



BEC INCORPORATED

CERTIFICATION APPLICATION TEST REPORT

TEST STANDARDS:

**FCC Part 15 Subpart C, IC RSS-Gen, IC RSS-247
DTS Intentional Radiator**

EUT:

Legrand WNRH1 Smart Gateway Switch with Netatmo

FCC ID: 2AU5D-WNRH1

ISED ID: 25764-WNRH1

REPORT#: BEC-2107-01 REV2

TEST DATES: 12/07/2020 – 03/02/2021

CUSTOMER:

**Pass & Seymour/Legrand
50 Boyd Avenue
Syracuse, NY 13209**

PREPARED BY:

Paul Banker, Test Engineer

REVIEWED and APPROVED BY:

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Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	01/12/2021
1	Corrections to report to add data for Wifi modes and other corrections based on ATCB026535 Comments Letter 01 -2-26-2021.doc	03/04/2021	03/08/2021
2	Section 4.10 Correction to table on page 60 Added Band-Edge Measurements	03/10/2021	03/11/2021



1.0 Administrative Information

1.1 Project General Information

Project Number	BEC-2107			
Manufacturer	Legrand			
Equipment Under Test	Legrand Model WNRH1 Smart Gateway Switch with Netatmo			
Radio Types	Zigbee		Wi-Fi	
EUT Test Types	Un-modified: Emissions Configuration	SMA connector on transmitter output: Conducted Configuration	Un-modified: Emissions Configuration	SMA connector on transmitter output: Conducted Configuration
EUT Serial Numbers	2	4	6	8
EUT Sample Numbers	2107-02	2107-04	2107-06	2107-08
FCC ID	2AU5D-WNRH1			
ISED ID	25764-WNRH1			
Zigbee Radio Chip Info	Atmel Model # SAMR21E			
Wi-Fi Radio Chip Info	AMPAK Model # AP6212			
Frequency of Operation	Zigbee: 2405 – 2480 MHz		Wi-Fi: 2412-2462 MHz	
Antenna Gain	+ 1.0 dBi		+ 1.0 dBi	
FCC Classification	Digital Transmission System (DTS)			
Date Samples Received	12/04/2020			
Condition Samples Received	Suitable for test			
Sample Type	Production units			
Software/Firmware Version	Zigbee: certifications_nlg_zb permanent stm32_boot0_app-jtag and TestRadio_v1		Wi-Fi: nlg-stm32-v2-app	
Applicable FCC Rules	FCC Rules Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System			
Applicable ISED Rules	RSS-Gen: General Requirements for Compliance of Radio Apparatus & RSS-247: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices			



1.2 Preface

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures, and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

1.3 Laboratory and Customer Information

Test Laboratory Location	BEC Incorporated 970 East High Street Pottstown, PA 19464
Test Personnel	Paul Banker / Steve Fanella / JR Fanella
BEC Laboratory Number FCC Registration	US1118
BEC Laboratory Number ISED Registration	7342A-1
Test Performed For	Pass & Seymour/Legrand 50 Boyd Avenue Syracuse, NY 13209
Customer Technical Contact	Collin Richards
Customer Reference Number	PO # SP017123-802



1.4 Measurement Uncertainty

Measurement	Measurement Distance	Range	Measurement Limit	Expanded Uncertainty
Radiated Disturbance Open Area Test Site	3 Meter	30 MHz – 1 GHz	Class A or B	3.93
Conducted Disturbance AC Mains	N/A	150 kHz – 30 MHz	Class A or B	2.69
Radio Frequency	N/A	1 MHz – 26.5 GHz	N/A	±0.086 ppm
RF power, conducted	N/A	1 MHz – 26.5 GHz	N/A	±1.48 dB
Conducted spurious emission of transmitter, valid up to 6 GHz	N/A	150 kHz – 26.5 GHz	N/A	±2.73 dB
Occupied Bandwidth	N/A	1 MHz – 26.5 GHz	N/A	±2 %
Temperature	N/A	15 – 35° C	N/A	±0.5 °C
Humidity	N/A	20 – 95 %	N/A	±2.5%

No adjustments to measured data presented in this report are required because all values of uncertainty are less than the CISPR 16-4-2:2018 recommendations. These uncertainties have a coverage factor of $k = 2$, which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.



1.5 Test Result Summary Table

The Legrand WNRH1 was tested and found to be compliant to the sections of the FCC Part 15 Subpart C and RSS-Gen RSS-247 standards listed below:

Report Section	FCC Part 15, Subpart C	RSS-Gen	RSS-247	Test Description	Result
4.1	15.203(b)	Annex A 10(g)		Antenna Requirement	PASS
4.2	15.204	8.3		External RF power amplifiers and antenna modifications	PASS
4.3	15.207	7.2		Conducted Limits (AC Power) 150 kHz – 30 MHz	PASS
4.4	15.205(a) 15.209	8.9, 8.10	3.3	Emissions in Non-Restricted and Restricted Frequency Band 30 MHz – 25 GHz	PASS
4.5	15.247(a)(2)		5.2 (a)	6 dB Occupied Bandwidth	PASS
4.6		6.7		99% Occupied Bandwidth	PASS
4.7	15.247(b)(3)		5.4 (d)	Maximum Conducted (Average) Power Output and EIRP	PASS
4.8	15.247(d)		5.5	Emissions in Restricted Frequency Bands 30 MHz – 25 GHz	PASS
4.9	15.247(e)		5.2 (b)	DTS maximum power spectral density level in the fundamental emission	PASS
4.10	15.247(d)		5.5	DTS band-edge emission measurements	PASS

Rationale for EUT operation: The EUT contains a Zigbee radio and a Wi-Fi radio. The radios were tested separately as the transmitters are designed to not operated at the same time. The Zigbee radio contained software that utilized O-QPSK modulation used in normal operation. The Wi-Fi radio utilizes IEEE 802.11 b/g/n modulations. The WiFi radio was evaluated in various combinations of modulation, data rate, packet length and packet size and packet number. The combination of packet size = 110, packet length = 2304 and selecting modulation modes that produce the highest emissions, narrowest or widest operating bandwidths (OBW) are specified for each of the tests contained in this report.



1.6 Condition of Received Sample

An evaluation of the EUT was conducted in order to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damage was noted. The test item condition was deemed acceptable for the performance of the requested test services.

1.7 Climatic Environment

Unless noted elsewhere in this report, the following were the ambient conditions in the laboratory during testing:

Temperature: $22^{\circ} \pm 5^{\circ}$

Humidity: $50\% \pm 20\%$

Barometric Pressure: $1000\text{mb} \pm 20\%$

1.8 Test Equipment

All test equipment is checked to manufacturer's specifications and, when applicable, have current N.I.S.T. traceable, ISO 9002 conforming certificates of calibration. Test equipment used for the tests described herein is listed in Appendix A.



2.0 Equipment Under Test

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 EUT Description

The Legrand Model WNRH1 is a Smart Gateway Switch with Netatmo. The Legrand Model WNRH1 requires 120Vac / 60 Hz input power. The Legrand Model WNRH1 serves as a Wi-Fi home and wireless access point. The WNRH1 broadcasts WiFi signals and Zigbee RF signal output over single, separate antennae. The EUT tested represents a family of products to include the Models WNRH1 (In-Wall) and WNRH2 (Over-Wall) and the only differences are the plastic EUT housing. The model WNRH1 was scanned for highest emissions, with and without external ground connection. The ungrounded WNRH1 produced the highest emissions and therefore was the only model tested.

WNRH1 Product Description- Radiant In-Wall Gateway Receptacle with Netatmo. 120VAC/60Hz input.

WNRH2 Product Description- Radiant Over-Wall Gateway Receptacle with Netatmo. 120VAC/60Hz input.

2.2 Product Category

FCC Part 15, Subpart C (Section 15.247), IC RSS-Gen, IC RSS-247

2.3 Product Classification

47 CFR Part 15, Subpart C, Section 15.247 “DTS Operation within the band of 900 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz.”

2.4 Test Configuration

The two radio types, Zigbee and Wi-Fi, were tested separately. The radios will not operate concurrently. Software, contained in each EUT sample, operated each radio in a manner consistent with normal use.



2.5 Test Configuration Rationale

The two radios are designed to operate such that both radios will not operate at the same time. The EUT was tested using a Zigbee radio and a Wi-Fi radio separately. The Zigbee radio contained software that utilized O-QPSK modulation used in normal operation. The Wi-Fi radio was evaluated in various combinations of modulation, data rate, packet length and packet size and packet number. The combination of packet size = 110, packet length = 2304 and using modulations that produced the highest transmitter output level, narrowest or widest operating bandwidths (OBW).

2.6 EUT Zigbee Radio and Wi-Fi Radio Details

The Legrand Model WNRH1 and WNRH2 have the following Zigbee and Wi-Fi radios. Below are the manufacturers, model numbers, part #s and serial numbers if available.

<u>WNRHX</u> <u>Zigbee Radio</u>	<u>Manufacturer</u>	<u>Model Number</u>	<u>Part Number</u>	<u>Serial #</u>
	Atmel	SAMR21E	ATSAMR21E18A	ATSAMR21E18A-MUT

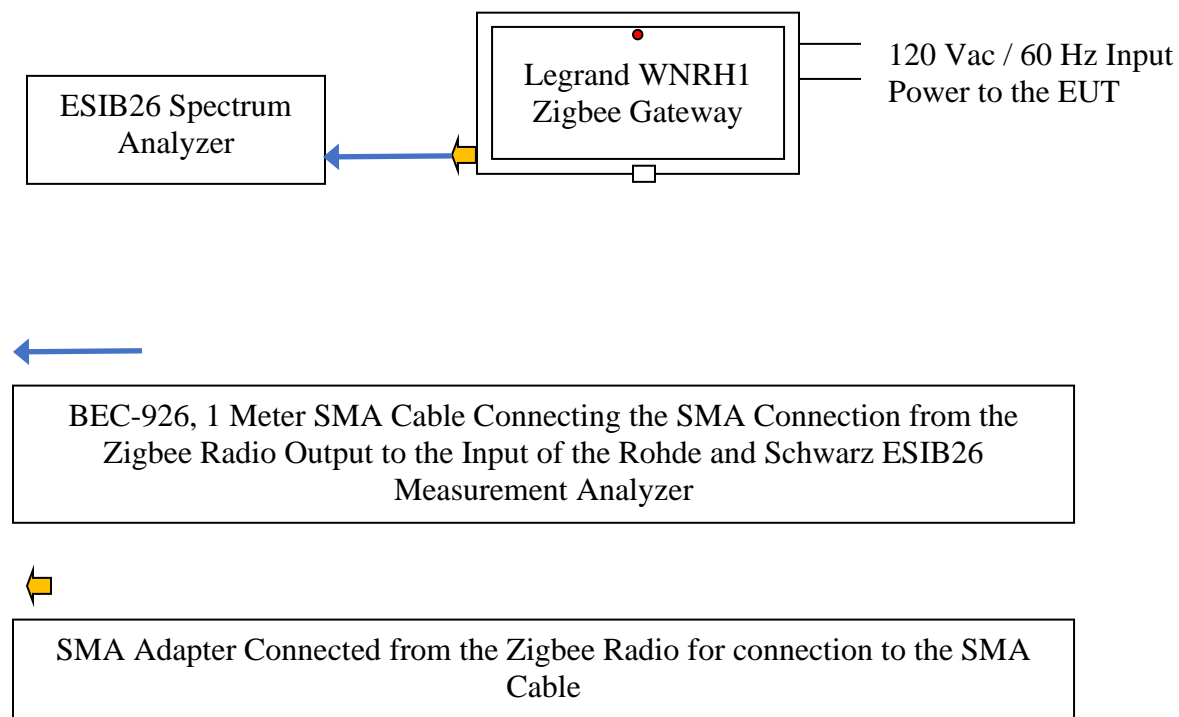
<u>WNRHX</u> <u>Wi-Fi Radio</u>	<u>Manufacturer</u>	<u>Model Number</u>
	AMPAK	AP6212



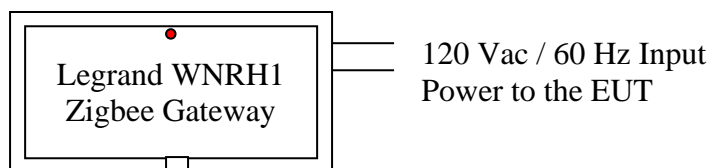
2.7 Test Configuration Diagrams – Zigbee Radio

Block diagrams of the EUT configuration showing interconnection cables are illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution. Diagrams show the Conducted Measurement configuration connection and Radiated Measurement configuration connection when testing the Zigbee Radio.

2.7.1 Zigbee Configuration – Conducted Measurement



2.7.2 Zigbee Configuration – Radiated Measurement

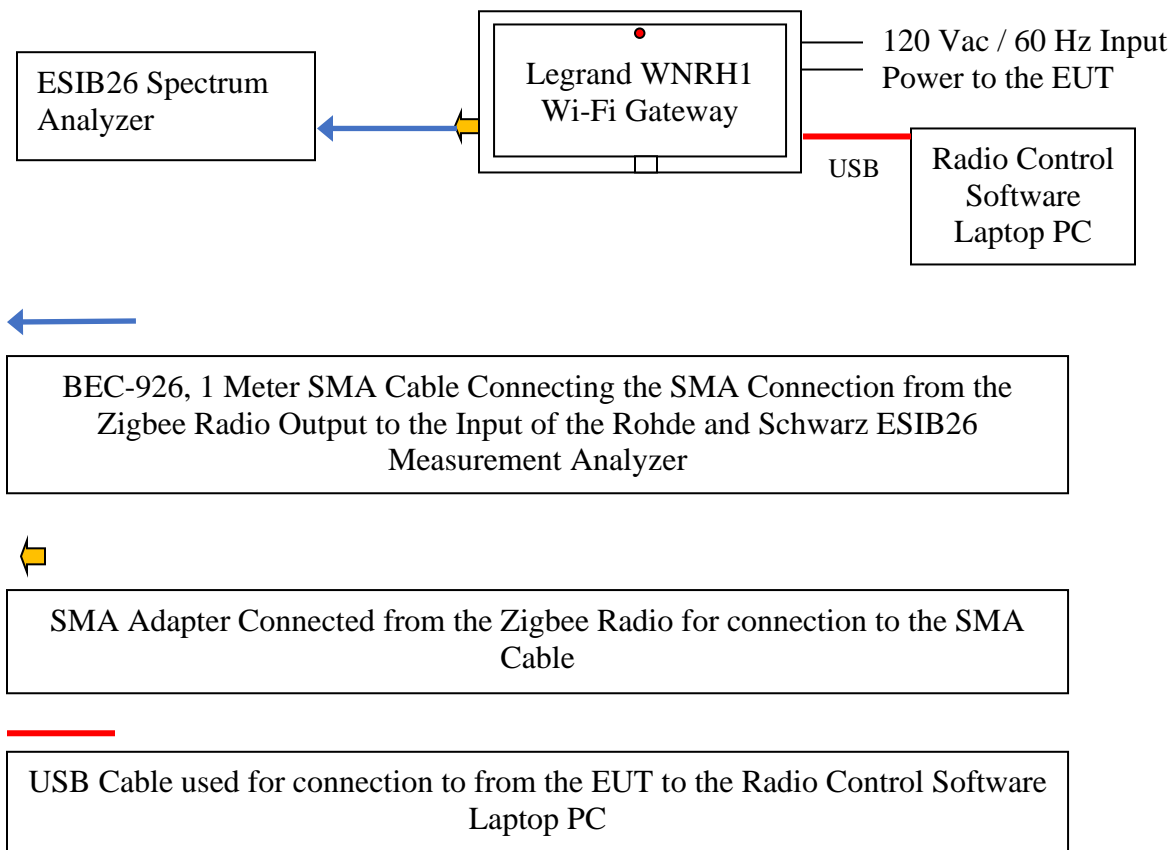




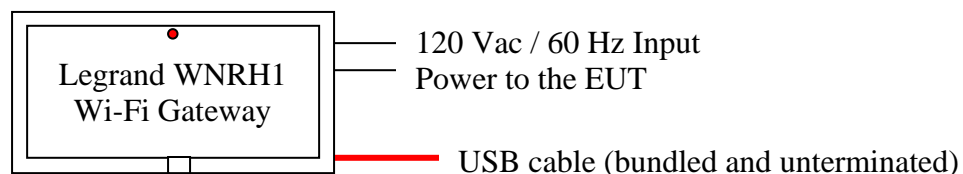
2.8 Test Configuration Diagrams – Wi-Fi Radio

Block diagrams of the EUT configuration showing interconnection cables are illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution. Diagrams show the Conducted Measurement configuration connection and Radiated Measurement configuration connection when testing the Wi-Fi Radio.

2.8.1 Wi-Fi Configuration – Conducted Measurement



2.8.2 Wi-Fi Configuration – Radiated Measurement





2.9 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Number	Sample Number
Smart Gateway Switch with Netatmo - Zigbee	Legrand	WNRH1	2	2107-02
			4	2107-04
Smart Gateway Switch with Netatmo - Wi-Fi			6	2107-06
			8	2107-08

Interconnection Cable List (Conducted Measurement Test Setup)

Manufacturer	Model	Type	Shielding	Length	Description
Suhner	S04272B	High Frequency RF Cable 1 to 40 GHz	Double Braid	1 Meter	Measurement Cable from the Antenna SMA Connector to the Rohde and Schwarz ESIB26 Receiver. Asset # BEC-962

Support Equipment

Description	Manufacturer	Model #	Serial #
EUT Radio Software Control Laptop Computer	Dell	Latitude 5400	12F3P13



2.10 Test Signals and Test Modulation

By design this product does not have an external modulation input connector, therefore, normal internally generated modulation was used. The Zigbee radio was evaluated with and without normal internal modulation (O-QPSK). The un-modulated carrier produced higher output amplitude. Therefore, the un-modulated carrier was used for radiated emissions, AC conducted emissions and antenna conducted measurements. The modulated carrier was used for antenna conducted measurements of bandwidth and power spectral density.

The Wi-Fi radio was evaluated with and without modulation. The Wi-Fi radio has the capability to operate in multiple modes of modulation for IEEE 802.11 b/g/n. There are also multiple packet number and packet length parameters. The modes of modulation, chosen for each of the tests in this report, were selected to produce the highest output power level, narrowest bandwidth or widest bandwidth depending upon test requirements.

2.10.1 Zigbee Radio - Test Signals and Modulation

The EUT transmits to a discrete frequency on a specific channel. The Legrand WNRH1 Zigbee radio has 16 Channels available. The 16 Channels and frequencies that can be transmitted by the EUT are as follows:

Zigbee Channel	Frequency (MHz)	Zigbee Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

For the required testing, the EUT was configured to transmit at low Channel 11 (2405 MHz), middle Channel 18 (2440 MHz) and high Channel 26 (2480 MHz). The Zigbee radio utilizes one modulation, O-QPSK.



2.10.2 Wi-Fi Radio - Test Signals and Modulation

The EUT transmits at eleven frequencies listed below. The channels shown can be modulated using any of the various modulation modes of IEEE 802.11 b/g/n:

Channel Number	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

LAN Standard	Data Rate	Modulation
IEEE 802.11b	1 Mbps	DBPSK
IEEE 802.11b	2 Mbps	DQPSK
IEEE 802.11b	5.5 Mbps	DQPSK
IEEE 802.11g	6 Mbps	64-QAM
IEEE 802.11g	9 Mbps	64-QAM
IEEE 802.11b	11 Mbps	DQPSK
IEEE 802.11g	12 Mbps	64-QAM
IEEE 802.11g	18 Mbps	64-QAM
IEEE 802.11g	24 Mbps	64-QAM
IEEE 802.11g	36 Mbps	64-QAM
IEEE 802.11g	48 Mbps	64-QAM
IEEE 802.11g	54 Mbps	64-QAM
IEEE 802.11n	MCS0 (7.2 Mbps)	BPSK
IEEE 802.11n	MCS1 (14.4 Mbps)	QPSK
IEEE 802.11n	MCS2 (21.7 Mbps)	QPSK
IEEE 802.11n	MCS3 (28.9 Mbps)	16-QAM
IEEE 802.11n	MCS4 (43.3 Mbps)	16-QAM
IEEE 802.11n	MCS5 (57.8 Mbps)	64-QAM
IEEE 802.11n	MCS6 (65 Mbps)	64-QAM
IEEE 802.11n	MCS7 (72.2 Mbps)	64-QAM

The modulation modes are identified in each of the test descriptions contained in this report

2.11 Grounding

There were no ground connections used; the EUT is AC powered by single-phase 120 Vac / 60 Hz.

2.12 EUT Modifications

With the exception for the attachment of an SMA connector directly to the antenna output on the main board of the Legrand Model WNRH1, no modifications were made to the test sample.



2.13 EUT Pictures Legrand WNRH1 With Zigbee and Wi-Fi Radios

LEGRAND WNRH1 GATEWAY SAMPLE 2107-02 FRONT SIDE



LEGRAND WNRH1 GATEWAY SAMPLE 2107-06 FRONT SIDE





LEGRAND WNRH1 GATEWAY SAMPLE 2107-02 REAR SIDE



LEGRAND WNRH1 GATEWAY SAMPLE 2107-06 REAR SIDE





LEGRAND WNRH1 GATEWAY SAMPLE 2107-04 FRONT SIDE

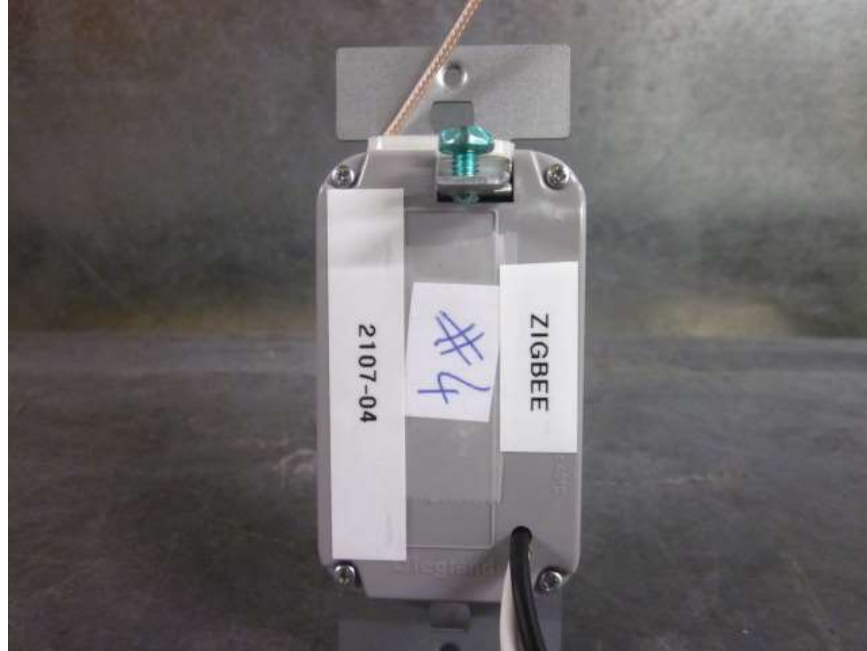


LEGRAND WNRH1 GATEWAY SAMPLE 2107-08 FRONT SIDE





LEGRAND WNRH1 GATEWAY SAMPLE 2107-04 REAR SIDE

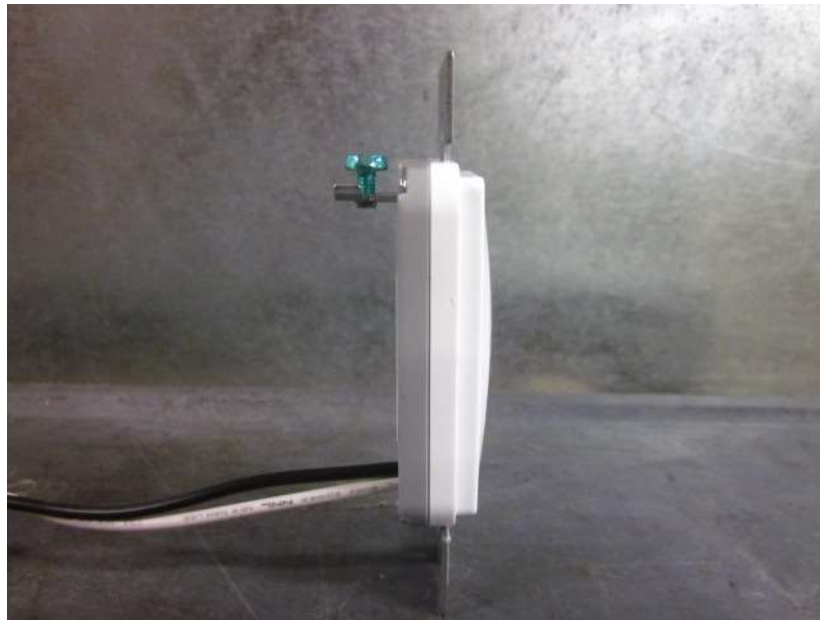


LEGRAND WNRH1 GATEWAY SAMPLE 2107-08 REAR SIDE

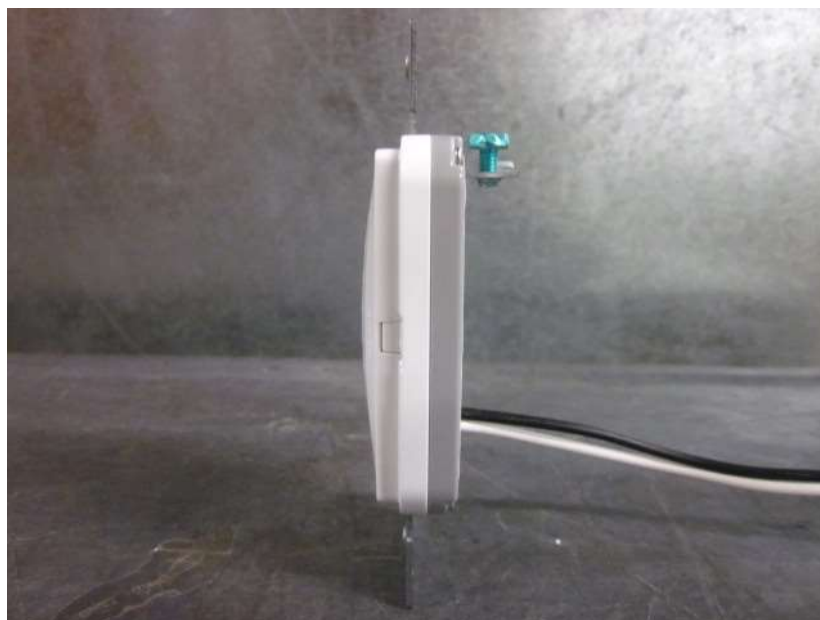




LEGRAND WNRH1 GATEWAY SAMPLE 2107-02, SAMPLE 2107-04, SAMPLE 2107-06 AND SAMPLE 2107-08 LEFT SIDE



LEGRAND WNRH1 GATEWAY SAMPLE 2107-02, SAMPLE 2107-04, SAMPLE 2107-06 AND SAMPLE 2107-08 RIGHT SIDE





3.0 Applicable Requirements, Methods, and Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirements at the discretion of the customer, regulatory agencies, or other entities.

3.1.1 FCC Requirements

Code of Federal Regulations: Title 47 – Telecommunication

Chapter I - Federal Communications Commission

Sub-chapter A – General

Part 15 – Radio Frequency Devices

Subpart C - Intentional Radiators

3.1.2 Industry Canada Requirements

RSS-Gen Issue 5: General Requirements for Compliance of Radio Apparatus

RSS-247 Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

3.1.3 Basic Test Methods and Test Procedures

558074 D01 DTS Meas Guidance v05r02, Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules.

ANSI C63.10-2013, American National Standard for Compliance Testing of Unlicensed Wireless Devices.

3.2 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.



4.0 Test Results

4.1 Antenna Requirement (47 CFR 15.203)(RSS-GEN ANNEX A (10)(g))

The antenna used by the Legrand WNRH1 is a quarter-wave, inverted F wire antenna. The antenna is mounted on the PCB inside the enclosure. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.

4.2 External RF power amps/antenna modifications (47 CFR 15.204)(RSS-GEN 8.3)

There are no RF power amplifier kits available to be used with the Legrand WNRH1. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.

4.3 Conducted Emissions AC Power Port (47 CFR 15.207)(RSS-GEN 7.2)

4.3.1 Conducted Emissions AC Power Port Test Procedure

AC Power Line

Conducted emissions at the power line input of the EUT were measured with an EMI receiver set to the appropriate detector and CISPR bandwidth, which was connected to the RF output of a 50 Ω , 50 μ H Line Impedance Stabilization Network (LISN) installed in each power line.

Measurements were made over the frequency range of 150 kHz to 30 MHz while the EUT was operating as described in the EUT section of this report. The significant amplitudes of emissions measured on the AC power lines of the EUT were recorded as follows:

$$\text{Emission (dB}\mu\text{V)} = \text{Meter Reading (dB}\mu\text{v)} + \text{Cable Loss (dB)} + \text{LISN Factor (dB)} + \text{Limiter Loss (dB)}$$

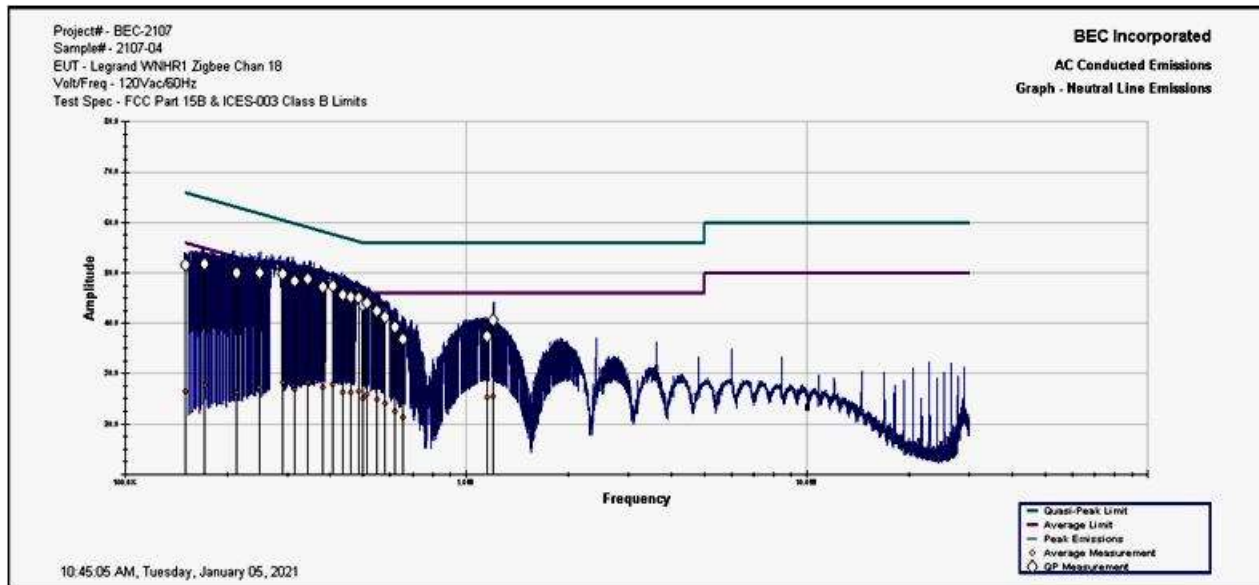
Both Zigbee and Wi-Fi radios were tested with the radio transmitting at low, middle and high frequencies and while in receive mode (non-transmission). The Zigbee radio was tested with an unmodulated signal and the Wi-Fi radio was tested with a DBPSK modulated signal. The conducted emissions did not differ among the three transmit channel frequencies. The middle channel only is displayed to avoid repetitive data.

Photographs of the Conducted Emissions AC Power Port test setups are in Section 5 of this report.



