



Compliance Testing, LLC

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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Test Report

Prepared for: AMI Global

Model: VAPOR-C & Cornell PILOT

Description: Smart Communication Gateway

Serial Number: N/A

FCC ID: 2AQ9C-VAPOR-C18

IC:24317-VAPORC18

To

FCC Part 15.247 DTS

ISED RSS 247 Issue 2

RSS-GEN Issue 5

Date of Issue: April 8, 2019

On the behalf of the applicant:

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Poona Saber
Project Test Engineer

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All results contained herein relate only to the sample tested.



Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	September 17, 2018	Poona Saber	Original Document
2.0	January 15, 2018	Poona Saber	- Revised 1.1310 report - Revised Cover page for IC ID and RSS versions - Added Measurement uncertainty - Added RSS rule parts under test summary table - Revised some plots on Annex A - Added QP measurement results on page 12 - Revise 207 data for Class B measurements
3.0	January 21, 2019	Poona Saber	Added frequency Stability section for RSS GEN
4.0	February 12, 2019	Poona Saber	revised model on page 1 and 6 page 8
5.0	April 8, 2019	Poona Saber	Revised annex B and added QP measurement plots



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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
23.3	28.9	967

EUT Description

Model: VAPOR-C & Cornell PILOT

Description: Smart Communication Gateway

Firmware: N/A

Software: N/A

Serial Number: N/A

Additional Information: Device under test is a vibration/temperature monitoring which updates its data to the cloud using different communication modes- the 900 MHz radio with frequency range of 903.9- 925.9. The antenna used with 900 MHz transceiver is permanently on the board and it has a 2 dBi gain.

EUT Operation during Tests

EUT was put on transmit on highest power setting and highest packet data rate sending 40 bytes ever 100 ms on Low, mid and high channel through the AMI_Bluegrass tester tool provided by the manufacturer.



Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Rs485 connector	AMI Global LLC	N/A	N/A

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	Mini USB to USB	<3	N/A	N/A	N

Modifications: None

15.203: Antenna Requirement:

- ☒ The antenna is permanently attached to the EUT
- ☐ The antenna uses a unique coupling
- ☐ The EUT must be professionally installed
- ☐ The antenna requirement does not apply



Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b) RSS 247 5.4	Peak Output Power	Pass	
15.247(b) RSS 247 5.5, RSS GEN	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205 RSS 246 5.5, RSS GEN	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205 RSS 247 5.5, RSS GEN	Emissions At Band Edges	Pass	
15.247(a)(2) RSS 247 5.2	Occupied Bandwidth	Pass	
15.247(e) RSS 247 5.2	Transmitter Power Spectral Density	Pass	
15.207	A/C Powerline Conducted Emissions	Pass	
RSS GEN, 8.11	Frequency stability	Pass	



Peak Output Power

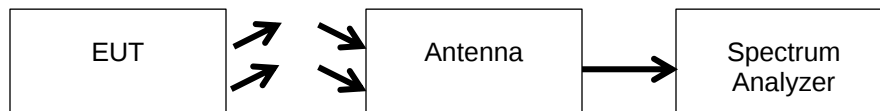
Engineer: Poona Saber

Test Date: 9/13/2018

Test Procedure

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was maximized for highest emission per X,Y,Z axes and set to transmit on the lowest, middle and highest frequencies at the maximum power level. The peak readings were taken, and the result was then compared to the limit.

Test Setup



Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
903.9	-5.33	1 W (30 dBm)	Pass
913.9	-5.06	1 W (30 dBm)	Pass
925.9	-7.554	1 W (30 dBm)	Pass



Radiated Spurious Emission in Non-Restricted Frequency Bands

Engineer: Poona Saber

Test Date: 9/14/2018

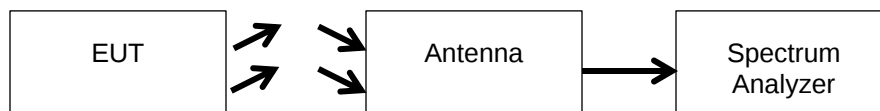
Test Procedure

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was maximized for highest emission per X, Y, Z axes and set to transmit on the lowest, middle and highest frequencies at the maximum power level.

The EUT was verified for spurious emissions of part 15.247 (d) and the frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed.

