FCC / ISED Test Report

For:
ITRON NETWORKED SOLUTIONS, INC.

Model Name:
NIC 511-NA1-0312

Product Description:
The MicroAP 5 is a unique product with cellular connectivity that supports both cellular and RF Mesh communications simultaneously.

FCC ID: OWS-NIC511-LTE
IC ID: 5975A-NIC511LTE

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

REPORT #: EMC_ITRO1_049_21001_FCC_15.247_DSS_ATT_Rev1

DATE: 2021-11-05

A2LA Accredited

IC recognized #
3462B
CABID: US0187

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: Contact@cetecom.com ◆ http://www.cetecom.com
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.

Based on '*NOTE (3)*' in the operational description of the EUT '*Functional Description (OWS-NIC511-LTE)_11-4-2021-1.pdf*' "*900 MHz mesh radio identical for all models*"

No deviations were ascertained.

Company	Description	Model #
ITRON NETWORKED SOLUTIONS, INC.	The MicroAP 5 is a unique product with cellular connectivity that supports both cellular and RF Mesh communications simultaneously.	NIC 511-NA1-0312

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2021-11-05	Compliance	Kevin Wang (EMC Lab Manager)	kevin.wang@cetecom.com Digitally signed by: kevin.wang@cetecom.com DN: CN = kevin.wang@cetecom.com Date: 2021.11.08 10:06:05 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2021-11-05	Compliance	Issa W Ghanma (Sr. 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: 2021.11.05 19:08:48 -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:	Kevin Wang
Responsible Project Leader:	Rami Saman

2.2 Identification of the Client

Client's Name:	ITRON NETWORKED SOLUTIONS, INC.
Street Address:	230 W Tasman Avenue
City/Zip Code	San Jose, CA 95134
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

Model No:	NIC 511-NA1-0312
HW Version :	09
SW Version :	5.2.0
FCC-ID :	OWS-NIC511-LTE
IC-ID :	5975A-NIC511LTE
Product Description:	The MicroAP 5 is a unique product with cellular connectivity that supports both cellular and RF Mesh communications simultaneously. It leverages cellular communications for backhaul connectivity and uses RF Mesh communications to connect with other nearby Itron Networked Solutions, Inc. devices.
Frequency Range / number of channels:	Nominal band: 902.3 – 926.9 MHz Center to center: 902.3 MHz (ch 0) – 926.9 MHz (ch 82), 83 Channels
Modes of Operation:	Hopping
Antenna Information as declared:	Omni-Directional Antenna Max Gain: -4.4 dBi
Measured Peak output Powers:	26.96 dBm
Power Supply/ Rated Operating Voltage Range:	Streetlight controller(Luminator): 120V (Low) / 277V (Max) AC Luminator output to EUT: 3.6V (Low) / 4.4V (Max) DC
Operating Temperature Range	-40º to 65º C
Other Radios included in the device:	Cellular: • (4G) 2, 4, 5, 12, 13
Sample Revision	☐Prototype Unit; ■Production Unit; ☐Pre-Production

3.2 EUT Sample details

EUT #	Model Number	HW Version	SW Version	MAC Address	Comments
1	NIC 511-SV1-0312	08	5.2.0	00:13:50:05:01:40:FE:24	RF Conducted output power
2	NIC 511-NA1-0312	09	5.2.0	00:13:50:05:01:5B:83:95	Radiated spurious emissions

3.3 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
Op. 1	900MHz Mesh	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle (≥ 98%) using software (CATT) that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
Op. 2	900MHz Mesh + LTE 2	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle (≥ 98%) using software (CATT) that is not available to the end user. The internal antennae was connected.

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	ISM radio was configured to: • Mode : FSK • Data Rate: : 100 kb/s • Max Power settings : +27 dBm • Transmit mode : Continuous TX • Hopping : No • Channel(s) : CH0(902.3MHz), CH43(915.2MHz), CH82(926.9MHz)
2	EUT#2	ISM radio was configured to: • Mode : FSK • Data Rate: : 100 kb/s • Max Power settings : +27 dBm • Transmit mode : Continuous TX • Hopping : No • Channel(s) : CH0(902.3MHz), CH43(915.2MHz), CH82(926.9MHz)

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on Low, Mid, High channels, highest duty cycle, and the maximum output power, simultaneously with the cellular radio transmission at the highest output power LTE band 2 representing the worst case scenario.

For radiated measurements,

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

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 Issue 2 of ISED Canada.

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

- FCC ID: OWS-NIC511-LTE
- IC ID: 5975A-NIC511LTE

Testing procedures are based on ANSI C63.10:2013 including section 7.8 for FHSS systems.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(b)(2) RSS-247 5.4(a)	Maximum Peak Conducted Output Power	Nominal	Op. 1	■	☐	☐	Complies
§15.247(d) RSS-247 5.5 RSS-Gen 8.10	Band Edge Compliance	Nominal	-	☐	☐	■	Note 1 Note 2
§15.247(a)(1) RSS-247 5.1(a)	Spectrum Bandwidth	Nominal	-	☐	☐	■	Note 1 Note 2
§15.247(a)(1) RSS-247 5.1(b)	Carrier Frequency Separation	Nominal	-	☐	☐	■	Note 1 Note 2
§15.247(a)(1)(i) RSS-247 5.1(c)	Number of Hopping Channels	Nominal	-	☐	☐	■	Note 1 Note 2
§15.247(a)(1)(i) RSS-247 5.1(c)	Time of occupancy	Nominal	-	☐	☐	■	Note 1 Note 2
§15.247(d) §15.209 (a) RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	Op. 2	■	☐	☐	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions	Nominal	Op. 2	■	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note2: Leveraged from module certification report # *SSNT135-U4_Conducted Rev B*, FCC / IC ID: OWS-NIC511-LTE / 5975A-NIC511LTE

6 Measurements

6.1 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)