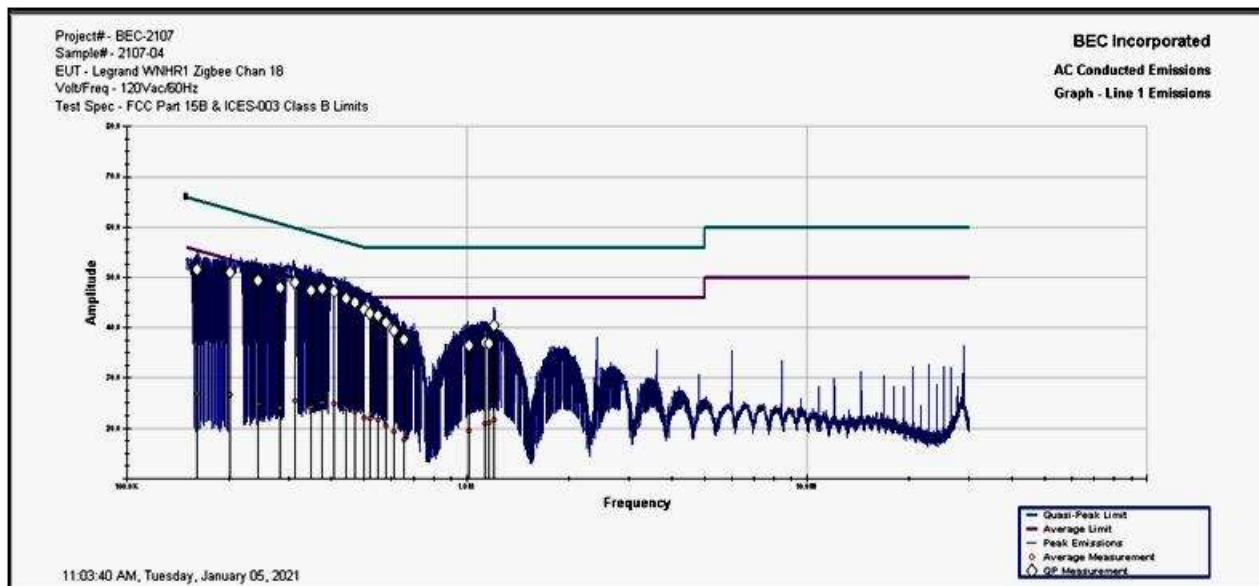
4.3.2 Conducted Emissions AC Power Port 150 kHz to 30 MHz Zigbee Radio Tx Mode Test Results (01/05/2021)

BEC Incorporated								
Neutral Line Conducted Emissions								
10:45:05 AM, Tuesday, January 05, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1501	26.51	56.00	-29.49	51.56	66.00	-14.44	10.17	Pass
0.1707	27.59	55.41	-27.82	51.72	65.41	-13.69	10.17	Pass
0.2121	26.22	54.23	-28.01	50.04	64.23	-14.19	10.17	Pass
0.2492	27.32	53.17	-25.85	49.99	63.17	-13.18	10.17	Pass
0.2893	28.22	52.02	-23.80	49.68	62.02	-12.34	10.17	Pass
0.3147	26.82	51.30	-24.48	48.29	61.30	-13.01	10.17	Pass
0.3437	28.17	50.47	-22.30	48.80	60.47	-11.67	10.17	Pass
0.3795	27.23	49.44	-22.21	47.12	59.44	-12.33	10.18	Pass
0.4066	27.82	48.67	-20.85	47.27	58.67	-11.40	10.18	Pass
0.4346	26.33	47.87	-21.54	45.50	57.87	-12.37	10.18	Pass
0.4587	26.25	47.18	-20.93	45.15	57.18	-12.03	10.18	Pass
0.4841	26.53	46.45	-19.92	44.90	56.45	-11.55	10.17	Pass
0.4995	25.17	46.01	-20.85	43.56	56.01	-12.45	10.17	Pass
0.5134	25.92	46.00	-20.08	43.98	56.00	-12.02	10.17	Pass
0.5498	24.84	46.00	-21.16	42.33	56.00	-13.67	10.18	Pass
0.5785	23.99	46.00	-22.01	41.11	56.00	-14.89	10.18	Pass
0.6207	22.44	46.00	-23.56	39.27	56.00	-16.73	10.19	Pass
0.6538	21.21	46.00	-24.79	36.76	56.00	-19.24	10.19	Pass
1.1510	25.30	46.00	-20.70	37.34	56.00	-18.66	10.20	Pass
1.2036	25.57	46.00	-20.43	40.57	56.00	-15.43	10.20	Pass





BEC Incorporated								
Line 1 Conducted Emissions								
11:03:40 AM, Tuesday, January 05, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1615	26.81	55.67	-28.86	51.61	65.67	-14.06	10.18	Pass
0.2021	26.59	54.51	-27.92	51.05	64.51	-13.46	10.18	Pass
0.2429	24.91	53.35	-28.43	49.46	63.35	-13.89	10.18	Pass
0.2827	24.10	52.21	-28.10	47.97	62.21	-14.24	10.18	Pass
0.3118	25.49	51.38	-25.89	48.93	61.38	-12.45	10.18	Pass
0.3480	24.32	50.34	-26.02	47.42	60.34	-12.92	10.18	Pass
0.3746	25.16	49.58	-24.43	47.85	59.58	-11.73	10.19	Pass
0.4062	24.79	48.68	-23.89	47.10	58.68	-11.58	10.19	Pass
0.4404	23.92	47.70	-23.79	45.82	57.70	-11.89	10.20	Pass
0.4697	23.29	46.87	-23.57	44.90	56.87	-11.97	10.20	Pass
0.5001	22.10	46.00	-23.90	43.60	56.00	-12.40	10.19	Pass
0.5205	21.97	46.00	-24.03	42.84	56.00	-13.16	10.19	Pass
0.5465	21.69	46.00	-24.31	42.34	56.00	-13.66	10.20	Pass
0.5782	20.56	46.00	-25.44	41.05	56.00	-14.95	10.20	Pass
0.6123	19.22	46.00	-26.78	39.31	56.00	-16.69	10.20	Pass
0.6529	17.77	46.00	-28.23	37.70	56.00	-18.30	10.20	Pass
1.0124	19.47	46.00	-26.53	36.43	56.00	-19.57	10.22	Pass
1.1295	20.94	46.00	-25.06	36.92	56.00	-19.08	10.22	Pass
1.1632	21.00	46.00	-25.00	36.78	56.00	-19.22	10.22	Pass
1.2018	21.61	46.00	-24.39	40.30	56.00	-15.70	10.22	Pass

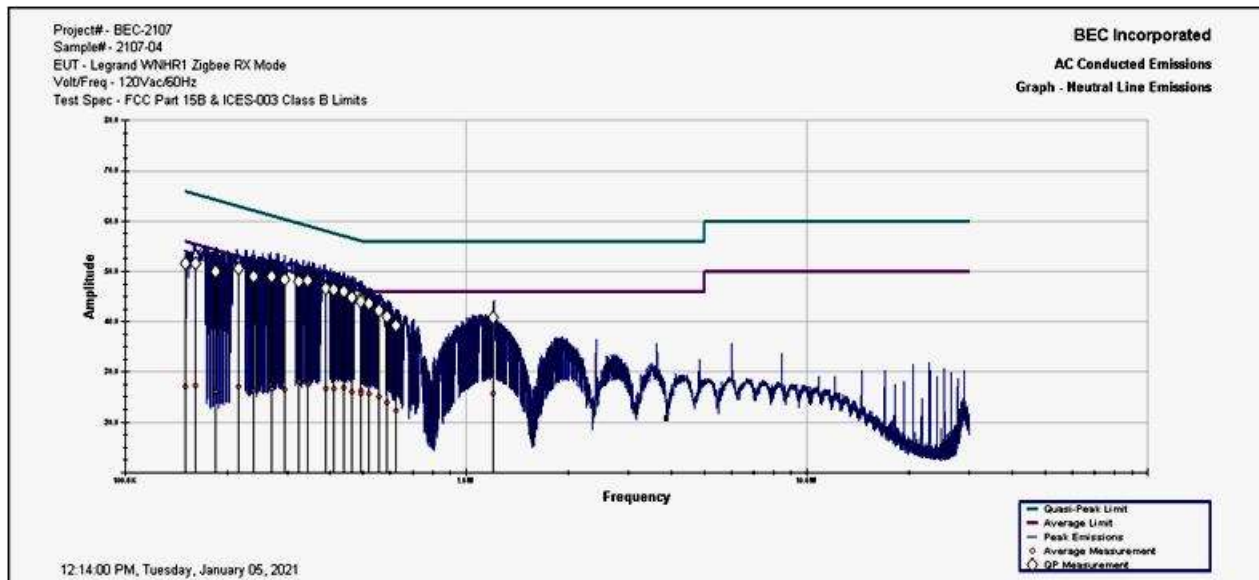


Results: Conducted emissions, measured on the AC Power Port of the Legrand Model WNRH1 Sample 2107-04, Zigbee Radio in Transmit Mode, are below the limit specified by FCC Part 15C and RSS-Gen by a margin of 11.40 dB.



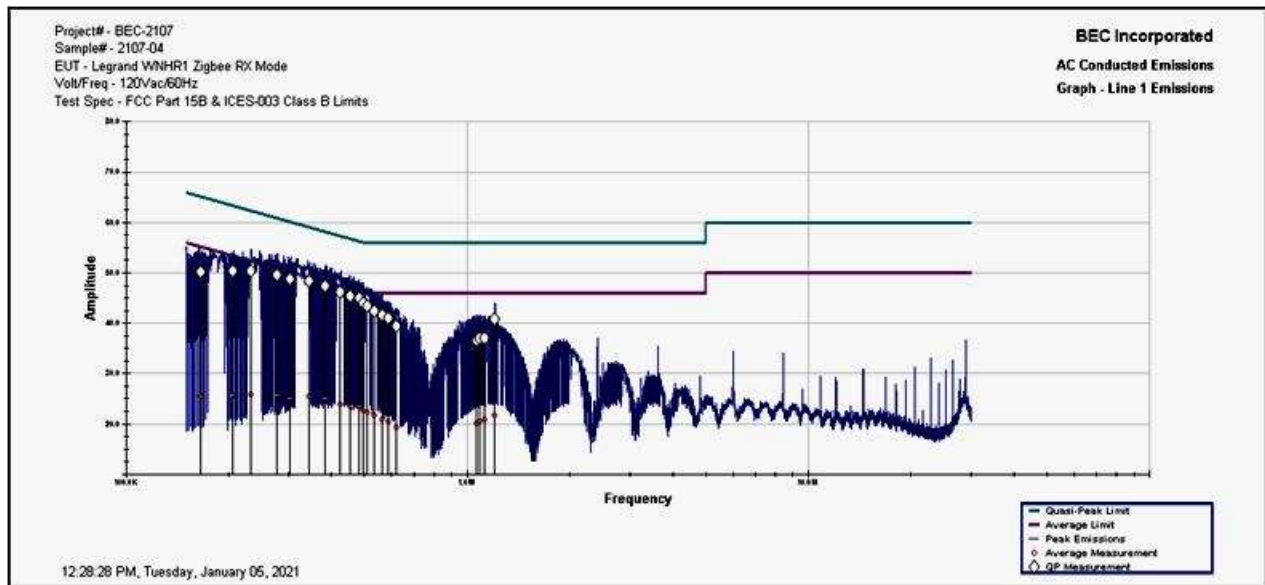
4.3.3 Conducted Emissions AC Power Port 150 kHz to 30 MHz Zigbee Radio Rx Mode Test Results (01/05/2021)

BEC Incorporated								
Neutral Line Conducted Emissions								
12:14:00 PM, Tuesday, January 05, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1503	26.98	55.99	-29.01	51.51	65.99	-14.48	10.17	Pass
0.1614	27.19	55.67	-28.49	51.59	65.67	-14.08	10.17	Pass
0.1843	26.13	55.02	-28.89	50.05	65.02	-14.97	10.17	Pass
0.2154	27.01	54.13	-27.13	50.47	64.13	-13.66	10.17	Pass
0.2385	26.27	53.47	-27.20	48.93	63.47	-14.54	10.17	Pass
0.2700	26.69	52.57	-25.88	48.99	62.57	-13.58	10.17	Pass
0.2949	26.38	51.86	-25.47	48.45	61.86	-13.41	10.17	Pass
0.3231	28.11	51.05	-22.94	47.98	61.05	-13.07	10.17	Pass
0.3435	27.47	50.47	-23.01	48.16	60.47	-12.31	10.17	Pass
0.3893	26.65	49.16	-22.52	46.54	59.16	-12.63	10.18	Pass
0.4097	26.75	48.58	-21.83	46.32	58.58	-12.26	10.18	Pass
0.4374	26.87	47.79	-20.92	46.05	57.79	-11.74	10.18	Pass
0.4624	26.06	47.08	-21.02	44.80	57.08	-12.28	10.18	Pass
0.4907	26.32	46.27	-19.94	44.48	56.27	-11.78	10.17	Pass
0.4935	25.67	46.19	-20.52	44.06	56.19	-12.13	10.17	Pass
0.5205	25.69	46.00	-20.31	43.51	56.00	-12.49	10.17	Pass
0.5560	25.01	46.00	-20.99	42.11	56.00	-13.89	10.18	Pass
0.5865	23.90	46.00	-22.10	41.00	56.00	-15.00	10.19	Pass
0.6224	22.35	46.00	-23.65	39.16	56.00	-16.84	10.19	Pass
1.2031	25.67	46.00	-20.33	40.71	56.00	-15.29	10.20	Pass





BEC Incorporated								
Line 1 Conducted Emissions								
12:28:28 PM, Tuesday, January 05, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1650	25.55	55.57	-30.02	50.13	65.57	-15.44	10.18	Pass
0.2054	25.69	54.42	-28.72	50.28	64.42	-14.14	10.18	Pass
0.2326	25.79	53.64	-27.84	50.32	63.64	-13.32	10.18	Pass
0.2762	25.60	52.40	-26.80	49.67	62.40	-12.73	10.18	Pass
0.3014	25.06	51.67	-26.62	48.87	61.67	-12.80	10.18	Pass
0.3431	25.37	50.48	-25.11	48.43	60.48	-12.05	10.18	Pass
0.3831	25.02	49.34	-24.32	47.45	59.34	-11.89	10.19	Pass
0.4246	23.82	48.16	-24.34	46.21	58.16	-11.94	10.20	Pass
0.4522	23.40	47.37	-23.96	45.47	57.37	-11.90	10.20	Pass
0.4806	23.52	46.55	-23.03	44.90	56.55	-11.65	10.19	Pass
0.4949	22.65	46.15	-23.49	44.00	56.15	-12.14	10.19	Pass
0.5077	22.20	46.00	-23.80	43.41	56.00	-12.59	10.19	Pass
0.5329	21.79	46.00	-24.21	42.43	56.00	-13.57	10.19	Pass
0.5622	20.80	46.00	-25.20	41.55	56.00	-14.45	10.20	Pass
0.5856	20.46	46.00	-25.54	41.05	56.00	-14.95	10.20	Pass
0.6198	19.31	46.00	-26.69	39.37	56.00	-16.63	10.20	Pass
1.0616	20.03	46.00	-25.97	36.62	56.00	-19.38	10.22	Pass
1.0878	20.55	46.00	-25.45	36.93	56.00	-19.07	10.22	Pass
1.1220	20.86	46.00	-25.14	37.10	56.00	-18.90	10.22	Pass
1.2042	21.78	46.00	-24.22	40.86	56.00	-15.14	10.22	Pass

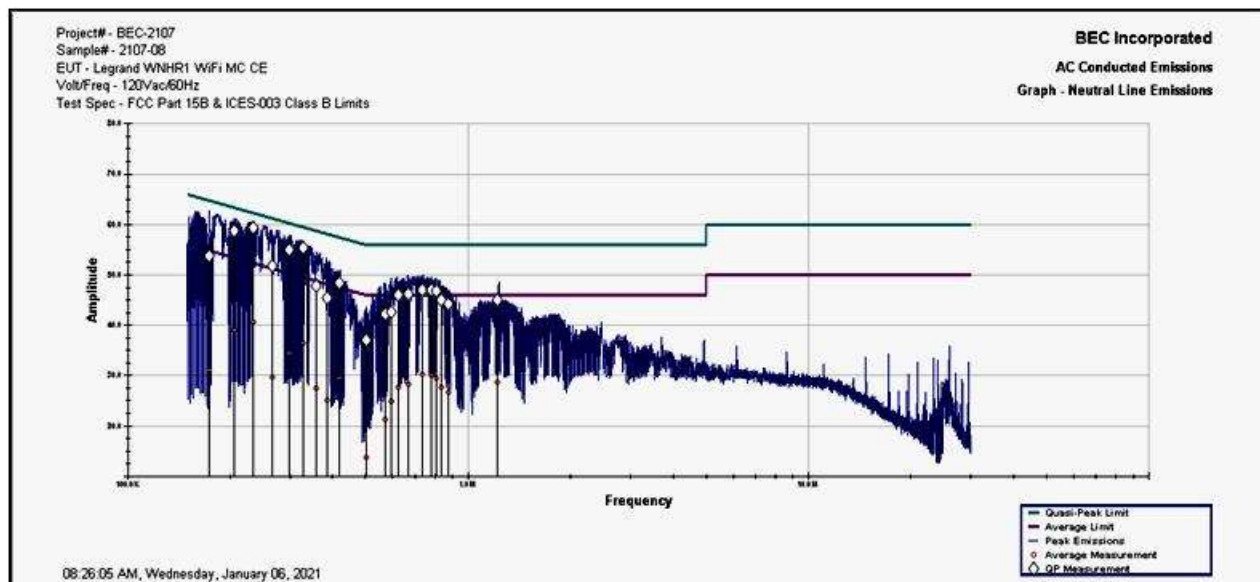


Results: Conducted emissions, measured on the AC Power Port of the Legrand Model WNHR1 Sample 2107-04, Zigbee Radio, in Receive Mode, are below the limit specified by FCC Part 15C and RSS-Gen by a margin of 11.65 dB.



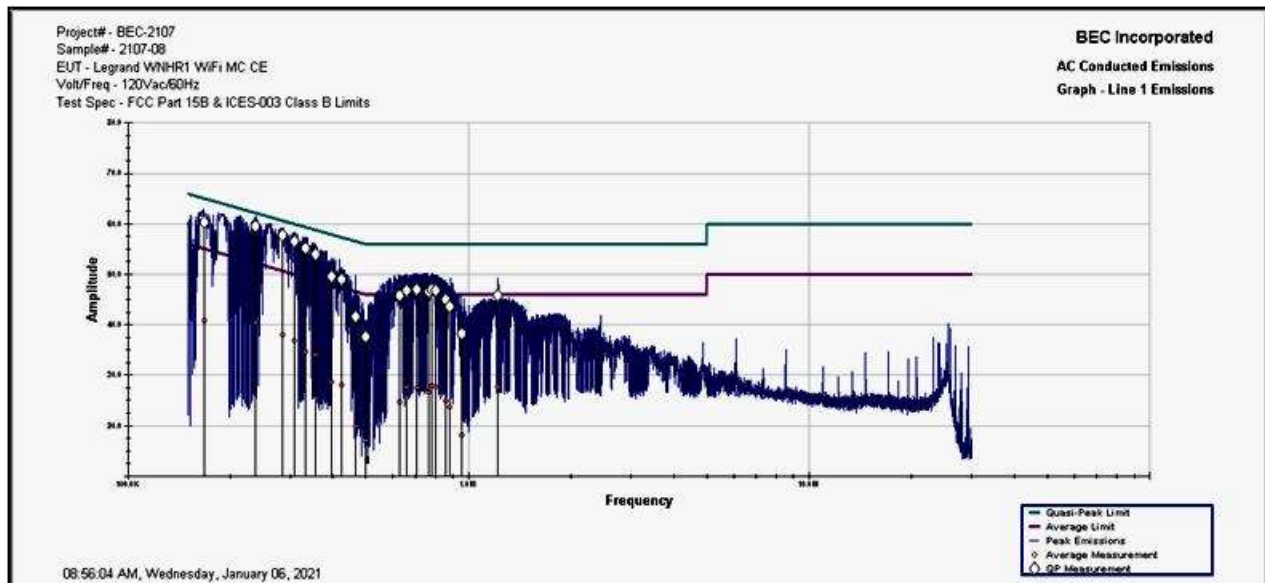
4.3.4 Conducted Emissions AC Power Port 150 kHz to 30 MHz Wi-Fi Radio Tx Mode Test Results (01/06/2021)

BEC Incorporated								
Neutral Line Conducted Emissions								
08:17:25 AM, Wednesday, January 06, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1741	31.13	55.31	-24.18	53.76	65.31	-11.55	10.17	Pass
0.2057	39.04	54.41	-15.37	58.81	64.41	-5.60	10.17	Pass
0.2335	40.55	53.61	-13.07	59.40	63.61	-4.21	10.17	Pass
0.2653	29.68	52.71	-23.02	51.82	62.71	-10.89	10.17	Pass
0.2975	34.49	51.79	-17.30	54.93	61.79	-6.86	10.17	Pass
0.3278	36.47	50.92	-14.45	55.34	60.92	-5.58	10.17	Pass
0.3579	27.39	50.06	-22.67	47.84	60.06	-12.22	10.17	Pass
0.3844	25.06	49.30	-24.24	45.47	59.30	-13.83	10.18	Pass
0.4180	29.47	48.34	-18.88	48.43	58.34	-9.91	10.18	Pass
0.5036	13.64	46.00	-32.36	36.99	56.00	-19.01	10.17	Pass
0.5724	21.39	46.00	-24.61	42.17	56.00	-13.83	10.18	Pass
0.5951	24.79	46.00	-21.21	42.58	56.00	-13.42	10.19	Pass
0.6247	27.59	46.00	-18.41	45.88	56.00	-10.12	10.19	Pass
0.6655	28.28	46.00	-17.72	46.27	56.00	-9.73	10.19	Pass
0.7345	30.26	46.00	-15.74	47.00	56.00	-9.00	10.19	Pass
0.7790	29.96	46.00	-16.04	47.02	56.00	-8.98	10.20	Pass
0.8045	29.48	46.00	-16.52	46.72	56.00	-9.28	10.20	Pass
0.8360	27.60	46.00	-18.40	44.89	56.00	-11.11	10.20	Pass
0.8739	26.75	46.00	-19.25	44.24	56.00	-11.76	10.20	Pass
1.2198	28.68	46.00	-17.32	44.95	56.00	-11.05	10.20	Pass





BEC Incorporated								
Line 1 Conducted Emissions								
08:47:32 AM, Wednesday, January 06, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1681	40.74	55.48	-14.75	60.31	65.48	-5.17	10.18	Pass
0.2366	40.33	53.53	-13.20	59.60	63.53	-3.93	10.18	Pass
0.2846	37.99	52.15	-14.17	57.65	62.15	-4.50	10.18	Pass
0.3079	36.85	51.49	-14.64	56.61	61.49	-4.88	10.18	Pass
0.3327	34.68	50.78	-16.10	55.18	60.78	-5.60	10.18	Pass
0.3552	33.95	50.14	-16.18	53.98	60.14	-6.16	10.18	Pass
0.3960	28.69	48.97	-20.28	49.66	58.97	-9.31	10.19	Pass
0.4235	28.13	48.19	-20.05	49.03	58.19	-9.15	10.20	Pass
0.4649	19.90	47.00	-27.10	41.63	57.00	-15.38	10.20	Pass
0.4971	17.10	46.08	-28.98	37.64	56.08	-18.44	10.19	Pass
0.6287	24.64	46.00	-21.36	45.81	56.00	-10.19	10.20	Pass
0.6600	27.62	46.00	-18.38	46.85	56.00	-9.15	10.20	Pass
0.7022	27.42	46.00	-18.58	46.99	56.00	-9.01	10.20	Pass
0.7639	26.62	46.00	-19.38	46.61	56.00	-9.39	10.21	Pass
0.7781	27.92	46.00	-18.08	46.98	56.00	-9.02	10.21	Pass
0.8007	27.57	46.00	-18.43	46.81	56.00	-9.19	10.21	Pass
0.8574	24.95	46.00	-21.05	45.02	56.00	-10.98	10.21	Pass
0.8825	23.69	46.00	-22.31	43.59	56.00	-12.41	10.22	Pass
0.9578	18.03	46.00	-27.97	38.23	56.00	-17.77	10.22	Pass
1.2189	27.64	46.00	-18.36	45.86	56.00	-10.14	10.22	Pass

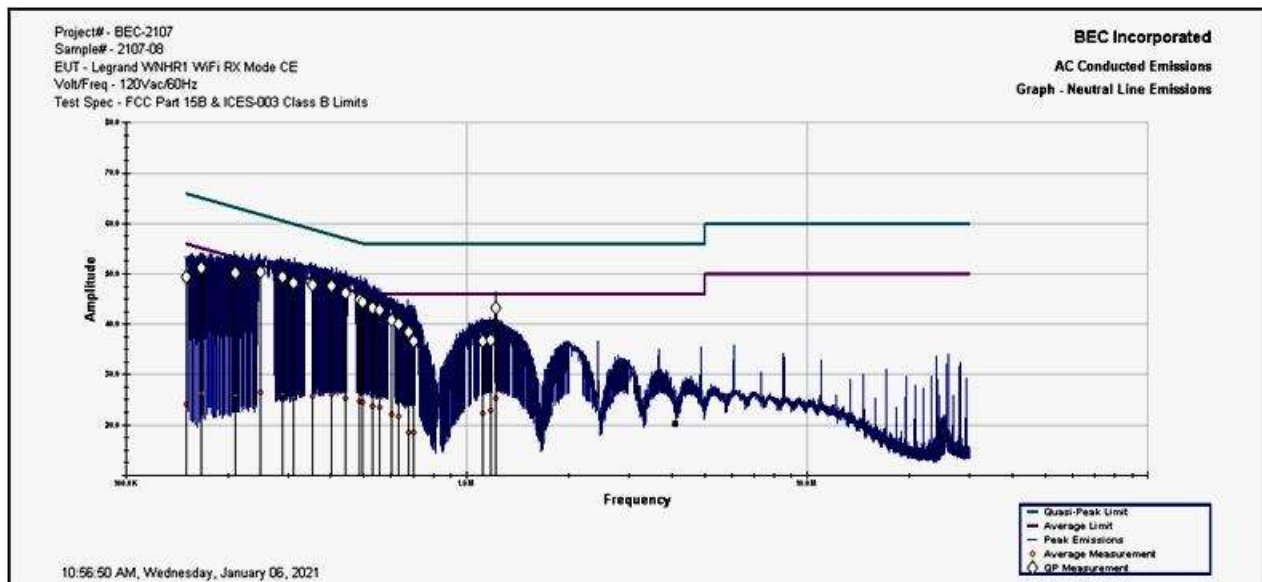


Results: Conducted emissions, measured on the AC Power Port of the Legrand Model WNRH1 Sample 2107-08, Wi-Fi Radio in Transmit Mode, are below the limit specified by FCC Part 15C and RSS-Gen by a margin of 3.93 dB.



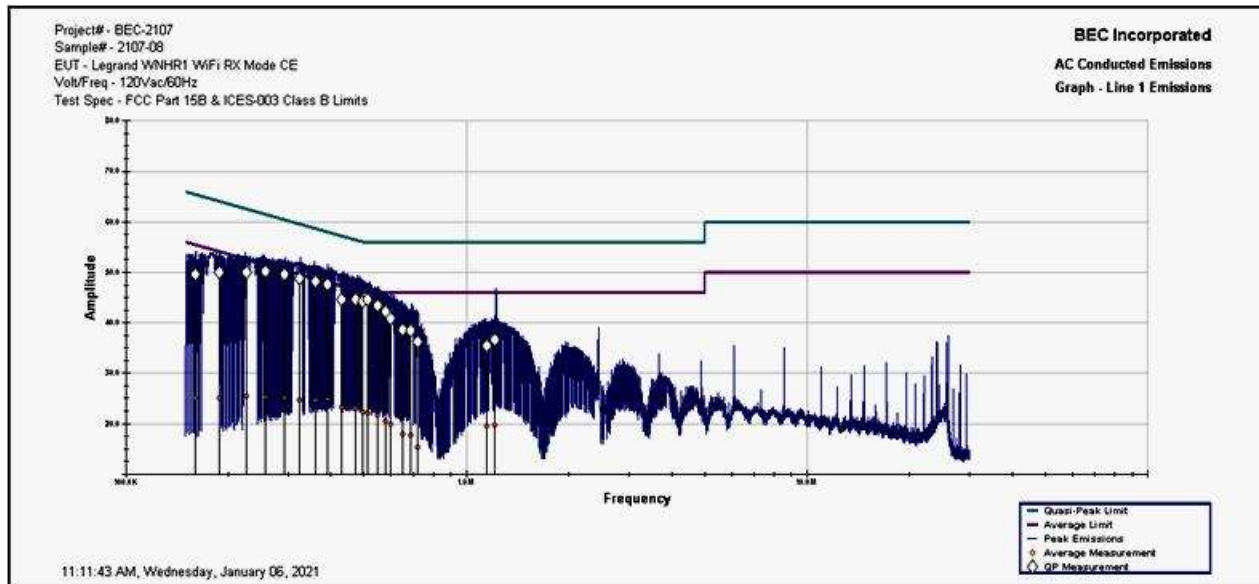
4.3.5 Conducted Emissions AC Power Port 150 kHz to 30 MHz Wi-Fi Radio Rx Mode Test Results (01/06/2021)

BEC Incorporated								
Neutral Line Conducted Emissions								
10:48:05 AM, Wednesday, January 06, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1505	24.02	55.99	-31.96	49.28	65.99	-16.71	10.17	Pass
0.1666	26.26	55.52	-29.26	51.13	65.52	-14.39	10.17	Pass
0.2096	25.96	54.30	-28.34	50.16	64.30	-14.14	10.17	Pass
0.2481	26.45	53.20	-26.75	50.44	63.20	-12.76	10.17	Pass
0.2885	26.09	52.04	-25.95	49.36	62.04	-12.68	10.17	Pass
0.3105	25.56	51.42	-25.85	48.25	61.42	-13.17	10.17	Pass
0.3520	25.61	50.23	-24.62	47.82	60.23	-12.41	10.17	Pass
0.4024	26.05	48.79	-22.74	47.52	58.79	-11.27	10.18	Pass
0.4414	25.28	47.68	-22.39	46.17	57.68	-11.51	10.18	Pass
0.4867	24.66	46.38	-21.72	44.72	56.38	-11.66	10.17	Pass
0.4968	24.45	46.09	-21.64	44.38	56.09	-11.71	10.17	Pass
0.5307	23.69	46.00	-22.31	43.29	56.00	-12.71	10.17	Pass
0.5558	23.56	46.00	-22.44	42.81	56.00	-13.19	10.18	Pass
0.6038	22.05	46.00	-23.95	40.78	56.00	-15.22	10.19	Pass
0.6300	21.67	46.00	-24.33	40.08	56.00	-15.92	10.19	Pass
0.6761	18.56	46.00	-27.44	38.37	56.00	-17.63	10.19	Pass
0.7001	18.50	46.00	-27.50	36.63	56.00	-19.37	10.19	Pass
1.1163	22.24	46.00	-23.76	36.67	56.00	-19.33	10.20	Pass
1.1755	22.94	46.00	-23.06	36.79	56.00	-19.21	10.20	Pass
1.2205	25.24	46.00	-20.76	43.14	56.00	-12.86	10.20	Pass





BEC Incorporated								
Line 1 Conducted Emissions								
11:02:58 AM, Wednesday, January 06, 2021								
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr	Result
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor	
0.1606	25.01	55.70	-30.69	49.60	65.70	-16.10	10.18	Pass
0.1876	25.10	54.93	-29.83	49.91	64.93	-15.02	10.18	Pass
0.2263	25.45	53.82	-28.37	49.96	63.82	-13.86	10.18	Pass
0.2569	25.32	52.95	-27.63	50.08	62.95	-12.87	10.18	Pass
0.2913	25.12	51.96	-26.84	49.53	61.96	-12.43	10.18	Pass
0.3241	24.65	51.03	-26.38	48.74	61.03	-12.29	10.18	Pass
0.3599	24.67	50.00	-25.33	48.26	60.00	-11.74	10.18	Pass
0.3918	24.86	49.09	-24.23	47.55	59.09	-11.54	10.19	Pass
0.4309	23.27	47.97	-24.70	44.50	57.97	-13.48	10.20	Pass
0.4737	22.99	46.75	-23.76	44.59	56.75	-12.17	10.20	Pass
0.4967	22.33	46.10	-23.77	44.26	56.10	-11.84	10.19	Pass
0.5130	22.15	46.00	-23.85	44.65	56.00	-11.35	10.19	Pass
0.5482	21.62	46.00	-24.38	43.37	56.00	-12.63	10.20	Pass
0.5801	20.48	46.00	-25.52	42.16	56.00	-13.84	10.20	Pass
0.5979	19.98	46.00	-26.02	40.79	56.00	-15.21	10.20	Pass
0.6510	17.98	46.00	-28.02	38.56	56.00	-17.44	10.20	Pass
0.6875	17.67	46.00	-28.33	38.42	56.00	-17.58	10.20	Pass
0.7164	15.31	46.00	-30.69	36.27	56.00	-19.73	10.20	Pass
1.1436	19.40	46.00	-26.60	35.50	56.00	-20.50	10.22	Pass
1.2120	19.62	46.00	-26.38	36.61	56.00	-19.39	10.22	Pass



Results: Conducted emissions, measured on the AC Power Port of the Legrand Model WNRH1 Sample 2107-08, Wi-Fi Radio in Receive Mode, are below the limit specified by FCC Part 15C and RSS-Gen by a margin of 11.27 dB.



4.4 Emissions in Non-Restricted and Restricted Frequency Bands, 30 MHz - 25 GHz (47 CFR 15.205, 15.209)(RSS-GEN 8.9, 8.10)

The emissions from the Legrand WNRH1, Zigbee Radio, which fall in the restricted bands of operation, detailed in this section, comply with the limits of 15.209. The Legrand WNRH1 was tested at three frequencies: Low (2405 MHz), Middle (2440 MHz) and High (2480 MHz). The modulation was O-QPSK.

Measurement of the signals was performed with the EUT on a turntable and a variable height antenna mast at 3 meters distance. The signals residing in restricted bands of operation are listed in the tables below.

4.4.1 Radiated Spurious Emissions Test Facility

OATS

The Open Area Test Site (OATS) is an all-weather facility with a wooden enclosure that contains a ground level 4-foot diameter turntable capable of rotating equipment 360 degrees. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This non-metallic enclosure and the 3 and 10 meter test range existing outside the enclosure rest upon a protective insulating material, which in turn covers a flat, metal, continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel indoors. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The test site complies with the attenuation measurements specified in ANSI C63.4.

