

FCC/ISED RF TEST REPORT



Vista Labs
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Test Report Number.....	WAP-19091821-LC-FCC-IC-WCDMA
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 22 47CFR Part 24 47CFR Part 27 RSS-132 Issue 3: Jan 2013 RSS-133 Issue 6: Jan 2018 RSS-139 Issue 3: Jul 2015
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

Bruce Li/Test Engineer

Approved By:

David Zhang

David Zhang/Technical Manager



Laboratory Introduction

Vista Labs is an A2LA accredited 17025 compliant regulatory compliance testing laboratories (Cert. number: 4848-01) strategically located in Orange County, providing services in the electrical and telecommunication industries. Vista labs is also recognized testing facility for Australia (ACMA), Chinese Taipei (BSMI), Chinese Taipei (NCC), Hong Kong (OFCA), Israel (MOC), Korea (RRA), Singapore (IMDA), Vietnam (MIC), etc.

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.



17025 Product Testing Accreditation Certificate



17065 Product Certification Accreditation Certificate

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

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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
Maximum output power	See test result

Antenna Information	Internal PCB trace antenna Peak Gain: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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
	<p>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,</p> <p>Directional Gain:</p> <ul style="list-style-type: none"> - 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 22 47CFR Part 24 47CFR Part 27 RSS-132 Issue 3: Jan 2013 RSS-133 Issue 6: Jan 2018 RSS-139 Issue 3: Jul 2015 RSS-Gen Issue 5: Mar 2019
Test method	ANSI C63.26: 2015 KDB 971168 D01 Power Meas License Digital Systems v03r01 KDB 412172 D01 Determining ERP and EIRP v01r01

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

N/A

4 Test configuration and operation

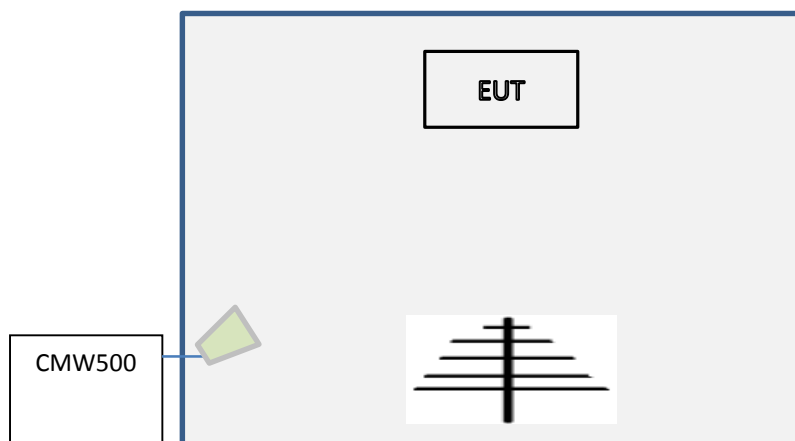
4.1 EUT test configuration

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 Supporting Equipment

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

4.3 EUT setup diagram



4.4 EUT operation

The radio can be set to transmit continuously in different modulation, test channel and data rate.

4.5 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 FCC filing

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



6 Test Summary

FCC Rules	ISED Rules	Test Item	Section	Verdict
§ 2.1046, § 22.913 § 24.232, § 27.50 (d)	RSS-132 (4.4), RSS-133 (6.4), RSS-139	Effective (Isotropic) Radiated Power	8.1	Pass
§ 2.1046, § 22.913 § 24.232, § 27.50 (d)	RSS-133 (6.4) RSS-139	Peak to Average Ratio	8.2	Pass
§2.1049	RSS-Gen (6.7)	Occupied bandwidth	8.3	Pass
§ 2.1051; § 22.917(a) § 24.238, § 27.53 (h)	RSS-132 (4.5.1), RSS-133 (6.5.1), RSS-139	Conducted Band Edge	8.4	Pass
§ 2.1051; § 22.917(a) § 24.238, § 27.53 (h)	RSS-132 (4.5.1), RSS-133 (6.5.1), RSS-139	Conducted Spurious Emission	8.5	Pass
§ 2.1051; § 22.917(a) § 24.238, § 27.53 (h)	RSS-132 (4.5.1), RSS-133 (6.5.1), RSS-139	Field Strength of Spurious Radiation	8.6	Pass
§ 2.1055, § 22.355 § 24.235, § 27.54	RSS-132 (4.3), RSS-133 (6.3), RSS-139, RSS-Gen	Frequency Stability	8.7	Pass



7 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
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

8 Test summary and result

8.1 RF Output Power

8.1.1 Requirement

§ 22.913(a) – ERP limit: 38.45 dBm

RSS-132(5.4) – EIRP limit: 40.61 dBm

§ 24.232(c) / RSS-133(6.4) – EIRP limit: 33 dBm

§ 27.50(d) / RSS-139(6.5) – EIRP limit: 30 dBm

8.1.2 Test setup



8.1.3 Test Procedure

For Conducted Power:

- The transmitter output port was connected to base station.
- Set EUT at maximum power through base station.
- Select lowest, middle, and highest channels for each band and different test mode.

For ERP/EIRP:

- According with 971168 D01 Power Meas License Digital Systems v03r01
- The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.
- The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.
- The frequency ranges up to tenth harmonic of the fundamental frequency was investigated.
- Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.
- Spurious emissions in dB = $10 \log (\text{TX power in Watts}/0.001)$ – the absolute level
- Spurious attenuation limit in dB = $43 + 10 \log_{10} (\text{power out in Watts})$.

8.1.4 Test Result

Conducted Output Power

WCDMA Band 2	Conducted Power(dBm)	Channel 9262	Channel 9400	Channel 9538
		1852.4(MHz)	1880(MHz)	1907.6(MHz)
RMC	-	23.63	23.71	24.36
HSDPA	Sub - Test 1	22.74	22.97	23.07
	Sub - Test 2	22.55	22.85	23.35
	Sub - Test 3	22.3	22.59	22.88
	Sub - Test 4	22.41	22.84	22.92
HSUPA	Sub - Test 1	21.53	22.03	22.64
	Sub - Test 2	21.98	21.96	21.99
	Sub - Test 3	21.4	21.9	22.26
	Sub - Test 4	22.04	21.91	21.46
	Sub - Test 5	21.47	21.93	22.66
DC-HSDPA	Sub - Test 1	21.97	21.91	21.96
	Sub - Test 2	21.40	21.91	22.34
	Sub - Test 3	21.98	22.01	21.43
	Sub - Test 4	22.12	21.86	21.37

WCDMA Band 4	Conducted Power(dBm)	Channel 1312	Channel 1413	Channel 1513
		1712.4 (MHz)	1732.6 (MHz)	1752.6 (MHz)
RMC	-	23.96	23.24	24.07
HSDPA	Sub - Test 1	22.21	21.86	22.52
	Sub - Test 2	22.61	22.17	22.25
	Sub - Test 3	22.07	22.55	21.94
	Sub - Test 4	22.52	22.10	22.71
HSUPA	Sub - Test 1	22.67	23.41	23.28
	Sub - Test 2	23.03	22.99	23.07
	Sub - Test 3	23.45	22.87	22.74
	Sub - Test 4	22.32	22.45	22.97
	Sub - Test 5	22.27	22.13	22.13
DC-HSDPA	Sub - Test 1	23.35	23.95	23.64
	Sub - Test 2	23.53	24.19	23.82
	Sub - Test 3	23.36	23.07	23.04
	Sub - Test 4	23.29	23.36	23.58



WCDMA Band 5	Conducted Power(dBm)	Channel 4132	Channel 4183	Channel 4233
		826.4(MHz)	836.6(MHz)	846.6(MHz)
RMC	-	23.84	23.30	24.23
HSDPA	Sub - Test 1	22.49	21.63	22.83
	Sub - Test 2	22.83	21.99	22.02
	Sub - Test 3	22.37	22.72	22.26
	Sub - Test 4	22.24	21.95	22.55
HSUPA	Sub - Test 1	22.66	23.64	23.33
	Sub - Test 2	22.88	22.82	23.04
	Sub - Test 3	23.19	22.89	22.84
	Sub - Test 4	22.00	22.39	22.87
	Sub - Test 5	22.41	22.08	22.11
DC-HSDPA	Sub - Test 1	23.02	23.79	23.60
	Sub - Test 2	23.30	24.08	23.75
	Sub - Test 3	23.03	23.30	23.25
	Sub - Test 4	23.48	23.50	23.73

Radiated Power

Mode	Channel	Frequency (MHz)	EIRP (dBm)	ERP (dBm)	EIRP/ERP Limit (dBm)	Conclusion
WCDMA B2	9262	1852.4	29.16	-	33 / -	Pass
	9400	1880	29.24	-	33 / -	Pass
	9538	1907.6	29.89	-	33 / -	Pass
WCDMA B4	1312	1712.4	29.49	-	30 / -	Pass
	1413	1732.6	29.72	-	30 / -	Pass
	1513	1752.6	29.60	-	30 / -	Pass
WCDMA B5	4132	826.4	28.16	26.01	40.61 / 38.45	Pass
	4183	836.6	28.40	26.25	40.61 / 38.45	Pass
	4233	846.6	28.55	26.40	40.61 / 38.45	Pass

8.2 Peak to Average Ratio

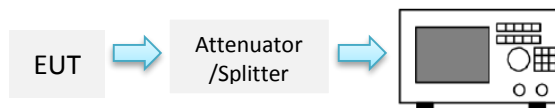
8.2.1 Requirement

§ 2.1046, § 22.913, § 24.232, § 27.50 (d)

RSS-132(5.4), RSS-133(6.4), RSS-139(6.5)

The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

8.2.2 Test setup



8.2.3 Test Procedure

For Peak Power measurement

- The total peak output power may be measured using a broadband peak RF power meter. The power meter must have a video bandwidth that is greater than or equal to the emission bandwidth and utilize a fast-responding diode detector.