Conducted measurement

RF conducted measurement	±0.5 dB

6.2 Environmental Conditions During Testing:

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

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

6.3 Dates of Testing:

6/7/2021 – 11/3/2021

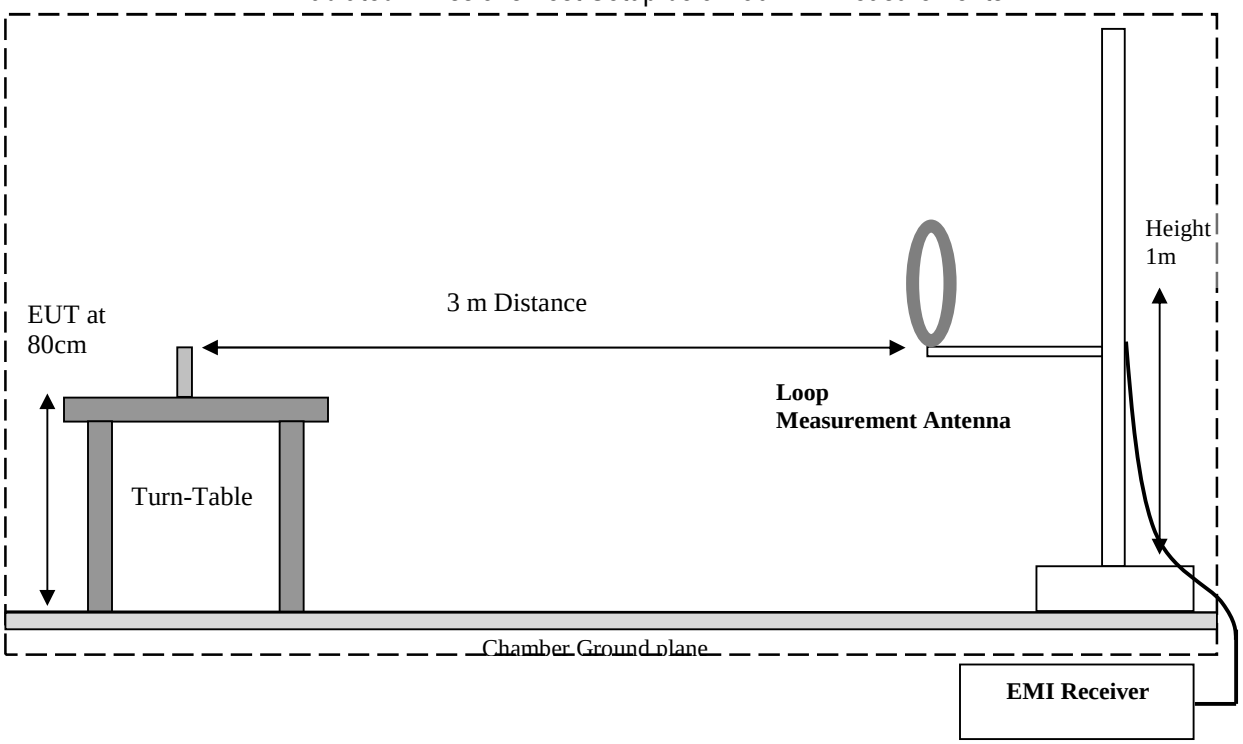
7 Measurement Procedures

7.1 Radiated Measurement

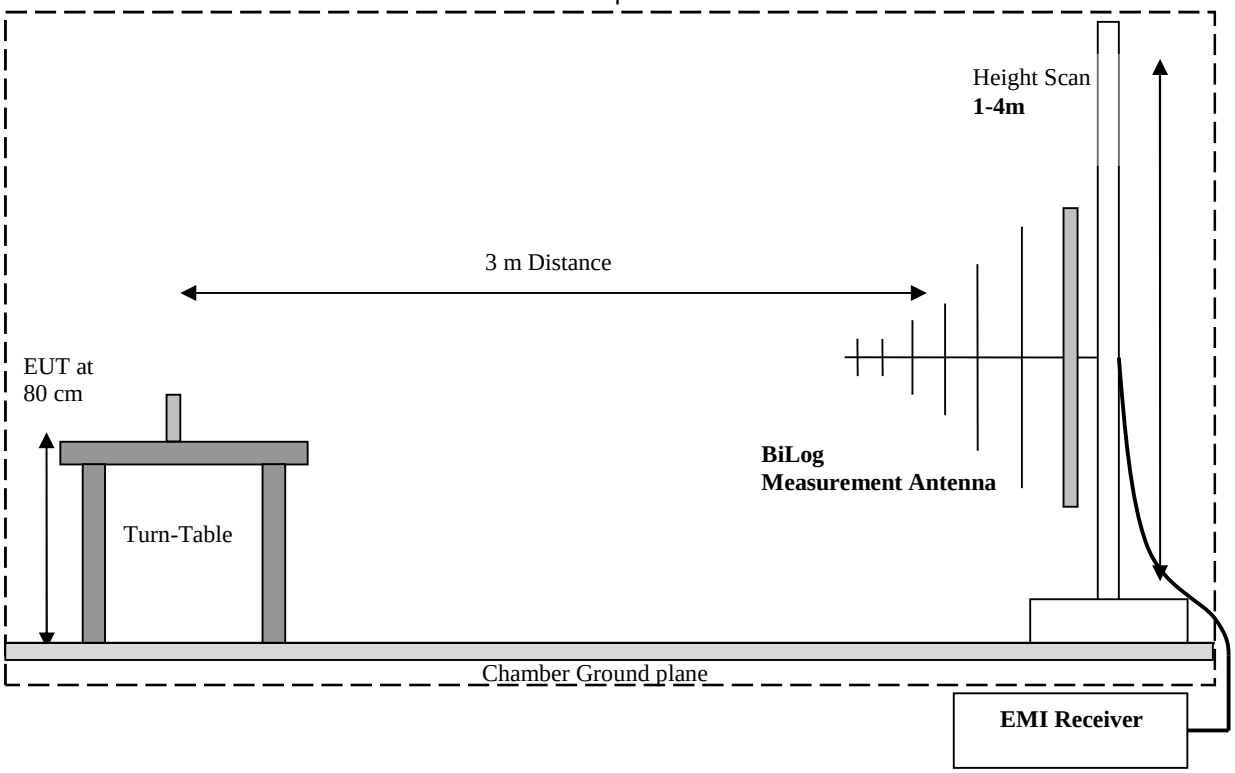
The radiated measurement is performed according to: ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

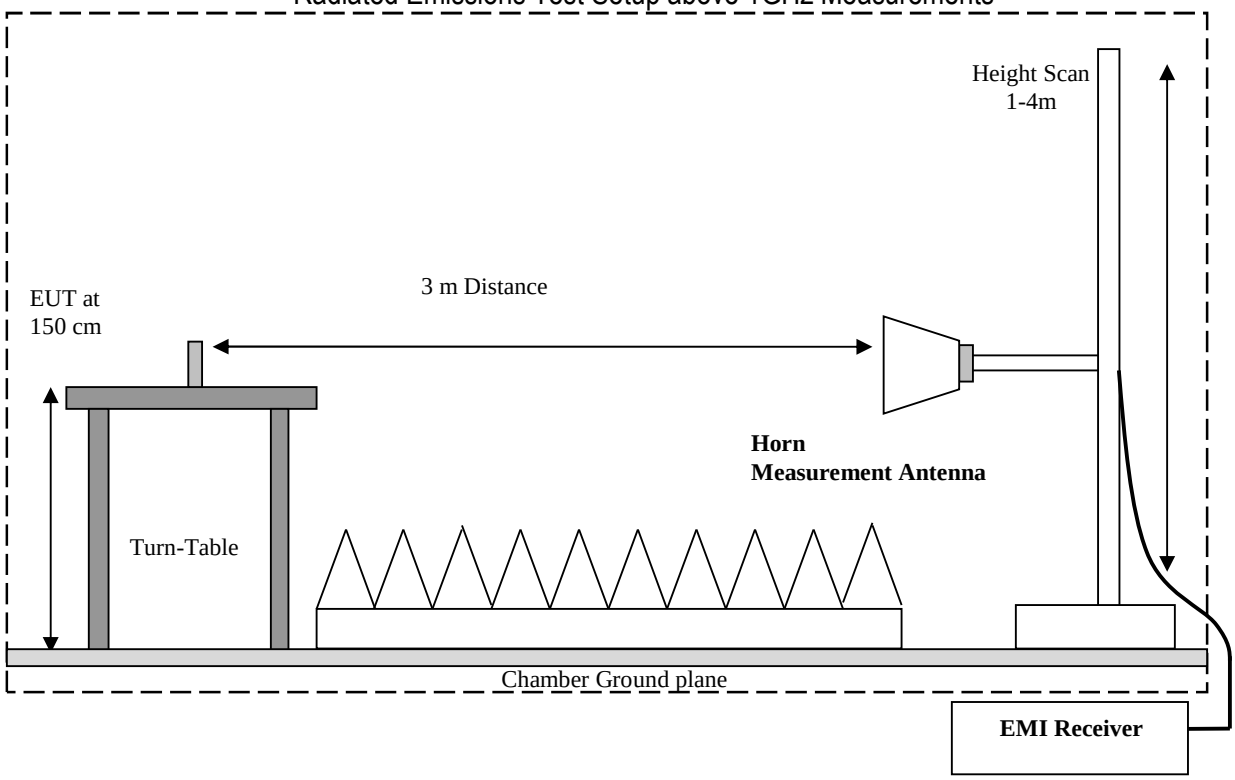
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

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

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

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

Example:

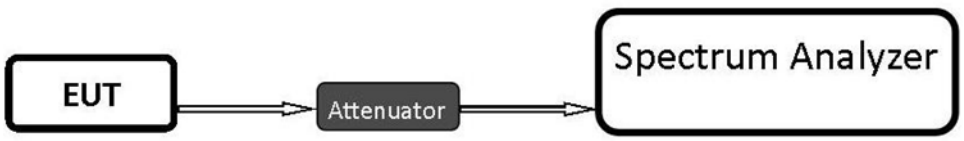
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

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

7.3 RF Conducted Measurement Procedure

Reference: ANSI C63.10 (2013) Section 6.7, and 7.8



- 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 ANSI C63.10 Section 7.8.5

Spectrum Analyzer settings:

- Span = approximately 5 times the 20 dB bandwidth
- RBW > the 20 dB bandwidth of the emission being measured
- VBW ≥ RBW
- Sweep = Auto Couple
- Detector function = Peak
- Trace = Max hold
- Use the marker-peak function to set the marker to the peak of the emission.

8.1.2 Limits:

Maximum Peak Conducted Output Power:

FCC §15.247:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
  - (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

IC RSS-247 5.4:

- (a) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p shall not exceed 1 W if the hopset uses less than 50 hopping channels.

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	1	Op.1	120 V AC	-4.4 dBi

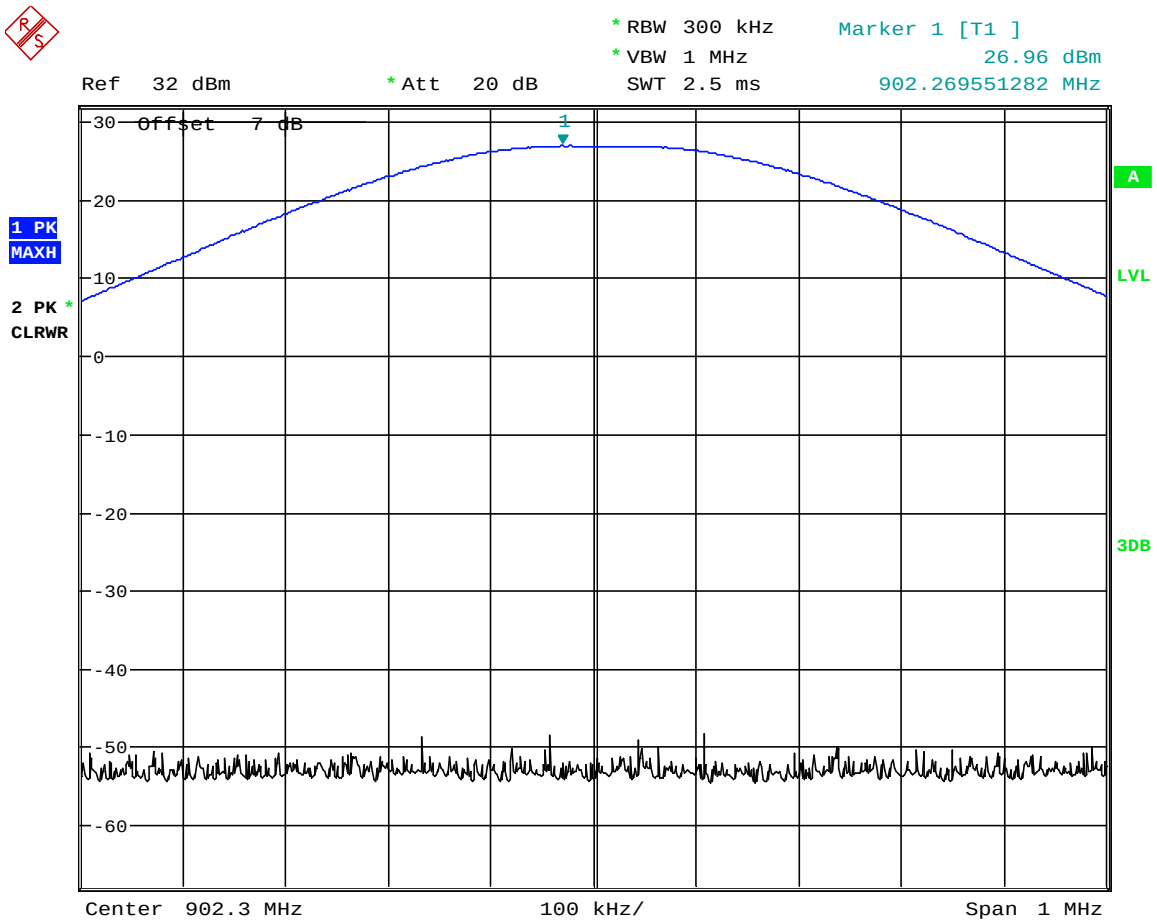
8.1.4 Measurement result:

Plot #	EUT operating mode	Channel #	TX Frequency (MHz)	Measured PK power		Conducted Limit		Calculated E.I.R.P*1		ISED E.I.R.P Limit		Result
				W	dBm	W	dBm	W	dBm	W	dBm	
1	Op.1	0	902.3	0.50	26.96	1	30	0.18	22.56	4	36	Pass
2		43	915.2	0.47	26.75	1	30	0.17	22.35	4	36	Pass
3		82	926.9	0.45	26.51	1	30	0.16	22.11	4	36	Pass

1: E.I.R.P = Measured PK power + Antenna Gain

8.1.5 Measurement Plots:

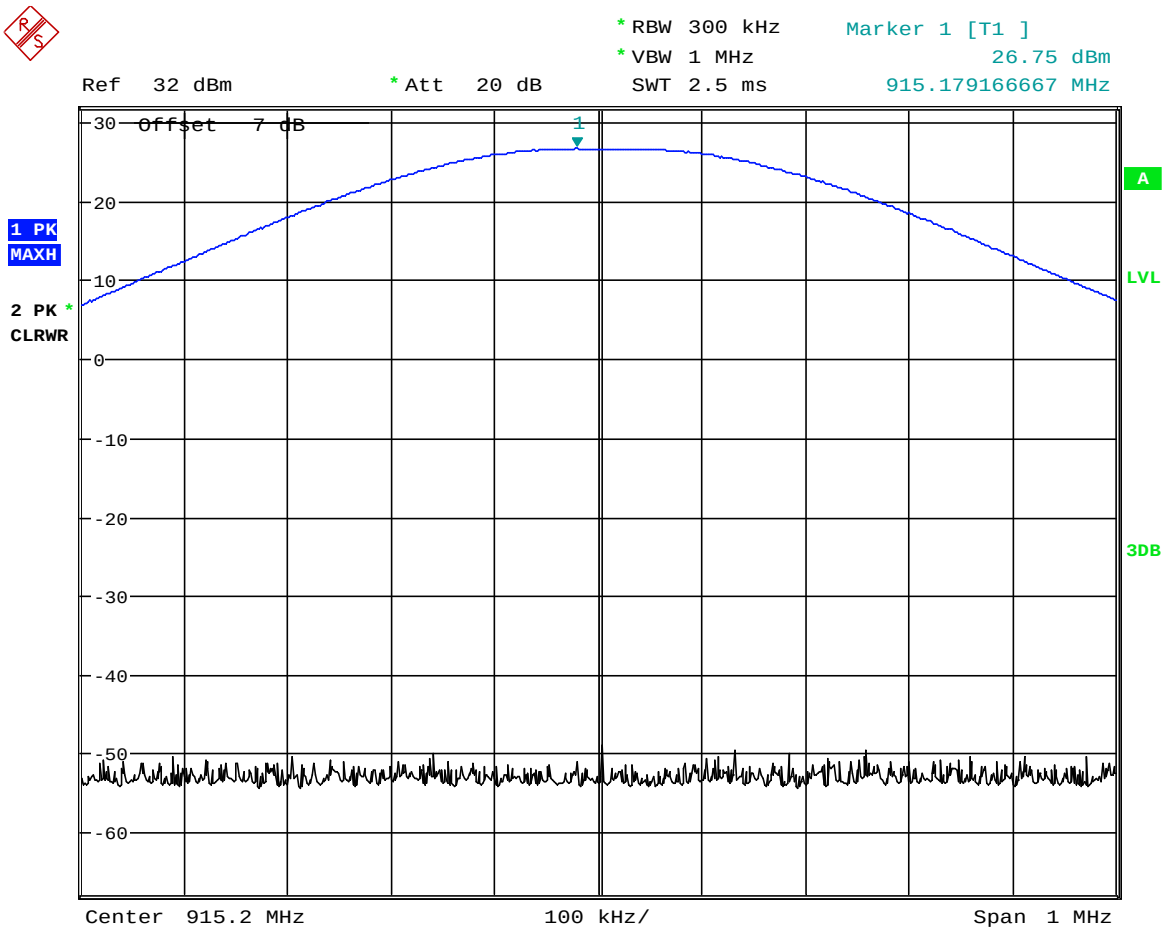
Plot # 1		
Tx Frequency: 902.3 MHz	**Channel #: 0**	**Mode: FSK**



Date: 2.NOV.2021 16:38:45

Plot # 2

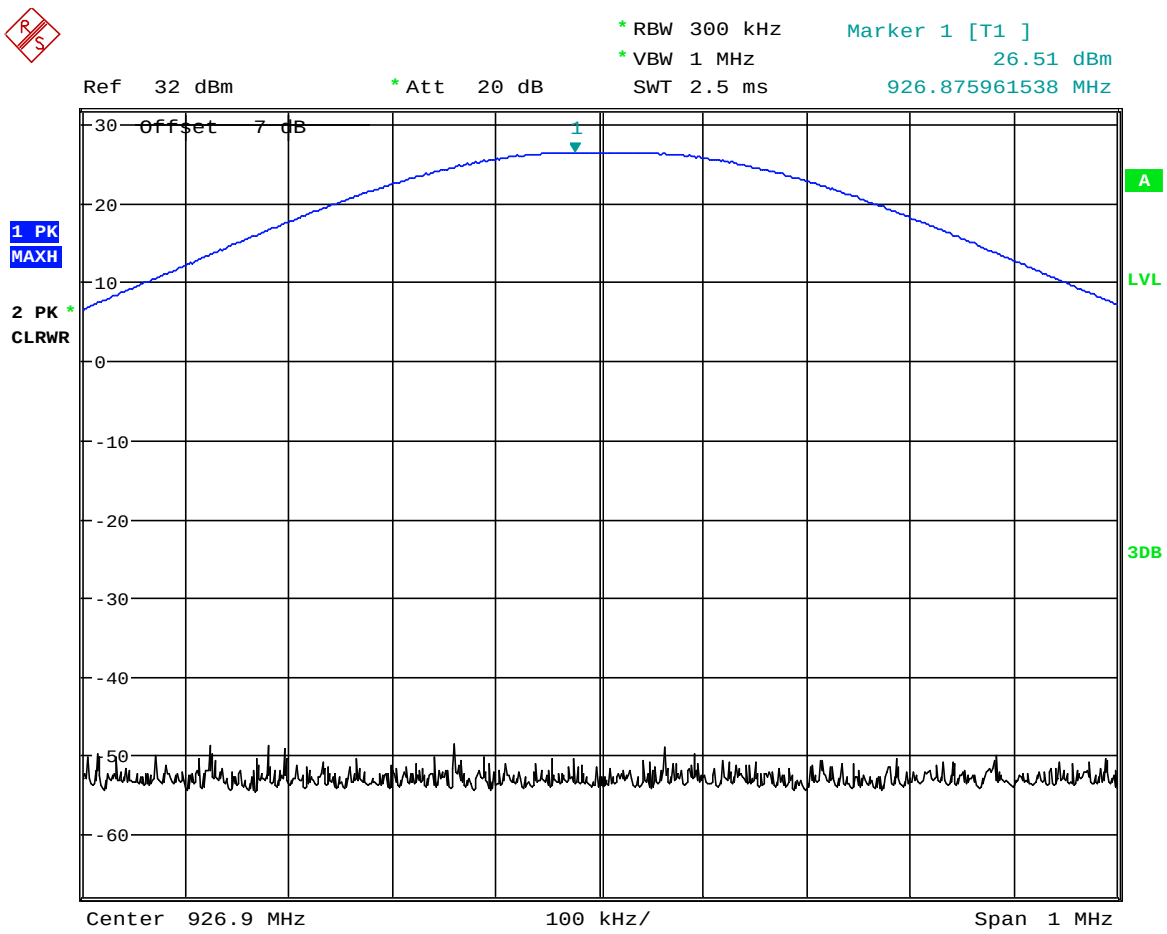
Tx Frequency: 915.2 MHz	Channel #: 43	Mode: FSK



Date: 2.NOV.2021 16:40:30

Plot # 3

Tx Frequency: 926.9 MHz	Channel #: 82	Mode: FSK



Date: 2.NOV.2021 16:41:40

8.2 Transmitter Spurious Emissions and Restricted Bands

8.2.1 Measurement according to ANSI C63.10

Analyzer Settings:

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

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

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

8.2.2 Limits: FCC 15.247(d)/15.209(a) /RSS-Gen 6.13

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= 74dB µV/m
- AVG. LIMIT= 54dB µV/m

