Report No.: FR022708-01



# RADIO TEST REPORT

FCC ID

: 2ANC3PHYCF009

Equipment

: Phyn Smart Water Assistant

**Brand Name** 

: Phyn

Model Name

: PHYCF009

Applicant

: Phyn LLC

1855 Del Amo Blvd, Torrance, CA United States 90501

Manufacturer

: Phyn LLC

1855 Del Amo Blvd, Torrance, CA United States 90501

Standard

: 47 CFR FCC Part 15.247

The product was received on Jan. 08, 2021, and testing was started from Jan. 11, 2021 and completed on Feb. 24, 2021. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory

No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)

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: Jun. 10, 2021

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Photographs of EUT v01

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## History of this test report

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Report No.	Version	Description	Issued Date
FR022708-01	01	Initial issue of report	Jun. 10, 2021

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## **Summary of Test Result**

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.207	AC Power-line Conducted Emissions	PASS	-
3.2	15.247(a)	DTS Bandwidth	PASS	-
3.3	15.247(b)	Maximum Conducted Output Power	PASS	-
3.4	15.247(e)	Power Spectral Density	PASS	-
3.5	15.247(d)	Emissions in Non-restricted Frequency Bands	PASS	-
3.6	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

#### **Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

#### **Comments and Explanations:**

- 1. The test configuration, test mode and test software were written in this test report are declared by the manufacturer.
- 2. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen Report Producer: Vicky Huang

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## 1 General Description

#### 1.1 Information

#### 1.1.1 RF General Information

Frequency Range (MHz)	IEEE Std. 802.11	Ch. Frequency (MHz)	Channel Number
2400-2483.5	b, g, n (HT20)	2412-2462	1-11 [11]
2400-2483.5	n (HT40)	2422-2452	3-9 [7]

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Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	802.11b	20	1TX
2.4-2.4835GHz	802.11g	20	1TX
2.4-2.4835GHz	802.11n HT20	20	1TX
2.4-2.4835GHz	802.11n HT40	40	1TX

#### Note:

- ◆ 11b mode uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
- ◆ 11g, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
- BWch is the nominal channel bandwidth.

#### 1.1.2 Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	ARISTOTLE	RFA-AP821A-70B-84	PIFA Antenna	I-PEX	2.6

Note: The above information was declared by manufacturer.

#### For 2.4GHz WLAN function

#### For IEEE 802.11b/g/n mode (1TX, 1RX):

Only Port 1 can be used as transmitting/receiving antenna.

#### 1.1.3 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
802.11b	1	0	n/a (DC>=0.98)	n/a (DC>=0.98)
802.11g	1	0	n/a (DC>=0.98)	n/a (DC>=0.98)
802.11n HT20	1	0	n/a (DC>=0.98)	n/a (DC>=0.98)
802.11n HT40	1	0	n/a (DC>=0.98)	n/a (DC>=0.98)

#### Note:

- DC is Duty Cycle.
- DCF is Duty Cycle Factor.

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## 1.1.4 EUT Operational Condition

EUT Power Type	From Power Adapter or Host System				
Beamforming Function	☐ With beamforming ☐ Without beamforming			Without beamforming	
Function				Point-to-point	
Test Software Version Tera Term Version 4.75					

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Note: The above information was declared by manufacturer.

#### 1.1.5 Table for Multiple Listing

Table for LED board and Transition board Information

Type	LED board		Transition board	
Туре	Brand	Model	Brand	Model
1	CHENSOURCE	PHYCBE02 Rev 4_Led board	CHENSOURCE	PHYCBE03 Rev 06
2	Zinwell	ZIO-P002 LED board	Zinwell	ZIO-P002 Transition board

#### Table for Combination of EUT

EUT	LED board	Transition board
1	Type 1	Type 1
2	Type 2	Type 2

Note1: The above information was declared by manufacturer.

Note2: From the above, EUT 1 has selected to execute all test items and EUT 2 has selected to execute the AC Power-line Conducted Emissions, Emissions in Restricted Frequency Bands below 1GHz test.

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## 1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

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- 47 CFR FCC Part 15
- ANSI C63.10-2013

The following reference test guidance is not within the scope of accreditation of TAF.

- FCC KDB 558074 D01 v05r02
- FCC KDB 414788 D01 v01r01

### 1.3 Testing Location Information

**Testing Location Information** 

Test Lab.: Sporton International Inc. Hsinchu Laboratory

Hsinchu ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)

(TAF: 3787) TEL: 886-3-656-9065 FAX: 886-3-656-9085

Test site Designation No. TW3787 with FCC.

Conformity Assessment Body Identifier (CABID) TW3787 with ISED.

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
RF Conducted	TH01-CB	Lucke Hsieh	13.8-14.1 / 57-62	Jan. 13, 2021
Radiated (Below 1GHz)	03CH05-CB	Kevin Huang	20.8-22 / 55-58	Jan. 28, 2021~ Feb. 22, 2021
Radiated (Above 1GHz)	03CH04-CB	Brian Sun	22.2-22.6 / 63-65	Jan. 11, 2021~ Jan. 12, 2021
AC Conduction	CO02-CB	Wei Li	22~23 / 56~58	Feb. 24, 2021

## 1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.0 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	3.8 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	5.0 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.9 dB	Confidence levels of 95%
Conducted Emission	2.8 dB	Confidence levels of 95%
Output Power Measurement	1.4 dB	Confidence levels of 95%
Power Density Measurement	2.8 dB	Confidence levels of 95%
Bandwidth Measurement	0.4%	Confidence levels of 95%

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## 2 Test Configuration of EUT

## 2.1 Test Channel Mode

Mode	Power Setting
802.11b_Nss1,(1Mbps)_1TX	-
2412MHz	36
2437MHz	36
2462MHz	40
802.11g_Nss1,(6Mbps)_1TX	-
2412MHz	31
2417MHz	40
2437MHz	40
2457MHz	38
2462MHz	33
802.11n HT20_Nss1,(MCS0)_1TX	-
2412MHz	31
2417MHz	40
2437MHz	40
2457MHz	39
2462MHz	31
802.11n HT40_Nss1,(MCS0)_1TX	-
2422MHz	22
2427MHz	25
2437MHz	29
2447MHz	22
2452MHz	19

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## 2.2 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests		
Tests Item	AC power-line conducted emissions	
Condition	AC power-line conducted measurement for line and neutral	
Operating Mode Normal Link		
1 Normal Link-EUT 1 + Adapter 1		
2 Normal Link-EUT 1 + Adapter 2		
Mode 1 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.		
Normal Link-EUT 2 + Adapter 1		
For operating mode 1 is the worst case and it was record in this test report.		

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7	he Worst Case Mode for Following Conformance Tests
Tests Item	DTS Bandwidth Maximum Conducted Output Power Power Spectral Density Emissions in Non-restricted Frequency Bands
Test Condition	Conducted measurement at transmit chains
1	EUT 1

The Worst Case Mode for Following Conformance Tests			
Tests Item	Emissions in Restricted Frequency Bands		
Test Condition  Radiated measurement  If EUT consist of multiple antenna assembly (multiple antenna are used in E regardless of spatial multiplexing MIMO configuration), the radiated test she be performed with highest antenna gain of each antenna type.			
Operating Mode < 1GHz	Operating Mode < 1GHz Normal Link		
1 Normal Link-EUT 1 at Y-axis + Adapter 1			
2	Normal Link-EUT 1 at Z-axis + Adapter 1		
	Mode 2 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.		
3	Normal Link-EUT 1 at Z-axis + Adapter 2		
Mode 2 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.			
4 Normal Link-EUT 2 at Z-axis + Adapter 1			
For operating mode 4 is the worst case and it was record in this test report.			

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Operating Mode > 1GHz CTX	
The EUT was performed at X axis, Y axis and Z axis position. The worst case was found at	Z axis for
bandedge, Y axis for harmonic, so it was selected to perform test and its test result was written in	the report.

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EUT 1 at Z-axis for bandedge / EUT 1 at Y-axis for harmonic

#### **EUT Operation during Test** 2.3

For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

For Normal Link:

During the test, the EUT operation to normal function.

#### 2.4 **Accessories**

Accessories			
Equipment Brand Name		Model Name	Rating
Adapter 1	Phyn	F8J040PHY	Input:100-240VAC, 0.5A, 50-60Hz Output:DC 5V, 2.4A
Adapter 2	Phyn	WCA002dqPHY	Input:100-240VAC, 0.5A, 50-60Hz Output:DC 5V/2.4A
Sensor	Brand Name	Model Name	Remark
Phyn Smart Water Assistant Sensor Fittings	Phyn	PHYCBC03	Shielded, 1.2m

#### 2.5 **Support Equipment**

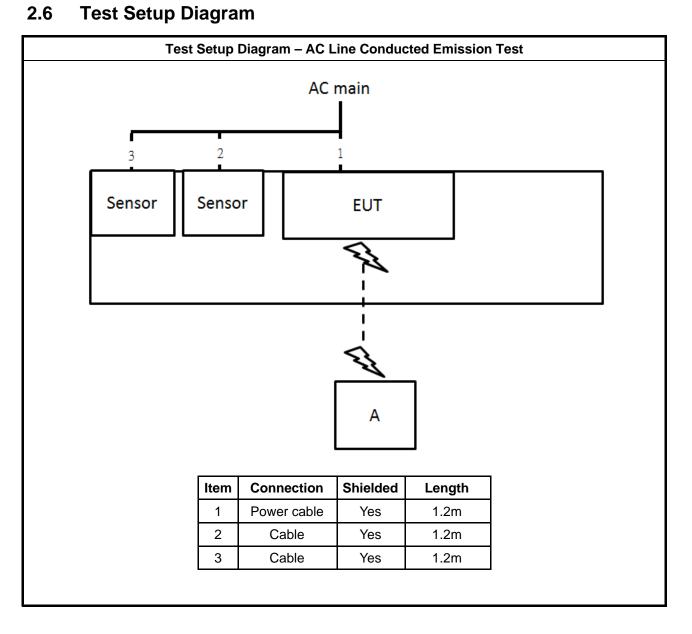
#### For AC Conduction:

Support Equipment				
No. Equipment Brand Name Model Name FCC ID				FCC ID
Α	2.4G NB	DELL	E6430	N/A

