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Honeywell International, Inc.
TEST REPORT

SCOPE OF WORK
EMISSIONS TESTING – L510 Lamp Controllers

REPORT NUMBER
104161294BOX-001

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March 17, 2021

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DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017

EMISSIONS TEST REPORT
(FULL COMPLIANCE)

Report Number: 104161294BOX-001
Project Number: G104161294

Report Issue Date: 01/16/2020
Report Revision Date: 03/17/2021

Model(s) Tested: Triac Model Number: 201-7051
Model(s) Partially Tested: Relay Model Number: 201-7050
FET Model Number: 201-7052
Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C: 12/2019,
CFR47 FCC Part 15 Subpart B: 12/2019,
RSS-247 Issue 2 February 2017,
ICES-003 Issue 6 Published: January 2016 Updated: April 2019,
RSS-Gen Issue 5 April 2018,
RSS-102 Issue 5 March 2015

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Honeywell International, Inc.
12 Clintonville Rd
Northford, CT 06472
USA

Report prepared by

Kouma Sinn / EMC Staff Engineer

Report reviewed by

Vathana Ven / EMC Staff Engineer

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested was found to Comply with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Maximum Peak Output Power and Human RF exposure CFR47 FCC Part 15 Subpart C:12/2019, Section 15.247 (b)(3) RSS-247 Issue 2 February 2017, RSS-102 Issue 5 March 2015	Pass
7	6 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C: 12/2019, Section 15.247 (a)(2) RSS-247 Issue 2 February 2017	Pass
8	Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 12/2019, Section 15.247 (e) RSS-247 Issue 2 February 2017	Pass
9	Band Edge Compliance CFR47 FCC Part 15 Subpart C: 12/2019, Section 15.247 (d) RSS-247 Issue 2: 02/2017)	Pass
10	Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 12/2019, Section 15.247 (d) RSS-247 Issue 2 February 2017	Pass
11	Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 12/2019, ICES-003 Issue 6 Published: January 2016 Updated: April 2019	Pass
12	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 12/2019 ICES-003 Issue 6 Published: January 2016 Updated: April 2019	Pass
13	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Honeywell International, Inc.
12 Clintonville Rd
Northford, CT 06472
USA

Contact: Ravi Sagar
Telephone: +1 (203) 484-6367
Fax: None
Email: ravi.sagar@honeywell.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: DISPLAY ELECTRONICS(SHENZHEN) CO., LTD
Fifth Road, Yangyong Industrial Park, Shapu Community, Songgang, BaoAn District, Shenzhen, China

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Triac Dimmer RF Lamp Controller	Honeywell International, Inc.	201-7051	None
FET Dimmer RF Lamp Controller (Variant Model)	Honeywell International, Inc.	201-7052	None
Relay Actuator RF Lamp Controller (Variant Model)	Honeywell International, Inc.	201-7050	None

Receive Date:	11/27/2019
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The L510 Lamp Controller is designed for the hospitality industry to provide convenient switched and dimming control of several different load types, including; incandescent, CFL and LEDs. By doing this, it converts any standard lamp into a remotely controlled lamp with the ability to create scenic and mood lighting. The L510 is able to participate in Honeywell's overall Energy Management System (EMS) to provide energy savings along with enhanced guest experience. A typical application would include a L510 controlling scenic lighting around a headboard of a guestroom bed. To provide this control, the L510 is equipped with an INNCOM WBI relay, Triac or FET actuator and communicates via the on-board 2.4Ghz radio over the INNCOM DeepMesh network. The L510 which is controlling the lamp can be controlled by an INNCOM MODEVA or EVORA switch as well as also be controlled locally. Other applications include; desk and floor lamp control as well as wall sconce control. 

Equipment Under Test Power Configuration				
Model No.	Rated Voltage	Rated Power	Rated Frequency	Number of Phases
201-7050	120-240 VAC	500 Watts	50/60 Hz	Single
201-7051	120 VAC	650 Watts	50/60 Hz	Single
201-7052	120 VAC	350 Watts	50/60 Hz	Single

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Pre-programmed to transmit at low, mid, and high channels at 100% duty cycle
2	Pre-programmed to receive

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	N/A

Radio/Receiver Characteristics	
Frequency Band(s)	2405-2480 MHz
Modulation Type(s)	O-QPSK
Maximum Output Power	Low Channel (2405 MHz): 0.87 dBm Mid Channel (2445 MHz): -1.38 dBm High Channel (2480 MHz): -1.95 dBm
Test Channels	Low Channel: 2405 MHz Mid Channel: 2445MHz High Channel: 2480 MHz
Occupied Bandwidth	Low Channel (2405 MHz): 2.299 MHz Mid Channel (2445 MHz): 2.298 MHz High Channel (2480 MHz): 2.300 MHz
6 dB Bandwidth	Low Channel (2405 MHz): 1.590 MHz Mid Channel (2445 MHz): 1.580 MHz High Channel (2480 MHz): 1.580 MHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
ETSI LBT/Adaptivity	Non-Adaptive
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	3
Antenna Type and Gain	Integrated, 1.3 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

FET Dimmer RF Lamp Controller, Model: 201-7052
Relay Actuator RF Lamp Controller, Model: 2017050

5 System Setup and Method

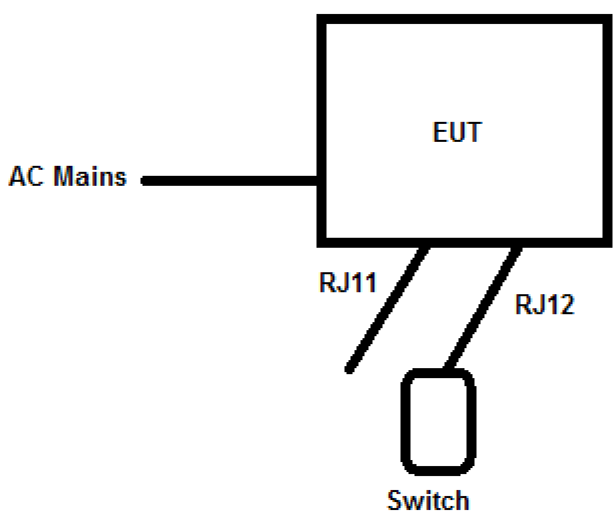
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	RJ11	1.83	None	None	None
--	RJ12	2.40	None	None	Switch

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Switch	None	None	None

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 12/2019, FCC Part 15 Subpart B: 12/2019, RSS 247 Issue 2: 02/2017, ICES 003 Issue 6: 01/2016 updated 06/2016, RSS-Gen Issue 5 April 2018, RSS-102 Issue 5 March 2015, ANSI C 63.10: 2013, and ANSI C 63.4: 2014.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample 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

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

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = $10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/14/2019	10/14/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

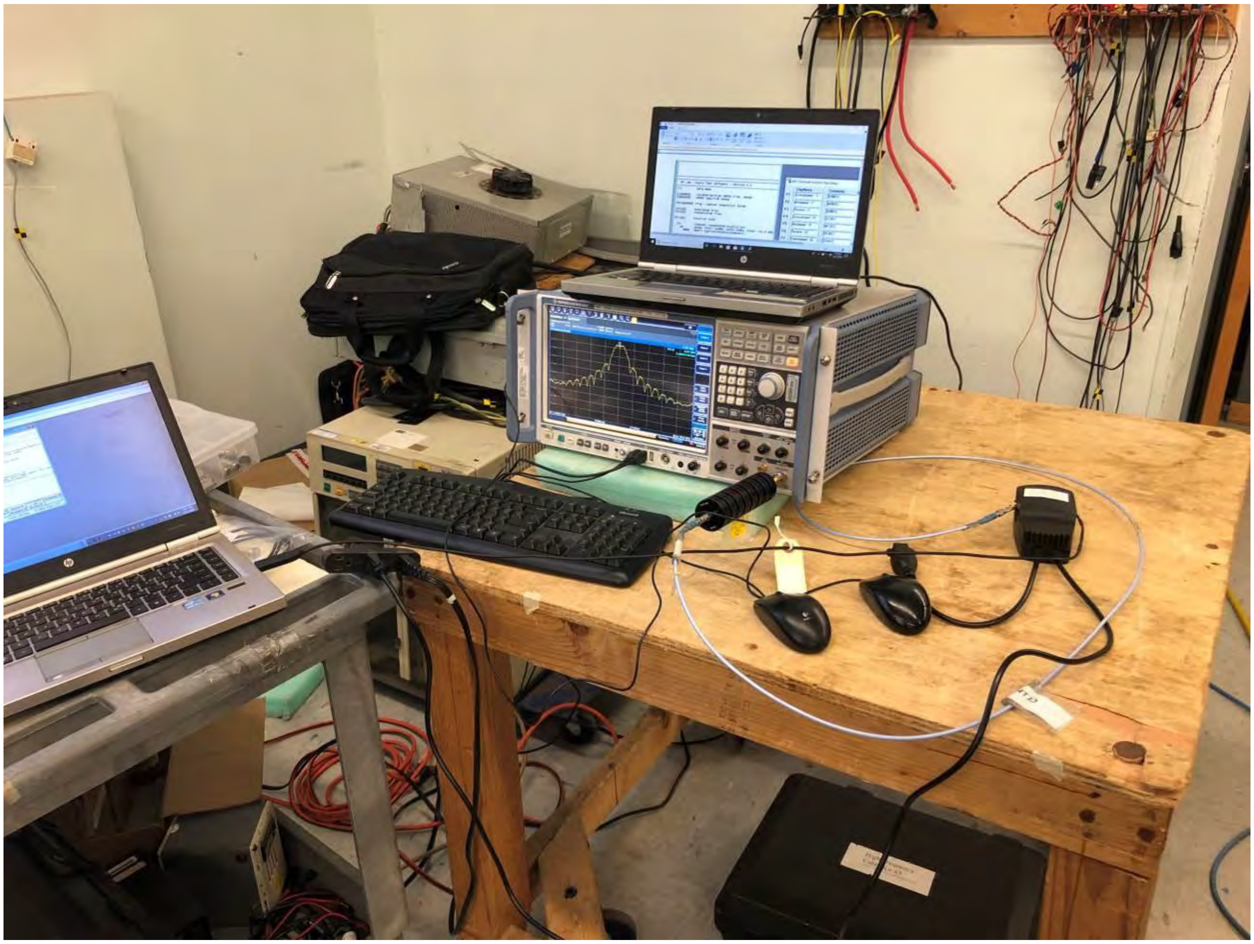
Name	Manufacturer	Version
None	--	--

6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

6.4 Setup Photograph:

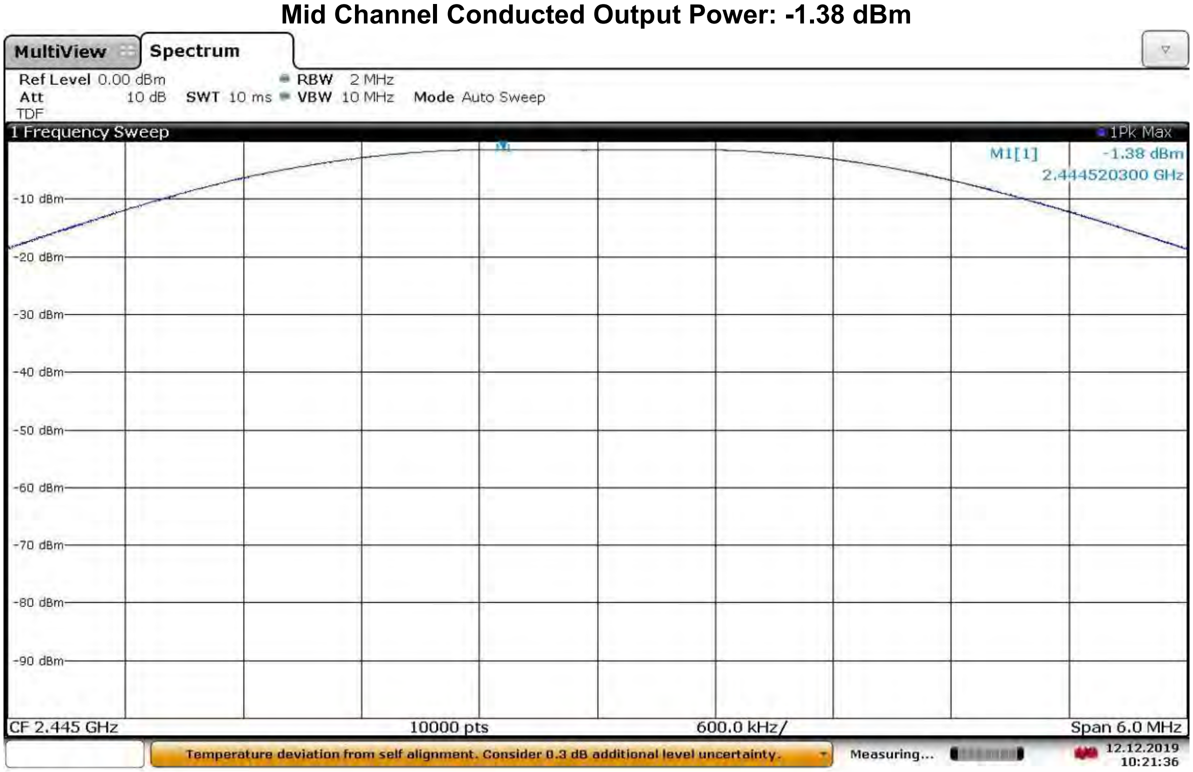


6.5 Plots/Data:

Low Channel Conducted Output Power: 0.87 dBm

10:22:31 12.12.2019

Mid Channel Conducted Output Power: -1.38 dBm



10:21:36 12.12.2019

High Channel Conducted Output Power: -1.95 dBm

Maximum Conducted Output Power

Frequency (MHz)	Maximum Conducted Output Power (dBm)	Limit (dBm)
2405	0.87	30.00
2445	-1.38	30.00
2480	-1.95	30.00

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

MPE Calculation

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

RSS-102 Issue 5 Exposure Limits:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
$0.003-10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

1.2 Results:

Maximum Conducted Output Power = 0.660693 mW

Maximum Antenna Gain = 1.3 dBi = 10^(-0.87/10) = 1.35

Power Density = (0.660693* 1.35)/ 5025.6

Power Density = 0.000177mW/cm^2

Limit at 2.405 GHz = 1mW/cm^2

RSS-102 Issue 5 Exposure Limit at 2.402GHz = 5.35 W/m^2

Power Density = 0.00177W/m^2

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247, RSS-102	Limit Applied:	See report section 6.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	39 %
		Atmospheric Pressure:	1029 mbars

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/14/2019	10/14/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

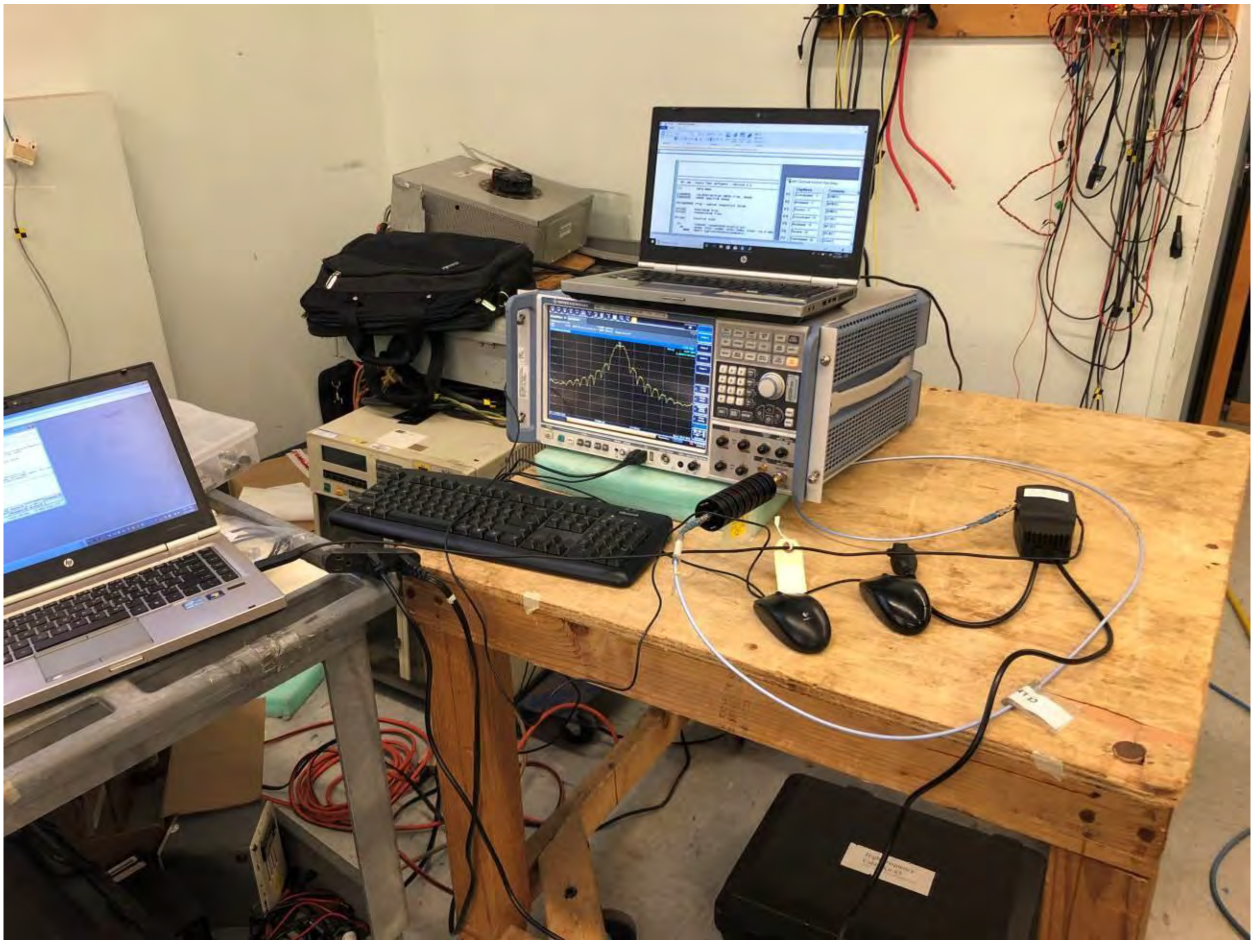
Name	Manufacturer	Version
None	--	--

7.3 Results:

The sample tested was found to Comply.

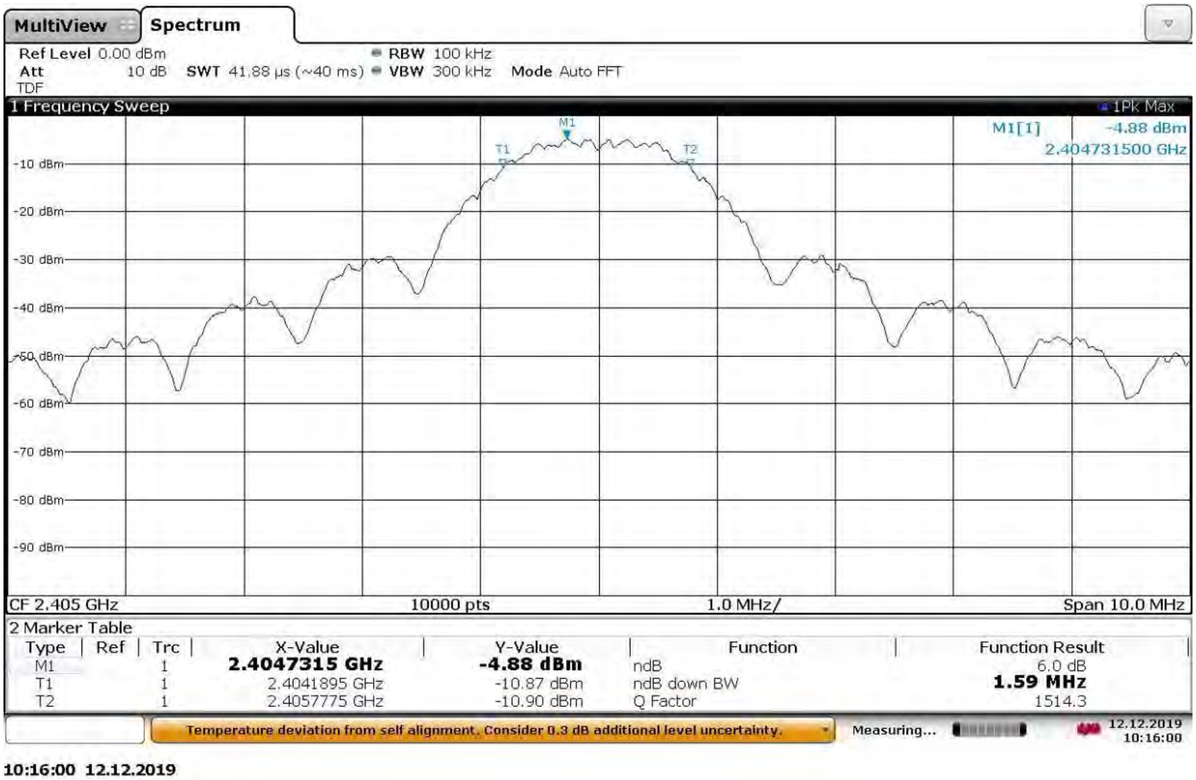
§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.4 Setup Photograph:

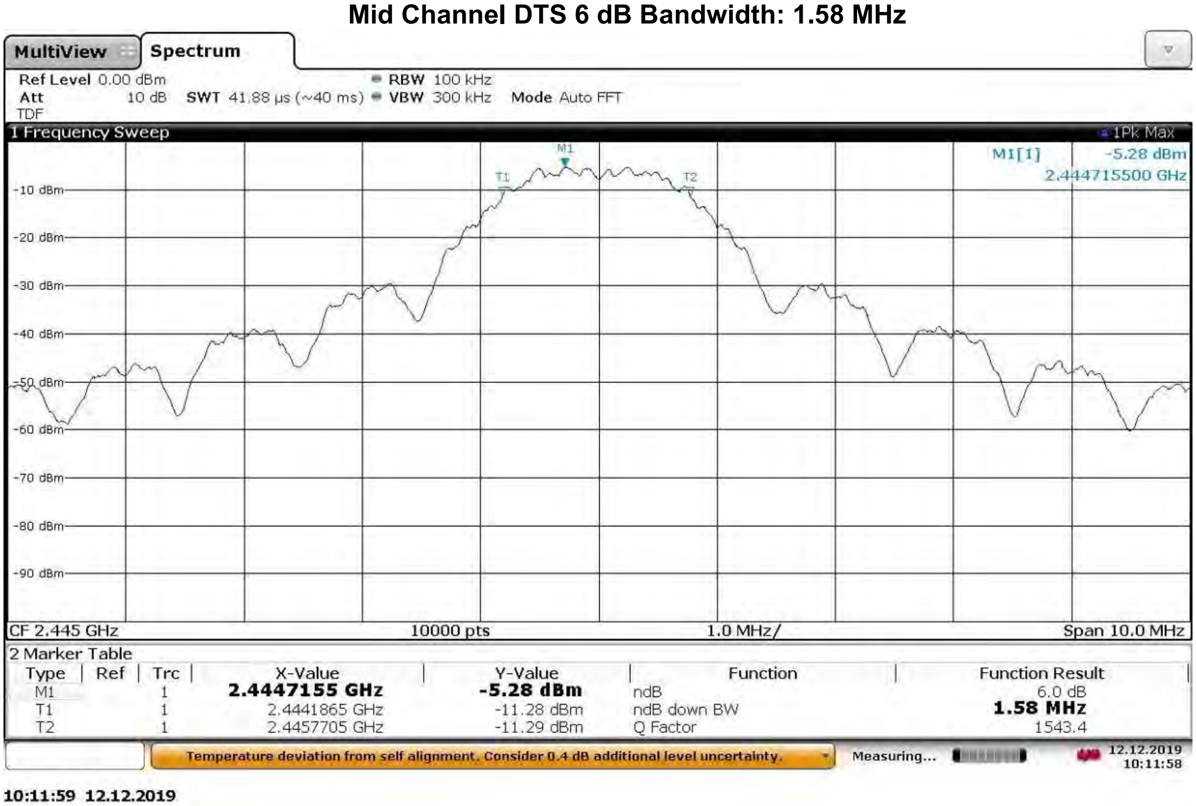


7.5 Plots/Data:

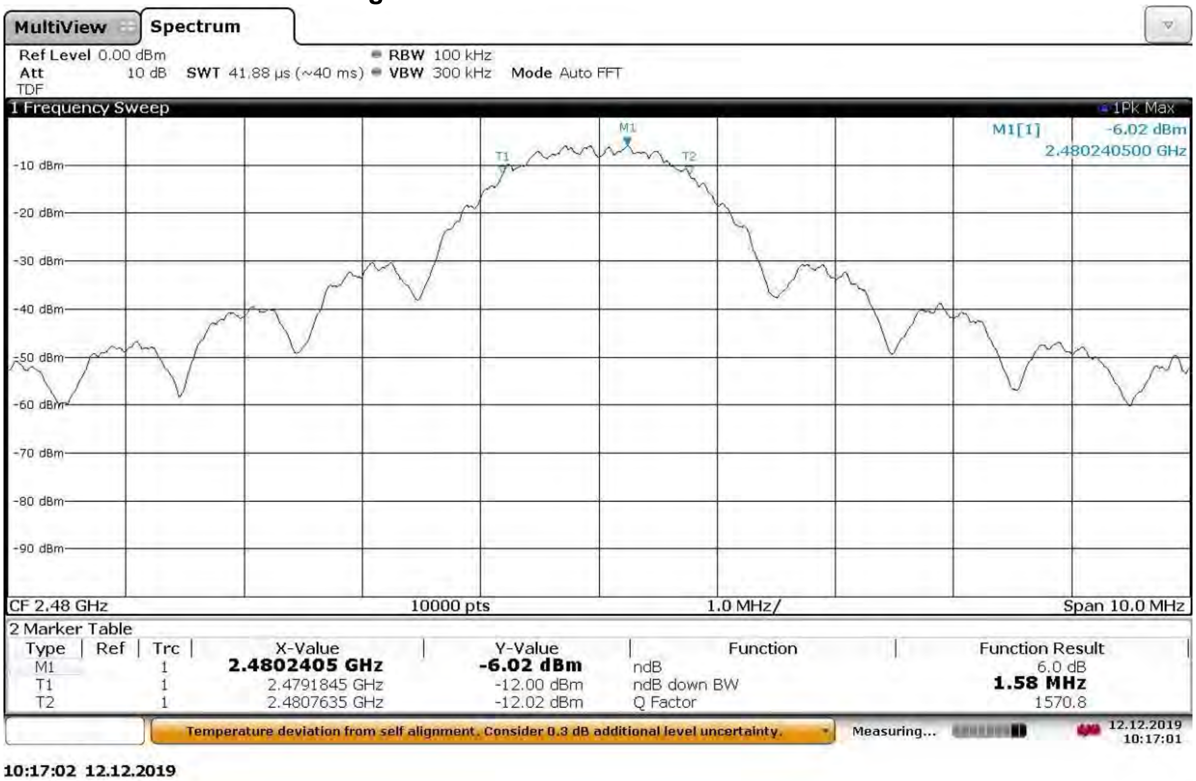
Low Channel DTS 6 dB Bandwidth: 1.59 MHz



