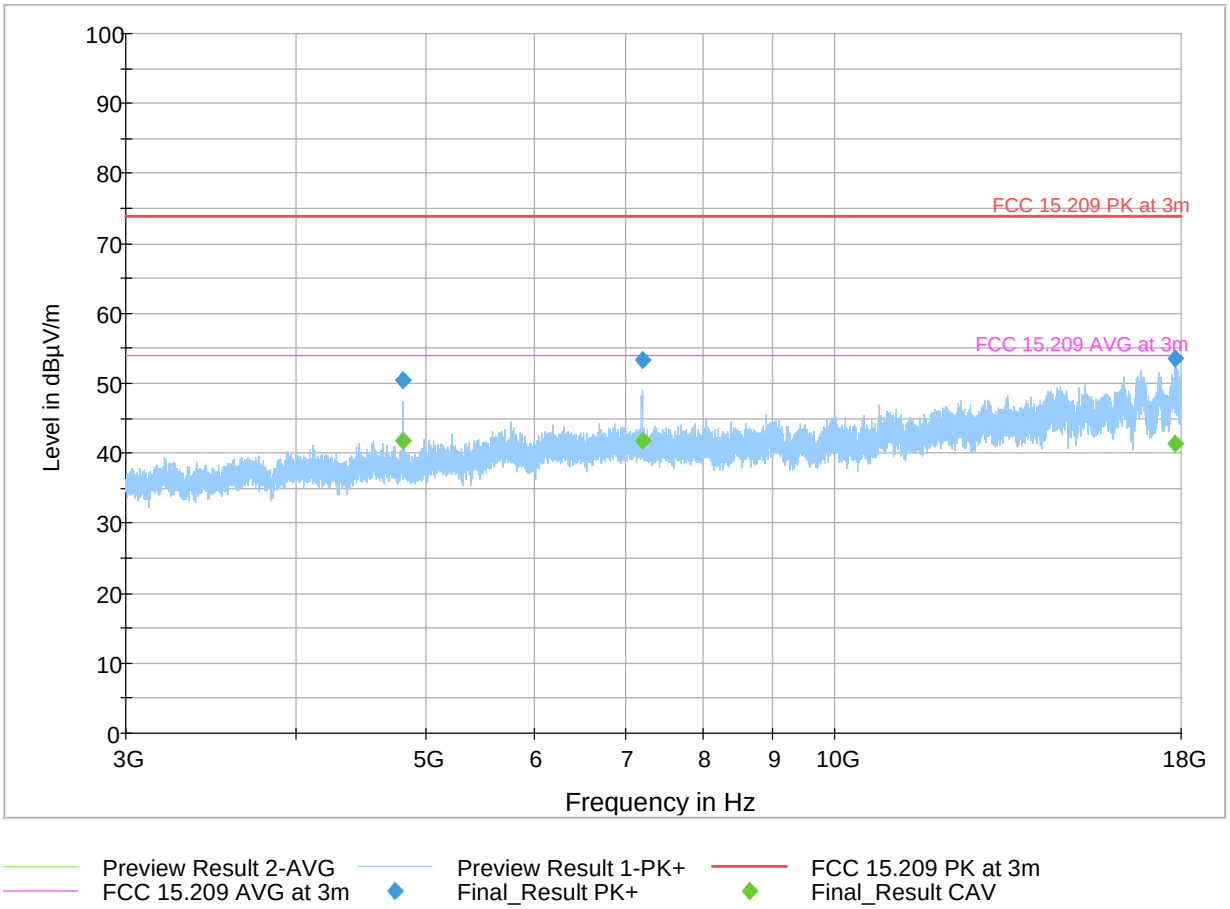


Plot # 3 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2402 MHz	Mode: GFSK 1 Mbps

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)
4803.75	---	41.81	53.98	12.17	500.0	1000.0	100.0	H	141.0	-3.3
4803.75	50.54	---	73.98	23.44	500.0	1000.0	100.0	H	141.0	-3.3
7206.50	---	41.83	53.98	12.15	500.0	1000.0	164.0	V	191.0	-0.6
7206.50	53.34	---	73.98	20.64	500.0	1000.0	164.0	V	191.0	-0.6
17799.50	---	41.33	53.98	12.65	500.0	1000.0	100.0	V	13.0	17.8
17799.50	53.50	---	73.98	20.48	500.0	1000.0	100.0	V	13.0	17.8

