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Wireless Test Report – 1R368533-10TRFWL

Applicant:

Ring LLC

Product name:

Ring

Model:

Base Station NA

FCC ID: 2AEUPBHABN002

ISED Registration number: 20271-BHABN002

Specifications:

FCC 47 CFR Part 15 Subpart C, §15.247

Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz

RSS-247, Issue 2, Feb 2017, Section 5

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, 5) Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz

Date of issue: April 2, 2019

Test engineer(s):	Mark Libbrecht, EMC/Wireless Specialist	Signature:
Reviewed by:	David Duchesne, Senior EMC/Wireless Specialist	Signature:

Lab and Test location(s)

Company name	Nemko Canada Inc. (Cambridge)	
Facility	130 Saltsman Drive, Unit #1 Cambridge, ON Canada, N3E 0B2 Tel: +1 519 680 4811 Test Firm Registration Number: 332406	
Test site registration	**Organization**	**Designation Number**
	FCC/ISED	CA0101
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 contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Ring LLC
Address	1523 26th Street, Santa Monica, CA, United States, 90404

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

558074 D01 DTS Meas Guidance v05r01 (February 11, 2019)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus

1.4 Exclusions

None

1.5 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 1.4 below. 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.

1.6 Test report revision history

Table 1.6-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
TRF	March 28, 2019	Original report issued
R1	April 2, 2019	Removed model variant

Section 2. Summary of test results

2.1 Testing period

Test start date	February 1, 2019
Test end date	March 25, 2019

2.2 FCC Part 15 Subpart C, intentional radiators test results for digital transmission systems (DTS), test results

Table 2.2-1: *FCC general requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass

2.3 FCC Part 15 Subpart C, intentional radiators test results for digital transmission systems (DTS), test results

Table 2.3-1: *FCC 15.247 results for DTS*

Part	Test description	Verdict
§15.247(a)(2)	Minimum 6 dB bandwidth	Pass
§15.247(b)(3)	Maximum peak output power in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density	Pass

Notes: Only test applicable to the EUT have been included in this table.

2.4 RSS-Gen, Issue 5, test results

Table 2.4-1: *RSS-Gen results*

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Pass

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.1 RSS-247, Issue 2, test results for digital transmission systems (DTS), test results

Table 2.1-1: *RSS-247 results for DTS*

Part	Test description	Verdict
5.2 (a)	Minimum 6 dB bandwidth	Pass
5.2 (b)	Maximum power spectral density	Pass
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (d)	Systems employing digital modulation techniques	Pass
5.5	Unwanted emissions	Pass

Notes: Only test applicable to the EUT have been included in this table.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 1, 2019
Nemko sample ID number	Item # 1 (conducted sample) and Item # 3 (radiated sample)

3.2 EUT information

Product name	Ring
Model	Base Station NA
Serial number	BHBN21851PG000046 (conducted), BHBN21851PG000052 (radiated)

3.3 Technical information

Applicant IC company number	20271
IC UPN number	20271-BHABN002
All used IC test site(s) Reg. number	332406
RSS number and Issue number	RSS-247 Issue 2, Feb 2017
Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2412 (20 MHz), 2422 (40 MHz)
Frequency Max (MHz)	2462 (20 MHz), 2452 (40 MHz)
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted	0.023 (13.52 dBm) 20 MHz, 0.011 (10.5 dBm) 40 MHz
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	17400 (20 MHz), 36000 (40 MHz)
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	OQPSK
Emission classification (F1D, G1D, D1D)	G1D
Transmitter spurious, Units @ distance	2.485 GHz, 72.86 dBµV/m (peak) 49.83 dBµV/m (average) @ 3 m
Power requirements	5 V_{DC} (via external 100-240 VAC, 50/60 Hz power adapter)
Antenna information	Reported antenna gain is 5.8 dBi The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

Communications Hub for Home Security Products

3.5 EUT exercise details

The EUT was setup in continuous transmit state.

3.6 EUT setup diagram

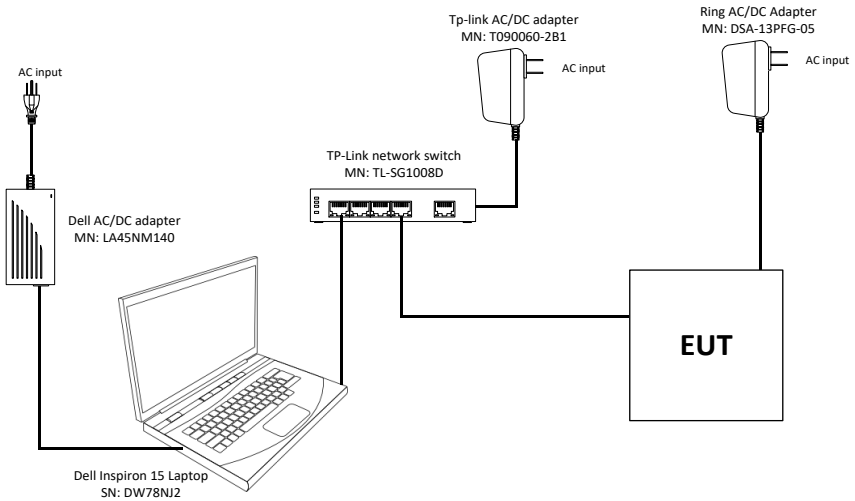


Figure 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
AC/DC Adapter	Ring	DSA-13PFG-05	BHAB11851DV000116
Laptop	Dell	Inspiron 15	DW78NJ2
Network switch	TP-Link	TL-SG1008D	2171682000263

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

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.

5.2 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 ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 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.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Serial no.	Asset no.	Cal./Ver. cycle	Next cal./ver.
3 m EMI test chamber	TDK	SAC-3		FA003012	1 year	Aug. 22/19
Flush mount turntable	SUNAR	FM2022		FA003006	—	NCR
Controller	SUNAR	SC110V	050118-1	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	042418-5	FA003007	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	101367	FA002969	1 year	June 1/19
Spectrum analyzer	Rohde & Schwarz	FSW43	104437	FA002971	1 year	June 1/19
Horn antenna (1–18 GHz)	ETS-Lindgren	3117	00052793	FA002911	1 year	Aug. 16/19
Preamp (1–18 GHz)	ETS-Lindgren	124334	00224880	FA002956	1 year	Sept 18/19
Bilog antenna (30–2000 MHz)	SUNAR	JB1	A053018-2	FA003010	1 year	Sept. 6/19
50 Ω coax cable	Huber + Suhner	None	457630	FA003047	1 year	Nov 12/19
50 Ω coax cable	Huber + Suhner	None	457624	FA003044	1 year	Nov 12/19
Two-line v-network	Rohde & Schwarz	ENV216	101376	FA002964	1 year	Mar. 27/19
50 Ω coax cable	Rohde & Schwarz	None		FA003074	1 year	Dec. 21/19
AC Power source	Chroma	61605	616050002253	FA003034	—	VOU
Filter 2.4 – 2.4835 GHz	Microwave Circuits	N0324413	499781	FA003027	1 year	Oct. 1/19
Horn antenna (18-25 GHz)	ETS-Lindgren	3116B	00122305	FA002948	1 year	Apr. 18/19

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

Section 8. Testing data

8.1 FCC 15.31(e) Variation of power source

8.1.1 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 date

Start date	February 22, 2019

8.1.3 Observations, settings and special notes

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

a) 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.
b) For devices where operating at a supply voltage deviating ±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.
c) 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.
d) 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

The EUT AC Input supply voltage was varied between 85% and 115% of the nominal rated supply voltage. No change to transmitter performance was observed.

8.2 FCC 15.31(m) and RSS-Gen 6.9 Number of frequencies

8.2.1 Definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or receivers, other than TV broadcast 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 Section 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 date

Start date	February 14, 2019

8.2.3 Observations, settings and special notes

Per ANSI C63.10 Subclause 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:

a) 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.
b) 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.
c) 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.

Per ANSI C63.10 Subclause 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:

a) 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).
b) 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).
c) 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 Channels*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
2400	2483.5	83.5	2412	2437	2462

Table 8.2-3: *Test channels selection 40 MHz Channels*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
2400	2483.5	83.5	2422	2437	2452

8.3 FCC 15.203 and RSS-Gen 6.8 Antenna requirement

8.3.1 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.

RSS-Gen Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test date

Start date	February 14, 2019

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

- The EUT has an internal integrated antenna, non-detachable.
- The EUT will not be professionally installed

8.4 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.4.1 Definitions and limits

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 µH/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 subclause 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.

RSS-GEN Section 8.8:

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.4-1: *AC power line conducted emissions limit*

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

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

8.4.2 Test date

Start date	February 13, 2019

8.4.3 Observations, settings and special notes

Port under test – Coupling device	AC Input – Artificial Mains Network (AMN)
EUT power input during test	5 V_{DC} (Powered via external power adapter @ 120 V_{AC} 60 Hz)
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. No conducted emissions were overserved within 10 dB of limit. – The spectral plots have been corrected with transducer factors.

Receiver settings:

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

8.4.4 Test data

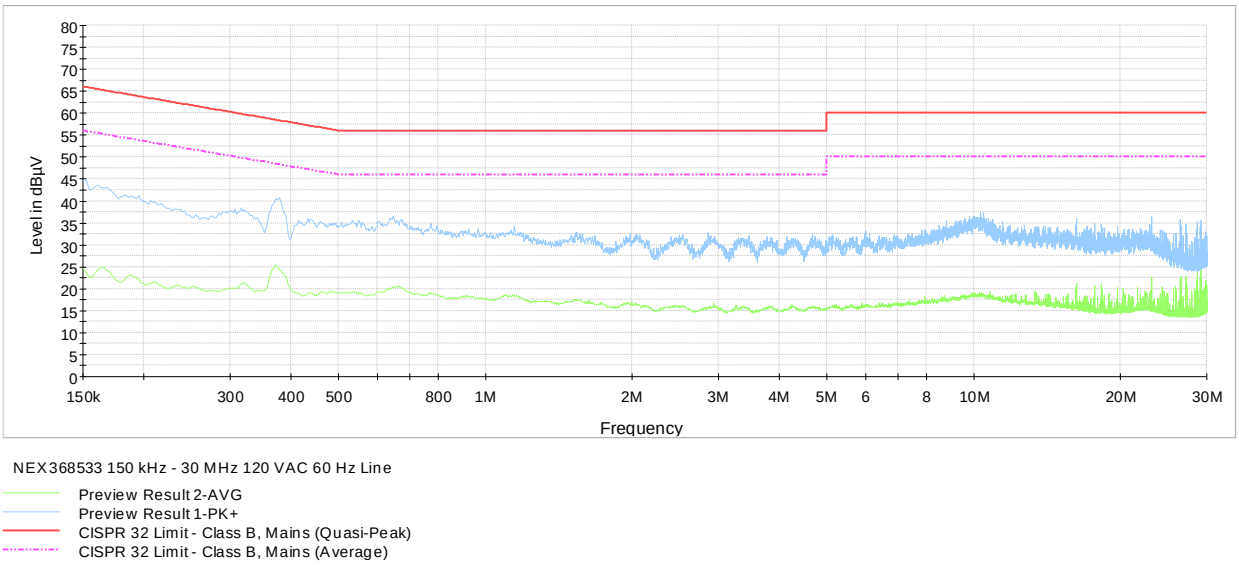


Figure 8.4-1: *AC power line conducted emissions – spectral plot on phase line*

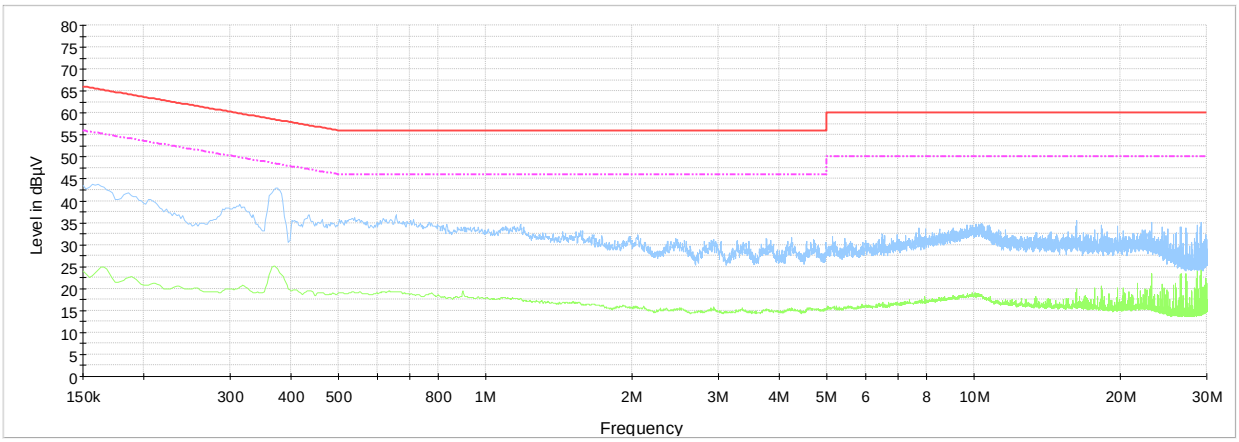


Figure 8.4-2: *AC power line conducted emissions – spectral plot on neutral line*

8.5 FCC 15.247(a)(2) and RSS-247 5.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.5.1 Definitions and limits

FCC §15.247 (a)(2):

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

RSS-247 Section 5.2 (a):

The minimum 6 dB bandwidth shall be 500 kHz.

8.5.2 Test date

Start date	February 14, 2019

8.5.3 Observations, settings and special notes

The test was performed as per KDB 558074, section 8.2 with reference to ANSI C63.10 subclause 11.8.

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥3 × RBW
Frequency span	30 MHz for 20 MHz channel; 100 MHz for 40 MHz channel
Detector mode	Peak
Trace mode	Max Hold

8.5.4 Test data

Table 8.5-1: *6 dB bandwidth results*

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11b	2412	12.1	0.5	11.6
	2437	12.0	0.5	11.5
	2462	12.0	0.5	11.5
802.11g	2412	16.6	0.5	16.1
	2437	16.6	0.5	16.1
	2462	16.6	0.5	16.1
802.11n HT20	2412	17.8	0.5	17.3
	2437	17.8	0.5	17.3
	2462	17.9	0.5	17.4
802.11n HT40	2422	36.4	0.5	35.9
	2437	36.5	0.5	36.0
	2452	36.5	0.5	36.0

Notes: None

Table 8.5-2: *99% Occupied bandwidth results*

Modulation	Frequency, MHz	99% Occupied bandwidth, MHz
802.11b	2412	13.5
	2437	13.5
	2462	13.5
802.11g	2412	16.4
	2437	16.5
	2462	16.5
802.11n HT20	2412	17.6
	2437	17.6
	2462	17.6
802.11n HT40	2422	36.1
	2437	36.2
	2452	36.2

Notes: There is no 99% occupied bandwidth limit in the standard's requirements, the measurement results provided for information purposes only.

