Emissions
Test Report

EUT Name / PMN: CTP2019DTNA

Model No. / HVIN: CTP19TNv3

CFR 47 Part 15.247: 2023 and RSS 247 Issue 2.

Prepared for:

Daimler Truck North America LLC
4555 N. Channel Ave, PORTLAND OR 97217-3849 USA

Prepared by:

Bureau Veritas Consumer Products Services, Inc.
775 Montague Expressway,
Milpitas, CA 95035
Tel: (408) 526-1188

Report/Issue Date: October 18, 2023
Revision Number 4
Report Number: FCC_IC_RF_CIXU-TNY-P23050039 CTP2_WLAN_15.247

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
1	07/10/2023	Original Document	James Ma
2	08/03/2023	Updated measurement uncertainty, EUT name and model number	Abhijit Patibandla
3	10/16/2023	Updated Power Output Measurement and Out of Band Emission	Abhijit Patibandla
4	10/18/2023	Remove LTE Information	Abhijit Patibandla

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	Daimler Truck North America LLC 4555 N. Channel Ave, PORTLAND OR 97217-3849 USA
Requester / Applicant:	Daimler Truck North America LLC
Name of Equipment / PMN: *Model No's / HVIN*	CTP2019DTNA CTP19TNv3
Type of Equipment: *Application of Regulations:* *Test Dates:*	Integrated Device. Automotive Telematics Unit CFR 47 Part 15.247: 2023 and RSS 247 Issue 2. May 22, 2023 to October 15, 2023

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02,

Test Methods:

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02,

This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any government agencies.

Abhijit Patibandla & James Ma

Test Engineer Date: October 18, 2023

Suresh Kondapalli

Reviewer Signatory Date: October 18, 2023

Testing Cert #2742-01 **US1109** **4842D**

Table of Contents

Contents

Table of Contents

Index of Tables

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2023 and RSS 247 Issue 2. based on the results of testing performed on May 22, 2023 to October 15, 2023 on the Integrated Device Automotive Telematics Unit Model CTP19TNv3 manufactured by Daimler Truck North America LLC. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2412 MHz to 2462 MHz frequency band is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.10:2013	Test Parameters	Measured Value	Result
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	30 dBm w/ 6 dBi antenna	+17.94 dBm	**Complied**
Occupied Bandwidth	CFR47 15.247 (a2), RSS GEN Sect.6.7, RSS 247 Sect. 5.2 (a)	≥ 500 kHz	13.24 MHz (99%) 10.04 MHz (DTS)	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2 (b)	8 dBm/ 3 kHz	-3.28 dBm	**Complied**
Out of Band Emission	CFR47 15.247 (d), RSS 247 Sect.5.5	-30 dBr	-4.85 dB (Margin)	**Complied**
Restricted Bands of Operation	CFR47 15.205, RSS GEN Sect.8.10	Class B	-15.0dB (Margin) @4943.9 MHz	**Complied**
Spurious Emission in Transmitted Mode	CFR47 15.209, CFR47 15.247 (d) RSS GEN Sect.8.9	Class B		**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	N/A	N/A	N/A

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

Bureau Veritas Consumer Products Services, Inc. at 775 Montague Expressway, Milpitas CA 95035 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No. US1109). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, 20, 22, 24, 25, 27, 90, 95, 95, 97 and 101. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

Bureau Veritas Consumer Products Services, Inc is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:2017 and ISO 9002 (Lab Code 2742-01). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada

Bureau Veritas Consumer Products Services, Inc. at the 775 Montague Expressway, Milpitas, CA 95035 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 4842D). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. Bureau Veritas Consumer Products Services, Inc. at 775 Montague Expressway, Milpitas, CA 95035 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures.
VCCI Registration No. for for Milpitas: A-0133

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all Bureau Veritas Consumer Products Services, Inc. at 775 Montague Expressway, Milpitas, CA 95035 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 775 Montague Expressway, Milpitas, California, 95035, USA.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 10 meters. The site is listed with the FCC and accredited by A2LA (Lab Code 2742-01. A report detailing this site can be obtained from Bureau Veritas Consumer Products Services, Inc.

2.2.2 Measurement Uncertainty

The following calculation follows the procedures as set forth in the clause 7.2.3 of ETSI TR 100 028-1 V1.4.1 (2001-12). The expression of Uncertainty in Radiated RF Testing is according to ISO/IEC 17025: 2017 and TR 100 028-1 V1.4.1 (2001-12):

Emission Measurement Uncertainty

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64 dB
	6GHz ~ 18GHz	4.82 dB
	18GHz ~ 40GHz	4.91 dB

Radio Measurement Uncertainty

Estimated Combined Standard Uncertainty Type	Uncertainty
Frequency Error Measurements	± 3.88 Hz
Carrier Power Measurements	± 0.70 dB.
Adjacent Channel Power Measurements	± 1.47 dB.
Modulation Frequency Response Measurements	± 0.46 dB.
Transmitter Conducted Emission measurements	± 2.06 dB

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

3 General Information

3.1 General Description of EUT

<table>
<tr><td>Product / PMN</td><td>CTP2019DTNA</td></tr>
<tr><td>Brand</td><td>CTP</td></tr>
<tr><td>Test Model / HVIN</td><td>CTP19TNv3</td></tr>
<tr><td>Identification No. of EUT</td><td>A6633000000
Or A6633000500</td></tr>
<tr><td>Status of EUT</td><td>Engineering sample</td></tr>
<tr><td>Power Supply Rating</td><td>12 V input is expected from vehicles. Supports 8V to 32V</td></tr>
<tr><td>Temperature Operating Range</td><td>-35C to 75C</td></tr>
<tr><td>BT/WLAN Module</td><td>
<table>
<tr><td colspan="2">Model</td><td>UGKZ7A10</td></tr>
<tr><td colspan="2">Manufacturer</td><td>ALPS</td></tr>
<tr><td rowspan="5">WiFi</td><td>Frequency</td><td>2412 to 2462MHz for 802.11b/g/n</td></tr>
<tr><td>Channel Bandwidth</td><td>20 MHz</td></tr>
<tr><td>Modulation</td><td>802.11b – BPSK, QPSK, CCK, DSSS
802.11g – BPSK, QPSK, 16/64QAM, OFDM
802.11n – HT mode MCS0-7</td></tr>
<tr><td>Data rate max</td><td>802.11b – 11Mbps
802.11g – 54Mbps
802.11n – 72.2Mbps</td></tr>
<tr><td>Output Level</td><td>802.11b – +15dBm
802.11g – +13dBm
802.11n – +11dBm</td></tr>
<tr><td rowspan="2"></td><td>Sensitivity</td><td>802.11b – -90dBm
802.11g – -74dBm
802.11n – -72dBm</td></tr>
<tr><td rowspan="2">BT</td><td>Frequency</td><td>2402 ~2480MHz</td></tr>
<tr><td>Channel Spacing</td><td>Normal mode – 1MHz
BLE mode –2MHz</td></tr>
</table>
</td></tr>
<tr><td>Antenna Information</td><td>
<table>
<tr><td>ANTENNA-CABLE, WIFI/BT, INT</td><td>A66-12157-000</td><td>2400-2485 MHz
5150-5925 MHz</td><td>30 dBm</td><td>Antenna Type: WiFi/BT
2400-2485 MHz: 4.0 dBi
5150-5925 MHz: 5.0 dBi</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Note: The above radio information is for the BT/ WLAN radio module inside CTP19TNv3.
This report is only document the WiFi radio.</td></tr>
</table>

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The CTP19TNv3 is an antenna unique connector cable that is used “Professional installation required.”

3.5 Duty Cycle

The CTP19TNv3

3.5.1 Results

Mode	Duty Cycle (%)	Duty Factor (dB)
11b	38.08	4.11
11g	41.40	3.83
11n	37.80	4.23

Notes: EUT was configured and measured for the duty cycle at each data rate.

The duty cycle was calculated based on the trace data with the timing correlating to values that are above the -20dB level from the maximum level recorded.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2023 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b):2021 and RSS 247: 2017 Sect. 5.4 (d).

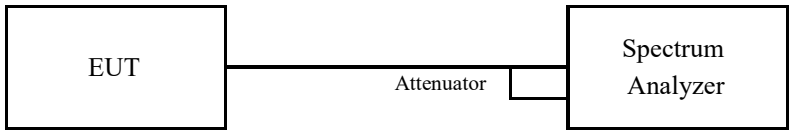
The maximum transmitted powers are

Band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

The ANSI C63.10-2013 Section 11.9.2.2.4 conducted method was used to measure the channel power output. The preliminary investigation was performed at different data rate/ chain to determine the highest power output for each mode. The worst findings were conducted on 3 channels in each operating range per CFR47 Part 15.247(b): 2023 and RSS 247 Sect. 5.4 (d). This test was conducted on 3 channels of Engineering Sample. The worst mode result indicated below.

Test Setup:



Method AVGSA-2 of "KDB 558074 – DTS Measurement Guidance v05r02" applies since the EUT continuously transmits with duty cycle less than 98%. Sample detector was used.

4.1.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results

Test Date: 10-10-2023	**Test By:** Abhijit Patibandla
Test Method: Conducted Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

Frequency (MHz)	**Limit [dBm]**	**Output [dBm]**	**Duty Factor [dB]**	**∑ Power [dBm]**	**Margin [dB]**
11b					
2412	+30.00	13.74	4.11	17.85	-12.15
2437	+30.00	13.83	4.11	17.94	-12.06
2462	+30.00	13.68	4.11	17.79	-12.21
11g					
2412	+30.00	12.06	3.83	15.89	-14.11
2437	+30.00	11.96	3.83	15.79	-14.21
2462	+30.00	12.27	3.83	16.10	-13.90
11n					
2412	+30.00	11.75	4.23	15.98	-14.02
2437	+30.00	11.73	4.23	15.96	-14.04
2462	+30.00	11.65	4.23	15.88	-14.12

802.11b CH1

802.11b CH6

802.11b CH11

802.11g CH1

802.11g CH6

802.11g CH11

802.11n CH1

802.11n CH6


Spectrum Analyzer 1
Channel Power
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Off
Atten: 40 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 2.462000000 GHz
Avg|Hold: 100/100
Radio Std: None
1 Graph
Scale/Div 10.0 dB
Log
Ref Lvl Offset 1.20 dB
Ref Value 31.20 dBm
Mkr1 2.458665667 GHz
1.637 dBm
Center 2.46200 GHz
#Res BW 1.0000 MHz
#Video BW 3.0000 MHz*
Span 40 MHz
#Sweep 101 ms (10000 pts)
2 Metrics
Total Channel Power
11.65 dBm / 17.6 MHz
Total Power Spectral Density
-60.81 dBm/Hz
Oct 10, 2023
2:01:29 PM

802.11n CH11

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

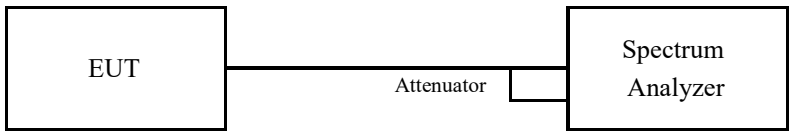
The minimum 6 dB bandwidth shall be at least 500 kHz.

The bandwidth shall be at least 500 kHz per Section CFR47 15.247(a2) 2023 and RSS 247 Sect.5.2 (a) 2017

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth according to ANSI C63.10:2013 Section 11.8.1. The measurement was performed with modulation per CFR47 15.247(a) (2) 2023 and RSS 247 Sect. 5.2 (a) 2017. The preliminary investigation was performed to find the narrowest 6 dB bandwidth for each operational mode at different data rates. This worst finding was performed on 3 channels in each operating frequency range; 2412 MHz to 2462 MHz. This test was conducted on 3 channels in each mode of Engineering Sample. The worst sample result indicated below.

Test Setup:



4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results

Test Date: 05-31-2023	**Test By:** Abhijit Patibandla
Test Method: Conducted Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

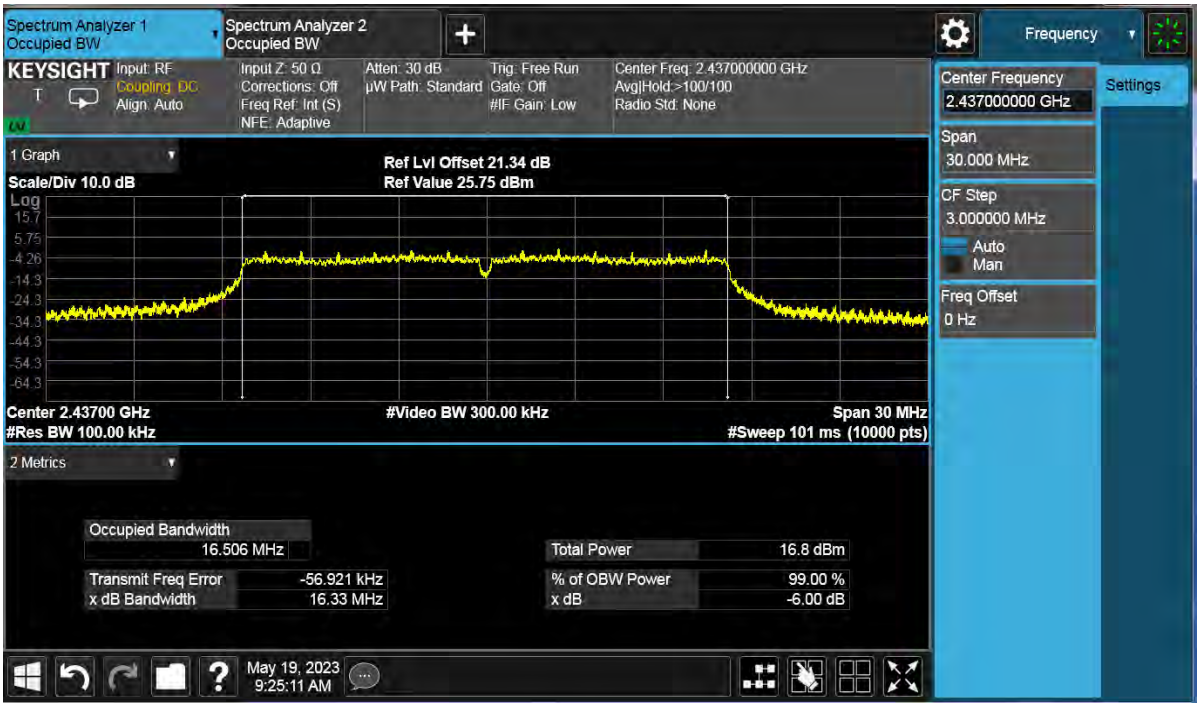
Frequency (MHz)	Limit (kHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Results
11b				
2412	>500	10.04	13.344	Pass
2437	>500	10.04	13.293	Pass
2462	>500	10.05	13.241	Pass
11g				
2412	>500	16.35	16.579	Pass
2437	>500	16.33	16.552	Pass
2462	>500	16.33	16.572	Pass
11n				
2412	>500	17.29	17.592	Pass
2437	>500	17.54	17.593	Pass
2462	>500	17.51	17.579	Pass

DTS BW at 802.11b CH1

DTS BW at 802.11b CH6

DTS BW at 802.11b CH11

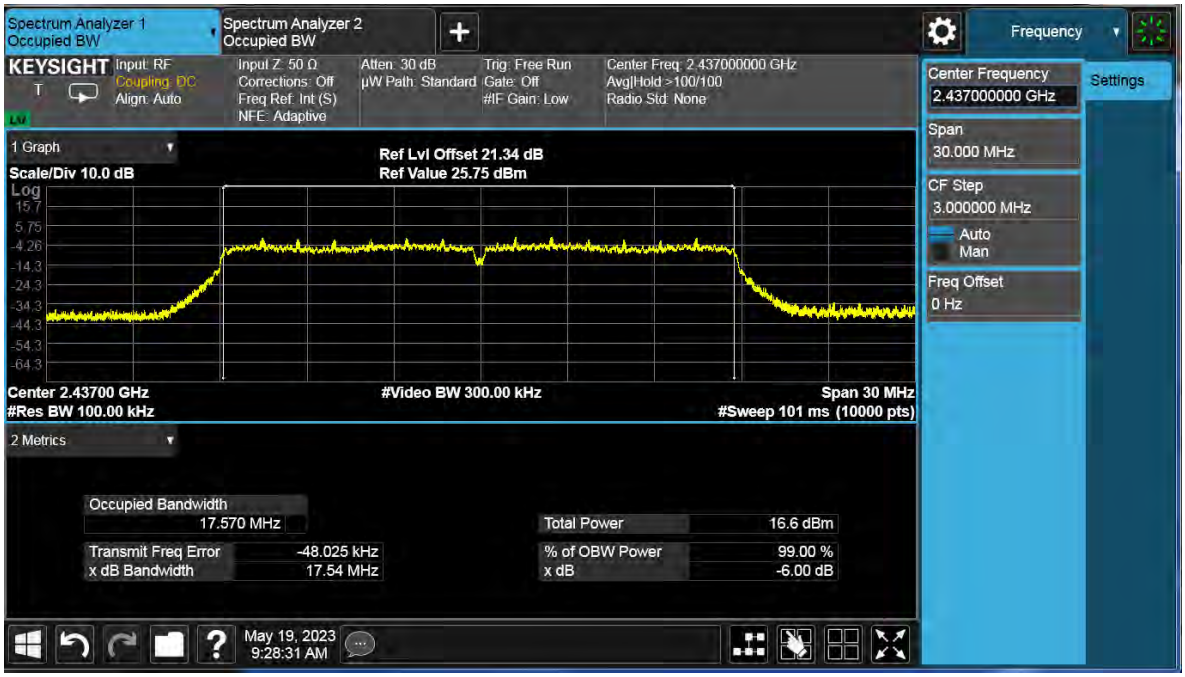
DTS BW at 802.11g CH1



DTS BW at 802.11g CH6

DTS BW at 802.11g CH11

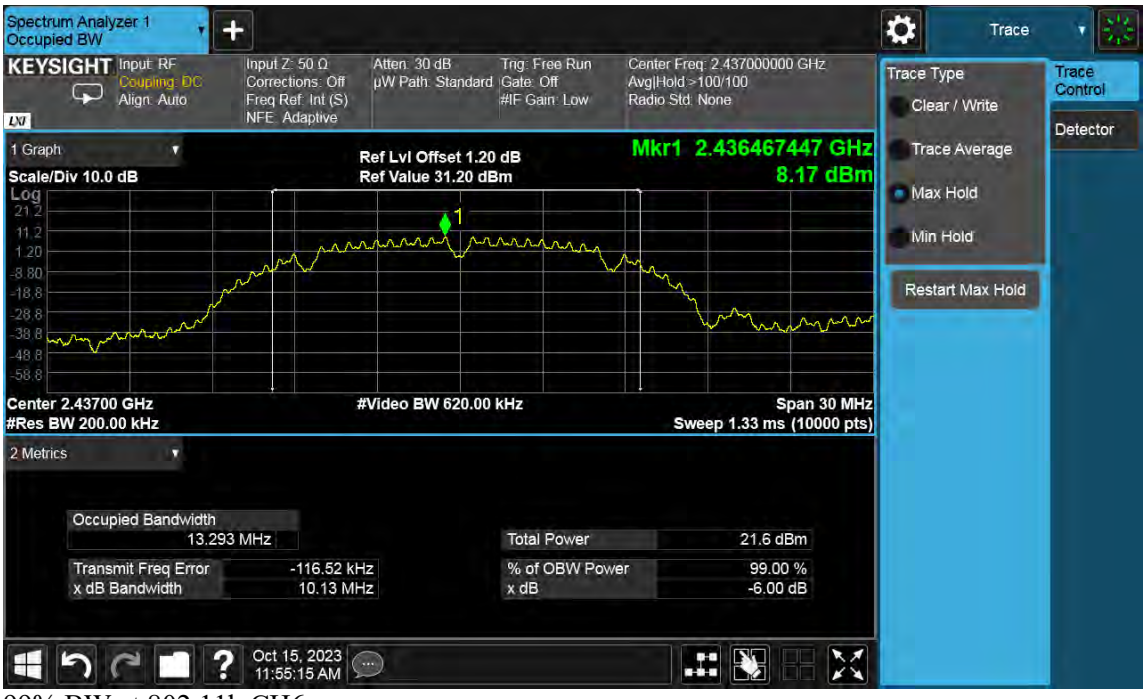
DTS BW at 802.11n CH1



DTS BW at 802.11n CH6

DTS BW at 802.11n CH11

99% BW at 802.11b CH1



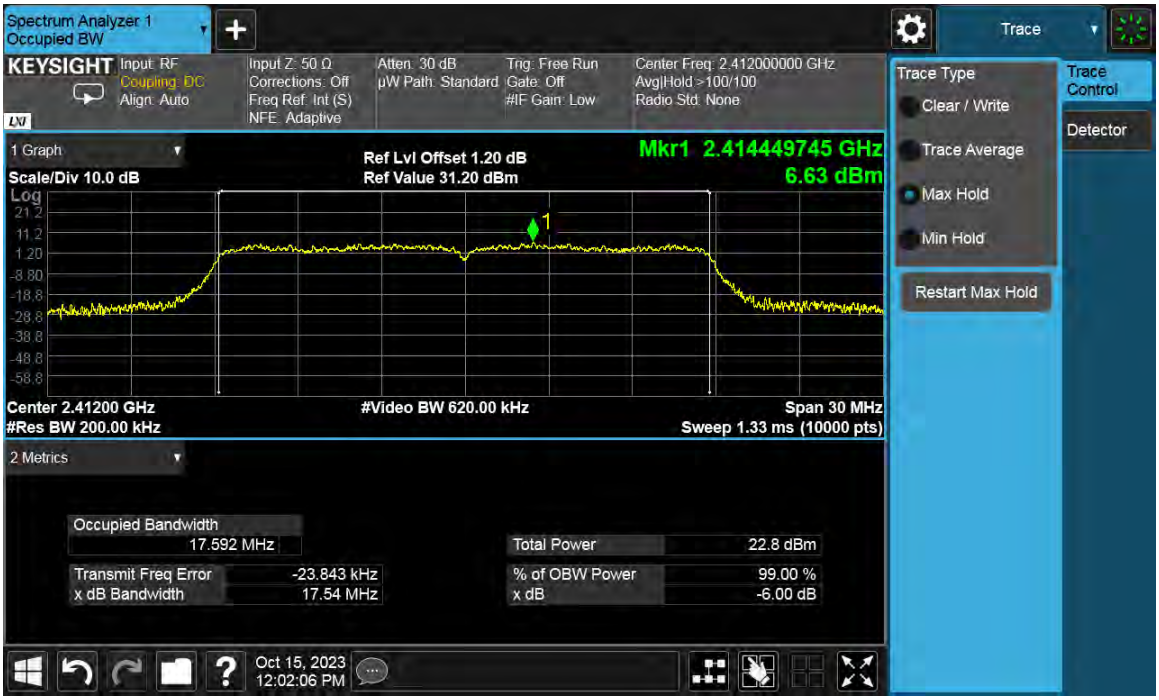
99% BW at 802.11b CH6

99% BW at 802.11b CH11

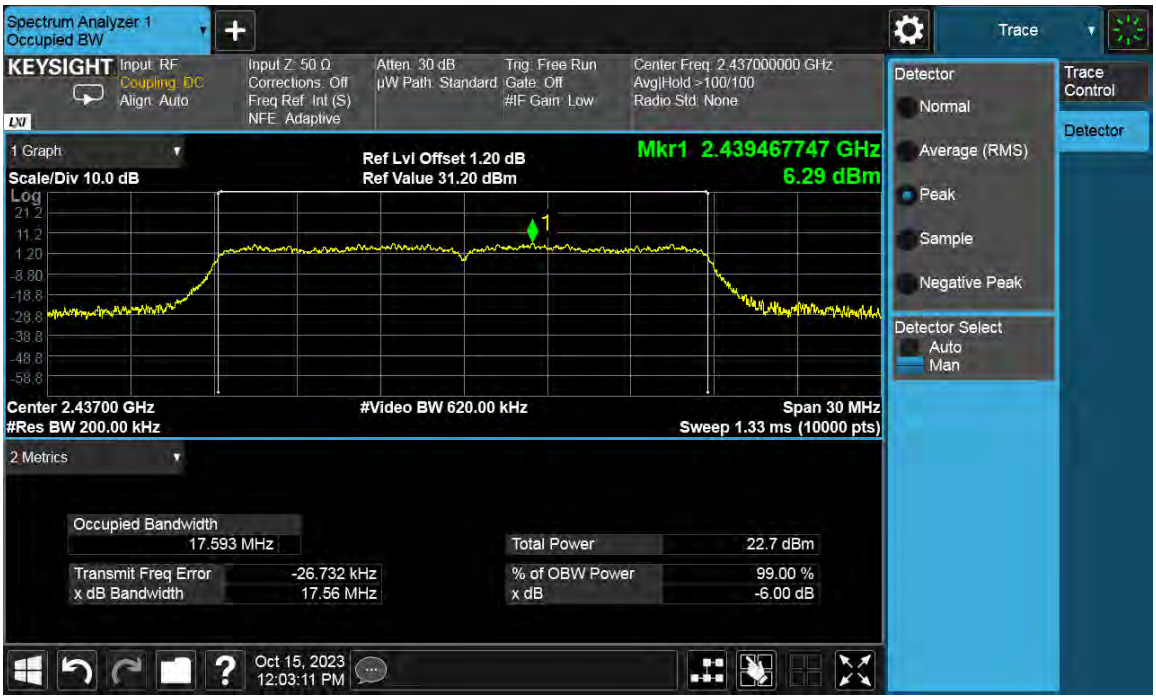
99% BW at 802.11g CH1

99% BW at 802.11g CH6

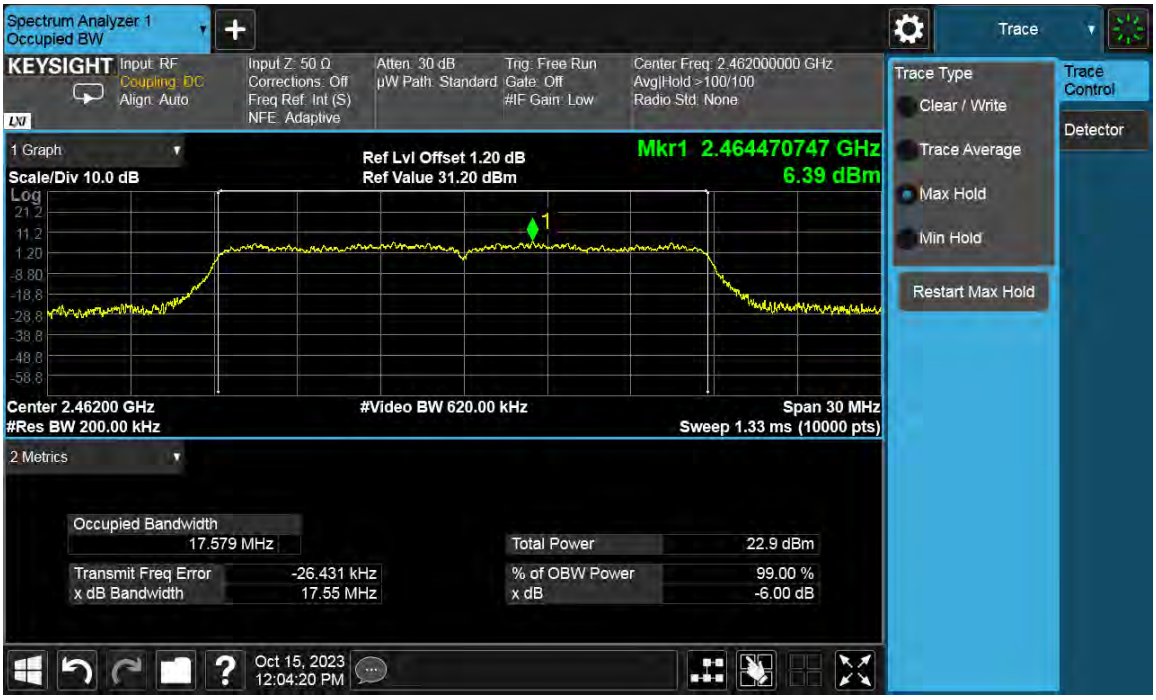
99% BW at 802.11g CH11



99% BW at 802.11n CH1



99% BW at 802.11n CH6



99% BW at 802.11n CH11

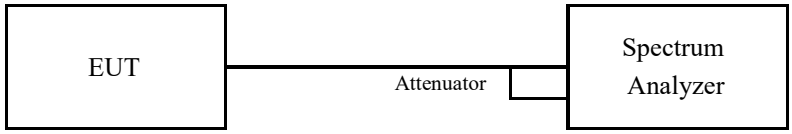
4.3 Maximum Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b), the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.1 Test Method

The conducted method was used to measure the power spectral density per ANSI C63.10-2013 Section 11.10.5 (AVGPSD-2). The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b). The pre-evaluation was performed to find the worst modes. The worst findings were conducted on 3 channels in each operating frequency range of 2412 MHz to 2462 MHz. This test was conducted on 3 channels of Engineering Sample. The worst sample result indicated below.

