FCC/ISED Test Report

FOR:
CalAmp

Model Number:
TTU2900MB

Product Description:
Solar-based telematics gateway

FCC ID: APV-2900MB
IC ID: 5843C-2900MB

Per:
47 CFR: Part 22, Part 24, Part 27, Part 90
RSS-130 Issue 2; RSS-132 Issue 3; RSS-133 Issue 6; RSS-139 Issue 3

REPORT #: EMC_CALAM-118-21001_FCC_22_24_27_90_ISED

DATE: 2021-02-19

A2LA Accredited

IC recognized #
3462B-1
CABID: US0187

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TABLE OF CONTENTS

1 ASSESSMENT 3

2 ADMINISTRATIVE DATA 4

2.1 IDENTIFICATION OF THE TESTING LABORATORY ISSUING THE EMC TEST REPORT 4
2.2 IDENTIFICATION OF THE CLIENT 4
2.3 IDENTIFICATION OF THE MANUFACTURER 4

3 EQUIPMENT UNDER TEST (EUT) 5

3.1 EUT SPECIFICATIONS 5
3.2 EUT SAMPLE DETAILS 6
3.3 ACCESSORY EQUIPMENT DETAILS 6
3.4 TEST SAMPLE CONFIGURATION 6
3.5 MODE OF OPERATION DETAILS 7
3.6 JUSTIFICATION FOR WORST CASE MODE OF OPERATION 7

4 SUBJECT OF INVESTIGATION 8

4.1 DATES OF TESTING: 8
4.2 MEASUREMENT UNCERTAINTY 8
4.3 ENVIRONMENTAL CONDITIONS DURING TESTING: 8

5 MEASUREMENT PROCEDURES 9

5.1 RADIATED MEASUREMENT 9
5.2 SAMPLE CALCULATIONS FOR FIELD STRENGTH MEASUREMENTS 11

6 MEASUREMENT RESULTS SUMMARY 12

6.1 FCC 22, RSS-132: 12
6.2 FCC 24, RSS-133: 13
6.3 FCC 27, RSS-130, RSS-139: 14

7 TEST RESULT DATA 16

7.1 E(I)RP 16
7.2 RADIATED SPURIOUS EMISSIONS 17

8 TEST SETUP PHOTO 67

9 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTING 67

10 REVISION HISTORY 68

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, 90 and Industry Canada Radio Standard Specifications RSS: 130 Issue 2, 132 Issue 3, 133 Issue 6 and 139 Issue 3.

Company	Description	Model #
CalAmp	Solar-based telematics gateway	TTU2900MB

No deficiencies were ascertained.

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2021-02-19	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: 2021-02-24 11:28:21

Responsible for the Report:

Date	Section	Name	Signature
2021-02-19	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: 2021.02.19 18:25:58 -08'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

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:	CalAmp
Street Address:	2200 Faraday Avenue, Suite 220
City/Zip Code	Carlsbad, CA 92008
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):	TTU2900MB
Product Marketing Name (PMN):	TTU2900MB
Antenna Information as declared:	Antenna model Electronics Antenna P/N: 1004795 Antenna gains: • LTE Band 2, 25: 3.1 dBi • LTE Band 4: 3.1 dBi • LTE Band 5, 26: 1.6 dBi • LTE Band 12: 1.6 dBi • LTE Band 13: 1.6 dBi
Other Radios included in the device:	❖ BLE • Manufacture: Texas Instruments • Module name/number: CC2640
Power Supply/ Rated Operating Voltage Range:	Vmin: 8 VDC/ Vnom: 12 VDC / Vmax: 32 VDC
Operating Temperature Range:	Low -30ºC, Nominal 25ºC, High 70ºC
Sample Revision	☐Prototype Unit; ☐Production Unit; ■Pre-Production
EUT Dimensions(mm):	414 x 128 x 50
Weight(grams):	1188
EUT Diameter	■ < 60 cm ☐ Other _____

Module Information	
Module Name:	Quectel BG96
Model Number:	BG96
FCC ID:	XMR201707BG96
IC ID:	10224A-201709BG96

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	6002001035	REV A	8.5	Radiated Measurement

3.3 Accessory Equipment details

AE #	Type	Model	Manufacturer	Serial Number
1	Charging and communication cable	-	-	-

3.4 Support Equipment

SE #	Description
1	Laptop, Dell Latitude 7490

3.5 Test Sample Configuration

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

3.6 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 BLE mid channel. For radiated measurements, the internal antenna was connected.

3.7 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 BLE mid 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:** APV-2900MB / **IC ID:** 5843C-2900MB.

The pre-certified module to be integrated (Quectel BG96) 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, 90 and Industry Canada Radio Standard Specifications RSS: 130 Issue 2, 132 Issue 3, 133 Issue 6 and 139 Issue 3.

LTE Band 2 and 5 are covered by Band 25 and 26. (B2 is a subset of B25, and B5 is a subset of B26. Both bands share the same hardware and have the same radio performance. Separate measurement in B2 and B5 are not required) Cat M1 LTE Band 4, 5, 12, 13, 25 and 26 are tested for radiated spurious emissions based on client's declaration.

The conducted module test data that can be obtained under the **FCC Filing ID:** XMR201707BG96 is applicable for the host described in section 3.

4.1 Dates of Testing:

01/18/2021 – 01/20/2021

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%

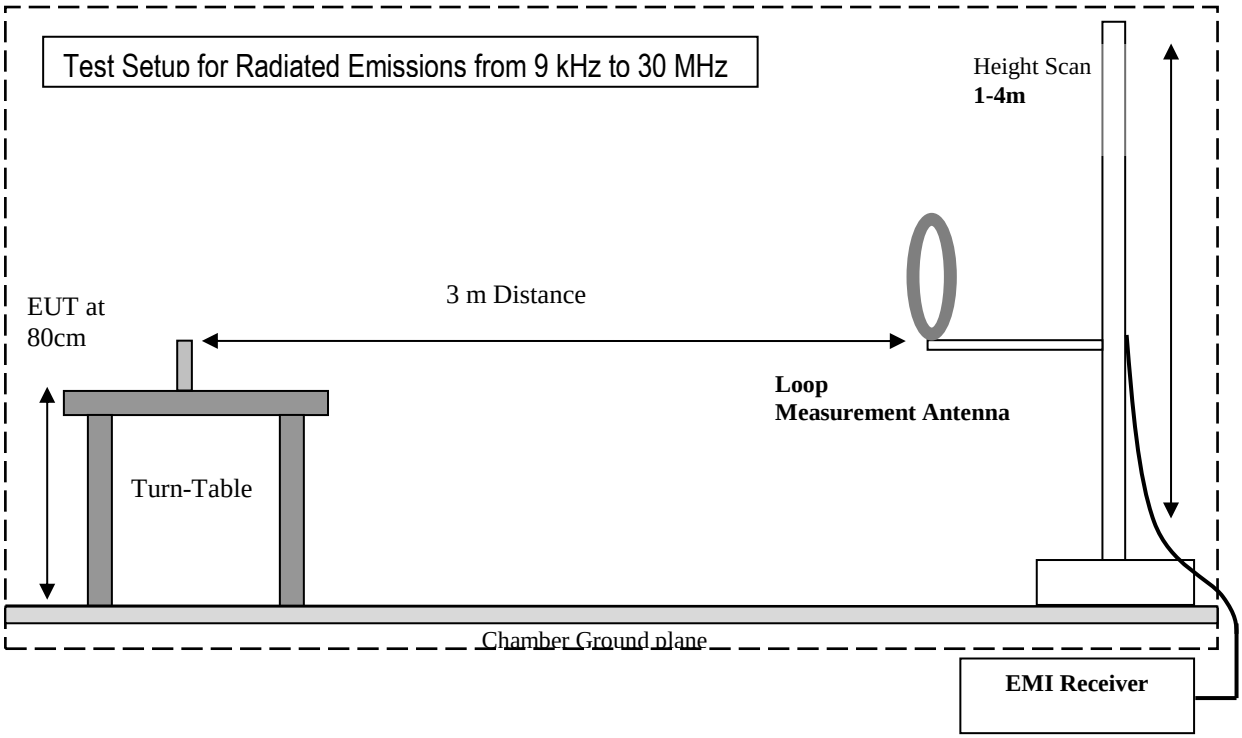
Deviating test conditions are indicated at individual test description where applicable.

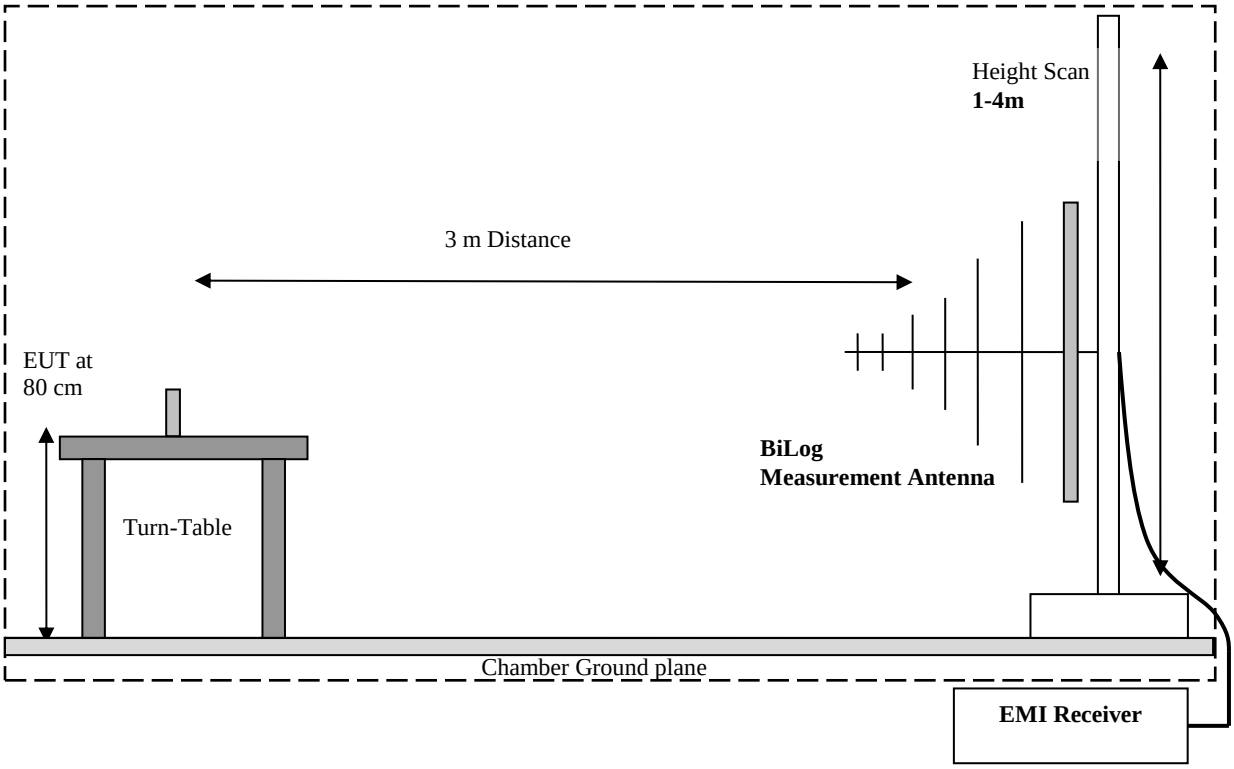
5 Measurement Procedures

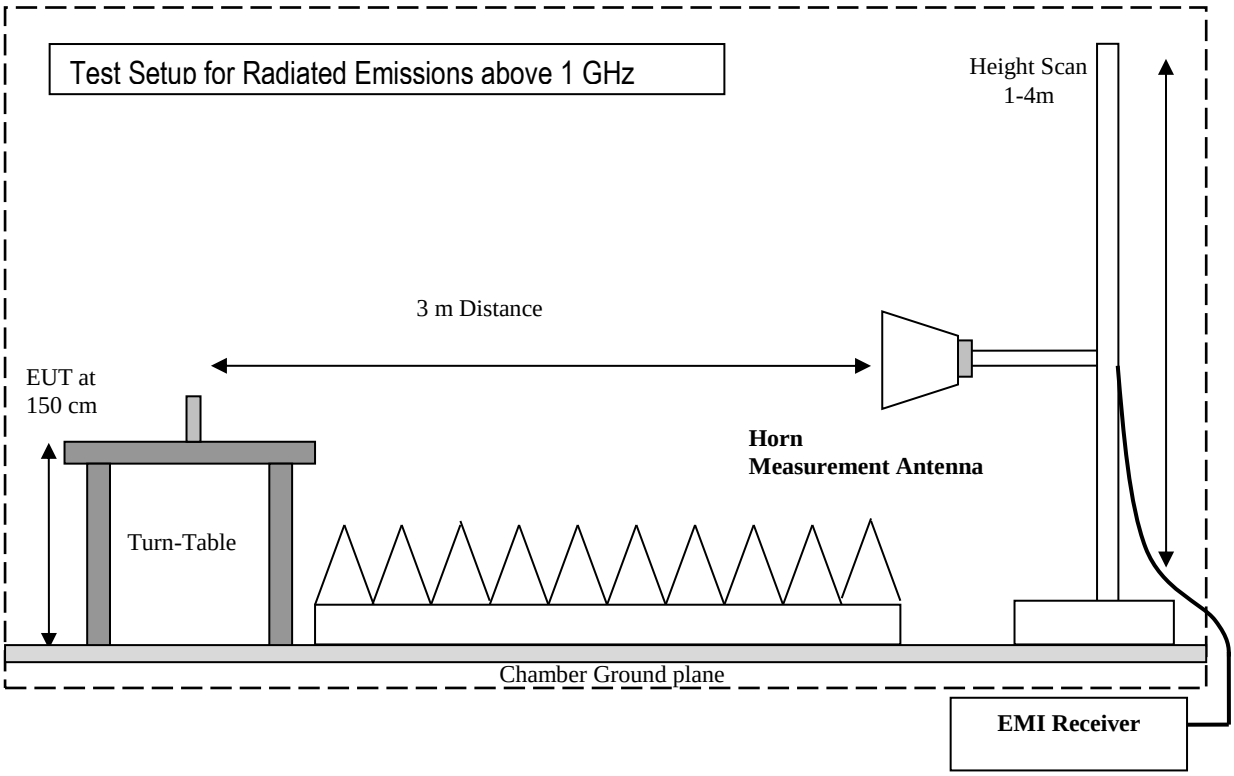
Testing is performed according to the guidelines provided in FCC publication (KDB) 971168 D01 v03 – "Measurement Guidance for Certification of Licensed Digital Transmitters" and according to ANSI C63.26 as detailed below.

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: The conducted measurements results from module certification FCC ID: XMR201707BG96 were evaluated for compliance against the applicable rules.

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: The conducted measurements results from module certification FCC ID: XMR201707BG96 were evaluated for compliance against the applicable rules.

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: The conducted measurements results from module certification FCC ID: XMR201707BG96 were evaluated for compliance against the applicable rules.

6.1 FCC 90, RSS-132:

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §90.635 (b)	RF Output Power	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1055; §90.213	Frequency Stability	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1049; §90.209	Occupied Bandwidth	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §90.691	Band Edge Compliance	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1051; §90.691	Conducted Spurious Emissions	Nominal	-	☐	☐	☐	■	Note 1 Note 2
§2.1053; §90.691; RSS-132 Issue 3-5.5;	Radiated Spurious Emissions	Nominal	Op.1	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: The conducted measurements results from module certification FCC ID: XMR201707BG96 were evaluated for compliance against the applicable rules.

7 Test Result Data

7.1 E(I)RP

Band	Frequency Range (MHz)	Power conducted (W)	Emission Designator	Antenna Gain (dBi)	gain linear	EIRP[1] (W)	ERP[1] (W)	Frequency deviation (ppm)	Limit ERP (W)
GSM 850	824.2 – 848.8	1.702	246KGXW	1.6	1.445	2.460	1.500	0.03950	7
GSM 850	824.2 – 848.8	0.476	249KG7W	1.6	1.445	0.688	0.420	0.03170	7
GSM 1900	1850.2 – 1909.8	0.946	246KGXW	3.1	2.042	1.931	-	0.01850	2
GSM 1900	1850.2 – 1909.8	0.404	248KG7W	3.1	2.042	0.825	-	0.01930	2
LTE Band 2	1850.7 – 1909.3	0.247	1M90W7D	3.1	2.042	0.504	-	0.00639	2
LTE Band 2	1850.7 – 1909.3	0.240	1M25G7D	3.1	2.042	0.490	-	0.00230	2
LTE Band 4	1710.7 – 1754.3	0.175	1M21G7D	3.1	2.042	0.357	-	0.00330	1
LTE Band 4	1710.7 – 1754.3	0.173	1M11W7D	3.1	2.042	0.353	-	0.01527	1
LTE Band 5	824.7 – 848.3	0.242	1M05W7D	1.6	1.445	0.350	0.213	0.01753	7
LTE Band 5	824.7 – 848.3	0.222	1M20G7D	1.6	1.445	0.321	0.196	0.00430	7
LTE Band 12	699.7 – 715.3	0.233	1M08W7D	1.6	1.445	0.337	0.205	0.00582	3
LTE Band 12	699.7 – 715.3	0.219	1M21G7D	1.6	1.445	0.317	0.193	0.00365	3
LTE Band 13	779.5 – 784.5	0.246	1M05W7D	1.6	1.445	0.356	0.217	0.03445	3
LTE Band 13	779.5 – 784.5	0.219	1M19G7D	1.6	1.445	0.317	0.193	0.00276	3
LTE Band 25	1850.7 – 1914.3	0.284	1M11W7D	3.1	2.042	0.580	0.354	0.00750	2
LTE Band 25	1850.7 – 1914.4	0.257	1M21G7D	3.1	2.042	0.525	0.320	0.00928	2
LTE Band 26	824.7 – 848.3	0.239	1M06W7D	1.6	1.445	0.345	0.211	0.04157	7
LTE Band 26	824.7 – 848.3	0.206	1M21G7D	1.6	1.445	0.298	0.182	0.00237	7
LTE Band 26	814.7 – 823.3	0.229	1M26W7D	1.6	1.445	0.331	0.202	0.03463	7
LTE Band 26	814.7 – 823.3	0.201	1M20G7D	1.6	1.445	0.291	0.177	0.00161	7
NB-IOT Band 2	1850.1 – 1909.9	0.199	199KG7D	3.1	2.042	0.406	-	0.00245	2
NB-IOT Band 4	1710.2 – 1754.8	0.222	187KG7D	3.1	2.042	0.453	-	0.00941	1
NB-IOT Band 5	824.7 – 848.3	0.187	195KG7D	1.6	1.445	0.270	0.165	0.00662	7
NB-IOT Band 12	699.1 – 715.9	0.239	198KG7D	1.6	1.445	0.345	0.211	0.00734	3
NB-IOT Band 13	777.1 – 786.9	0.206	195KG7D	1.6	1.445	0.298	0.182	0.00334	3
NB-IOT Band 25	1850.1 – 1914.9	0.264	133KG7D	3.1	2.042	0.539	-	0.03484	2
NB-IOT Band 26	824.2 – 848.8	0.205	184KG7D	1.6	1.445	0.296	0.181	0.00956	7
NB-IOT Band 26	814.2 – 823.8	0.206	184KG7D	1.6	1.445	0.298	0.182	0.00939	7

Note 1: E(I)RP are calculated from maximum power in grant of cellular module Quectel BG96 adding the maximum gain of the utilized cellular antenna per operational description.
Note 2: Cat M1 LTE Band 4, 5, 12, 13, 25 and 26 are tested for radiated spurious emissions based on client's declaration.

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:

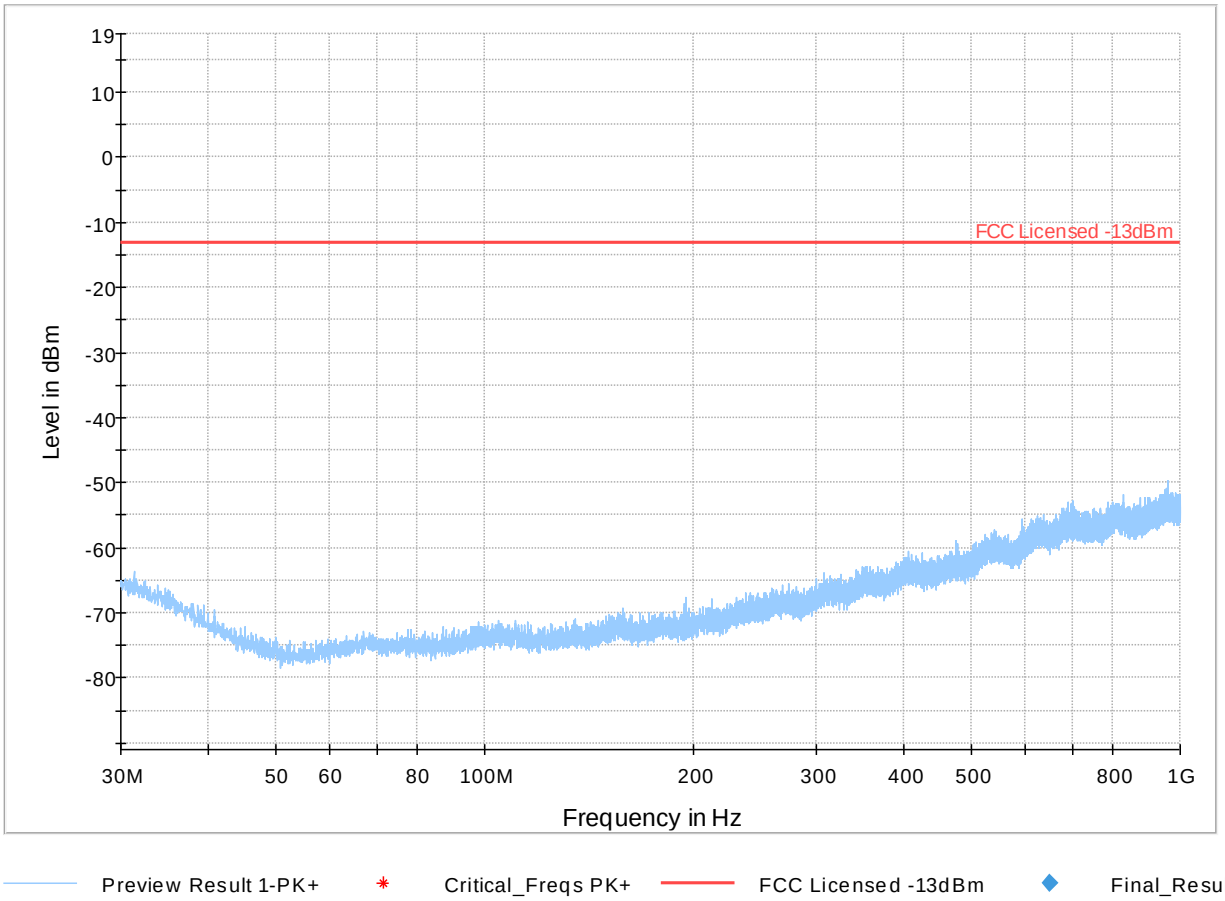
Ambient Temperature (C)	**EUT operating mode**	**Power Input**
22	Op. 1	12 VDC