For Average Power measurement

- As an alternative to the use of a spectrum/signal analyzer or EMI receiver to perform a measurement of the total in-band average output power, a wideband RF average power meter with a thermocouple detector or equivalent can be used under certain conditions
- If the EUT can be configured to transmit continuously (i.e., the burst duty cycle $\geq 98\%$) and at all times the EUT is transmitting at its maximum output power level, then a conventional wide-band RF power meter can be used.
- If the EUT cannot be configured to transmit continuously (i.e., the burst duty cycle $< 98\%$), then there are two options for the use of an average power meter. First, a gated average power meter can be used to perform the measurement if the gating parameters can be adjusted such that the power is measured only over active transmission bursts at maximum output power levels. A conventional average power meter can also be used if the measured burst duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to $10\log(1/\text{duty cycle})$



8.2.4 Test Result

Peak to Average Ratio

Mode	Channel	Frequency (MHz)	Peak (dBm)	Avg (dBm)	PAPR (dB)	Limit (dB)	Conclusion
WCDMA Band 2 (RMC)	9262	1852.4	26.82	23.79	3.03	≤13	PASS
	9400	1880	26.77	23.81	2.95	≤13	PASS
	9538	1907.6	26.59	23.52	3.07	≤13	PASS
WCDMA Band 4 (RMC)	1312	1712.4	26.86	23.73	3.13	≤13	PASS
	1413	1732.6	26.91	23.72	3.19	≤13	PASS
	1513	1752.6	26.65	23.66	2.98	≤13	PASS
WCDMA Band 5 (RMC)	4132	826.4	26.86	23.70	3.16	≤13	PASS
	4183	836.6	26.76	23.88	2.88	≤13	PASS
	4233	846.6	26.69	23.55	3.14	≤13	PASS

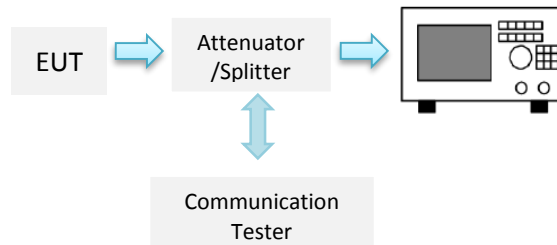
8.3 Occupied Bandwidth

8.3.1 Requirement

§2.1049, RSS-Gen (6.7)

- 99% Occupied Bandwidth(kHz)
- 26 dB Bandwidth(kHz)

8.3.2 Test setup



8.3.3 Test Procedure

- The EUT was connected to Spectrum Analyzer and Base Station via power divider.
- Set RBW = 1% to 5% of the actual occupied BW.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Span = large enough to capture all products of the modulation process
- Allow the trace to stabilize.
- Use automatic bandwidth measurement capability on instrument to obtain 99% and 26 dB BW.
-



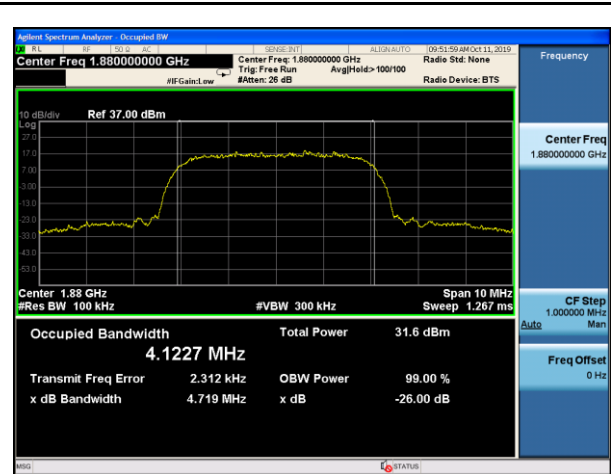
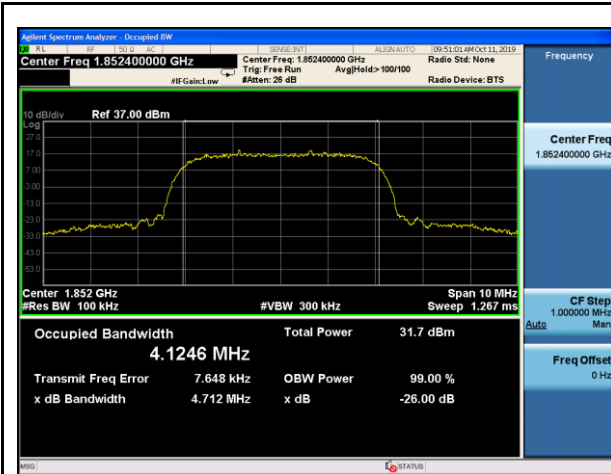
8.3.4 Test Result

Occupied Bandwidth

Mode	Channel	Frequency (MHz)	99% Power Bandwidth (MHz)	-26dBc Bandwidth(MHz)	Conclusion
WCDMA Band 2 (RMC)	9262	1852.4	4.1246	4.712	N/A
	9400	1880	4.1227	4.719	N/A
	9538	1907.6	4.1255	4.703	N/A
WCDMA Band 4 (RMC)	1312	1712.4	4.1090	4.696	N/A
	1413	1732.6	4.1331	4.691	N/A
	1513	1752.6	4.1161	4.695	N/A
WCDMA Band 5 (RMC)	4132	826.4	4.1255	4.732	N/A
	4183	836.6	4.1132	4.701	N/A
	4233	846.6	4.1169	4.682	N/A

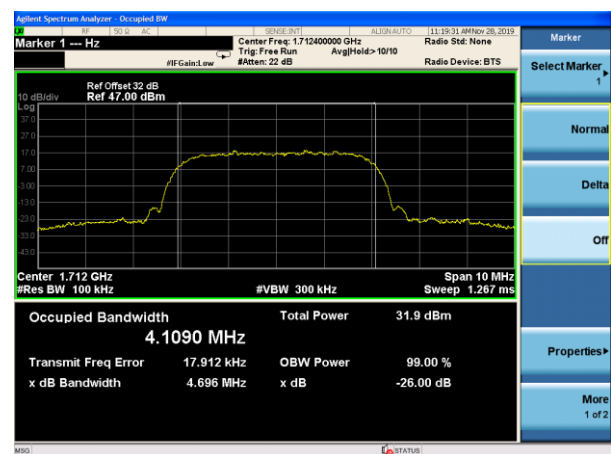
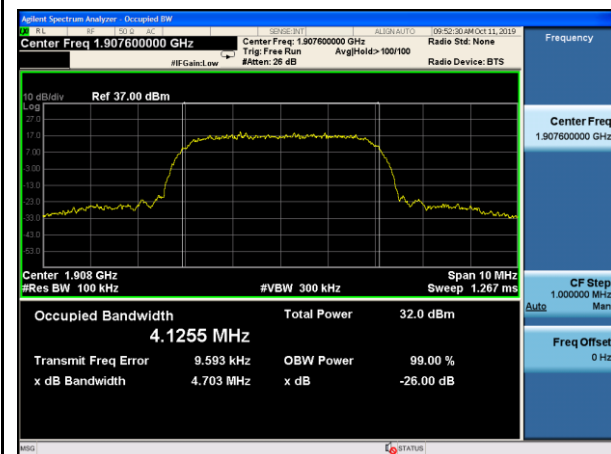


8.3.5 Test Plots



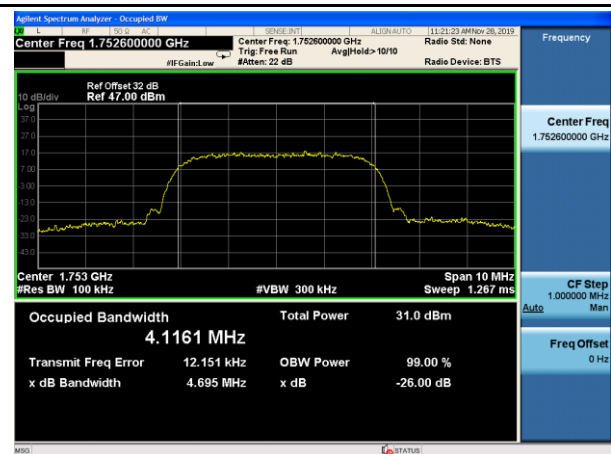
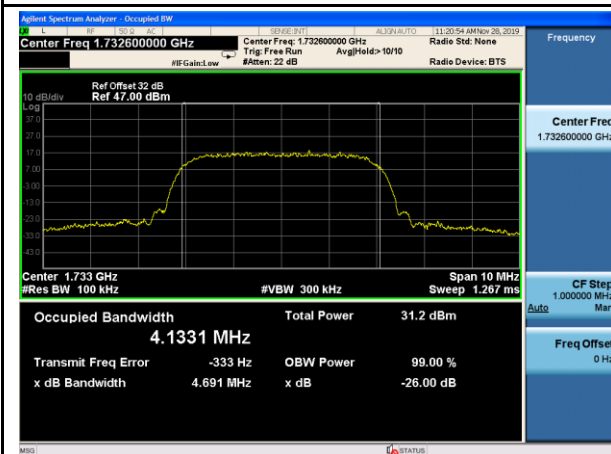
WCDMA Band 2 – Low CH

WCDMA Band 2 – Mid CH



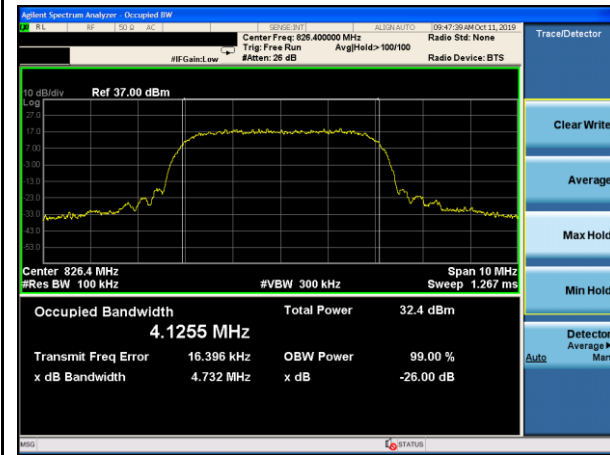
WCDMA Band 2 – High CH

WCDMA Band 4 – Low CH

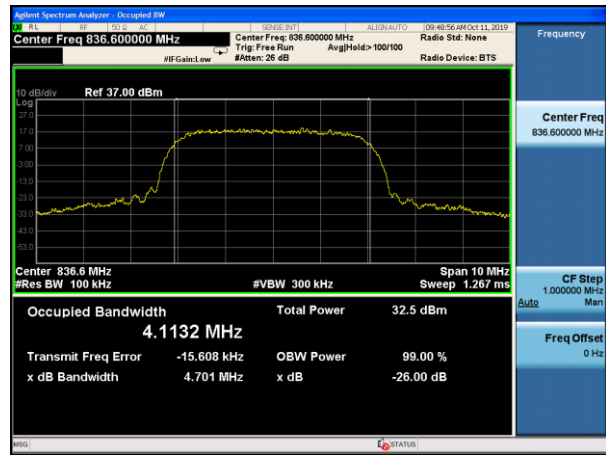


WCDMA Band 4 – Mid CH

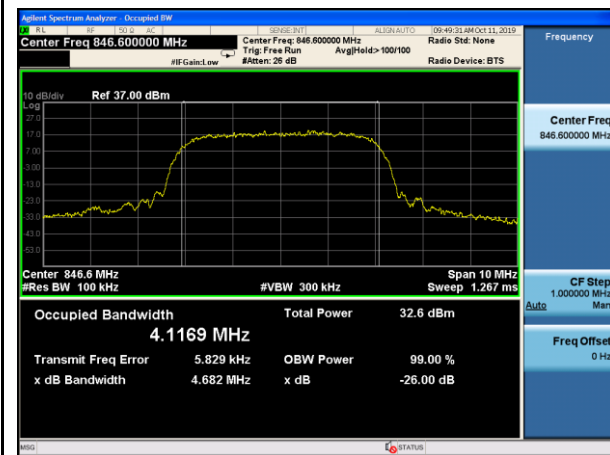
WCDMA Band 4 – High CH



WCDMA Band 5 – Low CH



WCDMA Band 5 – Mid CH



WCDMA Band 5 – High CH

8.4 Band Edge

8.4.1 Requirement

§ 2.1051, 22.917(a), 24.238(a), 27.53 (h)

RSS-132(5.5), RSS-133(6.5), RSS-139(6.6)

FCC 47 CFR Part 22, Clause 22.917 (a) and FCC 47 CFR Part 24, Clause 24.238 (a)

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC 47 CFR Part 27, Clause 27.53 (c)(2) and (5)

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

FCC 47 CFR Part 27, Clause 27.53 (f)

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

FCC 47 CFR Part 27, Clause 27.53 (g)