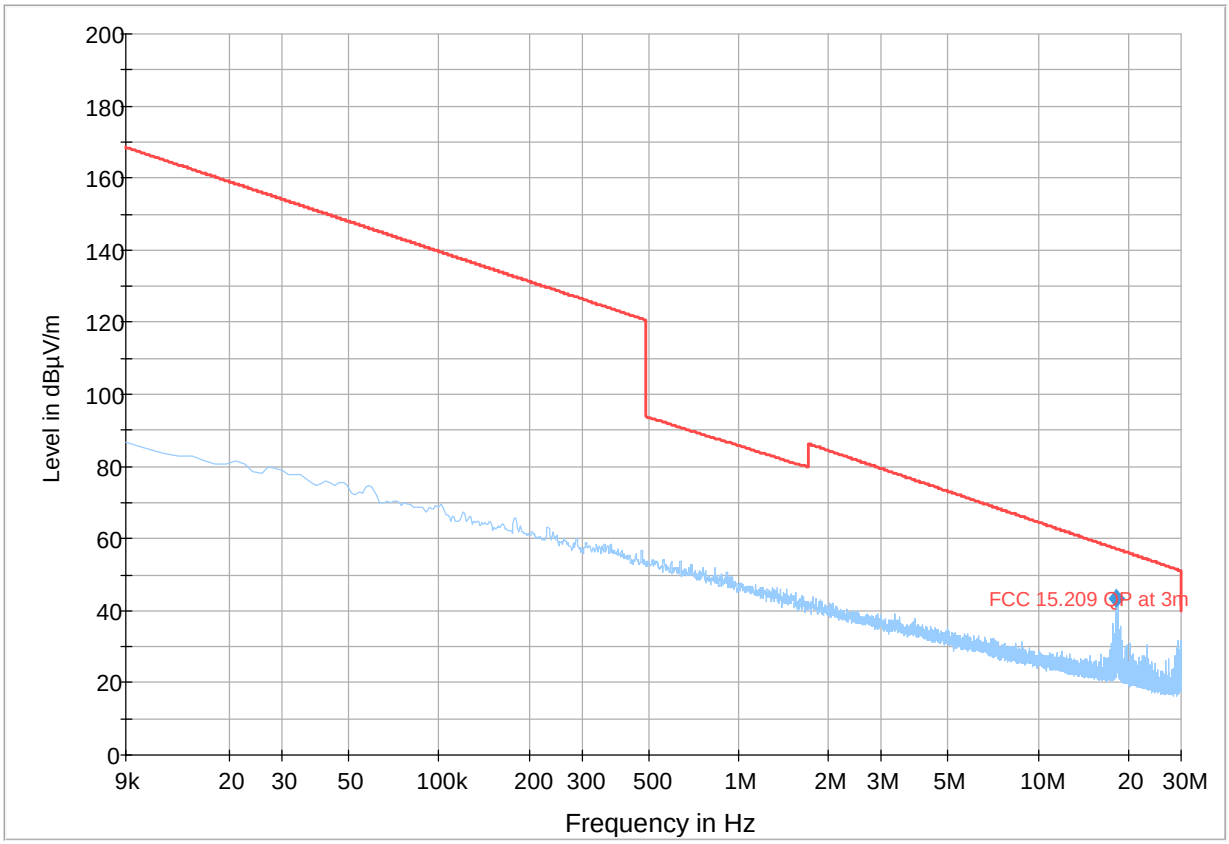


Plot # 4 Radiated Emissions: 9 kHz – 30 MHz

Tx Frequency: 2440 MHz	Mode: GFSK 1 Mbps

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)
18.24	43.31	57.16	13.85	500.0	9.0	100.0	H	318.0	16.6