7.2.4 Measurement Plots:

LTE Band 4

Plot # 1 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low

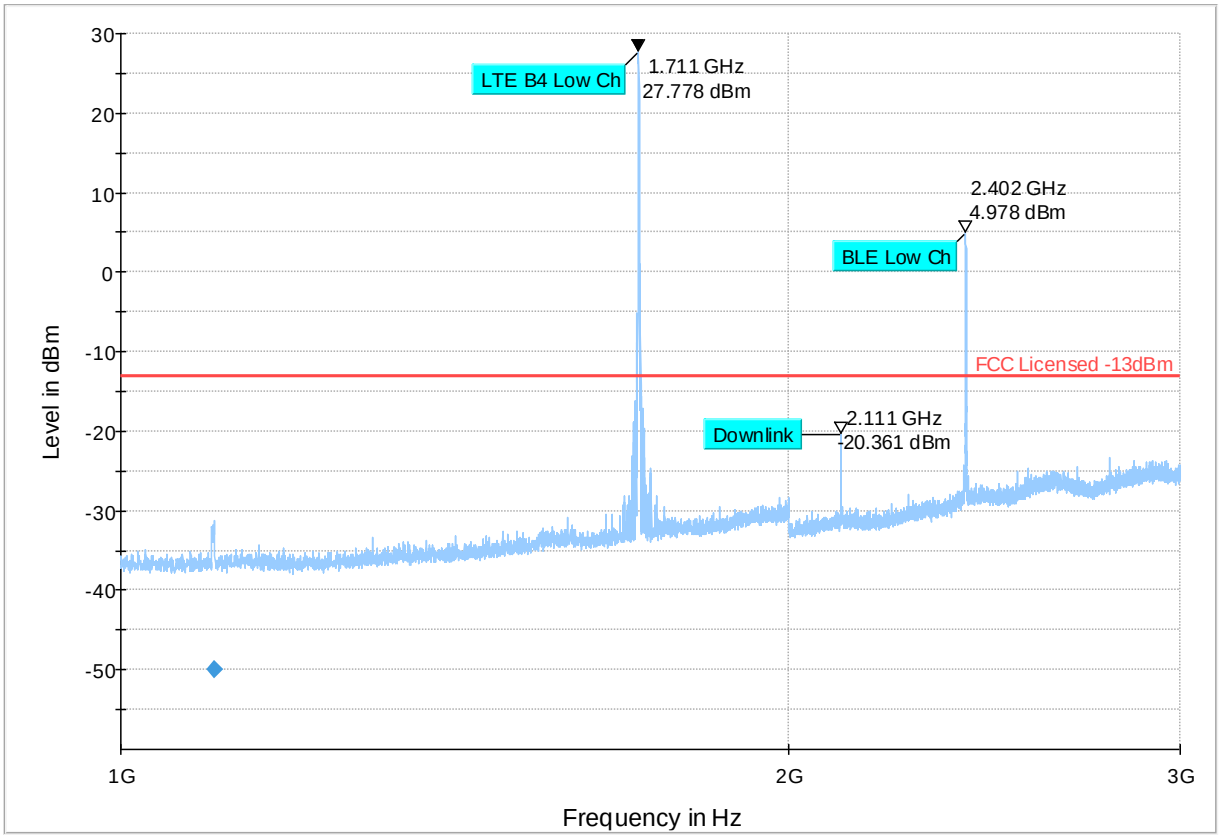


Plot # 2 Radiated Emissions: 1 GHz - 3 GHz

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
1102.000	-49.87	-13.00	36.87	500.0	1000.000	229.0	H	69.0	-65.3	



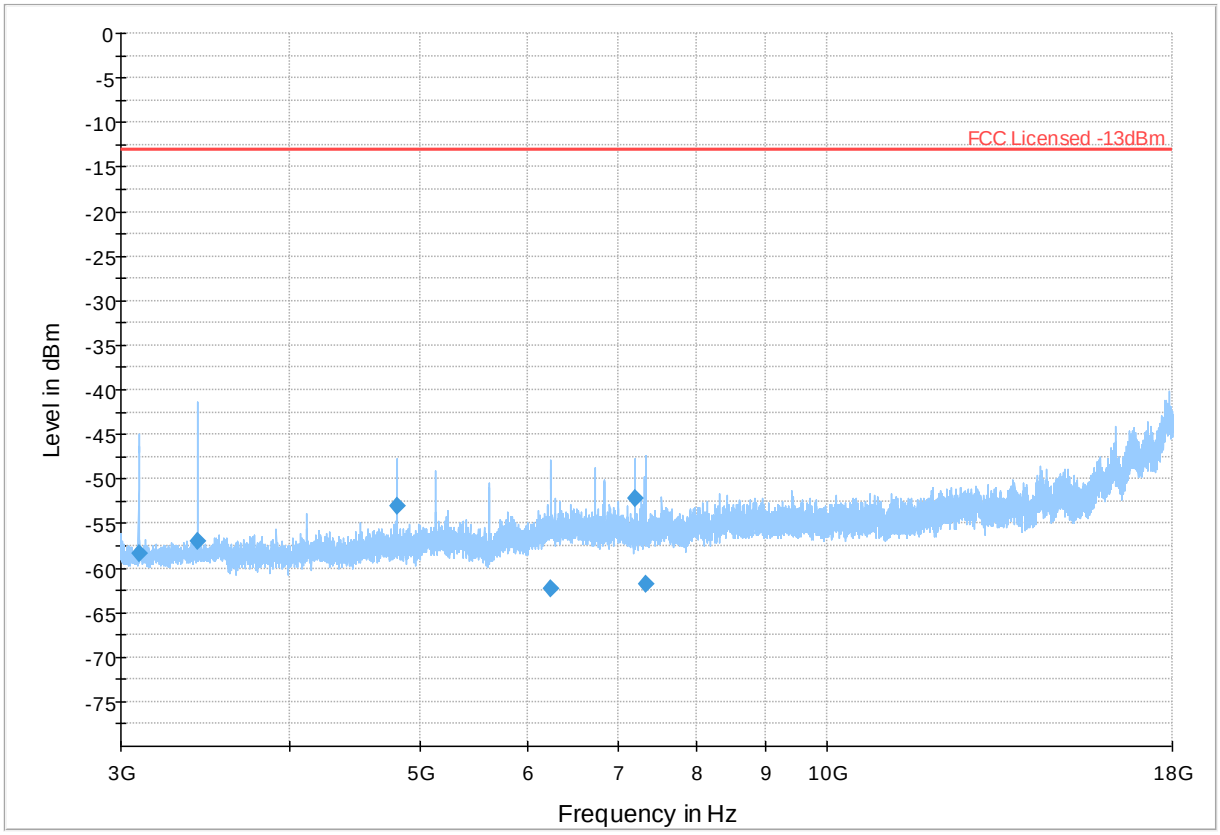
Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 3 Radiated Emissions: 3 GHz - 18 GHz

Channel: Low

Final_Result

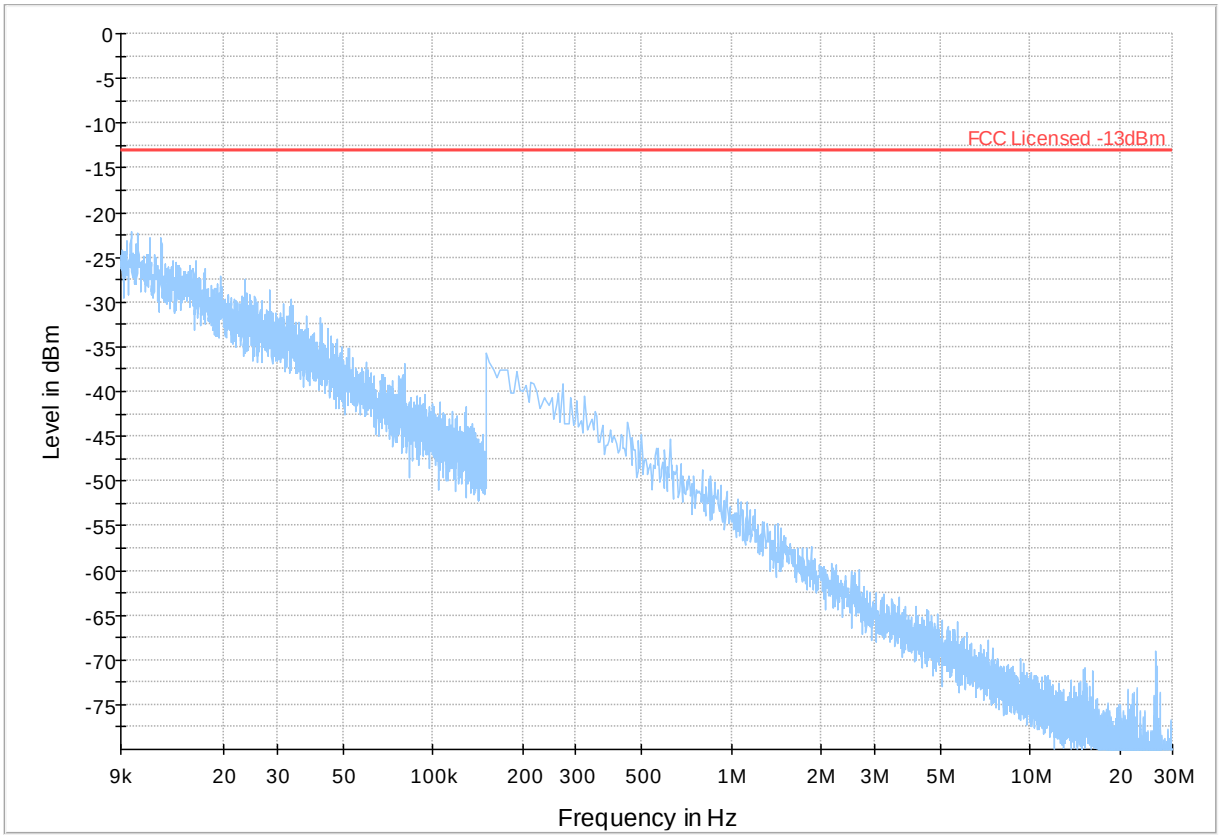
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3092.500	-58.43	-13.00	45.44	500.0	1000.000	228.0	V	220.0	-104.2	
3422.000	-57.04	-13.00	44.04	500.0	1000.000	140.0	H	217.0	-103.3	
4803.500	-53.01	-13.00	40.01	500.0	1000.000	140.0	H	70.0	-100.0	
6235.000	-62.27	-13.00	49.27	500.0	1000.000	164.0	V	28.0	-96.0	
7206.500	-52.19	-13.00	39.19	500.0	1000.000	140.0	V	287.0	-95.8	
7337.500	-61.74	-13.00	48.74	500.0	1000.000	140.0	V	135.0	-95.7	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 4 Radiated Emissions: 9 kHz - 30 MHz

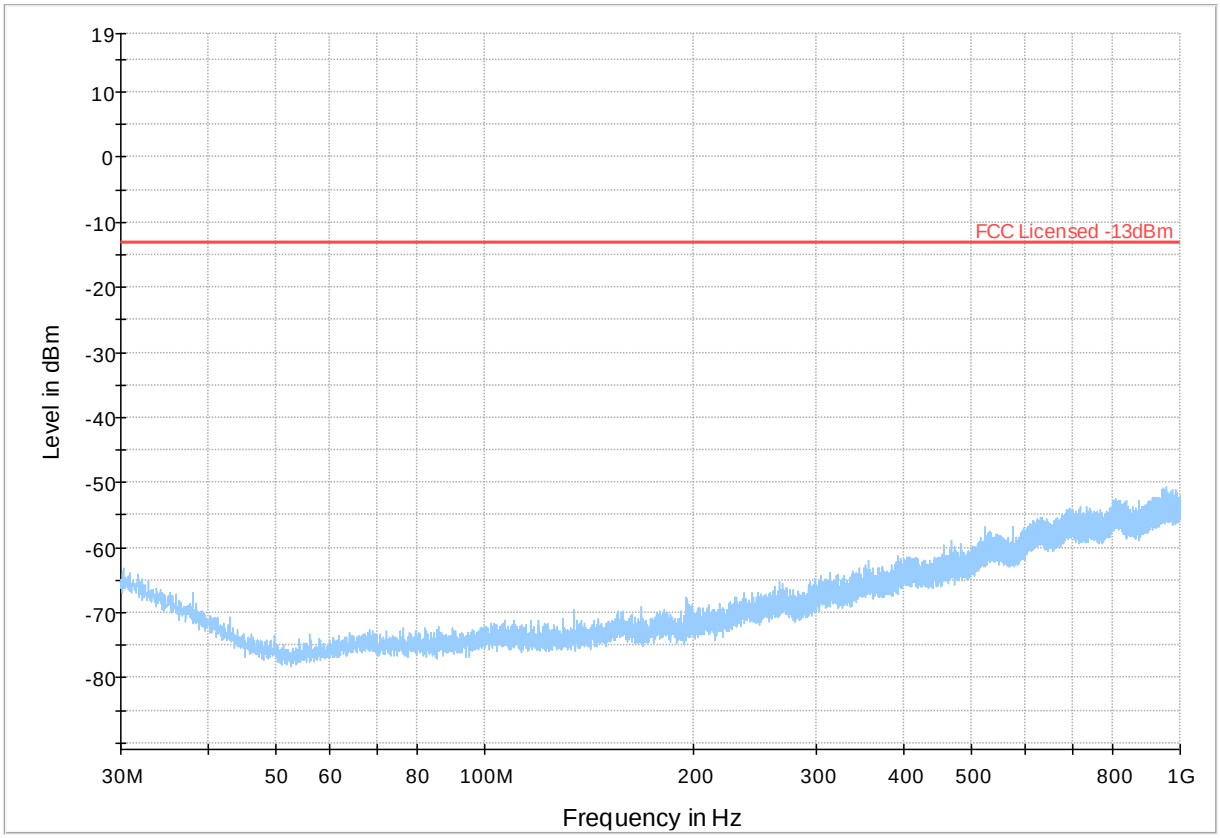
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 5 Radiated Emissions: 30 MHz – 1 GHz

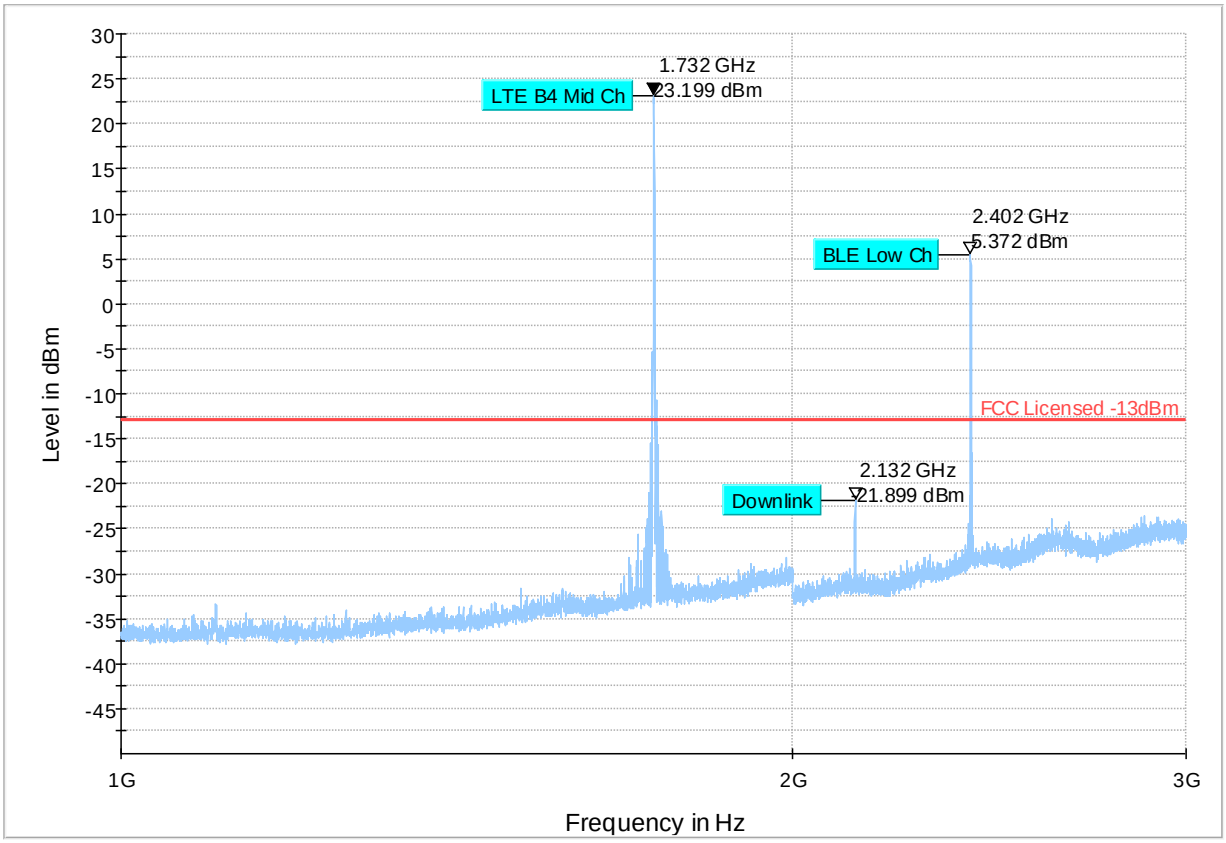
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 6 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid



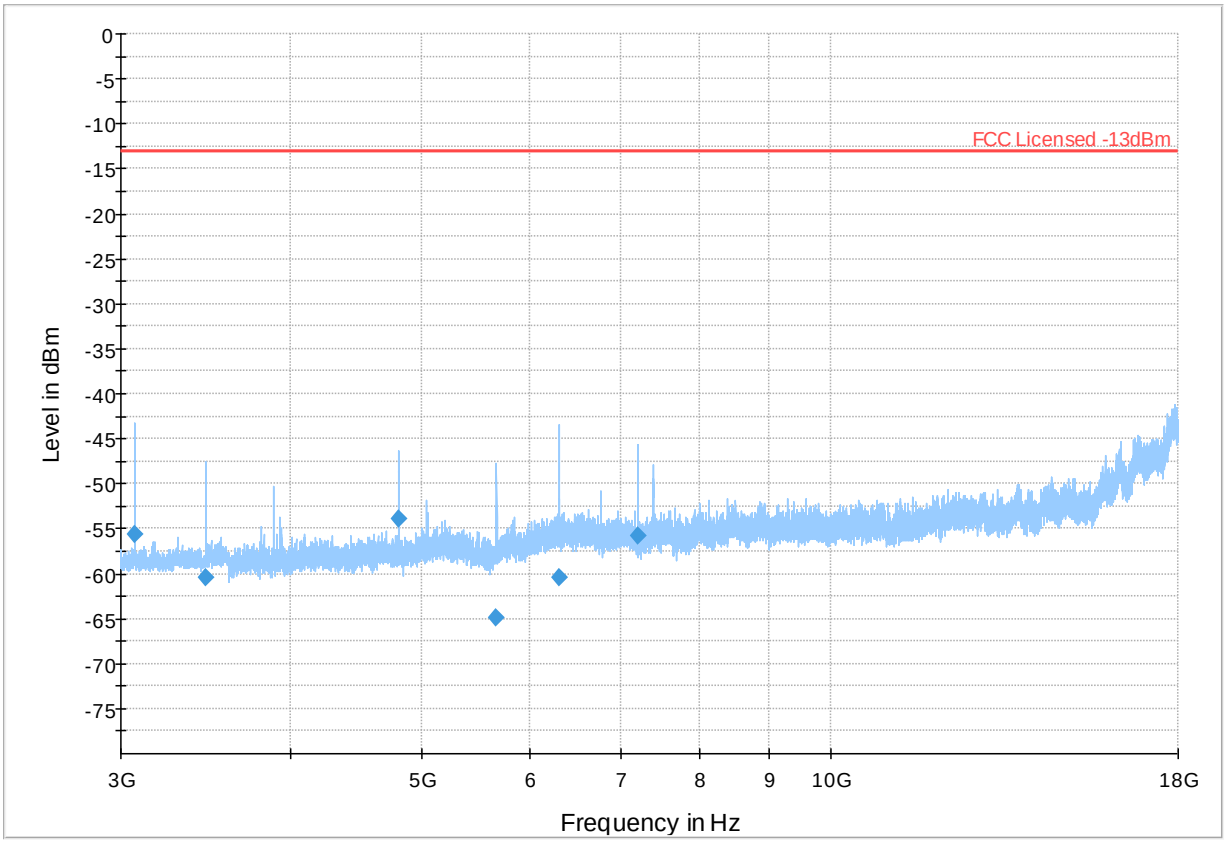
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 7 Radiated Emissions: 3 GHz – 18GHz

Channel: Mid

Final_Result

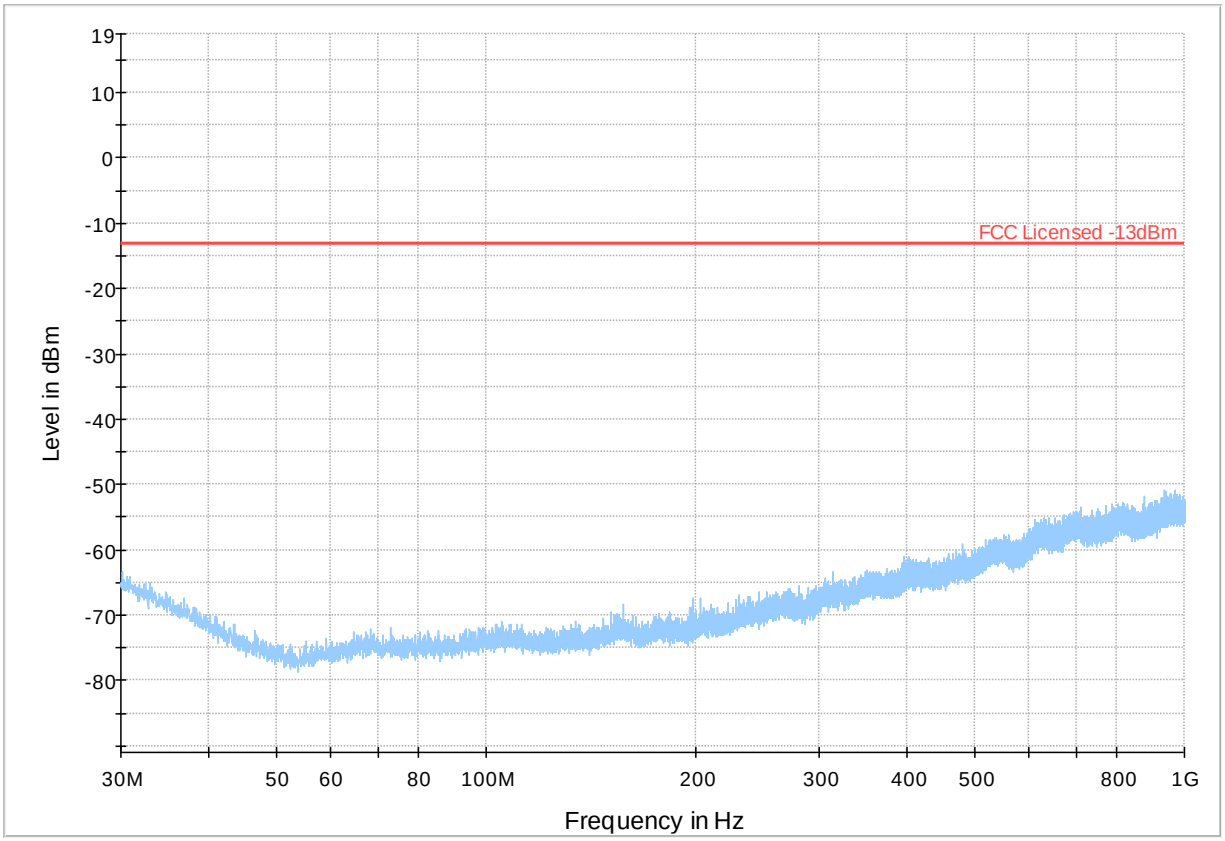
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3071.000	-55.54	-13.00	42.54	500.0	1000.000	262.0	V	221.0	-104.3	
3465.500	-60.41	-13.00	47.41	500.0	1000.000	140.0	H	159.0	-103.1	
4804.500	-53.90	-13.00	40.90	500.0	1000.000	174.0	V	37.0	-100.0	
5671.500	-64.86	-13.00	51.86	500.0	1000.000	162.0	V	66.0	-99.3	
6301.500	-60.49	-13.00	47.49	500.0	1000.000	164.0	V	215.0	-95.9	
7207.000	-55.75	-13.00	42.75	500.0	1000.000	140.0	V	287.0	-95.8	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 8 Radiated Emissions: 30 MHz - 1 GHz