If the maximum peak conducted output power procedure was used to determine compliance, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc) which is done by reference level measurements per 11.11.2 of C63.10-2013 and emission level measurement of 11.11.3.

Test Setup



Note: For measurements in restricted bands per KDB 558074 a maximum ground reflection factor of 4.7 dB shall be added to EIRP level for frequencies between 30 MHz and 1000 MHz.

See Annex A for test results



Radiated Spurious Emissions in Restricted Frequency Bands

Engineer: Poona Saber

Test Date: 9/14/2018

Test Procedure Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in a semi-anechoic test chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for general Radiated Emissions limits of 15.209 if emissions fall in 15.205 restricted band. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

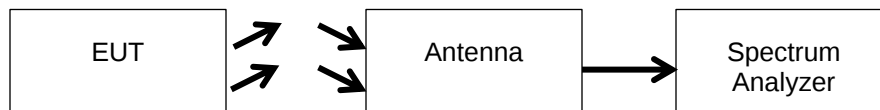
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

VBW = 300 KHz

Detector – Quasi Peak

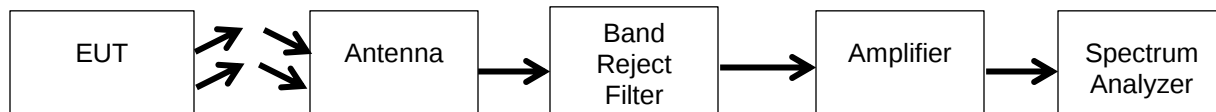
Test Setup



Test Procedure for Radiated Spurious Emissions above 1 GHz

The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. The antenna, band reject filter, amplifier and cable correction factors were input into the spectrum analyzer before recording the Measured Level to ensure accurate readings. The spectrum for each tuned frequency was examined to the 10th harmonic.

Test Setup



Detector Settings	RBW (MHz)	VBW (MHz)	Span
Peak	1	3	As Necessary
Average	1	3	As Necessary



Test Results

Emission Frequency (MHz)	Measured Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Antenna Polarity (V/H)	Turntable Position (deg)	Detector (QP,PK,Avg)
121.12	43.32	44	-0.68	110	V	90	QP
118.98	43.02	44	-0.98	115	V	102	QP
118.23	43.12	44	-0.88	115	V	103	QP
248.89	45.27	46	-0.73	123	V	89	QP

See Annex B for test results



DTS Bandwidth

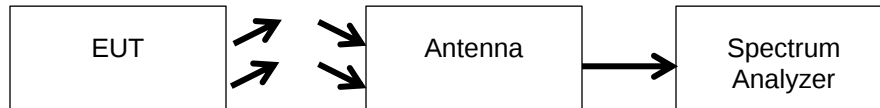
Engineer: Poona Saber

Test Date: 9/13/2018

Test Procedure

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. Procedures on ANSI C63.10 subclause 11.8 were followed. The analyzer was set to max hold and when the entire spectrum was captured the 6dB and 99% bandwidths were measured to verify the bandwidth met the specification.