SR#1

The Semi-Anechoic Shielded Room (SR#1) is an ferrite and absorber lined chamber which houses a 5-foot diameter turntable capable of rotating equipment 360 degrees and antenna mast for Horizontal and Vertical polarity measurements. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This 3 meter shielded enclosure has a raised computer floor with metal tile bottoms providing a continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel outside the chamber. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.



4.4.2 Emissions in Non-Restricted and Restricted Frequency Bands Test Procedure

Radiated Emissions 30 MHz – 40 GHz

The EMI receiver was set to quasi-peak mode for frequencies from 30MHz to 1GHz and the appropriate CISPR bandwidths were employed. The receiver was set to average mode for frequencies above 1GHz with the appropriate CISPR bandwidths were employed. Significant emissions found during the preliminary scans were maximized by rotating the turntable and varying the antenna height. Both horizontal and vertical antenna polarities were also investigated for suspect emissions. The signals are maximized and measured using the in house generated RADE or off the shelf TILE software. The support equipment and test item(s) were powered off in turn to determine the source of the emissions where appropriate.

Field strengths were calculated as follows:

Field Strength (dB μ V/m) = Meter Reading (dB μ V) + Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

The EUTs were tested in the 30 to 1000 MHz, 1 to 18 GHz and then 18 to 25 GHz frequency ranges. Both the Legrand Model WNRH1 with Zigbee radio and the Legrand Model WNRH1 with Wi-Fi radio were tested with the radio transmitting at low, middle and high frequencies and while in receive mode (non-transmission). The Zigbee radio was tested with an unmodulated signal and the Wi-Fi radio was tested with a DBPSK modulated signal. The selection of these modulation modes produced the highest transmitter output level.

The following tables are the highest emissions recorded and summarized. The use of the 15.209 limit table for restricted band emissions is not required but ensures compliance to 15.205 and 15.209. The signals in the tables that fall into the restricted bands, described in 15.205, are marked with an asterisk.

Photographs of the radiated emissions test setups are in Section 5 of this report.



4.4.3 Emissions in Frequency Bands 30 MHz – 1000 MHz WNRH1 With Zigbee Radio

4.4.3.1 Emissions in Frequency Bands 30 MHz – 1000 MHz WNRH1 With Zigbee Radio Test Results (12/09/2020)

Radiated emissions scans between 30 – 1000 MHz were made for each of the three; low, middle and high transmission frequencies with an unmodulated transmit signal and with the radio in the Rx mode. The Model WNRH1 was used for all radiated emission tests.

Legrand Model WNRH1 Zigbee Radio, Low Channel 11, 2405 MHz, Unmodulated

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC 15.205/209 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.454	20.88	19.43	H	123	148	-0.71	40.00	-20.57	PASS
43.757	28.79	28.31	V	154	120	-9.78	40.00	-11.69	PASS
77.946	29.05	27.37	V	352	119	-12.98	40.00	-12.63	PASS
113.398*	32.92	32.26	V	009	157	-7.32	43.52	-11.26	PASS
118.255*	30.34	28.91	H	260	115	-6.90	43.52	-14.61	PASS
159.120	31.10	33.41	V	079	144	-7.18	43.52	-10.11	PASS
159.453	41.82	39.24	H	115	200	-7.21	43.52	-4.28	PASS
216.335	31.04	30.38	H	225	100	-8.08	46.02	-15.64	PASS
216.370	28.63	27.19	V	316	101	-8.08	46.02	-18.83	PASS
220.891	33.12	32.76	H	240	116	-8.32	46.02	-13.26	PASS
220.931	30.49	30.67	V	182	240	-8.32	46.02	-15.35	PASS
249.27*	31.69	30.62	H	114	135	-8.65	46.02	-15.40	PASS
323.752*	32.06	30.00	H	240	104	-7.96	46.02	-16.02	PASS
323.797*	26.84	25.13	V	215	131	-7.96	46.02	-20.89	PASS
349.673	21.45	20.25	V	183	121	-7.89	46.02	-25.77	PASS
373.250	24.04	24.13	H	132	104	-7.76	46.02	-21.89	PASS
398.359	18.04	16.63	V	213	121	-7.71	46.02	-29.39	PASS
404.416	20.26	19.91	H	233	213	-7.73	46.02	-26.11	PASS
952.680	19.94	17.07	H	109	121	-3.54	46.02	-28.95	PASS
960.153*	21.59	17.17	V	250	126	-3.47	53.98	-36.81	PASS
*Restricted Band Signal									



Legrand Model WNRH1 Zigbee Radio, Middle Channel 18, 2440 MHz, Unmodulated

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC 15.205/209 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.506	19.83	19.10	H	340	241	-0.74	40.00	-20.90	PASS
43.732	30.69	28.98	V	159	104	-9.76	40.00	-11.02	PASS
112.31*	30.37	28.22	H	235	255	-7.51	43.52	-15.30	PASS
145.293	28.27	31.81	V	128	109	-7.30	43.52	-11.71	PASS
147.635	27.59	28.19	V	269	102	-7.26	43.52	-15.33	PASS
153.613	31.00	32.75	V	130	131	-7.21	43.52	-10.77	PASS
158.303	30.24	33.94	V	120	131	-7.17	43.52	-9.58	PASS
159.408	42.20	40.32	H	093	173	-7.21	43.52	-3.20	PASS
161.913	34.59	32.33	V	104	101	-7.33	43.52	-11.19	PASS
164.255*	30.16	31.15	V	121	141	-7.43	43.52	-12.37	PASS
167.831*	31.23	29.86	V	315	119	-7.75	43.52	-13.66	PASS
173.656	31.73	31.35	V	317	110	-8.28	43.52	-12.17	PASS
177.182	31.74	30.93	V	310	104	-8.50	43.52	-12.59	PASS
216.322	30.21	30.01	H	233	126	-8.08	46.02	-16.01	PASS
235.042	37.36	35.98	H	120	101	-8.65	46.02	-10.04	PASS
315.292	32.41	31.14	H	229	106	-8.02	46.02	-14.88	PASS
372.399	25.93	23.39	H	113	104	-7.78	46.02	-22.63	PASS
401.634*	21.92	19.20	H	243	255	-7.70	46.02	-26.82	PASS
959.343	19.18	16.82	H	140	255	-3.48	46.02	-29.20	PASS
969.963*	17.99	17.00	H	113	250	-3.33	53.98	-36.98	PASS
*Restricted Band Signal									



Legrand Model WNRH1 Zigbee Radio, High Channel 26, 2480 MHz, Unmodulated

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC 15.205/209 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.260	19.04	19.43	H	069	152	-0.62	40.00	-20.57	PASS
43.967	28.84	28.70	V	172	110	-9.92	40.00	-11.30	PASS
77.951	26.91	26.22	V	320	148	-12.98	40.00	-13.78	PASS
119.288*	30.33	28.85	H	248	245	-6.79	43.52	-14.67	PASS
155.938	31.04	31.02	V	135	168	-7.19	43.52	-12.50	PASS
163.063*	35.71	36.40	H	092	151	-7.42	43.52	-7.12	PASS
182.042	28.92	28.13	V	320	105	-8.64	43.52	-15.39	PASS
209.023	30.39	28.21	V	298	111	-7.60	43.52	-15.31	PASS
216.325	28.49	26.62	V	297	100	-8.08	46.02	-19.40	PASS
216.342	31.53	30.65	H	237	105	-8.08	46.02	-15.37	PASS
235.027	37.83	36.14	H	100	104	-8.65	46.02	-9.88	PASS
235.028	33.12	31.99	V	170	188	-8.65	46.02	-14.03	PASS
277.51*	16.20	14.25	V	073	101	-8.33	46.02	-31.77	PASS
315.357	32.12	31.28	H	214	101	-8.02	46.02	-14.74	PASS
323.71*	24.71	24.80	V	214	126	-7.96	46.02	-21.22	PASS
349.911*	26.94	25.58	H	231	126	-7.89	46.02	-20.44	PASS
374.409	24.38	22.29	H	112	105	-7.75	46.02	-23.73	PASS
405.137*	27.86	26.09	H	227	255	-7.73	46.02	-19.93	PASS
415.871	20.96	18.33	V	268	111	-7.78	46.02	-27.69	PASS
485.503	16.29	13.93	H	020	135	-7.69	46.02	-32.09	PASS
*Restricted Band Signal									



Legrand Model WNRH1 Zigbee Radio, Rx Mode

Frequency	Peak	QP	Polarity	TT angle	Ant Height	Correction Factors	FCC 15.205/209 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.19	21.31	19.20	H	031	127	-0.58	40.00	-20.80	PASS
44.14	31.25	29.45	V	194	101	-10.03	40.00	-10.55	PASS
77.93	27.45	26.46	V	360	136	-12.98	40.00	-13.54	PASS
115.73	32.24	31.59	H	126	116	-7.07	43.52	-11.93	PASS
115.77	31.91	32.21	V	010	172	-7.06	43.52	-11.31	PASS
154.72	30.83	31.98	V	110	116	-7.20	43.52	-11.54	PASS
161.91	38.83	38.35	H	105	178	-7.33	43.52	-5.17	PASS
182.02	28.89	28.53	V	331	111	-8.64	43.52	-14.99	PASS
209.00	31.04	30.00	V	294	103	-7.60	43.52	-13.52	PASS
216.32	28.84	28.98	V	189	146	-8.08	46.02	-17.04	PASS
216.32	31.63	29.90	H	226	109	-8.08	46.02	-16.12	PASS
234.98	33.60	31.89	V	171	167	-8.65	46.02	-14.13	PASS
235.00	37.05	35.59	H	103	116	-8.65	46.02	-10.43	PASS
313.19	32.77	30.97	H	231	104	-8.03	46.02	-15.05	PASS
323.56	25.85	23.77	V	227	115	-7.95	46.02	-22.25	PASS
372.29	24.86	25.56	H	221	193	-7.78	46.02	-20.46	PASS
402.53	20.96	25.51	H	229	255	-7.71	46.02	-20.51	PASS
413.03	19.37	20.11	V	272	166	-7.75	46.02	-25.91	PASS
542.05	19.16	17.09	H	231	141	-6.40	46.02	-28.93	PASS
857.59	18.28	16.37	H	093	146	-4.34	46.02	-29.65	PASS

Test Results: The Legrand Model WNRH1 with Zigbee Radio complies with the requirements of 47 CFR Part 15.205, 15.209 and RSS-Gen Section 8.10 for non-restricted and restricted bands of operation, between 30 MHz – 1 GHz, with a margin of 3.20 dB.



4.4.4 Emissions in Frequency Bands 1 - 18 GHz WNRH1 With Zigbee Radio

4.4.4.1 Emissions in Frequency Bands 1 - 18 GHz WNRH1 With Zigbee Radio Test Results (12/10/2020)

Radiated emissions scans between 1 – 18 GHz were made for each of the three; low, middle and high transmission frequencies with an unmodulated transmit signal and with the radio in the Rx mode. The Model WNRH1 was used for all radiated emission tests.

Legrand Model WNRH1 Zigbee Radio, Low Channel 11, 2405 MHz, Unmodulated

Frequency	PeakLevel	AvgLevel	AntPol	Azimuth	AntHght	C/F	AvgLimit	AvgMargin	FCC 15.205/209 Limit	FCC 15.205/209 Limit	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	PeakLimit	PeakMargin	
4.80893*	45.74	42.47	H	331	143	1.60	53.98	-11.51	73.98	-28.24	PASS
4.80896*	48.45	46.83	V	340	120	1.60	53.98	-7.15	73.98	-25.53	PASS
6.52920	42.08	33.24	V	058	148	2.85	53.98	-20.74	73.98	-31.90	PASS
7.10508	43.35	34.21	H	083	101	3.79	53.98	-19.77	73.98	-30.64	PASS
7.21368	45.60	36.07	H	325	174	4.21	53.98	-17.91	73.98	-28.38	PASS
7.28402*	44.39	34.45	V	082	137	4.46	53.98	-19.53	73.98	-29.59	PASS
8.34614*	46.15	37.19	V	146	160	5.77	53.98	-16.79	73.98	-27.83	PASS
9.61487	48.13	37.98	H	133	102	7.25	53.98	-16.00	73.98	-25.85	PASS
11.75620*	50.10	39.98	V	084	173	8.35	53.98	-14.00	73.98	-23.88	PASS
14.49410*	55.54	48.01	H	291	168	12.91	53.98	-5.97	73.98	-18.44	PASS

*Restricted Band Signal

Legrand Model WNRH1 Zigbee Radio, Middle Channel 18, 2440 MHz, Unmodulated

Frequency	PeakLevel	AvgLevel	AntPol	Azimuth	AntHght	C/F	AvgLimit	AvgMargin	FCC 15.205/209 Limit	FCC 15.205/209 Limit	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	PeakLimit	PeakMargin	
4.80893*	45.74	42.47	H	331	143	1.60	53.98	-11.51	73.98	-28.24	PASS
4.80896*	48.45	46.83	V	340	120	1.60	53.98	-7.15	73.98	-25.53	PASS
6.52920	42.08	33.24	V	058	148	2.85	53.98	-20.74	73.98	-31.90	PASS
7.10508	43.35	34.21	H	083	101	3.79	53.98	-19.77	73.98	-30.64	PASS
7.21368	45.60	36.07	H	325	174	4.21	53.98	-17.91	73.98	-28.38	PASS
7.28402*	44.39	34.45	V	082	137	4.46	53.98	-19.53	73.98	-29.59	PASS
8.34614*	46.15	37.19	V	146	160	5.77	53.98	-16.79	73.98	-27.83	PASS
9.61487	48.13	37.98	H	133	102	7.25	53.98	-16.00	73.98	-25.85	PASS
11.75620*	50.10	39.98	V	084	173	8.35	53.98	-14.00	73.98	-23.88	PASS
14.49410*	55.54	48.01	H	291	168	12.91	53.98	-5.97	73.98	-18.44	PASS

*Restricted Band Signal



Legrand Model WNRH1 Zigbee Radio, High Channel 26, 2480 MHz, Unmodulated

Frequency	PeakLevel	AvgLevel	AntPol	Azimuth	AntHght	C/F	AvgLimit	AvgMargin	FCC 15.205/209 Limit	FCC 15.205/209 Limit	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	PeakLimit	PeakMargin	
4.87898*	45.63	40.86	H	206	101	1.81	53.98	-13.13	73.98	-28.35	PASS
4.87904*	49.80	47.69	V	317	109	1.81	53.98	-6.29	73.98	-24.18	PASS
5.89844	41.01	30.41	V	205	183	3.12	53.98	-23.57	73.98	-32.97	PASS
6.88174	42.86	34.35	V	199	150	3.64	53.98	-19.63	73.98	-31.12	PASS
7.60705*	44.33	35.28	H	126	152	4.61	53.98	-18.70	73.98	-29.66	PASS
8.24654*	47.12	36.93	V	000	099	5.58	53.98	-17.05	73.98	-26.86	PASS
9.33809*	46.77	38.10	H	267	171	7.43	53.98	-15.88	73.98	-27.21	PASS
11.38040*	48.78	39.23	V	030	198	7.27	53.98	-14.75	73.98	-25.20	PASS
11.56910*	50.19	39.70	H	180	184	7.84	53.98	-14.28	73.98	-23.79	PASS

*Restricted Band Signal

Legrand Model WNRH1 Zigbee Radio, Rx Mode

Frequency	PeakLevel	AvgLevel	AntPol	Azimuth	AntHght	C/F	AvgLimit	AvgMargin	FCC 15.205/209 Limit	FCC 15.205/209 Limit	Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	PeakLimit	PeakMargin	
1.00298*	30.74	21.58	H	252	159	-12.91	53.98	-32.40	73.98	-43.24	PASS
1.01548*	29.44	20.98	V	247	116	-12.91	53.98	-33.00	73.98	-44.54	PASS
2.40842	32.57	24.46	V	205	210	-5.51	53.98	-29.52	73.98	-41.41	PASS
2.41618	33.60	24.24	H	163	128	-5.50	53.98	-29.74	73.98	-40.38	PASS
2.77232*	34.17	25.36	V	057	195	-4.38	53.98	-28.62	73.98	-39.81	PASS
4.23964*	38.85	28.20	V	356	200	0.31	53.98	-25.78	73.98	-35.13	PASS
8.30872*	47.81	37.16	V	233	207	5.71	53.98	-16.82	73.98	-26.17	PASS

*Restricted Band Signal

Test Results: The Legrand Model WNRH1 with Zigbee Radio complies with the requirements of 47 CFR Part 15.205, 15.209 and RSS-Gen Section 8.10 for non-restricted and restricted bands of operation between 1 – 18 GHz with a margin of 18.44 dB.



4.4.5 Emissions in Frequency Bands 18 – 25 GHz WNRH1 With Zigbee Radio

4.4.5.1 Emissions in Frequency Bands 18 – 25 GHz WNRH1 With Zigbee Radio Test Results (12/14/2020)

Radiated emissions scans between 18 – 25 GHz were made for each of the three; low, middle and high transmission frequencies with an unmodulated transmit signal and with the radio in the Rx mode. No measurable signals were detected. All scans are retained by BEC Incorporated and are available upon request. The Model WNRH1 was used for all radiated emission tests.

Test Results: The Legrand Model WNRH1 with Zigbee Radio complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 for restricted bands of operation without measurable emissions between 18 and 25 GHz.



4.4.6 Emissions in Frequency Bands 30 – 1000 MHz WNRH1 With Wi-Fi Radio

4.4.6.1 Emissions in Frequency Bands 30 – 1000 MHz WNRH1 With Wi-Fi Radio Test Results (12/29/2020 and 12/30/2020)

Radiated emissions scans between 30 – 1000 MHz were made for each of the three; low, middle and high transmission frequencies with a DBPSK modulated transmit signal and with the radio in the Rx mode. The Model WNRH1 was used for all radiated emission tests.

Legrand Model WNRH1 Wi-Fi Radio, Low Channel 1, 2412 MHz, DBPSK Modulation

Frequency	Corrected Peak Level	Corrected QP Level	Polarity	TT angle	Ant Height	Correction Factor	FCC 15.205/209 & RSS-247 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
31.182	21.15	19.43	H	201	193	-1.14	40.00	-20.57	Pass
58.568	34.36	33.19	V	254	100	-13.43	40.00	-6.81	Pass
117.055	35.13	36.51	V	050	145	-6.93	43.52	-7.01	Pass
122.258	32.52	35.59	H	289	120	-6.69	43.52	-7.93	Pass
149.366	25.61	26.19	V	292	100	-7.24	43.52	-17.33	Pass
149.453	29.48	30.20	H	084	252	-7.24	43.52	-13.32	Pass
175.567	25.60	16.25	V	309	116	-8.40	43.52	-27.27	Pass
183.015	21.37	14.60	H	117	161	-8.73	43.52	-28.92	Pass
216.200	24.06	21.44	V	236	125	-8.07	46.02	-24.58	Pass
216.288	25.97	26.03	H	074	228	-8.08	46.02	-19.99	Pass
222.318	23.50	21.37	H	080	151	-8.39	46.02	-24.65	Pass
225.904	22.29	21.57	V	012	104	-8.53	46.02	-24.45	Pass
263.992	34.74	34.89	H	252	119	-8.47	46.02	-11.13	Pass
322.920	25.62	25.06	H	220	115	-7.95	46.02	-20.96	Pass
360.015	32.63	32.11	H	343	230	-7.85	46.02	-13.91	Pass
360.022	27.11	26.96	V	151	136	-7.85	46.02	-19.06	Pass
407.985	21.33	21.06	H	304	110	-7.73	46.02	-24.96	Pass
522.071	24.10	21.20	V	309	104	-6.67	46.02	-24.82	Pass
552.001	22.03	20.25	V	034	109	-6.34	46.02	-25.77	Pass
959.275	17.67	17.45	V	293	208	-3.48	46.02	-28.57	Pass



Legrand Model WNRH1 Wi-Fi Radio, Middle Channel 6, 2437 MHz, DBPSK Modulation

Frequency	Corrected Peak Level	Corrected QP Level	Polarity	TT angle	Ant Height	Correction Factor	FCC 15.205/209 & RSS-247 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.741	20.63	19.74	H	337	230	-0.85	40.00	-20.26	Pass
58.633	34.32	33.60	V	135	100	-13.43	40.00	-6.40	Pass
113.575	39.08	38.27	V	037	100	-7.30	43.52	-5.25	Pass
119.727	38.42	36.71	H	276	115	-6.74	43.52	-6.81	Pass
151.277	21.93	30.62	H	049	255	-7.22	43.52	-12.90	Pass
167.494	29.78	27.63	V	175	167	-7.72	43.52	-15.89	Pass
184.223	26.56	24.50	H	131	188	-8.72	43.52	-19.02	Pass
193.847	24.26	24.01	V	082	104	-8.04	43.52	-19.51	Pass
215.980	22.58	19.79	H	096	131	-8.06	43.52	-23.73	Pass
216.542	22.13	20.60	V	207	109	-8.09	46.02	-25.42	Pass
223.786	21.62	19.32	H	088	193	-8.46	46.02	-26.70	Pass
229.713	23.39	21.77	V	018	101	-8.57	46.02	-24.25	Pass
264.015	34.79	33.95	H	253	129	-8.47	46.02	-12.07	Pass
264.048	22.97	25.15	V	303	120	-8.47	46.02	-20.87	Pass
321.828	27.79	25.58	H	123	104	-7.94	46.02	-20.44	Pass
359.982	29.73	29.16	V	135	104	-7.85	46.02	-16.86	Pass
360.027	33.10	32.70	H	358	229	-7.85	46.02	-13.32	Pass
528.919	22.24	21.31	V	311	109	-6.50	46.02	-24.71	Pass
842.573	16.71	16.51	H	140	245	-4.43	46.02	-29.51	Pass
959.348	16.72	17.58	V	124	209	-3.48	46.02	-28.44	Pass



Legrand Model WNRH1 Wi-Fi Radio, High Channel 11, 2462 MHz, DBPSK Modulation

Frequency	Corrected Peak Level	Corrected QP Level	Polarity	TT angle	Ant Height	Correction Factor	FCC 15.205/209 & RSS-247 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.228	20.34	19.68	H	164	220	-0.60	40.00	-20.32	Pass
62.199	32.15	25.83	V	036	111	-13.11	40.00	-14.17	Pass
113.503	38.23	38.27	V	031	105	-7.31	43.52	-5.25	Pass
119.667	39.39	35.59	H	281	119	-6.75	43.52	-7.93	Pass
159.202	30.91	28.81	H	061	255	-7.19	43.52	-14.71	Pass
167.470	31.65	32.14	V	197	130	-7.72	43.52	-11.38	Pass
185.418	29.38	27.52	H	135	177	-8.66	43.52	-16.00	Pass
193.593	27.36	26.67	V	087	115	-8.07	43.52	-16.85	Pass
215.997	25.18	23.98	H	098	109	-8.06	43.52	-19.54	Pass
216.310	17.83	24.21	V	197	147	-8.08	46.02	-21.81	Pass
228.234	21.16	22.39	V	031	119	-8.55	46.02	-23.63	Pass
229.721	22.00	22.08	H	064	167	-8.57	46.02	-23.94	Pass
264.025	33.75	32.12	H	241	147	-8.47	46.02	-13.90	Pass
322.844	24.99	25.03	H	201	110	-7.95	46.02	-20.99	Pass
359.957	29.40	30.00	H	113	213	-7.85	46.02	-16.02	Pass
359.995	29.25	28.56	V	145	115	-7.85	46.02	-17.46	Pass
531.603	20.91	20.80	V	303	120	-6.49	46.02	-25.22	Pass
647.888	22.37	21.22	H	216	116	-5.89	46.02	-24.80	Pass
648.013	20.26	19.49	V	345	145	-5.89	46.02	-26.53	Pass
919.558	19.79	17.25	V	065	109	-3.92	46.02	-28.77	Pass



Legrand Model WNRH1 Wi-Fi Radio, Rx Mode

Frequency	Corrected Peak Level	Corrected QP Level	Polarity	TT angle	Ant Height	Correction Factor	FCC 15.205/209 & RSS-247 Limit	Margin	Result
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	
30.616	22.21	18.73	H	151	121	-0.79	40.00	-21.27	Pass
58.950	25.47	24.43	V	003	104	-13.43	40.00	-15.57	Pass
114.535	38.99	36.88	V	028	101	-7.20	43.52	-6.64	Pass
125.498	30.50	35.03	H	282	247	-6.66	43.52	-8.49	Pass
171.346	28.61	32.13	V	192	100	-8.07	43.52	-11.39	Pass
175.151	29.08	30.33	H	318	214	-8.40	43.52	-13.19	Pass
197.714	27.23	25.70	V	092	100	-7.35	43.52	-17.82	Pass
203.744	30.64	22.71	H	267	108	-7.26	43.52	-20.81	Pass
215.842	27.65	24.83	H	260	130	-8.05	43.52	-18.69	Pass
216.510	20.90	14.74	V	029	172	-8.09	46.02	-31.28	Pass
229.064	35.01	26.24	H	087	192	-8.56	46.02	-19.78	Pass
229.065	29.00	30.96	V	023	135	-8.56	46.02	-15.06	Pass
264.035	28.75	21.85	H	067	176	-8.47	46.02	-24.17	Pass
322.800	25.36	29.38	H	116	108	-7.95	46.02	-16.64	Pass
324.468	23.05	16.56	V	359	156	-7.96	46.02	-29.46	Pass
360.475	17.43	15.39	H	325	119	-7.84	46.02	-30.63	Pass
503.953	16.08	13.09	V	059	101	-7.14	46.02	-32.93	Pass
551.956	16.75	16.44	V	070	103	-6.35	46.02	-29.58	Pass
647.918	25.79	16.40	H	231	120	-5.89	46.02	-29.62	Pass
936.560	19.01	15.84	V	109	217	-3.72	46.02	-30.18	Pass

Test Results: The Legrand Model WNRH1 with Wi-Fi Radio complies with the requirements of 47 CFR Part 15.205, 15.209 and RSS-Gen Section 8.10 for non-restricted and restricted bands of operation, between 30 MHz – 1 GHz, with a margin of 5.25 dB.



4.4.7 Emissions in Frequency Bands 1 - 18 GHz WNRH1 With Wi-Fi Radio

4.4.7.1 Emissions in Frequency Bands 1 - 18 GHz WNRH1 With Wi-Fi Radio Test Results (12/30/2020)

Radiated emissions scans between 1 – 18 GHz were made for each of the three; low, middle and high transmission frequencies with a DBPSK modulated transmit signal and with the radio in the Rx mode. The Model WNRH1 was used for all radiated emission tests.

Legrand Model WNRH1 Wi-Fi Radio, Low Channel 1, 2412 MHz, DBPSK Modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4111	40.53	34.20	V	093	123	-5.51	53.98	-19.78	73.98	-33.45	Pass
3.2607	36.79	27.02	H	273	144	-2.04	53.98	-26.96	73.98	-37.19	Pass
3.6181	45.47	42.47	V	025	101	-1.10	53.98	-11.51	73.98	-28.51	Pass
3.6181	41.98	34.92	H	203	198	-1.10	53.98	-19.06	73.98	-32.00	Pass
4.8240	47.76	46.66	H	347	207	1.67	53.98	-7.32	73.98	-26.22	Pass
4.8242	45.51	41.87	V	152	104	1.67	53.98	-12.11	73.98	-28.47	Pass
8.2598	45.70	37.11	H	222	126	5.61	53.98	-16.87	73.98	-28.28	Pass
8.4515	46.57	37.44	V	044	195	6.04	53.98	-16.54	73.98	-27.41	Pass

Legrand Model WNRH1 Wi-Fi Radio, Middle Channel 6, 2437 MHz, DBPSK Modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4348	41.34	35.13	V	106	102	-5.49	53.98	-18.85	73.98	-32.64	Pass
2.9811	37.07	27.14	H	352	171	-2.97	53.98	-26.84	73.98	-36.91	Pass
3.6557	44.61	41.11	V	237	101	-0.83	53.98	-12.87	73.98	-29.37	Pass
3.9925	38.83	29.37	H	139	182	0.67	53.98	-24.61	73.98	-35.15	Pass
4.8740	50.21	47.42	H	337	202	1.80	53.98	-6.56	73.98	-23.77	Pass
4.8741	45.33	41.68	V	164	111	1.80	53.98	-12.30	73.98	-28.65	Pass
5.8439	39.74	30.17	H	358	204	3.00	53.98	-23.81	73.98	-34.24	Pass
8.5493	47.85	37.07	V	359	156	6.19	53.98	-16.91	73.98	-26.13	Pass



Legrand Model WNRH1 Wi-Fi Radio, High Channel 11, 2462 MHz, DBPSK Modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4608	42.52	37.43	V	076	114	-5.45	53.98	-16.55	73.98	-31.459	Pass
3.2623	36.49	27.40	H	307	124	-2.04	53.98	-26.58	73.98	-37.492	Pass
3.5858	36.72	28.25	H	360	184	-1.28	53.98	-25.73	73.98	-37.262	Pass
3.6930	45.93	42.10	V	030	101	-0.48	53.98	-11.88	73.98	-28.05	Pass
4.9239	48.34	44.77	H	018	209	1.84	53.98	-9.21	73.98	-25.644	Pass
4.9240	44.56	42.38	V	277	210	1.84	53.98	-11.60	73.98	-29.424	Pass
8.5644	47.82	37.64	H	147	132	6.22	53.98	-16.34	73.98	-26.162	Pass
10.2892	47.67	37.62	V	341	101	6.54	53.98	-16.37	73.98	-26.307	Pass

Legrand Model WNRH1 Wi-Fi Radio, Rx mode

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
1.0320	33.08	25.15	H	317	120	-12.90	53.98	-28.83	73.98	-40.9	Pass
1.0354	30.52	20.83	V	298	200	-12.90	53.98	-33.15	73.98	-43.459	Pass
1.8612	31.95	23.74	V	127	214	-7.64	53.98	-30.24	73.98	-42.026	Pass
2.4147	33.67	23.86	V	216	163	-5.51	53.98	-30.12	73.98	-40.305	Pass
2.4574	34.32	24.89	H	228	199	-5.46	53.98	-29.09	73.98	-39.656	Pass
3.0798	36.17	27.31	H	332	128	-2.42	53.98	-26.67	73.98	-37.809	Pass

Test Results: The Legrand Model WNRH1 with Wi-Fi Radio complies with the requirements of 47 CFR Part 15.205, 15.209 and RSS-Gen Section 8.10 for non-restricted and restricted bands of operation between 1 – 18 GHz, with a margin of 23.77 dB.



4.4.8 Emissions in Frequency Bands 18 – 25 GHz WNRH1 With Wi-Fi Radio

4.4.8.1 Emissions in Frequency Bands 18 – 25 GHz WNRH1 With Wi-Fi Radio Test Results (01/04/2021)

Radiated emissions scans between 18 – 25 GHz were made for each of the three; low, middle and high transmission frequencies with a DBPSK modulated transmit signal and with the radio in the Rx mode. The Model WNRH1 was used for all radiated emission tests.

No measurable signals were detected. All scans are retained by BEC Incorporated and are available upon request.

Test Results: The Legrand Model WNRH1 with Wi-Fi Radio complies with the requirements of 47 CFR Part 15.205 and RSS-Gen Section 8.10 for restricted bands of operation without measurable emissions between 18 and 25 GHz.



4.5 Occupied Bandwidth OBW (FCC Section 15.247(a)(2) RSS-247 5.2(a))

4.5.1 Occupied Bandwidth – Test Procedure

The transmission of the Zigbee radio produces a wide band, noise-like emission. Therefore, the procedure of KDB 550874 D01 Section 8.3.1.2, suggests the use of the integrated average power measurement of Section 8.3.2. The measurement is referenced to the OBW instead of the DTS Bandwidth. ANSI C63.10, Section 6.9.2., the relative measurement procedure was used. The SA span was 5 MHz, resolution bandwidth was 30 kHz and the video bandwidth was 100 kHz. For the Zigbee radio, O-QPSK is the only modulation mode used.

The transmission bandwidth of the Wi-Fi radio produces an emission that is wider than the highest bandwidth of the spectrum analyzer used for measurement. In this case, $RBW < OBW$, KDB 550874 D01, Section 8.3.1.1 requires the use of ANSI C63.10, Section 6.9.2., the relative measurement procedure. DQPSK (5.5 Mbps) modulation produced the narrowest bandwidth for IEEE 802.11b, 64 QAM (6 Mbps) for IEEE 802.11g and MCS0 BPSK (7.2 Mbps) for IEEE 802.11n. Spectrum Analyzer settings are listed for each measurement.