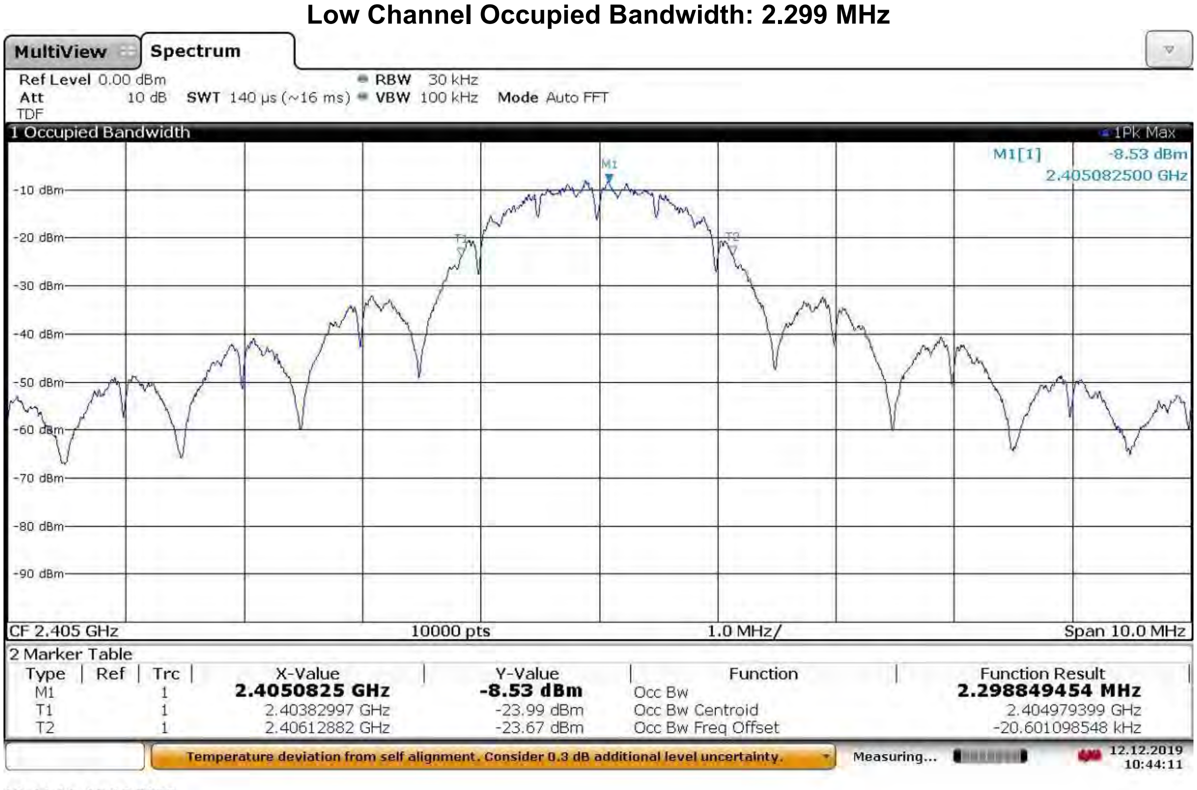
Mid Channel DTS 6 dB Bandwidth: 1.58 MHz



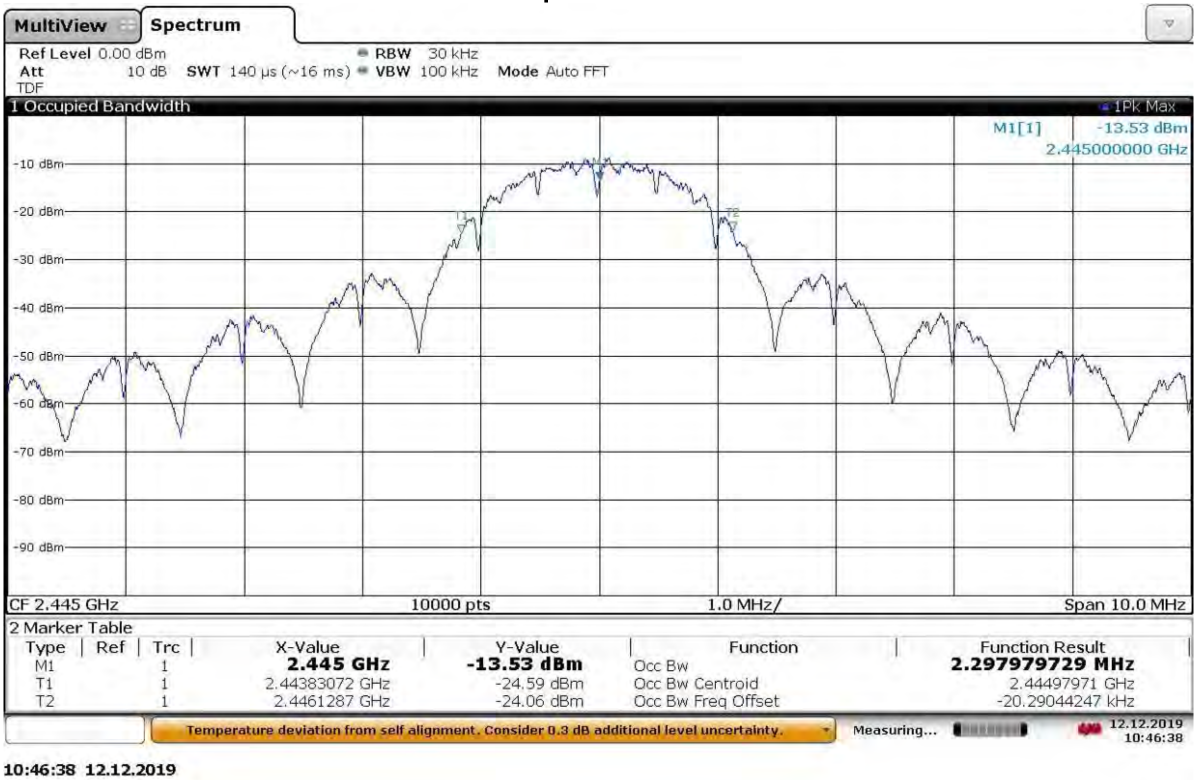
High Channel DTS 6 dB Bandwidth: 1.58 MHz



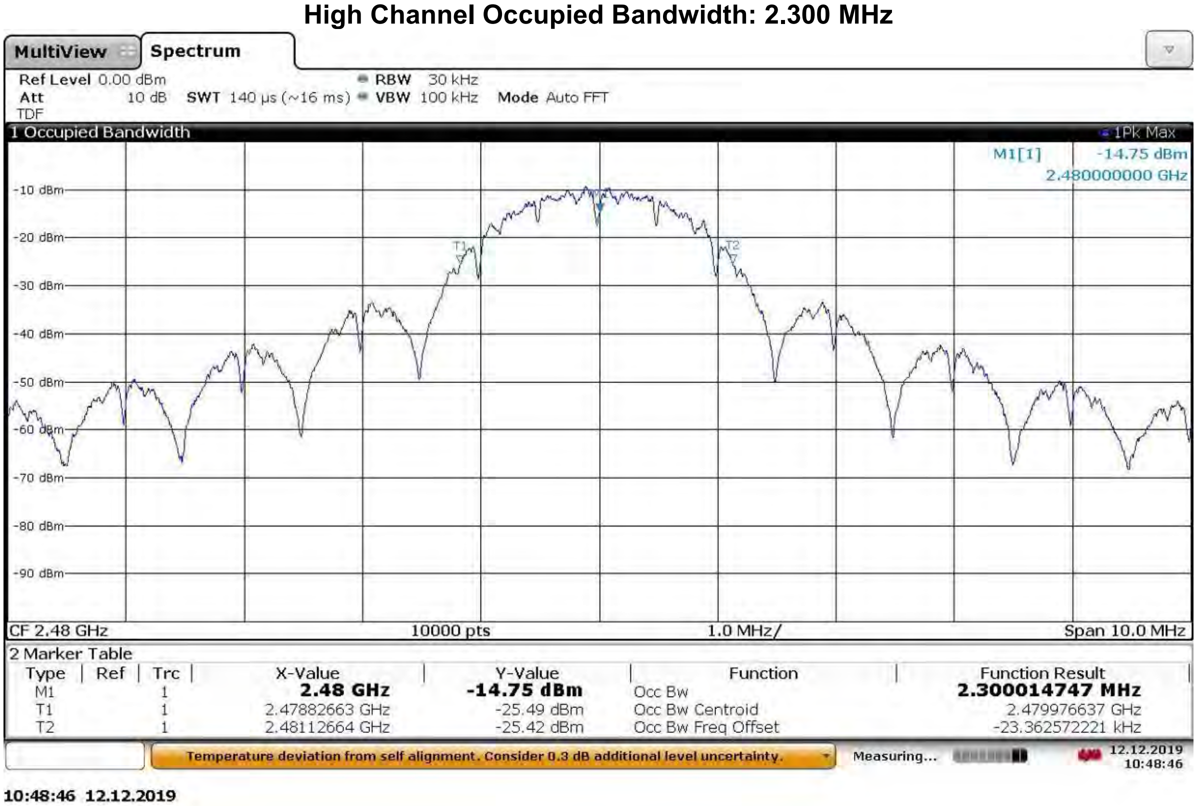
Low Channel Occupied Bandwidth: 2.299 MHz



Mid Channel Occupied Bandwidth: 2.298 MHz



High Channel Occupied Bandwidth: 2.300 MHz



DTS 6 dB Bandwidth

Frequency (MHz)	DTS 6 dB Bandwidth (MHz)	Limit (MHz)
2405	1.59	≥ 0.500
2445	1.58	≥ 0.500
2480	1.58	≥ 0.500

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Occupied Bandwidth

Frequency (MHz)	Occupied Bandwidth (MHz)	Limit
2405	2.299	Occupied Bandwidth must remain within the band
2445	2.298	Occupied Bandwidth must remain within the band
2480	2.300	Occupied Bandwidth must remain within the band

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 7.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	39 %
		Atmospheric Pressure:	1029 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
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ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/14/2019	10/14/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

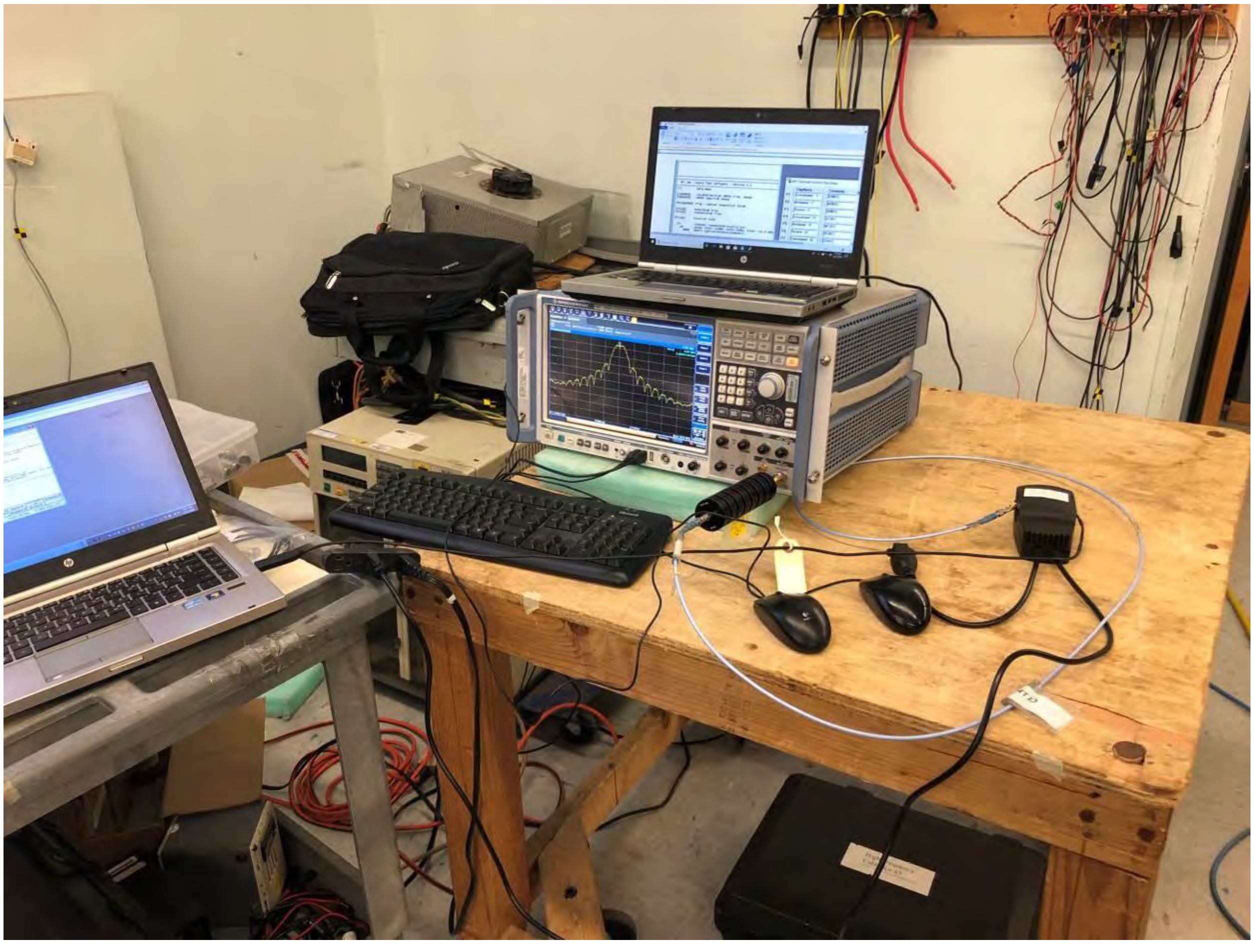
Name	Manufacturer	Version
None	--	--

8.3 Results:

The sample tested was found to Comply.

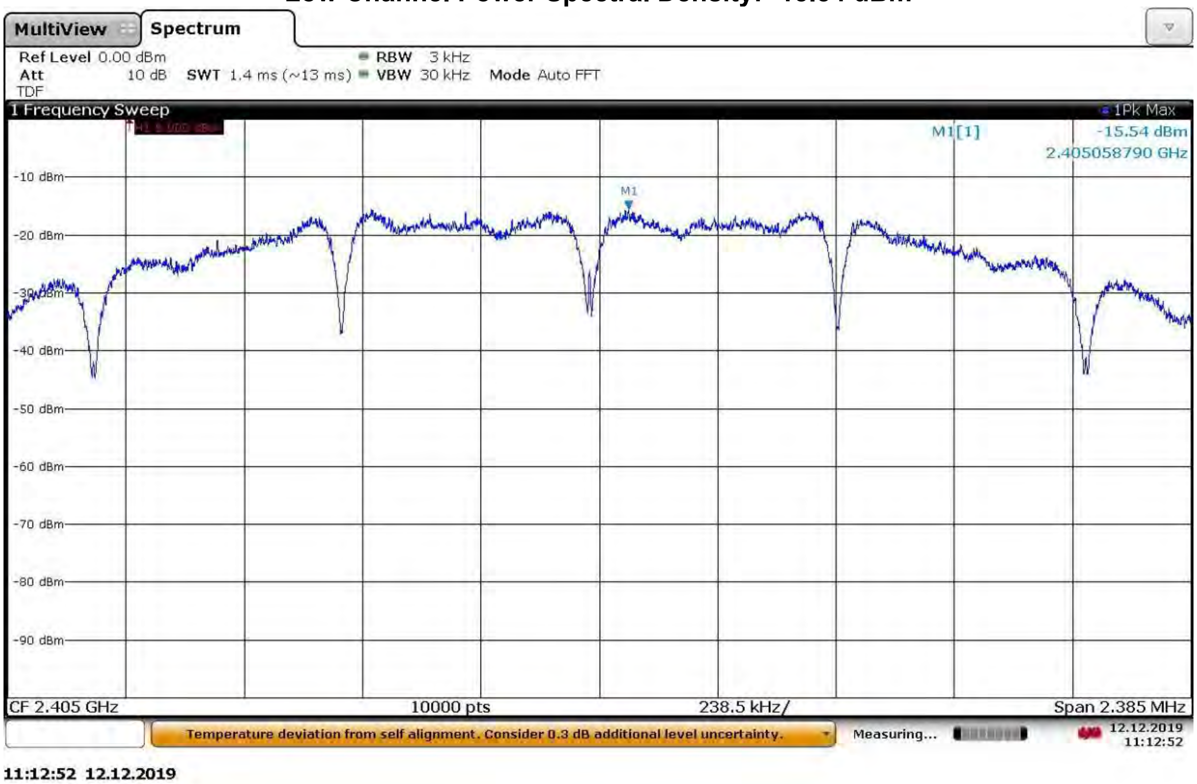
§15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.4 Setup Photograph:

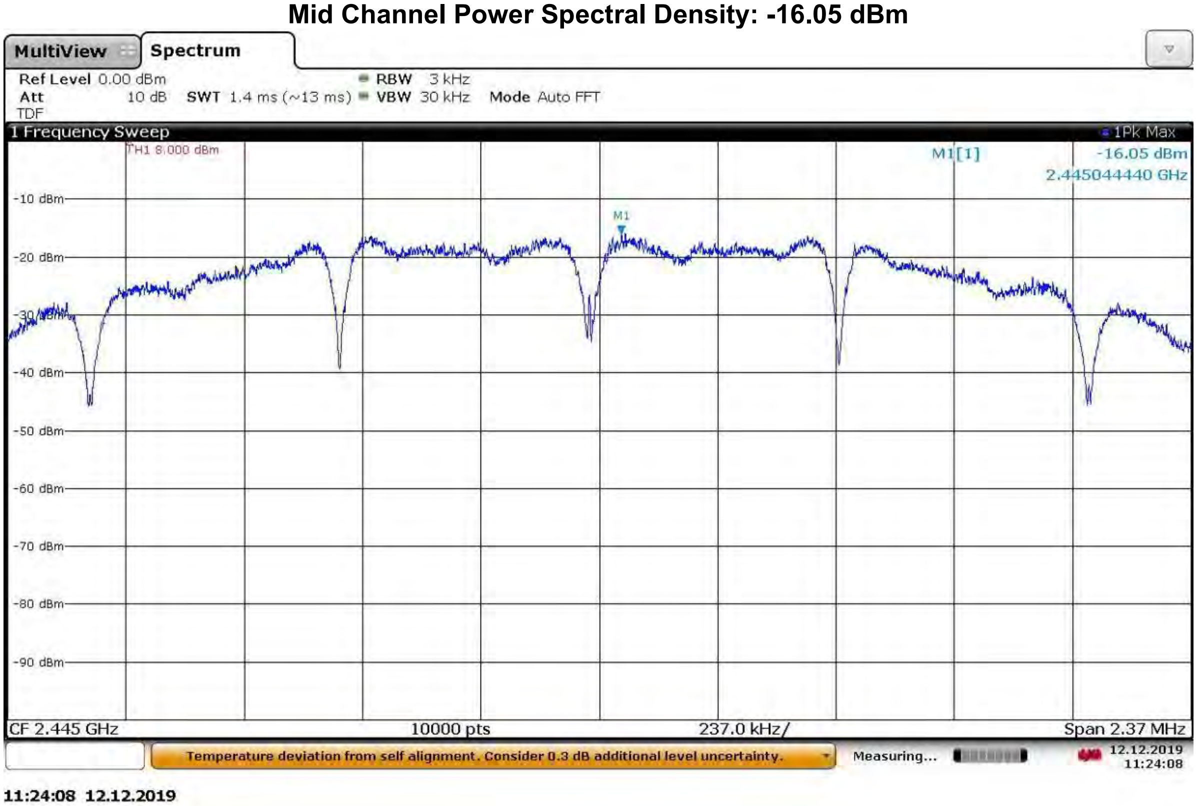


8.5 Plots/Data:

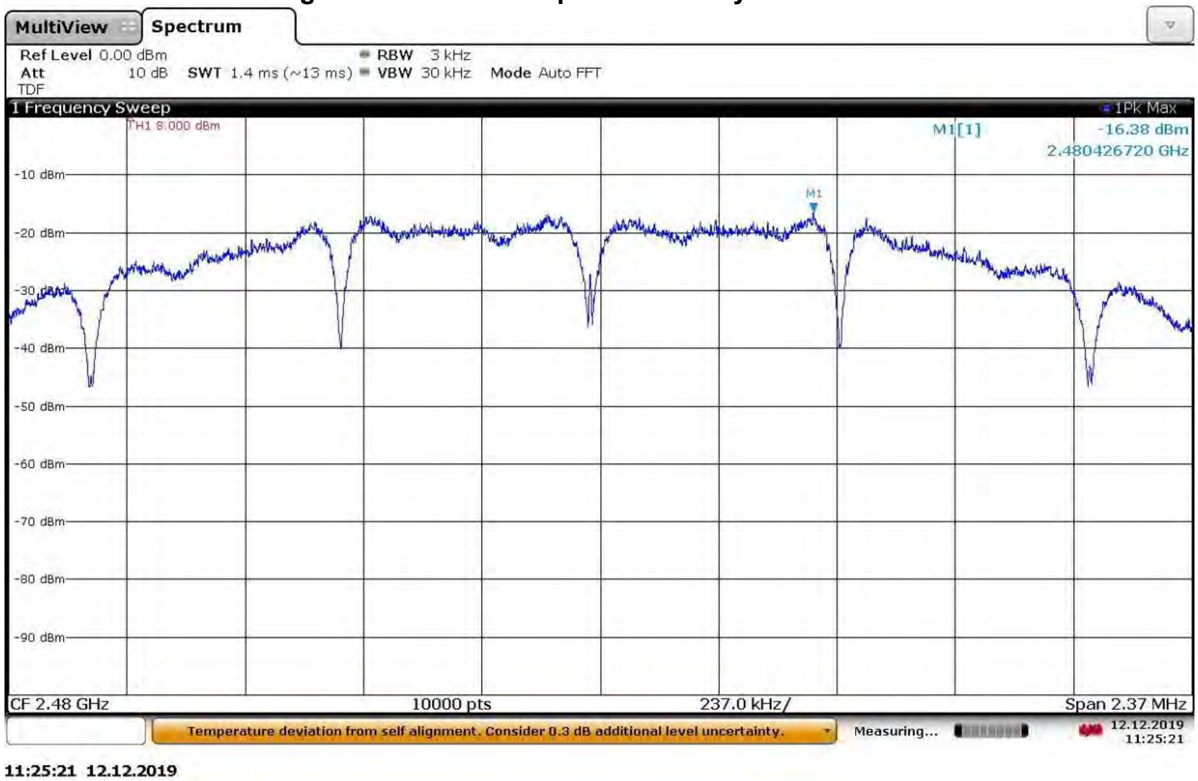
Low Channel Power Spectral Density: -15.54 dBm



Mid Channel Power Spectral Density: -16.05 dBm



High Channel Power Spectral Density: -16.38 dBBm



Power Spectral Density

Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)
2405	-15.54	8.00
2445	-16.05	8.00
2480	-16.38	8.00

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 8.3
Input Voltage:	120VAC 60Hz		
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Ambient Temperature:	22 °C
		Relative Humidity:	39 %
		Atmospheric Pressure:	1029 mbars

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247 RSS 247, ANSI C 63.10, and ANSI C 63.4.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample 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

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

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = $10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

9.2 Test Equipment Used:

Equipment used for antenna port measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/14/2019	10/14/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

Name	Manufacturer	Version
None	--	--

Equipment used for radiated measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	05/30/2019	05/30/2020
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/06/2019	06/06/2020
145-416	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/22/2019	07/22/2020

Software Utilized:

Name	Manufacturer	Version
None	--	--

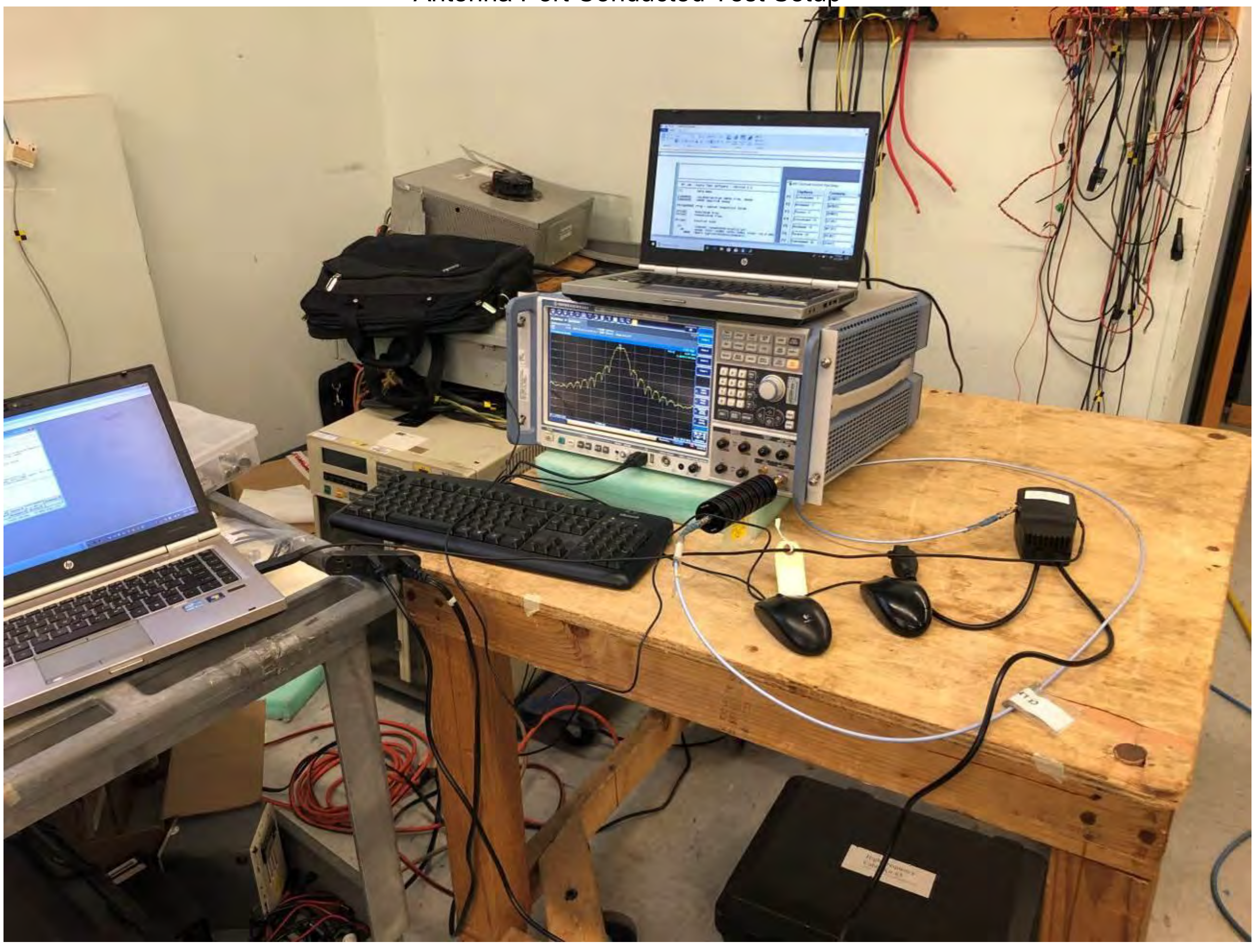
9.3 Results:

The sample tested was found to Comply.

