TEST REPORT

Report Number: 103948971MPK-001A
Project Number: G103948971
Original Issue: December 30, 2019
Revision Date: January 17, 2020

Testing performed on the
SmartBypass™
Model Number: SmartBypass 2000-63
(Simultaneous Transmission)

FCC ID: QPS01008
IC: 22326-01008

to
FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 2

For

Smart Wires, Inc.

Test Performed by:	Test Authorized by:
Intertek	Smart Wires, Inc.
1365 Adams Court	3292 Whipple Rd.
Menlo Park, CA 94025 USA	Union City, CA 94587 USA

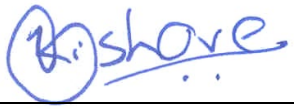
Prepared by: _____ **Date:** December 30, 2019
Anderson Soungpanya

Reviewed by: _____ **Date:** December 30, 2019
Krishna K Vemuri

Report No. 103948971MPK-001A	
Equipment Under Test:	SmartBypass™
Trade Name:	Smart Wires, Inc.
Model Number(s):	SmartBypass 2000-63
Applicant:	Smart Wires, Inc.
Contact:	Karamjit Singh
Address:	Smart Wires, Inc. 3292 Whipple Rd. Union City, CA 94587
Country:	USA
Tel. Number:	(510) 952-2668
Email:	karamjit.singh@smartwires.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 2
Date of Test:	December 09, 2019 – January 02, 2020

Original: We attest to the accuracy of this report:

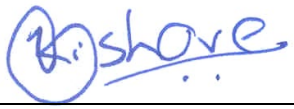
Anderson Soungpanya
Project Engineer



Krishna K Vemuri
Engineering Team Lead

Revision: We attest to the accuracy of this report:

Anderson Soungpanya
Project Engineer



Krishna K Vemuri
Engineering Team Lead

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1.0 Introduction

This report is designed to show compliance of the 900 MHz and 2.4GHz transceiver while transmitting simultaneously to the requirements of FCC Part 15 Subpart C (15.247) and RSS-247.

1.1 Summary of Tests

TEST	Reference FCC	Reference Industry Canada	RESULTS
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-GEN	Complies

2.0 General Description

2.1 Product Description

Smart Wires, Inc. supplied the following description of the EUT:

Smart Wires' SmartBypass technology is designed to protect other Smart Wires series compensation devices. The SmartBypass does this by automatically activating switches to carry the transmission line current during line faults or when operators desire to manually bypass the series compensation. The SmartBypass technology builds on the protection used in other Smart Wires products. The SmartBypass is installed on a single-phase basis, meaning that for most transmission deployments, there will be an equal number of units per phase.

For more information, see user's manual provided by the manufacturer.

Applicant	Smart Wires, Inc.
Model No.	SmartBypass 2000-63
FCC Identifier	QPS01008
IC Identifier	22326-01008
Type of Transmission	Frequency Hopping Spread Spectrum
Antenna(s) & Gain	Internal Antenna, Gain: 1.15 dBi (90 0MHz) & 4.42 dBi (2.4 GHz)
Applicant Name & Address	Smart Wires, Inc. 3292 Whipple Rd. Union City, CA 94587 USA

EUT receive date: November 18, 2019

EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

Test start date: December 09, 2019

Test completion date: January 02, 2020

The test results in this report pertain only to the item tested.

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents “Guidance for Performing Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System devices Operating under §15.247” (KDB 558074 D01 15.247 Meas Guidance v05r02), RSS-247 Issue 2, ANSI C63.10: 2013 and RSS-GEN Issue 5.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013 & ANSI C63.4-2014. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

Following is the channel test plan which produces the worst-case emissions (refer #103948971MPK-001 & 103948971MPK-002 reports for worst-case emissions channels):

Channels in 900 MHz band			
Test Channel		Frequency, MHz	Tested
Middle	32	914.867	√

Channels in 2.4 GHz band			
Test Channel		Frequency, MHz	Tested
High	23	2463.921747	√

