Certification Test Report

FCC ID: 2AB7YVPR9XYLN
IC: 20699-VPR9XYLN

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

ACS Report Number: 16-2053.W06.2A

Applicant: Viper Design LLC

Model(s): VPR9XYLND

Test Begin Date: **October 13, 2016**
Test End Date: **January 27, 2017**

Report Issue Date: January 27, 2017

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 27 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development (ISED) Canada's Radio Standards Specification RSS-247 for modular approval.

1.2 Applicant Information

Viper Design LLC
125 Glancy St
Goodlettsville, TN 37072

1.3 Product Description

The Viper Design LLC model VPR9XYLND is a Sub GHz Communications Module. The module contains a processor and a radio which operates in the 900 MHz ISM band.

Technical Details

Mode of Operation:	900 MHz ISM
Frequency Range:	915.3 MHz - 927.3 MHz
Number of Channels:	29
Channel Separation:	448 kHz
Data Rate:	100 kbps
Modulations:	FSK
Antenna Type/Gain:	Wire Antenna, 2.2 dBi
Input Power:	2.6 VDC - 3.6 VDC

Model Number(s): VPR9XYLND

Test Sample Serial Number(s): N/A (sample directly soldered on Interface board).
Interface boards S/N: 2184 (RF Conducted Emissions), 2182 (Radiated and Power Line Conducted Emissions).

Test Sample Condition: The equipment was provided in good condition without any physical damage.

1.4 Test Methodology and Considerations

The EUT was evaluated for the 900 MHz radio module while connected to an interface board.

The radiated emissions evaluation was performed with the EUT set in three orthogonal orientations. The results are provided for the orientation leading to the worst case emissions.

The RF conducted emissions evaluation was performed on a sample configured with an SMA connector at the antenna port.

The assessment for unintentional emissions is documented separately in a Verification test report.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Test Firm Registration #: 475089
Innovation, Science and Economic Development Canada Lab Code: 4175C