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

FCC 47 CFR Part 27, Clause 27.53 (h)

(h) AWS emission limits — (1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132, Clause 5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

RSS-133, Clause 6.5.1

Equipment shall comply with the limits in (i) and (ii) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

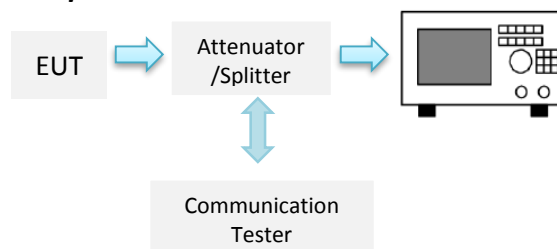
(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

RSS-139, Clause 6.6

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

8.4.2 Test setup



8.4.3 Test Procedure

- The EUT was connected to Spectrum Analyzer and Base Station via power divider.
- Set RBW as roughly BW/100.
- Detector = average
- Sweep = auto couple.
- Allow the trace to stabilize.
- Set Marker to edge frequency
- The Band Edges of low and high channels for the highest RF powers were measured

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

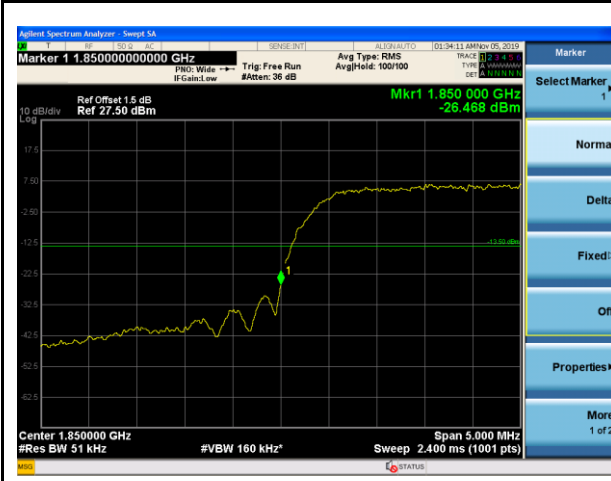


8.4.4 Test Result

See test plots



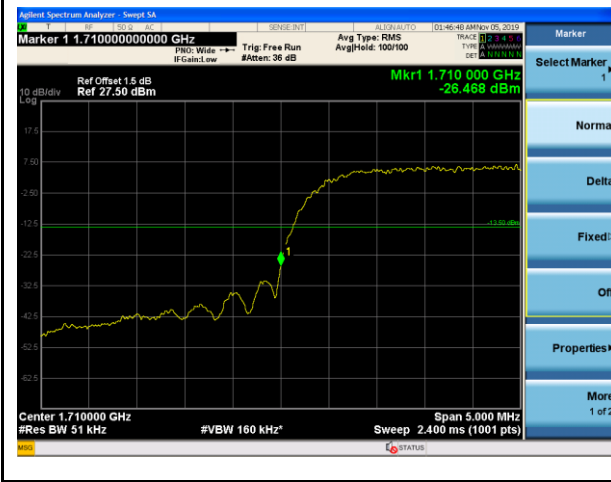
8.4.5 Test Plots



WCDMA Band 2, Low CH



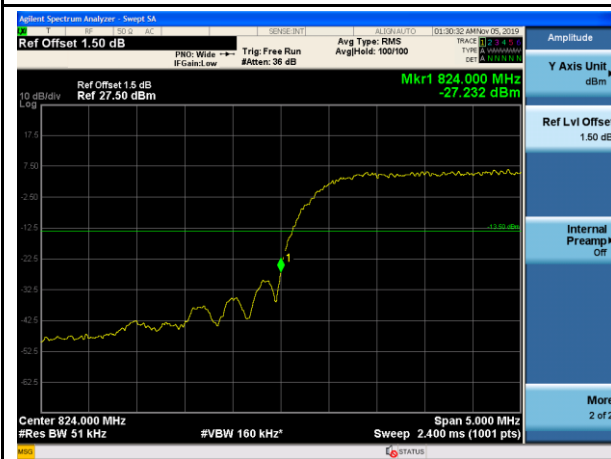
WCDMA Band 2, High CH



WCDMA Band 4, Low CH



WCDMA Band 4, High CH



WCDMA Band 5, Low CH



WCDMA Band 5, High CH

8.5 Conducted Spurious Radiation

8.5.1 Requirement

§ 2.1051, 22.917(a), 24.238(a), 27.53 (h)

RSS-132(5.5), RSS-133(6.5), RSS-139(6.6)

FCC 47 CFR Part 22, Clause 22.917 (a) and FCC 47 CFR Part 24, Clause 24.238 (a)

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC 47 CFR Part 27, Clause 27.53 (c)(2) and (5)

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

FCC 47 CFR Part 27, Clause 27.53 (f)

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

FCC 47 CFR Part 27, Clause 27.53 (g)

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.



FCC 47 CFR Part 27, Clause 27.53 (h)

(h) AWS emission limits — (1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132, Clause 5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

RSS-133, Clause 6.5.1

Equipment shall comply with the limits in (i) and (ii) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

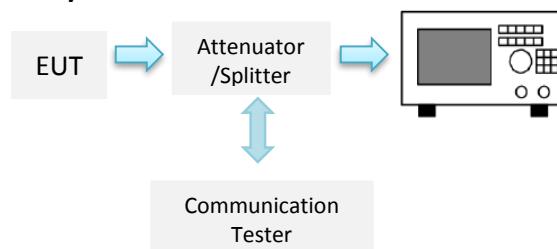
(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

RSS-139, Clause 6.6

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

8.5.2 Test setup



8.5.3 Test Procedure

- The EUT was connected to Spectrum Analyzer and Base Station via power divider.
- Set RBW = 100KHz and VBW=300KHz for below 1GHz; set RBW=1MHz and VBW=3MHz for above 1GHz.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Use marker peak to search for spurious emission

