



FCC / ISED Test Report

FOR:

Zonar Systems

Model Name:

V4 / ZTCU4B

Product Description:

Vehicle mounted telematics device

FCC ID: SEJ-V4 / SEJ-ZTCU4B

IC ID: 5266A-V4 / 5266A-ZTCU4B

Applied Rules and Standards:

47 CFR Part 15.247 (DTS)

RSS-247 Issue 2 (DTSs) & RSS-Gen Issue 5

REPORT #: EMC_ZONAR-016-17001_15.247_WIFI_DTS_Rev1

DATE: 2019-07-02



A2LA Accredited

IC recognized #
3462B-2

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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 (AE) DETAILS..... | 6 |
| 3.4 | TEST SAMPLE CONFIGURATION | 6 |
| 3.5 | JUSTIFICATION FOR WORST CASE MODE OF OPERATION..... | 6 |
| 4 | SUBJECT OF INVESTIGATION | 7 |
| 5 | MEASUREMENT RESULTS SUMMARY | 7 |
| 6 | MEASUREMENT UNCERTAINTY..... | 8 |
| 6.1 | ENVIRONMENTAL CONDITIONS DURING TESTING:..... | 8 |
| 6.2 | DATES OF TESTING: | 8 |
| 7 | MEASUREMENT PROCEDURES..... | 9 |
| 7.1 | RADIATED MEASUREMENT..... | 9 |
| 7.2 | POWER LINE CONDUCTED MEASUREMENT PROCEDURE | 11 |
| 7.3 | RF CONDUCTED MEASUREMENT PROCEDURE | 11 |
| 8 | TEST RESULT DATA | 12 |
| 8.1 | RADIATED TRANSMITTER SPURIOUS EMISSIONS AND RESTRICTED BANDS | 12 |
| 9 | TEST SETUP PHOTOS | 20 |
| 10 | TEST EQUIPMENT AND ANCILLARIES USED FOR TESTING | 20 |
| 11 | HISTORY | 21 |

1 **Assessment**

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

| Company | Description | Model # |
|---------------|-----------------------------------|-------------|
| Zonar Systems | Vehicle mounted telematics device | V4 / ZTCU4B |

Responsible for Testing Laboratory:

| 2019-07-02 | Compliance | Cindy Li (Lab Manager) | |
|------------|------------|---------------------------|-----------|
| Date | Section | Name | Signature |

Responsible for the Report:

| 2019-07-02 | Compliance | Yuchan Lu (Test Engineer) | |
|------------|------------|------------------------------|-----------|
| Date | Section | Name | Signature |

The test results of this test report relate exclusively to the test item specified in Section 3.
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: | Sangeetha Sivaraman |

2.2 Identification of the Client

| | |
|--------------------------|----------------------------|
| Applicant's Name: | Zonar Systems |
| Street Address: | 18200 Cascade Avenue South |
| City/Zip Code | Seattle, WA 98188 |
| Country | USA |

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

| | |
|---|---|
| Model No: | V4 / ZTCU4B |
| HW Version : | 1 / 2 |
| SW Version : | 4 / 4.8 |
| FCC-ID : | SEJ-V4 / SEJ-ZTCU4B |
| IC-ID: | 5266A-V4 / 5266A-ZTCU4B |
| HVIN: | V4 / ZTCU4B |
| Product Description: | Vehicle mounted Telematics device |
| Frequency Range / number of channels: | Nominal band: 2412 MHz (Ch. 1) – 2472 (Ch.13), 13 channels |
| Type(s) of Modulation: | 802.11b: DSSS 802.11g/n: OFDM 802.11n: MCS (20 & 40 MHz) |
| Modes of Operation: | 802.11n: (HT20) |
| Antenna Information as declared: | max gain 0.5 dBi |
| Max. Peak Output Power: | Conducted Power 24.4 dBm (See FCC ID: PV7-WIBEAR11N-SF1 for uBlox module report) |
| Power Supply/ Rated Operating Voltage Range: | Vmin: 8.0 VDC / Vnom: 12 VDC / Vmax: 30 VDC |
| Operating Temperature Range | -40 °C to 85 °C |
| Other Radios included in the device: | ublox TOBY-L200-02S-00; FCC ID: XPYTOBYL200; IC ID: 8595A-TOBYL200 Laird BT900; FCC ID: SQGBT900; IC ID: SQGBT900 |
| Sample Revision | <input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production |

3.2 EUT Sample details

| EUT # | Serial Number | HW Version | SW Version | Notes/Comments |
|-------|---------------|------------|------------|--------------------|
| 1 | 18999166 | 1 | 4 | Radiated Emissions |

3.3 Accessory Equipment (AE) details

| AE # | Type | Model | Manufacturer | Serial Number |
|------|-----------------|-------|--------------|---------------|
| 1 | DC Power Supply | 3003B | Protek | AC, 2648 |
| 2 | Laptop | E5420 | Dell | JYCNLQ1 |

3.4 Test Sample Configuration

| EUT Set-up # | Combination of AE used for test set up | Comments |
|--------------|--|--|
| 1 | EUT#1 | The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The internal antenna was connected. |
| 2 | EUT#1 + AE#1 + AE#2 | The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The internal antenna was connected. |

3.5 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 highest possible duty cycle of 50%. 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 measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISSED Canada.