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

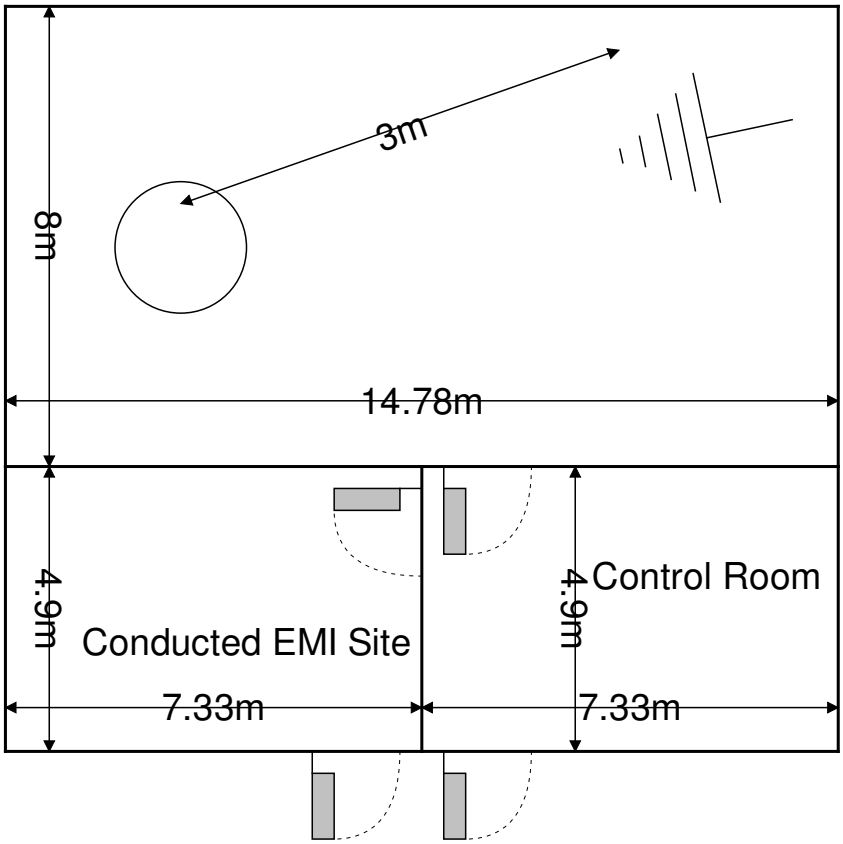


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

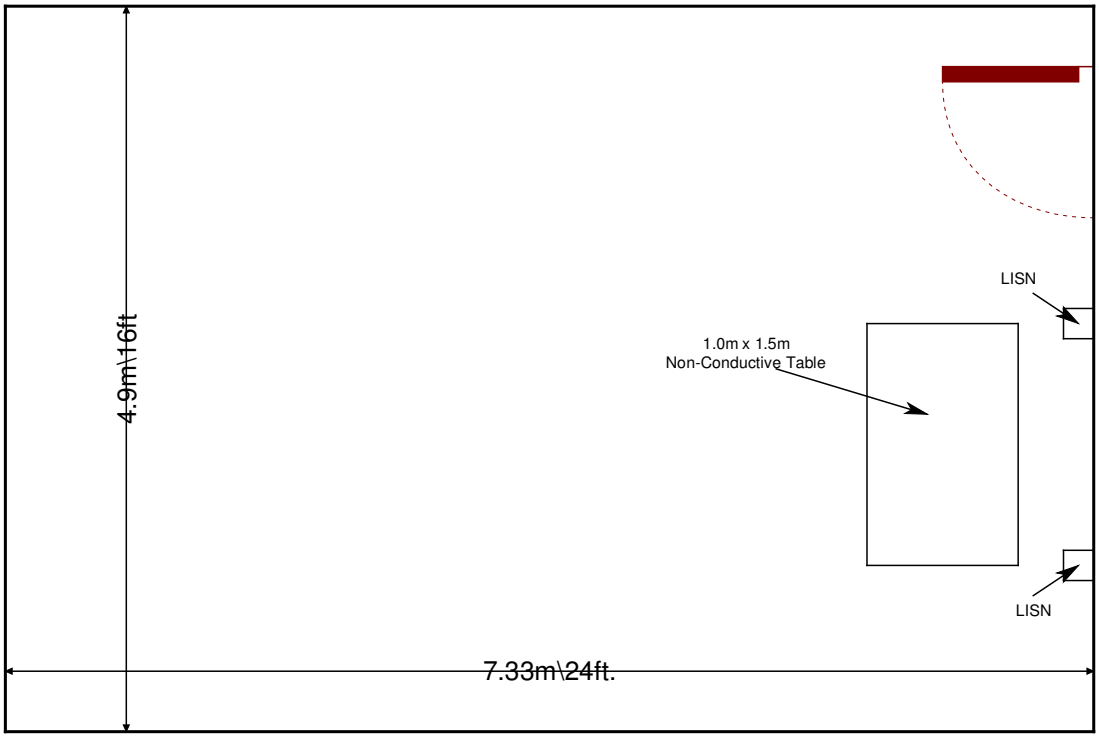


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2017.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- FCC KDB 558074 D01 DTS Meas Guidance v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 8, 2016.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
78	EMCO	6502	Antennas	9104-2608	5/11/2016	5/11/2018
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	7/21/2016	7/21/2018
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/9/2016	12/9/2018
2002	EMCO	3108	Antennas	2147	11/19/2015	11/19/2017
2004	EMCO	3146	Antennas	1385	11/19/2015	11/19/2017
2006	EMCO	3115	Antennas	2573	4/14/2015	4/14/2017
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/18/2015	11/18/2016
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/2/2016	11/2/2017
2069	Trilithic, Inc.	7NM867/122-X1-AA	Notch Filter	200315126	3/25/2016	3/25/2017
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	11/17/2015	11/17/2016
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	11/1/2016	11/1/2017
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/16/2015	11/16/2016
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/2/2016	11/2/2017
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/9/2015	12/9/2016
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/2/2016	12/2/2017
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2111	Aeroflex Inmet	40AH2W-20	Attenuator	2111	7/20/2016	7/20/2017
2112	Teledyne Storm Products	921-0101-036	Cables	12-06-698	11/13/2015	11/13/2016
2112	Teledyne Storm Products	921-0101-036	Cables	12-06-698	11/2/2016	11/2/2017
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/1/2016	8/1/2017
2022	EMCO	LISN3825/2R	LISN	1095	9/14/2015	9/14/2017
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	11/11/2015	11/11/2016
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	10/31/2016	10/31/2017
3004	Teseq	CFL 9206A	Attenuators	34720	9/14/2016	9/14/2017

Notes:

- **NCR=No Calibration Required**
- **The assets calibration cycle information is provided to cover the entire test period.**

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Viper Design LLC	VPR9XYLND	N/A
2	Interface Board	Kidde	SBR101	2182
3	Power Supply	Phihong	PSA10F-050Q	N/A

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	USB	1 m	No	EUT to Power Supply
B	Extension Cord	2.7 m	No	Power Supply to AC Mains

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

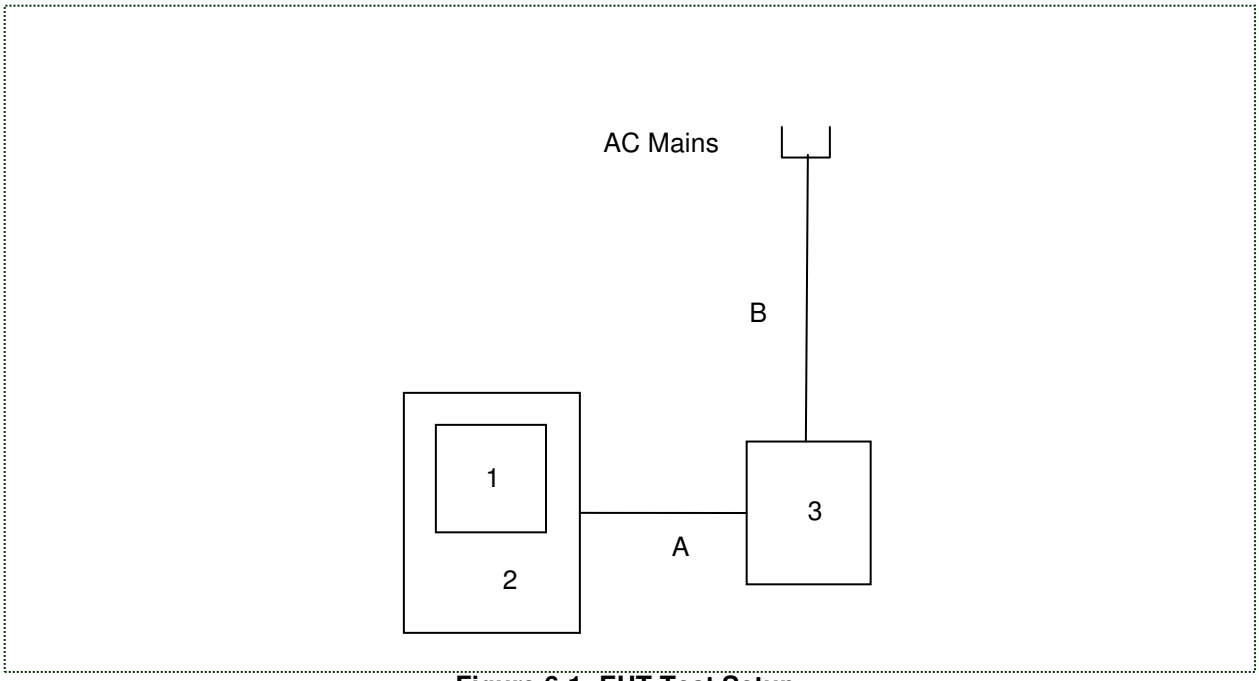


Figure 6-1: EUT Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses a 2.2 dBi wire antenna that is directly soldered to the PCB. The antenna is not removable, thus meeting the requirements of FCC 15.203.

7.2 6 dB Bandwidth - FCC: Section 15.247(a)(2); ISED Canada: RSS-247 5.2(1); 99% Bandwidth ISED Canada: RSS-GEN 6.6

7.2.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 8.2 Option 2. The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the emissions and >> RBW.

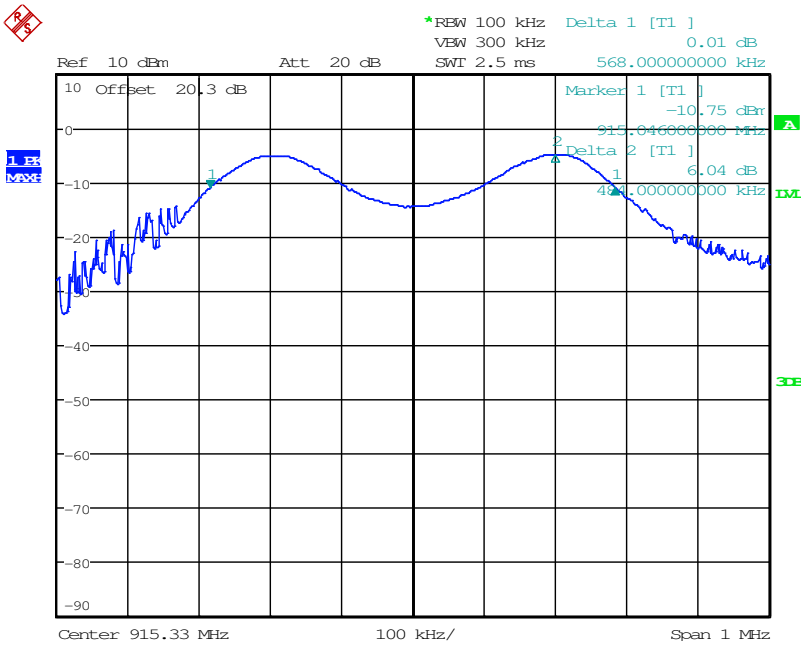
The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set from 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using 99% bandwidth equipment function of the spectrum analyzer using a sample detector.

7.2.2 Measurement Results

Results are shown below.