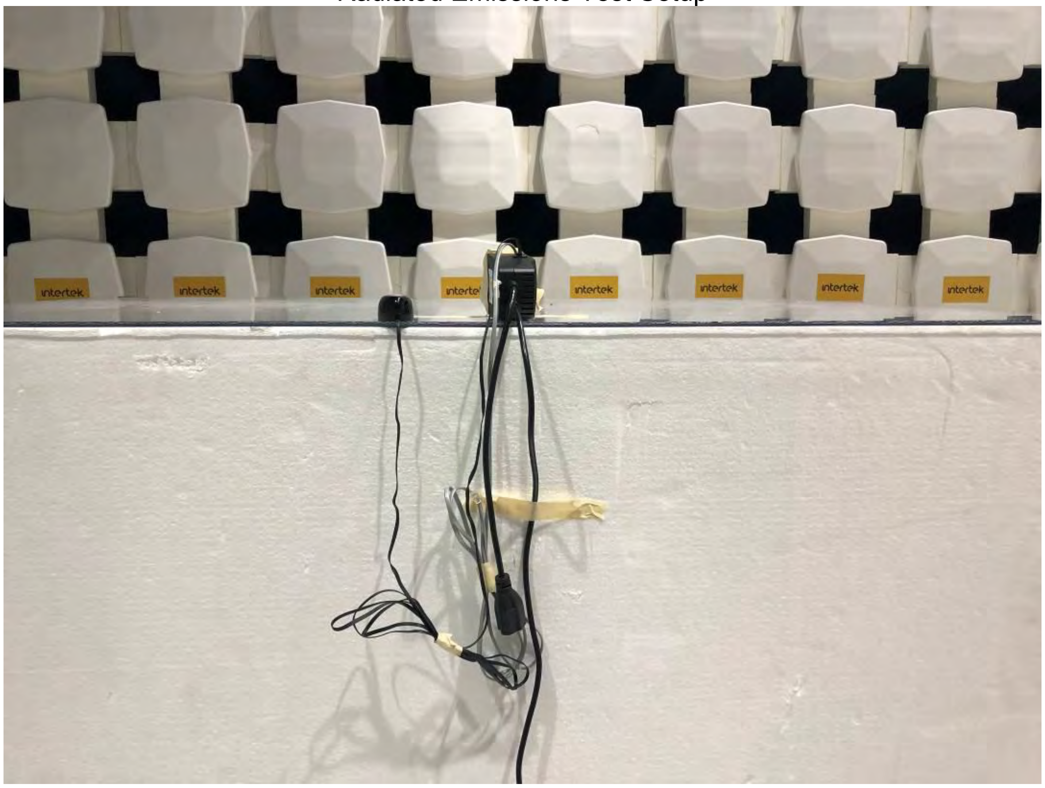
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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))

9.4 Setup Photographs:

Antenna Port Conducted Test Setup

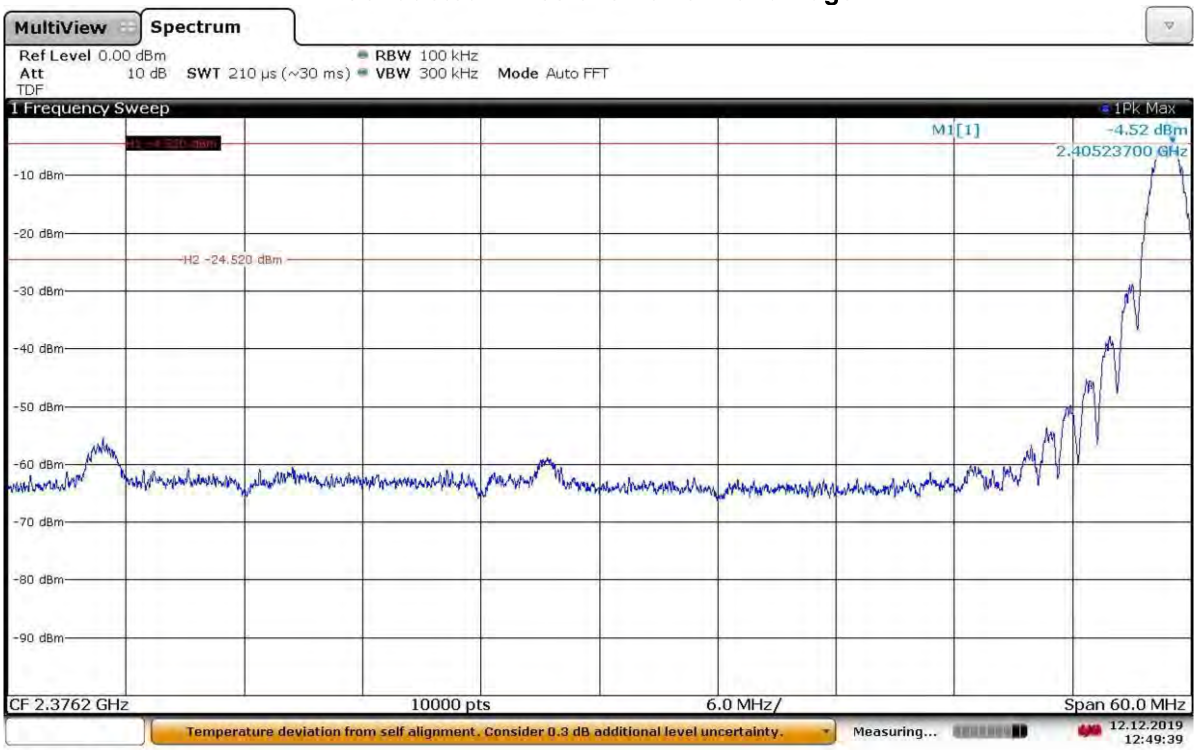


Radiated Emissions Test Setup



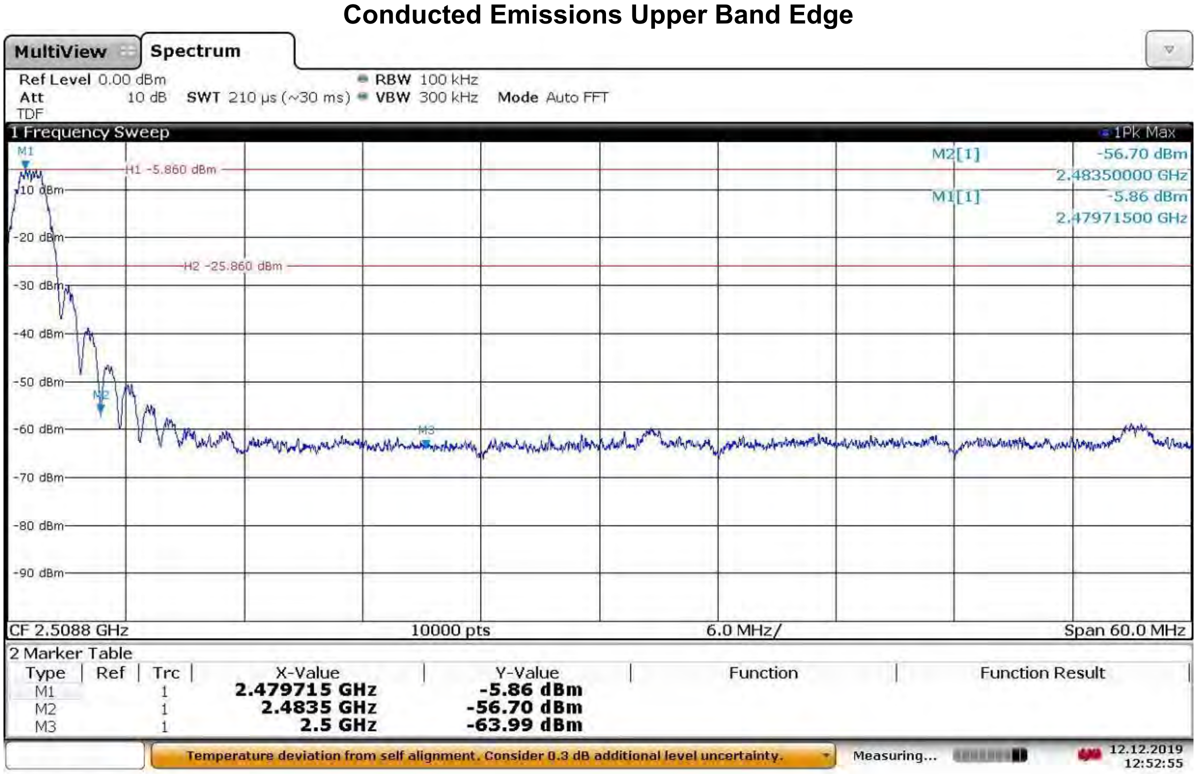
9.5 Plots/Data:

Conducted Emissions Lower Band Edge



12:49:39 12.12.2019

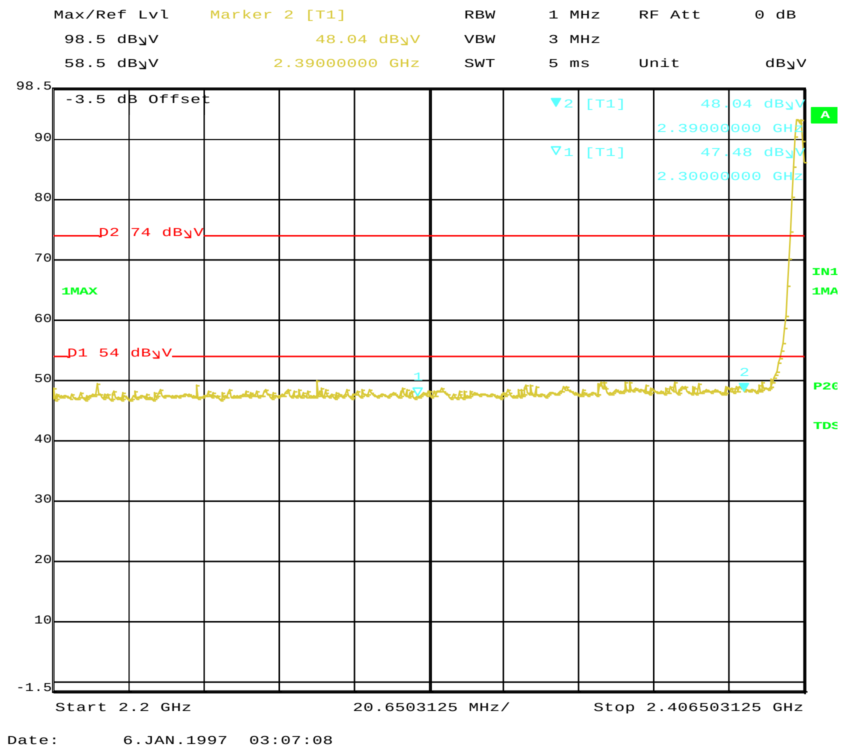
Conducted Emissions Upper Band Edge



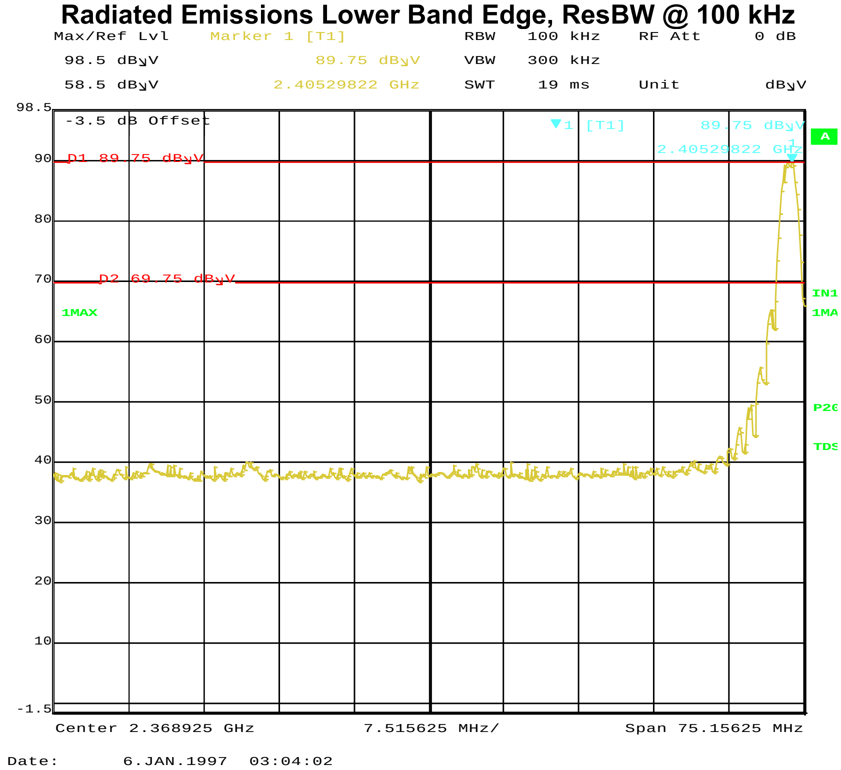
12:52:56 12.12.2019

Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Radiated Emissions Lower Band Edge, ResBW @ 1 MHz

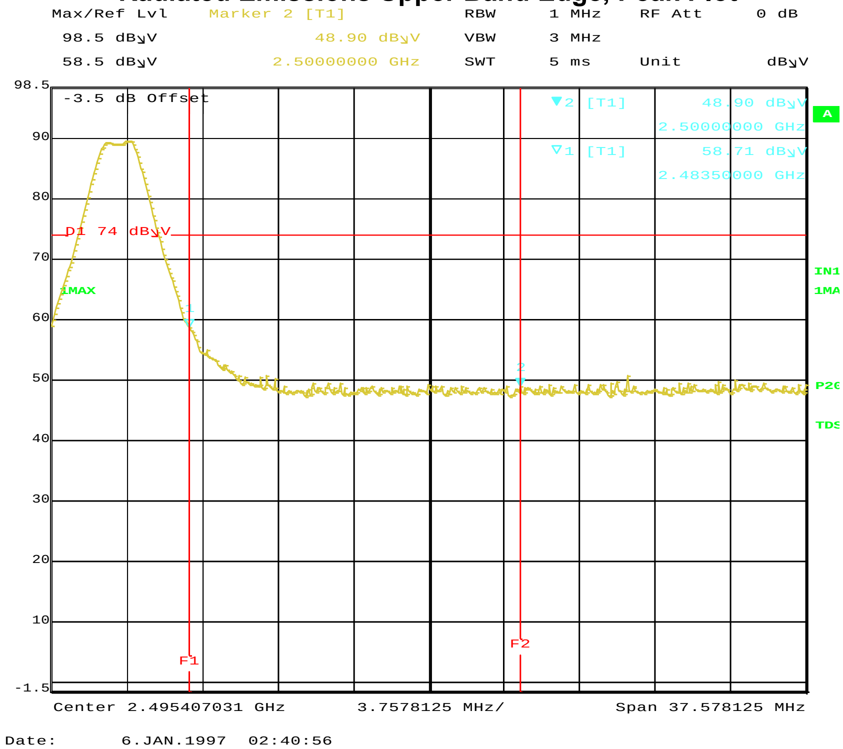


Radiated Emissions Lower Band Edge, ResBW @ 100 kHz

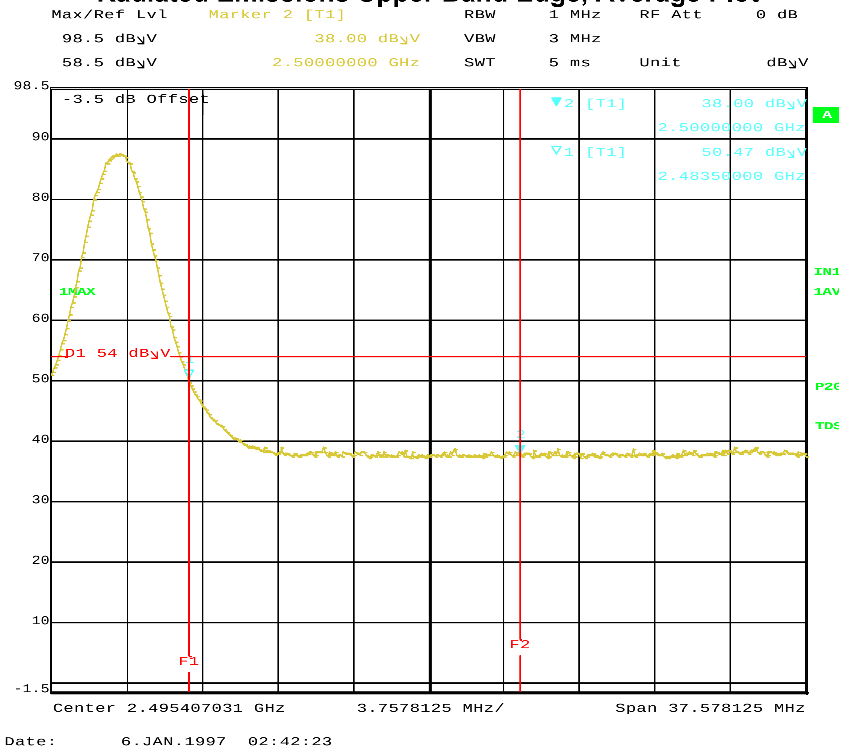


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDS). Test was performed at 2 meters and the distance factor of -3.5 dB was entered as dB off-set.

Radiated Emissions Upper Band Edge, Peak Plot



Radiated Emissions Upper Band Edge, Average Plot



Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDS). Test was performed at 2 meters and the distance factor of -3.5 dB was entered as dB off-set.

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019, 12/14/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 9.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	22, 23 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	39, 40 %
		Atmospheric Pressure:	1029, mbars

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, RSS 247 ICES 003, ANSI C 63.10, and ANSI C 63.4.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = $10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

10.2 Test Equipment Used:

Equipment used for antenna port measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/14/2019	10/14/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/01/2019	02/01/2020

Software Utilized:

Name	Manufacturer	Version
None	--	--

Equipment used for radiated emission measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
PRE10'	30-1000MHz pre-amp	ITS	PRE10	PRE10	01/22/2019	01/22/2020
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/22/2019	07/22/2020
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	05/30/2019	05/30/2020
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/25/2019	02/25/2020
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2019	07/11/2020
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/01/2019	02/01/2020
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/14/2019	02/14/2020
PRE8'	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	04/23/2019	04/23/2020
ETS004'	18-40GHZ horn antenna	ets004	3116C	00218579	01/10/2019	01/10/2020
REA008'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/13/2018	07/13/2019
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/25/2019	02/25/2020
REA006'	18GHz High Pass Filter	Reactel, Inc	7HS-18G/40G K11	(06)1	02/25/2019	02/25/2020
145029'	Guided Ridged Horn (1 GHz to 18 GHz)	EMCO	EMCO 3115	5520	07/30/2019	07/30/2020
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/06/2019	06/06/2020
145-416	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/22/2019	07/22/2020

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16
EMI Boxborough.xls	Intertek	08/27/2010

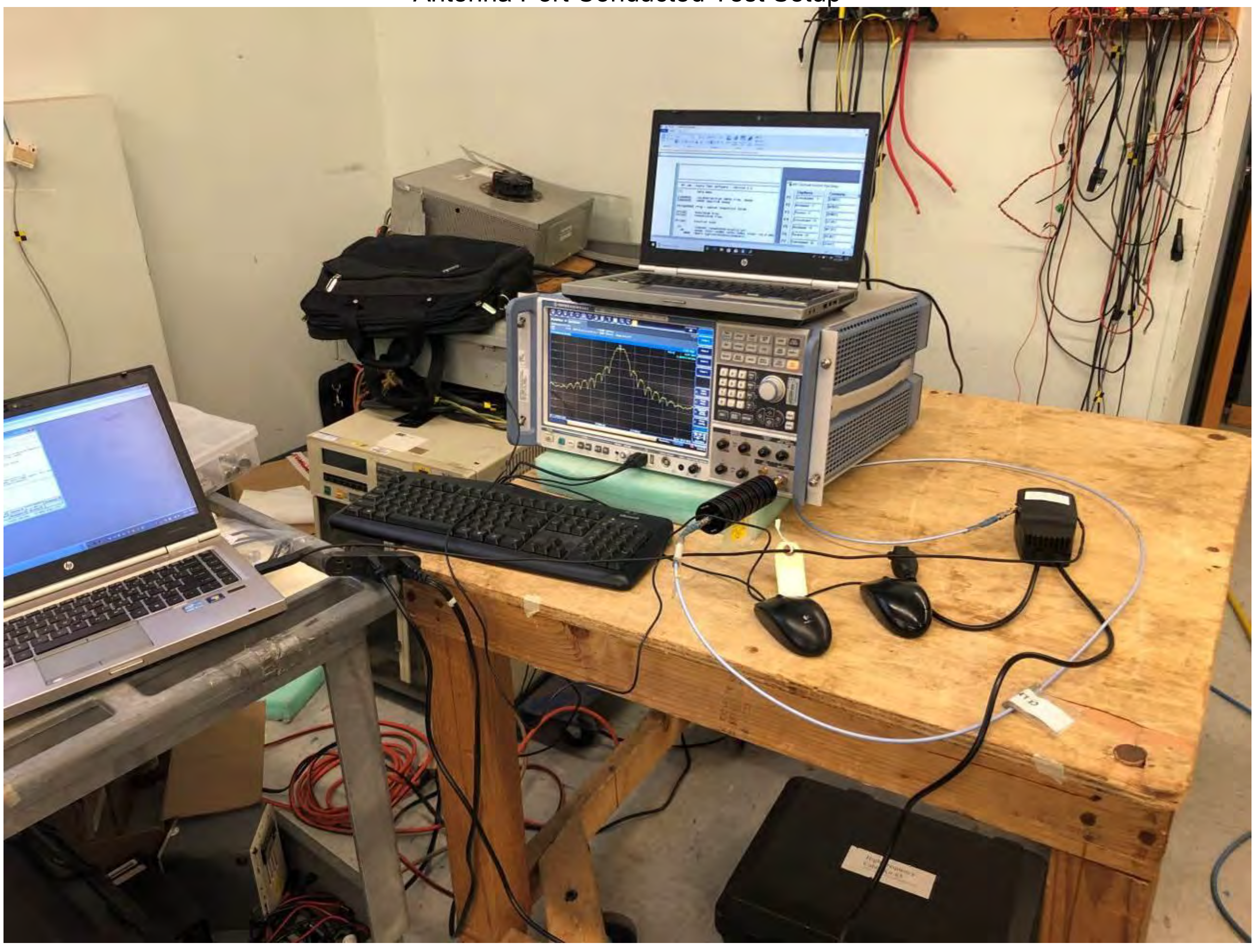
10.3 Results:

The sample tested was found to Comply.

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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))

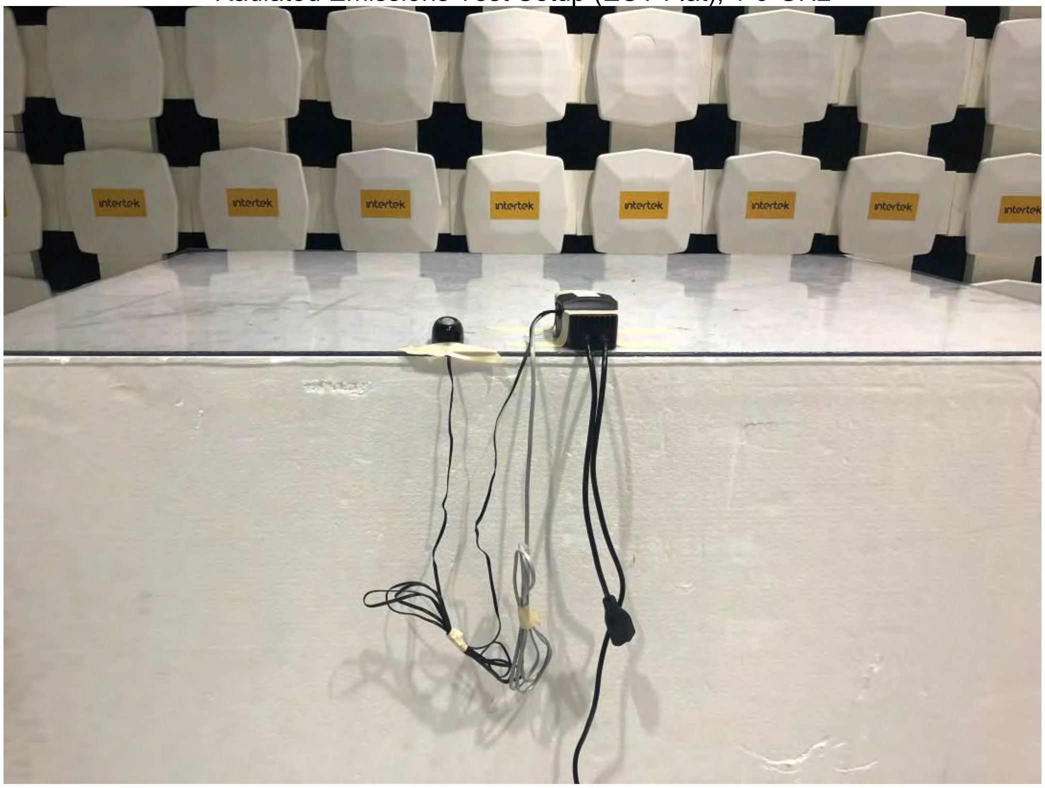
10.4 Setup Photographs:

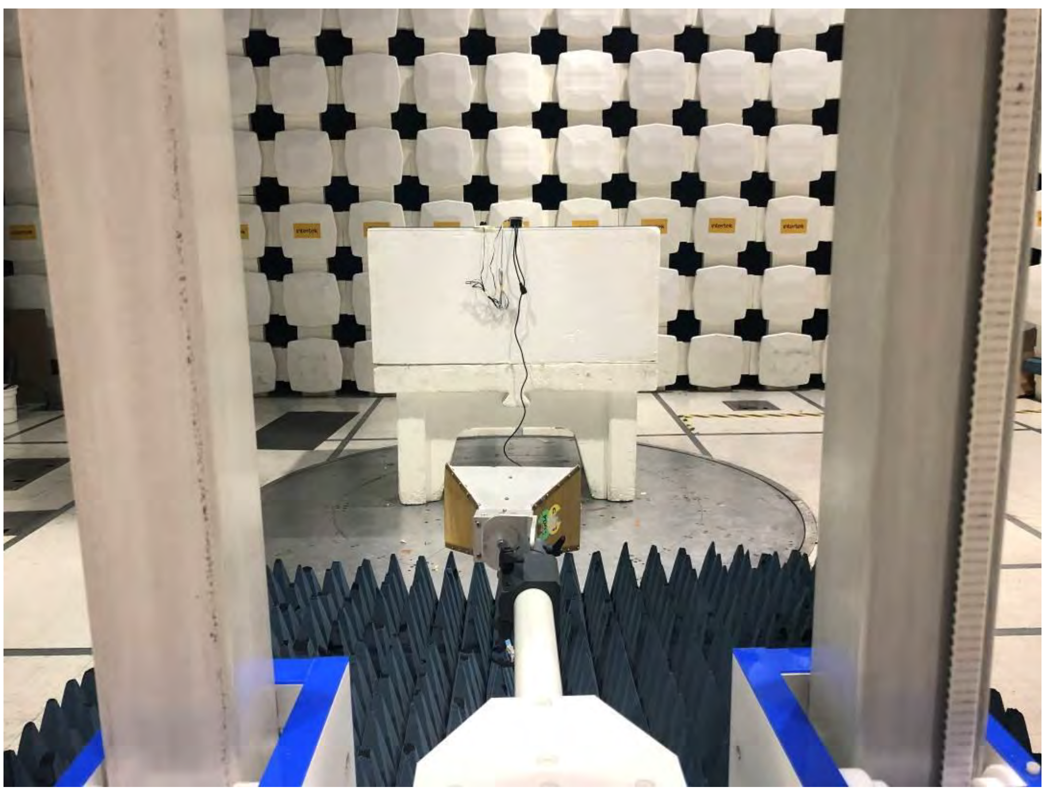
Antenna Port Conducted Test Setup



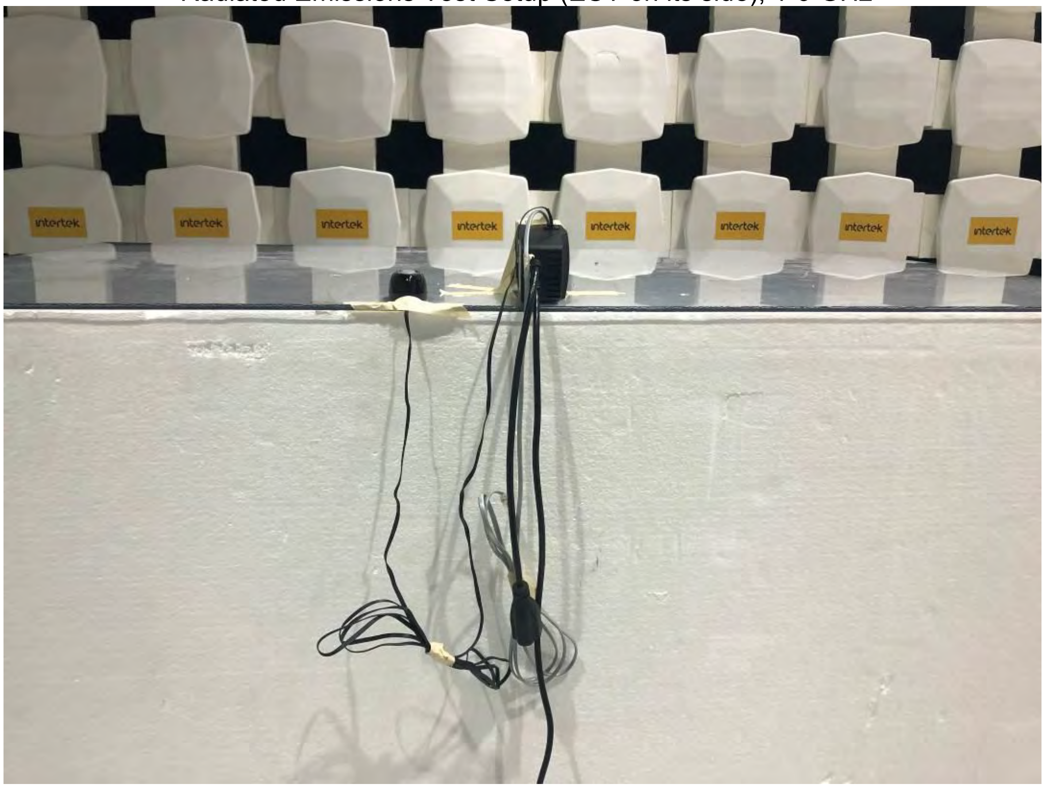
Radiated Emissions Test Setup, 30-1000 MHz