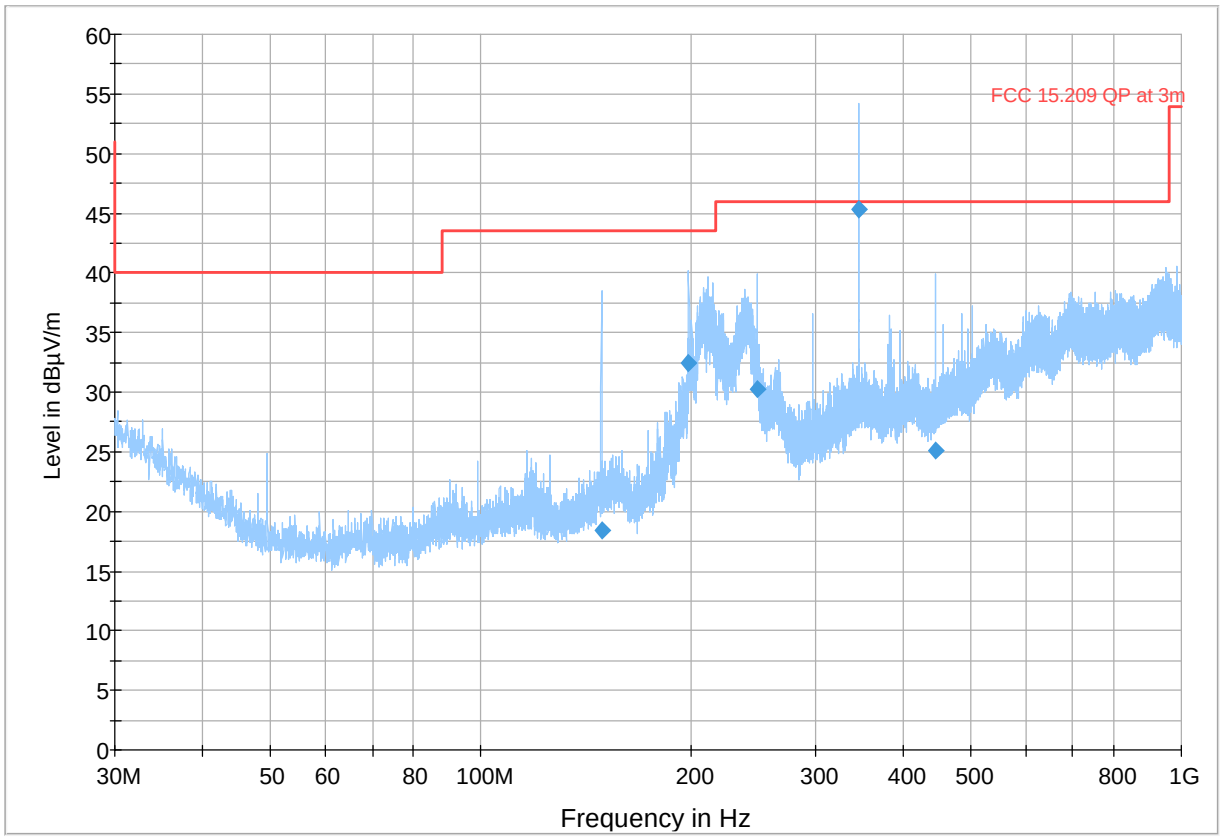


Plot # 5 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2440 MHz	Mode: GFSK 1 Mbps

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)
148.469	18.41	43.50	25.09	500.0	120.000	150.0	V	124.0	17.2
197.972	32.51	43.50	10.99	500.0	120.000	196.0	H	-34.0	18.1
247.506	30.29	46.02	15.73	500.0	120.000	231.0	H	1.0	20.9
346.479	45.30	46.02	0.72	500.0	120.000	184.0	H	171.0	24.3
445.483	25.15	46.02	20.87	500.0	120.000	302.0	H	197.0	25.3

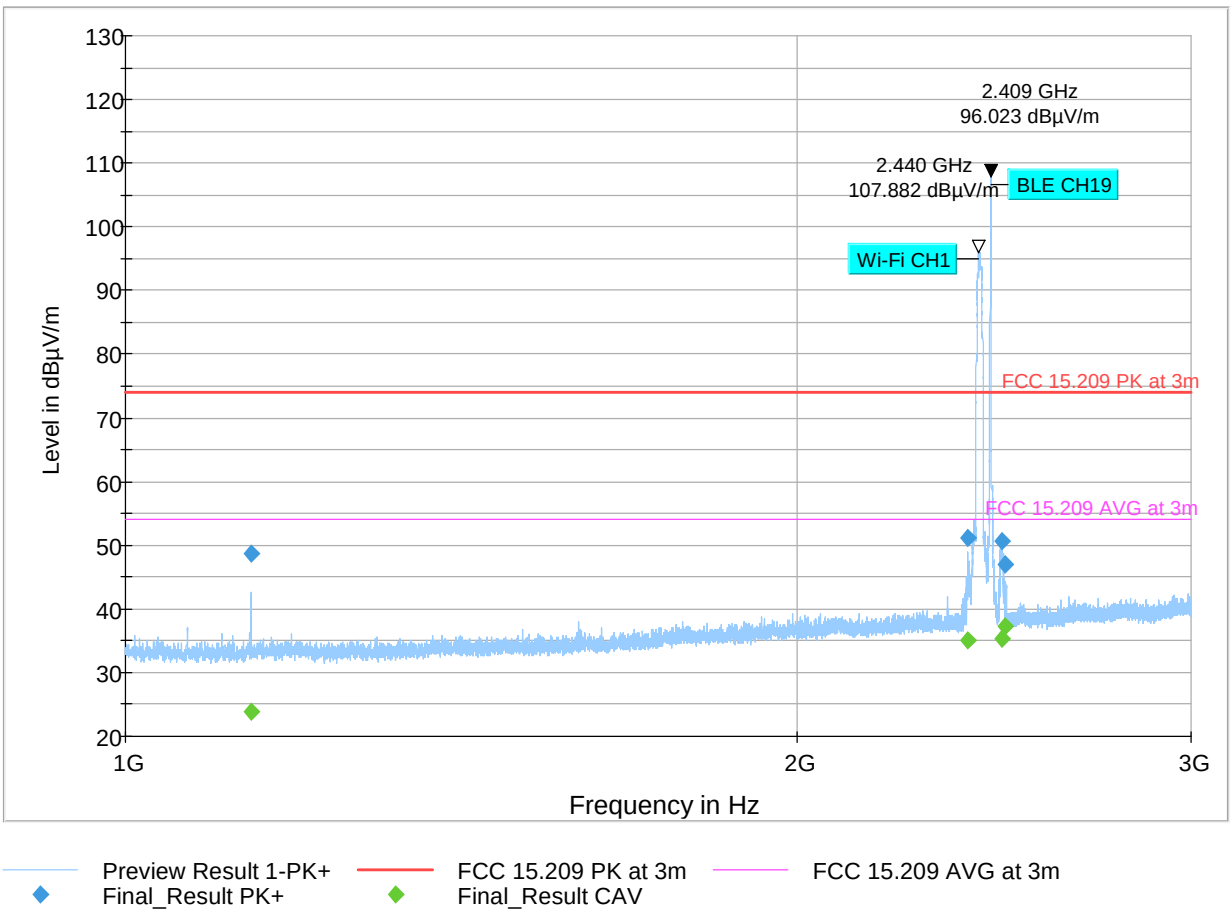


Plot # 6 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2440 MHz	Mode: GFSK 1 Mbps

