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Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

The Boeing Co. TEST REPORT

SCOPE OF WORK

EMC TESTING – CELLULAR MODULE

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104056598LEX-002.2

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104056598LEX-002.2

Project Number: G104056598

Report Issue Date: 11/18/2020

Model(s) Tested: Cellular Module

Standards: FCC Part 15B
ICES-003 Issue 6

FCC Part 22, FCC Part 24, FCC Part 27, FCC
Part 90, RSS-195 Issue 2, RSS-199 Issue 3,
RSS-130 Issue 2, RSS-132 Issue 3, RSS-133
Issue 6 Amendment 1, RSS-139 Issue 3
(All limited to radiated spurious emissions)

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:
The Boeing Co.
Spectrum Management, MC 1K-105
P.O. Box 3707
Seattle, WA 98124-2207
USA

Report prepared by



Ben Coolbear,
Engineer

Report reviewed by



Bryan Taylor,
Team Leader

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
6	Radiated Emissions (Transmitters Idle) (ANSI C63.4:2014)	Pass
6	Radiated Spurious Emissions (Transmitters Active) (ANSI C63.26:2015)	Pass
7	Conducted Emissions (ANSI C63.4:2014)	NA ¹

1 This test was not applicable as the Cellular Module is used onboard an aircraft and does not connect to the AC mains.



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	The Boeing Co.
Address:	Spectrum Management, MC 1K-105 P.O. Box 3707 Seattle, WA 98124-2207 USA
Contact:	Joel Thorsheim
Email:	joel.d.thorsheim@boeing.com
Manufacturer Information	
Manufacturer Name:	The Boeing Co.
Manufacturer Address:	90 Laurel View Drive Smithfield, PA 15478 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Cellular Module
Supported Transmit Bands	LTE – B1, B2, B3, B4, B5, B7, B8, B9, B12, B13, B18, B19, B20, B26, B28, B29, B30, B32, B41, B46, B66 WCDMA – B1,2,4,5,6,8,9,19
Embedded Module	Sierra Wireless EM7565
Embedded Module hardware Version	1.0
Embedded Module Firmware Version	SWI9X50C_01.08.04.00 08 SWI9X50C_01.07.02.00
Receive Date	11/10/2019
Test Start Date	11/11/2019
Test End Date	11/18/2019
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	3.3V
Rated Current	1.5A
Rated Frequency	DC
Number of Phases	NA
Description of Equipment Under Test (provided by client)	
Cellular Module	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 System Setup and Method

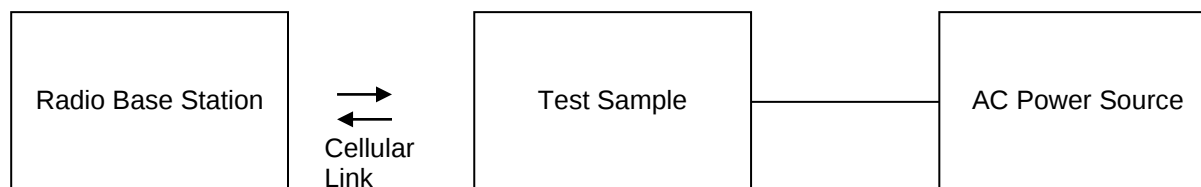
5.1 Method:

Configuration as required by ANSI C63.4:2014.

No.	Descriptions of EUT Exercising
1	The Cellular Module was powered during all tests. The LTE transmitter was disabled during the Part 15B tests
2	The Cellular module was connected to the base station for the LTE and WCDMA test cases. The Base was used to set maximum output power, adjust transmit channel, and resource block settings.

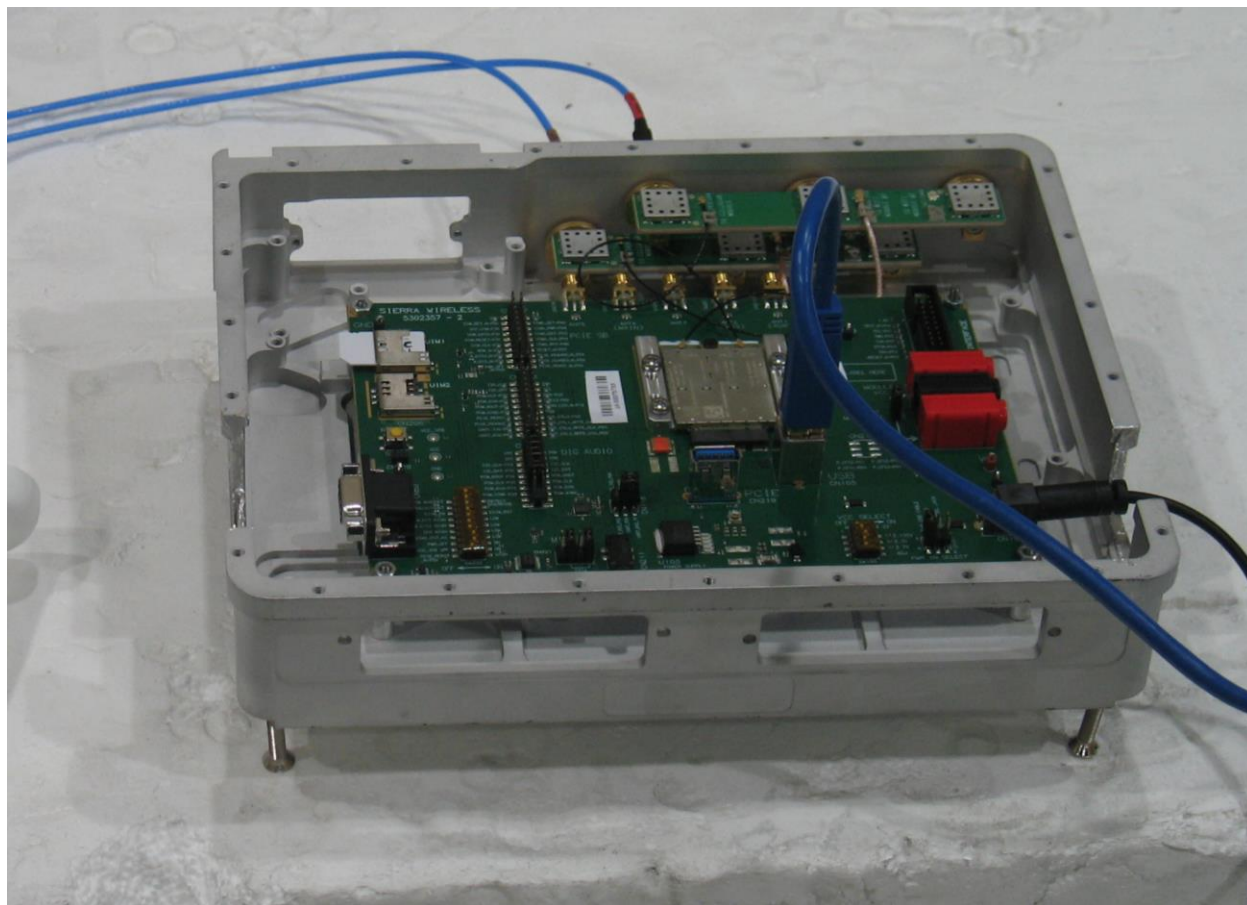
Cables					
#	Description	Length (m)	Shielding	Ferrites	Termination
1	Power cable	2	No	No	AC/DC converter
2	Antenna cables	1	Yes	No	Antenna
1	Ethernet	3	No	No	Network Hub

5.2 EUT Block Diagram:



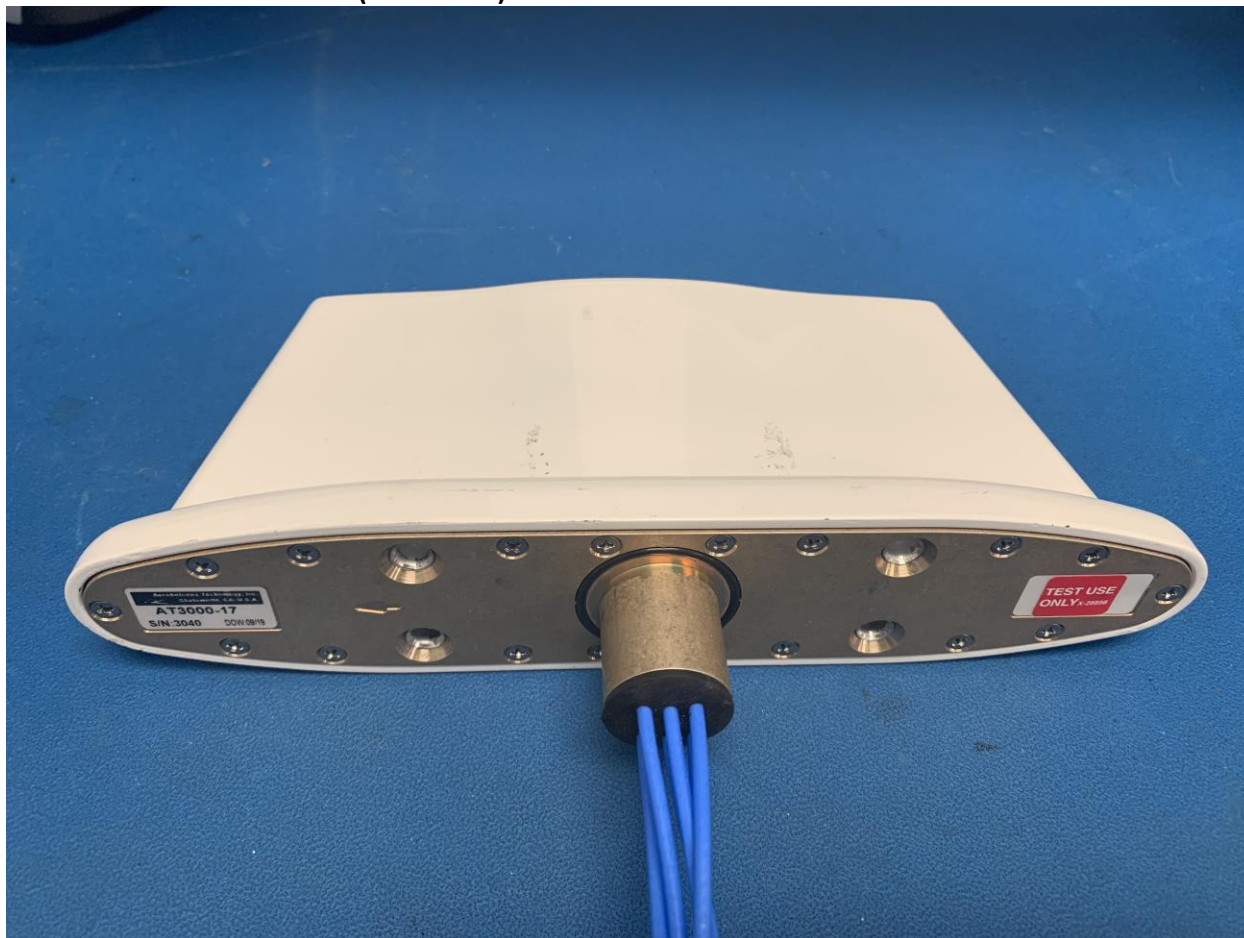


5.3 EUT Photo:





5.1 Antenna Photo (AT3000-17)



Note, the highest gain antenna (AT3000-17) was used for testing. The AT3000-18 antenna may also be used since it has lower gain in the 700 – 1500MHz Band

Antenna p/n	Function	Frequency (MHz)	Max Gain (dBi)	Min Cable Loss (dB)
AT3000-17	WiFi	2400-2500	4	0.5
		5100-5900	5	0.5
	Cellular	700-1500	6	0.5
		1700-2700	4	0.5
AT3000-18	WiFi	2400-2500	4	0.5
		5100-5900	5	0.5
	Cellular	700-1500	4	0.5
		1700-2700	4	0.5



6 Radiated Emissions

6.1 Method

Tests are performed in accordance with ANSI C63.4:2014. And ANSI C63.26

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.



6.2 Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$
$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

6.3 Field Strength to Power Calculation

As allowable by ANSI C63.26: 2015 section 5.2.7, the output power of unwanted emissions can be calculated from a field strength measurement. The transmitter measurements that follow in this report have applied the following calculation to the -13dBm limit to arrive an equivalent field strength limit at 3 meters as follows:

$E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20\log(D) + 104.8$; where D is the measurement distance (in the far field region) in m.

Example:

$$\text{Limit (dB}\mu\text{V/m)} = -13 - 20\log(3) + 104.8 = 82.25 \text{ dB}\mu\text{V/m}$$

**6.4 Test Equipment Used:**

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/18/2019	9/18/2020
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	8/8/2019	8/8/2020
Horn Antenna	3780	ETS Lindgren	3117	6/7/2019	6/7/2020
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/26/2018	11/26/2019
3m Cable Preamplifier	3918	Rohde & Schwarz	TS-PR18	11/26/2018	11/26/2019
3m Cable Preamp→Chamber	2588			11/26/2018	11/26/2019
3m Cable Chamber→Control Room	2593			11/26/2018	11/26/2019
3m Cable Control Room→Receiver	2592			11/26/2018	11/26/2019

6.5 Software Utilized:

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

6.6 Results:

The sample tested was found to Comply.

