

RADIO TEST REPORT – 389104-1TRFWL

Type of assessment:

Final product testing

Applicant:

Trilliant Networks Inc.

Product:

WAN-2000

Model:

SecureMesh WAN Series 2

Model variant(s):

GATE-2000

XTEN-2000

FCC ID:

TMB-WAN2000

Specifications:

- ◆ FCC 47 CFR Part 15 Subpart E, §15.407
- ◆ RSS-247, Issue 2, Feb 2017, Section 6

Date of issue: October 7, 2020

Yong Huang, Wireless/EMC Specialist

Tested by



Signature

Mark Libbrecht, EMC/RF Specialist

Reviewed by

Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation

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Test site identifier	Organization FCC: ISED:	Ottawa/Almonte CA2040 2040A-4	Montreal CA2041 2040G-5	Cambridge CA0101 24676
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart E, Clause 15.407	Unlicensed National Information Infrastructure Devices operating in the 5.15–5.35 GHz, 5.47–5.725 GHz, 5.725–5.85 GHz, and 5.925–7.125 GHz bands.
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1.2 Test methods

789033 D02 General U-NII Test Procedures New Rules v02r01 (December 14, 2017)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
662911 D02 MIMO with Cross Polarized Antenna v01 (October 25, 2011)	Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	October 7, 2020	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

The following modifications were performed by client: Switchboard PCB assembly changed from version CL-R0398A-3.1 to version CL-R0398A-4.1. This change included many modifications such as the additional filter to meet the mask requirement.

2.2 Technical judgment

None

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Table 4.1-1: Measurement uncertainty calculations

Test name	Measurement uncertainty, $\pm$ dB
All antenna port measurements	0.55
Occupied bandwidth	4.45
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 5 Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Applicant name	Trilliant Networks Inc.
Applicant address	401 Harrison Oaks Blvd, Suite 300 Cary, NC, 27513 USA
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

Product	WAN-2000
Model	SecureMesh WAN Series 2
Model variant(s)	GATE-2000 & XTEN-2000
Serial number	F000000000 (prototype)
Part number	Same as model variants
Power supply requirements	DC: 48 V via POE 802.3 at
Product description and theory of operation	The WAN products, Gateway, Extender and other devices form a Wide Area Network in the 5 GHz bands to connect WAN client devices in direct support of Distribution Automation (DA) or Internet of Things (IoT) monitoring, substation monitoring, video surveillance, and work-force management applications to/from the customer's wired backhaul network

5.4 Radio technical information

Device type	☒	Outdoor access point
	☐	Indoor access point
	☒	Fixed point-to-point access point
	☒	Client device
	☐	Device installed in vehicles
Frequency band	5725–5850 MHz (U-NII-3)	
Frequency Min (MHz)	5735 MHz (802.11a and 802.11n HT20) 5755 MHz (802.11n HT40)	
Frequency Max (MHz)	5835 MHz (802.11a and 802.11n HT20) 5825 MHz (802.11n HT40)	
Channel numbers	149 through 165 and irregular channels	
RF power Max (W), Conducted	0.851(29.3 dBm)	
Field strength, dBµV/m @ 3 m	N/A	
Measured BW (kHz), 99% OBW	21250 for 20 MHz ch BW 37100 for 40 MHz ch BW	
Type of modulation	802.11a/n/ac: OFDM (QPSK, BPSK, 16-QAM, 64-QAM)	
Emission classification	W7D	
Transmitter spurious, dBµV/m @ 3 m	39.4, Quasi-peak at 37.720MHz	
Antenna information	Directional Dual Stream PCB Antenna, Trilliant CL-R0411A. Gain of 16.5 dBi	
Firmware version	2.6.0 dev8+	

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	EUT was exercise through a Command Line Interface (CLI) using an Ethernet connection. It was tested in continuous transmit mode on high/middle/low channels and for three type of modulations: 802.11a, and 802.11n HT20 802.11n HT40.
Transmitter state	Transmitter set in to continuous mode.
Receiver state	Idle is the same as receiver modes

Table 5.5-1: EUT sub assemblies

Description	Brand name	Model, Part number, Serial number, Revision level
SecureMesh WAN Gateway 2	Trilliant	GATE-2000, prototype

Table 5.5-2: EUT interface ports

Description	Qty.
Ethernet port	1

Table 5.5-3: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
POE injector 802.3 at	MicroSemi	MN: PD-9001GR/AT/AC SNC19296582000000147

Table 5.5-4: Inter-connection cables

Cable description	From	To	Length (m)
Shielded CAT6	PoE injector	EUT	1m

EUT setup configuration, continued

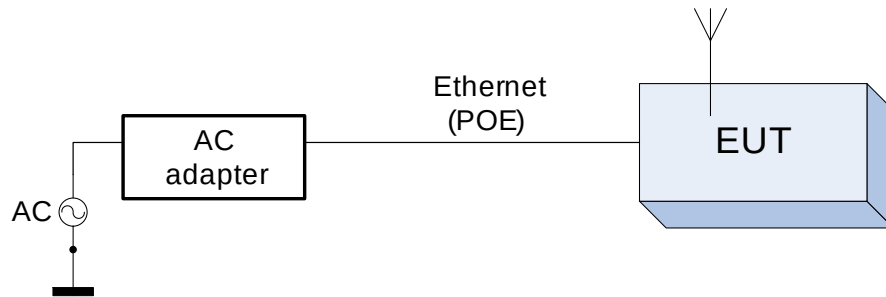


Figure 5.5-1: Radiated testing block diagram

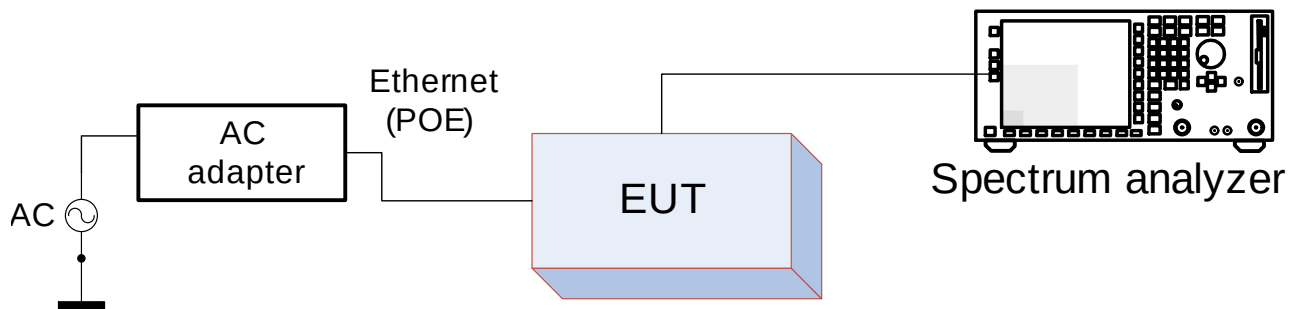


Figure 5.5-2: Antenna port testing block diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Montreal
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6.2 Testing period

Test start date	January 21, 2020	Test end date	September 24, 2020
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6.3 Sample information

Receipt date	January 21, 2020	Nemko sample ID number(s)	1
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6.4 FCC Part 15 Subpart A and C, general requirements test results

Table 6.4-1: FCC general requirements results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31l	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
Notes: EUT is an DC powered device., via POE		

6.5 FCC Part §15.407 test results

Table 6.5-1: FCC §15.407 requirements results

Part	Test description	Verdict
§15.403	Emission bandwidth	Pass
§15.407(a)(1)	Power and density limits within 5.15–5.25 GHz band	Not applicable
§15.407(a)(2)	Power and density limits within 5.25–5.35 GHz and 5.47–5.725 GHz bands	Not applicable
§15.407(a)(3)	Power and density limits within 5.725–5.85 GHz band	Pass
§15.407(a)(4)	Power and density limits within 5.925–6.425 GHz and 6.525–6.875 GHz band	Not applicable
§15.407(a)(5)	Power and density limits within 5.925–7.125 GHz band	Not applicable
§15.407(a)(6)	Power and density limits within 5.925–7.125 GHz band	Not applicable
§15.407(a)(7)	Power and density limits within 5.925–6.425 GHz and 6.525–6.875 GHz band	Not applicable
§15.407(a)(8)	Power and density limits within 5.925–7.125 GHz band	Not applicable
§15.407(b)(1)	Undesirable emission limits for 5.15–5.25 GHz band	Not applicable
§15.407(b)(2)	Undesirable emission limits for 5.25–5.35 GHz band	Not applicable
§15.407(b)(3)	Undesirable emission limits for 5.47–5.725 GHz bands	Not applicable
§15.407(b)(4)	Undesirable emission limits for 5.725–5.85 GHz band	Pass
§15.407(b)(5)	Undesirable emission limits for 5.925–7.125 GHz band	Not applicable
§15.407(b)(5)	Undesirable emission limits for 5.925–7.125 GHz band	Not applicable
§15.407(b)(6)	Mask for 5.925–7.125 GHz band	Not applicable
§15.407(b)(8)	AC power line conducted limits	Pass
§15.407(e)	Minimum 6 dB bandwidth of U-NII devices within the 5.725–5.85 GHz band	Pass
§15.407(g)	Frequency stability	Pass
§15.407(h)(1) ¹	Transmit power control (TPC)	Not applicable
§15.407(h)(2) ¹	Dynamic Frequency Selection (DFS)	Not applicable
§15.407(k)	Automated frequency coordination (AFC) system	Not applicable

Notes

¹DFS and TPC requirements are only applicable to 5.25–5.35 GHz and 5.47–5.725 GHz bands

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Horn antenna (1–18 GHz)	EMCO	3115	FA001451	1 year	October 12, 2020
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	June 1, 2021
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	January 28, 2021
3 m EMI test chamber (Emissions)	TDK	SAC-3	FA002532	2 year	February 25, 2022
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Pre-amplifier (0.5–18 GHz)	Com-Power	PAM-118A	FA002561	1 year	September 18, 2020
3 Phase AC Power Supply	apc AC Power	AFC-33045T	FA002677	—	VOU
Power Meter	HIOKI	PW3337	FA002727	1 year	February 21, 2021
Horn antenna (18–40 GHz)	EMCO	3116	FA002487	2 year	March 11, 2021
Pre-amplifier (18–40 GHz)	Com-Power	PAM-840	FA002508	1 year	October 20, 2020
2.4 GHz band Notch Filter	Microwave Circuits	N0324413	FA002693	—	VOU
LISN	Rohde & Schwarz	ENV216	FA002514	1 year	February 5, 2021
Environmental Chamber	Espec	EPX-4H	FA002736	1 year	May 28, 2021
True RMS Multimeter	Fluke	175	FA002642	1 year	November 22, 2020

Notes: NCR - no calibration required, VOU - verify on use

Section 8 Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

FCC §15.31 (e):

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.1.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	September 24, 2020

8.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

- Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.
- For devices, where operating at a supply voltage deviating $\pm 15\%$ from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.
- For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.
- For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

8.1.4 Test data

EUT Power requirements:	☐ AC	☒ DC	☐ Battery
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☒ NO	☐ N/A
If EUT is battery operated, was the testing performed using fresh batteries?	☐ YES	☐ NO	☒ N/A
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☐ YES	☐ NO	☒ N/A

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

- (m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: Frequency Range of Operation

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: “near” means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	January 30, 2020

8.2.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

- For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.
- For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.
- If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

- Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

8.2.4 Test data

Table 8.2-2: *Test channels selection, 20 MHz channel*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
5725	5850	125	5735	5785	5835

Table 8.2-3: *Test channels selection, 40 MHz channel*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
5725	5850	125	5755	5795	5825



8.3 Antenna requirement

8.3.1 References, definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

8.3.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	January 30, 2020

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

Must the EUT be professionally installed? ☒ YES ☐ NO
Does the EUT have detachable antenna(s)? ☐ YES ☒ NO
If detachable, is the antenna connector(s) non-standard? ☐ YES ☐ NO ☐ N/A

Table 8.3-1: Antenna information

Antenna type	Manufacturer	Model number	Maximum gain	Connector type
Directional Dual Stream PCB Antenna	Trilliant	CL-R0411A	16.5 dBi	2x MCX Male

8.4 AC power line conducted emissions limits

8.4.1 References, definitions and limits

FCC §15.407(b):

- (8) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.

FCC §15.207:

- (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

ANSI C63.10, Clause 6.2:

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements shall be made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required. For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an “off-the-shelf” unmodified ac power adapter shall be used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host.

Table 8.4-1: Conducted emissions limit

Frequency of emission, MHz	Conducted emissions limit, dB μ V	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Notes: * - The level decreases linearly with the logarithm of the frequency.
 ** - A linear average detector is required.