2.4 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

3.0 System Test Configuration

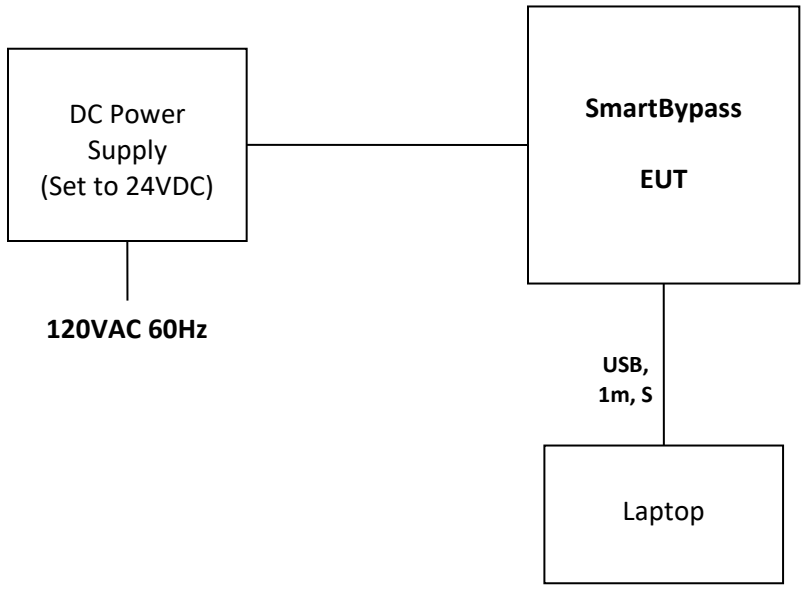
3.1 Support Equipment

Description	Manufacturer	Model Number
Laptop	DELL	Latitude 7490
DC Power Supply	Exetech	D30030012

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Communication Device	Smart Wires, Inc.	SmartBypass 2000-63	3919-004-20-50-06-1

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.



S = Shielded **U** = Unshielded	**F** = With Ferrite **m** = Length in Meters

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive platform15cm off the ground. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

The SmartBypass' size and weight were excessive (~2600 pounds) to safely lift onto an 80cm or 1.5m table for testing. Arrangements were made to safely test it as a floor standing unit as instructed by FCC (Inquiry Tracking Number: 158185).

This is a supplement test report for report numbers 103948971MPK-001 & 103948971MPK-002, to cover simultaneous transmission on the 900 MHz and 2.4 GHz Radio.

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power.

The Maximum power allowed by the manufacturer's provided GUI is RF Power = 22 for 900MHz Radio

The Maximum power allowed by the manufacturer's provided GUI is RF Power = 15 for 2.4 GHz Radio

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Emissions Measurement Results

4.1 Simultaneous Transmitter Radiated Emissions
FCC Rules: 15.247(d), 15.209, 15.205; RSS-247, 5.5;

4.1.1 Requirement

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.1.2 Procedure

Radiated emission measurements were performed from 30 MHz to 26 GHz according to the procedure described in ANSI C63.10: 2013. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Measurements are made with a preamp from 30 MHz to 26 GHz.

Measurements may be made with a Peak Detector and compared to QP limits for 30 MHz – 1 GHz and Average limits for 1 GHz – 26 GHz.

Radiated measurements were performed in the nominal orientation of the EUT. Out-of-Band Radiated Spurious Emissions Measurements were performed with a 50-ohm load on the antenna port.

4.1.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

4.1.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

4.1.5 General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified for determining quasi-peak, peak, and average conducted output power, respectively.

