

FCC/ISED UNII RF TEST REPORT



Test Report Number.....	WAP-19091821-LC-FCC-IC-UNII
Applicant.....	Ford Motor Company
Applicant Address.....	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124
Product Name.....	Vehicle Telematics Control Unit
Model Number.....	MUST-14H074-NAC
Family Product/Model.....	N/A
FCC ID.....	KMH-14H074-NA1
ISED ID.....	1422A-14H074NA1
Date of EUT received.....	09/27/2019
Date of Test.....	09/27/2019 – 11/25/2019
Report Issue Date.....	12/02/2019
Test Standards.....	47CFR Part 15.407 RSS-247 Issue2: Feb 2017
Test Result.....	Pass

Issued By:

Vista Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com

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Tested by:

Bruce Li/Test Engineer

Approved By:

David Zhang/Technical Manager

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



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Laboratory Introduction

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Our comprehensive testing services include safety testing, EMC emission and susceptibility testing, RF and wireless testing (including DFS).

As your partner, Vista investigates appropriate test standards, develops test plans, performs troubleshooting & failure analysis, reviews documentation, and provides test reports for a complete compliance testing and certification package.



Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



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REVISION HISTORY

Revision	Issue Date	Description	Note
Original	12/02/2019	Original release	N/A

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



1 General Information

1.1 Applicant

Applicant:	Ford Motor Company
Applicant address:	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124
Manufacturer:	Ford Motor Company
Manufacturer Address:	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124

1.2 Product information

Product Name	Vehicle Infotainment System
Model Number	FB5-TCU-NA
Family Model Number	N/A
Serial Number	ENMHF19050112411, ENMHF19050112546 (Conducted), ENMHF19050112536, ENMHF19050112440 (Radiated)
Frequency Band	BT BDR/EDR: 2402-2480MHz BLE: 2402-2480MHz 802.11b/g/n-20MHz: 2412-2462MHz 802.11n-40MHz: 2422-2452MHz 802.11a/n-20MHz: 5500-5580MHz, 5660-5720, 5725-5825MHz 802.11n-40MHz: 5510-5550MHz, 5630-5710, 5755-5795MHz 802.11ac: 5530, 5690MHz, 5775MHz WCDMA Band 2: 1852.4- 1907.6MHz WCDMA Band 4: 1712.4- 1752.6MHz WCDMA Band 5: 826.4- 846.6MHz LTE Band 2: 1850.7-1909.3MHz LTE Band 4: 1710.7-1754.3MHz LTE Band 5: 824.7-848.3MHz LTE Band 12: 699.7-713.5MHz LTE Band 17: 706.5-784.5 MHz LTE Band 66: 1710.7-1779.3MHz
Type of modulation	BT BDR/EDR: GFSK, $\pi/4$ DQPSK, 8DPSK BLE: GFSK 802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g: OFDM-CCK (BPSK, QPSK, 16QAM, 64QAM) 802.11a/n/ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) WCDMA: QPSK LTE: QPSK, 16QAM
Equipment Class/ Category	DSS, DTS, UNII, PCB
Maximum output power	See test result

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Antenna Information	Internal PCB trace antenna Peak Gain: - Antenna1: 3.40 dBi @2.4GHz WiFi/Bluetooth, 8.00 dBi @5GHz WiFi - Antenna2: 3.39 dBi @2.4GHz WiFi/Bluetooth, 6.17 dBi @5GHz WiFi
	External Antenna Peak Gain: - Antenna3: 9.74 dBi @2.4GHz WiFi/Bluetooth
	Cellular main and diversity antennas: Peak Gain: 4.32 dBi @ 698-850MHz 5.53 dBi @ 1700-1910MHz For 2.4GHz Wi-Fi, it has total 3 antennas that can transmit simultaneously (Internal antenna 1 &2, and external antenna). For 5GHz Wi-Fi, it has total 2 antennas that can transmit simultaneously (Internal antenna 1 &2). The directional gain is calculated per KDB 662911 D01 Multiple Transmitter Output v02r01, Directional Gain: - 12.59 dBi @2.4GHz - 10.143 dBi @5GHz
Clock Frequencies	N/A
Port/Connectors	CAN bus
Input Power	Vehicle Battery powered: 12VDC
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BT/BLE, WLAN and cellular radio can transmit simultaneously
Additional Info	This device is original equipment (OEM) devices, which will be installed in vehicles by vehicles manufacturers. The operation in band 5600-5650MHz is not allowed per ISSED rules. This device does not operate as DFS master, nor as client device with DFS detection capability.

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1.3 Test standard and method

Test standard	47CFR Part 15.407
Test method	ANSI C63.10: 2013 789033 D02 General UNII Test Procedures New Rules v02r01

1.4 Test Purpose and statement

The purpose of this test report is intended to demonstrate the compliance of product listed in section 1.2, received from company listed in section 1.1, to the requirements of standard and method listed in section 1.3. Based on our test results, we conclude that the product tested complies with the requirements of the standards indicated.

2 Test site information

Lab performing tests	Vista Laboratories
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www. Vista-compliance.com

Test condition	Test Engineer	Test Environment	Test Date
RF conducted	Bruce Li	23.5°C / 58.2%/996 mbar	09/27/2019–11/25/2019
Radiated	Bruce Li	23.5°C / 58.2%/996 mbar	09/27/2019–11/25/2019

3 Modification of EUT

The EUT is an engineering test sample loaded with RF testing software specifically designed to support the RF TX/RX measurement in different aspects.

4 Test configuration and operation

4.1 EUT test configuration

EUT is powered by external DC power supply for testing purpose. EUT's RF antenna port is connected to spectrum analyzer through RF test cable for measurement. The test software is used to set EUT to different transmission mode in terms of radio mode (WLAN, BLE), test channel, data rate, etc. For Cellular radio, it's controlled by communication tester to change to different mode.

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4.2 EUT test channel

Radio	Channel	Radio	Channel
802.11-a	5500	802.11-a	5745
802.11-a	5580	802.11-a	5785
802.11-a	5700	802.11-a	5825
802.11-n-20	5500	802.11-n-20	5745
802.11-n-20	5580	802.11-n-20	5785
802.11-n-20	5700	802.11-n-20	5825
802.11-n-40	5510	802.11-n-40	5755
802.11-n-40	5550	802.11-n-40	5795
802.11-n-40	5670	802.11-ac-80	5775
802.11-ac-80	5530		

Radio	Channel		
802.11-a	5720		
802.11-n-20	5720		
802.11-n-40	5710		
802.11-ac-80	5690		

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4.3 Supporting Equipment

Index	Description	Model	S/N	Brand	Remark
1	AC/DC Adapter	GST60A12-P1J	EB74Q81066	MEAN WELL	-

4.4 EUT setup diagram



4.5 EUT operation

The test software is used to set EUT to different transmission mode in terms of radio mode (WLAN, BLE), test channel, data rate, etc. For Cellular radio, it's controlled by communication tester to change to different mode.

4.6 Test software

Index	Description	Remark
1	Qualcomm QRCT ver 4.0.00138.0	Set Wi-Fi radio to different test mode
2	Window command prompt	Set BDR/EDR and BLE to different test mode
3	EMISoft Vasona 6.0049	EMC/Spurious emission test software used during testing

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5 EUT and test setup pictures

[See associated filing](#)

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6 Test Summary

FCC Rules	ISED Rules	Test Item	Section	Verdict
§15.203	-	Antenna Requirement	8.1	Pass
§15.407(e)	RSS-247 §6.2	6 dB Bandwidth	8.2	
§15.407(a)	-	26 dB Bandwidth	8.3	Pass
-	RSS-Gen §6.7	99% Occupied Bandwidth	8.4	Pass
§15.407(a)	RSS-247 §6.2	Conducted Maximum Output Power & E.I.R.P	8.5	Pass
§15.407(a)	RSS-247 §6.2	Power Spectral Density & E.I.R.Psd	8.6	Pass
§15.407(c)	RSS-247 §6.4 (a)	Automatically Discontinue Transmission	8.7	Pass
§15.205, §15.209, §15.407(b)	RSS-247 §6.2	Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	8.8	Pass
§15.207 (a)	RSS-Gen §8.8	AC Power Line Conducted Emissions	N/A	N/A 1)
-	RSS-Gen §7.3	Receiver Spurious Emission	N/A	N/A 2)

Note1: EUT is powered by Vehicle mains. It does not connect to public AC mains. This item is not applicable.

Note2: Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

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7 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

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8 Test summary and result

8.1 Antenna Requirement

8.1.1 Requirement

Per § 15.203, 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.

8.1.2 Result

Analysis:

EUT has internal and external antennas.

- For Internal antennas, they're PCB trace antenna. No standard RF connector or coupling is used.
- For External antennas, they're connected using non-standard coupling port. No standard RF connector or coupling is used.

Conclusion:

EUT complies with antenna requirement in § 15.203.

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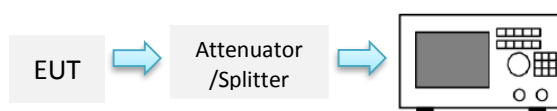
8.2 6 d Bandwidth

8.2.1 Requirement

§ 15.407 (e), RSS-247 §6.2

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

8.2.2 Test setup



8.2.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section C) Emission bandwidth.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

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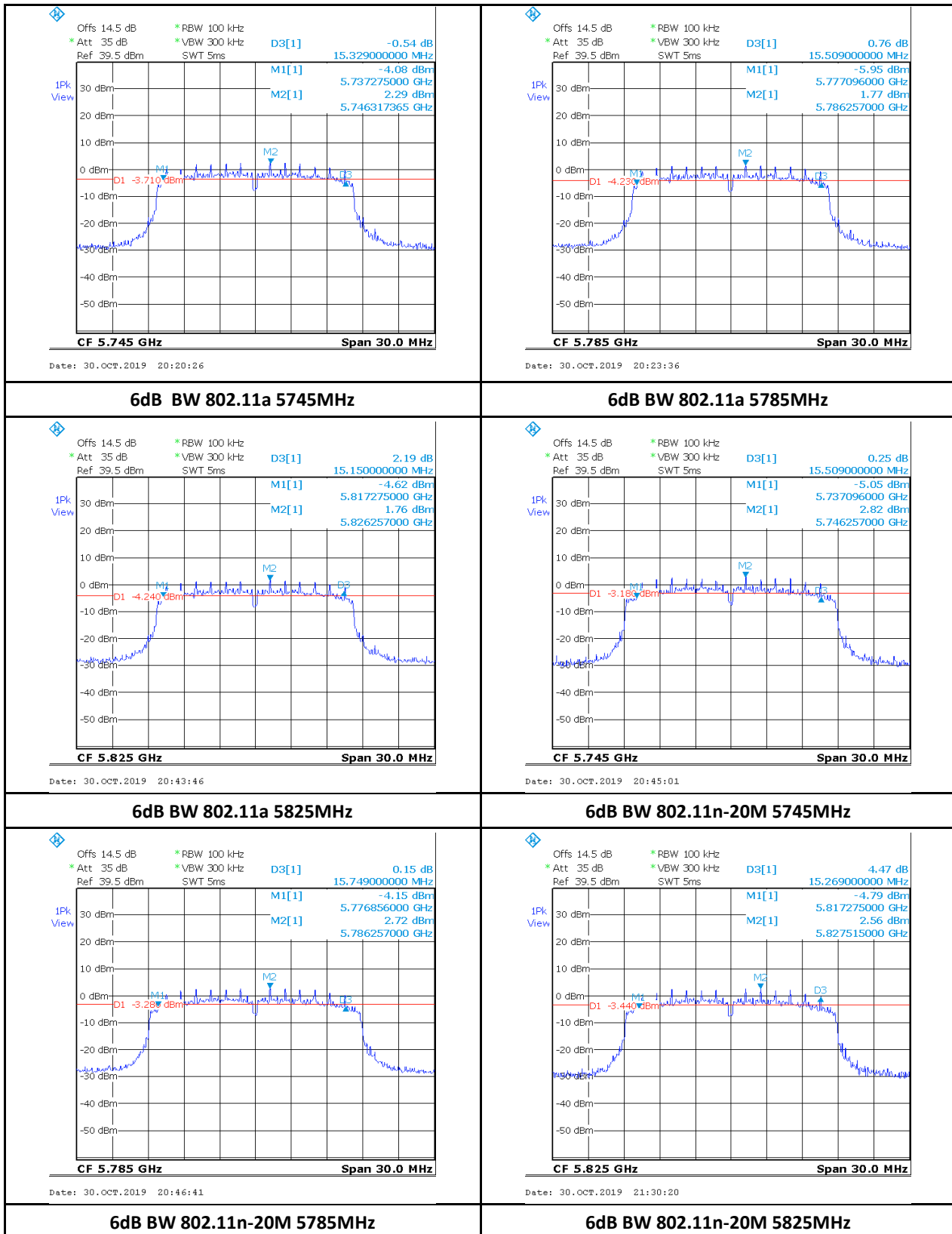


8.2.4 Test Result

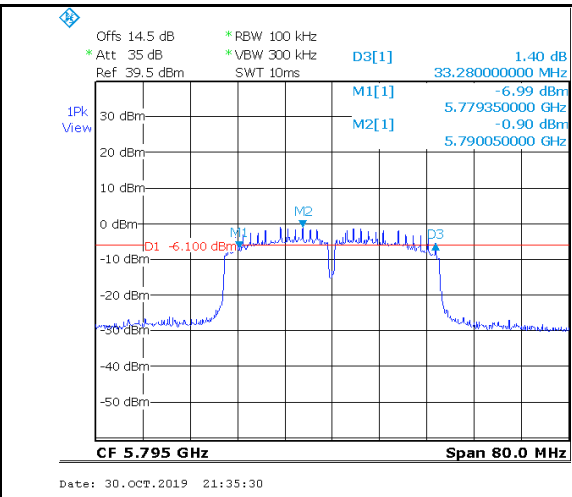
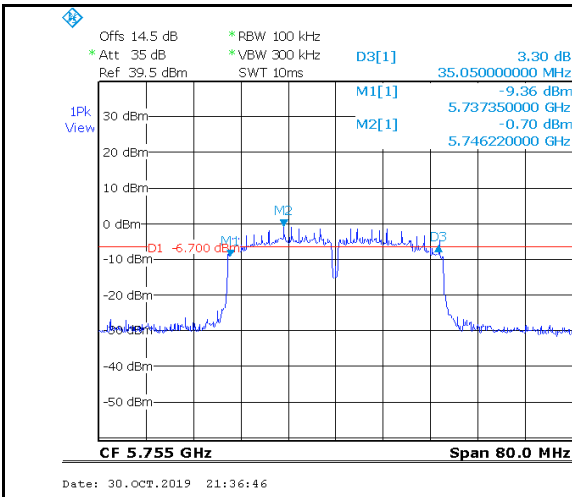
For U-NII-3 band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	149	5745	6Mbps	15329	500	Pass
11a	157	5785	6Mbps	15509	500	Pass
11a	165	5825	6Mbps	15150	500	Pass
11n-20M	149	5745	MCS0	15509	500	Pass
11n-20M	157	5785	MCS0	15749	500	Pass
11n-20M	165	5825	MCS0	15269	500	Pass
11n-40M	155	5755	MCS0	35050	500	Pass
11n-40M	159	5795	MCS0	33280	500	Pass
11ac-80M	155	5775	VHC-MCS0	74970	500	Pass

8.2.5 Test Plots

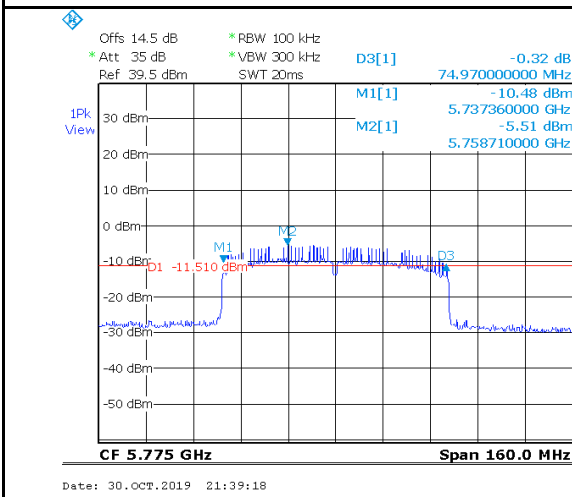


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6dB BW 802.11n-40M 5755MHz

6dB BW 802.11n-40M 5795MHz



6dB BW 802.11ac-80M 5775MHz

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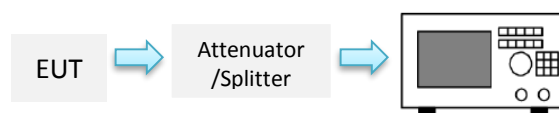
8.3 26 d Bandwidth

8.3.1 Requirement

§ 15.407 (a)

This section is for reporting purpose only. There are no restriction limits for bandwidth.

8.3.2 Test setup



8.3.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section C) Emission bandwidth.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 26 dB, if the functionality described above (i.e., $RBW, VBW \geq 3 \times RBW$, peak detector with maximum hold) is implemented by the instrumentation function.

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the video bandwidth (VBW) $\geq 3 \times RBW$.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

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8.3.4 Test Result

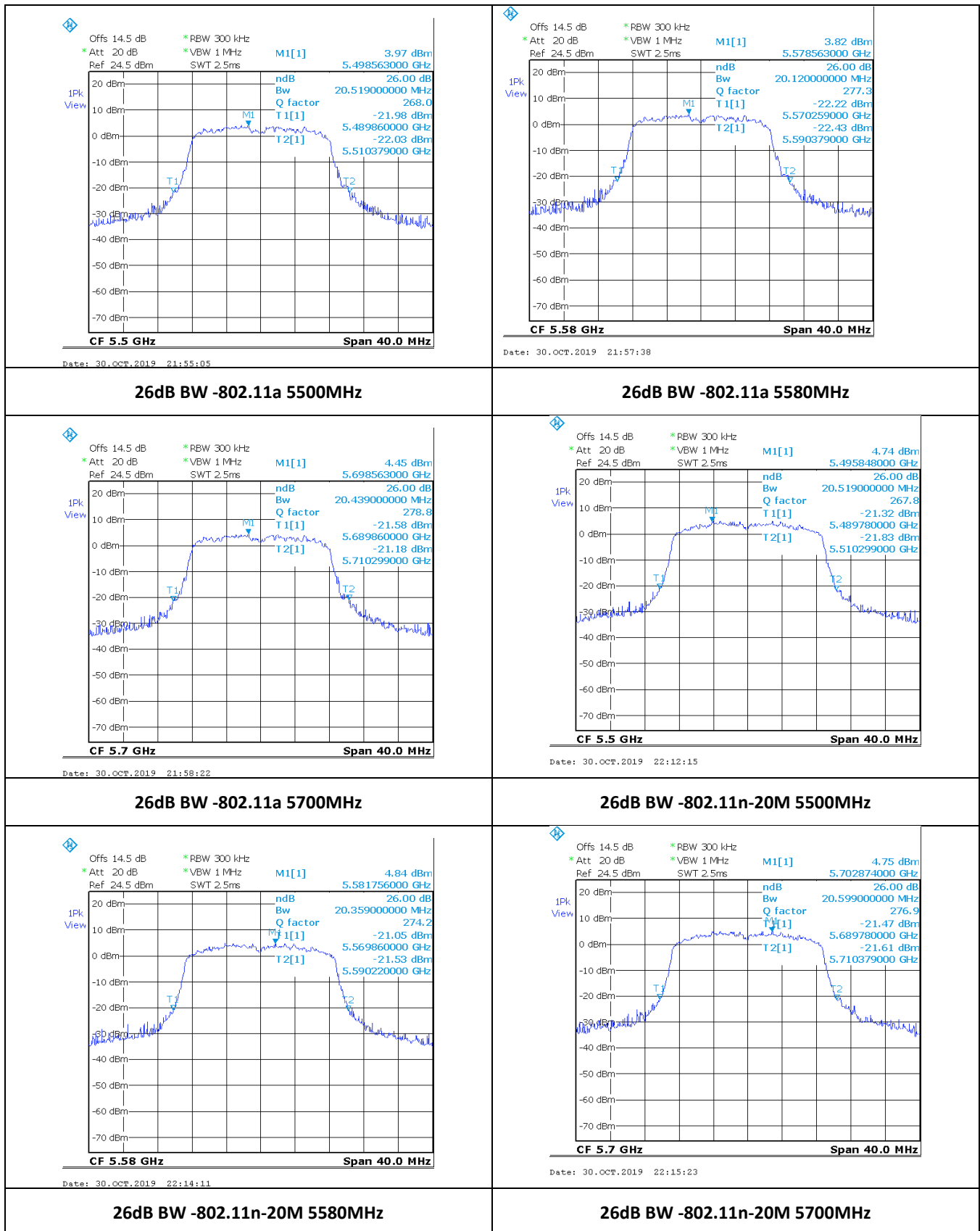
For U-NII-2C band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 26 dB Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	100	5500	6Mbps	20519	N/A	N/A
11a	120	5580	6Mbps	20120	N/A	N/A
11a	140	5700	6Mbps	20439	N/A	N/A
11n-20M	100	5500	MCS0	20519	N/A	N/A
11n-20M	120	5580	MCS0	20359	N/A	N/A
11n-20M	140	5700	MCS0	20599	N/A	N/A
11n-40M	102	5510	MCS0	43110	N/A	N/A
11n-40M	110	5550	MCS0	43110	N/A	N/A
11n-40M	134	5670	MCS0	42790	N/A	N/A
11ac-80M	106	5530	VHC-MCS0	82400	N/A	N/A

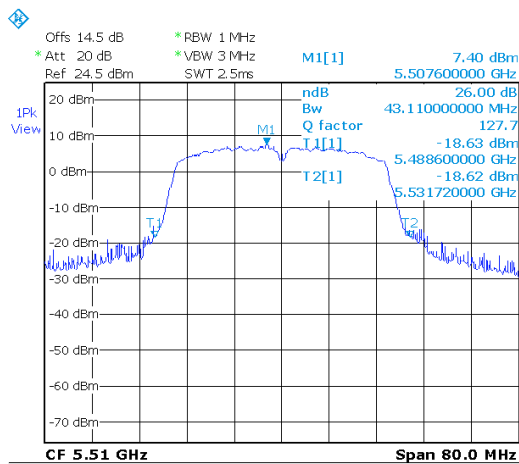
For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 26 dB Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	144	5720	6Mbps	20120	N/A	N/A
11n	144	5720	MCS0	20519	N/A	N/A
11n-40M	144	5710	MCS0	43270	N/A	N/A
11ac-80M	136	5690	VHC-MCS0	82080	N/A	N/A

8.3.5 Test Plots

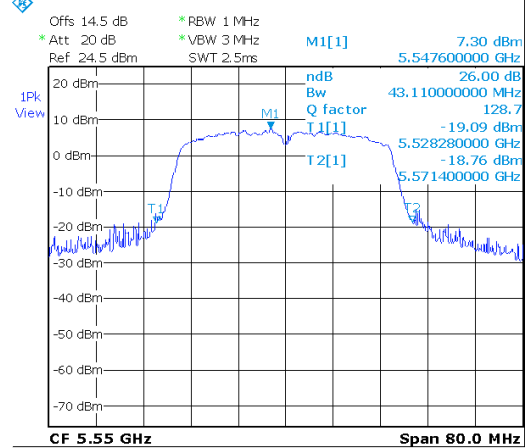


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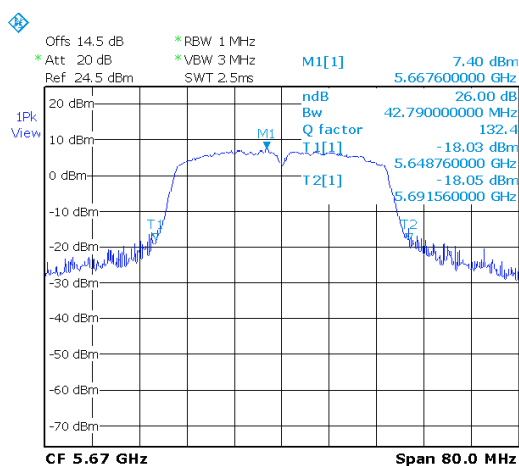
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26dB BW -802.11n-40M 5510MHz



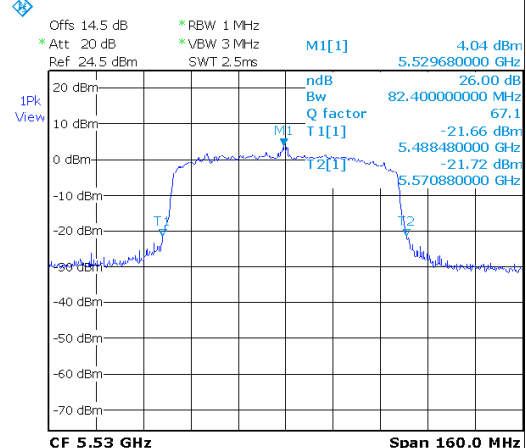
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26dB BW -802.11n-40M 5550MHz



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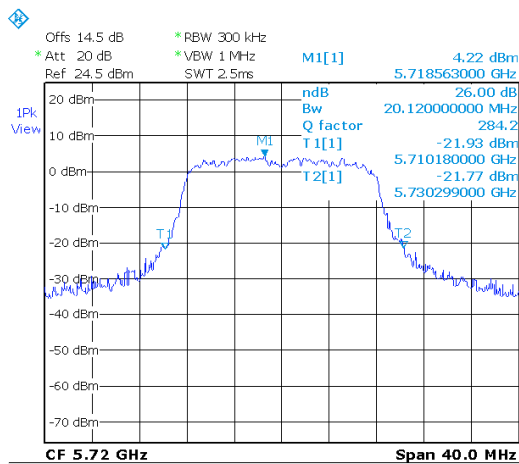
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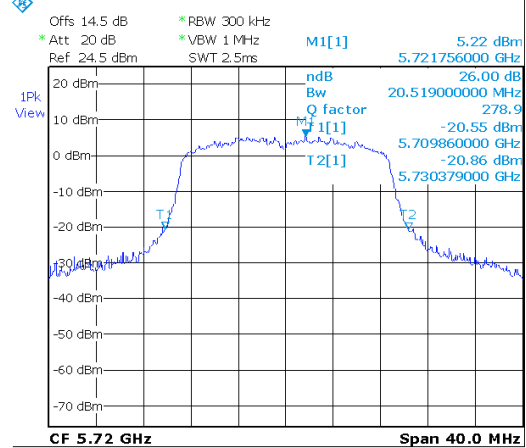
26dB BW -802.11ac-80M 5530MHz

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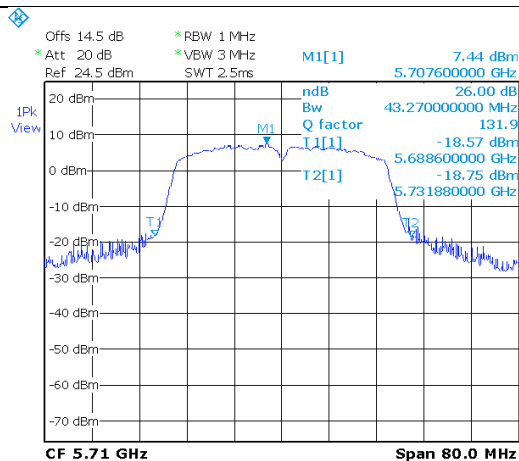
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26dB BW -802.11a-20M 5720MHz



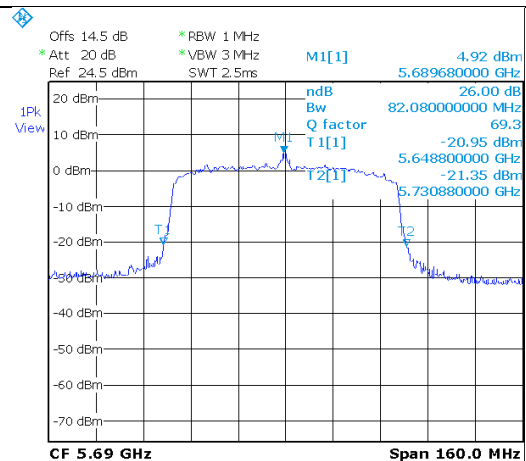
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26dB BW -802.11n-20M 5720MHz



Date: 30.OCT.2019 22:36:04

26dB BW -802.11n-40M 5710MHz



Date: 30.OCT.2019 22:46:42

26dB BW -802.11ac-80M 5690MHz

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8.4 Occupied Bandwidth (99%)

8.4.1 Requirement

RSS-Gen §6.7

This section is for reporting purpose only. There are no restriction limits for bandwidth.