8.5.4 Test data, continued

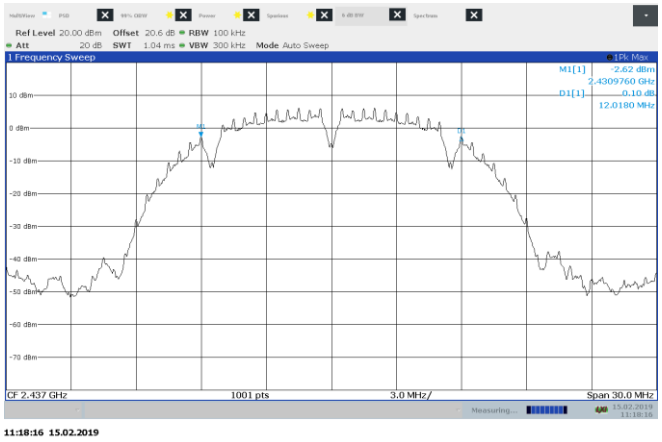


Figure 8.5-1: *6 dB bandwidth on 802.11b, sample plot*

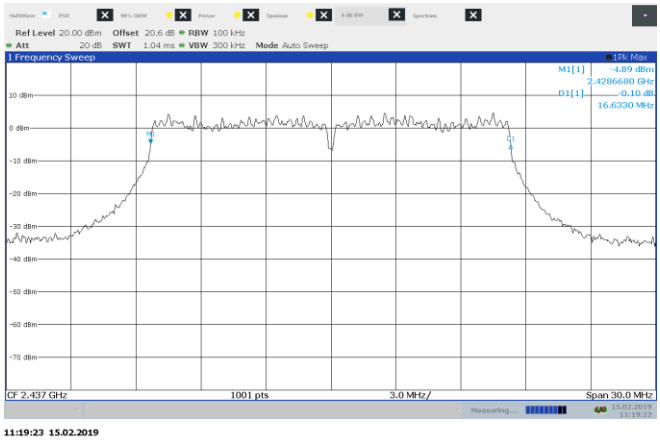


Figure 8.5-2: *6 dB bandwidth on 802.11g, sample plot*

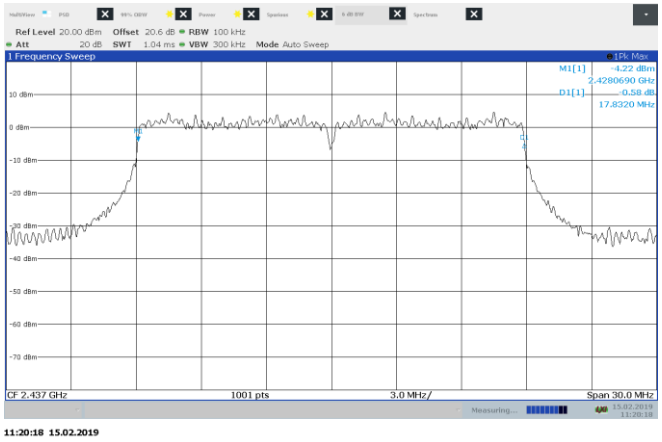


Figure 8.5-3: *6 dB bandwidth on 802.11n HT20, sample plot*

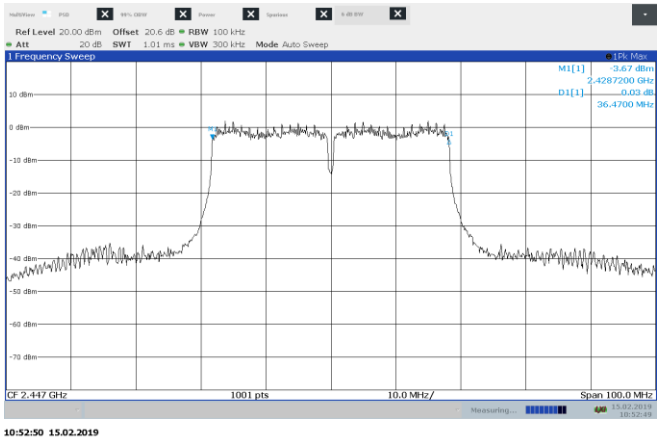


Figure 8.5-4: *6 dB bandwidth on 802.11n HT40, sample plot*

8.5.4 Test data, continued

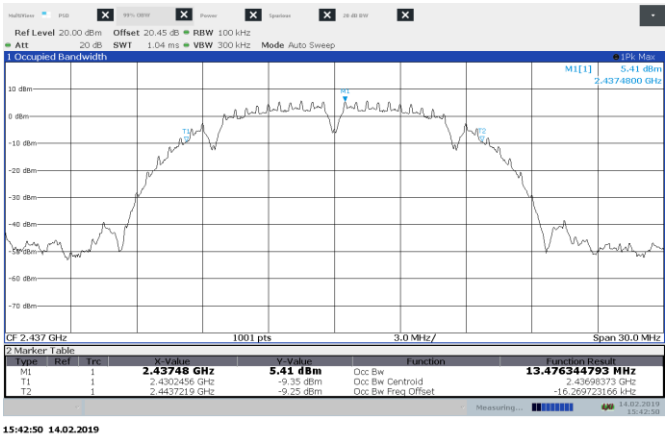


Figure 8.5-5: *99% occupied bandwidth on 802.11b, sample plot*

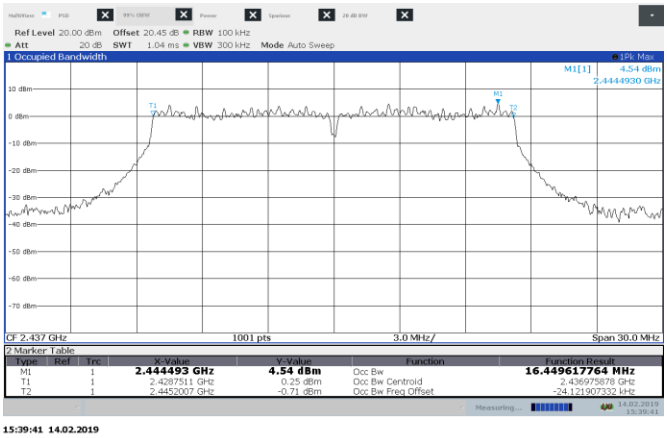


Figure 8.5-6: *99% occupied bandwidth on 802.11g, sample plot*

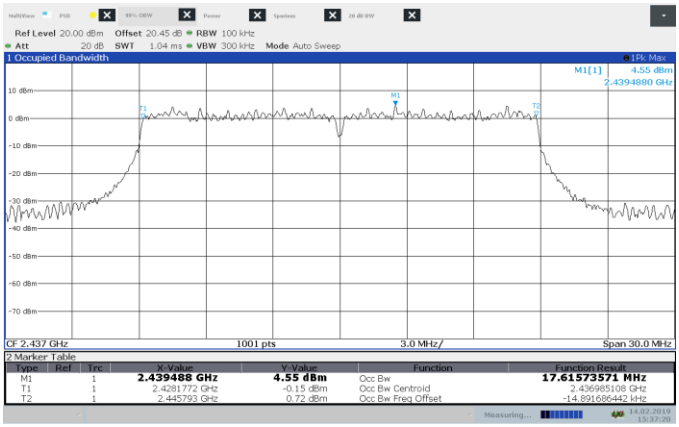


Figure 8.5-7: *99% occupied bandwidth on 802.11n HT20, sample plot*

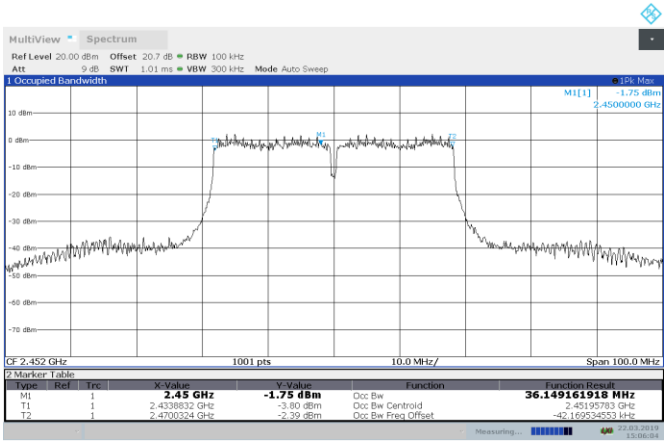


Figure 8.5-8: *99% occupied bandwidth on 802.11n HT40, sample plot*

8.6 FCC 15.247(b(3)(4)) and RSS-247 5.4 (d) Transmitter output power and e.i.r.p. requirements

8.6.1 Definitions and limits

FCC §15.247:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 Section 5.4:

d. For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode

8.6.2 Test date

Start date	February 14, 2019

8.6.3 Observations, settings and special notes

- The test was performed as per KDB 558074, section 8.3 with reference to ANSI C63.10 subclause 11.9.2 (average power)
- The test was performed using method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

Spectrum analyser settings:

Resolution bandwidth	1–5 % OBW
Video bandwidth	≥3 × RBW
Frequency span	30 MHz for 20 MHz channel; 100 MHz for 40 MHz channel
Detector mode	RMS
Trace mode	Average

8.6.4 Test data

Table 8.6-1: *Output power measurements results - 802.11b modulation*

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	13.5	30.0	16.5	5.8	19.3	36.0	16.7
2437	13.3	30.0	16.7	5.8	19.1	36.0	16.9
2462	13.4	30.0	16.6	5.8	19.2	36.0	16.8

Notes: EIRP = Output power + Antenna gain

Table 8.6-2: *Output power measurements results - 802.11g modulation*

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	9.9	30.0	20.1	5.8	15.7	36.0	20.3
2437	11.0	30.0	19.0	5.8	16.8	36.0	19.2
2462	10.1	30.0	19.9	5.8	15.9	36.0	20.1

Notes: EIRP = Output power + Antenna gain

Table 8.6-3: *Output power measurements results - 802.11HT20 modulation*

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	9.7	30.0	20.3	5.8	15.5	36.0	20.5
2437	10.9	30.0	19.1	5.8	16.7	36.0	19.3
2462	10.9	30.0	19.1	5.8	16.7	36.0	19.3

Notes: EIRP = Output power + Antenna gain

Table 8.6-4: *Output power measurements results - 802.11HT40 modulation*

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2422	10.5	30.0	19.5	5.8	16.3	36	19.7
2447	9.5	30.0	20.5	5.8	15.3	36	20.7
2452	9.4	30.0	20.6	5.8	15.2	36	20.8

Notes: EIRP = Output power + Antenna gain

8.6.4 Test data, continued

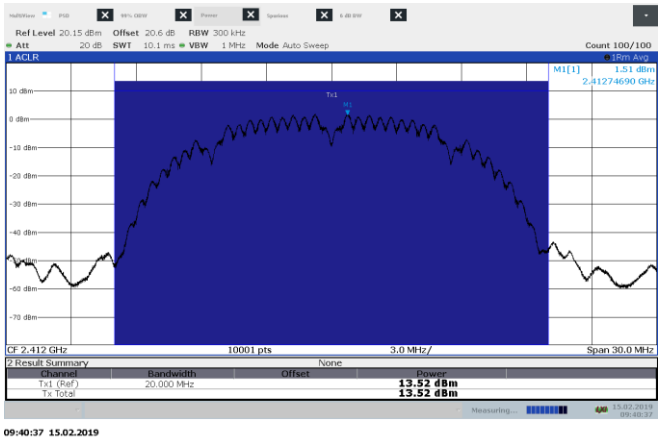


Figure 8.6-1: *Conducted output power 802.11b, sample plot*

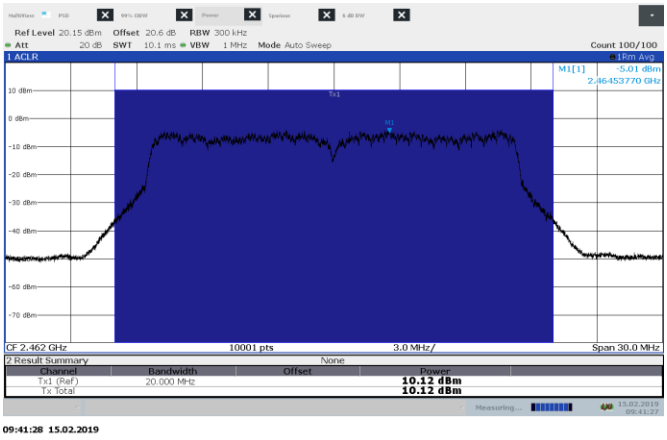


Figure 8.6-2: *Conducted output power on 802.11g, sample plot*

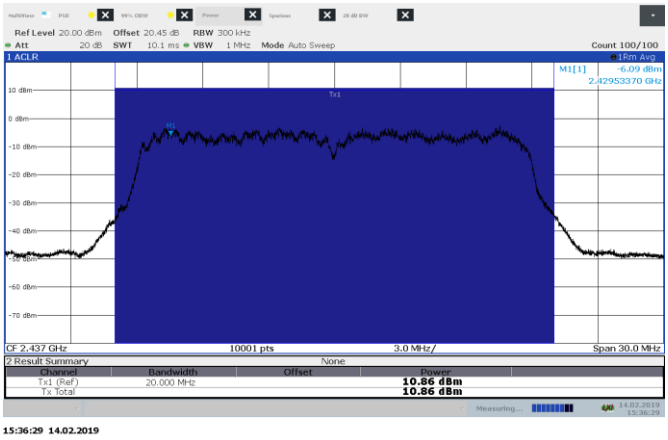


Figure 8.6-3: *Conducted output power on 802.11n HT20, sample plot*

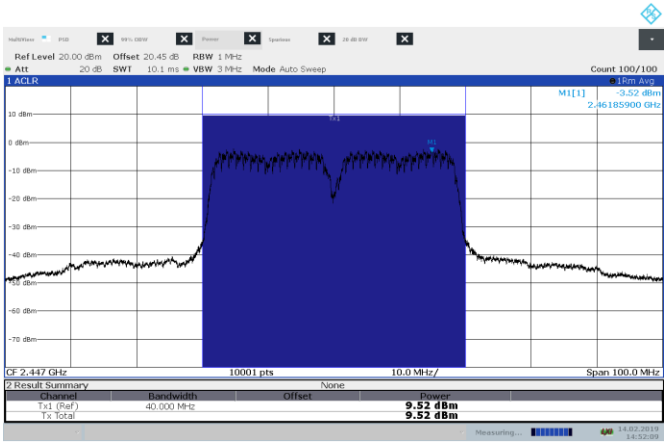


Figure 8.6-4: *Conducted output power on 802.11n HT40, sample plot*

8.7 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.7.1 Definitions and limits

FCC §15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-247 Part 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.7-1: *FCC §15.209 and RSS-Gen – 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

Table 8.7-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Notes: Certain frequency bands listed in and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

8.7.1 Definitions and limits, continued

Table 8.7-3: *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			

Notes: None

8.7.2 Test date

Start date	February 25, 2019

8.7.3 Observations, settings and special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
  EUT was set to transmit with 100 % duty cycle.
- Radiated measurements from 1 – 18 GHz were performed at a distance of 3 m.
- Radiated measurements from 18 - 25 GHz were performed at a distance of 30 cm.
- DTS emissions in non-restricted frequency bands test was performed as per KDB 558074, section 8.5 with reference to ANSI C63.10 subclause 11.11.
- Since fundamental power was tested using maximum conducted (average) output power procedure to demonstrate compliance, the spurious emissions limit is −30 dBc/100 kHz.
- DTS emissions in restricted frequency bands test was performed as per KDB 558074, section 8.6 with reference to ANSI C63.10 subclause 11.12.2.7
- DTS band-edge emission measurements test was performed as per KDB 558074, section 8.7 with reference to ANSI C63.10 subclause 11.13.
- No transmitter related radiated emissions were detected below 1 GHz. Emissions detected within restricted bands that were close to the limit were found to be digital emissions.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz or 120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

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

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

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	RMS
Trace mode:	Average (100 Counts)

Spectrum analyser settings for conducted measurements:

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

8.7.4 Test data

Table 8.7-4: *Radiated field strength measurement results for 802.11b*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	65.18	74.00	8.82	48.61	54.00	5.39
High	2483.5	66.06	74.00	7.94	44.97	54.00	9.03

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

Table 8.7-5: *Radiated field strength measurement results for 802.11g*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	71.27	74.00	2.73	48.22	54.00	5.78
High	2483.5	71.52	74.00	2.48	47.62	54.00	6.38

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

Table 8.7-6: *Radiated field strength measurement results for 802.11n HT20*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	72.29	74.00	1.71	48.92	54.00	5.08
High	2483.5	72.86	74.00	1.14	49.83	54.00	4.17