Test Setup:



4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

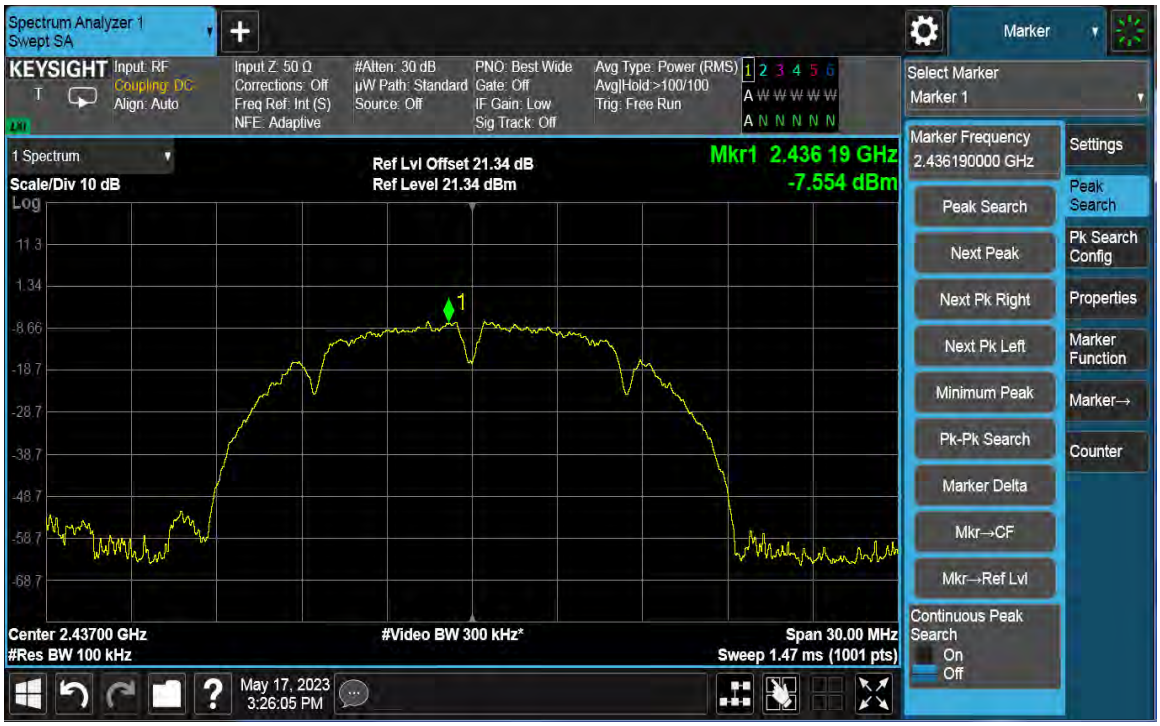
Table 4: Maximum Power Spectral Density – Test Results

Test Date: 05-31-2023	**Test By:** Abhijit Patibandla
Test Method: Conducted Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%
Peak Power Spectral Density	

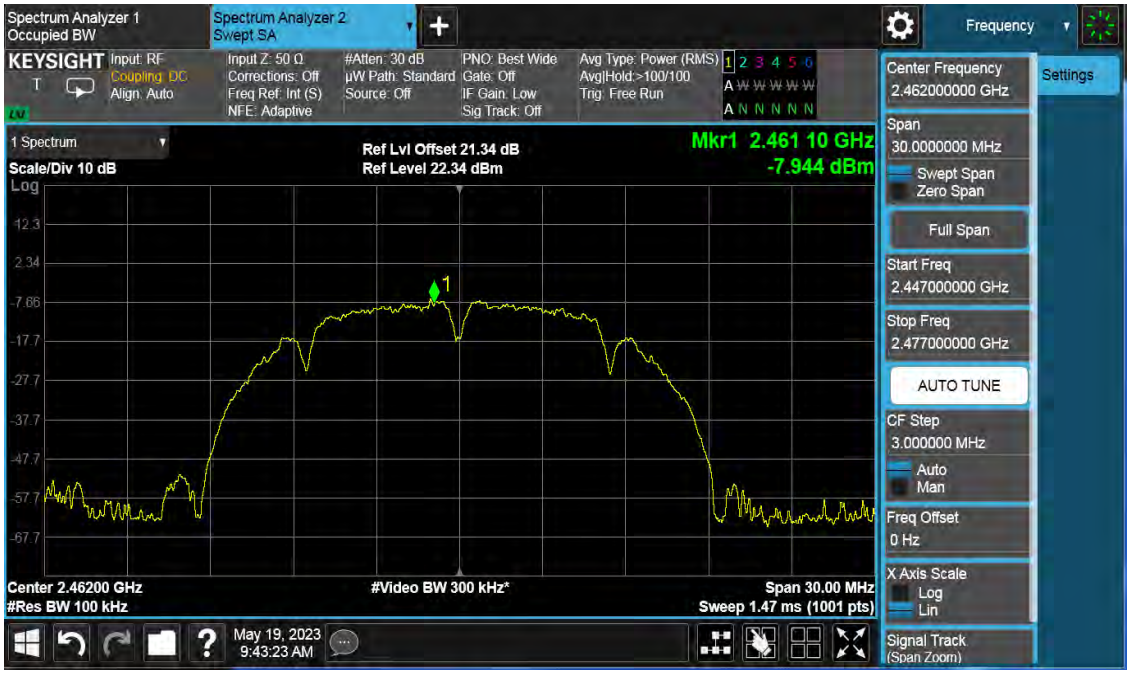
Freq. (MHz)	Output [dBm]	CF [dB]	Max. PSD [dBm]	Limit [dBm]	Margin [dB]
11b					
2412	-7.39	4.11	-3.28	8	-11.28
2437	-7.55	4.11	-3.44	8	-11.44
2462	-7.94	4.11	-3.83	8	-11.83
11g					
2412	-14.26	3.83	-10.43	8	-18.43
2437	-14.38	3.83	-10.55	8	-18.55
2462	-16.65	3.83	-12.82	8	-20.82
11n					
2412	-13.27	4.23	-9.04	8	-17.04
2437	-14.58	4.23	-10.35	8	-18.35
2462	-16.65	4.23	-12.42	8	-20.42

Note: CF accounted for the duty cycle correction.

802.11b CH1



802.11b CH6

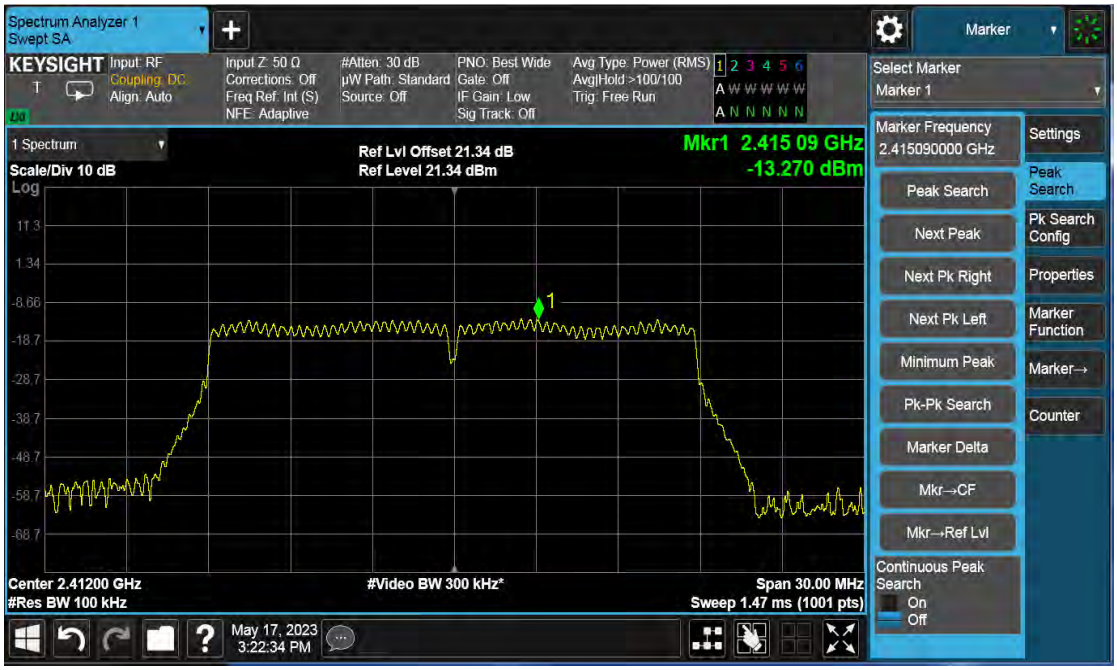


802.11b CH11

802.11g CH1

802.11g CH6

802.11g CH11



802.11n CH1

802.11n CH6


Spectrum Analyzer 1
Occupied BW
Spectrum Analyzer 2
Swept SA
Marker
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 30 dB
µW Path: Standard
Source: Off
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold:>100/100
Trig: Free Run
Select Marker
Marker 1
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 21.34 dB
Ref Level 22.34 dBm
Mkr1 2.464 79 GHz
-16.649 dBm
Log
12.3
2.34
-7.66
-17.7
-27.7
-37.7
-47.7
-57.7
-67.7
Center 2.46200 GHz
#Res BW 100 kHz
#Video BW 300 kHz*
Span 30.00 MHz
Sweep 1.47 ms (1001 pts)
Marker Frequency
2.464790000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter
May 19, 2023
9:44:51 AM

802.11n CH11

4.4 Out of Band Emissions

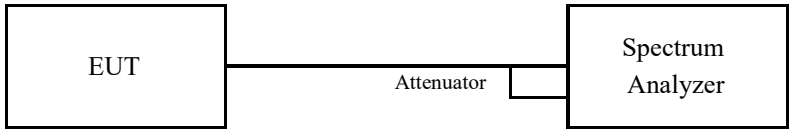
The setup was identical to RF output power measurement. Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 20 dB or 30 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Since the transmitter complies with the conducted power limits base on the use of RMS averaging per CFR47 Part 15.247(b)(3), any frequency outside the band of 2412MHz to 2462MHz, the power output level must be below 30db from the in-band transmitting signal; CFR 47 Part 15.215, 15.247(d) and RSS-247 Sect.5.5..

4.4.1 Test Method

The conducted method was used to measure the out-of-band emission requirement. The measurement was performed with modulation per CFR47 15.247(4) (d) 2023 and *RSS-247 Sect.5.5: 2017*. This test was conducted on 3 channels of Engineering Sample. The worst sample result indicated below.

Test Setup:



4.4.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 5: Out of Band Emissions – Test Results

Test Date: 10-10-2023	**Test By:** Abhijit Patibandla
Test Method: Conducted Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

Out of Band Results for CTP2019DTNA

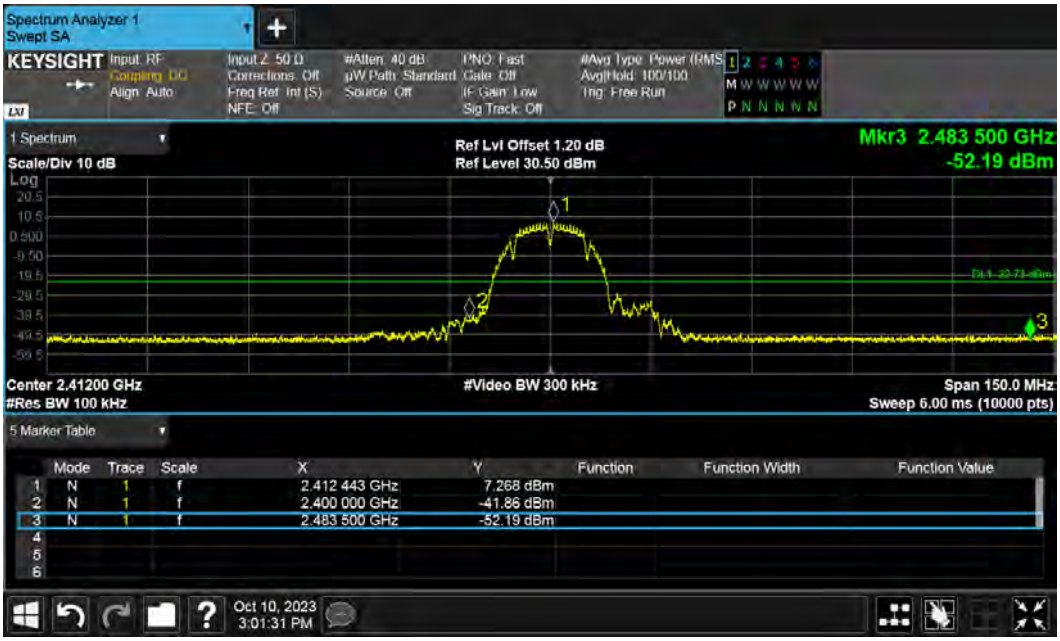
Frequency (MHz)	Rate (Mbps)	Out of Band Level (dBm)	30 dBc Level (dBm)	Margin (dB)
2412	11b @ 1Mbps	-40.68	-22.73	-17.95
2437	11b @ 1Mbps	-40.77	-22.37	-18.40
2462	11b @ 1Mbps	-40.34	-22.70	-17.64
2412	11g @ 6Mbps	-32.97	-25.05	-7.92
2437	11g @ 6Mbps	-41.27	-25.69	-15.58
2462	11g @ 6Mbps	-36.19	-24.78	-11.41
2412	11n @ 6.5Mbps	-30.12	-25.27	-4.85
2437	11n @ 6.5Mbps	-40.39	-25.17	-15.22
2462	11n @ 6.5Mbps	-32.14	-24.41	-7.73

Note: dBc is defined as the level below the main carrier.

The band-edge level must be lower than the 30 dBc level.

The maximum out of band emission on each individual output is at least 30 dB below the maximum in-band PSD on that output.

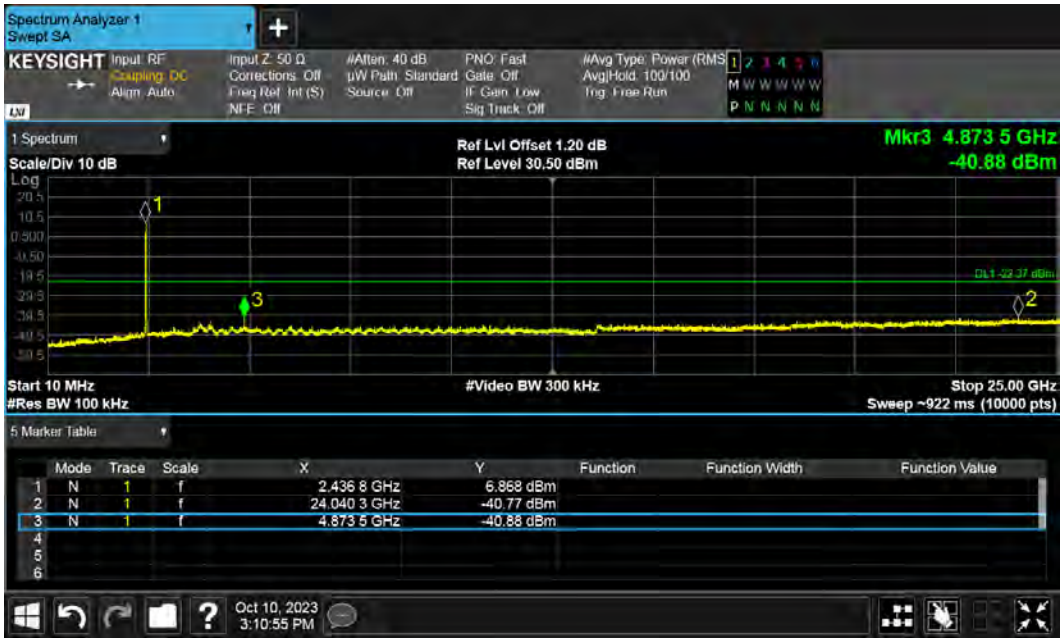
(*) The band-edge is compared to the highest -30 dBc level of the test mode.



802.11b_Conducted Band Edge – 2412 MHz

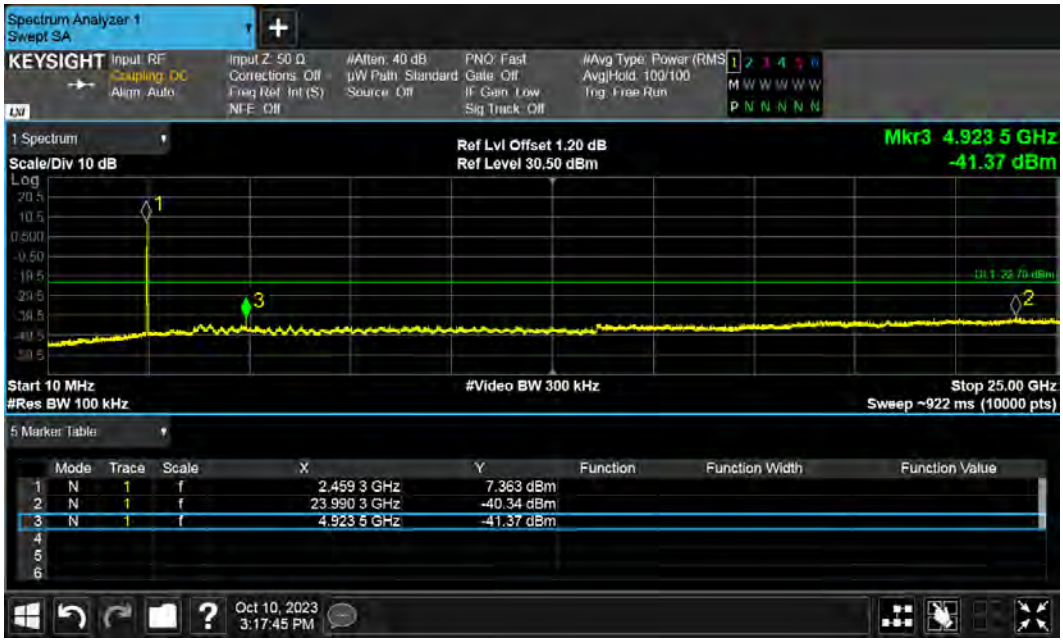
802.11b - Out of Band Emission - 2412 MHz