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.4.2 Test setup



8.4.3 Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v01, Section C) Emission bandwidth.

The automatic bandwidth measurement capability of an instrument is used for this measurement.

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = 1.5 times to 5.0 times the OBW
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

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8.4.4 Test Result

For U-NII-2C band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 99% Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	100	5500	6Mbps	16447	N/A	N/A
11a	120	5580	6Mbps	16447	N/A	N/A
11a	140	5700	6Mbps	16447	N/A	N/A
11n-20M	100	5500	MCS0	17565	N/A	N/A
11n-20M	120	5580	MCS0	17565	N/A	N/A
11n-20M	140	5700	MCS0	17565	N/A	N/A
11n-40M	102	5510	MCS0	36248	N/A	N/A
11n-40M	110	5550	MCS0	36248	N/A	N/A
11n-40M	134	5670	MCS0	36248	N/A	N/A
11ac-80M	106	5530	VHC-MCS0	75369	N/A	N/A

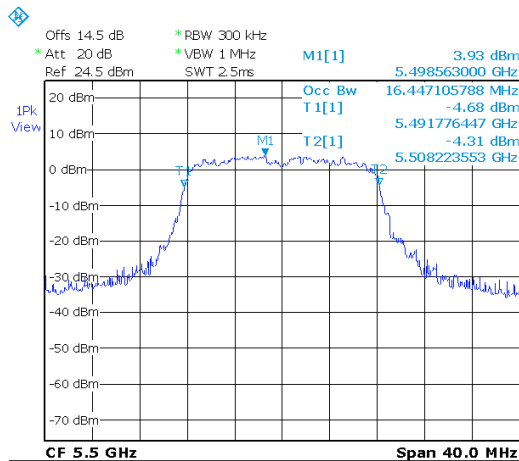
For U-NII-3 band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 99% Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	149	5745	6Mbps	17086	N/A	N/A
11a	157	5785	6Mbps	17166	N/A	N/A
11a	165	5825	6Mbps	17166	N/A	N/A
11n-20M	149	5745	MCS0	18204	N/A	N/A
11n-20M	157	5785	MCS0	18044	N/A	N/A
11n-20M	165	5825	MCS0	17964	N/A	N/A
11n-40M	155	5755	MCS0	36248	N/A	N/A
11n-40M	159	5795	MCS0	36248	N/A	N/A
11ac-80M	155	5775	VHC-MCS0	75050	N/A	N/A

For U-NII-2C band Cross-band channel

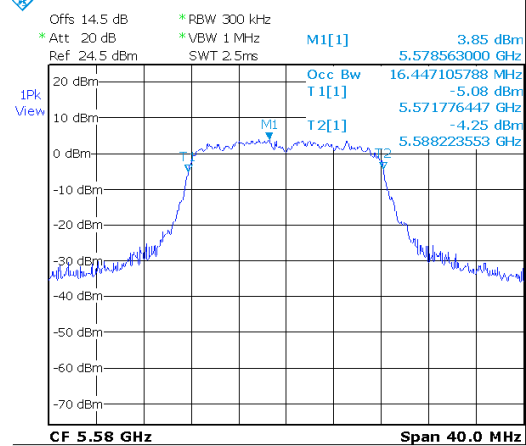
Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 99% Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
11a	144	5720	6Mbps	16447	N/A	N/A
11n	144	5720	MCS0	17565	N/A	N/A
11n-40M	144	5710	MCS0	36248	N/A	N/A
11ac-80M	136	5690	VHC-MCS0	75369	N/A	N/A

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



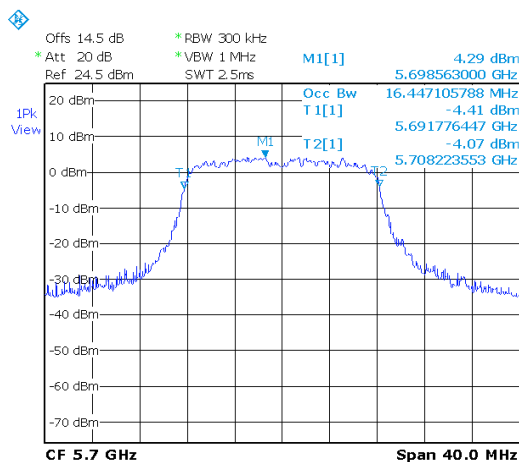
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OBW-802.11a 5500MHz



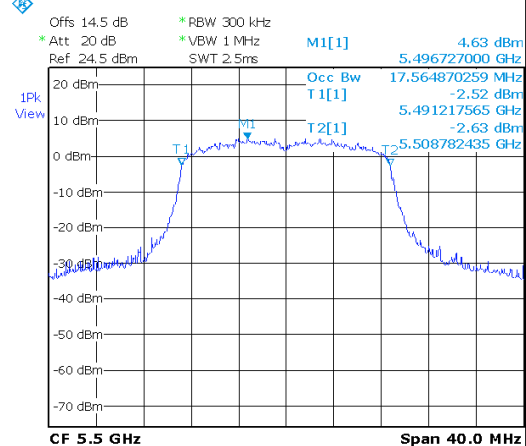
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OBW-802.11a 5580MHz



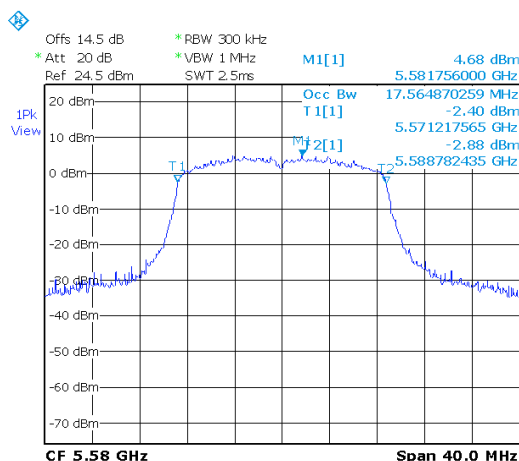
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OBW-802.11a 5700MHz



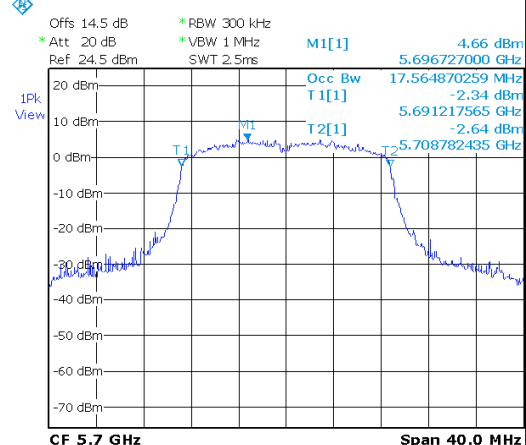
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OBW-802.11n-20M 5500MHz



Date: 30.OCT.2019 22:13:35

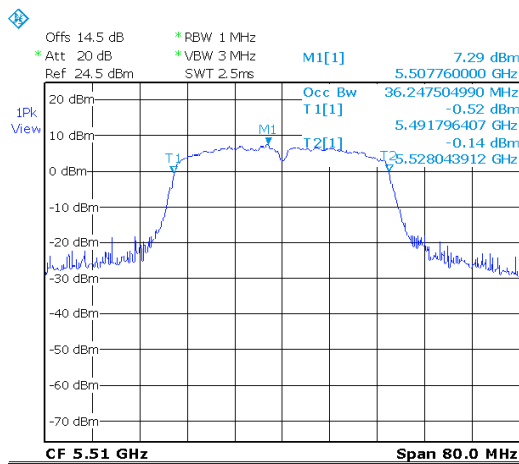
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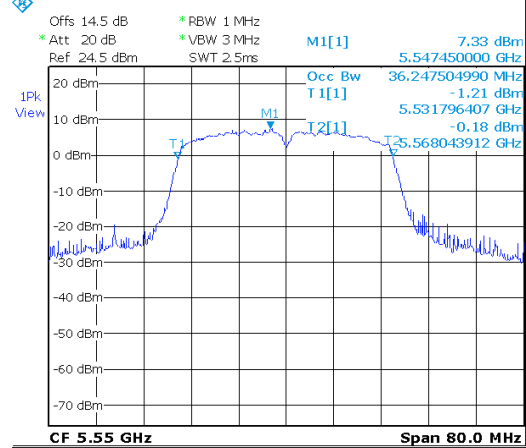
OBW-802.11n-20M 5700MHz

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



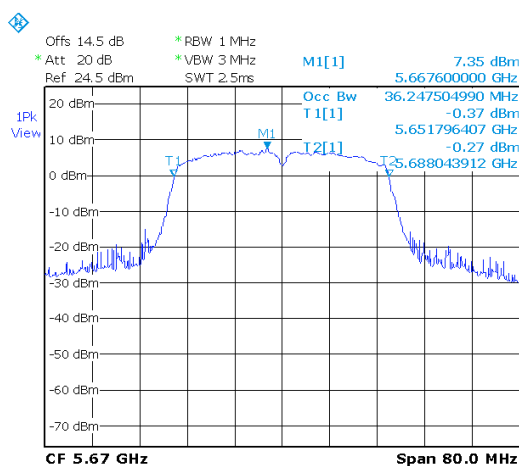
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OBW-802.11n-40M 5510MHz



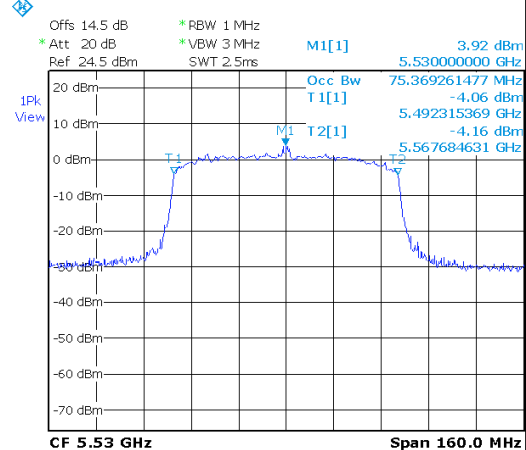
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OBW-802.11n-40M 5550MHz



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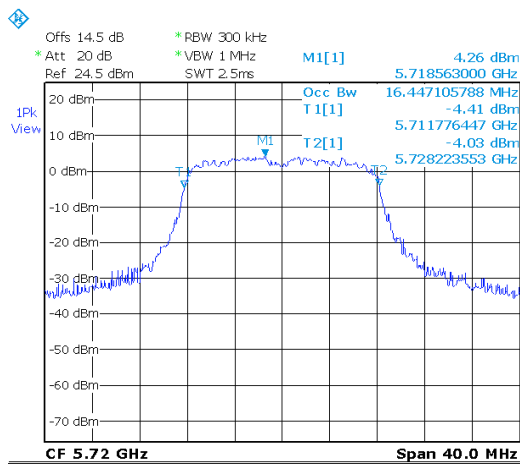
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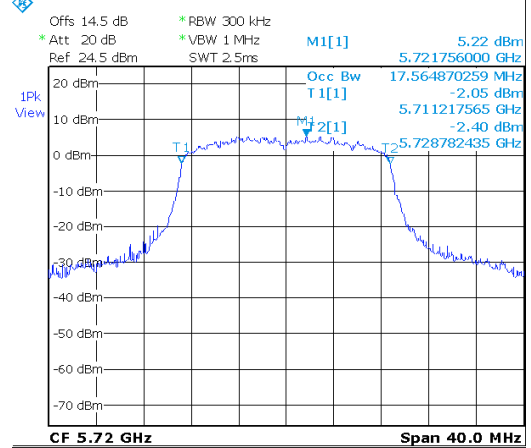
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Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



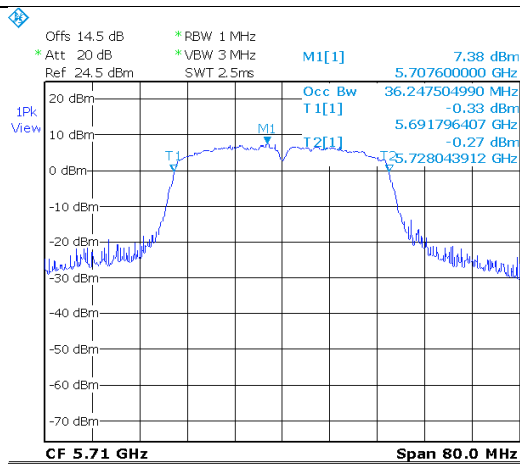
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OBW-802.11a-20M 5720MHz



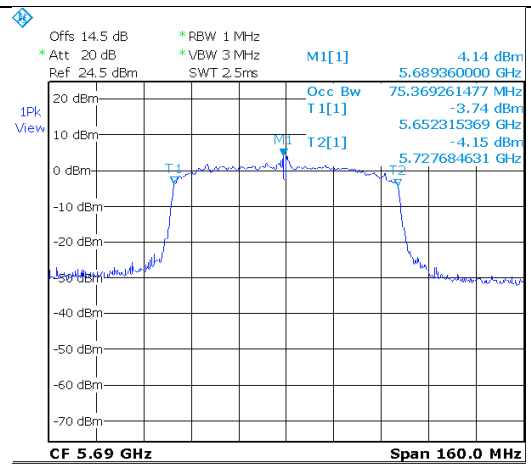
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OBW-802.11n-20M 5720MHz



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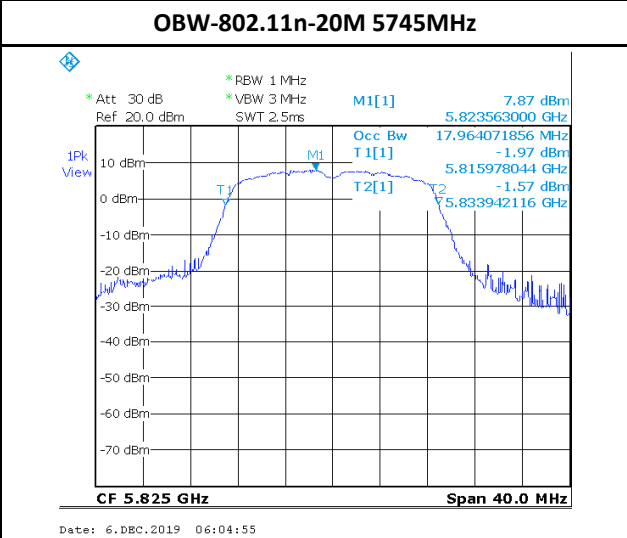
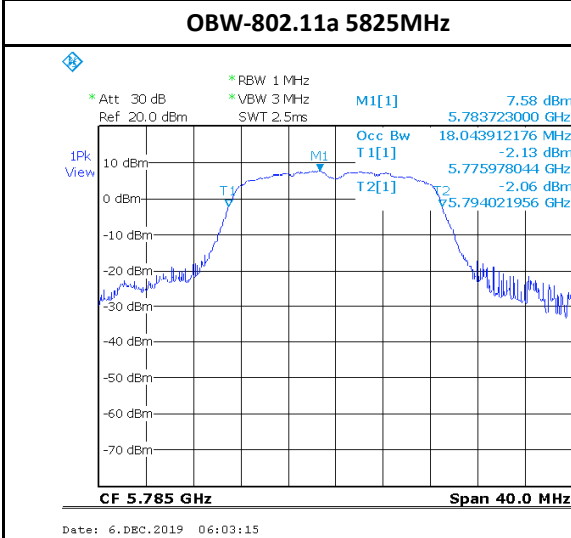
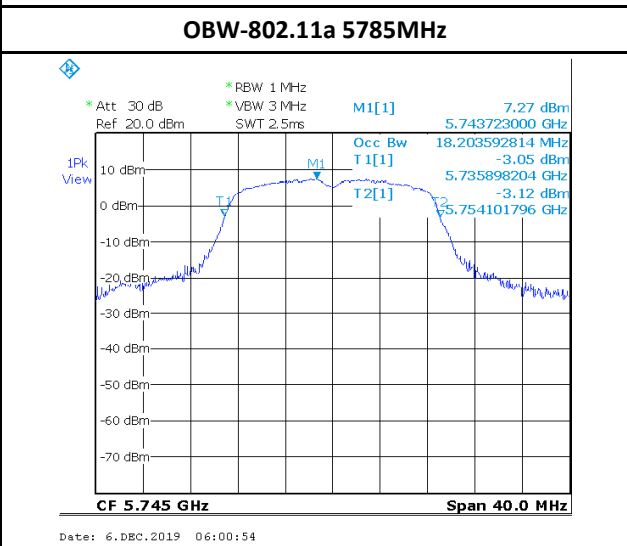
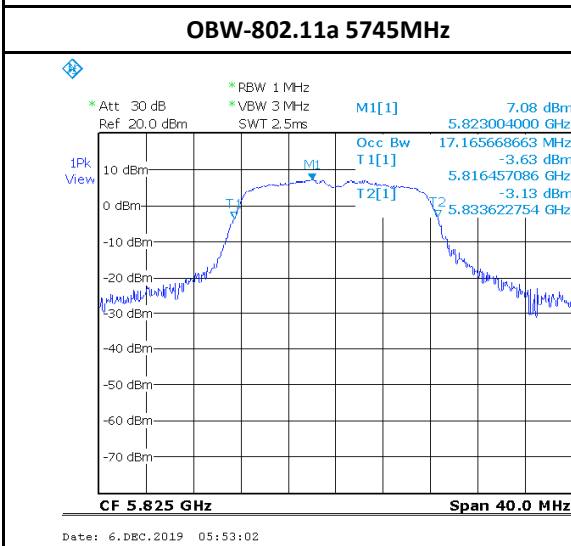
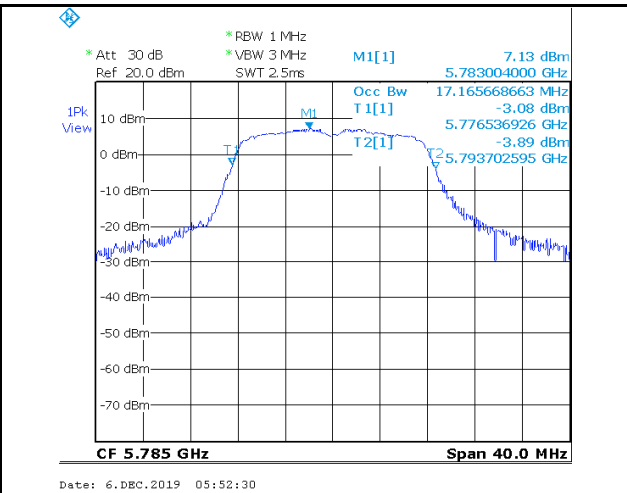
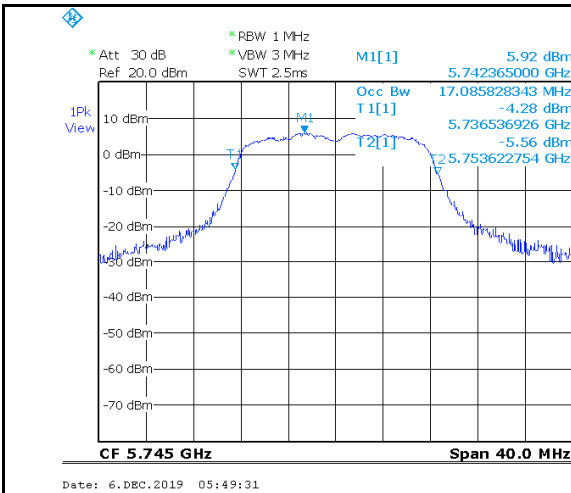
OBW-802.11a-40M 5710MHz



Date: 30.OCT.2019 22:47:24

OBW-802.11ac-80M 5690MHz

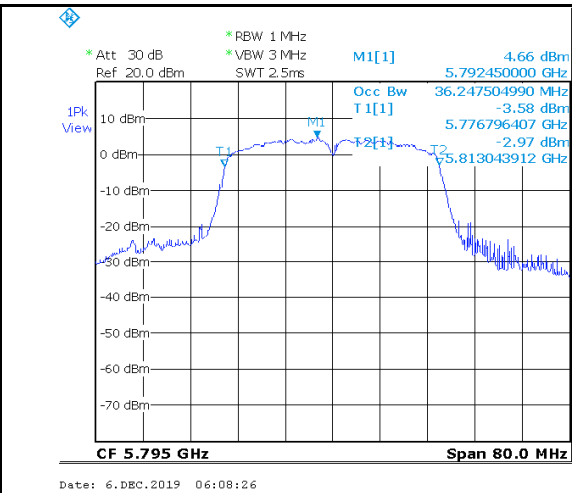
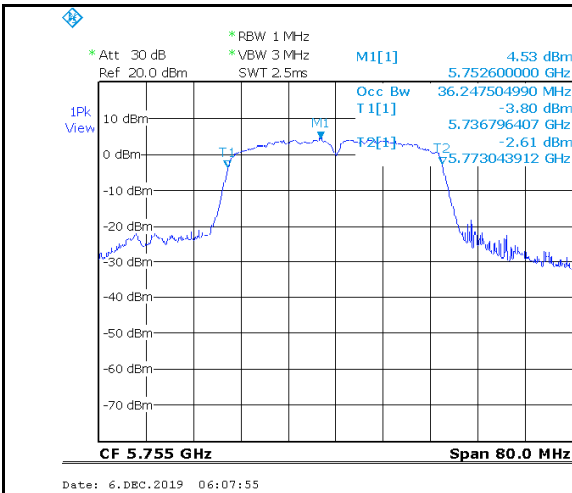
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



OBW-802.11n-20M 5785MHz

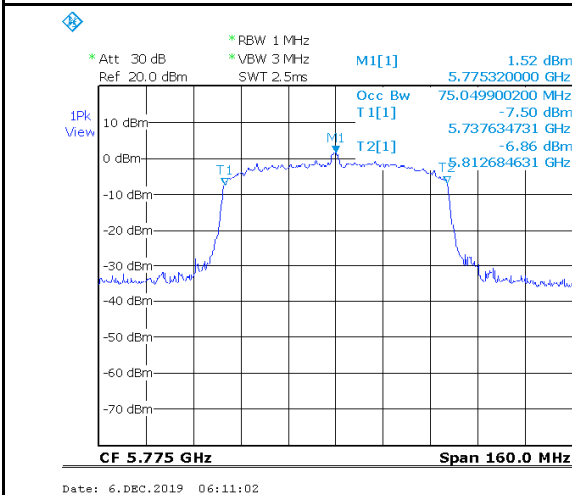
OBW-802.11n-20M 5825MHz

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



OBW-802.11n-40M 5755MHz

OBW-802.11n-40M 5795MHz



OBW-802.11ac-80M 5775MHz

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



8.5 Maximum Output Power

8.5.1 Requirement

§ 15.407 (a), RSS-247 §6.2

FCC For the 5.15–5.25 GHz bands:

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

ISED For the 5.15–5.25 GHz bands:

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For the 5.25–5.725 GHz bands:

The maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

For the band 5.725-5.85 GHz:

The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



Per § 15.407 (a),

For the 5.15–5.25 GHz bands:

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25–5.725 GHz bands:

The maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

For the band 5.725-5.85 GHz:

The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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Model Number:	FB5-TCU-NA



Per RSS-247 §6.2

For the 5.15–5.25 GHz bands:

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For the 5.25–5.350 GHz bands:

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

- a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
- b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

For the 5.47–5.600GHz and 5.65-5.725GHz bands:

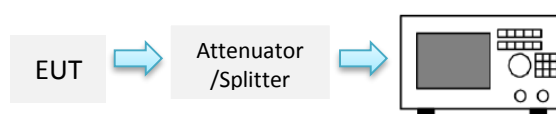
The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order

For the 5.725–5.850 GHz bands:

The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.5.2 Test setup



Report Number:	WAP-19091821-LC-FCC-IC-UNII
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Model Number:	FB5-TCU-NA



8.5.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section E) Maximum conducted output power, 2, b), method SA-1

1. Set span to encompass the entire emission bandwidth (EBW)(or, alternatively, the entire 99% occupied bandwidth) of the signal.
2. Set RBW=1MHz
3. Set VBW $\geq 3 \times$ RBW
4. Number of points in sweep $\geq 2 \times$ span/ RBW. (This ensures that bin-to-bin spacing is $\leq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
5. Sweep time = auto couple.
6. Detector = Power averaging (RMS)
7. Trace average at least 100 traces in power averaging(rms)mode.
8. Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges.

