# MEASUREMENT REPORT

## FCC PART 15 Subpart C WLAN 802.11b/g/n

| | |
|---|---|
| **FCC ID:** | 2AVK9-30252 |
| **Applicant:** | Strong Current Enterprises Limited |
| **Application Type:** | Certification |
| **Product:** | RANGEXTD USB Repeater |
| **Model No.:** | 30252 |
| **FCC Classification:** | Digital Transmission System (DTS) |
| **FCC Rule Part(s):** | Part15 Subpart C (Section 15.247) |
| **Test Procedure(s):** | ANSI C63.10-2013, KDB 662911 D01v02r01 |
| **Test Date:** | January 07 ~ 15, 2020 |

Reviewed By: Sunny Sun
( Sunny Sun )

Approved By: Robin Wu
( Robin Wu )

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 2001RSU021-U1 | Rev. 01 | Initial Report | 02-24-2020 | Valid |
| | | | | |

# CONTENTS

## General Information

| | |
|---|---|
| **Applicant:** | Strong Current Enterprises Limited |
| **Applicant Address:** | Suite 2201, 22/F, Chinachem Century Tower, 178 Gloucester Road, Wan Chai, Hong Kong |
| **Test Site:** | MRT Technology (Suzhou) Co., Ltd |
| **Test Site Address:** | D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China |

**Test Facility / Accreditations**

**Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.**

- **MRT facility is a FCC registered (MRT Designation No. CN1166) test facility with the site description report on file and has met all the requirements specified in ANSI C63.4-2014.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications, Radio and SAR testing.**

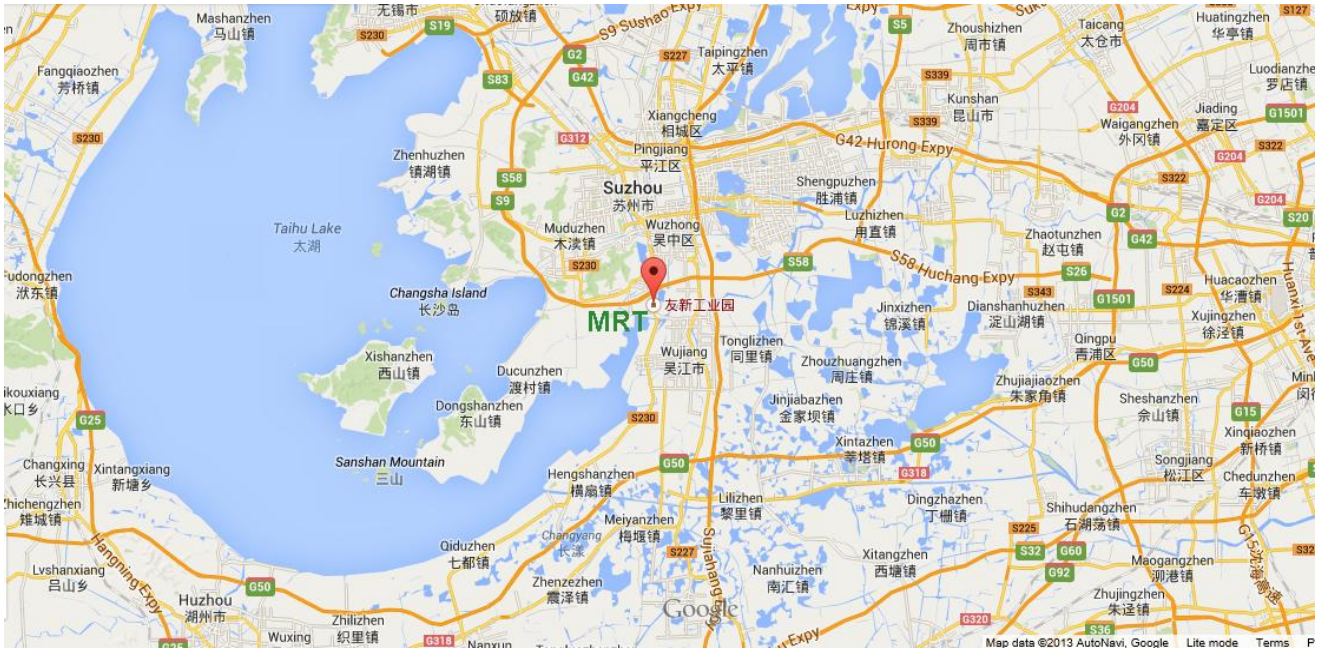
# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The measurement facility compliant with the test site requirements specified in ANSI C63.4-2014.



# 2. PRODUCT INFORMATION

## 2.1. Feature of Equipment under Test

| | |
|---|---|
| Product Name: | RANGEXTD USB Repeater |
| Model No.: | 30252 |
| Wi-Fi Specification: | 802.11b/g/n |
| Frequency Range: | 802.11b/g/n-HT20: 2412 ~ 2462MHz<br>802.11n-HT40: 2422 ~ 2452MHz |
| Channel Number: | 802.11b/g/n-HT20: 11<br>802.11n-HT40: 7 |
| Type of Modulation: | 802.11b: DSSS<br>802.11g/n: OFDM |
| Data Rate: | 802.11b: 1/2/5.5/11Mbps<br>802.11g: 6/9/12/18/24/36/48/54Mbps<br>802.11n: up to 300Mbps |

## 2.2. Working Frequencies for this report

802.11b/g/n-HT20

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 01 | 2412 MHz | 02 | 2417 MHz | 03 | 2422 MHz |
| 04 | 2427 MHz | 05 | 2432 MHz | 06 | 2437 MHz |
| 07 | 2442 MHz | 08 | 2447 MHz | 09 | 2452 MHz |
| 10 | 2457 MHz | 11 | 2462 MHz | -- | -- |

802.11n-HT40

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 03 | 2422 MHz | 04 | 2427 MHz | 05 | 2432 MHz |
| 06 | 2437 MHz | 07 | 2442 MHz | 08 | 2447 MHz |
| 09 | 2452 MHz | -- | -- | -- | -- |

## 2.3. Description of Available Antennas

| Antenna Type | Frequency Band (MHz) | $T_X$ Paths | Max Antenna Gain (dBi) | | CDD Directional Gain (dBi) | |
|---|---|---|---|---|---|---|
| | | | Ant 0 | Ant 1 | For Power | For PSD |
| Shrapnel Antenna | 2412 ~ 2462 | 2 | 2.0 | 1.0 | 2 | 5.01 |

Note: The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

For CDD transmissions, directional gain is calculated as follows, $N_{ANT} = 2$, $N_{SS} = 1$.

