TEST REPORT

Report Number. : 12934208-E2V3

Applicant	:	BENDIX COMMERCIAL VEHICLE SYSTEMS LLC #2110 – 6900 GRAYBAR ROAD RICHMOND, B. C. V6W 0A5 CANADA
FCC ID	:	NATRXK138360
Model Numbers	:	K138360, K138369, K138370, K138371, K138372
EUT Description	:	433.92 MHz TRANSCEIVER
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART B

Date Of Issue:

November 15, 2019

Prepared by:

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NVLAP Lab code: 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	9/17/2019	Initial Issue	--
V2	11/05/2019	Report revised based on reviewer's comments.	Bobby Bayani
V2	11/15/2019	Report revised based on reviewer's comments.	Bobby Bayani

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BENDIX COMMERCIAL VEHICLE SYSTEMS LLC #2110 – 6900 GRAYBAR ROAD RICHMOND, B. C. V6W 0A5 CANADA
EUT DESCRIPTION:	433.92 MHZ TRANSCEIVER
MODEL NUMBERS:	K138360, K138369, K138370, K138371, K138372
SERIAL NUMBER:	0001023
DATE TESTED:	AUGUST 26, 2019 to NOVEMBER 3, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC 47 CFR PART 15 SUBPART B	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Reviewed By:

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Prepared By:

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Approved & Released For
UL Verification Services Inc By:

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UL Verification Service Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2014.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
☐ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☒ Chamber J
☐ Chamber C	☐ Chamber F	☒ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a 433.92MHz transceiver used for Tire Pressure Monitoring Systems.

Only Model K138360 was tested.

GENERAL INFORMATION

EUT Receiver Frequency	433.92 MHz

Model Differences:

Note: Hardware on all versions of these model variants are identical. The only differences are different CAN messages requested by different customers and the CAN Baud Rate. See below for details.

K138360: 250K CAN Communication
K138369: 250k CAN Communication for Customer 1: Only changes are specific CAN messages.
K138370: 500k CAN Communication
K138371: 500k CAN Communication for Customer 1: Only changes are specific CAN messages.
K138372: 250k CAN Communication for Customer 2: Only changes are specific CAN messages.

Other details regarding the EUT are documented in the applicable MFR product documentation.

The radio utilizes an Internal Antenna (For Receive Mode only) with a gain of -5.0 dBi and external PIFA Antenna with a gain of 0 dBi.

Testing has been performed on both internal and external antenna.

5.2. TEST CONFIGURATIONS

The following configuration was tested:

EUT Configuration	Description
Power On	The EUT was installed in a typical configuration

5.3. MODE(S) OF OPERATION

Mode	Description
Receive mode	The EUT was exercised during testing.

5.4. SOFTWARE AND FIRMWARE

The software used in the EUT during testing was CANRXTOOL Test Ver. 1.0.2449.19148.
The firmware installed in the EUT during testing was K119204B000V4.04.

5.5. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop PC	LENOVO	T460	PC0C3DUA
AC Adapter	LENOVO	ADLX66NCT2A	11S36200280ZZ10048KF26
DC Power Supply	SORENSEN	XT 15-4	1319A02780
USB-Link	NEXIQ	-	73726