Channel: High



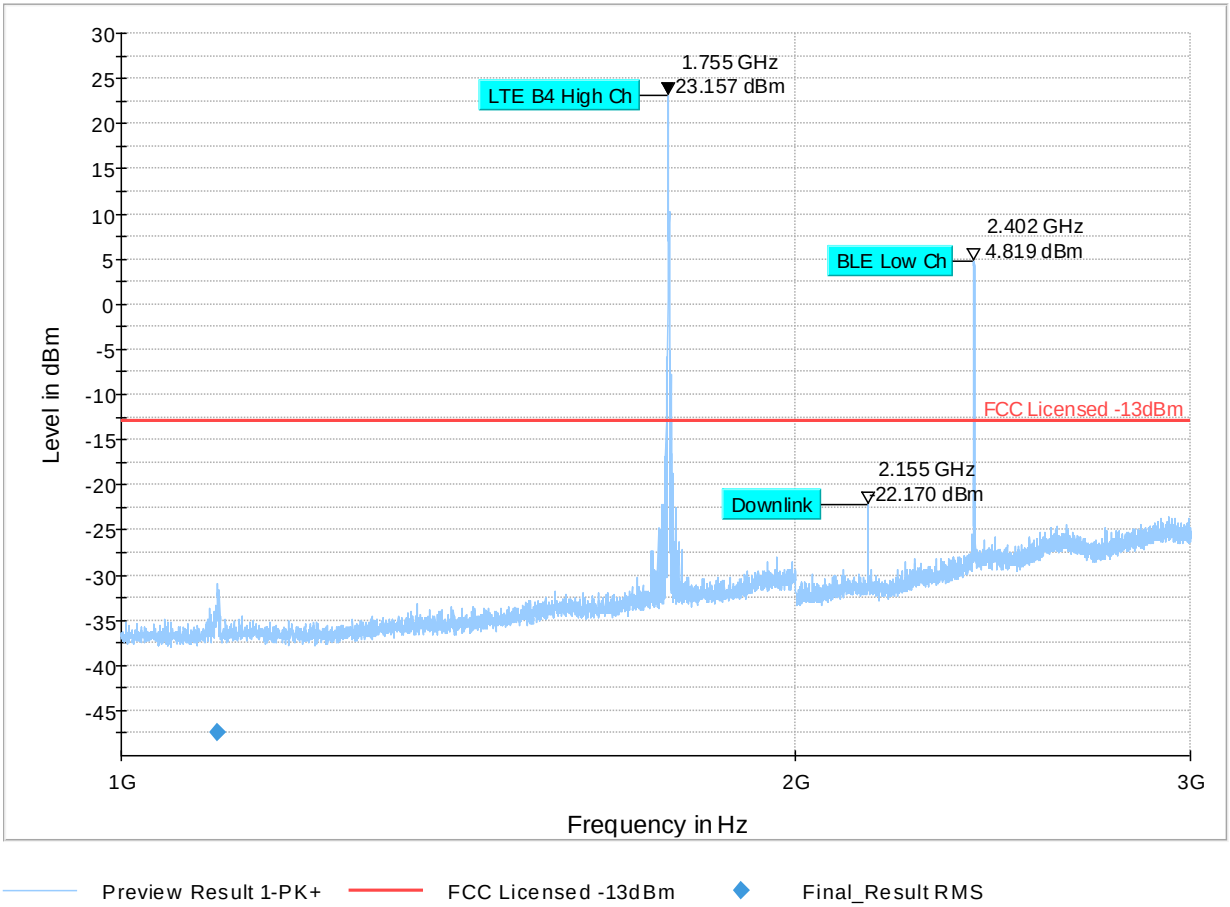
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 9 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
1104.000	-47.34	-13.00	34.34	500.0	1000.000	238.0	H	173.0	-65.3	

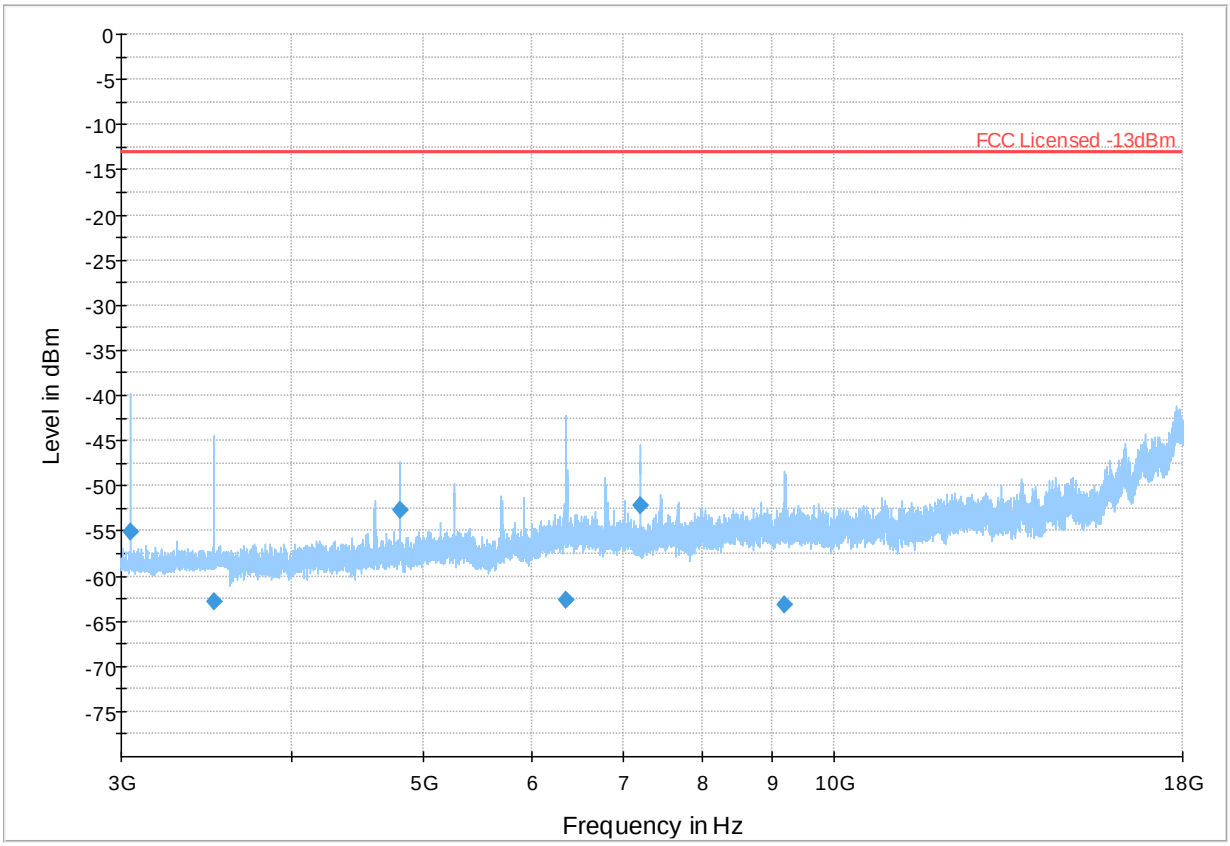


Plot # 10 Radiated Emissions: 3 GHz - 18 GHz

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
3048.500	-55.15	-13.00	42.15	500.0	1000.000	275.0	V	221.0	-104.3	
3508.500	-62.78	-13.00	49.78	500.0	1000.000	152.0	V	330.0	-102.9	
4803.500	-52.75	-13.00	39.75	500.0	1000.000	196.0	V	35.0	-100.0	
6360.500	-62.64	-13.00	49.64	500.0	1000.000	186.0	V	121.0	-95.8	
7205.500	-52.23	-13.00	39.23	500.0	1000.000	140.0	V	287.0	-95.8	
9199.500	-63.10	-13.00	50.10	500.0	1000.000	162.0	V	121.0	-93.8	

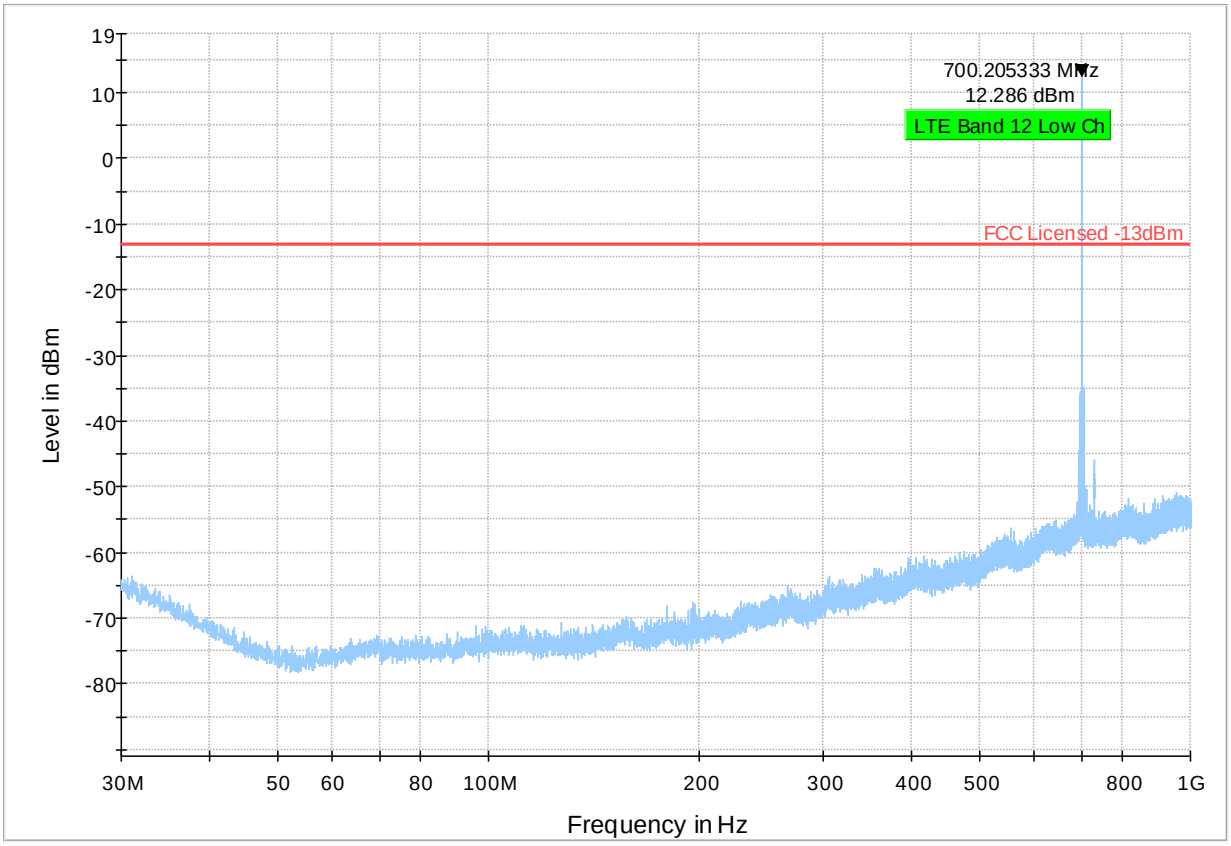


Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

LTE Band 12

Plot # 11 Radiated Emissions: 30 MHz – 1GHz

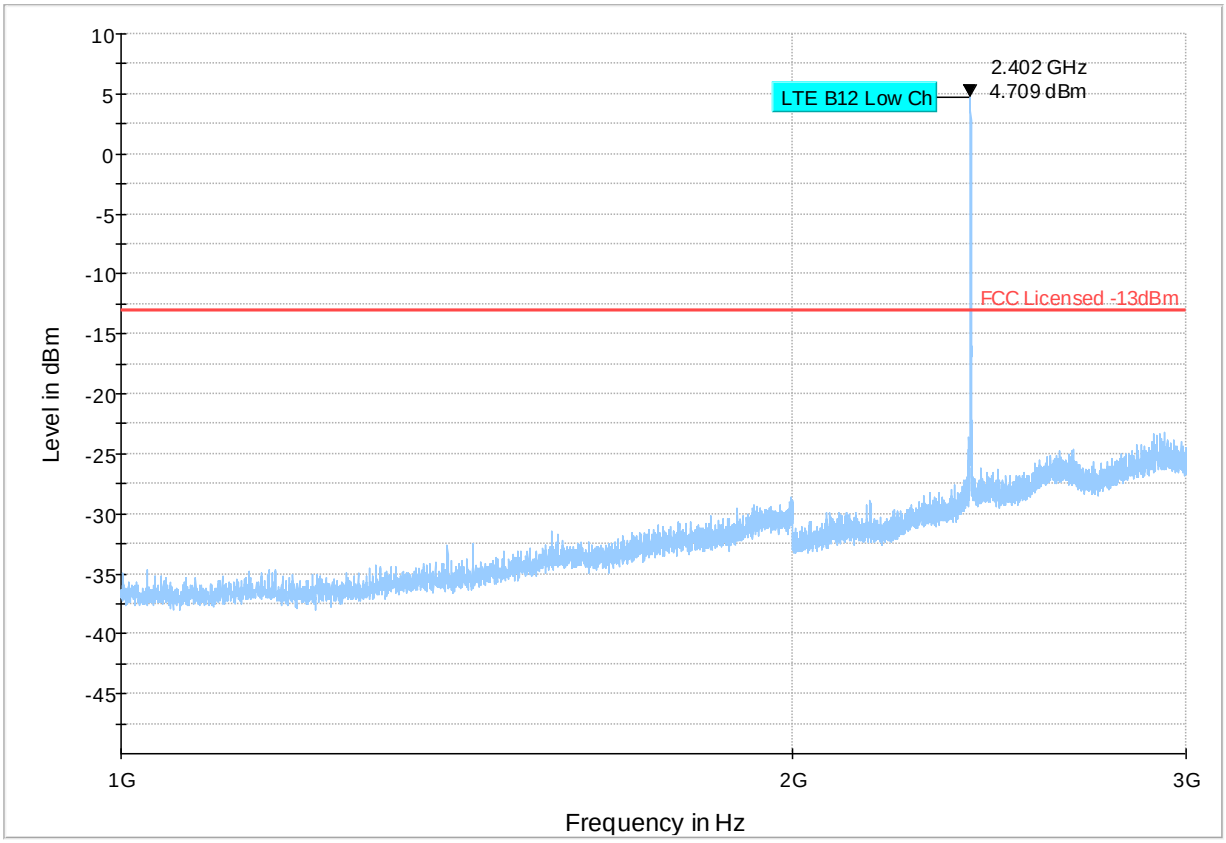
Channel: Low



Preview Result 1-PK+ * Critical_Freqs PK+ FCC Licensed -13dBm ◆ Final_Result RM

Plot # 12 Radiated Emissions: 1 GHz - 3 GHz

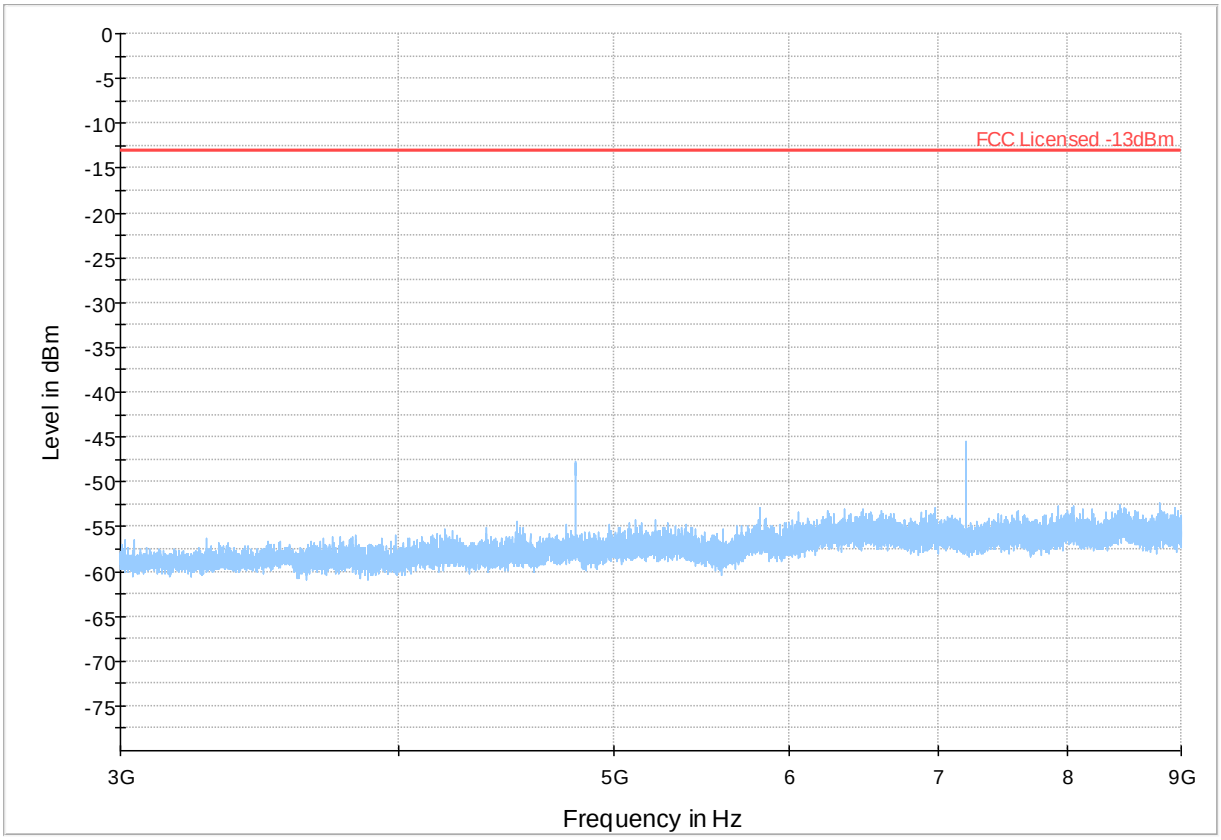
Channel: Low



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 13 Radiated Emissions: 3 GHz – 9 GHz

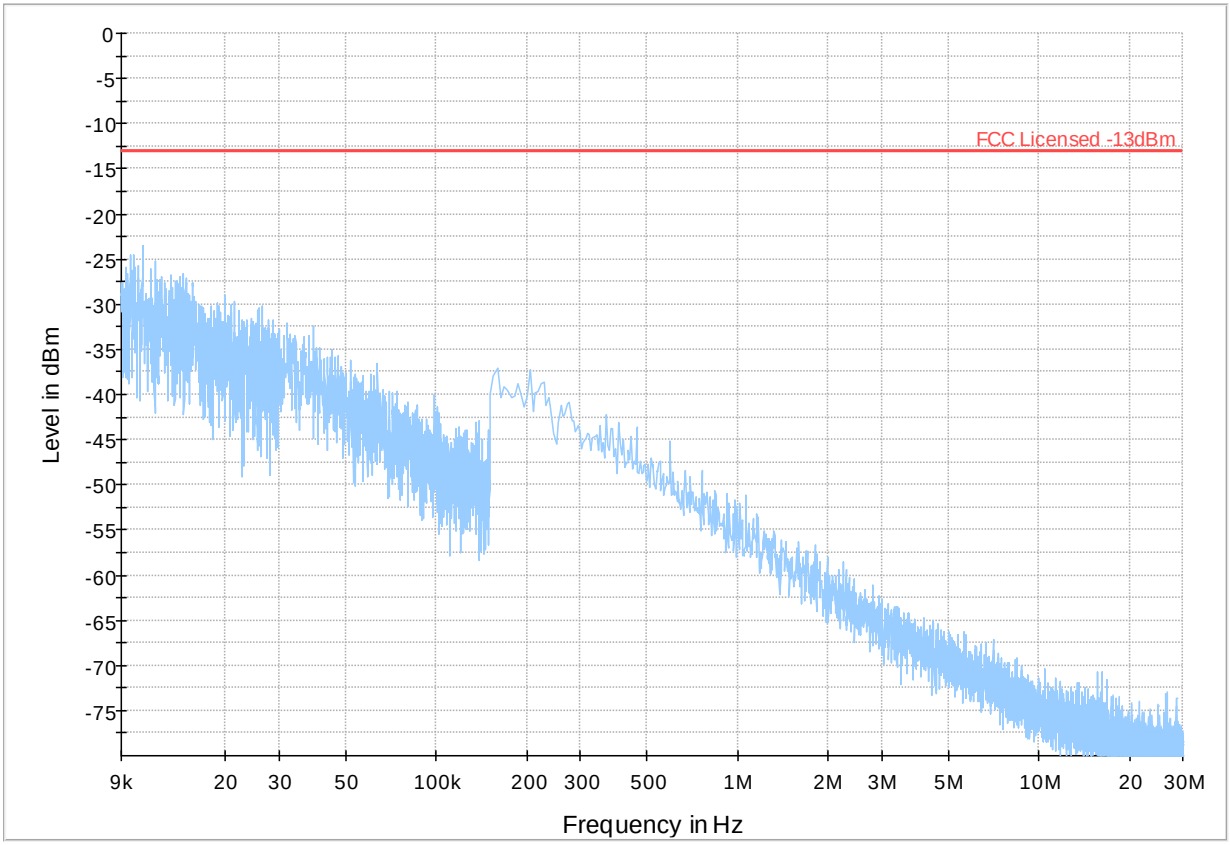
Channel: Low



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 14 Radiated Emissions: 9 kHz - 30 MHz