8.4.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	March 10, 2020

8.4.3 Observations, settings and special notes

Port under test – Coupling device	AC Mains – Artificial Mains Network (AMN)
EUT power input during test	48 V _{DC} (via external POE power adapter)
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.
Additional notes:	– The EUT was set up as tabletop configuration per ANSI C63.10-2013 measurement procedure. – The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance. Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB) – Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Conducted AC line emissions test was performed as per ANSI C63.10, Clause 6.2. Spectrum analyser settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview), Quasi-peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms (Preview), 160 ms (Final)

8.4.4 Test data

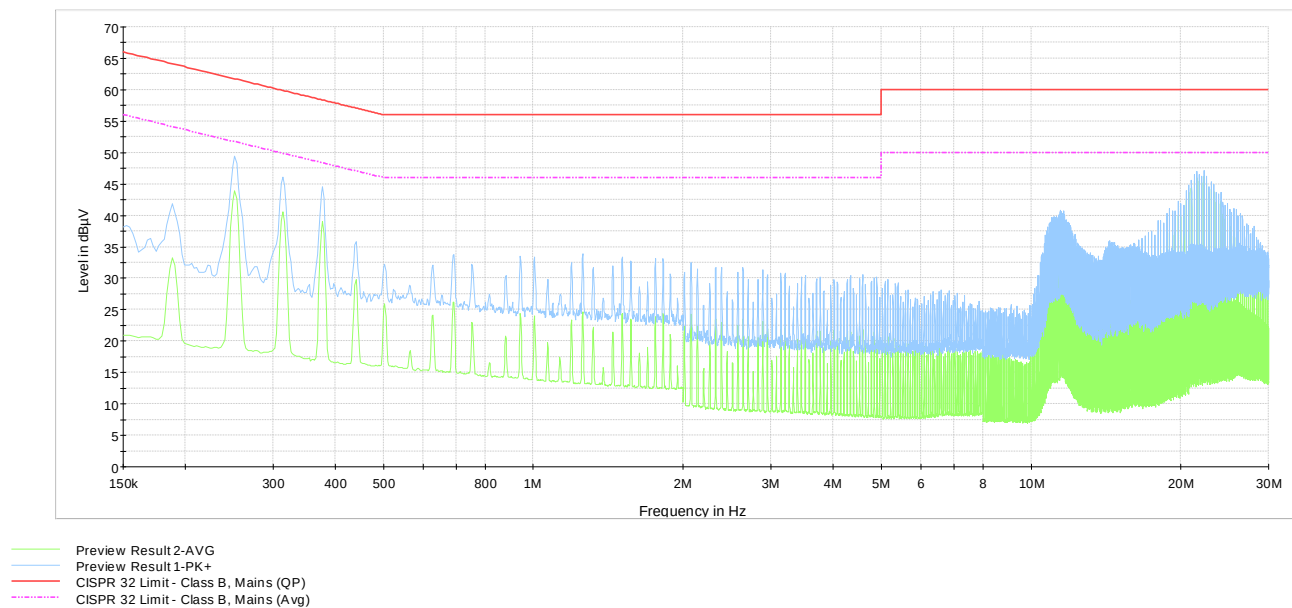
Table 8.4-2: Conducted emissions results on phase line

Frequency, MHz	CAverage result, dBμV	CAverage limit, dBμV	CAverage margin, dB	Correction factor, dB
0.251	43.9	51.7	7.8	9.7
0.314	40.5	49.9	9.4	9.8
0.377	39.1	48.3	9.3	9.9
21.259	45.3	50.0	4.7	10.9
21.511	46.1	50.0	3.9	10.9
21.765	45.4	50.0	4.6	10.8

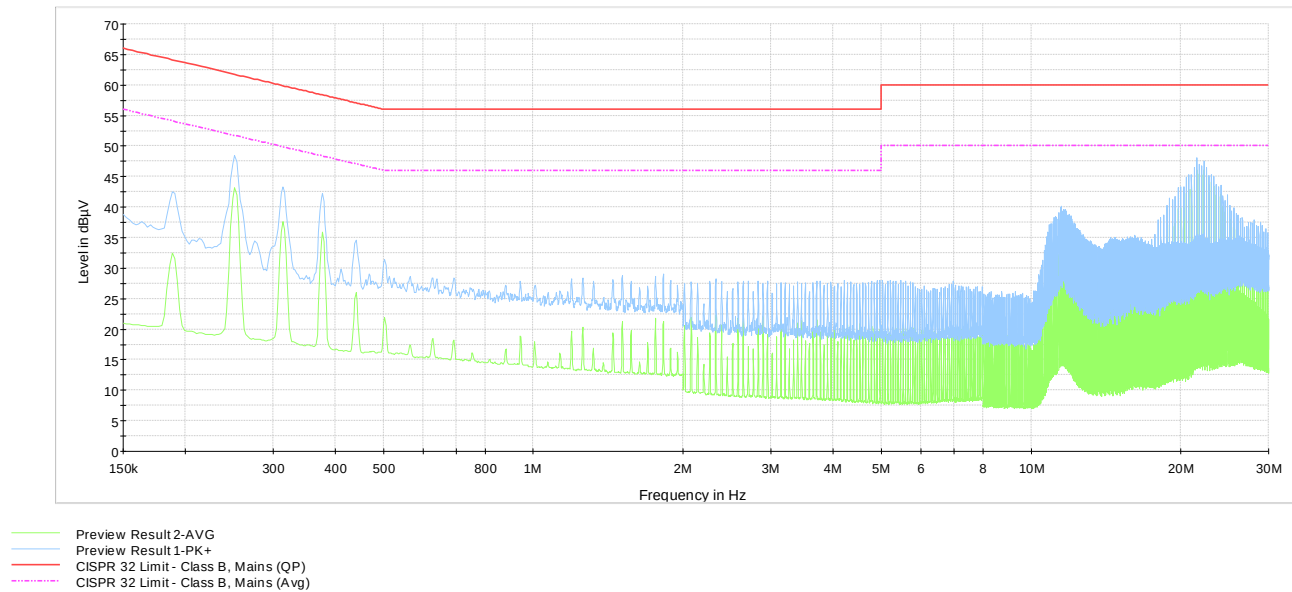
Table 8.4-3: Conducted emissions results on neutral line

Frequency, MHz	CAverage result, dBμV	CAverage limit, dBμV	CAverage margin, dB	Correction factor, dB
0.251	43.1	51.7	8.6	9.8
20.499	42.1	50.0	7.9	10.6
20.753	42.6	50.0	7.4	10.7
21.511	45.9	50.0	4.1	10.8
21.765	45.0	50.0	5.0	10.8
22.017	45.2	50.0	4.8	10.8

Test data, continued



Plot 8.4-1: Conducted emissions on phase line



Plot 8.4-2: Conducted emissions on neutral line

8.5 Emission bandwidth and 6 dB BW

8.5.1 References, definitions and limits

FCC §15.403:

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

FCC §15.407:

- (e) Within the 5.725–5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

8.5.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test start date	August 6, 2020

8.5.3 Observations, settings and special notes

The emission bandwidth was tested per ANSI C63.10, Clause 12.4 and KDB 789033 D02, Clause II(C)(1). Spectrum analyser settings:

Resolution bandwidth	approximately 1% of the emission bandwidth
Video bandwidth	> RBW
Detector mode	Peak
Trace mode	Max Hold

The 6 dB bandwidth was tested per ANSI C63.10, Clause 11.8 and KDB 789033 D02, Clause II(C)(2). Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Detector mode	Peak
Trace mode	Max Hold

As per response of inquiry to FCC(Tracking Number 550787) , it is permitted if 26 dB bandwidth extends outside of the band, as long as 99% bandwidth in within the U-NII3 band, DFS and TCP are not required.

8.5.4 Test data

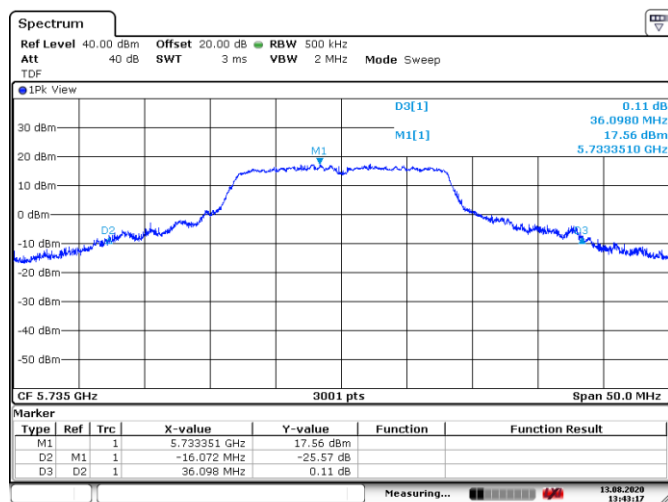
Table 8.5-1: 26 dB bandwidth results

Modulation	Frequency, MHz	26 dB bandwidth, MHz
802.11a	5735	36.1
	5785	37.3
	5835	29.2
802.11n Ht20	5735	38.0
	5785	39.1
	5835	30.0
802.11n Ht40	5755	47.4
	5795	47.7
	5825	48.4

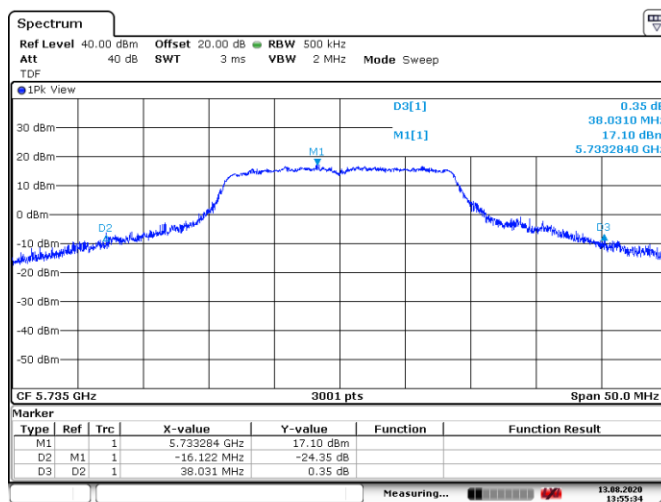
Table 8.5-2: 6 dB bandwidth results

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11a	5735	15.825	0.5	15.325
	5785	15.900	0.5	15.400
	5835	16.250	0.5	15.750
802.11n Ht20	5735	16.925	0.5	16.425
	5785	17.875	0.5	17.375
	5835	17.775	0.5	17.275
802.11n Ht40	5755	35.893	0.5	35.393
	5795	35.718	0.5	35.218
	5825	35.700	0.5	35.200

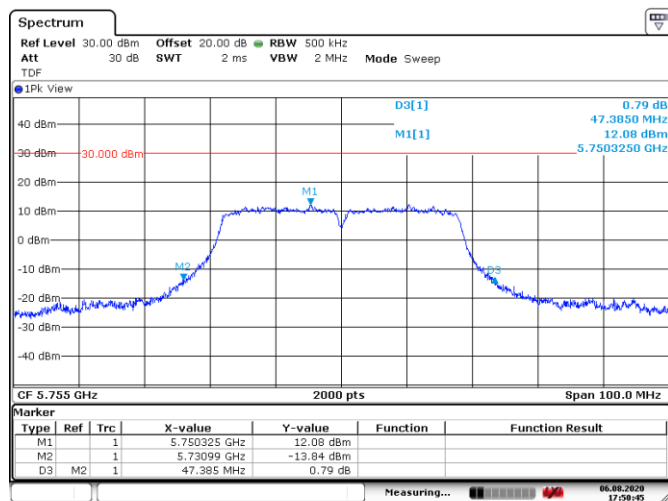
Test data, continued



Date: 13.AUG.2020 13:43:17



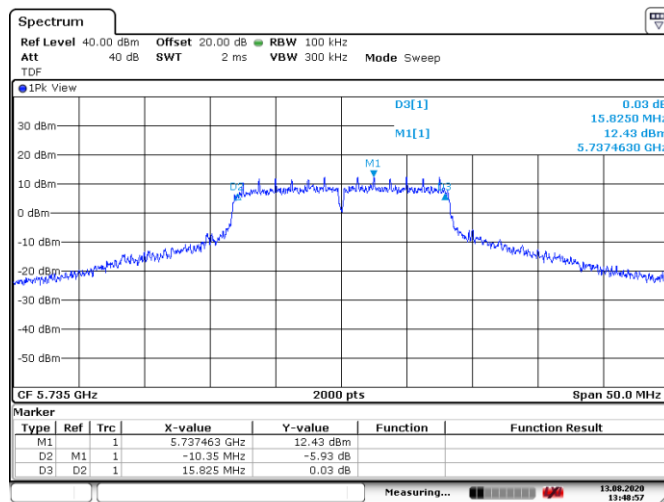
Date: 13.AUG.2020 13:55:34



Date: 6.AUG.2020 17:50:45

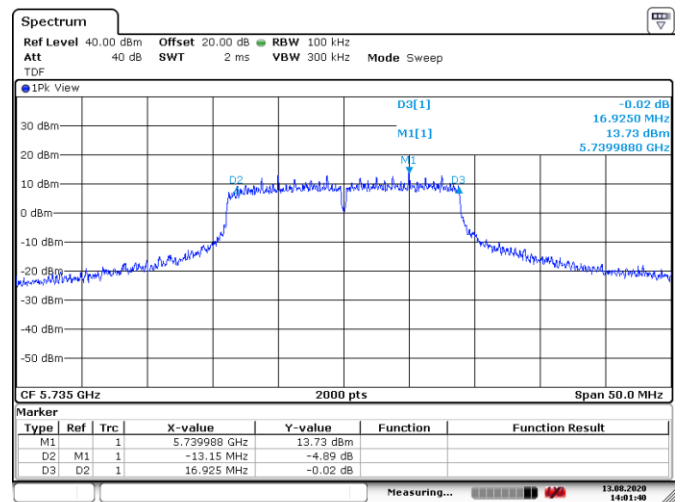
Figure 8.5-3: 26 dB bandwidth on 802.11n HT20, sample plot