Test Setup



6 dB Occupied Bandwidth Summary

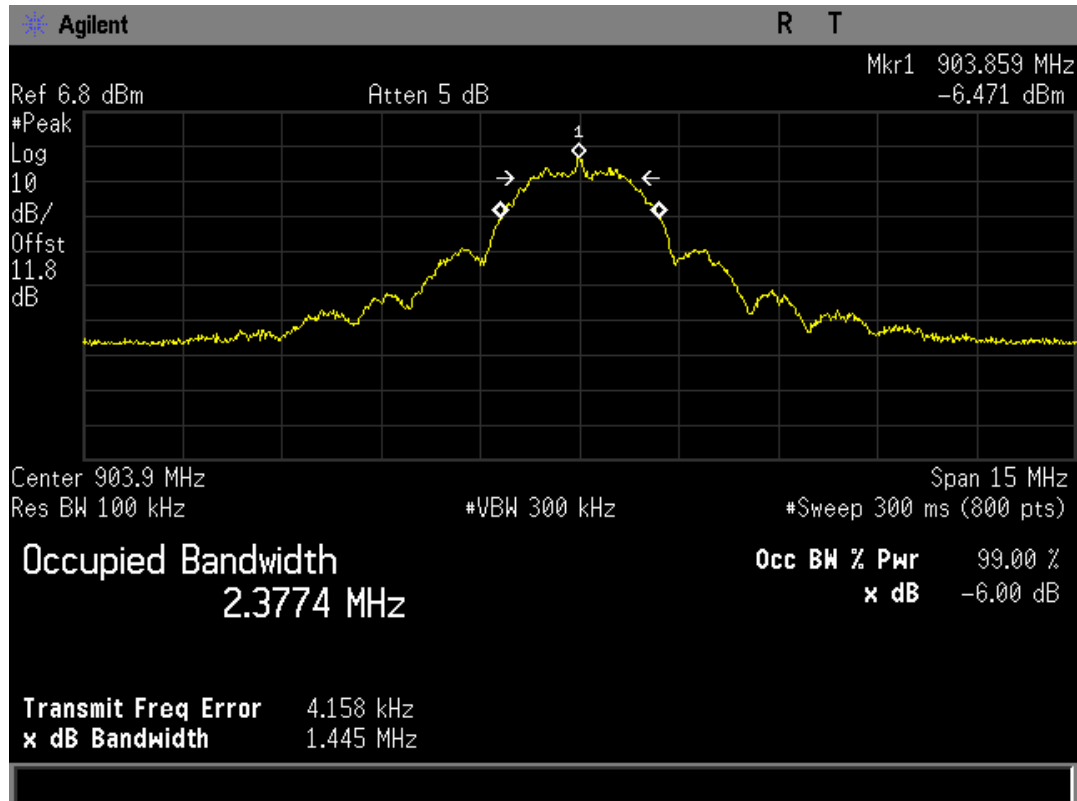
Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
903.9	1.445	≥ 500	Pass
913.9	1.443	≥ 500	Pass
925.9	1.465	≥ 500	Pass

99% Bandwidth Summary

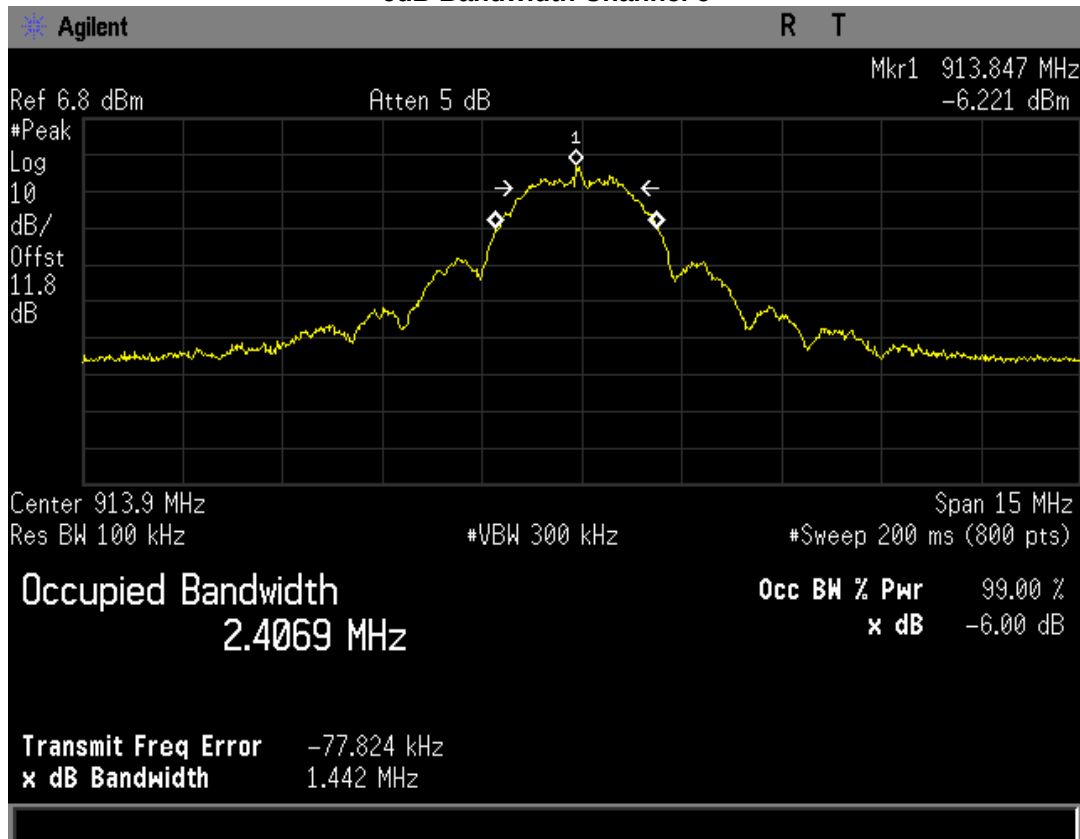
Frequency (MHz)	Measured Bandwidth (MHz)	Result
903.9	2.377	Pass
913.9	2.406	Pass
925.9	2.391	Pass



