
Project 21589-15

**Hubbell Control Solutions
NX Wireless Rocker Switch
(Model NXSW-WRS-WH)**

Wireless Certification Report

Prepared for:

Hubbell Control Solutions
710 Hesters Crossing Road
Suite 100
Round Rock, TX 78681

By

Professional Testing (EMI), Inc.
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11 Nov 2021

Reviewed by



Shakil Murad
Lead EMC Engineer

Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Draft 01	For review.	10 Apr 2020
Final 01	Final release	21 Sep 2021
Final 02	Added peak power plots; corrected tabular peak power; minor corrections	11 Nov 2021

Errata:

None.

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Certificate of Compliance

FCC MRA Designation Number: US5270

NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification
Hubbell Control Solutions 710 Hesters Crossing Road Suite 100 Round Rock, TX 78681 Certificate Date: 11 Nov 2021	FCC ID: YH9NXSWWRS Industry Canada ID: 9044A-NXSWWRS Model(s): NXSW-WRS-WH Laboratory Project ID: 21589-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, <u>2400-2483.5 MHz</u> , and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.107, 15.207	Conducted emission limits.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 5, Amd. 1	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Hubbell Building Automation / NX Wireless Rocker Switch Model NXSW-WRS-WH	None	Wall switch for building lighting system control. Uses a 2400-2483.5 MHz FHSS transceiver with Bluetooth Low Energy radio protocols. Approximately 1 x 4 x 9 cm.

Table 1.2.2: Support Equipment		
Manufacturer / Model	Serial #	Description
none		none

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

The EUT was tested as a DTS device as its bandwidth satisfies the DTS minimum bandwidth requirements. In the final application it will be also hopping per the Bluetooth protocol.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 776781, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665. CAB Identifier: US 0123.

1.6 Radiated Measurements

Table 1.6 1 Corrections for Radiated Measurements	
Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses
Distance Extrapolation	If required for above 30 MHz applies 1/d.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents	
Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 5, Amd. 1	General Requirements for Compliance of Radio Apparatus
ANSI C63.10 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Table 1.7.2: Applicable Clauses		
Parameter	FCC Part 15 Rule Paragraphs	IC RSS References
Transmitter Characteristics	15.247	RSS-247 5.2 (DTS) & 5.4, RSS-Gen
Bandwidth	15.247(a)(1), 2.1049, KDB 558074 D01	RSS-Gen 4.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 4.9, 4.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 4.9
Antenna Requirement	15.203	RSS-Gen 8.3
Conducted Emissions, Mains	15.207	RSS-Gen 8.8

2.0 Fundamental Power and Duty Cycle

2.1 Test Procedure

Peak power is measured using radiated means. The transmitter hopping sequence is disabled to operate on a single channel for the measurement.

Duty cycle measurement is taken based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter harmonics to determine average power.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-247 5.2	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dB μ V/m @ 3 m	11 Mar 2020

2.3 Test Summary, Peak Power

The EUT was measured for radiated power in normal upright orientation for wall mounted device.

Table 2.3.1 Power, Peak, Radiated			
Frequency MHz	Measured Peak Power dB μ V/m @ 3 m Vertical Polarity	Measured Peak Power dB μ V/m @ 3 m Horizontal Polarity	Maximum Measured Peak Power Restated as EIRP dBm mW
2402	84.21	99.45	4.2 2.6
2444	86.52	102.09	6.9 4.9
2480	88.43	103.63	8.4 6.9

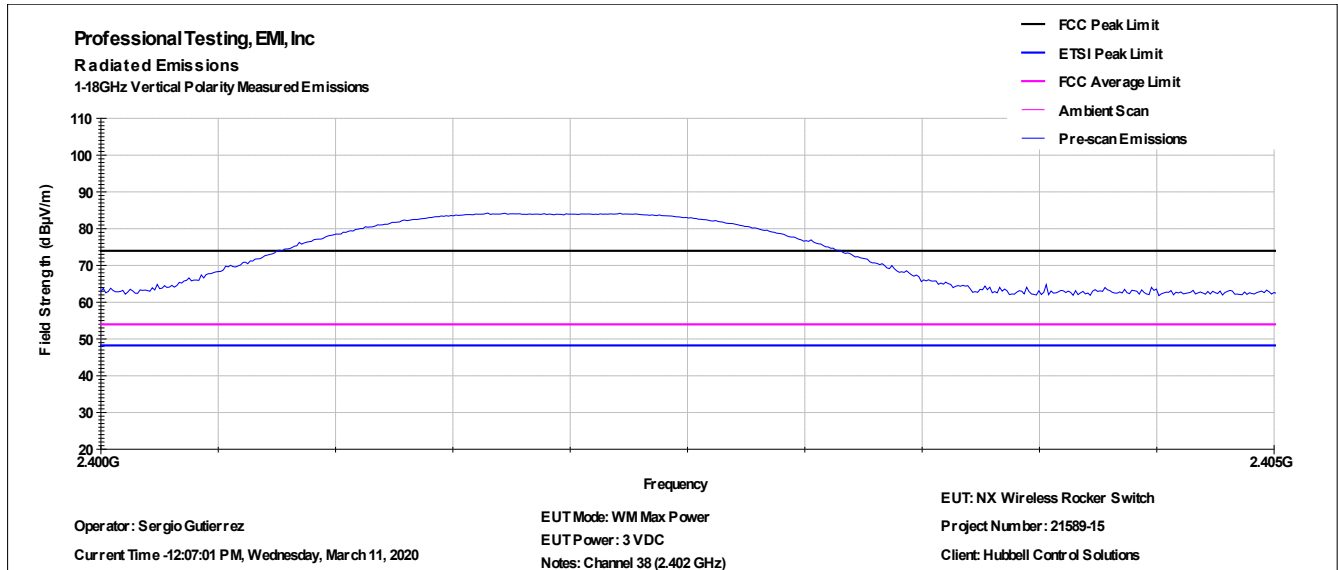
Measured in 1 MHz RBW, 3 MHz VBW.

The EUT was found to be in compliance with the applicable criteria.

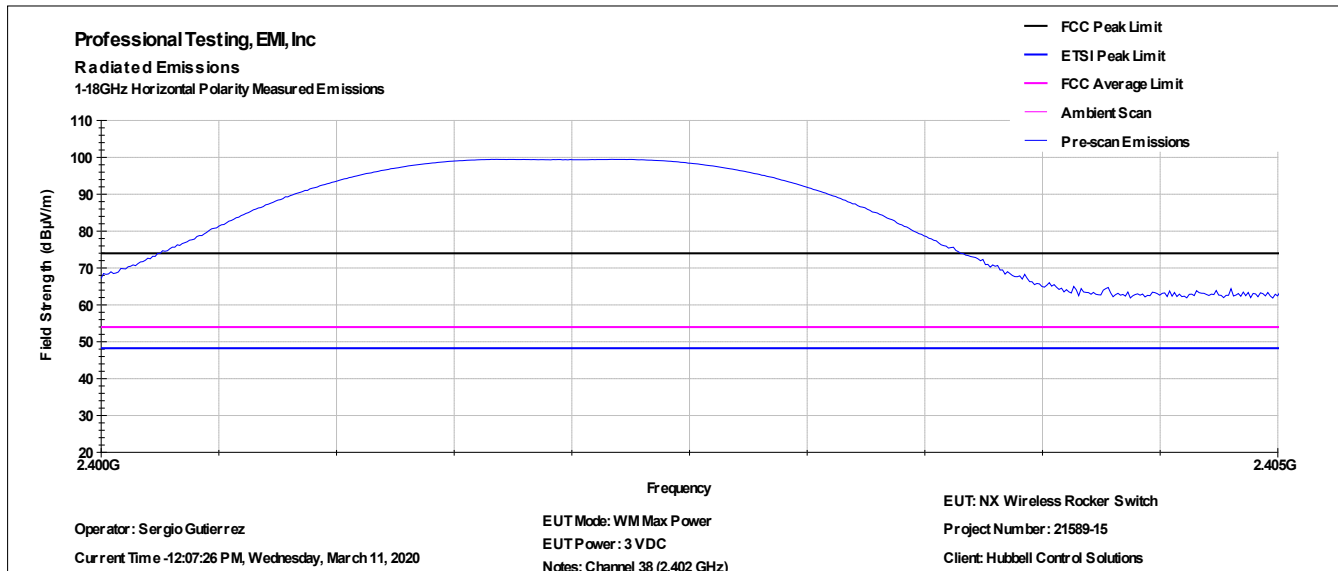
Graphical data presented on pages below.