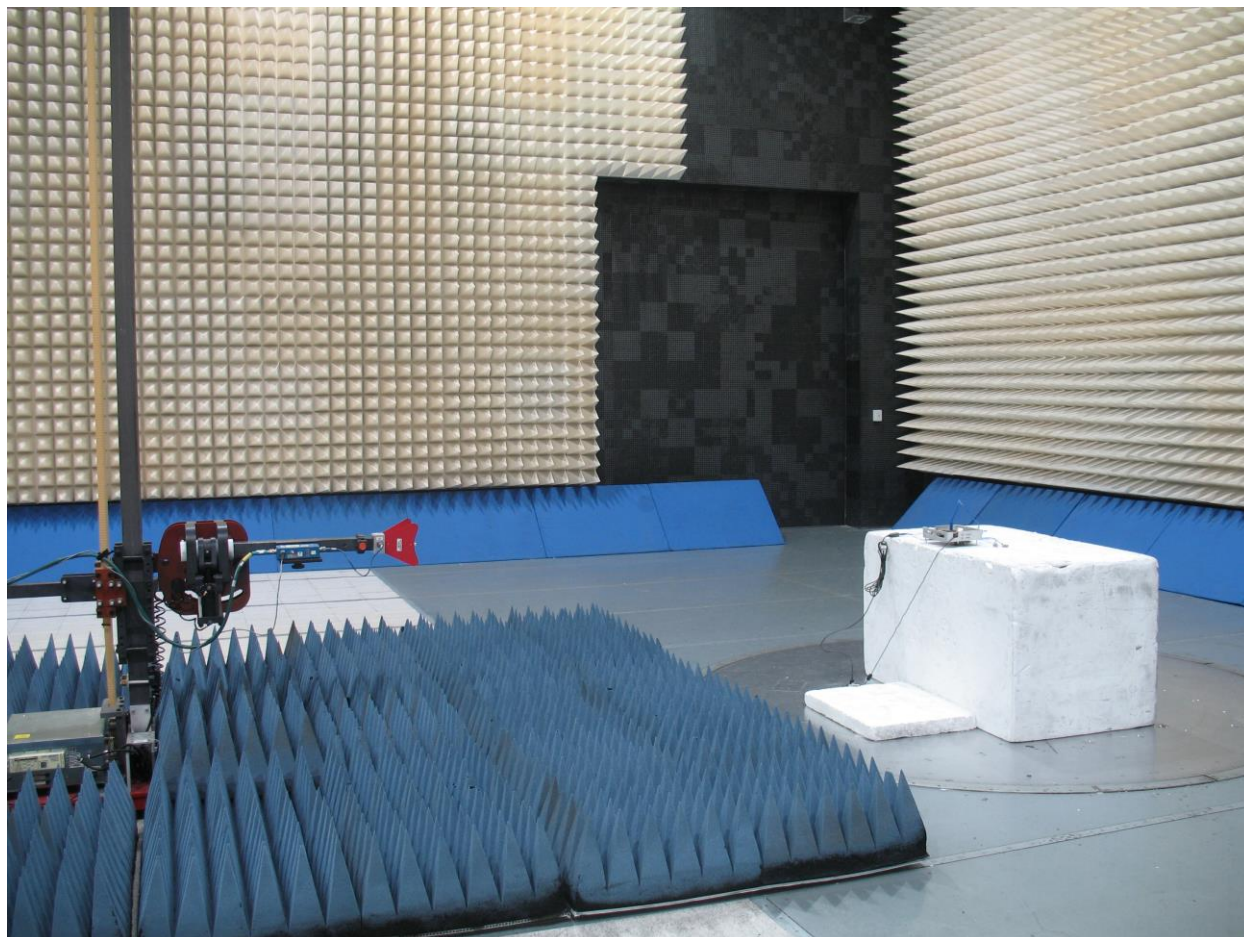


6.7 Setup Photographs: Radiated Emissions (FCC Part 15B, Part 22, Part 24 , Part 27 Below 1GHz)





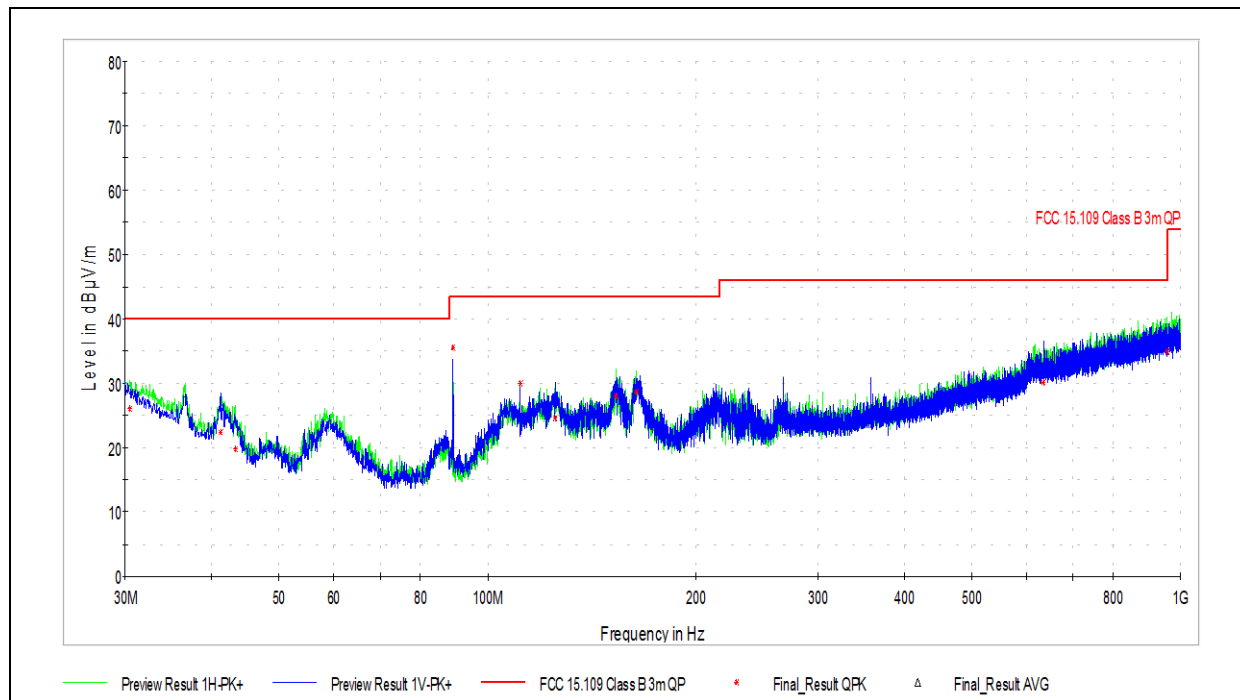
6.8 Setup Photographs: Radiated Emissions (FCC Part 15B Above 1GHz)





6.9 Setup Photographs: Radiated Emissions (FCC Part 22, Part 24, Part 27 Above 1GHz)



**6.10 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.431111	26.08	40.00	13.92	120.000	340.0	H	128.0	28.4
41.155000	22.40	40.00	17.60	120.000	220.0	V	166.0	19.8
43.310556	19.82	40.00	20.18	120.000	256.0	H	74.0	19.1
89.223889	35.58	43.52	7.94	120.000	316.0	V	118.0	16.4
111.533889	29.97	43.52	13.55	120.000	160.0	V	144.0	20.8
125.113889	24.52	43.52	19.00	120.000	124.0	V	163.0	22.0
153.243889	28.06	43.52	15.46	120.000	244.0	H	139.0	21.0
163.913889	28.59	43.52	14.93	120.000	244.0	H	137.0	21.1
633.825000	30.12	46.02	15.90	120.000	316.0	V	72.0	30.1
956.134444	34.96	46.02	11.06	120.000	190.0	H	137.0	34.9

Test Personnel: Michael Carlson

Supervising/Reviewing Engineer: NA
(Where Applicable)

Product Standard: ICES-003 Issue 6

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

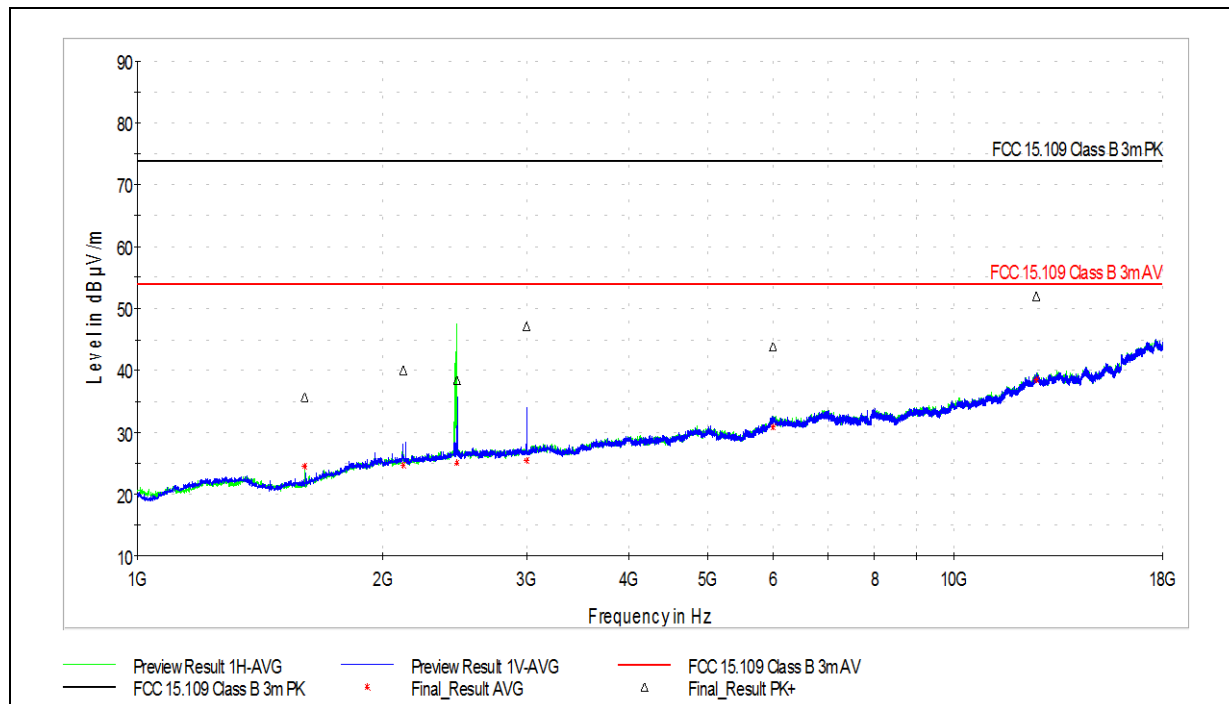
Limit Applied: Class B

Ambient Temperature: 22.5 °C

Relative Humidity: 36.8 %

Atmospheric Pressure: 982.1 mbar

Deviations, Additions, or Exclusions: None

**6.11 Plots/Data: Radiated Emissions, 1GHz – 18GHz (Transmitters Idle)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1603.000000	35.64	73.98	38.34	1000.000	128.0	H	0.0	-2.1
2117.500000	40.00	73.98	33.98	1000.000	410.0	V	11.0	1.9
2462.500000	38.40	73.98	35.58	1000.000	344.0	H	240.0	3.3
2999.500000	47.09	73.98	26.89	1000.000	100.0	V	343.0	4.3
6009.500000	43.88	73.98	30.10	1000.000	372.0	H	73.0	9.2
12626.000000	51.96	73.98	22.02	1000.000	410.0	V	133.0	19.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1603.000000	24.56	53.98	29.42	1000.000	128.0	H	0.0	-2.1
2117.500000	24.65	53.98	29.33	1000.000	410.0	V	11.0	1.9
2462.500000	25.10	53.98	28.88	1000.000	344.0	H	240.0	3.3
2999.500000	25.39	53.98	28.59	1000.000	100.0	V	343.0	4.3
6009.500000	30.77	53.98	23.21	1000.000	372.0	H	73.0	9.2
12626.000000	38.41	53.98	15.57	1000.000	410.0	V	133.0	19.0