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

Table 8.7-7: *Radiated field strength measurement results for 802.11n HT40*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	72.29	74.00	1.71	48.92	54.00	5.08
High	2483.5	72.86	74.00	1.14	49.83	54.00	4.17

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

8.7.4 Test data, continued

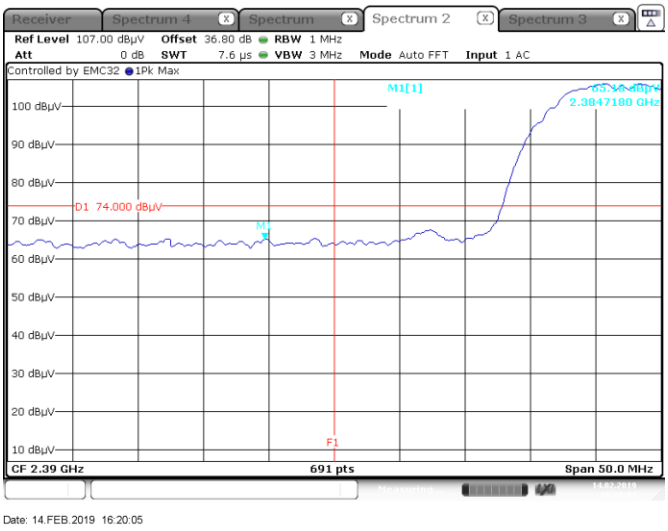


Figure 8.7-1: *Unwanted emissions in restricted band Peak 2390 MHz 802.11b, low channel*

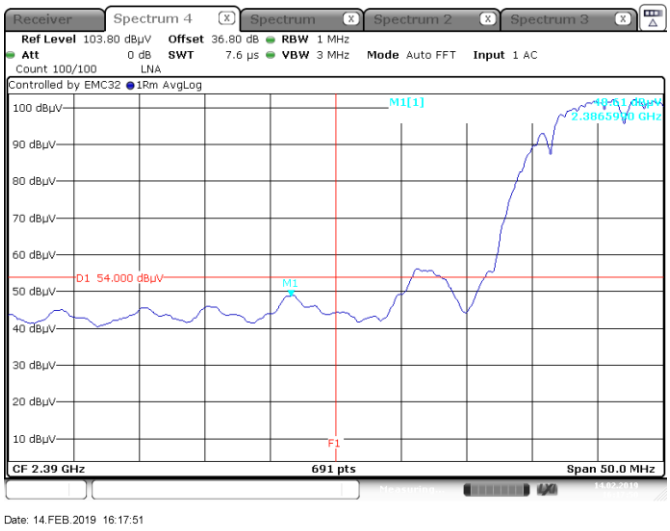


Figure 8.7-2: *Unwanted emissions in restricted band Average 2390 MHz 802.11b, low channel*

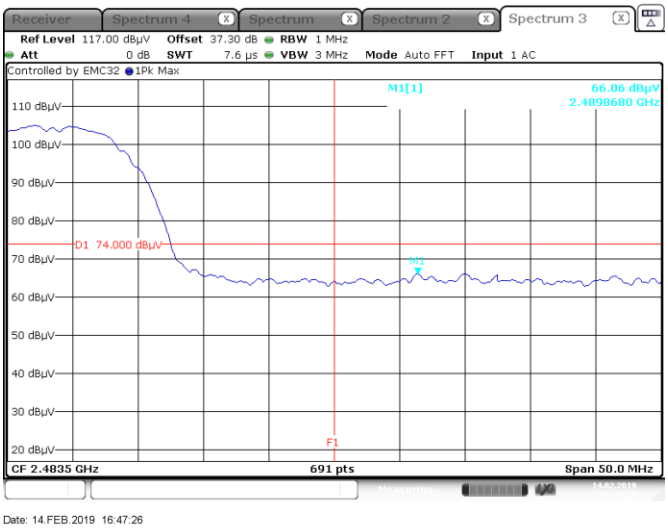


Figure 8.7-3: *Unwanted emissions in restricted band Peak 2483.5 MHz 802.11b, high channel*

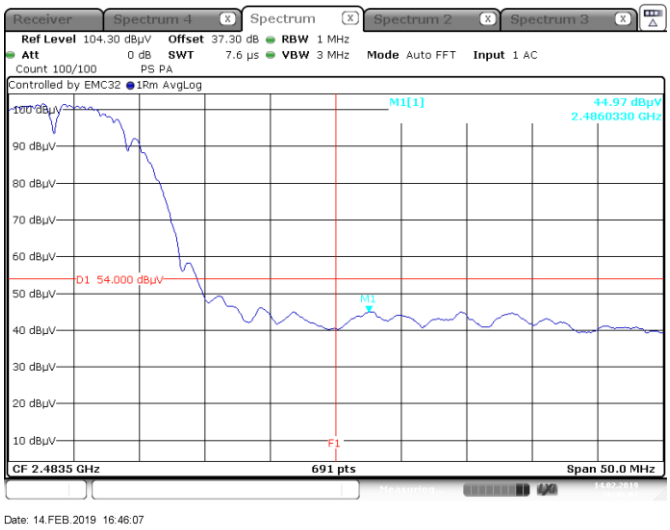


Figure 8.7-4: *Unwanted emissions in restricted band Average 2483.5 MHz 802.11b, high channel*

8.7.4 Test data, continued

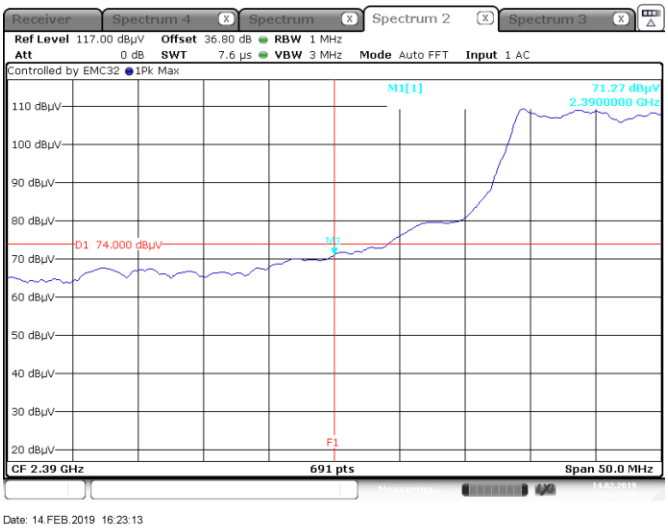


Figure 8.7-5: *Unwanted emissions in restricted band Peak 2390 MHz 802.11g, low channel*

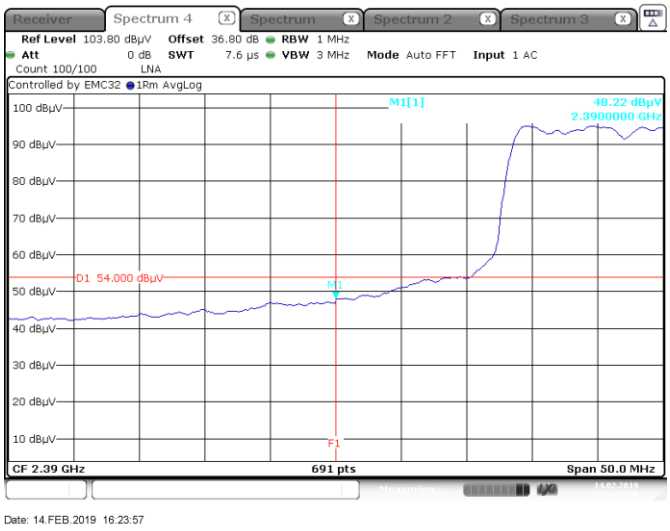


Figure 8.7-6: *Unwanted emissions in restricted band Average 2390 MHz 802.11g, low channel*

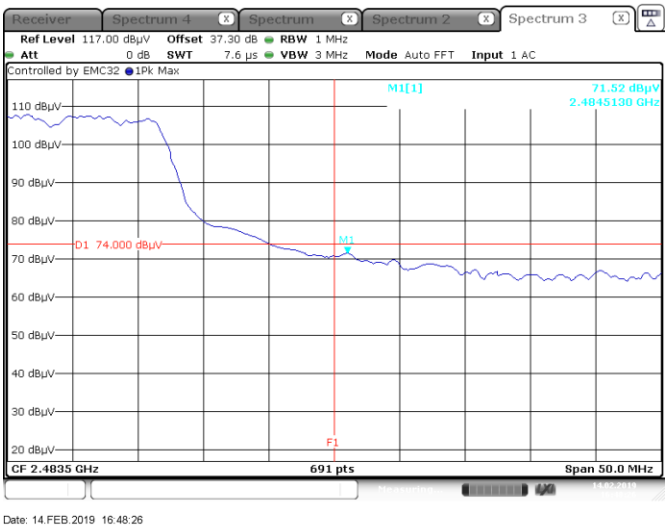


Figure 8.7-7: *Unwanted emissions in restricted band Peak 2483.5 MHz 802.11g, high channel*

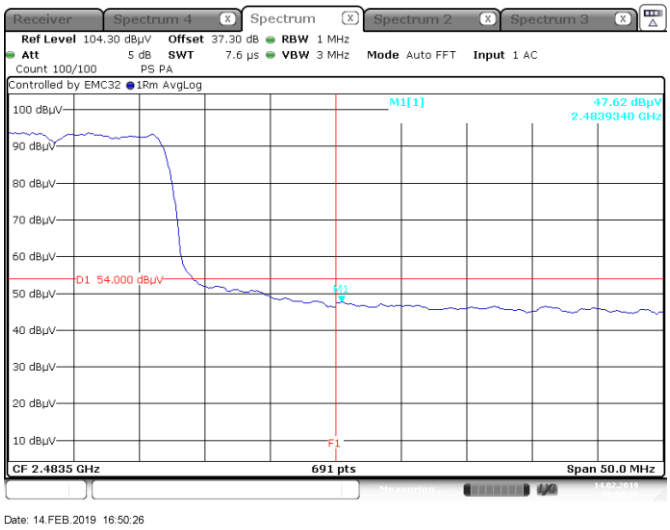


Figure 8.7-8: *Unwanted emissions in restricted band Average 2483.5 MHz 802.11g, high channel*

8.7.4 Test data, continued

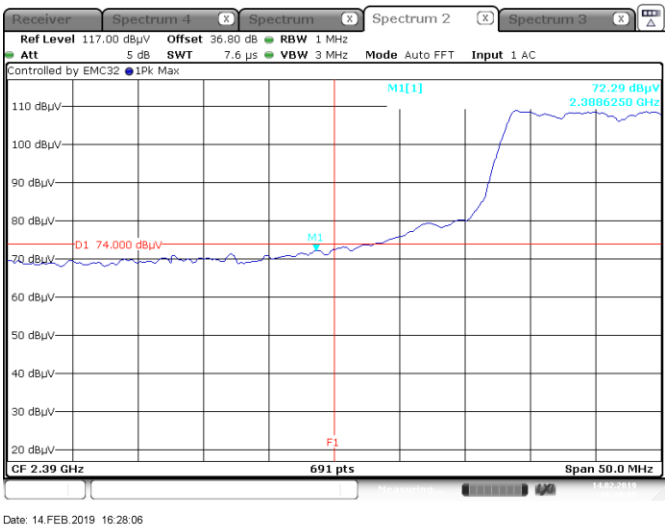


Figure 8.7-9: *Unwanted emissions in restricted band Peak 2390 MHz 802.11n HT20, low channel*

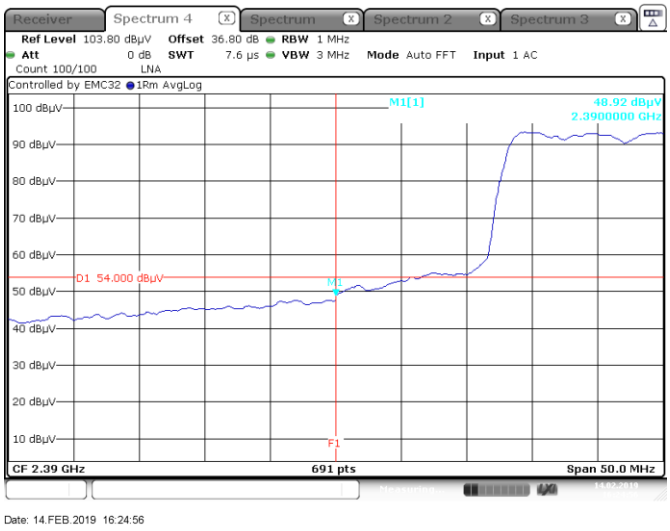


Figure 8.7-10: *Unwanted emissions in restricted band Average 2390 MHz 802.11n HT20, low channel*

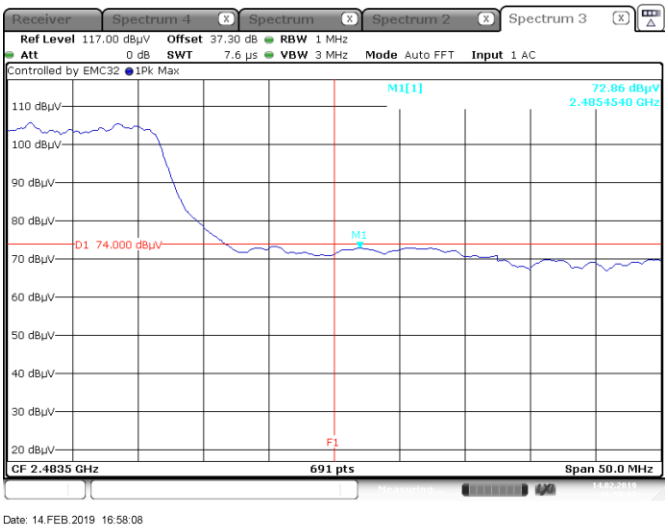


Figure 8.7-11: *Unwanted emissions in restricted band Peak 2483.5 MHz 802.11n HT20, high channel*

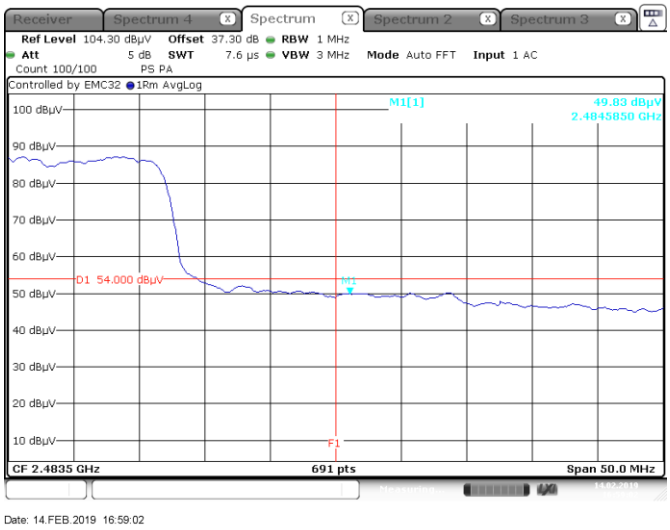


Figure 8.7-12: *Unwanted emissions in restricted band Average 2483.5 MHz 802.11n HT20, high channel*

8.7.4 Test data, continued

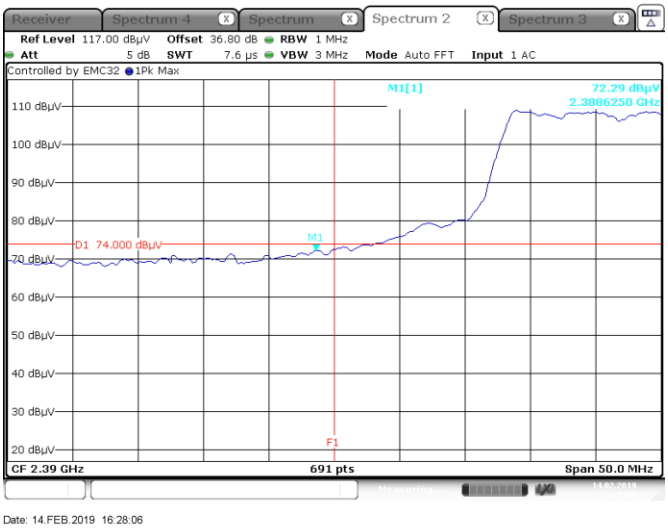


Figure 8.7-13: *Unwanted emissions in restricted band Peak 2390 MHz 802.11n HT40, low channel*