This test report is to support a request for new equipment authorization under the FCC ID: SEJ-V4 IC ID: 5266A-V4

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – “GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247” - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

| Test Specification | Test Case | Temperature and Voltage Conditions | Mode | Pass | NA | NP | Result |
|--|---|------------------------------------|-----------------|-------------------------------------|-------------------------------------|-------------------------------------|----------|
| §15.247(a)(1) RSS-247 5.2(1) | Emission Bandwidth | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Note 2 |
| §15.247(e) RSS-247 5.2(2) | Power Spectral Density | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Note 2 |
| §15.247(b)(1) RSS-247 5.4(4) | Maximum Conducted Output Power and EIRP | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Note 2 |
| §15.247(d) RSS-247 5.5 | Band edge compliance Unrestricted Band Edges | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Note 2 |
| §15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10 | Band edge compliance Restricted Band Edges | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Note 2 |
| §15.247(d); §15.209 RSS-Gen 6.13 | TX Spurious emissions- Radiated | Nominal | 802.11 /n | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Complies |
| §15.207(a) RSS Gen 8.8 | AC Conducted Emissions | Nominal | 802.11 b/g/n | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | NA |

Note: NA= Not Applicable; NP= Not Performed.

Note 2: Data leveraged from modular approval FCC ID: PV7-WIBEAR11N-SF1

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

| | |
|--------------------|---------------------------------|
| 9 kHz to 30 MHz | ±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

| | |
|-------------------|----------------|
| 150 kHz to 30 MHz | ±0.7 dB (LISN) |
|-------------------|----------------|

| | |
|--------------------------|---------|
| RF conducted measurement | ±0.5 dB |
|--------------------------|---------|

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: <http://physics.nist.gov/cuu/Uncertainty/typeb.html>. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions During Testing:

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

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

6.2 Dates of Testing:

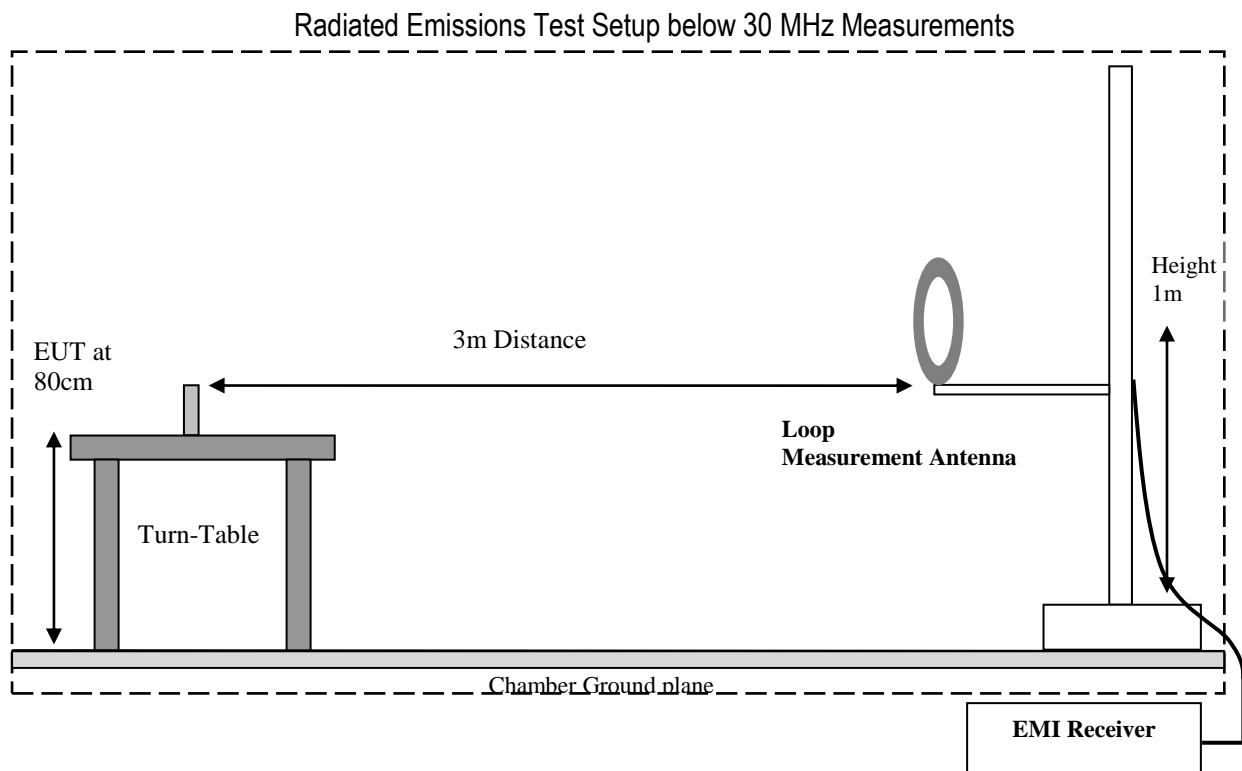
12/11/2017 - 02/09/2018

7 Measurement Procedures

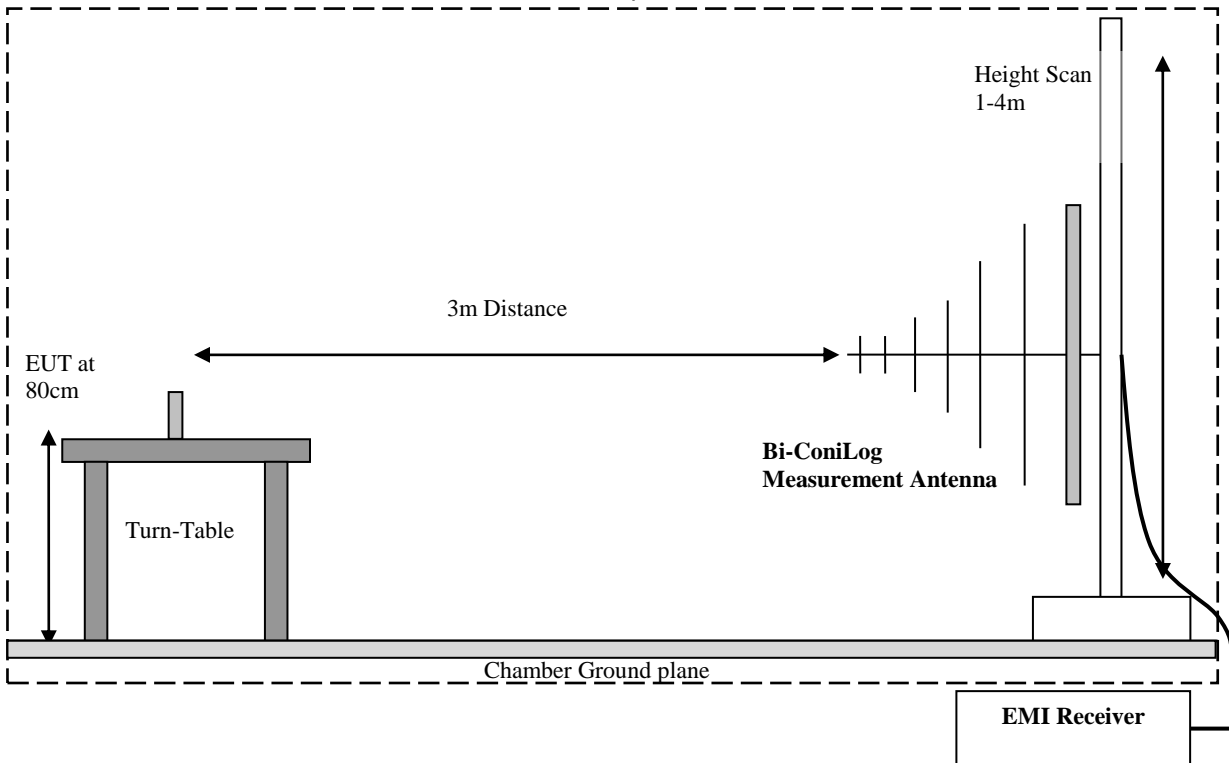
7.1 Radiated Measurement

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

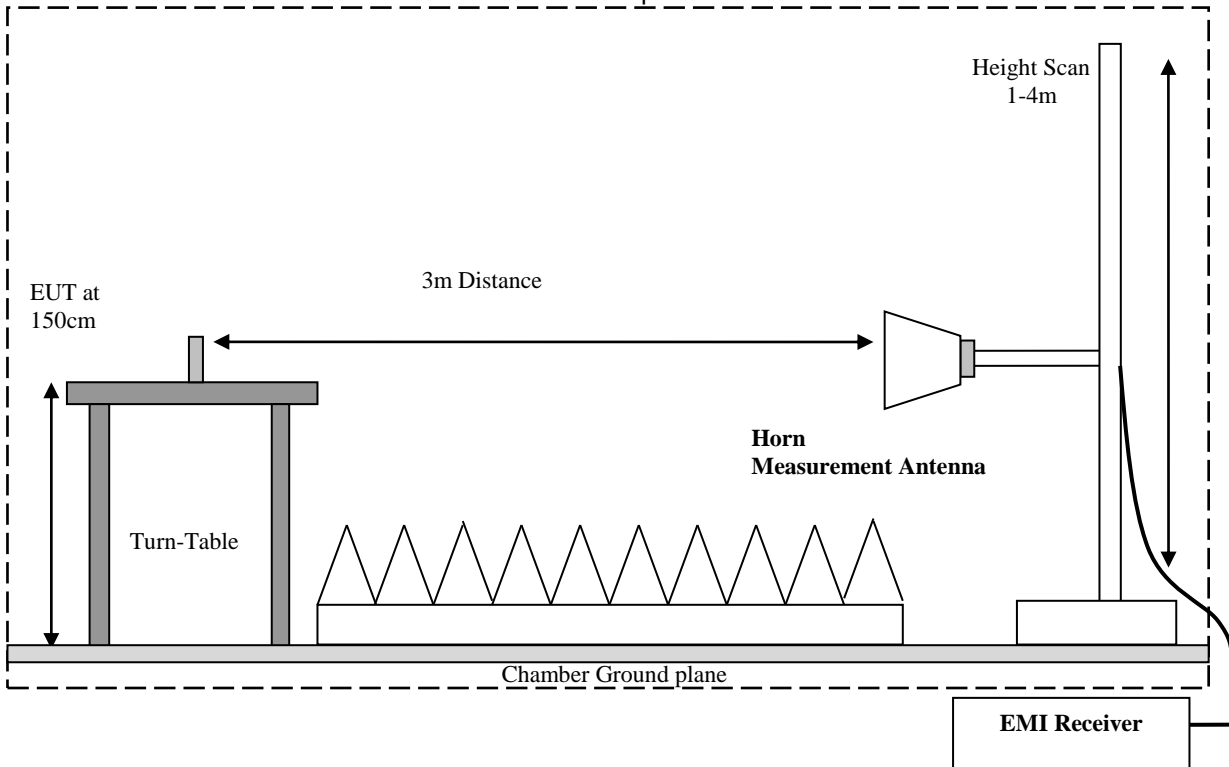
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to 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 30 MHz-1 GHz Measurements



Radiated Emissions Test Setup above 1 GHz 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 dB μ V
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:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

