TEST REPORT

Report Number: 104368457MPK-001
Project Numbers: G103948971, G104368457
October 19, 2020

Testing performed on the
SmartValve™
Model Number: SmartValve 10-3600i-63

FCC ID: QPS01009
IC: 22326-01009

to
FCC Part 15 Subpart C (15.247)
ISED 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:** October 19, 2020
Anderson Soungpanya

Reviewed by: _____ **Date:** October 19, 2020
Krishna K Vemuri

Report No. 104368457MPK-001	
Equipment Under Test:	SmartValve™
Trade Name:	Smart Wires, Inc.
Model Number(s):	SmartValve 10-3600i-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) ISED RSS-247 Issue 2
Date of Test:	November 18 – December 10, 2019 & September 11 – 19, 2020

We attest to the accuracy of this report:

Anderson Soungpanya
Project Engineer

Krishna K Vemuri
EMC Manager

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1.0 Introduction

This report is designed to show compliance of the EUT's 900MHz transceiver with the requirements of FCC Part 15 Subpart C (15.247) and RSS-247. This test report covers only the FHSS radio.

1.1 Summary of Tests

TEST	Reference FCC	Reference ISED	RESULTS
RF Output Power	15.247(b)	RSS-247, 5.4.2	Complies
20-dB Bandwidth	15.247(a)(1)	RSS-247, 5.1.1	Complies
Channel Separation	15.247(a)(1)	RSS-247, 5.1.2	Complies
Number of Hopping Channels	15.247(a)(1)	RSS-247, 5.14	Complies
Average Channel Occupancy Time	15.247(a)(1)	RSS-247, 5.14	Complies
Out-of-Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-GEN	Complies
RF Exposure	15.247(i)	RSS-102	Complies
AC Conducted Emission	15.207	RSS-GEN	Complies
Antenna Requirement	15.203	RSS-GEN	Complies (Professional Installation)

2.0 General Description

2.1 Product Description

Smart Wires, Inc. supplied the following description of the EUT:
The SmartValve™ builds upon the success of its predecessors. By using revolutionary power electronics, the SmartValve effectively increases or decreases the reactance of a given circuit, enabling real-time control of power flow. A modular, Static Synchronous Series Compensator (SSSC), the SmartValve injects a leading or lagging voltage in quadrature with the line current, providing the functionality of a series capacitor or series reactor respectively. However, unlike conventional series capacitors or reactors, the SmartValve can inject the voltage independently of the line current, thus increasing the ohmic injection when operated below the rated value. Also, the SmartValve does not have the negative characteristics of these passive devices, such as the risk of sub-synchronous resonance (SSR) with series capacitors and the constant VAr consumption of series reactors. As a modular device that can be deployed and re-deployed, the solution size of an installation can be scaled up or down to support the dynamic needs of the transmission grid. Given the fast response of the unit's power electronics, the unit can provide dynamic services and its set-point can be changed frequently to actively manage power flows with no degradation in unit life.

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

Information about the 900 MHz radio is presented below:

Applicant	Smart Wires, Inc.
Model No.	SmartValve 10-3600i-63
FCC Identifier	QPS01009
IC Identifier	22326-01009
Type of Transmission	Frequency Hopping Spread Spectrum
Rated RF Output	22.46 dBm or 176.198 mW
Antenna(s) & Gain	Internal Antenna, Gain: 5.2 dBi
Frequency Range	902.400 – 926.944 MHz
Number of Channel(s)	64
Modulation Type	2-FSK
Applicant Name & Address	Smart Wires, Inc. 3292 Whipple Rd. Union City, CA 94587 USA

EUT receive date: November 18, 2019, September 10, 2020

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: November 18, 2019, September 11, 2020

Test completion date: December 10, 2019, September 19, 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:

Channels in 900 MHz band			
Test Channel		Frequency, MHz	Tested
Low	0	902.400	√
Middle	32	914.867	√
High	63	926.944	√
Hopping Mode	0-63	902.400 - 926.944	√

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

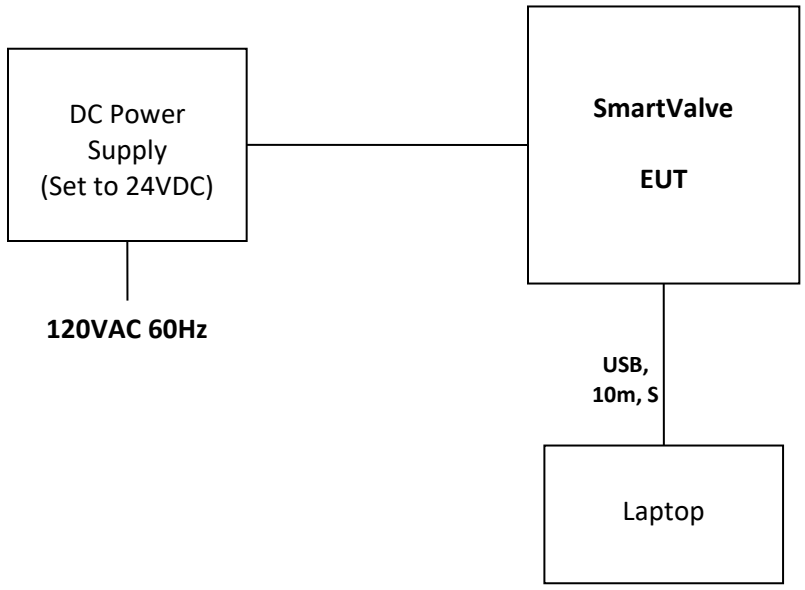
3.1 Support Equipment

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.	SmartValve 10-3600i-63	11520-001-10-04-63-04

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

The SmartValve' size and weight were excessive (>16,000 pounds) to safely lift onto an 80cm or 1.5m table for testing or to move into a semi-anechoic chamber. Due to the practical considerations dictated by the size and installation, requirements of the Equipment Under Test (EUT), testing was performed *in situ* at the applicant's location. Arrangements were made to perform *in situ* testing at the client's premise with the approval from FCC.

For radiated emission measurements 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.

Per the manufacturer, the SmartBypass 2000-63 and SmartValve 10-3600i-63 uses the identical RF circuitry and PCB boards. Therefore, conducted antenna port measurements are taken from report number 103948971MPK-001.

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on the low channel, middle channel, high channel and with hopping channels enabled.

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

Radiated Spurious testing on 900MHz Radio was performed with simultaneous transmission of 2.4GHz 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 20dB Bandwidth, and 99% Occupied Bandwidth
FCC Rule 15.247(a)(1)

4.1.1 Procedure

The Procedure described in the FCC Publication 558074 D01 Meas Guidance v05r02 & Section 7.8.7 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the 20dB bandwidth.

- Span = Approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A Peak output reading was taken, a Display line was drawn for 20dB lower than Peak level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

Tested By	Test Date
Anderson Soungpanya	November 18, 2019

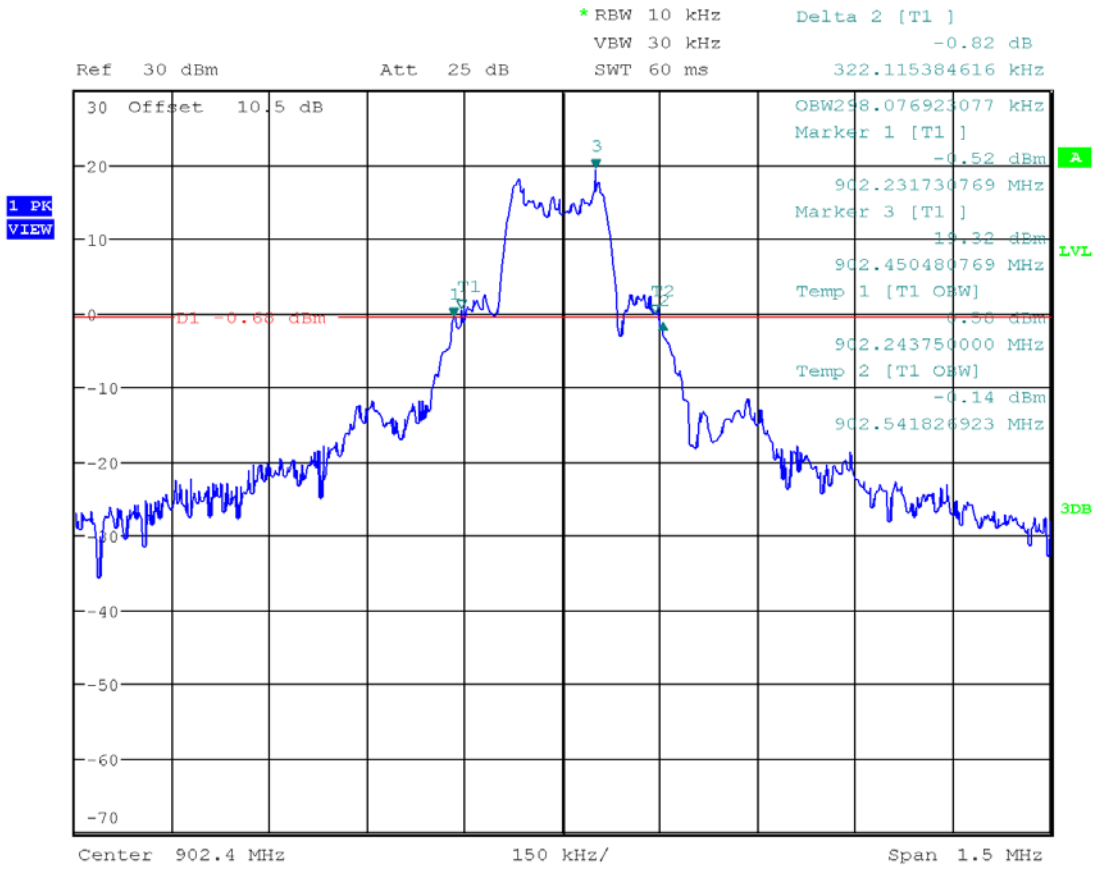
4.1.2 Test Result

Frequency MHz	20 dB FCC Bandwidth, kHz	99% Bandwidth, kHz	Plot #
902.400	322.115	298.077	1.1
914.867	322.116	295.673	1.2
926.944	317.308	300.481	1.3

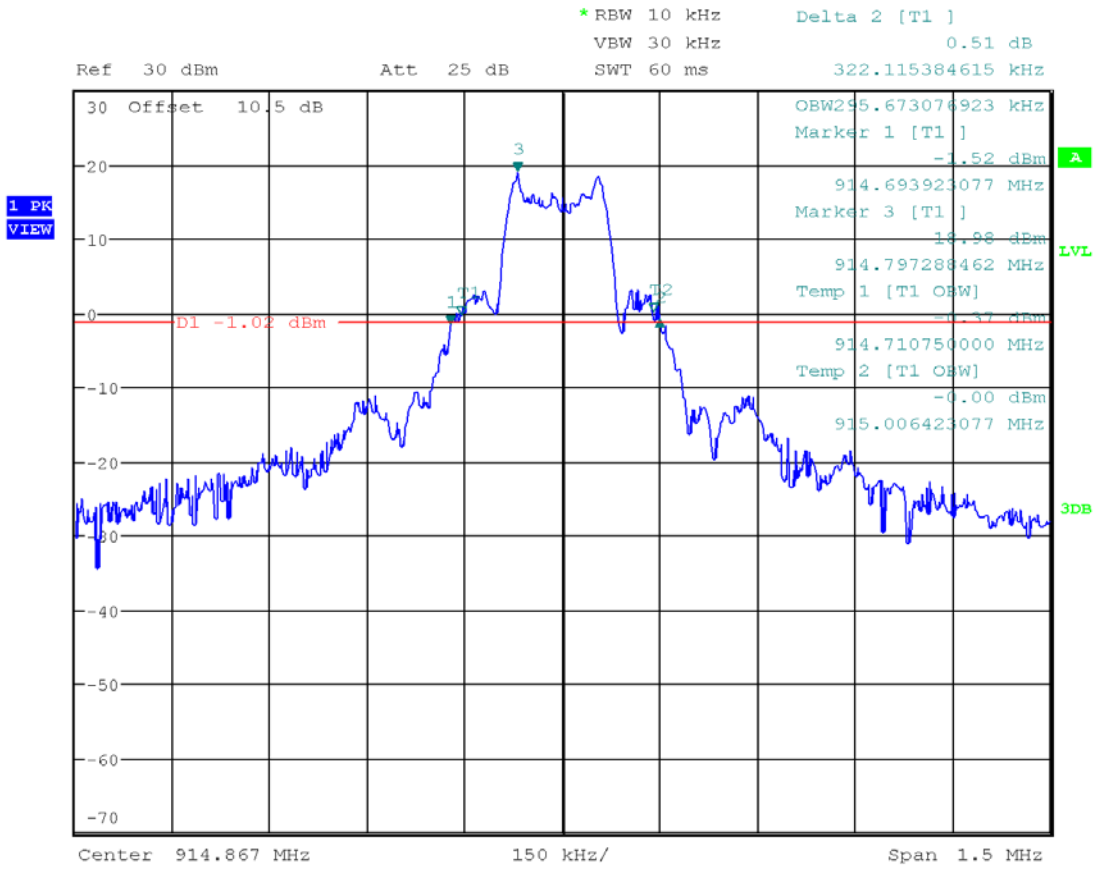
For frequency hopping systems operating in the 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Results	Complies