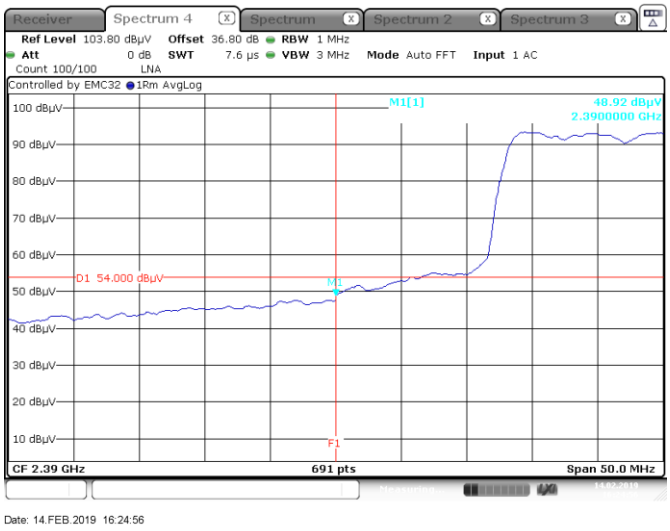


Figure 8.7-14: *Unwanted emissions in restricted band Average 2390 MHz 802.11n HT40, low channel*

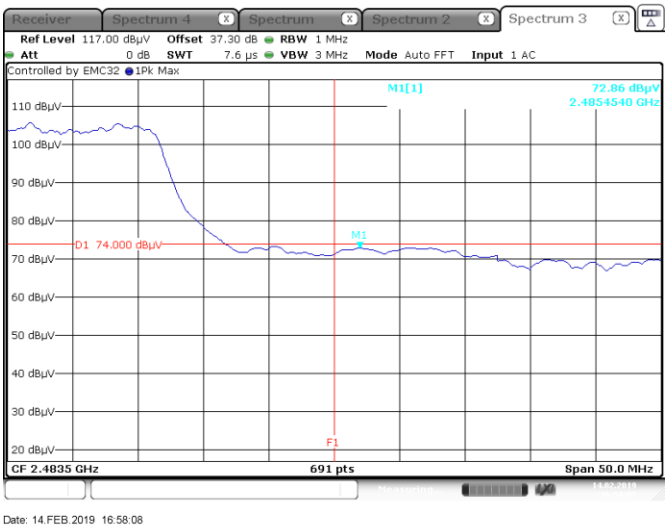


Figure 8.7-15: *Unwanted emissions in restricted band Peak 2483.5 MHz 802.11n HT40, high channel*

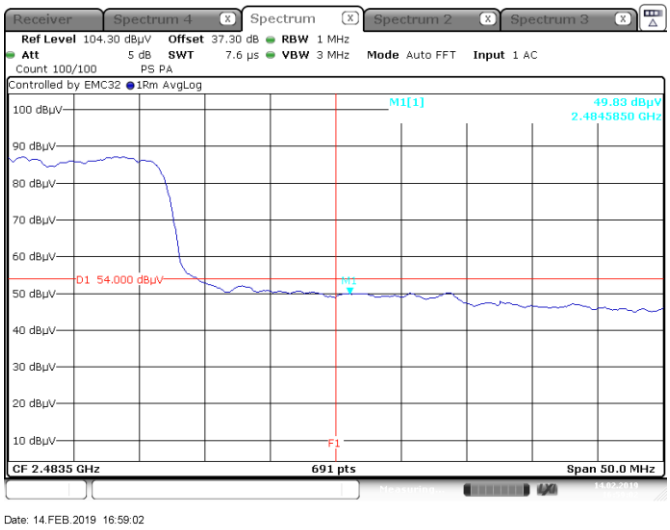


Figure 8.7-16: *Unwanted emissions in restricted band Average 2483.5 MHz 802.11n HT40, high channel*

8.7.4 Test data, continued

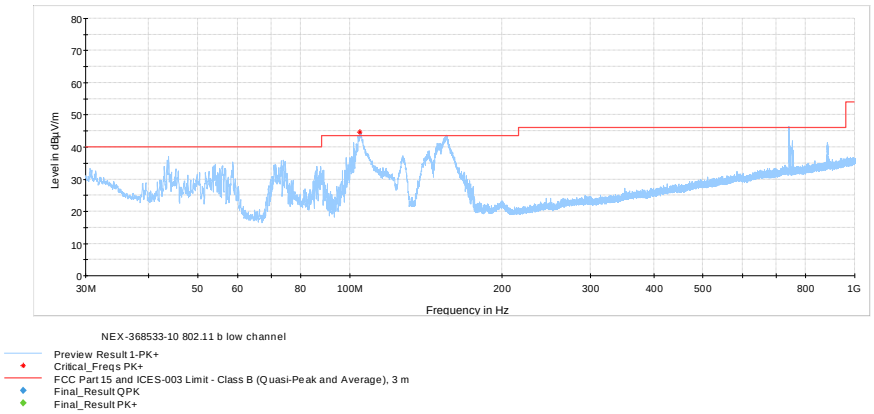


Figure 8.7-17: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, low channel*

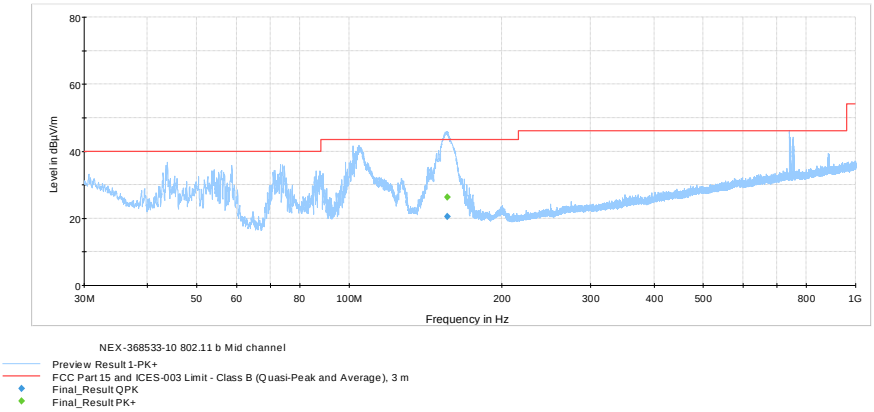


Figure 8.7-18: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, mid channel*

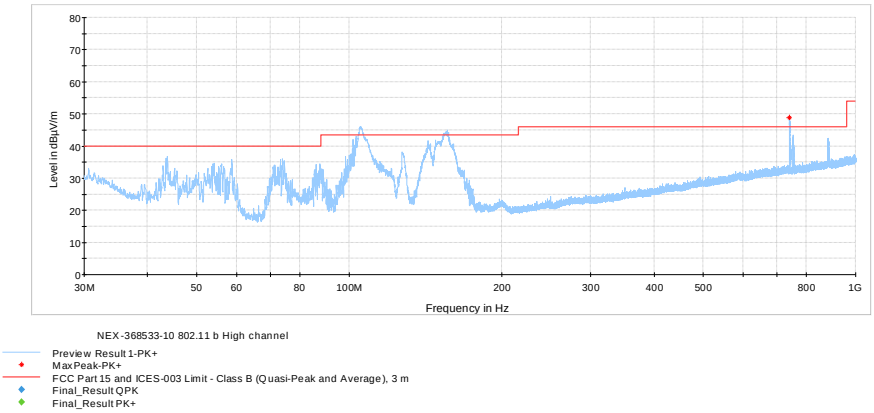


Figure 8.7-19: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, high channel*

8.7.4 Test data, continued

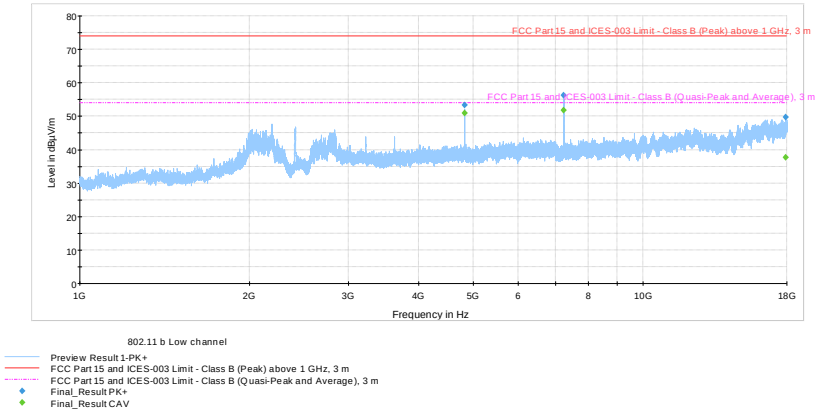


Figure 8.7-20: *Radiated spurious emissions 1 - 18 GHz for 802.11b, low channel*

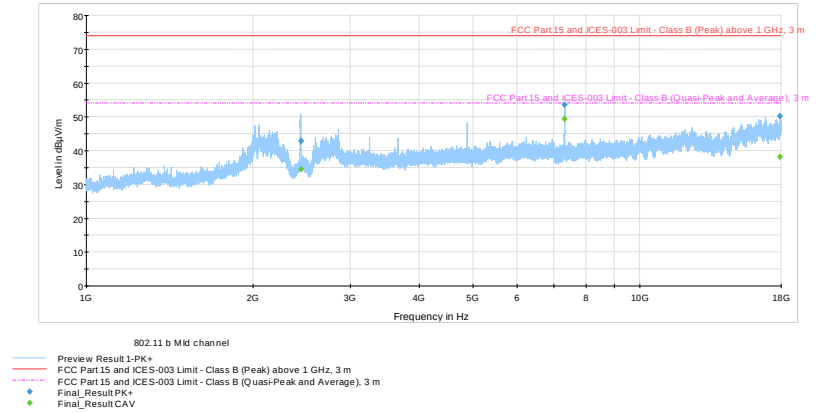


Figure 8.7-21: *Radiated spurious emissions 1 - 18 GHz for 802.11b, mid channel*

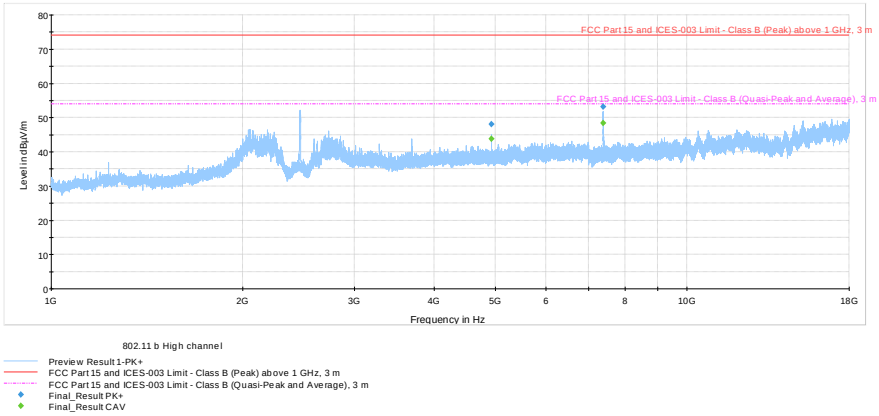


Figure 8.7-22: *Radiated spurious emissions 1 - 18 GHz for 802.11b, high channel*

8.7.4 Test data, continued

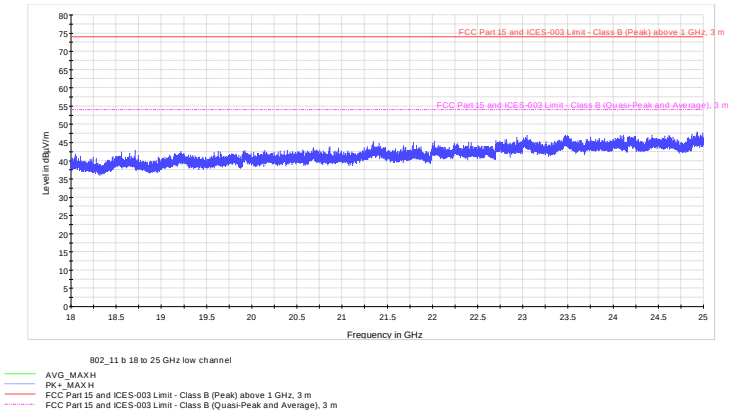


Figure 8.7-23: *Radiated spurious emissions 18 - 25 GHz for 802.11b, low channel*

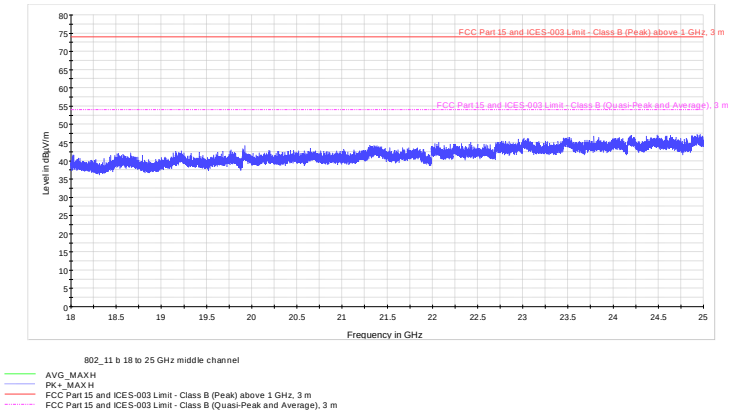


Figure 8.7-24: *Radiated spurious emissions 18 - 25 GHz for 802.11b, mid channel*

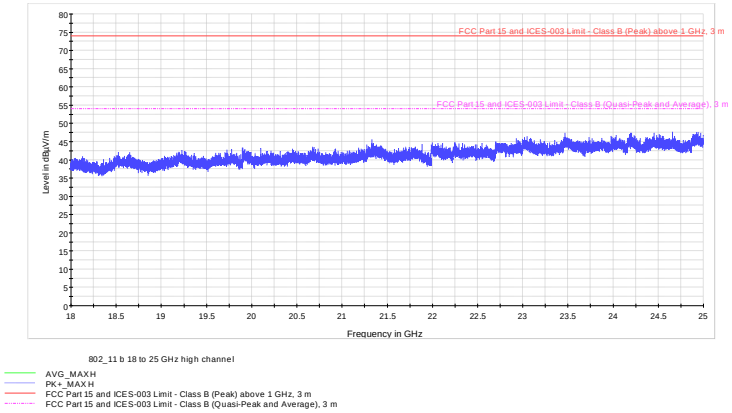


Figure 8.7-25: *Radiated spurious emissions 18 - 25 GHz for 802.11b, high channel*

8.7.4 Test data, continued

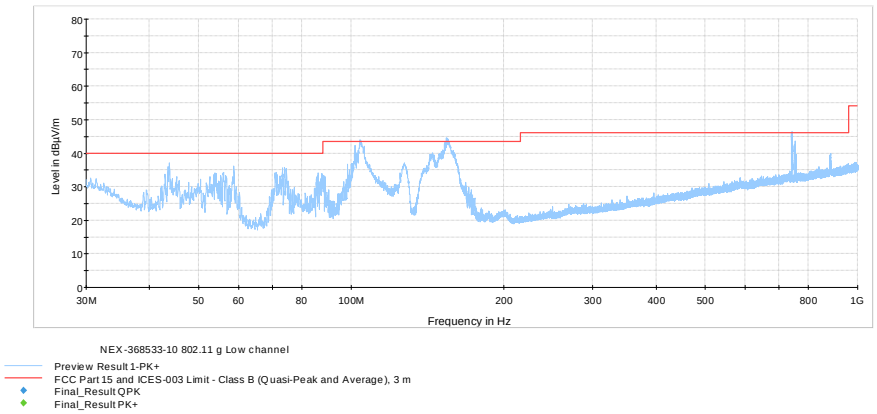


Figure 8.7-26: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, low channel*