802.11b_Conducted Band Edge – 2437 MHz

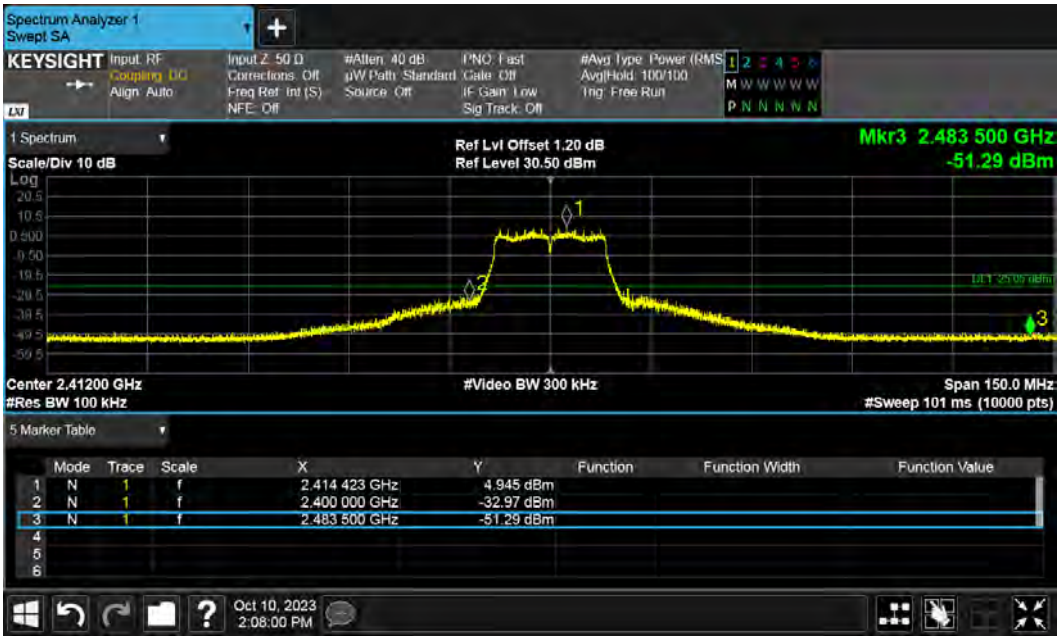


802.11b - Out of Band Emission - 2437 MHz

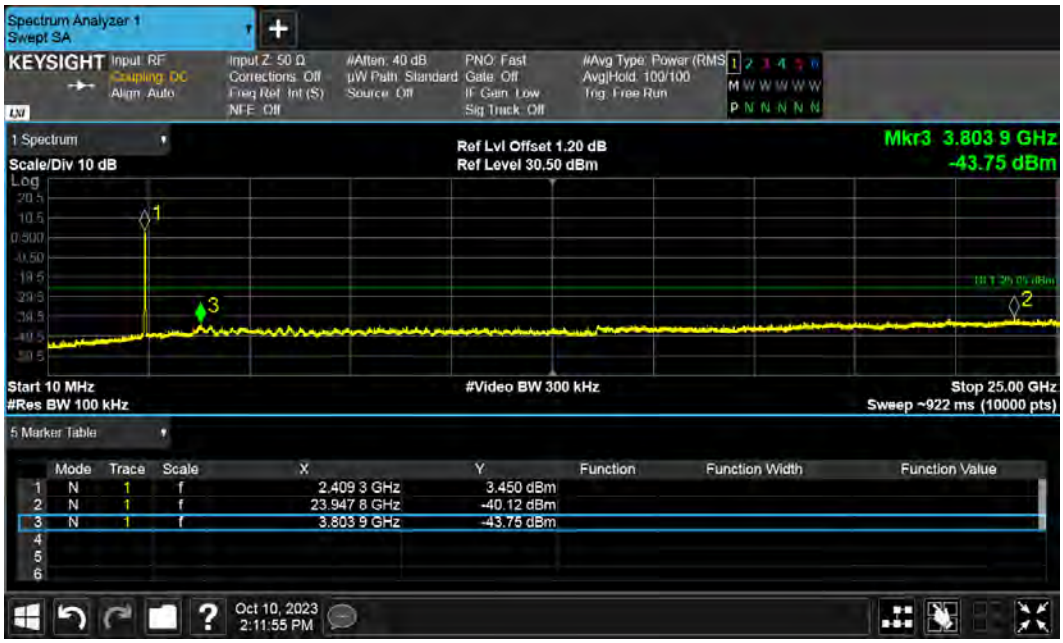
802.11b_Conducted Band Edge – 2462 MHz



802.11b - Out of Band Emission - 2462 MHz

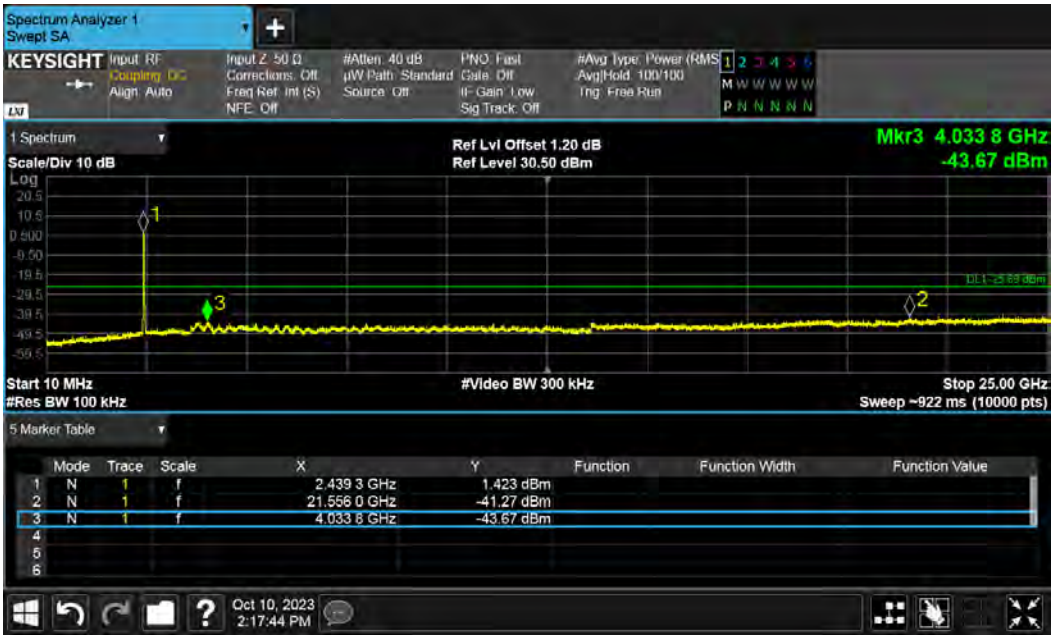


802.11g_Conducted Band Edge – 2412 MHz

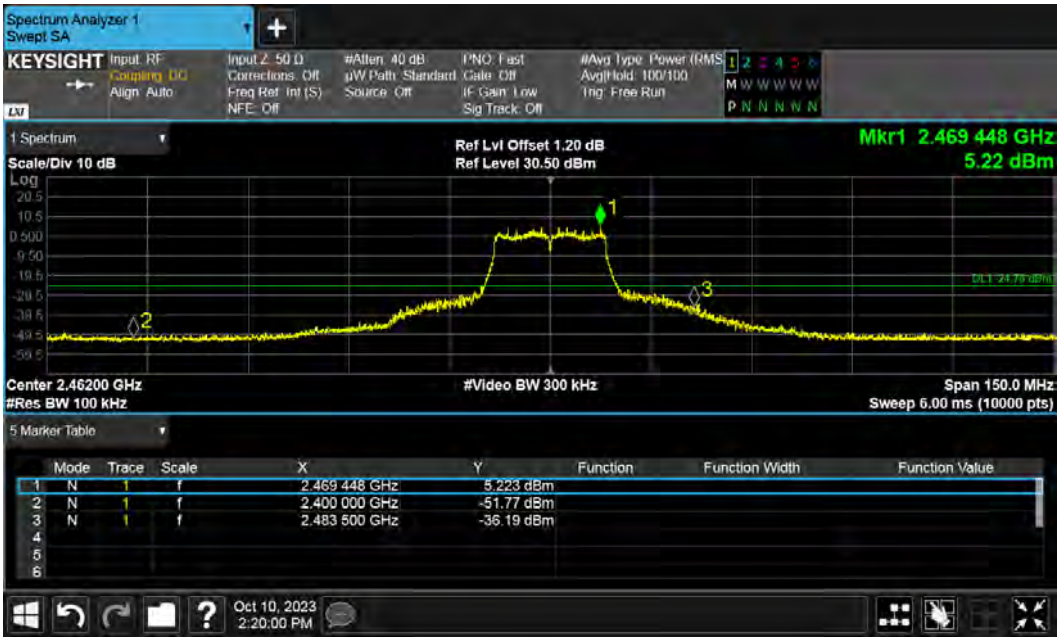


802.11g - Out of Band Emission - 2412 MHz

802.11g_Conducted Band Edge – 2437 MHz

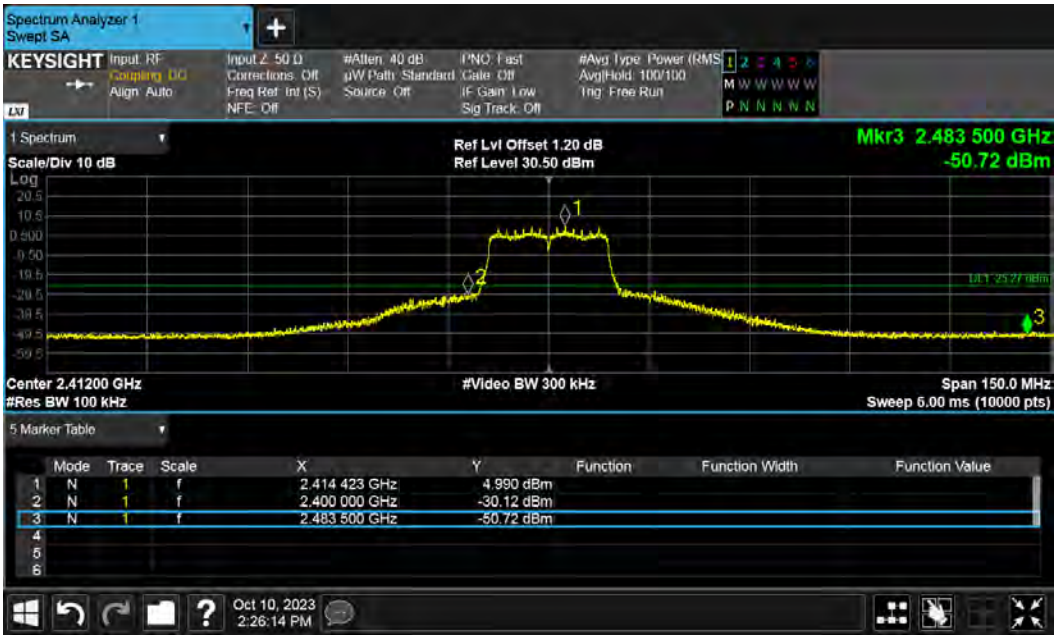


802.11g - Out of Band Emission - 2437 MHz

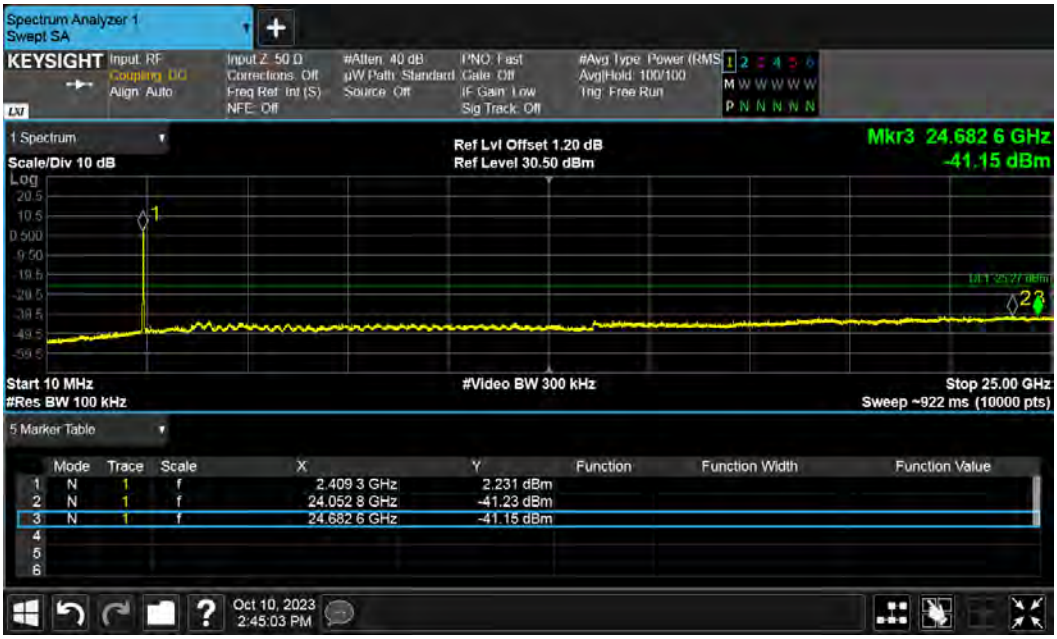


802.11g_Conducted Band Edge – 2462 MHz

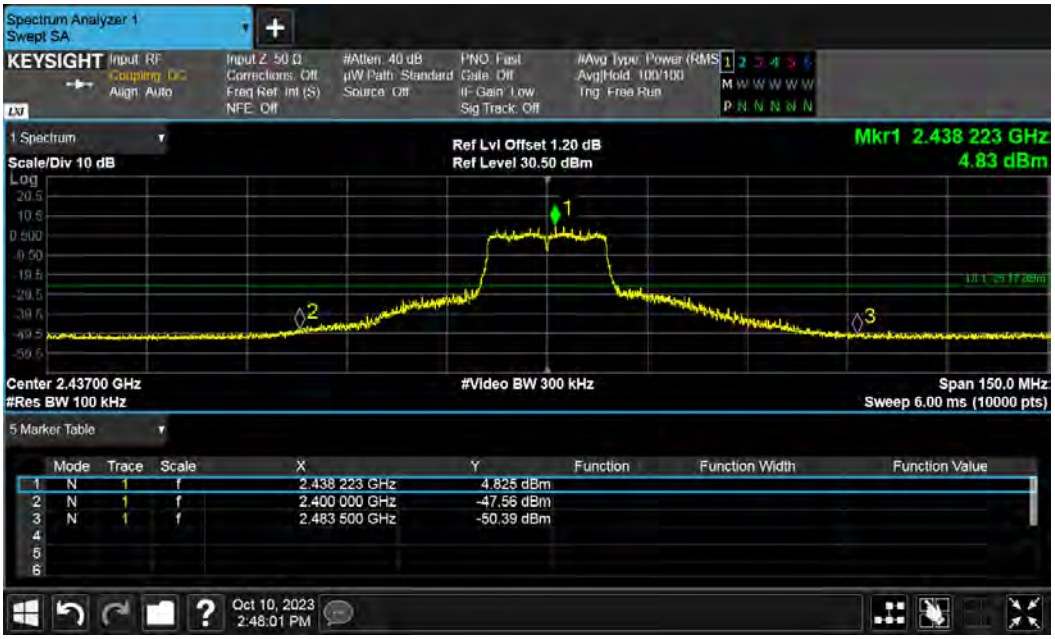
802.11g - Out of Band Emission - 2462 MHz



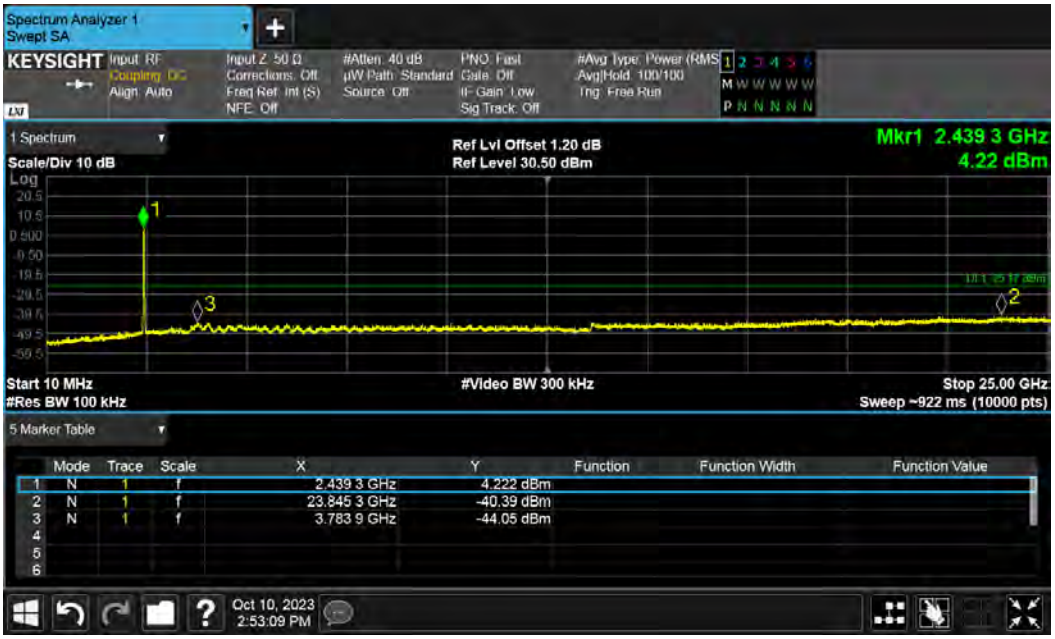
802.11n_Conducted Band Edge – 2412 MHz



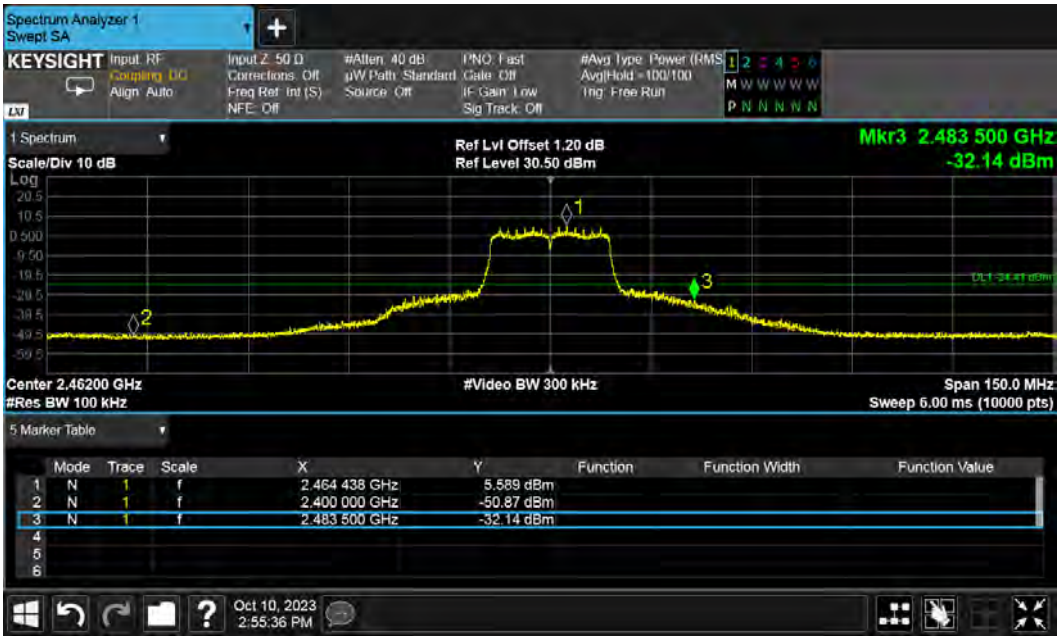
802.11n - Out of Band Emission - 2412 MHz



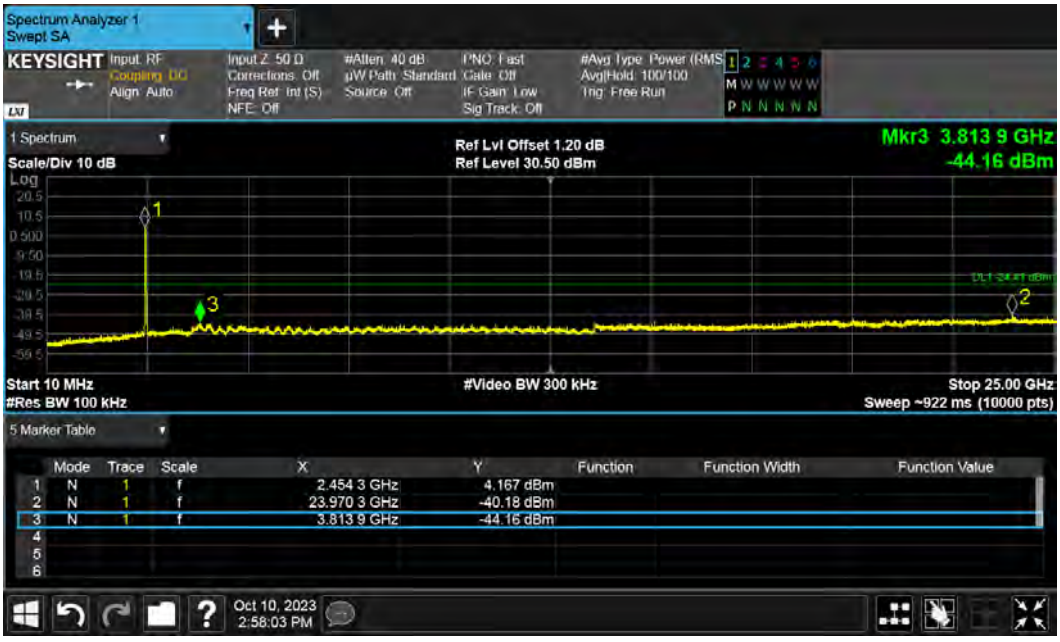
802.11n_Conducted Band Edge – 2437 MHz



802.11n - Out of Band Emission - 2437 MHz



802.11n_Conducted Band Edge – 2462 MHz



802.11n - Out of Band Emission - 2462 MHz

4.5 Transmit Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-Gen Sect. 8.9.

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pres-scans were performed to determine the worst case configuration for data rate.

4.5.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

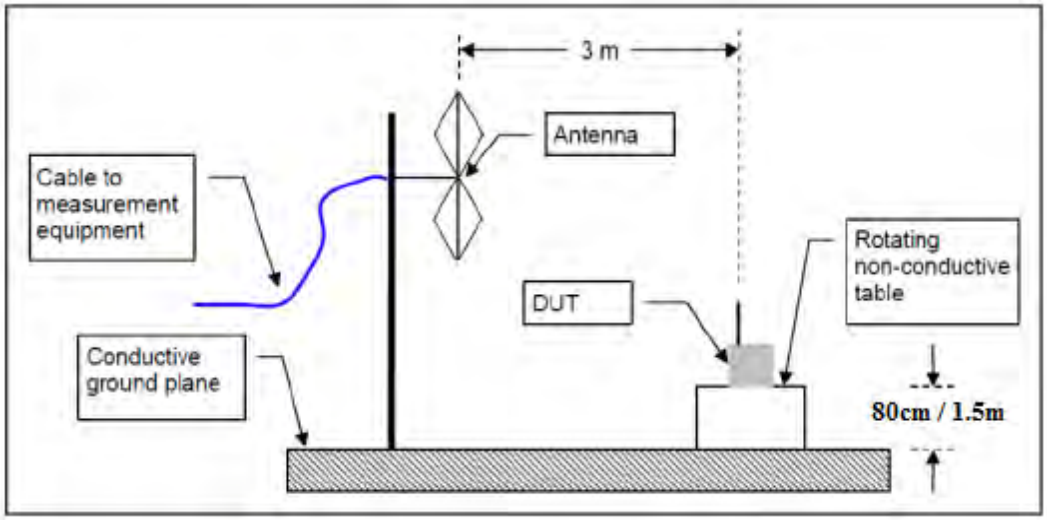
The final scans performed on the worst axis, Y-Axis up, for three operating channels in each operating mode;

2412 MHz, 2437 MHz, and 2462 MHz

4.5.1.3 Deviations

None.

Test Setup:



4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2023 and RSS Gen Sect. 8.10: 2019.

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

All harmonics and spurious emission which are outside of the restricted band shall be 20dB below the in-band emission.

4.5.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: Transmit Spurious Emissions at Band-Edge Requirements (802.11b)

Test Date: May 30, 2023	**Test By:** James Ma
Test Method: Radiated Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

Band-Edge Results for 802.11b

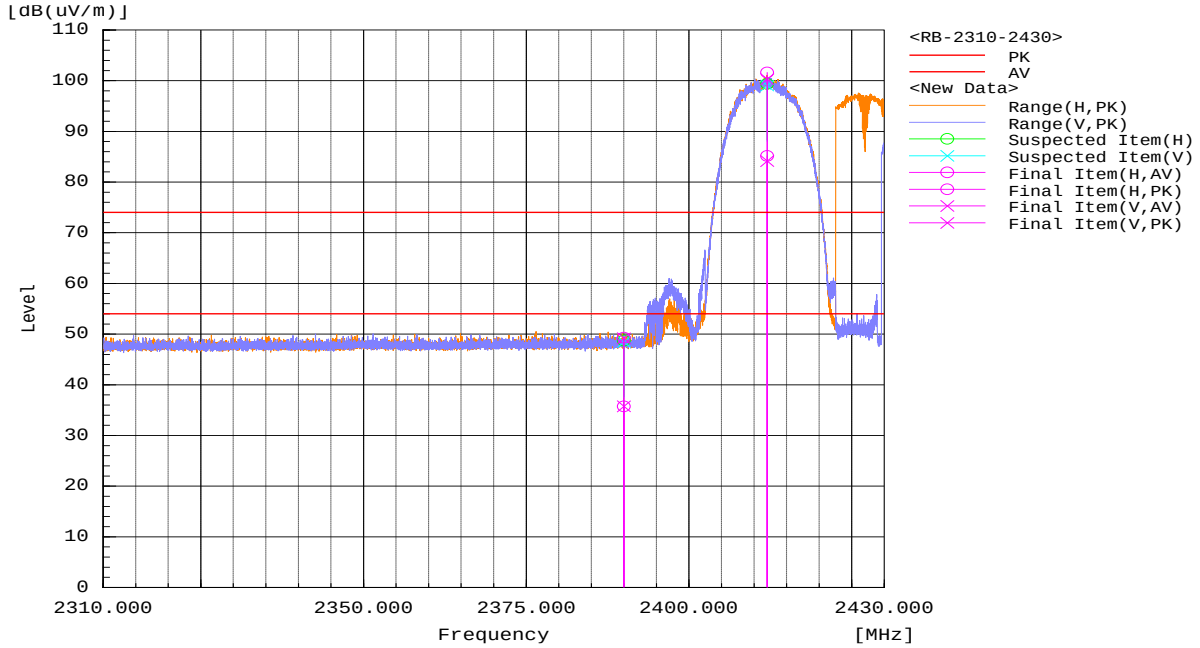
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No.	Frequency (MHz)	Pol (H/V)	Reading AV (dBuV/m)	Reading PK (dBuV/m)	Factor (dB)	Level AV (dBuV/m)	Level PK dB(uV/m)	Limit AV (dBuV/m)	Limit PK (dBuV/m)	Margin AV (dB)	Margin PK (dB)	Hght (cm)	Angle (Deg)	Pass/ Fail
1	2390	V	-1.9	11.5	37.7	35.8	49.2	54	74	-18.2	-24.8	114.3	224.2	Pass
2	2390	H	-2.0	11.6	37.7	35.7	49.3	54	74	-18.3	-24.7	319	210	Pass
3	2412	H	47.4	63.9	37.7	85.1	101.6	54	74			325.5	226.8	N/A*
4	2412	V	46.4	62.6	37.7	84.1	100.3	54	74			380.9	221.3	N/A*
5	2462	V	47.6	64.2	37.9	85.5	102.1	54	74			105	228.8	N/A*
6	2462	H	51.2	67.9	37.9	89.1	105.8	54	74			143	330.8	N/A*
7	2483.5	H	-1.1	12.7	38.0	36.9	50.7	54	74	-17.1	-23.3	123	328.6	Pass
8	2483.5	V	-1.6	12.3	38.0	36.4	50.3	54	74	-17.6	-23.7	111	221.3	Pass

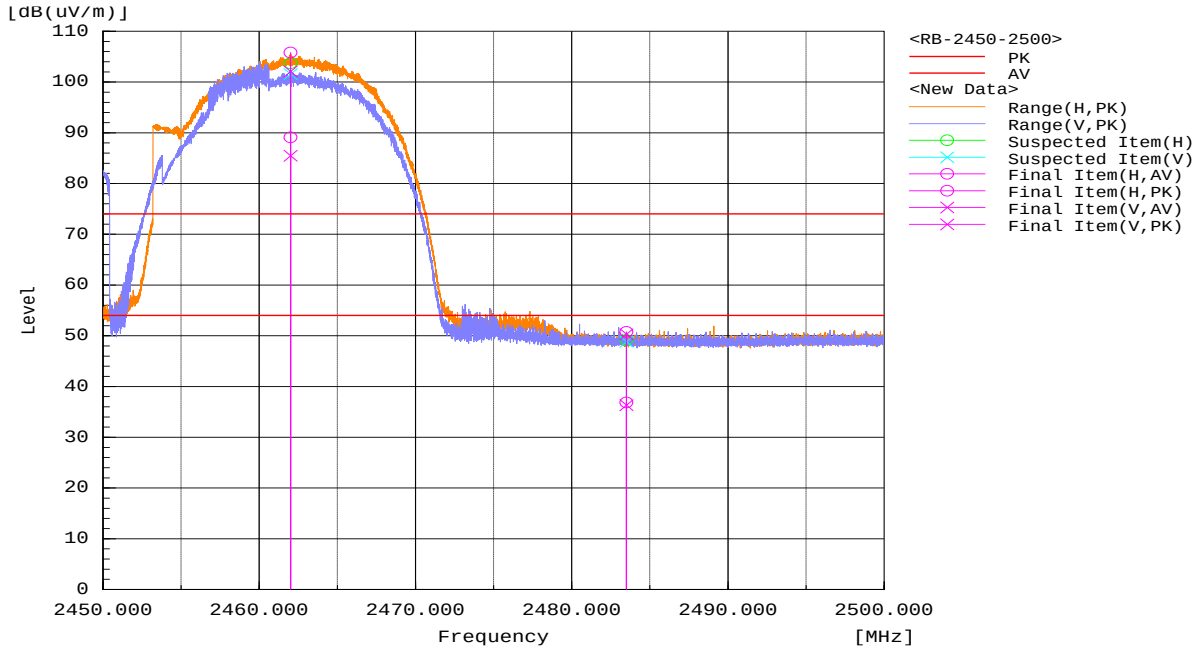
Note: The emissions were measured at the adjacent restricted band of the fundamental signal.
All the band-edge measurements met the restricted band requirements of CFR47 15.205
Band-edge measurement plots use a wider span than 2 MHz to evaluate additional spectrum bands for in-band leakage and spurious emission.