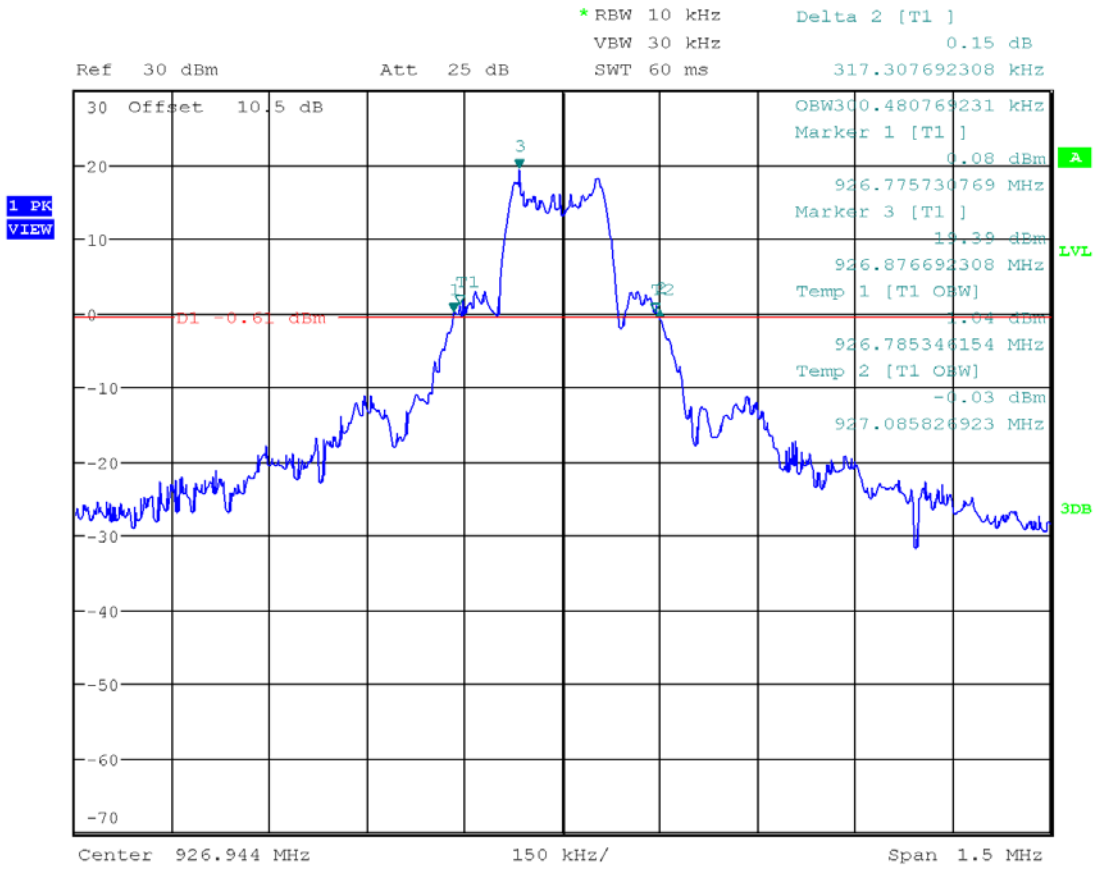
Plot 1. 1 – 20dB Bandwidth and 99% Bandwidth Low Channel



Plot 1. 2 – 20dB Bandwidth and 99% Bandwidth Middle Channel



Plot 1. 3 – 20dB Bandwidth and 99% Bandwidth High Channel



4.2 Conducted Output Power at Antenna Terminals
FCC Rule 15.247(b)(1)

4.2.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels

4.2.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.5 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the RF Output Power.

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot.

The antenna port of the EUT was connected to the input of a spectrum analyzer. Power was read directly from the spectrum analyzer and cable loss correction was added to the reading to obtain the power at the antenna terminals.

Tested By	Test Date
Anderson Soungpanya	November 18, 2019

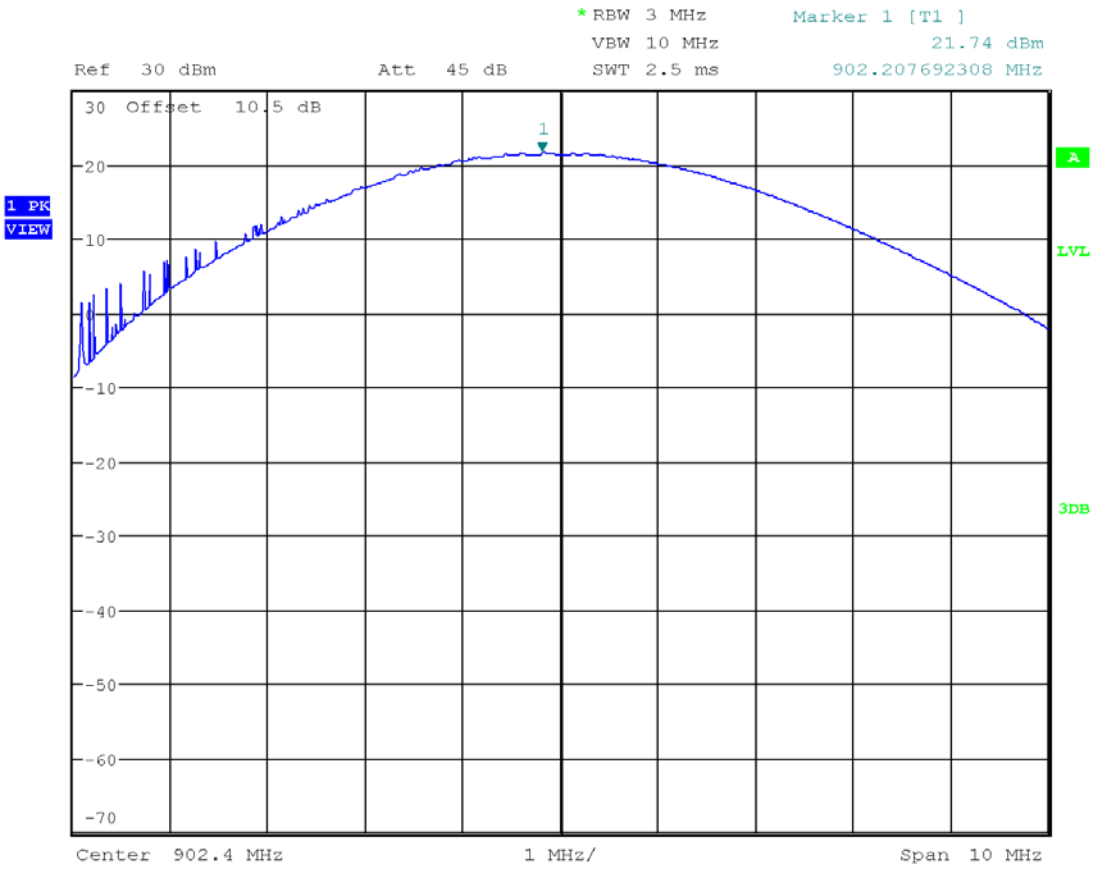
4.2.3 Test Result

Refer to the following plots for the test result:

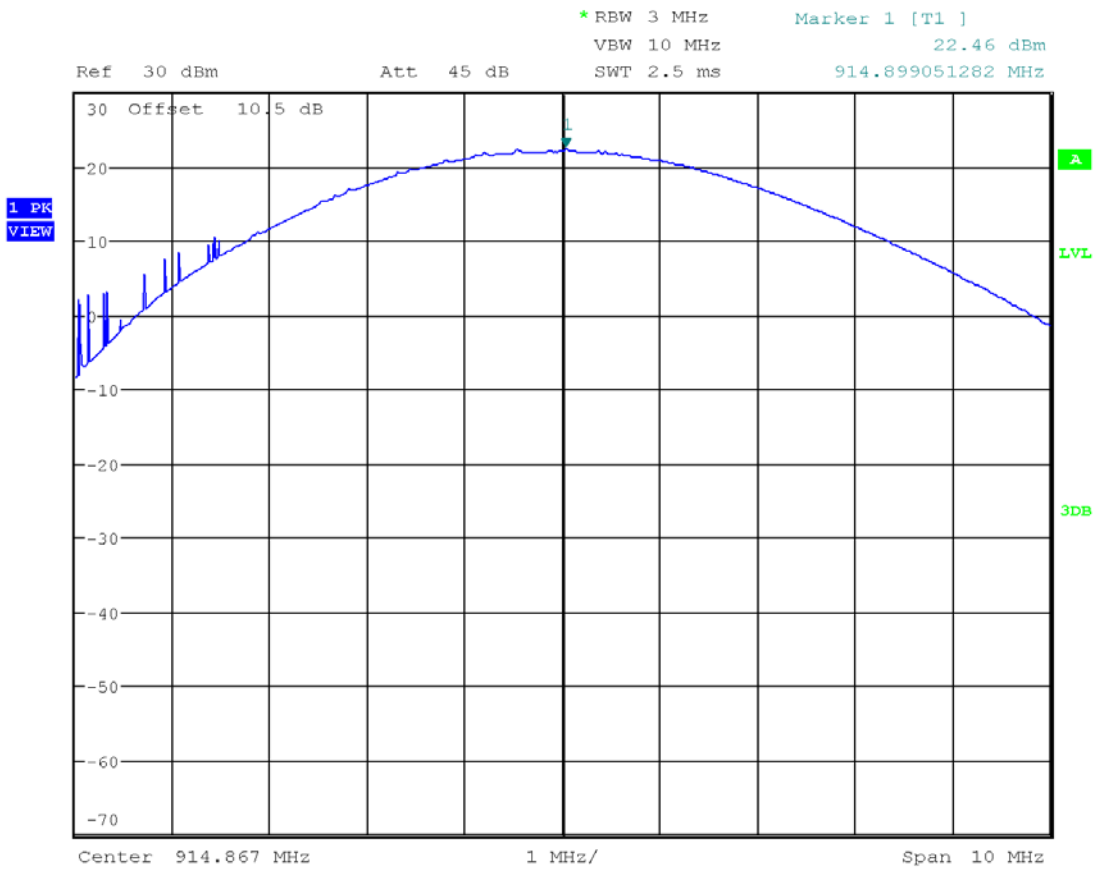
Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
902.400	21.74	149.279	2.1
914.867	22.46	176.198	2.2
926.944	22.21	166.341	2.3

Results	Complies

Plot 2. 2 – Output Power Low Channel

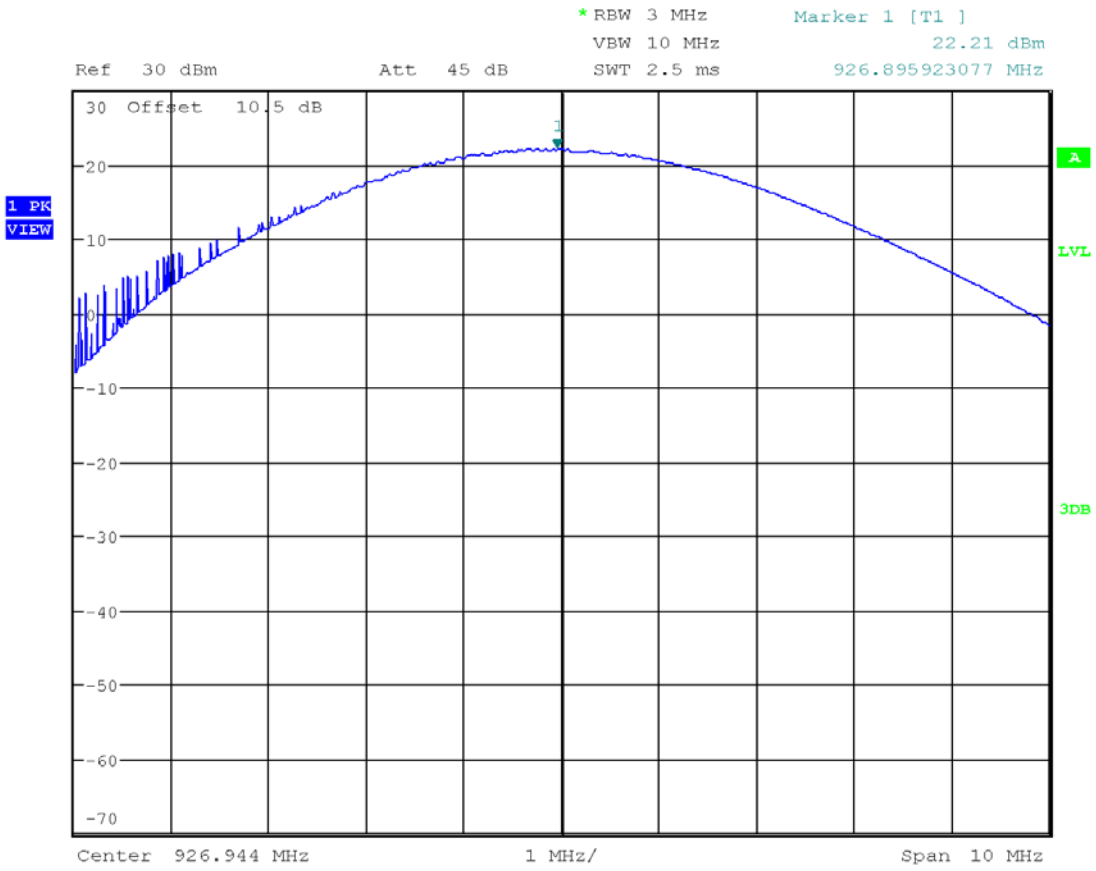


Plot 2. 2 – Output Power Middle Channel



Date: 18.NOV.2019 11:00:51

Plot 2. 3 – Output Power High Channel



Date: 18.NOV.2019 11:10:06

4.3 Carrier Frequency Separation
FCC 15.247 (a)(1)

4.3.1 Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

4.3.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.2 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Carrier Frequency Separation.