Spectrum Analyzer Settings During Measurements of Zigbee Radio

SA Settings			ANSI C63.10 Requirement
Span	5	MHz	2 to 5 times OBW
RBW	30	kHz	1 - 5 % of OBW
VBW	100	kHz	≈3 times RBW
Sweep Time	14	ms	Auto

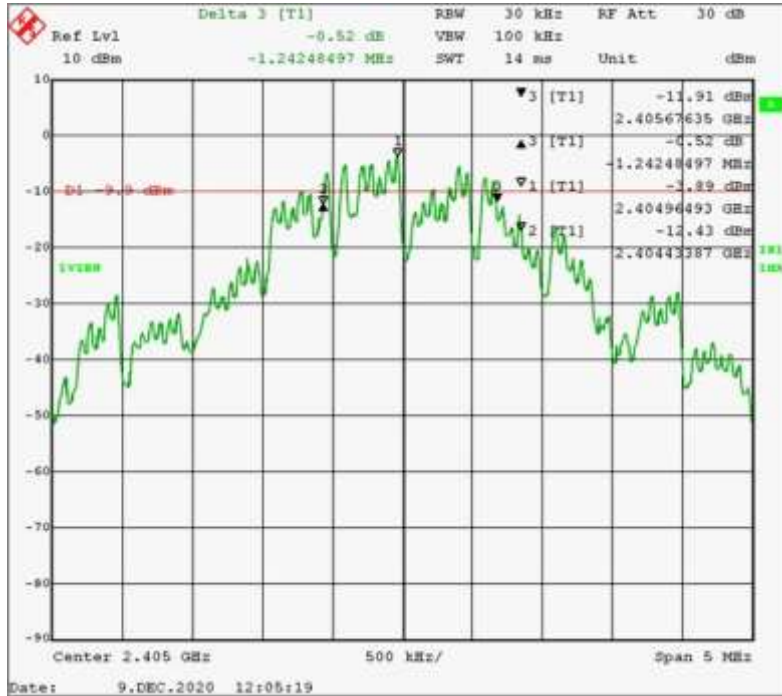
Spectrum Analyzer Settings During Measurements of Wi-Fi Radio

Spectrum Analyzer Settings					
	DQPSK 5.5 Mbps		64-QAM 6 Mbps MCS0 BPSK 7.2 Mbps		KDB 550874 Requirement
Span	30	MHz	50	MHz	2 to 5 times OBW
RBW	100	kHz	500	kHz	1 - 5 % of OBW
VBW	300	kHz	2	MHz	≈3 times RBW
Sweep Time	7.5	ms	5	ms	Auto

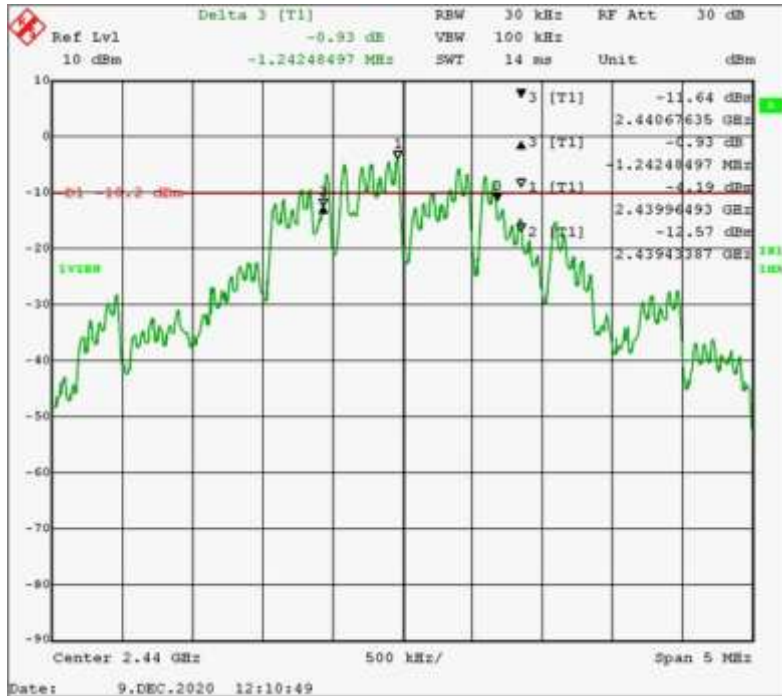


4.5.1.1 Occupied Bandwidth Test Results WNRH1 With Zigbee Radio (12/09/2020)

Legrand Model WNRH1 Zigbee Radio Low channel 11, 2405 MHz, O-QPSK Modulation



Legrand Model WNRH1 Zigbee Radio Middle channel 18, 2440 MHz, O-QPSK Modulation





Legrand Model WNRH1 Zigbee Radio High channel 26, 2480 MHz, O-QPSK Modulation



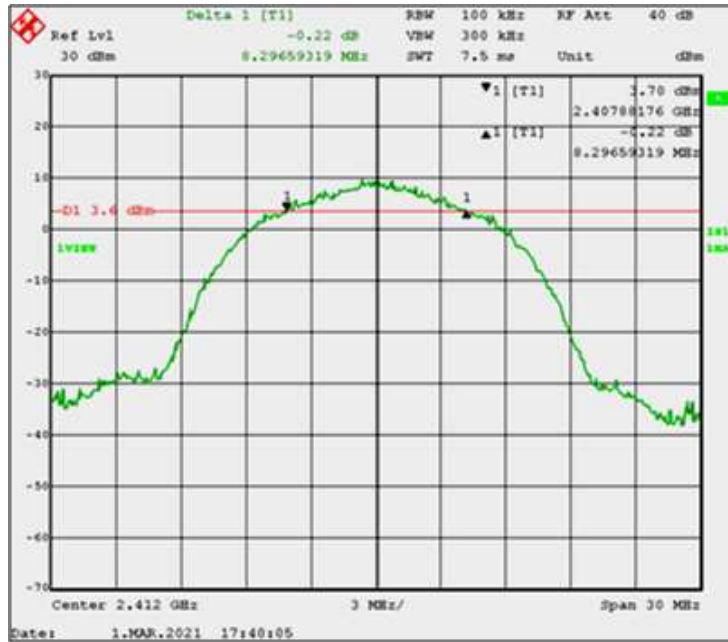
Channel	Frequency	Measured 6 dB BW	47 CFR 15.247(a)(2) & RSS-247 5.2 Minimum Limit	Margin	Result
	MHz	kHz	kHz	kHz	
11	2405.0	1242.5	500	742.5	Pass
18	2440.0	1242.5	500	742.5	Pass
26	2780.0	1422.8	500	922.8	Pass

Test Results: The 6-dB, Occupied Bandwidth measurements for the Legrand Model WNRH1 with Zigbee Radio with O-QPSK Modulation were measured and are compliant to the minimum bandwidth requirements. The results are also used to select bandwidths and frequency spans for other radio measurements.

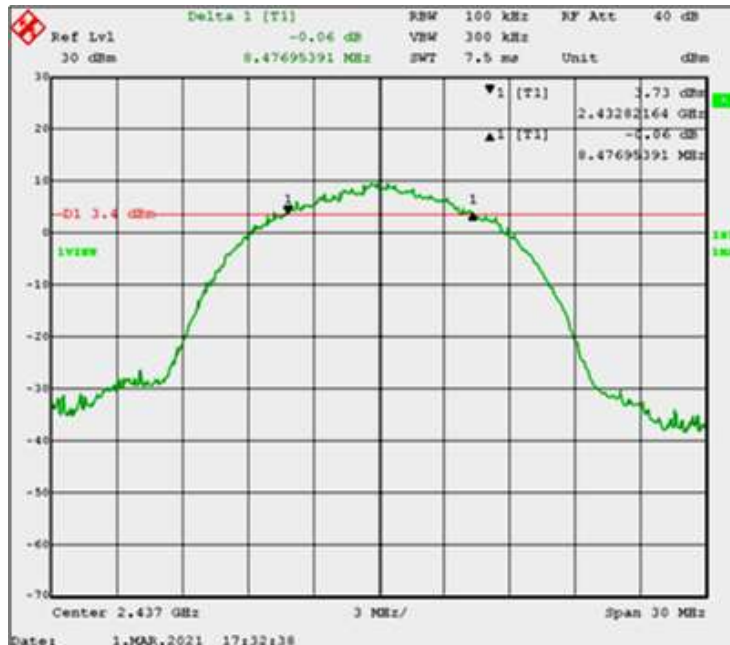


4.5.1.2 Occupied Bandwidth Test Results WNRH1 With Wi-Fi Radio (03/01/2021)

Legrand Model WNRH1 Wi-Fi Radio, DQPSK (5.5 Mbps) modulation, Minimum bandwidth, Low Channel 1, (2412 MHz)



Legrand Model WNRH1 Wi-Fi Radio, DQPSK (5.5 Mbps) modulation, minimum bandwidth, Middle channel 6, (2437 MHz)





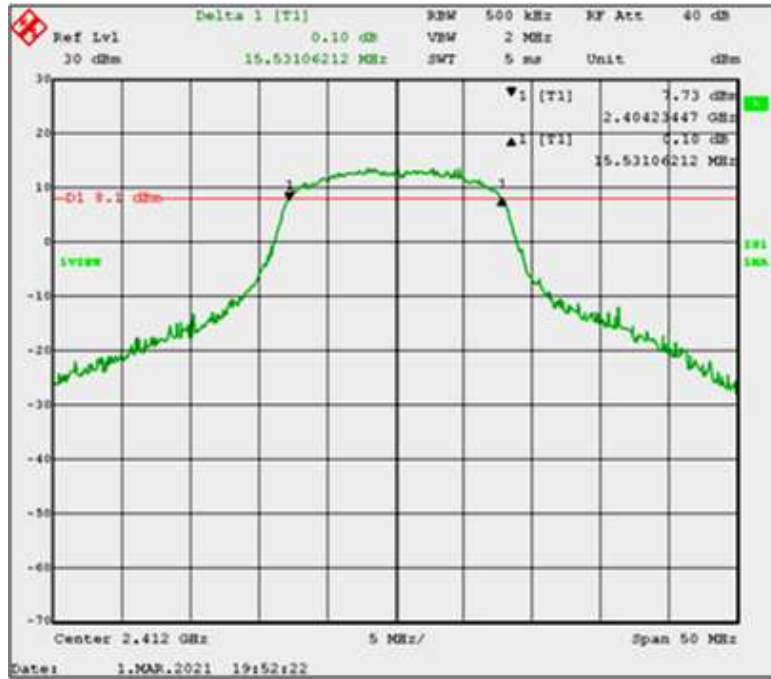
Legrand Model WNRH1 Wi-Fi Radio, DBPSK modulation, minimum bandwidth,
High channel 11, (2462 MHz)



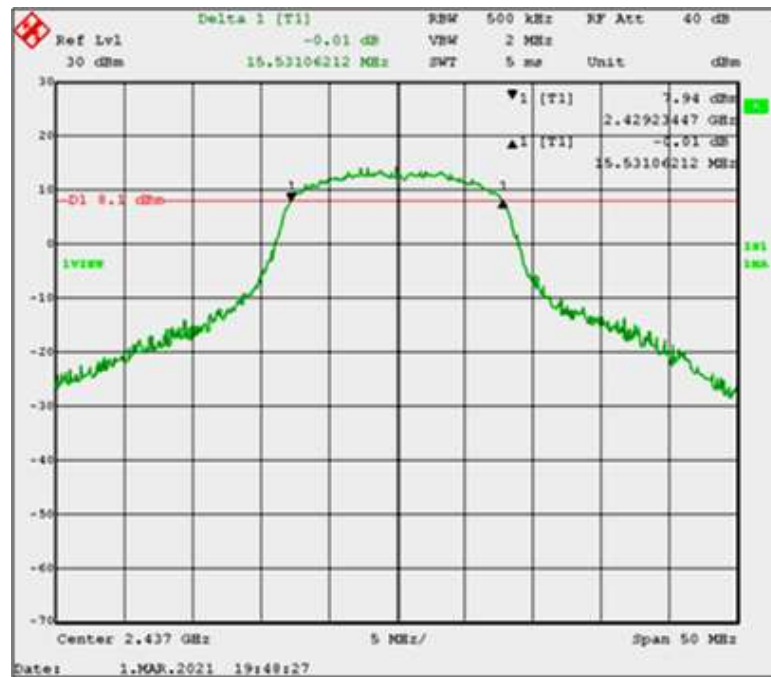
DQPSK 5.5 Mbps Modulation					
Channel	Frequency (MHz)	6 dB BW (MHz)	47 CFR 15.247(a)(2) & RSS-247 5.2 Minimum Limit (MHz)	Margin (MHz)	Result
1	2412.0	8.297	0.5	7.797	Pass
6	2437.0	8.477	0.5	7.977	Pass
11	2462.0	9.319	0.5	8.819	Pass



Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, Minimum bandwidth, Low Channel 1, (2412 MHz)

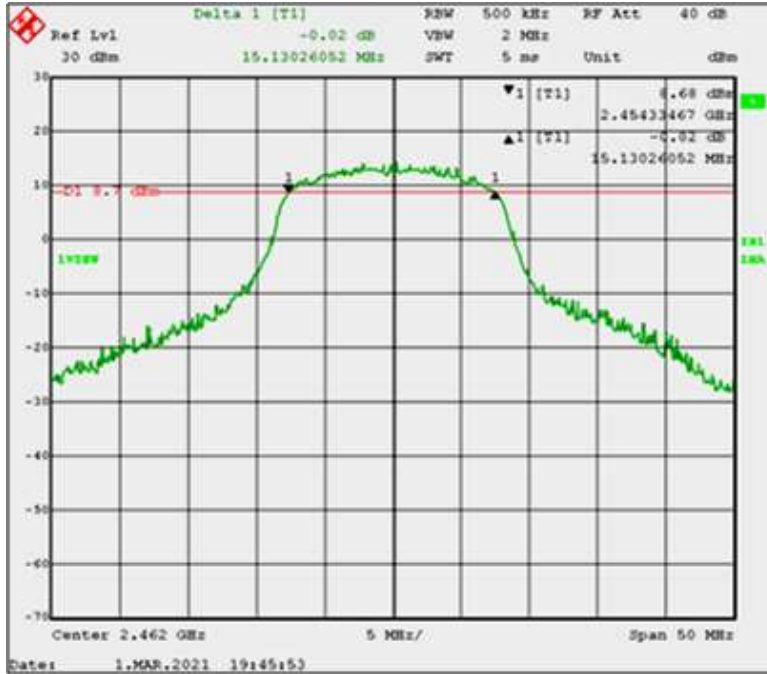


Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, minimum bandwidth, Middle channel 6, (2437 MHz)





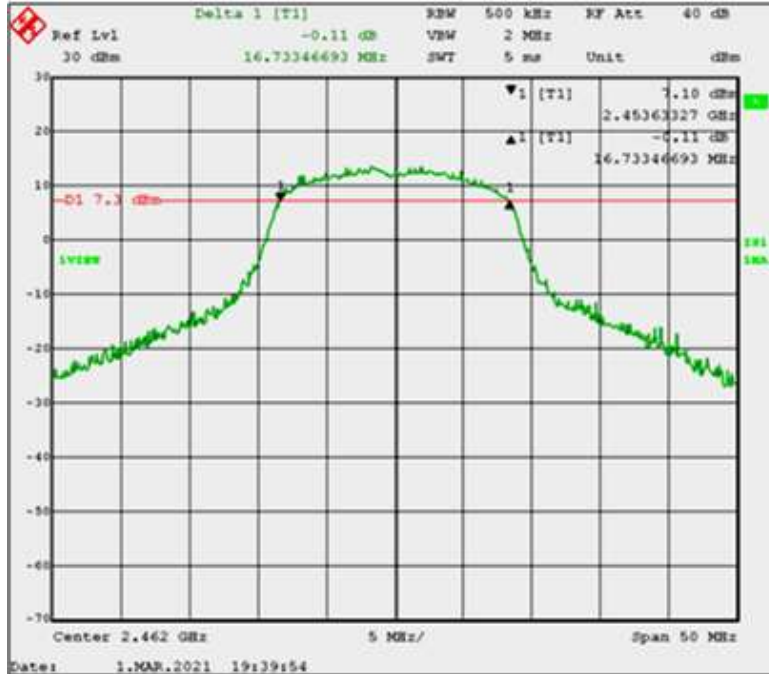
Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, minimum bandwidth,
High channel 11, (2462 MHz)



64 QAM 6 Mbps Modulation					
Channel	Frequency (MHz)	6 dB BW (MHz)	47 CFR 15.247(a)(2) & RSS-247 5.2 Minimum Limit (MHz)	Margin (MHz)	Result
1	2412.0	15.531	0.5	15.031	Pass
6	2437.0	15.531	0.5	15.031	Pass
11	2462.0	15.531	0.5	15.031	Pass



Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, minimum bandwidth, High channel 11, (2462 MHz)



MCS0, BPSK 7.2 Mbps Modulation					
Channel	Frequency (MHz)	6 dB BW (MHz)	47 CFR 15.247(a)(2) & RSS-247 5.2 Minimum Limit (MHz)	Margin (MHz)	Result
1	2412.0	17.034	0.5	16.534	Pass
6	2437.0	16.333	0.5	15.833	Pass
11	2462.0	16.733	0.5	16.233	Pass

Test Results: The 6 dB, Occupied Bandwidth measurements for the Legrand Model WNRH1 with Wi-Fi Radio were measured are compliant to the minimum bandwidth requirements. The results are also used to select bandwidths and frequency spans for other radio measurements.



4.6 99% Occupied Bandwidth (RSS-247 5.2(a))

4.6.1 99% Occupied Bandwidth Test Procedure

RSS-GEN requires the measurement of the 99% bandwidth of the transmitter. The Zigbee radio utilizes only O-QPSK modulation. The Wi-Fi radio produced various bandwidths for each of the IEEE 802.11 b/g/n standards. The results below are shown for each radio.

ANSI C63.10, Section 6.9.3 permits the use of the automated, bandwidth measurement utility of the spectrum analyzer was used to measure the 99% bandwidth at each of the low, middle and high operating frequencies. The SA settings are listed in the table below.

Spectrum Analyzer Settings for Zigbee Radio Measurements

SA Settings			ANSI C63.10 Requirement
Span	3	MHz	(1.5 to 5 times OBW)
RBW	50	kHz	(1 to 5% of OBW)
VBW	200	kHz	(3 X RBW)
Sweep Time	5	ms	Auto

Spectrum Analyzer Settings for Wi-Fi Radio Measurements

Spectrum Analyzer Settings					
	DQPSK 5.5 Mbps		64-QAM 6 Mbps MCS0 BPSK 7.2 Mbps		KDB 550874 Requirement
Span	30	MHz	50	MHz	2 to 5 times OBW
RBW	100	kHz	500	kHz	1 - 5 % of OBW
VBW	300	kHz	2	MHz	≈3 times RBW
Sweep Time	7.5	ms	5	ms	Auto



4.6.1.1 99% BW, WNRH1 With Zigbee Radio Test Results (12/09/2020)

Legrand Model WNRH1 Zigbee Radio
Low Channel 11, 2405 MHz, O-QPSK Modulation



Legrand Model WNRH1 Zigbee Radio
Middle Channel 18, 2440 MHz, O-QPSK Modulation





**Legrand Model WNRH1 Zigbee Radio
High Channel 26, 2480 MHz, O-QPSK Modulation**



Channel	Frequency (MHz)	99% Occupied BW (MHz)
11	2405.0	2.2184
18	2440.0	2.2485
26	2480.0	2.2184

Test Results: The 99% Occupied Bandwidth measurements for the Legrand Model WNRH1 with Zigbee Radio are displayed above and included in the ISED Un-licensed Radio application.

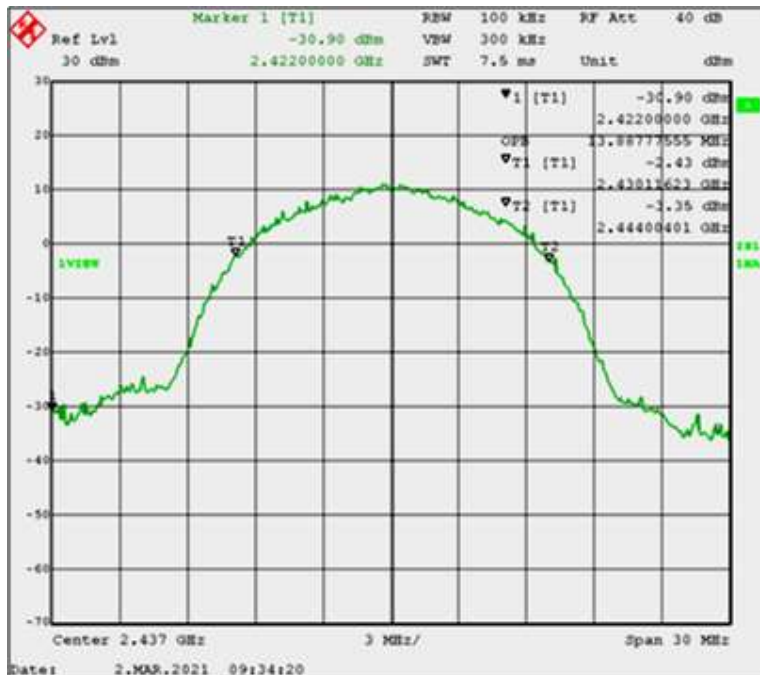


4.6.1.2 99% BW, WNRH1 With Wi-Fi Radio Test Results (03/01/2021)

Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, Minimum Bandwidth, Low Channel 1, (2412 MHz)



Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, minimum bandwidth, Middle Channel 6, (2437 MHz)





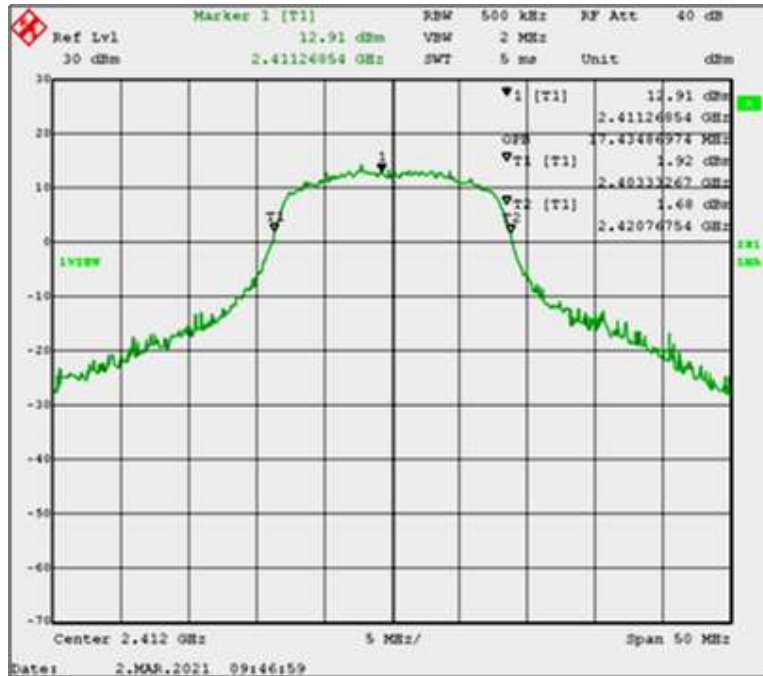
Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, minimum bandwidth, High Channel 11, (2462 MHz)



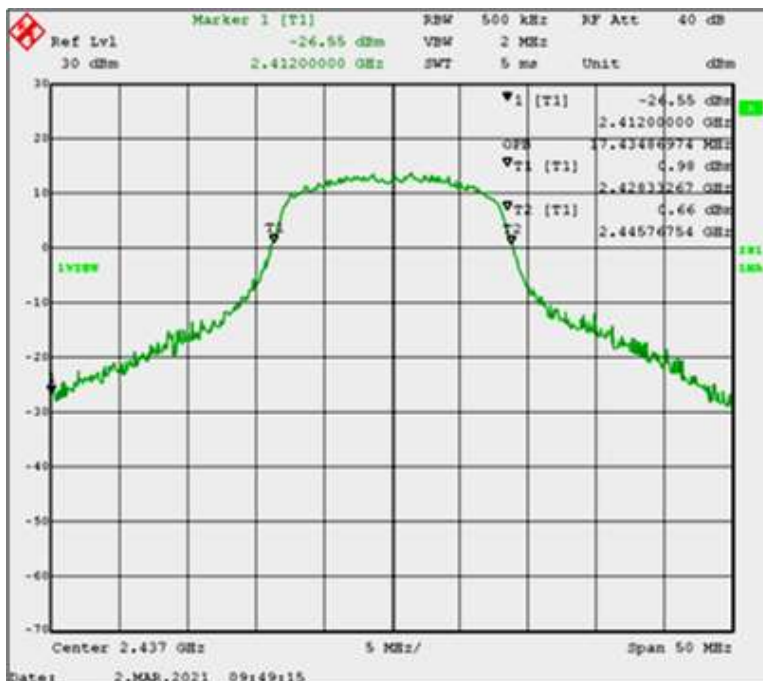
DQPSK 5.5 Mbps Modulation		
Channel	Frequency (MHz)	99% Occupied BW (MHz)
1	2412.0	14.008
6	2437.0	13.888
11	2462.0	13.888



Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, Minimum bandwidth, Low Channel 1, (2412 MHz)

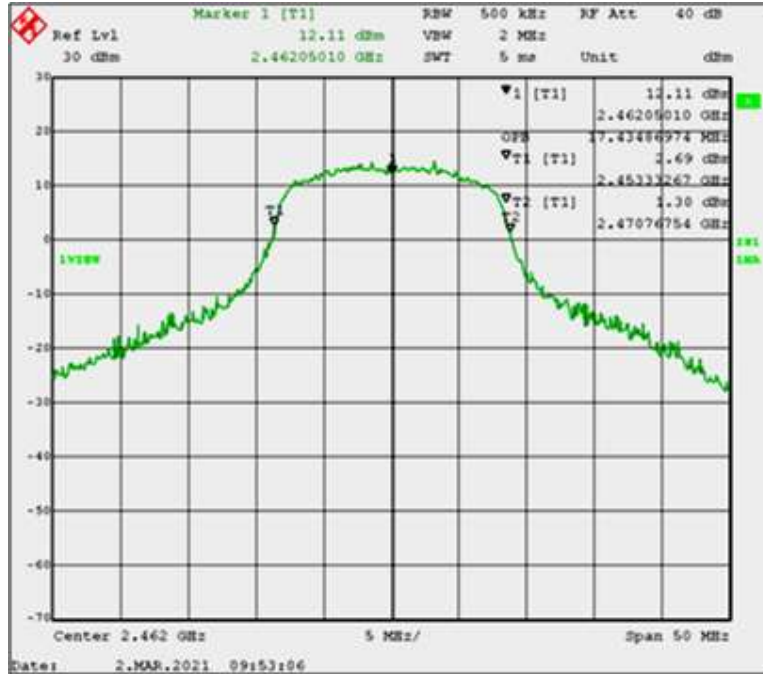


Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, minimum bandwidth, Middle Channel 6, (2437 MHz)





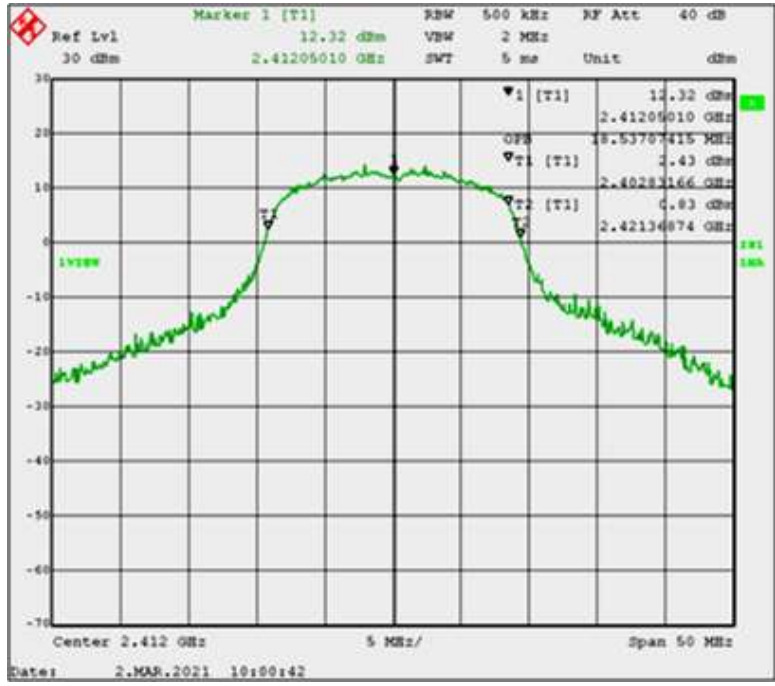
Legrand Model WNRH1 Wi-Fi Radio, 64 QAM (6 Mbps) modulation, minimum bandwidth,
High Channel 11, (2462 MHz)



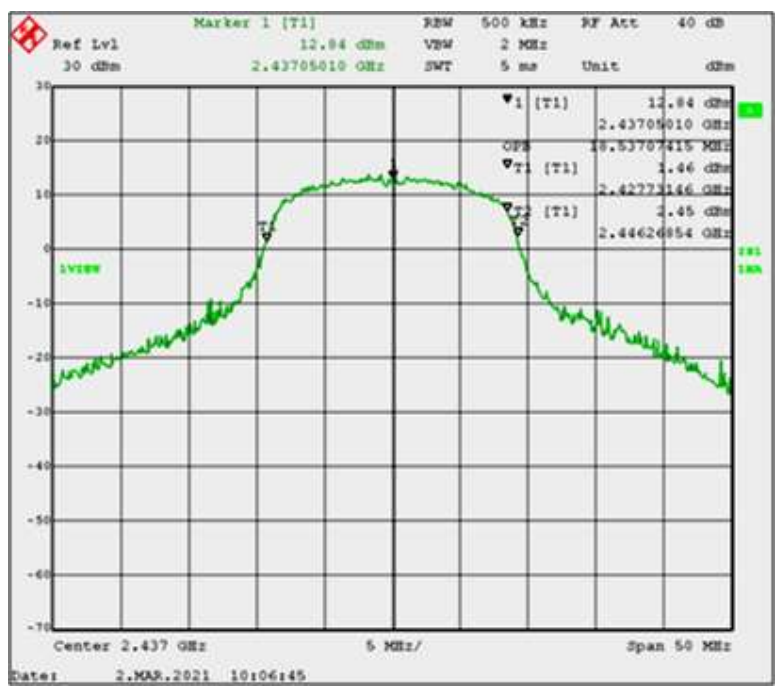
64 QAM 6 Mbps Modulation		
Channel	Frequency (MHz)	99% Occupied BW (MHz)
1	2412.0	17.435
6	2437.0	17.435
11	2462.0	17.435



Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, Minimum Bandwidth, Low Channel 1, (2412 MHz)

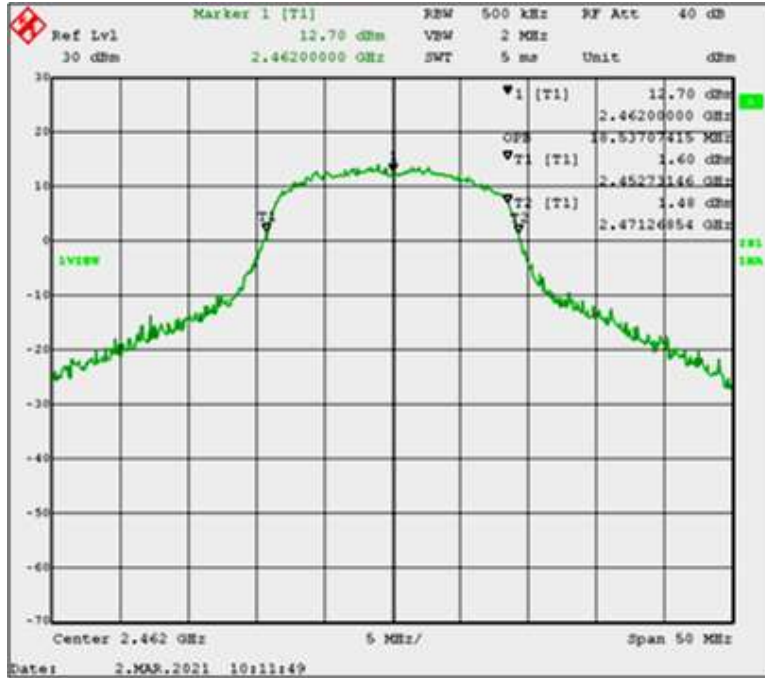


Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, minimum bandwidth, Middle Channel 6, (2437 MHz)





Legrand Model WNRH1 Wi-Fi Radio, MCS0 BPSK (7.2 Mbps) modulation, minimum bandwidth, High Channel 11, (2462 MHz)



MCS0 BPSK 7.2 Mbps Modulation		
Channel	Frequency (MHz)	99% Occupied BW (MHz)
1	2412.0	18.537
6	2437.0	18.537
11	2462.0	18.537

Test Results: The 99% Occupied Bandwidth measurements for the Legrand WNRH1, Wi-Fi Radio, are displayed above and included in the ISED Un-licensed Radio application.



4.7 Maximum Conducted (Average) Output Power and EIRP (FCC Part 15.247(b)(3), RSS-247 Section 5.4(d))

4.7.1 Maximum Conducted (Average) Output Power Test Procedure

A conducted power measurement of the output frequency of the Zigbee radio was measured according to the guidance of KDB 550874 D01, Section 8.3.1.2. The modulated, transmitter output signal is wide-band and noise-like. Further guidance from the KDB document identified ANSI C63.10, Section 11.9.2.2.2. (Method AVGSA-1) as the measurement procedure. Spectrum analyzer parameters are listed for the Zigbee radio maximum conducted (average) output power. The un-modulated carrier, produced higher emissions.

The Wi-Fi radio was evaluated for maximum peak transmitter output by operating the device at various modulation modes of IEEE 802.11 b/g/n and un-modulated. DBPSK (1 Mbps) showed highest emissions for IEEE 802.11b, 64 QAM (36 Mbps) for 802.11g and MCS4 16 QAM (43.3 Mbps) for 802.11n. The un-modulated carrier was less than the modulated carriers. Packet number was set to 110 and Packet length to 2034.

