FCC/ISED Test Report

FOR:
Telular AMETEK

Model Name:
SHB1000

Product Description:
SkyHub Wireless Telematics Hub

FCC ID: MTFSHB1000
IC ID: 2175D-SHB1000

Per:
47 CFR: Part 22, Part 24, Part 27
RSS-130 Issue 2; RSS-132 Issue 3; RSS-133 Issue 6; RSS-139 Issue 3

REPORT #: EMC_TELUL-087-20001_FCC_22_24_27_ISED_R1

DATE: 2020-11-04

A2LA Accredited

IC recognized # 3462B-1

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

TABLE OF CONTENTS

1 Assessment

The following device as further described in section 3 of this report was evaluated for radiated spurious emissions in simultaneous transmission of cellular and unlicensed radios according to criteria specified in the Code of Federal Regulations Title 47 parts 22, 24, 27 and Industry Canada Radio Standard Specifications RSS: 130 Issue 2, 132 Issue 3, 133 Issue 6 and 139 Issue 3.

Company	Description	Model #
Telular AMETEK	SkyHub Wireless Telematics Hub	SHB1000

No deficiencies were ascertained.

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2020-11-04	Compliance	Cindy Li (Lab Manager)	Cindy Li Digitally signed by cindy.li@cetecom.com DN: CN=cindy.li@cetecom.com Reason: I have reviewed this document Location: Date: 2020-11-06 20:54:19

Responsible for the Report:

Date	Section	Name	Signature
2020-11-04	Compliance	Yuchan Lu (Test Engineer)	Yuchan Lu Digitally signed by: Yuchan Lu DN: CN = Yuchan Lu email = Yuchan.Lu@cetecom.com C = US O = CETECOM Inc. OU = EMC Date: 2020.11.04 10:55:53 -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
Lab Manager:	Cindy Li
Responsible Project Leader:	Cathy Palacios

2.2 Identification of the Client

Client's Name:	Telular AMETEK
Street Address:	3225 Cumberland Blvd, Suite 300
City/Zip Code	Atlanta, GA 30339
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

Hardware Version Identification Number (HVIN):	SHB1000
Product Marketing Name (PMN):	SkyHub
Antenna Information as declared:	Antenna model Ethertronics/AVX P822601 Antenna gains: • LTE Band 2: 4.4 dBi • LTE Band 4: 4.4 dBi • LTE Band 5: 2.6 dBi • LTE Band 12: 2.6 dBi • LTE Band 13: 2.6 dBi • WCDMA Band II: 4.4 dBi • WCDMA Band V: 2.6 dBi
Other Radios included in the device:	❖ BLE • Module name: BL654 • Module number: 451-00001 • FCC/IC ID: SQGBL654 / 3147A-BL654 ❖ GPS • Module name: L86 • Module number: L86s-M3 ❖ ISM • Module name: EFR32 • Module number: EFR32FG1P131F256GM32-C0
Power Supply/ Rated Operating Voltage Range:	Low 10 VDC, Nominal 12 VDC, High 30 VDC
Operating Temperature Range:	Low -40ºC, Nominal 25ºC, High 70ºC
Sample Revision	☐Prototype Unit; ☐Production Unit; ■Pre-Production
EUT Dimensions(mm):	480 x 95 x 38
Weight(grams):	1300
EUT Diameter	■ < 60 cm ☐ Other _____

Module Information	
Module Name:	LE910
Model Number:	LE910B1-NA1
FCC ID:	RI7LE910NAV2
IC ID:	5131A-LE910NAV2

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	SHB5AKEY202600190	B	EM.00.01.1025,BM.00.01.1017,CM.00.01.1021	Radiated Measurement

3.3 Accessory Equipment details

AE #	Type	Manufacture	Model	P/N
1	DC Charging Cable	-	-	-

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT# 1 +AE# 1	Worst Case

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
Op. 1	Cellular Transmission	Cellular was tested on Low, Mid, High Channels at the maximum power, and co-transmitting with ISM low channel. For radiated measurements, the internal antenna was connected.

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 co-transmitting with ISM low channel at the maximum power transmission.

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 evaluation conducted by CETECOM Inc. is to support a request for new equipment authorization under **FCC ID:** MTFSHB1000/ **IC ID:** 2175D-SHB1000.

The pre-certified module to be integrated (LE910) as described in Section 3, Radiated Spurious Emissions test was performed. Results have been checked to meet limits per Code of Federal Regulations Title 47 parts 22, 24, 27 and Industry Canada Radio Standard Specifications RSS: 130 Issue 2, 132 Issue 3, 133 Issue 6 and 139 Issue 3.

The conducted module test data that can be obtained under the **FCC Filing ID:** RI7LE910NAV2 is applicable for the host described in section 3.

4.1 Dates of Testing:

07/24/2020 – 07/31/2020

4.2 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.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

4.3 Environmental Conditions during Testing:

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

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

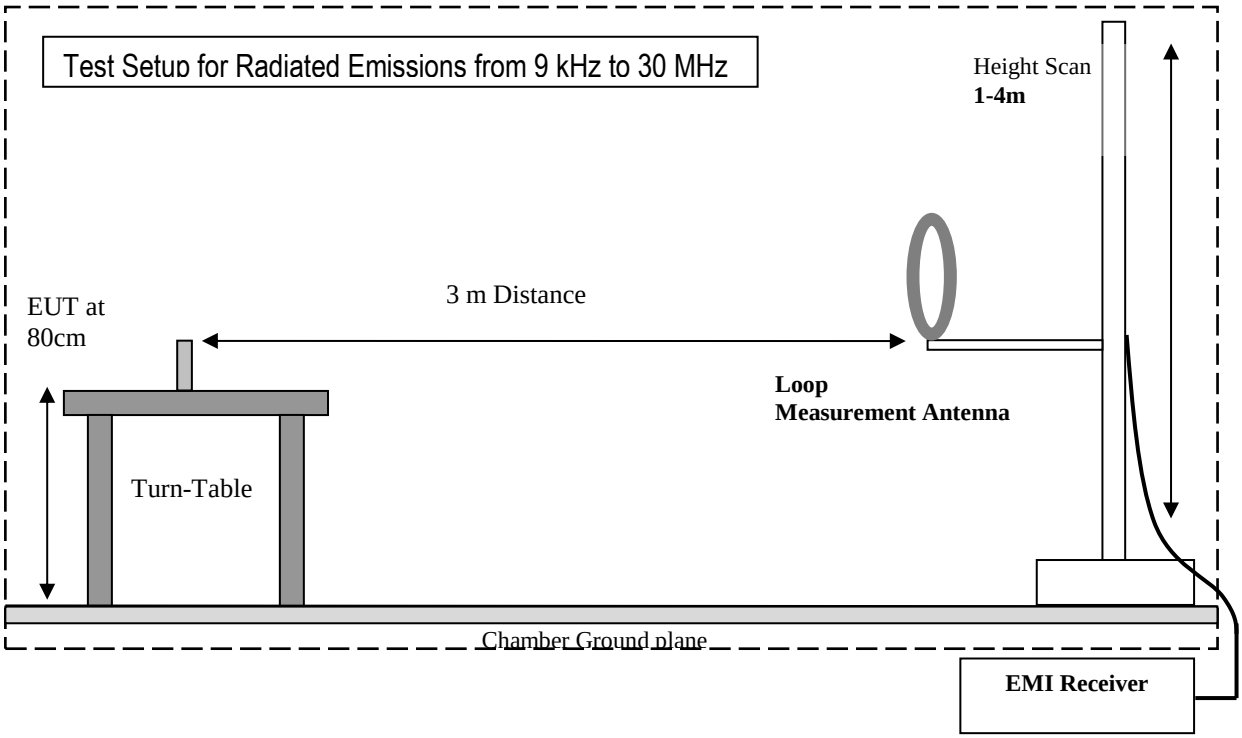
Deviating test conditions are indicated at individual test description where applicable.

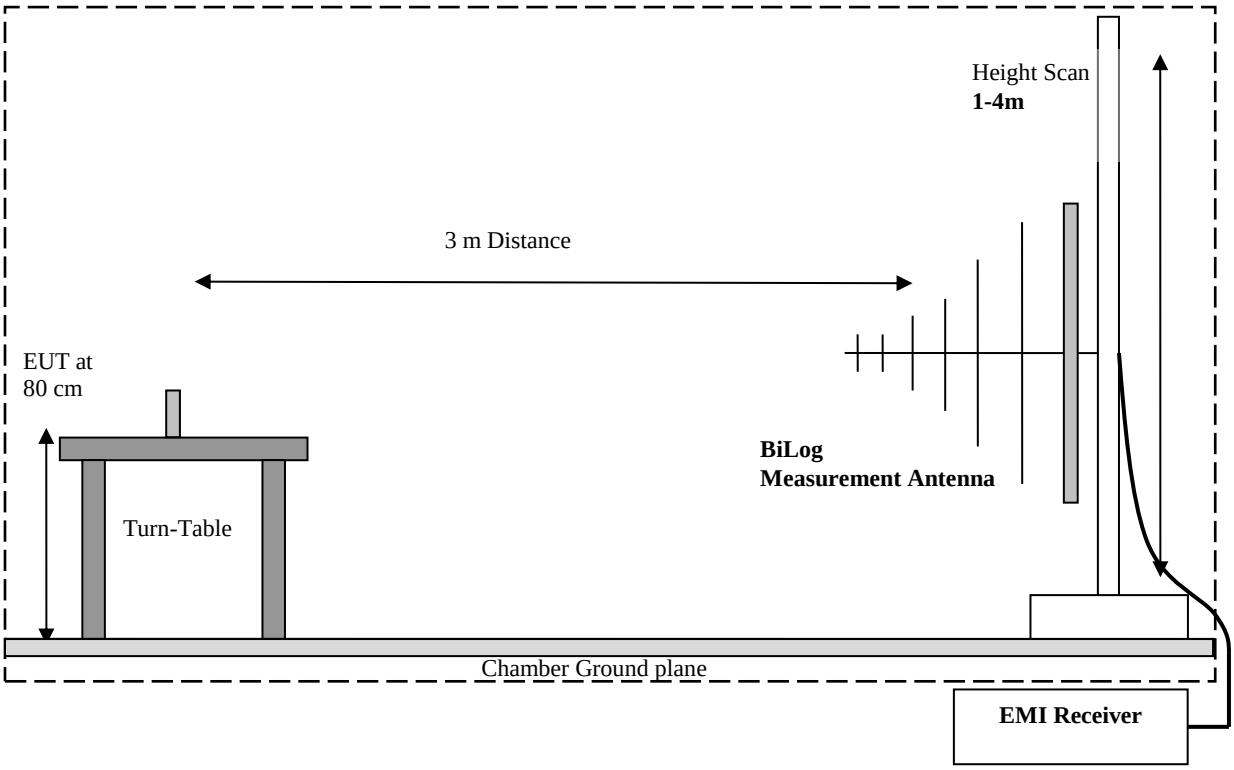
5 Measurement Procedures

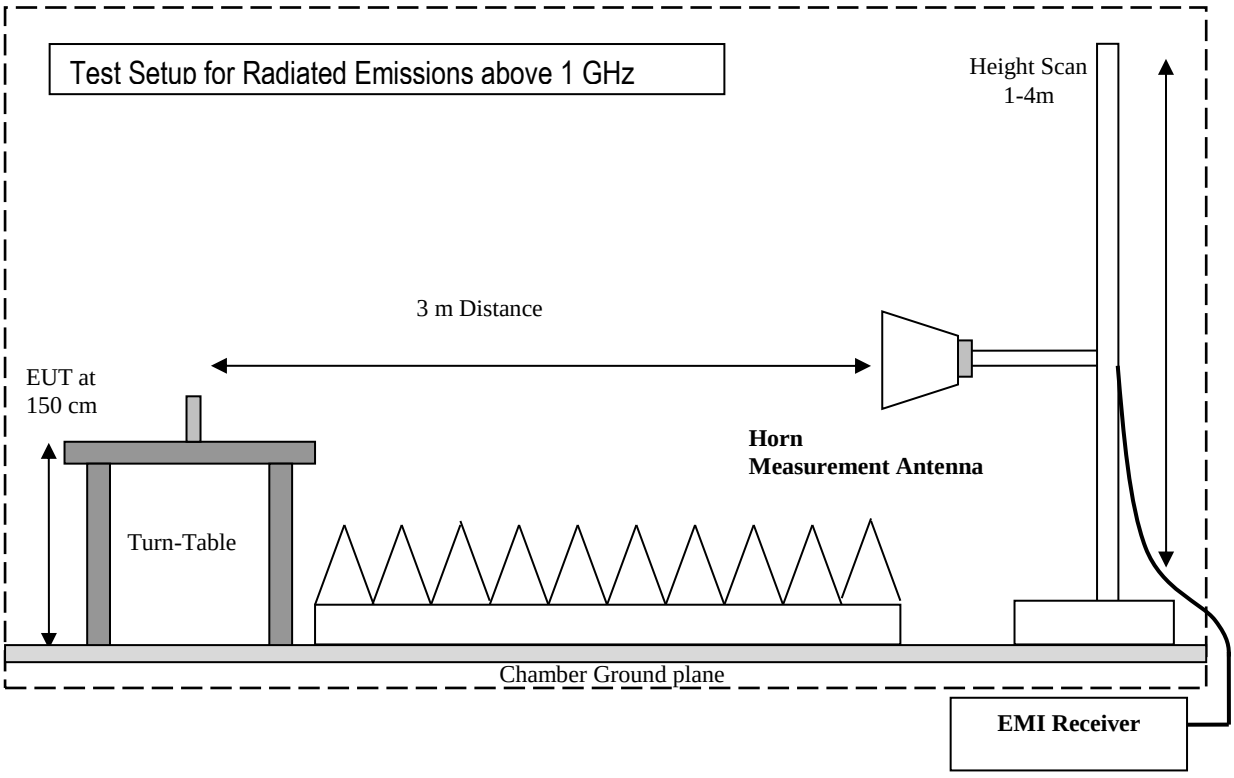
Testing is performed according to the guidelines provided in FCC publication (KDB) 971168 D01 v03 – "Measurement Guidance for Certification of Licensed Digital Transmitters" and according to ANSI C63.26 as detailed below.

5.1 Radiated Measurement

- 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.




Height Scan
1-4m
3 m Distance
EUT at
80 cm
BiLog
Measurement Antenna
Turn-Table
Chamber Ground plane
EMI Receiver


Test Setup for Radiated Emissions above 1 GHz
Height Scan
1-4m
3 m Distance
EUT at
150 cm
Horn
Measurement Antenna
Turn-Table
Chamber Ground plane
EMI Receiver

5.2 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

- Measured reading in dBµV
- Cable Loss between the receiving antenna and SA in dB and
- 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

6 Measurement Results Summary

6.1 FCC 22, RSS-132:

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §22.913 (a)	RF Output Power	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1055; §22.355	Frequency Stability	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1049; §22.917	Occupied Bandwidth	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §22.917	Band Edge Compliance	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §22.917	Conducted Spurious Emissions	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1053; §22.917(a); RSS-132 Issue 3-5.5;	Radiated Spurious Emissions	Nominal	Op.1	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Leveraged from module certification FCC ID: RI7LE910NAV2

6.2 FCC 24, RSS-133:

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §24.232 (a)	RF Output Power	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1055; §24.235	Frequency Stability	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1049; §24.238	Occupied Bandwidth	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §24.238	Band Edge Compliance	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §24.238	Conducted Spurious Emissions	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1053; §24.238(a); RSS-133 Issue 6-6.5.1;	Radiated Spurious Emissions	Nominal	Op.1	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Leveraged from module certification FCC ID: RI7LE910NAV2

6.3 FCC 27, RSS-130, RSS-139:

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §27.50 (d)	RF Output Power	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1055; §27.54	Frequency Stability	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1049; §27.53	Occupied Bandwidth	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §27.53	Band Edge Compliance	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §27.53	Conducted Spurious Emissions	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1053; §27.53(g); §27.53(h); RSS-130 Issue 2-4.6; RSS-139 Issue 3-6.6;	Radiated Spurious Emissions	Nominal	Op.1	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Leveraged from module certification FCC ID: RI7LE910NAV2

7 Test Result Data

7.1 E(I)RP

Band	Frequency Range (MHz)	Power conducted (W)	Emission Designator	Antenna Gain + Cable loss (dBi)	gain linear	EIRP[1] (W)	ERP[1] (W)	Frequency deviation (ppm)	Limit ERP (W)
WCDMA II	1852.4 – 1907.6	0.232	4M09F9W	4.4	2.754	0.639	-	1.0	2
WCDMA V	826.4 – 846.6	0.229	4M08F9W	2.6	1.820	0.417	0.254	1.0	7
LTE 2	1852.5 – 1907.5	0.219	4M47G7D	4.4	2.754	0.603	-	1.0	2
LTE 2	1860 – 1900	0.219	17M9G7D	4.4	2.754	0.603	-	1.0	2
LTE 4	1710.7 – 1754.3	0.205	1M08G7D	4.4	2.754	0.565	-	1.0	1
LTE 4	1710.7 – 1754.3	0.205	13M5G7D	4.4	2.754	0.565	-	1.0	1
LTE 4	1720 – 1745	0.203	18M0G7D	4.4	2.754	0.559	-	1.0	1
LTE 5	824.7 – 848.3	0.191	1M09G7D	2.6	1.820	0.348	0.212	1.0	7
LTE 5	829 – 844	0.190	8M97G7D	2.6	1.820	0.346	0.211	1.0	7
LTE 12	700.5 – 714.5	0.193	2M69G7D	2.6	1.820	0.351	0.214	1.0	3
LTE 12	704 – 711	0.190	8M98G7D	2.6	1.820	0.346	0.211	1.0	3
LTE 13	779.5 - 784.5	0.194	4M47G7D	2.6	1.820	0.353	0.215	1.0	3
LTE 13	782 - 782	0.188	8M96G7D	2.6	1.820	0.342	0.209	1.0	3

Note 1: E(I)RP are calculated from maximum power in grant of cellular module LE910 adding the maximum gain of the utilized cellular antenna per operational description.

7.2 Radiated Spurious Emissions

7.2.1 Measurement according to FCC: CFR 47 Part 2.1053; CFR Part 22.917; CFR Part 24.238 and Part 27.53 utilizing KDB 971168 D01 Power Meas License Digital Systems v03, and according to ANSI C63.26 2017

Spectrum Analyzer Settings for FCC 22

Frequency Range	30 MHz – 1 GHz	1 – 1.58 GHz	1.58 – 9 GHz
Resolution Bandwidth	100 kHz	1 MHz	1 MHz
Video Bandwidth	100 kHz	1 MHz	1 MHz
Detector	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto

Spectrum Analyzer Settings for FCC 24 and 27

Frequency Range	30MHz – 1 GHz	1 – 2.7 GHz	2.7 – 18 GHz	18 – 19.1 GHz
Resolution Bandwidth	100 kHz	1 MHz	1 MHz	1 MHz
Video Bandwidth	100 kHz	1 MHz	1 MHz	1 MHz
Detector	Peak	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto	Auto

7.2.2 Limits:

- **FCC Part 22.917(a), Part 24.238(a), Part 27.53 (g) and Part 27.53 (h)**
- **RSS-130 Issue 2-4.6, RSS-132 Issue 3 5.5, RSS-133 Issue 6 6.5.1, RSS-139 Issue 3 6.6**

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB = (-13dBm)

7.2.3 Test conditions and setup:

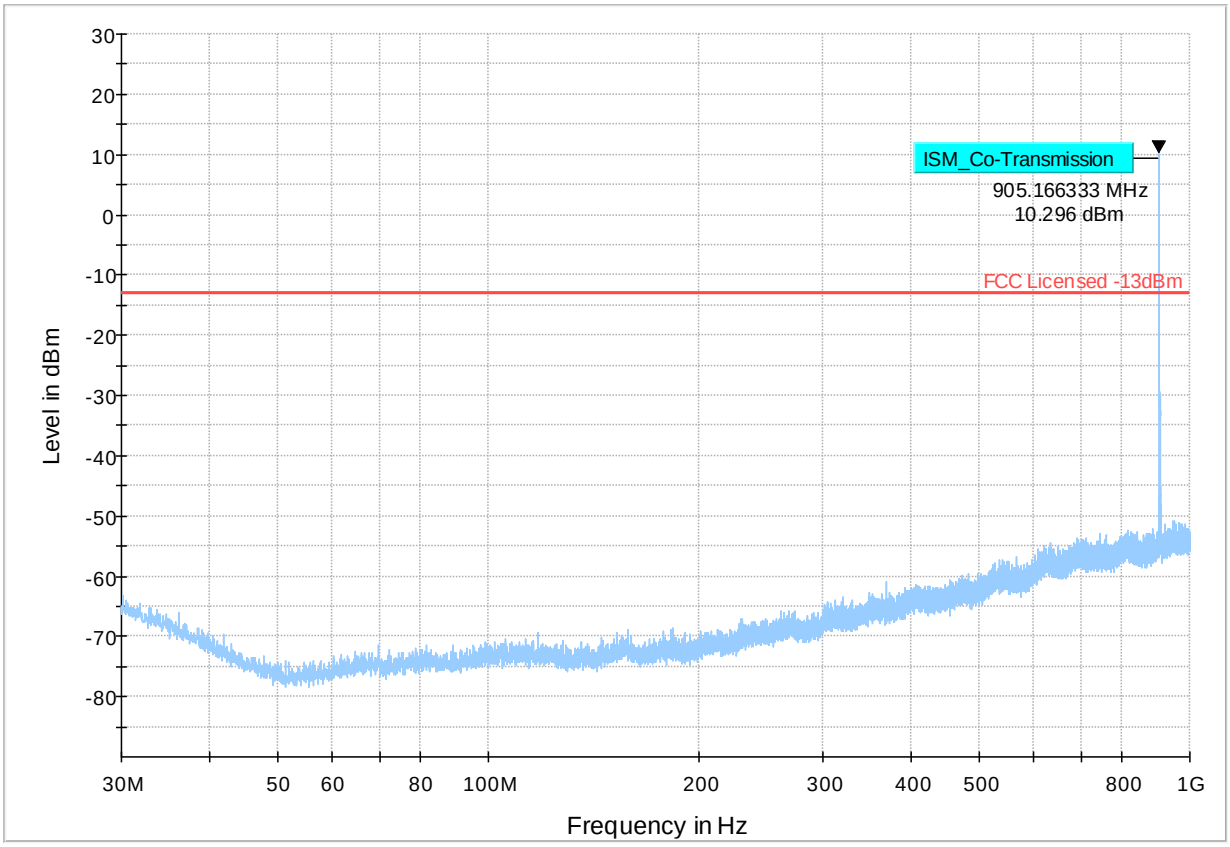
Ambient Temperature (C)	EUT operating mode	Power Input
22	Op. 1	12 VDC

7.2.4 Measurement Plots:

WCDMA Band II

Plot # 1 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low

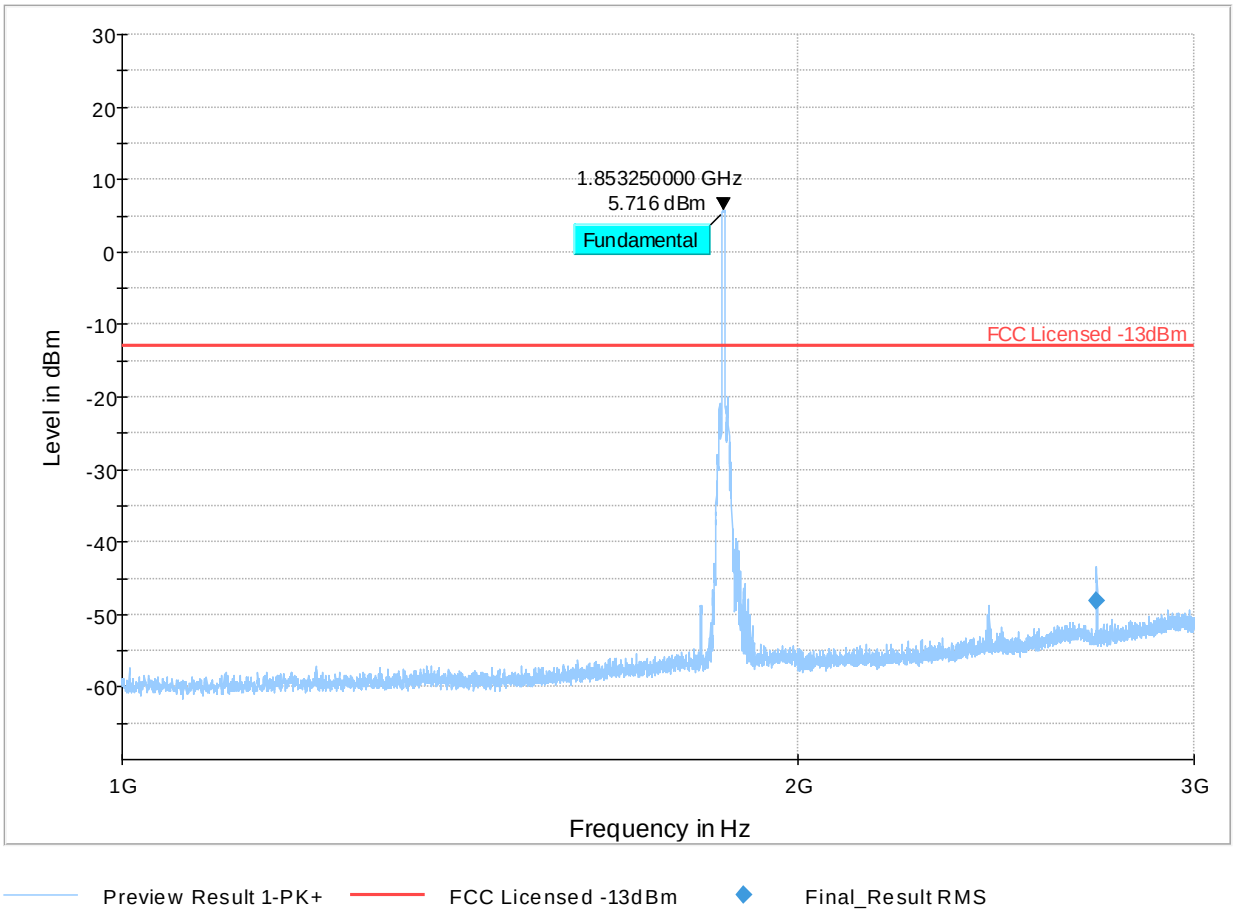


Plot # 2 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
2714.500	-48.02	-13.00	35.02	500.0	1000.000	140.0	V	291.0	-87.0	

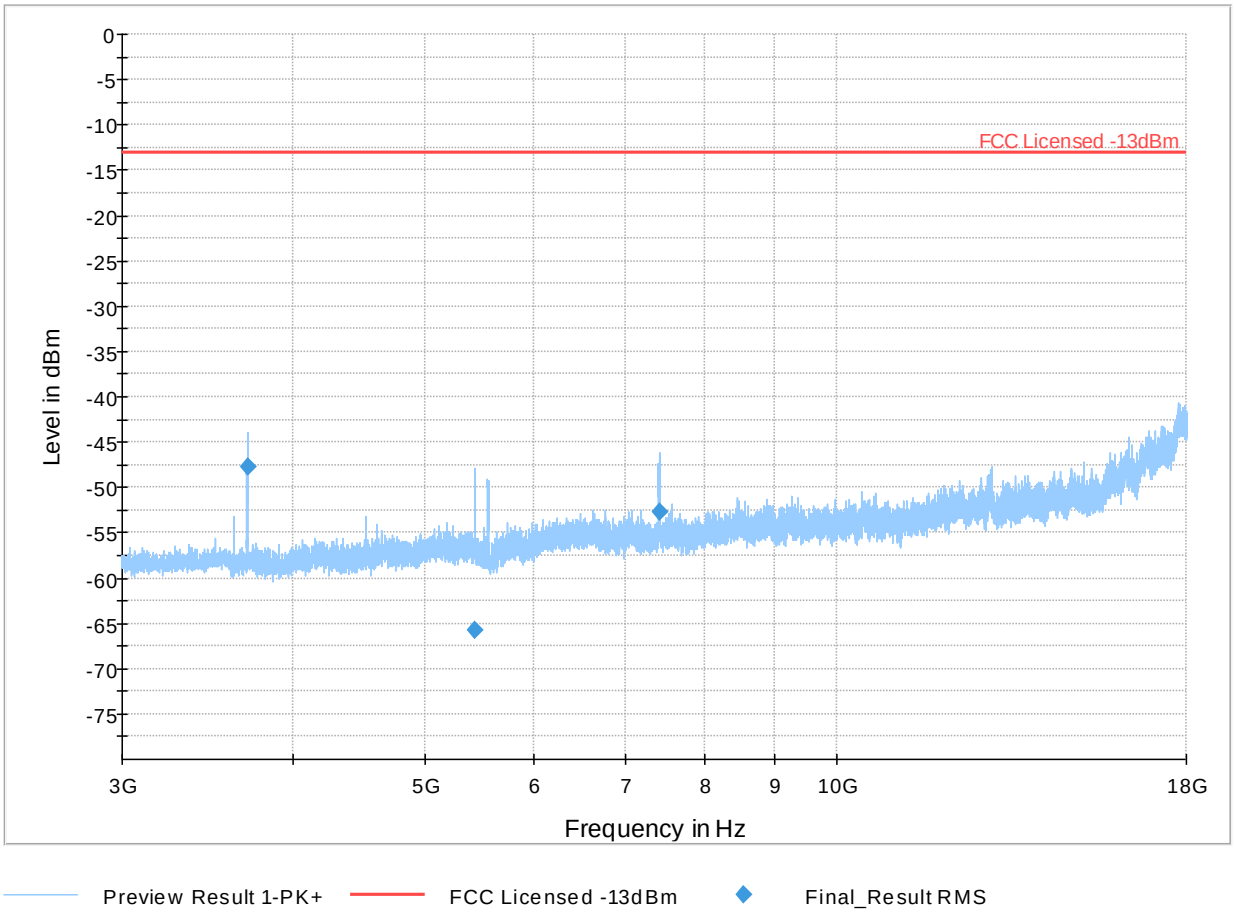


Plot # 3 Radiated Emissions: 3 GHz - 18 GHz

Channel: Low

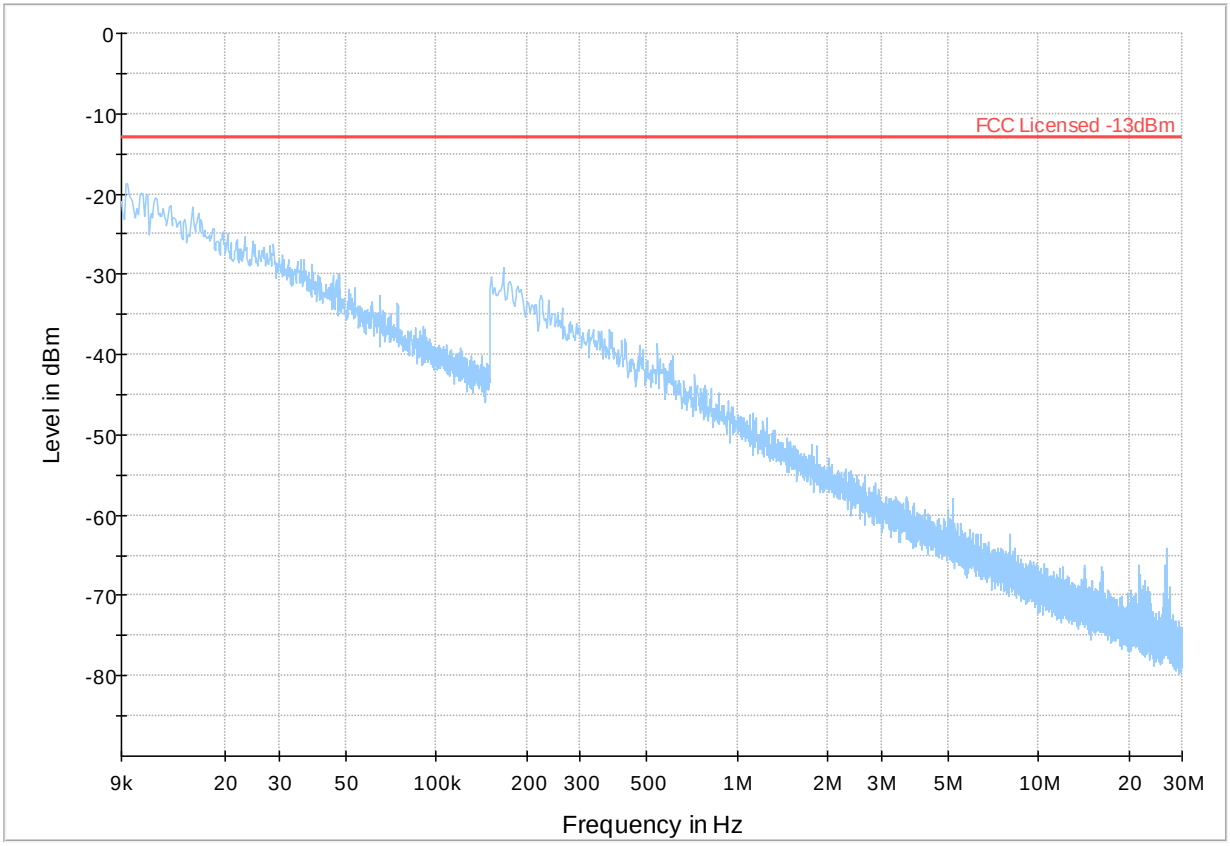
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3706.500	-47.68	-13.00	34.68	500.0	1000.000	163.0	H	333.0	-101.6	
5429.000	-65.80	-13.00	52.80	500.0	1000.000	286.0	V	40.0	-99.4	
7414.500	-52.70	-13.00	39.70	500.0	1000.000	152.0	V	20.0	-95.5	