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)
1138.571	---	23.82	53.98	30.15	500.0	1000.000	150.0	H	98.0	4.2
1138.571	48.71	---	73.98	25.27	500.0	1000.000	150.0	H	98.0	4.2
2383.714	---	35.03	53.98	18.95	500.0	1000.000	149.0	H	190.0	8.5
2383.714	51.11	---	73.98	22.87	500.0	1000.000	149.0	H	190.0	8.5
2469.000	---	35.38	53.98	18.60	500.0	1000.000	149.0	H	238.0	9.1
2469.000	50.55	---	73.98	23.43	500.0	1000.000	149.0	H	238.0	9.1
2478.143	---	37.29	53.98	16.69	500.0	1000.000	150.0	V	128.0	8.6
2478.143	46.95	---	73.98	27.03	500.0	1000.000	150.0	V	128.0	8.6

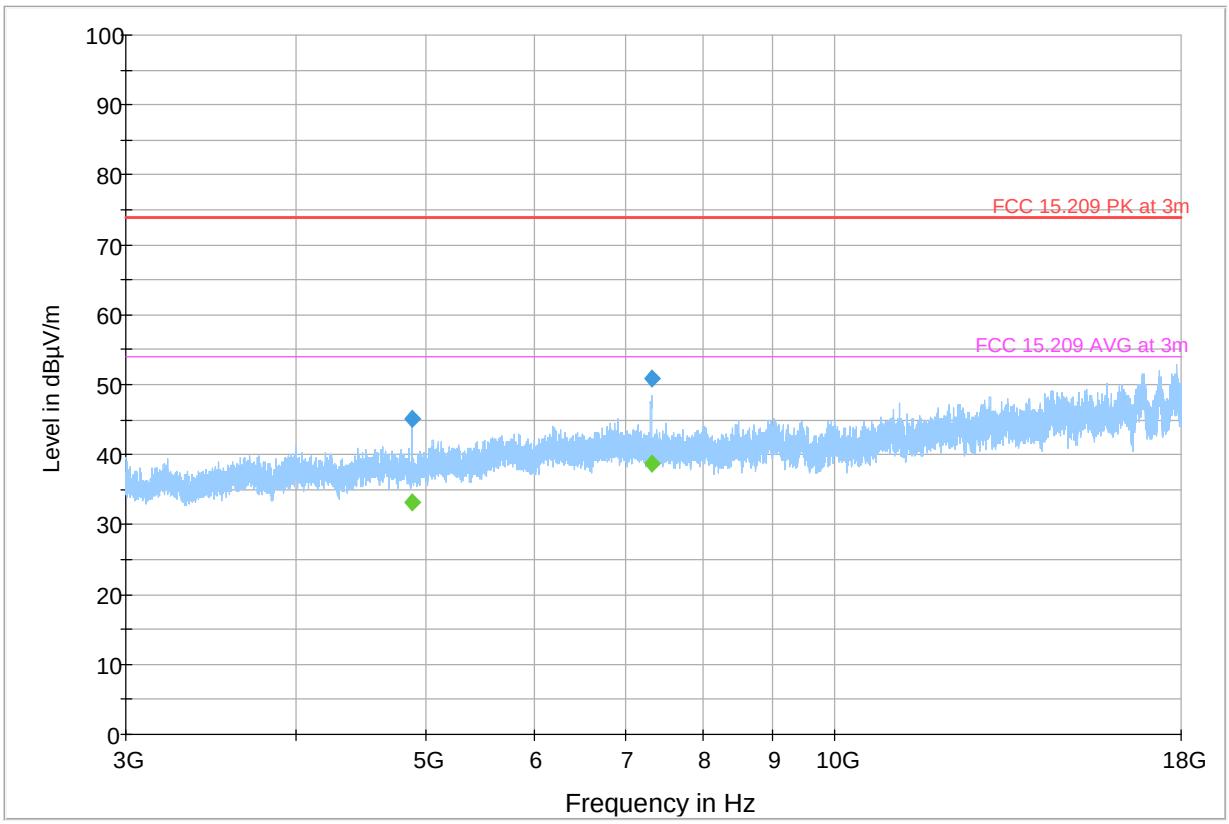


Plot # 7 Radiated Emissions: 3 – 18 GHz

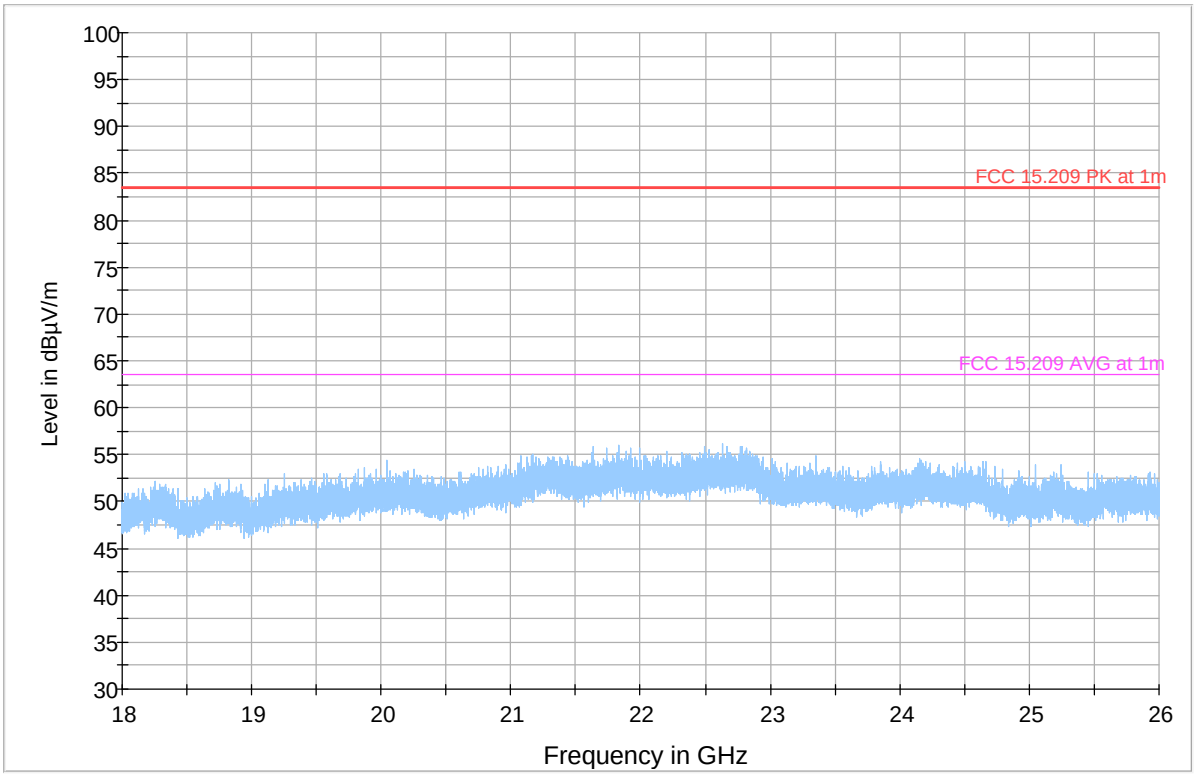
Tx Frequency: 2440 MHz	Mode: GFSK 1 Mbps

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)
4880.25	---	33.20	53.98	20.78	500.0	1000.0	150.0	H	270.0	-3.8
4880.25	45.18	---	73.98	28.80	500.0	1000.0	150.0	H	270.0	-3.8
7320.25	---	38.78	53.98	15.20	500.0	1000.0	161.0	V	114.0	-0.4
7320.25	50.78	---	73.98	23.20	500.0	1000.0	161.0	V	114.0	-0.4



Plot # 8 Radiated Emissions: 18 – 26 GHz	
Tx Frequency: 2440 MHz	Mode: GFSK 1 Mbps