Directional gain = $G_{ANT\ MAX}$ + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
  Array Gain = 10 log ($N_{ANT}$/ $N_{SS}$) dB = 3.01;
- For power measurements on IEEE 802.11 devices,
  Array Gain = 0 dB for $N_{ANT} \leq 4$;

## 2.4. Test Mode

| | |
|---|---|
| Test Mode | Mode 1: Transmit by 802.11b (1Mbps) |
| | Mode 2: Transmit by 802.11g (6Mbps) |
| | Mode 3: Transmit by 802.11n-HT20 (MCS0) |
| | Mode 4: Transmit by 802.11n-HT40 (MCS0) |

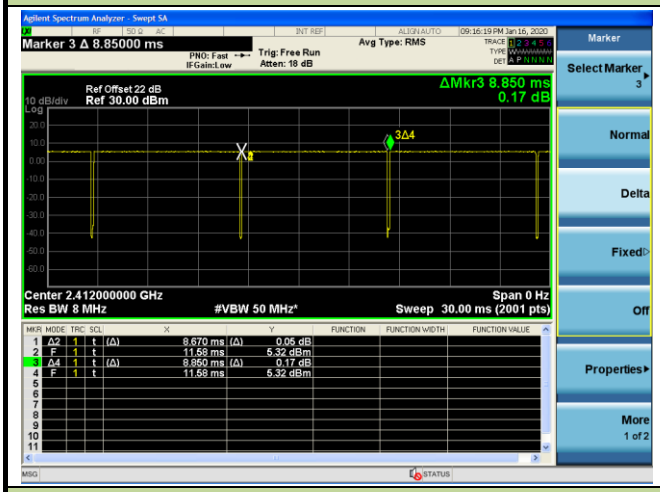
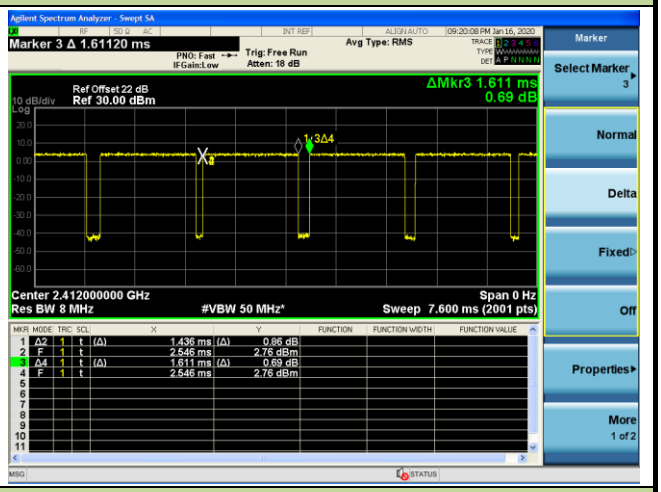
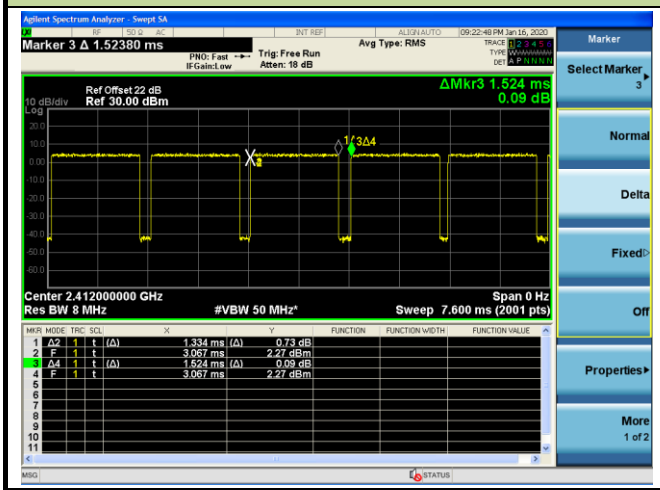
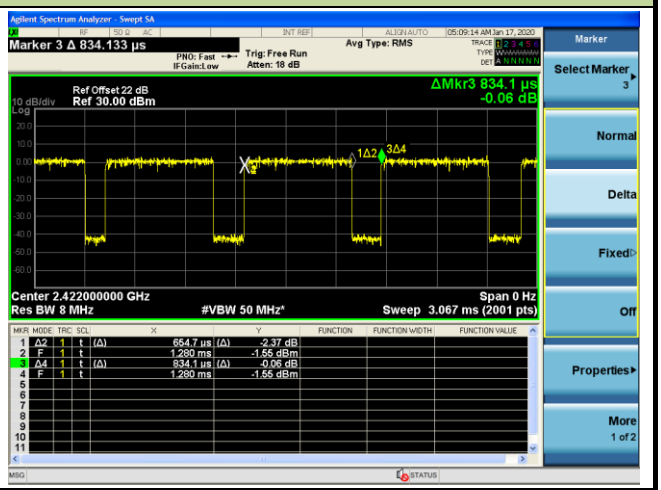
## 2.5. Description of Test Software

The test command used during testing was provided by manufacturer.

## 2.6. Duty Cycle

The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

| Test Mode | Duty Cycle |
|---|---|
| 802.11b | 97.97% |
| 802.11g | 89.14% |
| 802.11n-HT20 | 87.53% |
| 802.11n-HT40 | 78.49% |

| Duty Cycle | |
|---|---|
| 802.11b (T = 8.670ms) | 802.11g (T = 1.436ms) |
|  |  |
| 802.11n-HT20 (T = 1.334ms) | 802.11n-HT40 (T = 654.7us) |
|  |  |

## 2.7. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.8. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

# 3. DESCRIPTION of TEST

## 3.1. Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance was used in the measurement.

**Deviation from measurement procedure…….....None**

## 3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

## 3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.
For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.
Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

# 4. ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna of the device is **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The unit complies with the requirement of §15.203.

