



RF Test Report

For

Applicant Name: Shenzhen Zhijia Sifang Technology Co., Ltd.
Address: Room 405, Lingnan Bay Science and Technology Park, Nanwan Street, Longgang District, Shenzhen
EUT Name: Multimedia Module
Brand Name: N/A
Model Number: STT_CP
Series Model Number: STT_FCA, STT_BCA

Issued By

Company Name: BTF Testing Lab (Shenzhen) Co., Ltd.
Address: F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China

Report Number: BTF230703R00603
Test Standards: 47 CFR Part 15 Subpart C Section 15.247
FCC ID: 2BBZT-STT-CP
Test Conclusion: Pass
Test Date: 2023-06-27 to 2023-07-12
Date of Issue: 2023-07-12

Prepared By: Elma.yang
Date: 2023-07-12

Approved By: Ryan.CJ / EMC Manager
Date: 2023-07-12



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| Revision History | | |
|------------------|--|-------------------|
| Version | Issue Date | Revisions Content |
| R_V0 | July 12th 2023 | Original |
| | | |
| Note: | Once the revision has been made, then previous versions reports are invalid. | |

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1. Introduction

1.1 Identification of Testing Laboratory

| | |
|---------------|---|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130 |
| Fax Number: | +86-0755-23146130 |

1.2 Identification of the Responsible Testing Location

| | |
|--------------------------|--|
| Test Location: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Description: | All measurement facilities used to collect the measurement data are located at F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| FCC Registration Number: | 518915 |
| Designation Number: | CN1330 |

1.3 Laboratory Condition

| | |
|----------------------------|--------------------|
| Ambient Temperature: | 20°C to 25°C |
| Ambient Relative Humidity: | 45% to 55% |
| Ambient Pressure: | 100 kPa to 102 kPa |

1.4 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2. Product Information

2.1 Application Information

| | |
|---------------|--|
| Company Name: | Shenzhen Zhijia Sifang Technology Co., Ltd. |
| Address: | Room 405, Lingnan Bay Science and Technology Park, Nanwan Street, Longgang District, Shenzhen |

2.2 Manufacturer Information

| | |
|---------------|--|
| Company Name: | Shenzhen Zhijia Sifang Technology Co., Ltd. |
| Address: | Room 405, Lingnan Bay Science and Technology Park, Nanwan Street, Longgang District, Shenzhen |

2.3 General Description of Equipment under Test (EUT)

| | |
|---|---------------------------------------|
| EUT Name | Multimedia Module |
| Under Test Model Name | STT_CP |
| Series Model Name | STT_FCA, STT_BCA |
| Description of Model name differentiation | All the same except the model number. |
| Hardware Version | V02 |
| Software and Firmware Version | V6.0 |

2.4 Technical Information

| | |
|---------------------------|---|
| Modulation Type | DSSS, OFDM |
| Product Type | <input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable <input type="checkbox"/> Fixed Location |
| Frequency Range | 802.11b/g/n(20 MHz): 2.412 GHz - 2.462 GHz $f_c = 2412 \text{ MHz} + (N-1)*5 \text{ MHz}$, where - f_c = "Operating Frequency" in MHz, - N = "Channel Number" with the range from 1 to 11. 802.11n(40 MHz): 2.422 GHz - 2.452 GHz $f_c = 2412 \text{ MHz} + (N-1)*5 \text{ MHz}$, where - f_c = "Operating Frequency" in MHz, - N = "Channel Number" with the range from 3 to 9. |
| Antenna Type | External Antenna |
| Antenna Gain [#] | 3.69 dBi |

| | |
|--|-----|
| Antenna Impedance | 50Ω |
| Antenna System (MIMO Smart Antenna) | N/A |

Note:

#: The antenna gain provided by the applicant, and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.

| Modulation technology | Modulation Type | Transfer Rate (Mbps) |
|-----------------------|-----------------|-------------------------------|
| DSSS (802.11b) | DBPSK | 1 |
| | DQPSK | 2 |
| | CCK | 5.5/11 |
| OFDM (802.11g) | BPSK | 6/9 |
| | QPSK | 12/18 |
| | 16QAM | 24/36 |
| | 64QAM | 48/54 |
| OFDM (802.11n(HT20)) | BPSK | 6.5/7.2 |
| | QPSK | 13/19.5/14.4/21.7 |
| | 16QAM | 26/39/28.9/43.3 |
| | 64QAM | 52/58.5/65/57.8/65/72.2 |
| OFDM (802.11n(HT40)) | BPSK | 13.5/15.0 |
| | QPSK | 27.0/40.5/30.0/45.0 |
| | 16QAM | 54.0/81.0/60.0/90.0 |
| | 64QAM | 108.0/121.5/135.0/120.0/150.0 |

Note: Preliminary tests were performed in different data rate in above table to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

| Test Items | Mode | Data Rate | Channel | |
|----------------------------|---------------------|-------------------|---------|-------|
| Peak Output Power and EIRP | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |
| 6dB Bandwidth | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |

| | | | | |
|------------------------------|---------------------|-------------------|--------|-------|
| Conducted Spurious Emission | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |
| Conducted Emission | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |
| Radiated Spurious Emission | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |
| Band Edge | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |
| Power spectral density (PSD) | b/g/n(HT20)/n(HT40) | 1/6/6.5/13.5 Mbps | 1/6/11 | 3/6/9 |

Note: The above EUT information in section 2.4 and 2.6 was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

All channel was listed on the following table:

| Channel number | Freq. (MHz) | Channel number | Freq. (MHz) |
|----------------|-------------|----------------|-------------|
| 1 | 2412 | 7 | 2442 |
| 2 | 2417 | 8 | 2447 |
| 3 | 2422 | 9 | 2452 |
| 4 | 2427 | 10 | 2457 |
| 5 | 2432 | 11 | 2462 |
| 6 | 2437 | | |

3. Summary of Test Results

3.1 Test Standards

| No. | Identity | Document Title |
|-----|---|--|
| 1 | 47 CFR Part 15 Subpart C Section 15.247 | Intentional Radiators |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices |
| 3 | KDB 558074 D01 15.247 Meas Guidance v05r02 | Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules |

3.2 Summary of Test Result

| No. | Description | FCC Part No. | Channel | Test Result | Verdict | Remark |
|-----|--|---------------------|-----------------|----------------|---------|--------|
| 1 | Antenna Requirement | 15.203 | N/A | -- | Pass | -- |
| 2 | Peak Output Power | 15.247(b) | Low/Middle/High | ANNEX A.1 | Pass | -- |
| 3 | Occupied Bandwidth | 15.247(a) | Low/Middle/High | ANNEX A.2 | Pass | -- |
| 4 | Conducted Spurious Emission | 15.247(d) | Low/Middle/High | ANNEX A.3 | Pass | -- |
| 5 | Band Edge(Authorized- band band-edge) | 15.247(d) | Low/ High | ANNEX A.3 | Pass | -- |
| 6 | Conducted Emission | 15.207 | Low/Middle/High | ANNEX A.4 | N/A | -- |
| 7 | Radiated Spurious Emission | 15.209 15.247(d) | Low/Middle/High | ANNEX A.5 | Pass | -- |
| 8 | Band Edge(Restricted- band band-edge) | 15.209 15.247(d) | Low/High | ANNEX A.6 | Pass | -- |
| 9 | Power spectral density (PSD) | 15.247(e) | Low/Middle/High | ANNEX A.7 | Pass | -- |

3.3 Uncertainty of Test

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2 and TR100 028-1/-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

| Measurement | Value |
|-----------------------------------|---------|
| Occupied Channel Bandwidth | 69 KHz |
| RF output power, conducted | 0.87 dB |
| Power Spectral Density, conducted | 0.69 dB |
| Unwanted Emissions, conducted | 0.94 dB |
| All emissions, radiated(<1GHz) | 4.12 dB |
| All emissions, radiated(>1GHz) | 4.16 dB |
| Temperature | 0.82 °C |
| Humidity | 4.1 % |

4. Test Configuration

4.1 Environment Condition

| Environment Parameter | Selected Values During Tests | | | |
|---|------------------------------|---------------------|-------------------|--------------------|
| | Temperature | Voltage | Relative Humidity | Ambient Pressure |
| Normal Temperature, Normal Voltage (NTNV) | 20°C to 25°C | DC 12V from battery | 30% to 60% | 100 kPa to 102 kPa |

4.2 Test Equipment List

| Conducted Method Test | | | | | | |
|--|---|-----------|-------------|------------|------------|-----|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| MXA Signal Analyzer | KEYSIGHT | N9020A | MY50410020 | 2022.11.24 | 2023.11.23 | ☑ |
| WIDEBAND RADIO COMMUNICATION TESTER | Rohde & Schwarz | CMW500 | 161997 | 2022.11.24 | 2023.11.23 | ☑ |
| ESG VECTOR SIGNAL GENERATOR | Agilent | E4438C | MY45094854 | 2022.11.24 | 2023.11.23 | ☑ |
| MXG Vector Signal Generator | Agilent | N5182A | MY46240163 | 2022.11.24 | 2023.11.23 | ☑ |
| Adjustable Direct Current Regulated Power Supply | Dongguan Tongmen Electronic Technology Co., LTD | etm-6050c | 20211026123 | 2022.11.25 | 2023.11.24 | ☑ |
| Programmable constant temperature and humidity box | ZZCKONG | ZZ-K02A | 20210928007 | 2022.11.24 | 2023.11.23 | ☑ |
| RF Control Unit | TST | TST-Full | S01 | / | / | ☑ |
| RF Test software | TST | V2.0 | / | / | / | ☑ |

| Radiated Method Test | | | | | | |
|-----------------------|---------------|---------------|------------|------------|------------|-----|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| SIGNAL ANALYZER | ROHDE&SCHWARZ | FSQ40 | 100010 | 2022.11.24 | 2023.11.23 | ☑ |
| EMI TEST RECEIVER | ROHDE&SCHWARZ | ESCI7 | 101032 | 2022.11.24 | 2023.11.23 | ☑ |
| Log periodic antenna | SCHWARZBECK | VULB 9168 | 01328 | 2021.11.28 | 2023.11.27 | ☑ |
| Horn Antenna | SCHWARZBECK | BBHA9170 | 01157 | 2021.11.28 | 2023.11.27 | ☑ |
| POSITIONAL CONTROLLER | SKET | PCI-GPIB | / | / | / | ☑ |
| RE Cable | REBES Talent | UF2-NMNM-10m | 21101570 | 2022.11.24 | 2023.11.23 | ☑ |
| RE Cable | REBES Talent | UF2-NMNM-2.5m | 21101573 | 2022.11.24 | 2023.11.23 | ☑ |
| RE Cable | REBES Talent | UF2-NMNM-1m | 21101576 | 2022.11.24 | 2023.11.23 | ☑ |

| | | | | | | |
|--------------------------------|------------------|------------------------|----------|------------|------------|-------------------------------------|
| Coaxial cable Multiflex 141 | Schwarzbeck | N/SMA 0.5m | 517386 | 2023.3.24 | 2024.3.23 | <input checked="" type="checkbox"/> |
| RE Cable | Talent Microwave | A40-2.92M2.92 M-14M | 22080539 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| RE Cable | Talent Microwave | A81-SMAMNM- 14M | 22080538 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| Preamplifier | SCHWARZBECK | BBV9744 | 00246 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| Horn Antenna | Schwarzbeck | BBHA9120D | 2597 | 2022.5.22 | 2024.5.21 | <input checked="" type="checkbox"/> |
| Broadband Preamplifier | Schwarzbeck | BBV9718D | 00008 | 2023.3.24 | 2024.3.23 | <input checked="" type="checkbox"/> |