#### For Radiated and RF Conducted:

		Support Equ	ipment	
No.	Equipment	Brand Name	Model Name	FCC ID
Α	2.4G NB	DELL	E4300	N/A

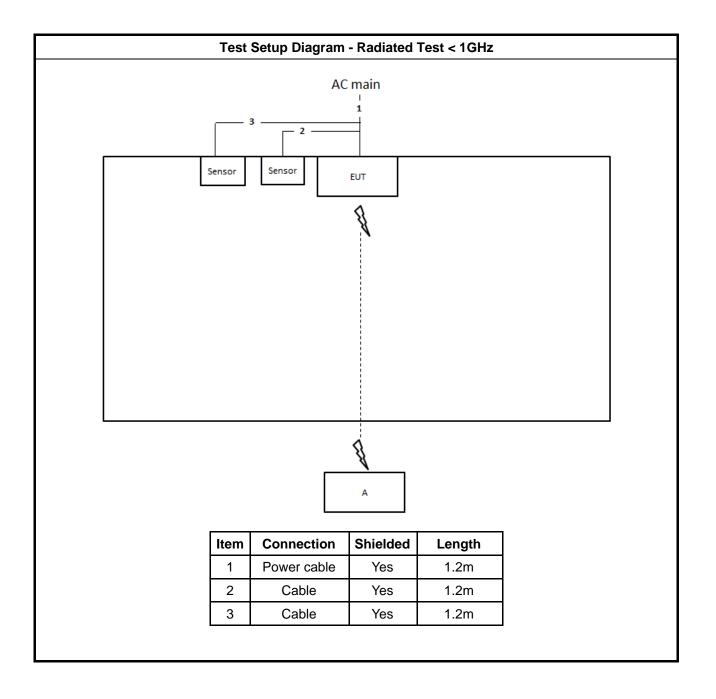
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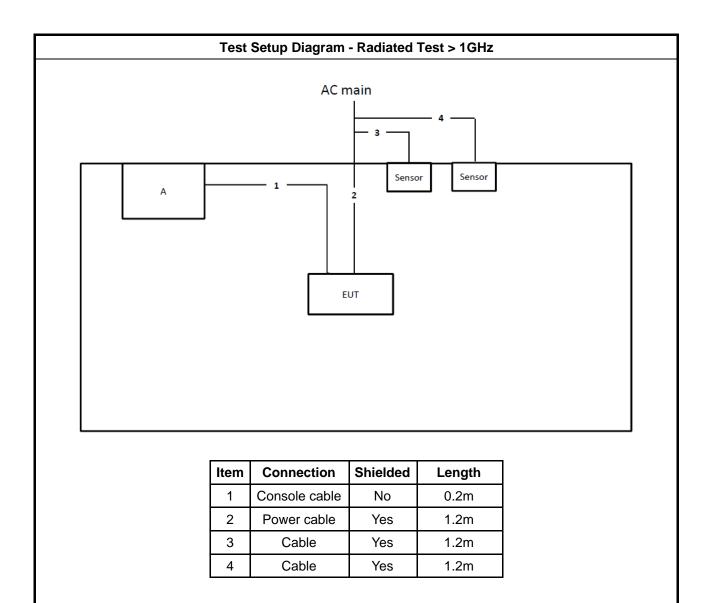
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## 3 Transmitter Test Result

## 3.1 AC Power-line Conducted Emissions

#### 3.1.1 AC Power-line Conducted Emissions Limit

AC Power	er-line Conducted Emissions L	imit
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of	of the frequency.	

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### 3.1.2 Measuring Instruments

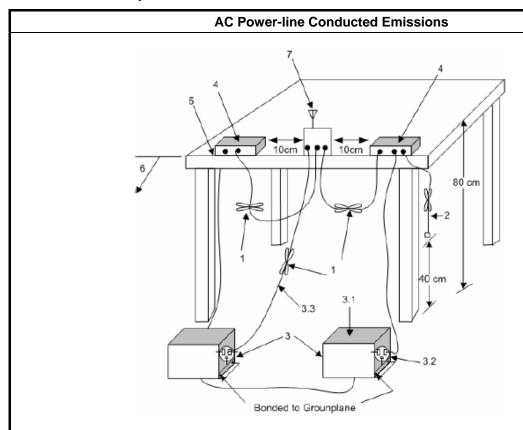
Refer a test equipment and calibration data table in this test report.

#### 3.1.3 Test Procedures

Test Method
Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

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#### 3.1.4 Test Setup



1—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.

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- 2—The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- 3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50  $\Omega$  loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
- 3.1—All other equipment powered from additional LISN(s).
- 3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment.
- 3.3—LISN at least 80 cm from nearest part of EUT chassis.
- 4—Non-EUT components of EUT system being tested.
- 5—Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
- 6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
- 7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

#### 3.1.5 Measurement Results Calculation

The measured Level is calculated using:

- a. Corrected Reading: LISN Factor (LISN) + Attenuator (AT/AUX) + Cable Loss (CL) + Read Level (Raw) = Level
- b. Margin = -Limit + Level

#### 3.1.6 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A

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## 3.2 DTS Bandwidth

#### 3.2.1 6dB Bandwidth Limit

6dB Bandwidth Limit
Systems using digital modulation techniques:
■ 6 dB bandwidth ≥ 500 kHz.

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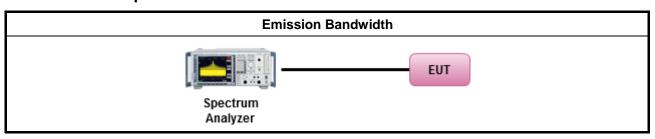
#### 3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

#### 3.2.3 Test Procedures

		Test Method
•	For	the emission bandwidth shall be measured using one of the options below:
	$\boxtimes$	Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.1 Option 1 for 6 dB bandwidth measurement.
		Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.2 Option 2 for 6 dB bandwidth measurement.
		Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.

## 3.2.4 Test Setup



#### 3.2.5 Test Result of Emission Bandwidth

Refer as Appendix B

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## 3.3 Maximum Conducted Output Power

#### 3.3.1 Maximum Conducted Output Power Limit

#### **Maximum Conducted Output Power Limit**

- If G<sub>TX</sub> ≤ 6 dBi, then P<sub>Out</sub> ≤ 30 dBm (1 W)
- Point-to-multipoint systems (P2M): If  $G_{TX} > 6$  dBi, then  $P_{Out} = 30 (G_{TX} 6)$  dBm
- Point-to-point systems (P2P): If  $G_{TX} > 6$  dBi, then  $P_{Out} = 30 (G_{TX} 6)/3$  dBm
- Smart antenna system (SAS):
  - Single beam: If  $G_{TX} > 6$  dBi, then  $P_{Out} = 30 (G_{TX} 6)/3$  dBm
  - Overlap beam: If  $G_{TX} > 6$  dBi, then  $P_{Out} = 30 (G_{TX} 6)/3$  dBm
  - Aggregate power on all beams: If  $G_{TX} > 6$  dBi, then  $P_{Out} = 30 (G_{TX} 6)/3 + 8$ dB dBm

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 $\mathbf{P}_{\text{Out}}$  = maximum peak conducted output power or maximum conducted output power in dBm,  $\mathbf{G}_{\text{TX}}$  = the maximum transmitting antenna directional gain in dBi.

#### 3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

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#### 3.3.3 Test Procedures

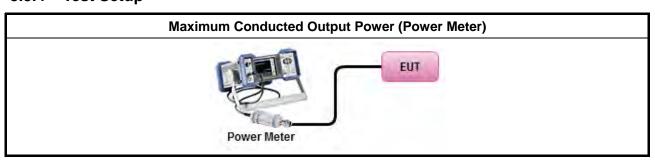
		Test Method					
•	Max	imum Peak Conducted Output Power					
		Refer as FCC KDB 558074, clause 8.3.1.1 & C63.10 clause 11.9.1.1 (RBW ≥ EBW method).					
		Refer as FCC KDB 558074, clause 8.3.1.3 & C63.10 clause 11.9.1.3 (peak power meter).					
•	Maximum Conducted Output Power						
	[dut	y cycle ≥ 98% or external video / power trigger]					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.2 Method AVGSA-1.					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.3 Method AVGSA-1A. (alternative)					
	duty	cycle < 98% and average over on/off periods with duty factor					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.4 Method AVGSA-2.					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.5 Method AVGSA-2A (alternative)					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.6 Method AVGSA-3					
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.7 Method AVGSA-3A (alternative)					
	Mea	surement using a power meter (PM)					
		Refer as FCC KDB 558074, clause 8.3.2.3 & C63.10 clause 11.9.2.3.1 Method AVGPM (using an RF average power meter).					
	$\boxtimes$	Refer as FCC KDB 558074, clause 8.3.2.3 & C63.10 clause 11.9.2.3.2 Method AVGPM-G (using an gate RF average power meter).					
•	For	conducted measurement.					
	•	If the EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.					
	•	If multiple transmit chains, EIRP calculation could be following as methods: $P_{total} = P_1 + P_2 + + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$					

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## 3.3.4 Test Setup



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## 3.3.5 Test Result of Maximum Conducted Output Power

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Refer as Appendix C

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## 3.4 Power Spectral Density

## 3.4.1 Power Spectral Density Limit

# Power Spectral Density Limit ■ Power Spectral Density (PSD) ≤ 8 dBm/3kHz

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#### 3.4.2 Measuring Instruments

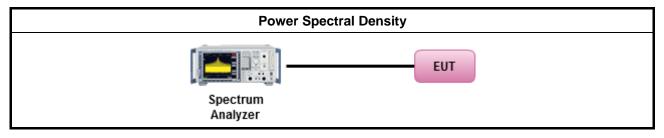
Refer a test equipment and calibration data table in this test report.