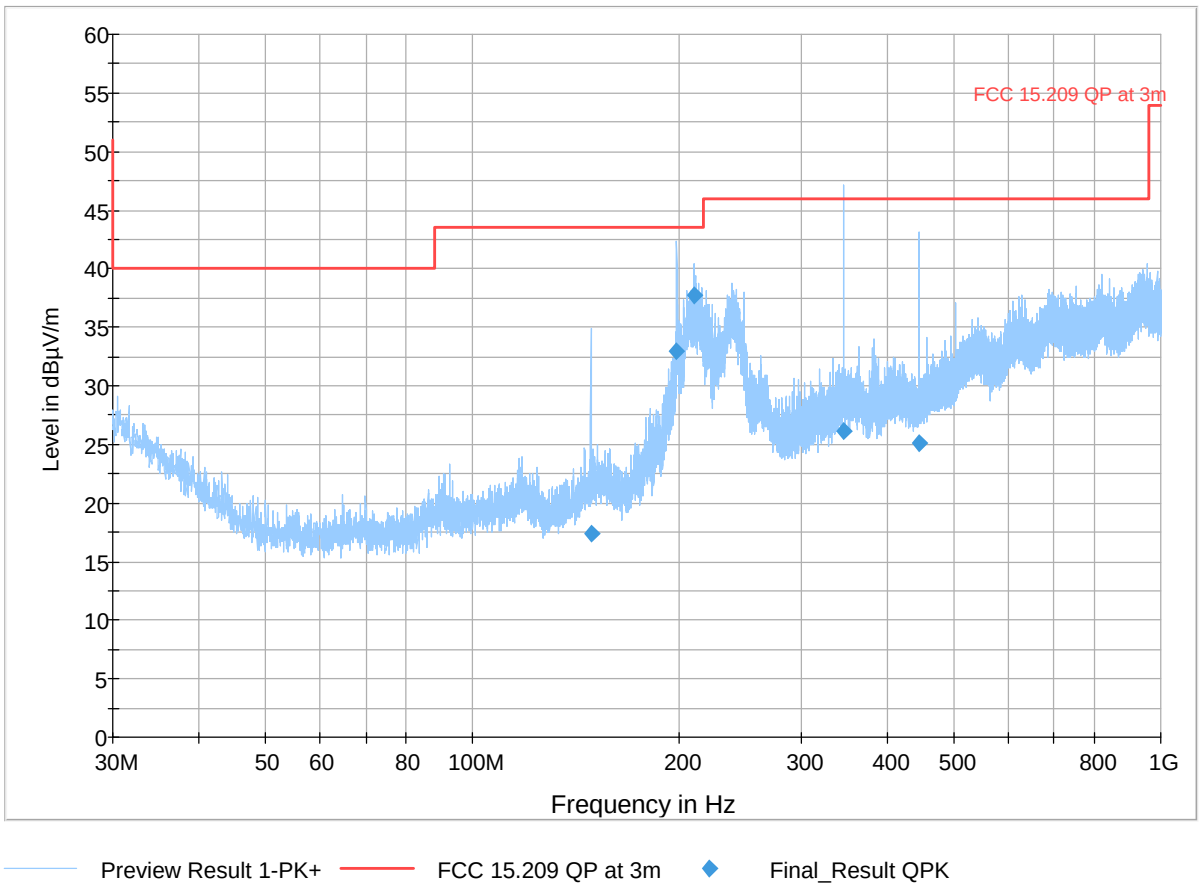


Plot # 9 Radiated Emissions: 30 MHz – 1 GHz

Tx Frequency: 2480 MHz	Mode: GFSK 1 Mbps

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)
148.502	17.43	43.50	26.07	500.0	120.000	185.0	H	-44.0	16.9
197.972	32.98	43.50	10.52	500.0	120.000	186.0	H	-44.0	18.1
209.741	37.67	43.50	5.83	500.0	120.000	163.0	H	-34.0	19.5
346.511	26.13	46.02	19.89	500.0	120.000	244.0	H	-38.0	24.3