2.4 Test Results, Peak Power

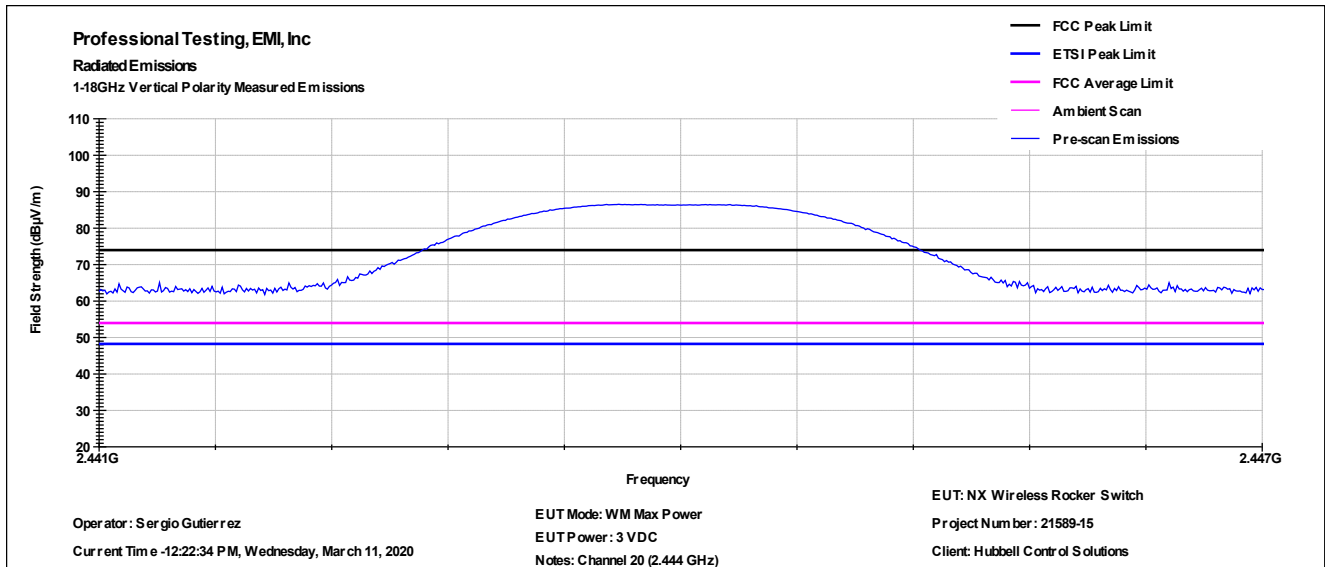
Low Channel, Vertical Polarization



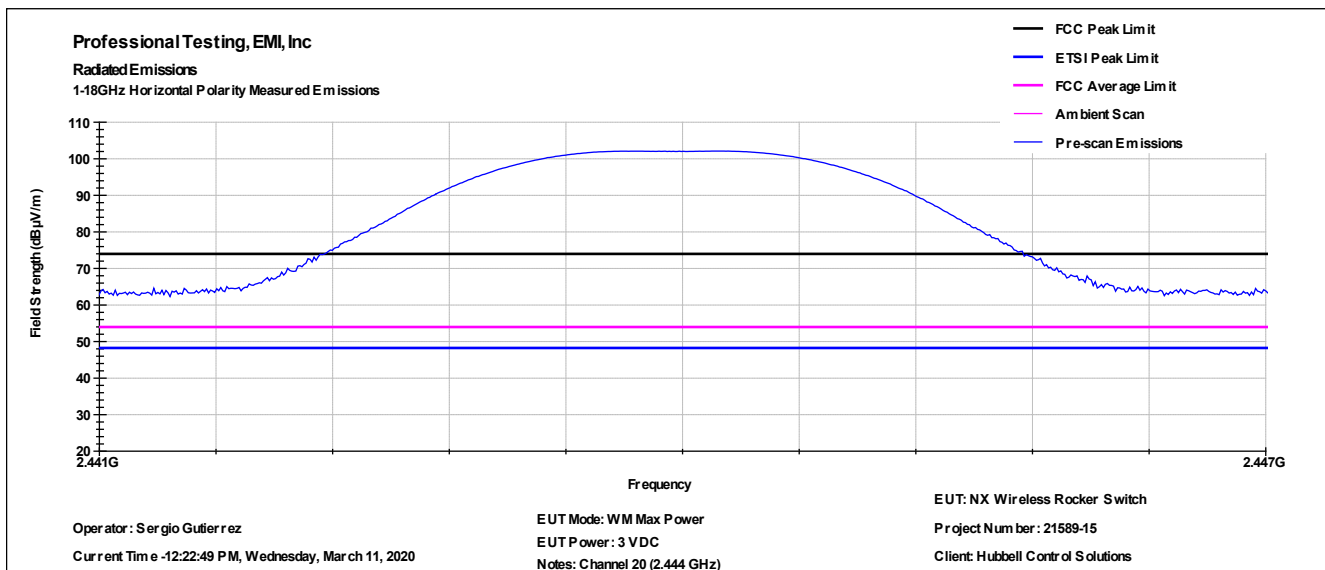
Low Channel, Horizontal Polarization



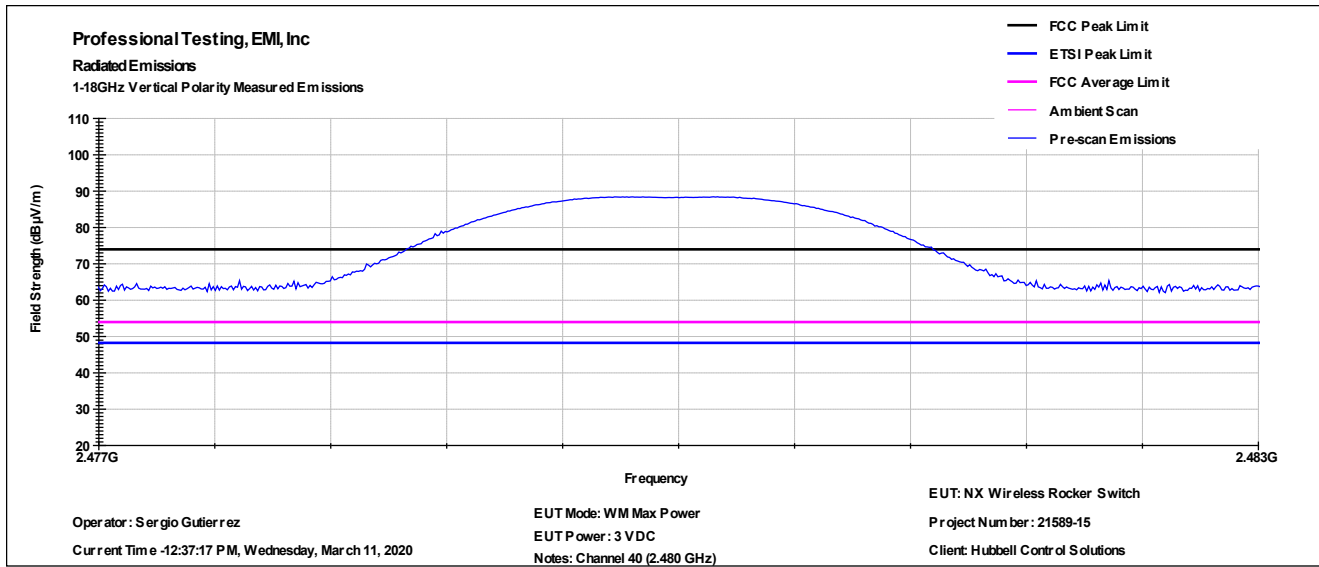
Middle Channel, Vertical Polarization



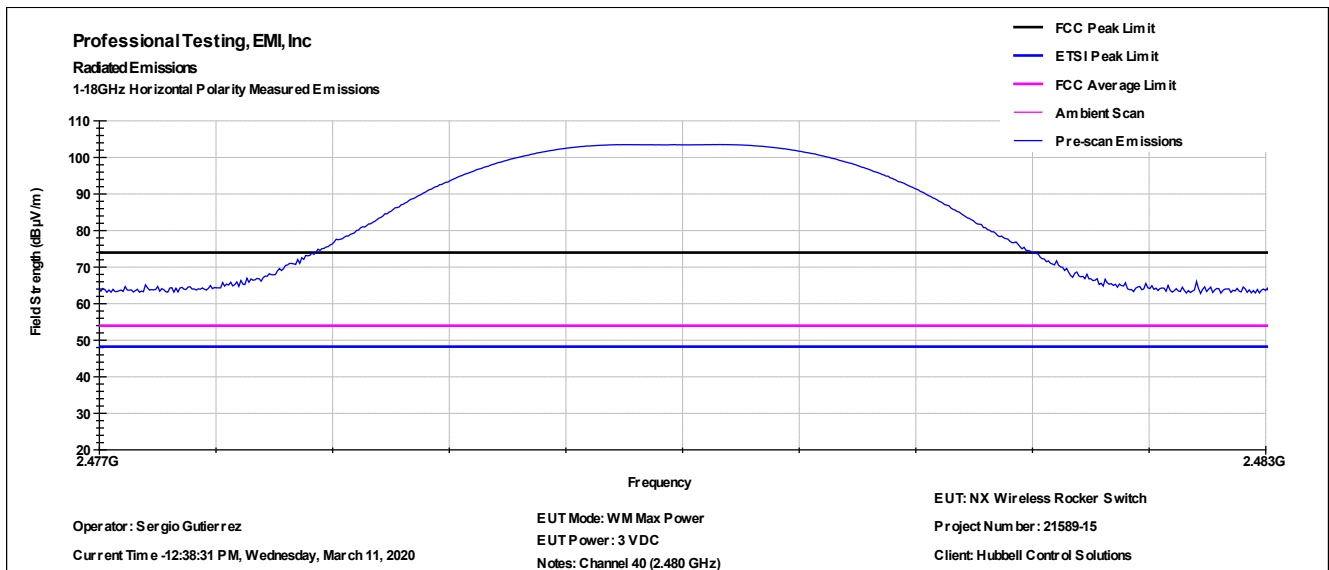
Middle Channel, Horizontal Polarization



High Channel, Vertical Polarization

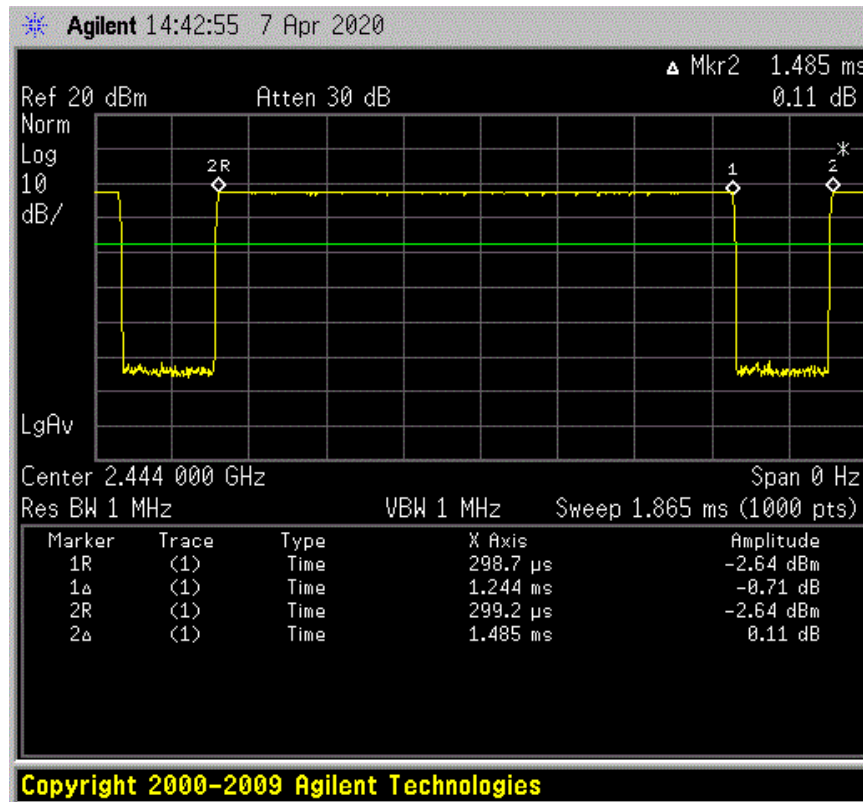


High Channel, Horizontal Polarization



2.5 Test Results, Duty Cycle

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter harmonics to determine average power. This is not a pass/fail measurement.



Transmit time: 1.244 ms

Period: 1.485 ms

$$DC = 1.244 / 1.485 = 0.8377 = 83.77 \%$$

$$\text{Averaging factor for harmonics: } 20 \log (0.8377) = -1.54 \text{ dB}$$

$$\text{Weighting factor for exposure: } 10 \log (0.8377) = -0.78 \text{ dB}$$

3.0 Power Spectral Density

3.1 Test Procedure

A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the prescribed resolution bandwidth.

