Willow Run (WR) Test Labs, Inc.
7117 Fieldcrest Dr.
Brighton, Michigan 48116 USA
Tel: (734) 252-9785
Fax: (734) 926-9785
e-mail: info@wrtest.com

Testing of

Electromagnetic Emissions

per

USA: CFR Title 47, Part 15.109 (Emissions)
Canada: ISED RSS-GEN (Emissions)

are herein reported for

Advantage PressurePro, LLC
APPDHD and APPGLT

Test Report No.: 20170428-RPTLECT100060Ar0

Applicant/Provider:
Advantage PressurePro, LLC
205 West Wall St, Harrisonville Missouri 64701 USA
Phone: 816 887 3505, Fax: 816 887 3705
Contact Person: Phillip Zaroor; pzaroor@pressurepro.us

Data Recorded by: Dr. Joseph Brunett, EMC-002790-NE

Reviewed by: Dr. Joseph Brunett, EMC-002790-NE

Prepared by: Dr. Joseph Brunett, EMC-002790-NE

Date of Issue: April 28, 2017

Results of testing completed on (or before) April 25, 2017 are as follows.

Emissions: Radiated spurious emissions associated with the receive chain of this device **COMPLY** the regulatory limit(s) by no less than 5.0 dB. RF conducted emissions via the EUT's external antenna port **COMPLY** with the regulatory limit by 7.5 dB.

Revision History

Rev. No.	Date	Details	Revised By
r0	April 28, 2017	Initial Release.	J. Brunett

Contents

List of Tables

List of Figures

1 Test Report Scope and Limitations

1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 688478) and with ISED Canada, Ottawa, ON (File Ref. No: IC8719A-1 and IC22227-1).

1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until April 2027.

1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

1.4 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

1.5 Copyright

1.6 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

1.7 Test Location

The EUT was fully tested by **Willow Run (WR) Test Labs, Inc.**, 7117 Fieldcrest Dr., Brighton, Michigan 48116 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report.

Table 1: Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	8501 Beck Rd. Bldg 2227, Belleville MI 48111	OATSA

1.8 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Willow Run (WR) Test Labs, Inc. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Last Cal By / Date Due
Spectrum Analyzer	Rohde & Schwarz / FSV30	101660	RSFSV30001	RS / May-2018
Spectrum Analyzer	Rohde & Schwarz / FSV4	101222	RSFSV4001	RS / Mar-2018
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Lib. Labs / Aug-2017
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Lib. Labs / Aug-2017
Quad Ridge Horn	ETS Lind. / 3164-04	00066988	HRNQR316401	Lib. Labs / Aug-2017

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The ultimate goal of Advantage PressurePro, LLC is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Advantage PressurePro, LLC APPDHD and APPGLT for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
United States	Code of Federal Regulations	CFR Title 47, Part 15.109
Canada	ISED Canada	ISED RSS-GEN

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2014	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.10:2013 (USA)	"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The equipment under test is a superheterodyne receiver. The EUT is approximately 9 x 13 x 2 cm (approx) in dimension, and is depicted in Figure 1. It is powered by 13.4 VDC vehicular power system. In use, this device is permanently affixed inside a motor vehicle. Table 3 outlines provider declared EUT specifications.