(*) Fundamental/ Inband emission.

Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
Margin value = Emission level – Limit value.



Band-Edge 802.11b - 2412 MHz

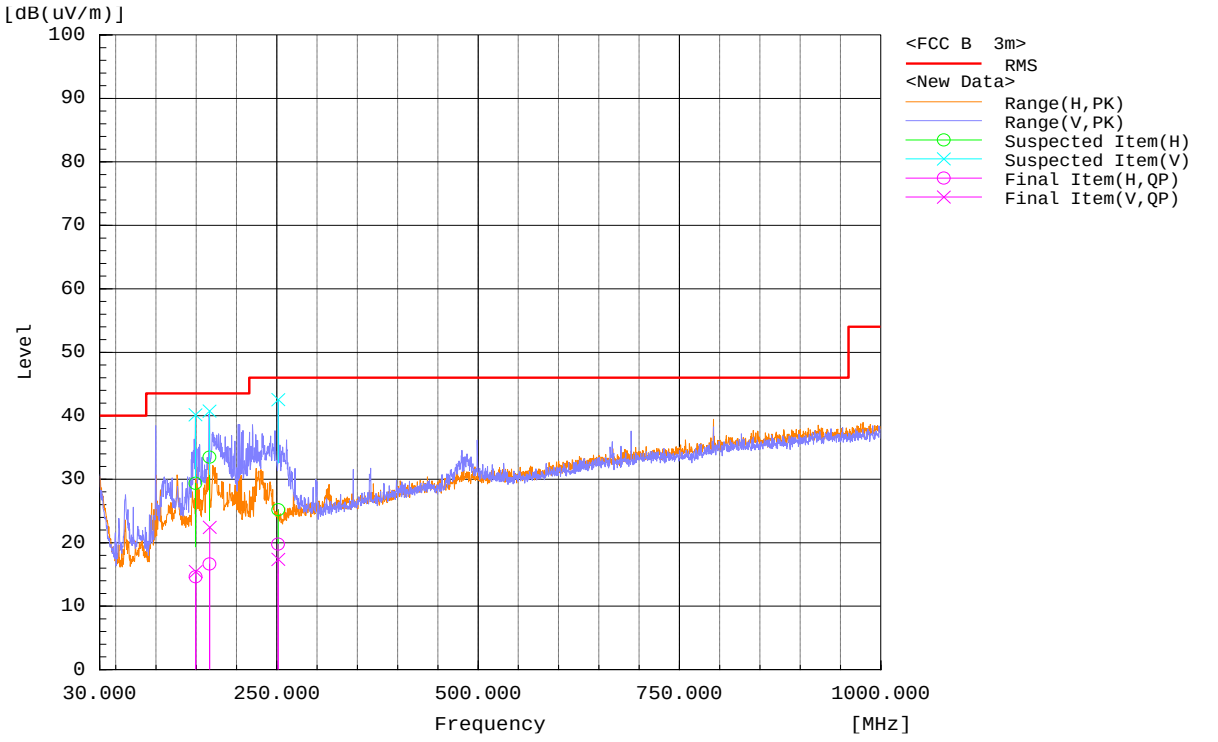


Band-Edge 802.11b - 2462 MHz

Radiated Emissions			
EUT Name	CTP2019DTNA	**Date**	06/01/2023
EUT Model	CTP19TNv3	**Temp / Hum in**	23°C / 40% RH
EUT Serial	N/A	**Temp / Hum out**	N/A
EUT Config.	EUT on Vertical Position	**Line AC / Freq**	N/A
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB6	**Performed by**	James Ma

802.11b (30M - 1GHz) _ CH1

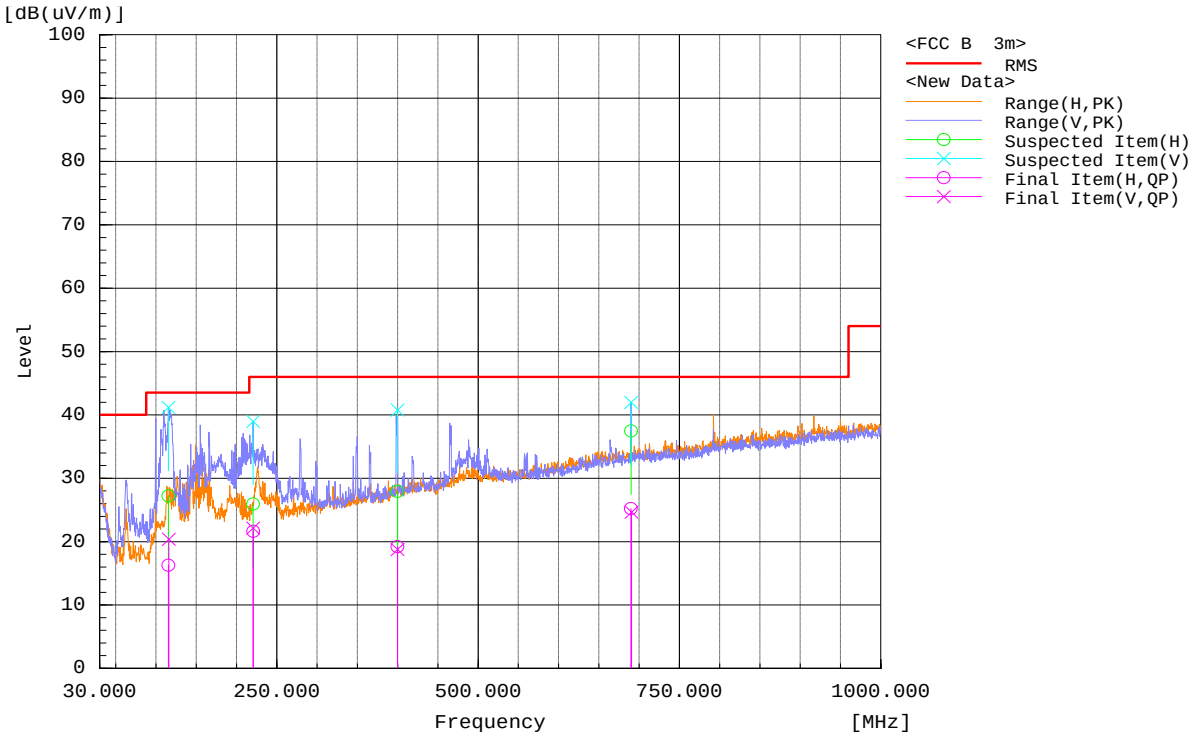
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
149.203	H	-9.4	24.0	14.6	43.5	-28.9	116.0	224.4
149.342	V	-8.7	24.2	15.5	43.5	-28.0	119.0	291.8
166.696	V	-1.4	23.8	22.4	43.5	-21.1	100.1	251.0
166.432	H	-7.0	23.6	16.6	43.5	-26.9	257.0	355.4
251.67	H	-4.0	23.8	19.8	46.0	-26.2	113.5	89.2
251.736	V	-6.5	23.9	17.4	46.0	-28.6	212.1	228.8



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11b (30M - 1GHz) _ CH6

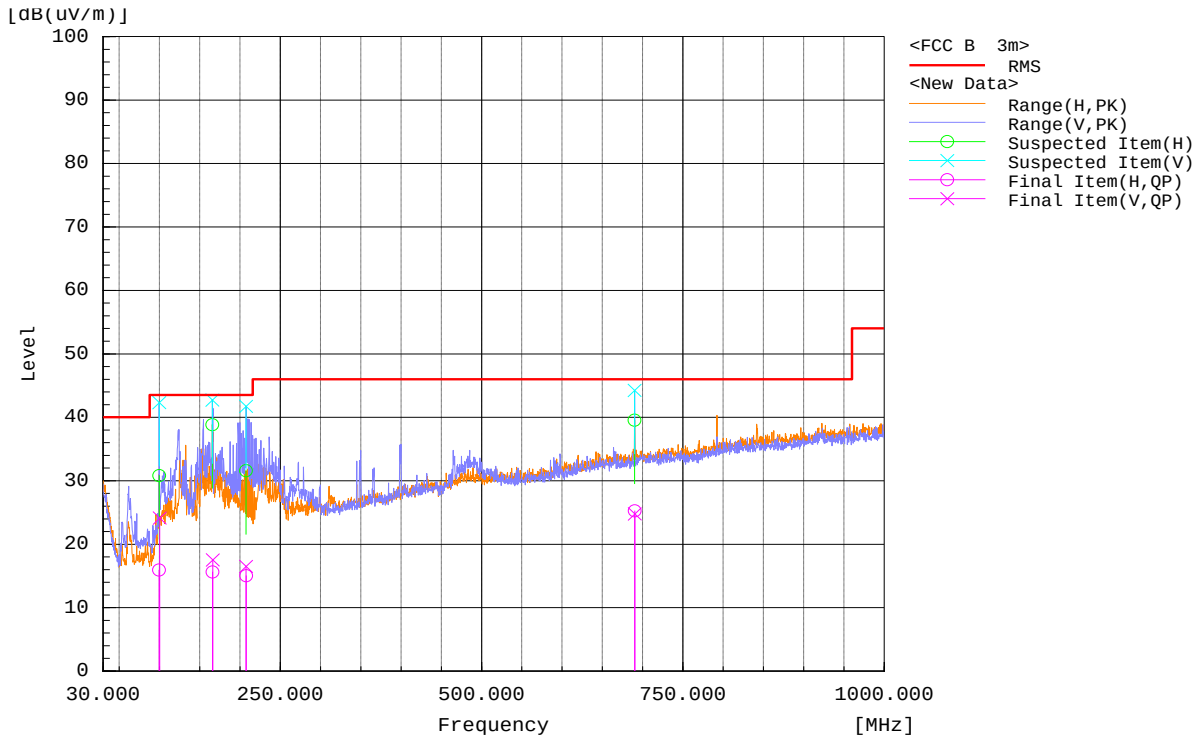
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
115.892	V	-3.7	24.1	20.4	43.5	-23.1	100.3	186.6
115.334	H	-7.7	24.0	16.3	43.5	-27.2	315.8	250.4
220.757	H	-1.3	22.9	21.6	46	-24.4	152.5	298.8
220.669	V	-0.7	22.9	22.2	46	-23.8	100.1	265.4
399.957	V	-9.6	28.4	18.8	46	-27.2	224.8	108.8
399.74	H	-9.5	28.7	19.2	46	-26.8	139.5	341.8
689.669	H	-9.4	34.6	25.2	46	-20.8	254.6	0.1
690.412	V	-9.4	34.1	24.7	46	-21.3	369.6	271.2



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11b (30M - 1GHz) _ CH11

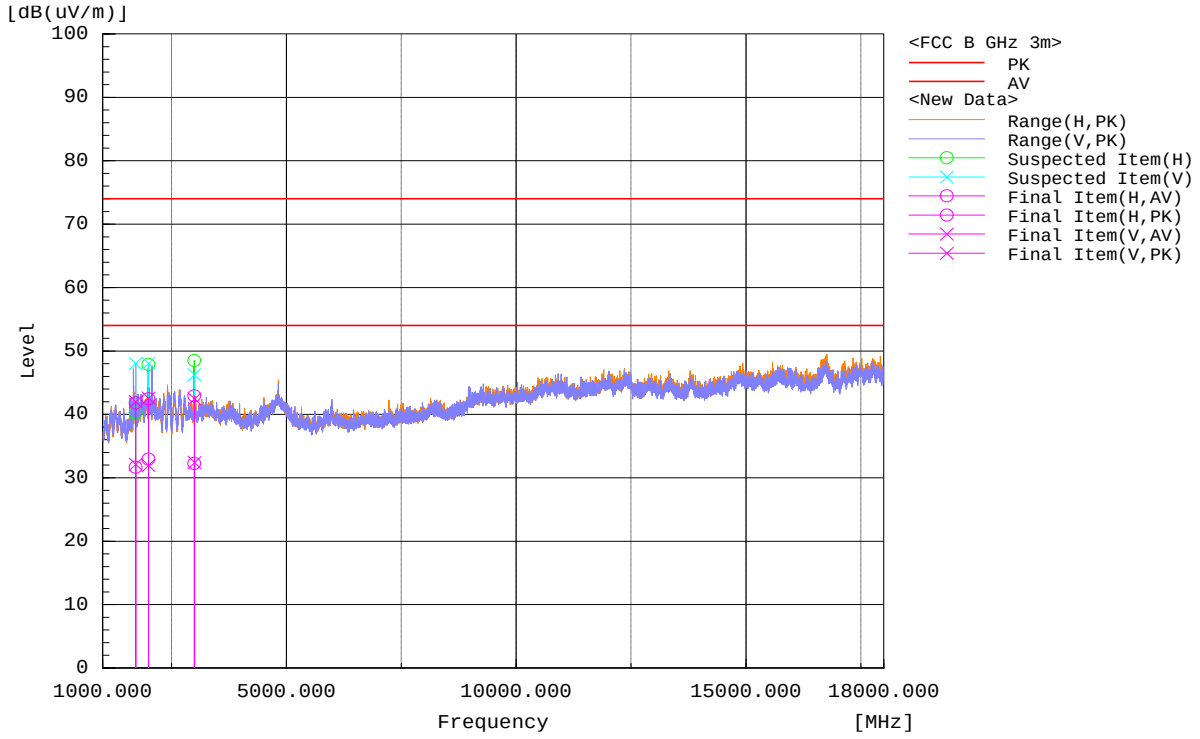
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
100.227	V	2.7	21.4	24.1	43.5	-19.4	102.7	280.4
99.385	H	-4.9	20.8	15.9	43.5	-27.6	183.6	116.5
165.96	H	-8.1	23.7	15.6	43.5	-27.9	294.3	345
166.15	V	-6.4	23.9	17.5	43.5	-26.0	161.3	127.9
207.572	V	-6.3	22.8	16.5	43.5	-27.0	115.4	320.2
207.695	H	-7.5	22.5	15.0	43.5	-28.5	241.9	290.8
690.17	H	-9.3	34.6	25.3	46.0	-20.7	378.5	239.9
690.192	V	-9.3	34.1	24.8	46.0	-21.2	352.7	0



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11b (1- 18 GHz) _ CH1

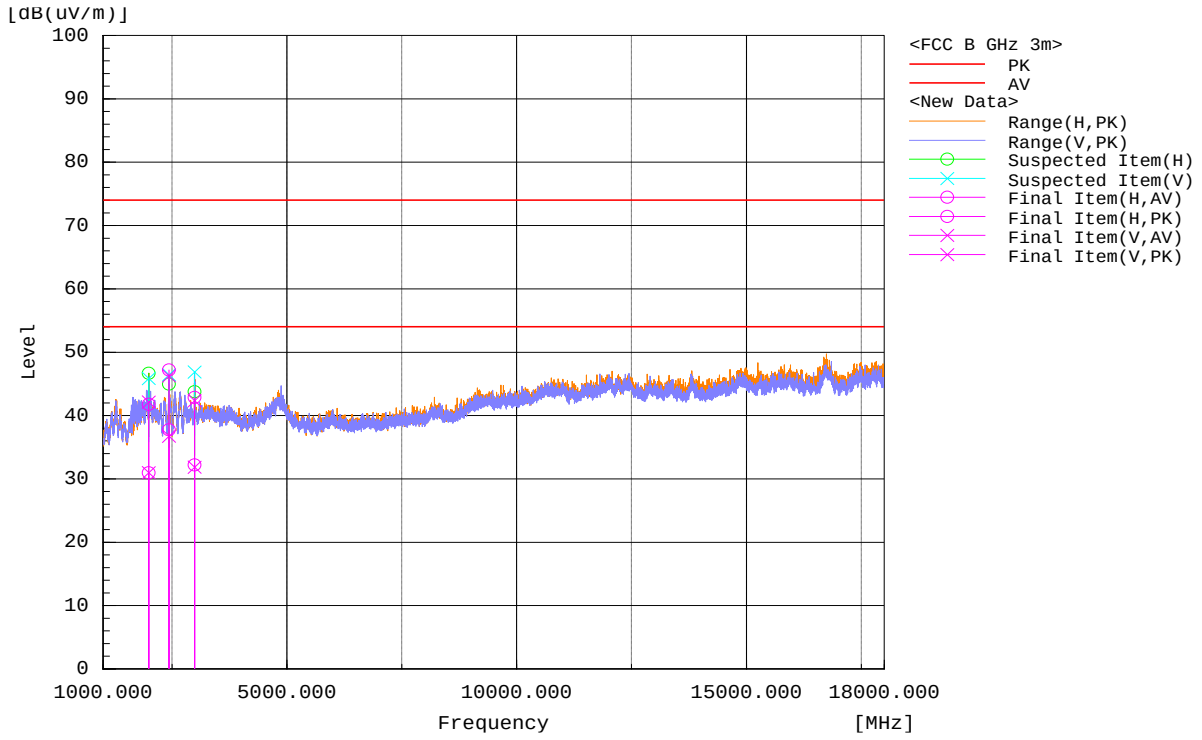
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1719.254	H	44.0	54.1	-12.3	31.7	41.8	54	74	-22.3	-32.2
1719.178	V	44.4	54.3	-12.3	32.1	42.0	54	74	-21.9	-32.0
1998.023	H	43.4	52.9	-10.5	32.9	42.4	54	74	-21.1	-31.6
1996.753	V	42.4	53.1	-10.5	31.9	42.6	54	74	-22.1	-31.4
2998.305	V	42.2	52.3	-9.8	32.4	42.5	54	74	-21.6	-31.5
2997.86	H	42.1	52.7	-9.8	32.3	42.9	54	74	-21.7	-31.1



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11b (1- 18 GHz) _ CH6

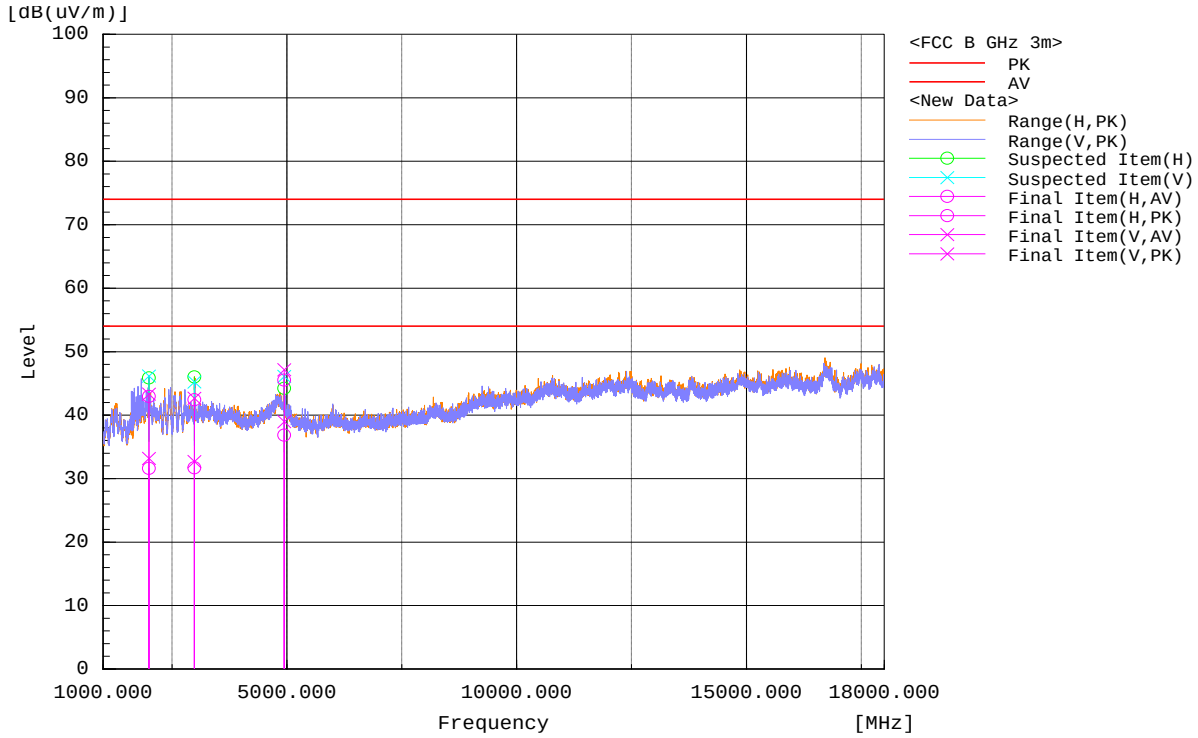
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1992.036	H	41.5	52.3	-10.5	31.0	41.8	54	74	-23.0	-32.2
1992.807	V	41.5	52.7	-10.5	31.0	42.2	54	74	-23.0	-31.8
2435.754	V	47.2	56.7	-10.4	36.8	46.3	54	74	-17.2	-27.7
2435.057	H	48.2	57.6	-10.4	37.8	47.2	54	74	-16.2	-26.8
2989.863	H	42.0	52.7	-9.8	32.2	42.9	54	74	-21.8	-31.1
2992.132	V	41.7	52.2	-9.8	31.9	42.4	54	74	-22.1	-31.6



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11b (1- 18 GHz) _ CH11

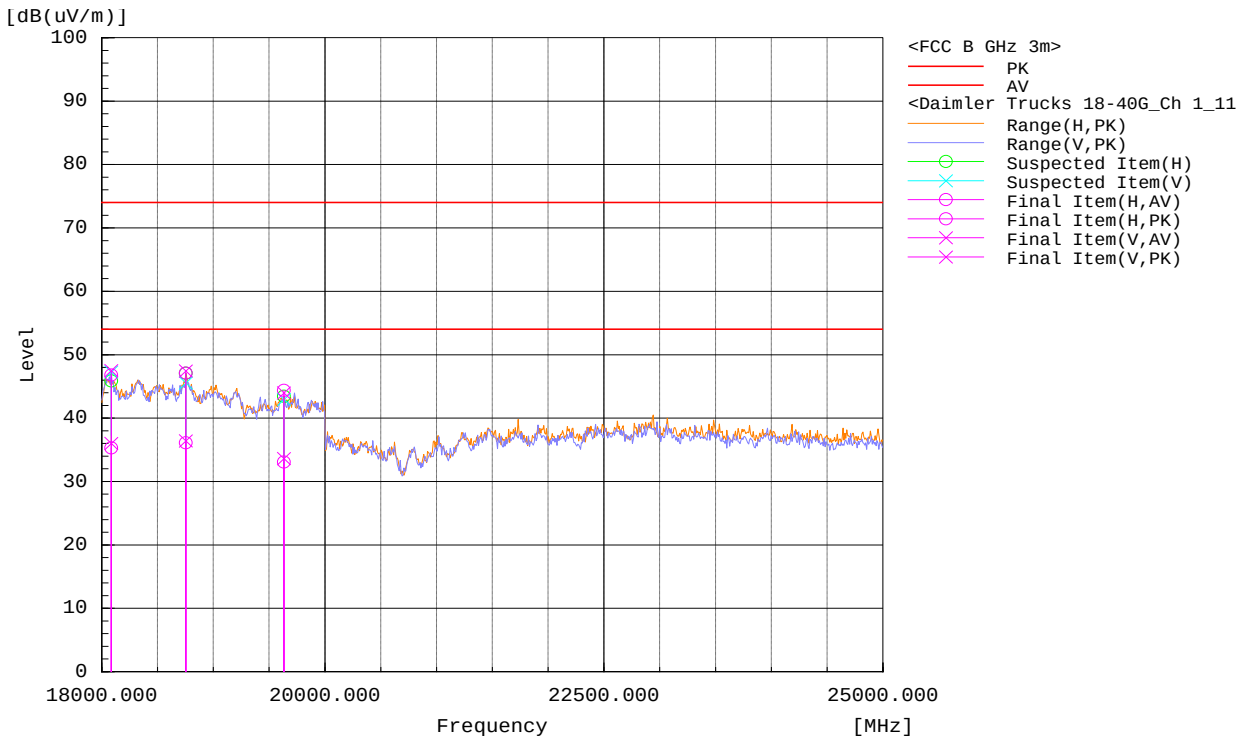
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1997.329	V	43.7	53.8	-10.5	33.2	43.3	54	74	-20.8	-30.7
1996.459	H	42.1	53.5	-10.5	31.6	43.0	54	74	-22.4	-31.0
2987.116	H	41.5	52.2	-9.8	31.7	42.4	54	74	-22.3	-31.6
2986.113	V	42.5	52.5	-9.8	32.7	42.7	54	74	-21.3	-31.3
4943.906	V	46.6	54.8	-7.6	39.0	47.2	54	74	-15.0	-26.8
4943.89	H	44.5	53.1	-7.6	36.9	45.5	54	74	-17.1	-28.5



