

FCC/ISED DTS RF TEST REPORT



Test Report Number.....	WAP-19091821-LC-FCC-IC-DTS
Applicant.....	Ford Motor Company
Applicant Address.....	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124
Product Name.....	Vehicle Telematics Control Unit
Model Number.....	FB5-TCU-NA
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 15.247 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-DTS
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Laboratory Introduction

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17025 Product Testing Accreditation Certificate



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Electromagnetic Compatibility
Radio Frequency
Product Certification
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REVISION HISTORY

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

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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

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Maximum output power	See test result
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	N/A

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1.3 Test standard and method

Test standard	47CFR Part 15.247 RSS-247 Issue2: Feb 2017
Test method	ANSI C63.10: 2013 558074 D01 15.247 Meas Guidance v05r02

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 firmware 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.

4.2 EUT test mode

Radio	Channel	Frequency (MHz)
BLE	0	2402
BLE	20	2442
BLE	39	2480
802.11-b	1	2412
802.11-b	6	2437
802.11-b	11	2462
802.11-g	1	2412
802.11-g	6	2437
802.11-g	11	2462
802.11-n-20	1	2412
802.11-n-20	6	2437
802.11-n-20	11	2462

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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
§15.207 (a)	RSS-Gen §8.8	AC Power Line Conducted Emissions	N/A	N/A
§15.247 (a)(2)	RSS-247 §5.2	DTS (6 dB) Channel Bandwidth	8.2	Pass
-	RSS-Gen §6.7	Occupied Bandwidth	8.3	Pass
§15.247(b)(3)	RSS-247 §5.4	Conducted Maximum Output Power	8.4	Pass
§15.247(e)	RSS-247 §5.2	Power Spectral Density	8.5	Pass
§15.247(d)	RSS-247 §5.5	Conducted Band-Edge & Unwanted Emissions	8.6	Pass
§15.205, §15.209	RSS-247 §5.5	Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	8.7	Pass

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

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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 antennas. 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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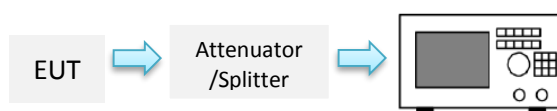
8.2 DTS (6 dB) Bandwidth

8.2.1 Requirement

§ 15.247 (a)(2), RSS-247 §5.2

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

8.2.2 Test setup



8.2.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2013:

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.

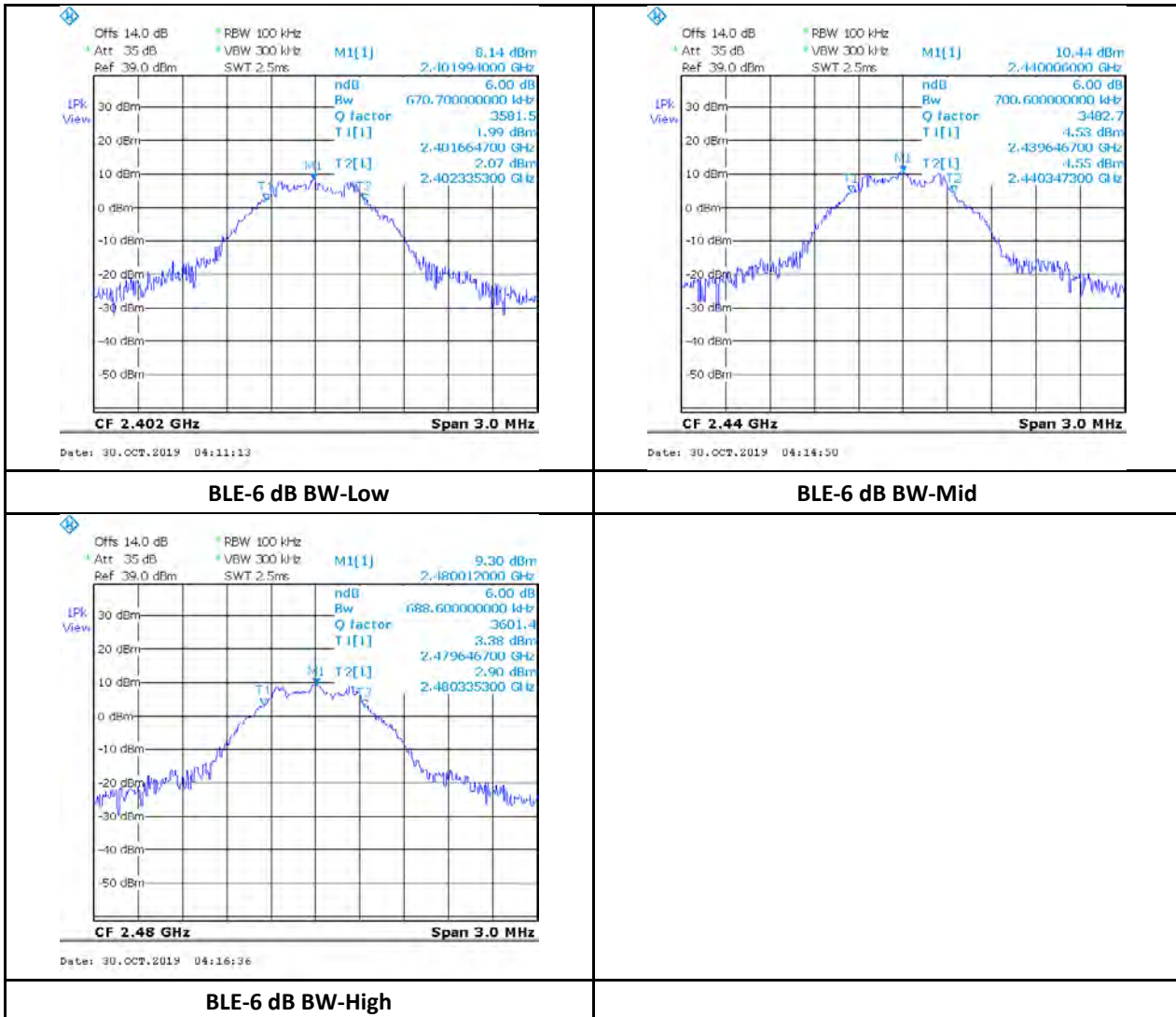
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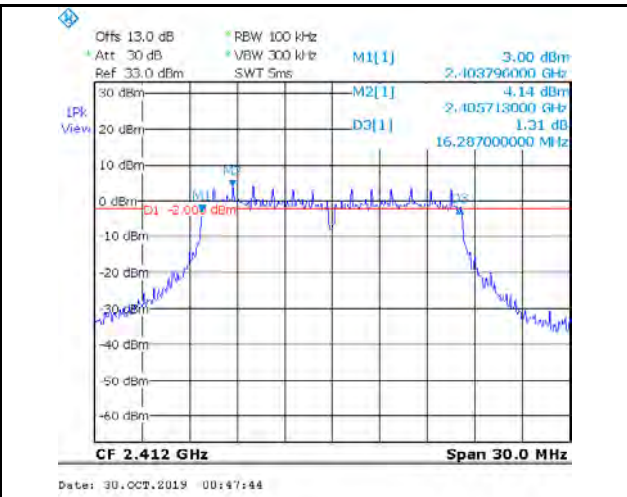
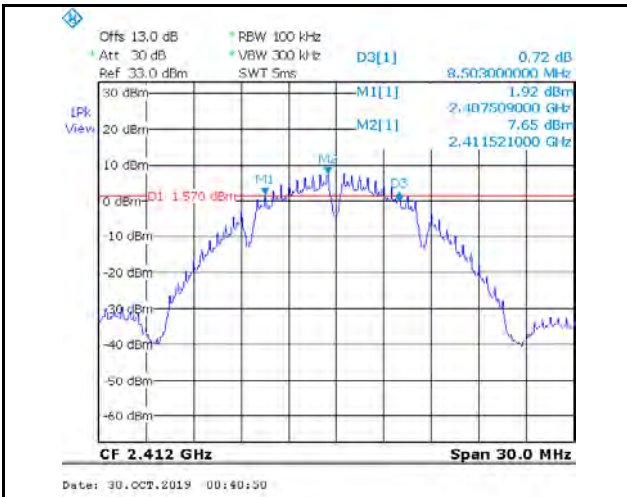
8.2.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
BLE	2402	1Mbps	670.7	500	Pass
BLE	2440	1Mbps	700.6	500	Pass
BLE	2480	1Mbps	688.6	500	Pass
11b	2412	1Mbps	8503	500	Pass
11b	2437	1Mbps	7605	500	Pass
11b	2462	1Mbps	8982	500	Pass
11g	2412	6Mbps	16287	500	Pass
11g	2437	6Mbps	15569	500	Pass
11g	2462	6Mbps	16048	500	Pass
11n-20M	2412	MCS0	16826	500	Pass
11n-20M	2437	MCS0	16766	500	Pass
11n-20M	2462	MCS0	16477	500	Pass
11n-40M	2422	MCS0	35690	500	Pass
11n-40M	2437	MCS0	34970	500	Pass
11n-40M	2452	MCS0	35660	500	Pass

8.2.5 Test Plots

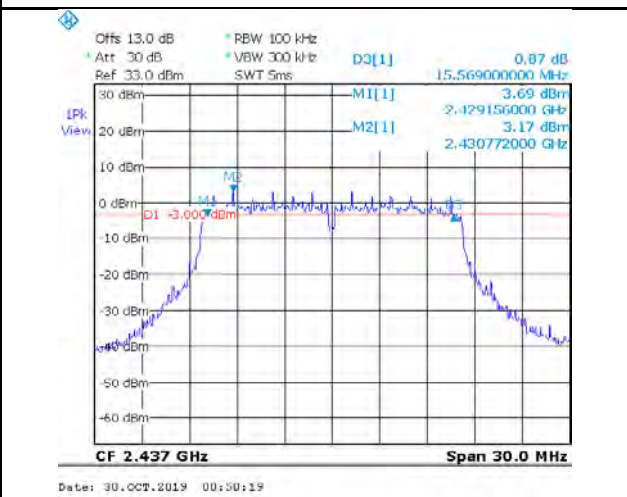
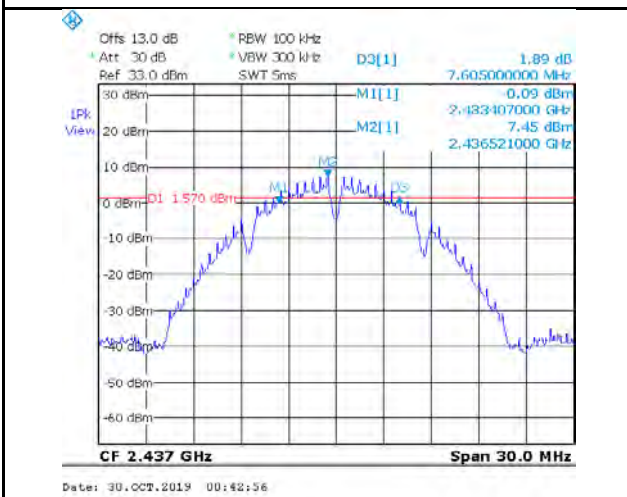


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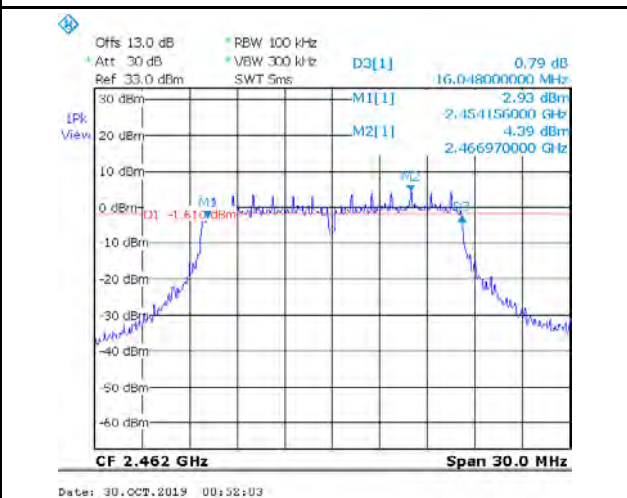
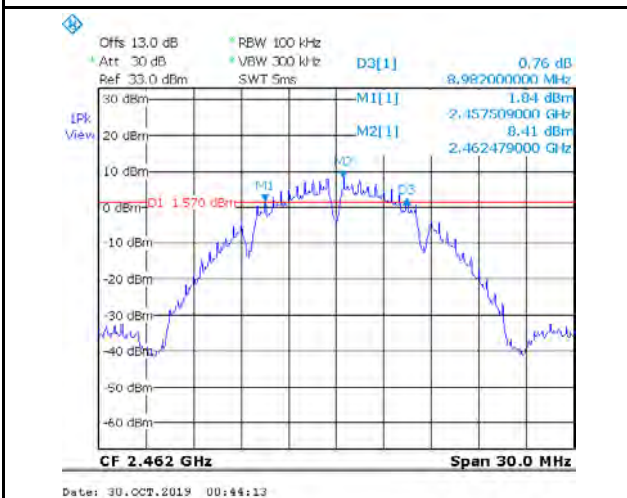
11b-6dB BW-Low

11g-6dB BW-Low



11b-6dB BW-Mid

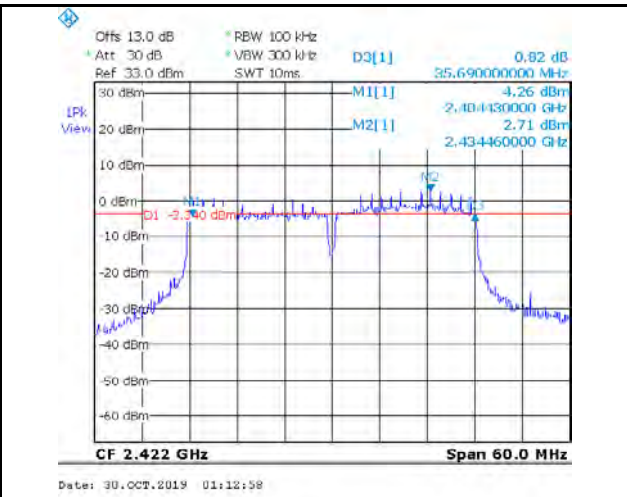
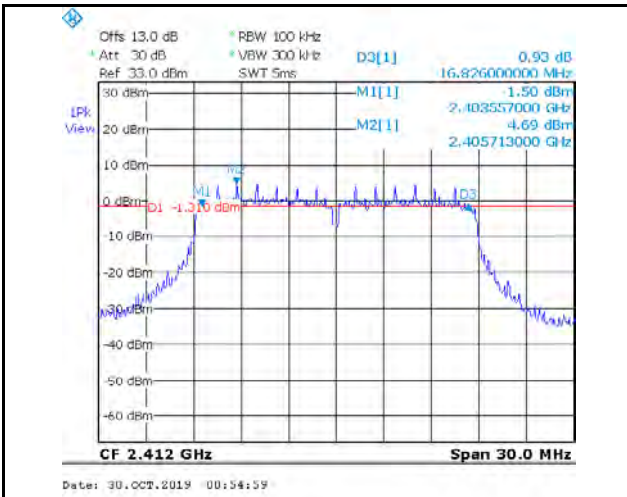
11g-6dB BW-Mid



11b-6dB BW-High

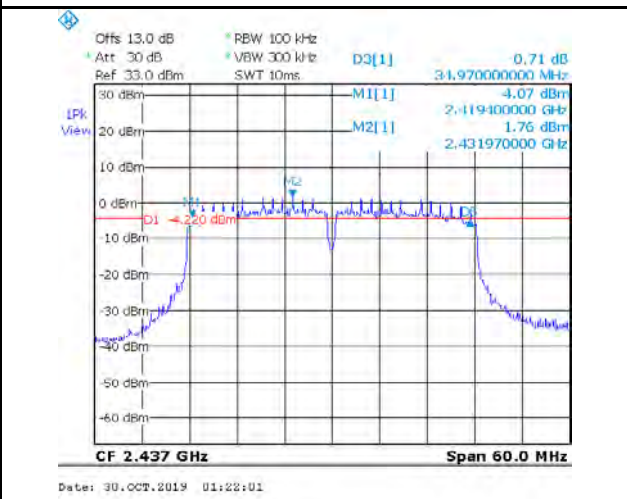
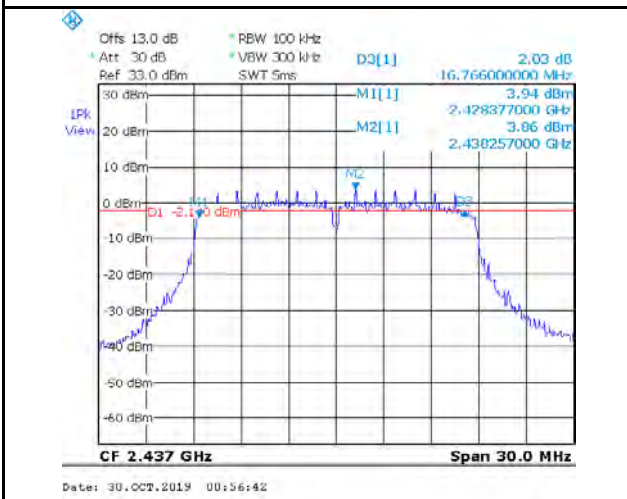
11g-6dB BW-High

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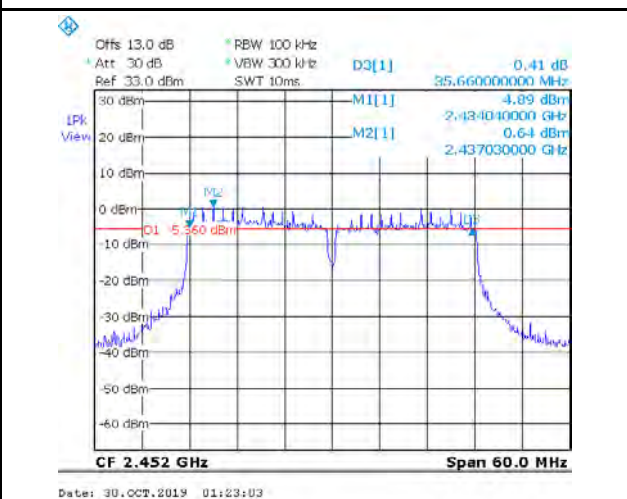
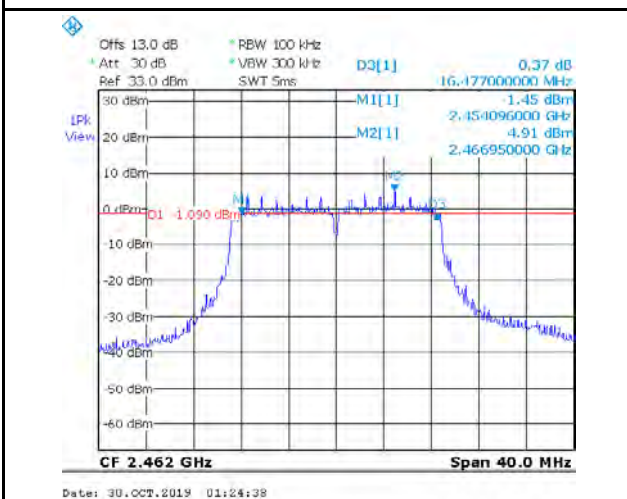
11n-20MHz-6dB BW-Low

11n-40MHz-6dB BW-Low



11n-20MHz-6dB BW-Mid

11n-40MHz-6dB BW-Mid



11n-20MHz-6dB BW-High

11n-40MHz-6dB BW-High

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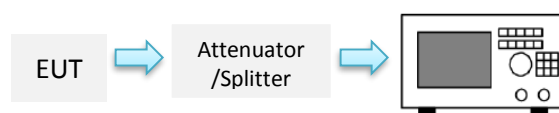
8.3 Occupied Bandwidth (99%)

8.3.1 Requirement

RSS-Gen §6.7

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.

8.3.2 Test setup



8.3.3 Test Procedure

According to section RSS-Gen §6.7

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 = 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 = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

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8.3.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured 99% OBW (KHz)	Limit (KHz)	Result
BLE	2402	1Mbps	1029.9	N/A	Pass
BLE	2440	1Mbps	1095.8	N/A	Pass
BLE	2480	1Mbps	1077.8	N/A	Pass
11b	2412	1Mbps	14052	N/A	Pass
11b	2437	1Mbps	13253	N/A	Pass
11b	2462	1Mbps	13812	N/A	Pass
11g	2412	6Mbps	16846	N/A	Pass
11g	2437	6Mbps	16448	N/A	Pass
11g	2462	6Mbps	16687	N/A	Pass
11n-20M	2412	MCS0	17884	N/A	Pass
11n-20M	2437	MCS0	17645	N/A	Pass
11n-20M	2462	MCS0	17804	N/A	Pass
11n-40M	2422	MCS0	36886	N/A	Pass
11n-40M	2437	MCS0	36407	N/A	Pass
11n-40M	2452	MCS0	37006	N/A	Pass

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8.4 Maximum Output Power

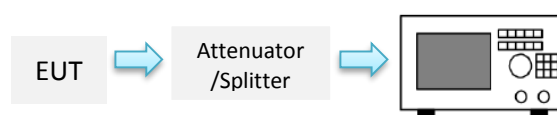
8.4.1 Requirement

§ 15.247 (b)(3), RSS-247 §5.4

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

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

8.4.2 Test setup



8.4.3 Test Procedure

For BLE, power measurement is according to subclause 11.9.1.1 of ANSI C63.10-2013:

1. Set the RBW $\geq$ DTS bandwidth
2. Set VBW $\geq 3 \times$ RBW.
2. Set SPAN $\geq 3 \times$ RBW.
3. Sweep time = auto couple.
4. Detector = peak.
5. Trace mode = max hold
6. Allow trace to fully stabilize.
7. Use peak marker function to determine the peak amplitude level.

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For WLAN, power measurement is according to subclause 11.9.2.2.2 of ANSI C63.10-2013:

1. Set span to at least 1.5 times of the OBW.
2. Set the RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
2. Set VBW $\geq 3 \times$ RBW.
3. Set number of points in sweep $\geq [2 \times \text{span} / \text{RBW}]$
4. Sweep time = auto couple.
5. Detector = RMS
6. If transmit duty cycle < 98%, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at the maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no OFF intervals) or at duty cycle 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."
7. Trace average at least 100 traces in power averaging (rms) mode.
8. Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

8.4.4 Test Result

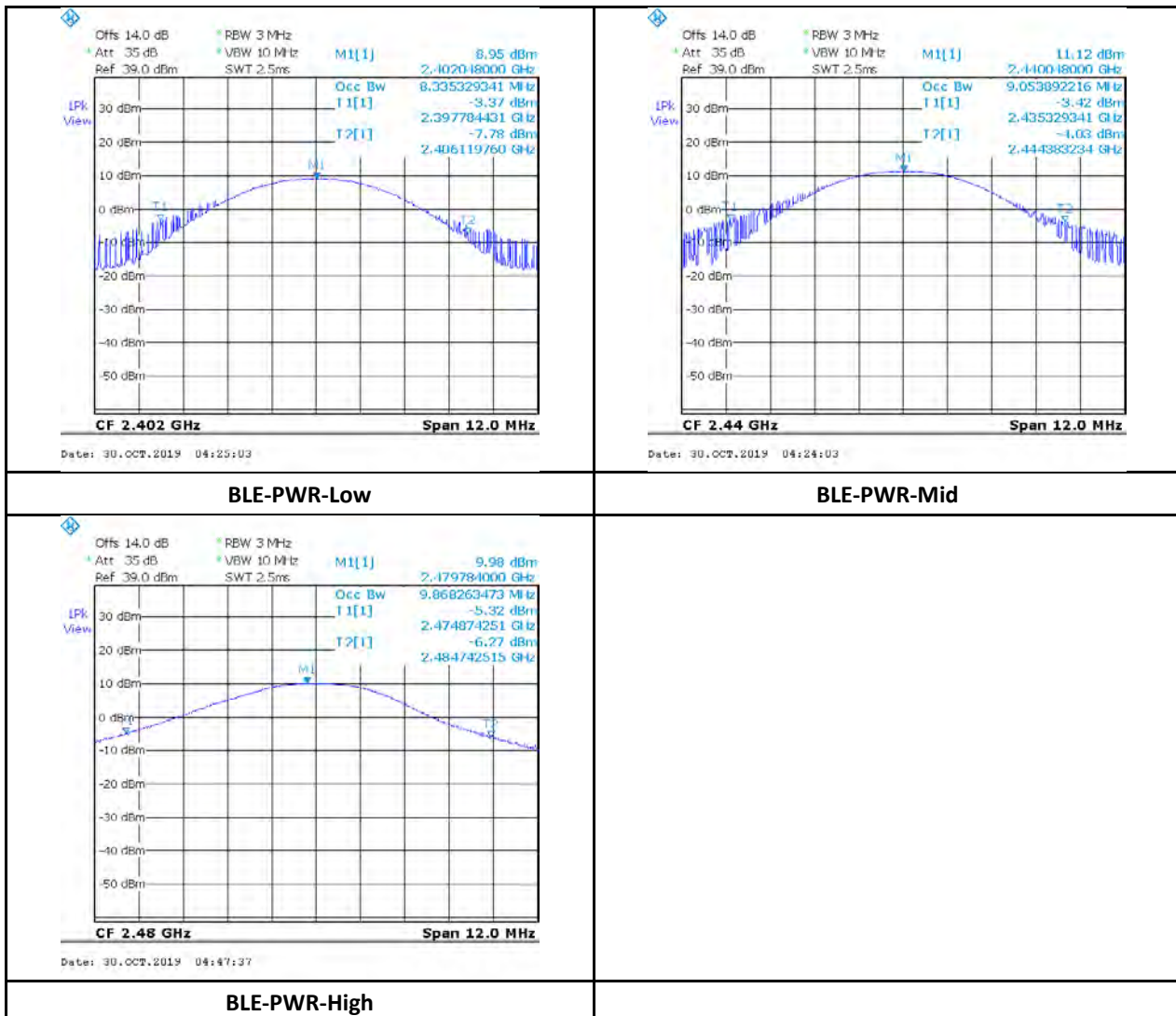
Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Output Power (dBm)	Max Output Power (dBm)	Result
BLE	2402	1Mbps	11.12	30	Pass
BLE	2440	1Mbps	8.95	30	Pass
BLE	2480	1Mbps	9.98	30	Pass