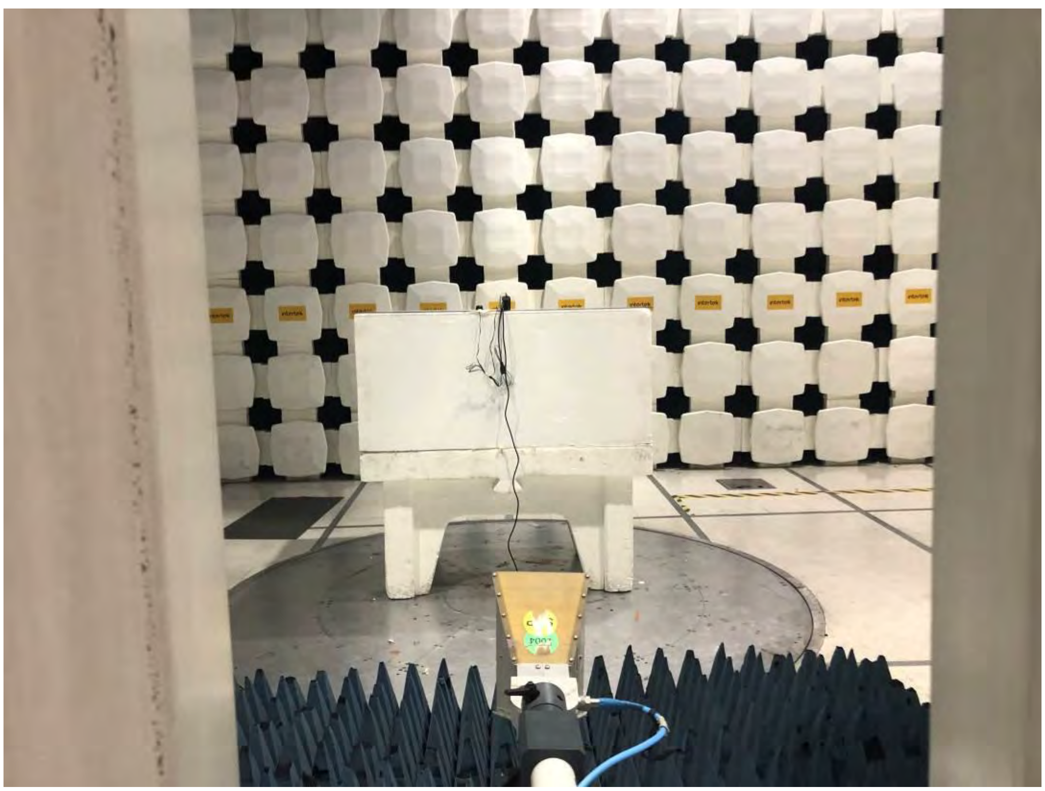
Radiated Emissions Test Setup (EUT Flat), 1-9 GHz



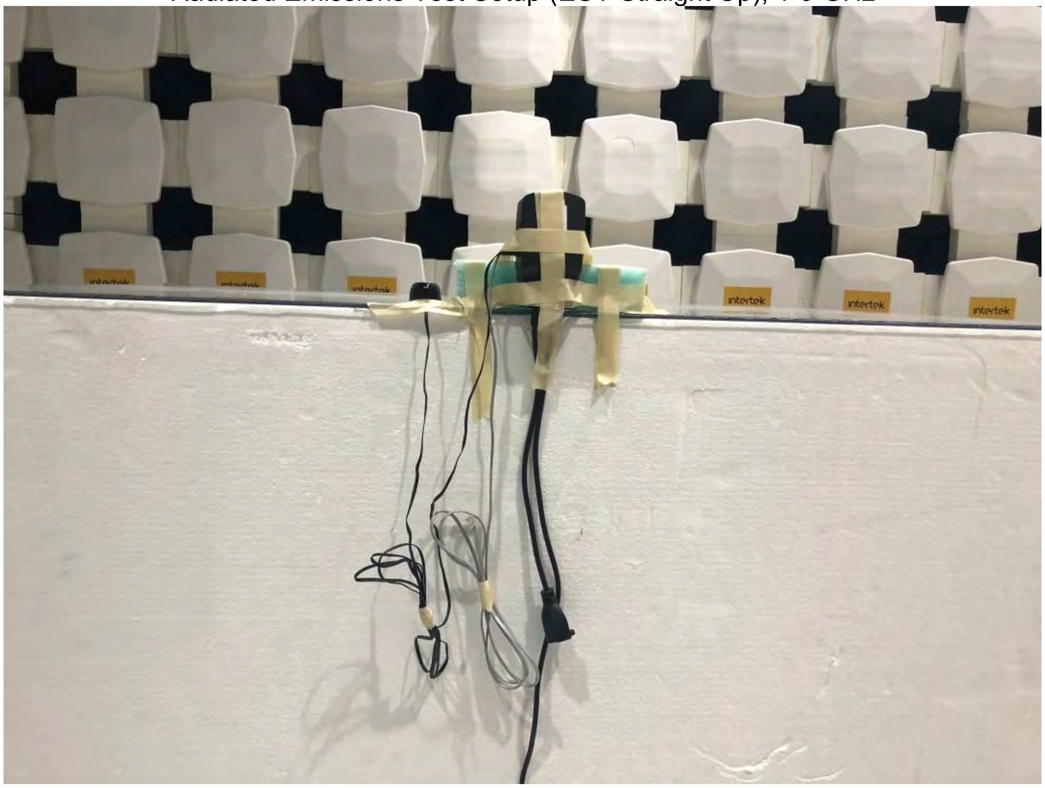


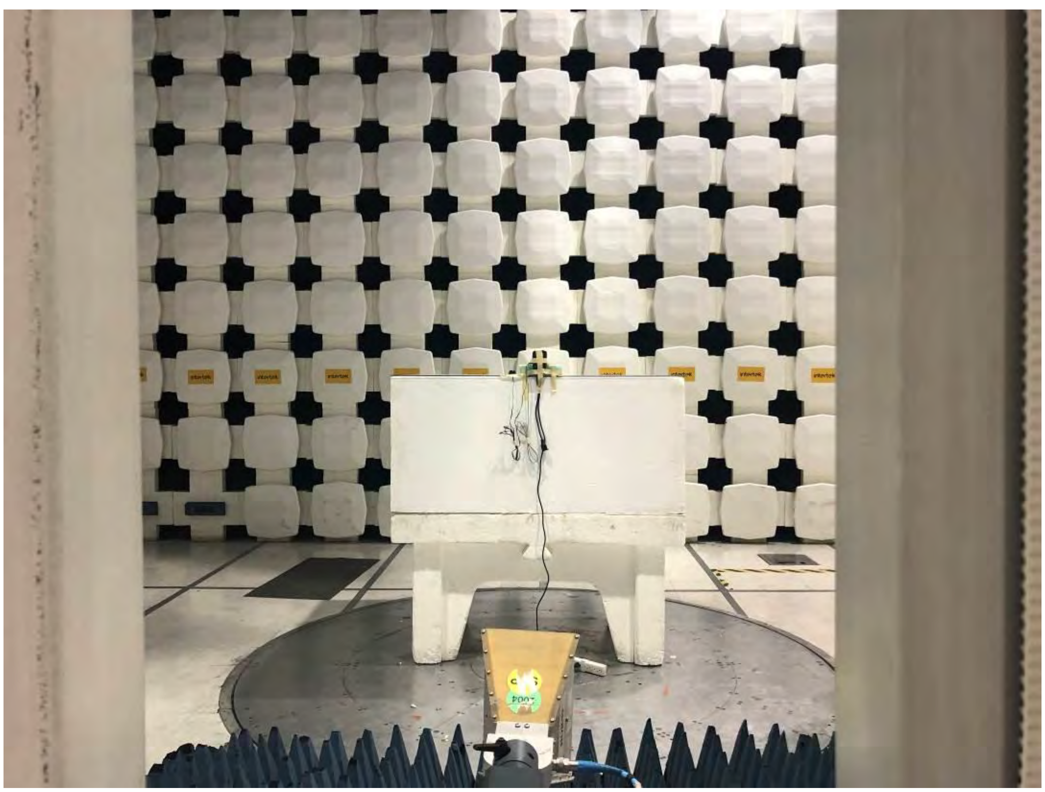
Radiated Emissions Test Setup (EUT on its side), 1-9 GHz



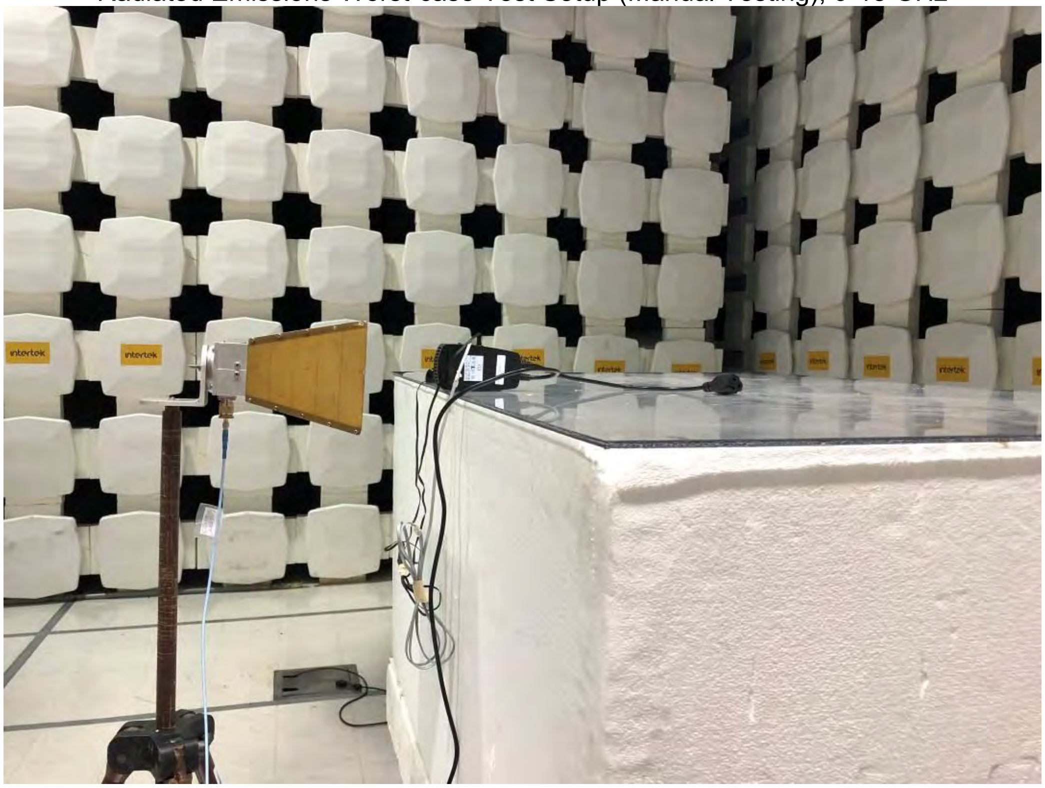


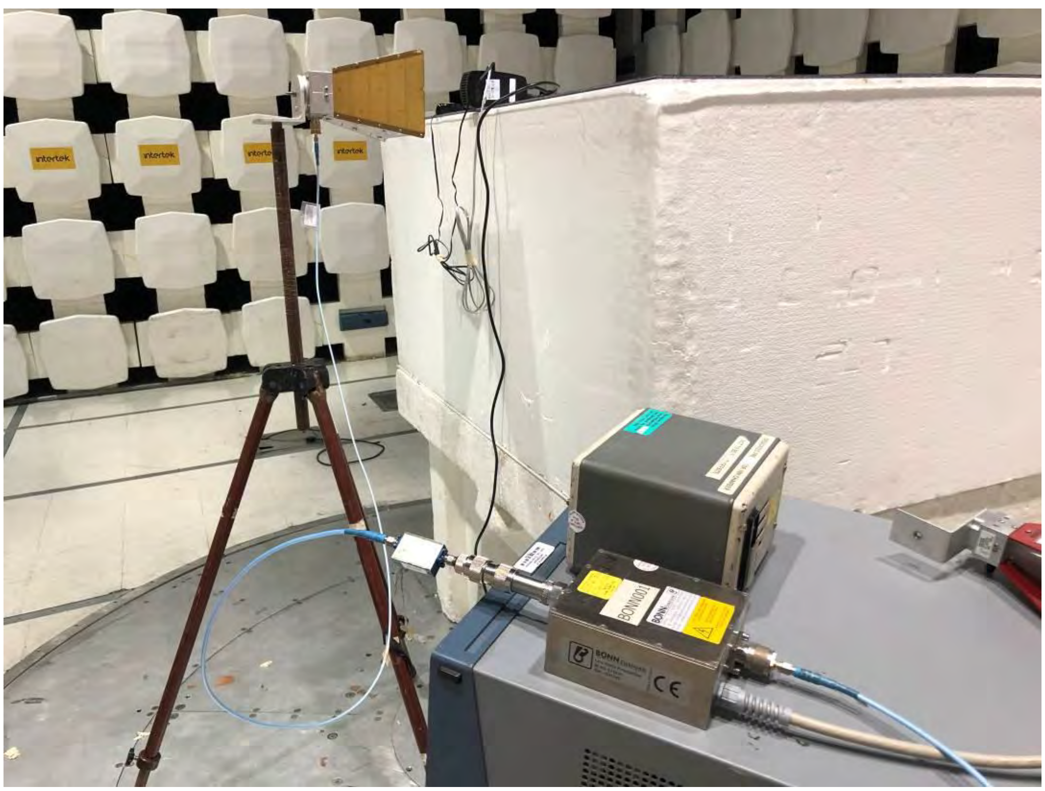
Radiated Emissions Test Setup (EUT Straight Up), 1-9 GHz



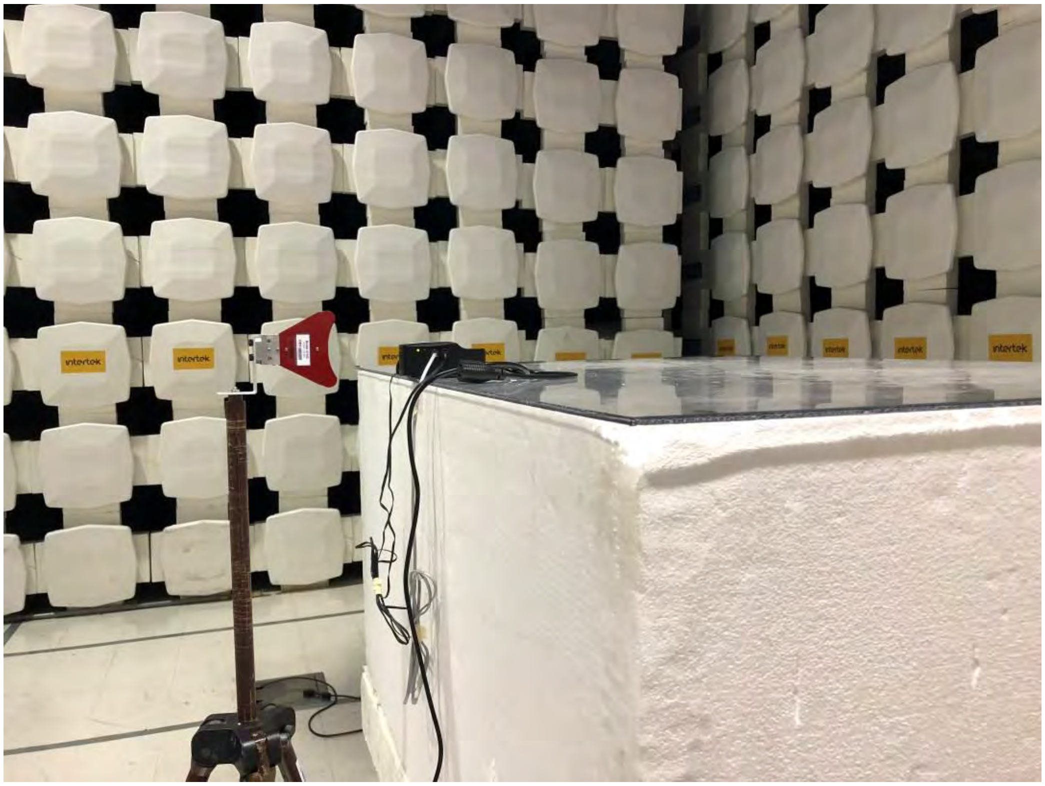


Radiated Emissions Worst-case Test Setup (Manual Testing), 9-18 GHz





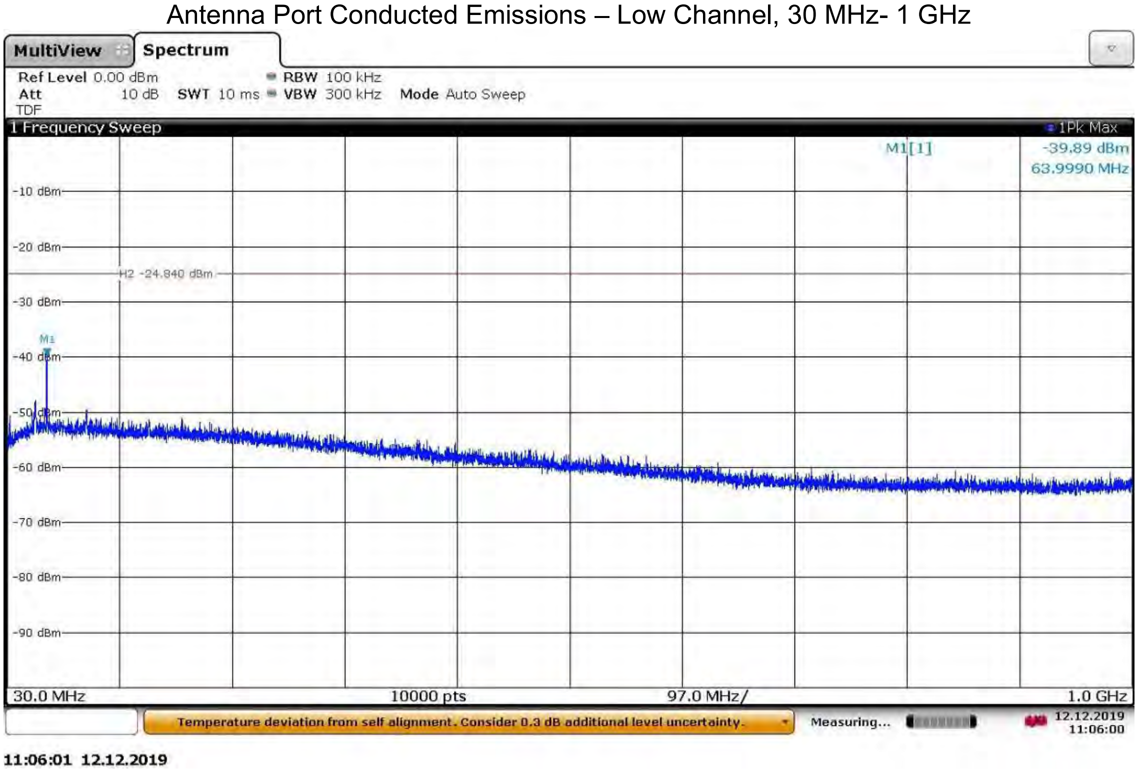
Radiated Emissions Test Setup (Manual Testing), 18-25 GHz



10.5 Plots/Data:

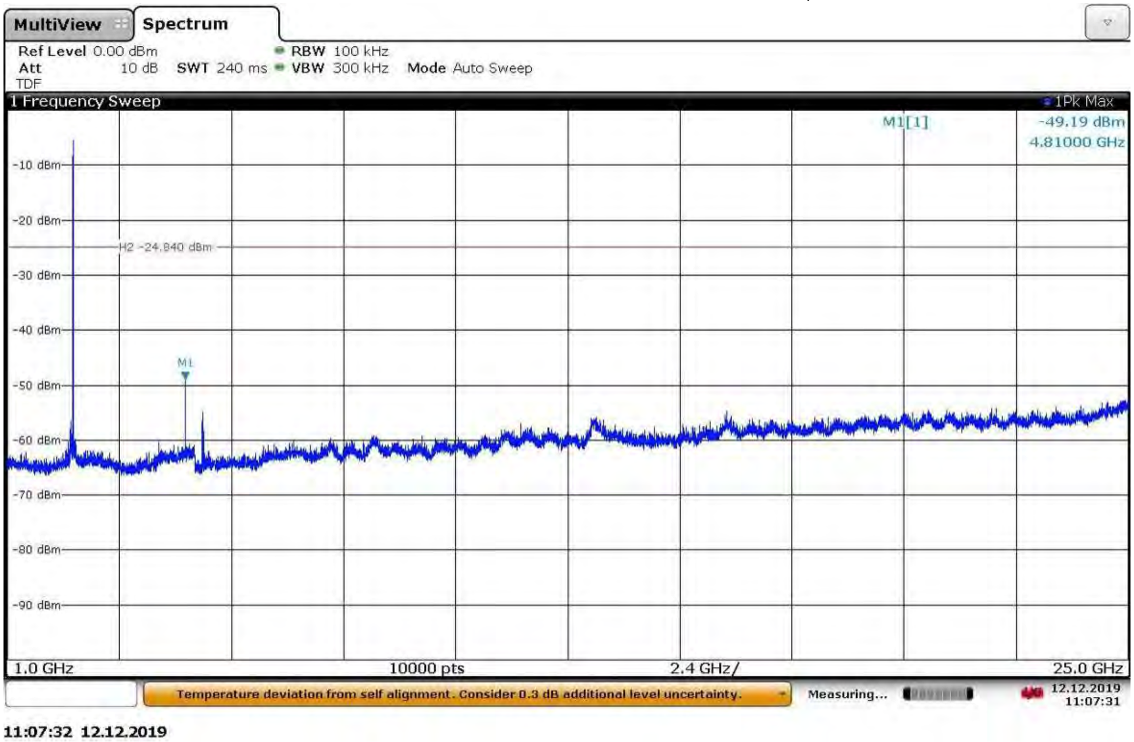
Antenna Port Conducted Emissions – Low Channel 20 dB Down From the Carrier Limit

Antenna Port Conducted Emissions – Low Channel, 30 MHz- 1 GHz

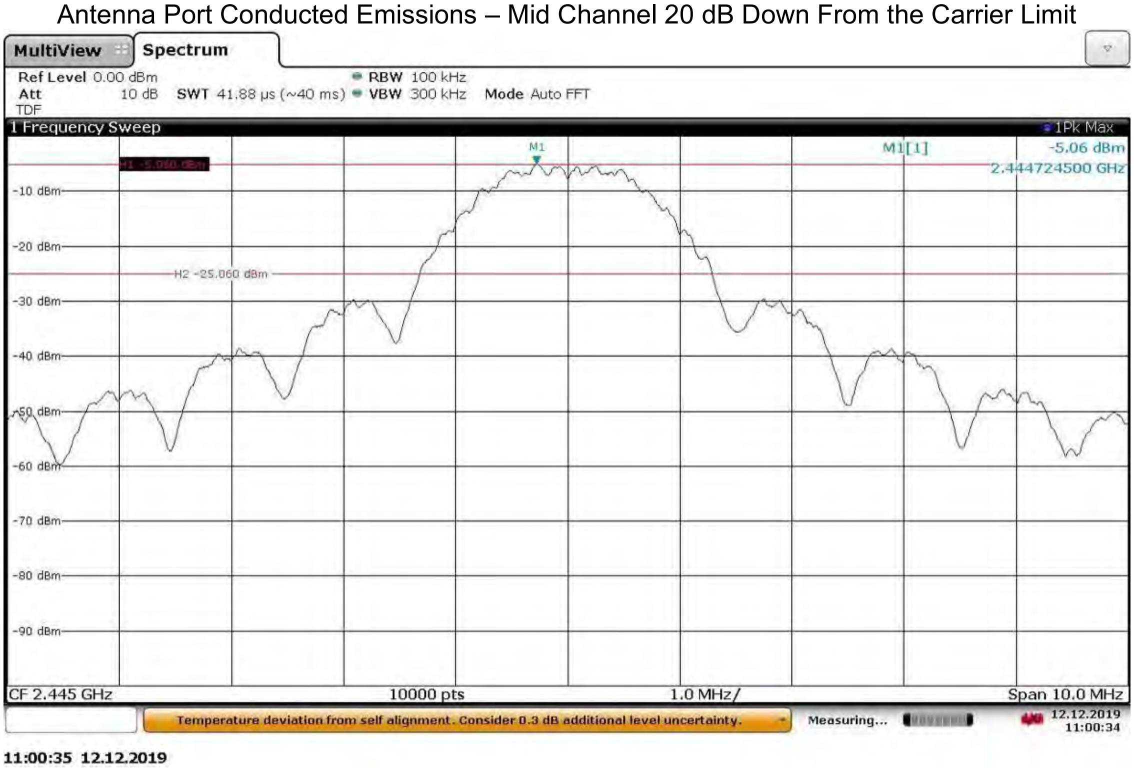


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Antenna Port Conducted Emissions – Low Channel, 1-25 GHz