- The EUT must have its hopping function enabled
- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) = 1% of the span
- Video (or Average) Bandwidth (VBW) = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

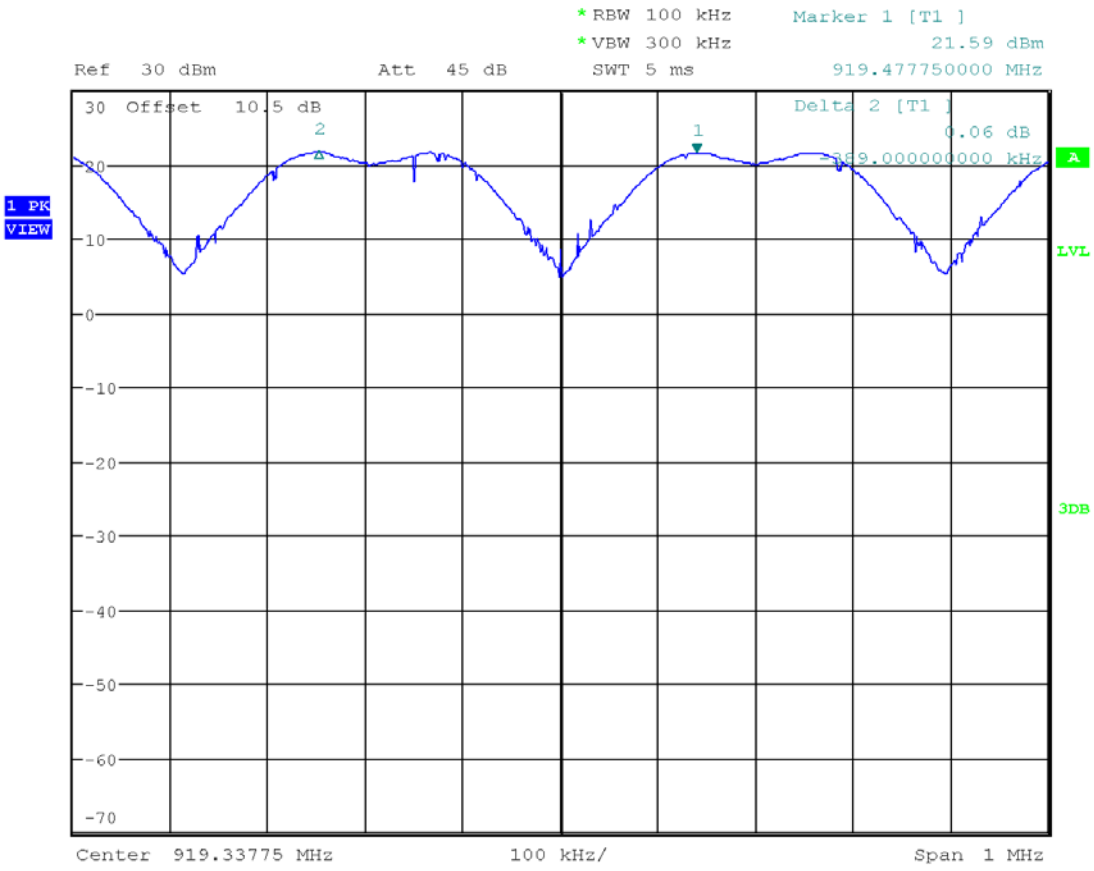
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Tested By	Test Date
Anderson Soungpanya	November 22, 2019

4.3.3 Test Result

The worst case 20dB Bandwidth is 322.116 kHz, therefore the minimum Carrier Frequency Separation shall be greater than 322.116 kHz. The measured channel separation is 389.0 kHz. Carrier Frequency Separation meets the minimum requirement. Please refer to spectrum analyzer Plot 3.1 below for the test result.

Plot 3.1– Channel Separation



Results	Complies

4.4 Number of Channels
FCC 15.247 (a)(1)(iii)

4.4.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.4.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.3 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Number of Channels.

- The EUT must have its hopping function enabled.
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

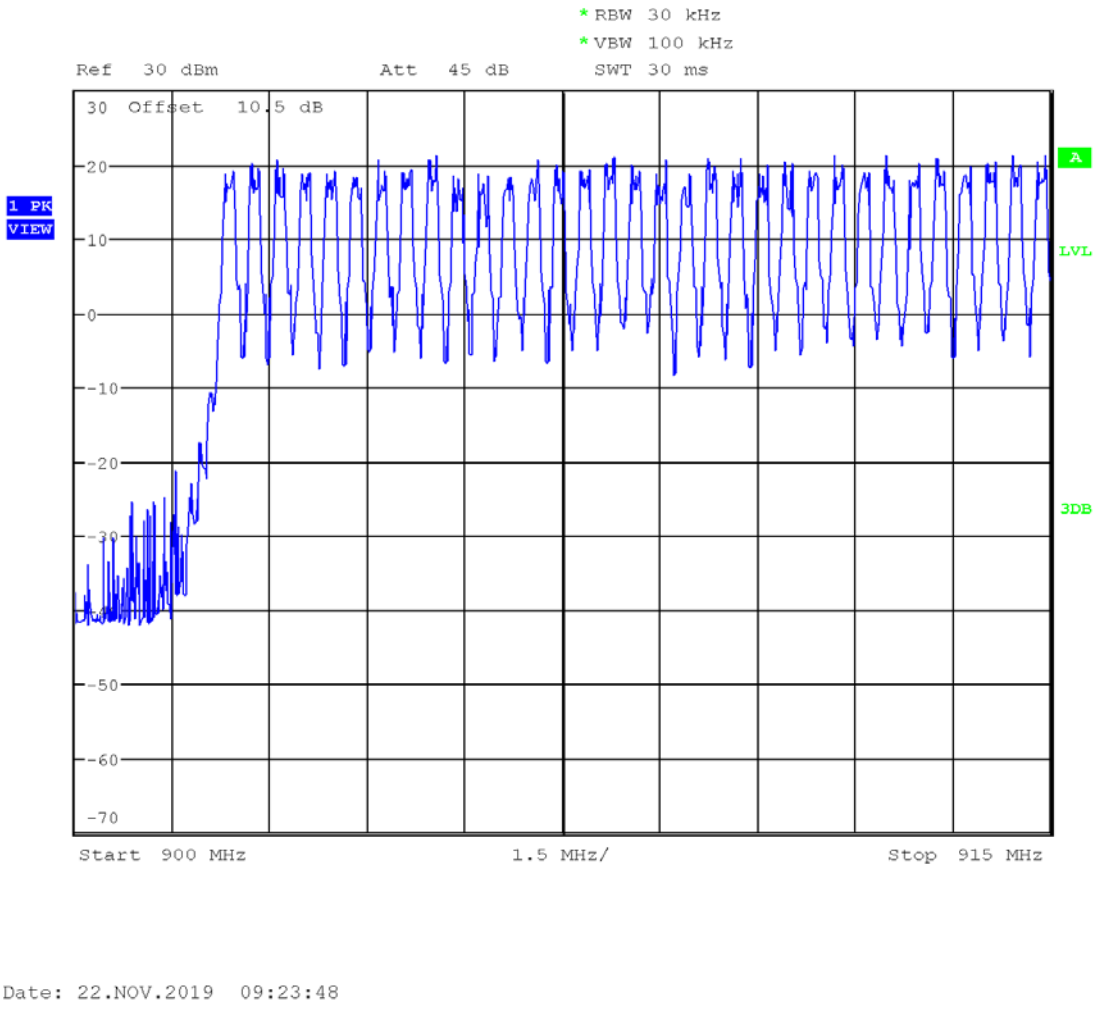
Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

With the analyzer set to MAX HOLD, readings were taken once channels were filled in. The channel peaks were recorded and compared to the minimum number of channels required in the regulation.

Tested By	Test Date
Anderson Soungpanya	November 22, 2019

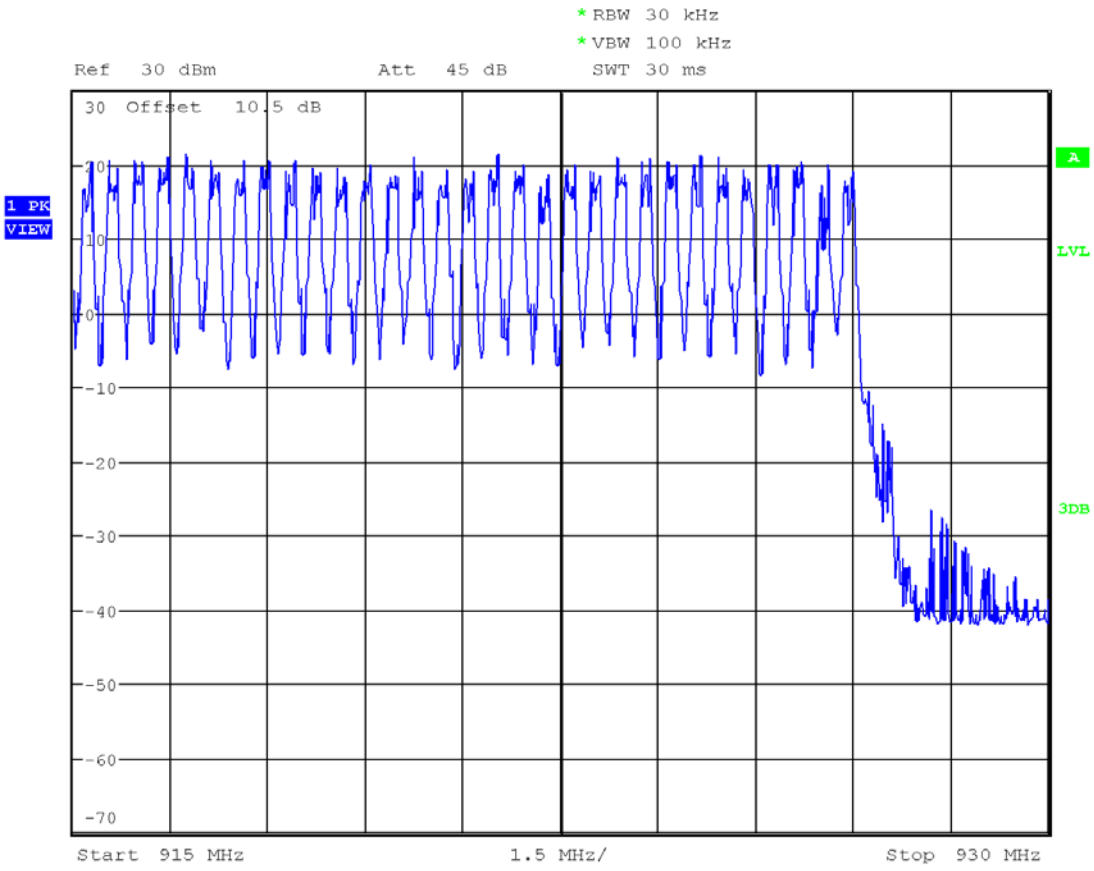
4.4.3 Test Result

Plot 4.1 - Number of hopping channels, 900 - 915MHz



4.4.3 Test Result (Continued)

Plot 4.2 - Number of hopping channels, 915 - 930MHz



Results	Complies, 64 Channels

4.5 Average Channel Occupancy Time
FCC 15.247(a)(1)

4.5.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.5.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.4 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Average Channel Occupancy Time.

- The EUT must have its hopping function enabled.
- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW = 3 x RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. An oscilloscope may be used instead of a spectrum analyzer.

The spectrum analyzer center frequency was set to one of the known hopping channels, the SPAN was set to ZERO SPANS, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

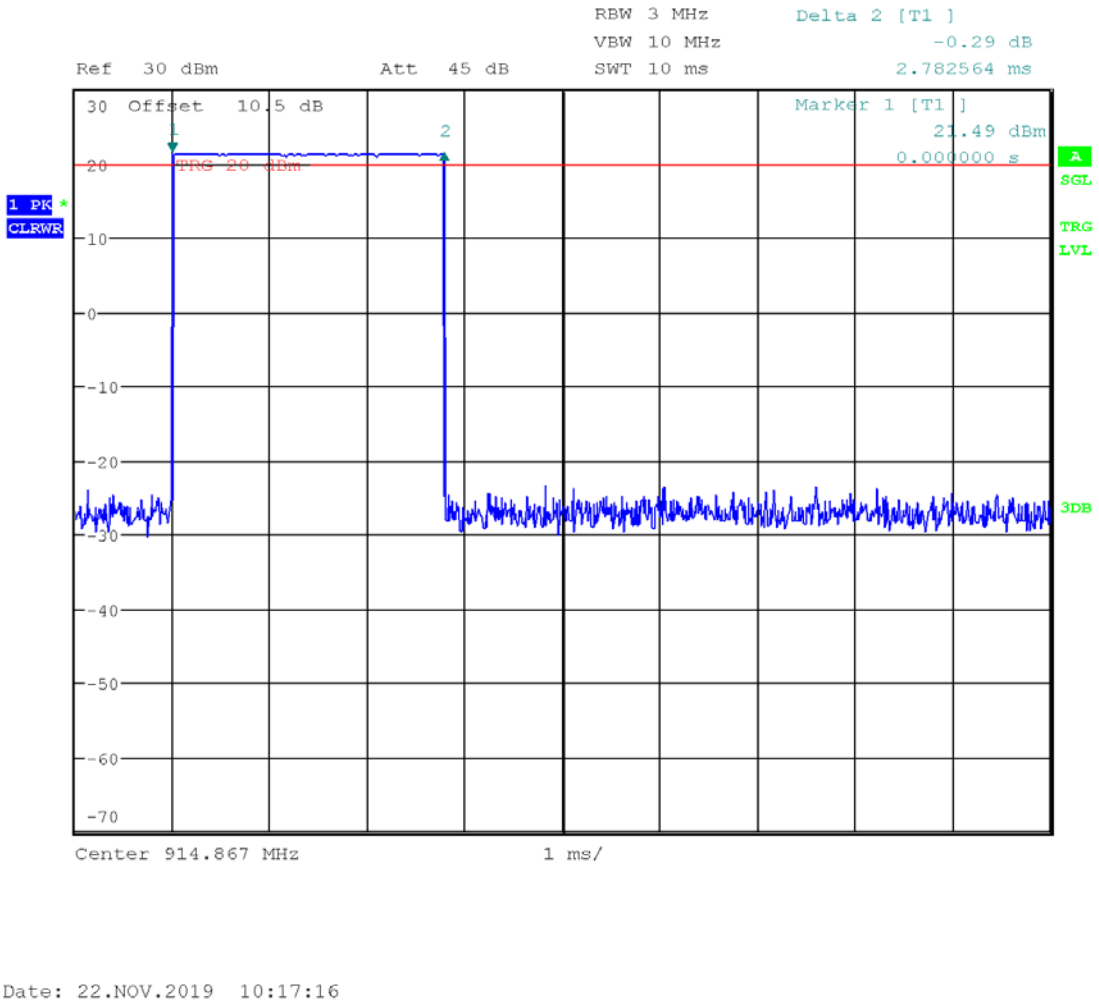
Tested By	Test Date
Anderson Soungpanya	November 22, 2019