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

8.2.3 Test conditions and setup:

Ambient Temperature	EUT operating mode	Power Input
23° C	Op. 2	120 VAC

8.2.4 Measurement result:

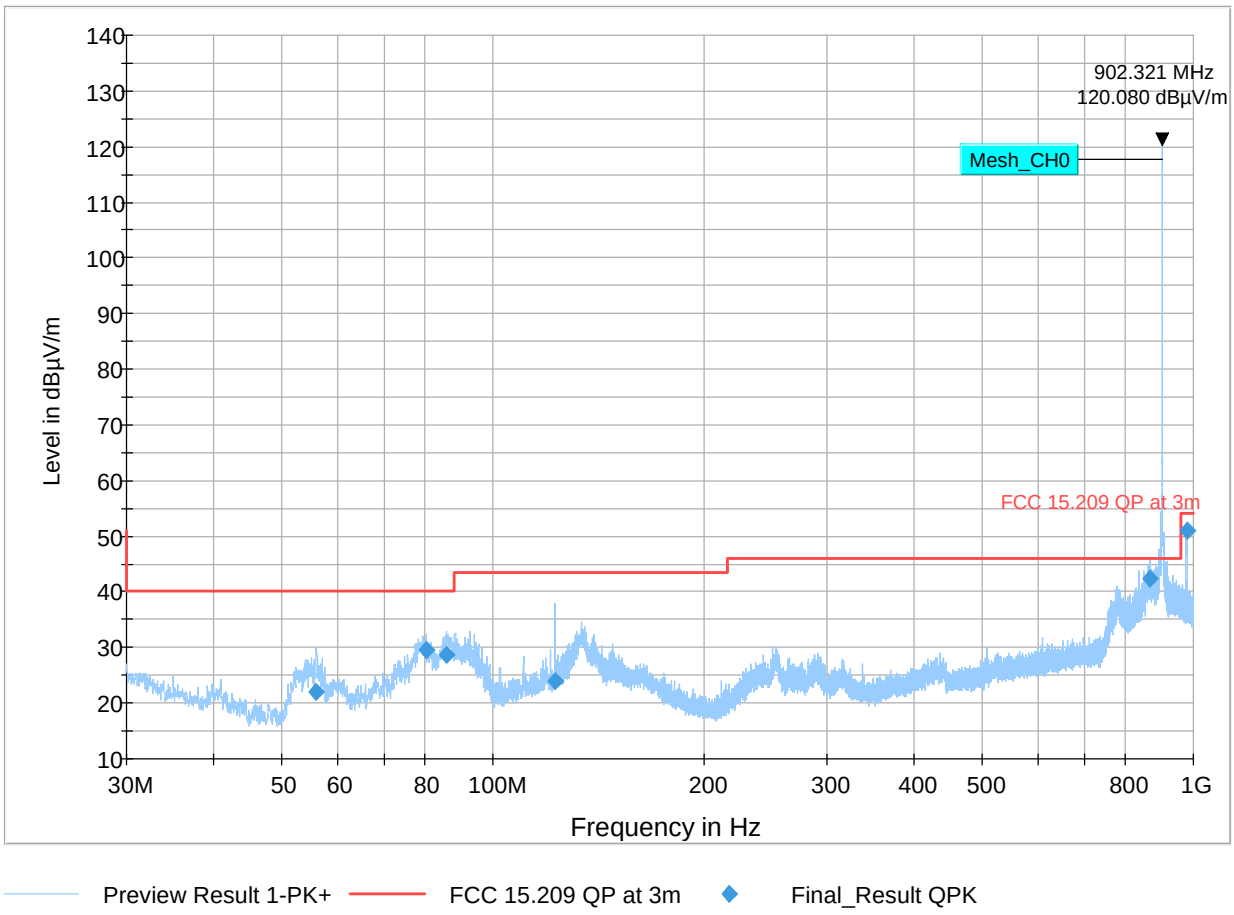
Plot #	Channel #	EUT Set-up #	Scan Frequency	Result
4-7	0	2	30 MHz – 18 GHz	Pass
8-10	43	2	9 kHz – 18 GHz	Pass
11-13	82	2	30 MHz – 18 GHz	Pass

8.2.5 Measurement Plots:

Plot # 4

Mesh CH 0: 902.3 MHz | **LTE 2: 1880 MHz**

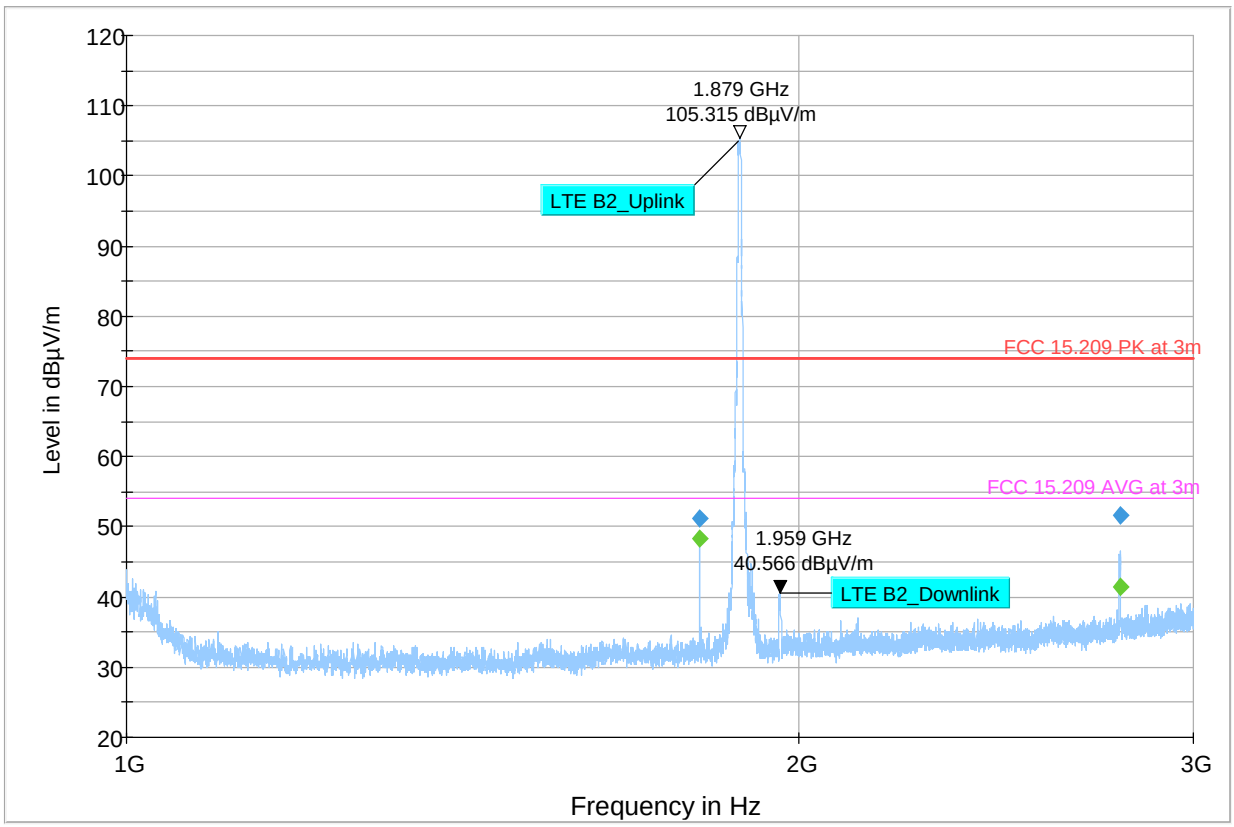
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
56.028	21.98	40.00	18.02	500.0	120.000	135.0	V	30.0	7.6
80.440	29.60	40.00	10.40	500.0	120.000	100.0	V	301.0	9.7
85.969	28.70	40.00	11.30	500.0	120.000	125.0	V	25.0	11.1
122.797	23.86	43.50	19.64	500.0	120.000	134.0	V	-45.0	17.6
868.759	42.42	46.02	3.60	500.0	120.000	100.0	V	274.0	24.8
978.013	50.99	53.98	2.99	500.0	120.000	271.0	V	56.0	26.0



Plot # 5

Mesh CH 0: 902.3 MHz | LTE 2: 1880 MHz

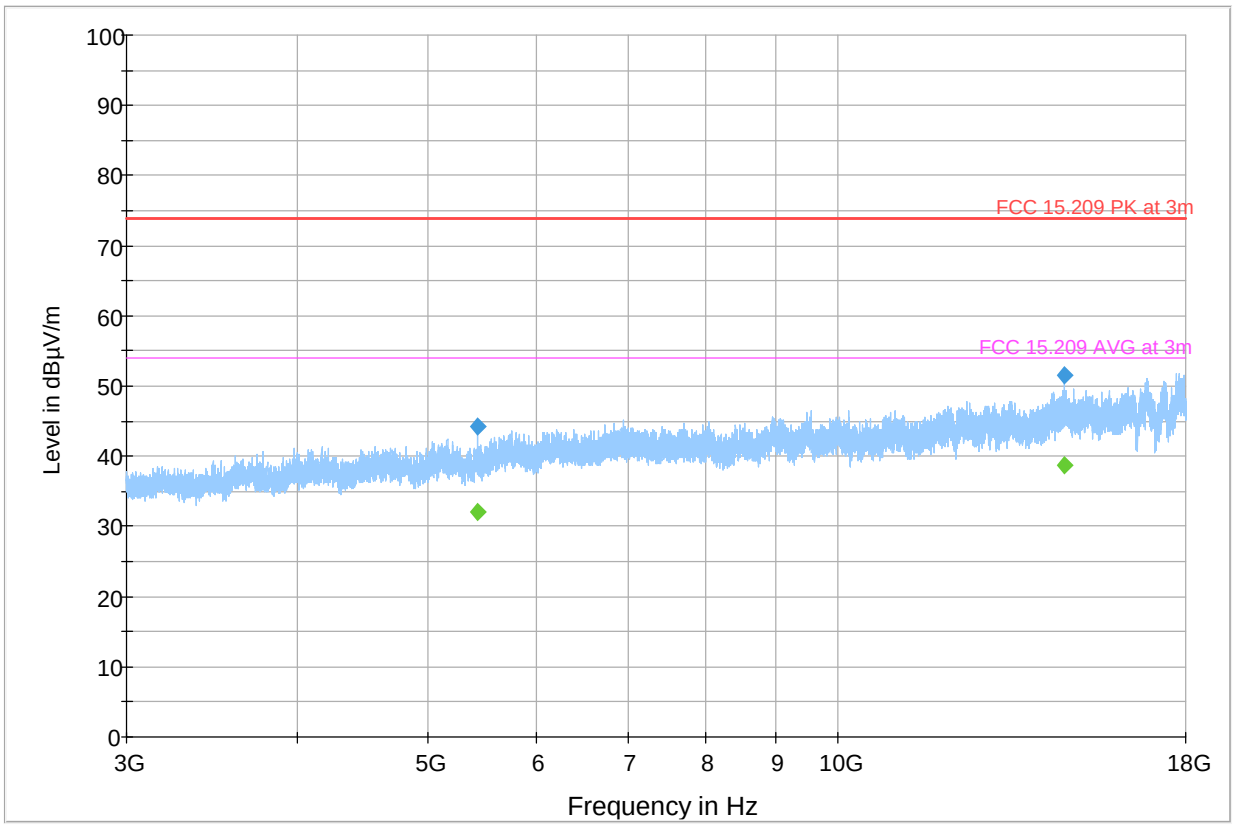
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.429	---	48.24	53.98	5.74	500.0	1000.000	191.0	H	249.0	4.3
1804.429	51.31	---	73.98	22.67	500.0	1000.000	191.0	H	249.0	4.3
2782.571	---	41.50	53.98	12.48	500.0	1000.000	151.0	V	100.0	7.4
2782.571	51.72	---	73.98	22.26	500.0	1000.000	151.0	V	100.0	7.4