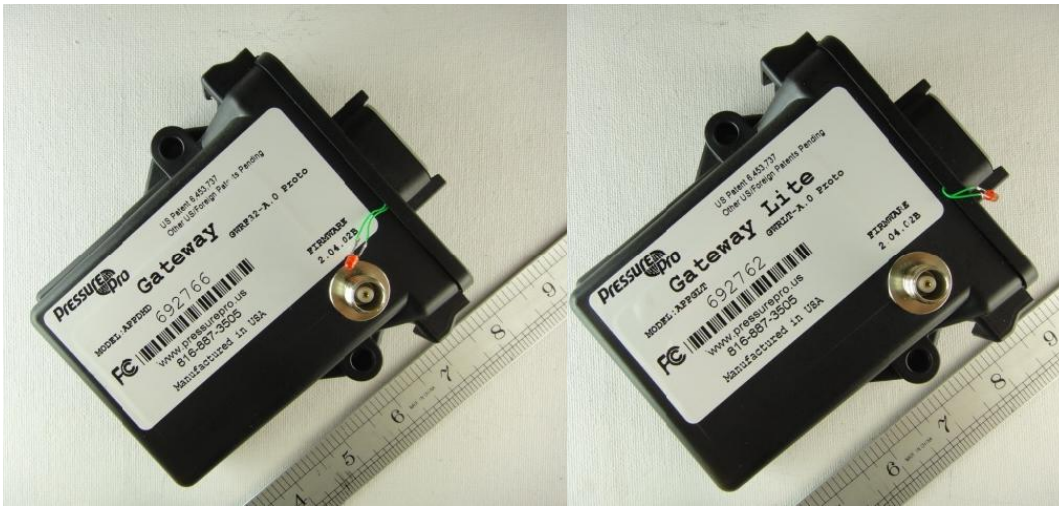


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations			
Equipment Type:	Receiver	**Country of Origin:**	Not Declared
Nominal Supply:	13.4 VDC	**Oper. Temp Range:**	Not Declared
Frequency Range:	433.92 MHz	**Antenna Dimension:**	Not Declared
Antenna Type:	Integral	**Antenna Gain:**	Not Declared
United States			
FCC ID Number:	RMDAPPINTRX	**Classification:**	CYY
Canada			
IC Number:	RSS-GEN/CNR-GEN	**Classification:**	Remote Control Device, Vehicular Device

3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

3.1.2 Modes of Operation

There is only a single mode of operation, as a receiver.

3.1.3 Variants

There are two variants of the EUT. The model APPDHD (a.k.a Gateway) is fully populated, the model APPGLT (a.k.a Gateway-Lite) has some digital components depopulated. Both variants are tested herein.

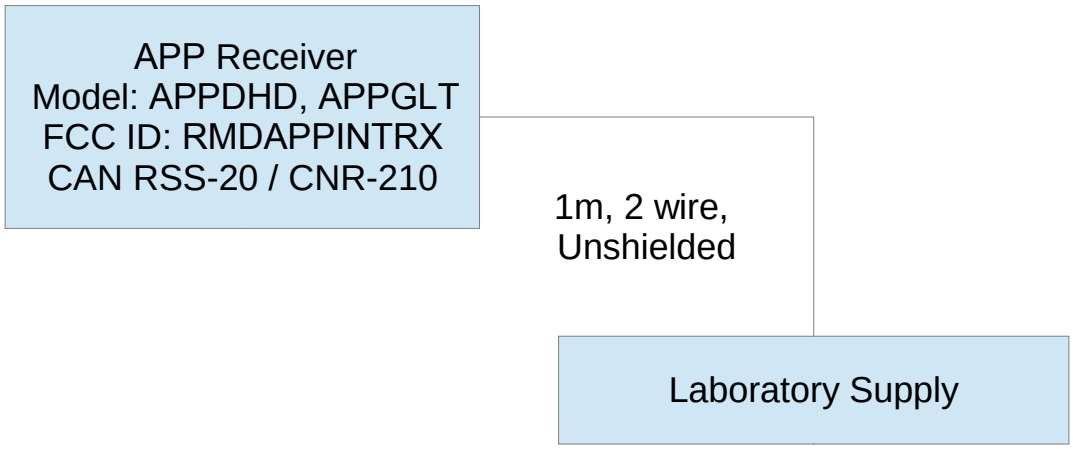


Figure 2: EUT Test Configuration Diagram.

3.1.4 Test Samples

Two samples in total were provided, one of each variant. Both variants were software modified to keep the receiver awake and provided confirmation of receiver functionality by addition of an LED indicator light.

3.1.5 Functional Exerciser

Normal operating EUT functionality was verified by observation of transmitted signal.

3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory. However, the manufacturer provided samples with an LED + resistor attached to the unit to indicate proper operation when paired with an associated transmitter provided for functionality testing. This LED and resistor are not typically included with the product.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003).

4 Emissions

4.1 General Test Procedures

4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our shielded anechoic chamber or GTEM test cell. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.7 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded.