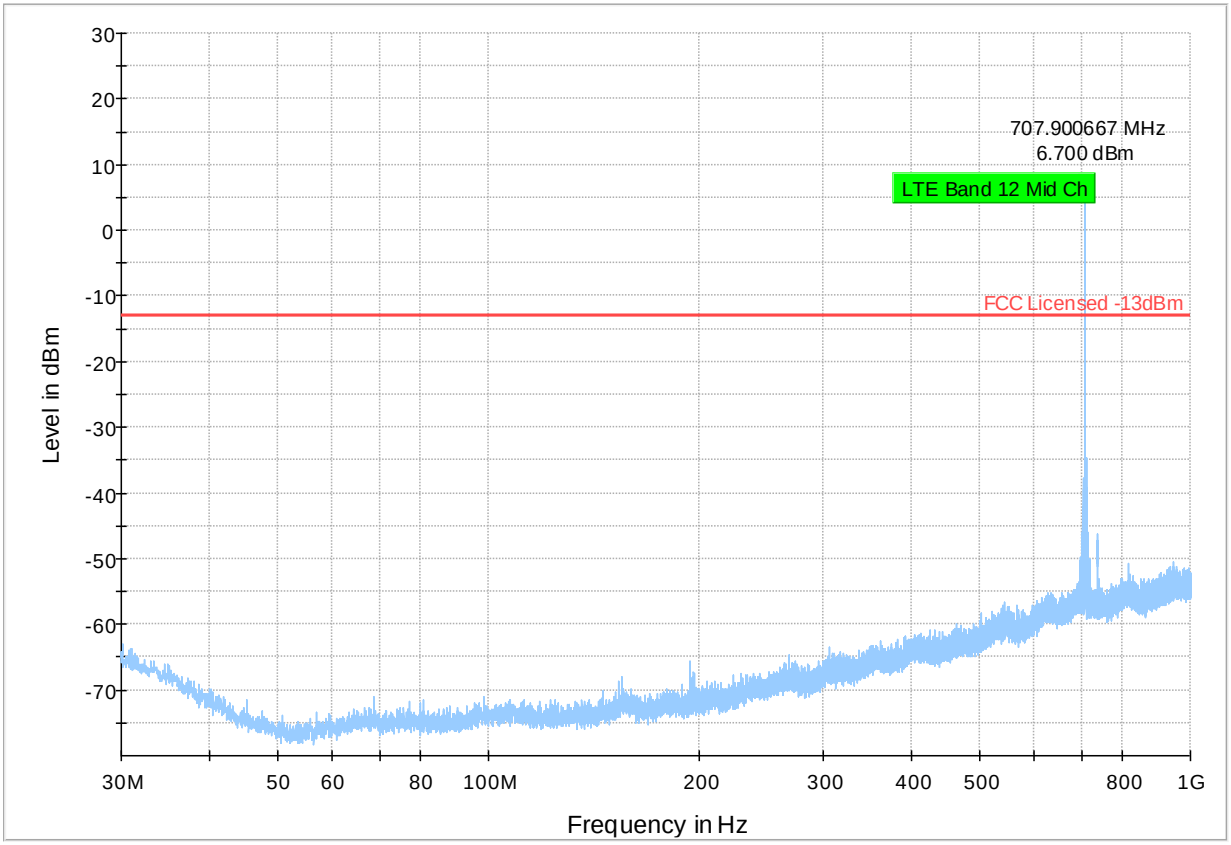
Channel: Mid



Preview Result 1-PK+ * Critical_Freqs PK+ FCC Licensed -13dBm ◆ Final_Result RM

Plot # 15 Radiated Emissions: 30 MHz – 1GHz

Channel: Mid



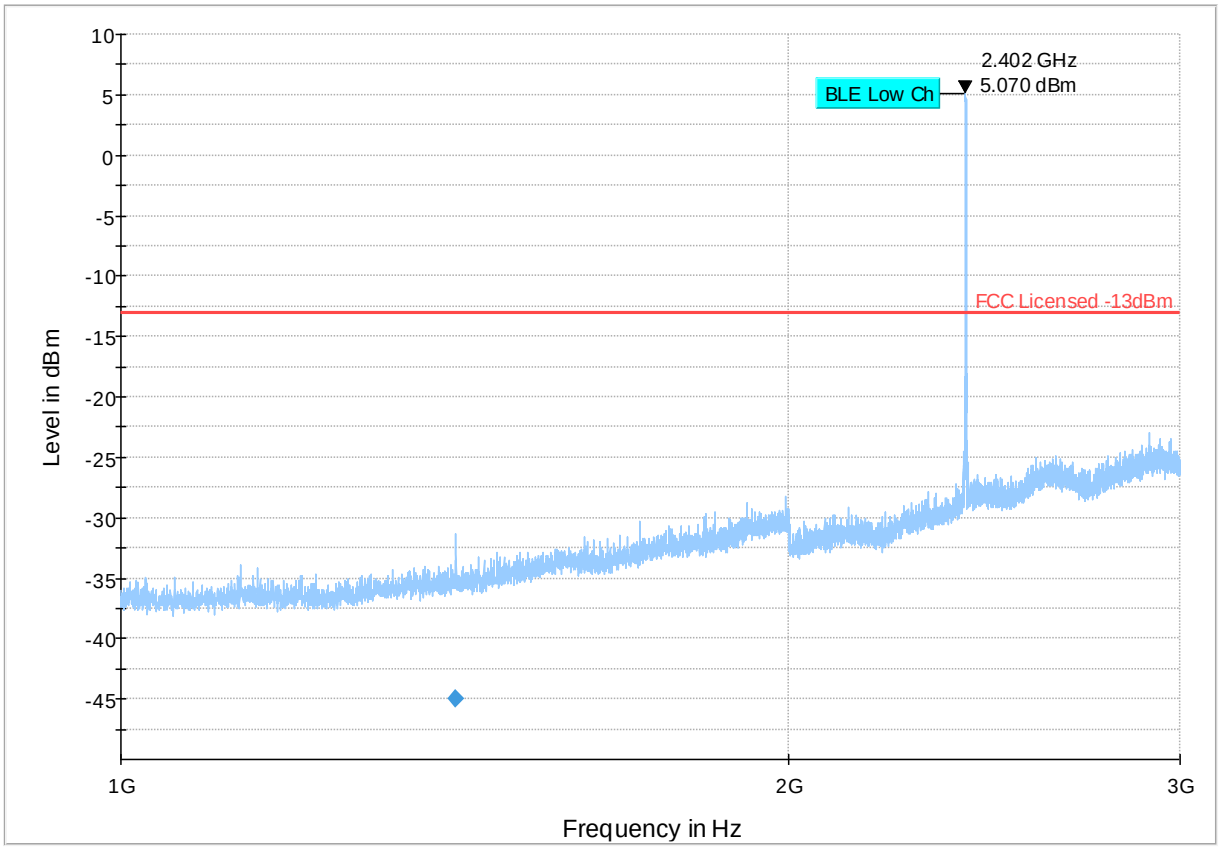
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 16 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid

Final_Result

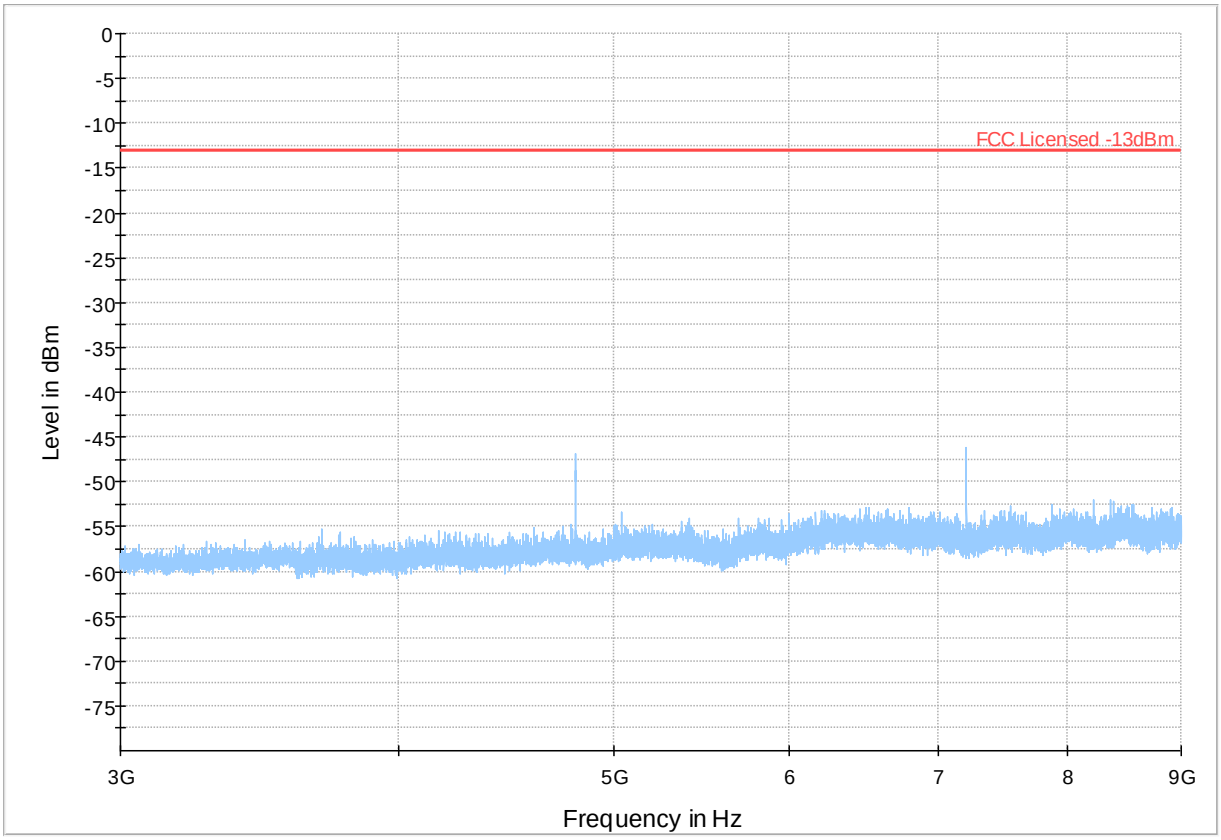
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1415.750	-44.98	-13.00	31.98	500.0	1000.000	152.0	H	69.0	-64.1	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 17 Radiated Emissions: 3 GHz – 9 GHz

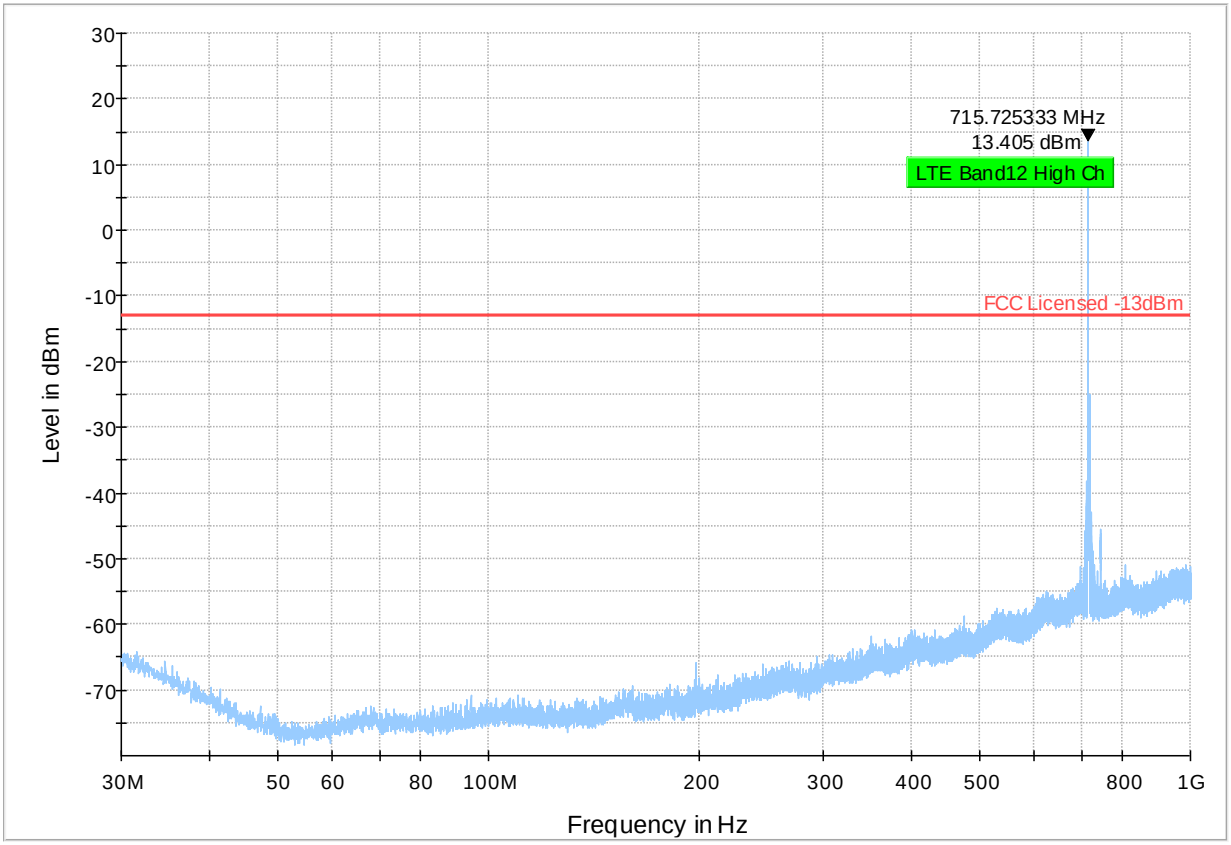
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 18 Radiated Emissions: 30 MHz – 1GHz

Channel: High



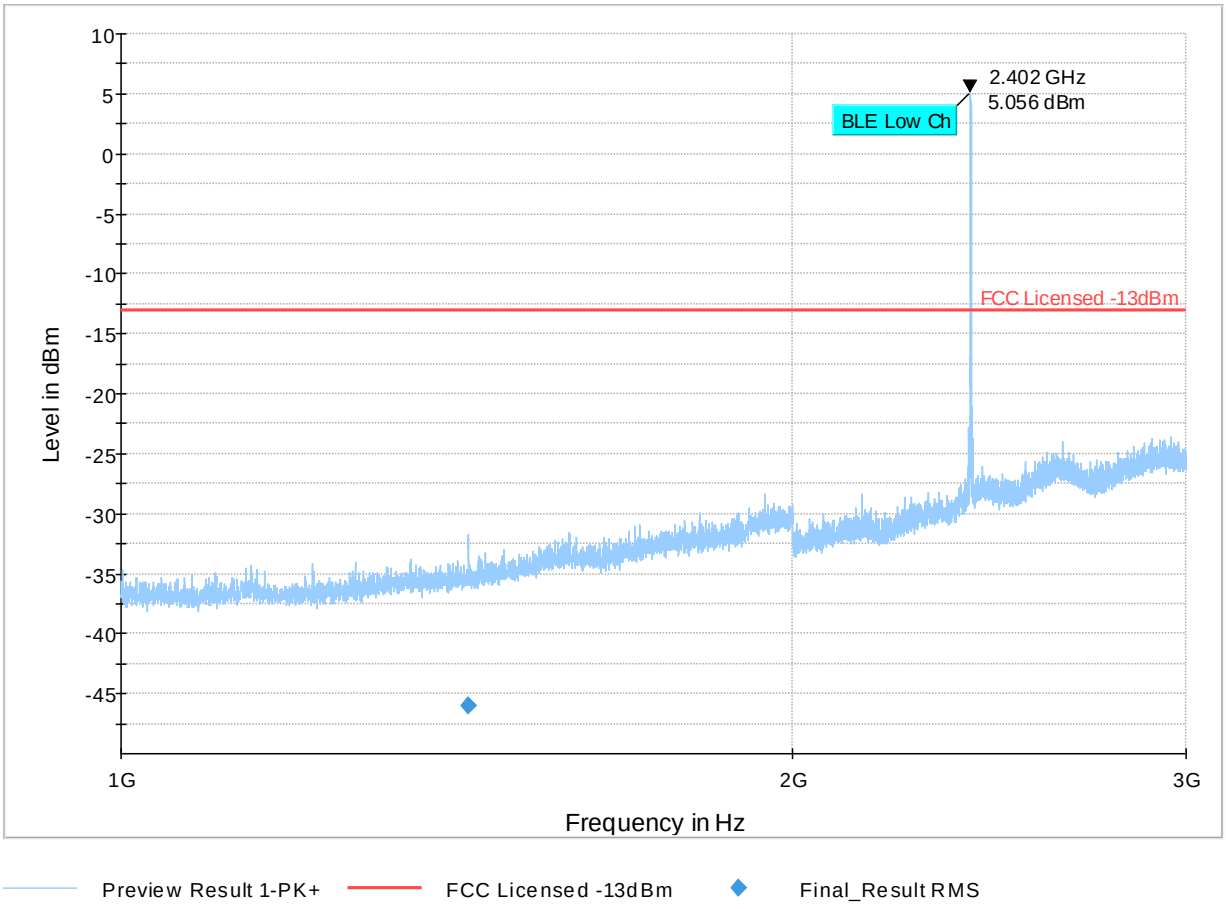
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 19 Radiated Emissions: 1 GHz - 3 GHz

Channel: High

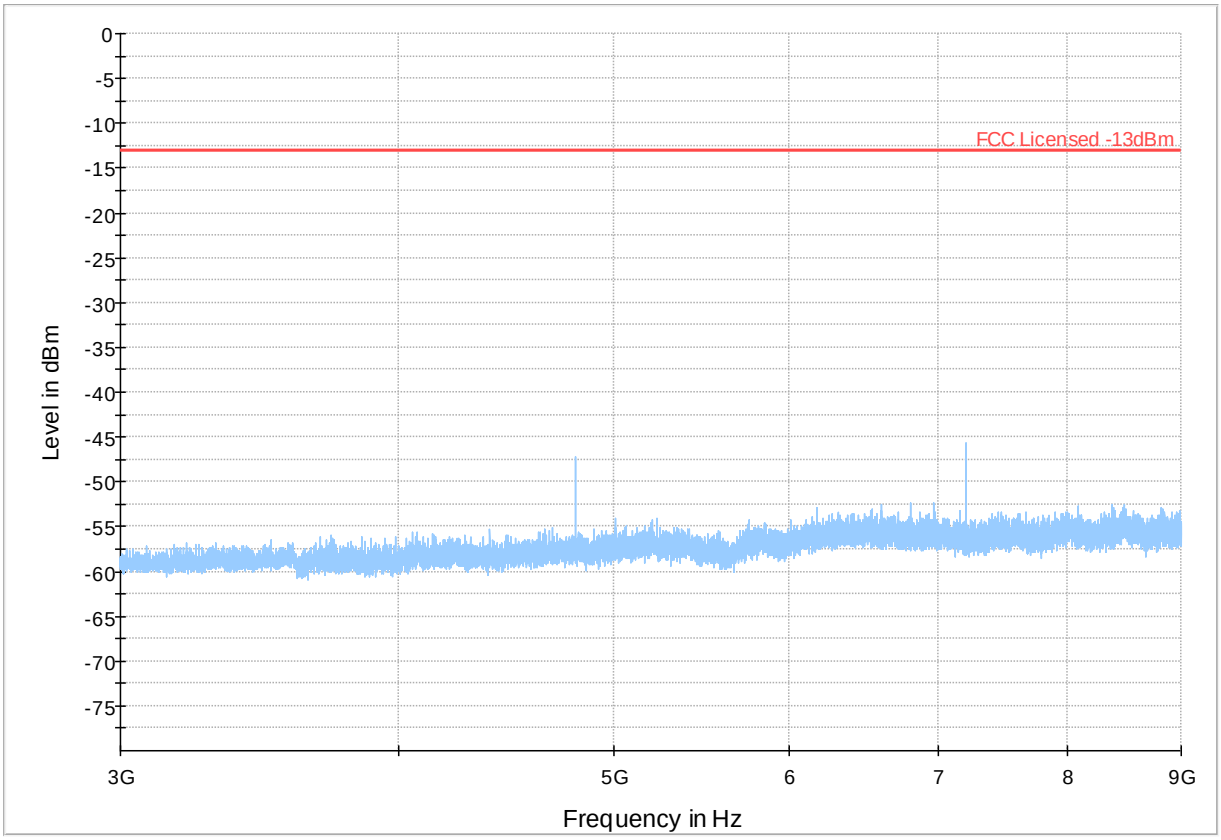
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1431.000	-46.07	-13.00	33.07	500.0	1000.000	140.0	H	64.0	-64.0	



Plot # 20 Radiated Emissions: 3 GHz – 9 GHz

Channel: High

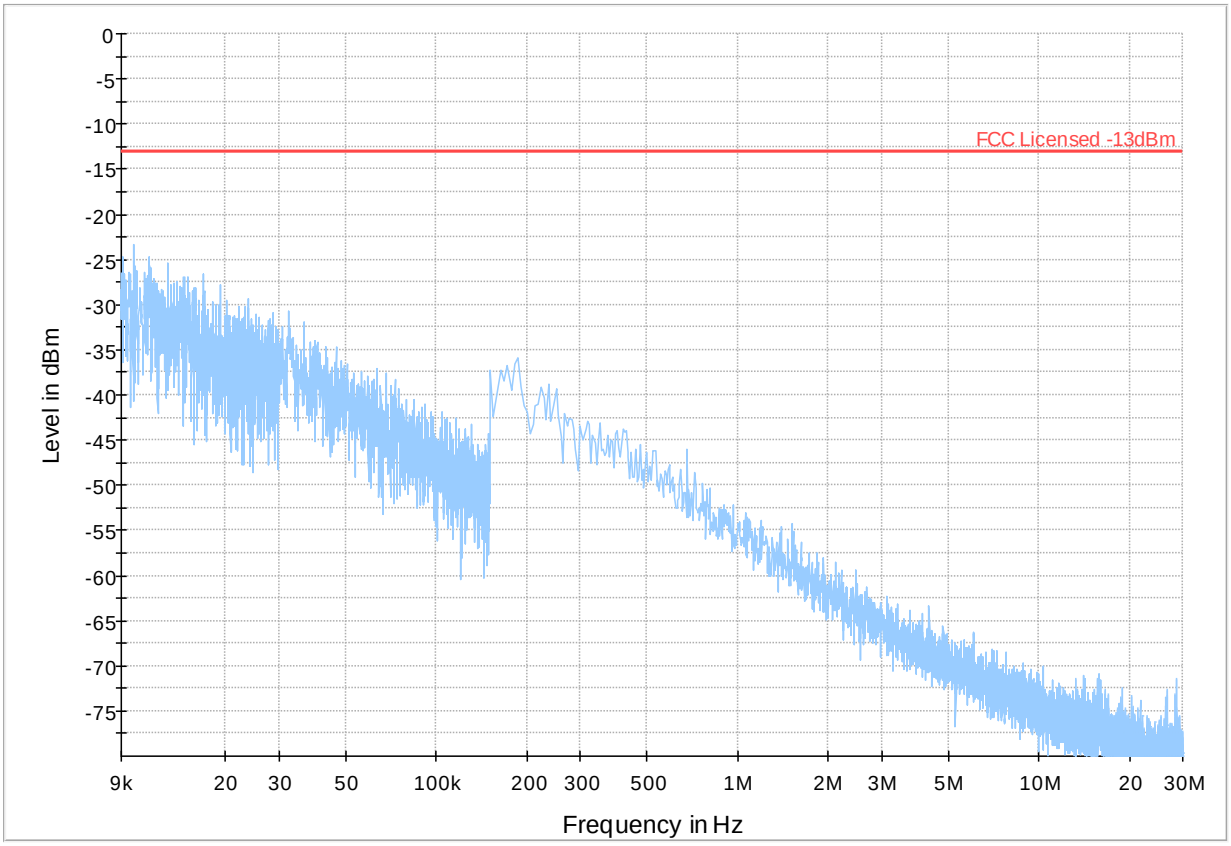


Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

LTE Band 13

Plot # 21 Radiated Emissions: 9 kHz - 30 MHz

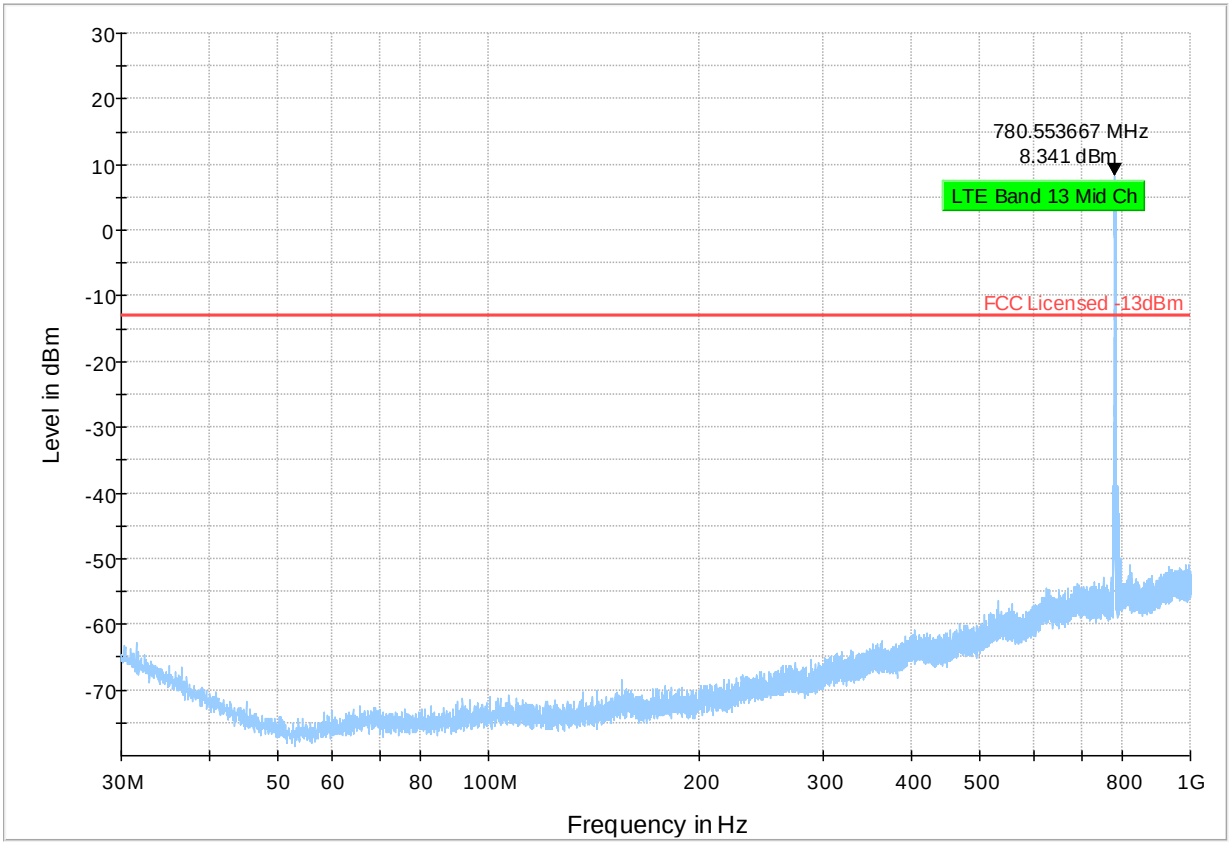
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 22 Radiated Emissions: 30 MHz – 1GHz