Plot # 6

Mesh CH 0: 902.3 MHz | LTE 2: 1880 MHz

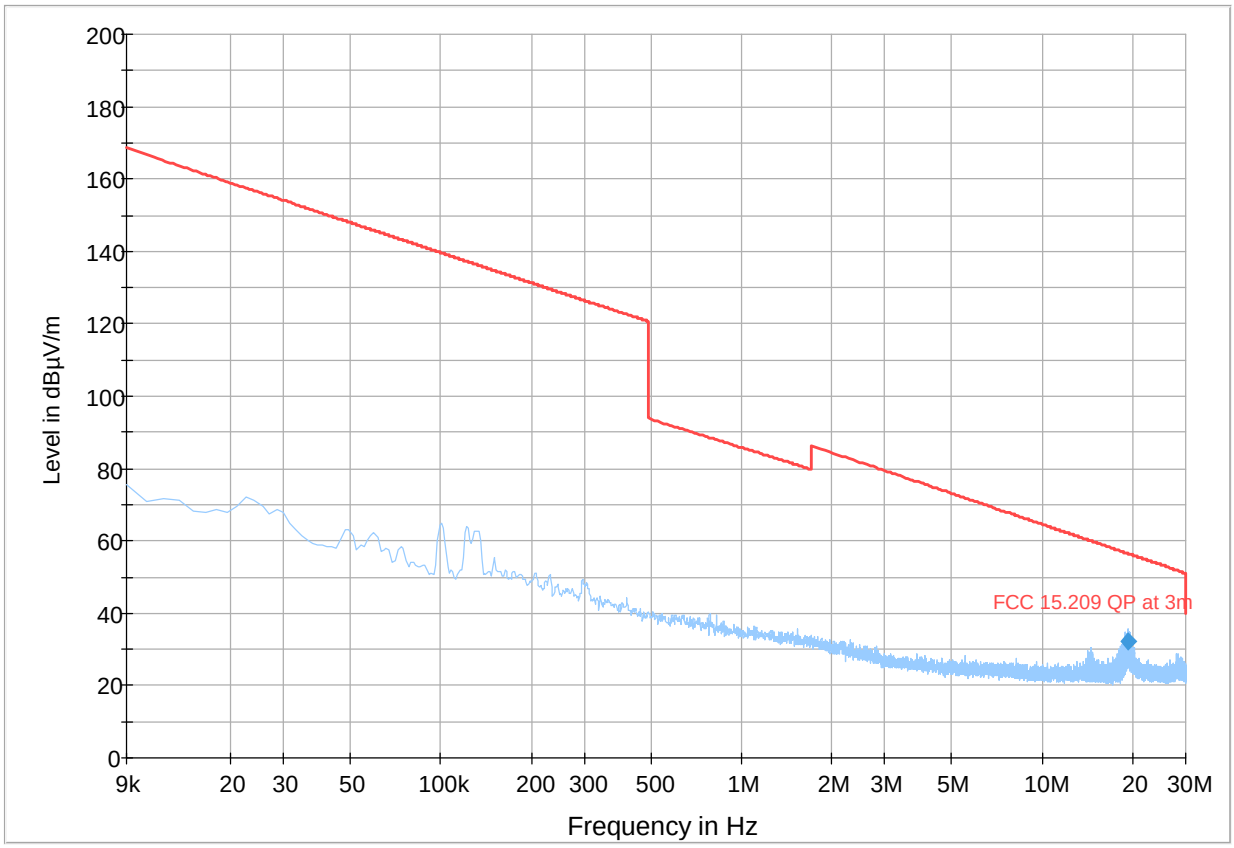
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5436.000	---	32.03	53.98	21.95	500.0	1000.000	186.0	H	-18.0	-2.5
5436.000	44.23	---	73.98	29.75	500.0	1000.000	186.0	H	-18.0	-2.5
14678.500	---	38.76	53.98	15.22	500.0	1000.000	275.0	V	40.0	8.9
14678.500	51.63	---	73.98	22.35	500.0	1000.000	275.0	V	40.0	8.9



Plot # 7

Mesh CH 43: 915.2 MHz | **LTE 2: 1880 MHz**

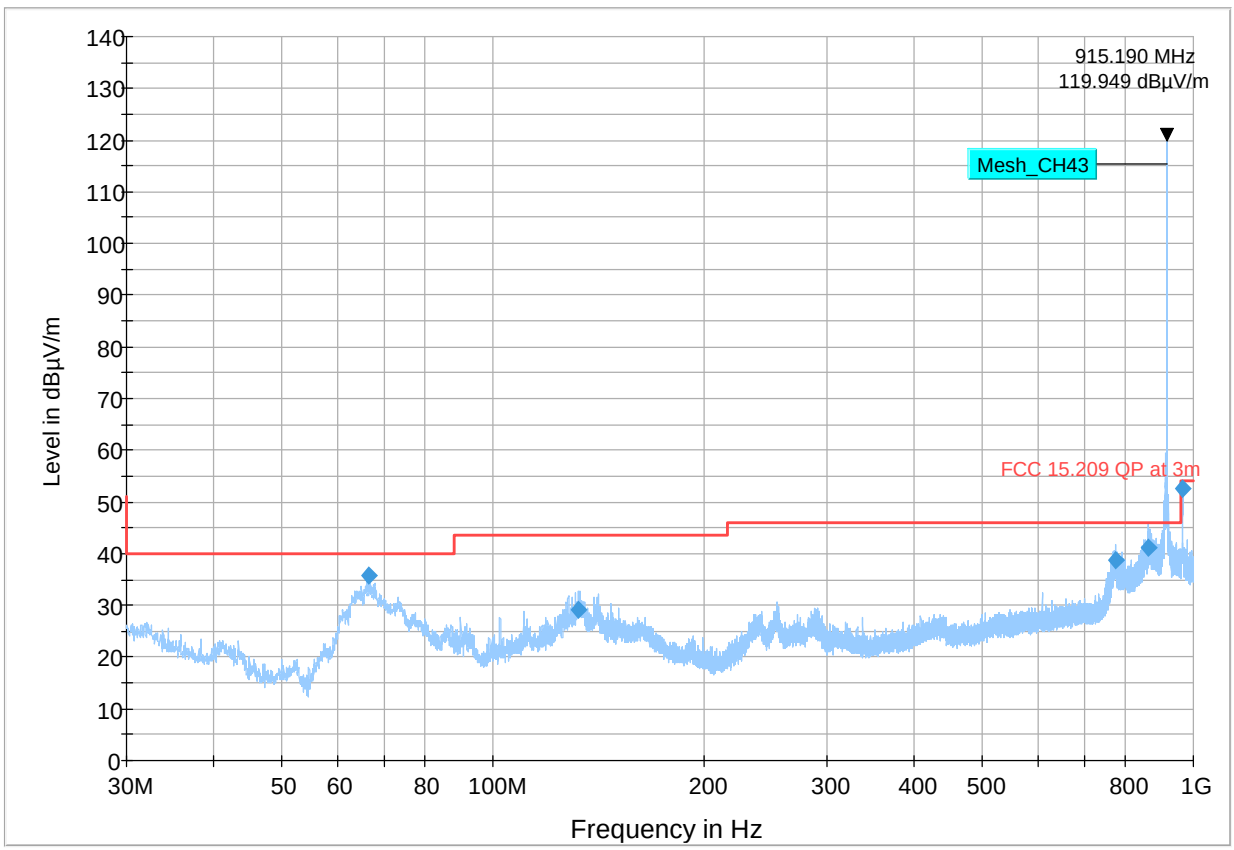
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19.250	32.17	56.50	24.33	500.0	9.000	100.0	H	151.0	33.8