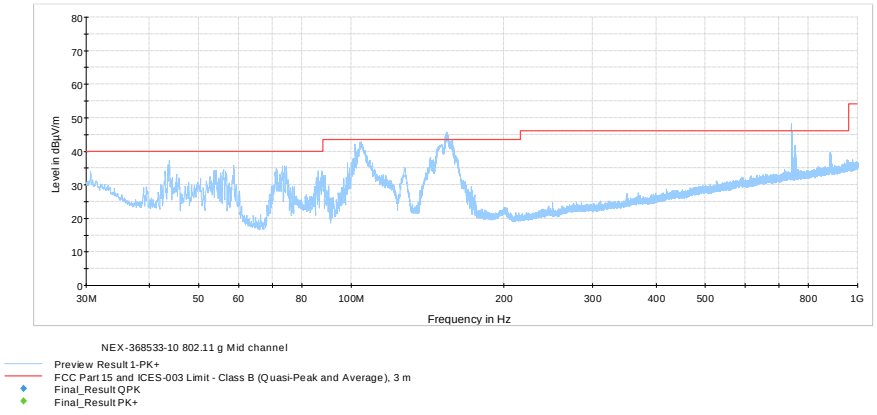


Figure 8.7-27: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, mid channel*

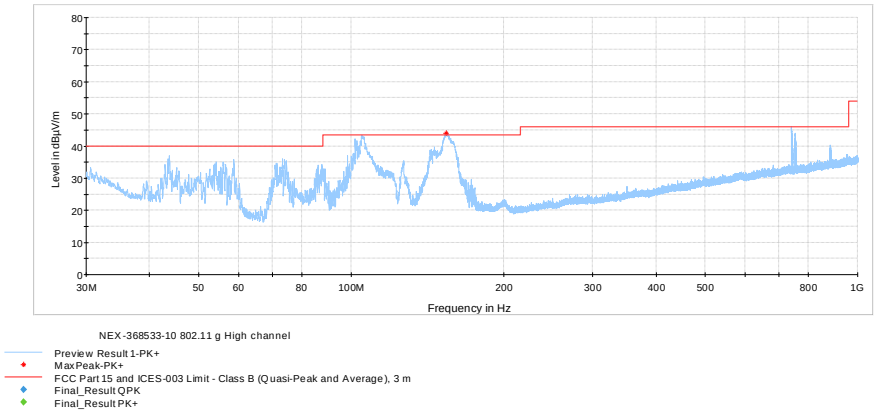


Figure 8.7-28: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, high channel*

8.7.4 Test data, continued

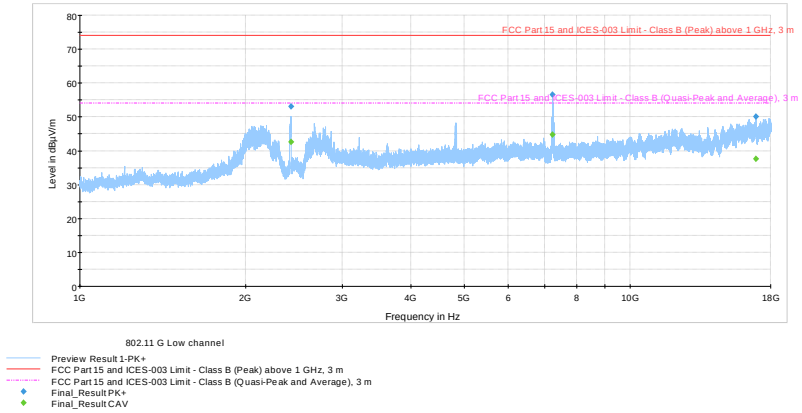


Figure 8.7-29: *Radiated spurious emissions 1 - 18 GHz for 802.11g, low channel*

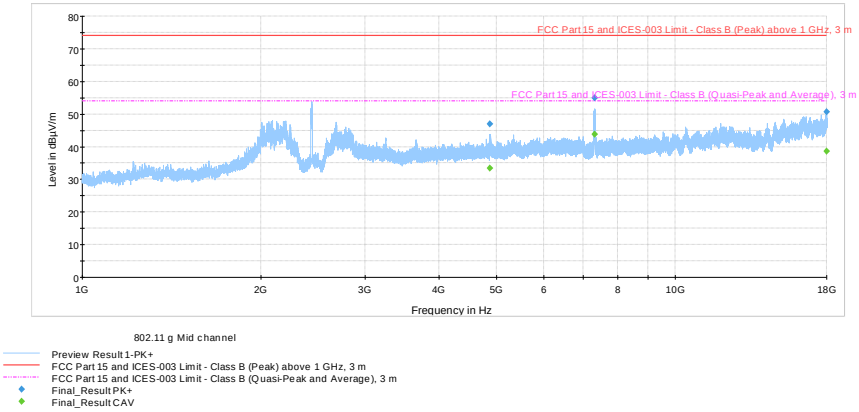


Figure 8.7-30: *Radiated spurious emissions 1 - 18 GHz for 802.11g, mid channel*

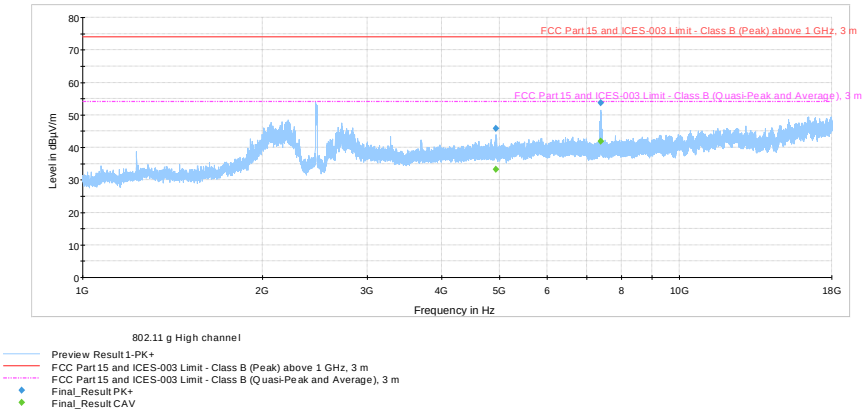


Figure 8.7-31: *Radiated spurious emissions 1 - 18 GHz for 802.11g, high channel*

8.7.4 Test data, continued

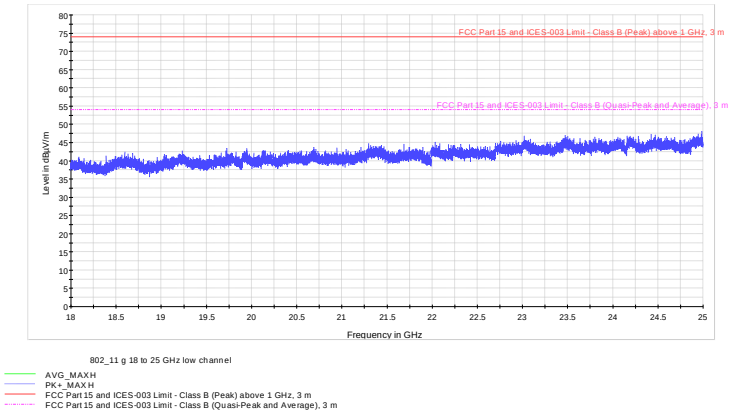


Figure 8.7-32: *Radiated spurious emissions 18 - 25 GHz for 802.11g, low channel*

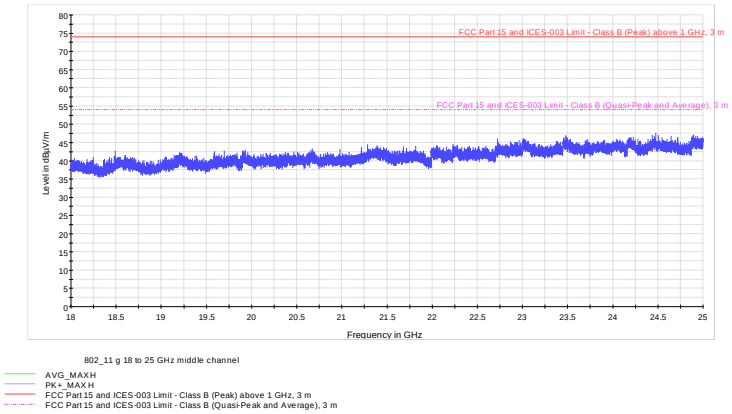


Figure 8.7-33: *Radiated spurious emissions 18 - 25 GHz for 802.11g, mid channel*

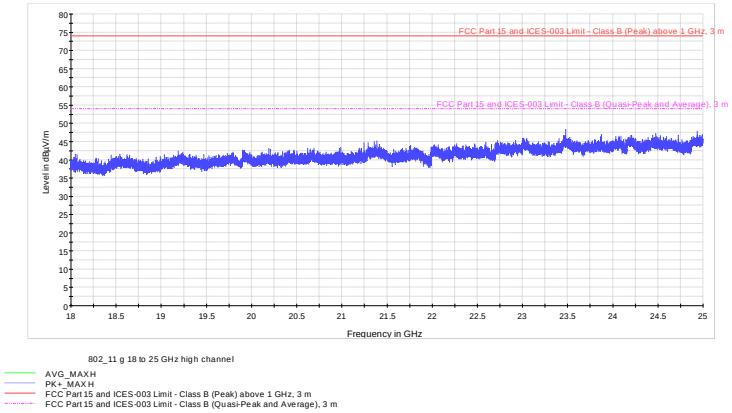


Figure 8.7-34: *Radiated spurious emissions 18 - 25 GHz for 802.11g, high channel*

8.7.4 Test data, continued

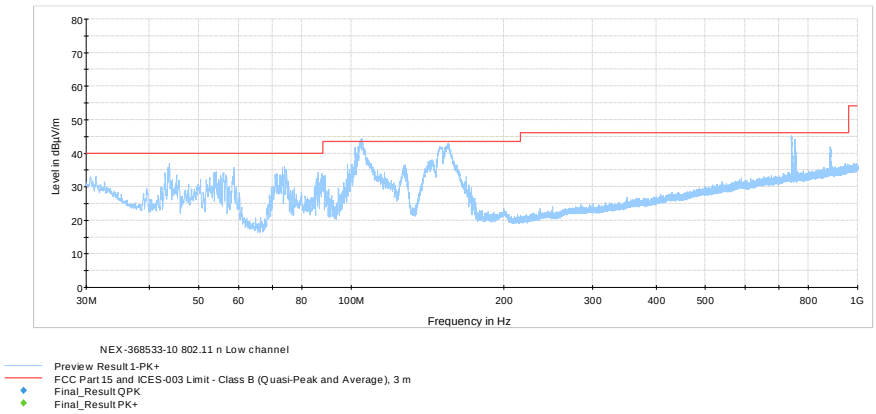


Figure 8.7-35: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, low channel*

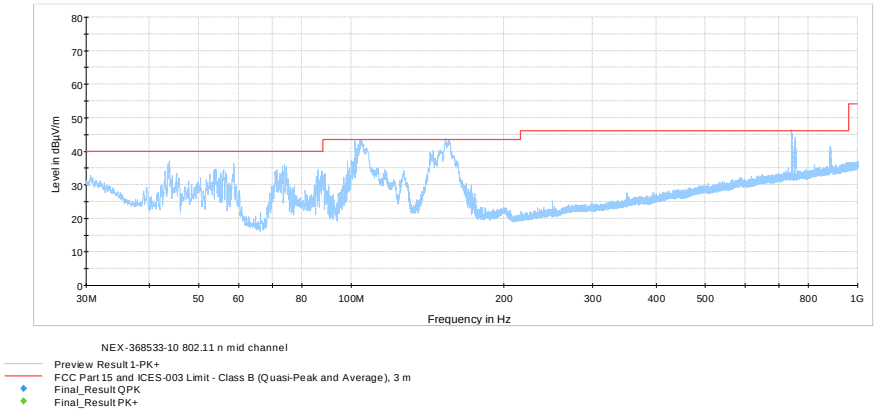


Figure 8.7-36: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, mid channel*

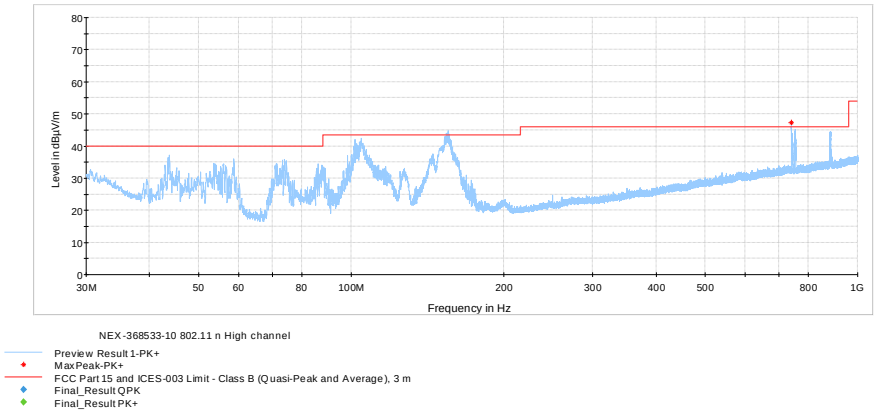


Figure 8.7-37: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, high channel*

8.7.4 Test data, continued

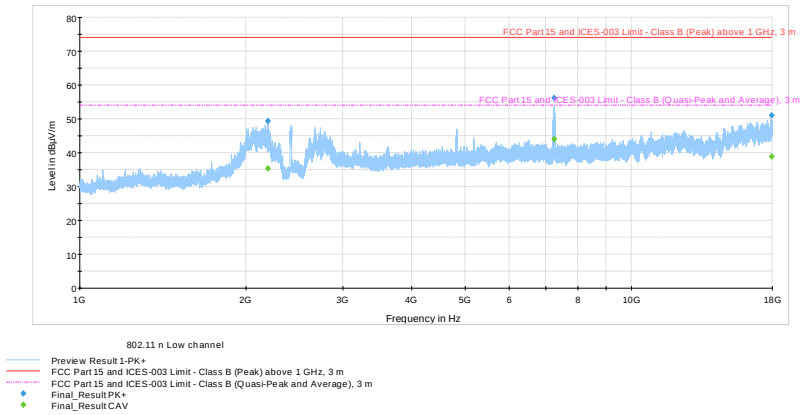


Figure 8.7-38: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, low channel*

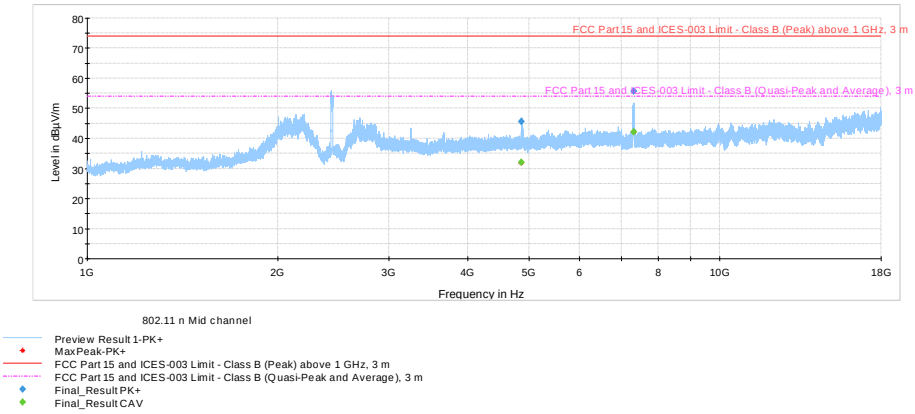


Figure 8.7-39: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, mid channel*