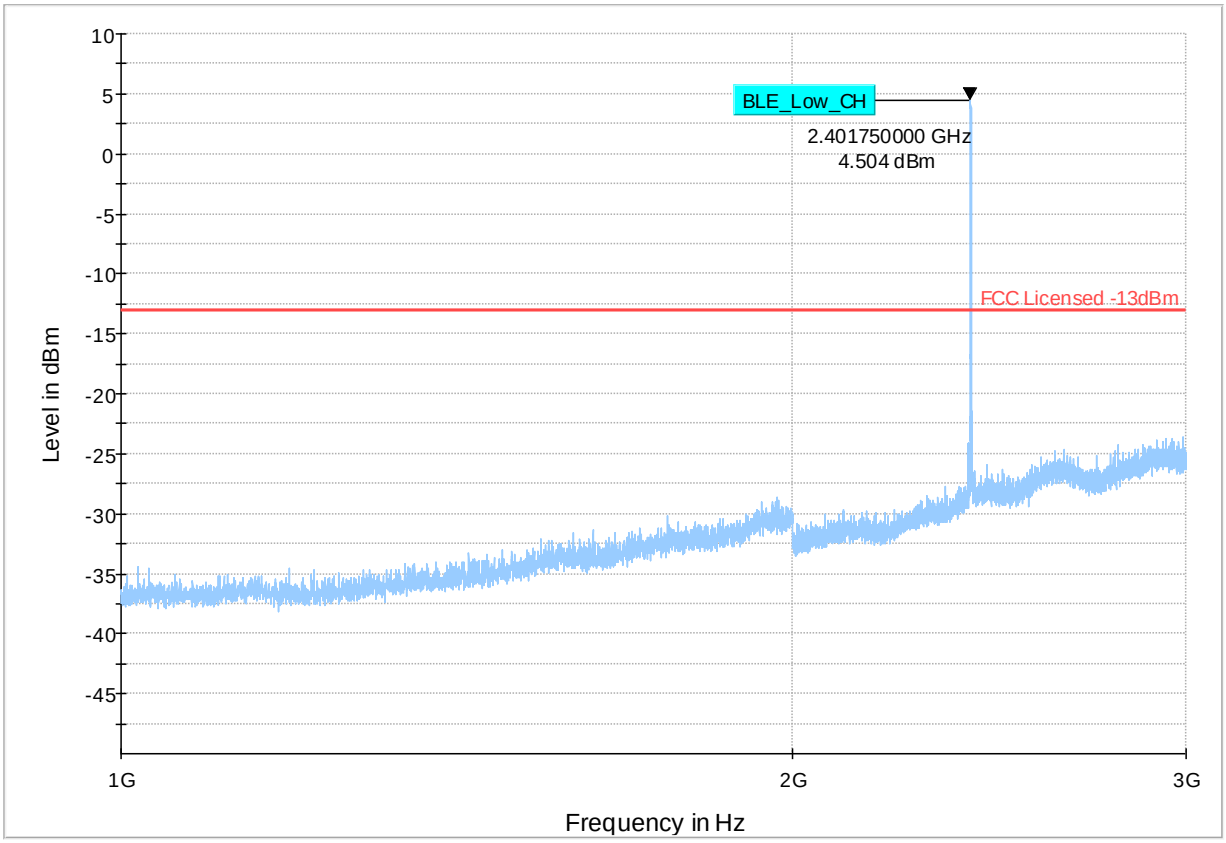
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 23 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid



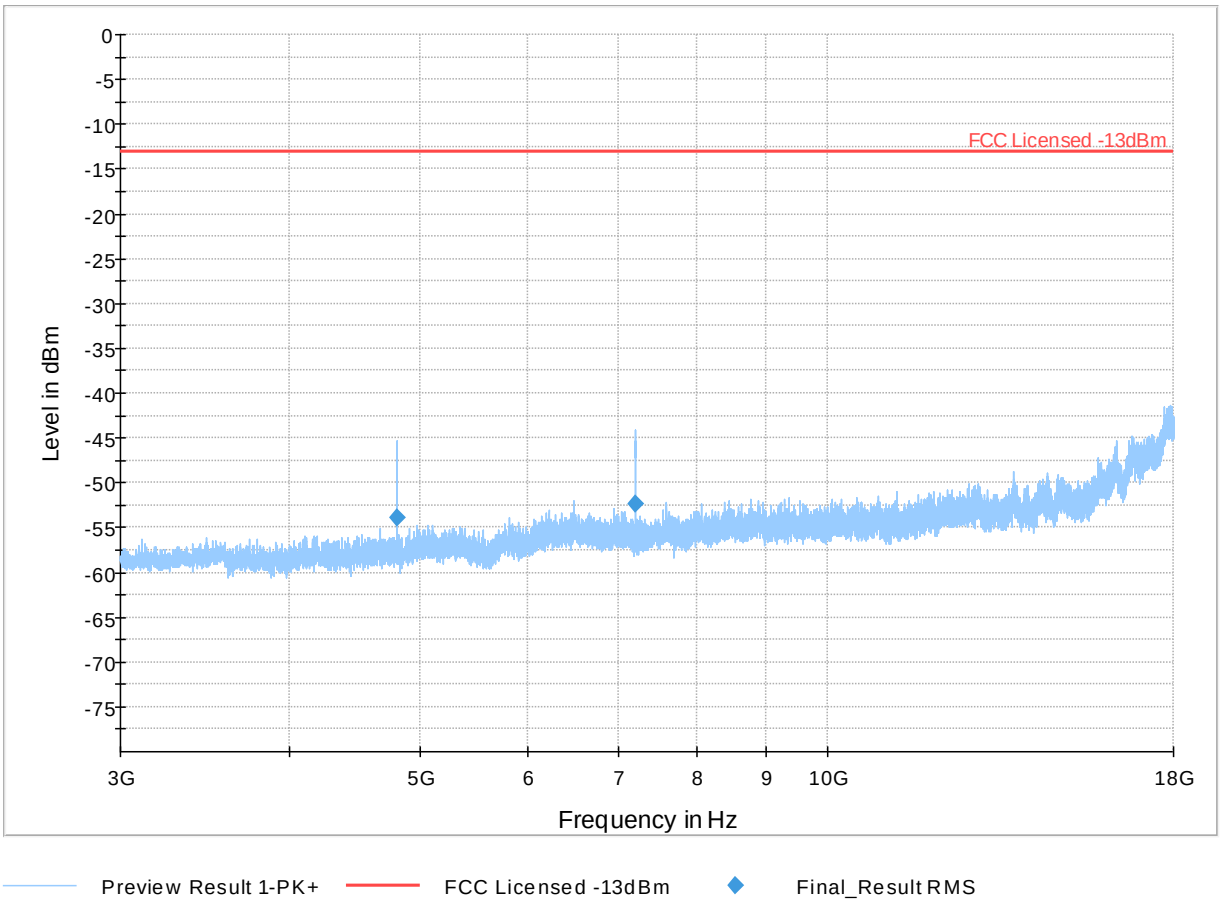
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 24 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid

Final_Result

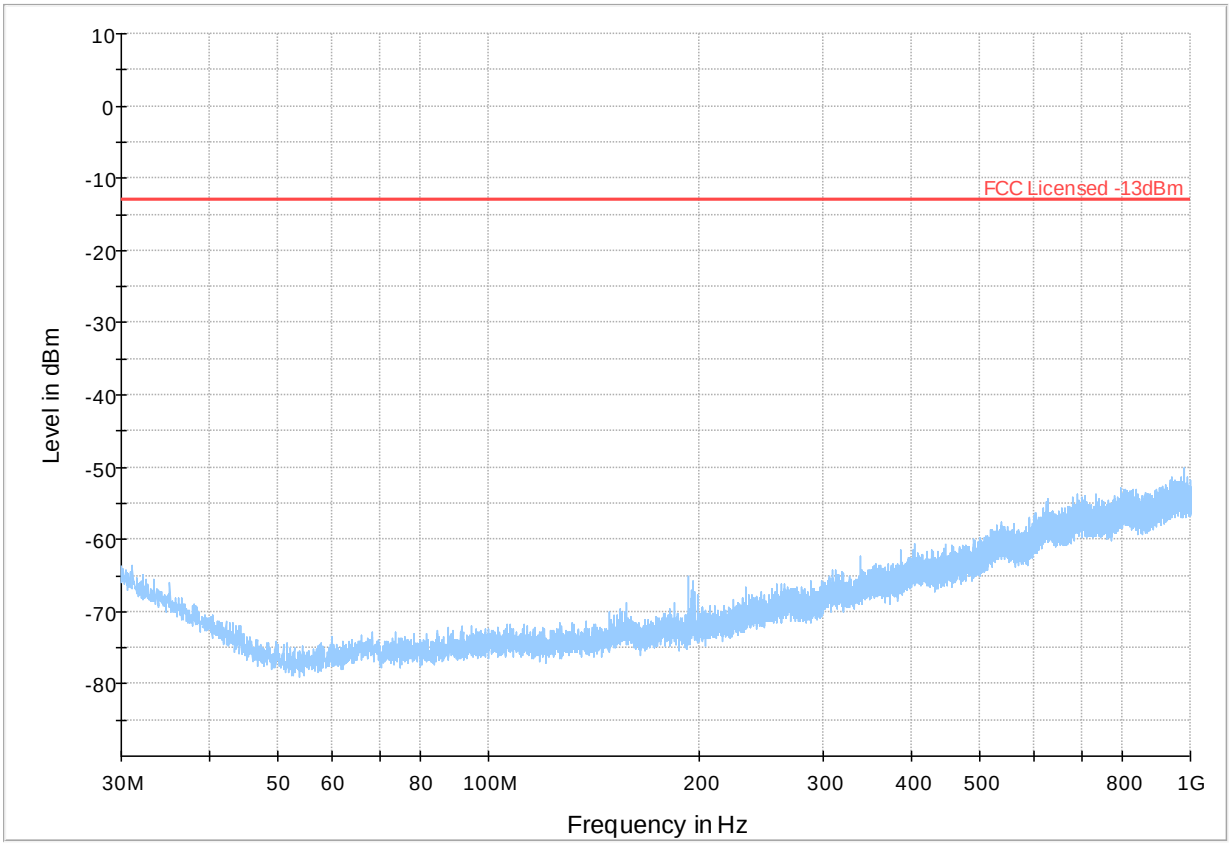
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
4804.500	-53.85	-13.00	40.85	500.0	1000.000	140.0	H	319.0	-100.0	
7205.500	-52.33	-13.00	39.33	500.0	1000.000	152.0	V	104.0	-95.8	



LTE Band 25

Plot # 25 Radiated Emissions: 30 MHz - 1 GHz

Channel: Low



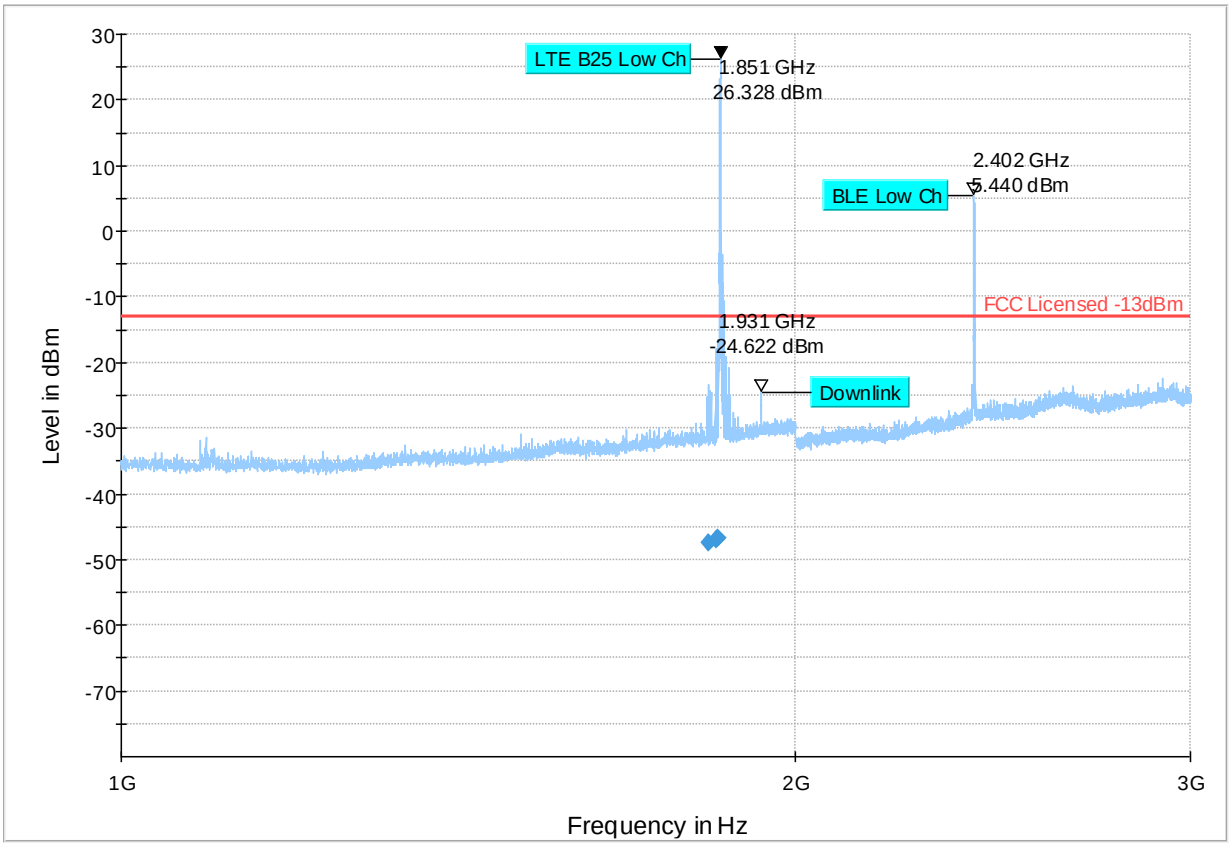
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 26 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
1828.000	-47.48	-13.00	34.48	500.0	1000.000	184.0	H	83.0	-61.4	
1842.250	-46.90	-13.00	33.90	500.0	1000.000	163.0	H	341.0	-61.3	
1845.750	-46.69	-13.00	33.69	500.0	1000.000	152.0	V	329.0	-61.3	



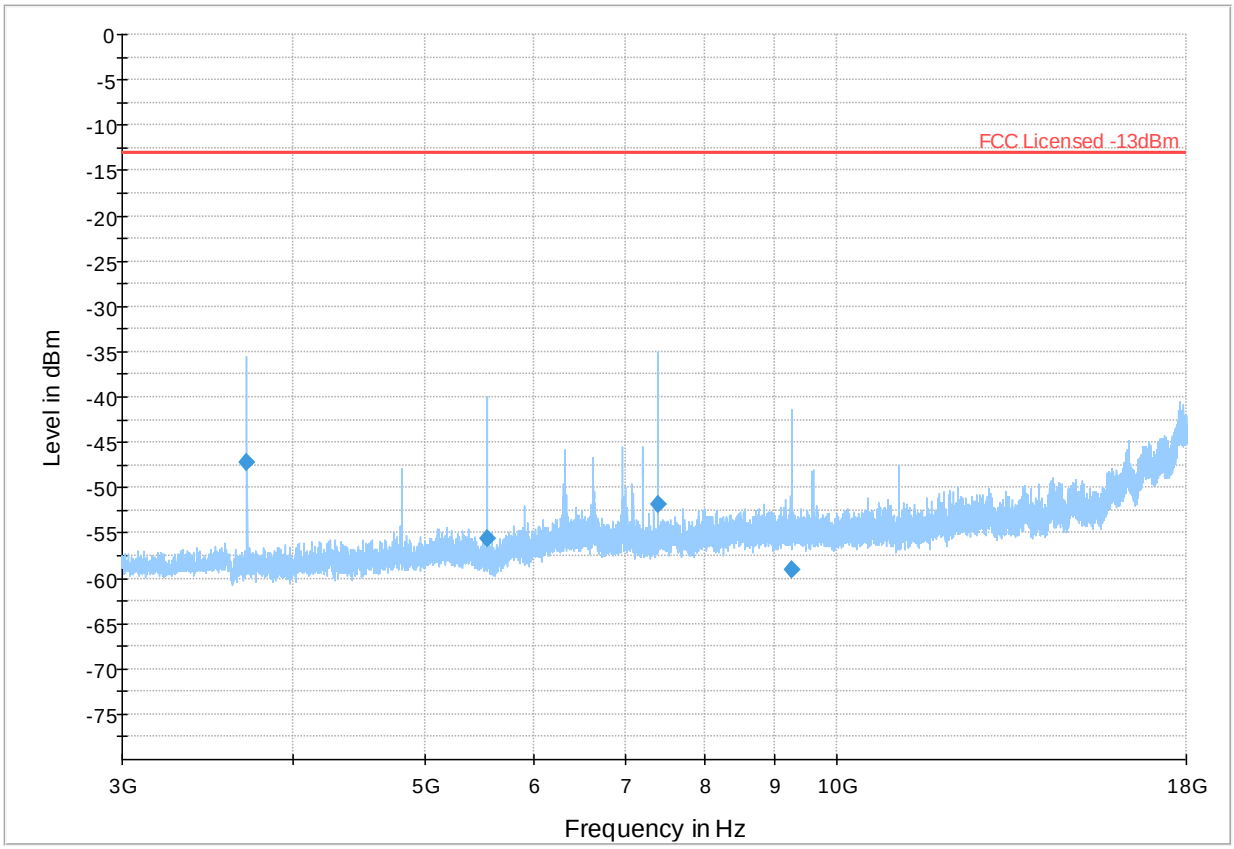
Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 27 Radiated Emissions: 3 GHz - 18 GHz

Channel: Low

Final_Result

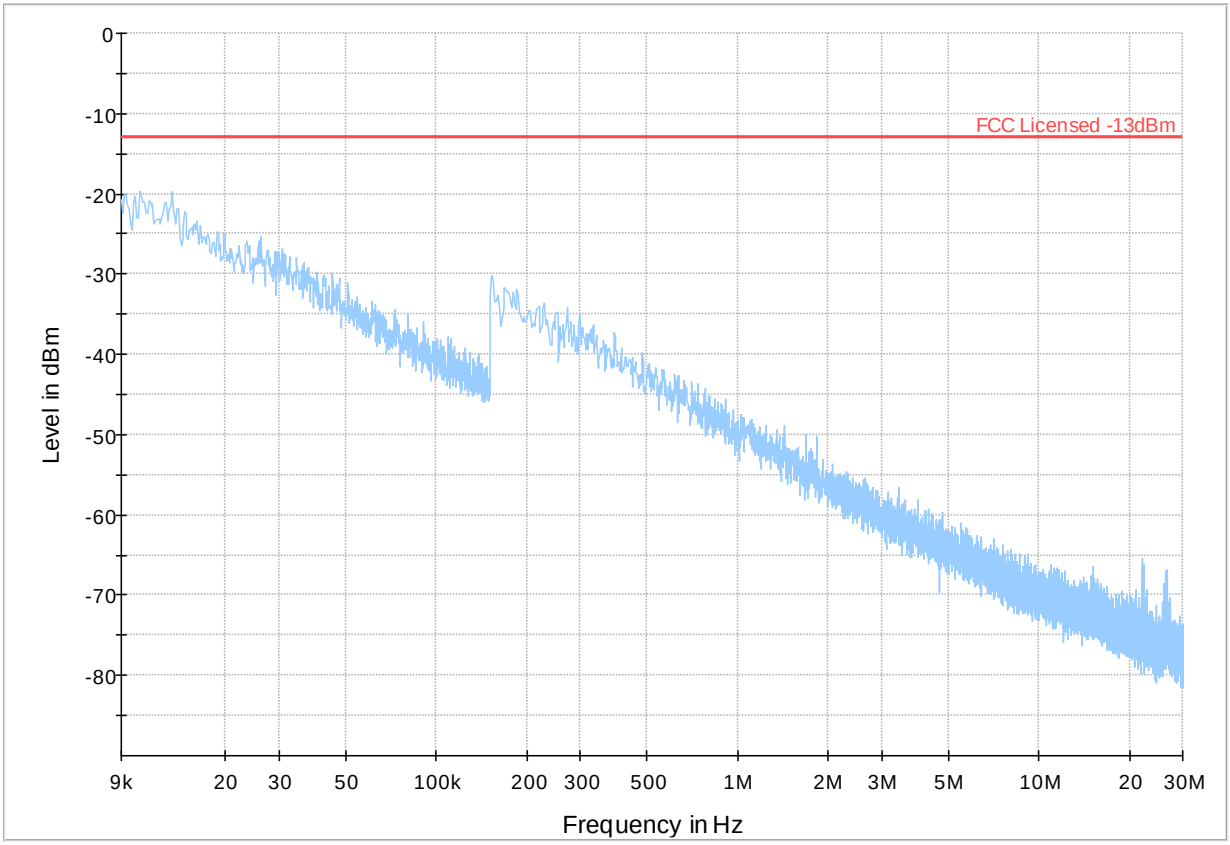
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3702.500	-47.28	-13.00	34.28	500.0	1000.000	174.0	V	212.0	-101.7	
5553.500	-55.65	-13.00	42.65	500.0	1000.000	152.0	V	217.0	-99.7	
7403.500	-51.89	-13.00	38.89	500.0	1000.000	152.0	V	135.0	-95.5	
9254.000	-59.00	-13.00	46.00	500.0	1000.000	151.0	H	209.0	-93.8	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 28 Radiated Emissions: 9 kHz - 30 MHz

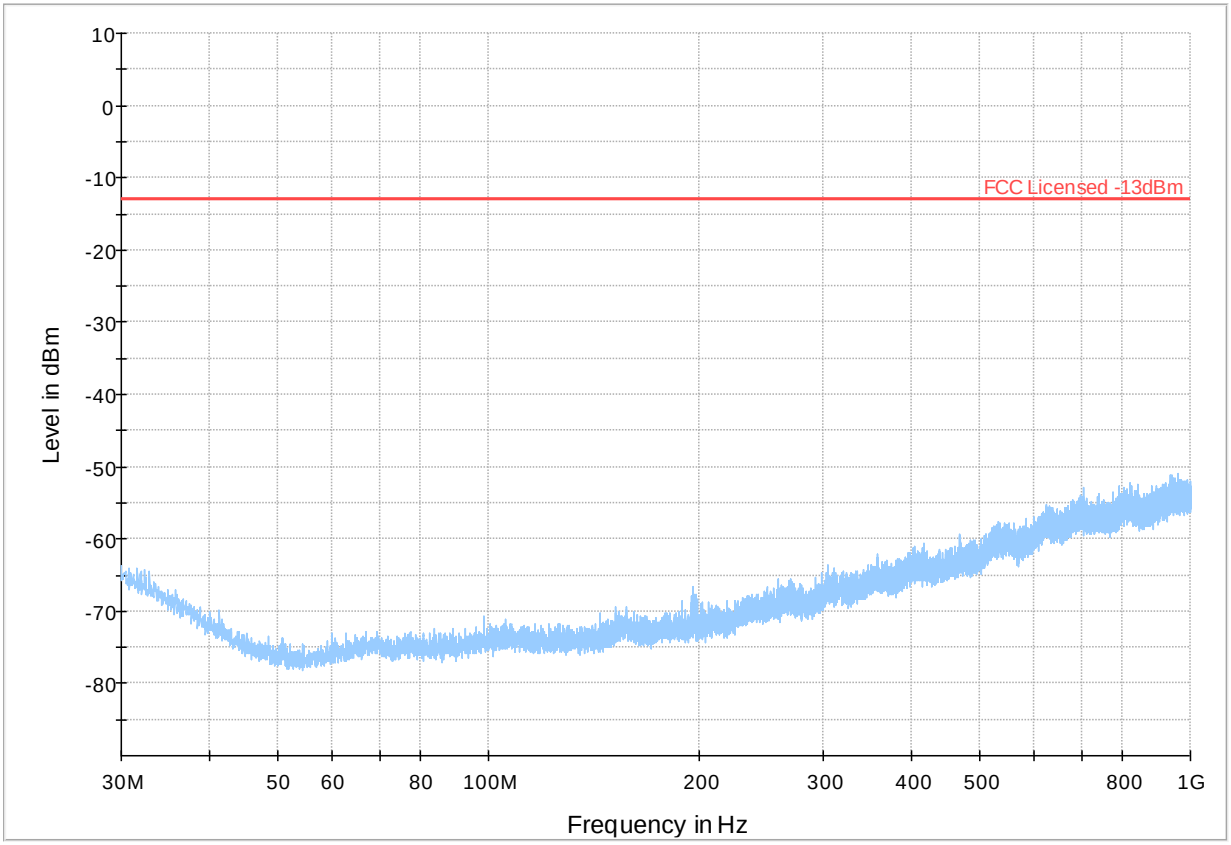
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 29 Radiated Emissions: 30 MHz – 1GHz