The duty cycles for the Wi-Fi modulation modes were measured for each of the IEEE 802.11 b/g/n modulation modes. DBPSK (1 Mbps) produced a duty cycle of 99.58%. This conforms to ANSI C63.10, Section 11.9.2.2.2 (AVGSA-1). 64 QAM (36 Mbps) produced a duty cycle of 81.1 % and MCS4 16 QAM (43.3 Mbps) produced a duty cycle of 80.43%. The latter two modes of modulation, with duty cycles <98%, required ANSI C63.10, (Section 11.9.2.2.4 (AVGSA-2)).

4.7.1.1 Maximum Conducted (Average) Output Power WNRH1 With Zigbee Radio O-QPSK Modulation Test Results (12/09/2020)

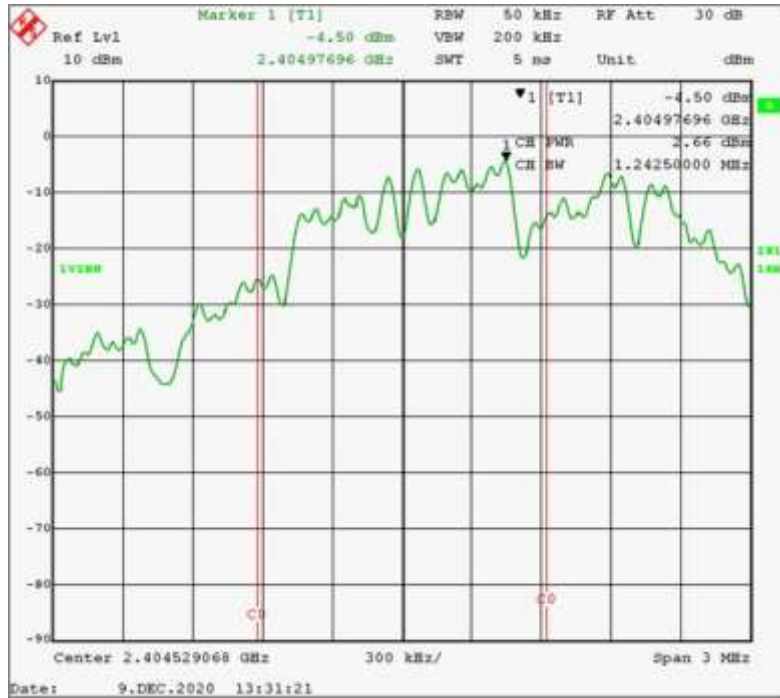
Spectrum Analyzer Settings for Zigbee Radio Measurements

Zigbee Radio, O-QPSK modulation			
Spec Analyzer Settings			ANSI C63.10 requirement
Span	3	MHz	≥1.5 times OBW
RBW	50	kHz	1X to 5X OBW (Max 1 MHz)
VBW	200	kHz	≥ 3 X RBW
Sweep	5	ms	Auto

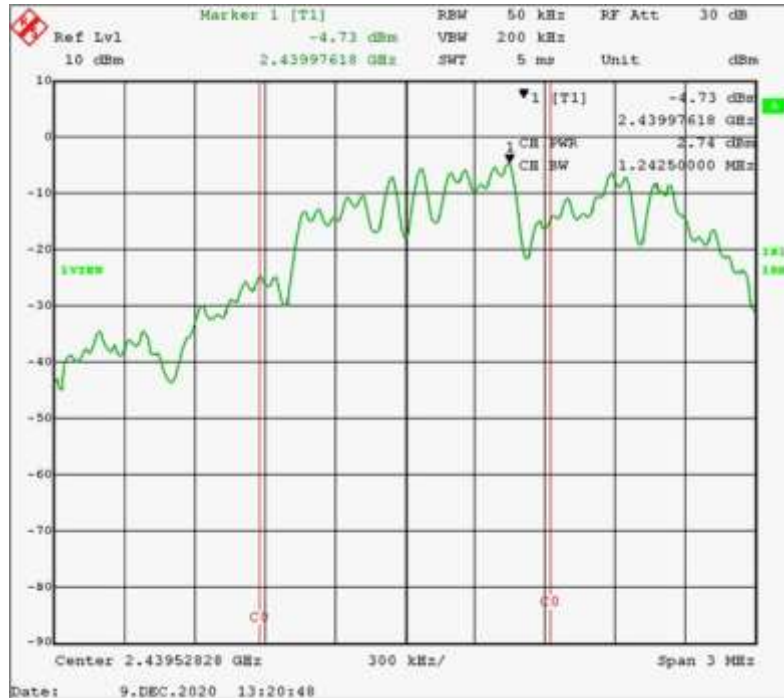
The RMS Detector was averaged over 100 traces.



Legrand Model WNRH1 Zigbee Radio
Low Channel 11, 2405 MHz, O-QPSK Modulation

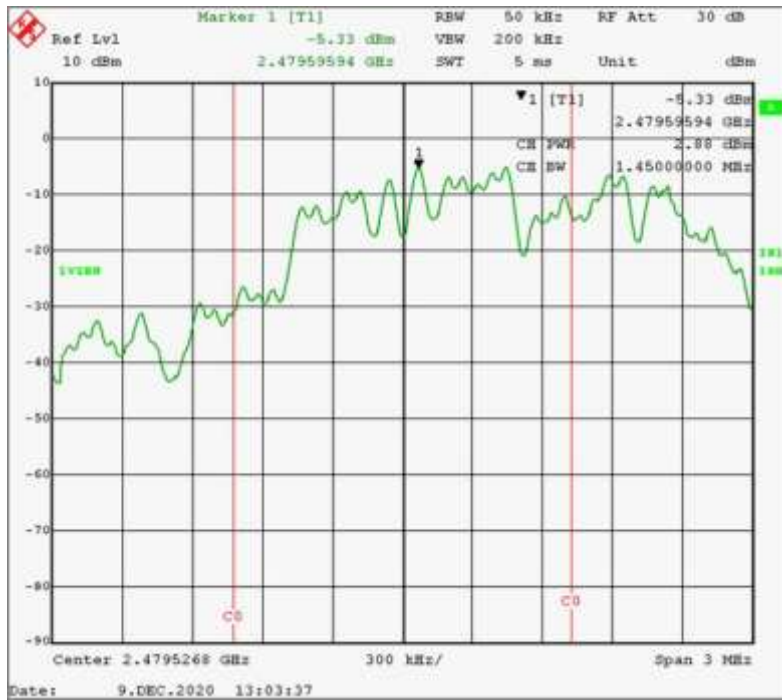


Legrand Model WNRH1 Zigbee Radio
Middle Channel 18, 2440 MHz, O-QPSK Modulation



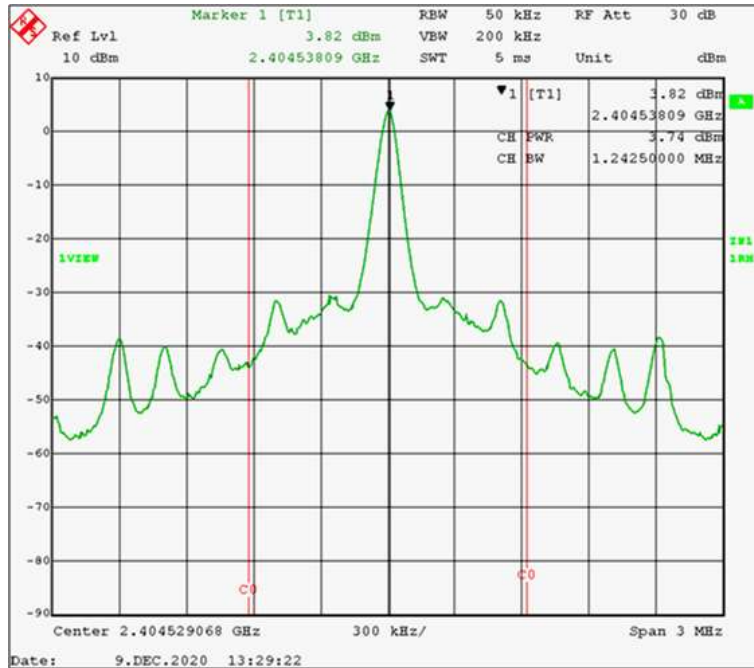


Legrand Model WNRH1 Zigbee Radio
High Channel 26, 2480 MHz, O-QPSK Modulation

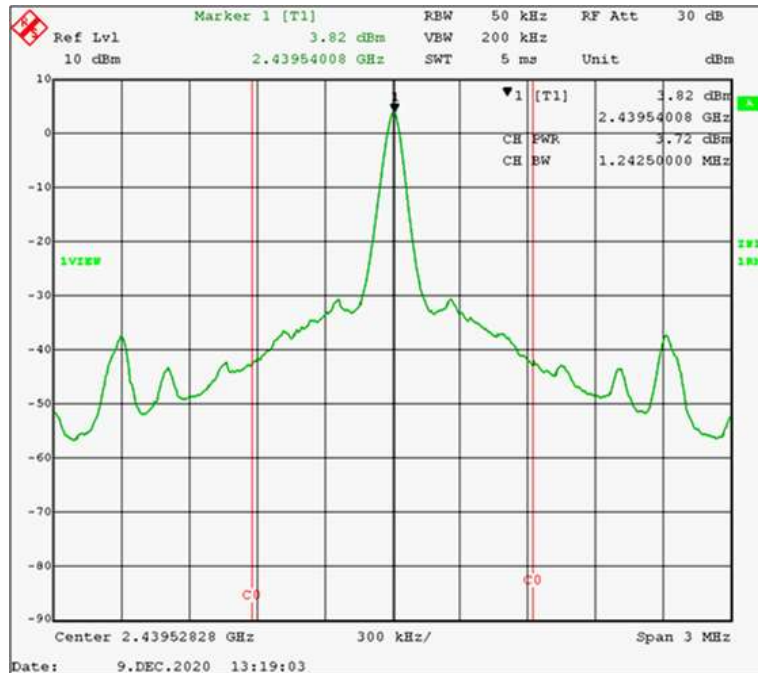




Legrand Model WNRH1 Zigbee Radio
Low Channel 11, 2405 MHz, Un-modulated

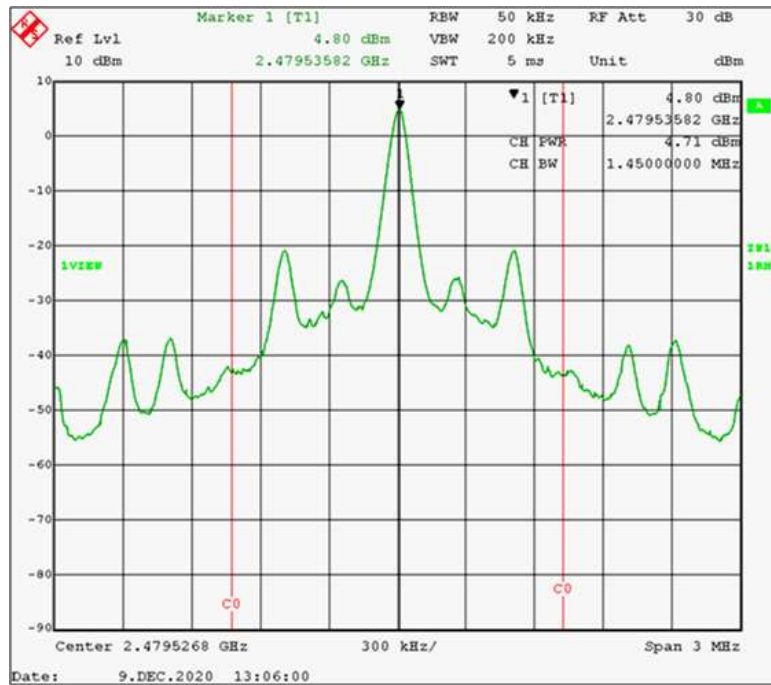


Legrand Model WNRH1 Zigbee Radio
Middle Channel 18, 2440 MHz, Un-modulated





Legrand Model WNRH1 Zigbee Radio
High Channel 26, 2480 MHz, Un-modulated



Channel	Modulation	Frequency (MHz)	Measured Level	Cable # 962 Loss	Total		Limit		Margin		Result
					dBm	Watts	dBm	Watts	dBm	Watts	
11	O-QPSK	2405.0	2.66	0.47	3.13	0.0021	30.00	1.000	-26.87	-0.998	Pass
18		2440.0	2.74	0.47	3.21	0.0021	30.00	1.000	-26.79	-0.998	Pass
26		2480.0	2.88	0.47	3.35	0.0022	30.00	1.000	-26.65	-0.998	Pass

Channel	Modulation	Frequency (MHz)	Measured Level	Cable # 962 Loss	Total		Limit		Margin		Result
					dBm	Watts	dBm	Watts	dBm	Watts	
11	None	2405.0	3.74	0.47	4.21	0.0026	30.00	1.000	-25.79	-0.997	Pass
18		2440.0	3.72	0.47	4.19	0.0026	30.00	1.000	-25.81	-0.997	Pass
26		2480.0	4.71	0.47	5.18	0.0033	30.00	1.000	-24.82	-0.997	Pass

Test Results: The Maximum Conducted (Average) Power Output measurements for the Legrand Model WNRH1 with Zigbee Radio, modulated with O-QPSK, are compliant to the requirements of 47 CFR Part 15.247(b)(3) and ISED, RSS-247 Section 5.4(d).



4.7.1.2 EIRP Level WNRH1 With Zigbee Radio Test Results (12/09/2020)

The Innovation, Science and Economic Development Canada (ISED), RSS-247 requires the calculation of the Effective Isotropic Radiated Power (EIRP) for the Legrand Model WNRH1 with Zigbee Radio. Below is the tabular data, using measured power levels from the previous section.

Channel	Modulation	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP				Result
			dBm	Watts	Isotropic	Numeric	Total		Limit Watts	Margin Watts	
							dBm	Watts			
11	O-QPSK	2405.0	3.13	0.0021	1.00	1.2590	4.13	0.0026	4.00	-3.9974	Pass
18		2440.0	3.21	0.0021	1.00	1.2590	4.21	0.0026	4.00	-3.9974	Pass
26		2480.0	3.35	0.0022	1.00	1.2590	4.35	0.0027	4.00	-3.9973	Pass

Channel	Modulation	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP				Result
			dBm	Watts	Isotropic	Numeric	Total		Limit Watts	Margin Watts	
							dBm	Watts			
11	None	2405.0	4.21	0.0026	1.00	1.2590	5.21	0.0033	4.00	-3.9967	Pass
18		2440.0	4.19	0.0026	1.00	1.2590	5.19	0.0033	4.00	-3.9967	Pass
26		2480.0	5.18	0.0033	1.00	1.2590	6.18	0.0041	4.00	-3.9959	Pass

Test Results: The Effective Isotropic Radiated Power measurements for the Legrand Model WNRH1 with Zigbee Radio, modulated with O-QPSK, are compliant to the requirements of ISED, RSS-247 Section 5.4(d).

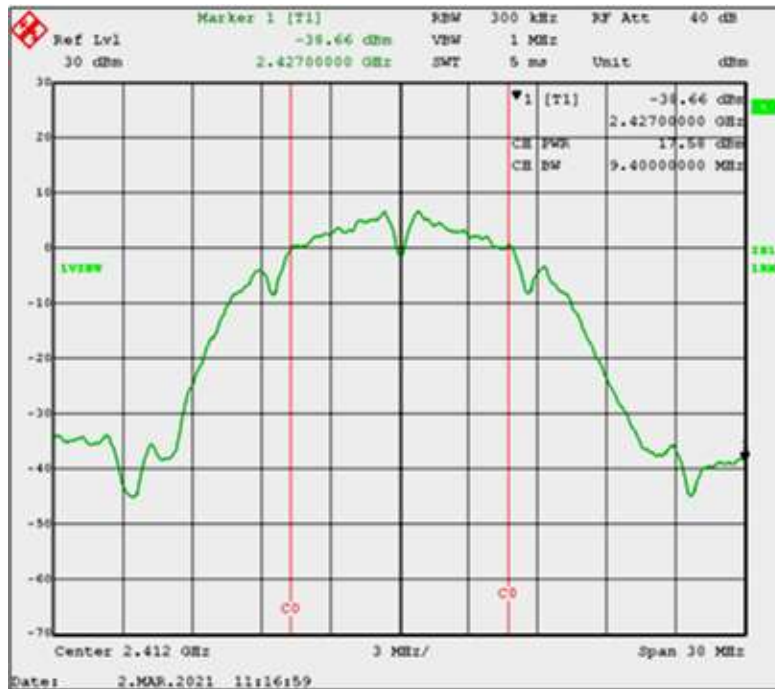


4.7.1.2.1 Maximum Conducted (Average) Output Power WNRH1 With Wi-Fi Radio DBPSK Modulation Test Results (03/02/2021)

Spectrum Analyzer Settings for Wi-Fi Radio DBPSK Modulation Measurements

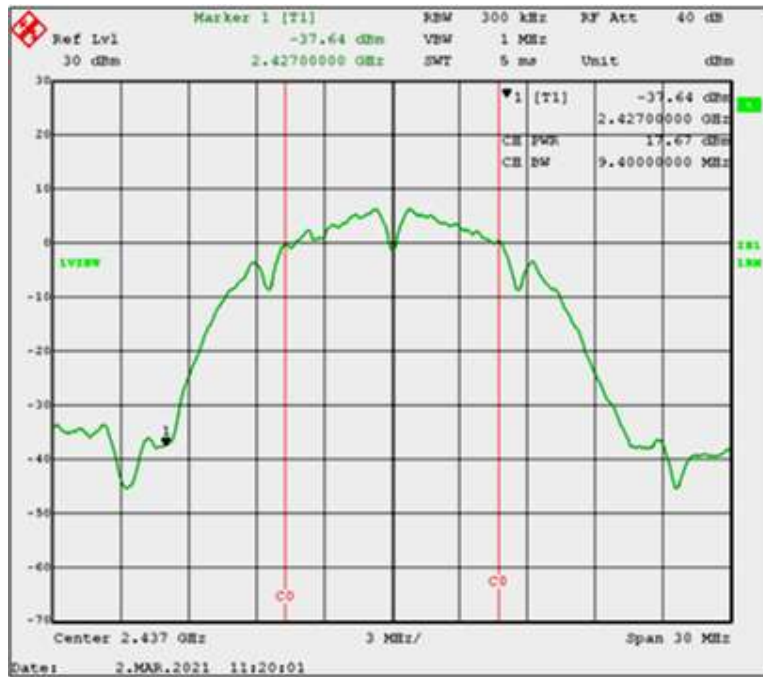
DBPSK 1 Mbps Modulation (9.5 MHz OBW)			
SA Settings			ANSI C63.10 Requirement
Span	30	MHz	1.5 to 5 times OBW
RBW	300	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	1	MHz	≥ 3 times RBW
Sweep Time	5	ms	Auto

Legrand Model WNRH1 Wi-Fi Radio, Low Channel 1 2412 MHz, DBPSK (1 Mbps) Modulation

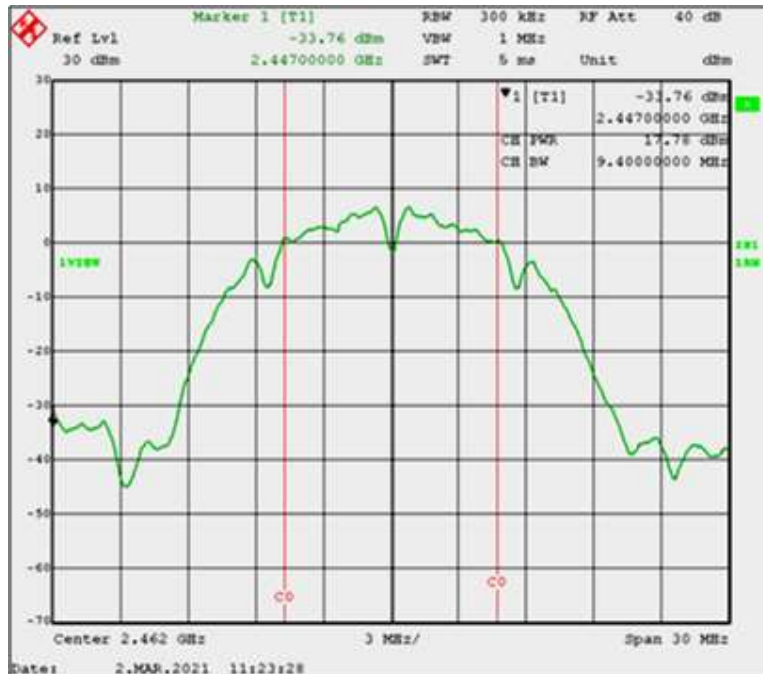




Legrand Model WNRH1 Wi-Fi Radio, Middle Channel 6, 2437 MHz, DBPSK (1Mbps)
Modulation



Legrand Model WNRH1 Wi-Fi Radio, High Channel 11, 2462 MHz, DBPSK (1 Mbps)
Modulation





Channel	Modulation	Frequency (MHz)	Measured Level (dBm)	Cable # 962 Loss (dB)	Duty Cycle Adj (dB)	Total		Limit		Margin		Result
						dBm	Watts	dBm	Watts	dBm	Watts	
1	DBPSK 1 Mbps	2412.0	17.58	0.47	0.00	18.05	0.0638	30.00	1.0000	-11.95	-0.936	Pass
6		2437.0	17.67	0.47	0.00	18.14	0.0652	30.00	1.0000	-11.86	-0.935	Pass
11		2462.0	17.78	0.47	0.00	18.25	0.0668	30.00	1.0000	-11.75	-0.933	Pass

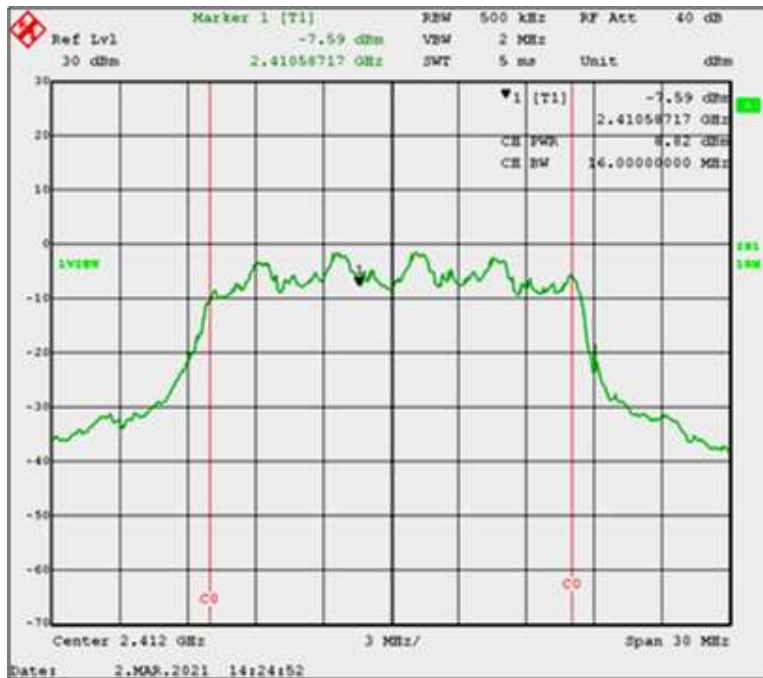
Test Results: The Maximum Conducted (Average) Power Output measurements for the Legrand Model WNRH1 with Wi-Fi Radio, modulated with DBPSK (1 Mbps) modulation, are compliant to the requirements of 47 CFR Part 15.247(b)(3) and ISED, RSS-247 Section 5.4(d).



4.7.1.2.2 Maximum Conducted (Average) Output Power WNRH1 With Wi-Fi Radio, 64 QAM (36 Mbps) Modulation Test Results (03/02/2021)

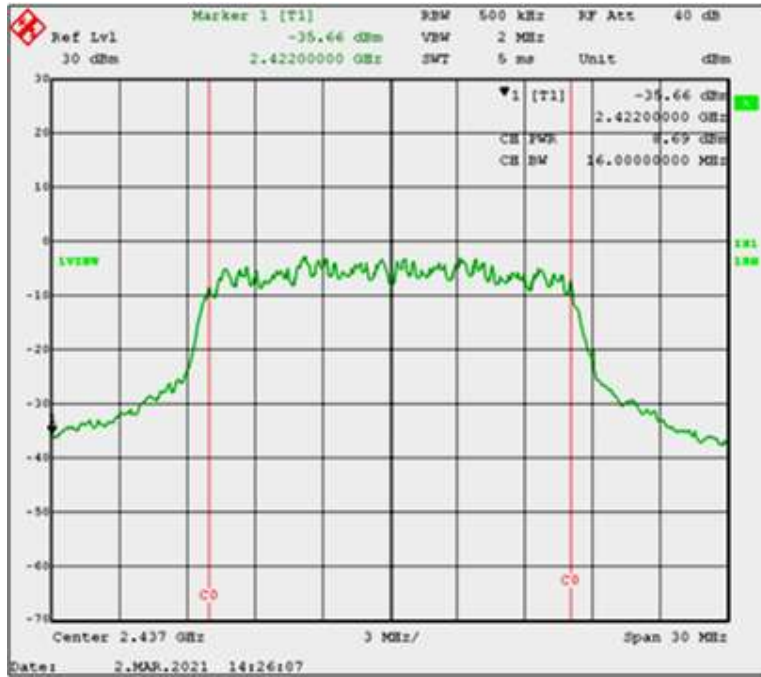
64 QAM 36 Mbps Modulation(16 MHz OBW)			
MCS4 43.3 Mbps Modulation (16.8 MHz OBW)			
SA Settings			ANSI C63.10 Requirement
Span	30	MHz	1.5 to 5 times OBW
RBW	500	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	2	MHz	≥ 3 times RBW
Sweep Time	5	ms	Auto

Legrand Model WNRH1 Wi-Fi Radio, Low Channel 1 2412 MHz, 64 QAM (36 Mbps) Modulation

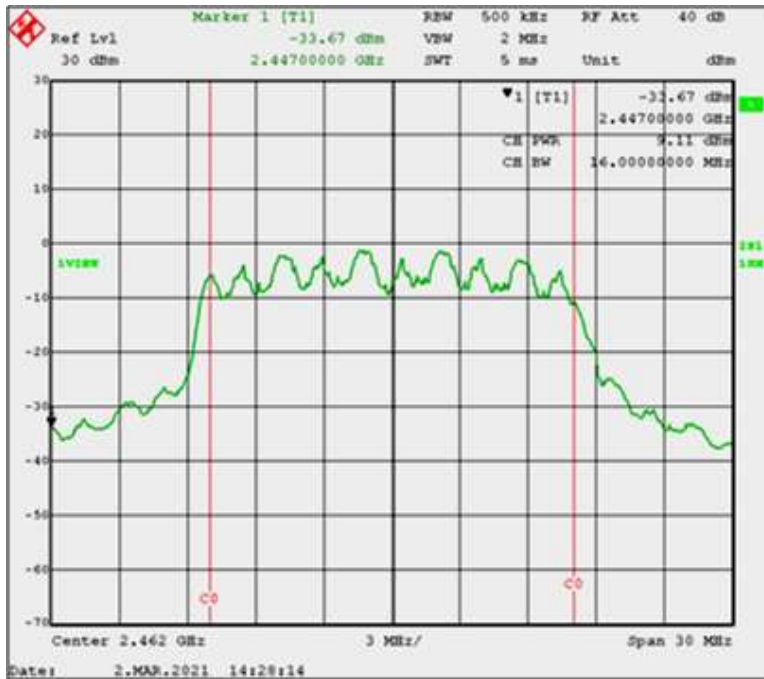




Legrand Model WNRH1 Wi-Fi Radio, Middle Channel 6, 2437 MHz, 64 QAM (36 Mbps) Modulation



Legrand Model WNRH1 Wi-Fi Radio, High Channel 11, 2462 MHz, 64 QAM (36 Mbps) Modulation





Channel	Modulation	Frequency (MHz)	Measured Level (dBm)	Cable # 962 Loss (dB)	Duty Cycle Adj (dB)	Total		Limit		Margin		Result
						dBm	Watts	dBm	Watts	dBm	Watts	
1	64 QAM 36 Mbps	2412.0	8.82	0.47	0.91	10.20	0.0105	30.00	1.0000	-19.80	-0.990	Pass
6		2437.0	8.69	0.47	0.91	10.07	0.0102	30.00	1.0000	-19.93	-0.990	Pass
11		2462.0	9.11	0.47	0.91	10.49	0.0112	30.00	1.0000	-19.51	-0.989	Pass

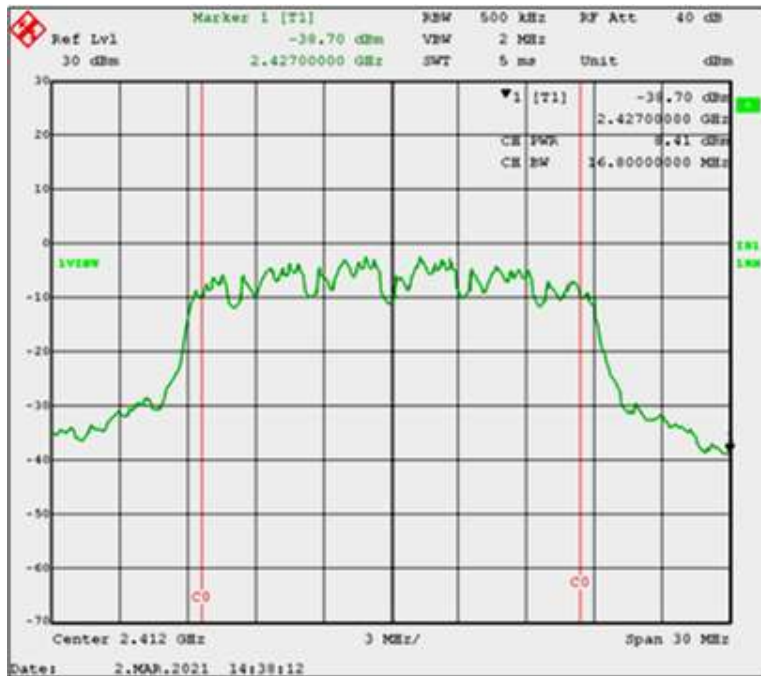
Test Results: The Maximum Conducted (Average) Power Output measurements for the Legrand Model WNRH1 with Wi-Fi Radio, modulated with 64 QAM (36 Mbps) modulation, are compliant to the requirements of 47 CFR Part 15.247(b)(3) and ISED, RSS-247 Section 5.4(d).



4.7.1.2.3 Maximum Conducted (Average) Output Power WNRH1 With Wi-Fi Radio, MCS4 16 QAM (43.3 Mbps) Modulation Test Results (03/02/2021)

64 QAM 36 Mbps Modulation(16 MHz OBW)			
MCS4 43.3 Mbps Modulation (16.8 MHz OBW)			
SA Settings			ANSI C63.10 Requirement
Span	30	MHz	1.5 to 5 times OBW
RBW	500	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	2	MHz	≥ 3 times RBW
Sweep Time	5	ms	Auto

Legrand Model WNRH1 Wi-Fi Radio, Low Channel 1 2412 MHz, MCS4 16 QAM (43.3 Mbps) Modulation

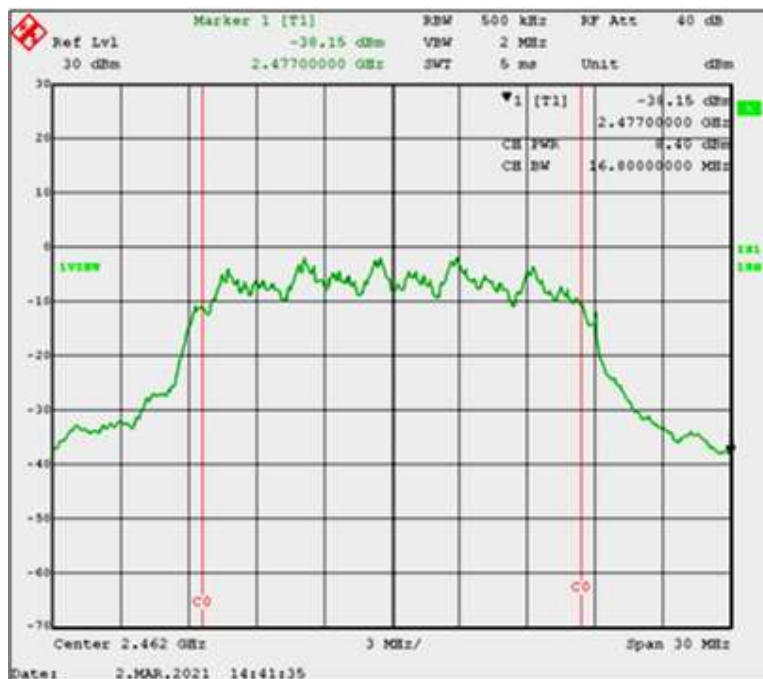




Legrand Model WNRH1 Wi-Fi Radio, Middle Channel 6, 2437 MHz, MCS4 16 QAM (43.3 Mbps) Modulation



Legrand Model WNRH1 Wi-Fi Radio, High Channel 11, 2462 MHz, MCS4 16 QAM (43.3 Mbps) Modulation





Channel	Modulation	Frequency (MHz)	Measured Level (dBm)	Cable # 962 Loss (dB)	Duty Cycle Adj (dB)	Total		Limit		Margin		Result
						dBm	Watts	dBm	Watts	dBm	Watts	
1	MCS4 43.3 Mbps	2412.0	8.41	0.47	0.95	9.83	0.0096	30.00	1.0000	-20.17	-0.990	Pass
6		2437.0	8.40	0.47	0.95	9.82	0.0096	30.00	1.0000	-20.18	-0.990	Pass
11		2462.0	8.40	0.47	0.95	9.82	0.0096	30.00	1.0000	-20.18	-0.990	Pass

Test Results: The Maximum Conducted (Average) Power Output measurements for the Legrand Model WNRH1 with Wi-Fi Radio, modulated with MCS4 16 QAM (43.3 Mbps), are compliant to the requirements of 47 CFR Part 15.247(b)(3) and ISSED, RSS-247 Section 5.4(d).