# 5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR3 | MRTSUE06185 | 1 year | 2020/04/15 |
| Two-Line V-Network | R&S | ENV 216 | MRTSUE06002 | 1 year | 2020/06/13 |
| Two-Line V-Network | R&S | ENV 216 | MRTSUE06003 | 1 year | 2020/06/13 |
| Thermohygrometer | Testo | 608-H1 | MRTSUE06404 | 1 year | 2020/08/08 |
| Shielding Room | MIX-BEP | Chamber-SR2 | MRTSUE06215 | N/A | N/A |

Radiated Emissions - AC1

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | MRTSUE06001 | 1 year | 2020/08/01 |
| PXA Signal Analyzer | Keysight | 9030B | MRTSUE06395 | 1 year | 2020/09/03 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2020/11/13 |
| Bilog Period Antenna | Schwarzbeck | VULB 9168 | MRTSUE06172 | 1 year | 2020/03/31 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9120D | MRTSUE06023 | 1 year | 2020/10/13 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06597 | 1 year | 2020/02/24 |
| Microwave System Amplifier | Agilent | 83017A | MRTSUE06076 | 1 year | 2020/11/15 |
| Preamplifier | Schwarzbeck | BBV 9721 | MRTSUE06121 | 1 year | 2020/06/11 |
| Thermohygrometer | Testo | 608-H1 | MRTSUE06403 | 1 year | 2020/08/08 |
| Anechoic Chamber | TDK | Chamber-AC1 | MRTSUE06212 | 1 year | 2020/04/30 |

Radiated Emission - AC2

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | MRTSUE06125 | 1 year | 2020/08/01 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2020/11/13 |
| Bilog Period Antenna | Schwarzbeck | VULB 9162 | MRTSUE06022 | 1 year | 2020/10/13 |
| Horn Antenna | Schwarzbeck | BBHA9120D | MRTSUE06171 | 1 year | 2020/10/27 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06597 | 1 year | 2020/02/24 |
| Broadband Coaxial Preamplifier | Schwarzbeck | BBV 9718 | MRTSUE06176 | 1 year | 2020/11/15 |
| Preamplifier | Schwarzbeck | BBV 9721 | MRTSUE06121 | 1 year | 2020/06/11 |
| Temperature/Humidity Meter | Minggao | ETH529 | MRTSUE06170 | 1 year | 2020/12/15 |
| Anechoic Chamber | RIKEN | Chamber-AC2 | MRTSUE06213 | 1 year | 2020/04/30 |

Conducted Test Equipment - TR3

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EXA Signal Analyzer | Agilent | N9020A | MRTSUE06106 | 1 year | 2020/04/15 |
| EXA Signal Analyzer | Keysight | N9010B | MRTSUE06452 | 1 year | 2020/07/11 |
| Signal Analyzer | R&S | FSV40 | MRTSUE06218 | 1 year | 2020/04/15 |
| Power Meter | Agilent | U2021XA | MRTSUE06030 | 1 year | 2020/11/18 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06446 | 1 year | 2020/06/30 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06447 | 1 year | 2020/06/30 |
| Bluetooth Test Set | Anritsu | MT8852B-042 | MRTSUE06389 | 1 year | 2020/06/13 |
| Audio Analyzer | Agilent | U8903B | MRTSUE06143 | 1 year | 2020/06/13 |
| Modulation Analyzer | HP | 8901A | MRTSUE06098 | 1 year | 2020/10/10 |
| Wideband Radio Communication Tester | R&S | CMW 500 | MRTSUE06243 | 1 year | 2020/11/07 |
| DC Power Supply | GWINSTEK | DPS-3303C | MRTSUE06064 | N/A | N/A |
| Temperature & Humidity Chamber | BAOYT | BYH-150CL | MRTSUE06051 | 1 year | 2020/11/07 |
| Thermohygrometer | testo | 608-H1 | MRTSUE06401 | 1 year | 2020/08/08 |

| Software | Version | Function |
|---|---|---|
| EMI Software | V3 | EMI Test Software |

# 6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

| Conducted Emission Measurement - SR2 |
|---|
| The maximum measurement uncertainty is evaluated as:<br>9kHz~150kHz: 3.84dB<br>150kHz~30MHz: 3.46dB |
| **Radiated Emission Measurement - AC1** |
| The maximum measurement uncertainty is evaluated as:<br>Horizontal: 30MHz~300MHz: 4.07dB<br>300MHz~1GHz: 3.63dB<br>1GHz~18GHz: 4.16dB<br>Vertical: 30MHz~300MHz: 4.18dB<br>300MHz~1GHz: 3.60dB<br>1GHz~18GHz: 4.76dB |
| **Radiated Emission Measurement - AC2** |
| The maximum measurement uncertainty is evaluated as:<br>Horizontal: 30MHz~300MHz: 3.75dB<br>300MHz~1GHz: 3.53dB<br>1GHz~18GHz: 4.28dB<br>Vertical: 30MHz~300MHz: 3.86dB<br>300MHz~1GHz: 3.53dB<br>1GHz~18GHz: 4.33dB |

# 7. TEST RESULT

## 7.1. Summary

| FCC Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 15.247(a)(2) | 6dB Bandwidth | ≥ 500kHz | Conducted | Pass | Section 7.2 |
| 15.247(b)(3) | Output Power | ≤ 30dBm | | Pass | Section 7.3 |
| 15.247(e) | Power Spectral Density | ≤ 8dBm/3kHz | | Pass | Section 7.4 |
| 15.247(d) | Band Edge / Out-of-Band Emissions | ≥ 20dBc (Peak) | | Pass | Section 7.5 |
| 15.205<br>15.209 | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | Radiated | Pass | Section 7.6 & 7.7 |
| 15.207 | AC Conducted Emissions 150kHz - 30MHz | < FCC 15.207 limits | Line Conducted | Pass | Section 7.8 |

**Notes:**

1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
3) Test Items “6dB Bandwidth” & “Band Edge / Out-of-Band Emissions” have been assessed MIMO transmission, and showed the worst test data in this report.