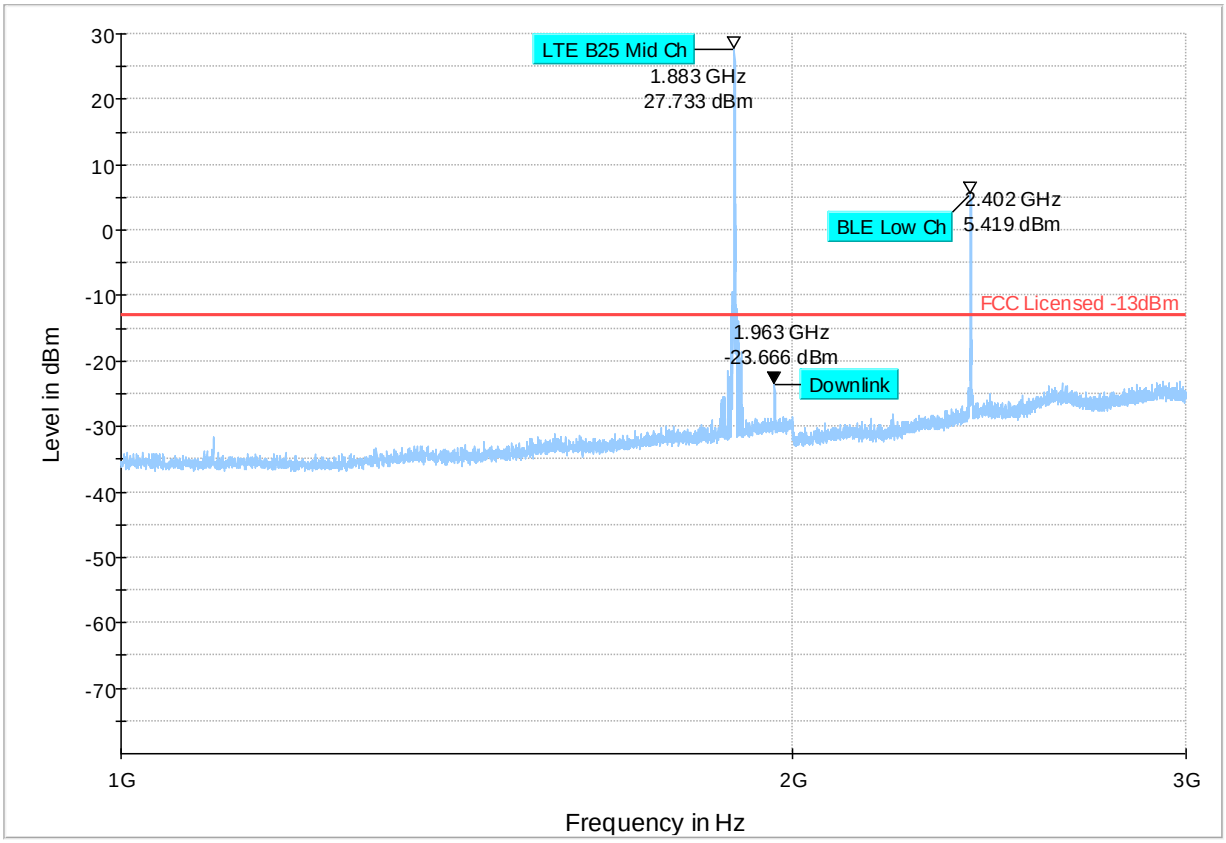
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 30 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid



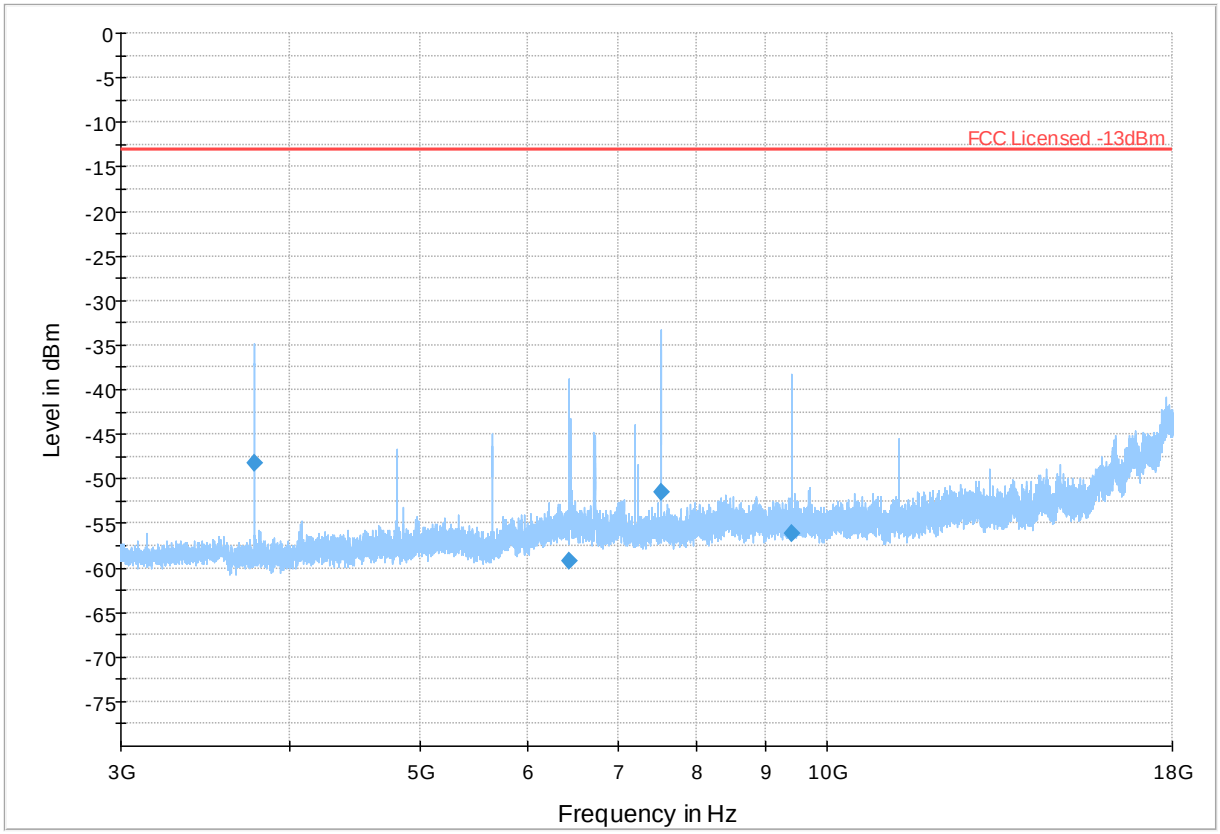
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 31 Radiated Emissions: 3 GHz – 18 GHz

Channel: Mid

Final_Result

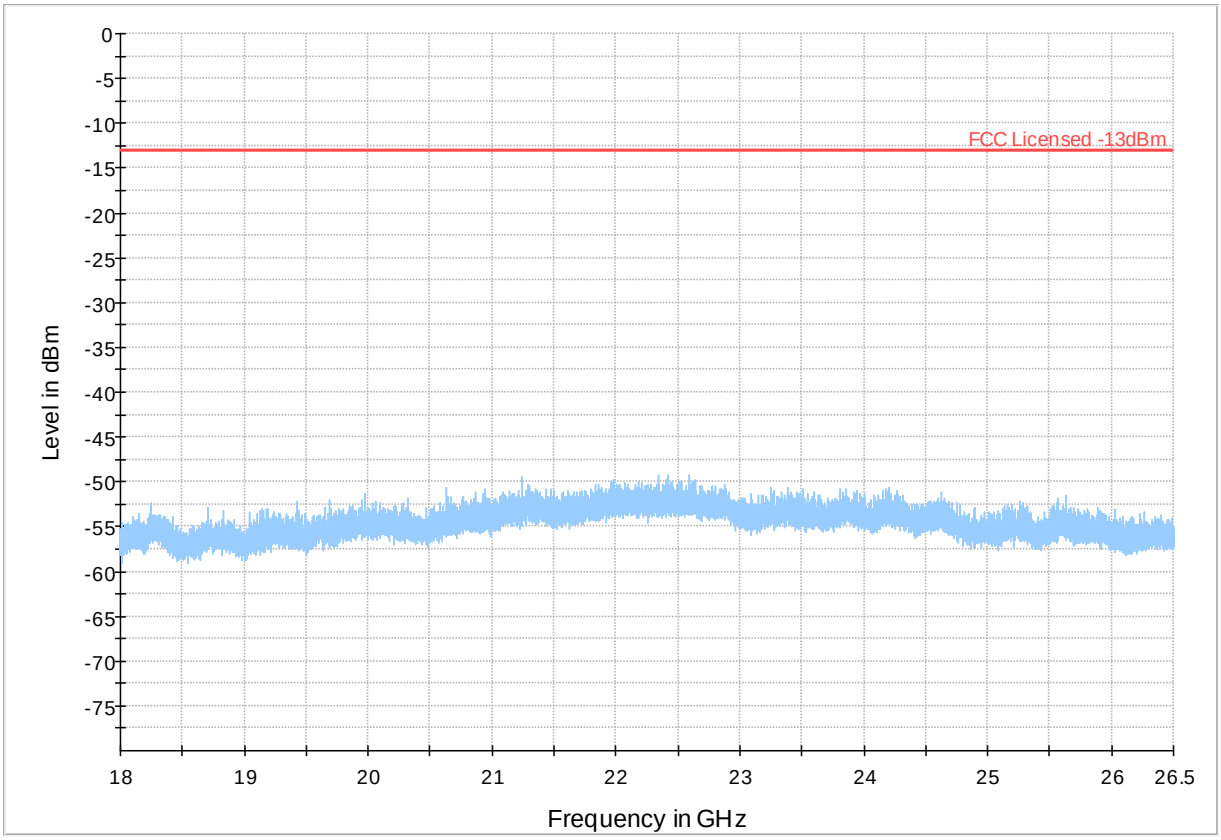
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
3765.000	-48.29	-13.00	35.29	500.0	1000.000	219.0	V	210.0	-101.8	
6444.000	-59.26	-13.00	46.26	500.0	1000.000	209.0	H	173.0	-95.8	
7532.000	-51.48	-13.00	38.48	500.0	1000.000	153.0	H	325.0	-95.2	
9412.500	-56.19	-13.00	43.19	500.0	1000.000	194.0	H	55.0	-93.4	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 32 Radiated Emissions: 18 GHz – 26.5 GHz

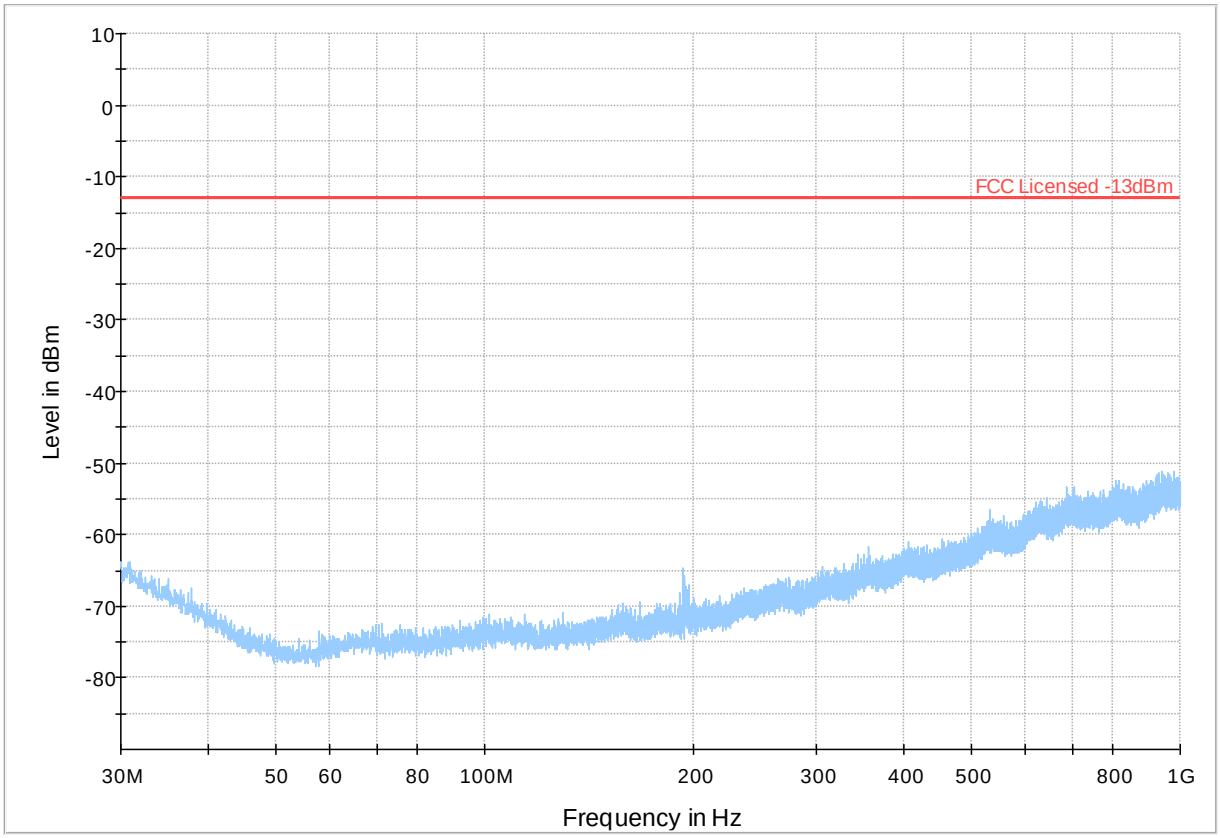
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 33 Radiated Emissions: 30 MHz - 1 GHz

Channel: High



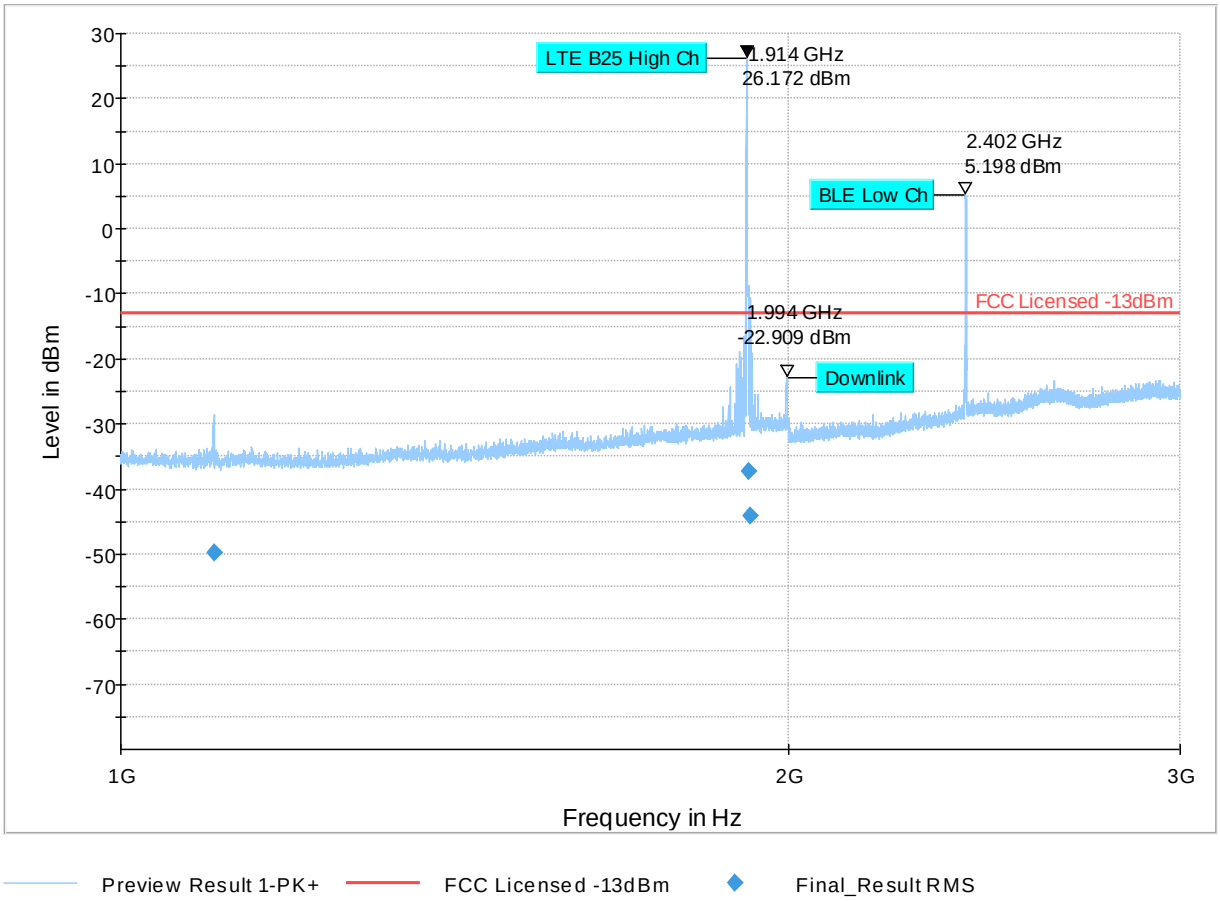
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 34 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
1101.250	-49.88	-13.00	36.88	500.0	1000.000	217.0	H	78.0	-64.4	
1917.500	-37.28	-13.00	24.28	500.0	1000.000	268.0	H	34.0	-61.0	
1920.250	-44.19	-13.00	31.19	500.0	1000.000	152.0	H	336.0	-61.0	

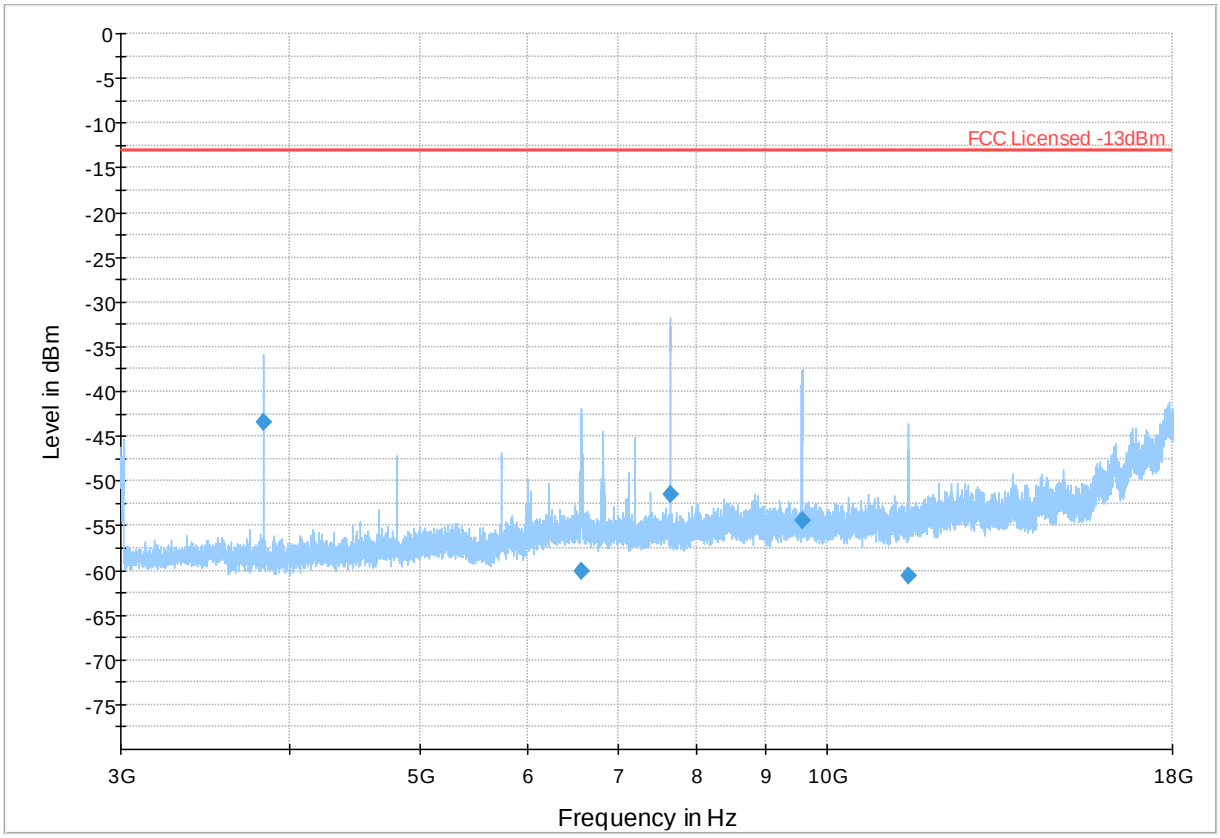


Plot # 35 Radiated Emissions: 3 GHz - 18 GHz

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
3829.500	-43.50	-13.00	30.50	500.0	1000.000	231.0	V	211.0	-101.7	
6575.500	-60.17	-13.00	47.17	500.0	1000.000	175.0	H	172.0	-95.7	
7657.000	-51.58	-13.00	38.58	500.0	1000.000	282.0	V	254.0	-95.7	
9571.000	-54.39	-13.00	41.39	500.0	1000.000	140.0	V	121.0	-93.5	
11489.000	-60.56	-13.00	47.56	500.0	1000.000	140.0	V	148.0	-93.8	