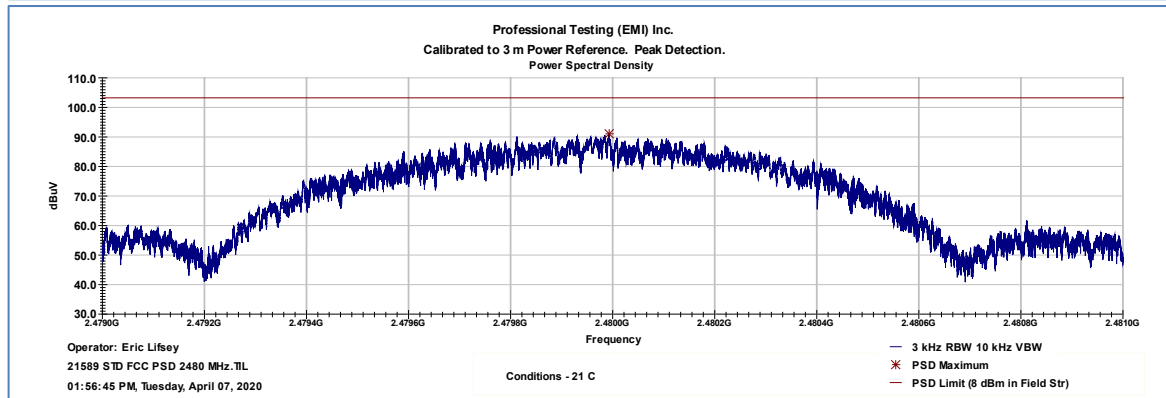
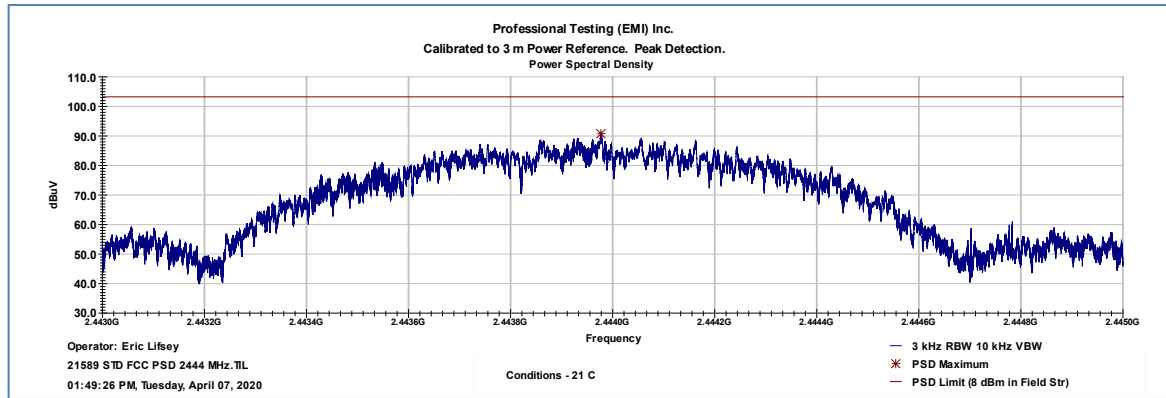
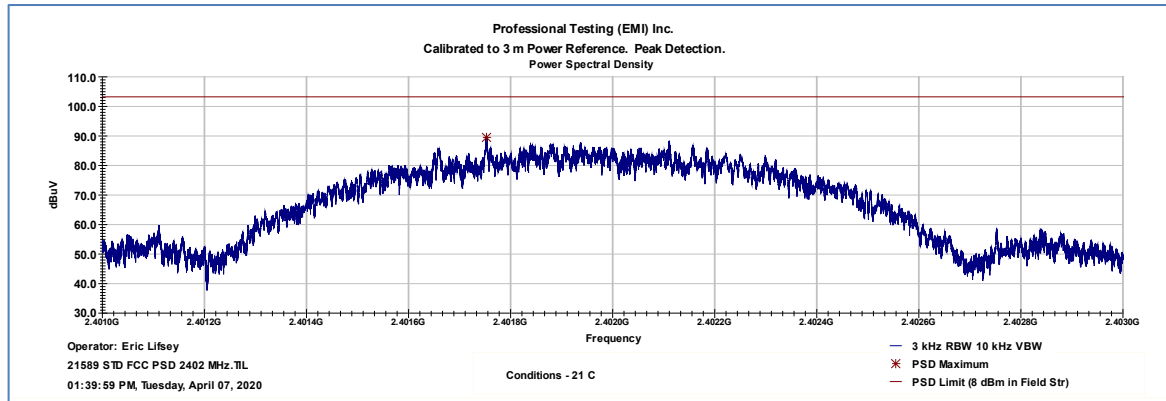
3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247, 5.2	Power Spectral Density, Conducted Limit: 8 dBm / 3 kHz Restated as radiated limit: 103.2 @ 3 meters	7 Apr 2020

3.3 Test Results

Highest output polarization measured (vertical). The EUT satisfied the requirement.

Table 2.3.1 Power Spectral Density, Peak, Radiated		
Frequency MHz	Measured Peak PSD dB μ V/m @ 3 m Horizontal Polarity	Measured Peak PSD Restated as EIRP dBm
2402	89.5	-5.7
2444	90.7	-4.5
2480	91.0	-4.2



4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by radiated means. A recording of the results is included.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 4.6	Bandwidth, 6 dB, 99%	13 Mar 2020

4.3 Test Results

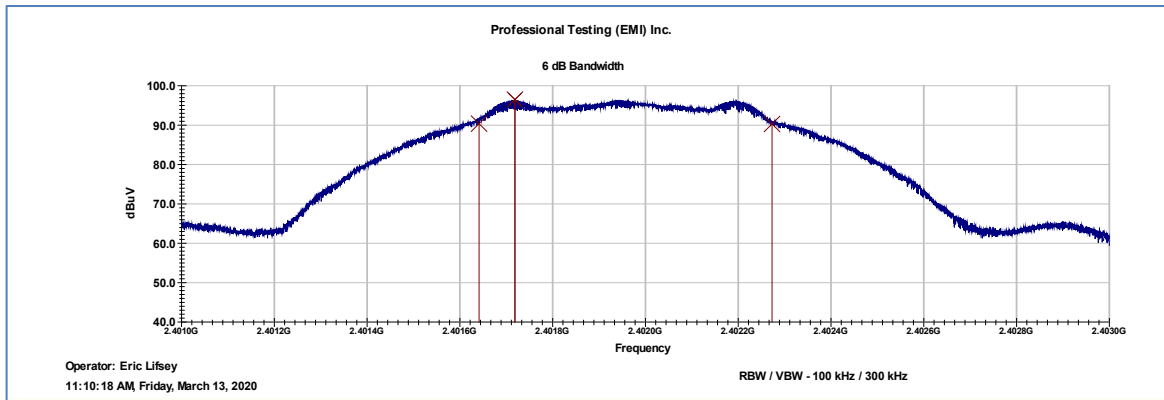
The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

The EUT satisfied the requirements.

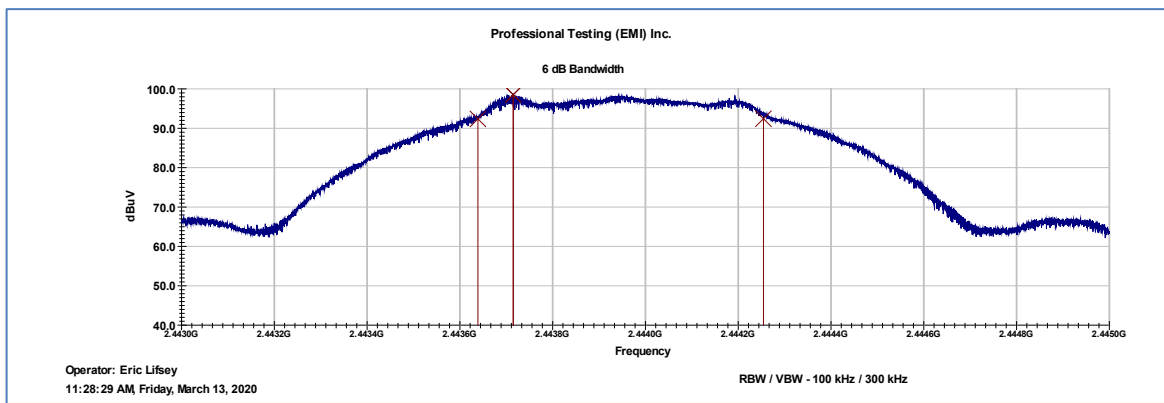
Table 4.3.1 Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Minimum BW (kHz)
632	616	607	607

Table 4.3.3 Bandwidth OBW 99%, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1041	1045	1045	1045