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
E = EIRP – 20log D + 104.8+DCF (DCF for Average measurements)
where:
E = electric field strength in dBµV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.
DCF = Duty Cycle Correction Factor
f) Compare the resultant electric field strength level to the applicable limit.
g) Perform radiated spurious emission test

4.1.6 Test Results

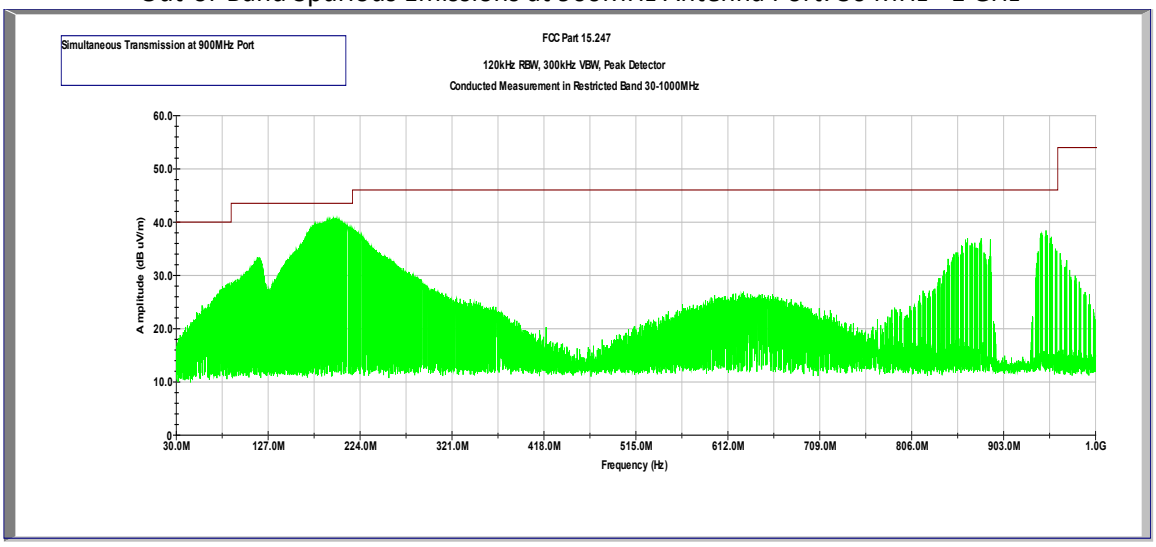
Tested By	Test Date
Anderson Soungpanya	December 09 -11, 2019 & January 2, 2020

Measurements performed at the 2.4GHz Antenna Port were made with the consideration of path losses and the addition of a 4.42 dBi Antenna.

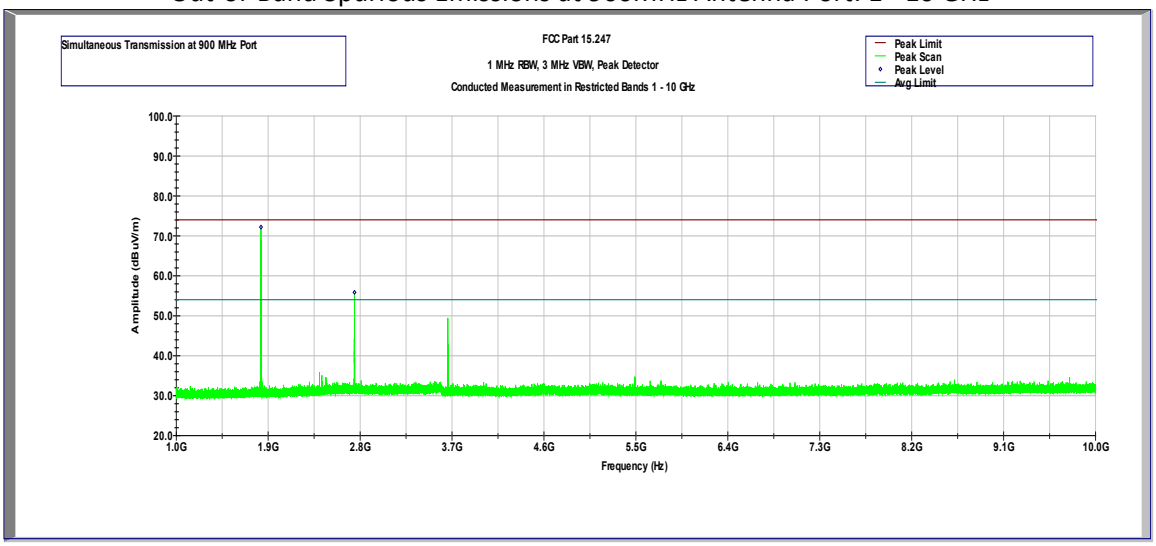
Measurements performed at the 900MHz Antenna Port were made with a notch filter when scanned from 30MHz to 1GHz. These measurements were performed with the consideration of path losses and the addition of a 2dBi Antenna.