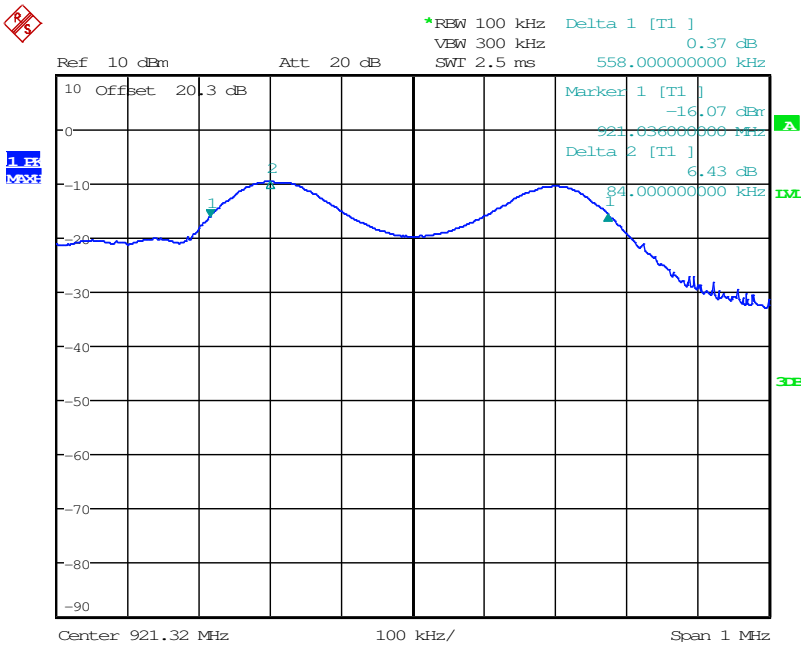
Table 7.2.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [kHz]	99% Bandwidth [kHz]
915.3	568.0	540.0
921.3	558.0	848.0
927.3	606.0	576.0