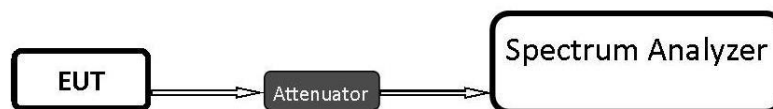
| Frequency (MHz) | Measured SA (dB μ V) | Cable Loss (dB) | Antenna Factor Correction (dB/m) | Field Strength Result (dB μ V/m) |
|-----------------|--------------------------|-----------------|----------------------------------|--------------------------------------|
| 1000 | 80.5 | 3.5 | 14 | 98.0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

7.2 Power Line Conducted Measurement Procedure

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

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – “GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247” - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Radiated Transmitter Spurious Emissions and Restricted Bands

8.1.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 kHz – 30 MHz
- RBW = 9 kHz
- Detector: Peak

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

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

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = $40 \log (D/d) = 40 \log (300\text{m} / 3\text{m}) = 80\text{dB}$

8.1.2 Limits:

FCC §15.247

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

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency of emission (MHz) | Field strength (μV/m) | Measurement Distance (m) | Field strength @ 3m (dBμV/m) |
|-----------------------------|-----------------------|--------------------------|------------------------------|
| 0.009–0.490 | 2400/F(kHz) / ----- | 300 | - |
| 0.490–1.705 | 24000/F(kHz) / ----- | 30 | - |
| 1.705–30.0 | 30 / (29.5) | 30 | - |
| 30–88 | 100 | 3 | 40 dBμV/m |
| 88–216 | 150 | 3 | 43.5 dBμV/m |
| 216–960 | 200 | 3 | 46 dBμV/m |
| Above 960 | 500 | 3 | 54 dBμV/m |

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| 10.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74 dBμV/m

*AVG. LIMIT= 54 dBμV/m

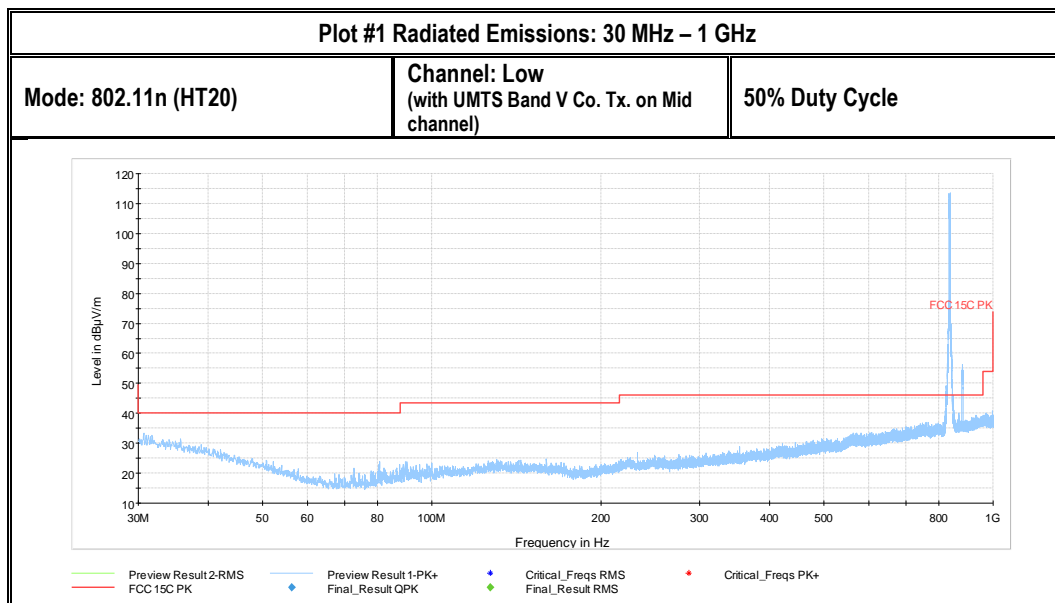
8.1.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 22° C | 2 | 802.11n (HT20) | 12VDC |

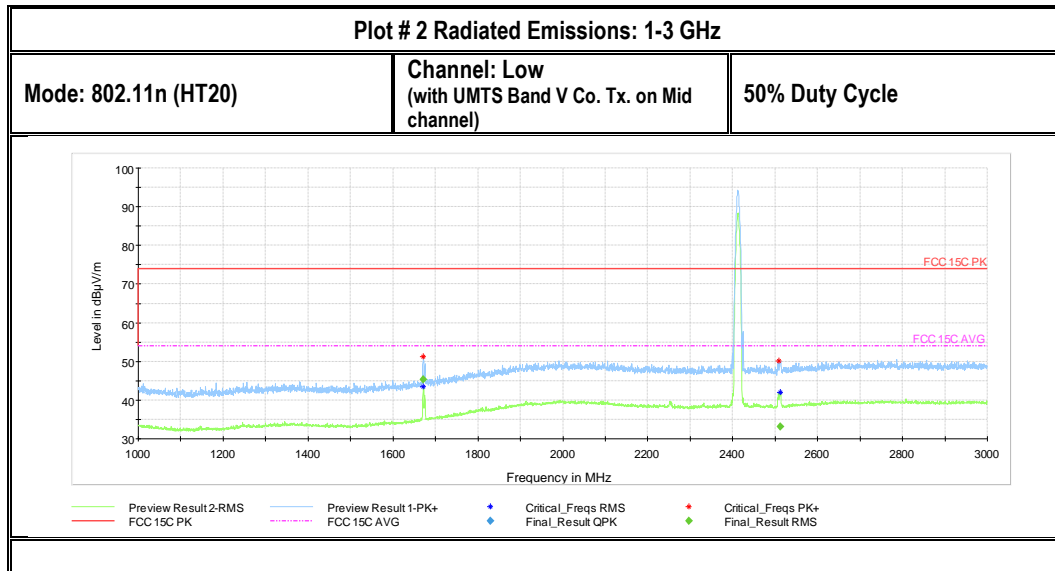
8.1.4 Measurement result:

| Plot # | Channel # | Scan Frequency | Limit | Result |
|--------|-----------|-----------------|-------------------|--------|
| 1-3 | Low | 30 MHz – 18 GHz | See section 8.1.2 | Pass |
| 4-8 | Mid | 9 kHz – 26 GHz | See section 8.1.2 | Pass |
| 9-11 | High | 30 MHz – 18 GHz | See section 8.1.2 | Pass |