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11b (18 - 25 GHz) _ CH1

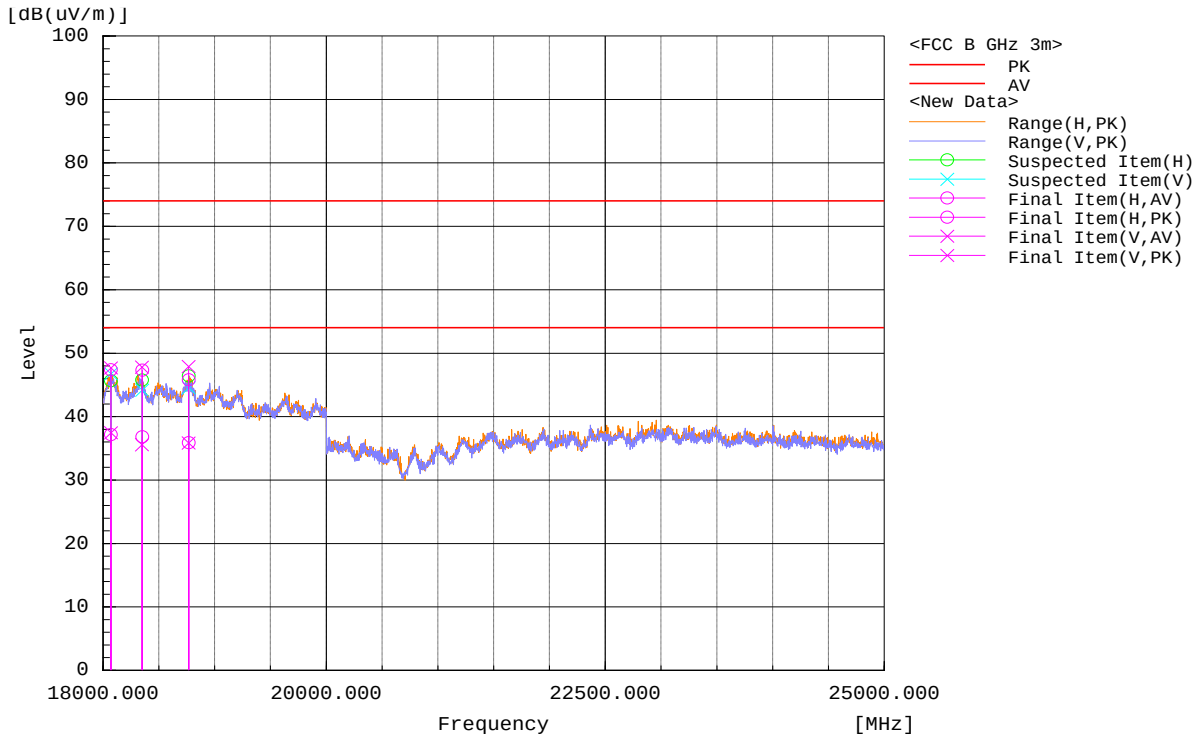
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18085.444	H	18.5	30.0	16.8	35.3	46.8	54	74	-18.7	-27.2
18085.758	V	19.2	30.7	16.8	36.0	47.5	54	74	-18.0	-26.5
18754.156	V	20.5	31.6	15.9	36.4	47.5	54	74	-17.6	-26.5
18753.34	H	20.3	31.3	15.8	36.1	47.1	54	74	-17.9	-26.9
19632.48	H	18.9	30.2	14.2	33.1	44.4	54	74	-20.9	-29.6
19632.844	V	19.3	29.7	14.3	33.6	44.0	54	74	-20.4	-30.0



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11b (18 - 25 GHz) _ CH6

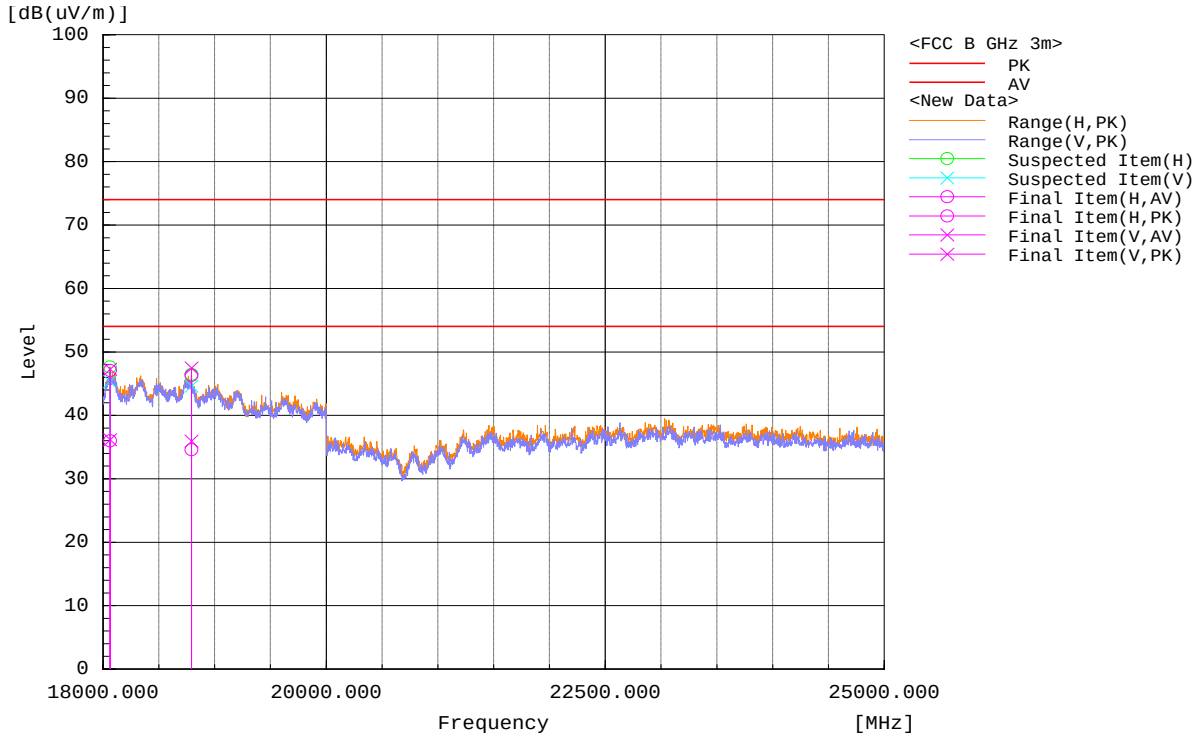
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18070.288	V	20.8	31.0	16.7	37.5	47.7	54	74	-16.5	-26.3
18069.68	H	20.6	30.7	16.6	37.2	47.4	54	74	-16.8	-26.6
18351.898	H	20.7	31.2	16.1	36.8	47.3	54	74	-17.2	-26.7
18348.848	V	19.4	31.6	16.2	35.6	47.8	54	74	-18.4	-26.2
18767.074	V	20.0	32.0	15.9	35.9	47.9	54	74	-18.1	-26.1
18767.498	H	20.0	29.9	15.9	35.9	45.8	54	74	-18.1	-28.2



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11b (18 - 25 GHz) _ CH11

Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18062.388	H	19.5	30.6	16.5	36.0	47.1	54	74	-18.0	-26.9
18062.418	V	19.7	30.8	16.5	36.2	47.3	54	74	-17.8	-26.7
18791.52	V	20.1	31.7	15.8	35.9	47.5	54	74	-18.1	-26.5
18791.47	H	18.9	30.6	15.7	34.6	46.3	54	74	-19.4	-27.7



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

Table 7: Transmit Spurious Emissions at Band-Edge Requirements (802.11g)

Test Date: June 1st, 2023	**Test By:** James Ma
Test Method: Radiated Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

Band-Edge Results for 802.11g

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

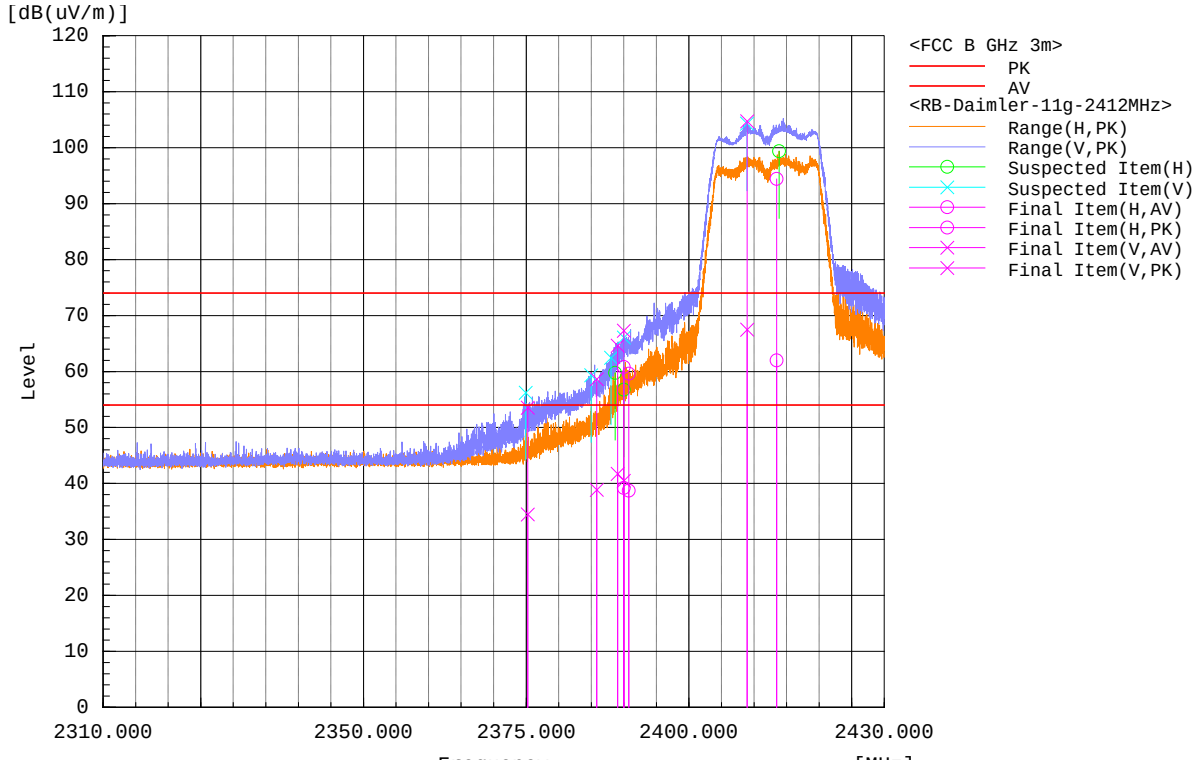
No.	Frequency (MHz)	Pol (H/V)	Reading AV (dBuV/m)	Reading PK (dBuV/m)	Factor (dB)	Level AV (dBuV/m)	Level PK dB(uV/m)	Limit AV (dBuV/m)	Limit PK (dBuV/m)	Margin AV (dB)	Margin PK (dB)	Hght (cm)	Angle (Deg)	Pass/ Fail
1	2375.24	V	1.10	20.20	33.40	34.50	53.60	54.00	74.00	-19.50	-20.40	204	33	Pass
2	2385.82	V	5.50	25.20	33.40	38.90	58.60	54.00	74.00	-15.10	-15.40	215	65	Pass
3	2389.04	V	8.20	31.10	33.50	41.70	64.60	54.00	74.00	-12.30	-9.40	250	360	Pass
4	2390.00	V	7.00	33.80	33.50	40.50	67.30	54.00	74.00	-13.50	-6.70	232	44	Pass
5	2390.00	H	5.70	27.30	33.50	39.20	60.80	54.00	74.00	-14.80	-13.20	128	141	Pass
6	2390.76	H	5.20	26.10	33.50	38.70	59.60	54.00	74.00	-15.30	-14.40	250	291	Pass
7	2408.93	V	34.00	71.20	33.50	67.50	104.7	54.00	74.00			134	15	N/A*
8	2413.48	H	28.50	60.90	33.50	62.00	94.40	54.00	74.00			100	196	N/A*
9	2459.20	H	30.10	62.60	33.70	63.80	96.30	54.00	74.00			215	306	N/A*
10	2464.73	V	36.60	67.60	33.70	70.30	101.3	54.00	74.00			145	341	N/A*
11	2483.50	H	9.70	32.90	33.80	43.50	66.70	54.00	74.00	-10.50	-7.30	232	22	Pass
12	2483.50	V	10.20	33.60	33.80	44.00	67.40	54.00	74.00	-10.00	-6.60	247	53	Pass
13	2483.77	V	7.20	32.60	33.80	41.00	66.40	54.00	74.00	-13.00	-7.60	197	0	Pass
14	2483.93	V	7.20	28.00	33.80	41.00	61.80	54.00	74.00	-13.00	-12.20	134	276	Pass
15	2484.75	H	7.30	27.80	33.80	41.10	61.60	54.00	74.00	-12.90	-12.40	250	21	Pass
16	2485.20	V	5.40	28.20	33.80	39.20	62.00	54.00	74.00	-14.80	-12.00	128	265	Pass
17	2485.36	V	6.50	32.40	33.80	40.30	66.20	54.00	74.00	-13.70	-7.80	100	344	Pass
18	2485.47	H	3.10	21.70	33.80	36.90	55.50	54.00	74.00	-17.10	-18.50	128	198	Pass
19	2485.59	H	5.90	28.80	33.80	39.70	62.60	54.00	74.00	-14.30	-11.40	247	0	Pass
20	2486.93	V	1.60	20.20	33.80	35.40	54.00	54.00	74.00	-18.60	-20.00	247	243	Pass
21	2487.02	H	3.70	25.80	33.80	37.50	59.60	54.00	74.00	-16.50	-14.40	134	217	Pass
22	2487.28	V	5.10	28.60	33.80	38.90	62.40	54.00	74.00	-15.10	-11.60	100	276	Pass
23	2487.41	H	2.40	22.50	33.80	36.20	56.30	54.00	74.00	-17.80	-17.70	100	213	Pass
24	2488.40	V	5.10	31.60	33.80	38.90	65.40	54.00	74.00	-15.10	-8.60	145	44	Pass

25	2488.50	H	3.40	25.20	33.80	37.20	59.00	54.00	74.00	-16.80	-15.00	215	278	Pass
26	2489.36	V	2.20	18.10	33.80	36.00	51.90	54.00	74.00	-18.00	-22.10	100	196	Pass
27	2490.05	V	4.10	29.30	33.80	37.90	63.10	54.00	74.00	-16.10	-10.90	102	305	Pass
28	2490.60	V	5.30	23.90	33.80	39.10	57.70	54.00	74.00	-14.90	-16.30	128	257	Pass
29	2492.28	H	3.00	21.50	33.80	36.80	55.30	54.00	74.00	-17.20	-18.70	250	76	Pass
30	2493.71	H	2.00	20.50	33.80	35.80	54.30	54.00	74.00	-18.20	-19.70	102	216	Pass
31	2494.14	V	2.20	18.60	33.80	36.00	52.40	54.00	74.00	-18.00	-21.60	100	290	Pass
32	2495.18	V	3.30	23.60	33.80	37.10	57.40	54.00	74.00	-16.90	-16.60	134	130	Pass
33	2496.01	V	3.20	26.40	33.80	37.00	60.20	54.00	74.00	-17.00	-13.80	215	45	Pass
34	2496.75	H	2.80	20.70	33.80	36.60	54.50	54.00	74.00	-17.40	-19.50	223	2	Pass
35	2497.55	H	1.80	20.50	33.80	35.60	54.30	54.00	74.00	-18.40	-19.70	250	33	Pass

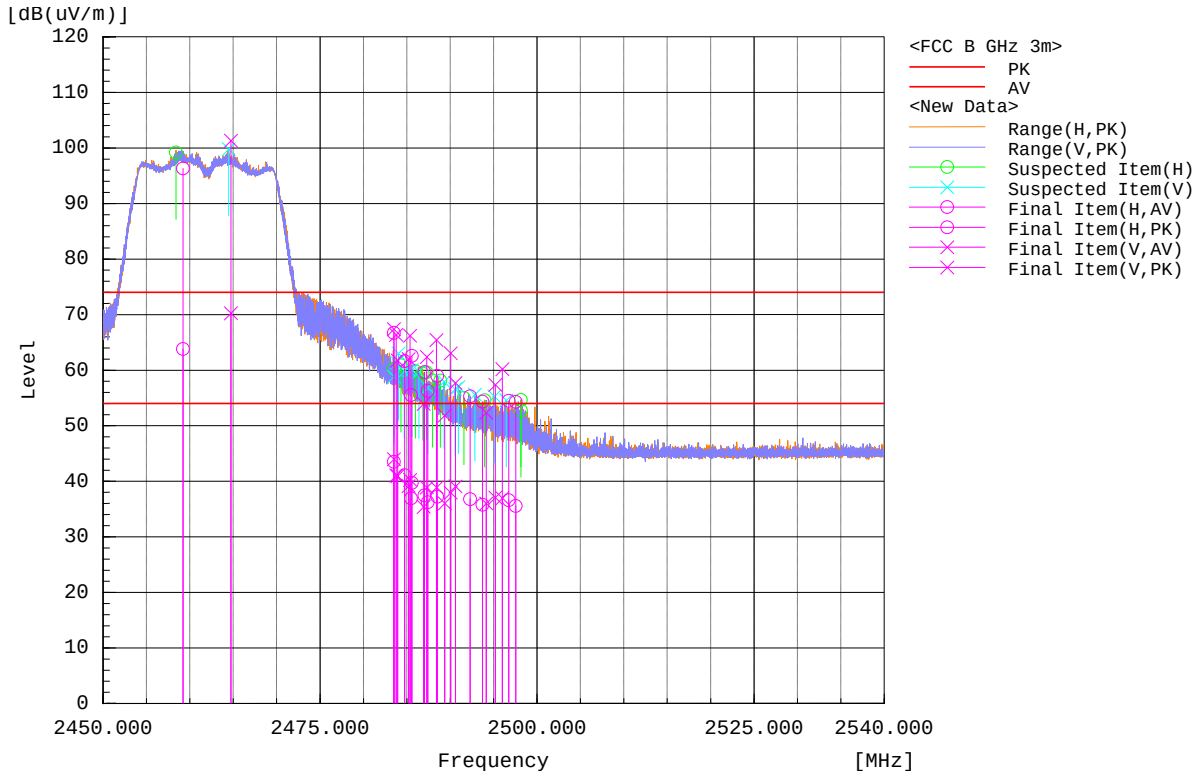
Note: The emissions were measured at the adjacent restricted band of the fundamental signal.
All the band-edge measurements met the restricted band requirements of CFR47 15.205
Band-edge measurement plots use a wider span than 2 MHz to evaluate additional spectrum bands for in-band leakage and spurious emission.

(*) Fundamental/ Inband emission.

Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
Margin value = Emission level – Limit value.



Band-Edge 802.11g - 2412 MHz

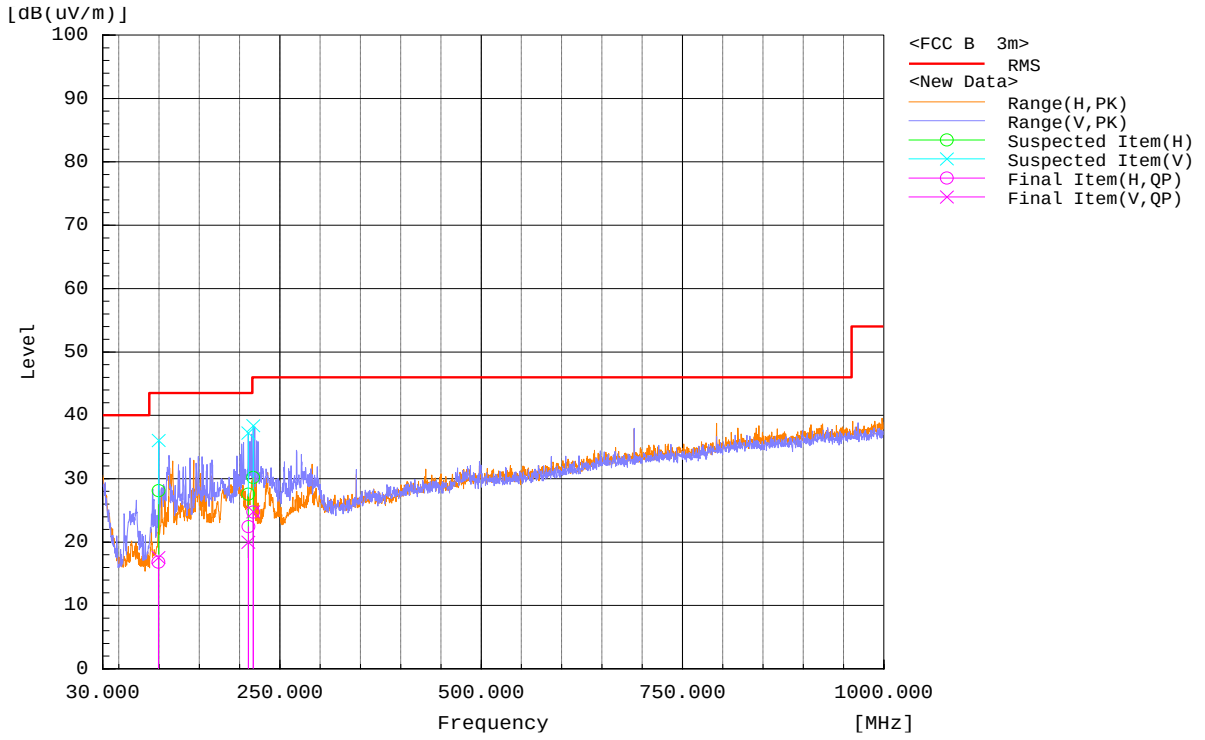


Band-Edge 802.11g - 2462 MHz

Radiated Emissions			
EUT Name	CTP2019DTNA	**Date**	06/01/2023
EUT Model	CTP19TNv3	**Temp / Hum in**	23°C / 40% RH
EUT Serial	N/A	**Temp / Hum out**	N/A
EUT Config.	EUT on Vertical Position	**Line AC / Freq**	N/A
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB6	**Performed by**	James Ma

802.11g (30M - 1GHz) _ CH1

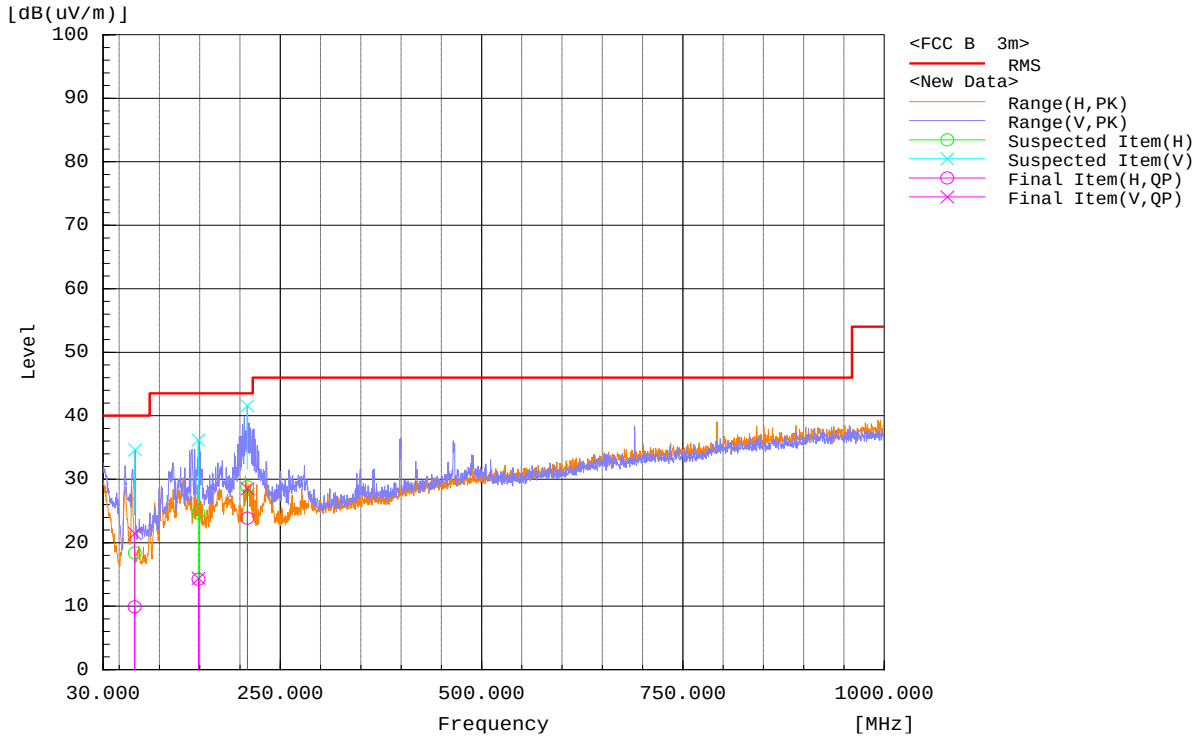
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
99.204	H	-4.0	20.8	16.8	43.5	-26.7	170.5	83.6
99.199	V	-3.7	21.3	17.6	43.5	-25.9	102.3	103.5
211.075	H	-0.1	22.5	22.4	43.5	-21.1	152.6	203
210.759	V	-2.6	22.6	20.0	43.5	-23.5	115.3	113.7
216.929	V	2.1	22.7	24.8	46	-21.2	110.4	265.5
216.997	H	2.0	22.7	24.7	46	-21.3	115.3	174