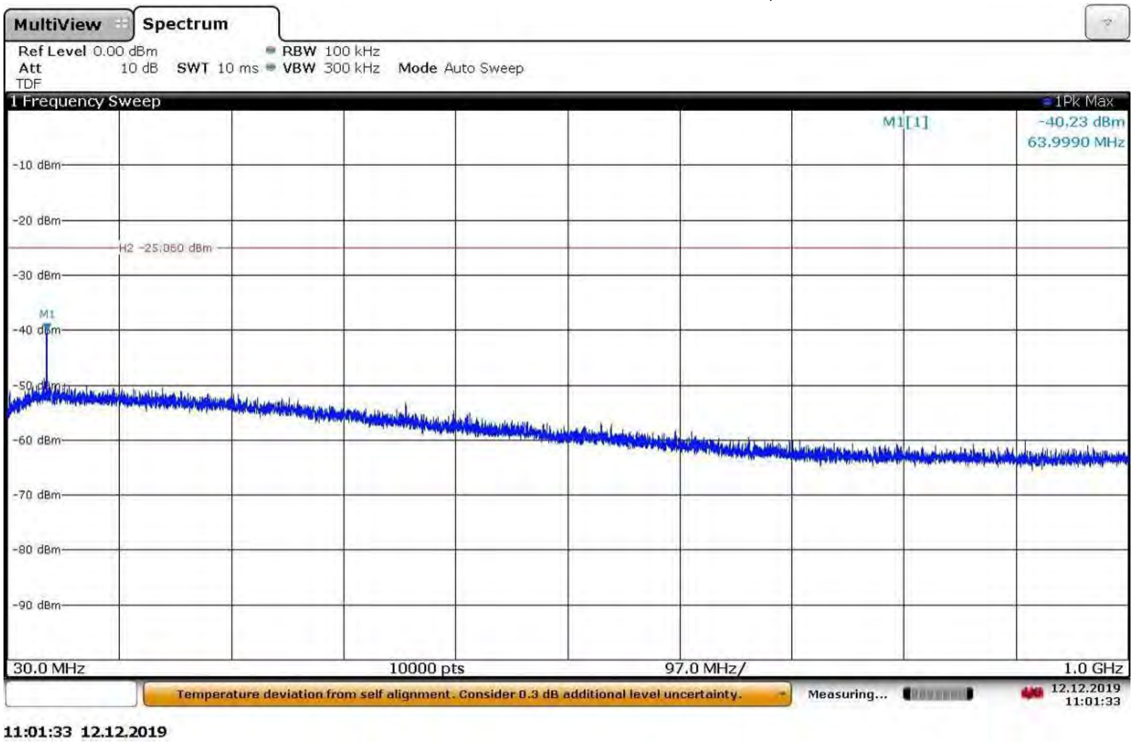


Antenna Port Conducted Emissions – Mid Channel 20 dB Down From the Carrier Limit

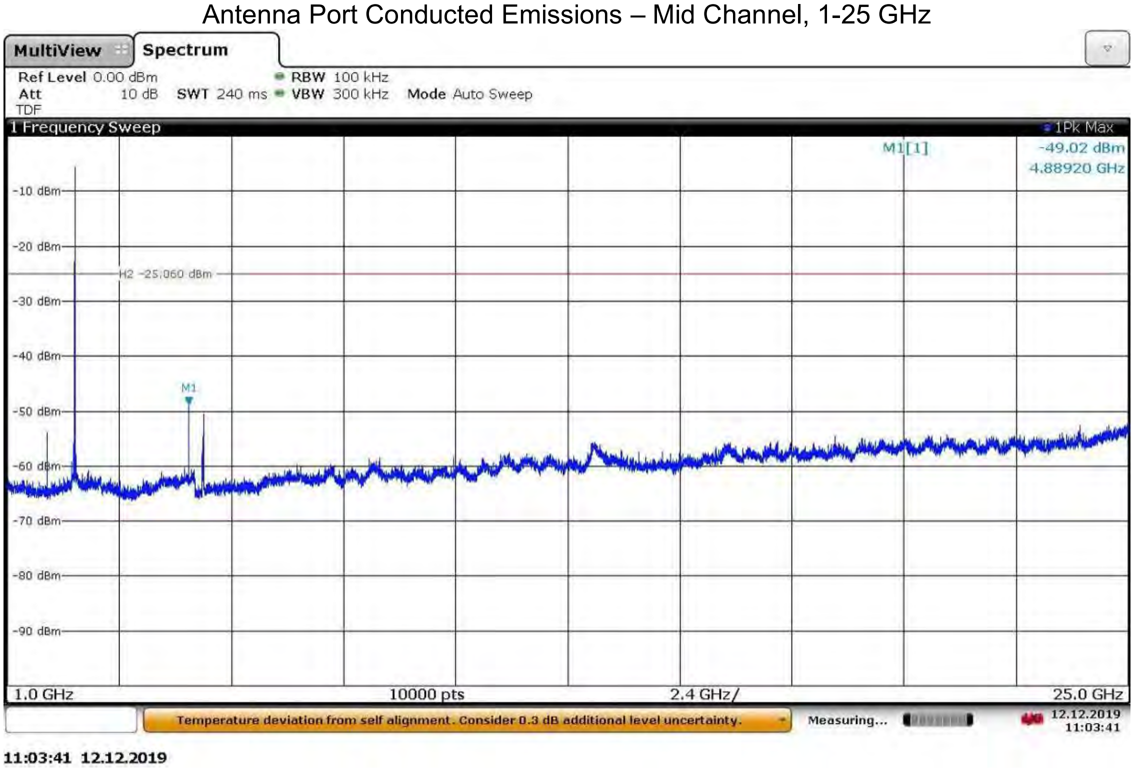


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Antenna Port Conducted Emissions – Mid Channel, 30 MHz- 1 GHz

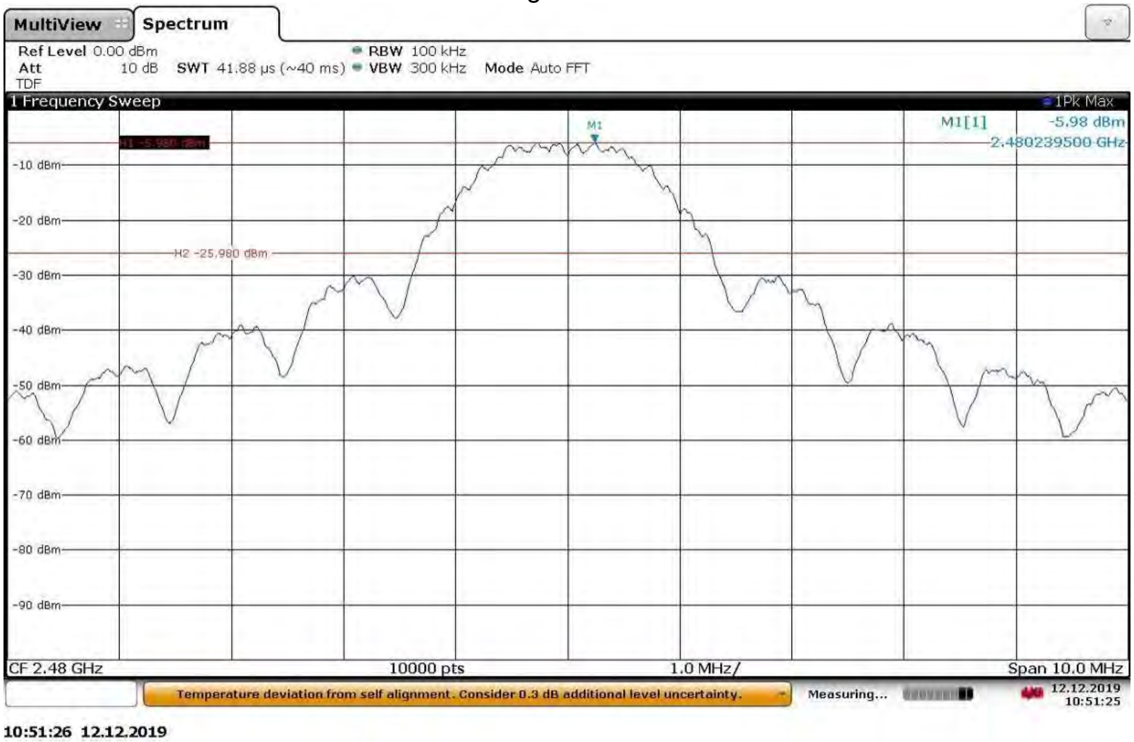


Antenna Port Conducted Emissions – Mid Channel, 1-25 GHz

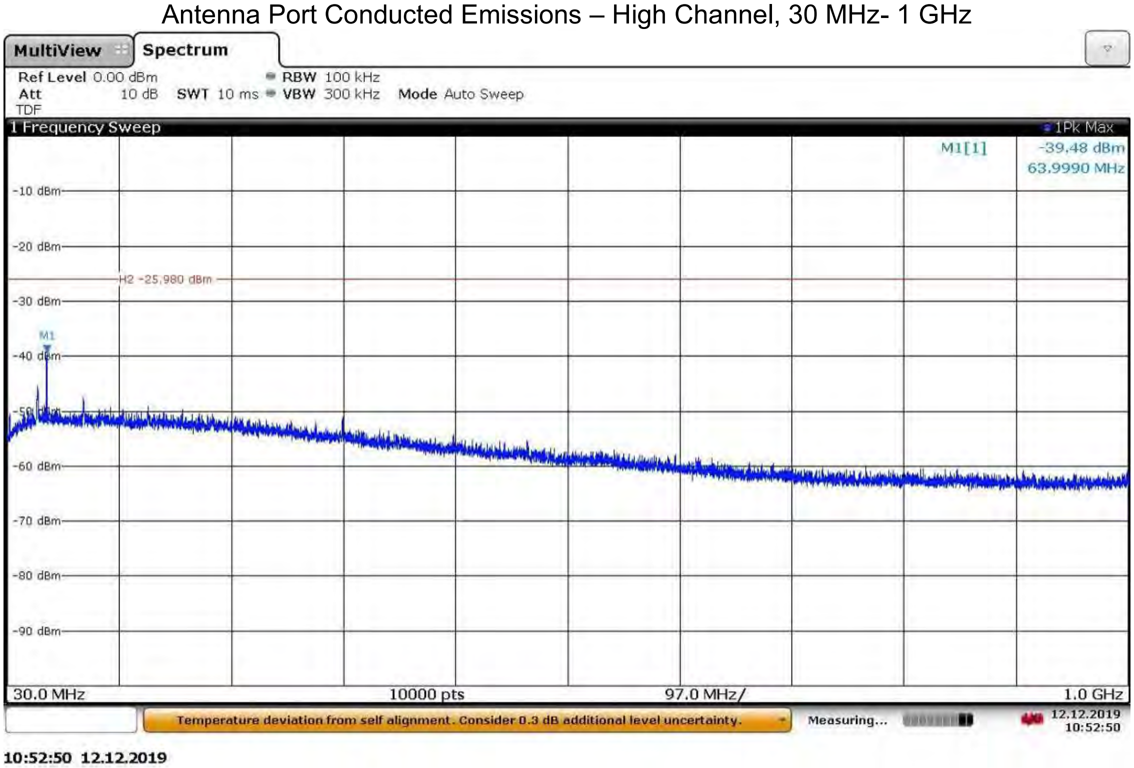


Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Antenna Port Conducted Emissions – High Channel 20 dB Down From the Carrier Limit

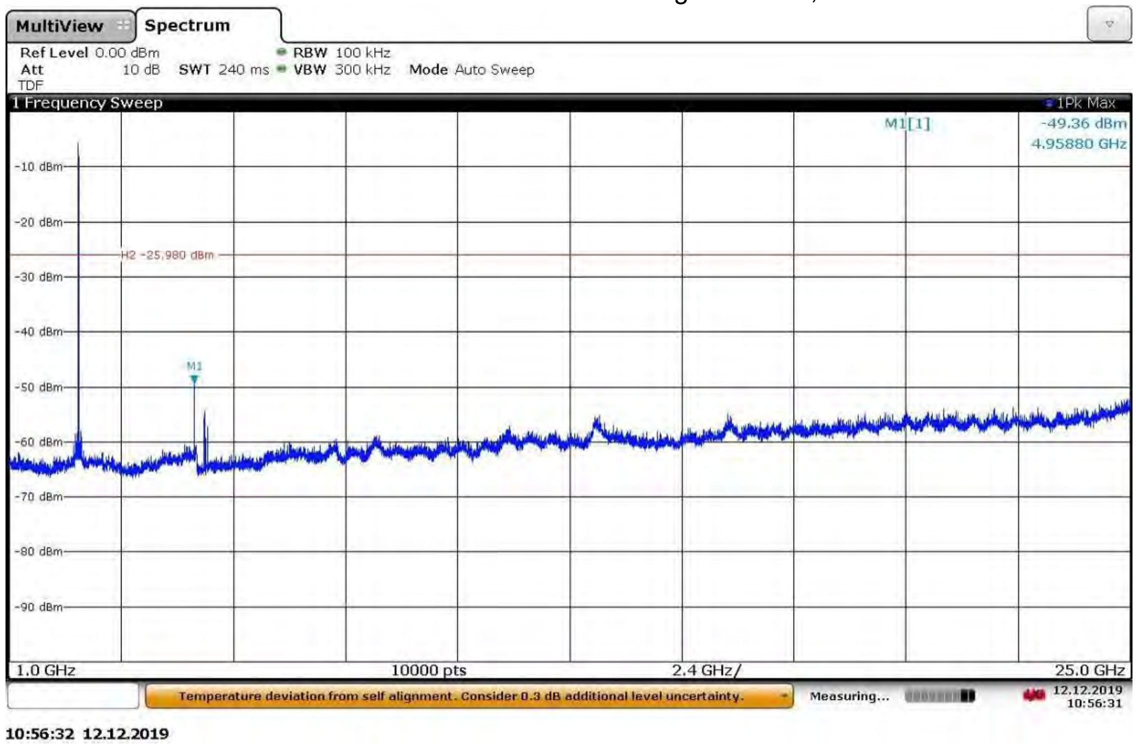


Antenna Port Conducted Emissions – High Channel, 30 MHz- 1 GHz



Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Antenna Port Conducted Emissions – High Channel, 1-25 GHz



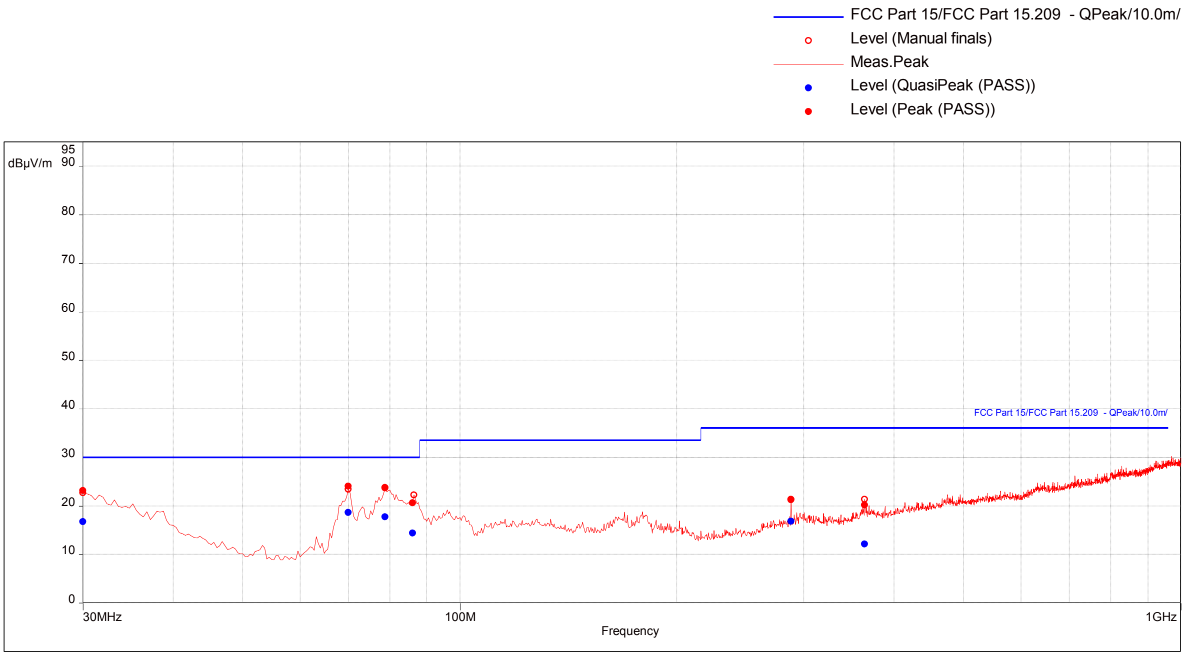
Notes: Cable loss and attenuator factors were internally compensated as transducer factor (TDF).

Triac, Transmits @ Low Channel, EUT Sits Flat, 30-1000MHz

Test Information:

Date and Time	12/13/2019 8:41:53 AM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	25%
Atmospheric Pressure	1024mbar
Comments	Triac, Transmit @ Low Channel, EUT Sits Flat, 30-1000MHz SA mode

Graph:



Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.04736842	16.73	30.00	-13.27	113.00	4.00	Vertical	120000.00	-12.47
70.03157895	18.58	30.00	-11.42	288.00	1.51	Vertical	120000.00	-24.73
78.76842105	17.72	30.00	-12.28	275.00	2.44	Vertical	120000.00	-25.03
86.17894737	14.34	30.00	-15.66	120.00	1.01	Vertical	120000.00	-25.36
288	16.77	36.00	-19.23	256.00	1.35	Vertical	120000.00	-18.22
364.2421053	12.10	36.00	-23.90	68.00	1.36	Vertical	120000.00	-16.30

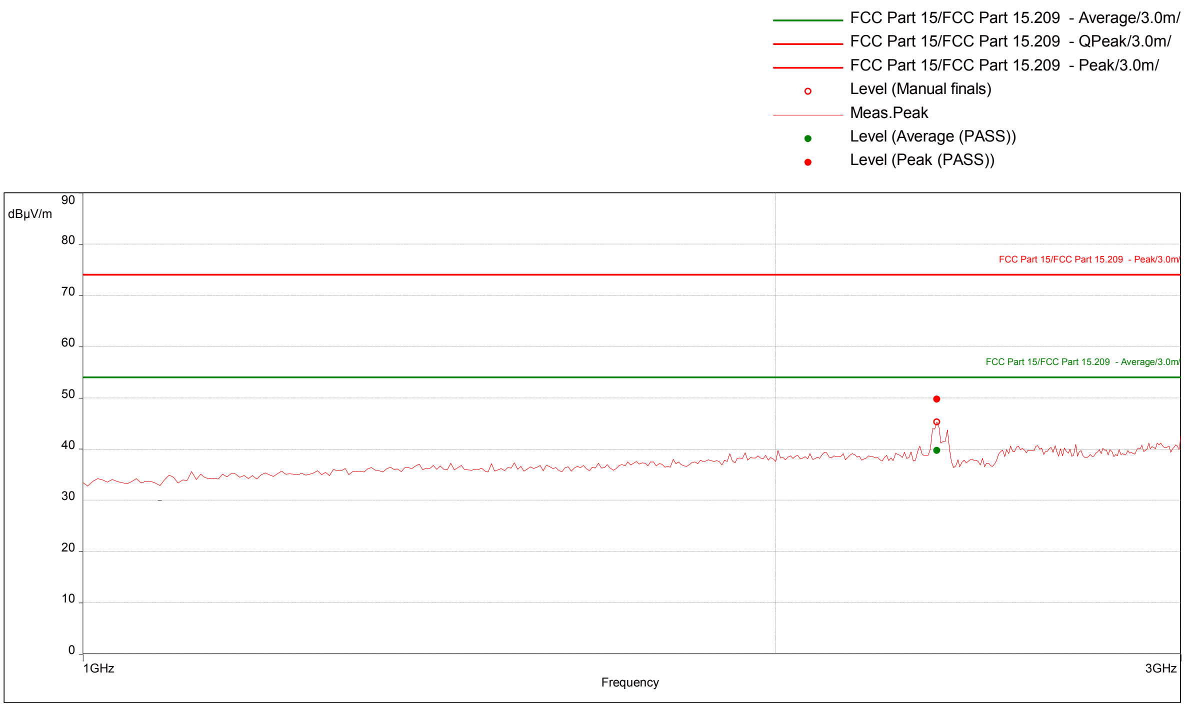
Notes: Performed only in one x-axis (EUT flat).

Triac, Transmits @ Low Channel, EUT Flat, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:29:18 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, Flat, 1-3 GHz

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2350.789474	49.67	74.00	-24.33	359.00	1.35	Horizontal	1000000.00	-20.09

Average (PASS) (1)

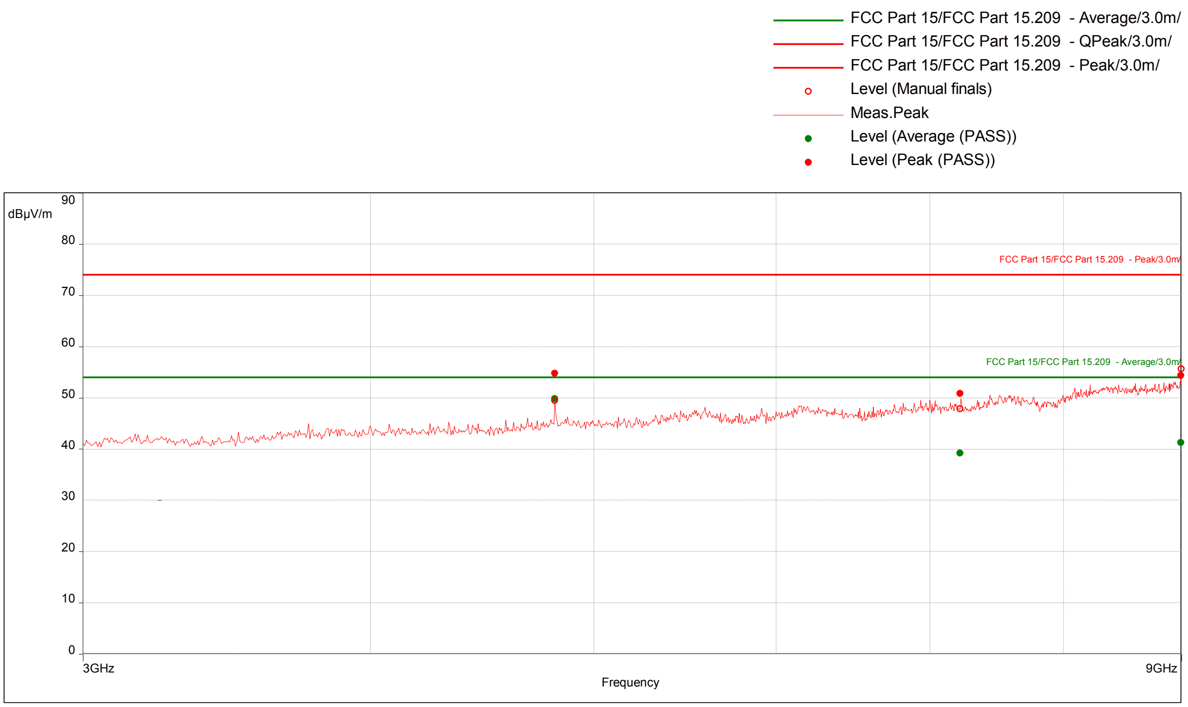
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2350.789474	39.71	54.00	-14.29	359.00	1.35	Horizontal	1000000.00	-20.09

Triac, Transmits @ Low Channel, EUT Flat, 3-9 GHz

Test Information:

Date and Time	12/14/2019 2:01:59 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, Flat, 3 to 9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4810	54.76	74.00	-19.24	23.00	3.89	Vertical	1000000.00	-11.17
7213.157895	50.81	74.00	-23.19	281.00	3.34	Horizontal	1000000.00	-5.87
8996.184211	54.36	74.00	-19.64	10.00	1.20	Vertical	1000000.00	-1.67

Average (PASS) (3)

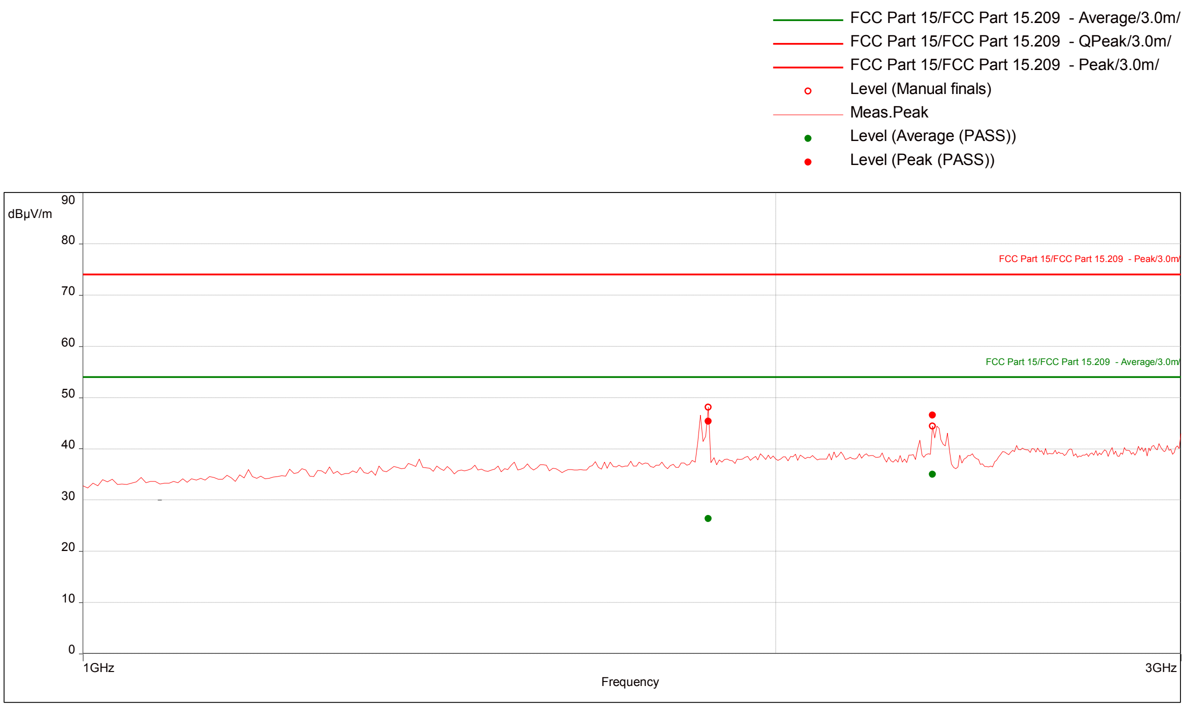
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4810	49.79	54.00	-4.21	23.00	3.89	Vertical	1000000.00	-11.17
7213.157895	39.21	54.00	-14.79	281.00	3.34	Horizontal	1000000.00	-5.87
8996.184211	41.23	54.00	-12.77	10.00	1.20	Vertical	1000000.00	-1.67

Triac, Transmits @ Low Channel, EUT on its side, 1-3 GHz

Test Information:

Date and Time	12/14/2019 6:03:01 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, EUT on its side, 1-3 GHz

Graph:



Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
1868.157895	45.35	74.00	-28.65	3.00	3.98	Vertical	1000000.00	-21.86
2341.578947	46.51	74.00	-27.49	341.00	1.10	Vertical	1000000.00	-20.18

Average (PASS) (2)

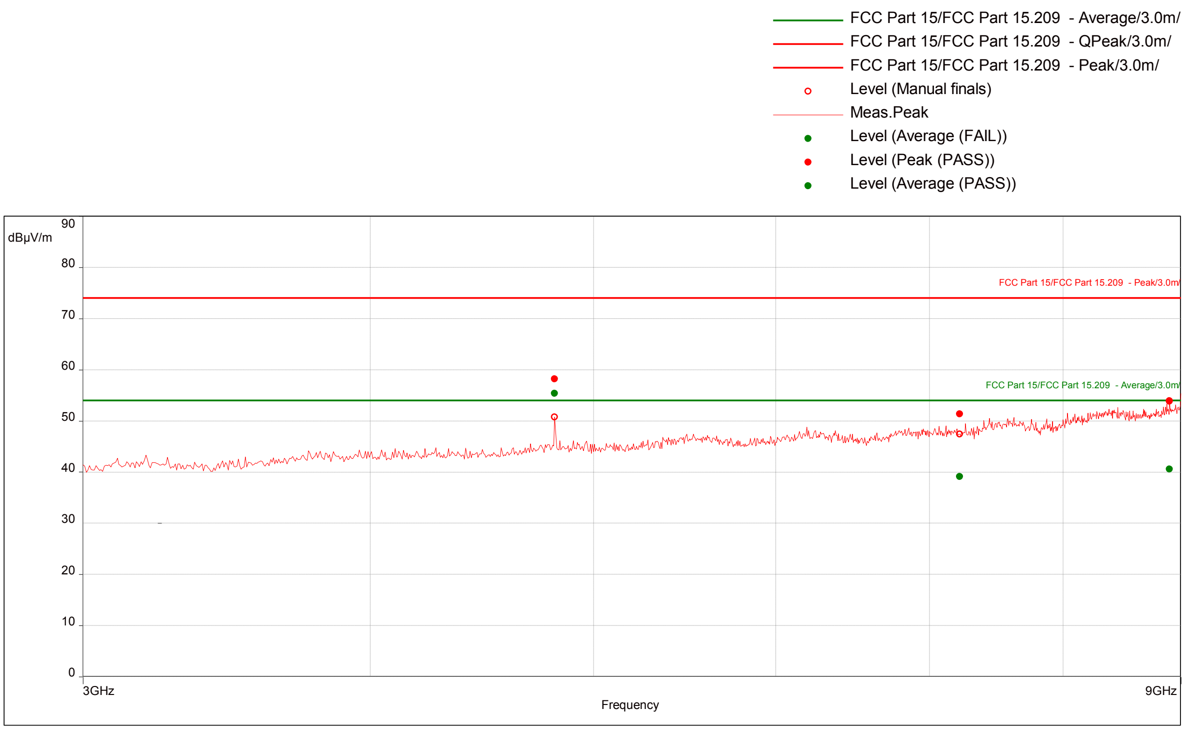
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
1868.157895	26.36	54.00	-27.64	3.00	3.98	Vertical	1000000.00	-21.86
2341.578947	34.97	54.00	-19.03	341.00	1.10	Vertical	1000000.00	-20.18

Triac, Transmits @ Low Channel, EUT on its side, 3-9 GHz

Test Information:

Date and Time	12/14/2019 4:59:19 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, EUT on its side, 3-9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4810	58.19	74.00	-15.81	107.00	3.05	Horizontal	1000000.00	-11.17
7213.684211	51.36	74.00	-22.64	68.00	3.30	Vertical	1000000.00	-5.87
8901.052632	53.78	74.00	-20.22	146.00	2.05	Horizontal	1000000.00	-1.73

Average (PASS) (3), Average Readings = Peak Readings – Average Factor

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4810	32.19	54.00	-21.81	107.00	3.05	Horizontal	1000000.00	-11.17
7213.684211	25.36	54.00	-28.64	68.00	3.30	Vertical	1000000.00	-5.87
8901.052632	27.78	54.00	-26.22	146.00	2.05	Horizontal	1000000.00	-1.73

Average Factor = 20*log((Total on time)/100 mS) or 20*log(5mS/100mS) or 26 dB

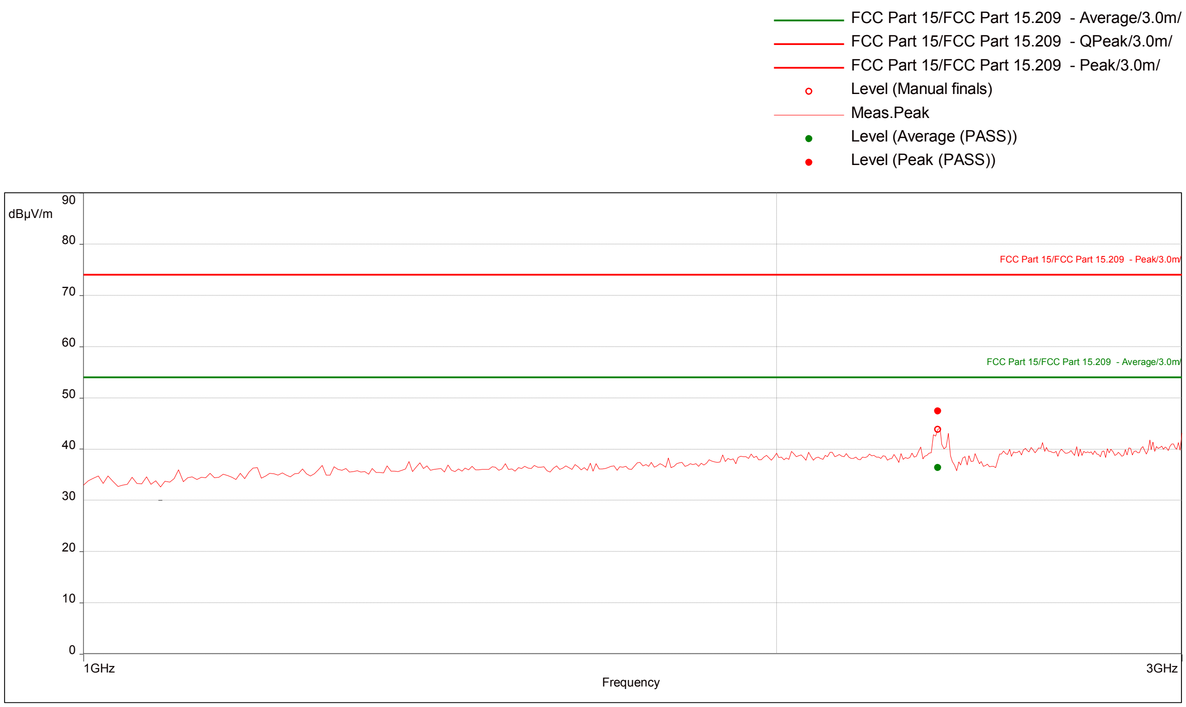
Notes: Disregard the average readings on the plot as these readings were measured using the test instrument average detector.