Simultaneous Tx at 914.867 MHz & 2463.921747 GHz

Out-of-Band Spurious Emissions at 900MHz Antenna Port: 30 MHz - 1 GHz



Out-of-Band Spurious Emissions at 900MHz Antenna Port: 1 - 10 GHz



Frequency[1]	Peak Amplitude	Peak Limit[2]	Results
GHz	dB(µV/m)	dB(µV/m)	
1.830	72.19	99.69 (-20dBc)	Pass

[1] Spurious emission frequencies does not fall under the restricted bands of 15.205, therefore the 15.209 limits does not apply to these frequencies.

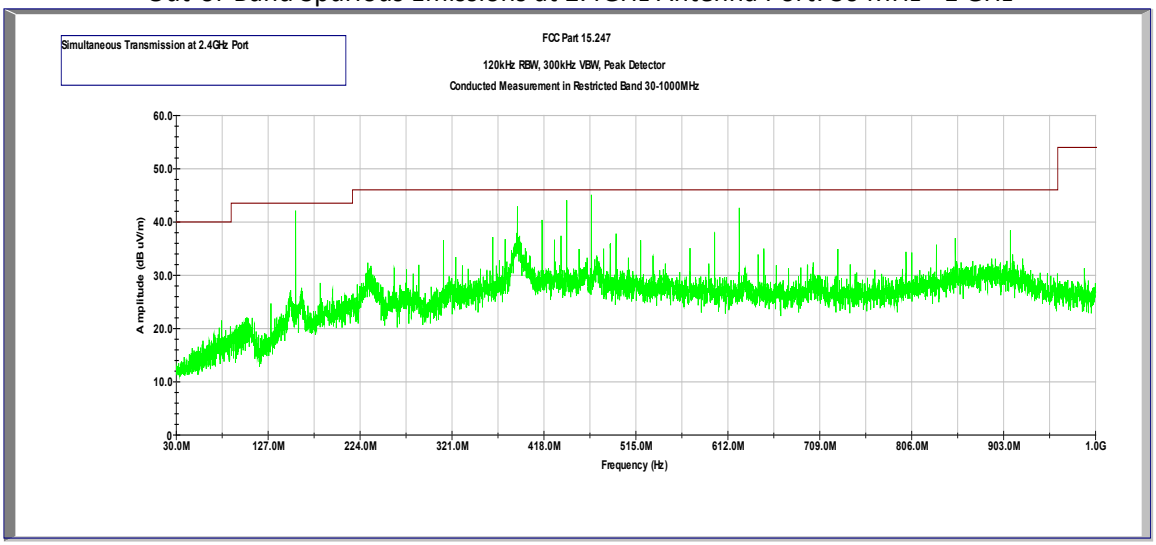
[2] Limit is based on EIRP of 22.46dBm + 2 dBi Antenna. 24.46dBm EIRP is Converted to a dBuV/m Limit at 3m using: dBuV/m = EIRP – 20Log(D) + 104.77 - 20. Where (D)istance is 3m.