## 7.2. 6dB Bandwidth Measurement

### 7.2.1.Test Limit

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

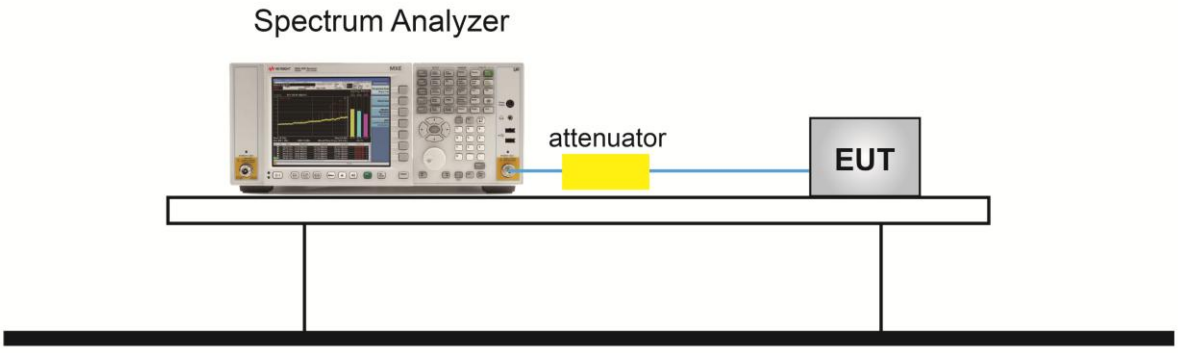
### 7.2.2.Test Procedure used

ANSI C63.10 Section 11.8

### 7.2.3.Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

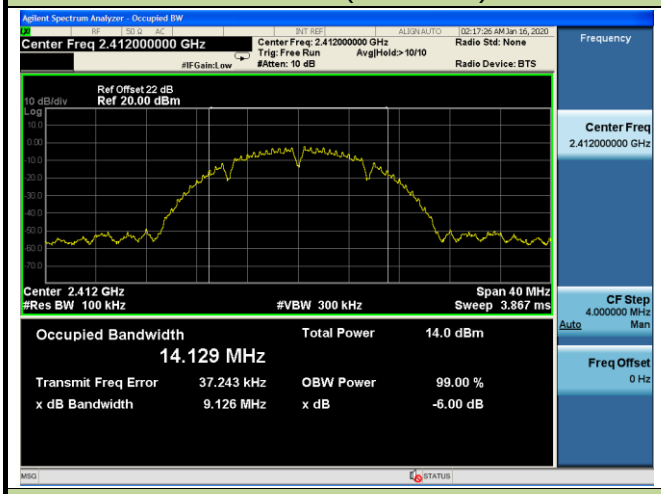
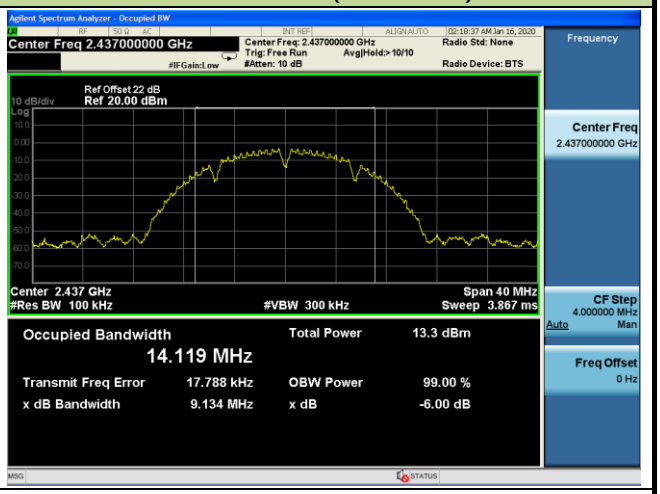
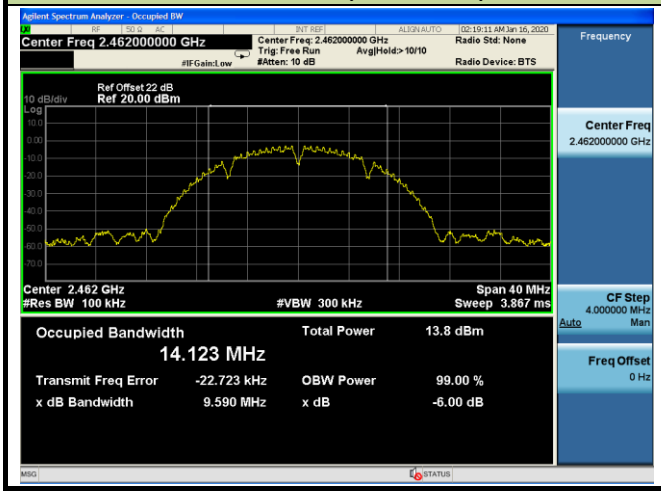
### 7.2.4.Test Setup

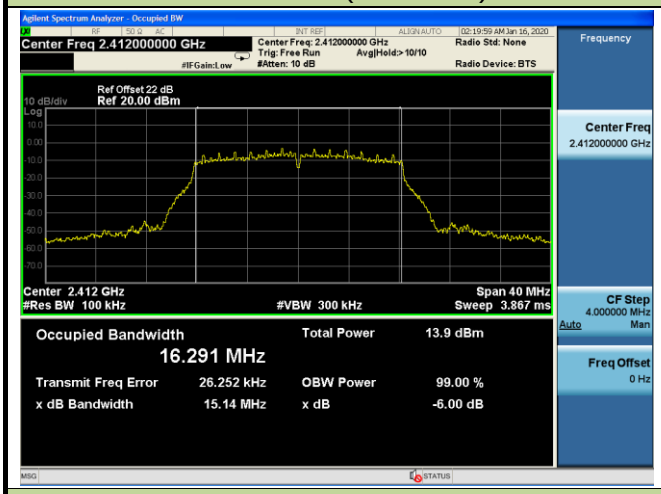
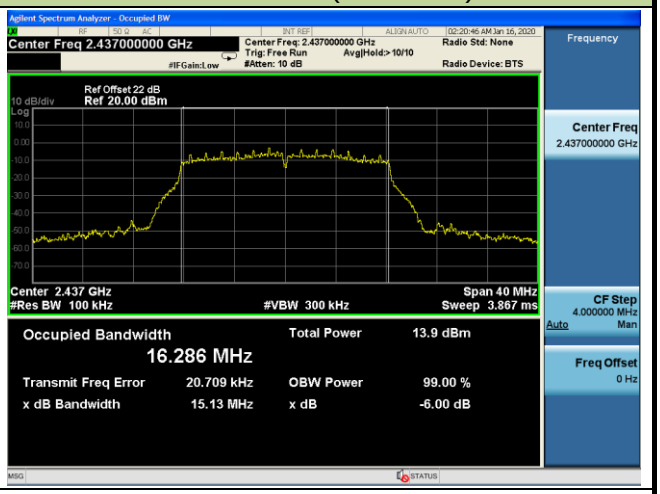
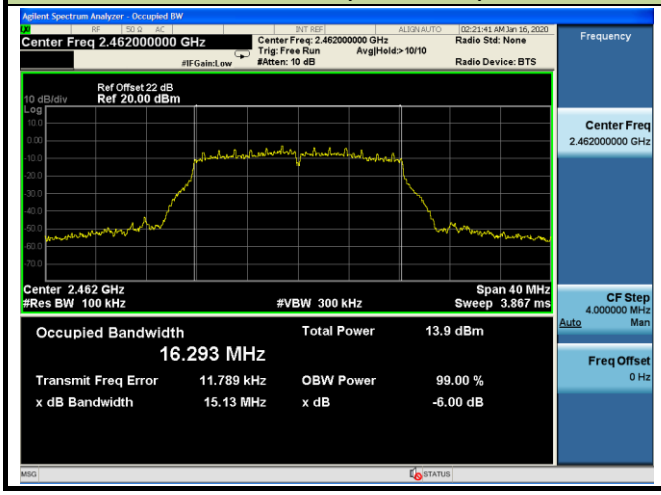