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Model Number:	FB5-TCU-NA

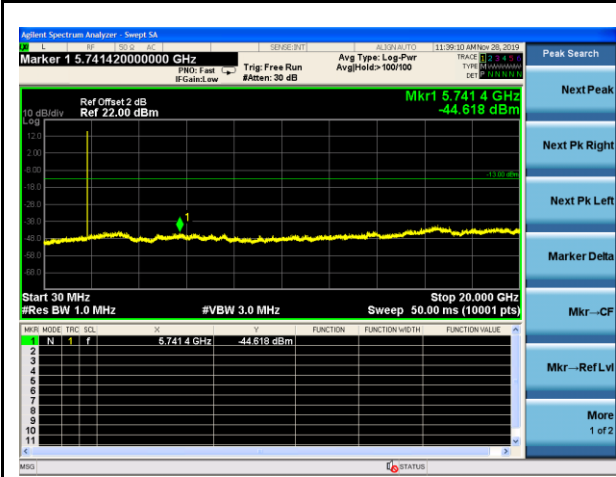


8.5.4 Test Result

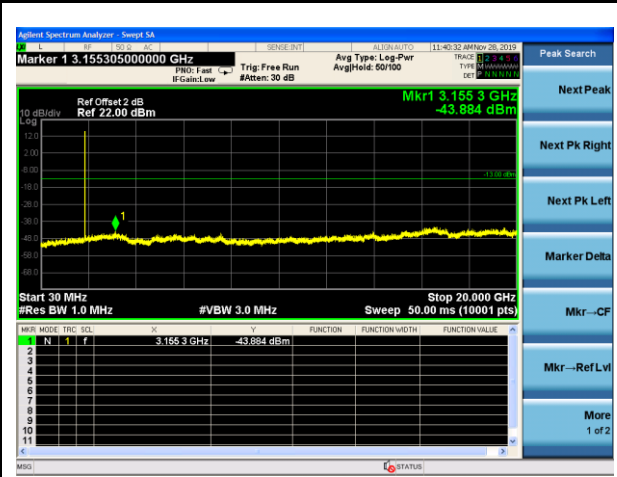
See test plots



8.5.5 Test Plots



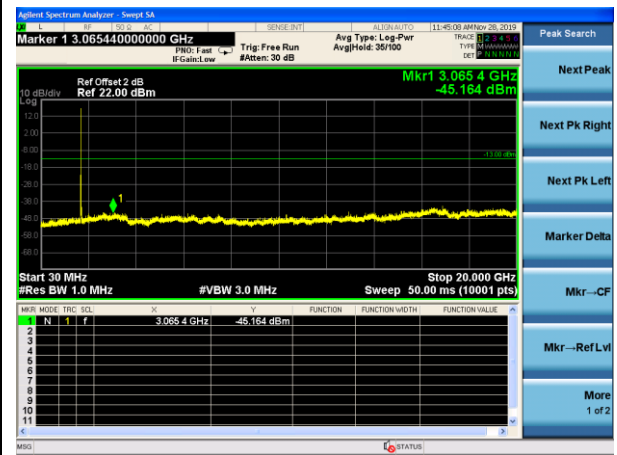
WCDMA Band 2, Low CH



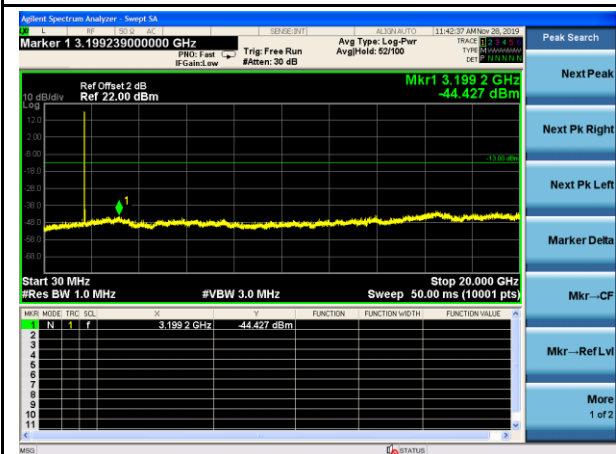
WCDMA Band 2, Mid CH



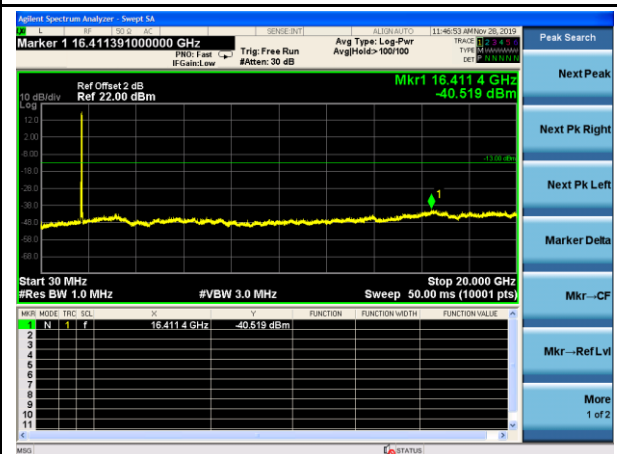
WCDMA Band 2, High CH



WCDMA Band 4, Low CH



WCDMA Band 4, Mid CH

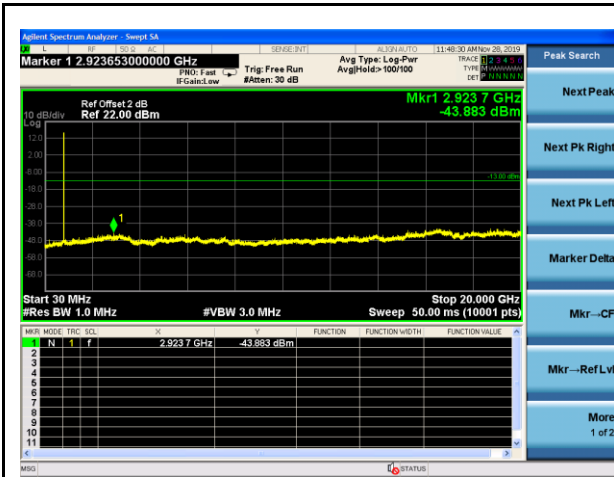


WCDMA Band 4, High CH

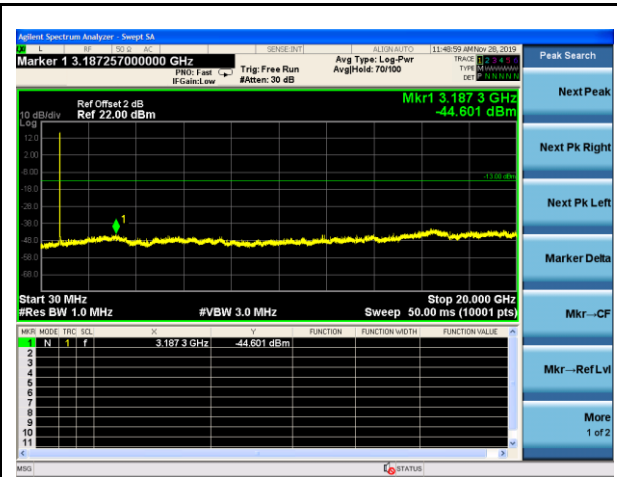
Report Number: WAP-19091821-LC-FCC-IC-WCDMA
Product: Vehicle Telematics Control Unit
Model Number: FB5-TCU-NA



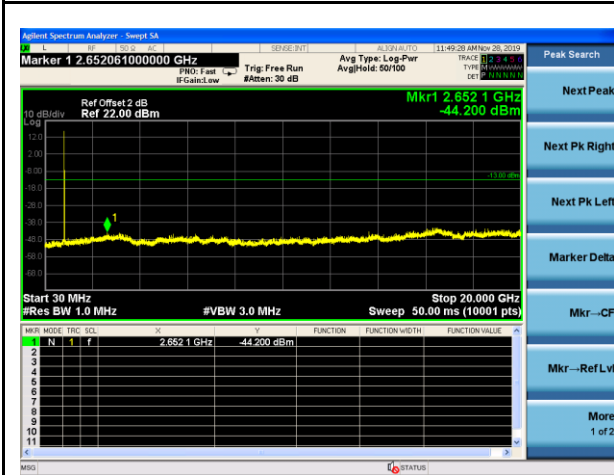
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WCDMA Band 5, Low CH



WCDMA Band 5, Mid CH



WCDMA Band 5, High CH



Electromagnetic Compatibility
Radio Frequency
Product Certification
International Approval

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

8.6 Field Strength of Spurious Radiation

8.6.1 Requirement

§ 2.1051, 22.917(a), 24.238(a), 27.53 (f), (g), (h) and (c)(2) and (5)

RSS-132(5.5), RSS-133(6.5), RSS-139(6.6)

FCC 47 CFR Part 22, Clause 22.917 (a) and FCC 47 CFR Part 24, Clause 24.238 (a)

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC 47 CFR Part 27, Clause 27.53 (c)(2) and (5)

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

FCC 47 CFR Part 27, Clause 27.53 (f)

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

FCC 47 CFR Part 27, Clause 27.53 (g)

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

FCC 47 CFR Part 27, Clause 27.53 (h)

(h) AWS emission limits — (1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-132, Clause 5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

RSS-133, Clause 6.5.1

Equipment shall comply with the limits in (i) and (ii) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

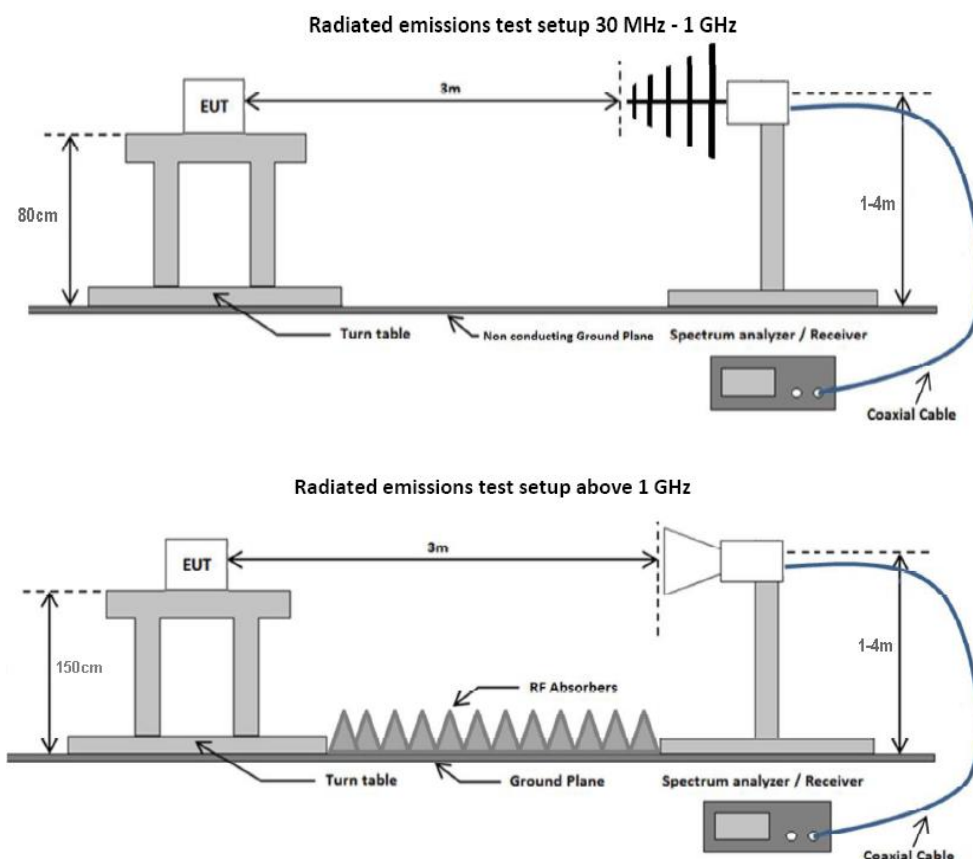
(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

RSS-139, Clause 6.6

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

8.6.2 Test setup



8.6.3 Test Procedure

ANSI C63.26: 2015 section 5.5

KDB 971168 D01 Power Meas License Digital Systems v03r01 section 7

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.

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Product:	Vehicle Telematics Control Unit
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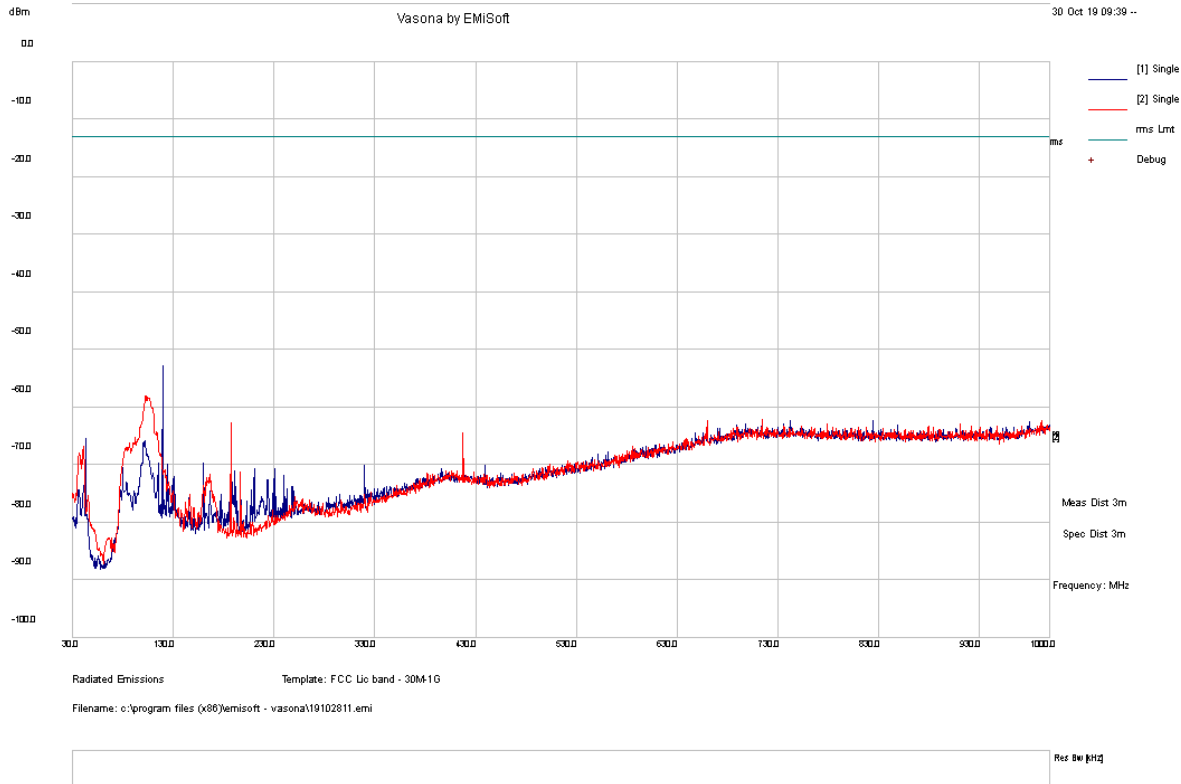
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution 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. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter.
8. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained.
9. Steps 2 - 8 were repeated for the next frequency point, until all selected frequency points were measured



8.6.4 Test Result

Test Standard:	Part24E, RSS-133	Mode:	WCDMA Band 2
Frequency Range:	30 - 1000 MHz	Test Date:	10/30/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WCDMA Band 2