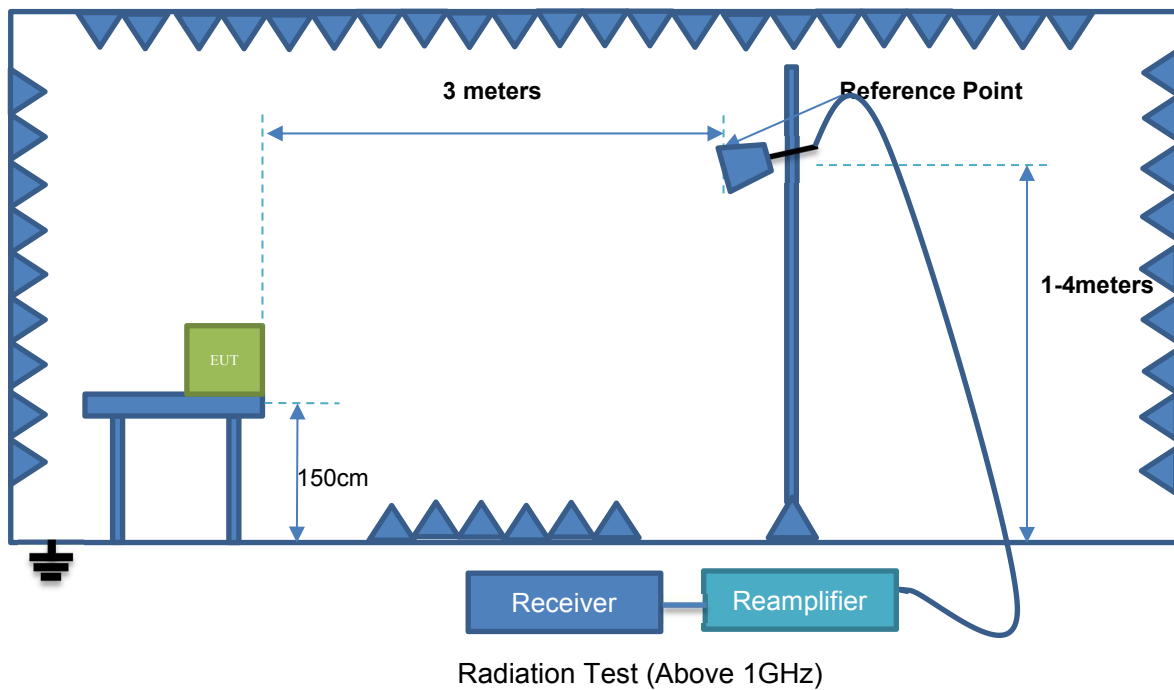
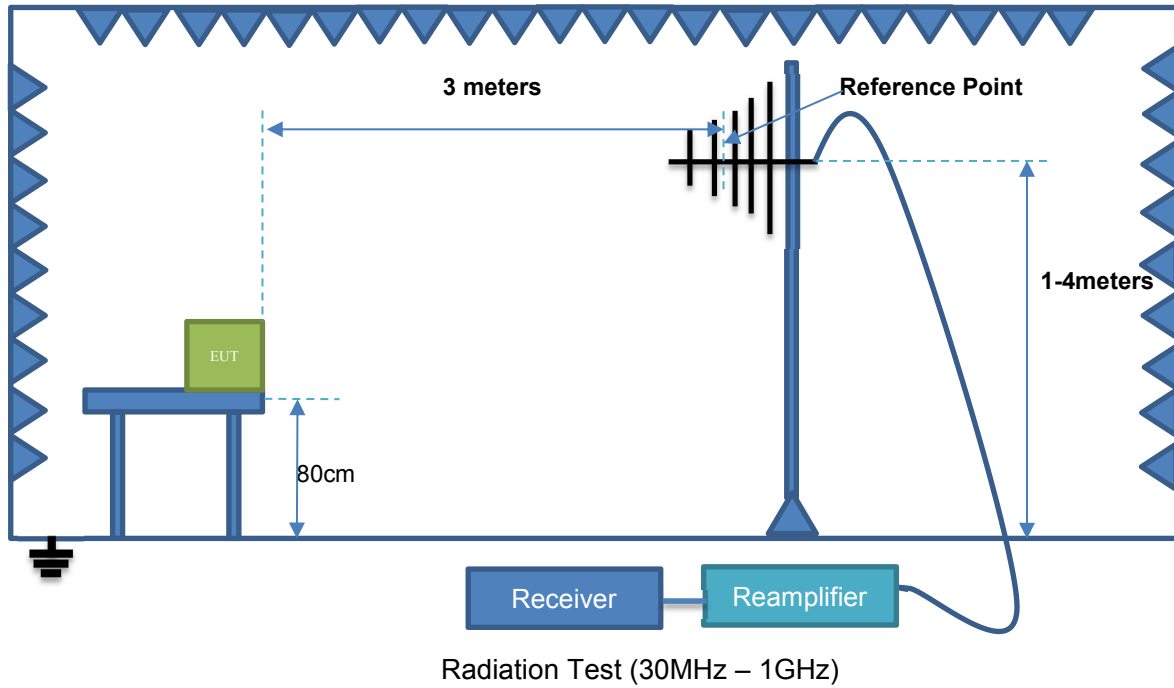
| Conducted disturbance Test | | | | | | |
|----------------------------|---------------|-------------------|-------------|------------|------------|-------------------------------------|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| EMI Receiver | ROHDE&SCHWARZ | ESCI3 | 101422 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| V-LISN | SCHWARZBECK | NSLK 8127 | 01073 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| LISN | AFJ | LS16/110VAC | 16010020076 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| Coaxial Switcher | SCHWARZBECK | CX210 | CX210 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| Pulse Limiter | SCHWARZBECK | VTSD 9561-F | 00953 | 2022.11.24 | 2023.11.23 | <input checked="" type="checkbox"/> |
| EZ_EMG | Frad | EMC-CON 3A1.1+ | / | / | / | <input checked="" type="checkbox"/> |

4.3 Test Auxiliary Equipment

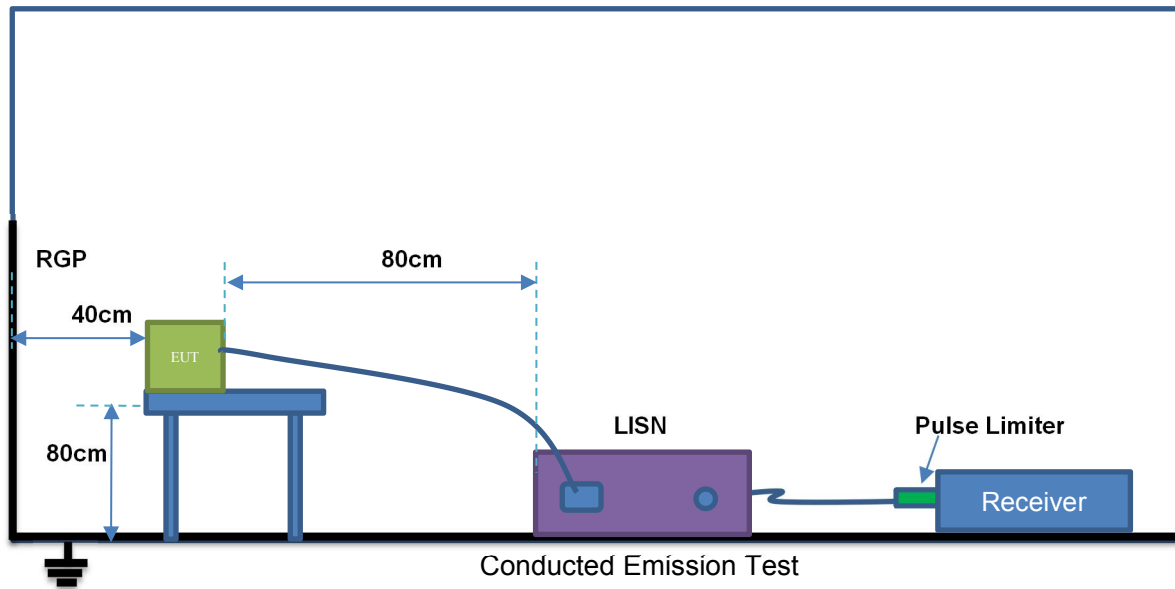
| Description | Manufacturer | Model | Serial No. | Length | Description | Use |
|-------------|--------------|-------|------------|--------|-------------|-------------------------------------|
| | | | | | | <input checked="" type="checkbox"/> |