445.483	25.07	46.02	20.95	500.0	120.000	174.0	V	233.0	25.1

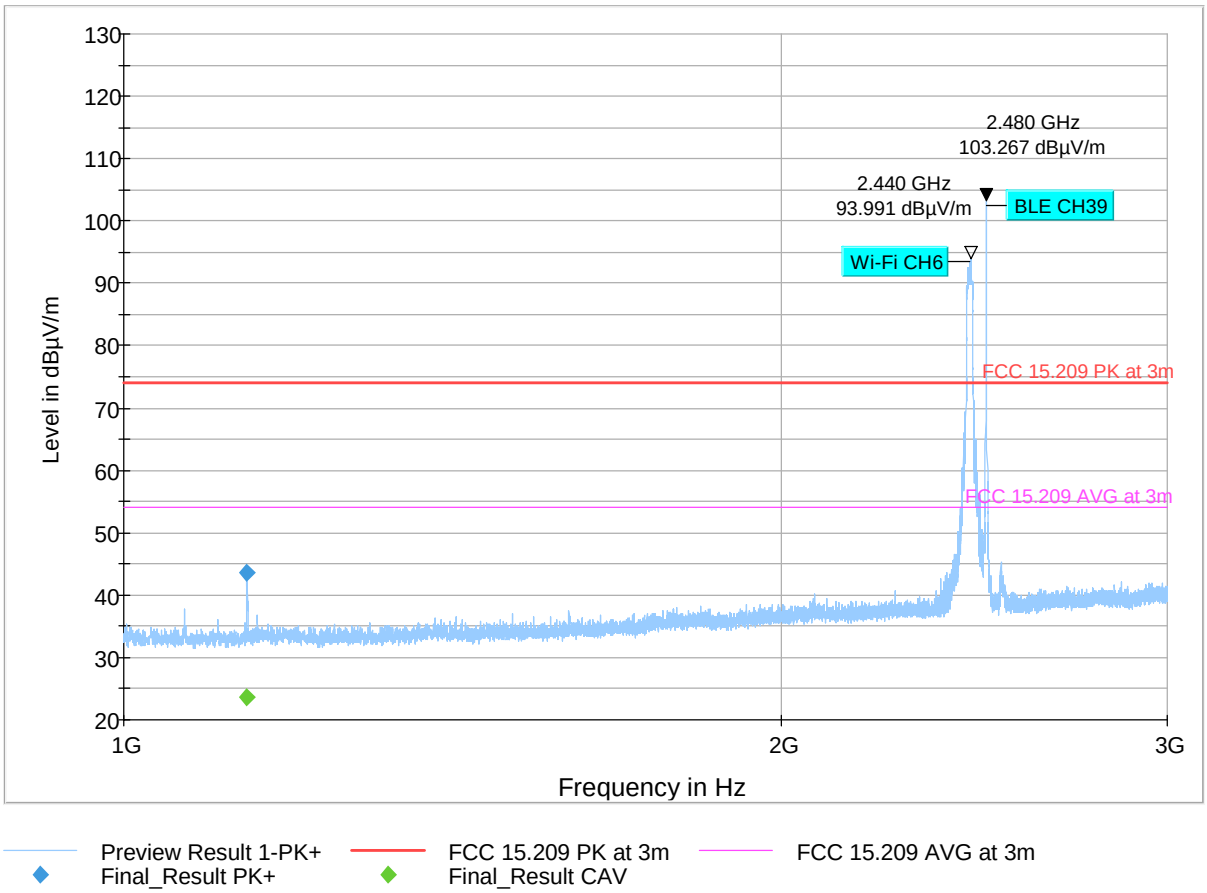


Plot # 10 Radiated Emissions: 1 – 3 GHz

Tx Frequency: 2480 MHz	Mode: GFSK 1 Mbps

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)
1139.143	---	23.65	53.98	30.32	500.0	1000.000	150.0	H	110.0	4.2
1139.143	43.55	---	73.98	30.43	500.0	1000.000	150.0	H	110.0	4.2