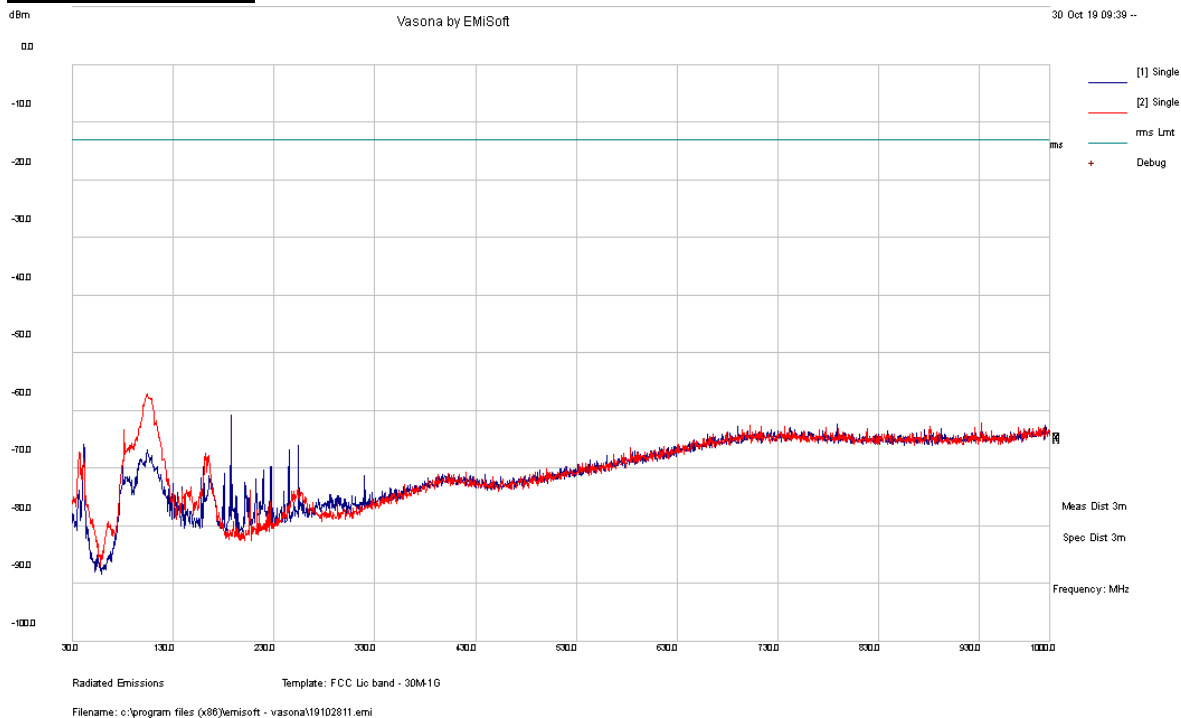
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
119.5833	-62.17	3.86	-23.17	-81.48	RMS Max	H	304	168	-13	-68.48	Pass
102.2595	-42.53	3.6	-23.63	-62.56	RMS Max	V	139	202	-13	-49.56	Pass
42.87561	-67.21	2.62	-21.95	-86.54	RMS Max	H	400	53	-13	-73.54	Pass

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



Test Standard:	Part27, RSS-139	Mode:	WCDMA Band 4
Frequency Range:	30 - 1000 MHz	Test Date:	10/30/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WCDMA Band 4



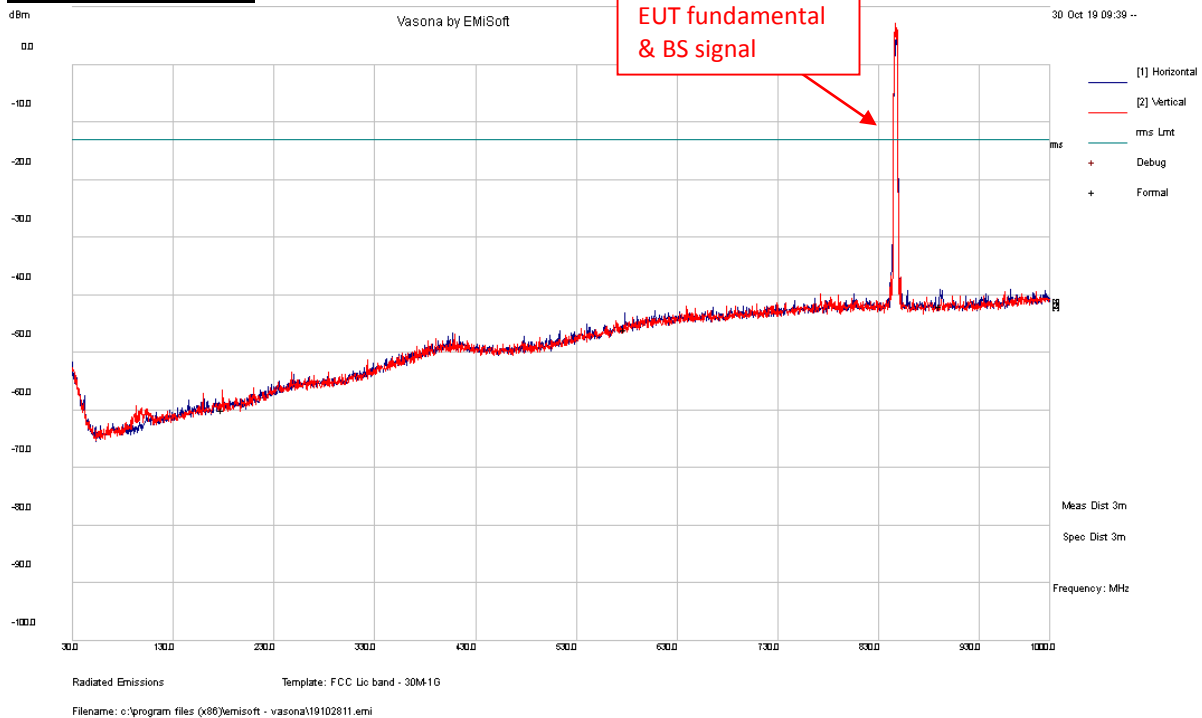
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
187.1732	-68.23	4.62	-21.97	-85.58	RMS Max	V	180	37	-13	-72.58	Pass
714.5062	-69.83	7.3	-6.48	-69.01	RMS Max	V	365	0	-13	-56.01	Pass
417.5725	-69.17	6.31	-13.68	-76.54	RMS Max	V	252	185	-13	-63.54	Pass

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



Test Standard:	Part22H, RSS-132	Mode:	WCDMA Band 5
Frequency Range:	30 - 1000 MHz	Test Date:	10/30/2019
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Bruce Li
Remark:	N/A	Test Result:	Pass

WCDMA Band 5



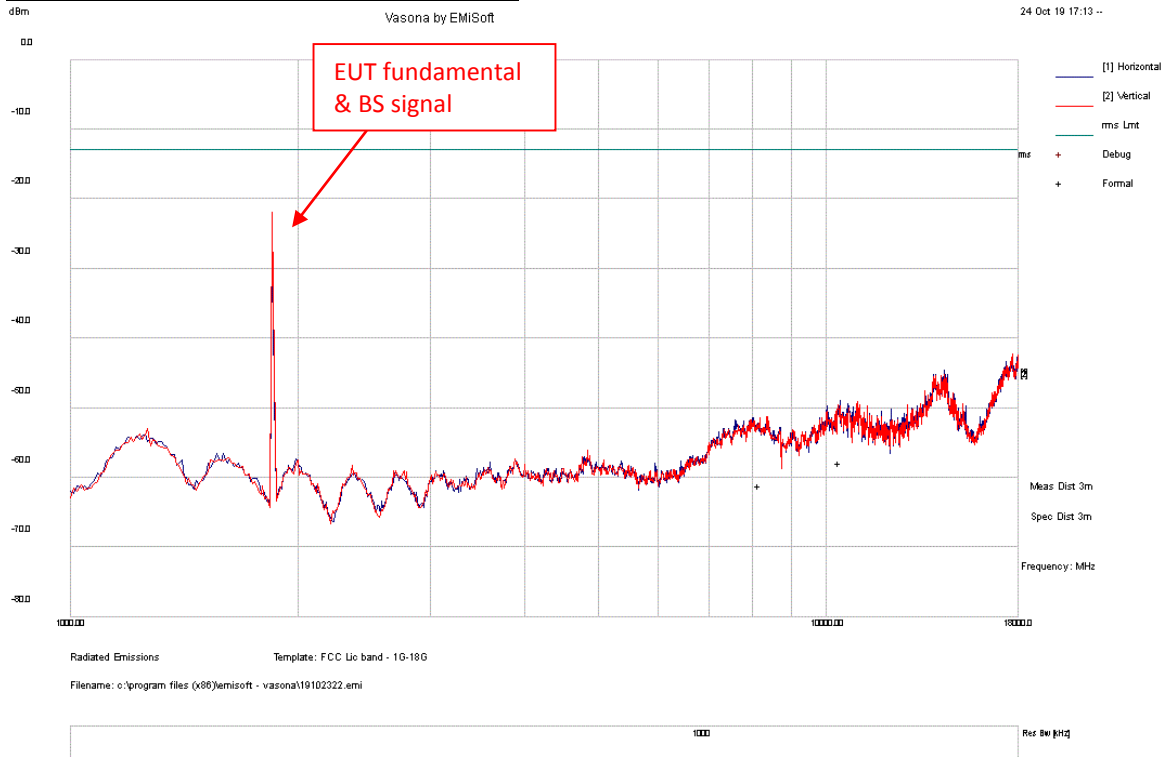
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
891.0422	-84.47	19.35	23.34	-41.78	RMS Max	H	356	52	-13	-28.78	Pass
578.5213	-85.23	18.72	20.6	-45.92	RMS Max	H	213	19	-13	-32.92	Pass
178.9503	-85.98	16.31	9.69	-59.98	RMS Max	V	218	236	-13	-46.98	Pass

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



Test Standard:	Part24E, RSS-133	Mode:	WCDMA Band 2 Low 1852.4 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

WCDMA Band 2 Low 1852.4 MHz



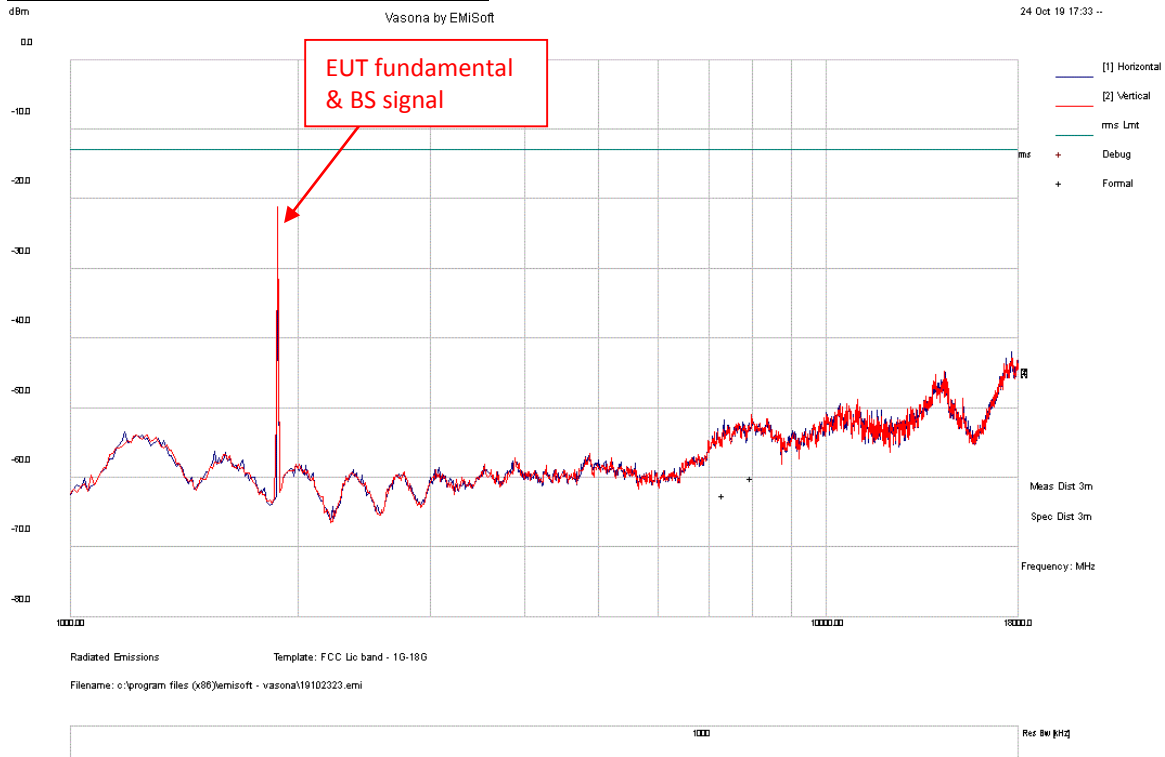
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
10445.75	-77.92	23.62	-3.51	-57.80	RMS Max	H	103	268	-13.00	-44.80	Pass
8172.98	-76.75	21.58	-5.97	-61.14	RMS Max	V	305	286	-13.00	-48.14	Pass