#### 3.4.3 Test Procedures

	Test Method									
•	Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).									
	Refer as FCC KDB 558074, clause 8.4 & C63.10 clause 11.10 Method Max. PSD.									
•	For conducted measurement.									
	If The EUT supports multiple transmit chains using options given below:									
	Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 66 In-band power spectral density (PSD). Sample all transmit ports simultaneously us spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to NTX output to obtain the value for the first frequency bin of the summed spectrum.). At the amplitude (power) values for the different transmit chains and use this as the new trace.	ing a t port in the o the dd up								
	Option 2: Measure and sum spectral maxima across the outputs. With this technique, spare measured at each output of the device at the required resolution bandwidth maximum value (peak) of each spectrum is determined. These maximum values are summed mathematically in linear power units across the outputs. These operations shaperformed separately over frequency spans that have different out-of-band or spuemission limits,	The then all be								
	Option 3: Measure and add 10 log(N) dB, where N is the number of transmit chains. Ref FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit cand each transmit chains shall be compared with the limit have been reduced with 10 log or each transmit chains shall be add 10 log(N) to compared with the limit.	hains								

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## 3.4.4 Test Setup



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## 3.4.5 Test Result of Power Spectral Density

Refer as Appendix D

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## 3.5 Emissions in Non-restricted Frequency Bands

#### 3.5.1 Emissions in Non-restricted Frequency Bands Limit

Un-restricted Band Emissions Limit					
RF output power procedure	Limit (dBc)				
Peak output power procedure	20				
Average output power procedure	30				

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- Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.
- Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

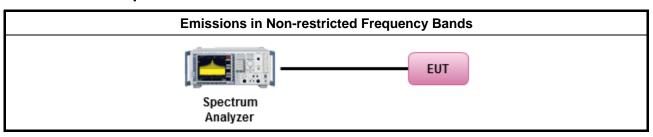
#### 3.5.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

#### 3.5.3 Test Procedures

# Test Method ■ Refer as FCC KDB 558074, clause 8.5 for unwanted emissions into non-restricted bands.

#### 3.5.4 Test Setup



#### 3.5.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix E

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## 3.6 Emissions in Restricted Frequency Bands

#### 3.6.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit							
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)				
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300				
0.490~1.705	24000/F(kHz)	33.8 - 23	30				
1.705~30.0	30	29	30				
30~88	100	40	3				
88~216	150	43.5	3				
216~960	200	46	3				
Above 960	500	54	3				

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- Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).
- Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the ELIT
- Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

#### 3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

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#### 3.6.3 Test Procedures

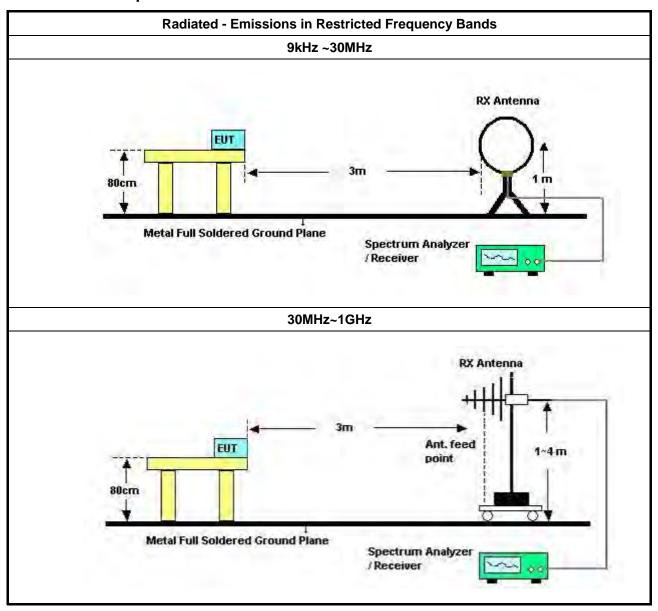
		Test Method						
•	The	average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].						
•	Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.							
•	For	the transmitter unwanted emissions shall be measured using following options below:						
	•	Refer as FCC KDB 558074, clause 8.6 for unwanted emissions into restricted bands.						
		Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.1(trace averaging for duty cycle ≥98%).						
		Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.2(trace averaging + duty factor).						
		☐ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.3(Reduced VBW≥1/T).						
		Refer as ANSI C63.10, clause 7.5 average value of pulsed emissions.						
		Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.4 measurement procedure peak limit.						
•	For	the transmitter band-edge emissions shall be measured using following options below:						
	•	Refer as FCC KDB 558074 clause 8.7 & C63.10 clause 11.13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.						
	•	Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta method for band-edge measurements.						
	•	Refer as FCC KDB 558074, clause 8.7 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).						
	•	For conducted unwanted emissions into restricted bands (absolute emission limits).  Devices with multiple transmit chains using options given below:  (1) Measure and sum the spectra across the outputs or  (2) Measure and add 10 log(N) dB						
	•	For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.						

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## 3.6.4 Test Setup



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Above 1GHz

Spectrum Analyzer

Above 1GHz

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#### 3.6.5 Measurement Results Calculation

The measured Level is calculated using:

Corrected Reading: Antenna factor (AF) + Cable loss (CL) + Read level (Raw) - Preamp factor (PA) (if applicable) = Level.

#### 3.6.6 Emissions in Restricted Frequency Bands (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10th harmonic or 40 GHz, whichever is appropriate.

#### 3.6.7 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix F

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## 4 Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark	
LISN	Schwarzbeck	NSLK 8127	8127650	9kHz ~ 30MHz	Dec. 04, 2020	Dec. 03, 2021	Conduction (CO02-CB)	
LISN	Schwarzbeck	NSLK 8127	8127478	9kHz ~ 30MHz	Nov. 20, 2020	Nov. 19, 2021	Conduction (CO02-CB)	
EMI Receiver	Agilent	N9038A	MY52260140	9kHz ~ 8.4GHz	Mar. 10, 2020	Mar. 09, 2021	Conduction (CO02-CB)	
COND Cable	Woken	Cable	2	0.15MHz ~ 30MHz	Oct. 20, 2020	Oct. 19, 2021	Conduction (CO02-CB)	
Pulse Limiter	Schwarzbeck	VTSD 9561F-N	00378	9kHz ~ 30MHz	Mar. 19, 2020	Mar. 18, 2021	Conduction (CO02-CB)	
Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conduction (CO02-CB)	
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz~1 GHz	Aug. 10, 2020	Aug. 09, 2021	Radiation (03CH05-CB)	
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 27, 2020	Mar. 26, 2021	Radiation (03CH05-CB)	
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Apr. 13, 2020	Apr. 12, 2021	Radiation (03CH05-CB)	
Pre-Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	Apr. 28, 2020	Apr. 27, 2021	Radiation (03CH05-CB)	
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Nov. 10, 2020	Nov. 09, 2021	Radiation (03CH05-CB)	
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 13, 2020	May 12, 2021	Radiation (03CH05-CB)	
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Oct. 05, 2020	Oct. 04, 2021	Radiation (03CH05-CB)	
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH05-CB)	
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH04-CB	1GHz ~18GHz 3m	Feb. 26, 2020	Feb. 25, 2021	Radiation (03CH04-CB)	
Horn Antenna	ETS · Lindgren	3115	00143147	750MHz~18GHz	Oct. 23, 2020	Oct. 22, 2021	Radiation (03CH04-CB)	
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 21, 2020	Jul. 20, 2021	Radiation (03CH04-CB)	
Pre-Amplifier	Agilent	83017A	MY53270063	0.5GHz ~ 26.5GHz	Jul. 14, 2020	Jul. 13, 2021	Radiation (03CH04-CB)	
Pre-Amplifier	MITEQ	TTA1840-35-H G	1864479	18GHz ~ 40GHz	Jul. 08, 2020	Jul. 07, 2021	Radiation (03CH04-CB)	
Signal Analyzer	R&S	FSV40	101904	9kHz ~ 40GHz	May 12, 2020	May 11, 2021	Radiation (03CH04-CB)	
RF Cable-high	Woken	RG402	High Cable-21	1GHz - 18GHz	Oct. 05, 2020	Oct. 04, 2021	Radiation (03CH04-CB)	

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Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	RG402	High Cable-21+67	1GHz - 18GHz	Nov. 05, 2020	Nov. 04, 2021	Radiation (03CH04-CB)
RF Cable-high	Woken	RG402	High Cable-40G#1	18GHz ~ 40 GHz	Jul. 16, 2020	Jul. 15, 2021	Radiation (03CH04-CB)
RF Cable-high	Woken	RG402	High Cable-40G#2	18GHz ~ 40 GHz	Jul. 16, 2020	Jul. 15, 2021	Radiation (03CH04-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH04-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	May 05, 2020	May 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-06	1 GHz – 26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-07	1 GHz –26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-08	1 GHz –26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-09	1 GHz –26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-10	1 GHz –26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-30	1 GHz –26.5 GHz	Oct. 05, 2020	Oct. 04, 2021	Conducted (TH01-CB)
Power Sensor	Agilent	E9327A	US40442088	50MHz~18GHz	Feb. 07, 2020	Feb. 06, 2021	Conducted (TH01-CB)
Power Meter	Agilent	E4416A	GB41291199	50MHz~18GHz	Feb. 07, 2020	Feb. 06, 2021	Conducted (TH01-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conducted (TH01-CB)

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Note: Calibration Interval of instruments listed above is one year.

NCR means Non-Calibration required.