Test data, continued



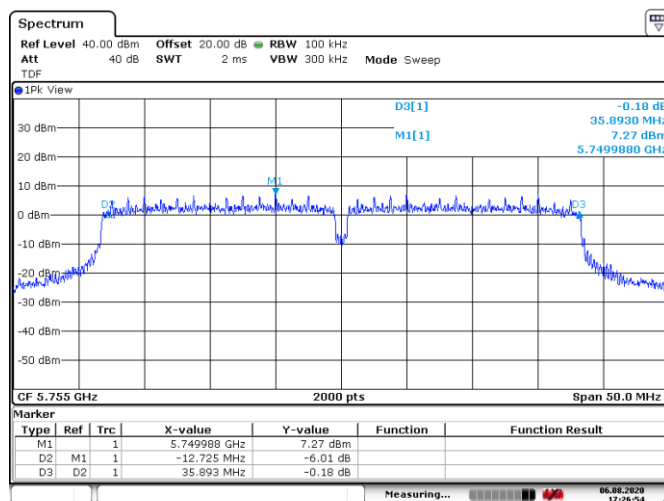
Date: 13.AUG.2020 13:48:57

Figure 8.5-4: 6 dB bandwidth on 802.11a, sample plot



Date: 13.AUG.2020 14:01:40

Figure 8.5-5: 6 dB bandwidth on 802.11n HT20, sample plot



Date: 6.AUG.2020 17:26:54

Figure 8.5-6: 6 dB bandwidth on 802.11n HT40, sample plot

8.6 Occupied bandwidth

8.6.1 References, definitions and limits

ANSI C63.10-2013, Clause 6.9.3:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

8.6.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test star date	March 10, 2020

8.6.3 Observations, settings and special notes

The emission bandwidth was tested per ANSI C63.10, Clause 6.9.3 and KDB 789033 D02, Clause II(D). Spectrum analyser settings:

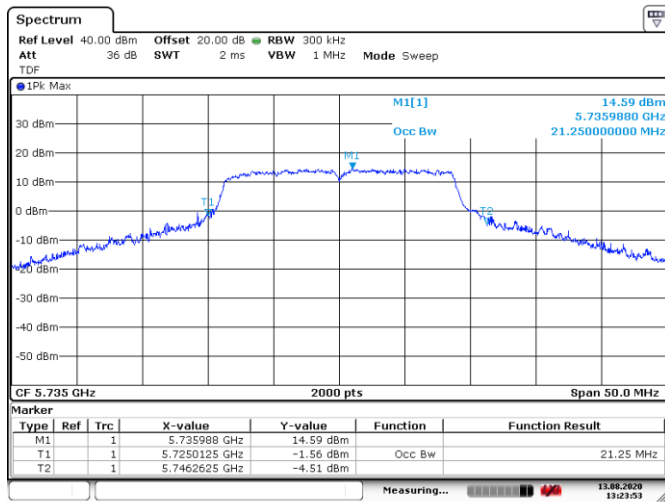
Resolution bandwidth:	$\geq 1\%$ of span
Video bandwidth:	$\geq 3 \times \text{RBW}$
Detector mode:	Peak
Trace mode:	Max Hold

8.6.4 Test data

Table 8.6-1: 99% bandwidth results

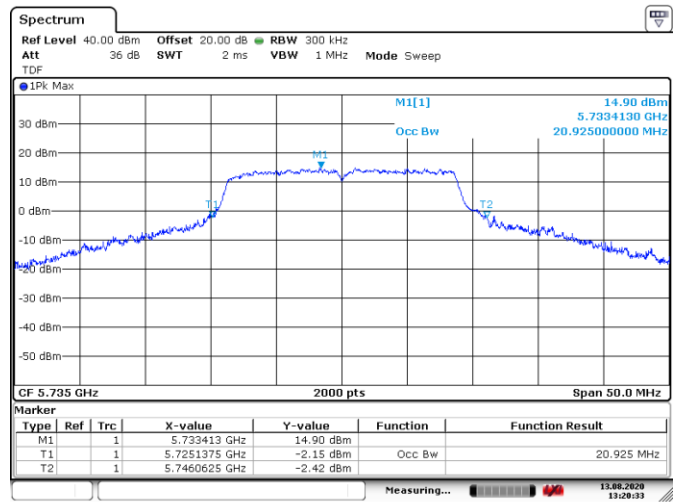
Modulation	Frequency, MHz	99% bandwidth, MHz
802.11a	5735	21.25
	5785	19.03
	5835	17.40
802.11n Ht20	5735	20.93
	5785	19.65
	5835	18.48
802.11n Ht40	5755	36.90
	5795	37.10
	5825	37.00

Test data, continued



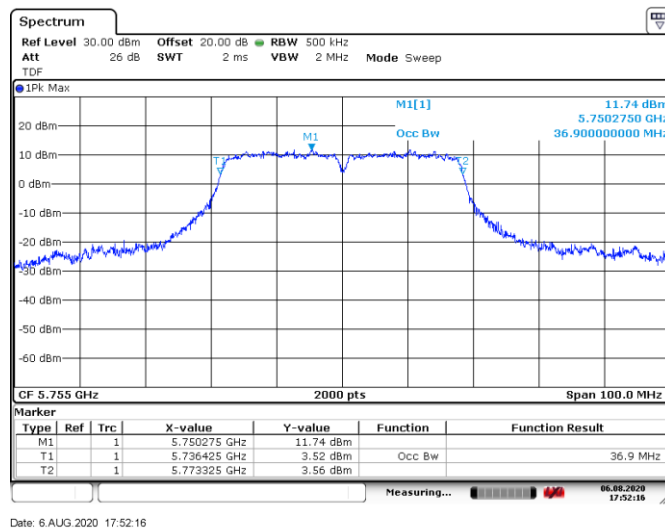
Date: 13.AUG.2020 13:23:53

Figure 8.6-1: 99% bandwidth on 802.11a, sample plot



Date: 13.AUG.2020 13:20:33

Figure 8.6-2: 99% bandwidth on 802.11n HT20, sample plot



Date: 6.AUG.2020 17:52:16

Figure 8.6-3: 99% bandwidth on 802.11n HT40, sample plot



8.7 Transmitter output power and e.i.r.p. requirements for 5725–5850 MHz band

8.7.1 References, definitions and limits

FCC §15.407:

- (a) Power limits:
- (3) For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
- (11) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.
- (12) Power spectral density measurement. The maximum power spectral density is measured as either a conducted emission by direct connection of a calibrated test instrument to the equipment under test or a radiated measurement. Measurements in the 5.725–5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in all other bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

8.7.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	August 6, 2020

8.7.3 Observations, settings and special notes

Combined average output power was calculated as follows: $P_{combined} = 10 \times \log_{10} \left((10^{P_{cho}/10}) + (10^{P_{ch1}/10}) \right)$

EIRP was calculated as follows: $EIRP = P_{combined} + \text{antenna gain}$

Combined PPSP was calculated as follows: $PPSP_{combined} = 10 \times \log_{10} \left((10^{PPSP_{cho}/10}) + (10^{PPSP_{ch1}/10}) \right)$

The EUT is a fixed point-to-point device; therefore it may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

MIMO operation is only available on 802.11n HT20 and 802.11HT40 modes.

Power spectral density was tested per ANSI C63.10, Clause 12.5 and 789033 D02, Clause II(F).

Conducted output power was tested per ANSI C63.10, Clause 12.3 and 789033 D02, Clause II(E) using method SA-1 or SA-1 Alternative (averaging with the EUT transmitting at full power throughout each sweep).

Spectrum analyser settings:

Resolution bandwidth	500 kHz
Video bandwidth	≥ 3 MHz
Frequency span	Enough to encompass the entire 26 dB EBW or 99% OBW of the signal
Detector mode	RMS
Trace mode	Max Hold
Power aggregation	Over 26 dB EBW or 99% OBW

As configured by client on site, the power setting in EUT is as below:

Modulation	Frequency, MHz	Power setting
802.11a	5735	19
	5785	19
	5835	19
802.11n HT20	5735	19
	5785	19
	5835	19
802.11n HT40	5755	15
	5795	15
	5825	15

8.7.4 Test data

Table 8.7-1: Output power measurements results for FCC

Modulation	Frequency, MHz	Conducted output power, dBm	Power limit, dBm	Margin, dB
802.11a	5735	25.86	30	4.14
	5785	26.30	30	3.70
	5835	22.50	30	7.50

Table 8.7-2: Output power measurements results for FCC, MIMO 2×2

Modulation	Frequency, MHz	Measured average conducted output power, dBm			Power limit, dBm	Margin, dB
		On ch0	On ch1	Combined		
802.11n HT20	5735	25.97	26.59	29.30	30.00	0.70
	5785	25.60	25.70	28.66	30.00	1.34
	5835	22.30	24.60	26.61	30.00	3.39
802.11n HT40	5755	23.38	23.76	26.58	30.00	3.42
	5795	21.99	22.49	25.26	30.00	4.74
	5825	19.79	21.66	23.84	30.00	6.16

Table 8.7-3: PPSD measurements results for FCC

Modulation	Frequency, MHz	PPSD, dBm/MHz	PPSD limit, dBm/0.5 MHz	Margin, dB
802.11a	5735	11.9	30	18.1
	5785	12.1	30	17.9
	5835	8.8	30	21.2

Table 8.7-4: PPSD measurements results for FCC, MIMO 2×2

Modulation	Frequency, MHz	Measured Peak Power Spectral Density (PPSD), dBm/0.5MHz			PPSD limit, dBm/0.5 MHz	Margin, dB
		On ch0	On ch1	Combined		
802.11n HT20	5735	11.9	12.5	15.2	30	14.8
	5785	11.8	12.3	15.1	30	14.9
	5835	8.8	11.2	13.2	30	16.8
802.11n HT40	5755	6.3	6.9	9.6	30	20.4
	5795	6.1	5.6	8.9	30	21.1
	5825	4.2	5.2	7.7	30	22.3