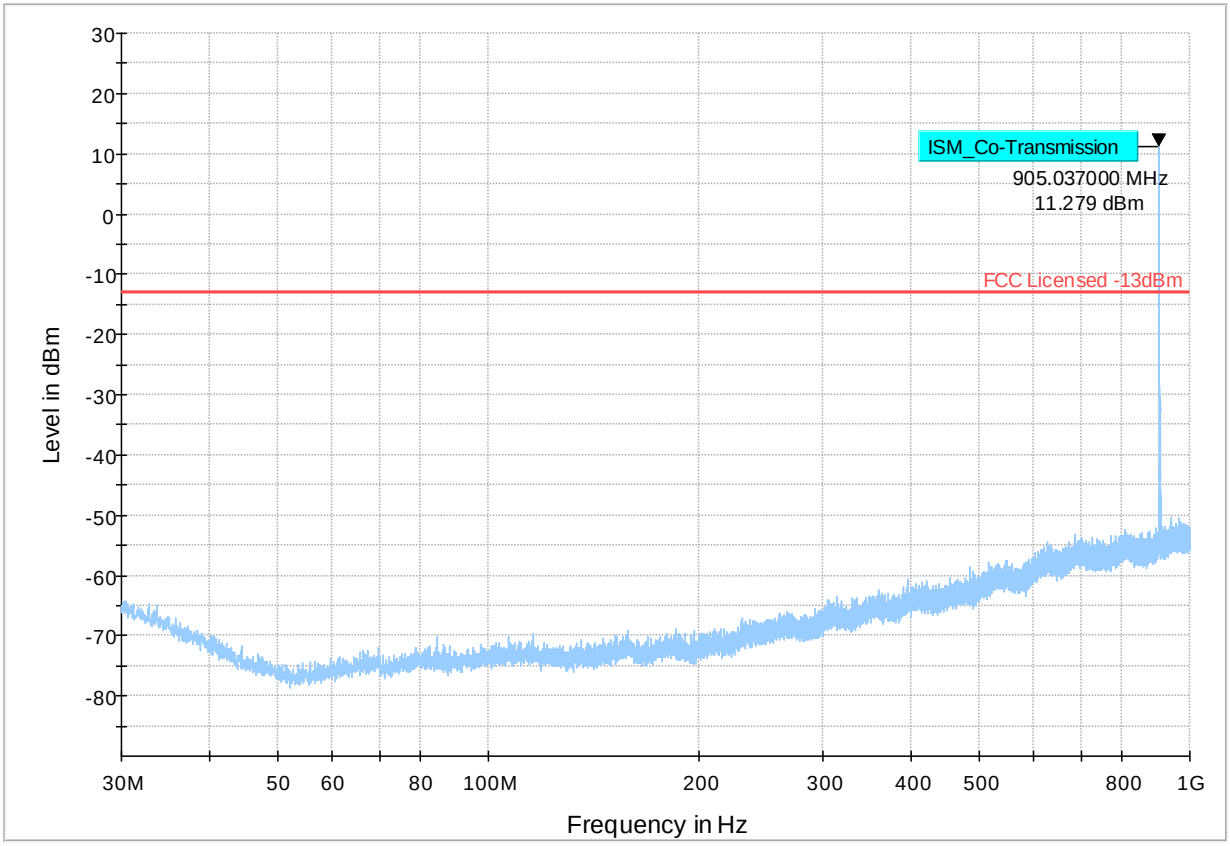
Plot # 4 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



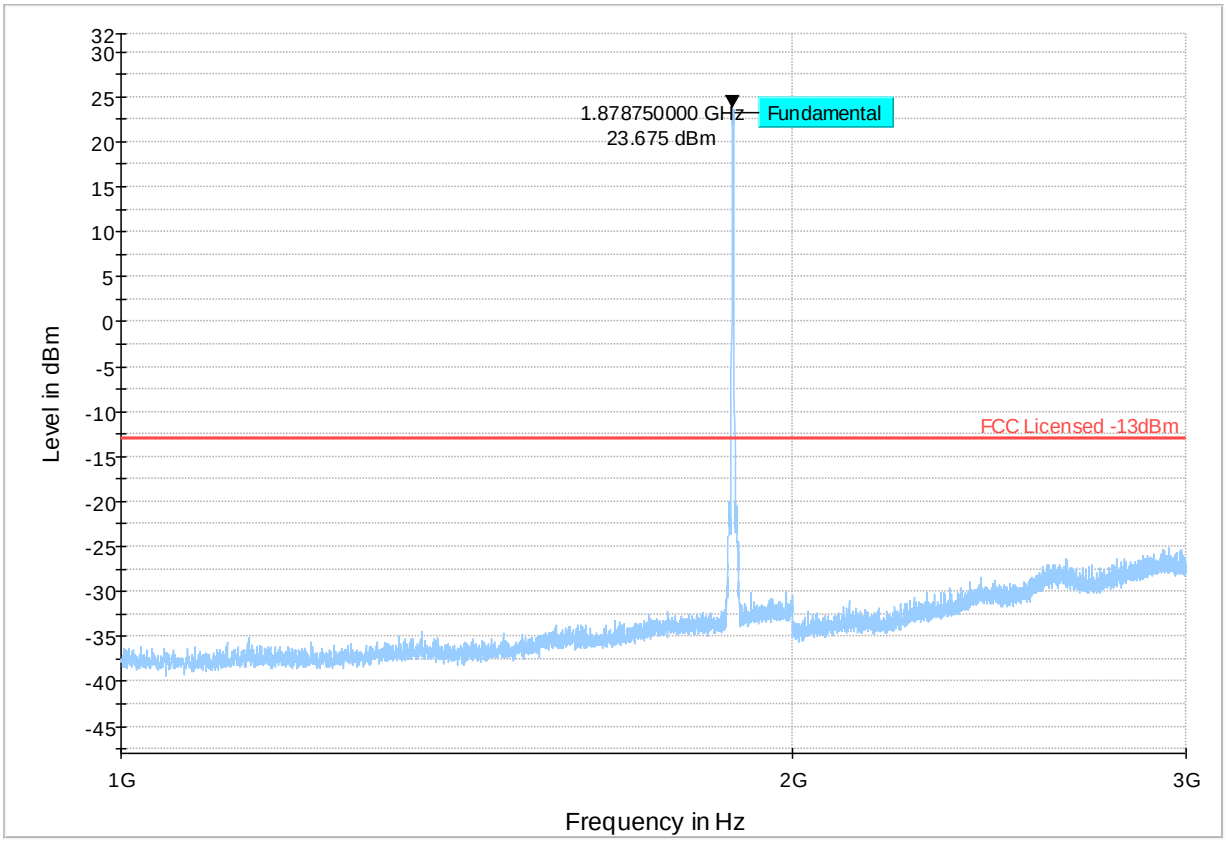
Plot # 5 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid



Plot # 6 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

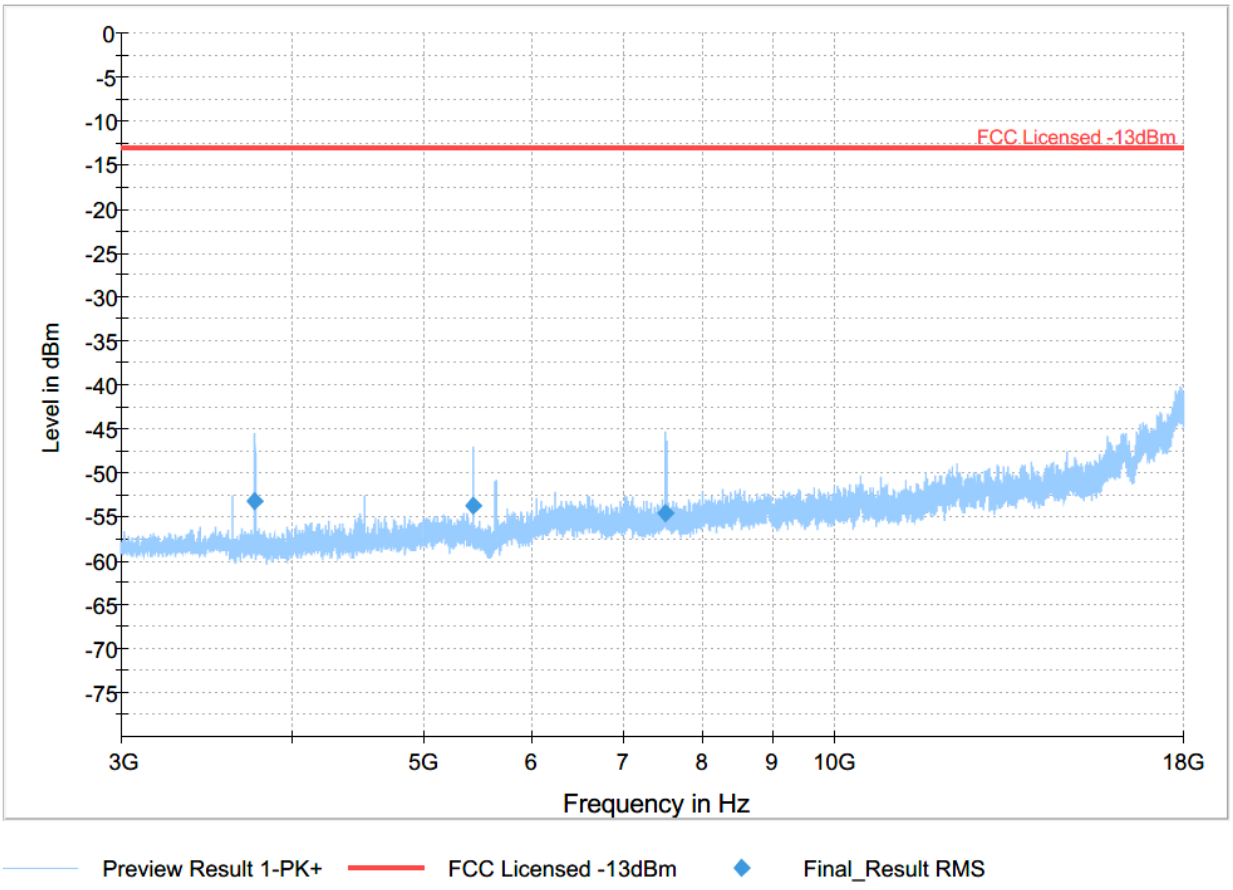


Plot # 7 Radiated Emissions: 3 GHz – 18 GHz

Channel: Mid

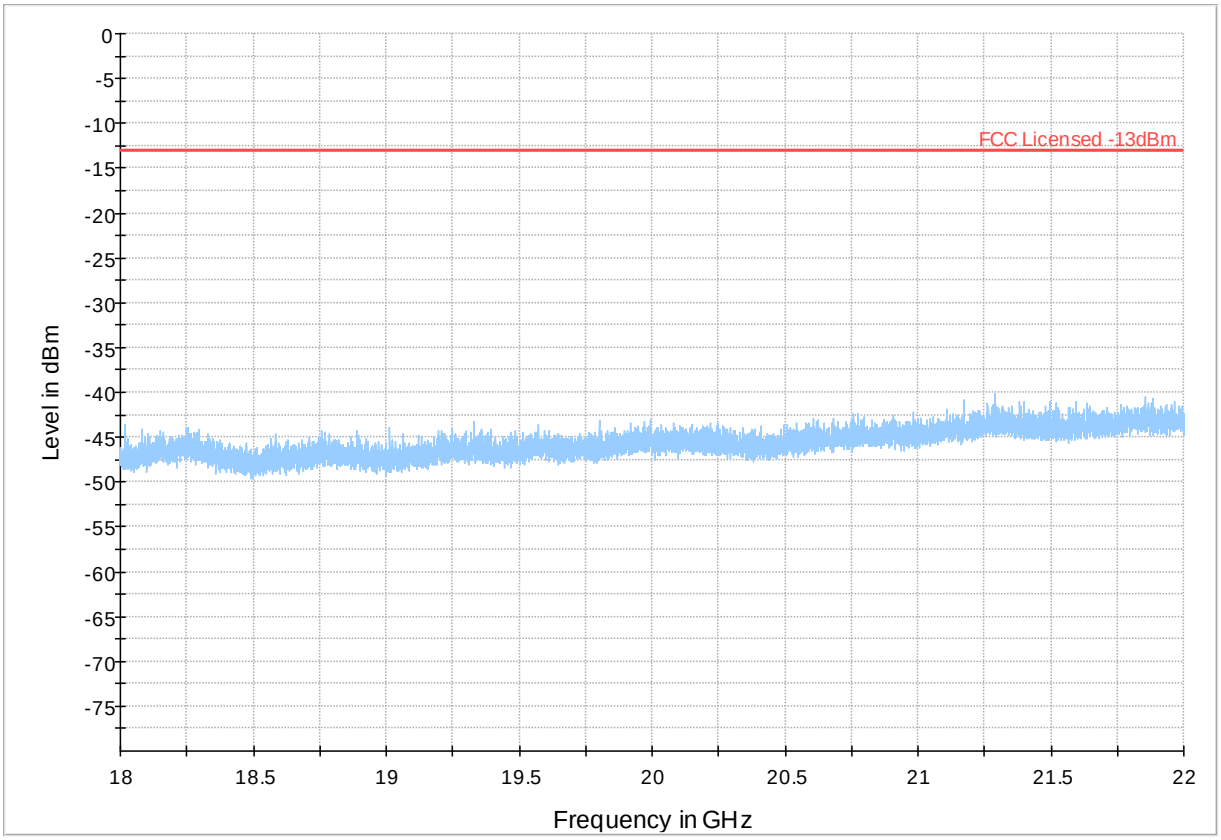
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3757.500	-53.16	-13.00	40.16	500.0	1000.000	218.0	H	341.0	-101.7	
5429.000	-53.81	-13.00	40.81	500.0	1000.000	140.0	V	83.0	-99.4	
7515.500	-54.56	-13.00	41.56	500.0	1000.000	164.0	V	21.0	-95.3	



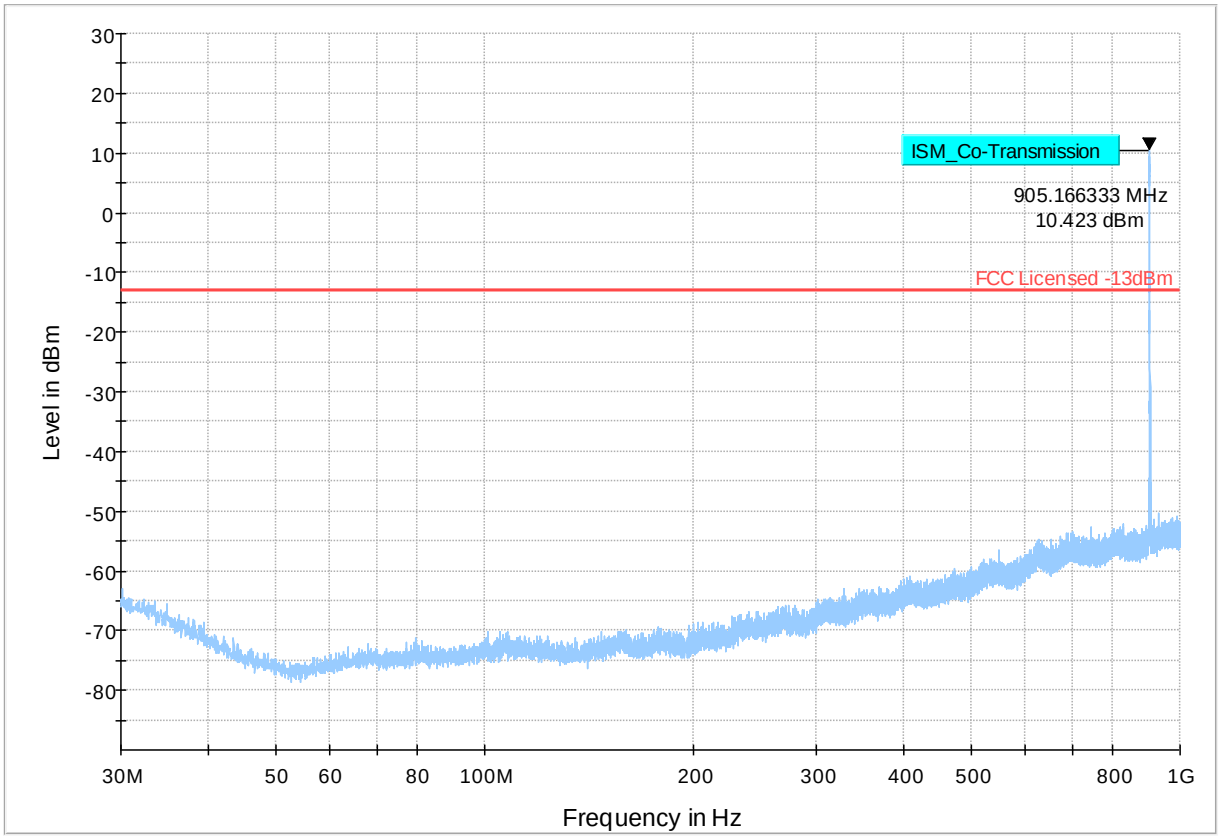
Plot # 8 Radiated Emissions: 18 GHz – 22 GHz

Channel: Mid



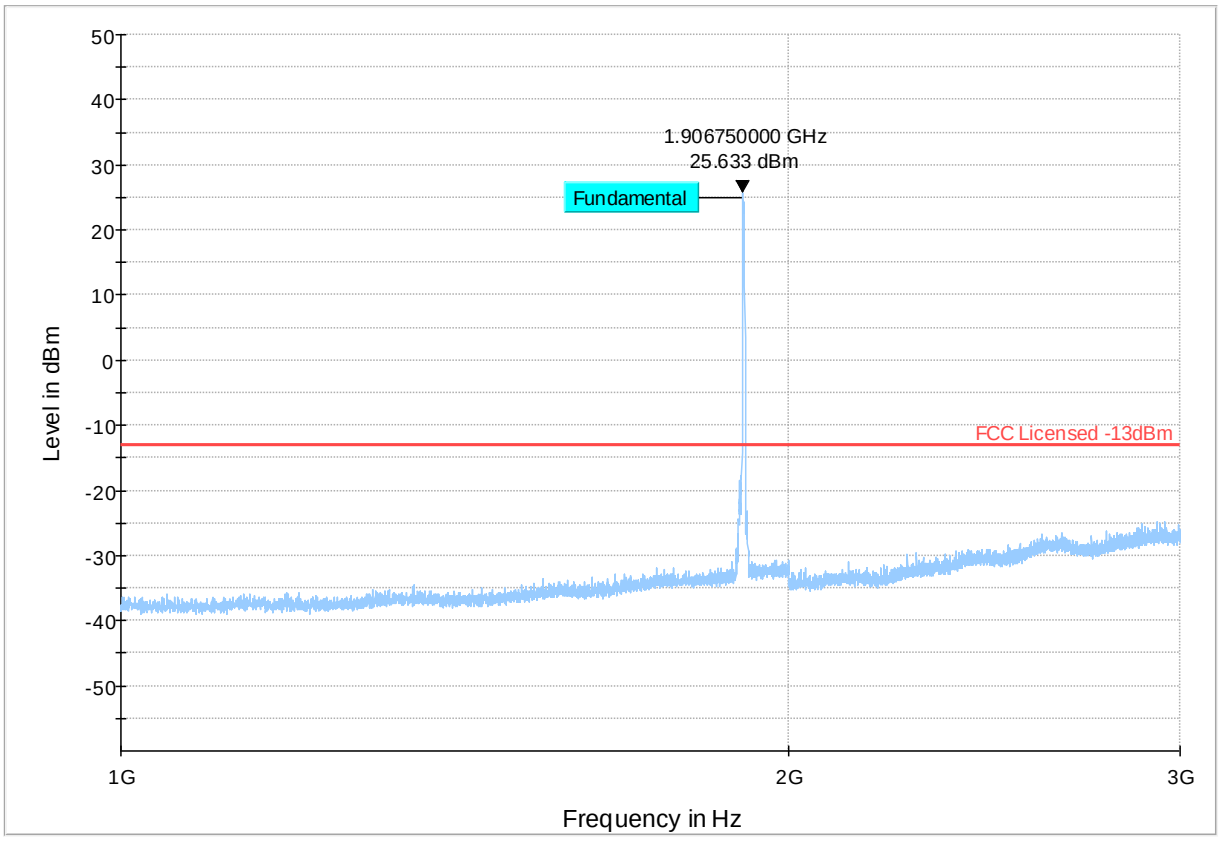
Plot # 9 Radiated Emissions: 30 MHz - 1 GHz

Channel: High



Plot # 10 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

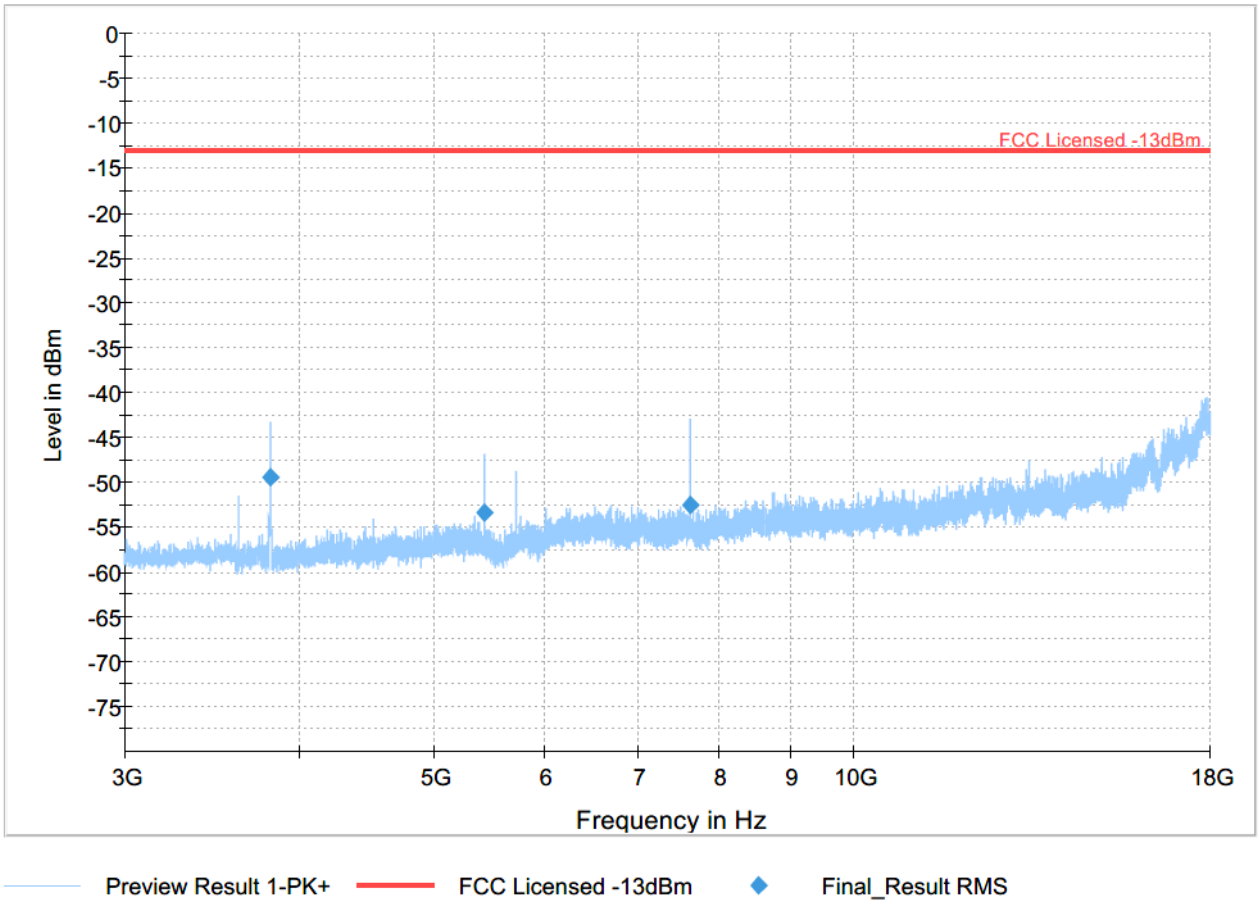


Plot # 11 Radiated Emissions: 3 GHz - 18 GHz

Channel: High

Final_Result

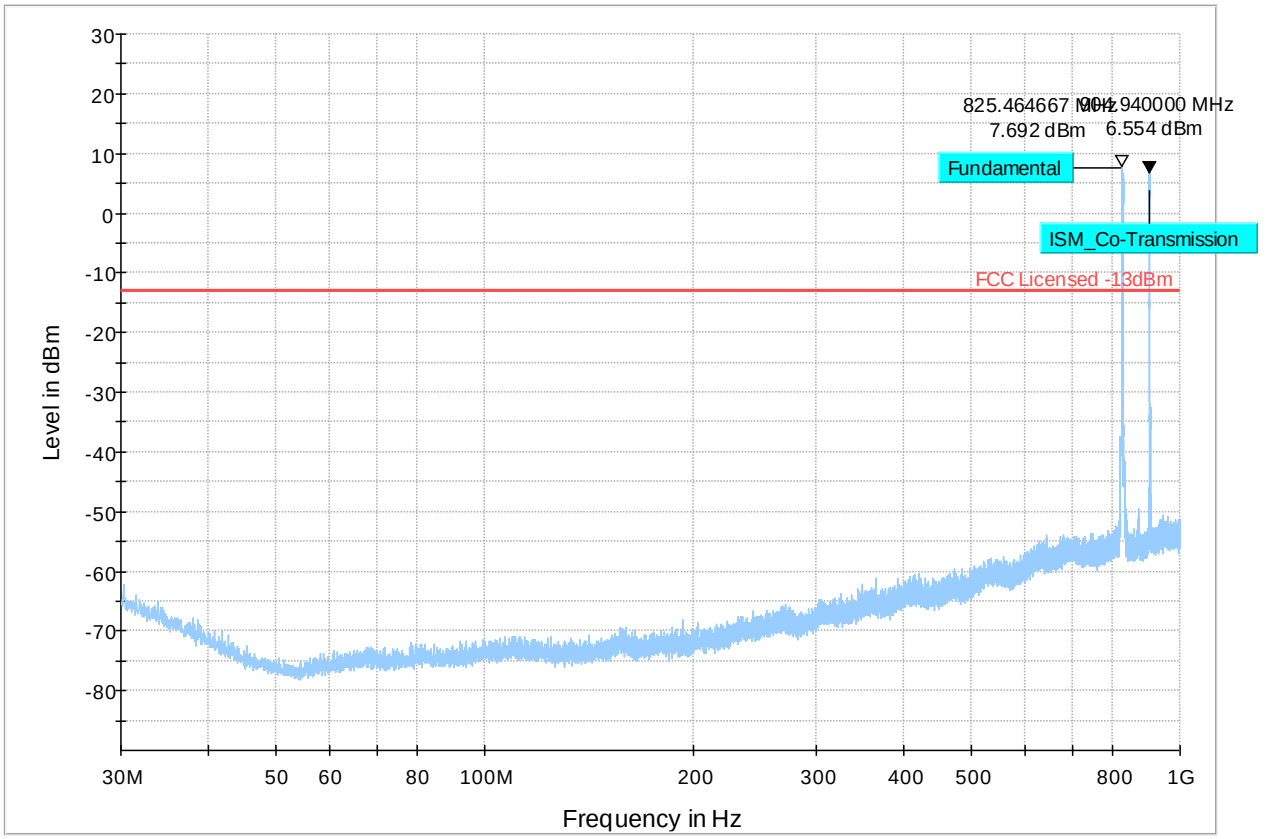
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3818.000	-49.45	-13.00	36.45	500.0	1000.000	140.0	H	338.0	-101.7	
5431.000	-53.33	-13.00	40.33	500.0	1000.000	220.0	V	29.0	-99.4	
7635.500	-52.48	-13.00	39.48	500.0	1000.000	140.0	V	16.0	-95.7	



