

JAPAN MIC
TEST REPORT
For
ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD.

Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park,
Shanghai, China (201203)

Tested Model: ESP-EYE

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: WIFI & Bluetooth Development Board
Test Engineer: Max Min	<i>Max Min</i>
Report Number: RSHD190123002-24C	
Report Date: 2019-02-27	
Reviewed By: Oscar Ye RF Leader	<i>Oscar Ye</i>
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road, Kunshan, Jiangsu province, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD.
Tested Model:	ESP-EYE
Product Type:	WIFI & Bluetooth Development Board
Dimension:	41mm(L)× 21mm(W)×6.5mm(H)
Power Supply:	DC 5V

**All measurement and test data in this report was gathered from production sample serial number: 20190123002.
(Assigned by the BACL. The EUT supplied by the applicant was received on 2019-01-23)*

Objective

The objective of the manufacturer is to demonstrate compliance with Radio Law of Japan item 19 of Article 2 Paragraph 1

Related Submittal(s)/Grant(s)

Item 19 of Article 2 Paragraph 1 for BLE
Item 19 of Article 2 Paragraph 1 for BT3.0
Item 19-2 of Article 2 Paragraph 1 for Wi-Fi 2484MHz

Test Methodology

All measurements contained in this report were conducted with technical regulations of the Radio Law of Japan.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

EUT TEST CONFIGURATION

Description of Test Configuration

Test channel list is as below,

For 802.11b, 802.11g and 802.11n-HT20 mode, EUT was tested with Channel 1, 7 and 13.

For 802.11n-HT40 mode, EUT was tested with Channel 3, 7 and 11.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442	/	/

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PSD across all data rates, bandwidths and modulations.

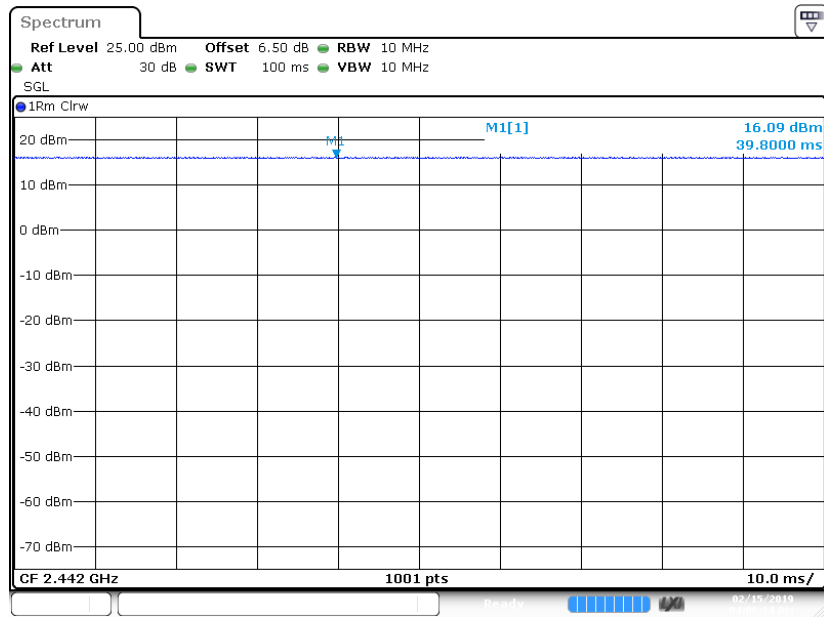
EUT Exercise Software

RF test tool: espRFTool

We have pretested all the data rate, the worst condition was performed under:

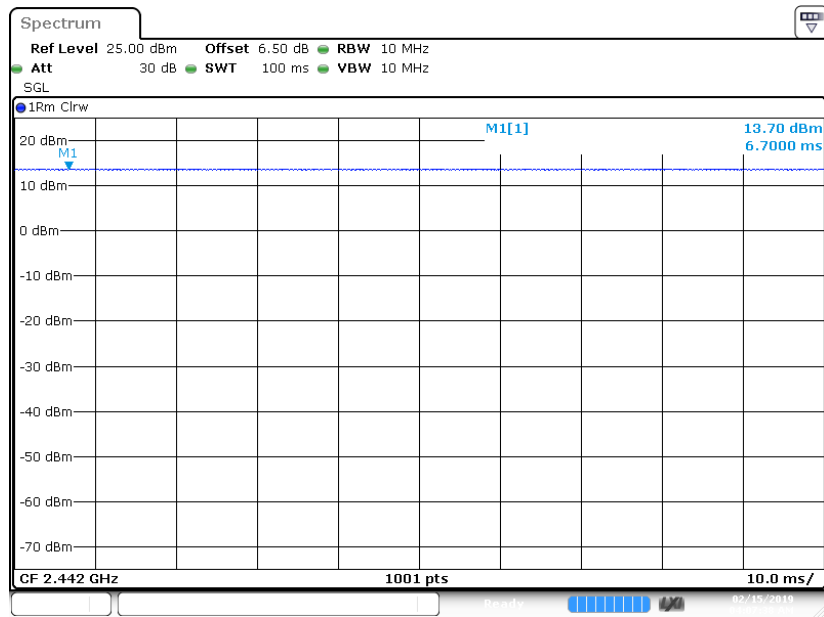
Mode	Data	Power Level
802.11b	1 Mbps	8
802.11g	6 Mbps	2
802.11n-HT20	MCS0	4
802.11n-HT40	MCS0	26

802.11b Mode Middle Channel Duty Cycle



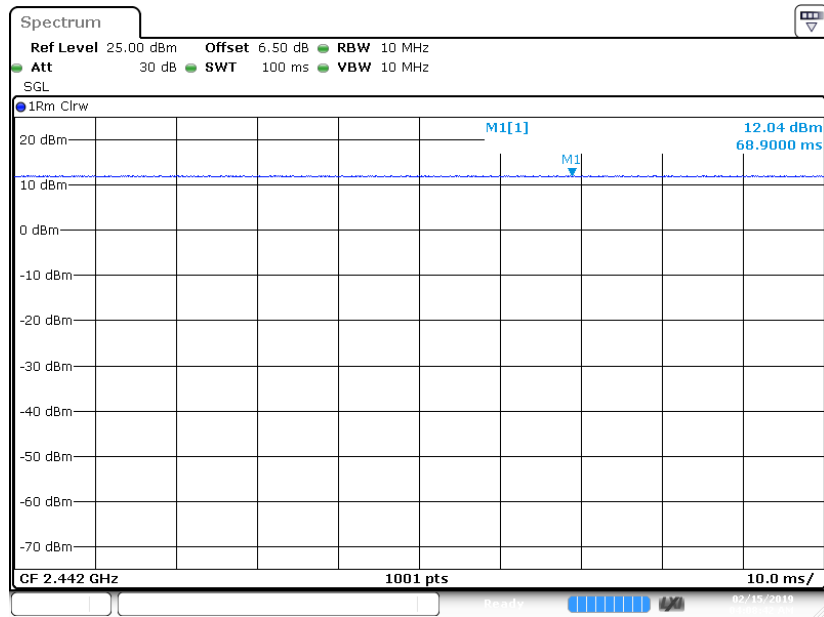
Date: 15.FEB.2019 04:08:15

802.11g Mode Middle Channel Duty Cycle

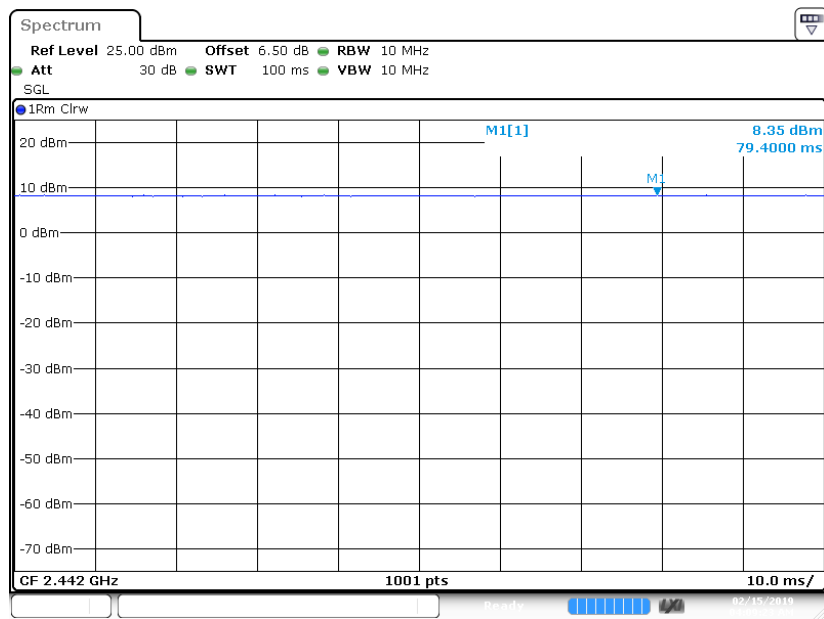


Date: 15.FEB.2019 04:07:39

802.11n-HT20 Mode Middle Channel Duty Cycle



802.11n-HT40 Mode Middle Channel Duty Cycle

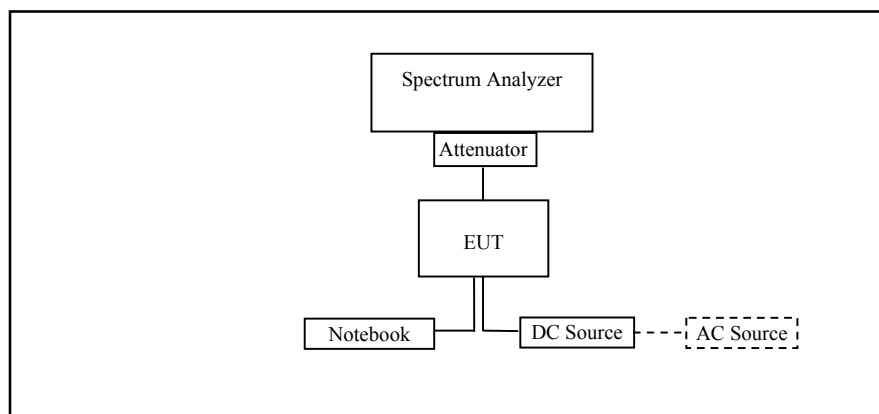


Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Narda	Attenuator/6dB	10690812-2	26850-6
BEST	DC Power Supply	PS-1502D+	DC001
DELL	Notebook	GX620	D65874152

External I/O Cable

Cable Description	Length (m)	From/Port	To
RF Cable	0.1	Attenuator	EUT
DC Cable	0.8	EUT	DC Source
USB Cable	1.2	EUT	Notebook

Configuration of Test Setup

SUMMARY OF TEST RESULTS

MIC Notice No.88 Appendix No.43 Article 2, Paragraph 1, Item 19 Rules Section	Description of Test	Result
3	Frequency Error	Compliance
4	Occupied Bandwidth and Spreading Bandwidth	Compliance
5	Transmitter Spurious Emission and Unwanted Emission Intensity	Compliance
6	Antenna Output Power and Output Power Tolerance	Compliance
7	Receiver Spurious Emission and Unwanted Emission Intensity	Compliance
8	Transmission Antenna Gain	Not Applicable (See Note 1)
9	Transmission Radiation Angle Width	Not Applicable (See Note 1)
10	Carrier sense capability	Compliance
11	Frequency Hopping Dwell Time	Not Applicable (See Note 2)
12	Interference prevention function	Compliance
Appendix	Construction Protection Confirmation	Compliance

Note:

1. This test item will not be applied to the transmission antenna which EIRP is less than 12.14 dBm/MHz.
2. Testing is only required for FHSS system devices.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	FSV40 Signal Analyzer	FSV40	101116	2018-07-23	2019-07-22
Narda	Attenuator/6dB	10690812-2	26850-6	2019-01-10	2020-01-09
Rohde & Schwarz	SMB 100A Signal Generator	SMB100A	110390	2018-07-22	2019-07-21
Mini-Circuits	Power Splitter	ZFRSC-14-S+	SF019411452	2018-11-10	2019-11-09
BEST	DC Power Supply	PS-1502D+	DC001	2018-10-10	2019-10-09
R & S	Wideband Radio Communication Tester	CMW500	104478	2018-07-22	2019-07-21

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements, traceable to National Primary Standards and International System of Units (SI).

FREQUENCY ERROR

Limit

The Tolerance of frequency shall be $\pm 50\text{ppm}$.

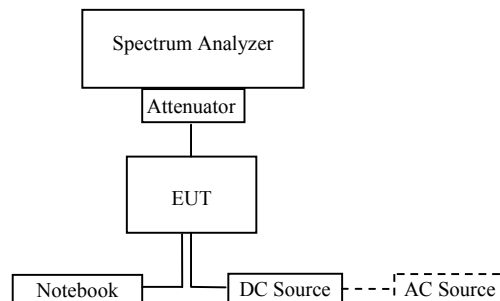
Test Procedure

Set the EUT to the measurement frequency without modulation.

Setting of SA is following as: RB: 1kHz / VB: 30 kHz / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.

Record the peak spot frequency.

If the EUT can't set at un-modulation mode, measure the 10dBc center frequency.



Test Data

Environmental Conditions

Temperature:	23.2°C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

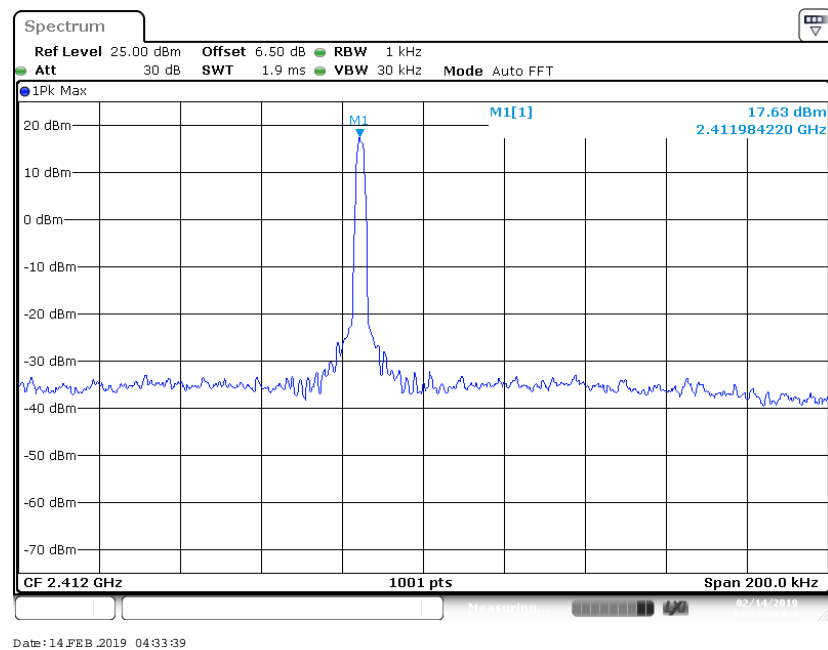
Test Result: Compliant

Test Mode: Transmitting

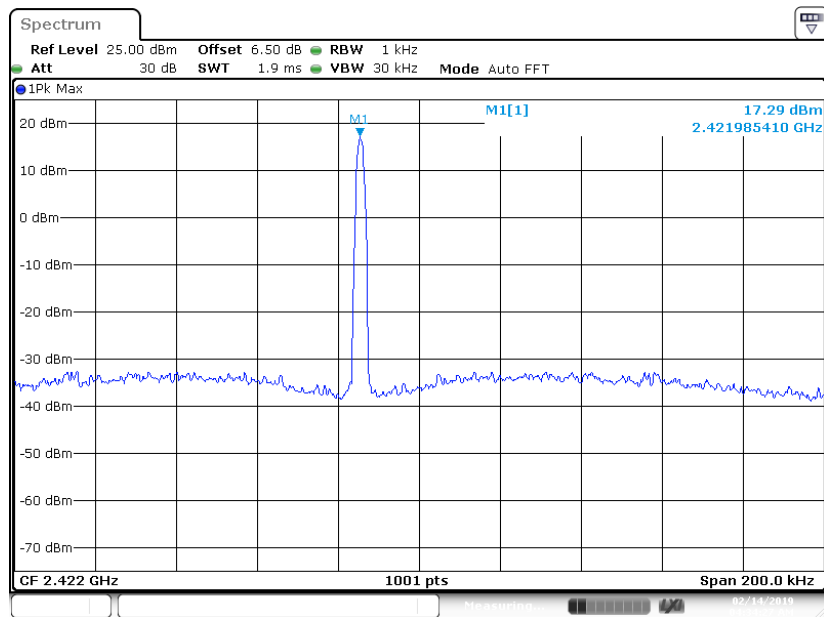
Frequency (MHz)	Voltage (V _{DC})	Measure Frequency (MHz)	Frequency Tolerance (ppm)	Limit (ppm)
2412	4.5	2411.98532	-6.08	±50
	5.0	2411.98422	-6.54	
	5.5	2411.98233	-7.33	
2422	4.5	2421.98392	-6.64	
	5.0	2421.98541	-6.02	
	5.5	2421.98719	-5.29	
2442	4.5	2441.98285	-7.02	
	5.0	2441.98482	-6.22	
	5.5	2441.98625	-5.63	
2462	4.5	2461.98240	-7.15	
	5.0	2461.98342	-6.73	
	5.5	2461.98267	-7.04	
2472	4.5	2471.98287	-6.93	
	5.0	2471.98302	-6.87	
	5.5	2471.98362	-6.63	

Please refer to the following plots for normal voltage:

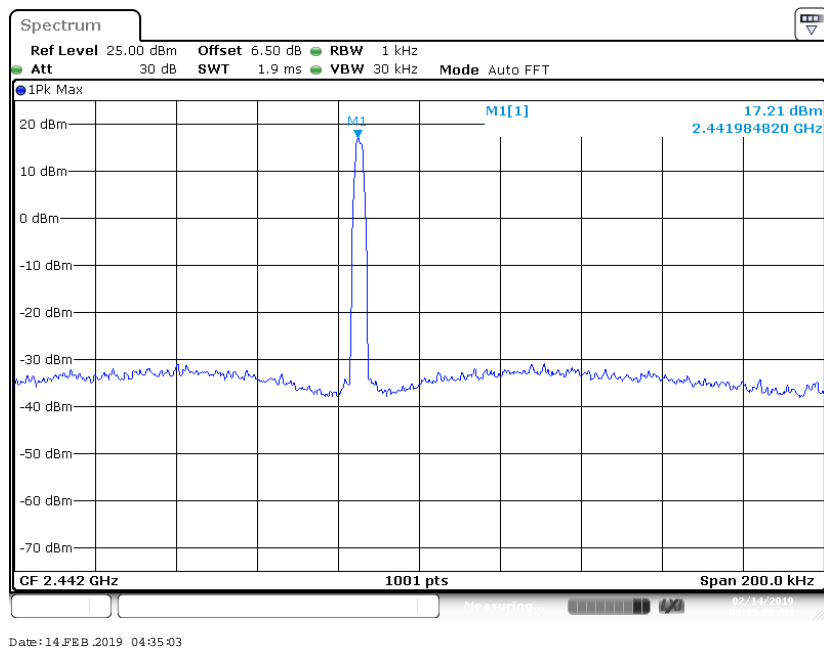
Test Frequency: 2412MHz



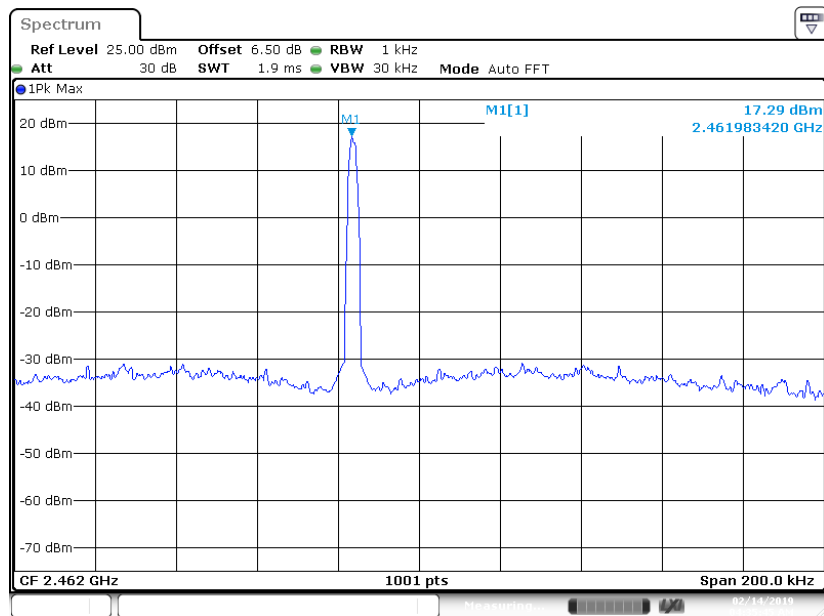
Test Frequency: 2422MHz



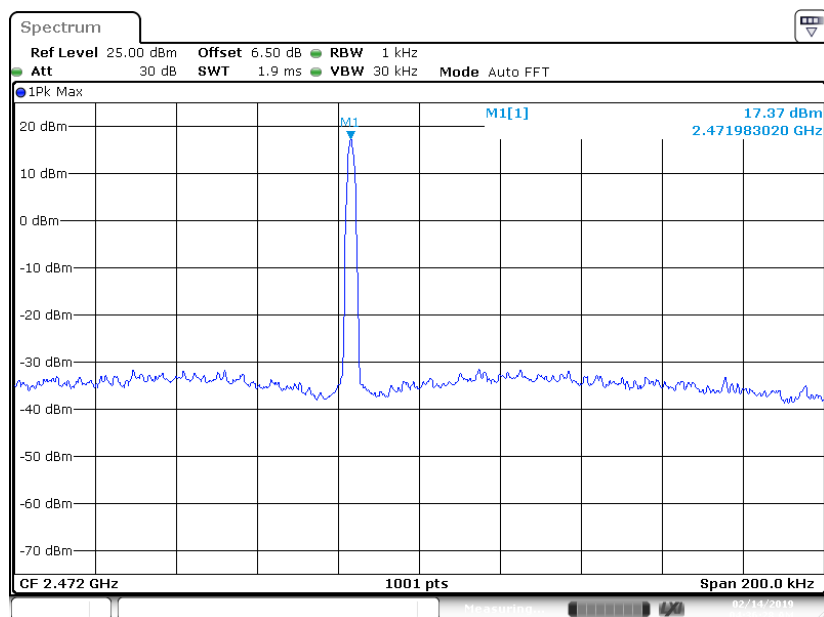
Test Frequency: 2442MHz



Test Frequency: 2462MHz



Test Frequency: 2472MHz



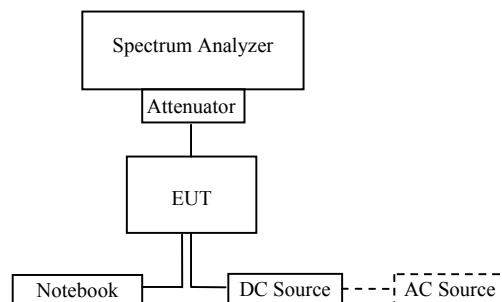
OCCUPIED BANDWIDTH AND SPREADING BANDWIDTH

Limit

- Occupied bandwidth: FH \leq 83.5 MHz; OFDM, DS \leq 26 MHz; \leq 38MHz (40MHz Mode), Others \leq 26 MHz
- Spread Bandwidth: \geq 500 kHz (FH, DS), Spread factor > 5 .

Test Procedure

1. Setting of SA is following as: RB: 300 kHz / VB: 300 kHz / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
2. EUT have transmitted the maximum modulation signal and fixed channelize. SA set to 99% of occupied bandwidth to measure occupied bandwidth.
3. EUT have transmitted the maximum modulation signal and fixed channelize. SA set to 90% of occupied bandwidth to measure spread bandwidth.
4. Spread Factor = Spread Bandwidth/modulation rate.



Test Data

Environmental Conditions

Temperature:	23.2℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Compliant

Test Mode: Transmitting

Frequency	2412MHz			2442 MHz			2472 MHz			Limit
Voltage(V _{DC})	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11b Mode										
Occupied Bandwidth (MHz)	13.07	13.07	13.02	13.07	13.07	13.02	13.02	13.02	13.07	≤ 26MHz
Spread Bandwidth (MHz)	9.55	9.51	9.59	9.51	9.59	9.51	9.51	9.51	9.59	≥ 0.5MHz
Spread Factor	6.95	6.92	6.98	6.92	6.98	6.92	6.92	6.92	6.98	> 5
802.11g Mode										
Occupied Bandwidth (MHz)	16.86	16.90	16.70	16.70	16.70	16.90	16.90	16.86	16.86	≤ 26MHz
Spread Bandwidth (MHz)	14.83	14.83	14.83	14.83	14.83	14.83	14.83	14.83	14.83	≥ 0.5MHz
Spread Factor	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	> 5
802.11n-HT20 Mode										
Occupied Bandwidth (MHz)	17.62	17.62	17.67	17.67	17.62	17.62	17.62	17.62	17.67	≤ 26MHz
Spread Bandwidth (MHz)	15.66	15.66	15.69	15.66	15.66	15.69	15.66	15.58	15.58	≥ 0.5MHz
Spread Factor	10.44	10.44	10.46	10.44	10.44	10.46	10.44	10.39	10.39	> 5

Frequency	2422MHz			2442 MHz			2462 MHz			Limit
Voltage(V _{DC})	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11n-HT40 Mode										
Occupied Bandwidth (MHz)	36.44	36.44	36.35	36.35	36.44	36.44	36.35	36.35	36.44	≤ 38MHz
Spread Bandwidth (MHz)	32.40	32.45	32.45	32.34	32.29	32.29	32.44	32.44	32.29	≥ 0.5MHz
Spread Factor	10.80	10.82	10.82	10.78	10.76	10.76	10.81	10.81	10.76	> 5

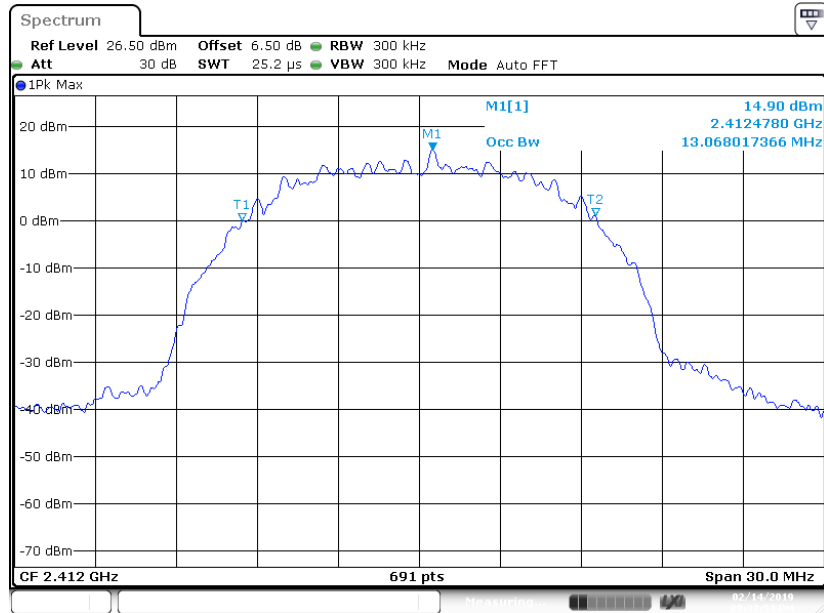
Note: Spread Factor=Spread Bandwidth/modulation rate.

The modulation rate: MR=1.375 for 802.11b, MR=1.5 for 802.11g/n20, MR=3 for 802.11n40.

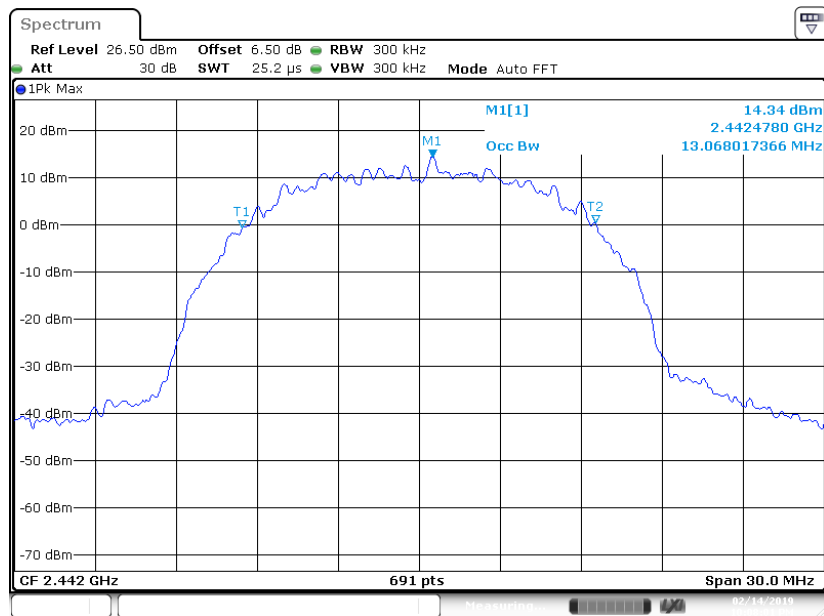
Please refer to the following plots for normal voltage:

Occupied Bandwidth:

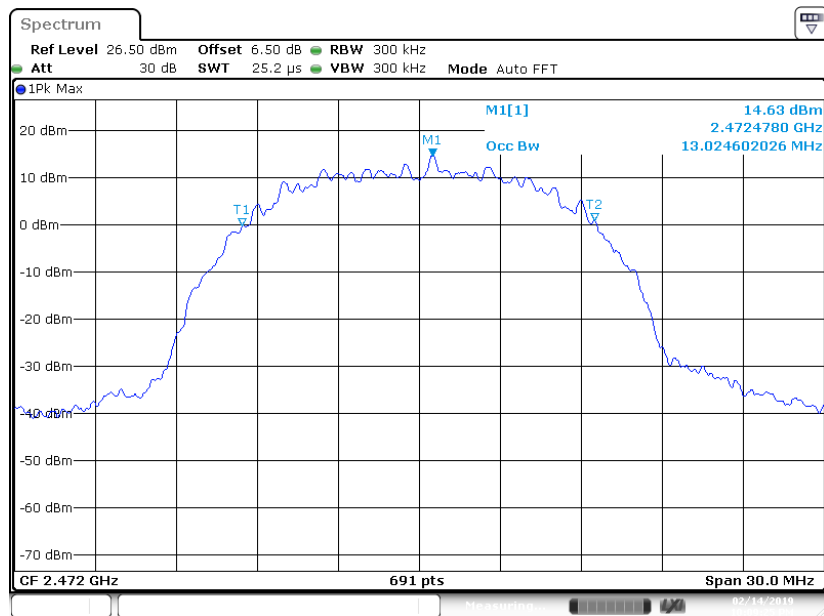
802.11b Mode Test Frequency: 2412MHz



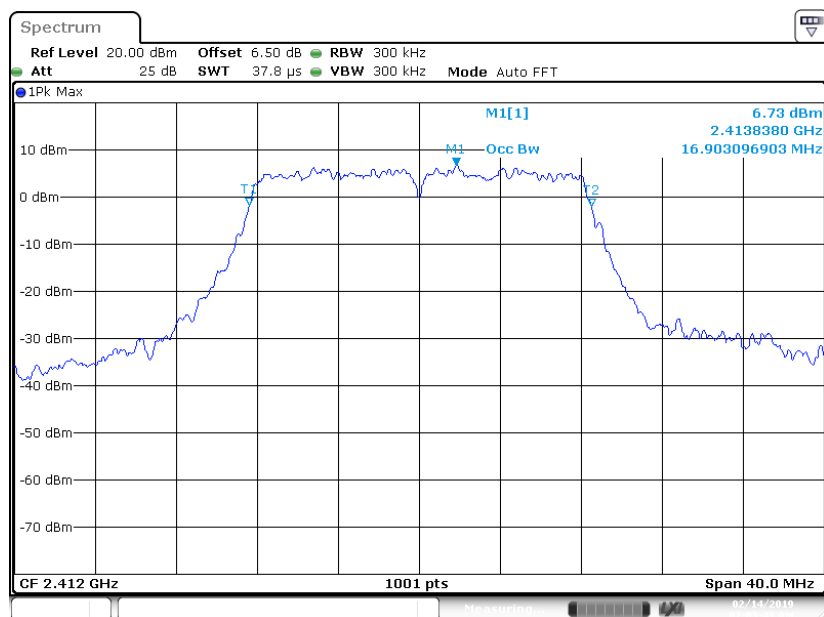
802.11b Mode Test Frequency: 2442MHz



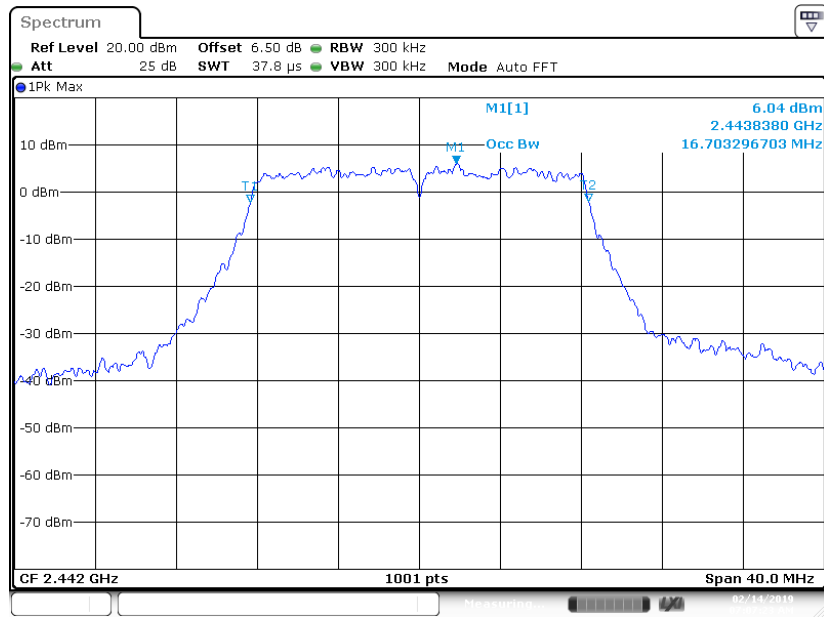
802.11b Mode Test Frequency: 2472MHz



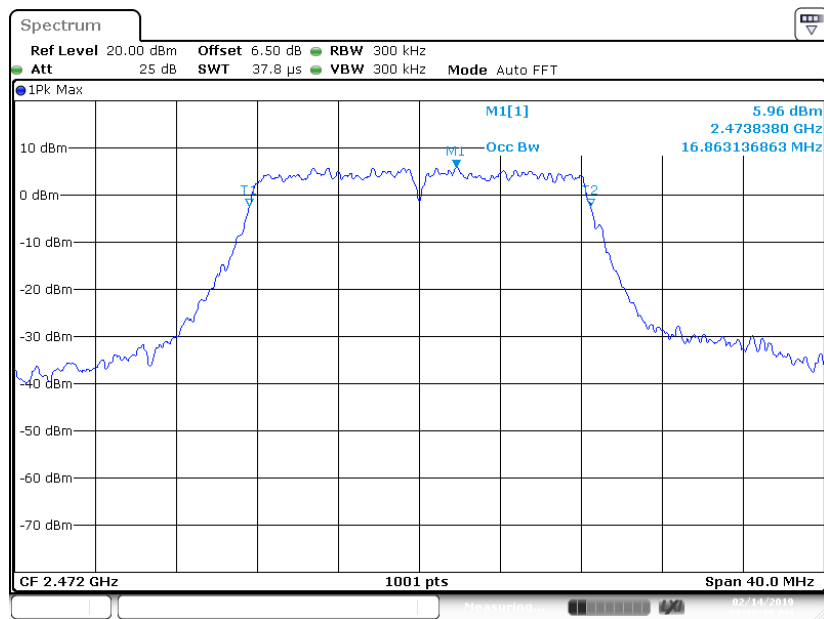
802.11g Mode Test Frequency: 2412MHz



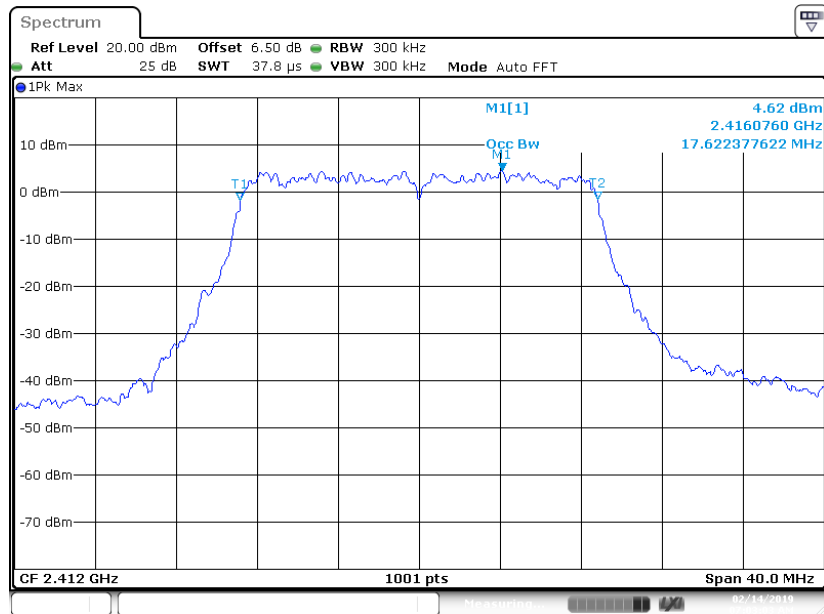
802.11g Mode Test Frequency: 2442MHz



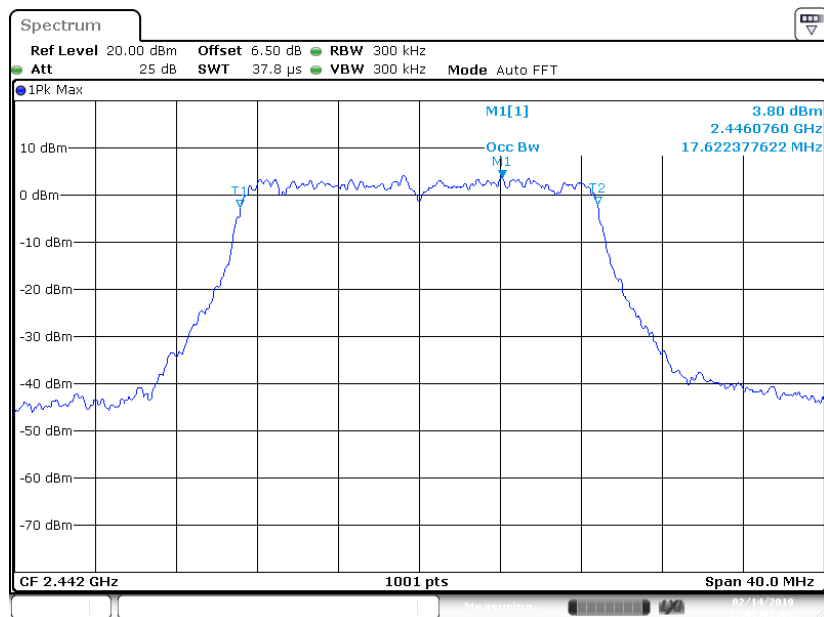
802.11g Mode Test Frequency: 2472MHz



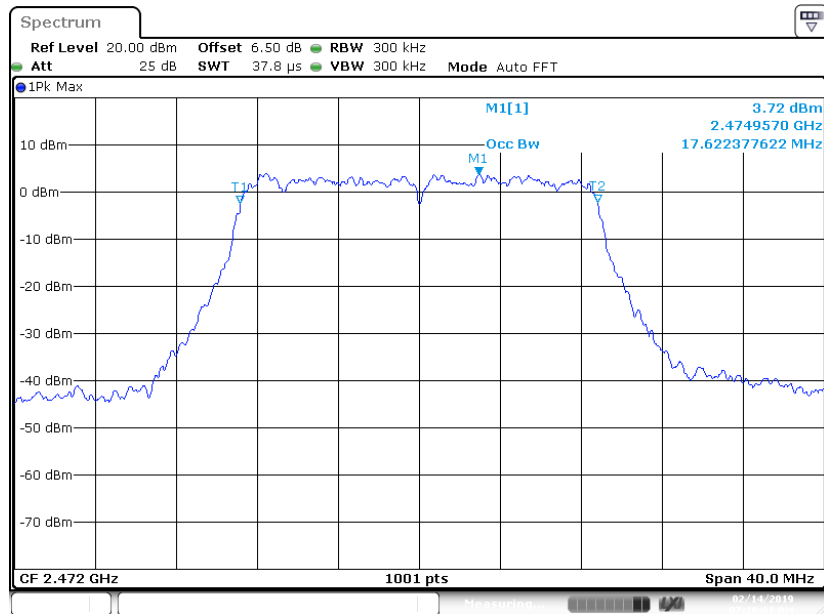
802.11n-HT20 Mode Test Frequency: 2412MHz



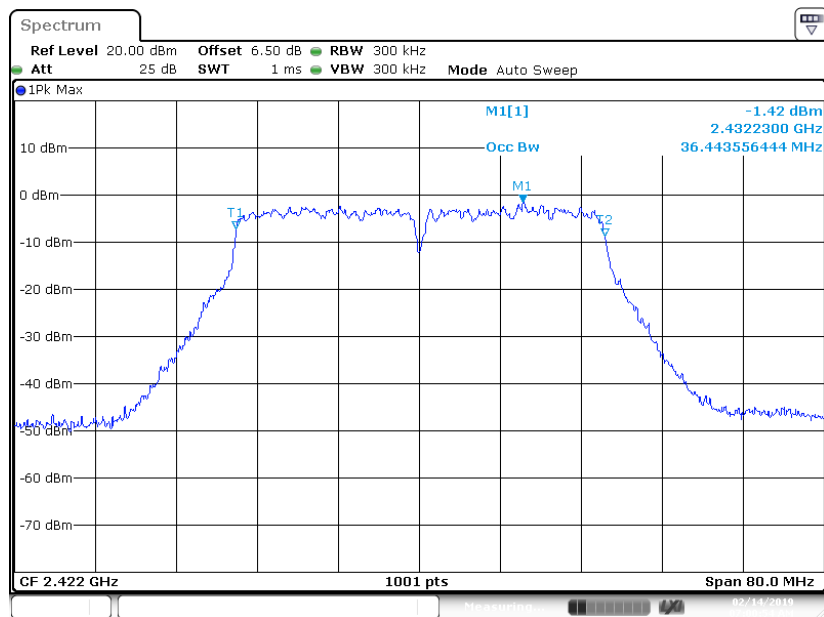
802.11n-HT20 Mode Test Frequency: 2442MHz



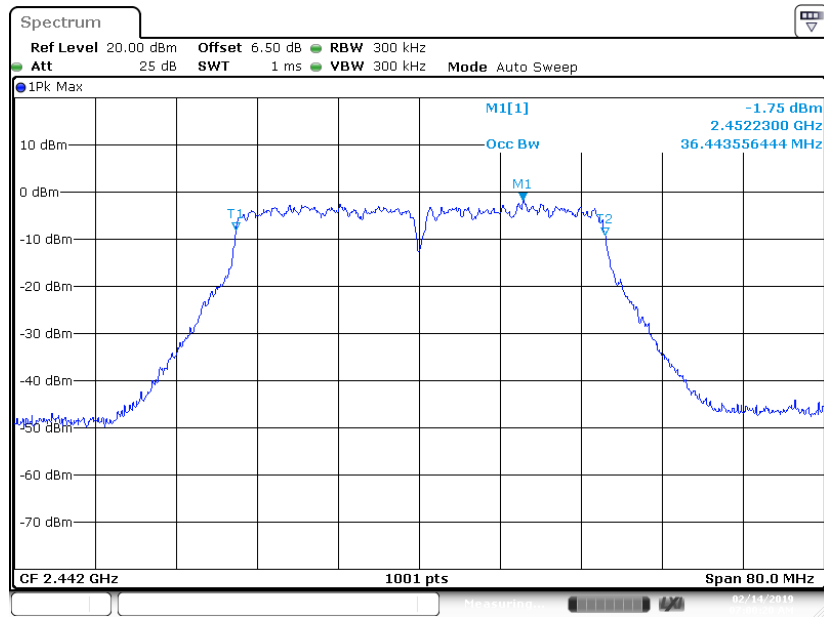
802.11n-HT20 Mode Test Frequency: 2472MHz



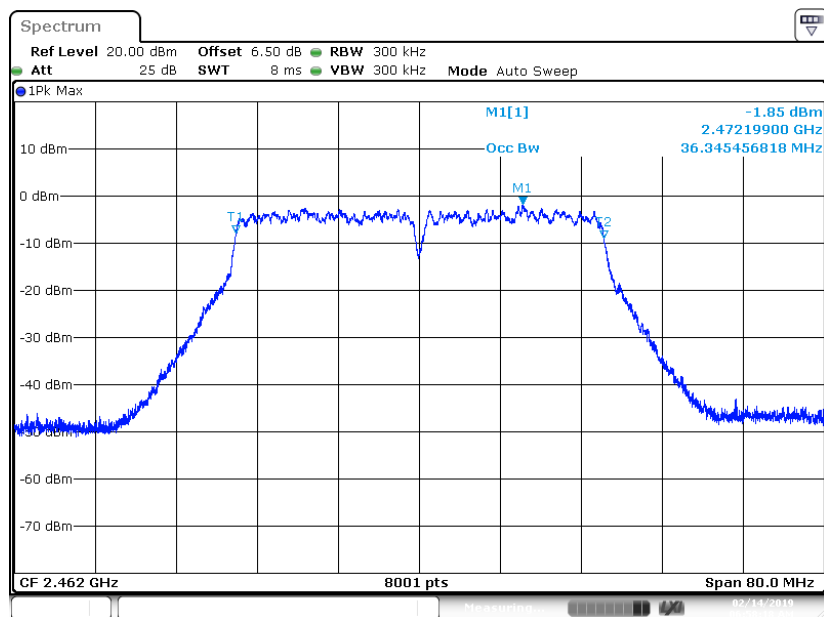
802.11n-HT40 Mode Test Frequency: 2422MHz



802.11n-HT40 Mode Test Frequency: 2442MHz

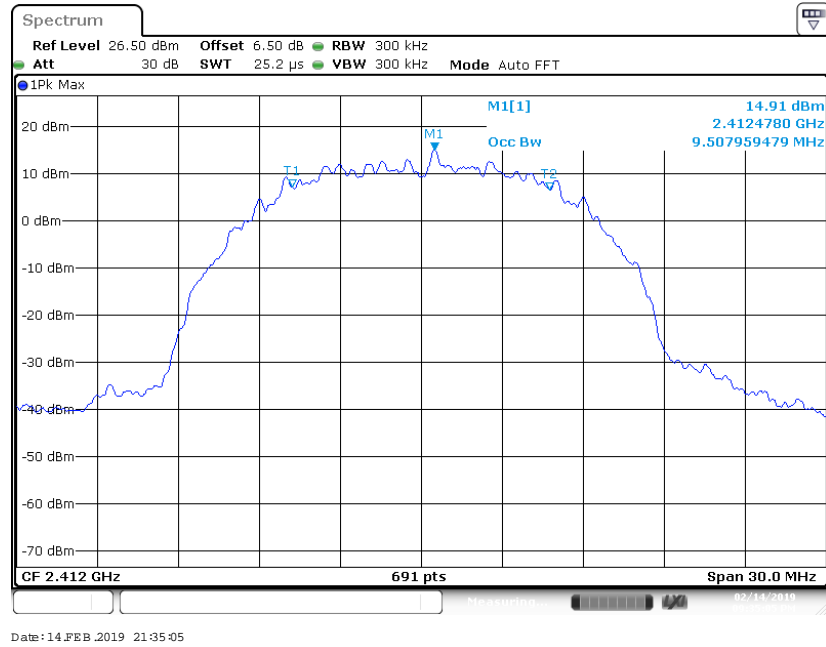


802.11n-HT40 Mode Test Frequency: 2462MHz

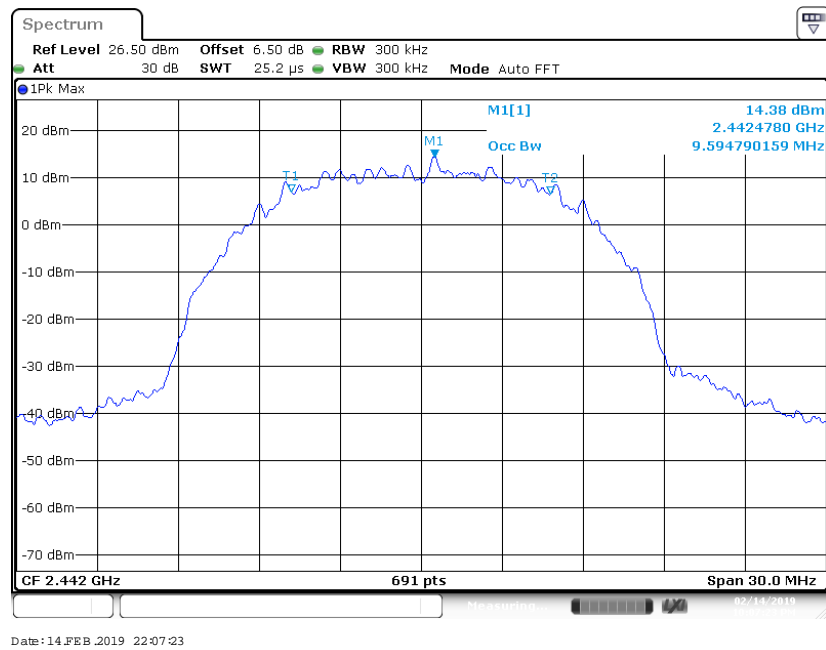


Spreading Bandwidth:

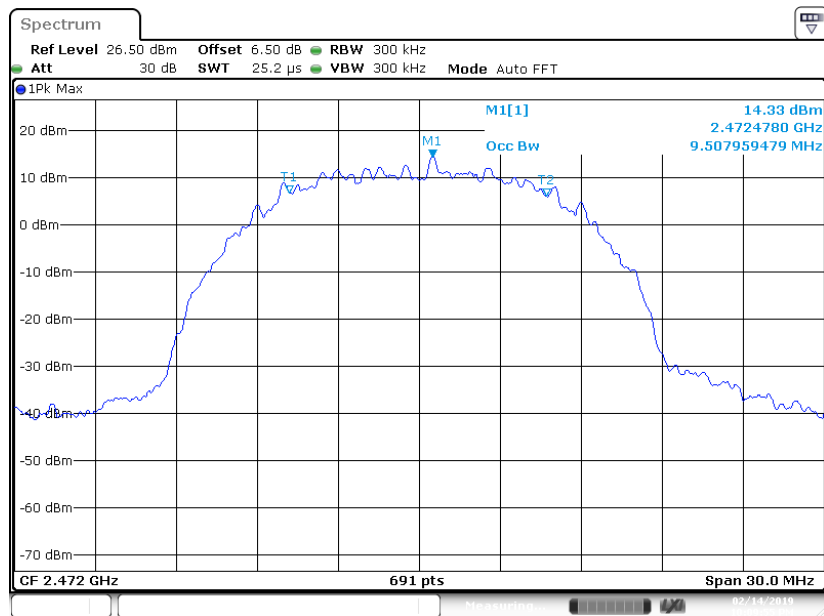
802.11b Mode Test Frequency: 2412MHz



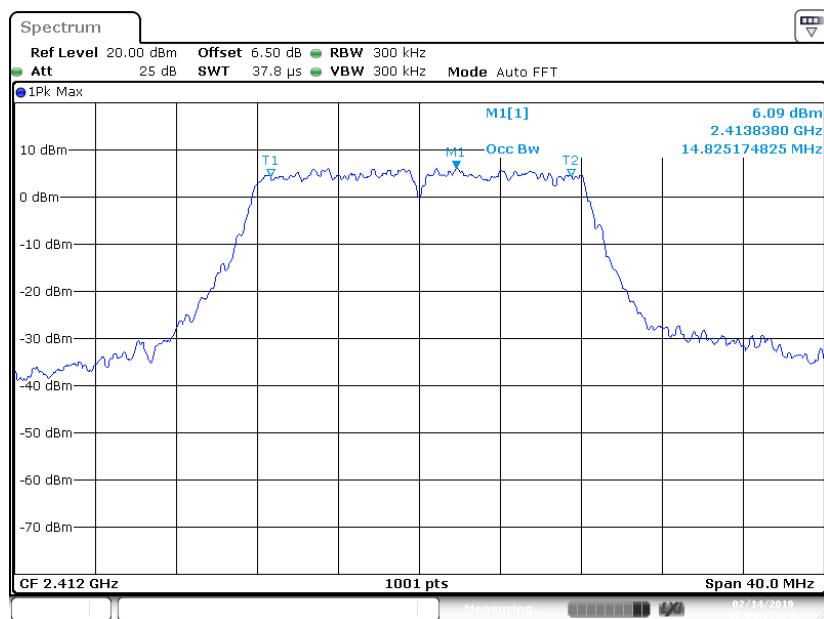
802.11b Mode Test Frequency: 2442MHz



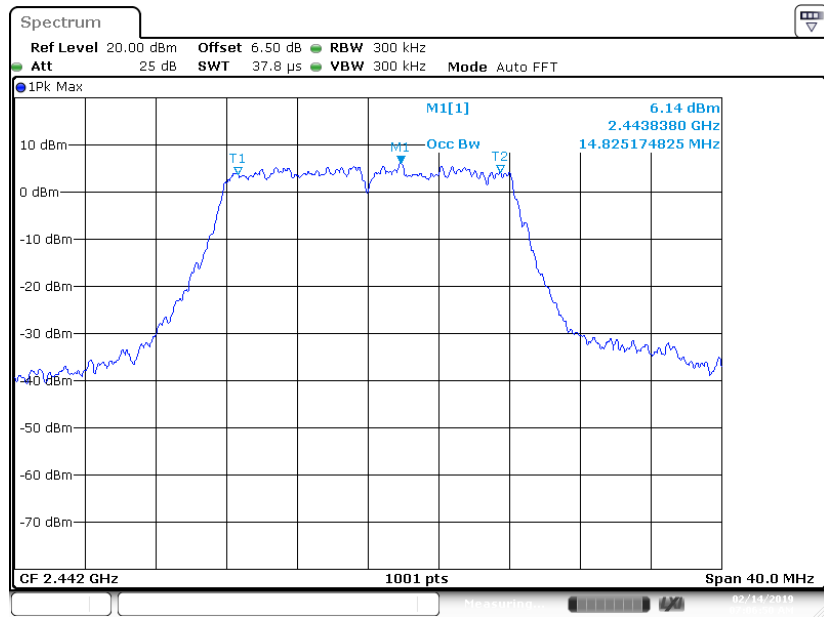
802.11b Mode Test Frequency: 2472MHz



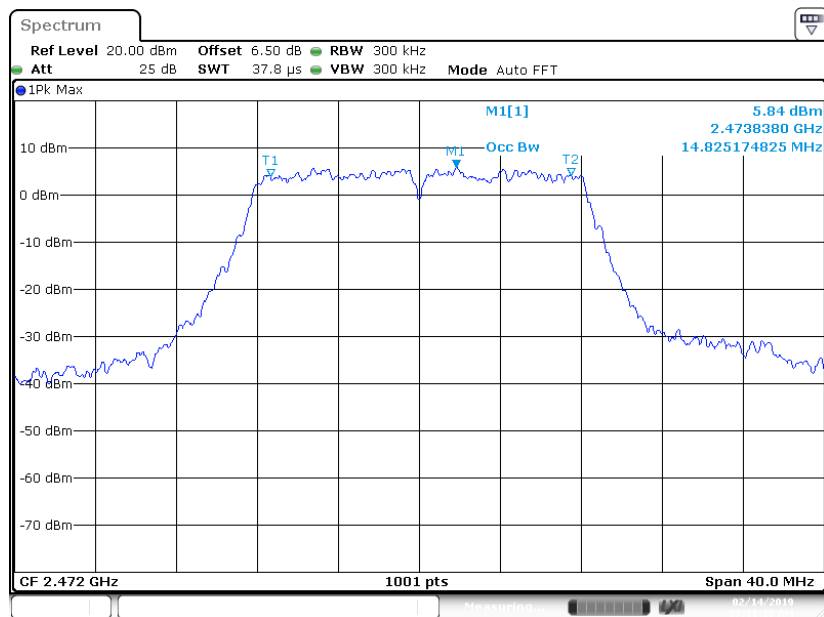
802.11g Mode Test Frequency: 2412MHz



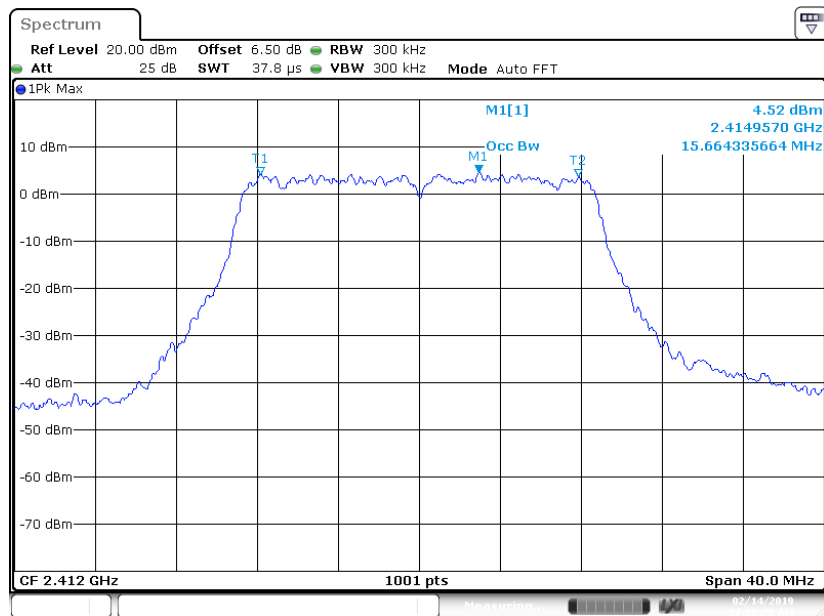
802.11g Mode Test Frequency: 2442MHz



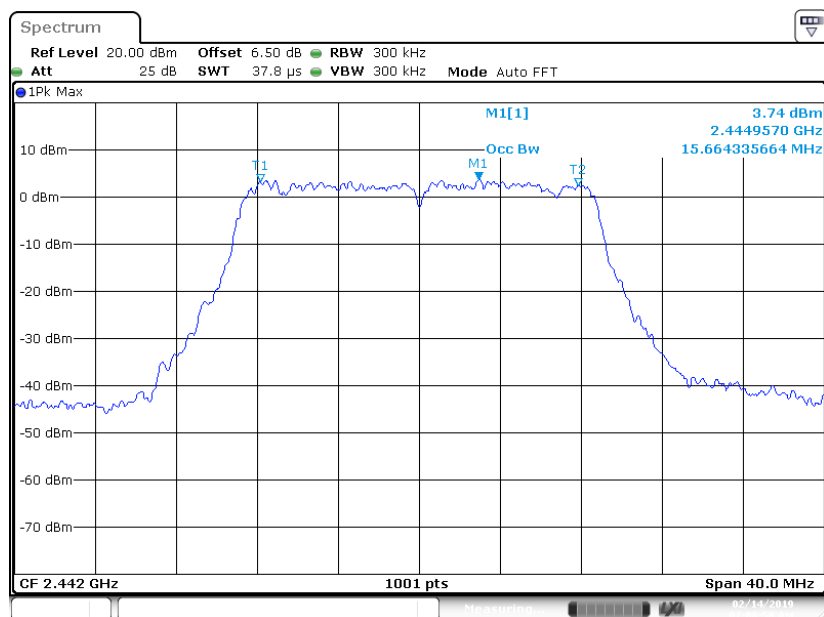
802.11g Mode Test Frequency: 2472MHz



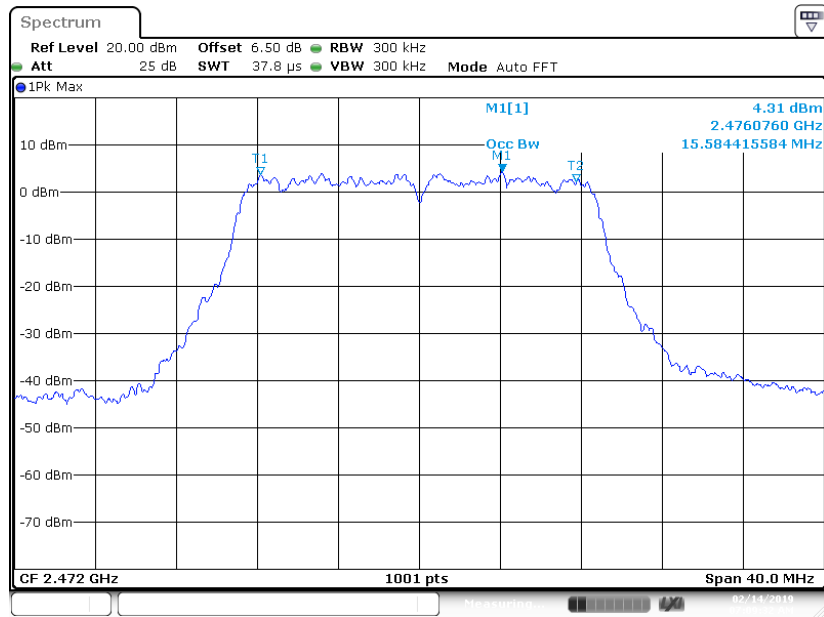
802.11n-HT20 Mode Test Frequency: 2412MHz



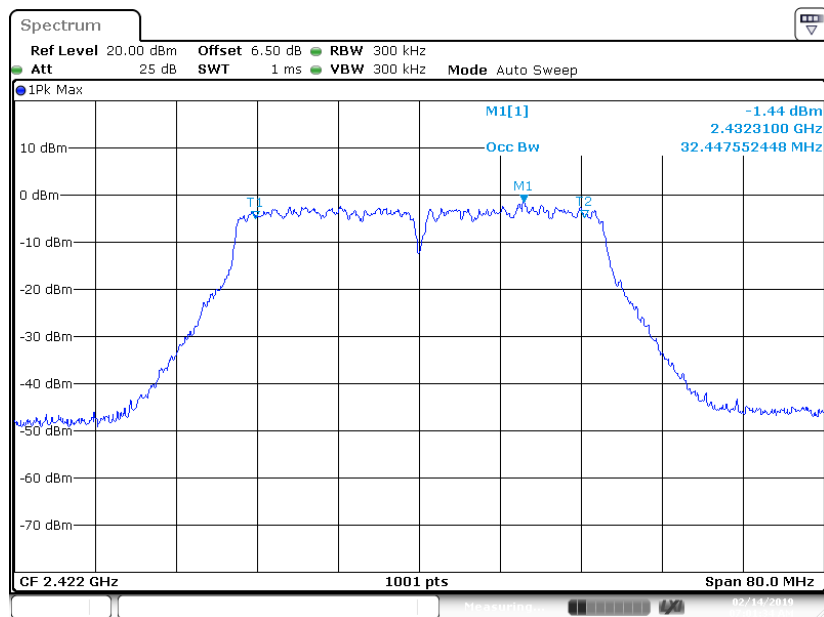
802.11n-HT20 Mode Test Frequency: 2442MHz



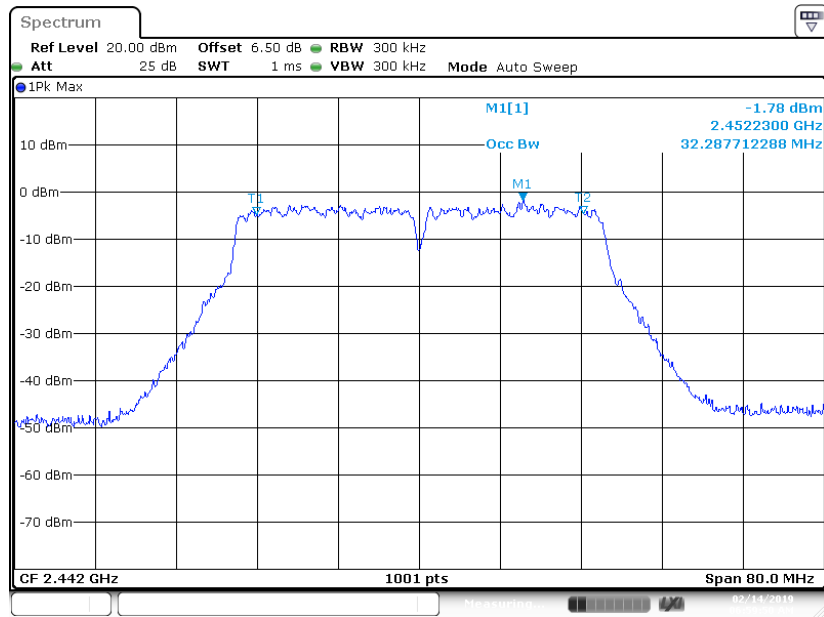
802.11n-HT20 Mode Test Frequency: 2472MHz



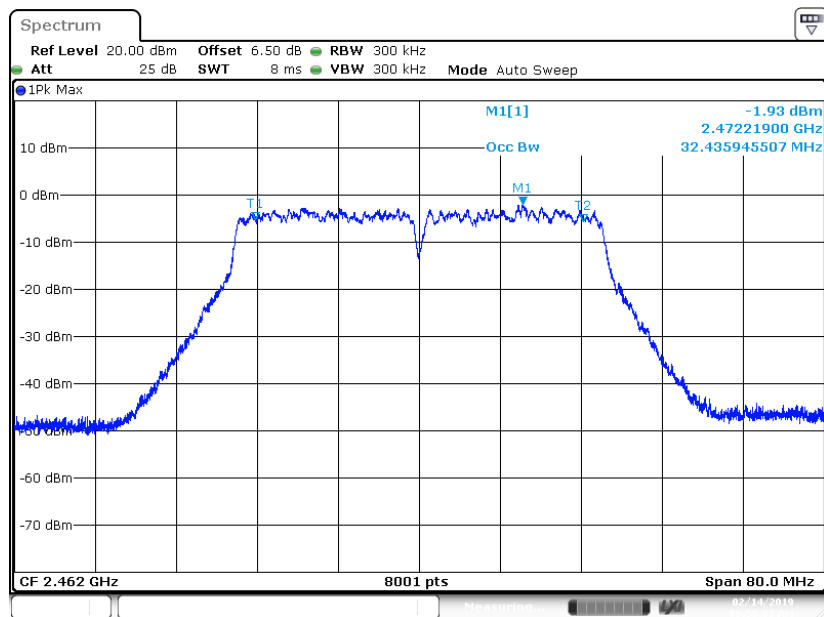
802.11n-HT40 Mode Test Frequency: 2422MHz



802.11n-HT40 Mode Test Frequency: 2442MHz



802.11n-HT40 Mode Test Frequency: 2462MHz



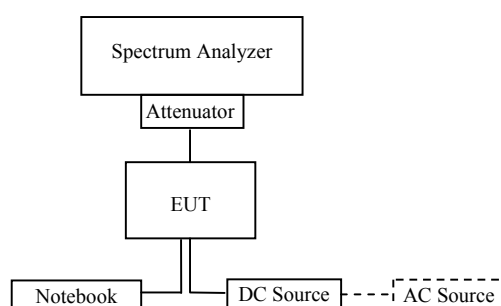
TRANSMITTER SPURIOUS EMISSION STRENGTH AND UNWANTED EMISSION INTENSITY

Limit

- $30\text{MHz} \leq f \leq 1\text{GHz}$: $0.25\mu\text{W}/100\text{kHz}$
- $1\text{GHz} < f < 2387\text{MHz}$; $2496.5\text{MHz} < f \leq 12500\text{MHz}$: $\leq 2.5\mu\text{W}/\text{MHz}$
- $2387\text{MHz} \leq f \leq 2400\text{MHz}$; $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$: $\leq 25\mu\text{W}/\text{MHz}$

Test Procedure

❖ Measurement System Diagram



❖ Conditions of Application Equipment (EUT)

- The modulation state shall be in continuously transmitting mode.

❖ Spectrum Analyzer Conditions

- Setting of SA start 30MHz and stop frequency 1GHz, RB: 100kHz/VB: 100kHz, Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than $0.25\mu\text{W}$.
- Setting of SA start 1GHz and stop frequency 2387MHz, RB: 1MHz/VB: 1MHz, Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than $2.5\mu\text{W}$.
- Setting of SA start 2387MHz and stop frequency 2400MHz, RB: 1MHz/VB: 1MHz, Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than $25\mu\text{W}$.
- Setting of SA start 2483.5MHz and stop frequency 2496.5MHz, RB: 1MHz/VB: 1MHz, Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than $25\mu\text{W}$.
- Setting of SA start 2496.5MHz and stop frequency 12500MHz, RB: 1MHz/VB: 1MHz, Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than $2.5\mu\text{W}$.

Test Data**Environmental Conditions**

Temperature:	23.2°C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Compliant

Test Mode: Transmitting

Frequency (MHz)		2412			2442			2472			Limit
Voltage(V _{DC})		4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11b Mode											
Unwanted Emission Intensity	Band I	-52.42	-51.68	-50.88	-51.76	-51.82	-52.76	-52.06	-51.95	-52.42	-36dBm/100kHz
	(dBm/100kHz)										(0.25μW/100k Hz)
	Band II	-39.61	-39.82	-38.92	-41.74	-42.40	-42.83	-41.18	-42.03	-41.39	-26dBm/MHz
	(dBm/MHz)										(2.5 μW/MHz)
	Band III	-32.77	-31.92	-32.20	-40.66	-41.08	-40.87	-41.20	-40.95	-41.56	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band IV	-41.88	-41.06	-41.79	-40.77	-40.15	-39.76	-26.58	-27.36	-28.33	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band V	-38.12	-38.62	-39.22	-37.50	-38.08	-38.70	-38.09	-37.58	-37.61	-26dBm/MHz
(dBm/MHz)	(2.5μW/MHz)										
802.11g Mode											
Unwanted Emission Intensity	Band I	-61.22	-61.50	-61.26	-62.33	-62.30	-62.01	-61.48	-61.62	-62.49	-36dBm/100kHz
	(dBm/100kHz)										(0.25μW/100k Hz)
	Band II	-37.64	-37.10	-36.40	-47.99	-48.58	-48.36	-48.18	-48.82	-48.63	-26dBm/MHz
	(dBm/MHz)										(2.5 μW/MHz)
	Band III	-21.25	-21.38	-21.68	-46.37	-45.78	-45.96	-45.35	-46.16	-46.23	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band IV	-46.95	-46.17	-45.93	-50.40	-49.89	-50.84	-19.90	-20.75	-19.97	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band V	-48.80	-48.49	-48.23	-46.88	-47.66	-47.59	-35.56	-36.07	-35.60	-26dBm/MHz
(dBm/MHz)	(2.5μW/MHz)										
802.11n-HT20 Mode											
Unwanted Emission Intensity	Band I	-57.87	-57.83	-57.91	-60.79	-60.99	-60.72	-60.10	-60.80	-60.79	-36dBm/100kHz
	(dBm/100kHz)										(0.25μW/100k Hz)
	Band II	-40.63	-41.62	-40.80	-48.34	-48.68	-49.17	-48.35	-48.57	-48.55	-26dBm/MHz
	(dBm/MHz)										(2.5 μW/MHz)
	Band III	-24.55	-25.16	-24.51	-46.15	-45.47	-44.57	-45.34	-46.14	-45.39	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band IV	-44.70	-45.69	-44.96	-45.38	-45.76	-45.89	-21.72	-20.93	-21.03	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band V	-47.98	-48.11	-49.02	-47.72	-47.93	-48.89	-42.83	-43.23	-44.02	-26dBm/MHz
(dBm/MHz)	(2.5μW/MHz)										

Frequency (MHz)		2422			2442			2462			Limit
Voltage(V _{DC})		4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11n-HT40 Mode											
Unwanted Emission Intensity	Band I	-62.49	-61.97	-62.09	-60.82	-61.27	-60.61	-60.79	-61.56	-61.09	-36dBm/100kHz
	(dBm/100kHz)										(0.25μW/100k Hz)
	Band II	-43.12	-43.83	-42.89	-48.63	-47.82	-48.80	-47.73	-47.66	-47.63	-26dBm/MHz
	(dBm/MHz)										(2.5 μW/MHz)
	Band III	-20.92	-21.55	-22.28	-40.36	-39.98	-40.54	-40.70	-39.73	-40.43	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band IV	-45.80	-46.38	-46.79	-41.64	-40.88	-40.28	-20.12	-19.16	-19.79	-16dBm/MHz
	(dBm/MHz)										(25 μW/MHz)
	Band V	-48.96	-48.22	-48.50	-47.79	-47.55	-48.14	-41.31	-40.62	-40.53	-26dBm/MHz
	(dBm/MHz)										(2.5μW/MHz)

Note : Band I:30MHz~1GHz

Band II:1GHz~2387MHz

Band III:2387MHz~2400MHz

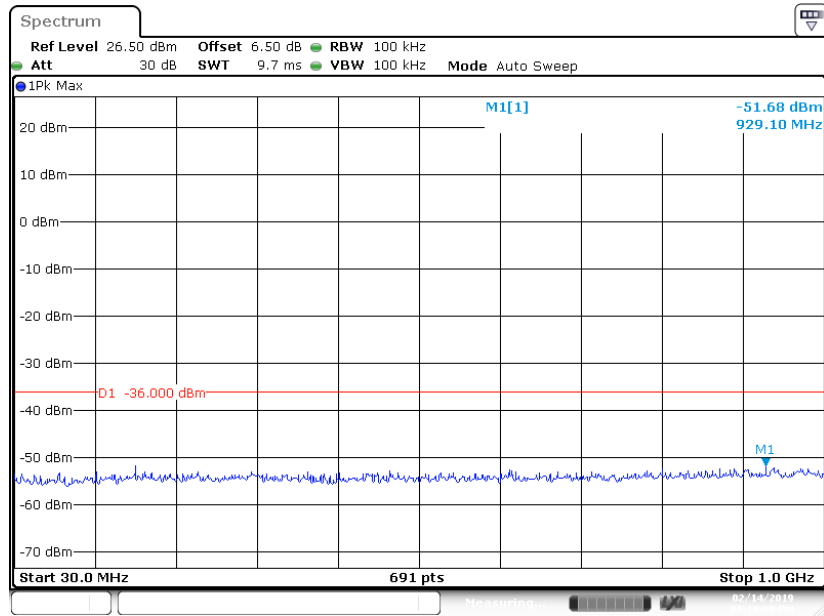
Band IV:2483.5MHz~2496.5MHz

Band V:2496.5MHz~12500MHz

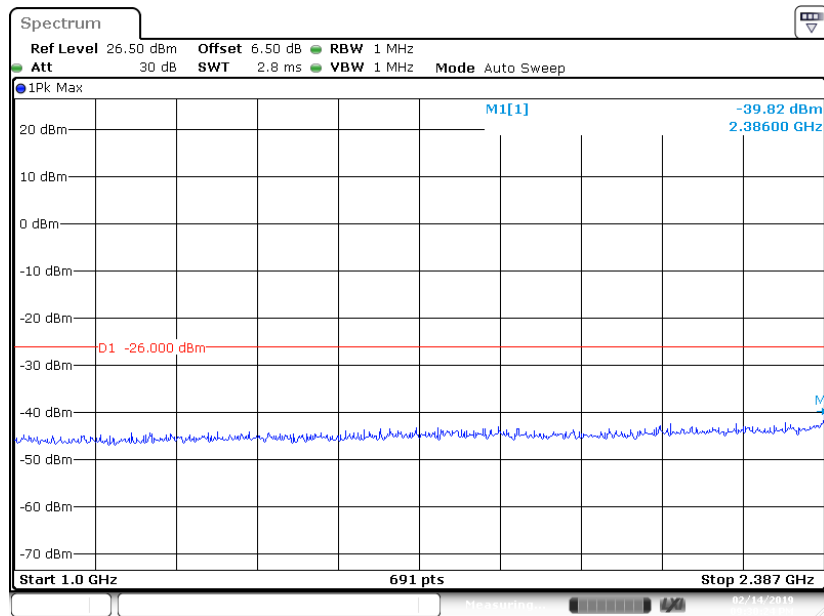
Please refer to the following plots for normal voltage:

802.11b mode

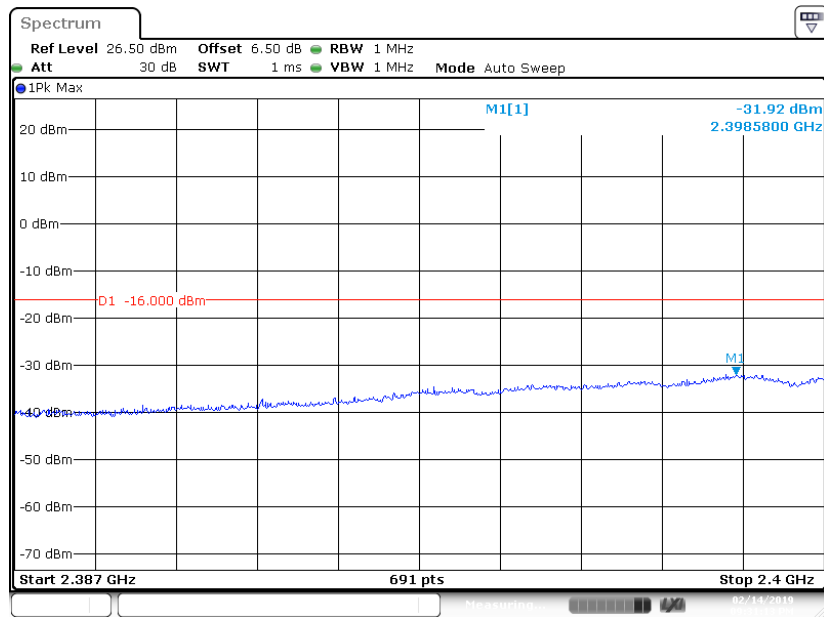
Low Channel 30MHz~1GHz



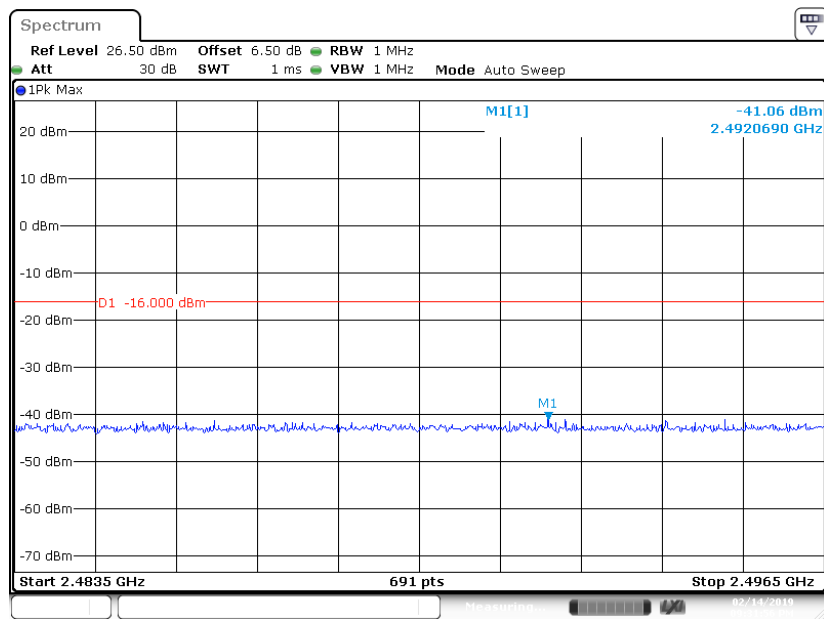
Low Channel 1GHz~2387MHz



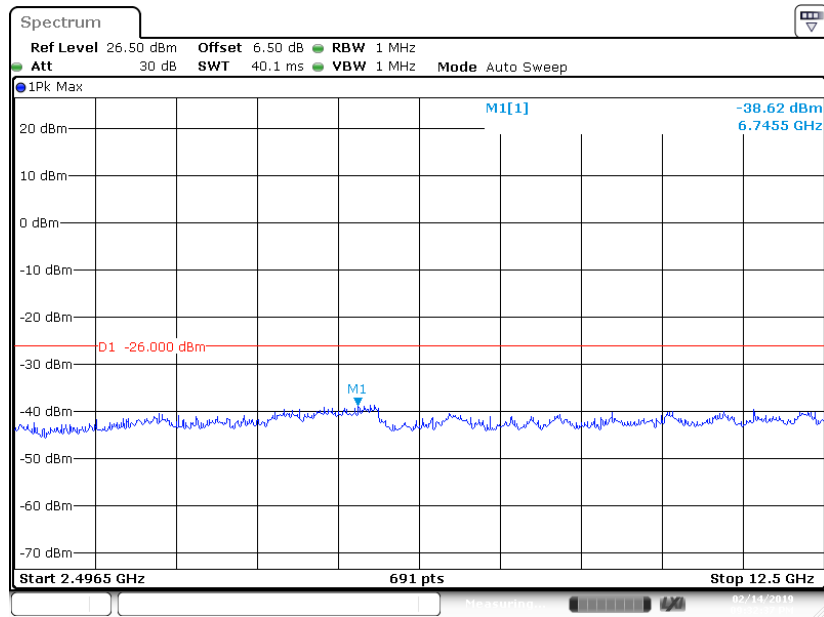
Low Channel 2387MHz~2400MHz



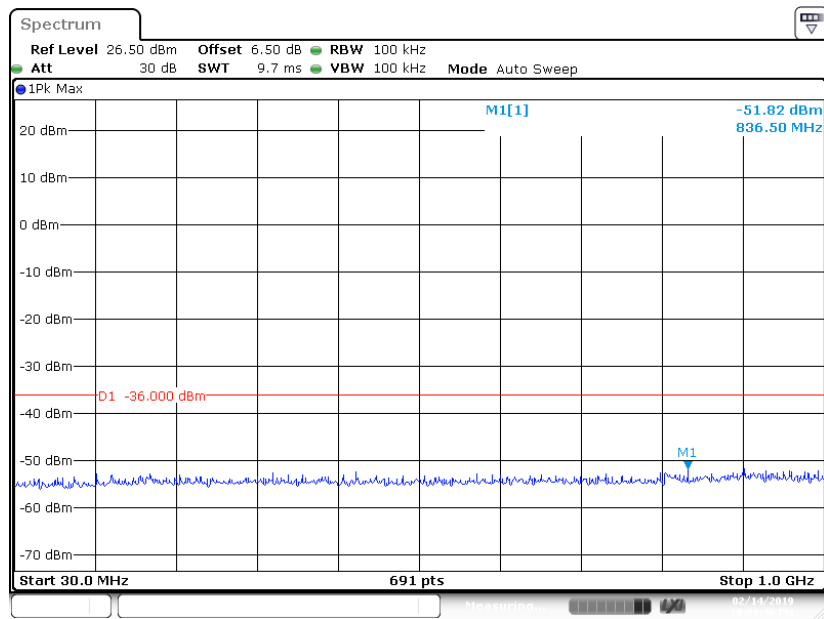
Low Channel 2483.5MHz~2496.5MHz



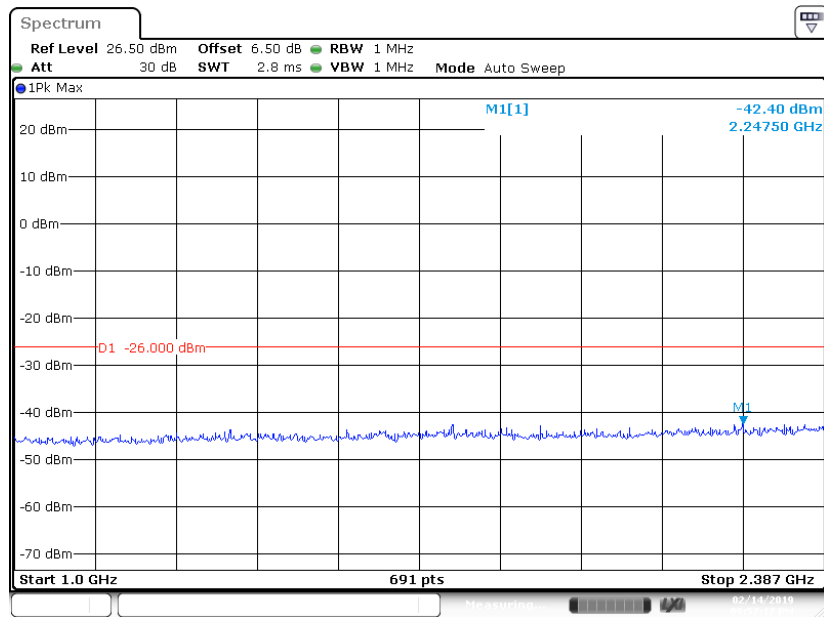
Low Channel 2496.5MHz~12500MHz



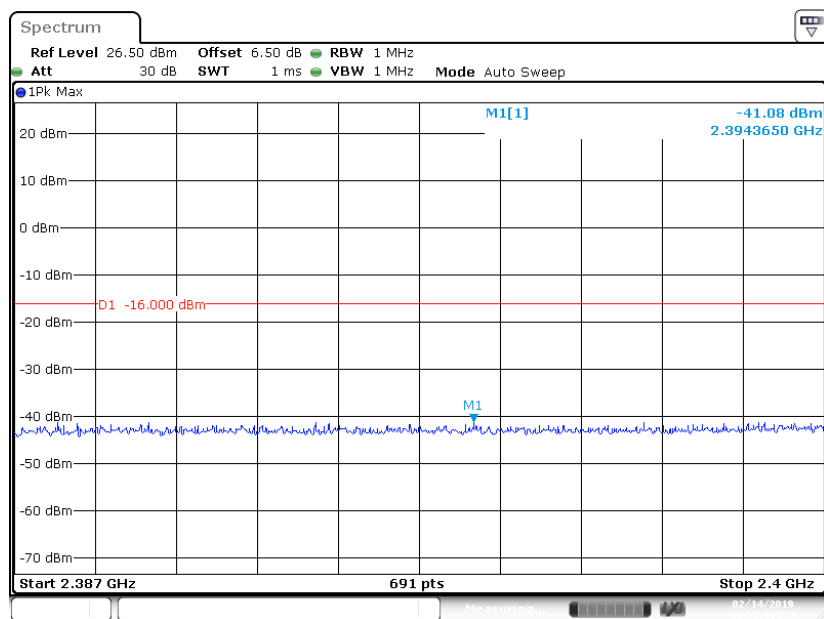
Middle Channel 30MHz~1GHz



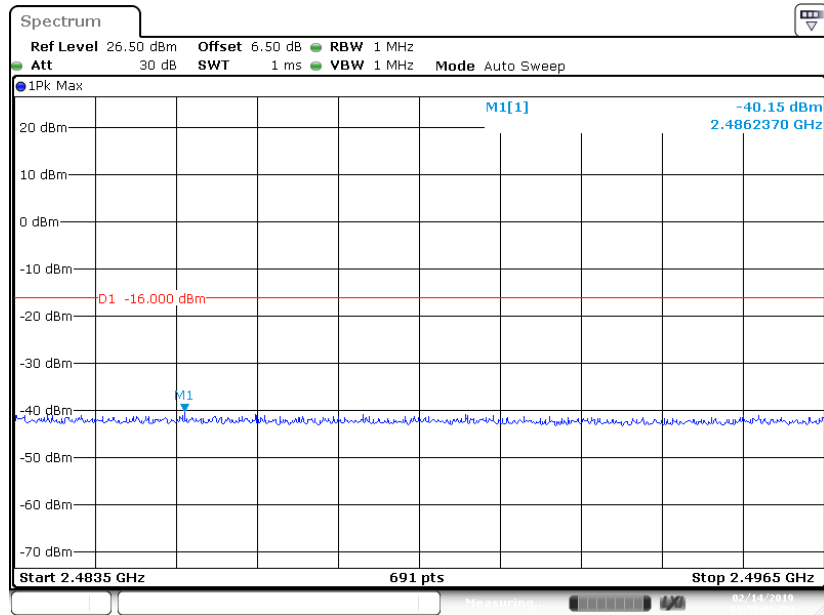
Middle Channel 1GHz~2387MHz



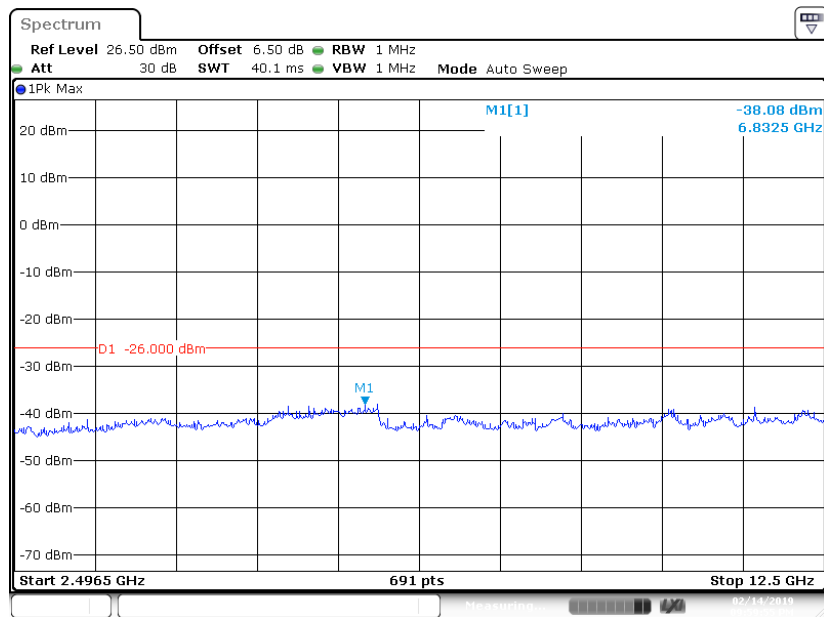
Middle Channel 2387MHz~2400MHz



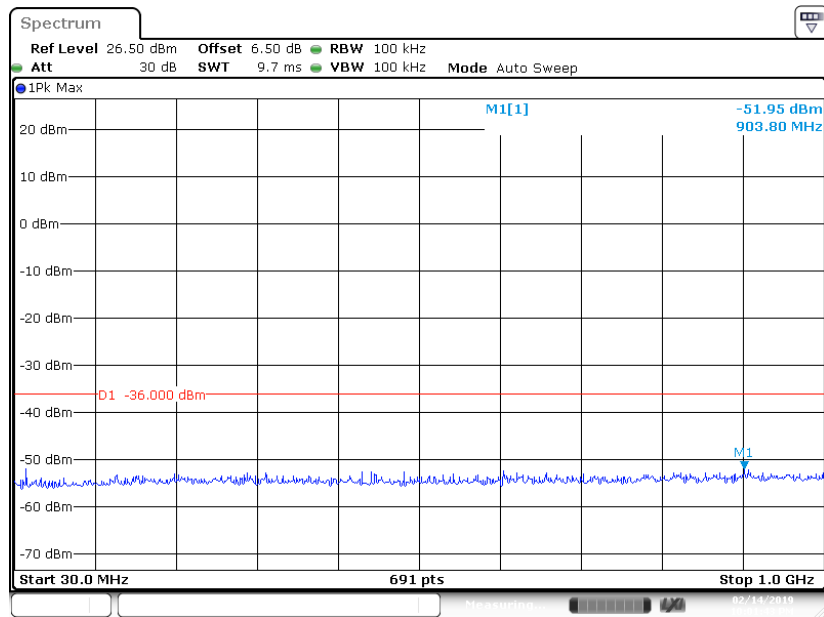
Middle Channel 2483.5MHz ~2496.5MHz



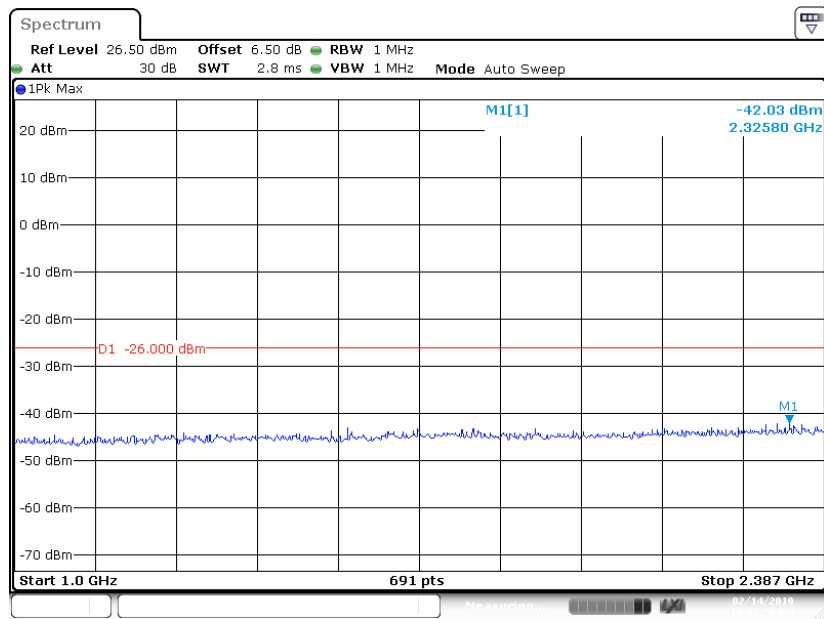
Middle Channel 2496.5MHz ~12500MHz



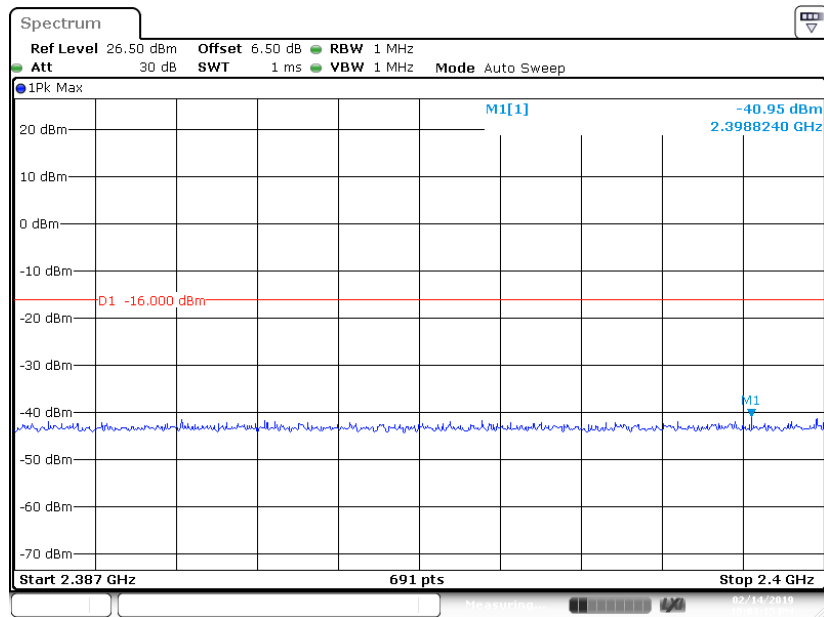
High Channel 30MHz~1GHz



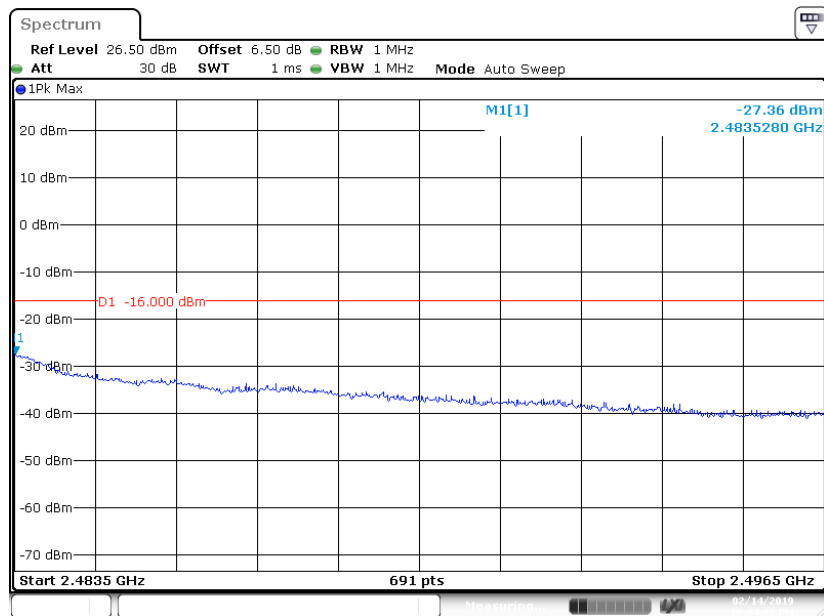
High Channel 1GHz~2387MHz



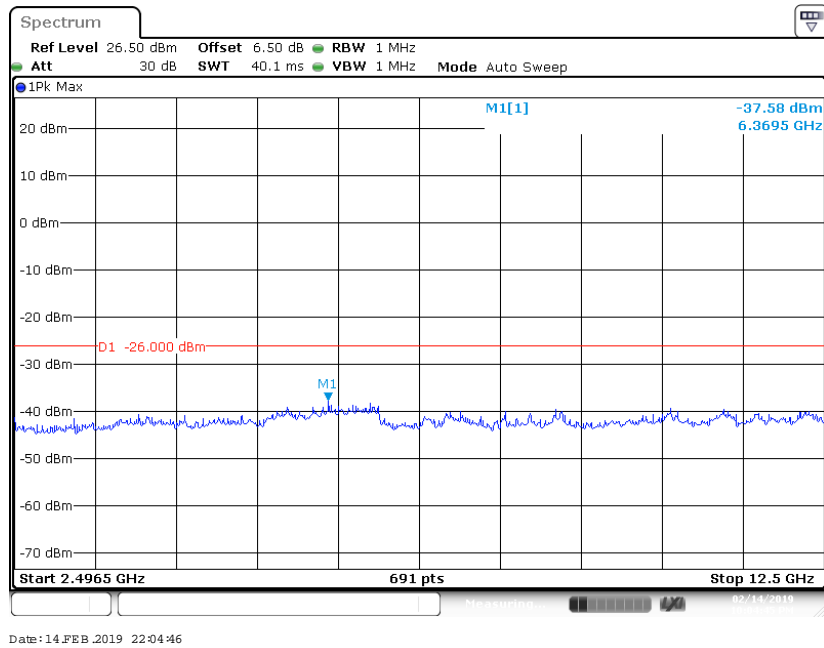
High Channel 2387MHz~2400MHz



High Channel 2483.5MHz~2496.5MHz

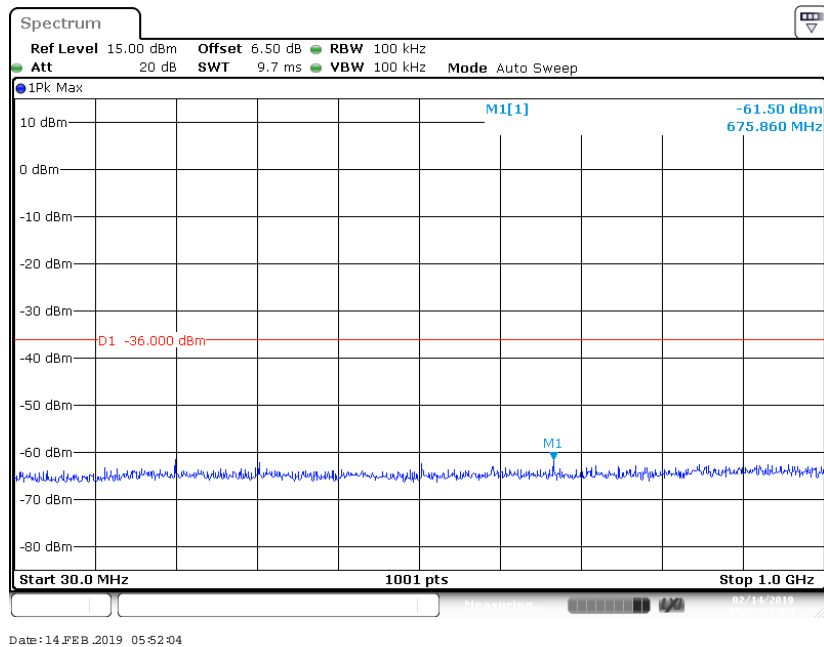


High Channel 2496.5MHz~12500MHz

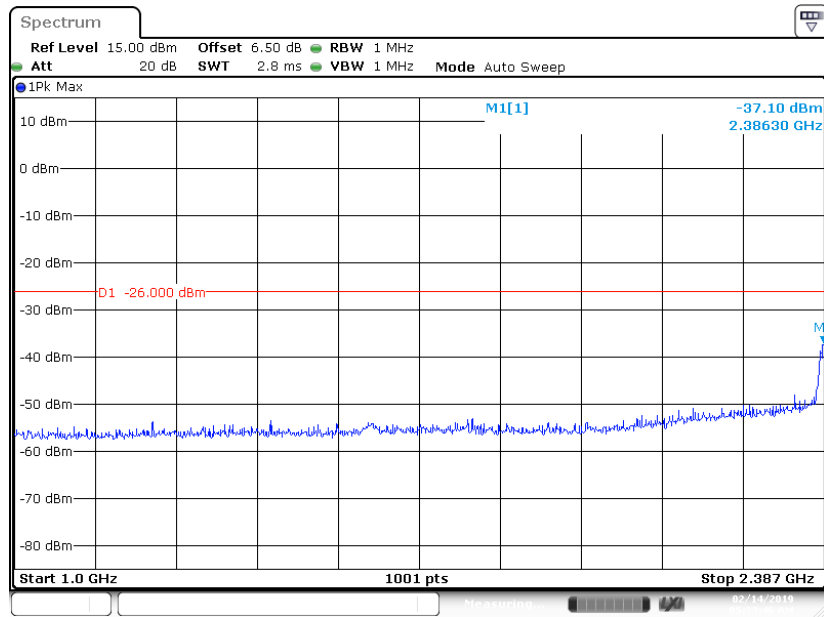


802.11g mode

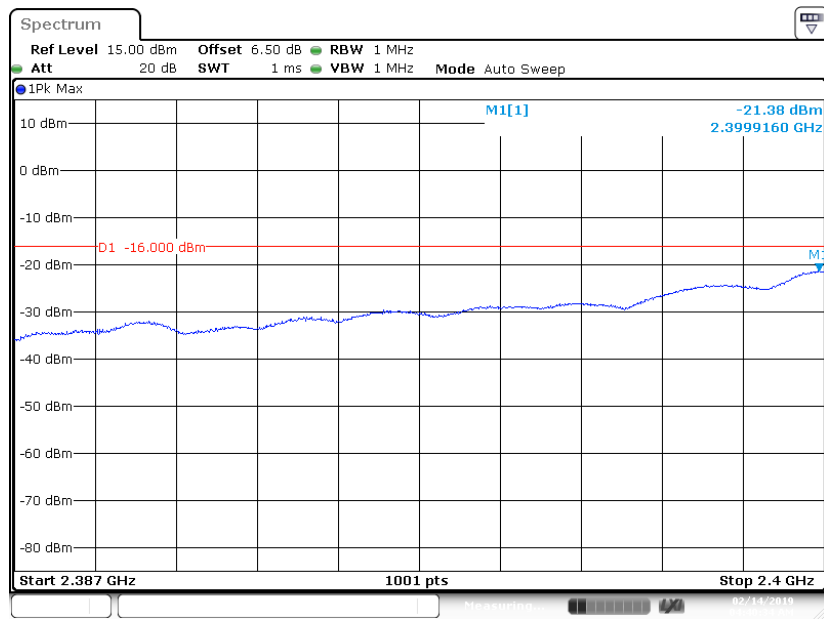
Low Channel 30MHz~1GHz



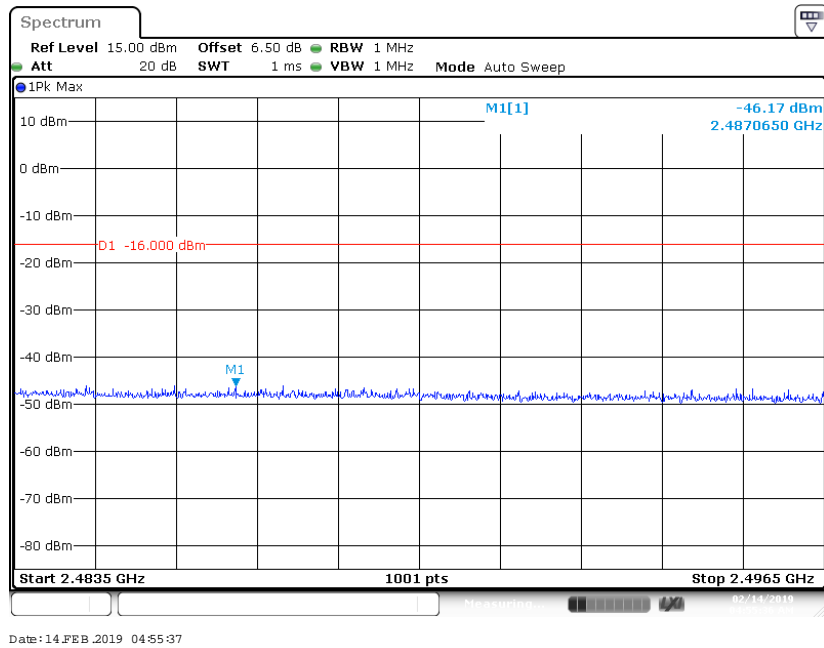
Low Channel 1GHz~2387MHz



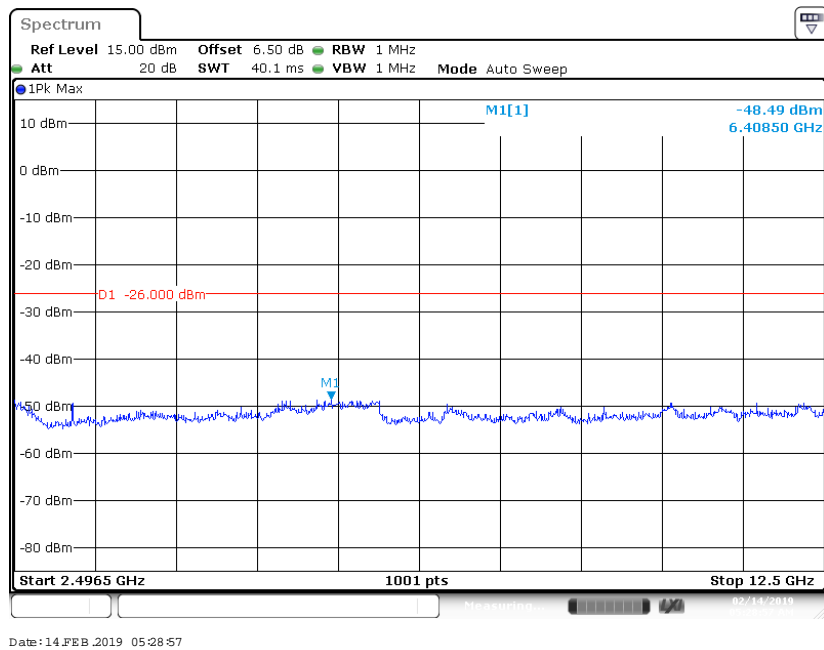
Low Channel 2387MHz~2400MHz



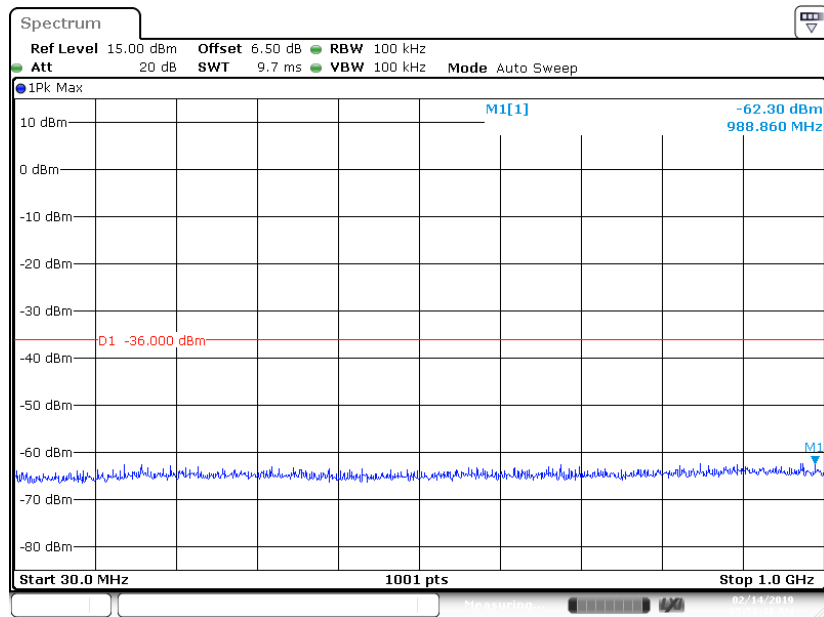
Low Channel 2483.5MHz ~2496.5MHz



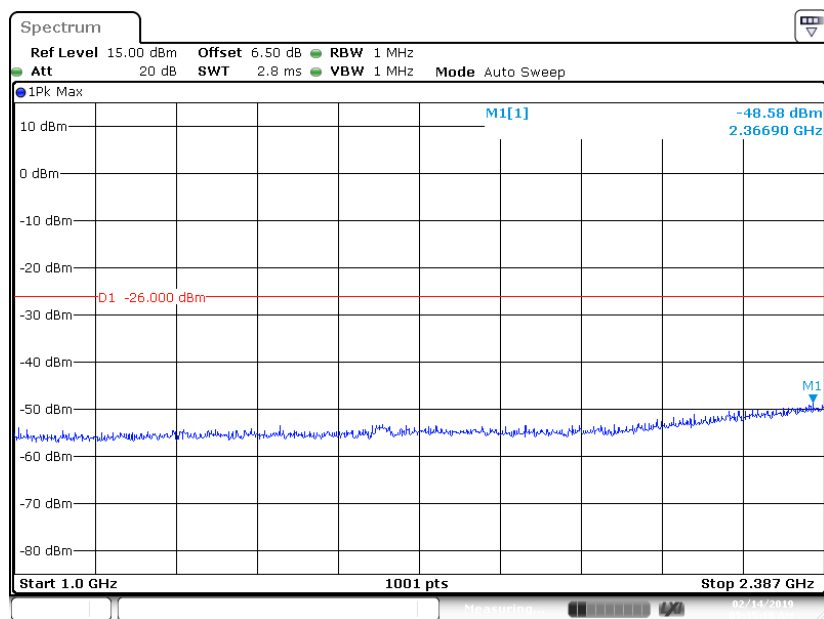
Low Channel 2496.5MHz ~12500MHz



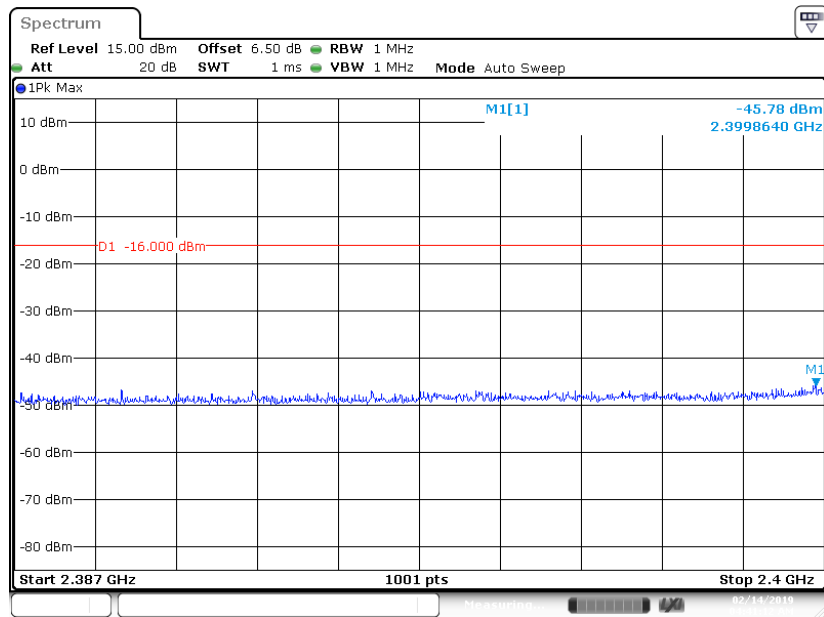
Middle Channel 30MHz~1GHz



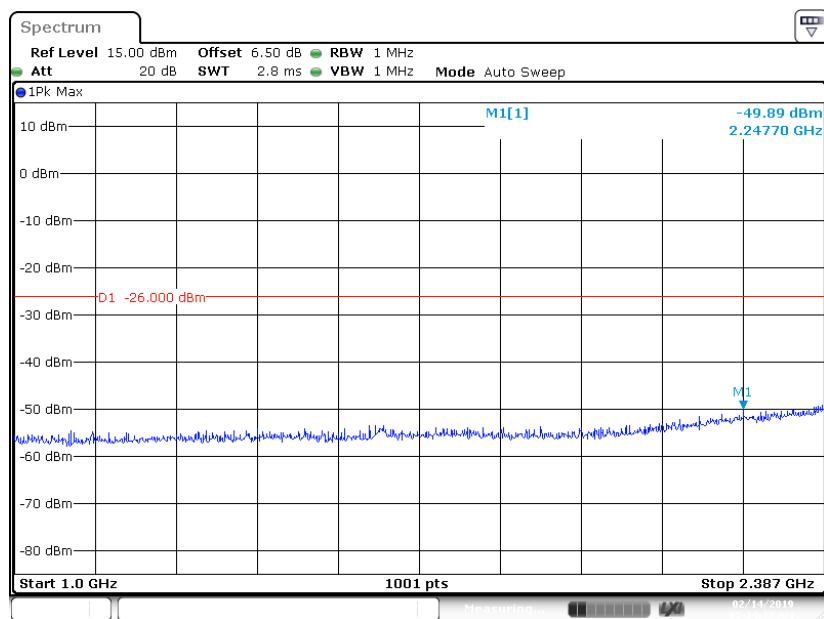
Middle Channel 1GHz~2387MHz



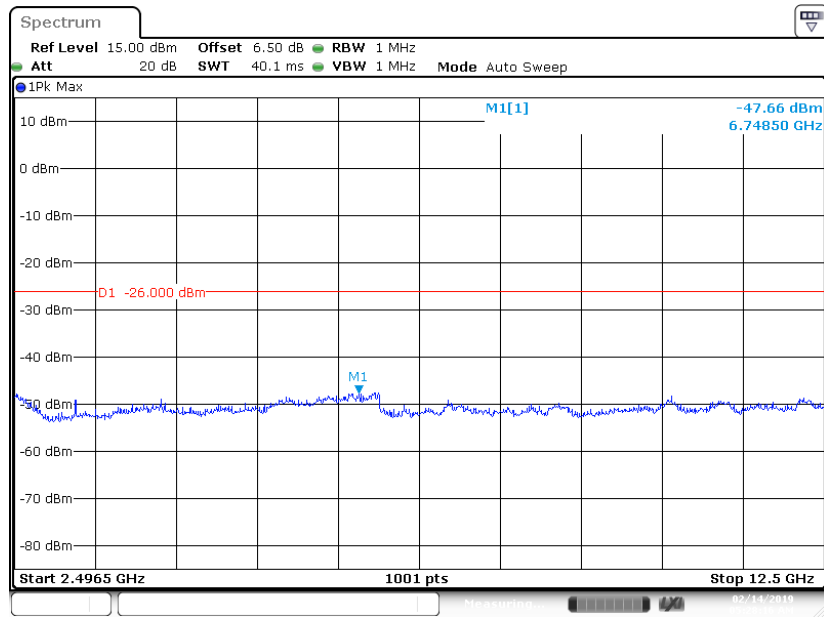
Middle Channel 2387MHz ~2400MHz



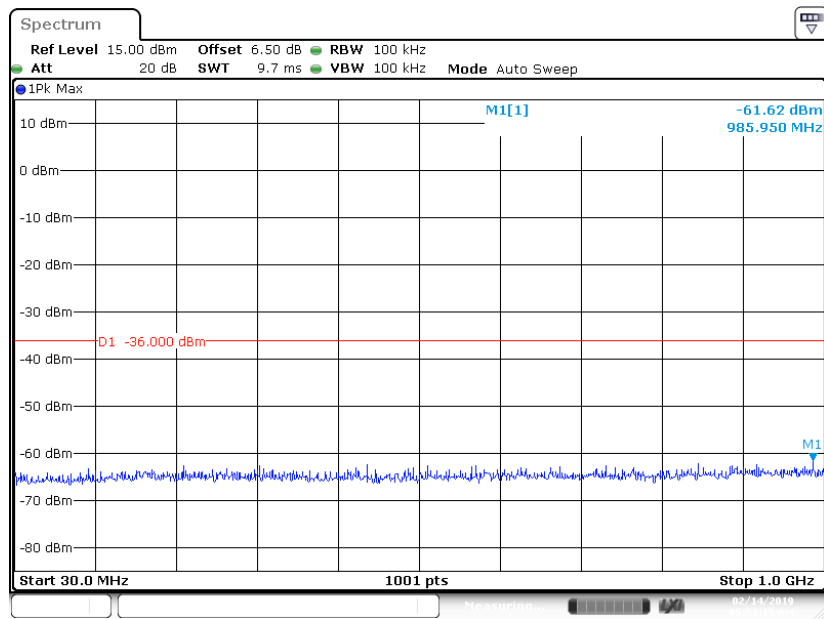
Middle Channel 2483.5MHz ~2496.5MHz



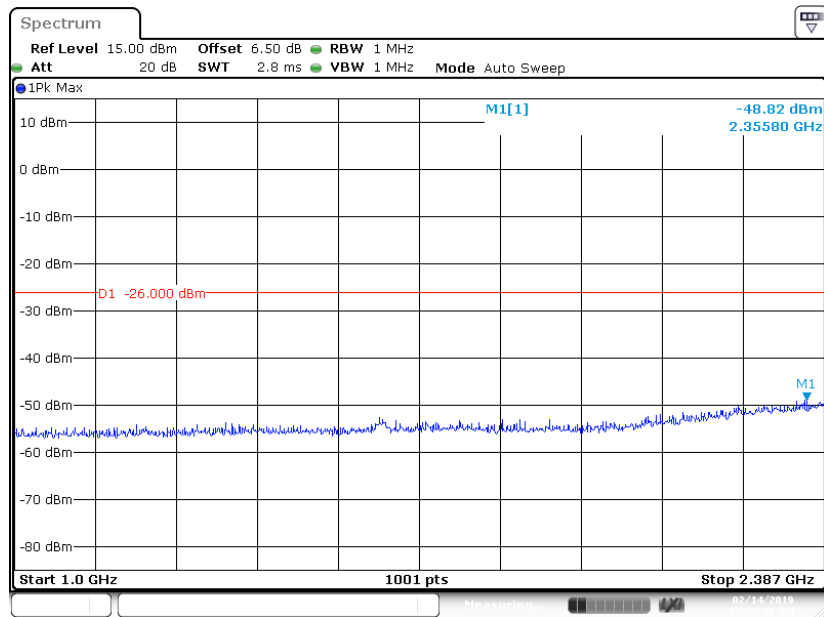
Middle Channel 2496.5MHz~12500MHz



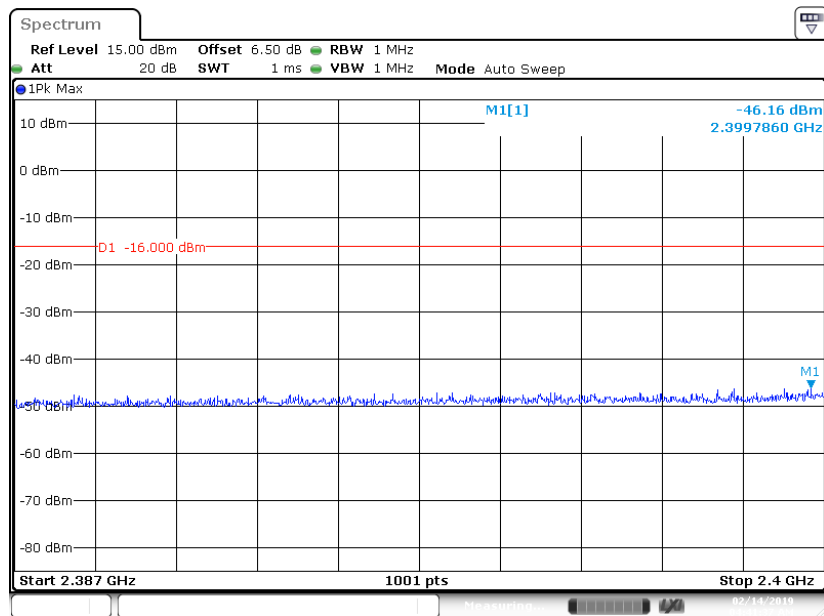
High Channel 30MHz~1GHz



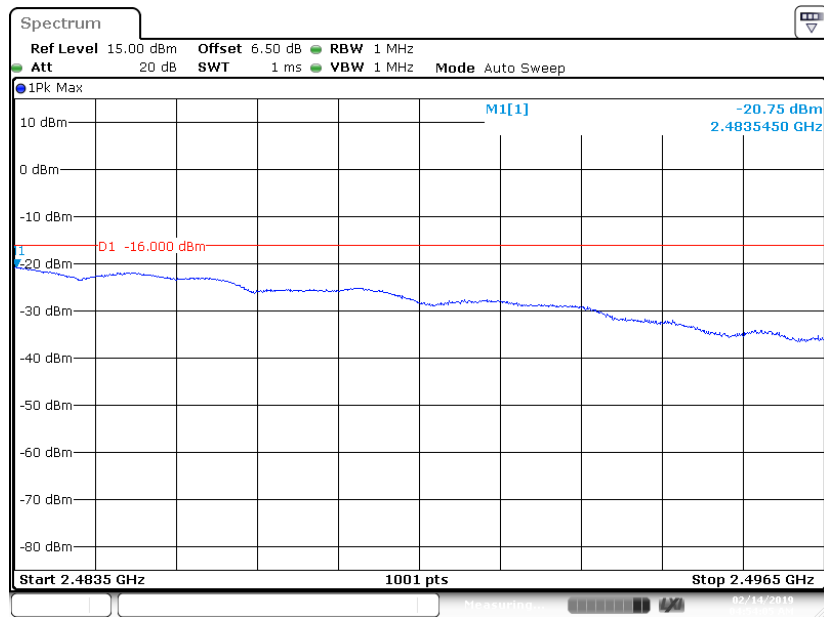
High Channel 1GHz ~2387MHz



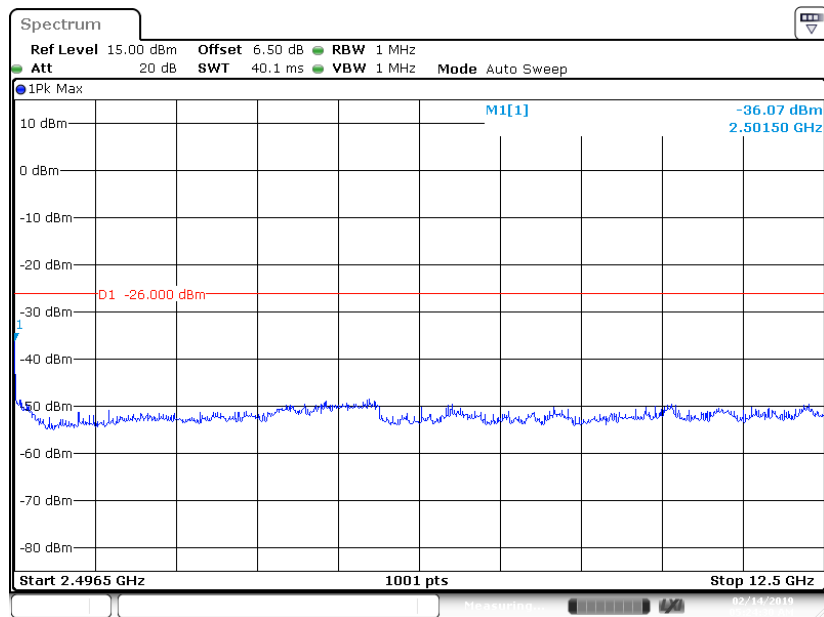
High Channel 2387MHz ~2400MHz



High Channel 2483.5MHz~2496.5MHz

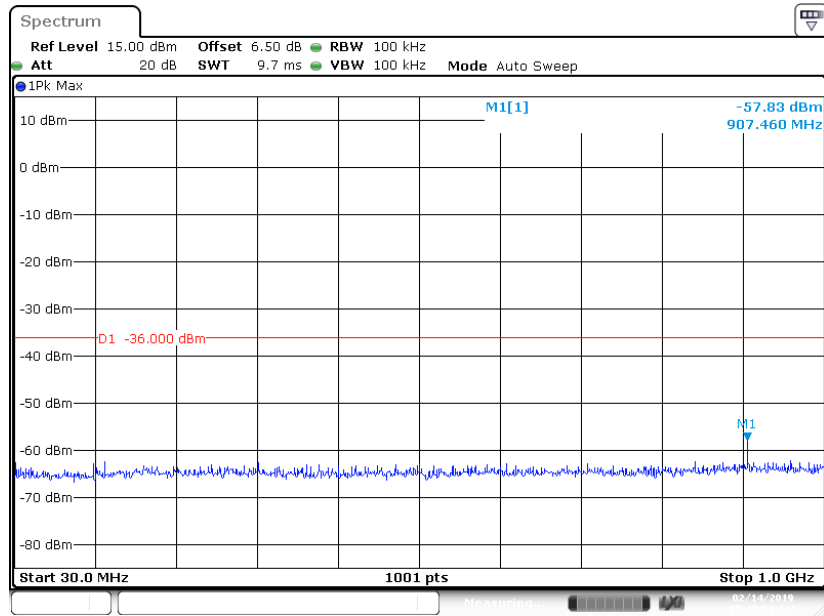


High Channel 2496.5MHz~12500MHz

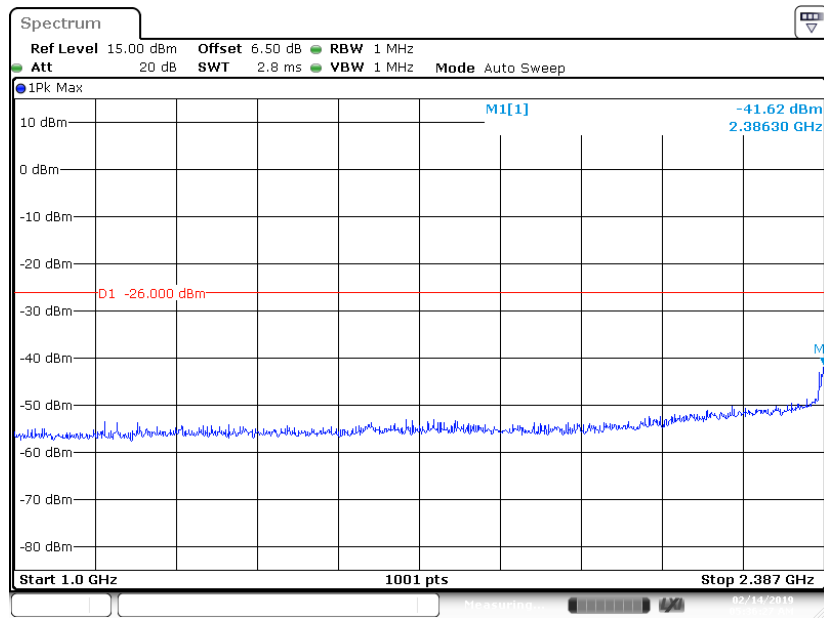


802.11n-HT20

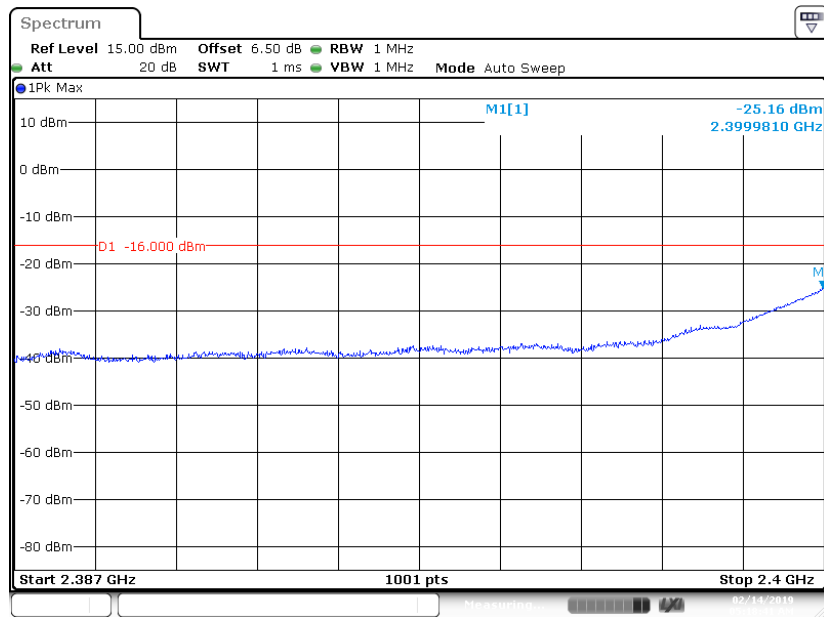
Low Channel 30MHz~1GHz



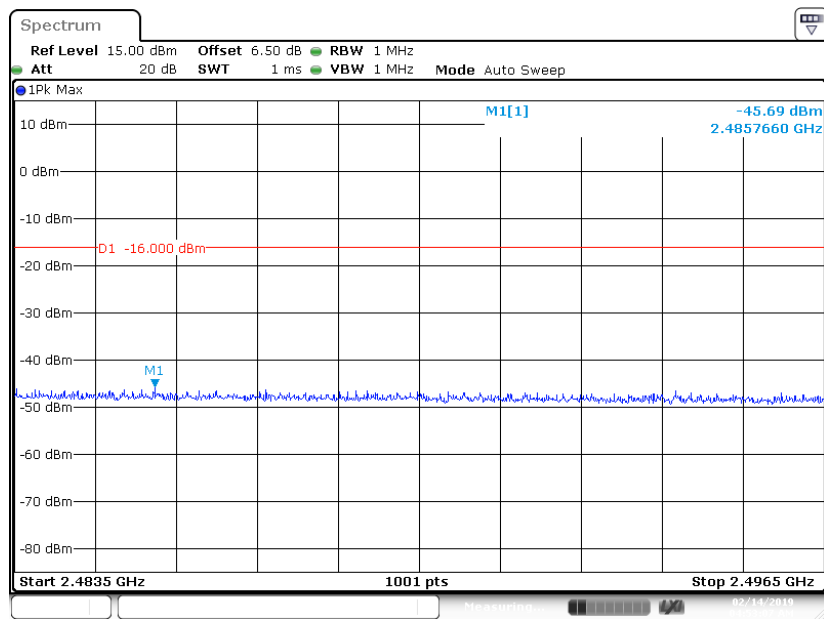
Low Channel 1GHz~2387MHz



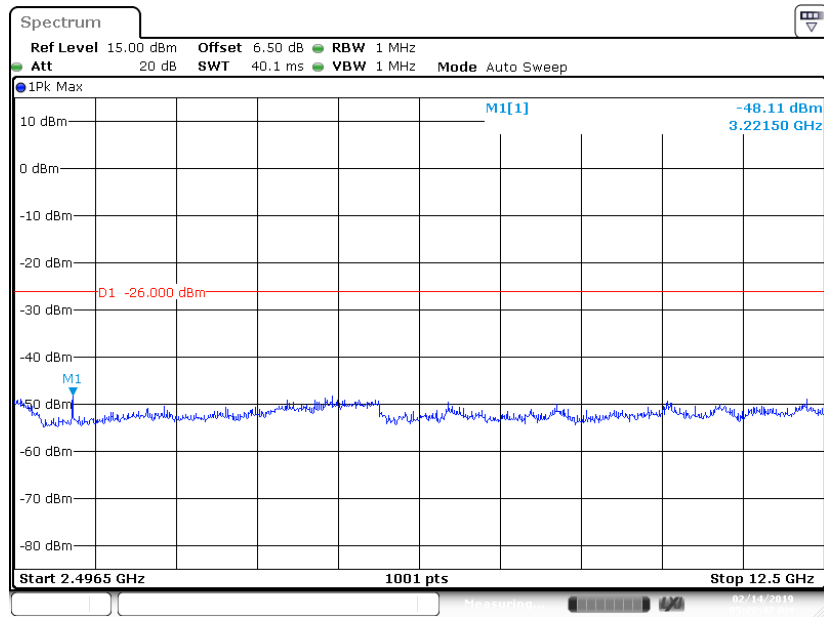
Low Channel 2387MHz~2400MHz



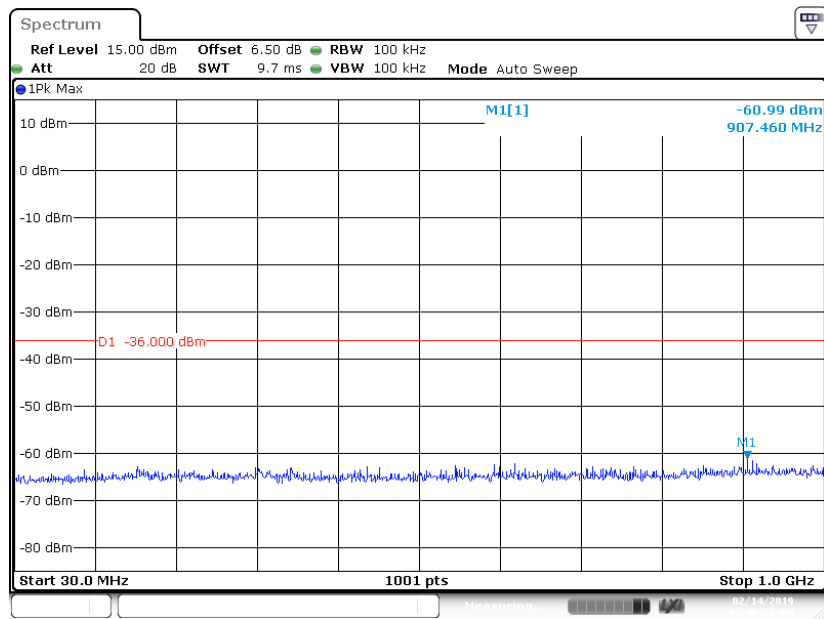
Low Channel 2483.5MHz~2496.5MHz



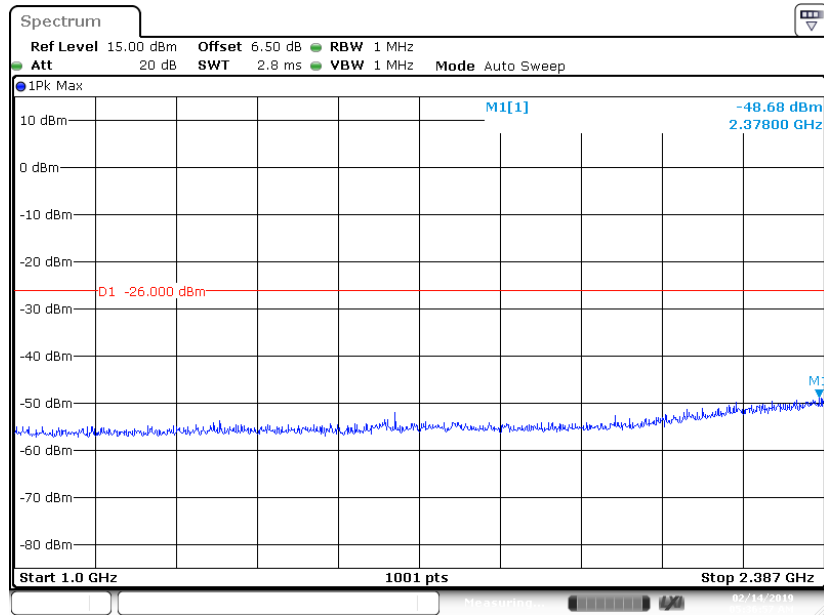
Low Channel 2496.5MHz~12500MHz



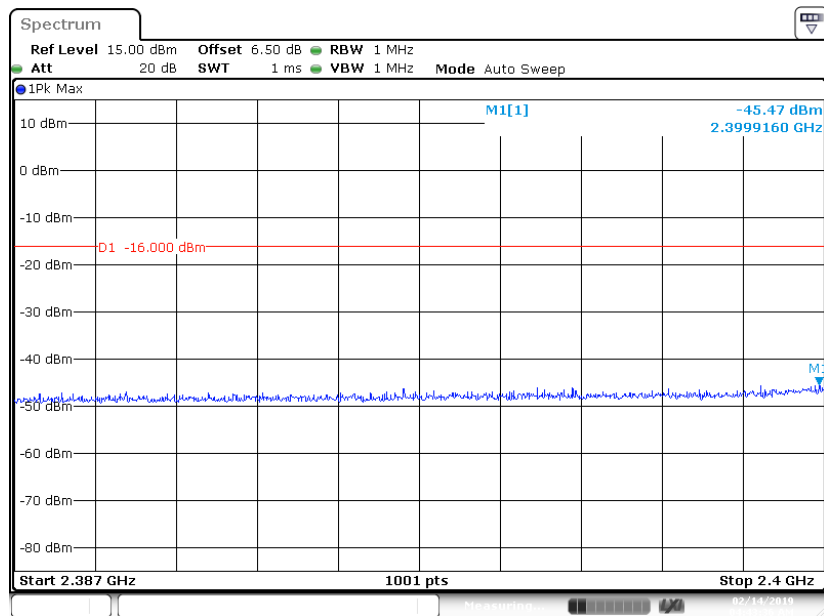
Middle Channel 30MHz~1GHz



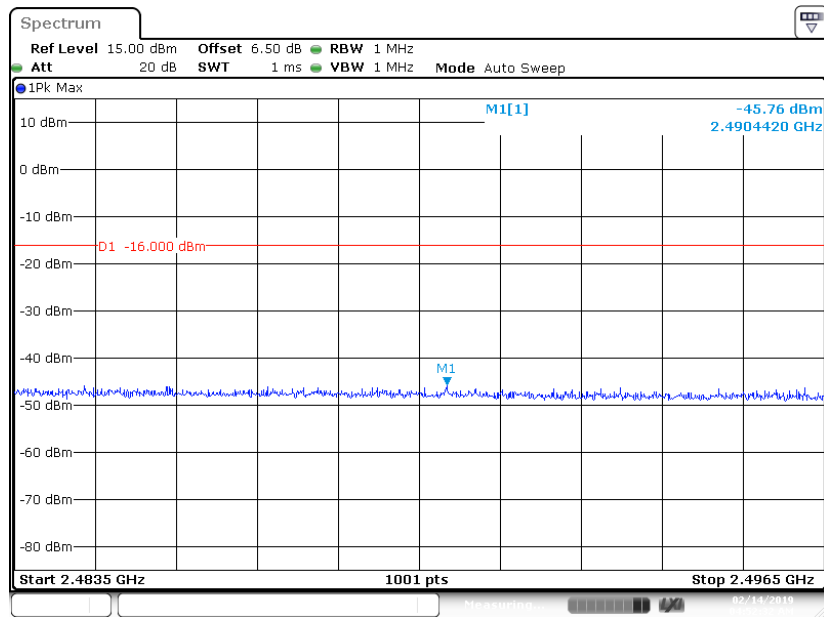
Middle Channel 1GHz~2387MHz



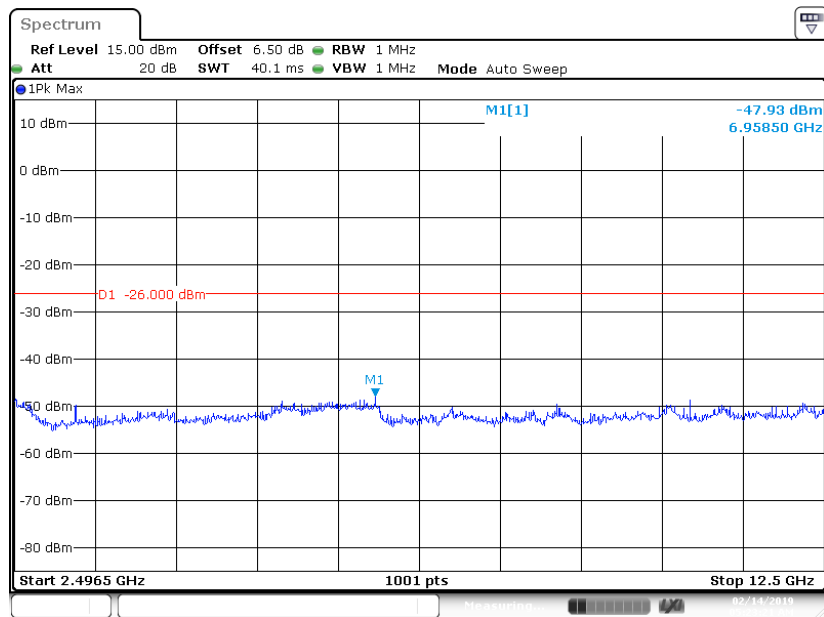
Middle Channel 2387MHz~2400MHz



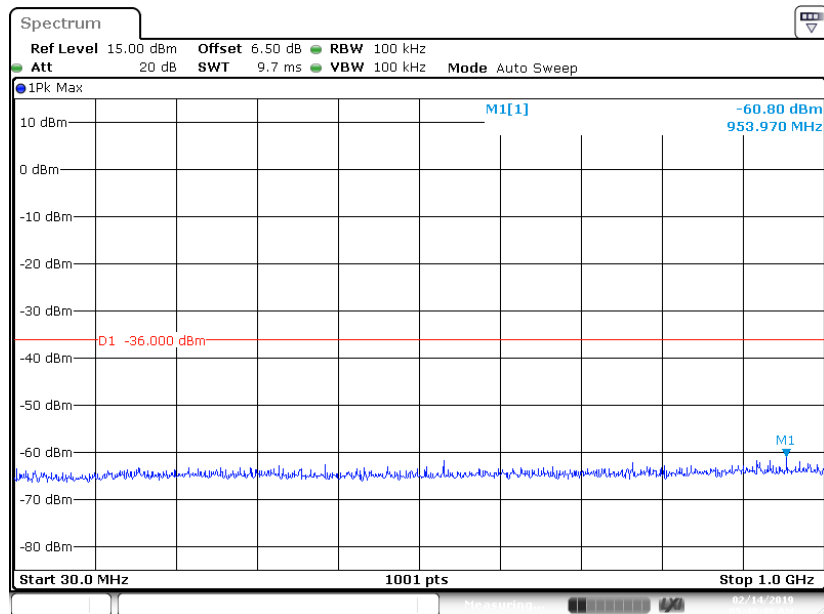
Middle Channel 2483.5MHz ~2496.5MHz



Middle Channel 2496.5MHz ~12500MHz

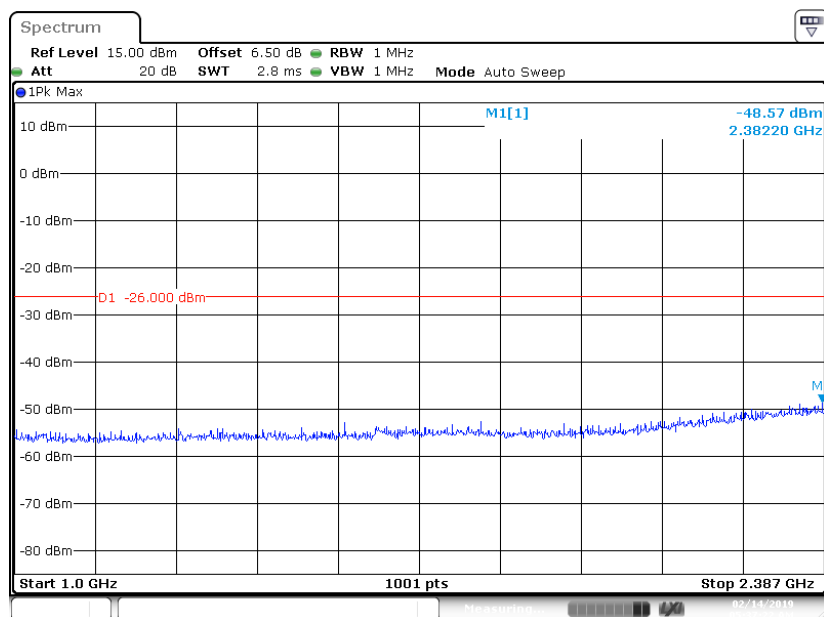


High Channel 30MHz~1GHz



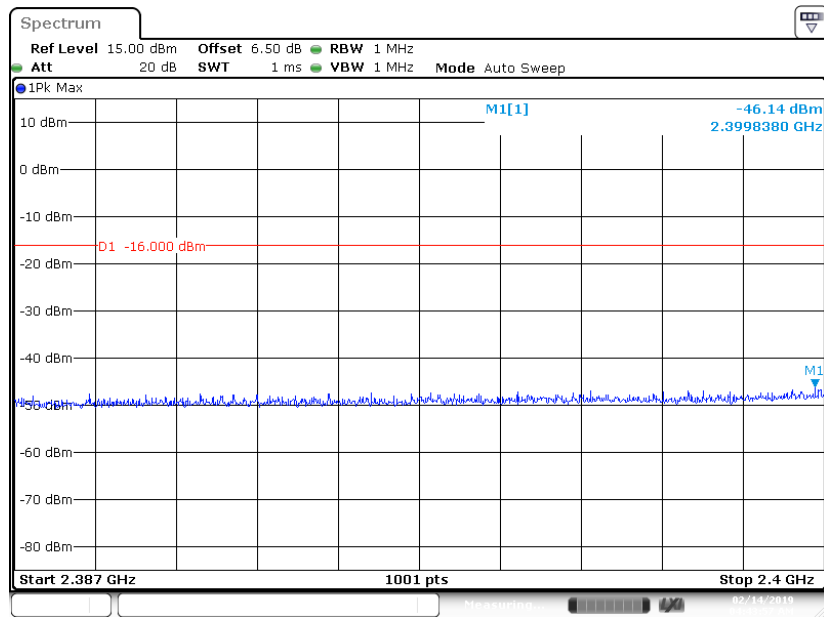
Date: 14 FEB 2019 05:48:49

High Channel 1GHz~2387MHz

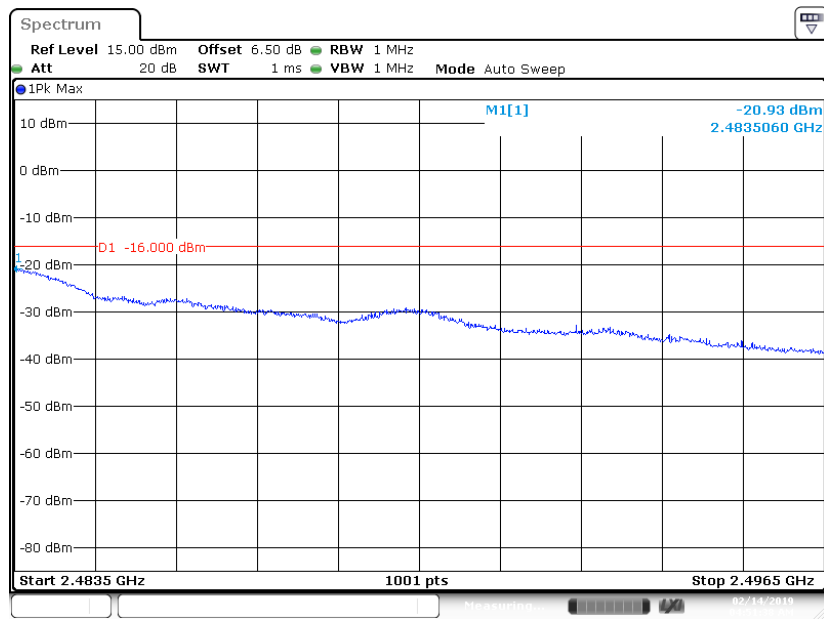


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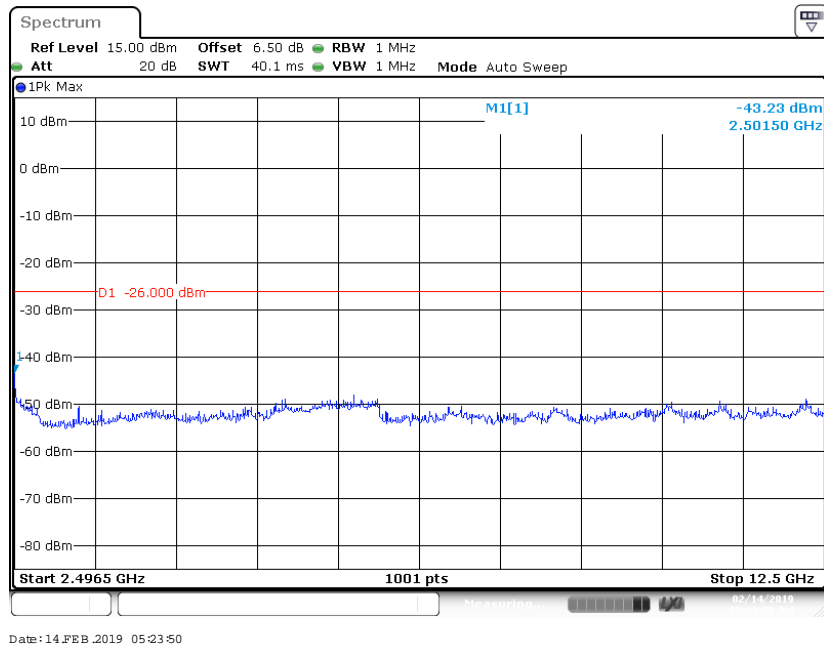
High Channel 2387MHz~2400MHz



High Channel 2483.5MHz~2496.5MHz

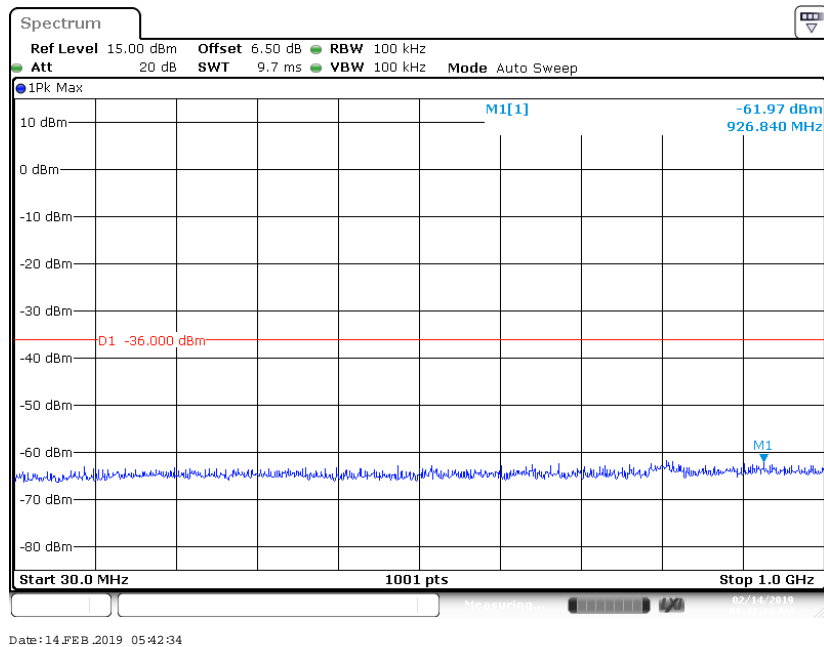


High Channel 2496.5MHz~12500MHz

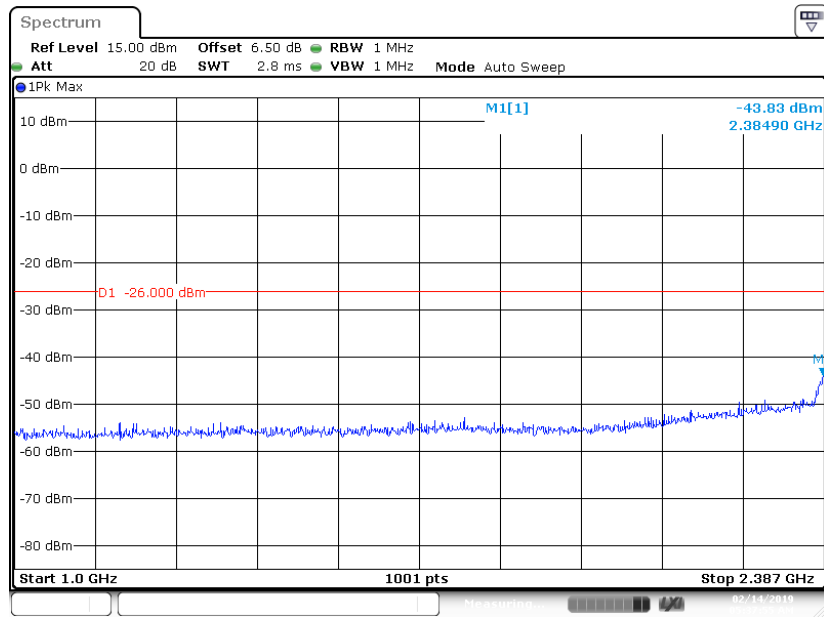


802.11n-HT40

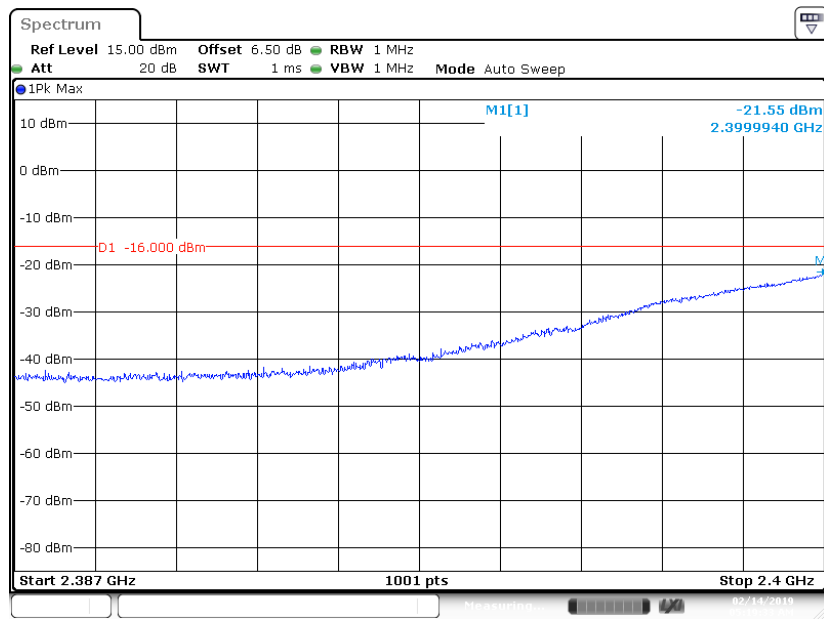
Low Channel 30MHz~1GHz



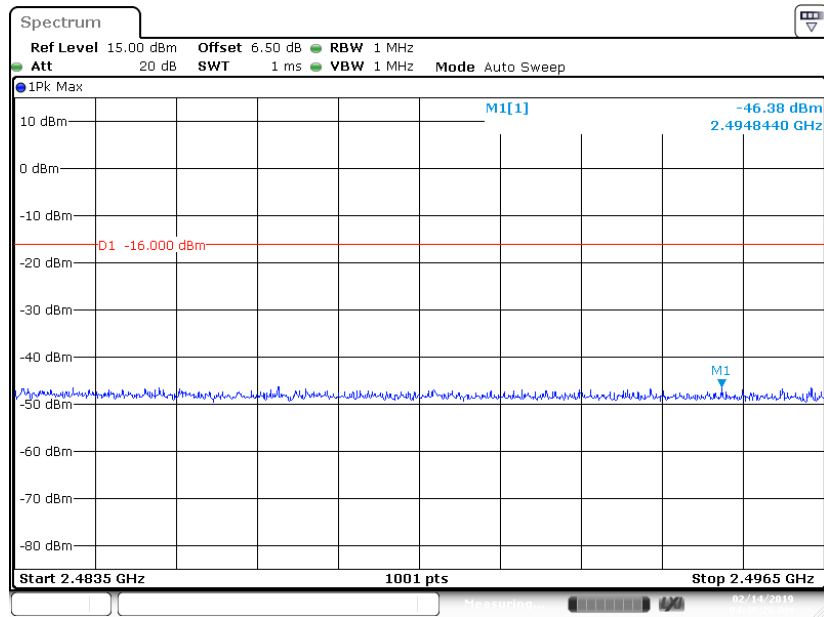
Low Channel 1GHz~2387MHz



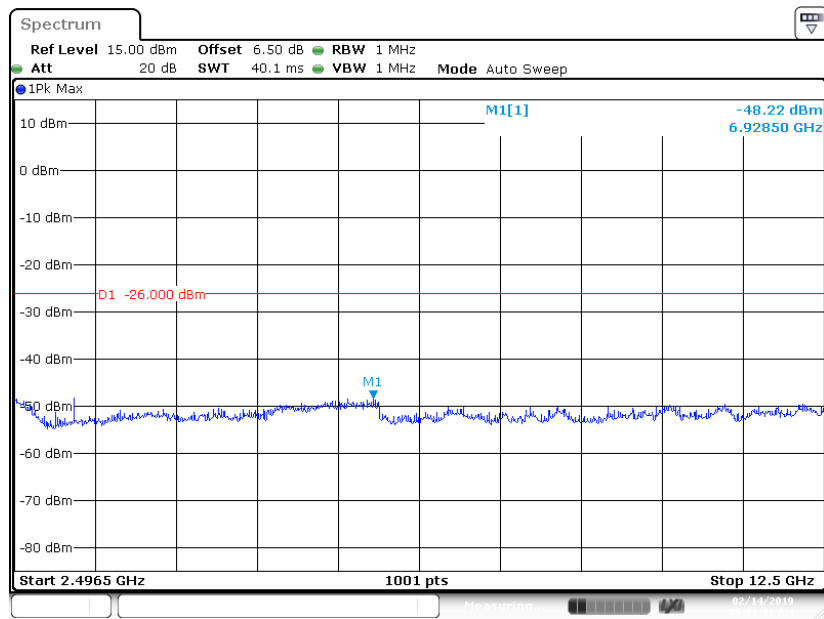
Low Channel 2387MHz~2400MHz



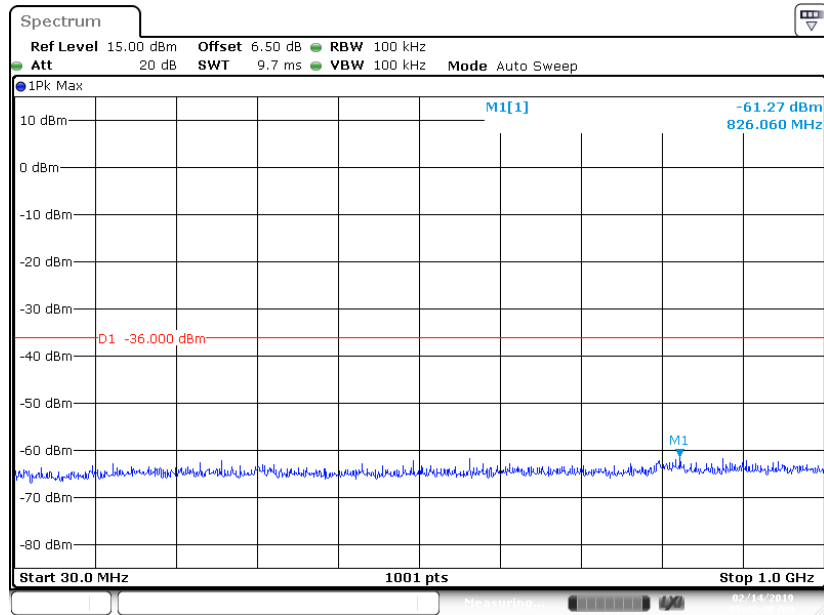
Low Channel 2483.5MHz~2496.5MHz



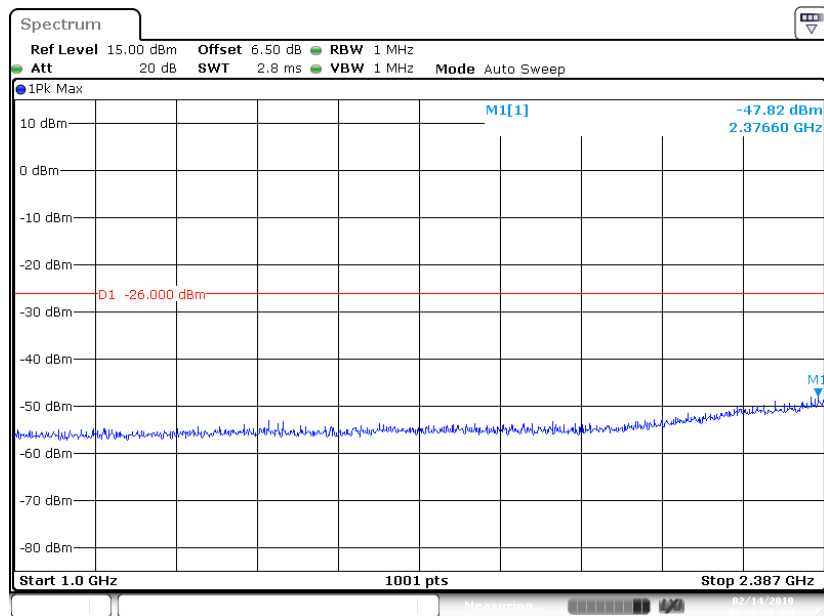
Low Channel 2496.5MHz~12500MHz



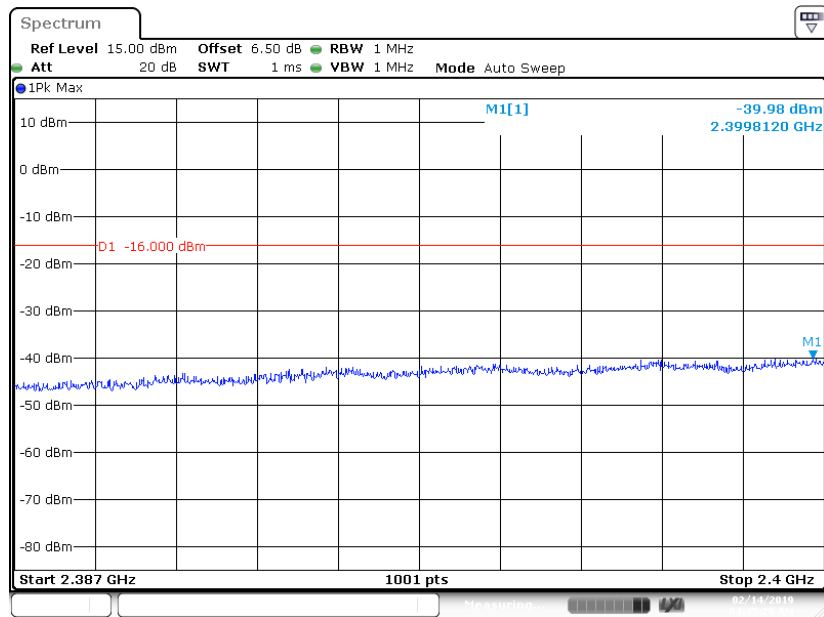
Middle Channel 30MHz~1GHz



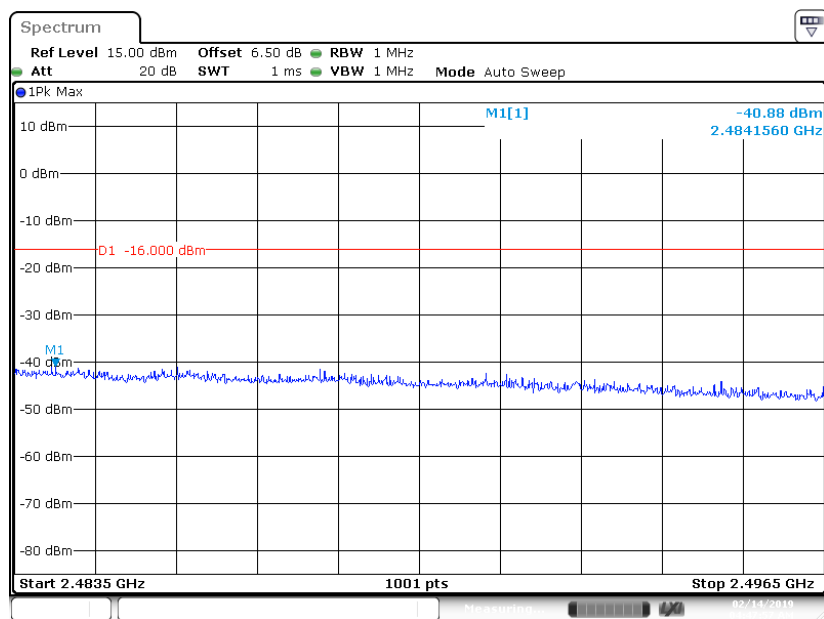
Middle Channel 1GHz~2387MHz



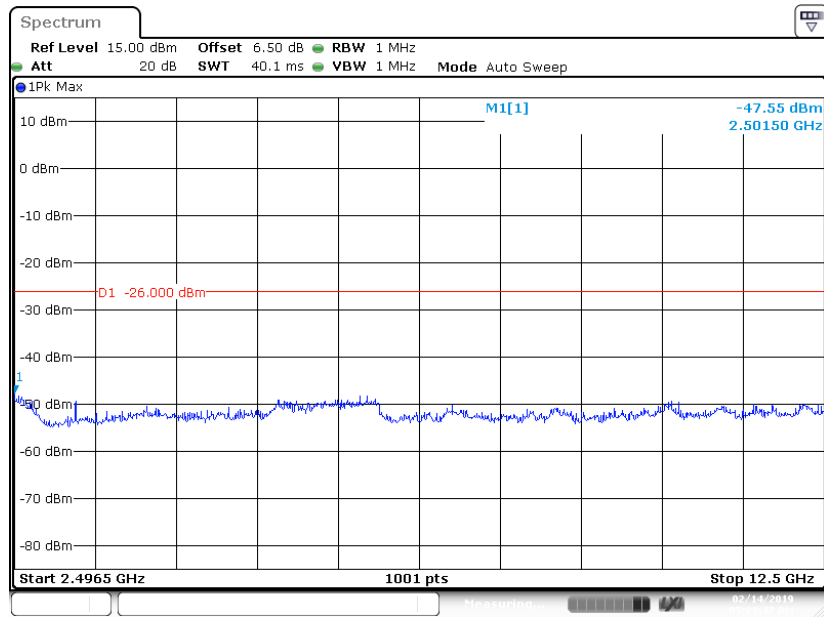
Middle Channel 2387MHz ~2400MHz



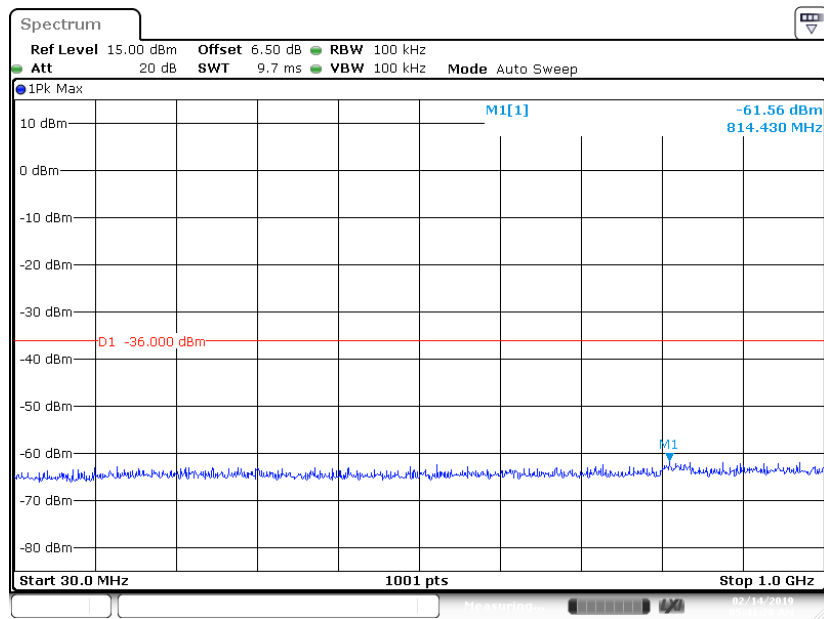
Middle Channel 2483.5MHz ~2496.5MHz



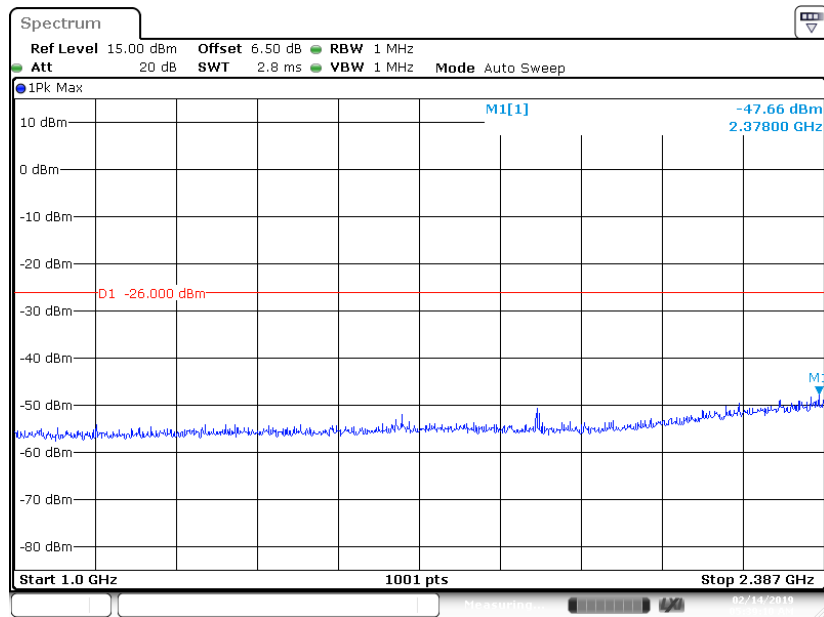
Middle Channel 2496.5MHz~12500MHz



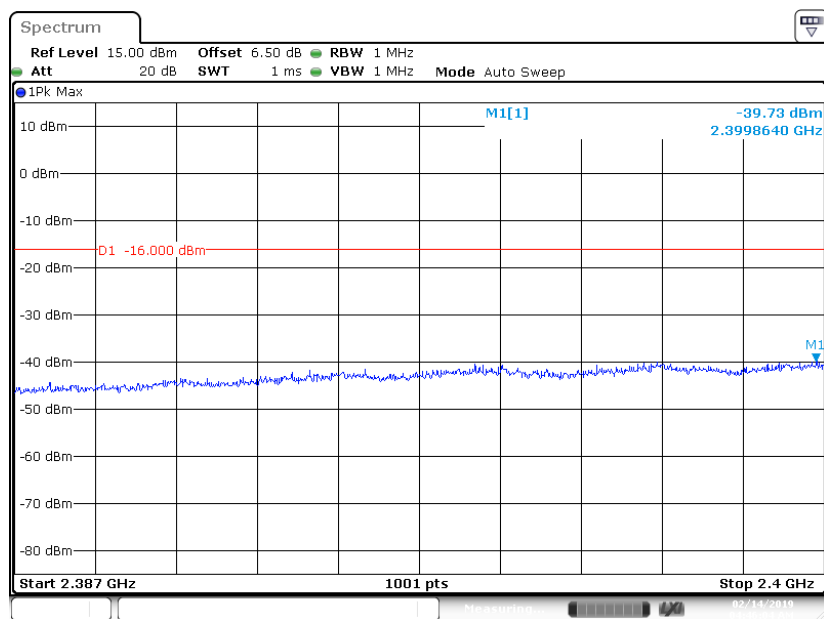
High Channel 30MHz~1GHz



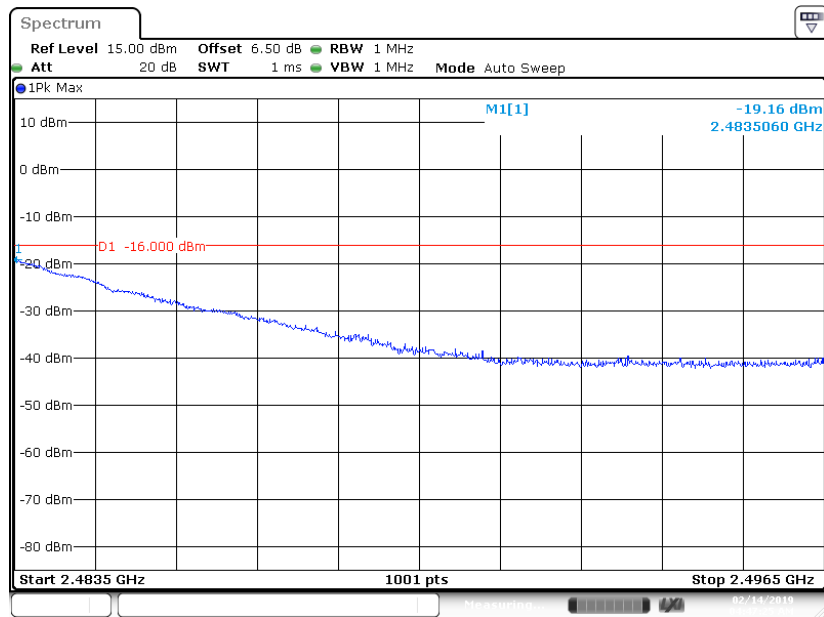
High Channel 1GHz ~2387MHz



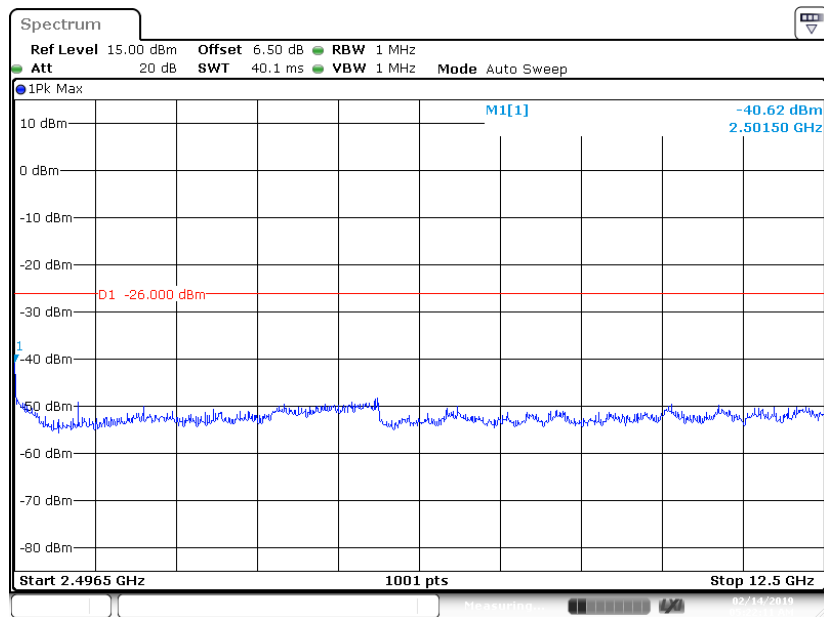
High Channel 2387MHz ~2400MHz



High Channel 2483.5MHz~2496.5MHz



High Channel 2496.5MHz~12500MHz



ANTENNA OUTPUT POWER, ANTENNA POWER TOLERANCE AND TRANSMISSION ANTENNA GAIN

Limit

- $\leq 3 \text{ mW/MHz}$ (FHSS from 2402-2480 MHz)
- $\leq 10 \text{ mW/MHz}$ (OFDM, DSSS from 2400-2483.5 MHz)
- $\leq 5 \text{ mW/MHz}$ ($26\text{MHz} < \text{OBW} \leq 38\text{MHz}$)
- $\leq 10 \text{ mW}$ (other from 2400-2483.5 MHz)

The Output Power Tolerance must be within +20%, -80%.

E.i.r.p:

- $\leq 12.14\text{dBm/MHz}$ (OFDM, DS from 2400-2483.5MHz)

Test Procedure

For FHSS UUT:

Connect the UUT to the spectrum analyser and use the following settings:

- Frequency to measure (2402 MHz, 2441MHz, and 2480MHz)
- RBW: 1MHz
- VBW: 1MHz
- Span: Wide enough to cover the complete power envelope of the signal of the UUT.
- Detector: Average (see note).
- Trace Mode: Max Hold.

For OFDM, DSSS UUT:

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: The centre frequency of the channel under test.
- RBW: 1 MHz.
- VBW: 1 MHz.
- Span: Wide enough to cover the complete power envelope of the signal of the UUT.
- Detector: Peak.
- Trace Mode: Max Hold.

Step 2:

When the trace is complete, find the peak value of the power envelope and record the frequency.

Step 3:

Make the following changes to the settings of the spectrum analyser:

- Centre Frequency: Equal to the frequency recorded in step 2.
- Span: 3 MHz.
- RBW: 1 MHz.
- VBW: 1 MHz.
- Detector: Average (see note).
- Trace Mode: Max Hold.

For other UUT:

Make the following changes to the settings of the spectrum analyser:

- Centre Frequency: The centre frequency of the channel under test.
- Span: 5MHz.
- RBW: 3 MHz.
- VBW: 10 MHz.
- Detector: Peak
- Trace Mode: Max Hold.

NOTE: The detector mode "Average" is often referred to as "RMS Average" or "Sample" but do not use Video Average.

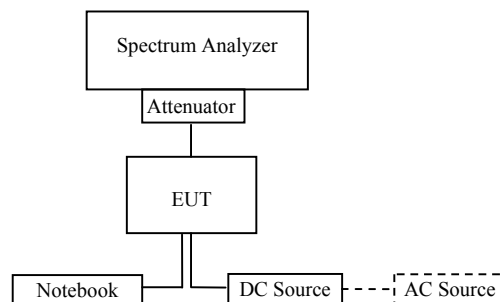
When the trace is complete, capture the trace, for example using the "View" option on the spectrum analyser. For Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as D.

D shall be recorded in the test report.

The maximum PD, which is e.i.r.p. PSD (spectral density power) or power, is calculated from the above measured value D, and the applicable antenna assembly gain "G" in dBi, according to the formula below. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$PD = D + G$$

Test Setup Block diagram



Test Data

Environmental Conditions

Temperature:	23.2°C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Compliant*Test Mode: Transmitting*

Frequency (MHz)	2412			2442			2472			Limit
Voltage(V _{DC})	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11b Mode										
Antenna Output Power (dBm/MHz)	8.96	9.00	9.05	8.81	8.83	8.86	8.60	8.64	8.69	10dBm/MHz
EIRP (dBm/MHz)	11.94	11.98	12.03	11.79	11.81	11.84	11.58	11.62	11.67	12.14dBm/MHz
Declared Power (mW/MHz)	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	/
Antenna Output Power (mW/MHz)	7.87	7.94	8.04	7.60	7.64	7.69	7.24	7.31	7.40	10mW/MHz
Antenna Output Power Tolerance(%)	-1.62	-0.71	0.44	-4.96	-4.52	-3.86	-9.45	-8.61	-7.55	+20% ~ -80%
802.11g Mode										
Antenna Output Power (dBm/MHz)	3.24	3.27	3.31	2.52	2.55	2.59	2.73	2.77	2.81	10dBm/MHz
EIRP (dBm/MHz)	6.22	6.25	6.29	5.50	5.53	5.57	5.71	5.75	5.79	12.14dBm/MHz
Declared Power (mW/MHz)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	/
Antenna Output Power (mW/MHz)	2.11	2.12	2.14	1.79	1.80	1.82	1.87	1.89	1.91	10mW/MHz
Antenna Output Power Tolerance(%)	5.43	6.16	7.14	-10.68	-10.06	-9.22	-6.25	-5.38	-4.51	+20% ~ -80%
802.11n-HT20 Mode										
Antenna Output Power (dBm/MHz)	1.53	1.55	1.56	1.09	1.13	1.14	0.89	0.90	0.92	10dBm/MHz
EIRP (dBm/MHz)	4.51	4.53	4.54	4.07	4.11	4.12	3.87	3.88	3.90	12.14dBm/MHz
Declared Power (mW/MHz)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	/
Antenna Output Power (mW/MHz)	1.42	1.43	1.43	1.29	1.30	1.30	1.23	1.23	1.24	10mW/MHz
Antenna Output Power Tolerance(%)	-5.18	-4.74	-4.52	-14.31	-13.52	-13.32	-18.17	-17.98	-17.60	+20% ~ -80%

Frequency (MHz)	2422			2442			2462			Limit
Voltage(V _{DC})	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11n-HT40 Mode										
Antenna Output Power (dBm/MHz)	-4.71	-4.67	-4.64	-5.12	-5.09	-5.06	-5.11	-5.09	-5.07	6.99dBm/MHz
EIRP (dBm/MHz)	-1.73	-1.69	-1.66	-2.14	-2.11	-2.08	-2.13	-2.11	-2.09	9.13dBm/MHz
Declared Power (mW/MHz)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	/
Antenna Output Power (mW/MHz)	0.34	0.34	0.34	0.31	0.31	0.31	0.31	0.31	0.31	5mW/MHz
Antenna Output Power Tolerance(%)	-32.39	-31.76	-31.29	-38.48	-38.05	-37.62	-38.34	-38.05	-37.77	+20% ~ -80%

Note 1: Antenna Power Tolerance = (Antenna Output Power - Declared Power)/ Declared Power *100%

Note2: Antenna gain is 2.98dBi.

802.11b mode: Declared Power is 8.00mW/MHz.

802.11g mode: Declared Power is 2.00mW/MHz.

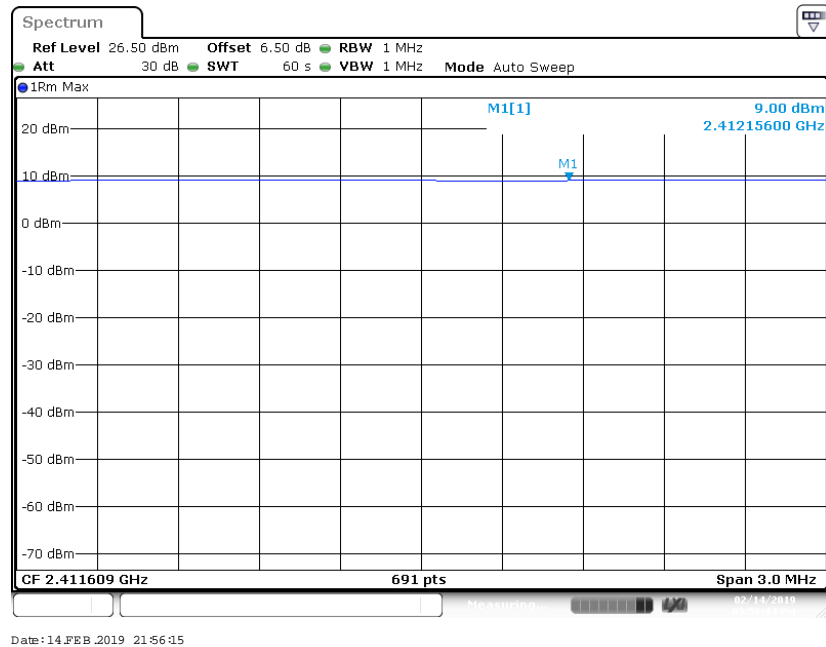
802.11n-HT20 mode: Declared Power is 1.50mW/MHz.

802.11n-HT40 mode: Declared Power is 0.50mW/MHz

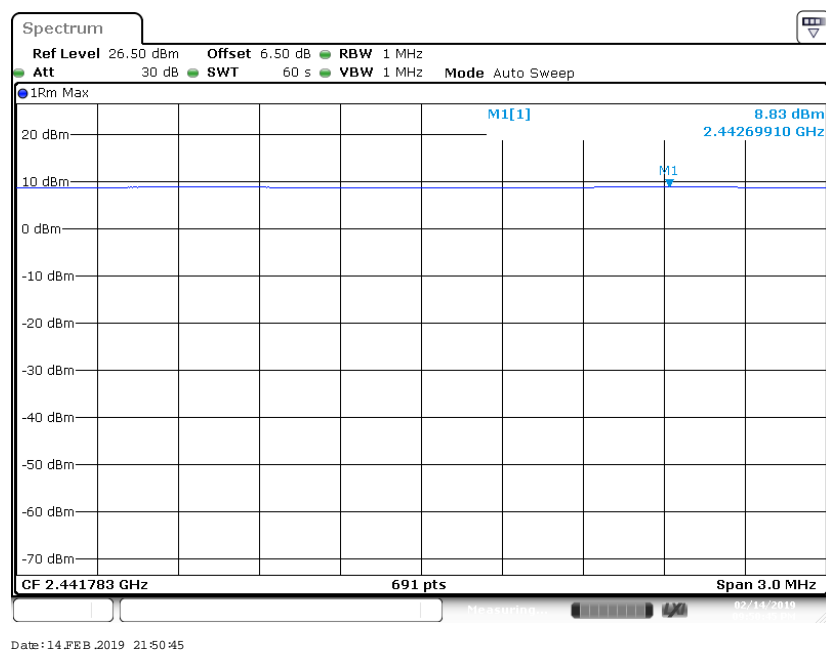
Please refer to the plots for normal voltage test.

ANTENNA OUTPUT POWER:

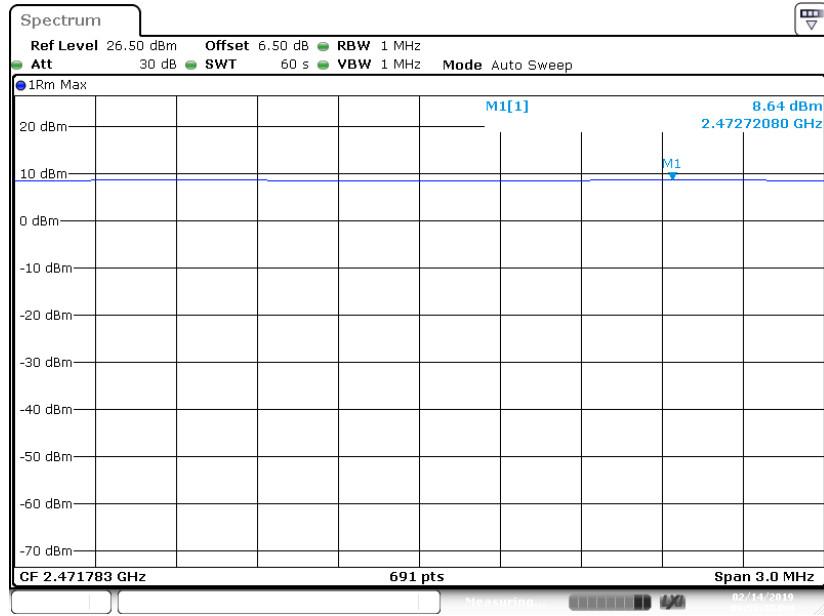
802.11b mode Test Frequency: 2412MHz



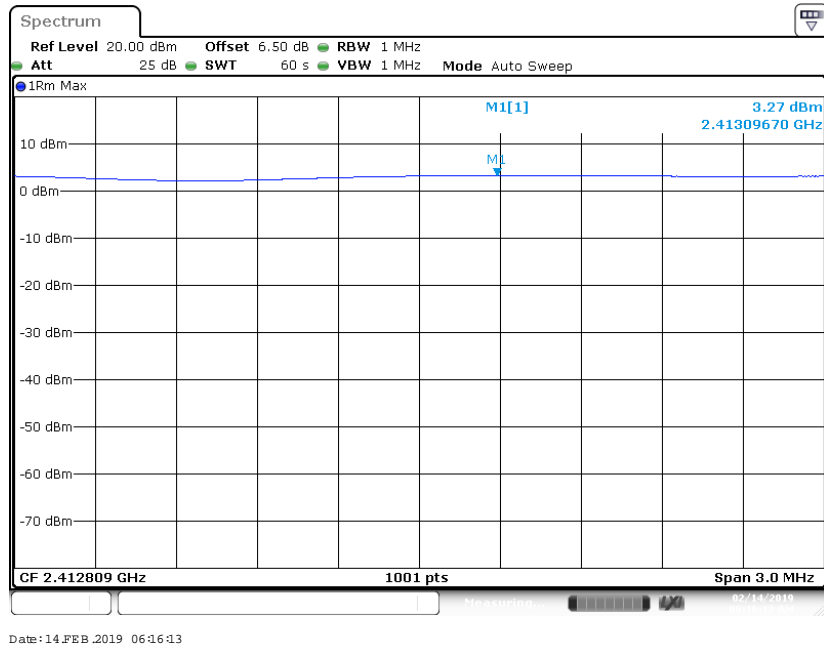
802.11b mode Test Frequency: 2442MHz



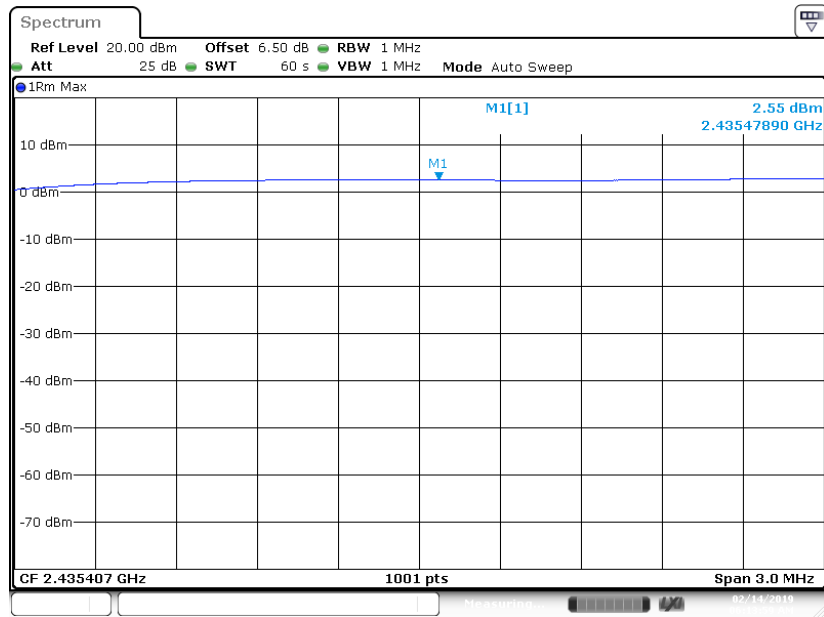
802.11b mode Test Frequency: 2472MHz



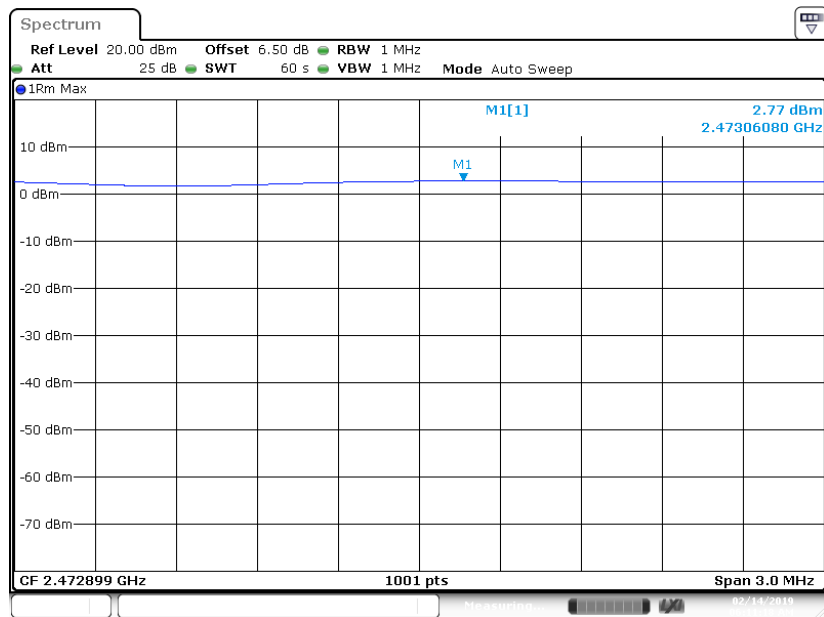
802.11g mode Test Frequency: 2412MHz



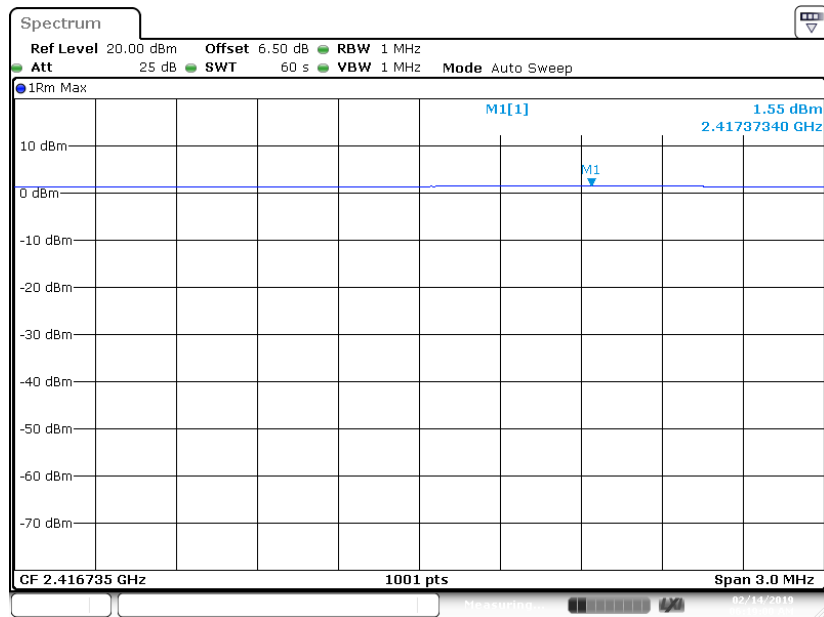
802.11g mode Test Frequency: 2442MHz



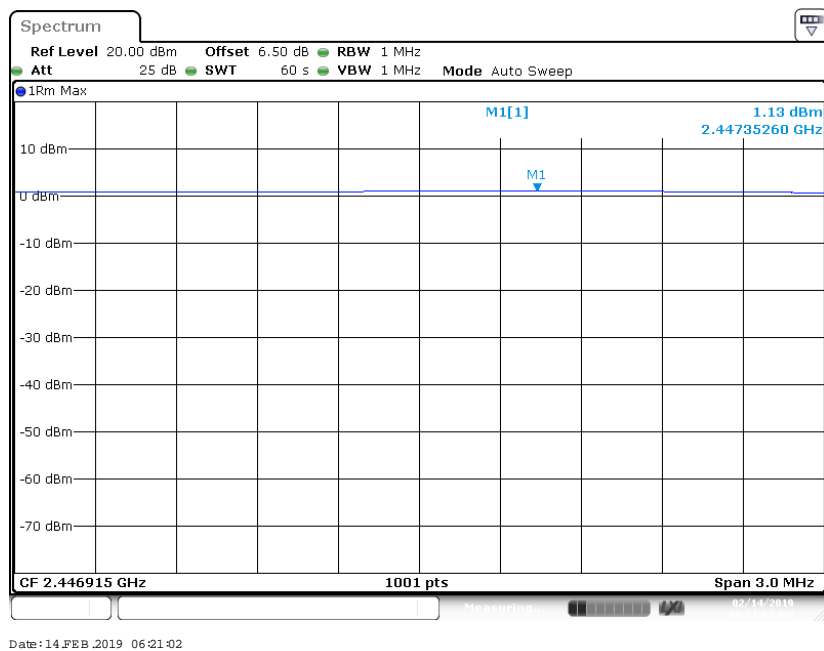
802.11g mode Test Frequency: 2472MHz



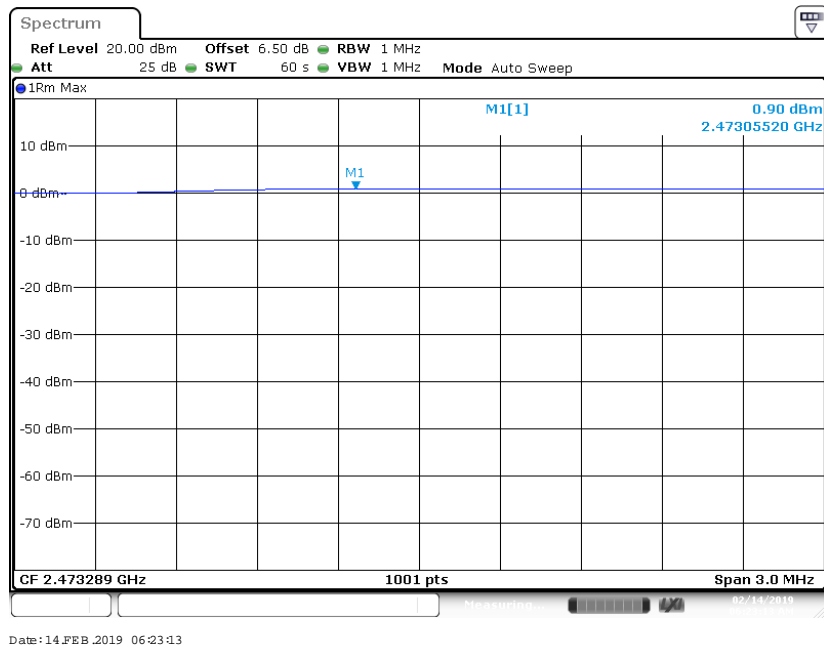
802.11n-HT20 mode Test Frequency: 2412MHz



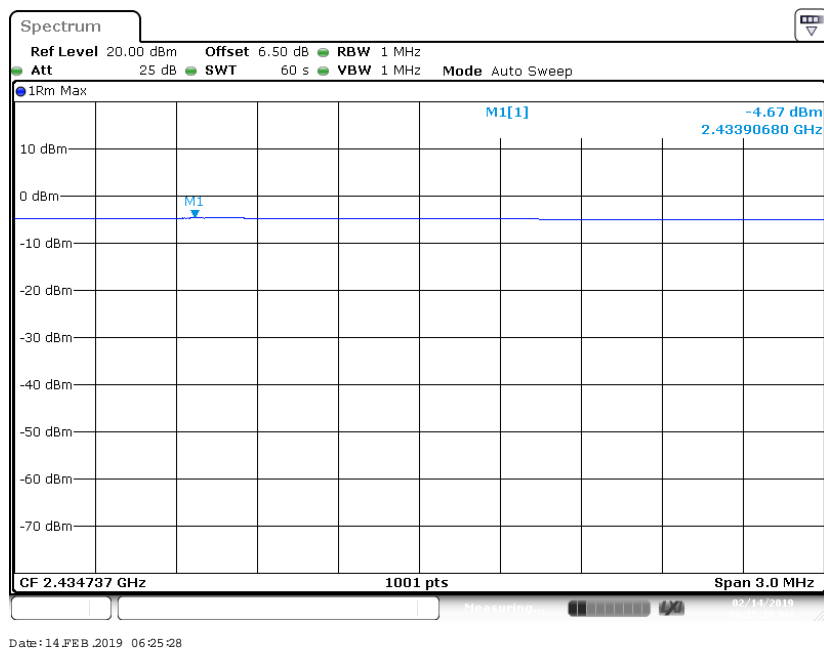
802.11n-HT20 mode Test Frequency: 2442MHz



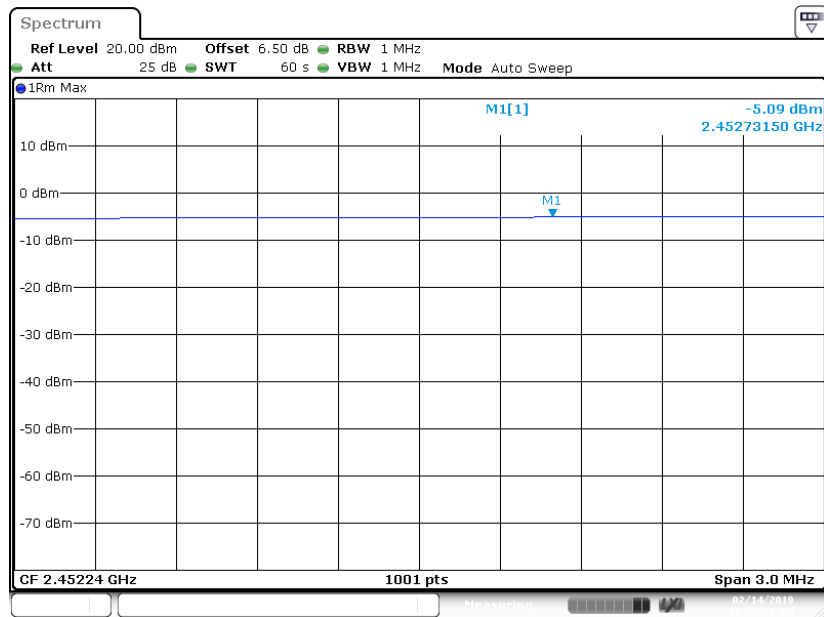
802.11n-HT20 mode Test Frequency: 2472MHz



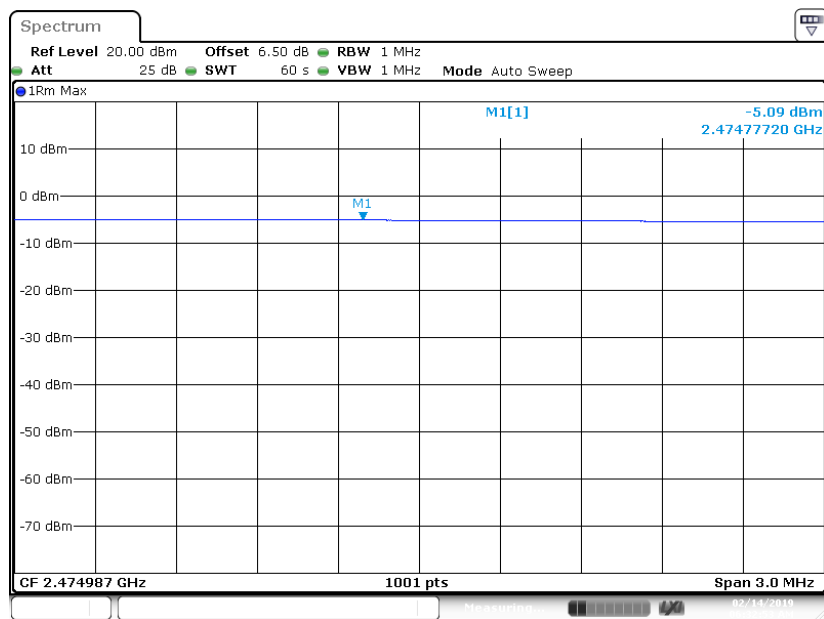
802.11n-HT40 mode Test Frequency: 2422MHz



802.11n-HT40 mode Test Frequency: 2442MHz



802.11n-HT40 mode Test Frequency: 2462MHz



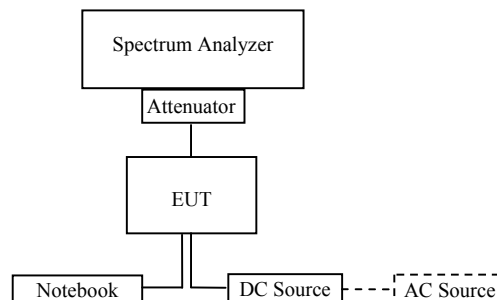
RECEIVER SPURIOUS EMISSION AND UNWANTED EMISSION INTENSITY

Limit

- $\leq 4 \text{ nW}$ ($30 \text{ MHz} \leq f \leq 1000 \text{ MHz}$)
- $\leq 20 \text{ nW}$ ($1 \text{ GHz} \leq f \leq 12.5 \text{ GHz}$)

Test Procedure

❖ Measurement System Diagram



❖ Conditions of Application Equipment (EUT)

- The modulation state shall be “continuous receiving mode”.

❖ Spectrum Analyzer Conditions

- Start Frequency: Start Frequency of frequency range to measure (30MHz or 1GHz)
- Stop Frequency: Stop Frequency of frequency range to measure (1GHz or 12.5GHz)
- Span: AUTO (Measurement Range)
- RBW: 100 kHz, VBW: 100 kHz for Frequency < 1 GHz
- RBW: 1MHz, VBW: 1MHz for Frequency > 1 GHz
- Sweep time: AUTO or more
- Sweep mode: Auto Sweep
- Detection: Positive Peak
- Reference Level: Enough level for maximum dynamic range

Measurement Result

Environmental Conditions

Temperature:	23.5 °C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Compliant

Test Mode: Receiving

Frequency (MHz)		2412 MHz			2442 MHz			2472 MHz			Limit
Voltage(V _{DC})		4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11b Mode											
Unwanted Emission Intensity	Band VI (dBm)	-81.41	-81.88	-81.03	-81.71	-81.29	-80.51	-82.78	-82.39	-83.31	-54dBm (4nW)
	Band VII (dBm)	-62.89	-63.20	-62.97	-63.89	-64.13	-64.66	-65.94	-66.00	-65.57	-47dBm (20nW)
802.11g Mode											
Unwanted Emission Intensity	Band VI (dBm)	-81.12	-81.85	-81.48	-81.06	-81.74	-81.22	-82.31	-82.25	-82.59	-54dBm (4nW)
	Band VII (dBm)	-62.83	-62.89	-63.59	-63.51	-63.96	-64.36	-66.21	-66.36	-66.07	-47dBm (20nW)
802.11n-HT20 Mode											
Unwanted Emission Intensity	Band VI (dBm)	-81.99	-81.84	-81.53	-83.10	-82.19	-82.86	-82.30	-81.72	-81.37	-54dBm (4nW)
	Band VII (dBm)	-64.05	-63.43	-62.70	-63.64	-63.93	-63.19	-65.83	-65.36	-65.44	-47dBm (20nW)

Frequency (MHz)		2422 MHz			2442 MHz			2462 MHz			Limit
Voltage(V _{DC})		4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	
802.11n-HT40 Mode											
Unwanted Emission Intensity	Band VI (dBm)	-81.18	-81.65	-81.24	-81.51	-81.47	-80.56	-82.76	-82.54	-82.58	-54dBm (4nW)
	Band VII (dBm)	-64.42	-63.60	-62.80	-63.17	-63.84	-63.04	-66.48	-65.60	-66.56	-47dBm (20nW)

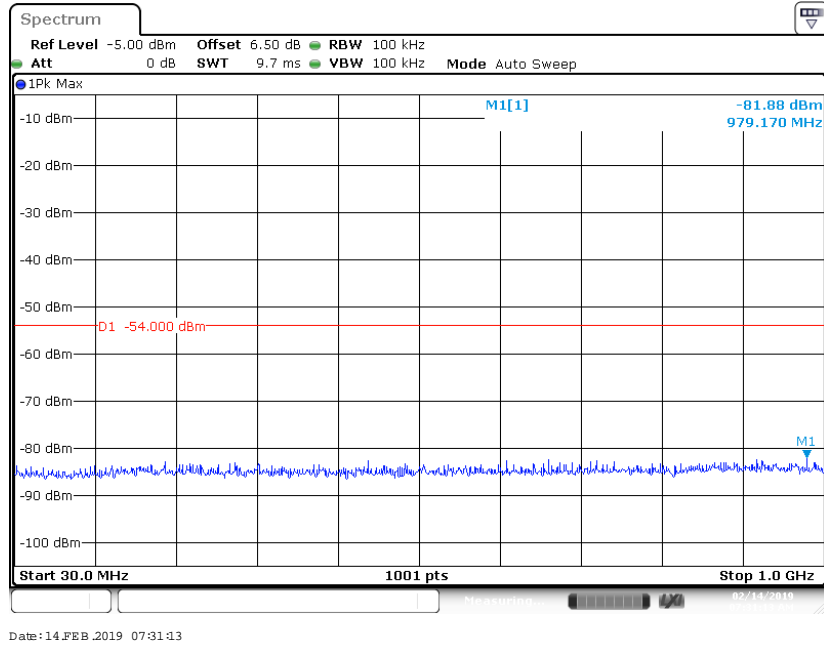
Note: Band VI:30MHz~1000MHz

Band VII:1000MHz~12500MHz

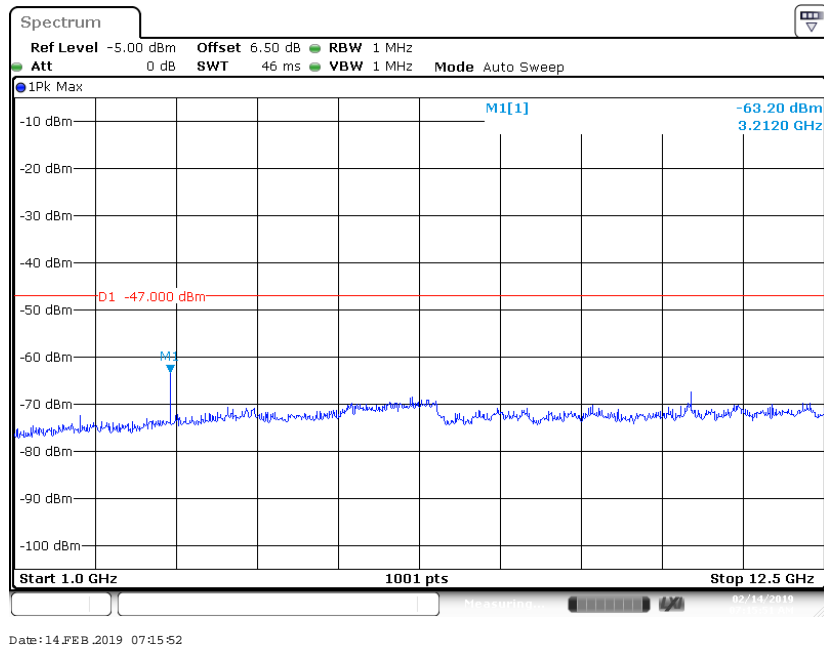
Please refer to the following plots for normal voltage:

802.11b mode

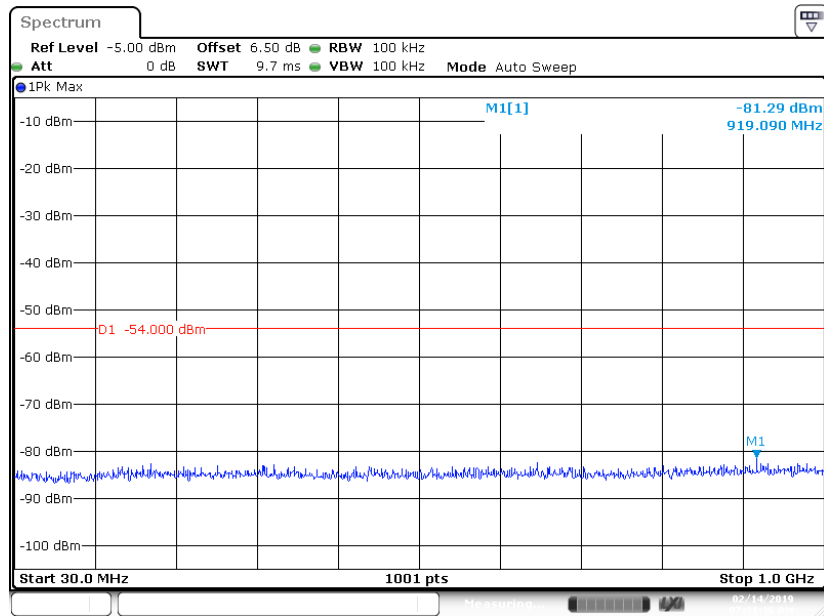
Low Channel ,30MHz~1000MHz



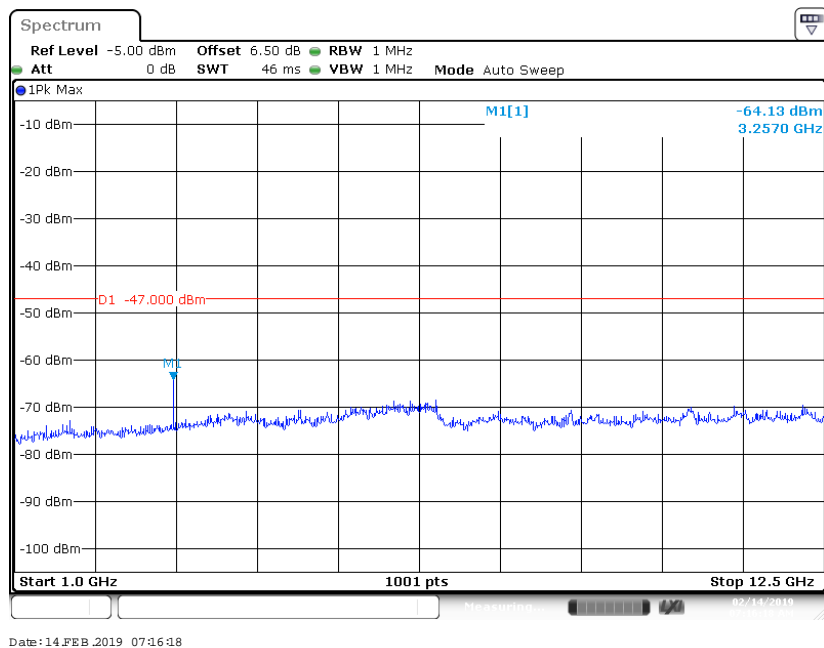
Low Channel ,1000MHz~12500MHz



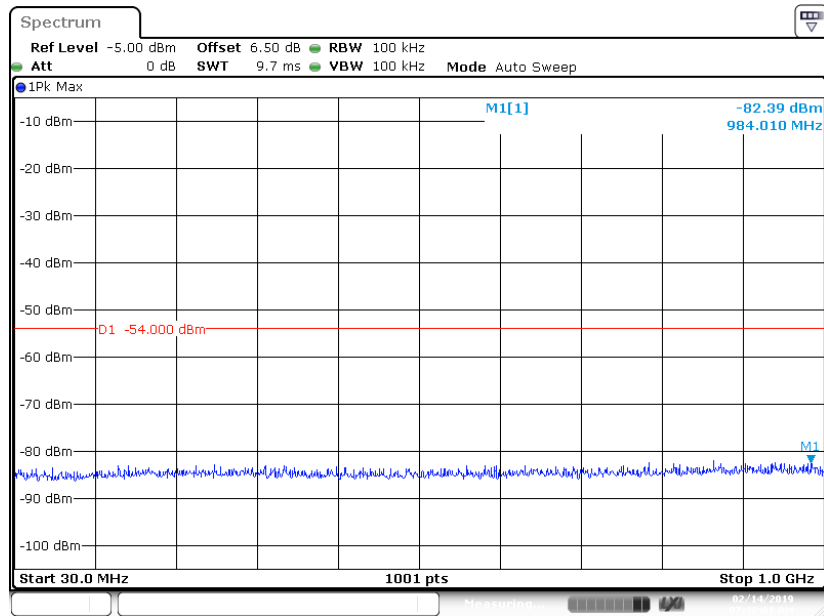
Middle Channel, 30MHz ~ 1000MHz



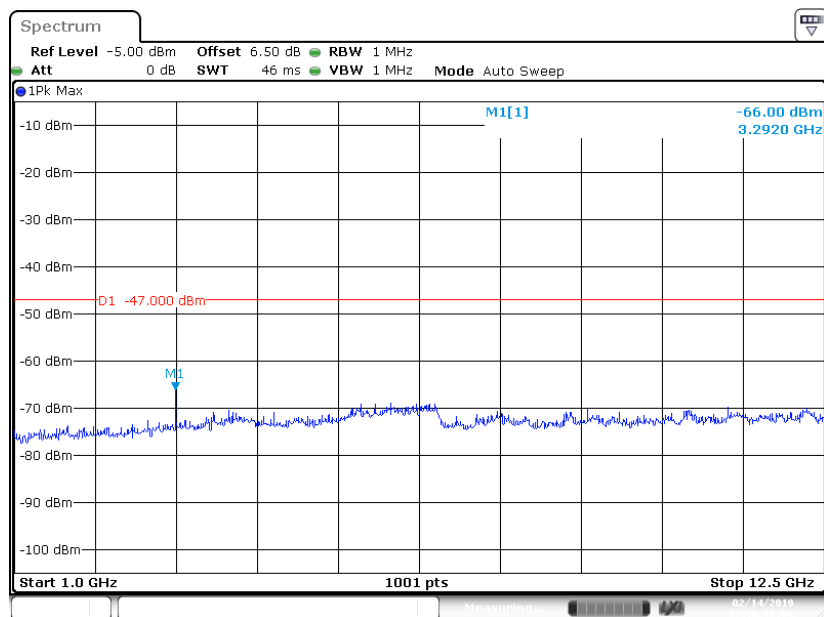
Middle Channel, 1000MHz ~ 12500MHz



High Channel ,30MHz~1000MHz

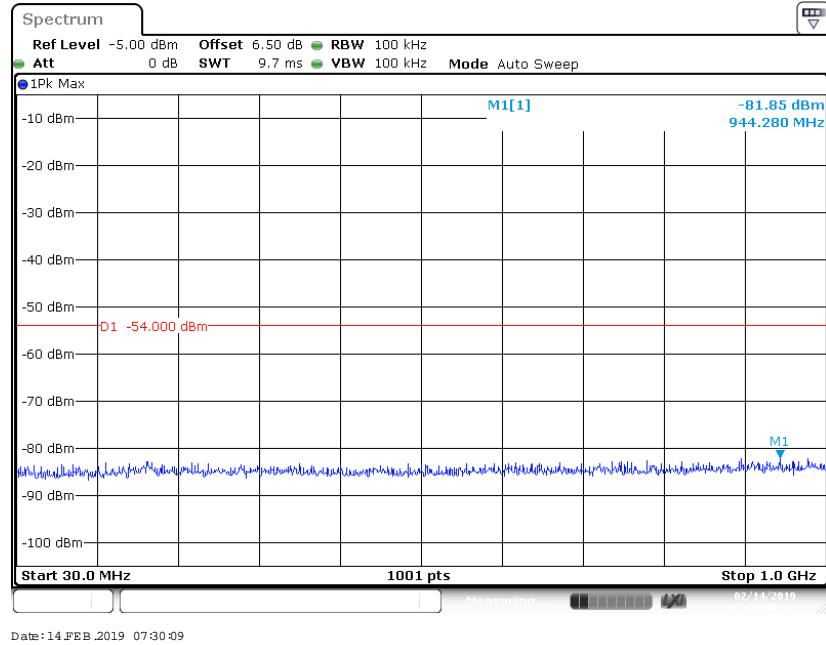


High Channel ,1000MHz~12500MHz

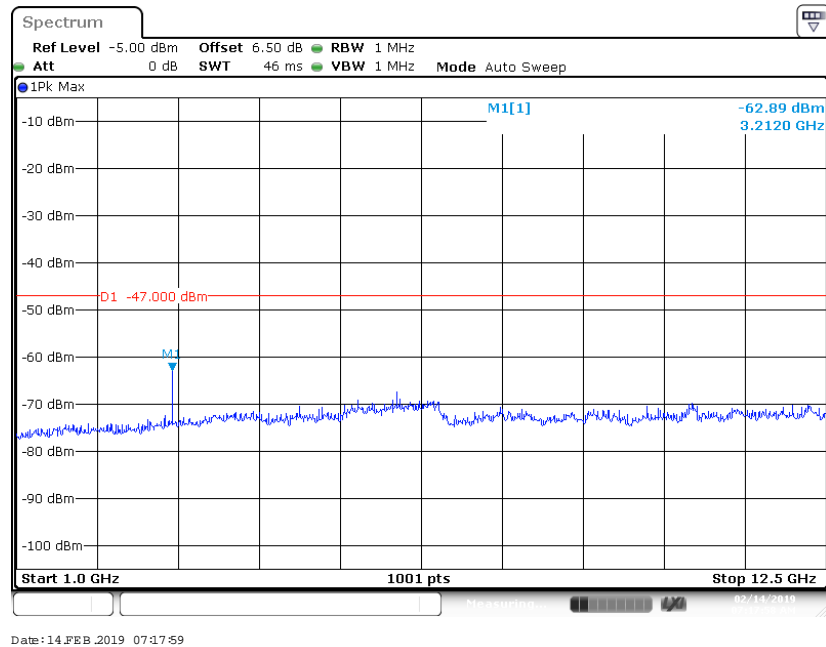


802.11g mode

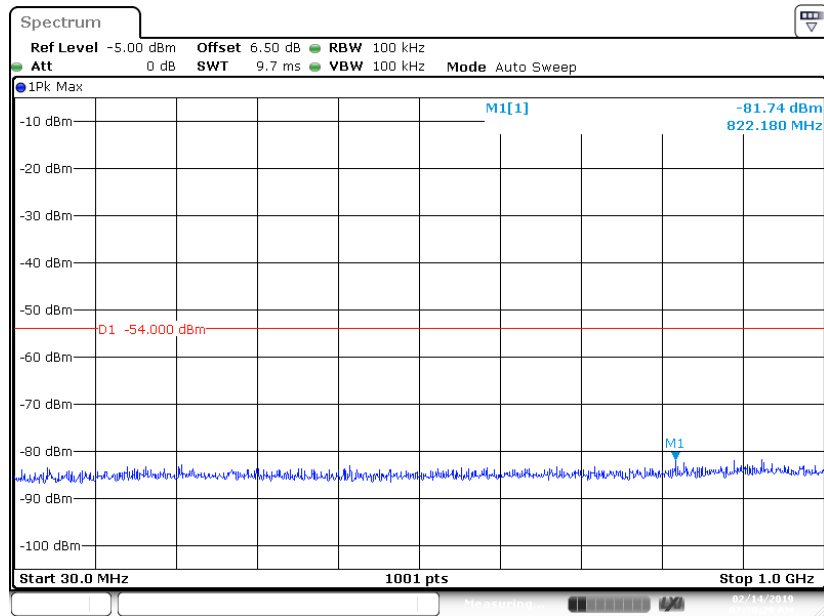
Low Channel ,30MHz~1000MHz



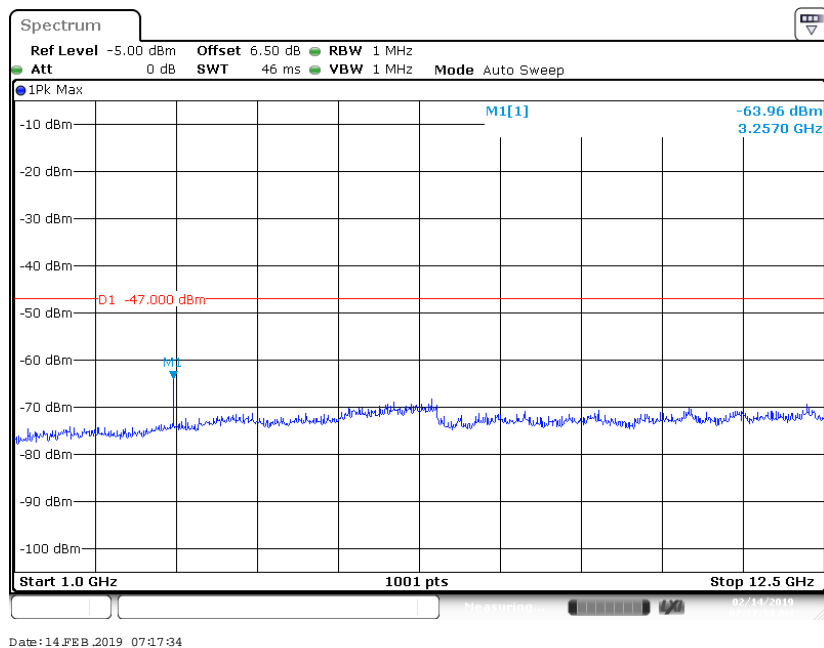
Low Channel ,1000MHz~12500MHz



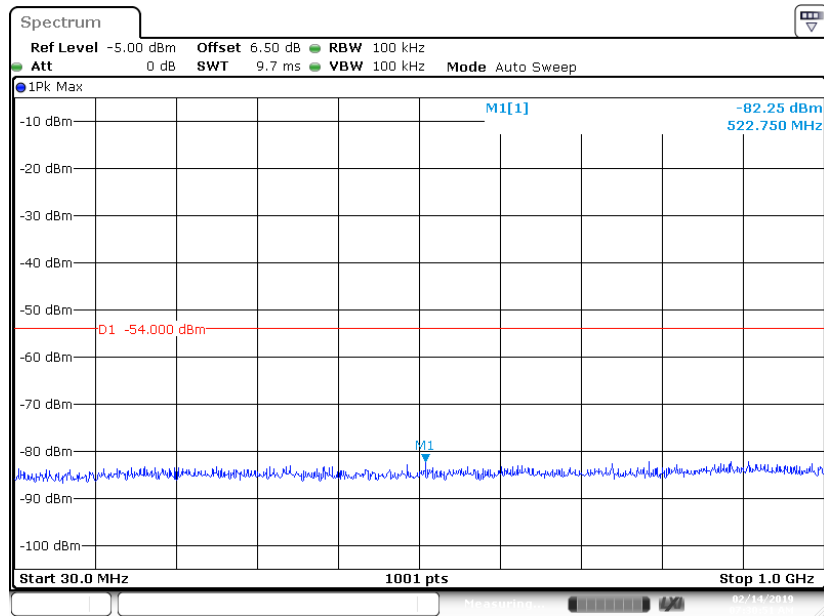
Middle Channel ,30MHz~1000MHz



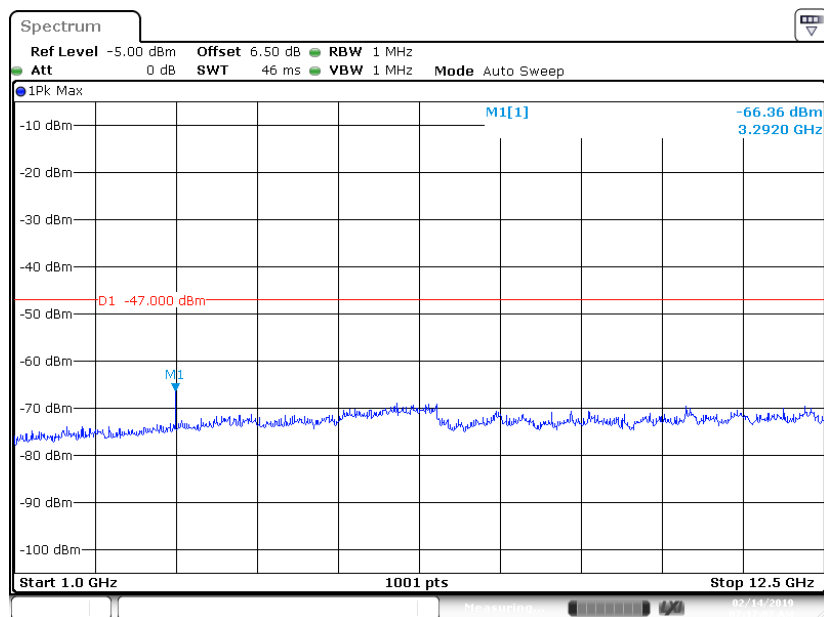
Middle Channel ,1000MHz~12500MHz



High Channel ,30MHz~1000MHz

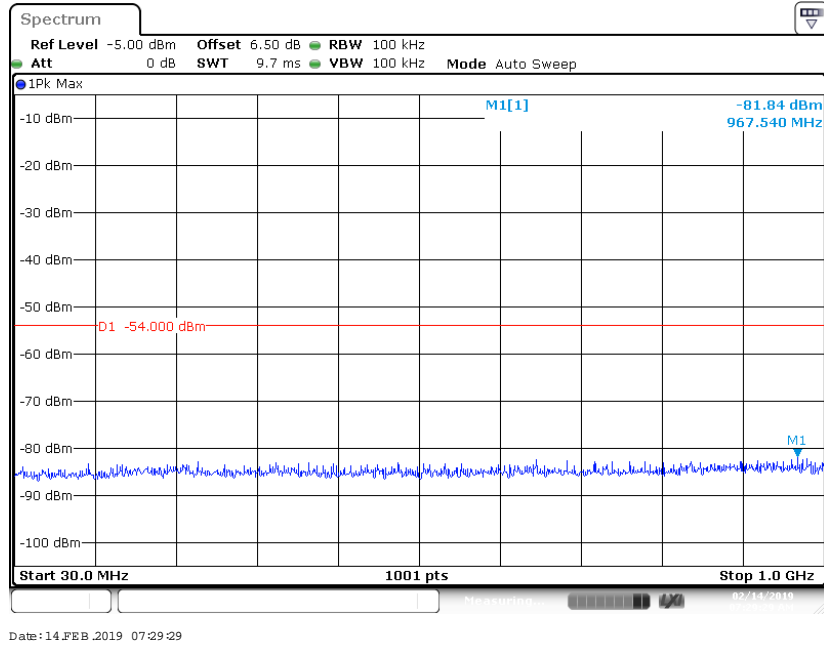


High Channel ,1000MHz~12500MHz

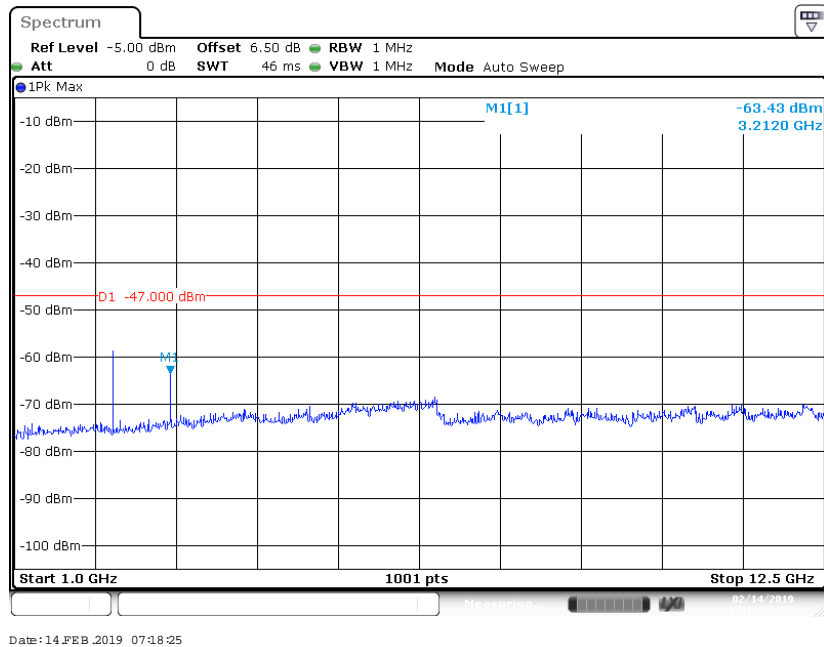


802.11n-HT20 mode

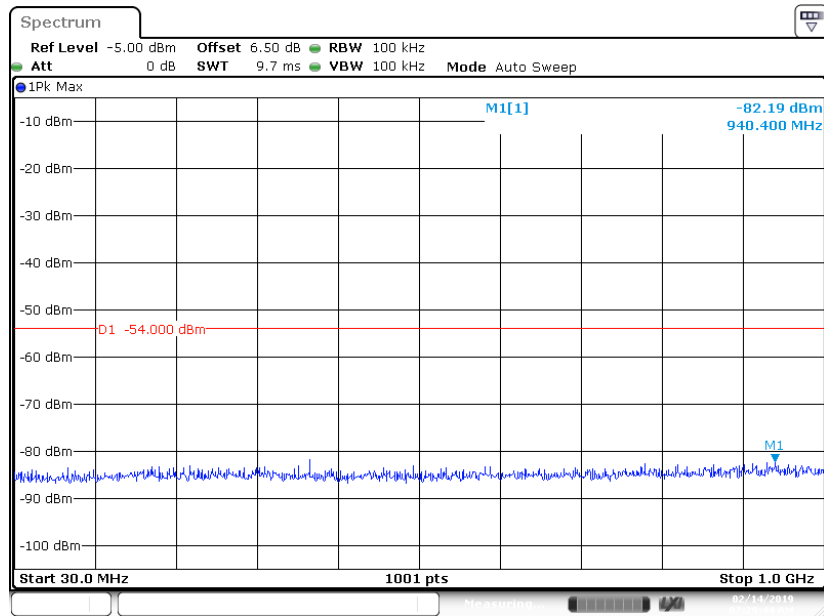
Low Channel ,30MHz~1000MHz



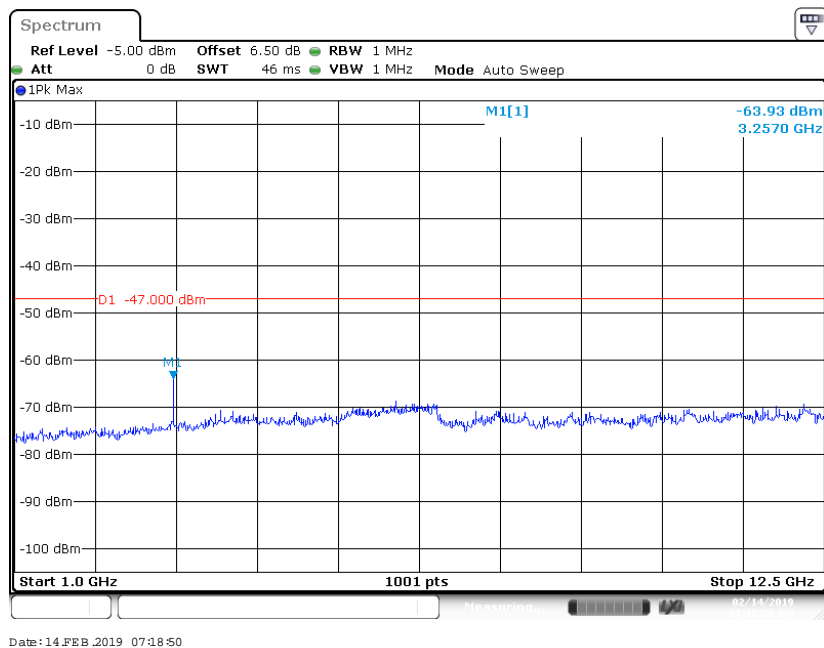
Low Channel ,1000MHz~12500MHz



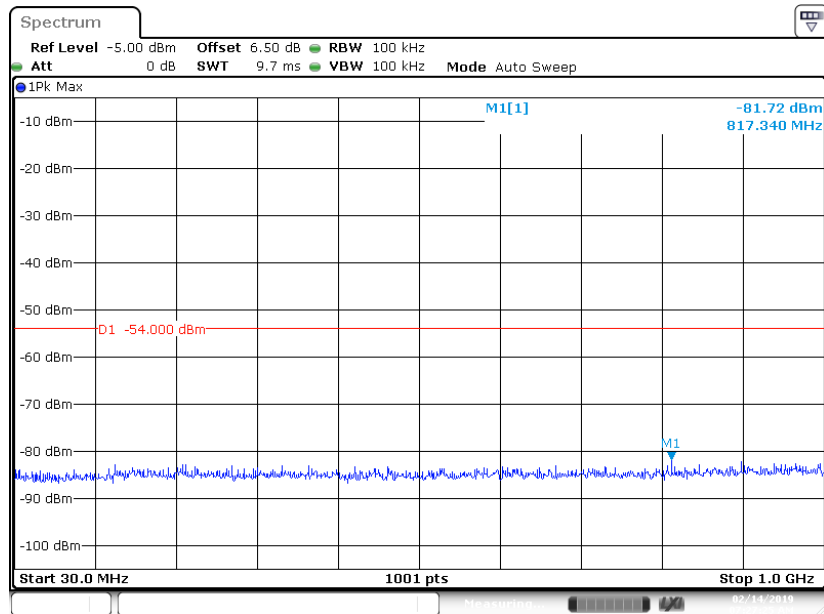
Middle Channel, 30MHz ~ 1000MHz



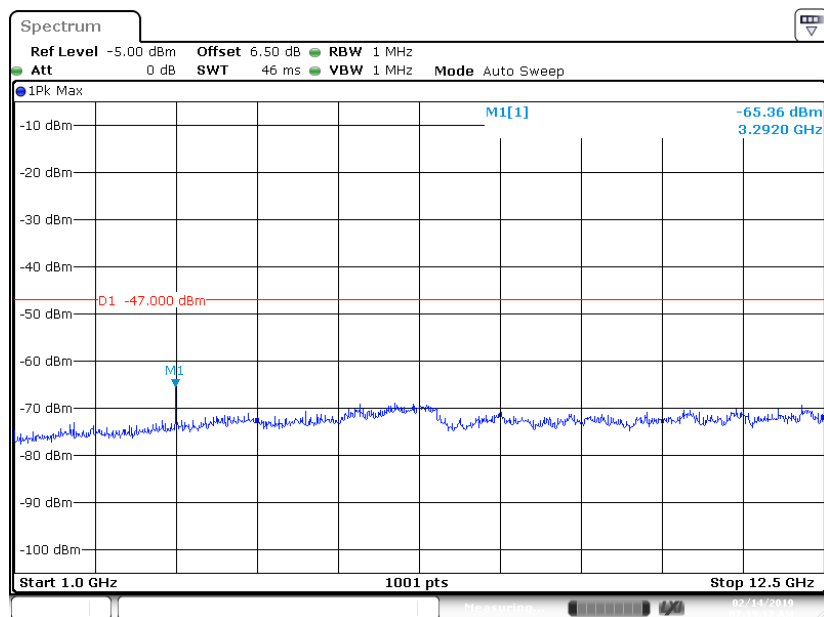
Middle Channel, 1000MHz ~ 12500MHz



High Channel ,30MHz~1000MHz

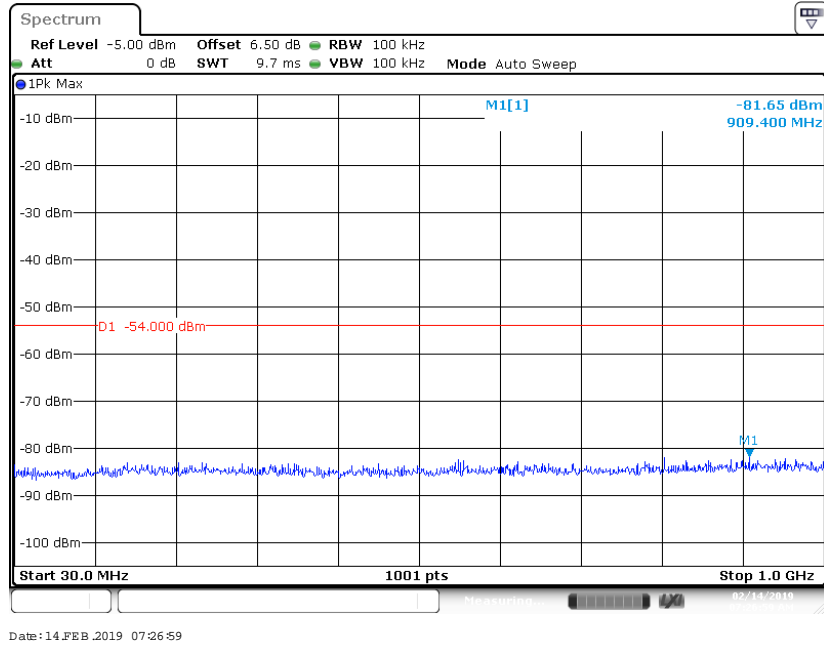


High Channel ,1000MHz~12500MHz

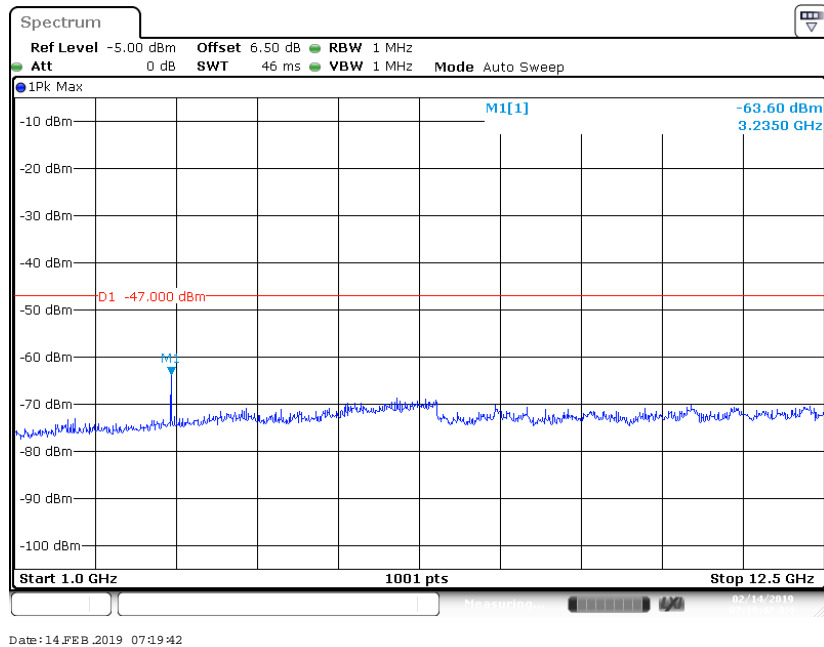


802.11n-HT40 mode

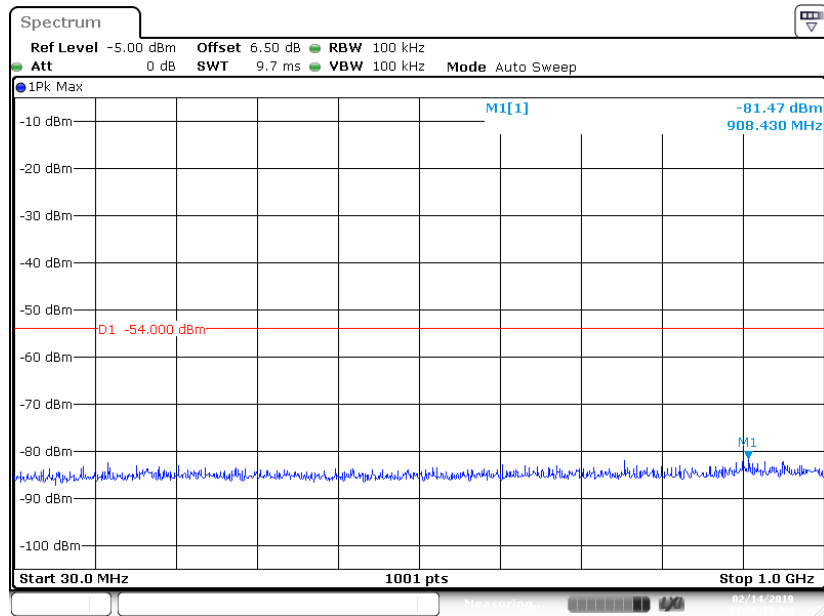
Low Channel ,30MHz~1000MHz



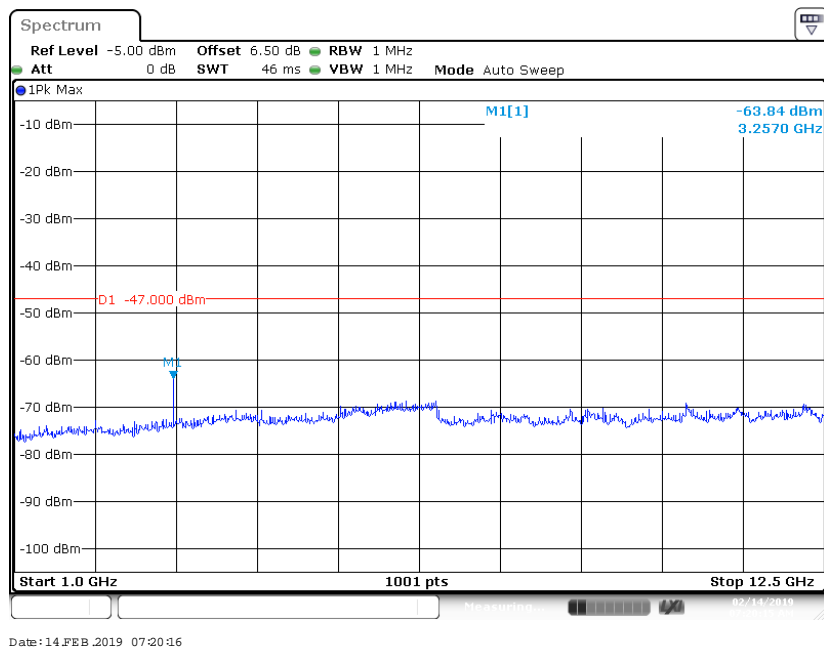
Low Channel ,1000MHz~12500MHz



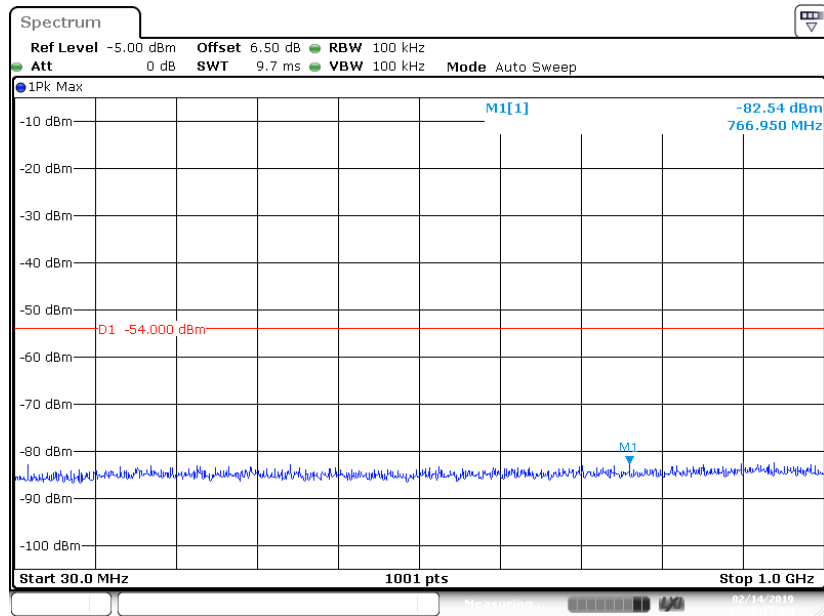
Middle Channel, 30MHz ~ 1000MHz



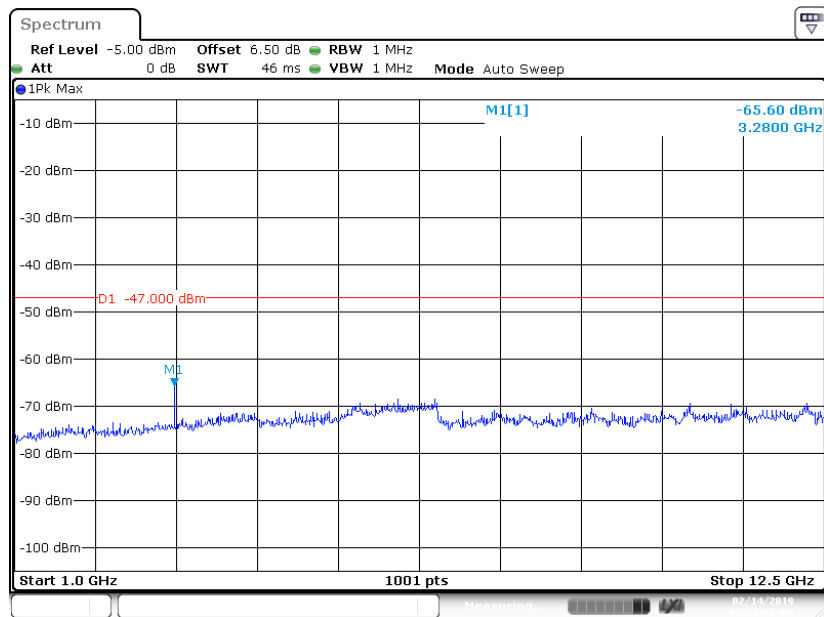
Middle Channel, 1000MHz ~ 12500MHz



High Channel ,30MHz~1000MHz



High Channel ,1000MHz~12500MHz



CARRIER SENSE CAPABILITY

Requirement

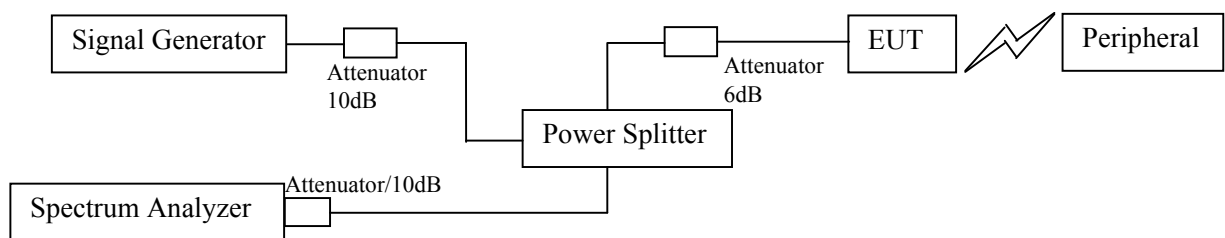
MIC Notice No.88 Appendix No.43

Article 2, Paragraph 1, Item 19 Rules Section 10

Test Procedure

1. SG adjusted the frequency as same as the EUT transmitted signal and emitted the absence of modulation from SG and power level is (on $22.79 + G - 20 \cdot \log(f) \text{ dBm}$) (G is the antenna gain is the test frequency).
2. Turn off the RF signal of the SG
3. EUT have transmitted the maximum modulation signal and fixed channelize.
4. Setting of SA: RBW/VBW=1MHz/1MHz, Span=50MHz, Sweep time=auto, Sweep mode=continuous, Detect mode=positive peak
5. SG RF signal on.
6. EUT shall be stop the transmitted any signal and SG RF signal off, the EUT will be continuous, transmitted signal.

Test Block



Test Data**Environmental Conditions**

Temperature:	23.5 °C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Pass

INTERFERENCE PREVENTION FUNCTION

Requirement

The EUT shall have the interference prevention capability to transmit or to receive the identification automatically, so that sender and receiver shall exclude other equipment.

Test Procedure

In the case that the EUT has the function of automatically transmitting the identification code:

1. Transmit the predetermined identification codes from EUT
2. Check the transmitted identification codes with the demodulator.

In the case of receiving the identification codes:

1. Transmit the predetermined identification codes from the counterpart.
2. Check if communication is normal
3. Transmit the signal other than predetermined ID codes from the counterpart.
4. Check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

Test Data

Environmental Conditions

Temperature:	23.5℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2019-02-14.

Test Result: Good.

CONSTRUCTION PROTECTION CONFIRMATION

Limit

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

Confirmation Method

The EUT is used for OEM (original equipment manufacturer) to install the final device, the high frequency section and modulation section will be protected by the host device. Please refer the external photographs.

******END OF REPORT******