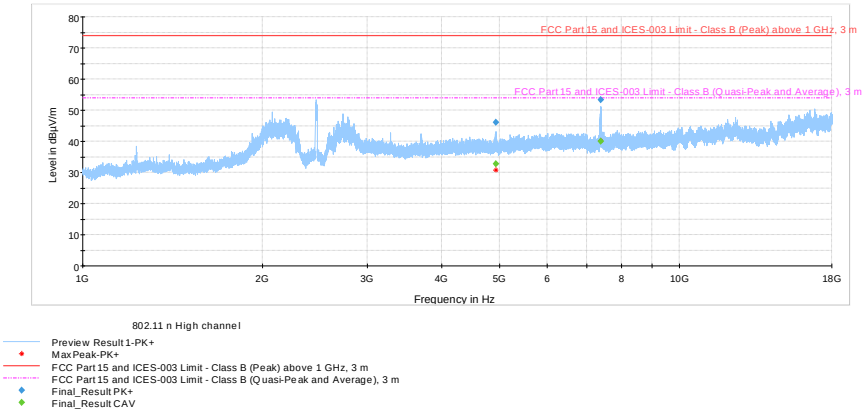


Figure 8.7-40: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, high channel*

8.7.4 Test data, continued

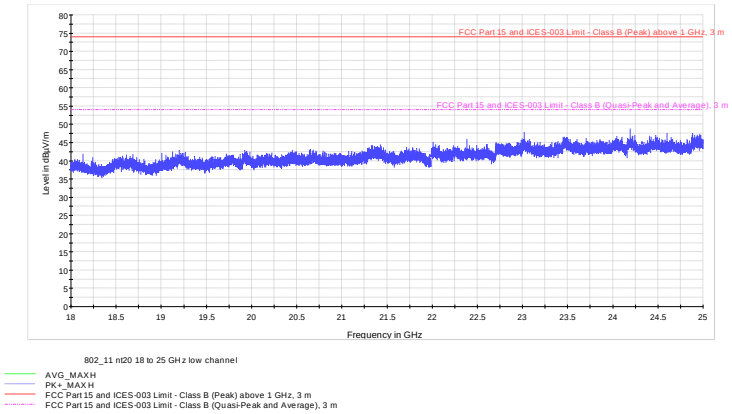


Figure 8.7-41: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, low channel*

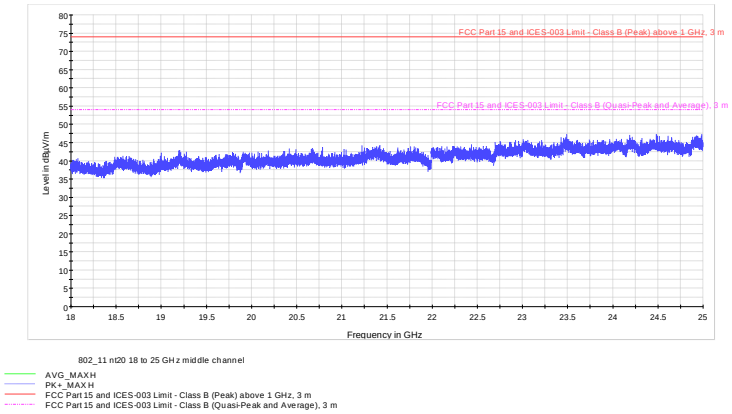


Figure 8.7-42: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, mid channel*

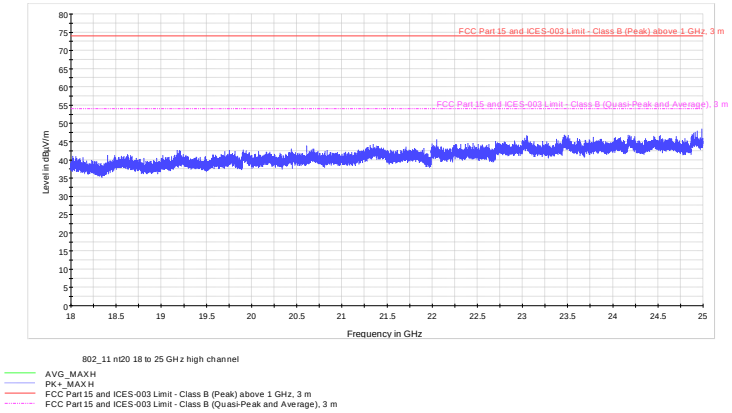


Figure 8.7-43: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, high channel*

8.7.4 Test data, continued

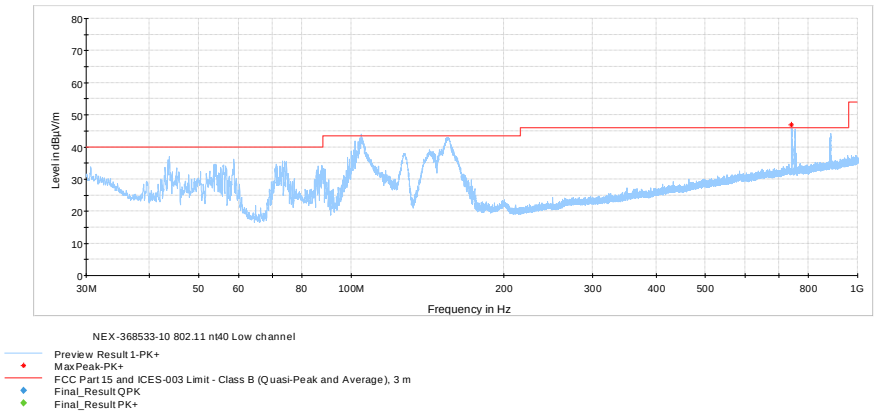


Figure 8.7-44: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT40, low channel*

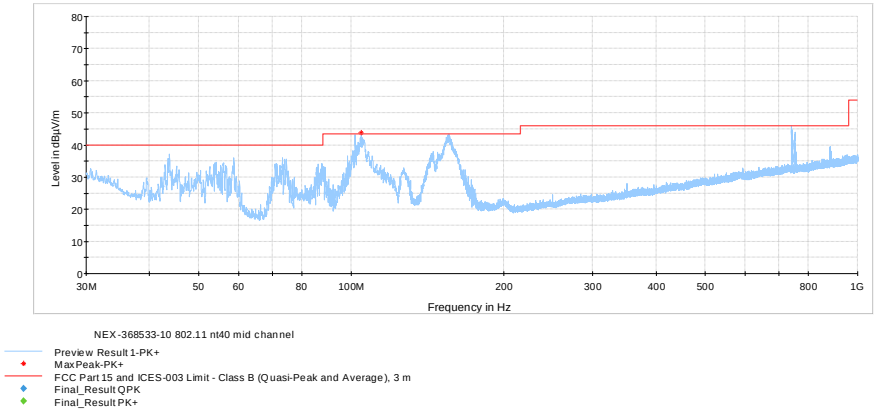


Figure 8.7-45: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT40, mid channel*

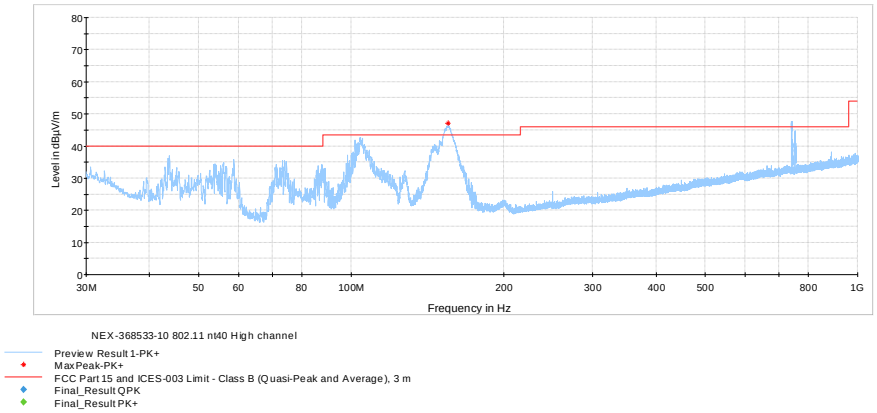


Figure 8.7-46: *Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT40, high channel*

8.7.4 Test data, continued

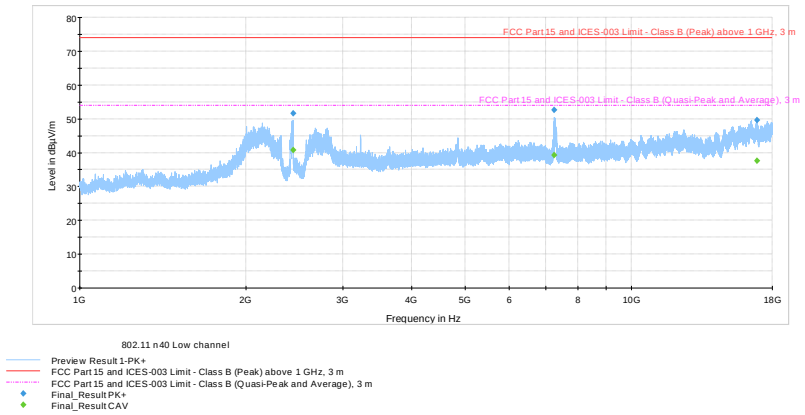


Figure 8.7-47: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT40, low channel*

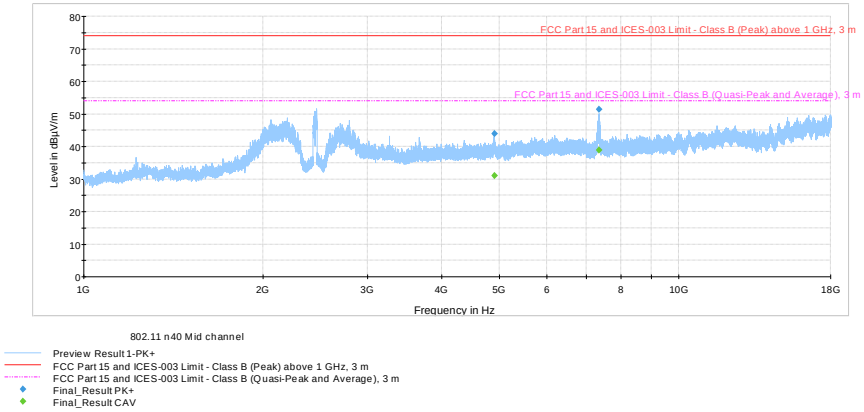


Figure 8.7-48: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT40, mid channel*

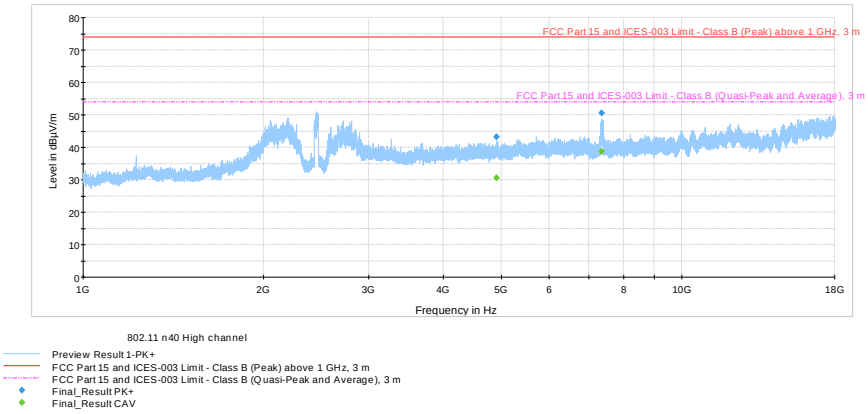


Figure 8.7-49: *Radiated spurious emissions 1 - 18 GHz for 802.11n HT40, high channel*

8.7.4 Test data, continued

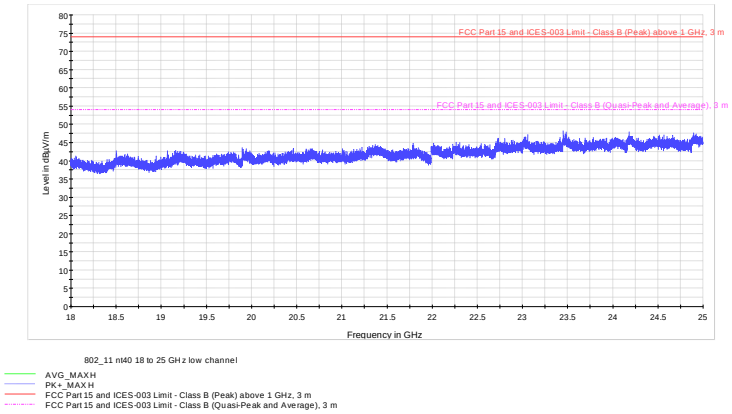


Figure 8.7-50: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT40, low channel*

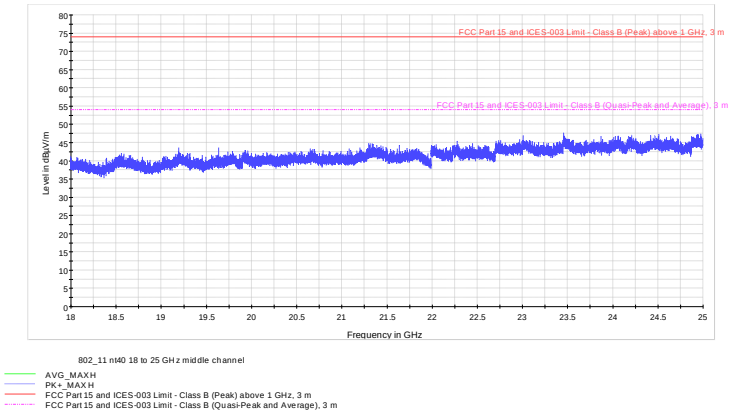


Figure 8.7-51: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT40, mid channel*

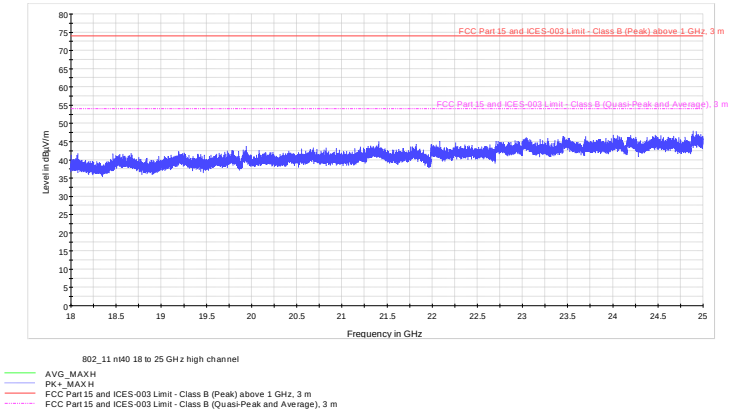


Figure 8.7-52: *Radiated spurious emissions 18 - 25 GHz for 802.11n HT40, high channel*