4.7.1.3 EIRP Level WNRH1 With Wi-Fi Radio Test Results (03/02/2021)

The Innovation, Science and Economic Development Canada (ISED), RSS-247 requires the calculation of the Effective Isotropic Radiated Power (EIRP) for the Legrand Model WNRH1 with Wi-Fi radio. Below is the tabular data, using measured power levels from the previous section.

Channel	Modulation	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP				Result
			dBm	Watts	Isotropic	Numeric	Total		Limit Watts	Margin Watts	
							dBm	Watts			
1	DBPSK 1 Mbps	2412.0	18.05	0.0638	1.00	1.2590	19.05	0.0804	4.00	-3.9196	Pass
6		2437.0	18.14	0.0652	1.00	1.2590	19.14	0.0820	4.00	-3.9180	Pass
11		2462.0	18.25	0.0668	1.00	1.2590	19.25	0.0841	4.00	-3.9159	Pass

Channel	Modulation	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP				Result
			dBm	Watts	Isotropic	Numeric	Total		Limit Watts	Margin Watts	
							dBm	Watts			
1	64 QAM 36 Mbps	2412.0	10.20	0.0105	1.00	1.2590	11.20	0.0132	4.00	-3.9868	Pass
6		2437.0	10.07	0.0102	1.00	1.2590	11.07	0.0128	4.00	-3.9872	Pass
11		2462.0	10.49	0.0112	1.00	1.2590	11.49	0.0141	4.00	-3.9859	Pass

Channel	Modulation	Frequency (MHz)	Transmitter Output Total		Antenna Gain		EIRP				Result
			dBm	Watts	Isotropic	Numeric	Total		Limit Watts	Margin Watts	
							dBm	Watts			
1	MCS4 16	2412.0	9.83	0.0026	1.00	1.2590	10.83	0.0033	4.00	-3.9967	Pass
6	QAM 43.3 Mbps	2437.0	9.82	0.0026	1.00	1.2590	10.82	0.0033	4.00	-3.9967	Pass
11		2462.0	9.82	0.0033	1.00	1.2590	10.82	0.0041	4.00	-3.9959	Pass

Test Results: The Effective Isotropic Radiated Power measurements for the Legrand Model WNRH1 with Wi-Fi Radio, modulated with O-QPSK, are compliant to the requirements of ISED, RSS-247 Section 5.4(d).



4.8 Emissions in Non-restricted Frequency Bands 30 MHz – 25 GHz (FCC Section 15.247(d), RSS-247 Sec.5)

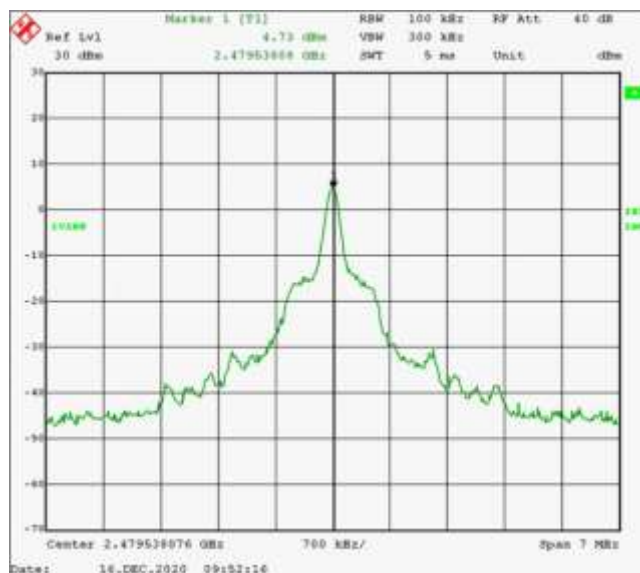
4.8.1 Emissions in Non-restricted Frequency Bands 30 MHz – 25 GHz Test Procedure

558074 D01 DTS Meas Guidance advises using the maximum Power Spectral Density results to determine which carrier frequency and modulation to use when measuring emissions. The results of the Power Spectral Density test determined that the un-modulated carrier produced the highest transmission output level for the Zigbee radio.

The Wi-Fi radio Power Spectral Density was tested in a representative mode of each of the modulated modes of IEEE 802.11 b/g/n. DBPSK (1 Mbps) modulation produced the highest PSD level for the Wi-Fi radio. Therefore, DBPSK (1 Mbps), IEEE 802.11b, was used for this test. Receive Mode is also included for both radios to show no transmitter activity while receiving.

4.8.2 Emissions in Non-restricted Frequency Bands 30 MHz – 25 GHz 30 dB Reference Measurement.

4.8.2.1 WNRH1 With Zigbee Radio Reference Measurement (12/16/2020)

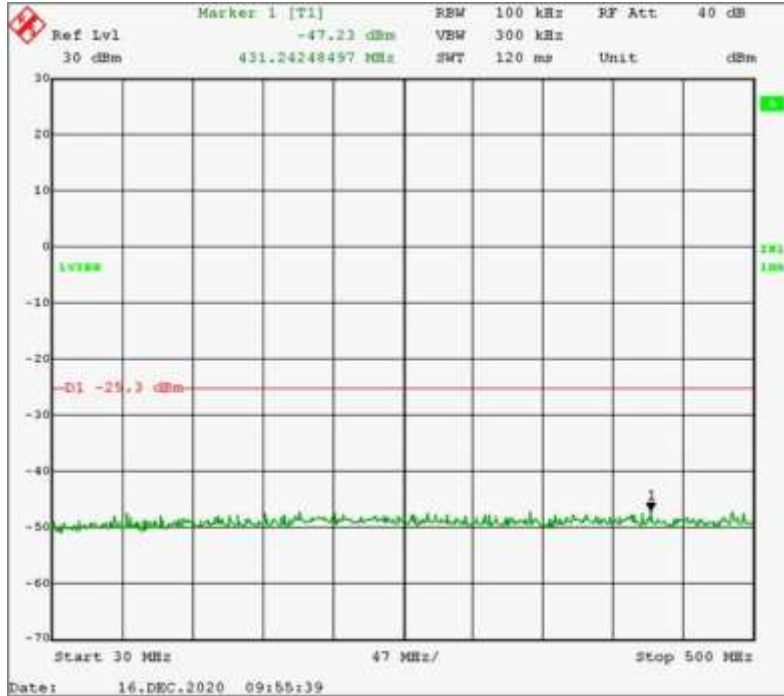


The peak level of 4.73 dBm is the maximum peak output of the Legrand WNRH1 Zigbee radio. The conducted spurious emissions from the antenna port must be 30 dB down from this peak. The resultant limit is therefore -25.27 dBm. This limit is displayed on the plots below.

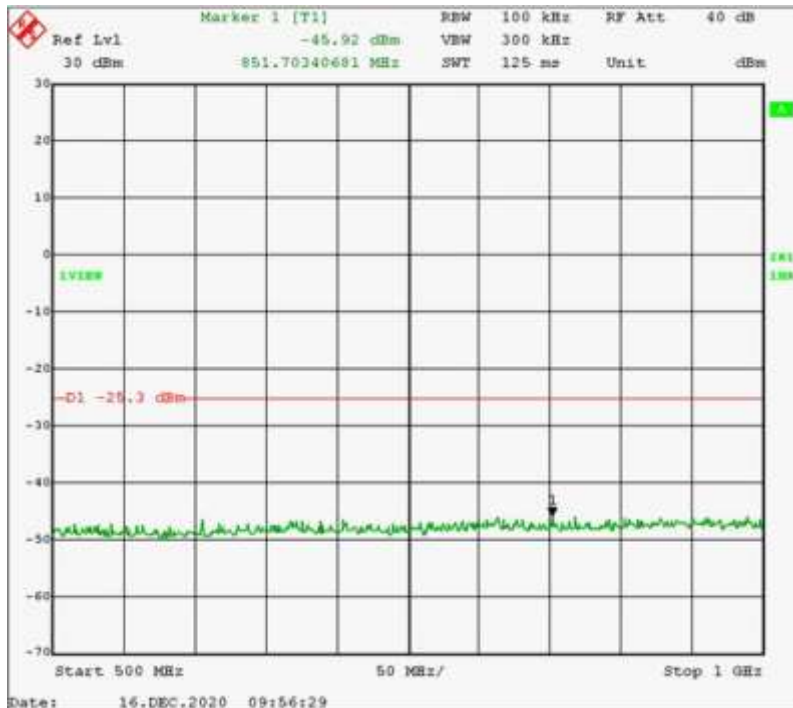


4.8.2.2 Emissions in Non-restricted Frequency Bands WNRH1 With Zigbee Radio Test Results (12/10/2020 & 12/16/2020)

WNRH1 With Zigbee Radio Transmitting: 30 MHz – 500 MHz (Without High Pass Filter)

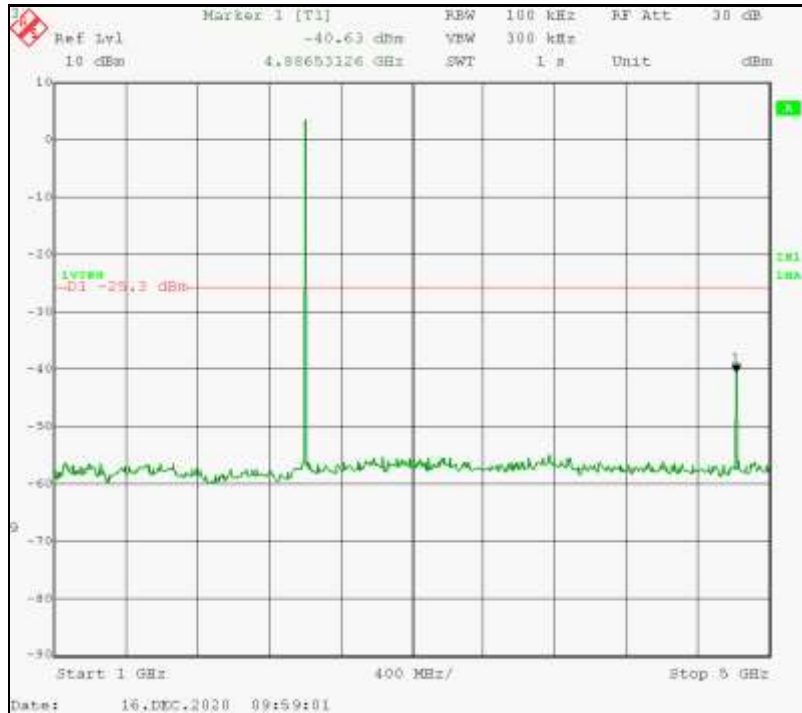


WNRH1 With Zigbee Radio Transmitting: 500 MHz – 1000 MHz (Without High Pass Filter)

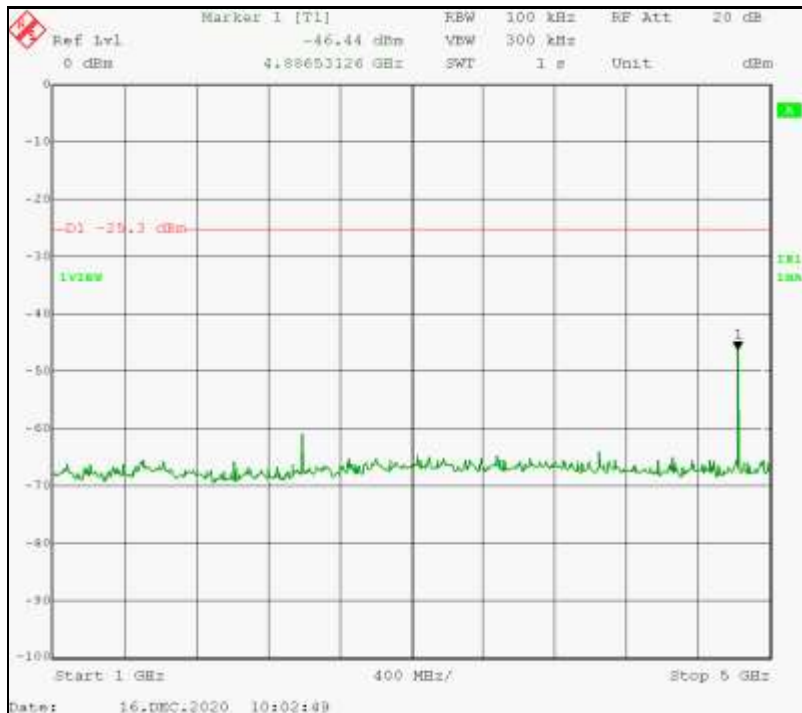




WNRH1 With Zigbee Radio Transmitting (Without High Pass Filter): 1 GHz – 5 GHz

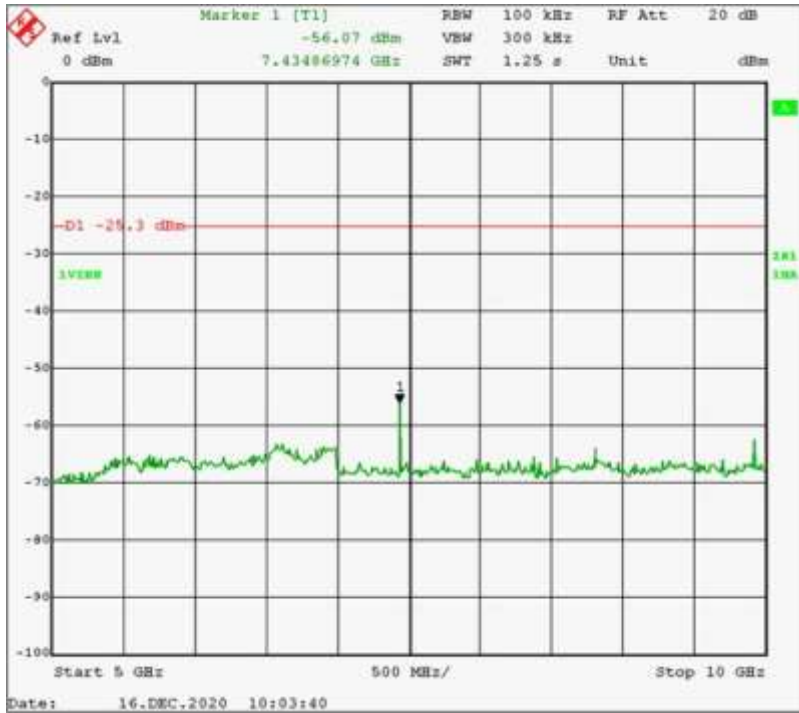


WNRH1 With Zigbee Radio Transmitting (With High Pass Filter Installed): 1 GHz – 5 GHz

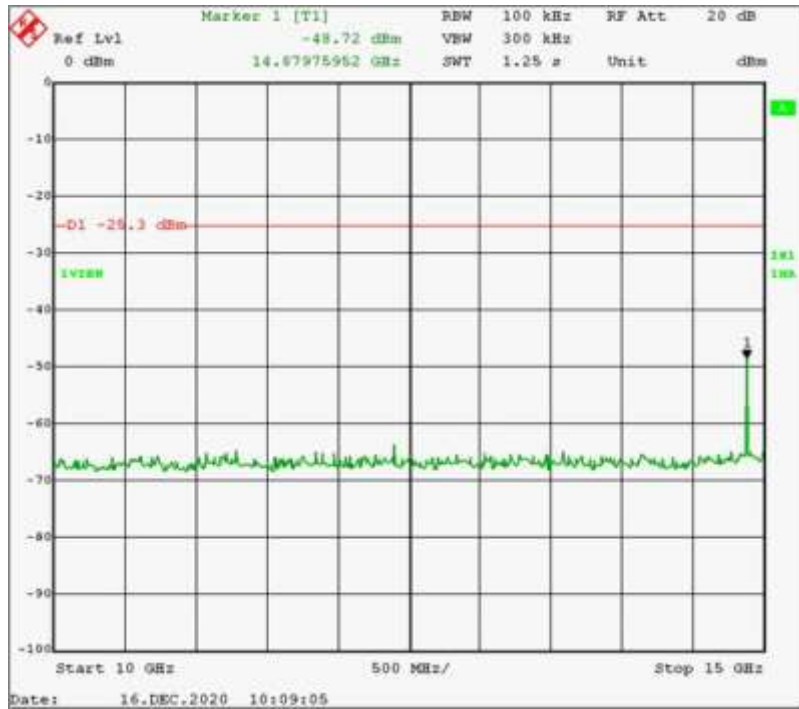




WNRH1 With Zigbee Radio Transmitting (With High Pass Filter Installed): 5 GHz – 10 GHz

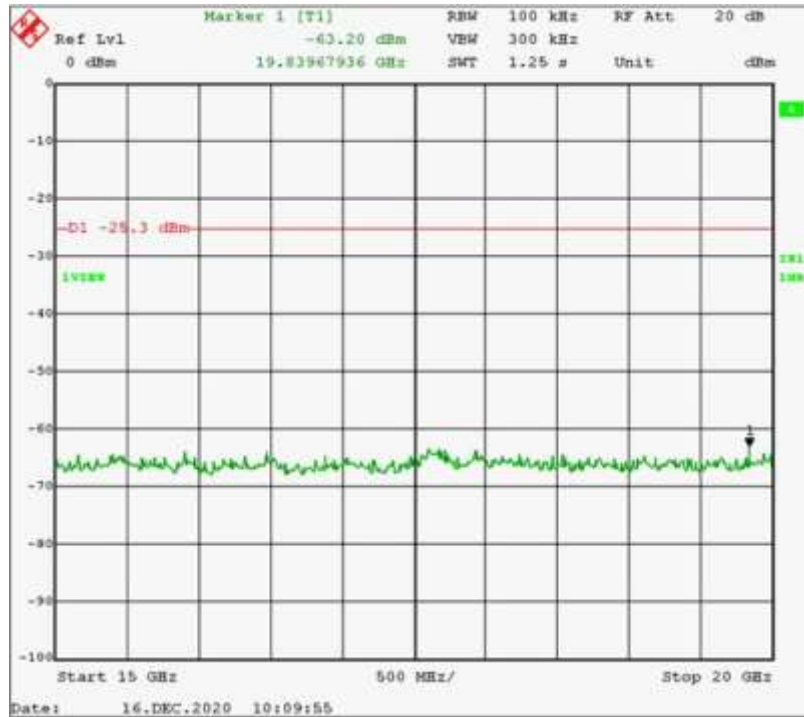


WNRH1 With Zigbee Radio Transmitting (With High Pass Filter Installed): 10 GHz – 15 GHz

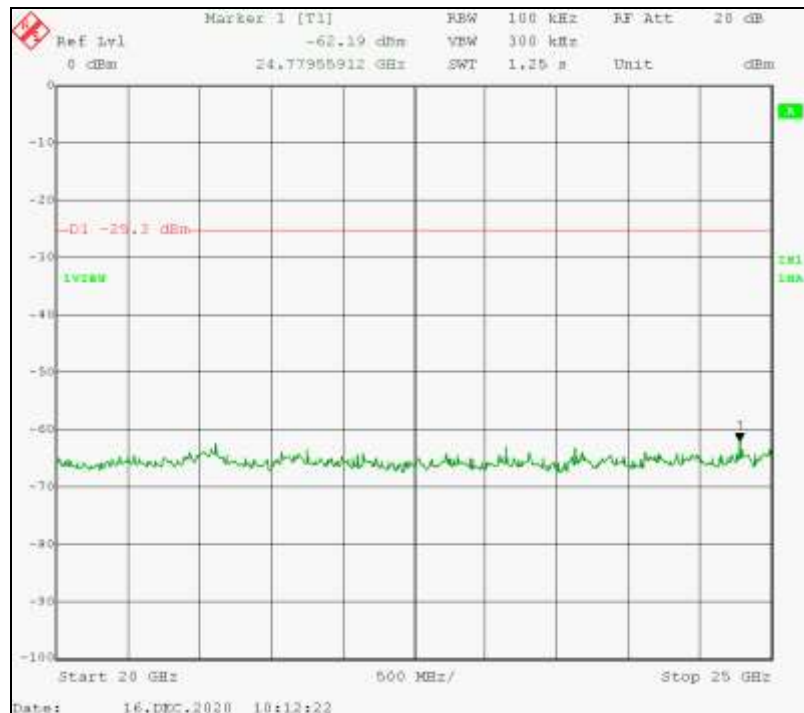




WNRH1 With Zigbee Radio Transmitting (With High Pass Filter Installed): 15 GHz – 20 GHz

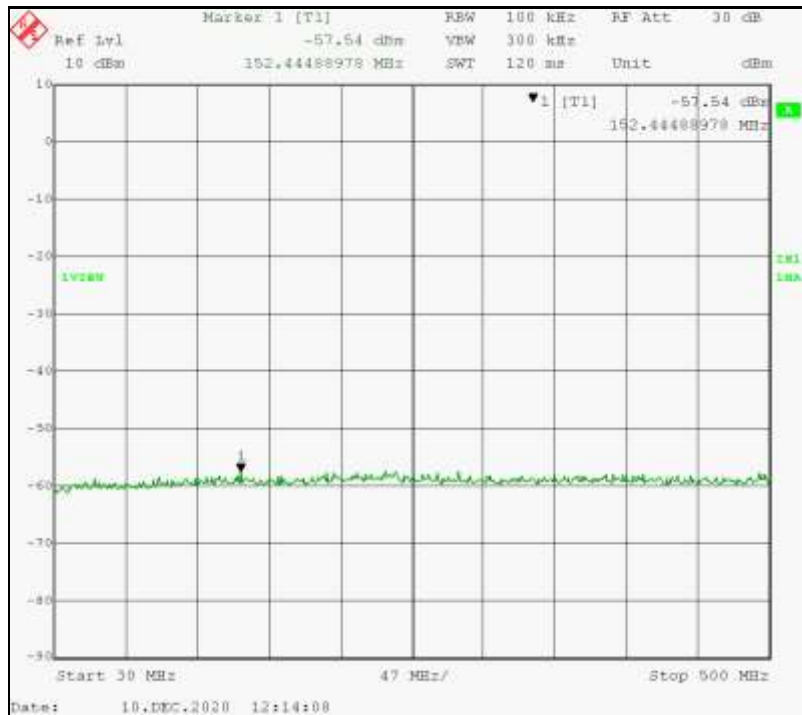


WNRH1 With Zigbee Radio Transmitting (With High Pass Filter Installed): 20 GHz – 25 GHz

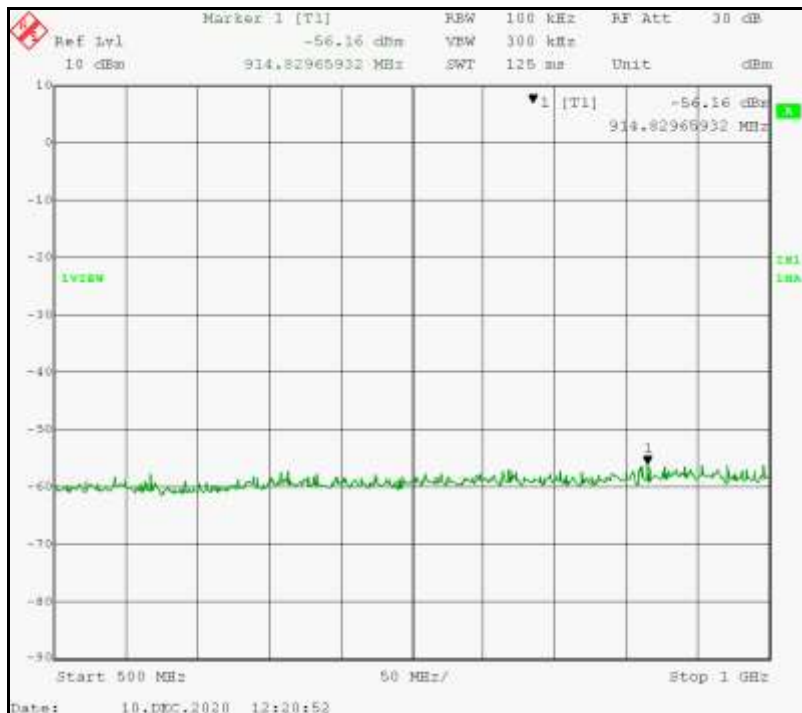




WNRH1 With Zigbee Radio Receive Mode: 30 MHz – 500 MHz

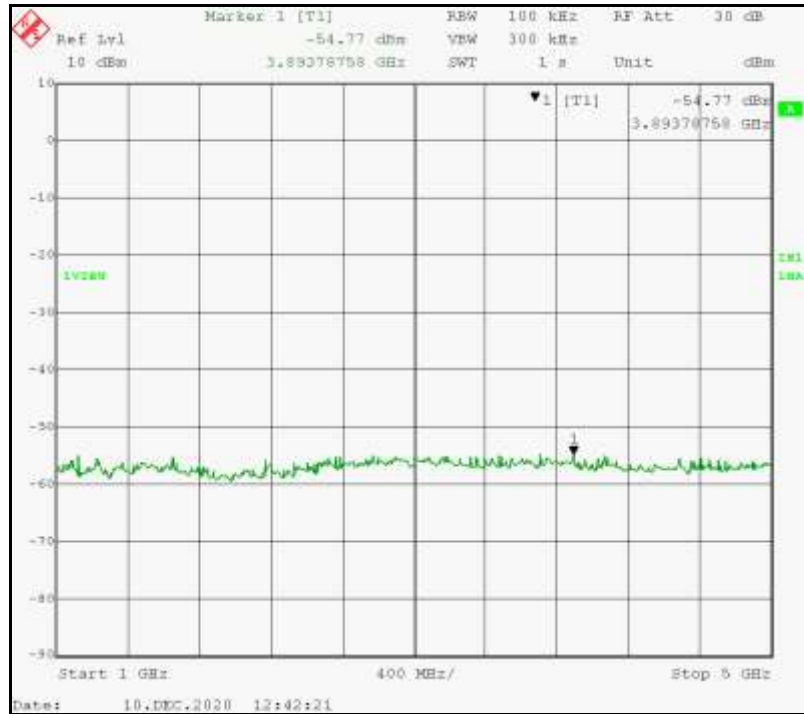


WNRH1 With Zigbee Radio Receive Mode: 500 MHz – 1000 MHz

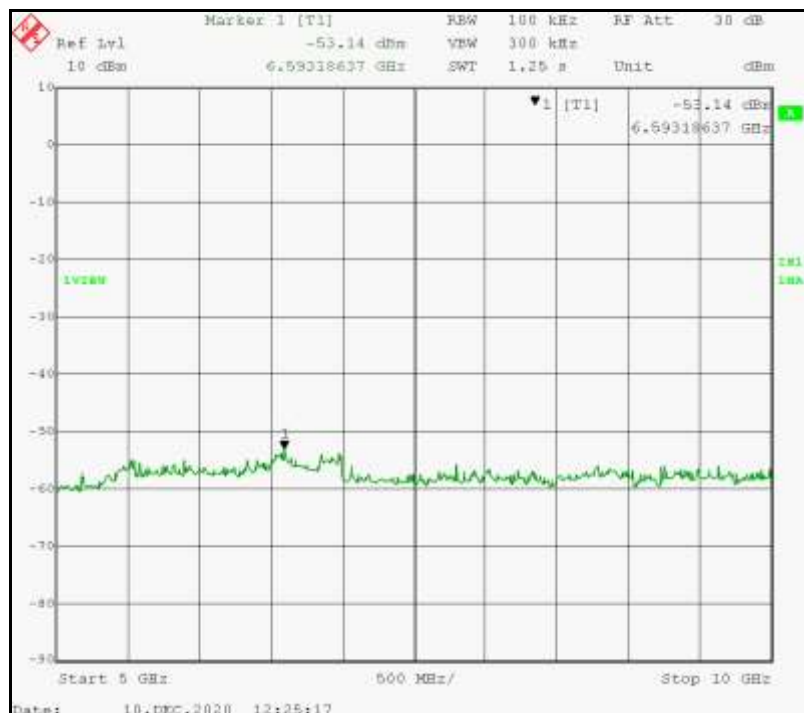




WNRH1 With Zigbee Radio Receive Mode: 1 GHz – 5 GHz

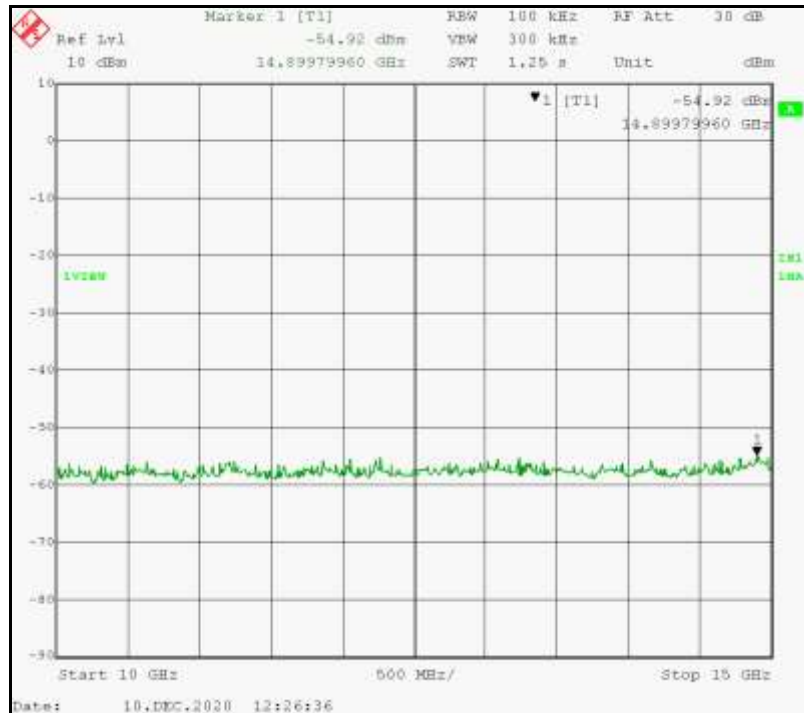


WNRH1 With Zigbee Radio Receive Mode: 5 GHz – 10 GHz

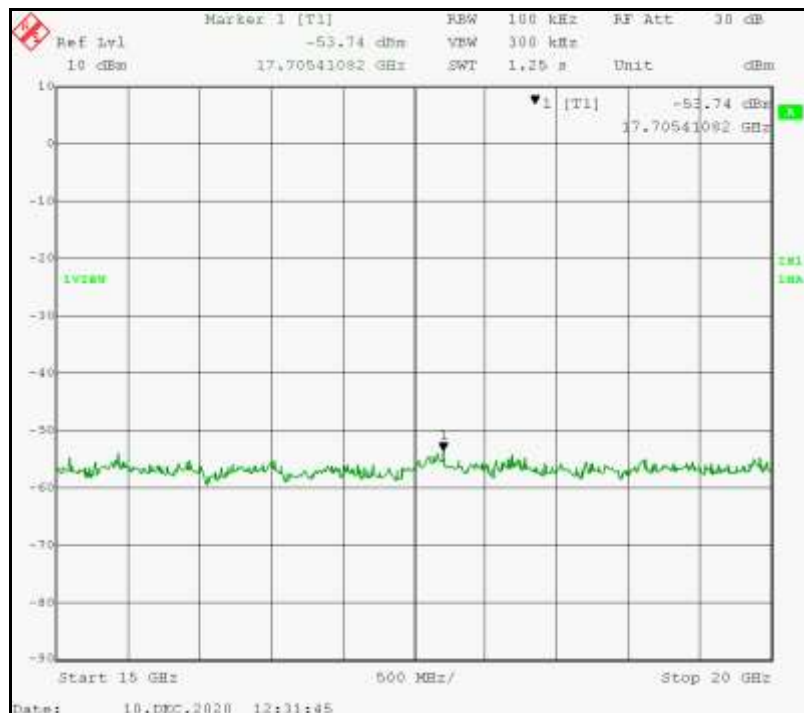




WNRH1 With Zigbee Radio Receive Mode: 10 GHz – 15 GHz

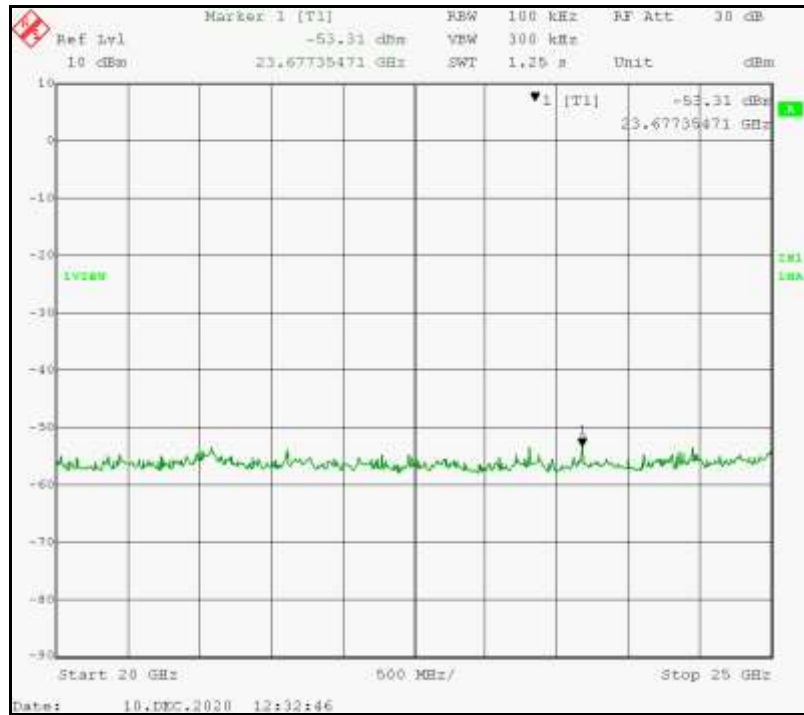


WNRH1 With Zigbee Radio Receive Mode: 15 GHz – 20 GHz





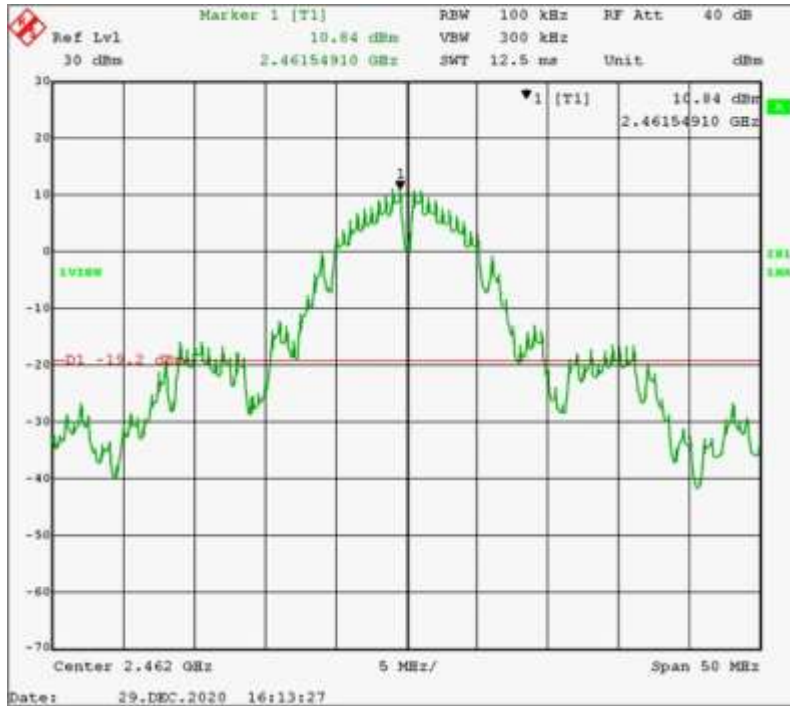
WNRH1 With Zigbee Radio Receive Mode: 20 GHz – 25 GHz



Test Results: Emissions in Non-Restricted Frequency Bands, measured from the Legrand Model WNRH1 with Zigbee Radio, comply with the requirements of 47 CFR Part 15.247 (d) with 21.17 dB of margin.