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Model Number:	FB5-TCU-NA



8.5.4 Test Result

For U-NII-2C band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 power (dBm)	TX2 power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
11a	5500	6Mbps	9.92	9.14	9.92	21.98	Pass
11a	5580	6Mbps	9.61	8.8	9.61	21.98	Pass
11a	5700	6Mbps	9.82	8.82	9.82	21.98	Pass
11n-20M	5500	MCS0	10.63	8.44	12.68	19.837	Pass
11n-20M	5580	MCS0	10.17	7.41	12.02	19.837	Pass
11n-20M	5700	MCS0	10.26	7.62	12.15	19.837	Pass
11n-40M	5510	MCS0	8.03	5.78	10.06	19.837	Pass
11n-40M	5550	MCS0	8.05	5.7	10.04	19.837	Pass
11n-40M	5670	MCS0	8.15	4.81	9.80	19.837	Pass
11ac-80M	5530	VHC-MCS0	1.77	0.46	4.17	19.837	Pass

For U-NII-3 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 power (dBm)	TX2 power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
11a	5745	6Mbps	9.7	6.35	9.7	30	Pass
11a	5785	6Mbps	9.04	6.61	9.04	30	Pass
11a	5825	6Mbps	9.53	7.65	9.53	30	Pass
11n-20M	5745	MCS0	9.95	4.94	11.14	25.857	Pass
11n-20M	5785	MCS0	10.17	4.9	11.30	25.857	Pass
11n-20M	5825	MCS0	10.35	5.59	11.60	25.857	Pass
11n-40M	5755	MCS0	8.38	4.05	9.74	25.857	Pass
11n-40M	5795	MCS0	7.74	3.81	9.22	25.857	Pass
11ac-80M	5775	VHC-MCS0	1.9	-1.25	3.61	25.857	Pass

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 power (dBm)	TX2 power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
11a	5720	6Mbps	10.07	7	10.07	21.98	Pass
11n	5720	MCS0	10.6	5.39	11.74	19.837	Pass
11n-40M	5710	MCS0	7.94	4.54	9.57	19.837	Pass
11ac-80M	5690	VHC-MCS0	1.95	-0.96	3.74	19.837	Pass

Note:

- 1) For 802.11a, the highest output power is recorded.
- 2) For 5GHz non-11a mode, it's under 2x2 MIMO mode, the output power is combined together to compare to limit.
- 3) For 5GHz non-11a mode, directional gain is calculated per KDB 662911 D01. For 5GHz WiFi non-11a mode, directional gain = 10.143 dBi, exceeding 6 dBi. The power and PSD limit will be reduced by the amount that it exceeds 6 dBi.

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Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



8.5.5 Test Result for e.i.r.p

For U-NII-2C band

Mode/ Bandwidth	Frequency (MHz)	Data rate	Highest or Total power (dBm)	Directional Ant Gain (dBi)	Highest or Total E.I.R.P (dBm)	Max E.I.R.P (dBm)	Result
11a	5500	6Mbps	9.92	8	17.92	30.00	Pass
11a	5580	6Mbps	9.61	8	17.61	30.00	Pass
11a	5700	6Mbps	9.82	8	17.82	30.00	Pass
11n-20M	5500	MCS0	12.68	10.143	22.82	30.00	Pass
11n-20M	5580	MCS0	12.02	10.143	22.16	30.00	Pass
11n-20M	5700	MCS0	12.15	10.143	22.29	30.00	Pass
11n-40M	5510	MCS0	10.06	10.143	20.20	30.00	Pass
11n-40M	5550	MCS0	10.04	10.143	20.19	30.00	Pass
11n-40M	5670	MCS0	9.80	10.143	19.95	30.00	Pass
11ac-80M	5530	VHC-MCS0	4.17	10.143	14.32	30.00	Pass

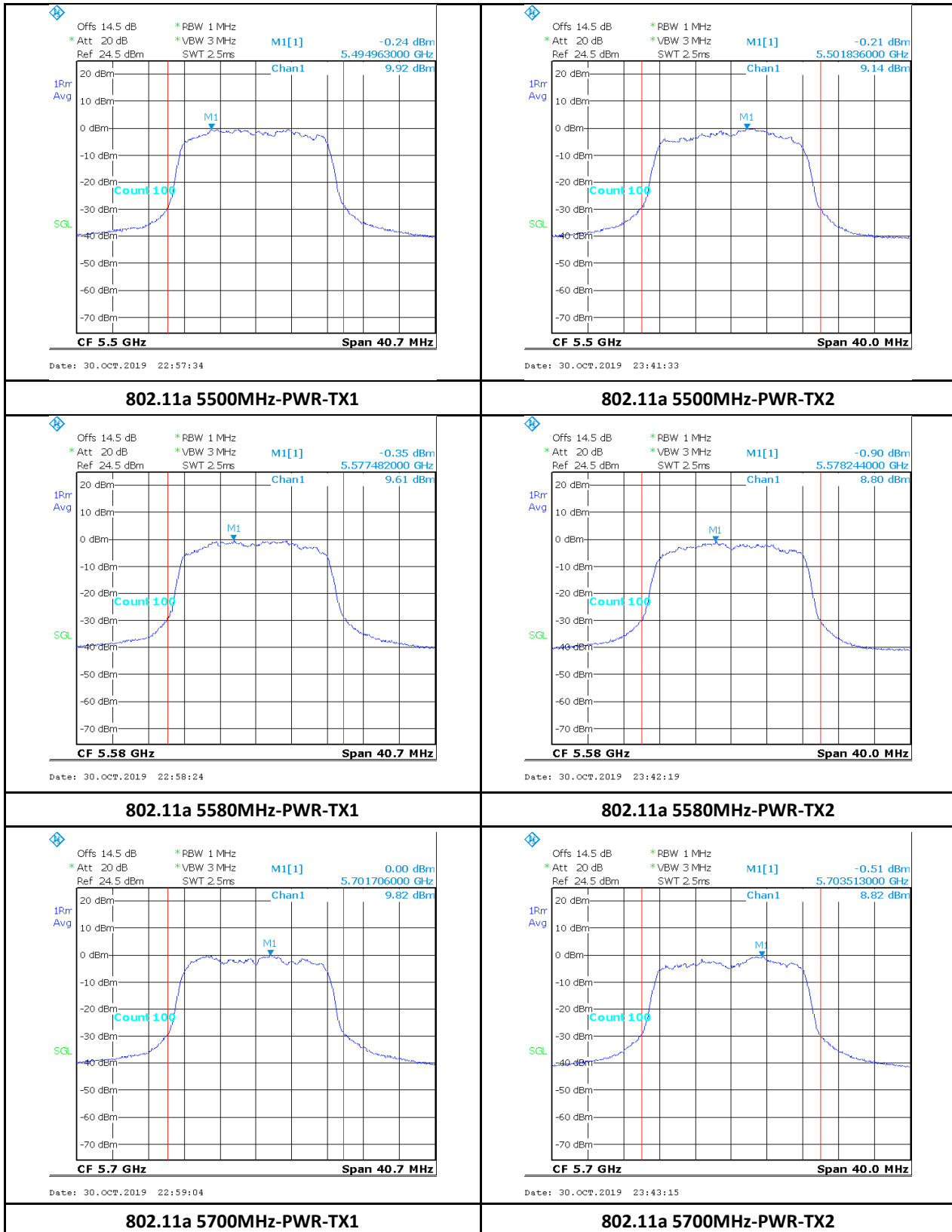
For U-NII-3 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	Highest or Total power (dBm)	Directional Ant Gain (dBi)	Highest or Total E.I.R.P (dBm)	Max E.I.R.P (dBm)	Result
11a	5745	6Mbps	9.7	8	17.70	36.00	Pass
11a	5785	6Mbps	9.04	8	17.04	36.00	Pass
11a	5825	6Mbps	9.53	8	17.53	36.00	Pass
11n-20M	5745	MCS0	11.14	10.143	21.28	36.00	Pass
11n-20M	5785	MCS0	11.30	10.143	21.44	36.00	Pass
11n-20M	5825	MCS0	11.60	10.143	21.75	36.00	Pass
11n-40M	5755	MCS0	9.74	10.143	19.89	36.00	Pass
11n-40M	5795	MCS0	9.22	10.143	19.36	36.00	Pass
11ac-80M	5775	VHC-MCS0	3.61	10.143	13.76	36.00	Pass

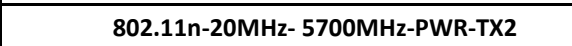
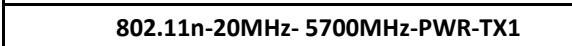
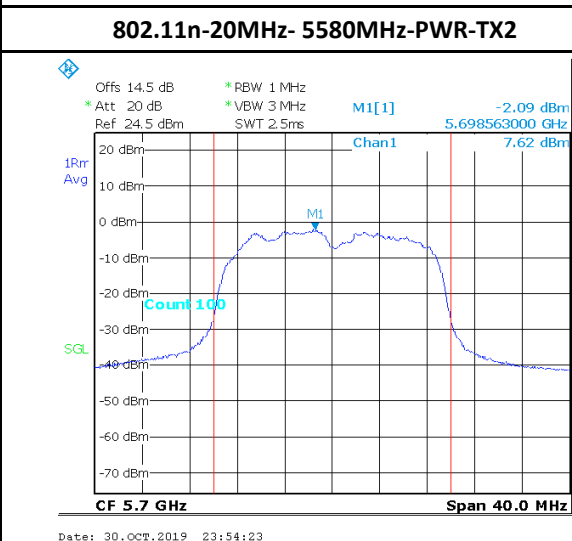
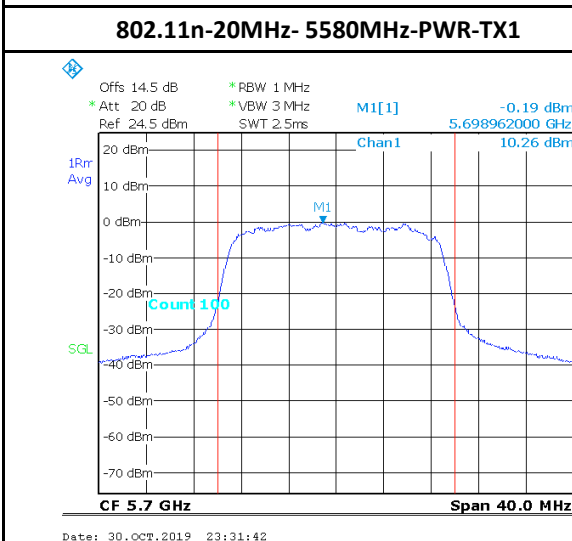
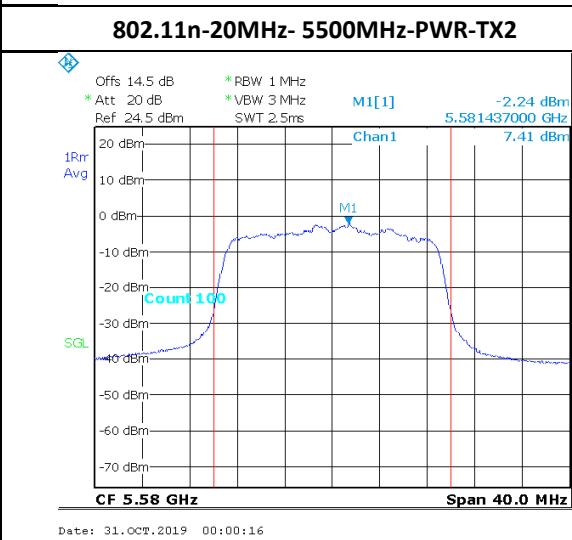
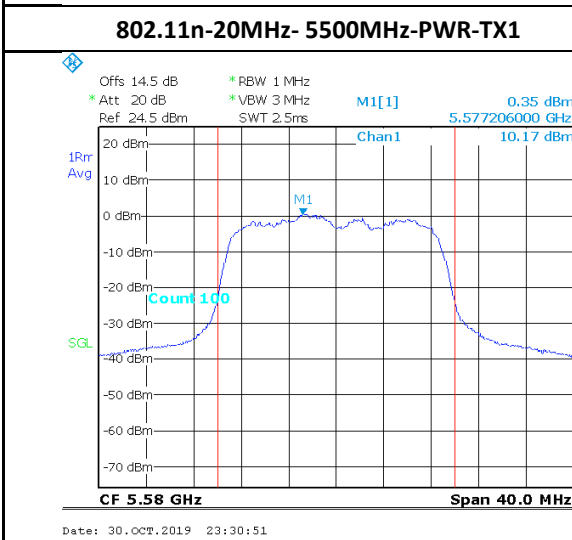
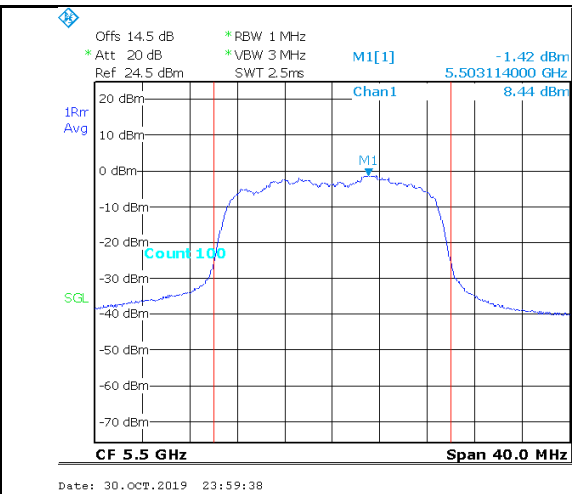
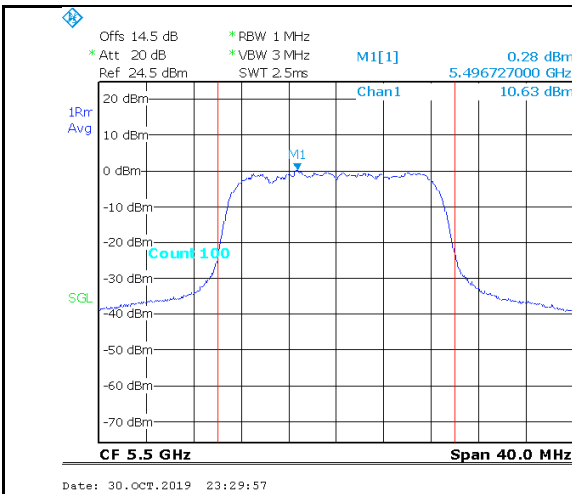
For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Frequency (MHz)	Data rate	Highest or Total power (dBm)	Directional Ant Gain (dBi)	Highest or Total E.I.R.P (dBm)	Max E.I.R.P (dBm)	Result
11a	5720	6Mbps	10.07	8	18.07	30.00	Pass
11n	5720	MCS0	11.74	10.143	21.89	30.00	Pass
11n-40M	5710	MCS0	9.57	10.143	19.72	30.00	Pass
11ac-80M	5690	VHC-MCS0	3.74	10.143	13.89	30.00	Pass

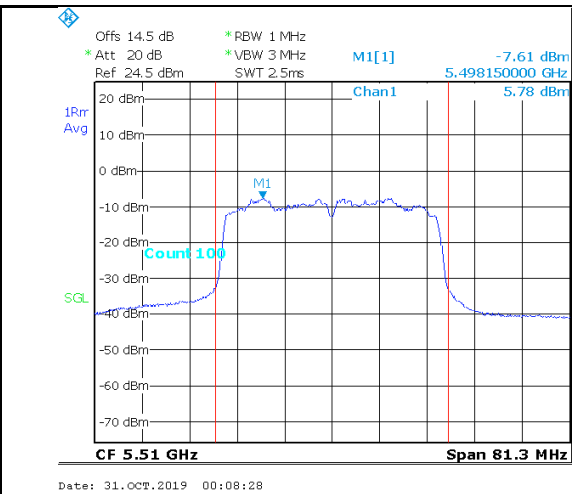
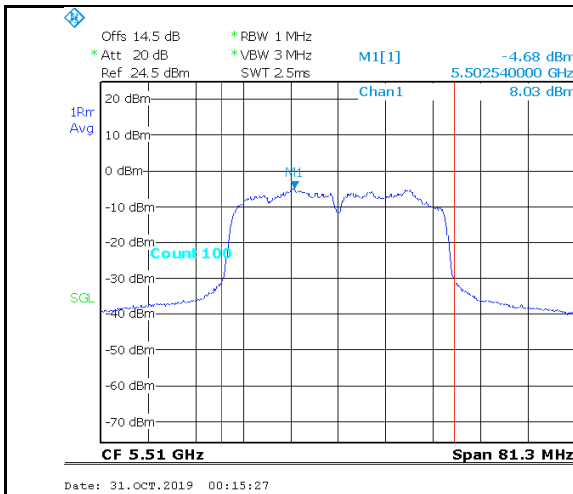
8.5.6 Test Plots



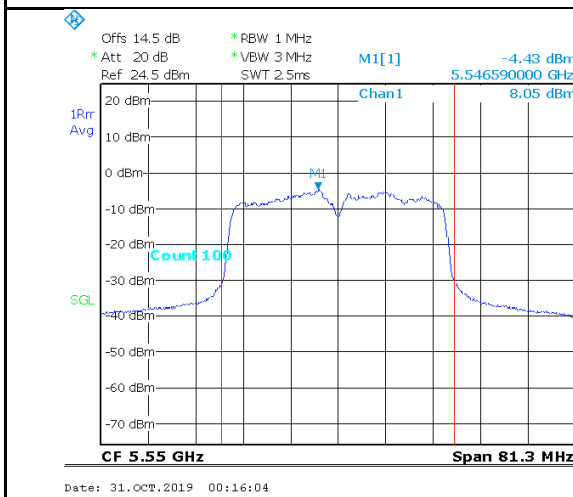
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



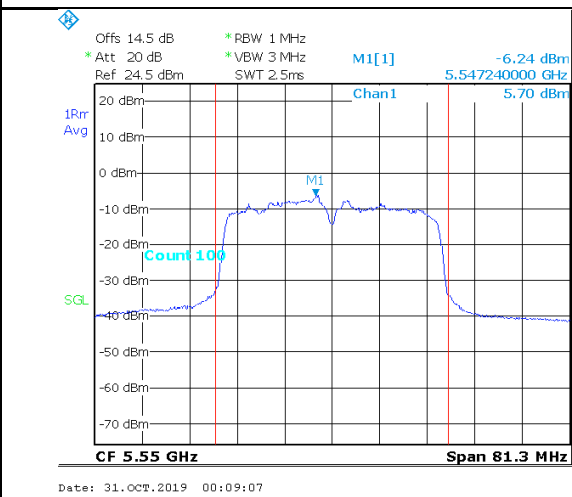
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



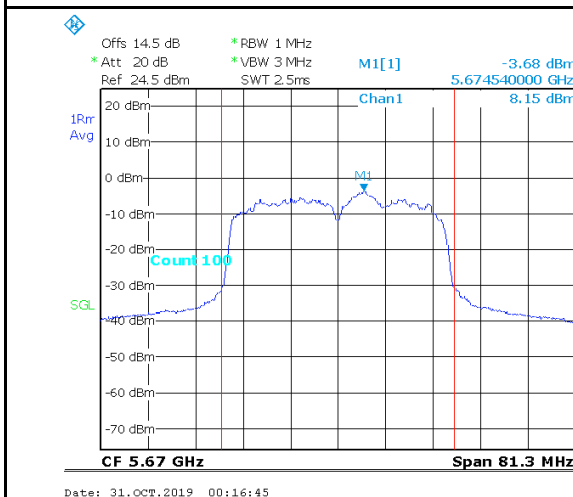
802.11n-40MHz- 5510MHz-PWR-TX1



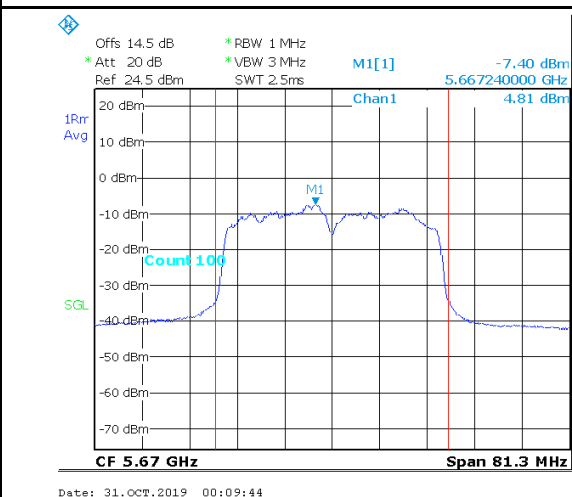
802.11n-40MHz- 5510MHz-PWR-TX2



802.11n-40MHz- 5550MHz-PWR-TX1



802.11n-40MHz- 5550MHz-PWR-TX2

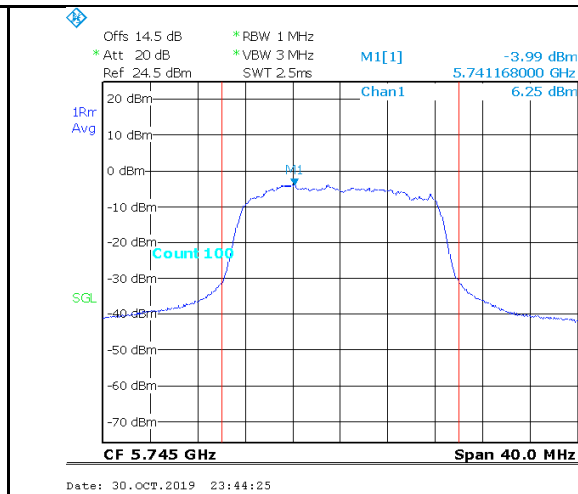
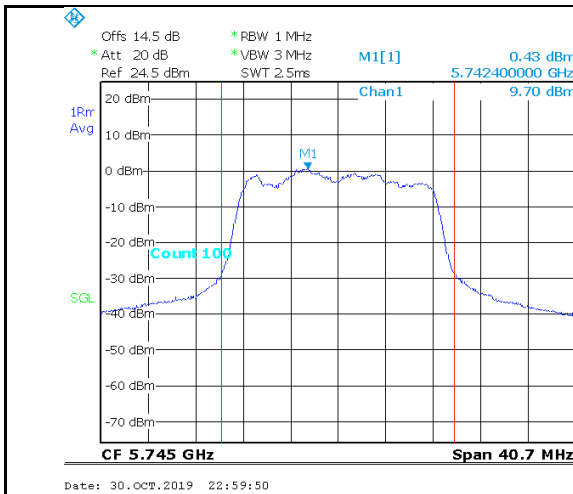


802.11n-40MHz- 5670MHz-PWR-TX1



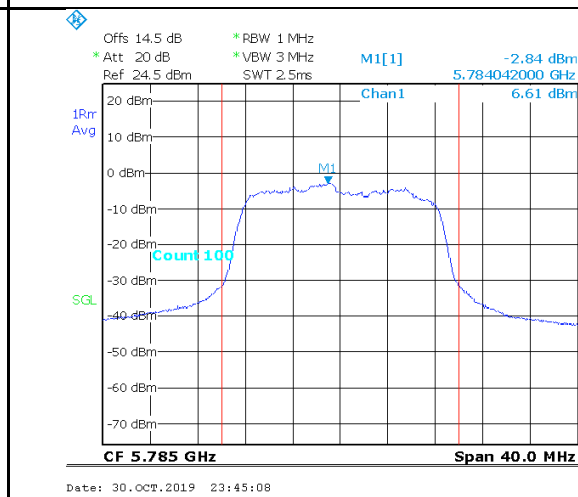
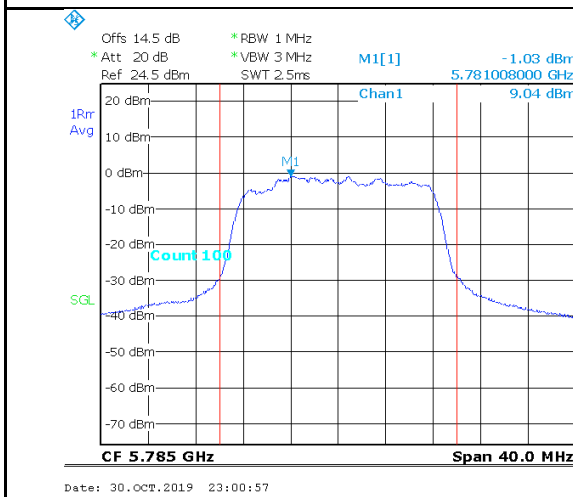
802.11n-40MHz- 5670MHz-PWR-TX2





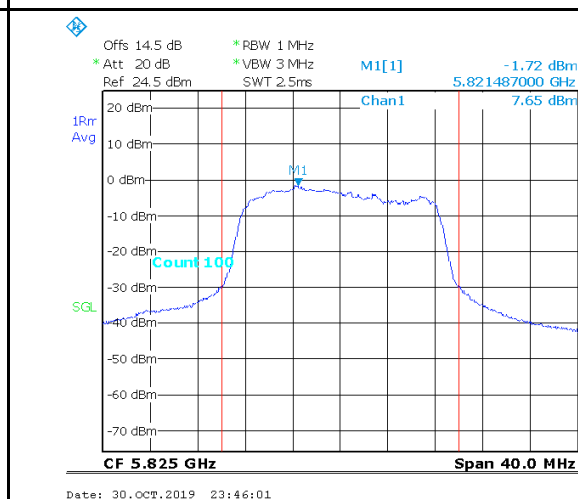
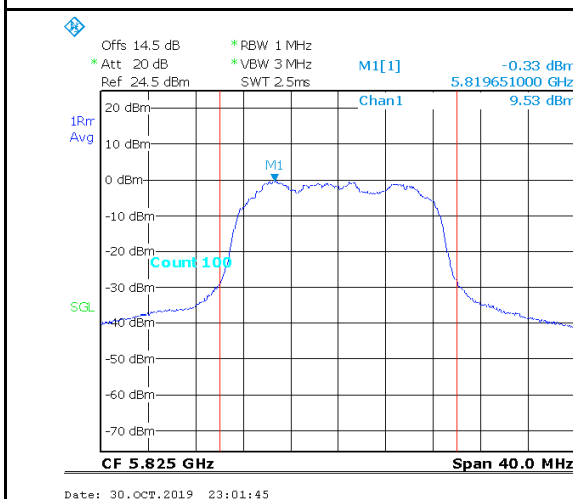
802.11a 5745MHz-PWR-TX1