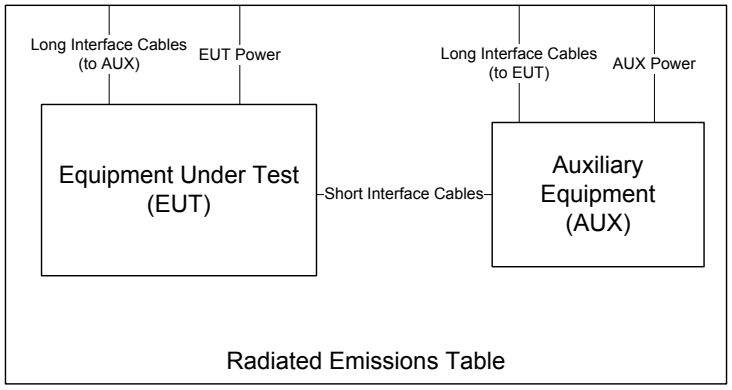


Figure 3: Radiated Emissions Diagram of the EUT.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used. It is placed at a 1 meter receive height. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain horn or broadband ridge-horn antennas on our OATS with a 4×5 m rectangle of H-4 absorber placed over the ground screen covering the OATS ground screen. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

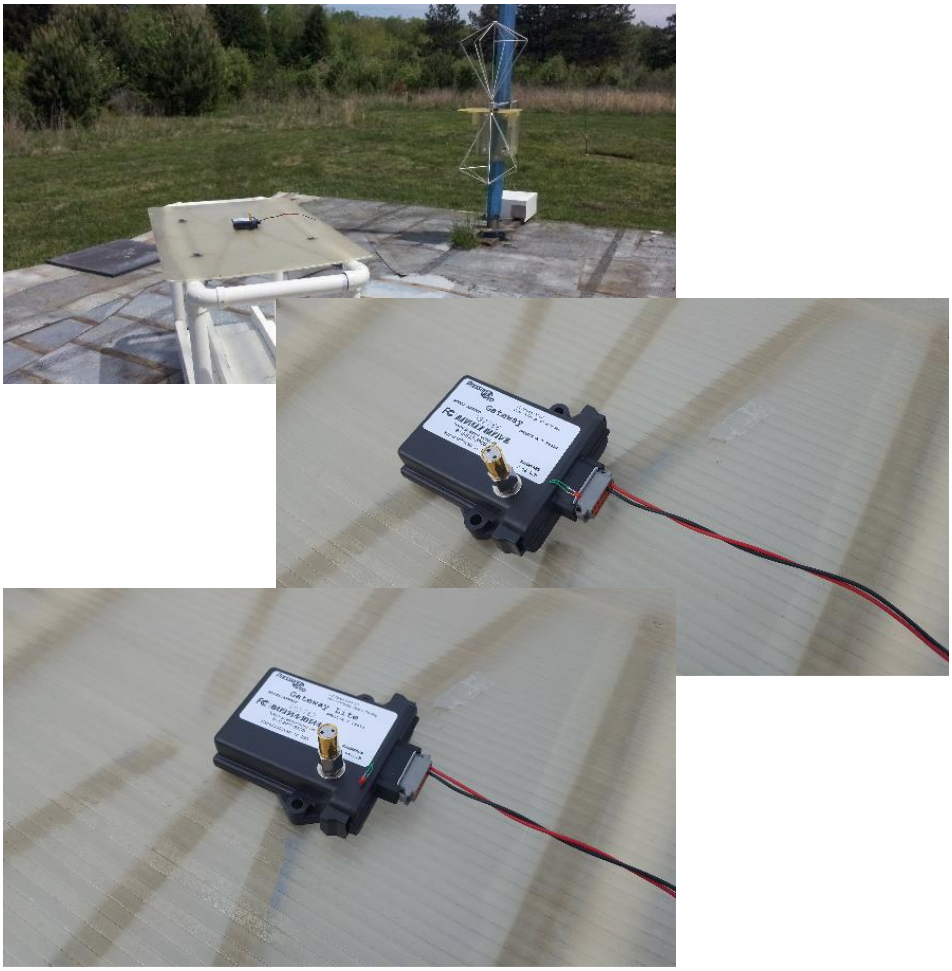


Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

Receive Antenna Port Conducted Emissions The EUT employs a receiver operating between 30 and 960 MHz that employs a 50Ω receive antenna port. Antenna terminal conducted emissions measurements are made on this port(s) by connecting the EUT port directly to the 50Ω measurement receiver and recording all signals up to 5 times the highest tuned receive frequency or 1 GHz, whichever is greater.