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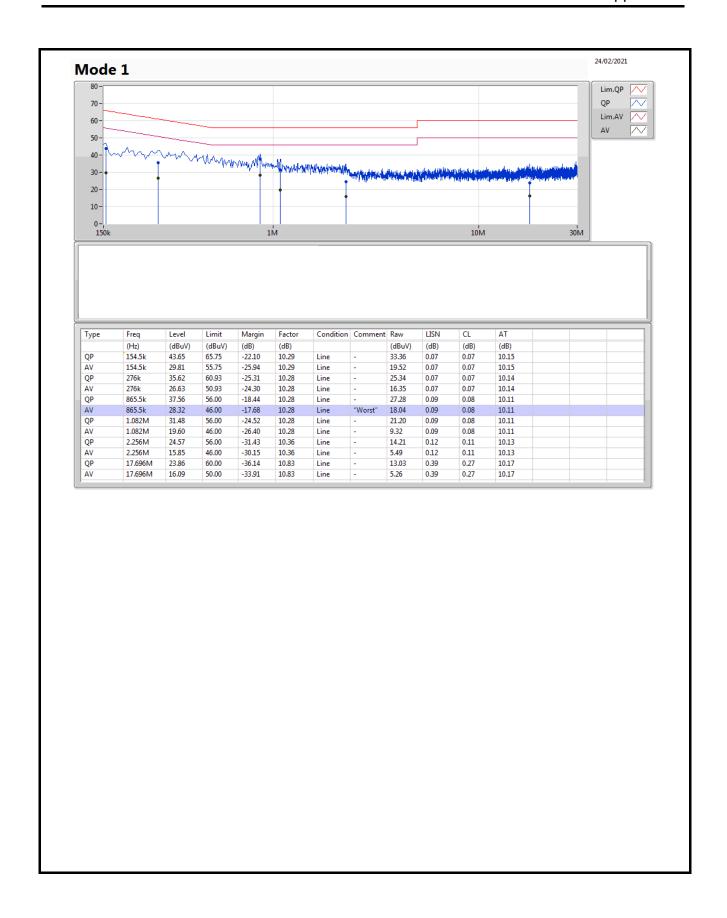
## AC Power Port Conducted Emission Result

Appendix A

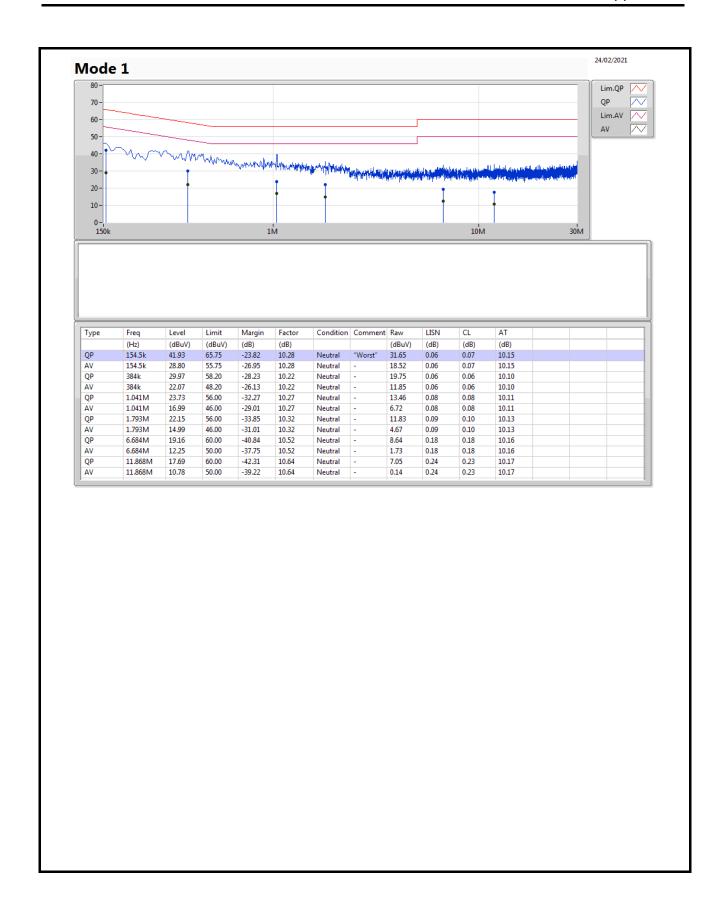
Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 1	Pass	AV	865.5k	28.32	46.00	-17.68	Line











**Summary** 

Mode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
	(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4835GHz	-	-	-	-	-
802.11b_Nss1,(1Mbps)_1TX	10.05M	15.542M	15M5G1D	9.525M	14.918M
802.11g_Nss1,(6Mbps)_1TX	16.325M	18.891M	18M9D1D	16.3M	16.617M
802.11n HT20_Nss1,(MCS0)_1TX	17.525M	19.64M	19M6D1D	17.3M	17.641M
802.11n HT40_Nss1,(MCS0)_1TX	36.05M	36.332M	36M3D1D	35.4M	35.982M

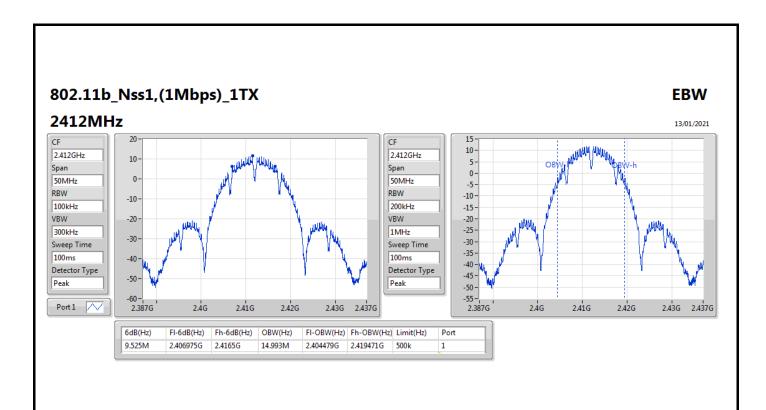
Max-N dB = Maximum 6dB down bandwidth; Max-OBW = Maximum 99% occupied bandwidth; Min-N dB = Minimum 6dB down bandwidth; Min-OBW = Minimum 99% occupied bandwidth;

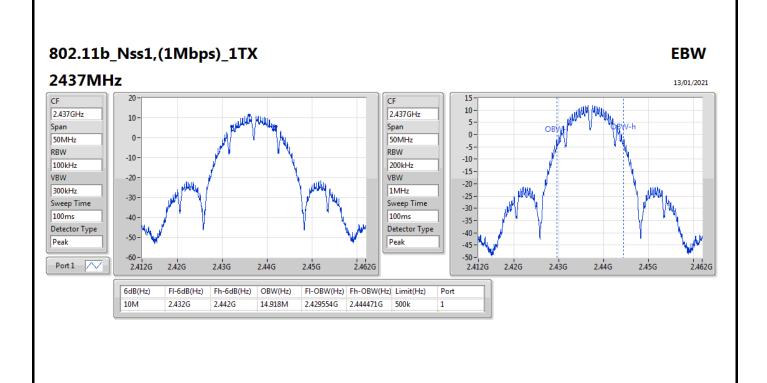


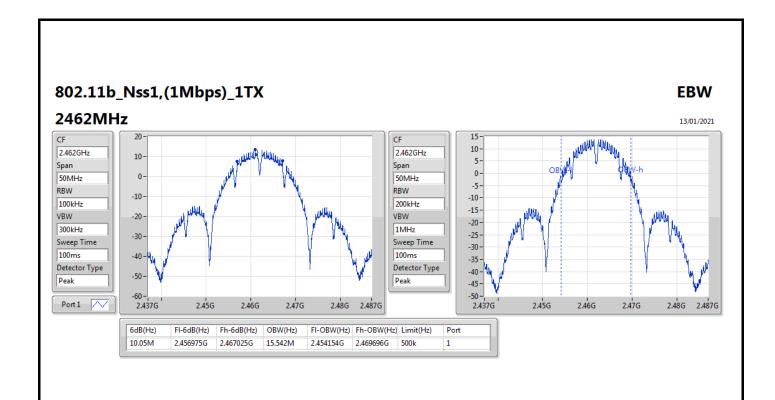
#### Result

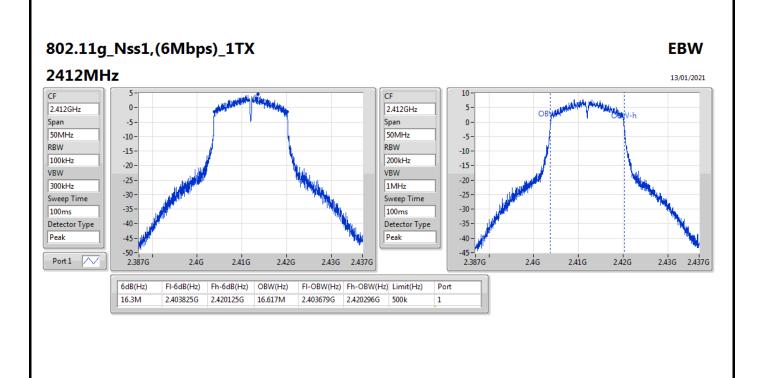
Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-
2412MHz	Pass	500k	9.525M	14.993M
2437MHz	Pass	500k	10M	14.918M
2462MHz	Pass	500k	10.05M	15.542M
802.11g_Nss1,(6Mbps)_1TX	-	-	-	-
2412MHz	Pass	500k	16.3M	16.617M
2437MHz	Pass	500k	16.3M	18.891M
2462MHz	Pass	500k	16.325M	16.642M
802.11n HT20_Nss1,(MCS0)_1TX	-	-	-	-
2412MHz	Pass	500k	17.525M	17.691M
2437MHz	Pass	500k	17.525M	19.64M
2462MHz	Pass	500k	17.3M	17.641M
802.11n HT40_Nss1,(MCS0)_1TX	-	-	-	-
2422MHz	Pass	500k	36.05M	36.182M
2437MHz	Pass	500k	35.4M	36.332M
2452MHz	Pass	500k	35.6M	35.982M

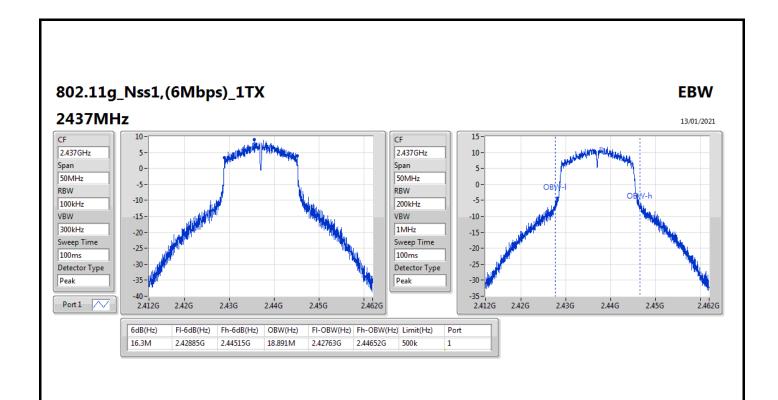
Port X-N dB = Port X 6dB down bandwidth; Port X-OBW = Port X 99% occupied bandwidth;