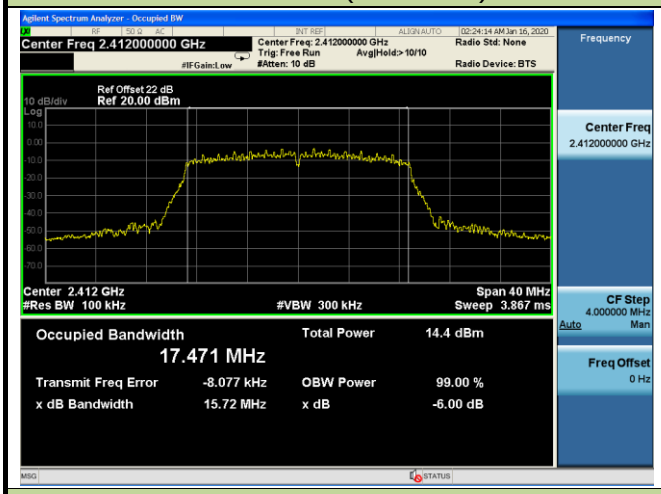
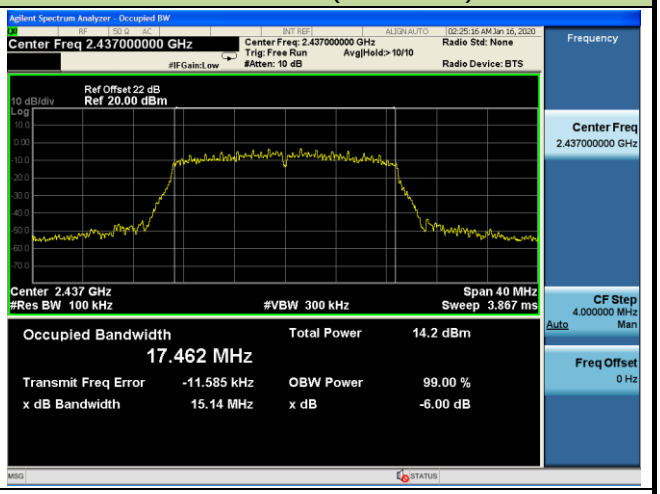
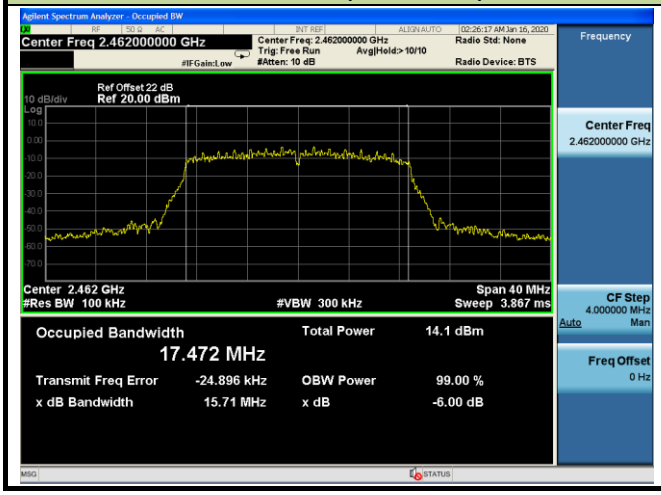
### 7.2.5.Test Result