4.4 Test Setup

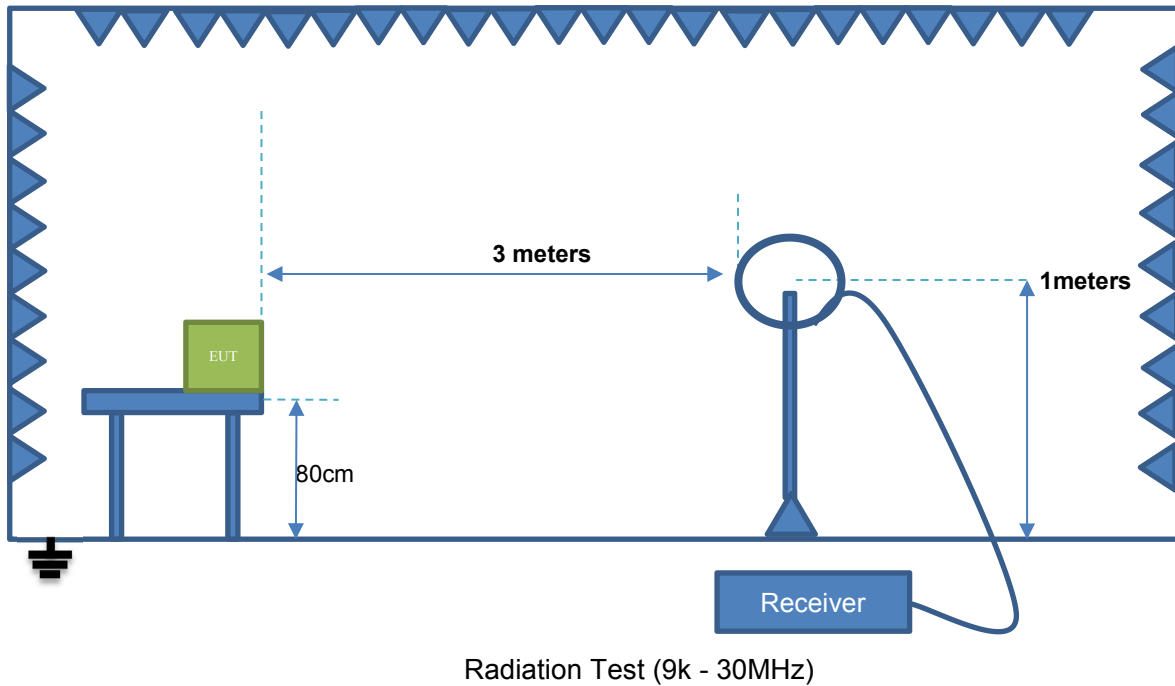
Test Setup 1



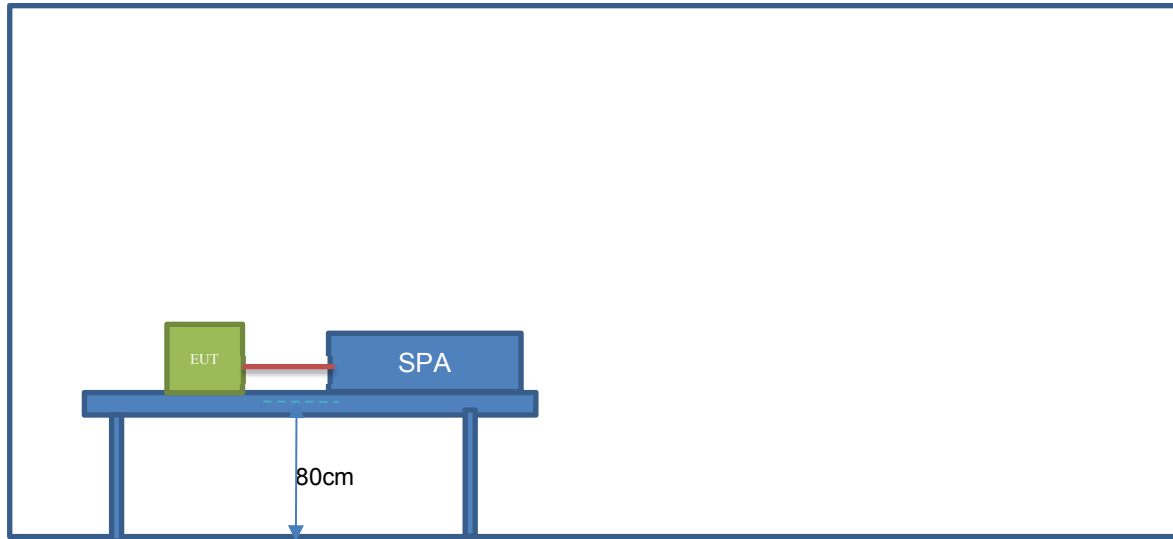
Test Setup 2



Test Setup 3



Test Setup 4



5. Test Items

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203; RSS-247, 5.4(f)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

| Protected Method | Description |
|---|--|
| The antenna is embedded in the product. | An embedded in antenna design is used. |

| Reference Documents | Item |
|---------------------|--|
| Photo | Please refer to the EUT Photo documents. |

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Output Power

5.2.1 Limit

FCC § 15.247(b); RSS-247, 5.4(d)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements.

5.2.2 Test Setup

Maximum peak conducted output power

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

Maximum conducted (average) output power (Reporting Only)

a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

- 1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
 - 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
 - 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.
- c) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- d) Adjust the measurement in dBm by adding $10\log(1/x)$, where x is the duty cycle to the measurement result.

Measurements of duty cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission. Set RBW \geq OBW if possible; otherwise, set RBW to the largest available value.

Set VBW \geq RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of

sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

5.2.3 Test Result

Please refer to ANNEX A.1

5.3 Emission Bandwidth

5.3.1 Limit

FCC §15.247(a); RSS-GEN, 6.7; RSS-247, 5.2 (a)

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

5.3.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Set RBW = 100 kHz.

Set the video bandwidth (VBW) ≥ 3 RBW. Detector = Peak.

Trace mode = max hold.

Sweep = auto couple.

Allow the trace to stabilize.

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.

5.3.4 Test Result

Please refer to ANNEX A.2

5.4 Conducted Spurious Emission

5.4.1 Limit

FCC §15.247(d) ; RSS-247, 5.5

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.

5.4.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

5.4.3 Test Procedure

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then 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 (i.e., 20 dBc).

b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

The following procedures shall be used to demonstrate compliance to these limits. Note that these procedures can be used in either an antenna-port conducted or radiated test set-up. Radiated tests must conform to the test site requirements and utilize maximization procedures defined herein.

Reference level measurement:

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency. Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz. Set the VBW $\geq 3 \times$ RBW. Detector = peak.

Sweep time = auto couple. Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Emission level measurement:

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

Set the RBW = 100 kHz. Set the VBW $\geq 3 \times$ RBW. Detector = peak.

Sweep time = auto couple. Trace mode = max hold.

Allow trace to fully stabilize.

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

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b).

Report the three highest emissions relative to the limit.

5.4.4 Test Result

Please refer to ANNEX A.3

5.5 Band Edge (Authorized-band band-edge)

5.5.1 Limit

FCC §15.247(d) ; RSS-GEN, 8.9, RSS-247, 5.5

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.

5.5.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

5.5.3 Test Procedure

The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is utilized, use the procedure described in 13.2.1. Use the procedure described in 13.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., duty cycle $\geq 98\%$). Use the procedure described in 13.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent). Use the procedure described in 13.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2 percent).

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used.

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

Set span to 2 MHz RBW = 100 kHz. VBW $\geq 3 \times$ RBW.

Detector = peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweep to continue until the trace stabilizes (required measurement time may increase for low duty cycle applications)

Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

Standard method (The 99% OBW of the fundamental emission is without 2 MHz of the authorized band):

Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2.

Attenuation: Auto (at least 10 dB preferred). Sweep time: Coupled.

Resolution bandwidth: 100 kHz. Video bandwidth: 300 kHz.

Detector: Peak.

5.5.4 Test Result

Please refer to ANNEX A.3

5.6 Conducted Emission

5.6.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dBμV) | |
|--------------------------|------------------------|----------|
| | Quai-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 0.50 - 30 | 60 | 50 |

5.6.2 Test Setup

See section 4.5 for test setup description for setup 2. The photo of test setup please refer to ANNEX B

5.6.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.6.4 Test Result

Please refer to ANNEX A.4

NOTE:

1. Results (dBuV) = Reading (dBuV) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss

3. Over limit = Results – Limit.

5.7 Radiated Spurious Emission

5.7.1 Limit

FCC §15.209&15.247(d) ; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a). According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.7.2 Test Setup

See section 4.5 for test setup description for setup 1 and 3. The photo of test setup please refer to ANNEX B

5.7.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious

emissions is required.

General Procedure for conducted measurements in restricted bands:

- a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
- b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)
- c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
- d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
- e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20\log D + 104.8$$

where:

E = electric field strength in dB μ V/m,

EIRP = equivalent isotropic radiated power in dBm D = specified measurement distance in meters.

- f) Compare the resultant electric field strength level to the applicable limit.

- g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure:

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

- a) RBW = as specified in Table 1.
- b) VBW $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer

for low duty cycle applications).

Table 1—RBW as a function of frequency

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

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

- a) The EUT shall be configured to operate at the maximum achievable duty cycle.
- b) Measure the duty cycle, x , of the transmitter output signal as described in section 6.0.
- c) RBW = 1 MHz (unless otherwise specified).
- d) VBW $\geq 3 \times$ RBW.
- e) Detector = RMS, if $\text{span}/(\# \text{ of points in sweep}) \leq (\text{RBW}/2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- f) Averaging type = power (i.e., RMS).
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- g) Sweep time = auto.
- h) Perform a trace average of at least 100 traces.
- i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.
 - 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $20 \log(1/x)$, where x is the duty cycle.
 - 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not

permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain:

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test:

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak Trace = max hold

5.7.4 Test Result

Please refer to ANNEX A.5

NOTE:

1. Results (dBuV) = Reading (dBuV) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss

3. Over limit = Results – Limit.

5.8 Band Edge (Restricted-band-edge)

5.8.1 Limit

FCC §15.209&15.247(d) ; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.8.2 Test Setup

See section 4.5 for test setup description for antenna port. The photo of test setup please refer to ANNEX B

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.8.4 Test Result

Please refer to ANNEX A.6

5.9 Power Spectral Density

5.9.1 Limit

FCC §15.209&15.247(e) ; RSS-247, 5.2 (b)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.9.2 Test Setup

See section 4.5 for test setup description for antenna port. The photo of test setup please refer to ANNEX B

5.9.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency. Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. Set the VBW $\geq 3 \text{ RBW}$.

Detector = peak.

Sweep time = auto couple. Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.9.4 Test Result