Triac, Transmits @ Low Channel, EUT Straight Up, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:41:58 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, EUT Straight Up, 1-3 GHz

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2350.526316	47.38	74.00	-26.62	145.00	1.00	Vertical	1000000.00	-20.09

Average (PASS) (1)

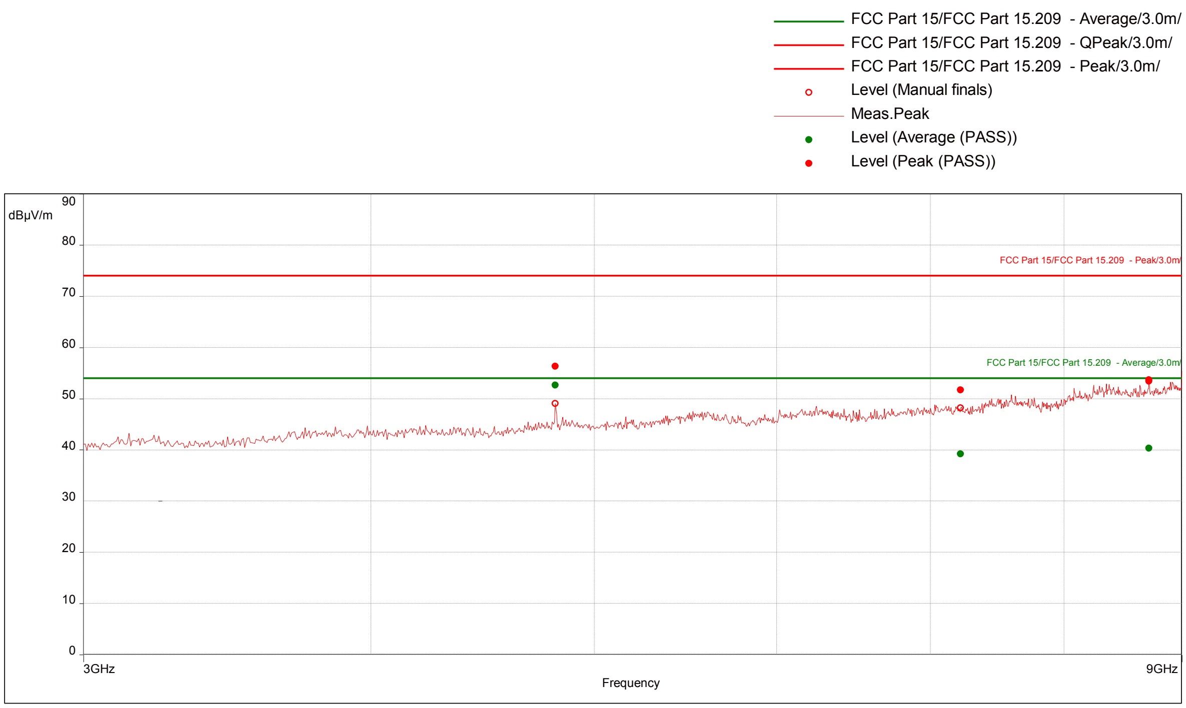
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2350.526316	36.39	54.00	-17.61	145.00	1.00	Vertical	1000000.00	-20.09

Triac, Transmits @ Low Channel, EUT Straight Up, 3-9 GHz

Test Information:

Date and Time	12/14/2019 4:39:15 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Low Channel, EUT Straight Up, 3-9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
4810	56.30	74.00	-17.70	0.00	3.79	Vertical	1000000.00	-11.17
7213.684211	51.66	74.00	-22.34	358.00	3.98	Vertical	1000000.00	-5.87
8708.684211	53.43	74.00	-20.57	101.00	1.10	Horizontal	1000000.00	-2.08

Average (PASS) (3)

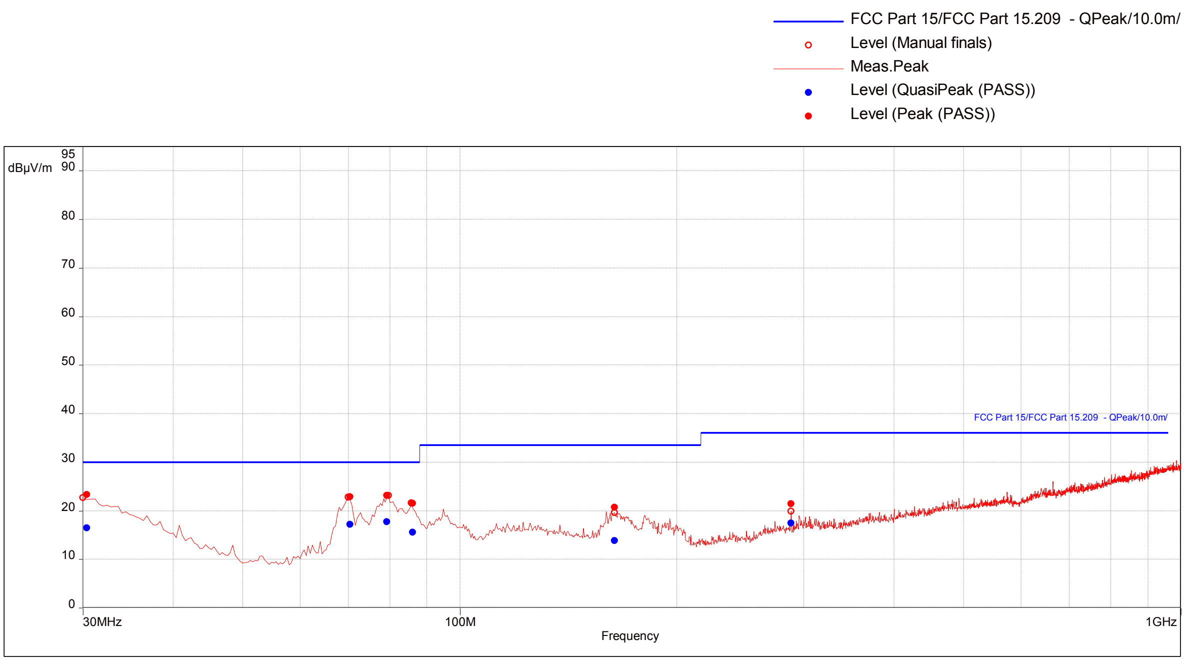
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
4810	52.59	54.00	-1.41	0.00	3.79	Vertical	1000000.00	-11.17
7213.684211	39.16	54.00	-14.84	358.00	3.98	Vertical	1000000.00	-5.87
8708.684211	40.27	54.00	-13.73	101.00	1.10	Horizontal	1000000.00	-2.08

Triac, Transmits @ Mid Channel, EUT Sits Flat, 30-1000MHz

Test Information:

Date and Time	12/13/2019 9:36:16 AM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	25%
Atmospheric Pressure	1024mbar
Comments	Triac, Transmit @ Mid Channel, EUT Sits Flat, 30-1000MHz SA mode

Graph:



Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.56842105	16.43	30.00	-13.57	146.00	2.13	Horizontal	120000.00	-12.72
70.34736842	17.17	30.00	-12.83	248.00	1.73	Vertical	120000.00	-24.73
79.18947368	17.70	30.00	-12.30	269.00	2.50	Vertical	120000.00	-25.07
85.82105263	15.50	30.00	-14.50	0.00	1.66	Vertical	120000.00	-25.39
164.1578947	13.82	33.50	-19.68	35.00	1.37	Vertical	120000.00	-19.89
288	17.42	36.00	-18.58	210.00	1.00	Vertical	120000.00	-18.22

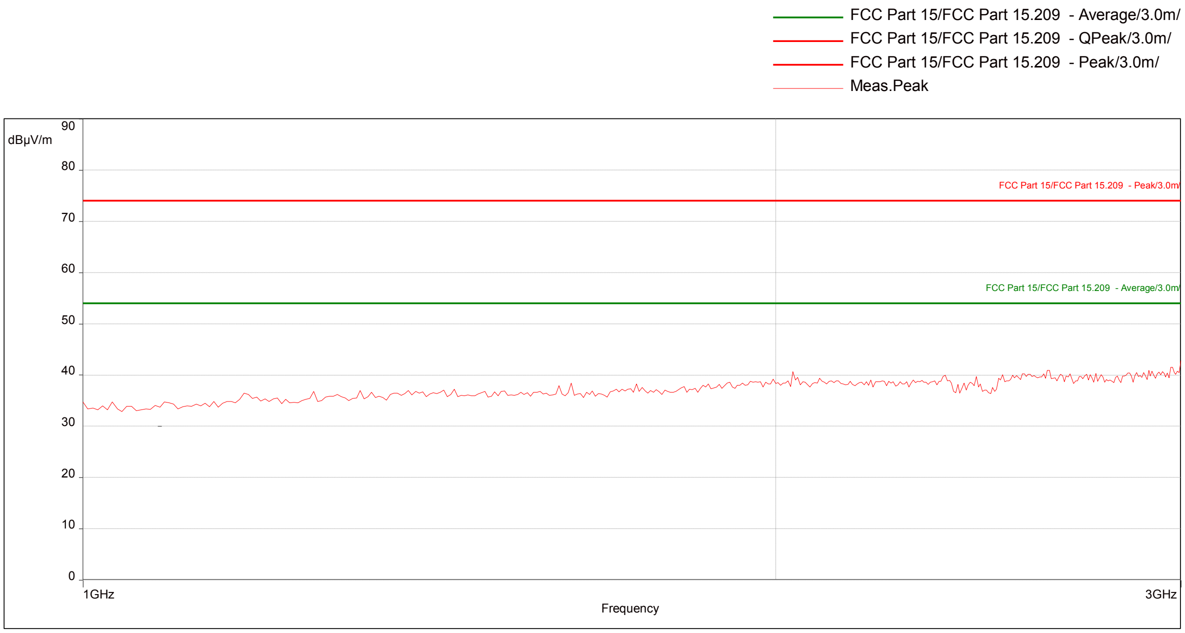
Notes: Performed only in one x-axis (EUT flat).

Triac, Transmits @ Mid Channel, EUT Flat, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:23:18 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, Flat, 1-3 GHz

Graph:



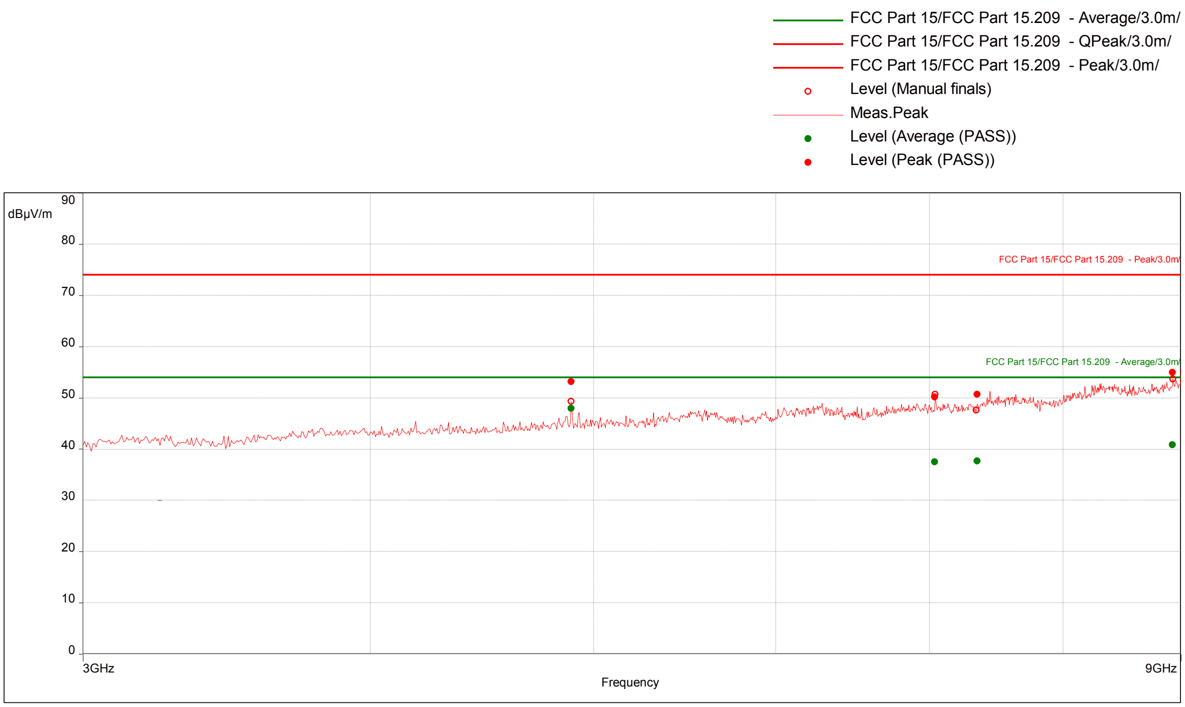
Results: No emission was detected.

Triac, Transmits @ Mid Channel, EUT Flat, 3-9 GHz

Test Information:

Date and Time	12/14/2019 2:28:52 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, Flat, 3 to 9 GHz

Graph:



Results:

Peak (PASS) (4)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	53.12	74.00	-20.88	42.00	3.98	Vertical	1000000.00	-10.91
7035.526316	50.11	74.00	-23.89	24.00	1.35	Vertical	1000000.00	-6.44
7337.894737	50.61	74.00	-23.39	16.00	3.39	Vertical	1000000.00	-5.28
8926.842105	54.96	74.00	-19.04	94.00	1.20	Horizontal	1000000.00	-1.72

Average (PASS) (4)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	47.93	54.00	-6.07	42.00	3.98	Vertical	1000000.00	-10.91
7035.526316	37.47	54.00	-16.53	24.00	1.35	Vertical	1000000.00	-6.44
7337.894737	37.69	54.00	-16.31	16.00	3.39	Vertical	1000000.00	-5.28
8926.842105	40.84	54.00	-13.16	94.00	1.20	Horizontal	1000000.00	-1.72

Triac, Transmits @ Mid Channel, EUT on its side, 1-3 GHz

Test Information:

Date and Time	12/14/2019 5:55:12 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, EUT on its side, 1-3 GHz

Graph:

Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2996.973684	41.57	74.00	-32.43	359.00	3.50	Vertical	1000000.00	-17.41

Average (PASS) (1)

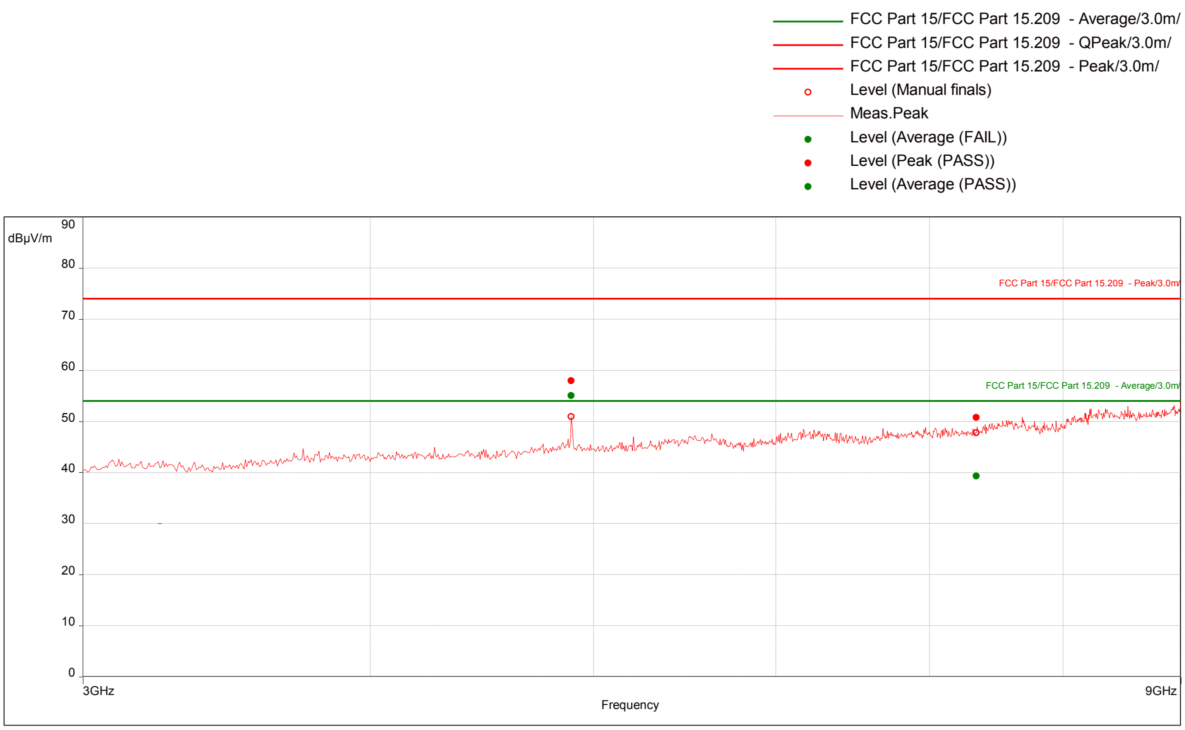
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (	Pol.	RBW (Hz)	Correction (dB)
2996.973684	28.32	54.00	-25.68	359.00	3.50	Vertical	1000000.00	-17.41

Triac, Transmits @ Mid Channel, EUT on its side, 3-9 GHz

Test Information:

Date and Time	12/14/2019 5:18:11 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, EUT on its side, 3-9 GHz

Graph:



Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	57.95	74.00	-16.05	107.00	3.00	Horizontal	1000000.00	-10.91
7337.105263	50.74	74.00	-23.26	321.00	3.20	Vertical	1000000.00	-5.29

Average (PASS) (2), Average Readings = Peak Readings – Average Factor

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	31.95	54.00	-22.05	107.00	3.00	Horizontal	1000000.00	-10.91
7337.105263	24.74	54.00	-29.26	321.00	3.20	Vertical	1000000.00	-5.29

Average Factor = 20*log((Total on time)/100 mS) or 20*log(5mS/100mS) or 26 dB

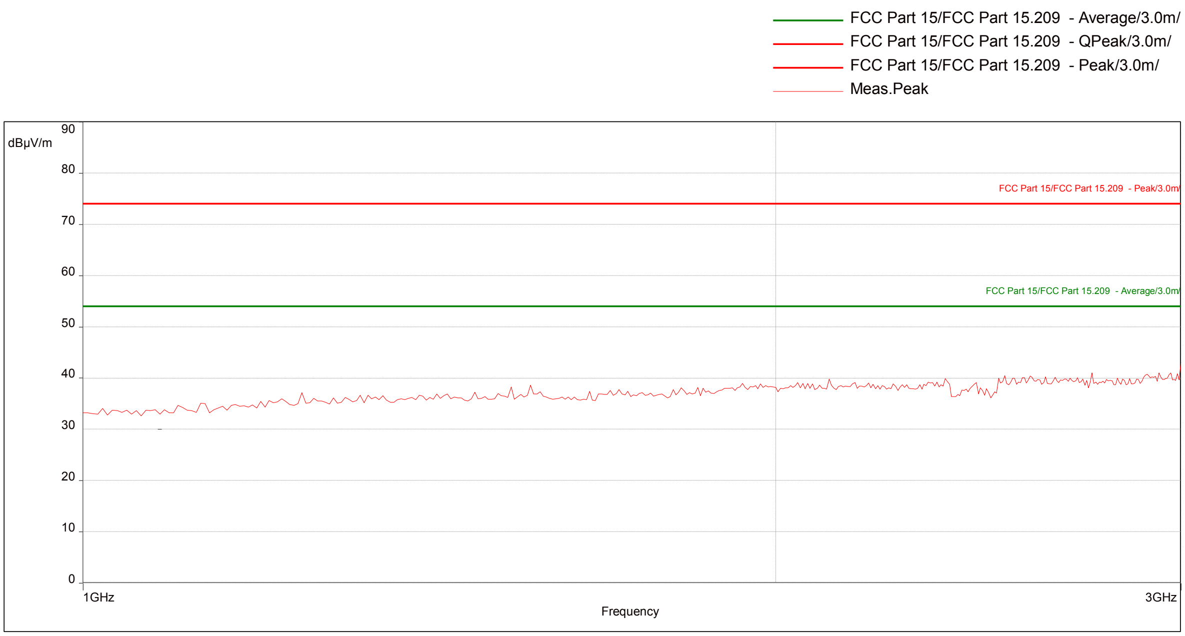
Notes: Disregard the average readings on the plot as these readings were measured using the test instrument average detector.

Triac, Transmits @ Mid Channel, EUT Straight Up, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:52:47 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, EUT Straight Up, 1-3 GHz

Graph:



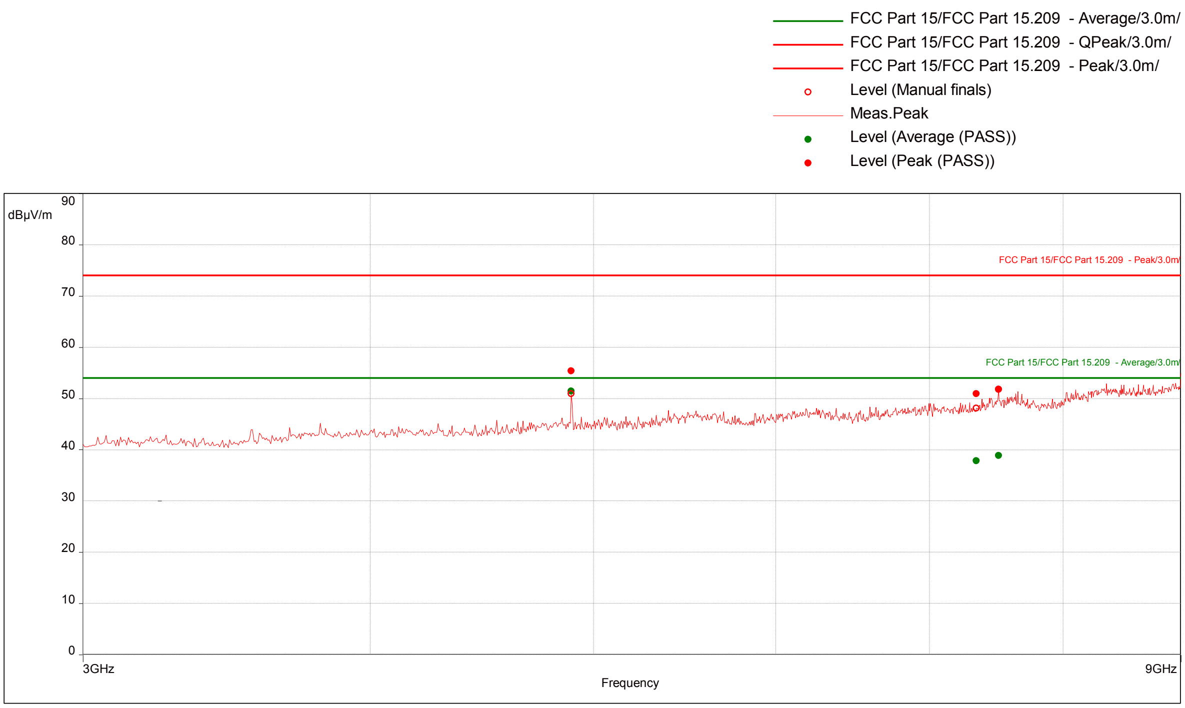
Results: No emission was detected.