6dB Bandwidth Channel 1

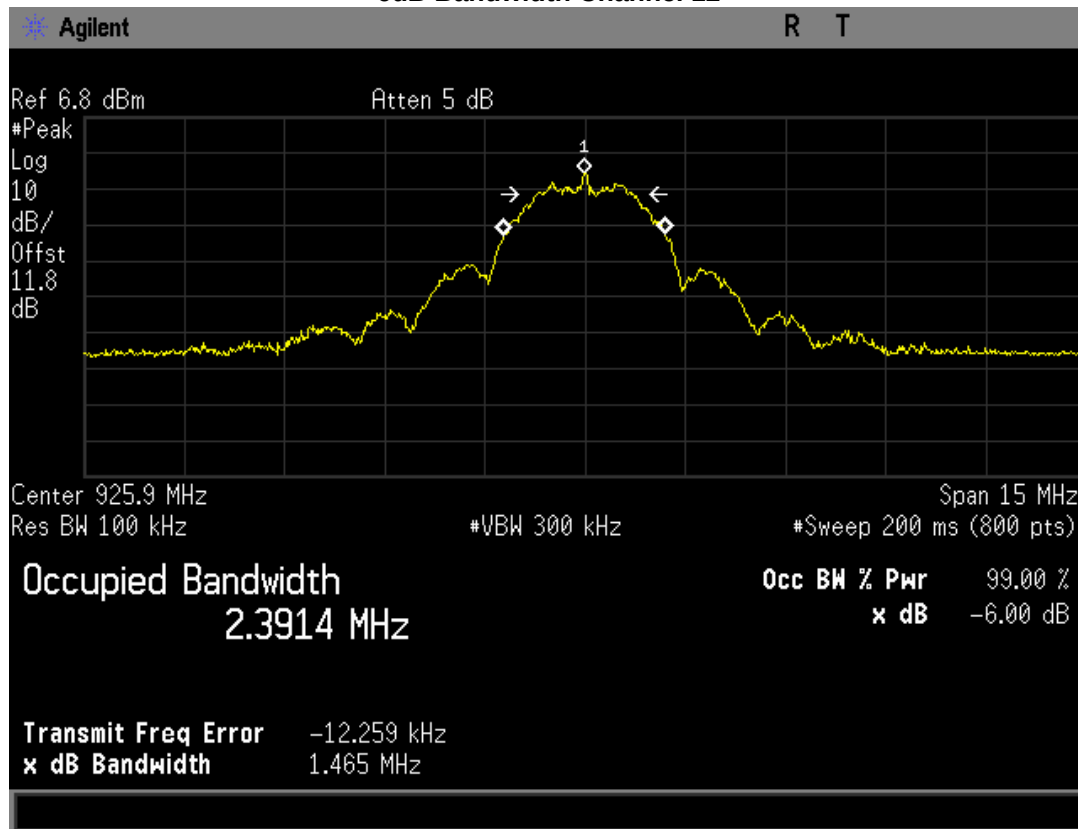


6dB Bandwidth Channel 6





6dB Bandwidth Channel 12





Transmitter Power Spectral Density (PSD)

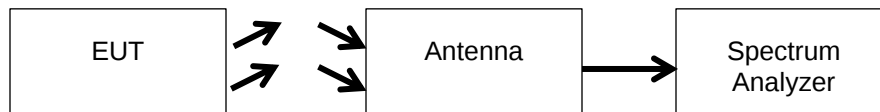
Engineer: Poona Saber

Test Date: 9/13/18

Test Procedure

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The test was performed per section 11.10 of C63.10:2013 "Procedure for determining PSD for DTS devices"