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



Test Standard:	Part24E, RSS-133	Mode:	WCDMA Band 2 Mid 1880 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

WCDMA Band 2 Mid 1880 MHz



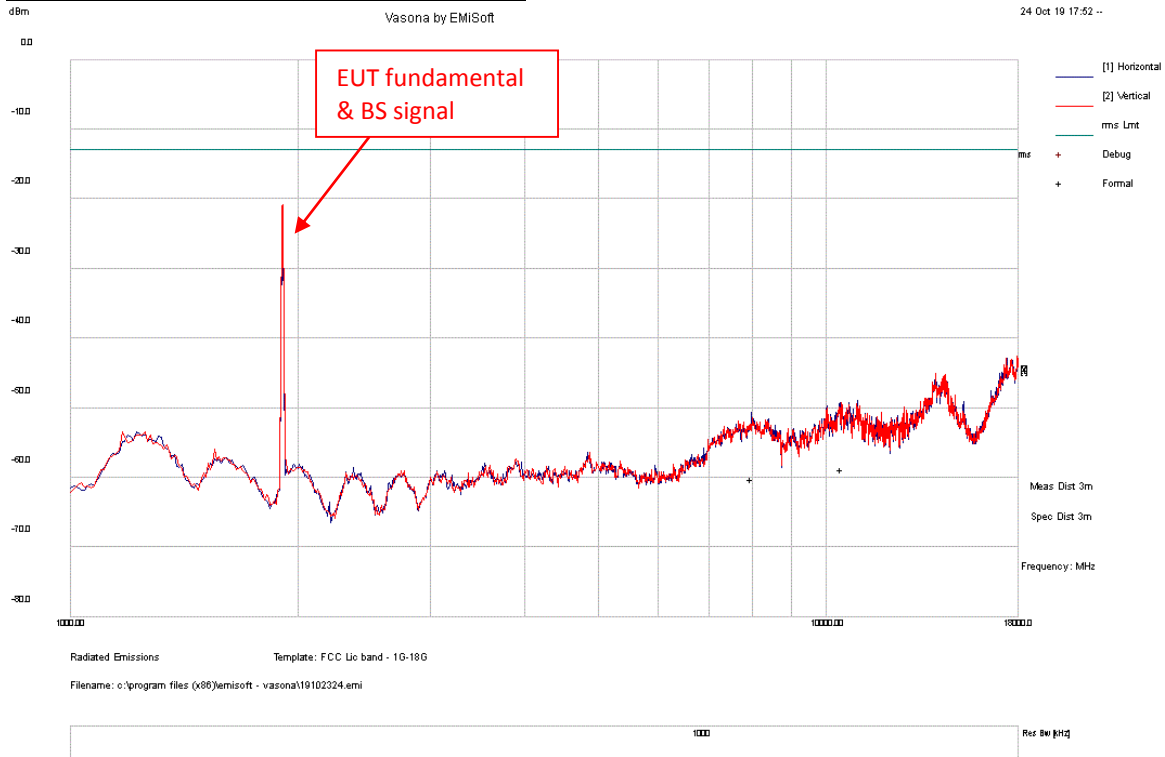
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
7332.32	-75.87	21.22	-7.86	-62.51	RMS Max	V	249	81	-13.00	-49.51	Pass
7984.74	-75.35	21.55	-6.29	-60.09	RMS Max	H	358	114	-13.00	-47.09	Pass

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



Test Standard:	Part24E, RSS-133	Mode:	WCDMA Band 2 High 1907.6 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

WCDMA Band 2 High 1907.6 MHz



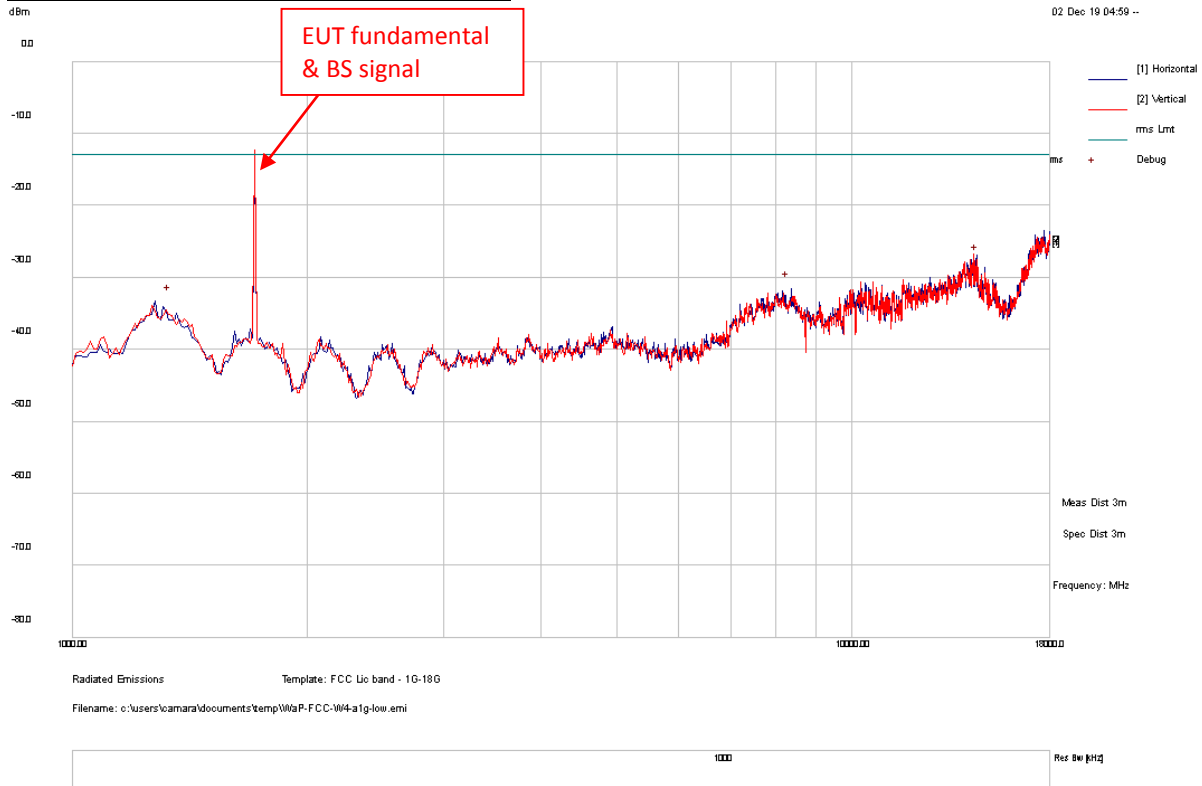
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
10507.61	-79.09	23.70	-3.46	-58.86	RMS Max	H	237	175	-13.00	-45.86	Pass
7980.67	-75.48	21.55	-6.31	-60.24	RMS Max	V	276	338	-13.00	-47.24	Pass

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



Test Standard:	Part27, RSS-139	Mode:	WCDMA Band 4 Low 1712.4MHz
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

WCDMA Band 4 Low 1712.4MHz



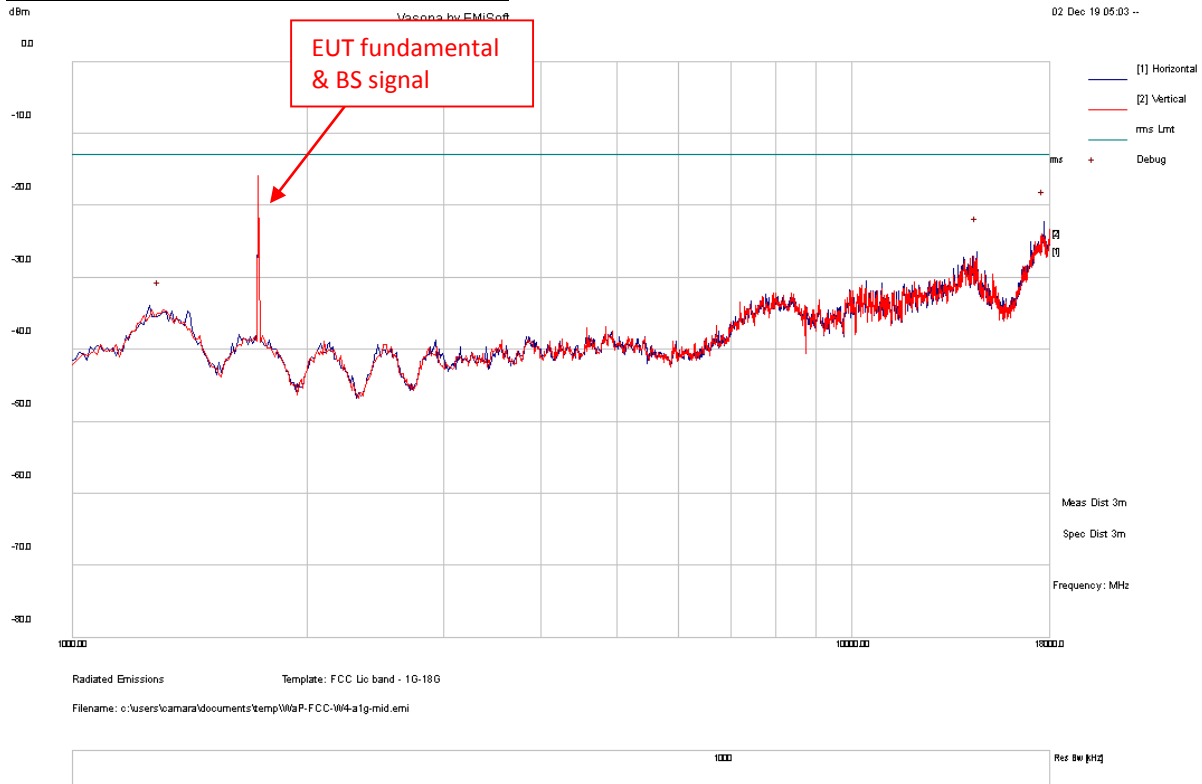
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
14450	-78.7	26.53	21.84	-30.33	RMS Max	V	150	78	-13	-17.33	Pass
8271.9	-70.01	21.6	14.31	-34.11	RMS Max	V	150	102	-13	-21.11	Pass
1329.4	-51.64	15.95	-0.24	-35.93	RMS Max	V	150	163	-13	-22.93	Pass

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



Test Standard:	Part27, RSS-139	Mode:	WCDMA Band 4 Low 1732.6MHz
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