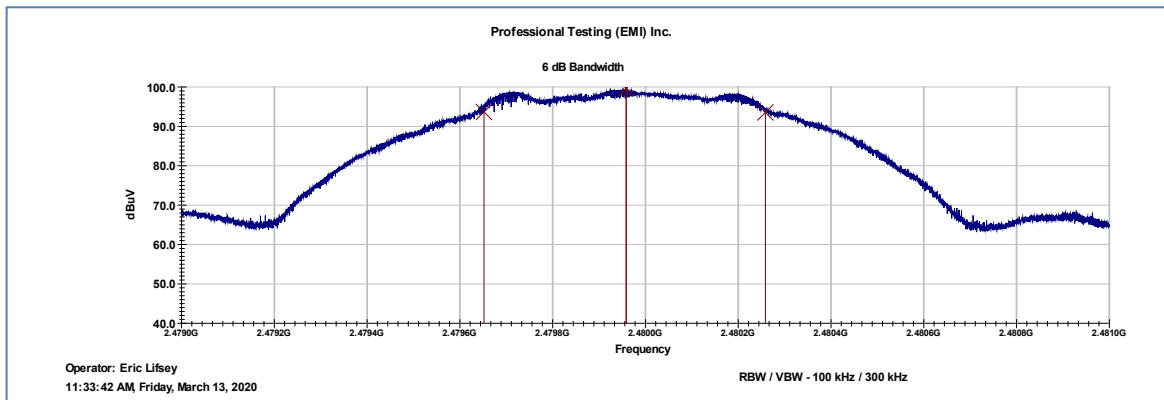
4.3.1 Bandwidth Plots, 6 dB



6 dB, Bottom Channel

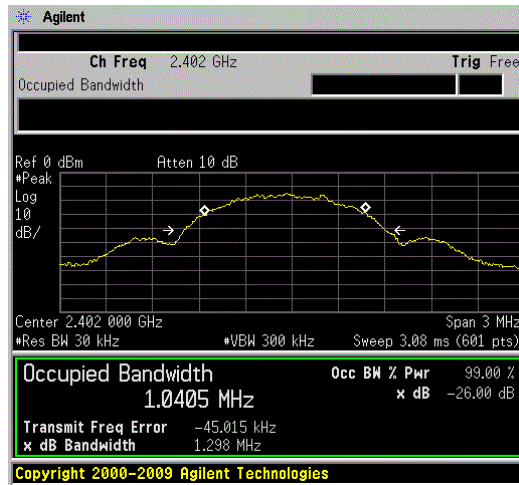


6 dB, Middle Channel

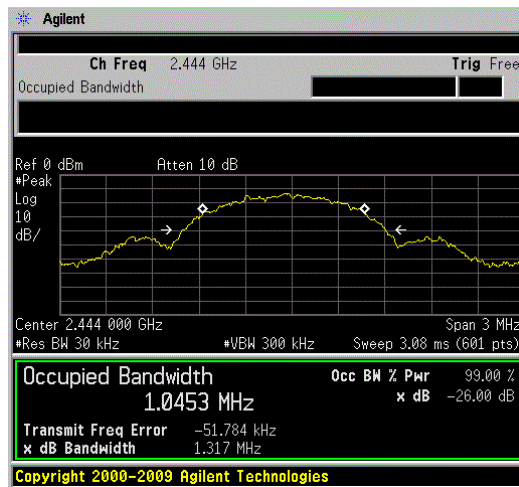


6 dB, Top Channel

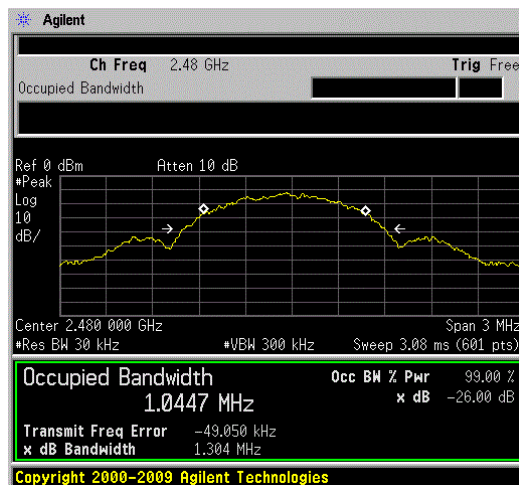
4.3.2 Bandwidth Plots, OBW 99%



Bottom Channel



Middle Channel



Top Channel

5.0 Band Edge

5.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is approximately centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method of C63.4 is utilized.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.205 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band, Radiated	7 Apr 2020

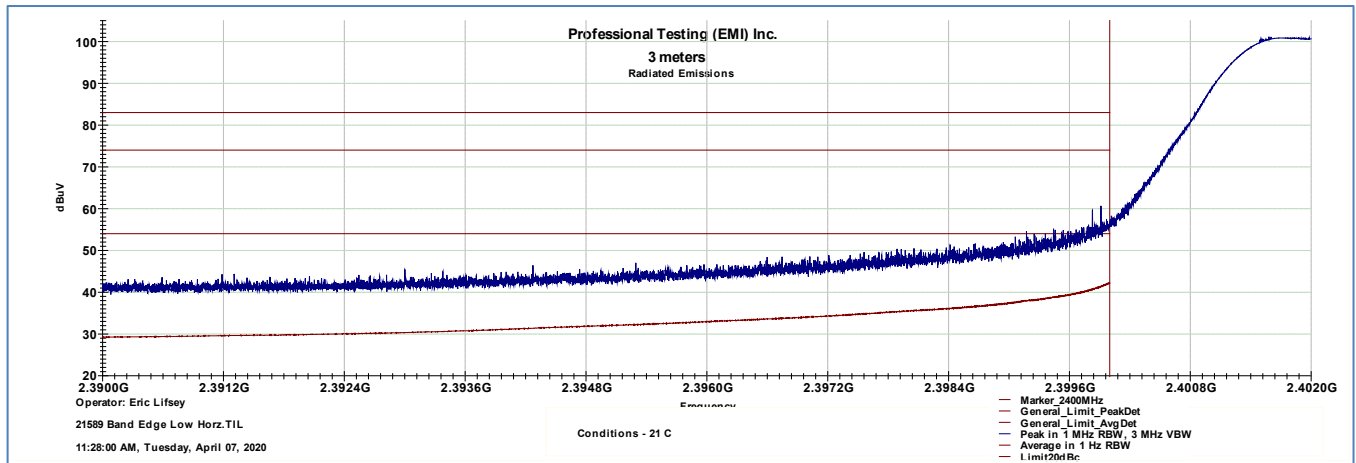
5.3 Test Results

Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed.

Peak detection of emissions at both band edges were below the general emission limits for average limit levels.

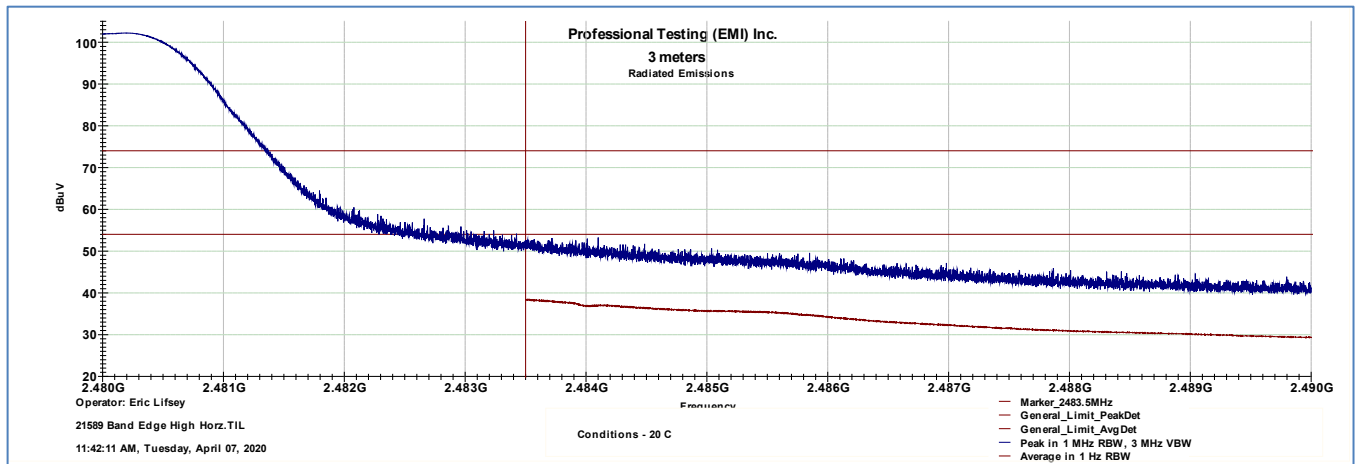
The worse-case polarity was measured. The EUT satisfied the criteria.

5.3.1 Bottom Channel Band Edge



Bottom Channel, 20 dBc Limit Applies

5.3.2 Top Channel Band Edge



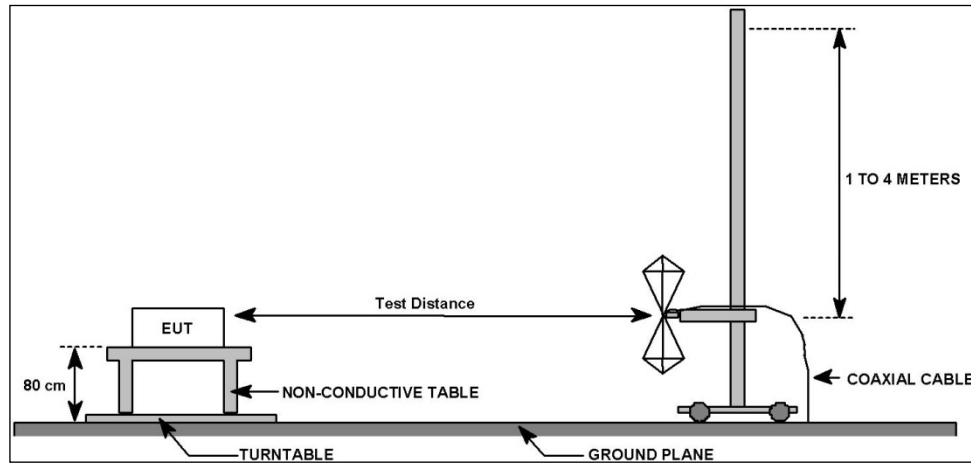
Top Channel, General Emission Limit Applies

6.0 Radiated Spurious Emissions, Receive Mode

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured using quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate and with 1 MHz resolution bandwidth.



6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	12 Mar 2020

6.3 Test Results

The EUT was tuned to the middle channel and placed in receive mode.

The EUT satisfied the criteria.

6.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.								
Test Method:		ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz						
In accordance with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits						
Section:		15.109						
Test Date(s):		3/12/2020			EUT Serial #:		0437369	
Customer:		Hubbell Control Solutions			EUT Part #:		NX Wireless Rocker Switch	
Project Number:		21589-15			Test Technician:		Sergio Gutierrez	
Purchase Order #:		N/A			Supervisor:		Shakil Murad	
Equip. Under Test:		NX Wireless Rocker Switch			Witness' Name:		N/A	
Radiated Emissions Test Results Data Sheet								
EUT Line Voltage:		3 VDC			EUT Power		0 N/A	
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz	
EUT Mode of Operation:					BLE Advertising			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
31.222	10	157	2.66	Quasi-peak	11.622	29.5	-17.9	Pass
55.509	10	103	3.05	Quasi-peak	6.203	29.5	-23.3	Pass
60.032	10	130	3.41	Quasi-peak	15.953	29.5	-13.5	Pass
255.809	10	115	1.64	Quasi-peak	11.336	35.6	-24.3	Pass
576.034	10	58	2.67	Quasi-peak	21.833	35.6	-13.8	Pass
909.372	10	202	3.78	Quasi-peak	25.507	35.6	-10.1	Pass
Professional Testing, EMI, Inc Radiated Emissions 30MHz - 1GHz Vertical Polarity Measured Emissions Operator: Sergio Gutierrez Current Time -09:18:37 AM, Thursday, March 12, 2020 EUT Mode: BLE Adv- EUT Power: 3 VDC Notes: EUT: NX Wireless Rocker Switch Project Number: 21589-15 Client: Hubbell Control Solutions								
≤ 1GHz Vertical Antenna Polarity Measured Emissions								

Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	3/12/2020	EUT Serial #:	0437369
Customer:	Hubbell Control Solutions	EUT Part #:	NX Wireless Rocker Switch
Project Number:	21589-15	Test Technician:	Sergio Gutierrez
Purchase Order #:	N/A	Supervisor:	Shakil Murad
Equip. Under Test:	NX Wireless Rocker Switch	Witness' Name:	N/A