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 15B

Input Voltage: ICES-003 Issue 6

Pretest Verification w / Ambient Signals or BB Source: 3.3VDC

Yes

Test Date: 11/18/2019

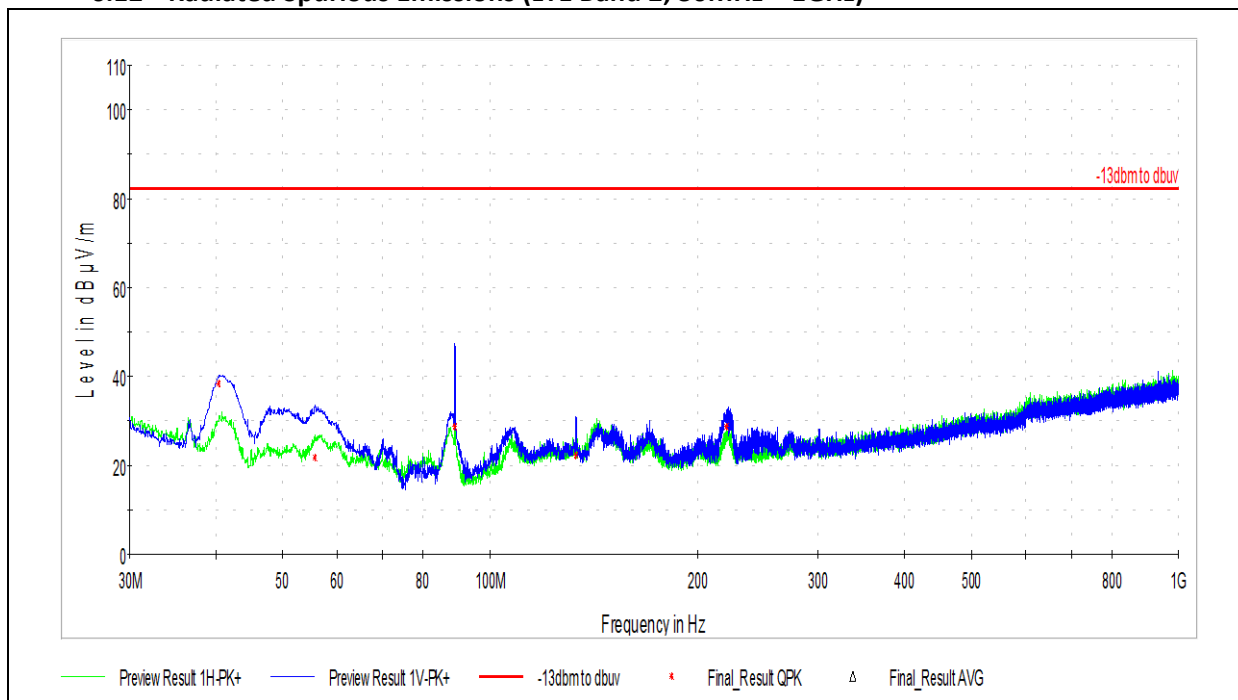
Limit Applied: Class B

Ambient Temperature: 22.5 °C

Relative Humidity: 29.8 %

Atmospheric Pressure: 977.0 mbar

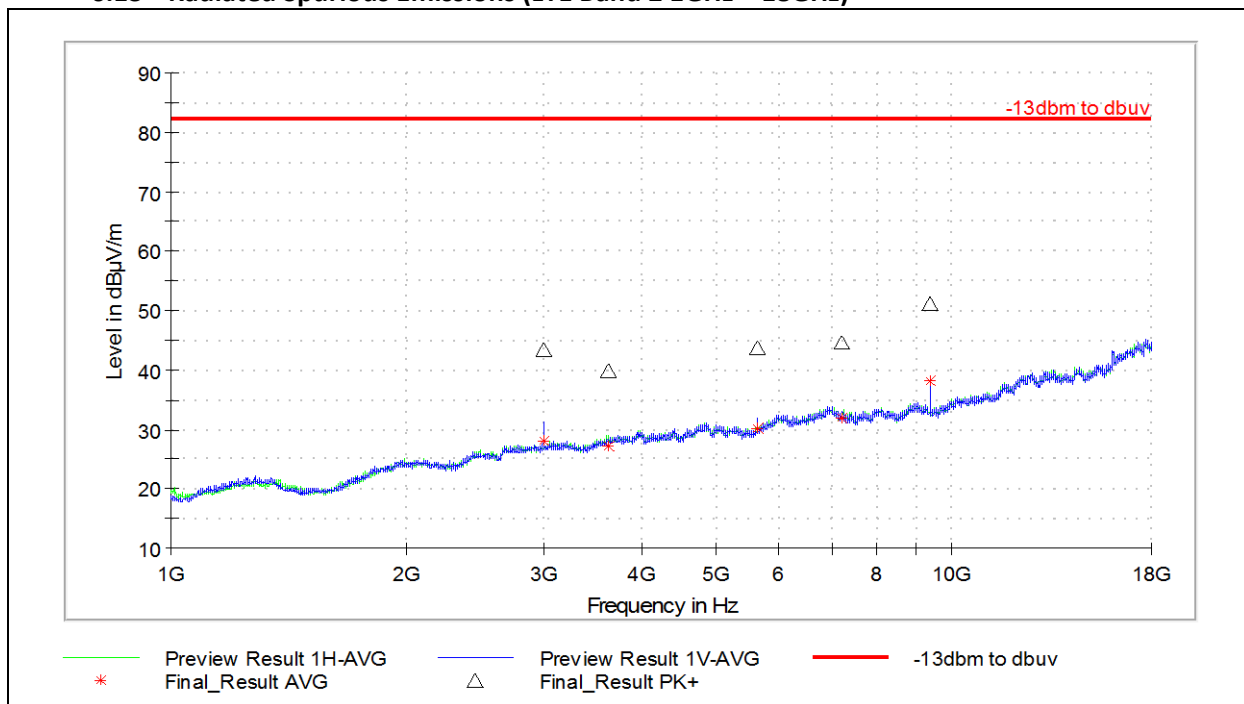
Deviations, Additions, or Exclusions: None

**6.12 Radiated Spurious Emissions (LTE Band 2; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.400556	38.20	82.25	44.05	120.000	100.0	V	209.0	20.4
55.758889	21.51	82.25	60.74	120.000	105.1	V	274.0	14.7
89.008333	28.60	82.25	53.65	120.000	100.0	V	130.0	16.4
133.520556	22.15	82.25	60.10	120.000	100.1	V	182.0	21.9
220.335556	28.55	82.25	53.70	120.000	99.7	V	346.0	19.9

Test Personnel: Ben Coolbear
 Supervising/Reviewing Engineer: NA
 (Where Applicable)
 Product Standard: FCC Part 24
 Input Voltage: 3.3VDC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/11/2019
 Limit Applied: -13 dBµv
 Ambient Temperature: 22.5 °C
 Relative Humidity: 36.8 %
 Atmospheric Pressure: 982.1 mbar

**6.13 Radiated Spurious Emissions (LTE Band 2 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
3000.500000	43.39	82.25	38.86	1000.000	318.0	V	270.0	4.3
3623.500000	40.03	82.25	42.22	1000.000	100.0	H	23.0	5.2
5629.000000	43.71	82.25	38.54	1000.000	109.0	H	158.0	8.2
7240.000000	44.78	82.25	37.47	1000.000	410.0	V	336.0	11.1
9383.500000	51.25	82.25	31.00	1000.000	371.0	V	100.0	12.9

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
3000.500000	27.97	82.25	54.28	1000.000	318.0	V	270.0	4.3
3623.500000	27.20	82.25	55.05	1000.000	100.0	H	23.0	5.2
5629.000000	30.02	82.25	52.23	1000.000	109.0	H	158.0	8.2
7240.000000	31.79	82.25	50.46	1000.000	410.0	V	336.0	11.1
9383.500000	38.20	82.25	44.05	1000.000	371.0	V	100.0	12.9

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 24

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

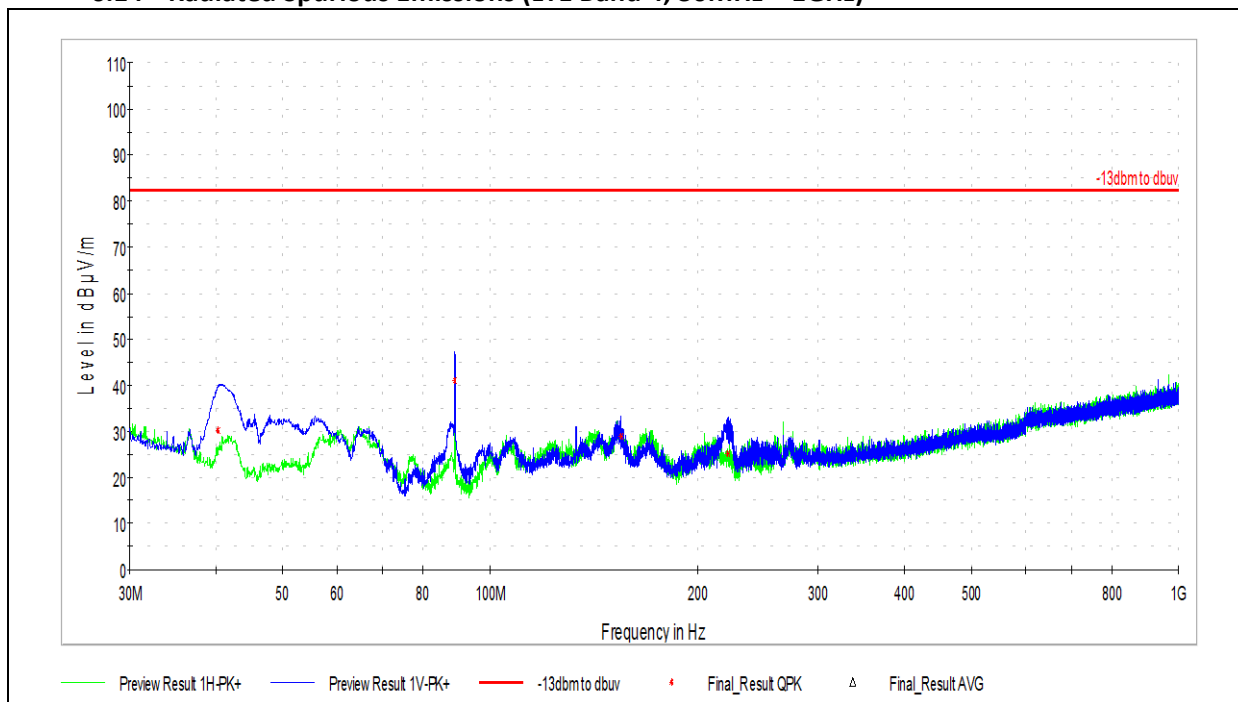
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

Deviations, Additions, or Exclusions: None

**6.14 Radiated Spurious Emissions (LTE Band 4; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.292778	30.16	82.25	52.09	120.000	100.1	V	256.0	20.4
89.008333	41.14	82.25	41.11	120.000	100.1	V	165.0	16.4
155.130000	28.93	82.25	53.32	120.000	105.1	V	99.0	21.1
221.736667	25.19	82.25	57.06	120.000	104.3	V	308.0	19.9

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

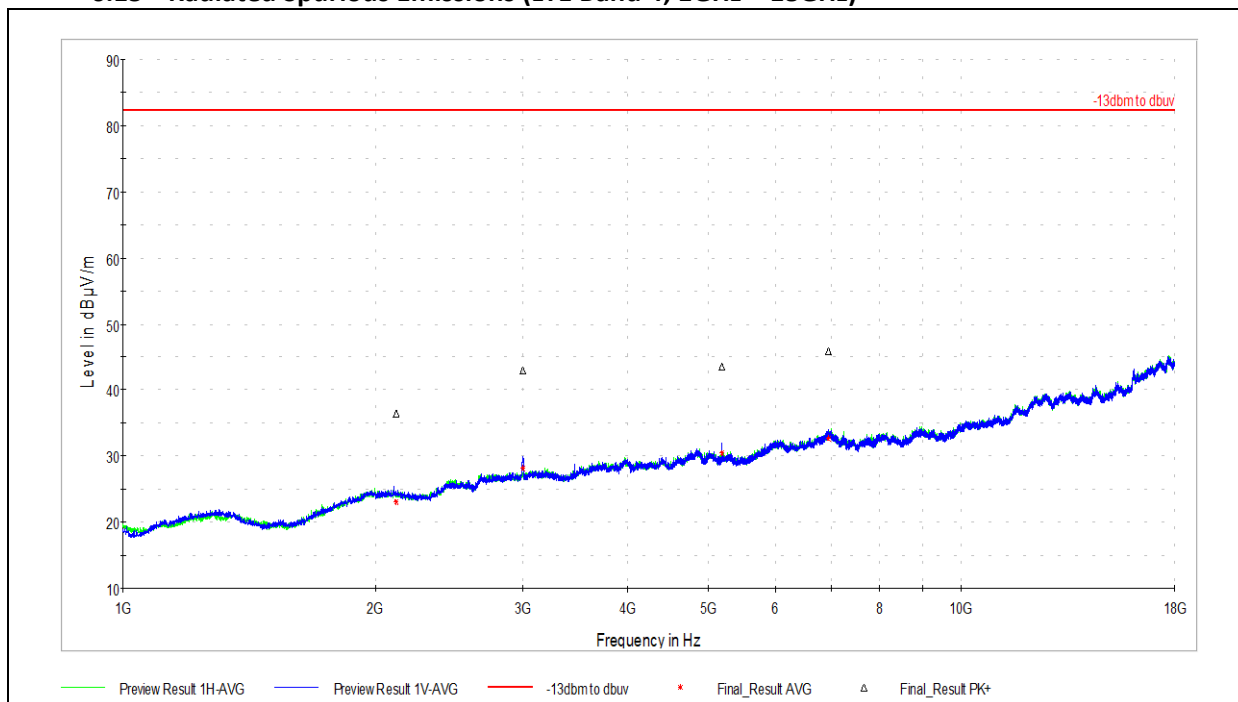
Test Date: 11/11/2019

Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

**6.15 Radiated Spurious Emissions (LTE Band 4; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2118.500000	36.36	82.25	45.89	1000.000	410.0	V	252.0	1.9
2997.000000	42.97	82.25	39.28	1000.000	352.0	V	272.0	4.3
5188.000000	43.47	82.25	38.78	1000.000	362.0	V	46.0	7.6
6950.000000	45.83	82.25	36.42	1000.000	410.0	V	47.0	10.8

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2118.500000	23.07	82.25	59.18	1000.000	410.0	V	252.0	1.9
2997.000000	28.18	82.25	54.07	1000.000	352.0	V	272.0	4.3
5188.000000	30.45	82.25	51.80	1000.000	362.0	V	46.0	7.6
6950.000000	32.64	82.25	49.61	1000.000	410.0	V	47.0	10.8