Please refer to ANNEX A.7

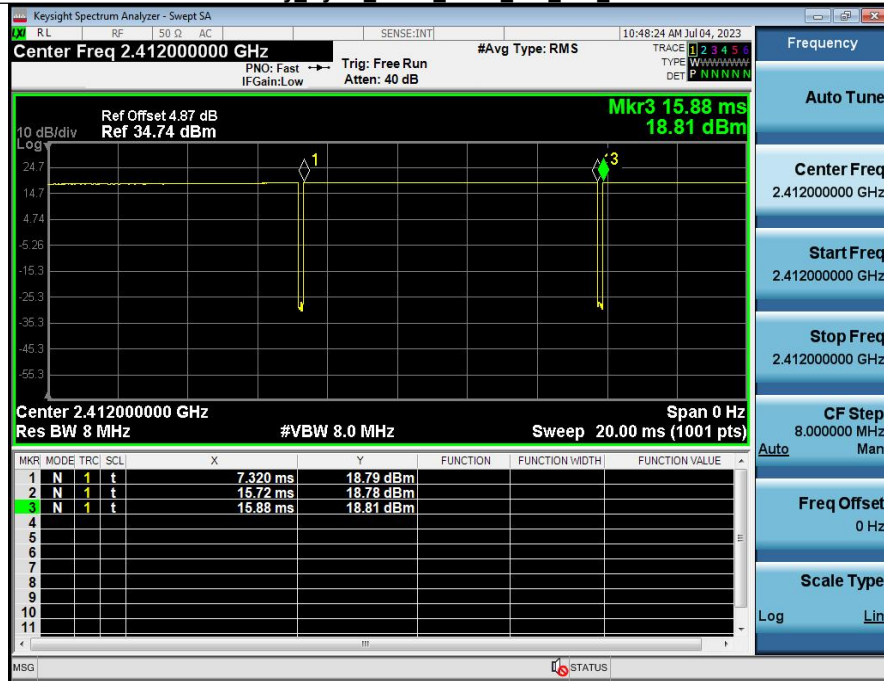
ANNEX A Test Results

A.1 Output Power, Duty Cycle

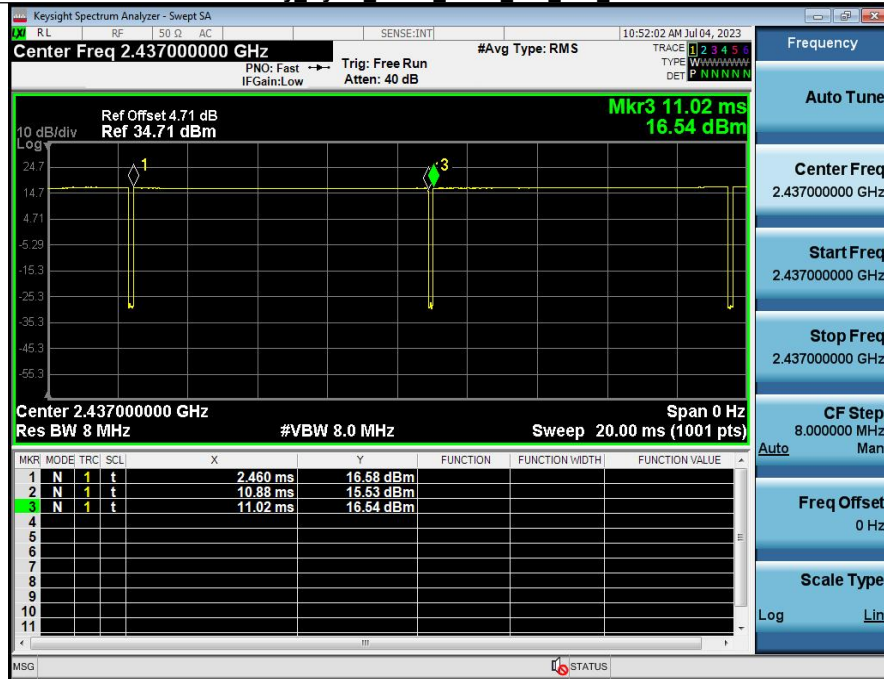
| Modulation | Frequency (MHz) | Dutycycle(%) | Duty_factor |
|---------------|-----------------|--------------|-------------|
| 802.11b | 2412.00 | 98.36 | 0.00 |
| 802.11b | 2437.00 | 98.60 | 0.00 |
| 802.11b | 2462.00 | 98.37 | 0.00 |
| 802.11g | 2412.00 | 89.74 | 0.47 |
| 802.11g | 2437.00 | 92.21 | 0.35 |
| 802.11g | 2462.00 | 90.91 | 0.41 |
| 802.11n(HT20) | 2412.00 | 90.91 | 0.41 |
| 802.11n(HT20) | 2437.00 | 89.55 | 0.48 |
| 802.11n(HT20) | 2462.00 | 88.06 | 0.55 |
| 802.11n(HT40) | 2422.00 | 83.78 | 0.77 |
| 802.11n(HT40) | 2437.00 | 81.08 | 0.91 |
| 802.11n(HT40) | 2452.00 | 81.08 | 0.91 |

| Modulation | Frequency (MHz) | Detector | Conducted Power(dBm) | Duty factor(dB) | Total Power(dBm) | limit(dBm) | Result |
|---------------|-----------------|----------|----------------------|-----------------|------------------|------------|--------|
| 802.11b | 2412.00 | Peak | 18.61 | 0.00 | 18.61 | 30 | Pass |
| 802.11b | 2437.00 | Peak | 17.97 | 0.00 | 17.97 | 30 | Pass |
| 802.11b | 2462.00 | Peak | 18.85 | 0.00 | 18.85 | 30 | Pass |
| 802.11g | 2412.00 | Peak | 17.71 | 0.47 | 18.18 | 30 | Pass |
| 802.11g | 2437.00 | Peak | 16.28 | 0.35 | 16.63 | 30 | Pass |
| 802.11g | 2462.00 | Peak | 17.71 | 0.41 | 18.12 | 30 | Pass |
| 802.11n(HT20) | 2412.00 | Peak | 17.68 | 0.41 | 18.09 | 30 | Pass |
| 802.11n(HT20) | 2437.00 | Peak | 16.21 | 0.48 | 16.69 | 30 | Pass |
| 802.11n(HT20) | 2462.00 | Peak | 17.71 | 0.55 | 18.26 | 30 | Pass |
| 802.11n(HT40) | 2422.00 | Peak | 16.30 | 0.77 | 17.07 | 30 | Pass |
| 802.11n(HT40) | 2437.00 | Peak | 15.28 | 0.91 | 16.19 | 30 | Pass |
| 802.11n(HT40) | 2452.00 | Peak | 16.25 | 0.91 | 17.16 | 30 | Pass |