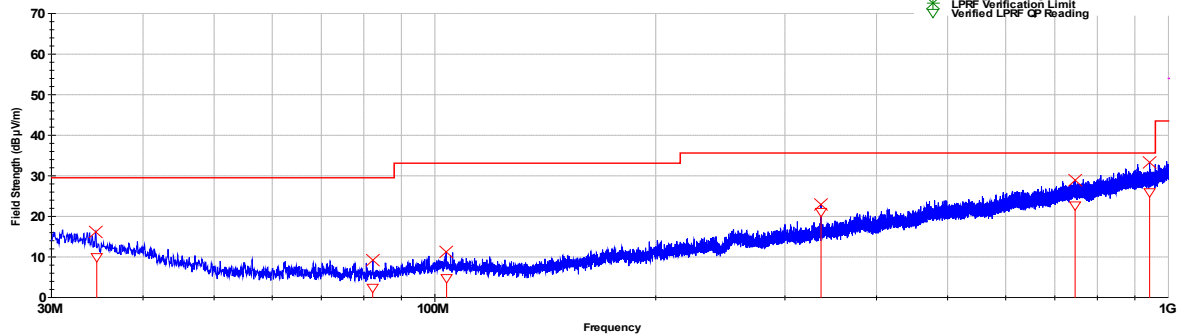
Radiated Emissions Test Results Data Sheet

EUT Line Voltage:		3 VDC			EUT Power		0 N/A	
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz	
EUT Mode of Operation:					BLE Advertising			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
34.585	10	228	3.09	Quasi-peak	9.946	29.5	-19.6	Pass
82.252	10	30	3.47	Quasi-peak	2.394	29.5	-27.1	Pass
103.738	10	69	1.93	Quasi-peak	4.766	33.1	-28.3	Pass
336.019	10	32	2.62	Quasi-peak	21.084	35.6	-14.5	Pass
746.108	10	272	1.49	Quasi-peak	22.692	35.6	-12.9	Pass
942.578	10	319	2.52	Quasi-peak	25.931	35.6	-9.7	Pass

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time -09:24:47 AM, Thursday, March 12, 2020

EUT Mode: BLE Adv-

EUT Power: 3 VDC

Notes:

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Above 1 GHz

Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	3/12/2020	EUT Serial #:	0437369
Customer:	Hubbell Control Solutions	EUT Part #:	NX Wireless Rocker Switch
Project Number:	21589-15	Test Technician:	Sergio Gutierrez
Purchase Order #:	N/A	Supervisor:	Shakil Murad
Equip. Under Test:	NX Wireless Rocker Switch	Witness' Name:	N/A

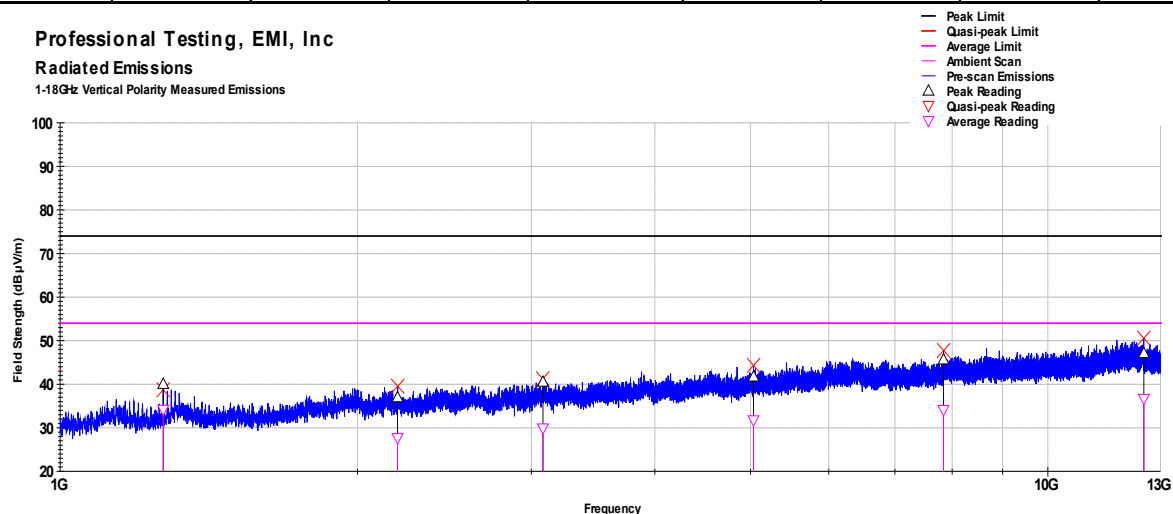
Radiated Emissions Test Results Data Sheet

EUT Line Voltage:		3 VDC			EUT Power Frequency:		0 N/A	
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz	
EUT Mode of Operation:					BLE Advertising			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1271.9	3	17	1.01	Average	34.147	54.0	-19.8	Pass
2196.21	3	290	1.01	Average	27.66	54.0	-26.3	Pass
3082.32	3	76	2.73	Average	29.868	54.0	-24.1	Pass
5035.58	3	146	3.77	Average	31.725	54.0	-22.2	Pass
7840.13	3	111	3.59	Average	34.104	54.0	-19.9	Pass
12505.91	3	111	1.4	Average	36.651	54.0	-17.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions

1-18GHz Vertical Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time -09:55:34 AM, Thursday, March 12, 2020

EUT Mode: BLE Adv-

EUT Power: 3 VDC

Notes:

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	3/12/2020	EUT Serial #:	0437369
Customer:	Hubbell Control Solutions	EUT Part #:	NX Wireless Rocker Switch
Project Number:	21589-15	Test Technician:	Sergio Gutierrez
Purchase Order #:	N/A	Supervisor:	Shakil Murad
Equip. Under Test:	NX Wireless Rocker Switch	Witness' Name:	N/A

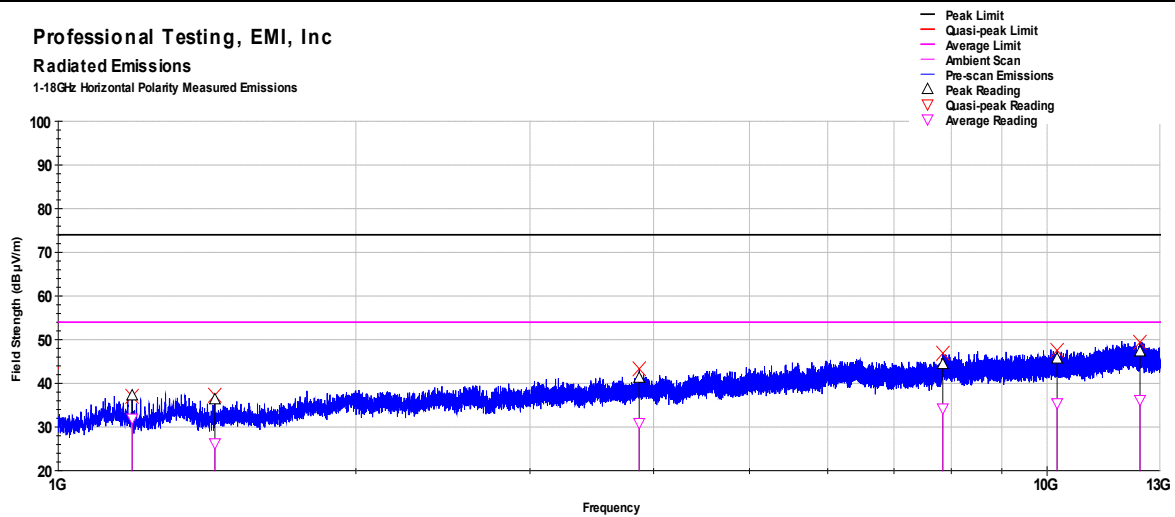
Radiated Emissions Test Results Data Sheet

EUT Line Voltage:		3 VDC			EUT Power	0 N/A		
Antenna Orientation:		Horizontal			Frequency Range:	Above 1GHz		
EUT Mode of Operation:					BLE Advertising			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1188.13	3	201	1.02	Average	31.958	54.0	-22.0	Pass
1440.32	3	312	1.13	Average	26.3	54.0	-27.7	Pass
3868.04	3	295	1.89	Average	30.946	54.0	-23.0	Pass
7843.53	3	336	3.46	Average	34.292	54.0	-19.7	Pass
10235.3	3	139	1.26	Average	35.466	54.0	-18.5	Pass
12413.82	3	201	3.01	Average	36.205	54.0	-17.8	Pass

Professional Testing, EMI, Inc

Radiated Emissions

1-18GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time -10:04:54 AM, Thursday, March 12, 2020

EUT Mode: BLE Adv-

EUT Power: 3 VDC

Notes:

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

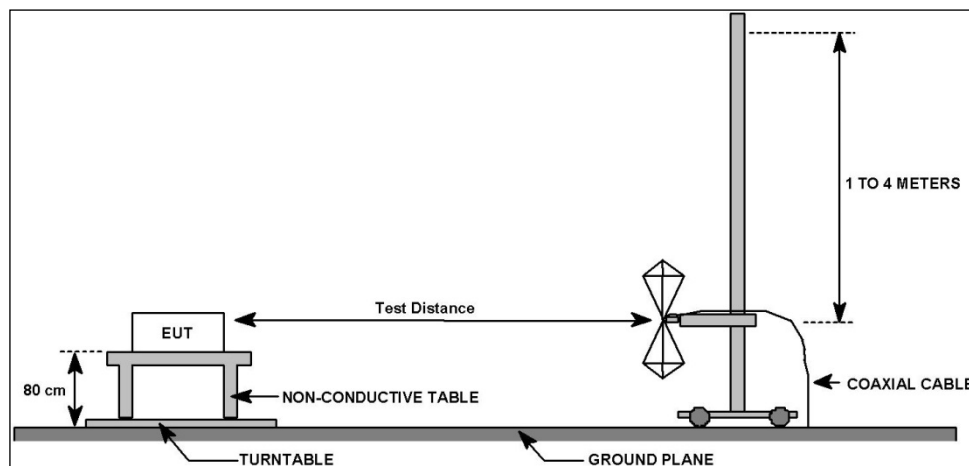
> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Radiated Spurious Emissions, Transmit Mode

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters. The EUT height was 80 cm up to 1 GHz and 150 cm above 1 GHz.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate using 1 MHz resolution bandwidth. Transmit harmonics are measured as peak values and averaged by the duty cycle factor.



7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	11 Mar 2020

7.3 Test Results

Below 1 GHz measurements were taken for the middle channel. Above 1 GHz measurements were taken for the three standard channels of the band. The Duty Cycle correction factor was not applied to the average measurements presented in this section.

Plotted results in the following graphs represent peak emissions data. Tabular data indicates average measurements.