Plot # 8

Mesh CH 43: 915.2 MHz | **LTE 2: 1880 MHz**

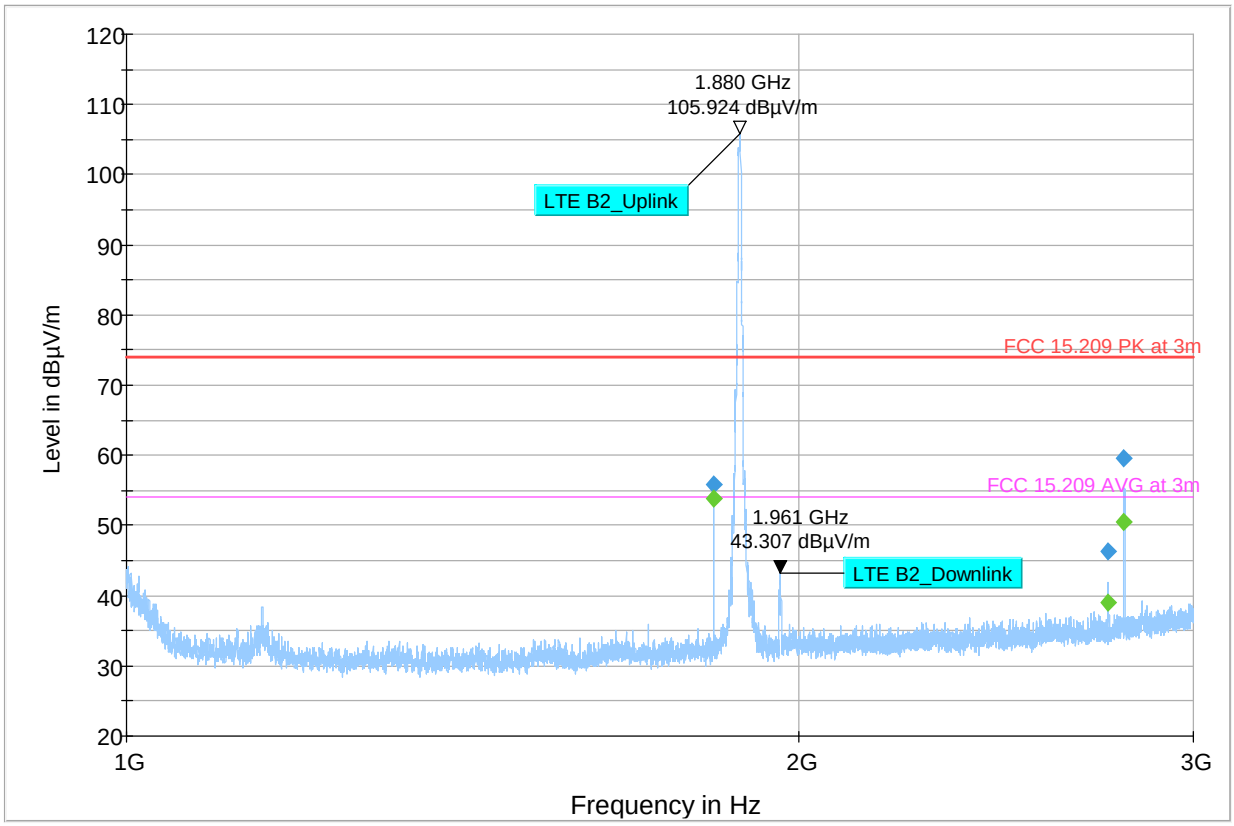
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
66.472	35.76	40.00	4.24	500.0	120.000	117.0	V	78.0	7.0
132.303	29.07	43.50	14.43	500.0	120.000	142.0	V	174.0	17.9
773.537	38.74	46.02	7.28	500.0	120.000	100.0	H	107.0	24.0
863.198	41.02	46.02	5.00	500.0	120.000	203.0	V	52.0	24.8
963.948	52.53	53.98	1.45	500.0	120.000	169.0	V	255.0	25.8



Plot # 9

Mesh CH 43: 915.2 MHz | LTE 2: 1880 MHz

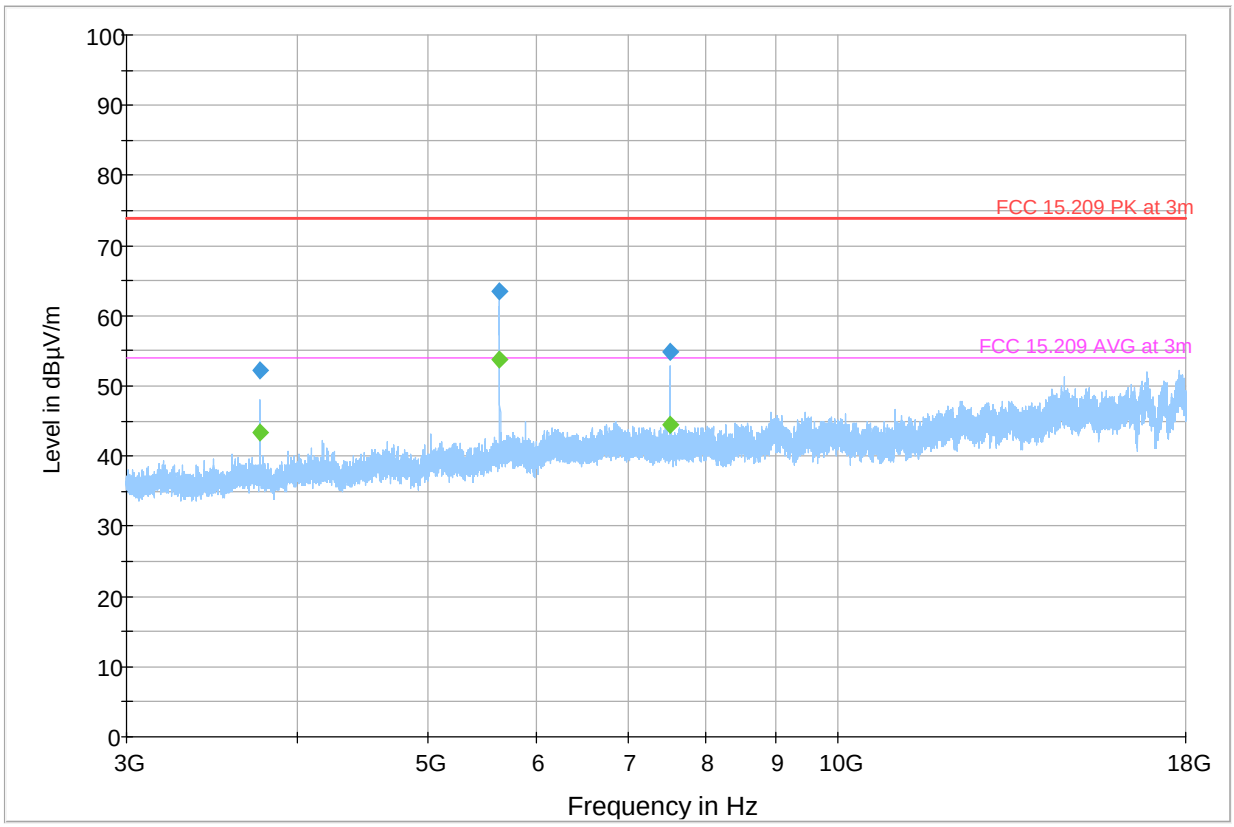
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1830.429	55.73	---	73.98	18.25	500.0	1000.000	134.0	V	139.0	4.4
1830.429	---	53.93	53.98	0.05	500.0	1000.000	134.0	V	139.0	4.4
2745.714	46.23	---	73.98	27.75	500.0	1000.000	125.0	V	232.0	7.1
2745.714	---	39.05	53.98	14.93	500.0	1000.000	125.0	V	232.0	7.1
2793.857	---	50.63	53.98	3.35	500.0	1000.000	142.0	V	98.0	7.4
2793.857	59.50	---	73.98	14.48	500.0	1000.000	142.0	V	98.0	7.4



Plot # 10

Mesh CH 43: 915.2 MHz | LTE 2: 1880 MHz

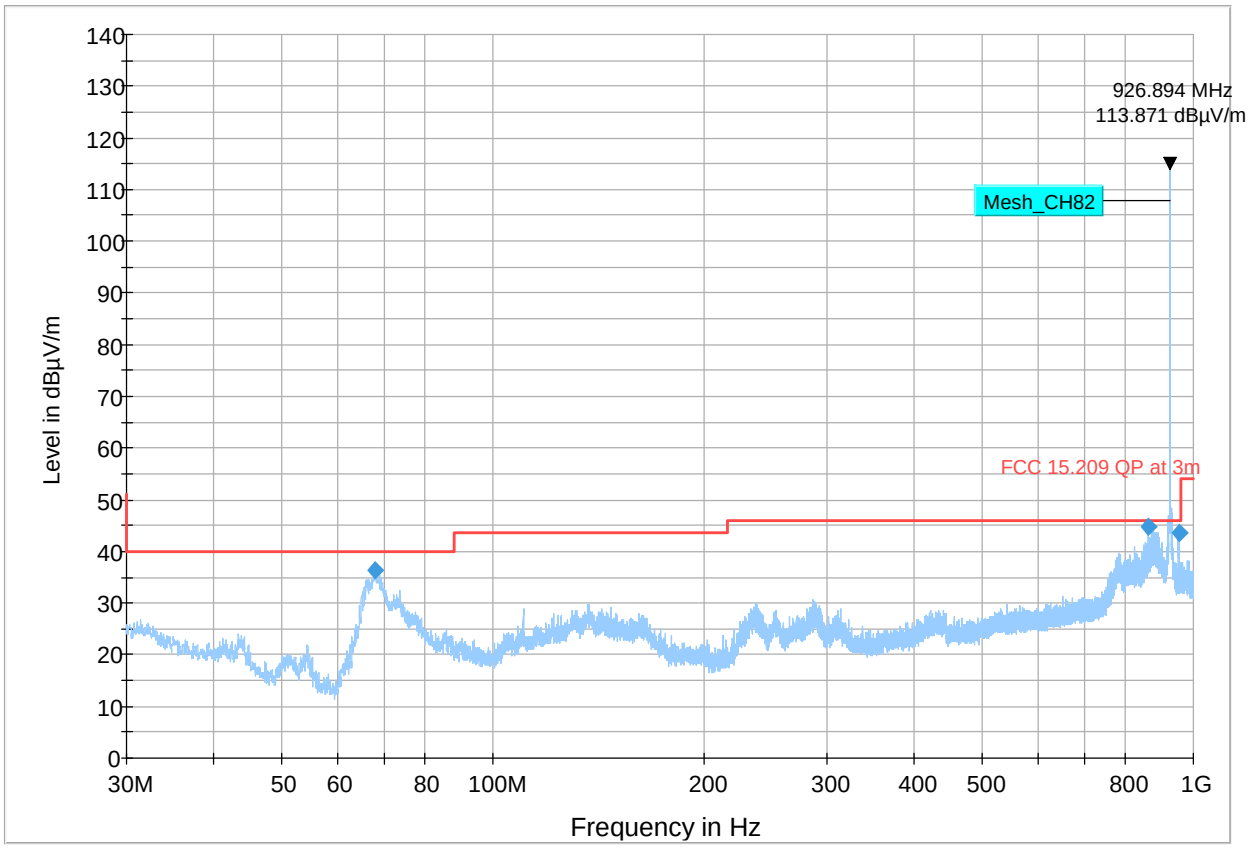
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3759.500	---	43.26	53.98	10.72	500.0	1000.000	116.0	H	303.0	-5.7
3759.500	52.16	---	73.98	21.82	500.0	1000.000	116.0	H	303.0	-5.7
5640.500	---	53.82	53.98	0.16	500.0	1000.000	107.0	V	244.0	-1.1
5640.500	63.53	---	73.98	10.45	500.0	1000.000	107.0	V	244.0	-1.1
7519.500	---	44.39	53.98	9.59	500.0	1000.000	117.0	V	349.0	0.2
7519.500	54.79	---	73.98	19.19	500.0	1000.000	117.0	V	349.0	0.2