WCDMA Band 4 Mid 1732.6MHz



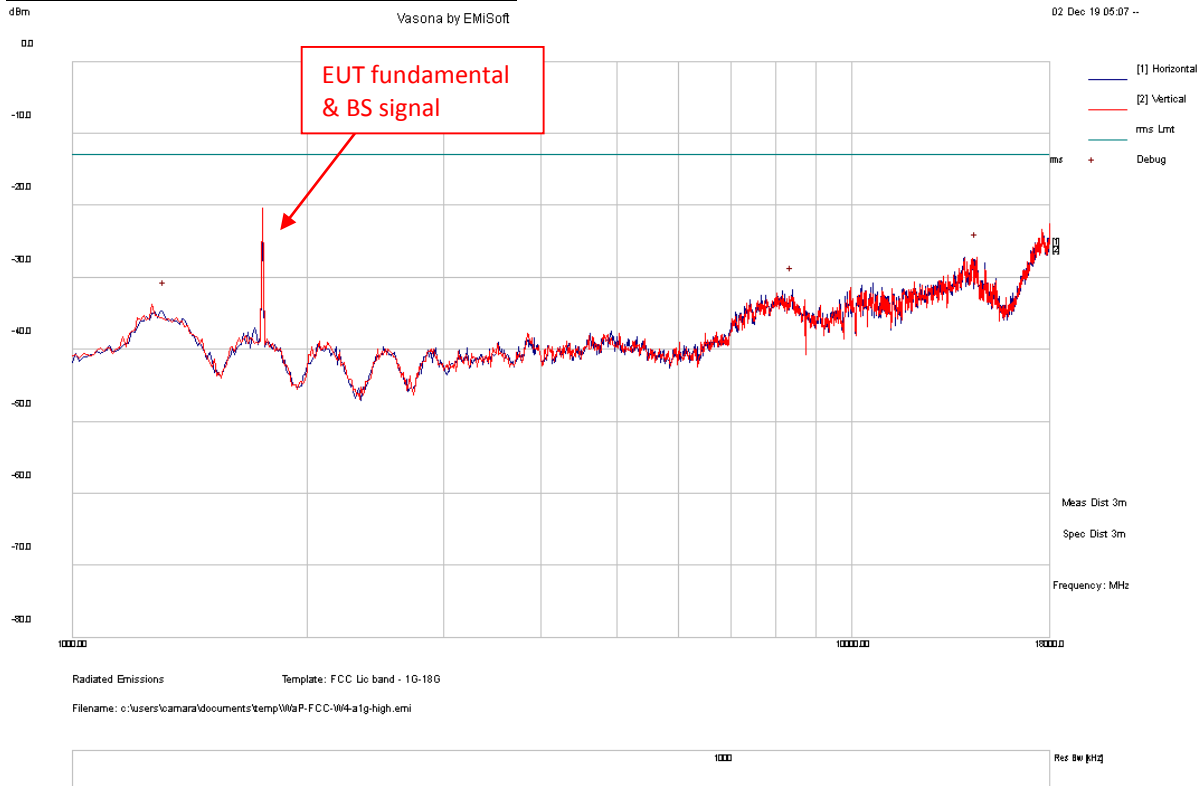
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1293.4	-51.37	15.89	0.16	-35.32	RMS Max	V	150	142	-13	-22.32	Pass
14492	-74.61	26.63	21.48	-26.49	RMS Max	V	150	113	-13	-13.49	Pass
17672	-75.12	29.15	23.28	-22.69	RMS Max	V	150	98	-13	-9.69	Pass

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



Test Standard:	Part27, RSS-139	Mode:	WCDMA Band 4 High 1752.6MHz
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

WCDMA Band 4 High 1752.6MHz



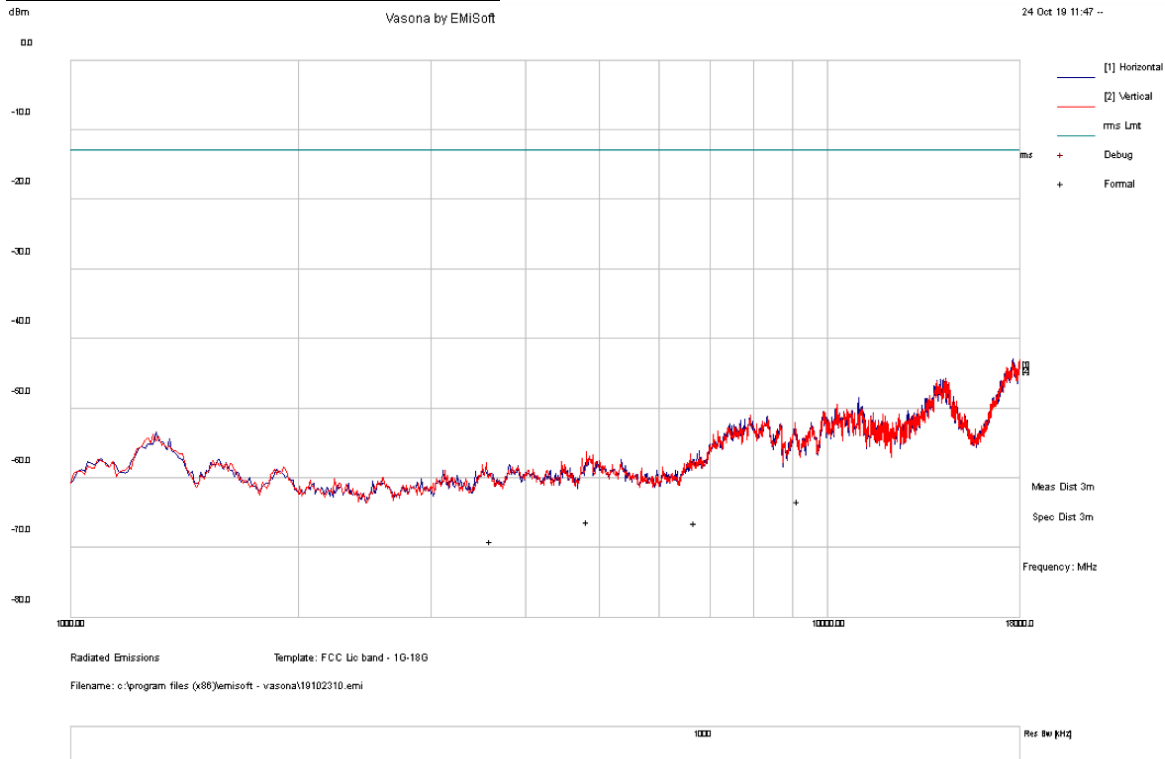
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1312.2	-51.16	15.92	-0.03	-35.27	RMS Max	V	150	91	-13	-22.27	Pass
8380.2	-69.37	21.62	14.4	-33.35	RMS Max	V	150	153	-13	-20.35	Pass
14450	-76.95	26.53	21.84	-28.58	RMS Max	V	150	182	-13	-15.58	Pass

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



Test Standard:	Part22H, RSS-132	Mode:	WCDMA Band 5 Low 826.4 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

WCDMA Band 5 Low 826.4 MHz



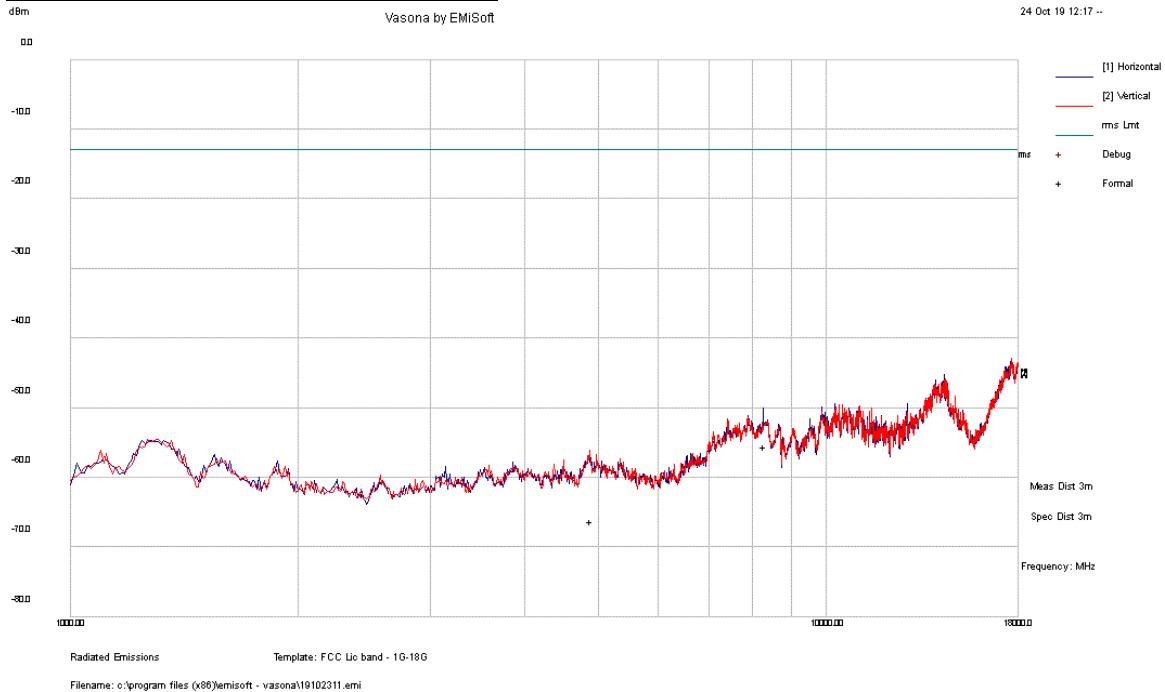
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
6687.87	-75.86	19.97	-10.46	-66.36	RMS Max	V	284	136	-13	-53.36	Pass
4825.50	-71.47	18.65	-13.36	-66.19	RMS Max	V	188	233	-13	-53.19	Pass
9161.21	-79.58	21.94	-5.59	-63.23	RMS Max	V	270	0	-13	-50.23	Pass
3592.53	-69.39	17.76	-17.34	-68.96	RMS Max	V	332	250	-13	-55.96	Pass

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



Test Standard:	Part22H, RSS-132	Mode:	WCDMA Band 5 Mid 836.6 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