Vehicle Power Conducted Spurious The EUT is not subject to power line conducted emissions regulations as it is powered solely by the vehicle power system for use in said motor vehicle.

4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

4.1.4 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report. The provider has declared that the EUT is designed for operation over the temperature range Not Declared. Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber, temperature and humidity are recorded, and thermal balance is verified via a thermocouple–based probe.

4.2 Unintentional Emissions

4.2.1 Antenna Terminal Receiver Spurious

The EUT employs one or more external receive antenna terminals (ports). With the receiver antenna terminal connected to a termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified shall not exceed 2.0 nanowatts. Measurements of conducted spurious emissions are detailed in Section 4.2.3 of this report.

4.2.2 Radiated Receiver Spurious

The results for the measurement of radiated receiver spurious emissions (emissions arrising from the receiver chain, e.g. LO or VCO) at the nominal voltage and temperature are reported in Table 4. Receive chain emissions are measured to 5 times the highest receive chain frequency employed or 4 GHz, whichever is higher. If no emissions are detected, only those noise floor emissions at the LO/VCO frequency are reported.

Table 4: Receiver Chain Spurious Emissions $\geq$ 30 MHz.

Test Date: 03/29/17 **EUT Modes:** a1 Always awake

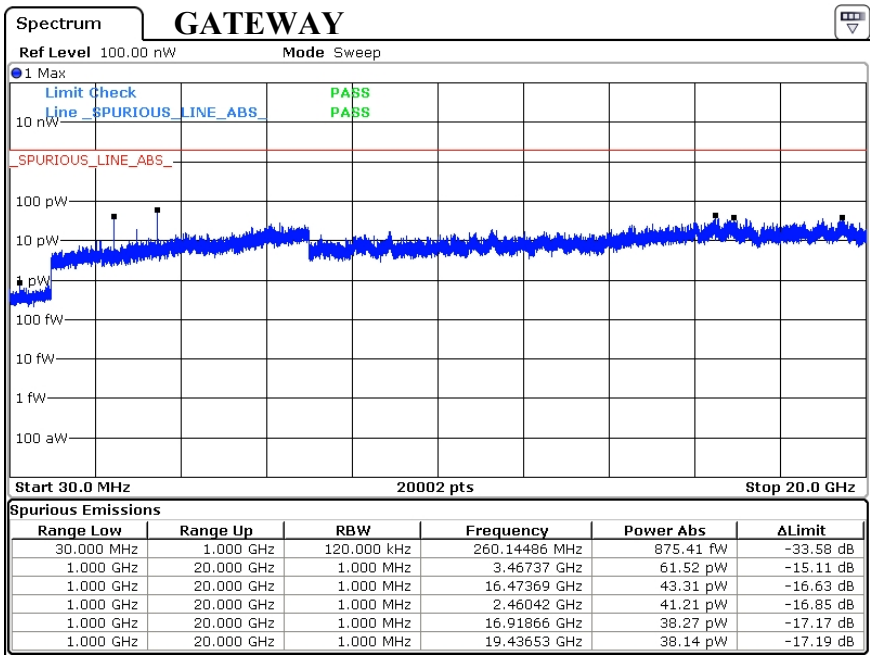
Test Engineer: Joseph Brunett

	Frequency		Site					EUT			Test Antenna			Cable	Receiver				Field Strength @ DR						Details
	Start	Stop	Temp.	MR	DR	N/F	CF				Pol.	Dim.	Ka	Kg	Rx Power		Bandwidth		Pk			Qpk/Avg			
R0								Mode see	Volt.	Dim					Pk	Qpk/Avg	RBW	VBW	Meas.	Limit USA	Limit CAN	Meas.	Limit USA	Limit CAN	Pass Fail
	MHz	MHz	(C)	m			dB	table	(V)	cm	H/V	cm	dB/m	dB	dBuV/m		MHz		dBuV/m						dB
R1	SETUP:		OATSA					APP GATEWAY			BICEMCO01				RSFSV4001				NOTES: All background noise						
R2	30.0	88.0	18	3.0	3.0	1.3	0.0	a1	13.4	10.0	H	150.0	9.5	26.5			0.12	0.3	23.5	60.0	60.0		40.0	40.0	16.5
R3	30.0	88.0	18	3.0	3.0	1.3	0.0	a1	13.4	10.0	V	150.0	9.5	26.5			0.12	0.3	25.7	60.0	60.0		40.0	40.0	14.3