Plot # 11

Mesh CH 82: 926.9 MHz | **LTE 2: 1880 MHz**

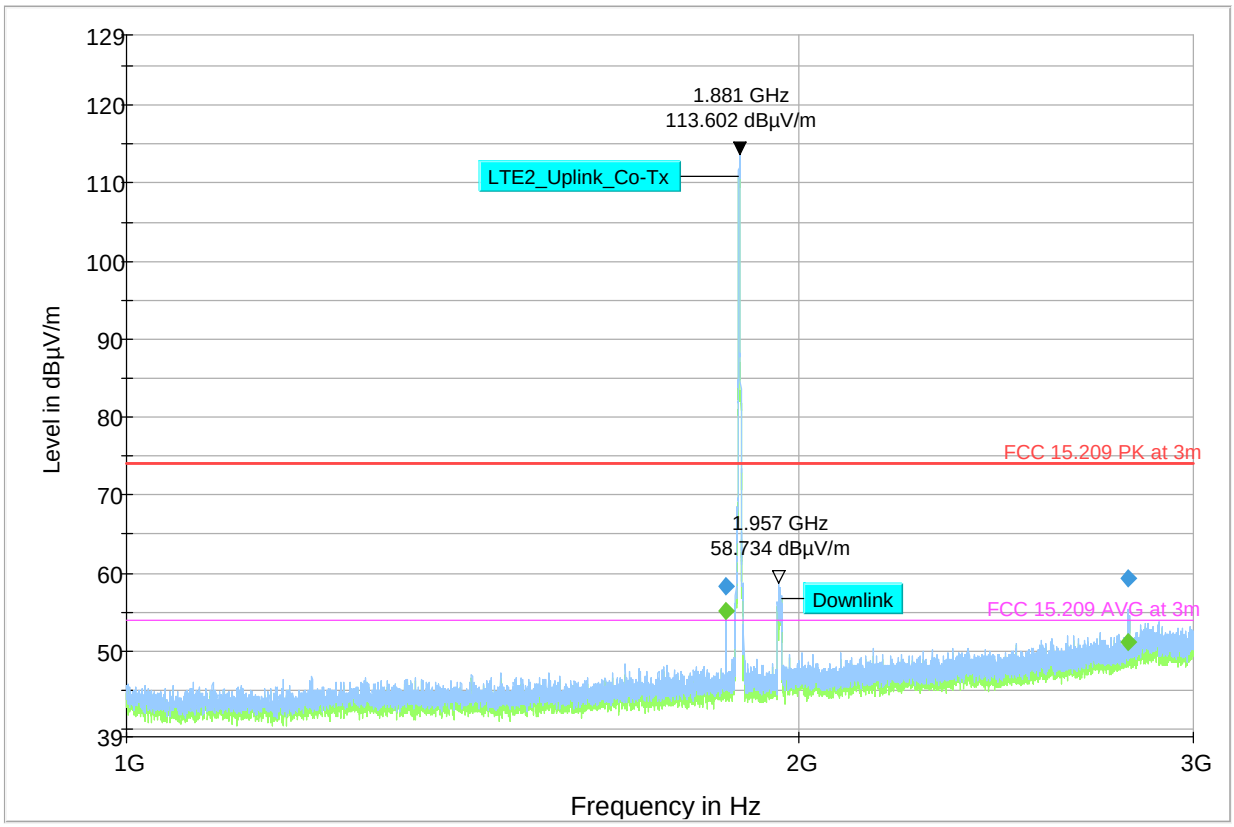
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
67.959	36.45	40.00	3.55	500.0	120.000	264.0	V	76.0	7.1
862.907	44.63	46.02	1.39	500.0	120.000	192.0	H	190.0	25.0
953.925	43.52	46.02	2.50	500.0	120.000	203.0	V	263.0	25.6



Plot # 12

Mesh CH 82: 926.9 MHz	LTE 2: 1880 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1853.714	---	55.23	53.98	-1.25	500.0	1000.000	100.0	H	150.0	14.5
1853.714	58.23	---	73.98	15.75	500.0	1000.000	100.0	H	150.0	14.5
2807.000	---	51.22	53.98	2.76	500.0	1000.000	160.0	V	321.0	17.5
2807.000	59.34	---	73.98	14.64	500.0	1000.000	160.0	V	321.0	17.5



- **Further testing for ~ 1854 MHz [Non-restricted Band]:**
  - **Limits: Non-restricted Band §15.247 and RSS-247 5.5**

FCC15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

- **Measurement according to ANSI C63.10 Section 6.10**

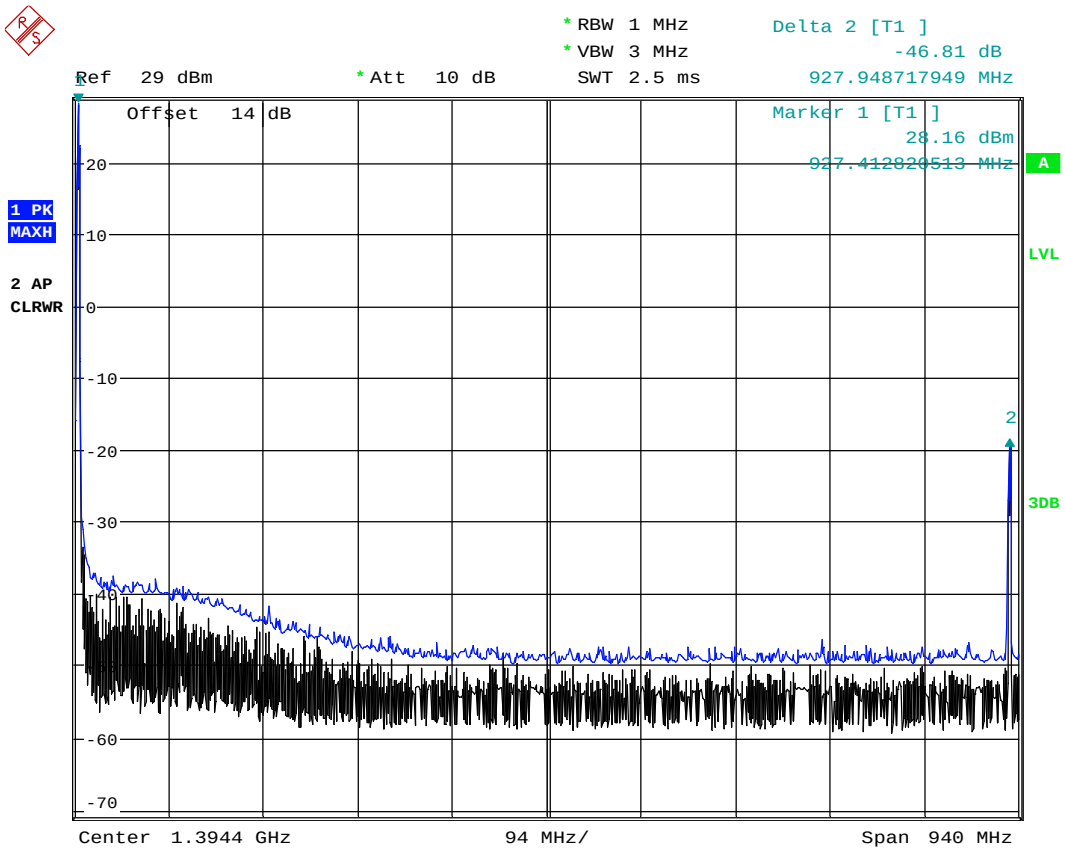
Spectrum Analyzer settings for non-restricted band edge:

- Span: wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW ≥ 1% of the span
- VBW ≥ RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge.
- Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- Now, using the same instrument settings, enable the hopping function of the EUT.
- Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

Spectrum Analyzer settings for restricted band:

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

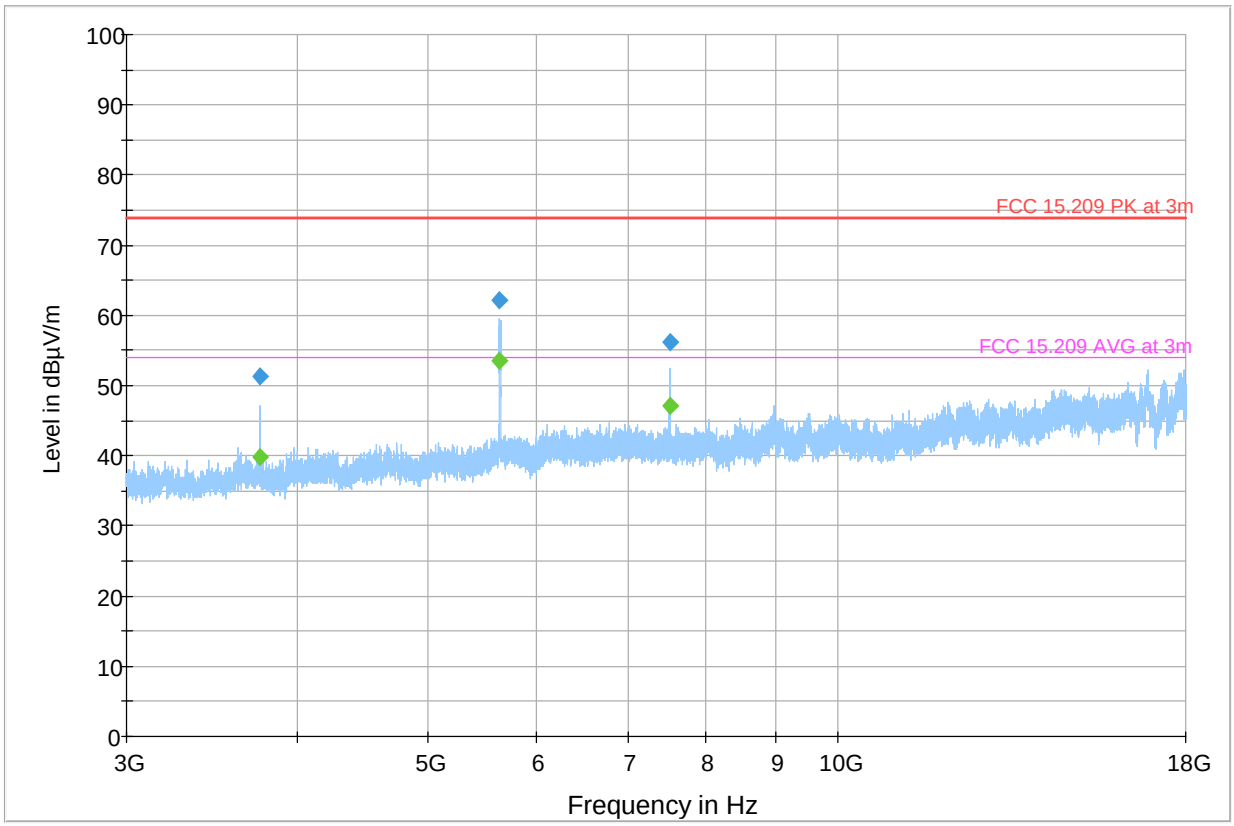
Marker delta (dBc): 46.81	Limit (dBc): >20



Plot # 13

Mesh CH 82: 926.9 MHz | LTE 2: 1880 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3760.000	---	39.91	53.98	14.07	500.0	1000.000	116.0	H	305.0	-5.7
3760.000	51.27	---	73.98	22.71	500.0	1000.000	116.0	H	305.0	-5.7
5637.750	62.27	---	73.98	11.71	500.0	1000.000	117.0	V	243.0	-1.1
5637.750	---	53.61	53.98	0.36	500.0	1000.000	117.0	V	243.0	-1.1
7520.000	56.25	---	73.98	17.73	500.0	1000.000	107.0	V	55.0	0.2
7520.000	---	47.10	53.98	6.88	500.0	1000.000	107.0	V	55.0	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)
- Pre-scan Detector = Peak / Average for
- Final Measurements Detector = Quasi-Peak / Average

8.3.2 Limits: FCC 15.207 & RSS-Gen 8.8

(a) 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 emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

8.3.3 Test conditions and setup:

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

8.3.4 Measurement Result:

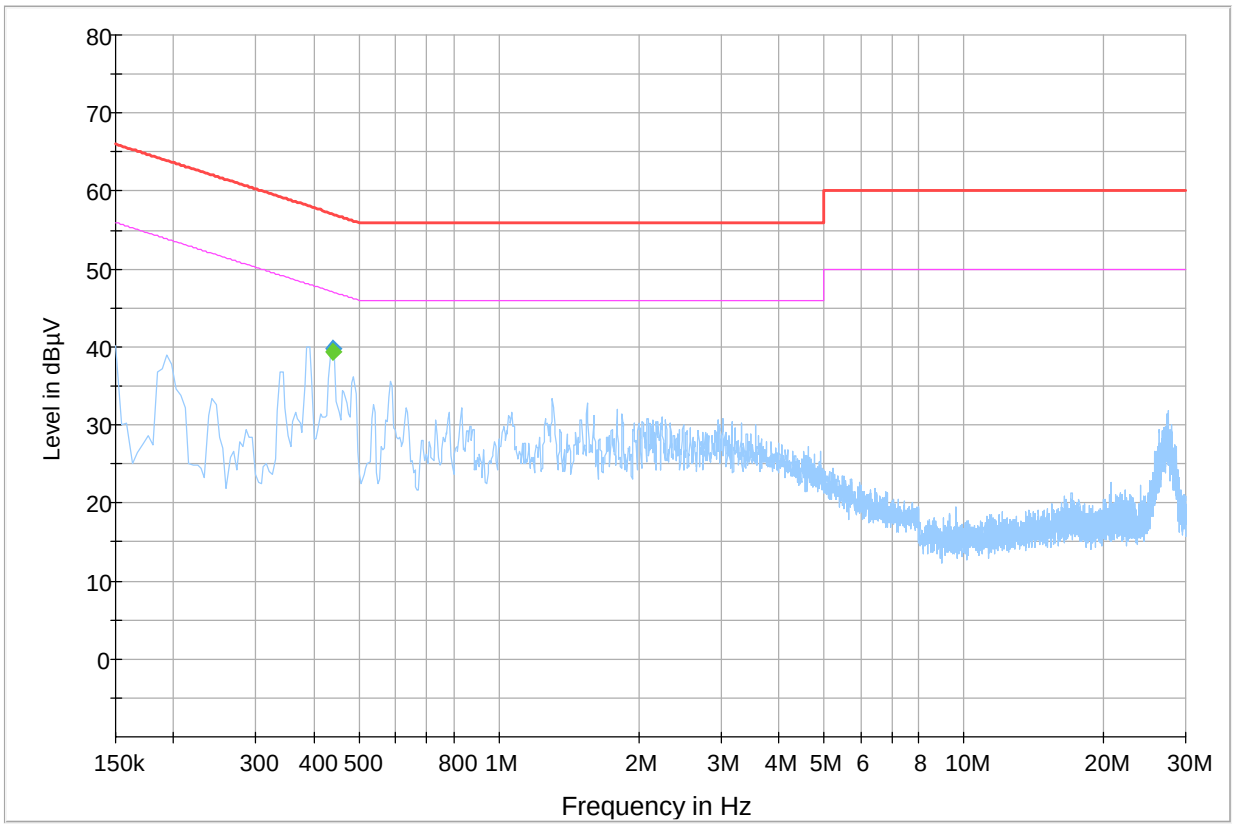
Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Result
14	AC Mains	2	Op. 2	150 kHz – 30 MHz	Pass

8.3.5 Measurement Plots:

Plot # 14

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.440	---	39.46	47.07	7.60	500.0	9.000	L1	GND	10.0
0.440	39.70	---	57.07	17.37	500.0	9.000	L1	GND	10.0



9 Test setup photos

Setup photos are included in supporting file name: "EMC_ITRO1_049_21001_FCC_ISED_ATT_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Active Loop Antenna	ETS Lindgren	6507	161344	2 Years	10/30/2020
Biconilog Antenna	ETS Lindgren	3142E	166067	2 Years	03/12/2020
Horn Antenna	ETS Lindgren	3115	35114	2 Years	10/10/2020
Horn Antenna	ETS Lindgren	3117-PA	215984	2 Years	01/31/2021
Horn Antenna	ETS Lindgren	3116	00070497	2 Years	11/23/2020
Spectrum Analyzer	R&S	ESU40	100251	2 Years	09/13/2021
LISN	FCC	FCC-LISN-50-25-2-08	08014	2 Years	08/31/2021
Thermometer Humidity Monitor	Dickson	TM320	5280063	2 Years	11/02/2020

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 Revision History

Date	Template Revision	Changes to report	Prepared by
2021-09-21	EMC_ITRO1_049_21001_FCC_15.247_DSS_ATT	Initial Version	Issa W Ghanma
2021-11-05	EMC_ITRO1_049_21001_FCC_15.247_DSS_ATT_Rev1	1. Section 1: Add client declaration 2. Section 3.1: Replace "Max. declared output Powers" with "Measured Peak output powers" 3. Section 3.2: Add EUT Sample details for the EUT used for RF conducted output power measurement. (EUT#1) 4. Section 3.3: Add Mode of operation details for the EUT used for RF conducted output power measurement. (Op.1) 5. Section 3.4: Add Test Sample configuration for the EUT used for RF conducted output power. (EUT Set-up # 1) 6. Section 3.5: a. Add Low, and High channels to the statement. b. Add the Co-Transmitter information to the statement. 7. Section 5: a. Update the Test Specification column. b. Add the maximum peak conducted output power to the performed test cases. c. Update the Mode column with the suitable operating mode number for the performed test cases. d. Add Note2. 8. Section 6.3: Update the dates of testing. 9. Add section 7.3 10. Add section 8.1 11. Section 8.2.3: Update the EUT operation mode 12. Section 8.2.4: Update the Plot # and EUT Set-up # 13. Section 8.3.4: Update the Plot #, EUT Set-up #, and EUT operating mode. 14. Section 10: Update test equipment with the latest calibration dates.	Issa W Ghanma

<<< The End >>>