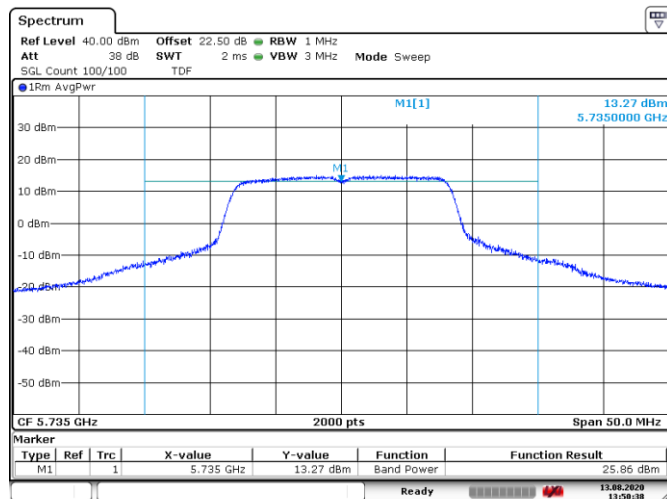


Figure 8.7-1: Sample plot for power on 802.11a

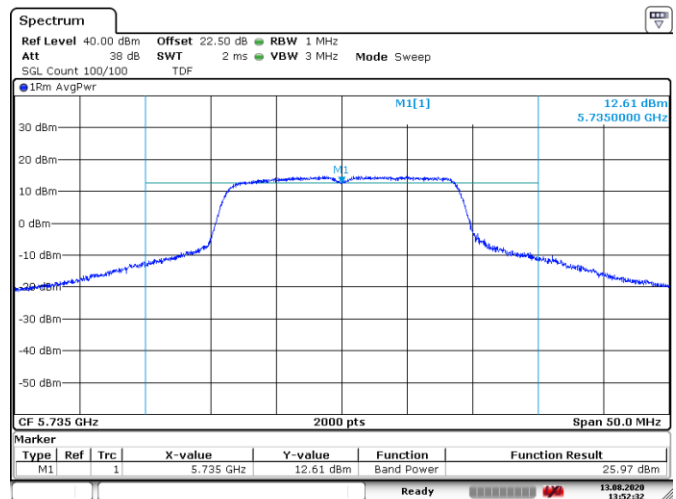


Figure 8.7-2: Sample plot for power on 802.11n HT20

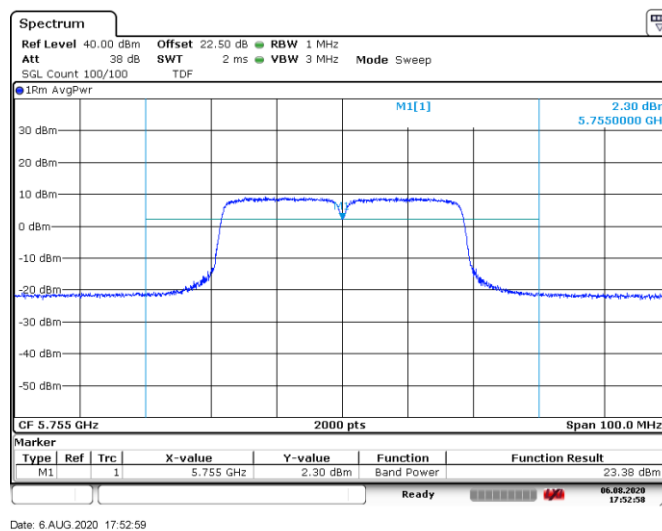


Figure 8.7-3: Sample plot for power on 802.11n HT40

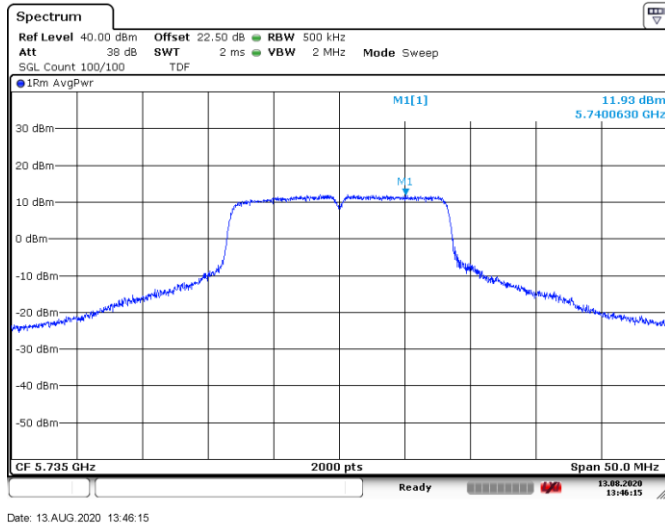


Figure 8.7-4: Sample plot for PPSS on 802.11a

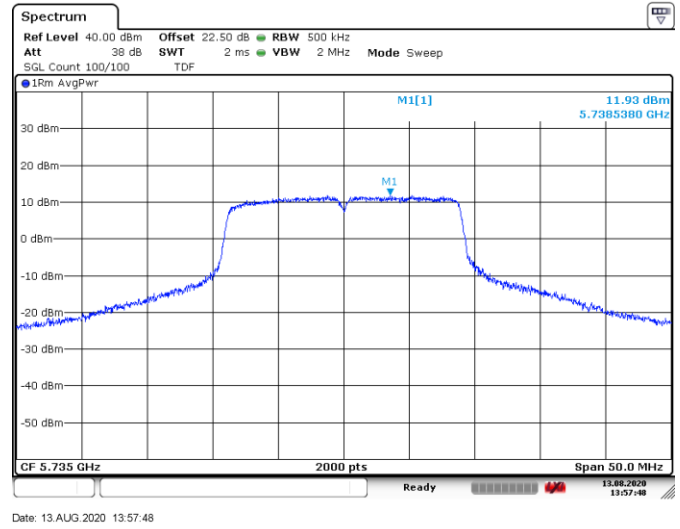


Figure 8.7-5: Sample plot for PPSS on 802.11n HT20

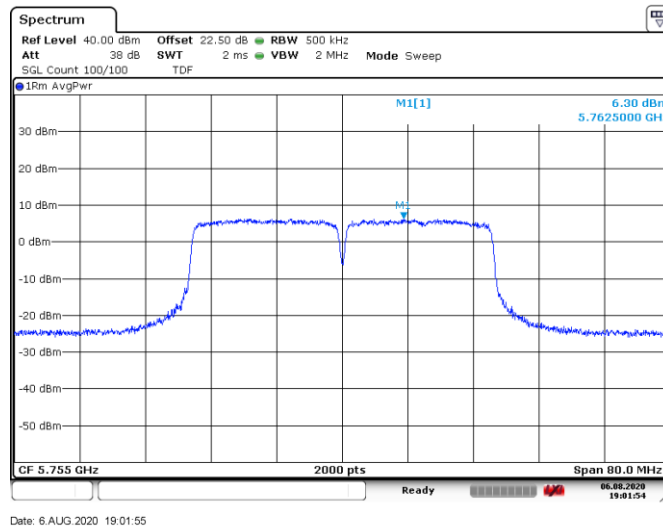


Figure 8.7-6: Sample plot for PPSS on 802.11n HT40

8.8 Spurious unwanted (undesirable) emissions

8.8.1 References, definitions and limits

FCC §15.407:

- (b) Undesirable emission limits.
 Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
- (4) For transmitters operating in the 5.725–5.85 GHz band:
 - (i) All emissions shall be limited to a level of –27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
- (7) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
- (8) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.
- (9) The provisions of § 15.205 apply to intentional radiators operating under this section.
- (10) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Table 8.8-1: FCC §15.209– Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
 For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

References, definitions and limits, continued

Table 8.8-2: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.8.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test start date	January 21, 2020

8.8.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 40 GHz has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 100 % duty cycle. The EUT was transmitting on both MIMO chains simultaneously when working MIMO mode, which is only available on 802.11n HT20 and 802.11HT40 modes.
- Radiated measurements were performed at a distance of 3 m below 18 GHz, 1m from 18 GHz to 40 GHz. Above 18 GHz, no emissions were found within 10 dB below the limits.
- The spurious emission was tested per ANSI C63.10, Clause 12.7 and 789033 D02, Clause II(G).
- Colocation of a 2.4 GHz wifi transmitter inside EUT has been investigated, no inter-harmonics spurious were found within 6 dB below the limits

Spectrum analyser for peak conducted measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser for peak conducted measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

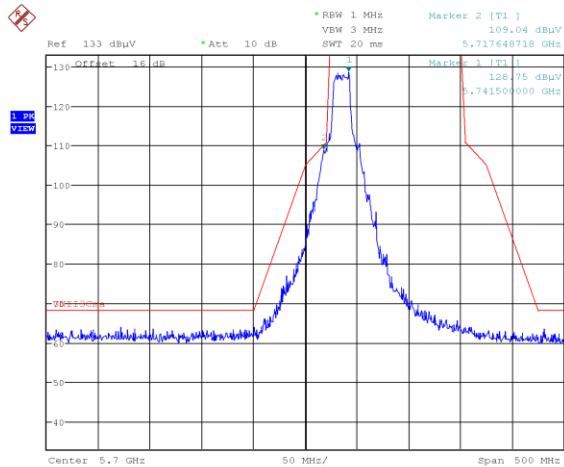
Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

Spectrum analyser for peak conducted measurements outside restricted bands:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

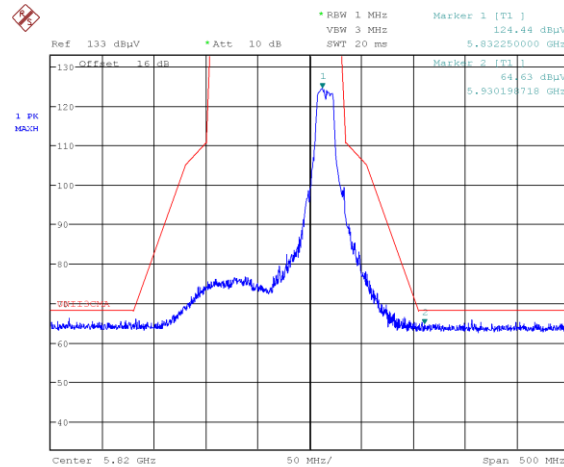
8.8.4 Test data

Test data, continued



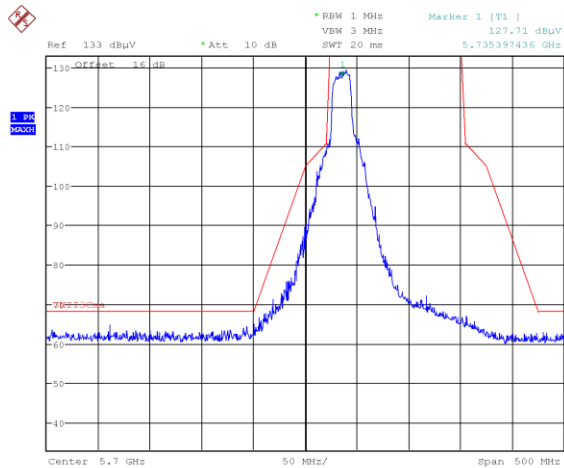
Date: 4.AUG.2020 17:08:37

Figure 8.8-1: Undesirable emission mask limits, 802.11a, low channel



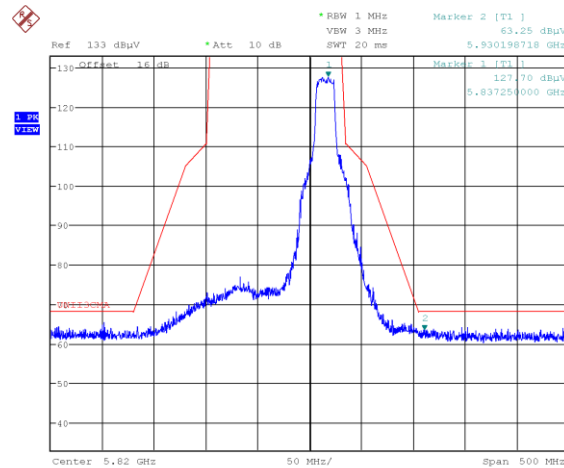
Date: 7.AUG.2020 12:38:04

Figure 8.8-2: Undesirable emission mask limits, 802.11a, high channel



Date: 4.AUG.2020 16:37:18

Figure 8.8-3: Undesirable emission mask limits, 802.11nHT20, low channel

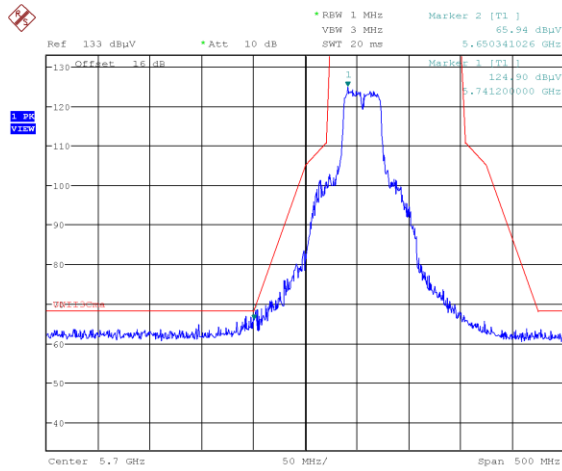


Date: 7.AUG.2020 12:33:45

Figure 8.8-4: Undesirable emission mask limits, 802.11nHT20, high channel

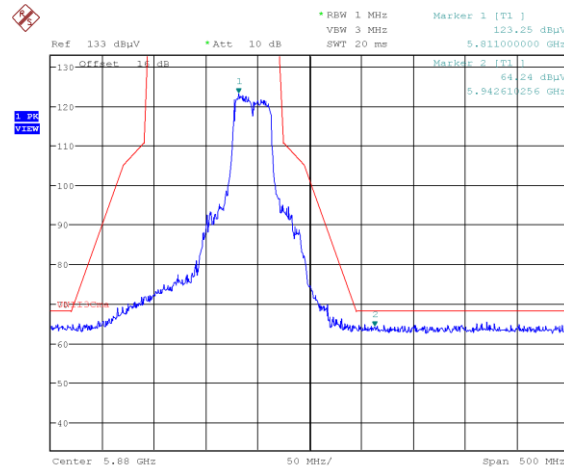


Section 8 *Testing data*
Test name *Spurious unwanted (undesirable) emissions*
Specification *FCC Part 15 Subpart E and RSS-247, Issue 2*