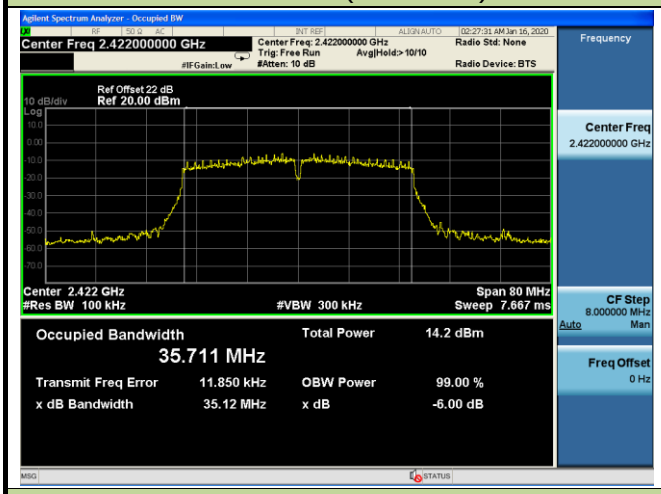
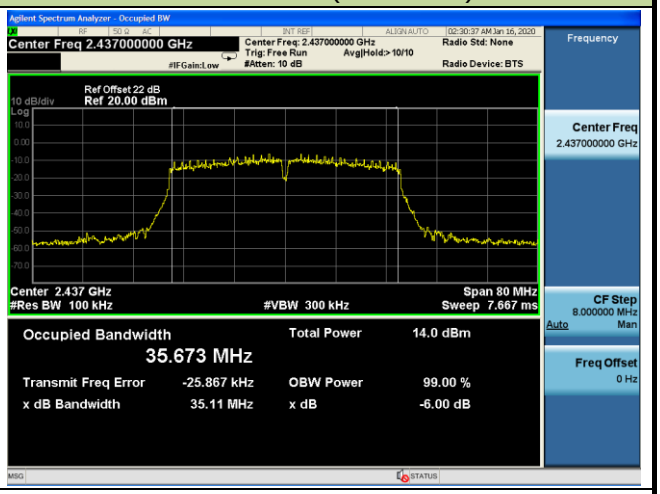
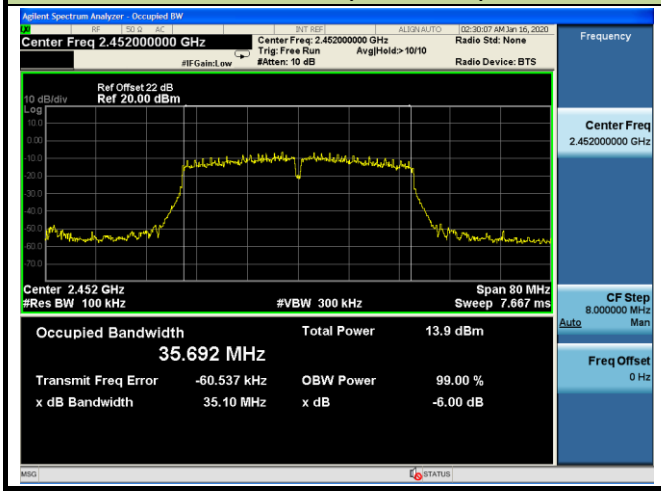
| | | | |
|---|---|---|---|
| Product | RANGEXTD USB Repeater | Temperature | 25°C |
| Test Engineer | Bacon Dong | Relative Humidity | 54% |
| Test Site | TR3 | Test Date | 2020/01/16 |

| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| Ant 1 / Ant 0 + 1 | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 9.13 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 9.13 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 9.59 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 15.14 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 15.13 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 15.13 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 15.72 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 15.14 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 15.71 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 35.12 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 35.11 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 35.10 | ≥ 0.5 | Pass |

| 802.11b 6dB Bandwidth - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11g 6dB Bandwidth - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 6dB Bandwidth - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT40 6dB Bandwidth - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

## 7.3. Output Power Measurement

### 7.3.1.Test Limit

The maximum output power shall be less 1 Watt (30dBm).

The conducted output power limit specified in paragraph FCC Part 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs FCC Part 15.247(b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 7.3.2.Test Procedure Used

ANSI C63.10 - Section 11.9.1.3

ANSI C63.10 - Section 11.9.2.3.2

### 7.3.3.Test Setting

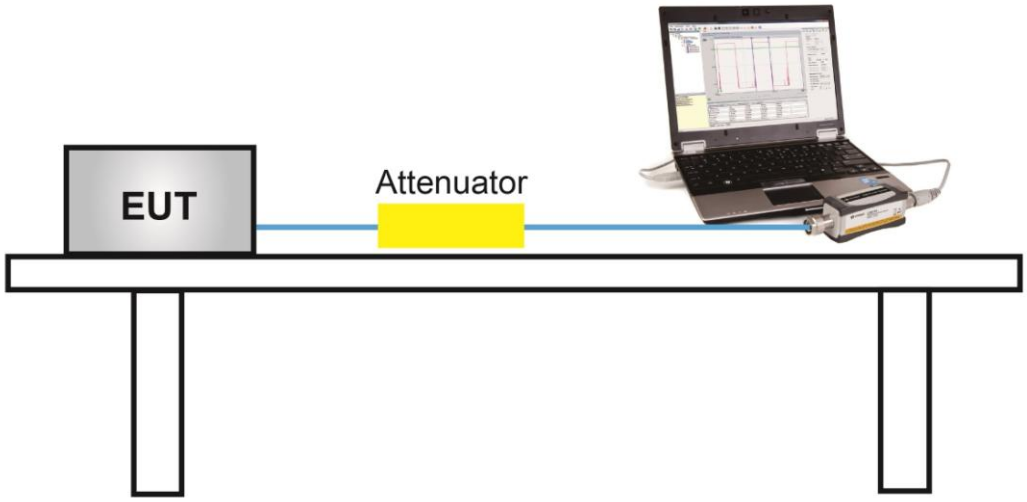
**PKPM1 Peak Power Meter Method**

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 use a fast-responding diode detector.

**Average Power Measurement**

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

### 7.3.4.Test Setup



### 7.3.5.Test Result

Power output test was verified over all data rates of each mode shown as below table, and then choose the maximum power output (gray marker) for final test of each channel.

Pre-Test RF Output Power at various data rates for Ant 0.

| Test Mode | Bandwidth (MHz) | Channel No. | Frequency (MHz) | Data Rate/ MCS | RF Output Power (dBm) |
|---|---|---|---|---|---|
| 11b | 20 | 6 | 2437 | 1Mbps | 5.80 |
| | | | | 5.5Mbps | 5.15 |
| | | | | 11Mbps | 4.27 |
| 11g | 20 | 6 | 2437 | 6Mbps | 6.12 |
| | | | | 24Mbps | 5.36 |
| | | | | 54Mbps | 4.76 |
| 11n | 20 | 6 | 2437 | MCS0 | 5.82 |
| | | | | MCS3 | 5.31 |
| | | | | MCS7 | 5.02 |
| 11n | 40 | 6 | 2437 | MCS0 | 6.16 |
| | | | | MCS3 | 5.43 |
| | | | | MCS7 | 5.11 |

Note: All modes of operation and data rates were investigated, so all RF test requirements shall be executed at low data rates.

| Product | RANGEXTD USB Repeater | Temperature | 25°C |
|---|---|---|---|
| Test Engineer | Bacon Dong | Relative Humidity | 50% |
| Test Site | TR3 | Test Date | 2020/01/13 |