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11g (30M - 1GHz) _ CH6

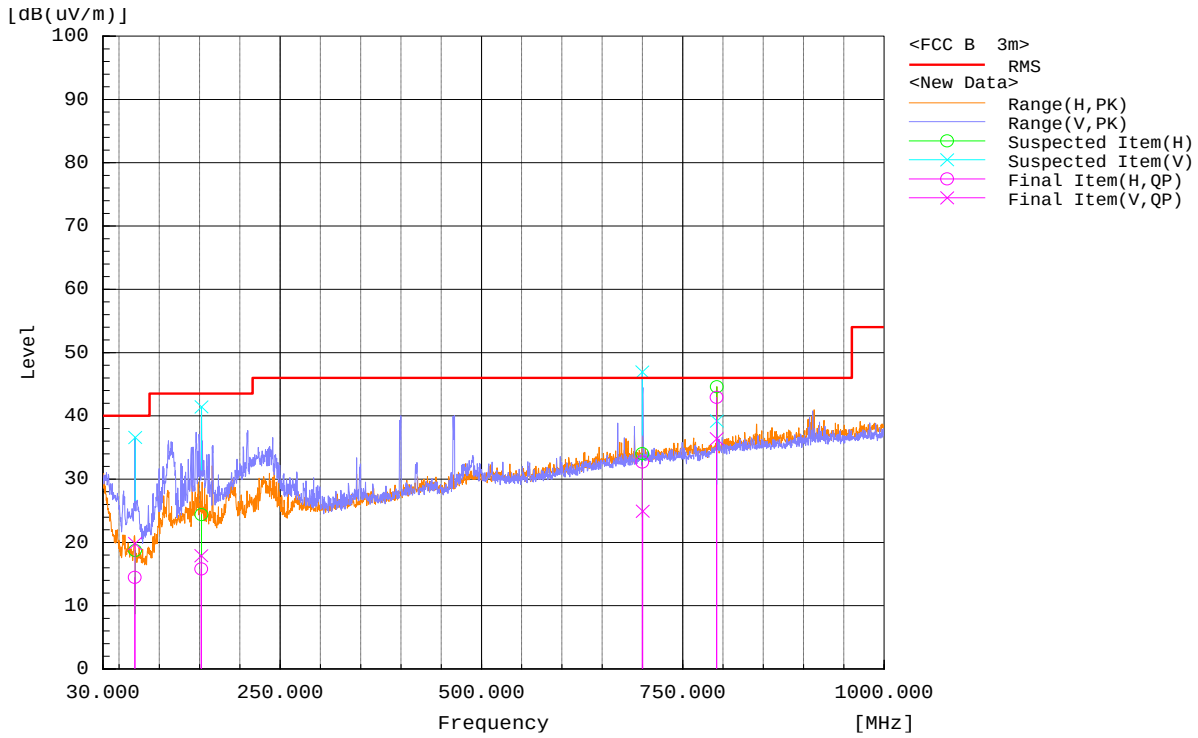
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
69.131	V	3.5	18.0	21.5	40.0	-18.5	114.4	9.1
69.169	H	-8.3	18.2	9.9	40.0	-30.1	360.5	251.7
148.506	H	-9.8	24.0	14.2	43.5	-29.3	333.6	154.2
148.541	V	-9.8	24.2	14.4	43.5	-29.1	246.7	198.0
209.208	V	5.8	22.7	28.5	43.5	-15.0	100.3	196.8
209.286	H	1.3	22.5	23.8	43.5	-19.7	100.3	95.1



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11g (30M - 1GHz) _ CH11

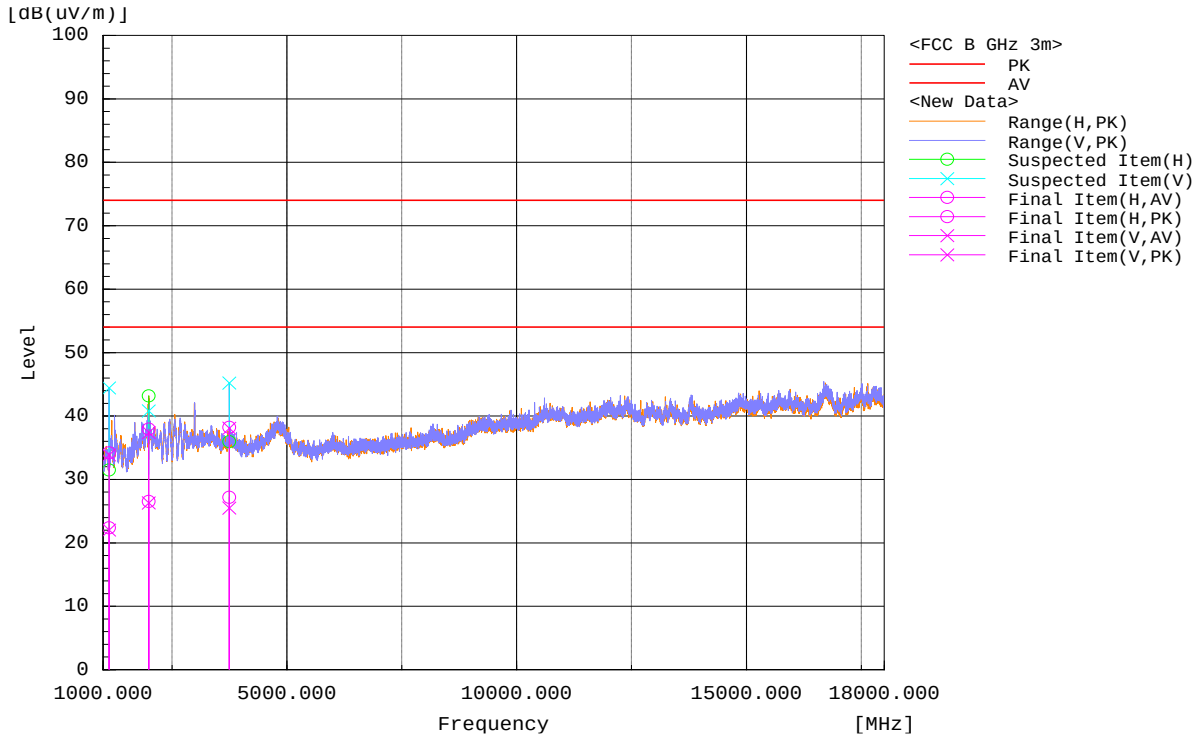
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
69.764	V	1.9	17.9	19.8	40.0	-20.2	164.7	3.3
69.429	H	-3.7	18.2	14.5	40.0	-25.5	312.9	273.6
151.956	H	-8.1	23.9	15.8	43.5	-27.7	161.1	269.2
152.001	V	-6.3	24.2	17.9	43.5	-25.6	118.6	280.1
700.166	V	-9.5	34.4	24.9	46.0	-21.1	183.8	231.6
699.571	H	-2.2	34.9	32.7	46.0	-13.3	229.4	228.9
792.017	V	0.8	35.6	36.4	46.0	-9.6	105.8	208.0
792.007	H	6.9	36.0	42.9	46.0	-3.1	100.5	225.7



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11g (1 - 18 GHz) _ CH1

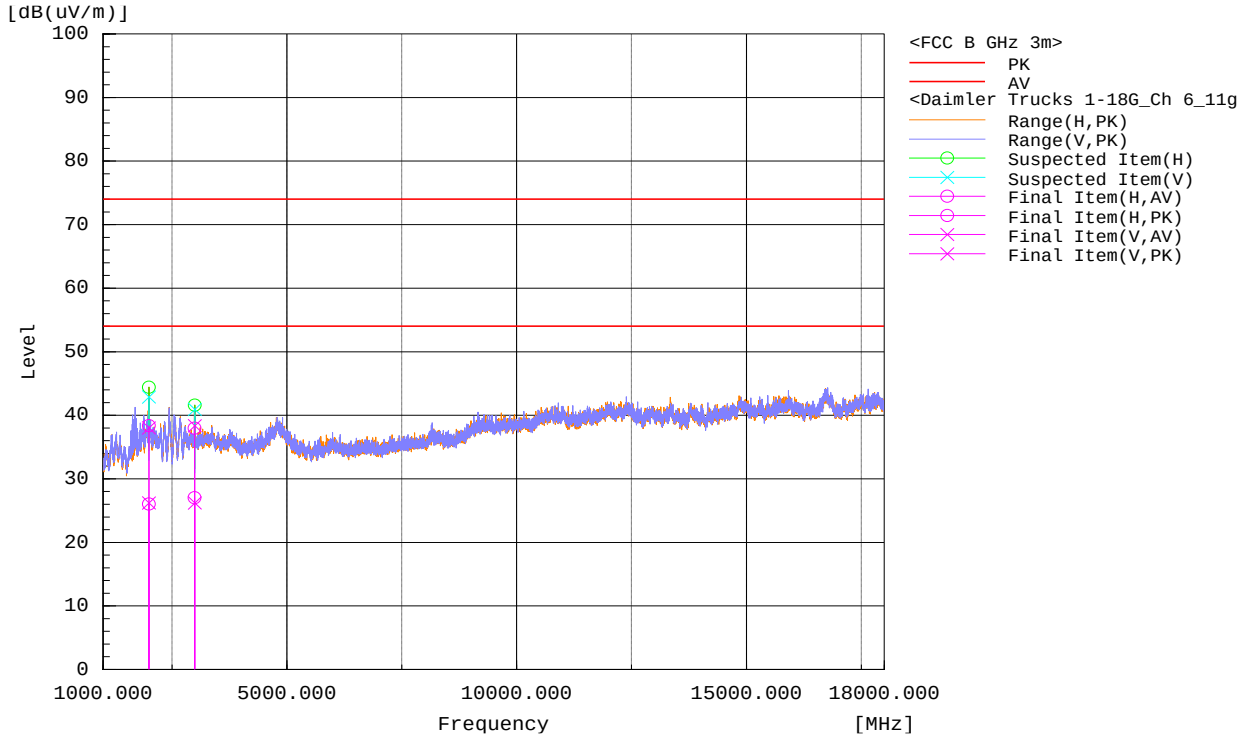
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1129.827	V	39.9	51.8	-17.9	22.0	33.9	54	74	-32.0	-40.1
1130.187	H	40.3	52.1	-17.9	22.4	34.2	54	74	-31.6	-39.8
1993.119	H	41.2	52.6	-14.7	26.5	37.9	54	74	-27.5	-36.1
1992.465	V	41.0	52.1	-14.7	26.3	37.4	54	74	-27.7	-36.6
3747.679	V	39.0	51.6	-13.5	25.5	38.1	54	74	-28.5	-35.9
3745.738	H	40.7	51.7	-13.5	27.2	38.2	54	74	-26.8	-35.8



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11g (1 - 18 GHz) _ CH6

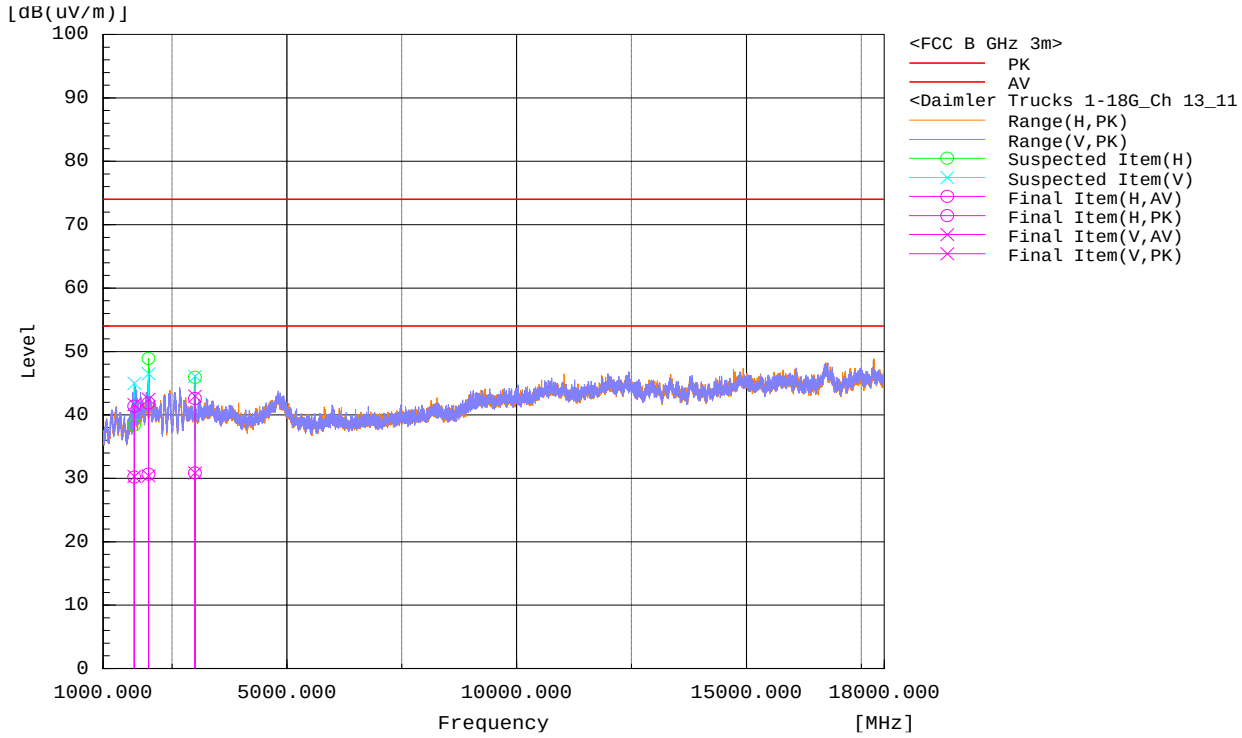
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1998.054	V	40.9	52.7	-14.7	26.2	38.0	54	74	-27.8	-36.0
1998.223	H	40.7	53.1	-14.7	26.0	38.4	54	74	-28.0	-35.6
2993.309	H	41.0	51.9	-14.0	27.0	37.9	54	74	-27.0	-36.1
2994.175	V	40.2	52.4	-14.0	26.2	38.4	54	74	-27.8	-35.6



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11g (1 - 18 GHz) _ CH11

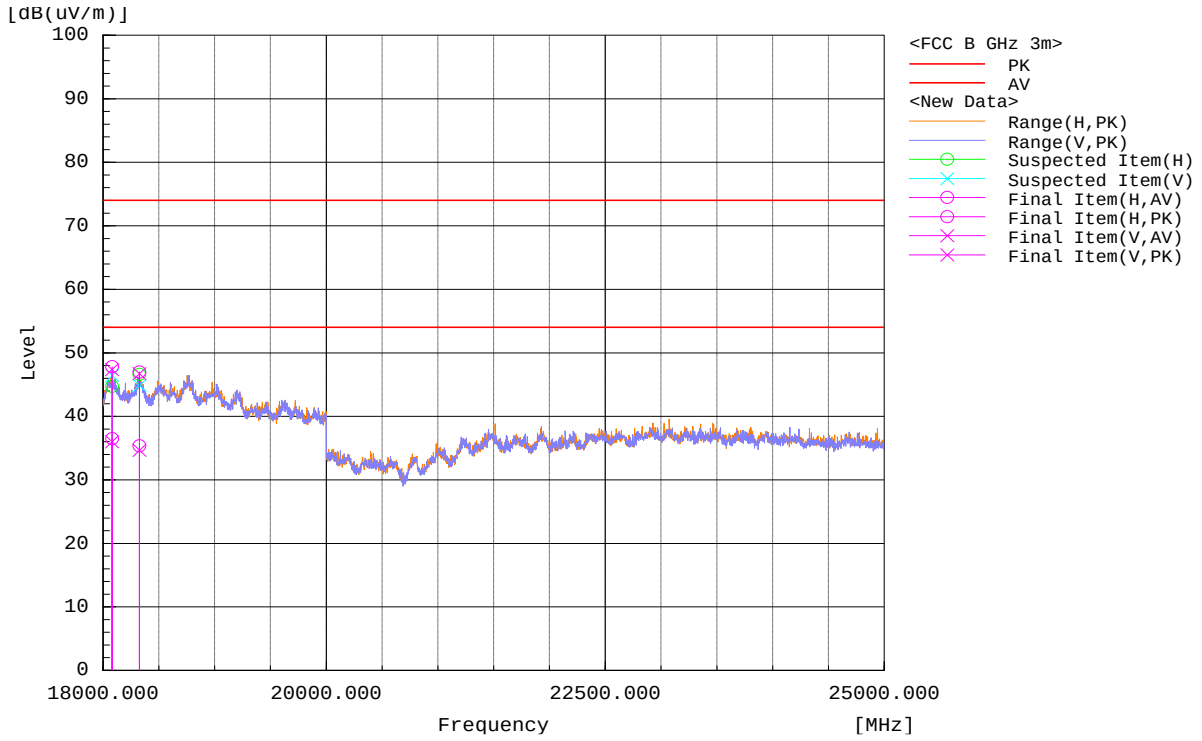
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1678.579	H	42.8	54.0	-12.6	30.2	41.4	54	74	-23.8	-32.6
1679.711	V	42.9	54.2	-12.6	30.3	41.6	54	74	-23.7	-32.4
1990.642	H	41.1	52.4	-10.5	30.6	41.9	54	74	-23.4	-32.1
1990.731	V	40.9	53.0	-10.5	30.4	42.5	54	74	-23.6	-31.5
3000.015	V	40.7	52.8	-9.8	30.9	43.0	54	74	-23.1	-31.0
2998.356	H	40.6	52.4	-9.8	30.8	42.6	54	74	-23.2	-31.4



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11g (18 - 25 GHz) _ CH1

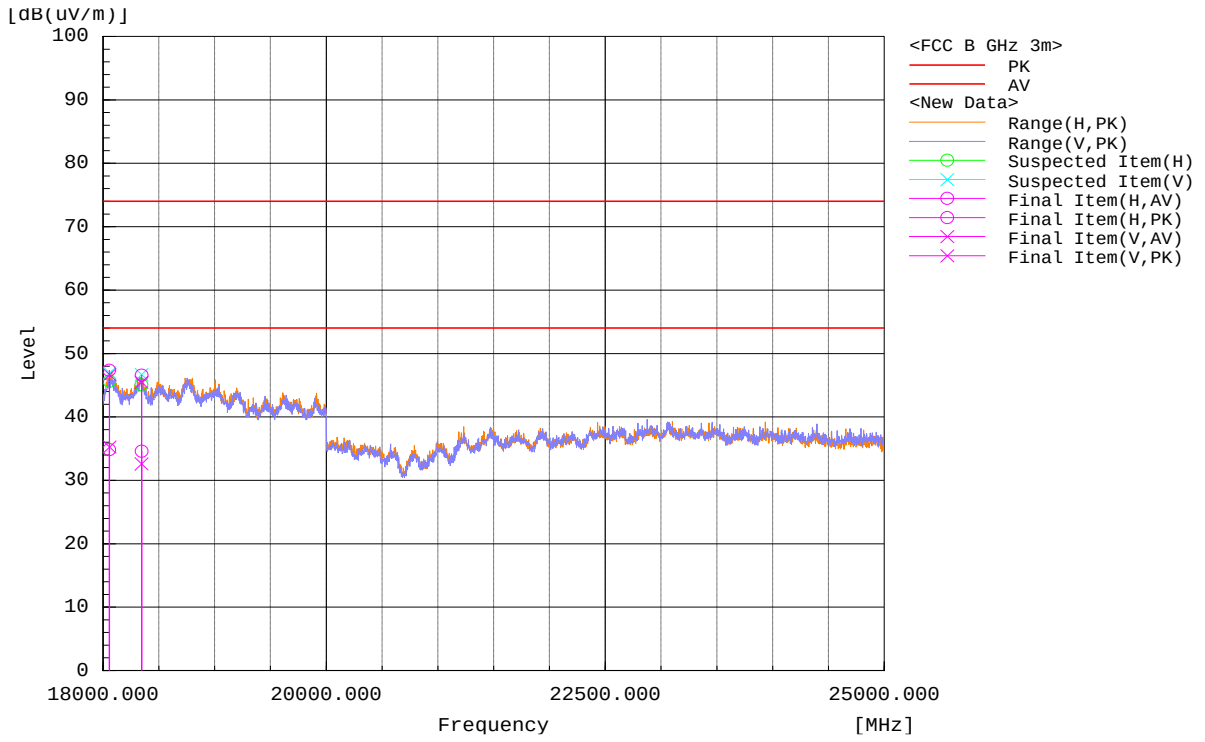
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18080.33	V	19.2	30.6	16.8	36.0	47.4	54	74	-18.0	-26.6
18081.564	H	19.7	31.0	16.8	36.5	47.8	54	74	-17.5	-26.2
18325.742	H	18.8	30.4	16.6	35.4	47.0	54	74	-18.6	-27.0
18325.252	V	18.1	30.1	16.6	34.7	46.7	54	74	-19.3	-27.3



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11g (18 - 25 GHz) _ CH6

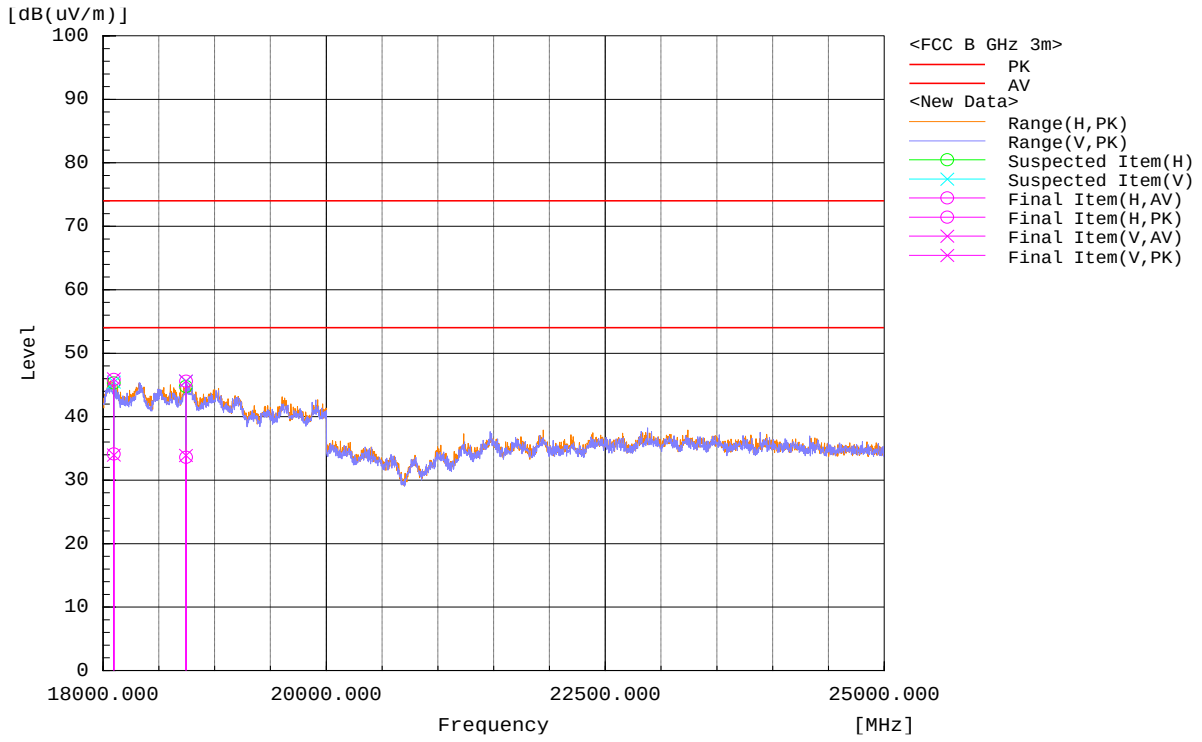
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18057.358	V	18.8	30.3	16.5	35.3	46.7	54	74	-18.7	-27.3
18056.286	H	18.4	30.9	16.4	34.8	47.3	54	74	-19.2	-26.7
18345.548	H	18.3	30.3	16.3	34.6	46.6	54	74	-19.4	-27.4
18344.93	V	16.3	29.2	16.3	32.6	45.5	54	74	-21.4	-28.5