802.11a 5745MHz-PWR-TX2



802.11a 5785MHz-PWR-TX1

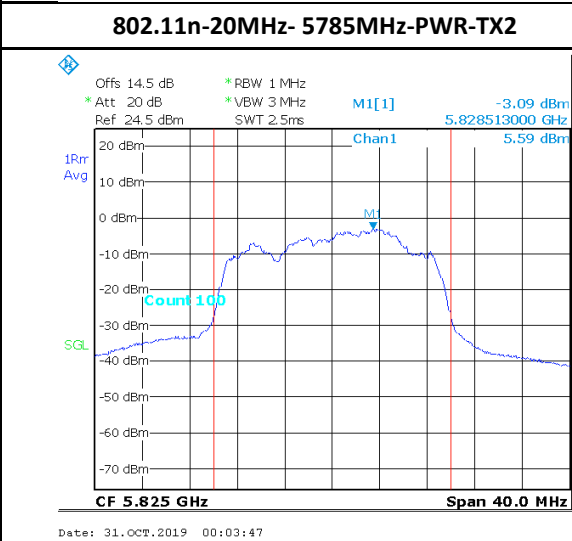
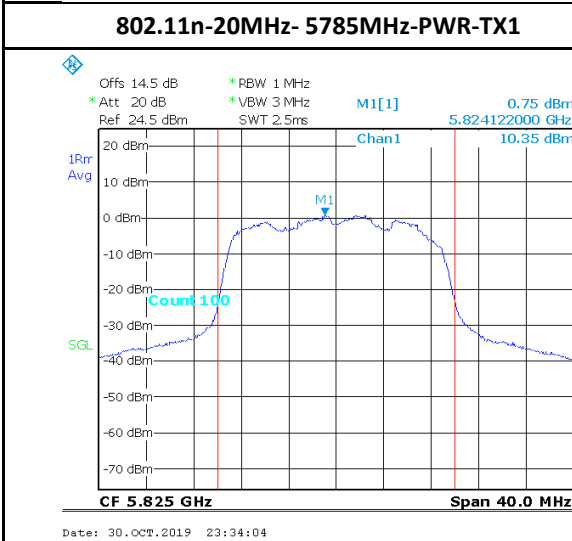
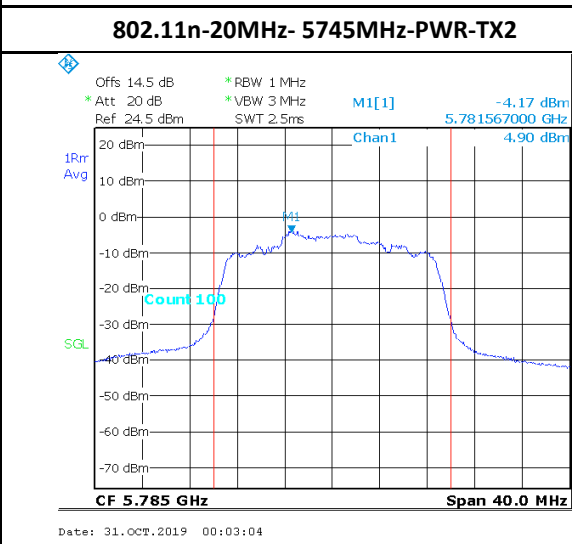
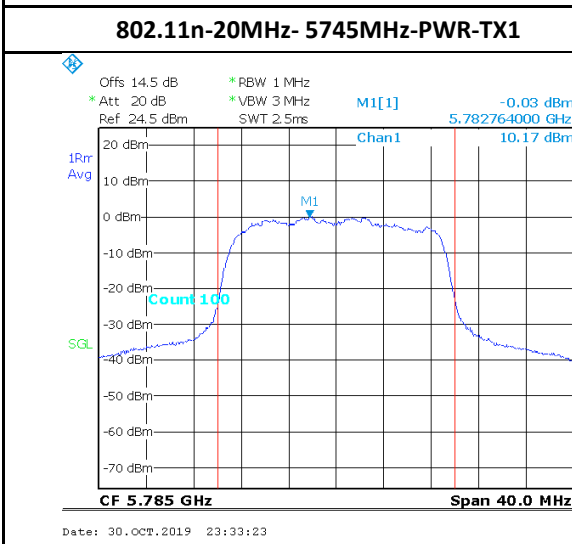
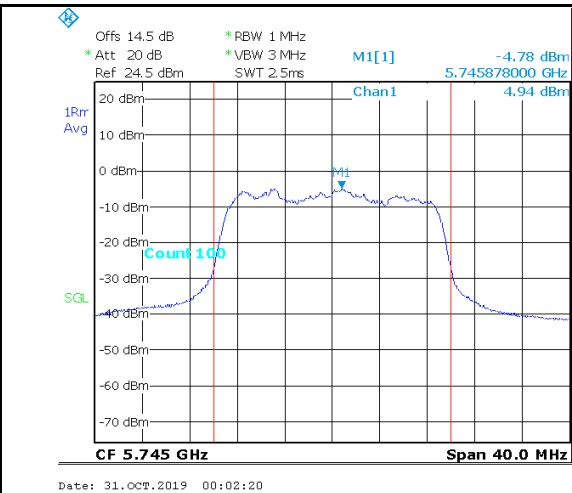
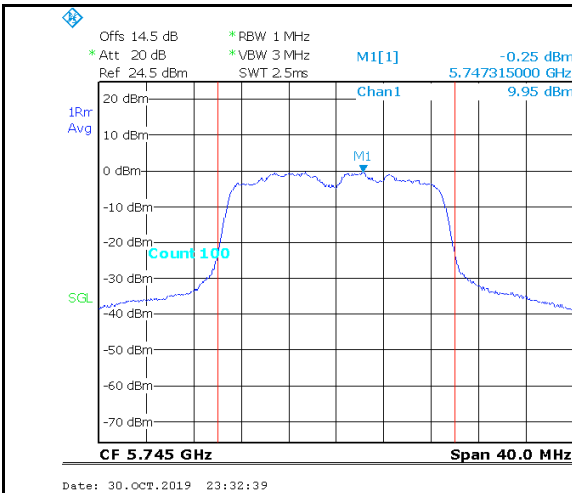
802.11a 5785MHz-PWR-TX2



802.11a 5825MHz-PWR-TX1

802.11a 5825MHz-PWR-TX2

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



802.11n-20MHz- 5825MHz-PWR-TX1

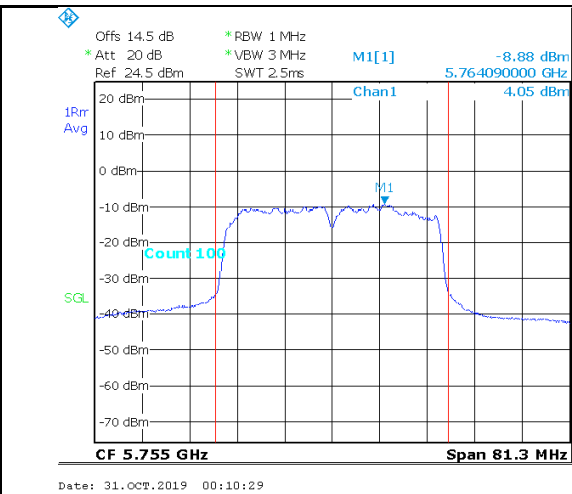
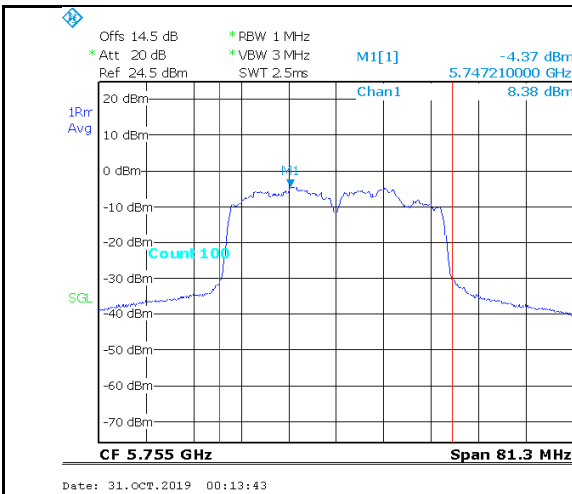
802.11n-20MHz- 5825MHz-PWR-TX2



Electromagnetic Compatibility
 Radio Frequency
 Product Certification
 International Approval

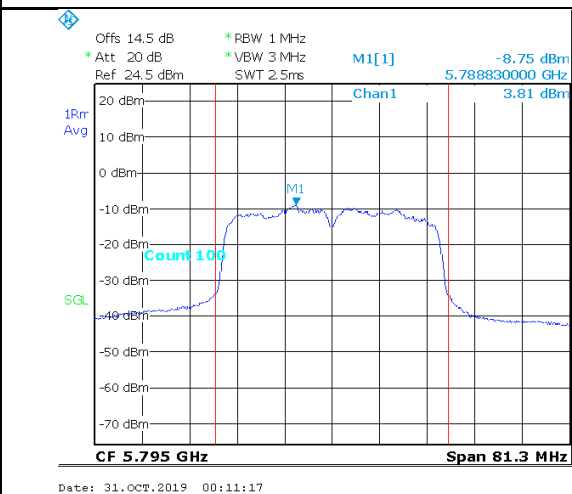
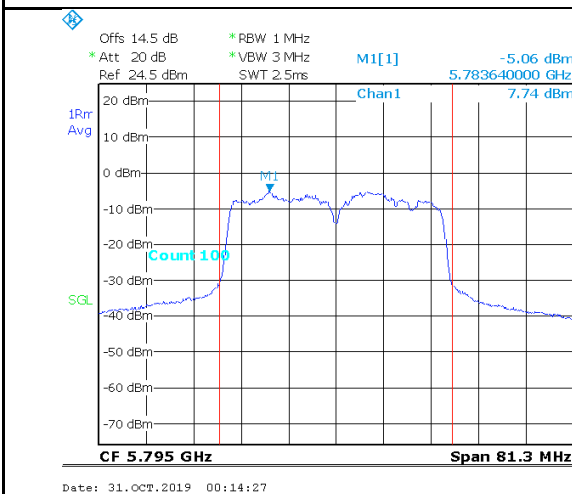
1261 Puerta Del Sol
 San Clemente, CA, 92673
 +1 (949) 393-1123
www.vista-compliance.com

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



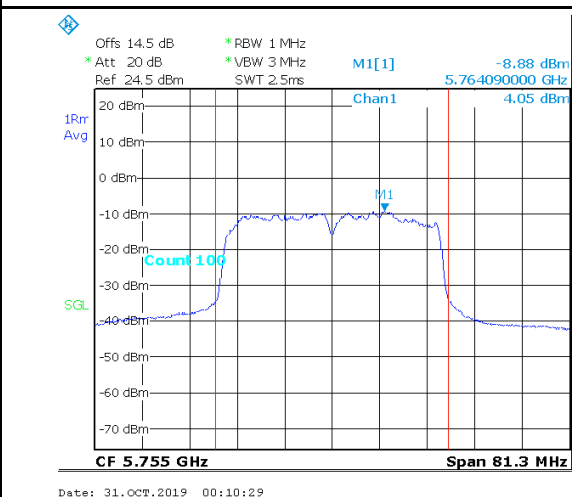
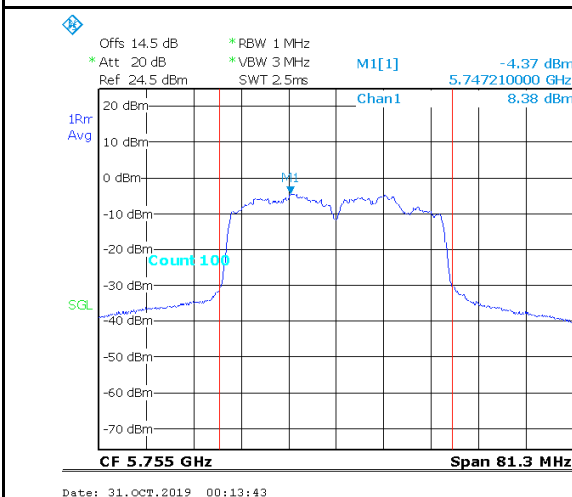
802.11n-40MHz- 5755MHz-PWR-TX1

802.11n-40MHz- 5755MHz-PWR-TX2



802.11n-40MHz- 5795MHz-PWR-TX1

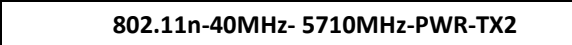
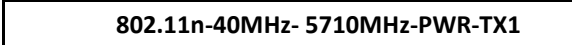
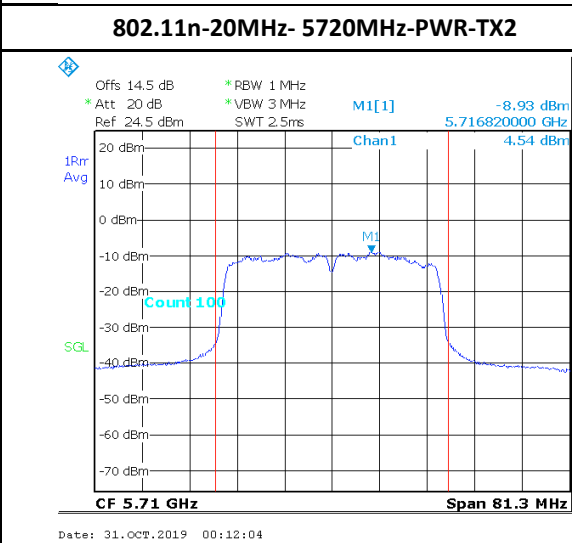
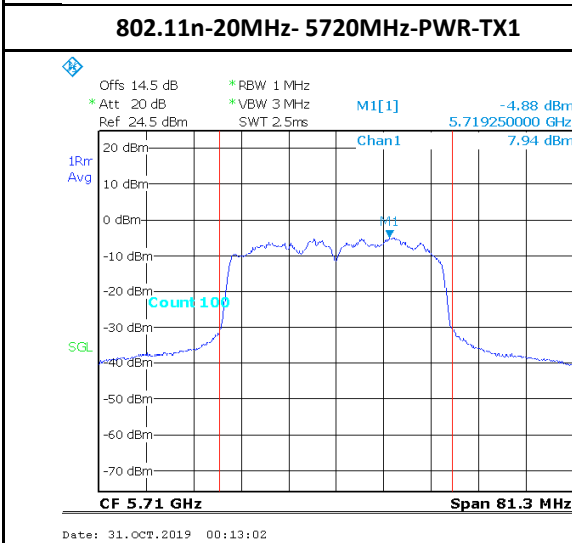
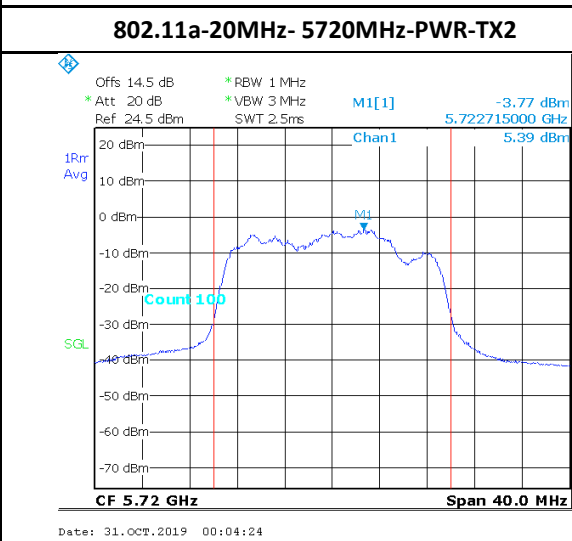
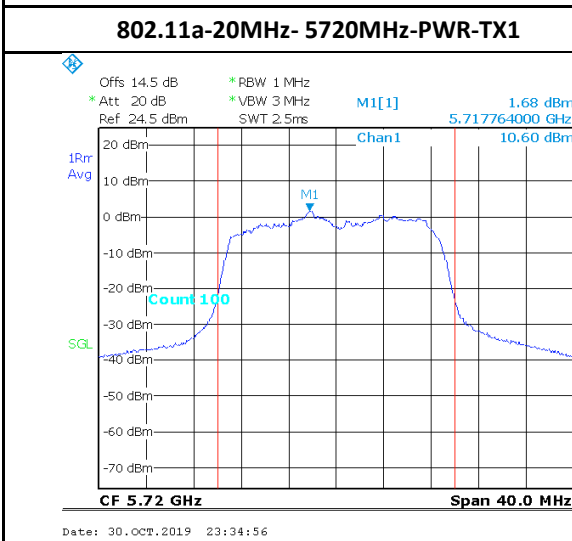
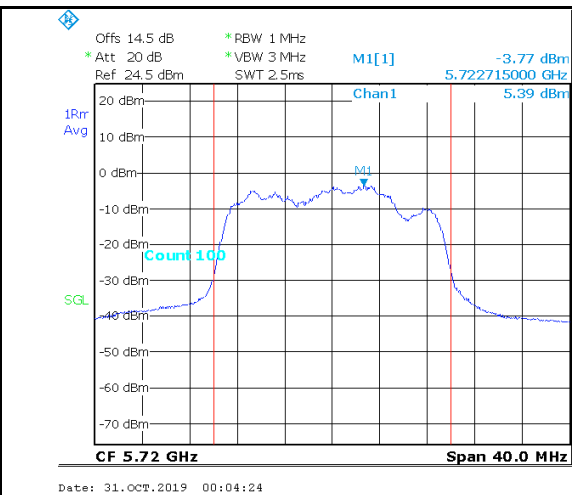
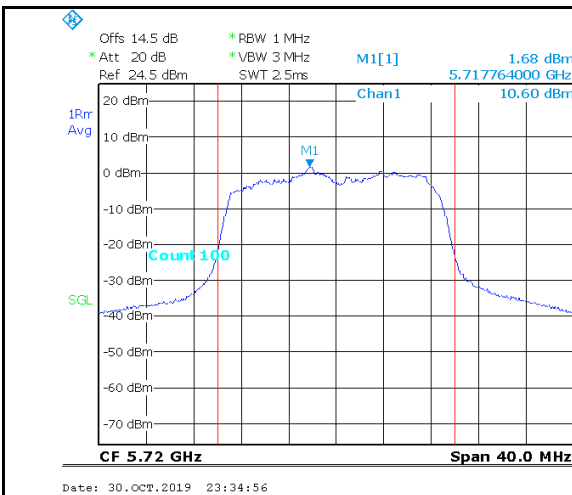
802.11n-40MHz- 5795MHz-PWR-TX2



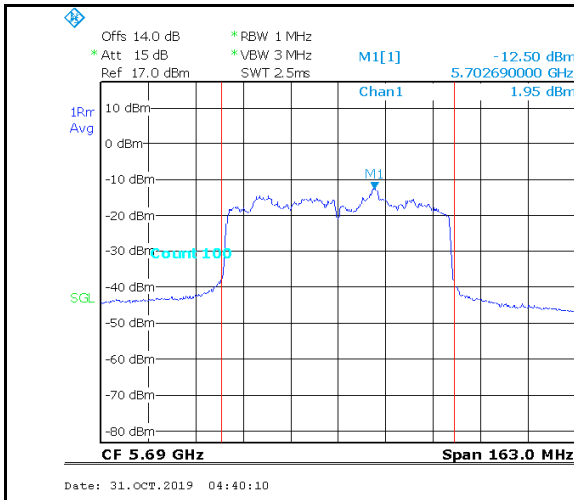
802.11ac-80MHz- 5775MHz-PWR-TX1

802.11ac-80MHz- 5775MHz-PWR-TX2

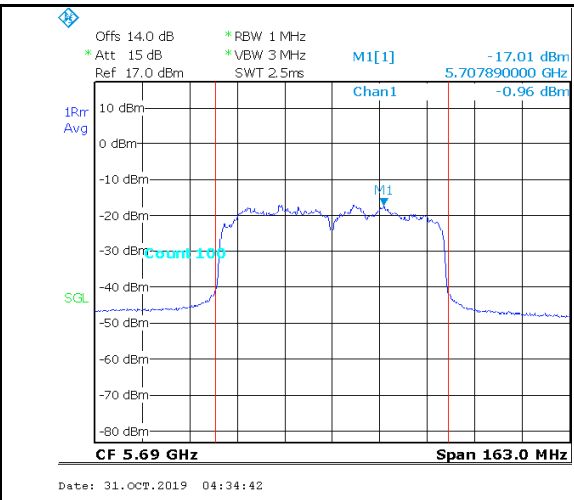
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



802.11ac-80MHz- 5690MHz-PWR-TX1



802.11ac-80MHz- 5690MHz-PWR-TX2

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



8.6 Power Spectral Density

8.6.1 Requirement

§ 15.407 (a)

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.6.2 Test setup



8.6.3 Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, section F) Maximum power spectral density. Method SA-1

1. Set span to encompass the entire emission bandwidth (EBW)(or, alternatively, the entire 99% occupied bandwidth)of the signal.
2. Set RBW=1MHz
3. Set VBW $\geq 3 \times$ RBW
4. Number of points in sweep $\geq 2 \times$ span/ RBW. (This ensures that bin-to-bin spacing is $\leq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
5. Sweep time = auto couple.
6. Detector = Power averaging (RMS)
7. Trace average at least 100 traces in power averaging(rms)mode.
8. Use the peak marker function to determine the maximum amplitude level within the RBW.

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8.6.4 Test Result

For U-NII-2C band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 PSD (dBm/MHz)	TX2 PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
11a	5500	6Mbps	-0.24	-0.21	-0.21	9	Pass
11a	5580	6Mbps	-0.35	-0.9	-0.35	9	Pass
11a	5700	6Mbps	0	-0.51	0	9	Pass
11n-20M	5500	MCS0	0.28	-1.42	2.52	6.857	Pass
11n-20M	5580	MCS0	0.35	-2.24	2.26	6.857	Pass
11n-20M	5700	MCS0	-0.19	-2.09	1.97	6.857	Pass
11n-40M	5510	MCS0	-4.68	-7.61	-2.89	6.857	Pass
11n-40M	5550	MCS0	-4.43	-6.24	-2.23	6.857	Pass
11n-40M	5670	MCS0	-3.68	-7.4	-2.14	6.857	Pass
11ac-80M	5530	VHC-MCS0	-13.06	-15.01	-10.92	6.857	Pass

For U-NII-3 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 PSD (dBm/MHz)	TX2 PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Corrected PSD (dBm/500KHz)	Max PSD (dBm/500KHz)	Result
11a	5745	6Mbps	0.43	-3.99	0.43	3.43	30	Pass
11a	5785	6Mbps	-1.03	-2.84	-1.03	1.97	30	Pass
11a	5825	6Mbps	-0.33	-1.72	-0.33	2.67	30	Pass
11n-20M	5745	MCS0	-0.25	-4.78	1.06	4.06	25.857	Pass
11n-20M	5785	MCS0	-0.03	-4.17	1.39	4.39	25.857	Pass
11n-20M	5825	MCS0	0.75	-3.09	2.25	5.25	25.857	Pass
11n-40M	5755	MCS0	-4.37	-8.88	-3.05	-0.05	25.857	Pass
11n-40M	5795	MCS0	-5.06	-8.75	-3.51	-0.51	25.857	Pass
11ac-80M	5775	VHC-MCS0	-13.36	-15.93	-11.45	-8.45	25.857	Pass

Note: If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10 log (1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

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For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 PSD (dBm/MHz)	TX2 PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
11a	5720	6Mbps	0.16	-2.85	0.16	9	Pass
11n	5720	MCS0	1.68	-3.77	2.77	6.857	Pass
11n-40M	5710	MCS0	-4.88	-8.93	-3.44	6.857	Pass
11ac-80M	5690	VHC-MCS0	-12.5	-17.01	-11.18	6.857	Pass

Note:

- 1) For 802.11a, the highest PSD is recorded.
- 2) For 5GHz non-11a mode, it's under 2x2 MIMO mode, the PSD is combined together to compare to limit.
- 3) For 5GHz non-11a mode, directional gain is calculated per KDB 662911 D01. For 5GHz WiFi non-11a mode, directional gain = 10.143 dBi, exceeding 6 dBi. The power and PSD limit will be reduced by the amount that it exceeds 6 dBi.

8.6.5 Test Plots

Refer to test plots in conducted peak output power

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



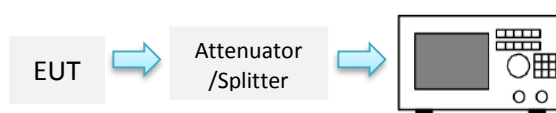
8.7 Automatically Discontinue Transmission

8.7.1 Requirement

§ 15.407 (c)

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signalling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

8.7.2 Test setup



8.7.3 Test Result

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

8.8 Radiated Spurious Emissions into Restricted Frequency Bands

8.8.1 Requirement

§ 15.205, 15.209, 15.407(b)

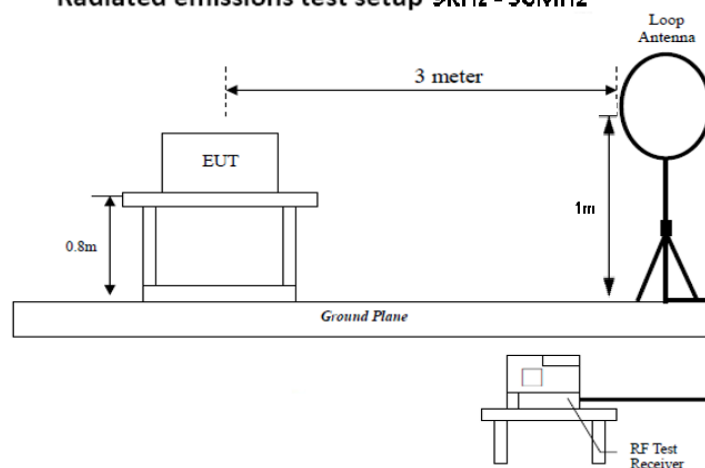
- (1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.
- (3) For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz.
- (5) Restricted band, emission must also comply with the radiated emission limits specified in 15.209

Attenuation below the general limits specified in §15.209(a) and RSS-Gen 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)).