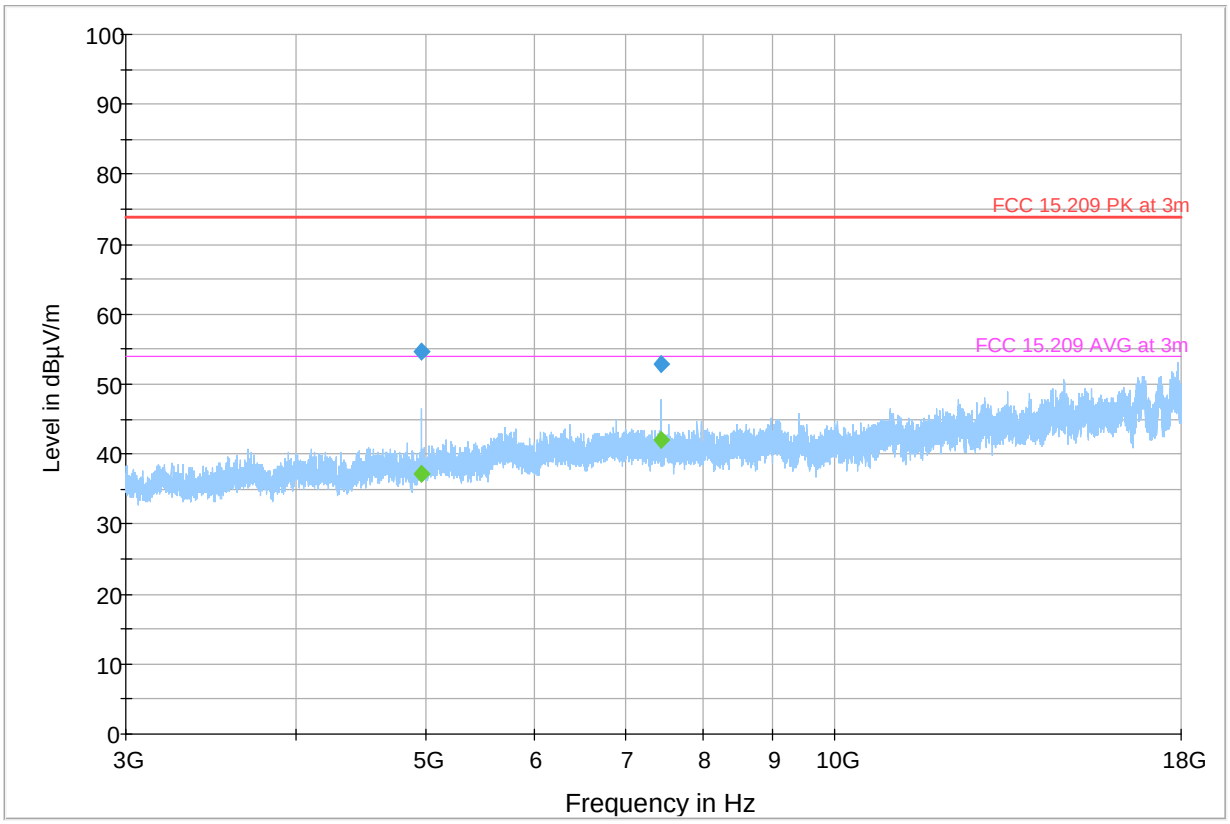


Plot # 11 Radiated Emissions: 3 – 18 GHz

Tx Frequency: 2480 MHz	Mode: GFSK 1 Mbps

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	---	37.08	53.98	16.89	500.0	1000.0	142.0	H	221.0	-3.2
4959.25	54.71	---	73.98	19.27	500.0	1000.0	142.0	H	221.0	-3.2
7439.75	---	41.98	53.98	12.00	500.0	1000.0	138.0	V	189.0	0.2
7439.75	52.82	---	73.98	21.16	500.0	1000.0	138.0	V	189.0	0.2



8.3 AC Power Line Conducted Emissions

8.3.1 Measurement according to ANSI C63.4

Analyzer Settings:

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

8.3.2 Limits: §15.207 & RSS-Gen 8.8

FCC §15.207(a) & RSS-Gen 8.8

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

Frequency of emissions (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
5-30	60	50

*Decreases with the logarithm of the frequency.