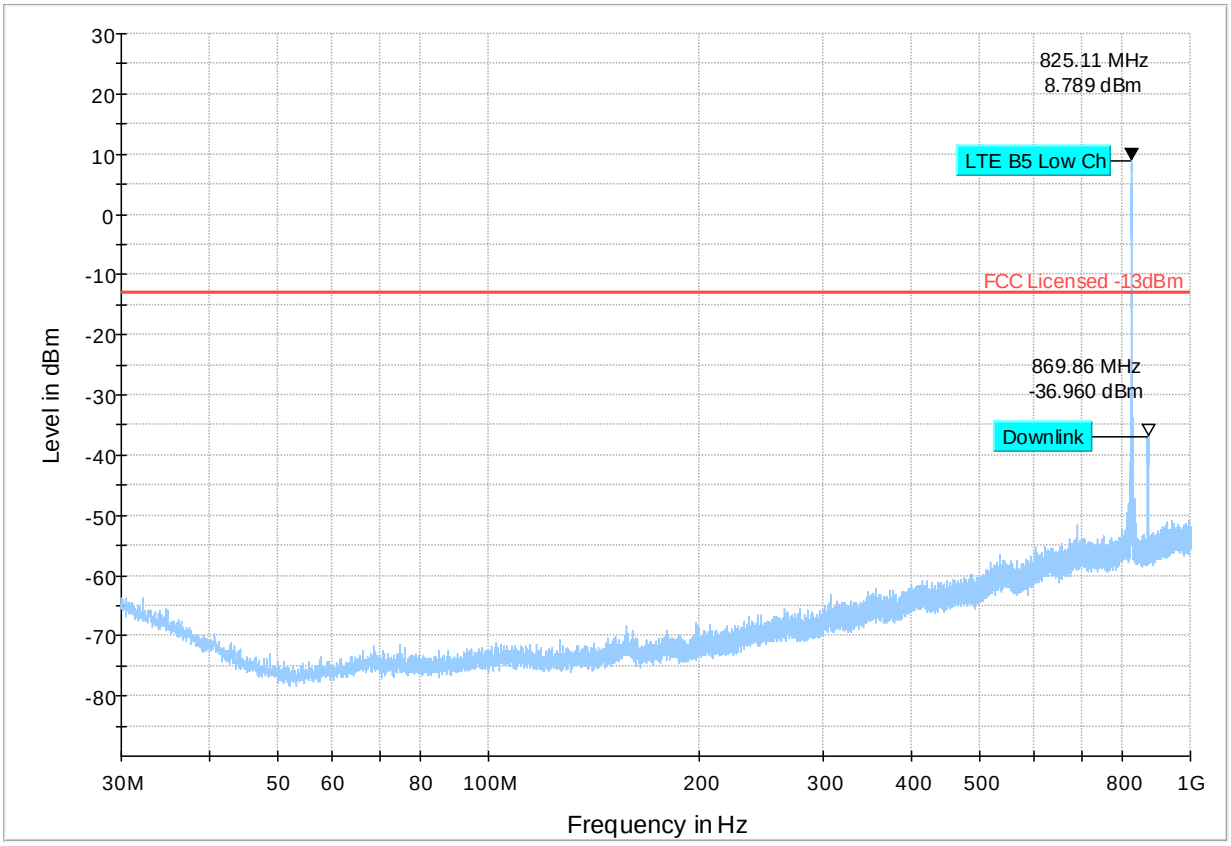


Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

LTE Band 26

Plot # 36 Radiated Emissions: 30 MHz – 1GHz

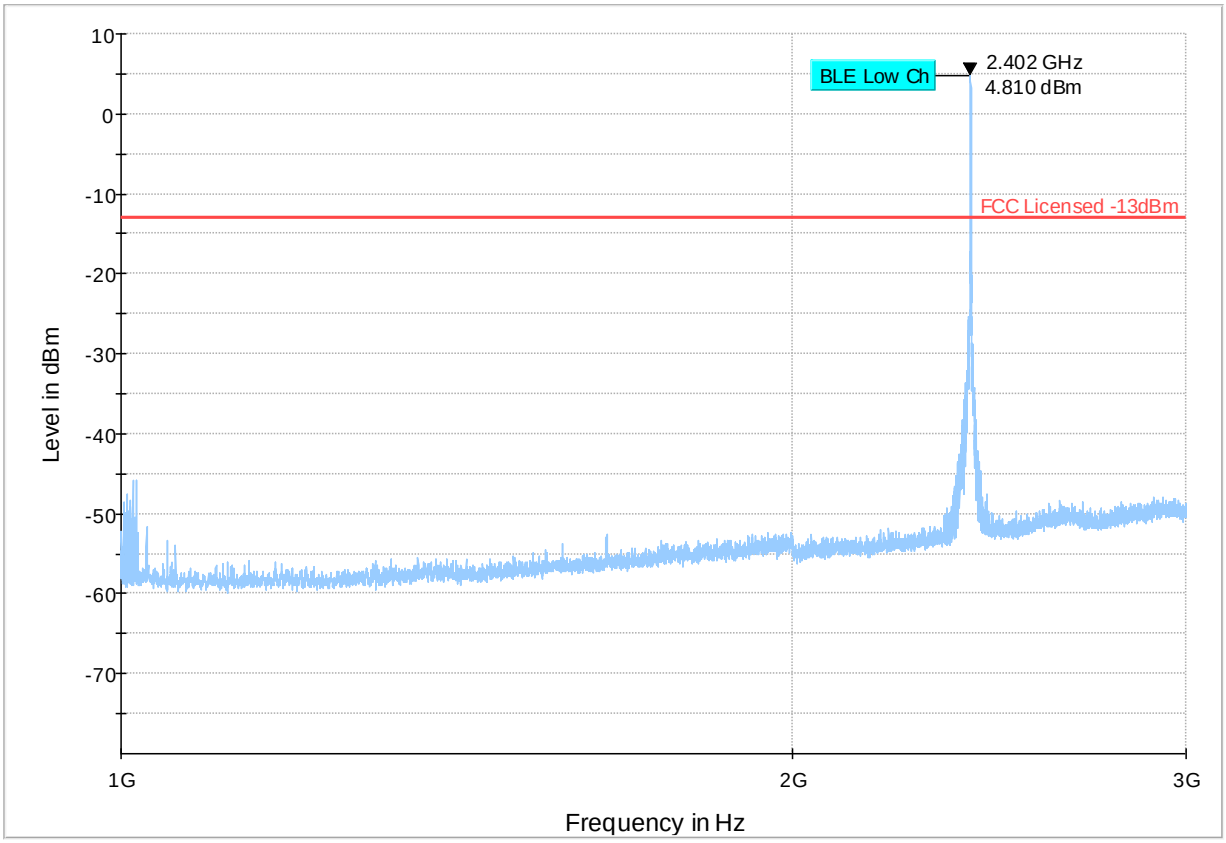
Channel: Low



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 37 Radiated Emissions: 1 GHz - 3 GHz

Channel: Low



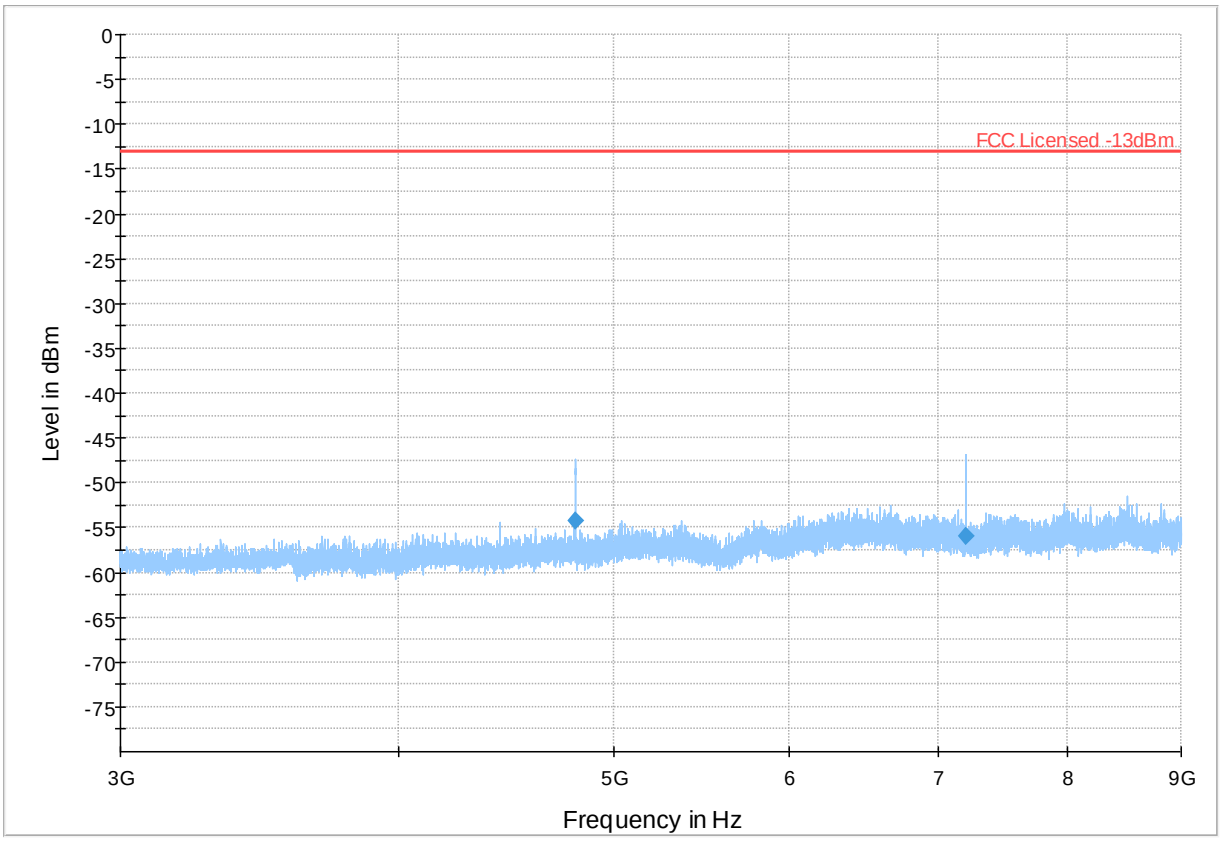
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 38 Radiated Emissions: 3 GHz – 9 GHz

Channel: Low

Final_Result

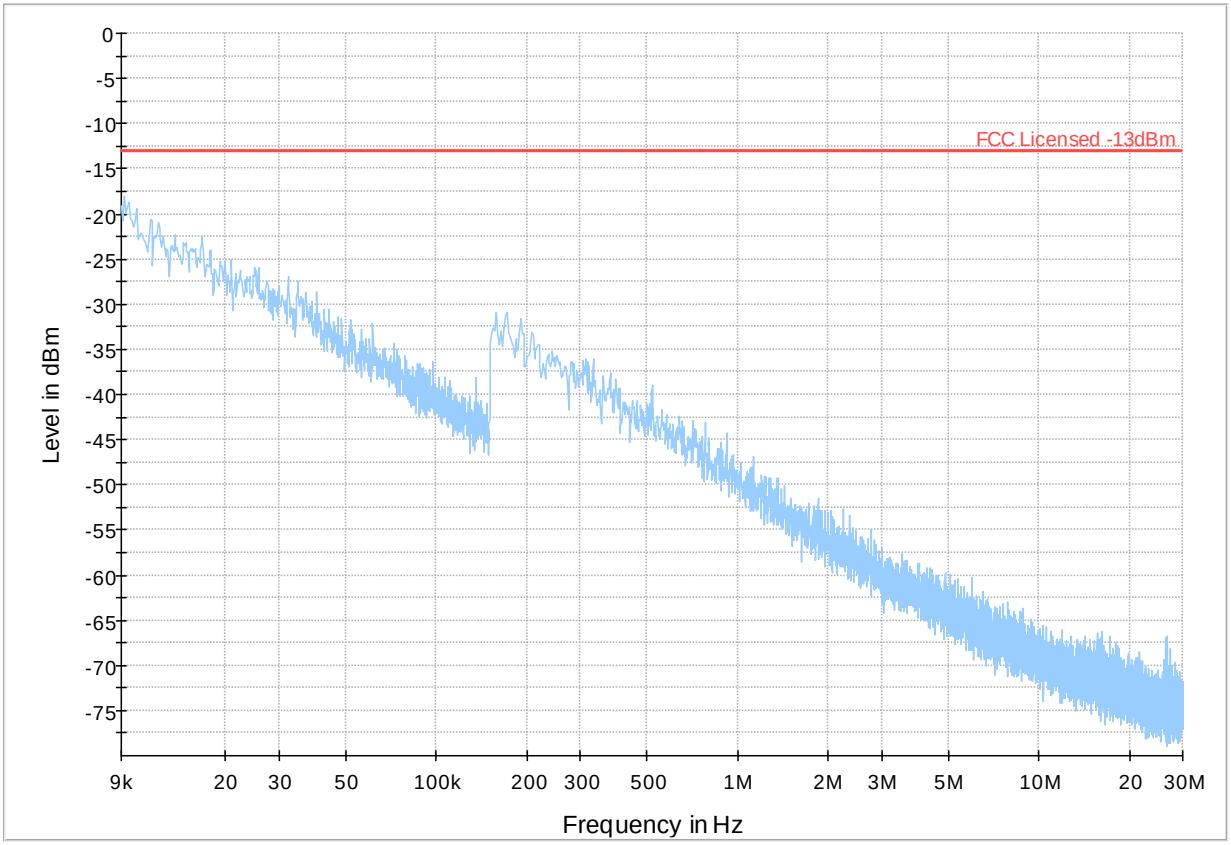
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
4804.500	-54.25	-13.00	41.25	500.0	1000.000	173.0	V	36.0	-100.0	
7207.000	-55.94	-13.00	42.94	500.0	1000.000	140.0	V	286.0	-95.8	



Preview Result 1-PK+ FCC Licensed -13dBm Final_Result RMS

Plot # 39 Radiated Emissions: 9 kHz - 30 MHz

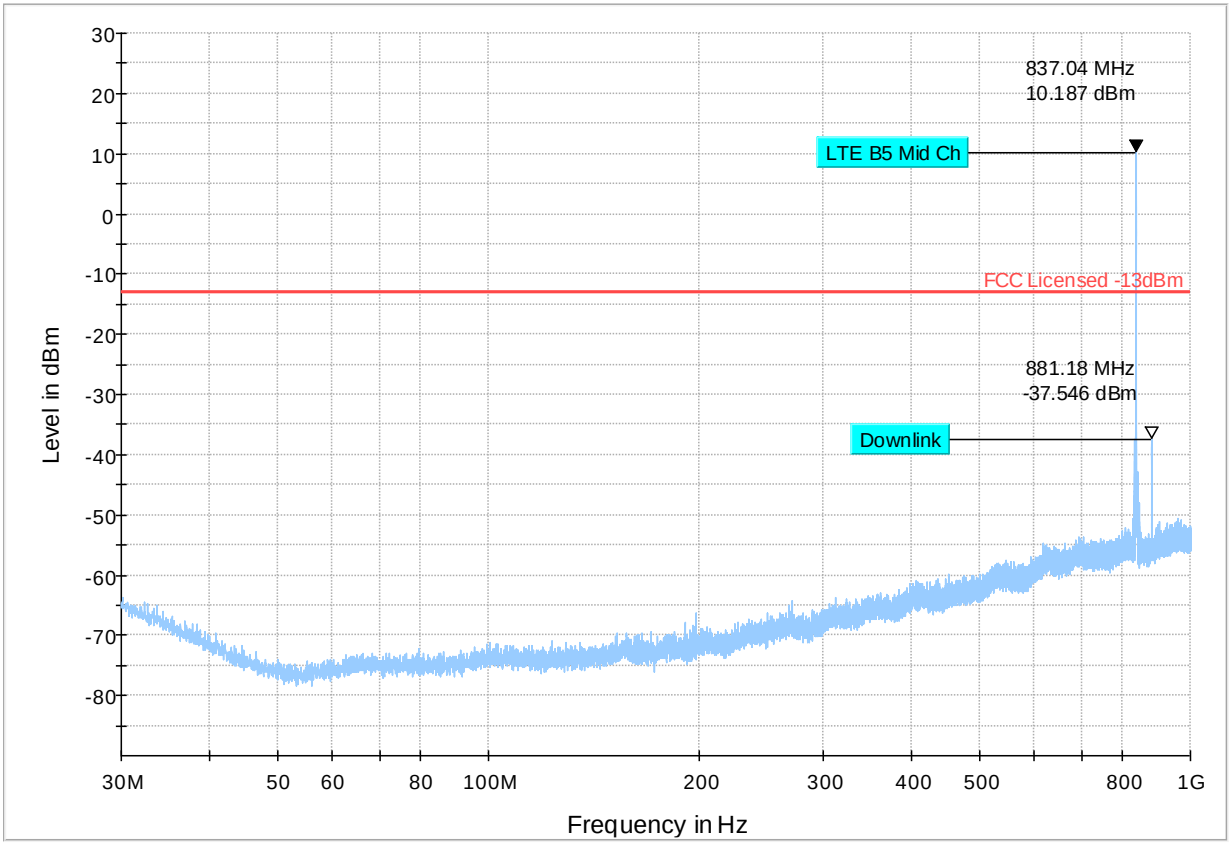
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 40 Radiated Emissions: 30 MHz – 1GHz

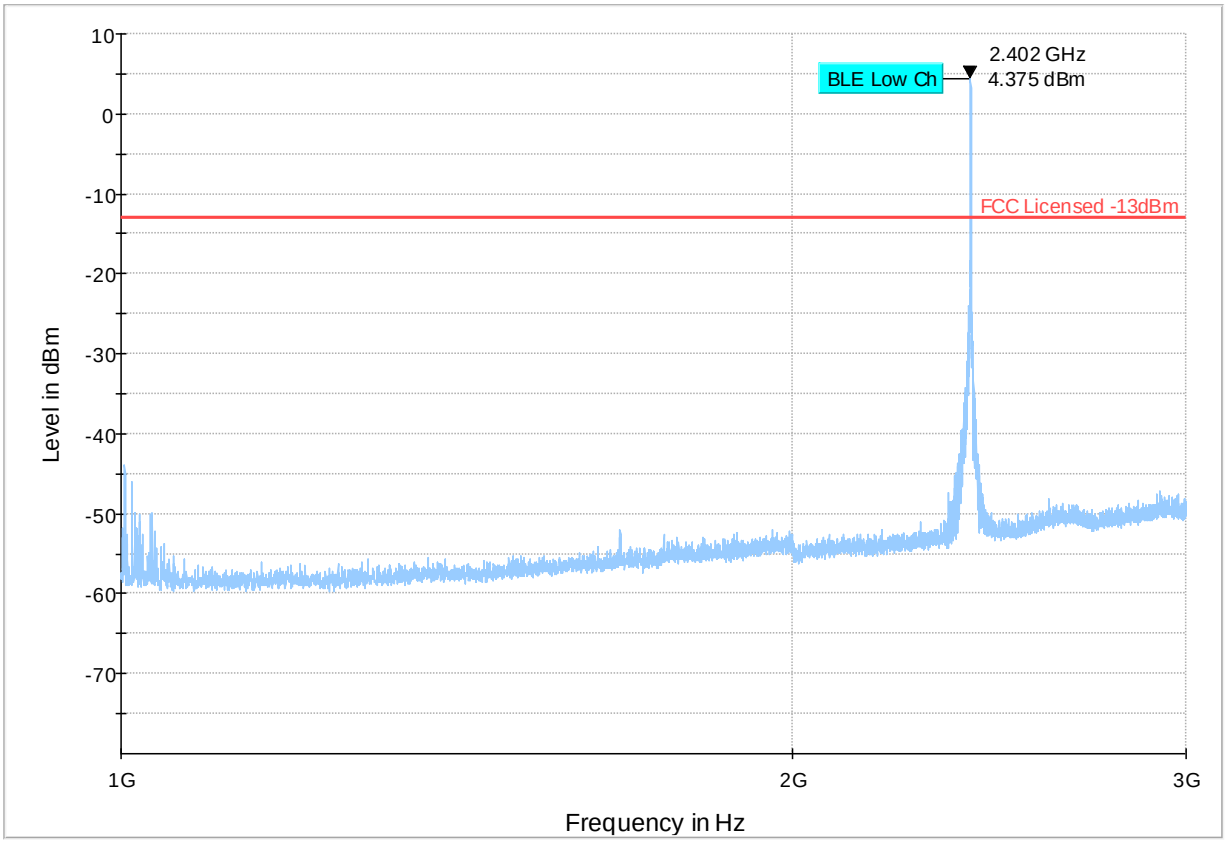
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 41 Radiated Emissions: 1 GHz - 3 GHz

Channel: Mid



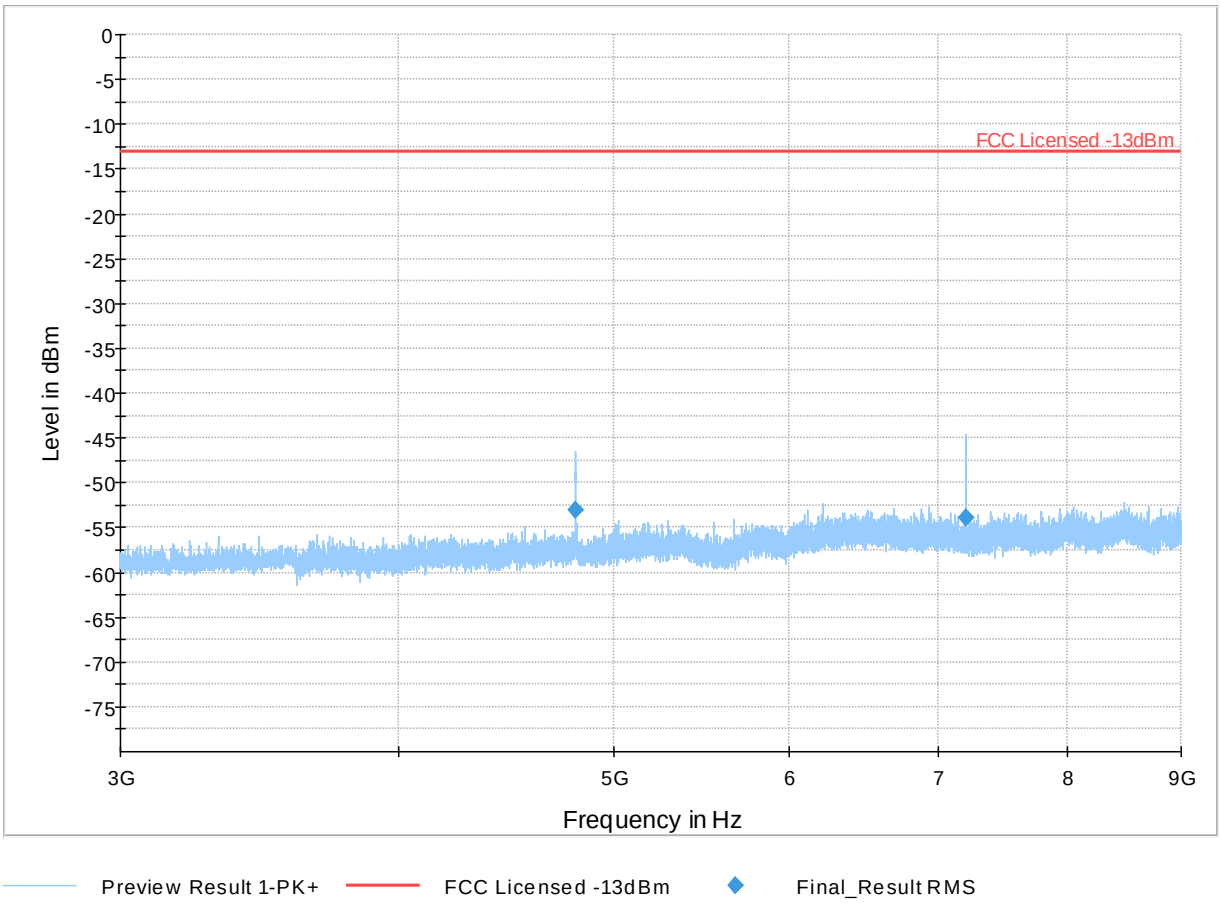
Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 42 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid

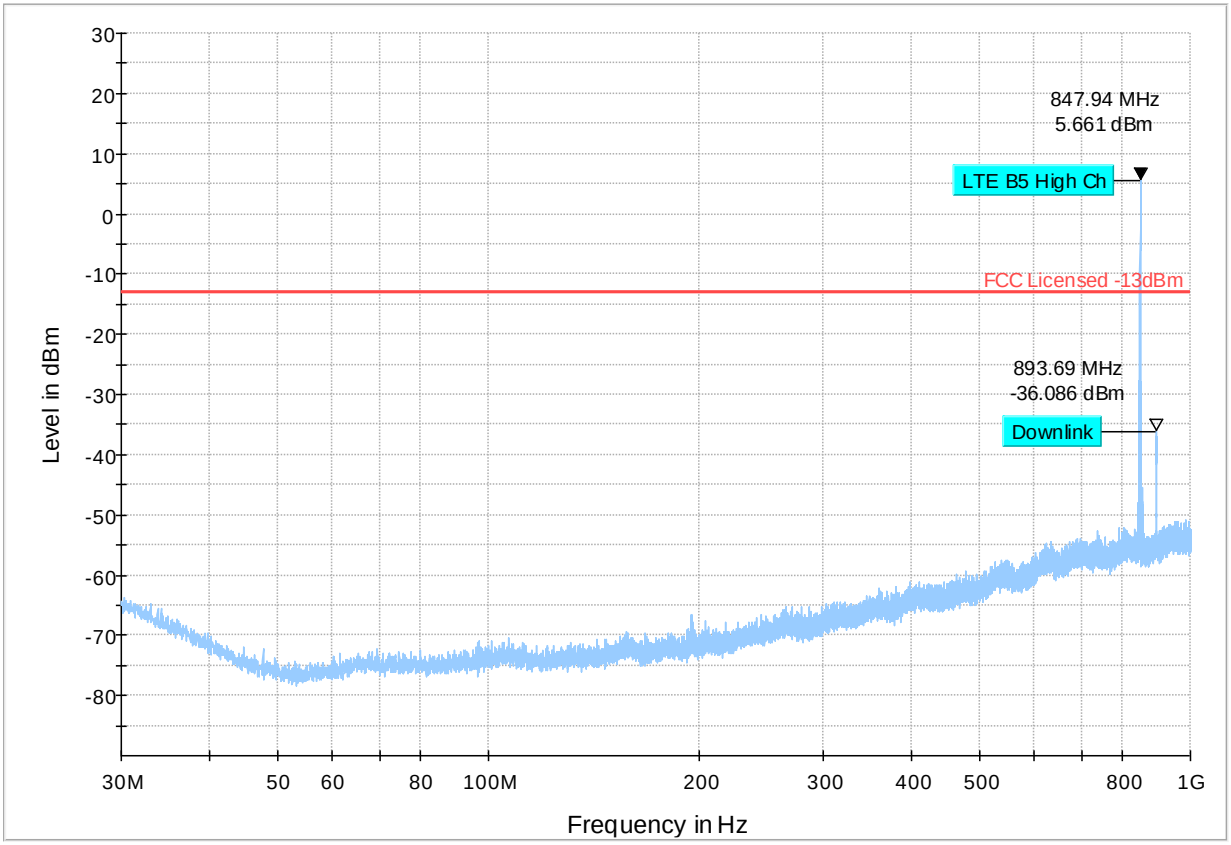
Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
4803.500	-53.08	-13.00	40.08	500.0	1000.000	140.0	H	70.0	-100.0	
7206.000	-53.86	-13.00	40.86	500.0	1000.000	140.0	V	285.0	-95.8	



Plot # 43 Radiated Emissions: 30 MHz – 1GHz

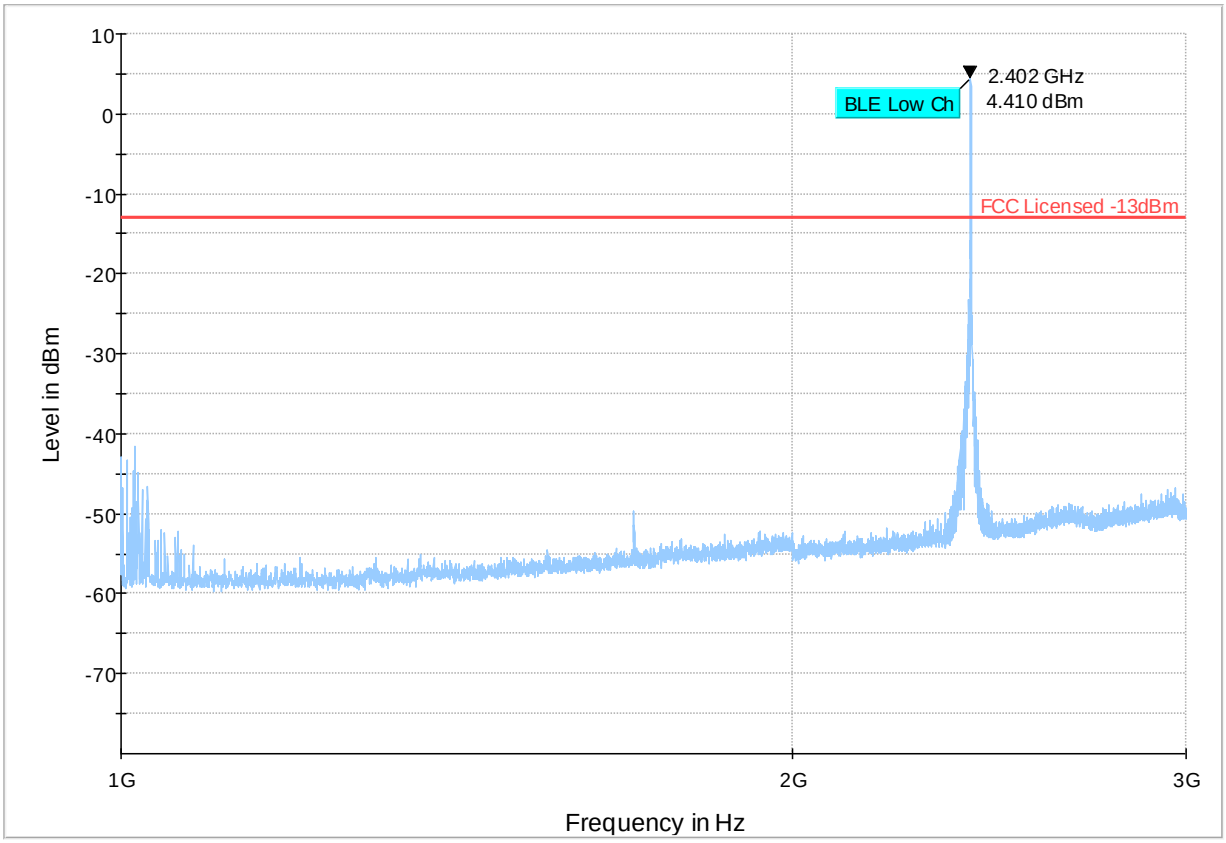
Channel: High



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 44 Radiated Emissions: 1 GHz - 3 GHz

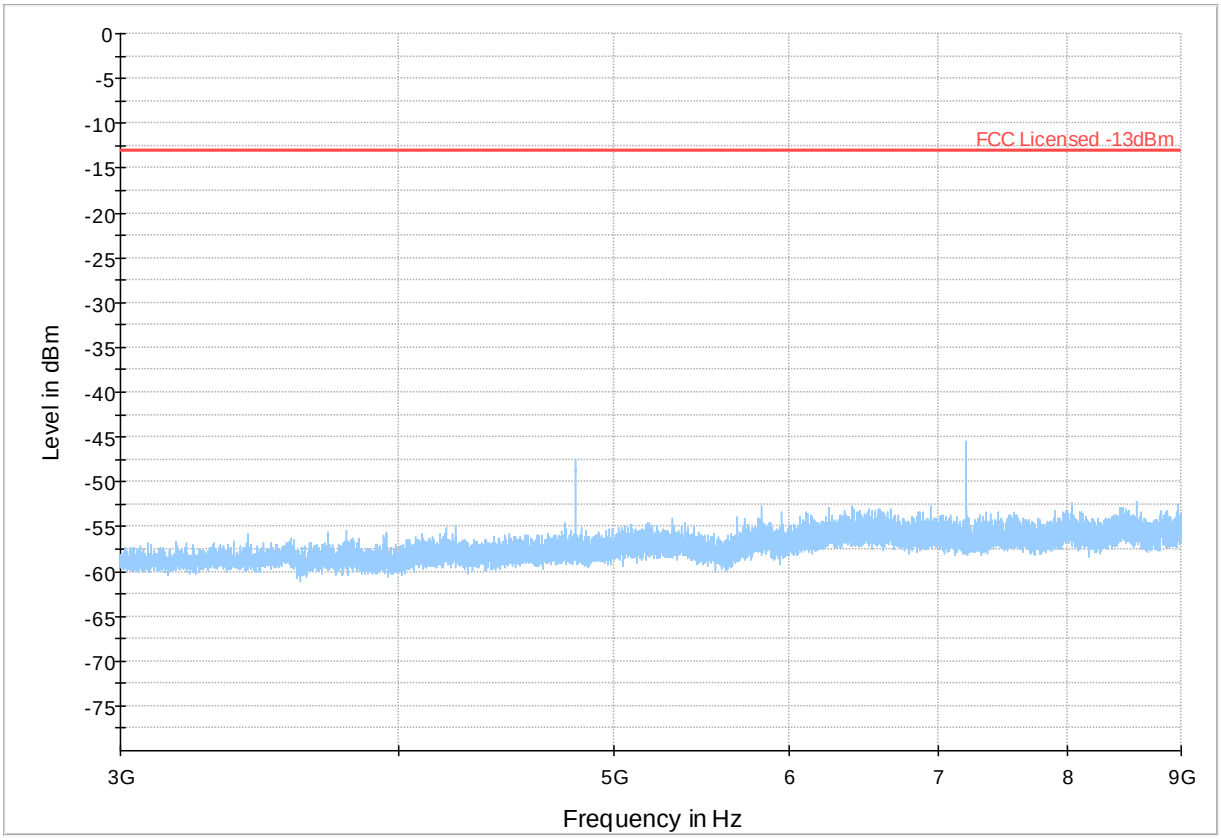
Channel: High



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 45 Radiated Emissions: 3 GHz – 9 GHz

Channel: High

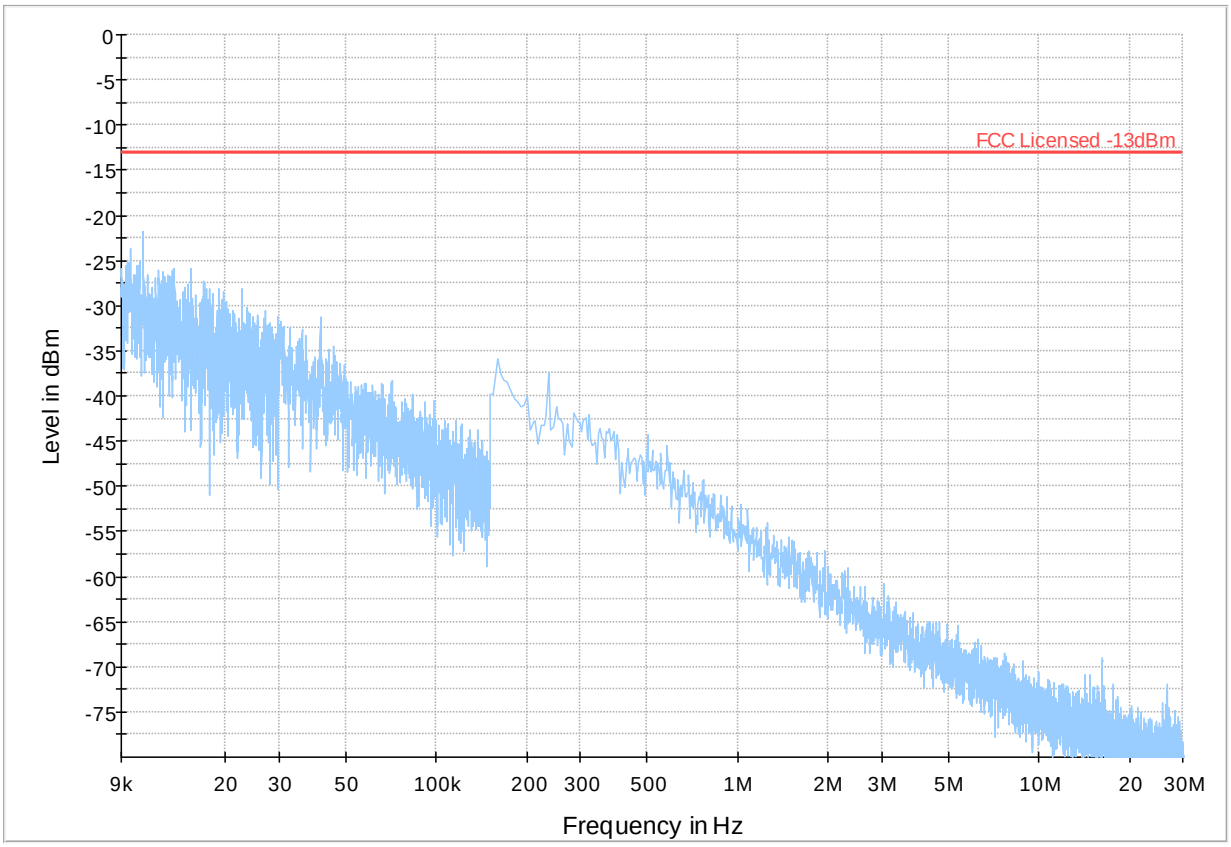


Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

FCC 90 LTE Band 26

Plot # 46 Radiated Emissions: 9 kHz - 30 MHz

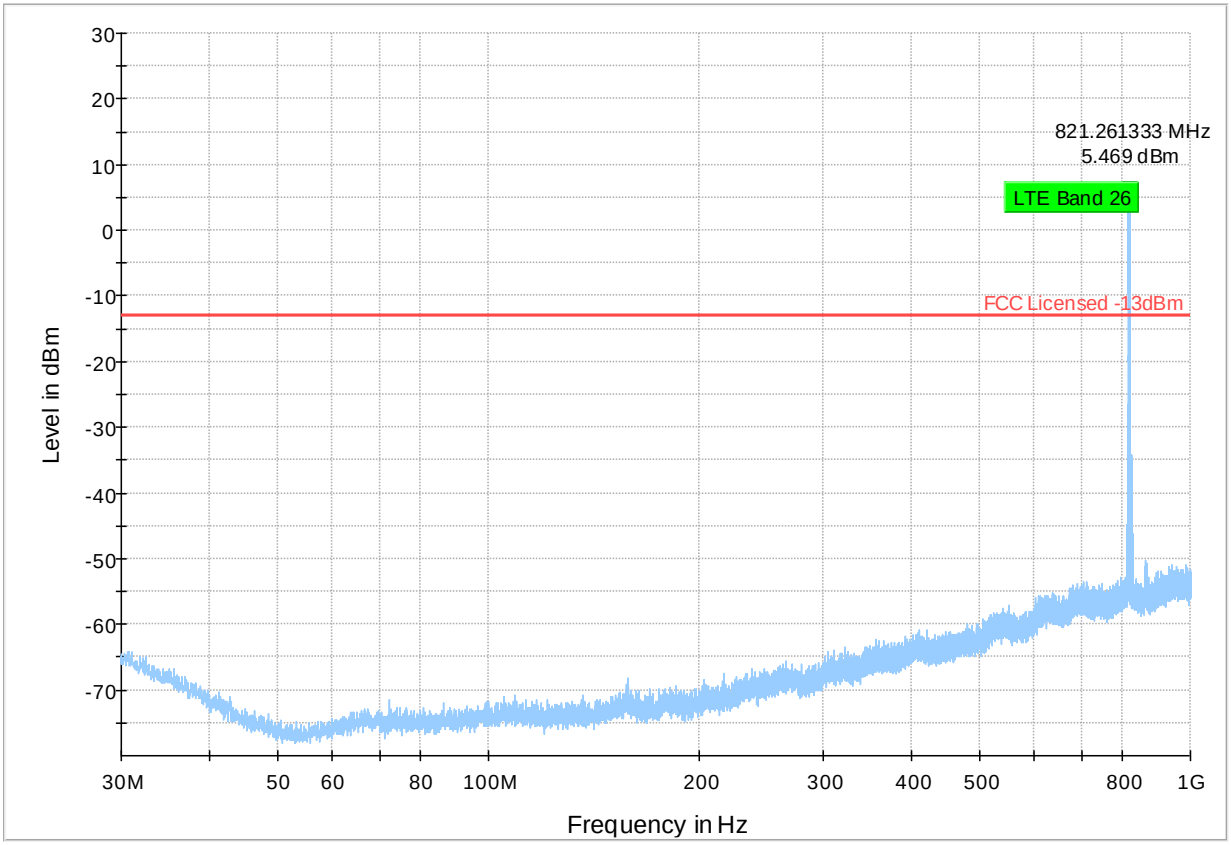
Channel: Mid



Preview Result 1-PK+ * Critical_Freqs PK+ FCC Licensed -13dBm ◆ Final_Result RM

Plot # 47 Radiated Emissions: 30 MHz – 1GHz

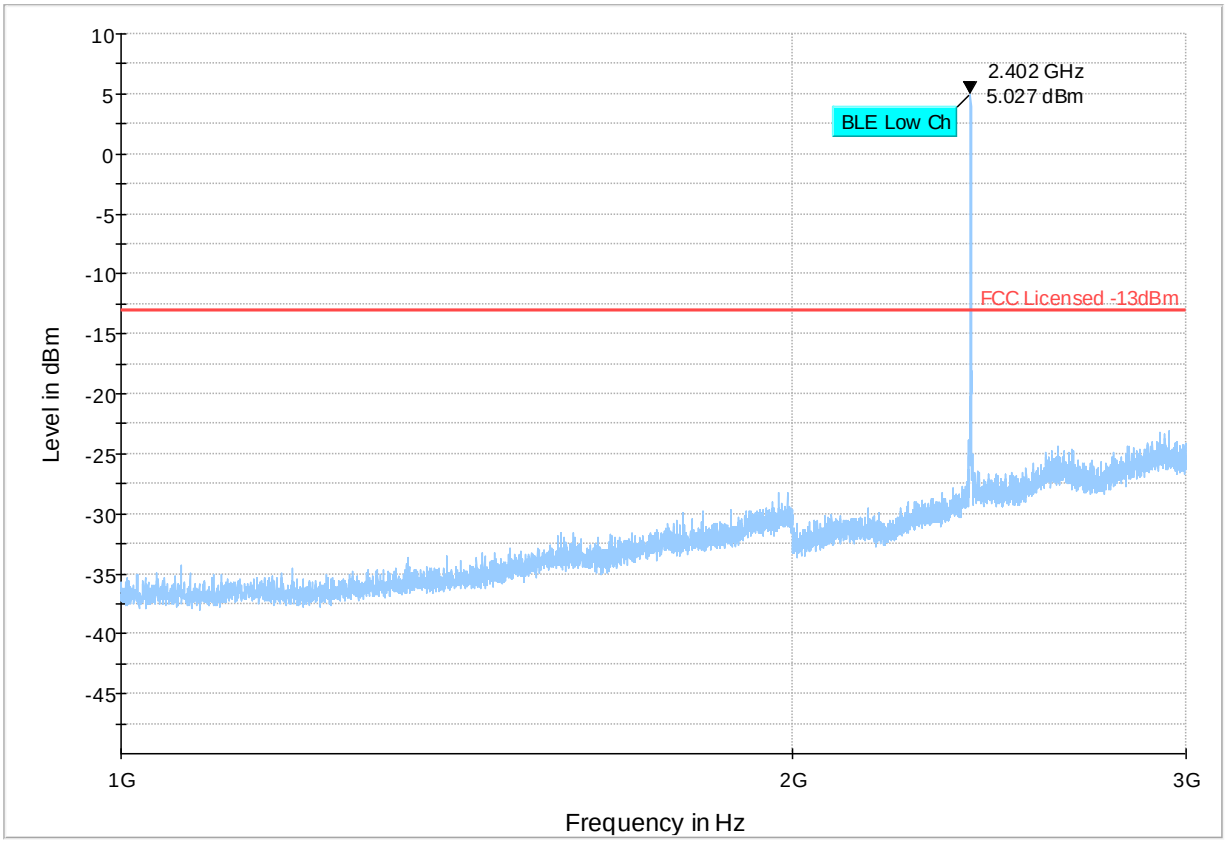
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 48 Radiated Emissions: 1 GHz - 3 GHz

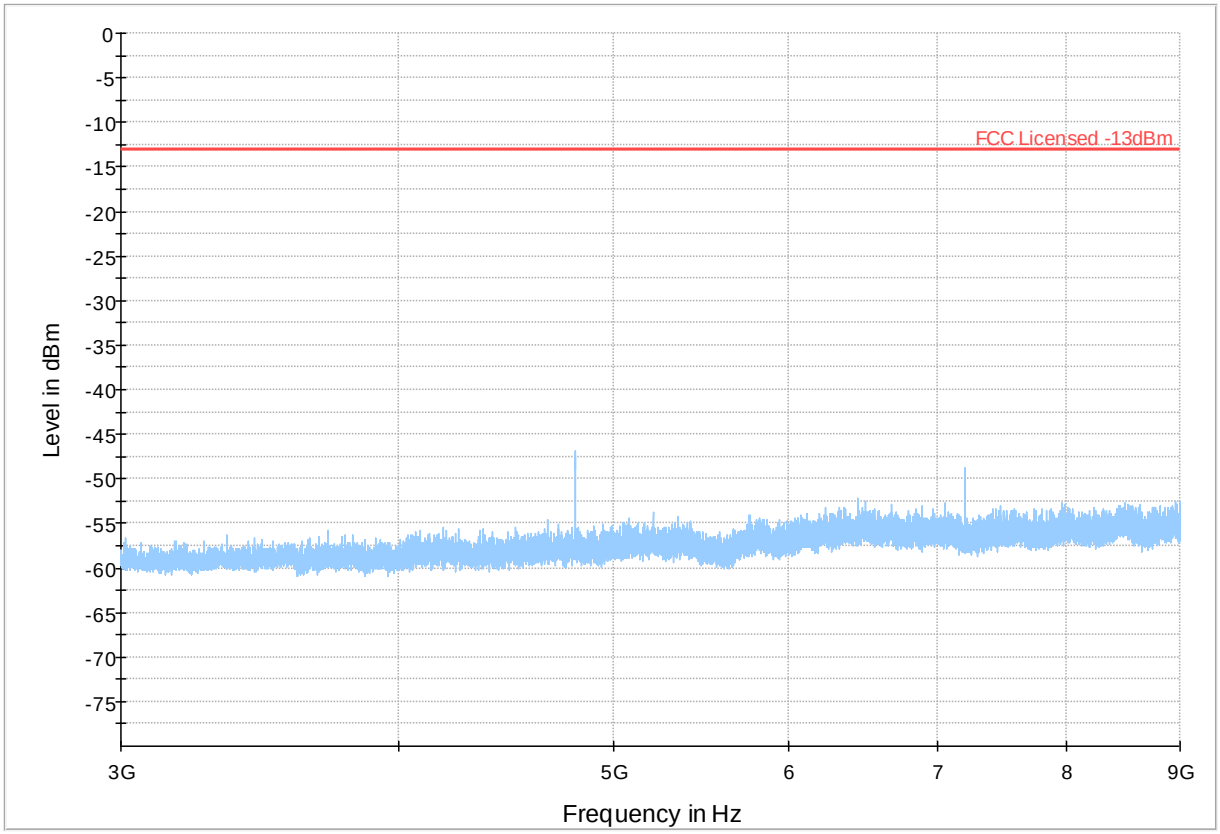
Channel: Mid



Preview Result 1-PK+ Critical_Freqs PK+ FCC Licensed -13dBm Final_Result RM

Plot # 49 Radiated Emissions: 3 GHz – 9 GHz

Channel: Mid



Preview Result 1-PK+ * Critical_Freqs PK+ FCC Licensed -13dBm ◆ Final_Result RM

8 Test setup photo

Setup photos are included in supporting file name: “EMC_CALAM-118-21001_Setup_Photos.pdf”

9 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
BILOG ANTENNA	A.H.Systems	3049	569	3 YEARS	09/24/2020
HORN ANTENNA	ETS.LINDGREN	3115	00035111	3 YEARS	04/17/2019
HORN ANTENNA	ETS LINDGREN	3117	00169547	3 YEARS	09/01/2020
HORN ANTENNA	ETS LINDGREN	3116	00070497	3 YEARS	11/23/2020
WIDEBAND RADIO COMMUNICATION	R&S	CMW500	109825	3 YEARS	02/12/2018
SIGNAL ANALYZER	R&S	FSV 40	101022	3 YEARS	07/15/2019
COMPACT DIGITAL BAROMETER	CONTROL COMPANY	10510-922	200236891	3 YEARS	04/13/2020
DIGITAL THRMOMETER	CONTROL COMPANY	36934-164	191871994	3 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
2021-02-19	EMC_CALAM-118-21001_FCC_22_24_27_90_ISED	Initial version	Yuchan Lu

<<The End>>