4.8.2.3 WNRH1 With Wi-Fi Radio Reference Measurement (12/29/2020)

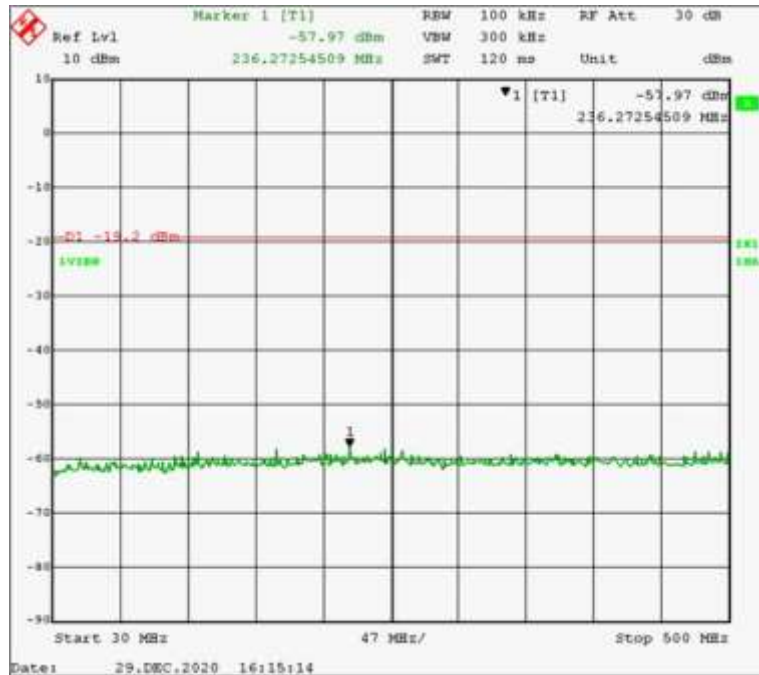


The peak level of 10.84 dBm is the maximum peak output of the Legrand WNRH1 Wi-Fi radio. The conducted spurious emissions from the antenna port must be 30 dB down from this peak. The resultant limit is therefore -19.16 dBm. This limit is displayed on the plots below.

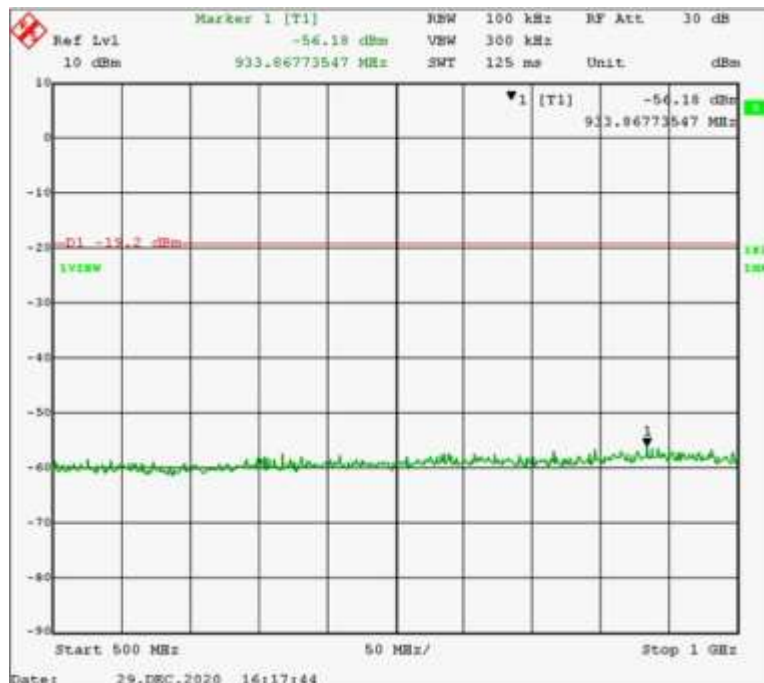


4.8.2.4 Emissions in Non-restricted Frequency Bands WNRH1 With Wi-Fi Radio Test Results (12/29/2020)

WNRH1 With Wi-Fi Radio Transmitting: 30 MHz – 500 MHz (Without High Pass Filter)

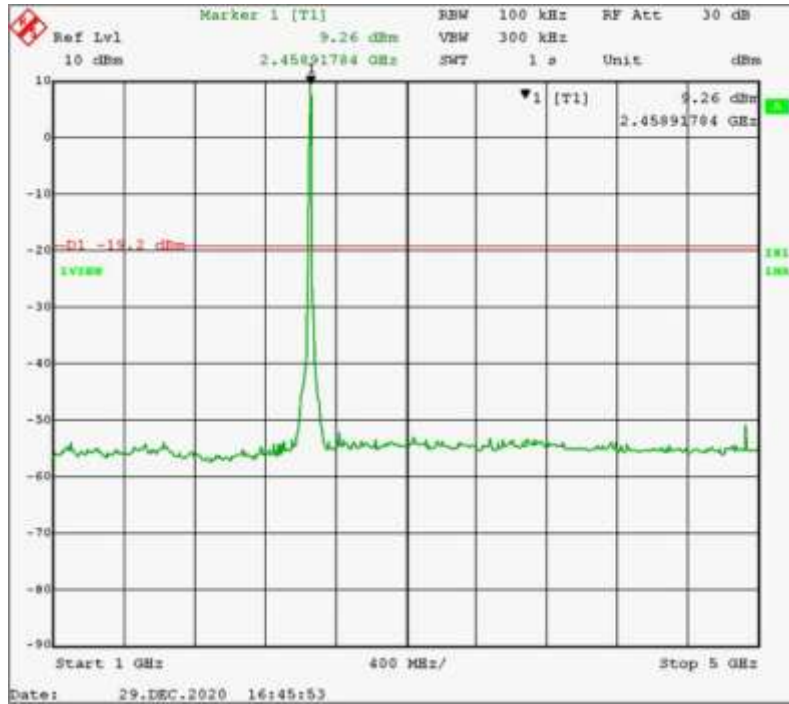


WNRH1 With Wi-Fi Radio Transmitting: 500 MHz – 1 GHz (Without High Pass Filter)

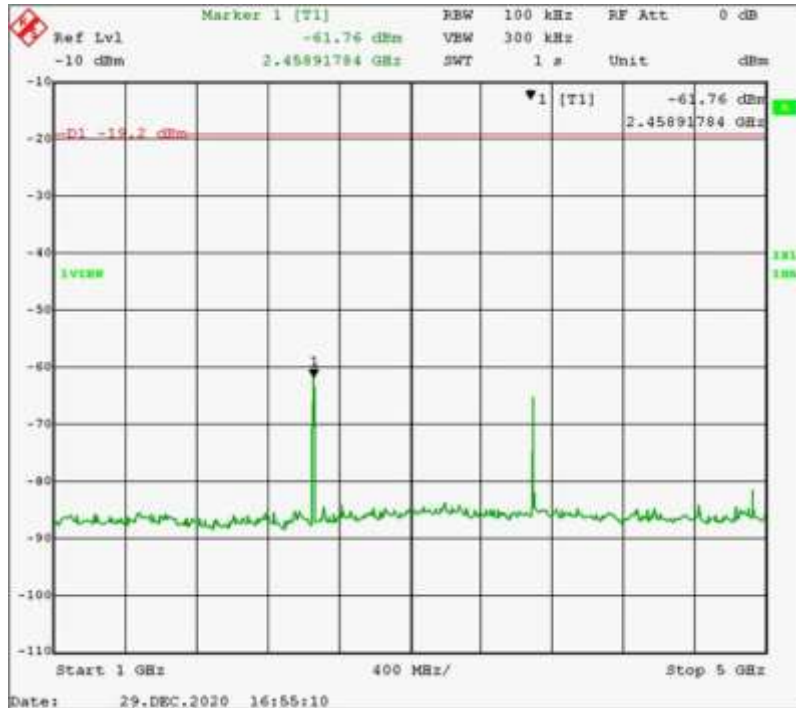




WNRH1 With Wi-Fi Radio Transmitting: 1 GHz – 5 GHz (Without High Pass Filter)

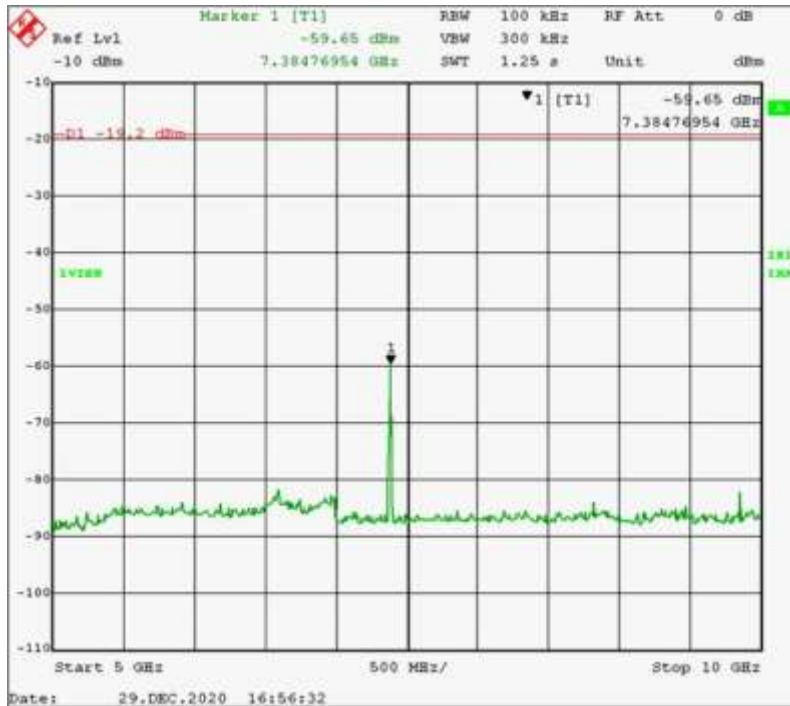


WNRH1 With Wi-Fi Radio Transmitting: 1 GHz – 5 GHz (With High Pass Filter)

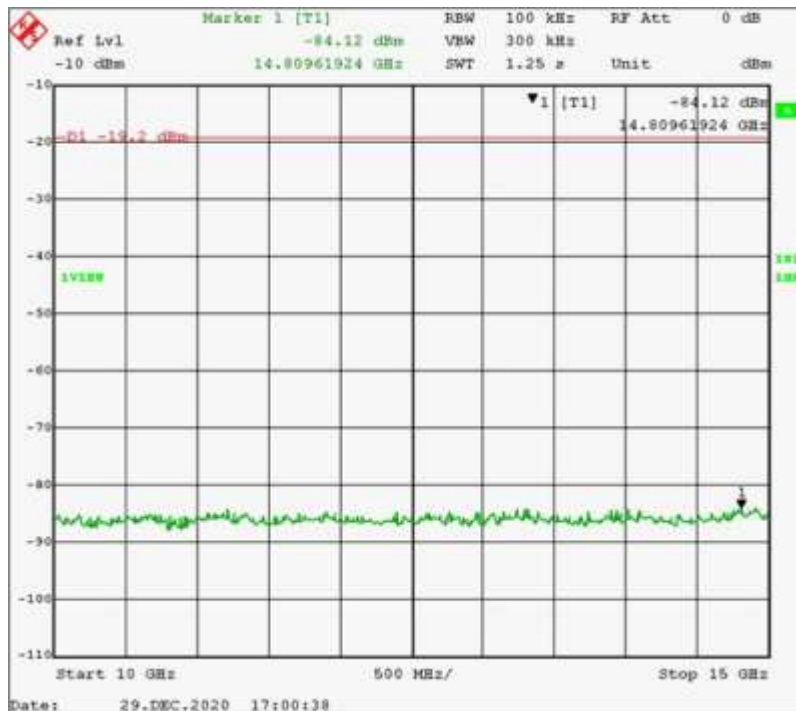




WNRH1 With Wi-Fi Radio Transmitting: 5 GHz – 10 GHz (With High Pass Filter)

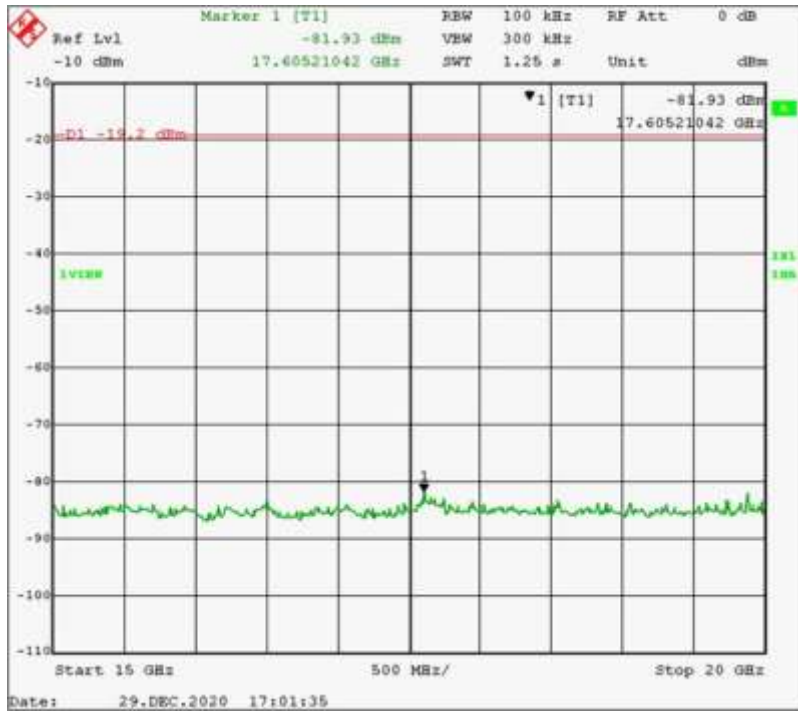


WNRH1 With Wi-Fi Radio Transmitting: 10 GHz – 15 GHz (With High Pass Filter)

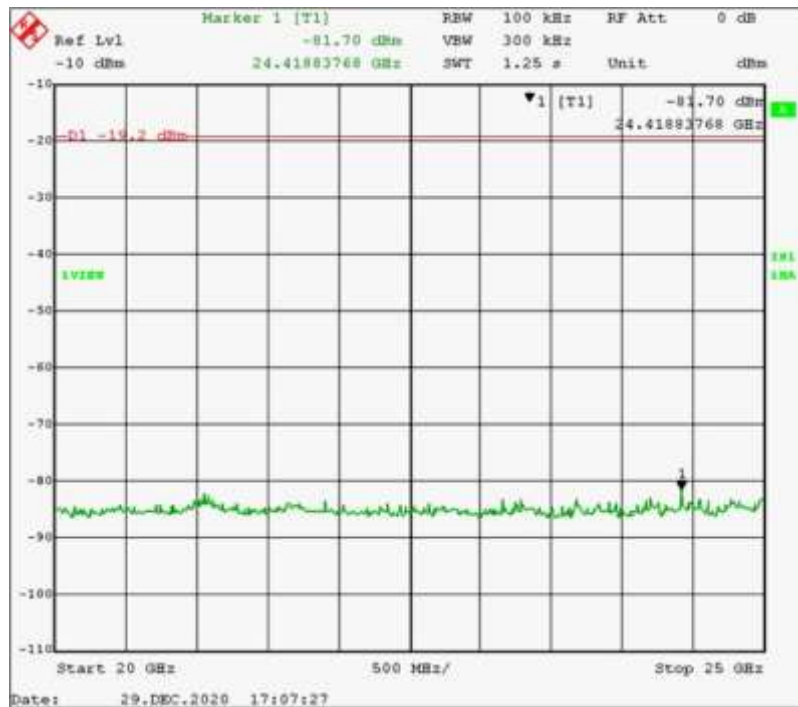




WNRH1 With Wi-Fi Radio Transmitting: 15 GHz – 20 GHz (With High Pass Filter)

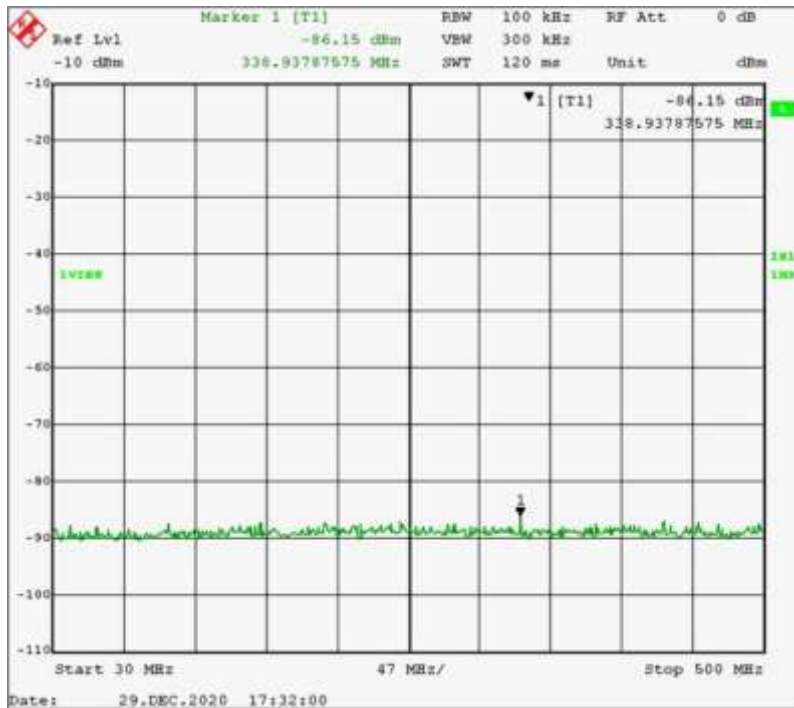


WNRH1 With Wi-Fi Radio Transmitting: 20 GHz – 25 GHz (With High Pass Filter)

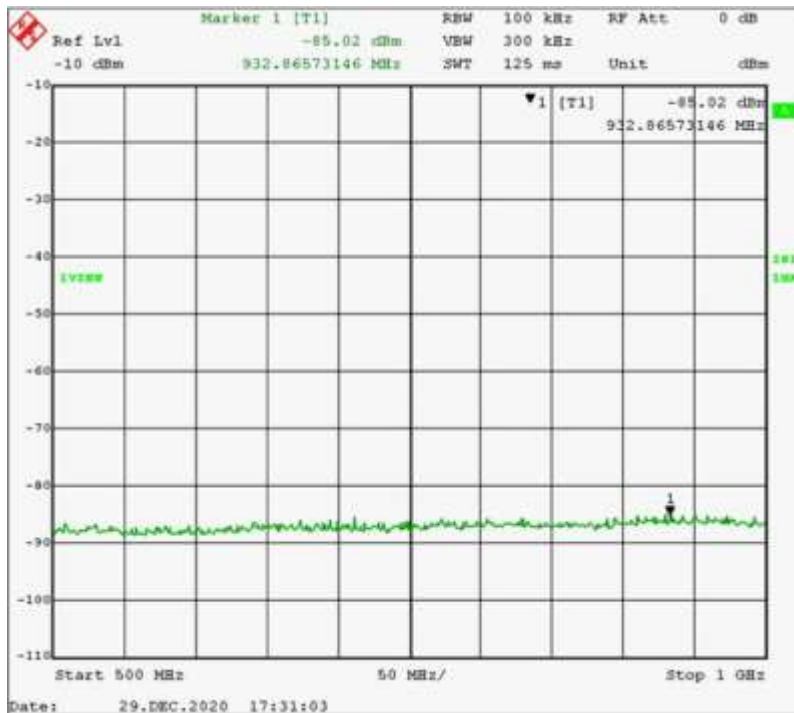




WNRH1 With Wi-Fi Radio Receive Mode: 30 MHz – 500 MHz

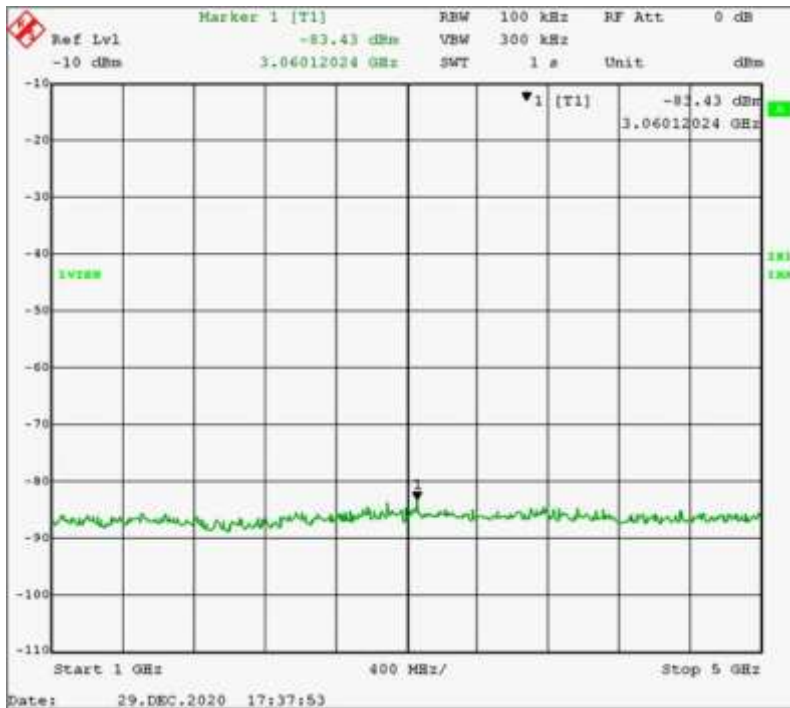


WNRH1 With Wi-Fi Radio Receive Mode: 500 MHz – 1 GHz

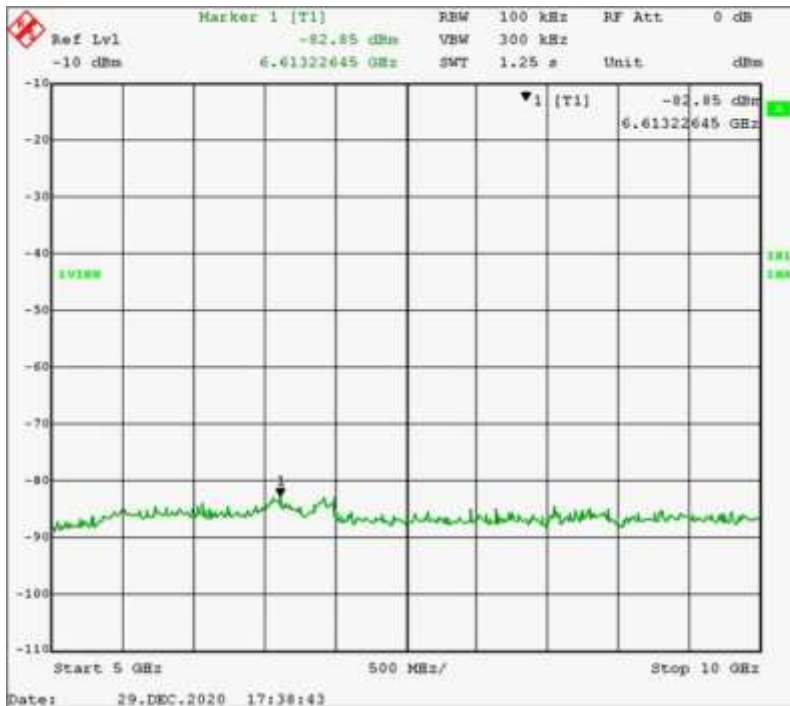




WNRH1 With Wi-Fi Radio Receive Mode: 1 GHz – 5 GHz

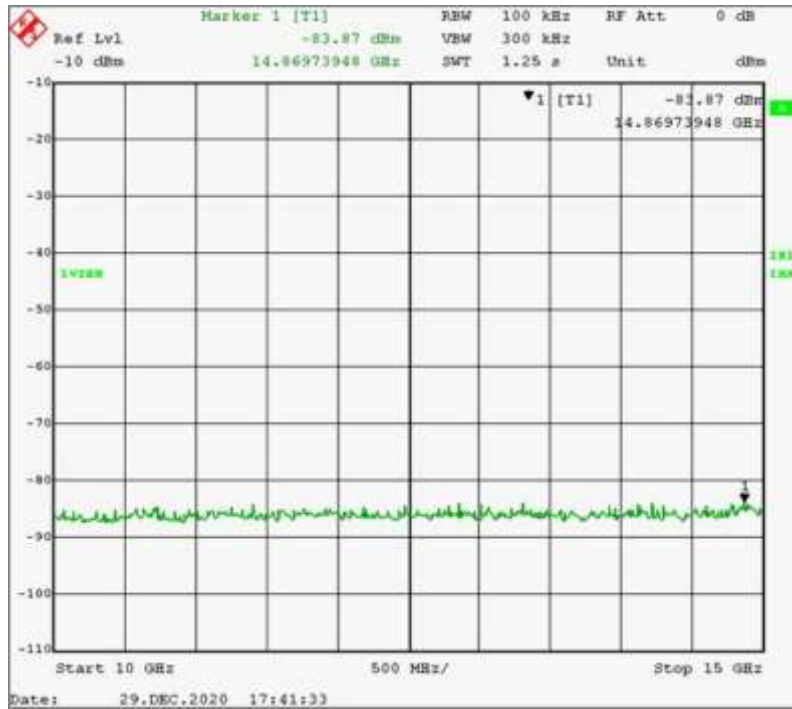


WNRH1 With Wi-Fi Radio Receive Mode: 5 GHz – 10 GHz

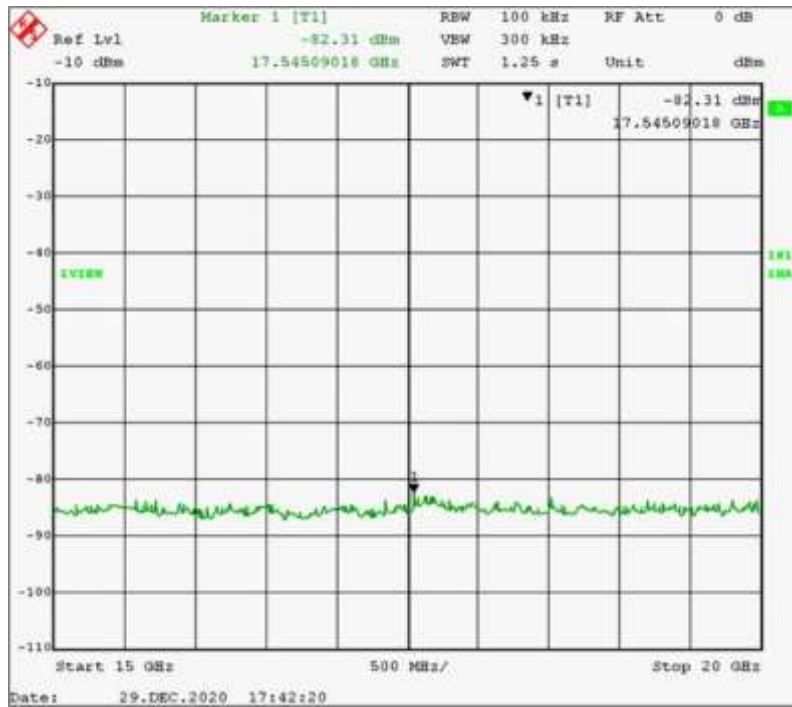




WNRH1 With Wi-Fi Radio Receive Mode: 10 GHz – 15 GHz

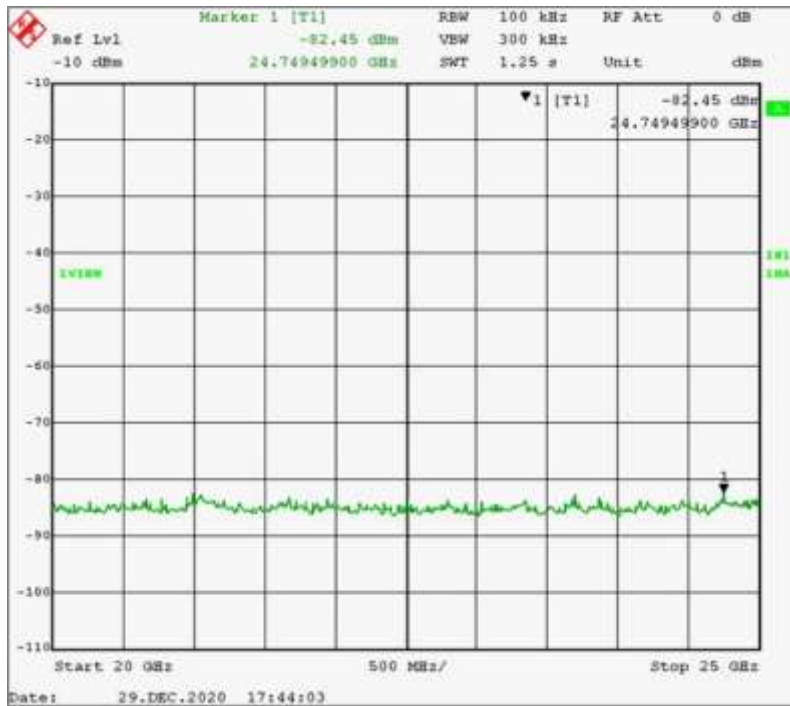


WNRH1 With Wi-Fi Radio Receive Mode: 15 GHz – 20 GHz





WNRH1 With Wi-Fi Radio Receive Mode: 20 GHz – 25 GHz



Test Results: Emissions in Non-Restricted Frequency Bands, measured from the Legrand WNRH1 Wi-Fi radio, utilizing DBPSK (1 Mbps) modulation, comply with the requirements of 47 CFR Part 15.247 (d) with 40.49 dB of margin.