Triac, Transmits @ Mid Channel, EUT Straight Up, 3-9 GHz

Test Information:

Date and Time	12/14/2019 4:21:50 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ Mid Channel, EUT Straight Up, 3-9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	55.39	74.00	-18.61	0.00	2.55	Vertical	1000000.00	-10.91
7336.052632	50.87	74.00	-23.13	307.00	3.69	Vertical	1000000.00	-5.29
7498.421053	51.78	74.00	-22.22	347.00	3.44	Vertical	1000000.00	-5.16

Average (PASS) (3)

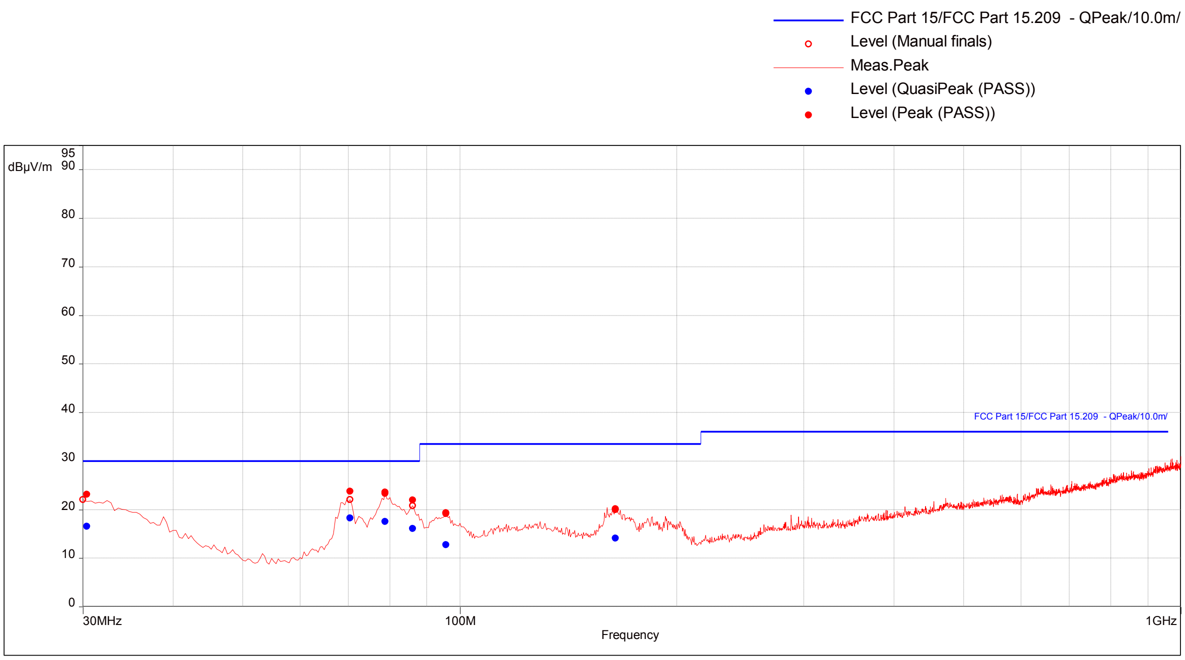
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4890	51.40	54.00	-2.60	0.00	2.55	Vertical	1000000.00	-10.91
7336.052632	37.84	54.00	-16.16	307.00	3.69	Vertical	1000000.00	-5.29
7498.421053	38.87	54.00	-15.13	347.00	3.44	Vertical	1000000.00	-5.16

Triac, Transmits @ High Channel, EUT Sits Flat, 30-1000MHz

Test Information:

Date and Time	12/13/2019 10:31:36 AM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	25%
Atmospheric Pressure	1024mbar
Comments	Triac, Transmit @ High Channel, EUT Sits Flat, 30-1000MHz SA mode

Graph:



Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.33157895	16.54	30.00	-13.46	179.00	1.47	Vertical	120000.00	-12.60
70.33684211	18.22	30.00	-11.78	250.00	2.02	Vertical	120000.00	-24.73
78.98947368	17.52	30.00	-12.48	290.00	2.58	Vertical	120000.00	-25.05
85.96842105	16.12	30.00	-13.88	121.00	2.21	Vertical	120000.00	-25.38
95.63157895	12.72	33.50	-20.78	277.00	1.74	Vertical	120000.00	-23.31
164.2736842	14.08	33.50	-19.42	36.00	2.11	Vertical	120000.00	-19.90

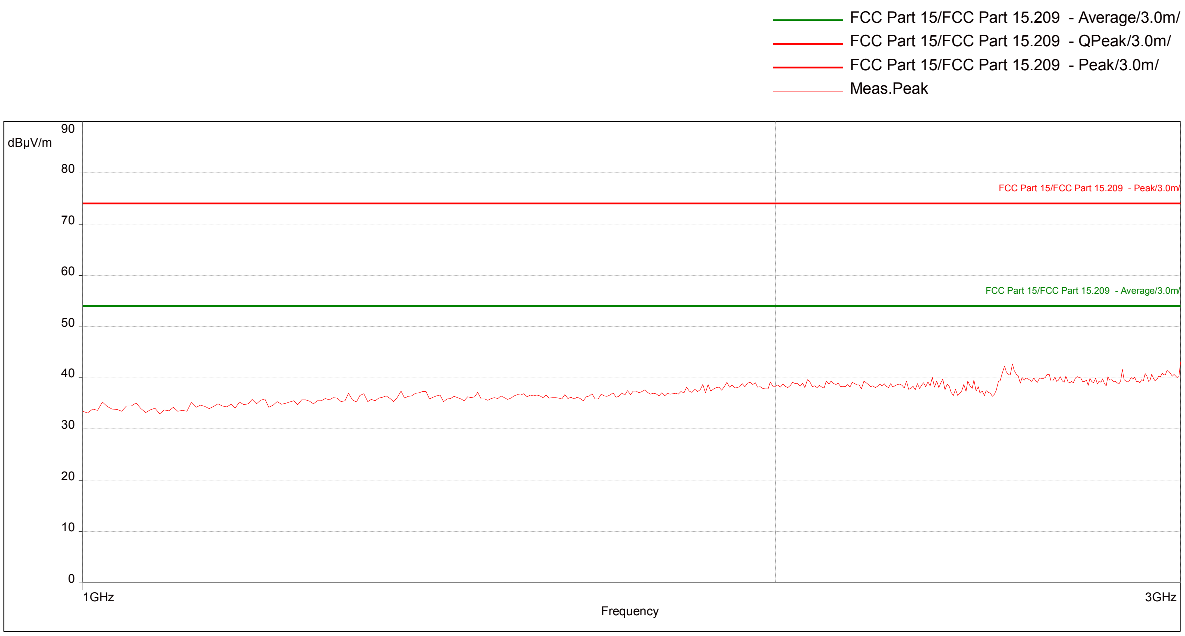
Notes: Performed only in one x-axis (EUT flat).

Triac, Transmits @ High Channel, EUT Flat, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:16:46 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, Flat, 1-3 GHz

Graph:



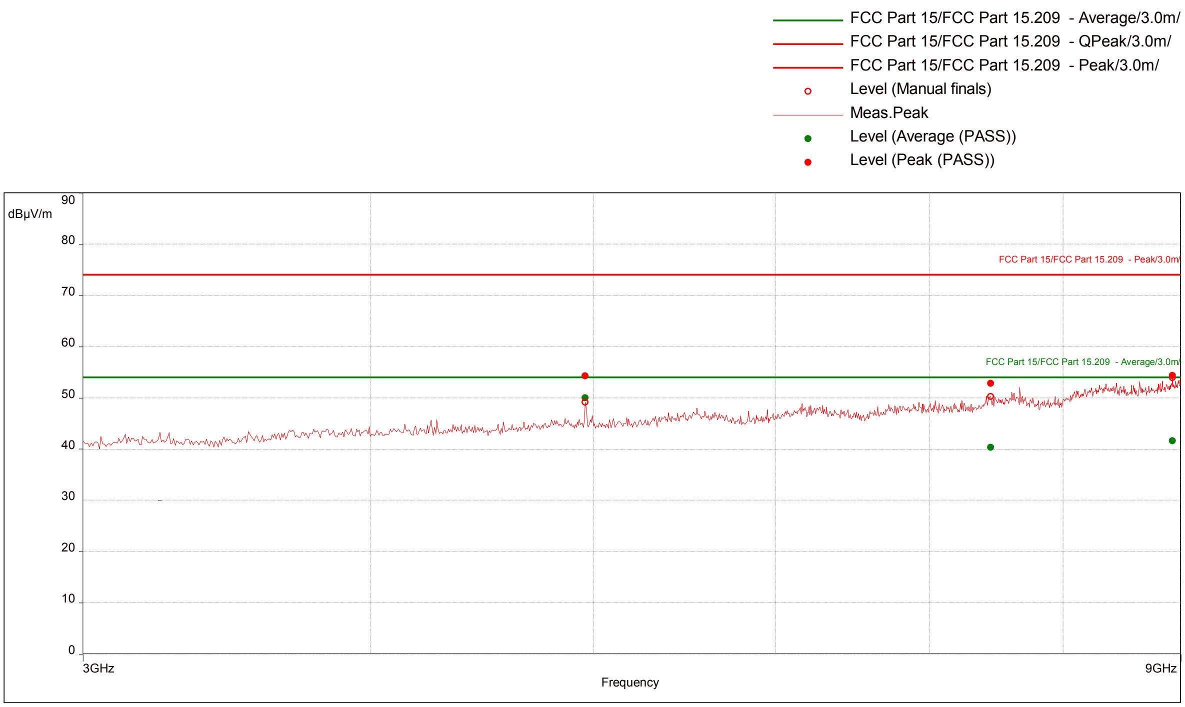
Result: No emission was detected.

Triac, Transmits @ High Channel, EUT Flat, 3-9 GHz

Test Information:

Date and Time	12/14/2019 2:54:59 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, Flat, 3 to 9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	54.25	74.00	-19.75	17.00	3.49	Vertical	1000000.00	-10.80
7438.421053	52.81	74.00	-21.19	48.00	3.44	Vertical	1000000.00	-5.16
8927.368421	54.31	74.00	-19.69	139.00	3.39	Vertical	1000000.00	-1.72

Average (PASS) (3)

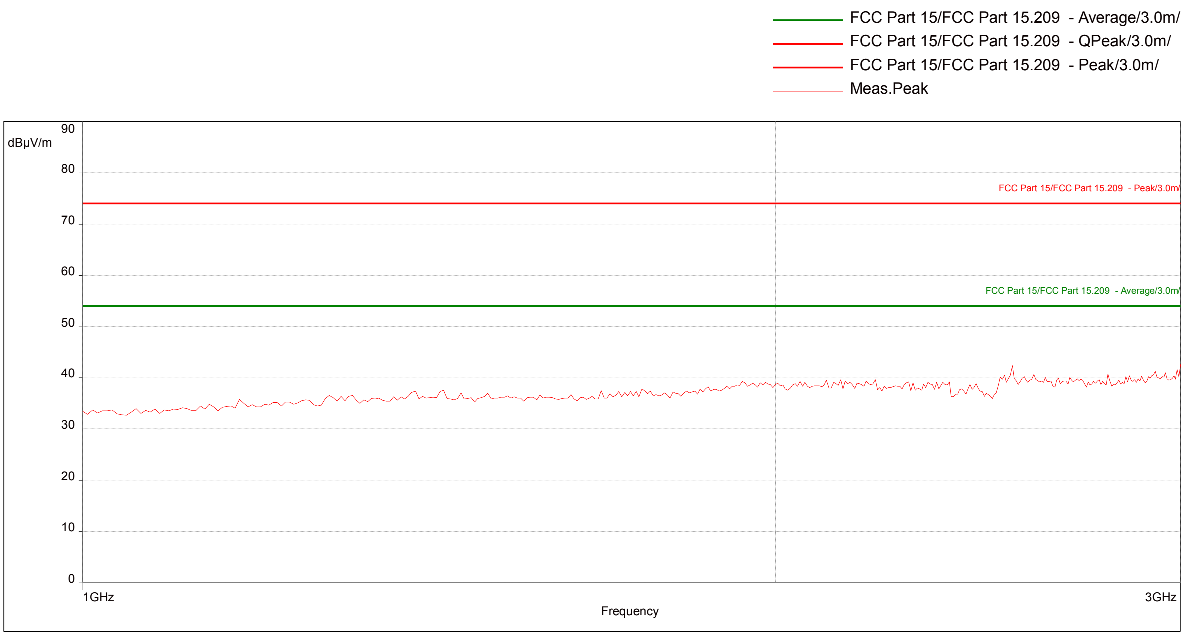
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	49.96	54.00	-4.04	17.00	3.49	Vertical	1000000.00	-10.80
7438.421053	40.26	54.00	-13.74	48.00	3.44	Vertical	1000000.00	-5.16
8927.368421	41.55	54.00	-12.45	139.00	3.39	Vertical	1000000.00	-1.72

Triac, Transmits @ High Channel, EUT on its side, 1-3 GHz

Test Information:

Date and Time	12/14/2019 5:52:11 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, EUT on its side, 1-3 GHz

Graph:



Results: No emission was detected.

Triac, Transmits @ High Channel, EUT on its side, 3-9 GHz

Test Information:

Date and Time	12/14/2019 5:34:17 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, EUT on its side, 3-9 GHz

Graph:

Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	57.46	74.00	-16.54	106.00	2.90	Horizontal	1000000.00	-10.80
7441.315789	52.51	74.00	-21.49	0.00	3.89	Horizontal	1000000.00	-5.16

Average (PASS) (2), Average Readings = Peak Readings – Average Factor

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	31.46	54.00	-22.54	106.00	2.90	Horizontal	1000000.00	-10.80
7441.315789	26.51	54.00	-27.49	0.00	3.89	Horizontal	1000000.00	-5.16

Average Factor = 20*log((Total on time)/100 mS) or 20*log(5mS/100mS) or 26 dB

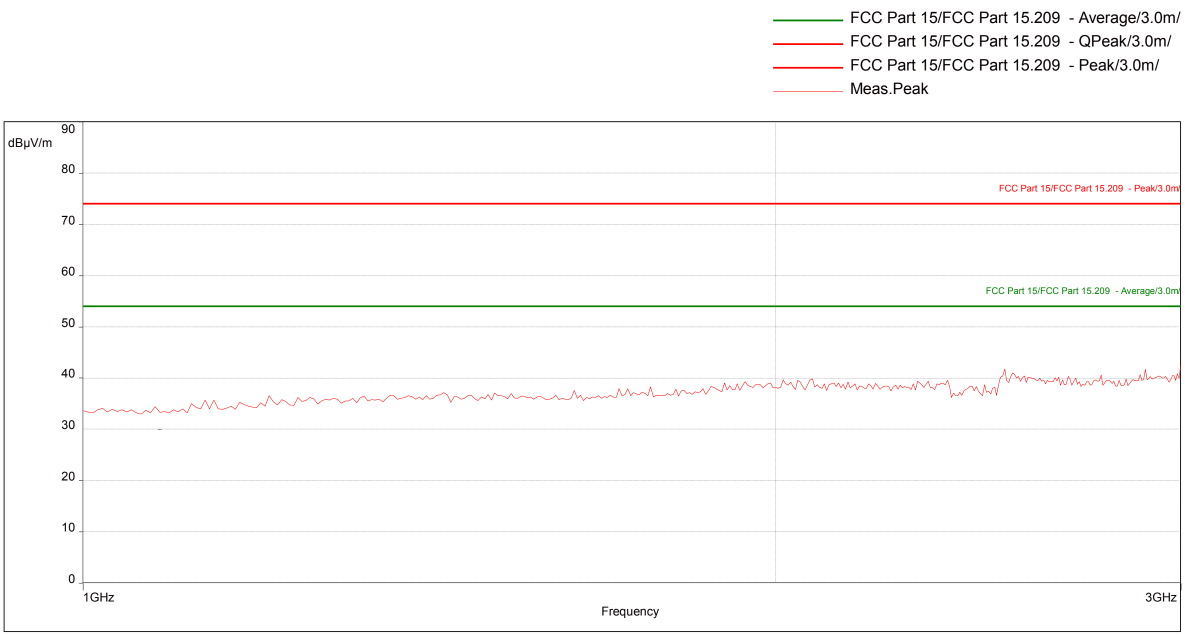
Notes: Disregard the average readings on the plot as these readings were measured using the test instrument average detector.

Triac, Transmits @ High Channel, EUT Straight Up, 1-3 GHz

Test Information:

Date and Time	12/14/2019 3:58:16 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, EUT Straight Up, 1-3 GHz

Graph:



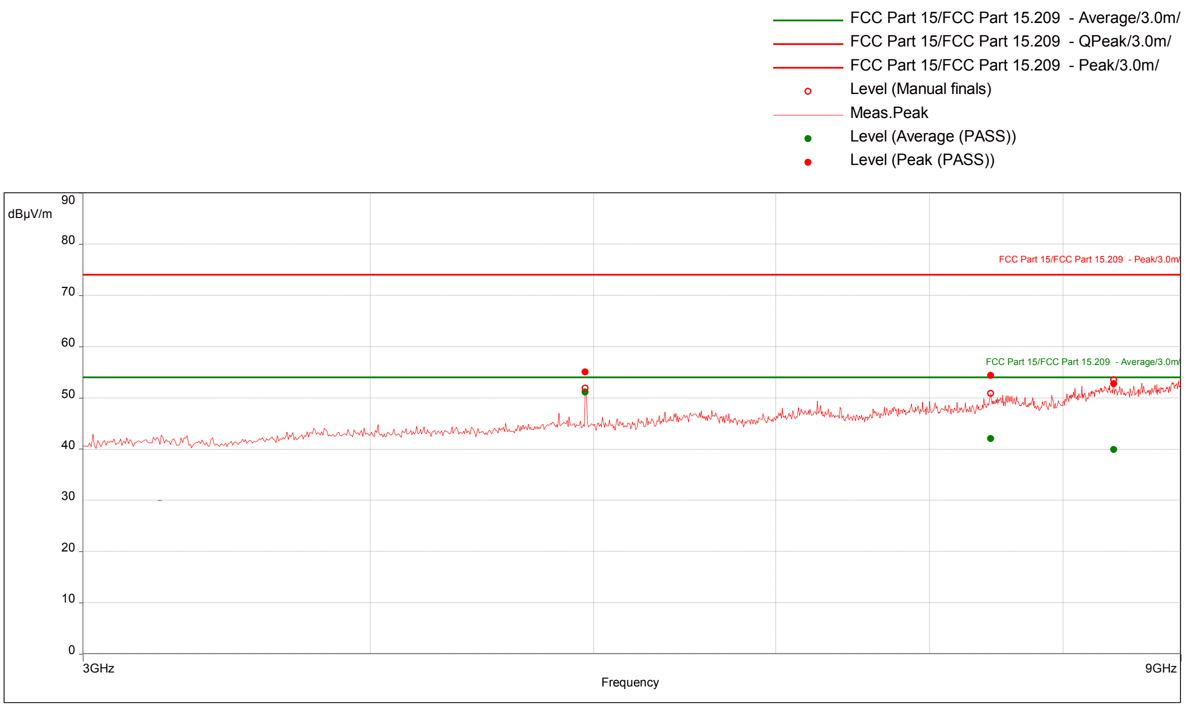
Results: No emission was detected.

Triac, Transmits @ High Channel, EUT Straight Up, 3-9 GHz

Test Information:

Date and Time	12/14/2019 4:03:41 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Transmits @ High Channel, EUT Straight Up, 3-9 GHz

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	54.99	74.00	-19.01	0.00	3.98	Vertical	1000000.00	-10.80
7441.578947	54.34	74.00	-19.66	10.00	3.39	Vertical	1000000.00	-5.16
8415.263158	52.75	74.00	-21.25	249.00	1.95	Horizontal	1000000.00	-3.15

Average (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960	51.11	54.00	-2.89	0.00	3.98	Vertical	1000000.00	-10.80
7441.578947	41.99	54.00	-12.01	10.00	3.39	Vertical	1000000.00	-5.16
8415.263158	39.90	54.00	-14.10	249.00	1.95	Horizontal	1000000.00	-3.15

9-25 GHz Manual Radiated EmissionsTesting (Low, Mid, and High Channels)

Company: Honeywell Internaltional, Inc.
Model #: Triac
Serial #: None
Engineers: Kouma Sinn
Project #: G104161294 Date(s): 12/15/19
Standard: FCC Part 15/Cispr22 Class B
Receiver: 145-108 Limit Distance (m): 3
PreAmp: BONN001_07-11-2020.txt Test Distance (m): 0.15
Location: 10m Chamber
Antenna & Cables: LF Bands: N, LF, HF, SHF
Antenna: 145-029_1m_Vert_8-05-2020.txt 145-029_1m_Hor_8-05-2020.txt
Cable(s): CBLHF2012-2M-1_02-01-8-2020.txt CBLHF2012-2M-2_2-14-20.txt
Barometer: DAV002 Filter: REA004
Temp/Humidity/Pressure: 23C 34% 992 mbar

PreAmp Used? (Y or N): Y Voltage/Frequency: 120VAC 60Hz Frequency Range: 9-125 GHz

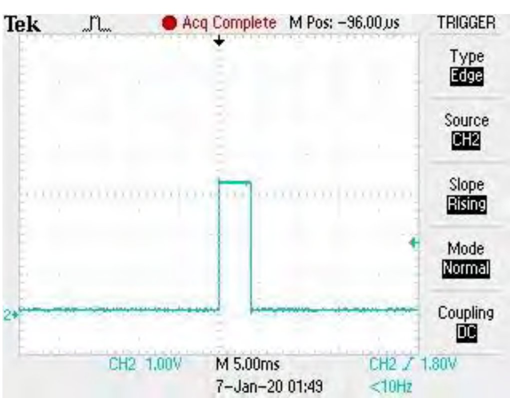
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

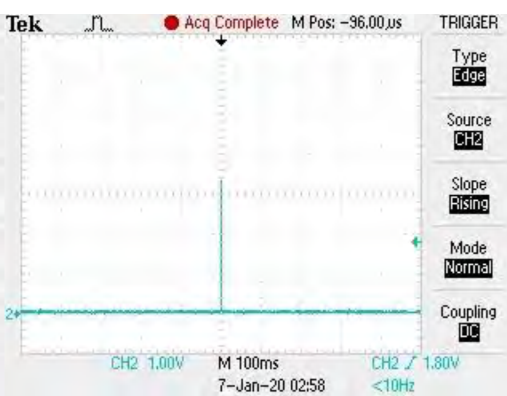
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Triac, EUT flat (worst-case), Transmits at Low Channel.											
PK	V	9620.000	66.90	37.23	5.16	53.57	26.02	29.69	74.00	-44.31	1/3 MHz
AVG	V	9620.000	63.62	37.23	5.16	53.57	26.02	26.41	54.00	-27.59	1/3 MHz
PK	V	12225.450	64.50	39.03	5.83	52.38	26.02	30.96	74.00	-43.04	1/3 MHz
AVG	V	12225.450	60.18	39.03	5.83	52.38	26.02	26.64	54.00	-27.36	1/3 MHz
PK	V	12273.710	65.23	39.13	5.85	52.32	26.02	31.88	74.00	-42.12	1/3 MHz
AVG	V	12273.710	60.80	39.13	5.85	52.32	26.02	27.45	54.00	-26.55	1/3 MHz
Triac, EUT flat (worst-case), Transmits at Mid Channel.											
PK	V	9780.000	67.96	37.42	5.20	53.55	26.02	31.02	74.00	-42.98	1/3 MHz
AVG	V	9780.000	65.37	37.42	5.20	53.55	26.02	28.43	54.00	-25.57	1/3 MHz
PK	V	12225.450	64.86	39.03	5.83	52.38	26.02	31.32	74.00	-42.68	1/3 MHz
AVG	V	12225.450	59.75	39.03	5.83	52.38	26.02	26.21	54.00	-27.79	1/3 MHz
PK	V	12273.710	64.37	39.13	5.85	52.32	26.02	31.02	74.00	-42.98	1/3 MHz
AVG	V	12273.710	58.06	39.13	5.85	52.32	26.02	24.71	54.00	-29.29	1/3 MHz
Triac, EUT flat (worst-case), Transmits at High Channel.											
PK	V	9920.000	66.76	37.64	5.25	53.57	26.02	30.06	74.00	-43.94	1/3 MHz
AVG	V	9920.000	62.64	37.64	5.25	53.57	26.02	25.94	54.00	-28.06	1/3 MHz

Notes: No emission was detected from 12.274 GHz to 25.000 GHz.
Test equipment used from 18-25 GHz: REA006, ETS004, CBLHF2012-2M-1, CBLHF2012-5M-2, 145-128, PRE8

Average Factor Calculation:





Average Factor = 20*log[(Total on time)/100 mS] or 20*log(5mS/100mS) or 26 dB

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019, 12/13/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 10.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	22, 25, 23 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	39, 25, 34 %
		Atmospheric Pressure:	1029, 1024, 992 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = $10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
PRE10'	30-1000MHz pre-amp	ITS	PRE10	PRE10	01/22/2019	01/22/2020
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/22/2019	07/22/2020
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	05/30/2019	05/30/2020
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2019	07/11/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/22/2019	07/22/2020

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

11.3 Results:

The sample tested was found to Comply.

§15.109 Radiated emission limits.

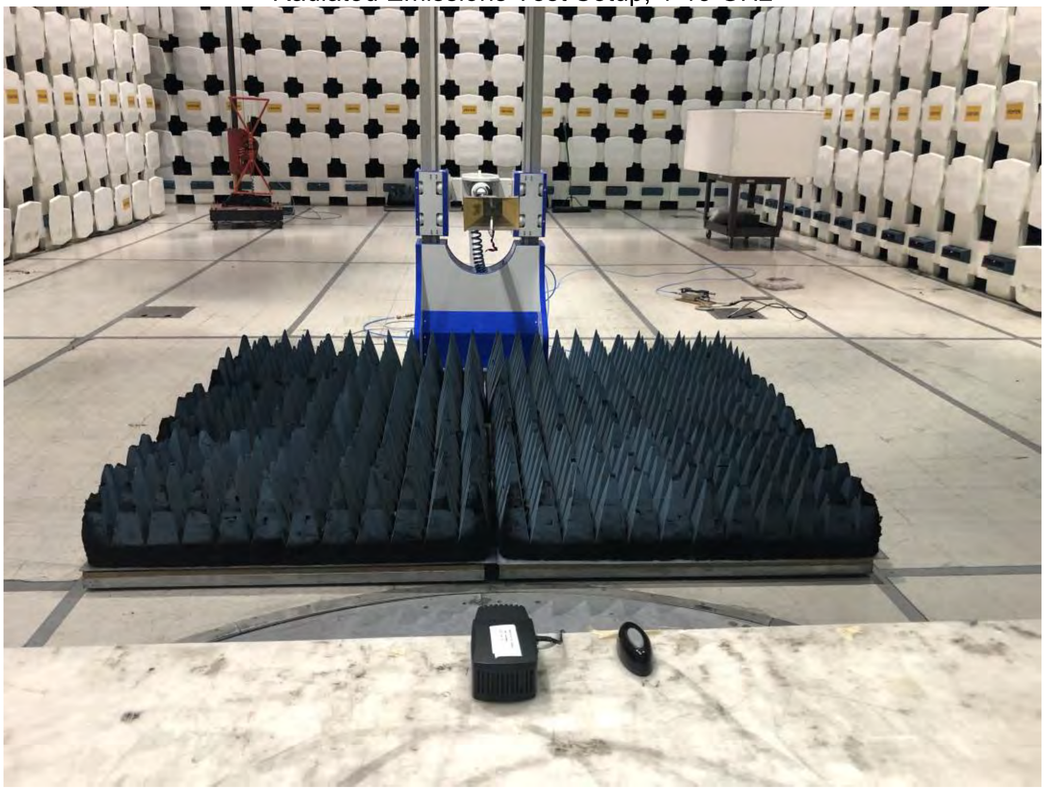
The field strength of radiated emissions form unintentional radiators at a distance of 3 meters shall not exceed the following values.