4.5.3 Test Results

No. of Burst in 10 seconds	Burst On Time (ms)	Dwell Time (ms)	Dwell Time limit (ms)
9	2.783	25.047	400

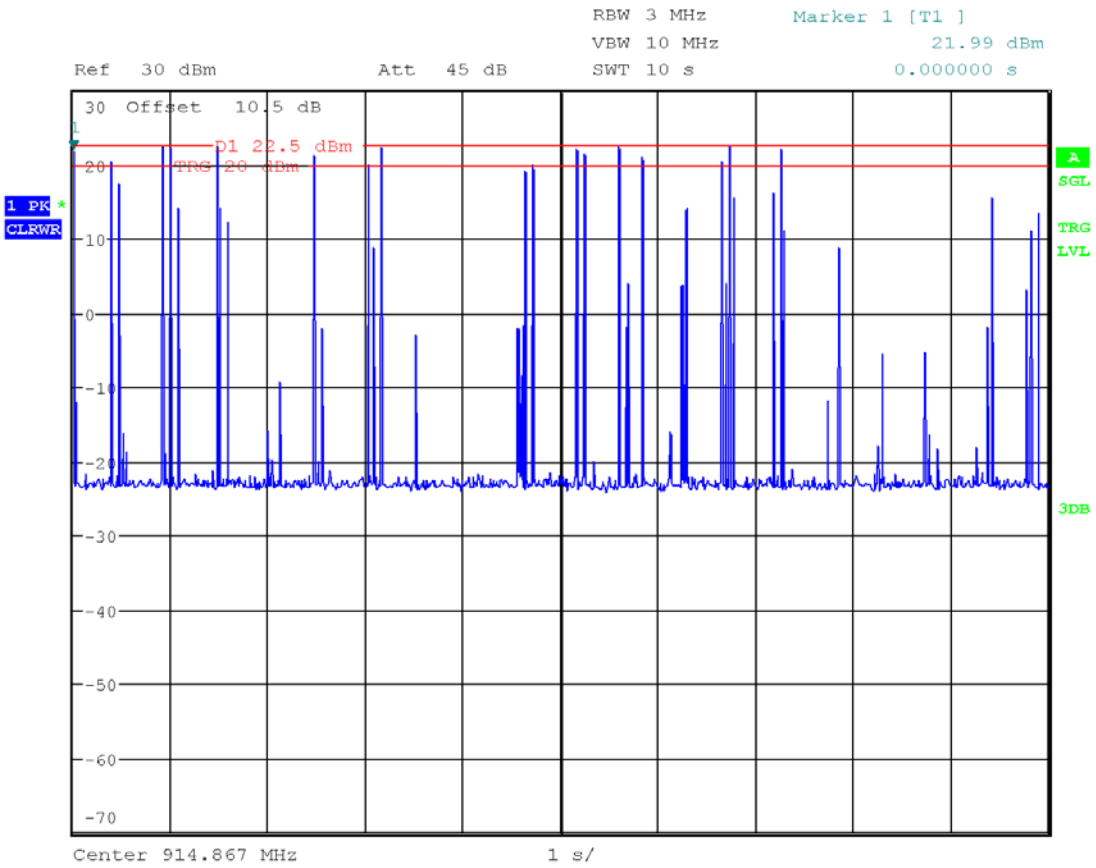
The 20-dB bandwidth of the hopping channel is greater than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Burst Time



4.5.3 Test Results (Continued)

Number of Burst in 10 seconds



Date: 22.NOV.2019 10:24:25

Results	Complies

4.6 Out-of-Band Conducted Emissions
FCC 15.247(d)

4.6.1 Requirement

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.

4.6.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.8 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Out-of-Band Conducted Emissions.

- Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
- RBW = 100 kHz
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 10 GHz.

Tested By	Test Date
Anderson Soungpanya	November 22, 2019

4.6.3 Test Result

Refer to the following plots and out-of-band conducted spurious emissions at the Band-Edge, Table 4.1 & 4.2 for the test results:

Table 4.1

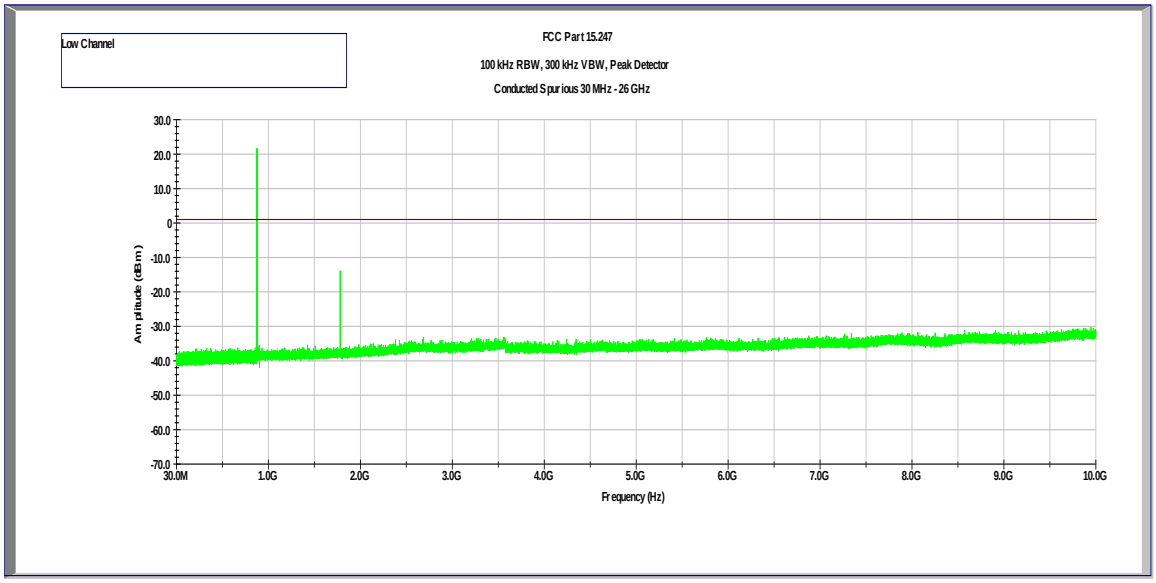
Frequency MHz	Description	Plot #
902.400	Scan 30 MHz – 10 GHz	4.1
914.867	Scan 30 MHz – 10 GHz	4.2
926.944	Scan 30 MHz – 10 GHz	4.3

Out-of-Band Conducted Spurious Emissions at the Band-Edge:

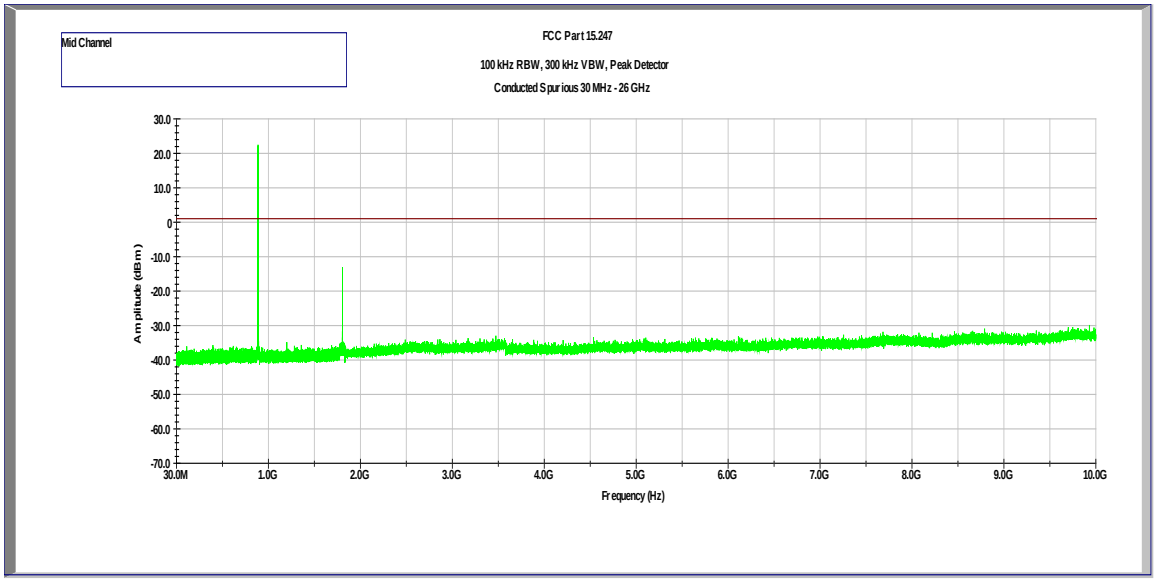
Table 4.2

Channel	Frequency MHz	Out-band emissions margin to In-band emissions	Plot #
0	902.400	Complies, Greater than 20dB	4.4
Hopping	Low Band Edge	Complies, Greater than 20dB	4.5
63	926.944	Complies, Greater than 20dB	4.6
Hopping	High Band Edge	Complies, Greater than 20dB	4.7