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

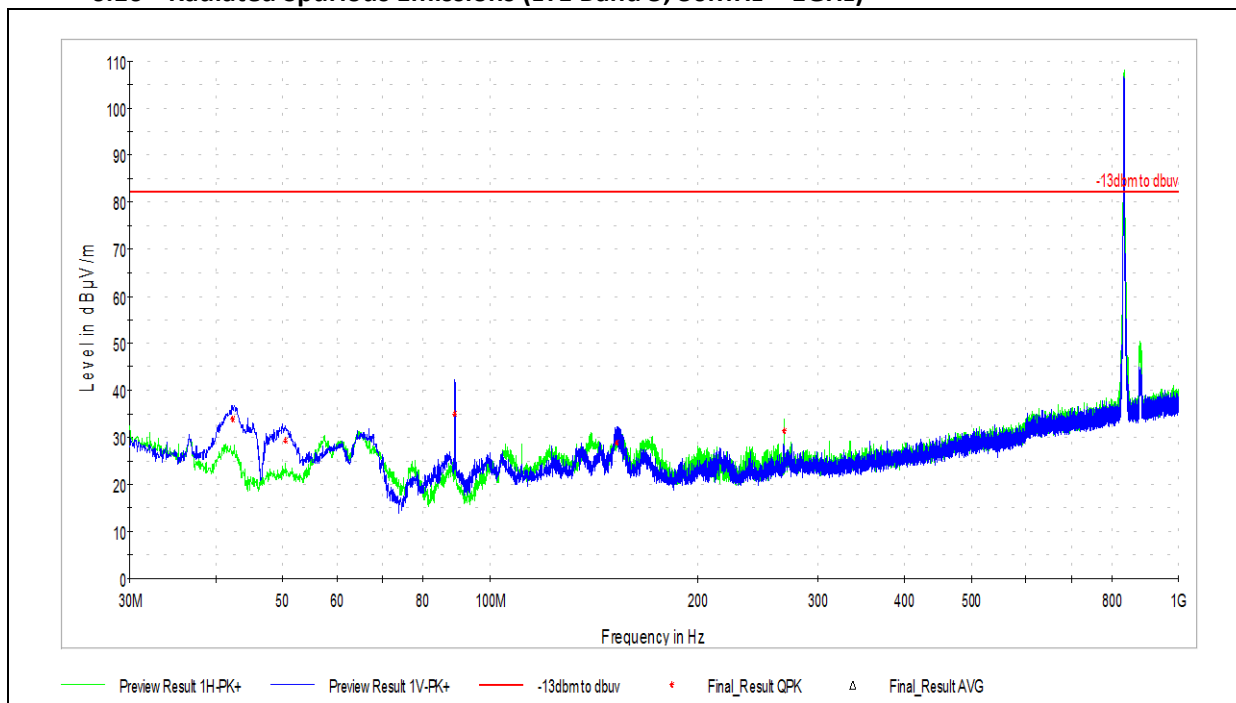
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

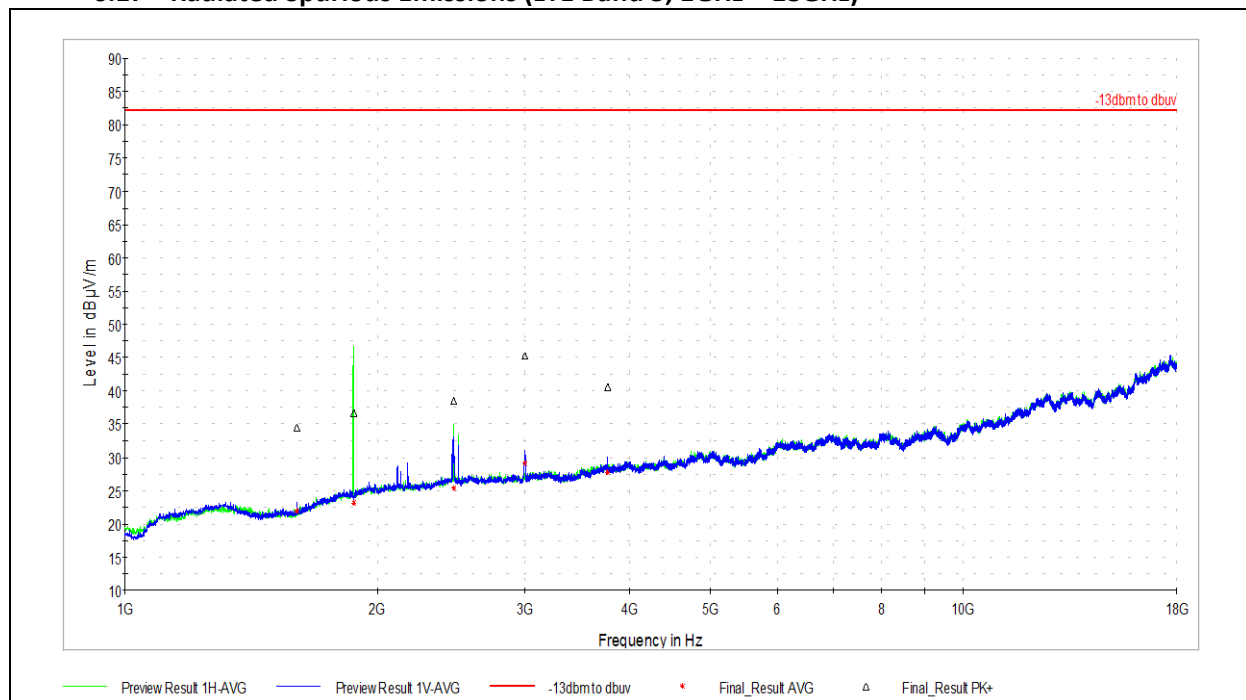
Deviations, Additions, or Exclusions: None

**6.16 Radiated Spurious Emissions (LTE Band 5; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.286667	33.83	82.25	48.42	120.000	105.0	V	238.0	19.0
50.477778	29.21	82.25	53.04	120.000	104.6	V	210.0	15.2
89.008333	35.06	82.25	47.19	120.000	109.9	V	147.0	16.4
152.920556	28.86	82.25	53.39	120.000	105.1	V	93.0	21.1
267.272778	31.32	82.25	50.93	120.000	106.6	H	275.0	22.5

Test Personnel: Ben Coolbear
Supervising/Reviewing Engineer: _____
(Where Applicable) NA
Product Standard: FCC Part 22
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/11/2019
Limit Applied: -13 dBμv
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.17 Radiated Spurious Emissions (LTE Band 5; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1604.500000	34.56	82.25	47.69	1000.000	285.0	V	222.0	-2.0
1873.000000	36.69	82.25	45.56	1000.000	410.0	H	169.0	1.2
2466.500000	38.55	82.25	43.70	1000.000	364.0	H	0.0	3.3
3000.000000	45.26	82.25	36.99	1000.000	356.0	V	275.0	4.3
3769.000000	40.54	82.25	41.71	1000.000	410.0	V	74.0	5.7

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1604.500000	21.90	82.25	60.35	1000.000	285.0	V	222.0	-2.0
1873.000000	23.14	82.25	59.11	1000.000	410.0	H	169.0	1.2
2466.500000	25.40	82.25	56.85	1000.000	364.0	H	0.0	3.3
3000.000000	29.08	82.25	53.17	1000.000	356.0	V	275.0	4.3
3769.000000	27.69	82.25	54.56	1000.000	410.0	V	74.0	5.7

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 22

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

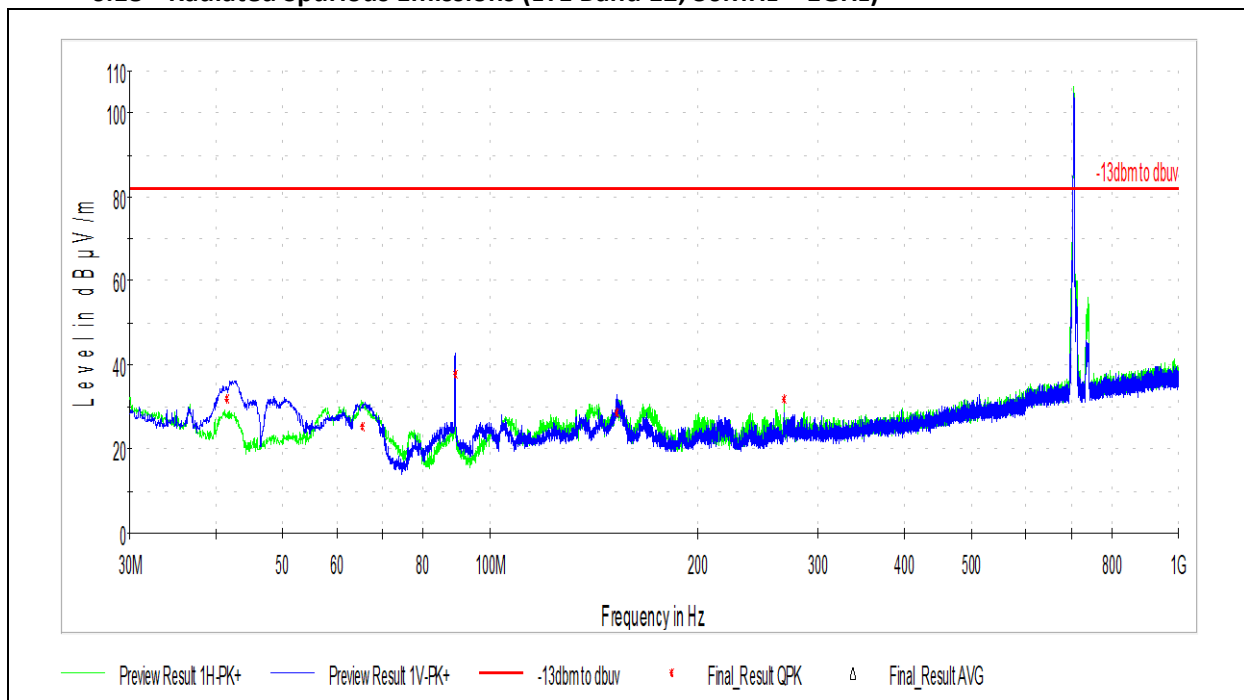
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

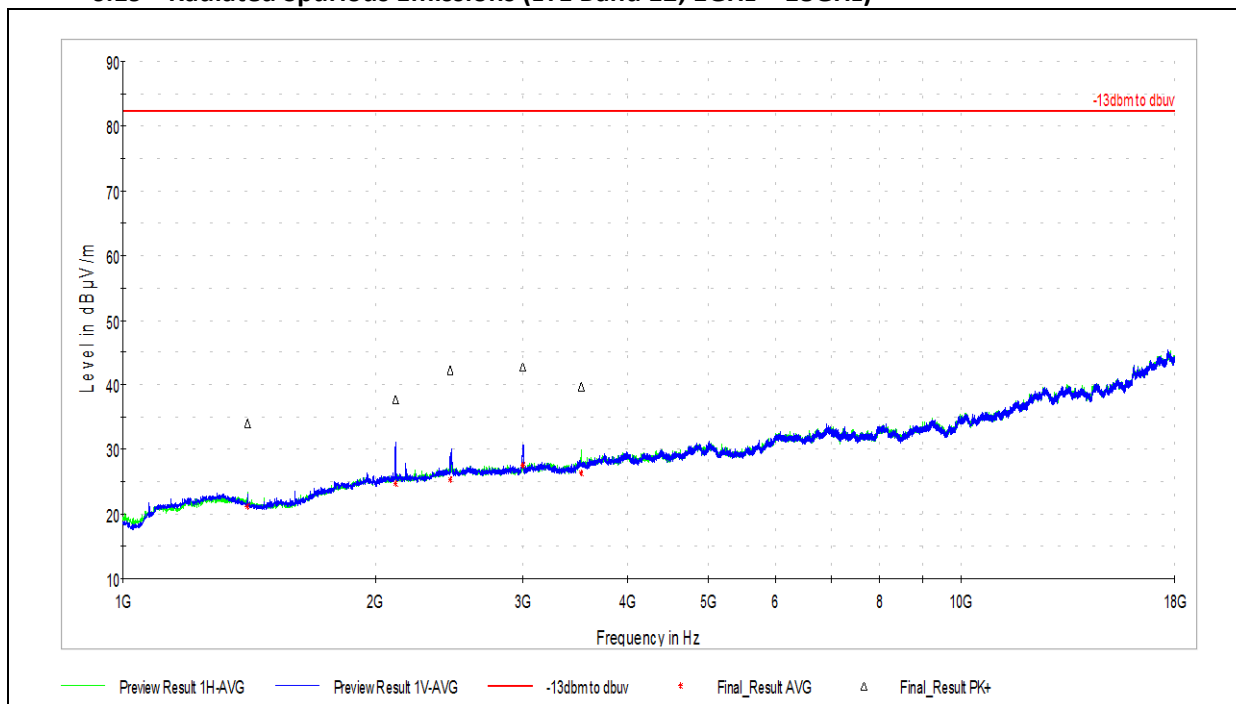
Deviations, Additions, or Exclusions: None

**6.18 Radiated Spurious Emissions (LTE Band 12; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.532222	31.75	82.25	50.50	120.000	105.1	V	246.0	19.5
65.297222	25.14	82.25	57.11	120.000	285.2	H	184.0	15.3
89.062222	37.95	82.25	44.30	120.000	100.1	V	175.0	16.4
152.866667	28.59	82.25	53.66	120.000	108.1	V	95.0	21.1
267.272778	31.90	82.25	50.35	120.000	106.8	H	273.0	22.5

Test Personnel: Ben Coolbear
Supervising/Reviewing Engineer: _____
(Where Applicable) NA
Product Standard: FCC Part 27
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/11/2019
Limit Applied: -13 dBµv
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.19 Radiated Spurious Emissions (LTE Band 12; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1407.000000	34.03	82.25	48.22	1000.000	220.0	H	82.0	-2.0
2112.000000	37.80	82.25	44.45	1000.000	250.0	V	13.0	1.9
2457.000000	42.23	82.25	40.02	1000.000	368.0	H	0.0	3.3
2998.000000	42.73	82.25	39.52	1000.000	353.0	V	266.0	4.3
3520.000000	39.67	82.25	42.58	1000.000	100.0	H	197.0	5.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1407.000000	21.20	82.25	61.05	1000.000	220.0	H	82.0	-2.0
2112.000000	24.66	82.25	57.59	1000.000	250.0	V	13.0	1.9
2457.000000	25.37	82.25	56.88	1000.000	368.0	H	0.0	3.3
2998.000000	27.55	82.25	54.70	1000.000	353.0	V	266.0	4.3
3520.000000	26.36	82.25	55.89	1000.000	100.0	H	197.0	5.0