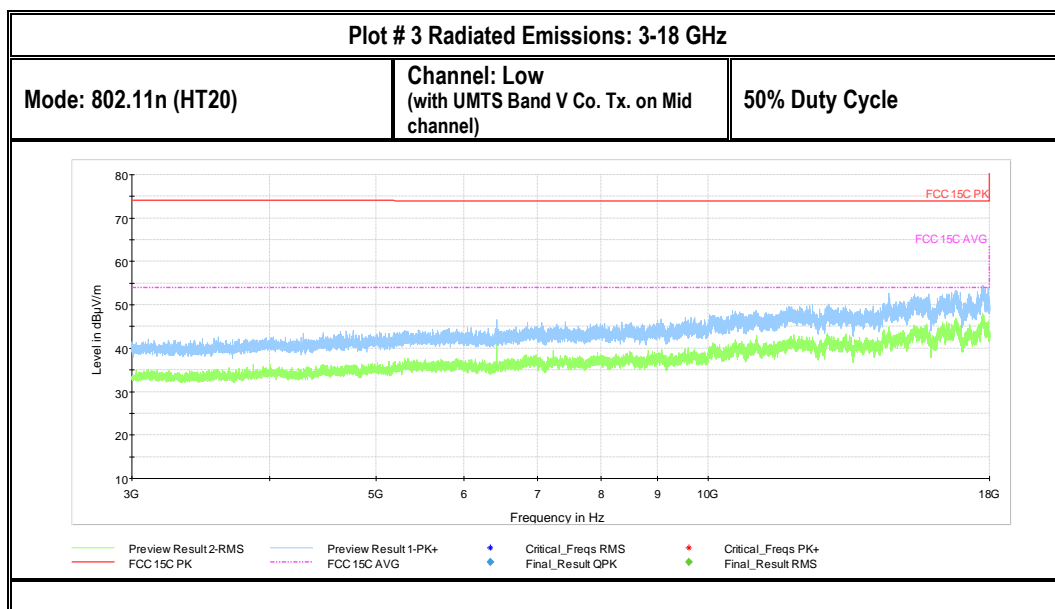
8.1.5 Measurement Plots:

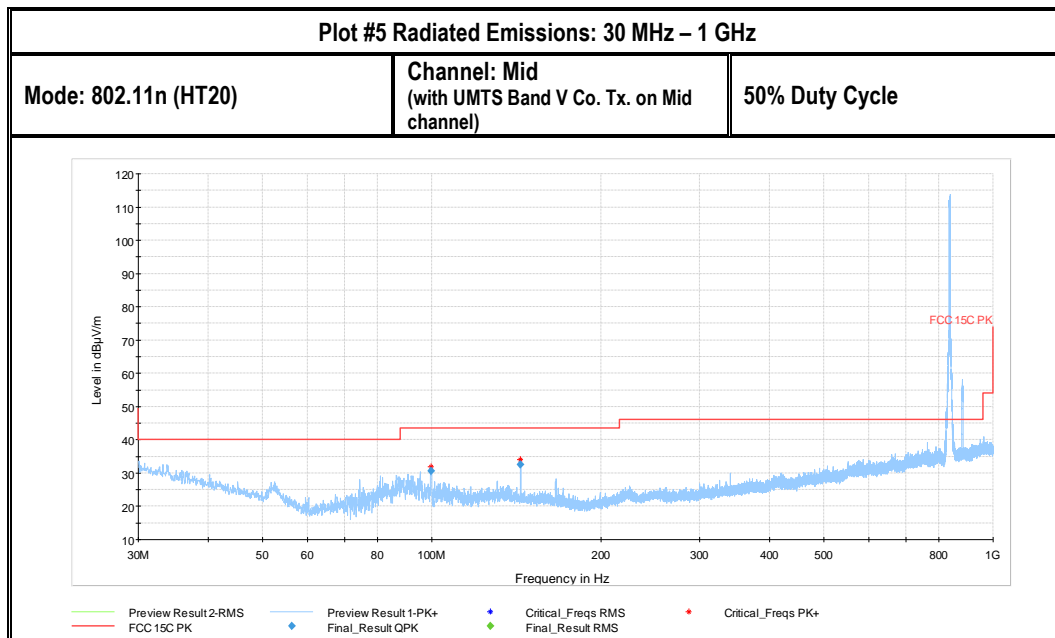
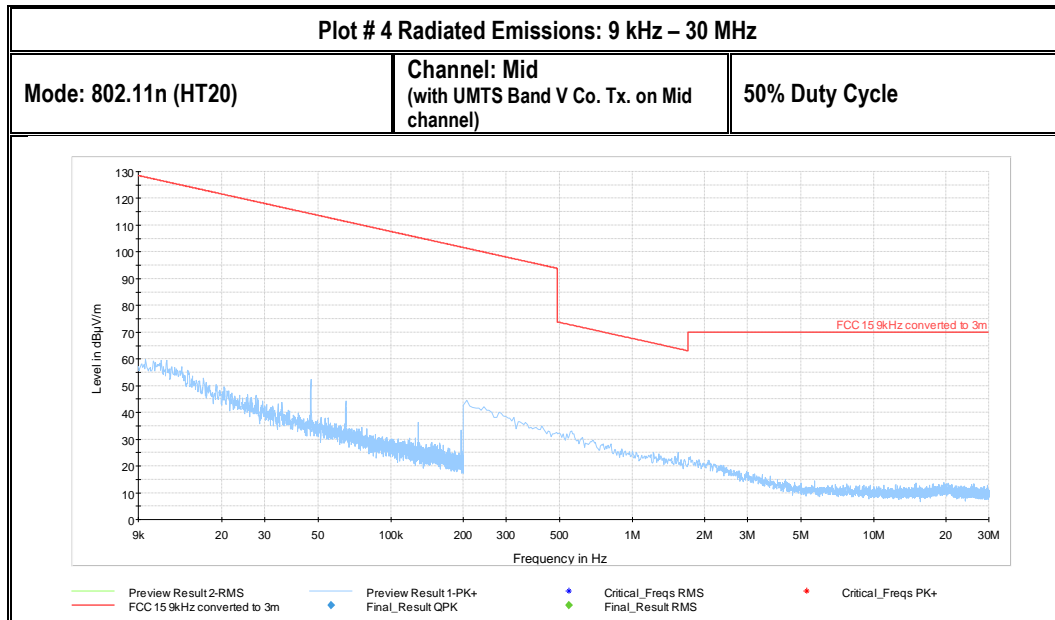