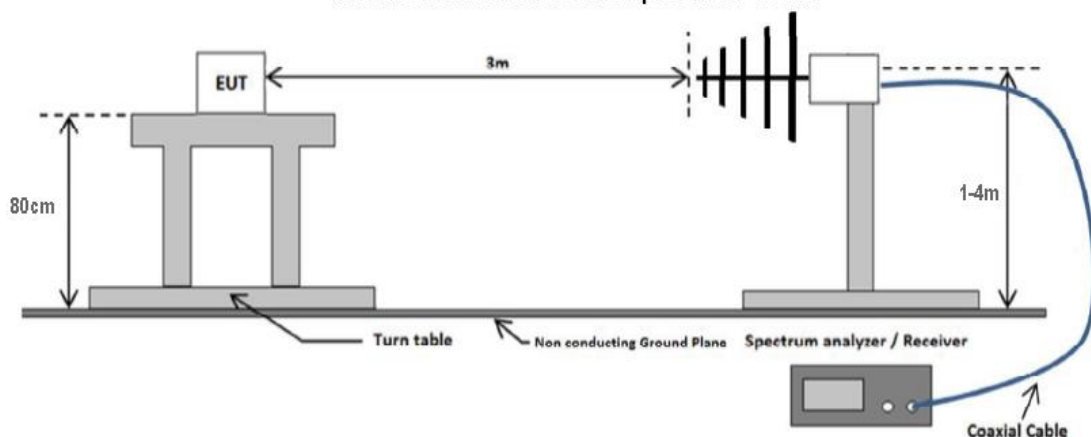
Frequency range (MHz)	Field Strength ($\mu\text{V}/\text{m}$)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

8.8.2 Test setup

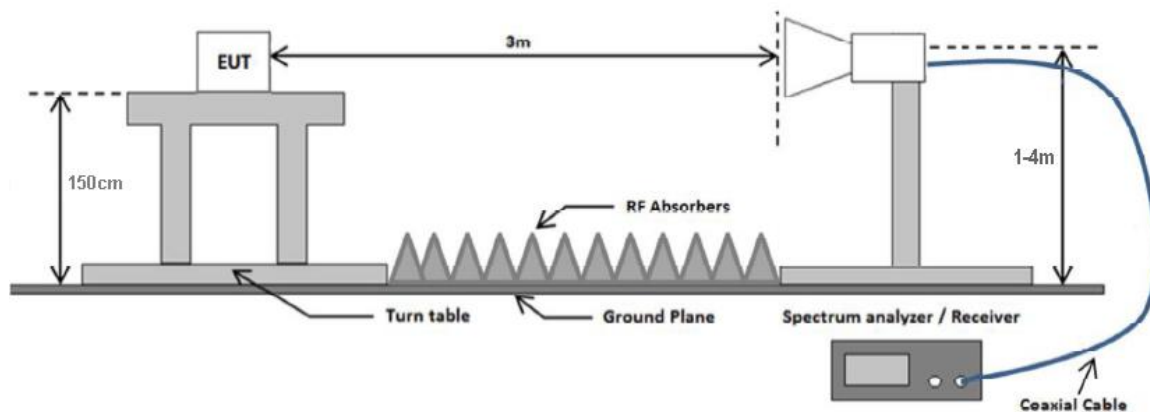
Radiated emissions test setup 9KHz - 30MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



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Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



8.8.3 Test Procedure

According to FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement. And subclause 12.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

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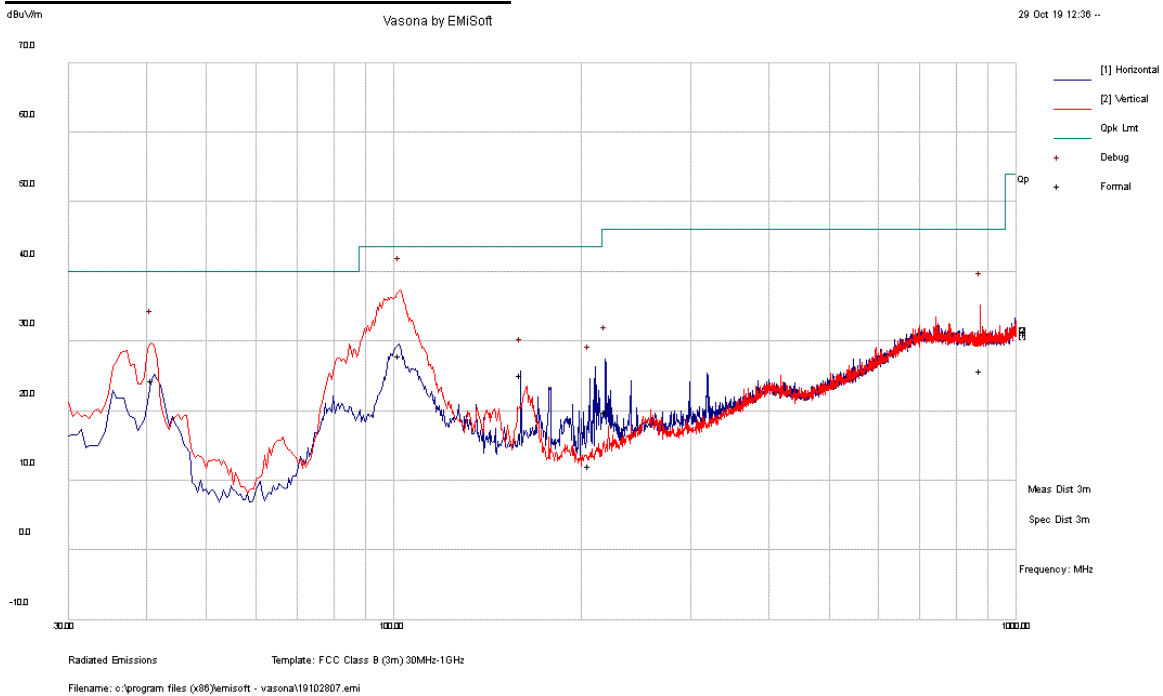


8.8.4 Test Result

RADIATED EMISSIONS < 1 GHz

Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20MHz BW 5500 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/28/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20MHz BW 5500 MHz



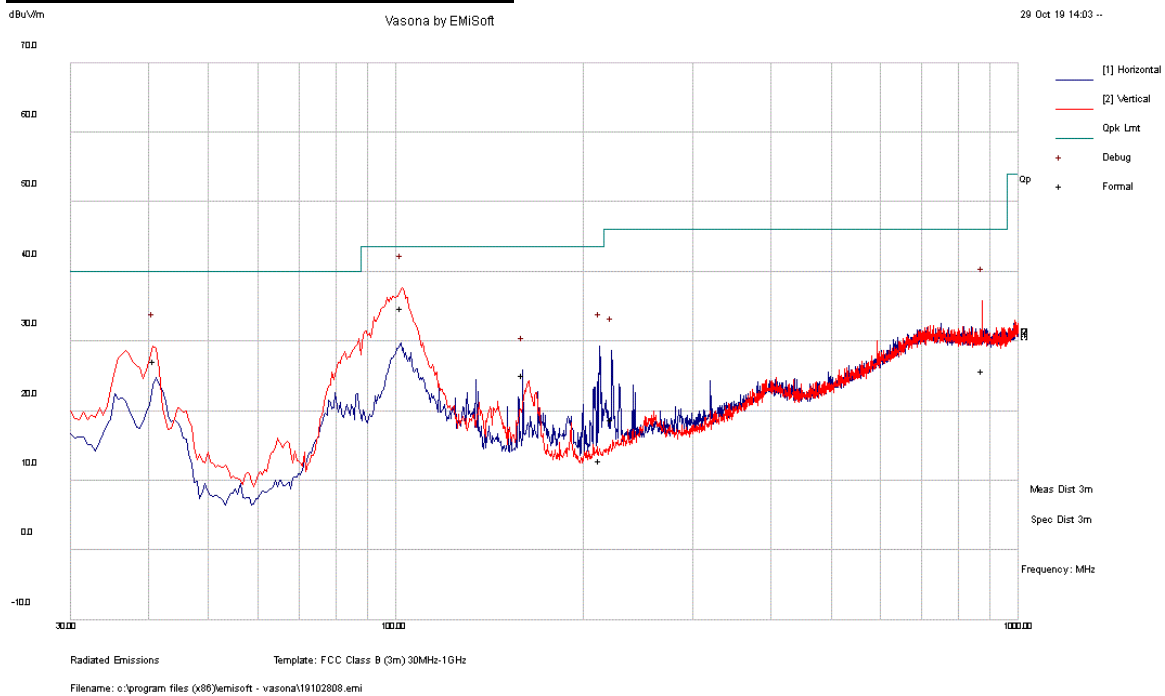
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
102.13	48.08	3.60	-23.63	28.04	Quasi Max	V	245	210	43.50	-15.46	Pass
40.91	42.84	2.57	-20.94	24.47	Quasi Max	V	179	360	40.00	-15.53	Pass
875.46	25.41	7.52	-7.12	25.81	Quasi Max	V	244	262	46.00	-20.19	Pass
160.0	43.24	4.35	-22.36	25.23	Quasi Max	H	181	344	43.50	-18.27	Pass
218.42	35.77	4.94	-20.80	19.91	Quasi Max	H	124	259	46.00	-26.09	Pass
206.15	28.76	4.80	-21.46	12.10	Quasi Max	H	125	92	43.50	-31.40	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20MHz BW 5500 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/28/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20MHz BW 5500 MHz



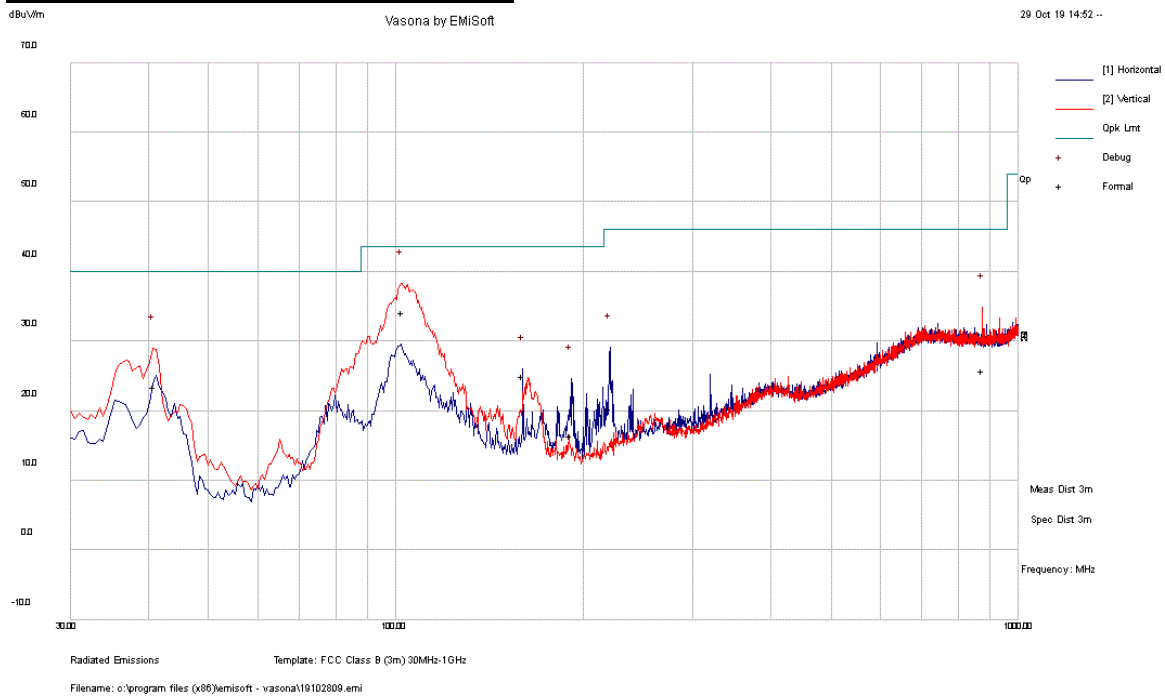
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
102.02	54.80	3.60	-23.63	34.76	Quasi Max	V	117	168	43.50	-8.74	Pass
875.27	25.44	7.52	-7.12	25.85	Quasi Max	V	226	196	46.00	-20.15	Pass
40.88	45.60	2.57	-20.92	27.25	Quasi Max	V	118	332	40.00	-12.75	Pass
212.26	29.11	4.87	-21.13	12.85	Quasi Max	H	224	50	43.50	-30.65	Pass
221.98	34.38	4.97	-20.61	18.74	Quasi Max	H	130	244	46.00	-27.26	Pass
160.01	43.18	4.35	-22.36	25.18	Quasi Max	H	162	182	43.50	-18.32	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40MHz BW 5510 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/28/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40MHz BW 5510 MHz



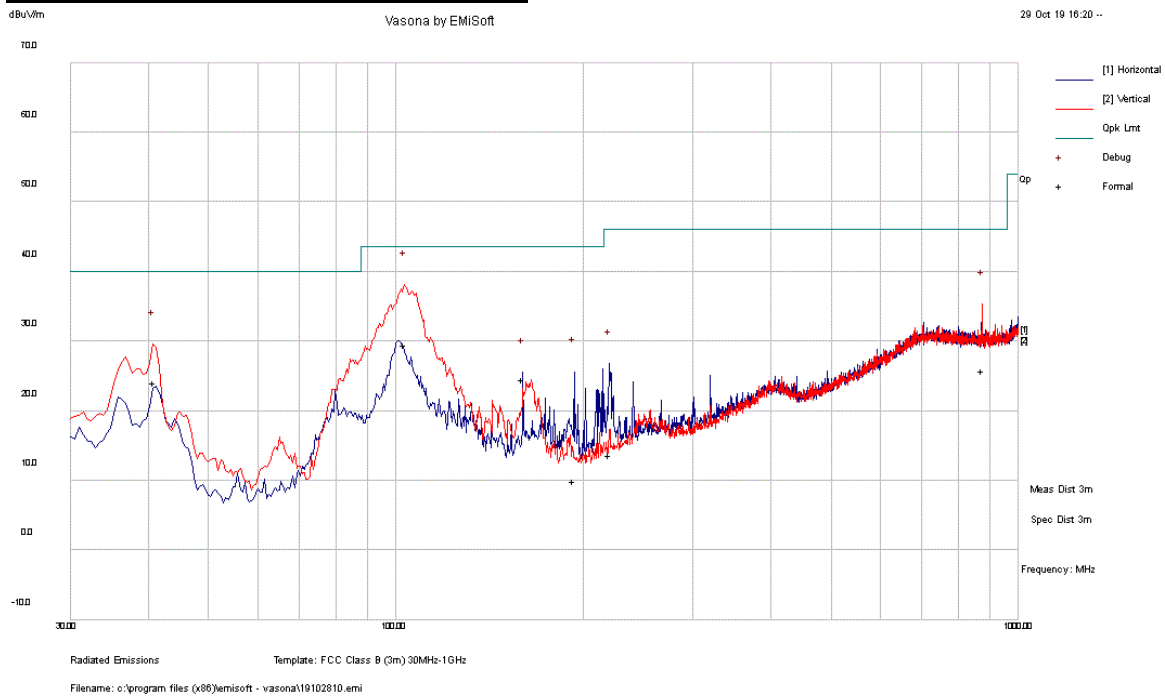
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
102.45	54.17	3.60	-23.62	34.16	Quasi Max	V	130	227	43.50	-9.34	Pass
40.86	41.79	2.57	-20.91	23.44	Quasi Max	V	161	310	40.00	-16.56	Pass
875.52	25.41	7.52	-7.12	25.81	Quasi Max	V	261	300	46.00	-20.19	Pass
220.64	36.12	4.96	-20.68	20.40	Quasi Max	H	123	248	46.00	-25.60	Pass
160.01	43.03	4.35	-22.36	25.02	Quasi Max	H	113	202	43.50	-18.48	Pass
191.21	33.83	4.65	-21.92	16.57	Quasi Max	H	118	347	43.50	-26.93	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11ac 80MHz BW 5755 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/28/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11ac 80MHz BW 5755 MHz



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
103.23	49.55	3.62	-23.60	29.57	Quasi Max	V	169	181	43.50	-13.93	Pass
40.92	42.40	2.57	-20.94	24.04	Quasi Max	V	Pass	312	40.00	-15.96	Pass
875.48	25.39	7.52	-7.12	25.79	Quasi Max	V	161	300	46.00	-20.21	Pass
193.3	27.22	4.67	-21.89	10.01	Quasi Max	H	304	148	43.50	-33.49	Pass
159.99	42.53	4.35	-22.36	24.52	Quasi Max	H	165	205	43.50	-18.98	Pass
220.08	29.47	4.95	-20.71	13.72	Quasi Max	H	126	345	46.00	-32.28	Pass

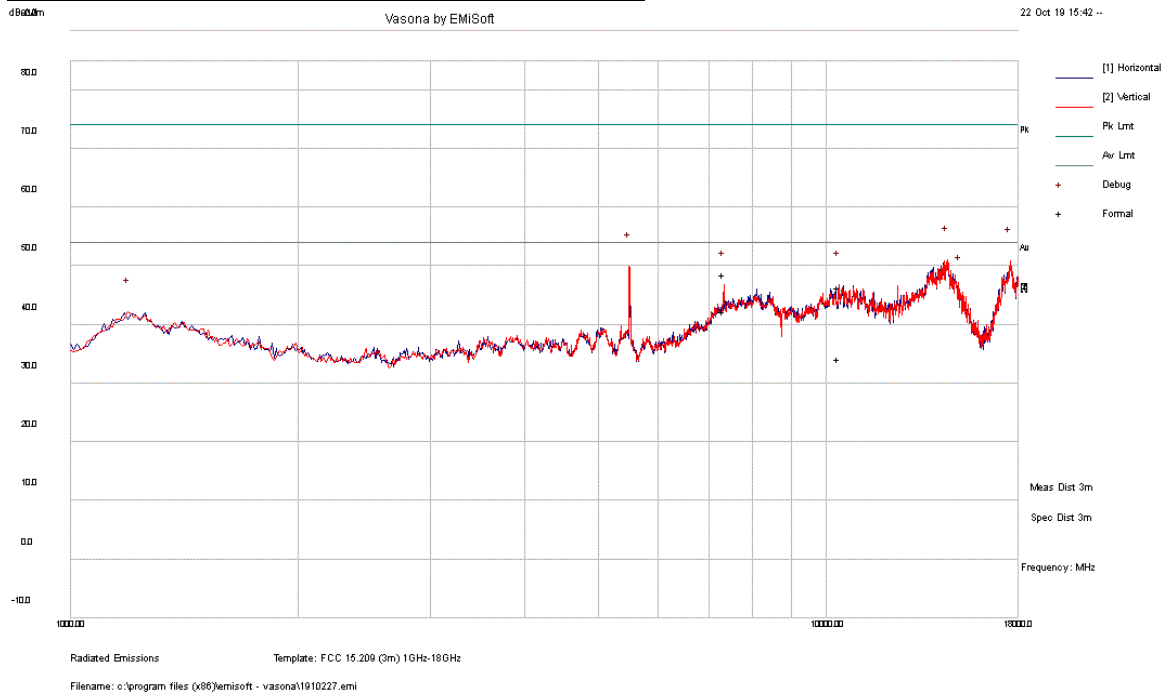
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



RADIATED EMISSIONS > 1 GHz

Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5500 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5500 MHz



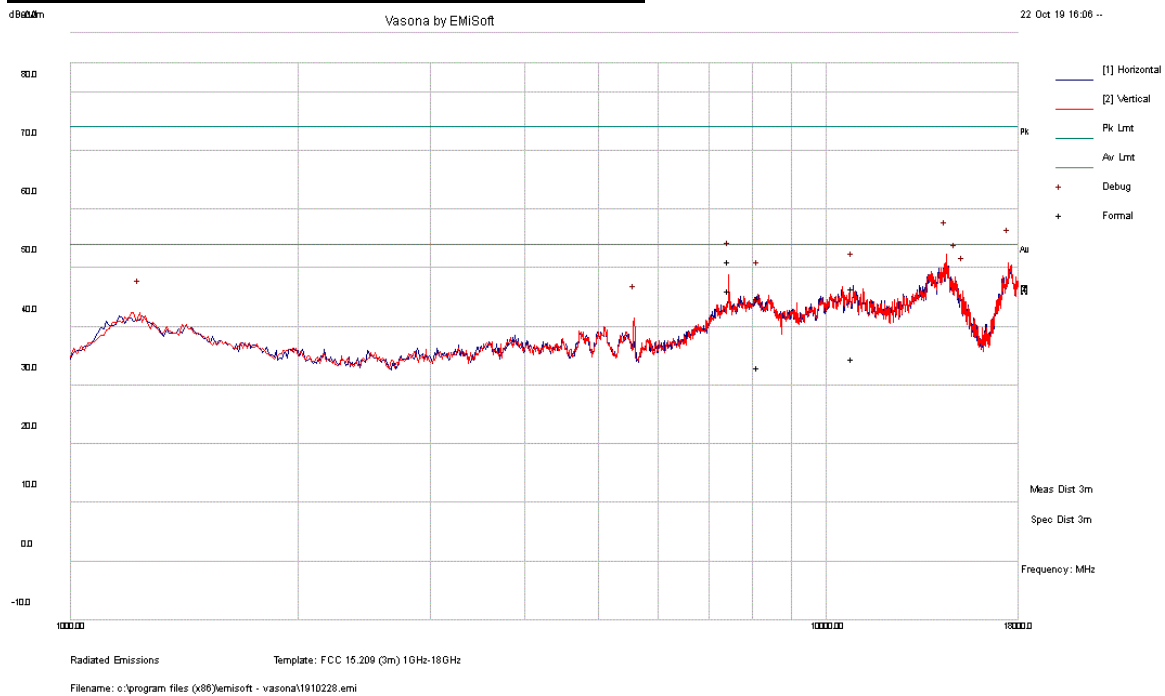
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7333.33	35.69	20.70	-7.85	48.53	Peak Max	H	130	160	74.00	-25.47	Pass
10402.13	26.94	22.98	-3.57	46.35	Peak Max	V	296	112	74.00	-27.65	Pass
7333.33	29.42	20.70	-7.85	42.27	Average Max	H	130	160	54.00	-11.74	Pass
10402.13	14.83	22.98	-3.57	34.24	Average Max	V	296	112	54.00	-19.76	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5580 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5580 MHz



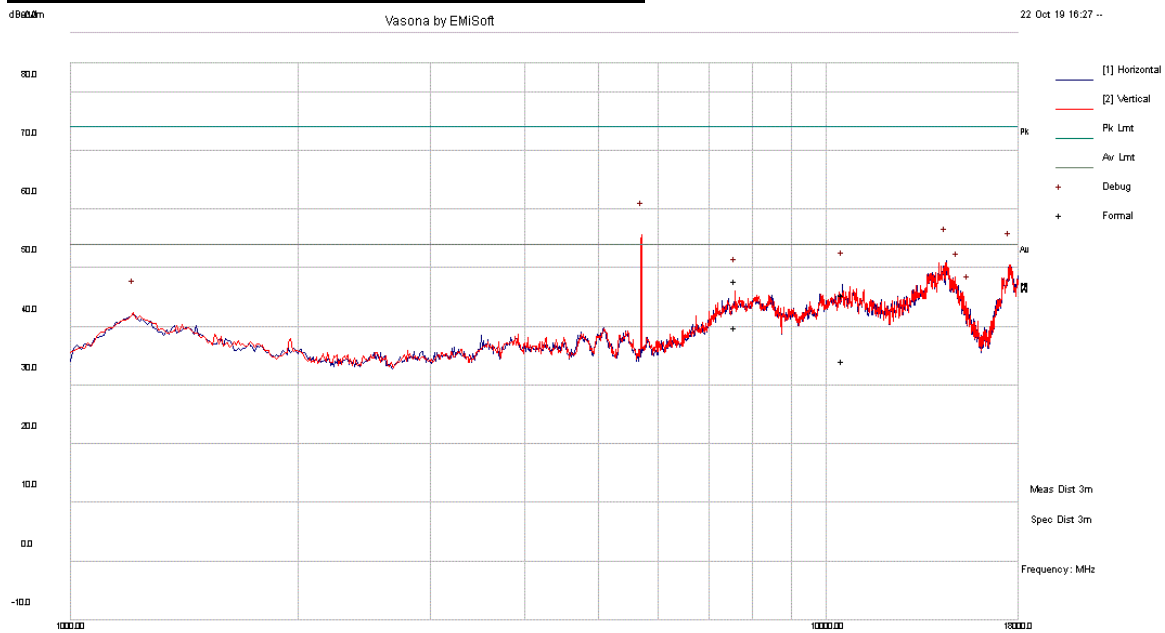
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7439.89	37.80	20.90	-7.64	51.07	Peak Max	V	101	148	74.00	-22.94	Pass
10871.05	26.20	23.68	-3.29	46.59	Peak Max	H	219	90	74.00	-27.41	Pass
8138.65	29.67	21.23	-6.03	44.87	Peak Max	V	124	68	74.00	-29.13	Pass
7439.89	32.91	20.90	-7.64	46.17	Average Max	V	101	148	54.00	-7.83	Pass
10871.05	14.19	23.68	-3.29	34.58	Average Max	H	219	90	54.00	-19.42	Pass
8138.65	17.83	21.23	-6.03	33.03	Average Max	V	124	68	54.00	-20.97	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5700 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5700 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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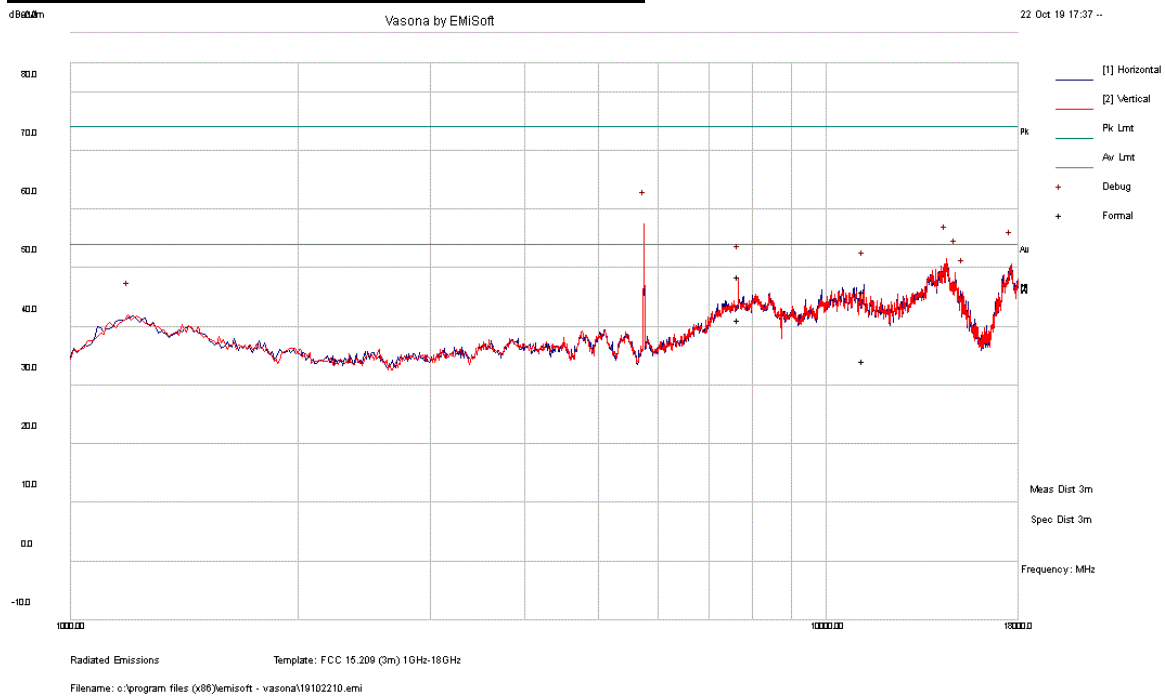
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10519.8	25.64	23.16	-3.47	45.34	Peak Max	H	126	158	74.00	-28.66	Pass
7600.02	34.20	21.06	-7.50	47.76	Peak Max	V	242	112	74.00	-26.24	Pass
10519.8	14.53	23.16	-3.47	34.22	Average Max	H	126	158	54.00	-19.78	Pass
7600.02	26.24	21.06	-7.50	39.81	Average Max	V	242	112	54.00	-14.19	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5745 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5745 MHz