Plot 4.1
Transmitter Spurious, Low Channel

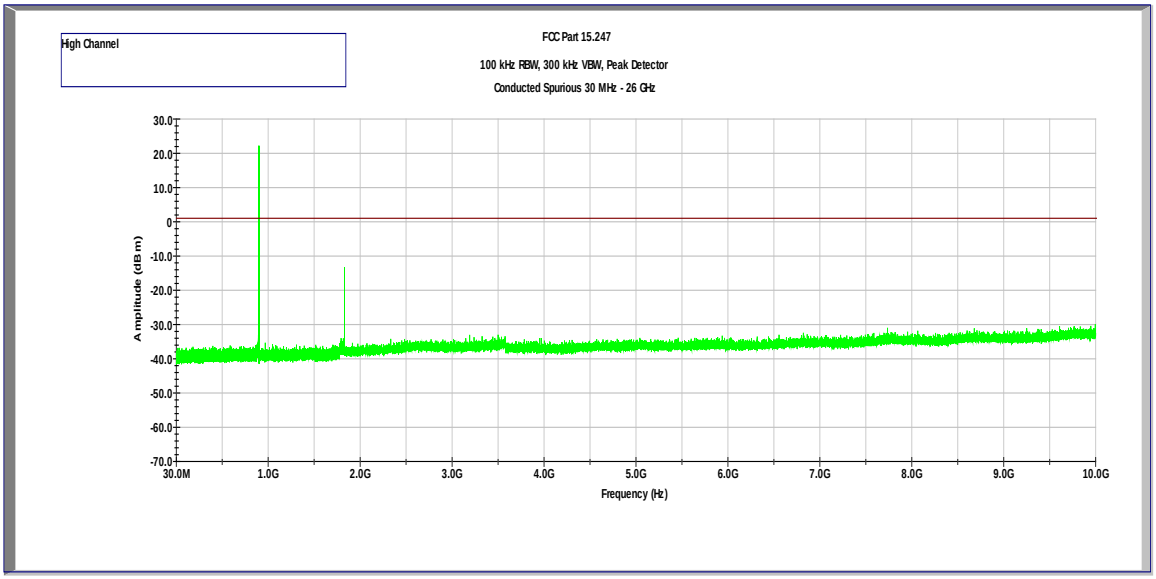


Plot 4.2
Transmitter Spurious, Middle Channel

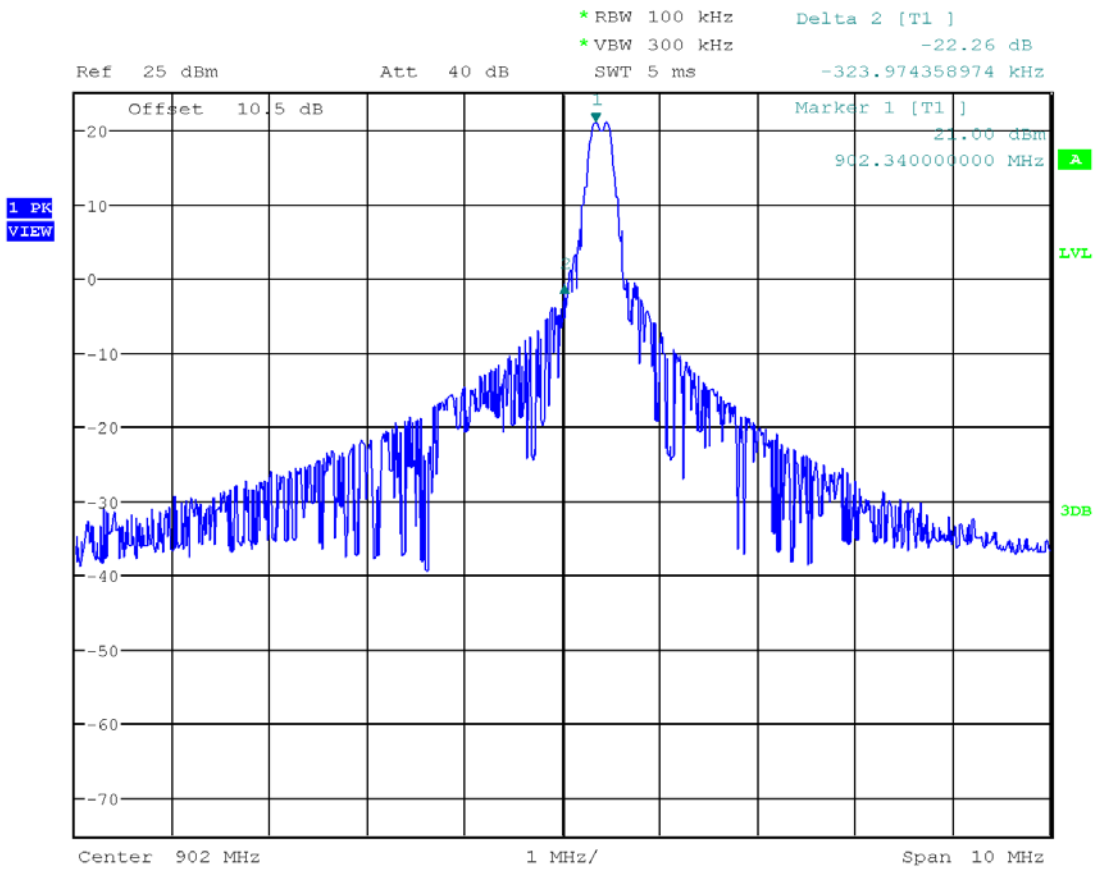


Plot 4.3

Transmitter Spurious, High Channel

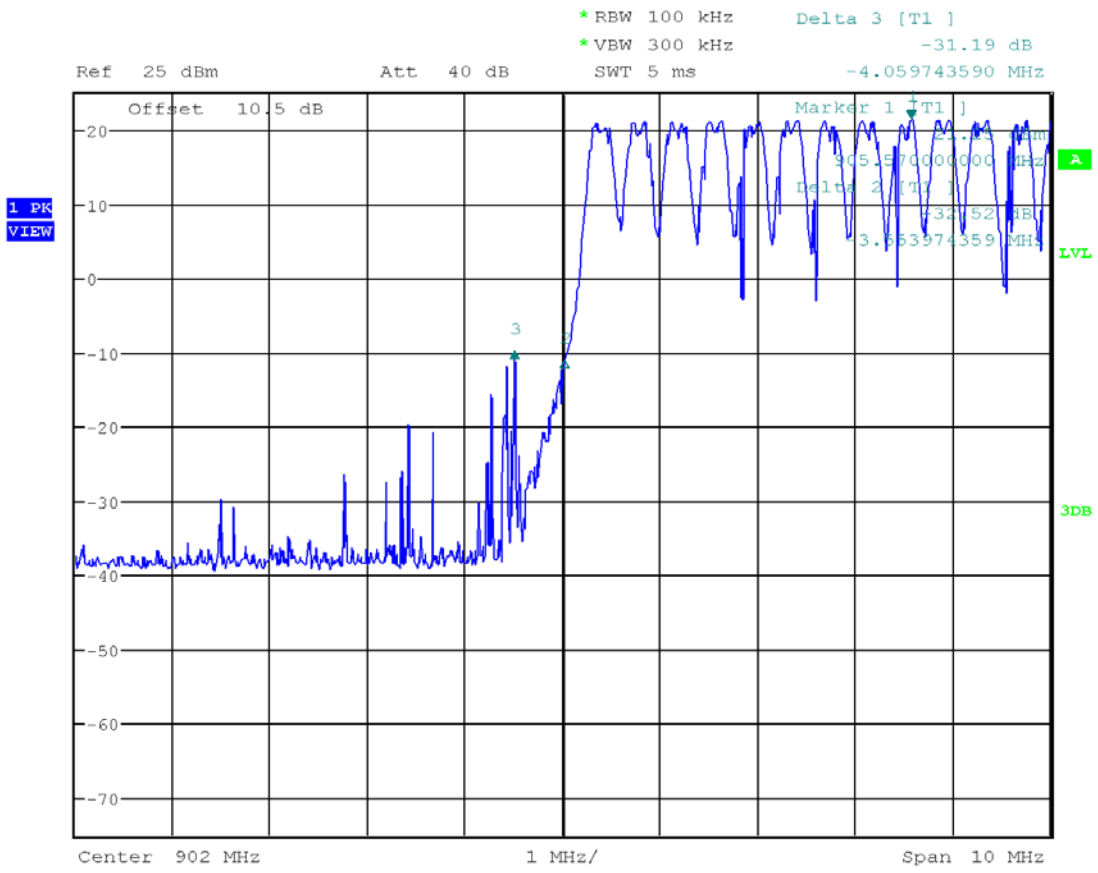


Plot 4.4
Conducted Band Edge, Low Channel



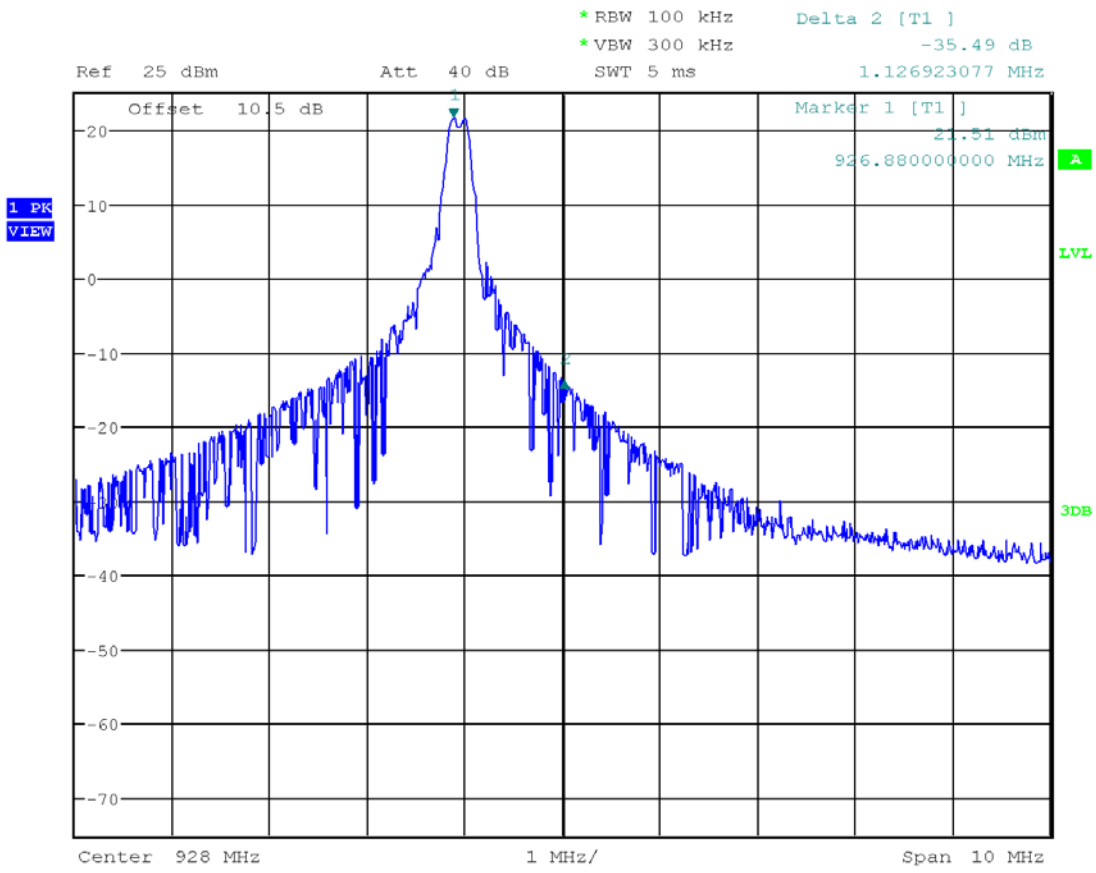
Date: 21.NOV.2019 12:08:14

Plot 4.11
Conducted Band Edge (Hopping)



Date: 21.NOV.2019 12:36:44

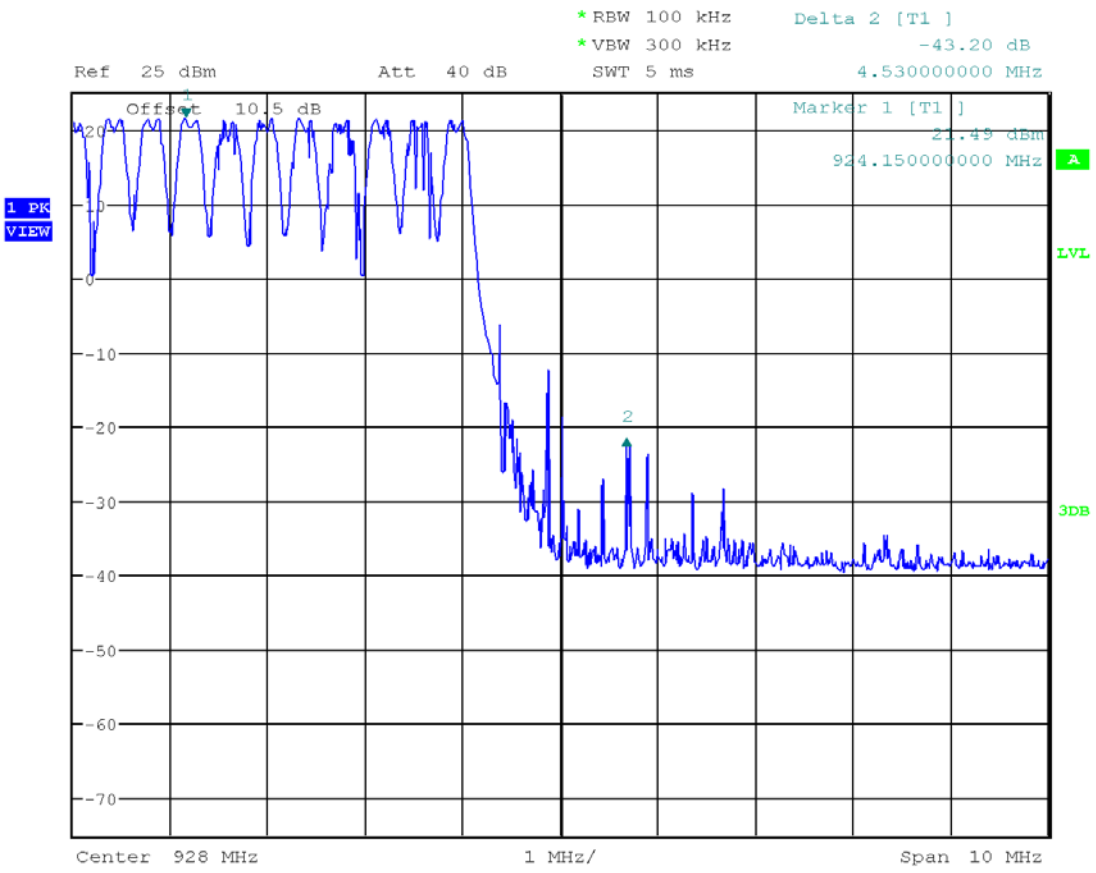
Plot 4.12
Conducted Band Edge, High Channel



Date: 21.NOV.2019 10:47:12

Plot 4.13

Conducted Band Edge (Hopping)



Results	Complies

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

4.7.1 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.

4.7.2 Procedure

Radiated emission measurements were performed from 9kHz to 10GHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz.

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 & below 1 GHz.

Spurious measurements are made with a preamp from 9kHz MHz to 10 GHz.

Measurements may be made with a Peak Detector and compared to QP limits for 9kHz – 1 GHz and Average limits for 1 GHz – 10 GHz.

Radiated Spurious measurements were performed at the customer's site, specifically in their parking lot. EUT was too large and heavy to transport to Intertek's facilities. Procedure and approval were made with the FCC to proceed with these measurements. Measuring Antenna was placed evenly at 16 positions around the EUT. Measuring antennas were 3m from the EUT during measurements. See Figure 1 and test photos for further details.

Out-of-Band Radiated Spurious Emissions

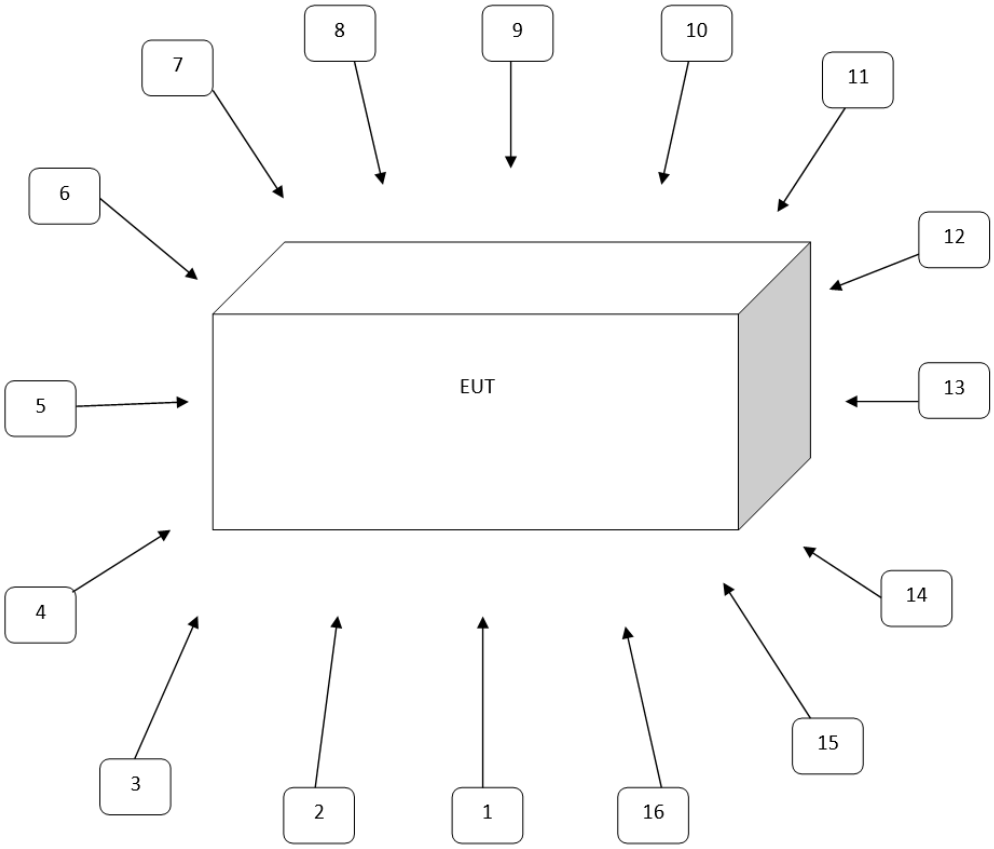


Figure 1. Measuring Antenna Positions; Separated by 22.5°
Note: Measuring Antenna Positioned 3m from the EUT.