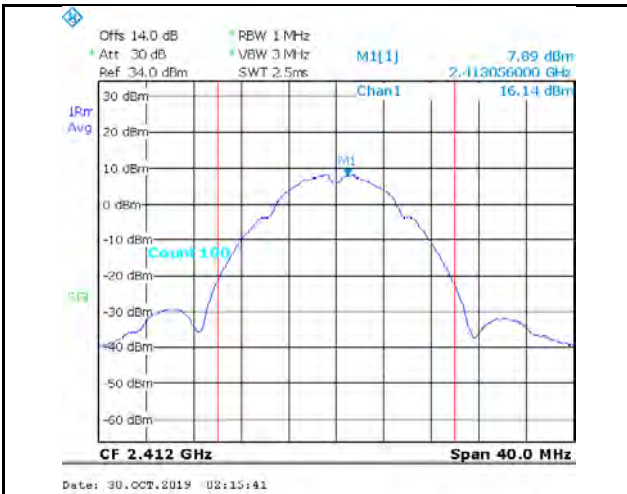
Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 power (dBm)	TX2 power (dBm)	TX3 power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
11b	2412	1Mbps	16.14	15.68	16.76	16.76	30	Pass
11b	2437	1Mbps	15.64	15.88	16.58	16.58	30	Pass
11b	2462	1Mbps	16.64	16.65	16.26	16.65	30	Pass
11g	2412	6Mbps	13.33	13.4	13.55	13.55	30	Pass
11g	2437	6Mbps	12.7	13.4	13.68	13.68	30	Pass
11g	2462	6Mbps	13.71	13.76	13.07	13.76	30	Pass
11n-20M	2412	MCS0	13.5	13.22	13.57	18.20	23.41	Pass
11n-20M	2437	MCS0	12.97	13.6	13.17	18.03	23.41	Pass
11n-20M	2462	MCS0	13.44	13.65	13.50	18.30	23.41	Pass
11n-40M	2422	MCS0	12.43	11.93	11.64	16.79	23.41	Pass
11n-40M	2437	MCS0	11.48	11.77	12.19	16.60	23.41	Pass
11n-40M	2452	MCS0	10.84	12.48	12.28	16.70	23.41	Pass

Note:

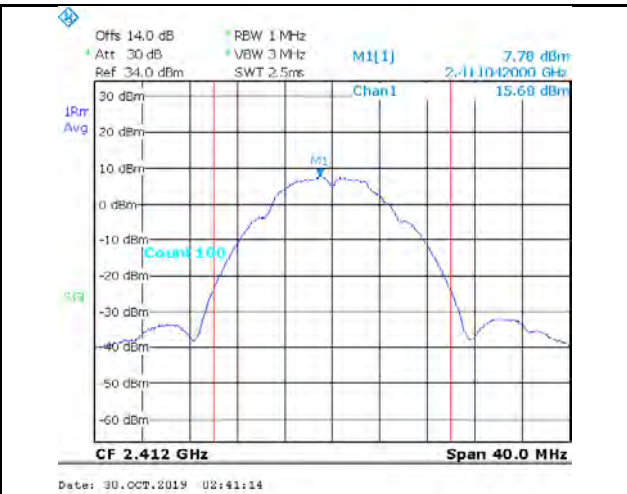
- 1) For 802.11b/g, the highest output power is recorded.
- 2) For 2.4GHz 802.11n mode, it's under 3x3 MIMO mode, the output power is combined together to compare to limit.
- 3) For 2.4GHz 11n mode, directional gain is calculated per KDB 662911 D01. For 2.4GHz WiFi, directional gain = 12.59 dBi. The output power limit is reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.4.5 Test Plots

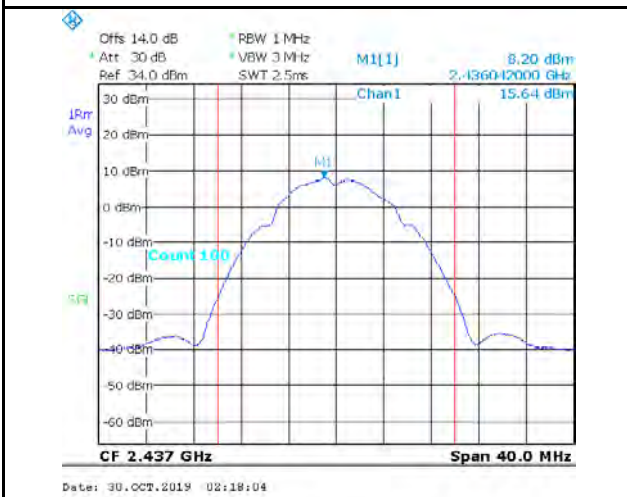




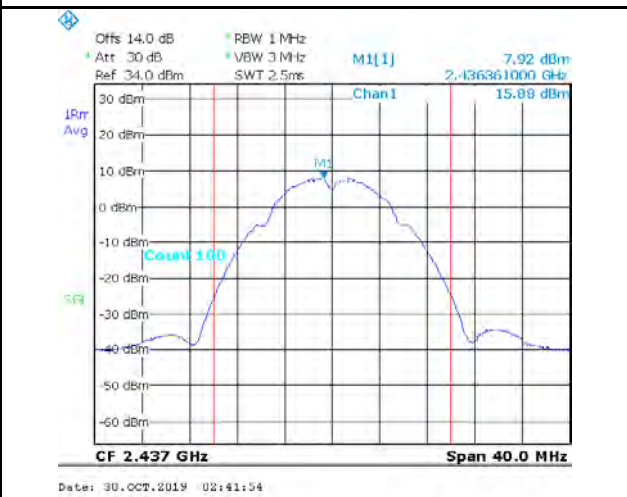
11b-PWR-Low-TX1



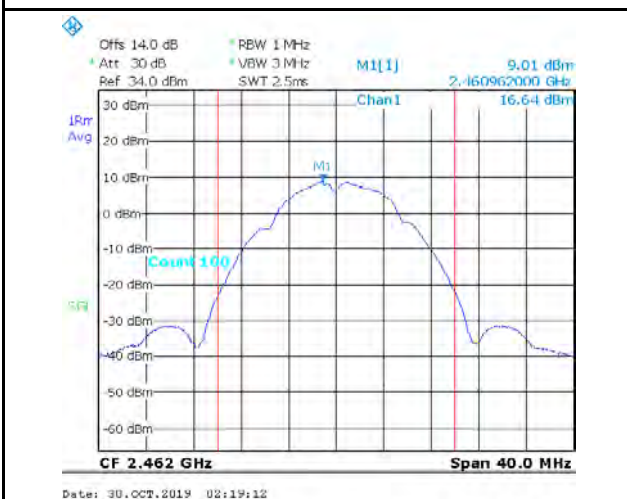
11b-PWR-Low-TX2



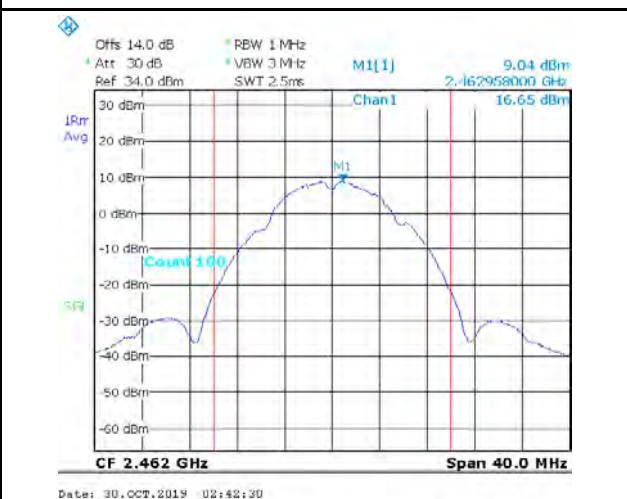
11b-PWR-Mid-TX1



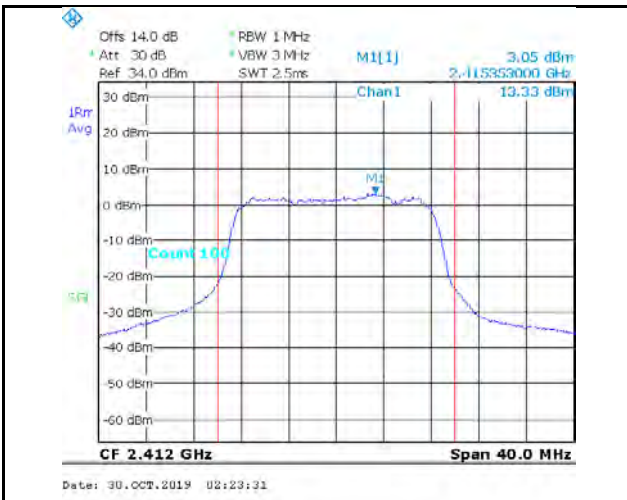
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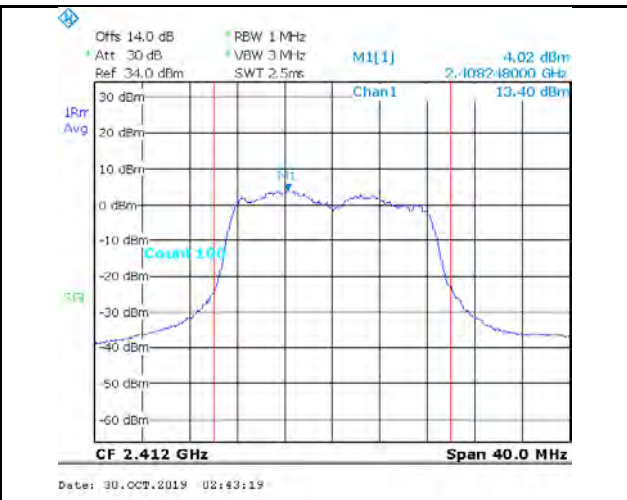
11b-PWR-High-TX1



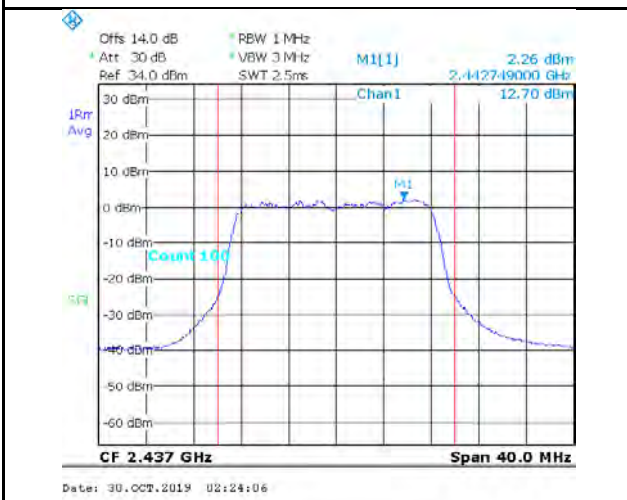
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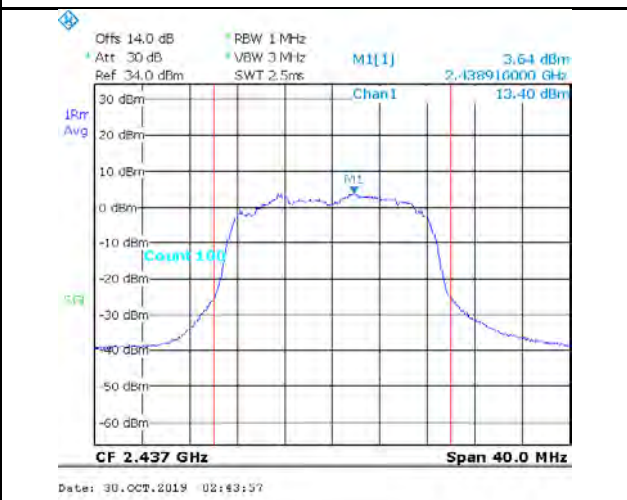
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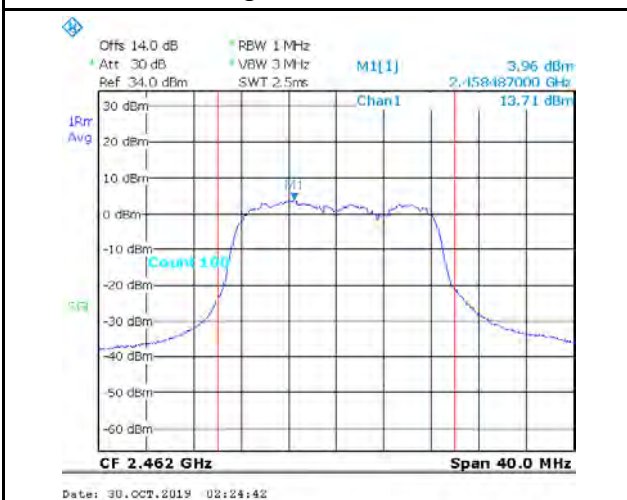
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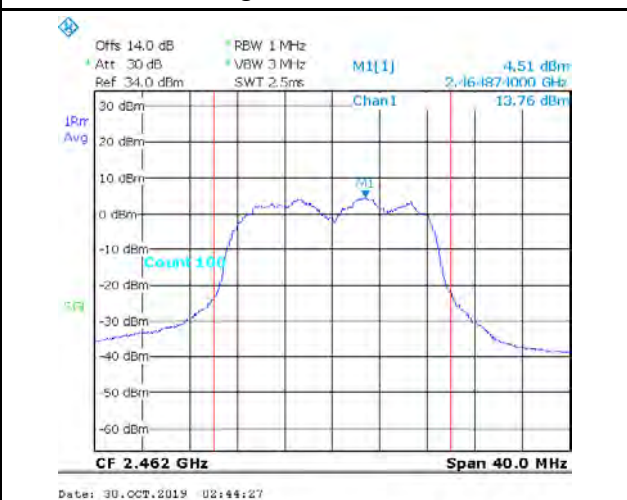
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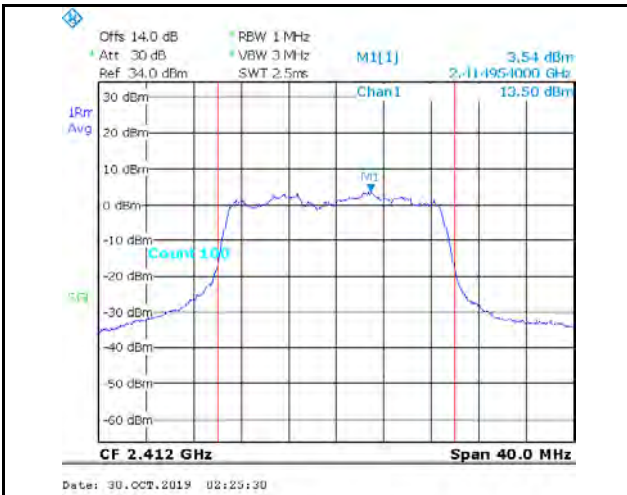
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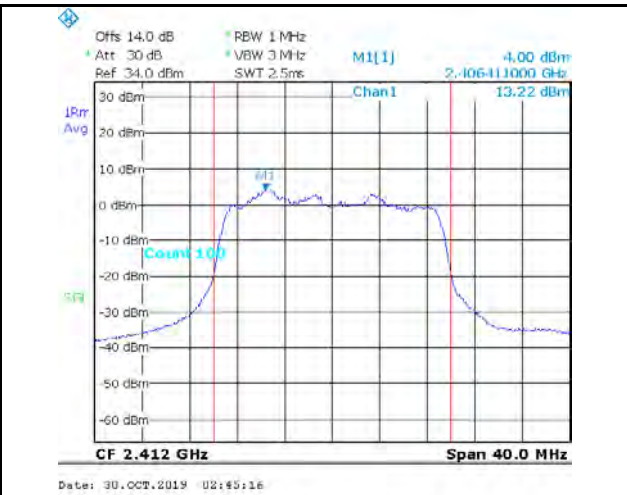
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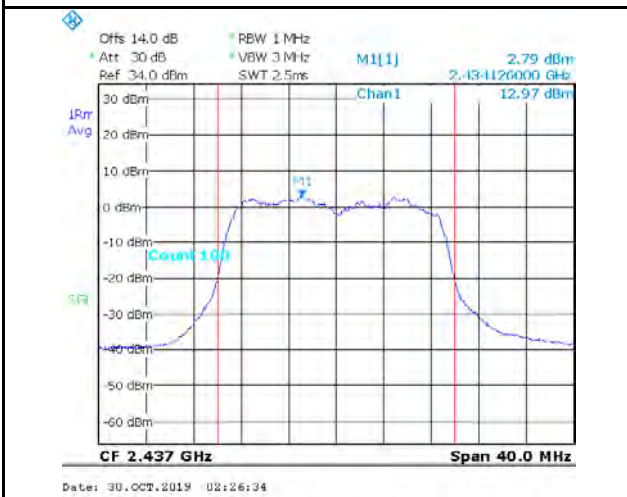
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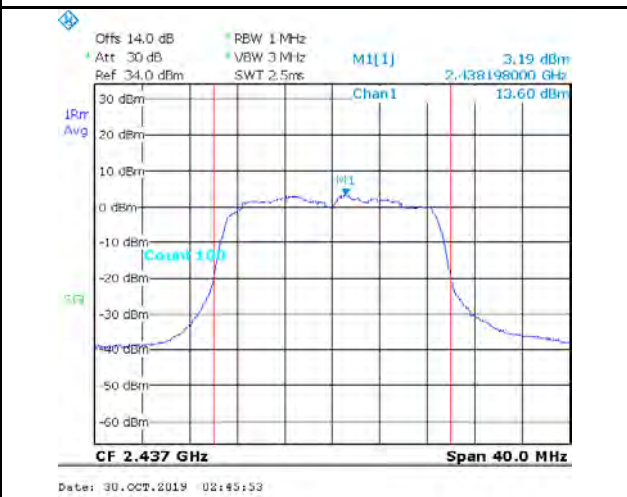
11n-20MHz-PWR-Low-TX1



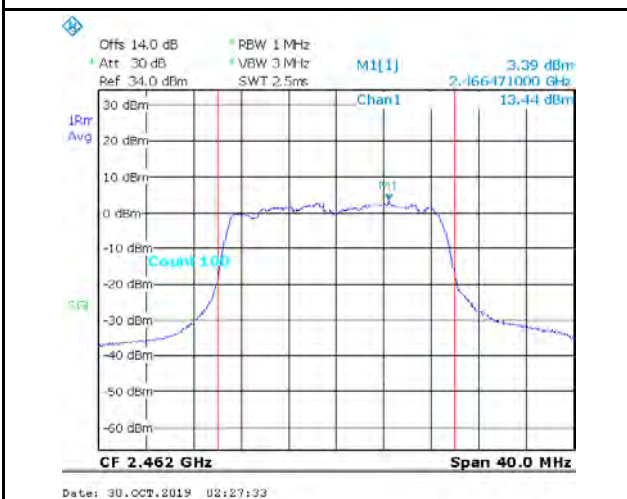
11n-20MHz-PWR-Low-TX2



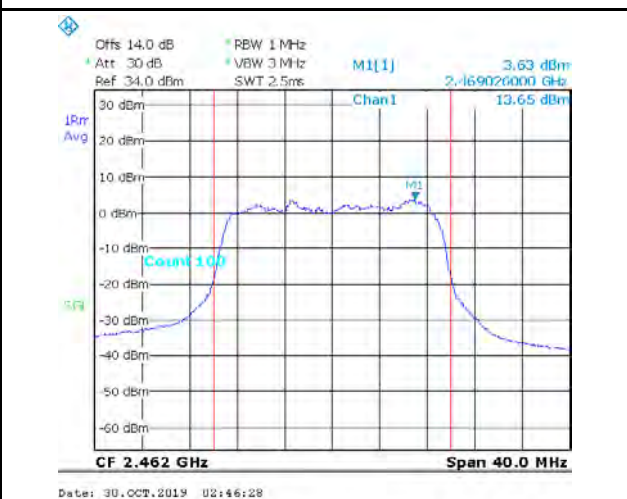
11n-20MHz-PWR-Mid-TX1



11n-20MHz-PWR-Mid-TX2

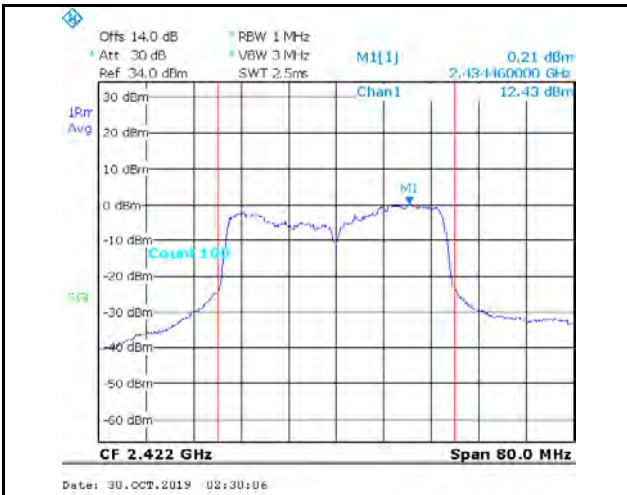


11n-20MHz-PWR-High-TX1

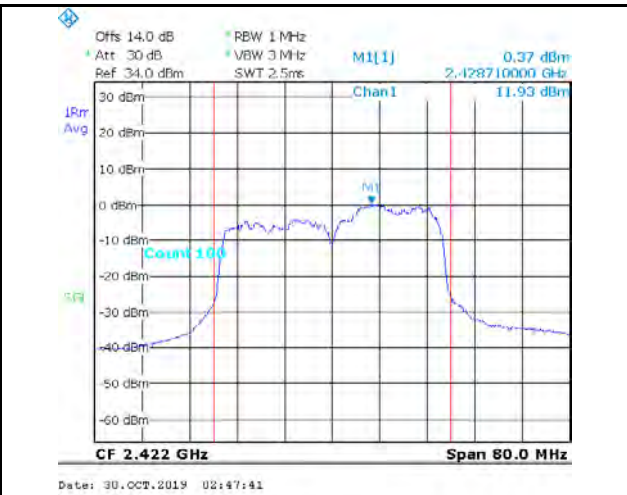


11n-20MHz-PWR-High-TX2

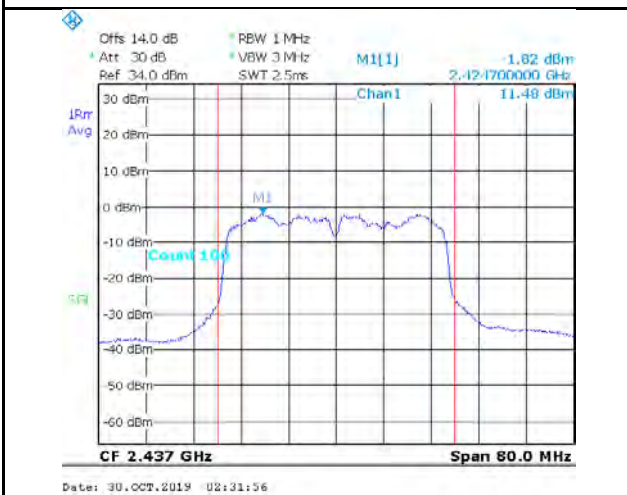
Report Number: WAP-19091821-LC-FCC-IC-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