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

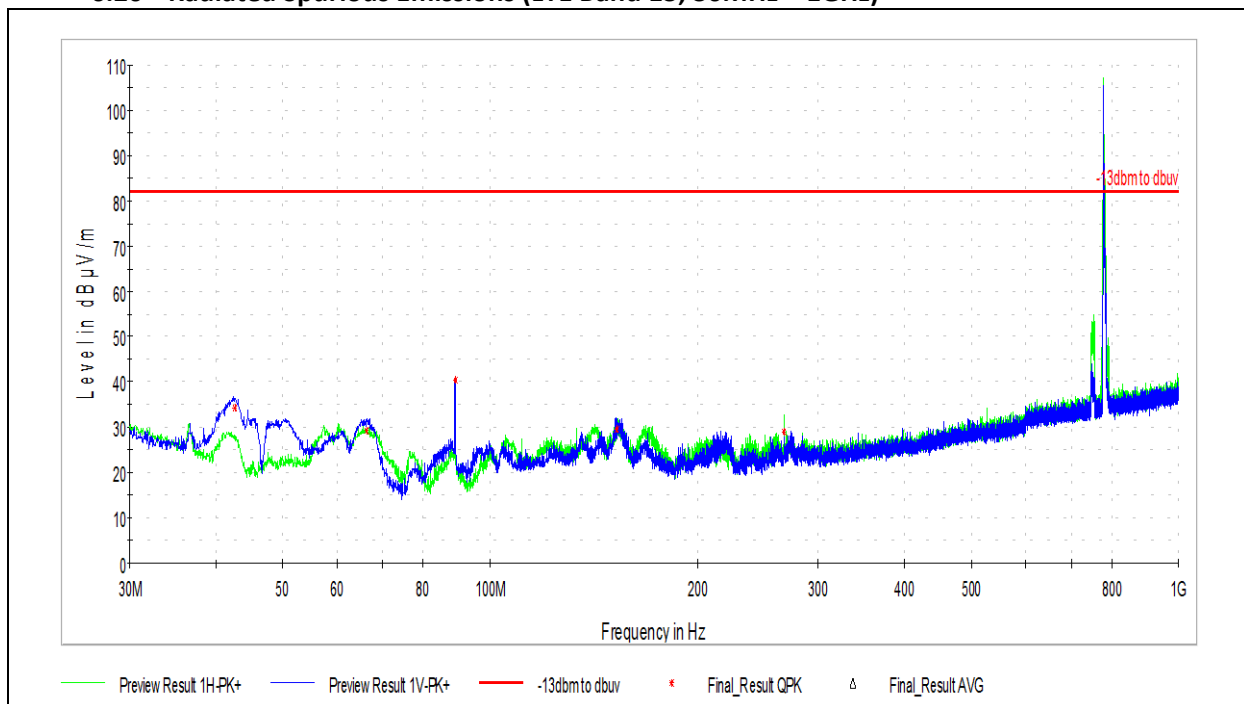
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

Deviations, Additions, or Exclusions: None

**6.20 Radiated Spurious Emissions (LTE Band 13; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.610000	34.19	82.25	48.06	120.000	104.7	V	240.0	18.8
66.159445	29.20	82.25	53.05	120.000	100.4	V	166.0	14.4
89.062222	40.41	82.25	41.84	120.000	106.2	V	146.0	16.4
153.028333	29.42	82.25	52.83	120.000	105.2	V	92.0	21.1
267.165000	28.94	82.25	53.31	120.000	118.2	H	269.0	22.5

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: _____

(Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

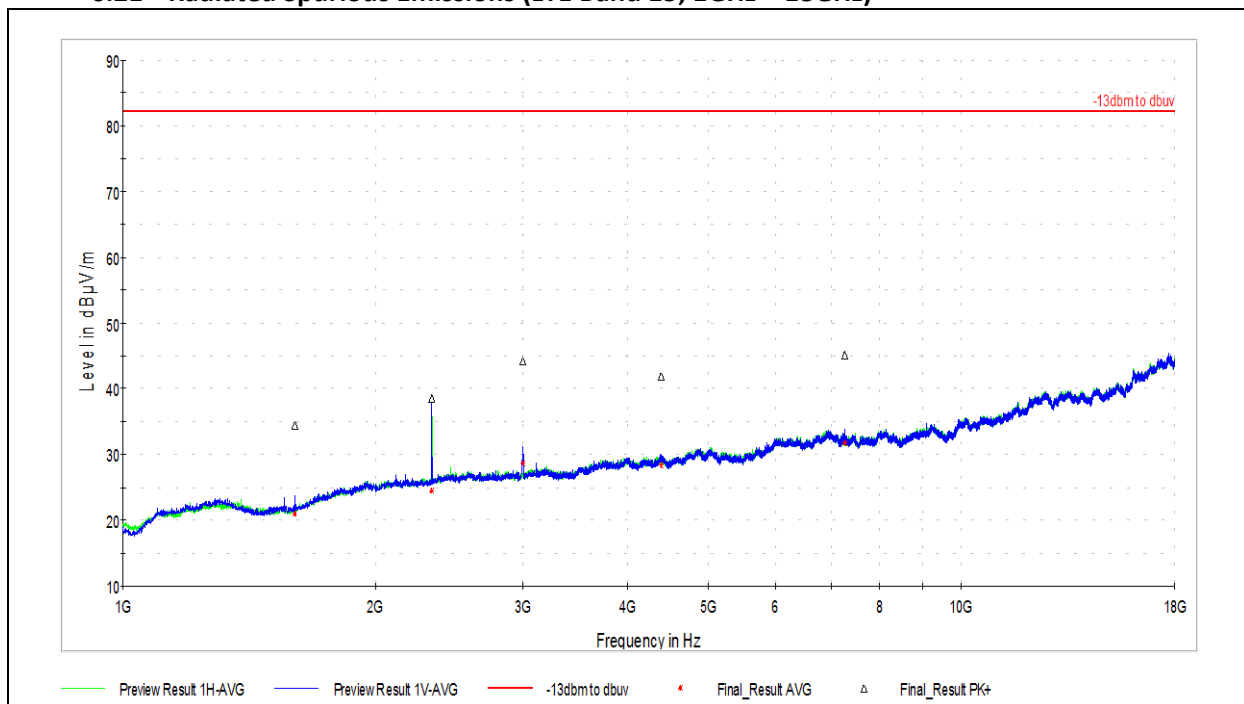
Test Date: 11/12/2019

Limit Applied: -13 dBμV

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

**6.21 Radiated Spurious Emissions (LTE Band 13; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1604.000000	34.50	82.25	47.75	1000.000	344.0	V	233.0	-2.0
2337.000000	38.45	82.25	43.80	1000.000	410.0	V	326.0	2.6
3000.500000	44.15	82.25	38.10	1000.000	294.0	V	0.0	4.3
4385.500000	41.92	82.25	40.33	1000.000	410.0	H	329.0	6.5
7260.500000	45.22	82.25	37.03	1000.000	410.0	H	145.0	11.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1604.000000	20.99	82.25	61.26	1000.000	344.0	V	233.0	-2.0
2337.000000	24.52	82.25	57.73	1000.000	410.0	V	326.0	2.6
3000.500000	28.58	82.25	53.67	1000.000	294.0	V	0.0	4.3
4385.500000	28.32	82.25	53.93	1000.000	410.0	H	329.0	6.5
7260.500000	31.74	82.25	50.51	1000.000	410.0	H	145.0	11.0

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

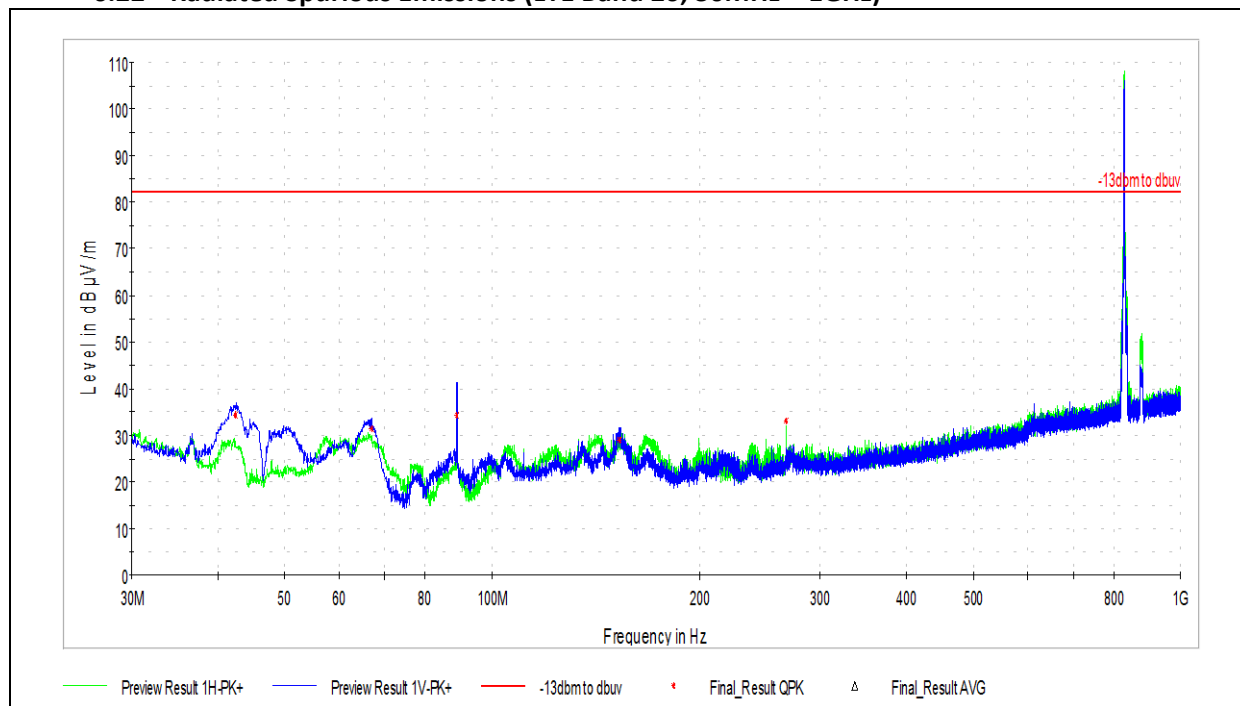
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

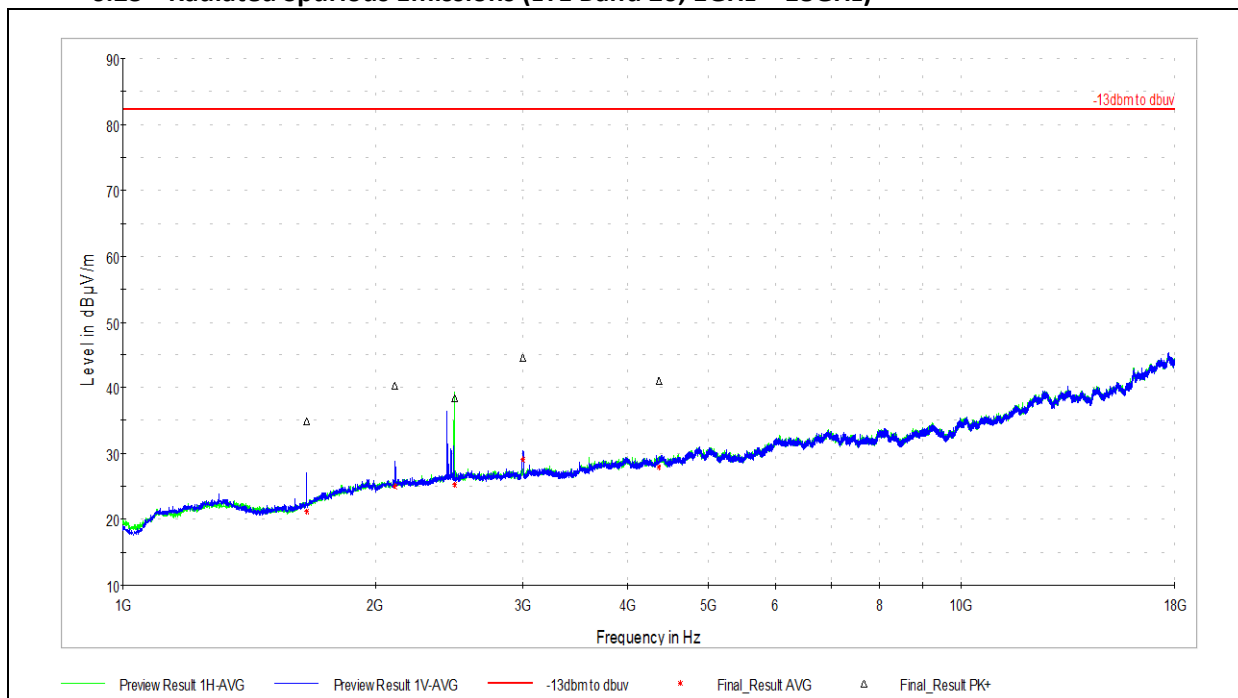
Deviations, Additions, or Exclusions: None

**6.22 Radiated Spurious Emissions (LTE Band 26; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.394445	34.28	82.25	47.97	120.000	105.0	V	236.0	18.9
66.806111	31.31	82.25	50.94	120.000	100.1	V	173.0	14.4
89.008333	34.44	82.25	47.81	120.000	100.0	V	166.0	16.4
153.405556	28.97	82.25	53.28	120.000	105.3	V	92.0	21.1
267.326667	33.15	82.25	49.10	120.000	106.5	H	283.0	22.5

Test Personnel: Ben Coolbear
 Supervising/Reviewing Engineer: _____
 (Where Applicable) NA
 Product Standard: FCC Part 90
 Input Voltage: 3.3VDC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
 Limit Applied: -13 dBμv
 Ambient Temperature: 21.8 °C
 Relative Humidity: 21.1 %
 Atmospheric Pressure: 997.5 mbar