8.7.4 Test data, continued

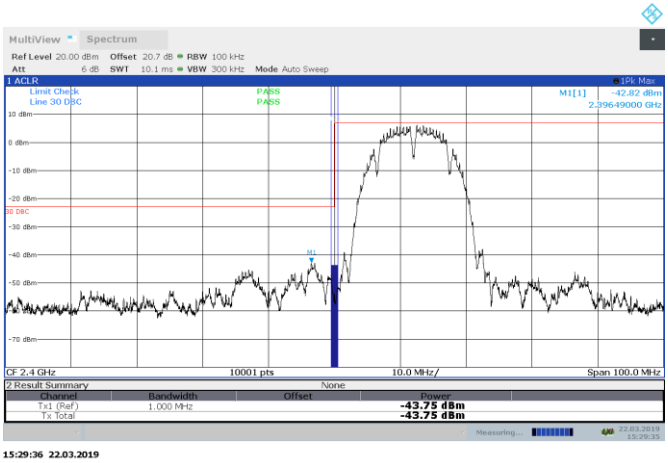


Figure 8.7-53: *Conducted band edge emissions for 802.11b, low channel*

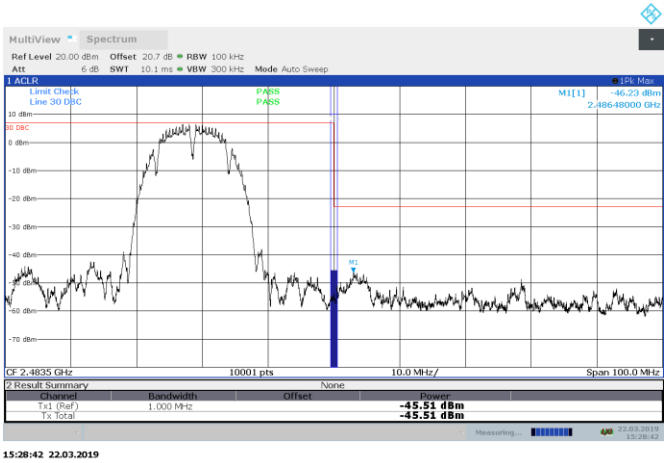


Figure 8.7-54: *Conducted band edge emissions for 802.11b, high channel*

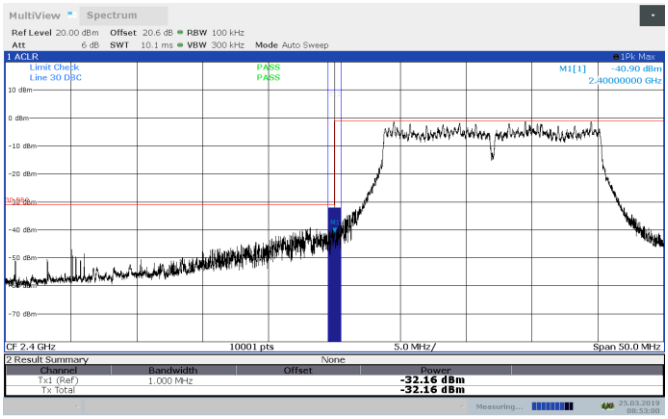


Figure 8.7-55: *Conducted band edge emissions for 802.11g, low channel*

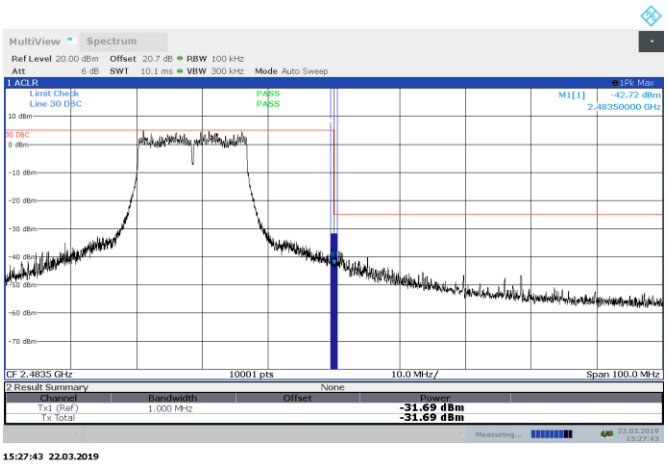


Figure 8.7-56: *Conducted band edge emissions for 802.11g, high channel*

8.7.4 Test data, continued

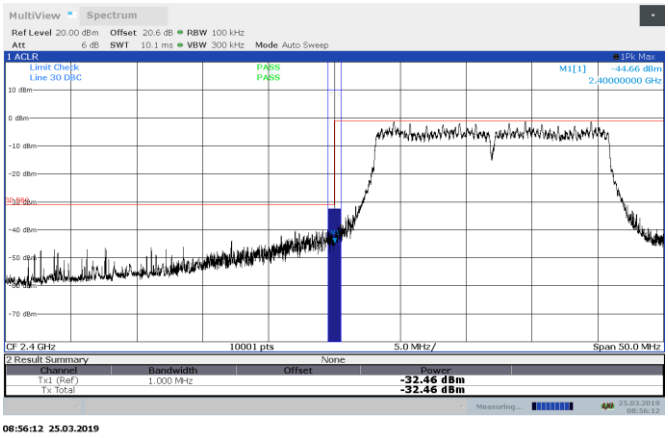


Figure 8.7-57: *Conducted band edge emissions for 802.11n HT20, low channel*

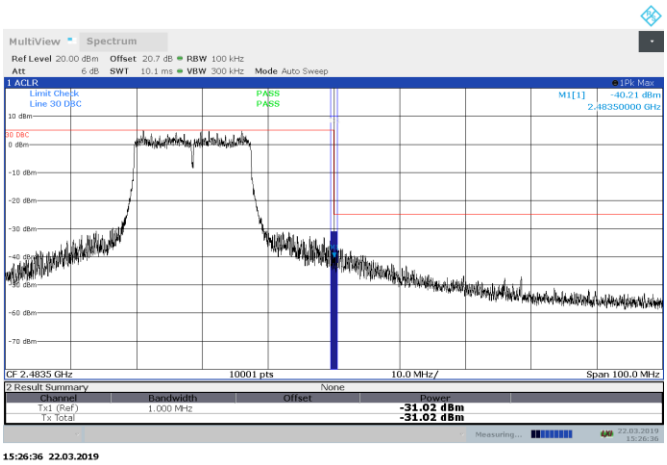


Figure 8.7-58: *Conducted band edge emissions for 802.11n HT20, high channel*

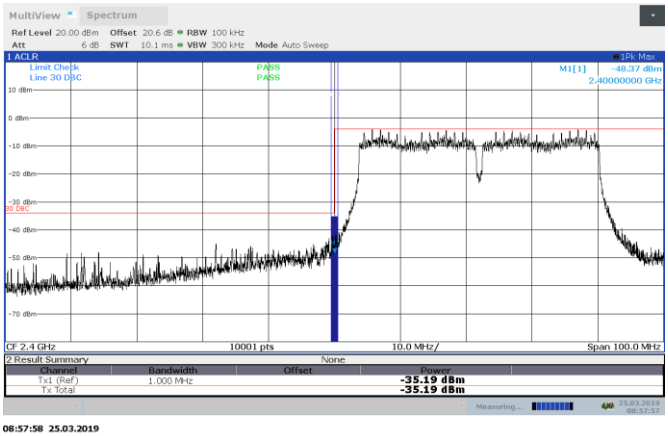


Figure 8.7-59: *Conducted band edge emissions for 802.11n HT40, low channel*

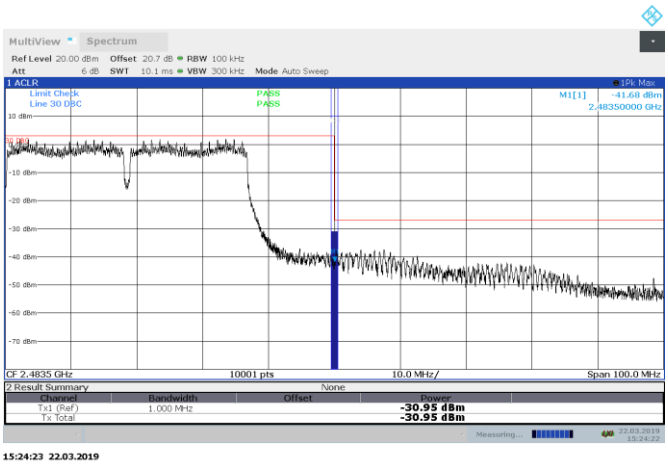


Figure 8.7-60: *Conducted band edge emissions for 802.11n HT40, high channel*

8.7.4 Test data, continued

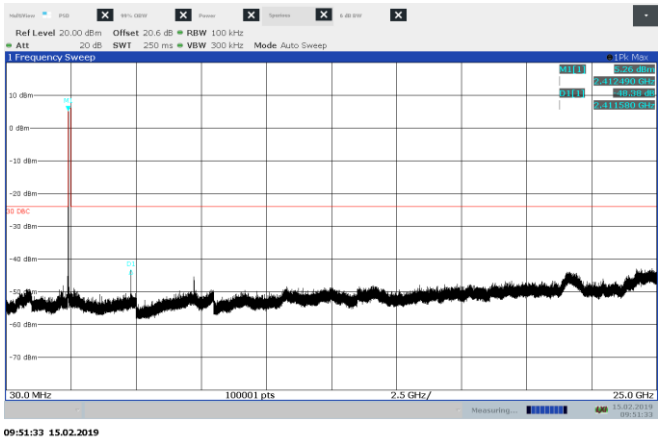


Figure 8.7-61: *Conducted spurious emissions for 802.11b, low channel*

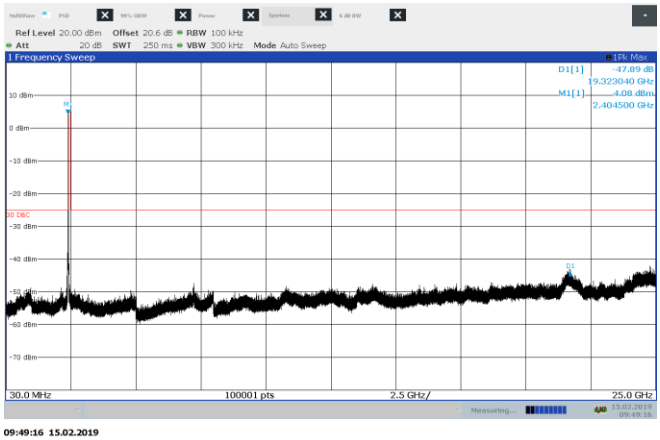


Figure 8.7-62: *Conducted spurious emissions for 802.11g, low channel*

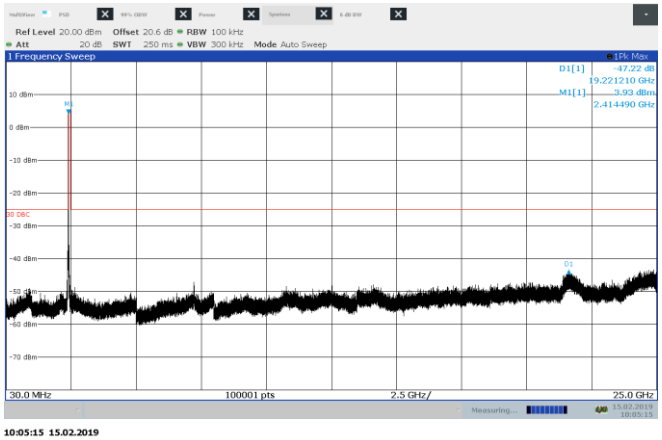


Figure 8.7-63: *Conducted spurious emissions for 802.11n HT20, low channel*

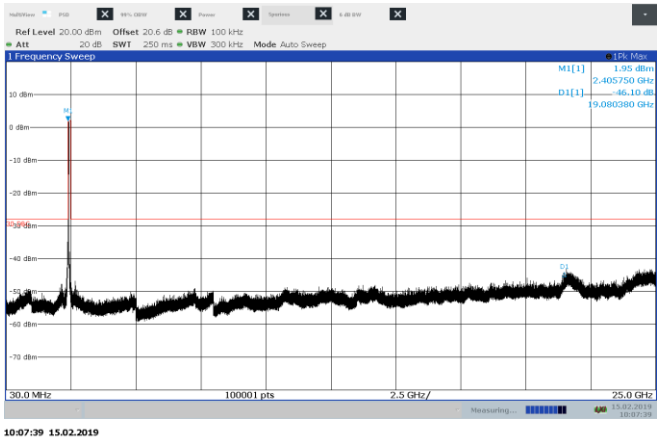


Figure 8.7-64: *Conducted spurious emissions for 802.11n HT40, low channel*

8.7.4 Test data, continued

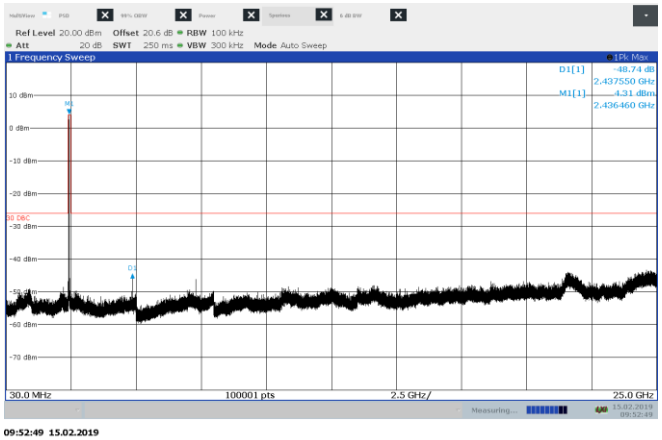


Figure 8.7-65: *Conducted spurious emissions for 802.11b, mid channel*

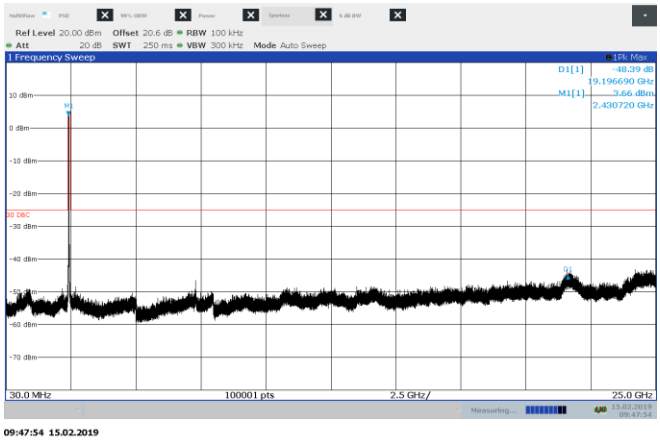


Figure 8.7-66: *Conducted spurious emissions for 802.11g, mid channel*

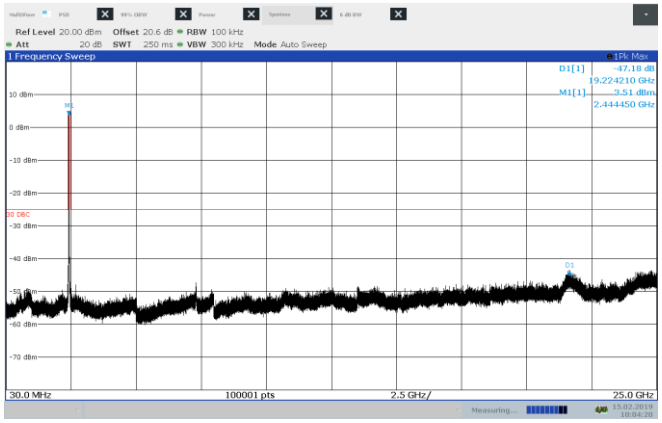


Figure 8.7-67: *Conducted spurious emissions for 802.11n HT20, mid channel*

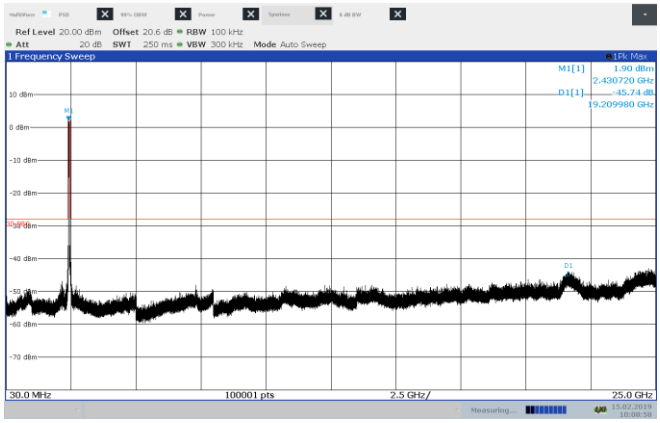


Figure 8.7-68: *Conducted spurious emissions for 802.11n HT40, mid channel*

8.7.4 Test data, continued

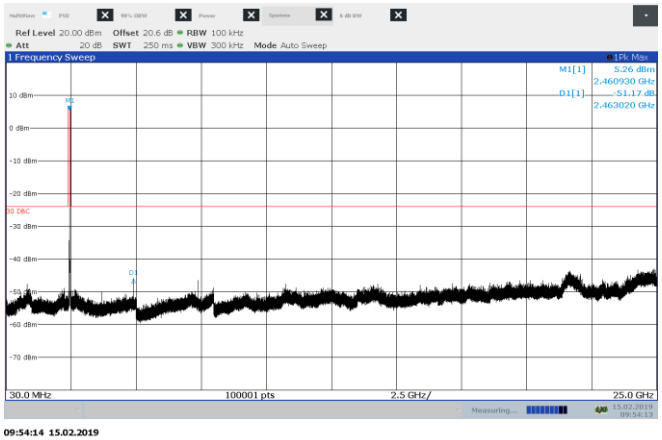


Figure 8.7-69: *Conducted spurious emissions for 802.11b, high channel*

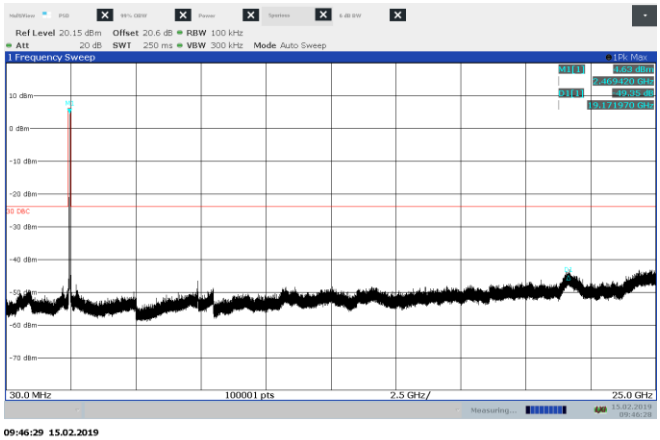


Figure 8.7-70: *Conducted spurious emissions for 802.11g, high channel*

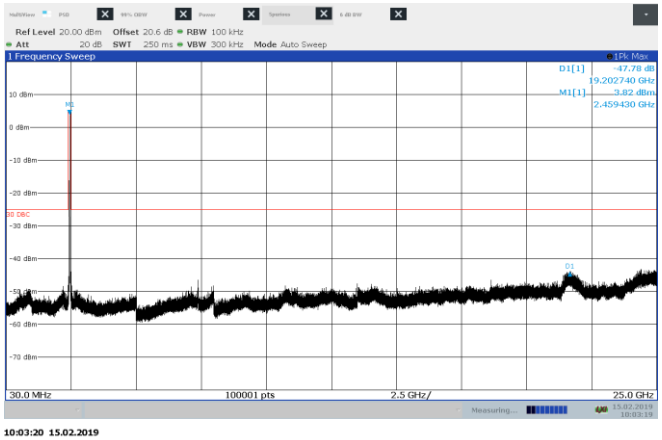


Figure 8.7-71: *Conducted spurious emissions for 802.11n HT20, high channel*