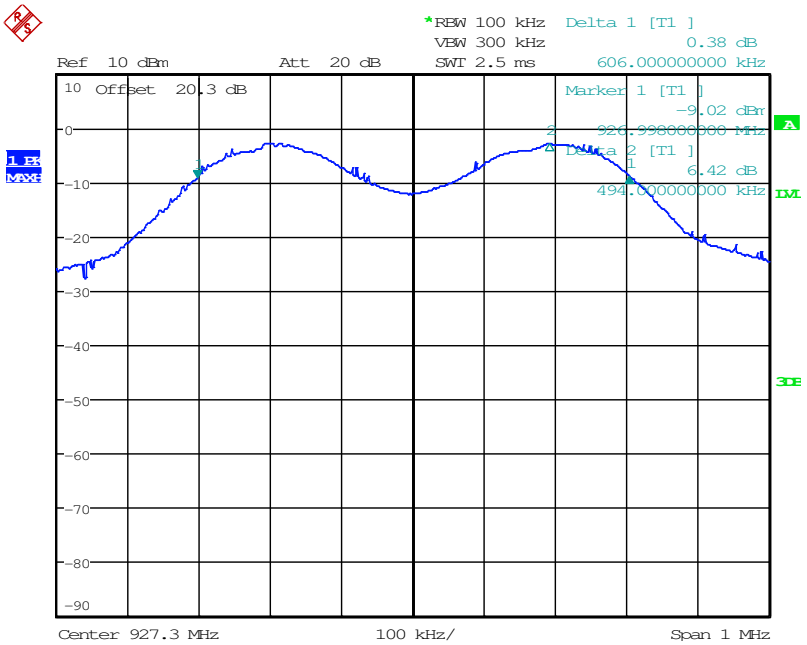
Date: 12.OCT.2016 20:26:01

Figure 7.2.2-1: 6dB BW - Low Channel



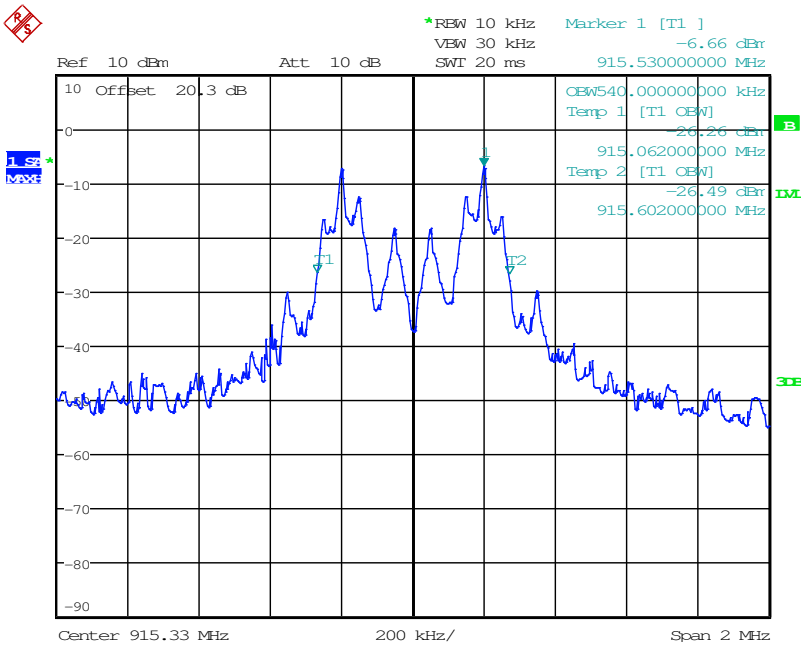
Date: 12.OCT.2016 20:18:07

Figure 7.2.2-2: 6dB BW - Middle Channel



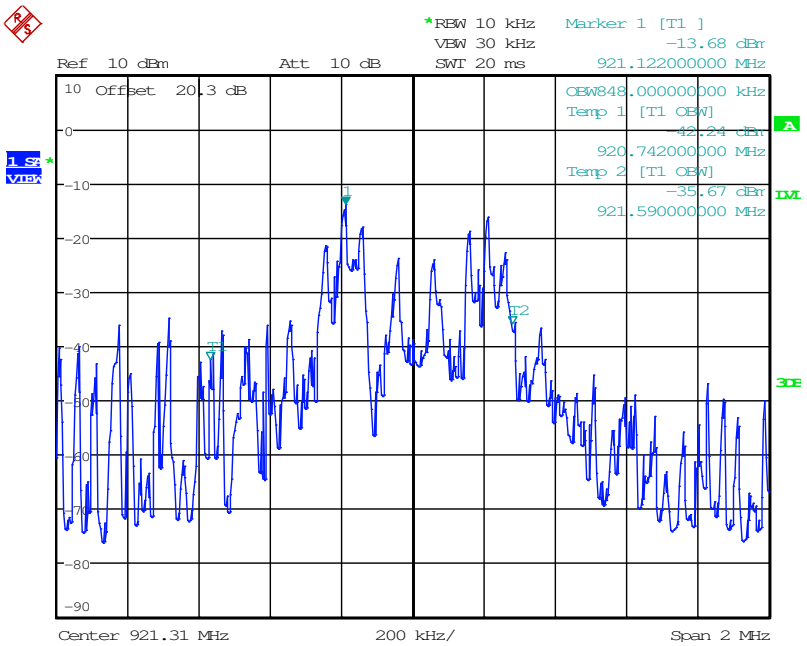
Date: 12.OCT.2016 21:56:43

Figure 7.2.2-3: 6dB BW - High Channel



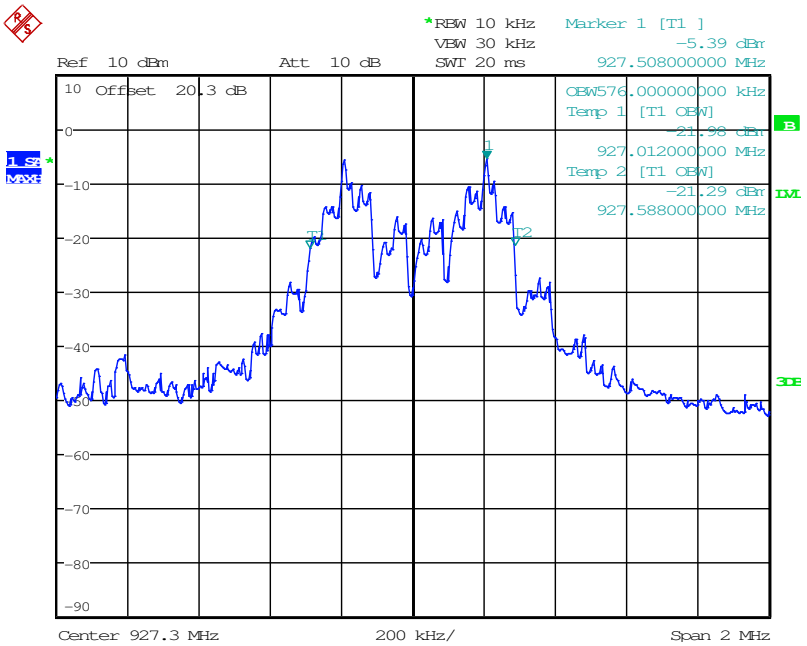
Date: 12.OCT.2016 20:35:04

Figure 7.2.2-4: 99% OBW - Low Channel



Date: 12.OCT.2016 22:55:38

Figure 7.2.2-5: 99% OBW - Middle Channel



Date: 12.OCT.2016 22:22:56

Figure 7.2.2-6: 99% OBW - High Channel

7.3 Peak Output Power – FCC: Section 15.247(b)(3); ISED Canada: RSS-247 5.4(4)

7.3.1 Measurement Procedure (Conducted Method)

The fundamental emission output power was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 9.1.1 RBW ≥ DTS bandwidth. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation. The RBW was set to 3 MHz which is greater than the DTS BW. The VBW and span were set to > 3xRBW.

7.3.2 Measurement Results

Results are shown below.

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
915.3	-4.35
921.3	-9.32
927.3	-1.85

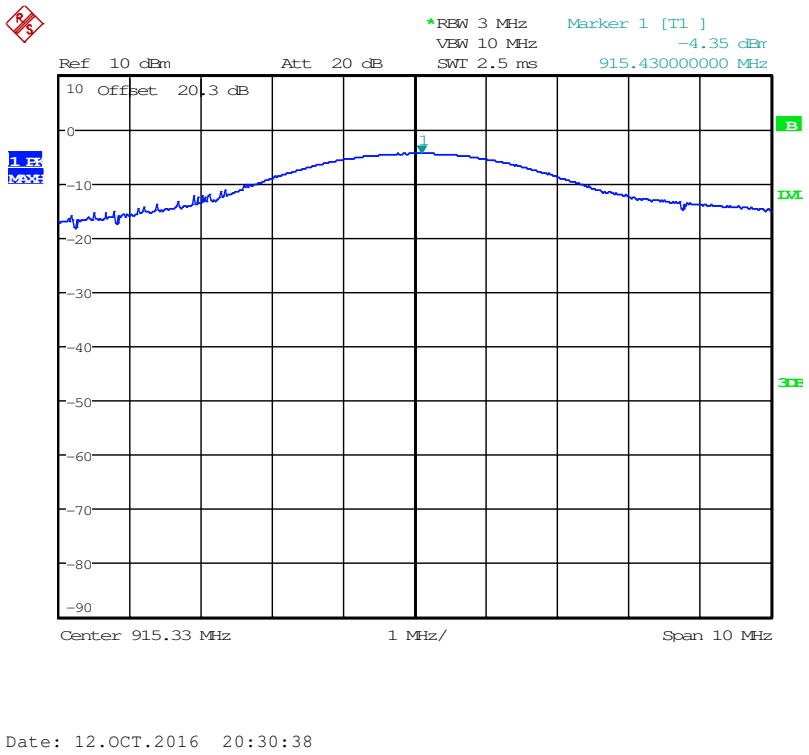
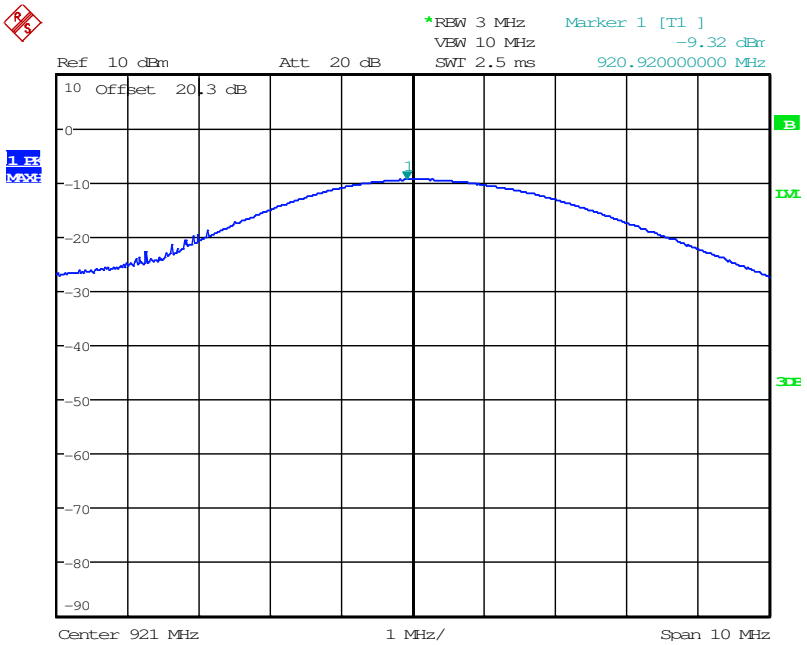
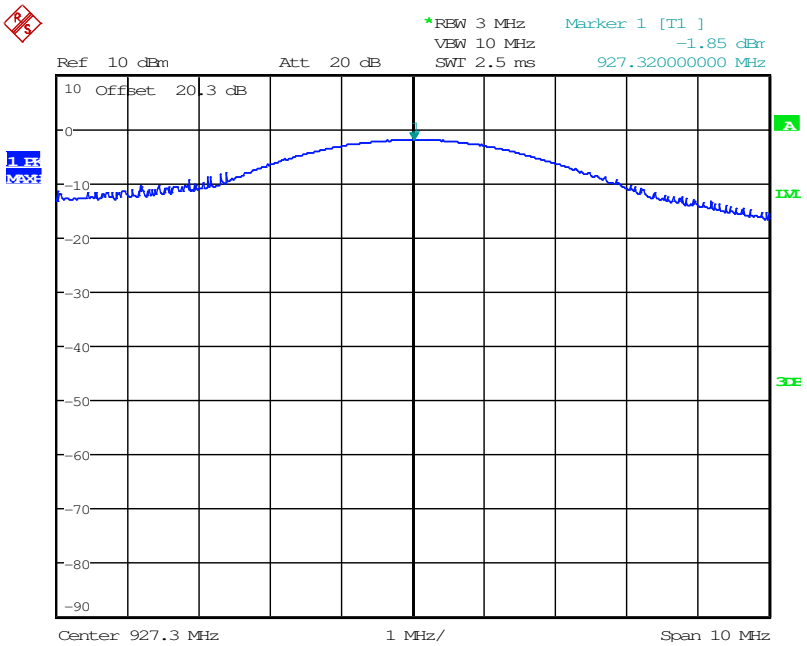