WCDMA Band V

Plot # 12 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low

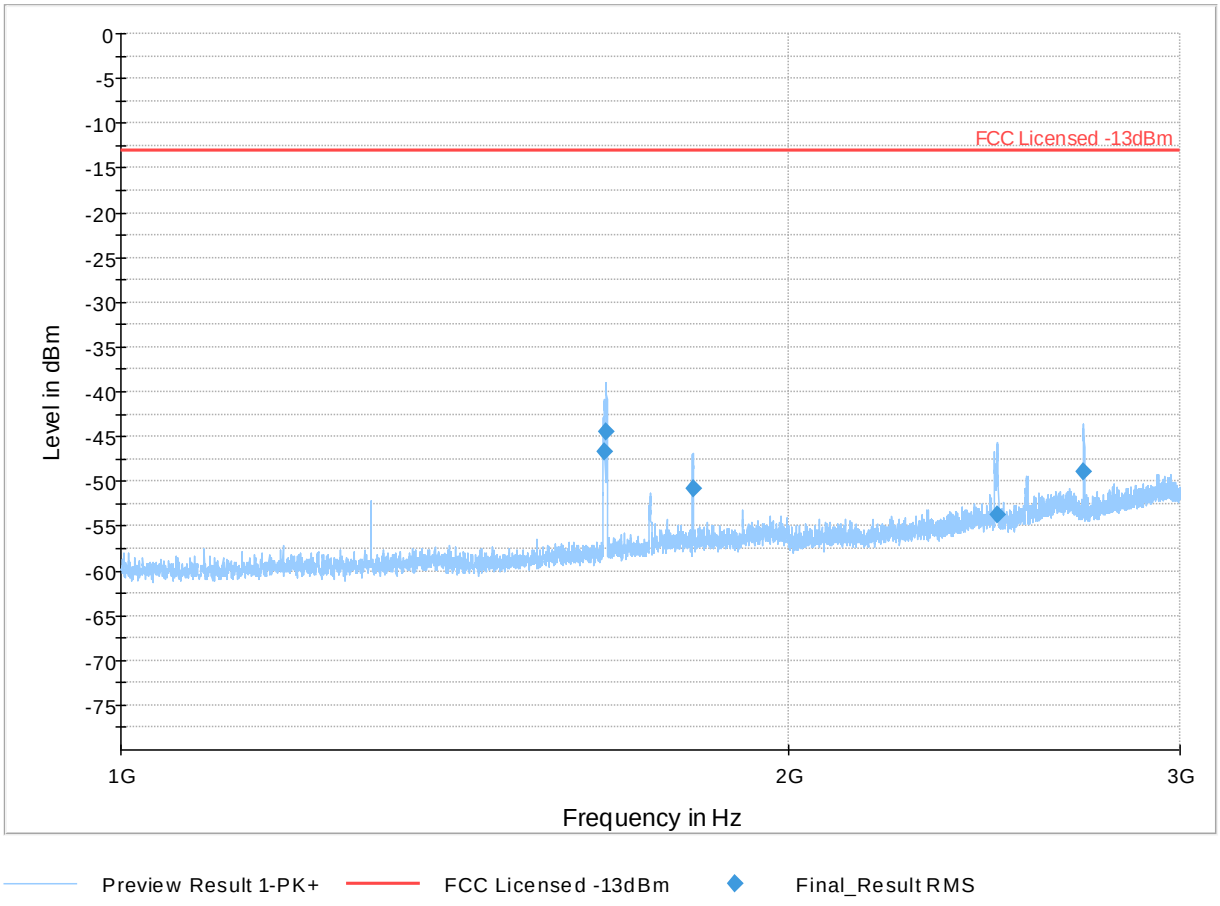


Plot # 13 Radiated Emissions: 1 GHz - 3 GHz

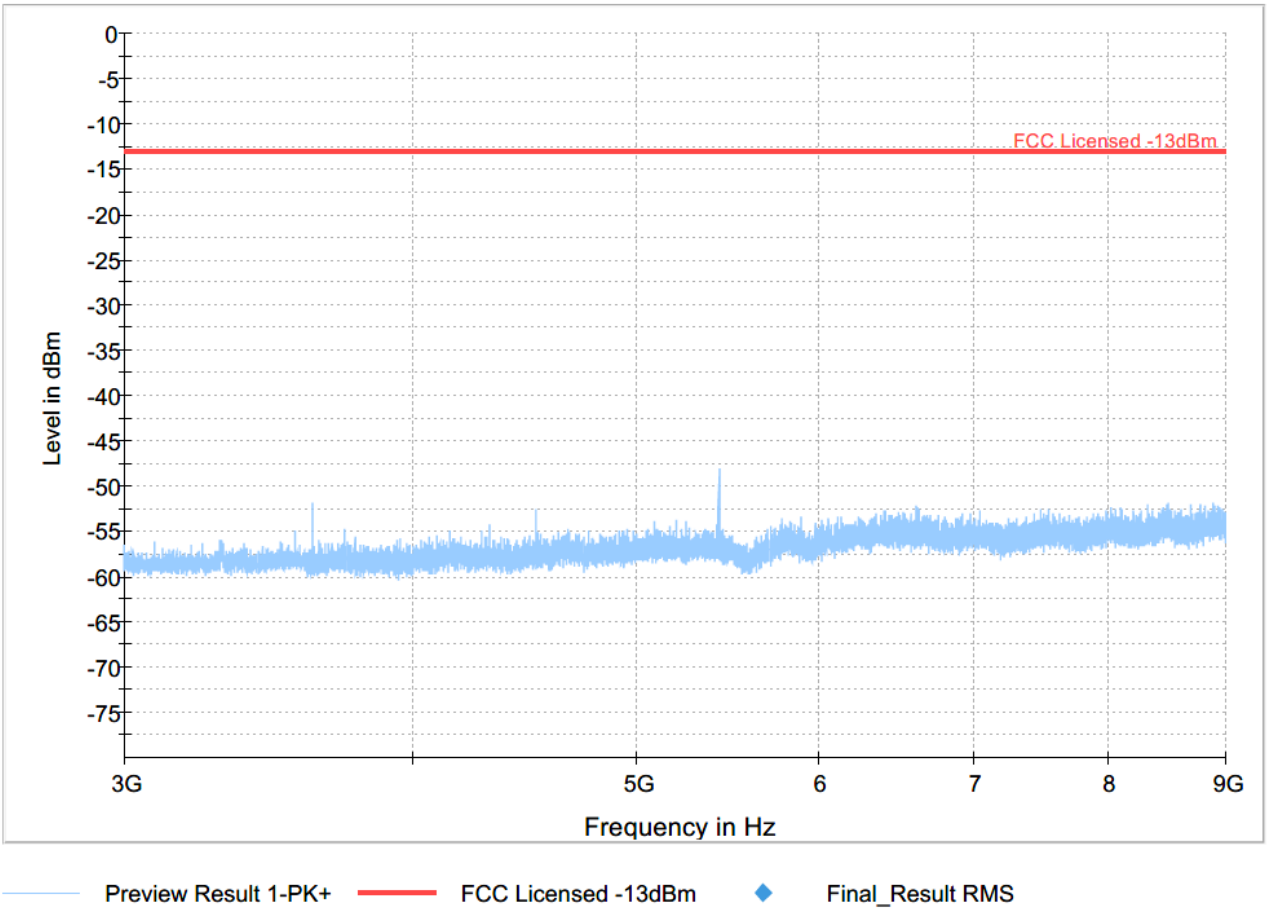
Channel: Low

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1650.500	-46.63	-13.00	33.63	500.0	1000.000	152.0	H	168.0	-91.3	
1654.500	-44.39	-13.00	31.39	500.0	1000.000	152.0	H	171.0	-91.3	
1809.750	-50.90	-13.00	37.90	500.0	1000.000	185.0	V	89.0	-90.4	
2483.000	-53.78	-13.00	40.78	500.0	1000.000	140.0	H	79.0	-88.3	
2715.500	-48.88	-13.00	35.88	500.0	1000.000	140.0	V	116.0	-87.0	

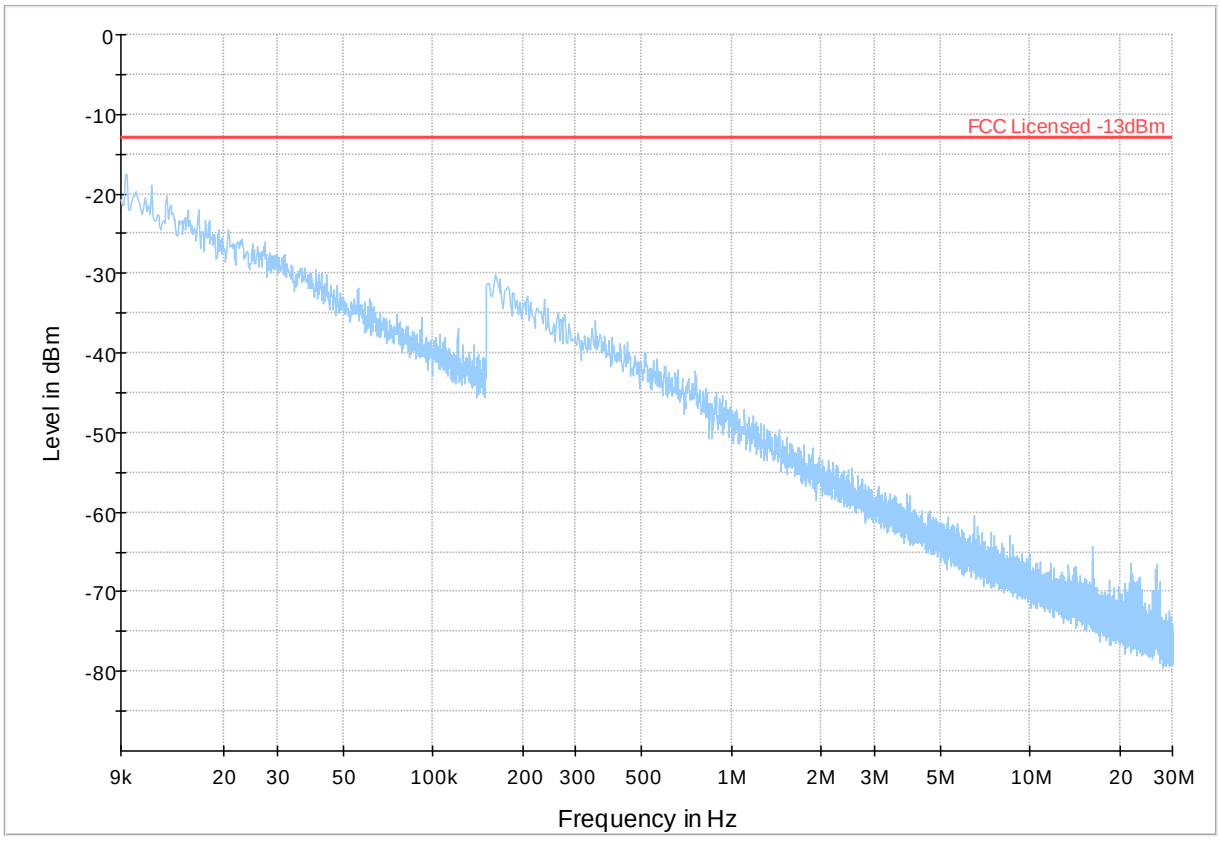


Plot # 14 Radiated Emissions: 3 GHz - 9 GHz
Channel: Low



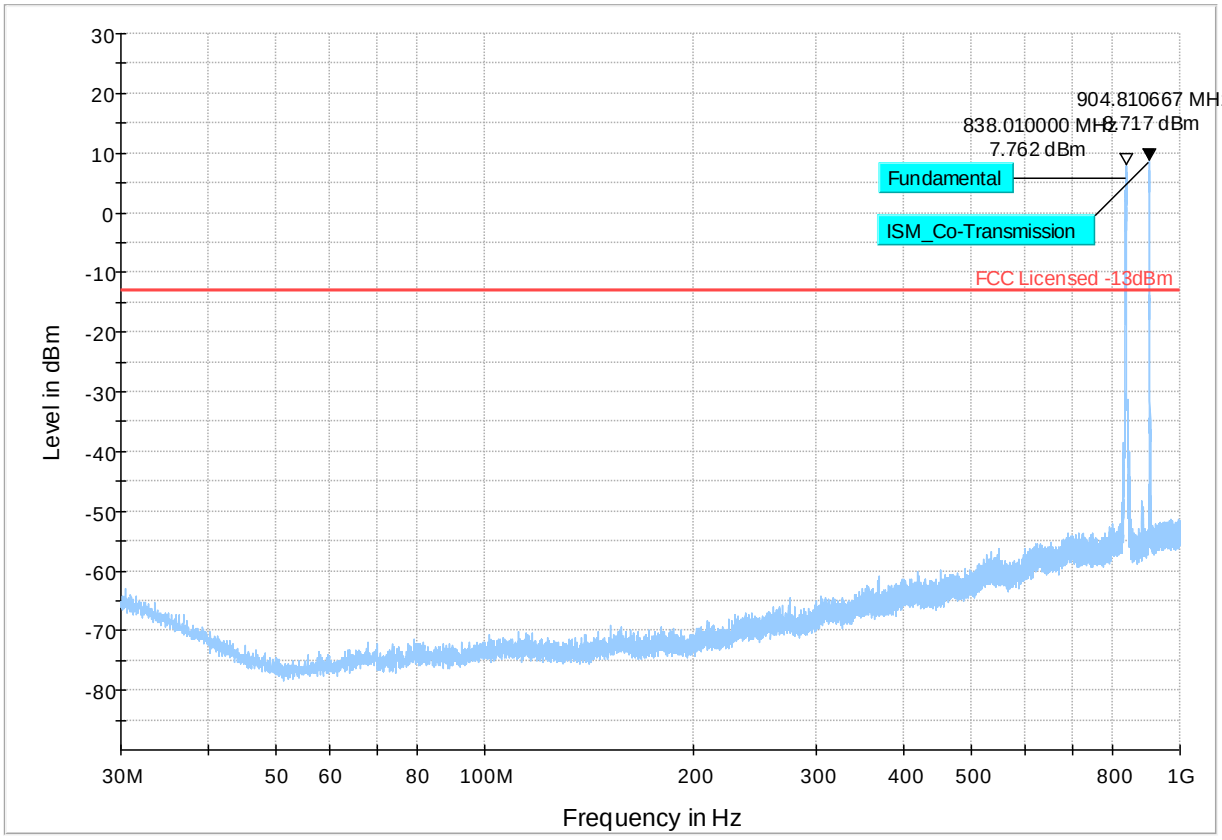
Plot # 15 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



Plot # 16 Radiated Emissions: 30 MHz – 1 GHz

Channel: Mid

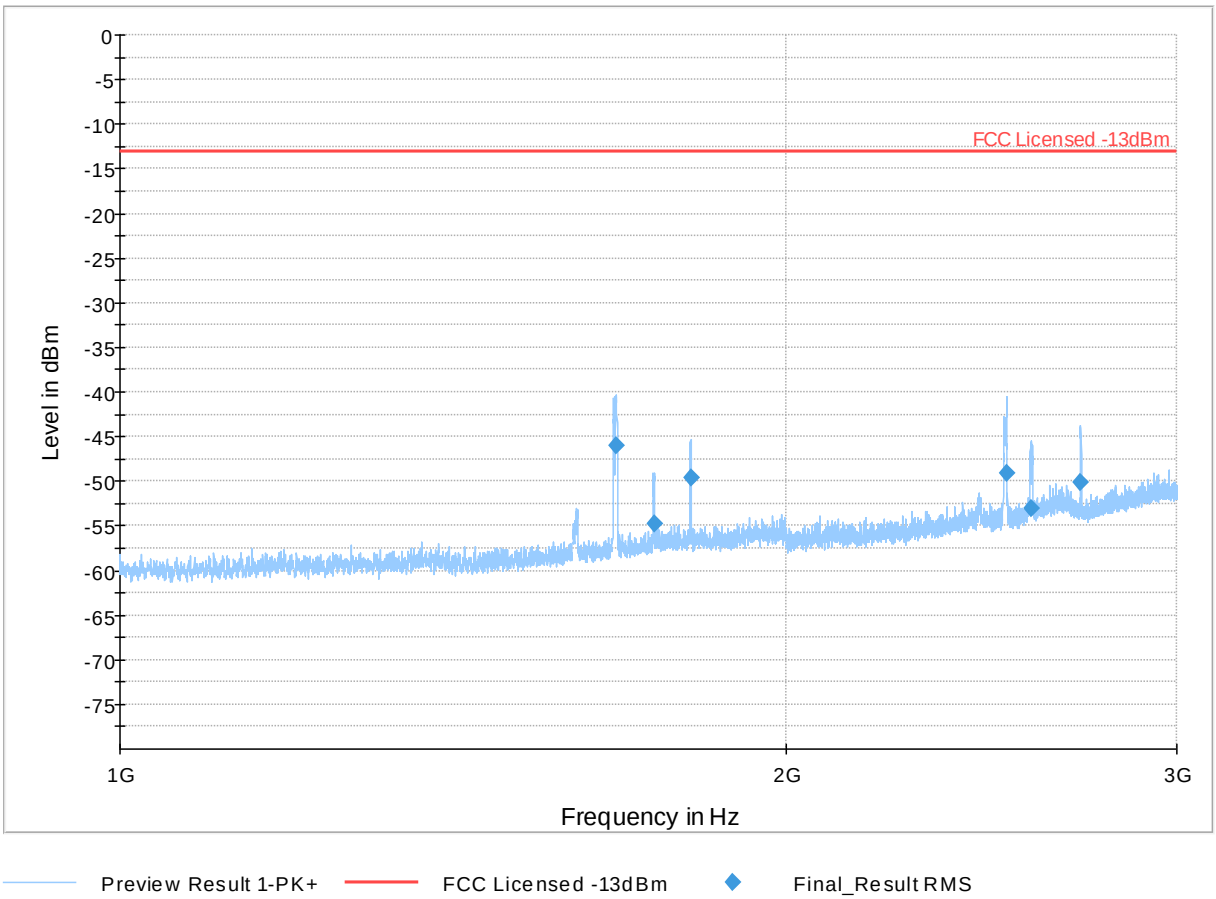


Plot # 17 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1675.250	-46.08	-13.00	33.08	500.0	1000.000	304.0	H	192.0	-91.1	
1743.250	-54.85	-13.00	41.85	500.0	1000.000	164.0	H	185.0	-90.4	
1809.750	-49.62	-13.00	36.62	500.0	1000.000	227.0	V	103.0	-90.4	
2513.250	-49.08	-13.00	36.08	500.0	1000.000	140.0	H	75.0	-88.1	
2580.500	-53.08	-13.00	40.08	500.0	1000.000	140.0	V	180.0	-87.5	
2715.750	-50.09	-13.00	37.09	500.0	1000.000	140.0	V	292.0	-87.0	

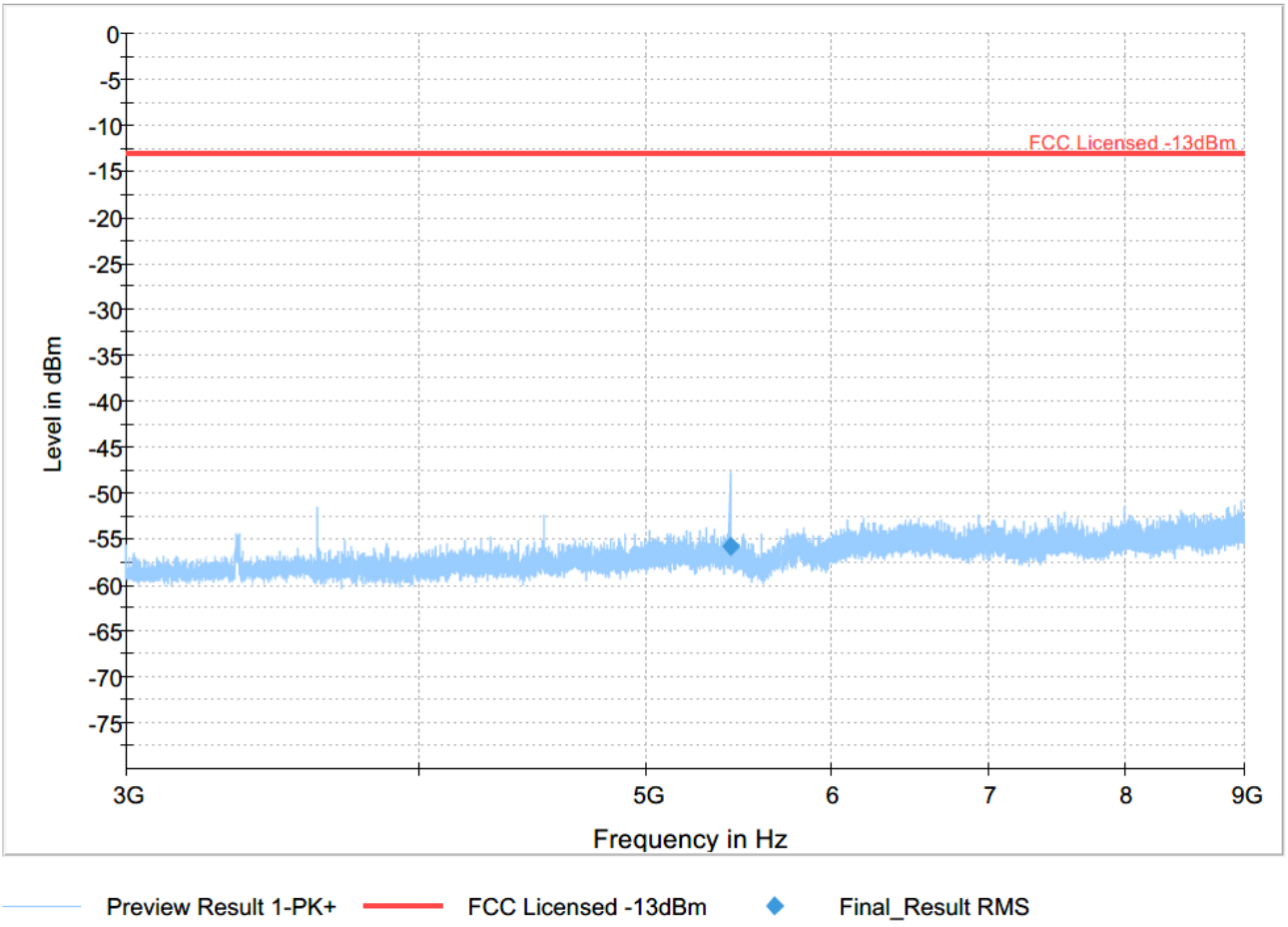


Plot # 18 Radiated Emissions: 3 GHz – 9GHz

Channel: Mid

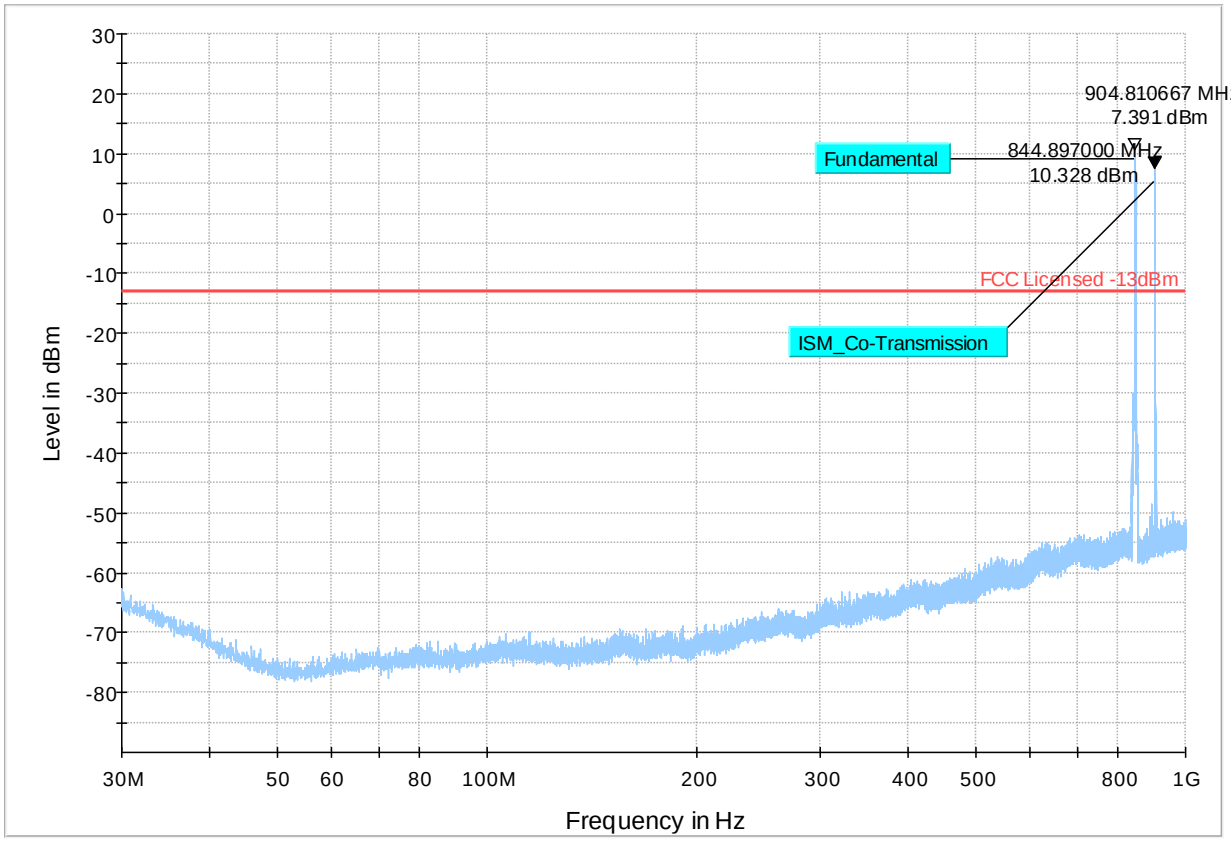
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
5429.000	-55.79	-13.00	42.79	500.0	1000.000	257.0	V	265.0	-99.4	



Plot # 19 Radiated Emissions: 30 MHz - 1 GHz

Channel: High

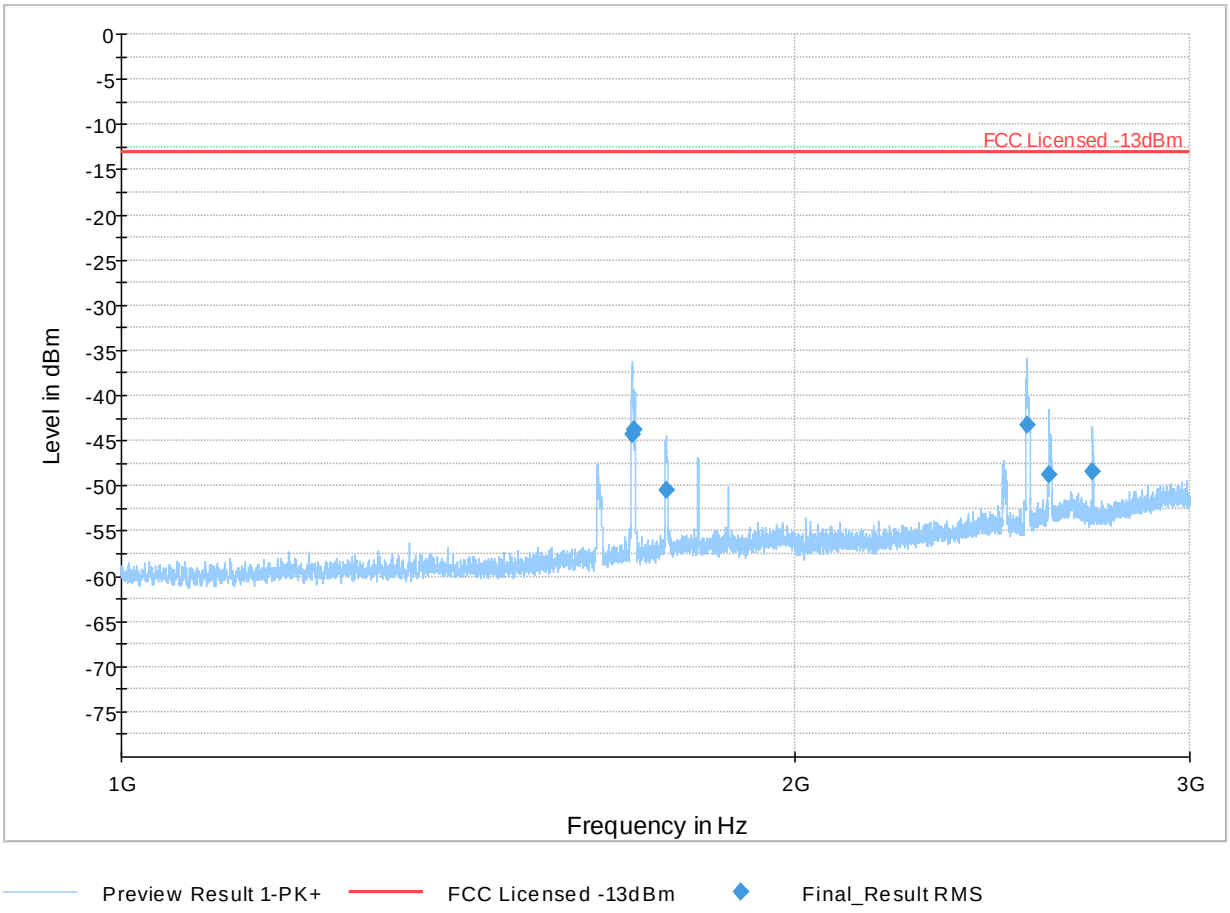


Plot # 20 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1690.750	-44.31	-13.00	31.31	500.0	1000.000	283.0	H	92.0	-90.9	
1694.500	-43.78	-13.00	30.78	500.0	1000.000	285.0	H	92.0	-90.9	
1750.750	-50.39	-13.00	37.39	500.0	1000.000	140.0	H	180.0	-90.4	
2536.750	-43.32	-13.00	30.32	500.0	1000.000	140.0	H	78.0	-88.0	
2596.000	-48.77	-13.00	35.77	500.0	1000.000	140.0	V	183.0	-87.4	
2715.500	-48.35	-13.00	35.35	500.0	1000.000	198.0	V	288.0	-87.0	

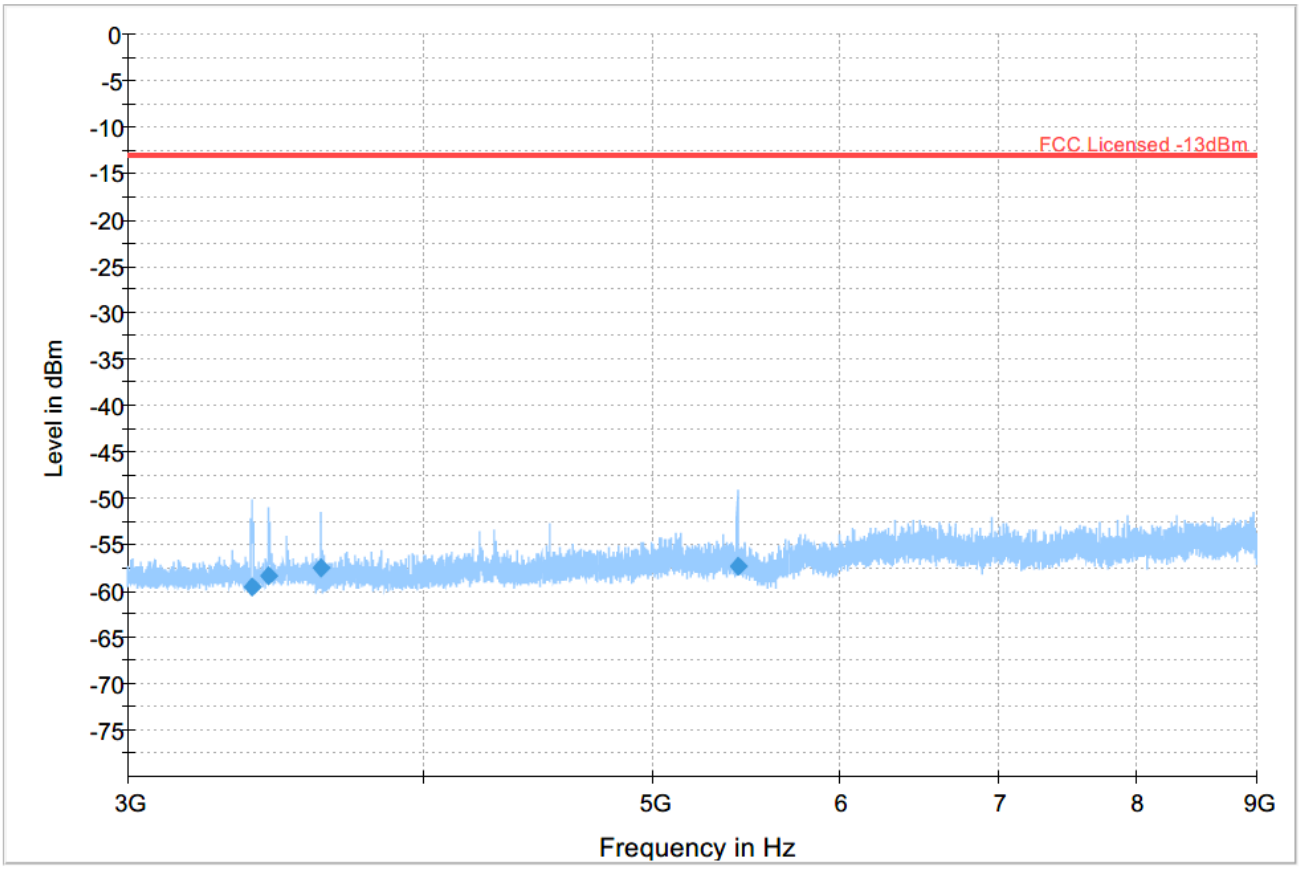


Plot # 21 Radiated Emissions: 3 GHz - 9 GHz

Channel: High

Final_Result

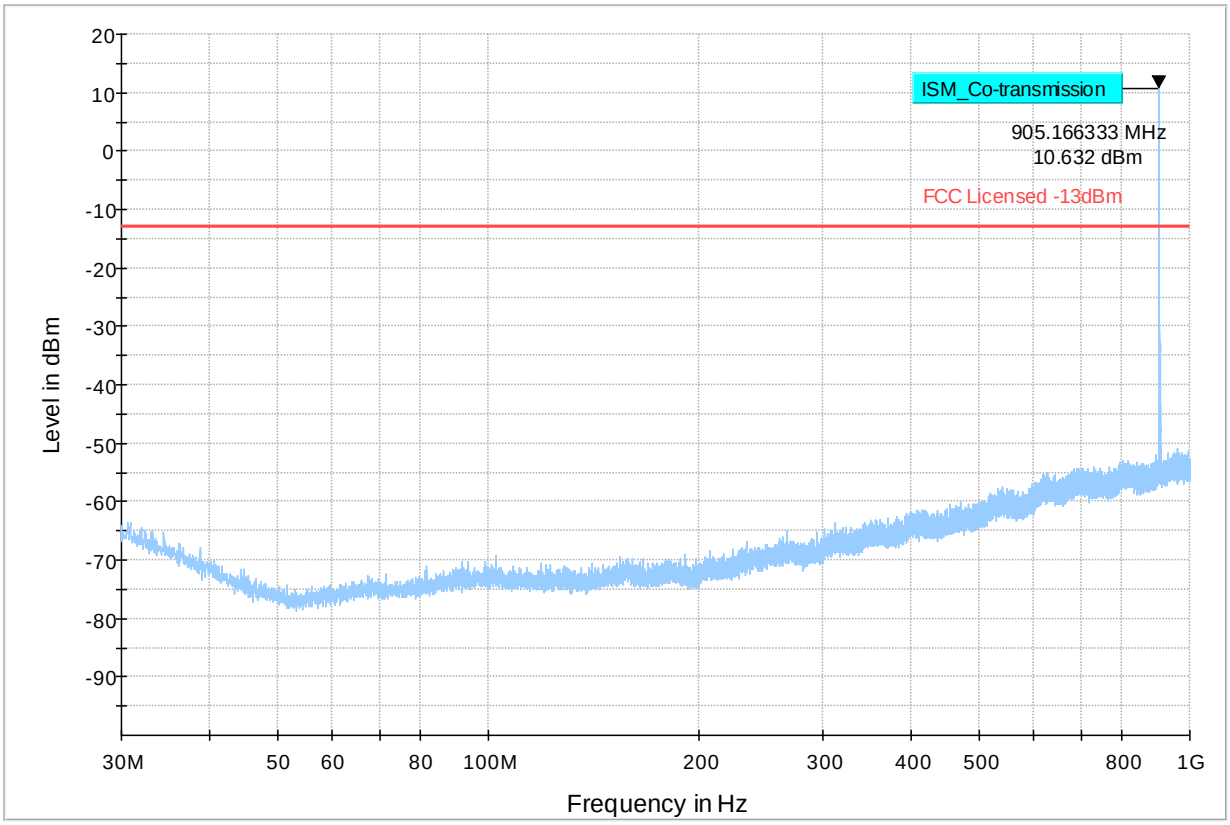
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3385.500	-59.53	-13.00	46.53	500.0	1000.000	164.0	V	189.0	-103.4	
3442.250	-58.45	-13.00	45.45	500.0	1000.000	153.0	V	189.0	-103.2	
3620.750	-57.48	-13.00	44.48	500.0	1000.000	151.0	V	230.0	-102.2	
5431.250	-57.38	-13.00	44.38	500.0	1000.000	140.0	V	84.0	-99.4	