I/O CABLES

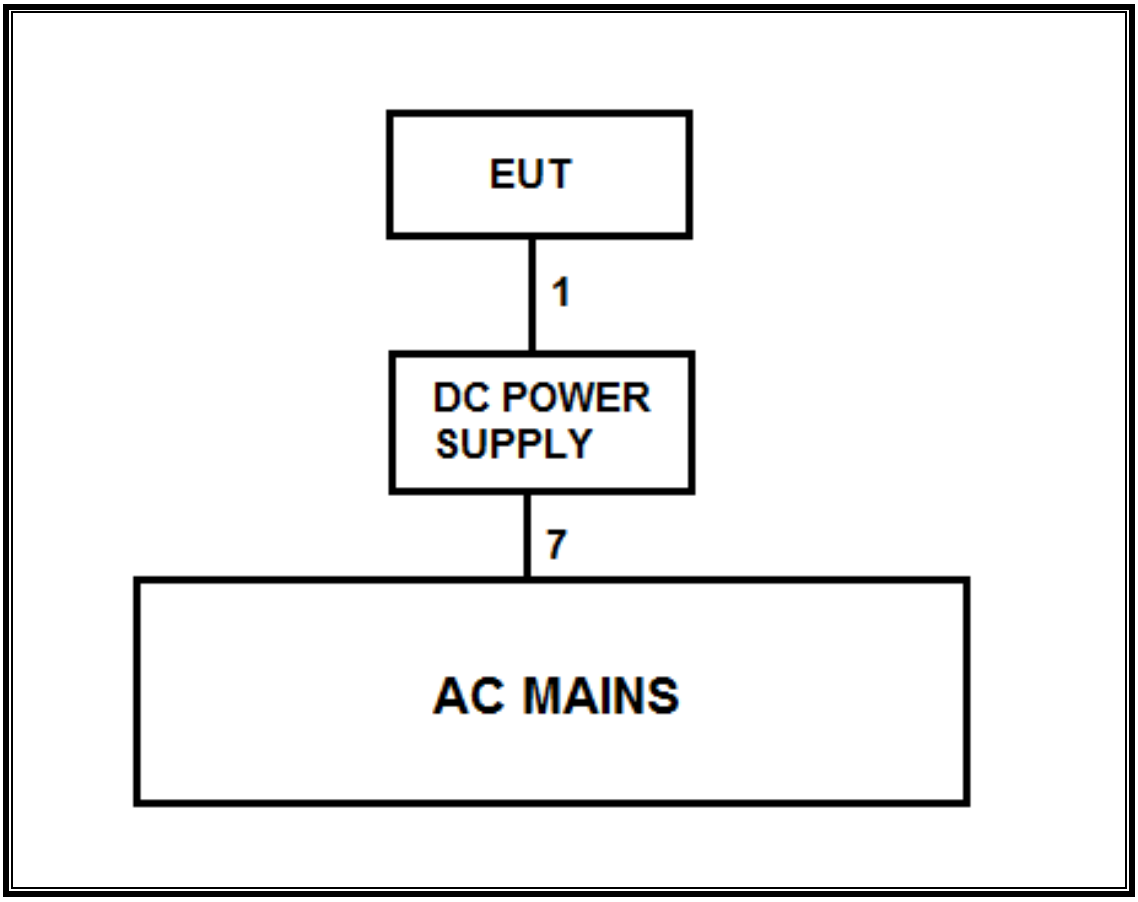
Note: All I/O cables used for testing were provided by the MFR.

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	DC	1	DC	Unshielded	1.0m	N/A
2	SERIAL	1	SERIAL	Unshielded	1.5m	N/A
3	USB	1	USB	Unshielded	1.0m	N/A
4	SERIAL	1	SERIAL	Shielded	0.3m	N/A
5	DC	1	DC	Unshielded	1.2m	N/A
6	AC	1	AC	Unshielded	1.2m	N/A
7	AC	1	AC	Unshielded	1.2m	N/A

TEST SETUP

Test software exercised the EUT.

SETUP DIAGRAM FOR NEXT GEN ECU



6. MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**ID No.**	**Cal Date**	**Cal Due**
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	05/16/2019	05/16/2020
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179372	02/16/2019	02/16/2020
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	05/16/2019	05/16/2020
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T899	08/23/2019	08/23/2020
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	FRE0184971	11/13/2018	11/13/2019
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	FRE0181575	09/05/2019	09/05/2020
Antenna, Horn 1-18GHz	AR	AMPL-ATH1G18	PRE0189055	04/20/2019	04/20/2020
Antenna, Horn 1-18GHz	ETS-LINDGREN	3117	PRE0100034	06/14/2019	06/14/2020
Amplifier, 9kHz to 1GHz, 32 dB	SONOMA INSTRUMENT	310	PRE0180174	06/01/2019	06/01/2020
Amplifier, 9kHz to 1GHz, 32 dB	SONOMA INSTRUMENT	310	PRE0180175	06/29/2019	06/29/2020
Amplifier, 9kHz to 1GHz, 32 dB	SONOMA INSTRUMENT	310	175953	12/13/2018	12/13/2019
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	PRE0181597	05/28/2019	05/28/2020
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	PRE0180022	06/04/2019	06/04/2020
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1569	04/04/2019	05/04/2020

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, June 22, 2018

7. RADIATED EMISSIONS LIMITS AND TEST RESULTS

LIMIT

§15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Limits for radiated disturbance of Class B ITE at measuring distance of 3 m	
Frequency range (MHz)	Quasi-peak limits (dBµV/m)
30 to 88	40
88 to 216	43.5
216 to 960	46
Above 960 MHz	54
Note: The lower limit shall apply at the transition frequency.	