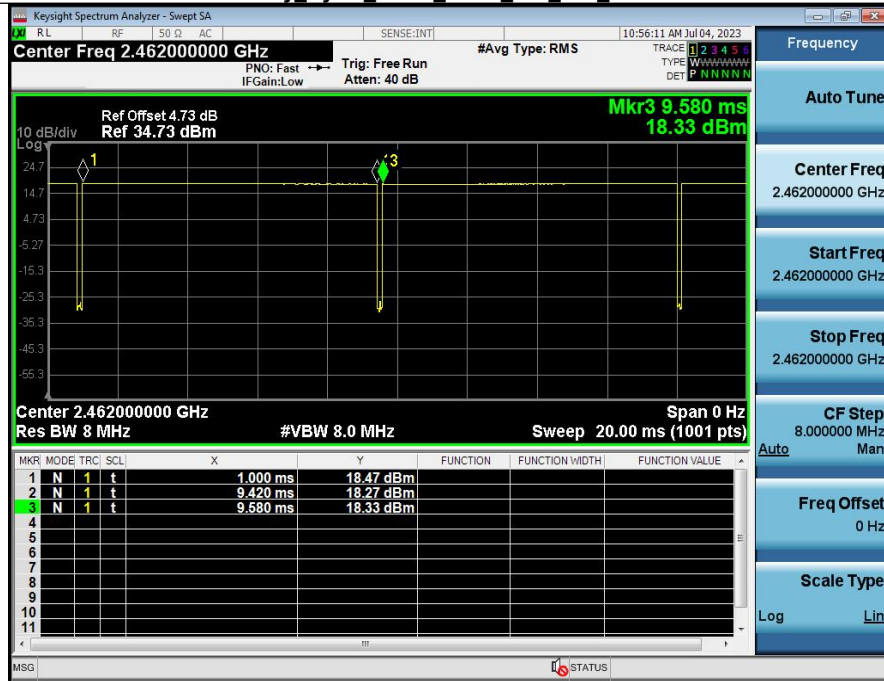
Duty Cycle NVNT ANT1_802_11b_2412



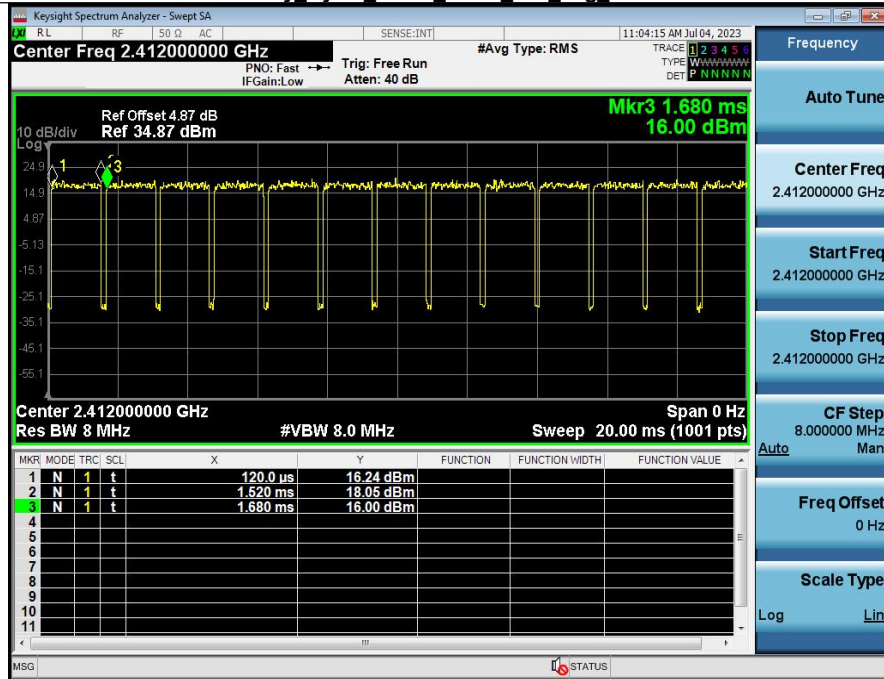
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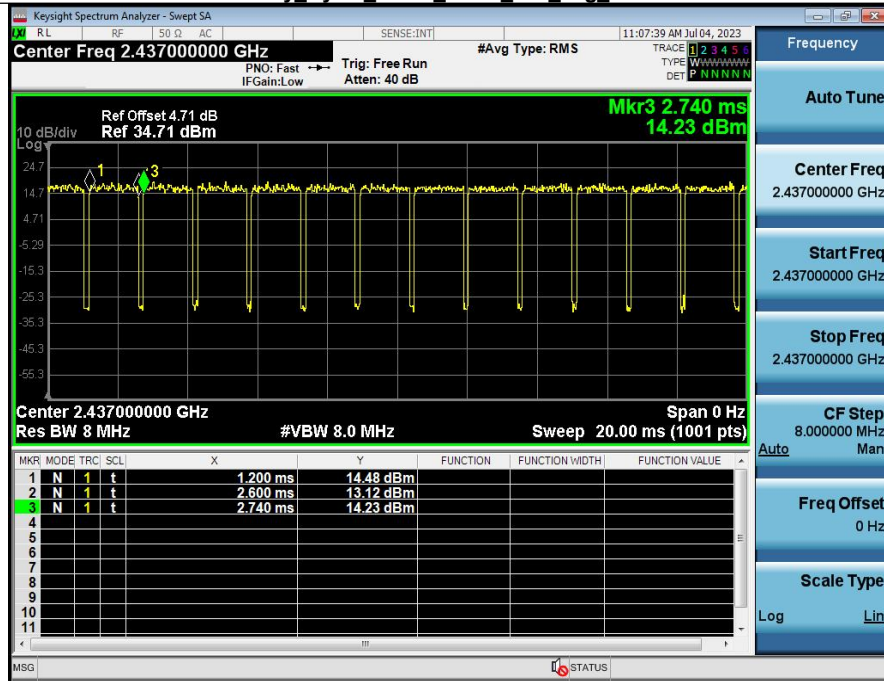
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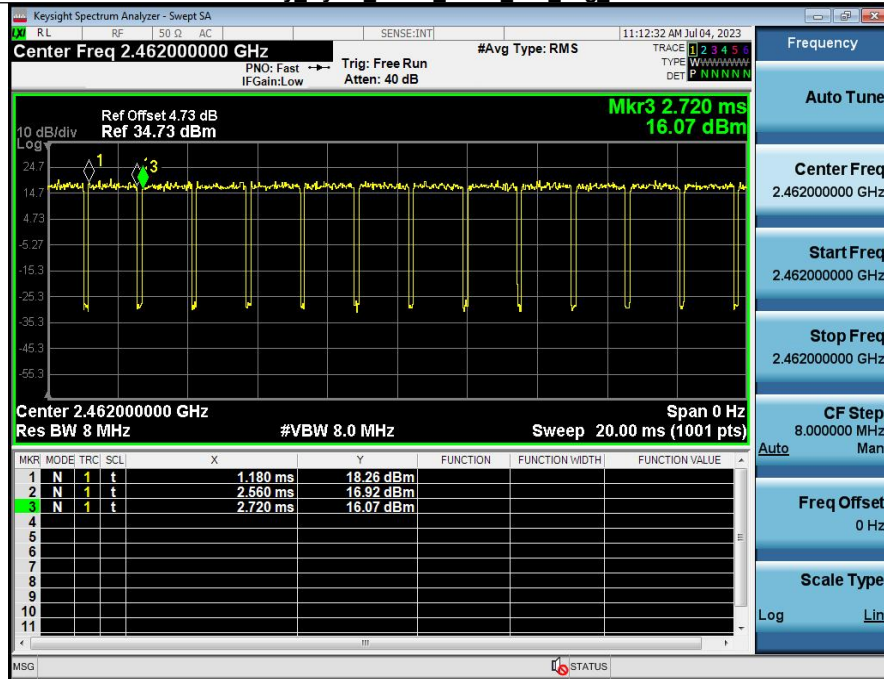
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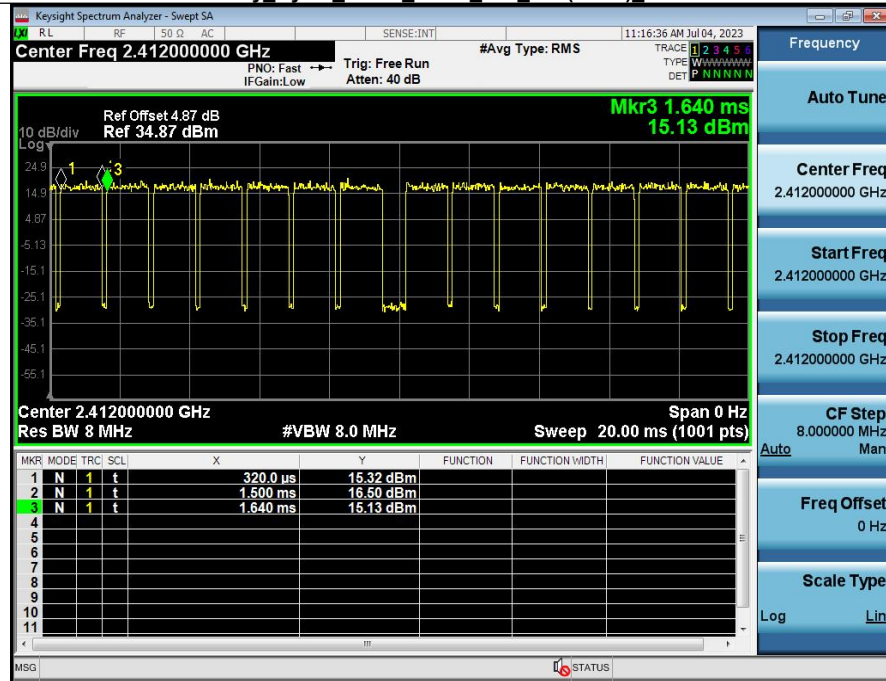
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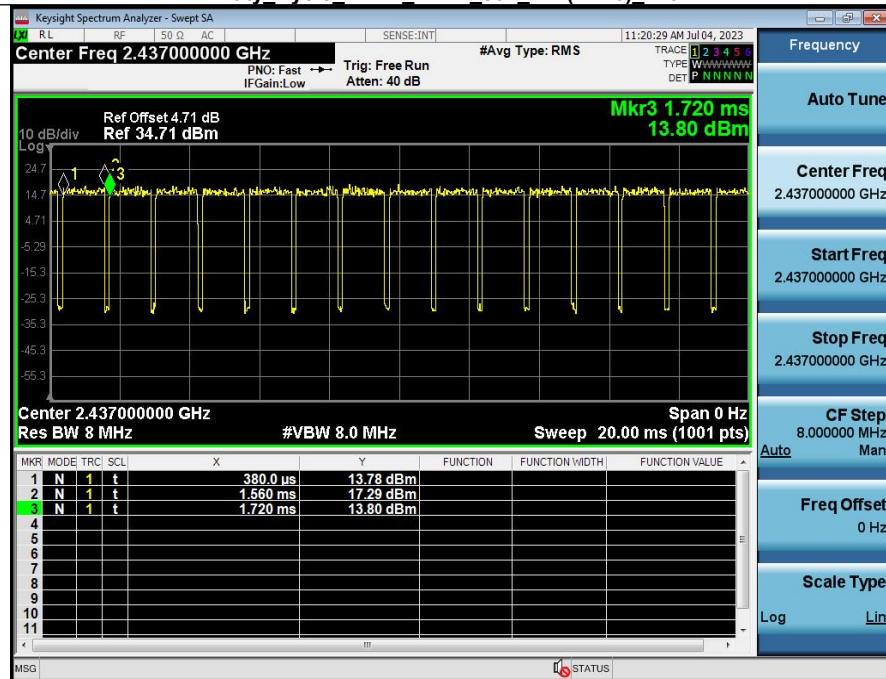
Duty Cycle NVNT ANT1_802_11g_2462