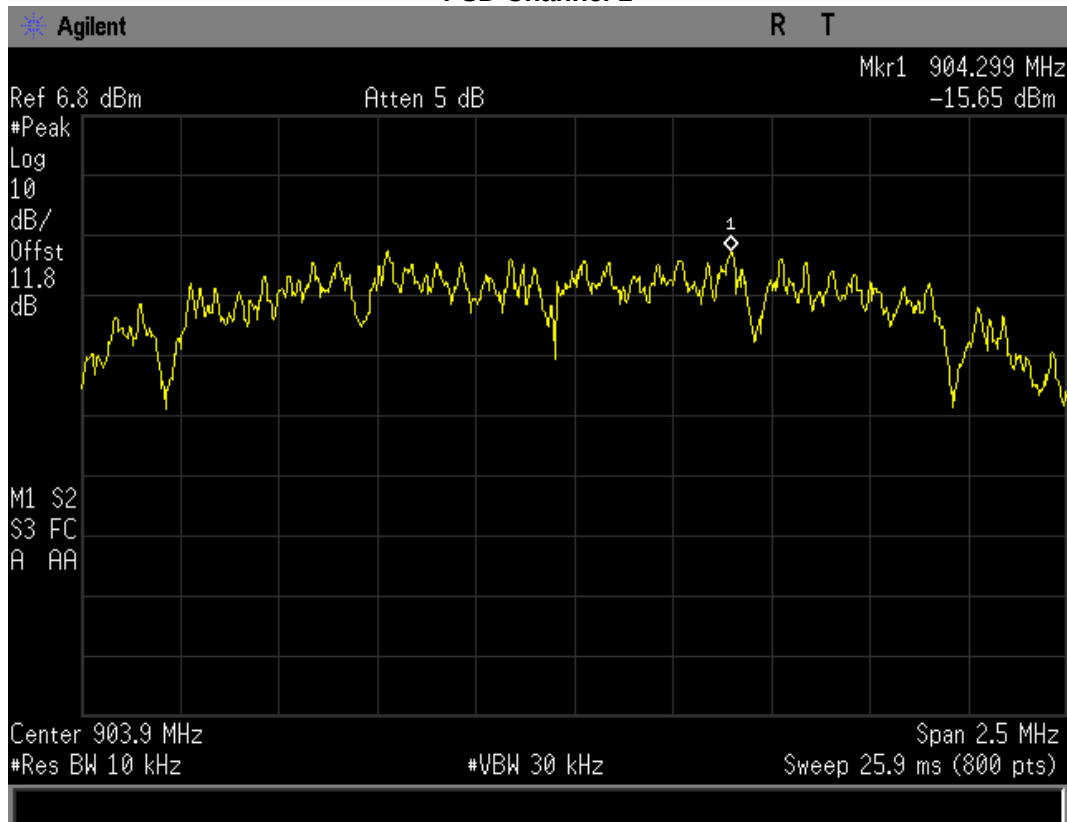
Test Setup



PSD Summary

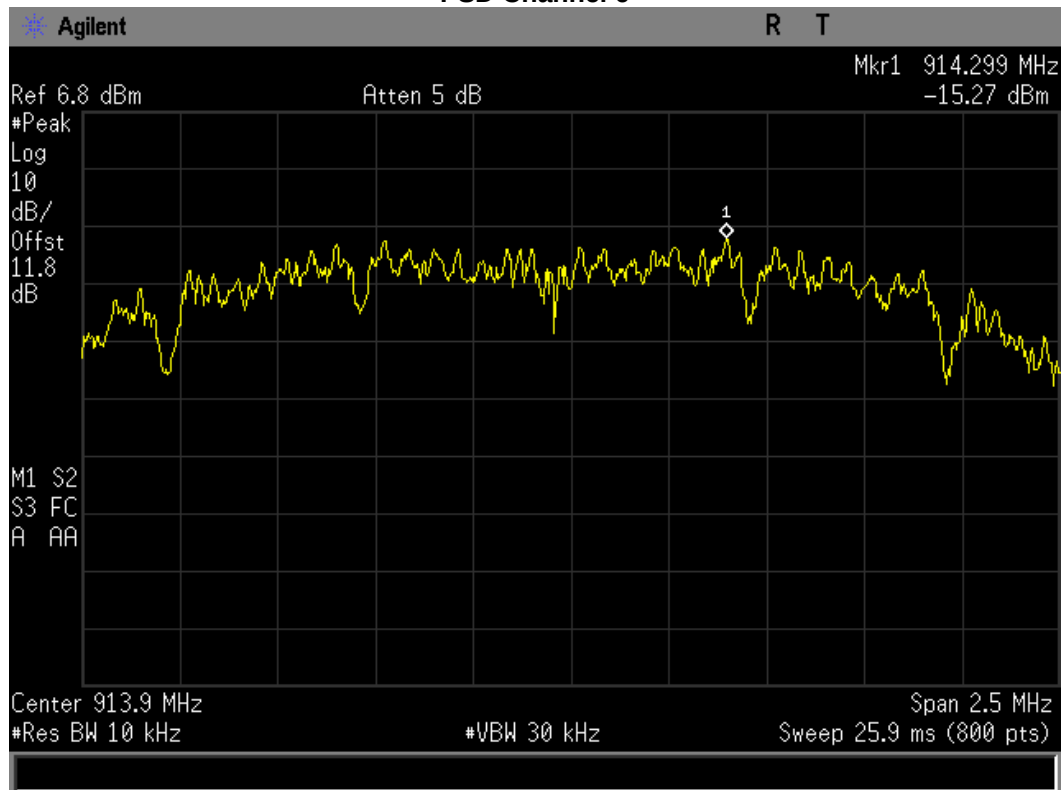
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
903.9	-15.65	8	Pass
913.9	-15.27	8	Pass
925.9	-18.19	8	Pass

