Compliance
Test
Services

**623 E. 100 S.**
**Salt Lake City, UT 84102**

# Test Report

## Certification

| | |
|---|---|
| **FCC ID** | 2AJAC-CORE1 |
| **IC ID** | 7848A-CORE1 |
| **Equipment Under Test** | C4-CORE1 |
| **Test Report Serial Number** | TR6994_03 |
| **Date of Test(s)** | January 6 and January 20, 2022 |
| **Report Issue Date** | 22 March 2022 |

| Test Specification | Applicant |
|---|---|
| 47 CFR FCC Part 15, Subpart C | Snap One LLC<br>1800 Continental Blvd., Suite 200 – 300<br>Charlotte NC 28273<br>U.S.A. |

NVLAP TESTING ilac-MRA

**NVLAP LAB CODE 600293-0**

## Certification of Engineering Report

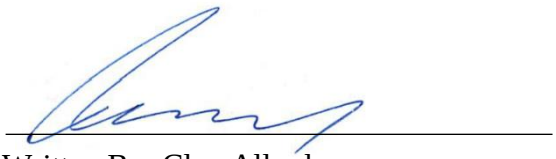
This report has been prepared by Compliance Test Services (CTS) to document compliance of the device described below with the requirement of Federal Communication Commissions (FCC) Part 15, Subpart B. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

| | |
|---|---|
| **Applicant** | Snap One LLC |
| **Manufacturer** | Snap One LLC |
| **Brand Name** | Snap One LLC |
| **Model Number** | C4-CORE1 |
| **FCC ID** | 2AJAC-CORE1 |
| **IC ID** | 7848A-CORE1 |

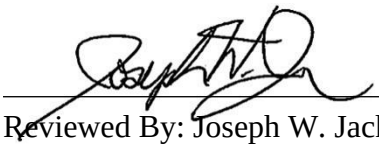
On this 22nd day of March 2022, I individually and for Compliance Test Services certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge and are made in good faith.

Although NVLAP has accredited the Compliance Test Services testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the U.S. federal government.

Compliance Test Services



Written By: Clay Allred



Reviewed By: Joseph W. Jackson

| Revision History | | |
|---|---|---|
| **Revision** | **Description** | **Date** |
| 01 | Original Report Release | 22 March 2022 |
| 02 | Amend Applicant Address | 18 April 2022 |
| 03 | Added Radiated Spurious Test Tables | 19 April 2022 |

# Table of Contents

# 1 Client Information

## 1.1 Applicant

| | |
|---|---|
| **Company** | Snap One, LLC<br>1800 Continental Blvd., Suite 200 – 300<br>Charlotte NC 28273<br>U.S.A. |
| **Contact Name** | Roger Midgley |
| **Title** | Principle Compliance Manager |

## 1.2 Manufacturer

| | |
|---|---|
| **Company** | Snap One, LLC<br>1800 Continental Blvd., Suite 200 – 300<br>Charlotte NC 28273<br>U.S.A. |
| **Contact Name** | Roger Midgley |
| **Title** | Principle Compliance Manager |

# 2 Equipment Under Test (EUT)

## 2.1 Identification of EUT

| | |
|---|---|
| **Brand Name** | Snap One, LLC |
| **Model Number** | C4-CORE1, LUM-BRIDGE-4CH |
| **Serial Number** | ST2146007A016F13/00FFF00000DF18F |
| **Rating / Power Supply** | Input: AC 100V-240 VAC, 50Hz/60Hz, Max 18W, Idle 9W, and PoE+ |
| **PCB Revision** | Rev. 3.0 |
| **Schematic Revision** | Rev 3.0 |
| **Dimensions (mm)** | 29.5 x 194.8 x 132 |

## 2.2 Description of EUT

The C4-CORE1 is a controller for Contol4's home automation system. The C4-CORE1 has an Ethernet port, HDMI port, SPDIF audio output, USB port, and 4 IR ports. An 802.15.4(ZigBee) transceiver which is used for communication with other devices in the system. These units are powered by 100-240 VAC, 60/50Hz or PoE+.

The highest internal clocks or internal clock frequency on the EUT is the 2.4 GHz Zigbee wireless and internal DDR 1.6 GHz clock.

This report covers the circuitry of the device subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Part 15 Subpart B was found to be compliant and is covered under a separate Compliance Test Services test report.

## 2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

| **Brand Name**<br>**Model Number**<br>**Serial Number** | **Description** | **Name of Interface Ports / Interface Cables** |
|---|---|---|
| BN: Control4<br>MN: C4-CORE1<br>SN: ST2146007A016F13 | System Controller | See Section 2.4 |
| BN: Dell<br>MN: XPS 13<br>SN: N/A | Laptop Personal Computer | See Section 24. |

Notes: (1) EUT
(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

## 2.4 Interface Ports on EUT

| Name of Ports | No. of Ports Fitted to EUT | Shielded Cable | Ferrite Core Installed | Cable Description/Length |
|---|---|---|---|---|
| Ethernet In/Out/PoE | 2 | No | No | Ethernet/Network Cat 5e cable |
| HDMI | 1 | Yes | No | 1 meter |
| USB | 1 | Yes | No | USBA extension cable to USB flash drive ,1 meter |
| Serial IR | 4 | No | No | Two conductor cables with 3.5mm mono connector/2 meters |
| SPDIF | 1 | Yes | No | RCA 75 Ohm cable, 1 meter |

## 2.5 Operating Environment

| | |
|---|---|
| **Power Supply** | 120V |
| **AC Mains Frequency** | 60Hz |
| **Temperature** | 22 – 24 °C |
| **Humidity** | 20 – 2 7% |
| **Barometric Pressure** | 1019 mBar |

## 2.6 Operating Modes

The C4-CORE1 was connected to a personal computer laptop and tested using test software in order to enable to constant duty cycle greater or equal to 98% of the Zigbee transceiver. The measurements within this report are corrected to reference a 100% duty cycle.