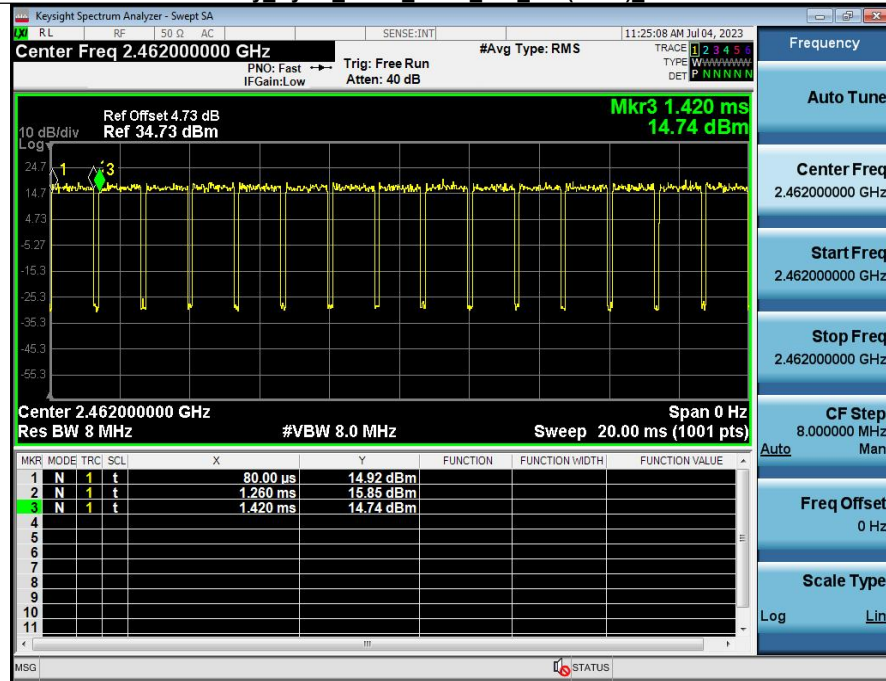
Duty Cycle NVNT ANT1_802_11n(HT20)_2412



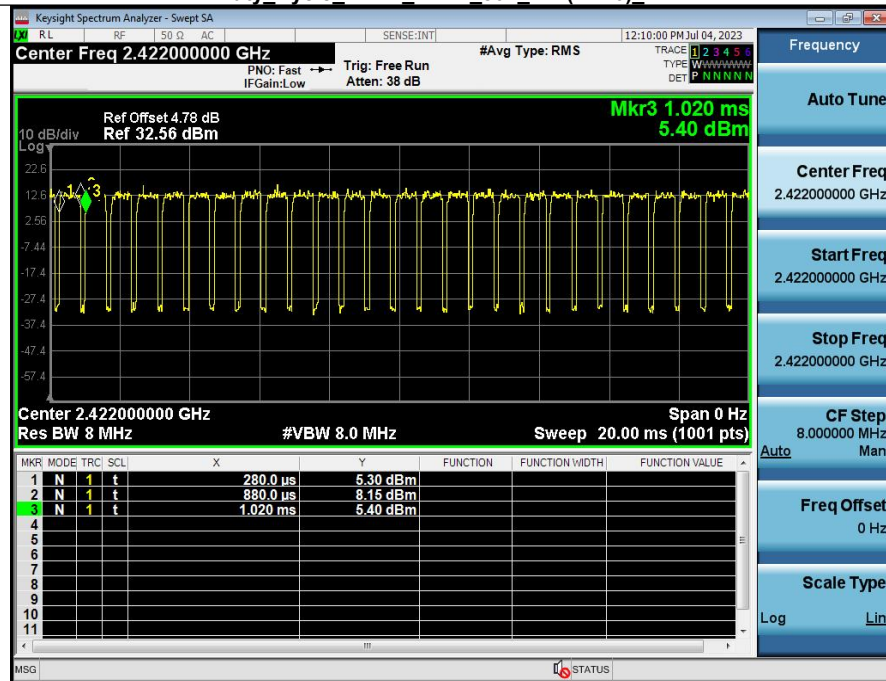
Duty Cycle NVNT ANT1_802_11n(HT20)_2437



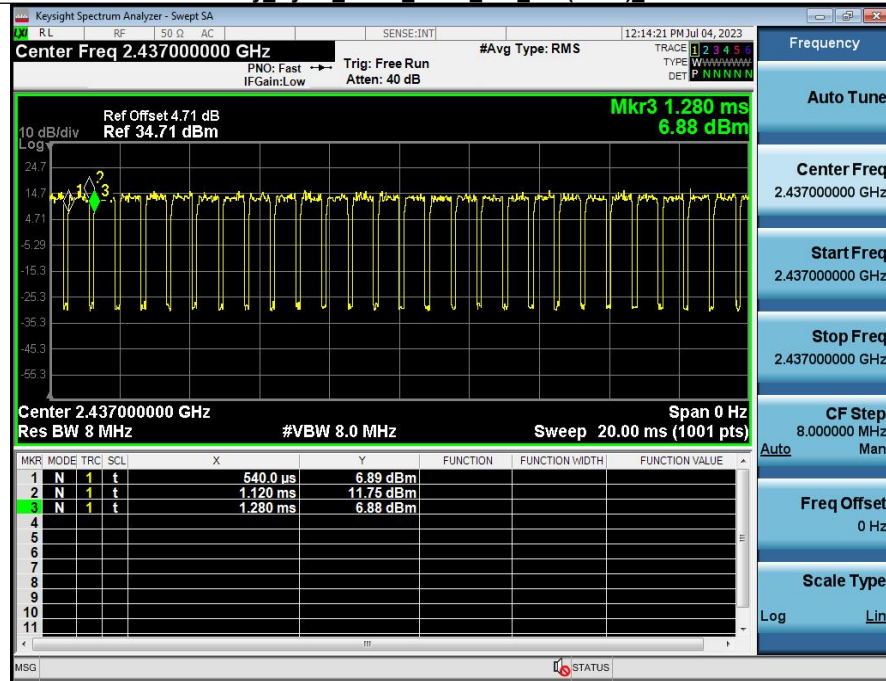
Duty Cycle NVNT_ANT1_802_11n(HT20)_2462



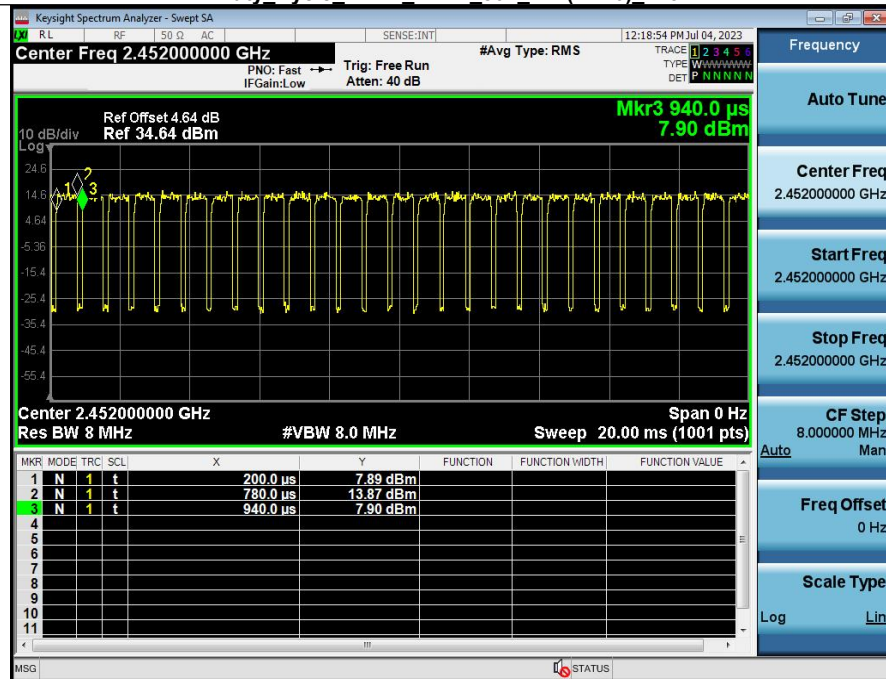
Duty Cycle NVNT_ANT1_802_11n(HT40)_2422



Duty Cycle NVNT ANT1_802_11n(HT40)_2437

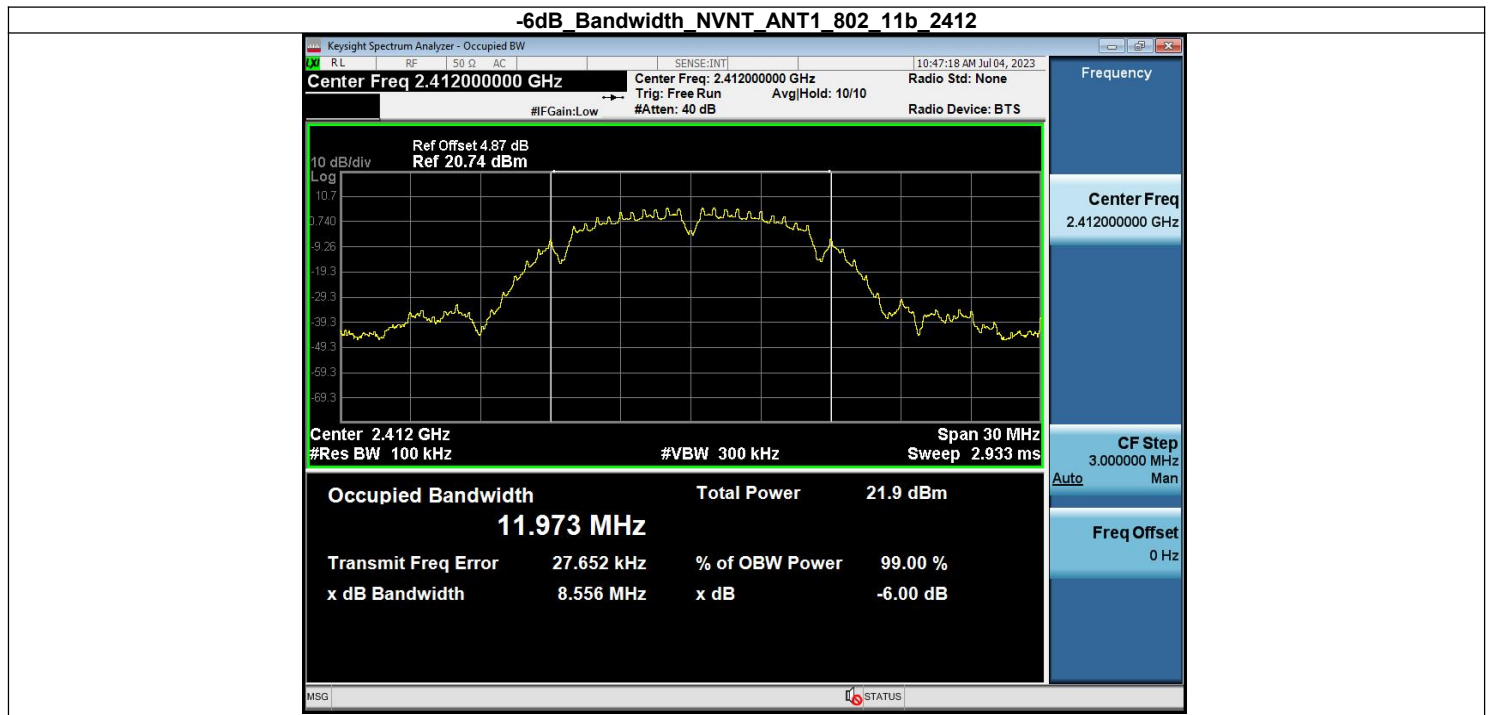


Duty Cycle NVNT ANT1_802_11n(HT40)_2452



A.2 Occupied Bandwidth

| Modulation | Frequency (MHz) | -6dB BW(MHz) | limit(kHz) | Result |
|---------------|-----------------|--------------|------------|--------|
| 802.11b | 2412.00 | 8.56 | 500 | Pass |
| 802.11b | 2437.00 | 8.59 | 500 | Pass |
| 802.11b | 2462.00 | 8.62 | 500 | Pass |
| 802.11g | 2412.00 | 16.08 | 500 | Pass |
| 802.11g | 2437.00 | 15.75 | 500 | Pass |
| 802.11g | 2462.00 | 16.34 | 500 | Pass |
| 802.11n(HT20) | 2412.00 | 16.73 | 500 | Pass |
| 802.11n(HT20) | 2437.00 | 16.32 | 500 | Pass |
| 802.11n(HT20) | 2462.00 | 16.76 | 500 | Pass |
| 802.11n(HT40) | 2422.00 | 35.84 | 500 | Pass |
| 802.11n(HT40) | 2437.00 | 35.32 | 500 | Pass |
| 802.11n(HT40) | 2452.00 | 35.25 | 500 | Pass |



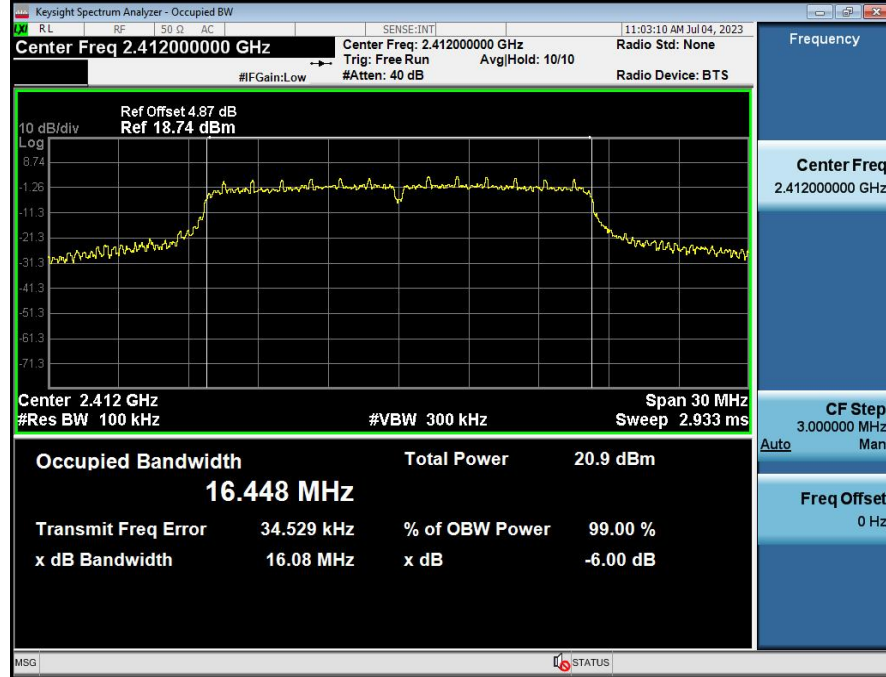
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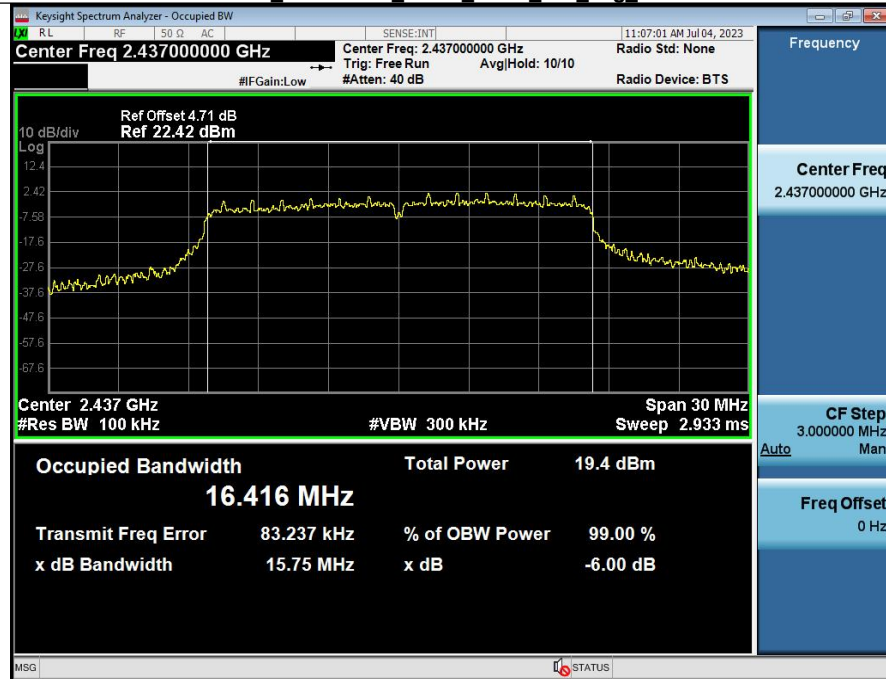
-6dB Bandwidth_NVNT_ANT1_802_11b_2462