Note: Intentional Transmission occurring on UMTS Band V: 836.5 MHz (uplink), 881.5 MHz (downlink) exceeding the FCC 15.247 test limit is acceptable due to UMTS Band V being regulated by FCC part 22 limits therefore not subjected to FCC 15.247 regulations.

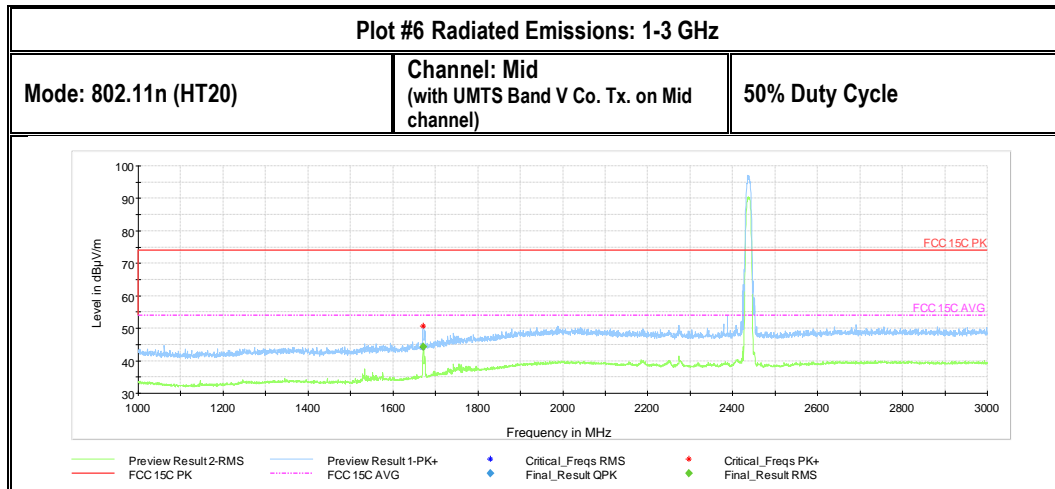


Note: Intentional Transmission occurring on Wi-Fi low channel: 2412 MHz

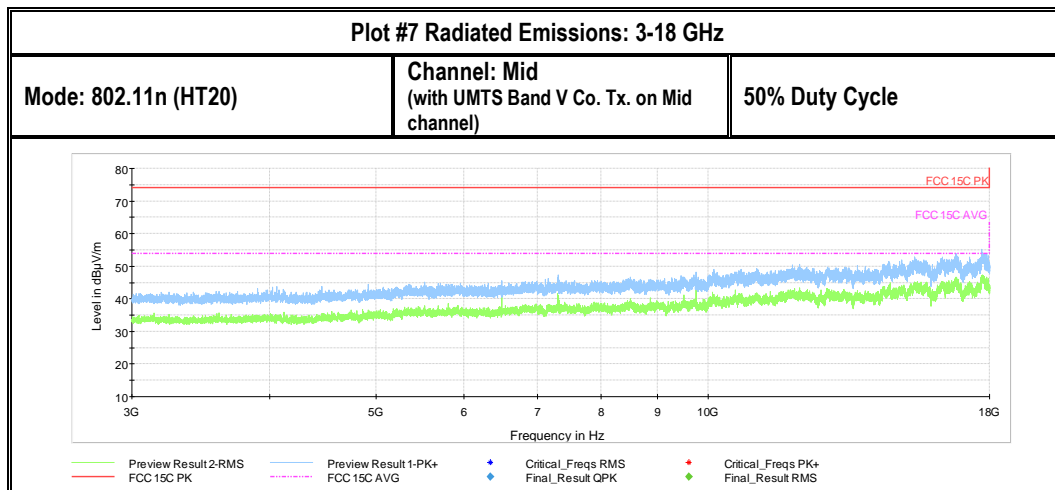


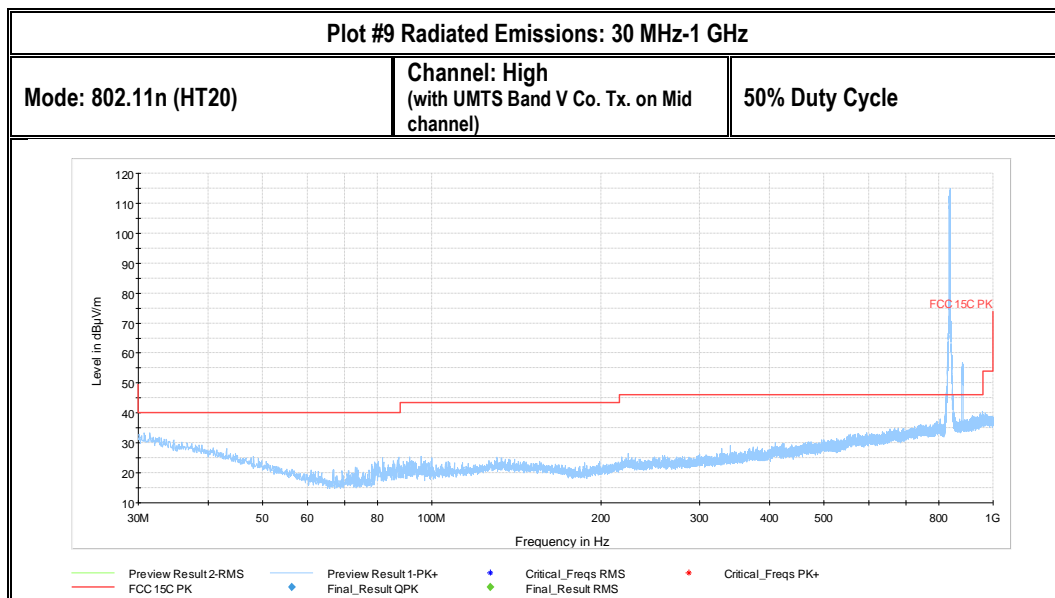
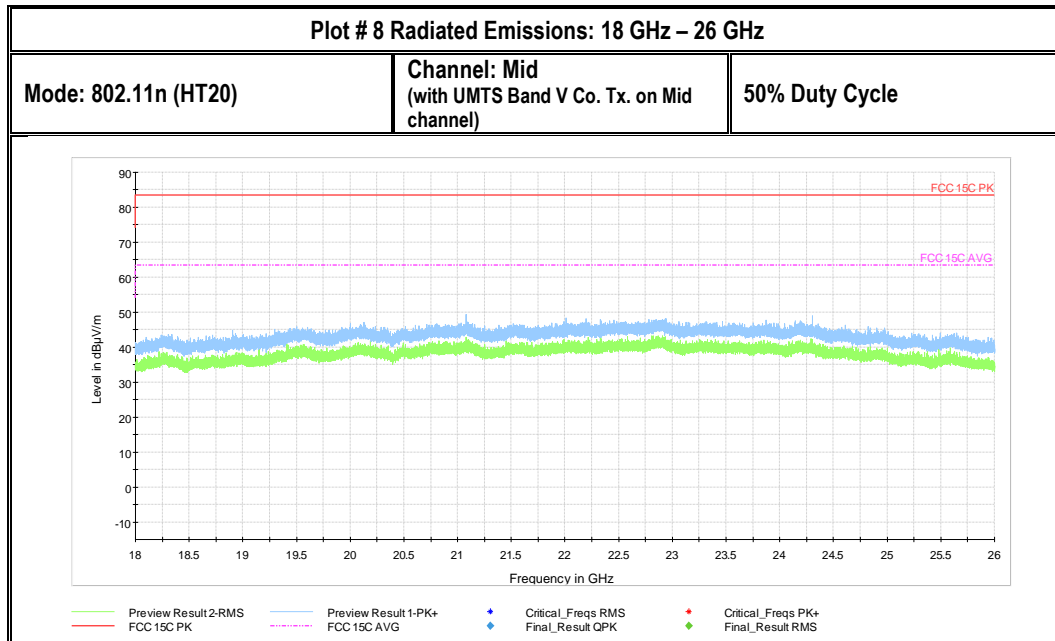


Note: Intentional Transmission occurring on UMTS Band V: 836.5 MHz (uplink), 881.5 MHz (downlink) exceeding the FCC 15.247 test limit is acceptable due to UMTS Band V being regulated by FCC part 22 limits therefore not subjected to FCC 15.247 regulations.