Date: 4.AUG.2020 17:02:33

Figure 8.8-5: Undesirable emission mask limits, 802.11nHT40, low channel



Date: 4.AUG.2020 17:24:58

Figure 8.8-6: Undesirable emission mask limits, 802.11nHT40, high channel

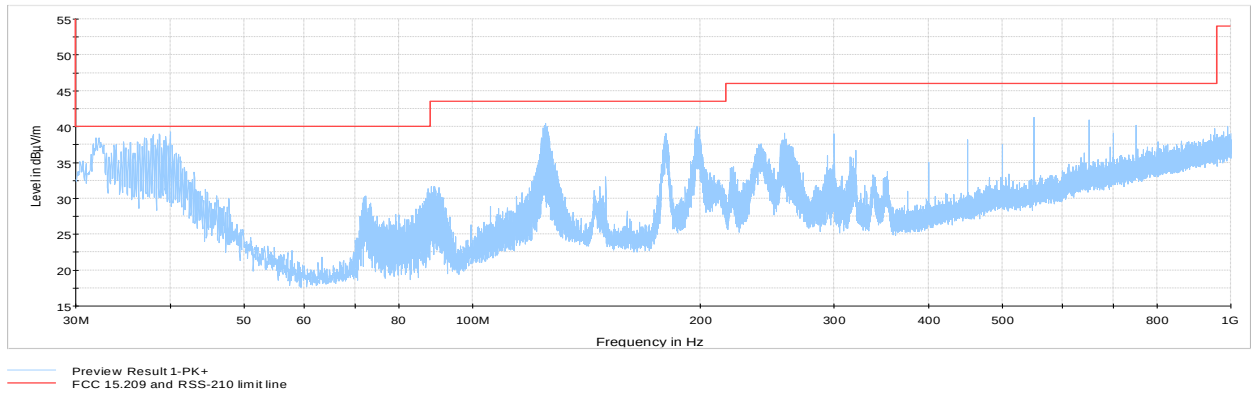


Figure 8.8-7: Radiated spurious emissions 30 MHz to 1 GHz, 802.11a, low channel

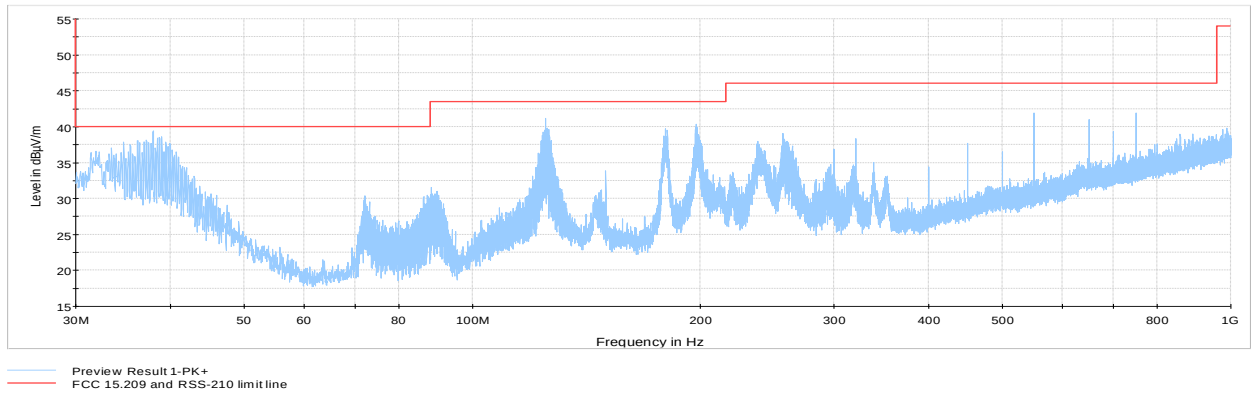


Figure 8.8-8: Radiated spurious emissions 30 MHz to 1 GHz, 802.11a, mid channel

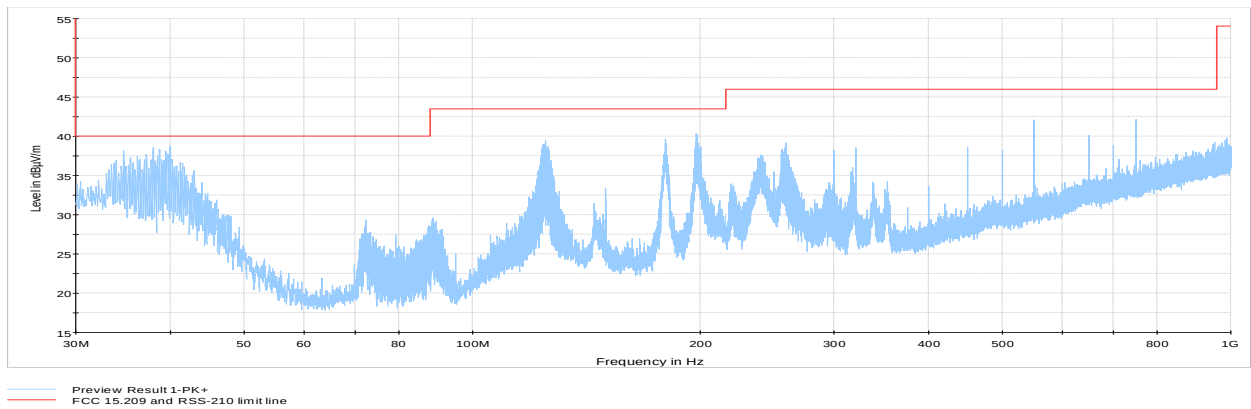


Figure 8.8-9: Radiated spurious emissions 30 MHz to 1 GHz, 802.11a, high channel



Table 8.8-3: Radiated field strength measurement results, 30 MHz to 1 GHz, 802.11a

Channel	Frequency, MHz	Quasi-Peak Field strength, dB μ V/m		Margin, dB
		Measured	Limit	
Low	31.940	36.3	40.0	3.7
Low	36.952	36.4	40.0	3.6
Low	37.194	35.6	40.0	4.4
Low	37.720	37.3	40.0	2.7
Low	37.962	38.2	40.0	1.8
Low	38.488	36.7	40.0	3.3
Low	38.690	34.6	40.0	5.4
Low	39.215	35.8	40.0	4.2
Low	39.458	35.7	40.0	4.3
Low	39.983	36.7	40.0	3.3
Mid	34.688	35.7	40.0	4.3
Mid	36.184	34.8	40.0	5.2
Mid	36.426	34.0	40.0	6.0
Mid	37.194	35.8	40.0	4.2
Mid	37.962	37.8	40.0	2.2
Mid	38.447	35.2	40.0	4.8
Mid	38.690	35.1	40.0	4.9
Mid	38.973	36.0	40.0	4.0
Mid	39.458	35.5	40.0	4.5
High	34.688	36.2	40.0	3.8
High	35.456	36.1	40.0	3.9
High	36.184	34.8	40.0	5.2
High	37.194	35.4	40.0	4.6
High	37.962	37.2	40.0	2.8
High	38.447	34.6	40.0	5.4
High	38.690	34.8	40.0	5.2
High	39.458	36.2	40.0	3.8
High	39.740	36.3	40.0	3.7
High	39.983	37.0	40.0	3.0

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

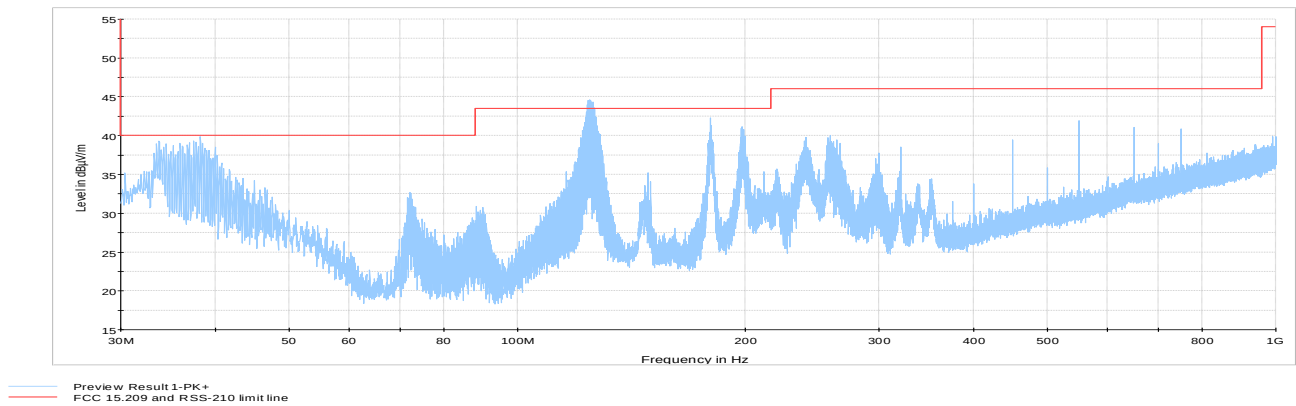


Figure 8.8-10: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT20, low channel

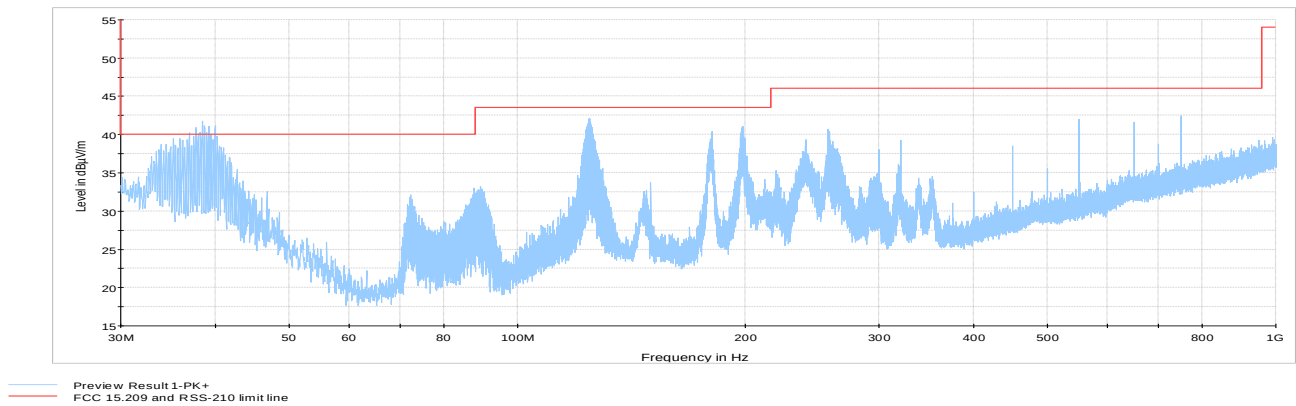


Figure 8.8-11: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT20, mid channel

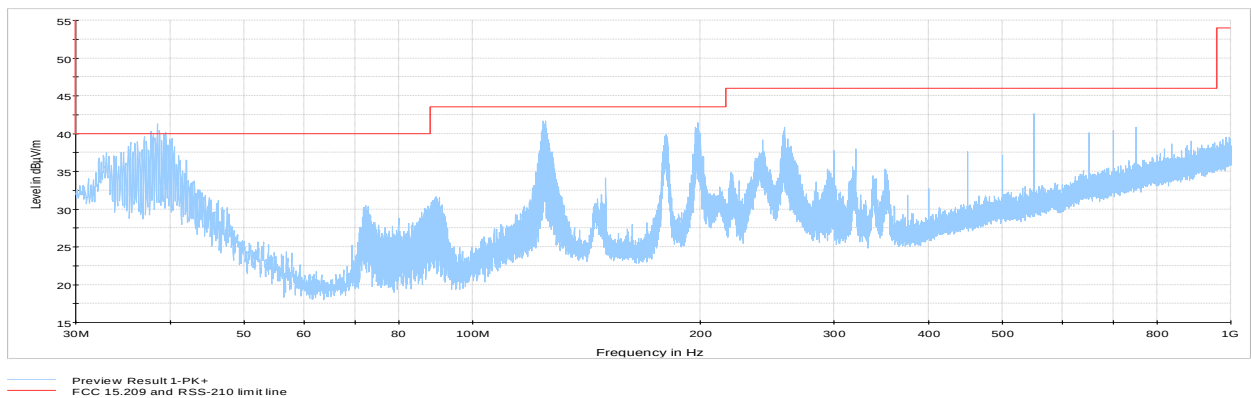


Figure 8.8-12: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT20, high channel



Table 8.8-4: Radiated field strength measurement results, 30 MHz to 1 GHz, 802.11nHT20