PSD Channel 1

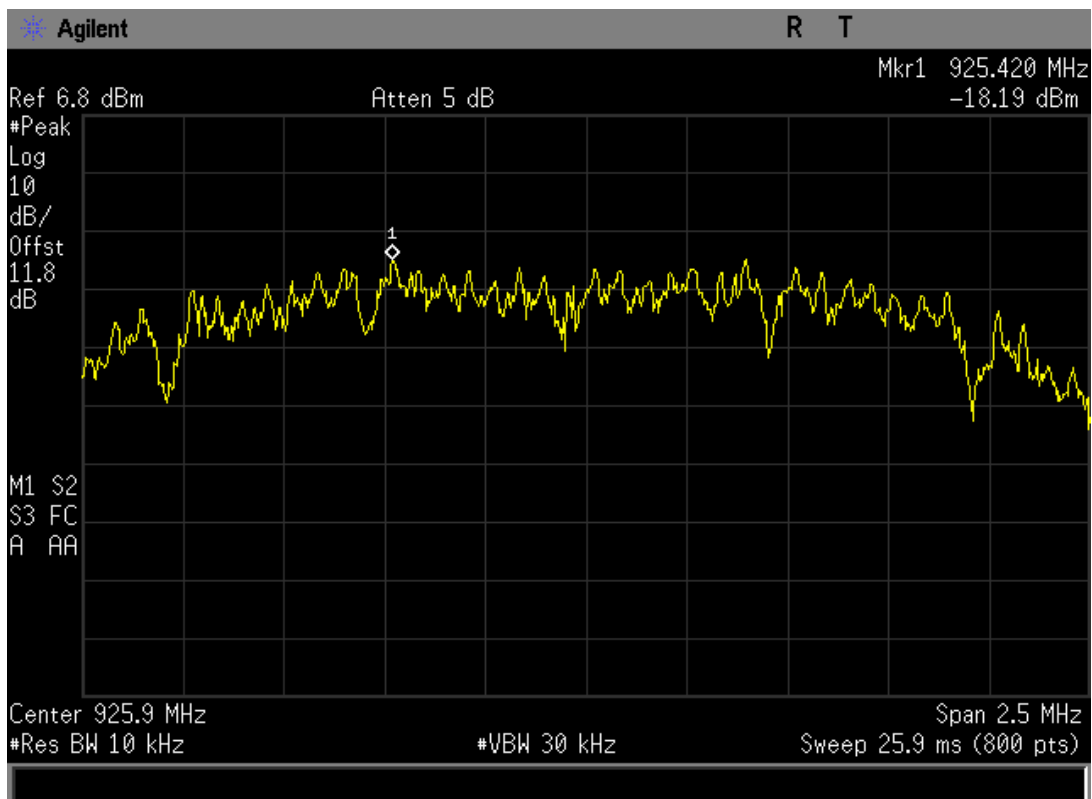




PSD Channel 6



PSD Channel 12





A/C Powerline Conducted Emission

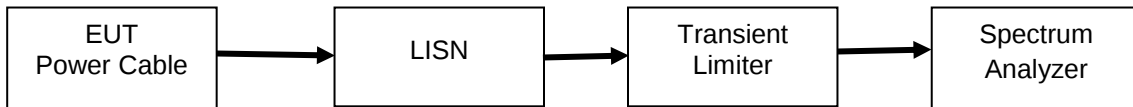
Engineer: Poona Saber

Test Date: 9/17/2018

Test Procedure

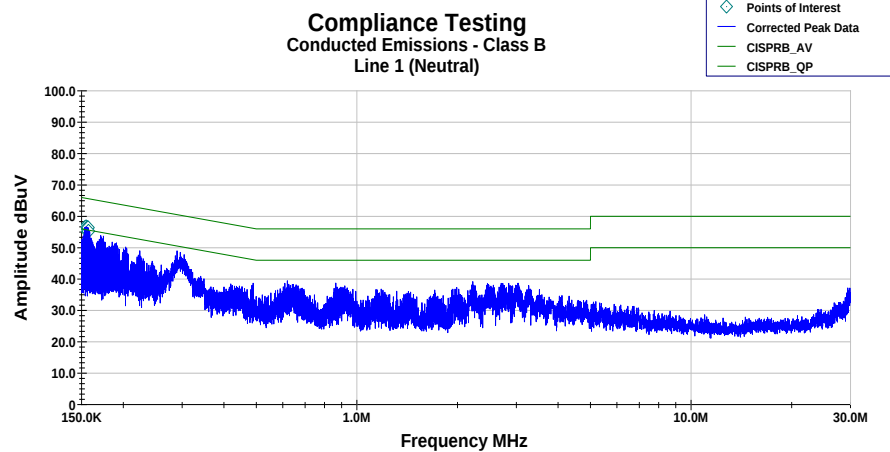
The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup

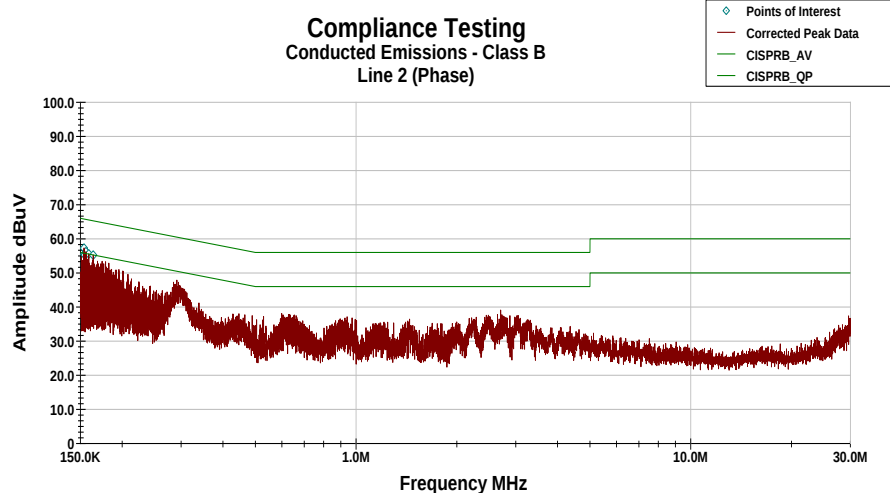


Conducted Emission Test Results

Line 1 Peak Plot



Line 2 Peak Plot





Line 1 Neutral Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
151.43 KHz	24.173	0.286	0.02	10.2	34.679	56	-21.321
152.83 KHz	24.58	0.272	0.02	10.2	35.072	56	-20.928
153.48 KHz	24.557	0.265	0.02	10.2	35.042	56	-20.958
157.95 KHz	24.243	0.221	0.02	10.2	34.684	56	-21.316
158.7 KHz	24.293	0.213	0.02	10.2	34.726	56	-21.274
177.65 KHz	21.31	0.2	0.02	10.1	31.63	56	-24.37

