FCC Test Report

Report Number		UCSFR-1904-0002		
Applicant	Company Name	TO21COMMS		
	Address	2-504, Ace High-End Tower2, 61, Digital-ro-26gil, Guro-gu, Seoul, KOREA		
Product	FCCID	2AMJ7-SQGLASS		
	Product Name	Smart Glass		
	Model Name	SQ Glass		
	Manufacturer	TO21COMMS		
	Serial No.	-		
Other	Receipt Date	2019-01-28	Receipt Number	UCS-R-2019-0180
	Issued Date	2019-04-15	Tested Date	2019-04-04 ~ 2019-04-12
Standards	FCC CFR 47 PART 15 SUBPART C, Section 15.247, ANSI C 63.10(2013), KDB 558074 D01(2019)			
Tested by	H. S. Lee (Sign)			
Approved by	T. Y. Yoon (Sign)			

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Contents

Revision History

Issued Report No.	Issued Date	Revisions	Effect section
UCSFR-1904-0002	2019-04-15	Initial Issue	All

1. APPLICANT AND MANUFACTURER INFORMATION

-. Applicant : TO21COMMS
-. Addres : 2-504, Ace High-End Tower2, 61, Digital-ro-26gil, Guro-gu, Seoul, KOREA
-. Manufacturer : TO21COMMS
-. Addres : 2-504, Ace High-End Tower2, 61, Digital-ro-26gil, Guro-gu, Seoul, KOREA

2. EUT DESCRIPTION

Model	SQ Glass	
Power Supply	DC 3.70 V (Li-ion Battery)	
Frequency Range	TX: 2 412 MHz ~ 2 472 MHz RX: 2 412 MHz ~ 2 472 MHz	
Output Power	Peak	Wi-Fi 802.11n_HT20 (-3.70 dBm)
	Average	Wi-Fi 802.11n_HT20 (-6.03 dBm)
Modulation Type	OFDM(BPSK/QPSK/16QAM/64QAM)	
Antenna Specification	Manufacturer : AMOTECH Co.,Ltd. Antenna type : Internal Antenna Peak Gain : 3.5 dBi	

3. Laboratory Information

3.1 Laboratory Name

UCS.co.,Ltd.

3.2 Location

UCS Co., Ltd.

#702, 268, Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056 Korea.

ER Center

1379-6, seohae-ro, Paltan-myeon, Hwaseong-si, Gyeonggi-do, 18524, KOREA

Test site

- FCC Registration Number: 767461
- Designation Number: KR0045
- This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

4. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v05r02 dated April 02, 2019 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in ANSI C63.10 (Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

4.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C/ RSS-Gen issue 5, RSS-247 issue 2.

4.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, whic varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenn both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

5. Summary of Test Results and Measurement Procedures

5.1 Summary of test results

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	CONDUCTED	PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 6.8		PASS
Radiated Spurious Emissions	§15.205, 15.209	cf. Section 6.6	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 6.7		PASS

5.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

5.3 Purpose of the test

To determine whether the equipment under test fulfills the RF spectrum electro magnetic compatibility requirements of the standards stated in section 2.1.

6. TEST RESULT

6.1 DUTY CYCLE

According to Section 6.0)b) in KDB 558074 v05r02

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

6.1.1 TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested accroding to the zerospan measurement method, 6.0)b) in KDB 558074 v05r02

The largest availble value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/T.

- RBW = 8 MHz (the largest availble value)
- VBW = 8 MHz (≥ RBW)
- SPAN = 0 Hz
- Detector = Peak
- Number of points in sweep > 100
- Trace mode = Clear write
- Measure T_{total} and T_{on}
- Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10*log(1/Duty Cycle)

6.1.2 Test Setup

6.1.3 Measurement results

The duty cycle is 100 %.

Pulse Duration (us)	Period (us)	Duty Cycle (dB)
-	-	-

Note : Duty Cycle Factor = 10*log(1/Duty Cycle). where, Duty Cycle = Ton / Ttotal

6.2 DTS BANDWIDTH

Test Requirements and limit, §15.247(a)

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

6.2.1 TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 8.1 in KDB 558074 v05r02)

- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize

Note : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

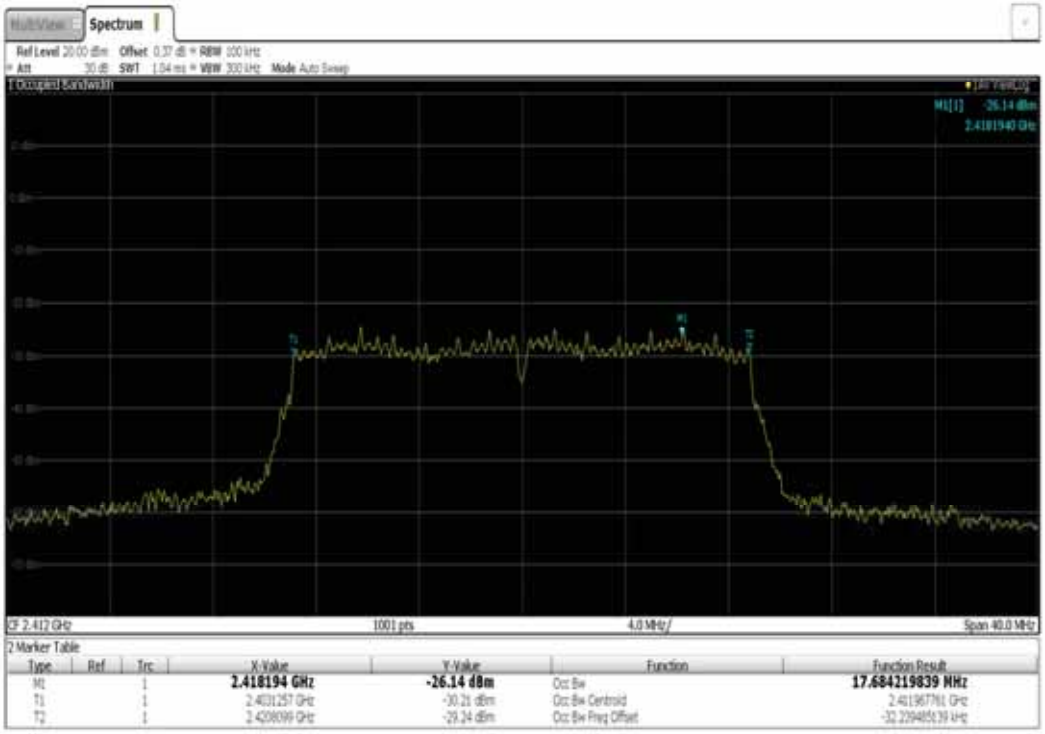
6.2.2 Test Setup

6.2.3 Measurement results

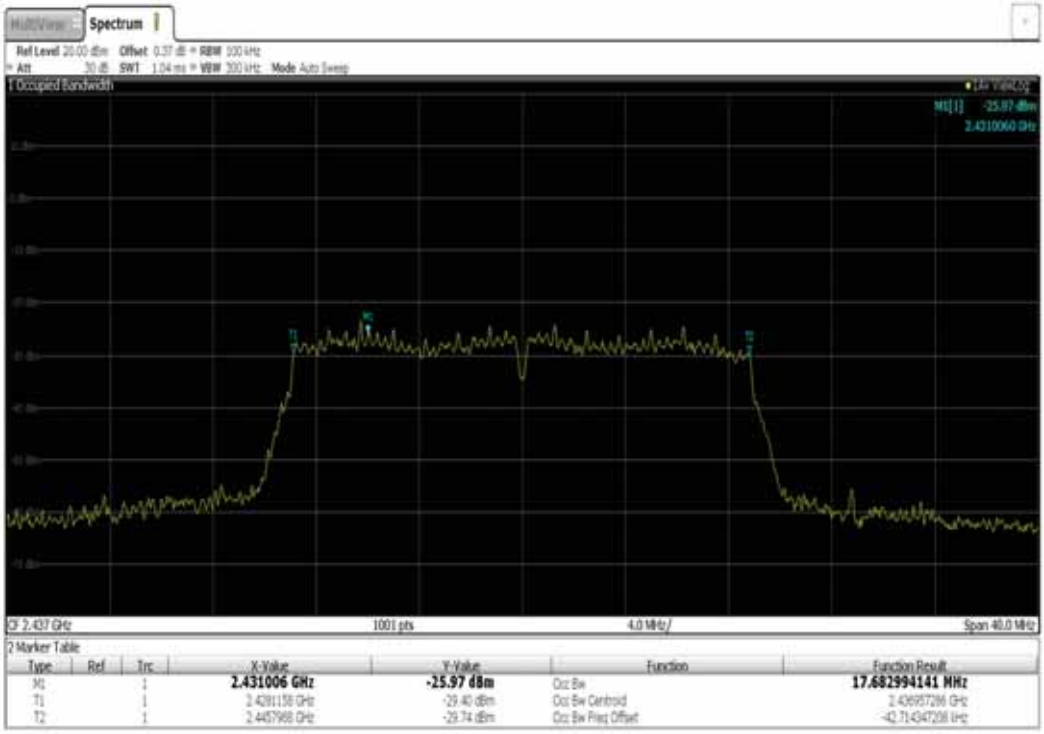
802.11n(HT20) Mode		Occupied Bandwidth [MHz]	Bandwidth at 6 dB below [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.				
2 412	1	17.68	17.42	≥ 0.5	Pass
2 437	6	17.68	17.46	≥ 0.5	Pass
2 462	11	17.70	17.38	≥ 0.5	Pass
2 467	12	17.68	17.38	≥ 0.5	Pass
2 472	13	17.69	17.38	≥ 0.5	Pass

6.2.4 Test data

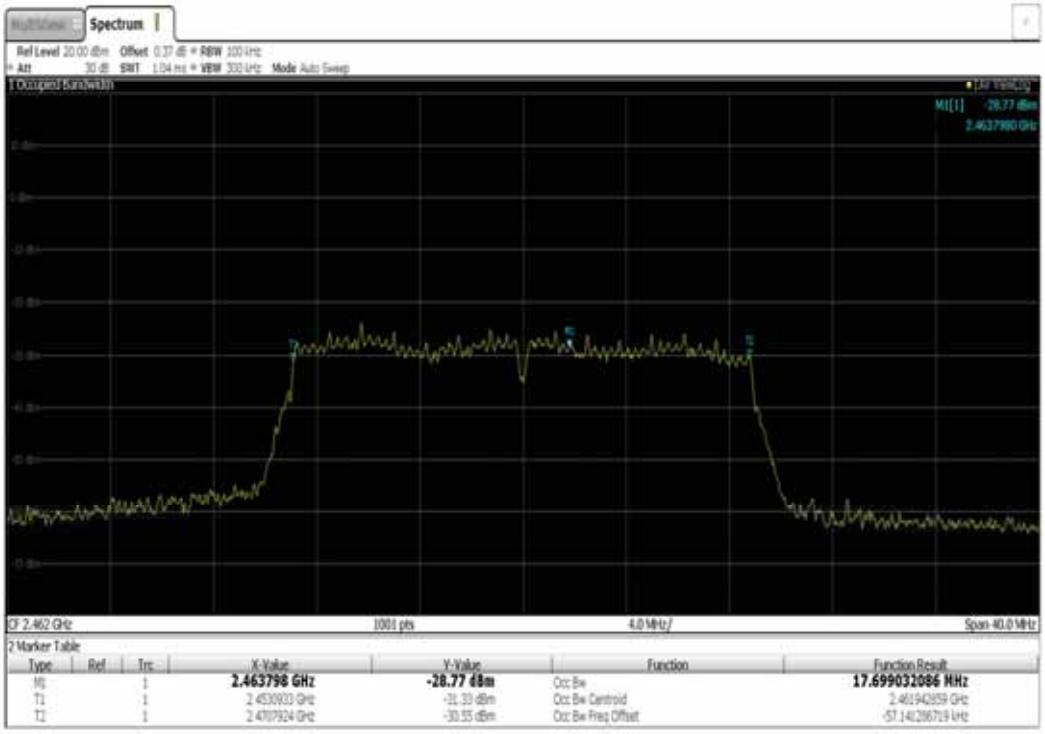
99 % Bandwidth plot (802.11n_HT20-CH 1)



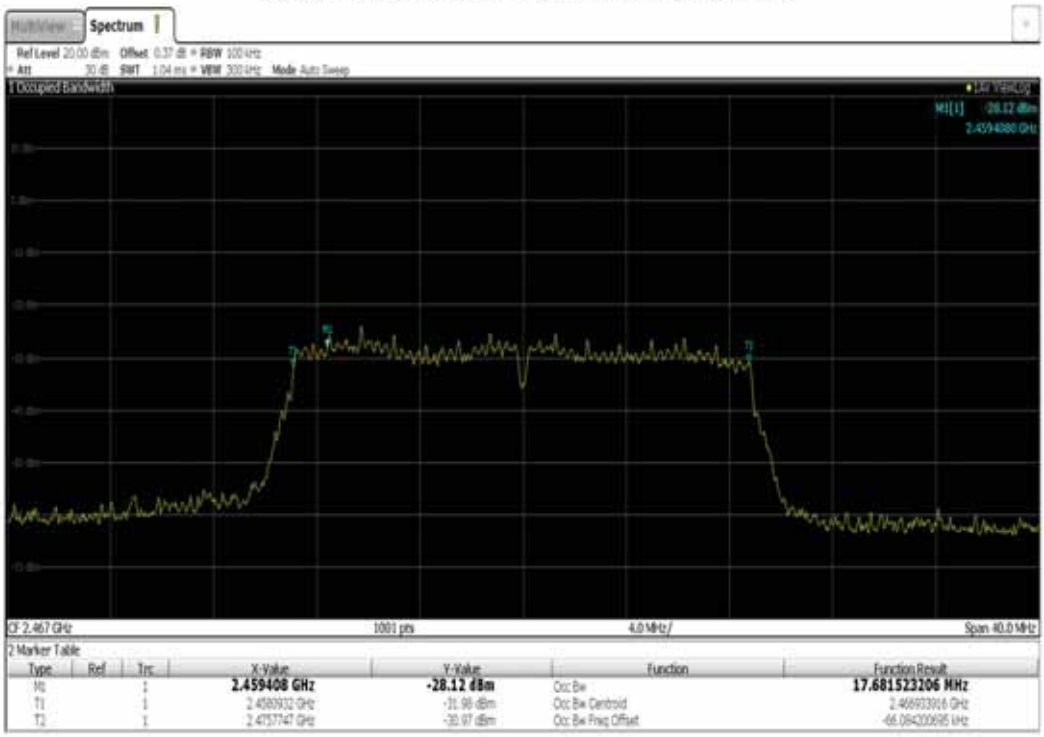
99 % Bandwidth plot (802.11n_HT20-CH 6)



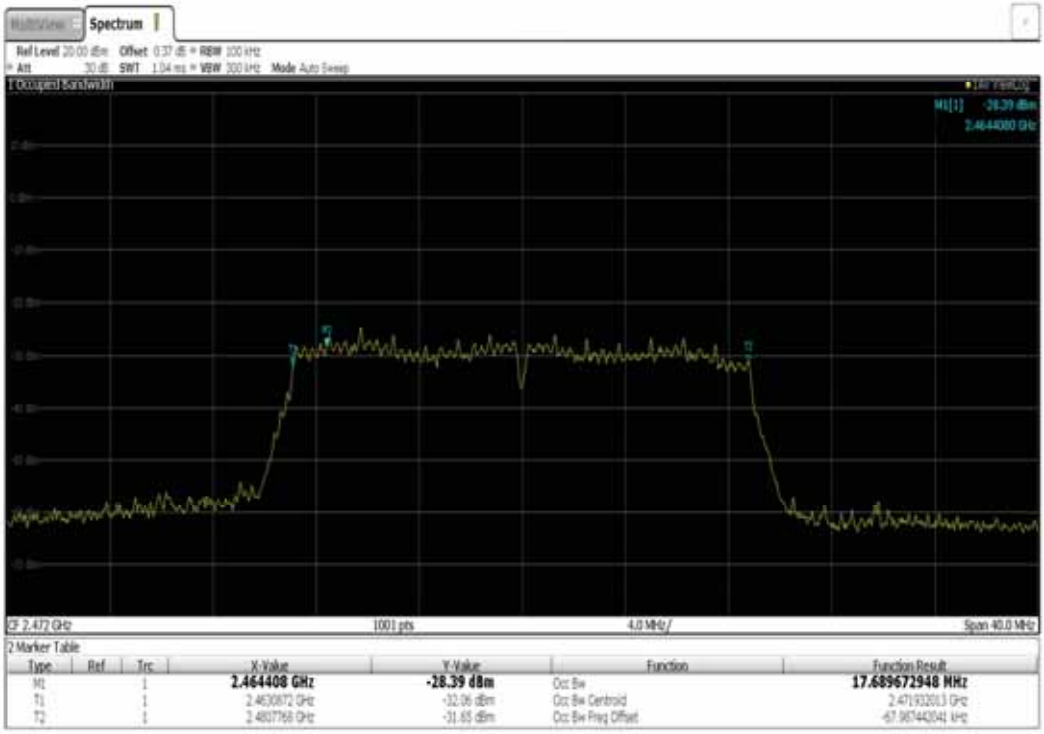
99 % Bandwidth plot (802.11n_HT20-CH 11)



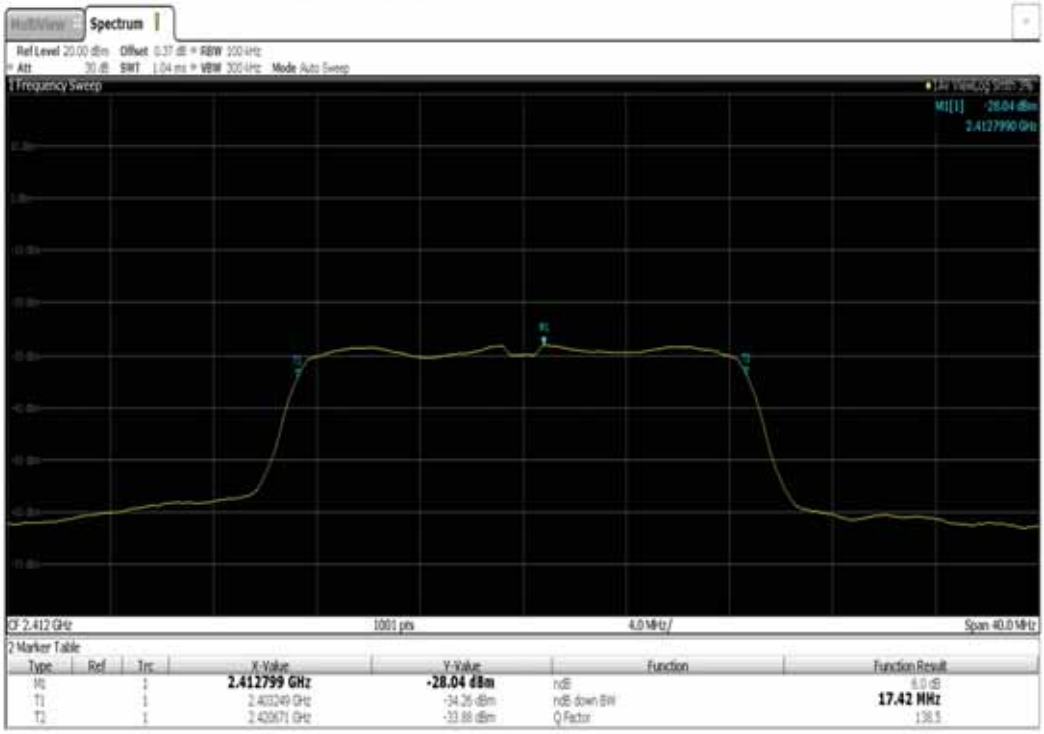
99 % Bandwidth plot (802.11n_HT20-CH 12)



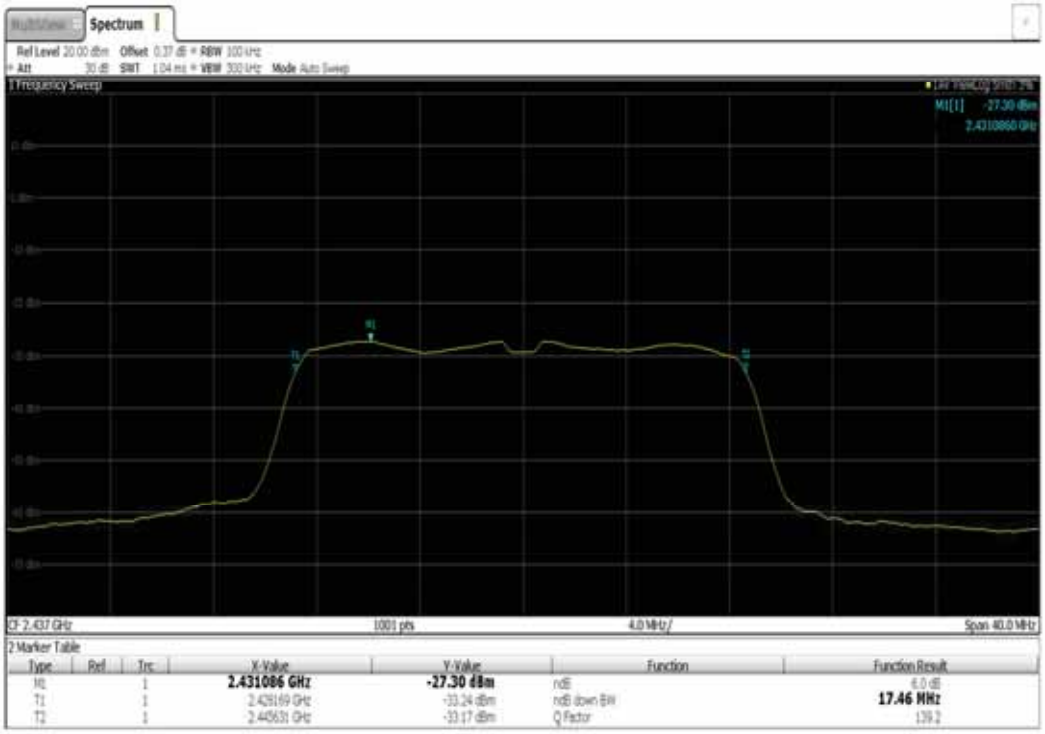
99 % Bandwidth plot (802.11n_HT20-CH 13)



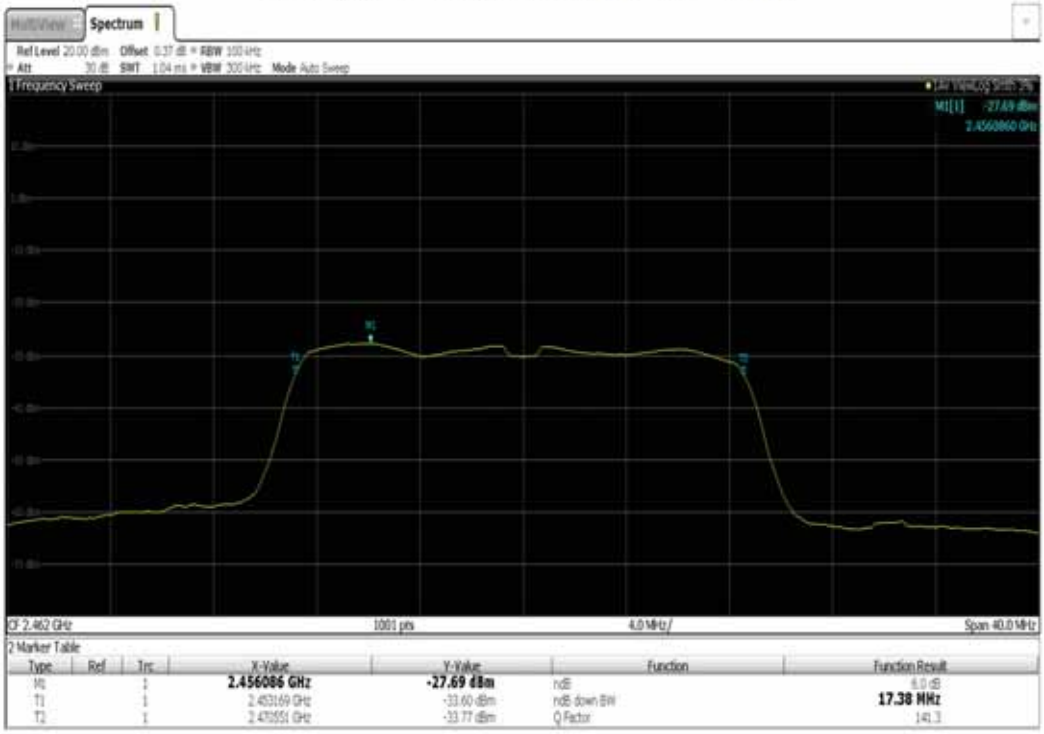
6dB Bandwidth plot (802.11n_HT20-CH 1)



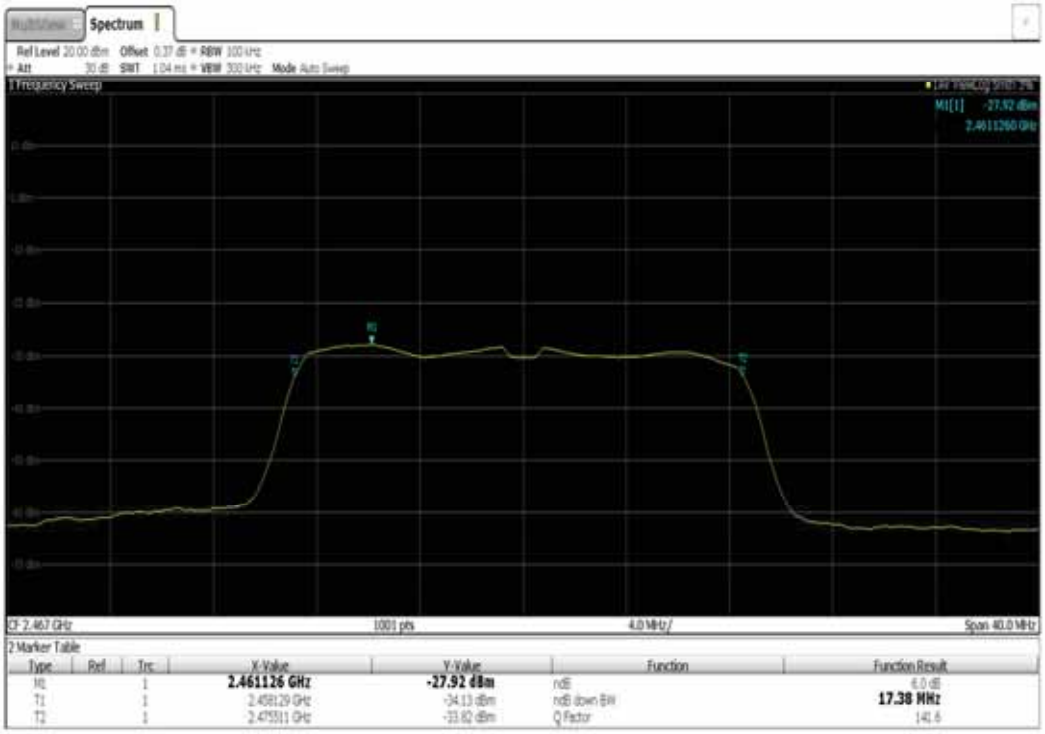
6dB Bandwidth plot (802.11n_HT20-CH 6)



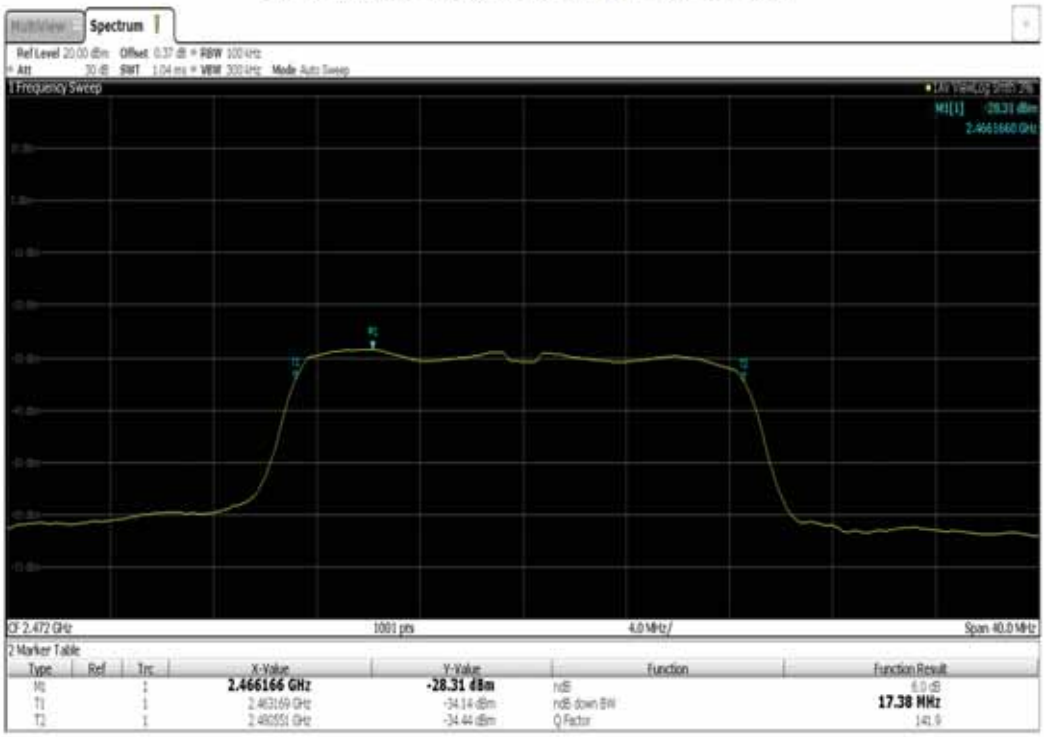
6dB Bandwidth plot (802.11n_HT20-CH 11)



6dB Bandwidth plot (802.11n_HT20-CH 12)



6dB Bandwidth plot (802.11n_HT20-CH 13)



6.3 OUTPUT POWER

Test Requirements and limit, §15.247(b)(3)

The transmitter output is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

6.3.1 TEST PROCEDURE

- Peak Power (Procedure 9.1.2 in KDB 558074 v05r02)
  1. Measure the peak power of the transmitter.
- Average Power (Procedure 9.2.3.1 in KDB 558074 v05r02)
  1. Measure the duty cycle.
  2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
  3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

6.3.2 Test Setup

6.3.3 Limit

Maximum Conducted Output Power

Operating Mode	Band	Mode	Ant. Port	Ant. Gain (dBi)	Limit (dBm)
SISO	2.4 GHz	802.11n(HT20)	0	3.5	30

6.3.4 Measurement results

TEST RESULTS - Peak

Conducted Output Power Measurements (802.11n_HT20 Mode)				
802.11n_HT20 Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2 412	1	0	-5.11	30
		1	-4.92	30
		2	-5.04	30
		3	-3.97	30
		4	-4.11	30
		5	-4.08	30
		6	-4.16	30
		7	-4.25	30
2 437	6	0	-4.51	30
		1	-4.29	30
		2	-4.47	30
		3	-3.70	30
		4	-3.76	30
		5	-3.76	30
		6	-3.74	30
		7	-3.86	30
2 462	11	0	-5.02	30
		1	-4.88	30
		2	-5.00	30
		3	-4.38	30
		4	-4.43	30
		5	-4.40	30
		6	-4.31	30
		7	-4.40	30
2 467	12	0	-5.36	30
		1	-5.22	30
		2	-5.31	30
		3	-4.65	30
		4	-4.77	30
		5	-4.75	30
		6	-4.67	30
		7	-4.82	30

TEST RESULTS - Peak

Conducted Output Power Measurements (802.11n_HT20 Mode)				
802.11n_HT20 Mode		MCS Index	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2 472	13	0	-5.67	30
		1	-5.56	30
		2	-5.65	30
		3	-5.05	30
		4	-5.09	30
		5	-5.11	30
		6	-5.07	30
		7	-5.23	30

TEST RESULTS - Average

Conducted Output Power Measurements (802.11n_HT20 Mode)						
802.11n_HT20 Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor(dB)	Limit (dBm)
Frequency [MHz]	Channel No.					
2 412	1	0	-7.80	-	-7.80	30
		1	-7.19	-	-7.19	30
		2	-7.28	-	-7.28	30
		3	-6.43	-	-6.43	30
		4	-6.51	-	-6.51	30
		5	-6.51	-	-6.51	30
		6	-6.46	-	-6.46	30
		7	-6.57	-	-6.57	30
2 437	6	0	-7.11	-	-7.11	30
		1	-6.59	-	-6.59	30
		2	-6.71	-	-6.71	30
		3	-5.99	-	-5.99	30
		4	-6.19	-	-6.19	30
		5	-6.09	-	-6.09	30
		6	-6.03	-	-6.03	30
		7	-6.18	-	-6.18	30
2 462	11	0	-7.63	-	-7.63	30
		1	-7.15	-	-7.15	30
		2	-7.17	-	-7.17	30
		3	-6.65	-	-6.65	30
		4	-6.69	-	-6.69	30
		5	-6.70	-	-6.70	30
		6	-6.65	-	-6.65	30
		7	-6.69	-	-6.69	30
2 467	12	0	-7.97	-	-7.97	30
		1	-7.39	-	-7.39	30
		2	-7.51	-	-7.51	30
		3	-7.01	-	-7.01	30
		4	-7.15	-	-7.15	30
		5	-6.99	-	-6.99	30
		6	-6.96	-	-6.96	30
		7	-7.11	-	-7.11	30

TEST RESULTS - Average

Conducted Output Power Measurements (802.11n_HT20 Mode)						
802.11n_HT20 Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor(dB)	Limit (dBm)
Frequency[MHz]	Ch No.					
2 472	13	0	-8.36	-	-8.36	30
		1	-7.76	-	-7.76	30
		2	-7.88	-	-7.88	30
		3	-7.35	-	-7.35	30
		4	-7.49	-	-7.49	30
		5	-7.45	-	-7.45	30
		6	-7.43	-	-7.43	30
		7	-7.51	-	-7.51	30

6.4 POWER SPECTRAL DENSITY (802.11n_HT20)

Test Requirements and limit, §15.247(e)

The peak power spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard – 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.

6.4.1 TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074 v05r02

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 x RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.4.2 Test Setup

6.4.3 Limit

Maximum Conducted Output Power

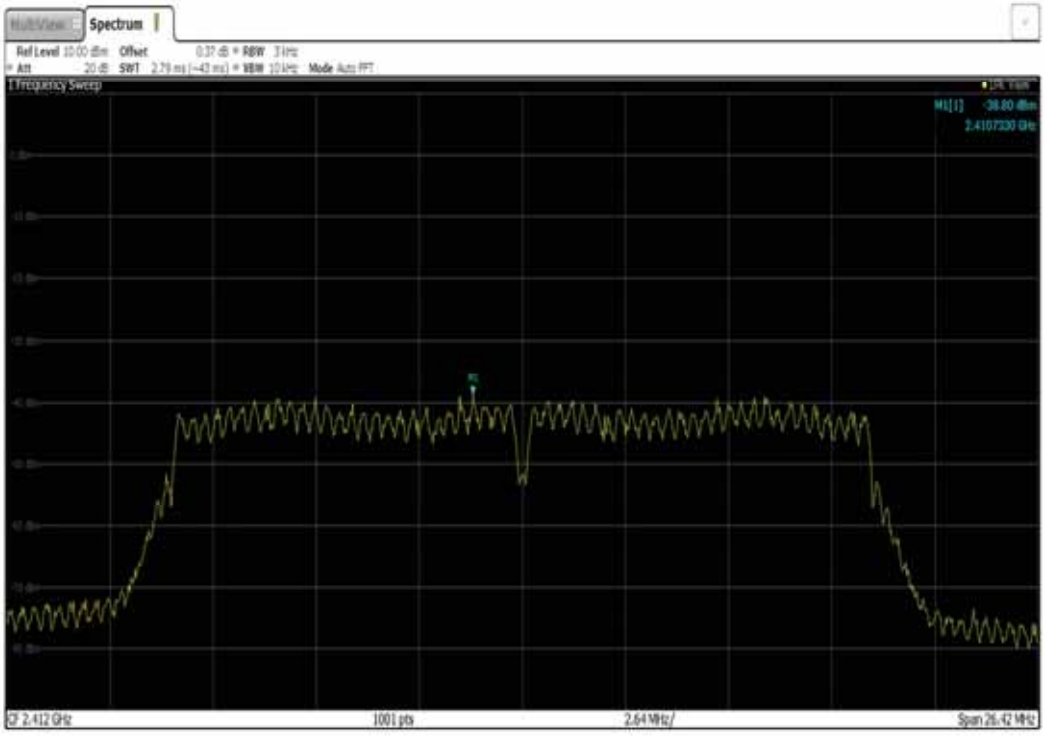
Operating Mode	Band	Mode	Ant. Port	Ant. Gain (dBi)	Limit (dBm)
SISO	2.4 GHz	802.11n(HT20)	0	3.5	8

6.4.4 Measurement results

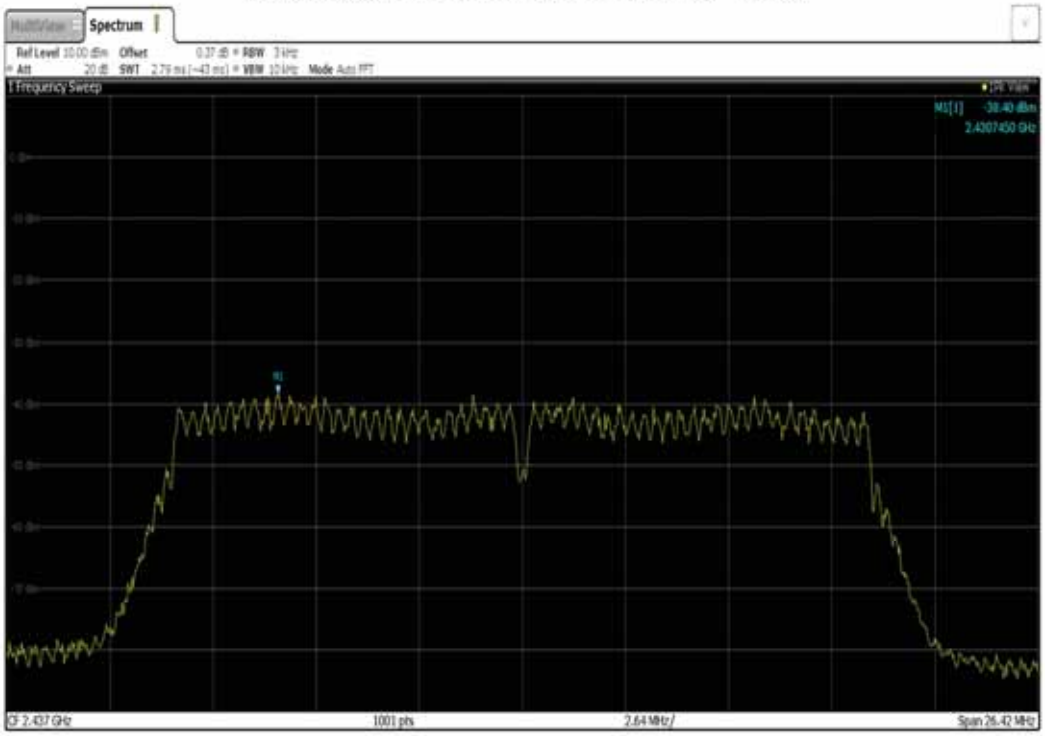
Conducted Power Density Measurements					
Frequency (MHz)	Channel No.	Mode	Test Result		
			PSD (dBm)	Limit (dBm)	Pass /Fail
2 412	1	802.11n HT20	-38.80	8	Pass
2 437	6		-38.40	8	Pass
2 462	11		-38.22	8	Pass
2 467	12		-38.56	8	Pass
2 472	13		-39.47	8	Pass

6.4.5 Test data

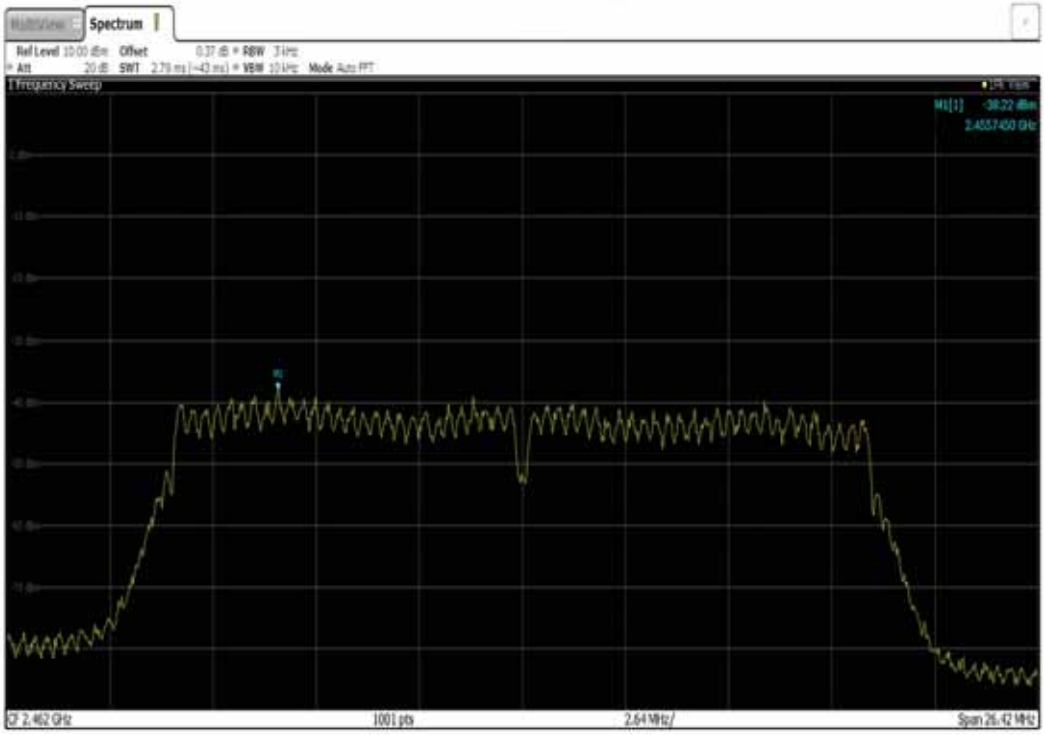
Power Spectral Density (802.11n_HT20 -CH 1)



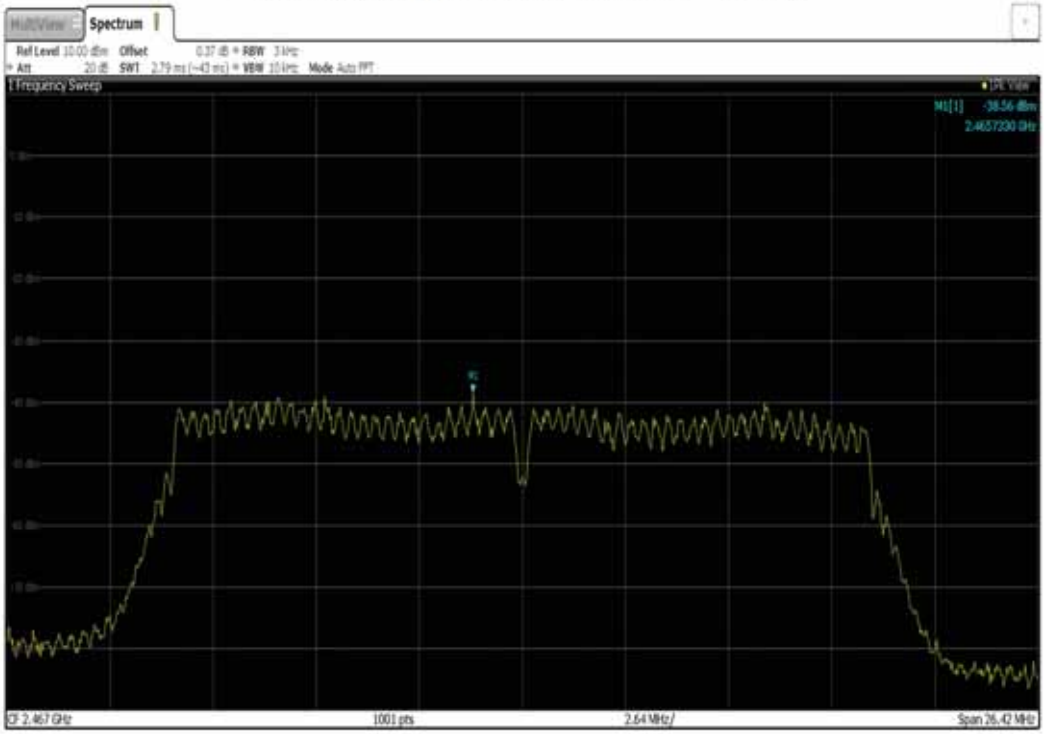
Power Spectral Density (802.11n_HT20 -CH 6)



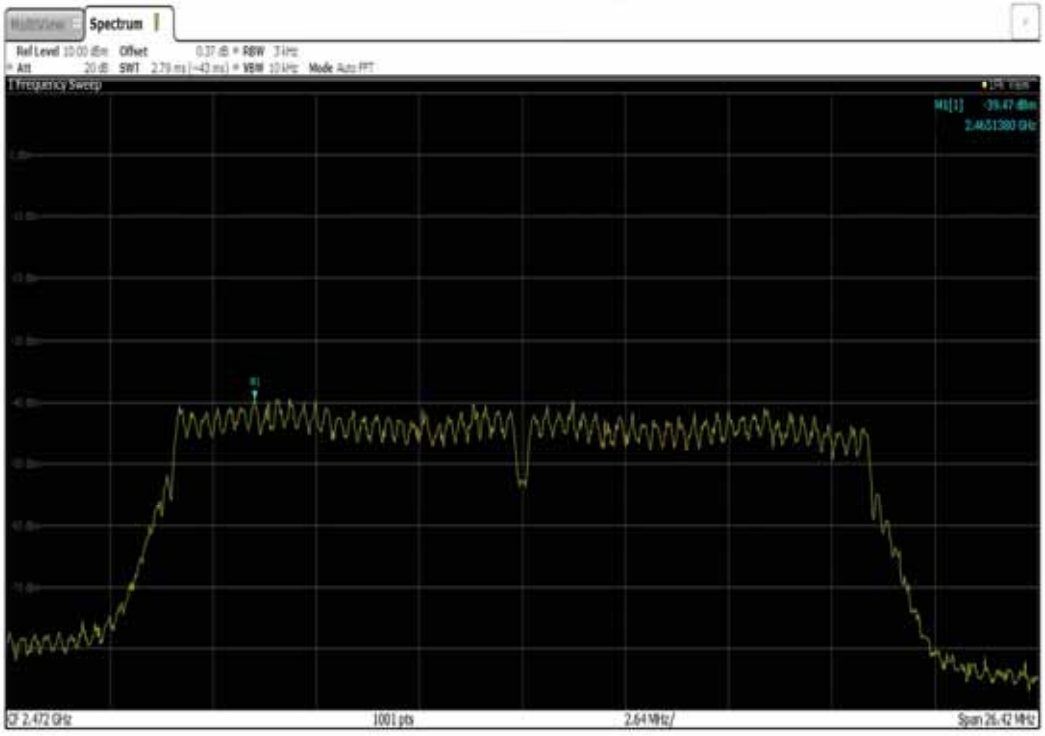
Power Spectral Density (802.11n_HT20 -CH 11)



Power Spectral Density (802.11n_HT20 -CH 12)



Power Spectral Density (802.11n_HT20 -CH 13)



6.5 OUT OF BAND EMISSIONS AT THE BAND EDGE /CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §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) / RSS-Gen 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)).

6.5.1 TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer.

(Procedure 11.0 in KDB 558074 v05r02)

- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Set span to encompass the spectrum to be examined
- Detector = Peak
- Trace Mode = max hold
- Sweep time = auto couple
- Ensure that the number of measurement points ≥ Span/RBW
- Allow trace to fully stabilize.
- Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10th harmonic range with the transmitter set to the lowest, middle, and highest channels.

Note :

1. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss

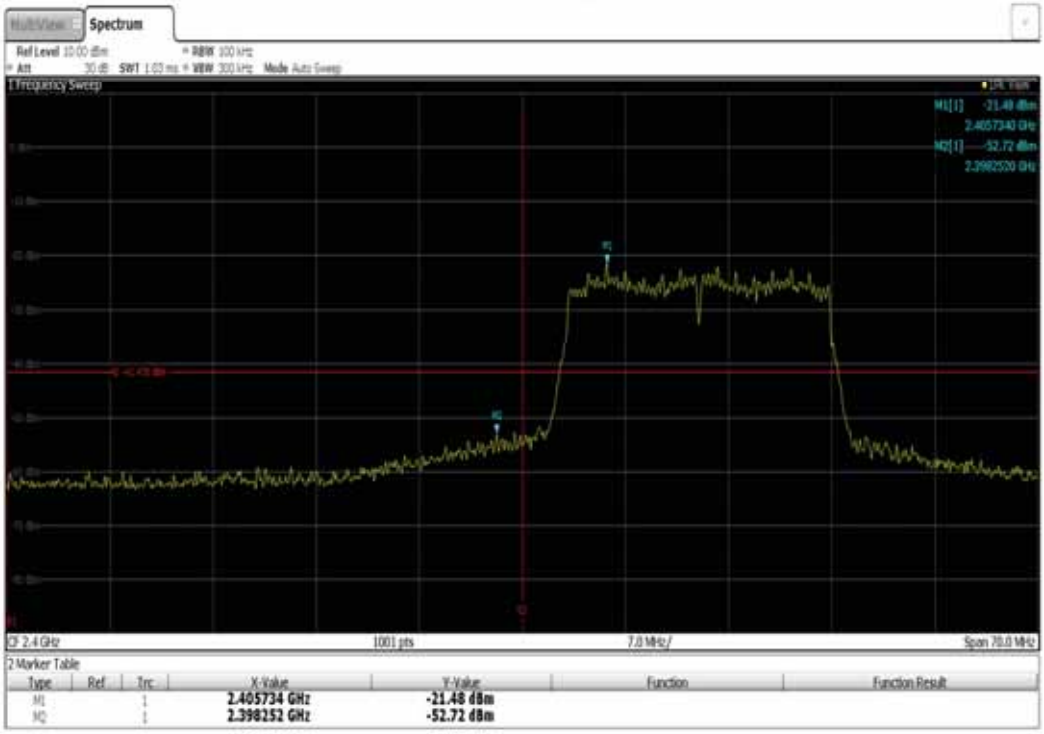
6.5.2 Test Setup

6.5.3 Limit

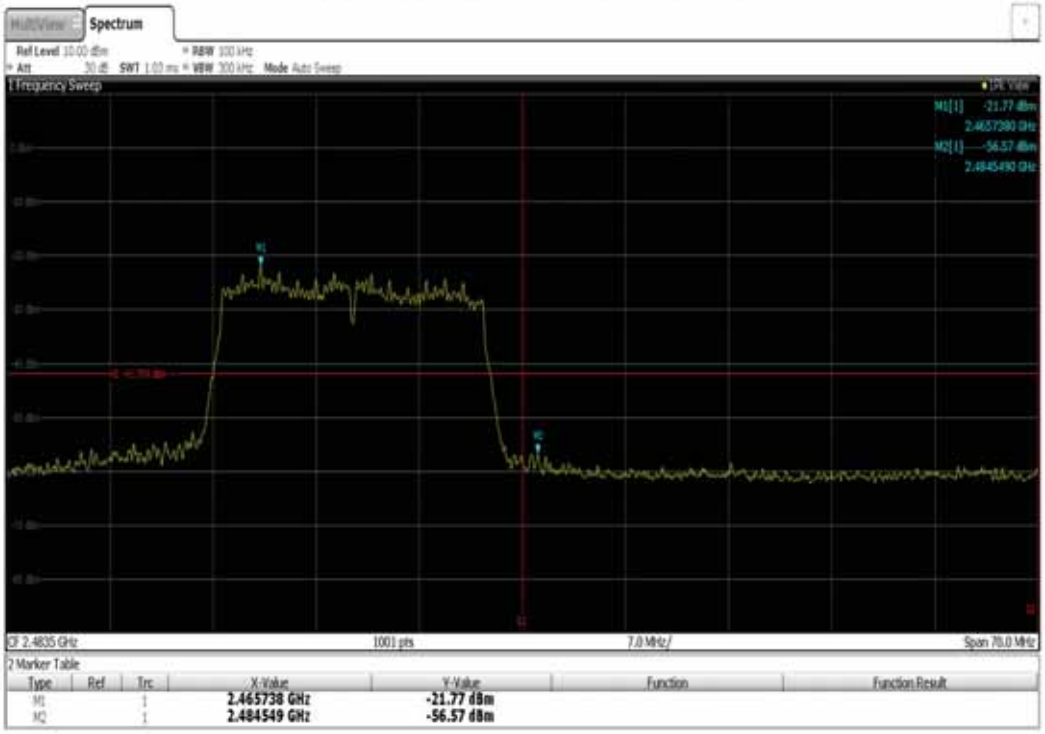
Frequency [MHz]	Channel No.	Mode	Limit
2 412	1	802.11n(HT20)	20 dBc
2 472	13	802.11n(HT20)	20 dBc

6.5.4 Test data

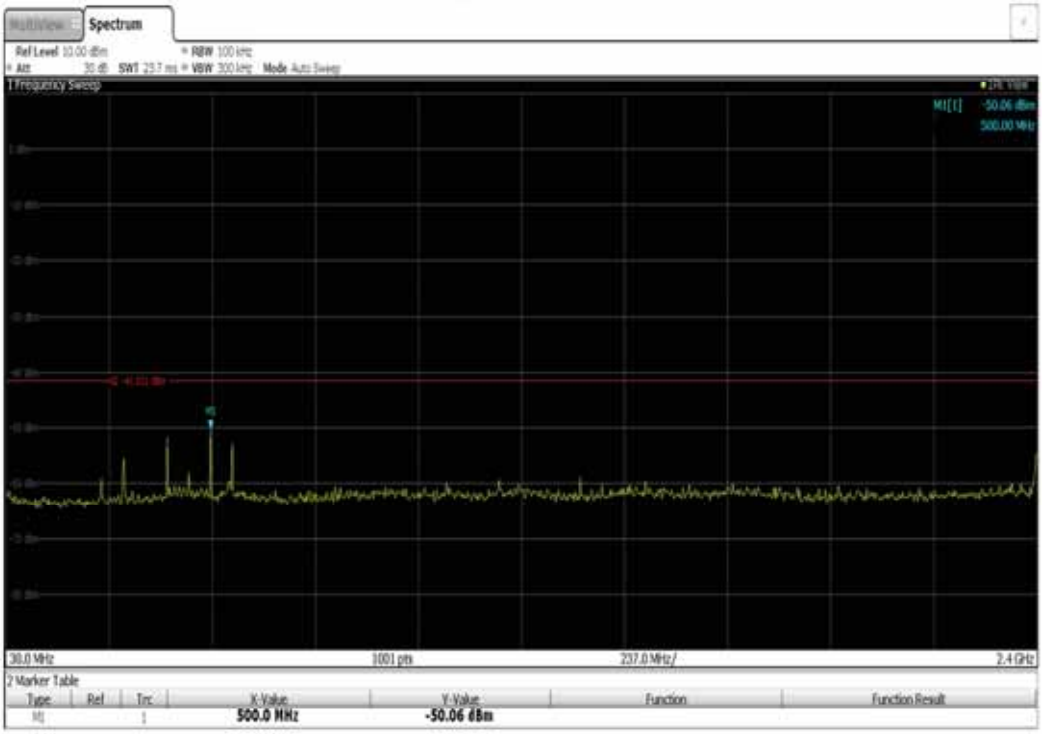
Band Edge (802.11n_HT20 - CH 1)



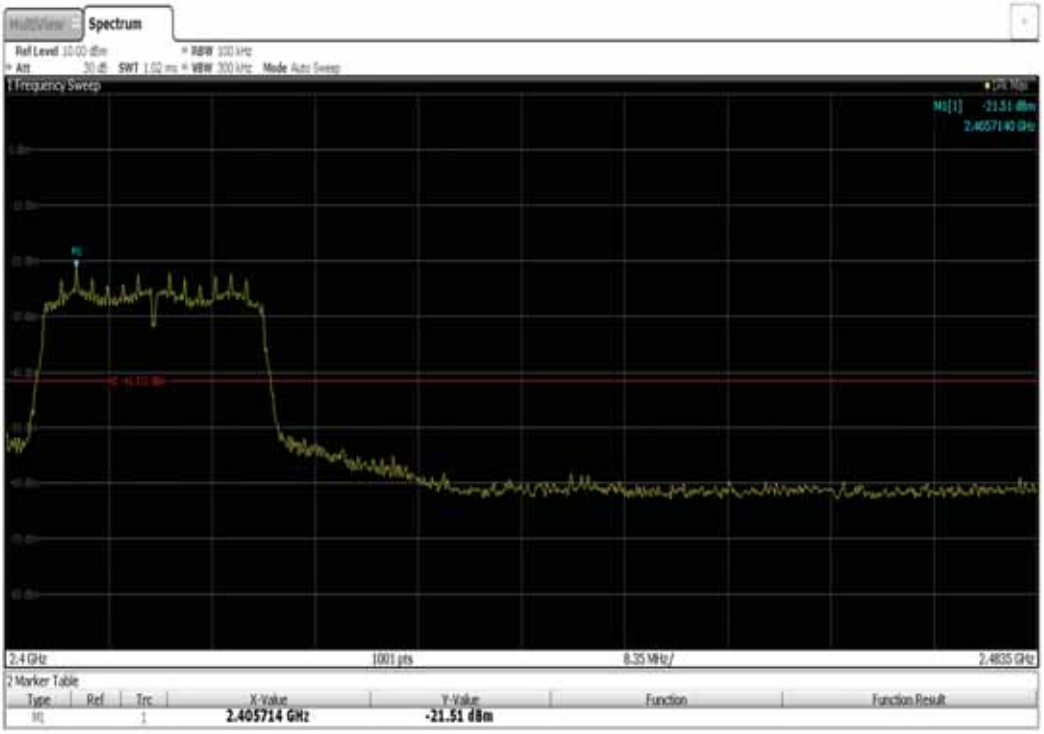
Band Edge (802.11n_HT20 - CH 13)



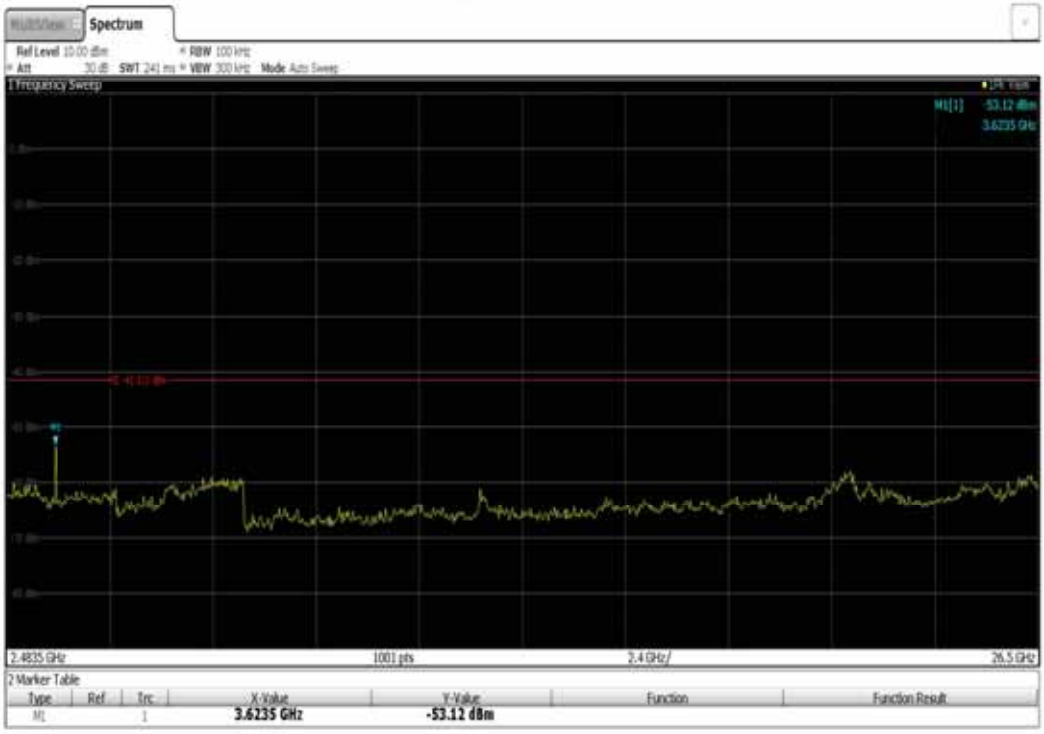
Conducted Spurious Emission (802.11n_HT20_CH 1) - 1



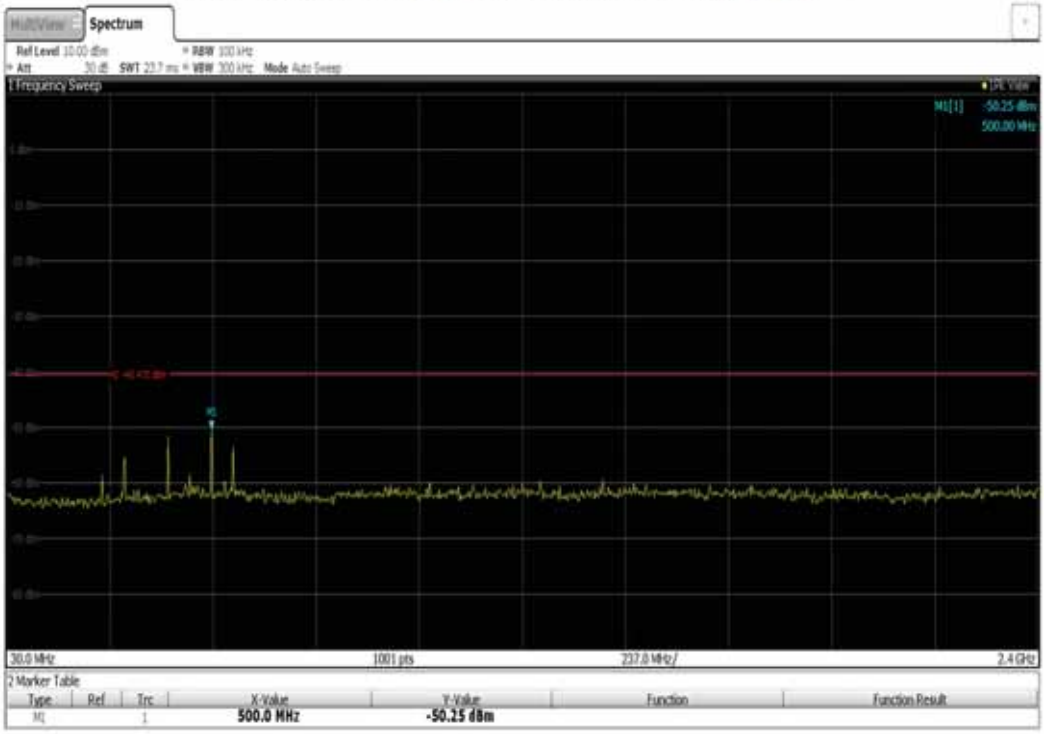
Conducted Spurious Emission (802.11n_HT20_CH 1) - 2



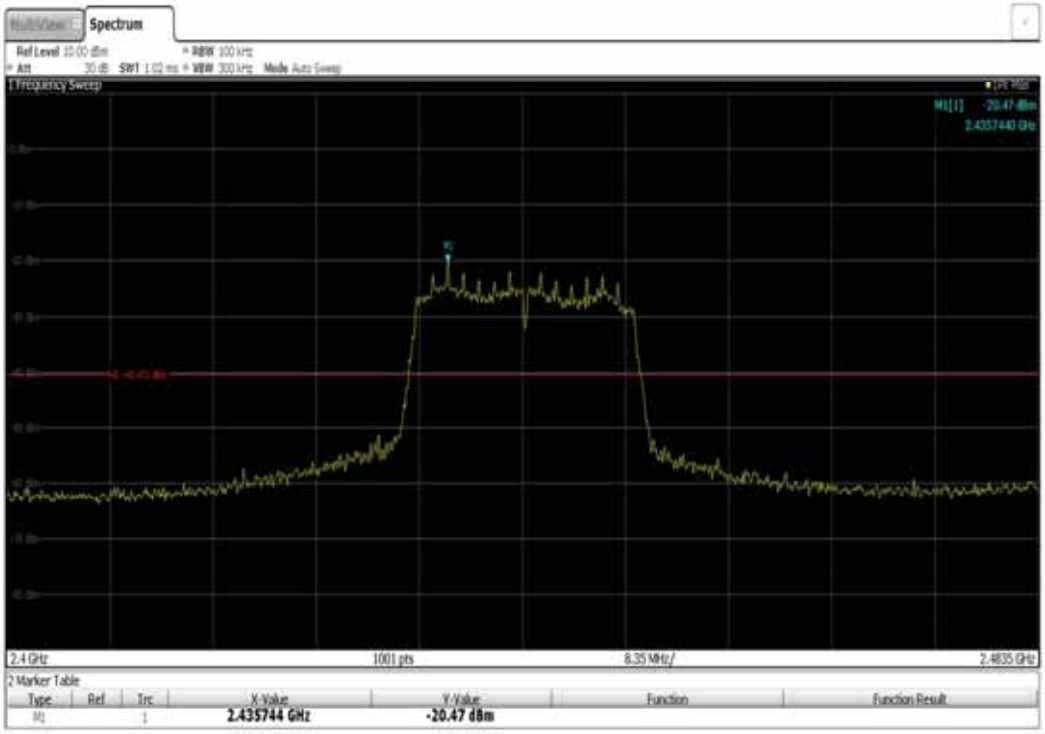
Conducted Spurious Emission (802.11n_HT20_CH 1) - 3



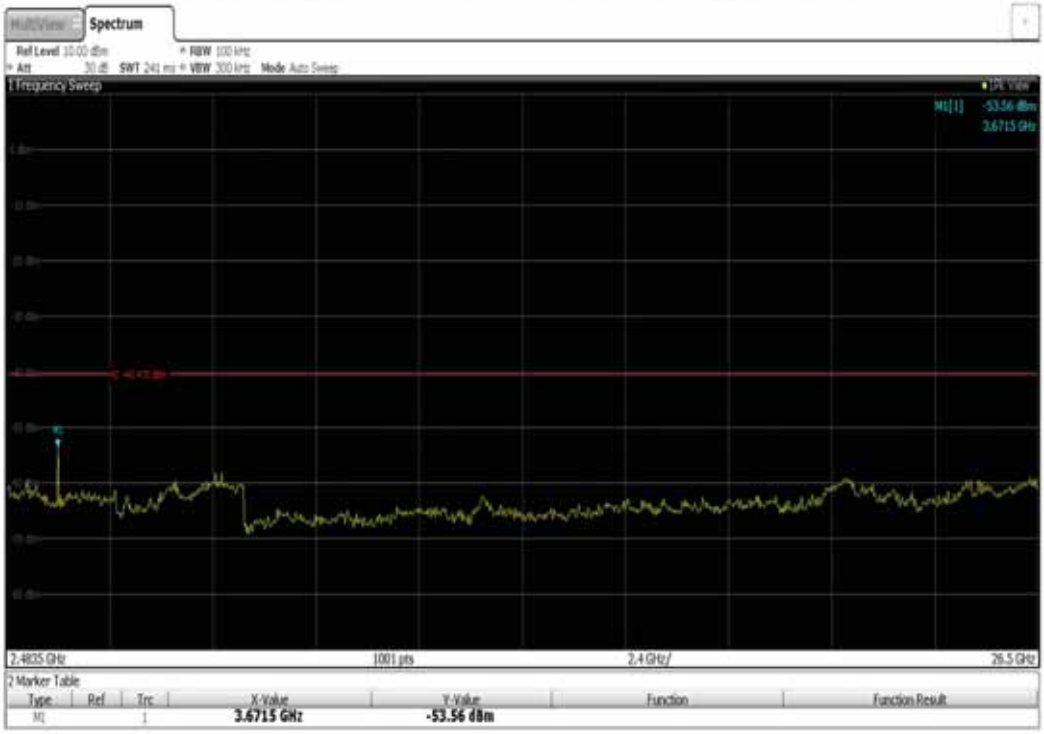
Conducted Spurious Emission (802.11n_HT20_CH 7) - 1



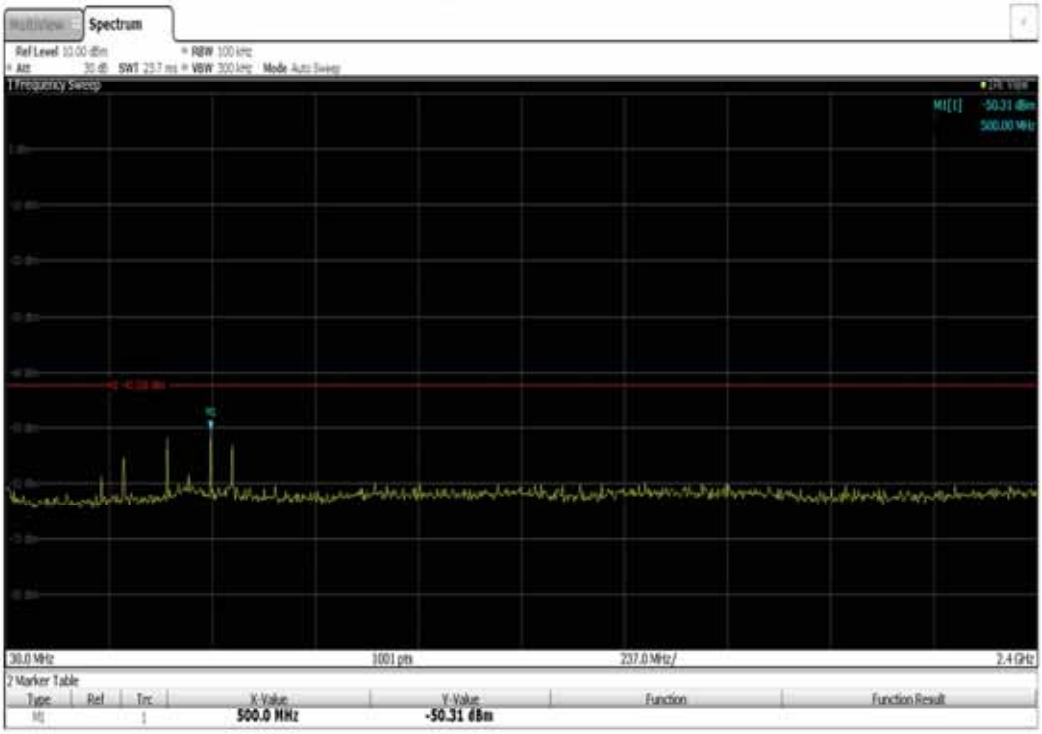
Conducted Spurious Emission (802.11n_HT20_CH 7) - 2



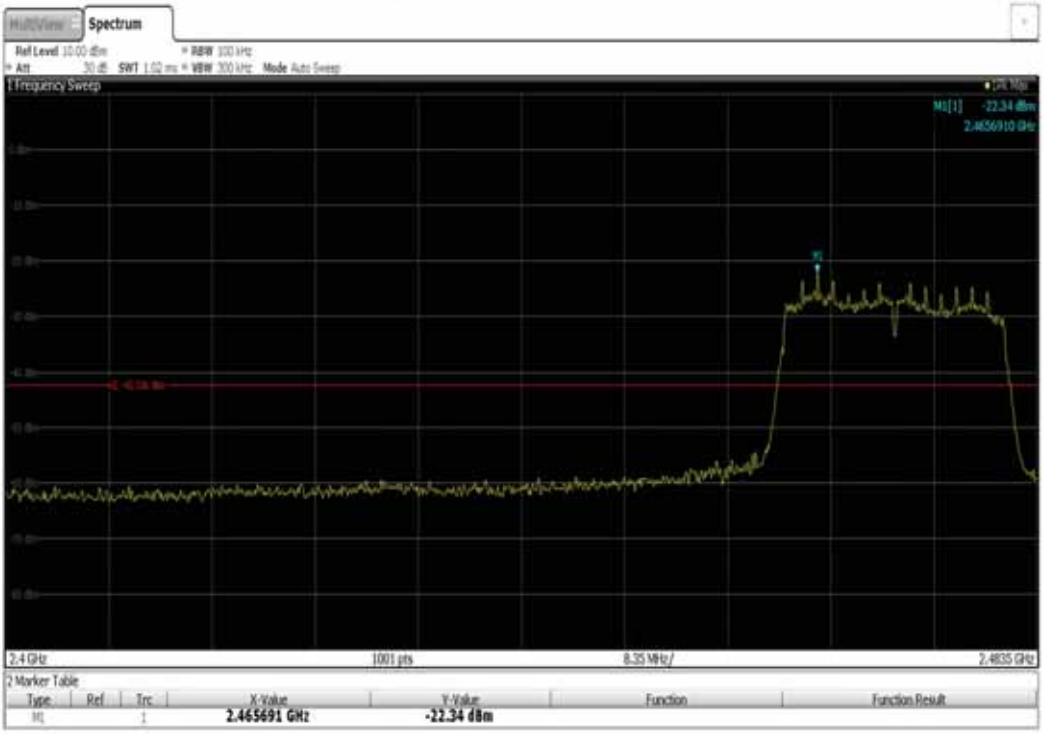
Conducted Spurious Emission (802.11n_HT20_CH 7) - 3



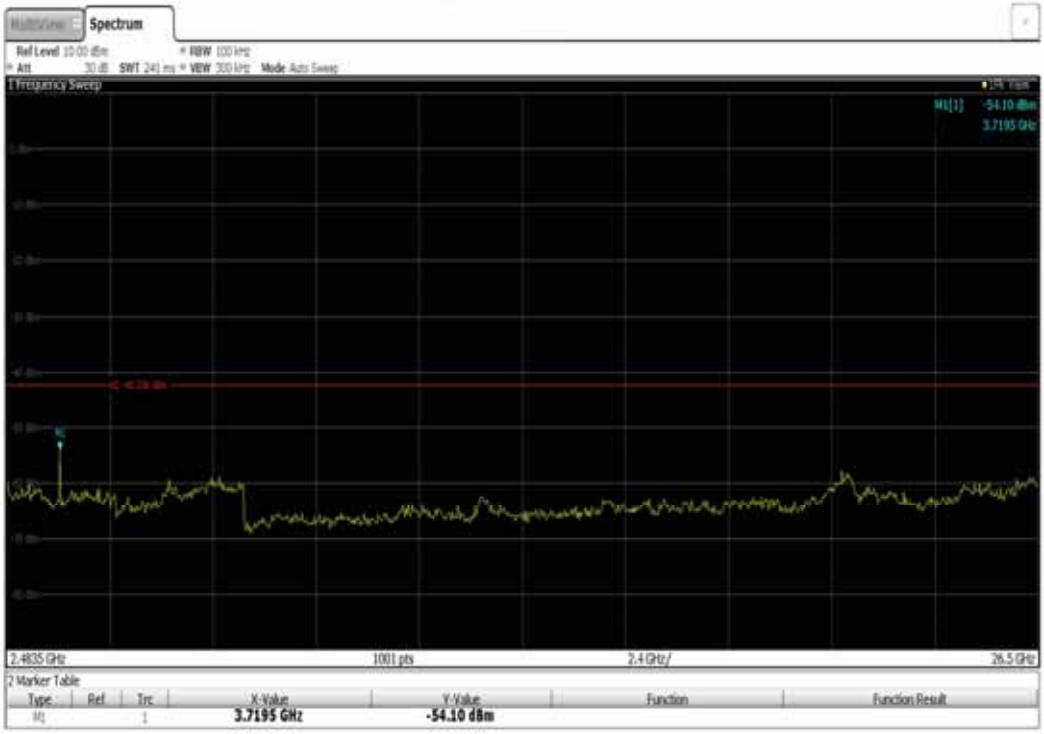
Conducted Spurious Emission (802.11n_HT20_CH 13) - 1



Conducted Spurious Emission (802.11n_HT20_CH 13) - 2



Conducted Spurious Emission (802.11n_HT20_CH 13) - 3



6.6 RADIATED MEASUREMENT

6.6.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.247(d)

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

6.6.2 TEST PROCEDURE

Method 12.1 in KDB 558074 v05r02

Spectrum Setting

■ Peak

Peak emission levels are measured by setting the instrument as follows :

- RBW =

Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

- VBW ≥ 3 x RBW
- Dectector = Peak
- Sweep time = Auto
- Trace mode = Max hold.

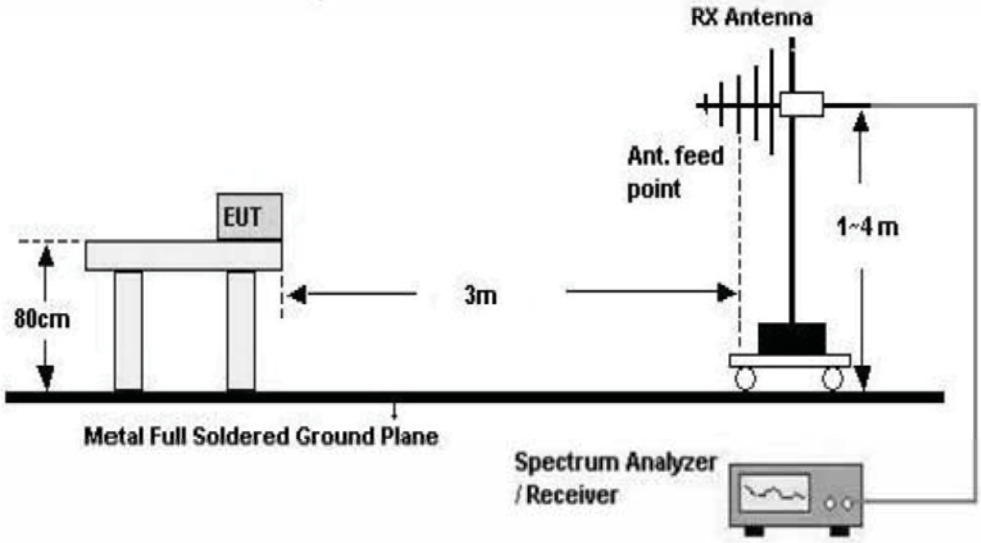
  Allow sweeps to continue until the trace stabilizes.

■ Average (duty cycle ≥ 98 %)

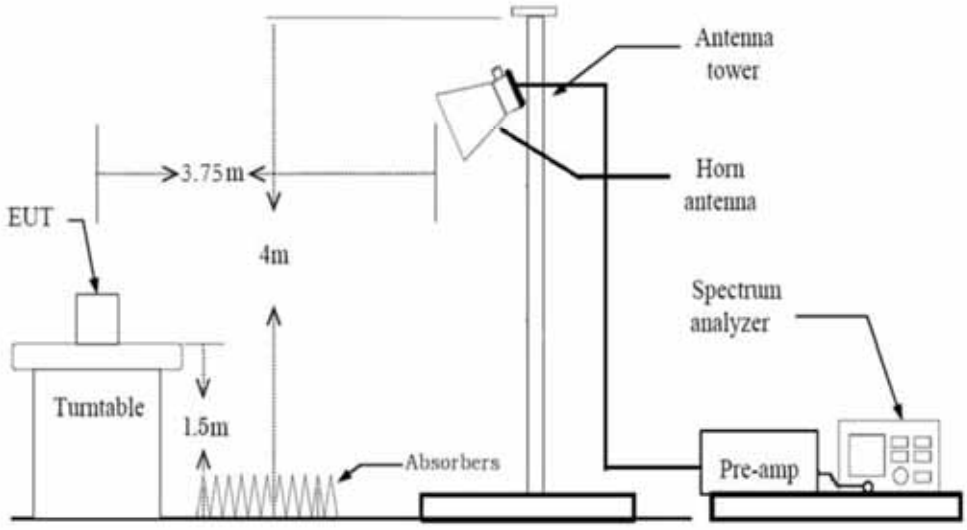
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Dectector = RMS
- Averaging type = Power (i.e., RMS)
- Sweep time = Auto
- Trace mode = Average

6.6.3 Test Setup

Below 1 000 MHz



Above 1 GHz



6.6.4 Test Data (30 MHz ~ 1 000 MHz)

Transmitter Radiated Emissions

Results : quasi-peak / Channel 1 / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
249.72	Horizontal	40.43	46.02	-5.59	Pass
367.45	Horizontal	41.38	46.02	-4.64	Pass
400.61	Horizontal	41.97	46.02	-4.05	Pass
849.91	Horizontal	41.10	46.02	-4.92	Pass
903.35	Horizontal	41.91	46.02	-4.11	Pass
984.86	Horizontal	49.32	53.98	-4.66	Pass

Results : quasi-peak / Channel 1 / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
199.69	Vertical	37.76	43.52	-5.76	Pass
249.72	Vertical	40.43	46.02	-5.59	Pass
328.58	Vertical	37.15	46.02	-8.87	Pass
551.78	Vertical	39.26	46.02	-6.76	Pass
889.68	Vertical	37.95	46.02	-8.07	Pass
984.86	Vertical	44.83	53.98	-9.15	Pass

Transmitter Radiated Emissions

Results : quasi-peak / Channel 6 / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
249.73	Horizontal	41.89	46.02	-4.13	Pass
299.86	Horizontal	41.52	46.02	-4.50	Pass
382.70	Horizontal	41.06	46.02	-4.96	Pass
400.61	Horizontal	41.82	46.02	-4.20	Pass
912.58	Horizontal	41.45	46.02	-4.57	Pass
984.86	Horizontal	47.37	53.98	-6.61	Pass

Results : quasi-peak / Channel 6 / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
150.23	Vertical	41.36	43.52	-2.16	Pass
249.72	Vertical	39.44	46.02	-6.58	Pass
360.06	Vertical	35.69	46.02	-10.33	Pass
551.78	Vertical	38.45	46.02	-7.57	Pass
880.69	Vertical	38.02	46.02	-8.00	Pass
984.86	Vertical	42.84	53.98	-11.14	Pass

Transmitter Radiated Emissions

Results : quasi-peak / Channel 13 / 802.11n(HT20)

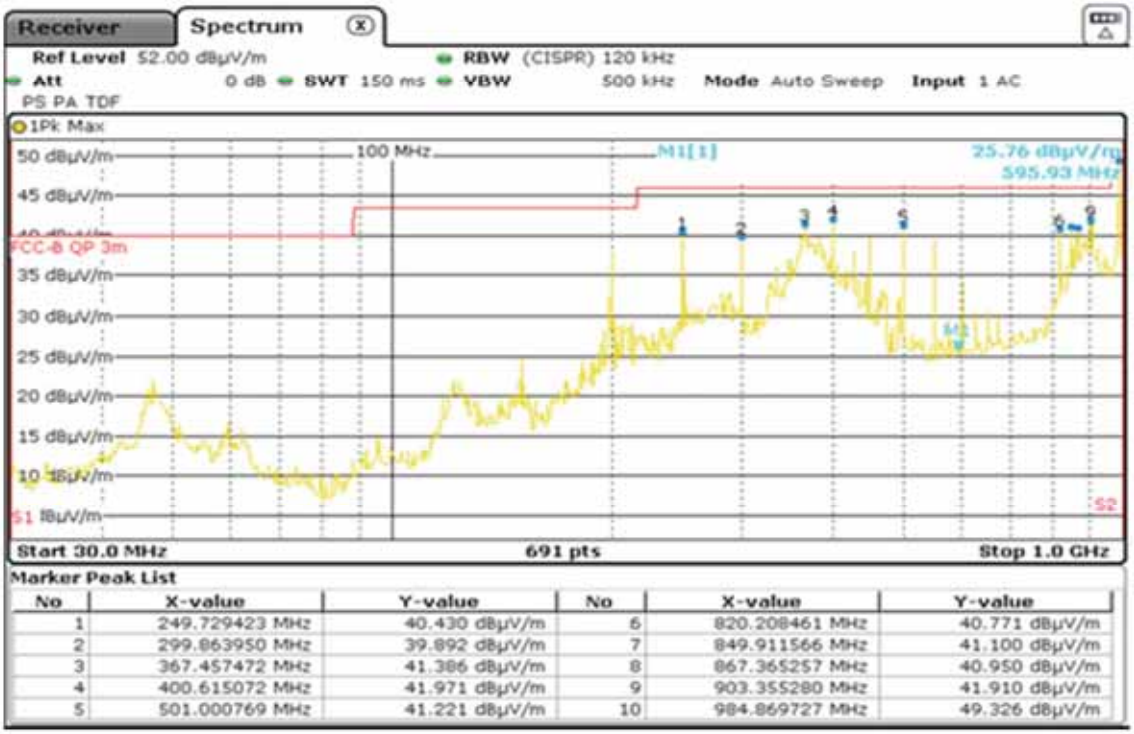
Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
249.73	Horizontal	40.98	46.02	-5.04	Pass
375.00	Horizontal	41.20	46.02	-4.82	Pass
400.61	Horizontal	42.27	46.02	-3.75	Pass
820.20	Horizontal	43.94	46.02	-2.08	Pass
898.77	Horizontal	41.40	46.02	-4.62	Pass
984.86	Horizontal	47.01	53.98	-6.97	Pass

Results : quasi-peak / Channel 13 / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
47.88	Vertical	35.62	40.00	-4.38	Pass
199.69	Vertical	36.23	43.52	-7.29	Pass
249.72	Vertical	40.05	46.02	-5.97	Pass
323.61	Vertical	40.17	46.02	-5.85	Pass
551.78	Vertical	37.62	46.02	-8.40	Pass
984.86	Vertical	41.84	53.98	-12.14	Pass

Transmitter Radiated Emissions(continued)

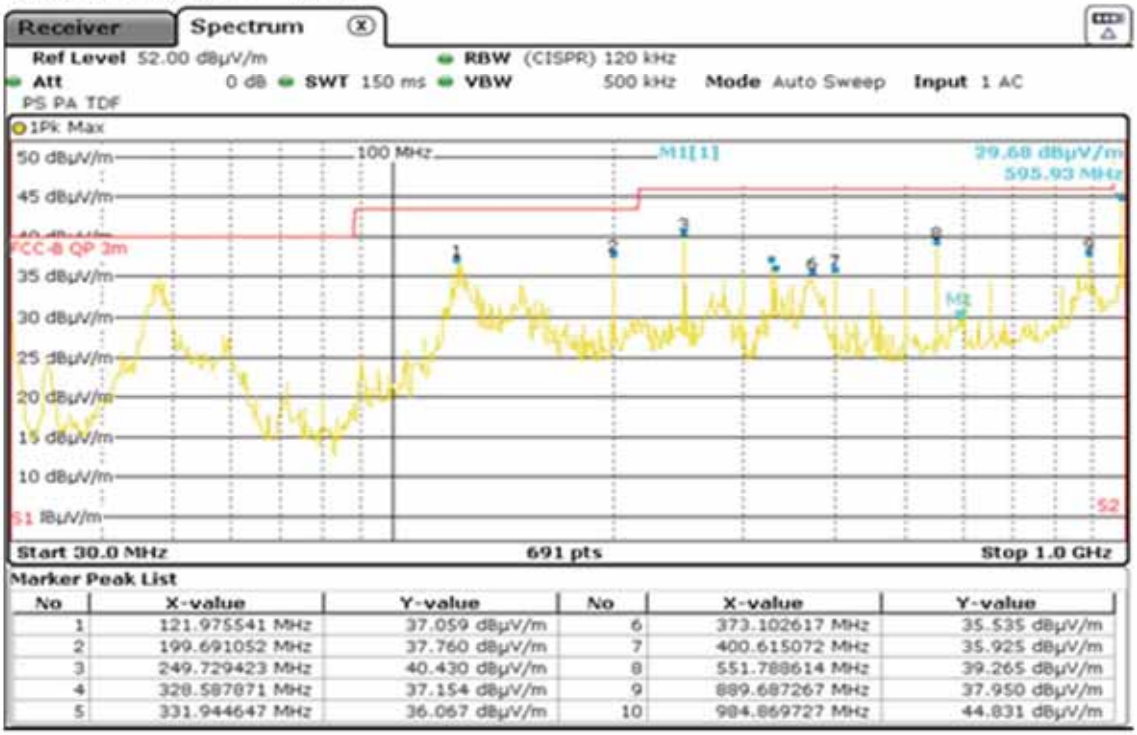
802.11n_HT20_CH 1 - Horizontal



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	249.729423 MHz	40.430 dBµV/m	6	820.208461 MHz	40.771 dBµV/m
2	299.863950 MHz	39.892 dBµV/m	7	849.911566 MHz	41.100 dBµV/m
3	367.457472 MHz	41.386 dBµV/m	8	867.365257 MHz	40.950 dBµV/m
4	400.615072 MHz	41.971 dBµV/m	9	903.355280 MHz	41.910 dBµV/m
5	501.000769 MHz	41.221 dBµV/m	10	984.869727 MHz	49.326 dBµV/m

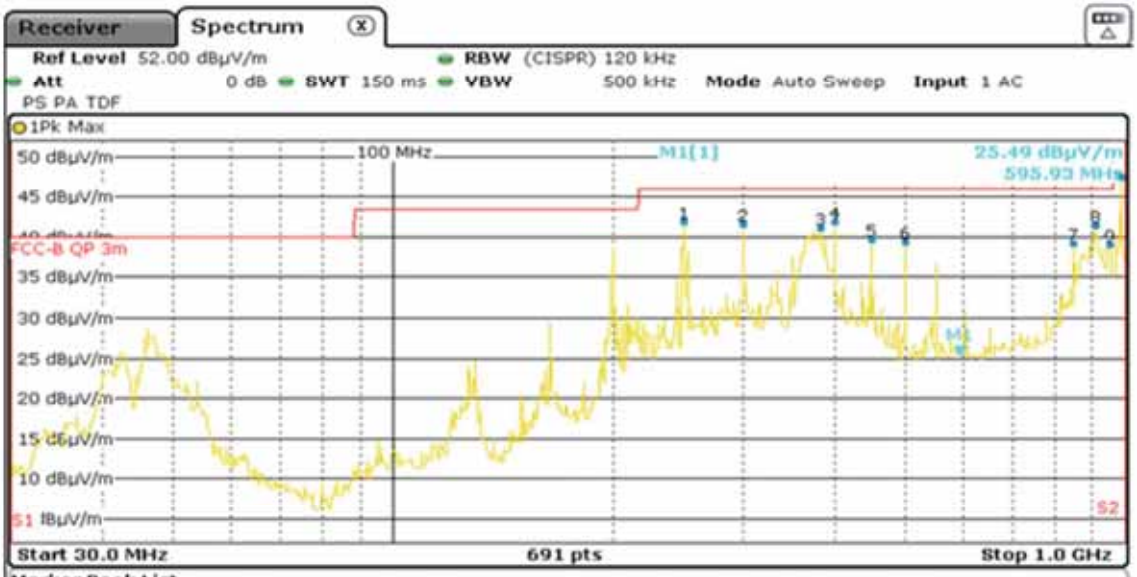
802.11n_HT20_CH 1 - Vertical



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	121.975541 MHz	37.059 dBµV/m	6	373.102617 MHz	35.535 dBµV/m
2	199.691052 MHz	37.760 dBµV/m	7	400.615072 MHz	35.925 dBµV/m
3	249.729423 MHz	40.430 dBµV/m	8	551.788614 MHz	39.265 dBµV/m
4	328.587871 MHz	37.154 dBµV/m	9	889.687267 MHz	37.950 dBµV/m
5	331.944647 MHz	36.067 dBµV/m	10	984.869727 MHz	44.831 dBµV/m

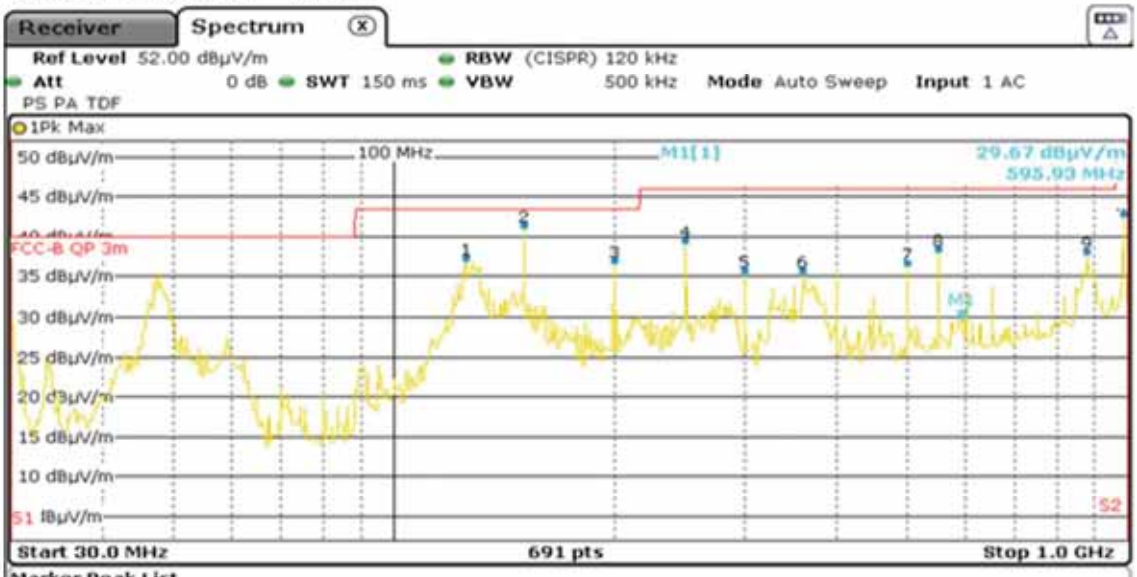
802.11n_HT20_CH 6 - Horizontal



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	249.729423 MHz	41.892 dBµV/m	6	501.000769 MHz	39.350 dBµV/m
2	299.863950 MHz	41.526 dBµV/m	7	849.911566 MHz	39.229 dBµV/m
3	382.704570 MHz	41.067 dBµV/m	8	912.583744 MHz	41.458 dBµV/m
4	400.615072 MHz	41.827 dBµV/m	9	950.450041 MHz	39.044 dBµV/m
5	450.287518 MHz	39.718 dBµV/m	10	984.869727 MHz	47.377 dBµV/m

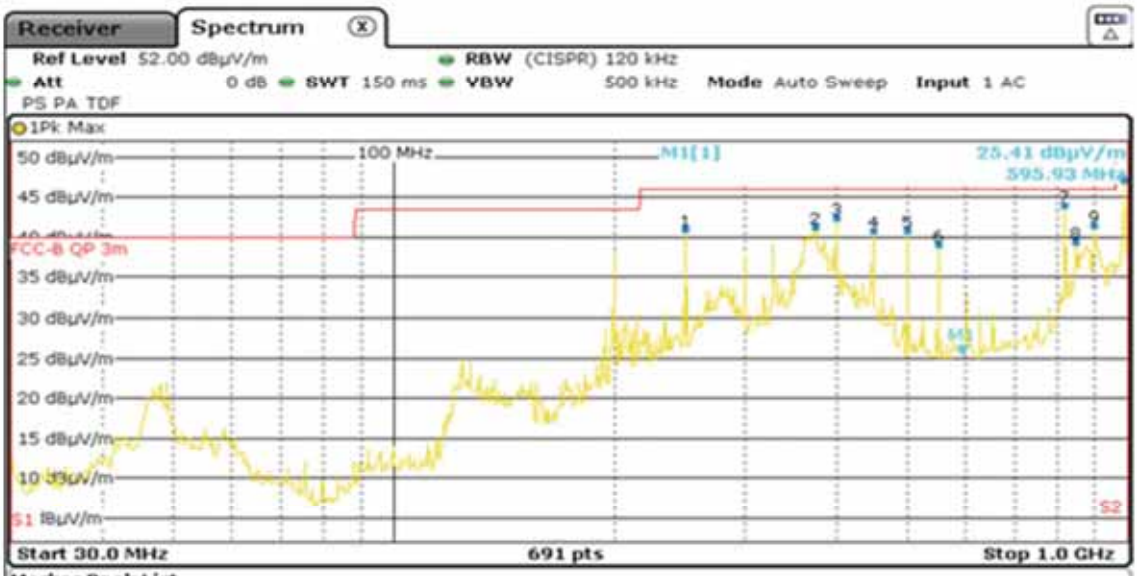
802.11n_HT20_CH 6 - Vertical



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	125.114633 MHz	37.274 dBµV/m	6	360.063253 MHz	35.696 dBµV/m
2	150.232069 MHz	41.367 dBµV/m	7	501.000769 MHz	36.720 dBµV/m
3	199.691052 MHz	37.033 dBµV/m	8	551.788614 MHz	38.452 dBµV/m
4	249.729423 MHz	39.447 dBµV/m	9	880.690342 MHz	38.029 dBµV/m
5	299.863950 MHz	35.680 dBµV/m	10	984.869727 MHz	42.842 dBµV/m

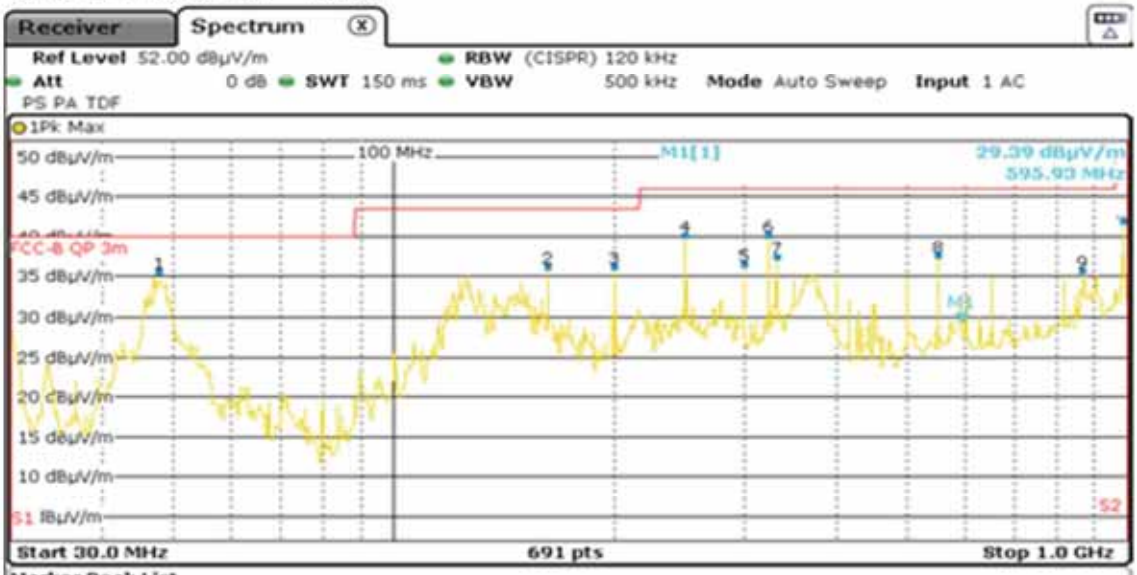
802.11n_HT20_CH 13 – Horizontal



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	249.729423 MHz	40.987 dBµV/m	6	551.788614 MHz	39.094 dBµV/m
2	375.003538 MHz	41.208 dBµV/m	7	820.208461 MHz	43.948 dBµV/m
3	400.615072 MHz	42.272 dBµV/m	8	849.911566 MHz	39.264 dBµV/m
4	450.287518 MHz	40.707 dBµV/m	9	898.776102 MHz	41.409 dBµV/m
5	501.000769 MHz	40.735 dBµV/m	10	984.869727 MHz	47.017 dBµV/m

802.11n_HT20_CH 13 – Vertical



Marker Peak List

No	X-value	Y-value	No	X-value	Y-value
1	47.881942 MHz	35.622 dBµV/m	6	323.616247 MHz	40.179 dBµV/m
2	162.131988 MHz	36.136 dBµV/m	7	331.944647 MHz	37.367 dBµV/m
3	199.691052 MHz	36.230 dBµV/m	8	551.788614 MHz	37.627 dBµV/m
4	249.729423 MHz	40.057 dBµV/m	9	867.365257 MHz	35.627 dBµV/m
5	299.863950 MHz	36.556 dBµV/m	10	984.869727 MHz	41.849 dBµV/m

Transmitter Radiated Emissions

Results : Peak / Middle Channel / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
1 591	Horizontal	55.69	74	-18.31	Pass

Results : Average / Middle Channel / 802.11n(HT20)

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
1 591	Horizontal	49.91	54	-4.09	Pass

Results : Peak / Middle Channel / 802.11n(HT20)

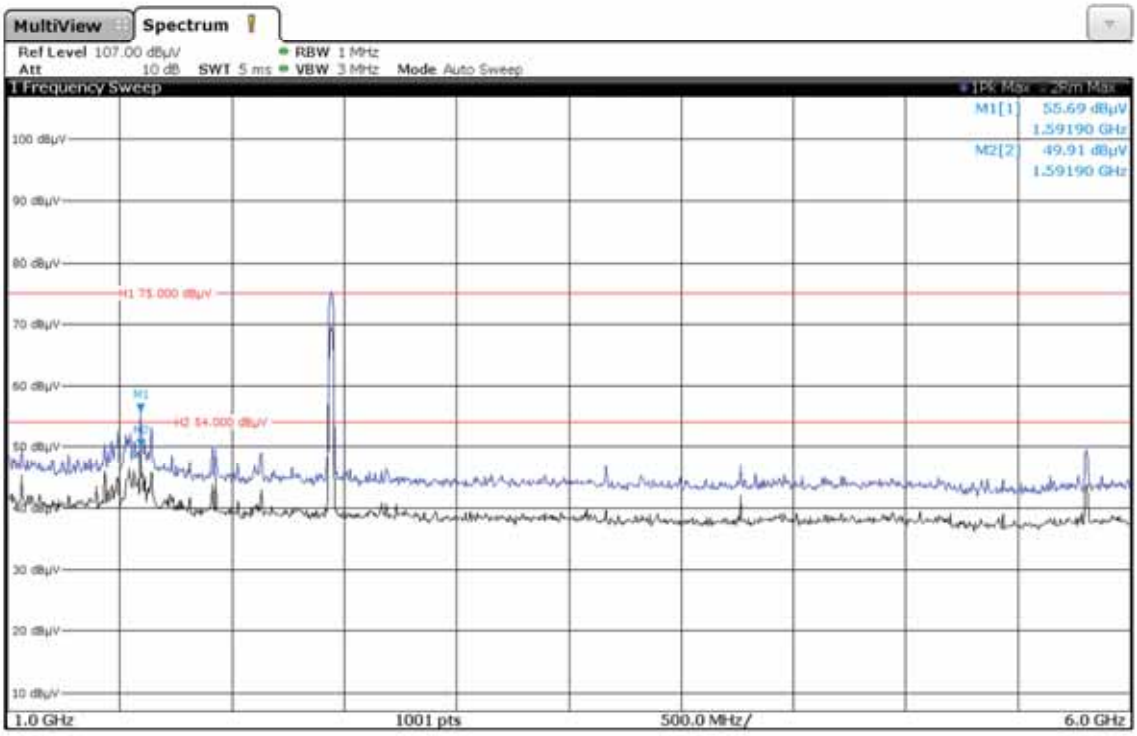
Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
1 636	Vertical	53.89	74	-20.11	Pass

Results : Average / Middle Channel / 802.11n(HT20)

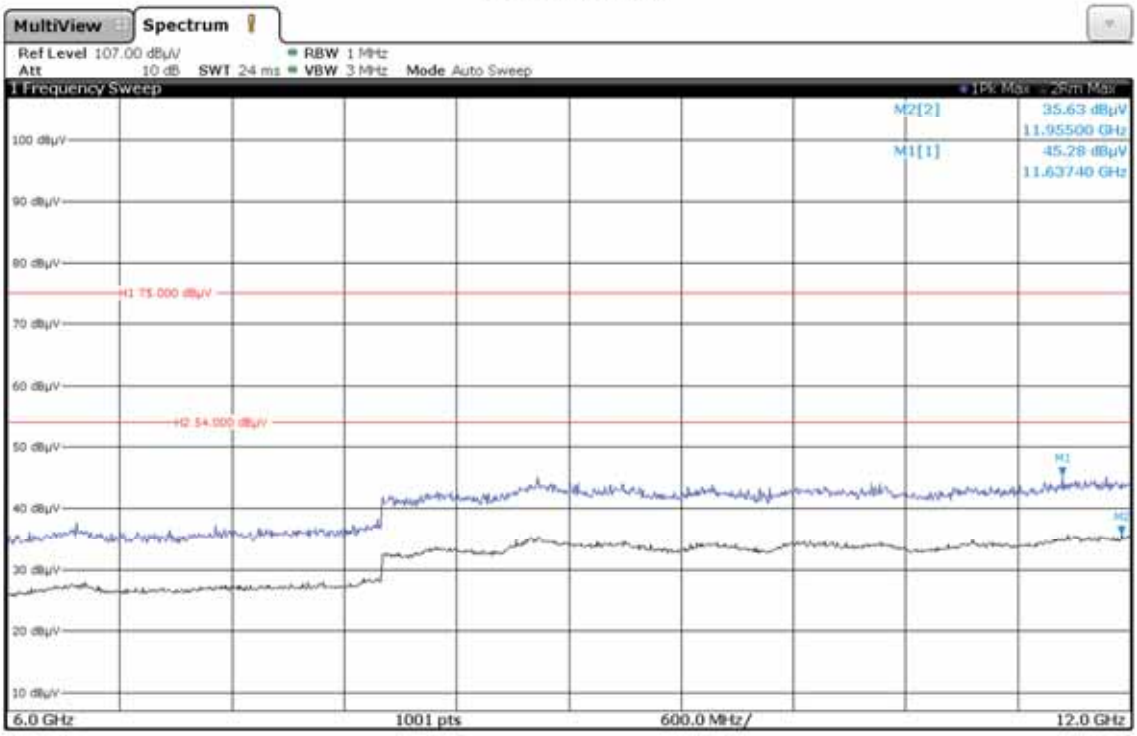
Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
5 802	Vertical	46.52	54	-7.48	Pass

Transmitter Radiated Emissions(continued)

Results : Horizontal / Middle Channel / 802.11n(HT20)