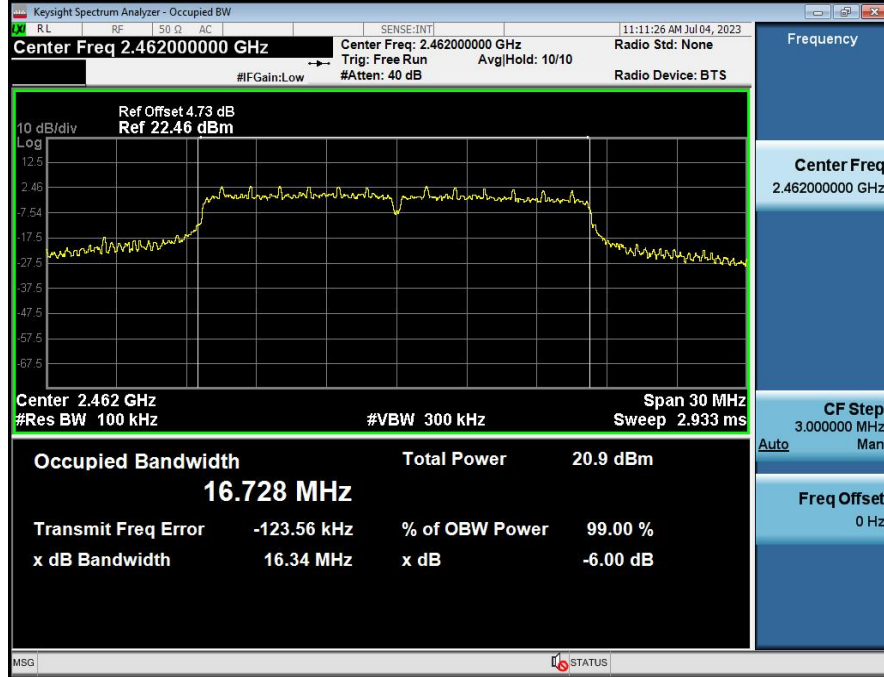
-6dB Bandwidth_NVNT_ANT1_802_11g_2412



-6dB Bandwidth_NVNT_ANT1_802_11g_2437



-6dB Bandwidth_NVNT_ANT1_802_11g_2462



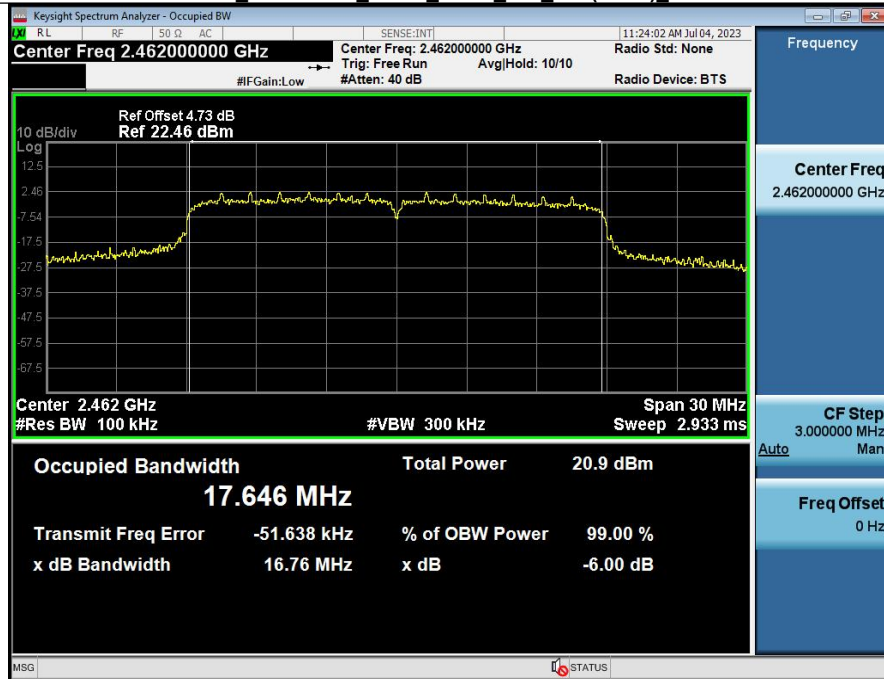
-6dB Bandwidth_NVNT_ANT1_802_11n(HT20)_2412



-6dB Bandwidth_NVNT_ANT1_802_11n(HT20)_2437



-6dB Bandwidth_NVNT_ANT1_802_11n(HT20)_2462

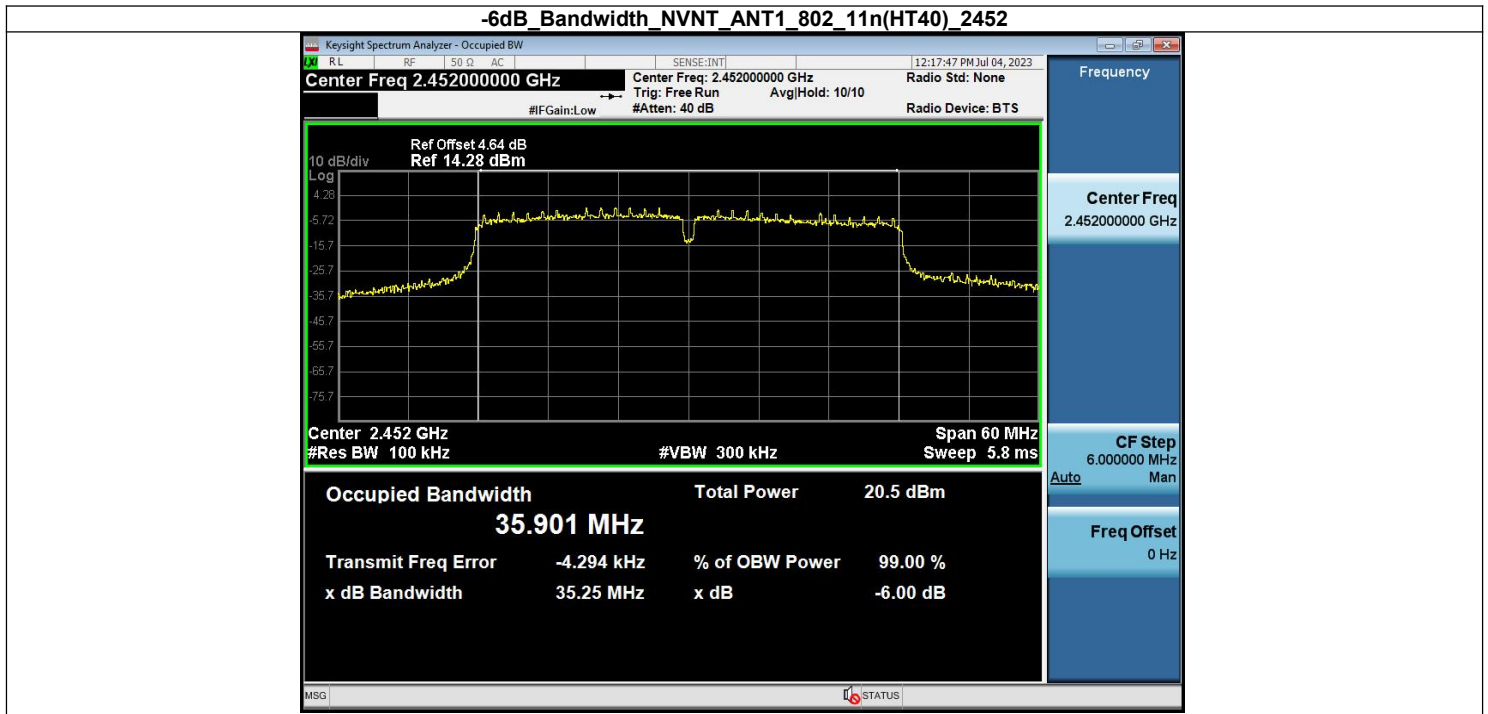


-6dB Bandwidth_NVNT_ANT1_802_11n(HT40)_2422



-6dB Bandwidth_NVNT_ANT1_802_11n(HT40)_2437





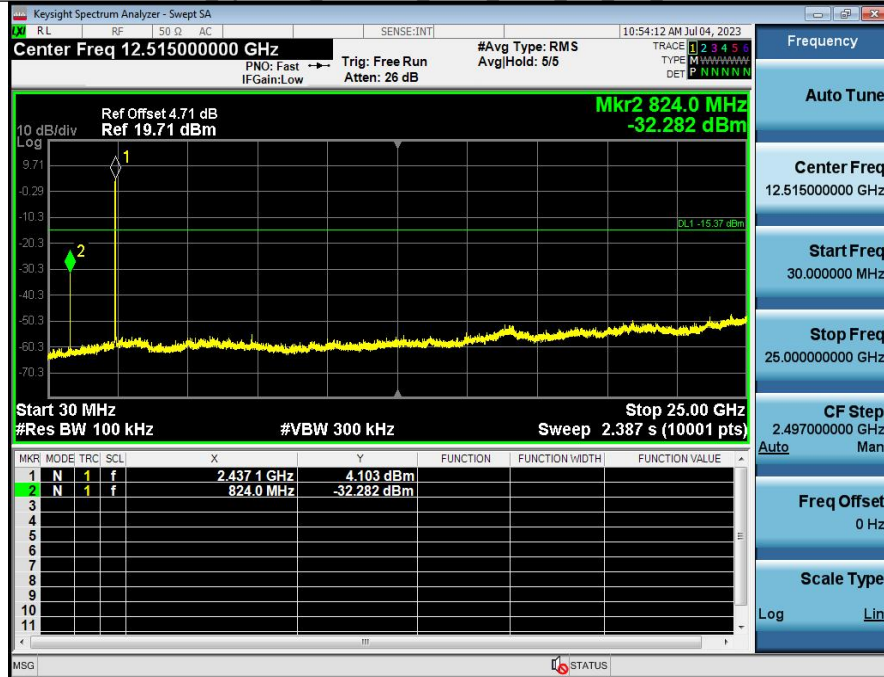
A.3 Conducted Spurious Emissions & Band Edge (Authorized-band band-edge)