Line 2 Phase Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
151.88 KHz	21.15	0.28	0.02	10.2	31.648	56	-24.352
152.85 KHz	21.25	0.27	0.02	10.2	31.745	56	-24.255
154.88 KHz	21.18	0.25	0.02	10.2	31.651	56	-24.349
155.48 KHz	21.17	0.25	0.02	10.2	31.632	56	-24.368
158.65 KHz	21.11	0.21	0.02	10.2	31.54	56	-24.46
165.63 KHz	19.29	0.2	0.02	10.144	29.657	56	-26.343

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
151.43 KHz	34.72	0.286	0.02	10.2	45.226	66	-20.774
152.83 KHz	34.84	0.272	0.02	10.2	45.332	66	-20.668
153.48 KHz	35.2	0.265	0.02	10.2	45.685	66	-20.315
157.95 KHz	35.15	0.221	0.02	10.2	45.59	66	-20.41
158.7 KHz	34.9	0.213	0.02	10.2	45.333	66	-20.667
177.65 KHz	31.75	0.2	0.02	10.1	42.07	66	-23.93

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
151.88 KHz	33.24	0.28	0.02	10.2	43.741	66	-35.259
152.85 KHz	33.21	0.27	0.02	10.2	43.701	66	-35.299
154.88 KHz	33.07	0.25	0.02	10.2	43.541	66	-35.459
155.48 KHz	33.31	0.25	0.02	10.2	43.775	66	-35.225
158.65 KHz	33.27	0.21	0.02	10.2	43.703	66	-35.297
165.63 KHz	31.32	0.2	0.02	10.144	41.684	66	-37.316



Frequency Stability

Engineer: Poona Saber

Test Date: 1/21/2018

Per RSS GEN PART 8.11 if the frequency stability of the license-exempt radio apparatus is not specified in applicable RSS the fundamental emissions of the radio apparatus should be kept within at least the central 80% of its permitted operating frequency band in order to minimize the possibility of out-of-band operation.

Per manufacturer's documents provided the device's RF section is driven by a transceiver crystal which has an operating temperature of -40 C to +85 C and frequency versus temperature characteristic of $\pm 30 * 10^{-6}$ from -20 C to +70 C. From measurement of low, Mid and High channels and frequency tolerance of above it's obvious that device fundamental emissions of the radio stays within central 80% of the permitted operating frequency and hence the requirement of the RSS GEN is met.

Measurement Uncertainty

Measurement Uncertainty (U_{lab}) for Compliance Testing is listed in the table below.
 The reported expanded uncertainty U_{lab} (dB) has been estimated at a 95% confidence level ($k=2$)

Measurement	U_{lab}
Radio Frequency	$\pm 1.0 \times 10^{-12}$
RF Power, conducted	± 0.43 dB
RF Power Density, conducted	$\pm .98$ dB
Spurious Emissions, Conducted	± 2.49 dB
All Emissions, radiated	± 5.7 dB
Temperature	± 1.0 deg C
Humidity	± 4.3 %
Dc voltage	$\pm .12$ %
Low Frequency voltages	± 2.3 %

The reported expanded uncertainty $\pm U_{lab}$ (dB) has been estimated at a 95% confidence level ($k=2$)

U_{lab} is less than or equal to U_{CISPR} therefore

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit
- Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/18	6/16/20
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	5/22/18	5/22/21
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/29/18	6/29/19
Spectrum Analyzer	Agilent	E4407B	i00331	11/21/17	11/21/18
Bi-Log antenna	Chase	CBL6111C	i00267	3/8/18	3/8/20
EMI Analyzer	Agilent	E7405A	i00379	2/13/18	2/13/19
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A
EMI Receiver	HP	8546A	i00033	3/26/18	3/26/19
Transient Limiter	Com-Power	LIT-153	i00123	Verified on: 9/17/18	
AC Power Source	Behlman	BL 6000	i00362	Verified on: 9/17/18	
LISN	COM-Power	LI-125A	i00447	9/11/17	9/11/19
LISN	COM-Power	LI-125A	i00449	9/11/17	9/11/19

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT