FCC Test Report

Report No.: ARFR-19MY2315VTSHPB-1

FCC ID: 2ANDLTY-R8804

Product: Smart Camera

Model: SC002-WA2/ SC002-WB2

Received Date: May.22, 2019

Test Date: May.26 to Jun.10, 2019

Issued Date: Jun.10, 2019

Applicant: Hangzhou Tuya Information Technology Co., Ltd

Address: Room701, Building3, More Center,No.87 GuDun Road, Hangzhou, Zhejiang, China

Issued By: BUREAU VERITAS ADT (Shanghai) Corporation

Lab Address: No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)

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Release Control Record

Issue No.	Description	Date Issued
ARFR-19MY2315VTSHPB-1	Original release	Jun.10, 2019

1 Certificate of Conformity

Product: Smart Camera

Brand: TUYA

Model: SC002-WA2/ SC002-WB2

Applicant: Hangzhou Tuya Information Technology Co., Ltd

Test Date: May.26 to Jun.10, 2019

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Will Yan , **Date:** Jun.10, 2019

Will Yan

Project Engineer

Approved by : , **Date:** Jun.10, 2019

Daniel Sun

RF Supervisor

BV ADT (SHANGHAI) CORPORATION E&E报告专用

2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions Measurement	PASS	Meet the requirement of limit.
15.247(d)	Emissions in non-restricted frequency bands	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Feb.10,18	Feb.09,19
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.27,18	Aug.26,19
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Oct.19, 18	Oct.18, 19
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Mar. 26, 18	Mar. 25, 20
EMI test recerver	R&S	ESR7	E1R1005	Dec.05, 18	Dec.04, 19
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.24,18	Jul.23, 19
EMI test recerver	R&S	ESCS30	E1R1001	Mar.26, 19	Mar.25, 20
LISN	R&S	ENV216	E1L1011	Jul.17, 18	Jul.18, 19
Humidity&Temp Tester	Baolima	WS508	E1H1011	Apr. 04, 19	Apr. 03, 20
Test Software	ADT	ADT_COND_V 7.3.1	N/A	N/A	N/A
Test Software	Toscend	JS32-RE	N/A	N/A	N/A
Test Software	Toscend	JS1120	N/A	N/A	N/A

2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Smart Camera
Brand	TUYA
Test Model	SC002-WA2/ SC002-WB2
Model Difference	Only the difference appearance
Power Rating	120Vac 60Hz for adaptor
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Operating Frequency	See clause 3.2
Number of Channel	See clause 3.2
Antenna Type	Ceramic Antenna
Antenna Connector	--
Antenna Gain	0dBi

Note:

1. The EUT incorporated a MIMO function. Physically, the EUT provides one completed transmitter and one receivers.
2. The schematic, PCB of model SC002-WA2 and SC002-WB2 is the same, just appearance is different. We choose the model of SC-002WA2 to test and show the test results in this report.

Modulation Mode	TX /RX Function
802.11b	1TX / 1RX
802.11g	1TX / 1RX
802.11n (HT20)	1TX / 1RX

3.2 Description of Test Modes

13 channels are provided for 802.11b, 802.11g and 802.11n (HT20)

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

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE ≥ 1G	RE < 1G	PLC	APCM	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE≤1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Radiated Emission Test (Above 1 GHz):

☒□ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 13	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 6, 11	OFDM	BPSK	6.5

Radiated Emission Test (Below 1 GHz):

☒□ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Power Line Conducted Emission Test:

☒□ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1	DSSS	DBPSK	1.0

Antenna Port Conducted Measurement

☒□ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

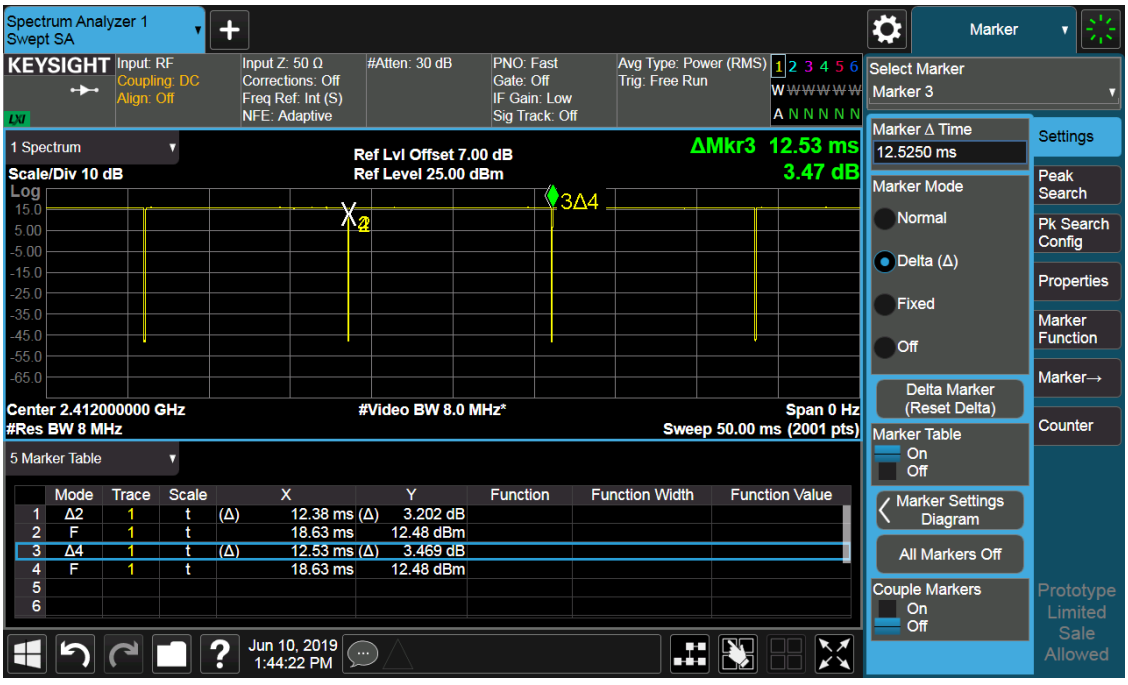
EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5

3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE ≥ 1G	25deg. C, 60%RH	120Vac, 60Hz
RE < 1G	25deg. C, 60%RH	120Vac, 60Hz
PLC	25deg. C, 60%RH	120Vac, 60Hz
APCM	25deg. C, 60%RH	120Vac, 60Hz

3.3 Duty Cycle of Test Signal

The Duty Cycle of the EUT is 98.80%.



Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

FCC Part 15, Subpart C (15.247)

KDB 558074 D01 DTS Meas Guidance v05r02

ANSI C63.10:2013

All relaxed test items have been performed and recorded as per the above standard.

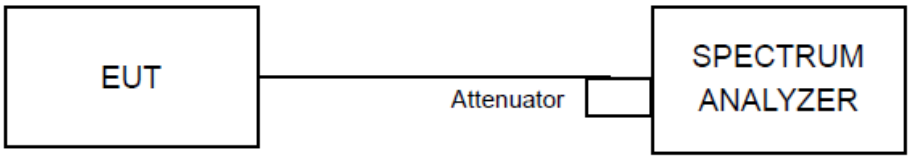
4 Test Procedure and Results

4.1 6dB Bandwidth Measurement

4.1.1 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz

4.1.2 Test Setup



4.1.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geqslant$ 3 · RBW, peak detector with maximum hold) is implemented by the instrumentation function.

4.1.4 Deviation of Test Standard

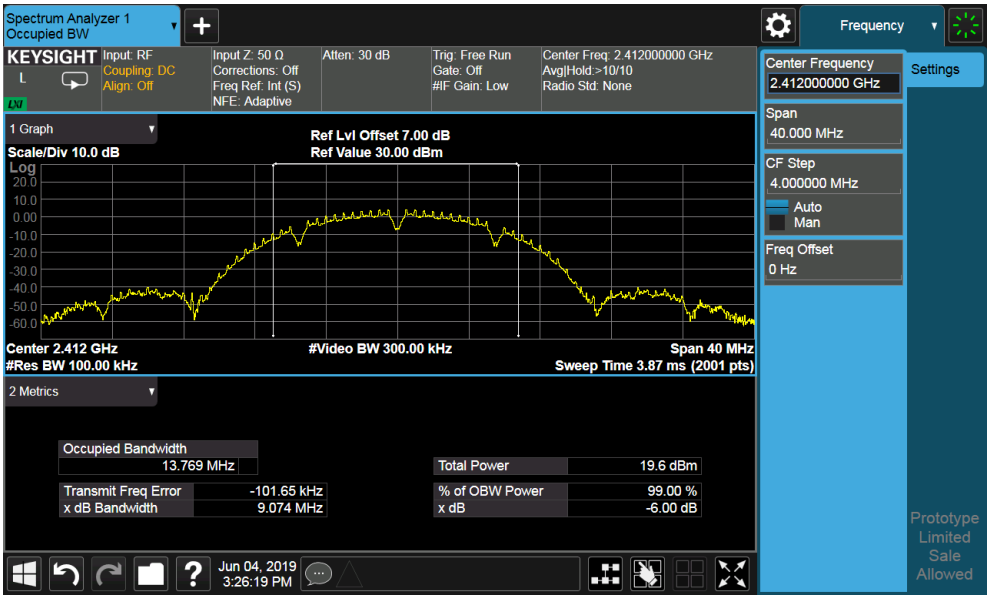
No deviation.

4.1.5 Test Results

802.11b

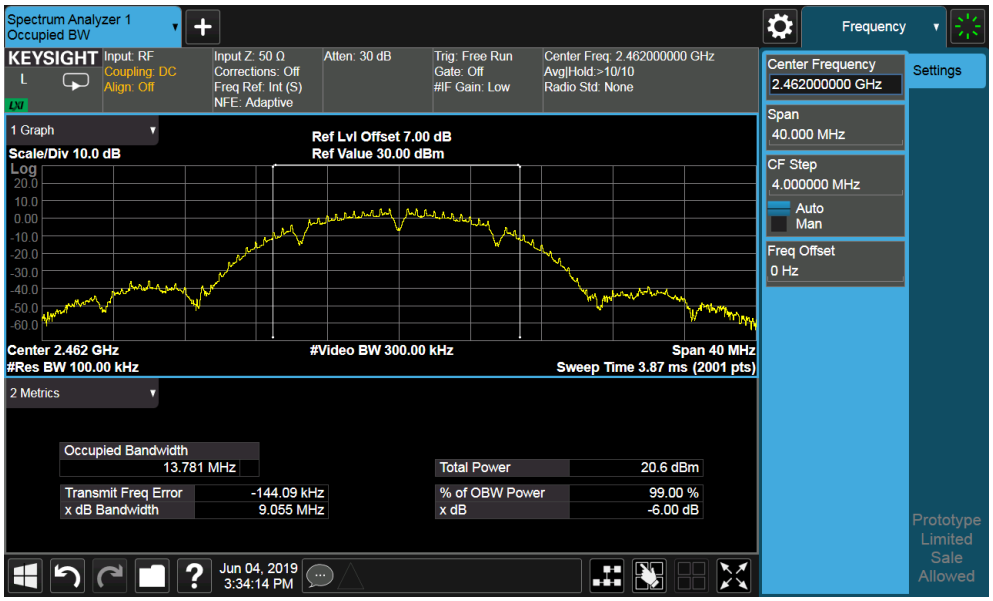
Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	13.769	9.074	0.5	Pass
6	2437	13.735	8.585	0.5	Pass
11	2462	13.781	9.055	0.5	Pass

Spectrum Plot
802.11b(2412MHz)



802.11b(2437MHz)

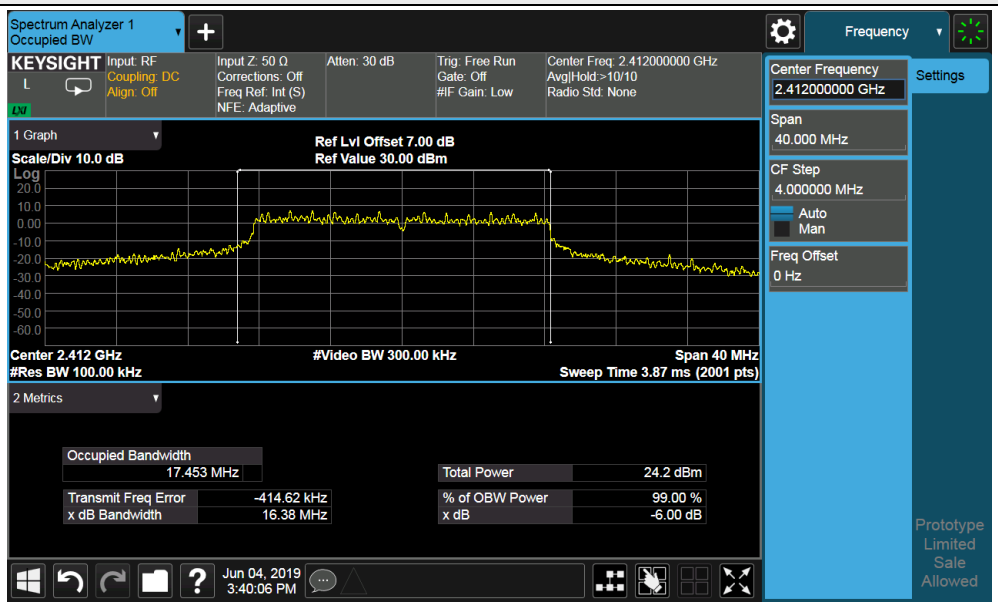
802.11b(2462MHz)



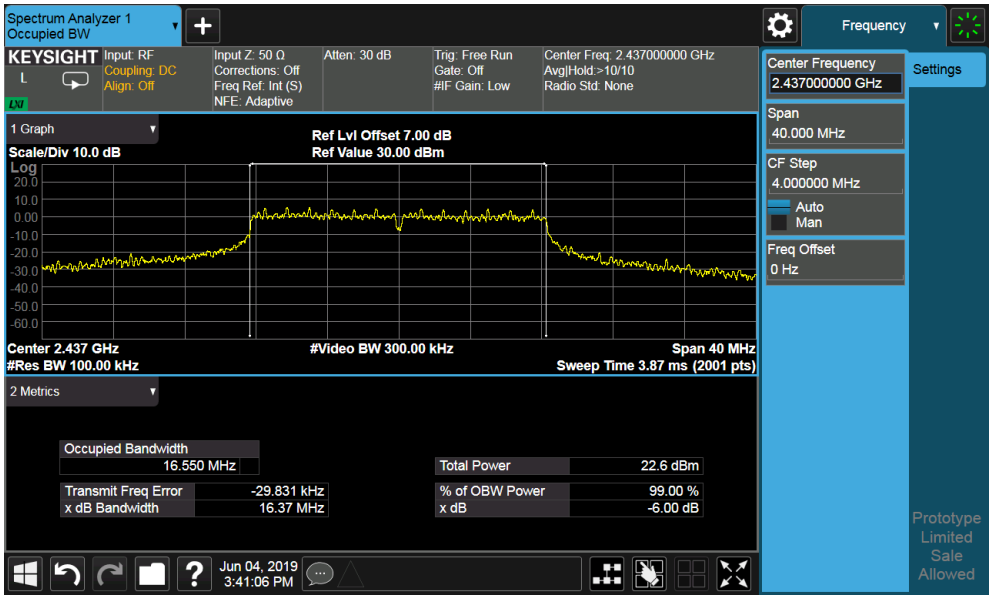
802.11g

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	17.453	16.380	0.5	Pass
6	2437	16.550	16.370	0.5	Pass
11	2462	16.487	16.370	0.5	Pass

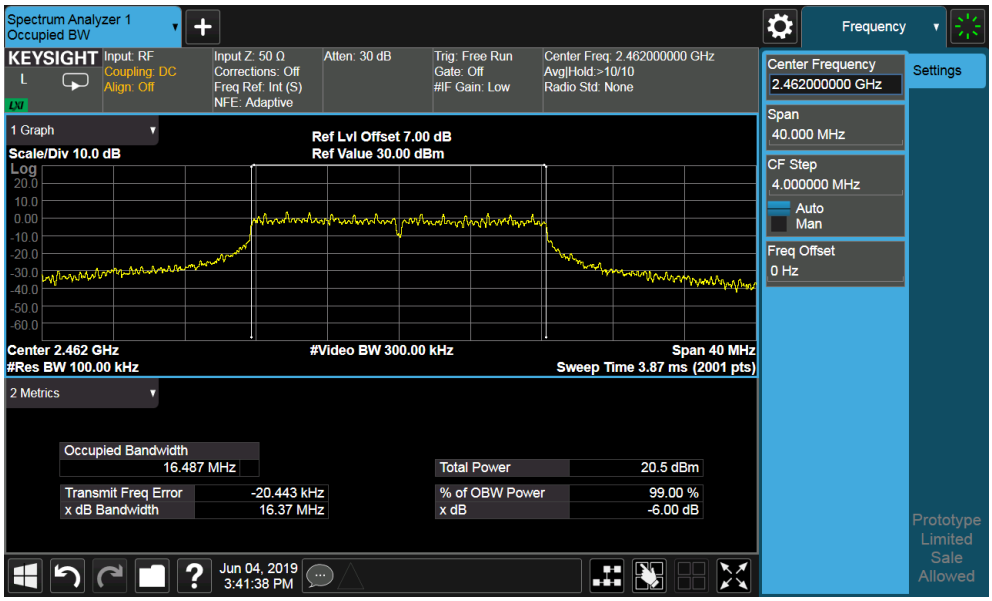
Spectrum Plot
802.11g(2412MHz)



802.11g(2437MHz)



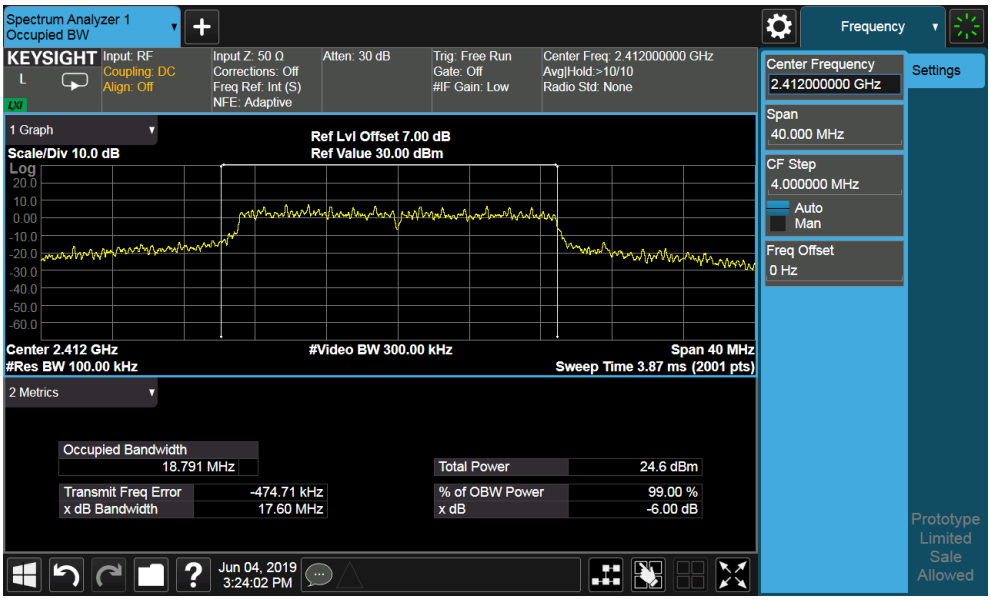
802.11g(2462MHz)



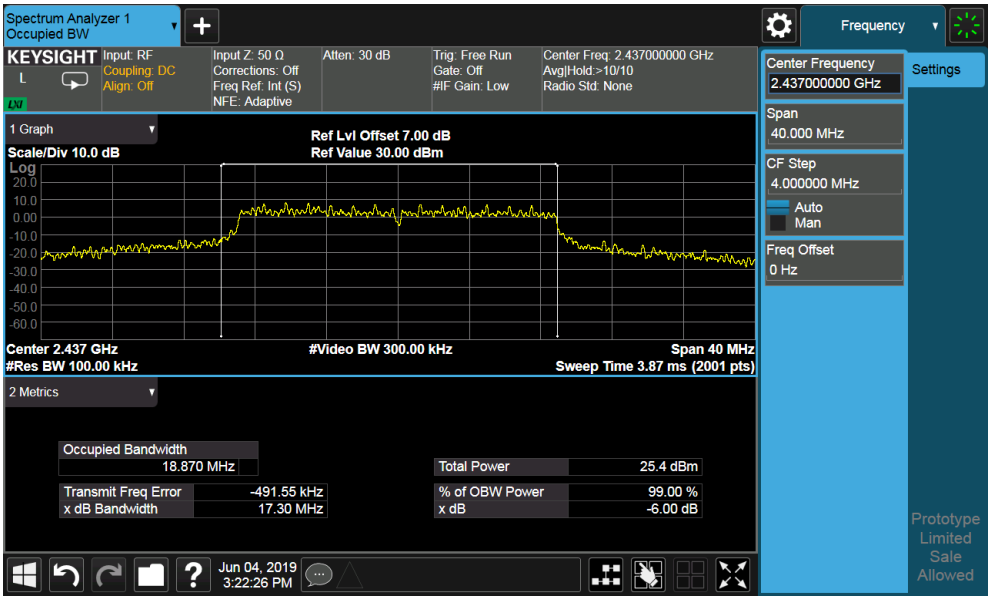
802.11n(HT20)

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	18.791	17.600	0.5	Pass
6	2437	18.870	17.300	0.5	Pass
11	2462	17.742	17.600	0.5	Pass

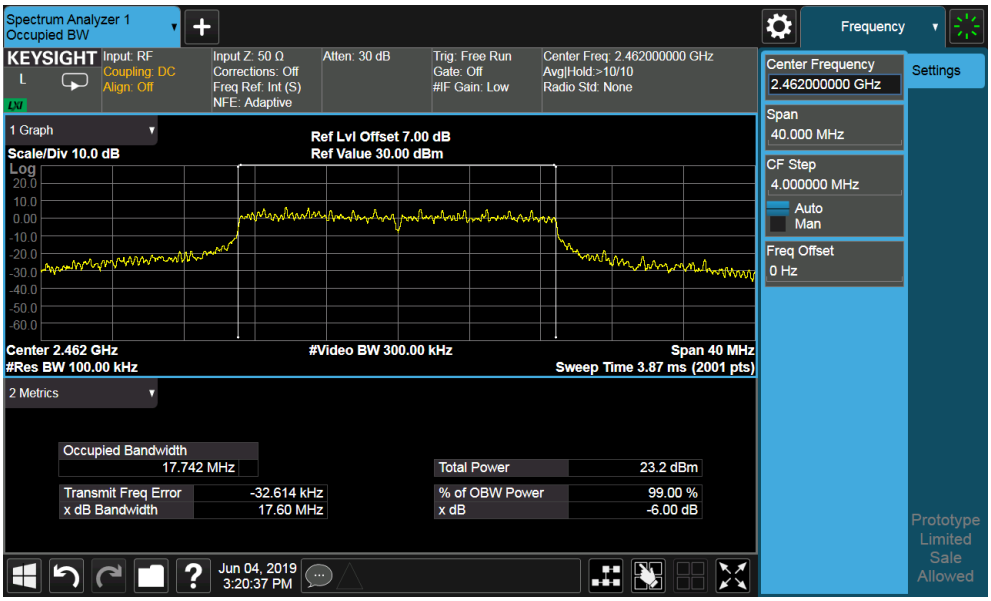
Spectrum Plot
802.11n(HT20)(2412MHz)



802.11n(HT20)(2437MHz)



802.11n(HT20)(2462MHz)

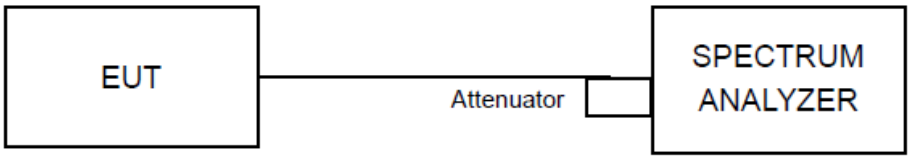


4.2 Conducted Output Power Measurement

4.2.1 Limit

For systems using digital modulation in the 2400 – 2483.5 MHz bands: 1 Watt (30 dBm)

4.2.2 Test Setup



4.2.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 9.2.2.4).

a) Measure the duty cycle, x, of the transmitter output signal as described in Section 6.0.

b) Set span to at least 1.5 OBW.

c) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz.

d) Set VBW ≥ 3 RBW.

e) Number of points in sweep ≥ 2 span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)

f) Sweep time = auto.

g) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.

h) Do not use sweep triggering. Allow the sweep to “free run”.

i) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.

j) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

k) 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 (because the measurement represents an average over both the on-

and off-times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25 %.

4.2.4 Deviation of Test Standard

No deviation.

4.2.5 Test Results

802.11b

Channel	Frequency (MHz)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	15.00	30	Pass
6	2437	15.28	30	Pass
11	2462	15.21	30	Pass

Spectrum Plot
802.11b(2412MHz)

802.11b(2437MHz)

802.11b(2462MHz)

802.11g

Channel	Frequency (MHz)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	14.41	30	Pass
6	2437	13.12	30	Pass
11	2462	11.16	30	Pass

Spectrum Plot
802.11g(2412MHz)

802.11g(2437MHz)

802.11b(2462MHz)

802.11n(HT20)

Channel	Frequency (MHz)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	13.82	30	Pass
6	2437	12.65	30	Pass
11	2462	11.13	30	Pass

Spectrum Plot
802.11n(HT20)(2412MHz)

802.11n(HT20)(2437MHz)

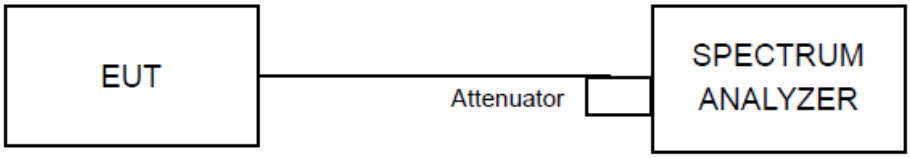
802.11n(HT20)(2462MHz)

4.3 Power Spectral Density Measurement

4.3.1 Limit

The Maximum of Power Spectral Density Measurement is 8 dBm in any 3 kHz band.

4.3.2 Test Setup



4.3.3 Test Procedures

The power output per FCC § 15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

a) Measure the duty cycle (x) of the transmitter output signal.

b) Set instrument center frequency to DTS channel center frequency.

c) Set span to at least 1.5 OBW.

d) Set RBW to: 3 kHz $\leqslant$ RBW $\leqslant$ 100 kHz.

e) Set VBW $\geqslant$ 3 RBW.

f) Detector = power averaging (RMS) or sample detector (when RMS not available).

g) Ensure that the number of measurement points in the sweep $\geqslant$ 2 span/RBW.

h) Sweep time = auto couple.

i) Do not use sweep triggering. Allow sweep to "free run".

j) Employ trace averaging (RMS) mode over a minimum of 100 traces.

k) Use the peak marker function to determine the maximum amplitude level.

l) Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.

m) If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum

measurement point requirement as the RBW is reduced).

4.3.4 Deviation of Test Standard

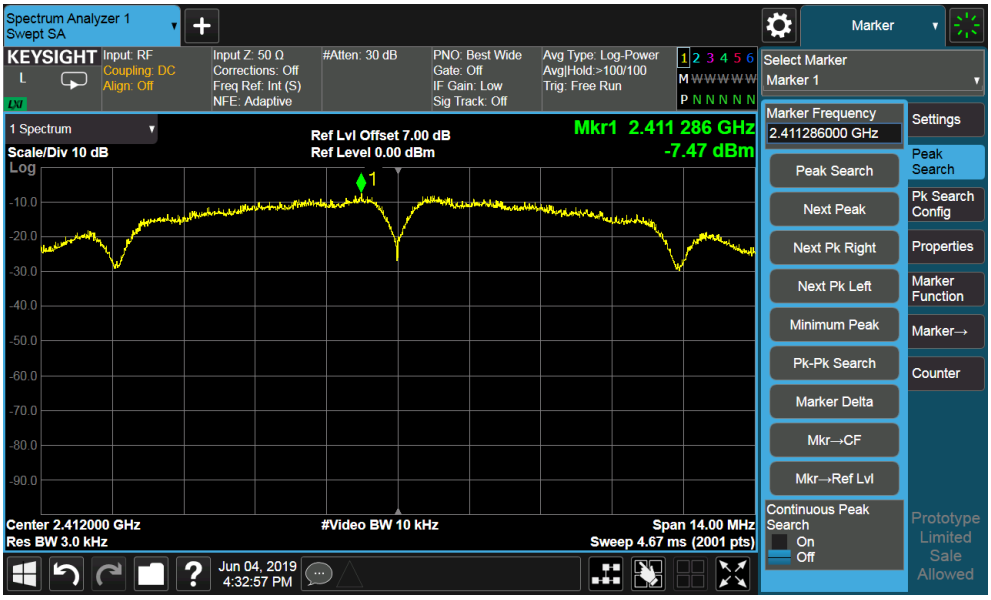
No deviation.

4.3.5 Test Results

802.11b

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
1	2412	-7.47	8	Pass
6	2437	-8.20	8	Pass
11	2462	-9.18	8	Pass

Spectrum Plot
802.11b(2412MHz)



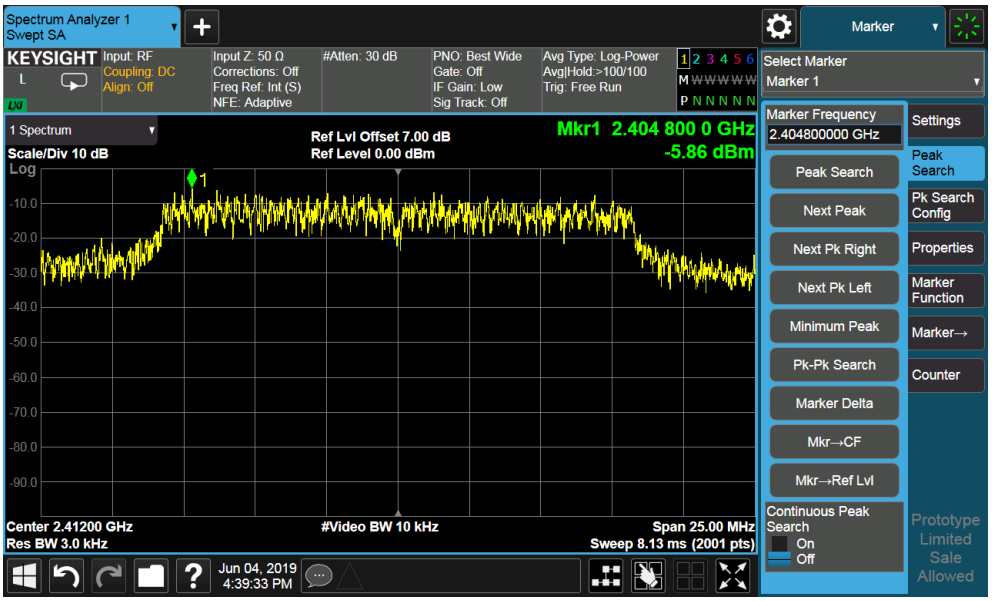
802.11b(2437MHz)

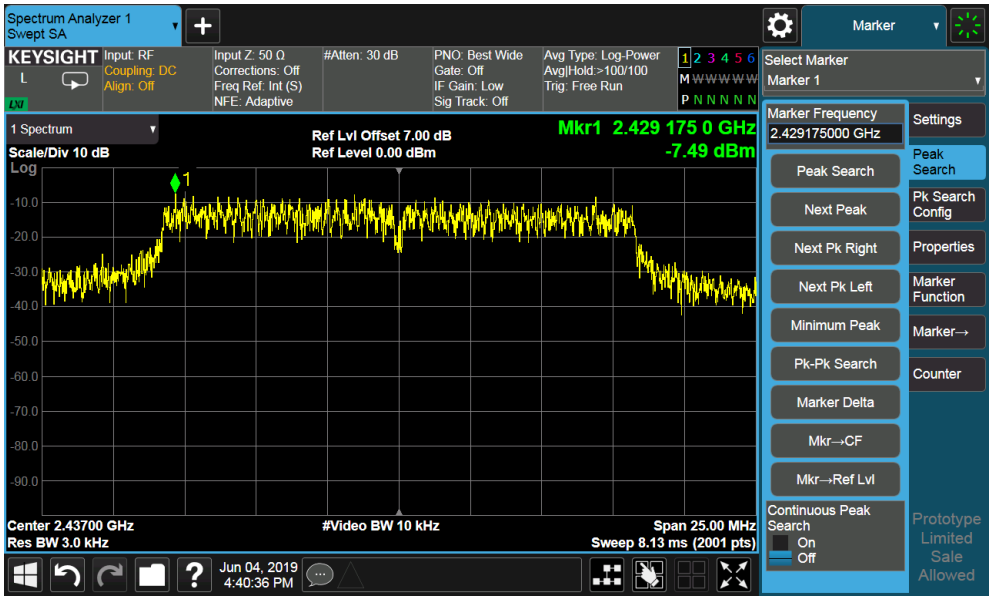
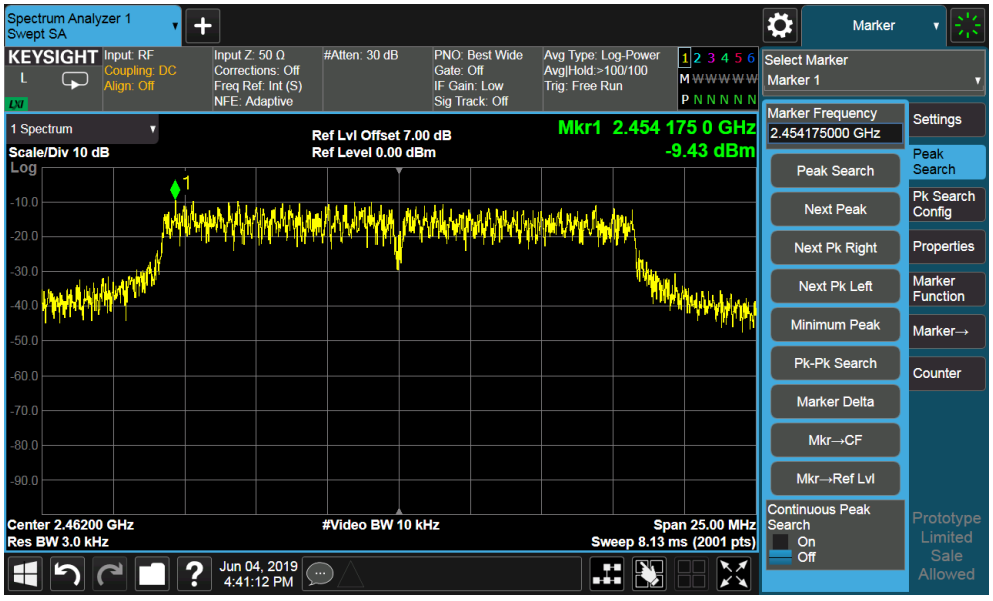
802.11b(2462MHz)

802.11g

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
1	2412	-5.86	8	Pass
6	2437	-7.49	8	Pass
11	2462	-9.43	8	Pass

Spectrum Plot
802.11g(2412MHz)

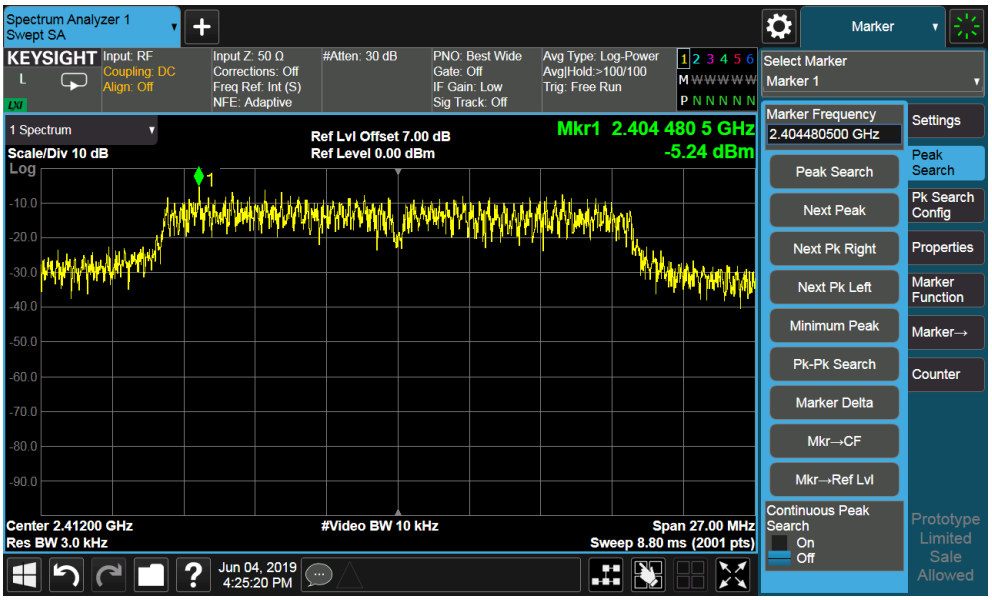


802.11g(2437MHz)

802.11g(2462MHz)


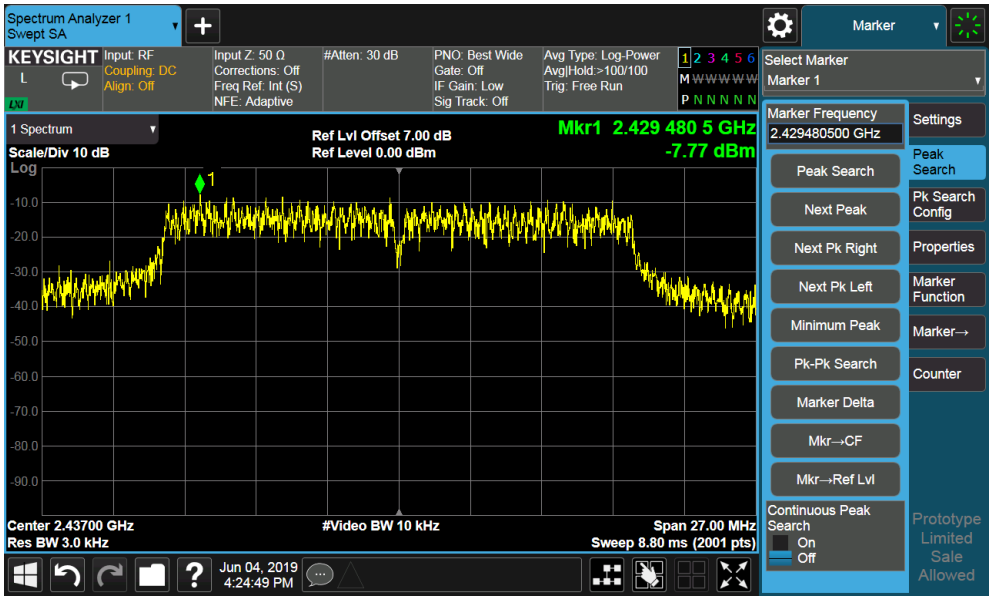
802.11n(HT20)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
1	2412	-5.24	8	Pass
6	2437	-7.77	8	Pass
11	2462	-8.33	8	Pass

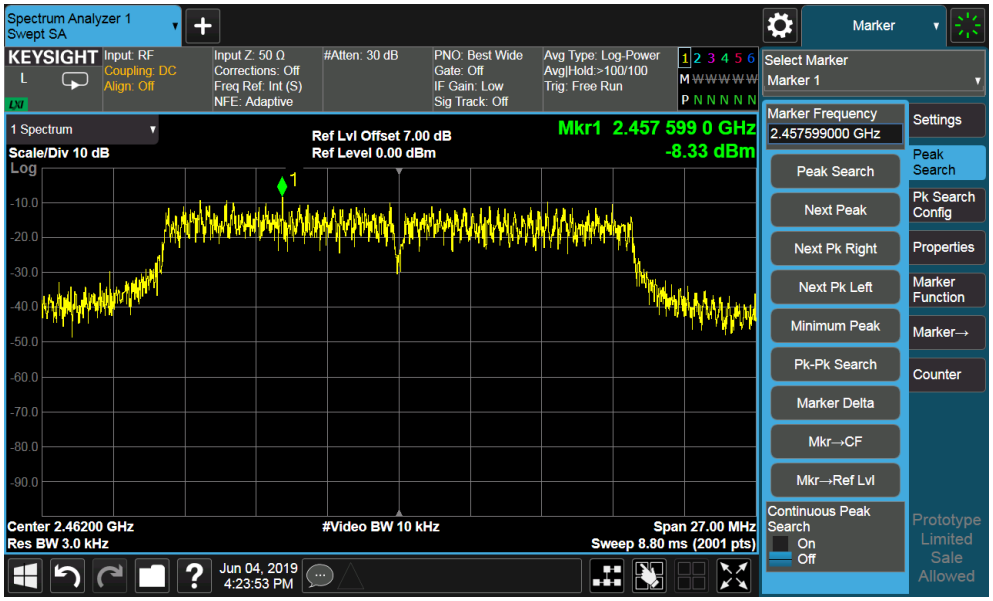
Spectrum Plot
802.11n(HT20)(2412MHz)



802.11n(HT20)(2437MHz)



802.11n(HT20)(2462MHz)

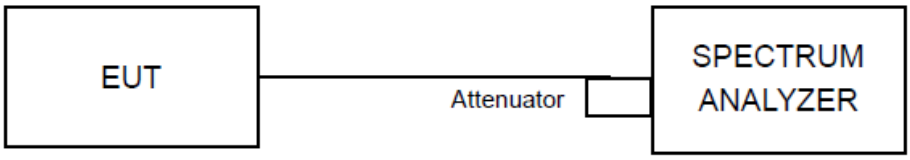


4.4 Emissions in non-restricted frequency bands

4.4.1 Limit

Below 30 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

4.4.2 Test Setup



4.4.3 Test Procedures

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ⩾ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ⩾ 300 kHz.
3. Detector = peak.

4. Sweep = auto couple.

5. Trace Mode = max hold.

6. Allow trace to fully stabilize.

7. Use the peak marker function to determine the maximum amplitude level.

4.4.4 Deviation of Test Standard

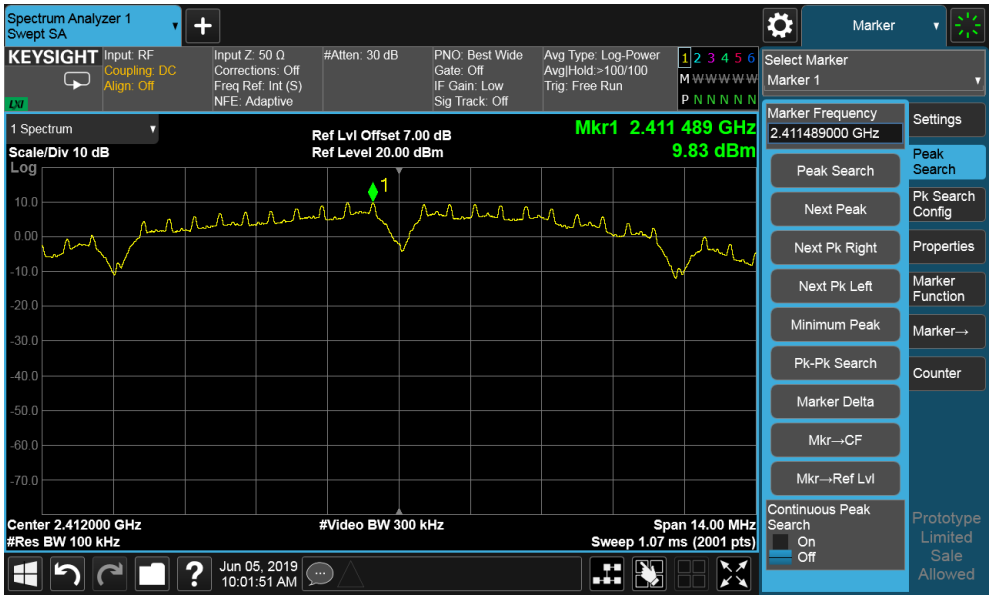
No deviation.

4.4.5 Test Results

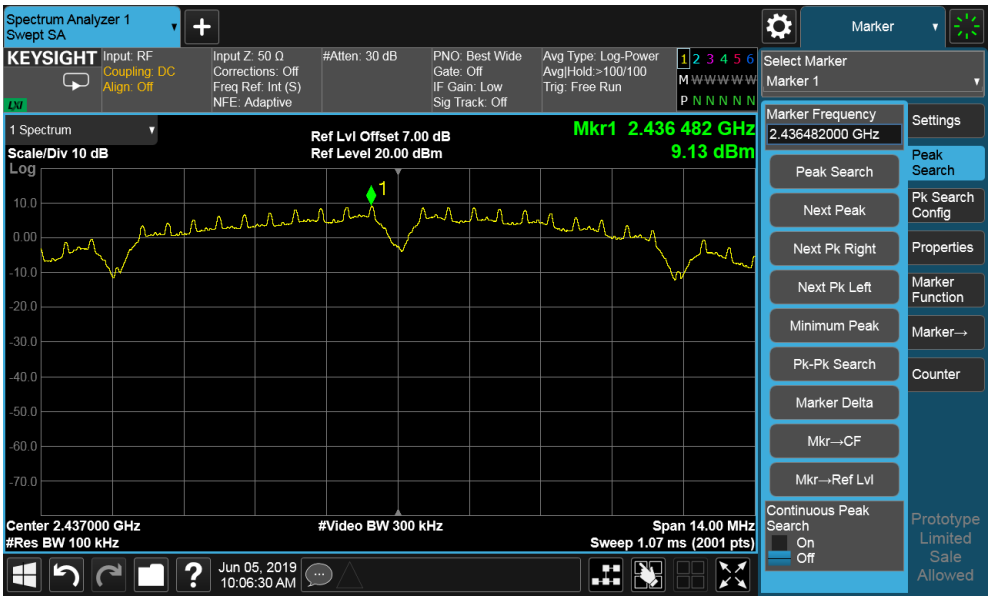
802.11b

Channel	Frequency (MHz)	Pass / Fail
1	2412	Pass
6	2437	Pass
11	2462	Pass

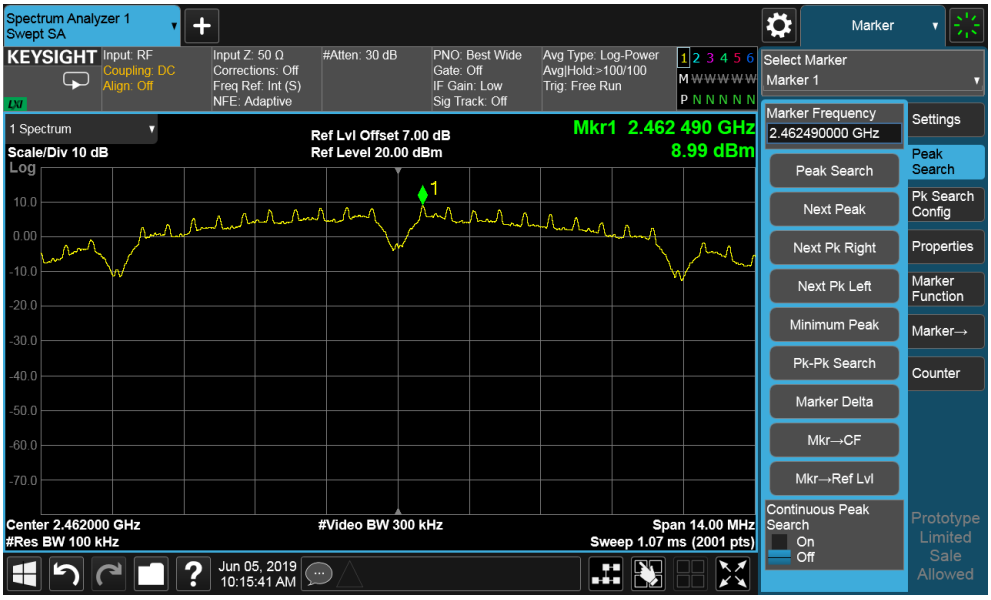
Spectrum Plot
802.11b(2412MHz)



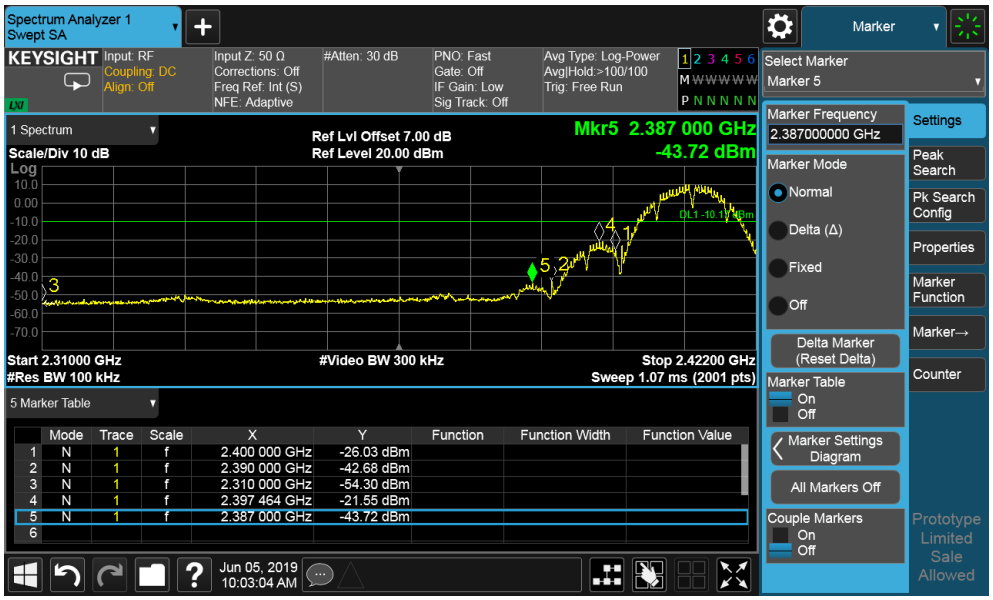
802.11b(2437MHz)



802.11b(2462MHz)



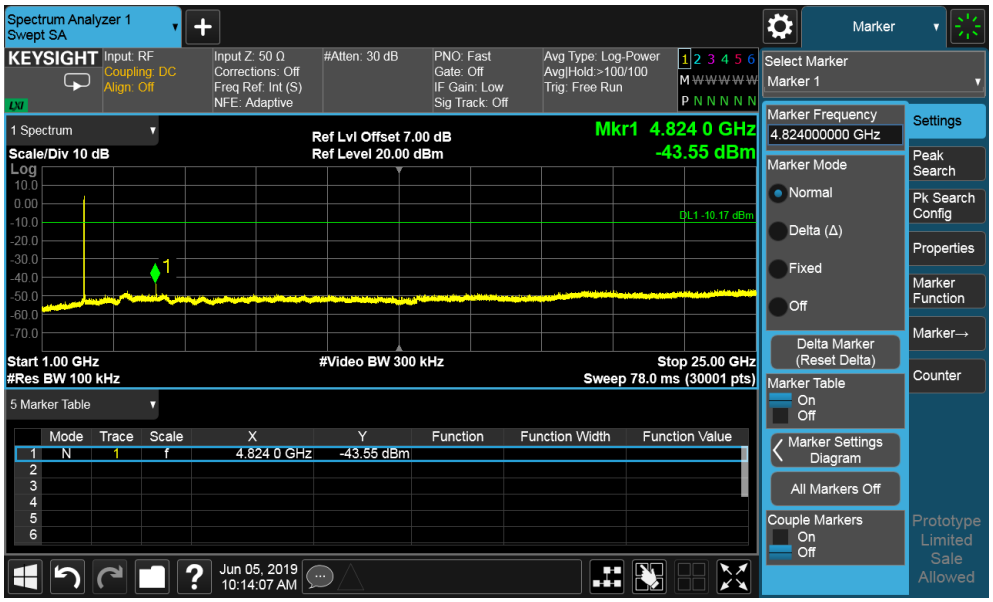
Spectrum Plot
802.11b(2412MHz) Band Edge



802.11b(2462MHz) Band Edge

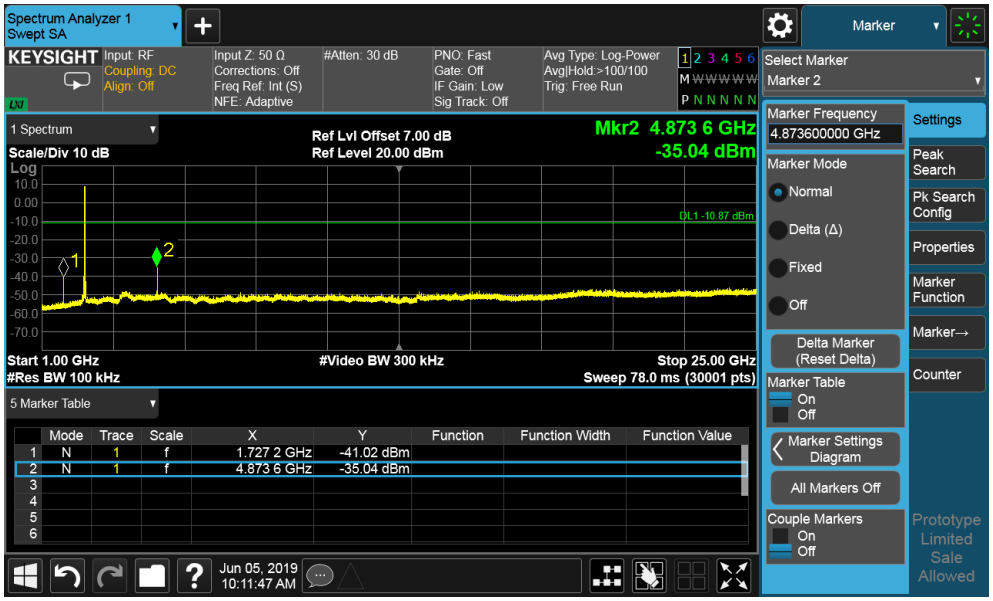
Spectrum Plot

802.11b(2412MHz) Out-of-Band Emissions



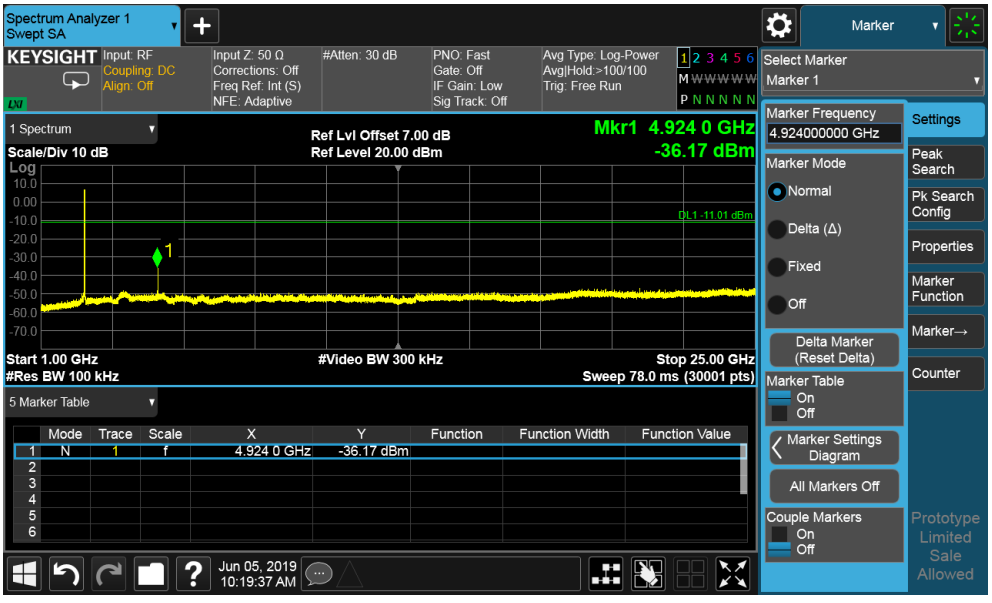
Spectrum Plot

802.11b(2437MHz) Out-of-Band Emissions



Spectrum Plot

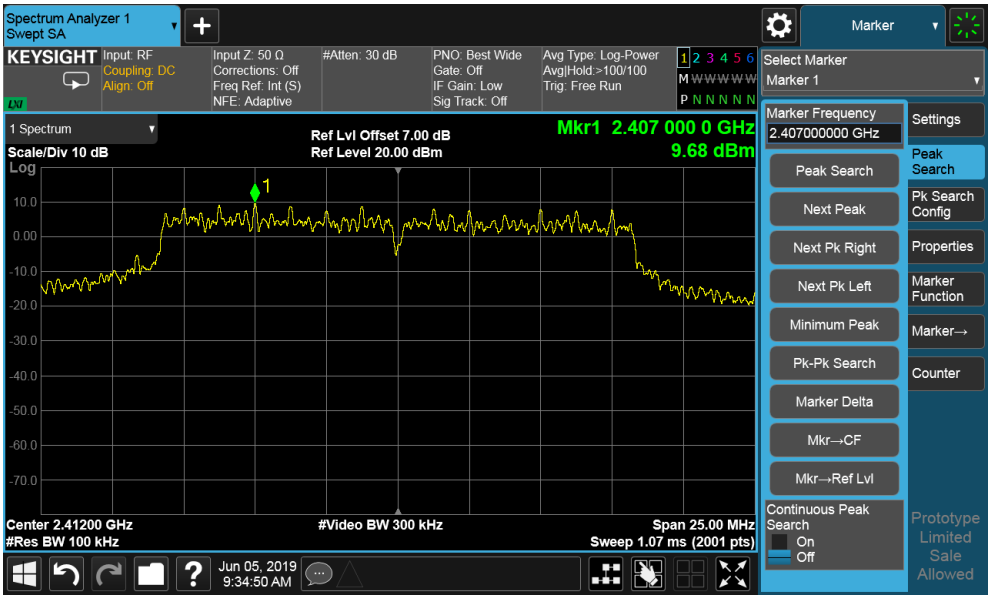
802.11b(2462MHz) Out-of-Band Emissions



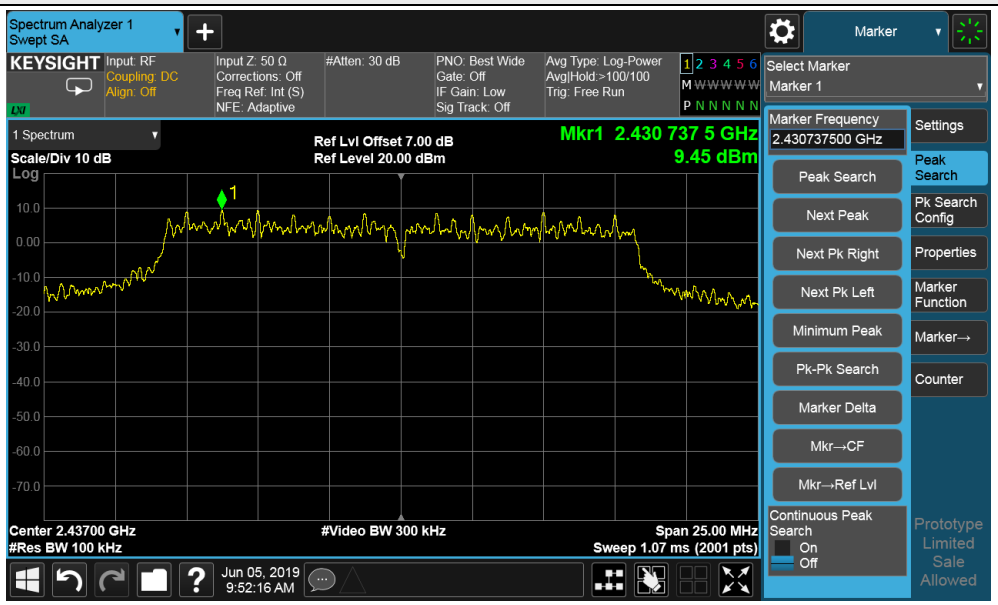
802.11g

Channel	Frequency (MHz)	Pass / Fail
1	2412	Pass
6	2437	Pass
11	2462	Pass

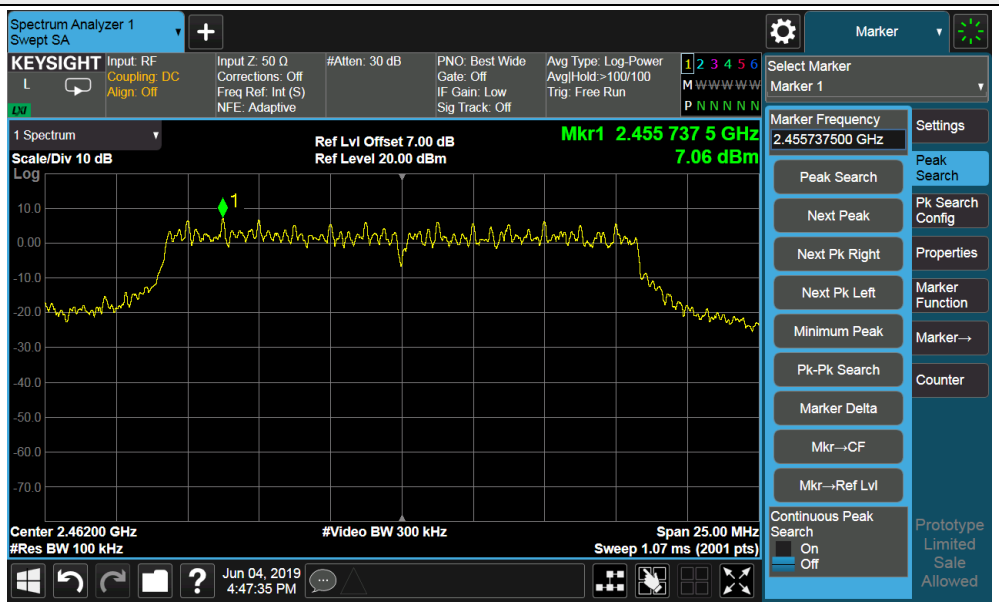
Spectrum Plot
802.11g(2412MHz)



802.11g(2437MHz)

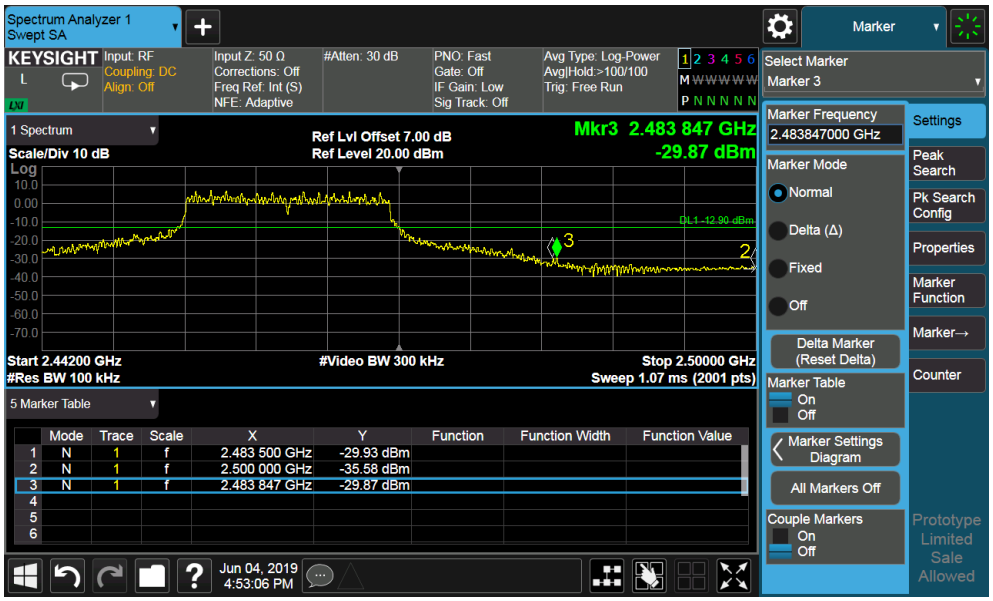


Spectrum Plot
802.11g(2462MHz)



Spectrum Plot
802.11g(2412MHz) Band Edge

802.11g(2462MHz) Band Edge



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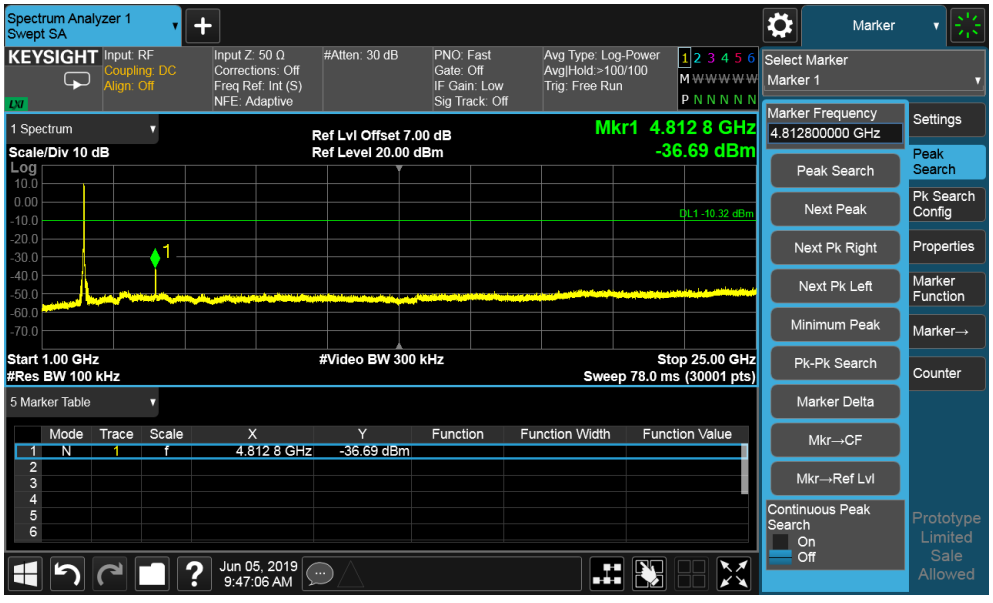
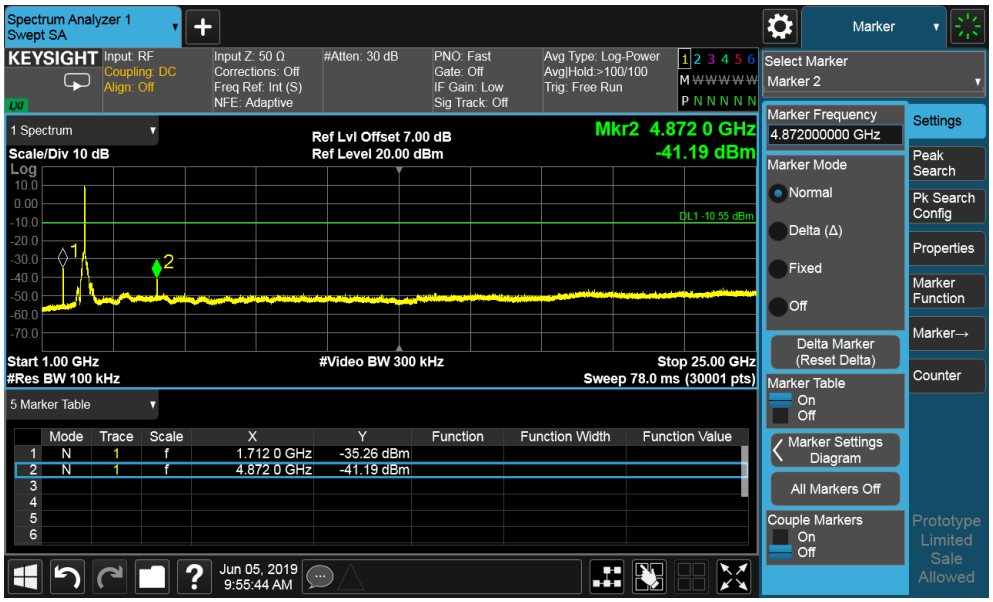
Spectrum Plot

802.11g(2412MHz) Out-of-Band Emissions

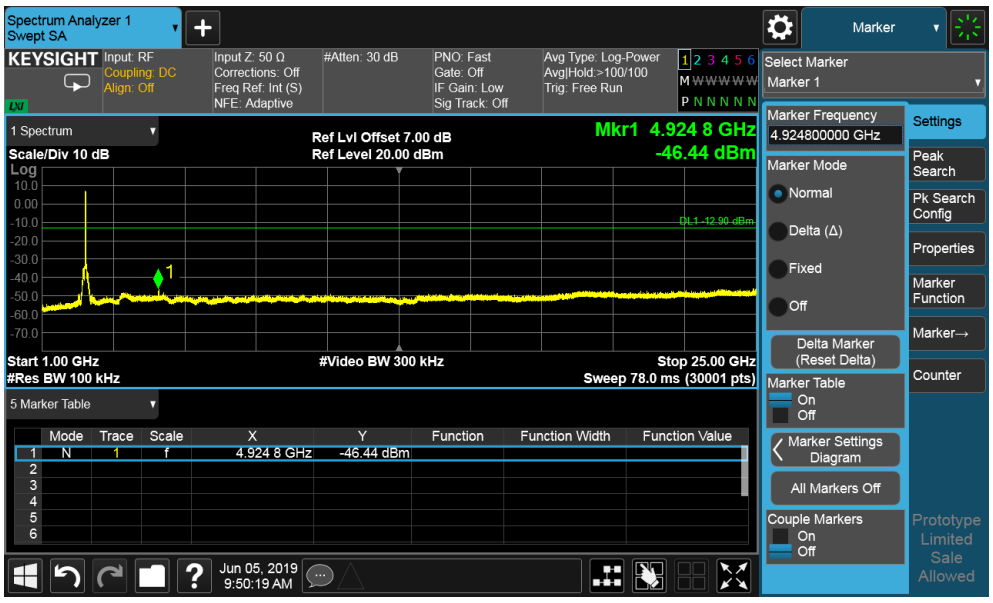


Spectrum Plot
802.11g(2437MHz) Out-of-Band Emissions



Spectrum Plot

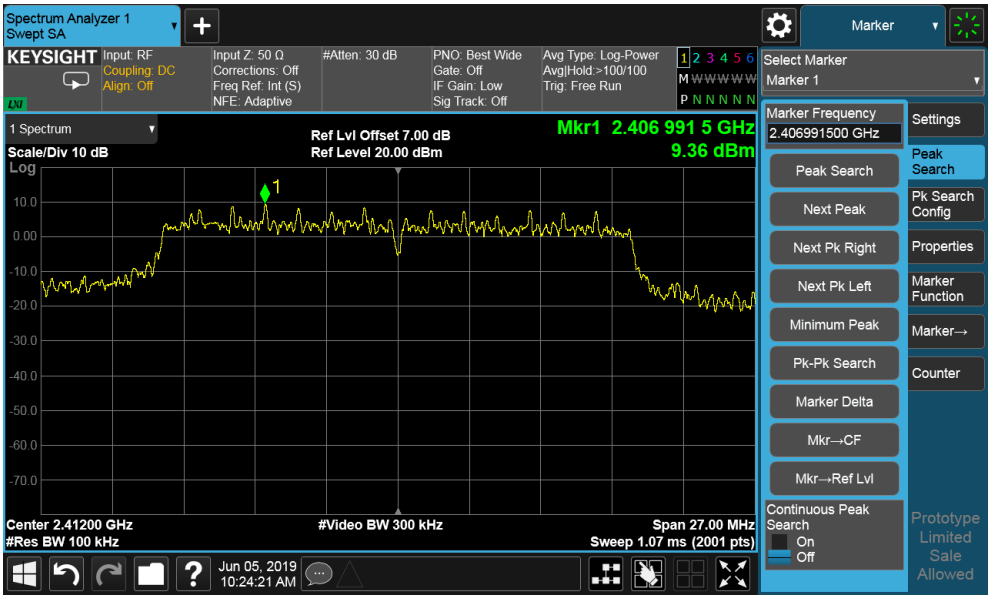
802.11g(2462MHz) Out-of-Band Emissions



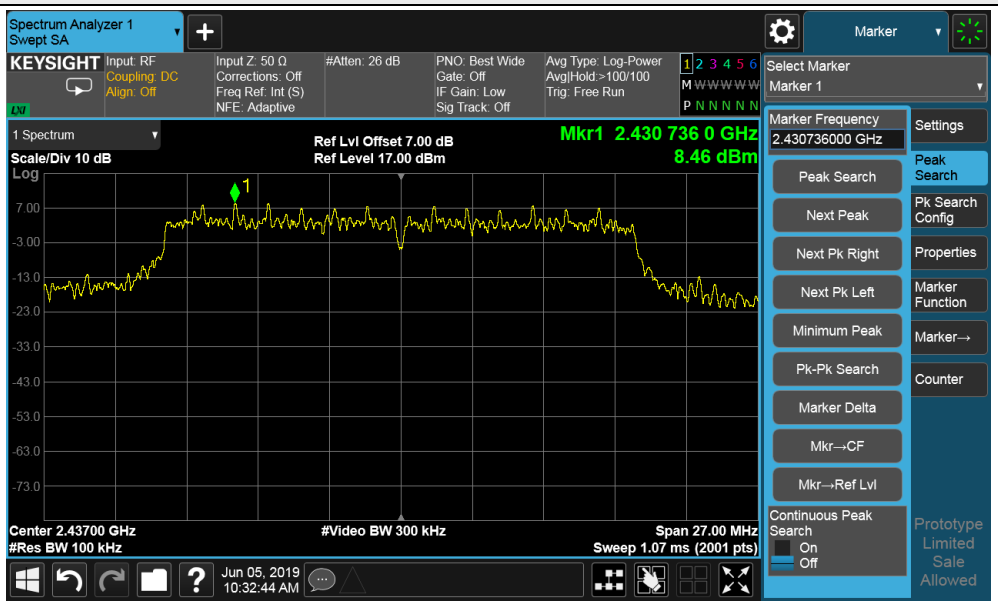
802.11n(HT20)

Channel	Frequency (MHz)	Pass / Fail
1	2412	Pass
6	2437	Pass
11	2462	Pass

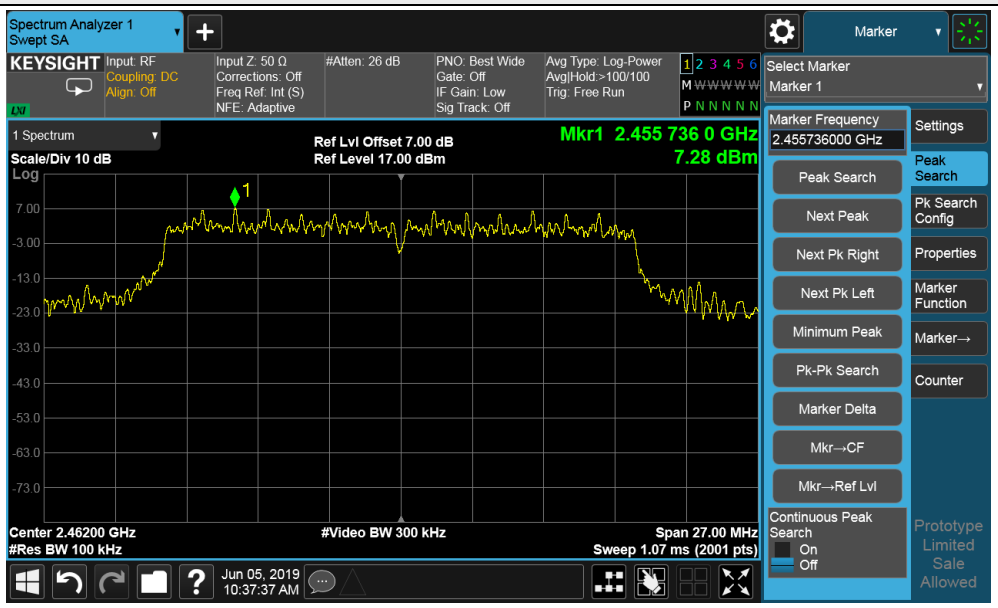
Spectrum Plot
802.11n(HT20)(2412MHz)



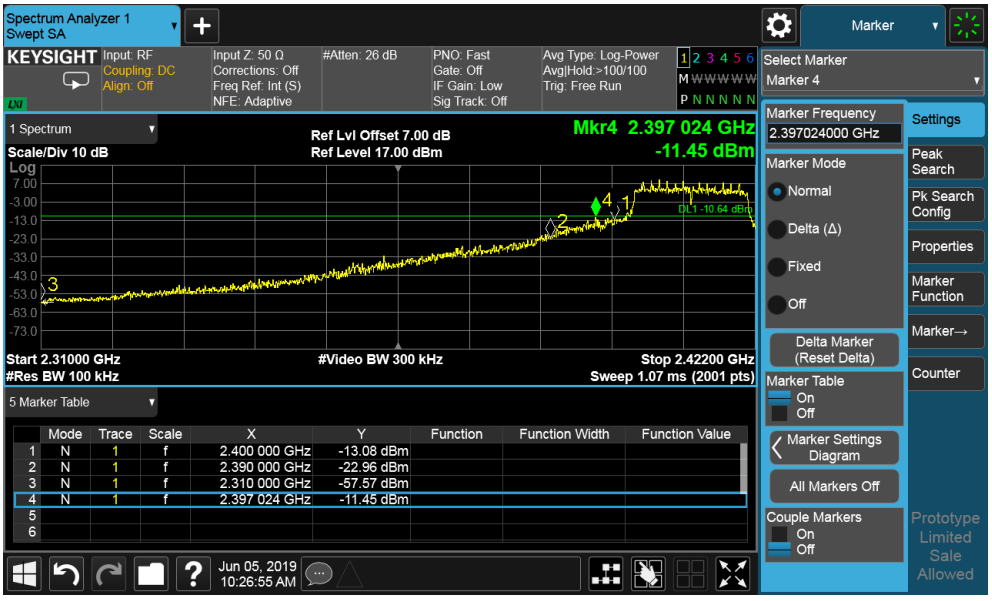
802.11n(HT20)(2437MHz)



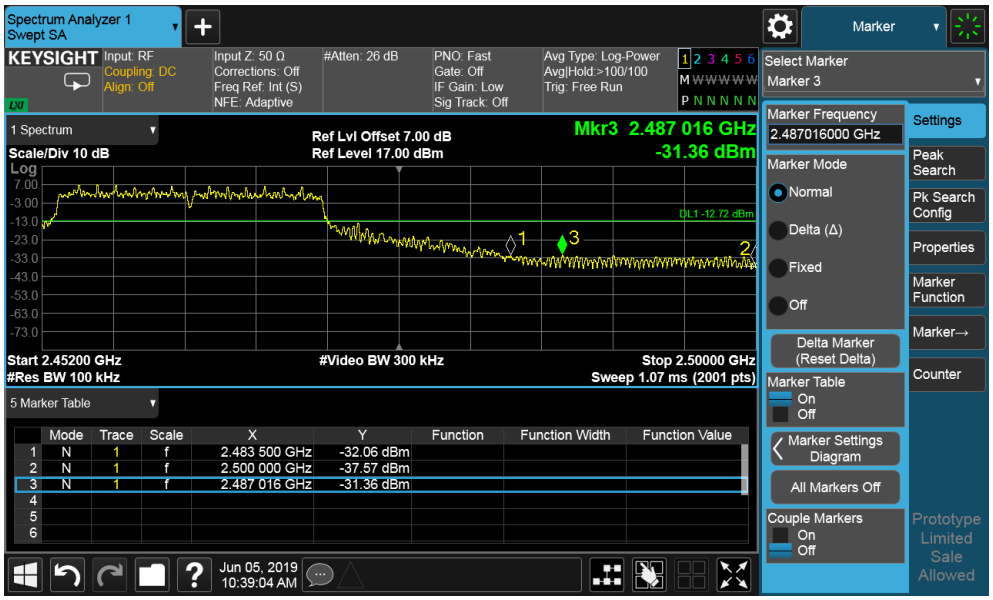
Spectrum Plot
802.11n(HT20)(2462MHz)



Spectrum Plot
802.11n(HT20)(2412MHz) Band Edge

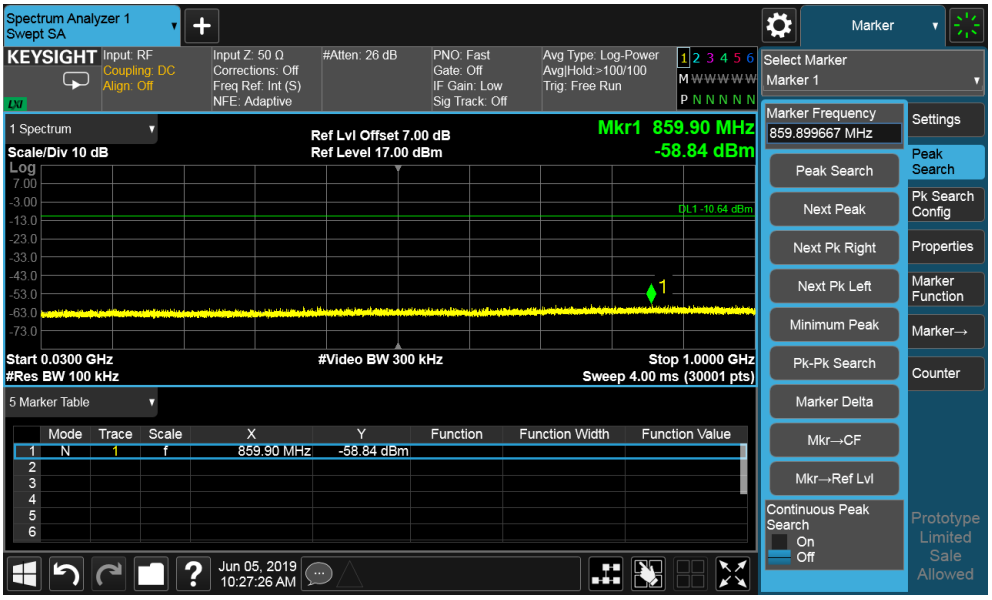


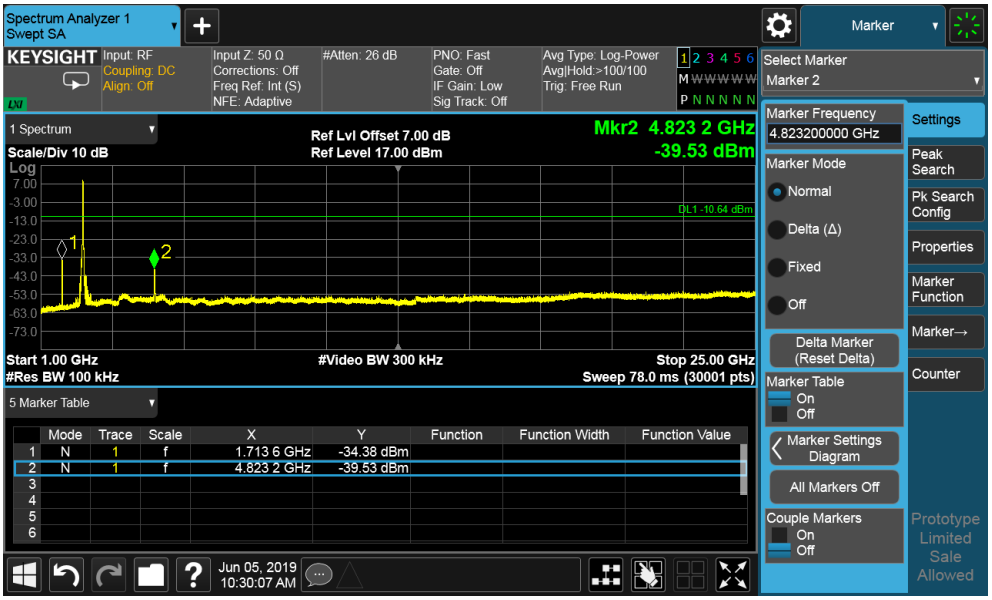
802.11n(HT20)(2462MHz) Band Edge



Spectrum Plot

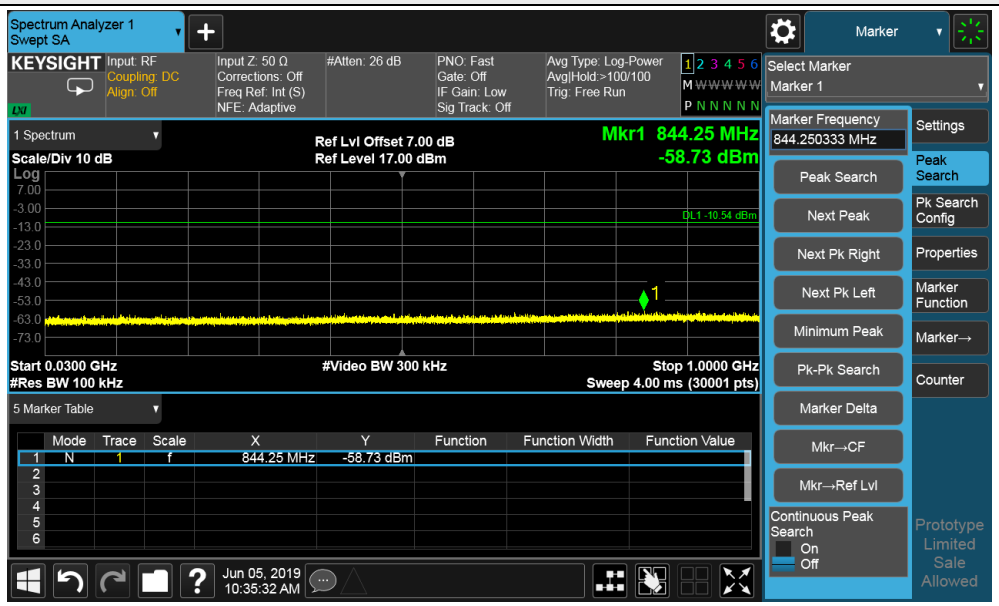
802.11n(HT20)(2412MHz) Out-of-Band Emissions

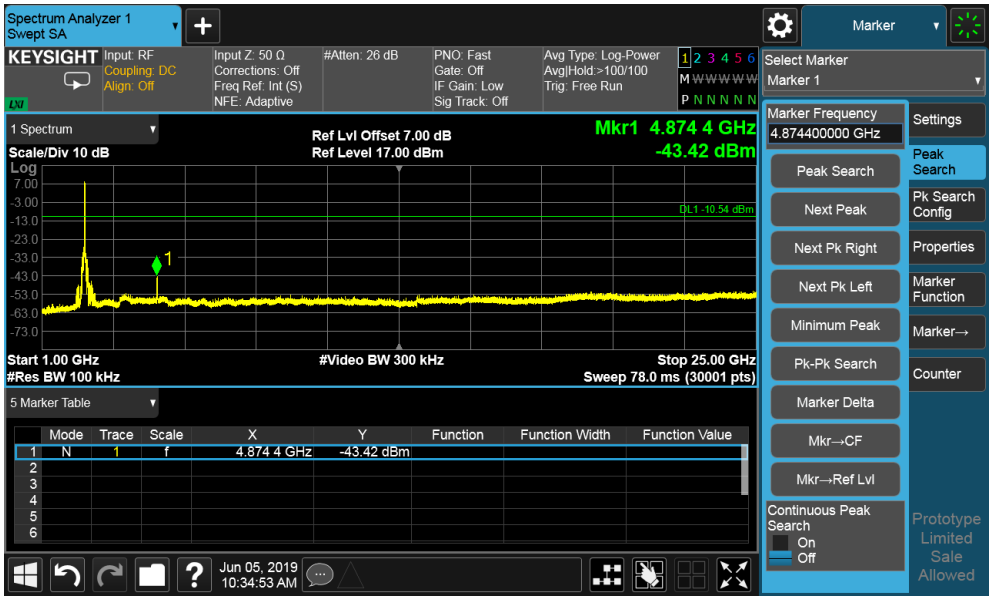

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Off
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 26 dB
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 7.00 dB
Ref Level 17.00 dBm
Mkr1 859.90 MHz
-58.84 dBm
DL1 -10.64 dBm
Start 0.0300 GHz
#Res BW 100 kHz
#Video BW 300 kHz
Stop 1.0000 GHz
Sweep 4.00 ms (30001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 859.90 MHz -58.84 dBm
Jun 05, 2019
10:27:26 AM
Marker
Select Marker
Marker 1
Marker Frequency
859.899667 MHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter
Prototype Limited Sale Allowed


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Off
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 26 dB
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 7.00 dB
Ref Level 17.00 dBm
Mkr2 4.823 2 GHz
-39.53 dBm
DL1 -10.64 dBm
Start 1.00 GHz
#Res BW 100 kHz
#Video BW 300 kHz
Stop 25.00 GHz
Sweep 78.0 ms (30001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 1.713 6 GHz -34.38 dBm
2 N 1 f 4.823 2 GHz -39.53 dBm
Jun 05, 2019
10:30:07 AM
Marker
Select Marker
Marker 2
Marker Frequency
4.823200000 GHz
Marker Mode
Normal
Delta (Δ)
Fixed
Off
Delta Marker (Reset Delta)
Marker Table
On
Off
Marker Settings Diagram
All Markers Off
Couple Markers
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter
Prototype Limited Sale Allowed

Spectrum Plot

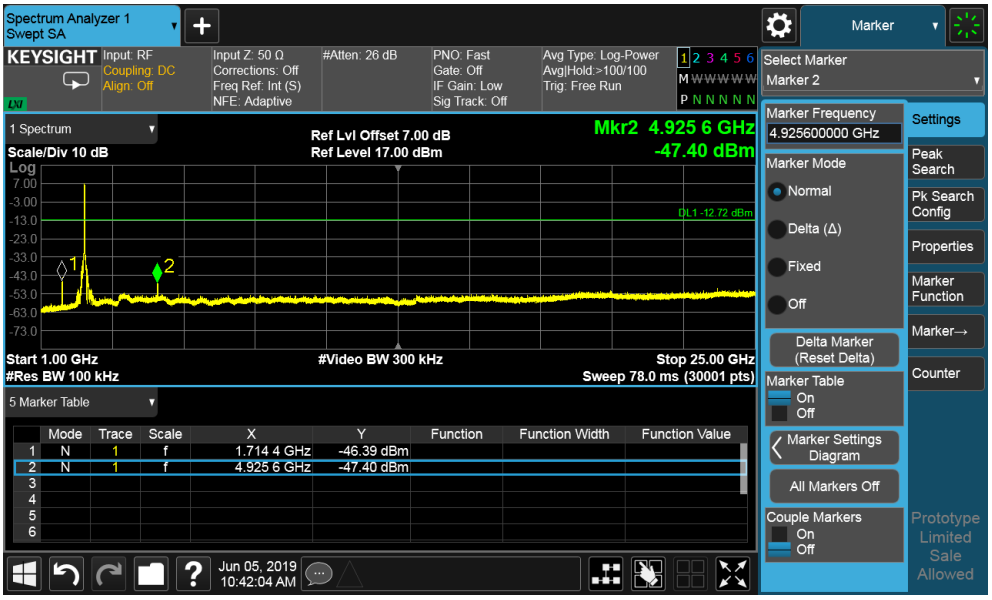
802.11n(HT20)(2437MHz) Out-of-Band Emissions





Spectrum Plot

802.11n(HT20)(2462MHz) Out-of-Band Emissions



4.5 Radiated Emission Measurement

4.5.1 Limits

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.5.2 Test Procedures

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degree to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Both X and Y axes of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned

from 0 degree to 360 degree to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle $\geqslant$ 98 %) for Average detection (AV) at frequency above 1 GHz.

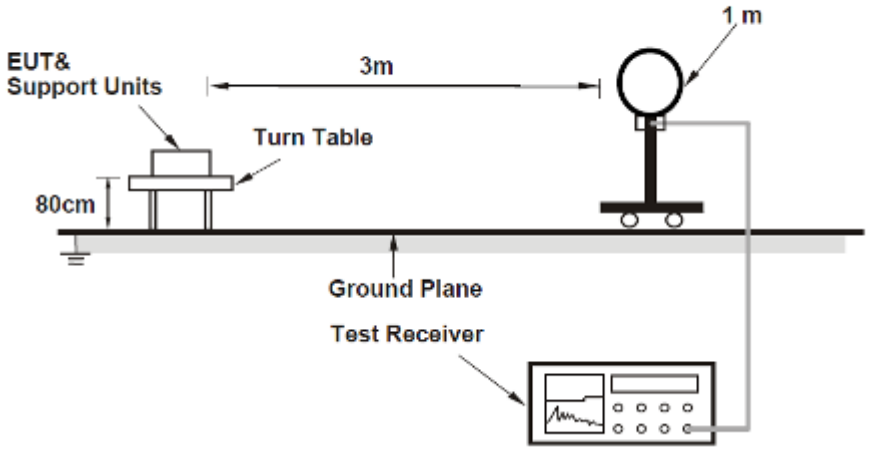
5. All modes of operation were investigated and the worst-case emissions are reported.

4.5.3 Deviation from Test Standard

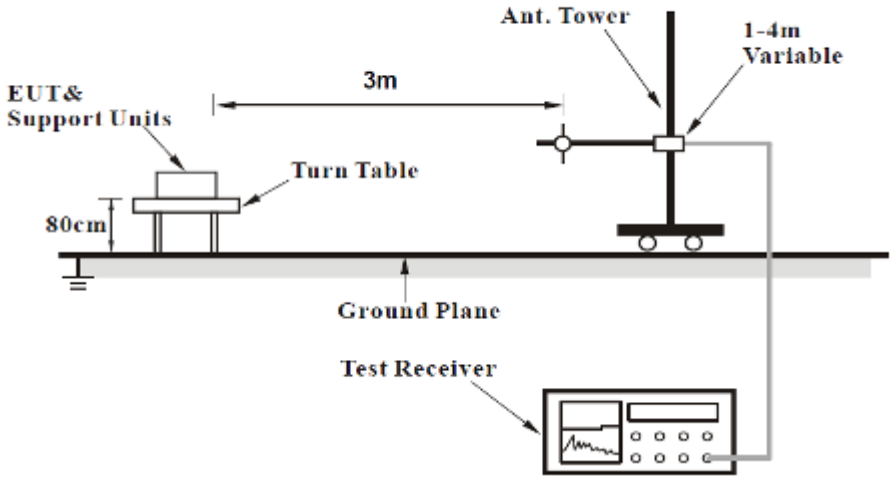
No deviation.

4.5.4 Test Setup

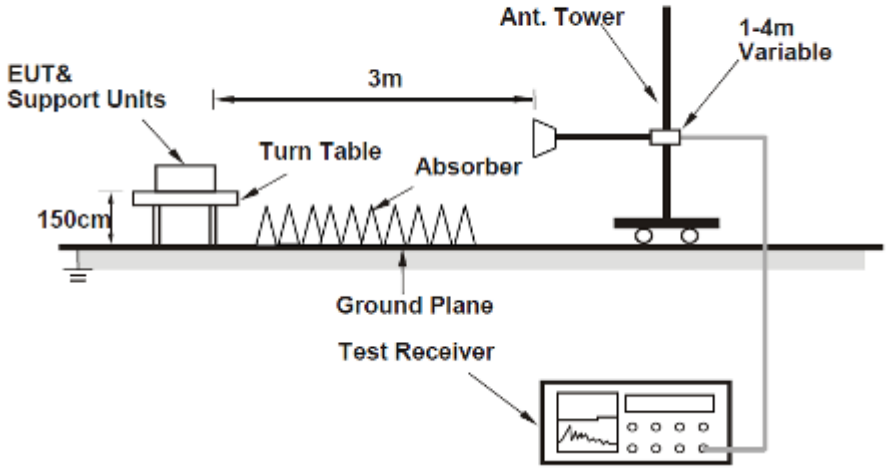
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.5.5 EUT Operating Conditions

a. Placed the EUT on a testing table.

b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.5.6 Test Results

Radiated Emissions Range 9kHz~30MHz

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

Radiated Emissions Range 30MHz~1GHz

Mode	802.11b-2412MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Horizontal

Spurious Emission Level					
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)
1	34.46	18.16	40	-21.84	-10.15
2	51.34	16.93	40	-23.07	-9.82
3	123.8	18.99	43.5	-24.51	-11.34
4	185.9	18.57	43.5	-24.93	-11.75
5	275.7	21.38	46.5	-25.12	-9.78
6	505.4	21.38	46.5	-25.12	-5.72

REMARKS:

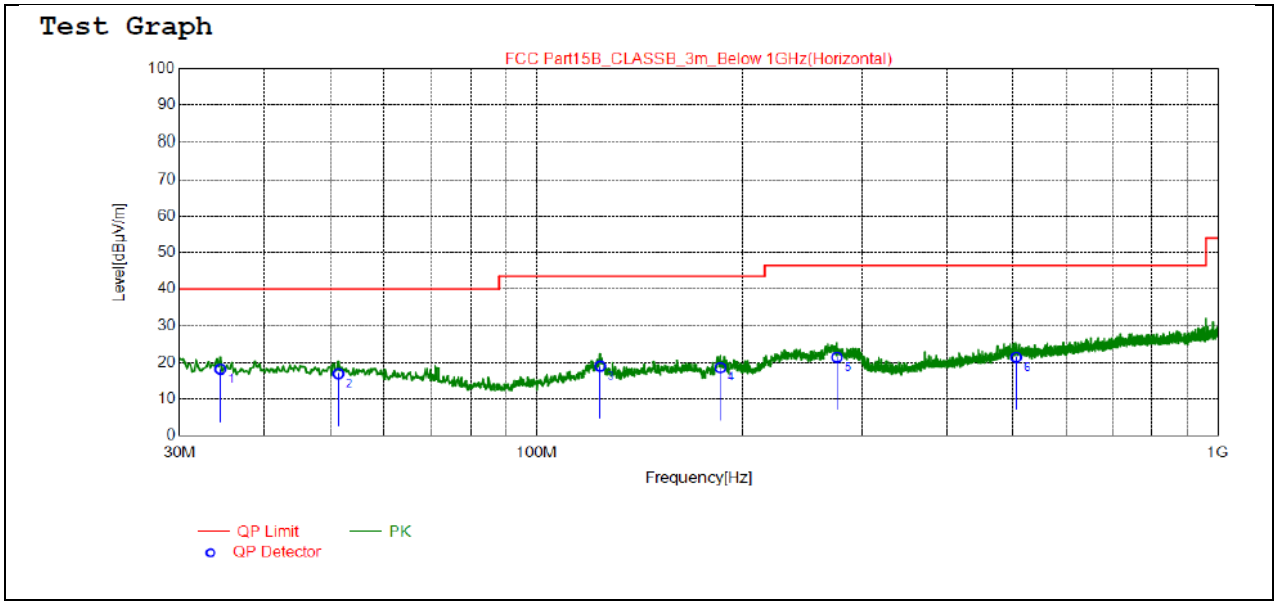
1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Test Plot:



Mode	802.11b-2412MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Vertical

Spurious Emission Level					
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)
1	30.00	31.02	40	-8.98	-10.71
2	34.26	28.42	40	-11.58	-10.18
3	54.83	23.96	40	-16.04	-10.11
4	67.05	21.79	40	-18.21	-11.65
5	120.5	25.76	43.5	-17.74	-11.66
6	151.2	26.23	43.5	-17.27	-9.25

REMARKS:

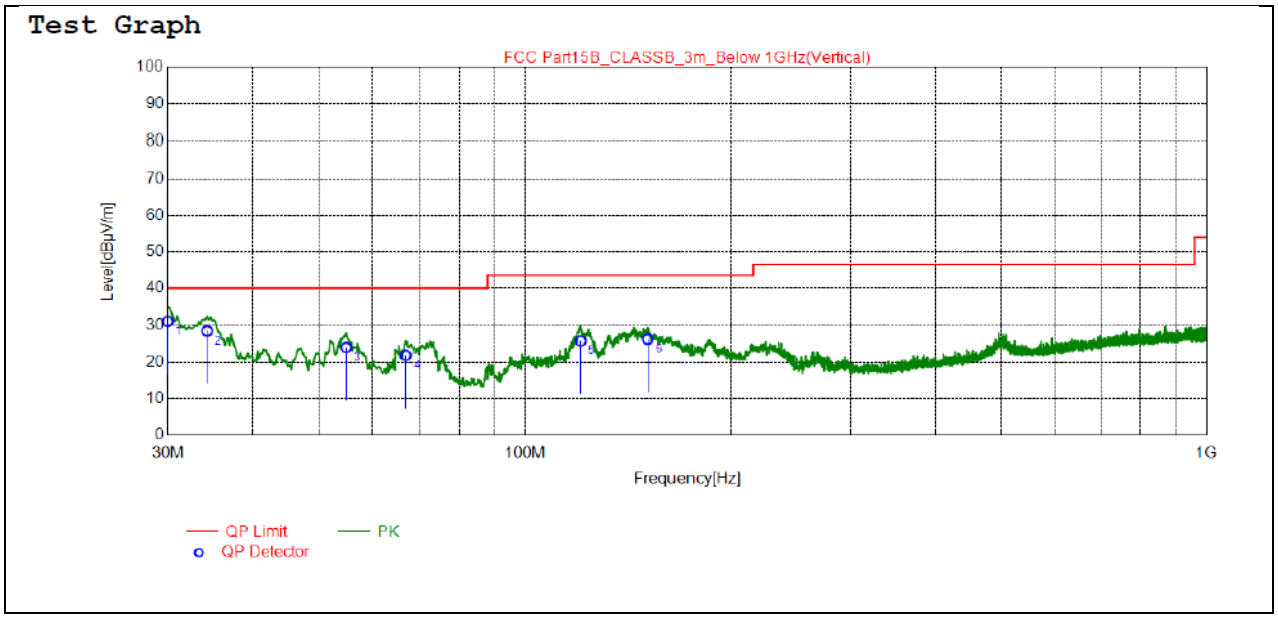
1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Test Plot:



Radiated Emission Range 1GHz~10th Harmonic

802.11b

Channel	TX Channel 1	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4824.00	48.26	74	-25.74	-9.40	H	PK
2	4824.00	46.23	54	-7.77	-9.40	H	AV
3	4824.00	49.29	74	-24.71	-9.40	V	PK
4	4824.00	46.60	54	-7.40	-9.40	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 6	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4874.00	44.61	74	-29.39	-9.33	H	PK
2	4874.00	41.20	54	-12.80	-9.33	H	AV
3	4874.00	45.62	74	-28.38	-9.33	V	PK
4	4874.00	42.29	54	-11.71	-9.33	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 11	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4924.00	45.48	74	-28.52	-9.27	H	PK
2	4924.00	41.79	54	-12.21	-9.27	H	AV
3	4924.00	46.20	74	-27.80	-9.27	V	PK
4	4924.00	42.66	54	-11.34	-9.27	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

802.11g

Channel	TX Channel 1	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4824.00	49.25	74	-24.75	-4.42	H	PK
2	4824.00	43.62	54	-10.38	-4.42	H	AV
3	4824.00	54.07	74	-19.93	-4.42	V	PK
4	4824.00	49.28	54	-4.72	-4.42	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 6	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4874.00	46.74	74	-27.26	-9.33	H	PK
2	4874.00	39.93	54	-14.07	-9.33	H	AV
3	4874.00	48.64	74	-25.36	-9.33	V	PK
4	4874.00	41.38	54	-12.62	-9.33	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 11	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4924.00	42.58	74	-31.42	-9.26	H	PK
2	4924.00	35.40	54	-18.60	-9.26	H	AV
3	4924.00	43.75	74	-30.25	-9.26	V	PK
4	4924.00	38.44	54	-15.56	-9.26	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

802.11n(HT20)

Channel	TX Channel 1	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4824.00	51.10	74	-22.90	-9.40	H	PK
2	4824.00	45.16	54	-8.84	-9.40	H	AV
3	4824.00	52.83	74	-21.17	-9.40	V	PK
4	4824.00	46.23	54	-7.77	-9.40	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 6	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4874.00	46.25	74	-27.75	-9.33	H	PK
2	4874.00	40.21	54	-13.79	-9.33	H	AV
3	4874.00	46.81	74	-27.19	-9.33	V	PK
4	4874.00	39.40	54	-14.60	-9.33	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 11	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4924.00	40.55	74	-33.45	-9.26	H	PK
2	4924.00	34.63	54	-19.37	-9.26	H	AV
3	4924.00	40.99	74	-33.01	-9.26	V	PK
4	4924.00	36.97	54	-17.03	-9.26	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

4.6 Conducted Emission Measurement

4.6.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.6.2 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

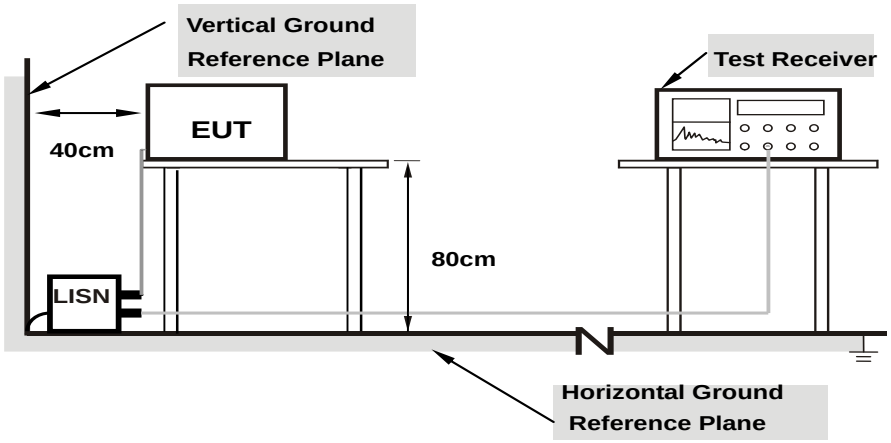
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.6.3 Deviation from Test Standard

No deviation.

4.6.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.6.5 EUT Operating Conditions

Same as 4.1.6.

4.6.6 Test Results

Working While Charging

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	9.88	30.74	15.05	40.62	24.93	65.79	55.79	-25.17	-30.86
2	0.49799	9.87	35.74	26.97	45.61	36.84	56.03	46.03	-10.42	-9.19
3	0.85380	9.92	27.60	17.84	37.52	27.76	56.00	46.00	-18.48	-18.24
4	1.26588	9.93	24.88	16.18	34.81	26.11	56.00	46.00	-21.19	-19.89
5	1.55913	9.94	24.58	16.40	34.52	26.34	56.00	46.00	-21.48	-19.66
6	2.32158	10.00	23.88	15.49	33.88	25.49	56.00	46.00	-22.12	-20.51

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.88	32.02	16.24	41.90	26.12	66.00	56.00	-24.10	-29.88
2	0.51363	9.87	33.32	25.74	43.19	35.61	56.00	46.00	-12.81	-10.39
3	0.85771	9.92	23.62	15.72	33.54	25.64	56.00	46.00	-22.46	-20.36
4	1.94622	9.97	22.36	15.31	32.33	25.28	56.00	46.00	-23.67	-20.72
5	2.33722	10.00	20.78	13.09	30.78	23.09	56.00	46.00	-25.22	-22.91
6	6.43099	10.08	14.20	6.97	24.28	17.05	60.00	50.00	-35.72	-32.95

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

---------- **END** ----------