

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant: Cadi Scientific Pte Ltd
31 Ubi Road 1, #07-01A Aztech Building, Singapore 408694
Product Name: SmartNODE
Brand Name: Cadi
Model No.: SMN-822W
Model Difference: N/A
Report Number: ER/2019/80073
FCC ID: VPE-SMN-822W
FCC Rule Part: §15.247, Cat: DTS
Issue Date: Oct. 17, 2019
Date of Test: Aug. 15, 2019 ~ Oct. 09, 2019
Date of EUT Received: Aug. 15, 2019

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By:

CHUN-CHIEH, CHEN

**Chun Chieh Chen /
Asst. Supervisor**



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Revision History

| Revision | Description | Issue Date | Remark |
|----------|-------------|---------------|-------------------------|
| Rev.00 | Original. | Oct. 17, 2019 | Revised by: Tiffany Kao |

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1 GENERAL INFORMATION

1.1 Product description

| | |
|-------------------|--|
| Product Name: | SmartNODE |
| Brand Name: | Cadi |
| Model No.: | SMN-822W |
| Model Difference: | N/A |
| Hardware Version: | V2.4 |
| Software Version: | V1.0 |
| Power Supply: | 3.6Vdc from Lithium Thionyl Chloride Battery |

1.2 WLAN

| Wi-Fi 802.11 | Frequency Range | Channels | Rated Power (dBm) | Modulation Technology |
|------------------|--------------------|---|-------------------|--------------------------|
| b | 2412-2462 | 11 | 11.62 | DSSS, |
| g | | | 15.79 | OFDM |
| n_HT20 | | | 16.22 | |
| Modulation type: | | CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM | | |
| Transition Rate: | | 802.11 b: 1/2/5.5/11 Mbps 802.11 g: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 72.2Mbps | | |

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1.3 Antenna Designation

| Antenna Type | Supplier | Antenna Part No. | Peak Antenna Gain (dBi) |
|--------------|----------|-------------------|-------------------------|
| Chip | YAGEO | ANT8010LL04R2400A | 5.46 |

1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance v04

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.5 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Designation number: 509634 / TW0001

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

1.8 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Configuration of Tested System

Fig. 2-1 Conducted Emission Configuration



Fig. 2-2 Radiated Emission Configuration



Table 2-1 Equipment Used in Tested System

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|--------------------|-----------|----------------|------------|------------|-------------|
| 1 | WLAN Test Software | N/A | N/A | N/A | N/A | N/A |
| 2 | Notebook | Lenovo | L420 | LR-7HXZA | Shielded | Un-shielded |

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3 SUMMARY OF TEST RESULTS

| FCC Rules | Description Of Test | Result |
|-----------------------|---|-----------|
| §15.207(a) | AC Power Line Conducted Emission | N/A |
| §15.247(b) (3) | Peak Output Power | Compliant |
| §15.247(a)(2) | 6dB & 99% Emission Bandwidth | Compliant |
| §15.247(d) | Conducted Band Edge and Spurious Emission | Compliant |
| §15.247(d) | Radiated Band Edge and Spurious Emission | Compliant |
| §15.247(e) | Power Spectral Density | Compliant |
| §15.203 §15.247(b) | Antenna Requirement | Compliant |

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

11 channels are provided for 802.11b, 802.11g and 802.11n HT20

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

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4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case. The given UE is pre-scanned among below modes.
4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

| Modulation | Transmission Chain | | | |
|--|---|------------------------------|------------------------------|------------------------------|
| <input checked="" type="checkbox"/> 802.11 b | <input checked="" type="checkbox"/> Ch0 | <input type="checkbox"/> Ch1 | <input type="checkbox"/> Ch2 | <input type="checkbox"/> Ch3 |
| <input checked="" type="checkbox"/> 802.11 g | <input checked="" type="checkbox"/> Ch0 | <input type="checkbox"/> Ch1 | <input type="checkbox"/> Ch2 | <input type="checkbox"/> Ch3 |
| <input checked="" type="checkbox"/> 802.11 n | <input checked="" type="checkbox"/> Ch0 | <input type="checkbox"/> Ch1 | <input type="checkbox"/> Ch2 | <input type="checkbox"/> Ch3 |

RADIATED EMISSION TEST:

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION | DATA RATE (Mbps) | ANTENNA PORT |
|---|-------------------|----------------|------------|------------------|--------------|
| RADIATED EMISSION TEST (BELOW 1 GHz) | | | | | |
| 802.11g | 1 to 11 | 1,6,11 | OFDM | 6 | Ch0 |
| RADIATED EMISSION TEST (ABOVE 1 GHz) | | | | | |
| 802.11b | 1 to 11 | 1, 6, 11 | DSSS | 1 | Ch0 |
| 802.11g | 1 to 11 | 1, 6, 11 | OFDM | 6 | Ch0 |
| 802.11n (HT20) | 1 to 11 | 1, 6, 11 | OFDM | MCS 0 | Ch0 |
| Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11b/g/n WLAN Transmitter for channel Low, Mid and High, the worst case H position was reported. | | | | | |

ANTENNA PORT CONDUCTED MEASUREMENT:

| CONDUCTED TEST | | | | | |
|-----------------------|-------------------|----------------|------------|------------------|--------------|
| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION | DATA RATE (Mbps) | ANTENNA PORT |
| 802.11b | 1 to 11 | 1,6,11 | DSSS | 1 | Ch0 |
| 802.11g | 1 to 11 | 1,6,11 | OFDM | 6 | Ch0 |
| 802.11n (HT20) | 1 to 11 | 1,6,11 | OFDM | MCS 0 | Ch0 |

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5 MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty |
|---|-----------------------------|
| AC Power Line Conducted Emission | +/- 2.586 dB |
| Peak Output Power | +/- 0.84 dB |
| 6dB Bandwidth | +/- 51.33 Hz |
| 100 KHz Bandwidth Of Frequency Band Edges | +/- 0.84 dB |
| Peak Power Density | +/- 1.3 dB |
| Temperature | +/- 0.65 °C |
| Humidity | +/- 4.6 % |
| DC / AC Power Source | DC= +/- 0.13%, AC= +/- 0.2% |

| Radiated Spurious Emission Measurement Uncertainty | |
|--|----------------------------|
| Polarization: Vertical | 9kHz~30MHz: +/-2.3dB |
| | 30MHz - 180MHz: +/- 3.37dB |
| | 180MHz -417MHz: +/- 3.19dB |
| | 0.417GHz-1GHz: +/- 3.19dB |
| | 1GHz - 18GHz: +/- 4.04dB |
| | 18GHz - 40GHz: +/- 4.04dB |
| Polarization: Horizontal | 9kHz~30MHz: +/-2.3dB |
| | 30MHz - 167MHz: +/- 4.22dB |
| | 167MHz -500MHz: +/- 3.44dB |
| | 0.5GHz-1GHz: +/- 3.39dB |
| | 1GHz - 18GHz: +/- 4.08dB |
| | 18GHz - 40GHz: +/- 4.08dB |

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

| Frequency range MHz | Limits dB(uV) | |
|------------------------|------------------|----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

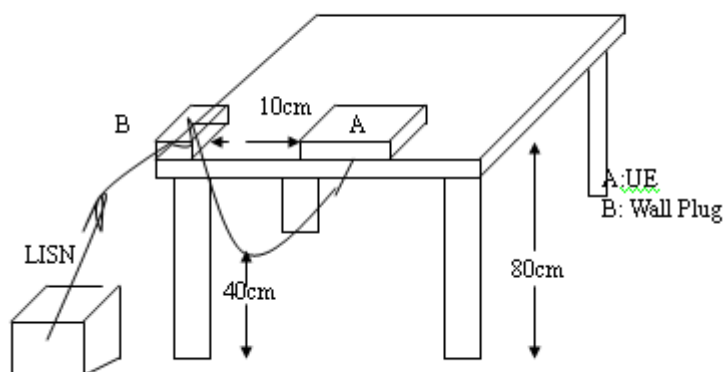
6.2 Measurement Equipment Used

N/A

6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



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6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result

N/A; Powered from Lithium Thionyl Chloride Battery.

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7 DUTY CYCLE OF TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

Formula:

$$\text{Duty Cycle} = T_{on} / (T_{on} + T_{off})$$

Measurement Procedure:

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

Duty Cycle:

| | Duty Cycle (%) | Duty Factor (dB) | 1/T (kHz) | VBW setting (kHz) |
|------------|----------------|------------------|-----------|-------------------|
| 802.11b | 99.22 | 0.03 | 0.12 | 0.01 |
| 802.11g | 95.17 | 0.21 | 0.74 | 1.00 |
| 802.11n_20 | 87.85 | 0.56 | 0.79 | 1.00 |

$b = 99.22\%$, $g = 95.17\%$, $n_{ht_20} = 87.85\%$

Duty Cycle Factor: $10 * \log(1/0.9922) = 0.03$

Duty Cycle Factor: $10 * \log(1/0.9517) = 0.21$

Duty Cycle Factor: $10 * \log(1/0.8785) = 0.56$

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7.1 DUTY CYCLE TEST SIGNAL Measurement Result

Duty Cycle 802.11b_20MHz_Chain0_2412MHz



Duty Cycle 802.11n_20MHz_Chain0_2412MHz



Duty Cycle 802.11g_20MHz_Chain0_2412MHz



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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

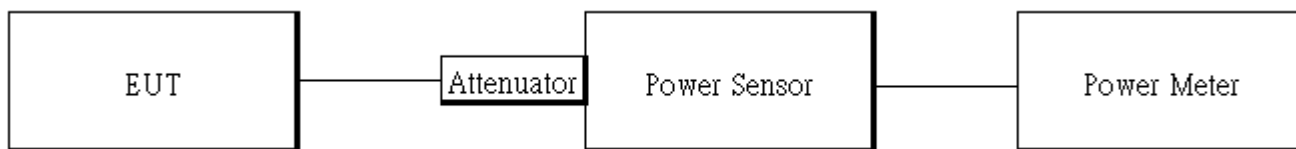
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|--------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2496A | 1804001 | 02/13/2019 | 02/12/2020 |
| Power Sensor | Anritsu | MA2411B | 1726104 | 02/13/2019 | 02/12/2020 |
| Power Sensor | Anritsu | MA2411B | 1726107 | 02/13/2019 | 02/12/2020 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 2 | 01/02/2019 | 01/01/2020 |

8.3 Test Set-up

Power Meter:



8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Spectrum or Power Meter.

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8.5 Measurement Result

| 802.11b Ch0 | | | | | |
|-------------|-------------|-----------|-------------------------|-------------|--------|
| CH | Freq. (MHz) | Data Rate | Peak Output Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | 1 | 11.55 | 30.00 | PASS |
| 6 | 2437 | 1 | 11.45 | 30.00 | PASS |
| 11 | 2462 | 1 | 11.62 | 30.00 | PASS |

| 802.11b Ch0 | | | | | |
|-------------|-------------|-----------|--|-------------|--------|
| CH | Freq. (MHz) | Data Rate | Max. Avg. Output include tune up tolerance Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | 1 | 9.24 | 30.00 | PASS |
| 6 | 2437 | 1 | 9.13 | 30.00 | PASS |
| 11 | 2462 | 1 | 9.32 | 30.00 | PASS |

| 802.11g Ch0 | | | | | |
|-------------|-------------|-----------|-------------------------|-------------|--------|
| CH | Freq. (MHz) | Data Rate | Peak Output Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | 6 | 15.79 | 30.00 | PASS |
| 6 | 2437 | 6 | 15.38 | 30.00 | PASS |
| 11 | 2462 | 6 | 15.38 | 30.00 | PASS |

| 802.11g Ch0 | | | | | |
|-------------|-------------|-----------|--|-------------|--------|
| CH | Freq. (MHz) | Data Rate | Max. Avg. Output include tune up tolerance Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | 6 | 8.41 | 30.00 | PASS |
| 6 | 2437 | 6 | 8.08 | 30.00 | PASS |
| 11 | 2462 | 6 | 8.26 | 30.00 | PASS |

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| 802.11n_HT20M Ch0 | | | | | |
|-------------------|----------------|--------------|---|----------------|--------|
| CH | Freq. (MHz) | Data Rate | Peak Output Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | MCS0 | 16.22 | 30.00 | PASS |
| 6 | 2437 | MCS0 | 15.22 | 30.00 | PASS |
| 11 | 2462 | MCS0 | 15.51 | 30.00 | PASS |
| 802.11n_HT20M Ch0 | | | | | |
| CH | Freq. (MHz) | Data Rate | Max. Avg. Output include tune up tolerance Power (dBm) | Limit (dBm) | RESULT |
| 1 | 2412 | MCS0 | 8.75 | 30.00 | PASS |
| 6 | 2437 | MCS0 | 8.18 | 30.00 | PASS |
| 11 | 2462 | MCS0 | 8.27 | 30.00 | PASS |

Note

Cable Loss 11.20 dB

*** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.**

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9 6DB BANDWIDTH MEASUREMENT

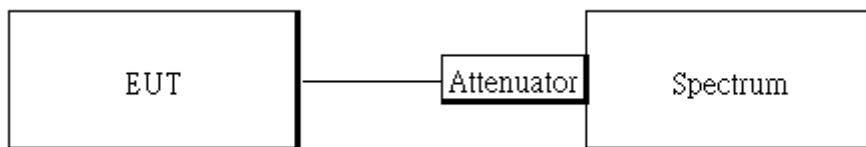
9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/02/2019 | 05/01/2020 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 2 | 01/02/2019 | 01/01/2020 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2019 | 01/01/2020 |

9.3 Test Set-up



9.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. For 6dB Bandwidth:
Set the spectrum analyzer as RBW = 100 kHz, VBW = 3*RBW, Span = 30M/50MHz, Detector=peak, Sweep=auto.
5. Mark the peak frequency and -6dB (upper and lower) frequency.
6. For 99% Bandwidth:
Set the spectrum analyzer as RBW=1%, VBW = 3*RBW, Span = 30M/50MHz, Detector=Sample, Sweep=auto.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all frequency of interest measured was complete.

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9.5 Measurement Result

6dB Bandwidth

802.11b Ch0

| Freq. (MHz) | 6dB BW (kHz) | Limit (kHz) | Result |
|-------------|-----------------|-------------|--------|
| 2412 | 12090.00 | > 500 | PASS |
| 2437 | 12070.00 | > 500 | PASS |
| 2462 | 12040.00 | > 500 | PASS |

802.11g Ch0

| Freq. (MHz) | 6dB BW (kHz) | Limit (kHz) | Result |
|-------------|-----------------|-------------|--------|
| 2412 | 15710.00 | > 500 | PASS |
| 2437 | 15700.00 | > 500 | PASS |
| 2462 | 15590.00 | > 500 | PASS |

802.11_n_HT20 Ch0

| Freq. (MHz) | 6dB BW (kHz) | Limit (kHz) | Result |
|-------------|-----------------|-------------|--------|
| 2412 | 15650.00 | > 500 | PASS |
| 2437 | 15500.00 | > 500 | PASS |
| 2462 | 15660.00 | > 500 | PASS |

**Refer to next page for plots*

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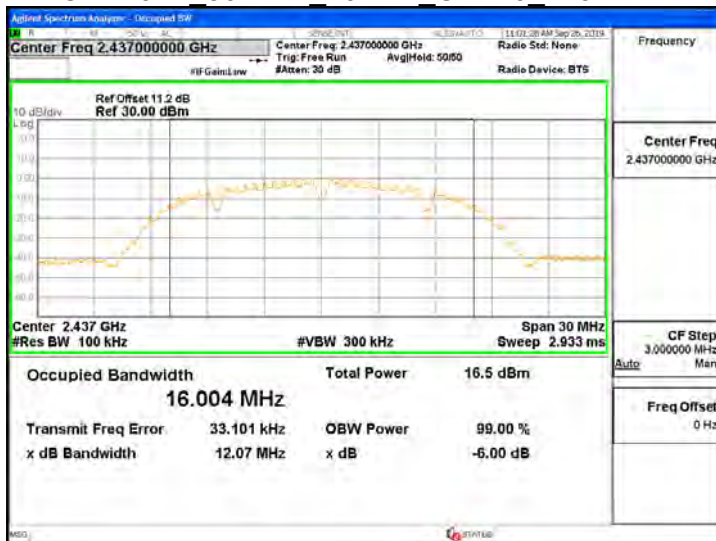
OBW 6dB 802.11b 20MHz Chain0 2412MHz



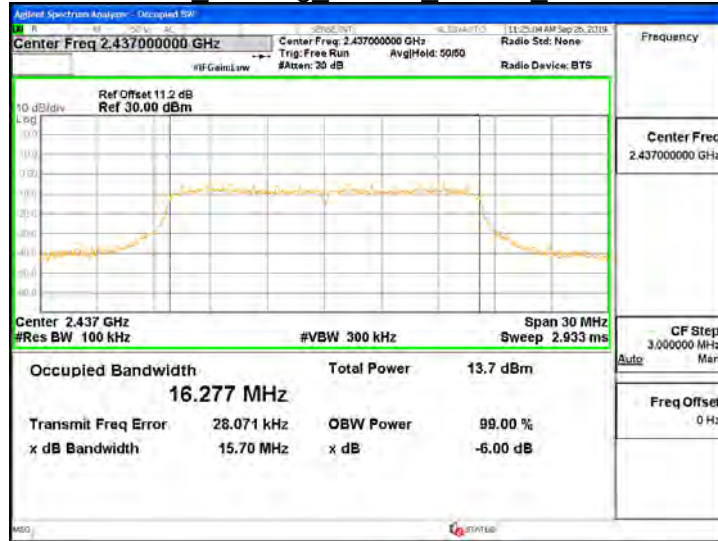
OBW 6dB 802.11g 20MHz Chain0 2412MHz



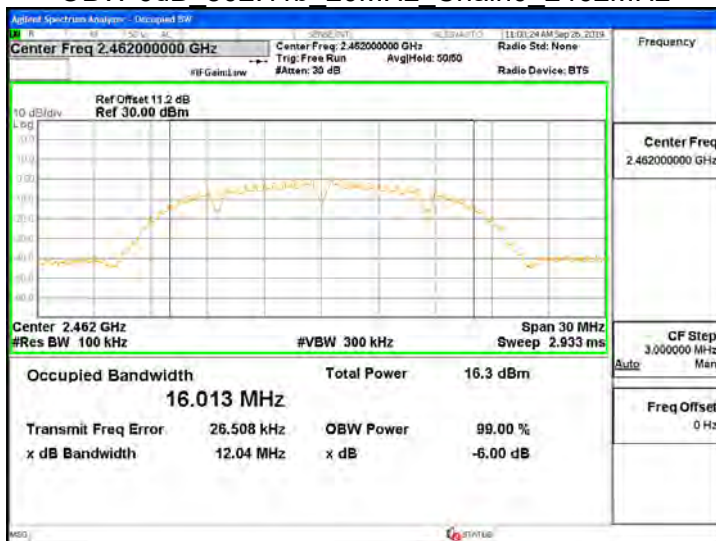
OBW 6dB 802.11b 20MHz Chain0 2437MHz



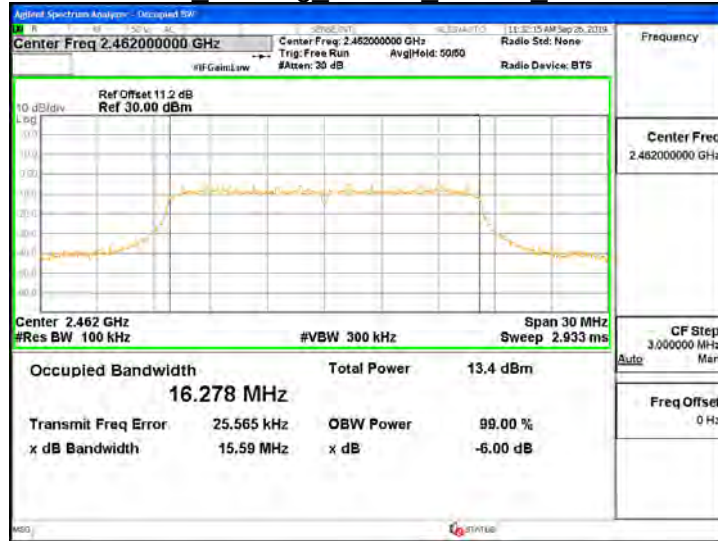
OBW 6dB 802.11g 20MHz Chain0 2437MHz



OBW 6dB 802.11b 20MHz Chain0 2462MHz



OBW 6dB 802.11g 20MHz Chain0 2462MHz

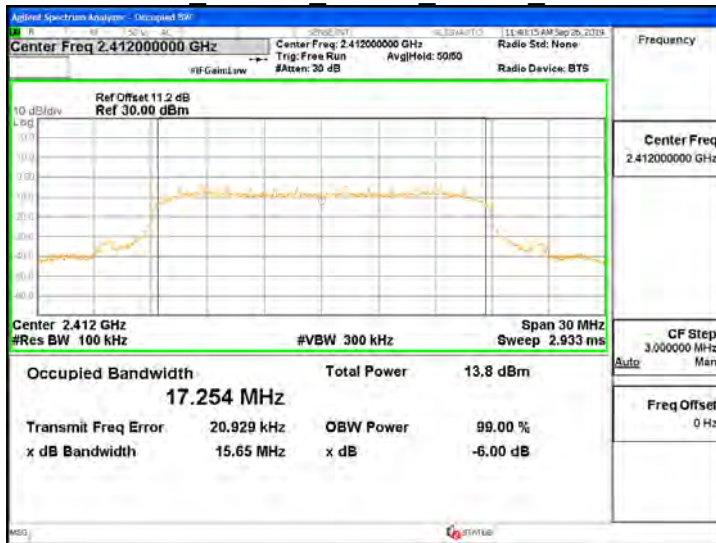


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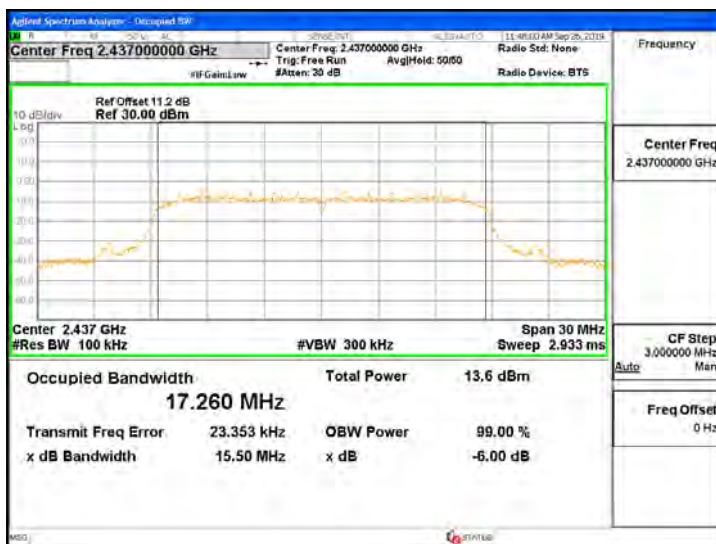
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OBW 6dB 802.11n 20MHz Chain0 2412MHz



OBW 6dB_802.11n_20MHz_Chain0_2437MHz



OBW 6dB_802.11n_20MHz_Chain0_2462MHz



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

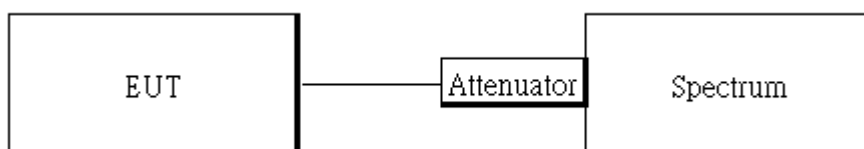
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

10.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/02/2019 | 05/01/2020 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 2 | 01/02/2019 | 01/01/2020 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2019 | 01/01/2020 |

10.3 Test SET-UP



10.4 Measurement Procedure

Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.

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8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Set DL as the limit = reading on marker 1 – 20dBm
8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set RBW = 100 kHz & VBW= 300 kHz, Detector =Peak, Sweep = Auto.
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.5 Measurement Result

| Reference Level of Limit 802.11b mode | | | Reference Level of Limit 802.11g mode | | |
|---------------------------------------|--------------|-----------------------------------|---------------------------------------|--------------|-----------------------------------|
| Freq. (MHz) | PSD (dBm) | Reference Level of Limit (dBm) | Freq. (MHz) | PSD (dBm) | Reference Level of Limit (dBm) |
| 2412 | 0.27 | -19.73 | 2412 | -3.02 | -23.02 |
| 2437 | 0.10 | -19.90 | 2437 | -3.93 | -23.93 |
| 2462 | -0.28 | -20.28 | 2462 | -4.35 | -24.35 |

| Reference Level of Limit 802.11n20 mode | | |
|---|--------------|-----------------------------------|
| Freq. (MHz) | PSD (dBm) | Reference Level of Limit (dBm) |
| 2412 | -3.87 | -23.87 |
| 2437 | -4.07 | -24.07 |
| 2462 | -4.33 | -24.33 |

Note
Cable Loss 11.20 dB

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Reference Level_802.11b_20MHz_Chain0_2412MHz



Reference Level_802.11g_20MHz_Chain0_2412MHz



Reference Level_802.11b_20MHz_Chain0_2437MHz



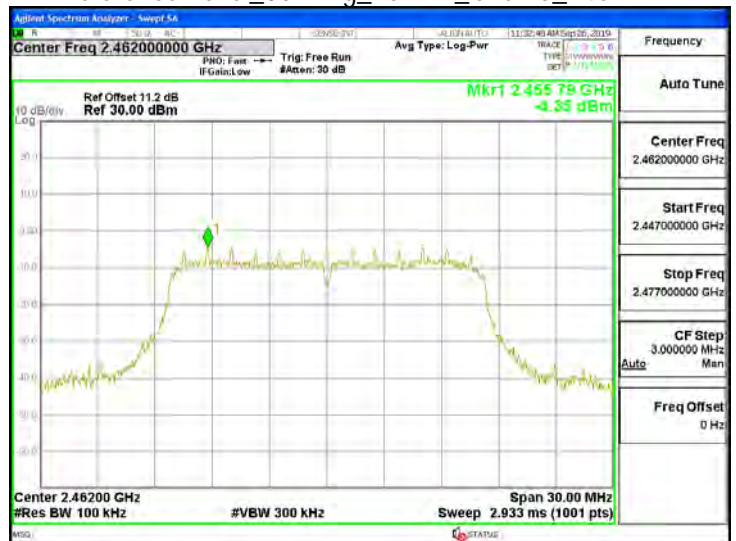
Reference Level_802.11g_20MHz_Chain0_2437MHz



Reference Level_802.11b_20MHz_Chain0_2462MHz



Reference Level_802.11g_20MHz_Chain0_2462MHz



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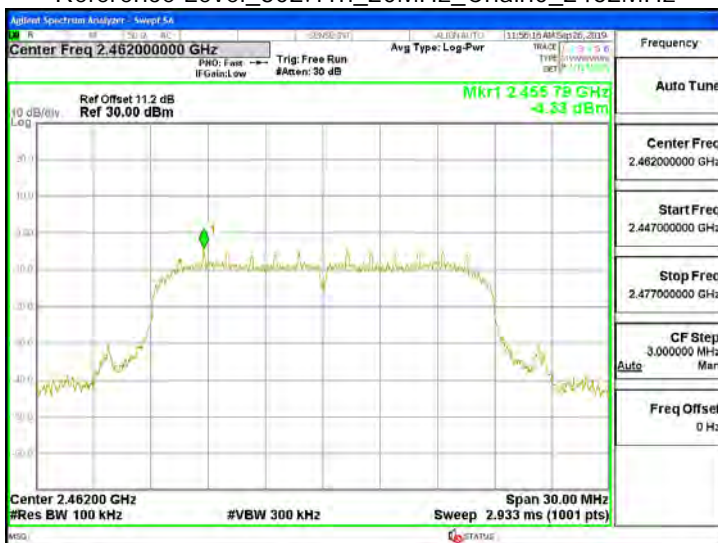
Reference Level_802.11n_20MHz_Chain0_2412MHz



Reference Level_802.11n_20MHz_Chain0_2437MHz



Reference Level_802.11n_20MHz_Chain0_2462MHz



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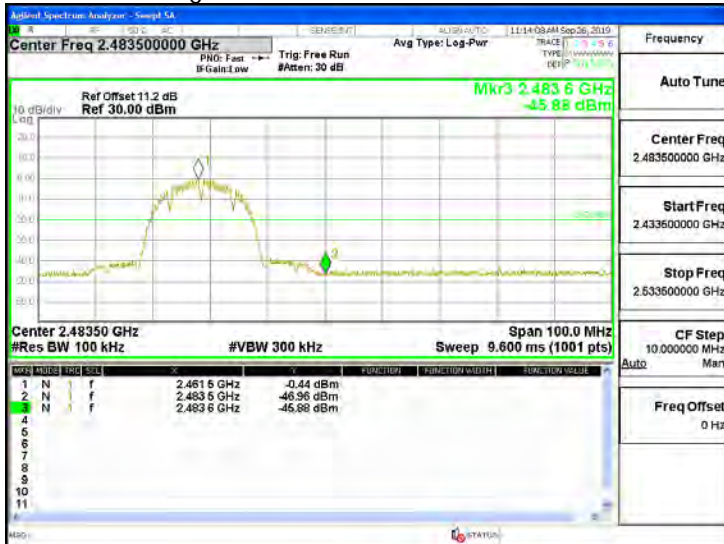
Band Edge_802.11b_20MHz_Chain0_2412MHz



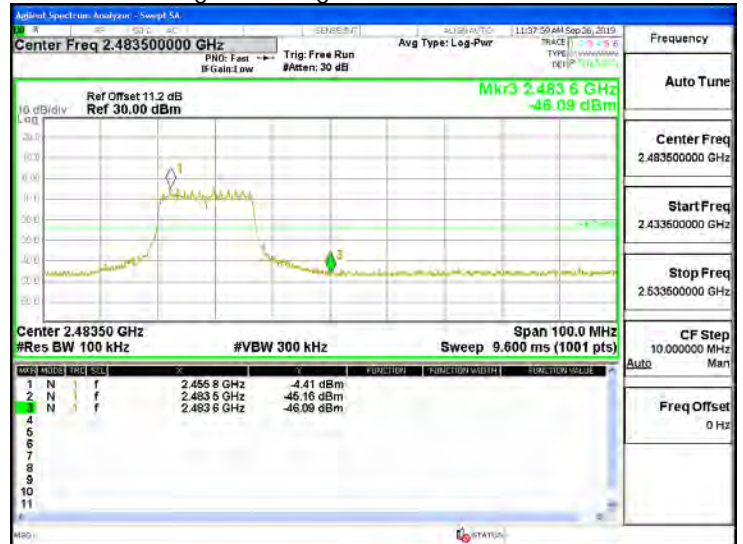
Band Edge_802.11g_20MHz_Chain0_2412MHz



Band Edge_802.11b_20MHz_Chain0_2462MHz



Band Edge_802.11g_20MHz_Chain0_2462MHz



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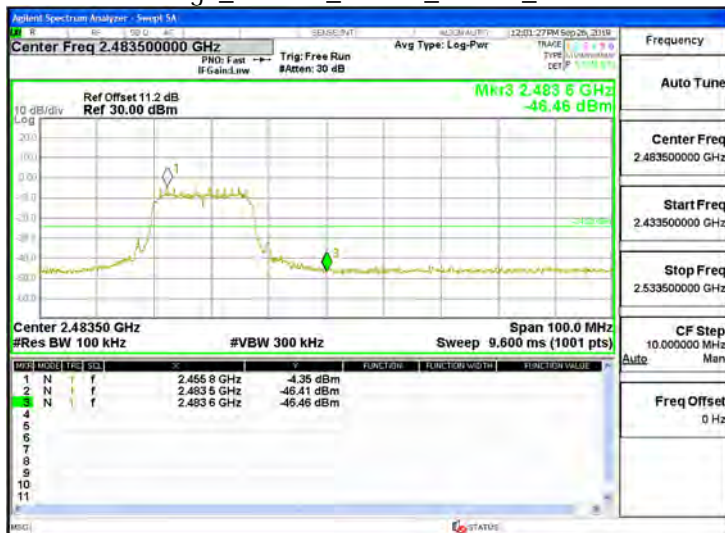
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Band Edge_802.11n_20MHz_Chain0_2412MHz



Band Edge_802.11n_20MHz_Chain0_2462MHz

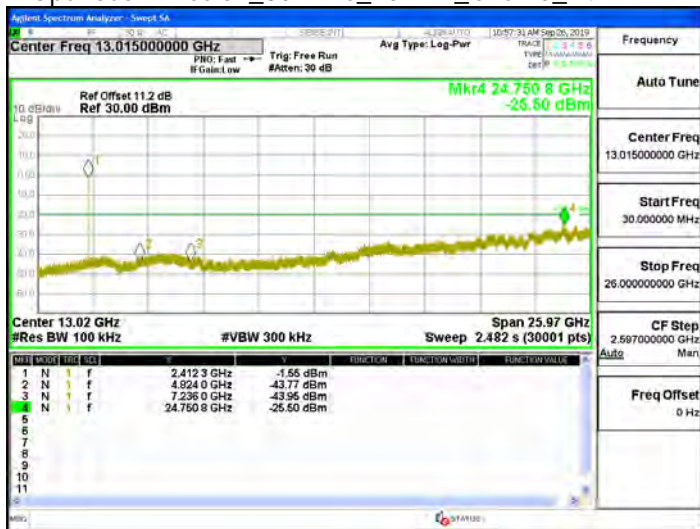


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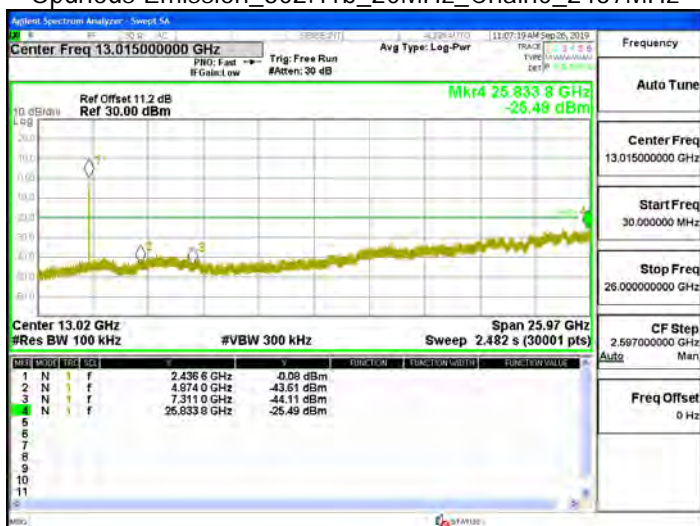
Spurious Emission_802.11b_20MHz_Chain0_2412MHz



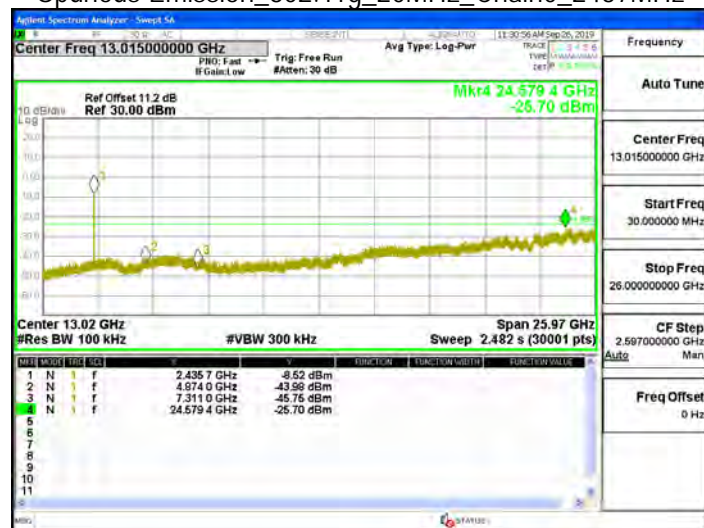
Spurious Emission_802.11g_20MHz_Chain0_2412MHz



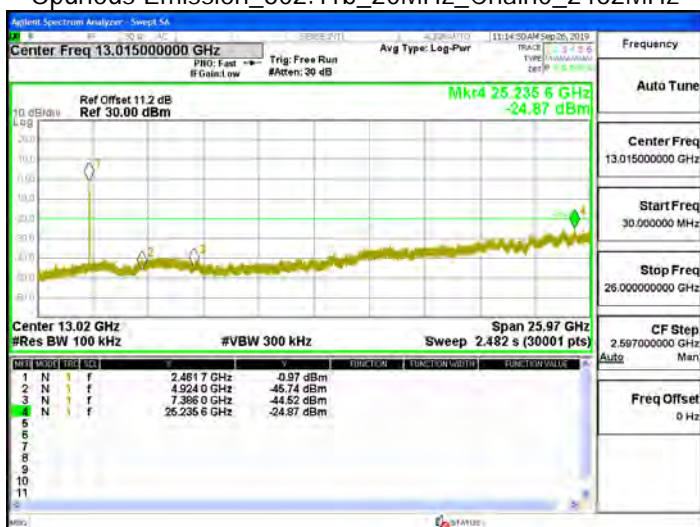
Spurious Emission_802.11b_20MHz_Chain0_2437MHz



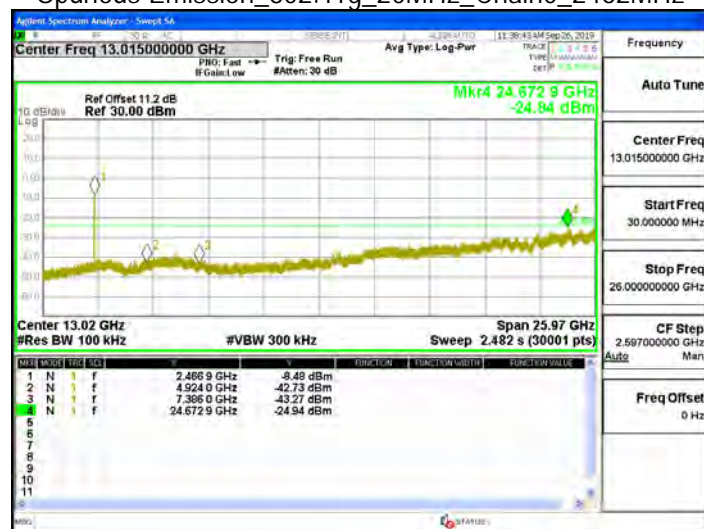
Spurious Emission_802.11g_20MHz_Chain0_2437MHz



Spurious Emission_802.11b_20MHz_Chain0_2462MHz



Spurious Emission_802.11g_20MHz_Chain0_2462MHz

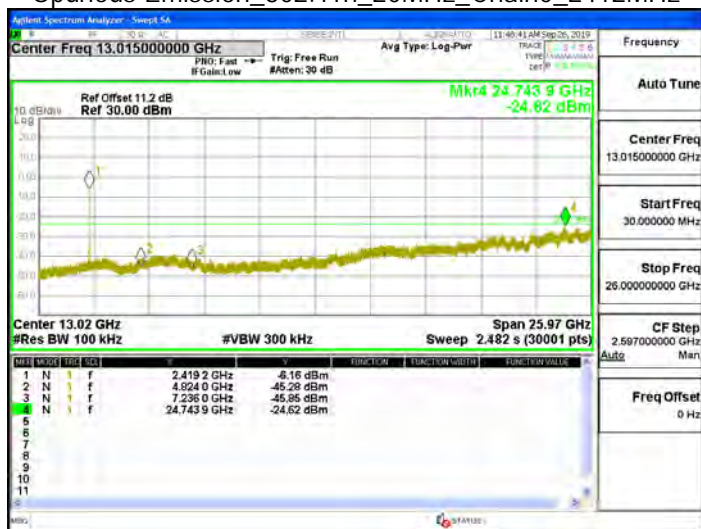


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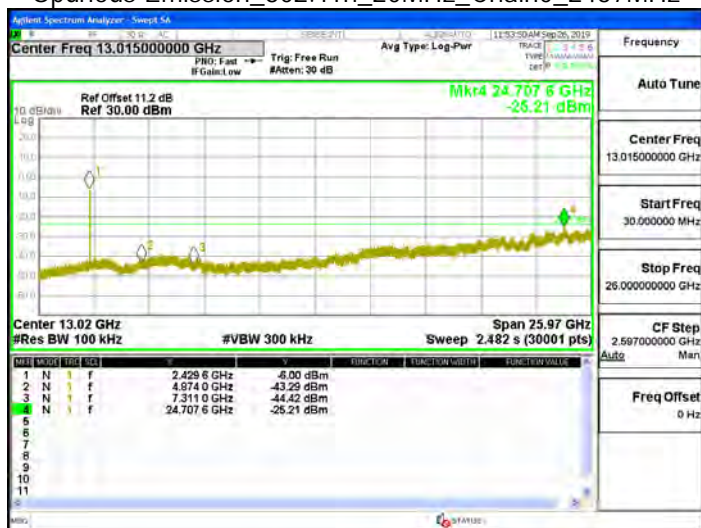
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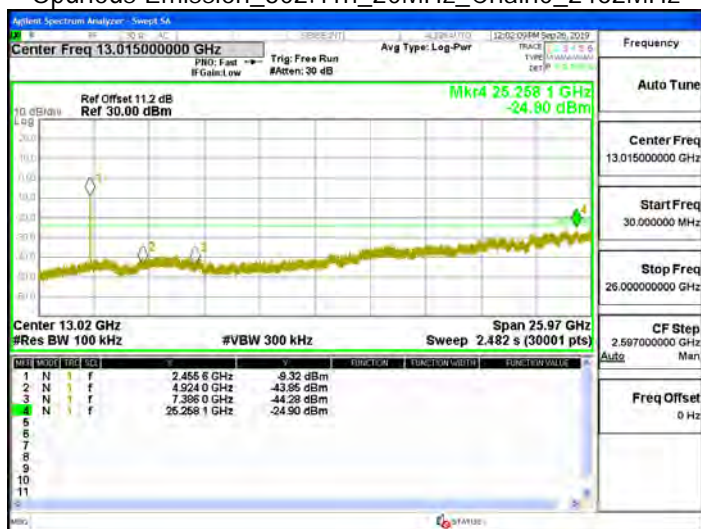
Spurious Emission_802.11n_20MHz_Chain0_2412MHz



Spurious Emission_802.11n_20MHz_Chain0_2437MHz



Spurious Emission_802.11n_20MHz_Chain0_2462MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

| Frequency (MHz) | Field strength (microvolts/meter) | Distance (meters) |
|-----------------|-----------------------------------|-------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

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11.2 Measurement Equipment Used:

| 966 Chamber | | | | | |
|------------------------|-----------------|------------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Bi-log Antenna | SCHWAZBECK | VULB9168 | 378 | 01/04/2019 | 01/03/2020 |
| Horn Antenna | Schwarzbeck | BBHA9120D | 1441 | 08/20/2019 | 08/19/2020 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 184 | 12/27/2018 | 12/26/2019 |
| 3m Site NSA | SGS | 966 chamber | N/A | 01/02/2019 | 01/01/2020 |
| Loop Antenna | ETS.LINDGREN | 6502 | 148045 | 10/08/2018 | 10/07/2019 |
| PXA Spectrum Analyzer | Agilent | N9030A | MY53120760 | 04/22/2019 | 04/21/2020 |
| EMI Test Receiver | R&S | ESCI 3 | 100335 | 02/12/2019 | 02/11/2020 |
| Pre-Amplifier | HP | 8449B | 3008A00578 | 01/02/2019 | 01/01/2020 |
| Pre-Amplifier | HP | 8447D | 2944A07676 | 01/02/2019 | 01/01/2020 |
| Pre-Amplifier | EMC Instruments | EMC184045B | 980135 | 01/02/2019 | 01/01/2020 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 4 | 01/02/2019 | 01/01/2020 |
| Filter 2400-2483.5 MHz | EWT | EWT-14-0166 | M1 | 01/02/2019 | 01/01/2020 |
| High Pass Filter | WI | WHKX4.0/18G-10SS | 22 | 01/01/2019 | 01/02/2020 |

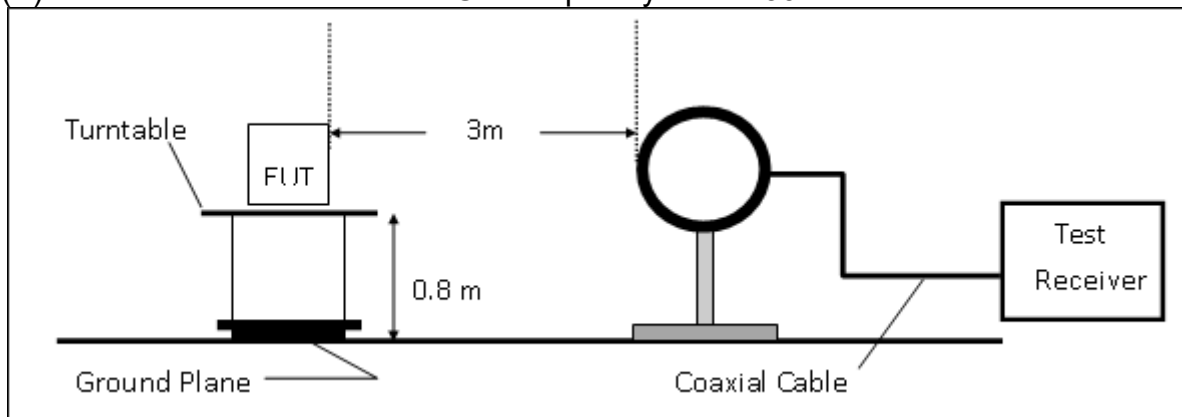
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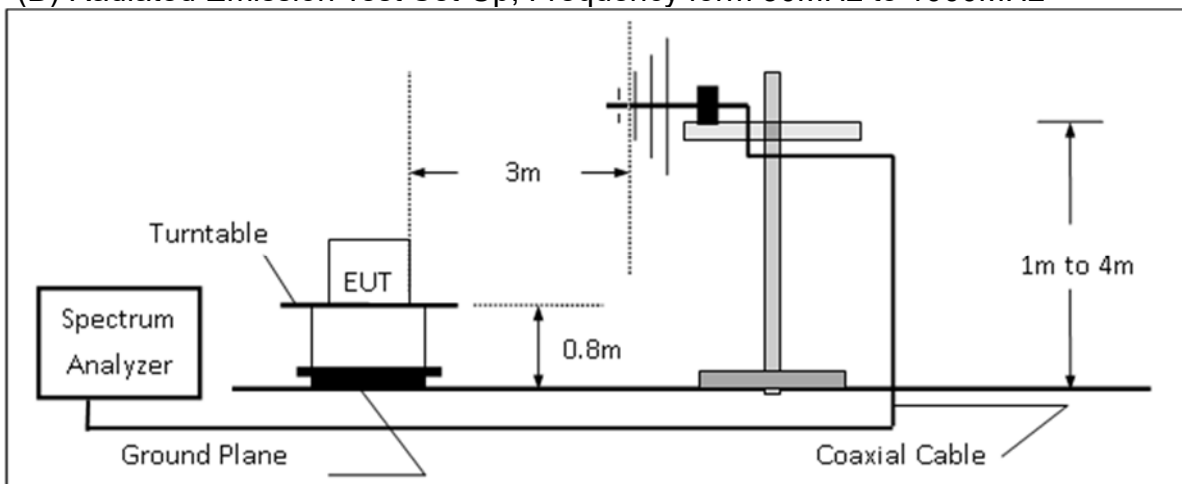
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11.3 Test SET-UP

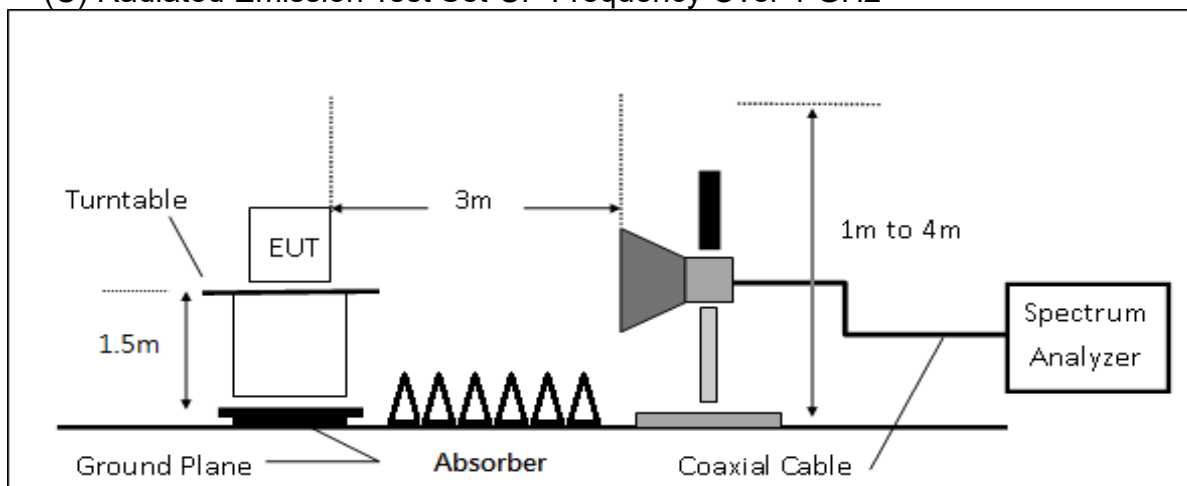
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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11.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
9. 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.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

11.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

| | |
|---------------------------|--|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

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11.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

11.7 Measurement Result

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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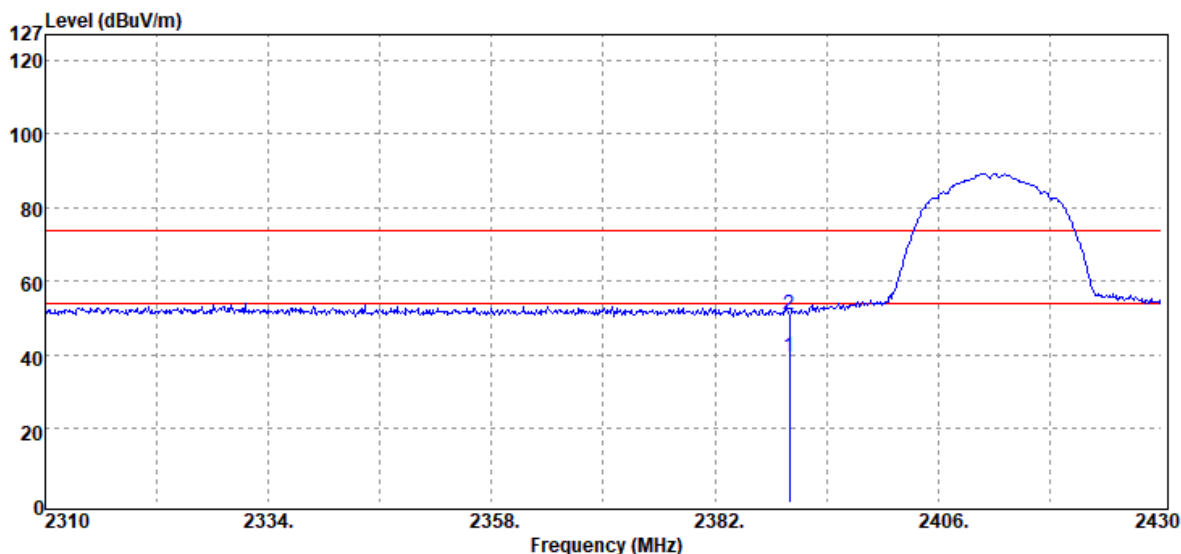
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Radiated Band Edge Measurement Result

Report Number :ER/2019/80073
Operation Mode :802.11b
Test Channel :2412 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :VERTICAL
Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 39.15 | 0.24 | 39.39 | 54.00 | -14.61 |
| 2390.00 | Peak | 50.93 | 0.24 | 51.17 | 74.00 | -22.83 |

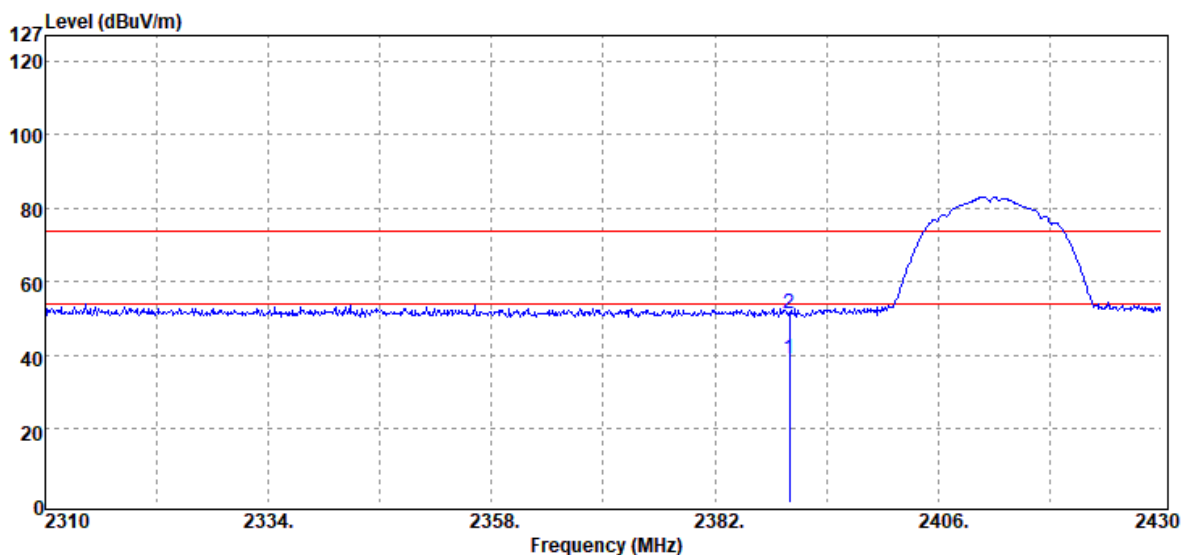
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2412 MHz
 Test Mode :Bandedge CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | Average | 38.85 | 0.24 | 39.09 | 54.00 | -14.91 |
| 2390.00 | Peak | 51.04 | 0.24 | 51.28 | 74.00 | -22.72 |

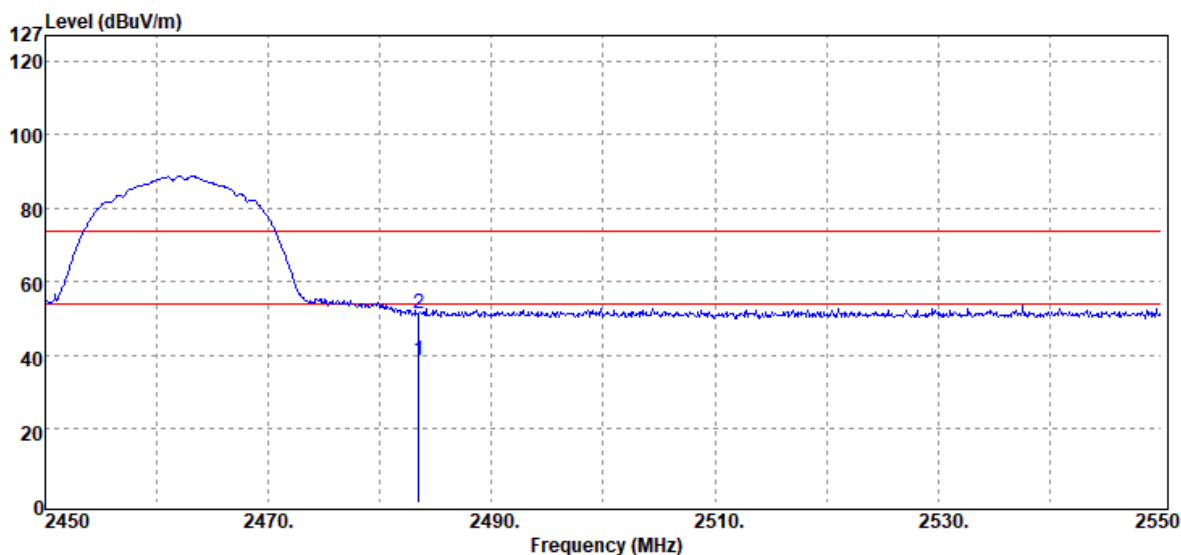
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2462 MHz
 Test Mode :Bandedge CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 2483.50 | Average | 38.83 | -0.17 | 38.66 | 54.00 | -15.34 |
| 2483.50 | Peak | 51.72 | -0.17 | 51.55 | 74.00 | -22.45 |

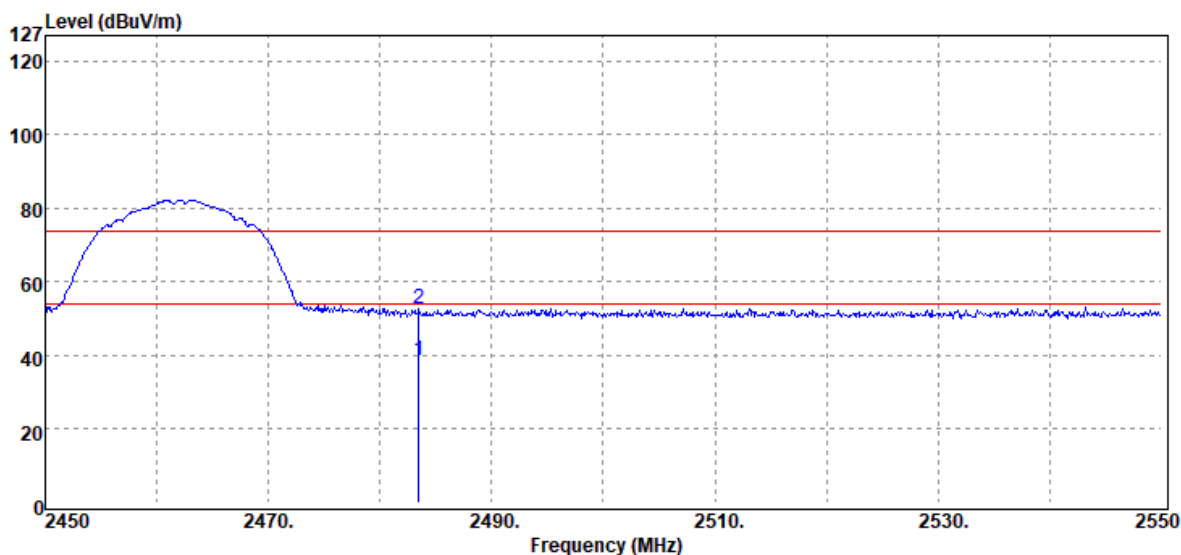
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Report Number :ER/2019/80073
Operation Mode :802.11b
Test Channel :2462 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :HORIZONTAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2483.50 | Average | 38.73 | -0.17 | 38.56 | 54.00 | -15.44 |
| 2483.50 | Peak | 52.83 | -0.17 | 52.66 | 74.00 | -21.34 |

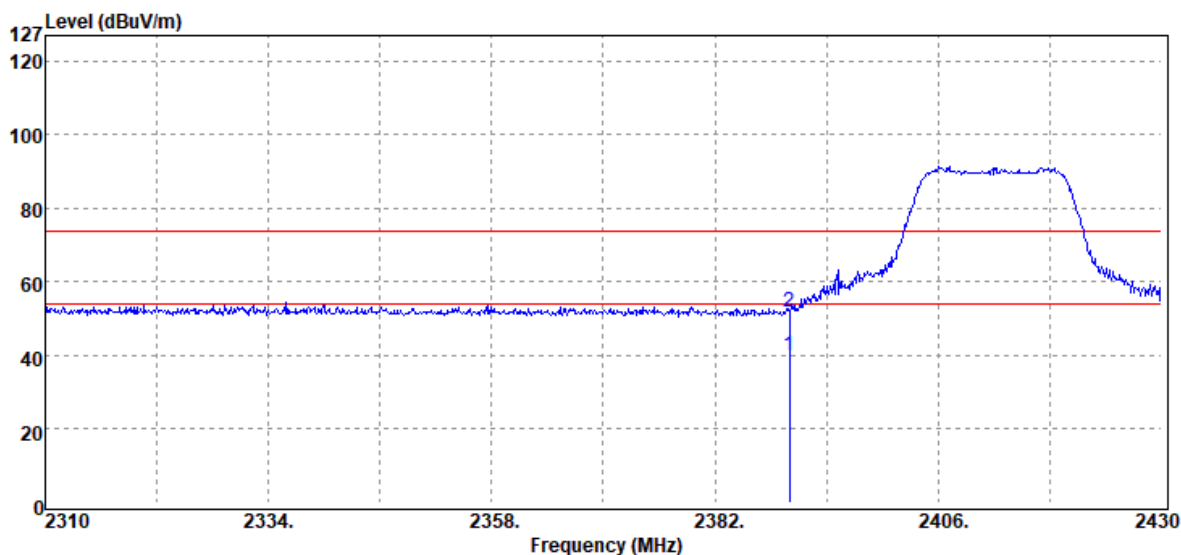
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2412 MHz
 Test Mode :Bandedge CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 39.86 | 0.24 | 40.10 | 54.00 | -13.90 |
| 2390.00 | Peak | 51.61 | 0.24 | 51.85 | 74.00 | -22.15 |

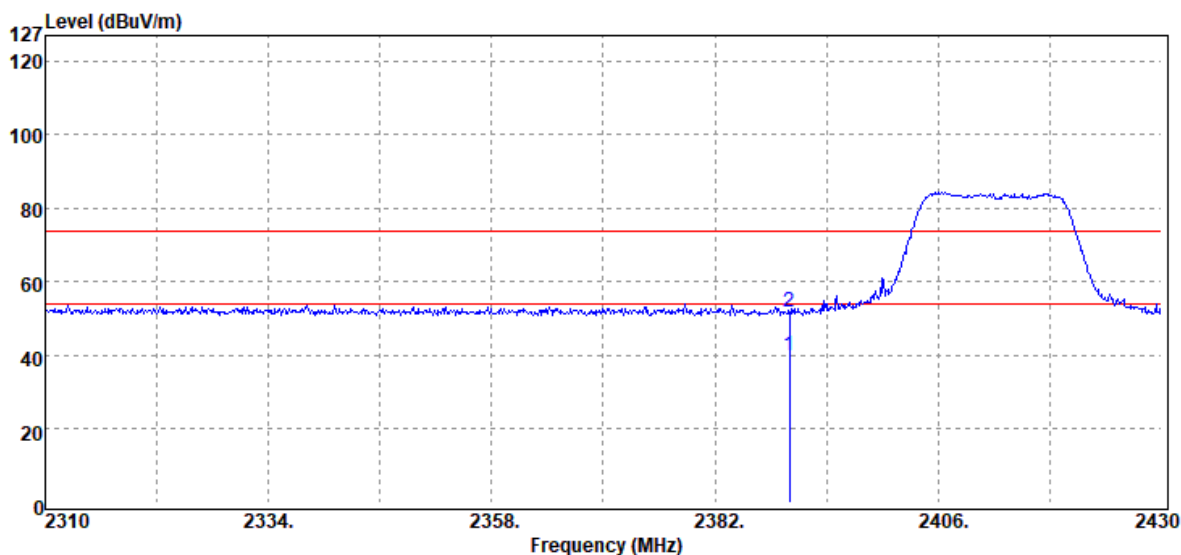
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Report Number :ER/2019/80073
Operation Mode :802.11g
Test Channel :2412 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :HORIZONTAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | Average | 39.64 | 0.24 | 39.88 | 54.00 | -14.12 |
| 2390.00 | Peak | 51.66 | 0.24 | 51.90 | 74.00 | -22.10 |

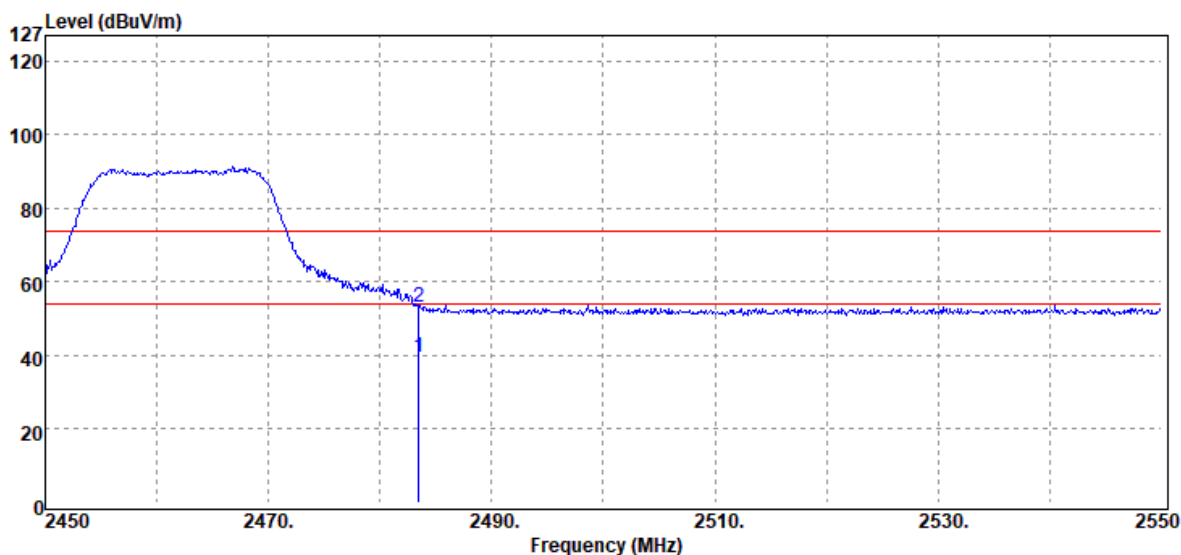
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Report Number :ER/2019/80073
Operation Mode :802.11g
Test Channel :2462 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :VERTICAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2483.50 | Average | 39.72 | -0.17 | 39.55 | 54.00 | -14.45 |
| 2483.50 | Peak | 53.25 | -0.17 | 53.08 | 74.00 | -20.92 |

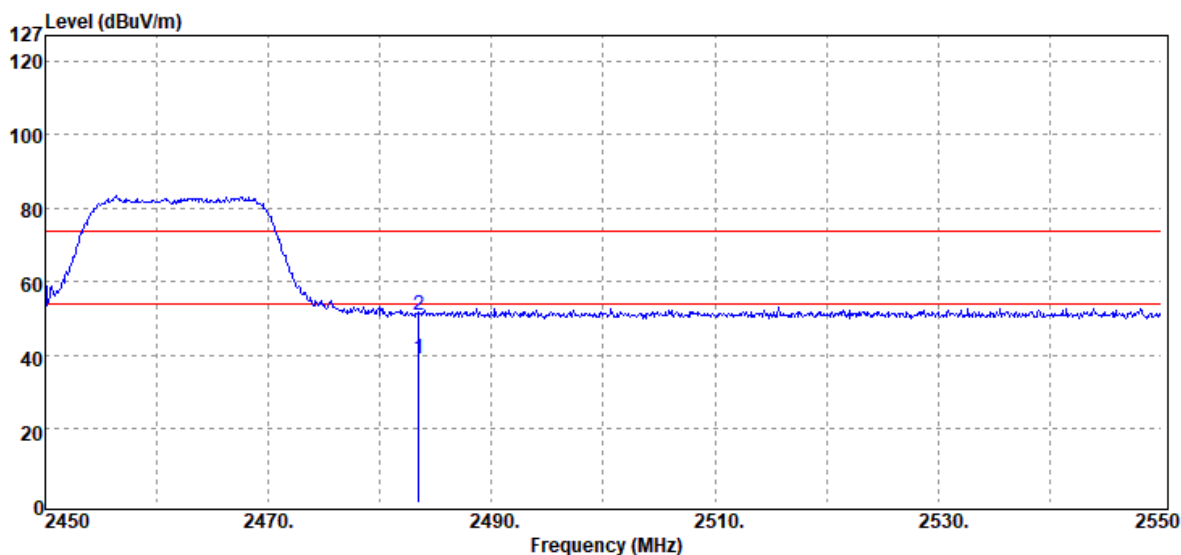
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Report Number :ER/2019/80073
Operation Mode :802.11g
Test Channel :2462 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :HORIZONTAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2483.50 | Average | 39.44 | -0.17 | 39.27 | 54.00 | -14.73 |
| 2483.50 | Peak | 51.08 | -0.17 | 50.91 | 74.00 | -23.09 |

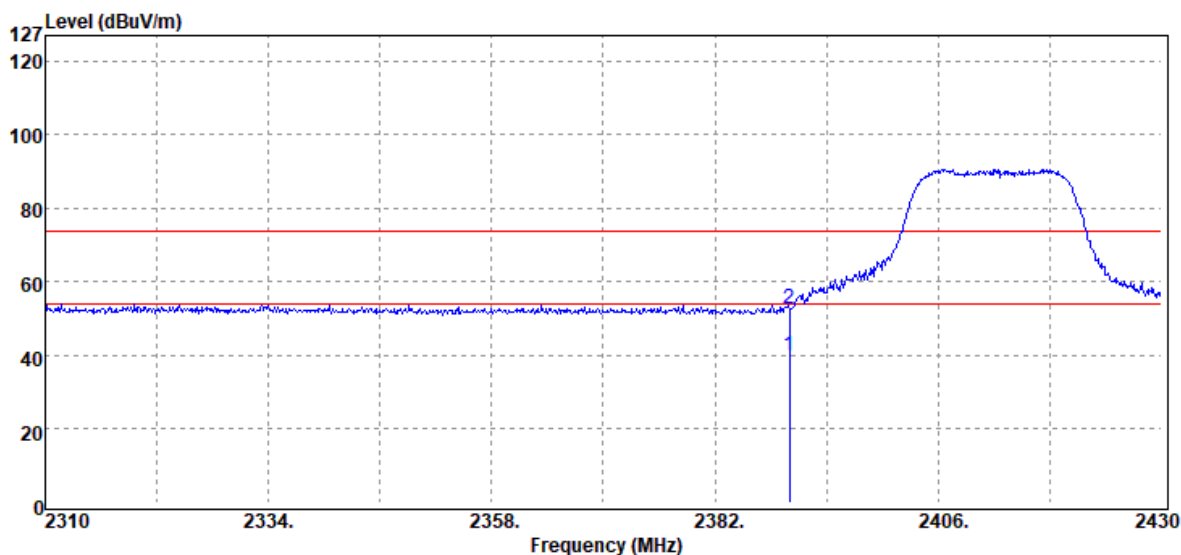
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Report Number :ER/2019/80073
Operation Mode :802.11n20
Test Channel :2412 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :VERTICAL
Engineer :Kane



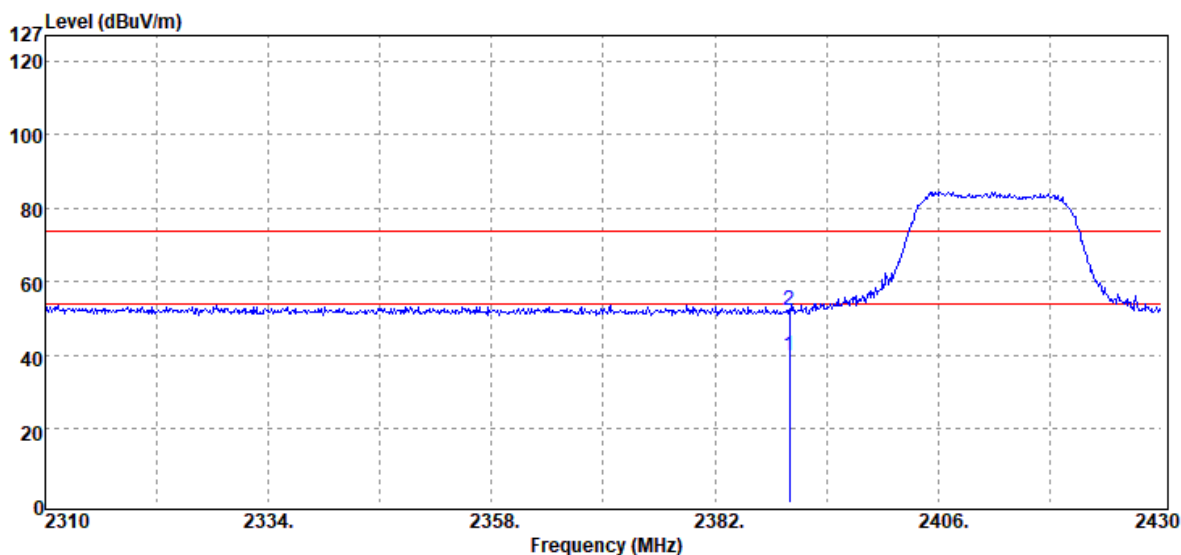
| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | Average | 39.90 | 0.24 | 40.14 | 54.00 | -13.86 |
| 2390.00 | Peak | 52.33 | 0.24 | 52.57 | 74.00 | -21.43 |

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| | | | |
|----------------|------------------|--------------|-------------|
| Report Number | :ER/2019/80073 | Test Date | :2019-09-24 |
| Operation Mode | :802.11n20 | Temp./Humi. | :24.4/57 |
| Test Channel | :2412 MHz | Antenna Pol. | :HORIZONTAL |
| Test Mode | :Bandedge CH Low | Engineer | :Kane |
| EUT Pol | :H Plane | | |



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | Average | 39.68 | 0.24 | 39.92 | 54.00 | -14.08 |
| 2390.00 | Peak | 52.06 | 0.24 | 52.30 | 74.00 | -21.70 |

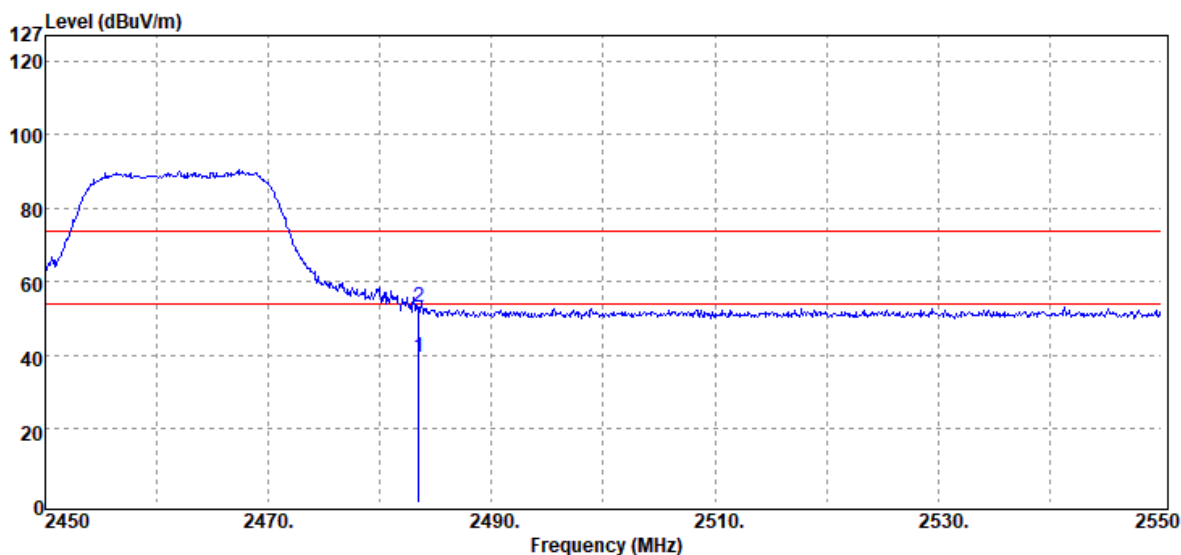
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2462 MHz
 Test Mode :Bandedge CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2483.50 | Average | 39.63 | -0.17 | 39.46 | 54.00 | -14.54 |
| 2483.50 | Peak | 53.30 | -0.17 | 53.13 | 74.00 | -20.87 |

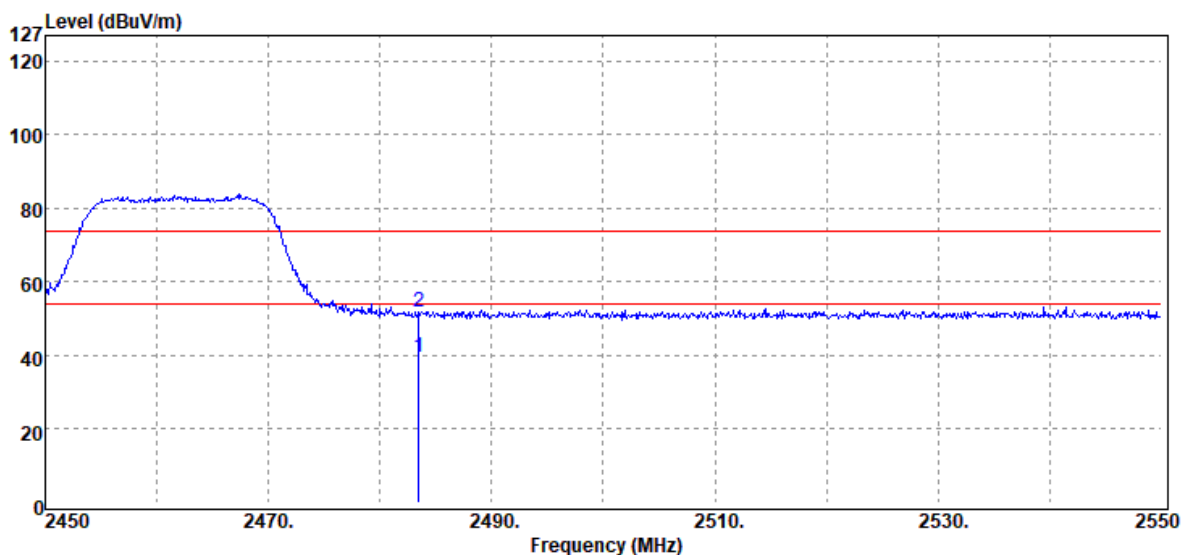
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2462 MHz
 Test Mode :Bandedge CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2483.50 | Average | 39.64 | -0.17 | 39.47 | 54.00 | -14.53 |
| 2483.50 | Peak | 52.06 | -0.17 | 51.89 | 74.00 | -22.11 |

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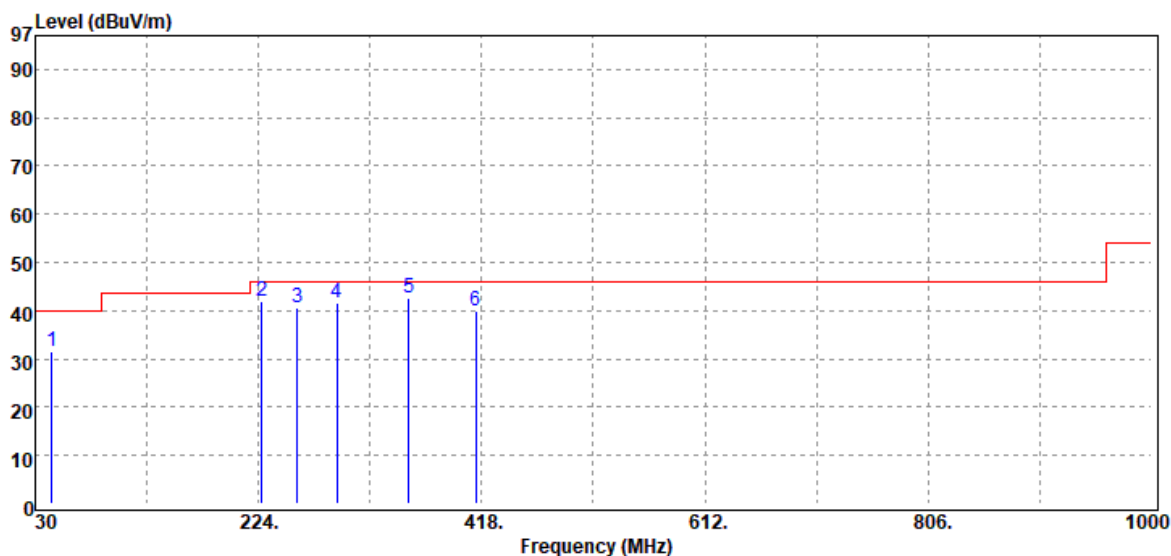
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Below 1GHz Worst-Case Data:

Radiated Spurious Emission Measurement Result

Report Number :ER/2019/80073
Operation Mode :802.11g
Test Channel :2437 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :VERTICAL
Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 44.55 | Peak | 39.73 | -8.04 | 31.69 | 40.00 | -8.31 |
| 226.91 | Peak | 50.81 | -8.85 | 41.96 | 46.00 | -4.04 |
| 257.95 | Peak | 48.30 | -7.55 | 40.75 | 46.00 | -5.25 |
| 291.90 | Peak | 47.80 | -6.21 | 41.59 | 46.00 | -4.41 |
| 354.95 | Peak | 47.48 | -5.01 | 42.47 | 46.00 | -3.53 |
| 413.15 | Peak | 43.52 | -3.65 | 39.87 | 46.00 | -6.13 |

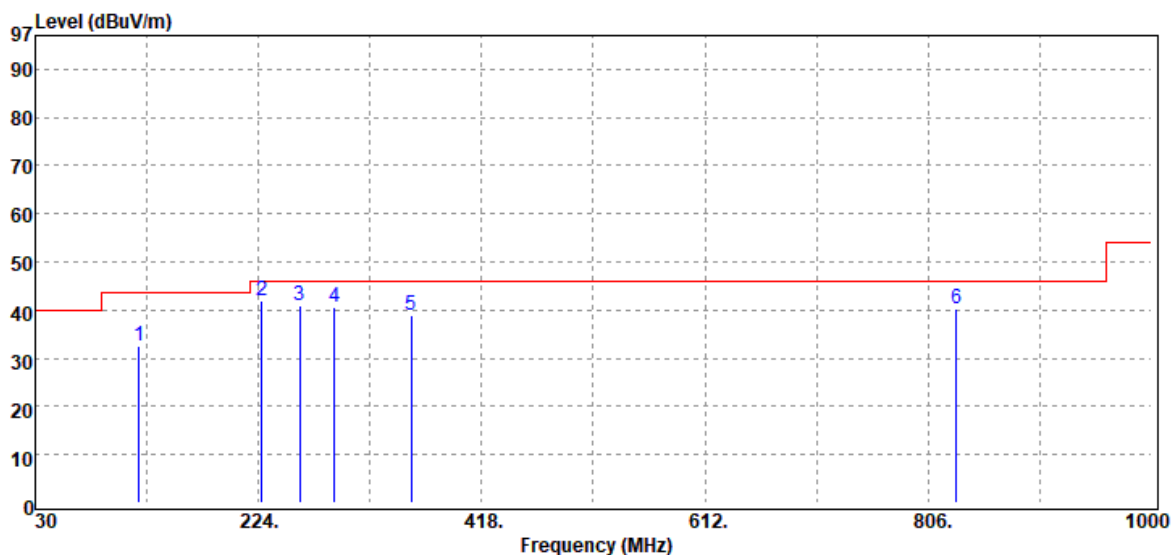
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 120.21 | Peak | 42.57 | -10.04 | 32.53 | 43.50 | -10.97 |
| 226.91 | Peak | 50.97 | -8.85 | 42.12 | 46.00 | -3.88 |
| 259.89 | Peak | 48.45 | -7.46 | 40.99 | 46.00 | -5.01 |
| 289.96 | Peak | 46.77 | -6.24 | 40.53 | 46.00 | -5.47 |
| 356.89 | Peak | 44.05 | -4.98 | 39.07 | 46.00 | -6.93 |
| 830.25 | Peak | 36.38 | 3.99 | 40.37 | 46.00 | -5.63 |

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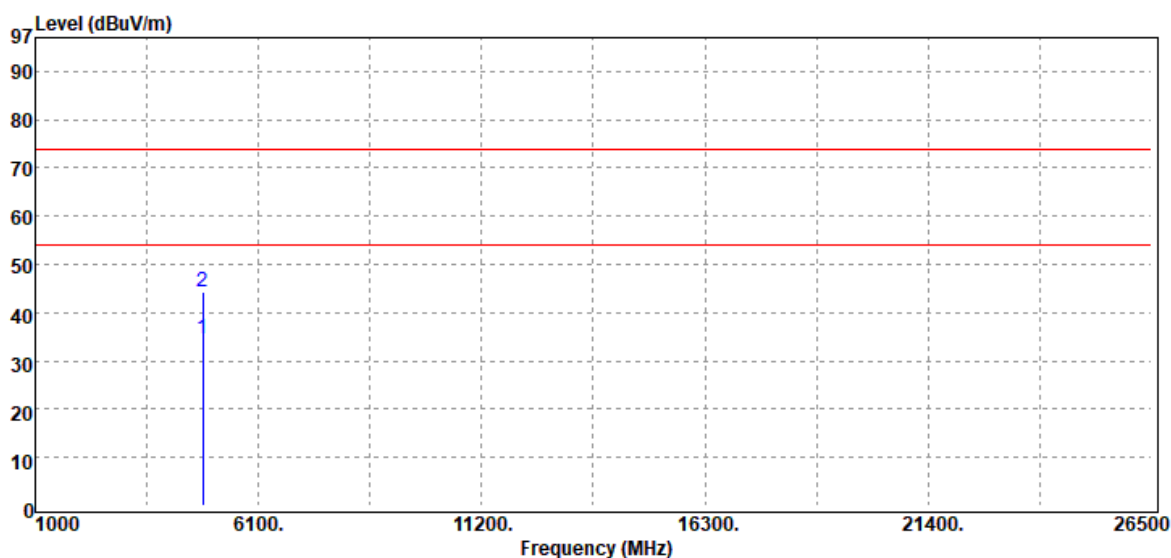
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Above 1GHz Data:

Radiated Spurious Emission Measurement Result

| | | | |
|----------------|----------------|--------------|-------------|
| Report Number | :ER/2019/80073 | Test Date | :2019-09-24 |
| Operation Mode | :802.11b | Temp./Humi. | :24.4/57 |
| Test Channel | :2412 MHz | Antenna Pol. | :VERTICAL |
| Test Mode | :Tx CH Low | Engineer | :Kane |
| EUT Pol | :H Plane | | |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4824.00 | Average | 27.90 | 6.53 | 34.43 | 54.00 | -19.57 |
| 4824.00 | Peak | 37.78 | 6.53 | 44.31 | 74.00 | -29.69 |

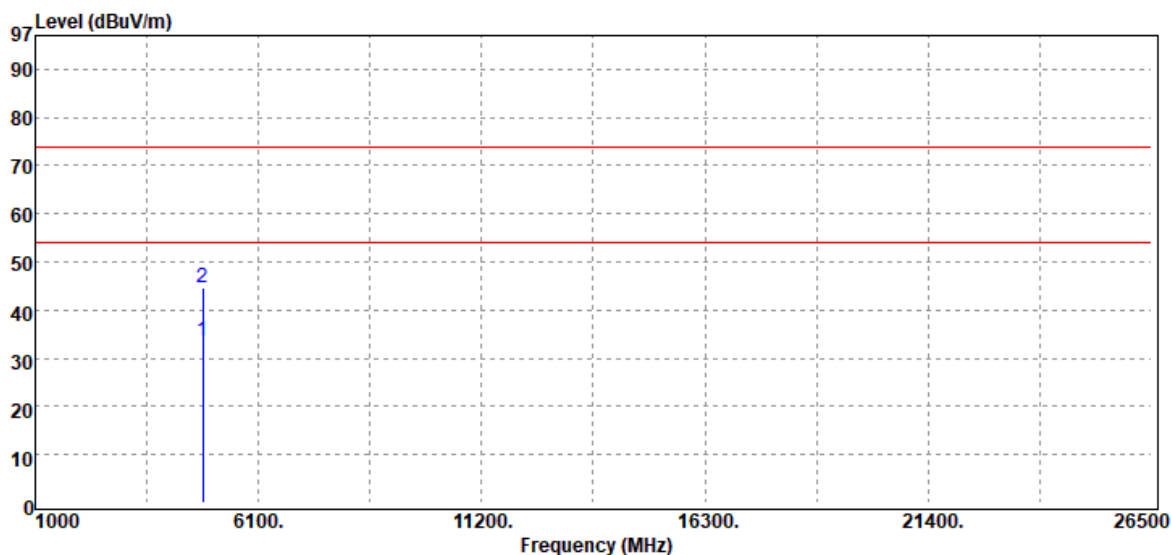
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2412 MHz
 Test Mode :Tx CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4824.00 | Average | 27.15 | 6.53 | 33.68 | 54.00 | -20.32 |
| 4824.00 | Peak | 38.13 | 6.53 | 44.66 | 74.00 | -29.34 |

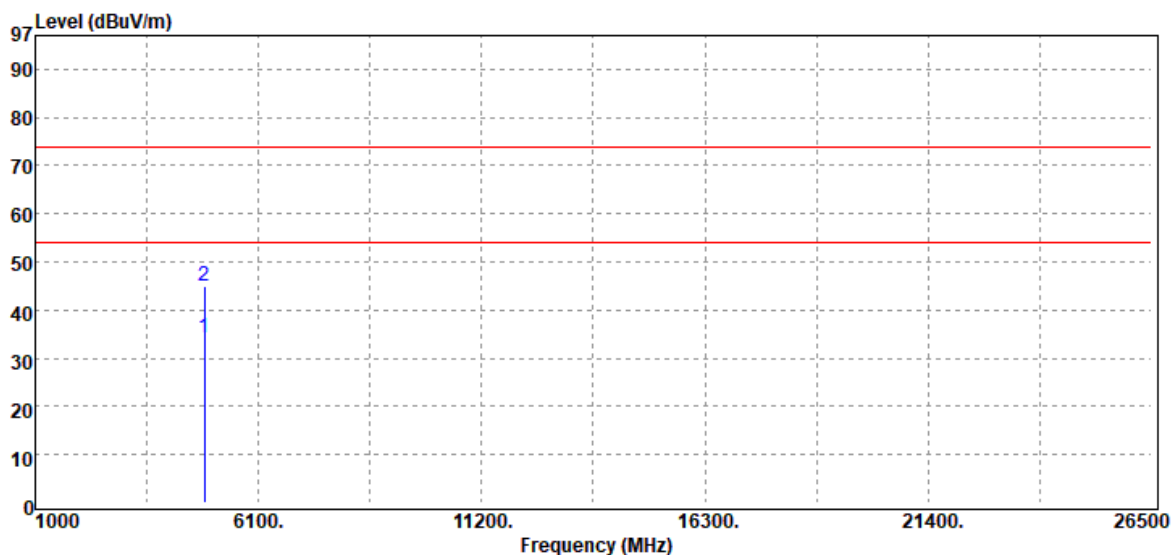
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Report Number :ER/2019/80073
Operation Mode :802.11b
Test Channel :2437 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :VERTICAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4874.00 | Average | 27.44 | 6.69 | 34.13 | 54.00 | -19.87 |
| 4874.00 | Peak | 38.19 | 6.69 | 44.88 | 74.00 | -29.12 |

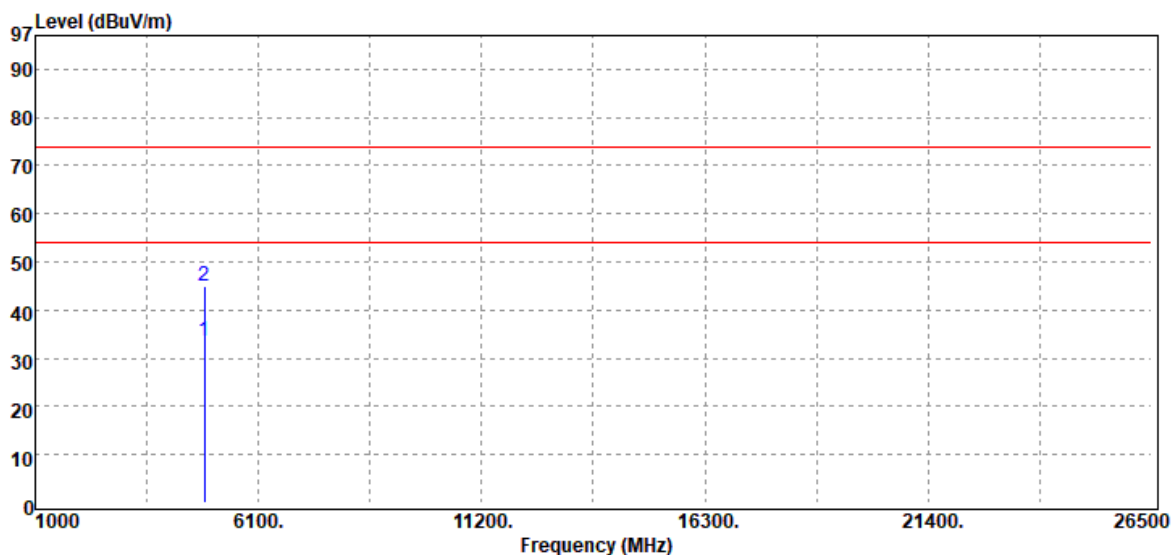
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4874.00 | Average | 26.84 | 6.69 | 33.53 | 54.00 | -20.47 |
| 4874.00 | Peak | 38.37 | 6.69 | 45.06 | 74.00 | -28.94 |

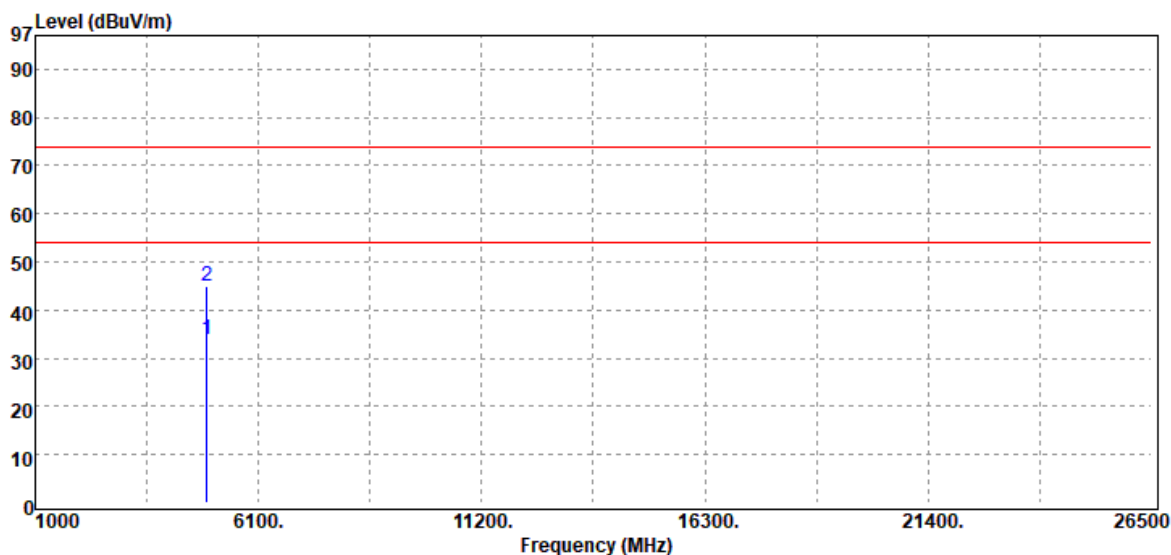
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2462 MHz
 Test Mode :Tx CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4924.00 | Average | 26.94 | 6.85 | 33.79 | 54.00 | -20.21 |
| 4924.00 | Peak | 38.24 | 6.85 | 45.09 | 74.00 | -28.91 |

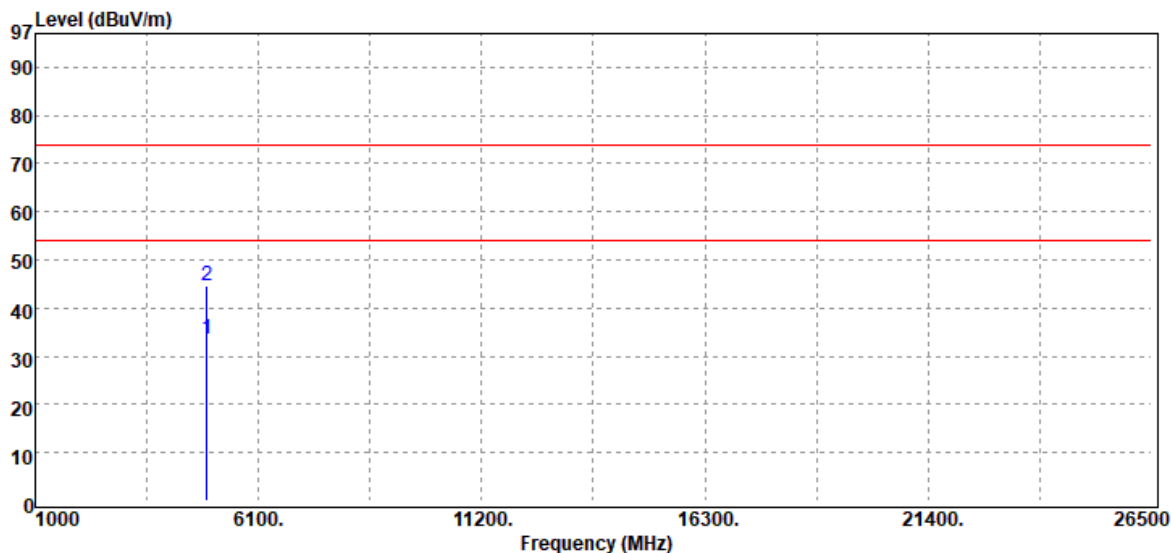
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Report Number :ER/2019/80073
 Operation Mode :802.11b
 Test Channel :2462 MHz
 Test Mode :Tx CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4924.00 | Average | 26.72 | 6.85 | 33.57 | 54.00 | -20.43 |
| 4924.00 | Peak | 37.69 | 6.85 | 44.54 | 74.00 | -29.46 |

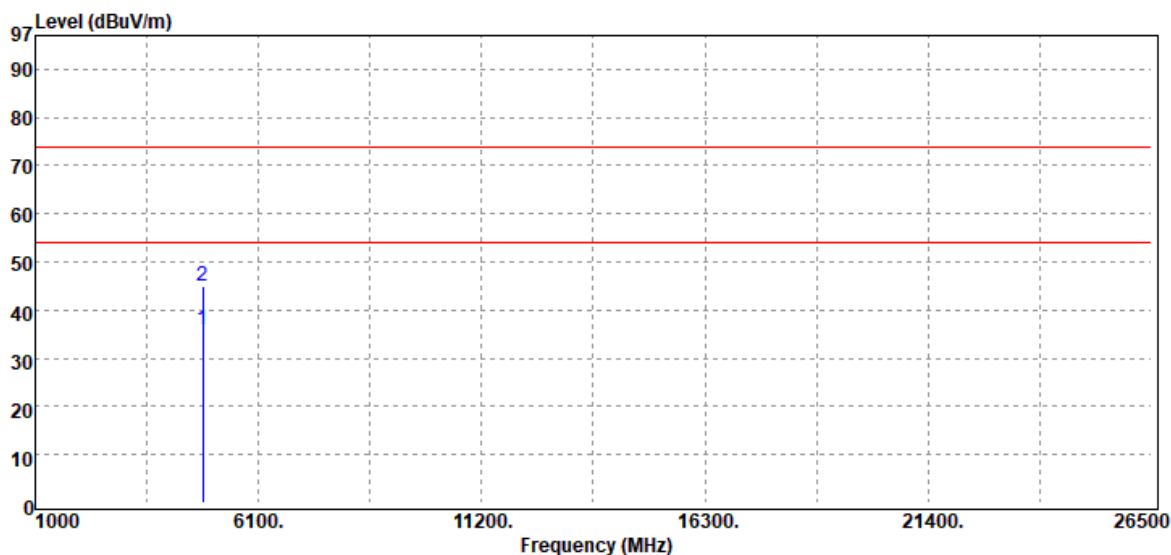
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2412 MHz
 Test Mode :Tx CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4824.00 | Average | 29.37 | 6.53 | 35.90 | 54.00 | -18.10 |
| 4824.00 | Peak | 38.50 | 6.53 | 45.03 | 74.00 | -28.97 |

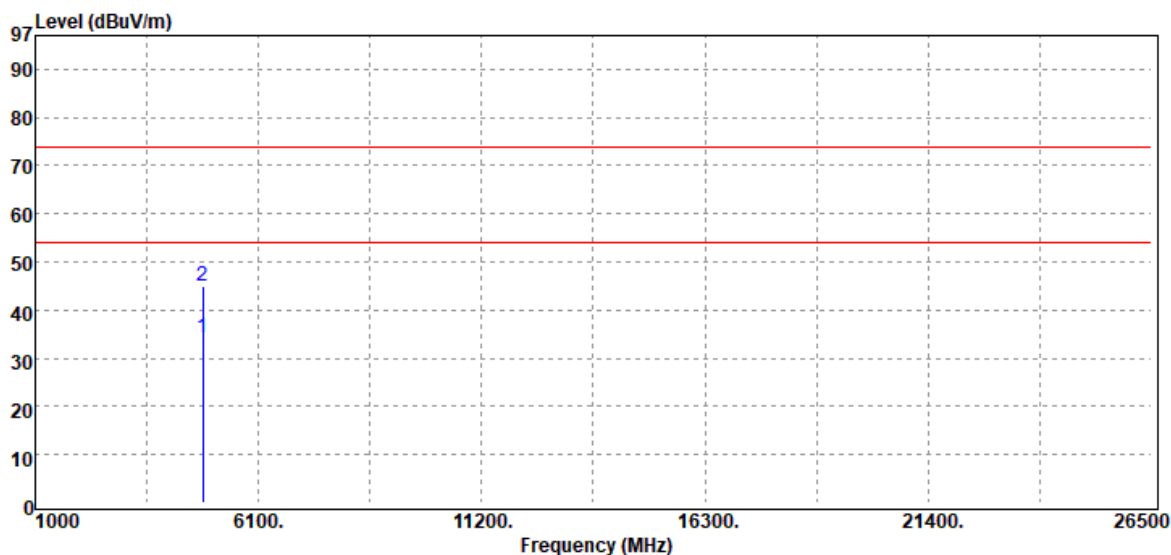
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Report Number :ER/2019/80073
Operation Mode :802.11g
Test Channel :2412 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2019-09-24
Temp./Humi. :24.4/57
Antenna Pol. :HORIZONTAL
Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4824.00 | Average | 27.86 | 6.53 | 34.39 | 54.00 | -19.61 |
| 4824.00 | Peak | 38.55 | 6.53 | 45.08 | 74.00 | -28.92 |

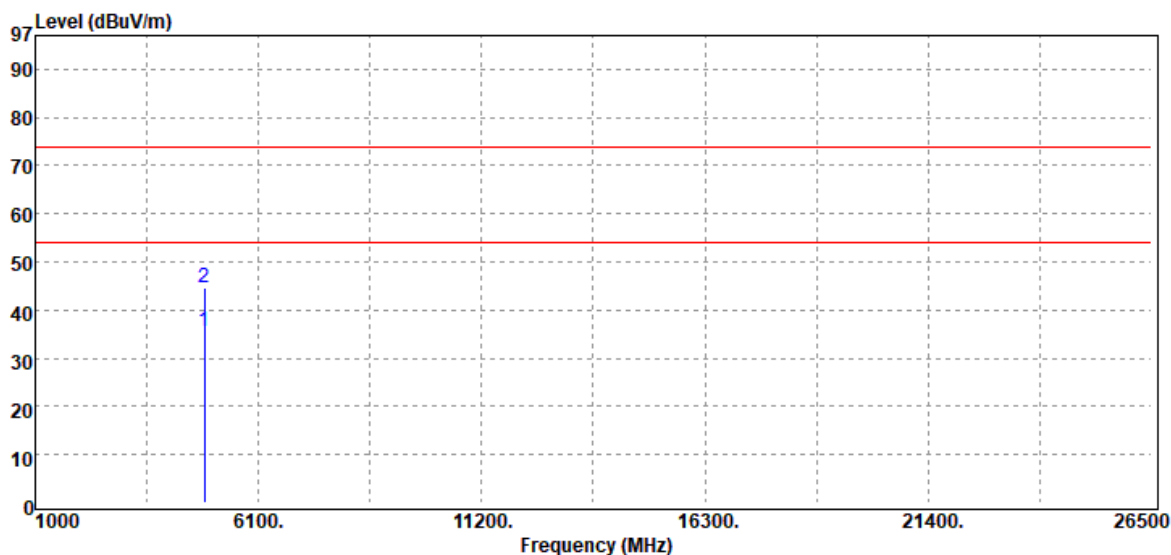
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4874.00 | Average | 29.03 | 6.69 | 35.72 | 54.00 | -18.28 |
| 4874.00 | Peak | 38.00 | 6.69 | 44.69 | 74.00 | -29.31 |

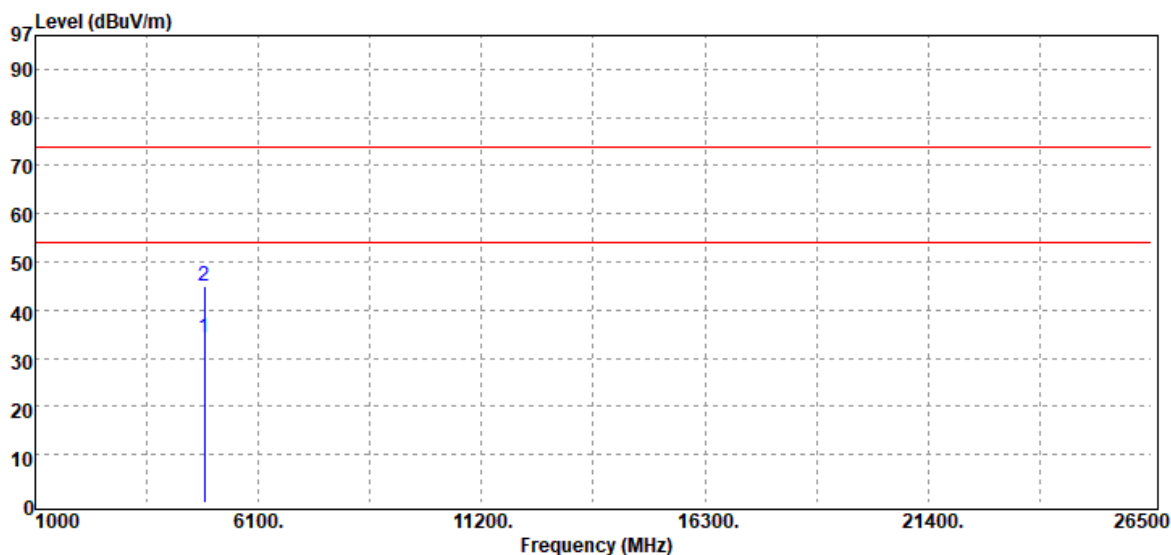
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4874.00 | Average | 27.64 | 6.69 | 34.33 | 54.00 | -19.67 |
| 4874.00 | Peak | 38.44 | 6.69 | 45.13 | 74.00 | -28.87 |

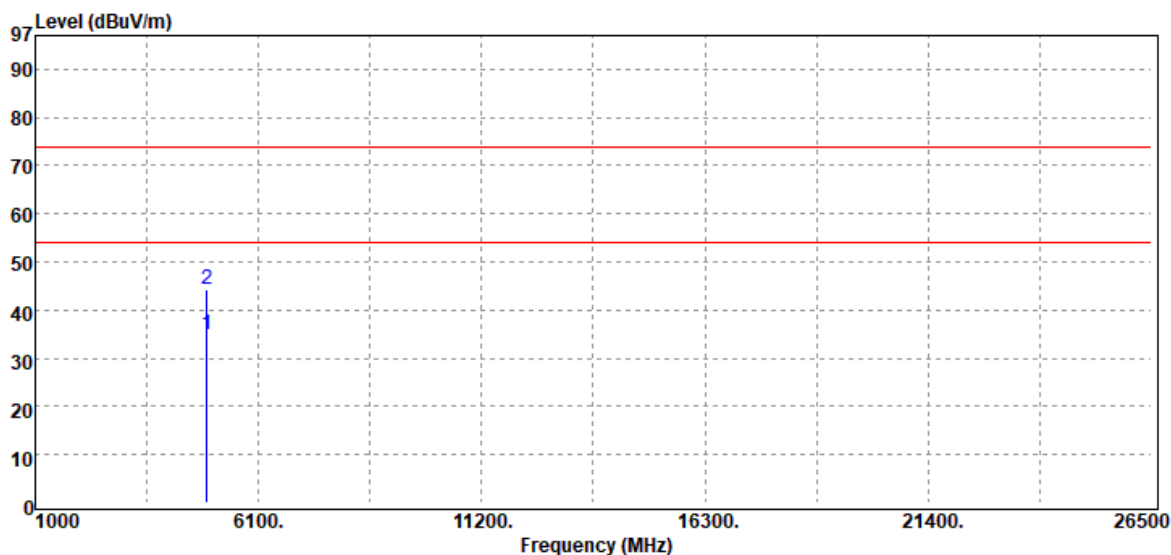
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Report Number :ER/2019/80073
 Operation Mode :802.11g
 Test Channel :2462 MHz
 Test Mode :Tx CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



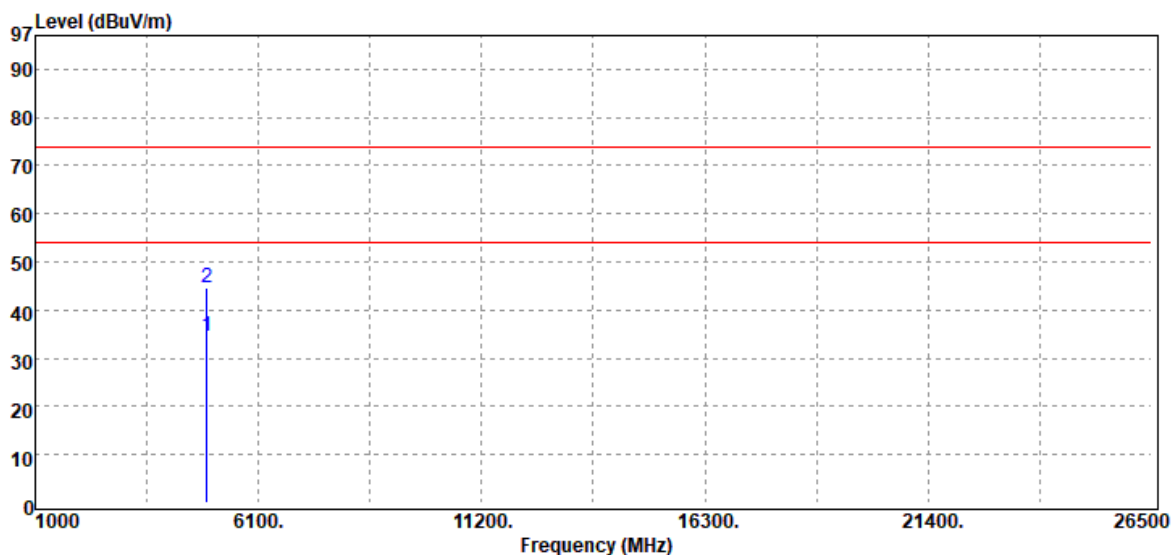
| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4924.00 | Average | 28.11 | 6.85 | 34.96 | 54.00 | -19.04 |
| 4924.00 | Peak | 37.57 | 6.85 | 44.42 | 74.00 | -29.58 |

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| | | | |
|----------------|----------------|--------------|-------------|
| Report Number | :ER/2019/80073 | Test Date | :2019-09-24 |
| Operation Mode | :802.11g | Temp./Humi. | :24.4/57 |
| Test Channel | :2462 MHz | Antenna Pol. | :HORIZONTAL |
| Test Mode | :Tx CH High | Engineer | :Kane |
| EUT Pol | :H Plane | | |



| Freq. | Detector | Spectrum | Factor | Actual | Limit | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz | Mode | Reading Level | | FS | @3m | |
| | PK/QP/AV | dB μ V | dB | dB μ V/m | dB μ V/m | dB |
| 4924.00 | Average | 27.87 | 6.85 | 34.72 | 54.00 | -19.28 |
| 4924.00 | Peak | 37.82 | 6.85 | 44.67 | 74.00 | -29.33 |

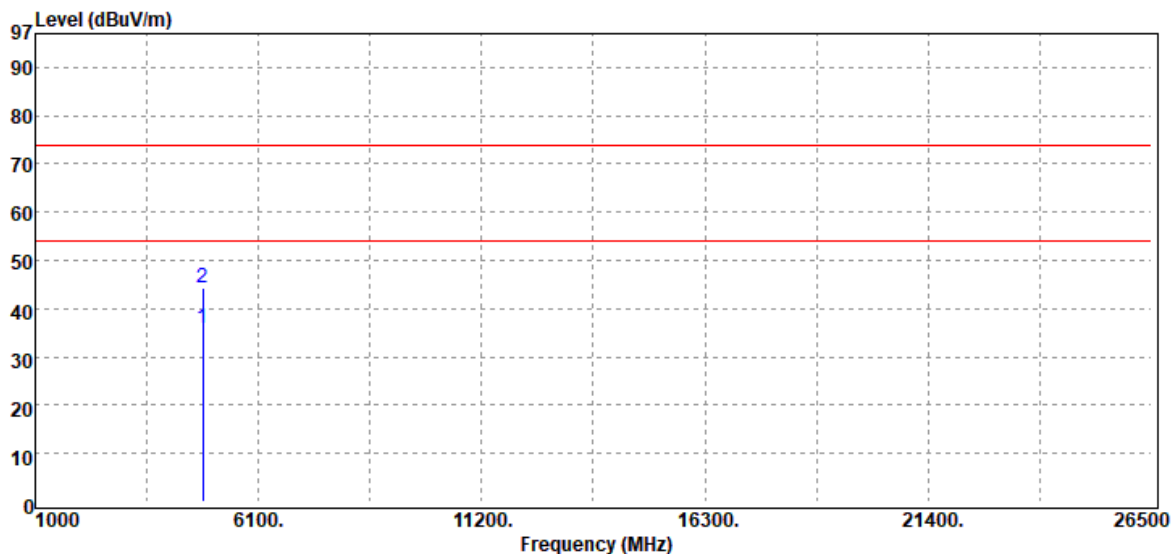
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2412 MHz
 Test Mode :Tx CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4824.00 | Average | 29.30 | 6.53 | 35.83 | 54.00 | -18.17 |
| 4824.00 | Peak | 37.79 | 6.53 | 44.32 | 74.00 | -29.68 |

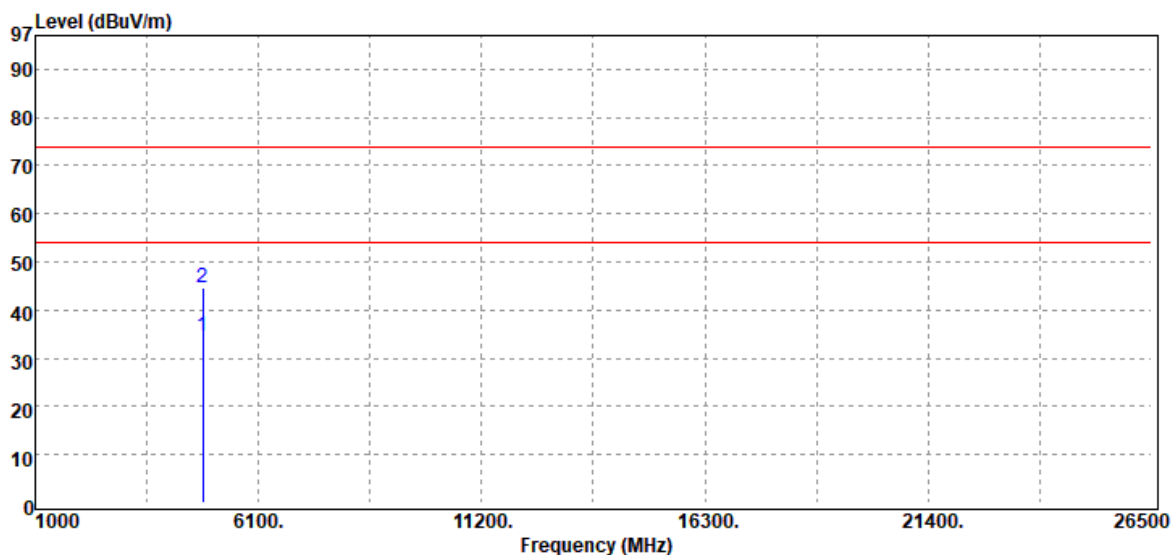
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2412 MHz
 Test Mode :Tx CH Low
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4824.00 | Average | 28.09 | 6.53 | 34.62 | 54.00 | -19.38 |
| 4824.00 | Peak | 38.24 | 6.53 | 44.77 | 74.00 | -29.23 |

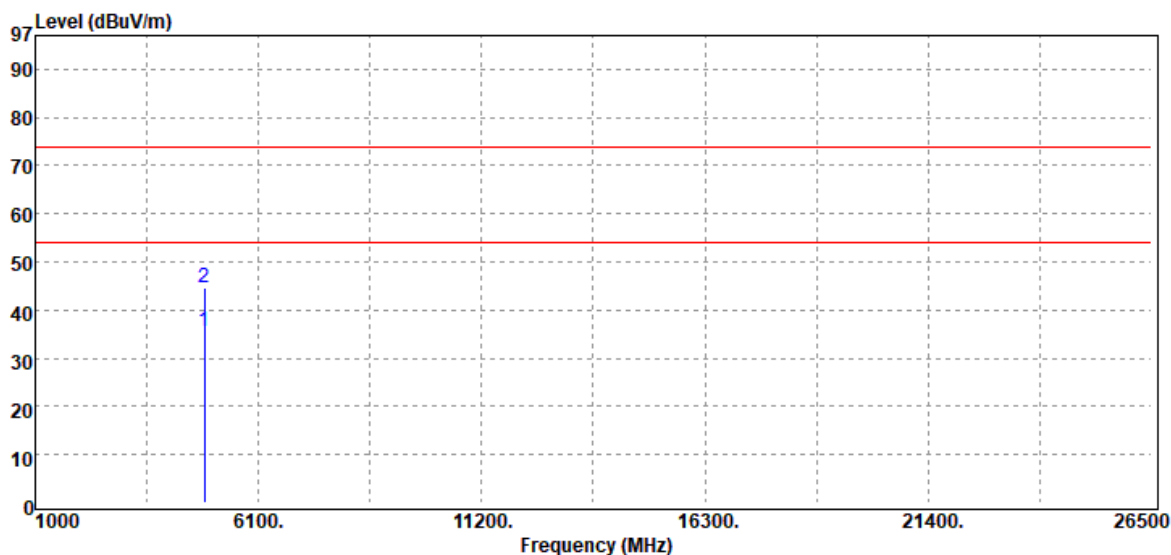
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4874.00 | Average | 28.94 | 6.69 | 35.63 | 54.00 | -18.37 |
| 4874.00 | Peak | 37.97 | 6.69 | 44.66 | 74.00 | -29.34 |

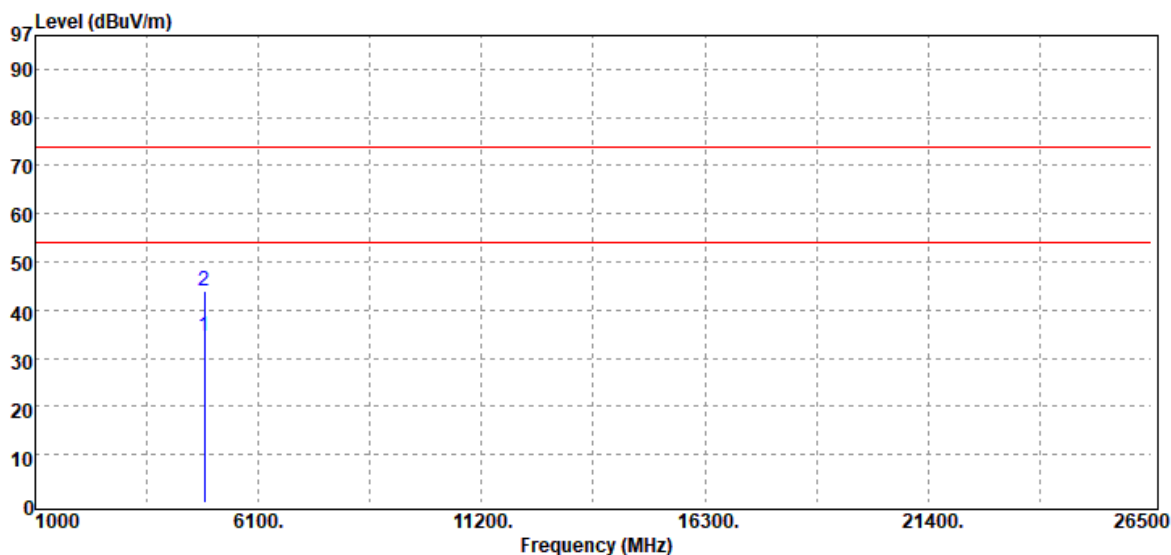
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2437 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4874.00 | Average | 27.73 | 6.69 | 34.42 | 54.00 | -19.58 |
| 4874.00 | Peak | 37.21 | 6.69 | 43.90 | 74.00 | -30.10 |

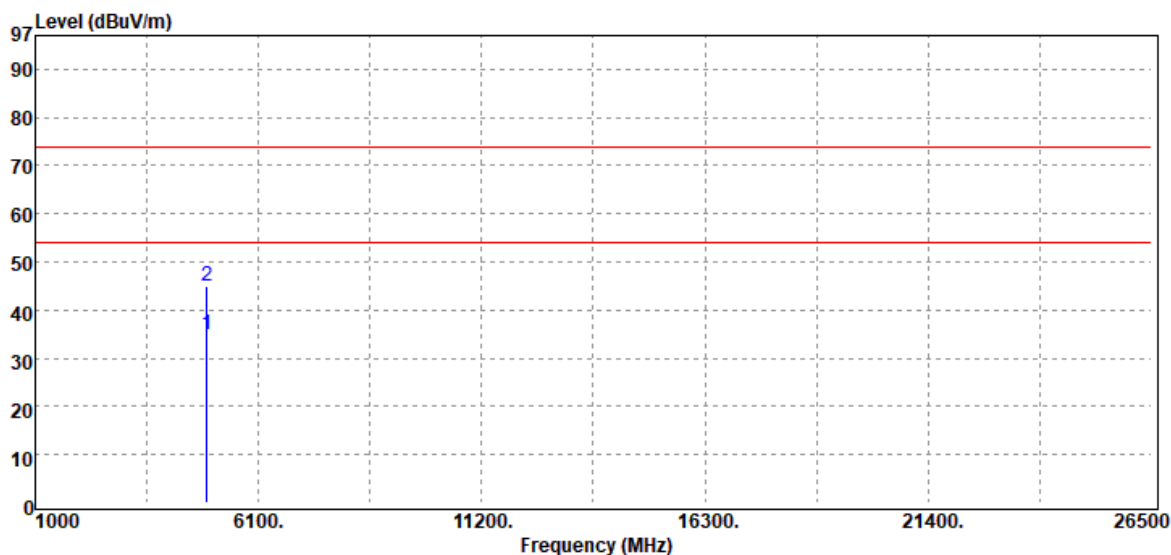
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2462 MHz
 Test Mode :Tx CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :VERTICAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4924.00 | Average | 28.00 | 6.85 | 34.85 | 54.00 | -19.15 |
| 4924.00 | Peak | 38.03 | 6.85 | 44.88 | 74.00 | -29.12 |

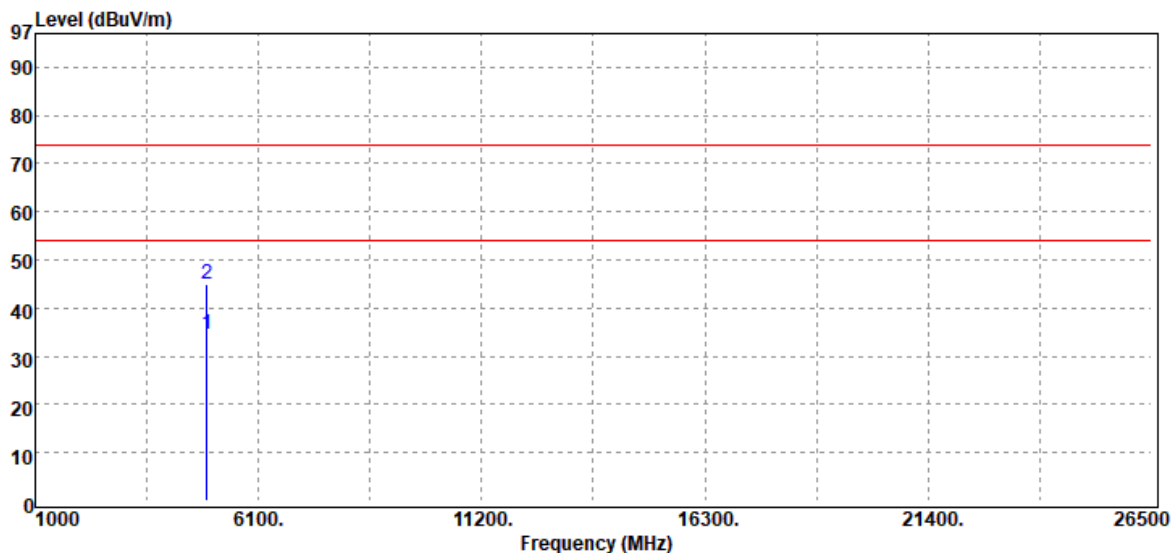
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Report Number :ER/2019/80073
 Operation Mode :802.11n20
 Test Channel :2462 MHz
 Test Mode :Tx CH High
 EUT Pol :H Plane

Test Date :2019-09-24
 Temp./Humi. :24.4/57
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4924.00 | Average | 27.67 | 6.85 | 34.52 | 54.00 | -19.48 |
| 4924.00 | Peak | 38.18 | 6.85 | 45.03 | 74.00 | -28.97 |

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12 POWER SPECTRAL DENSITY

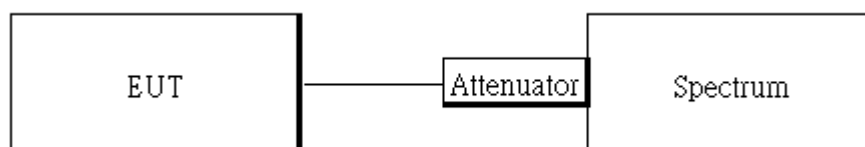
12.1 Standard Applicable

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/02/2019 | 05/01/2020 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 2 | 01/02/2019 | 01/01/2020 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2019 | 01/01/2020 |

12.3 Test Set-up



12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz & VBW = 10 kHz.
5. For defining Restricted Band Edge Limit:
Set the RBW = 100kHz & VBW = 300 kHz
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.

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12.5 Measurement Result

| POWER DENSITY 802.11b_Ch0 | | | |
|---------------------------|-------------------|---------------------|--------|
| Freq. (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Result |
| 2412 | -14.79 | 8.00 | PASS |
| 2437 | -13.25 | 8.00 | PASS |
| 2462 | -14.67 | 8.00 | PASS |

| POWER DENSITY 802.11g_Ch0 | | | |
|---------------------------|-------------------|---------------------|--------|
| Freq. (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Result |
| 2412 | -18.59 | 8.00 | PASS |
| 2437 | -18.49 | 8.00 | PASS |
| 2462 | -17.89 | 8.00 | PASS |

| POWER DENSITY 802.11n HT20_Ch0 | | | |
|--------------------------------|-------------------|---------------------|--------|
| Freq. (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Result |
| 2412 | -19.17 | 8.00 | PASS |
| 2437 | -19.31 | 8.00 | PASS |
| 2462 | -19.36 | 8.00 | PASS |

Note

Cable Loss 11.20 dB

*Refer to next page for plots

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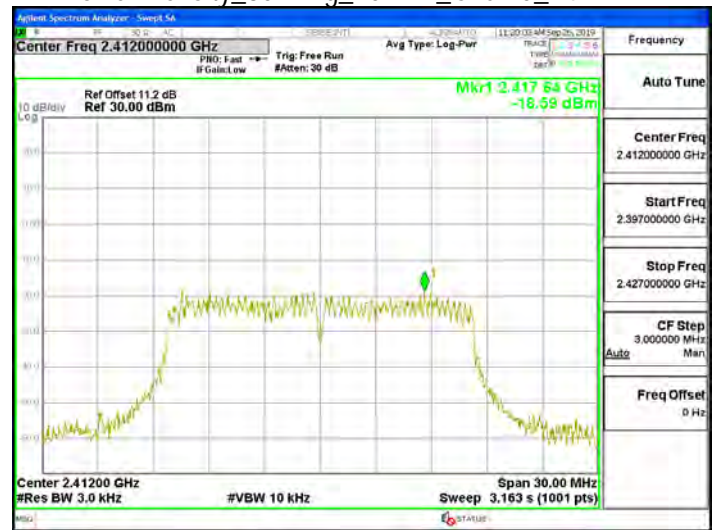
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Power Density_802.11b_20MHz_Chain0_2412MHz



Power Density_802.11g_20MHz_Chain0_2412MHz



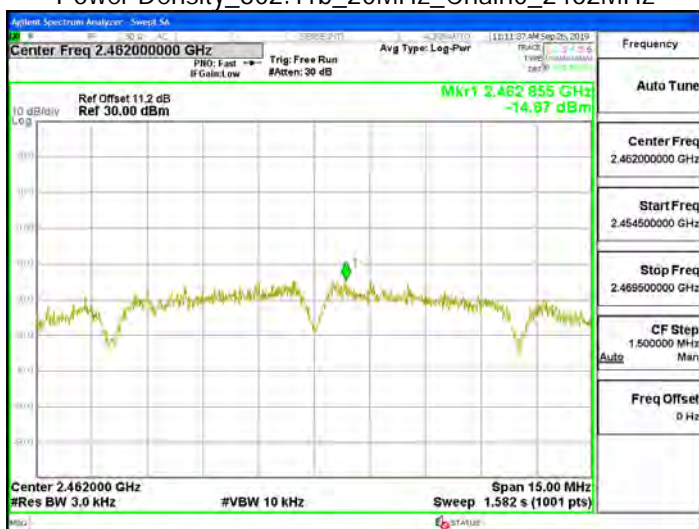
Power Density_802.11b_20MHz_Chain0_2437MHz



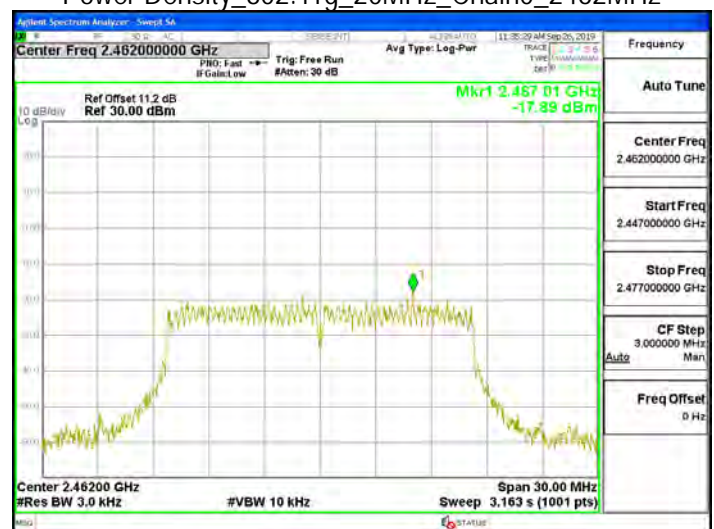
Power Density_802.11g_20MHz_Chain0_2437MHz



Power Density_802.11b_20MHz_Chain0_2462MHz



Power Density_802.11g_20MHz_Chain0_2462MHz



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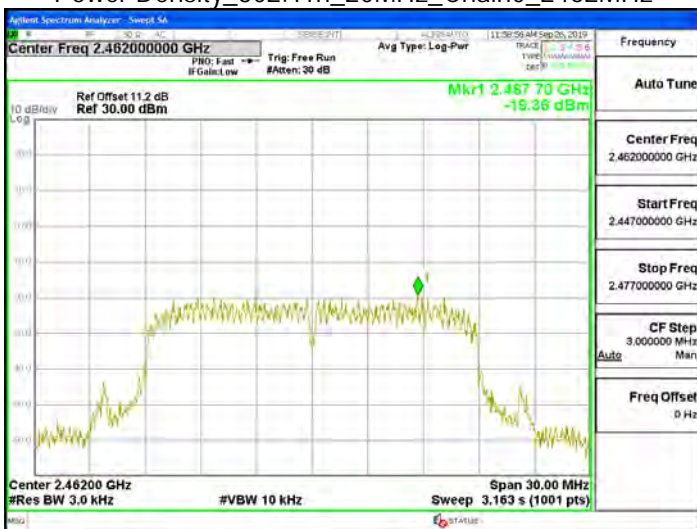
Power Density_802.11n_20MHz_Chain0_2412MHz



Power Density_802.11n_20MHz_Chain0_2437MHz



Power Density_802.11n_20MHz_Chain0_2462MHz



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13 ANTENNA REQUIREMENT

13.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

13.2 Antenna Connected Construction

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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