4.7.3 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.

4.7.4 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.

4.7.5 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

4.7.6 Test Results

Tested By	Test Date
Anderson Soungpanya	September 15 – September 19, 2020

These measurements were performed with Antenna in place.

Out-of-Band Radiated Spurious Emissions

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.
15.209 Radiated Spurious Emissions Low Channel, Tx at 902.400 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	44.75	32.02	35.10	0.20	48.03	1	1.00	Peak	69.50	-21.47
15.027	**Perp**	41.94	32.02	34.50	0.26	44.68	4	1.00	Peak	69.50	-24.82
18.130	**Perp**	42.51	32.02	34.79	0.32	45.60	2	1.00	Peak	69.50	-23.90
249.000	**V**	44.51	31.92	16.60	1.17	30.36	1	2.63	Peak	46.00	-15.64
327.000	**H**	50.54	31.93	18.40	1.34	38.35	1	1.43	Peak	46.00	-7.65
331.000	**H**	51.67	31.93	18.50	1.34	39.58	1	1.59	Peak	46.00	-6.42
400.000	**V**	48.62	31.97	20.30	1.50	38.45	2	2.16	Peak	46.00	-7.55
1721.800	**V**	64.40	45.30	25.35	3.06	47.50	1	1.55	Peak	54.00	-6.50
3681.100	**H**	58.50	44.12	30.86	4.56	49.79	1	1.43	Peak	54.00	-4.21
1804.800*	**V**	72.27	45.25	25.66	3.11	55.80	1	1.06	Peak	97.70 (20dBc)	-41.9
2707.200	**H**	49.41	44.66	28.71	3.89	37.35	1	1.00	Peak	54.00	-16.65
3609.600	**H**	50.98	44.15	30.67	4.52	42.02	1	1.00	Peak	54.00	-11.98
4512.000	**H**	50.37	43.80	32.12	5.08	43.77	1	1.00	Peak	54.00	-10.23
5414.400	**H**	49.86	43.63	33.59	5.61	45.43	1	1.00	Peak	54.00	-8.57
6316.800	**H**	50.08	43.67	35.43	6.10	47.95	1	1.00	Peak	54.00	-6.05
7219.200	**H**	50.67	43.92	37.19	6.54	50.48	1	1.00	Peak	54.00	-3.52
8121.600	**H**	51.11	44.12	37.10	6.93	51.03	1	1.00	Peak	54.00	-2.97
9024.000	**H**	51.37	44.18	37.53	7.31	52.02	1	1.00	Peak	54.00	-1.98

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.
15.209 Radiated Spurious Emissions Low Channel, Tx at 902.400 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	37.53	32.02	35.60	0.24	41.35	7	1.00	Peak	69.50	-28.15
11.726	**Perp**	28.84	32.02	34.65	0.20	31.68	6	1.00	Peak	69.50	-37.82
12.013	**Par**	42.66	32.02	34.60	0.21	45.44	6	1.00	Peak	69.50	-24.06
249.000	**V**	51.76	31.92	16.60	1.17	37.61	6	1.93	Peak	46.00	-8.39
327.000	**H**	53.80	31.93	18.40	1.34	41.61	7	1.20	Peak	46.00	-4.39
331.000	**H**	49.58	31.93	18.50	1.34	37.49	6	2.77	Peak	46.00	-8.51
400.000	**V**	46.25	31.97	20.30	1.50	36.08	7	2.68	Peak	46.00	-9.92
1721.800	**V**	60.95	45.30	25.35	3.06	44.05	6	1.90	Peak	54.00	-9.95
3681.100	**H**	59.70	44.12	30.86	4.56	50.99	6	1.35	Peak	54.00	-3.01
1804.800*	**V**	79.27	45.25	25.66	3.11	62.80	7	3.20	Peak	97.70 (20dBc)	-34.9
2707.200	**H**	50.70	44.66	28.71	3.89	38.64	7	1.00	Peak	54.00	-15.36
3609.600	**H**	51.52	44.15	30.67	4.52	42.56	7	1.00	Peak	54.00	-11.44
4512.000	**H**	51.73	43.80	32.12	5.08	45.13	7	1.00	Peak	54.00	-8.87
5414.400	**H**	51.82	43.63	33.59	5.61	47.39	7	1.00	Peak	54.00	-6.61
6316.800	**H**	51.02	43.67	35.43	6.10	48.89	7	1.00	Peak	54.00	-5.11
7219.200	**H**	50.66	43.92	37.19	6.54	50.47	7	1.00	Peak	54.00	-3.53
8121.600	**H**	51.57	44.12	37.10	6.93	51.49	7	1.00	Peak	54.00	-2.51
9024.000	**H**	51.34	44.18	37.53	7.31	51.99	7	1.00	Peak	54.00	-2.01

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 9 – 12.
15.209 Radiated Spurious Emissions Low Channel, Tx at 902.400 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	48.27	32.02	35.10	0.20	51.55	10	1.00	Peak	69.50	-17.95
11.487	**Perp**	43.54	32.02	34.70	0.20	46.42	12	1.00	Peak	69.50	-23.08
13.544	**Par**	42.91	32.02	34.38	0.23	45.50	10	1.00	Peak	69.50	-24.00
249.000	**V**	54.21	31.92	16.60	1.17	40.06	11	1.71	Peak	46.00	-5.94
327.000	**H**	54.83	31.93	18.40	1.34	42.64	12	1.85	Peak	46.00	-3.36
331.000	**H**	52.22	31.93	18.50	1.34	40.13	12	1.30	Peak	46.00	-5.87
400.000	**V**	42.86	31.97	20.30	1.50	32.69	11	2.21	Peak	46.00	-13.31
1721.800	**V**	63.57	45.30	25.35	3.06	46.67	12	2.94	Peak	54.00	-7.33
3681.100	**H**	57.53	44.12	30.86	4.56	48.82	12	1.12	Peak	54.00	-5.18
1804.800*	**V**	78.95	45.25	25.66	3.11	62.48	12	2.61	Peak	97.70 (-20dBc)	-35.22
2707.200	**H**	51.41	44.66	28.71	3.89	39.35	12	1.00	Peak	54.00	-14.65
3609.600	**H**	51.23	44.15	30.67	4.52	42.27	12	1.00	Peak	54.00	-11.73
4512.000	**H**	50.16	43.80	32.12	5.08	43.56	12	1.00	Peak	54.00	-10.44
5414.400	**H**	50.26	43.63	33.59	5.61	45.83	12	1.00	Peak	54.00	-8.17
6316.800	**H**	50.83	43.67	35.43	6.10	48.70	12	1.00	Peak	54.00	-5.30
7219.200	**H**	50.66	43.92	37.19	6.54	50.47	12	1.00	Peak	54.00	-3.53
8121.600	**H**	50.04	44.12	37.10	6.93	49.96	12	1.00	Peak	54.00	-4.04
9024.000	**H**	50.80	44.18	37.53	7.31	51.45	12	1.00	Peak	54.00	-2.55

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.
15.209 Radiated Spurious Emissions Low Channel, Tx at 902.400 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	47.37	32.02	35.60	0.24	51.19	14	1.00	Peak	69.50	-18.31
18.232	**Par**	40.29	32.02	34.79	0.32	43.37	15	1.00	Peak	69.50	-26.13
29.952	**Par**	48.70	32.01	24.48	0.40	41.57	16	1.00	Peak	69.50	-27.93
249.000	**V**	55.63	31.92	16.60	1.17	41.48	16	2.09	Peak	46.00	-4.52
327.000	**H**	55.49	31.93	18.40	1.34	43.30	16	2.55	Peak	46.00	-2.70
331.000	**H**	53.31	31.93	18.50	1.34	41.22	16	1.71	Peak	46.00	-4.78
400.000	**V**	47.16	31.97	20.30	1.50	36.99	15	2.77	Peak	46.00	-9.01
1721.800	**V**	64.12	45.30	25.35	3.06	47.22	15	1.17	Peak	54.00	-6.78
3681.100	**H**	59.56	44.12	30.86	4.56	50.85	16	1.23	Peak	54.00	-3.15
1804.800*	**V**	81.98	45.25	25.66	3.11	65.51	16	1.71	Peak	97.70 (20dBc)	-32.19
2707.200	**H**	51.17	44.66	28.71	3.89	39.11	16	1.00	Peak	54.00	-14.89
3609.600	**H**	50.75	44.15	30.67	4.52	41.79	16	1.00	Peak	54.00	-12.21
4512.000	**H**	50.77	43.80	32.12	5.08	44.17	16	1.00	Peak	54.00	-9.83
5414.400	**H**	51.66	43.63	33.59	5.61	47.23	16	1.00	Peak	54.00	-6.77
6316.800	**H**	51.39	43.67	35.43	6.10	49.26	16	1.00	Peak	54.00	-4.74
7219.200	**H**	50.67	43.92	37.19	6.54	50.48	16	1.00	Peak	54.00	-3.52
8121.600	**H**	50.09	44.12	37.10	6.93	50.01	16	1.00	Peak	54.00	-3.99
9024.000	**H**	51.25	44.18	37.53	7.31	51.90	16	1.00	Peak	54.00	-2.10

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Results	**Complies**

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.
15.209 Radiated Spurious Emissions Low Channel, Tx at 914.867 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	45.43	32.02	35.10	0.20	48.71	1	1.00	Peak	69.50	-20.79
15.027	**Perp**	43.46	32.02	34.50	0.26	46.20	3	1.00	Peak	69.50	-23.30
18.130	**Perp**	44.45	32.02	34.79	0.32	47.54	2	1.00	Peak	69.50	-21.96
249.000	**V**	44.72	31.92	16.60	1.17	30.57	1	2.66	Peak	46.00	-15.43
327.000	**H**	51.22	31.93	18.40	1.34	39.03	1	2.63	Peak	46.00	-6.97
331.000	**H**	52.48	31.93	18.50	1.34	40.39	1	1.35	Peak	46.00	-5.61
400.000	**V**	49.02	31.97	20.30	1.50	38.85	2	2.19	Peak	46.00	-7.15
1721.800	**V**	65.02	45.30	25.35	3.06	48.12	1	1.05	Peak	54.00	-5.88
3681.100	**H**	60.10	44.12	30.86	4.56	51.39	1	1.01	Peak	54.00	-2.61
1829.734*	**V**	74.91	45.23	25.92	3.15	58.75	1	1.85	Peak	97.70 (20dBc)	-38.95
2744.601	**H**	50.70	44.63	28.75	3.93	38.74	1	1.00	Peak	54.00	-15.26
3659.468	**H**	51.11	44.13	30.77	4.55	42.30	1	1.00	Peak	54.00	-11.70
4574.335	**H**	51.94	43.79	32.27	5.13	45.55	1	1.00	Peak	54.00	-8.45
5489.202	**H**	51.30	43.62	33.86	5.66	47.20	1	1.00	Peak	54.00	-6.80
6404.069	**H**	50.81	43.69	35.52	6.13	48.78	1	1.00	Peak	54.00	-5.22
7318.936	**H**	51.86	43.94	37.45	6.57	51.93	1	1.00	Peak	54.00	-2.07
8233.803	**H**	50.65	44.13	37.22	6.98	50.72	1	1.00	Peak	54.00	-3.28
9148.670	**H**	51.11	44.19	37.71	7.37	51.99	1	1.00	Peak	54.00	-2.01

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.
15.209 Radiated Spurious Emissions Low Channel, Tx at 914.867 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	37.92	32.02	35.60	0.24	41.74	7	1.00	Peak	69.50	-27.76
11.726	**Perp**	29.67	32.02	34.65	0.20	32.51	6	1.00	Peak	69.50	-36.99
12.013	**Par**	43.17	32.02	34.60	0.21	45.95	6	1.00	Peak	69.50	-23.55
249.000	**V**	52.84	31.92	16.60	1.17	38.69	6	1.55	Peak	46.00	-7.31
327.000	**H**	55.38	31.93	18.40	1.34	43.19	7	2.38	Peak	46.00	-2.81
331.000	**H**	51.30	31.93	18.50	1.34	39.21	6	1.48	Peak	46.00	-6.79
400.000	**V**	46.61	31.97	20.30	1.50	36.44	7	1.69	Peak	46.00	-9.56
1721.800	**V**	61.79	45.30	25.35	3.06	44.89	6	2.88	Peak	54.00	-9.11
3681.100	**H**	60.26	44.12	30.86	4.56	51.55	6	2.81	Peak	54.00	-2.45
1829.734*	**V**	80.06	45.23	25.92	3.15	63.90	7	1.85	Peak	97.70 (20dBc)	-33.8
2744.601	**H**	50.17	44.63	28.75	3.93	38.21	7	1.00	Peak	54.00	-15.79
3659.468	**H**	50.80	44.13	30.77	4.55	41.99	7	1.00	Peak	54.00	-12.01
4574.335	**H**	51.43	43.79	32.27	5.13	45.04	7	1.00	Peak	54.00	-8.96
5489.202	**H**	51.92	43.62	33.86	5.66	47.82	7	1.00	Peak	54.00	-6.18
6404.069	**H**	50.32	43.69	35.52	6.13	48.29	7	1.00	Peak	54.00	-5.71
7318.936	**H**	50.31	43.94	37.45	6.57	50.38	7	1.00	Peak	54.00	-3.62
8233.803	**H**	50.89	44.13	37.22	6.98	50.96	7	1.00	Peak	54.00	-3.04
9148.670	**H**	50.40	44.19	37.71	7.37	51.28	7	1.00	Peak	54.00	-2.72