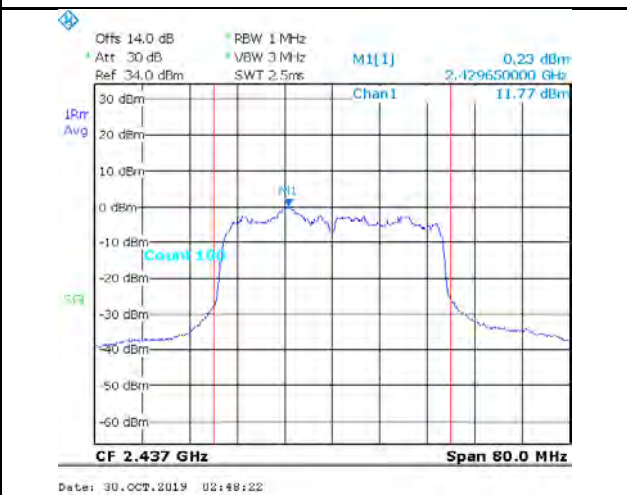
11n-40MHz-PWR-Low-TX1



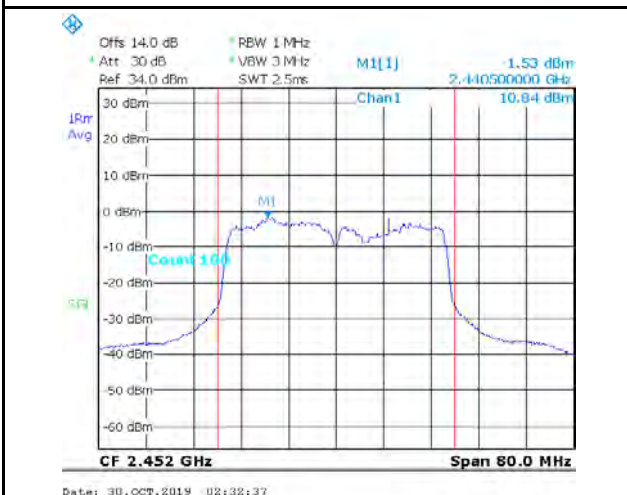
11n-40MHz-PWR-Low-TX2



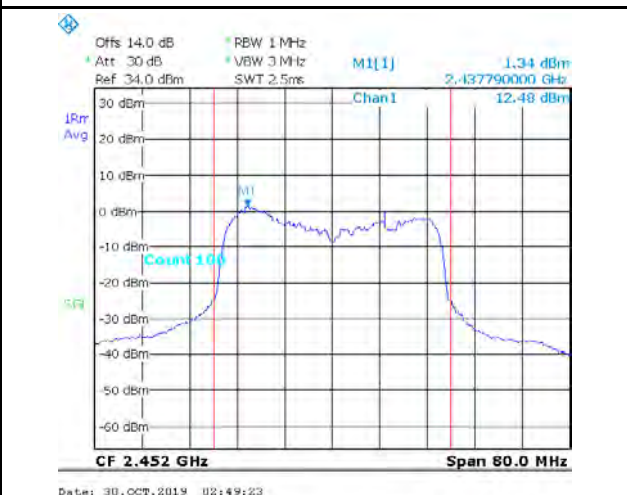
11n-40MHz-PWR-Mid-TX1



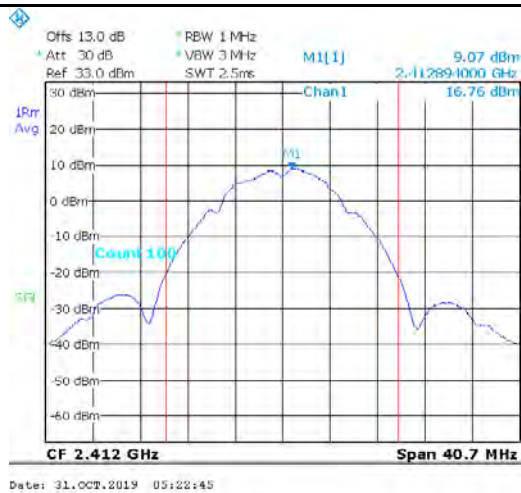
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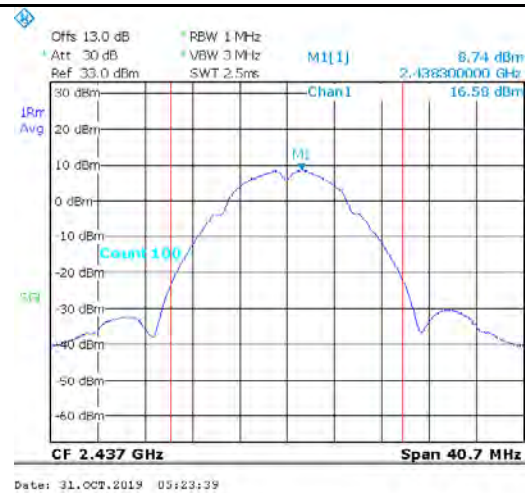
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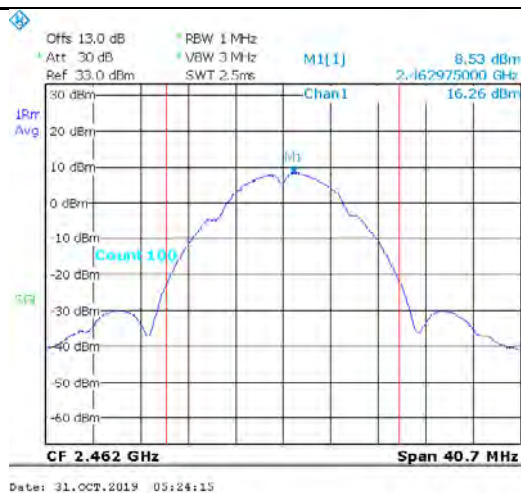
11n-40MHz-PWR-High-TX2



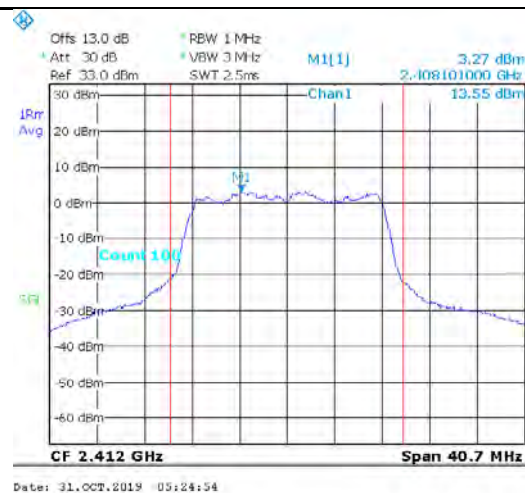
11b-PWR-Low-TX3



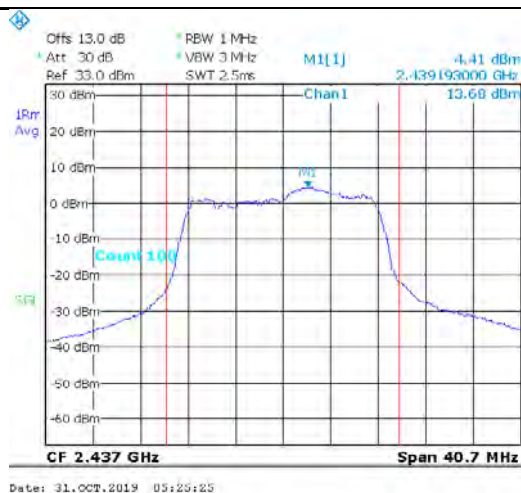
11b-PWR-Mid-TX3



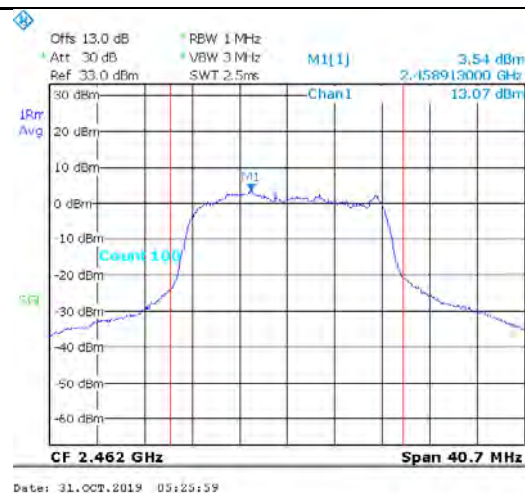
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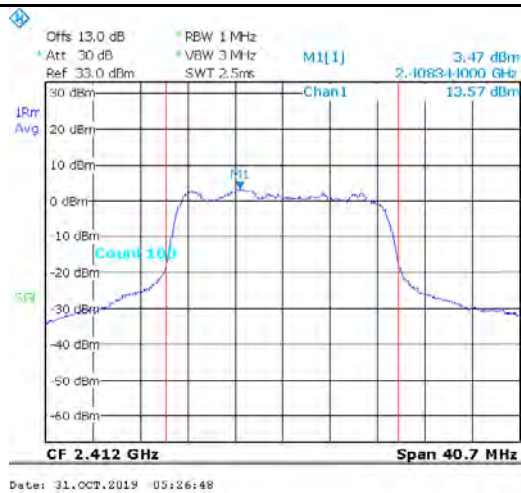
11g-PWR-Low-TX3



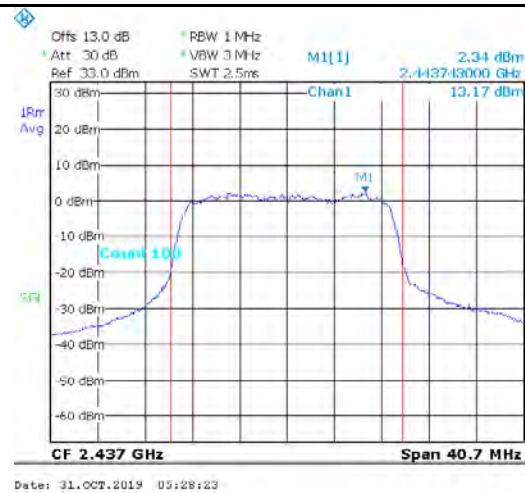
11g-PWR-Mid-TX3



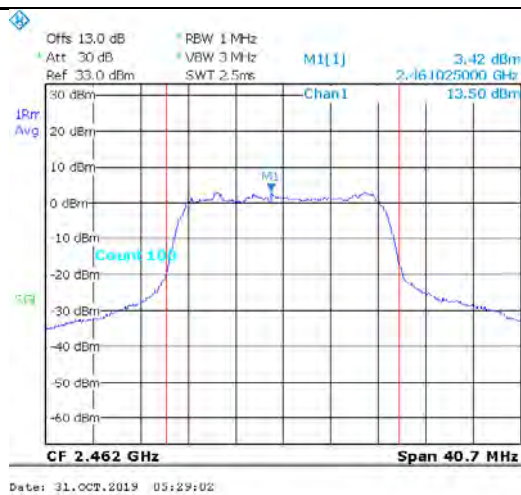
11g-PWR-High-TX3



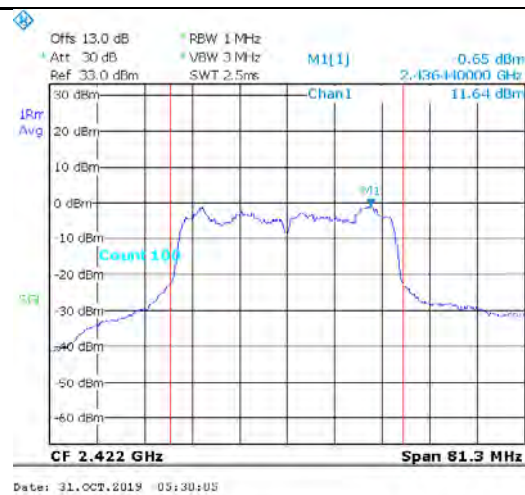
11n-20MHz-PWR-Low-TX3



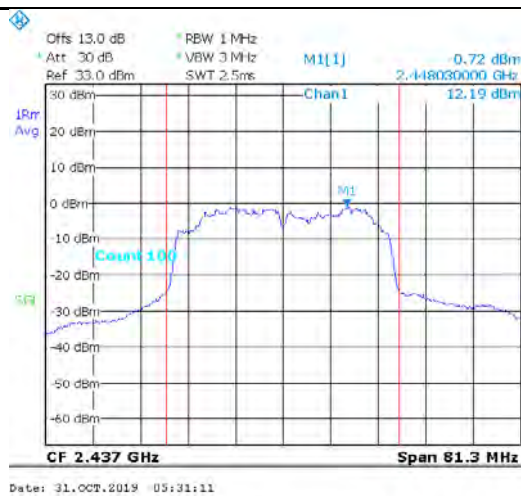
11n-20MHz-PWR-Mid-TX3



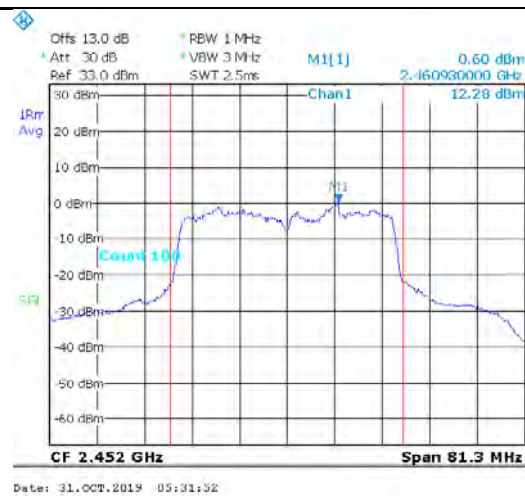
11n-20MHz-PWR-High-TX3



11n-40MHz-PWR-Low-TX3



11n-40MHz-PWR-Mid-TX3



11n-40MHz-PWR-High-TX3

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



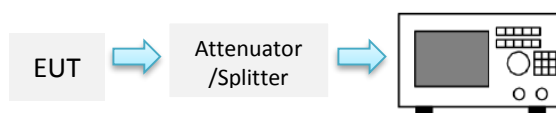
8.5 Power Spectral Density

8.5.1 Requirement

§ 15.247 (e), RSS-247 §5.2

For digitally modulated systems, 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

8.5.2 Test setup



8.5.3 Test Procedure

According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.2 PKPSD of ANSI C63.10-2013:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X DTS bandwidth.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

8.5.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
BLE	2402	1Mbps	-8.76	8	Pass
BLE	2440	1Mbps	-8.48	8	Pass
BLE	2480	1Mbps	-9.22	8	Pass

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 PSD (dBm/3KHz)	TX2 PSD (dBm/3KHz)	TX3 PSD (dBm/3KHz)	Highest or Total PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
11b	2412	1Mbps	2.11	2.16	-0.39	2.16	8	Pass
11b	2437	1Mbps	2.68	3.34	-1.71	3.34	8	Pass
11b	2462	1Mbps	2.79	2.51	-0.44	2.79	8	Pass
11g	2412	6Mbps	-8.34	-8.98	-12.01	-8.34	8	Pass
11g	2437	6Mbps	-9.49	-8.91	-12.43	-8.91	8	Pass
11g	2462	6Mbps	-9.73	-9.19	-11.93	-9.19	8	Pass
11n-20M	2412	MCS0	-9.44	-8.82	-13.76	-5.42	1.41	Pass
11n-20M	2437	MCS0	-10.6	-9.35	-13.17	-6.00	1.41	Pass
11n-20M	2462	MCS0	-9.47	-9.29	-13.08	-5.53	1.41	Pass
11n-40M	2422	MCS0	-12.22	-11.89	-16.50	-8.32	1.41	Pass
11n-40M	2437	MCS0	-13.5	-12.2	-15.79	-8.82	1.41	Pass
11n-40M	2452	MCS0	-14.05	-12.04	-15.45	-8.85	1.41	Pass

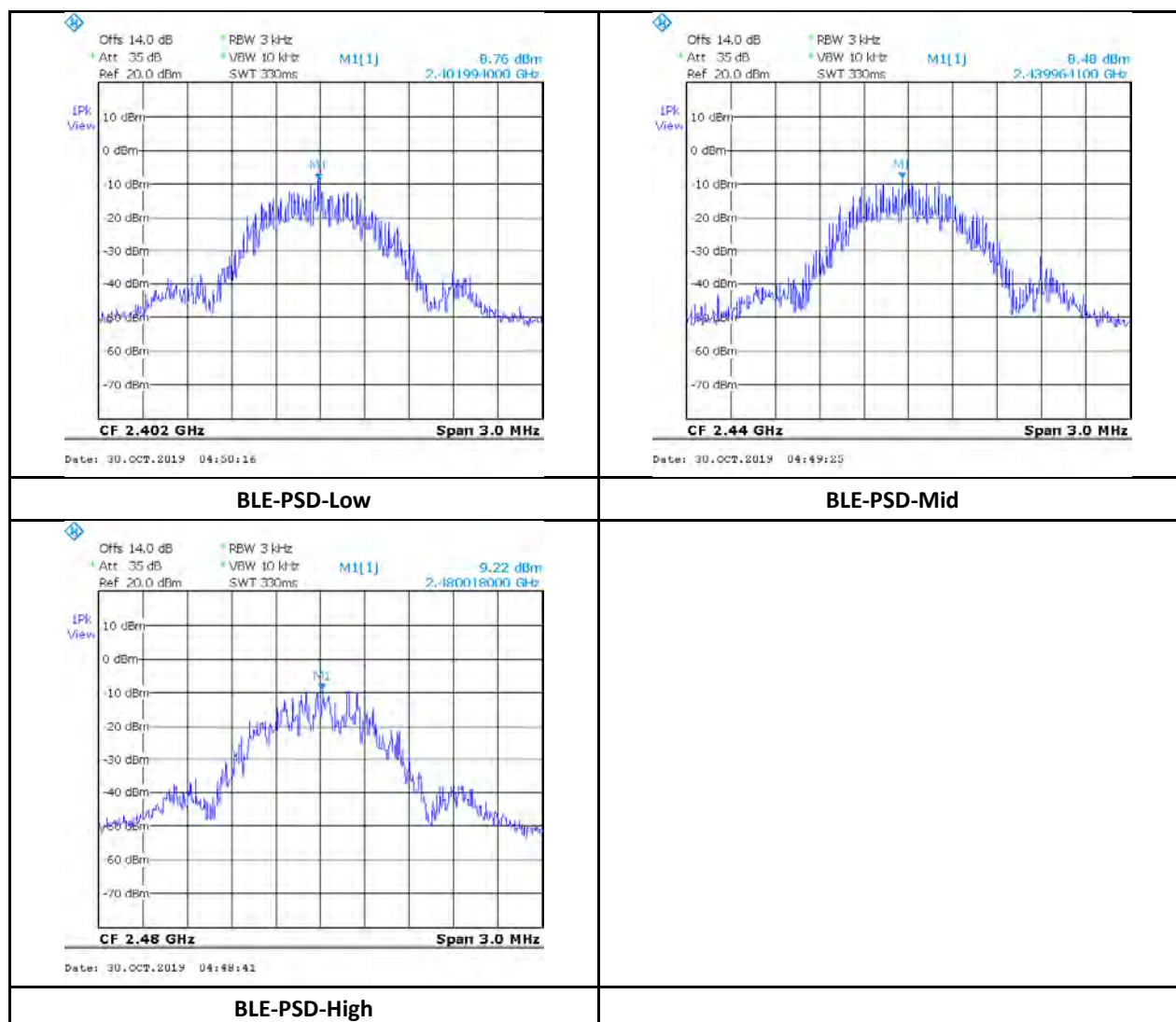
Note:

- 1) For 802.11b/g, the highest output power is recorded.
- 2) For 2.4GHz 802.11n mode, it's under 3x3 MIMO mode, the PSD is combined together to compare to limit.
- 3) For 2.4GHz 11n mode, directional gain is calculated per KDB 662911 D01. For 2.4GHz WiFi, directional gain = 12.59 dBi. The PSD limit is reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

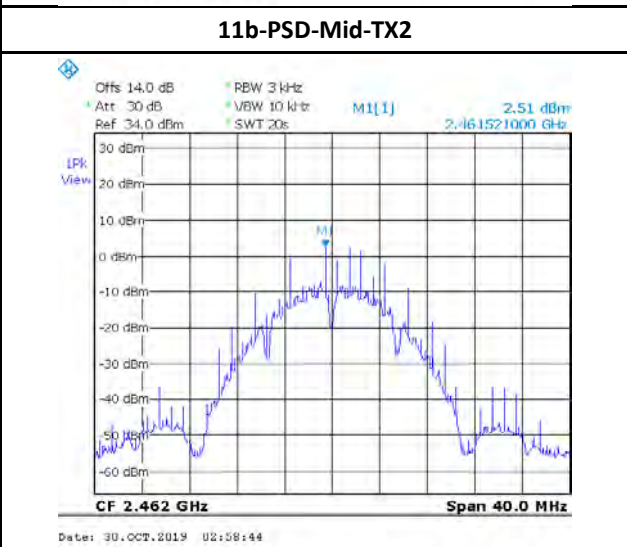
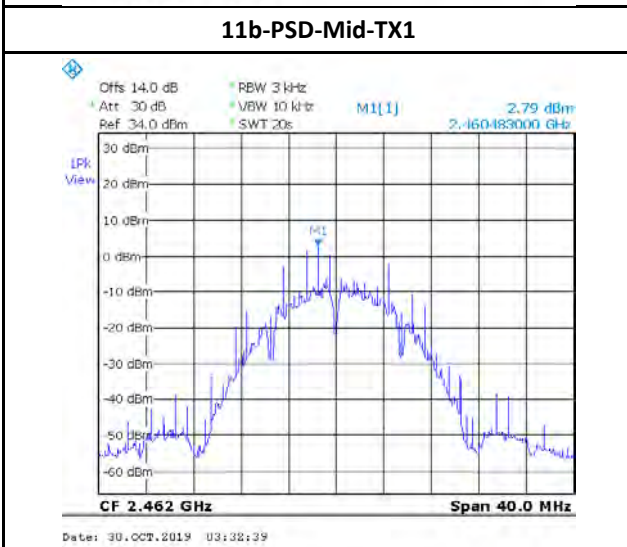
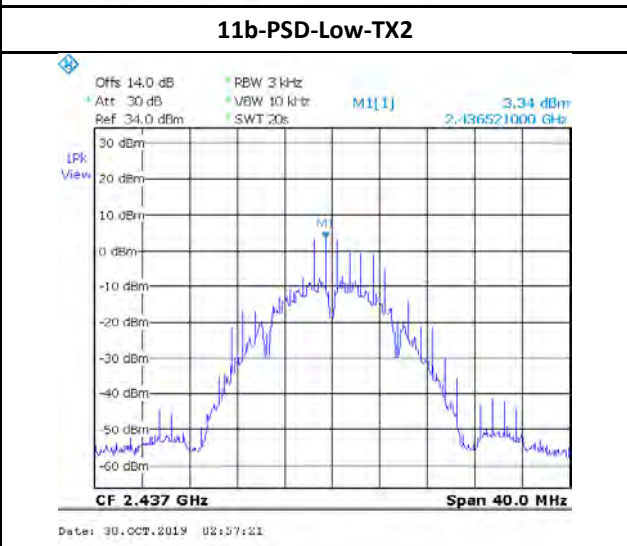
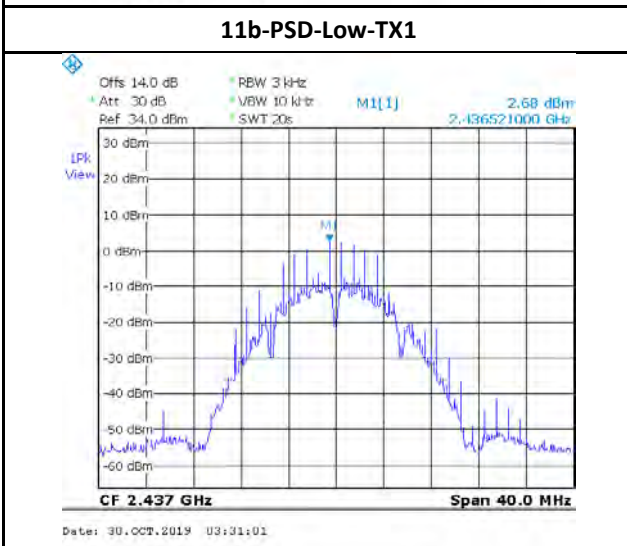
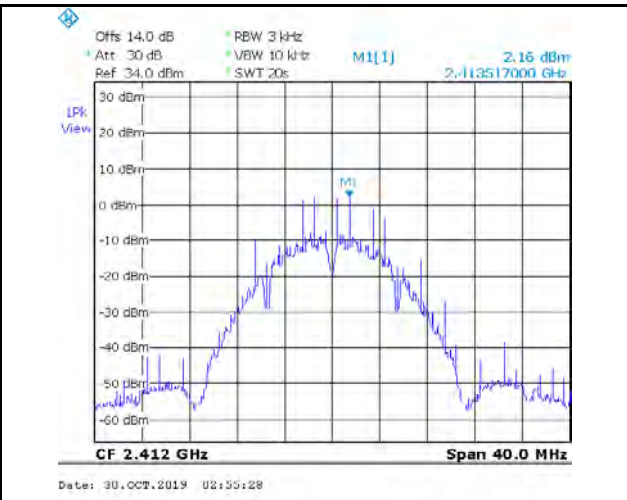
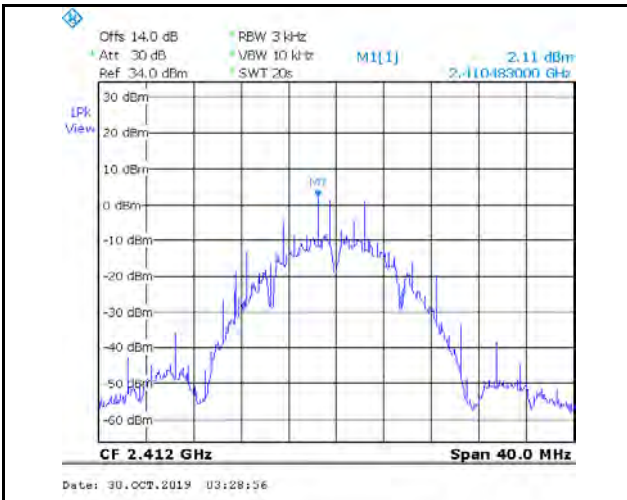
Report Number:	WAP-19091821-LC-FCC-IC-DTS
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA

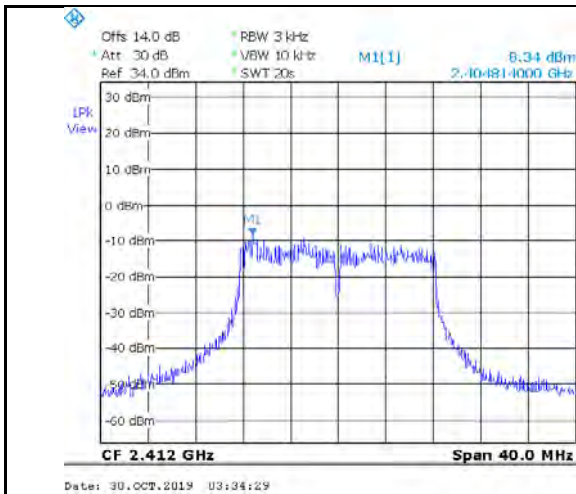


8.5.5 Test Plots

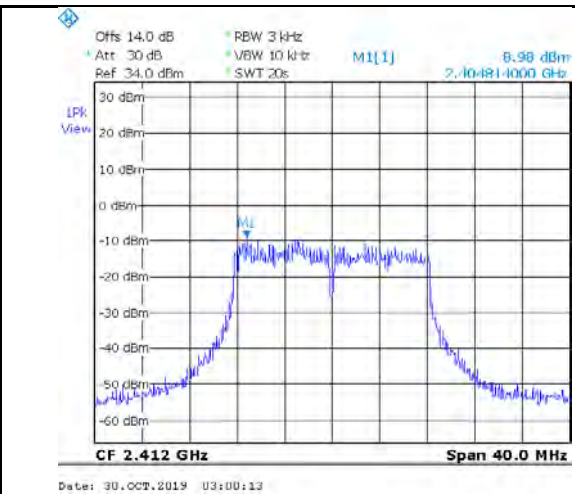


Report Number: WAP-19091821-LC-FCC-IC-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA

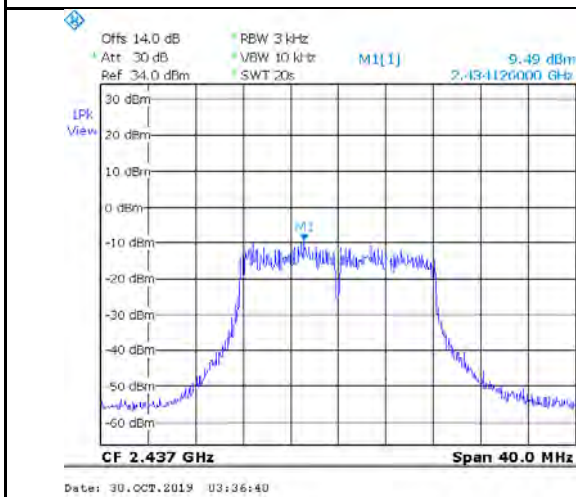




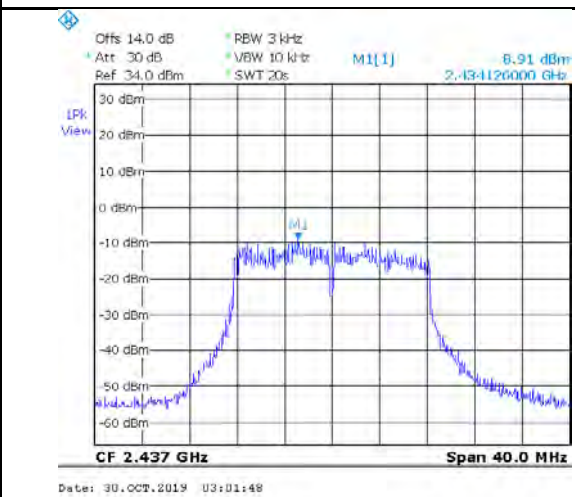
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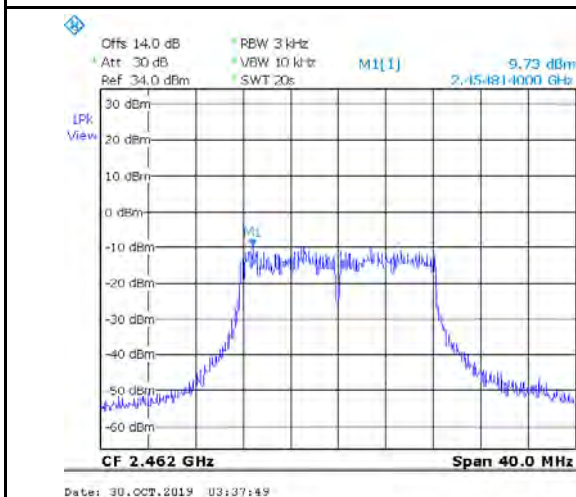
11g-PSD-Low-TX2



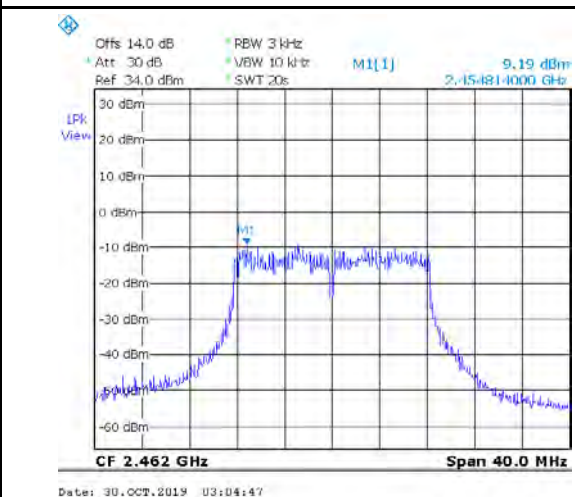
11g-PSD-Mid-TX1



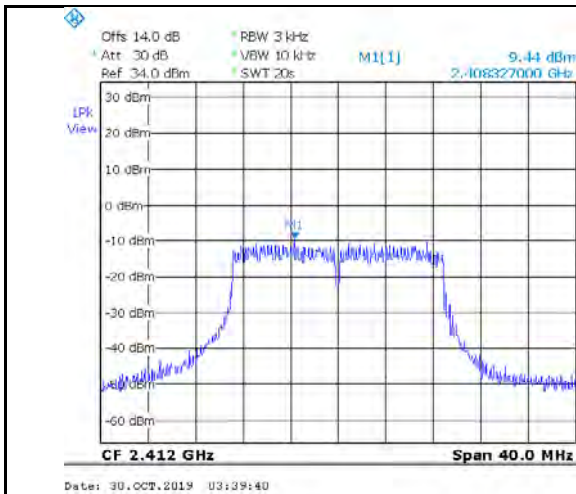
11g-PSD-Mid-TX2



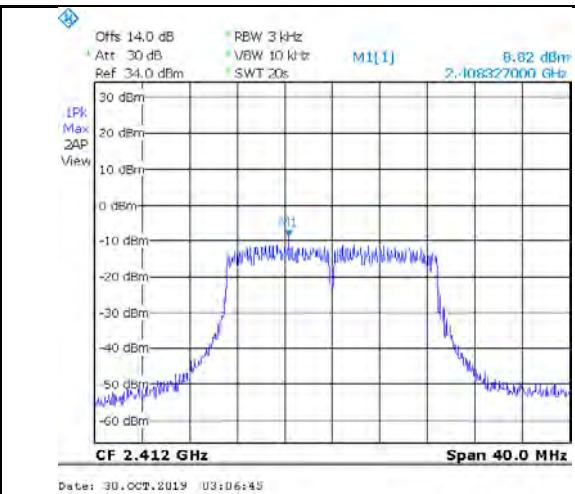
11g-PSD-High-TX1



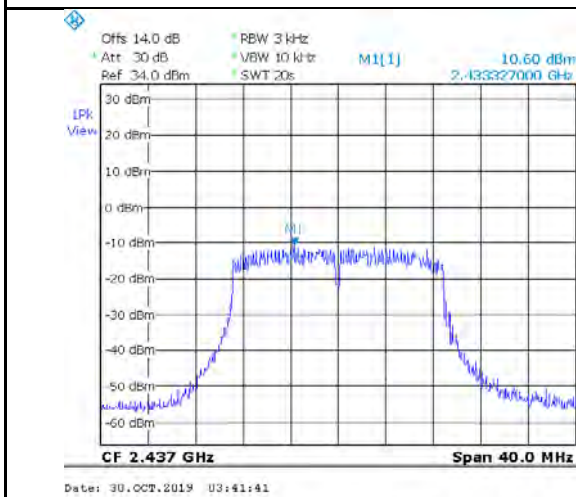
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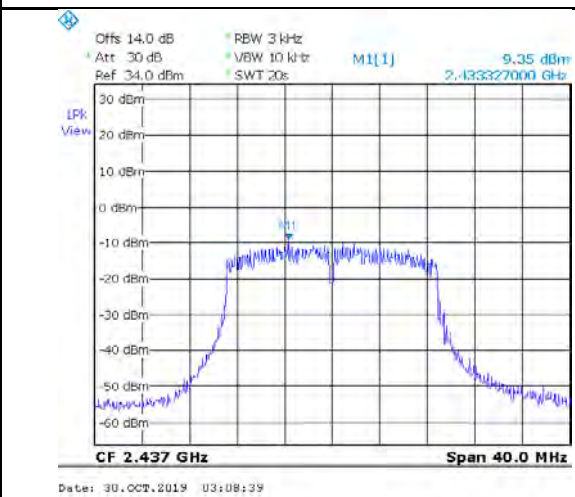
11n-20MHz-PSD-Low-TX1



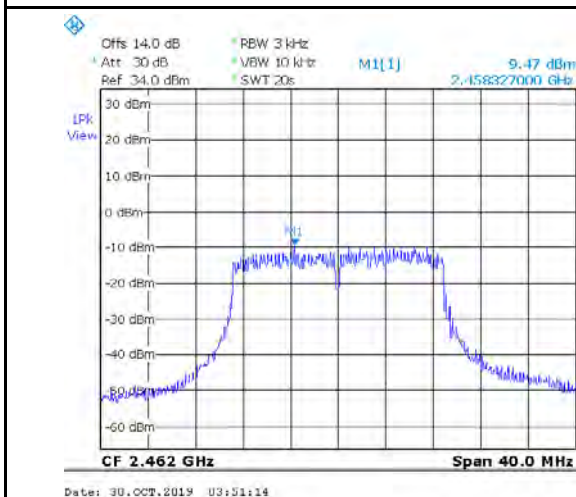
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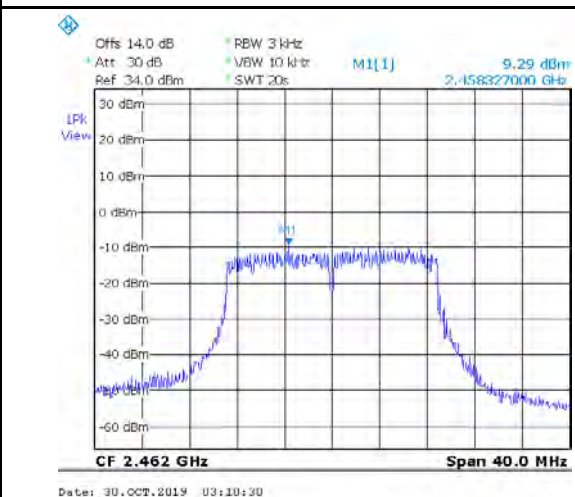
11n-20MHz-PSD-Mid-TX1



11n-20MHz-PSD-Mid-TX2

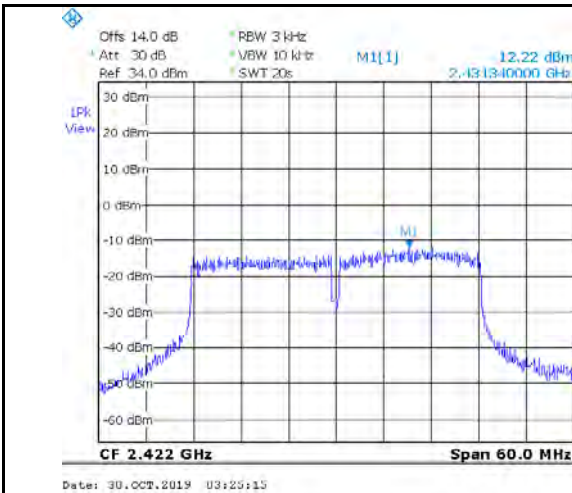


11n-20MHz-PSD-High-TX1

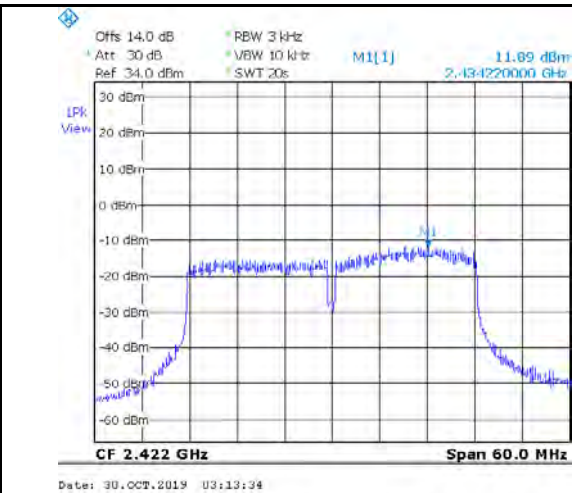


11n-20MHz-PSD-High-TX2

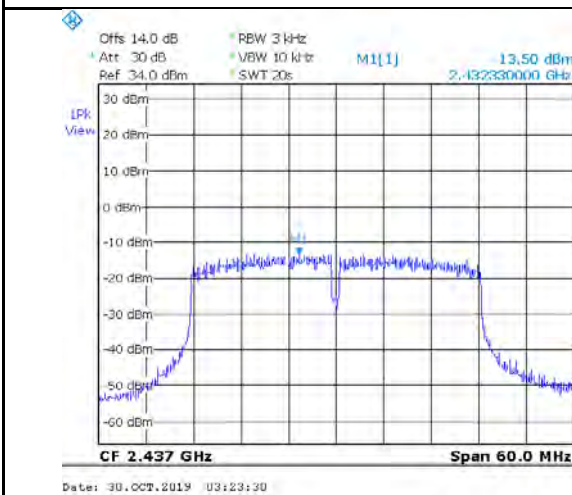
Report Number: WAP-19091821-LC-FCC-IC-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



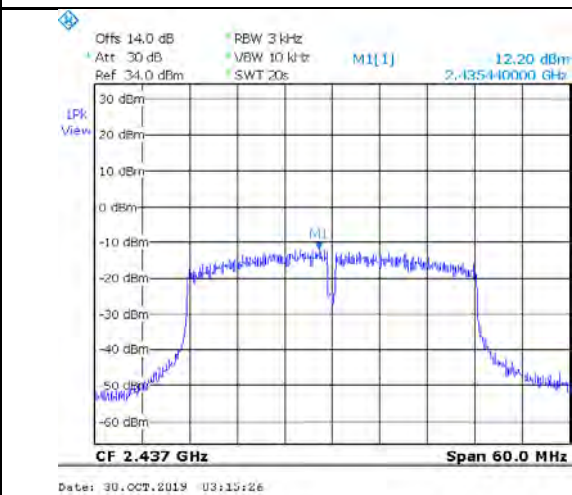
11n-40MHz-PSD-Low-TX1



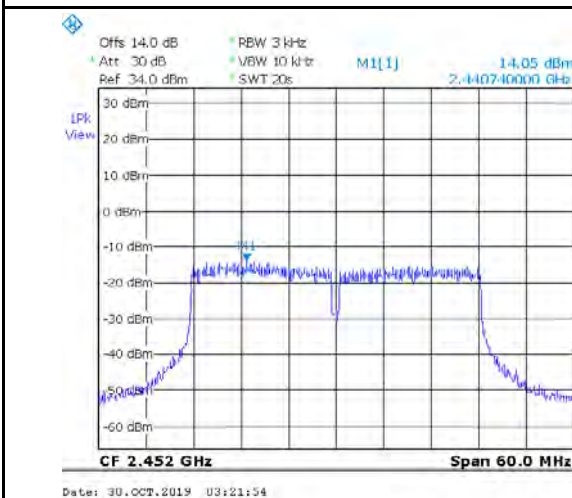
11n-40MHz-PSD-Low-TX2



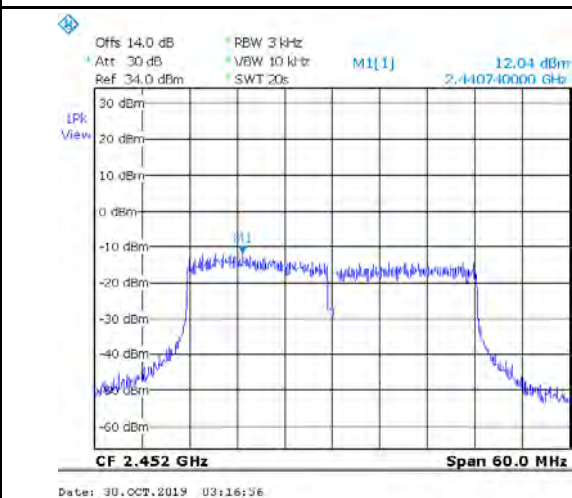
11n-40MHz-PSD-Mid-TX1



11n-40MHz-PSD-Mid-TX2

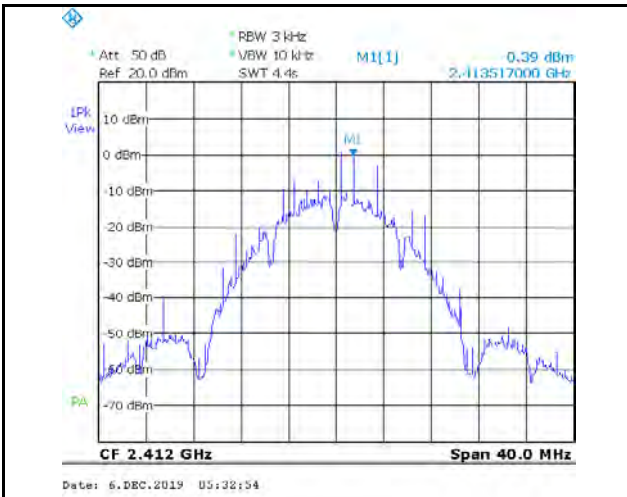


11n-40MHz-PSD-High-TX1



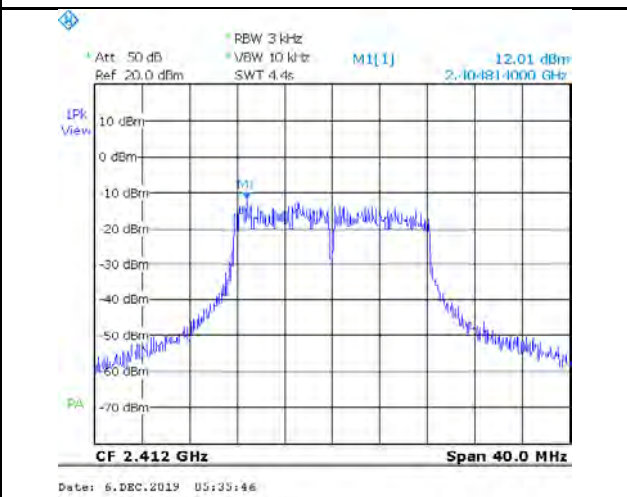
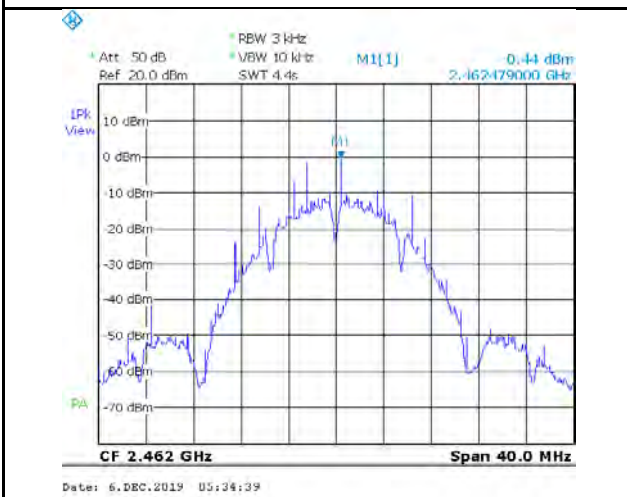
11n-40MHz-PSD-High-TX2

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



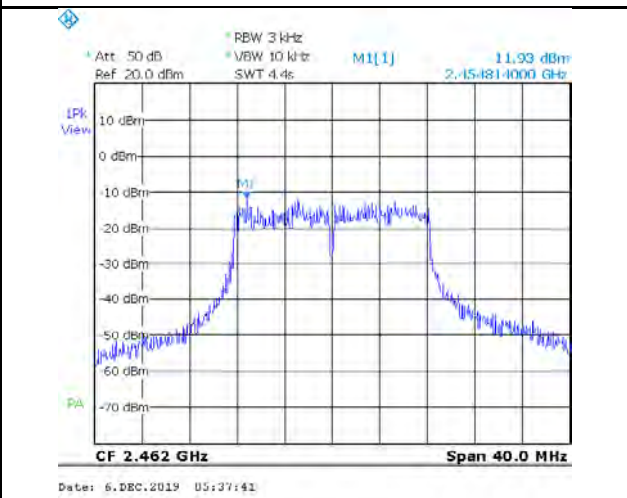
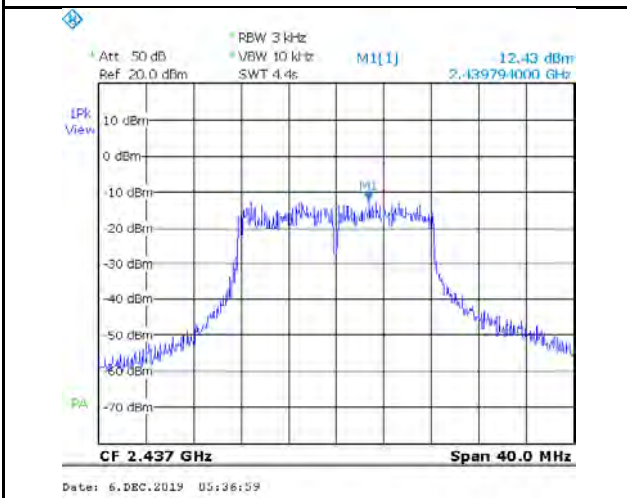
11b-PSD-Low-TX3

11b-PSD-Mid-TX3



11b-PSD-High-TX3

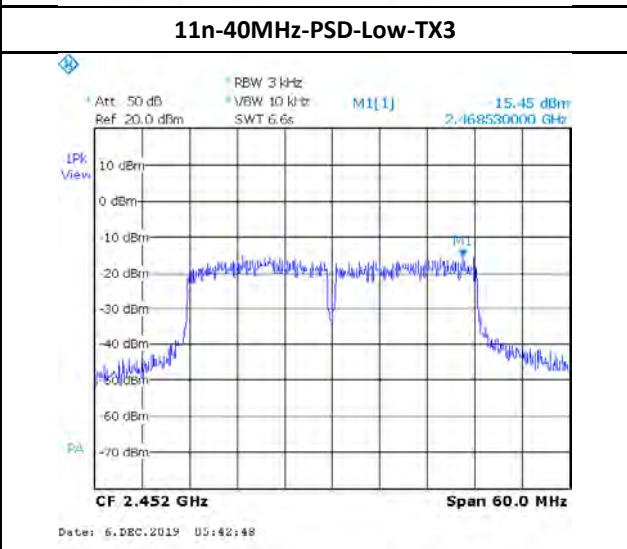
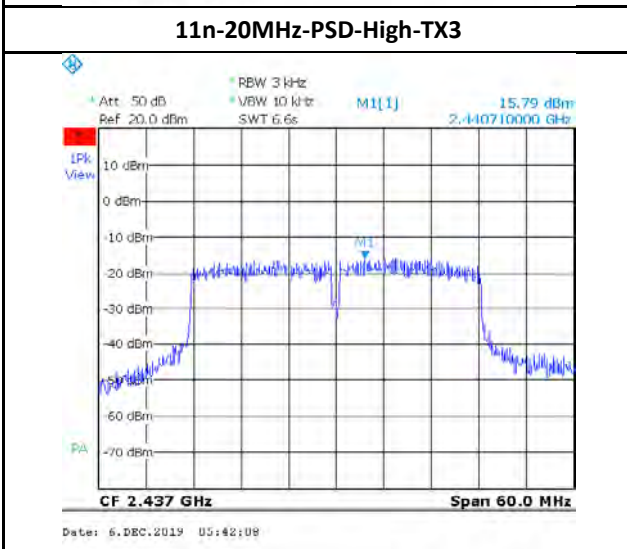
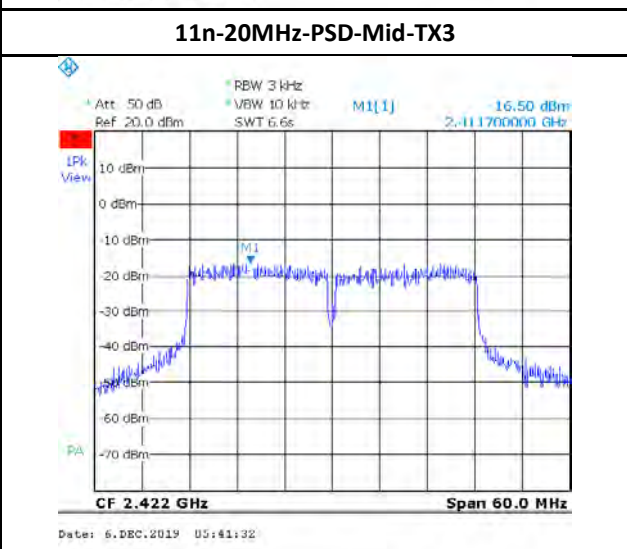
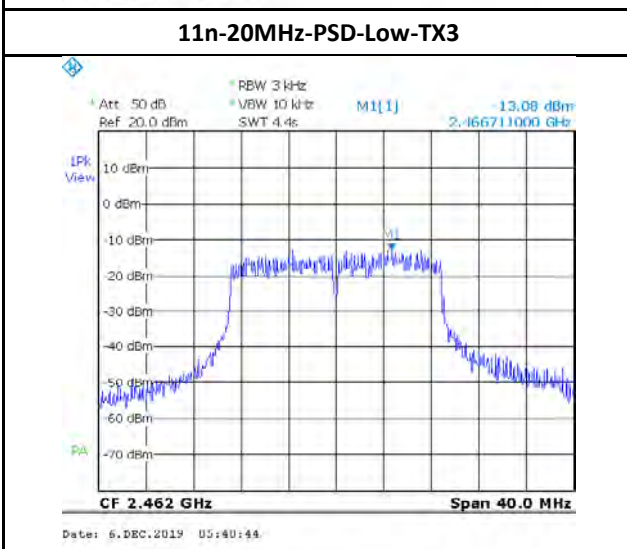
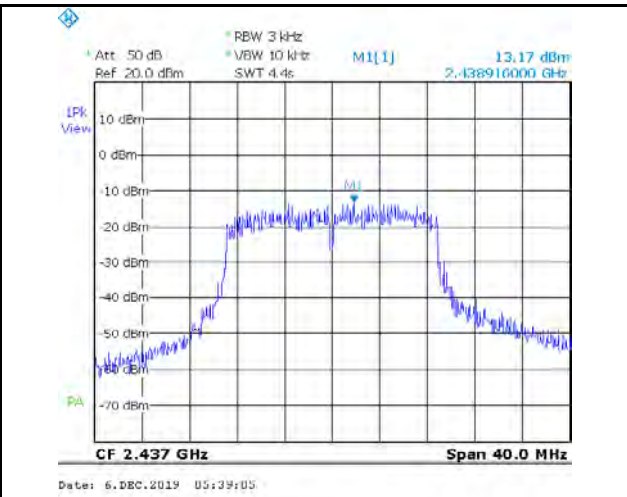
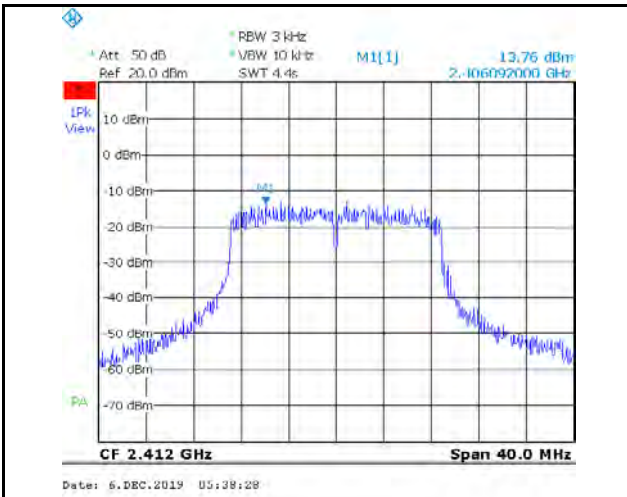
11g-PSD-Low-TX3