8.3.3 Test conditions and setup:

Ambient Temperature ©	Power line (L1, L2, L3, N)	Power Input
23° C	Line & Neutral	120V AC / 60Hz

8.3.4 Measurement Result:

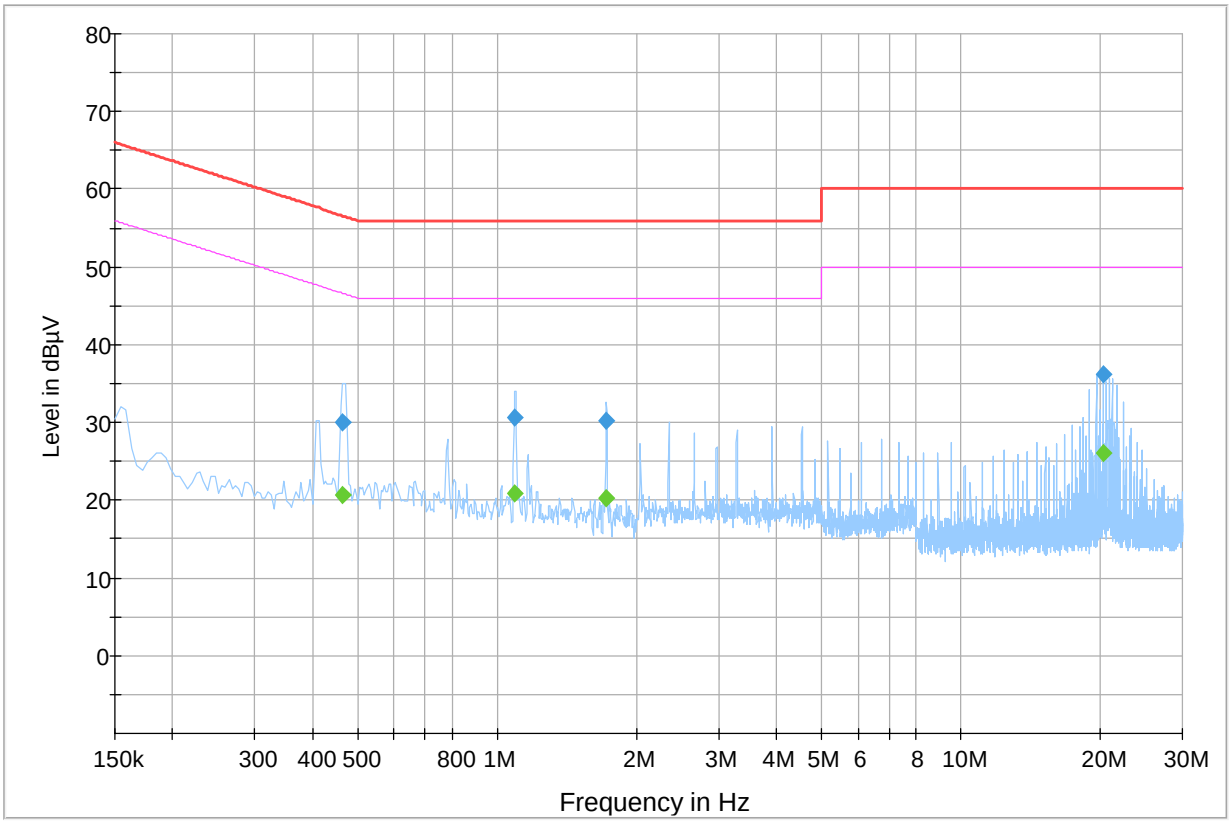
Plot #	Port	EUT operating mode	Scan Frequency	Limit	Result
12	AC Mains	Op.3	150 kHz – 30 MHz	See section 8.3.2	Pass

8.3.5 Measurement Plot:

Plot # 12 AC Conducted Emissions: 150 kHz – 30 MHz

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.466	---	20.61	46.58	25.97	500.0	9.000	L1	GND	10.0
0.466	30.06	---	56.58	26.52	500.0	9.000	L1	GND	10.0
1.094	---	20.86	46.00	25.14	500.0	9.000	L1	GND	10.1
1.094	30.69	---	56.00	25.31	500.0	9.000	L1	GND	10.1
1.722	30.26	---	56.00	25.74	500.0	9.000	N	GND	10.1
1.722	---	20.35	46.00	25.65	500.0	9.000	N	GND	10.1
20.211	36.24	---	60.00	23.76	500.0	9.000	L1	GND	10.3
20.211	---	25.95	50.00	24.05	500.0	9.000	L1	GND	10.3



9 Test setup photos

Setup photos are included in supporting file name: "EMC_LENNX_007_21001_FCC_ISED_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
BILOG ANTENNA	A.H. Systems	BiLA2G	569	2 YEARS	12/1/2020
HORN ANTENNA	EMCO	3115	00035111	2 YEARS	9/30/2021
HORN ANTENNA	ETS LINDGREN	3117-PA	00169547	2 YEARS	9/1/2020
HORN ANTENNA	ETS LINDGREN	3116	00169535	2 YEARS	9/23/2020
DIGITAL THERMOMETER	CONTROL COMPANY	36934-164	191871986	2 YEARS	10/20/2021
ESW.EMI TEST RECEIVER	R&S	ESW44	101715	2 YEARS	9/14/2021
EMI RECEIVER	R&S	ESU40	100251	2 YEARS	9/13/2021
FCC LISN	FCC	LISN FCC-LISN-50-25-2-08	8014	2 YEARS	8/31/2021

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 is internally characterized before use.

11 History

Date	Report Name	Changes to report	Report prepared by
7/1/2022	EMC_LENNX_007_21001_FCC_15.247_ISED_BTLE_DTS	Initial Version	Issa Ghanma

<<< The End >>>