Channel	Frequency, MHz	Quasi-Peak Field strength, dB μ V/m		Margin, dB
		Measured	Limit	
Low	33.435	37.0	40.0	3.0
Low	36.952	37.5	40.0	2.5
Low	38.205	37.4	40.0	2.6
Low	123.726	42.1	43.5	1.4
Low	124.009	42.7	43.5	0.8
Low	124.252	40.3	43.5	3.2
Low	124.494	43.1	43.5	0.4
Low	124.737	42.9	43.5	0.6
Low	125.020	39.9	43.5	3.6
Low	125.262	39.0	43.5	4.5
Low	125.505	43.2	43.5	0.3
Low	125.747	42.9	43.5	0.6
Low	126.030	36.8	43.5	6.7
Low	179.825	40.9	43.5	2.6
Mid	36.952	38.7	40.0	1.3
Mid	37.720	39.9	40.0	0.1
Mid	37.962	38.2	40.0	1.8
Mid	38.205	38.5	40.0	1.5
Mid	38.447	39.1	40.0	0.9
Mid	38.690	37.5	40.0	2.5
Mid	38.973	38.6	40.0	1.4
Mid	39.215	39.5	40.0	0.5
Mid	39.458	37.9	40.0	2.1
Mid	39.983	39.0	40.0	1.0
Mid	124.211	37.7	43.5	5.8
High	36.952	37.7	40.0	2.3
High	37.679	36.0	40.0	4.0
High	37.962	37.3	40.0	2.7
High	38.205	37.0	40.0	3.0
High	38.447	38.0	40.0	2.0
High	38.690	36.5	40.0	3.5
High	39.215	37.5	40.0	2.5
High	39.458	36.8	40.0	3.2
High	39.943	34.4	40.0	5.6
High	40.185	33.3	40.0	6.7
High	124.939	38.0	43.5	5.5

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

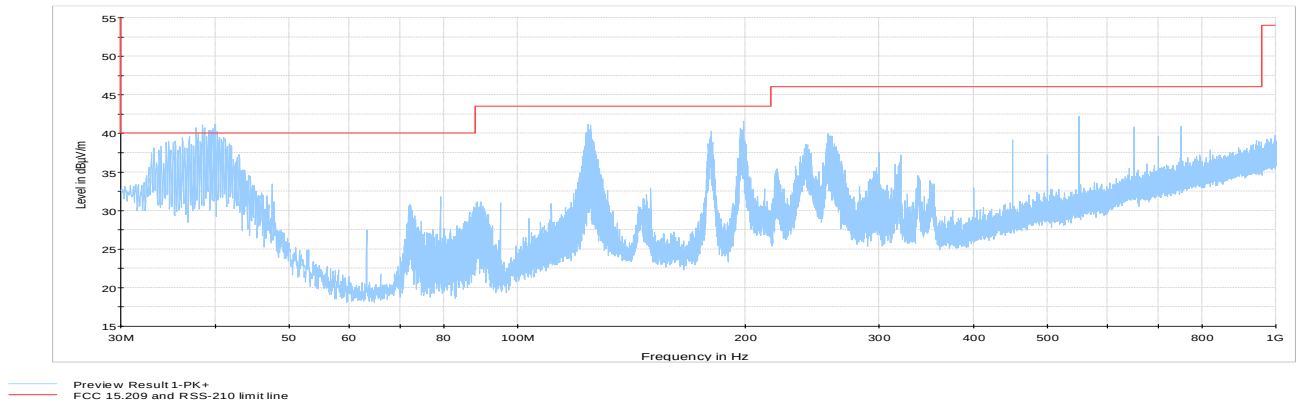


Figure 8.8-13: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT40, low channel

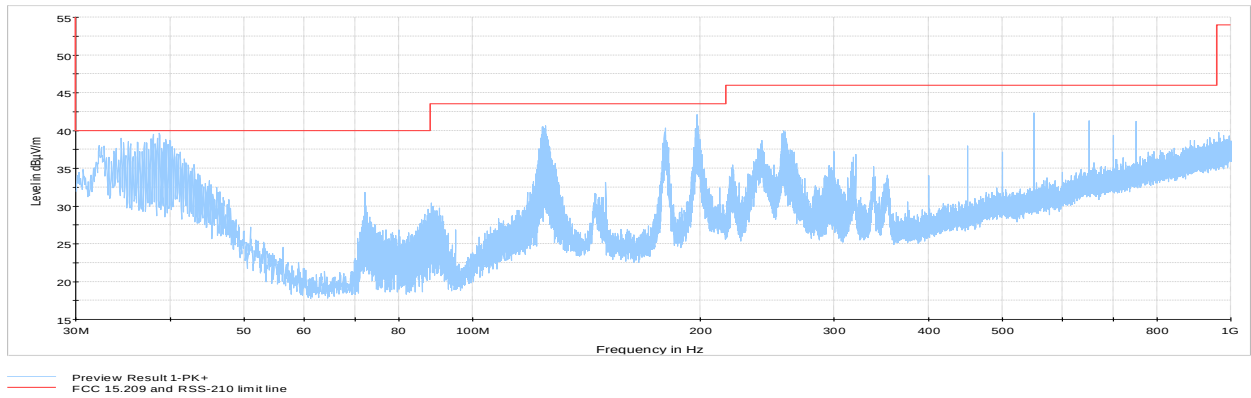


Figure 8.8-14: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT40, mid channel

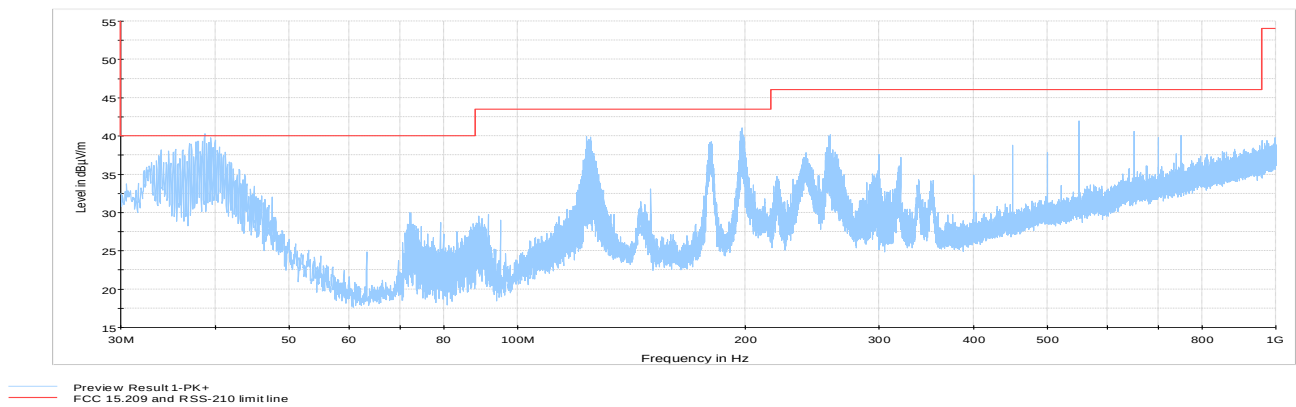


Figure 8.8-15: Radiated spurious emissions 30 MHz to 1 GHz, 802.11nHT40, high channel



Table 8.8-5: Radiated field strength measurement results, 30 MHz to 1 GHz, 802.11Nht40

Channel	Frequency, MHz	Quasi-Peak Field strength, dBμV/m		Margin, dB
		Measured	Limit	
Low	36.952	38.0	40.0	2.0
Low	37.720	39.4	40.0	0.6
Low	37.962	38.8	40.0	1.2
Low	38.447	38.5	40.0	1.5
Low	38.730	39.9	40.0	0.1
Low	39.215	39.0	40.0	1.0
Low	39.458	38.7	40.0	1.3
Low	39.700	37.6	40.0	2.4
Low	39.943	36.9	40.0	3.1
Low	40.225	38.6	40.0	1.4
Low	42.974	34.3	40.0	5.7
Low	123.969	38.1	43.5	5.4
Low	198.699	39.8	43.5	3.7
Mid	34.446	35.8	40.0	4.2
Mid	35.173	34.1	40.0	5.9
Mid	36.184	35.3	40.0	4.7
Mid	37.720	37.9	40.0	2.1
Mid	37.962	38.3	40.0	1.7
Mid	38.447	36.9	40.0	3.1
Mid	38.690	36.6	40.0	3.4
Mid	39.458	36.7	40.0	3.3
Mid	39.943	35.3	40.0	4.7
Mid	124.979	38.5	43.5	5.0
Mid	197.931	40.8	43.5	2.7
High	36.952	37.0	40.0	3.0
High	37.194	35.6	40.0	4.4
High	37.679	35.1	40.0	4.9
High	37.962	38.4	40.0	1.6
High	38.447	36.5	40.0	3.5
High	38.730	38.8	40.0	1.2
High	38.973	36.9	40.0	3.1
High	39.215	36.6	40.0	3.4
High	39.458	36.9	40.0	3.1
High	39.983	37.8	40.0	2.2
High	197.931	40.5	43.5	3.0

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

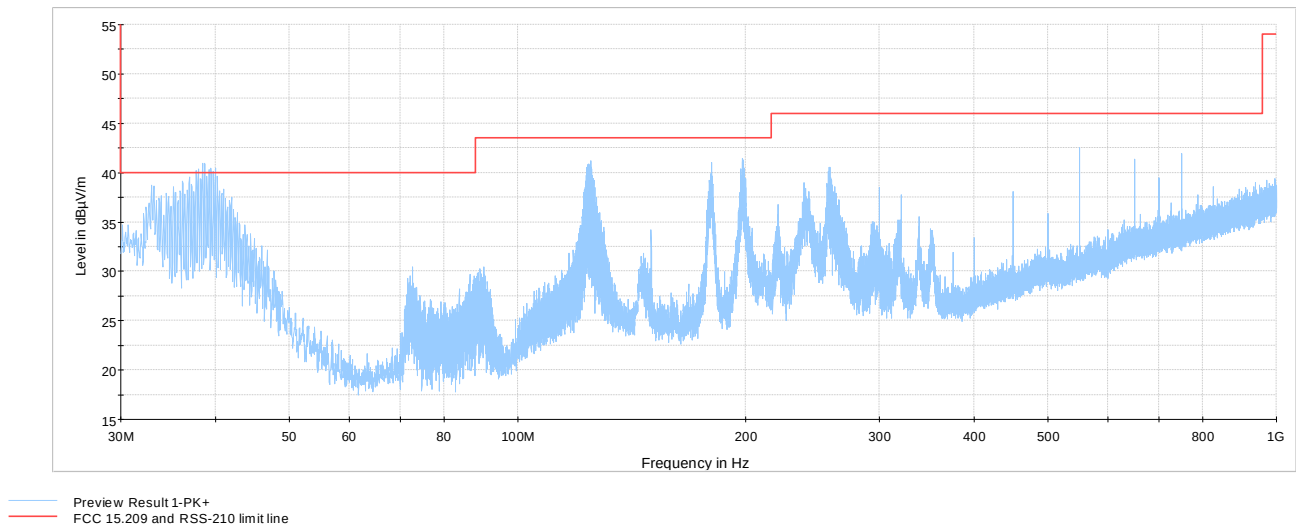


Figure 8.8-16: Radiated spurious emissions 30 MHz to 1 GHz, Tx: 802.11nHT20 @ 5785 MHz, colocation with WLAN @ 2440 MHz

Table 8.8-6: Radiated field strength measurement results, 30 MHz to 1 GHz, 802.11Nht40

Frequency, MHz	Quasi-Peak Field strength, dBμV/m		Margin, dB
	Measured	Limit	
37.679	36.2	40.0	3.8
37.962	38.1	40.0	1.9
38.447	38.1	40.0	1.9
38.690	37.4	40.0	2.6
38.973	37.6	40.0	2.4
39.215	38.3	40.0	1.7
39.458	37.3	40.0	2.7
39.740	38.0	40.0	2.0
39.983	37.3	40.0	2.7
40.225	37.5	40.0	2.5
124.979	40.5	43.5	3.0
197.689	40.6	43.5	2.9