The EUT satisfied the requirement.

7.3.1 Up to 1 GHz, Middle Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: 30MHz to 1GHz

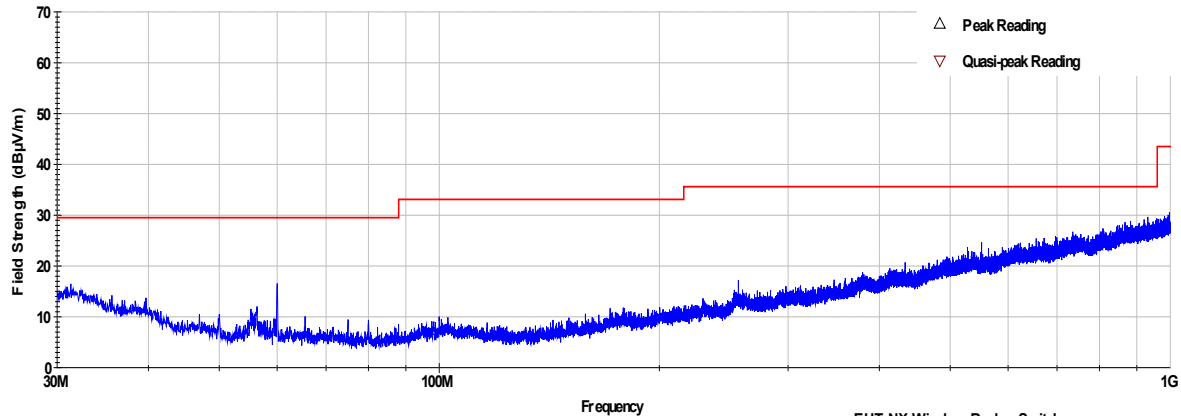
EUT Mode of Operation:

2.444 GHz Transmit

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Vertical Polarity Measured Emissions



Operator: Sergio Gutierrez

EUT Mode: WM Max Power

EUT: NX Wireless Rocker Switch

Current Time: 04:06:57 PM, Wednesday, March 11, 2020

EUT Power: 3 VDC

Project Number: 21589-15

Notes: Channel 20 (2.444 GHz)

Client: Hubbell Control Solutions

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

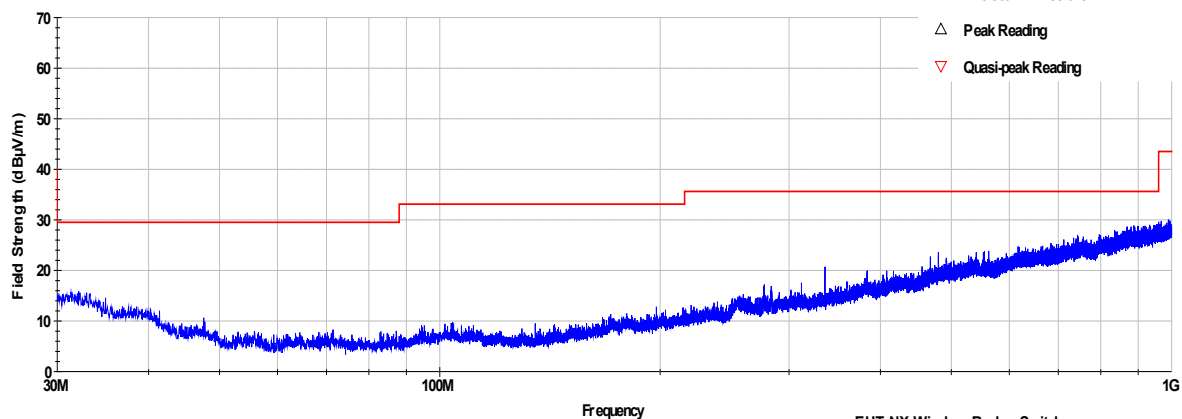
Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

2.444 GHz Transmit

Professional Testing, EMI, Inc
Radiated Emissions
30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

EUT Mode: WM Max Power

EUT: NX Wireless Rocker Switch

Current Time: 04:06:57 PM, Wednesday, March 11, 2020

EUT Power: 3 VDC

Project Number: 21589-15

Notes: Channel 20 (2.444 GHz)

Client: Hubbell Control Solutions

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.2 1 GHz to 18 GHz, Bottom Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

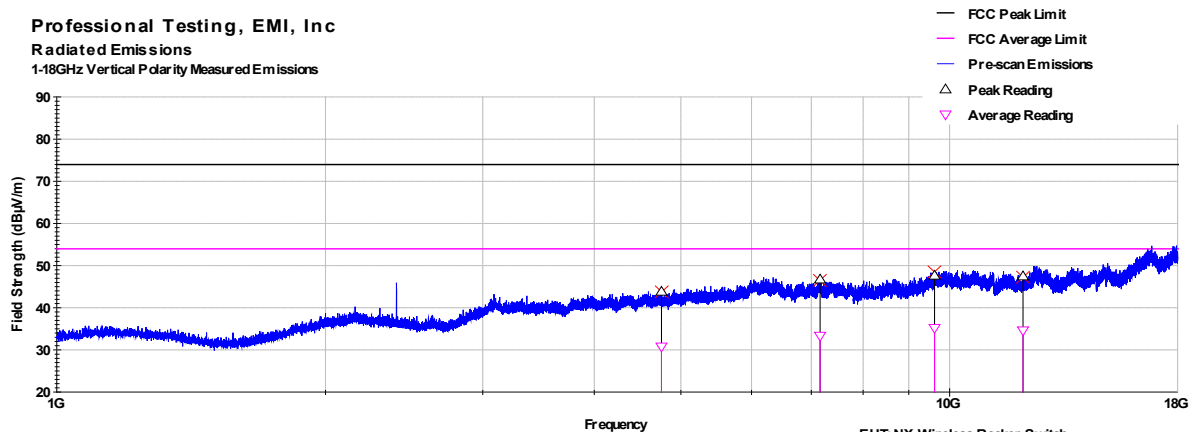
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.402 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4756.99	3	18	2.54	Average	30.739	54.0	-23.2	Pass
7160.51	3	16	1.02	Average	33.298	54.0	-20.7	Pass
9619.12	3	196	1.02	Average	35.163	54.0	-18.8	Pass
12084.13	3	358	3.24	Average	34.568	54.0	-19.4	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Vertical Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time: 02:55:55 PM, Wednesday, March 11, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 38 (2.402 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

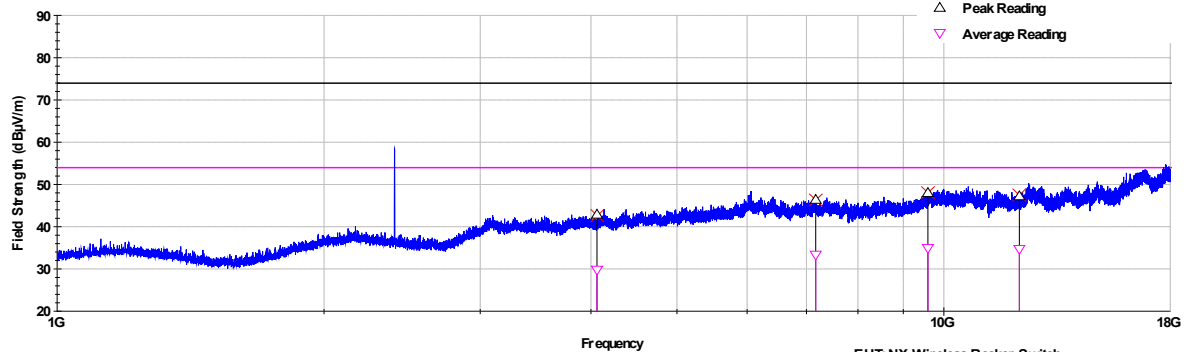
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:
2.402 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4062.67	3	358	3.41	Average	29.767	54.0	-24.2	Pass
7168.97	3	104	3.52	Average	33.326	54.0	-20.7	Pass
9594.84	3	229	1.02	Average	34.897	54.0	-19.1	Pass
12165.02	3	311	3.78	Average	34.675	54.0	-19.3	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time: 03:07:42 PM, Wednesday, March 11, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 38 (2.402 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.3 1 GHz to 18 GHz, Middle Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

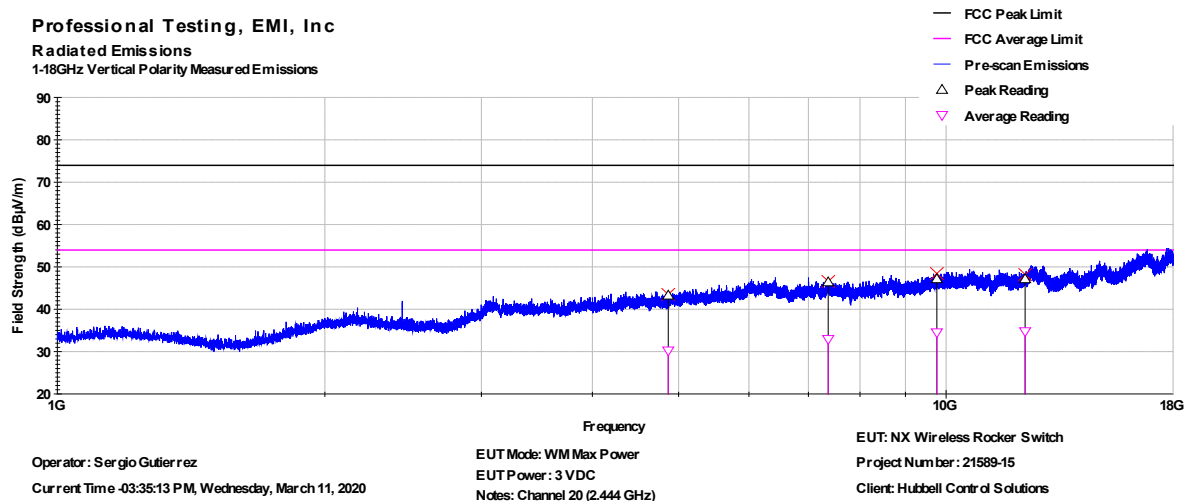
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.444 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4868.08	3	262	3.43	Average	30.206	54.0	-23.8	Pass
7368.08	3	357	1.26	Average	32.897	54.0	-21.1	Pass
9763.13	3	344	1	Average	34.489	54.0	-19.5	Pass
12270.33	3	100	3.38	Average	34.737	54.0	-19.3	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Vertical Polarity Measured Emissions