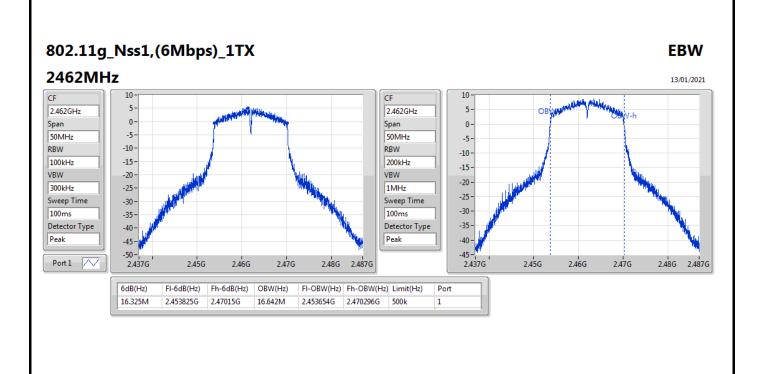




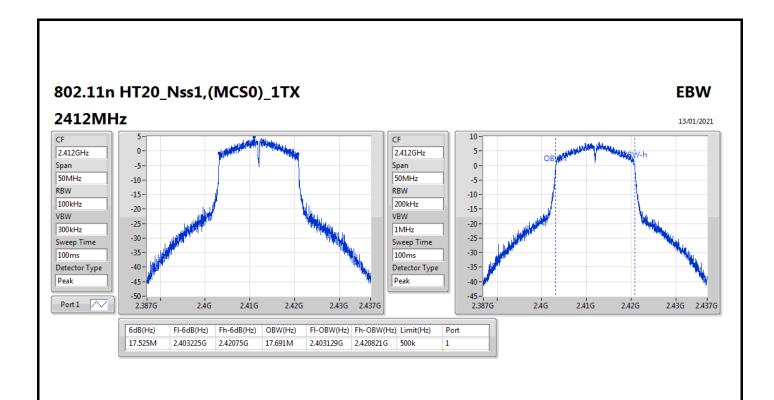


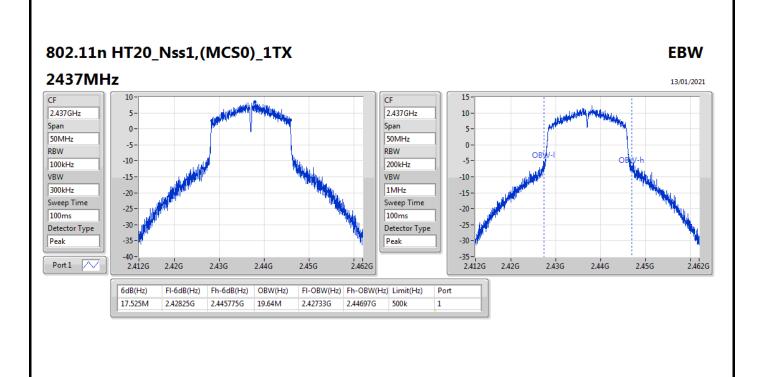




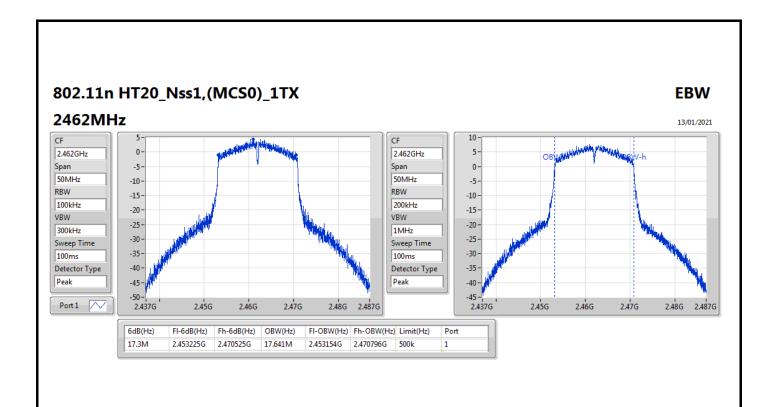


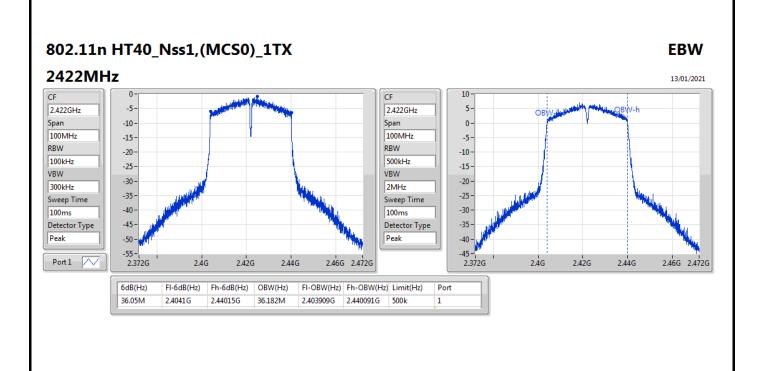
EBW Appendix B





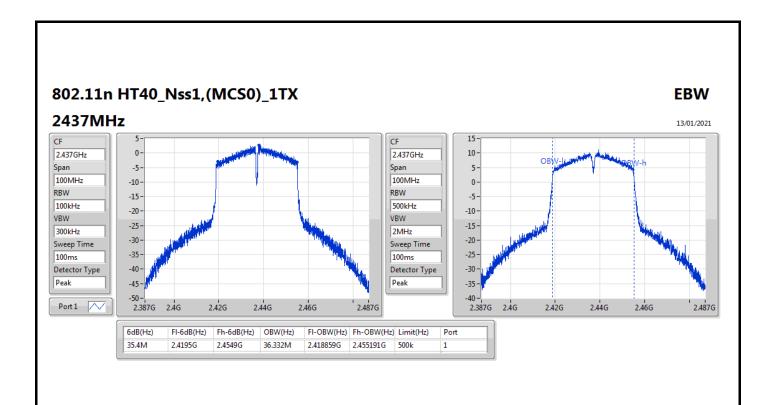
EBW Appendix B

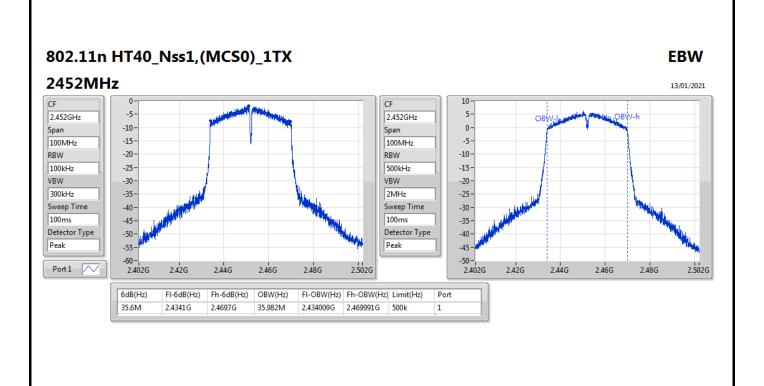




SPORTON LAB

EBW Appendix B







Average Power Appendix C

Mode	Total Power	Total Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
802.11b_Nss1,(1Mbps)_1TX	22.75	0.18836
802.11g_Nss1,(6Mbps)_1TX	21.34	0.13614
802.11n HT20_Nss1,(MCS0)_1TX	21.27	0.13397
802.11n HT40_Nss1,(MCS0)_1TX	18.59	0.07228

Average Power Appendix C

### Result

Mode	Result	DG	Port 1	Total Power	Power Limit
		(dBi)	(dBm)	(dBm)	(dBm)
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-	-
2412MHz	Pass	2.60	20.69	20.69	30.00
2437MHz	Pass	2.60	20.73	20.73	30.00
2462MHz	Pass	2.60	22.75	22.75	30.00
802.11g_Nss1,(6Mbps)_1TX	=	-	-	-	-
2412MHz	Pass	2.60	17.40	17.40	30.00
2417MHz	Pass	2.60	21.33	21.33	30.00
2437MHz	Pass	2.60	21.34	21.34	30.00
2457MHz	Pass	2.60	20.71	20.71	30.00
2462MHz	Pass	2.60	18.33	18.33	30.00
802.11n HT20_Nss1,(MCS0)_1TX	=	-	-	-	-
2412MHz	Pass	2.60	17.66	17.66	30.00
2417MHz	Pass	2.60	21.26	21.26	30.00
2437MHz	Pass	2.60	21.27	21.27	30.00
2457MHz	Pass	2.60	20.96	20.96	30.00
2462MHz	Pass	2.60	17.40	17.40	30.00
802.11n HT40_Nss1,(MCS0)_1TX	=	-	-	-	-
2422MHz	Pass	2.60	15.18	15.18	30.00
2427MHz	Pass	2.60	16.63	16.63	30.00
2437MHz	Pass	2.60	18.59	18.59	30.00
2447MHz	Pass	2.60	15.38	15.38	30.00
2452MHz	Pass	2.60	14.18	14.18	30.00

**DG** = Directional Gain; **Port X** = Port X output power



**Summary** 

Mode	PD
	(dBm/RBW)
2.4-2.4835GHz	·
802.11b_Nss1,(1Mbps)_1TX	-1.18
802.11g_Nss1,(6Mbps)_1TX	-4.18
802.11n HT20_Nss1,(MCS0)_1TX	-3.79
802.11n HT40_Nss1,(MCS0)_1TX	-9.09

RBW = 500 kHz for 5.725-5.85GHz band / 1MHz for other band;