**6.23 Radiated Spurious Emissions (LTE Band 26; 1GHz – 18GHz)**

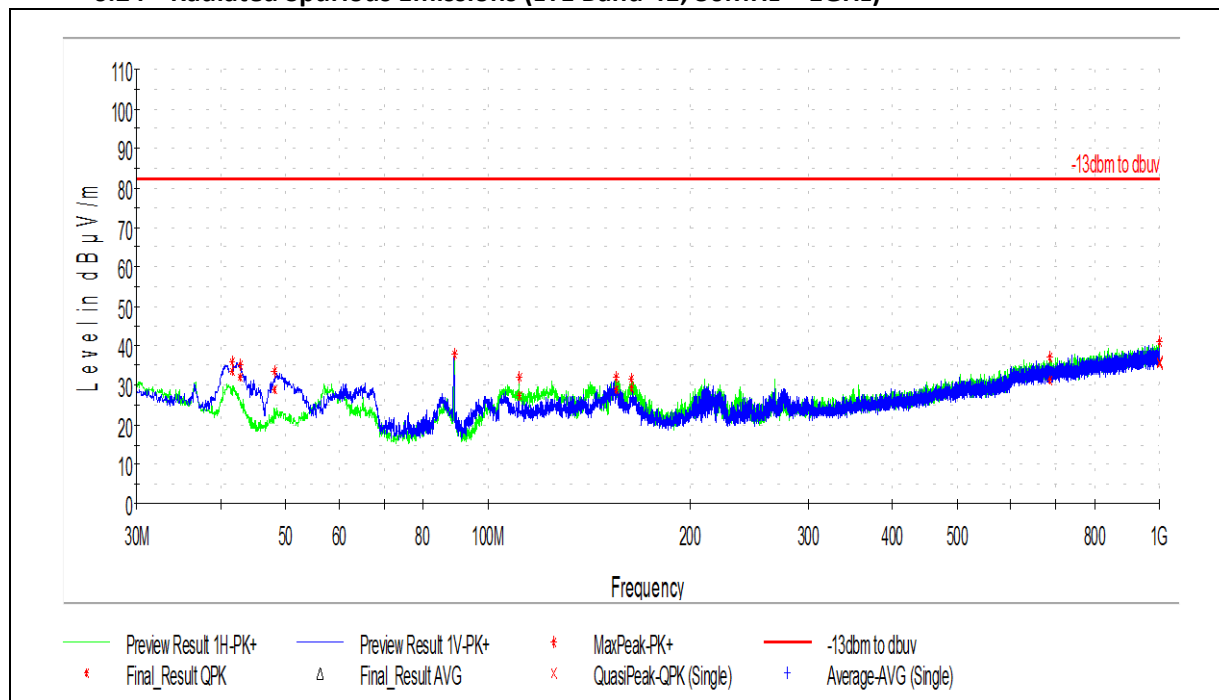
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1655.000000	34.98	82.25	47.27	1000.000	410.0	V	270.0	-1.5
2111.500000	40.26	82.25	41.99	1000.000	322.0	V	0.0	1.9
2485.500000	38.46	82.25	43.79	1000.000	100.0	H	38.0	3.4
3001.500000	44.49	82.25	37.76	1000.000	250.0	V	-1.0	4.3
4365.000000	40.98	82.25	41.27	1000.000	410.0	H	0.0	6.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1655.000000	21.26	82.25	60.99	1000.000	410.0	V	270.0	-1.5
2111.500000	24.98	82.25	57.27	1000.000	322.0	V	0.0	1.9
2485.500000	25.26	82.25	56.99	1000.000	100.0	H	38.0	3.4
3001.500000	29.02	82.25	53.23	1000.000	250.0	V	-1.0	4.3
4365.000000	27.91	82.25	54.34	1000.000	410.0	H	0.0	6.4

Test Personnel: Ben Coolbear
 Supervising/Reviewing Engineer: _____
 (Where Applicable) NA
 Product Standard: FCC Part 90
 Input Voltage: 3.3VDC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
 Limit Applied: -13 dBμV
 Ambient Temperature: 21.8 °C
 Relative Humidity: 21.1 %
 Atmospheric Pressure: 997.5 mbar

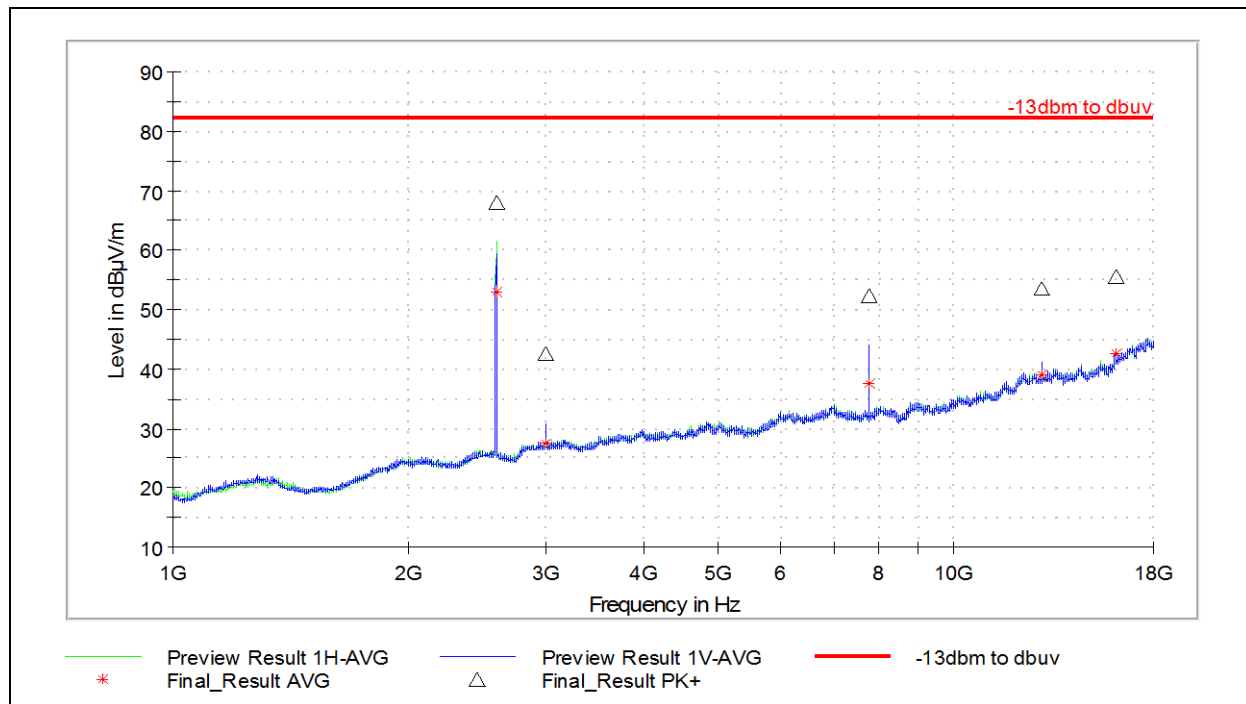
Deviations, Additions, or Exclusions: None

**6.24 Radiated Spurious Emissions (LTE Band 41; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.640000	33.54	82.25	48.71	1000.0	120.000	100.2	V	240.0	19.4
42.717778	32.00	82.25	50.25	1000.0	120.000	105.3	V	237.0	18.7
48.106667	29.01	82.25	53.24	1000.0	120.000	100.1	V	199.0	16.1
89.116111	37.99	82.25	44.26	1000.0	120.000	213.0	H	108.0	15.3
111.318333	27.35	82.25	54.90	1000.0	120.000	260.9	H	126.0	20.7
155.345556	28.90	82.25	53.35	1000.0	120.000	178.1	H	312.0	21.1
163.644445	29.22	82.25	53.03	1000.0	120.000	181.0	H	304.0	21.1
686.851667	31.12	82.25	51.13	1000.0	120.000	347.3	H	183.0	31.3

Test Personnel: Ben Coolbear
Supervising/Reviewing Engineer:
(Where Applicable) NA
Product Standard: FCC Part 27
Input Voltage: 3.3VDC
Pretest Verification w / Ambient
Signals or BB Source: Yes

Test Date: 11/12/2019
Limit Applied: -13 dBμv
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.25 Radiated Spurious Emissions (LTE Band 41; 1GH – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2589.000000	68.09	82.25	14.16	1000.000	398.0	H	224.0	3.5
3000.500000	42.45	82.25	39.80	1000.000	269.0	V	348.0	4.3
7769.500000	52.27	82.25	29.98	1000.000	337.0	V	86.0	11.2
12947.500000	53.48	82.25	28.77	1000.000	347.0	V	102.0	19.0
16088.500000	55.64	82.25	26.61	1000.000	375.0	V	255.0	24.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2589.000000	53.04	82.25	29.21	1000.000	398.0	H	224.0	3.5
3000.500000	27.39	82.25	54.86	1000.000	269.0	V	348.0	4.3
7769.500000	37.53	82.25	44.72	1000.000	337.0	V	86.0	11.2
12947.500000	38.93	82.25	43.32	1000.000	347.0	V	102.0	19.0
16088.500000	42.57	82.25	39.68	1000.000	375.0	V	255.0	24.6

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 27

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

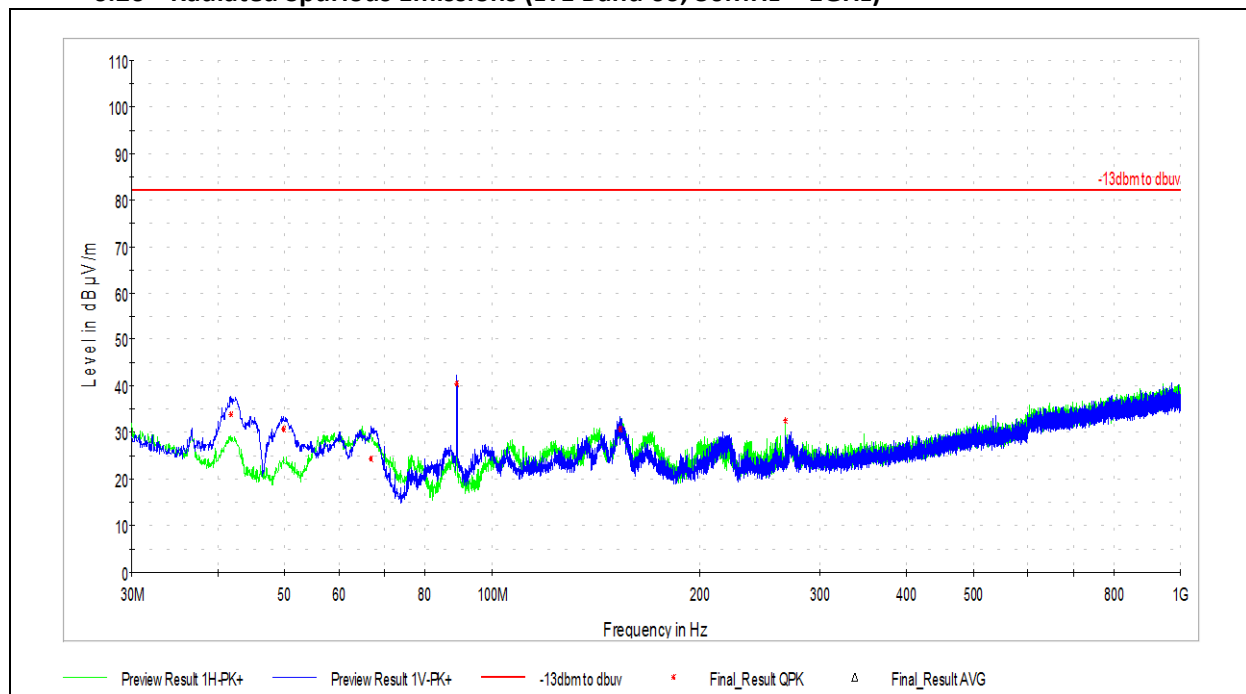
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

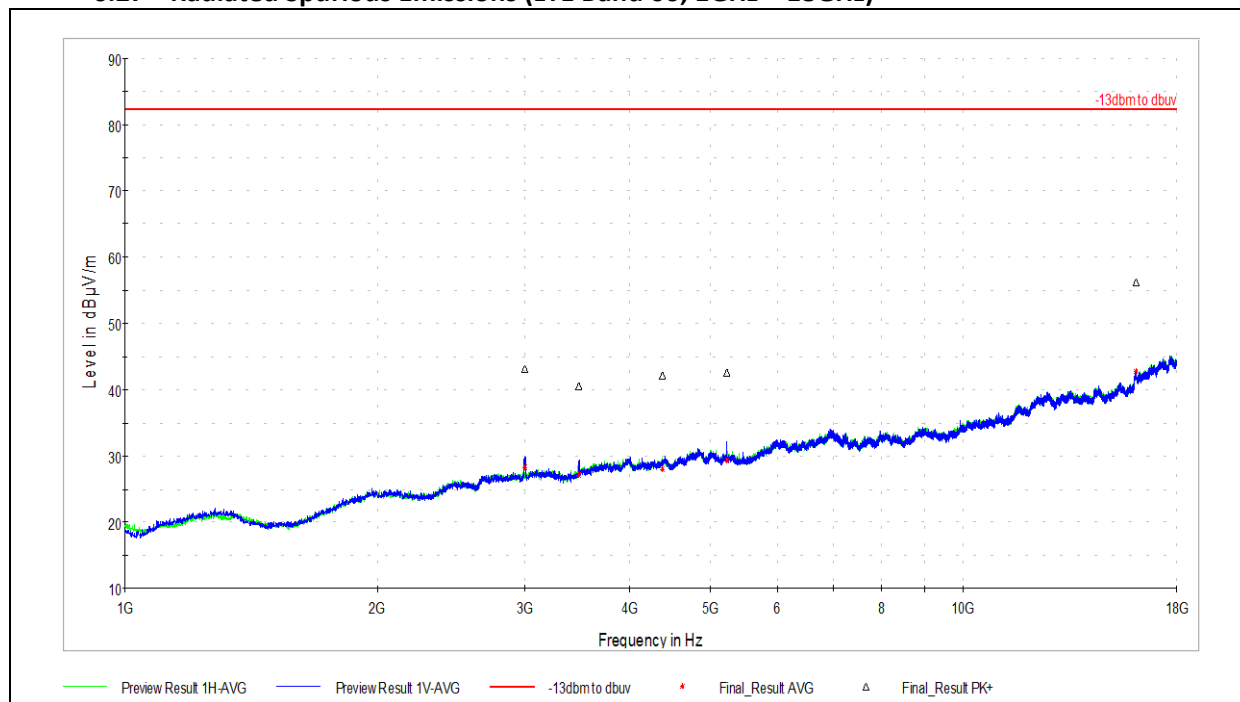
Deviations, Additions, or Exclusions: None