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 9 – 12.
15.209 Radiated Spurious Emissions Low Channel, Tx at 914.867 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	49.10	32.02	35.10	0.20	52.38	10	1.00	Peak	69.50	-17.12
11.487	**Perp**	43.71	32.02	34.70	0.20	46.59	12	1.00	Peak	69.50	-22.91
13.544	**Par**	43.72	32.02	34.38	0.23	46.31	10	1.00	Peak	69.50	-23.19
249.000	**V**	55.83	31.92	16.60	1.17	41.68	11	1.15	Peak	46.00	-4.32
327.000	**H**	54.97	31.93	18.40	1.34	42.78	12	1.30	Peak	46.00	-3.22
331.000	**H**	52.82	31.93	18.50	1.34	40.73	12	1.36	Peak	46.00	-5.27
400.000	**V**	43.76	31.97	20.30	1.50	33.59	11	2.07	Peak	46.00	-12.41
1721.800	**V**	65.24	45.30	25.35	3.06	48.34	12	2.86	Peak	54.00	-5.66
3681.100	**H**	57.53	44.12	30.86	4.56	48.82	12	1.73	Peak	54.00	-5.18
1829.734*	**V**	79.25	45.23	25.92	3.15	63.09	12	3.04	Peak	97.70 (20dBc)	-34.61
2744.601	**H**	51.28	44.63	28.75	3.93	39.32	12	1.00	Peak	54.00	-14.68
3659.468	**H**	50.34	44.13	30.77	4.55	41.53	12	1.00	Peak	54.00	-12.47
4574.335	**H**	51.96	43.79	32.27	5.13	45.57	12	1.00	Peak	54.00	-8.43
5489.202	**H**	50.92	43.62	33.86	5.66	46.82	12	1.00	Peak	54.00	-7.18
6404.069	**H**	51.64	43.69	35.52	6.13	49.61	12	1.00	Peak	54.00	-4.39
7318.936	**H**	50.17	43.94	37.45	6.57	50.24	12	1.00	Peak	54.00	-3.76
8233.803	**H**	50.53	44.13	37.22	6.98	50.60	12	1.00	Peak	54.00	-3.40
9148.670	**H**	50.27	44.19	37.71	7.37	51.15	12	1.00	Peak	54.00	-2.85

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.
15.209 Radiated Spurious Emissions Low Channel, Tx at 914.867 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	48.92	32.02	35.60	0.24	52.74	14	1.00	Peak	69.50	-16.76
18.232	**Par**	40.36	32.02	34.79	0.32	43.44	15	1.00	Peak	69.50	-26.06
29.952	**Par**	50.23	32.01	24.48	0.40	43.10	16	1.00	Peak	69.50	-26.40
249.000	**V**	56.91	31.92	16.60	1.17	42.76	16	2.13	Peak	46.00	-3.24
327.000	**H**	55.66	31.93	18.40	1.34	43.47	16	1.72	Peak	46.00	-2.53
331.000	**H**	54.85	31.93	18.50	1.34	42.76	16	2.26	Peak	46.00	-3.24
400.000	**V**	47.81	31.97	20.30	1.50	37.64	15	2.74	Peak	46.00	-8.36
1721.800	**V**	64.60	45.30	25.35	3.06	47.70	15	1.33	Peak	54.00	-6.30
3681.100	**H**	60.24	44.12	30.86	4.56	51.53	16	2.27	Peak	54.00	-2.47
1829.734*	**V**	81.96	45.23	25.92	3.15	65.80	16	2.25	Peak	97.70 (20dBc)	-31.90
2744.601	**H**	50.76	44.63	28.75	3.93	38.80	16	1.00	Peak	54.00	-15.20
3659.468	**H**	51.53	44.13	30.77	4.55	42.72	16	1.00	Peak	54.00	-11.28
4574.335	**H**	50.97	43.79	32.27	5.13	44.58	16	1.00	Peak	54.00	-9.42
5489.202	**H**	50.98	43.62	33.86	5.66	46.88	16	1.00	Peak	54.00	-7.12
6404.069	**H**	50.38	43.69	35.52	6.13	48.35	16	1.00	Peak	54.00	-5.65
7318.936	**H**	50.92	43.94	37.45	6.57	50.99	16	1.00	Peak	54.00	-3.01
8233.803	**H**	51.03	44.13	37.22	6.98	51.10	16	1.00	Peak	54.00	-2.90
9148.670	**H**	51.93	44.19	37.71	7.37	52.81	16	1.00	Peak	54.00	-1.19

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Results	**Complies**

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.
15.209 Radiated Spurious Emissions Low Channel, Tx at 926.944 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	45.48	32.02	35.10	0.20	48.76	1	1.00	Peak	69.50	-20.74
15.027	**Perp**	43.47	32.02	34.50	0.26	46.21	4	1.00	Peak	69.50	-23.29
18.130	**Perp**	43.93	32.02	34.79	0.32	47.02	2	1.00	Peak	69.50	-22.48
249.000	**V**	45.71	31.92	16.60	1.17	31.56	1	2.15	Peak	46.00	-14.44
327.000	**H**	51.24	31.93	18.40	1.34	39.05	1	1.59	Peak	46.00	-6.95
331.000	**H**	52.38	31.93	18.50	1.34	40.29	1	2.58	Peak	46.00	-5.71
400.000	**V**	49.48	31.97	20.30	1.50	39.31	1	1.42	Peak	46.00	-6.69
1721.800	**V**	65.11	45.30	25.35	3.06	48.21	1	1.36	Peak	54.00	-5.79
3681.100	**H**	58.54	44.12	30.86	4.56	49.83	1	2.47	Peak	54.00	-4.17
1853.888*	**V**	72.42	45.21	26.23	3.22	56.65	1	3.22	Peak	97.70 (20dBc)	-41.05
2780.832	**H**	51.99	44.61	28.74	3.95	40.06	1	1.00	Peak	54.00	-13.94
3707.776	**H**	50.12	44.11	30.97	4.58	41.57	1	1.00	Peak	54.00	-12.43
4634.720	**H**	51.16	43.77	32.49	5.17	45.05	1	1.00	Peak	54.00	-8.95
5561.664	**H**	50.55	43.62	34.02	5.69	46.65	1	1.00	Peak	54.00	-7.35
6488.608	**H**	50.84	43.71	35.75	6.19	49.08	1	1.00	Peak	54.00	-4.92
7415.552	**H**	51.80	43.97	37.44	6.64	51.90	1	1.00	Peak	54.00	-2.10
8342.496	**H**	51.89	44.14	37.33	7.04	52.12	1	1.00	Peak	54.00	-1.88
9269.440	**H**	50.70	44.20	37.89	7.42	51.82	1	1.00	Peak	54.00	-2.18

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.
15.209 Radiated Spurious Emissions Low Channel, Tx at 926.944 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	38.93	32.02	35.60	0.24	42.75	7	1.00	Peak	69.50	-26.75
11.726	**Perp**	30.38	32.02	34.65	0.20	33.22	6	1.00	Peak	69.50	-36.28
12.013	**Par**	42.70	32.02	34.60	0.21	45.48	6	1.00	Peak	69.50	-24.02
249.000	**V**	53.49	31.92	16.60	1.17	39.34	6	2.05	Peak	46.00	-6.66
327.000	**H**	55.54	31.93	18.40	1.34	43.35	7	2.18	Peak	46.00	-2.65
331.000	**H**	50.35	31.93	18.50	1.34	38.26	6	2.64	Peak	46.00	-7.74
400.000	**V**	46.92	31.97	20.30	1.50	36.75	7	1.56	Peak	46.00	-9.25
1721.800	**V**	61.52	45.30	25.35	3.06	44.62	6	2.34	Peak	54.00	-9.38
3681.100	**H**	59.89	44.12	30.86	4.56	51.18	6	1.12	Peak	54.00	-2.82
1853.888*	**V**	78.19	45.21	26.23	3.22	62.42	7	3.85	Peak	97.70 (20dBc)	-35.28
2780.832	**H**	51.01	44.61	28.74	3.95	39.08	7	1.00	Peak	54.00	-14.92
3707.776	**H**	50.89	44.11	30.97	4.58	42.34	7	1.00	Peak	54.00	-11.66
4634.720	**H**	51.39	43.77	32.49	5.17	45.28	7	1.00	Peak	54.00	-8.72
5561.664	**H**	51.09	43.62	34.02	5.69	47.19	7	1.00	Peak	54.00	-6.81
6488.608	**H**	50.15	43.71	35.75	6.19	48.39	7	1.00	Peak	54.00	-5.61
7415.552	**H**	51.71	43.97	37.44	6.64	51.81	7	1.00	Peak	54.00	-2.19
8342.496	**H**	51.64	44.14	37.33	7.04	51.87	7	1.00	Peak	54.00	-2.13
9269.440	**H**	50.14	44.20	37.89	7.42	51.26	7	1.00	Peak	54.00	-2.74

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 9 – 12.
15.209 Radiated Spurious Emissions Low Channel, Tx at 926.944 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
10.004	**Par**	49.32	32.02	35.10	0.20	52.60	10	1.00	Peak	69.50	-16.90
11.487	**Perp**	44.75	32.02	34.70	0.20	47.63	12	1.00	Peak	69.50	-21.87
13.544	**Par**	44.34	32.02	34.38	0.23	46.93	10	1.00	Peak	69.50	-22.57
249.000	**V**	55.03	31.92	16.60	1.17	40.88	11	2.00	Peak	46.00	-5.12
327.000	**H**	55.84	31.93	18.40	1.34	43.65	12	2.35	Peak	46.00	-2.35
331.000	**H**	53.97	31.93	18.50	1.34	41.88	12	1.58	Peak	46.00	-4.12
400.000	**V**	43.99	31.97	20.30	1.50	33.82	11	2.99	Peak	46.00	-12.18
1721.800	**V**	64.54	45.30	25.35	3.06	47.64	12	1.27	Peak	54.00	-6.36
3681.100	**H**	59.27	44.12	30.86	4.56	50.56	12	2.08	Peak	54.00	-3.44
1853.888*	**V**	80.46	45.21	26.23	3.22	64.69	12	1.31	Peak	97.70 (20dBc)	-33.01
2780.832	**H**	51.44	44.61	28.74	3.95	39.51	12	1.00	Peak	54.00	-14.49
3707.776	**H**	51.28	44.11	30.97	4.58	42.73	12	1.00	Peak	54.00	-11.27
4634.720	**H**	50.95	43.77	32.49	5.17	44.84	12	1.00	Peak	54.00	-9.16
5561.664	**H**	51.39	43.62	34.02	5.69	47.49	12	1.00	Peak	54.00	-6.51
6488.608	**H**	50.83	43.71	35.75	6.19	49.07	12	1.00	Peak	54.00	-4.93
7415.552	**H**	50.83	43.97	37.44	6.64	50.93	12	1.00	Peak	54.00	-3.07
8342.496	**H**	50.33	44.14	37.33	7.04	50.56	12	1.00	Peak	54.00	-3.44
9269.440	**H**	51.24	44.20	37.89	7.42	52.36	12	1.00	Peak	54.00	-1.64

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.
15.209 Radiated Spurious Emissions Low Channel, Tx at 926.944 MHz

Freq. (MHz)	Ant. Polarity	Raw Amp. @ 3m dBuV/m	Preamp dB	Ant. Factor dB/m	Cable Loss dB	Field Strength Final Amp @ 3m dBuV/m	Ant. Position	Ant Height m	Detector	Limit @3 m dBuV/m	Margin dB
5.986	**Perp**	47.74	32.02	35.60	0.24	51.56	14	1.00	Peak	69.50	-17.94
18.232	**Par**	42.02	32.02	34.79	0.32	45.10	15	1.00	Peak	69.50	-24.40
29.952	**Par**	48.76	32.01	24.48	0.40	41.63	16	1.00	Peak	69.50	-27.87
249.000	**V**	57.16	31.92	16.60	1.17	43.01	16	1.90	Peak	46.00	-2.99
327.000	**H**	55.67	31.93	18.40	1.34	43.48	16	2.14	Peak	46.00	-2.52
331.000	**H**	54.56	31.93	18.50	1.34	42.47	16	2.43	Peak	46.00	-3.53
400.000	**V**	47.64	31.97	20.30	1.50	37.47	15	1.14	Peak	46.00	-8.53
1721.800	**V**	65.60	45.30	25.35	3.06	48.70	15	1.52	Peak	54.00	-5.30
3681.100	**H**	60.49	44.12	30.86	4.56	51.78	16	1.86	Peak	54.00	-2.22
1853.888*	**V**	81.02	45.21	26.23	3.22	65.25	16	2.14	Peak	97.70 (20dBc)	-32.45
2780.832	**H**	50.64	44.61	28.74	3.95	38.71	16	1.00	Peak	54.00	-15.29
3707.776	**H**	51.99	44.11	30.97	4.58	43.44	16	1.00	Peak	54.00	-10.56
4634.720	**H**	50.02	43.77	32.49	5.17	43.91	16	1.00	Peak	54.00	-10.09
5561.664	**H**	50.93	43.62	34.02	5.69	47.03	16	1.00	Peak	54.00	-6.97
6488.608	**H**	51.49	43.71	35.75	6.19	49.73	16	1.00	Peak	54.00	-4.27
7415.552	**H**	51.53	43.97	37.44	6.64	51.63	16	1.00	Peak	54.00	-2.37
8342.496	**H**	51.08	44.14	37.33	7.04	51.31	16	1.00	Peak	54.00	-2.69
9269.440	**H**	50.93	44.20	37.89	7.42	52.05	16	1.00	Peak	54.00	-1.95