LTE Band 2

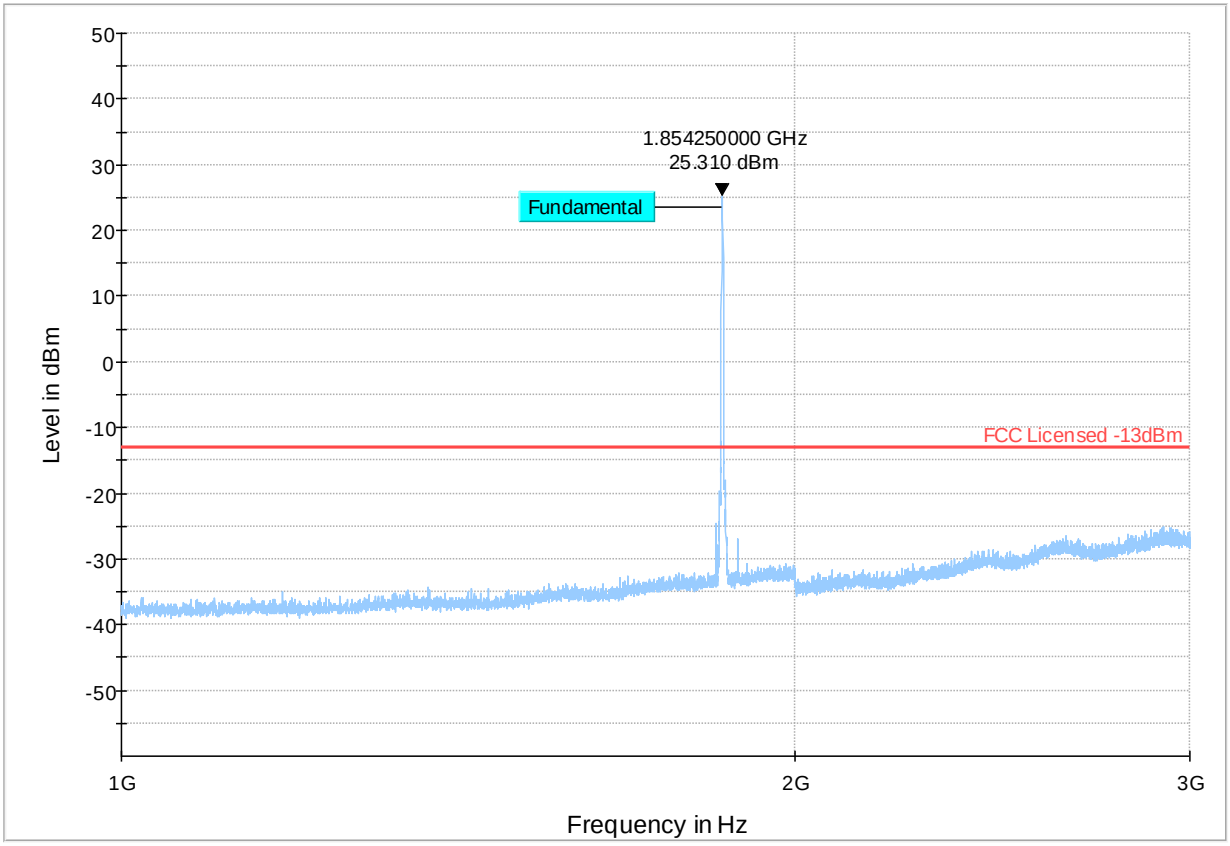
Plot # 22 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low



Plot # 23 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low

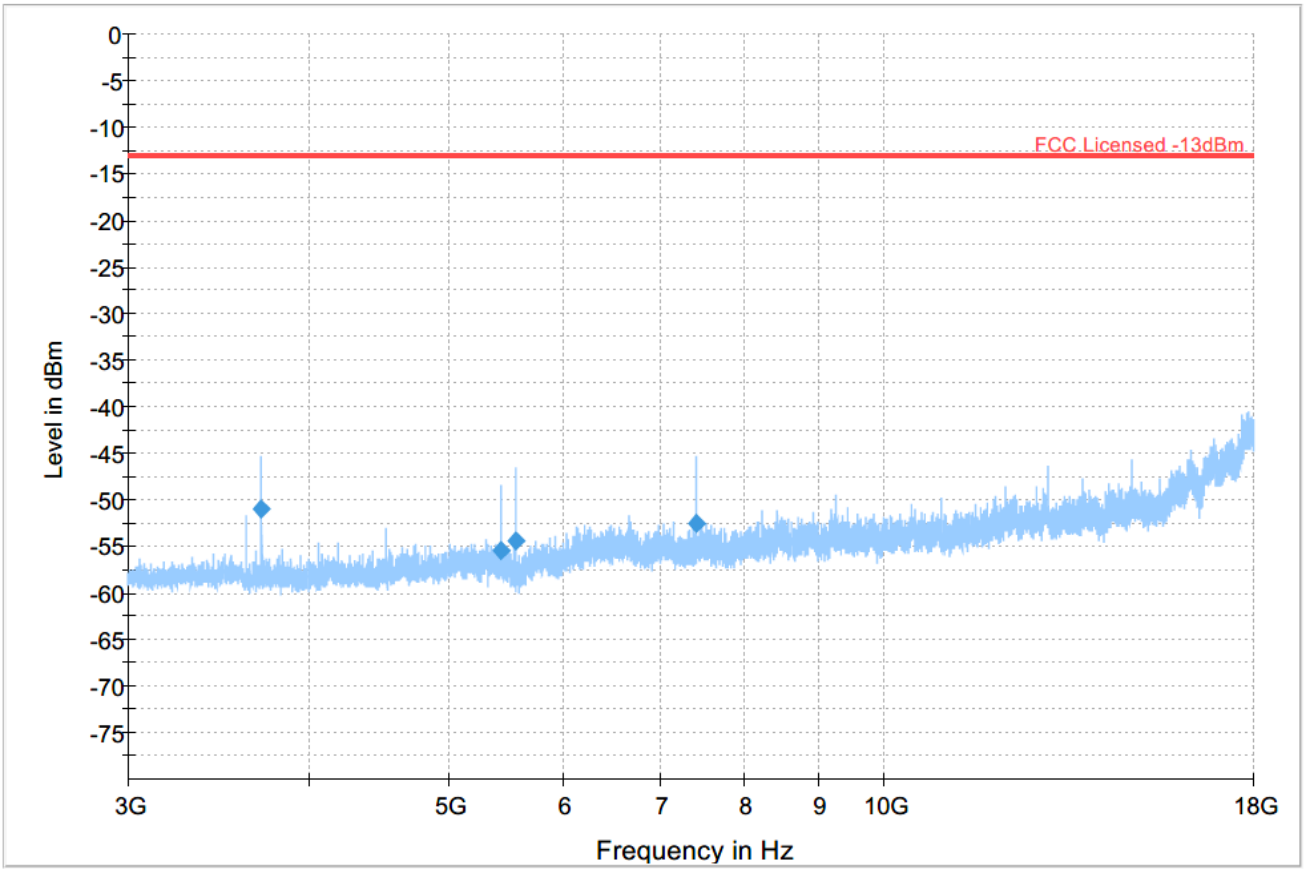


Plot # 24 Radiated Emissions: 3 GHz - 18 GHz

Channel: Low

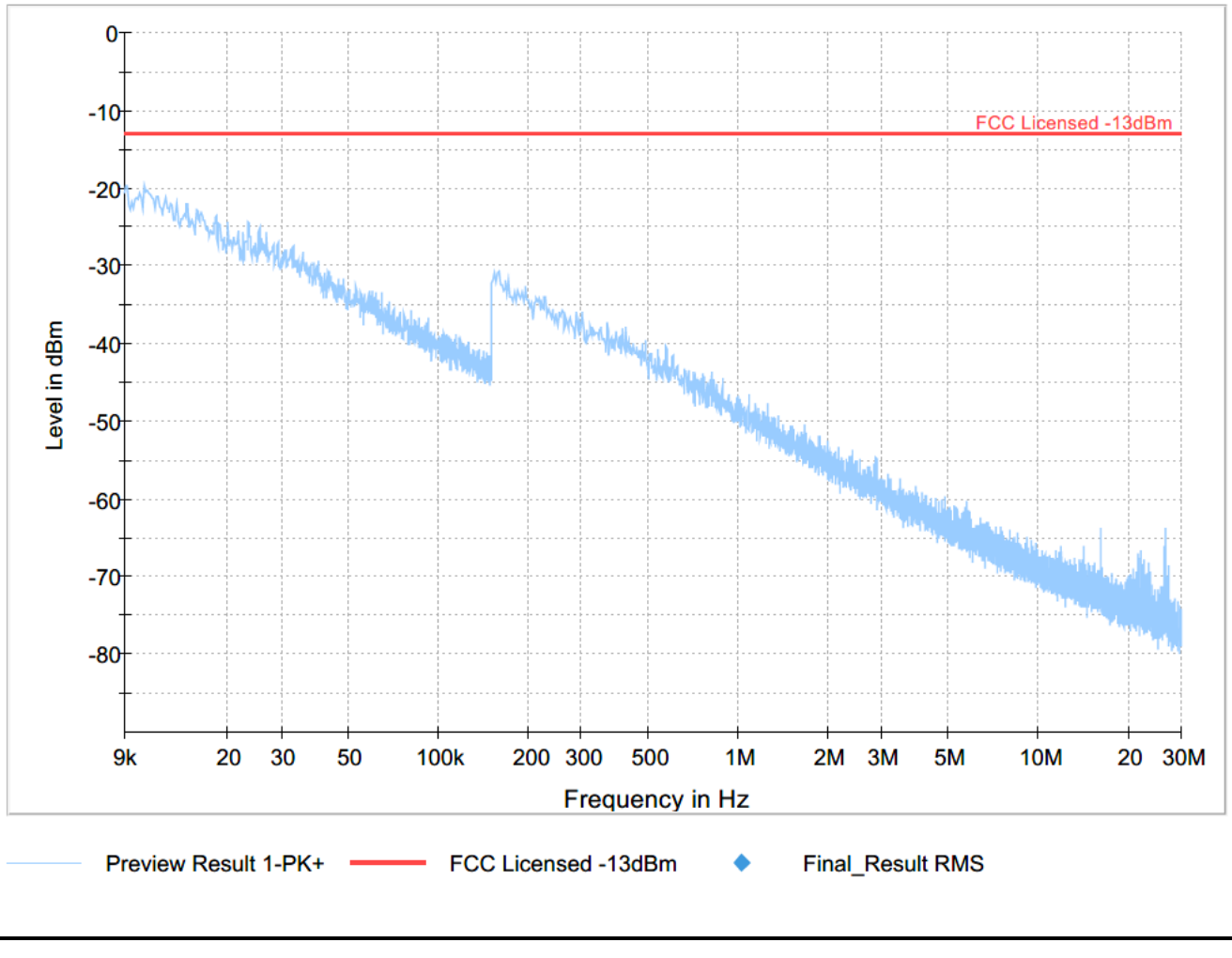
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3710.500	-50.95	-13.00	37.95	500.0	1000.000	173.0	H	331.0	-101.6	
5428.500	-55.51	-13.00	42.51	500.0	1000.000	185.0	V	29.0	-99.4	
5566.000	-54.39	-13.00	41.39	500.0	1000.000	164.0	V	5.0	-99.7	
7422.500	-52.49	-13.00	39.49	500.0	1000.000	152.0	V	-21.0	-95.4	



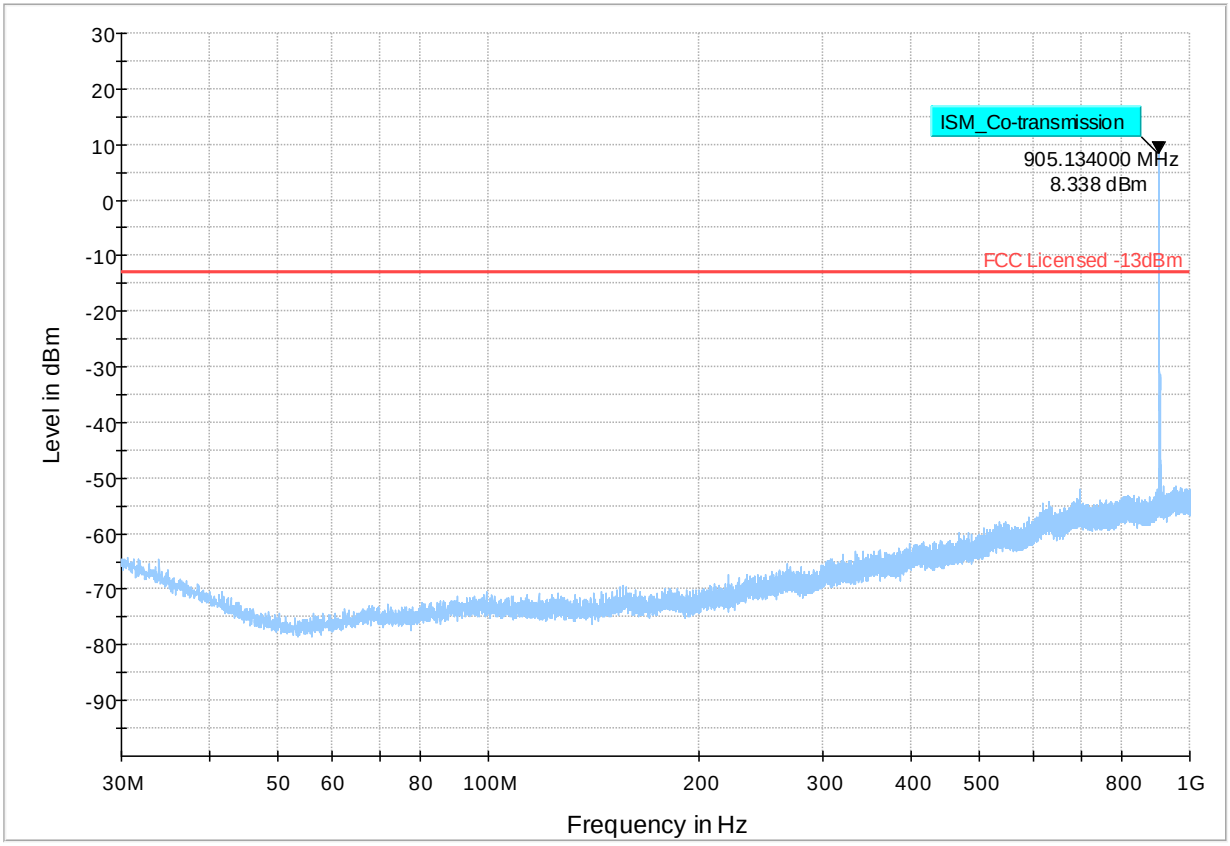
Plot # 25 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



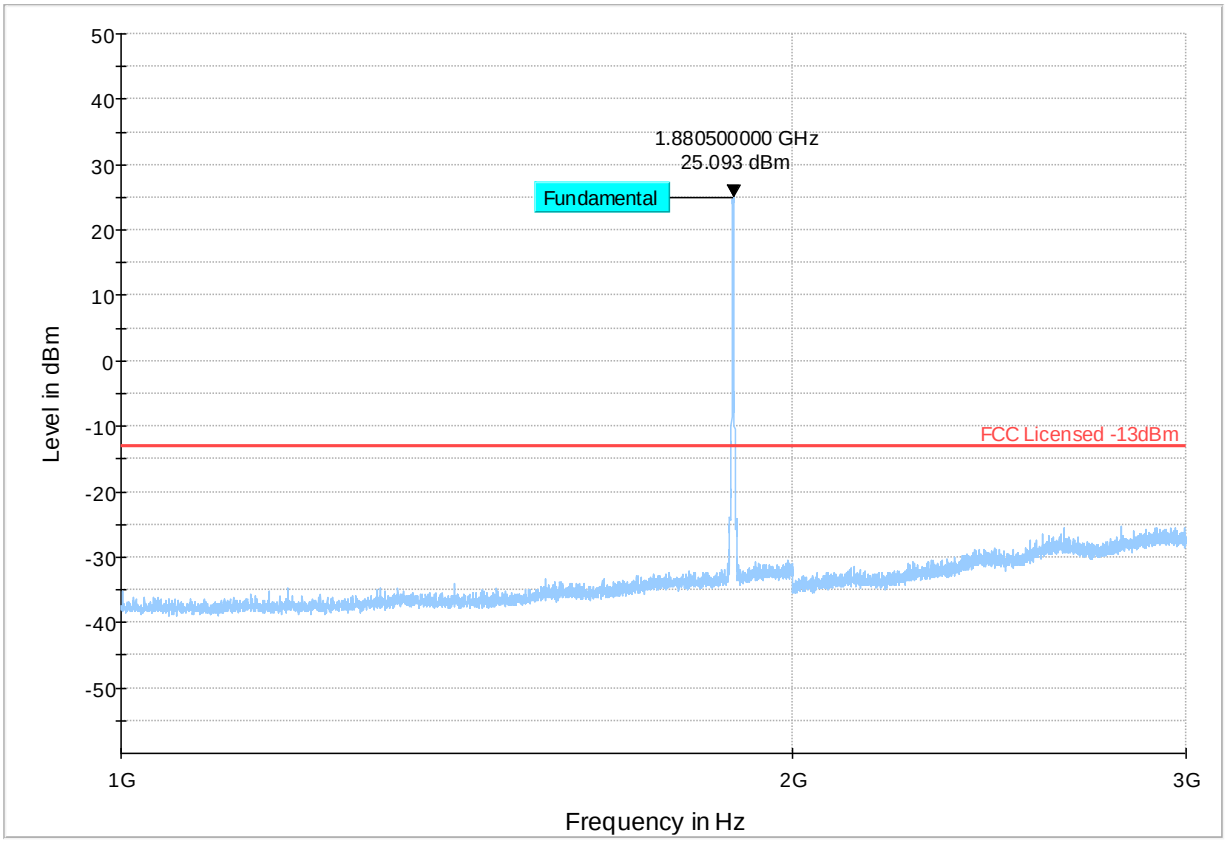
Plot # 26 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid



Plot # 27 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

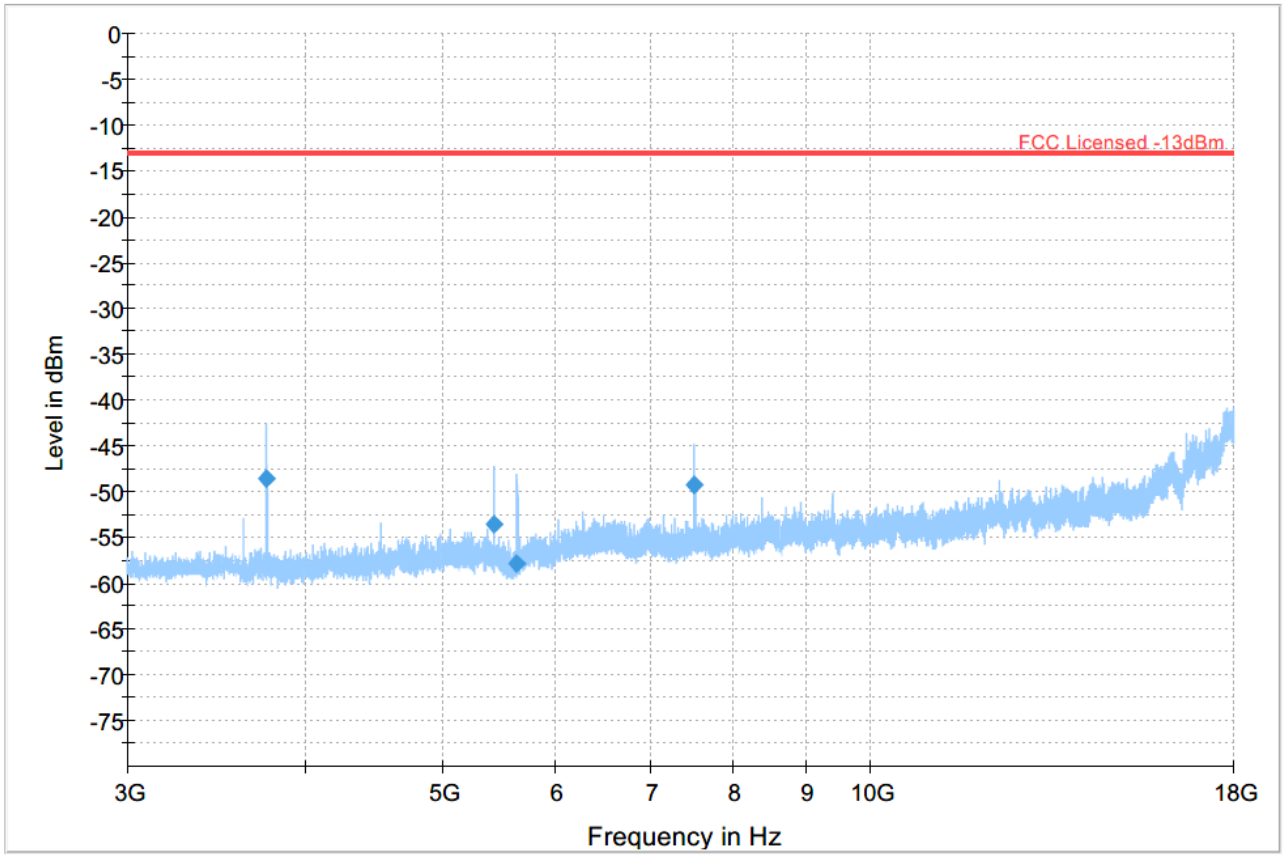


Plot # 28 Radiated Emissions: 3 GHz – 18 GHz

Channel: Mid

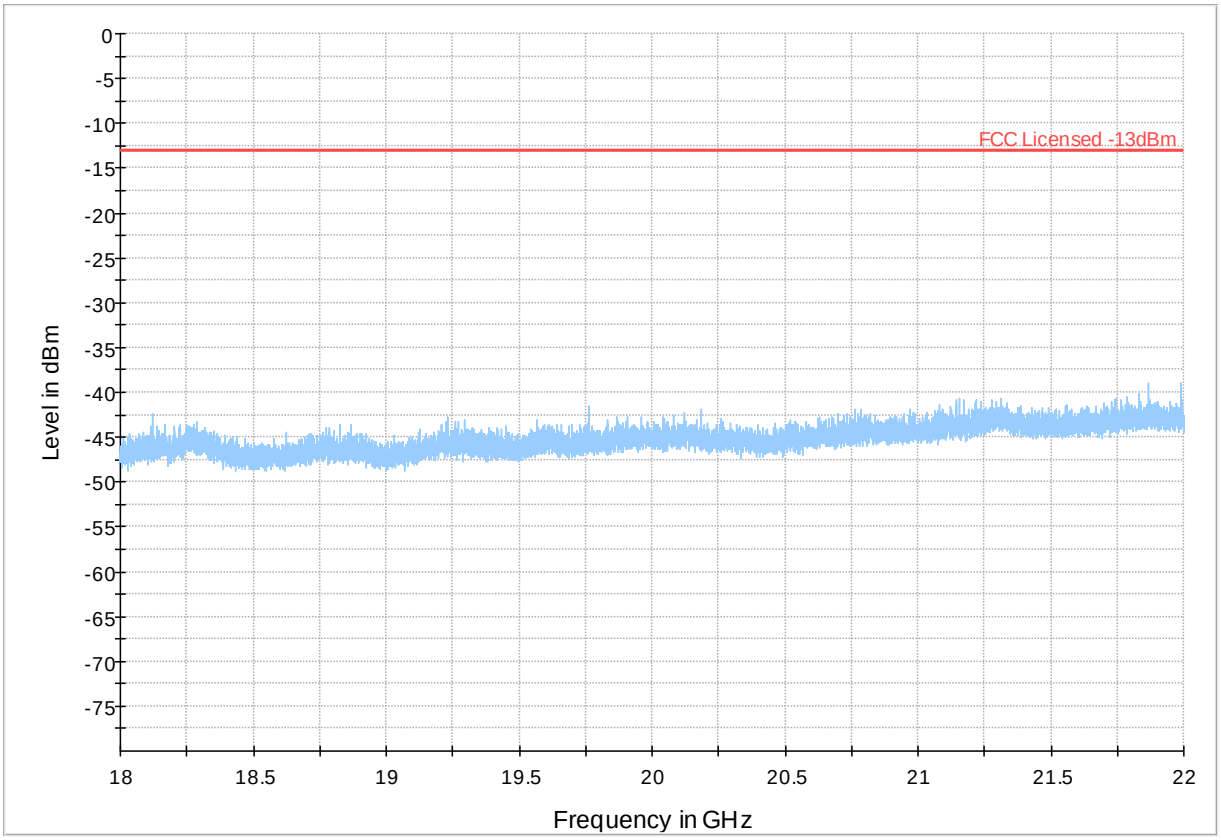
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3759.500	-48.52	-13.00	35.52	500.0	1000.000	163.0	H	344.0	-101.8	
5429.000	-53.49	-13.00	40.49	500.0	1000.000	251.0	V	29.0	-99.4	
5642.000	-57.90	-13.00	44.90	500.0	1000.000	291.0	V	7.0	-99.5	
7520.000	-49.34	-13.00	36.34	500.0	1000.000	195.0	V	15.0	-95.3	



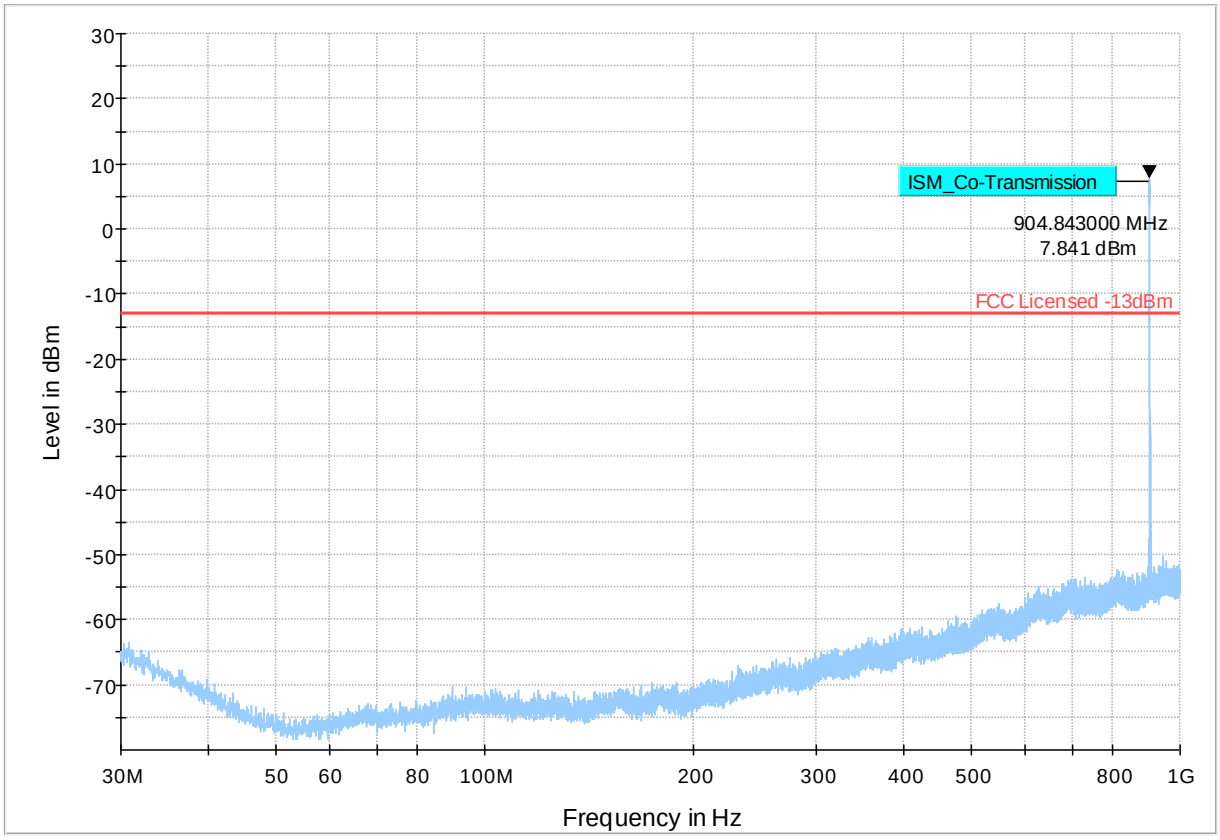
Plot # 29 Radiated Emissions: 18 GHz – 22 GHz

Channel: Mid



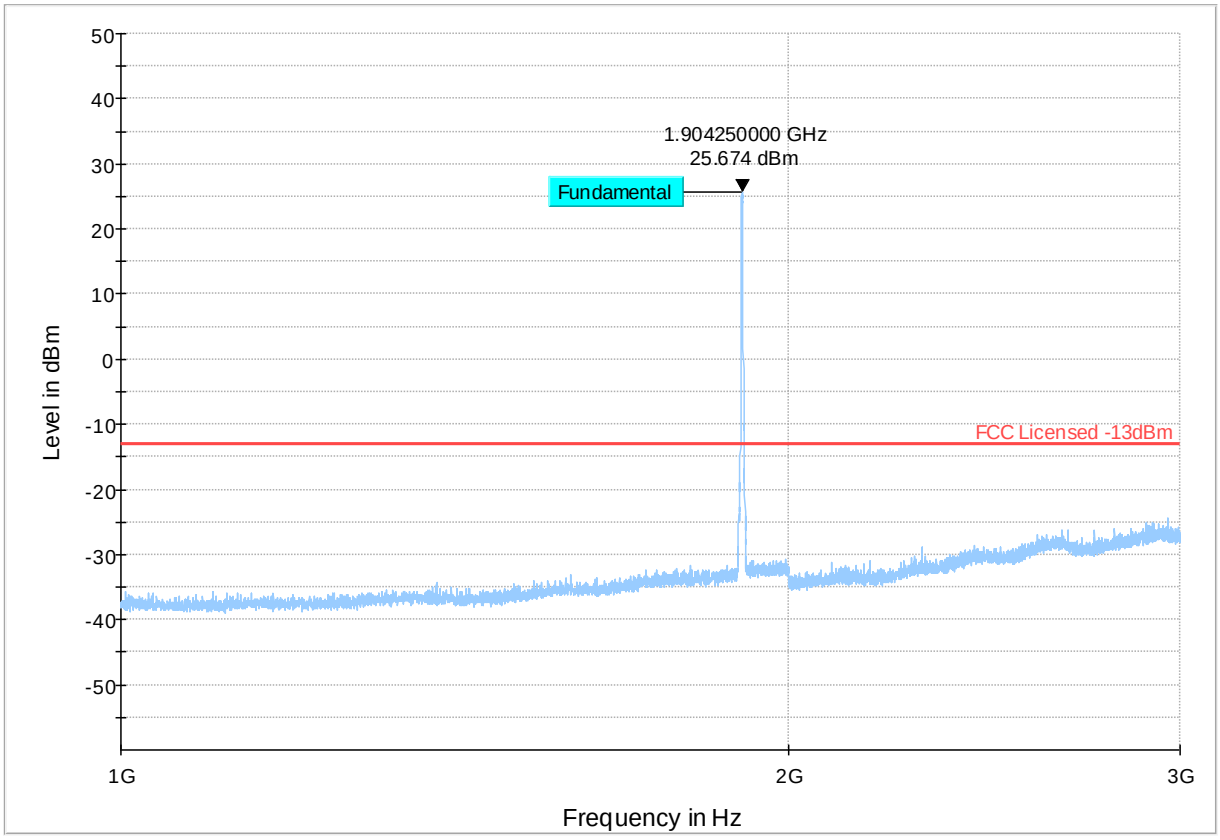
Plot # 30 Radiated Emissions: 30 MHz - 1 GHz