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11g (18 - 25 GHz) _ CH11

Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18096.662	H	17.4	29.1	16.7	34.1	45.8	54	74	-19.9	-28.2
18096.146	V	17.2	29.2	16.8	34.0	46.0	54	74	-20.0	-28.0
18742.612	V	18.1	29.8	15.8	33.9	45.6	54	74	-20.1	-28.4
18743.428	H	17.8	29.8	15.8	33.6	45.6	54	74	-20.4	-28.4



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

Table 8: Transmit Spurious Emissions at Band-Edge Requirements (802.11n)

Test Date: June 1st, 2023	**Test By:** James Ma
Test Method: Radiated Measurements	**Power Setting:** Level 14 dBm for 11b Level 11dBm for 11g & 11n
Antenna Type: Unique Connector Cable	**Max. Antenna Gain:** 4.0 dBi
Operating Mode: Uncorrelated	**Signal State**: Modulated
Ambient Temp.: 23 °C	**Relative Humidity:** 41%

Band-Edge Results for 802.11n

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

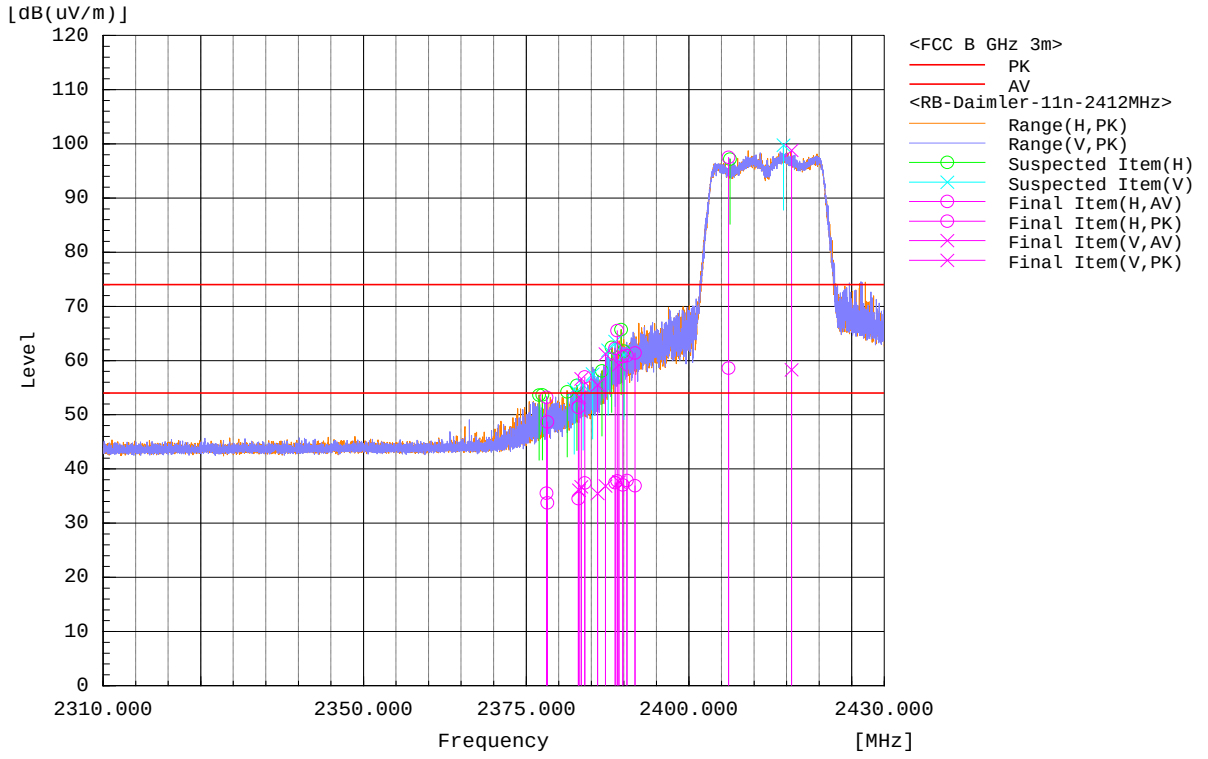
No.	Frequency (MHz)	Pol (H/V)	Reading AV (dBuV/m)	Reading PK (dBuV/m)	Factor (dB)	Level AV (dBuV/m)	Level PK dB(uV/m)	Limit AV (dBuV/m)	Limit PK (dBuV/m)	Margin AV (dB)	Margin PK (dB)	Hght (cm)	Angle (Deg)	Pass/ Fail
1	2378.11	H	2.10	19.80	33.40	35.50	53.20	54.00	74.00	-18.50	-20.80	180	292	Pass
2	2378.25	H	0.30	15.30	33.40	33.70	48.70	54.00	74.00	-20.30	-25.30	110	242	Pass
3	2383.01	H	1.10	17.90	33.40	34.50	51.30	54.00	74.00	-19.50	-22.70	145	37	Pass
4	2383.09	V	2.70	19.90	33.40	36.10	53.30	54.00	74.00	-17.90	-20.70	204	212	Pass
5	2383.45	V	3.30	23.20	33.40	36.70	56.60	54.00	74.00	-17.30	-17.40	145	131	Pass
6	2384.00	H	4.00	23.60	33.40	37.40	57.00	54.00	74.00	-16.60	-17.00	102	213	Pass
7	2385.97	V	2.10	22.10	33.40	35.50	55.50	54.00	74.00	-18.50	-18.50	100	257	Pass
8	2387.17	V	3.40	27.80	33.40	36.80	61.20	54.00	74.00	-17.20	-12.80	151	325	Pass
9	2388.65	H	4.00	28.90	33.50	37.50	62.30	54.00	74.00	-16.50	-11.70	250	288	Pass
10	2388.99	H	4.30	32.00	33.50	37.80	65.50	54.00	74.00	-16.20	-8.50	250	178	Pass
11	2389.24	V	4.10	25.80	33.50	37.60	59.30	54.00	74.00	-16.40	-14.70	145	213	Pass
12	2389.83	H	3.60	27.20	33.50	37.10	60.70	54.00	74.00	-16.90	-13.30	100	260	Pass
13	2390.47	H	4.40	27.40	33.50	37.90	60.90	54.00	74.00	-16.10	-13.10	232	196	Pass
14	2391.71	H	3.40	27.90	33.50	36.90	61.40	54.00	74.00	-17.10	-12.60	110	270	Pass
15	2406.07	H	25.10	64.00	33.50	58.60	97.50	54.00	74.00			128	154	N/A*
16	2415.74	V	24.70	65.20	33.60	58.30	98.80	54.00	74.00			187	216	N/A*
17	2459.24	H	30.70	62.50	33.70	64.40	96.20	54.00	74.00			215	0	N/A*
18	2463.76	V	32.80	66.50	33.70	66.50	100.2	54.00	74.00			180	335	N/A*
19	2483.50	H	4.80	29.50	33.80	38.60	63.30	54.00	74.00	-15.40	-10.70	110	34	Pass
20	2483.50	V	8.60	34.30	33.80	42.40	68.10	54.00	74.00	-11.60	-5.90	198	25	Pass
21	2484.29	H	7.50	26.50	33.80	41.30	60.30	54.00	74.00	-12.70	-13.70	100	294	Pass
22	2484.61	V	7.90	29.50	33.80	41.70	63.30	54.00	74.00	-12.30	-10.70	163	343	Pass
23	2485.01	H	4.00	26.10	33.80	37.80	59.90	54.00	74.00	-16.20	-14.10	128	0	Pass
24	2485.69	H	3.50	29.60	33.80	37.30	63.40	54.00	74.00	-16.70	-10.60	134	337	Pass

25	2486.06	V	5.60	31.10	33.80	39.40	64.90	54.00	74.00	-14.60	-9.10	163	345	Pass
26	2487.58	H	6.10	27.80	33.80	39.90	61.60	54.00	74.00	-14.10	-12.40	204	261	Pass
27	2488.15	H	6.50	31.30	33.80	40.30	65.10	54.00	74.00	-13.70	-8.90	238	19	Pass
28	2488.89	H	3.20	28.70	33.80	37.00	62.50	54.00	74.00	-17.00	-11.50	239	52	Pass
29	2488.93	V	2.20	23.00	33.80	36.00	56.80	54.00	74.00	-18.00	-17.20	100	189	Pass
30	2489.41	H	3.30	28.20	33.80	37.10	62.00	54.00	74.00	-16.90	-12.00	100	0	Pass
31	2490.44	H	3.70	27.10	33.80	37.50	60.90	54.00	74.00	-16.50	-13.10	238	42	Pass
32	2491.04	V	5.70	26.50	33.80	39.50	60.30	54.00	74.00	-14.50	-13.70	100	89	Pass
33	2492.07	H	2.90	25.00	33.80	36.70	58.80	54.00	74.00	-17.30	-15.20	250	353	Pass
34	2493.41	V	5.30	27.80	33.80	39.10	61.60	54.00	74.00	-14.90	-12.40	197	49	Pass
35	2494.12	H	2.70	25.80	33.80	36.50	59.60	54.00	74.00	-17.50	-14.40	221	0	Pass
36	2494.17	H	1.90	18.40	33.80	35.70	52.20	54.00	74.00	-18.30	-21.80	110	316	Pass
37	2494.55	V	5.50	26.10	33.80	39.30	59.90	54.00	74.00	-14.70	-14.10	180	15	Pass
38	2495.12	H	6.00	22.80	33.80	39.80	56.60	54.00	74.00	-14.20	-17.40	215	30	Pass
39	2495.21	V	4.90	24.50	33.80	38.70	58.30	54.00	74.00	-15.30	-15.70	163	133	Pass
40	2496.16	V	2.30	24.90	33.80	36.10	58.70	54.00	74.00	-17.90	-15.30	117	211	Pass
41	2496.17	H	3.50	24.00	33.80	37.30	57.80	54.00	74.00	-16.70	-16.20	204	257	Pass
42	2496.86	H	1.80	20.50	33.80	35.60	54.30	54.00	74.00	-18.40	-19.70	250	8	Pass
43	2497.23	V	4.90	24.70	33.80	38.70	58.50	54.00	74.00	-15.30	-15.50	117	19	Pass
44	2497.60	H	2.00	20.40	33.80	35.80	54.20	54.00	74.00	-18.20	-19.80	247	26	Pass
45	2498.46	H	3.80	24.70	33.80	37.60	58.50	54.00	74.00	-16.40	-15.50	250	106	Pass

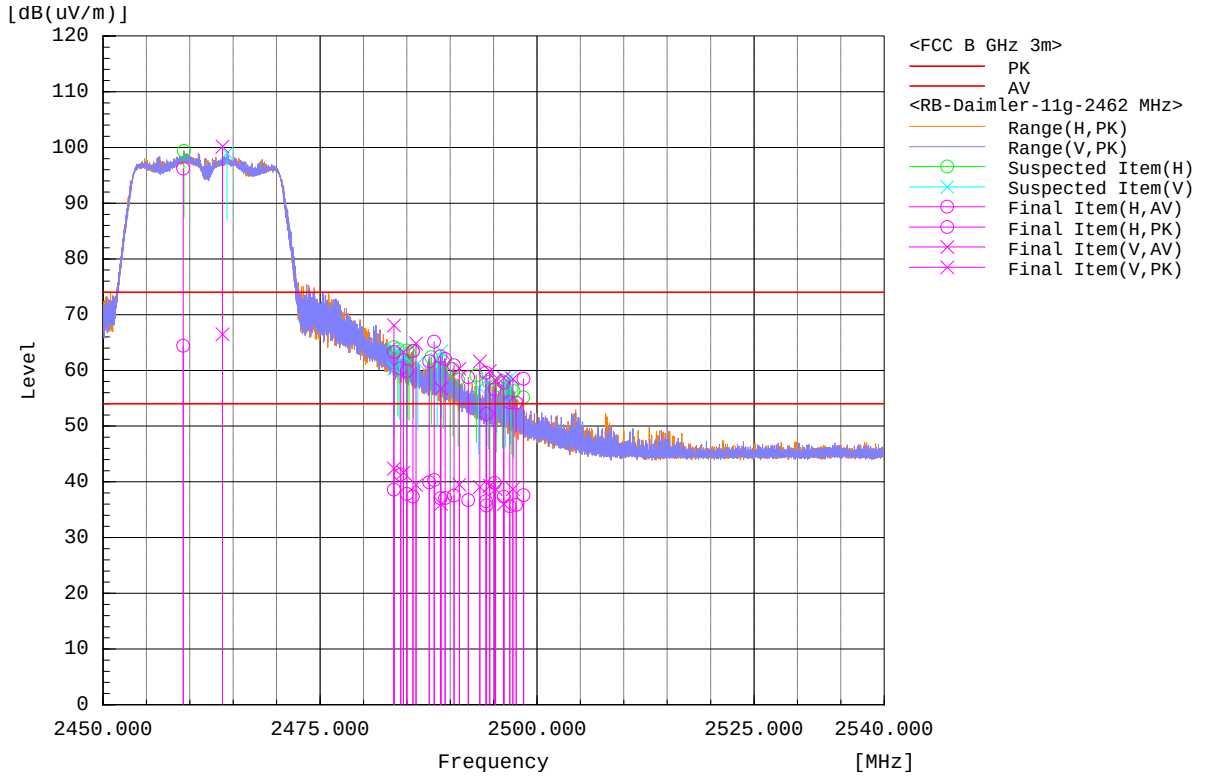
Note: The emissions were measured at the adjacent restricted band of the fundamental signal.
All the band-edge measurements met the restricted band requirements of CFR47 15.205
Band-edge measurement plots use a wider span than 2 MHz to evaluate additional spectrum bands for in-band leakage and spurious emission.

(*) Fundamental/ Inband emission.

Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
Margin value = Emission level – Limit value.



Band-Edge 802.11n - 2412 MHz



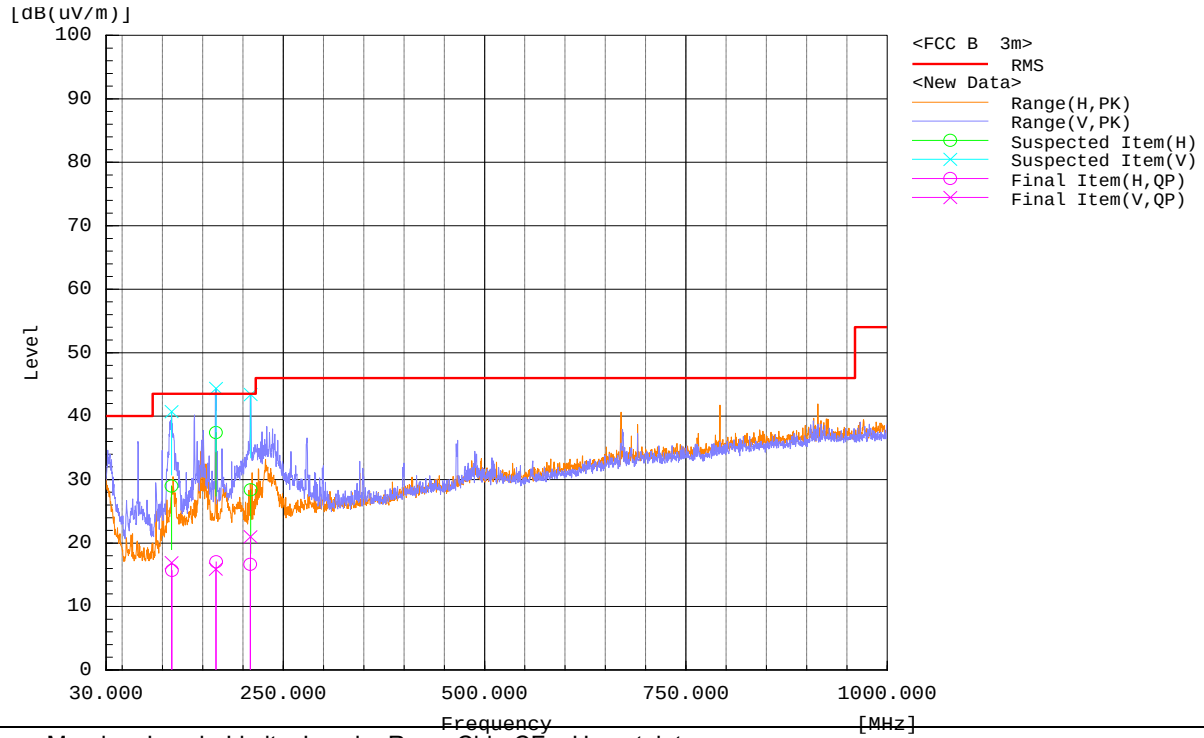
Band-Edge 802.11n - 2462 MHz

Bureau Veritas Consumer Products Services, Inc.
775 Montague Expressway, Milpitas, CA 95035
Tel: (408) 526-1188

Radiated Emissions			
EUT Name	CTP2019DTNA	**Date**	06/01/2023
EUT Model	CTP19TNv3	**Temp / Hum in**	23°C / 40% RH
EUT Serial	N/A	**Temp / Hum out**	N/A
EUT Config.	EUT on Vertical Position	**Line AC / Freq**	N/A
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB6	**Performed by**	James Ma

802.11n (30M - 1GHz) _ CH1

Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
111.782	H	-7.8	23.5	15.7	43.5	-27.8	291.5	281.5
111.298	V	-6.7	23.6	16.9	43.5	-26.6	100.6	86.9
166.262	V	-8.0	23.9	15.9	43.5	-27.6	122.3	248.2
166.822	H	-6.5	23.6	17.1	43.5	-26.4	174.1	273.0
209.102	H	-5.8	22.5	16.7	43.5	-26.8	168.8	178.6
209.236	V	-1.7	22.7	21.0	43.5	-22.5	111.5	232.6

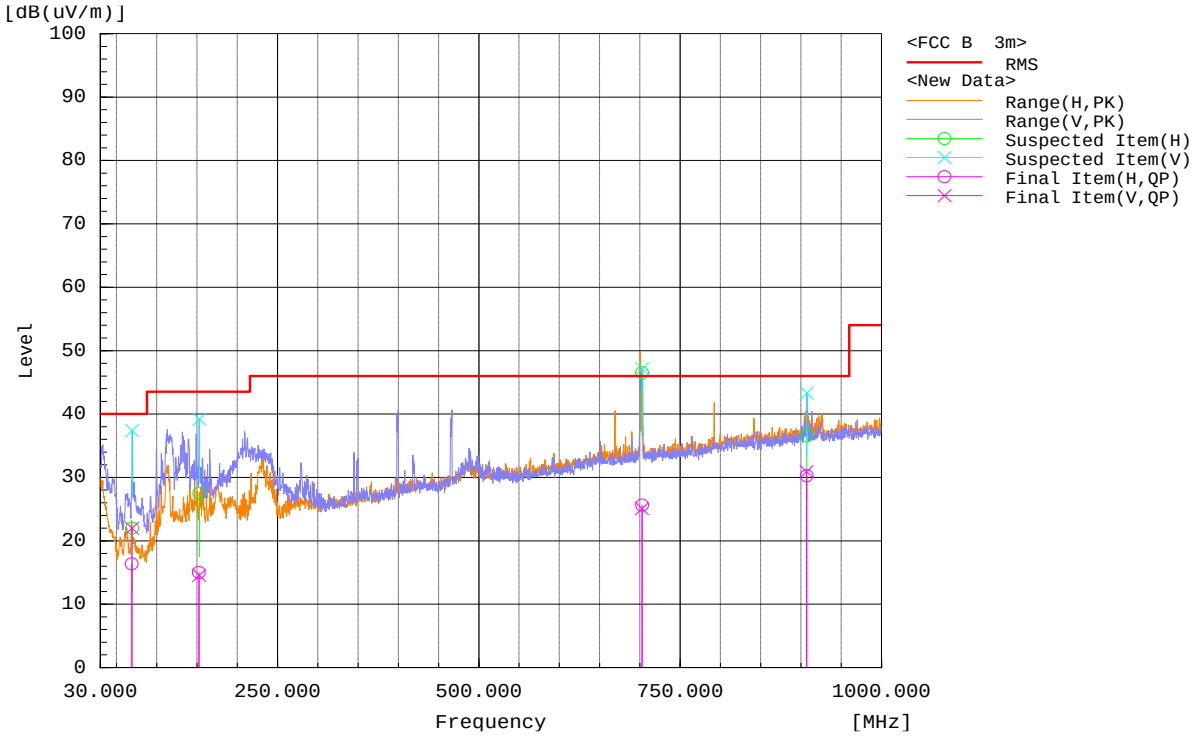


Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty
CF= Amp Gain + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11n (30M - 1GHz) _ CH6

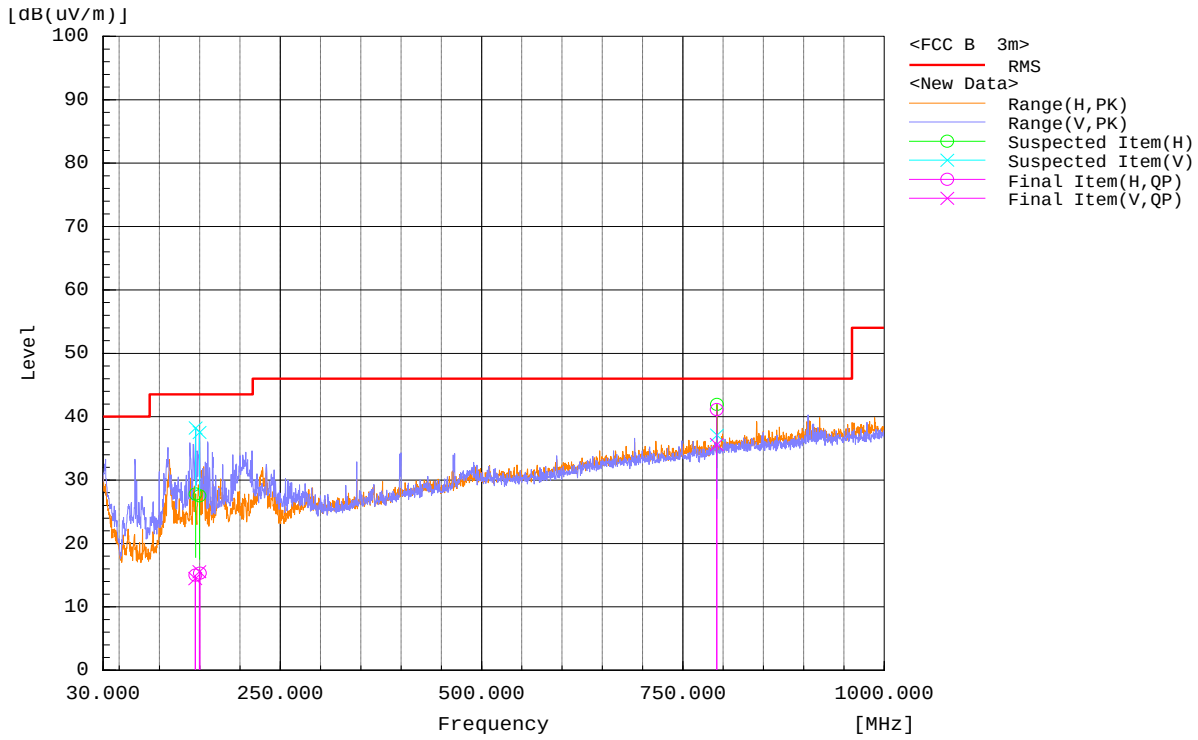
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
69.198	V	4.0	18.0	22.0	40.0	-18.0	132.3	249.2
69.082	H	-1.8	18.2	16.4	40.0	-23.6	236.1	247.8
152.287	H	-8.9	23.9	15.0	43.5	-28.5	105.6	249.3
152.476	V	-9.6	24.2	14.6	43.5	-28.9	187.1	265.8
702.465	V	-9.3	34.4	25.1	46.0	-20.9	338.4	0.1
702.736	H	-9.3	34.9	25.6	46.0	-20.4	377.6	85.4
907.056	H	-7.2	37.5	30.3	46.0	-15.7	144.5	357.1
906.829	V	-6.1	37.0	30.9	46.0	-15.1	292.1	269.5