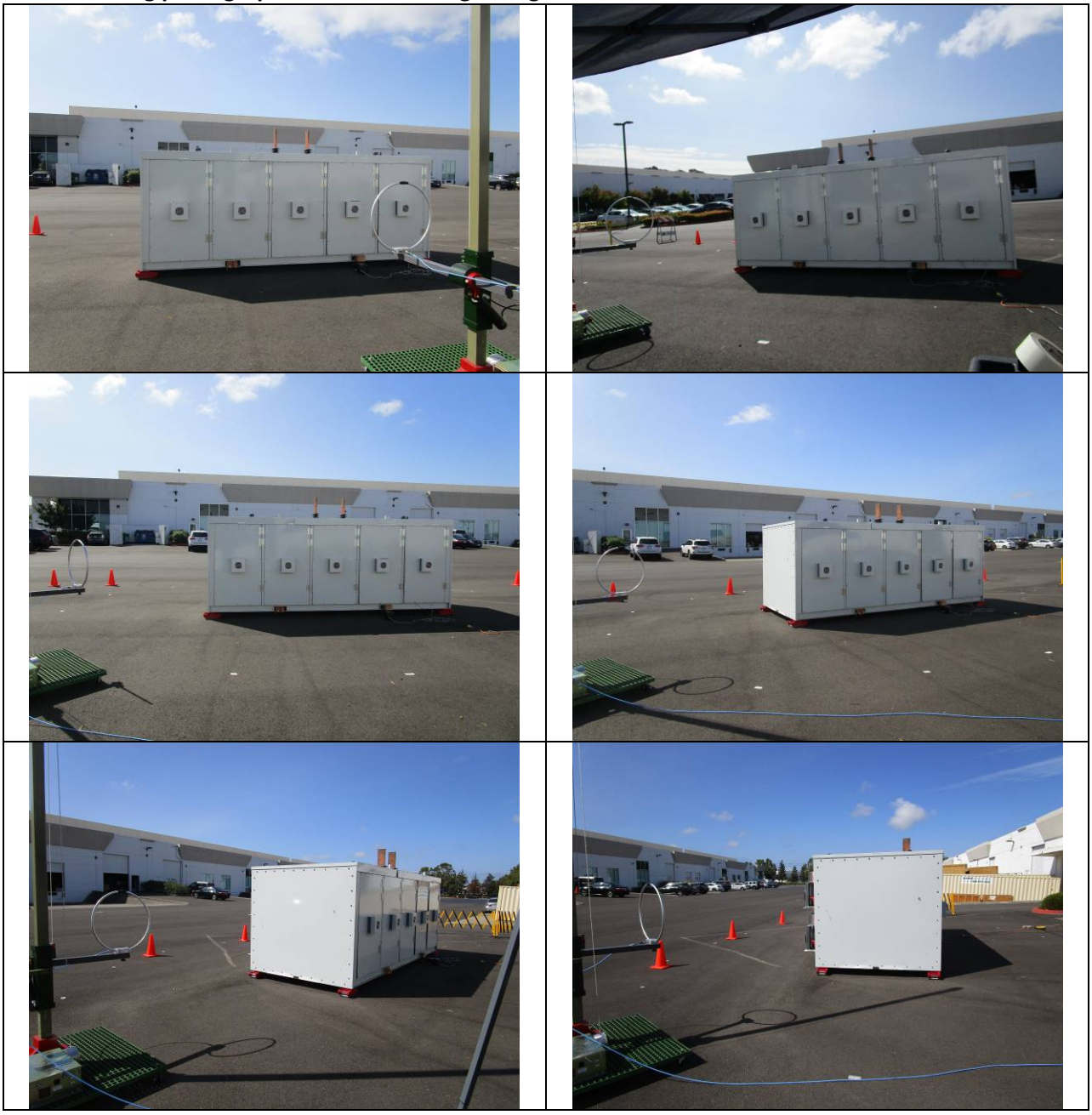
Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

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

Results	**Complies**

4.7.7 Test Setup Photographs

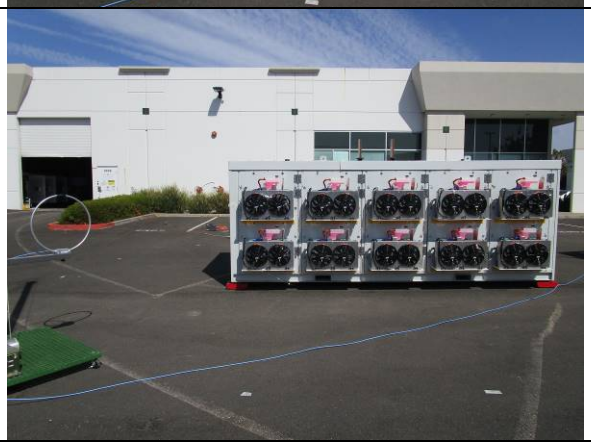
The following photographs show the testing configurations used.



4.7.7 Test Setup Photographs (Continued)








4.7.7 Test Setup Photographs (Continued)




4.7.7 Test Setup Photographs (Continued)






4.7.7 Test Setup Photographs (Continued)






4.7.7 Test Setup Photographs (Continued)




4.7.7 Test Setup Photographs (Continued)






4.7.7 Test Setup Photographs (Continued)






4.7.7 Test Setup Photographs (Continued)




4.8 AC Line Conducted Emission
FCC: 15.207

4.8.1 Requirement

Frequency Band MHz	Class B Limit dB(µV)		Class A Limit dB(µV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency*
At the transition frequency the lower limit applies.

4.8.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

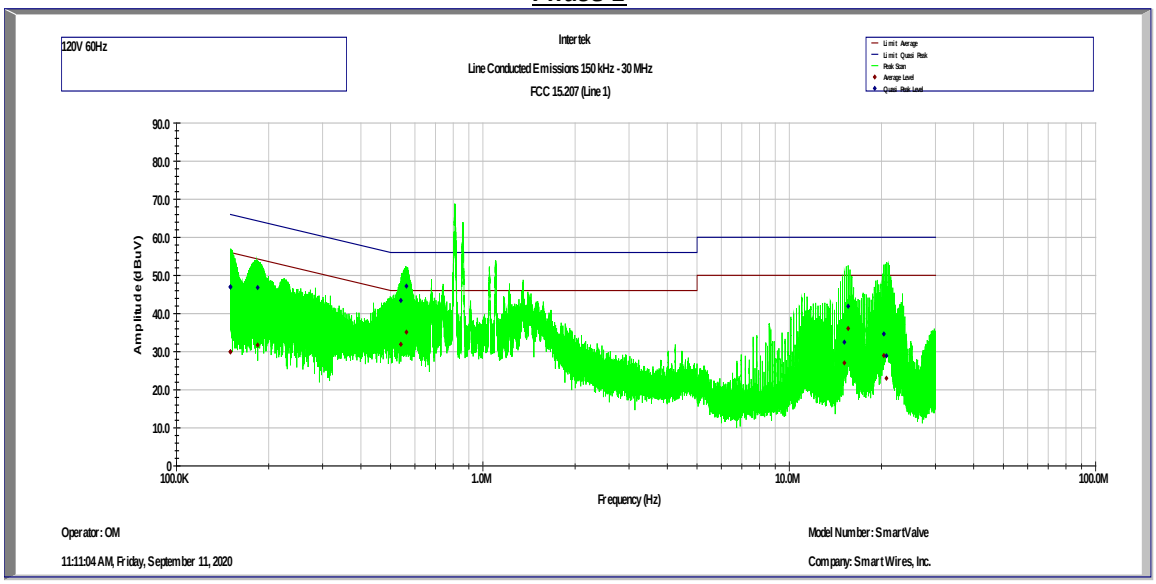
Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4:2014 and ANSI C63.10:2013.

4.8.3 Test Results

Tested By	Test Date
Gerardo Narvaez	September 11, 2020

Conducted Emissions 120VAC 60Hz, FCC Part 15.207

Phase 1

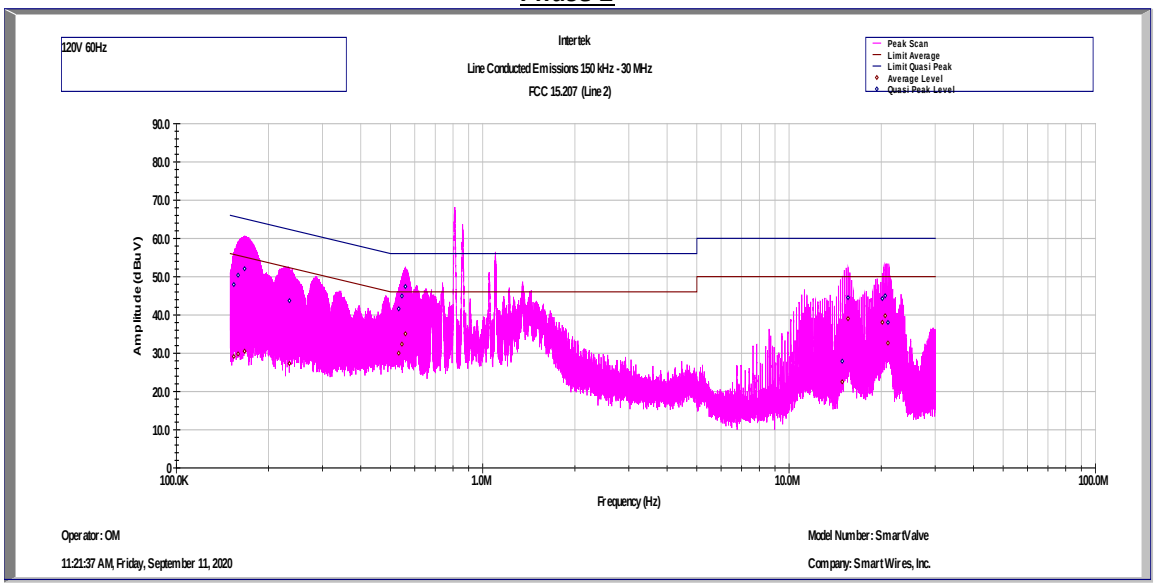


Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.150	29.90	47.00	56.00	66.00	-26.10	-19.00
0.184	31.70	46.80	55.00	65.00	-23.30	-18.20
0.540	31.90	43.40	46.00	56.00	-14.10	-12.60
0.563	35.10	47.20	46.00	56.00	-10.90	-8.80
15.116	27.00	32.50	50.00	60.00	-23.00	-27.50
15.560	36.10	41.90	50.00	60.00	-13.90	-18.10
20.340	29.00	34.60	50.00	60.00	-21.00	-25.40
20.740	23.00	28.90	50.00	60.00	-27.00	-31.10

Note: Spurious were investigated at 810 kHz, 860 kHz, 1.05 MHz, 1.10 MHz, 1.22 MHz & 1.305 MHz. These Spurious were confirmed to be the local AM Radio Stations.

Conducted Emissions 120VAC 60Hz, FCC Part 15.207

Phase 2



Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.154	29.10	47.90	55.90	65.90	-26.80	-18.00
0.159	29.80	50.40	55.70	65.70	-26.00	-15.40
0.167	30.50	52.00	55.50	65.50	-25.00	-13.50
0.234	27.30	43.70	53.60	63.60	-26.30	-19.90
0.532	30.00	41.60	46.00	56.00	-16.00	-14.40
0.545	32.30	44.90	46.00	56.00	-13.70	-11.10
0.559	35.00	47.40	46.00	56.00	-11.00	-8.60
14.900	22.50	27.90	50.00	60.00	-27.50	-32.10
15.570	39.00	44.50	50.00	60.00	-11.00	-15.50
20.145	38.00	44.30	50.00	60.00	-12.00	-15.70
20.580	39.70	45.00	50.00	60.00	-10.30	-15.00
21.010	32.60	38.00	50.00	60.00	-17.40	-22.00

Note: Spurious were investigated at 810 kHz, 860 kHz, 1.05 MHz, 1.10 MHz, 1.22 MHz & 1.305 MHz. These Spurious were confirmed to be the local AM Radio Stations.

Results: **Complies** by 8.60 dB

4.8.4 Test Configuration Photographs

5.0 List of Test Equipment and Software

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

Test dates: November 18 – December 10, 2019

Equipment Description	Manufacturer	Model/ Type	Asset No.	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
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS 00913	12	03/26/20
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
LISN	FCC	FCC-LISN-PA-NEMA-5-15	ITS 00551	12	11/13/20
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
Transient Limiter	COM-POWER	LIT-153A	ITS 01452	12	08/30/20
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

Test Dates: September 11 – 19, 2020

Equipment Description	Manufacturer	Model/ Type	Asset No.	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
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS 00913	12	01/04/21
Horn Antenna	ETS-Lindgren	3115	ITS 00982	12	04/21/21
Bi-Log Antenna	Teseq	CBL 6111D	01058	12	10/29/20
Loop Antenna	EMCO	6512	ITS 01598	12	10/22/20
Pre-Amplifier (30 – 1000 MHz)	Sonoma Instrument	310N	00415	12	04/27/21
1-18GHz Preamplifier	uComp Nordic	MCN-40-001018002510P	ITS 01817	12	04/16/21
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	03/02/21
LISN	COM-POWER	LIM-N-115A	ITS 01283	12	11/12/20
RF Cable	Megaphase	TM40-K1K1-59	ITS 01657	12	11/11/20
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01484	12	06/12/21
RF Cable	TRU Corporation	TRU CORE 300	ITS 01618	12	04/13/21
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	06/11/21
Notch Filter	Micro-Tronics	RBRC50722	ITS 01170	12	04/17/21
Notch Filter	Micro-Tronics	HPM50114-02	ITS 01722	12	11/11/20
Attenuator	Mini Circuits	FSCM99899	ITS 01582	12	10/07/20

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz Conducted Emissions
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G104368457	AS	KV	October 19, 2020	Original Document

END OF REPORT