R4	88.0	216.0	18	3.0	3.0	3.2	0.0	a1	13.4	10.0	H	150.0	15.9	24.2			0.12	0.3	31.7	63.5	63.5		43.5	43.5	11.8
R5	88.0	216.0	18	3.0	3.0	3.2	0.0	a1	13.4	10.0	V	150.0	15.9	24.2			0.12	0.3	33.9	63.5	63.5		43.5	43.5	9.6
R6	SETUP:		OATSA					APP GATEWAY			LOGEMCO01				RSFSV4001				NOTES: All background noise						
R7	216.0	960.0	18	3.0	3.0	6.4	0.0	a1	13.4	10.0	H	100.0	23.4	21.3			0.12	0.3	41.0	66.0	66.0		46.0	46.0	**5.0**
R8	216.0	960.0	18	3.0	3.0	6.4	0.0	a1	13.4	10.0	V	100.0	23.4	21.3			0.12	0.3	39.4	66.0	66.0		46.0	46.0	6.6
R9	SETUP:		OATSA					APP GATEWAY			HRNQR316401				RSFSV30001				NOTES: All background noise						
R10	960.0	1610.0	18	3.0	3.0	0.5	0.0	a1	13.4	10.0	H	22.0	27.6	-0.2			1.00	3.00	22.0	74.0	74.0		54.0	54.0	32.0
R11	960.0	1610.0	18	3.0	3.0	0.5	0.0	a1	13.4	10.0	V	22.0	27.6	-0.2			1.00	3.00	22.0	74.0	74.0		54.0	54.0	32.0
R12	1610.0	1990.0	18	3.0	3.0	0.6	0.0	a1	13.4	10.0	H	22.0	21.7	-0.2			1.00	3.00	25.3	74.0	74.0		54.0	54.0	28.7
R13	1610.0	1990.0	18	3.0	3.0	0.6	0.0	a1	13.4	10.0	V	22.0	21.7	-0.2			1.00	3.00	27.9	74.0	74.0		54.0	54.0	26.1
R14	1990.0	3100.0	18	3.0	3.0	1.0	0.0	a1	13.4	10.0	H	22.0	20.6	-0.3			1.00	3.00	33.1	74.0	74.0		54.0	54.0	20.9
R15	1990.0	3100.0	18	3.0	3.0	1.0	0.0	a1	13.4	10.0	V	22.0	20.6	-0.3			1.00	3.00	31.9	74.0	74.0		54.0	54.0	22.1
R16	3100.0	4500.0	18	3.0	3.0	1.5	0.0	a1	13.4	10.0	H/V	22.0	27.4	-0.5			1.00	3.00	35.8	74.0	74.0		54.0	54.0	18.2
R17	SETUP:		OATSA					APP GATEWAY			HQR2TO18S01				RSFSV30001				NOTES: All background noise						
R18	4500.0	18000.0	18	3.0	3.0	5.8	0.0	a1	13.4	10.0	H/V	22.0	34.3	-1.6			1.00	3.00	41.7	74.0	74.0		54.0	54.0	12.3
R19																									
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C31

(ROW)	(COLUMN)	NOTE:
R0	C4	MR is Measurement Range, which is reduced from DR to achieve necessary SNR.
R0	C5	DR is the regulatory Desired Range measurement distance.
R0	C6	N/F is Near-Field / Far-Field distance computed for max of EUT Antenna Dimension (C10) and Test Antenna dimension (C12), where applicable.
R0	C7	CF is computed using a 20 dB/decade Decay Rate.
R0	C15	When E-field or EIRP is reported directly, Antenna Factors and Cable losses are included directly in Receiver settings and Pr (C15/16) is not reported.
R0	C16	Qpk measured below 1 GHz, Avg measured above 1 Ghz.