Channel: High



Plot # 31 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

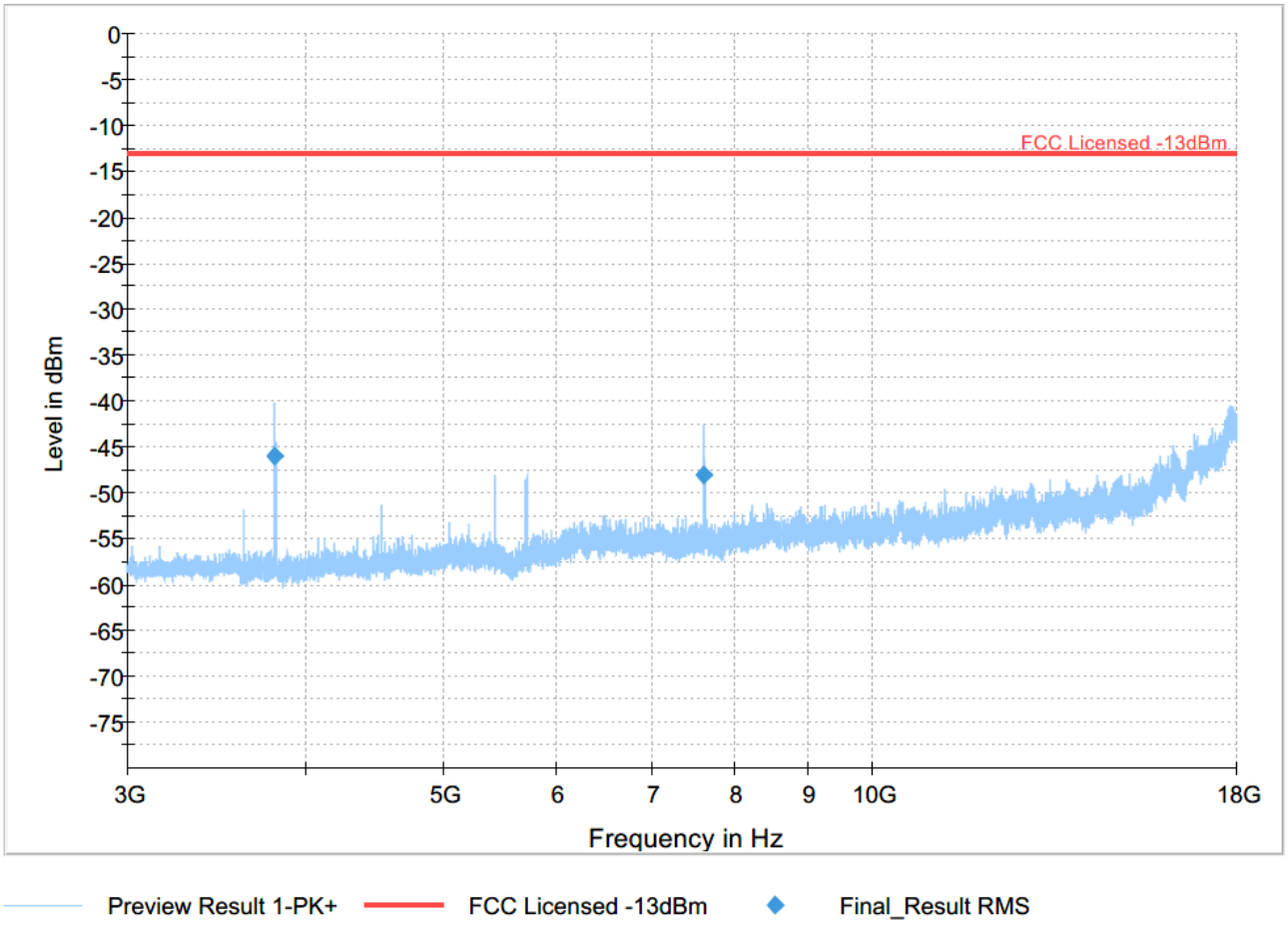


Plot # 32 Radiated Emissions: 3 GHz - 18 GHz

Channel: High

Final_Result

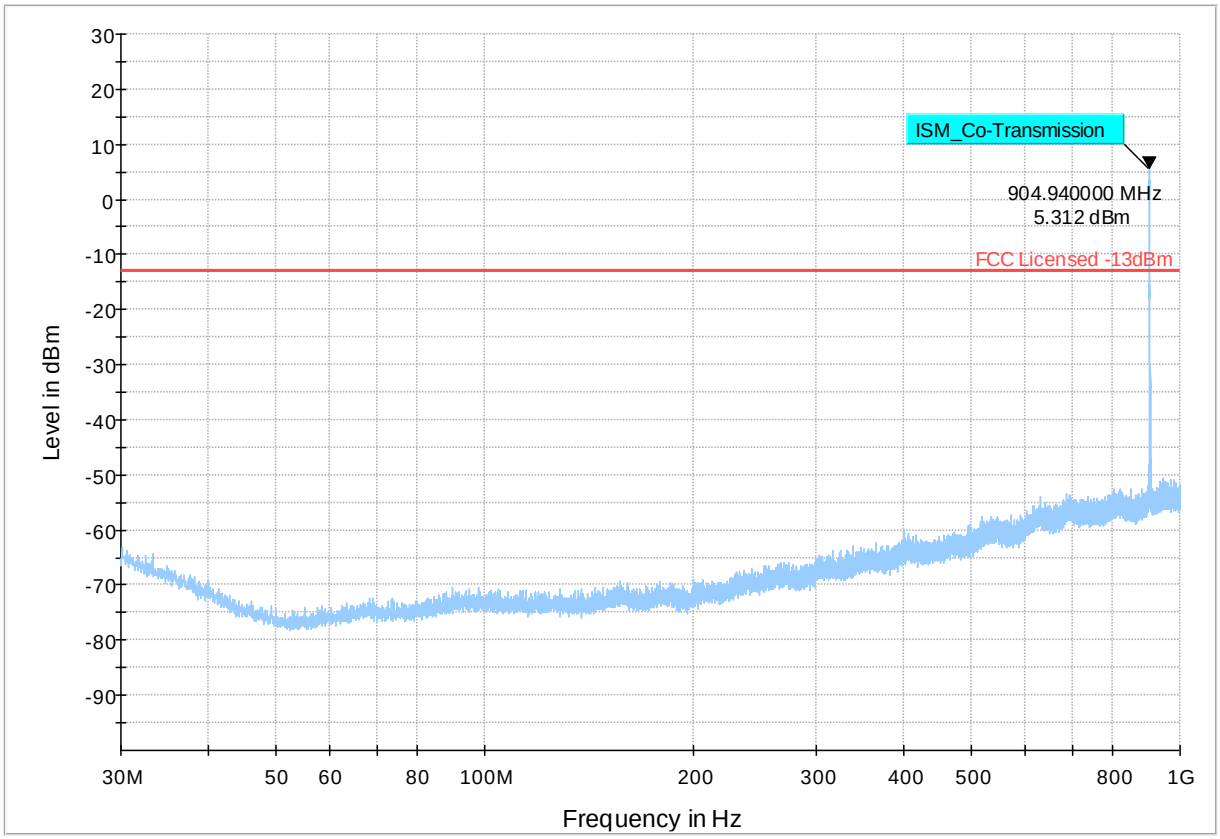
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3808.500	-46.07	-13.00	33.07	500.0	1000.000	140.0	H	339.0	-101.6	
7620.000	-48.07	-13.00	35.07	500.0	1000.000	153.0	V	15.0	-95.5	



LTE Band 4

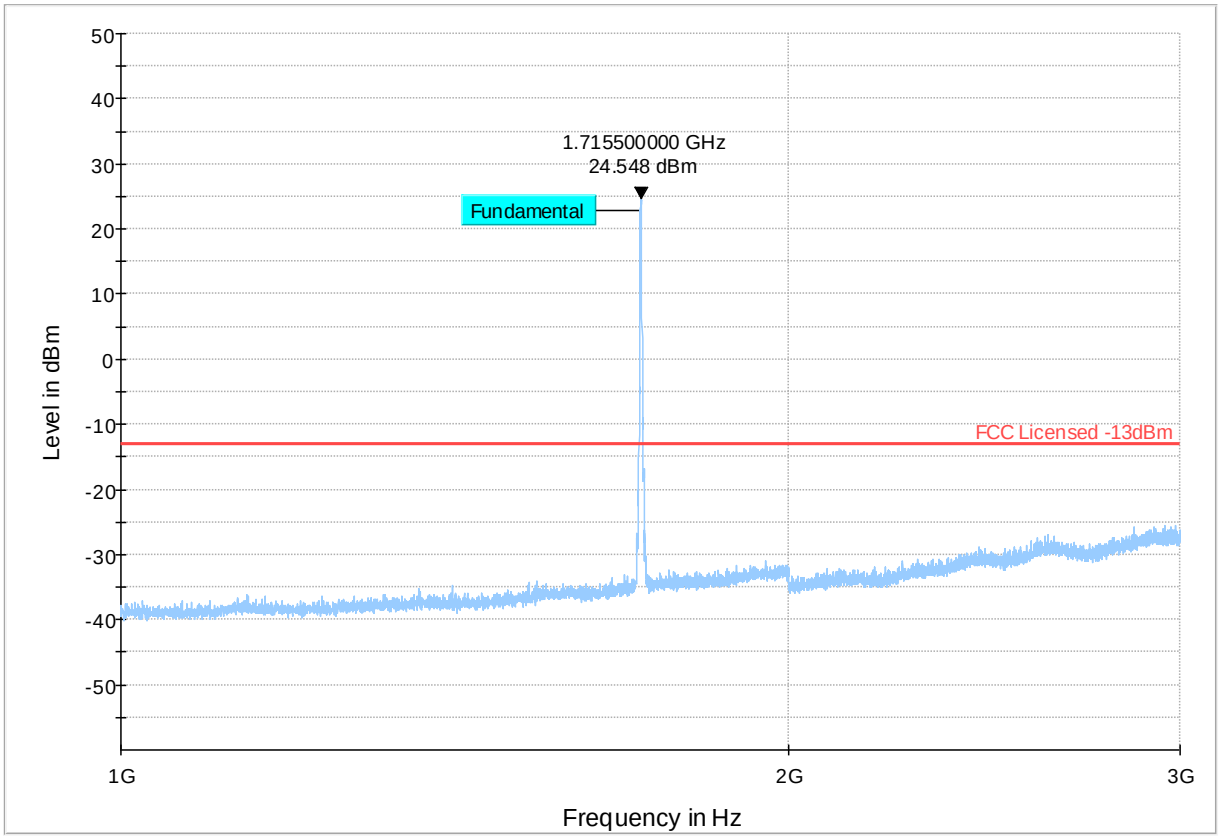
Plot # 33 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low



Plot # 34 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low

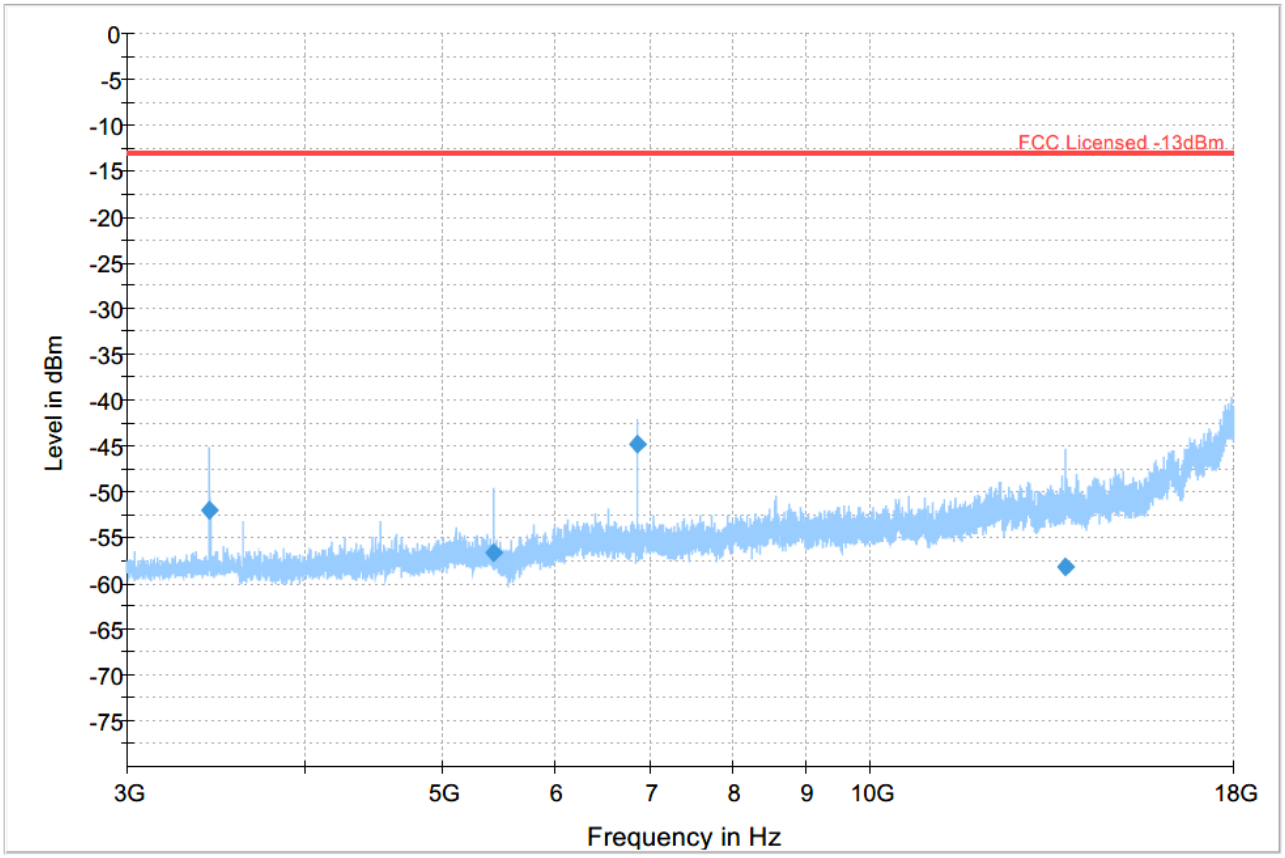


Plot # 35 Radiated Emissions: 3 GHz - 18 GHz

Channel: Low

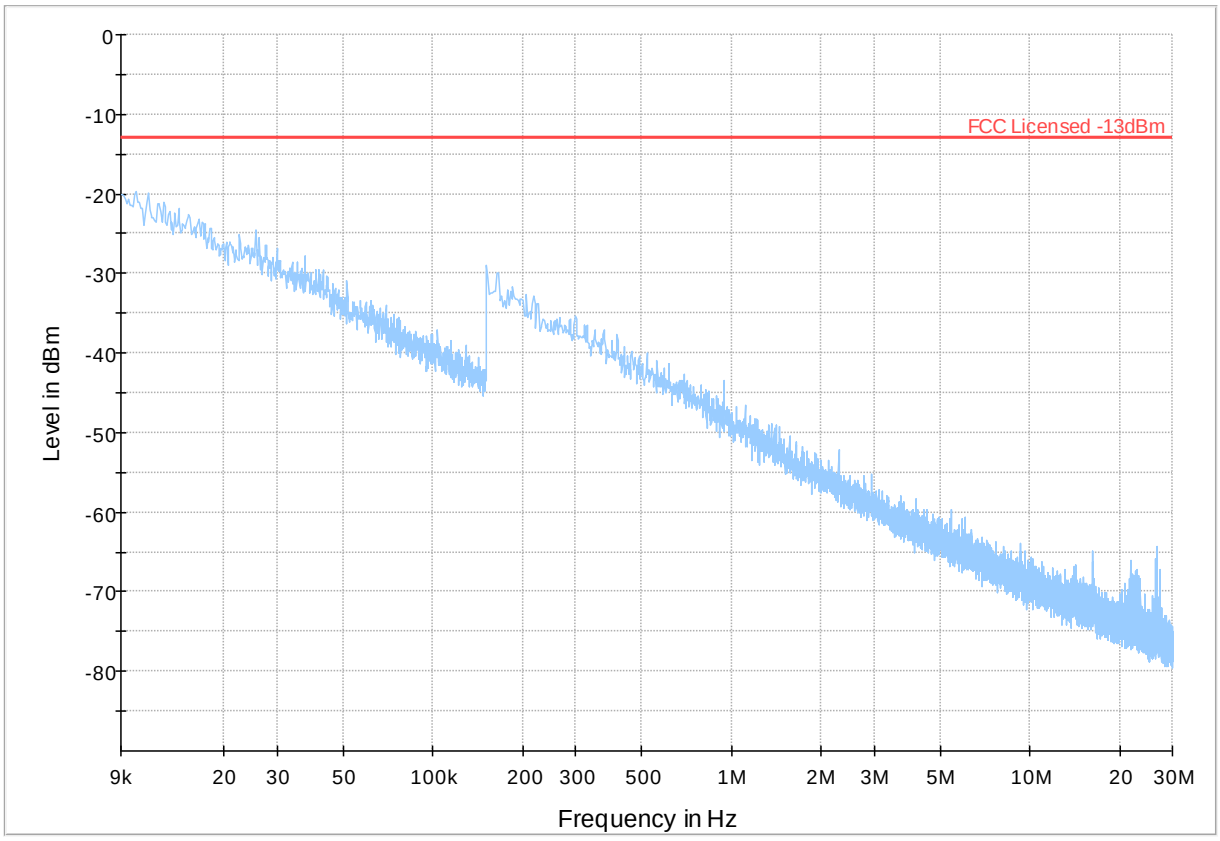
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3428.500	-51.99	-13.00	38.99	500.0	1000.000	163.0	H	9.0	-103.3	
5431.000	-56.57	-13.00	43.57	500.0	1000.000	259.0	V	282.0	-99.4	
6860.500	-44.88	-13.00	31.88	500.0	1000.000	283.0	V	31.0	-95.7	
13717.000	-58.15	-13.00	45.15	500.0	1000.000	208.0	V	353.0	-89.2	



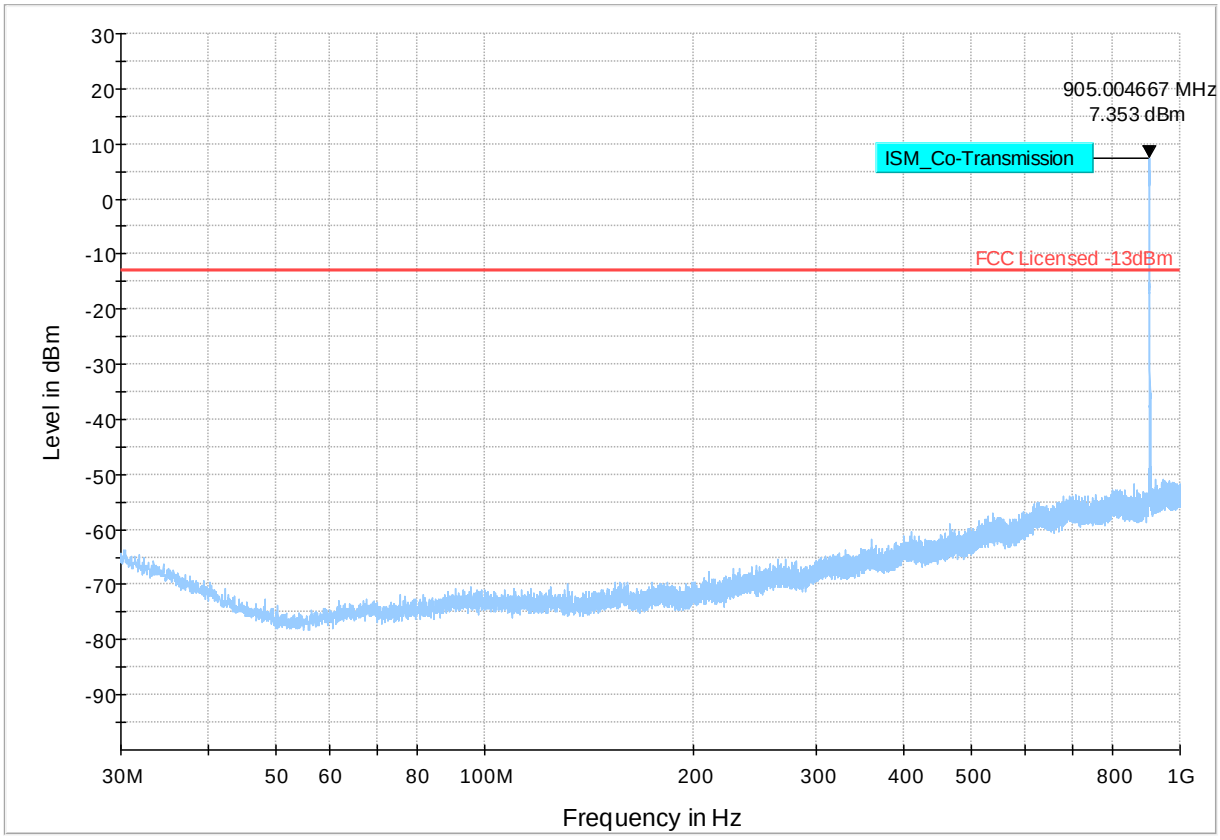
Plot # 36 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



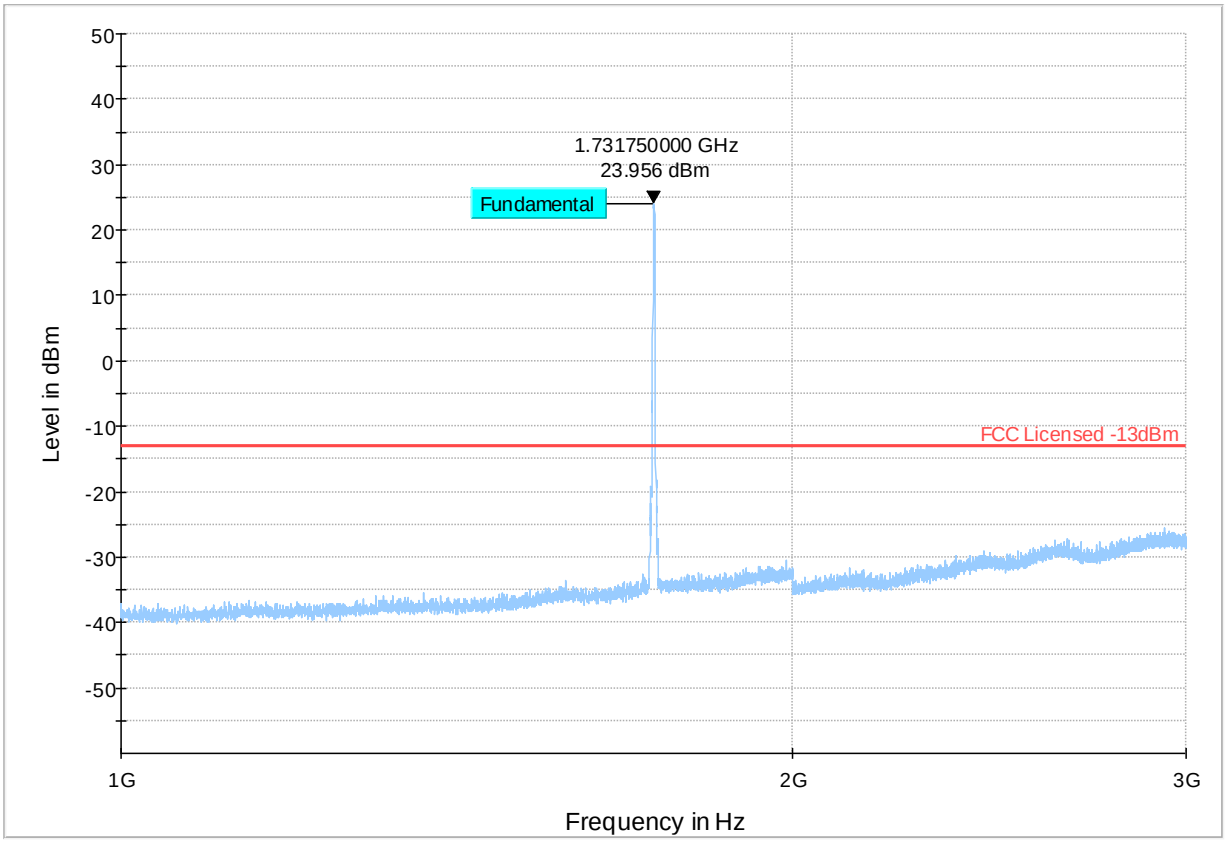
Plot # 37 Radiated Emissions: 30 MHz – 1 GHz

Channel: Mid



Plot # 38 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

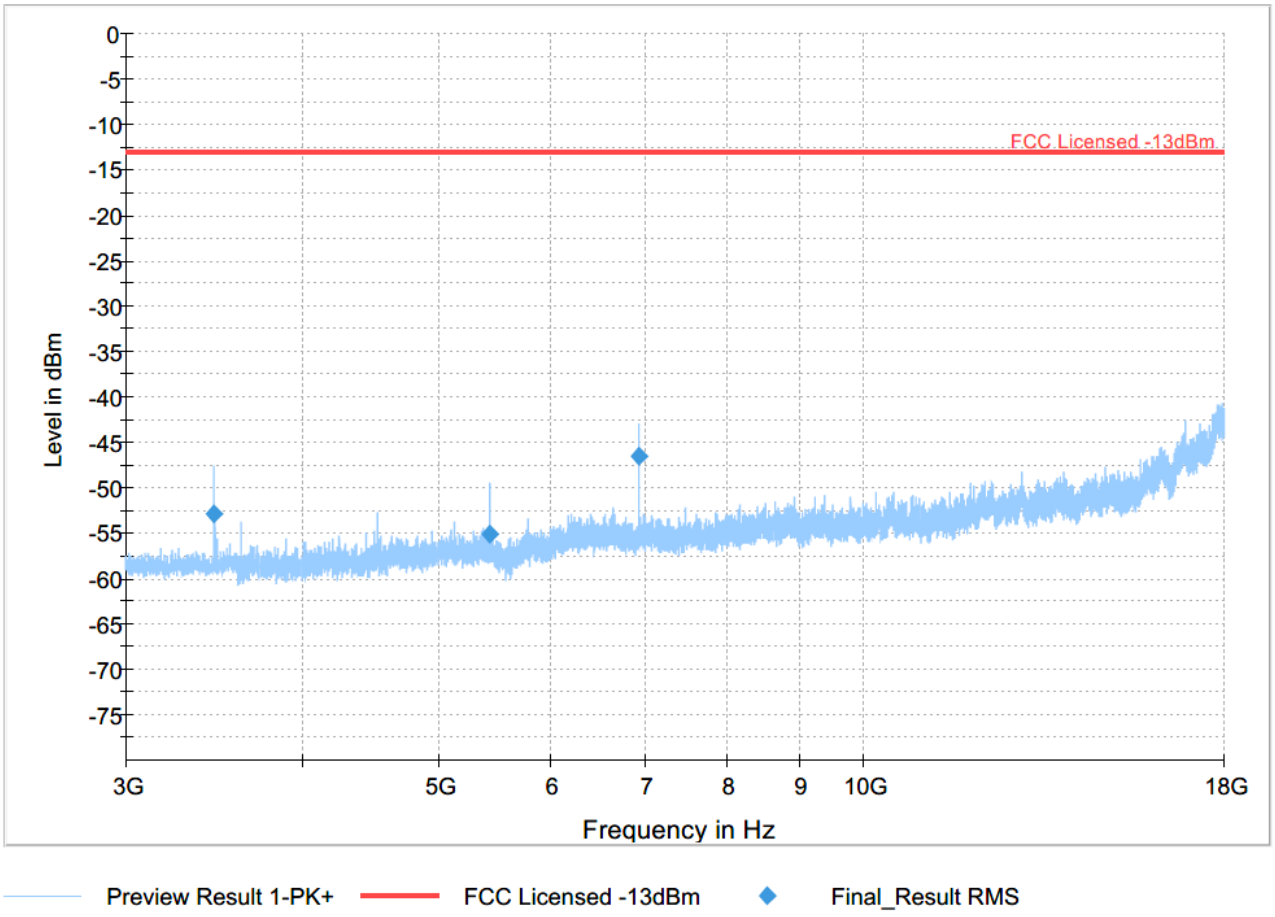


Plot # 39 Radiated Emissions: 3 GHz – 18GHz

Channel: Mid

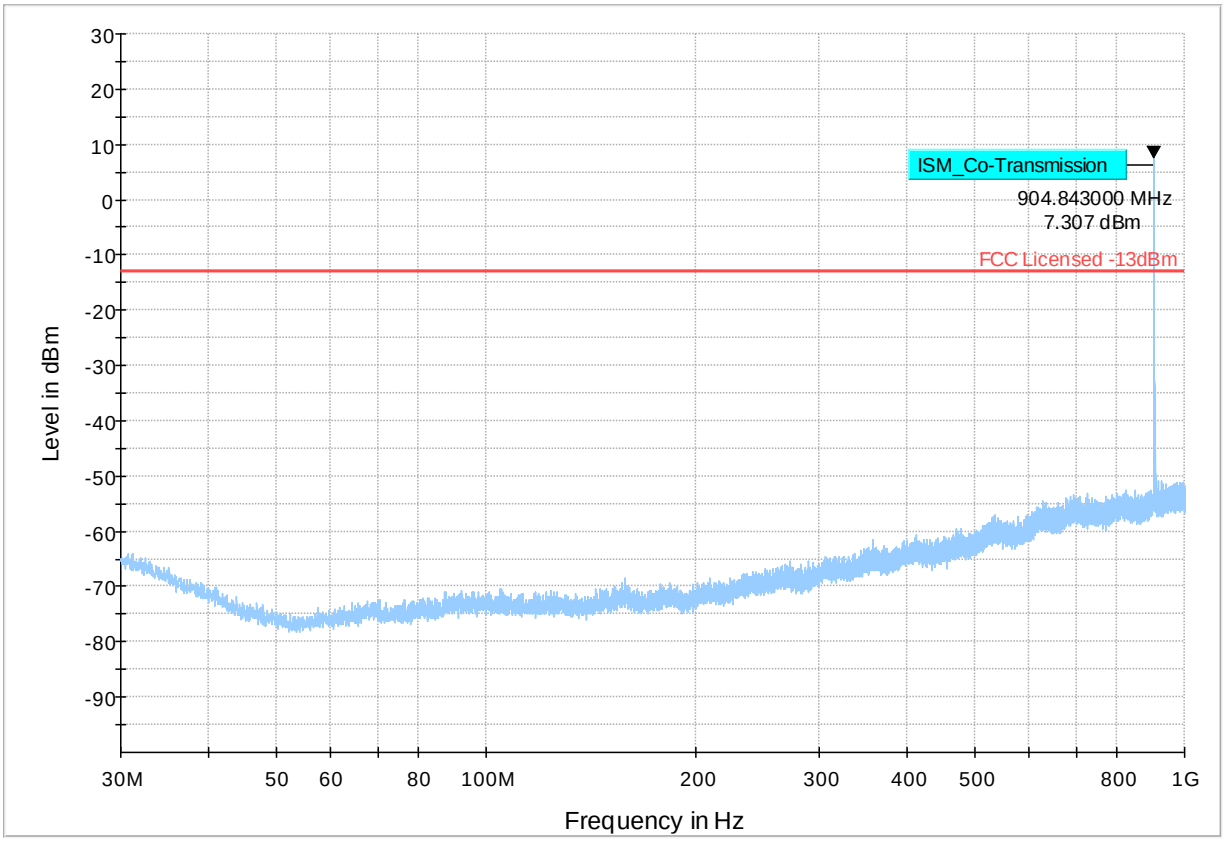
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3466.000	-52.83	-13.00	39.83	500.0	1000.000	195.0	H	-6.0	-103.1	
5429.000	-55.05	-13.00	42.05	500.0	1000.000	253.0	V	32.0	-99.4	
6930.000	-46.49	-13.00	33.49	500.0	1000.000	164.0	V	36.0	-95.6	