Figure 7.3.2-1: RF Output Power - Low Channel



Date: 12.OCT.2016 20:20:09

Figure 7.3.2-2: RF Output Power - Middle Channel



Date: 12.OCT.2016 22:19:00

Figure 7.3.2-3: RF Output Power - High Channel

7.4 Band-Edge Compliance and Spurious Emissions

7.4.1 Band-Edge Compliance of RF Conducted Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer via suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.4.1.2 Measurement Results

Results are shown below.

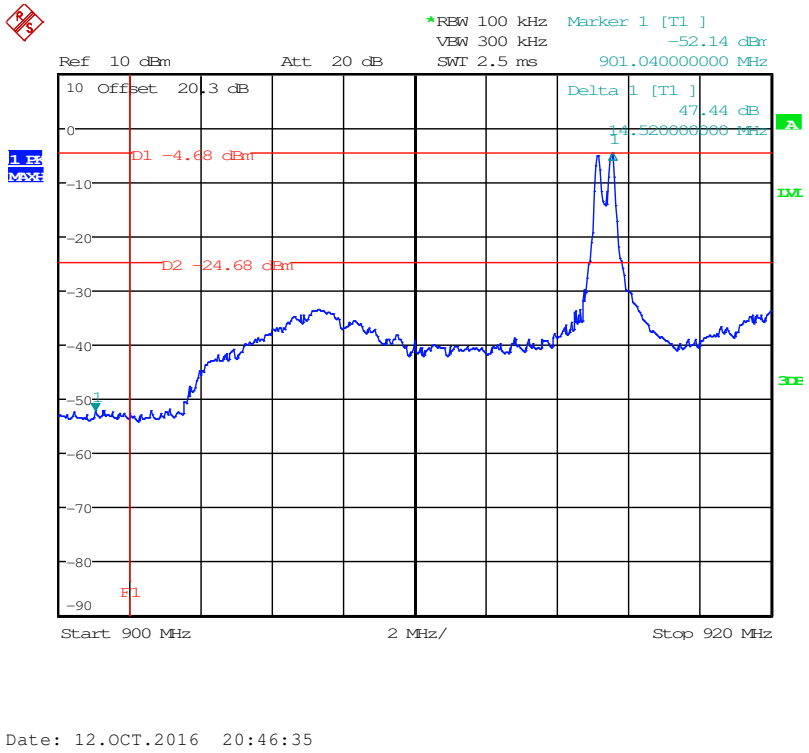
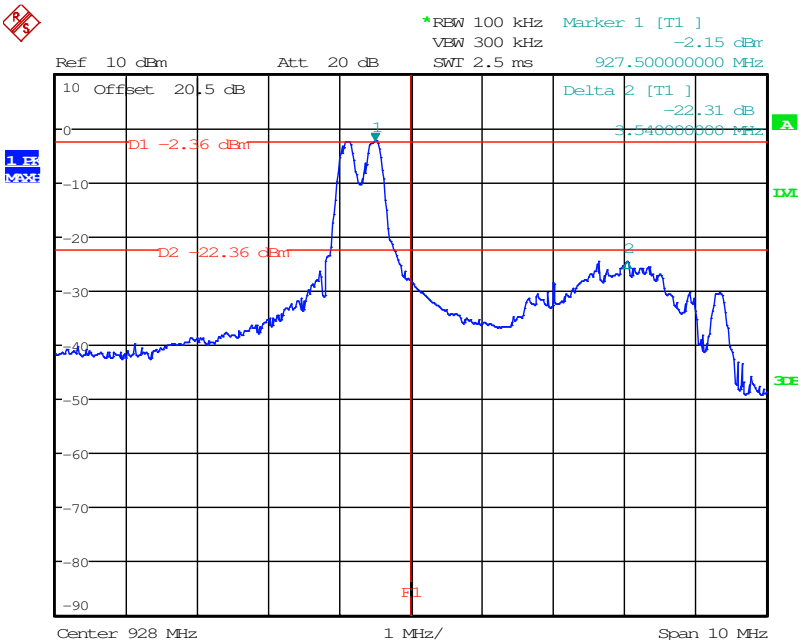


Figure 7.4.1.2-1: Lower Band-edge



Date: 27.JAN.2017 09:48:43

Figure 7.4.1.2-2: Upper Band-edge

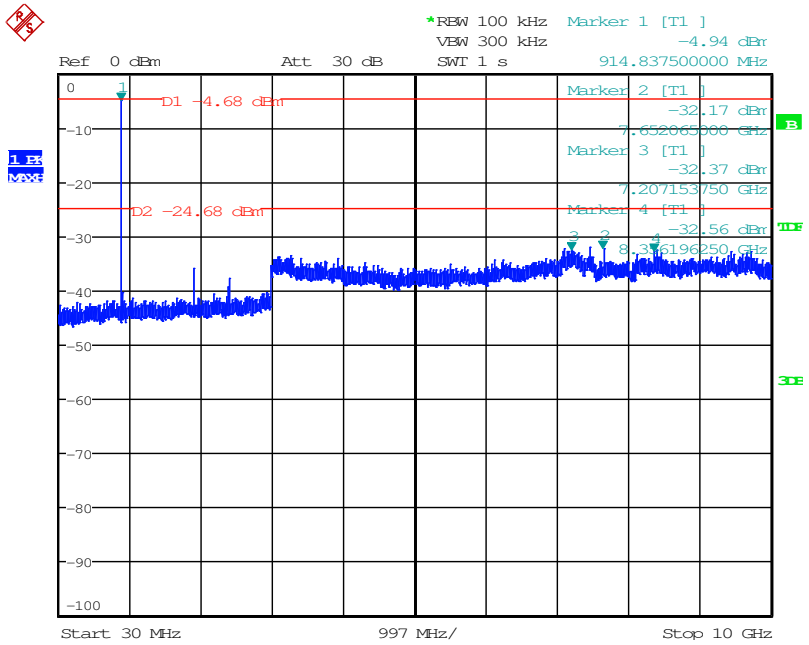
7.4.2 RF Conducted Spurious Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

7.4.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 11.0 Emissions in non-restricted frequency bands. The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30 MHz to 10 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized. The reference level was determined by measuring the Peak PSD level in any 100 kHz bandwidth within the DTS channel bandwidth.