Frequency[3]	Peak Amplitude	Peak Limit	Duty Cycle Correction	Avg Amplitude	Avg Limit	Results
GHz	dB(µV/m)	dB(µV/m)	dB	dB(µV/m)	dB(µV/m)	
2.745	55.9	74.0	-20.0	35.9	54.0	Pass

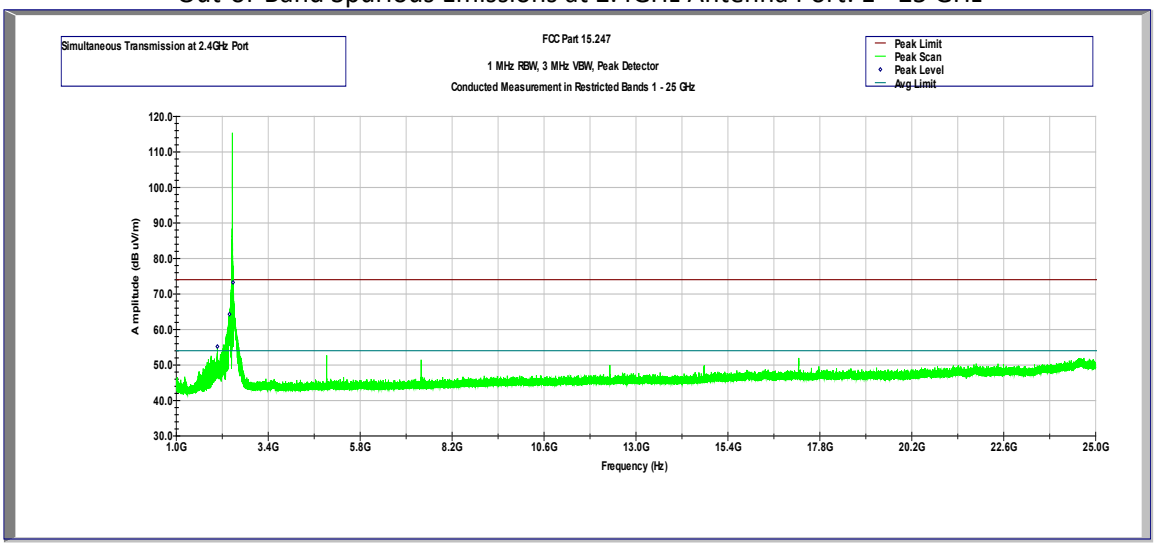
[3] The spurious identified in table above are compliant with 15.209 Average limit (54dBuV/m) by subtracting the Duty Cycle Correction Factor of 20dB to the Peak Amplitude (See Annex A for Duty Cycle calculation).