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

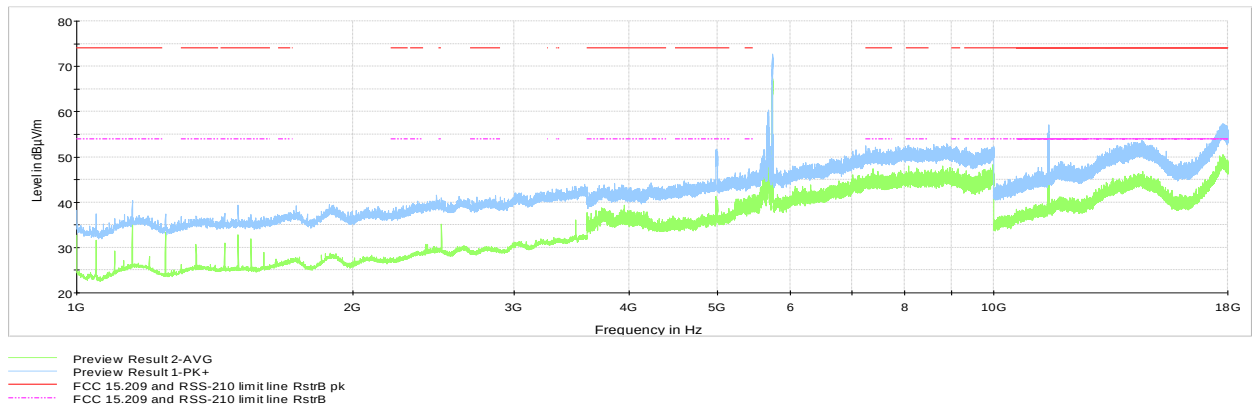


Figure 8.8-17: Radiated spurious emissions 1 to 18 GHz, 802.11a, low channel

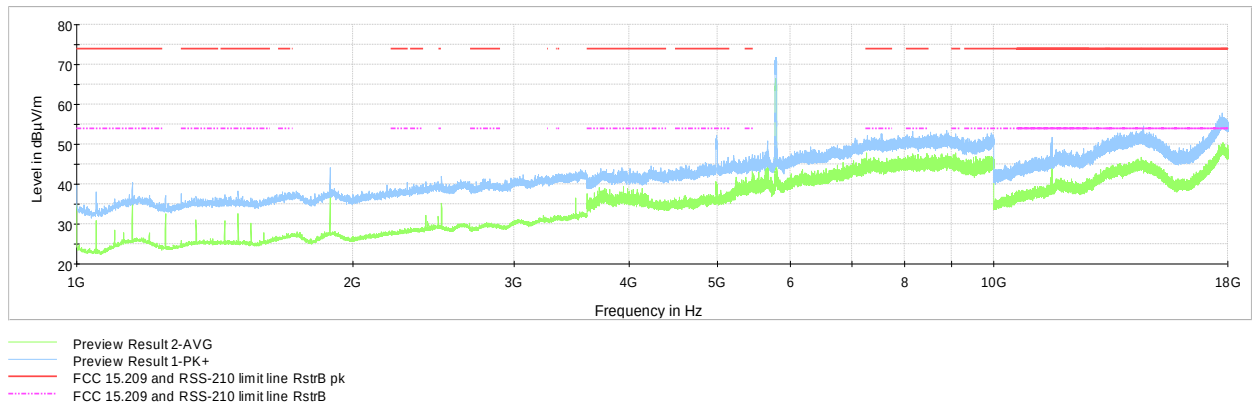


Figure 8.8-18: Radiated spurious emissions 1 to 18 GHz, 802.11a, mid channel

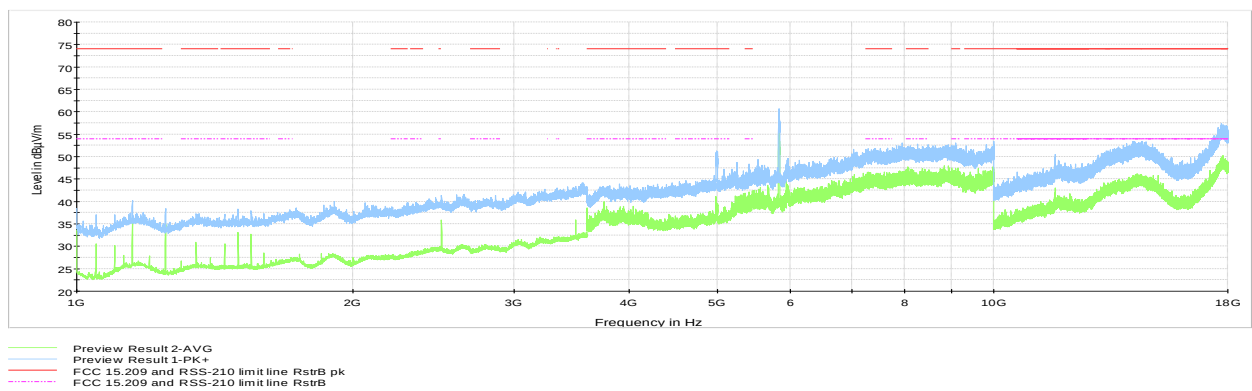


Figure 8.8-19: Radiated spurious emissions 1 to 18 GHz, 802.11a, high channel

Table 8.8-7: Radiated field strength measurement results, 1 to 18 GHz within restricted band, 802.11a

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	11472	65.2	74.00	8.8	52.5	54.00	1.5
Mid	11574	61.7	74.00	13.3	49.7	54.00	4.3
High	11667	58.2	74.00	15.8	46.6	54.00	7.4

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

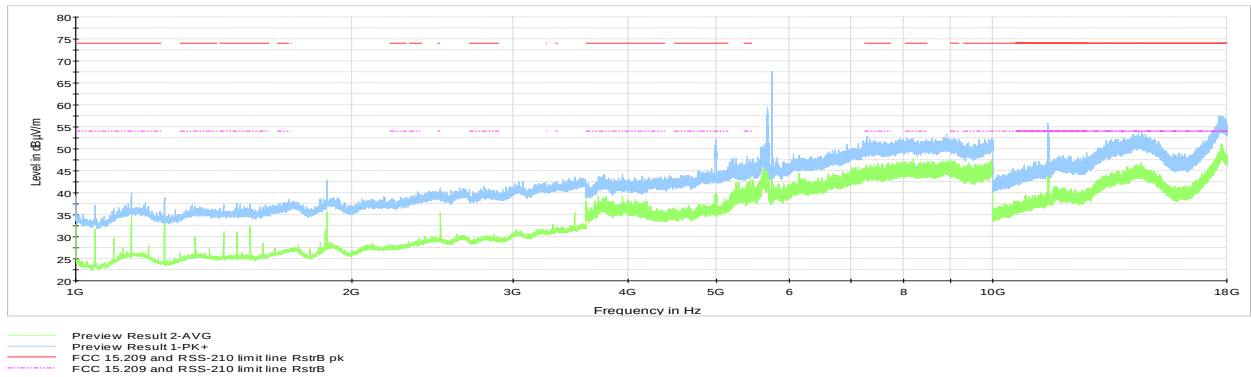


Figure 8.8-20: Radiated spurious emissions 1 to 18 GHz, 802.11nHT20, low channel

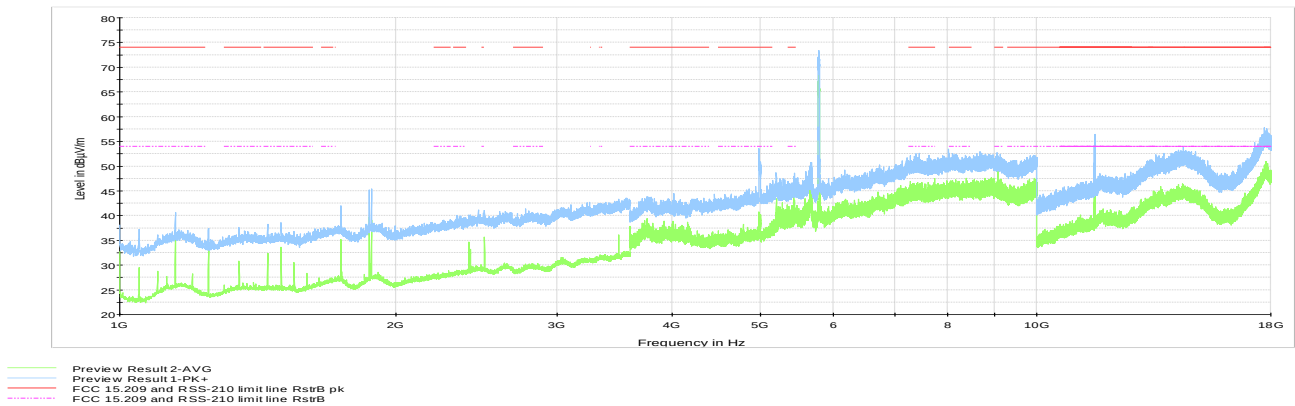


Figure 8.8-21: Radiated spurious emissions 1 to 18 GHz, 802.11nHT20, mid channel

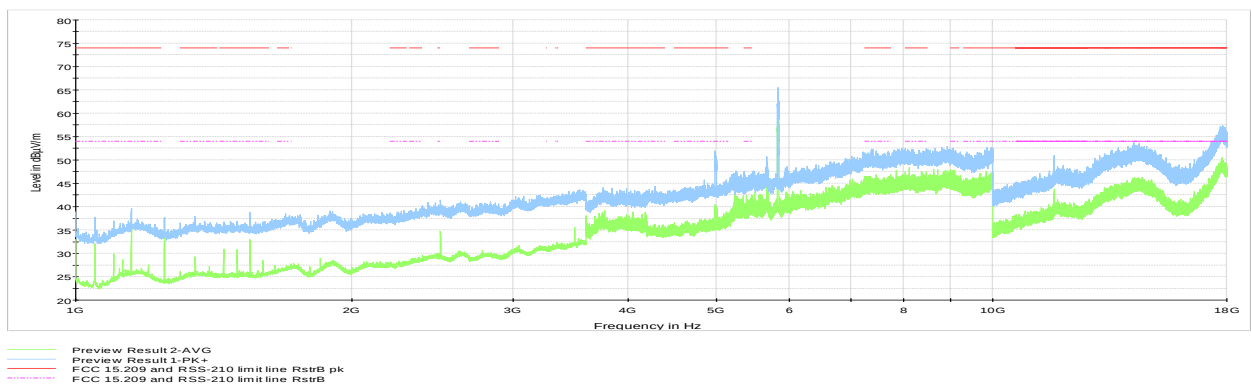


Figure 8.8-22: Radiated spurious emissions 1 to 18 GHz, 802.11nHT20, high channel

Table 8.8-8: Radiated field strength measurement results, 1 to 18 GHz within restricted band, 802.11nHT20

Channel	Frequency, MHz	Peak Field strength, dBμV/m			Average Field strength, dBμV/m		
		Measured	Limit	Margin, dB	Measured	Limit	Margin, dB
Low	11472	62.0	74.00	12.0	51.3	54.00	3.7
Mid	11571	64.2	74.00	9.8	52.8	54.00	1.2
High	11669	57.5	74.00	16.5	45.8	54.00	8.2