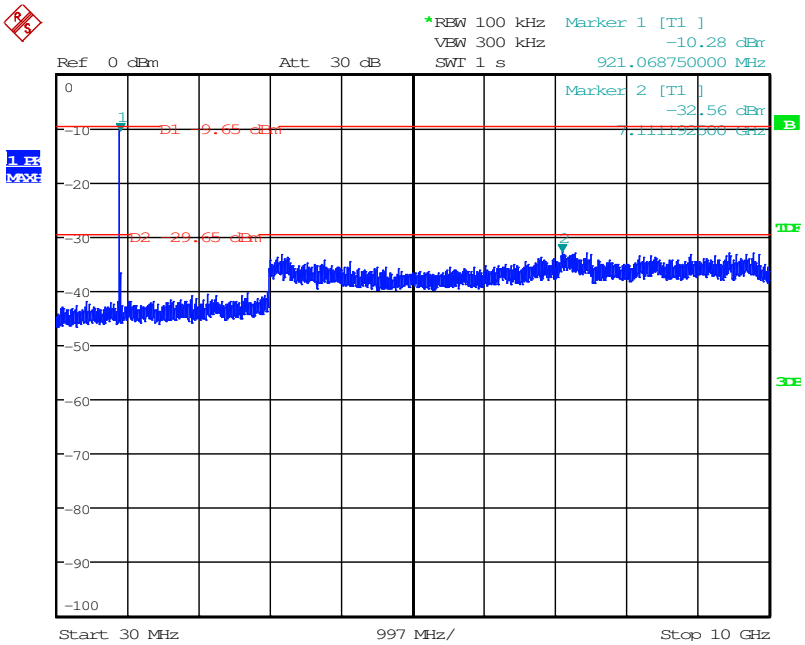
7.4.2.2 Measurement Results

Results are shown below.



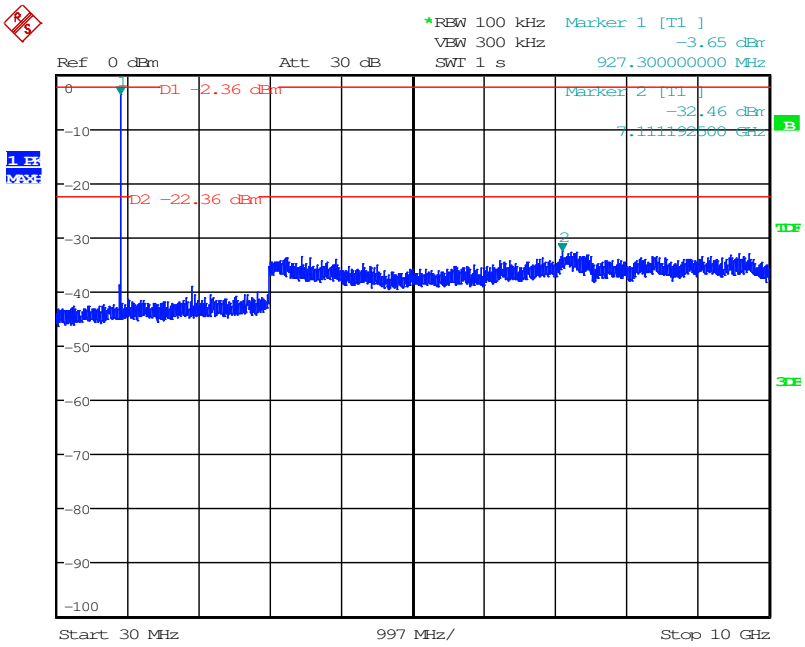
Date: 12.OCT.2016 22:40:53

Figure 7.4.2.2-1: 30 MHz – 10 GHz – Low Channel



Date: 12.OCT.2016 22:37:27

Figure 7.4.2.2-3: 30 MHz – 10 GHz –Middle Channel



Date: 12.OCT.2016 22:35:06

Figure 7.4.2.2-5: 30 MHz – 10 GHz – High Channel

7.4.3 Radiated Spurious Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISED Canada: RSS-Gen 8.9, 8.10

7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 . The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

7.4.3.2 Measurement Results

Radiated band-edge and spurious emissions found in the restricted frequency bands of 9 kHz to 10 GHz are reported in the tables below.

Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 915.32 MHz										
2745.96	48.00	34.43	H	-2.97	45.03	31.46	74.0	54.0	29.0	22.5
2745.96	46.54	33.22	V	-2.97	43.57	30.25	74.0	54.0	30.4	23.8
3661.28	50.03	39.78	H	1.47	51.50	41.25	74.0	54.0	22.5	12.7
3661.28	47.00	35.39	V	1.47	48.47	36.86	74.0	54.0	25.5	17.1
4576.6	48.62	38.67	H	2.06	50.68	40.73	74.0	54.0	23.3	13.3
4576.6	45.22	33.57	V	2.06	47.28	35.63	74.0	54.0	26.7	18.4
7322.56	44.12	30.58	H	9.16	53.28	39.74	74.0	54.0	20.7	14.3
Middle Channel = 921.32 MHz										
3685.28	44.43	32.08	H	1.57	46.00	33.65	74.0	54.0	28.0	20.4
4606.6	44.51	31.58	H	2.29	46.80	33.87	74.0	54.0	27.2	20.1
4606.6	43.58	30.51	V	2.29	45.87	32.80	74.0	54.0	28.1	21.2
High Channel = 927.3 MHz										
2781.9	47.34	34.71	H	-2.63	44.71	32.08	74.0	54.0	29.3	21.9
2781.9	46.35	33.68	V	-2.63	43.72	31.05	74.0	54.0	30.3	23.0
3709.2	48.46	37.61	H	1.65	50.11	39.26	74.0	54.0	23.9	14.7
3709.2	48.31	33.70	V	1.65	49.96	35.35	74.0	54.0	24.0	18.6
4636.5	48.03	37.39	H	2.39	50.42	39.78	74.0	54.0	23.6	14.2
4636.5	45.09	33.47	V	2.39	47.48	35.86	74.0	54.0	26.5	18.1
7418.4	43.64	30.95	H	9.42	53.06	40.37	74.0	54.0	20.9	13.6
7418.4	43.28	30.58	V	9.42	52.70	40.00	74.0	54.0	21.3	14.0

Note: All emissions above 7.418 GHz were attenuated below the limits and the noise floor of the measurement equipment

Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: 48.0 + (-2.97) = 45.03 dBµV/m

Margin: 74 dBµV/m – 45.03 dBµV/m = 29.0 dB

Example Calculation: Average

Corrected Level: 34.43 + (-2.97) = 31.46 dBµV/m

Margin: 54 dBµV/m – 31.46 dBµV/m = 22.5 dB

7.5 Power Spectral Density – FCC: Section 15.247(e); ISED Canada: RSS-247 5.2(2)

7.5.1 Measurement Procedure

The power spectral density was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 10.2 Method PKPSD (peak PSD). The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and external attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 1.5 times the 6 dB bandwidth and the sweep time was set to auto.

7.5.2 Measurement Results

Results are shown below.

