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# FLIR Commercial Systems Inc., Taiwan Branch

# TEST REPORT

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# Radio Spectrum
## TEST REPORT

| | |
|---|---|
| **Applicant:** | **FLIR Commercial Systems Inc., Taiwan Branch**<br>**10F., No.57, Zhouzi St., Neihu Dist., Taipei City 11493, Taiwan** |
| **Product:** | **MSX Borescope (with approved Li ion battery and Battery Charger)** |
| **Model No.:** | **VS290** |
| **Brand Name:** | **VS290 MSX Borescope** |
| **FCC ID:** | **2AXRO-VS290** |
| **Test Method/ Standard:** | **47 CFR FCC Part 15.247 & ANSI C63.10 2013**<br>**KDB 558074 D01 v05r02** |
| **Test By:** | **Intertek Testing Services Taiwan Ltd.,**<br>**Hsinchu Laboratory**<br>**No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,**<br>**Shiang-Shan District, Hsinchu City, Taiwan** |

Testing Laboratory
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# Revision History

| Report No. | Issue Date | Revision Summary |
|---|---|---|
| 200600283TWN-001 | Nov. 11, 2020 | Original report |

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## Summary of Test Data

| Test Requirement | Applicable Rule (Section 15.247) | Result |
|---|---|---|
| Minimum 6 dB Bandwidth | 15.247(a)(2) | Pass |
| Maximum Peak Conducted Output Power | 15.247(b)(3) | Pass |
| Power Spectral Density | 15.247(e) | Pass |
| Emissions In Non-Restricted Frequency Bands | 15.247(d) | Pass |
| Emissions In Restricted Frequency Bands (Radiated emission measurements) | 15.247(d), 15.205, 15.209 | Pass |
| Emission On The Band Edge | 15.247(d), 15.205 | Pass |
| AC Power Line Conducted Emission | 15.207 | Pass |
| Antenna Requirement | 15.203 | Pass |

Note: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.
Other Testing: the specification, standard and not taking into account the measurement uncertainty.

# 1. General Information

## 1.1 Identification of the EUT

| | |
|---|---|
| **Product:** | MSX Borescope (with approved Li ion battery and Battery Charger) |
| **Model No.:** | VS290 |
| **Operating Frequency:** | 2412 MHz ~ 2462 MHz for 802.11b, 802.11g, 802.11n HT20 |
| **Channel Number:** | 11 channels for 2412 MHz ~ 2462 MHz |
| **Frequency of Each Channel:** | 2412+5 k, k＝0 ~ 10 for 802.11b, 802.11g, 802.11n HT20 |
| **Access scheme:** | DSSS, OFDM |
| **Rated Power:** | DC 3.65V from battery<br>DC 5.35V from adapter |
| **Power Cord:** | N/A |
| **Sample receiving date:** | Jun. 16, 2020 |
| **Sample condition:** | Workable |
| **Test Date(s):** | Jun. 20, 2020 ~ Sep. 25, 2020 |

## 1.2 Adapter information

The EUT will be supplied with a power supply from below list:

| No. | Model no. | Specification |
|---|---|---|
| Adapter | PSAI10R-050Q | Input: 100-204Vac,0.3A, 50-60Hz<br>Output: 5.35Vdc, 2.0A |

## 1.3 Antenna description

Antenna Gain : 2.5 dBi
Antenna Type : PIFA antenna
Connector Type : I-Pex

### 1.4 Operation mode

EUT use TTL to USB cable connected to Notebook PC, executing “MCHPRT2 ver1.0” and select different frequency and modulation.

With individual verifying, the maximum output power were found out 1 Mbps data rate for 802.11b mode, 6 Mbps data rate for 802.11g mode, 6.5 Mbps data rate for 802.11n(HT20) mode , the final tests were executed under these conditions recorded in this report individually.

The signal is maximized through rotation and placement in the three orthogonal axes.

**X axis**

**Y axis**

**Z axis**

After verifying three axes, we found the maximum electromagnetic field was occurred at Z axis. The final test data was executed under this configuration.

| Modulation mode | Transmit path |
|---|---|
| | Chain 0 / Main |
| 802.11b | V |
| 802.11g | V |
| 802.11 n (HT20) | V |

### 1.5 Peripherals equipment

| Peripherals | Brand | Model No. | Serial No. | Data cable |
|---|---|---|---|---|
| Notebook PC | DELL | Latitude E5420 | HXYJBT1 | TTL to USB Cable 0.3 meter |

## 2. Minimum 6 dB Bandwidth

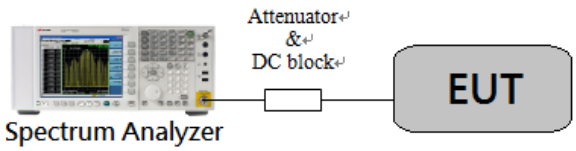
### 2.1 Instrument Setting

| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak |
| RBW | 100kHz |
| VBW | ≧3 x RBW |
| Sweep | Auto couple |
| Trace | Allow the trace to stabilize. |
| Span | Between two times and five times the occupied bandwidth |
| Attenuation | Auto |

### 2.2 Test Procedure

| | |
|---|---|
| Step 1 | The transmitter output was connected to the spectrum analyzer. |
| Step 2 | Test was performed accordance with ANSI C63.10. |
| Step 3 | Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission |

### 2.3 Test Diagram




### 2.4 Limit

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

### 2.5 Operating Environment Condition

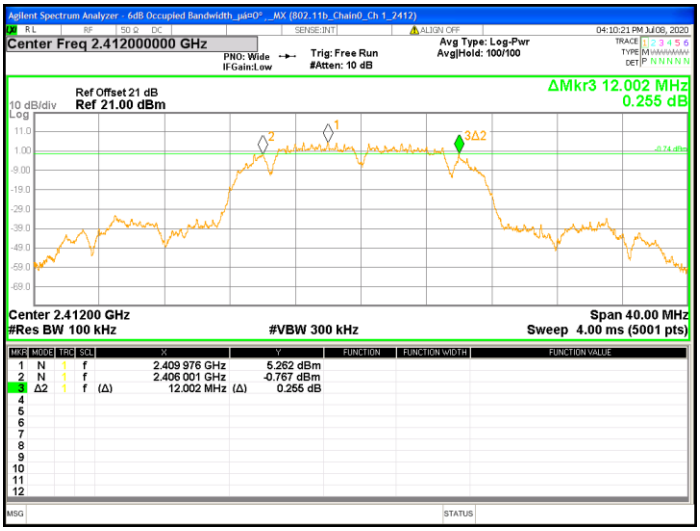
| | |
|---|---|
| Temperature (℃) : | 27 |
| Relative Humidity (%) : | 55 |
| Test date : | 2020/07/08 |

## 2.6 Test Results

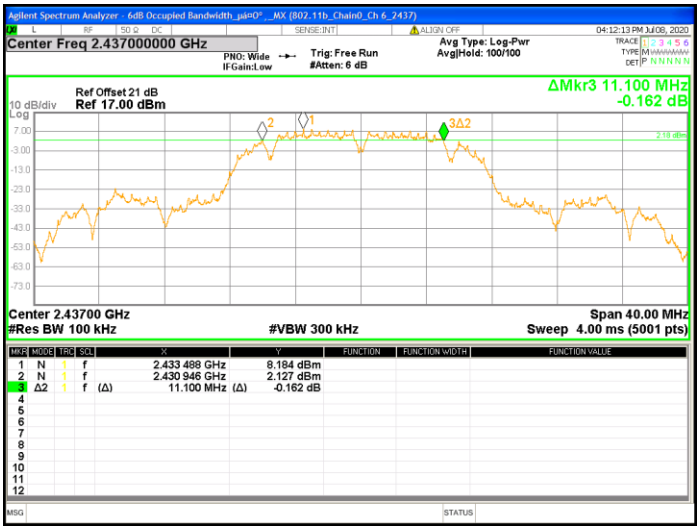
**Chain 0**

| Mode | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|---|
| 802.11b | 1 | 2412 | 12.00 | >0.5 | Pass |
| | 6 | 2437 | 11.10 | >0.5 | Pass |
| | 11 | 2462 | 11.11 | >0.5 | Pass |
| 802.11g | 1 | 2412 | 15.93 | >0.5 | Pass |
| | 6 | 2437 | 16.33 | >0.5 | Pass |
| | 11 | 2462 | 15.70 | >0.5 | Pass |
| 802.11n(HT20) | 1 | 2412 | 16.32 | >0.5 | Pass |
| | 6 | 2437 | 16.95 | >0.5 | Pass |
| | 11 | 2462 | 16.71 | >0.5 | Pass |

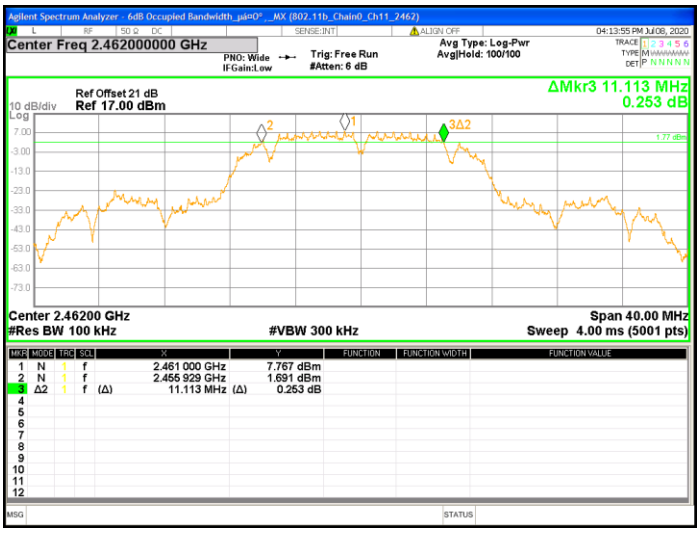
## Chain 0: 6dB Bandwidth @ 802.11b Mode Ch 1



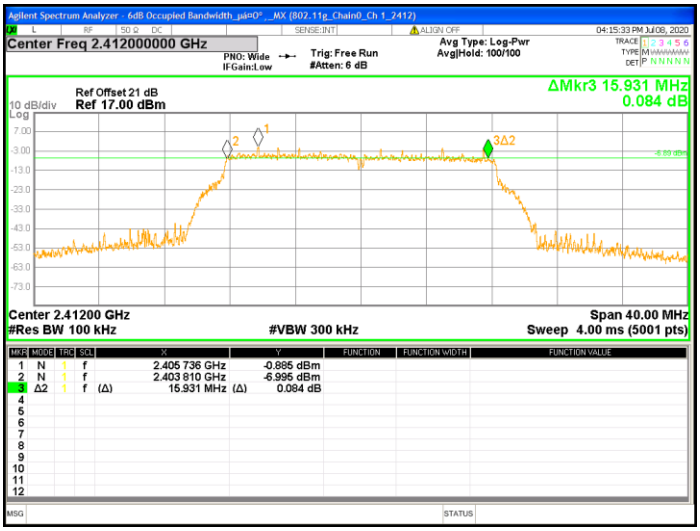

## Chain 0: 6dB Bandwidth @ 802.11b Mode Ch 6



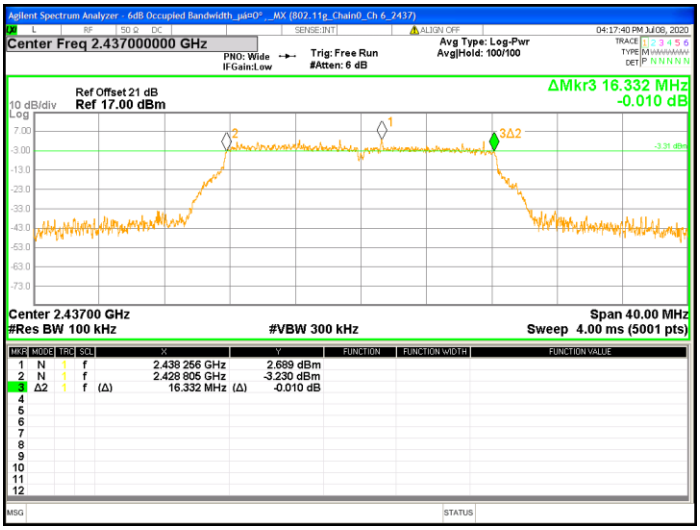

## Chain 0: 6dB Bandwidth @ 802.11b Mode Ch11



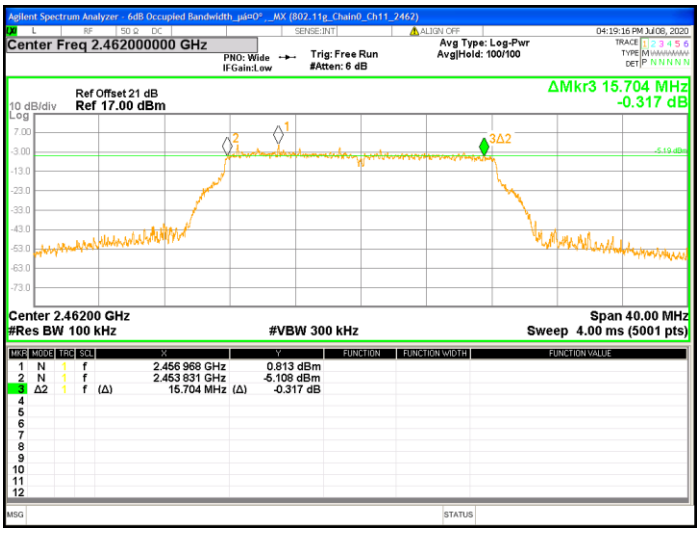
## Chain 0: 6dB Bandwidth @ 802.11g Mode Ch 1



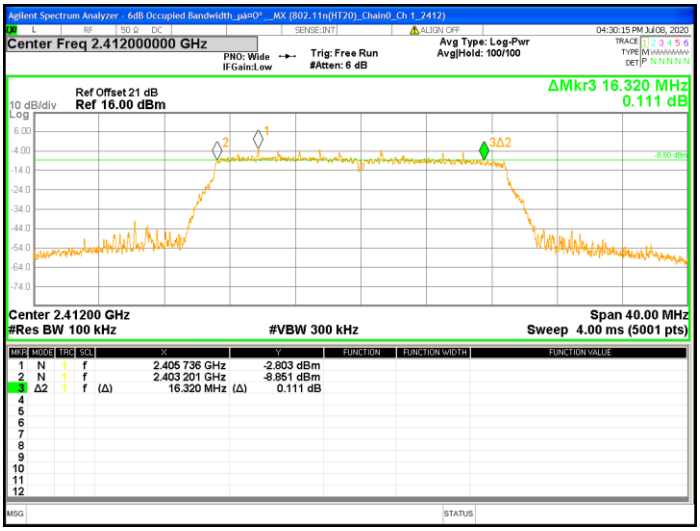

## Chain 0: 6dB Bandwidth @ 802.11g Mode Ch 6



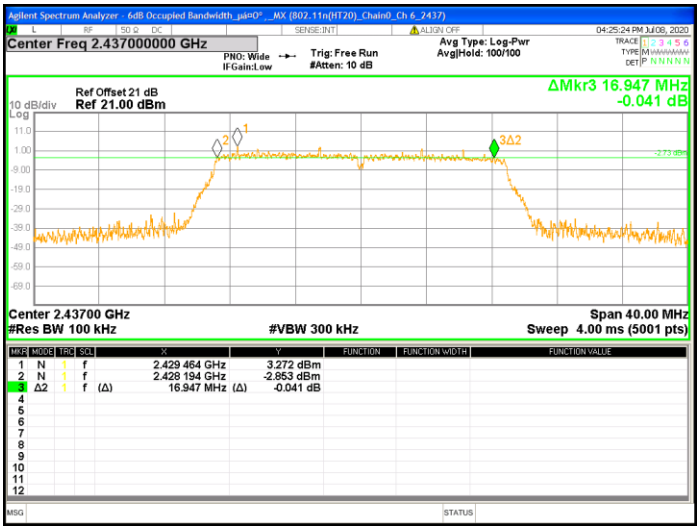

## Chain 0: 6dB Bandwidth @ 802.11g Mode Ch11



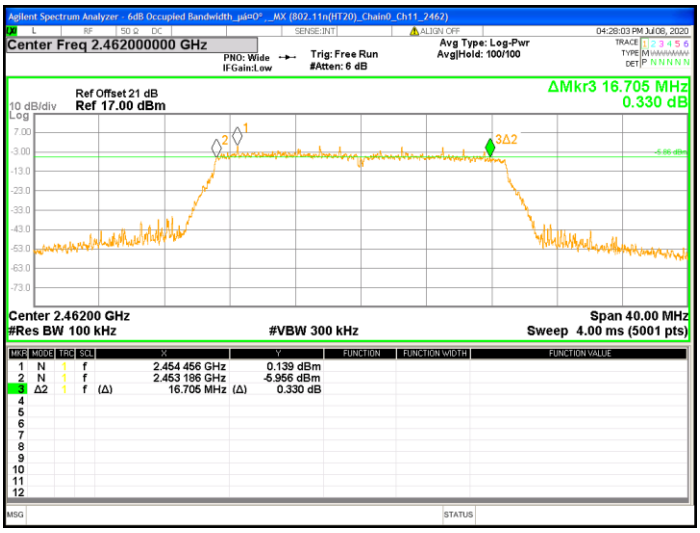
## Chain 0: 6dB Bandwidth @ 802.11n(HT20) Mode Ch 1




## Chain 0: 6dB Bandwidth @ 802.11n(HT20) Mode Ch 6




## Chain 0: 6dB Bandwidth @ 802.11n(HT20) Mode Ch11



## 3. Maximum Peak Conducted Output Power

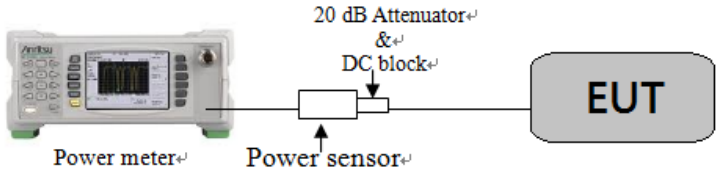
### 3.1 Instrument Setting

| Power Meter Parameter | Setting |
|---|---|
| Bandwidth | 65MHz bandwidth is greater than the EUT emission bandwidth |
| Detector | Peak & Average |

### 3.2Test Procedure

The preferred methodology is to use integrated average power measurements, as described in 11.9.2 and 11.13.3 of ANSI C63.10. The peak integrated band power methods of 11.9.1.2 and 11.13.3.2 of ANSI C63.10 are not applicable for FCC compliance testing purposes.

### 3.3 Test Diagram




### 3.4 Limit

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

### 3.5 Operating Environment Condition

| | |
|---|---|
| Temperature (℃) : | 27 |
| Relative Humidity (%) : | 55 |
| Test date : | 2020/07/08 |

### 3.6 Test Results

| Mode | Channel | Frequency (MHz) | Data Rate (Mbps) | Output Power (AV) (dBm) | Total Power (AV) (mW) | Maximum power (PK) (dBm) | Maximum power (PK) (mW) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 802.11b | 1 | 2412 | 1 | 16.04 | 40.18 | 18.71 | 74.30 | 30 | -11.29 |
| | 6 | 2437 | | 18.45 | 69.98 | 20.91 | 123.31 | 30 | -9.09 |
| | 11 | 2462 | | 18.52 | 71.12 | 20.96 | 124.74 | 30 | -9.04 |
| 802.11g | 1 | 2412 | 6 | 10.37 | 10.89 | 19.00 | 79.43 | 30 | -11.00 |
| | 6 | 2437 | | 14.51 | 28.25 | 22.61 | 182.39 | 30 | -7.39 |
| | 11 | 2462 | | 11.43 | 13.90 | 20.23 | 105.44 | 30 | -9.77 |
| 802.11n (HT20) | 1 | 2412 | 6.5 | 8.13 | 6.50 | 16.70 | 46.77 | 30 | -13.30 |
| | 6 | 2437 | | 14.38 | 27.42 | 22.24 | 167.49 | 30 | -7.76 |
| | 11 | 2462 | | 11.27 | 13.40 | 20.06 | 101.39 | 30 | -9.94 |

## 4. Power Spectral Density

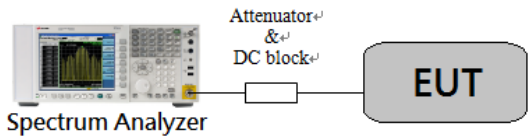
### 4.1 Instrument Setting

| Spectrum Function | Setting |
|---|---|
| Detector | Peak |
| RBW | ≧3 kHz |
| VBW | ≧3 x RBW |
| Sweep | Auto couple |
| Trace | Max hold |
| Span | 1.5 times x 6dB bandwidth |
| Attenuation | Auto |

### 4.2 Test Procedure

| | |
|---|---|
| Step 1 | Test procedure refer to subclause 11.10 of ANSI C63.10. |
| Step 2 | Using the maximum conducted output power in the fundamental emission demonstrates compliance. The EUT must be configured to transmit continuously at full power over the measurement duration. |
| Step 3 | Use the peak marker function to determine the maximum amplitude level within the RBW. |

### 4.3 Test Diagram




### 4.4 Limit

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

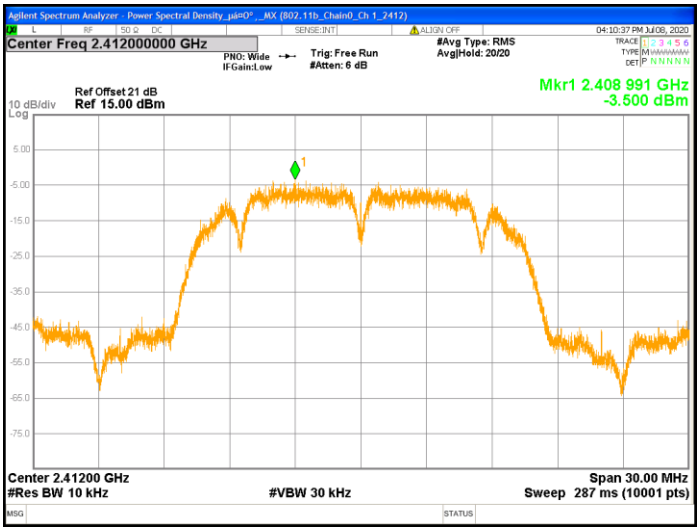
### 4.5 Operating Environment Condition

| | |
|---|---|
| Temperature (℃) : | 27 |
| Relative Humidity (%) : | 55 |
| Test date : | 2020/07/08 |

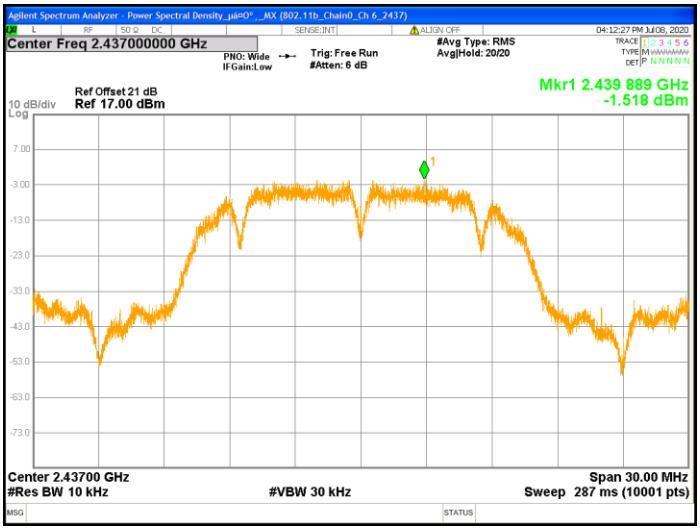
## 4.6 Test Results

| Mode | Channel | Frequency (MHz) | RBW factor | PSD in 10kHz | PSD in 3kHz | | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| | | | | | (dBm) | (mw) | | |
| 802.11b | 1 | 2412 | 5.23 | -3.50 | -8.73 | 0.13 | 8 | -16.73 |
| | 6 | 2437 | 5.23 | -1.52 | -6.75 | 0.21 | 8 | -14.75 |
| | 11 | 2462 | 5.23 | -0.04 | -5.27 | 0.30 | 8 | -13.27 |
| 802.11g | 1 | 2412 | 5.23 | -9.60 | -14.83 | 0.03 | 8 | -22.83 |
| | 6 | 2437 | 5.23 | -6.08 | -11.31 | 0.07 | 8 | -19.31 |
| | 11 | 2462 | 5.23 | -8.62 | -13.85 | 0.04 | 8 | -21.85 |
| 802.11n(HT20) | 1 | 2412 | 5.23 | -11.41 | -16.63 | 0.02 | 8 | -24.63 |
| | 6 | 2437 | 5.23 | -5.55 | -10.78 | 0.08 | 8 | -18.78 |
| | 11 | 2462 | 5.23 | -7.96 | -13.19 | 0.05 | 8 | -21.19 |

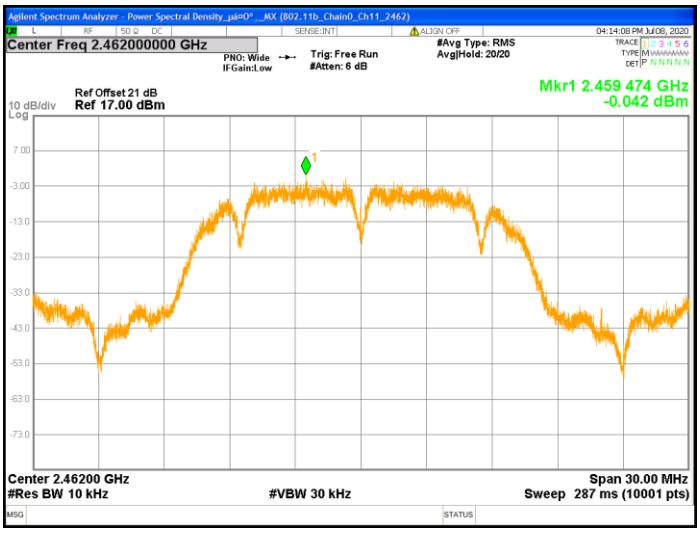
## Chain 0: Power Spectral Density @ 802.11b Mode Ch 1



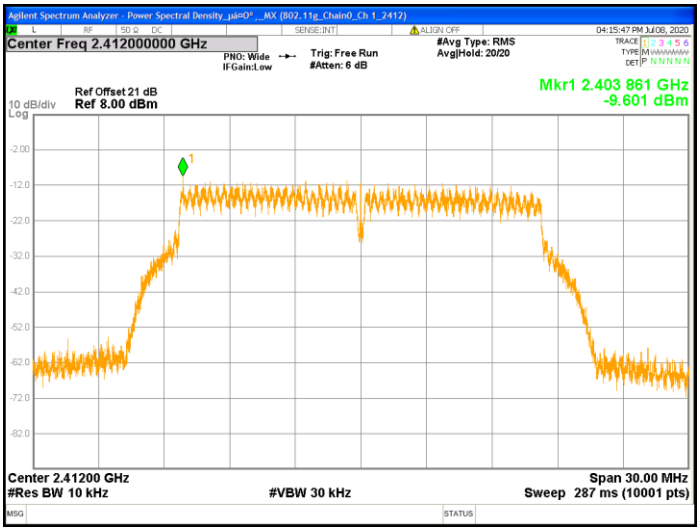

## Chain 0: Power Spectral Density @ 802.11b Mode Ch 6



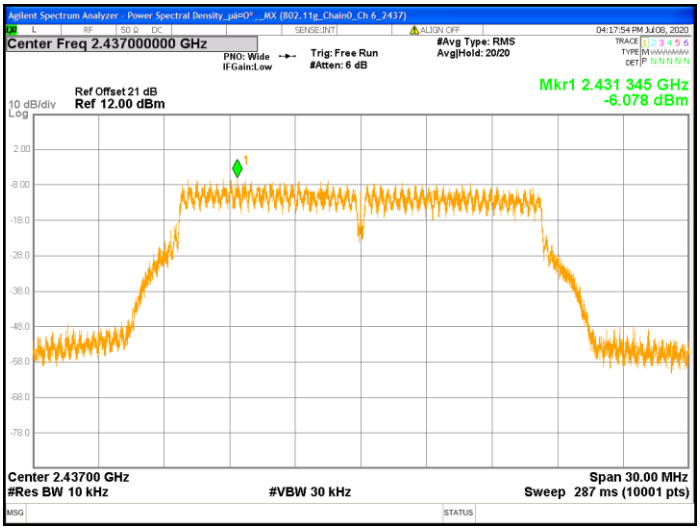

## Chain 0: Power Spectral Density @ 802.11b Mode Ch11



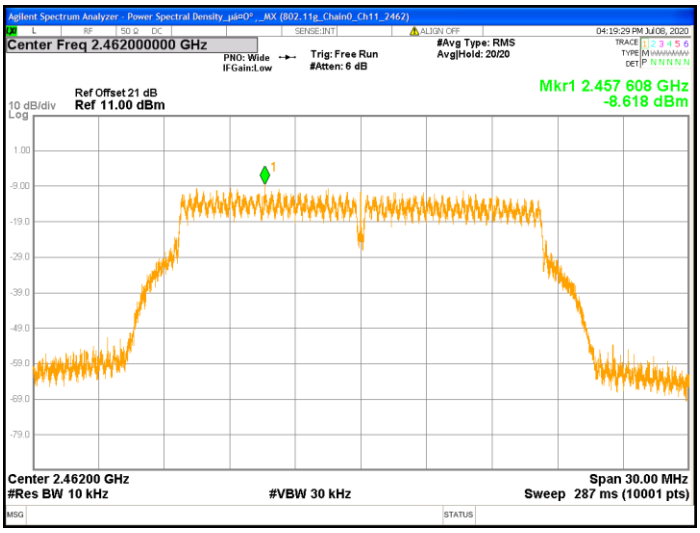
## Chain 0: Power Spectral Density @ 802.11g Mode Ch 1



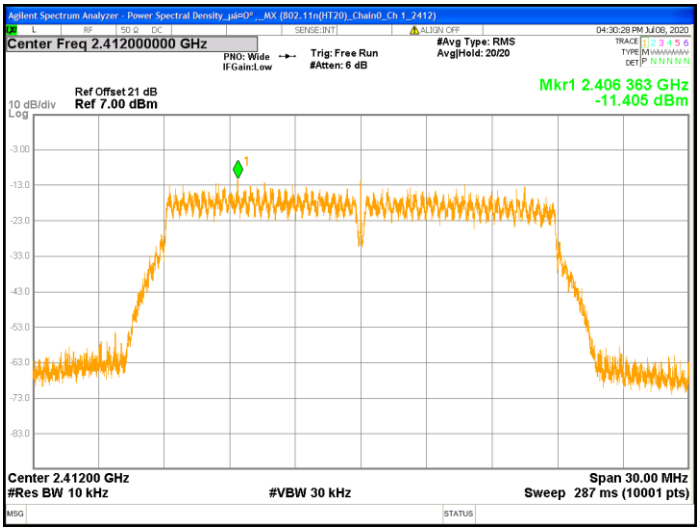

## Chain 0: Power Spectral Density @ 802.11g Mode Ch 6



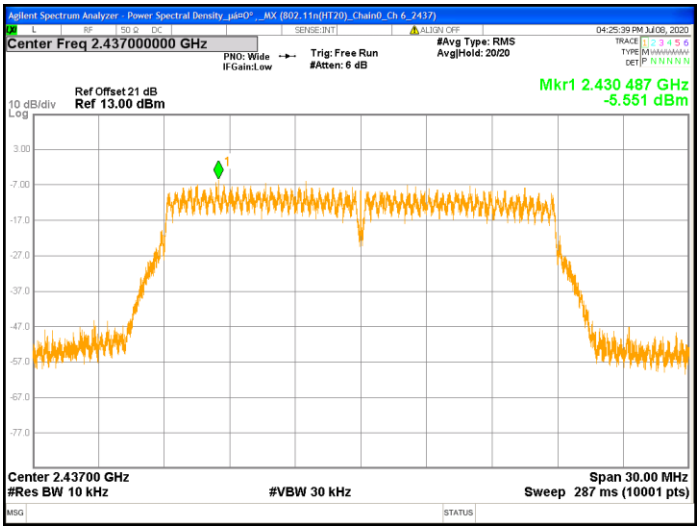

## Chain 0: Power Spectral Density @ 802.11g Mode Ch11



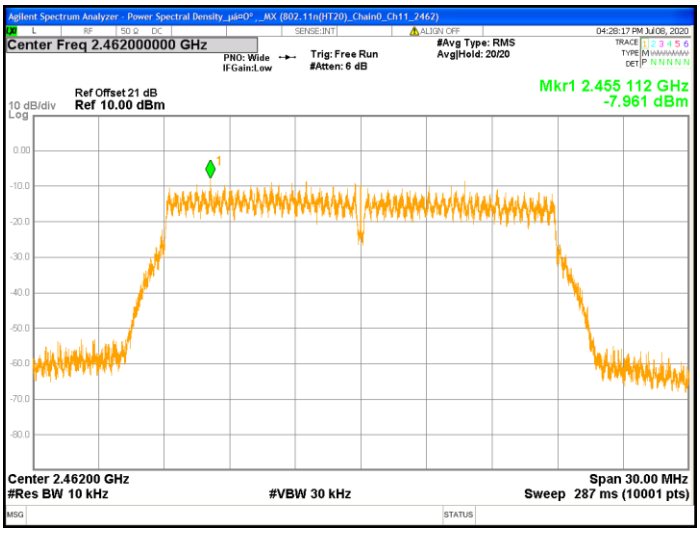
## Chain 0: Power Spectral Density @ 802.11n(HT20) Mode Ch 1




## Chain 0: Power Spectral Density @ 802.11n(HT20) Mode Ch 6




## Chain 0: Power Spectral Density @ 802.11n(HT20) Mode Ch11



## 5. Emissions in Non-Restricted Frequency Bands

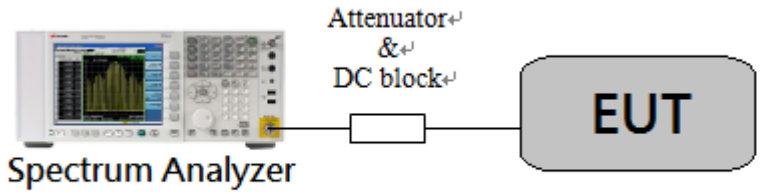
### 5.1 Instruments Setting

| Spectrum Function | Setting (Reference Level) | Setting (Emission Level) |
|---|---|---|
| Detector | Peak | Peak |
| RBW | ≧100 kHz | ≧100 kHz |
| VBW | ≧3 x RBW | ≧3 x RBW |
| Sweep | Auto couple | Auto couple |
| Trace | Max hold | Max hold |
| Span | ≧1.5 time 6dB bandwidth | |
| Attenuation | Auto | Auto |

### 5.2 Test Procedure

Step 1 The procedure was used in antenna-port conducted and connected to the spectrum analyzer.
Step 2 Set instrument center frequency to center frequency.
Step 3 Use the parameter configured in subclause 11.11 of ANSI C63.10 to measure.
Step 4 Use the peak marker function to determine the maximum amplitude level.

### 5.3 Test Diagram




### 5.4 Limit

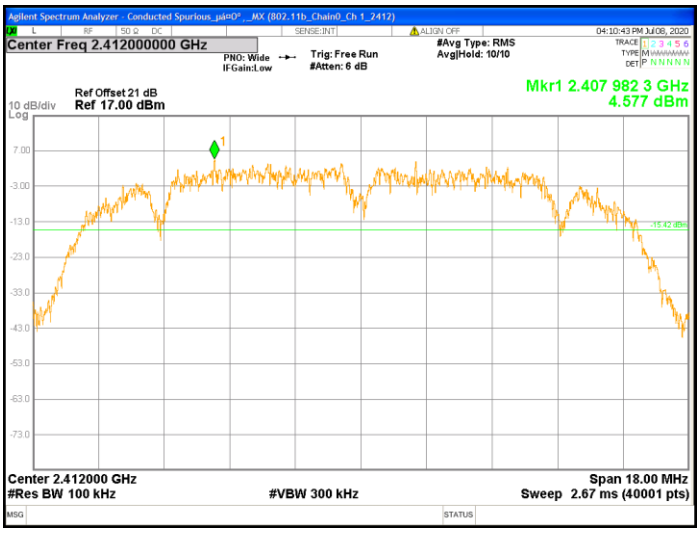
The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz

### 5.5 Operating Environment Condition

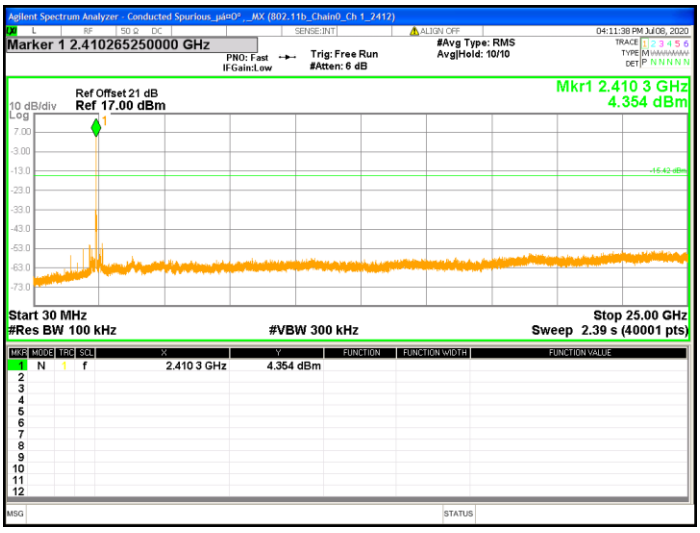
| | |
|---|---|
| Temperature (℃) : | 26 |
| Relative Humidity (%) : | 58 |
| Test date : | 2020/07/08 |

## 5.6 Test Results

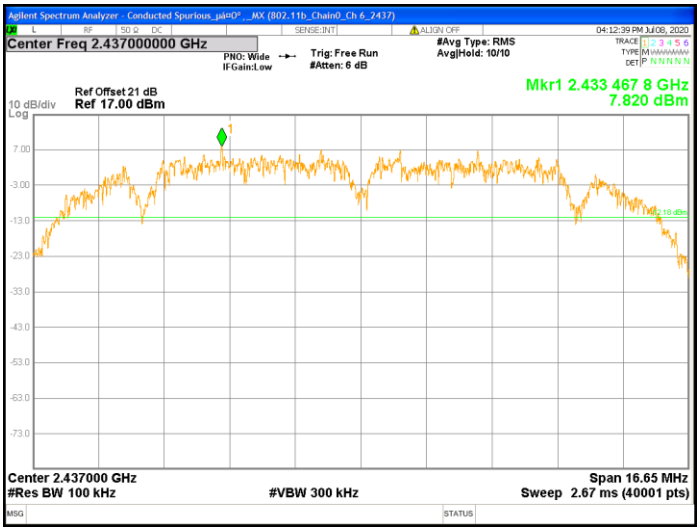
### Chain 0: Conducted Spurious @ 802.11b Mode Ch 1



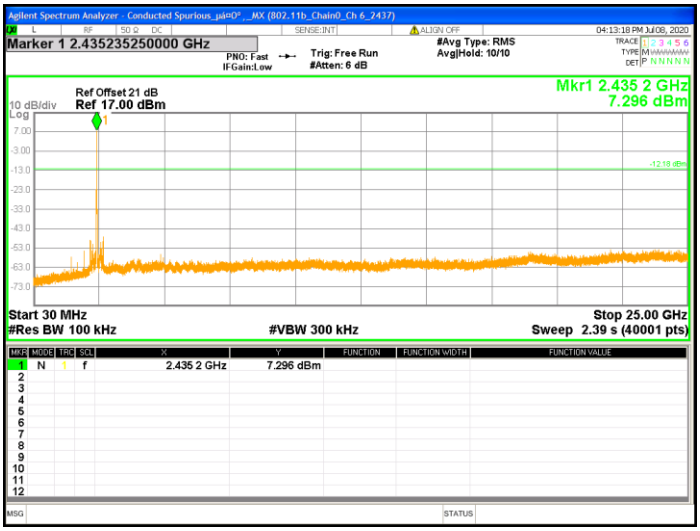

### Chain 0: Conducted Spurious @ 802.11b Mode Ch 1



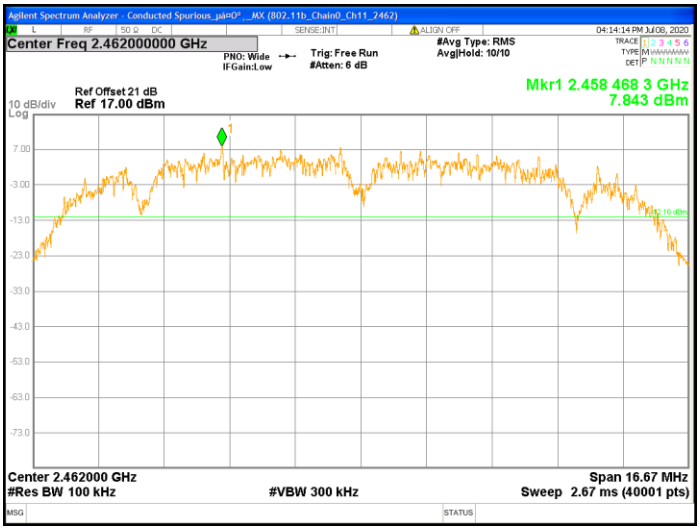

### Chain 0: Conducted Spurious @ 802.11b Mode Ch 6



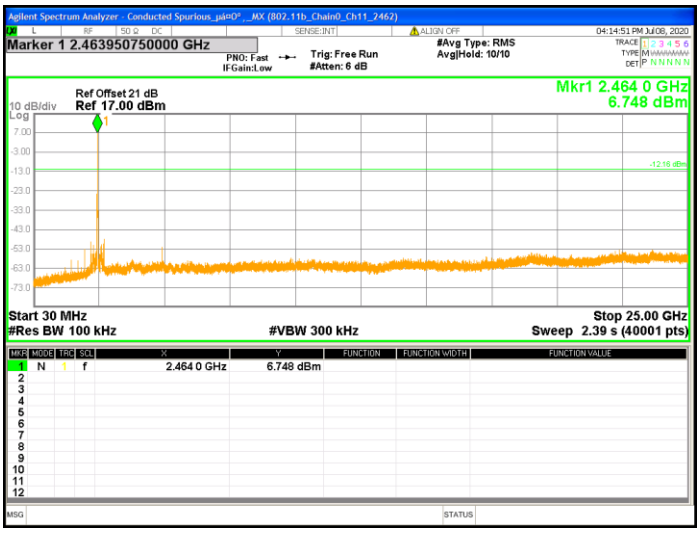
## Chain 0: Conducted Spurious @ 802.11b Mode Ch 6



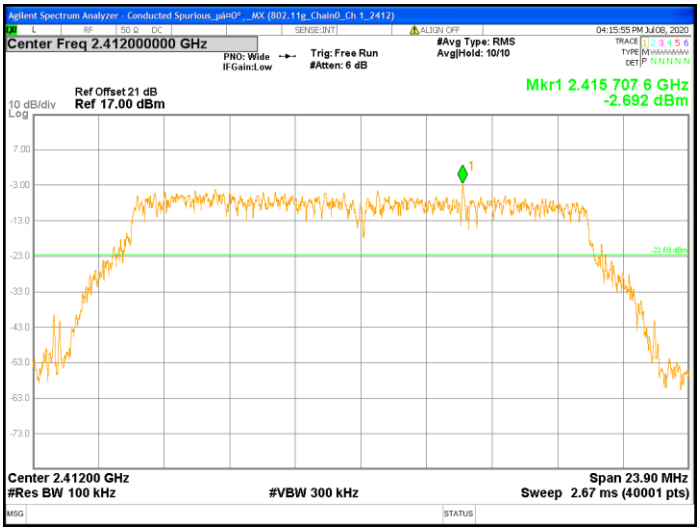

## Chain 0: Conducted Spurious @ 802.11b Mode Ch11



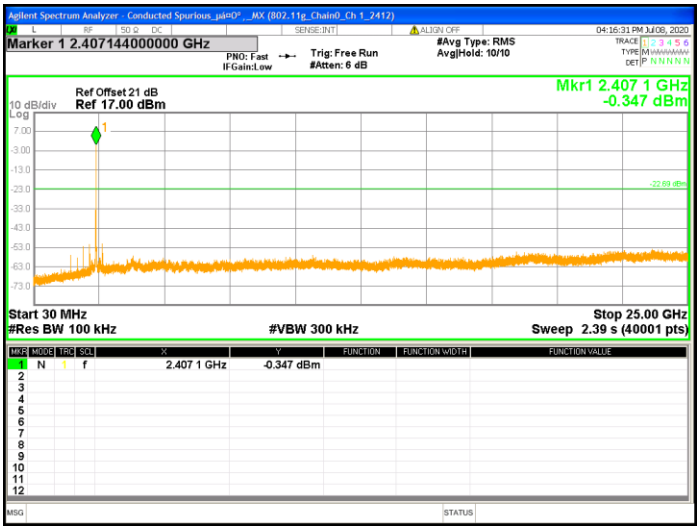

## Chain 0: Conducted Spurious @ 802.11b Mode Ch11



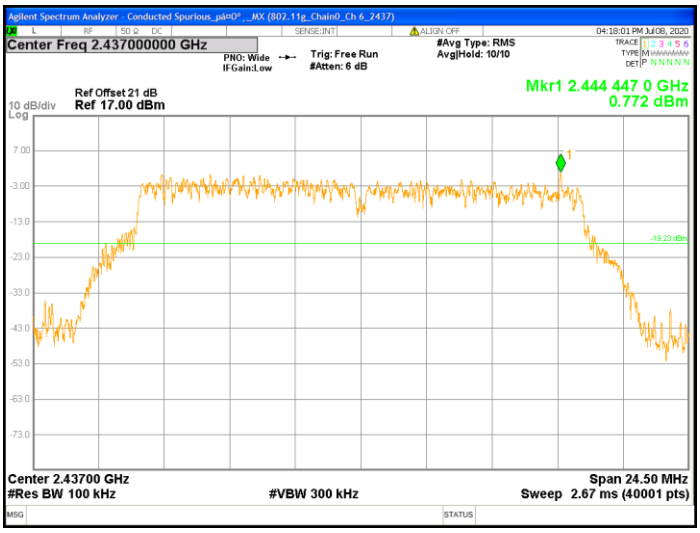
## Chain 0: Conducted Spurious @ 802.11g Mode Ch 1



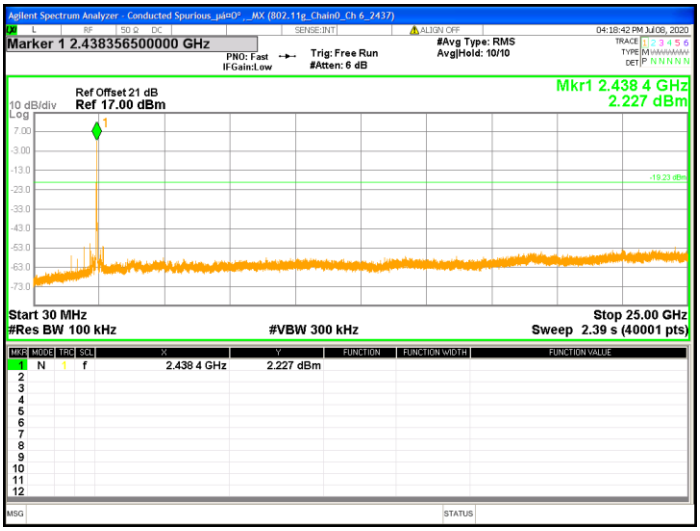

## Chain 0: Conducted Spurious @ 802.11g Mode Ch 1



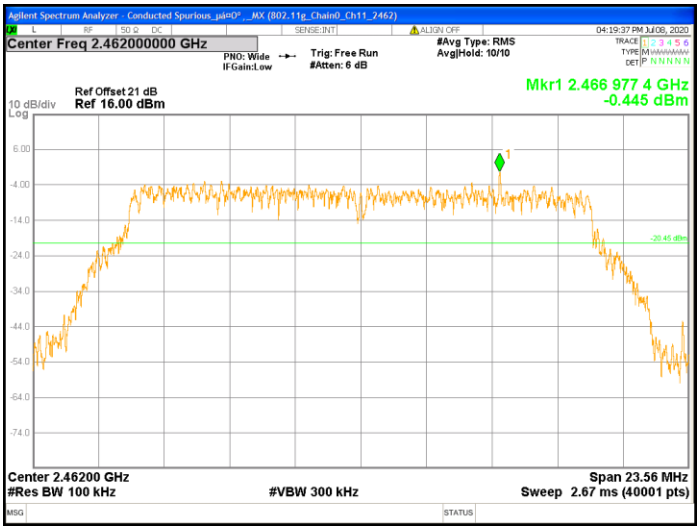

## Chain 0: Conducted Spurious @ 802.11g Mode Ch 6



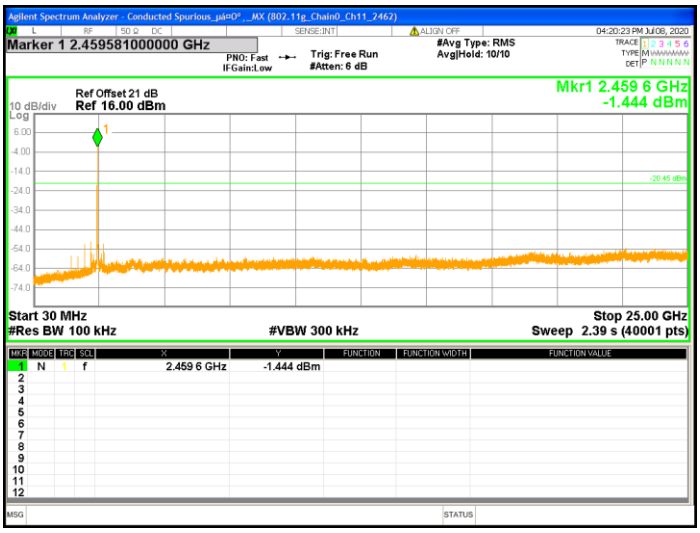
## Chain 0: Conducted Spurious @ 802.11g Mode Ch 6



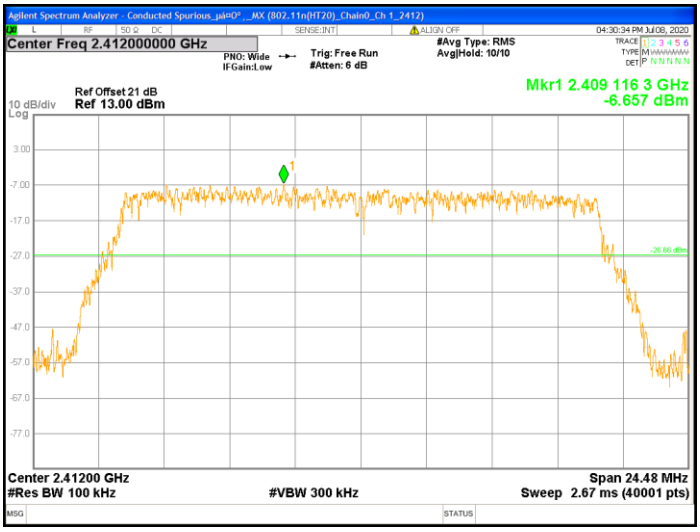

## Chain 0: Conducted Spurious @ 802.11g Mode Ch11



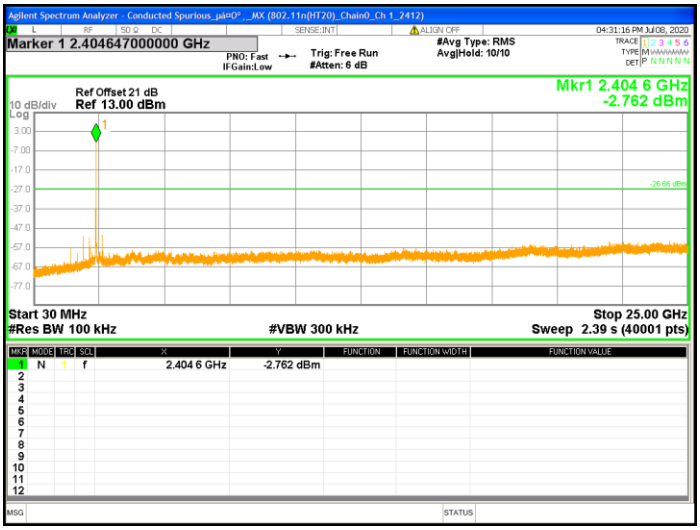

## Chain 0: Conducted Spurious @ 802.11g Mode Ch11



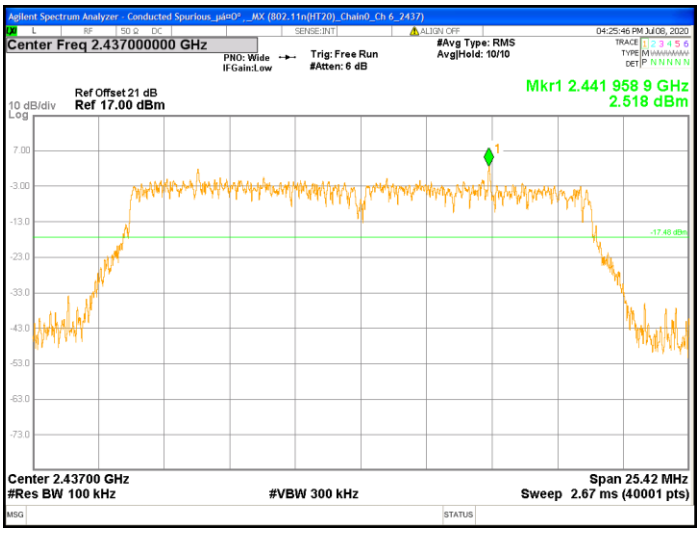
## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch 1



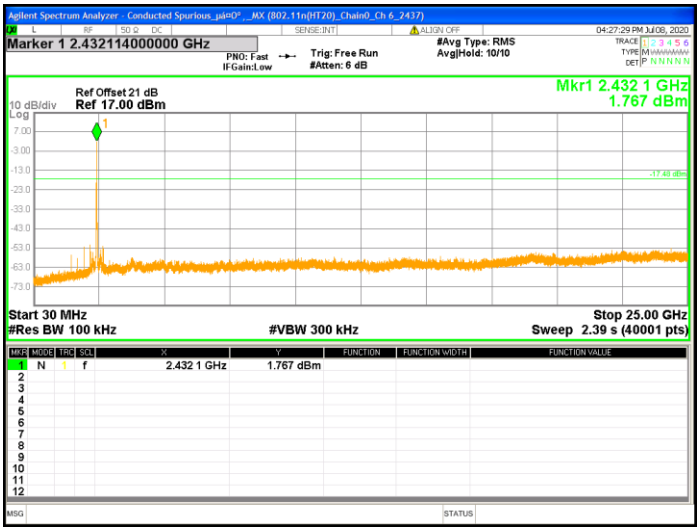

## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch 1



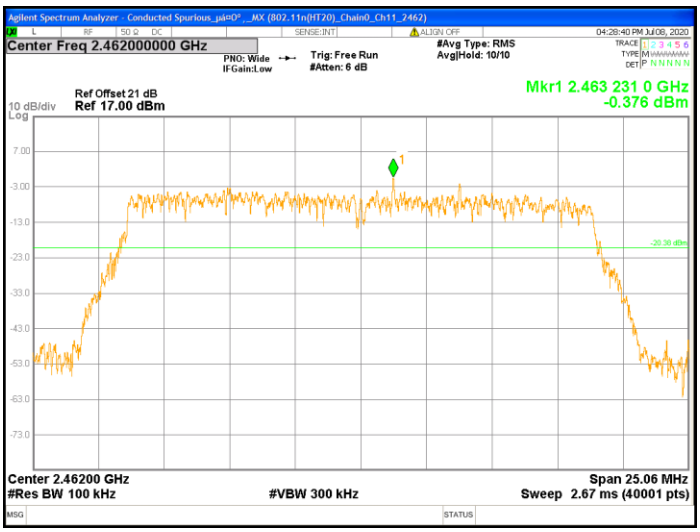

## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch 6



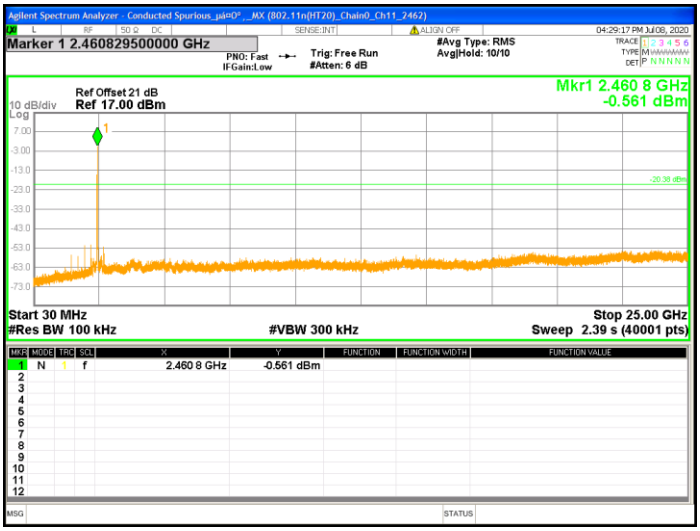
## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch 6



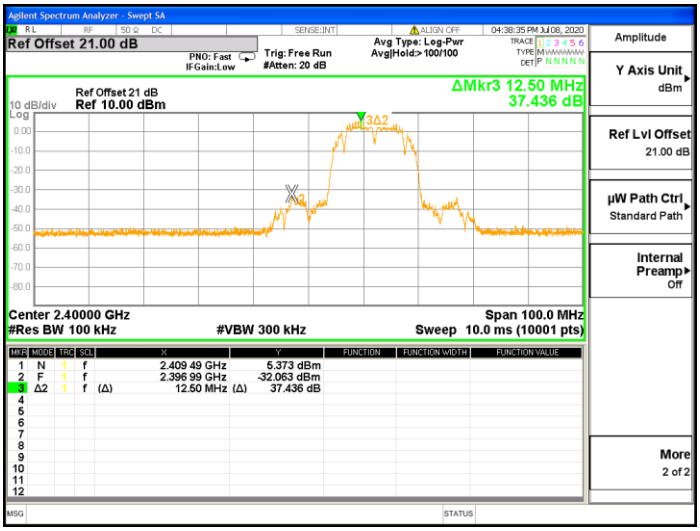

## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch11



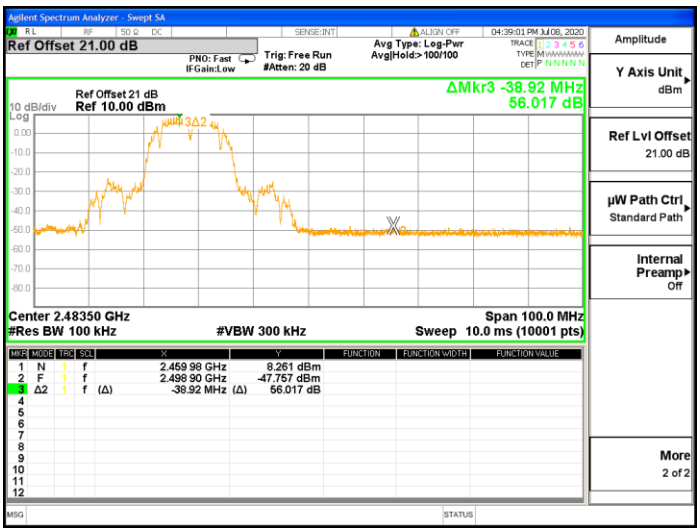

## Chain 0: Conducted Spurious @ 802.11n(HT20) Mode Ch11



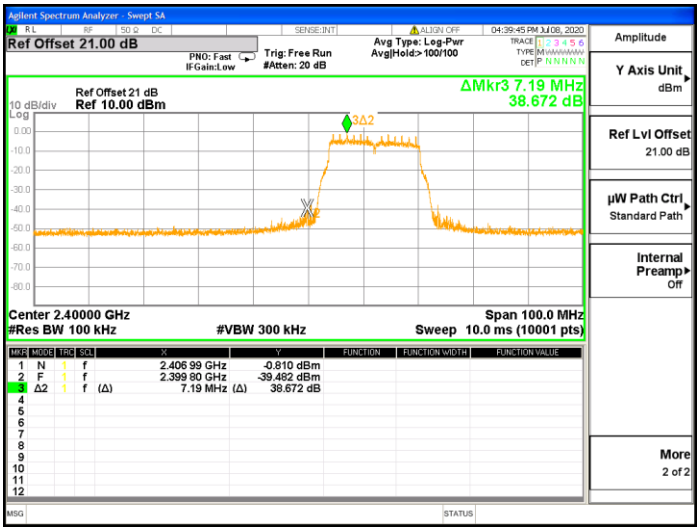
## Chain 0: Authorized Band Bandedge @ 802.11b Mode Ch1



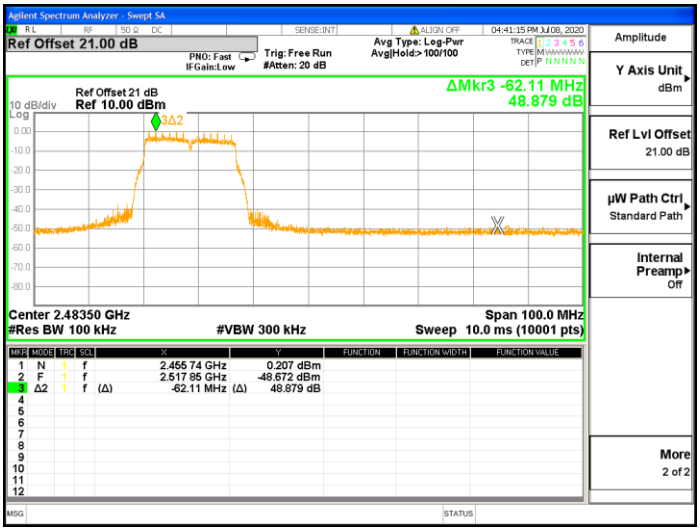

## Chain 0: Authorized Band Bandedge @ 802.11b Mode Ch11



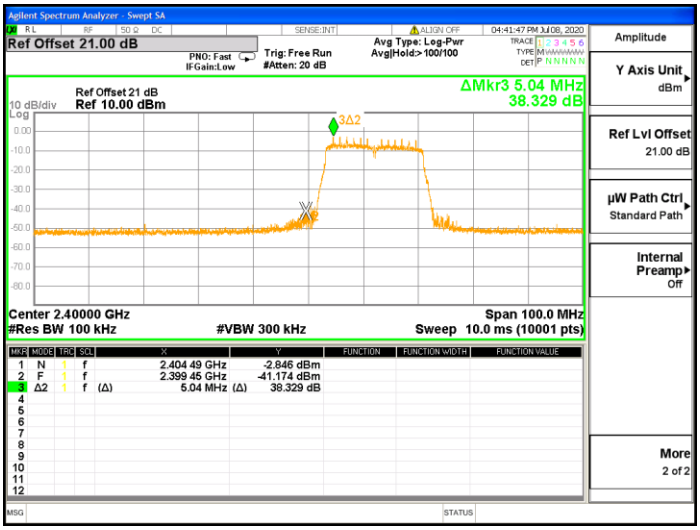

## Chain 0: Authorized Band Bandedge @ 802.11g Mode Ch1



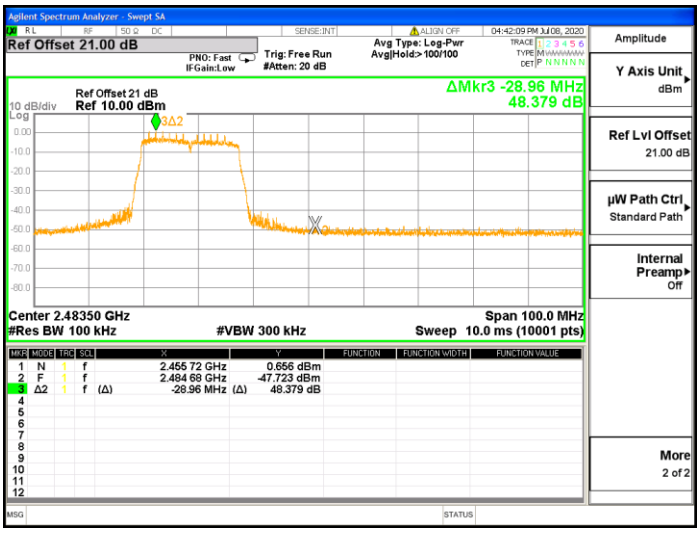
## Chain 0: Authorized Band Bandedge @ 802.11g Mode Ch11




## Chain 0: Authorized Band Bandedge @ 802.11n(HT20) Mode Ch1




## Chain 0: Authorized Band Bandedge @ 802.11n(HT20) Mode Ch11



## 6. Emissions in Restricted Frequency Bands (Radiated emission measurements)

### 6.1 Instrument Setting

| Receiver Function | Setting (Below 1GHz) | Setting (Above 1GHz) |
|---|---|---|
| Detector | QP | Peak and Average |
| RBW | 9-150 kHz ; 200-300 Hz<br>0.15-30 MHz; 9-10 kHz<br>30-1000 MHz; 100-120 kHz | 1MHz |
| VBW | ≧3 x RBW | 3MHz |
| Sweep | Auto couple | Auto couple |
| Start Frequency | 9 kHz | 1GHz |
| Stop Frequency | 1 GHz | Tenth harmonic |
| Attenuation | Auto | Auto |

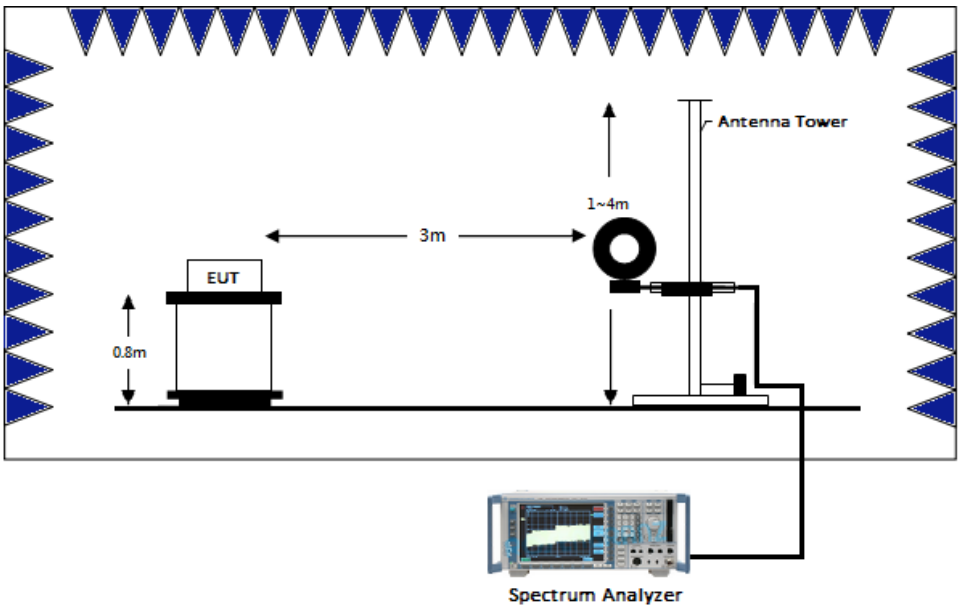
### 6.2 Test Procedure

| | |
|---|---|
| Step 1 | Configure the EUT according to ANSI C63.10:2013. The EUT was placed on the top of the turntable 0.8 meter (below 1GHz) and 1.5 meter (above 1GHz) above ground. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable. |
| Step 2 | Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level. |
| Step 3 | The height of the receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of the both horizontal and vertical polarization. |
| Step 4 | If find the frequencies above the limit or below within 3dB, the antenna tower was scan (from 1m to 4m) and then the turntable was rotated to find the maximum reading. |
| Step 5 | Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode. |
| Step 6 | For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for reading in spectrum analyzer.<br>Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. |
| Step 7 | If the emissions level of the EUT in peak mode was 3dB lower than the average limit specified then testing will be stopped and peak values of the EUT will be reported. Otherwise, the emissions which do not have 3dB margin will be measured using the quasi-peak method for below 1GHz. |

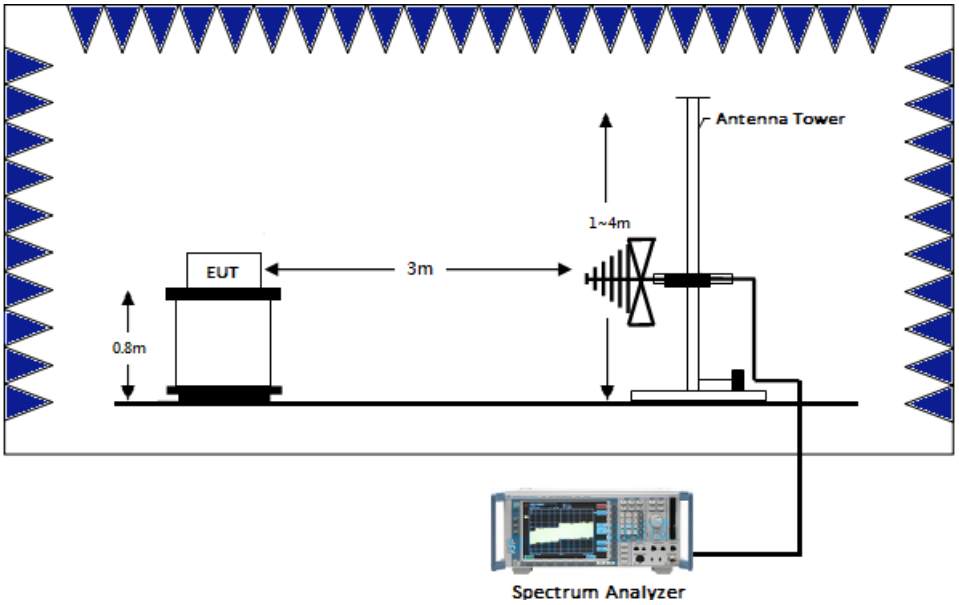
| | |
|---|---|
| Step 8 | For testing above 1GHz, The emissions level of the EUT in peak mode was lower than average limit, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. |
| Step 9 | In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be quasi-peak measured by receiver. |

## 6.3 Test Diagram

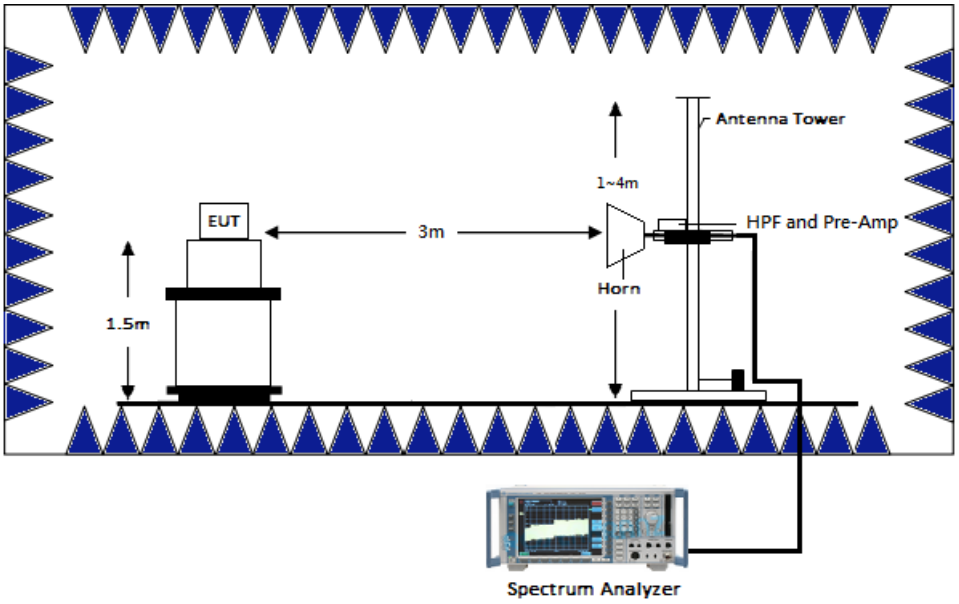
### 6.3.1 Radiated emission from 9kHz to 30MHz uses Loop Antenna:



### 6.3.2 Radiated emission below 1GHz using Bilog Antenna




### 6.3.3 Radiated emission above 1GHz using Horn Antenna



## 6.4 Limit

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

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

## 6.5 Operating Environment Condition

| | |
|---|---|
| Temperature (℃) : | 27 |
| Relative Humidity (%) : | 58 |
| Test date : | 2020/06/20 ~ 2020/09/25 |

## 6.6 Test Result

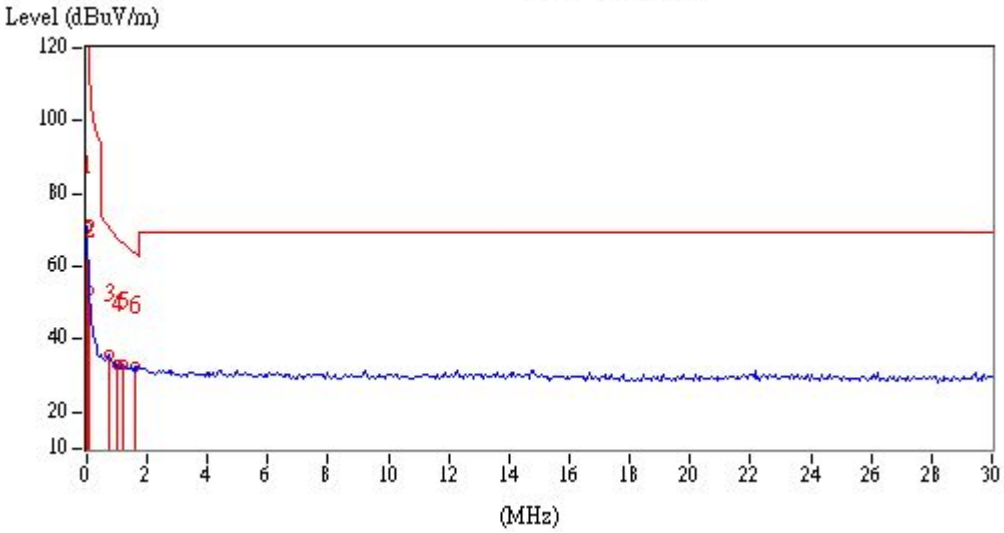
### 6.6.1 Measurement results: frequencies 9kHz to 30MHz

Test date: 2020/06/30

The test was performed on EUT under 802.11b/g/n continuously transmitting mode. The worst case occurred at 802.11n(HT20) Channel 6.

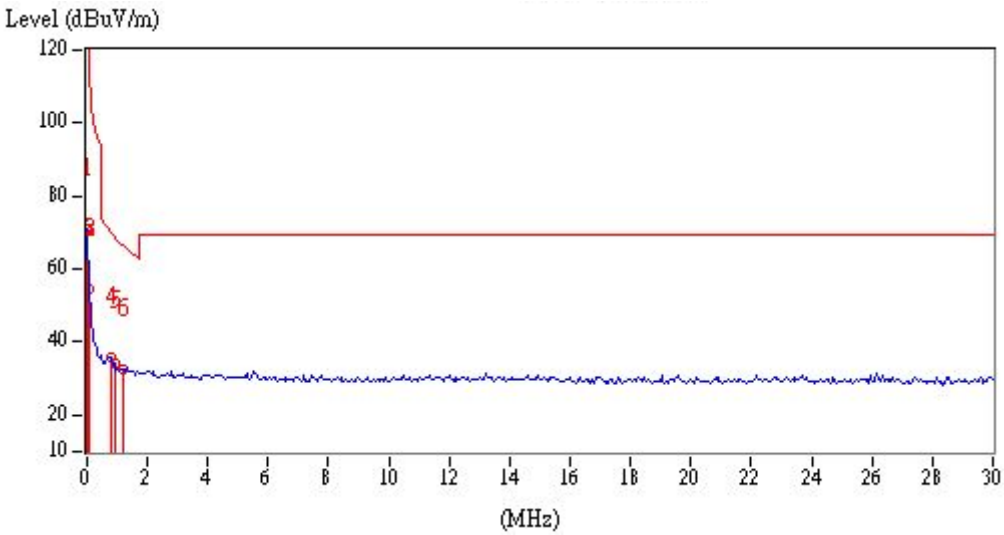
| Ant Polarity | Frequency (MHz) | Detector | Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Perpendicular | 0.01 | AV | 18.28 | 52.92 | 71.20 | 127.60 | -56.40 |
| Perpendicular | 0.07 | AV | 18.36 | 35.06 | 53.42 | 110.70 | -57.28 |
| Perpendicular | 0.73 | QP | 18.45 | 17.32 | 35.77 | 70.34 | -34.57 |
| Perpendicular | 1.03 | QP | 18.46 | 14.54 | 33.00 | 67.35 | -34.35 |
| Perpendicular | 1.21 | QP | 18.46 | 14.91 | 33.37 | 65.95 | -32.58 |
| Perpendicular | 1.57 | QP | 18.47 | 14.13 | 32.60 | 63.69 | -31.09 |

Remark: Corr. Factor = Antenna Factor + Cable Loss



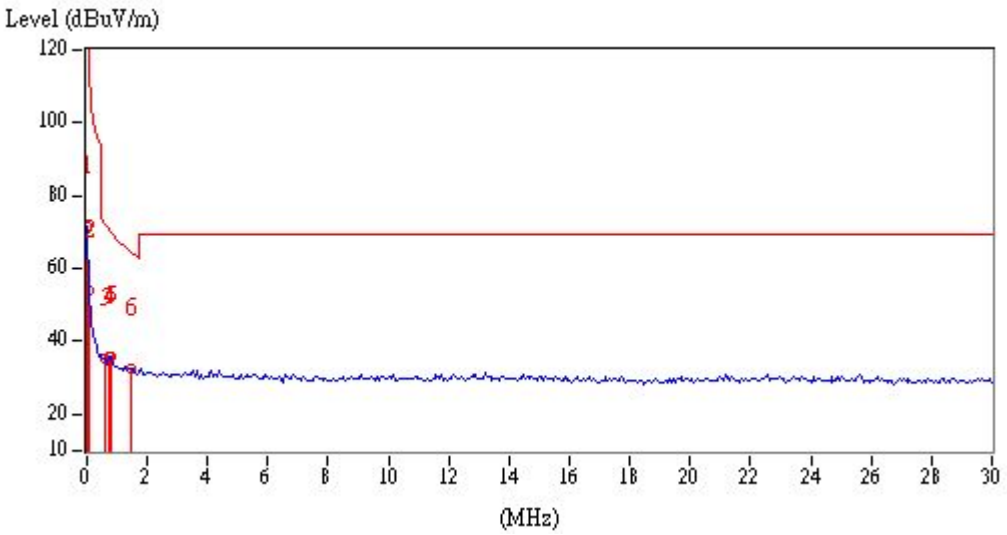
| Ant Polarity | Frequency (MHz) | Detector | Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Parallel | 0.01 | AV | 18.28 | 52.76 | 71.04 | 127.60 | -56.56 |
| Parallel | 0.07 | AV | 18.36 | 36.23 | 54.59 | 110.70 | -56.11 |
| Parallel | 0.79 | QP | 18.45 | 17.40 | 35.85 | 69.65 | -33.80 |
| Parallel | 0.91 | QP | 18.46 | 16.01 | 34.47 | 68.42 | -33.95 |
| Parallel | 1.21 | QP | 18.46 | 14.06 | 32.52 | 65.95 | -33.43 |

Remark: Corr. Factor = Antenna Factor + Cable Loss



| Ant Polarity | Frequency (MHz) | Detector | Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Ground-parallel | 0.01 | AV | 18.28 | 53.52 | 71.80 | 127.60 | -55.80 |
| Ground-parallel | 0.07 | AV | 18.36 | 35.78 | 54.14 | 110.70 | -56.56 |
| Ground-parallel | 0.61 | QP | 18.44 | 17.05 | 35.49 | 71.90 | -36.41 |
| Ground-parallel | 0.73 | QP | 18.45 | 17.62 | 36.07 | 70.34 | -34.27 |
| Ground-parallel | 0.79 | QP | 18.45 | 17.58 | 36.03 | 69.65 | -33.62 |
| Ground-parallel | 1.45 | QP | 18.46 | 14.14 | 32.60 | 64.38 | -31.78 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

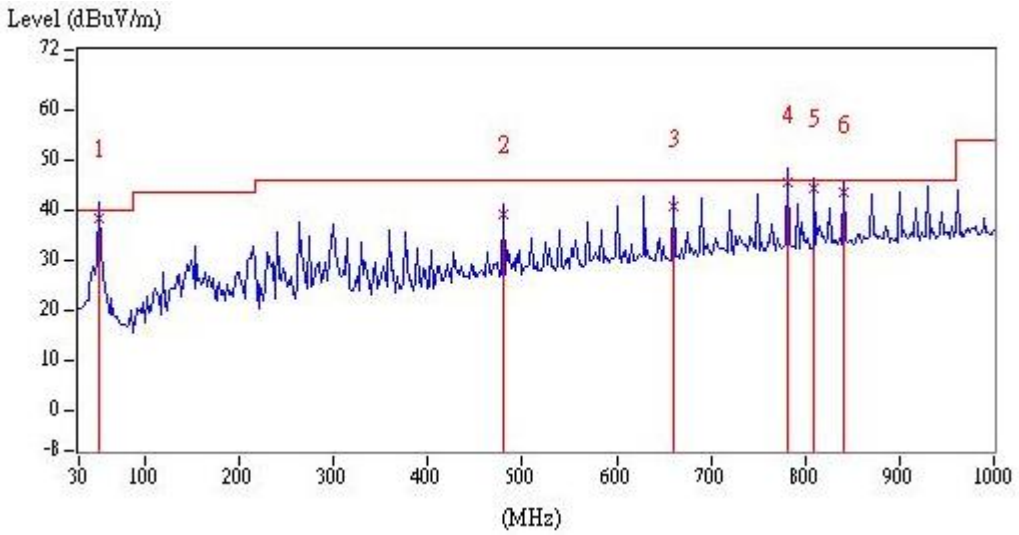


### 6.6.1 Measurement results: frequencies below 1 GHz

Test date: 2020/09/25

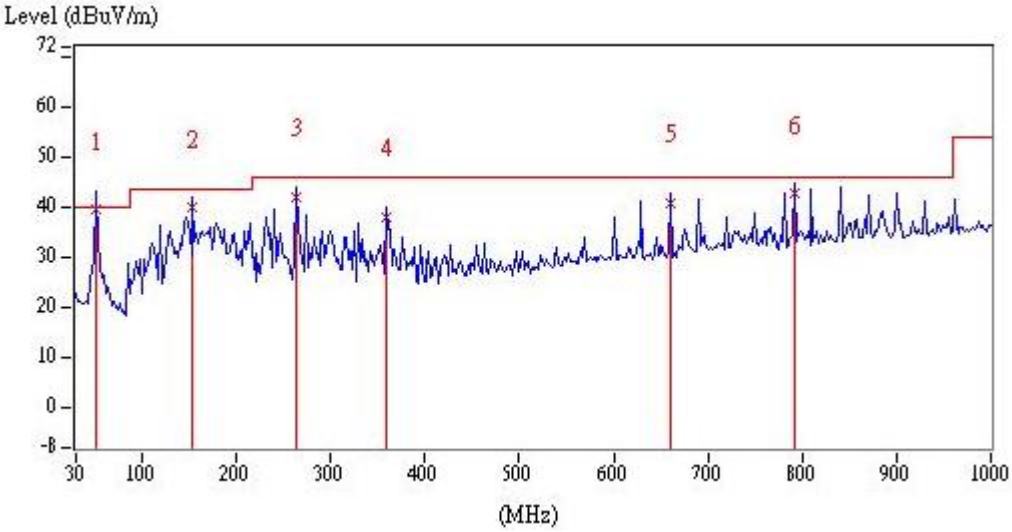
The test was performed on EUT under 802.11b/g/n continuously transmitting mode. The worst case occurred at 802.11n(HT20) Channel 6.

| Ant Polarity | Frequency (MHz) | Detector | Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Vertical | 51.34 | QP | 21.93 | 16.55 | 38.47 | 40.00 | -1.53 |
| Vertical | 480.08 | QP | 27.13 | 12.09 | 39.22 | 46.00 | -6.78 |
| Vertical | 660.50 | QP | 30.37 | 10.27 | 40.64 | 46.00 | -5.36 |
| Vertical | 780.78 | QP | 32.41 | 13.11 | 45.52 | 46.00 | -0.48 |
| Vertical | 809.88 | QP | 32.76 | 11.66 | 44.43 | 46.00 | -1.57 |
| Vertical | 840.92 | QP | 33.34 | 10.23 | 43.57 | 46.00 | -2.43 |



| Ant Polarity | Frequency (MHz) | Detector | Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| Horizontal | 51.34 | QP | 21.93 | 17.60 | 39.53 | 40.00 | -0.47 |
| Horizontal | 154.16 | QP | 21.83 | 18.07 | 39.89 | 43.50 | -3.61 |
| Horizontal | 262.80 | QP | 21.61 | 20.52 | 42.12 | 46.00 | -3.88 |
| Horizontal | 359.80 | QP | 24.22 | 13.79 | 38.01 | 46.00 | -7.99 |
| Horizontal | 660.50 | QP | 30.37 | 10.53 | 40.90 | 46.00 | -5.10 |
| Horizontal | 792.42 | QP | 32.51 | 10.19 | 42.70 | 46.00 | -3.30 |

Remark: Corr. Factor = Antenna Factor + Cable Loss



### 6.6.2 Measurement results: frequency above 1GHz to 25GHz

Test date: 2020/06/20

| Mode | Frequency (MHz) | Spectrum Analyzer Detector | Ant. Pol. (H/V) | Correction Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3 m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 802.11b_Ch1 | 4824 | PK | V | 6.97 | 42.96 | 49.93 | 74.00 | -24.07 |
| | 4824 | PK | H | 6.97 | 41.47 | 48.44 | 74.00 | -25.56 |
| 802.11b_Ch6 | 4874 | PK | V | 7.10 | 44.78 | 51.88 | 74.00 | -22.12 |
| | 4874 | PK | H | 7.10 | 44.38 | 51.48 | 74.00 | -22.52 |
| 802.11b_Ch11 | 4924 | PK | V | 7.24 | 46.19 | 53.43 | 74.00 | -20.57 |
| | 4924 | PK | H | 7.24 | 46.95 | 54.19 | 74.00 | -19.81 |
| | 4924 | AV | H | 7.24 | 44.93 | 52.17 | 54.00 | -1.83 |
| 802.11g_Ch1 | 4824 | PK | V | 6.97 | 35.44 | 42.41 | 74.00 | -31.59 |
| | 4824 | PK | H | 6.97 | 35.72 | 42.69 | 74.00 | -31.31 |
| 802.11g_Ch6 | 4874 | PK | V | 7.10 | 39.32 | 46.42 | 74.00 | -27.58 |
| | 4874 | PK | H | 7.10 | 38.78 | 45.88 | 74.00 | -28.12 |
| 802.11g_Ch11 | 4924 | PK | V | 7.24 | 39.56 | 46.80 | 74.00 | -27.20 |
| | 4924 | PK | H | 7.24 | 42.39 | 49.63 | 74.00 | -24.37 |
| 802.11n_Ch1 | 4824 | PK | V | 6.97 | 34.06 | 41.03 | 74.00 | -32.97 |
| | 4824 | PK | H | 6.97 | 34.64 | 41.61 | 74.00 | -32.39 |
| 802.11n_Ch6 | 4874 | PK | V | 7.10 | 37.23 | 44.33 | 74.00 | -29.67 |
| | 4874 | PK | H | 7.10 | 37.63 | 44.73 | 74.00 | -29.27 |
| 802.11n_Ch11 | 4924 | PK | V | 7.24 | 38.29 | 45.53 | 74.00 | -28.47 |
| | 4924 | PK | H | 7.24 | 41.88 | 49.12 | 74.00 | -24.88 |

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

## 7. Emission on Band Edge

### 7.1 Instrument Setting

| Spectrum Function | Setting |
|---|---|
| Detector | Peak and Average |
| RBW | 1MHz |
| VBW | 3MHz |
| Sweep | Auto couple |
| Restrict bands | 2310 MHz ~ 2390 MHz<br>2483.5 MHz ~ 2500 MHz |
| Attenuation | Auto |

### 7.2 Test Procedure

The test procedure is the same as Emissions in Restricted Frequency Bands (Radiated emission measurements).

### 7.3 Operating Environment Condition

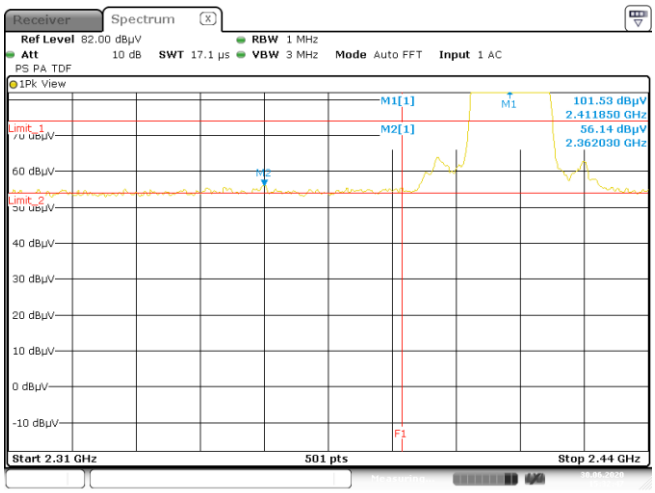
| | |
|---|---|
| Temperature (℃) : | 28 |
| Relative Humidity (%) : | 55 |
| Test date : | 2020/06/30 |

## 7.4 Test Results

| Mode | Frequency (MHz) | Spectrum Analyzer Detector | Ant. Pol. (H/V) | Correction Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3 m (dBµV/m) | Margin (dB) | Restricted band (MHz) |
|---|---|---|---|---|---|---|---|---|---|
| 802.11b | 2362.03 | PK | V | 34.40 | 21.74 | 56.14 | 74 | -17.86 | 2310~2390 |
| | 2390.00 | AV | V | 34.52 | 8.02 | 42.54 | 54 | -11.46 | |
| | 2484.01 | PK | V | 34.92 | 23.86 | 58.78 | 74 | -15.22 | 2483.5~2500 |
| | 2487.72 | AV | V | 34.94 | 14.76 | 49.70 | 54 | -4.30 | |
| 802.11g | 2375.26 | PK | V | 34.45 | 22.21 | 56.66 | 74 | -17.34 | 2310~2390 |
| | 2388.75 | AV | V | 34.51 | 9.05 | 43.57 | 54 | -10.43 | |
| | 2483.50 | PK | V | 34.92 | 23.55 | 58.47 | 74 | -15.53 | 2483.5~2500 |
| | 2483.65 | AV | V | 34.92 | 10.05 | 44.96 | 54 | -9.04 | |
| 802.11n (HT20) | 2345.68 | PK | V | 34.33 | 21.18 | 55.50 | 74 | -18.50 | 2310~2390 |
| | 2389.27 | AV | V | 34.51 | 8.94 | 43.46 | 54 | -10.54 | |
| | 2485.09 | PK | V | 34.93 | 24.83 | 59.75 | 74 | -14.25 | 2483.5~2500 |
| | 2483.77 | AV | V | 34.92 | 10.63 | 45.55 | 54 | -8.45 | |

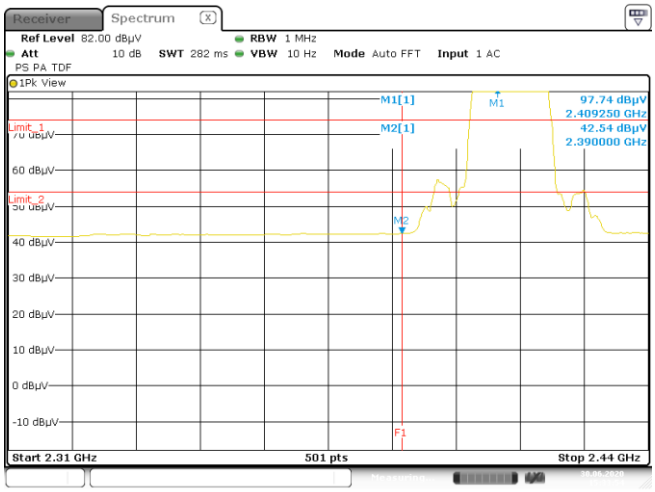
Remark: Correction Factor = Antenna Factor + Cable Loss

## Chain 0: Restricted Band Bandedge @ 802.11b Mode Ch1 PK



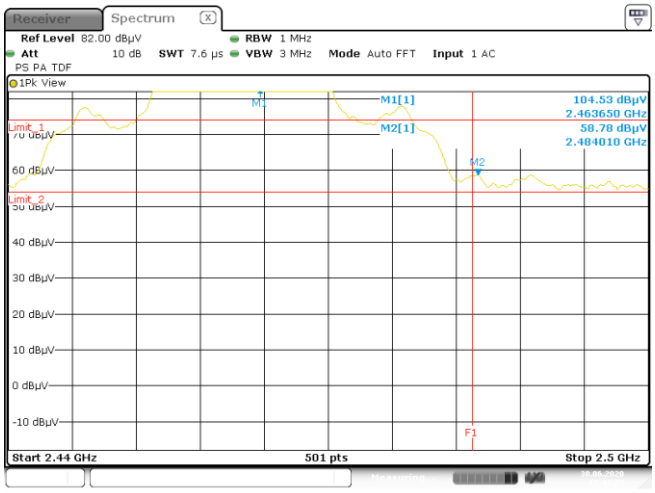

Date: 30.JUN.2020 15:32:48

## Chain 0: Restricted Band Bandedge @ 802.11b Mode Ch1 AV



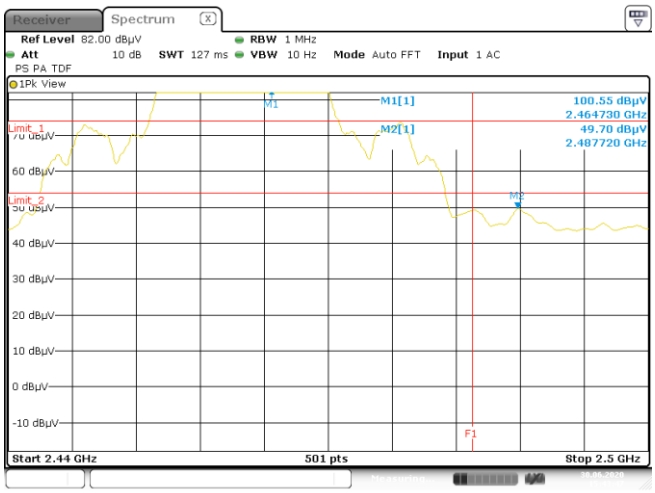

Date: 30.JUN.2020 15:33:55

## Chain 0: Restricted Band Bandedge @ 802.11b Mode Ch11 PK



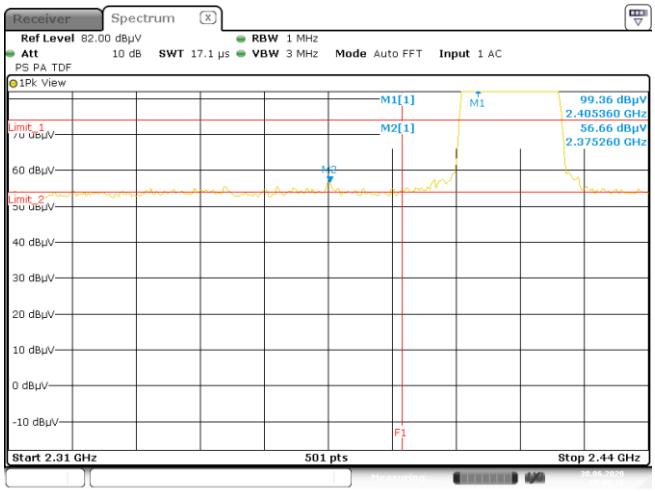

Date: 30.JUN.2020 15:42:30

## Chain 0: Restricted Band Bandedge @ 802.11b Mode Ch11 AV



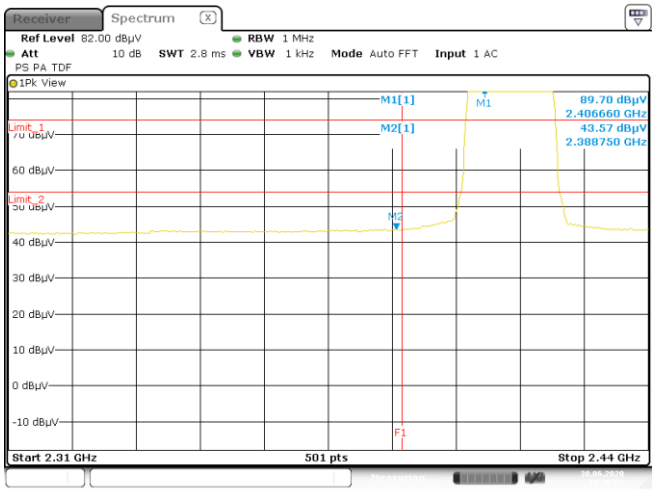

Date: 30.JUN.2020 15:43:47

## Chain 0: Restricted Band Bandedge @ 802.11g Mode Ch1 PK



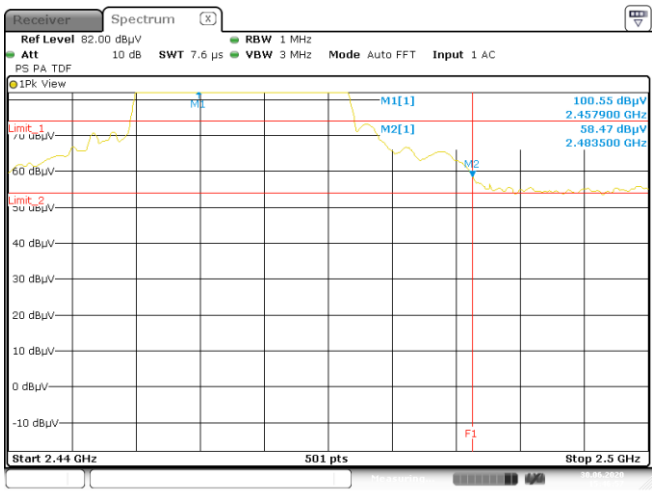

Date: 30.JUN.2020 15:45:17

## Chain 0: Restricted Band Bandedge @ 802.11g Mode Ch1 AV



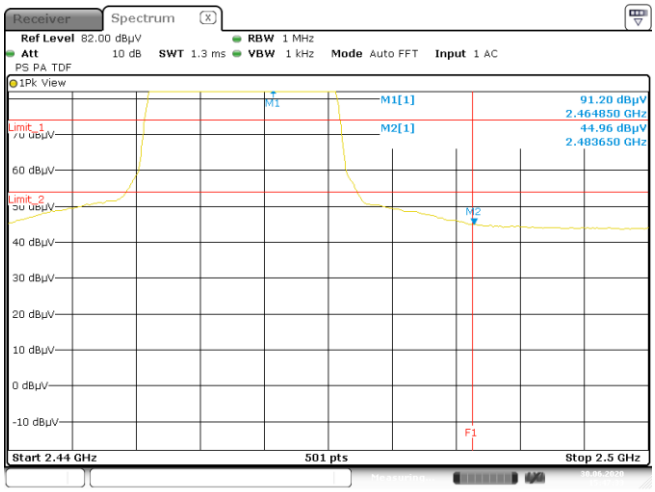

Date: 30.JUN.2020 15:45:57

## Chain 0: Restricted Band Bandedge @ 802.11g Mode Ch11 PK



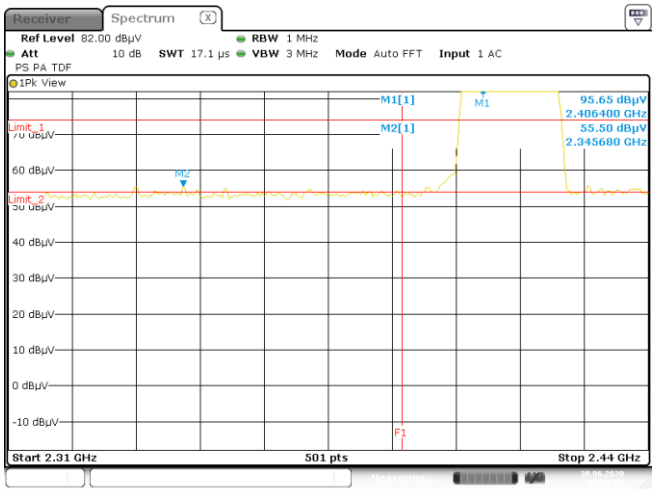

Date: 30.JUN.2020 15:46:57

## Chain 0: Restricted Band Bandedge @ 802.11g Mode Ch11 AV



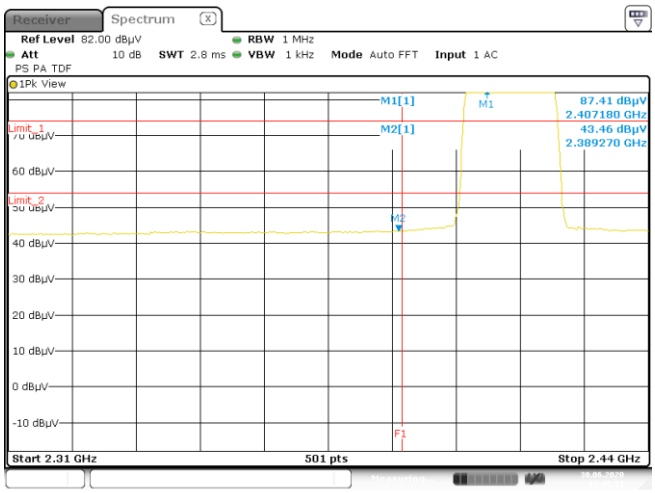

Date: 30.JUN.2020 15:47:33

## Chain 0: Restricted Band Bandedge @ 802.11n(HT20) Mode Ch1 PK



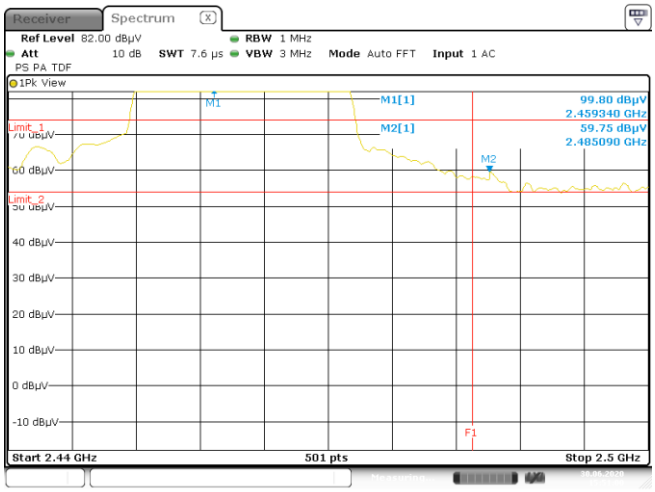

Date: 30.JUN.2020 15:49:05

## Chain 0: Restricted Band Bandedge @ 802.11n(HT20) Mode Ch1 AV



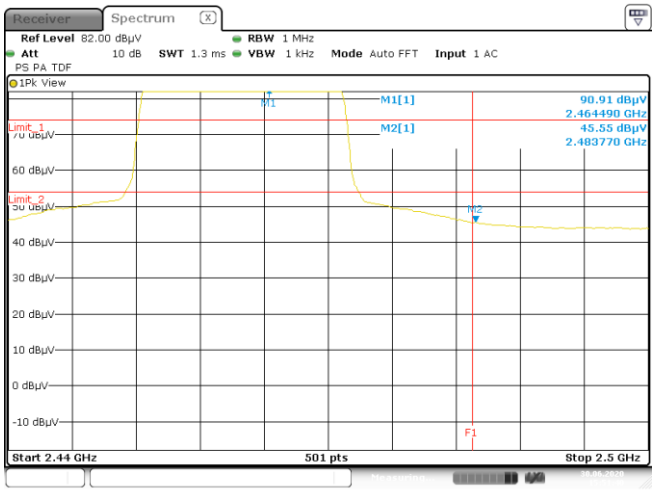

Date: 30.JUN.2020 15:49:51

## Chain 0: Restricted Band Bandedge @ 802.11n(HT20) Mode Ch11 PK




Date: 30.JUN.2020 15:51:00

## Chain 0: Restricted Band Bandedge @ 802.11n(HT20) Mode Ch11 AV




Date: 30.JUN.2020 15:51:41

## 8. AC Power Line Conducted Emission

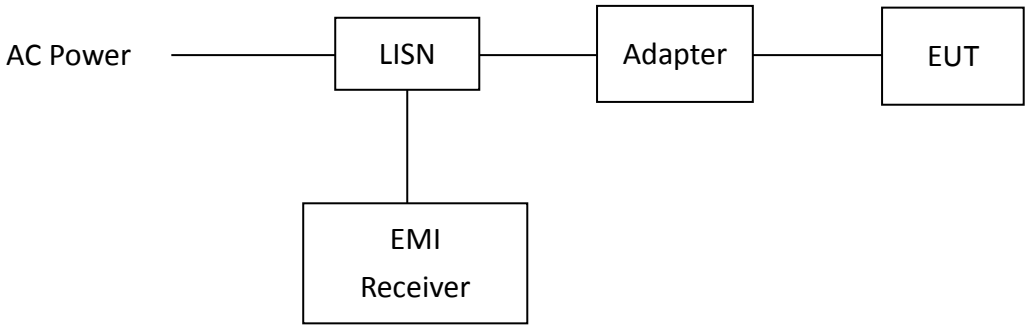
### 8.1 Measuring instrument setting

| Receiver Function | Setting |
|---|---|
| Detector | QP |
| Start frequency | 0.15MHz |
| Stop frequency | 30MHz |
| IF bandwidth | 9 kHz |
| Attenuation | 10dB |

### 8.2 Test Procedure

| | |
|---|---|
| Step 1 | Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface. |
| Step 2 | Connect EUT or host of EUT to the power mains through a line impedance stabilization network. |
| Step 3 | All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance. |
| Step 4 | The frequency range from 150 kHz to 30MHz was searched. |
| Step 5 | Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode. |
| Step 6 | The measurement has to be done between each power line and ground at the power terminal. |

### 8.3 Test Diagram



## 8.4 Limit

| Frequency (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Q.P. | Ave. |
| 0.15~0.50 | 66 – 56 | 56 – 46 |
| 0.50~5.00 | 56 | 46 |
| 5.00~30.0 | 60 | 50 |

## 8.5 Operating Environment Condition

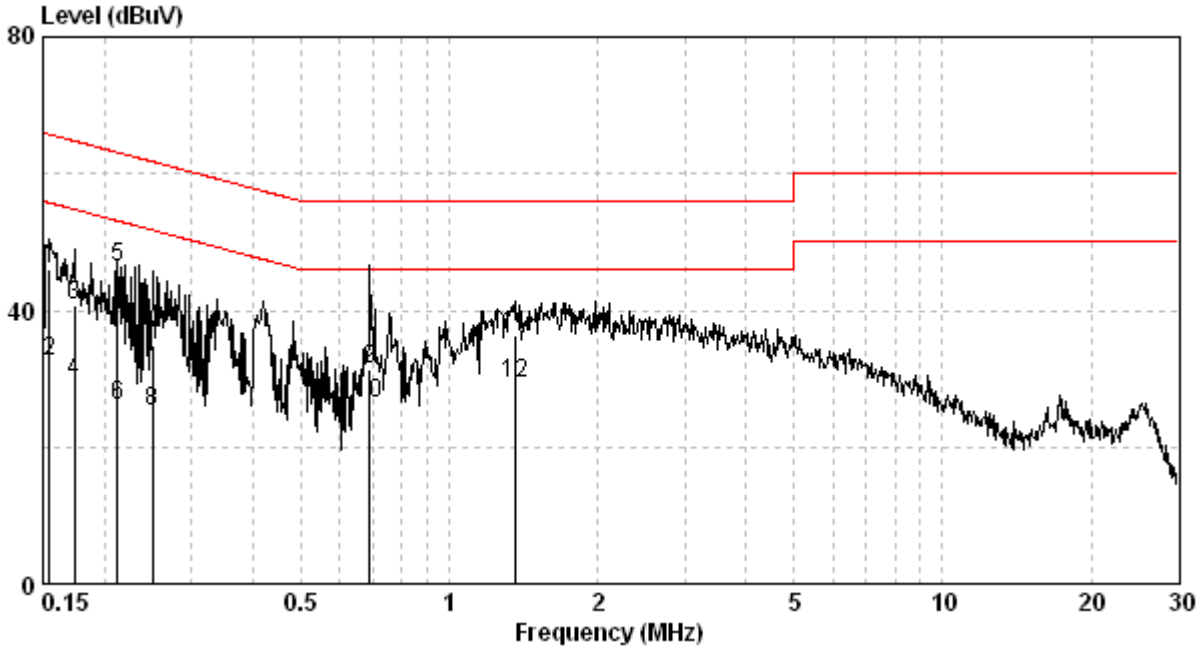
| | |
|---|---|
| Temperature (℃) : | 27 |
| Relative Humidity (%) : | 59 |
| Atmospheric Pressure (hPa) : | 1008 |
| Test date: | 2020/07/14 |

## 8.6 Test Results

Phase: Live Line
Model No.: VS290
Test Condition: Tx mode

| Frequency (MHz) | Corr. Factor (dB) | Reading QP (dBuV) | Level QP (dBuV) | Limit QP (dBuV) | Reading AV (dBuV) | Level AV (dBuV) | Limit AV (dBuV) | Margin (dB) QP | Margin (dB) AV |
|---|---|---|---|---|---|---|---|---|---|
| 0.155 | 9.67 | 36.38 | 46.05 | 65.74 | 22.98 | 32.65 | 55.74 | -19.69 | -23.09 |
| 0.174 | 9.67 | 31.01 | 40.68 | 64.77 | 19.80 | 29.47 | 54.77 | -24.09 | -25.30 |
| 0.213 | 9.67 | 36.49 | 46.16 | 63.10 | 16.48 | 26.15 | 53.10 | -16.93 | -26.94 |
| 0.251 | 9.67 | 25.13 | 34.81 | 61.73 | 15.59 | 25.27 | 51.73 | -26.92 | -26.46 |
| 0.690 | 9.69 | 21.73 | 31.42 | 56.00 | 16.63 | 26.32 | 46.00 | -24.58 | -19.68 |
| 1.367 | 9.74 | 26.70 | 36.44 | 56.00 | 19.70 | 29.43 | 46.00 | -19.56 | -16.57 |

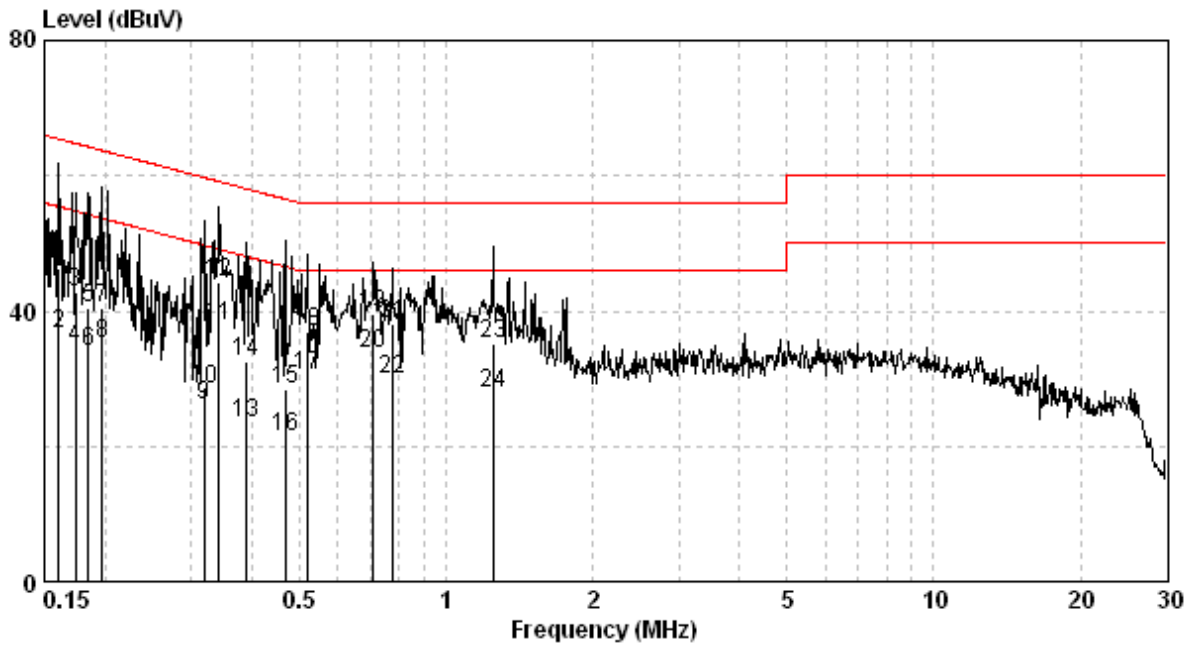
Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral Line
Model No.: VS290
Test Condition: Tx mode

| Frequency (MHz) | Corr. Factor (dB) | Reading QP (dBuV) | Level QP (dBuV) | Limit QP (dBuV) | Reading AV (dBuV) | Level AV (dBuV) | Limit AV (dBuV) | Margin (dB) QP | Margin (dB) AV |
|---|---|---|---|---|---|---|---|---|---|
| 0.161 | 9.66 | 36.61 | 46.27 | 65.43 | 27.00 | 36.66 | 55.43 | -19.16 | -18.77 |
| 0.174 | 9.66 | 33.16 | 42.82 | 64.77 | 25.06 | 34.72 | 54.77 | -21.95 | -20.05 |
| 0.184 | 9.66 | 30.91 | 40.57 | 64.28 | 24.33 | 33.99 | 54.28 | -23.71 | -20.29 |
| 0.198 | 9.66 | 30.77 | 40.43 | 63.71 | 25.43 | 35.09 | 53.71 | -23.28 | -18.62 |
| 0.318 | 9.67 | 18.80 | 28.47 | 59.75 | 16.53 | 26.19 | 49.75 | -31.28 | -23.56 |
| 0.343 | 9.67 | 34.71 | 44.38 | 59.13 | 28.14 | 37.81 | 49.13 | -14.76 | -11.33 |
| 0.389 | 9.67 | 22.99 | 32.66 | 58.08 | 13.78 | 23.45 | 48.08 | -25.42 | -24.63 |
| 0.469 | 9.67 | 18.67 | 28.35 | 56.54 | 11.78 | 21.45 | 46.54 | -28.19 | -25.09 |
| 0.518 | 9.68 | 27.11 | 36.79 | 56.00 | 20.71 | 30.39 | 46.00 | -19.21 | -15.61 |
| 0.708 | 9.69 | 29.90 | 39.59 | 56.00 | 23.94 | 33.63 | 46.00 | -16.41 | -12.37 |
| 0.775 | 9.69 | 28.27 | 37.96 | 56.00 | 20.19 | 29.88 | 46.00 | -18.04 | -16.12 |
| 1.249 | 9.73 | 25.55 | 35.28 | 56.00 | 18.13 | 27.86 | 46.00 | -20.72 | -18.14 |

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



## Appendix A: Test equipment list

| Test Equipment/ Test site | Brand | Model No. | Serial No. | Calibration Date | Next Calibration Date |
|---|---|---|---|---|---|
| EMI Test Receiver | Rohde & Schwarz | ESR-7 | 101232 | 2020/01/18 | 2021/01/16 |
| EMI Test Receiver | R&S | ESU40 | 100381 | 2020/05/29 | 2021/05/28 |
| Spectrum Analyzer | Rohde & Schwarz | FSP30 | 100137 | 2019/08/29 | 2020/08/27 |
| Signal Analyzer | Agilent | N9030A | MY51380492 | 2019/08/21 | 2020/08/19 |
| Active Loop Antenna | SCHWARZBECK MESS-ELEKTRONIC | FMZB1519 | 1519-067 | 2020/04/13 | 2021/04/12 |
| Broadband Antenna | SHWARZBECK | VULB 9168 | 9168-172 | 2020/06/02 | 2021/06/01 |
| Horn Antenna | SHWARZBECK | BBHA 9120 D | 9120D-456 | 2020/01/20 | 2021/01/18 |
| Horn Antenna | SCHWARZBECK | BBHA 9170 | BBHA9170159 | 2020/08/20 | 2023/08/19 |
| Pre-Amplifier | SCHWARZBECK | BBV9718 | 9718-004 | 2019/10/16 | 2020/10/14 |
| Pre-Amplifier | EMCI | EMC184045SE | 980512 | 2020/06/01 | 2021/05/31 |
| Hight Pass Filter | Reactel | 7HS-3G/18G-S 11 | N/A | 2020/05/27 | 2021/05/26 |
| RF Cable | SUHNER | SUCOFLEX 102 | CB0006 | 2020/04/30 | 2021/04/29 |
| 966-2(A) Cable | SUHNER | SMA / EX 100 | N/A | 2019/08/19 | 2020/08/17 |
| 966-2(A) Cable | SUHNER | SMA / EX 100 | N/A | 2020/08/17 | 2021/08/16 |
| 966-2(B) Cable | SUHNER | SUCOFLEX 104P | CB0005 | 2019/08/19 | 2020/08/17 |
| 966-2(B) Cable | SUHNER | SUCOFLEX 104P | CB0005 | 2020/08/17 | 2021/08/16 |

| Test Equipment | Brand | Model No. | Serial No. | Calibration Date | Next Calibration Date |
|---|---|---|---|---|---|
| 966-2_3m Semi-Anechoic Chamber | 966_2 | CEM-966_2 | N/A | 2020/02/23 | 2021/02/22 |
| Power Meter | Anritsu | ML2495A | 0844001 | 2019/10/23 | 2020/10/21 |
| Power Sensor | Anritsu | MA2411B | 0738452 | 2019/10/23 | 2020/10/21 |
| EMI Test Receiver | R&S | ESCI | 100059 | 2019/11/05 | 2020/11/03 |
| LISN | R&S | ENV216 | 101159 | 2020/06/08 | 2021/06/07 |
| CON-1 Cable | SUHNER | SUCOFLEX-104 | 26438414 | 2020/04/30 | 2021/04/29 |
| Test software | Audix | e3 | V4.20040112L | NCR | NCR |

Note: No Calibration Required (NCR).

**Appendix B: Measurement Uncertainty**

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

| Item | Uncertainty |
|---|---|
| Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m | 4.90 dB |
| Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m | 4.89 dB |
| Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m | 4.29 dB |
| Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m | 4.29 dB |
| Vertically polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m | 2.45 dB |
| Horizontally polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m | 2.45 dB |
| Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m | 3.32 dB |
| Emission on the Band Edge Test | 4.29 dB |
| Minimum 6 dB Bandwidth | 7.69 % |
| Maximum Peak Conducted Output Power | 0.37 dB |
| Power Spectral Density | 1.15 dB |
| Emissions In Non-Restricted Frequency Bands | 1.15 dB |
| AC Power Line Conducted Emission | 2.52 dB |