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 Output Power (dBm) | Ant 1 Output Power (dBm) | Total Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| **Peak Output Power** | | | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 8.23 | 8.81 | 11.54 | ≤ 30.00 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 8.04 | 8.28 | 11.17 | ≤ 30.00 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 8.34 | 8.93 | 11.66 | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 14.97 | 15.23 | 18.11 | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 15.66 | 15.77 | 18.73 | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 16.38 | 17.28 | **19.86** | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 14.50 | 15.53 | 18.06 | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 14.43 | 15.61 | 18.07 | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 14.88 | 15.40 | 18.16 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 15.75 | 16.36 | 19.08 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 15.81 | 15.95 | 18.89 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 15.77 | 17.13 | 19.51 | ≤ 30.00 | Pass |
| **Average Output Power** | | | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 6.21 | 6.71 | 9.48 | ≤ 30.00 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 5.80 | 6.15 | 8.99 | ≤ 30.00 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 6.31 | 6.81 | **9.58** | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 6.00 | 6.71 | 9.38 | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 6.12 | 6.68 | 9.42 | ≤ 30.00 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 6.22 | 6.83 | 9.55 | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 5.75 | 6.84 | 9.34 | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 5.82 | 6.74 | 9.31 | ≤ 30.00 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 5.97 | 6.72 | 9.37 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 6.12 | 6.79 | 9.48 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 6.16 | 6.78 | 9.49 | ≤ 30.00 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 6.04 | 6.68 | 9.38 | ≤ 30.00 | Pass |

Note: Total Power (dBm) = $10*\log \{10^{(\text{Ant 0 Output Power }/10)} + 10^{(\text{Ant 1 Output Power }/10)}$.

## 7.4. Power Spectral Density Measurement

### 7.4.1.Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

The same method of determining the conducted output power shall be used to determine the power spectral density.

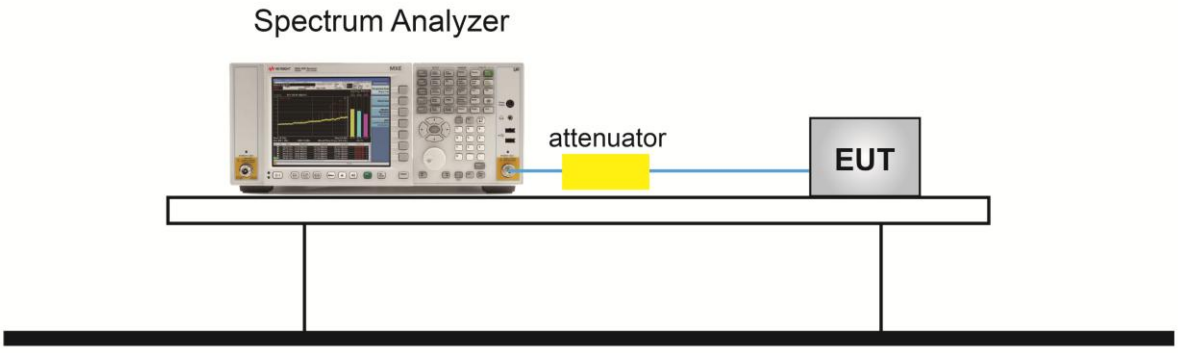
### 7.4.2.Test Procedure Used

ANSI C63.10 Section 11.10.5

### 7.4.3.Test Setting

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 10kHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

### 7.4.4.Test Setup



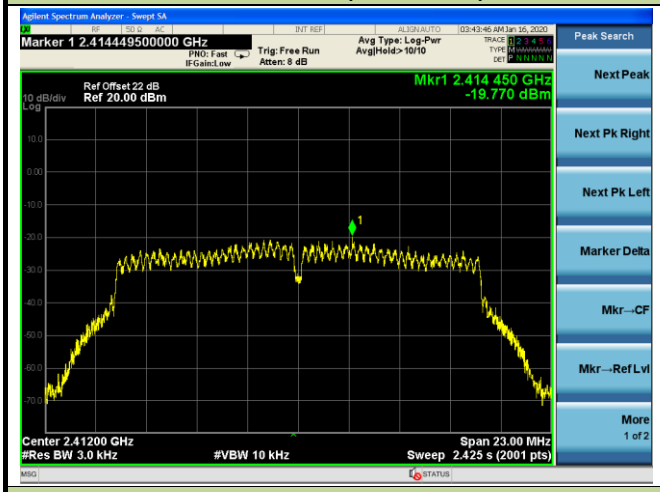
### 7.4.5.Test Result

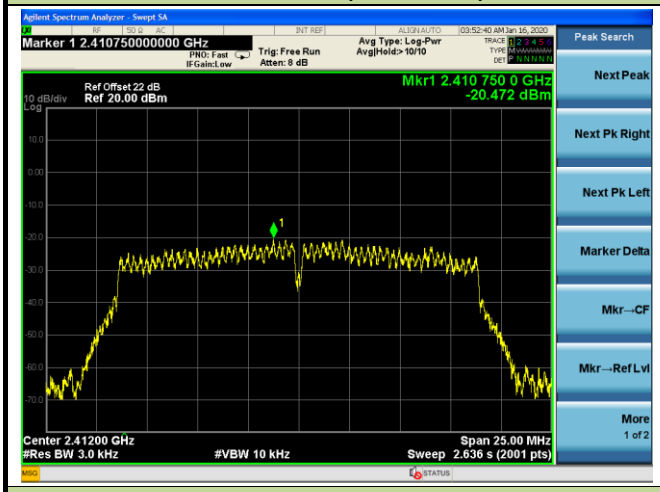
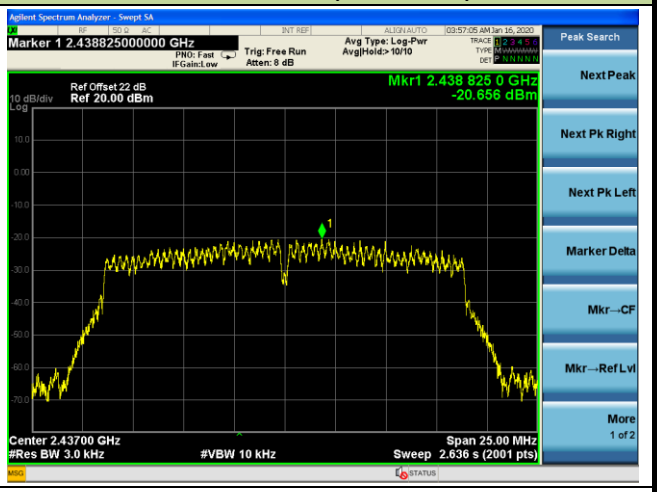
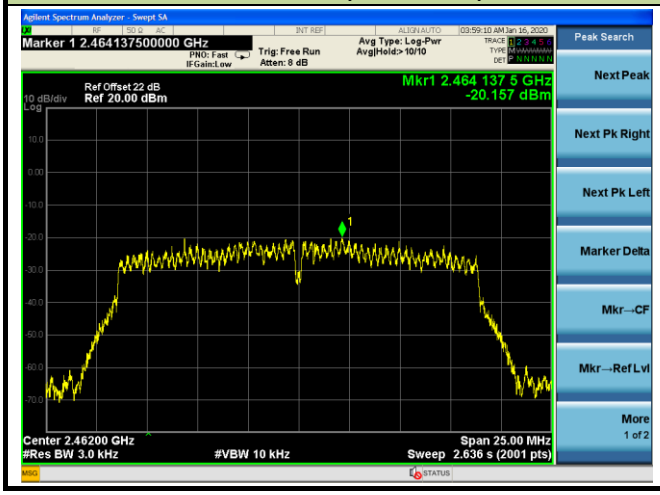
| Product | RANGEXTD USB Repeater | Temperature | 25°C |
|---|---|---|---|
| Test Engineer | Bacon Dong | Relative Humidity | 54% |
| Test Site | TR3 | Test Date | 2020/01/16 |