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

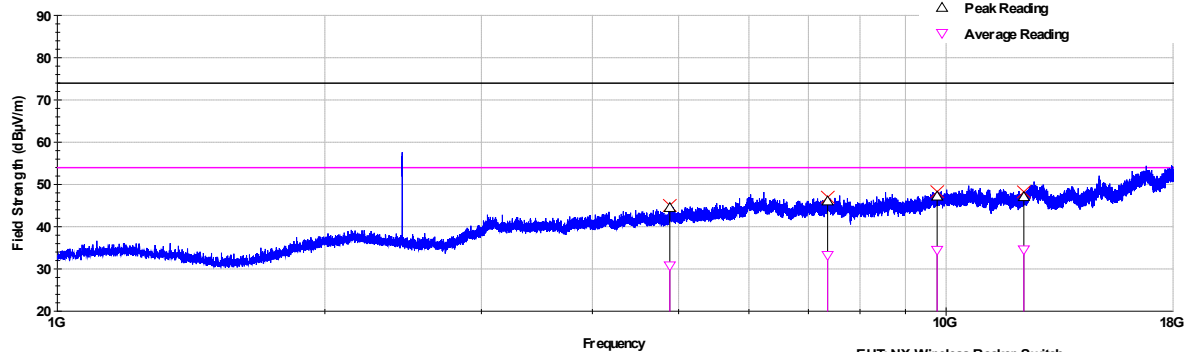
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:
2.444 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4888.14	3	2	1.02	Average	30.79	54.0	-23.2	Pass
7356.52	3	169	3.37	Average	33.246	54.0	-20.8	Pass
9770.94	3	236	1.82	Average	34.475	54.0	-19.5	Pass
12231.51	3	90	3.78	Average	34.563	54.0	-19.4	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time: 03:46:54 PM, Wednesday, March 11, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 20 (2.444 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.4 1 GHz to 18 GHz, Top Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

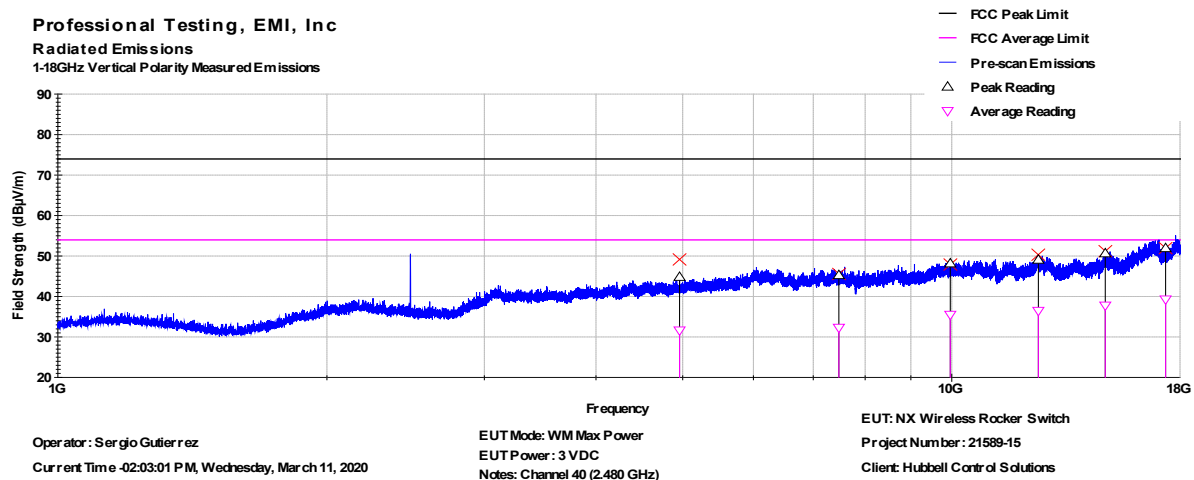
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.480 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4960.2	3	92	1	Average	31.587	54.0	-22.4	Pass
7477.09	3	243	2.05	Average	32.263	54.0	-21.7	Pass
9961.83	3	63	1.26	Average	35.458	54.0	-18.5	Pass
12498.89	3	206	3.77	Average	36.432	54.0	-17.6	Pass
14850.32	3	52	1.54	Average	37.743	54.0	-16.3	Pass
17346.39	3	74	2.65	Average	39.238	54.0	-14.8	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Vertical Polarity Measured Emissions



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

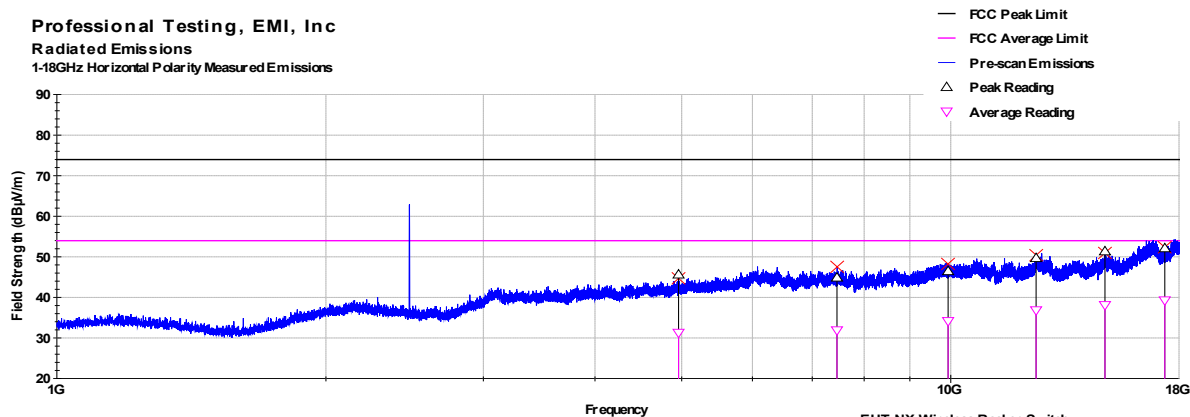
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:
2.480 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4959.67	3	307	1.46	Average	31.272	54.0	-22.7	Pass
7460.07	3	124	3.16	Average	31.876	54.0	-22.1	Pass
9930.96	3	217	1.32	Average	34.133	54.0	-19.9	Pass
12459.24	3	244	2.35	Average	36.795	54.0	-17.2	Pass
14874.92	3	356	1.02	Average	38.074	54.0	-15.9	Pass
17354.03	3	212	1.02	Average	39.241	54.0	-14.8	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

EUT Mode: WM Max Power

EUT: NX Wireless Rocker Switch

Current Time: 02:20:34 PM, Wednesday, March 11, 2020

EUT Power: 3 VDC

Project Number: 21589-15

Notes: Channel 40 (2.480 GHz)

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.5 18 GHz to 25 GHz, Bottom Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

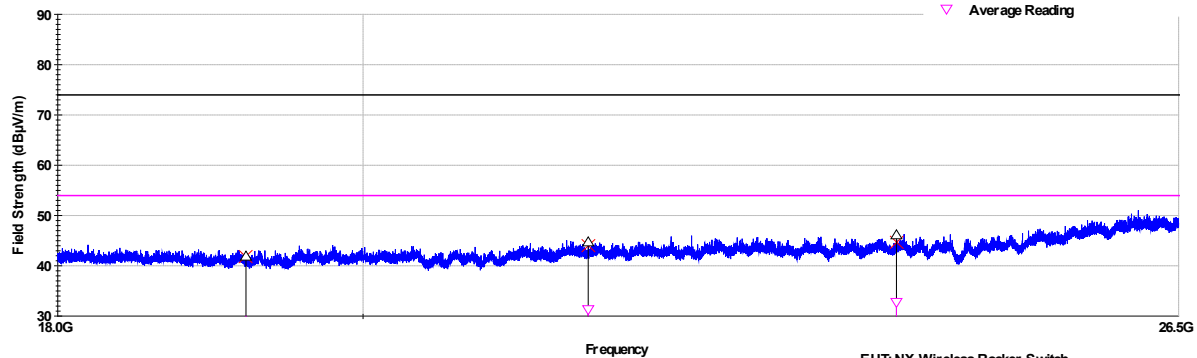
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.402 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
19208.37	1	179	1	Average	28.965	54.0	-25.0	Pass
21616.1	1	357	1	Average	31.308	54.0	-22.7	Pass
24041.45	1	254	1	Average	32.756	54.0	-21.2	Pass

Professional Testing, EMI, Inc

Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Vertical Polarity Measured Emissions

Operator: Sergio Gutierrez

Current Time: 10:50:35 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power
EUT Power: 3 VDC
Notes: Channel 38 (2.402 GHz)EUT: NX Wireless Rocker Switch
Project Number: 21589-15
Client: Hubbell Control Solutions

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

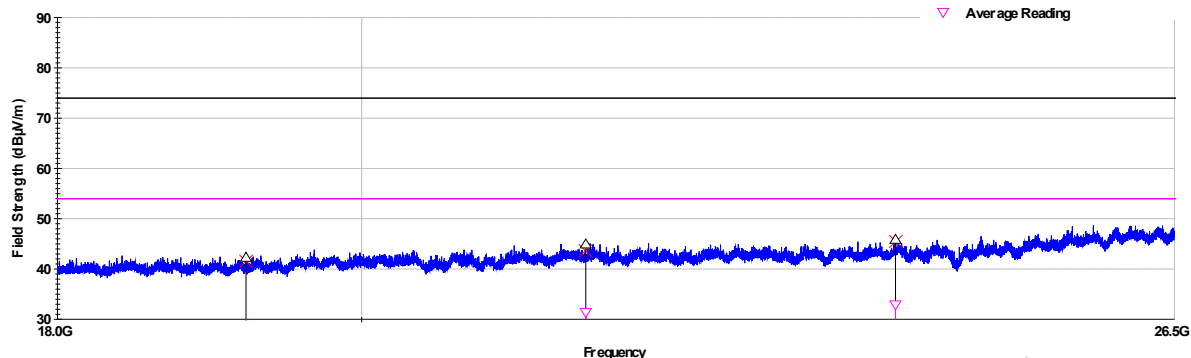
EUT Mode of Operation:

2.402 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19214.86	1	125	1	Average	28.893	54.0	-25.1	Pass
21614.07	1	97	1	Average	31.397	54.0	-22.6	Pass
24060.61	1	245	1	Average	32.9	54.0	-21.1	Pass

Professional Testing, EMI, Inc

Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Horizontal Polarity Measured Emissions



Operator: Sergio Gutierrez

Current Time: 10:43:05 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 38 (2.402 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.6 18 GHz to 25 GHz, Middle Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