1 Reference_Level_NVNT_ANT1_802_11b_2437



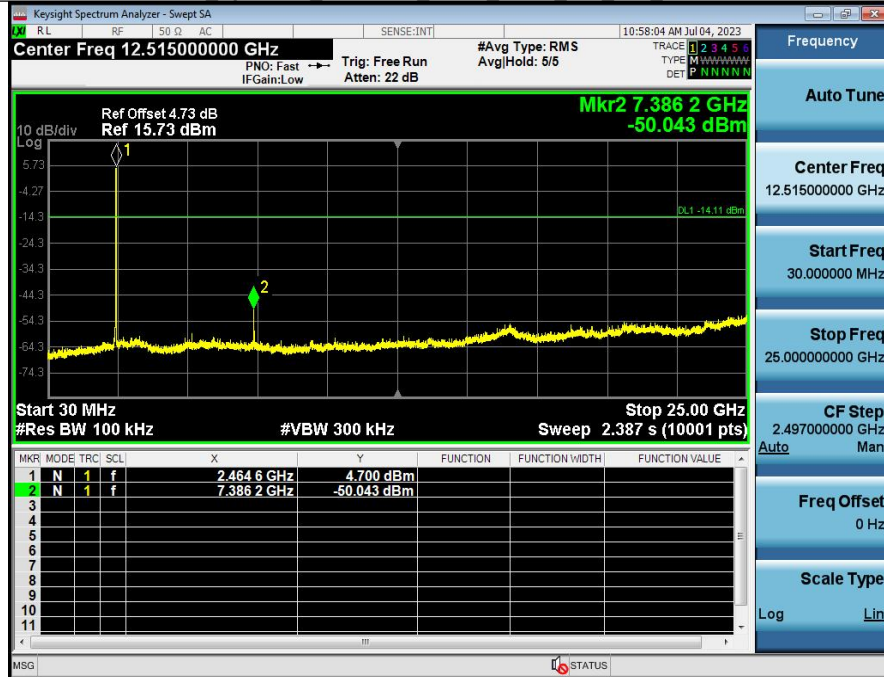
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1 Reference_Level_NVNT_ANT1_802_11b_2462



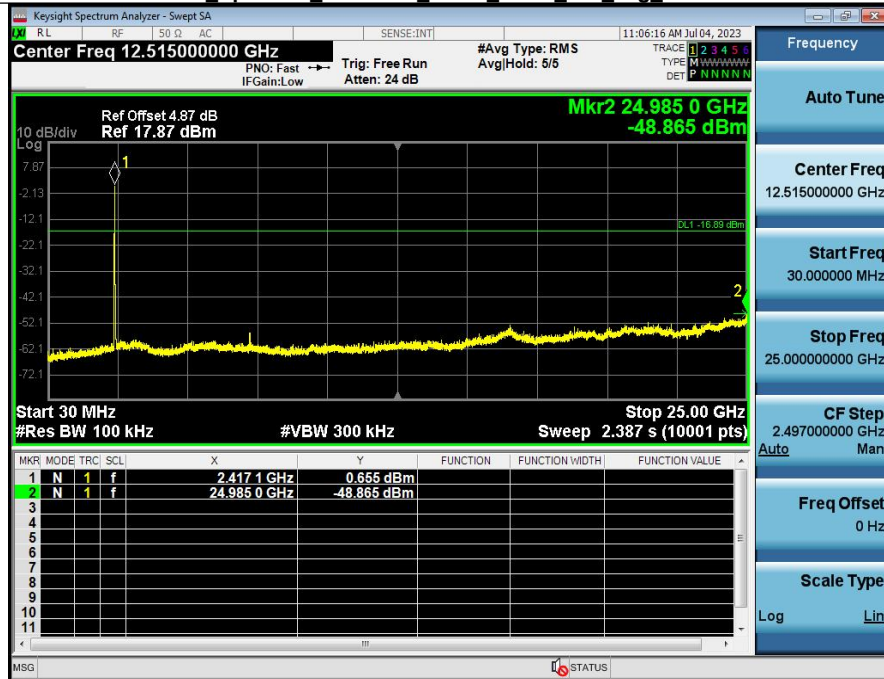
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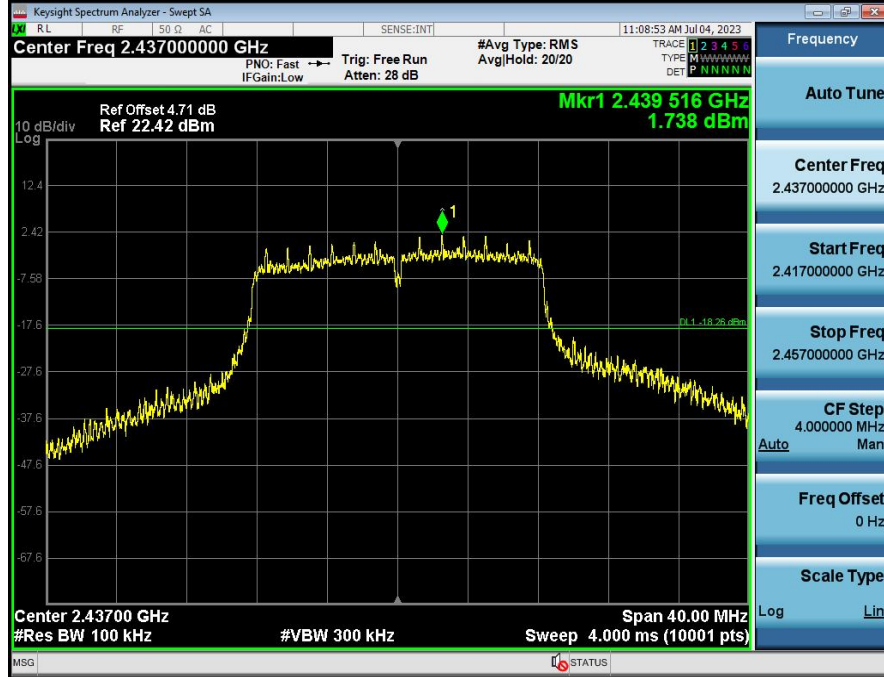
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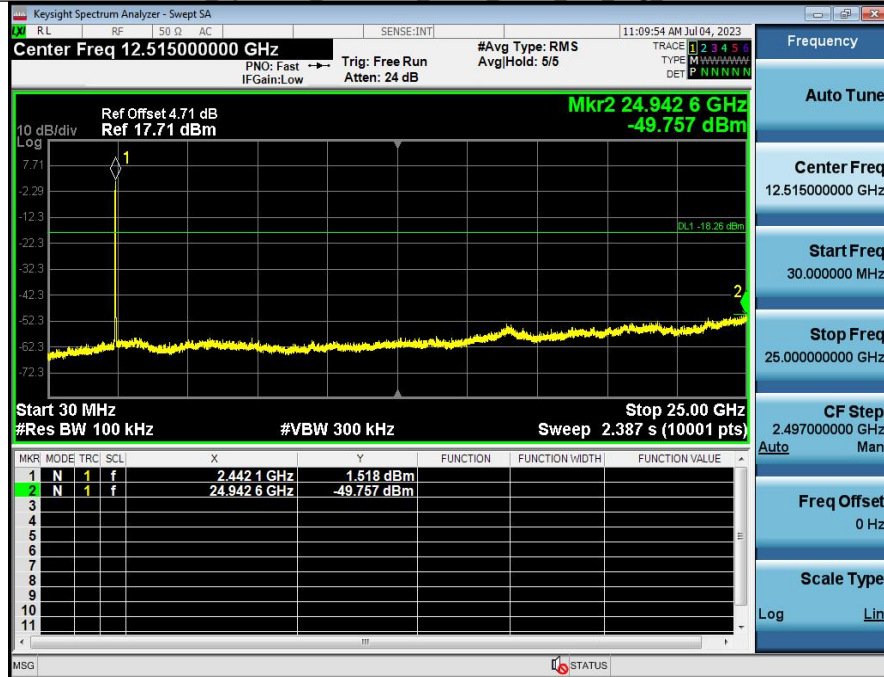
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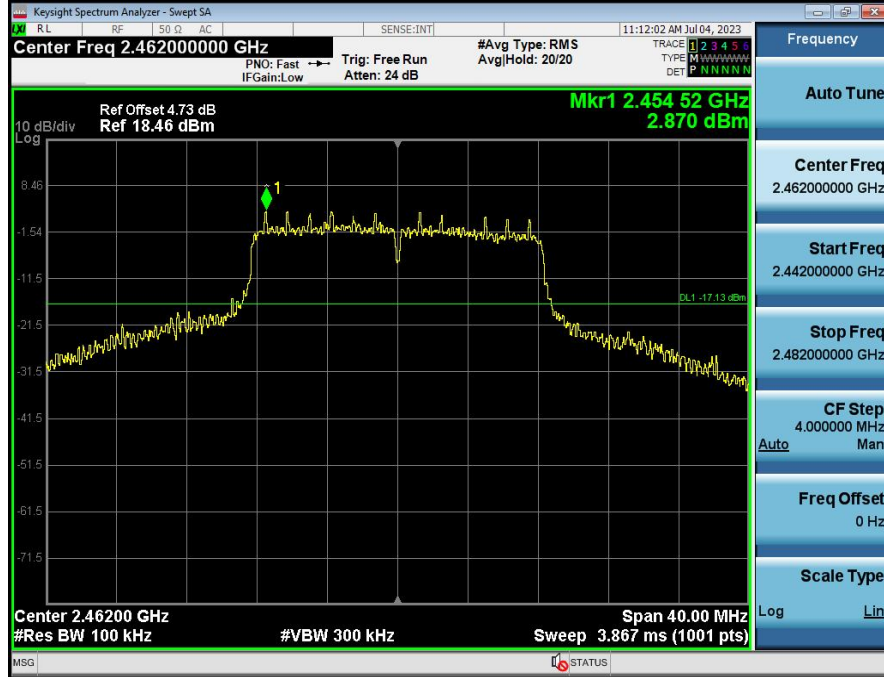
1 Reference_Level_NVNT_ANT1_802_11g_2437



2 Spurious_Emission_NVNT_ANT1_802_11g_2437



1 Reference_Level_NVNT_ANT1_802_11g_2462



2 Spurious_Emission_NVNT_ANT1_802_11g_2462