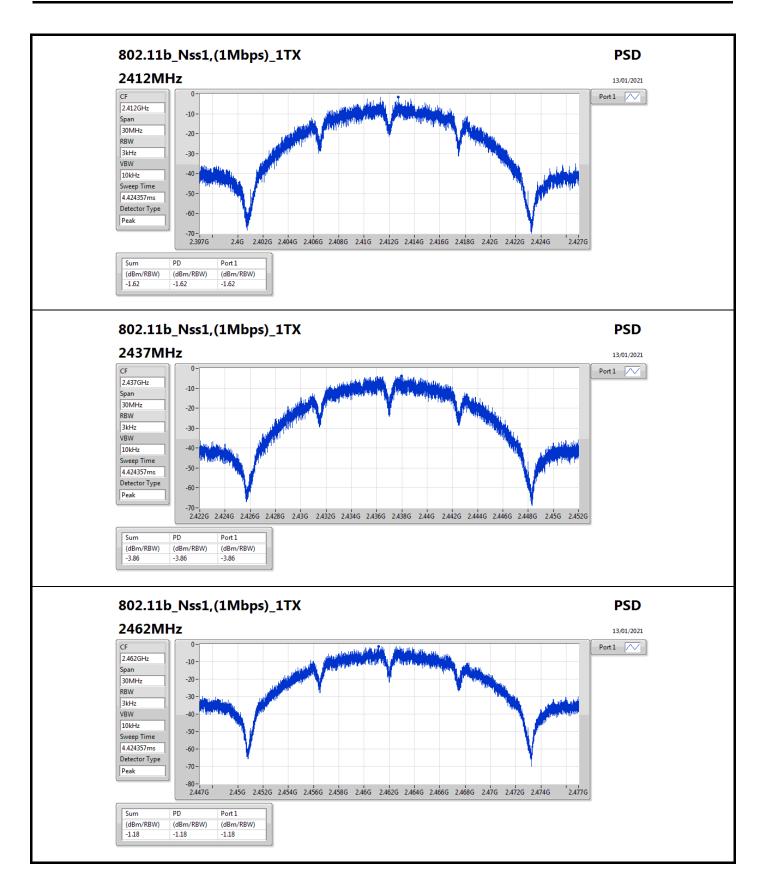


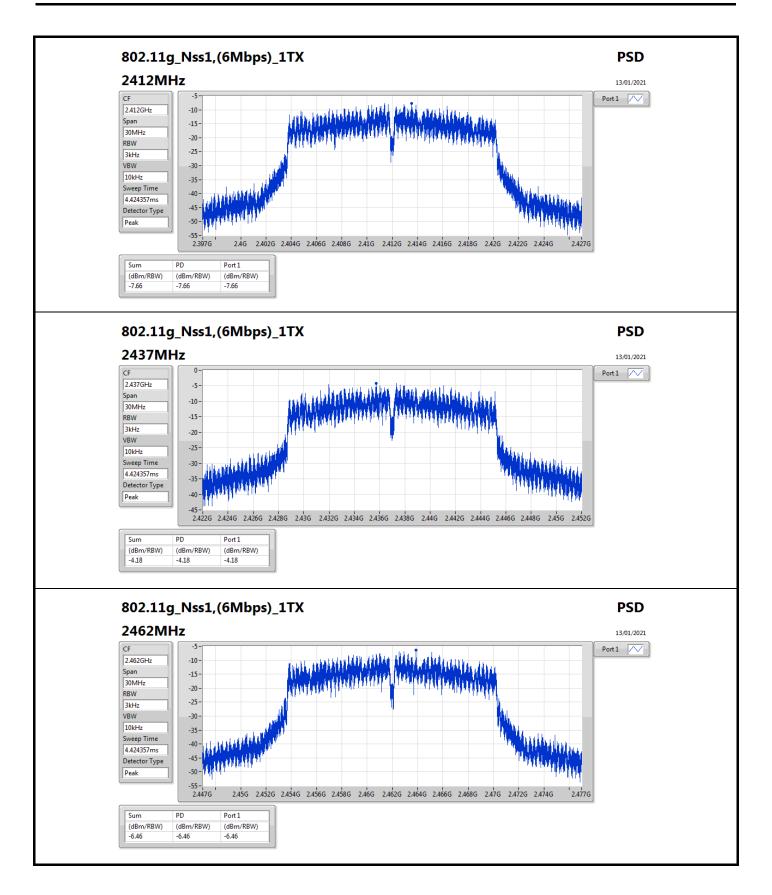
Appendix D **PSD** 

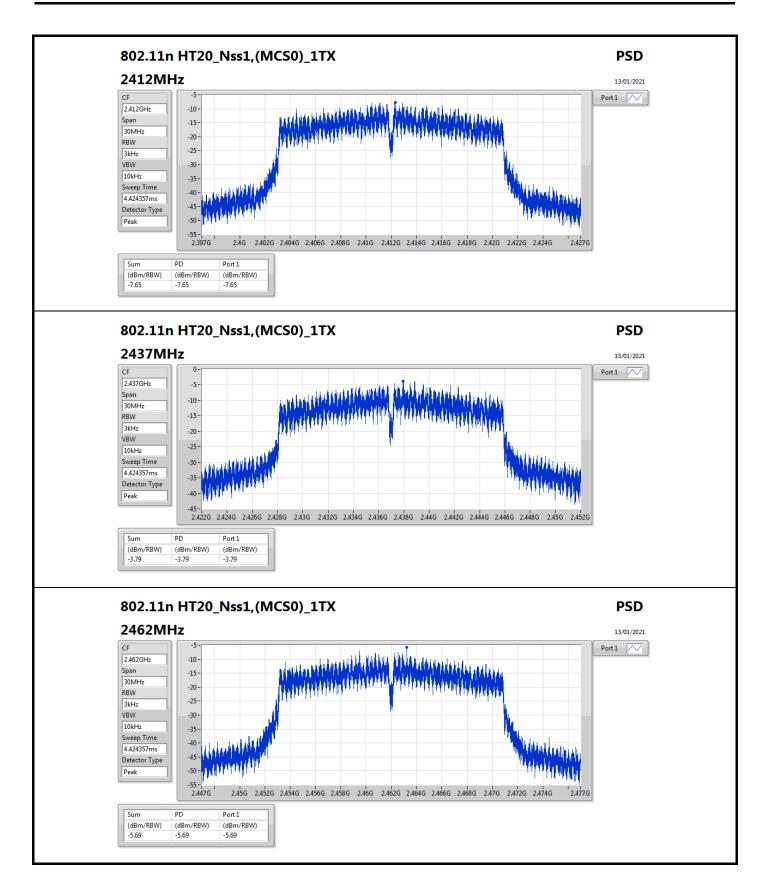
### Result

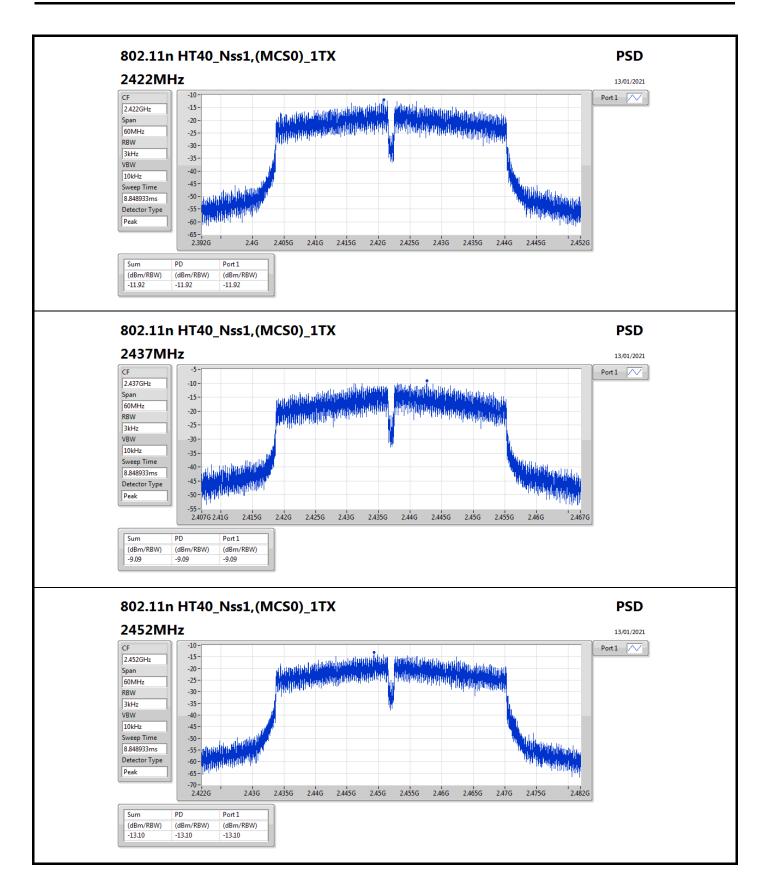
Mode	Result	DG	Port 1	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-	-
2412MHz	Pass	2.60	-1.62	-1.62	8.00
2437MHz	Pass	2.60	-3.86	-3.86	8.00
2462MHz	Pass	2.60	-1.18	-1.18	8.00
802.11g_Nss1,(6Mbps)_1TX	-	-	-	-	-
2412MHz	Pass	2.60	-7.66	-7.66	8.00
2437MHz	Pass	2.60	-4.18	-4.18	8.00
2462MHz	Pass	2.60	-6.46	-6.46	8.00
802.11n HT20_Nss1,(MCS0)_1TX	-	-	-	-	-
2412MHz	Pass	2.60	-7.65	-7.65	8.00
2437MHz	Pass	2.60	-3.79	-3.79	8.00
2462MHz	Pass	2.60	-5.69	-5.69	8.00
802.11n HT40_Nss1,(MCS0)_1TX	-	-	-	-	-
2422MHz	Pass	2.60	-11.92	-11.92	8.00
2437MHz	Pass	2.60	-9.09	-9.09	8.00
2452MHz	Pass	2.60	-13.10	-13.10	8.00

**DG** = Directional Gain; **RBW** = 500 kHz for 5.725-5.85GHz band / 1MHz for other band; **PD** = trace bin-by-bin of each transmits port summing can be performed maximum power density; **Port X** = Port X power density;











# CSE(Non-restricted Band)

Appendix E

Mode	Result	Ref	Ref	Limit	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Port
		(Hz)	(dBm)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
802.11b_Nss1,(1Mbps)_1TX	Pass	2.46254G	12.94	-17.06	1.92779G	-54.11	2.39802G	-21.15	2.4G	-27.81	2.496G	-49.94	16.54041G	-46.98	1
802.11g_Nss1,(6Mbps)_1TX	Pass	2.43574G	8.69	-21.31	2.30117G	-53.63	2.39918G	-21.86	2.4G	-25.54	2.50054G	-48.91	17.66985G	-47.06	1
802.11n HT20_Nss1,(MCS0)_1TX	Pass	2.43599G	8.53	-21.47	2.30321G	-52.91	2.39978G	-21.61	2.4G	-24.21	2.48506G	-49.61	16.20326G	-46.85	1
802.11n HT40_Nss1,(MCS0)_1TX	Pass	2.43849G	2.62	-27.38	743.62M	-54.10	2.39992G	-30.95	2.4G	-33.05	2.48442G	-41.37	16.36756G	-46.98	1