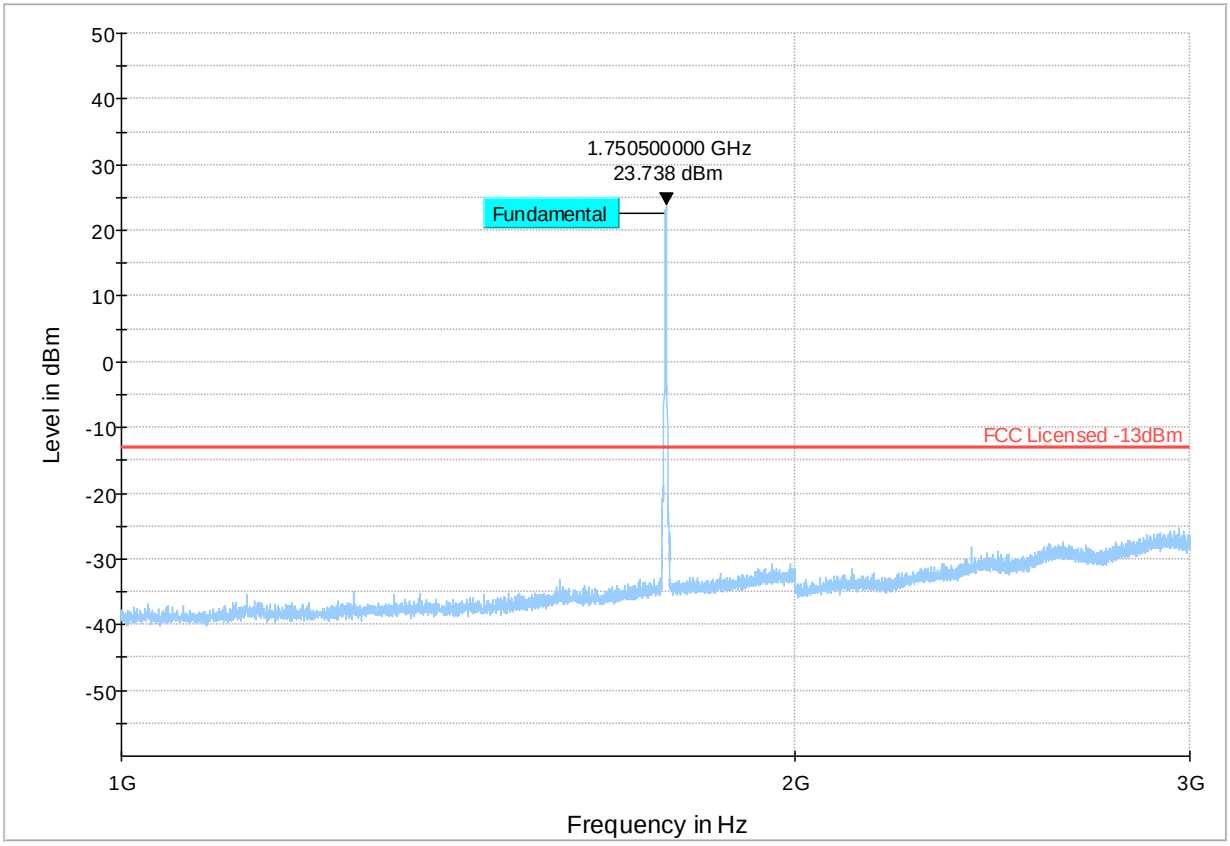
Plot # 40 Radiated Emissions: 30 MHz - 1 GHz

Channel: High



Plot # 41 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

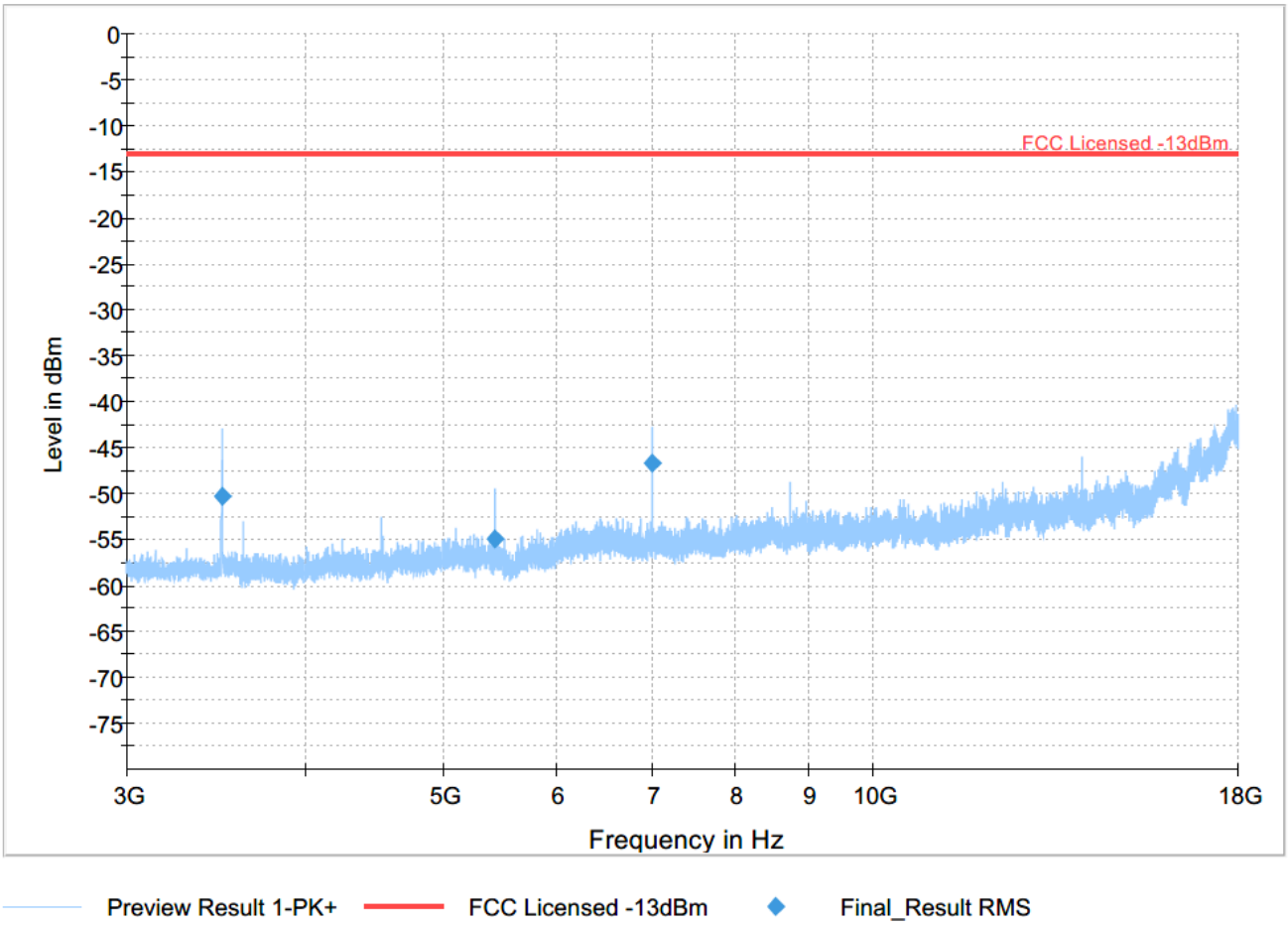


Plot # 42 Radiated Emissions: 3 GHz - 18 GHz

Channel: High

Final_Result

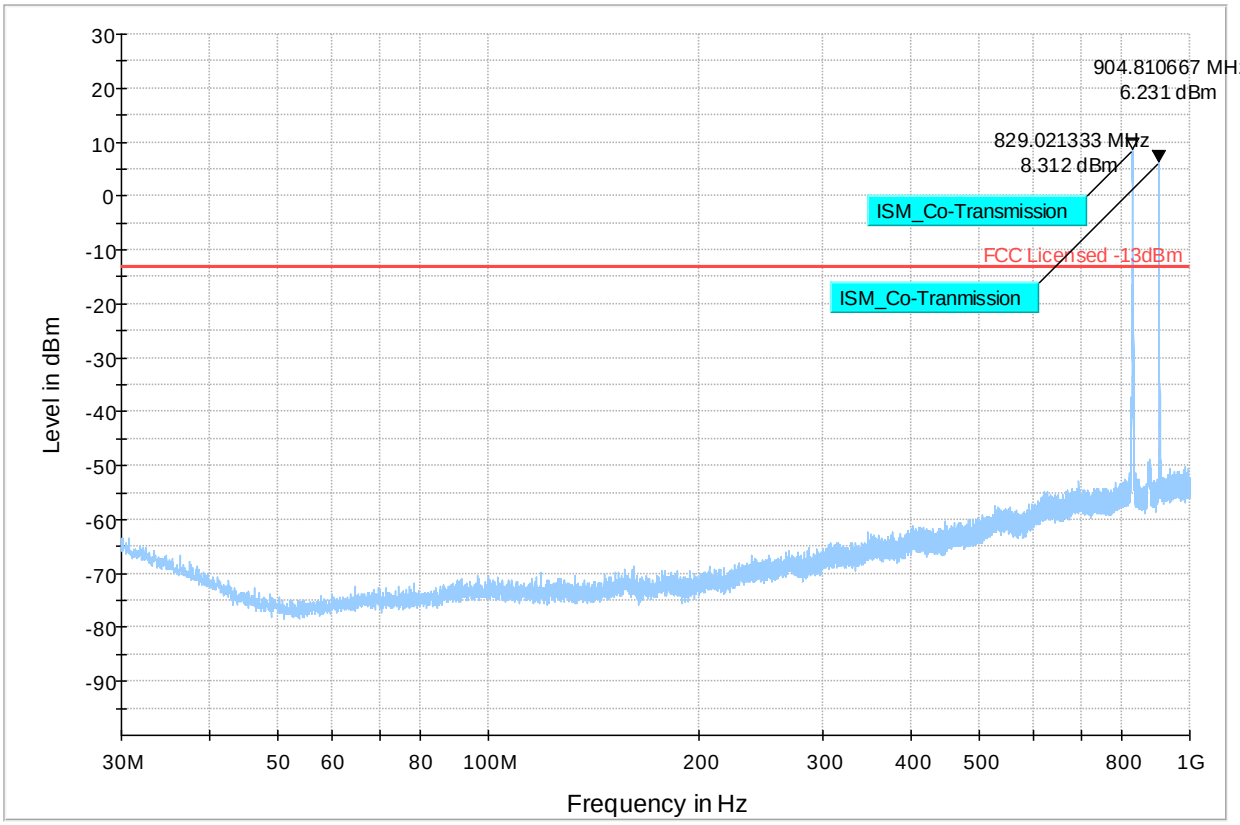
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3500.000	-50.23	-13.00	37.23	500.0	1000.000	195.0	H	352.0	-102.9	
5431.000	-54.93	-13.00	41.93	500.0	1000.000	220.0	V	33.0	-99.4	
7000.000	-46.62	-13.00	33.62	500.0	1000.000	140.0	V	36.0	-95.5	



LTE Band 5

Plot # 43 Radiated Emissions: 30 MHz – 1GHz

Channel: Low

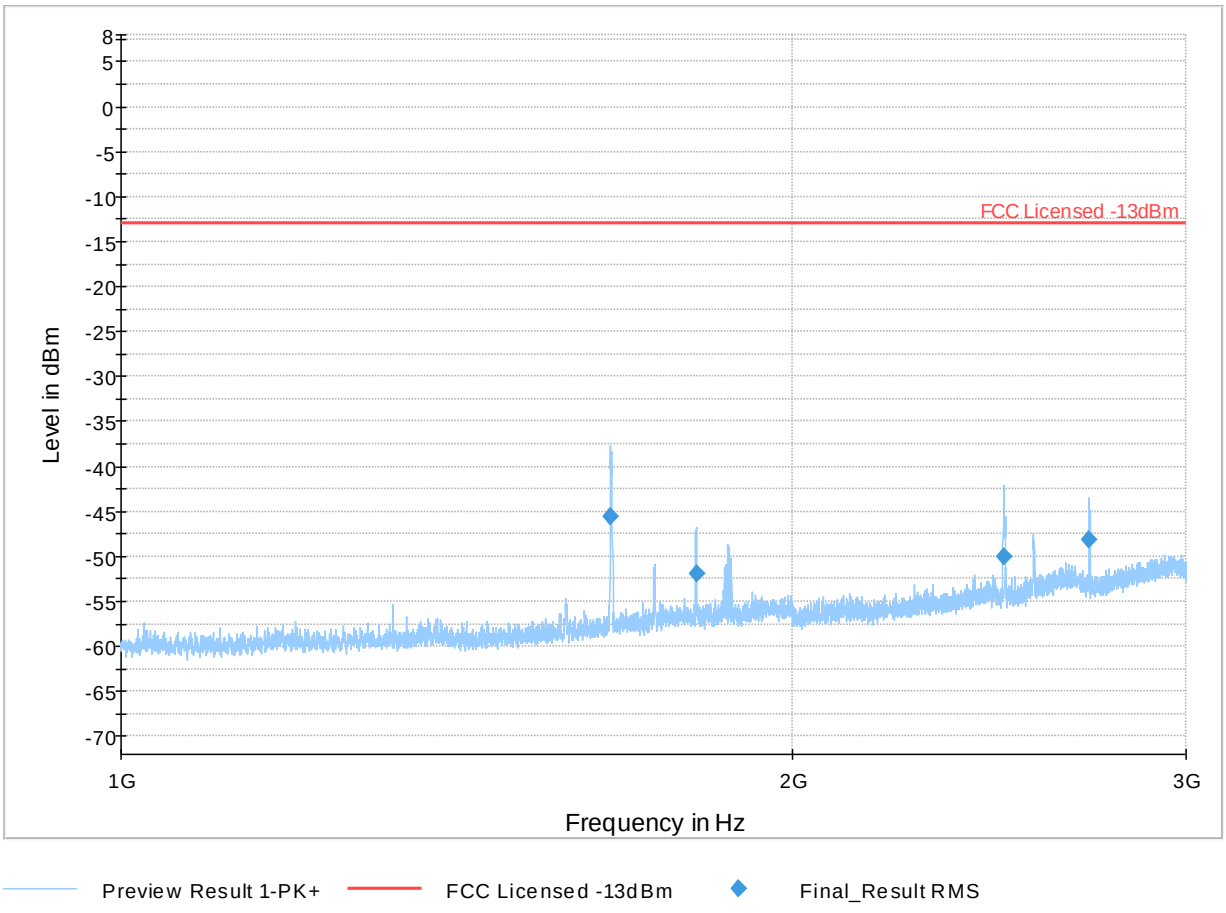


Plot # 44 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1656.750	-45.52	-13.00	32.52	500.0	1000.000	152.0	H	172.0	-91.3	
1809.750	-51.89	-13.00	38.89	500.0	1000.000	175.0	V	88.0	-90.4	
2487.000	-50.10	-13.00	37.10	500.0	1000.000	140.0	H	80.0	-88.2	
2714.750	-48.18	-13.00	35.18	500.0	1000.000	140.0	V	291.0	-87.0	

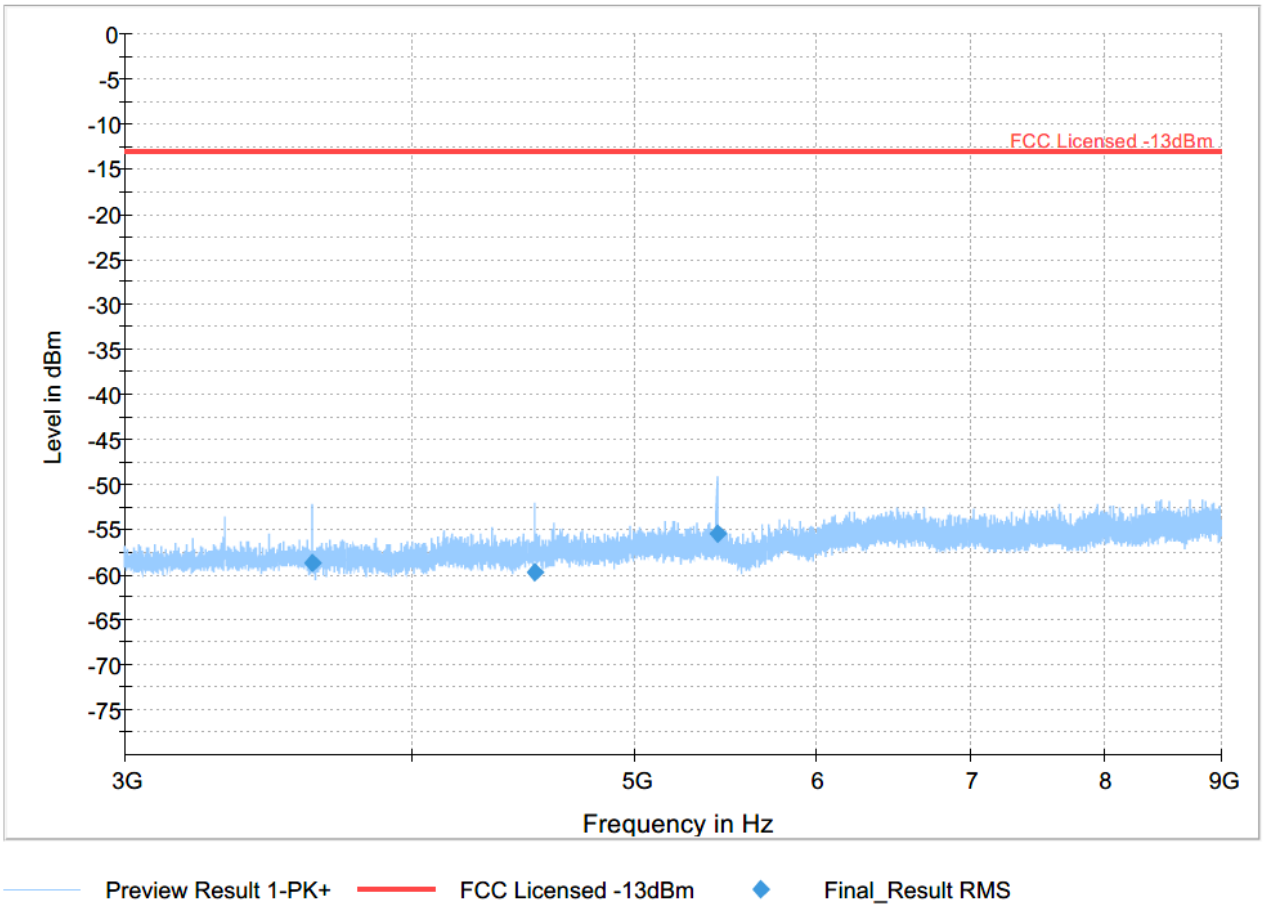


Plot # 45 Radiated Emissions: 3 GHz – 9 GHz

Channel: Low

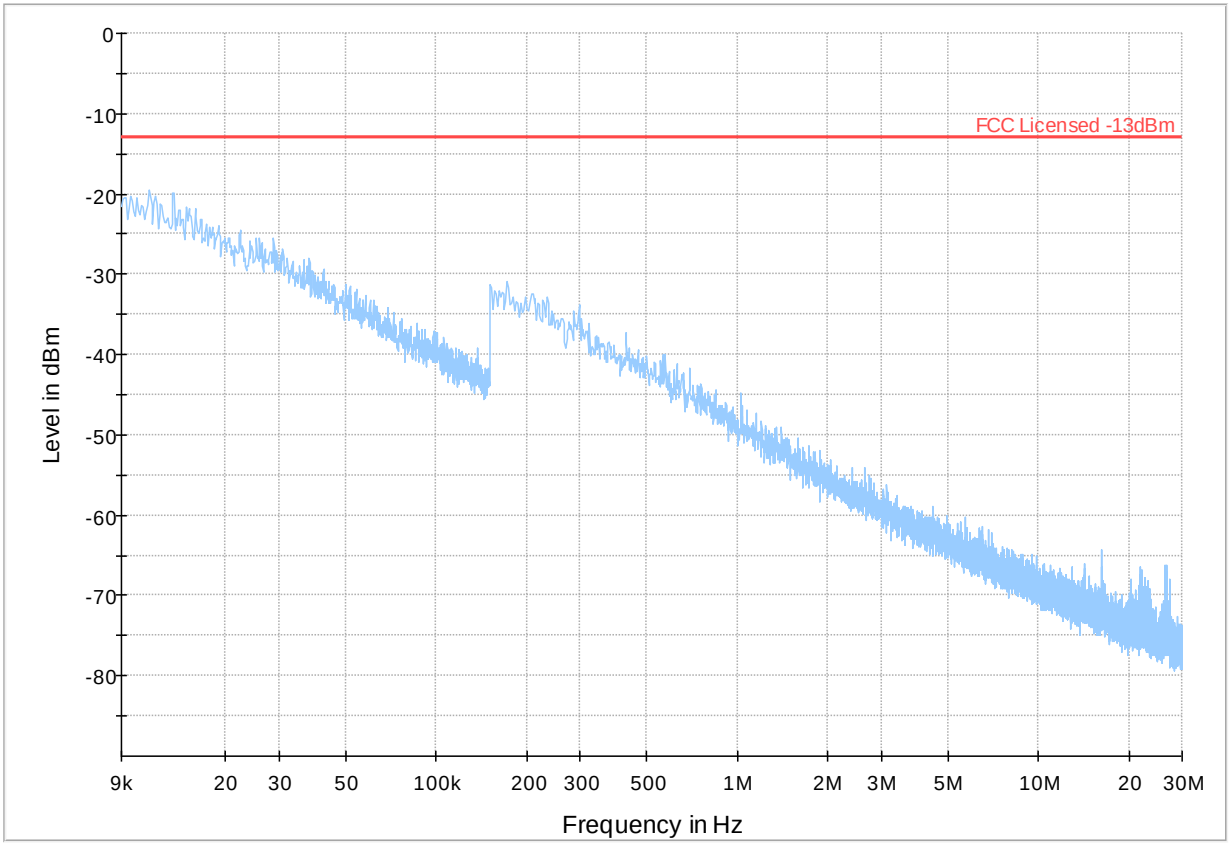
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3619.000	-58.79	-13.00	45.79	500.0	1000.000	140.0	V	232.0	-102.2	
4524.000	-59.76	-13.00	46.76	500.0	1000.000	183.0	V	3.0	-100.4	
5428.750	-55.39	-13.00	42.39	500.0	1000.000	152.0	V	267.0	-99.4	



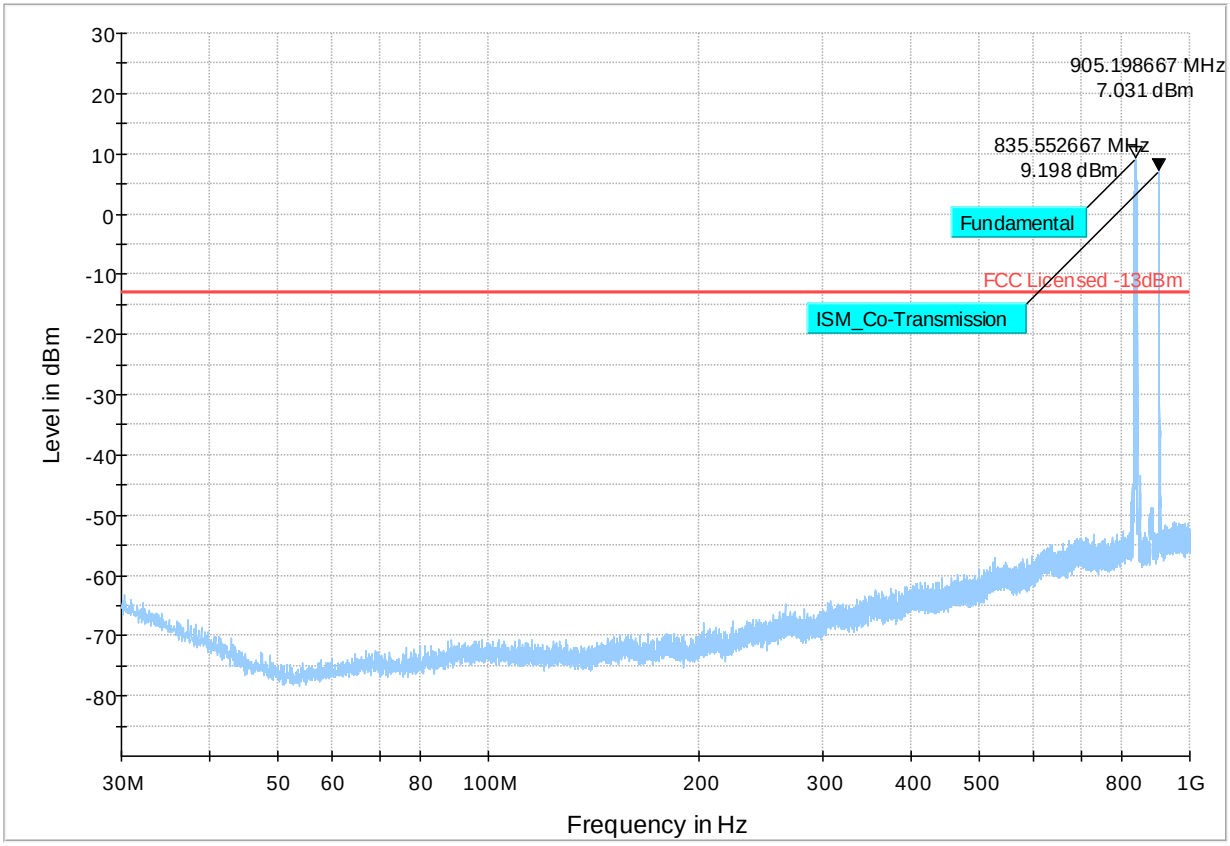
Plot # 46 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



Plot # 47 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid

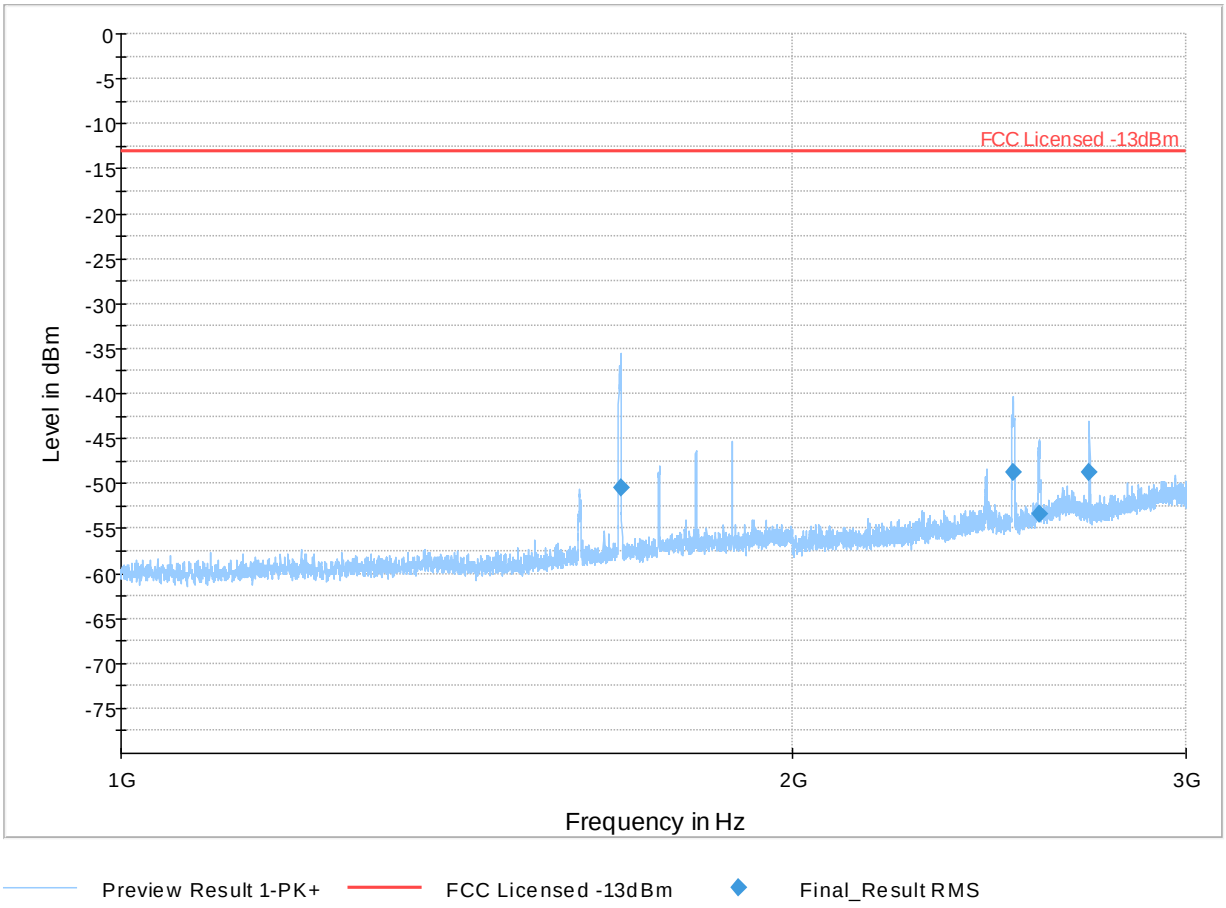


Plot # 48 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1674.750	-50.55	-13.00	37.55	500.0	1000.000	273.0	H	97.0	-91.1	
2510.000	-48.76	-13.00	35.76	500.0	1000.000	195.0	H	80.0	-88.1	
2577.750	-53.31	-13.00	40.31	500.0	1000.000	228.0	V	184.0	-87.5	
2715.500	-48.80	-13.00	35.80	500.0	1000.000	197.0	V	289.0	-87.0	