**6.26 Radiated Spurious Emissions (LTE Band 66; 30MHz – 1GHz)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.747778	33.93	82.25	48.32	120.000	105.0	V	240.0	19.4
49.885000	30.76	82.25	51.49	120.000	100.4	V	195.0	15.4
66.752222	24.35	82.25	57.90	120.000	105.0	V	203.0	14.4
88.954445	40.62	82.25	41.63	120.000	100.1	V	154.0	16.4
153.782778	30.84	82.25	51.41	120.000	100.3	V	95.0	21.1
266.949445	32.68	82.25	49.57	120.000	106.9	H	274.0	22.5

Test Personnel: Ben Coolbear
Supervising/Reviewing Engineer: (Where Applicable) NA
Product Standard: FCC Part 27
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
Limit Applied: -13 dBµv
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.27 Radiated Spurious Emissions (LTE Band 66; 1GHz – 18GHz)**

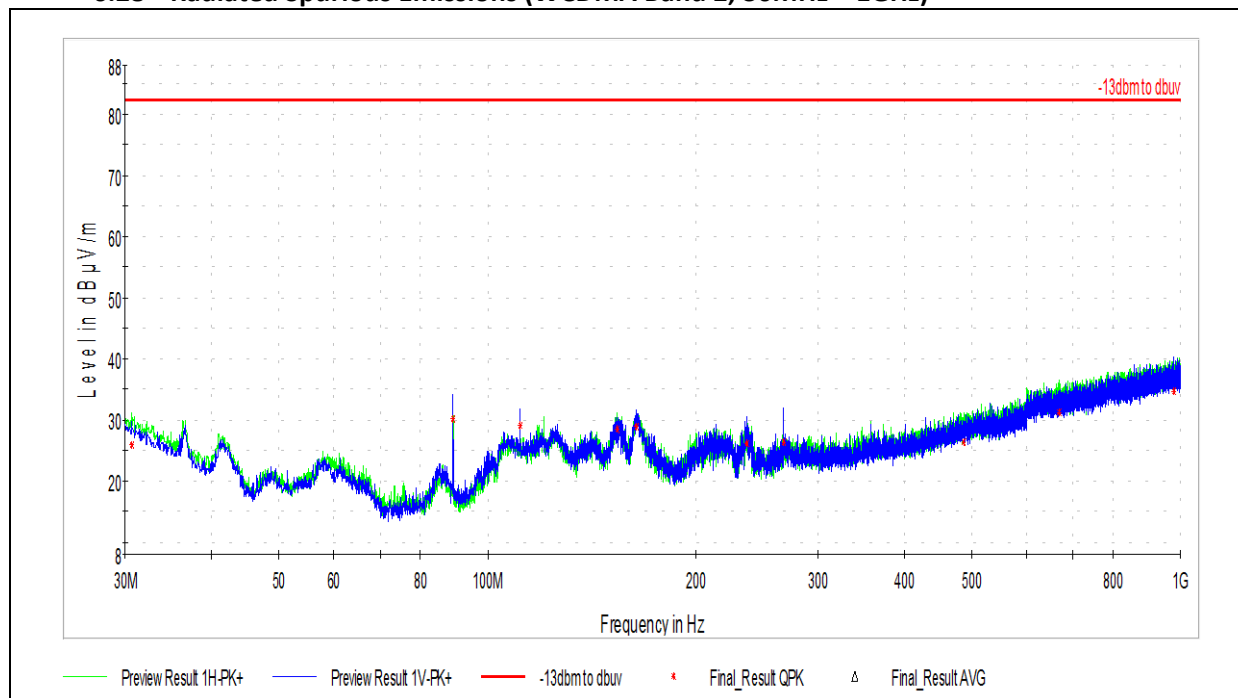
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
3001.000000	43.24	82.25	39.01	1000.000	270.0	V	0.0	4.3
3482.000000	40.59	82.25	41.66	1000.000	392.0	V	292.0	4.9
4380.500000	42.15	82.25	40.10	1000.000	410.0	H	233.0	6.5
5223.500000	42.55	82.25	39.70	1000.000	410.0	H	104.0	7.7
16086.000000	56.24	82.25	26.01	1000.000	378.0	V	0.0	24.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
3001.000000	28.33	82.25	53.92	1000.000	270.0	V	0.0	4.3
3482.000000	27.12	82.25	55.13	1000.000	392.0	V	292.0	4.9
4380.500000	27.92	82.25	54.33	1000.000	410.0	H	233.0	6.5
5223.500000	29.27	82.25	52.98	1000.000	410.0	H	104.0	7.7
16086.000000	42.82	82.25	39.43	1000.000	378.0	V	0.0	24.6

Test Personnel: Ben Coolbear
 Supervising/Reviewing Engineer: (Where Applicable) NA
 Product Standard: FCC Part 27
 Input Voltage: 3.3VDC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
 Limit Applied: -13 dBµv
 Ambient Temperature: 21.8 °C
 Relative Humidity: 21.1 %
 Atmospheric Pressure: 997.5 mbar

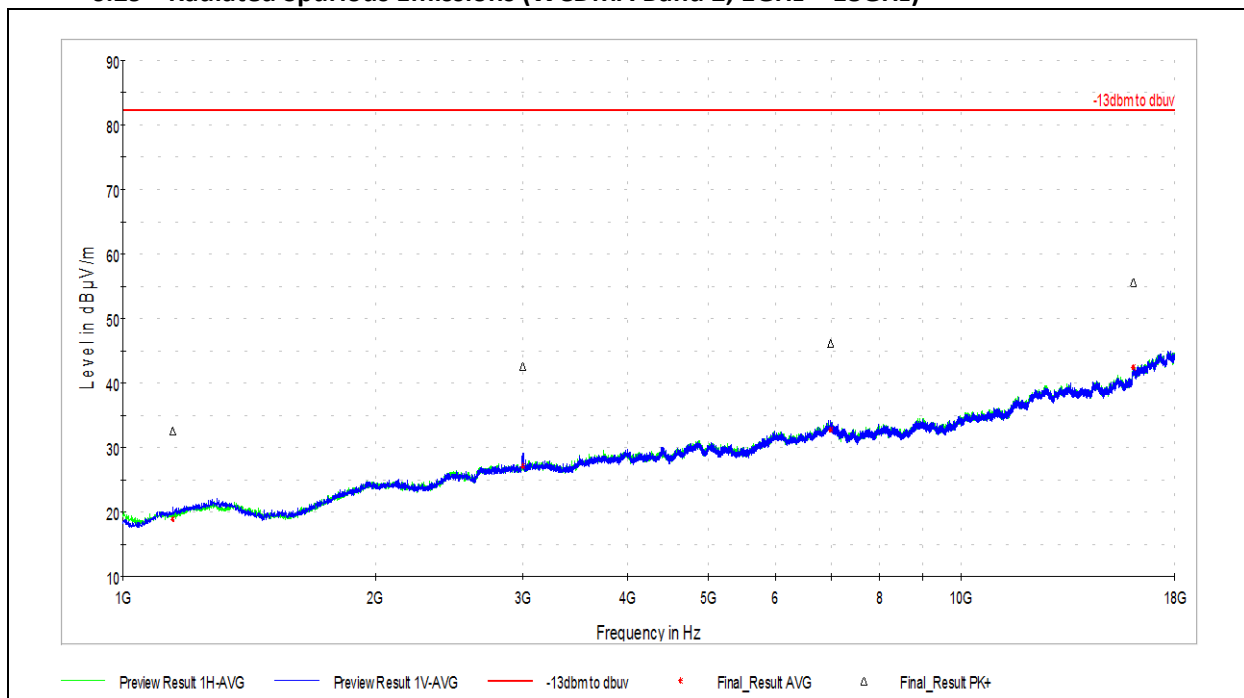
Deviations, Additions, or Exclusions: None

**6.28 Radiated Spurious Emissions (WCDMA Band 2; 30MHz – 1GHz)****Final_Result_QPK**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.700556	25.91	82.25	56.34	120.000	388.0	H	28.0	28.2
89.170000	30.10	82.25	52.15	120.000	388.0	V	117.0	16.4
111.533889	28.99	82.25	53.26	120.000	400.0	V	130.0	20.8
153.998333	28.50	82.25	53.75	120.000	100.0	H	136.0	21.1
163.967778	28.78	82.25	53.47	120.000	112.0	V	138.0	21.1
236.610000	26.02	82.25	56.23	120.000	400.0	V	250.0	20.7
267.596111	26.21	82.25	56.04	120.000	136.0	V	93.0	22.3
486.708333	26.22	82.25	56.03	120.000	400.0	H	163.0	27.9
668.745000	31.11	82.25	51.14	120.000	400.0	H	254.0	31.1
978.390556	34.49	82.25	47.76	120.000	184.0	V	332.0	34.3

Test Personnel: Michael Carlson
Supervising/Reviewing Engineer: (Where Applicable) NA
Product Standard: FCC Part 24
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
Limit Applied: -13 dBµV
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.29 Radiated Spurious Emissions (WCDMA Band 2; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1145.500000	32.56	82.25	49.69	1000.000	136.0	V	108.0	-2.8
3000.000000	42.53	82.25	39.72	1000.000	296.0	V	272.0	4.3
6996.000000	46.13	82.25	36.12	1000.000	410.0	V	246.0	10.9
16066.000000	55.62	82.25	26.63	1000.000	410.0	H	175.0	24.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1145.500000	18.80	82.25	63.45	1000.000	136.0	V	108.0	-2.8
3000.000000	27.12	82.25	55.13	1000.000	296.0	V	272.0	4.3
6996.000000	32.79	82.25	49.46	1000.000	410.0	V	246.0	10.9
16066.000000	42.38	82.25	39.87	1000.000	410.0	H	175.0	24.2