Simultaneous Tx at 914.867 MHz & 2463.921747 GHz

Out-of-Band Spurious Emissions at 2.4GHz Antenna Port: 30 MHz - 1 GHz



Out-of-Band Spurious Emissions at 2.4GHz Antenna Port: 1 - 25 GHz



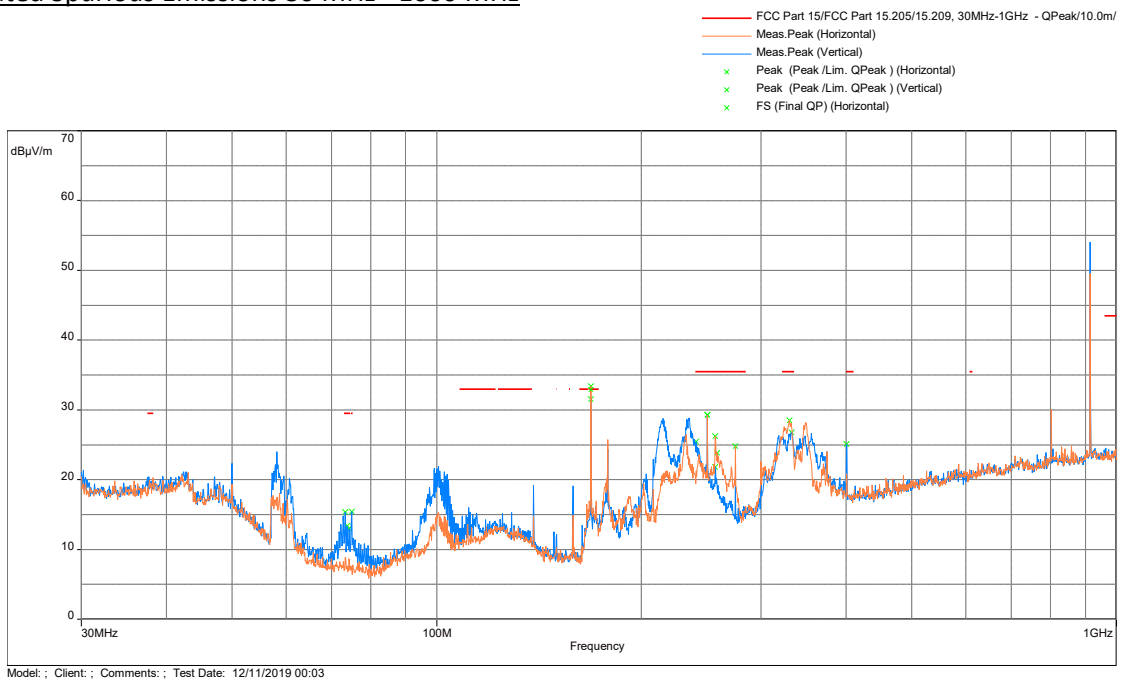
Frequency	Peak Amplitude	Peak Limit	Duty Cycle Correction	Avg Amplitude	Avg Limit	Results
GHz	dB(µV/m)	dB(µV/m)	dB	dB(µV/m)	dB(µV/m)	
2.0740	55.16	74.0	-20.0	35.16	54.0	Pass
2.3900	64.29	74.0	-20.0	44.29	54.0	Pass
2.4835	73.25	74.0	-20.0	43.25	54.0	Pass

Note: The spurious identified in table above are compliant with 15.209 Average limit (54dBuV/m) by subtracting the Duty Cycle Correction Factor of 20dB to the Peak Amplitude (See Annex A for Duty Cycle calculation).

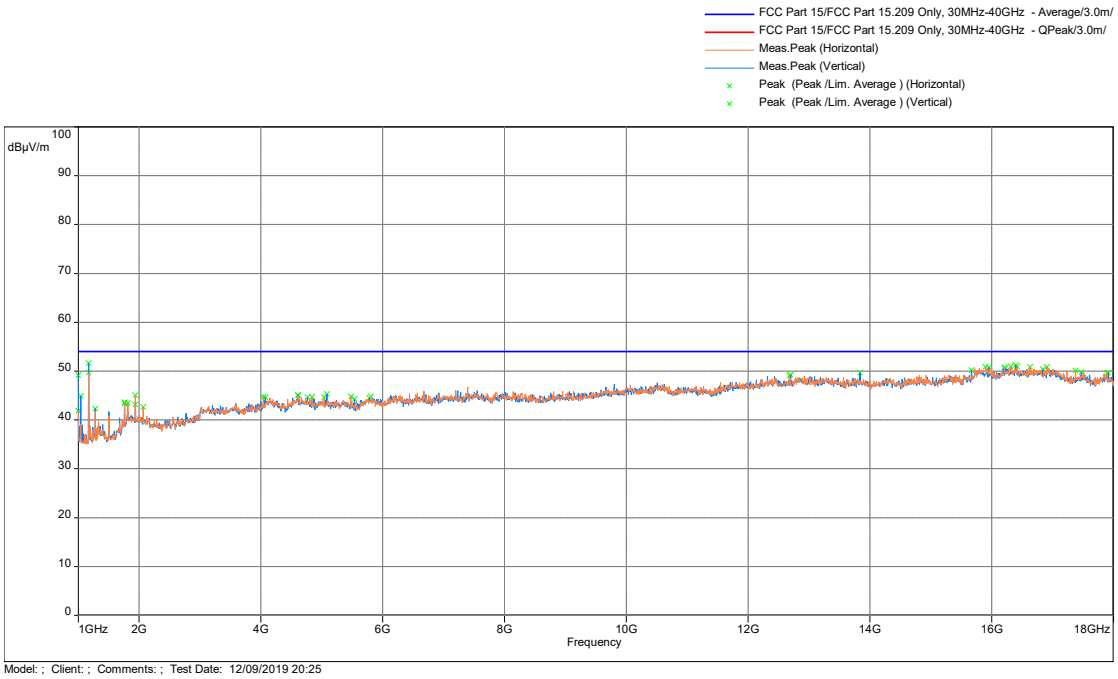
Out-of-Band Radiated Spurious Emissions

Test Results: 15.209 Radiated Spurious Emissions Low Channel,
Simultaneous Tx at 914.867 MHz & 2463.921747 GHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Avg & Limit