WCDMA Band 5 Mid 836.6 MHz



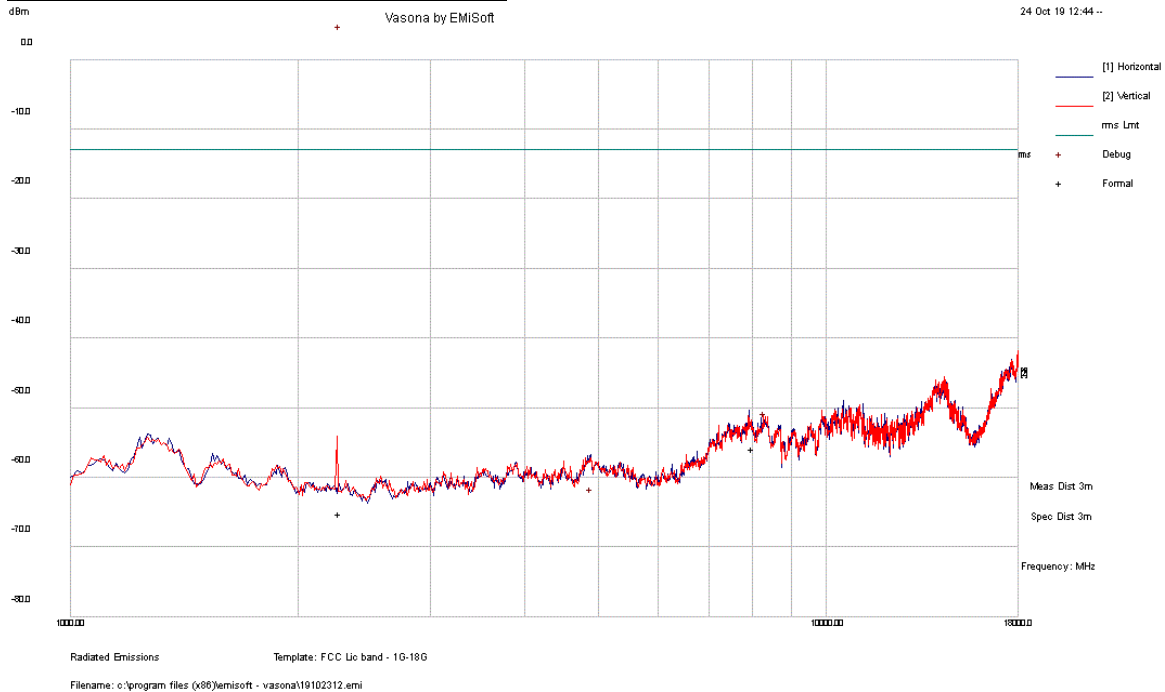
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
8317.08	-71.44	21.60	-5.64	-55.47	RMS Max	V	132	42	-13.00	-42.47	Pass
4886.32	-71.71	18.66	-13.26	-66.32	RMS Max	V	356	155	-13.00	-53.32	Pass

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



Test Standard:	Part22H, RSS-132	Mode:	WCDMA Band 5 High 846.6 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

WCDMA Band 5 High 846.6 MHz



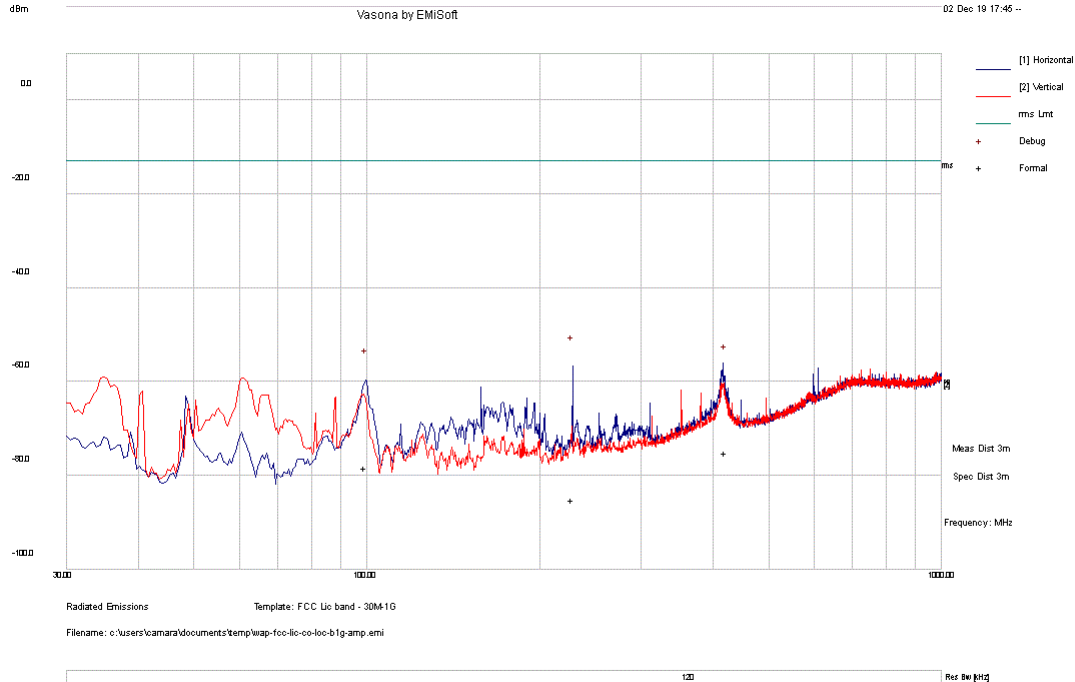
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
8000.19	-71.10	21.55	-6.24	-55.79	RMS Max	V	177	221	-13.00	-42.79	Pass
2271.03	-59.45	16.48	-22.27	-65.23	RMS Max	V	378	6	-13.00	-52.23	Pass

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



Test Standard:	Part24E, RSS-133	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



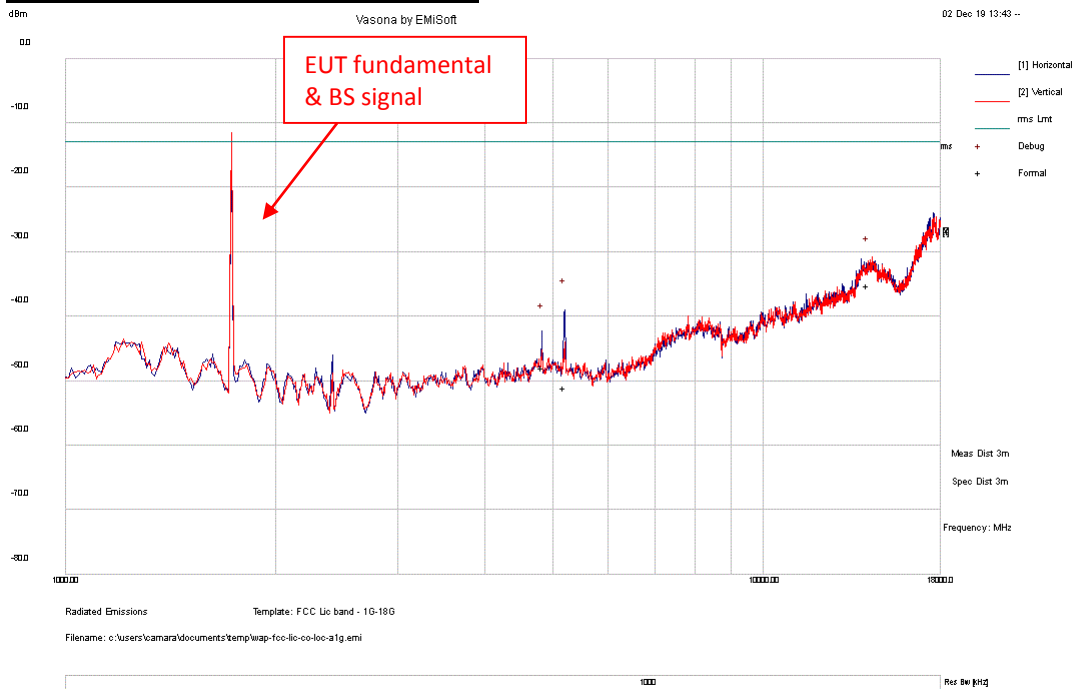
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
227.979	-81.6	16.8	-20.3	-85.1	RMS Max	V	171	296	-13	-72.1	Pass
419.97	-79.6	18.1	-13.7	-75.2	RMS Max	V	145	184	-13	-62.2	Pass
99.432	-69.9	15.3	-23.7	-78.3	RMS Max	V	141	105	-13	-65.3	Pass

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



Test Standard:	Part24E, RSS-133	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 dBm	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
14120.275	-82.6	25.7	21.7	-35.1	RMS Max	V	373	292	-13	-22.1	Pass
5197.841	-77	18.7	7.4	-51	RMS Max	V	169	177	-13	-38	Pass
4824.13	-73.2	18.6	6.6	-47.9	RMS Max	V	100	175	-13	-34.9	Pass

Report Number:	WAP-19091821-LC-FCC-IC-WCDMA
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.

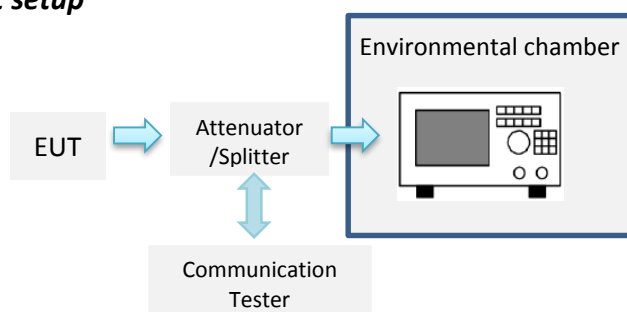
8.7 Frequency Stability

8.7.1 Requirement

§2.1055, §22.355 & §24.235, § 27.5(h); § 27.54
RSS-132(5.3), RSS-133(6.3), RSS-139(6.4)

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

8.7.2 Test setup



8.7.3 Test Procedure

- The testing follows ANSI C63.26 section 5.6.4.
- A communication link was established between EUT and base station.
- The EUT was set up in the thermal chamber and connected with the communication tester.
- With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
- With power OFF, the temperature was raised in 10°C steps up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.
- The frequency error was monitored and measured by base station under variation of ambient temperature and variation of primary supply voltage.

8.7.4 Test Result

UMTS/WCDMA Band 2 - 1880MHz					
Input Power (VDC)	Temperature (°C)	Frequency error(Hz)	Frequency error(ppm)	Limit (ppm)	Verdict
10.2	20	16	0.009	2.50	PASS
12	20	9	0.005	2.50	PASS
13.8	20	15	0.008	2.50	PASS
12	-30	11	0.006	2.50	PASS
12	-20	13	0.007	2.50	PASS
12	-10	12	0.006	2.50	PASS
12	0	9	0.005	2.50	PASS
12	10	9	0.005	2.50	PASS
12	20	15	0.008	2.50	PASS
12	30	9	0.005	2.50	PASS
12	40	11	0.006	2.50	PASS
12	50	5	0.002	2.50	PASS

UMTS/WCDMA Band 4 - 1732.6MHz					
Input Power (VDC)	Temperature (°C)	Frequency error(Hz)	Frequency error(ppm)	Limit (ppm)	Verdict
10.2	20	14	0.008	2.50	PASS
12	20	11	0.013	2.50	PASS
13.8	20	7	0.008	2.50	PASS
12	-30	5	0.006	2.50	PASS
12	-20	8	0.010	2.50	PASS
12	-10	11	0.013	2.50	PASS
12	0	3	0.004	2.50	PASS
12	10	8	0.010	2.50	PASS
12	20	4	0.005	2.50	PASS
12	30	13	0.016	2.50	PASS
12	40	9	0.011	2.50	PASS
12	50	3	0.004	2.50	PASS

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



UMTS/WCDMA Band 5 - 836.6MHz					
Input Power (VDC)	Temperature (°C)	Frequency error(Hz)	Frequency error(ppm)	Limit (ppm)	Verdict
10.2	20	8	0.009	2.50	PASS
12	20	11	0.014	2.50	PASS
13.8	20	11	0.013	2.50	PASS
12	-30	7	0.008	2.50	PASS
12	-20	5	0.006	2.50	PASS
12	-10	10	0.011	2.50	PASS
12	0	4	0.005	2.50	PASS
12	10	11	0.013	2.50	PASS
12	20	8	0.009	2.50	PASS
12	30	13	0.015	2.50	PASS
12	40	10	0.012	2.50	PASS
12	50	4	0.005	2.50	PASS



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
Temperature/Humidity Chamber	Thermotron	SM-8-8200	40991	9/8/2019	9/8/2020