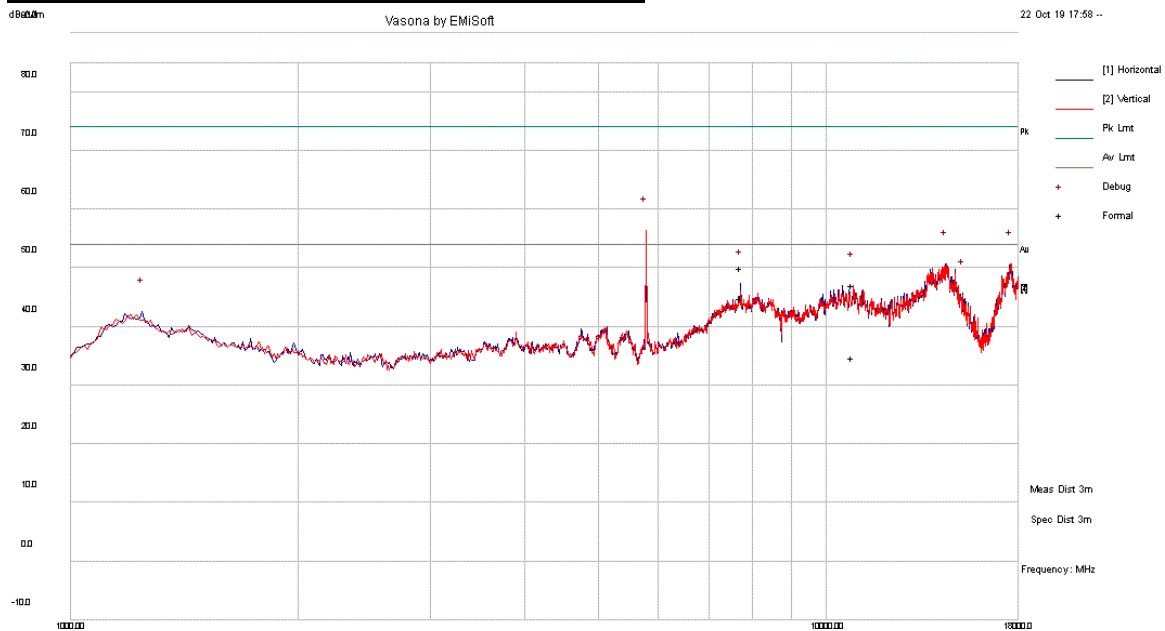
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7660.02	34.86	21.09	-7.32	48.64	Peak Max	V	157	128	74.00	-25.36	Pass
11233.21	24.63	24.28	-2.88	46.03	Peak Max	H	114	197	74.00	-27.97	Pass
7660.02	27.46	21.09	-7.32	41.24	Average Max	V	157	128	54.00	-12.76	Pass
11233.21	12.79	24.28	-2.88	34.20	Average Max	H	114	197	54.00	-19.81	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5785 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5785 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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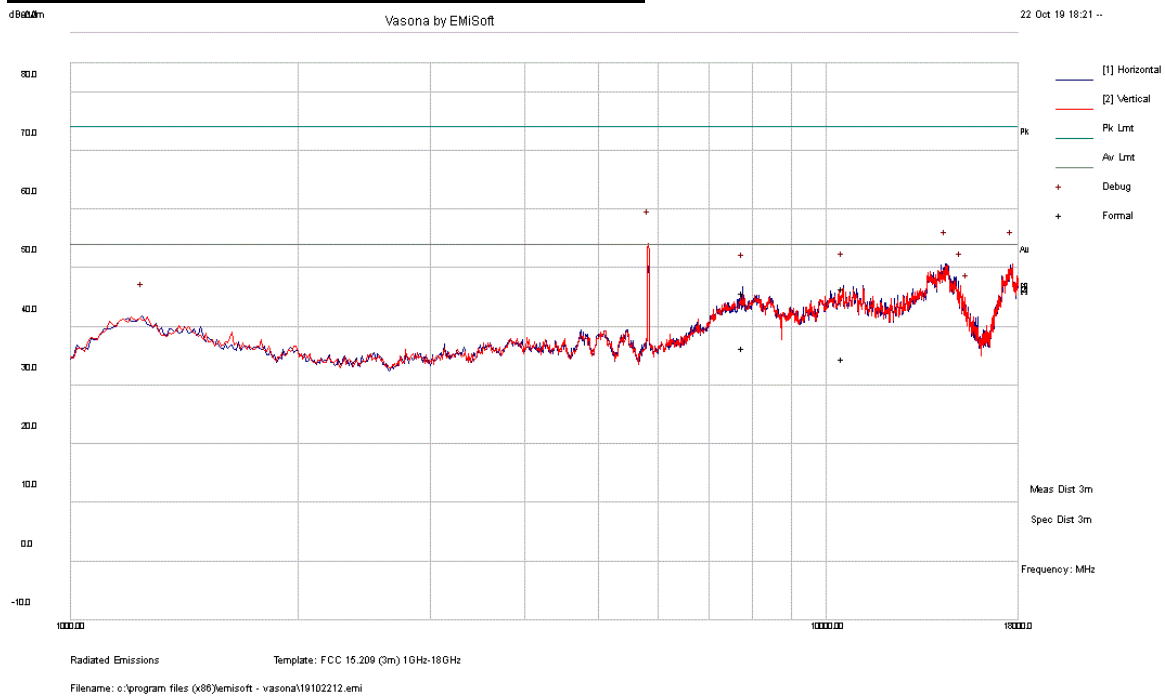
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7713.3	36.18	21.12	-7.18	50.12	Peak Max	H	100	189	74.00	-23.88	Pass
10871.29	26.78	23.68	-3.29	47.17	Peak Max	V	233	0	74.00	-26.83	Pass
7713.3	30.98	21.12	-7.18	44.92	Average Max	H	100	189	54.00	-9.09	Pass
10871.29	14.28	23.68	-3.29	34.67	Average Max	V	233	0	54.00	-19.33	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11a 20 MHz BW 6 Mbps 5825 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11a 20 MHz BW 6 Mbps 5825 MHz



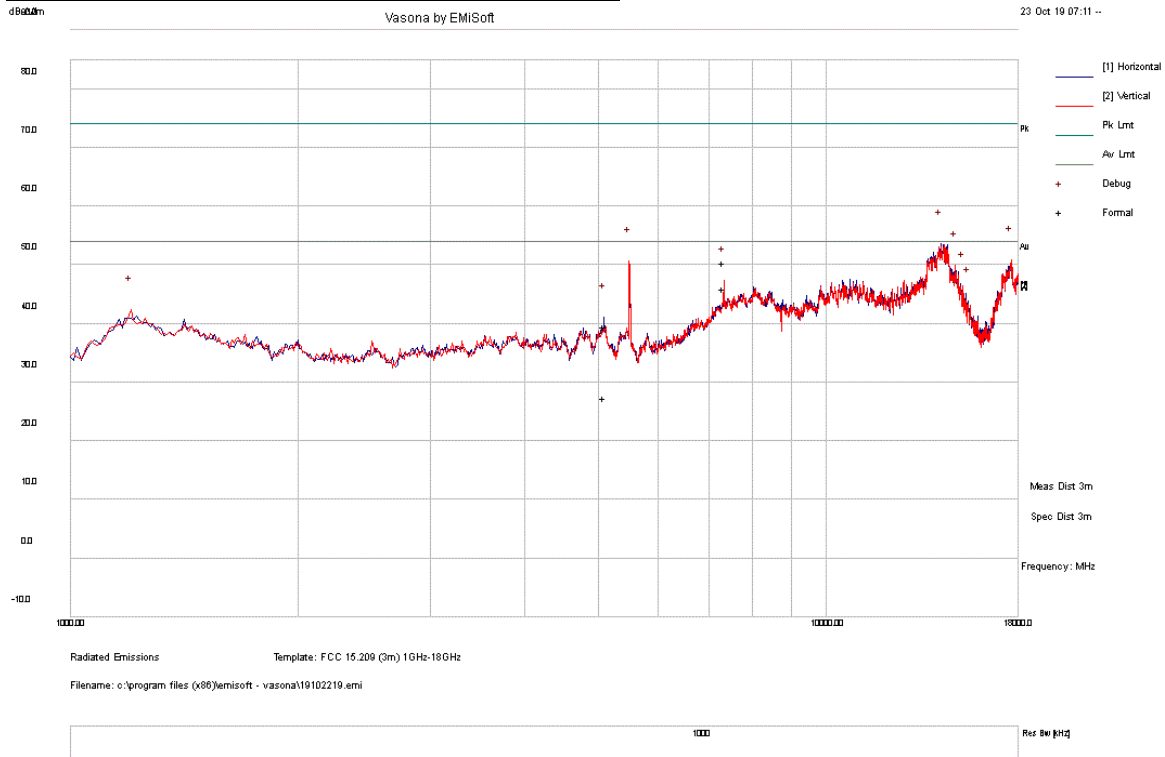
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10541.13	26.75	23.19	-3.48	46.46	Peak Max	H	400	225	74.00	-27.54	Pass
7766.22	31.78	21.15	-7.04	45.88	Peak Max	H	124	47	74.00	-28.12	Pass
10541.13	14.86	23.19	-3.48	34.57	Average Max	H	400	225	54.00	-19.43	Pass
7766.22	22.26	21.15	-7.04	36.37	Average Max	H	124	47	54.00	-17.64	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5500 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5500 MHz



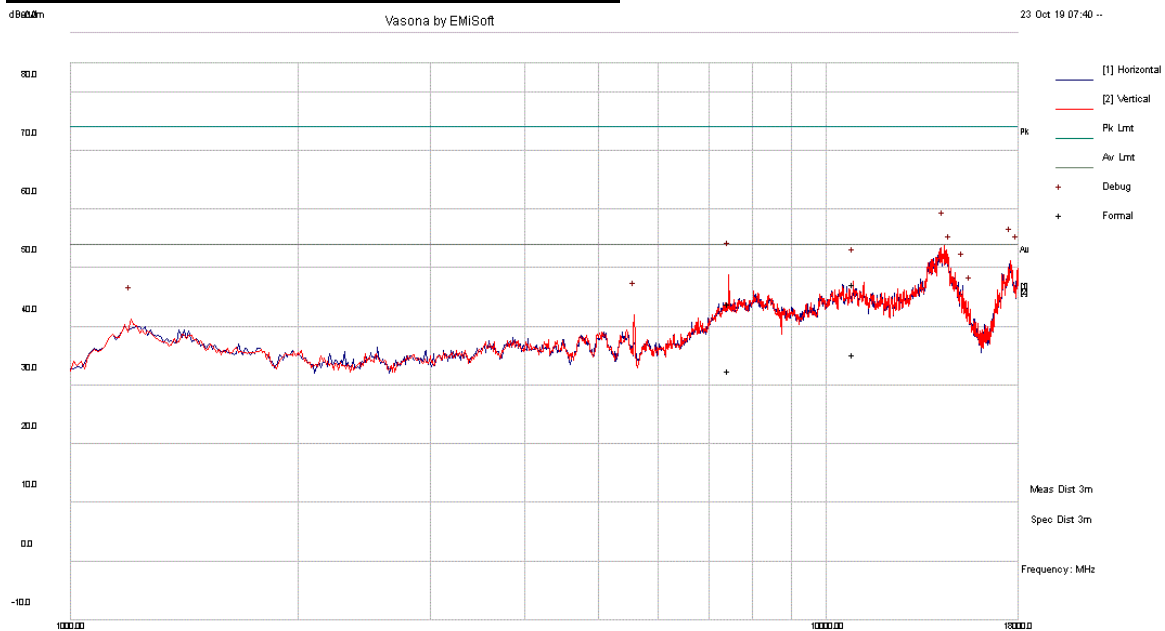
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7333.22	37.57	20.70	-7.85	50.41	Peak Max	V	169	135	74.00	-23.59	Pass
5089.3	34.93	17.42	-12.87	39.49	Peak Max	H	131	234	74.00	-34.51	Pass
7333.22	33.17	20.70	-7.85	46.01	Average Max	V	169	135	54.00	-7.99	Pass
5089.3	22.81	17.42	-12.87	27.37	Average Max	H	131	234	54.00	-26.63	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5580 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5580 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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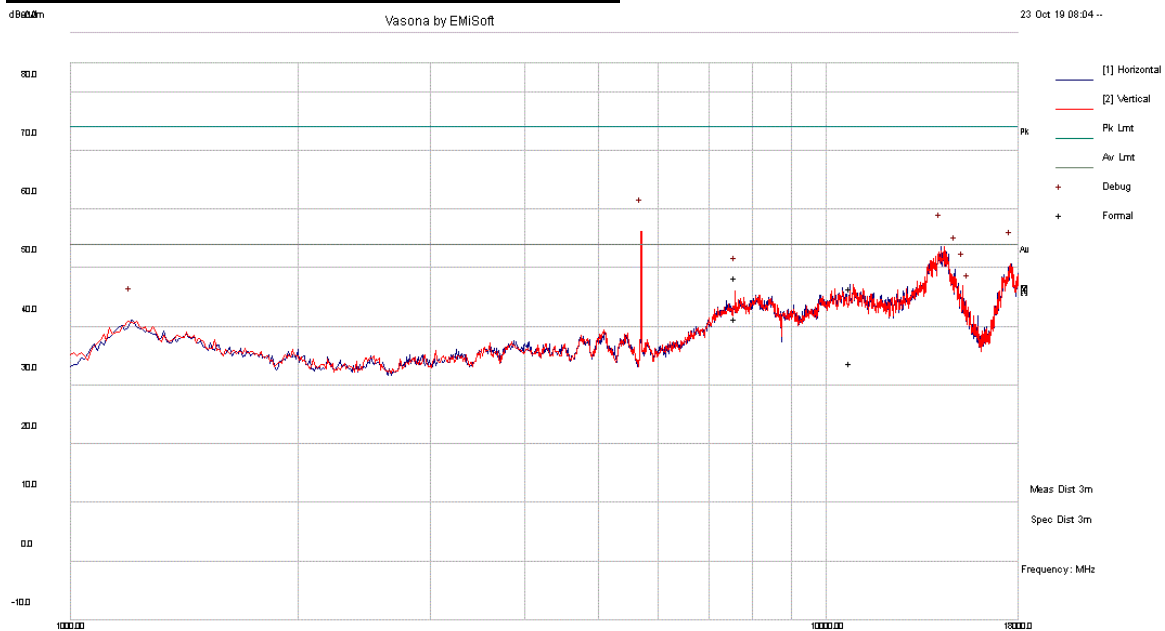
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7437.18	30.66	20.90	-7.64	43.91	Peak Max	V	232	93	74.00	-30.09	Pass
10882.11	26.88	23.69	-3.25	47.32	Peak Max	V	125	276	74.00	-26.68	Pass
7437.18	19.24	20.90	-7.64	32.49	Average Max	V	232	93	54.00	-21.51	Pass
10882.11	14.81	23.69	-3.25	35.25	Average Max	V	125	276	54.00	-18.75	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5700 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5700 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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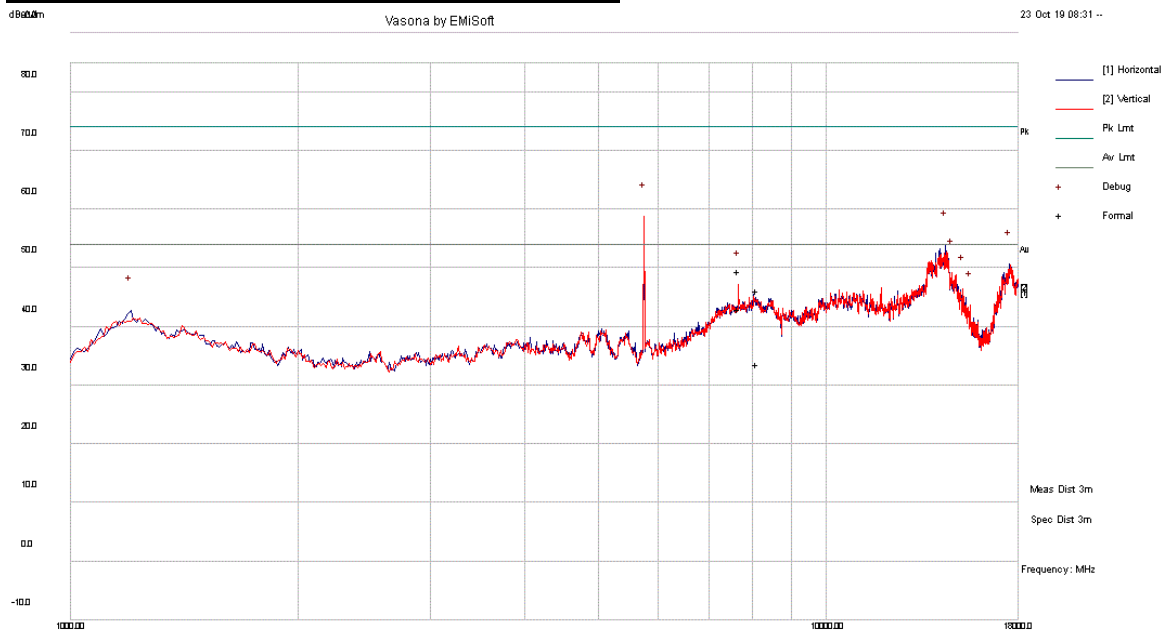
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7599.92	34.77	21.06	-7.50	48.33	Peak Max	V	193	192	74.00	-25.67	Pass
10769.28	26.61	23.53	-3.52	46.62	Peak Max	H	108	134	74.00	-27.38	Pass
7599.92	27.81	21.06	-7.50	41.38	Average Max	V	193	192	54.00	-12.62	Pass
10769.28	13.81	23.53	-3.52	33.82	Average Max	H	108	134	54.00	-20.19	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5745 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5745 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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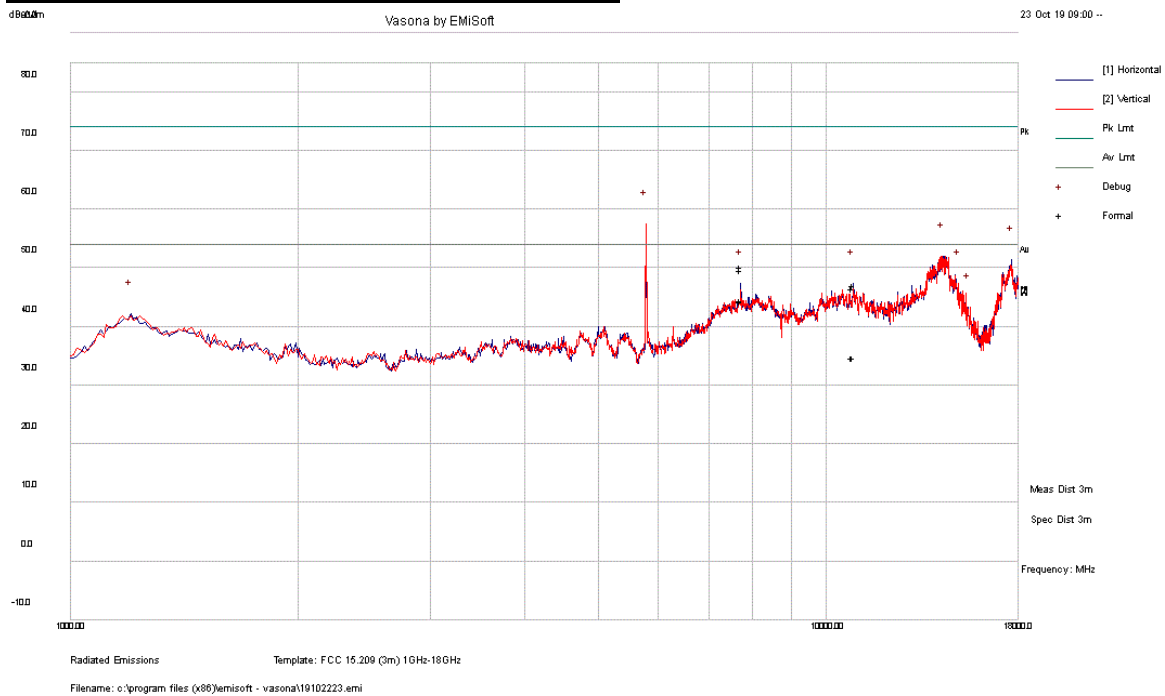
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7660.06	35.72	21.09	-7.32	49.50	Peak Max	V	100	67	74.00	-24.50	Pass
8102.84	30.98	21.24	-6.08	46.14	Peak Max	H	400	159	74.00	-27.86	Pass
7660.06	29.20	21.09	-7.32	42.98	Average Max	V	100	67	54.00	-11.02	Pass
8102.84	18.50	21.24	-6.08	33.66	Average Max	H	400	159	54.00	-20.34	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5785 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5785 MHz