11g-PSD-Mid-TX3

11g-PSD-High-TX3

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



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



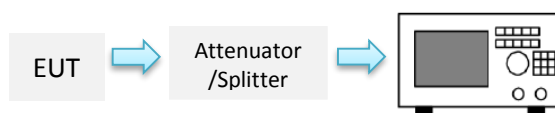
8.6 Conducted Band-Edge & Unwanted Emissions Measurement

8.6.1 Requirement

§ 15.247 (d), RSS-247 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

8.6.2 Test setup



8.6.3 Test Procedure

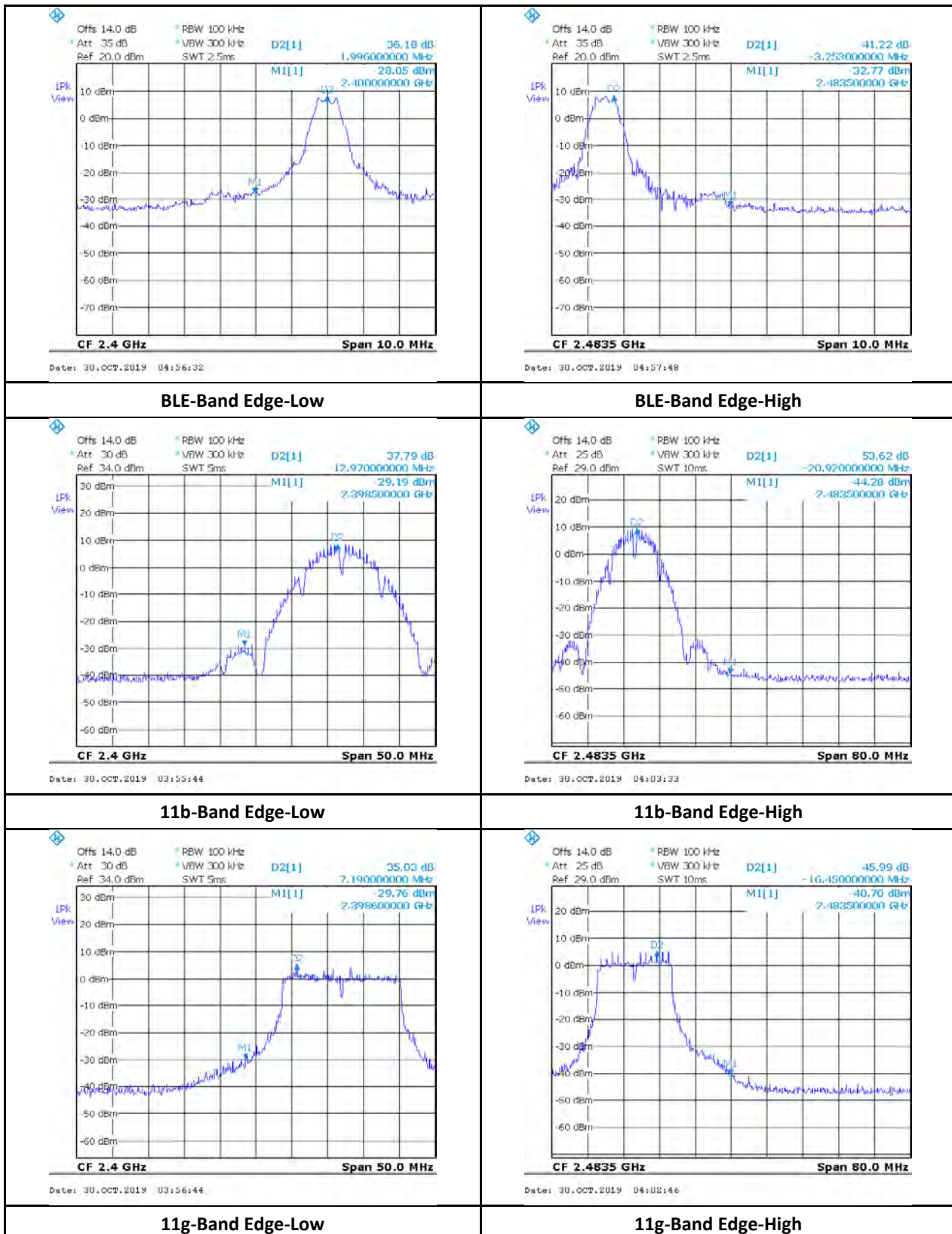
According to section 8.5 Emission level measurement, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.11.3 in ANSI C63.10-2013:

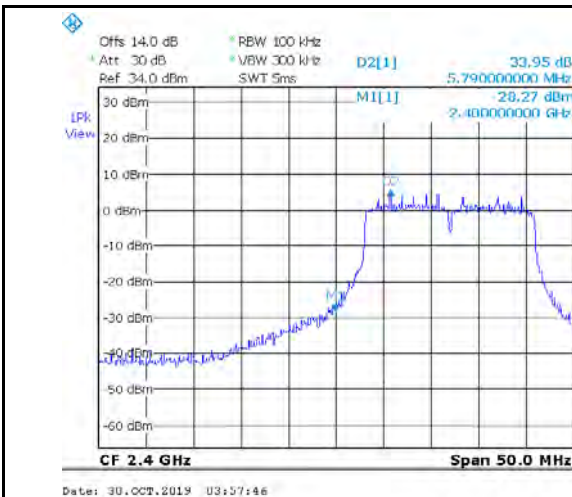
1. Set the centre frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

8.6.4 Test Result

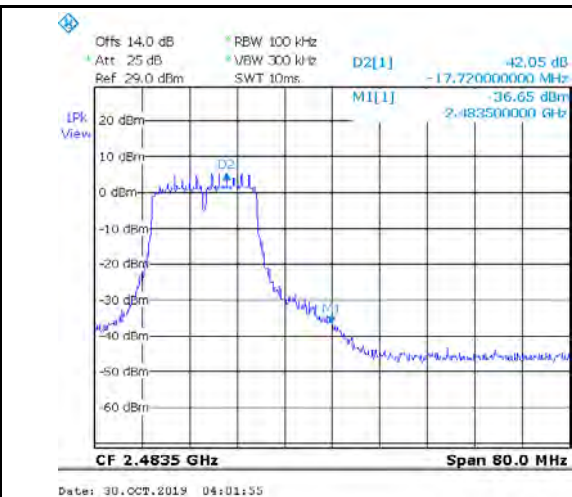
See test plots

8.6.5 Test Plots

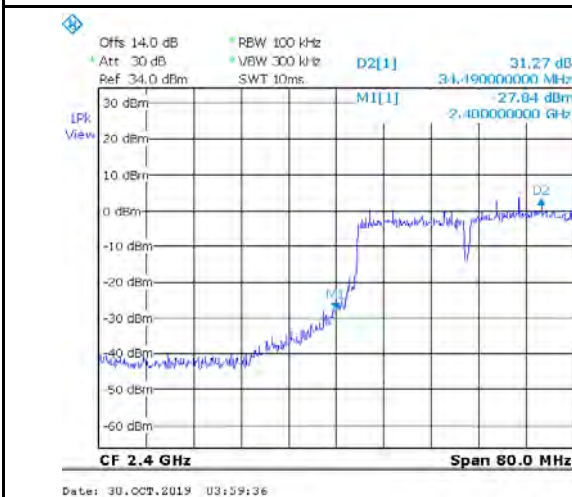




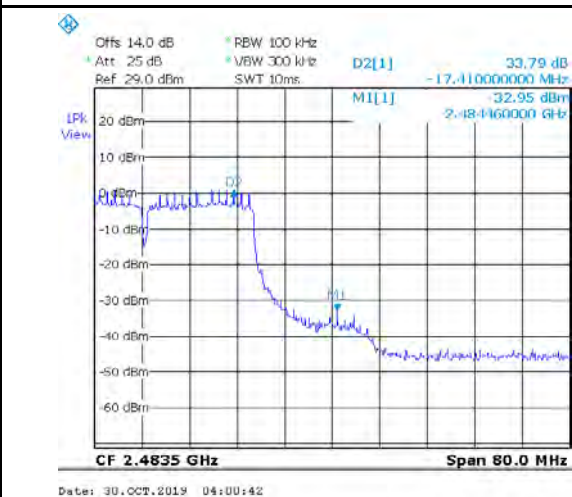
11n-20MHz-Band Edge-Low



11n-20MHz-Band Edge-High

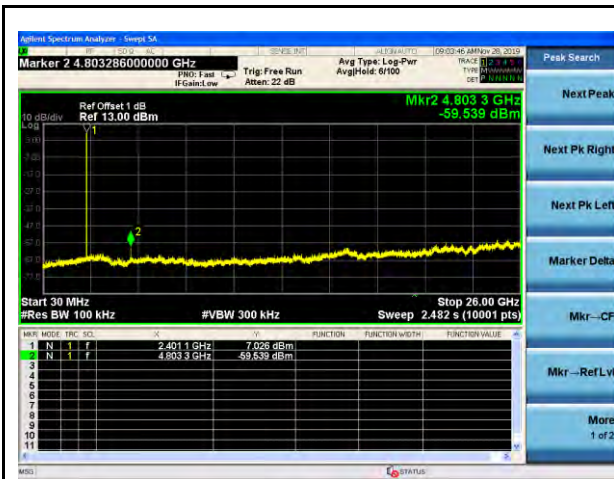


11n-40MHz-Band Edge-Low



11n-40MHz-Band Edge-High

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



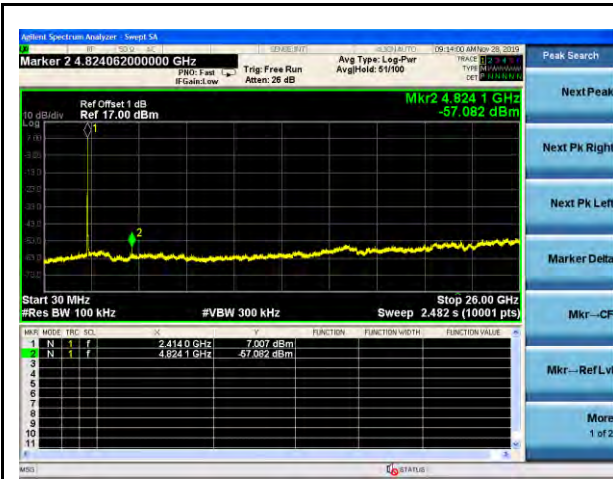
BLE-Out Of Band Emission-Low



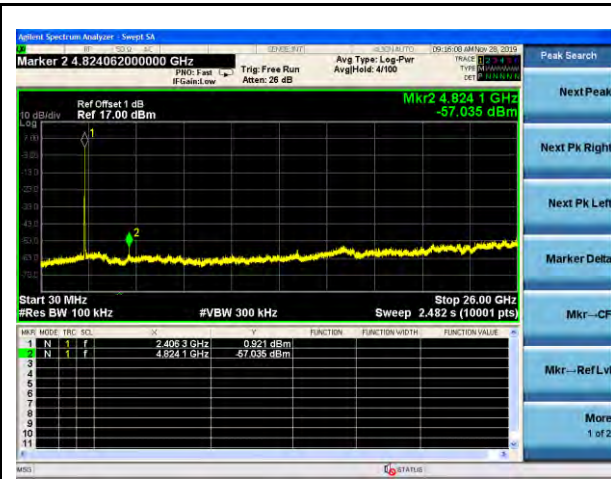
BLE-Out Of Band Emission-Mid



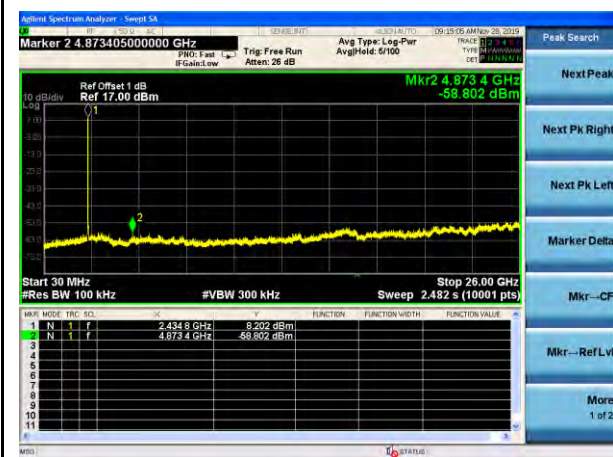
BLE-Out Of Band Emission-High



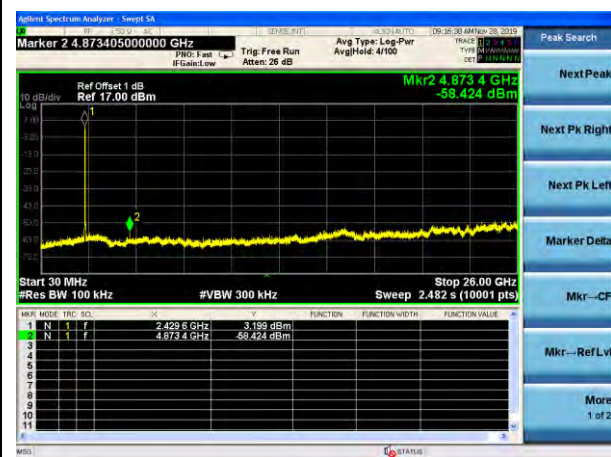
11b-Out Of Band Emission-Low



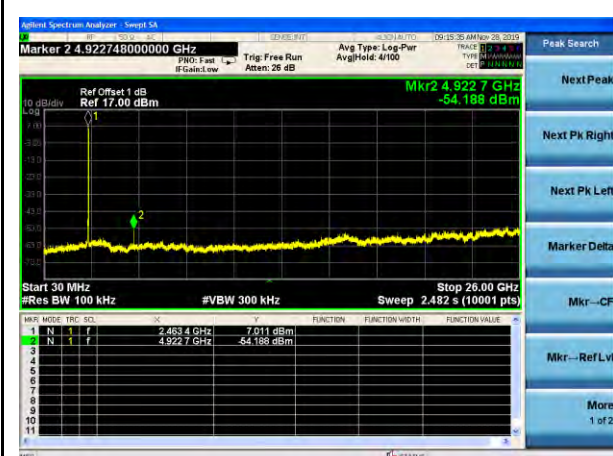
11g-Out Of Band Emission-Low



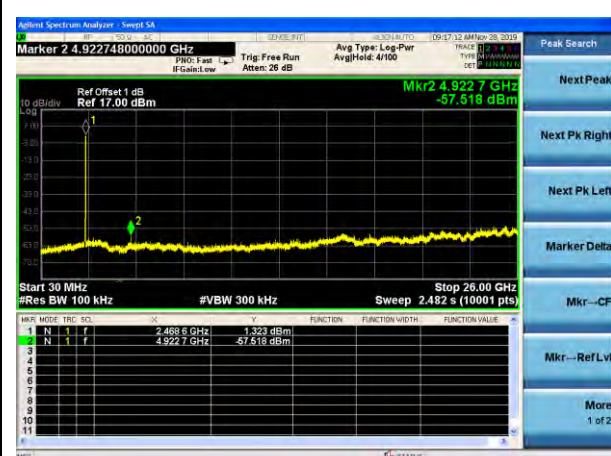
11b-Out Of Band Emission-Mid



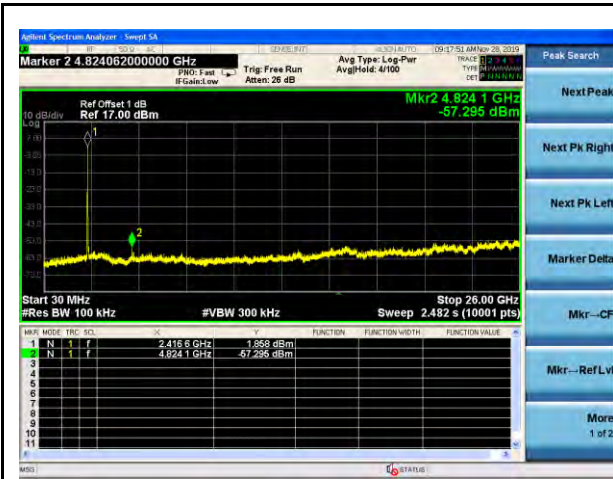
11g-Out Of Band Emission-Mid



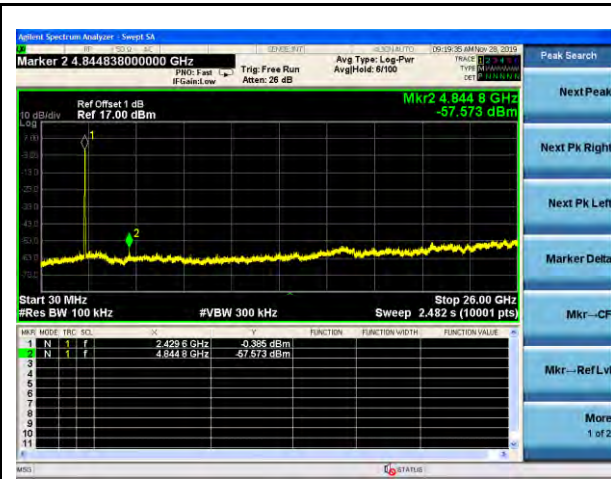
11b-Out Of Band Emission-High



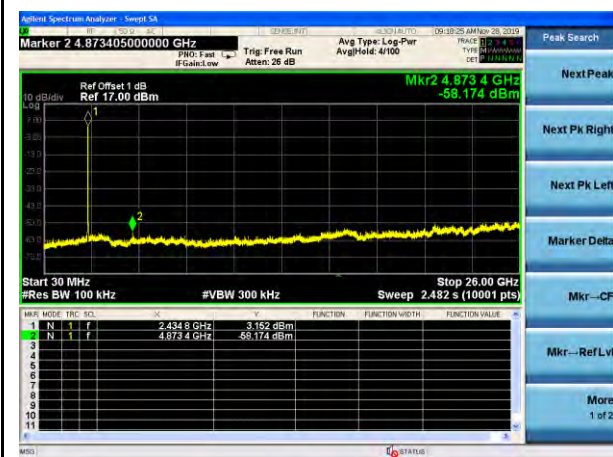
11g-Out Of Band Emission-High



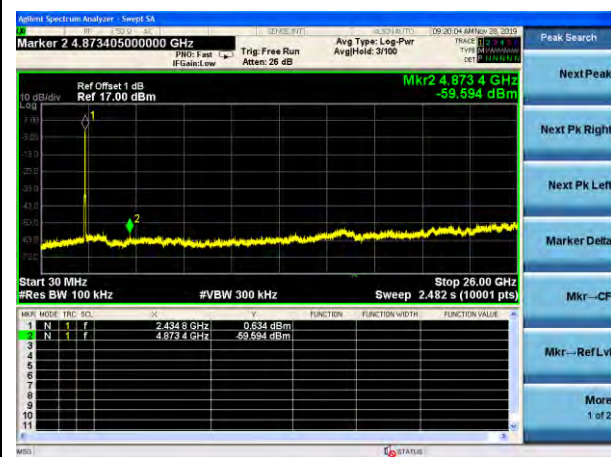
11n 20MHz-Out Of Band Emission-Low



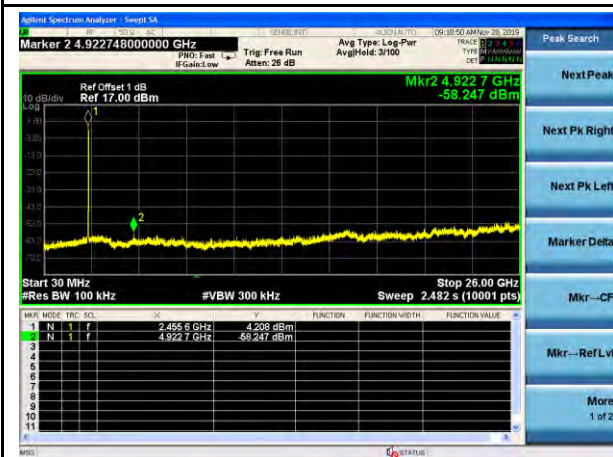
11n 40MHz-Out Of Band Emission-Low



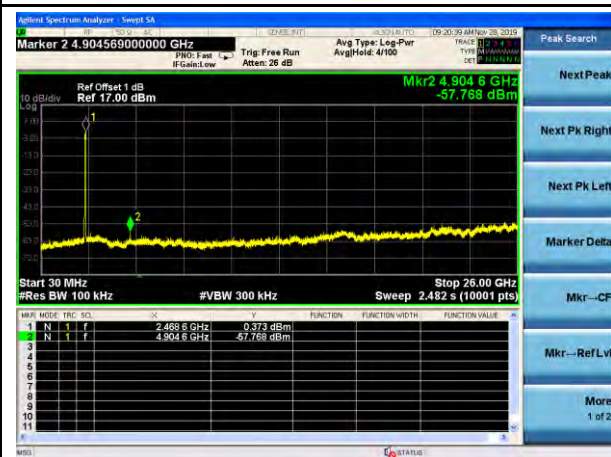
11n 20MHz-Out Of Band Emission-Mid



11n 40MHz-Out Of Band Emission-Mid



11n 20MHz-Out Of Band Emission-High



11n 40MHz-Out Of Band Emission-High

8.7 Radiated Band-Edge & Spurious Emissions into Restricted Frequency Bands

8.7.1 Requirement

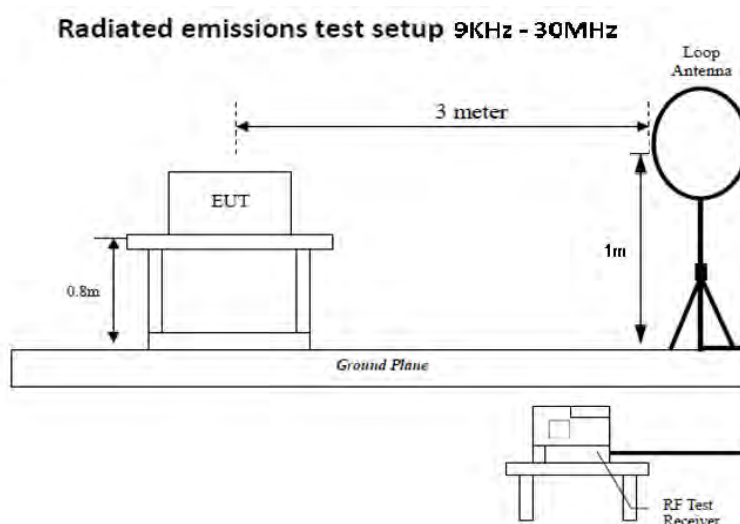
§ 15.247 (d), RSS-247 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

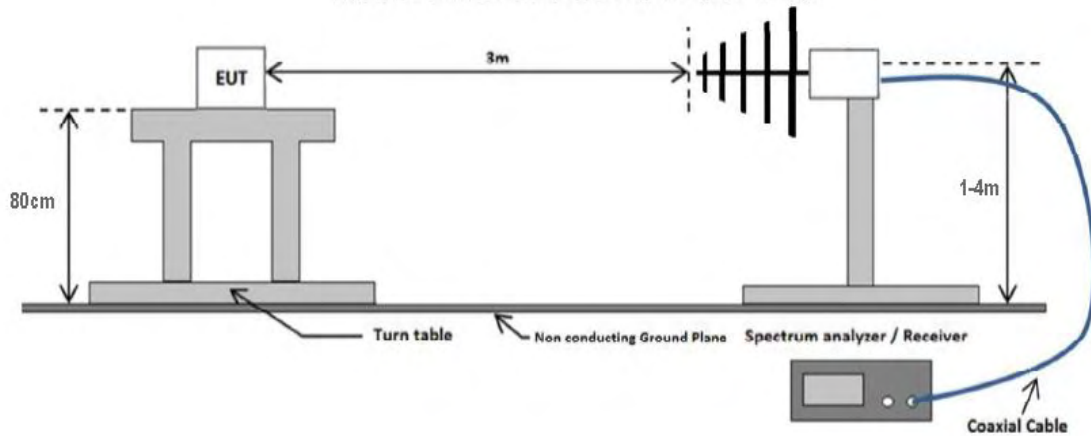
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency range (MHz)	Field Strength ($\mu\text{V/m}$)
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

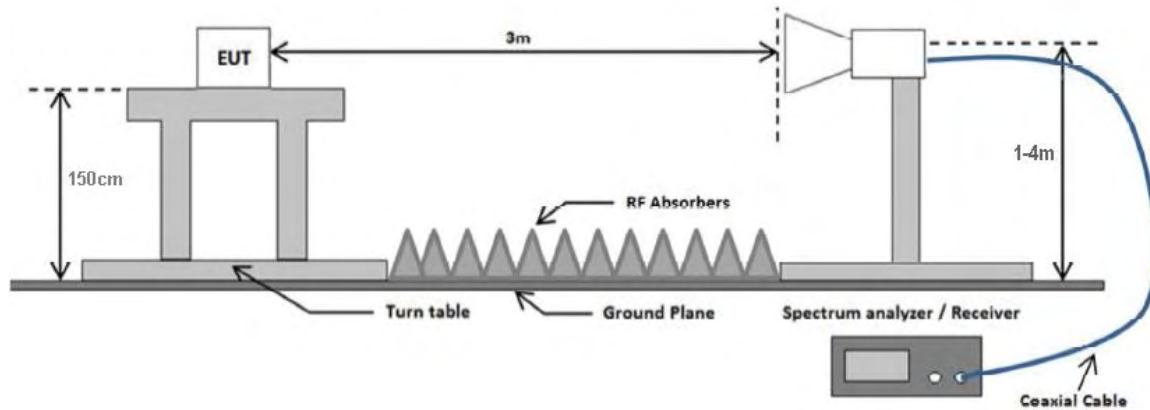
8.7.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



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



8.7.3 Test Procedure

According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 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.

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

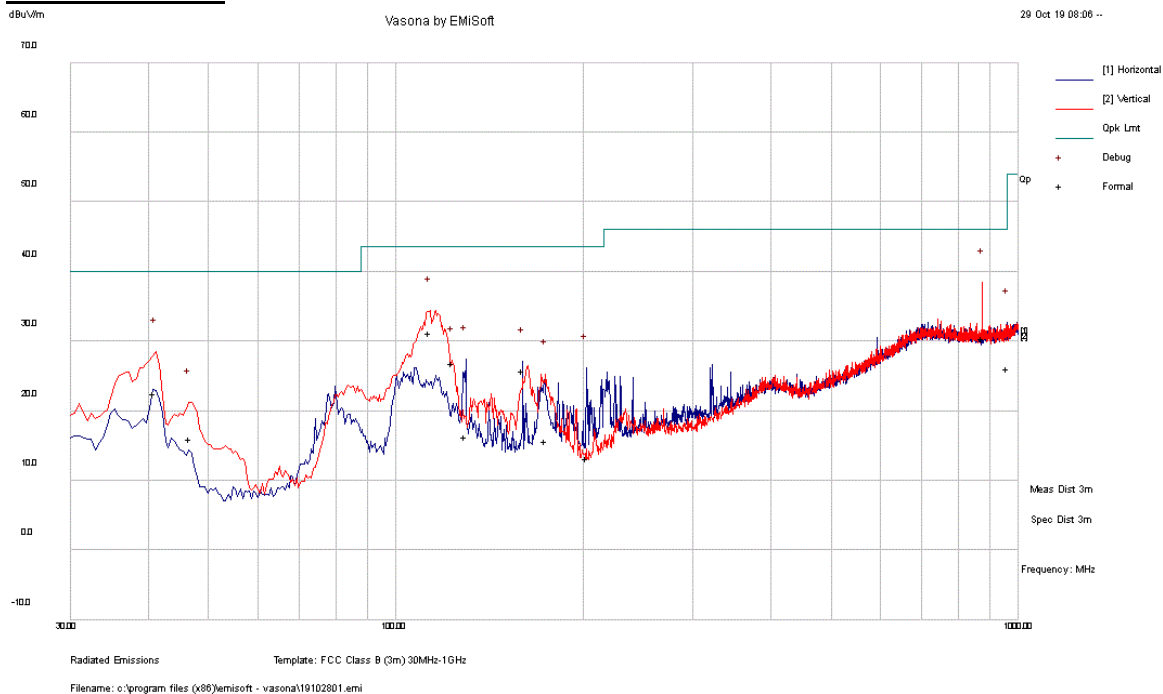


8.7.4 Test Result

RADIATED EMISSIONS < 1 GHZ

Test Standard:	15.209, 15.247	Mode:	BLE 2402 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

BLE 2402 MHz



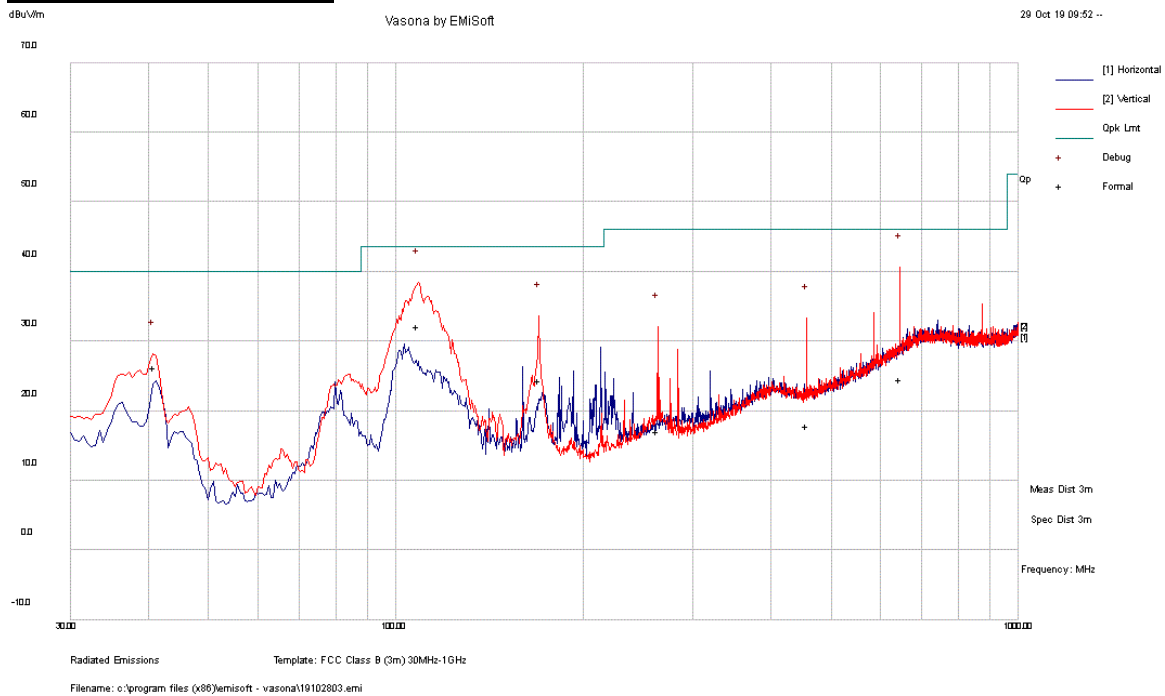
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
875.45	30.00	7.52	-7.12	30.40	Quasi Max	V	264	124	46.00	-15.60	Pass
113.4	50.77	3.78	-23.33	31.22	Quasi Max	V	Pass	238	43.50	-12.28	Pass
40.98	41.01	2.57	-20.97	22.61	Quasi Max	V	147	226	40.00	-17.39	Pass
959.13	24.86	7.84	-6.59	26.10	Quasi Max	H	250	332	46.00	-19.90	Pass
129.41	35.22	4.00	-22.94	16.28	Quasi Max	H	183	126	43.50	-27.22	Pass
123.31	46.07	3.92	-23.08	26.90	Quasi Max	V	100	216	43.50	-16.60	Pass
159.99	43.85	4.35	-22.36	25.85	Quasi Max	H	186	180	43.50	-17.65	Pass
202.41	30.21	4.76	-21.67	13.30	Quasi Max	H	135	107	43.50	-30.20	Pass
174.18	33.29	4.50	-22.15	15.64	Quasi Max	V	131	244	43.50	-27.86	Pass
46.61	36.83	2.71	-23.54	16.00	Quasi Max	V	102	322	40.00	-24.00	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11b 2412 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 11b 2412 MHz



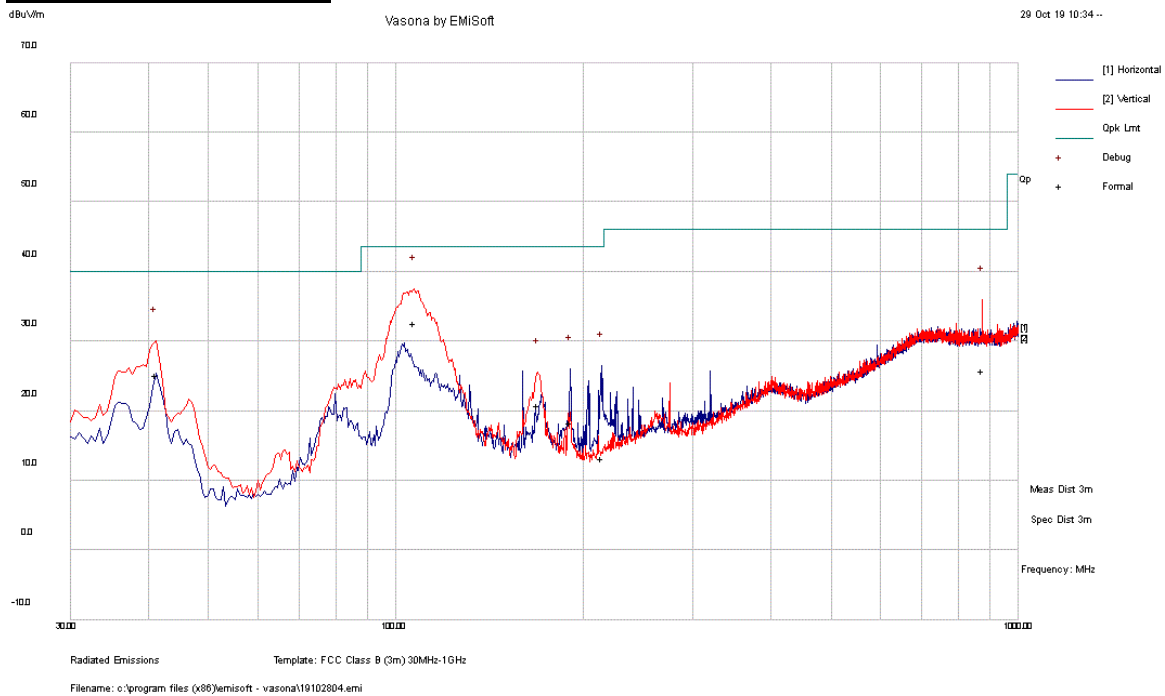
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
108.36	51.94	3.70	-23.46	32.18	Quasi Max	V	139	156	43.50	-11.32	Pass
645.47	25.60	7.24	-8.26	24.57	Quasi Max	V	343	182	46.00	-21.43	Pass
169.73	42.12	4.45	-22.21	24.37	Quasi Max	V	100	345	43.50	-19.13	Pass
40.9	44.64	2.57	-20.93	26.28	Quasi Max	V	146	325	40.00	-13.72	Pass
456.58	25.65	6.20	-13.92	17.92	Quasi Max	V	230	336	46.00	-28.08	Pass
263.53	30.85	5.38	-19.10	17.12	Quasi Max	V	168	156	46.00	-28.88	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11g 2412 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 11g 2412 MHz



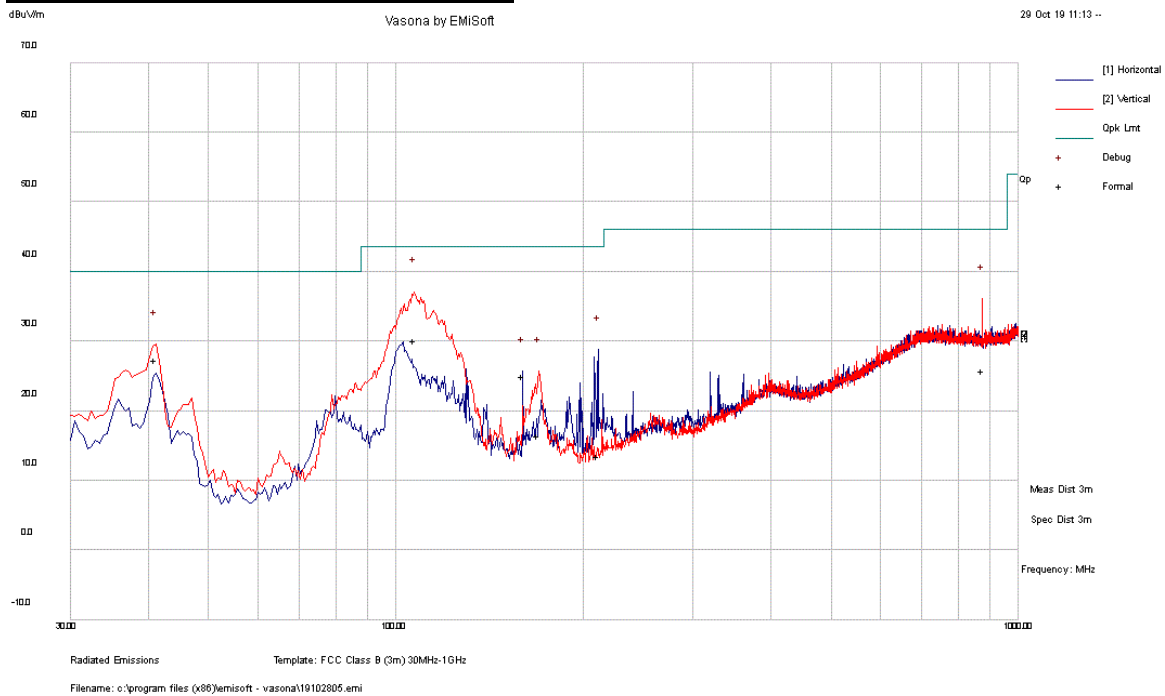
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
107.25	52.52	3.68	-23.49	32.71	Quasi Max	V	126	198	43.50	-10.79	Pass
41.21	43.63	2.58	-21.09	25.12	Quasi Max	V	118	Pass	40.00	-14.88	Pass
875.52	25.42	7.52	-7.12	25.83	Quasi Max	V	166	272	46.00	-20.17	Pass
214.47	29.41	4.89	-21.01	13.29	Quasi Max	H	211	273	43.50	-30.21	Pass
190.44	35.65	4.65	-21.93	18.37	Quasi Max	H	167	360	43.50	-25.13	Pass
169.13	38.58	4.45	-22.22	20.81	Quasi Max	V	128	342	43.50	-22.69	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 20MHz BW 2462 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 2462 MHz



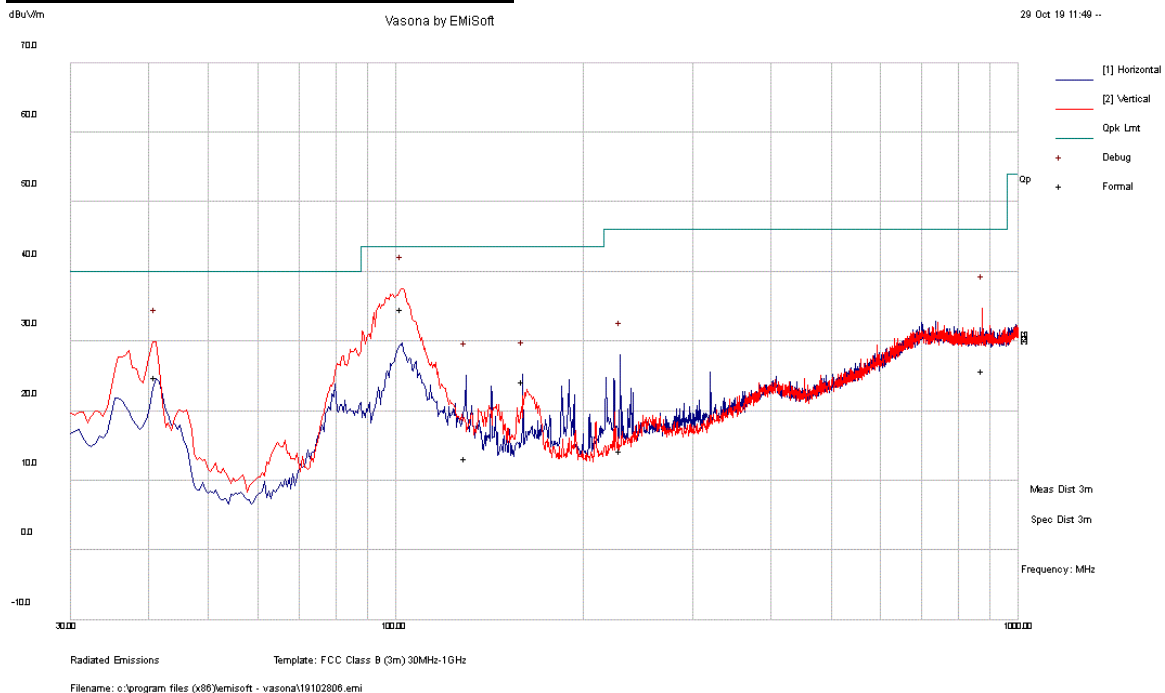
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
107.28	50.04	3.68	-23.49	30.23	Quasi Max	V	149	87	43.50	-13.27	Pass
875.27	25.41	7.52	-7.12	25.81	Quasi Max	V	163	144	46.00	-20.19	Pass
41.01	45.73	2.57	-20.99	27.31	Quasi Max	V	100	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-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 40MHz BW 2412 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 2412 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
102.14	54.67	3.60	-23.63	34.64	Quasi Max	V	125	212	43.50	-8.86	Pass
41.06	43.34	2.57	-21.01	24.90	Quasi Max	V	154	329	40.00	-15.10	Pass
875.54	25.45	7.52	-7.12	25.85	Quasi Max	V	192	58	46.00	-20.15	Pass
229.25	29.55	5.05	-20.24	14.35	Quasi Max	H	125	52	46.00	-31.65	Pass
160.0	42.28	4.35	-22.36	24.28	Quasi Max	H	147	174	43.50	-19.22	Pass
129.43	32.19	4.00	-22.94	13.25	Quasi Max	H	315	27	43.50	-30.25	Pass

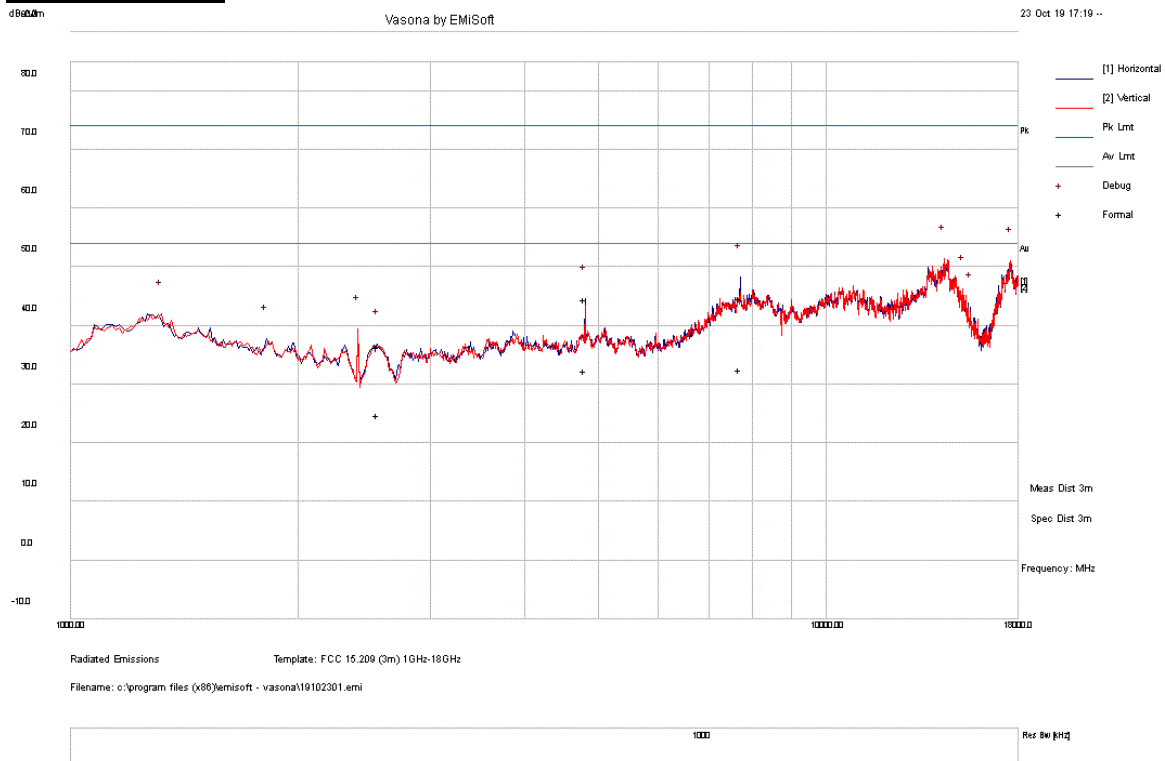
Report Number: WAP-19091821-LC-FCC-IC-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



RADIATED EMISSIONS > 1 GHz

Test Standard:	15.209, 15.247	Mode:	BLE 2402 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

BLE 2402 MHz



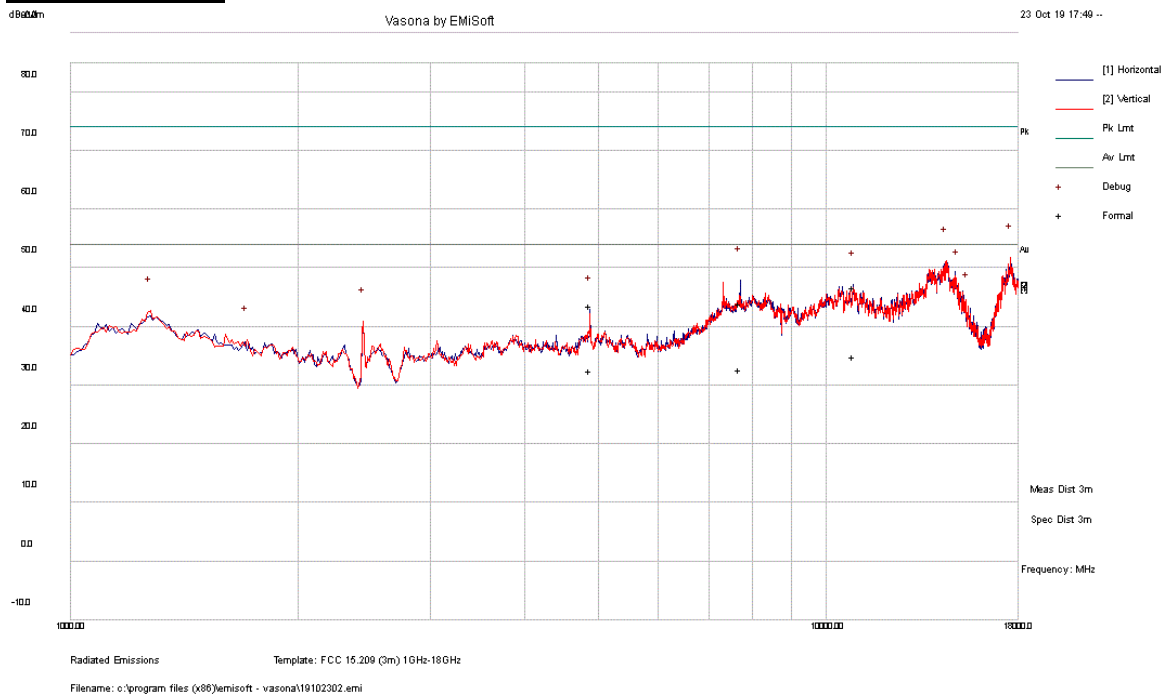
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7703.86	30.72	21.12	-7.21	44.63	Peak Max	H	220	156	74.00	-29.37	Pass
4803.35	40.60	17.35	-13.43	44.52	Peak Max	H	126	160	74.00	-29.48	Pass
2552.13	43.13	14.87	-21.55	36.46	Peak Max	H	152	132	74.00	-37.54	Pass
7703.86	18.64	21.12	-7.21	32.55	Average Max	H	220	156	54.00	-21.46	Pass
4803.35	28.40	17.35	-13.43	32.32	Average Max	H	126	160	54.00	-21.68	Pass
2552.13	31.37	14.87	-21.55	24.69	Average Max	H	152	132	54.00	-29.31	Pass

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



Test Standard:	15.209, 15.247	Mode:	BLE 2441 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

BLE 2441 MHz



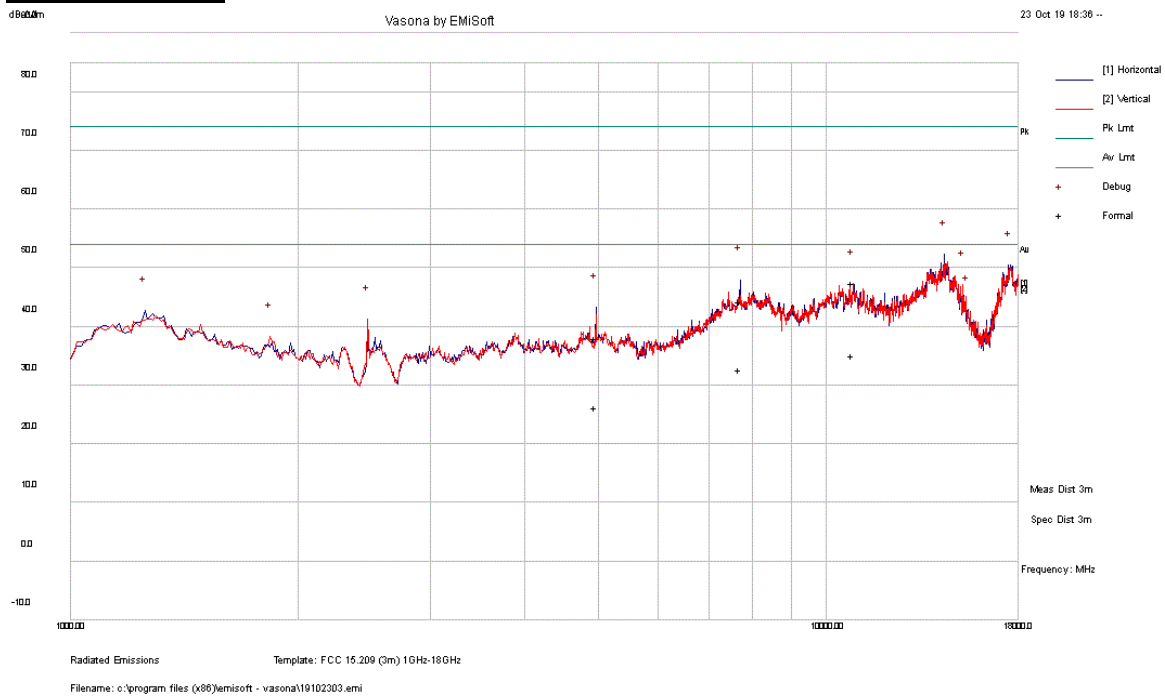
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7703.98	30.04	21.12	-7.21	43.95	Peak Max	H	351	259	74.00	-30.05	Pass
10893.33	26.29	23.71	-3.22	46.78	Peak Max	H	317	102	74.00	-27.22	Pass
4879.43	39.44	17.37	-13.27	43.54	Peak Max	H	101	160	74.00	-30.46	Pass
7703.98	18.72	21.12	-7.21	32.63	Average Max	H	351	259	54.00	-21.37	Pass
10893.33	14.50	23.71	-3.22	34.99	Average Max	H	317	102	54.00	-19.01	Pass
4879.43	28.38	17.37	-13.27	32.48	Average Max	H	101	160	54.00	-21.52	Pass

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



Test Standard:	15.209, 15.247	Mode:	BLE 2480 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

BLE 2480 MHz



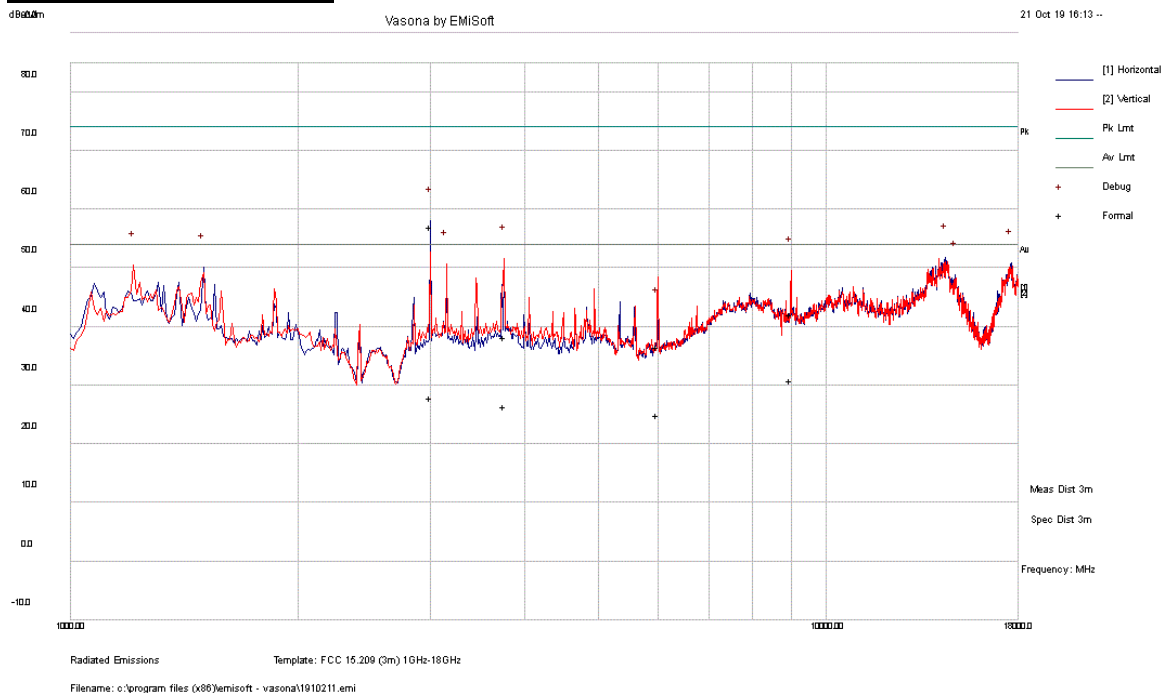
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7705.49	30.38	21.12	-7.20	44.29	Peak Max	H	342	30	74.00	-29.71	Pass
10869.24	27.01	23.67	-3.29	47.39	Peak Max	V	340	270	74.00	-26.61	Pass
4963.89	33.92	17.39	-13.22	38.09	Peak Max	H	385	354	74.00	-35.91	Pass
7705.49	18.73	21.12	-7.20	32.64	Average Max	H	342	30	54.00	-21.36	Pass
10869.24	14.66	23.67	-3.29	35.05	Average Max	V	340	270	54.00	-18.96	Pass
4963.89	22.02	17.39	-13.22	26.18	Average Max	H	385	354	54.00	-27.82	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11b 2412 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 11b 2412 MHz



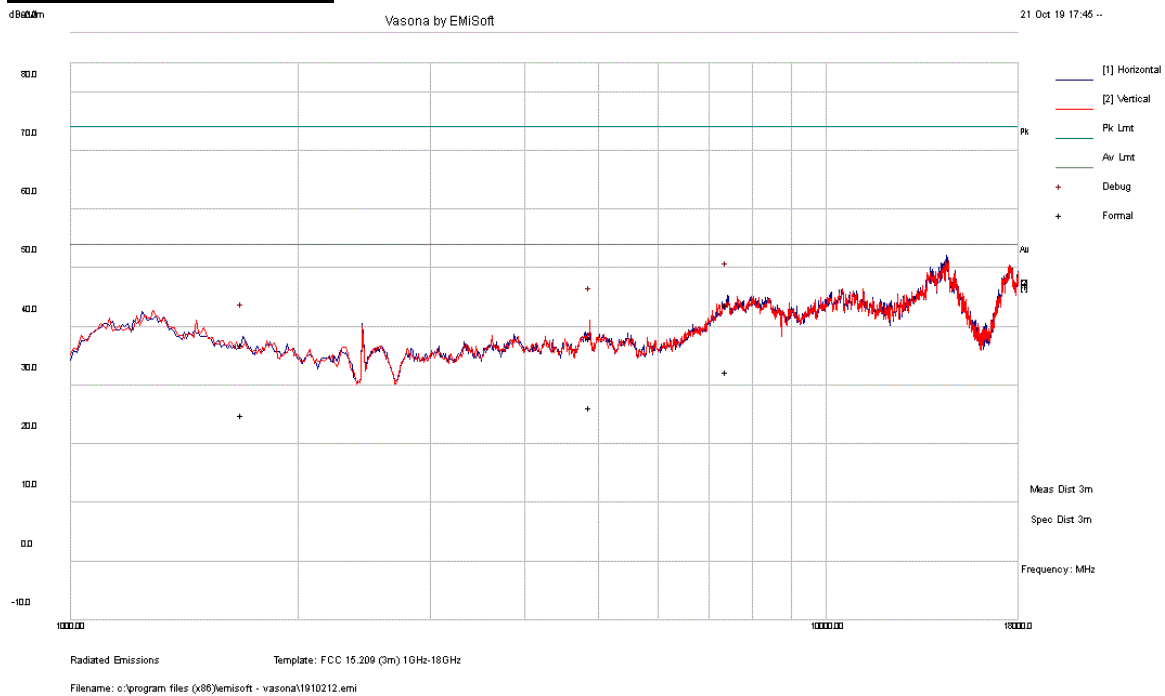
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
2999.02	61.84	15.32	-20.09	57.06	Peak Max	H	123	336	74.00	-16.94	Pass
3750.48	38.43	16.33	-16.58	38.18	Peak Max	V	182	220	74.00	-35.82	Pass
8998.82	26.56	21.09	-5.47	42.18	Peak Max	V	356	255	74.00	-31.82	Pass
5989.87	30.04	18.82	-12.24	36.62	Peak Max	V	350	150	74.00	-37.38	Pass
2999.02	32.66	15.32	-20.09	27.88	Average Max	H	123	336	54.00	-26.12	Pass
3750.48	26.61	16.33	-16.58	26.37	Average Max	V	182	220	54.00	-27.63	Pass
8998.82	15.29	21.09	-5.47	30.91	Average Max	V	356	255	54.00	-23.09	Pass
5989.87	18.29	18.82	-12.24	24.88	Average Max	V	350	150	54.00	-29.13	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11b 2437 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 11b 2437 MHz



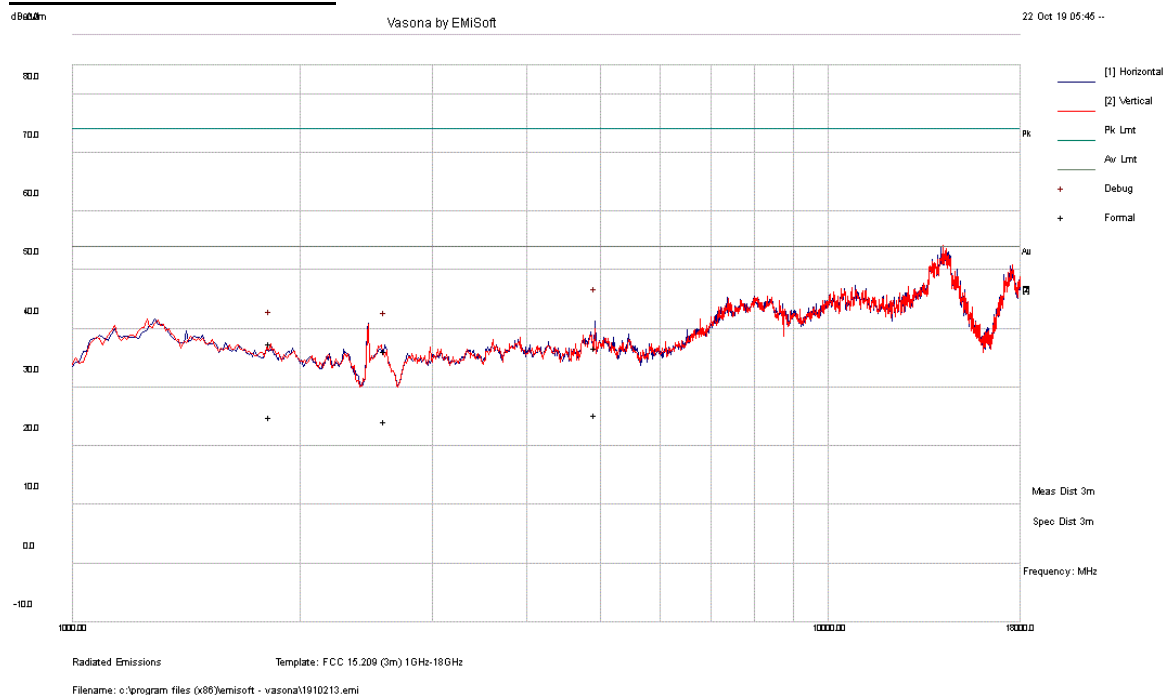
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7408.31	30.63	20.84	-7.68	43.79	Peak Max	H	274	313	74.00	-30.21	Pass
4876.38	33.95	17.37	-13.27	38.05	Peak Max	V	372	137	74.00	-35.95	Pass
1689.43	44.83	14.61	-22.58	36.87	Peak Max	H	136	204	74.00	-37.13	Pass
7408.31	19.09	20.84	-7.68	32.25	Average Max	H	274	313	54.00	-21.75	Pass
4876.38	22.22	17.37	-13.27	26.32	Average Max	V	372	137	54.00	-27.68	Pass
1689.43	32.91	14.61	-22.58	24.94	Average Max	H	136	204	54.00	-29.06	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11b 2462 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 11b 2462 MHz



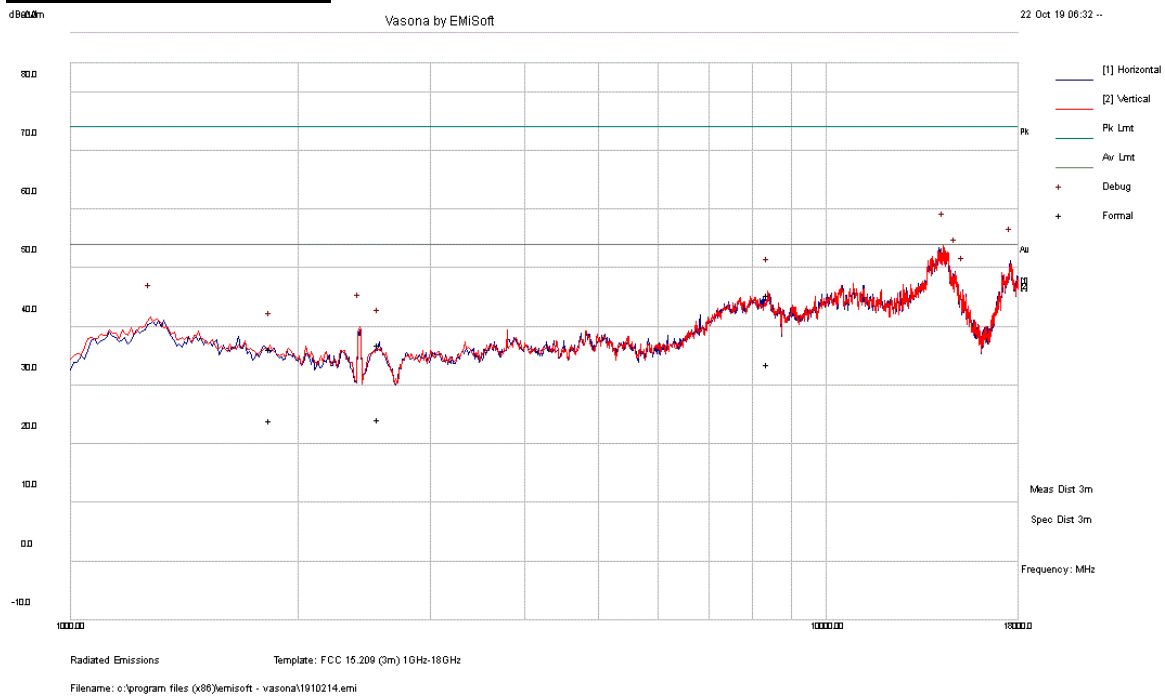
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4920.96	32.73	17.38	-13.27	36.84	Peak Max	H	100	309	74.00	-37.16	Pass
1827.1	44.68	14.44	-21.57	37.56	Peak Max	V	167	125	74.00	-36.44	Pass
2591.77	42.61	14.91	-21.33	36.20	Peak Max	H	252	46	74.00	-37.81	Pass
4920.96	21.27	17.38	-13.27	25.38	Average Max	H	100	309	54.00	-28.63	Pass
1827.1	32.13	14.44	-21.57	25.01	Average Max	V	167	125	54.00	-28.99	Pass
2591.77	30.59	14.91	-21.33	24.18	Average Max	H	252	46	54.00	-29.82	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11g 2412 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 11g 2412 MHz



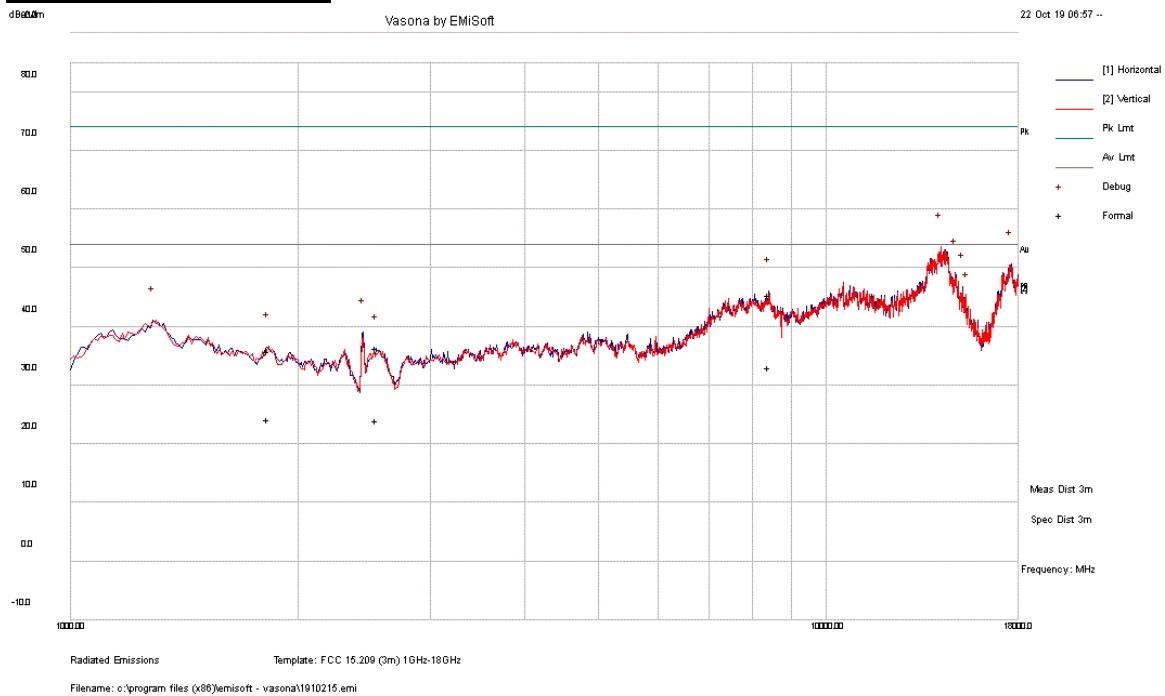
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8382.46	29.74	21.19	-5.60	45.34	Peak Max	V	278	143	74.00	-28.66	Pass
2561.11	43.51	14.88	-21.49	36.90	Peak Max	H	386	48	74.00	-37.10	Pass
1841.04	43.20	14.43	-21.43	36.21	Peak Max	V	165	148	74.00	-37.80	Pass
8382.46	17.98	21.19	-5.60	33.58	Average Max	V	278	143	54.00	-20.42	Pass
2561.11	30.81	14.88	-21.49	24.20	Average Max	H	386	48	54.00	-29.80	Pass
1841.04	31.12	14.43	-21.43	24.12	Average Max	V	165	148	54.00	-29.88	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11g 2437 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 11g 2437 MHz



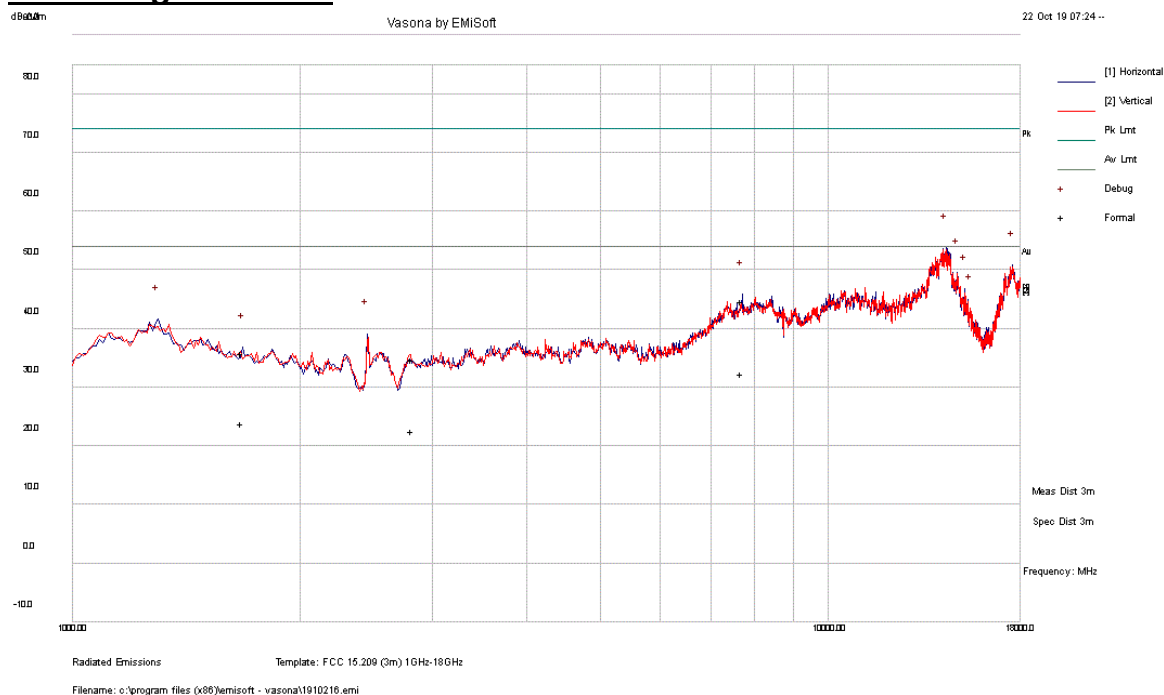
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8414.4	29.82	21.19	-5.56	45.44	Peak Max	H	301	357	74.00	-28.56	Pass
1827.22	43.04	14.44	-21.57	35.92	Peak Max	V	298	144	74.00	-38.08	Pass
2542.14	43.08	14.86	-21.60	36.35	Peak Max	H	100	185	74.00	-37.65	Pass
8414.4	17.51	21.19	-5.56	33.13	Average Max	H	301	357	54.00	-20.87	Pass
1827.22	31.32	14.44	-21.57	24.19	Average Max	V	298	144	54.00	-29.81	Pass
2542.14	30.73	14.86	-21.60	23.99	Average Max	H	100	185	54.00	-30.01	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11g 2462 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 11g 2462 MHz



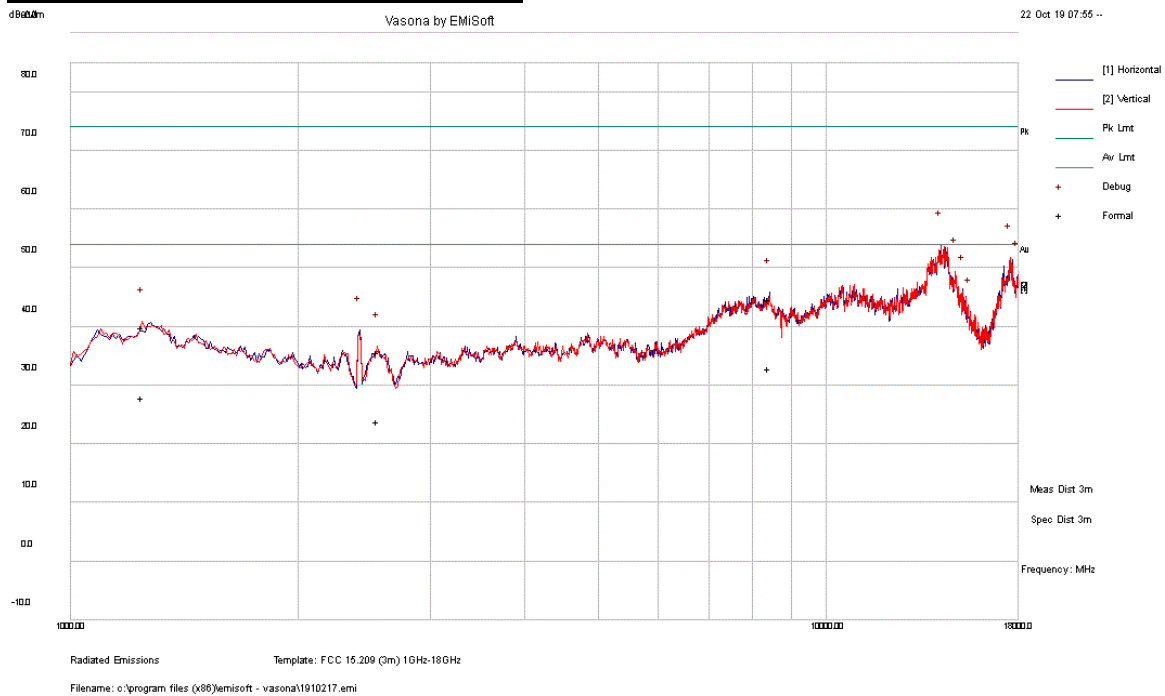
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7702.82	30.83	21.11	-7.21	44.73	Peak Max	H	118	318	74.00	-29.27	Pass
1678.43	43.81	14.63	-22.55	35.88	Peak Max	H	248	162	74.00	-38.12	Pass
2821.01	40.63	15.15	-21.04	34.73	Peak Max	V	273	206	74.00	-39.27	Pass
7702.82	18.38	21.11	-7.21	32.29	Average Max	H	118	318	54.00	-21.71	Pass
1678.43	31.87	14.63	-22.55	23.94	Average Max	H	248	162	54.00	-30.06	Pass
2821.01	28.37	15.15	-21.04	22.47	Average Max	V	273	206	54.00	-31.53	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 20 MHz BW 2412 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 2412 MHz



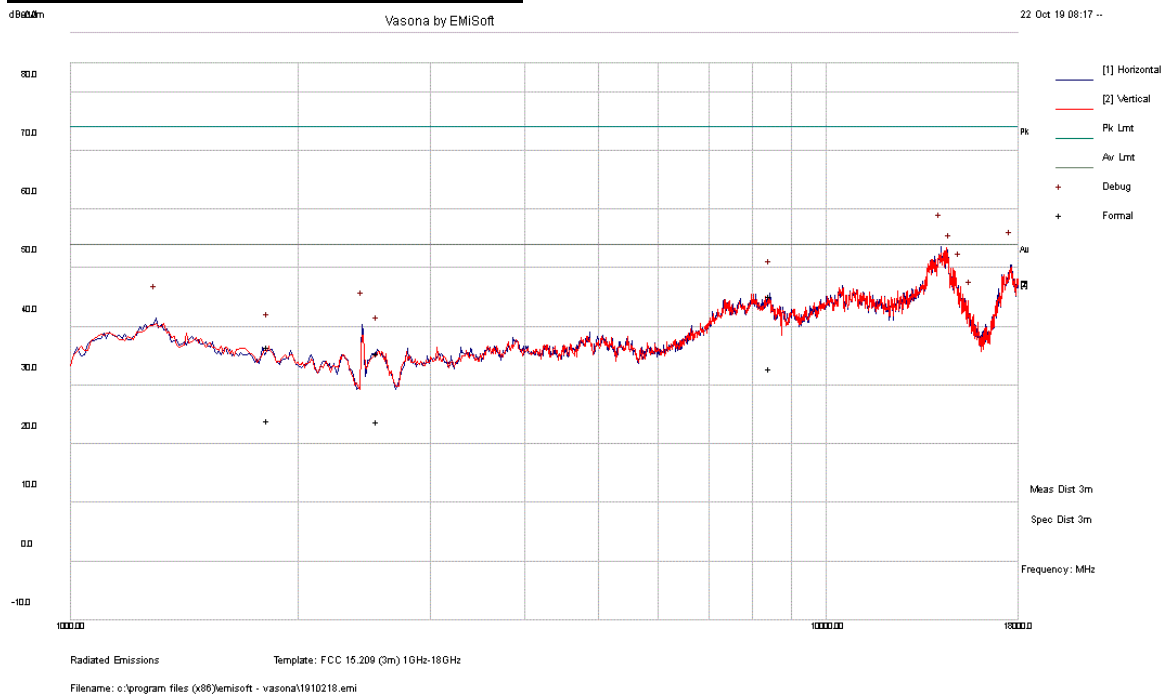
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8427.17	29.01	21.18	-5.56	44.63	Peak Max	H	209	235	74.00	-29.37	Pass
1245.28	44.99	14.40	-19.53	39.86	Peak Max	V	173	121	74.00	-34.14	Pass
2552.09	42.31	14.87	-21.55	35.63	Peak Max	V	167	26	74.00	-38.37	Pass
8427.17	17.32	21.18	-5.56	32.95	Average Max	H	209	235	54.00	-21.05	Pass
1245.28	32.97	14.40	-19.53	27.83	Average Max	V	173	121	54.00	-26.17	Pass
2552.09	30.56	14.87	-21.55	23.89	Average Max	V	167	26	54.00	-30.11	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 20 MHz BW 2437 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 2437 MHz



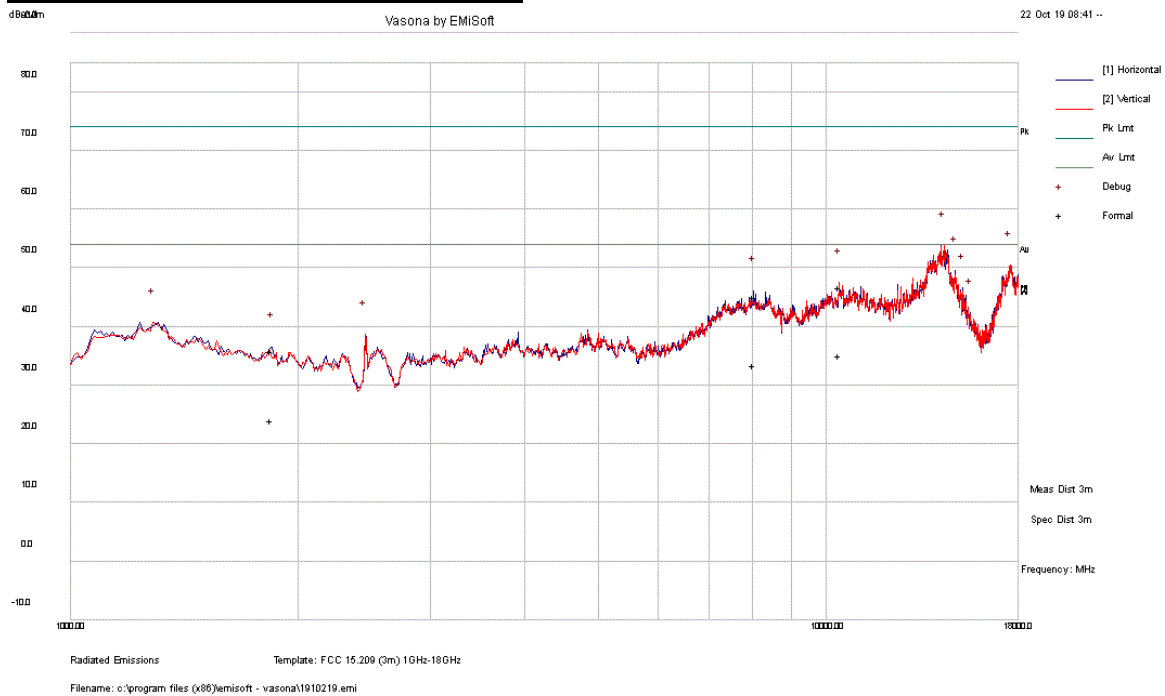
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8435.71	29.64	21.18	-5.55	45.27	Peak Max	H	171	19	74.00	-28.73	Pass
1829.82	43.62	14.44	-21.54	36.52	Peak Max	V	222	262	74.00	-37.48	Pass
2550.94	42.10	14.87	-21.55	35.42	Peak Max	H	124	0	74.00	-38.58	Pass
8435.71	17.18	21.18	-5.55	32.81	Average Max	H	171	19	54.00	-21.20	Pass
1829.82	31.19	14.44	-21.54	24.10	Average Max	V	222	262	54.00	-29.91	Pass
2550.94	30.52	14.87	-21.55	23.84	Average Max	H	124	0	54.00	-30.16	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 20 MHz BW 2462 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 2462 MHz



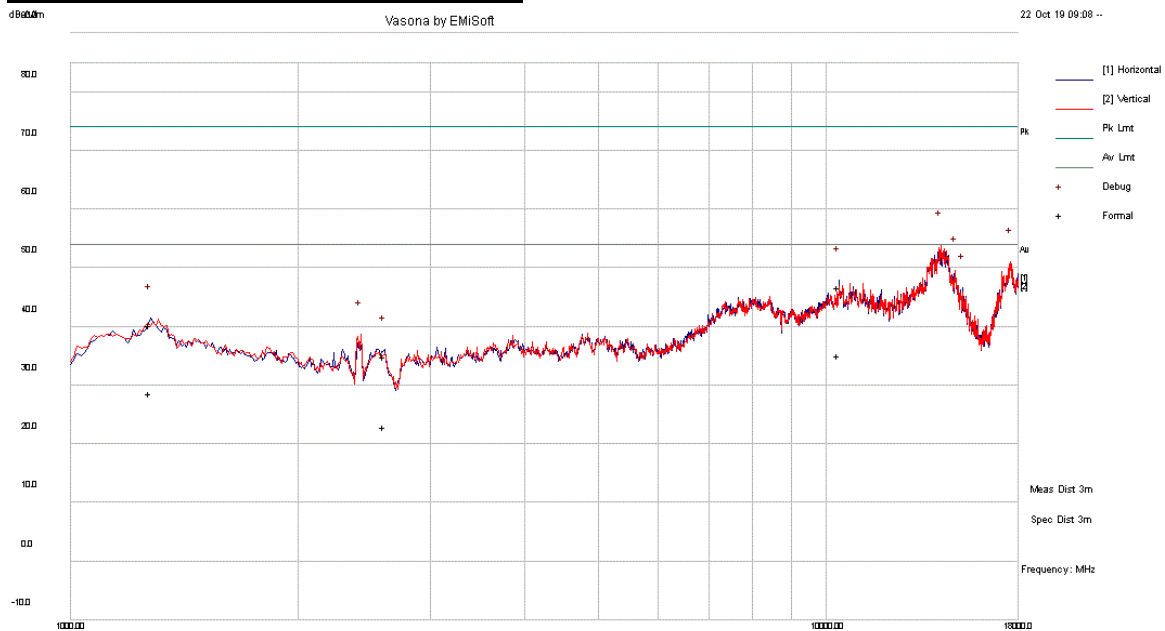
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10423.84	27.19	23.02	-3.54	46.67	Peak Max	V	239	140	74.00	-27.33	Pass
8032.66	30.00	21.25	-6.17	45.09	Peak Max	H	370	134	74.00	-28.91	Pass
1848.09	42.86	14.42	-21.35	35.93	Peak Max	H	243	333	74.00	-38.07	Pass
10423.84	15.59	23.02	-3.54	35.07	Average Max	V	239	140	54.00	-18.93	Pass
8032.66	18.28	21.25	-6.17	33.36	Average Max	H	370	134	54.00	-20.64	Pass
1848.09	31.06	14.42	-21.35	24.13	Average Max	H	243	333	54.00	-29.87	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 40 MHz BW 2422 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 2422 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
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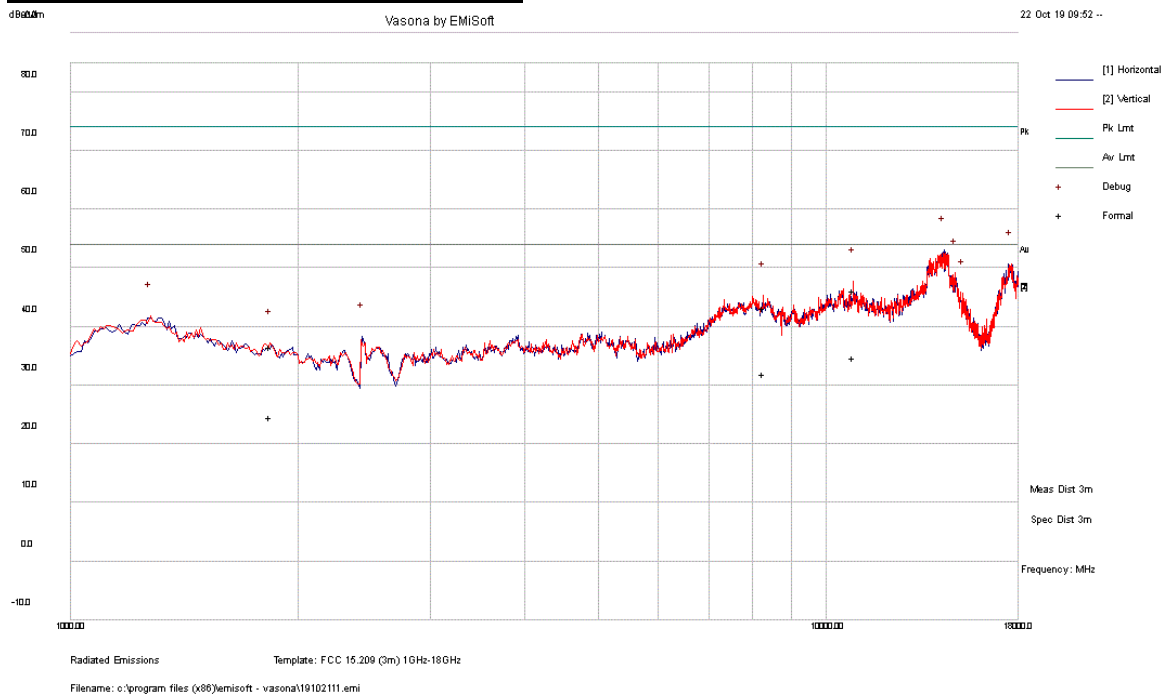
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10413.34	27.22	23.00	-3.55	46.67	Peak Max	H	142	318	74.00	-27.33	Pass
1276.32	45.49	14.46	-19.73	40.22	Peak Max	H	284	177	74.00	-33.78	Pass
2605.3	41.21	14.93	-21.29	34.85	Peak Max	H	297	291	74.00	-39.15	Pass
10413.34	15.60	23.00	-3.55	35.04	Average Max	H	142	318	54.00	-18.96	Pass
1276.32	33.84	14.46	-19.73	28.57	Average Max	H	284	177	54.00	-25.43	Pass
2605.3	29.26	14.93	-21.29	22.90	Average Max	H	297	291	54.00	-31.10	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 40 MHz BW 2437 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 2437 MHz



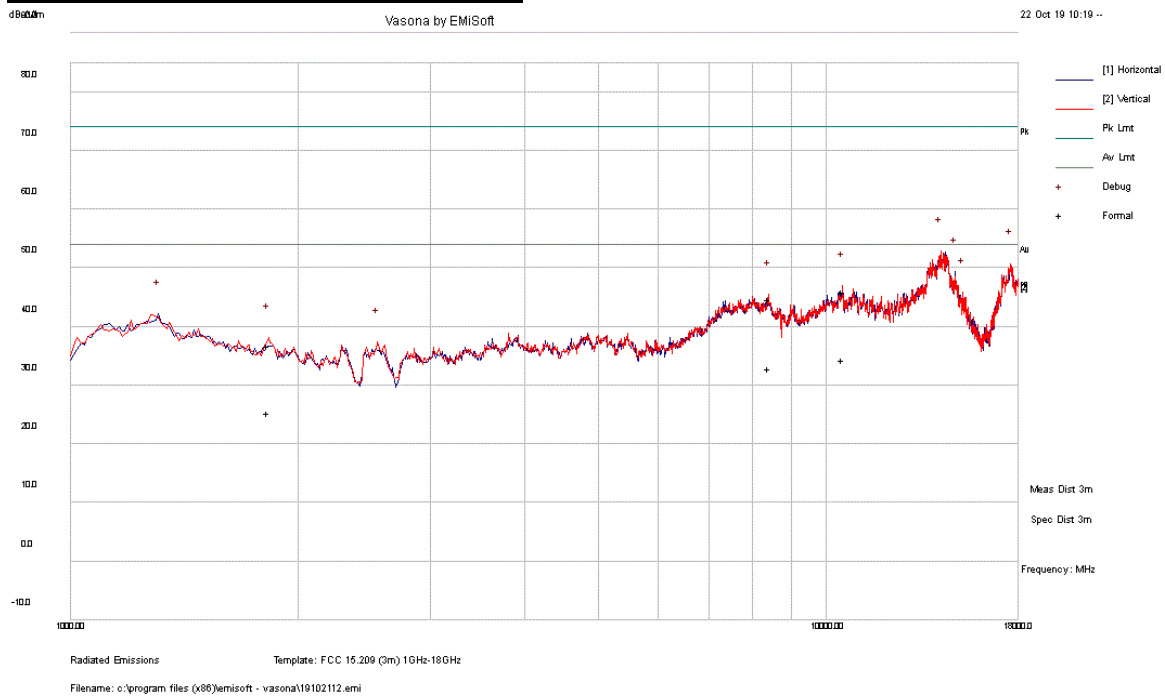
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10882.2	25.71	23.69	-3.25	46.15	Peak Max	V	358	316	74.00	-27.85	Pass
8268.3	27.64	21.21	-5.70	43.15	Peak Max	V	301	306	74.00	-30.85	Pass
1840.27	43.54	14.43	-21.43	36.53	Peak Max	V	189	218	74.00	-37.47	Pass
10882.2	14.33	23.69	-3.25	34.77	Average Max	V	358	316	54.00	-19.23	Pass
8268.3	16.45	21.21	-5.70	31.96	Average Max	V	301	306	54.00	-22.04	Pass
1840.27	31.61	14.43	-21.43	24.61	Average Max	V	189	218	54.00	-29.39	Pass

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



Test Standard:	15.209, 15.247	Mode:	WLAN 11n 40 MHz BW 2452 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 2452 MHz



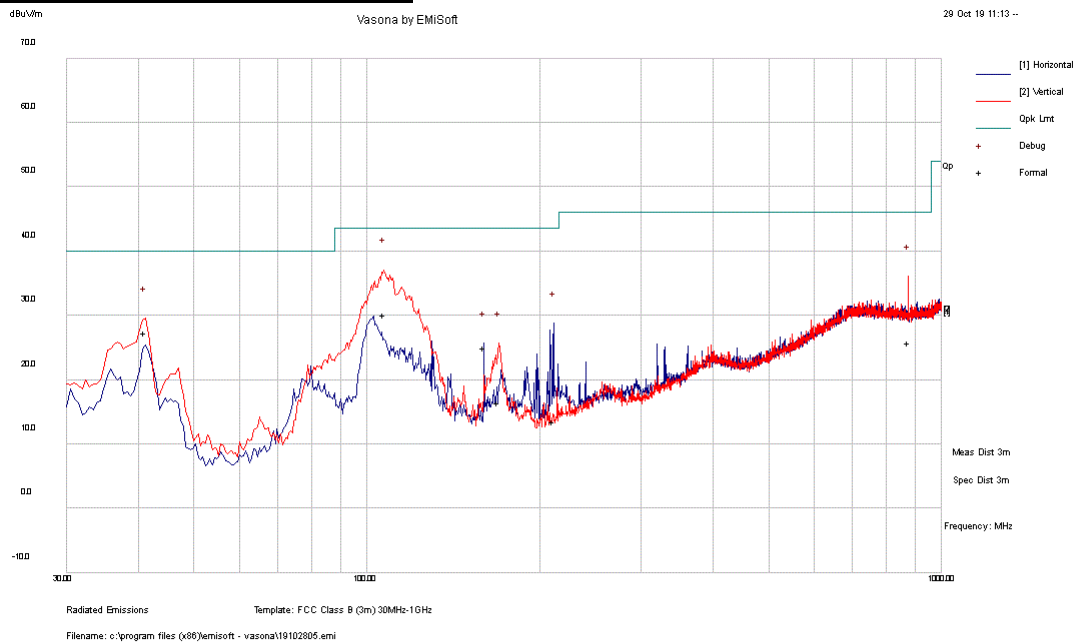
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10518.59	26.25	23.16	-3.47	45.95	Peak Max	V	385	64	74.00	-28.06	Pass
8404.19	28.98	21.19	-5.57	44.60	Peak Max	V	120	215	74.00	-29.40	Pass
1828.81	43.92	14.44	-21.55	36.82	Peak Max	V	100	72	74.00	-37.19	Pass
10518.59	14.65	23.16	-3.47	34.34	Average Max	V	385	64	54.00	-19.66	Pass
8404.19	17.23	21.19	-5.57	32.85	Average Max	V	120	215	54.00	-21.16	Pass
1828.81	32.39	14.44	-21.55	25.29	Average Max	V	100	72	54.00	-28.71	Pass

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



Test Standard:	15.209, 15.247	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



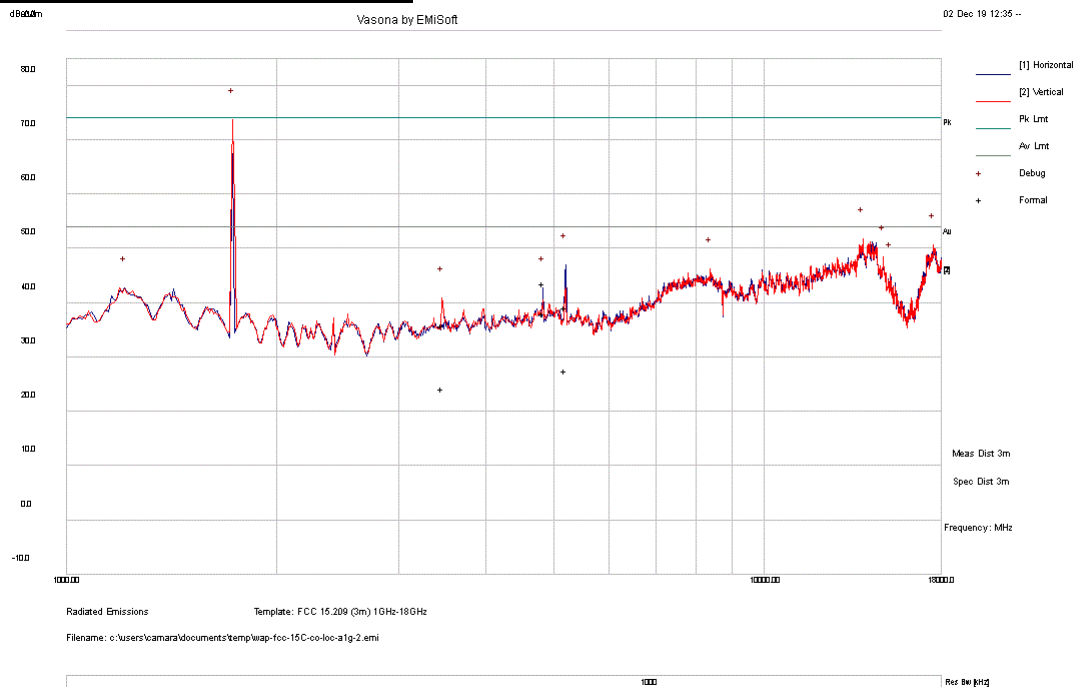
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
107.28	50.04	3.68	-23.49	30.23	Quasi Max	V	149	87	43.50	-13.27	Pass
875.27	25.41	7.52	-7.12	25.81	Quasi Max	V	163	144	46.00	-20.19	Pass
41.01	45.73	2.57	-20.99	27.31	Quasi Max	V	100	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-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



Test Standard:	15.209, 15.247	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

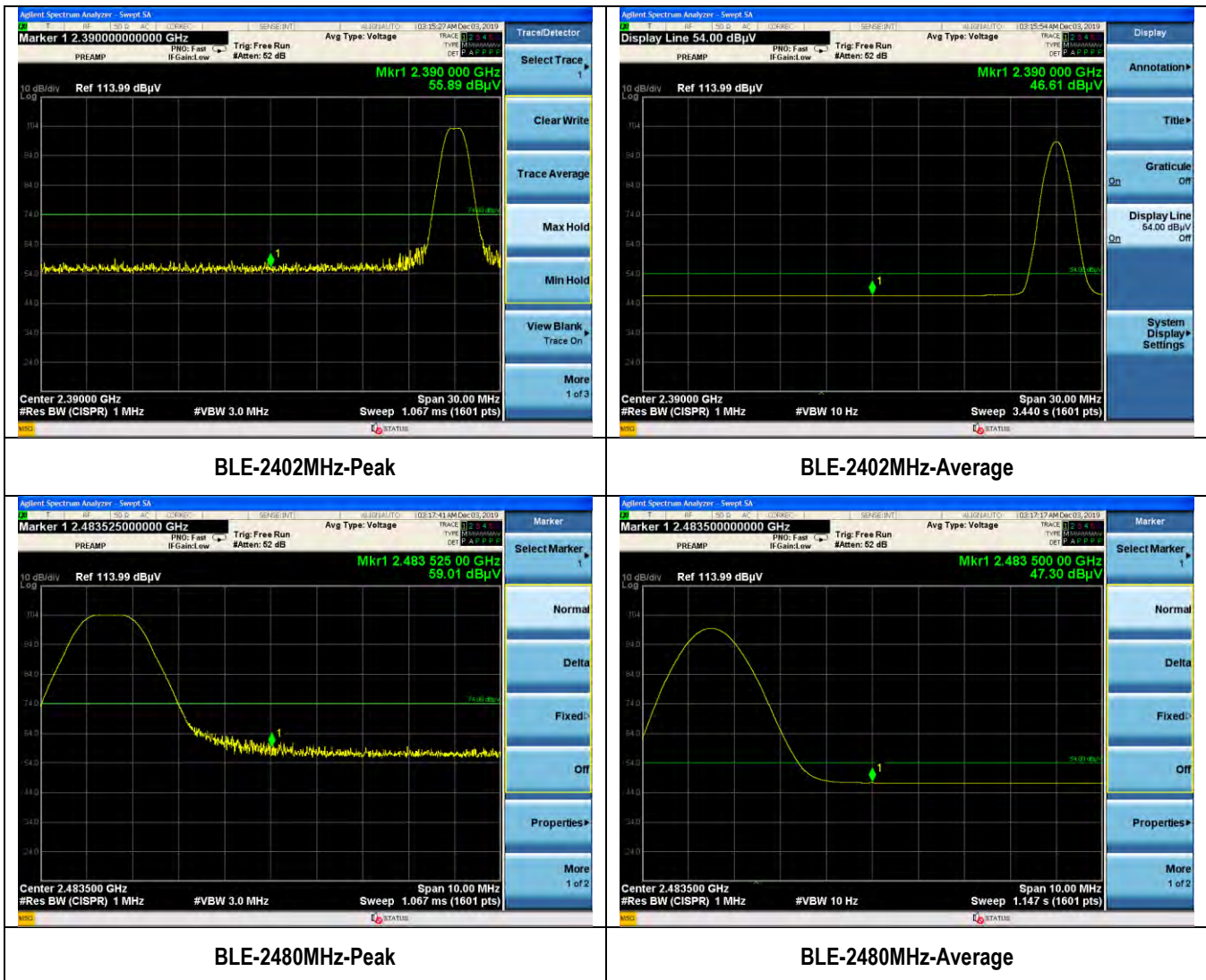
Report Number:	WAP-19091821-LC-FCC-IC-DTS
Product:	Vehicle Telematics Control Unit
Model Number:	FB5-TCU-NA



18GHz – 40GHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

Restricted Band Measurement Result



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



802.11b-2412MHz-Peak



802.11b-2462MHz-Average



802.11b-2462MHz-Peak



802.11b-2462MHz-Aveage



802.11g-2412MHz-Peak



802.11g-2462MHz-Average



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



802.11g-2462MHz-Peak



802.11g-2462MHz-Aveage



802.11n-2412MHz-Peak



802.11n-2412MHz-Aveage



802.11n-2462MHz-Peak



802.11n-2462MHz-Aveage



Electromagnetic Compatibility
Radio Frequency
Product Certification
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Report Number: WAP-19091821-LC-FCC-IC-DTS
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



802.11n40-2422MHz-Peak



802.11n40-2422MHz-Aveage



802.11n40-2452MHz-Peak



802.11n40-2452MHz-Aveage

Report Number:	WAP-19091821-LC-FCC-IC-DTS
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