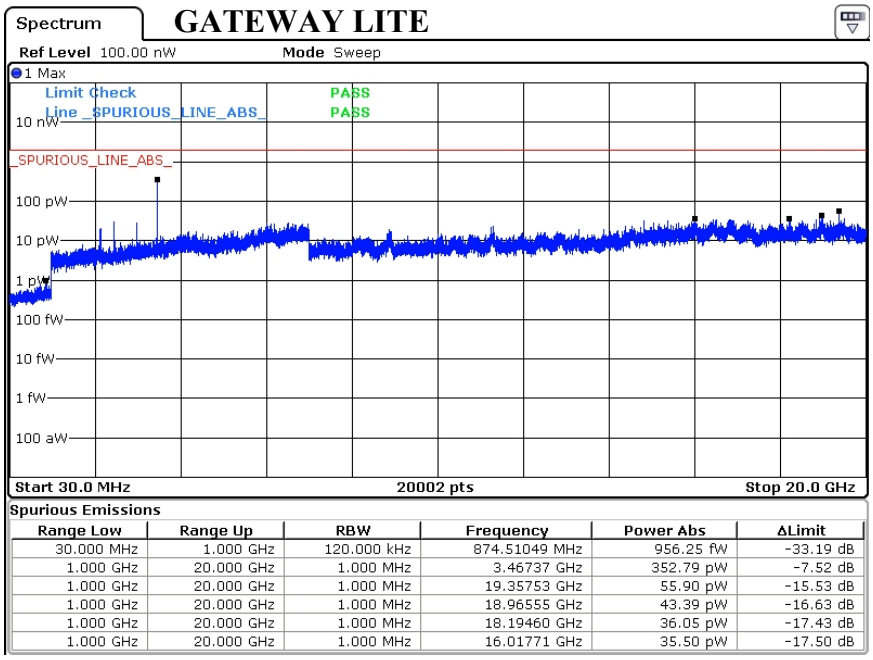
4.2.3 Conducted Receiver Spurious

The EUT employs one or more external receive antenna terminals. Measurement of conducted spurious emissions out of such ports at the nominal voltage and temperature were measured in accordance with the regulations. Radiated emissions are performed with these ports terminated. Tabulated results of these measurements are provided in Figure 5 below.



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.000 GHz	120.000 kHz	260.14486 MHz	875.41 fW	-33.58 dB
1.000 GHz	20.000 GHz	1.000 MHz	3.46737 GHz	61.52 pW	-15.11 dB
1.000 GHz	20.000 GHz	1.000 MHz	16.47369 GHz	43.31 pW	-16.63 dB
1.000 GHz	20.000 GHz	1.000 MHz	2.46042 GHz	41.21 pW	-16.85 dB
1.000 GHz	20.000 GHz	1.000 MHz	16.91866 GHz	38.27 pW	-17.17 dB
1.000 GHz	20.000 GHz	1.000 MHz	19.43653 GHz	38.14 pW	-17.19 dB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.000 GHz	120.000 kHz	874.51049 MHz	956.25 fW	-33.19 dB
1.000 GHz	20.000 GHz	1.000 MHz	3.46737 GHz	352.79 pW	-7.52 dB
1.000 GHz	20.000 GHz	1.000 MHz	19.35753 GHz	55.90 pW	-15.53 dB
1.000 GHz	20.000 GHz	1.000 MHz	18.96555 GHz	43.39 pW	-16.63 dB
1.000 GHz	20.000 GHz	1.000 MHz	18.19460 GHz	36.05 pW	-17.43 dB
1.000 GHz	20.000 GHz	1.000 MHz	16.01771 GHz	35.50 pW	-17.50 dB

Figure 5: Conducted Receiver Emissions Measured.

5 Measurement Uncertainty

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 5: Measurement Uncertainty.

Measured Parameter	**Measurement Uncertainty**[†]
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\text{Hz})$
Conducted Emm. Amplitude	$\pm 1.8\,\text{dB}$
Radiated Emm. Amplitude $(30 - 200\,\text{MHz})$	$\pm 2.7\,\text{dB}$
Radiated Emm. Amplitude $(200 - 1000\,\text{MHz})$	$\pm 2.5\,\text{dB}$
Radiated Emm. Amplitude $(f > 1000\,\text{MHz})$	$\pm 3.7\,\text{dB}$
DC and Low Frequency Voltages	$\pm 2\%$
Temperature	$\pm 0.5°\text{C}$
Humidity	$\pm 5\%$

[†]Ref: CISPR 16-4-2:2011+A1:2014