Table 7.5.2-1: Power Spectral Density

Frequency [MHz]	PSD [dBm]	Limit [dBm]	Margin [dB]
915.3	-9.26	8.0	17.26
921.3	-14.73	8.0	22.73
927.3	-7.56	8.0	15.56

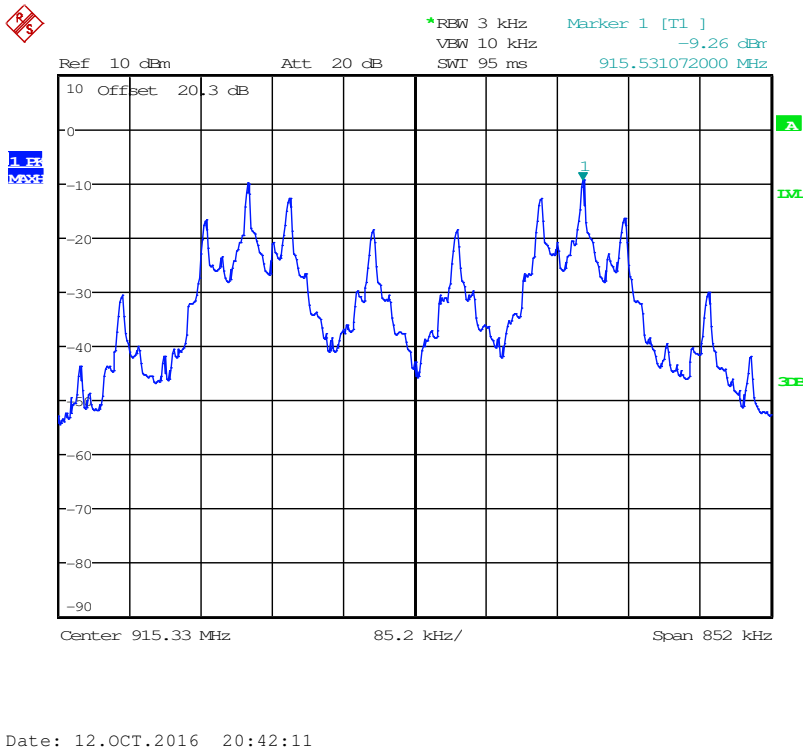
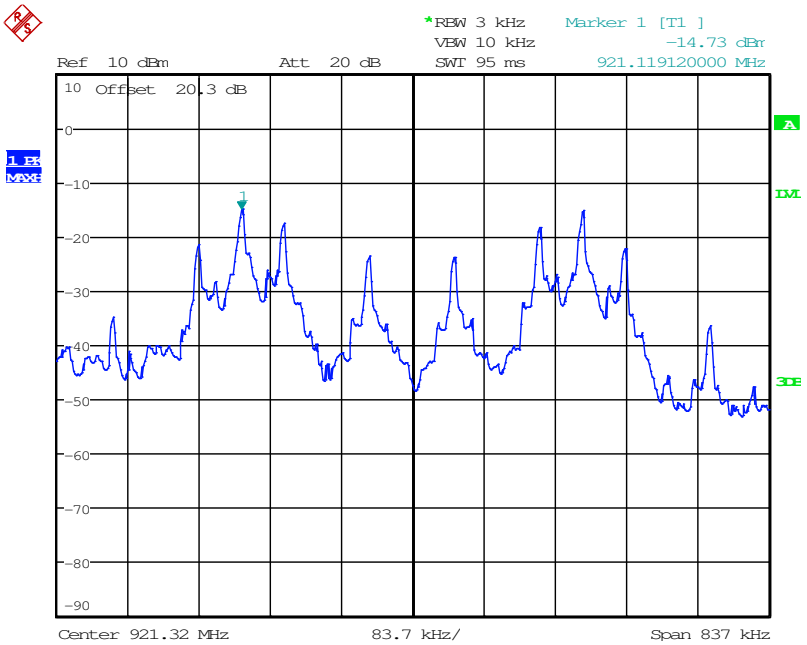


Figure 7.5.2-1: Power Spectral Density - Low Channel



Date: 12.OCT.2016 21:03:18

Figure 7.5.2-2: Power Spectral Density - Middle Channel

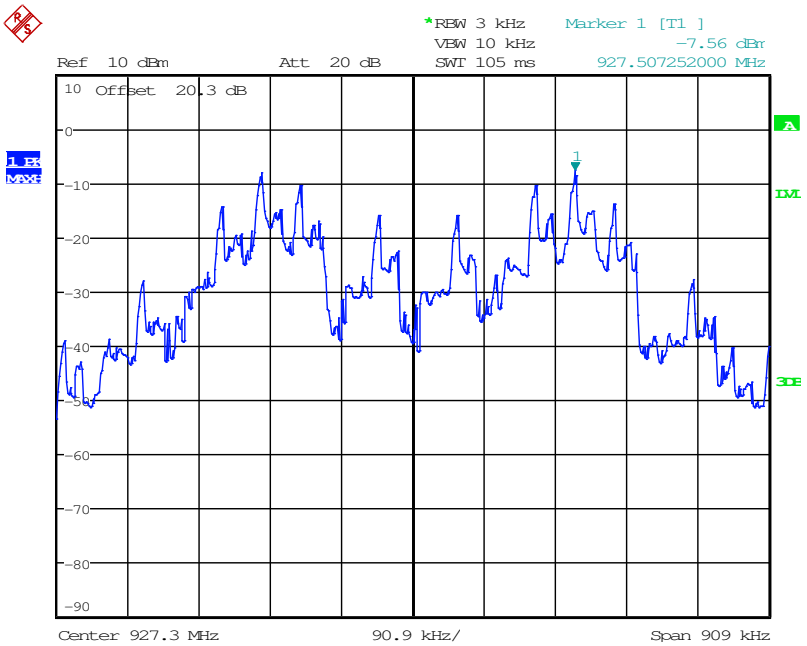


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Figure 7.5.2-3: Power Spectral Density – High Channel

7.6 Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8

7.6.1 Measurement Procedure

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.6.2 Measurement Results

Results are shown below.

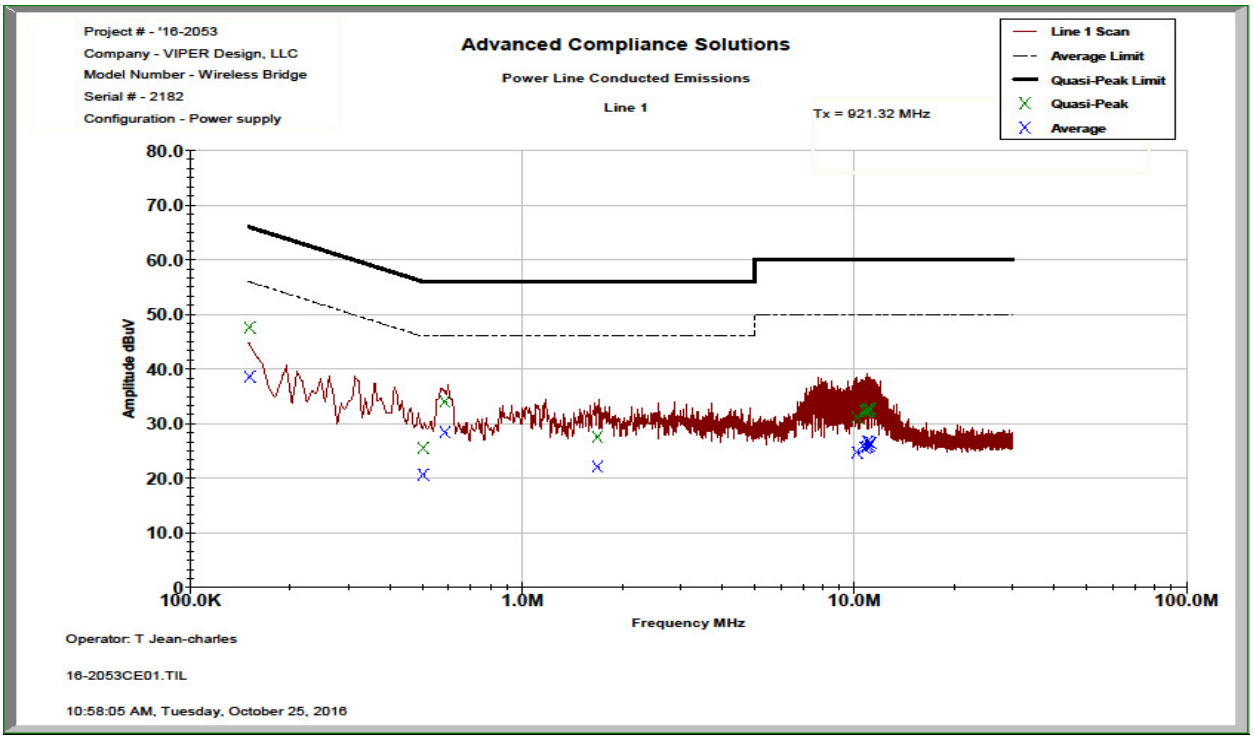

Figure 7.6.2-1: Conducted Emissions Results – Line 1

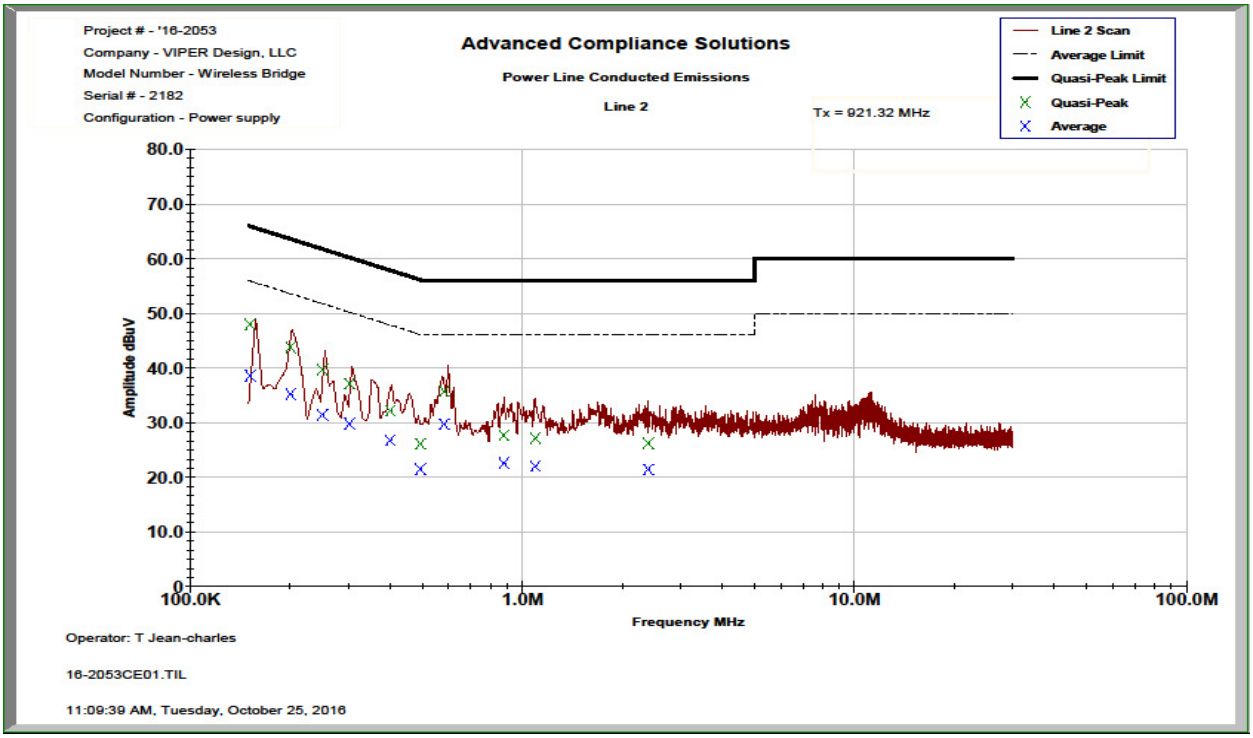

Figure 7.6.2-2: Conducted Emissions Results – Line 2

Table 7.6.2-1: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 16-2053CE01
Power Supply Description: 5 VDC PSA10F-050Q

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.151072	37.417	28.343	10.25	47.66	38.59	65.94	55.94	18.3	17.4
0.5033	15.338	10.448	10.23	25.56	20.67	56.00	46.00	30.4	25.3
0.585	23.848	18.139	10.24	34.08	28.37	56.00	46.00	21.9	17.6
1.6862	17.246	11.792	10.28	27.53	22.07	56.00	46.00	28.5	23.9
10.1784	20.341	13.965	10.78	31.12	24.74	60.00	50.00	28.9	25.3
10.7577	21.502	14.807	10.79	32.30	25.60	60.00	50.00	27.7	24.4
10.9422	21.418	15.028	10.80	32.22	25.83	60.00	50.00	27.8	24.2
10.9667	21.87	15.921	10.80	32.67	26.72	60.00	50.00	27.3	23.3
11.1435	21.47	15.082	10.81	32.28	25.89	60.00	50.00	27.7	24.1
11.195	21.922	15.686	10.81	32.73	26.49	60.00	50.00	27.3	23.5
Line 2									
0.151588	37.747	28.312	10.26	48.00	38.57	65.91	55.91	17.9	17.3
0.200738	33.556	24.959	10.24	43.80	35.20	63.58	53.58	19.8	18.4
0.250374	29.445	21.181	10.24	39.68	31.42	61.74	51.74	22.1	20.3
0.302512	26.861	19.561	10.24	37.10	29.80	60.17	50.17	23.1	20.4
0.400974	21.944	16.496	10.24	32.19	26.74	57.83	47.83	25.6	21.1
0.4936	15.903	11.244	10.25	26.15	21.49	56.11	46.11	30.0	24.6
0.58215	25.529	19.473	10.24	35.77	29.72	56.00	46.00	20.2	16.3
0.881324	17.372	12.328	10.27	27.65	22.60	56.00	46.00	28.4	23.4
1.09692	16.814	11.705	10.33	27.14	22.03	56.00	46.00	28.9	24.0
2.3987	15.79	10.995	10.41	26.20	21.40	56.00	46.00	29.8	24.6

8 CONCLUSION

In the opinion of ACS, Inc., the model VPR9XYLND manufactured by Viper Design LLC meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the test procedures documented in the test report.

END REPORT