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

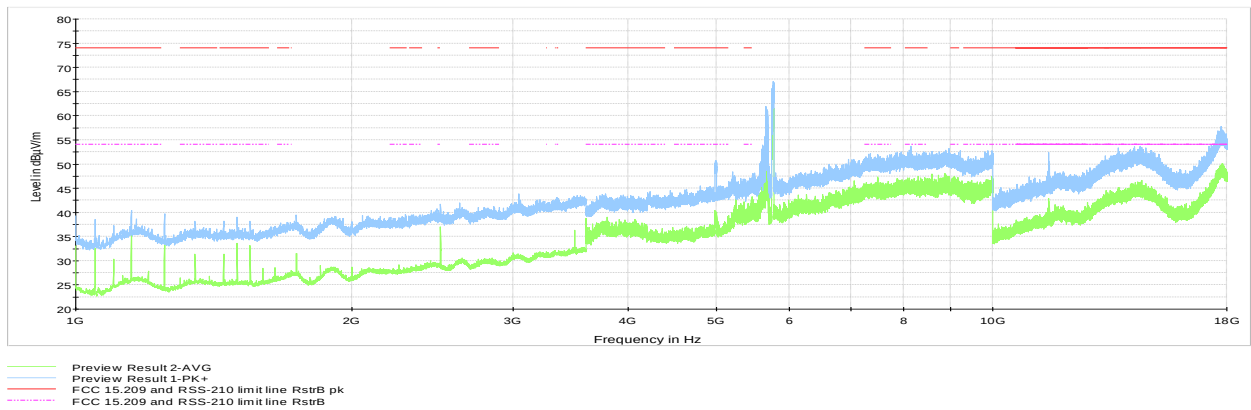


Figure 8.8-23: Radiated spurious emissions 1 to 18 GHz, 802.11nHT40, low channel

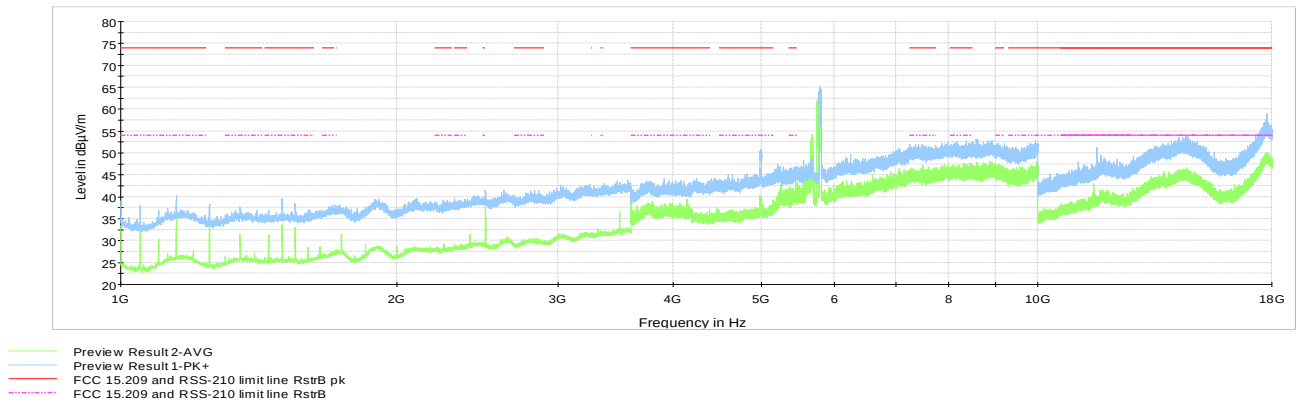


Figure 8.8-24: Radiated spurious emissions 1 to 18 GHz, 802.11nHT40, mid channel

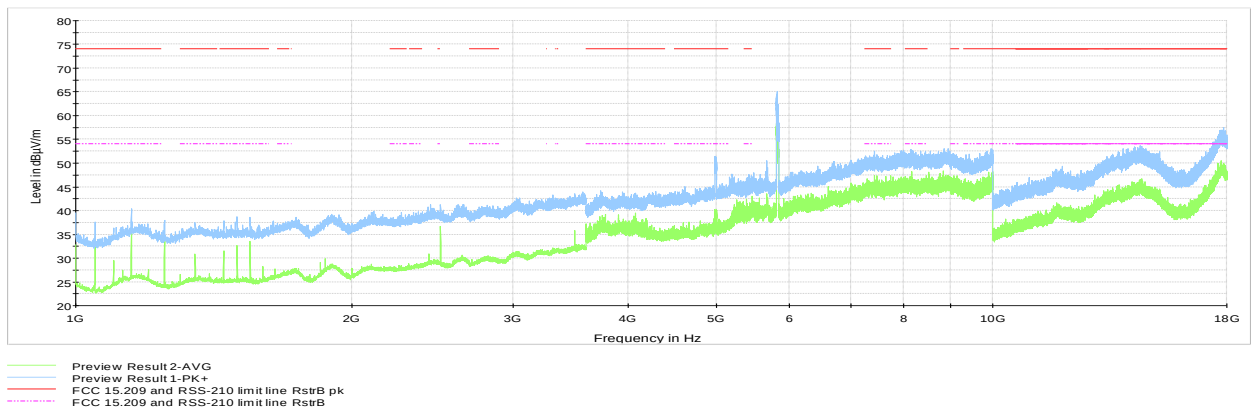


Figure 8.8-25: Radiated spurious emissions 1 to 18 GHz, 802.11nHT40, high channel

Table 8.8-9: Radiated field strength measurement results, 1 to 18 GHz within restricted bands, 802. 11nHT40

Channel	Frequency, MHz	Peak Field strength, dBμV/m			Average Field strength, dBμV/m		
		Measured	Limit	Margin, dB	Measured	Limit	Margin, dB
Low	11508	60.5	74.00	13.5	47.9	54.00	6.1
Mid	11591	59.1	74.00	14.9	47.2	54.00	6.8
High	11650	56.0	74.00	18.0	44.5	54.00	9.5

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

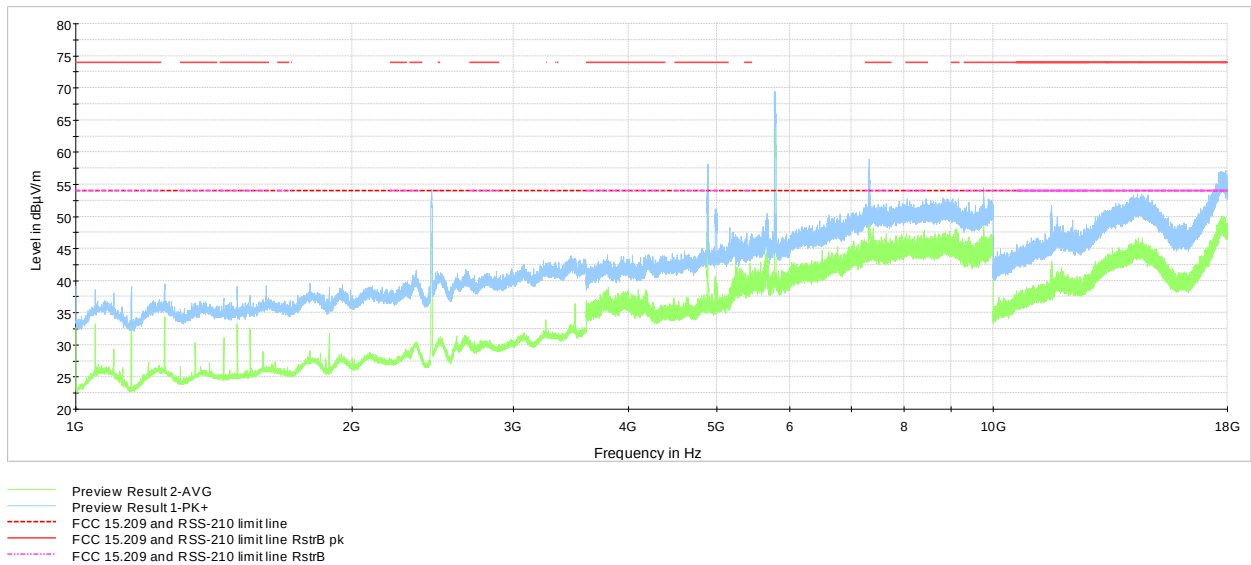


Figure 8.8-26: Radiated spurious emissions 1 to 18 GHz, Tx @ 802.11nHT20 5785 MHz, colocation with WLAN @2440 MHz

Note: Spike in the plot above are from intentional emissions or their harmonics, no inter-modulation product is found within 10 dB below the limits.
 EUT channels combination were chosen and configured by client on site as representative case

8.9 Frequency stability

8.9.1 References, definitions and limits

FCC §15.407:

- (g) Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

RSS-Gen, Clause 8.11:

If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable RSS, the fundamental emissions of the radio apparatus should be kept within at least the central 80% of its permitted operating frequency band in order to minimize the possibility of out-of-band operation.

8.9.2 Test summary

Verdict	Pass		
Tested by	Yong Huang	Test date	September 24, 2020

8.9.3 Observations, settings and special notes

Frequency stability test was performed as per ANSI C63.10, Clause 6.8 and 789033 D02, Clause II(A)(3). Spectrum analyser settings:

Resolution bandwidth:	100 Hz
Video bandwidth:	300 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.9.4 Test data

Table 8.9-1: Frequency drift measurement

Test conditions	Frequency, GHz	Drift, Hz
+70 °C, Nominal	5.785025600	23150
+60 °C, Nominal	5.785004760	2310
+50 °C, Nominal	5.784999550	-2900
+40 °C, Nominal	5.785000130	-2320
+30 °C, Nominal	5.785010550	8100
+20 °C, +15 %	5.785004470	2020
+20 °C, Nominal	5.785002450	Reference
+20 °C, -15 %	5.785003890	1440
+10 °C, Nominal	5.785010840	8390
0 °C, Nominal	5.785016630	14180
-10 °C, Nominal	5.785030810	28360
-20 °C, Nominal	5.785042390	39940
-30 °C, Nominal	5.785049910	47460
-40 °C, Nominal	5.785049910	47460



Test data, continued

Table 8.9-2: Lower band edge drift calculation

Modulation	99% lower cross	Drifted lower cross		Band edge, GHz	Margin, MHz
	point, GHz	Max negative drift, Hz	point, GHz		
802.11a	5.7250125	-2900	5.7250096	5.725	0.0096
802.11n HT20	5.7251375	-2900	5.7251346	5.725	0.1346
802.11n HT40	5.7364250	-2900	5.7364221	5.725	11.4221

Notes: Drifted lower cross point = 99% lower cross point – max negative drift.

Table 8.9-3: Upper band edge drift calculation

Modulation	99% upper cross	Drifted upper cross		Band edge, GHz	Margin, MHz
	point, GHz	Max positive drift, Hz	point, GHz		
802.11a	5.8435375	47460	5.84358496	5.85	6.41504
802.11n HT20	5.8443375	47460	5.84438496	5.85	5.61504
802.11n HT40	5.8431250	47460	5.84317246	5.85	6.82754

Notes: Drifted upper cross point = 99% upper cross point + max positive drift.

Section 9 EUT photos

9.1 External photos



Figure 9.1-1: Front view photo



Figure 9.1-2: Rear view photo



Figure 9.1-3: Side view photo



Figure 9.1-4: Side view photo

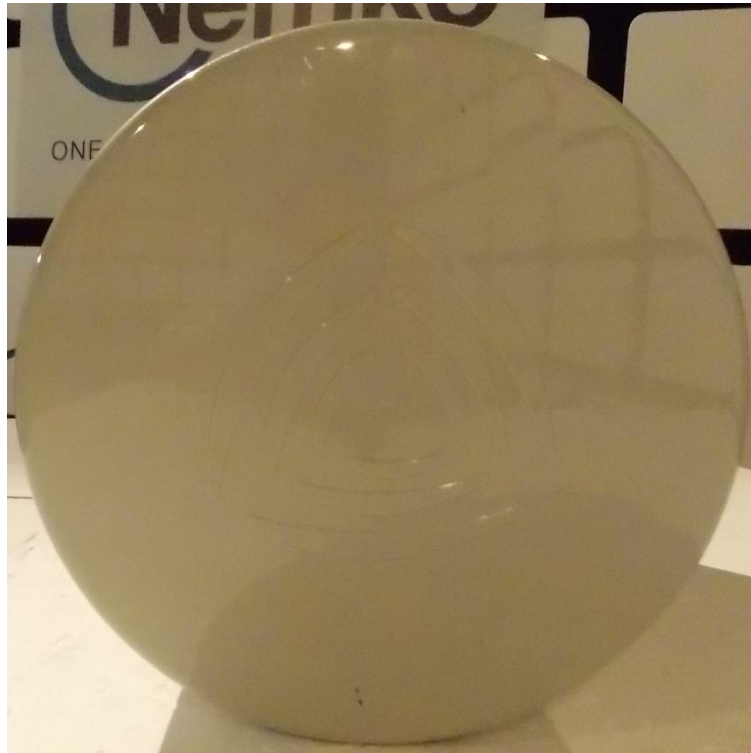


Figure 9.1-5: Top view photo

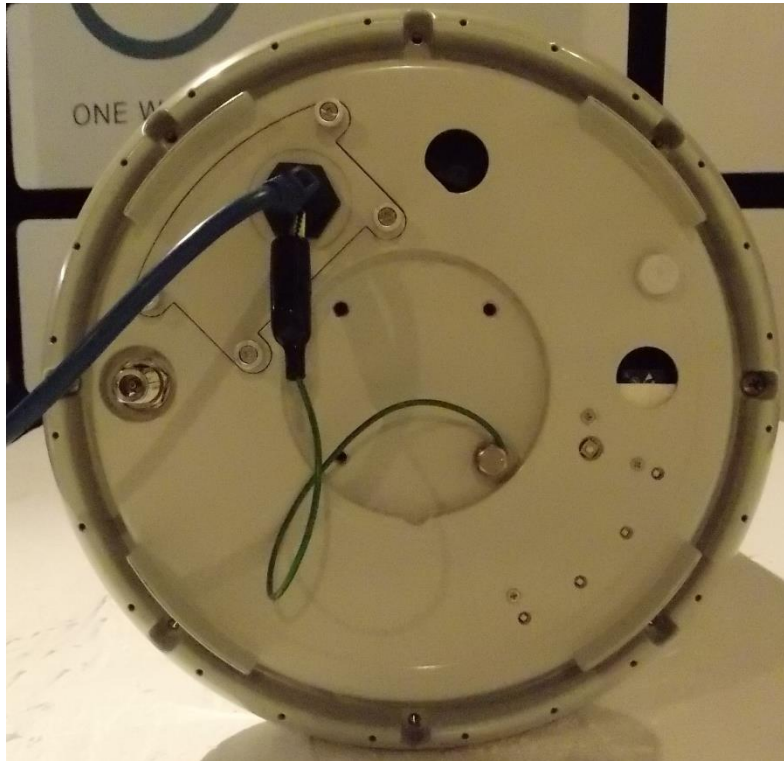


Figure 9.1-6: Bottom view photo

End of the test report