Test Personnel: Michael Carlson

Supervising/Reviewing Engineer: _____

(Where Applicable) NA

Product Standard: FCC Part 24

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019

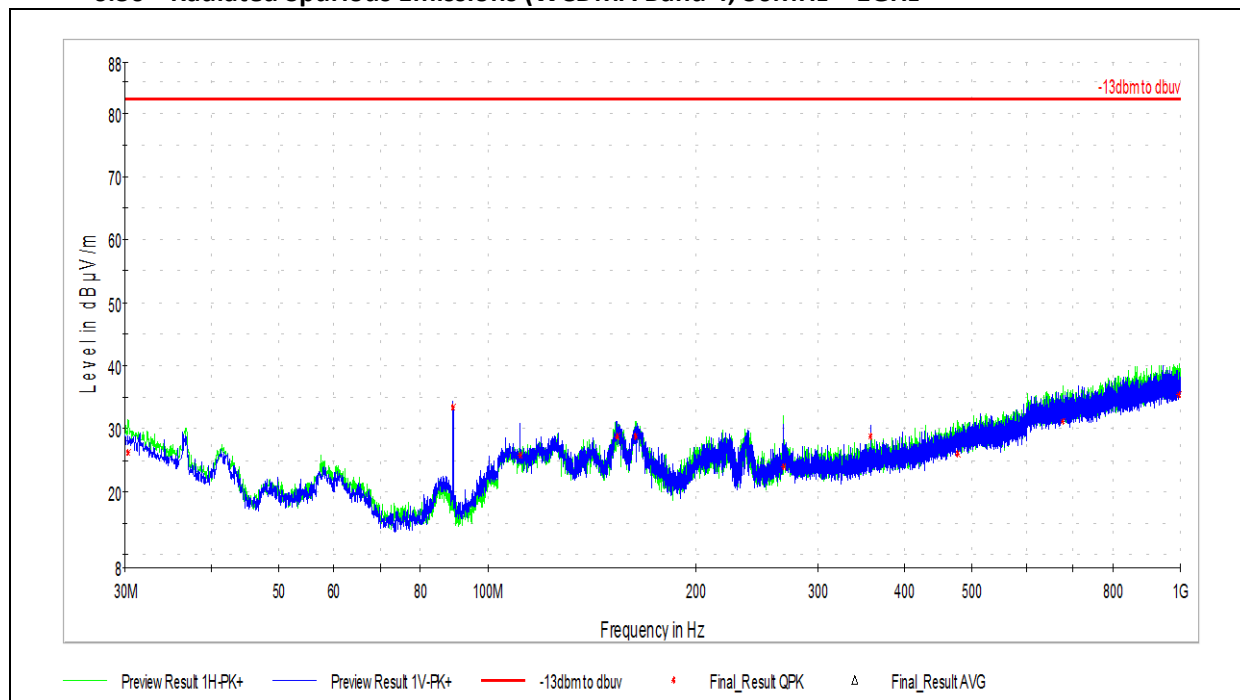
Limit Applied: -13 dBμv

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

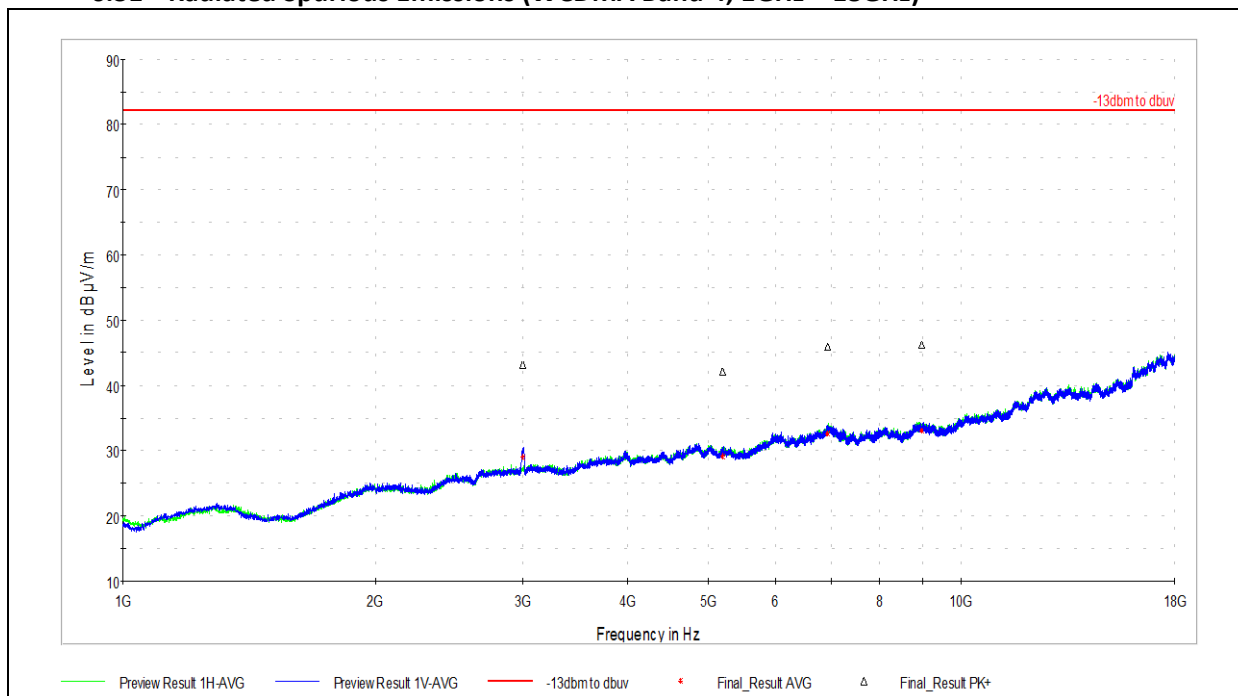
Deviations, Additions, or Exclusions: None

**6.30 Radiated Spurious Emissions (WCDMA Band 4; 30MHz – 1GHz)****Final_Result_QPK**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.323333	26.18	82.25	56.07	120.000	136.0	H	122.0	28.5
89.223889	33.34	82.25	48.91	120.000	220.0	V	129.0	16.4
111.533889	25.79	82.25	56.46	120.000	100.0	V	148.0	20.8
154.052222	28.69	82.25	53.56	120.000	220.0	V	137.0	21.1
163.860000	28.80	82.25	53.45	120.000	400.0	H	137.0	21.1
267.650000	23.92	82.25	58.33	120.000	124.0	H	100.0	22.5
356.890000	28.71	82.25	53.54	120.000	232.0	V	177.0	24.4
477.331667	25.97	82.25	56.28	120.000	292.0	H	54.0	27.7
677.151667	31.11	82.25	51.14	120.000	400.0	H	350.0	31.2
994.718889	35.49	82.25	46.76	120.000	148.0	H	80.0	35.3

Test Personnel: Michael Carlson
Supervising/Reviewing Engineer: _____
(Where Applicable) NA
Product Standard: FCC Part 27
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
Limit Applied: -13 dBµV
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

**6.31 Radiated Spurious Emissions (WCDMA Band 4; 1GHz – 18GHz)**

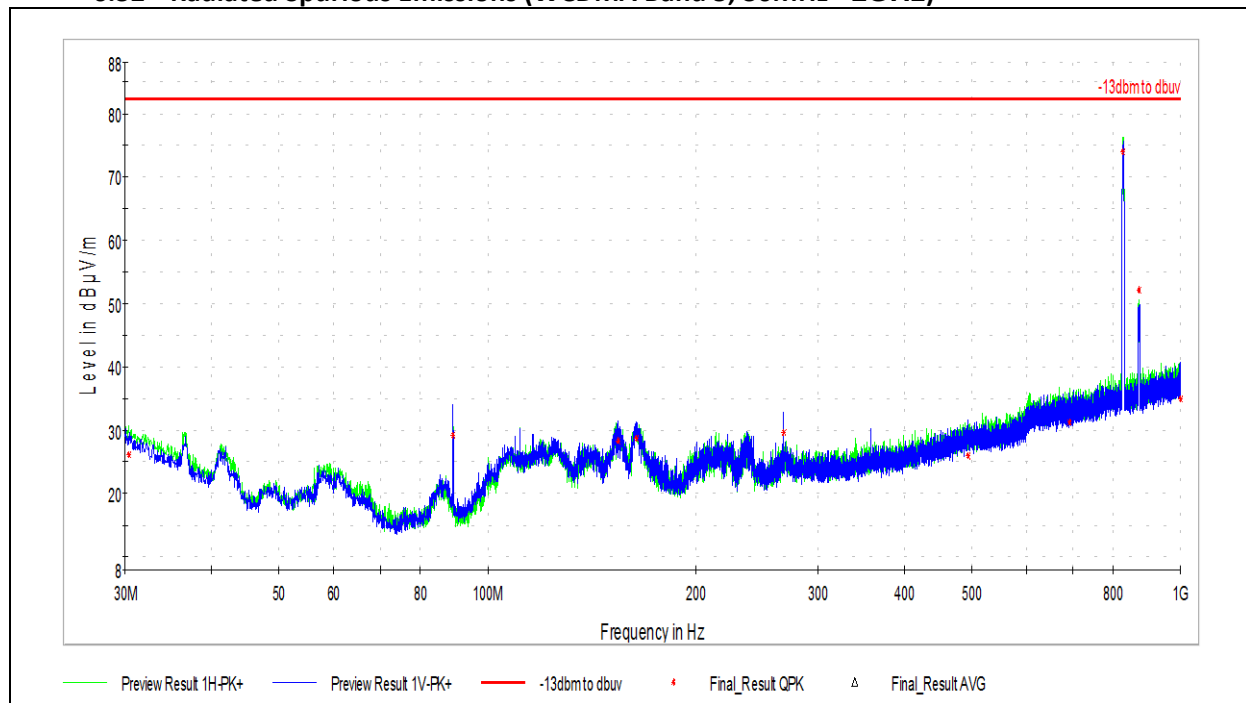
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2997.500000	43.22	82.25	39.03	1000.000	274.0	V	0.0	4.3
5194.500000	42.21	82.25	40.04	1000.000	410.0	V	171.0	7.7
6928.500000	45.99	82.25	36.26	1000.000	410.0	V	74.0	10.7
8983.000000	46.30	82.25	35.95	1000.000	100.0	H	297.0	12.5

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2997.500000	28.98	82.25	53.27	1000.000	274.0	V	0.0	4.3
5194.500000	29.08	82.25	53.17	1000.000	410.0	V	171.0	7.7
6928.500000	32.52	82.25	49.73	1000.000	410.0	V	74.0	10.7
8983.000000	33.03	82.25	49.22	1000.000	100.0	H	297.0	12.5

Test Personnel: Ben Coolbear
Supervising/Reviewing Engineer: _____
(Where Applicable) NA
Product Standard: FCC Part 27
Input Voltage: 3.3VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
Limit Applied: -13 dBµv
Ambient Temperature: 21.8 °C
Relative Humidity: 21.1 %
Atmospheric Pressure: 997.5 mbar

Deviations, Additions, or Exclusions: None

**6.32 Radiated Spurious Emissions (WCDMA Band 5; 30MHz - 1GHz)**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.377222	26.12	82.25	56.13	120.000	160.0	H	108.0	28.4
89.170000	29.32	82.25	52.93	120.000	244.0	V	118.0	16.4
154.267778	28.39	82.25	53.86	120.000	352.0	V	137.0	21.1
163.913889	28.68	82.25	53.57	120.000	328.0	V	137.0	21.1
267.703889	29.67	82.25	52.58	120.000	400.0	V	70.0	22.3
493.767778	25.93	82.25	56.32	120.000	232.0	V	7.0	27.6
691.486111	31.17	82.25	51.08	120.000	256.0	H	346.0	31.3
826.208333	73.90	82.25	8.35	120.000	256.0	H	320.0	33.4
870.289444	52.19	82.25	30.06	120.000	340.0	H	138.0	33.8
999.353333	34.88	82.25	47.37	120.000	172.0	V	167.0	34.6

Test Personnel: Ben Coolbear

Supervising/Reviewing Engineer: (Where Applicable) NA

Product Standard: FCC Part 22

Input Voltage: 3.3VDC

Pretest Verification w / Ambient Signals or BB Source: Yes

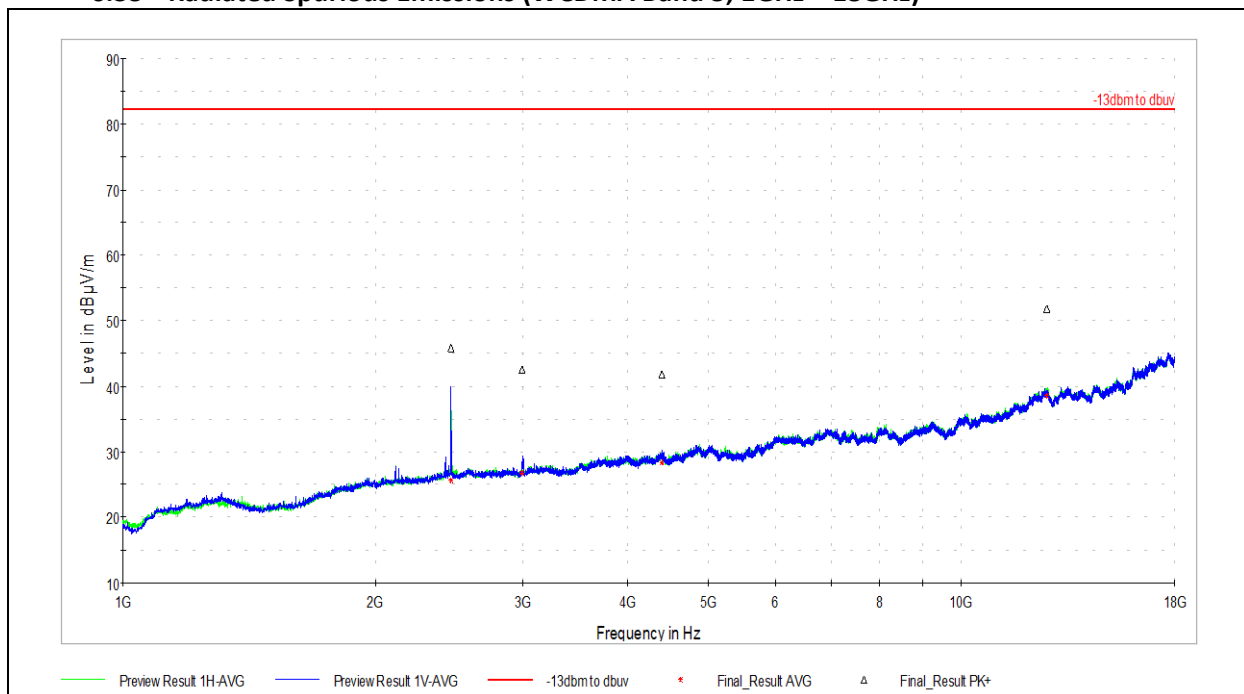
Test Date: 11/12/2019

Limit Applied: -13 dBμV

Ambient Temperature: 21.8 °C

Relative Humidity: 21.1 %

Atmospheric Pressure: 997.5 mbar

**6.33 Radiated Spurious Emissions (WCDMA Band 5; 1GHz – 18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2462.500000	45.81	82.25	36.44	1000.000	307.0	V	180.0	3.0
2994.000000	42.53	82.25	39.72	1000.000	248.0	V	0.0	4.3
4394.500000	41.83	82.25	40.42	1000.000	100.0	V	49.0	6.7
12664.500000	51.92	82.25	30.33	1000.000	410.0	H	263.0	18.9

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2462.500000	25.60	82.25	56.65	1000.000	307.0	V	180.0	3.0
2994.000000	26.83	82.25	55.42	1000.000	248.0	V	0.0	4.3
4394.500000	28.39	82.25	53.86	1000.000	100.0	V	49.0	6.7
12664.500000	38.54	82.25	43.71	1000.000	410.0	H	263.0	18.9

Test Personnel: Ben Coolbear
 Supervising/Reviewing Engineer: NA
 (Where Applicable)
 Product Standard: FCC Part 22
 Input Voltage: 3.3VDC
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 11/12/2019
 Limit Applied: -13 dBμv
 Ambient Temperature: 21.8 °C
 Relative Humidity: 21.1 %
 Atmospheric Pressure: 997.5 mbar

Deviations, Additions, or Exclusions: None



7 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	4/6/2020	104056598LEX-002	<i>JB</i>	<i>BCT</i>	Original Issue
1	5/20/2020	104056598LEX-002.1	<i>JB</i>	<i>BCT</i>	Editorial and product name changes were made. Removed the conducted emission test data since the module installs onboard an aircraft and doesn't connect to AC mains.
2	11/18/2020	104056598LEX-002.2	<i>JB</i>	<i>BCT</i>	Added Canadian standards to the cover page. Updated contact info and address.