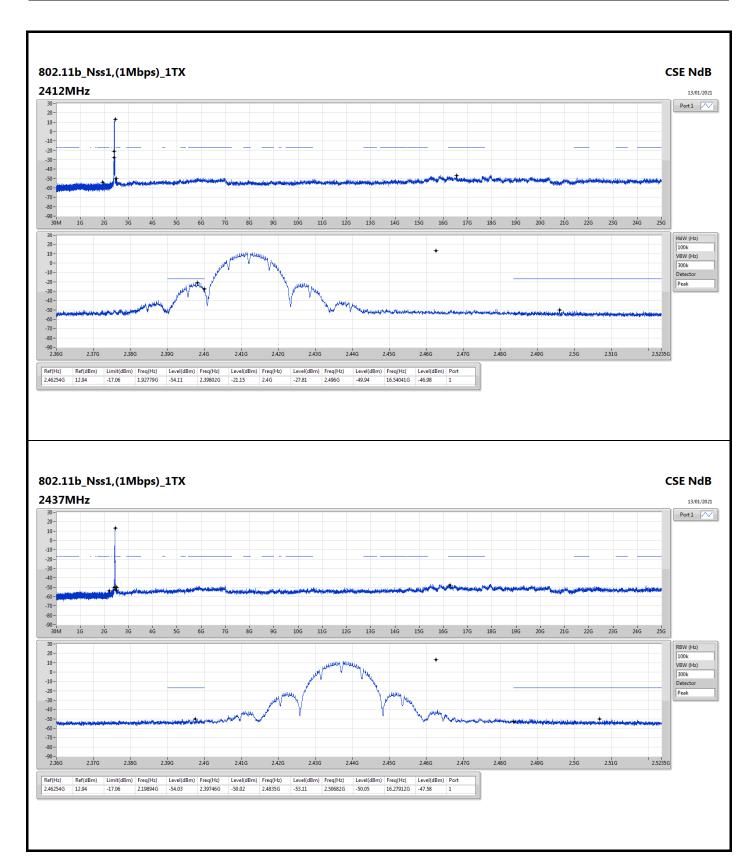
# CSE(Non-restricted Band)

# Appendix E

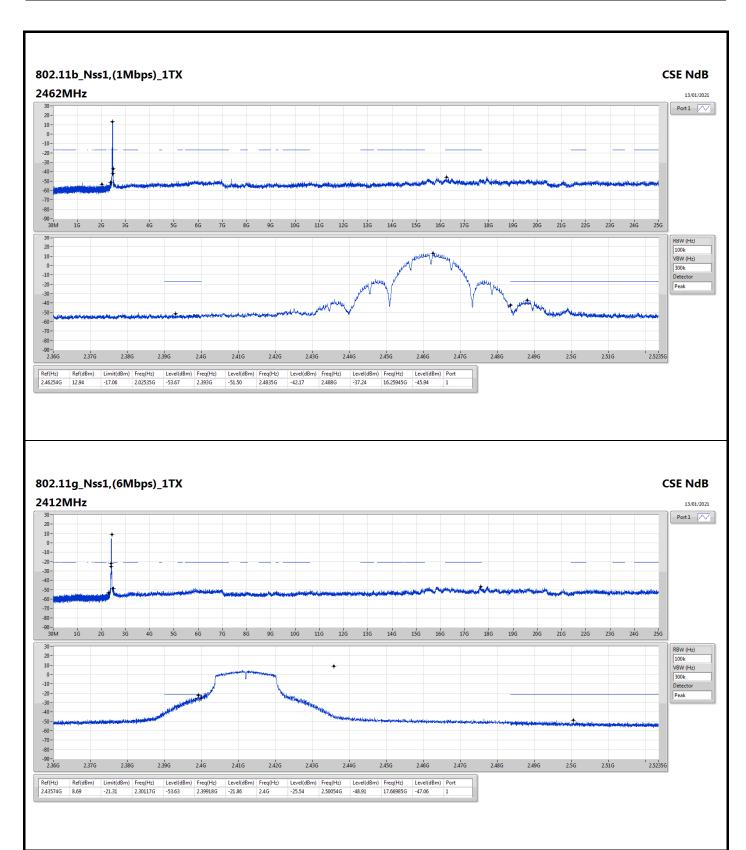
### Result

Mode	Result	Ref	Ref	Limit	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Port
		(Hz)	(dBm)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2412MHz	Pass	2.46254G	12.94	-17.06	1.92779G	-54.11	2.39802G	-21.15	2.4G	-27.81	2.496G	-49.94	16.54041G	-46.98	1
2437MHz	Pass	2.46254G	12.94	-17.06	2.19894G	-54.03	2.39746G	-50.02	2.4835G	-53.11	2.50682G	-50.05	16.27912G	-47.58	1
2462MHz	Pass	2.46254G	12.94	-17.06	2.02535G	-53.67	2.393G	-51.50	2.4835G	-42.17	2.488G	-37.24	16.25945G	-45.94	1
802.11g_Nss1,(6Mbps)_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2412MHz	Pass	2.43574G	8.69	-21.31	2.30117G	-53.63	2.39918G	-21.86	2.4G	-25.54	2.50054G	-48.91	17.66985G	-47.06	1
2437MHz	Pass	2.43574G	8.69	-21.31	479.98M	-53.03	2.39916G	-46.45	2.4G	-48.83	2.48496G	-46.55	17.61366G	-46.95	1
2462MHz	Pass	2.43574G	8.69	-21.31	2.05361G	-54.40	2.39424G	-49.03	2.4835G	-39.81	2.4836G	-37.08	16.26507G	-46.78	1
802.11n HT20_Nss1,(MCS0)_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2412MHz	Pass	2.43599G	8.53	-21.47	2.30321G	-52.91	2.39978G	-21.61	2.4G	-24.21	2.48506G	-49.61	16.20326G	-46.85	1
2437MHz	Pass	2.43599G	8.53	-21.47	900.55M	-54.04	2.39916G	-45.06	2.4G	-45.02	2.48634G	-47.10	17.61366G	-46.96	1
2462MHz	Pass	2.43599G	8.53	-21.47	812.01M	-54.13	2.39522G	-49.78	2.4835G	-37.37	2.4835G	-38.02	16.32126G	-47.14	1
802.11n HT40_Nss1,(MCS0)_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2422MHz	Pass	2.43849G	2.62	-27.38	479.99M	-53.92	2.39852G	-31.75	2.4G	-33.79	2.48542G	-50.32	16.48815G	-46.25	1
2437MHz	Pass	2.43849G	2.62	-27.38	743.62M	-54.10	2.39992G	-30.95	2.4G	-33.05	2.48442G	-41.37	16.36756G	-46.98	1
2452MHz	Pass	2.43849G	2.62	-27.38	889.04M	-53.30	2.39664G	-52.20	2.4835G	-41.57	2.48386G	-39.49	16.26659G	-46.26	1