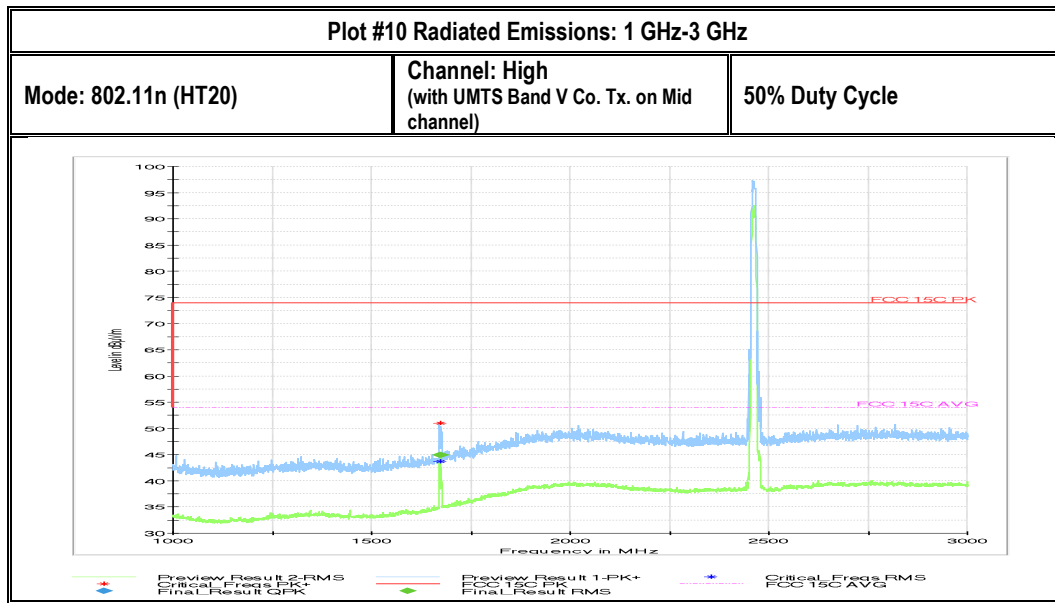


Note: Intentional Transmission occurring on Wi-Fi mid channel: 2437 MHz



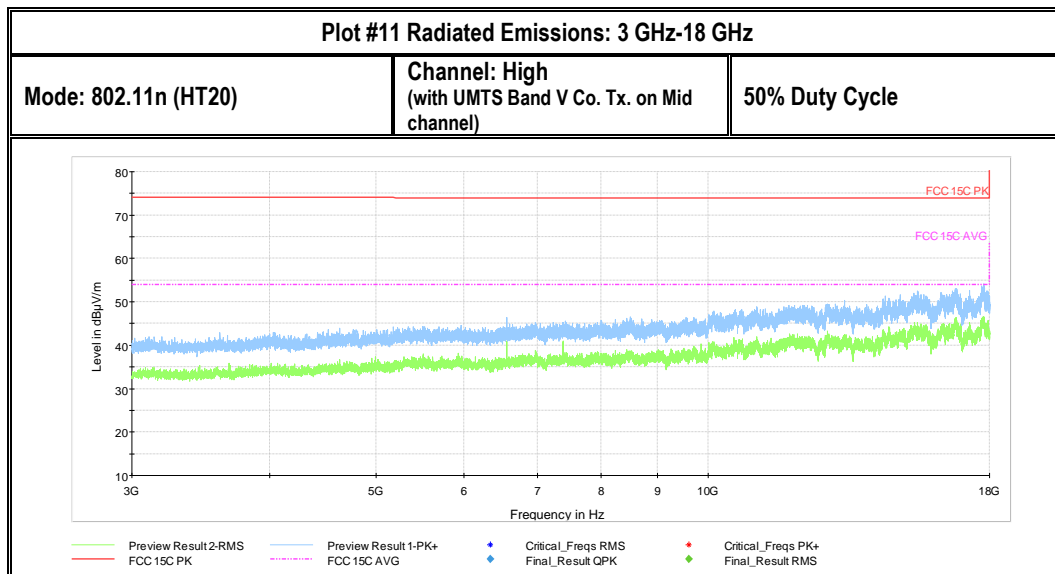


Note: Intentional Transmission occurring on UMTS Band V: 836.5 MHz (uplink), 881.5 MHz (downlink) exceeding the FCC 15.247 test limit is acceptable due to UMTS Band V being regulated by FCC part 22 limits therefore not subjected to FCC 15.247 regulations.



| Frequency (MHz) | Quasi-Peak (dBμV/m) | RMS (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol. | Azimuth (deg) |
|-----------------|---------------------|--------------|----------------|-------------|-----------------|-----------------|-------------|------|---------------|
| 1671.505000 | --- | 44.90 | 53.98 | 9.08 | 10.0 | 1000.000 | 100.0 | H | 161.0 |

Note: Intentional Transmission occurring on Wi-Fi high channel: 2462 MHz



9 Test setup photos

Setup photos are included in supporting file name: "EMC_ZONAR-016-17001_15.247_WIFI_DTS_Setup_Photos_Rev1.pdf"

10 Test Equipment And Ancillaries Used For Testing

| Item Name | Equipment Type | Manufacturer | Model | Serial # | Calibration Cycle | Last Calibration Date |
|------------------------------------|----------------------------|-----------------|-----------|----------|-------------------|-----------------------|
| Antenna Biconilog 3142E | BiConiLog Antenna | EMCO | 3142E | 166067 | 3 years | 06/27/2017 |
| Magnetic Loop Antenna | Loop Antenna | ETS Lindgren | 6512 | 49838 | 3 years | 07/28/2017 |
| Antenna Horn 3116 | Horn Antenna | ETS Lindgren | 3116 | 70497 | 3 years | 10/31/2017 |
| Antenna Horn 3115 | Horn Antenna | ETS Lindgren | 3115 | 35111 | 3 years | 07/24/2015 |
| Digital Barometer | Compact Digital Barometer | Control Company | 35519-055 | 91119547 | 2 Years | 06/08/2017 |
| Thermometer Humidity | Thermometer Humidity | Dickson | TM323 | 16253651 | 1 Year | 11/02/2017 |
| Receiver ESU40 | EMI Receiver | R&S | ESU40 | 100251 | 3 years | 07/01/2017 |
| Digital Radio Comm. Tester CMU 500 | Digital Radio Comm. Tester | R&S | CMW500 | 127068 | 2 Years | 7/01/2017 |

Note:

1. Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 History

| Date | Report Name | Changes to report | Report prepared by |
|------------|--|--|--------------------|
| 2018-03-06 | EMC_ZONAR-016-17001_15.247_WIFI_DTS | Initial Version | Elijah Garcia |
| 2019-07-02 | EMC_ZONAR-016-17001_15.247_WIFI_DTS_Rev1 | Added the FCC ID, IC ID, Model No, HW Version, SW version in Section 3.1, Page Head and front page Based on design similarity. Corrected IC ID typo. | Yuchan Lu |