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11n (30M - 1GHz) _ CH11

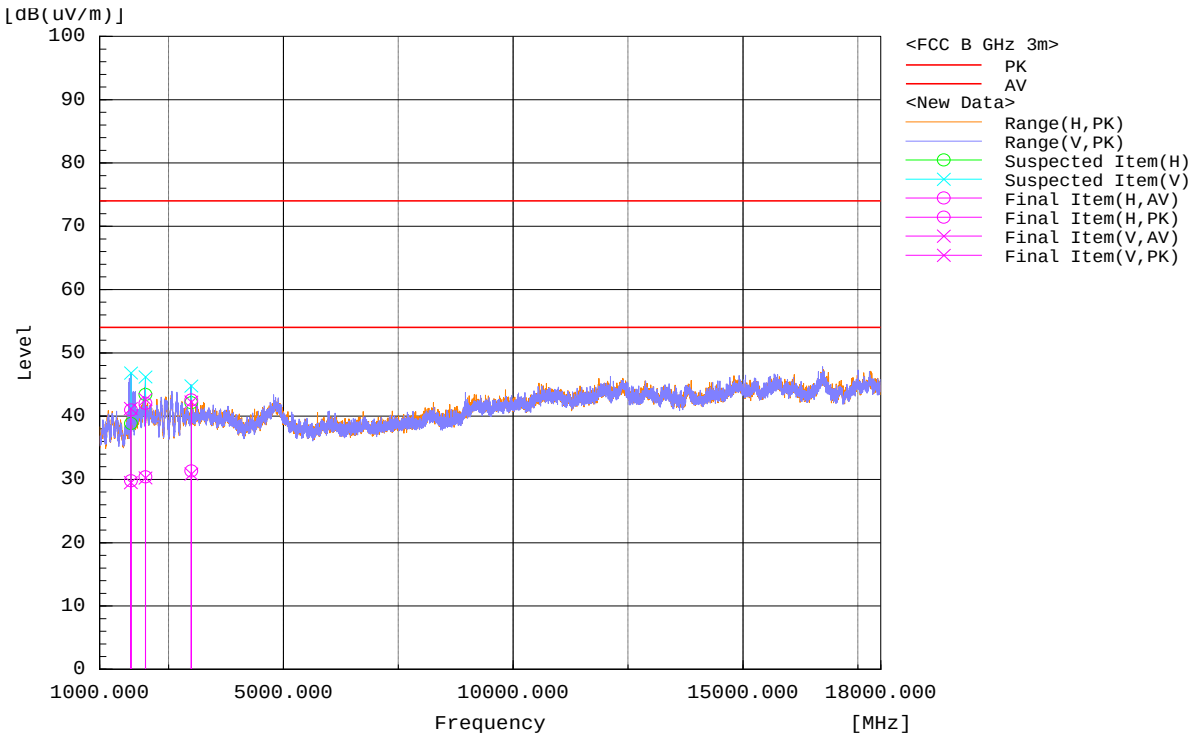
Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
144.432	V	-9.7	24.2	14.5	43.5	-29.0	188.1	22.9
144.599	H	-9.0	24.0	15.0	43.5	-28.5	153.3	106.0
150.209	H	-8.7	24.0	15.3	43.5	-28.2	212.1	259.4
149.396	V	-8.6	24.2	15.6	43.5	-27.9	102.5	244.3
792.011	V	0.0	35.6	35.6	46.0	-10.4	174.7	192.5
792.025	H	5.1	36.0	41.1	46.0	-4.9	102.8	233.2



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 3.51 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

802.11n (1 - 18 GHz) _ CH1

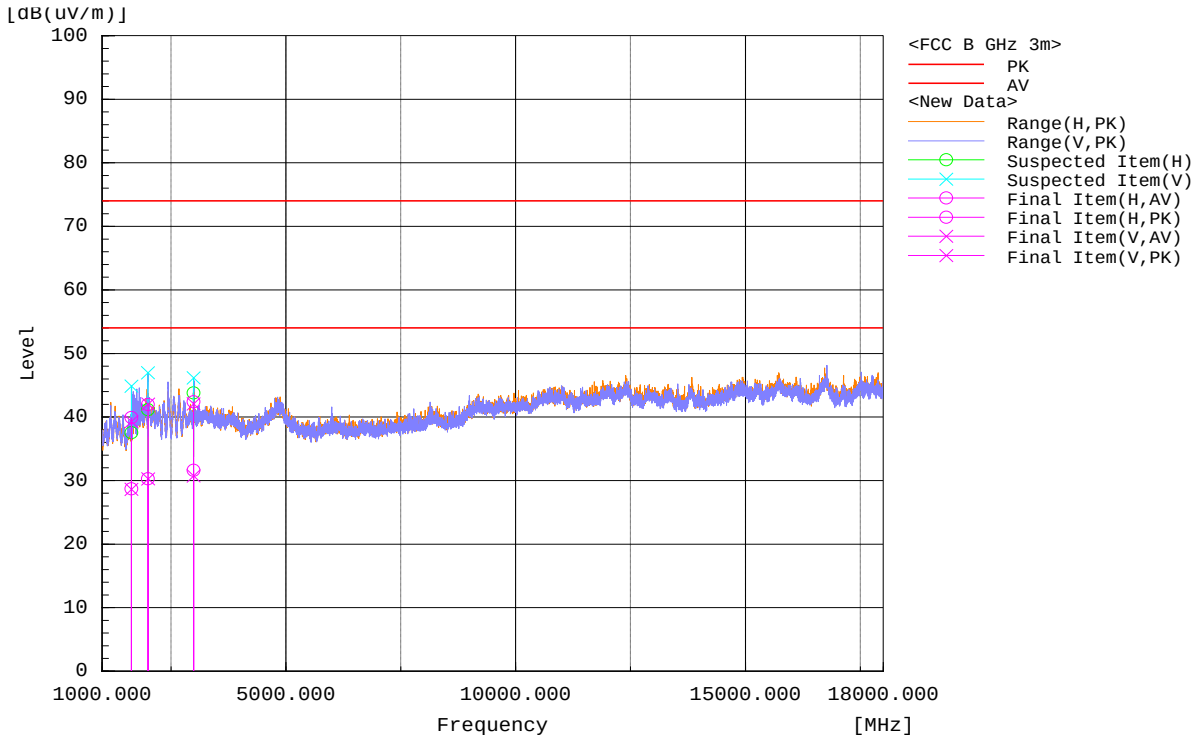
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1680.854	V	42.1	53.8	-12.6	29.5	41.2	54	74	-24.5	-32.8
1681.729	H	42.4	53.6	-12.6	29.8	41.0	54	74	-24.2	-33.0
1995.951	V	40.7	53.1	-10.5	30.2	42.6	54	74	-23.8	-31.4
1996.672	H	40.9	52.5	-10.5	30.4	42.0	54	74	-23.6	-32.0
2995.25	H	41.1	52.3	-9.8	31.3	42.5	54	74	-22.7	-31.5
2996.641	V	40.7	52.0	-9.8	30.9	42.2	54	74	-23.1	-31.8



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11n (1 - 18 GHz) _ CH6

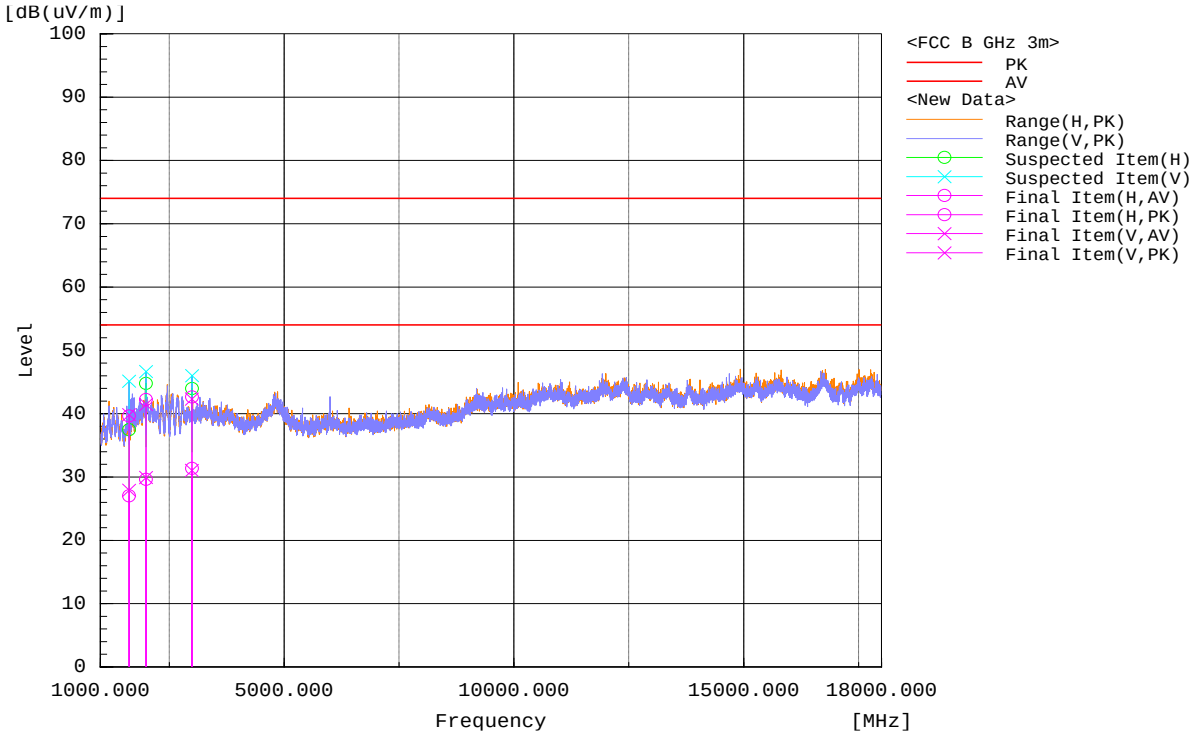
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1639.761	H	41.9	53.1	-13.2	28.7	39.9	54	74	-25.3	-34.1
1640.197	V	41.8	52.5	-13.2	28.6	39.3	54	74	-25.4	-34.7
2000.335	V	40.8	52.5	-10.5	30.3	42.0	54	74	-23.7	-32.0
1998.454	H	40.8	52.5	-10.5	30.3	42.0	54	74	-23.7	-32.0
2991.326	H	41.4	52.2	-9.8	31.6	42.4	54	74	-22.4	-31.6
2990.409	V	40.6	51.9	-9.8	30.8	42.1	54	74	-23.2	-31.9



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11n (1 - 18 GHz) _ CH11

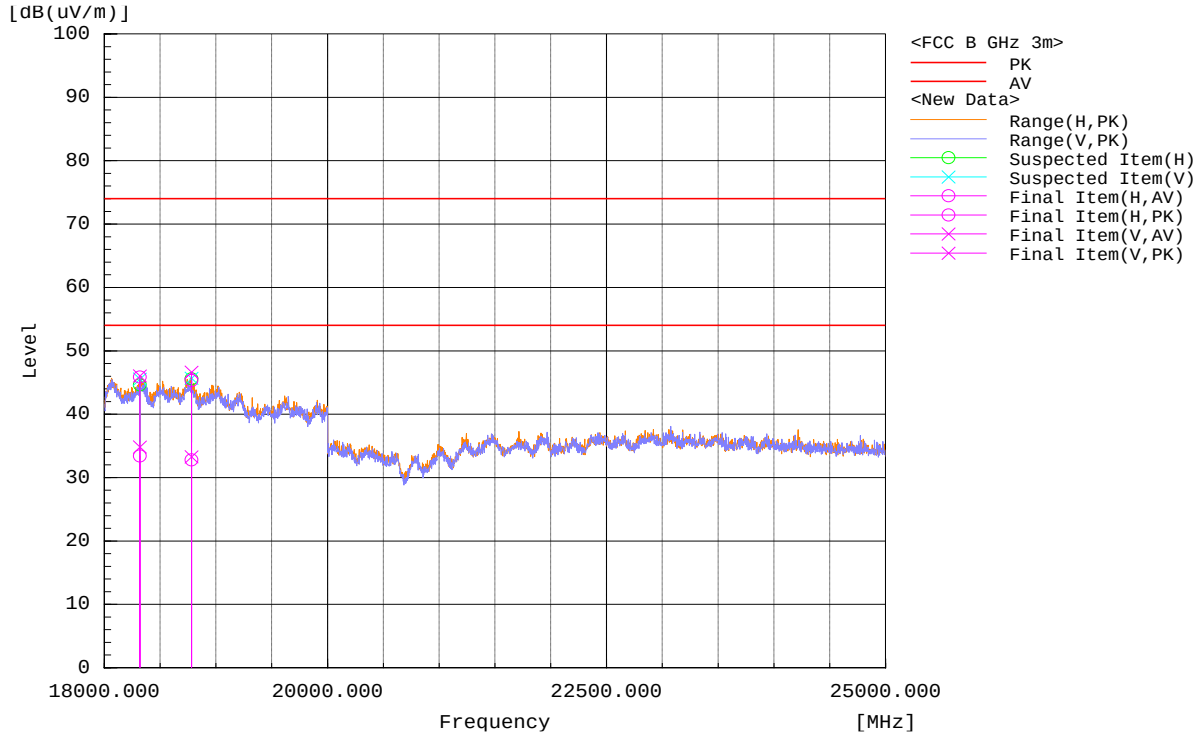
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1623.156	V	41.3	53.2	-13.4	27.9	39.8	54	74	-26.1	-34.2
1624.239	H	40.4	53.0	-13.4	27.0	39.6	54	74	-27.0	-34.4
1992.258	H	40.1	52.8	-10.5	29.6	42.3	54	74	-24.4	-31.7
1993.266	V	40.4	52.0	-10.5	29.9	41.5	54	74	-24.1	-32.5
2993.446	V	40.8	52.1	-9.8	31.0	42.3	54	74	-23.0	-31.7
2994.929	H	41.2	52.4	-9.8	31.4	42.6	54	74	-22.6	-31.4



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11n (18 - 25 GHz) _ CH1

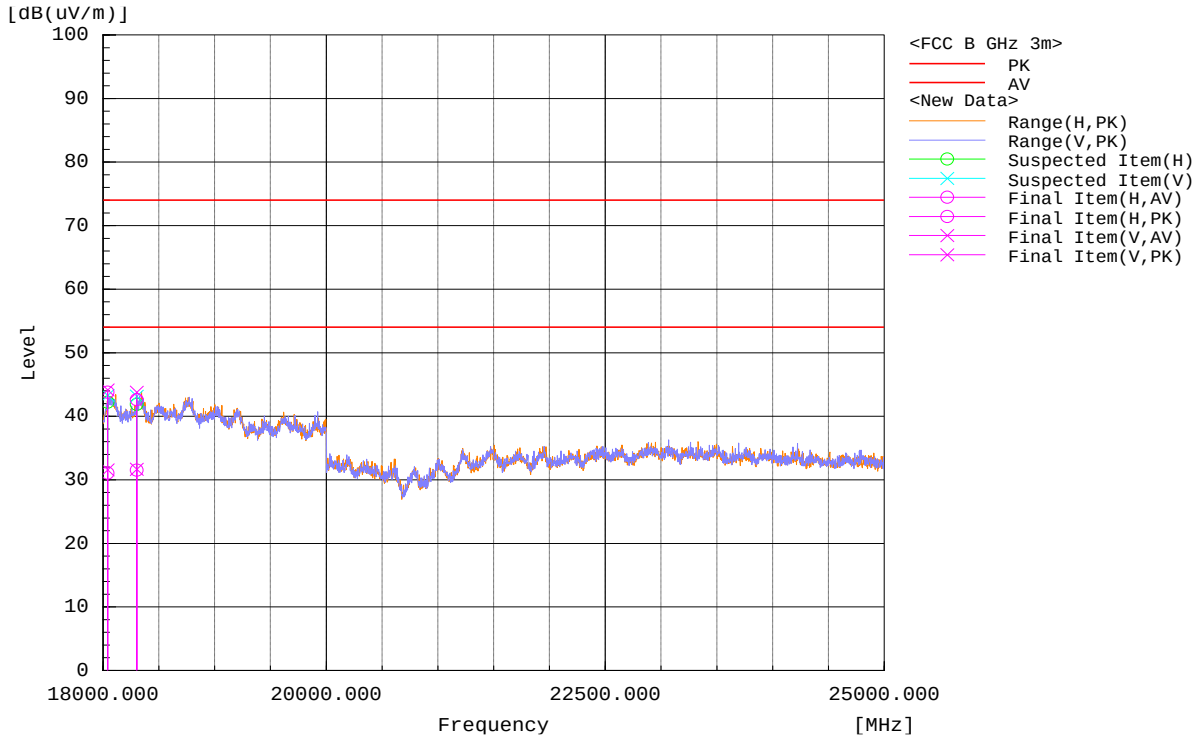
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18317.718	H	16.8	29.2	16.6	33.4	45.8	54	74	-20.6	-28.2
18318.996	V	18.2	29.4	16.6	34.8	46.0	54	74	-19.2	-28.0
18781.974	V	17.4	30.7	15.9	33.3	46.6	54	74	-20.7	-27.4
18780.24	H	16.9	29.4	15.9	32.8	45.3	54	74	-21.2	-28.7



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11n (18 - 25 GHz) _ CH6

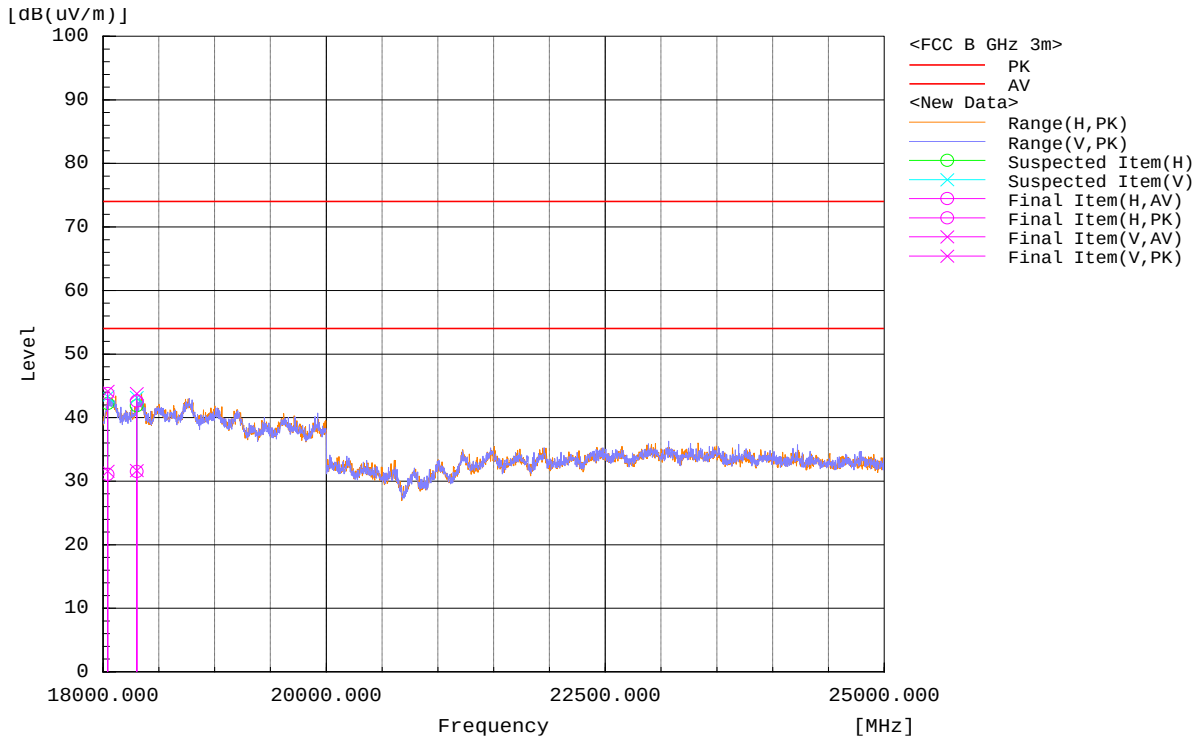
Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18039.842	H	19.1	31.8	12.0	31.1	43.8	54	74	-22.9	-30.2
18040.794	V	19.5	32.1	12.1	31.6	44.2	54	74	-22.4	-29.8
18301.756	V	19.4	31.5	12.3	31.7	43.8	54	74	-22.3	-30.2
18301.93	H	19.2	30.3	12.3	31.5	42.6	54	74	-22.5	-31.4



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

802.11n (18 - 25 GHz) _ CH11

Frequency [MHz]	Pol V/H	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
18039.842	H	19.1	31.8	12.0	31.1	43.8	54	74	-22.9	-30.2
18040.794	V	19.5	32.1	12.1	31.6	44.2	54	74	-22.4	-29.8
18301.756	V	19.4	31.5	12.3	31.7	43.8	54	74	-22.3	-30.2
18301.93	H	19.2	30.3	12.3	31.5	42.6	54	74	-22.5	-31.4



Spec Margin = Level - Limit, Level = Raw+ Cbl+ CF ± Uncertainty CF= Amp Gain + ANT Factor
Combined Standard Uncertainty $u_c(y)$ = ± 4.91dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence
Notes: All emissions passed the spurious emission limit. (*) Non-restricted band emission

4.5.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = FIM - AMP + CBL + ACF

Where: FIM = Field Intensity Meter (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

4.6 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.10: 2013. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2021 and RSS Gen: 2019 Sect. 8.8.

4.6.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

Testing is performed in Conducted Emission Station. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.6.1.1 Deviations

There were no deviations from this test methodology.

4.6.2 Test Results

N/A (EUT IS NOT CONNECTED AC POWER LINE).

5 Test Equipment List

5.1 Equipment List

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Receiver Rohde and Schwarz	ESW44	1328.4100K-101662-MH	09/20/2022	09/20/2024
PXA Signal Analyzer KEYSIGHT	N9030B	MY57140374	07/20/2022	07/20/2024
Biconilog Antenna Sunol	JB6	A111717	09/22/2022	09/22/2024
Horn Antenna ETS-Lindgren	3117	218554	08/11/2022	08/11/2024
The EMC Shop	PA18G-HA	001337	12/20/2022	12/20/2024
DRG Horn Antenna	SAS574	579	09/22/2022	09/22/2024
The EMC Shop	PA40G	17610-01	07/08/2022	07/08/2024

Test software used: Toyo Corporation: Radiated Emission EP7/RE Ver 8.0.1 30

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 9: Customer Information

Company Name	Daimler Truck North America LLC
Address	4555 N. Channel Ave,
City, State, Zip	PORTLAND OR 97217-3849 USA
Country	USA

6.3 Equipment Under Test (EUT)

Table 10: EUT Specifications

<table>
<tr><td>Product/ PMN</td><td>CTP2019DTNA</td></tr>
<tr><td>Brand</td><td>CTP</td></tr>
<tr><td>Test Model / HVIN</td><td>CTP19TNv3</td></tr>
<tr><td>Identification No. of EUT</td><td>A6633000000
Or A6633000500</td></tr>
<tr><td>Status of EUT</td><td>Engineering sample</td></tr>
<tr><td>Power Supply Rating</td><td>12 V input is expected from vehicles. Supports 8V to 32V</td></tr>
<tr><td>Temperature Operating Range</td><td>-35C to 75C</td></tr>
<tr><td>BT/WLAN Module</td><td>
<table>
<tr><td colspan="2">Model</td><td>UGKZ7A10</td></tr>
<tr><td colspan="2">Manufacturer</td><td>ALPS</td></tr>
<tr><td rowspan="5">WiFi</td><td>Frequency</td><td>2412 to 2462MHz for 802.11b/g/n</td></tr>
<tr><td>Channel Bandwidth</td><td>20 MHz</td></tr>
<tr><td>Modulation</td><td>802.11b – BPSK, QPSK, CCK, DSSS
802.11g – BPSK, QPSK, 16/64QAM, OFDM
802.11n – HT mode MCS0-7</td></tr>
<tr><td>Data rate max</td><td>802.11b – 11Mbps
802.11g – 54Mbps
802.11n – 72.2Mbps</td></tr>
<tr><td>Output Level</td><td>802.11b – +15dBm
802.11g – +13dBm
802.11n – +11dBm</td></tr>
<tr><td rowspan="2">BT</td><td>Sensitivity</td><td>802.11b – -90dBm
802.11g – -74dBm
802.11n – -72dBm</td></tr>
<tr><td>Frequency</td><td>2402 ~2480MHz</td></tr>
<tr><td></td><td>Channel Spacing</td><td>Normal mode – 1MHz
BLE mode –2MHz</td></tr>
</table>
</td></tr>
<tr><td>Antenna Information</td><td>
<table>
<tr><td>ANTENNA-CABLE, WIFI/BT, INT</td><td>A66-12157-000</td><td>2400-2485 MHz
5150-5925 MHz</td><td>30 dBm</td><td>Antenna Type: WiFi/BT
2400-2485 MHz: 4.0 dBi
5150-5925 MHz: 5.0 dBi</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Note: The above radio information is for the BT/ WLAN radio module inside CTP19TNv3.
This report is only document the WiFi radio.</td></tr>
</table>

Table 11: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
USB	Terminated	☒ Yes	☒ Metric:0.6 m	☒ M

Table 12: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	T430	PB-8HBRR	Set test mode

Table 13: Final Test Mode for 2412 MHz to 2462 MHz Band

Test	CTP19TNv3
Output Power	2412, 2437, 2462 MHz @ 802.11b, 11g & 11n
Occupied Bandwidth	2412, 2437, 2462 MHz @ 802.11b, 11g & 11n
Maximum Power Spectral Density	2412, 2437, 2462 MHz @ 802.11b, 11g & 11n
Out-of-Band (-30 dBr)	2412, 2437, 2462 MHz @ 802.11b, 11g & 11n
Band-Edge (Radiated)	2412, 2462 MHz @ 802.11b, 11g & 11n
Transmitted Spurious Emission (Radiated)	2412, 2437, 2462 MHz @ 802.11b, 11g & 11n
AC Conducted Emission	N/A
Note: EUT Transmit at 38.8% duty cycle at 11b, 41.4% duty cycle at 11g, and 37.8% duty cycle at 11n.	

6.4 Test Specifications

Table 14: Test Specifications

Emissions and Immunity	
Rules & Regulations / Standards	**Requirement**
CFR 47 Part 15.247: 2023	All
RSS 247 Issue 2, 2017	All

END OF REPORT