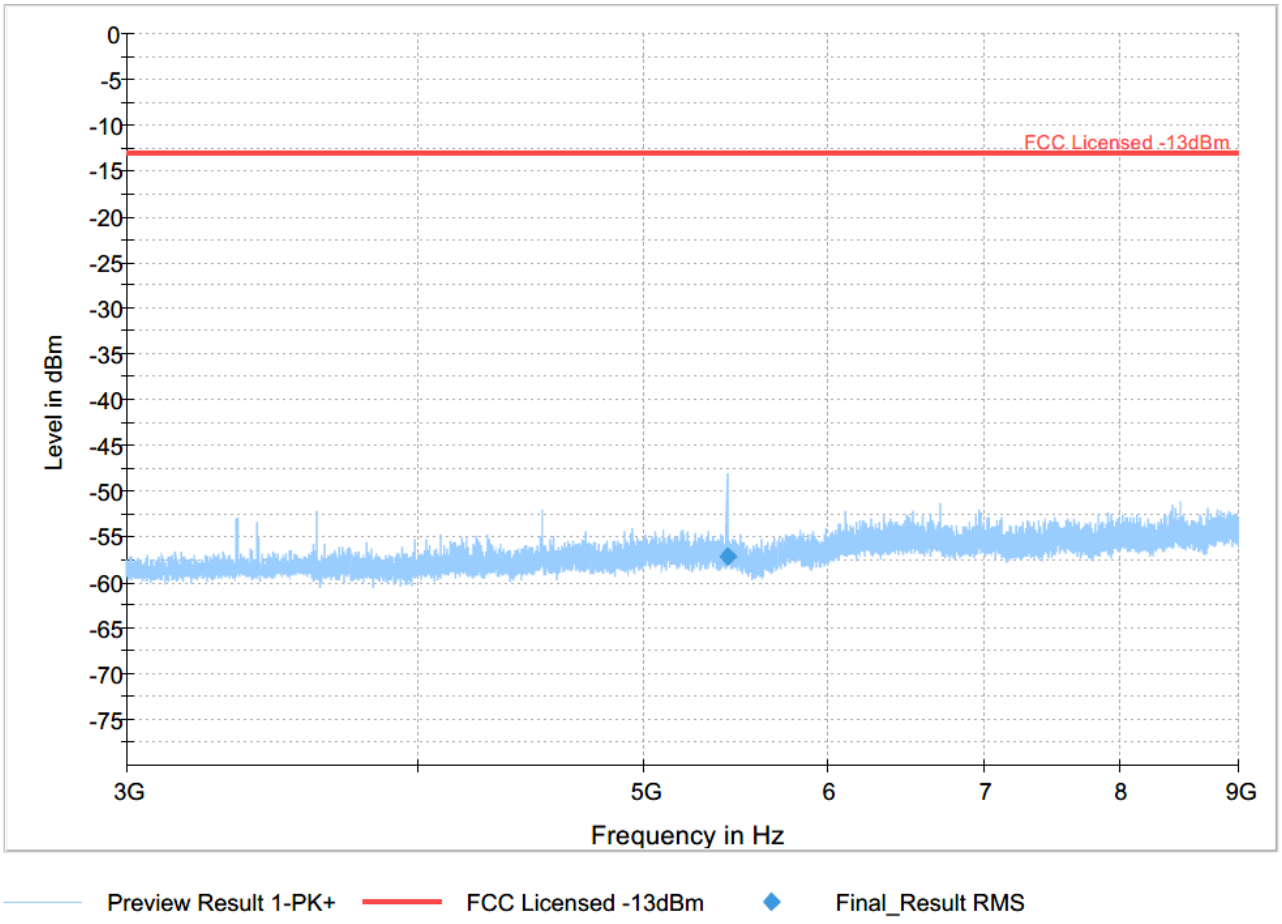


Plot # 49 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid

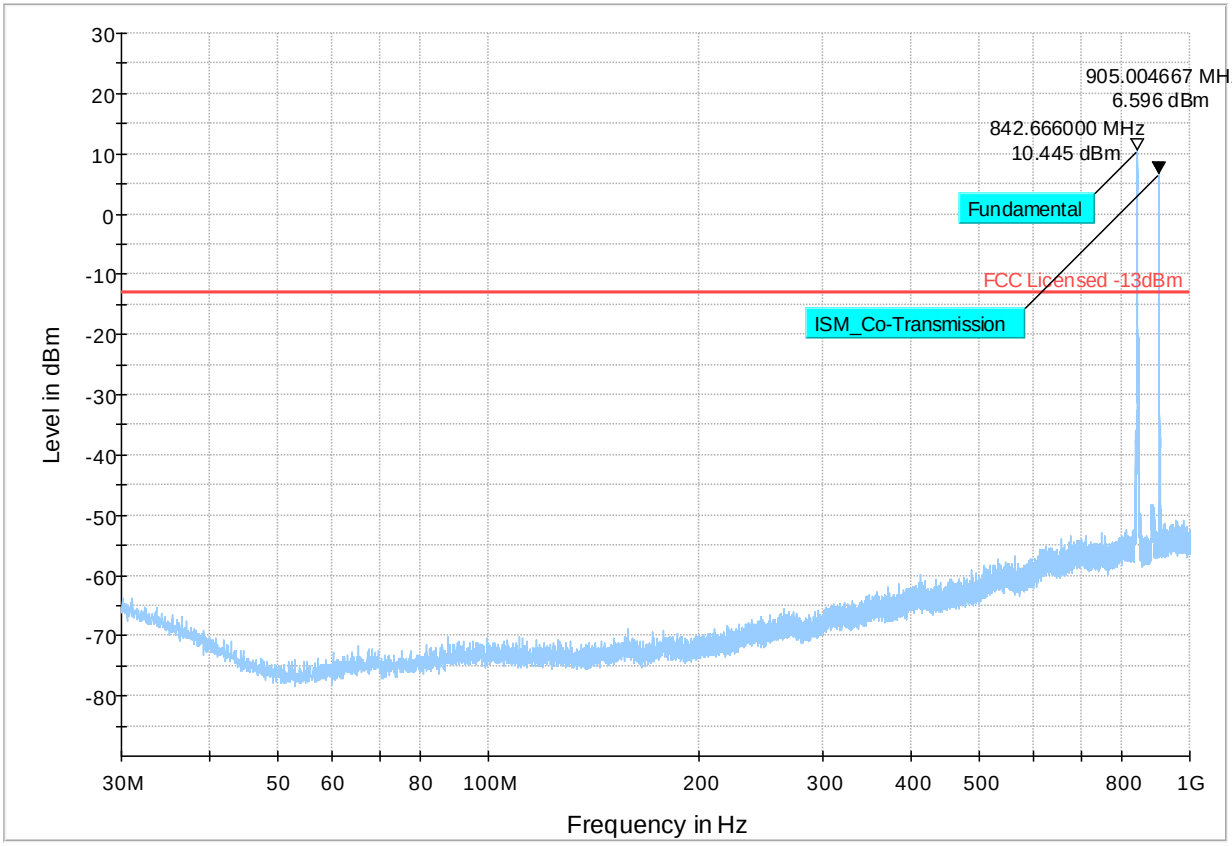
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
5428.750	-57.14	-13.00	44.14	500.0	1000.000	140.0	V	83.0	-99.4	



Plot # 50 Radiated Emissions: 30 MHz – 1GHz

Channel: High

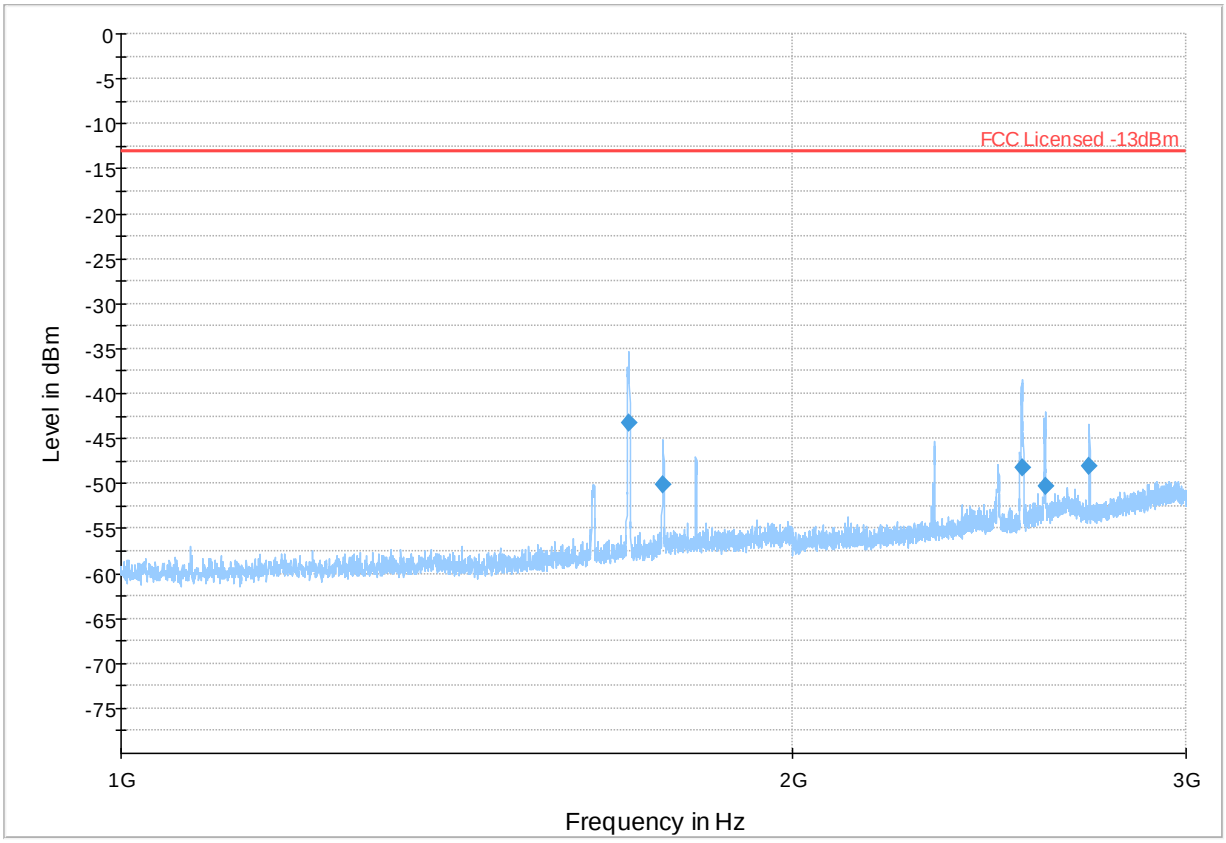


Plot # 51 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1687.750	-43.23	-13.00	30.23	500.0	1000.000	152.0	H	54.0	-91.0	
1749.750	-50.08	-13.00	37.08	500.0	1000.000	169.0	H	183.0	-90.4	
2534.250	-48.17	-13.00	35.17	500.0	1000.000	140.0	H	77.0	-88.0	
2594.250	-50.33	-13.00	37.33	500.0	1000.000	140.0	V	181.0	-87.4	
2715.500	-48.08	-13.00	35.08	500.0	1000.000	201.0	V	288.0	-87.0	

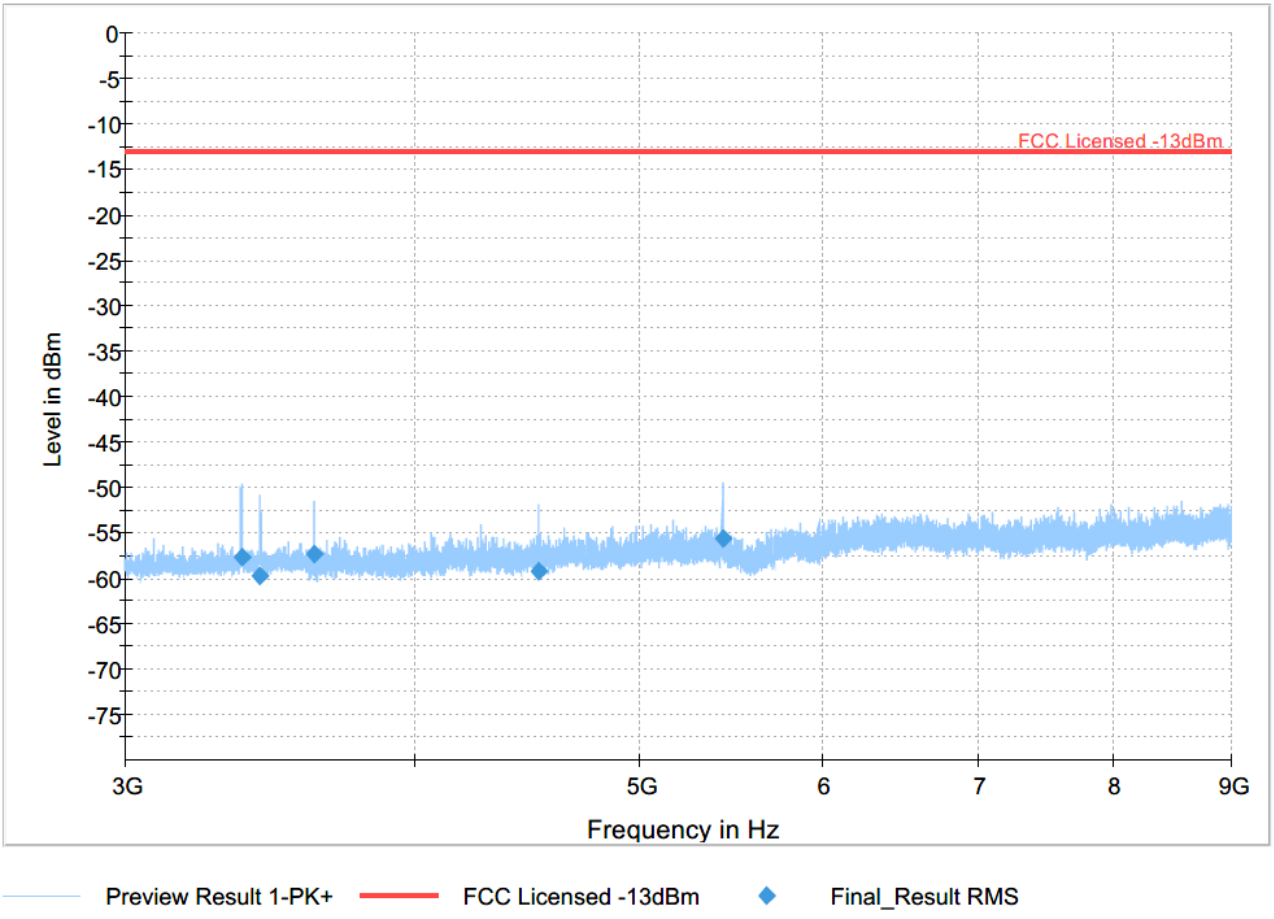


Plot # 52 Radiated Emissions: 3 GHz – 9 GHz

Channel: High

Final_Result

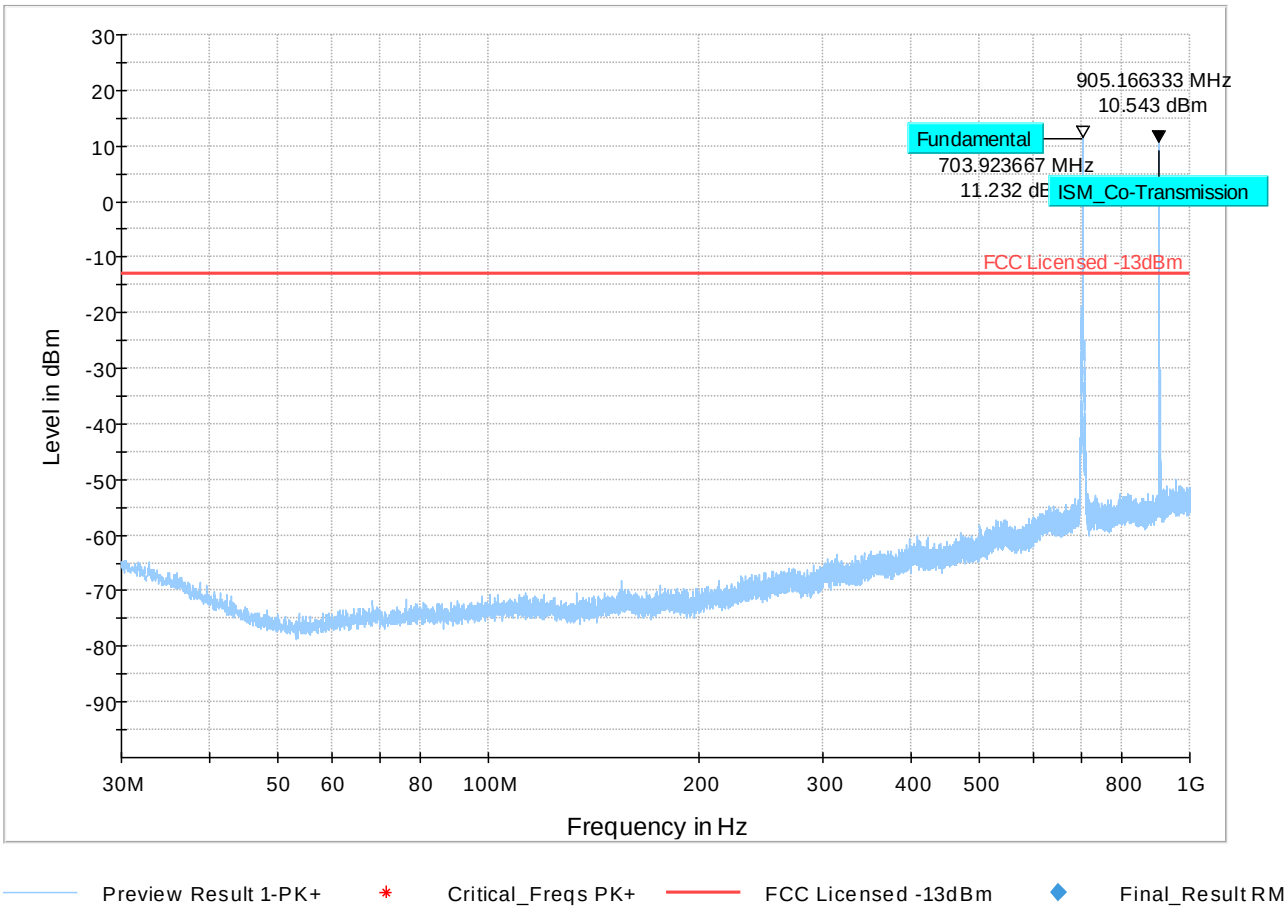
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3368.250	-57.64	-13.00	44.64	500.0	1000.000	140.0	V	182.0	-103.4	
3431.250	-59.77	-13.00	46.77	500.0	1000.000	140.0	V	177.0	-103.2	
3619.250	-57.36	-13.00	44.36	500.0	1000.000	186.0	V	232.0	-102.2	
4524.000	-59.20	-13.00	46.20	500.0	1000.000	185.0	V	2.0	-100.4	
5429.000	-55.59	-13.00	42.59	500.0	1000.000	140.0	V	252.0	-99.4	



LTE Band 12

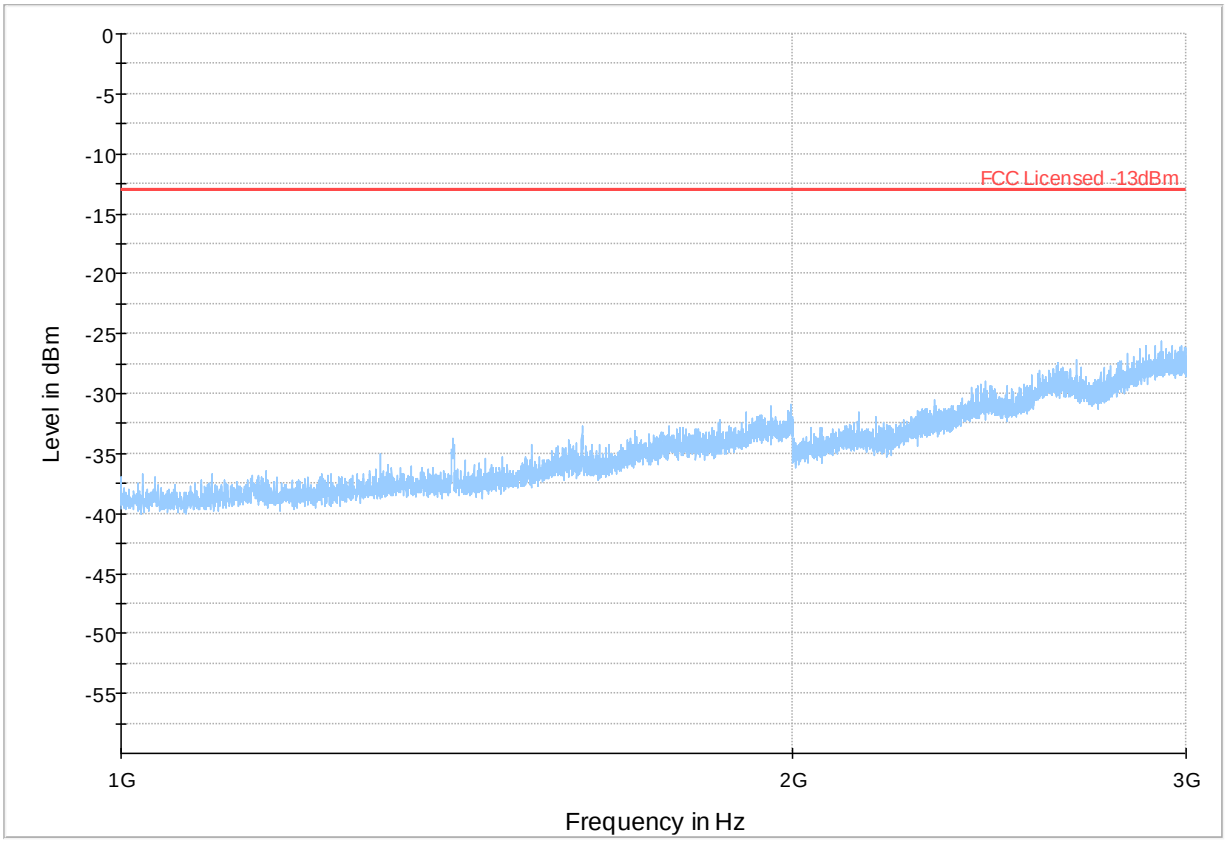
Plot # 53 Radiated Emissions: 30 MHz – 1GHz

Channel: Low



Plot # 54 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low

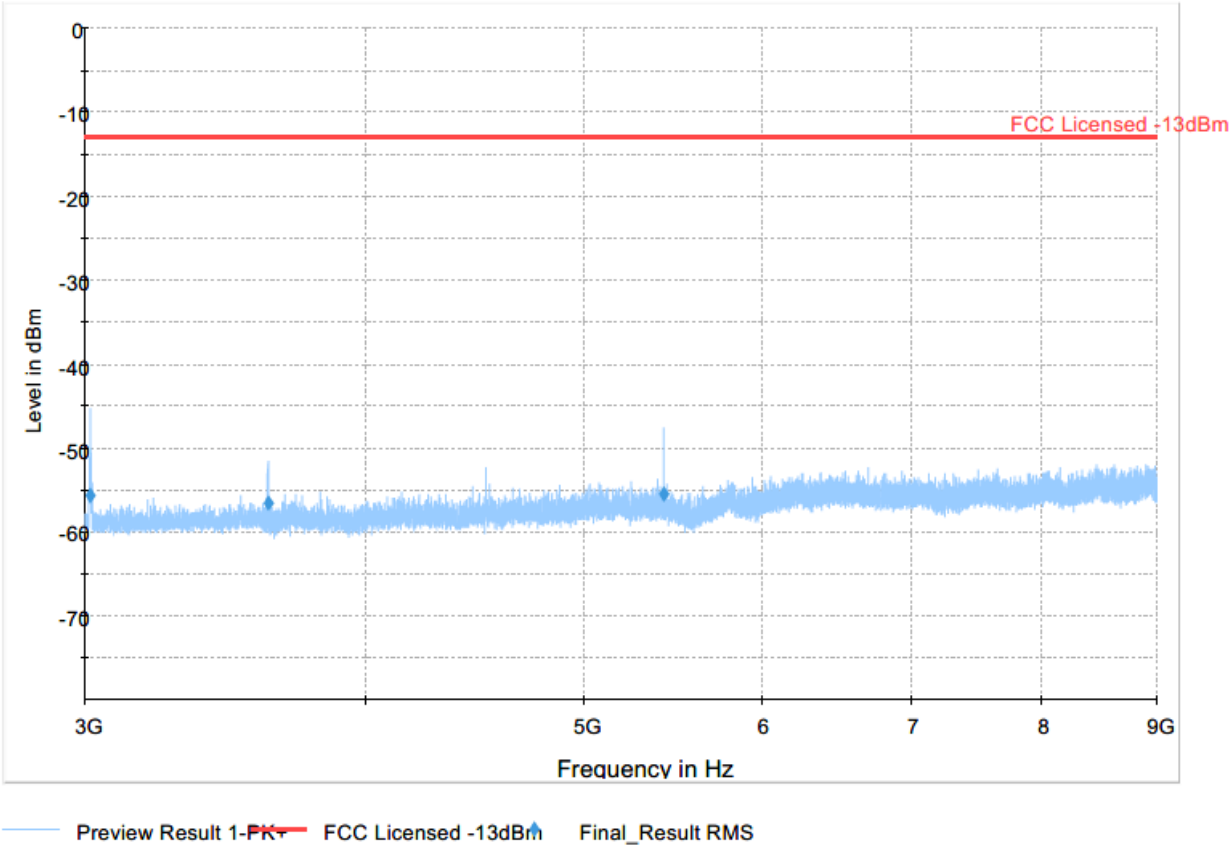


Plot # 55 Radiated Emissions: 3 GHz – 9 GHz

Channel: Low

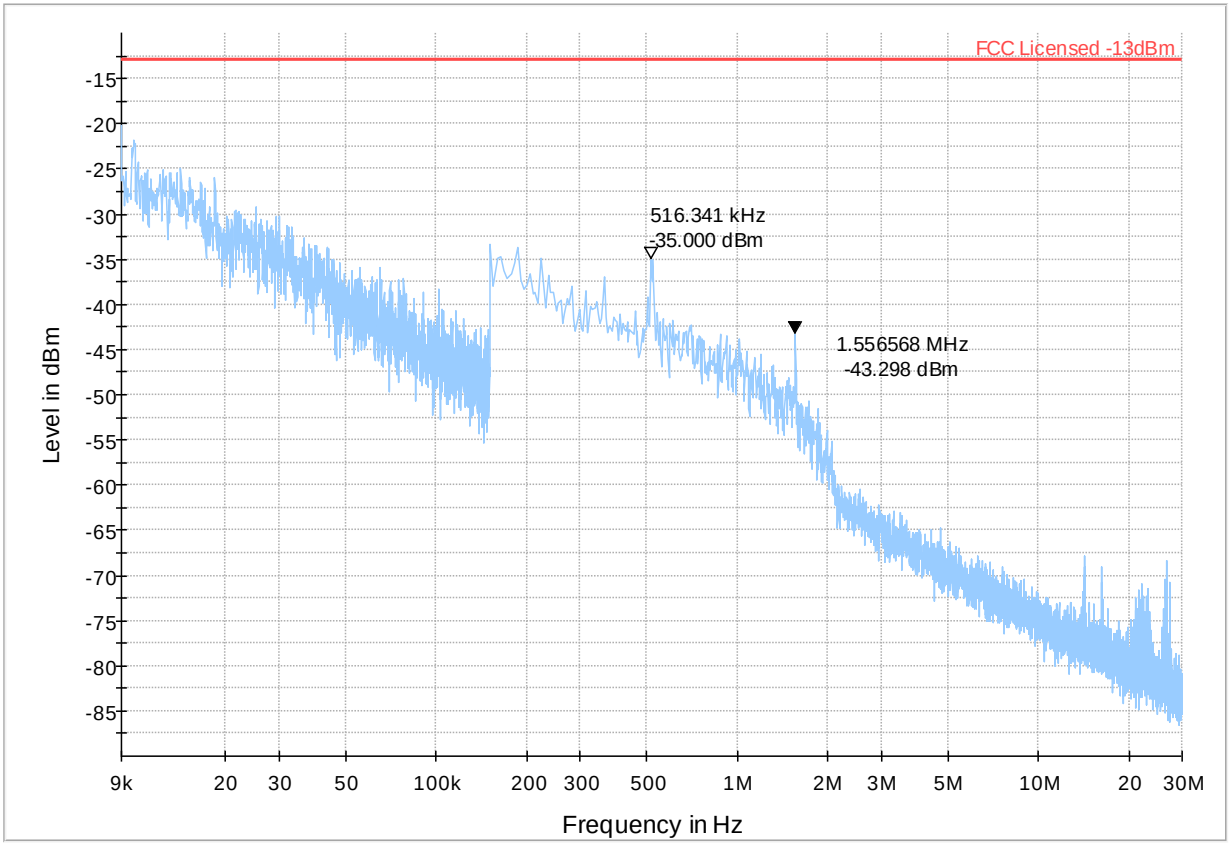
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3016.800	-55.68	-13.00	42.68	500.0	1000.000	140.0	V	183.0	-104.2	
3620.600	-56.67	-13.00	43.67	500.0	1000.000	140.0	H	226.0	-102.2	
5428.800	-55.49	-13.00	42.49	500.0	1000.000	307.0	V	255.0	-99.4	



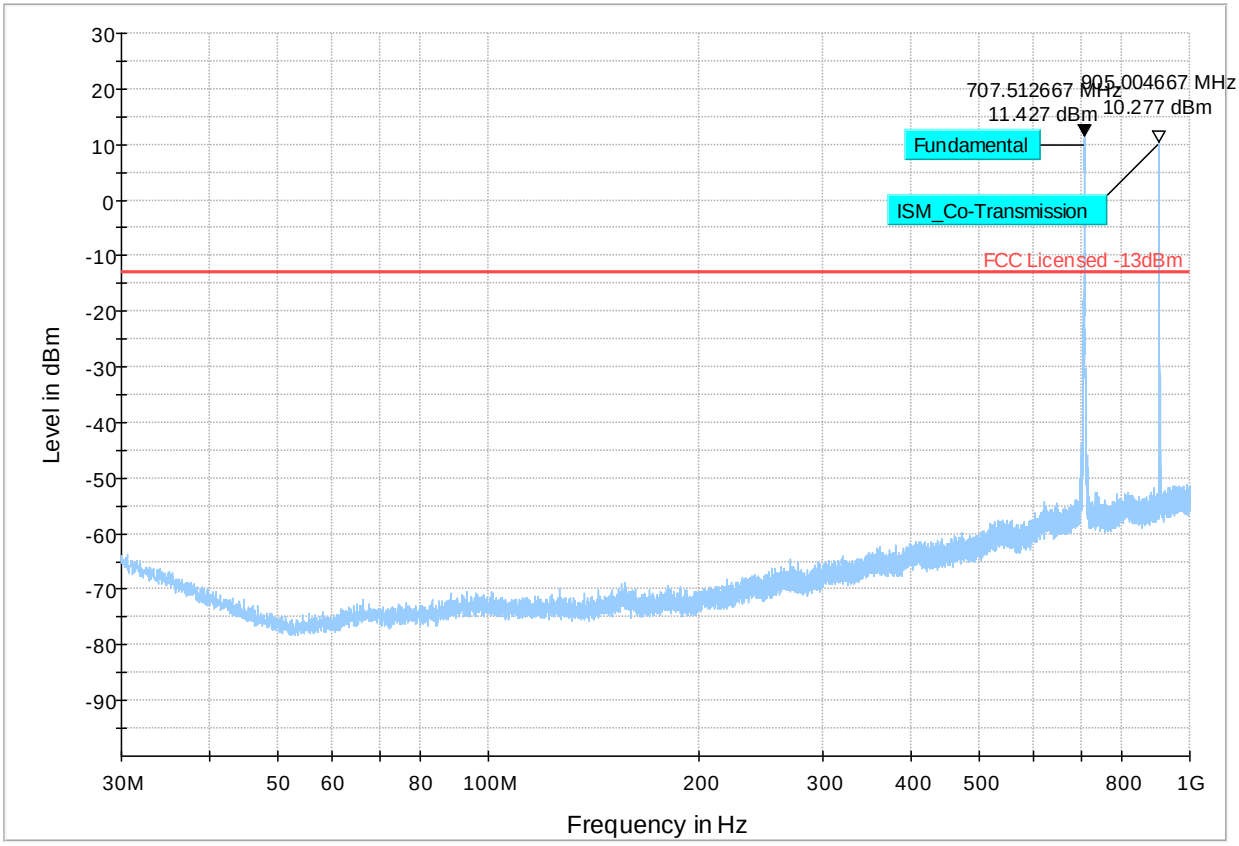
Plot # 56 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid



Plot # 57 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid

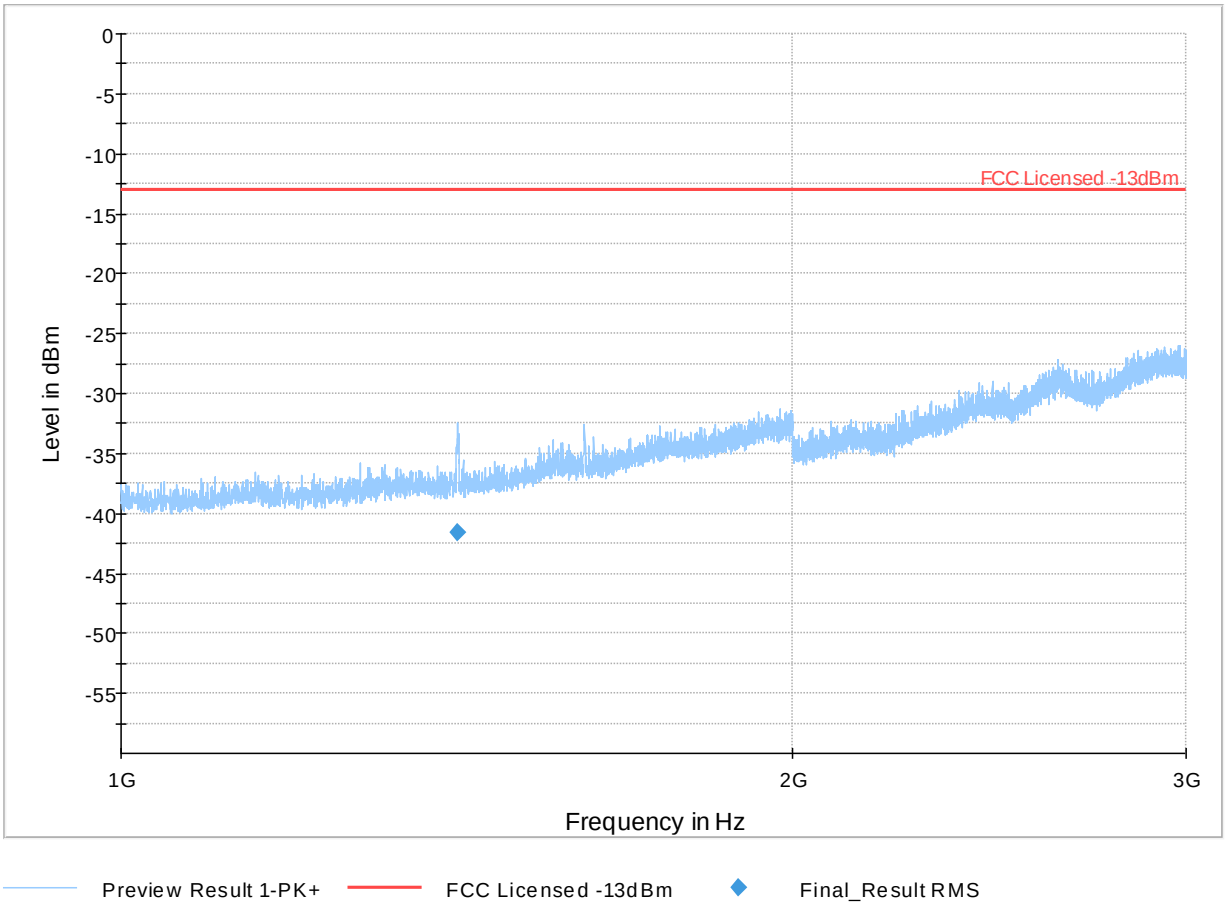


Plot # 58 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

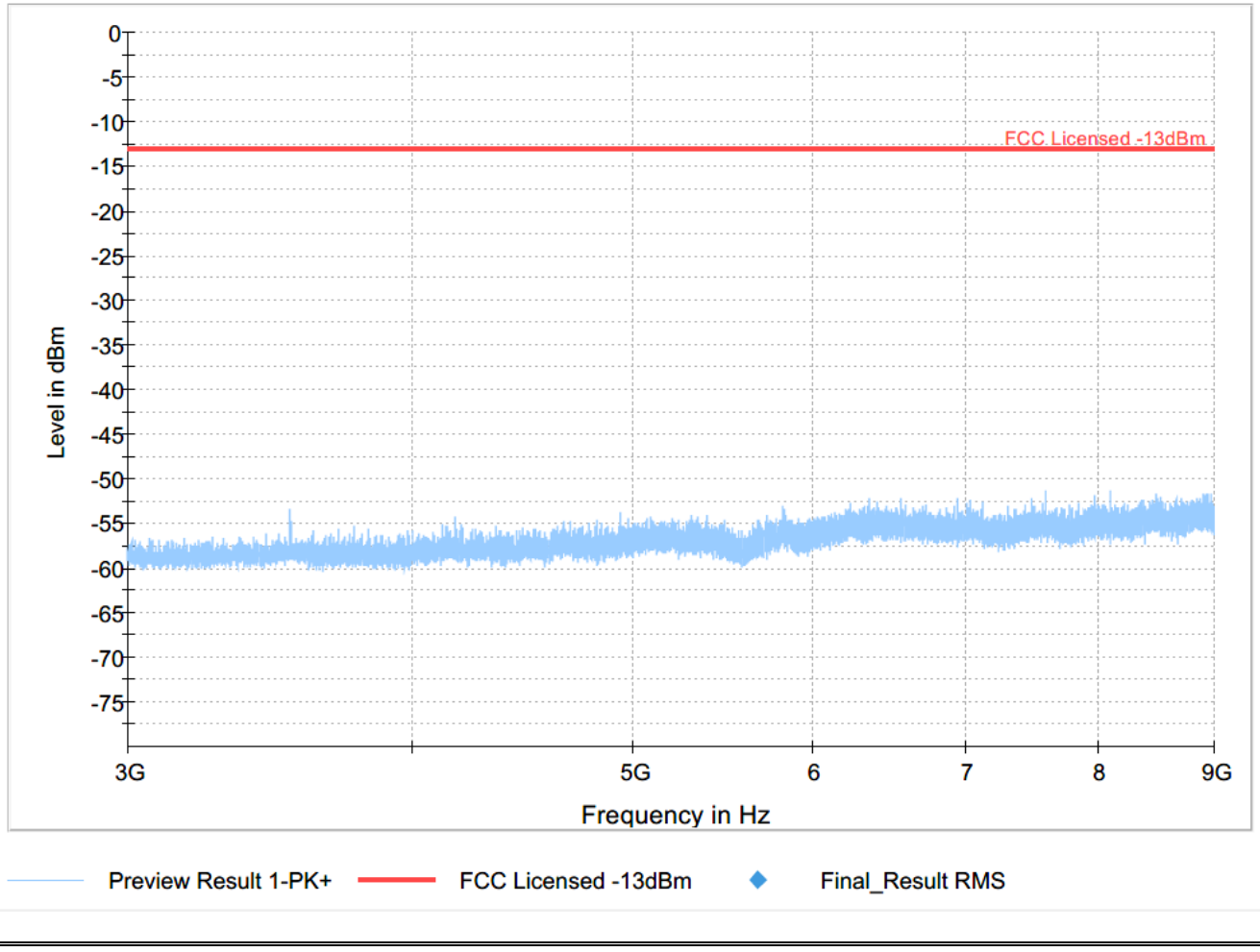
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1415.000	-41.62	-13.00	28.62	500.0	1000.000	253.0	V	132.0	-66.3	



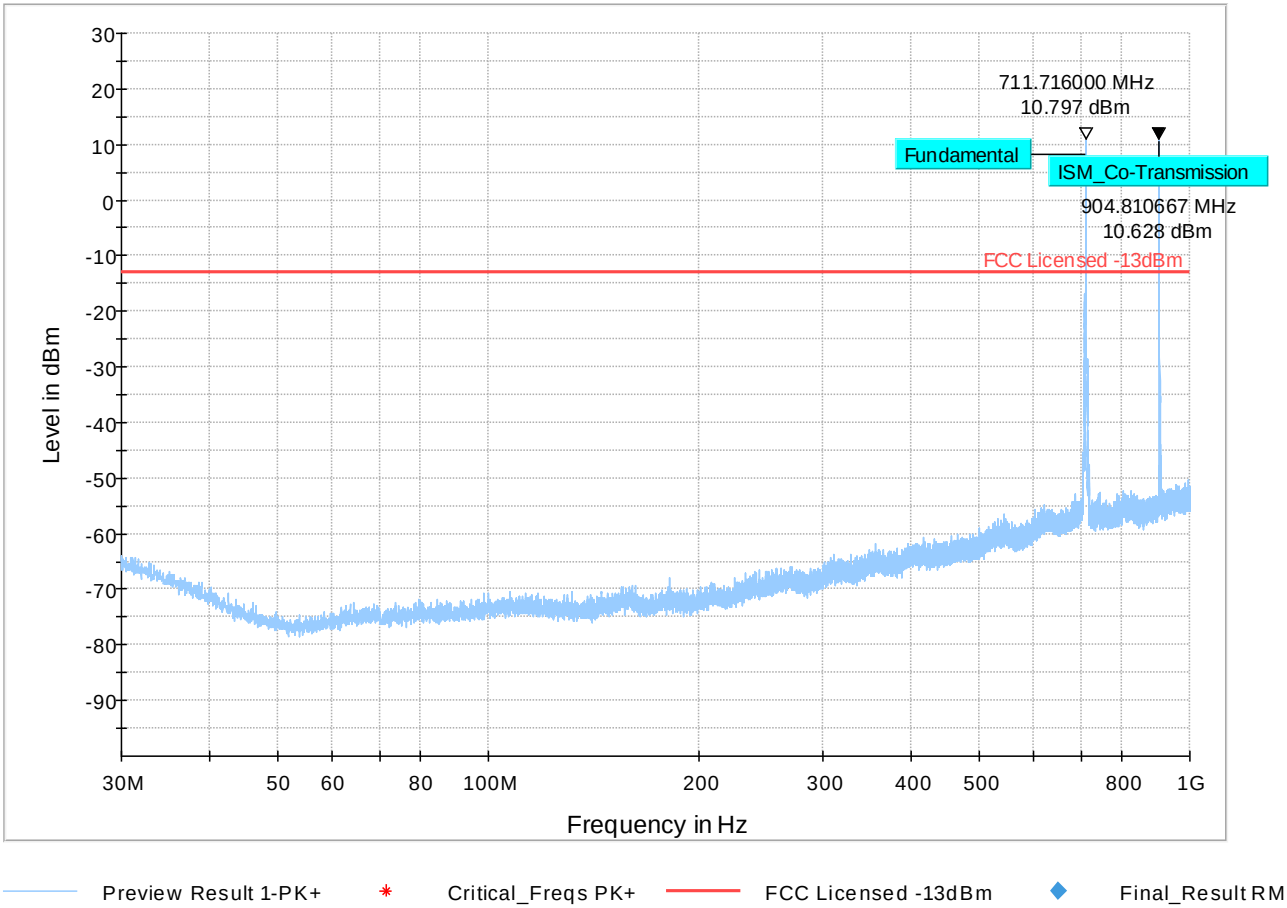
Plot # 59 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid



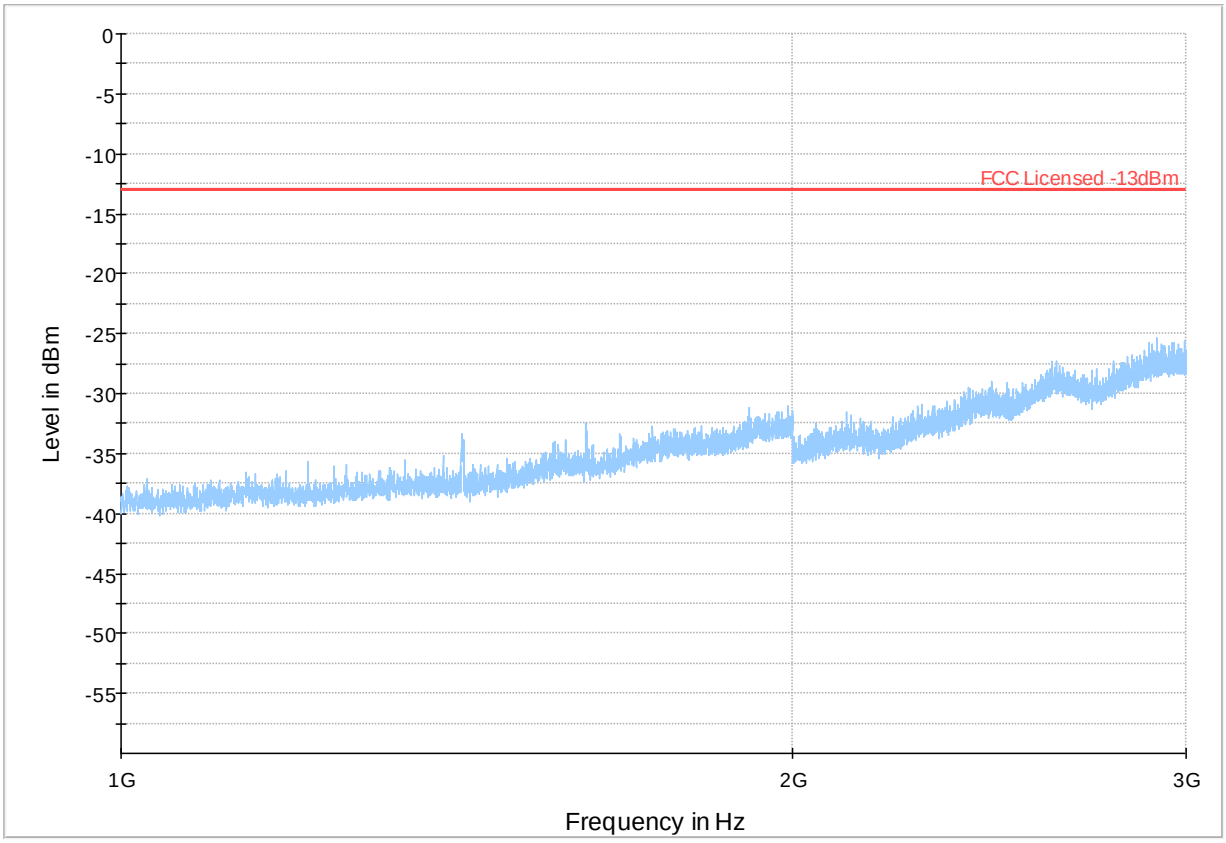
Plot # 60 Radiated Emissions: 30 MHz – 1GHz

Channel: High



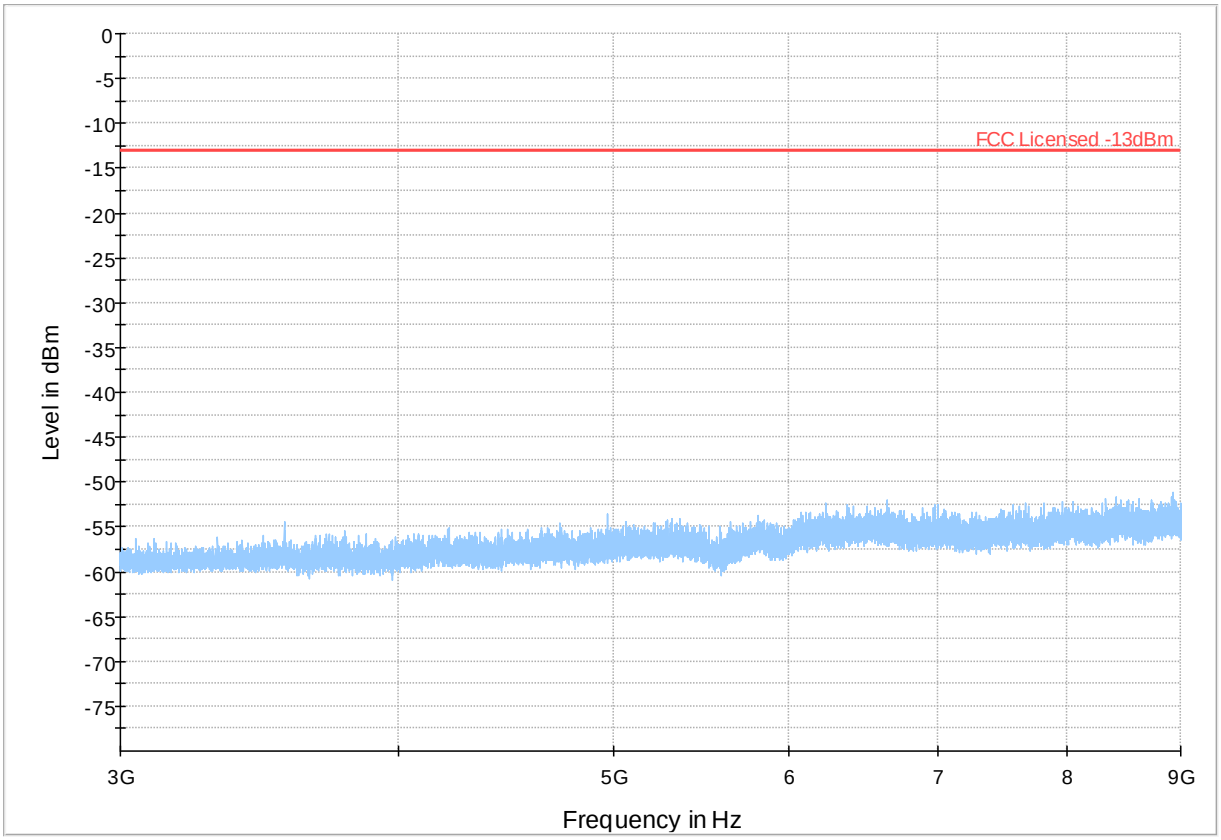
Plot # 61 Radiated Emissions: 1 GHz - 3 GHz

Channel: High



Plot # 62 Radiated Emissions: 3 GHz – 9 GHz

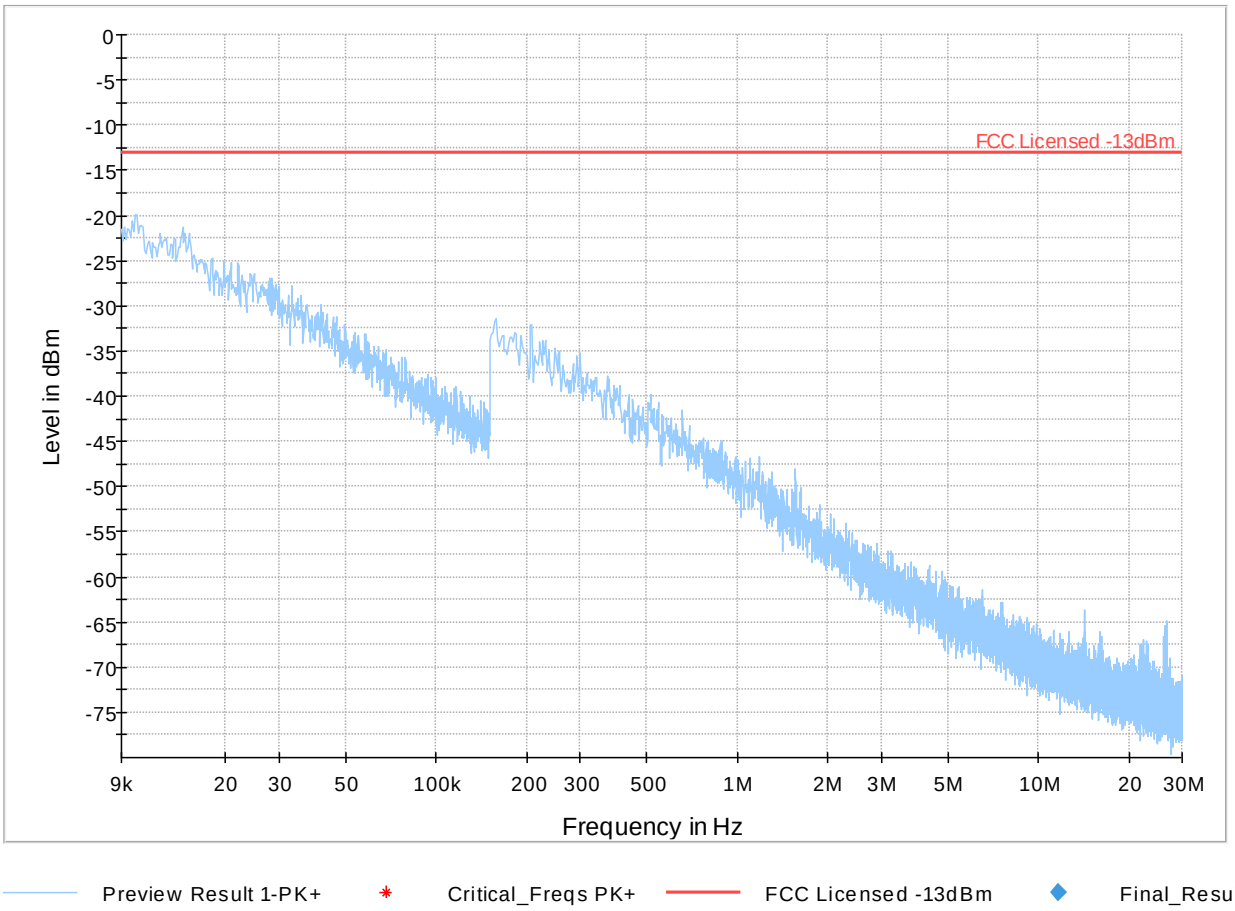
Channel: High



LTE Band 13

Plot # 63 Radiated Emissions: 9 kHz - 30 MHz

Channel: Mid

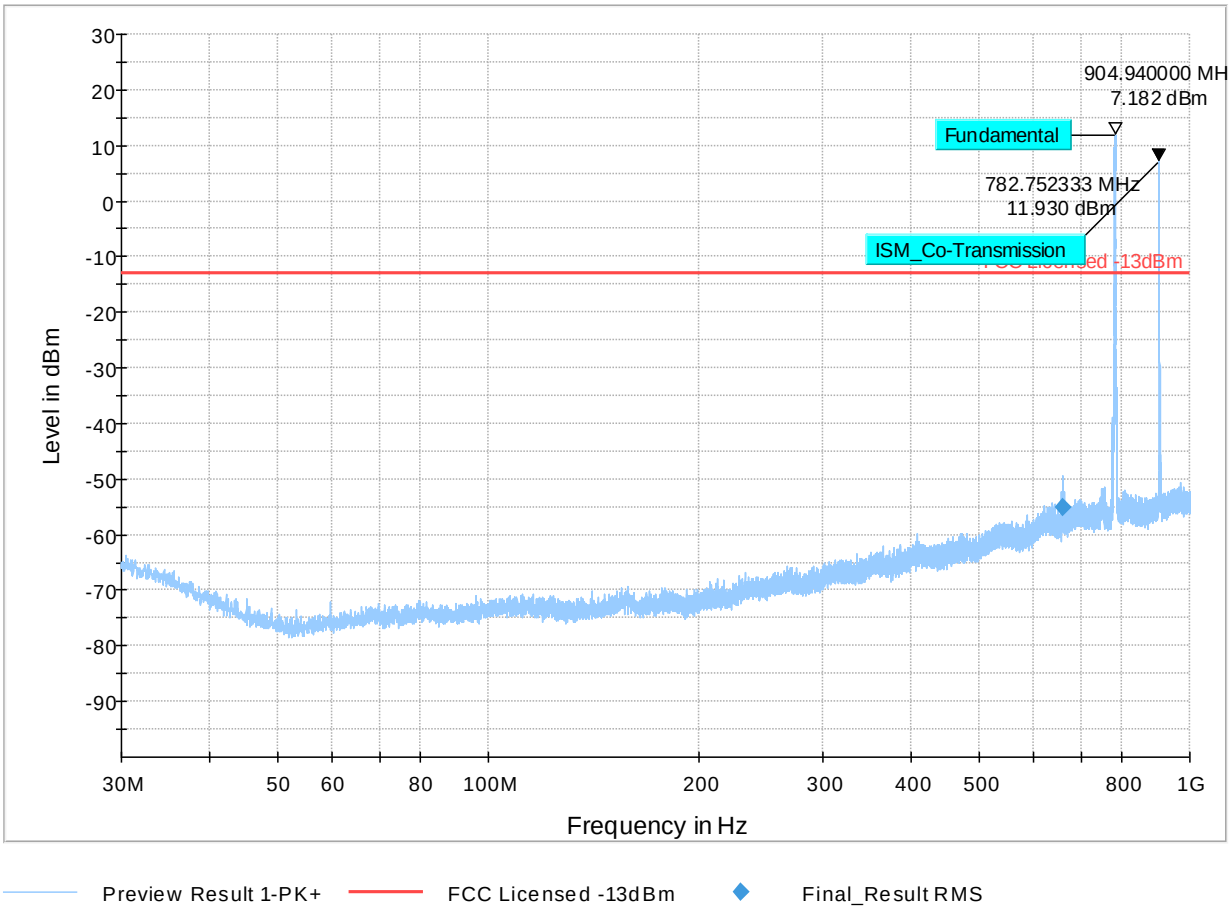


Plot # 64 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid

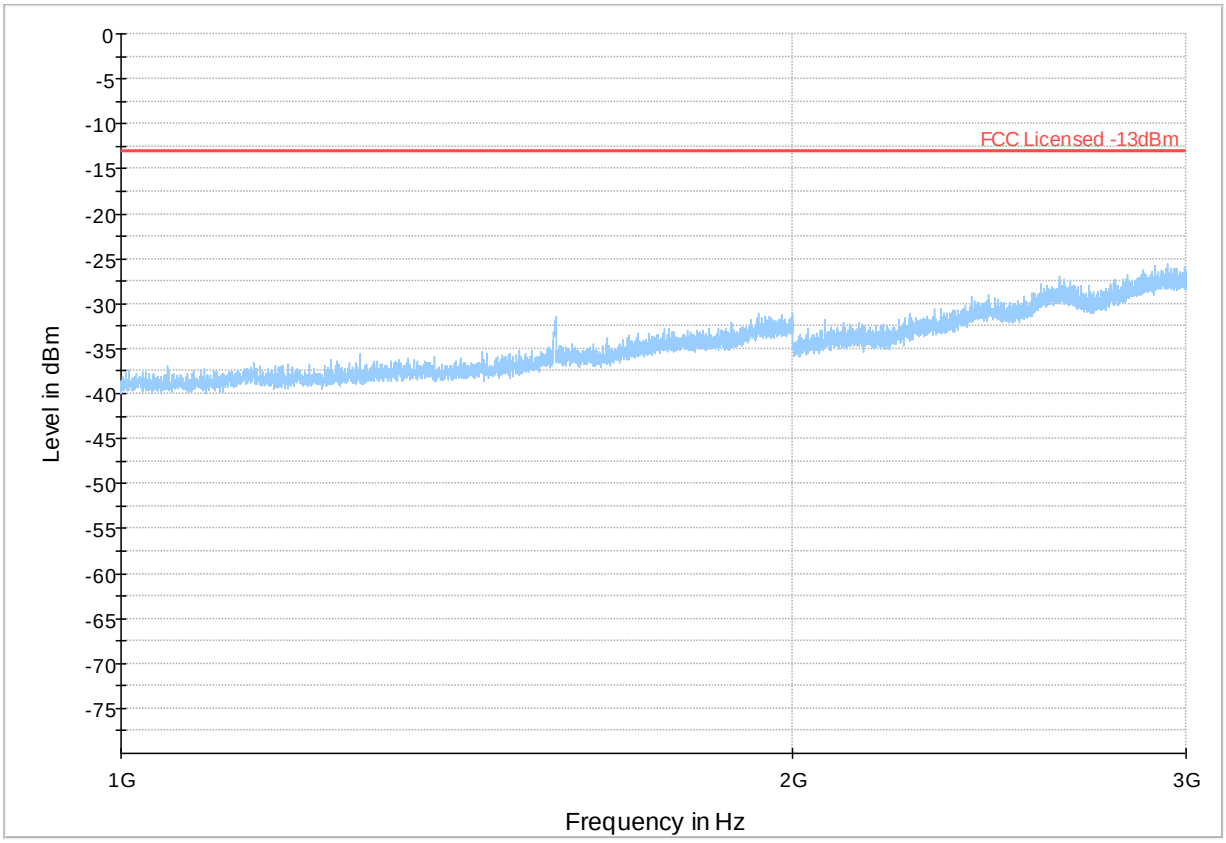
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
659.789	-55.01	-13.00	42.01	500.0	100.000	140.0	H	117.0	-76.0	



Plot # 65 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

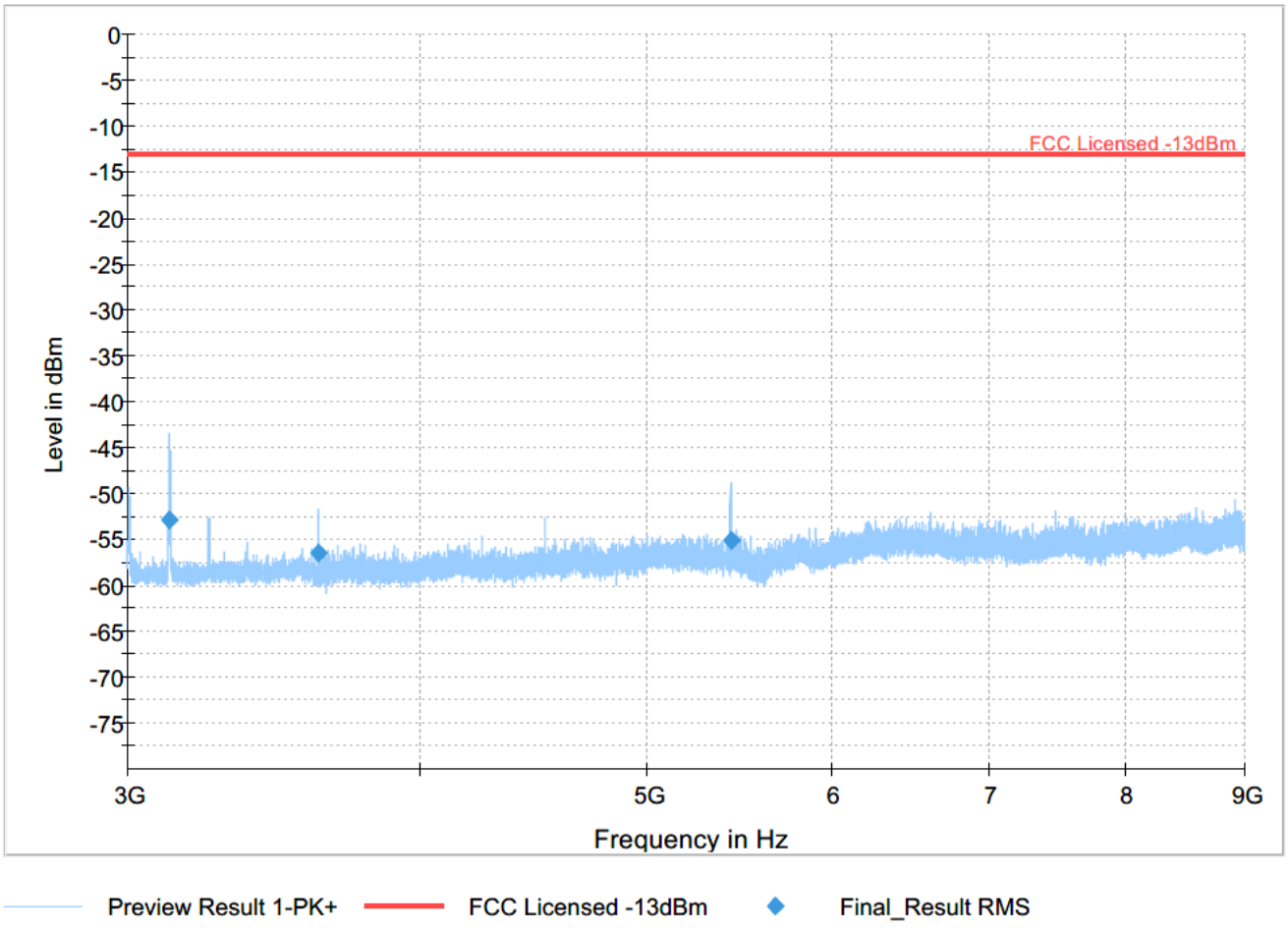


Plot # 66 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid

Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3128.400	-52.89	-13.00	39.89	500.0	1000.000	164.0	V	186.0	-104.1	
3619.200	-56.42	-13.00	43.42	500.0	1000.000	163.0	H	244.0	-102.2	
5428.800	-55.10	-13.00	42.10	500.0	1000.000	315.0	V	254.0	-99.4	



8 Test setup photo

Setup photos are included in supporting file name: "EMC_TELUL-087-20001_ISED_Setup_Photos_R1.pdf"

9 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
PASSIVE LOOP ANTENNA	ETS.LINDGREN	6507	00161344	3 YEARS	10/26/2017
BILOG ANTENNA	ETS.LINDGREN	3142	00166067	3 YEARS	03/12/2020
HORN ANTENNA	ETS.LINDGREN	3115	00035111	3 YEARS	04/17/2019
HORN ANTENNA	ETS.LINDGREN	3117	00215984	3 YEARS	01/26/2018
HORN ANTENNA	ETS.LINDGREN	3116	00070497	3 YEARS	10/31/2017
SIGNAL ANALYZER	R&S	FSU26	200065	3 YEARS	07/16/2019
SIGNAL ANALAYZER	R&S	FSV 40	101022	3 YEARS	07/15/2019
TEST RECEIVER	R&S	ESU.EMI	100256	3 YEARS	07/16/2019
COMPACT DIGITAL BAROMETER	CONTROL COMPANY	10510-922	200236891	3 YEARS	04/13/2020
DIGITAL THRMOMETER	CONTROL COMPANY	36934-164	181230565	2 YEARS	01/10/2019

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.

10 Revision History

Date	Report Name	Changes to report	Report prepared by
2020-08-10	EMC_ TELUL-087-20001_FCC_22_24_27_ISED	Initial version	Yuchan Lu
2020-11-04	EMC_ TELUL-087-20001_FCC_22_24_27_ISED_R1	Updated product description to "SkyHub Wireless Telematics Hub"; Delete FVIN	Yuchan Lu

<<The End>>