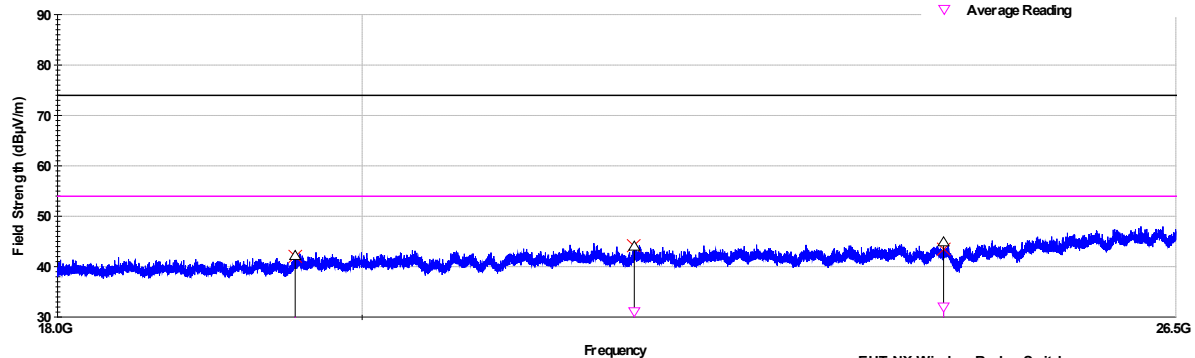
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.444 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
19542.28	1	34	1	Average	28.876	54.0	-25.1	Pass
21974.29	1	91	1	Average	31.088	54.0	-22.9	Pass
24454.58	1	215	1	Average	32.032	54.0	-22.0	Pass

Professional Testing, EMI, Inc

Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Vertical Polarity Measured Emissions

Operator: Sergio Gutierrez

Current Time: 11:18:51 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power
EUT Power: 3 VDC
Notes: Channel 20 (2.444 GHz)EUT: NX Wireless Rocker Switch
Project Number: 21589-15
Client: Hubbell Control Solutions

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

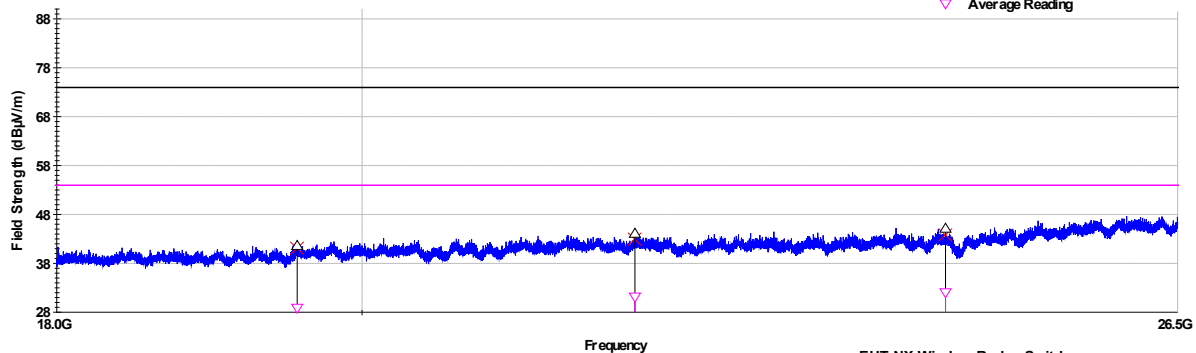
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:
2.444 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19557.53	1	315	1	Average	28.852	54.0	-25.1	Pass
21974.74	1	250	1	Average	31.124	54.0	-22.9	Pass
24460.83	1	357	1	Average	32.017	54.0	-22.0	Pass

Professional Testing, EMI, Inc

 Radiated Emissions, Measured at 1m and Scaled to 3m Distance
 18-26.5 GHz Horizontal Polarity Measured Emissions


Operator: Sergio Gutierrez

Current Time: 11:13:37 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 20 (2.444 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

7.3.7 18 GHz to 25 GHz, Top Channel

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

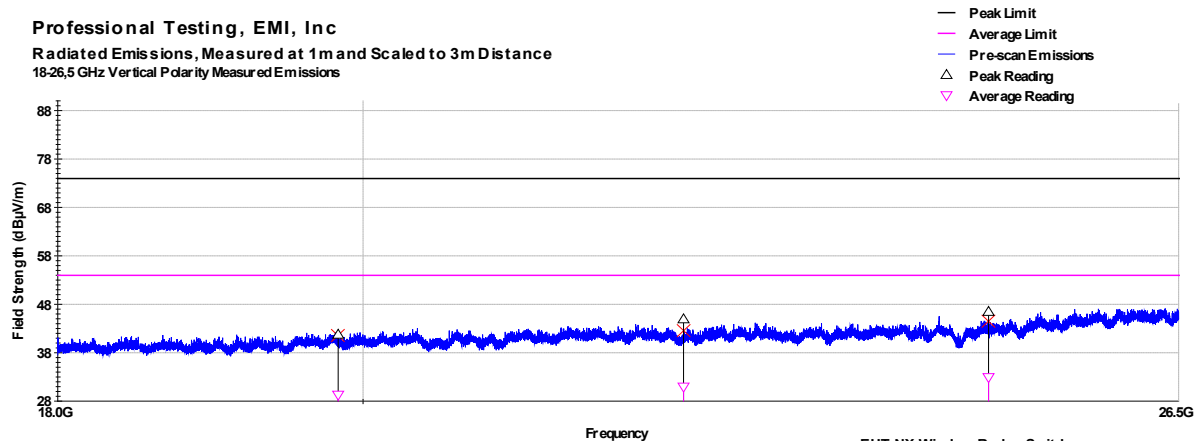
Frequency Range: Above 1GHz

EUT Mode of Operation:

2.480 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19829.84	1	22	1	Average	29.28	54.0	-24.7	Pass
22339.81	1	55	1	Average	30.949	54.0	-23.1	Pass
24818.47	1	81	1	Average	32.896	54.0	-21.1	Pass

Professional Testing, EMI, Inc

Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Vertical Polarity Measured Emissions

Operator: Sergio Gutierrez

Current Time: 11:53:49 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power
EUT Power: 3 VDC
Notes: Channel 40 (2.480 GHz)EUT: NX Wireless Rocker Switch
Project Number: 21589-15
Client: Hubbell Control Solutions

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.10

In accordance with: FCC Part 15

Section: 15.209

Test Date(s): 3/11/2020

EUT Serial #: 0437369

Customer: Hubbell Control Solutions

EUT Part #: NX Wireless Rocker Switch

Project Number: 21589-15

Test Technician: Sergio Gutierrez

Purchase Order #: N/A

Supervisor: Shakil Murad

Equip. Under Test: NX Wireless Rocker Switch

Witness' Name: Tom Hartnagel

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3 VDC

EUT Power: 0 N/A

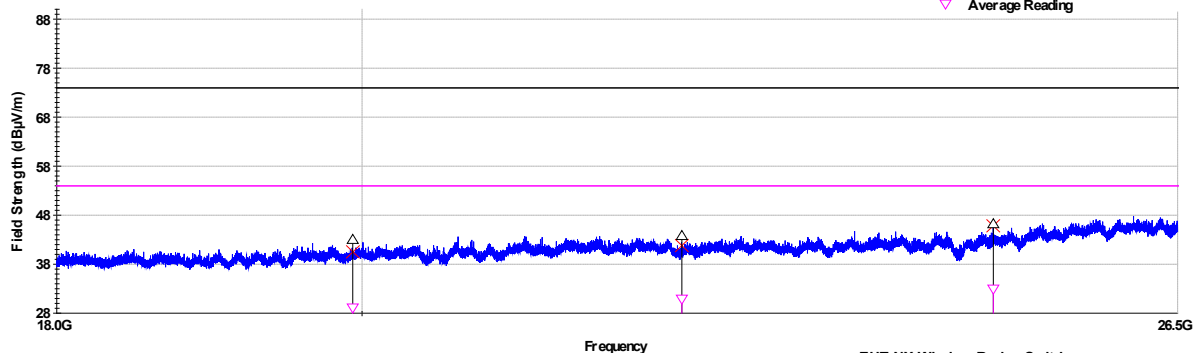
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:
2.480 GHz Transmit

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
19936.2	1	35	1	Average	29.103	54.0	-24.9	Pass
22333.25	1	79	1	Average	30.904	54.0	-23.1	Pass
24867.24	1	40	1	Average	21.946	54.0	-32.1	Pass

Professional Testing, EMI, Inc

 Radiated Emissions, Measured at 1m and Scaled to 3m Distance
 18-26.5 GHz Horizontal Polarity Measured Emissions


Operator: Sergio Gutierrez

Current Time: 11:47:54 AM, Thursday, March 12, 2020

EUT Mode: WM Max Power

EUT Power: 3 VDC

Notes: Channel 40 (2.480 GHz)

EUT: NX Wireless Rocker Switch

Project Number: 21589-15

Client: Hubbell Control Solutions

> 1GHz Horizontal Antenna Polarity Measured Emissions

8.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

8.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	9 Apr 2020

8.3 Results



- Antenna is chip style component soldered to the circuit board.
 - Antenna Model A5839
 - Peak Gain = 2.1 dBi
- There is no external antenna connector.

The antenna design above satisfies the requirements of the rules.

9.0 Conducted Emissions, Mains

9.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive reference plane (wall). The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and the measurement is taken.

9.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.107, 15.207 // RSS-Gen	Mains conducted emissions	N/A

9.3 Test Results

The EUT is exclusively DC powered. This test does not apply.

1.0 Equipment

1.1 Spurious Radiated Emissions 30 MHz to 25 GHz

Radiated Emissions Test Equipment List					
Tile! Software Version:		Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM			
Test Profile:		2019_May_Unintentional RE_TILE7_v2.5.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	9/17/2021
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/9/2022
2295	Keysight	E4440A-AYZ	PSA Spectrum Analyzer	MY46186204	11/6/2020
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/11/2021
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/9/2020
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
2054	Mini-Circuits	VHF-3100+	Filter, High Pass	N/A	4/19/2020
1509B	Braden	TDK 10M	TDK 10M Chamber, sVSWR > 1 GHz	DAC-012915-005	9/21/2021
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, 100MHz-18GHz	None	1/9/2022
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/9/2020
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/11/2021
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	N/A
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/7/2020
1977	Agilent	87421A	Power Supply	MY44350145	N/A

1.2 Occupied Bandwidth, Power Spectral Density, and Timings

Asset #	Manufacturer	Model #	Description	Calibration Due
1937	Agilent	E4440A	Spectrum Analyzer	8 Nov 2020
1443	HP	6215A	Power Supply	CIU
0463	Fluke	77A	DMM	10 Nov 2020
C355	Pasternack	PE300-120	RG type cable	30 May 2020
None	ETS	5211	Shielded Enclosure	CIU
None	PTI	None	2 GHz Sleeve Sense Antenna	CIU

1.3 Mains Conducted Emissions

2.0 Measurement Bandwidths

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps
*Notes: 1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz. 4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz. 5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.				

Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.01	0.15	0.3	7	Five 1 second sweeps
0.15	30	9	20	Five 1 second sweeps
*Notes: 1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.				

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report