## 2.7 EUT Exercise Software

Firmware/Software Version: 3.3.0.614843 was used to operate the transmitter using a constant transmit mode.

## 2.8 Block Diagram of Test Configuration

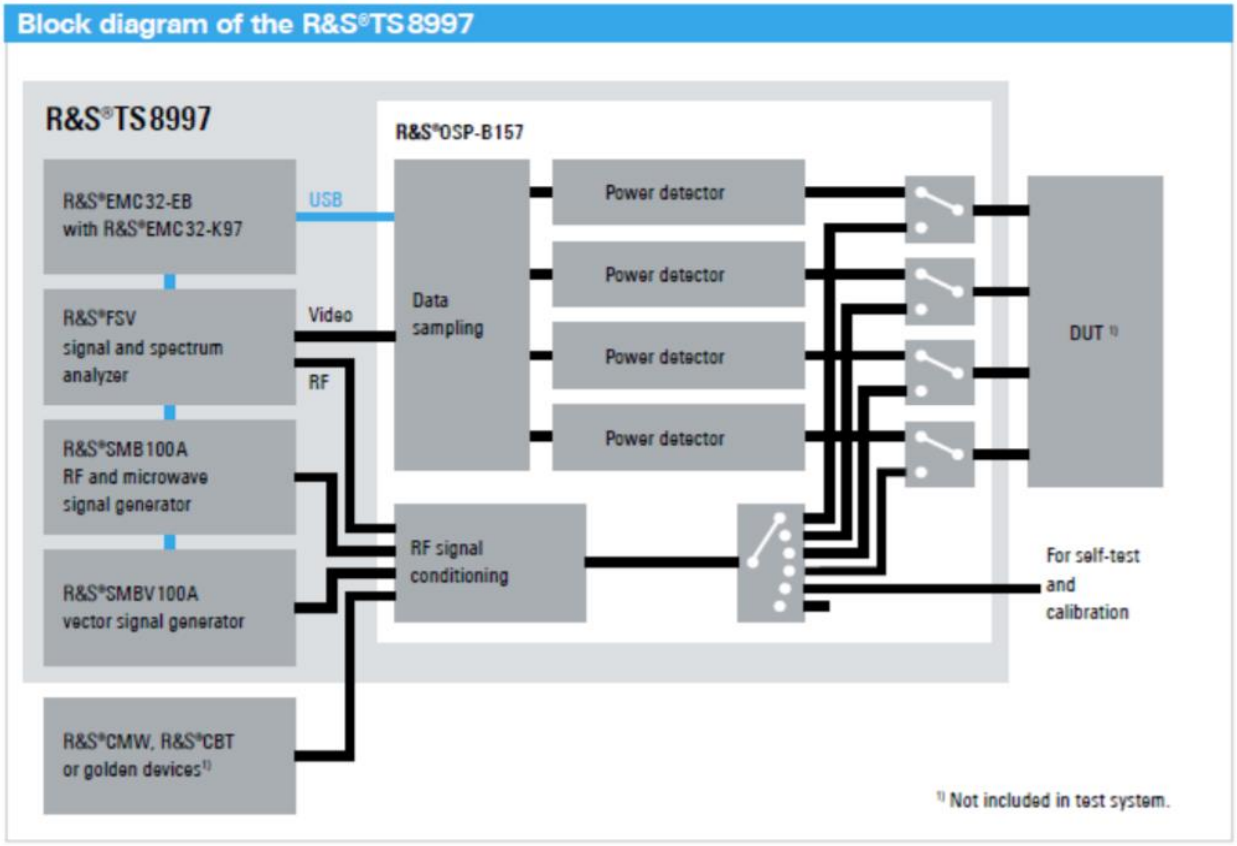



**Diagram 1: Test Configuration Block Diagram**

## 2.9 Modification Incorporated/Special Accessories on EUT

There were no modifications made to the EUT during testing to comply with the specification.

## 2.10 Deviation, Opinions Additional Information or Interpretations from Test Standard

There were no deviations, opinions, additional information or interpretations from the test specification.

# 3 Test Specification, Method and Procedures

## 3.1 Test Specification

| | |
|---|---|
| **Title** | 47 CFR FCC Part 15, Subpart C<br>15.203, 15.207 and 15.247<br>Limits and methods of measurement of radio interference characteristics of radio frequency devices. |
| **Purpose of Test** | The tests were performed to demonstrate initial compliance |

## 3.2 Methods & Procedures

### 3.2.1 47 CFR FCC Part 15 Section 15.207

See test standard for details.

### 3.2.2 47 CFR FCC Part 15 Section 15.247

See test standard for details.

## 3.3 FCC Part 15, Subpart C

### 3.3.1 Summary of Tests

| FCC Section | ISED Section | Environmental Phenomena | Frequency Range (MHZ) | Result |
|---|---|---|---|---|
| 15.203 | N/A | Antenna requirements | Structural Requirement | Compliant |
| 15.207 | RSS-Gen | Conducted Disturbance at Mains Port | 0.15 to 30 | Compliant |
| 15.247(a) | RSS-247 § 5.2 | Bandwidth Requirement | 2400 to 2483.5 | Compliant |
| 15.247(b) | RSS-247 § 5.4 | Peak Output Power | 2400 to 2483.5 | Compliant |
| 15.247(d) | RSS-247 § 5.4 | Antenna Conducted Spurious Emissions | 0.009 to 40000 | N/A |
| 15.247(d) | RSS-247 § 5.4 | Radiated Spurious Emissions | 0.009 to 40000 | Compliant |
| 15.247(e) | RSS-247 § 5.2 | Peak Power Spectral Density | 2400 to 2483.5 | Compliant |
| The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074 and 47 CFR Part 15. Where applicable, KDB 662911 was followed to sum required measurements. | | | | |

## 3.4 Results

In the configuration tested, the EUT complied with the requirements of the specification.

## 3.5 Test Location

Testing was performed at the Compliance Test Services Draper location at 427 West 12800 South, Draper, UT 84020. Compliance Test Services is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 600293-0 which is effective until December 31, 2022.

# 4 Test Equipment

## 4.1 Conducted Emissions at Mains Ports

| Type of Equipment | Manufacturer | Model Number | Asset Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| EMI Receiver | AFJ | FFT3010 | CTS-6754 | 12/8/2021 | 12/8/2022 |
| LISN | AFJ | LS16C/10 | CTS-6749 | 12/6/2021 | 12/6/2023 |
| Cat6 ISN | Teseq | ISN T8-Cat6 | CTS-2971 | 1/30/2022 | 1/30/2023 |
| ISN | Teseq | ISN T800 | CTS-2974 | 6/4/2021 | 6/4/2022 |
| LISN | Com-Power | LIN-120C | CTS-2612 | 1/6/2022 | 1/6/2023 |
| AC Power Source | Laplace Instruments | AC1000A | CTS-2857 | N/A | N/A |
| Test Software | CTS | Revision 1 | CTS-3107 | N/A | N/A |

**Table 1: List of equipment used for Conducted Emissions Testing at Mains Port**

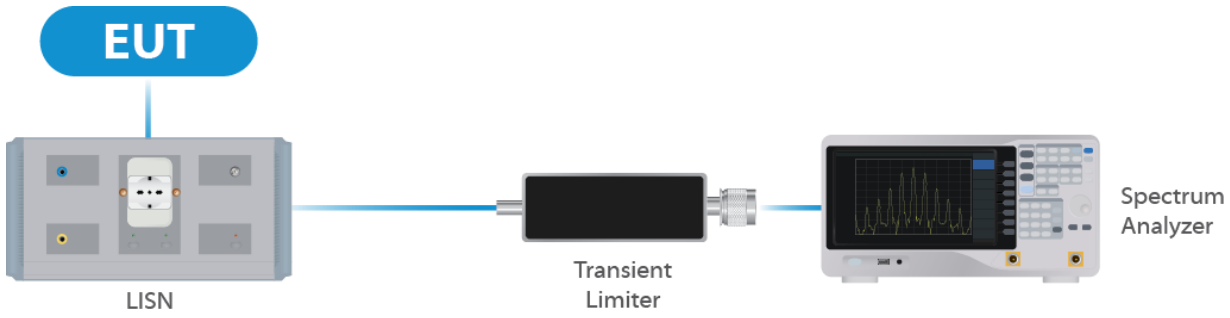



**Figure 1: Conducted Emissions Test**

## 4.2 Direct Connect at the Antenna Port Tests

| Type of Equipment | Manufacturer | Model Number | Asset Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV40 | CTS-2861 | 1/3/2022 | 1/3/2023 |
| Signal Generator | R&S | SMB100A | CTS-2864 | N/A | N/A |
| Vector Signal Generator | R&S | SMBV100A | CTS-2873 | N/A | N/A |
| Switch Extension | R&S | OSP-B157WX | CTS-2867 | 1/3/2022 | 1/3/2023 |
| Switch Extension | R&S | OSP-150W | CTS-2870 | 1/3/2022 | 1/3/2023 |

**Table 2: List of equipment used for Direct Connect at the Antenna Port**

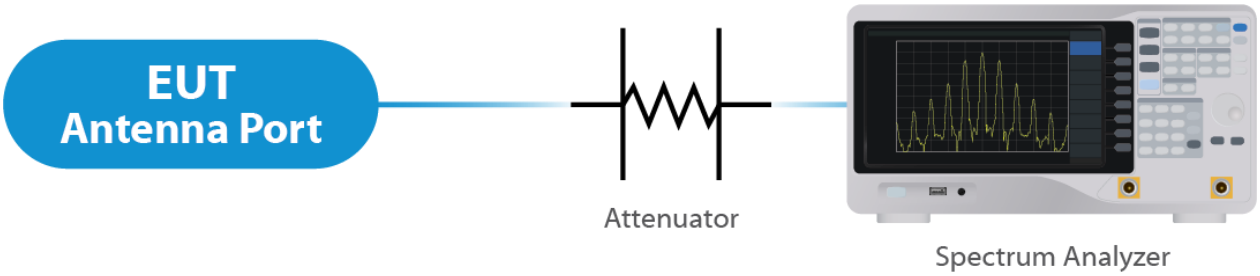



Figure 2: Direct Connect at the Antenna Port Test

## 4.3 Radiated Emissions

| Type of Equipment | Manufacturer | Model Number | Asset Number | Date of Last Calibration | Due Date of Calibration |
|---|---|---|---|---|---|
| EMI Receiver | Keysight | N9038A | CTS-2778 | 6/21/2021 | 6/21/2022 |
| Pre-Amplifier 9 kHz – 1 GHz | Sonoma Instruments | 310N | CTS-2889 | 10/7/2021 | 10/7/2022 |
| Broadband Antenna | Scwarzbeck | VULB 9163 | CTS-3062 | 8/28/2020 | 8/27/2022 |
| Broadband Antenna | Scwarzbeck | VULB 9163 | CTS-3071 | 5/19/2020 | 5/19/2022 |
| Double Ridge Horn Antenna | Scwarzbeck | BBHA 9120D | CTS-3065 | 7/8/2021 | 7/8/2022 |
| Log Periodic | Scwarzbeck | STLP 9129 | CTS-3068 | 11/16/2020 | 11/16/2022 |
| 15 - 40 GHz Horn Antenna | Scwarzbeck | BBHA 9170 | CTS-2487 | 5/21/2020 | 5/21/2022 |
| 1 – 18 GHz Amplifier | Com-Power | PAM 118A | CTS-3833 | 10/7/2021 | 10/7/2022 |
| Test Software | CTS | Revision 1 | CTS-3108 | N/A | N/A |

Table 3: List of equipment used for Radiated Emissions

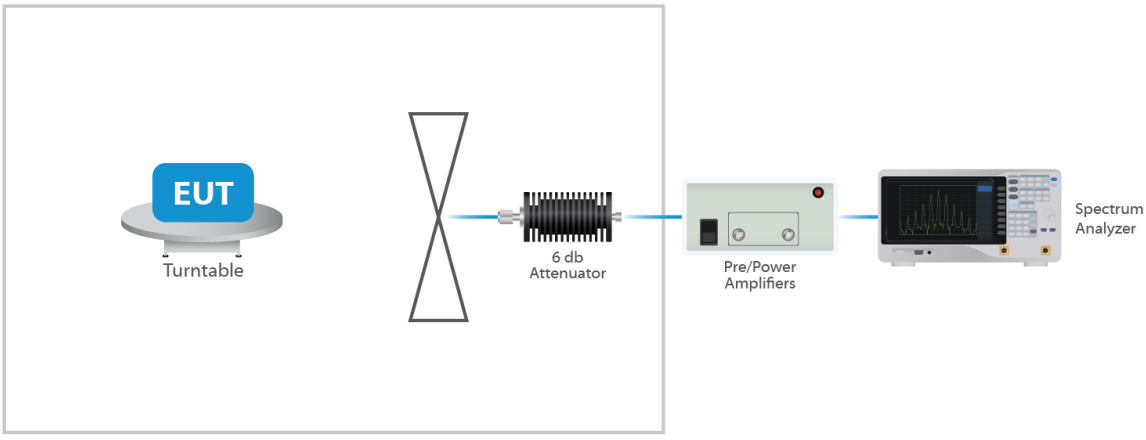



Figure 3: Radiated Emissions Test

## 4.4 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or Compliance Test Services personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request.

## 4.5 Measurement Uncertainty

| Test | Uncertainty (± dB) | Confidence (%) |
|---|---|---|
| Conducted Emissions | 1.44 | 95 |
| Asymmetric Mode Conducted Emissions | 3.61 | 95 |
| Shielded CDN Conducted Emissions | 3.33 | 95 |
| Radiated Emissions (30 MHz to 1 GHz) | 4.38 | 95 |
| Radiated Emissions (1 GHz to 17 GHz) | 4.37 | 95 |

# 5 Test Results

## 5.1 §15.203 Antenna Requirements

The EUT uses an external dipole antenna The Maximum gain of the antenna is 2.7 dBi. The antenna is user replaceable.

**Results**

The EUT complied with the specification

## 5.2 Conducted Emissions at Mains Ports Data

| Frequency (MHZ) | Detector | Receiver Measured Level (dBµV) | Correction Factor (dB) | Corrected Receiver Level (dBµV) | Limit Class B Limit (dBµV) | Margin (dB) |
|---|---|---|---|---|---|---|
| 0.159 | Quasi-Peak (Note 2) | 50.8 | 9.5 | 60.3 | 65.5 | -5.2 |
| 0.186 | Quasi-Peak (Note 2) | 44.8 | 9.5 | 54.4 | 64.2 | -9.8 |
| 0.201 | Quasi-Peak (Note 2) | 42.4 | 9.5 | 51.9 | 63.6 | -11.6 |
| 0.228 | Quasi-Peak (Note 2) | 40.1 | 9.5 | 49.6 | 62.5 | -12.9 |
| 0.159 | Average (Note 2) | 38.3 | 9.5 | 47.9 | 55.5 | -7.7 |
| 0.189 | Average (Note 2) | 33.0 | 9.5 | 42.5 | 54.1 | -11.6 |
| 0.231 | Average (Note 2) | 28.8 | 9.5 | 38.4 | 52.4 | -14.0 |
| 0.159 | Quasi-Peak (Note 2) | 50.8 | 9.5 | 60.3 | 65.5 | -5.2 |

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

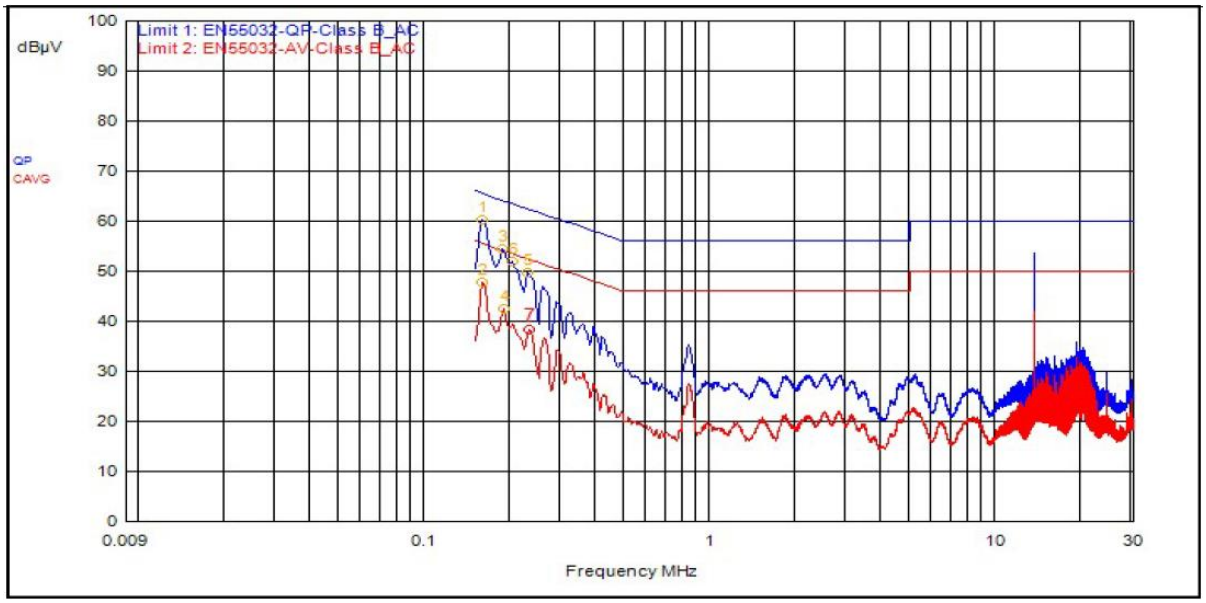
**Sample Calculation**

*Correction Factor = LISN Insertion Loss + Cable Insertion Loss + Transient Limiter Insertion Loss*

*Conducted Emissions Amplitude = Receiver Reading + Correction Factor*

**Result**

The EUT complied with the specification limit by a margin of -5.2 dB.




**Graph 1: Conducted Emissions Plot - Neutral**

| Frequency (MHZ) | Detector | Receiver Measured Level (dBµV) | Correction Factor (dB/m) | Corrected Receiver Level (dBµV) | Limit Class B Limit (dBµV) | Margin (dB) |
|---|---|---|---|---|---|---|
| 0.174 | Quasi-Peak (Note 2) | 49.7 | 9.5 | 59.2 | 64.8 | -5.6 |
| 0.222 | Quasi-Peak (Note 2) | 44.1 | 9.5 | 53.7 | 62.7 | -9.1 |
| 0.261 | Quasi-Peak (Note 2) | 40.1 | 9.6 | 49.7 | 61.4 | -11.7 |
| 0.309 | Quasi-Peak (Note 2) | 38.1 | 9.6 | 47.7 | 60.0 | -12.3 |
| 0.177 | Average (Note 2) | 36.8 | 9.5 | 46.3 | 54.6 | -8.3 |
| 0.219 | Average (Note 2) | 32.9 | 9.5 | 42.4 | 52.9 | -10.4 |
| 0.264 | Average (Note 2) | 29.9 | 9.6 | 39.5 | 51.3 | -11.8 |

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

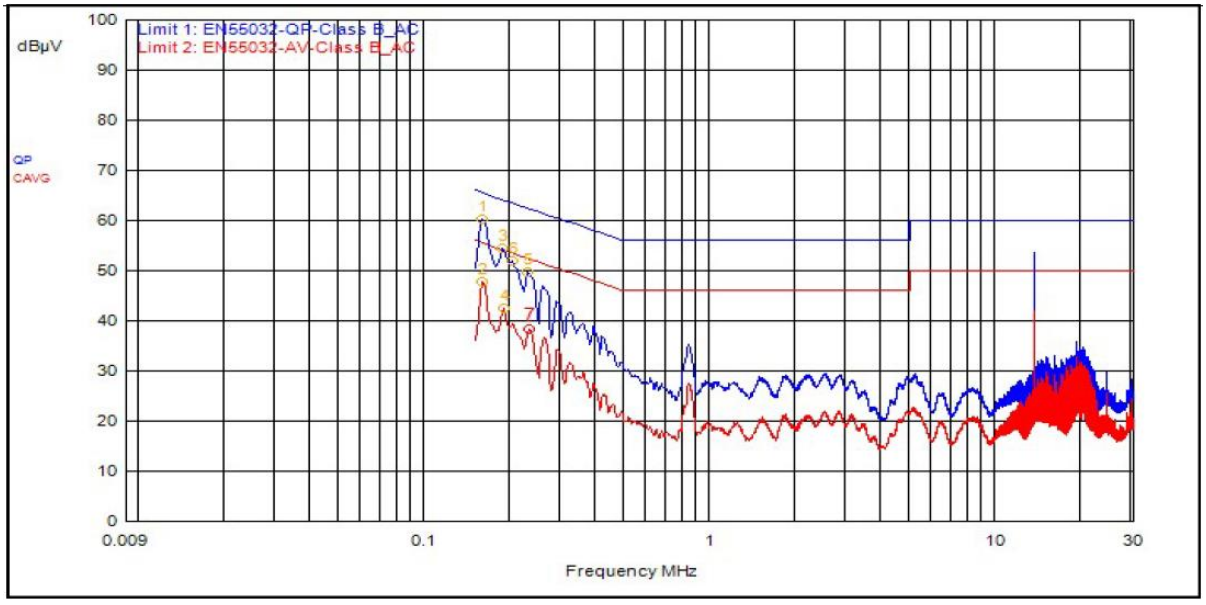
**Sample Calculation**

*Correction Factor = LISN Insertion Loss + Cable Insertion Loss + Transient Limiter Insertion Loss*

*Conducted Emissions Amplitude = Receiver Reading + Correction Factor*

**Result**

The EUT complied with the specification limit.




**Graph 2: Conducted Emissions Plot – Line 1**

## 5.3 §15.247(a)(2) Emissions Bandwidth

| Frequency (MHz) | Emissions 6 dB Bandwidth (MHz) | Emissions 99% Bandwidth (MHz) |
|---|---|---|
| 2405 | 1.742 | 2.23 |
| 2440 | 1.703 | 2.22 |
| 2470 | 1.703 | 2.23 |

**Result**

In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots within the Annex).

## 5.4 §15.247(b)(3) Maximum Average Output Power

The maximum average RF conducted output power measured for this device was 18.1 dBm or 65.56 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a gain of 2.7 dBi.

| Frequency (MHz) | Measured Output Power (dBm) | Output Power (mW) |
|---|---|---|
| 2405 | 18.1 | 64.56 |
| 2440 | 17.7 | 58.88 |
| 2475 | 18.0 | 63.09 |

**Result**

In the configuration tested, the maximum average RF output power was less than 1 watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plot within the Annex).

## 5.5 §15.247(d) Spurious Emissions

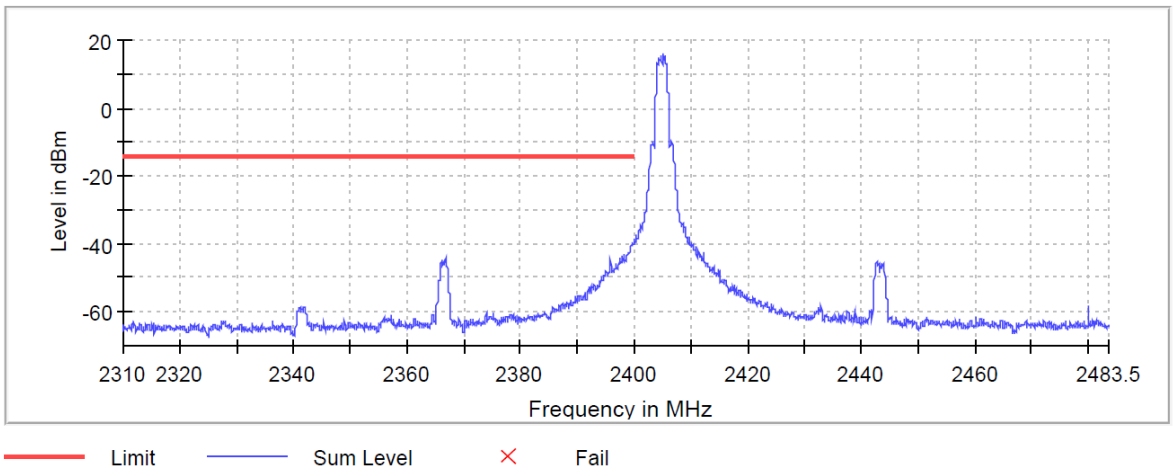
### 5.5.1 Conducted Spurious Emissions

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The table show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown below and within the Annex are plot(s) with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

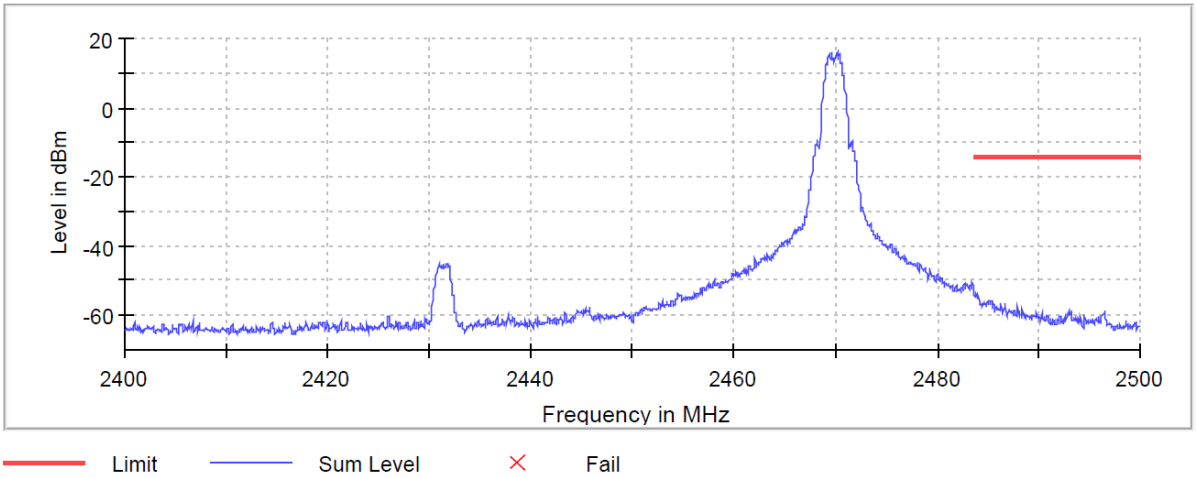
The emissions must be attenuated 30 dB below the highest power spectral density level measured within the authorized band as measured with a 100 kHz RBW.

**Result**

Conducted spurious emissions were attenuated 30 dB or more below the fundamental; therefore, the EUT complies with the specification. Please see associated annex.




**Graph 3: Lower Band Edge Plot**




**Graph 4: Upper Band Edge Plot**

### 5.5.2 Radiated Spurious Emissions in the Restricted Bands of §15.205

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emissions was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emissions that fell into the restricted bands of §15.205. The tables show the worst-case emissions measured from the EUT. For frequencies above 18.0 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limits. The emissions in the restricted bans must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown.

**Result**

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

| Freq. | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | Cor. (dB) | Det. |
|---|---|---|---|---|---|---|---|---|
| 7.4262 GHz | 50.691 | 74 | -23.309 | 46 | 3.793 | Vrt | -1.681 | Peak |
| 14.907 GHz | 55.176 | 74 | -18.824 | 213 | 3.793 | Vrt | 10.092 | Peak |
| 7.4262 GHz | 39.181 | 54 | -14.819 | 46 | 3.793 | Vrt | -1.681 | Ave |
| 14.907 GHz | 42.327 | 54 | -11.673 | 213 | 3.793 | Vrt | 10.092 | Ave |
| 14.904 GHz | 54.896 | 74 | -19.104 | 144 | 1.643 | Hztl | 10.004 | Peak |
| 14.904 GHz | 42.25 | 54 | -11.75 | 144 | 1.643 | Hztl | 10.004 | Ave |
| 7.213 GHz | 57.084 | 74 | -16.916 | 175 | 3.776 | Vrt | -2.083 | Peak |
| 14.896 GHz | 55.639 | 74 | -18.361 | 112 | 3.798 | Vrt | 9.566 | Peak |
| 7.213 GHz | 47.877 | 54 | -6.123 | 175 | 3.776 | Vrt | -2.083 | Ave |
| 14.896 GHz | 41.995 | 54 | -12.005 | 112 | 3.798 | Vrt | 9.566 | Ave |
| 7.213 GHz | 54.467 | 74 | -19.533 | 201 | 1.5 | Hztl | -2.083 | Peak |
| 12.759 GHz | 51.585 | 74 | -22.415 | 30 | 2.808 | Hztl | 5.708 | Peak |
| 15.024 GHz | 56.228 | 74 | -17.772 | 227 | 3.157 | Hztl | 10.357 | Peak |
| 7.213 GHz | 44.616 | 54 | -9.384 | 201 | 1.5 | Hztl | -2.083 | Ave |
| 12.759 GHz | 39.087 | 54 | -14.913 | 30 | 2.808 | Hztl | 5.708 | Ave |
| 15.024 GHz | 42.695 | 54 | -11.305 | 227 | 3.157 | Hztl | 10.357 | Ave |
| 7.3181 GHz | 54.538 | 74 | -19.462 | 165 | 3.307 | Vrt | -1.75 | Peak |
| 15.032 GHz | 55.363 | 74 | -18.637 | 51 | 1.834 | Vrt | 10.009 | Peak |
| 7.3181 GHz | 44.827 | 54 | -9.173 | 165 | 3.307 | Vrt | -1.75 | Ave |

| Freq. | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | Cor. (dB) | Det. |
|---|---|---|---|---|---|---|---|---|
| 15.032 GHz | 42.142 | 54 | -11.858 | 51 | 1.834 | Vrt | 10.009 | Ave |
| 7.3181 GHz | 52.353 | 74 | -21.647 | 195 | 2.312 | Hztl | -1.75 | Peak |
| 7.3181 GHz | 41.695 | 54 | -12.305 | 195 | 2.312 | Hztl | -1.75 | Ave |

**Sample Field Strength Calculation**

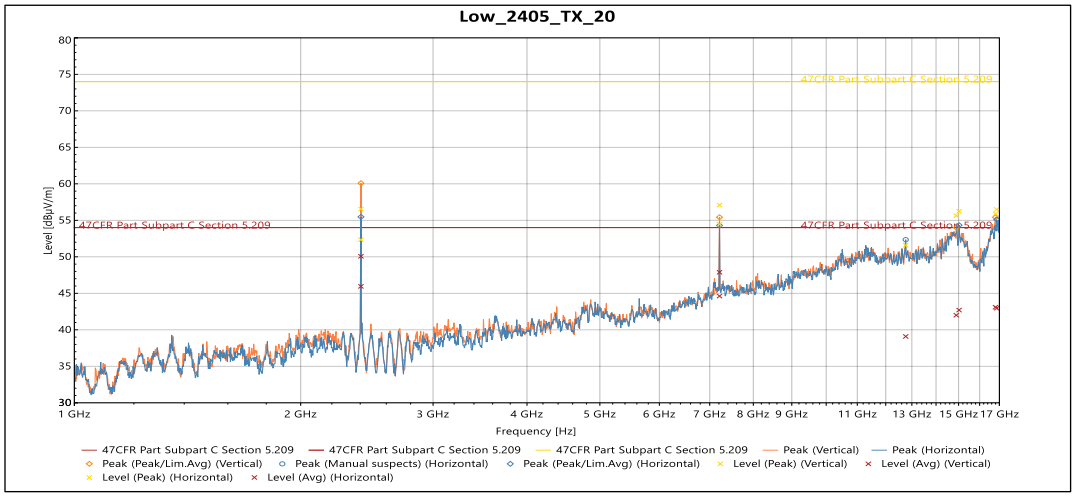
*Level = Receiver Reading + Correction Factor*

*Correction Factor = Antenna Factor + Cable Factor - Amplifier*

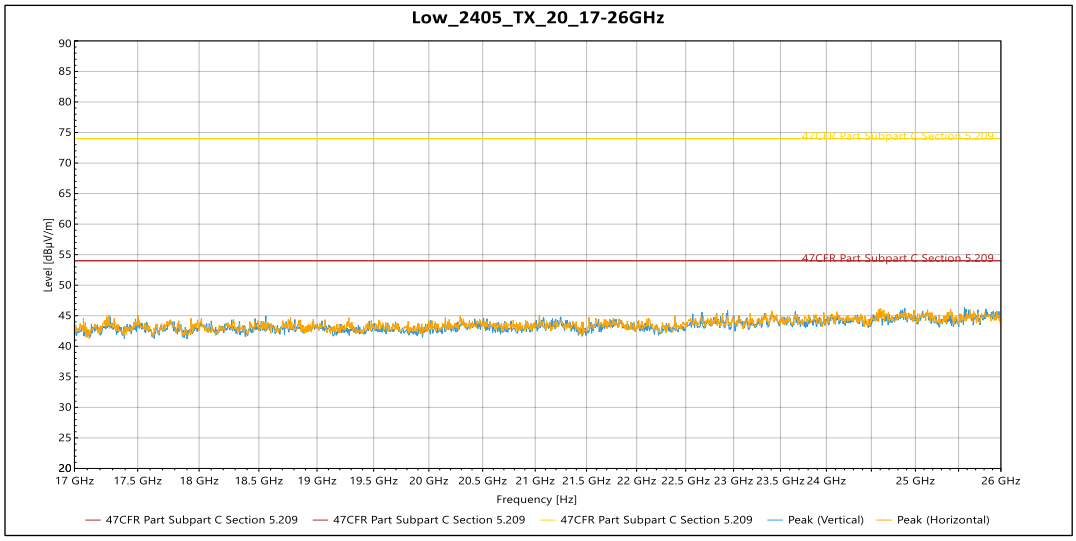
*Margin = Level - Limit*

## Result

The EUT complied with the specification limit by a margin of -6.123 dB.




**Graph 5: 1-17GHz Worst Case Plot**




**Graph 6: 17-26GHz Worst Case Plot**

## 5.6 §15.247(e) Maximum Average Power Spectral Density

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. Results of this testing are summarized.

| Frequency (MHz) | Measurement (dBm) | Criteria (dBm) |
|---|---|---|
| 2405 | 5.06 | 8.0 |
| 2440 | 4.74 | 8.0 |
| 2470 | 4.79 | 8.0 |

**Result**

The maximum average power spectral density was less than the limit of 8 dBm; therefore, the EUT complies with the specification.

-- End of Test Report --