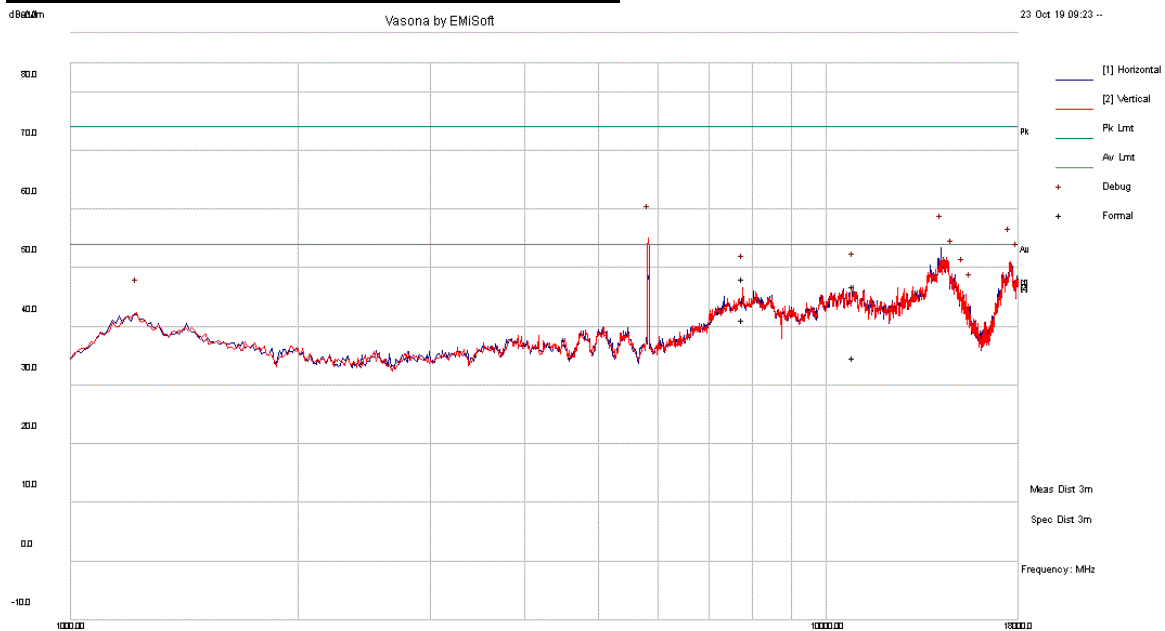
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10870.78	26.21	23.68	-3.29	46.60	Peak Max	H	306	25	74.00	-27.41	Pass
10872.58	26.73	23.68	-3.28	47.13	Peak Max	H	123	100	74.00	-26.88	Pass
7713.35	36.27	21.12	-7.18	50.21	Peak Max	H	104	0	74.00	-23.79	Pass
7713.3	35.64	21.12	-7.18	49.58	Peak Max	H	102	177	74.00	-24.42	Pass
10870.78	14.30	23.68	-3.29	34.69	Average Max	H	306	25	54.00	-19.31	Pass
10872.58	14.37	23.68	-3.28	34.76	Average Max	H	123	100	54.00	-19.24	Pass
7713.35	30.51	21.12	-7.18	44.44	Average Max	H	104	0	54.00	-9.56	Pass
7713.3	30.30	21.12	-7.18	44.23	Average Max	H	102	177	54.00	-9.77	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 20 MHz BW MCS0 5825 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 20 MHz BW MCS0 5825 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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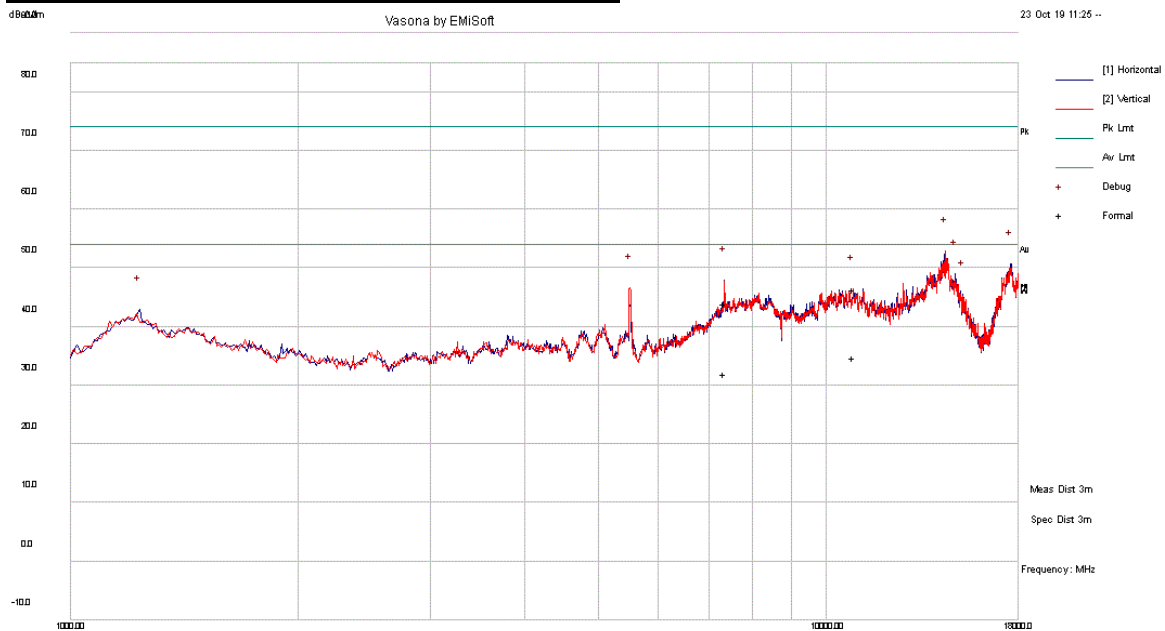
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10882.38	26.49	23.69	-3.25	46.93	Peak Max	V	100	186	74.00	-27.07	Pass
7766.47	34.17	21.15	-7.04	48.27	Peak Max	H	139	186	74.00	-25.73	Pass
10882.38	14.37	23.69	-3.25	34.81	Average Max	V	100	186	54.00	-19.19	Pass
7766.47	27.07	21.15	-7.04	41.17	Average Max	H	139	186	54.00	-12.83	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40 MHz BW MCS0 5510 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40 MHz BW MCS0 5510 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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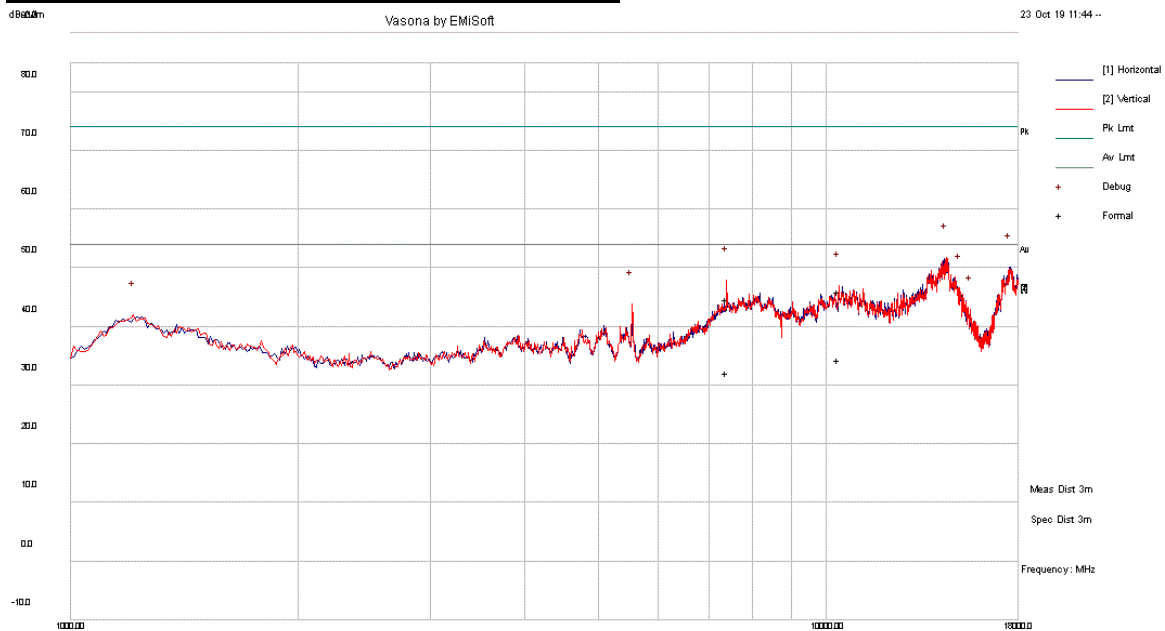
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7342.34	30.99	20.72	-7.82	43.89	Peak Max	H	100	249	74.00	-30.11	Pass
10872.45	26.03	23.68	-3.28	46.43	Peak Max	V	159	288	74.00	-27.57	Pass
7342.34	19.14	20.72	-7.82	32.03	Average Max	H	100	249	54.00	-21.97	Pass
10872.45	14.36	23.68	-3.28	34.75	Average Max	V	159	288	54.00	-19.25	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40 MHz BW MCS0 5550 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40 MHz BW MCS0 5550 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102230.emi

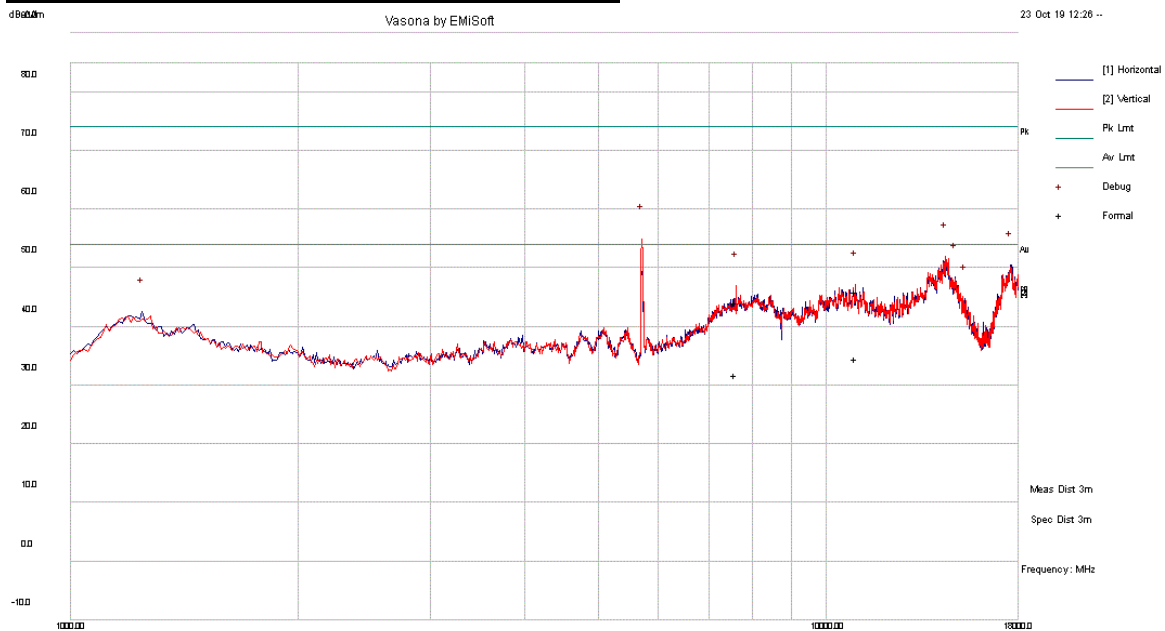
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7394.26	31.63	20.81	-7.71	44.74	Peak Max	V	249	106	74.00	-29.26	Pass
10401.53	26.53	22.98	-3.57	45.94	Peak Max	V	395	196	74.00	-28.06	Pass
7394.26	18.98	20.81	-7.71	32.09	Average Max	V	249	106	54.00	-21.92	Pass
10401.53	14.91	22.98	-3.57	34.32	Average Max	V	395	196	54.00	-19.68	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40 MHz BW MCS0 5710 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40 MHz BW MCS0 5710 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102231.emi

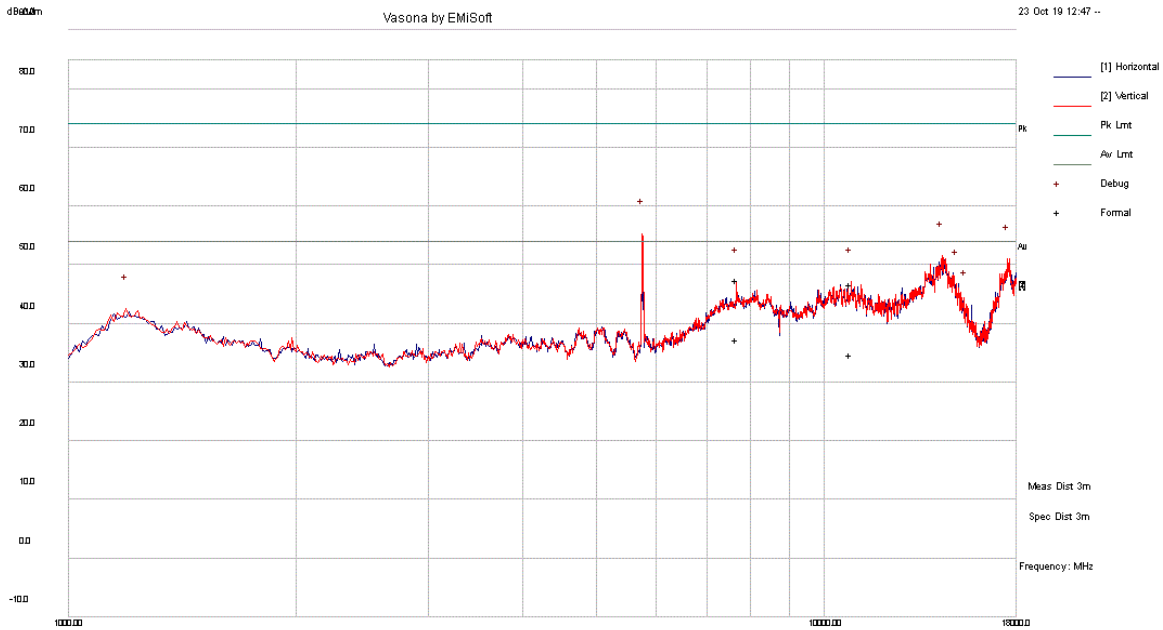
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10953.99	25.23	23.80	-2.99	46.04	Peak Max	V	382	299	74.00	-27.96	Pass
7606.97	30.58	21.07	-7.48	44.17	Peak Max	V	390	355	74.00	-29.83	Pass
10953.99	13.82	23.80	-2.99	34.62	Average Max	V	382	299	54.00	-19.38	Pass
7606.97	18.14	21.07	-7.48	31.73	Average Max	V	390	355	54.00	-22.27	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40 MHz BW MCS0 5755 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40 MHz BW MCS0 5755 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102232.emi

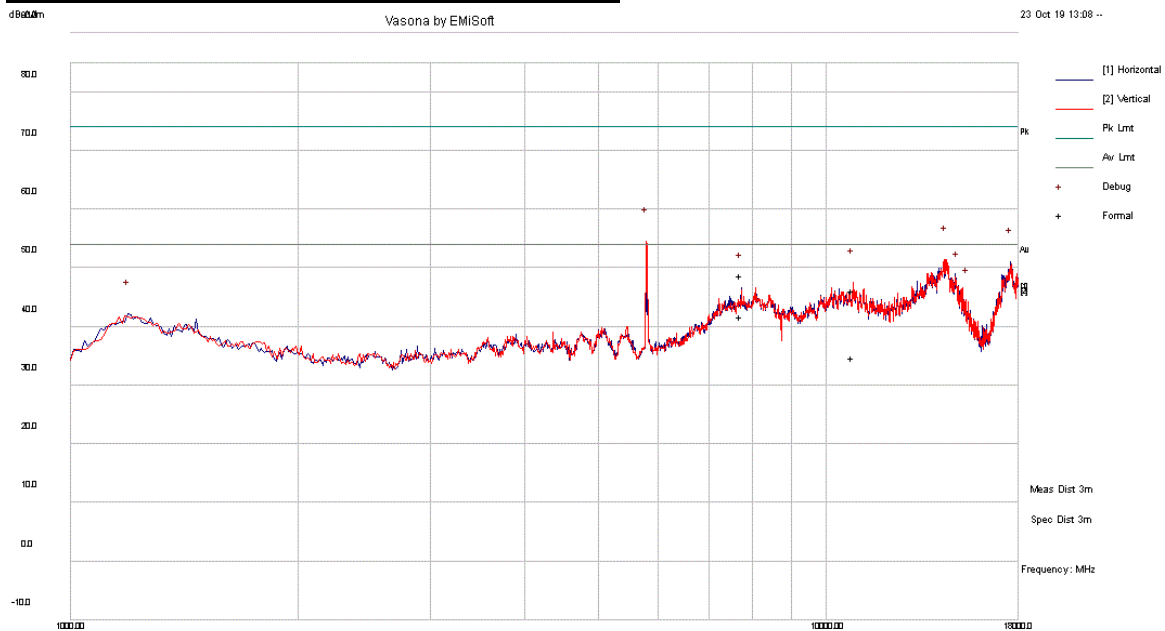
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10868.85	26.38	23.67	-3.29	46.76	Peak Max	V	366	245	74.00	-27.24	Pass
7672.93	33.56	21.10	-7.28	47.37	Peak Max	V	132	140	74.00	-26.63	Pass
10868.85	14.43	23.67	-3.29	34.81	Average Max	V	366	245	54.00	-19.19	Pass
7672.93	23.47	21.10	-7.28	37.29	Average Max	V	132	140	54.00	-16.72	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11n 40 MHz BW MCS0 5795 MHz
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11n 40 MHz BW MCS0 5795 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102233.emi

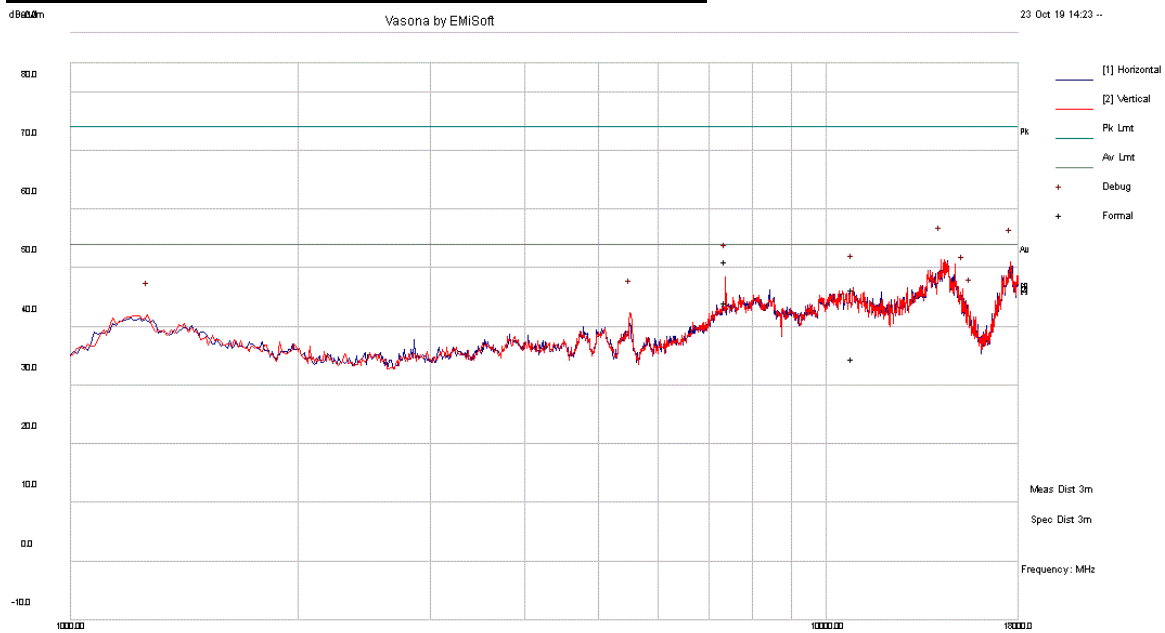
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10870.33	25.77	23.67	-3.29	46.16	Peak Max	V	366	0	74.00	-27.84	Pass
7726.48	34.78	21.13	-7.15	48.76	Peak Max	H	172	192	74.00	-25.24	Pass
10870.33	14.42	23.67	-3.29	34.80	Average Max	V	366	0	54.00	-19.20	Pass
7726.48	27.68	21.13	-7.15	41.66	Average Max	H	172	192	54.00	-12.34	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11ac 80 MHz BW VHT MCS0 5530 MHz.gif
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11ac 80 MHz BW VHT MCS0 5530 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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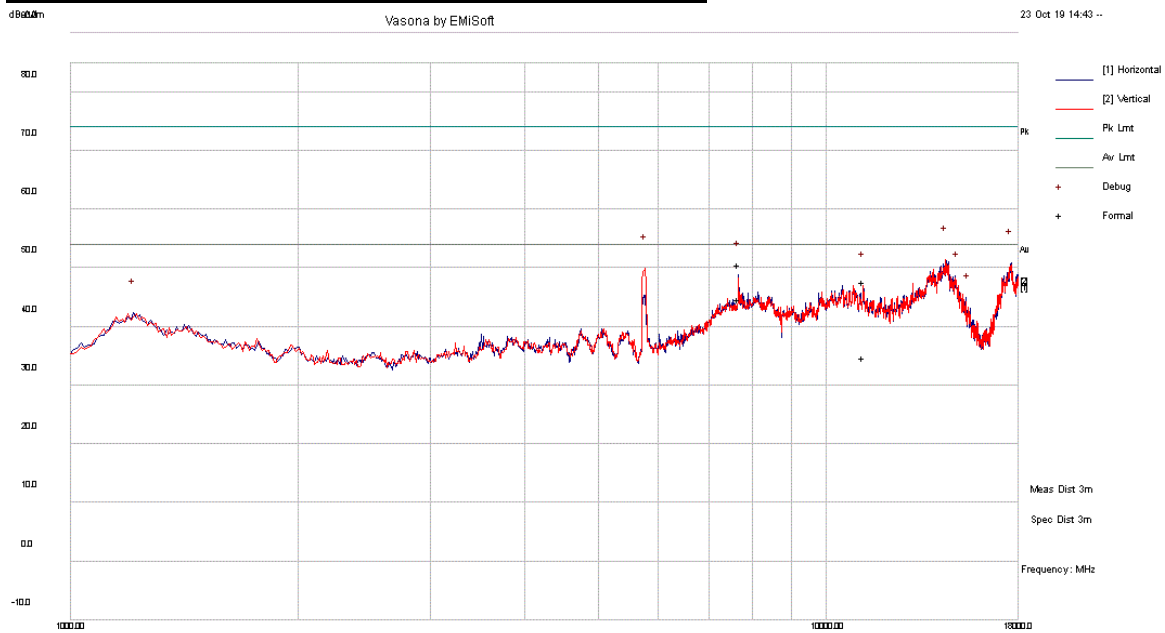
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7373.34	38.18	20.78	-7.74	51.21	Peak Max	V	153	166	74.00	-22.79	Pass
10861.18	25.94	23.66	-3.32	46.28	Peak Max	H	130	249	74.00	-27.72	Pass
7373.34	31.07	20.78	-7.74	44.10	Average Max	V	153	166	54.00	-9.90	Pass
10861.18	14.13	23.66	-3.32	34.48	Average Max	H	130	249	54.00	-19.52	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11ac 80 MHz BW VHT MCS0 5755 MHz.gif
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11ac 80 MHz BW VHT MCS0 5755 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102237.emi

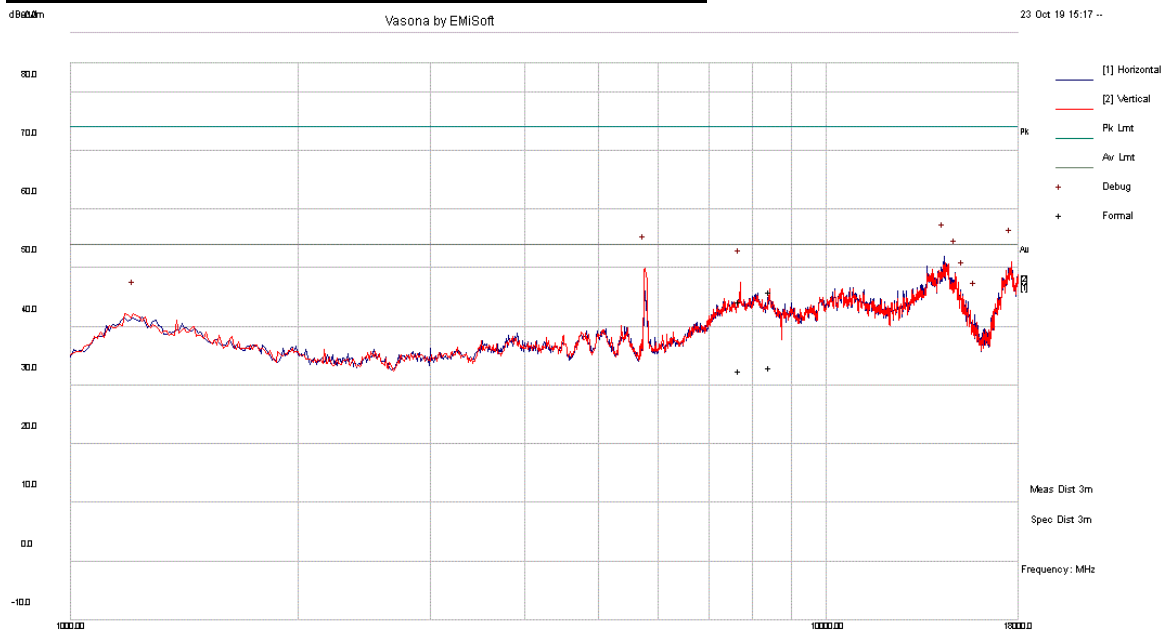
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7673.42	36.78	21.10	-7.28	50.60	Peak Max	H	100	184	74.00	-23.40	Pass
11220.39	26.26	24.26	-2.86	47.65	Peak Max	V	134	303	74.00	-26.35	Pass
7673.42	30.90	21.10	-7.28	44.72	Average Max	H	100	184	54.00	-9.28	Pass
11220.39	13.28	24.26	-2.86	34.68	Average Max	V	134	303	54.00	-19.32	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407, RSS-247	Mode:	WLAN 11ac 80 MHz BW VHT MCS0 5775 MHz.gif
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WLAN 11ac 80 MHz BW VHT MCS0 5775 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\19102238.emi

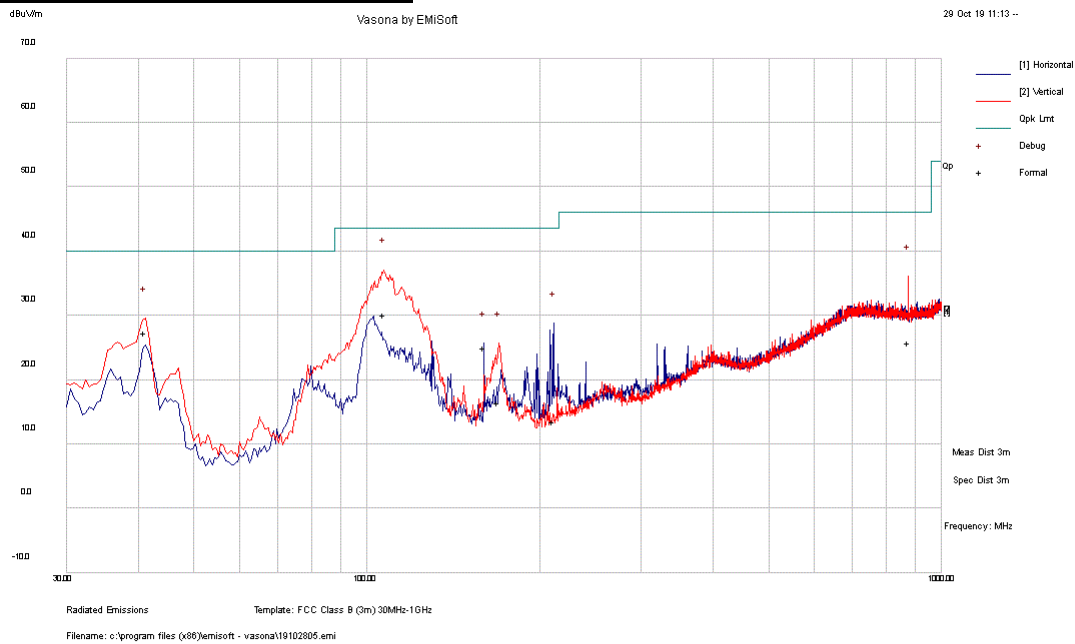
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7704.74	30.44	21.12	-7.20	44.35	Peak Max	V	109	356	74.00	-29.65	Pass
8435.47	30.27	21.18	-5.55	45.90	Peak Max	V	279	328	74.00	-28.10	Pass
7704.74	18.58	21.12	-7.20	32.49	Average Max	V	109	356	54.00	-21.51	Pass
8435.47	17.41	21.18	-5.55	33.04	Average Max	H	346	18	54.00	-20.96	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407	Mode:	BT+WLAN+Cellular co-location
Frequency Range:	30 - 1000 MHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