Frequency	FS @10m	Limit@10m	Margin	Height	Angle	Polarization	Correction
MHz	(dBµV/m)	(dBµV/m)	(dB)	(m)	(°)		(dB)
168.579	32.90	33.00	-0.10	3.91	24	Horizontal	-15.17
249.996	29.27	35.50	-6.23	4.00	50	Vertical	-11.83
256.883	26.24	35.50	-9.26	3.98	84	Horizontal	-11.38
330.312	28.47	35.50	-7.03	3.98	346	Horizontal	-9.20
Frequency	**FS @3m**	**Limit@3m**	**Margin**	**Height**	**Angle**	**Polarization**	**Correction**
MHz	**(dBµV/m)**	**(dBµV/m)**	**(dB)**	**(m)**	**(°)**		**(dB)**
1172.267	51.60	54.00	-2.40	1.99	103	Vertical	-18.17
1039.667	44.93	54.00	-9.07	1.01	28	Vertical	-18.39

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

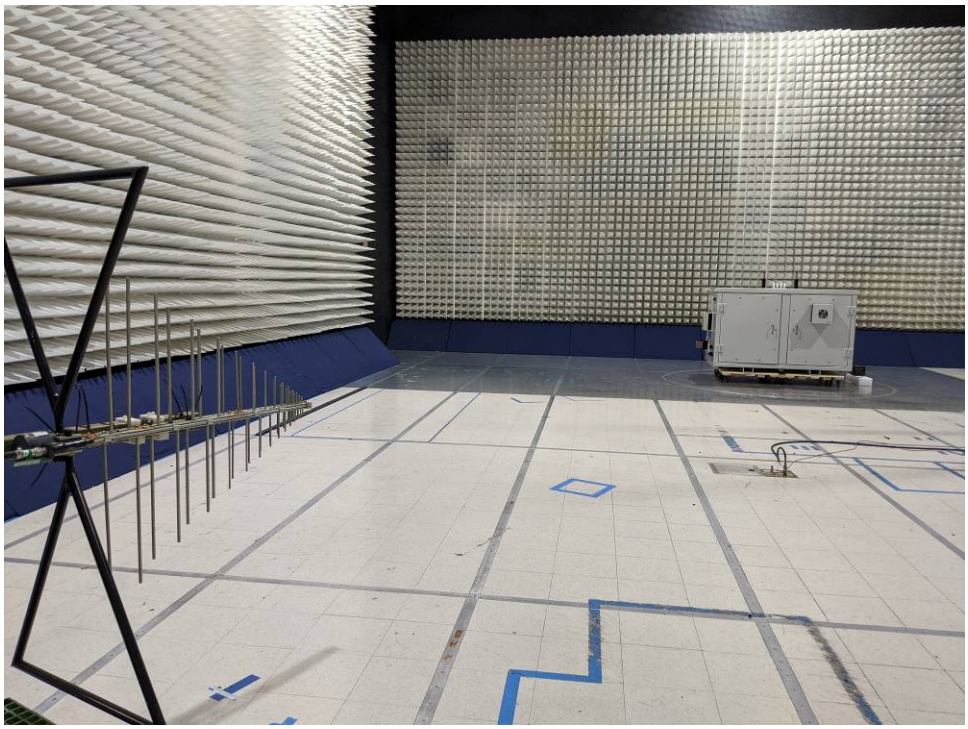
Note: FS@3m = RA + AF + CF - Preamp

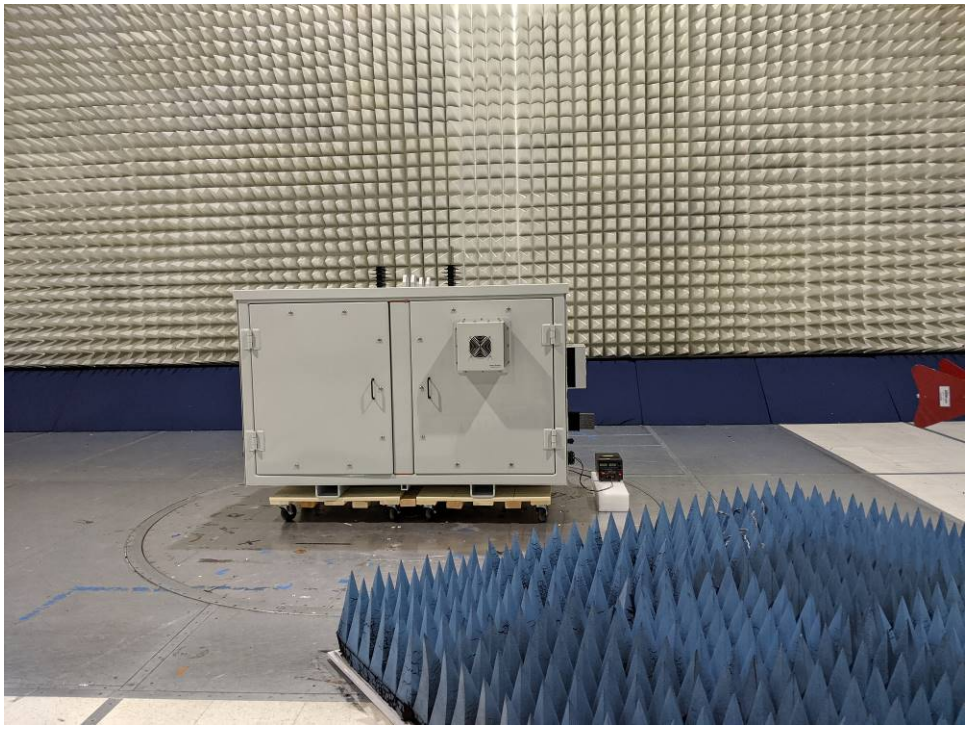
Results	Complies

4.1.7 Test Setup Photographs

The following photographs show the testing configurations used.

4.1.5 Test Setup Photographs (Continued)





5.0 List of Test Equipment and Software

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment Description	Manufacturer	Model/ Type	Asset No.	Monthly Cal Interval	Cal Due
EMI Receiver	Rohde and Schwarz	ESR	ITS 01607	12	10/23/20
EMI Receiver	Rohde and Schwarz	ESU40	ITS 00961	12	11/07/20
Active Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/17/20
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	04/24/20
Pre-Amplifier	Sonoma Instrument	310N	ITS 00415	12	04/104/20
Horn Antenna (10-40 GHz)	ETS-Lindgren	3116C	ITS 01376	12	02/15/20
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	02/08/20
RF Cable	Megaphase	TM40-K1K1-59	ITS 01657	12	11/11/20
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01537	12	02/20/20
RF Cable	TRU Corporation	TRU CORE 300	ITS 01330	12	05/09/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/27/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/27/20
Notch Filter	Micro-Tronics	BRC50722	ITS 01170	12	03/18/20
High Pass Filter	Micro-Tronics	HPM50144-02	ITS 01722	12	11/11/20
Attenuator	Mini Circuits	FSCM99899	ITS 01582	12	10/07/20
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	05/14/20

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
BAT-EMC	Nexio	3.16.0.64	Smartwires_G103948971.bpp

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G103948971	AS	KV	December 30, 2019	Original Document
1.1 / G103948971	AS	KV	January 17, 2020	Added additional tabular data & Conducted Antenna Port testing into section 4.1.4

END OF REPORT