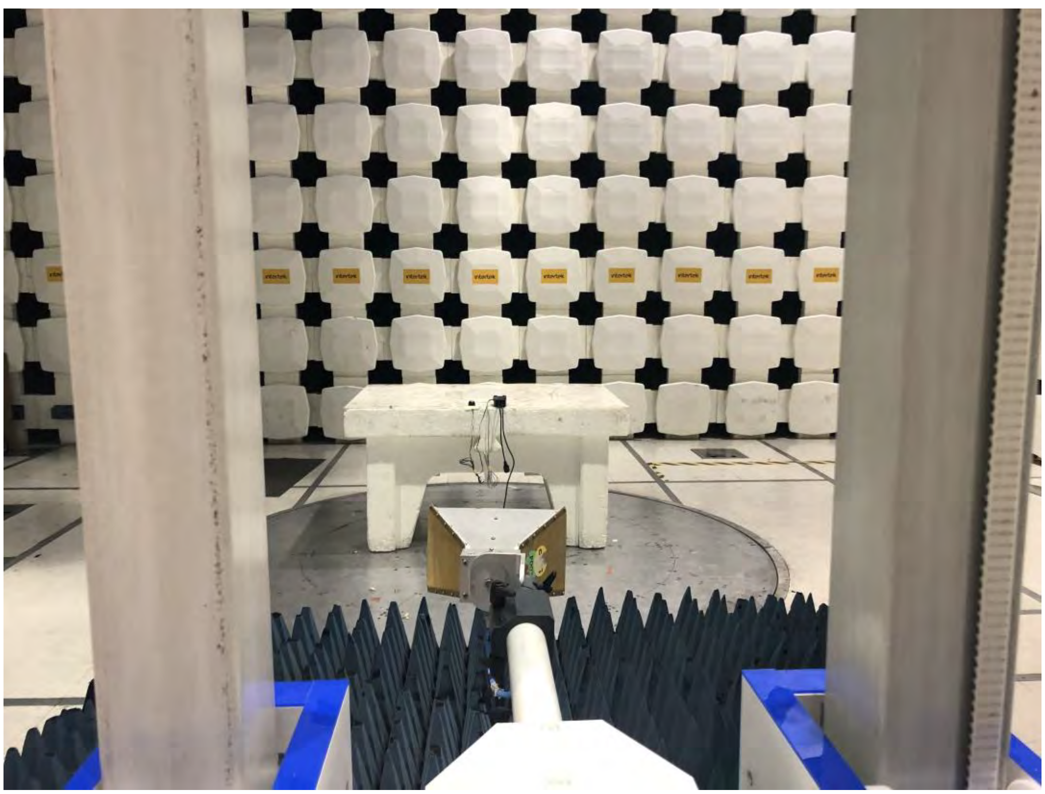
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

11.4 Setup Photographs:

Radiated Emissions Test Setup, 30-1000 MHz

Radiated Emissions Test Setup, 1-13 GHz





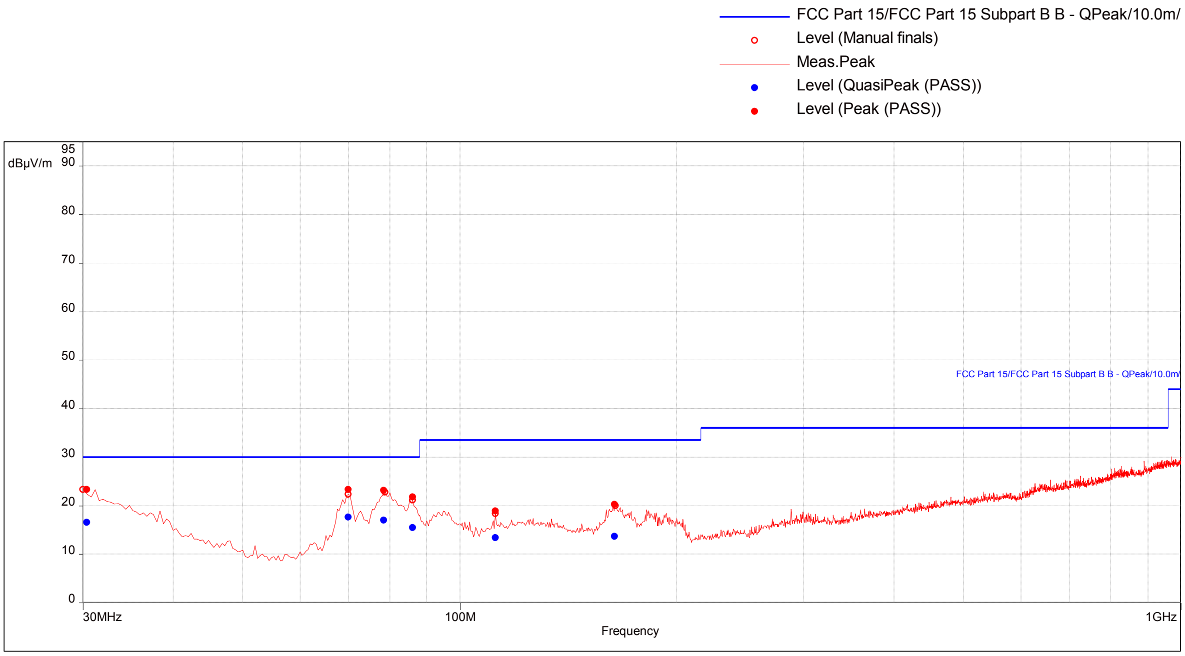
11.5 Plots/Data:

Triac, Receives @ Mid Channel, EUT Sits Flat, 30-1000MHz

Test Information:

Date and Time	12/13/2019 11:24:13 AM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	25%
Atmospheric Pressure	1024mbar
Comments	Triac, Receive @ Mid Channel, EUT Sits Flat, 30-1000MHz SA mode

Graph:



Results:

QuasiPeak (PASS) (6)

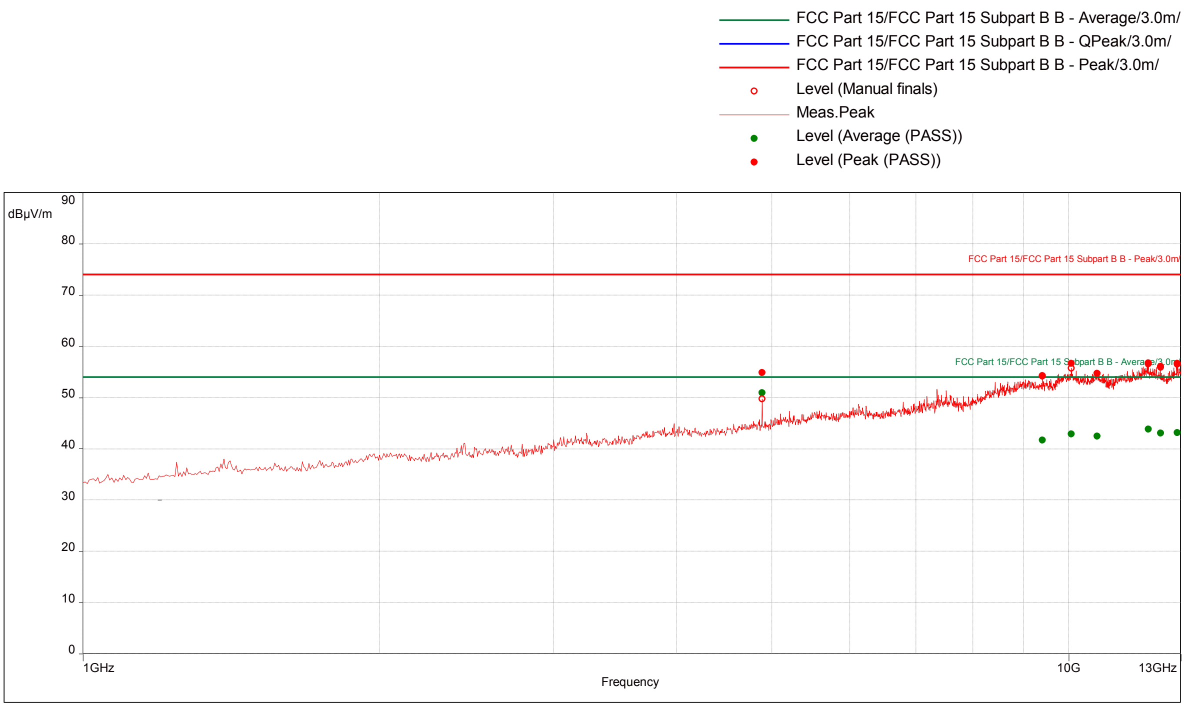
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.3	16.50	30.00	-13.50	184.00	2.17	Horizontal	120000.00	-12.59
70.18947368	17.59	30.00	-12.41	211.00	2.03	Vertical	120000.00	-24.73
78.57894737	17.01	30.00	-12.99	295.00	2.61	Vertical	120000.00	-25.01
85.87368421	15.49	30.00	-14.51	133.00	1.97	Vertical	120000.00	-25.39
112	13.38	33.50	-20.12	217.00	3.93	Vertical	120000.00	-19.39
164.0210526	13.65	33.50	-19.85	341.00	2.55	Vertical	120000.00	-19.88

Triac, Receive @ Mid Channel, EUT Flat, 1-13 GHz

Test Information:

Date and Time	12/14/2019 6:19:12 PM
Client and Project Number	Honeywell
Engineer	Kouma Sinn
Temperature	23C
Humidity	40%
Atmospheric Pressure	985mbar
Comments	Triac, Receive @ Mid Channel, EUT Flat, 1-13 GHz

Graph:



Results:

Peak (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4890	54.88	74.00	-19.12	17.00	3.69	Vertical	1000000.00	-10.91
9405.789474	54.27	74.00	-19.73	16.00	1.45	Vertical	1000000.00	-0.85
10065.78947	56.65	74.00	-17.35	210.00	2.20	Vertical	1000000.00	0.62
10688.94737	54.72	74.00	-19.28	335.00	1.50	Vertical	1000000.00	0.60
12052.36842	56.68	74.00	-17.32	224.00	1.85	Vertical	1000000.00	3.24
12399.21053	56.07	74.00	-17.93	314.00	2.35	Vertical	1000000.00	3.48
12900.78947	56.48	74.00	-17.52	127.00	2.80	Vertical	1000000.00	3.89

Average (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4890	50.92	54.00	-3.08	17.00	3.69	Vertical	1000000.00	-10.91
9405.789474	41.64	54.00	-12.36	16.00	1.45	Vertical	1000000.00	-0.85
10065.78947	42.83	54.00	-11.17	210.00	2.20	Vertical	1000000.00	0.62
10688.94737	42.41	54.00	-11.59	335.00	1.50	Vertical	1000000.00	0.60
12052.36842	43.83	54.00	-10.17	224.00	1.85	Vertical	1000000.00	3.24
12399.21053	43.08	54.00	-10.92	314.00	2.35	Vertical	1000000.00	3.48
12900.78947	43.09	54.00	-10.91	127.00	2.80	Vertical	1000000.00	3.89

Manual finals (7)

Test Personnel:	Kouma Sinn KPS	Test Date:	12/13/2019, 12/14/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 11.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	25, 23 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	25, 40 %
		Atmospheric Pressure:	1024, 985 mbars

Deviations, Additions, or Exclusions: None

12 AC Mains Conducted Emissions

12.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	1.2 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
UF = $10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “TF” is the LISN or ISN Correction Factor; “PA+CL” are Attenuator and Cable Loss. These are already accounted for in the “Level” column.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
LISN34'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191956	04/17/2019	04/17/2020
CBLBNC2012-4'	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBCN2012-4	05/07/2019	05/07/2020
DS27'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS27	10/25/2019	10/25/2020
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	06/12/2019	06/12/2020

Software Utilized:

Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

12.3 Results:

The sample tested was found to Comply.

§15.207 Conducted limits.

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

12.4 Setup Photographs:

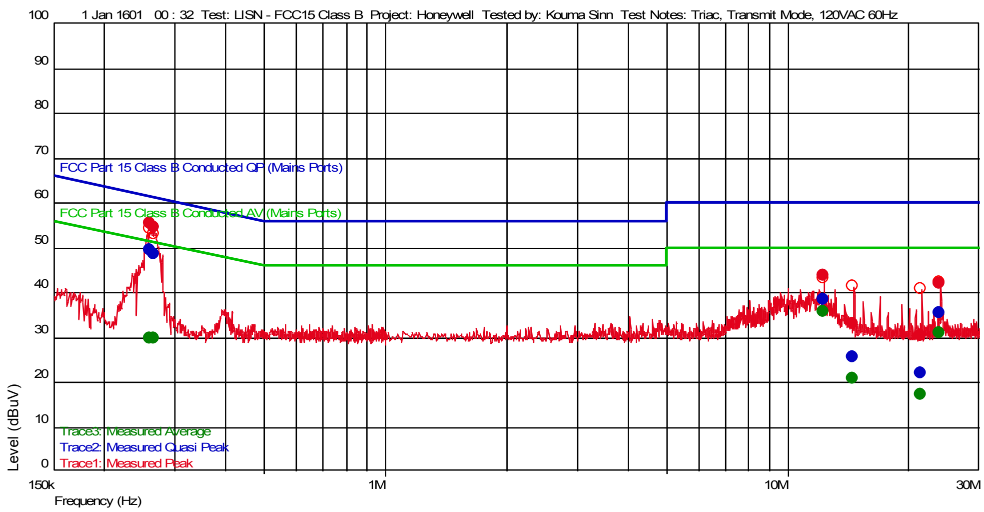
12.5 Plots/Data:

Triac, Transmit Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	Triac, Transmit Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 00 : 32	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable

Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
21.58 M	21.82	0.188	20.710	60.000	-38.18	9 k		N
14.62 M	25.67	0.122	20.639	60.000	-34.33	9 k		N
24.0 M	35.39	0.232	20.735	60.000	-24.61	9 k		L1
12.32 M	38.49	0.106	20.615	60.000	-21.51	9 k		N
267.3 k	48.36	0.057	20.101	61.201	-12.84	9 k		N
260.5 k	49.31	0.058	20.101	61.415	-12.11	9 k		N

Trace3: Measured Average

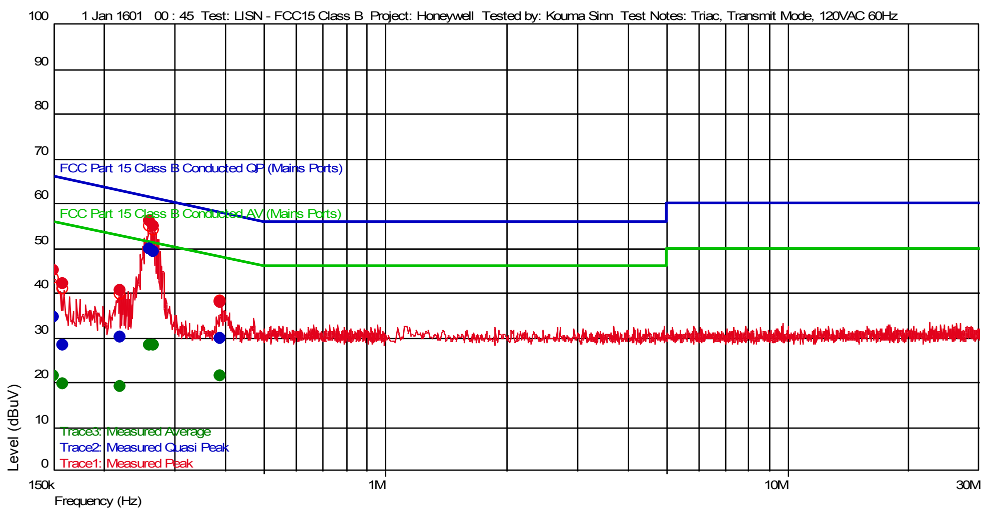
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
21.58 M	17.09	0.188	20.710	50.000	-32.91	9 k		N
14.62 M	20.71	0.122	20.639	50.000	-29.29	9 k		N
260.5 k	29.59	0.058	20.101	51.415	-21.82	9 k		N
267.3 k	29.62	0.057	20.101	51.201	-21.59	9 k		N
24.0 M	30.94	0.232	20.735	50.000	-19.06	9 k		L1
12.32 M	35.55	0.106	20.615	50.000	-14.45	9 k		N

Triac, Receive Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	Triac, Receive Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 00 : 45	

Prescan Emission Graph



Measured Peak Value	Swept Peak Data
Measured Quasi Peak Value	Swept Quasi Peak Data
Measured Average Value	Swept Average Data
Maximum Value of Mast and Turntable	

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
158.5 k	28.26	0.385	20.094	65.542	-37.28	9 k		N
220.55 k	30.07	0.066	20.098	62.798	-32.73	9 k		N
150.85 k	34.35	0.444	20.094	65.953	-31.60	9 k		N
391.4 k	29.63	0.047	20.118	58.034	-28.40	9 k		L1
267.3 k	49.01	0.057	20.101	61.201	-12.20	9 k		N
260.5 k	49.71	0.058	20.101	61.415	-11.71	9 k		N

Trace3: Measured Average

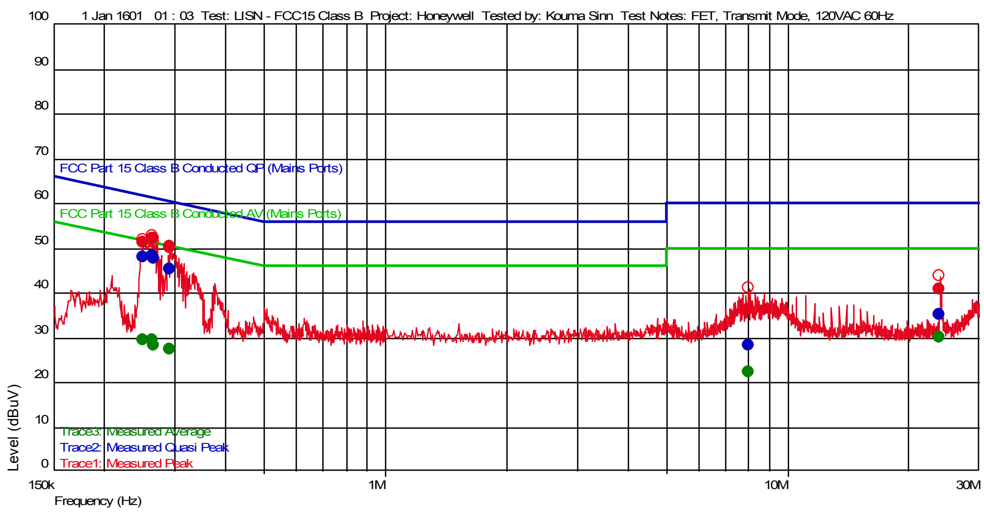
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
158.5 k	19.42	0.385	20.094	55.542	-36.12	9 k		N
150.85 k	21.42	0.444	20.094	55.953	-34.53	9 k		N
220.55 k	19.05	0.066	20.098	52.798	-33.75	9 k		N
391.4 k	21.31	0.047	20.118	48.034	-26.72	9 k		L1
260.5 k	28.21	0.058	20.101	51.415	-23.20	9 k		N
267.3 k	28.31	0.057	20.101	51.201	-22.89	9 k		N

FET, Transmit Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	FET, Transmit Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 01 : 03	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable
Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
8.038 M	28.26	0.082	20.504	60.000	-31.74	9 k		L1
24.02 M	35.22	0.232	20.735	60.000	-24.78	9 k		N
291.95 k	45.19	0.052	20.102	60.469	-15.28	9 k		N
250.3 k	47.81	0.060	20.100	61.747	-13.94	9 k		N
267.3 k	47.59	0.057	20.101	61.201	-13.61	9 k		N
264.75 k	48.27	0.057	20.101	61.281	-13.01	9 k		N

Trace3: Measured Average

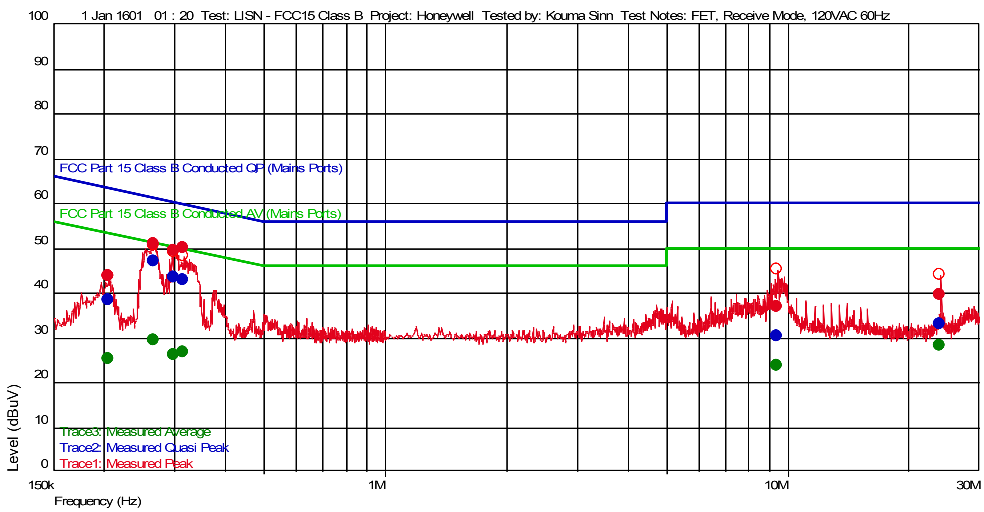
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
8.038 M	22.27	0.082	20.504	50.000	-27.73	9 k		L1
291.95 k	27.34	0.052	20.102	50.469	-23.13	9 k		N
267.3 k	28.07	0.057	20.101	51.201	-23.13	9 k		N
250.3 k	29.33	0.060	20.100	51.747	-22.42	9 k		N
264.75 k	29.34	0.057	20.101	51.281	-21.94	9 k		N
24.02 M	29.94	0.232	20.735	50.000	-20.06	9 k		N

FET, Receive Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	FET, Receive Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 01 : 20	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable

Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
9.433 M	30.16	0.088	20.567	60.000	-29.84	9 k		L1
24.02 M	33.08	0.232	20.735	60.000	-26.92	9 k		N
205.25 k	38.41	0.069	20.097	63.395	-24.99	9 k		N
298.75 k	43.36	0.050	20.103	60.278	-16.92	9 k		N
316.6 k	42.98	0.049	20.106	59.796	-16.81	9 k		N
266.45 k	47.14	0.057	20.101	61.228	-14.09	9 k		N

Trace3: Measured Average

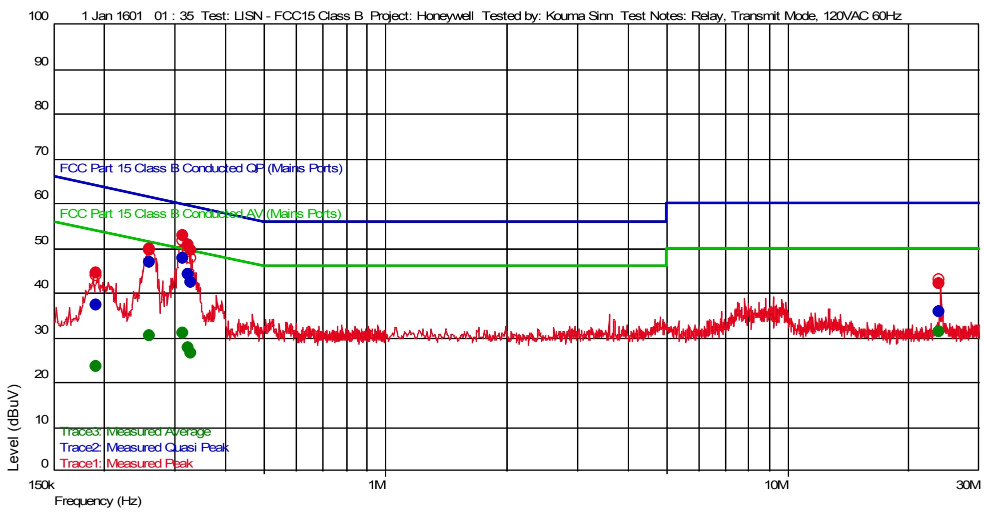
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
205.25 k	25.32	0.069	20.097	53.395	-28.08	9 k		N
9.433 M	23.86	0.088	20.567	50.000	-26.14	9 k		L1
298.75 k	26.10	0.050	20.103	50.278	-24.18	9 k		N
316.6 k	26.80	0.049	20.106	49.796	-22.99	9 k		N
266.45 k	29.46	0.057	20.101	51.228	-21.77	9 k		N
24.02 M	28.28	0.232	20.735	50.000	-21.72	9 k		N

Relay, Transmit Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	Relay, Transmit Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 01 : 35	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable

Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
191.65 k	37.29	0.133	20.096	63.965	-26.68	9 k		N
24.0 M	35.63	0.232	20.735	60.000	-24.37	9 k		N
330.2 k	42.12	0.049	20.108	59.446	-17.32	9 k		N
325.1 k	43.97	0.049	20.107	59.575	-15.61	9 k		N
260.5 k	46.73	0.058	20.101	61.415	-14.68	9 k		N
314.9 k	47.59	0.050	20.105	59.840	-12.25	9 k		N

Trace3: Measured Average

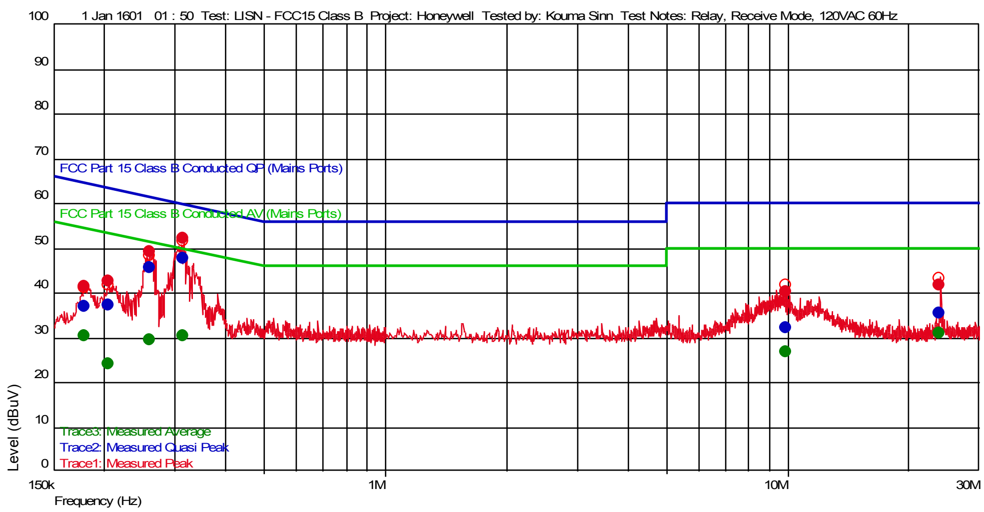
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
191.65 k	23.56	0.133	20.096	53.965	-30.40	9 k		N
330.2 k	26.41	0.049	20.108	49.446	-23.04	9 k		N
325.1 k	27.54	0.049	20.107	49.575	-22.03	9 k		N
260.5 k	30.20	0.058	20.101	51.415	-21.21	9 k		N
314.9 k	30.88	0.050	20.105	49.840	-18.96	9 k		N
24.0 M	31.27	0.232	20.735	50.000	-18.73	9 k		N

Relay, Receive Mode, 120VAC 60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Honeywell	
Test Notes:	Relay, Receive Mode, 120VAC 60Hz	
Temperature:	22C	
Humidity:	30%, 1028mbar	
Tested by:	Kouma Sinn	
Test Started:	1 Jan 1601 01 : 50	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
9.919 M	32.01	0.090	20.588	60.000	-27.99	9 k		N
179.75 k	37.00	0.224	20.096	64.497	-27.50	9 k		L1
205.25 k	37.20	0.069	20.097	63.395	-26.19	9 k		N
24.0 M	35.50	0.232	20.735	60.000	-24.50	9 k		N
260.5 k	45.50	0.058	20.101	61.415	-15.92	9 k		N
314.9 k	47.53	0.050	20.105	59.840	-12.31	9 k		N

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
205.25 k	24.02	0.069	20.097	53.395	-29.38	9 k		N
179.75 k	30.32	0.224	20.096	54.497	-24.17	9 k		L1
9.919 M	26.64	0.090	20.588	50.000	-23.36	9 k		N
260.5 k	29.33	0.058	20.101	51.415	-22.09	9 k		N
314.9 k	30.27	0.050	20.105	49.840	-19.57	9 k		N
24.0 M	30.95	0.232	20.735	50.000	-19.05	9 k		N

Test Personnel:	Kouma Sinn KPS	Test Date:	12/12/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B, ICES-003	Limit Applied:	See report section 12.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Signal Generator @ -20 dBm was used instead of BB source	Relative Humidity:	30 %
		Atmospheric Pressure:	1028 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	01/16/2020	104161294BOX-001	KPS KPS	VFV VFV	Original Issue
1	03/17/2021	104161294BOX-001	KPS KPS	VFV VFV	Added limit for occupied bandwidth on page 22