BT+WLAN+Cellular co-location



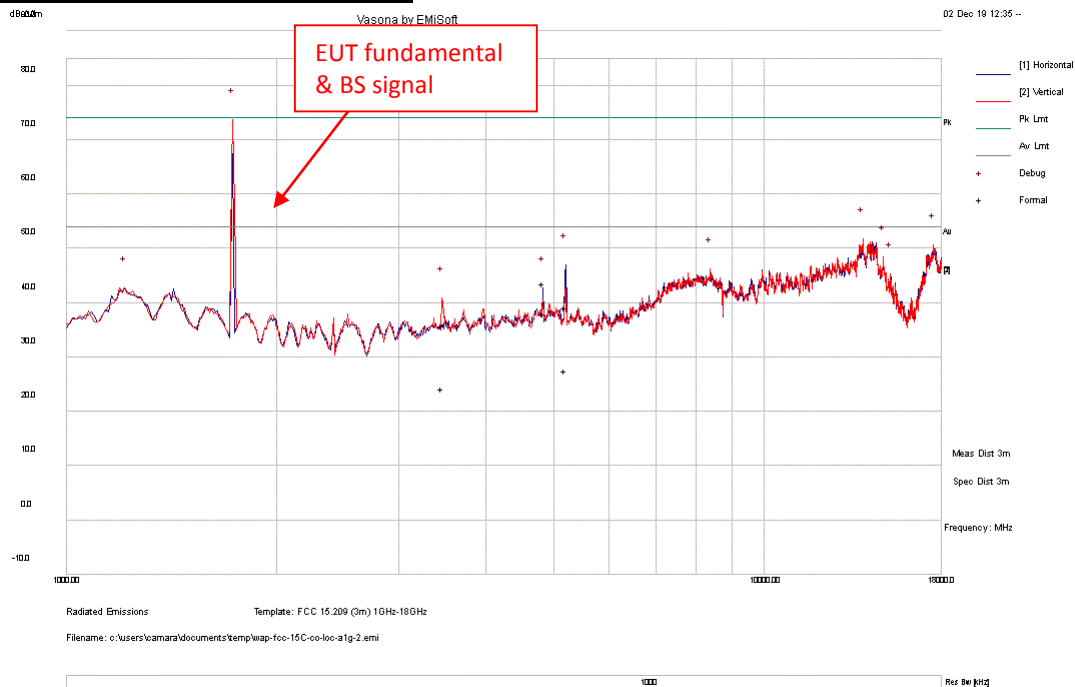
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
107.28	50.04	3.68	-23.49	30.23	Quasi Max	V	149	87	43.50	-13.27	Pass
875.27	25.41	7.52	-7.12	25.81	Quasi Max	V	163	144	46.00	-20.19	Pass
41.01	45.73	2.57	-20.99	27.31	Quasi Max	V	100	308	40.00	-12.69	Pass
211.26	29.79	4.86	-21.18	13.46	Quasi Max	H	103	84	43.50	-30.04	Pass
169.48	34.27	4.45	-22.22	16.51	Quasi Max	V	141	344	43.50	-26.99	Pass
160.0	43.08	4.35	-22.36	25.08	Quasi Max	H	206	174	43.50	-18.42	Pass

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.407	Mode:	BT+WLAN+Cellular co-location
Frequency Range:	1 - 18 GHz	Test Date:	10/22/2019 - 10/23/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

BT+WLAN+Cellular co-location



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
5199.20	34.4	17.5	-12.6	39.2	Peak Max	V	356	129	74	-34.8	Pass
4824.13	39.7	17.4	-13.4	43.7	Peak Max	V	101	156	74	-30.3	Pass
3456.57	38.1	15.8	-18.1	35.9	Peak Max	V	278	111	74	-38.1	Pass
5199.20	22.8	17.5	-12.6	27.6	Average Max	V	356	129	54	-26.4	Pass
4824.13	34.1	17.4	-13.4	38.1	Average Max	V	101	156	54	-15.9	Pass
3456.57	26.5	15.8	-18.1	24.2	Average Max	V	278	111	54	-29.8	Pass

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



18GHz – 40GHz test result

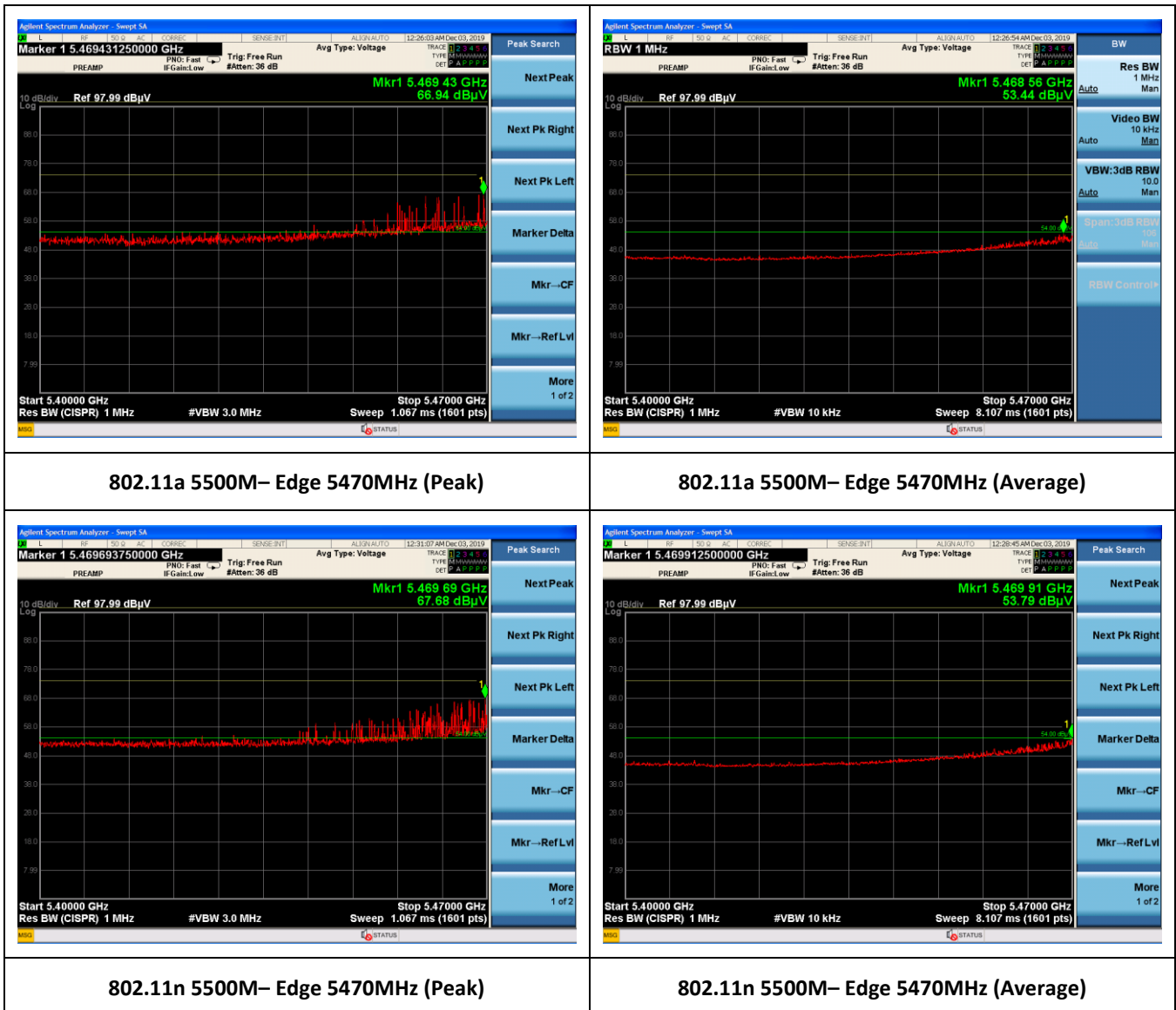
Note: no substantial emission is found other than the noise floor.

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



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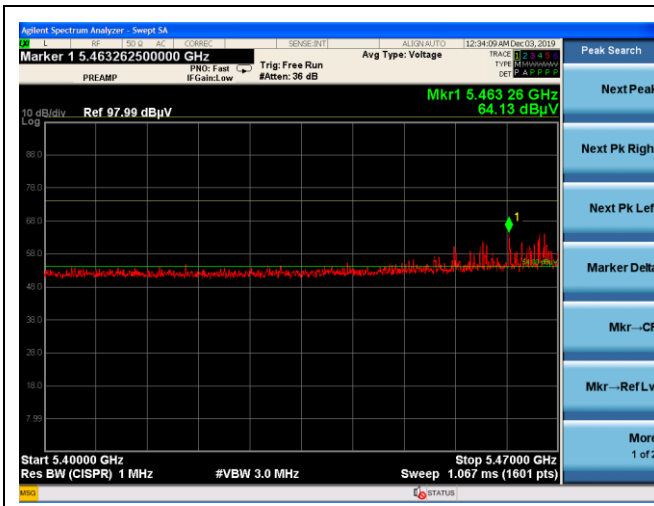
Radiated Band Edge measurement result



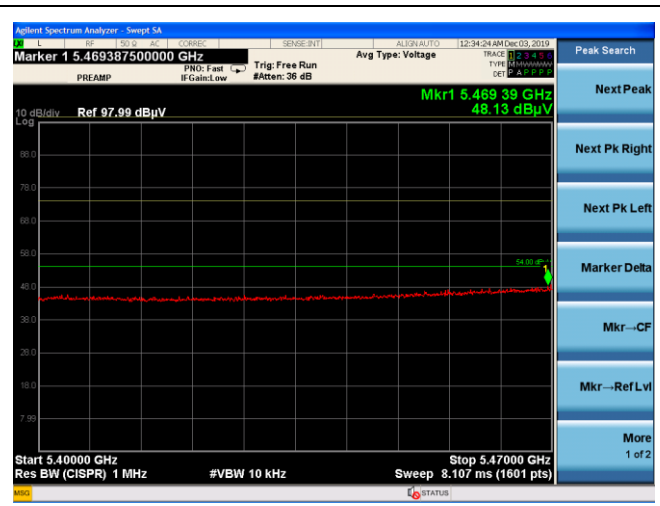
Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



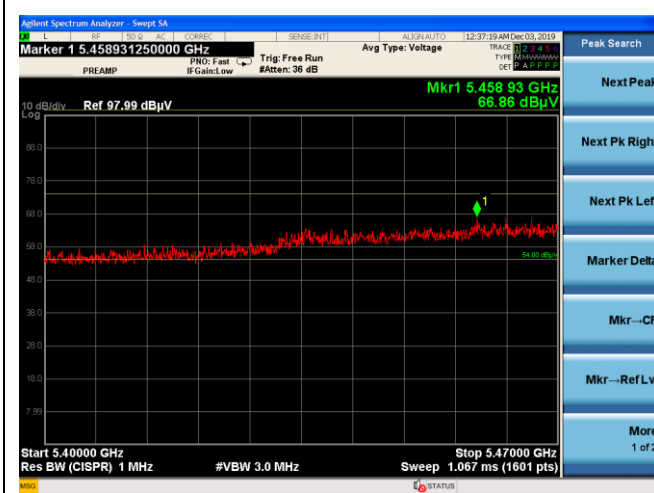
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802.11n40MHz 5510M– Edge 5470MHz (Peak)



802.11n40MHz 5510M– Edge 5470MHz (Average)

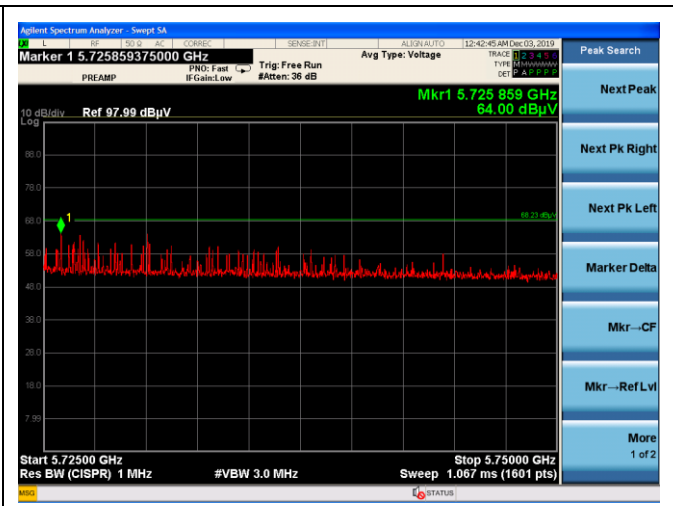
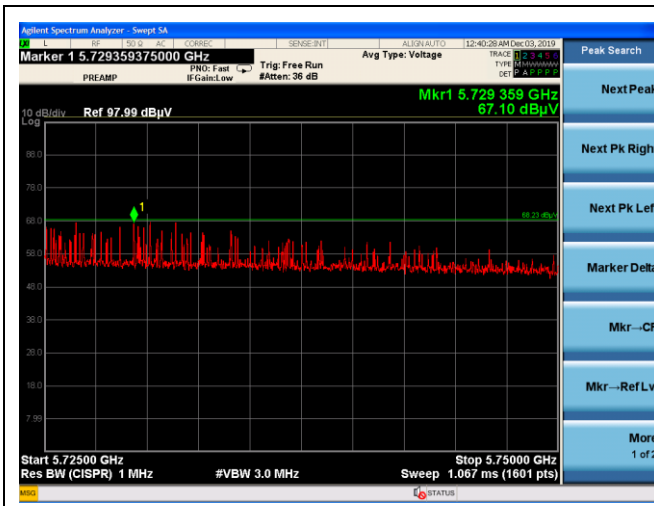


802.11ac40MHz 5530M– Edge 5470MHz (Peak)



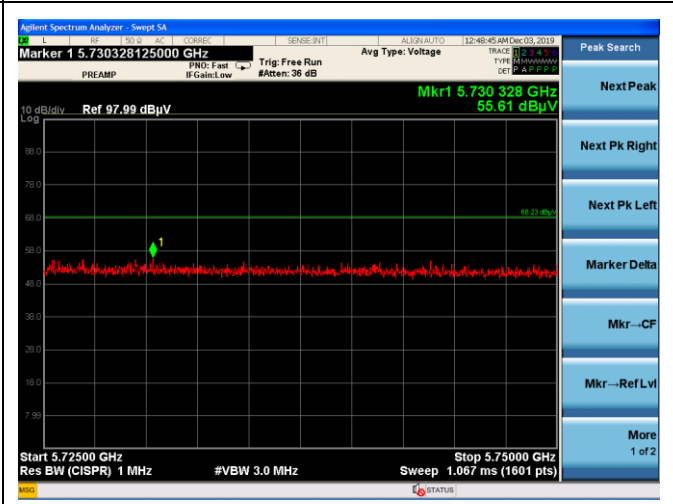
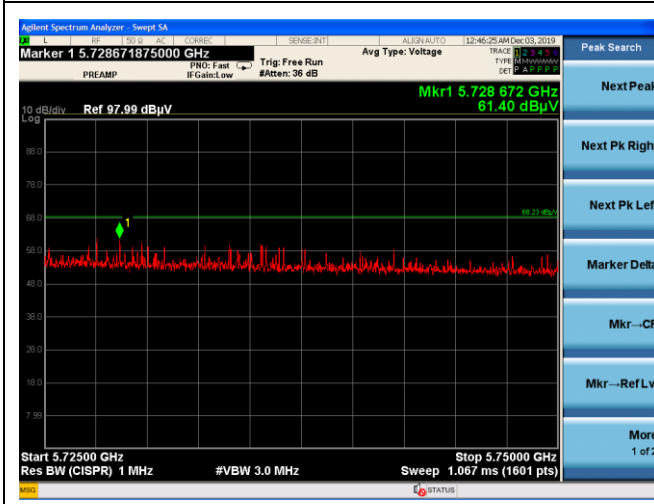
802.11ac40MHz 5530M– Edge 5470MHz (Average)

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



802.11a 5700M– Edge 5725MHz

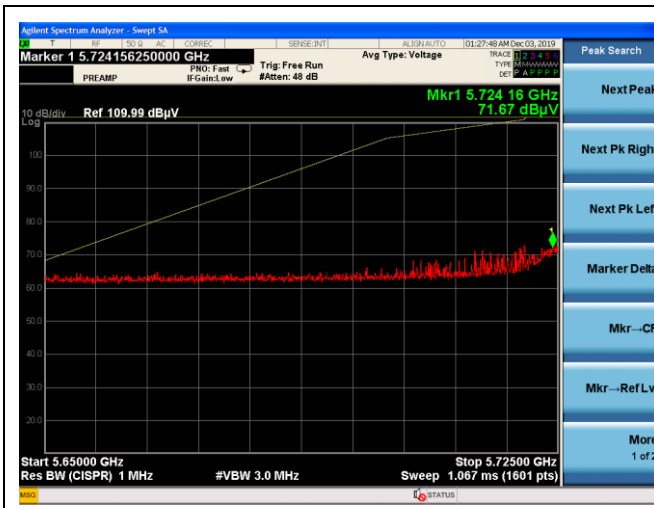
802.11n 5700M– Edge 5725MHz



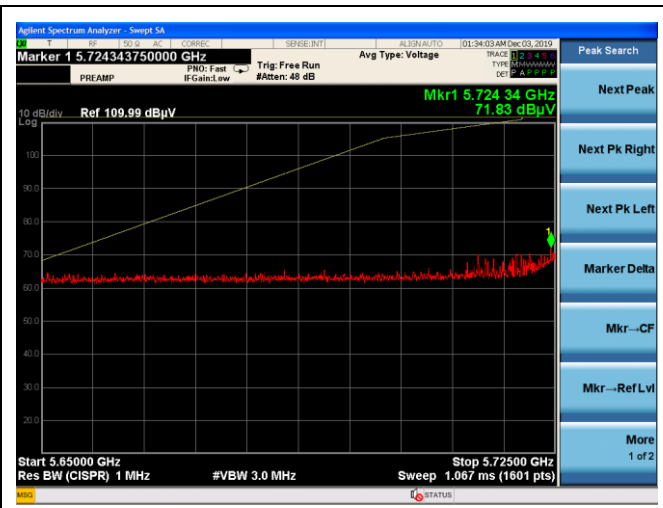
802.11n40MHz 5670M– Edge 5725MHz

802.11ac80MHz 5610M– Edge 5725MHz

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



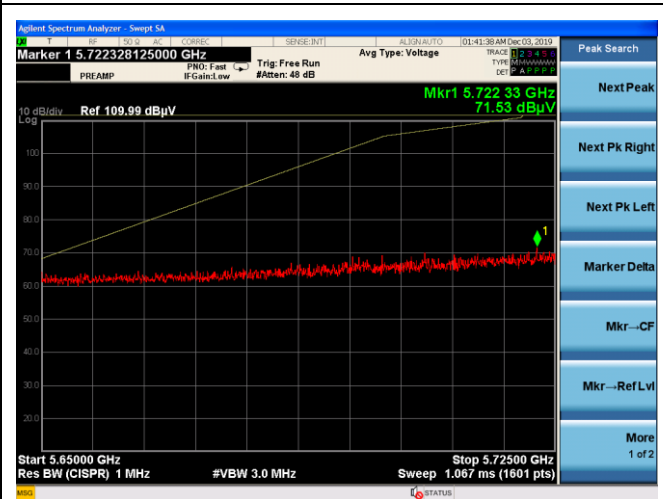
802.11a 5745M– Edge 5725MHz



802.11n 5745M– Edge 5725MHz



802.11n40MHz 5755M– Edge 5725MHz

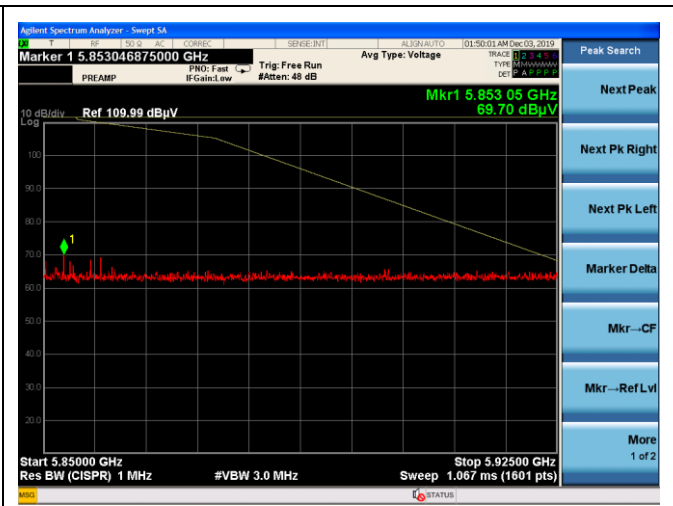
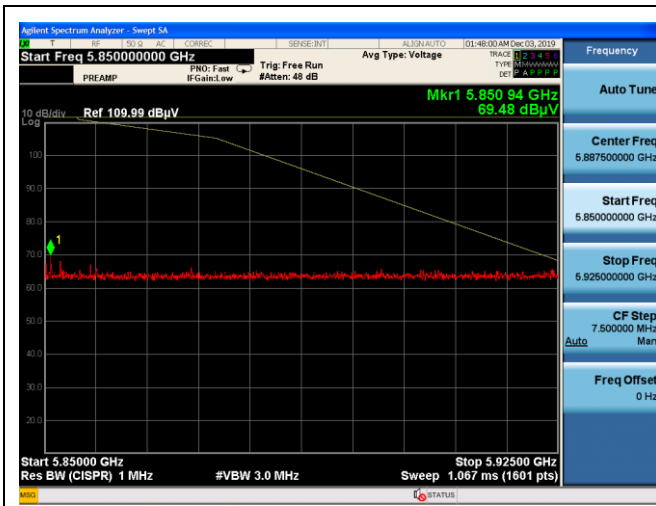


802.11ac 80MHz 5775M– Edge 5725MHz

Report Number: WAP-19091821-LC-FCC-IC-UNII
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA

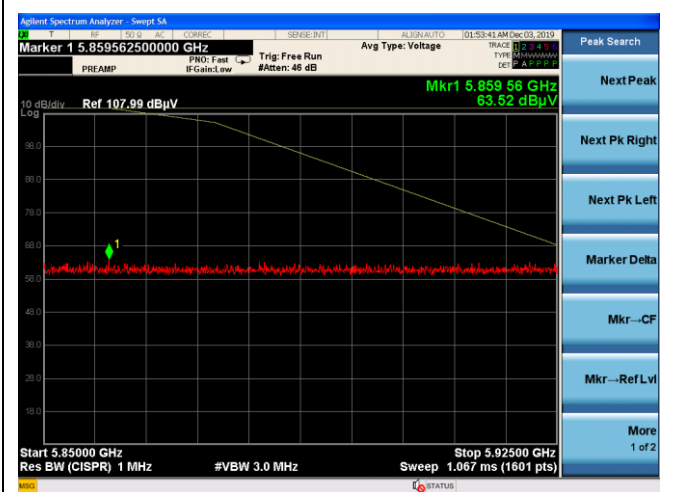
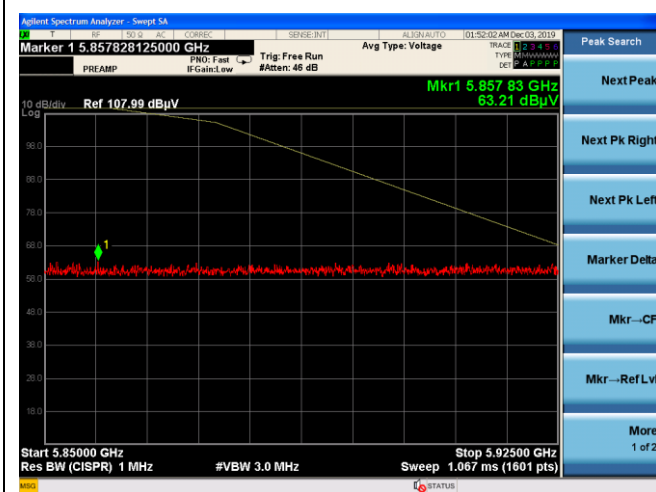


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802.11a 5825M- Edge 5850MHz

802.11n 5825M- Edge 5850MHz



802.11n40MHz 5795M- Edge 5850MHz

802.11ac 80MHz 5775M- Edge 5850MHz



Electromagnetic Compatibility
Radio Frequency
Product Certification
International Approval

1261 Puerta Del Sol
San Clemente, CA, 92673
+1 (949) 393-1123
www.vista-compliance.com

Report Number:	WAP-19091821-LC-FCC-IC-UNII
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



9 Test instrument list

Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	5/11/2019	5/11/2020
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	5/4/2019	5/4/2020
EMC Test Receiver	R&S	ESL6	100230	5/7/2019	5/7/2020
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/2019	5/4/2020
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2019	11/15/2020
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/2/2019	5/2/2020
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	5/2/2019	5/2/2020
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	5/10/2019	5/10/2020
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/10/2019	5/10/2020
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/9/2019	5/9/2020
RF Attenuator	Pasternack	PE7005-3	VL061	5/10/2019	5/10/2020
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392- 77150-11	064	5/10/2019	5/10/2020
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/9/2019	5/9/2020
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	5/10/2019	5/10/2020
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	5/10/2019	5/10/2020
RE test cable (>18GHz)	Sucoflex	104	344903/4	5/10/2019	5/10/2020
Pulse limiter	Com-Power	LIT-930A	531727	5/15/2019	5/15/2020
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	5/10/2019	5/10/2020
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	5/9/2019	5/9/2020
Wideband Communication	R&S	CMW500	147508	5/8/2019	5/8/2020