4.9 Power Spectral Density (FCC Section 15.247(e), RSS-247 Section 5.2(b))

4.9.1 Power Spectral Density Test Procedure

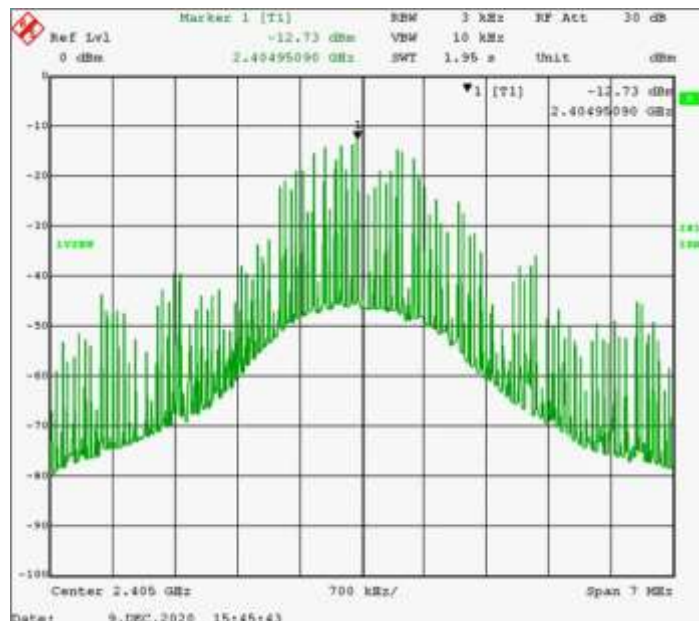
A conducted, average, power measurement of the output frequency was measured for the Legrand WNRH1 for each of the low, middle and high operating frequencies with modulation. The Zigbee radio was modulated with O-QPSK.

The Wi-Fi radio was tested with three modulation modes, one from each of the IEEE 802.11 b/g/n standards. DBPSK (1 Mbps) showed highest emissions for IEEE 802.11b, 64 QAM (36 Mbps) for 802.11g and MCS4 16 QAM (43.3 Mbps) for 802.11n. Method AVGSA-1 was used to measure output power for DBPSK (1Mbps), therefore, method AVGPS-1 was used to measure PSD. Method AVGSA-2 was used to measure output power for 64 QAM (36 Mbps) and MCS4 16 QAM (43.3 Mbps). Therefore, method AVGPS-2 was used to measure PSD.

4.9.2 Power Spectral Density WNRH1 With Zigbee Radio Test Results (12/09/2020)

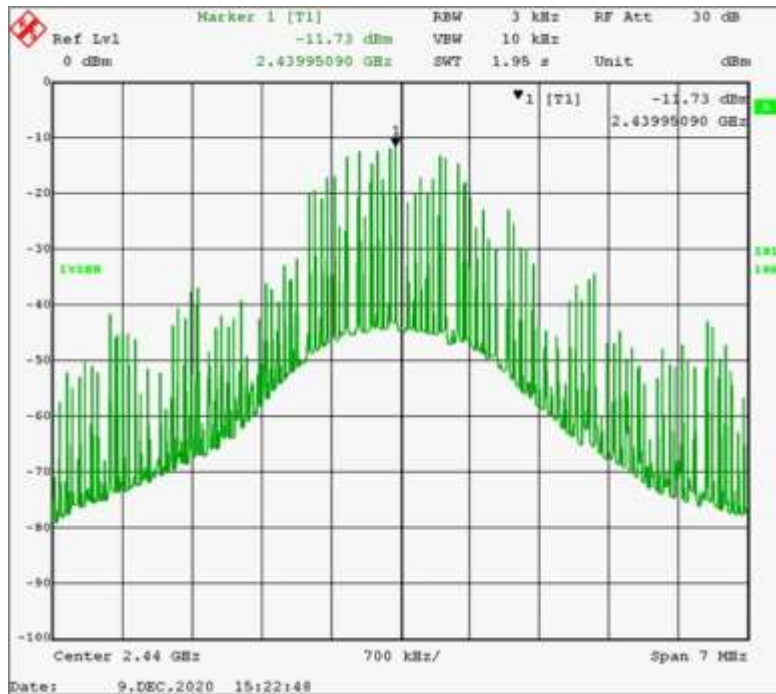
Channel	Modulation	Frequency (MHz)	Measured Level (dBm)	Cable # 814 Loss (dB)	Total dBm	Limit dBm	Margin dBm
11	O-QPSK	2405.0	-12.73	0.47	-12.26	8.00	-20.26
18		2440.0	-11.73	0.47	-11.26	8.00	-19.26
26		2480.0	-12.11	0.47	-11.64	8.00	-19.64

WNRH1 With Zigbee Radio Low Channel 11 2405 MHz PSD

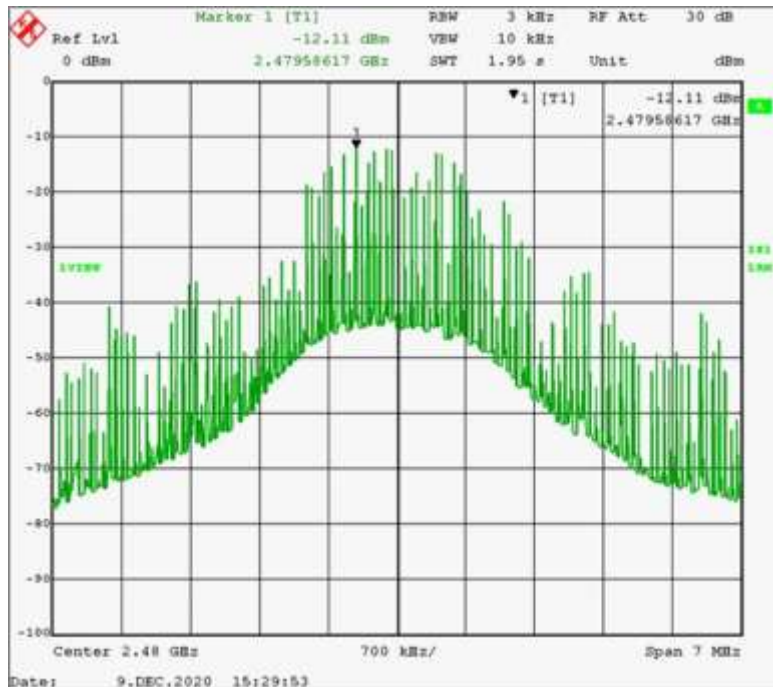




WNRH1 With Zigbee Radio Middle Channel 18 2440 MHz PSD



WNRH1 With Zigbee Radio High Channel 26 2480 MHz PSD



Test Results: The Power Spectral Density measurements of the Legrand Model WNRH1 with Zigbee Radio are compliant with the limits specified in FCC Section 15.247(e) with margin of 19.26 dB.



4.9.3 Power Spectral Density WNRH1 With Wi-Fi Radio Test Results (03/02/2021)

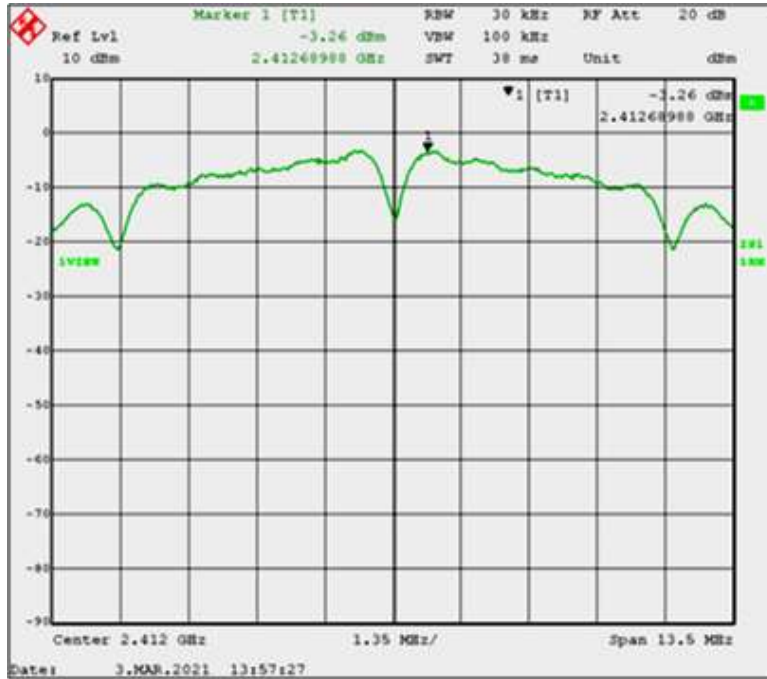
SA Settings			ANSI C63.10 Requirement
Span	13.5	MHz	1.5 to 5 times OBW
RBW	30	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	100	MHz	≥ 3 times RBW
Sweep Time	38	ms	Auto

64 QAM 36 Mbps Modulation (16 MHz OBW)			
SA Settings			ANSI C63.10 Requirement
Span	23.5	MHz	1.5 to 5 times OBW
RBW	100	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	300	MHz	≥ 3 times RBW
Sweep Time	6	ms	Auto

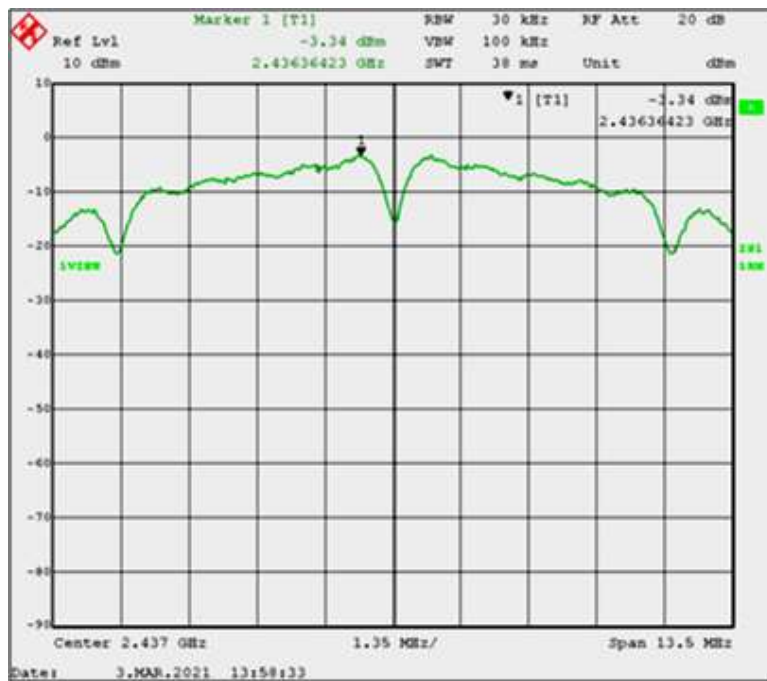
MCS4 43.3 Mbps Modulation (16.8 MHz OBW)			
SA Settings			ANSI C63.10 Requirement
Span	25.5	MHz	1.5 to 5 times OBW
RBW	100	kHz	1 - 5 % of OBW (max 1 MHz)
VBW	300	MHz	≥ 3 times RBW
Sweep Time	6.5	ms	Auto



WNRH1 With Wi-Fi Radio, Low Channel 1, 2412 MHz, DBPSK (1 Mbps) Modulation

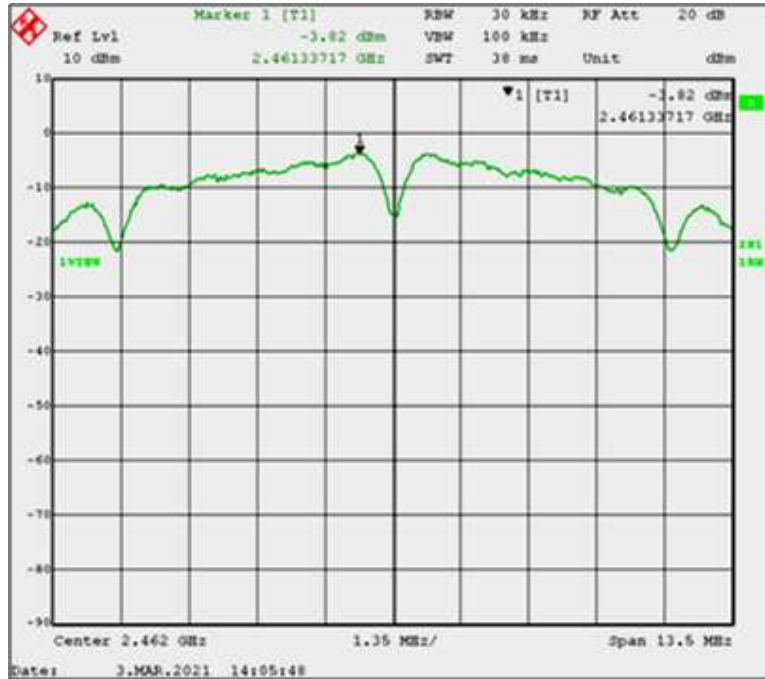


WNRH1 With Wi-Fi Radio, Middle Channel 6, 2437 MHz, DBPSK (1 Mbps) Modulation





WNRH1 With Wi-Fi Radio, High Channel 11, 2462 MHz, DBPSK (1 Mbps) Modulation



Channel	Modulation	Frequency	Measured Level	Cable # 814 Loss	Duty Cycle Adj	Total	Limit	Margin
		MHz	dBm	dB	dB	dBm	dBm	dBm
1	DBPSK 1 Mbps	2412.0	-3.26	0.47	0.00	-2.79	8.00	-10.79
6		2437.0	-3.34	0.47	0.00	-2.87	8.00	-10.87
11		2462.0	-3.82	0.47	0.00	-3.35	8.00	-11.35

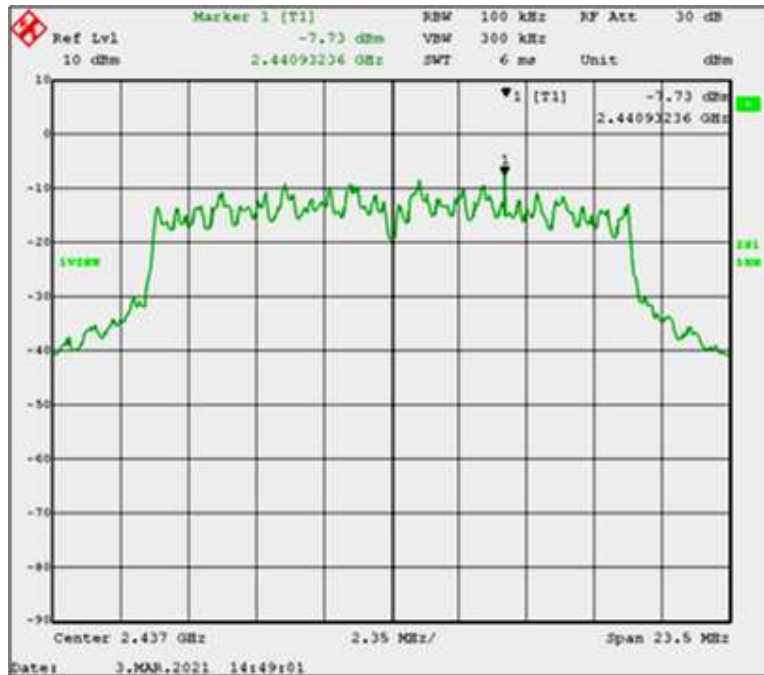
Test Results: The Power Spectral Density measurements of the Legrand Model WNRH1 with Wi-Fi Radio, modulated with DBPSK (1 Mbps) are compliant with the limits specified in FCC Section 15.247(e) with margin of 10.79 dB.



WNRH1 With Wi-Fi Radio, Low Channel 1, 2412 MHz, 64 QAM (36 Mbps) Modulation

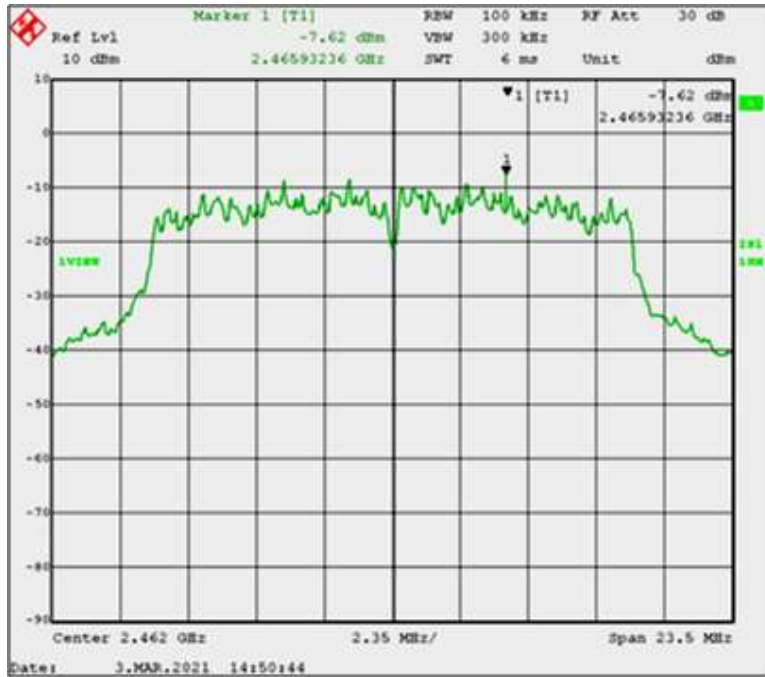


WNRH1 With Wi-Fi Radio, Middle Channel 6, 2437 MHz, 64 QAM (36 Mbps) Modulation





WNRH1 With Wi-Fi Radio, High Channel 11, 2462 MHz, 64 QAM (36 Mbps) Modulation

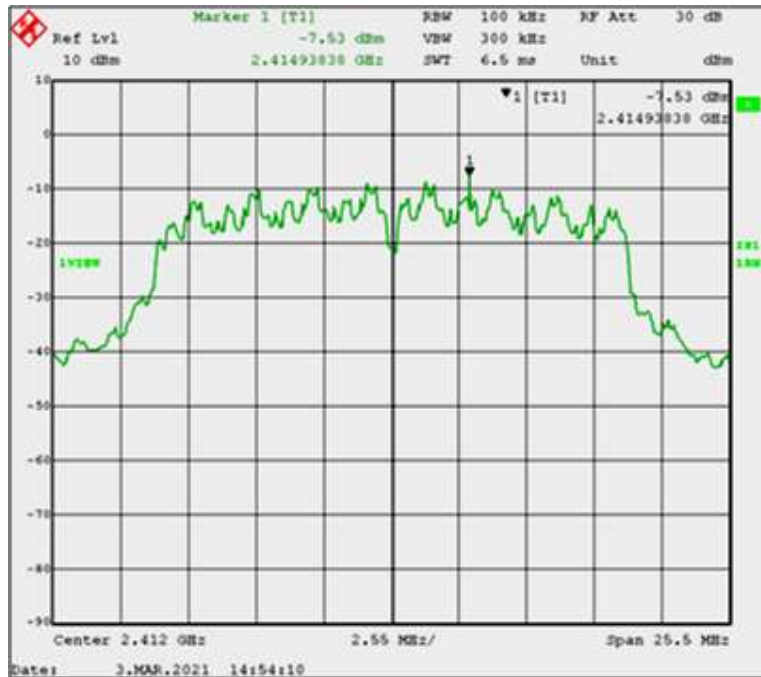


Channel	Modulation	Frequency	Measured Level	Cable # 814 Loss	Duty Cycle Adj	Total	Limit	Margin
		MHz	dBm	dB	dB	dBm	dBm	dBm
1	64 QAM 36 Mbps	2412.0	-8.47	0.47	0.91	-7.09	8.00	-15.09
6		2437.0	-7.73	0.47	0.91	-6.35	8.00	-14.35
11		2462.0	-7.62	0.47	0.91	-6.24	8.00	-14.24

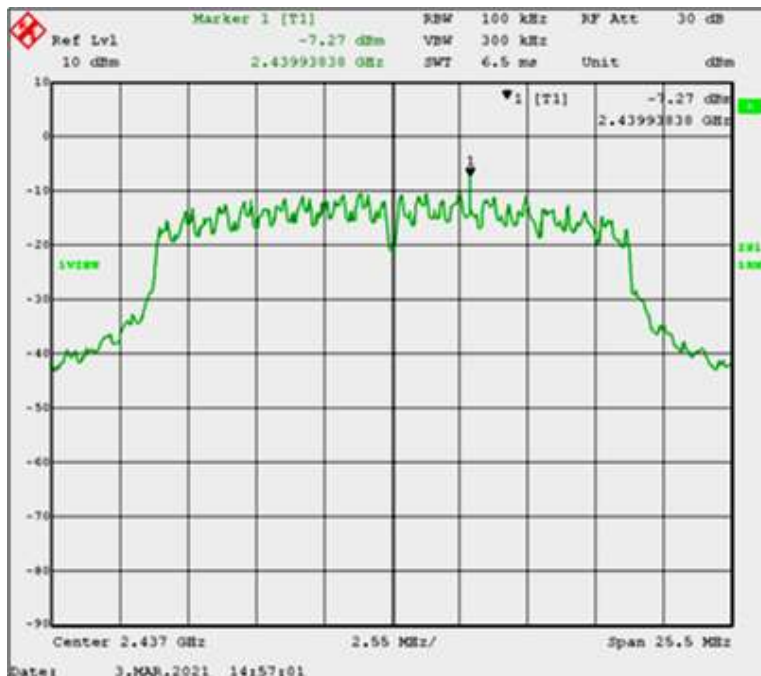
Test Results: The Power Spectral Density measurements of the Legrand Model WNRH1 with Wi-Fi Radio, modulated with 64 QAM (36 Mbps) are compliant with the limits specified in FCC Section 15.247(e) with margin of 14.24 dB.



WNRH1 With Wi-Fi Radio, Low Channel 1, 2412 MHz, MCS4 16 QAM (43.3 Mbps)
Modulation

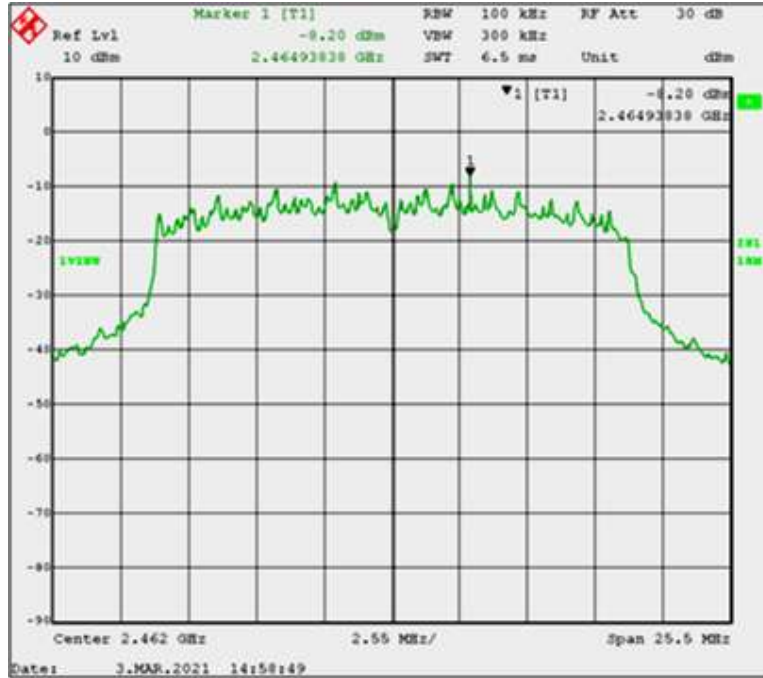


WNRH1 With Wi-Fi Radio, Middle Channel 6, 2437 MHz, MCS4 16 QAM (43.3 Mbps)
Modulation





WNRH1 With Wi-Fi Radio, High Channel 11, 2462 MHz, MCS4 16 QAM (43.3 Mbps)
Modulation



Channel	Modulation	Frequency	Measured Level	Cable # 814 Loss	Duty Cycle Adj	Total	Limit	Margin
		MHz	dBm	dB	dB	dBm	dBm	dBm
1	MCS4 16 QAM 43.3 Mbps	2412.0	-7.53	0.47	0.95	-6.11	8.00	-14.11
6		2437.0	-7.27	0.47	0.95	-5.85	8.00	-13.85
11		2462.0	-8.20	0.47	0.95	-6.78	8.00	-14.78

Test Results: The Power Spectral Density measurements of the Legrand Model WNRH1 with Wi-Fi Radio, modulated with MCS4 16 QAM (43.3 Mbps) are compliant with the limits specified in FCC Section 15.247(e) with margin of 13.85 dB.



4.10 Band Edge Measurement (FCC Part 15.247(d), RSS-247 5.5)

4.10.1 Band Edge Measurement Test Procedure

The measurement of the band edges for the Zigbee and Wi-Fi radios were made using the radiated emission test procedure described in Section 4.4.2 of this report. The operating channels of the WNHR1 did not fall within 2 MHz of an authorized band edge or restricted band edge, therefore the standard field strength test using standard EMC bandwidths was used for the measurements listed below. Measurements were made at the 2.4835 GHz Restricted Band Edge.

4.10.2 Band Edge Measurement Test Results – WNHR1 Zigbee Radio

Zigbee Radio transmitting at 2.48 GHz, O-QPSK modulation

Frequency	PeakLevel	AvgLevel	AntPol	Azimuth	AntHght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	Avg Limit	Avg Margin	Peak Limit	Peak Margin	
2.4835	35.01	26.81	V	320	110	-5.49	53.98	-27.17	73.98	-38.97	PASS
2.4835	34.02	25.70	H	329	125	-5.49	53.98	-28.28	73.98	-39.96	PASS

Test Results: Band-edge measurement of the WNRH1 Zigbee radio, transmitting with O-QPSK modulation, is compliant to the FCC and ISSED limits.

4.10.3 Band Edge Measurement Test Results – WNHR1 Wi-Fi Radio

WiFi Radio transmitting at 2.462 GHz, DBPSK (1 Mbps) modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4835	35.64	27.47	H	202	134	-5.49	53.98	-26.51	73.98	-38.34	Pass
2.4835	35.11	25.84	V	235	177	-5.49	53.98	-28.14	73.98	-38.87	Pass



WiFi Radio transmitting at 2.462 GHz, 64 QAM (36 Mbps) modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4835	36.27	26.14	H	210	107	-5.49	53.98	-27.84	73.98	-37.71	Pass
2.4835	35.69	26.62	V	287	112	-5.49	53.98	-27.36	73.98	-38.29	Pass

WiFi Radio transmitting at 2.462 GHz, MCS4 16 QAM (43.3 Mbps) modulation

Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	47 CFR Part 15.205, 15.209 & RSS-247				Result
							Avg Limit	Avg Margin	Peak Limit	Peak Margin	
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB	
2.4835	35.46	26.51	H	222	131	-5.49	53.98	-27.47	73.98	-38.52	Pass
2.4835	35.67	26.75	V	308	165	-5.49	53.98	-27.23	73.98	-38.31	Pass

Test Results: Band-edge measurements of the WNRH1 Wi-Fi radio, transmitting at IEEE 802.11b, 802.11g and 802.11n, are compliant to the FCC and ISSED limits.



5.0 Test Setup Pictures

5.1 Conducted Emissions AC Mains Test Setup Pictures

Conducted Emissions AC Mains WNRH1 With Zigbee Radio



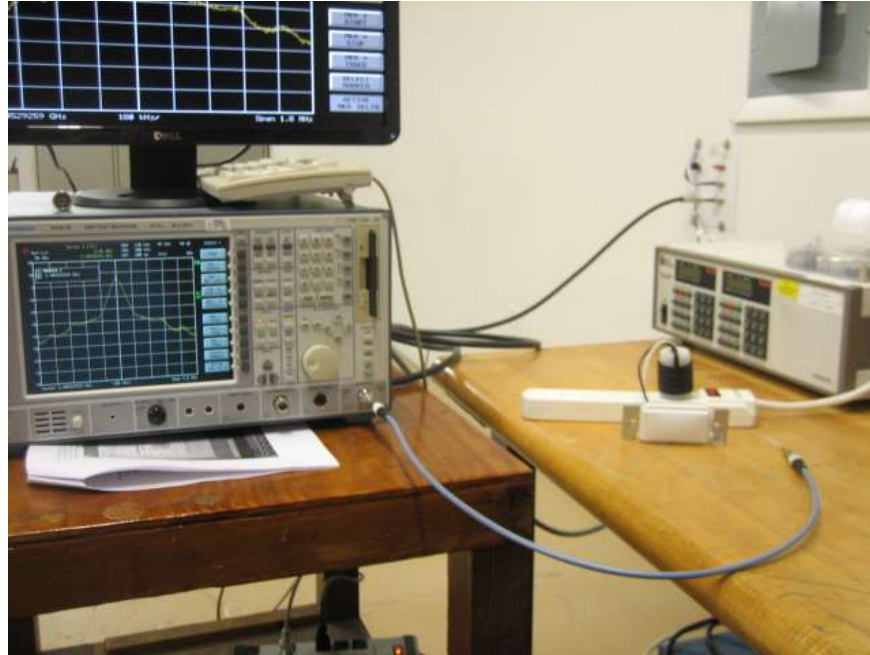
Conducted Emissions AC Mains WNRH1 With Wi-Fi Radio



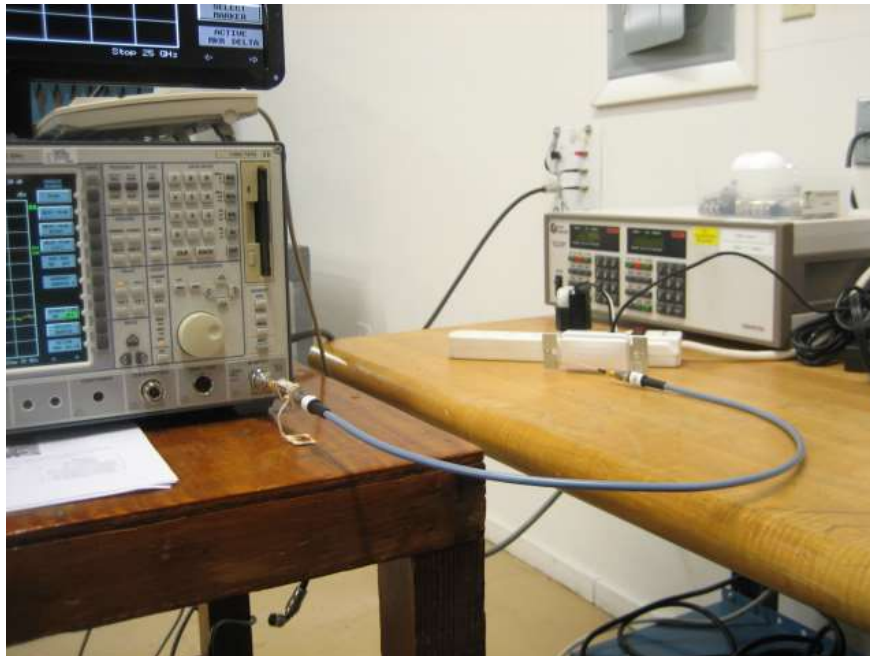


5.2 Antenna Conducted Emissions Test Setup Pictures

Antenna Conducted Emissions WNRH1 With Zigbee Radio



Antenna Conducted Emissions WNRH1 With Wi-Fi Radio





5.2 Radiated Emissions Test Setup Pictures

30 MHz – 1000 MHz Test Setup WNRH1 With Zigbee Radio



30 MHz – 1000 MHz Test Setup WNRH1 With Wi-Fi Radio





1 GHz - 18 GHz Test Setup WNRH1 With Zigbee Radio



1 GHz - 18 GHz Test Setup WNRH1 With Wi-Fi Radio





18 GHz - 25 GHz Test Setup WNRH1 With Zigbee Radio



18 GHz - 25 GHz Test Setup WNRH1 With Wi-Fi Radio





Appendix A – Test Equipment

Equipment	Manufacturer	Model #	Serial #	BEC #	Calibration Date	Calibration Cycle	Calibration Due Date
EMI Receiver (9 kHz - 6.5 GHz)	Hewlett Packard	8546A	3325A00158	761	12/20/19	3 Years	12/20/22
Four Line V-LISN	TESEQ	NNB 52	253551	950	06/18/19	3 Years	06/18/22
EMI Receiver (20 Hz – 26.5 GHz)	Rohde & Schwarz	ESIB 26	836119/006	1010	07/02/19	3 Years	07/02/22
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A022108	712	06/26/18	3 Years	06/26/21
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	02/27/18	3 Years	02/27/21
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A020714	882	05/16/18	3 Years	05/16/21
Amplifier (.09 – 1300 MHz)	Hewlett Packard	8447F	3313A06658	807	01/09/19	2 Years	01/09/21
EMC Analyzer (9 kHz - 1.8 GHz)	Hewlett Packard	8593EM	3710A00214	1026	03/23/20	3 Years	03/23/23
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	10/13/20	2 Years	10/13/22
Double Ridged Horn Antenna (1 - 18 GHz)	Eaton	3115	2113	836	01/08/19	3 Years	01/08/22
Shielded Room #1	ETS Lindgren	12-2/2-0	4078	859	05/17/18	3 Years	05/17/21



OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	08/03/20	1 Year	08/03/21
Intentional Radiator Testing High Frequency RF Test Cable	Suhner	S04272B	N/A	962	08/03/20	1 Year	08/03/21
Temp/Humidity Meter	Control Company	4096	151872672	780	04/08/19	2 Years	04/08/21
Software (Tile Instrument Control System)	Quantum Change/EMC Systems	Version 3	N/A	N/A	No Cal. Required	No Cal. Required	No Cal. Required
Radiated Emissions Test Software	BEC	RADE	2.2	N/A	No Cal. Required	No Cal. Required	No Cal. Required