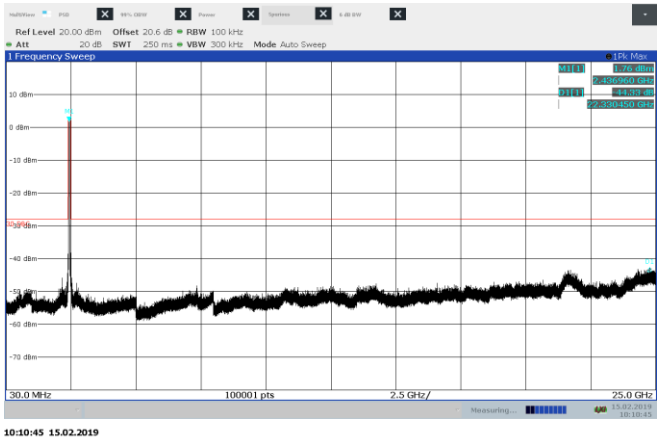


Figure 8.7-72: *Conducted spurious emissions for 802.11n HT40, high channel*

8.8 FCC 15.247(e) and RSS-247 5.2(b) Power spectral density for digitally modulated devices

8.8.1 Definitions and limits

FCC:
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

ISED:
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.3 Hybrid systems
Hybrid systems employ a combination of both frequency hopping and digital transmission techniques and shall comply with the following:

a. With the frequency hopping turned off, the digital transmission operation shall comply with the power spectral density requirements for digital modulation systems set out in of section 5.2(b) or section 6.2.4 for hybrid devices operating in the band 5725–5850 MHz.

8.8.1 Test date

Start date	February 14, 2019

8.8.2 Observations, settings and special notes

Power spectral density test was performed as per KDB 558074, section 8.4 with reference to ANSI C63.10 subclause 11.10.
The test was performed using method AVGPSD-1 (trace averaging with EUT transmitting at full power throughout each sweep).
Spectrum analyser settings:

Resolution bandwidth:	3 kHz
Video bandwidth:	≥3 × RBW
Frequency span:	≥ 1.5 times the OBW
Detector mode:	RMS
Trace mode:	Average
Averaging sweeps number:	100

8.8.3 Test data

Table 8.8-1: *PSD measurements results*

Modulation	Frequency, MHz	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
802.11b	2412	-18.1	8.00	26.1
	2437	-18.9	8.00	26.9
	2462	-19.8	8.00	27.8
802.11g	2422	-14.1	8.00	22.1
	2437	-13.9	8.00	21.9
	2457	-14.0	8.00	22.0
802.11n HT20	2412	-14.5	8.00	22.5
	2437	-14.5	8.00	22.5
	2462	-14.4	8.00	22.4
802.11n HT40	2422	-16.8	8.00	24.8
	2437	-17.8	8.00	25.8
	2452	-17.1	8.00	25.1

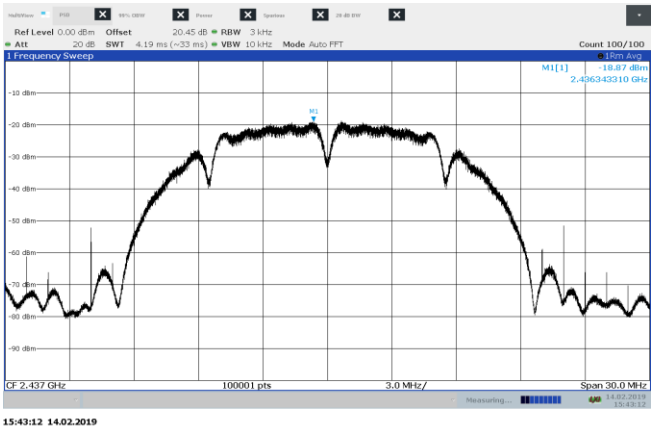


Figure 8.8-1: PSD sample plot on 802.11b

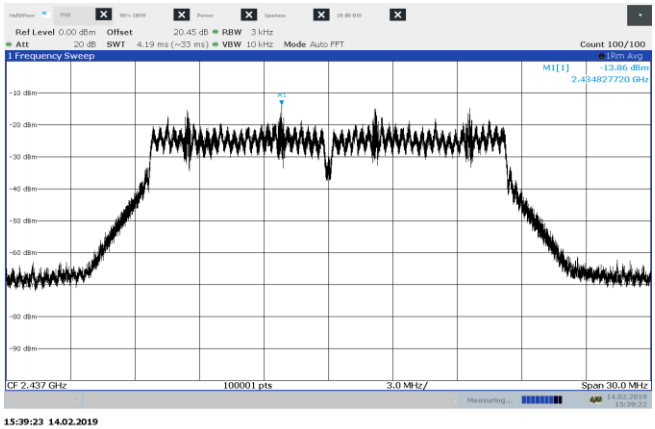


Figure 8.8-2: PSD sample plot on 802.11g

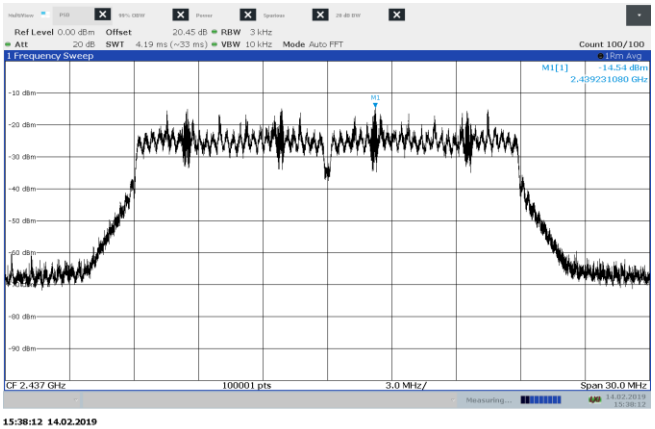


Figure 8.8-3: PSD sample plot on 802.11n HT40

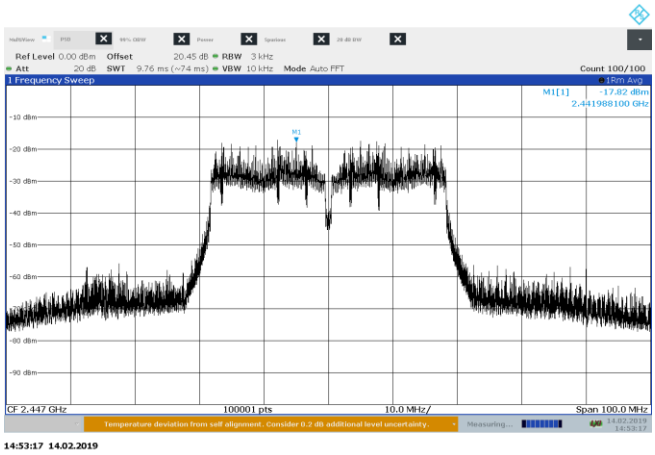
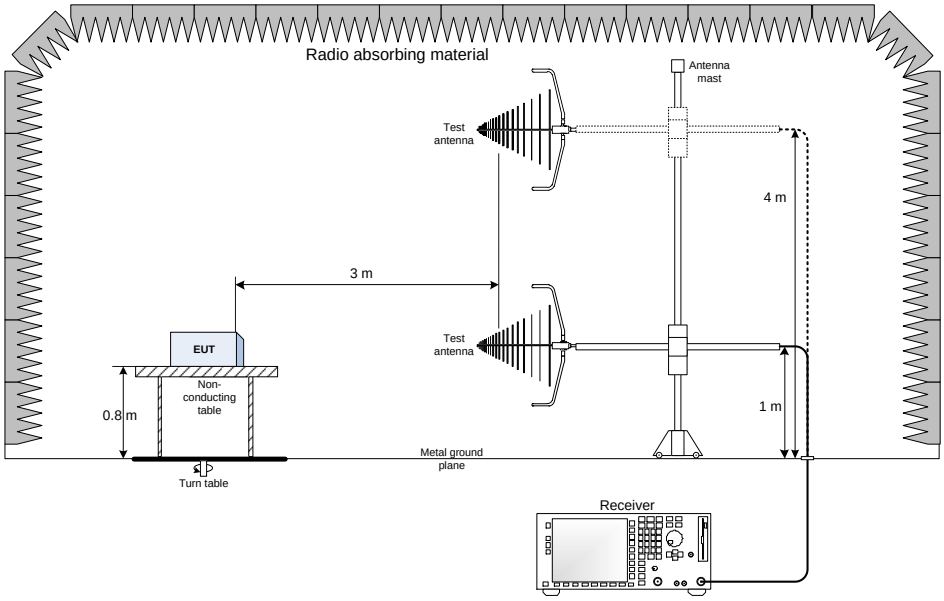


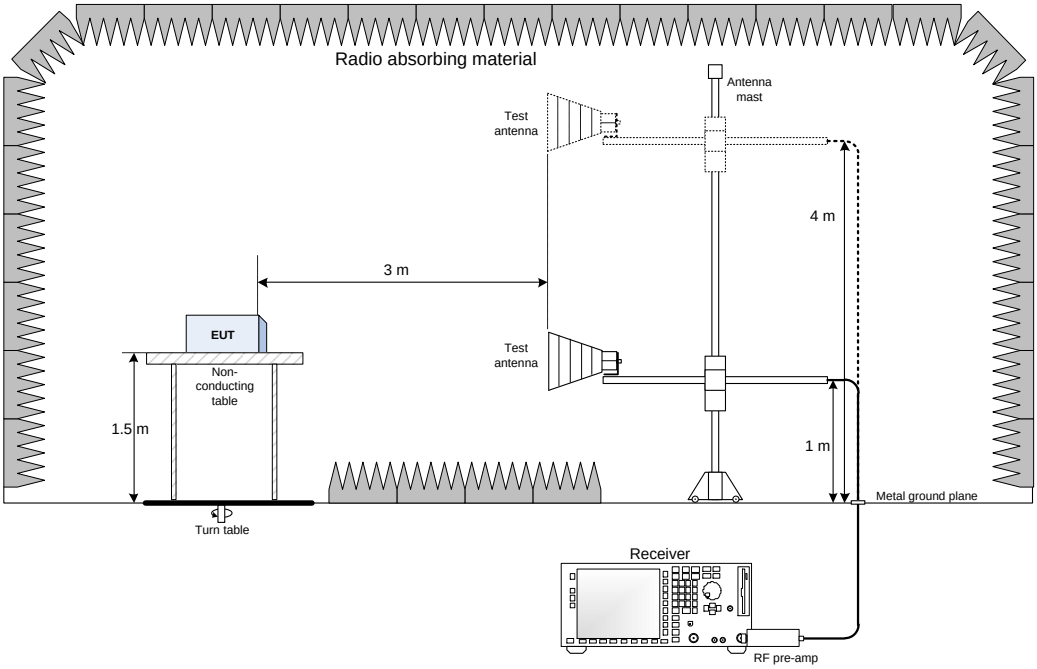
Figure 8.8-4: PSD sample plot on 802.11n HT40

Section 9. Block diagrams of test set-ups

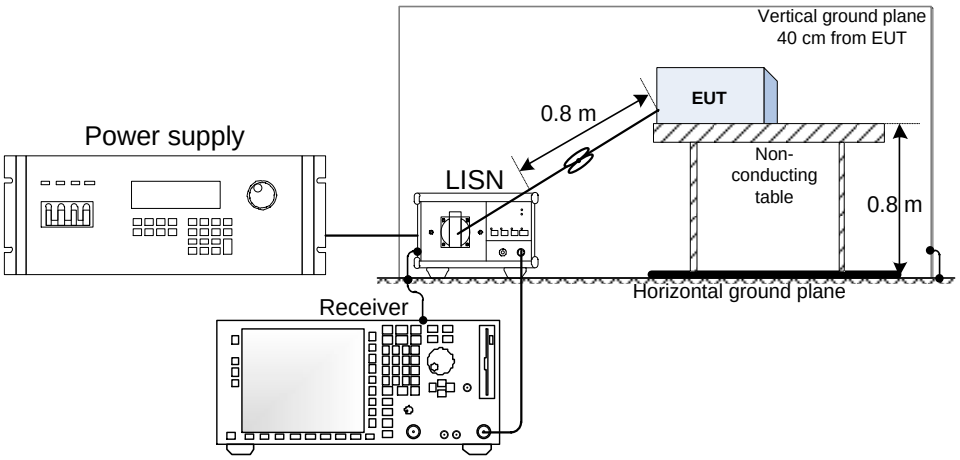
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up



9.4 Antenna port set-up