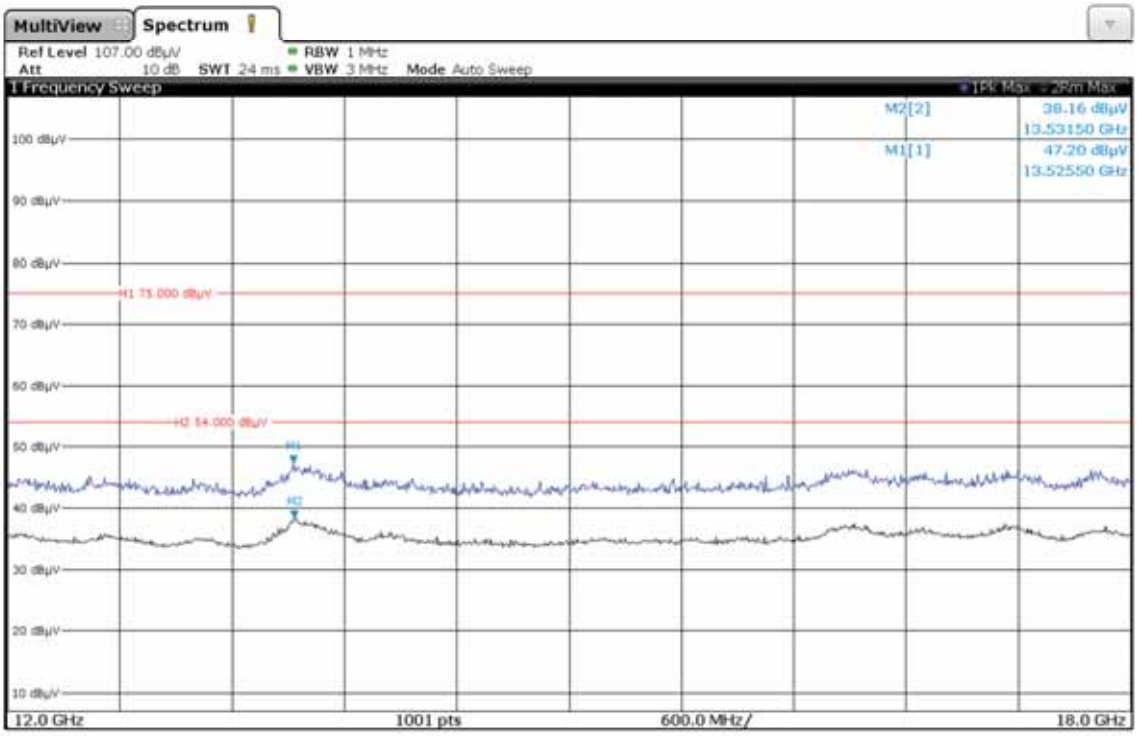


1 GHz to 6 GHz

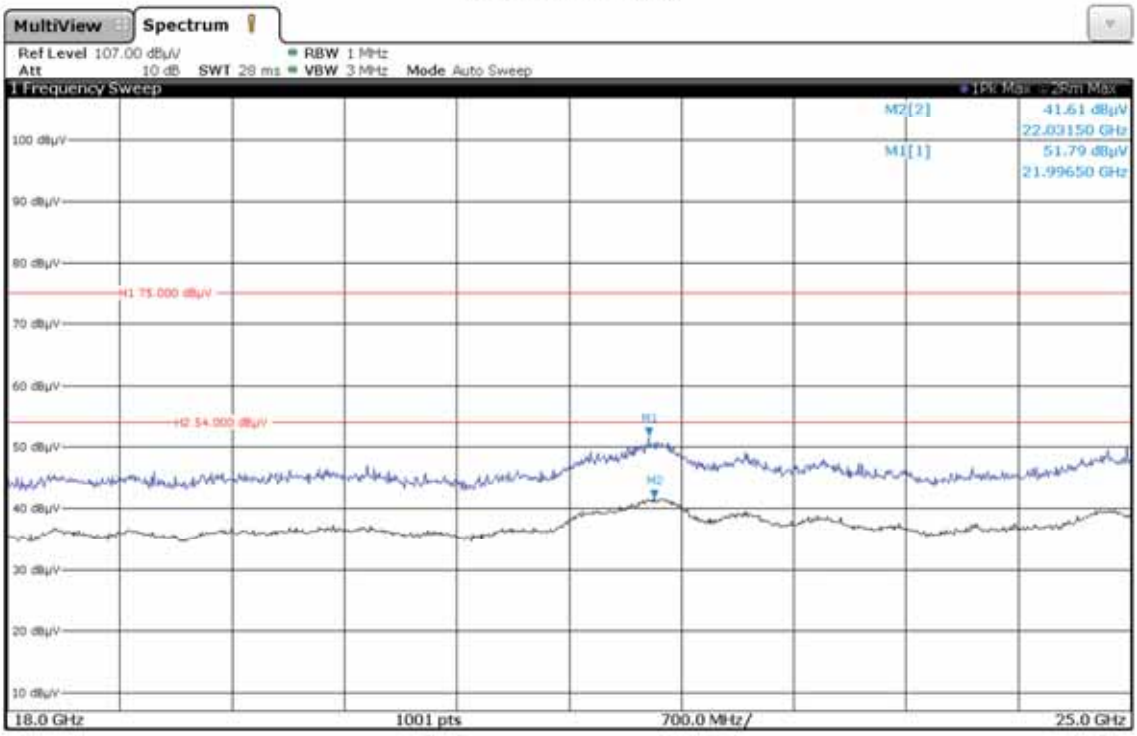


6 GHz to 12 GHz

Results : Horizontal / Middle Channel / 802.11n(HT20)

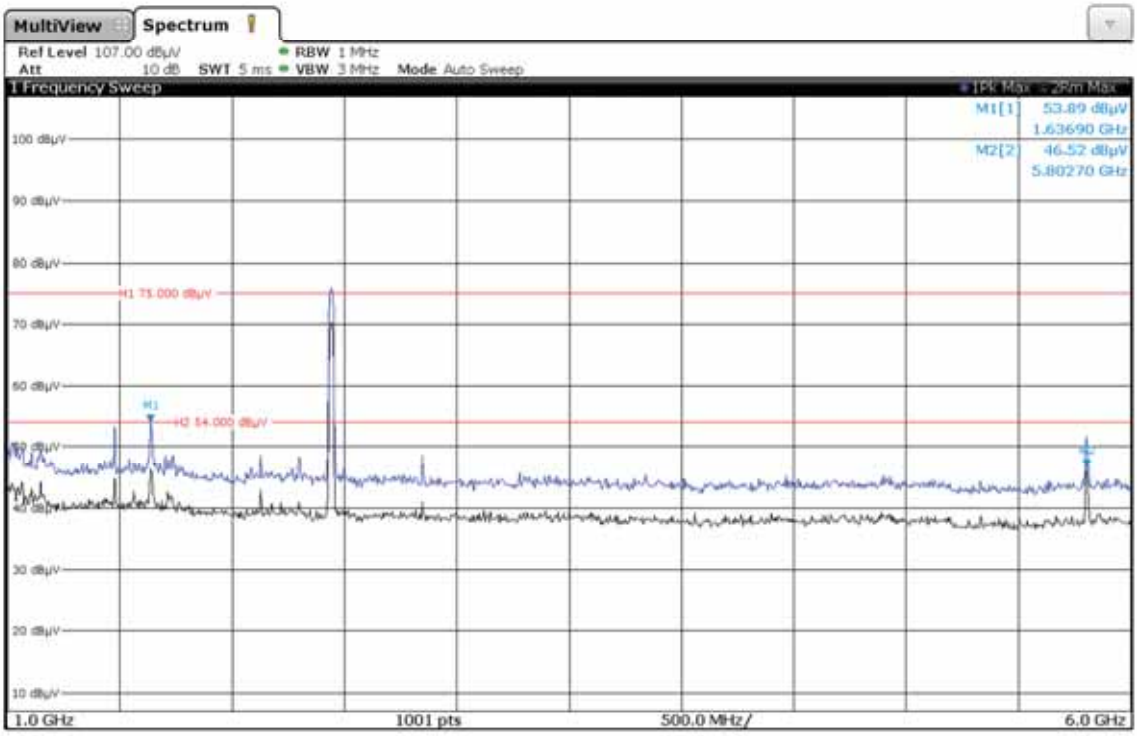


12 GHz to 18 GHz

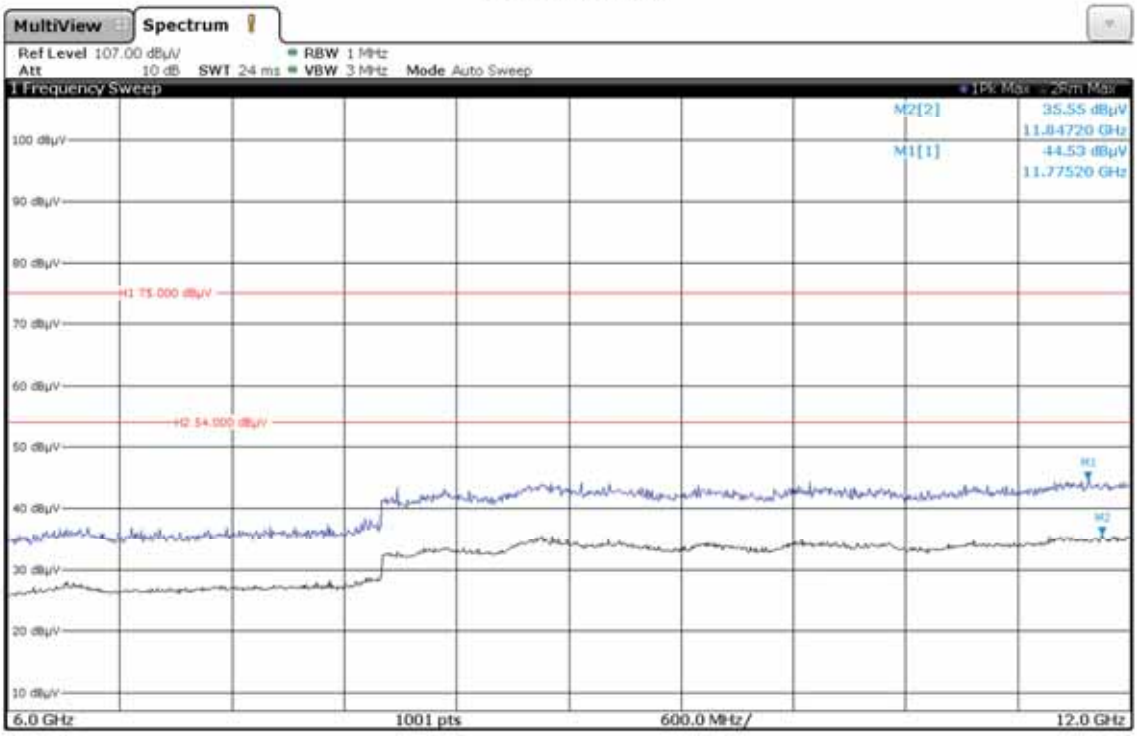


18 GHz to 25 GHz

Results : Vertical / Middle Channel / 802.11n(HT20)

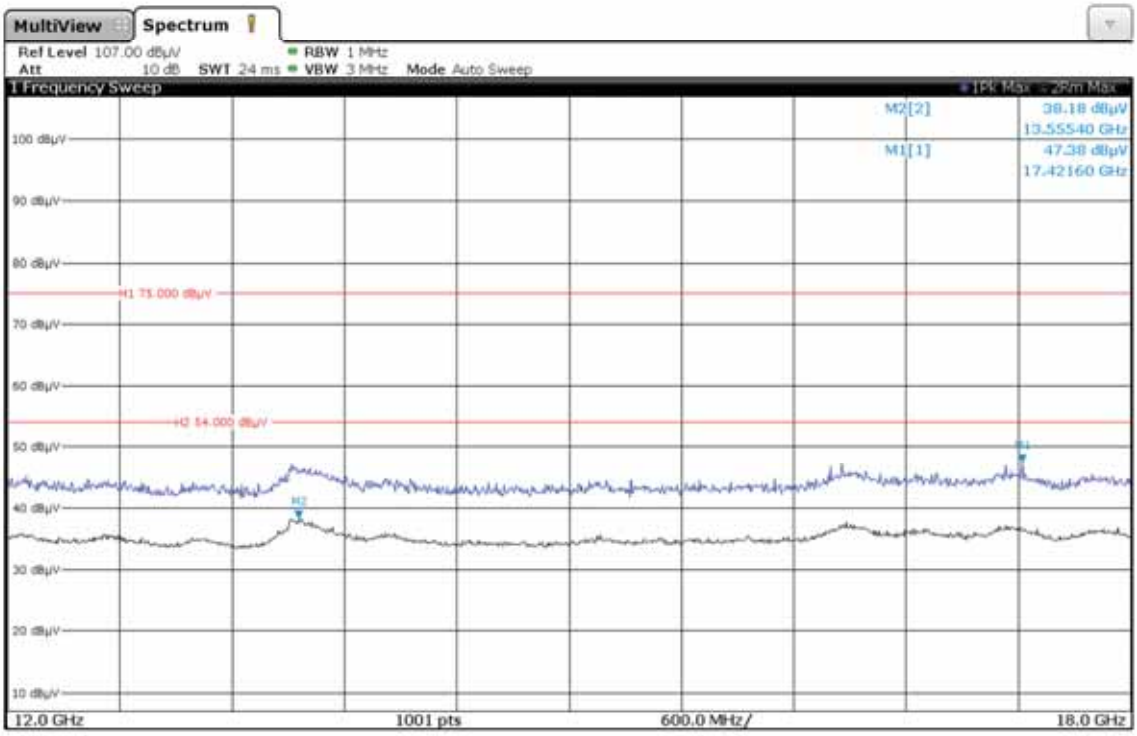


1 GHz to 6 GHz

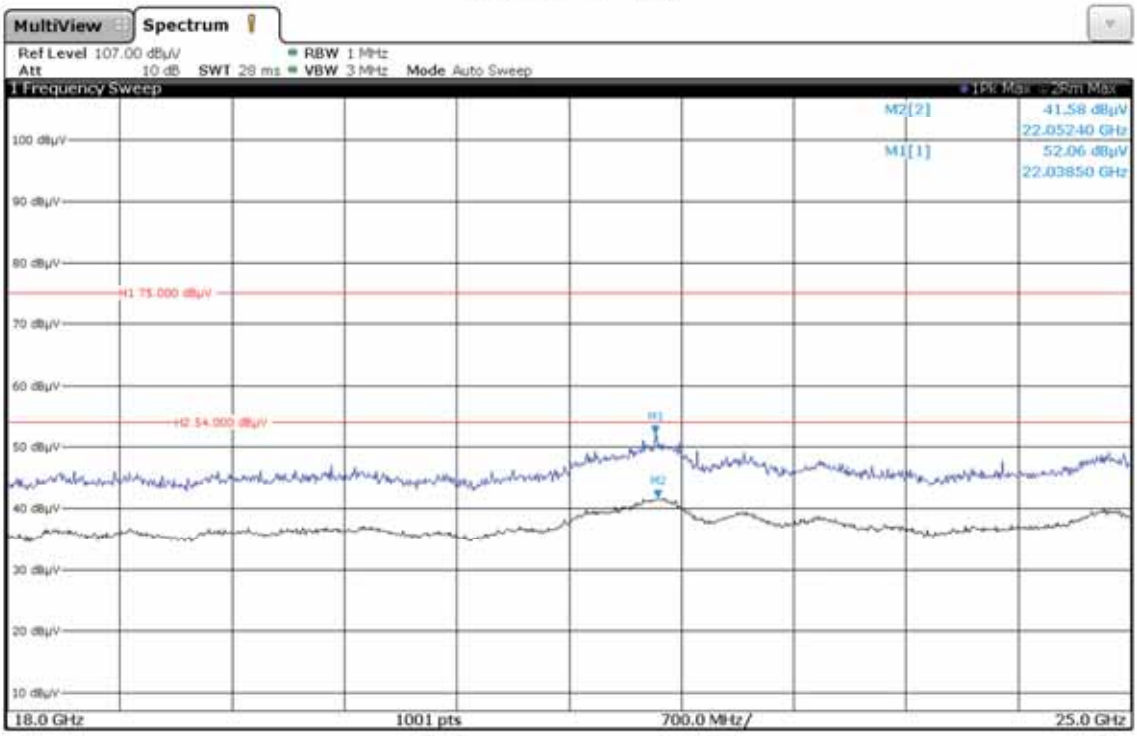


6 GHz to 12 GHz

Results : Vertical / Middle Channel / 802.11n(HT20)



12 GHz to 18 GHz



18 GHz to 25 GHz

6.7 RADIATED RESTRICTED BAND EDGE

Test Requirements and limit, §15.247(d), §15.205, §15.209

Spectrum Setting

■ Peak

Peak emission levels are measured by setting the instrument as follows :

- RBW = 1 % of the span
- VBW ≥ 3 x RBW
- Dectector = Peak
- Sweep time = Auto
- Trace mode = Max hold.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

■ Average (duty cycle ≥ 98 %)

- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Dectector = RMS
- Averaging type = Power (i.e., RMS)
- Sweep time = Auto
- Trace mode = Average
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

6.7.1 Test Data

Results : Peak / 802.11n(HT20) / Lower Band Edge

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 399.8	Horizontal	50.54	74	-23.46	Pass

Results : Average / 802.11n(HT20) / Lower Band Edge

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 399.7	Horizontal	46.65	54	-7.35	Pass

Results : Peak / 802.11n(HT20) / Upper Band Edge

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 483.75	Horizontal	51.95	74	-22.05	Pass

Results : Average / 802.11n(HT20) / Upper Band Edge

Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 483.6	Horizontal	46.33	54	-7.67	Pass

Results : Peak / 802.11n(HT20) / 2 310 MHz to 2 390 MHz Restricted Band

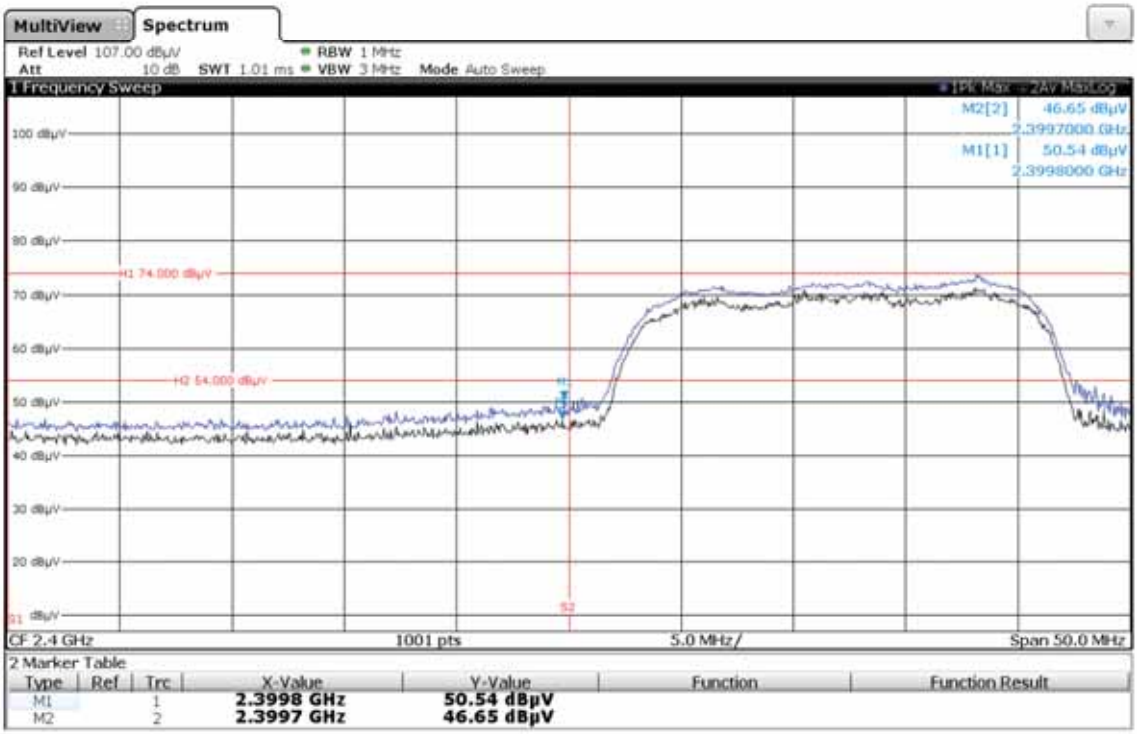
Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 370.93	Horizontal	47.13	74	-26.87	Pass

Results : Average / 802.11n(HT20) / 2 310 MHz to 2 390 MHz Restricted Band

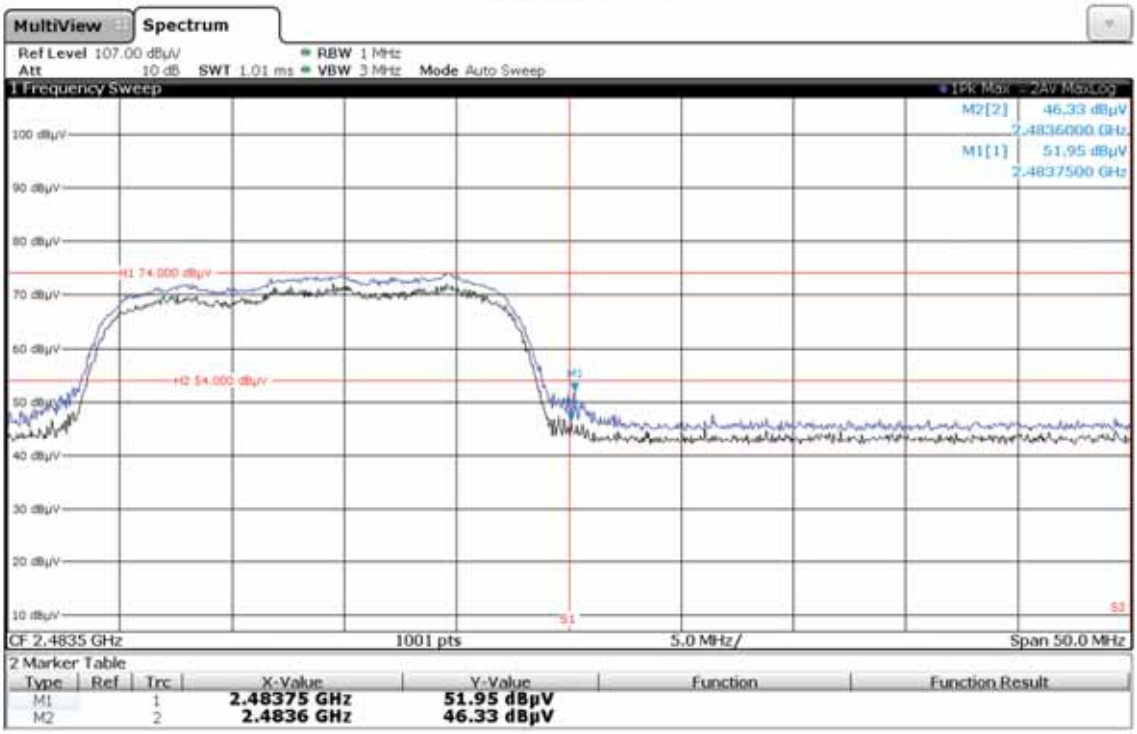
Frequency [MHz]	Antenna Polarity	Level (dBuV/m)	Level (dBuV/m)	Margin (dB)	Result
2 370.93	Horizontal	45.03	54	-8.97	Pass

Transmitter Radiated Emissions(continued)

Results : 802.11n(HT20)



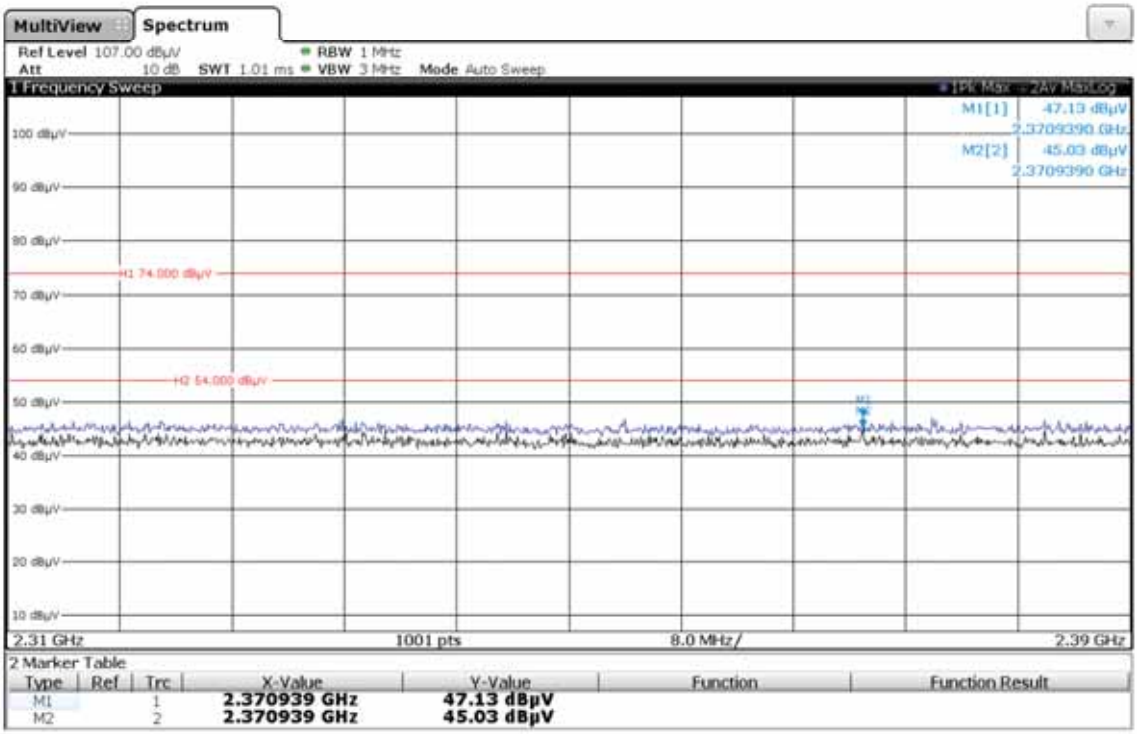
Lower Band Edge



Upper Band Edge

Transmitter Radiated Emissions(continued)

Results : 802.11n(HT20)



2 310 MHz to 2 390 MHz Restricted Band

6.8 Conducted Emission

Test Standard	FCC CFR 47 PART 15 SUBPART B, SECTION 15.207 (b)		
Test venue	Shield Room 2		
Input Ratings	120 v~, 60 Hz		
Tempature	22.6 °C	Humidity	38.0 % R.H.
Test result	Met Class B / Pass		

6.8.1 Limit

Frequency [MHz]	Class B [dBμV]	
	Quasi-Peak	Average
0.15 ~ 0.5	66 ~ 56 *	56 ~ 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

*Decreases with the logarithm of the frequency.

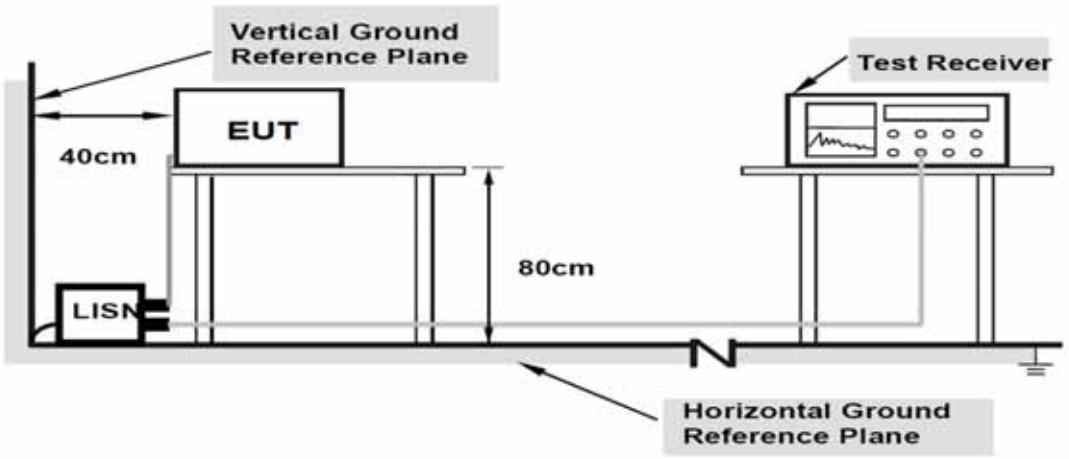
6.8.2 Test set-up and procedure

The mains terminal disturbance voltage was measured with the equipment under test (EUT) in a shield room.

The EUT was connected to an artificial mains network (LISN) placed on the floor.

The EUT was placed on non-metallic table 0.8 m above the metallic, grounded floor.

Amplitude measurements were performed with a quasi-peak detector and an average detector.



6.8.3 Test Data

- Frequency range : 150 kHz ~ 30 MHz
- Bandwidth : 9 kHz

Results : Quasi-Peak

Frequency [MHz]	LISN [dB]	Cable Loss [dB]	Line [H/N]	Limit [dBμV]	Reading [dBμV]	Results [dBμV]	Margin [dB]
0.16	9.85	0.05	H	65.46	36.47	46.37	-19.09
0.33	9.74	0.06	H	59.45	31.78	41.58	-17.87
0.40	9.83	0.07	H	57.85	32.74	42.64	-15.21
0.57	9.84	0.06	H	56.00	28.57	38.47	-17.53
0.66	9.81	0.06	H	56.00	24.26	34.13	-21.87
11.08	9.66	0.18	N	60.00	28.33	38.17	-21.83

Results : Average

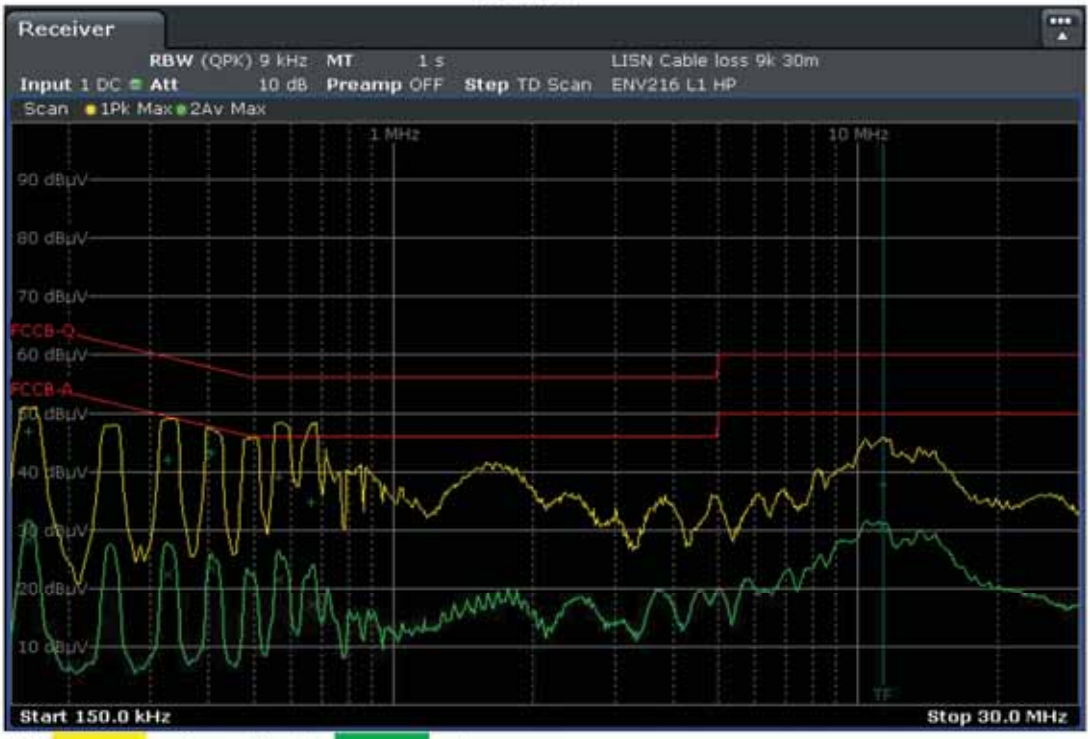
Frequency [MHz]	LISN [dB]	Cable Loss [dB]	Line [H/N]	Limit [dBμV]	Reading [dBμV]	Results [dBμV]	Margin [dB]
0.16	9.85	0.05	H	55.46	17.71	27.61	-27.85
0.33	9.74	0.06	H	49.45	11.97	21.77	-27.68
0.40	9.83	0.07	H	47.85	12.92	22.82	-25.03
0.57	9.84	0.06	H	46.00	10.97	20.87	-25.13
0.66	9.81	0.06	H	46.00	6.73	16.60	-29.40
11.08	9.66	0.18	N	50.00	20.90	30.74	-19.26

* Remark: “H” Hot Line, “N” Neutral Line
* Results [dBμV] = Reading [dBμV] + LISN [dB] + Cable Loss [dB], * Margin [dB] = Results [dBμV] - Limit [dBμV]

Measurement uncertainty

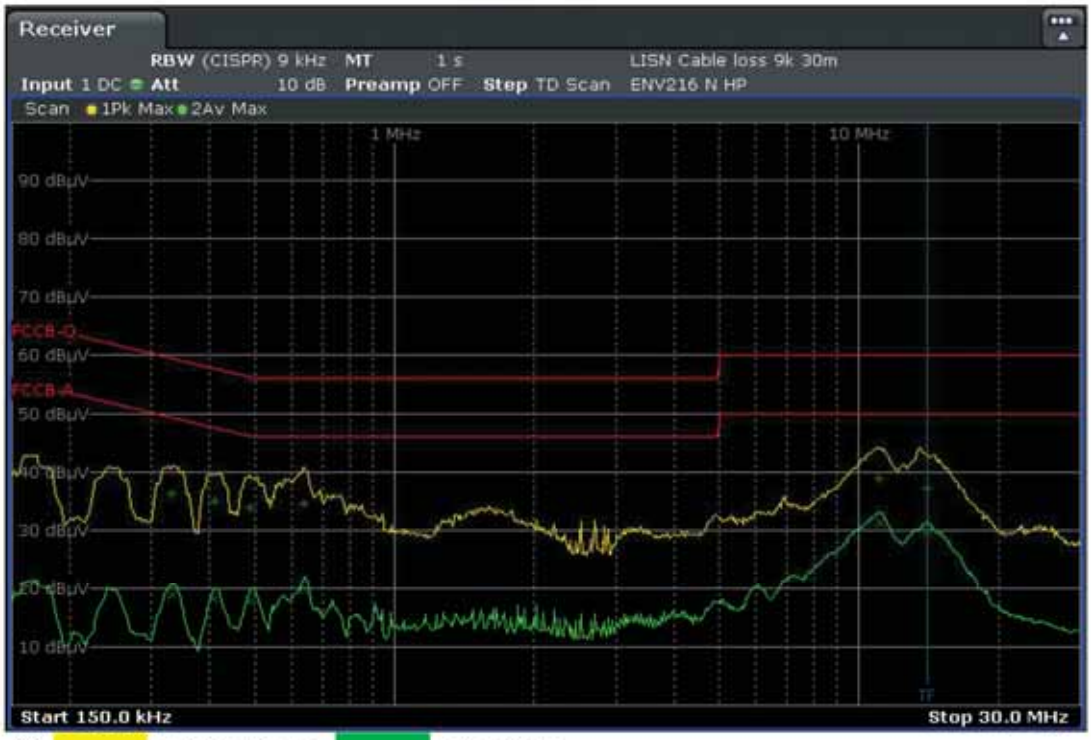
Conducted emission, quasi-peak detection: 2.2 dB
Conducted emission, average detection: 2.2 dB
The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

Hot Line



※ : Quasi-Peak, : Average

Neutral Line



※ : Quasi-Peak, : Average

7. Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Cal. Due Data
Spectrum Analyzer	FSW43	Rohde & Schwarz	104088	2019-08-03
Test Receiver	ESR7	Rohde & Schwarz	101969	2019-08-03
BI-LOG ANT	VULB 9163	Schwarzbeck	691	2020-01-03
Horn antenna	BBHA 9120D	Schwarzbeck	769	2019-09-25
SHF-EHF Horn	BBHA 9170	Schwarzbeck	#674	2021-04-19
Amplifier	310N	SONOMA	291723	2019-08-03
Microwave Preamplifier	8449B	Agilent	3008A02413	2020-04-09
Antenna Mast	MA4640 /800-XP-ET	Innco systems GmbH	-	-
Antenna Mast	MA4000-EP	Innco systems GmbH	-	-
Turntable	DT3000-t2	Innco systems GmbH	-	-
Controller	CO3000	Innco systems GmbH	CO3000/969 /39421016/L	-
LISN	NSLK 8127	8127518	SCHWARZBECK	2019-08-03
Two-Line V-Network	ENV216	3560.6550.12-101874-Rq	ROHDE & SCHWARZ	2019-08-03
Two-Line V-Network	ENV216	3560.6550.12-102073-Ax	ROHDE & SCHWARZ	2019-08-03
Four-Line V-Network	ENV432	101284	ROHDE & SCHWARZ	2019-08-03
ISN	ISN T800	30813	TESEQ	2020-02-11
ISN	ISN T8-Cat6	29709	TESEQ	2020-02-11
ARTFICIAL MAINS NETWORK	L3-32	1220X20311	PMM	-