TEST PROCEDURE

ANSI C63.4: 2014

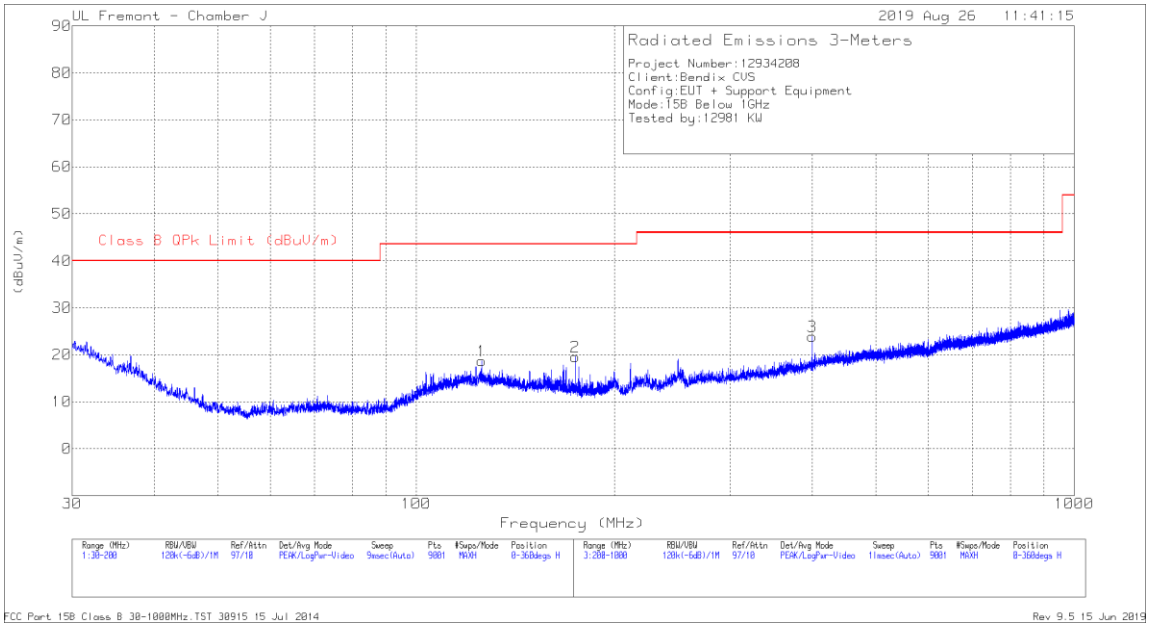
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	**Upper frequency of measurement range** (MHz)
Below 108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 2 GHz, whichever is lower

RESULTS

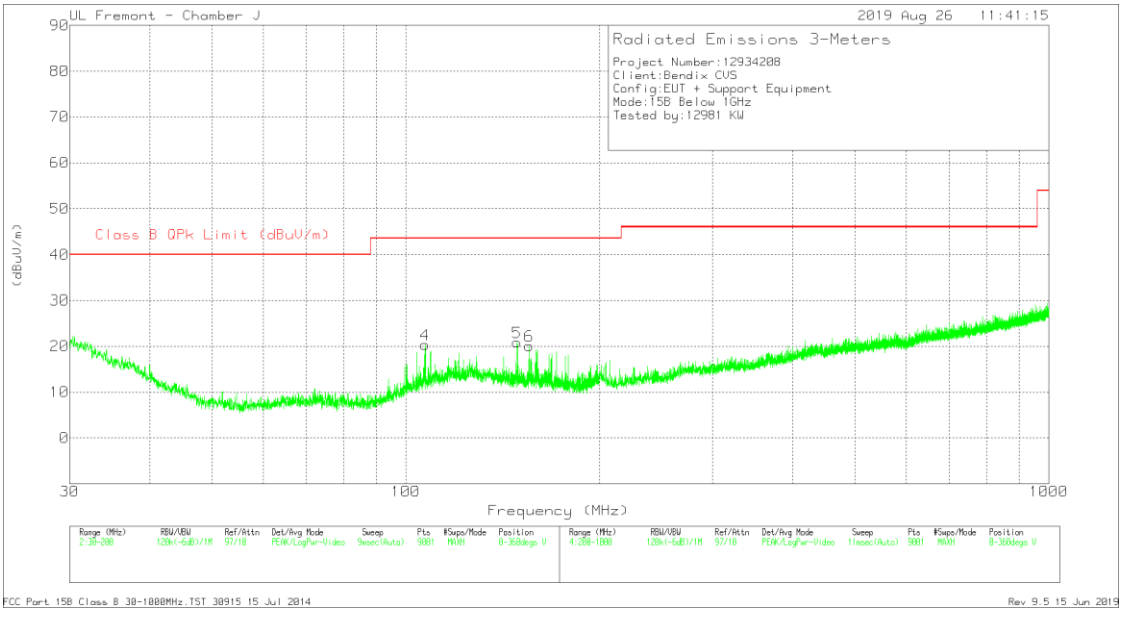
7.1. INTERNAL ANTENNA

RADIATED EMISSIONS 30 MHz to 1 GHz

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	125.7295	29.81	Pk	19.8	-30.9	18.71	43.52	-24.81	0-360	198	H
2	174.5575	32.81	Pk	17.3	-30.5	19.61	43.52	-23.91	0-360	198	H
4	107.2182	33.2	Pk	18.1	-31	20.3	43.52	-23.22	0-360	101	V
5	149.029	33.21	Pk	18.4	-30.7	20.91	43.52	-22.61	0-360	101	V
6	155.4607	32.49	Pk	18.3	-30.7	20.09	43.52	-23.43	0-360	101	V
3	399.9114	32.17	Pk	21.5	-29.8	23.87	46.02	-22.15	0-360	99	H

Pk - Peak detector

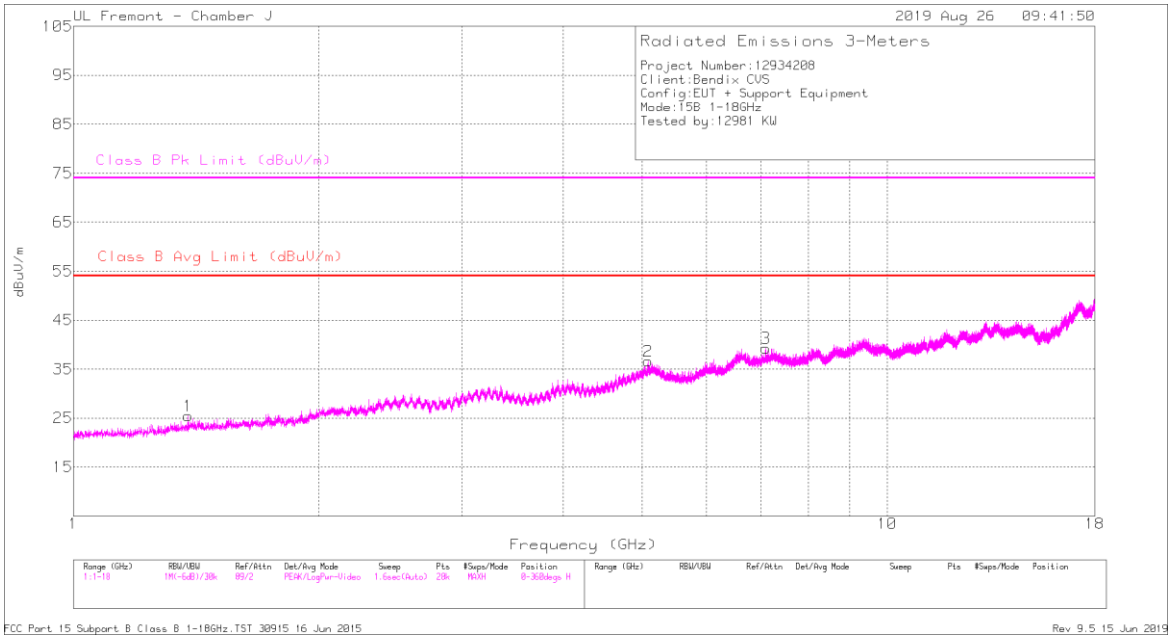
Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
155.2387	28.57	Pk	18.3	-30.7	16.17	43.52	-27.35	6	146	V
155.2387	21.24	Qp	18.3	-30.7	8.84	43.52	-34.68	6	146	V

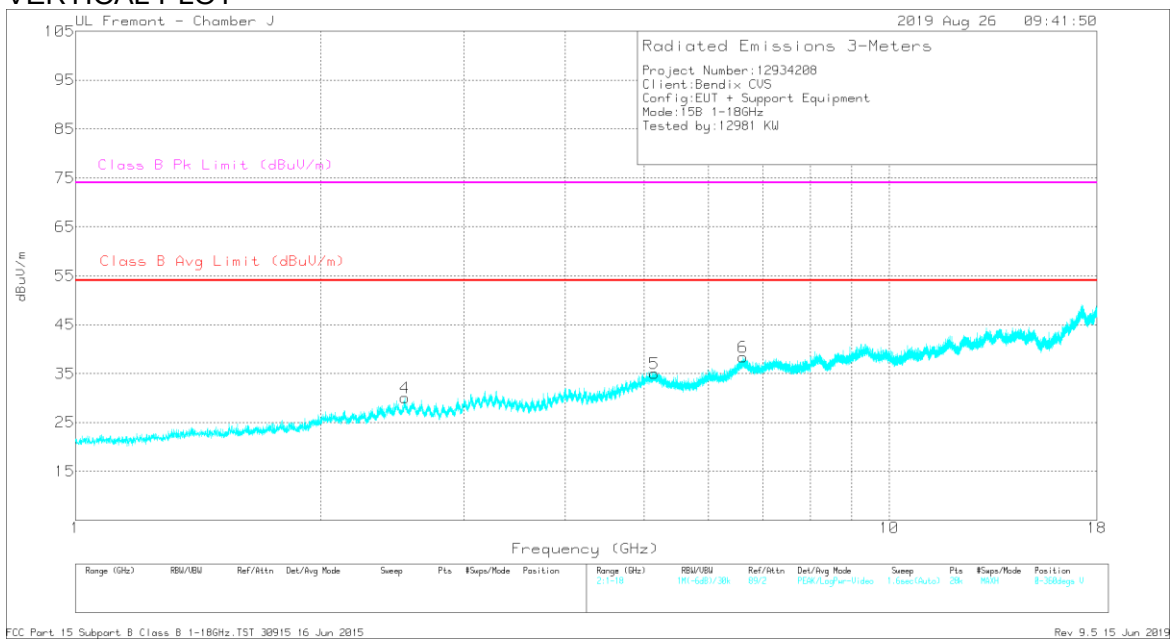
Pk - Peak detector
Qp - Quasi-Peak detector

RADIATED EMISSIONS 1 GHz to 18 GHz

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.38432	36.17	Avg	25.1	-35.8	25.47	54	-28.53	-	-	0-360	198	H
2	5.08061	32.32	Avg	35.6	-31.3	36.62	54	-17.38	-	-	0-360	102	H
3	7.09329	29.29	Avg	37.8	-27.8	39.29	54	-14.71	-	-	0-360	198	H
4	2.54154	35.27	Avg	30.2	-35.4	30.07	54	-23.93	-	-	0-360	101	V
5	5.14314	30.56	Avg	35.7	-31.2	35.06	54	-18.94	-	-	0-360	101	V
6	6.61	28.43	Avg	38.3	-28.4	38.33	54	-15.67	-	-	0-360	101	V

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

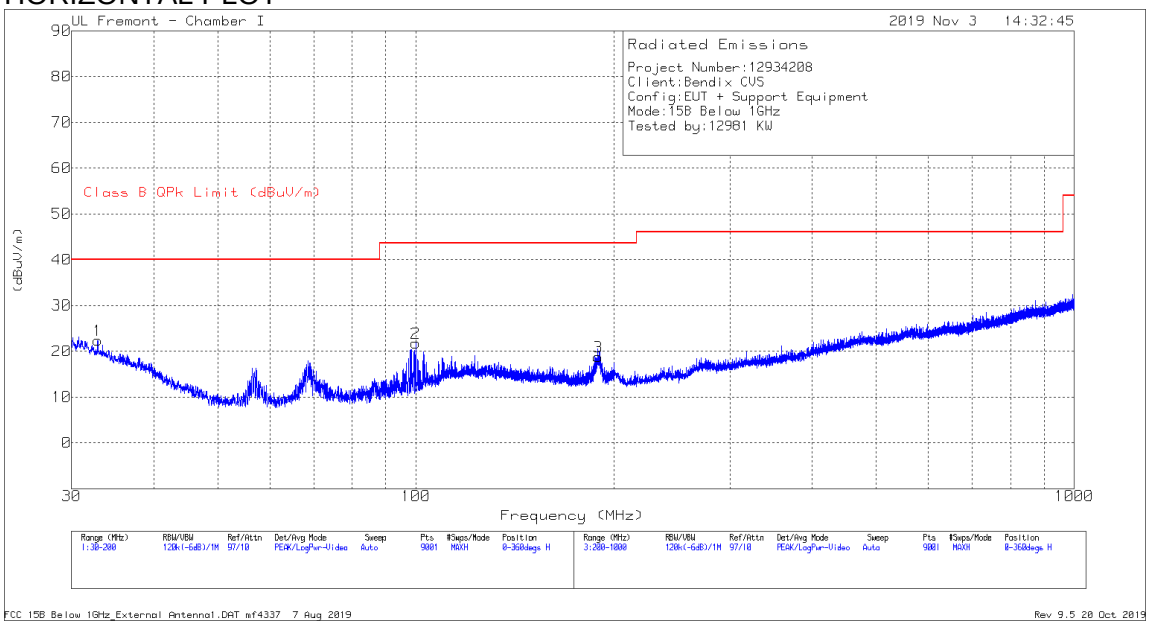
Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.38447	44.31	Pk	25.1	-35.8	33.61	-	-	74	-40.39	196	168	H
1.38447	30.5	Av	25.1	-35.8	19.8	54	-34.2	-	-	196	168	H
5.082	41.02	Pk	35.6	-31.3	45.32	-	-	74	-28.68	99	139	H
5.082	26.82	Av	35.6	-31.3	31.12	54	-22.88	-	-	99	139	H
7.09391	38.02	Pk	37.8	-27.8	48.02	-	-	74	-25.98	184	224	H
7.09191	23.54	Av	37.7	-27.8	33.44	54	-20.56	-	-	184	224	H
2.54337	44.11	Pk	30.2	-35.4	38.91	-	-	74	-35.09	251	204	V
2.54337	30.37	Av	30.2	-35.4	25.17	54	-28.83	-	-	251	204	V
5.14382	40.07	Pk	35.7	-31.2	44.57	-	-	74	-29.43	302	154	V
5.14382	26.67	Av	35.7	-31.2	31.17	54	-22.83	-	-	302	154	V
6.61013	37.67	Pk	38.3	-28.4	47.57	-	-	74	-26.43	96	110	V
6.61013	23.95	Av	38.3	-28.4	33.85	54	-20.15	-	-	96	110	V

Pk - Peak detector
Av - Average detection

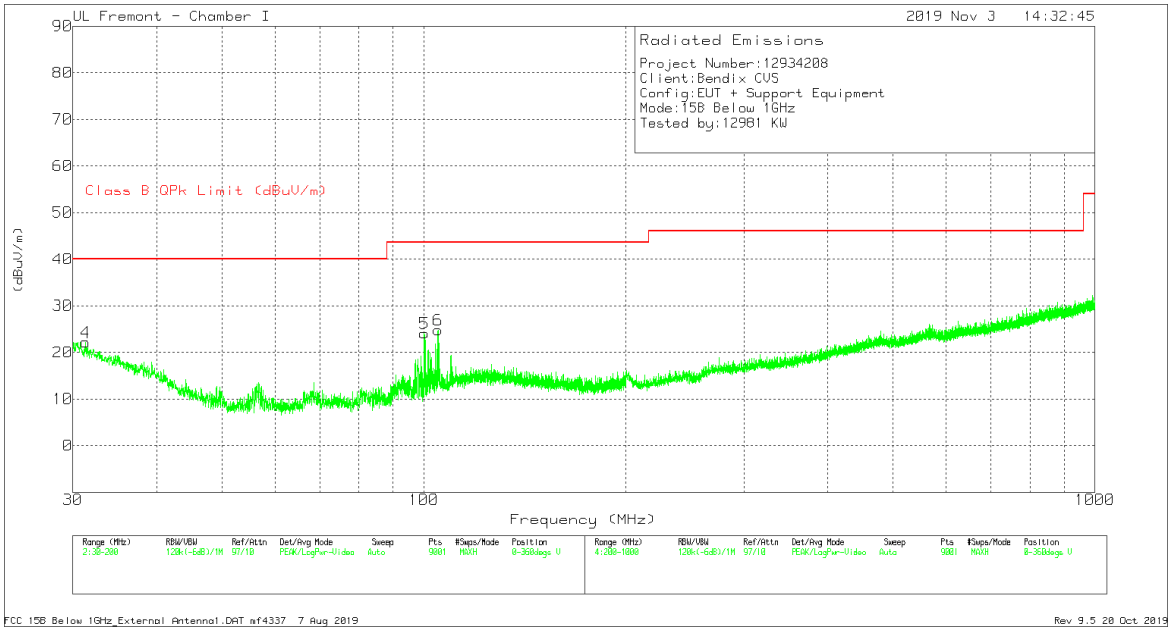
7.2. EXTERNAL ANTENNA

RADIATED EMISSIONS 30 MHz to 1 GHz

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0184971 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	32.8711	29.16	Pk	24.6	-31.4	22.36	40	-17.64	0-360	299	H
2	100.0026	36.47	Pk	16.1	-30.8	21.77	43.52	-21.75	0-360	399	H
3	189.1587	32.04	Pk	17	-30.3	18.74	43.52	-24.78	0-360	102	H
4	31.3411	27.94	Pk	25.6	-31.4	22.14	40	-17.86	0-360	102	V
5	100.1726	38.76	Pk	16.1	-30.8	24.06	43.52	-19.46	0-360	102	V
6	104.9893	38.19	Pk	17.4	-30.8	24.79	43.52	-18.73	0-360	102	V

Pk - Peak detector

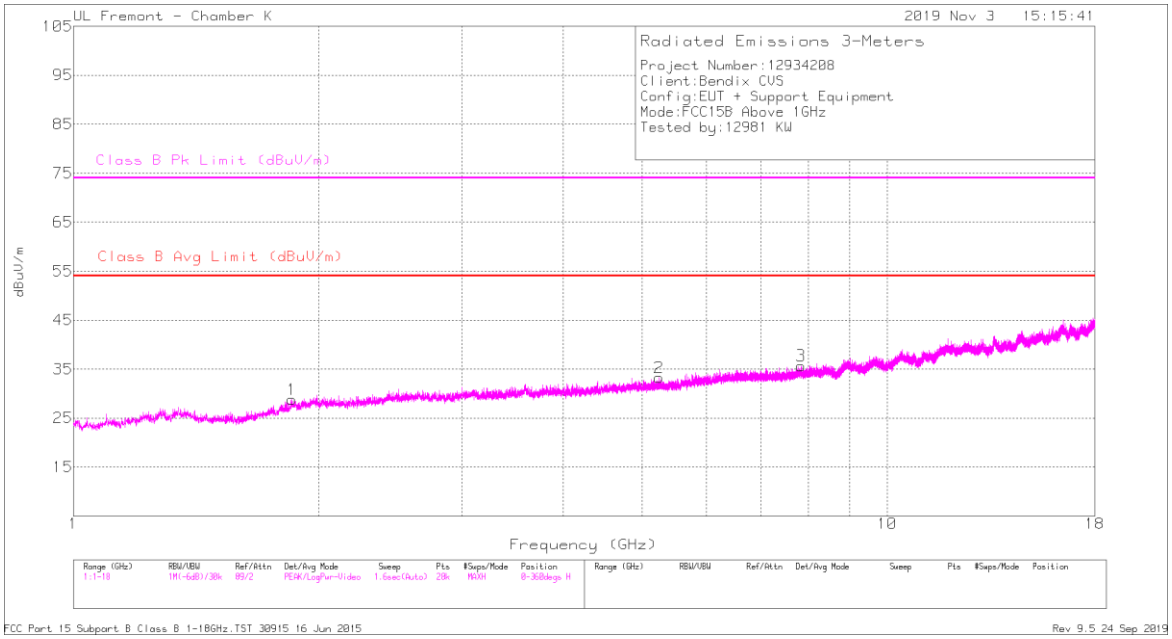
Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0184971 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
104.9049	28.98	Pk	17.4	-30.8	15.58	43.52	-27.94	360	358	V
104.9049	21.49	Qp	17.4	-30.8	8.09	43.52	-35.43	360	358	V

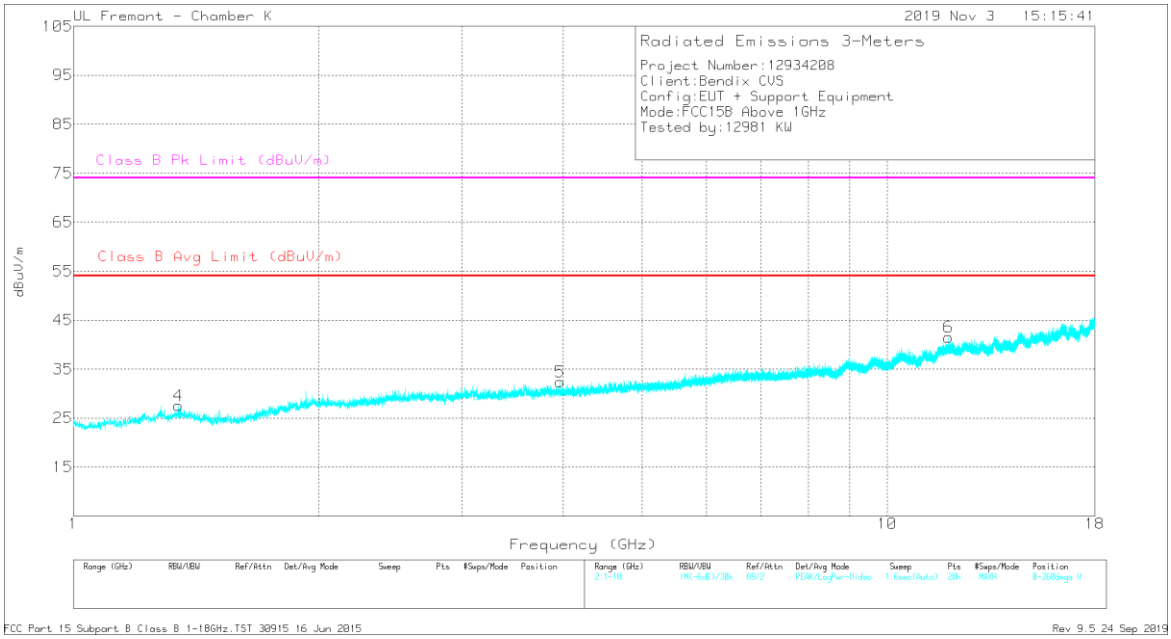
Pk - Peak detector
Qp - Quasi-Peak detector

RADIATED EMISSIONS 1 GHz to 18 GHz

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.85425	33.33	Avg	30.9	-35.4	28.83	54	-25.17	-	-	0-360	200	H
2	5.24514	29.18	Avg	34.3	-30.2	33.28	54	-20.72	-	-	0-360	101	H
3	7.83279	26.09	Avg	35.8	-26.2	35.69	54	-18.31	-	-	0-360	200	H
4	1.34607	33.47	Avg	29.5	-35.4	27.57	54	-26.43	-	-	0-360	101	V
5	3.96711	31.02	Avg	33.3	-31.9	32.42	54	-21.58	-	-	0-360	101	V
6	11.90672	23.63	Avg	38.7	-20.8	41.53	54	-12.47	-	-	0-360	200	V

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.85421	42.82	Pk	30.9	-35.4	38.32	-	-	74	-35.68	193	177	H
1.85421	29.2	Av	30.9	-35.4	24.7	54	-29.3	-	-	193	177	H
5.24401	38.39	Pk	34.3	-30.2	42.49	-	-	74	-31.51	157	152	H
5.24401	24.57	Av	34.3	-30.2	28.67	54	-25.33	-	-	157	152	H
7.83403	34.58	Pk	35.8	-26.2	44.18	-	-	74	-29.82	215	213	H
7.83403	21.47	Av	35.8	-26.2	31.07	54	-22.93	-	-	215	213	H
1.3449	42.29	Pk	29.4	-35.4	36.29	-	-	74	-37.71	139	143	V
1.3449	29.1	Av	29.4	-35.4	23.1	54	-30.9	-	-	139	143	V
3.9687	39.85	Pk	33.3	-31.9	41.25	-	-	74	-32.75	241	195	V
3.9687	25.97	Av	33.3	-31.9	27.37	54	-26.63	-	-	241	195	V
11.90654	31.74	Pk	38.7	-20.8	49.64	-	-	74	-24.36	326	120	V
11.90654	18.95	Av	38.7	-20.8	36.85	54	-17.15	-	-	326	120	V

Pk - Peak detector
Av - Average detection