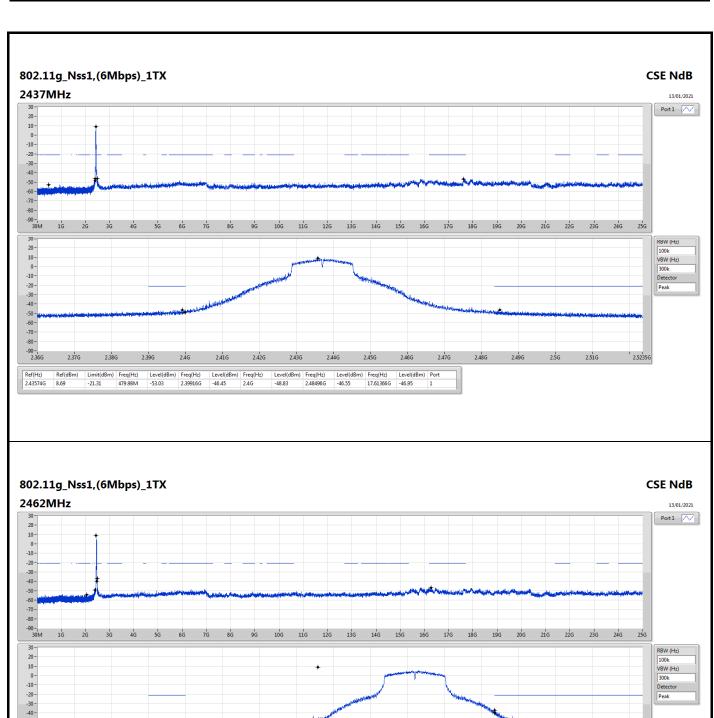












2.4G

2.41G

2.42G

2.43G

2.44G

2.45G

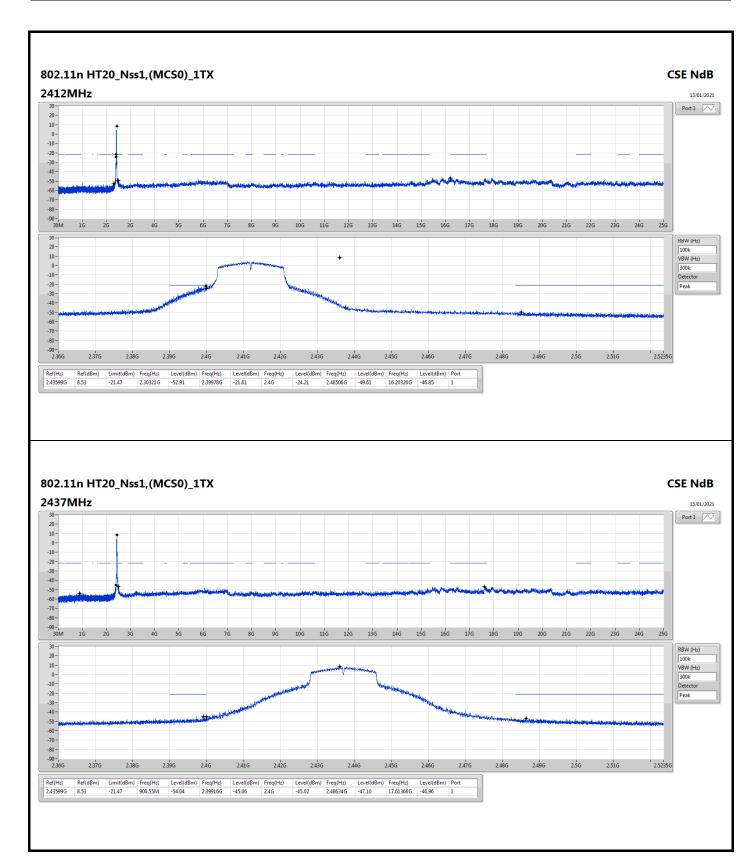
2.46G

2.47G

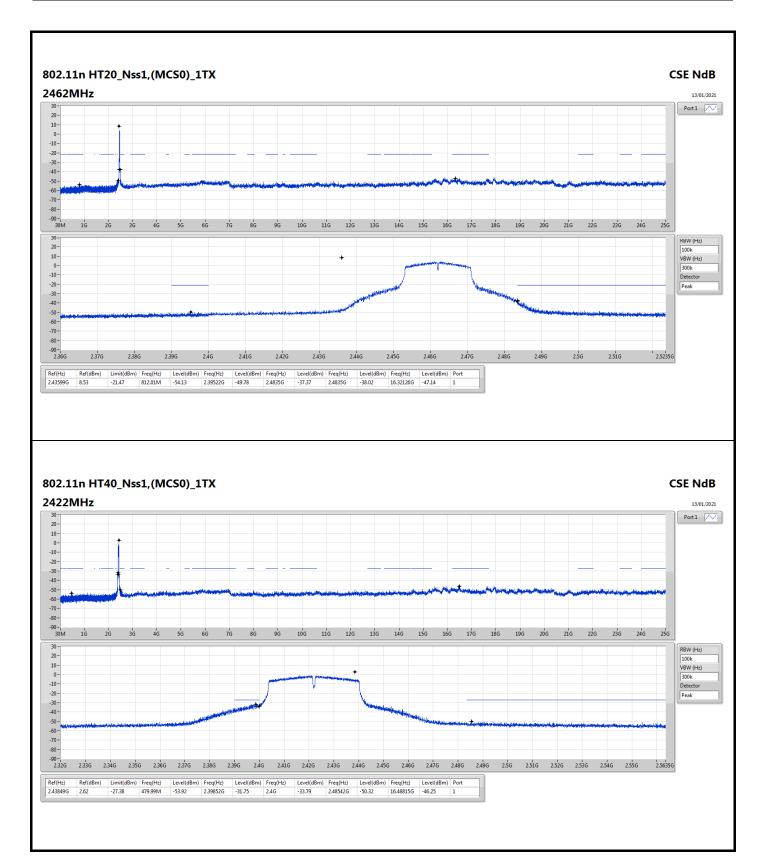
2.48G

-70 -

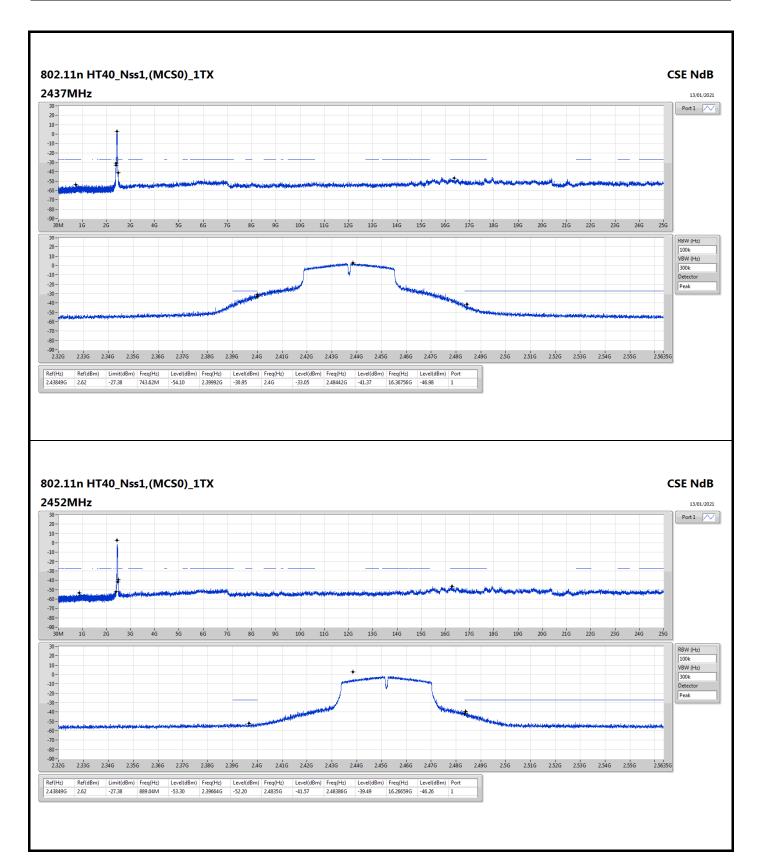












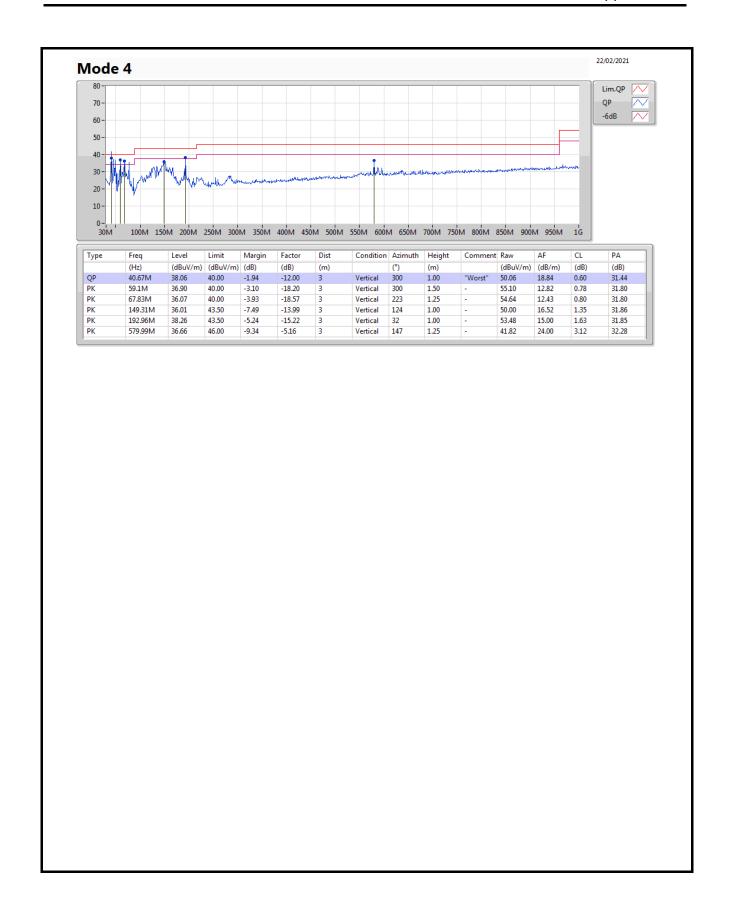


# Radiated Emission below 1GHz Result

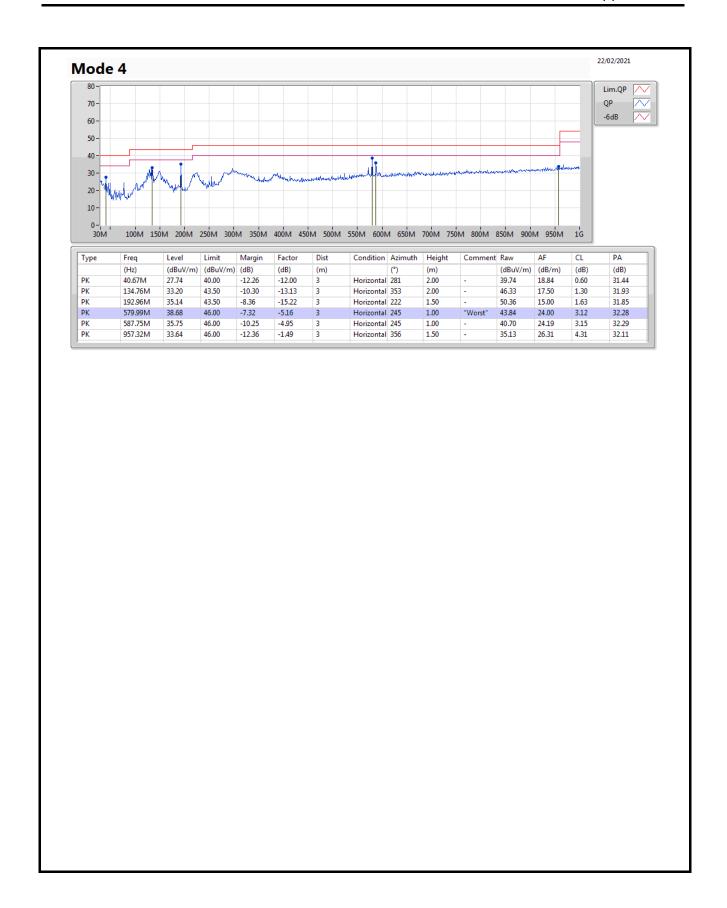
Appendix F.1

Mode	Result	Туре	Freq	Level	Limit	Margin	Condition
			(Hz)	(dBuV/m)	(dBuV/m)	(dB)	
Mode 4	Pass	QP	40.67M	38.06	40.00	-1.94	Vertical











### RSE TX above 1GHz

Appendix F.2

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Mode	Result	Туре	Freq	Level	Limit	Margin	Dist	Condition	Azimuth	Height	Comments
			(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(m)		(°)	(m)	
2.4-2.4835GHz	-	-	•	-	-	-	-	-	-	-	-
802.11b_Nss1,(1Mbps)_1TX	Pass	AV	4.87395G	53.99	54.00	-0.01	3	Horizontal	229	2.01	-
802.11g_Nss1,(6Mbps)_1TX	Pass	PK	2.4854G	73.96	74.00	-0.04	3	Horizontal	93	1.01	-
802.11n HT20_Nss1,(MCS0)_1TX	Pass	AV	2.39G	53.88	54.00	-0.12	3	Horizontal	90	1.01	-
802.11n HT40_Nss1,(MCS0)_1TX	Pass	AV	2.4835G	53.94	54.00	-0.06	3	Horizontal	97	1.00	-