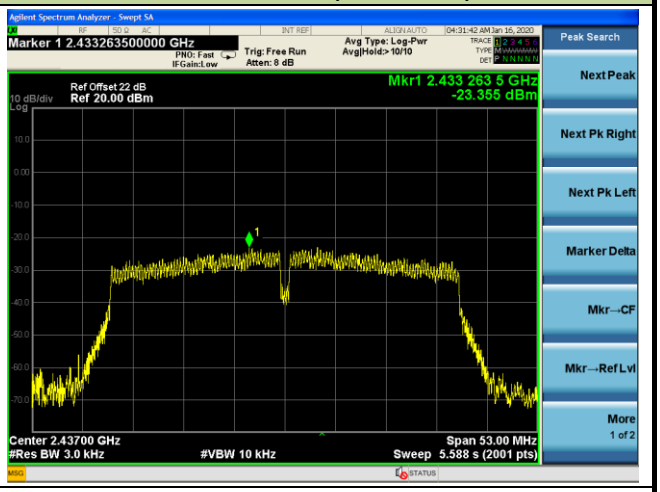
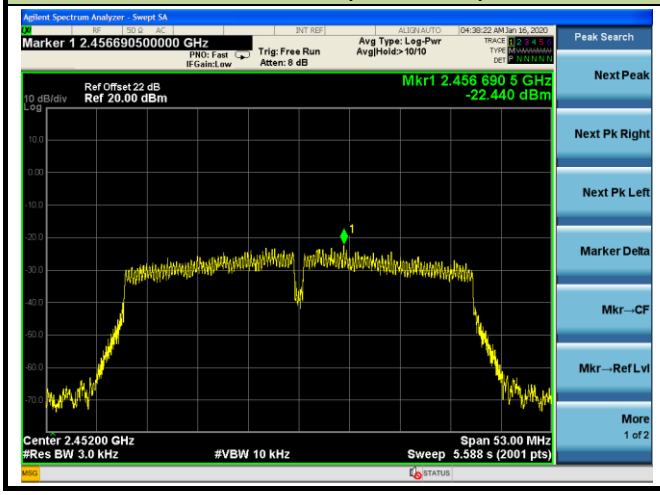
| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 PKPSD (dBm/3kHz) | Ant 1 PKPSD (dBm/3kHz) | Total PKPSD (dBm/3kHz) | Limit (dBm/3kHz) | Result |
|---|---|---|---|---|---|---|---|---|
| 802.11b | 1Mbps | 01 | 2412 | -8.10 | -4.10 | -2.64 | ≤ 8 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | -6.96 | -6.66 | -3.80 | ≤ 8 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | -4.30 | -5.70 | -1.93 | ≤ 8 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | -19.77 | -19.53 | -16.64 | ≤ 8 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | -20.33 | -18.84 | -16.51 | ≤ 8 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | -20.56 | -20.19 | -17.36 | ≤ 8 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | -20.47 | -19.56 | -16.98 | ≤ 8 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | -20.66 | -18.21 | -16.25 | ≤ 8 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | -20.16 | -18.39 | -16.17 | ≤ 8 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | -23.27 | -22.69 | -19.96 | ≤ 8 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | -23.36 | -22.63 | -19.97 | ≤ 8 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | -22.44 | -22.21 | -19.31 | ≤ 8 | Pass |

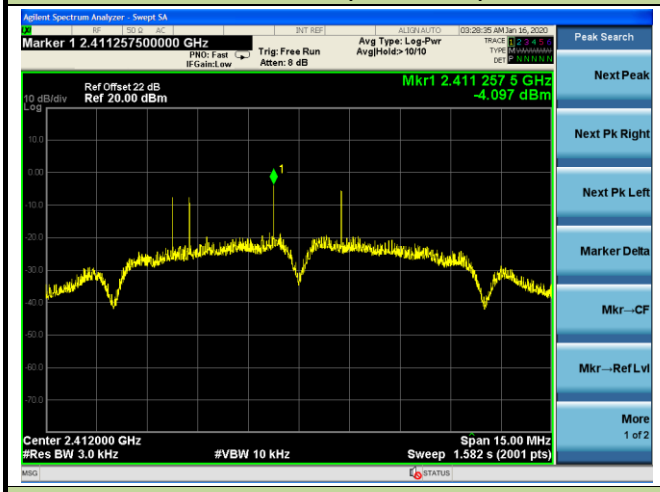
Note: Total PKPSD = $10*\log \{10^{(\text{Ant 0 PKPSD}/10)} + 10^{(\text{Ant 1 PKPSD}/10)}\}$

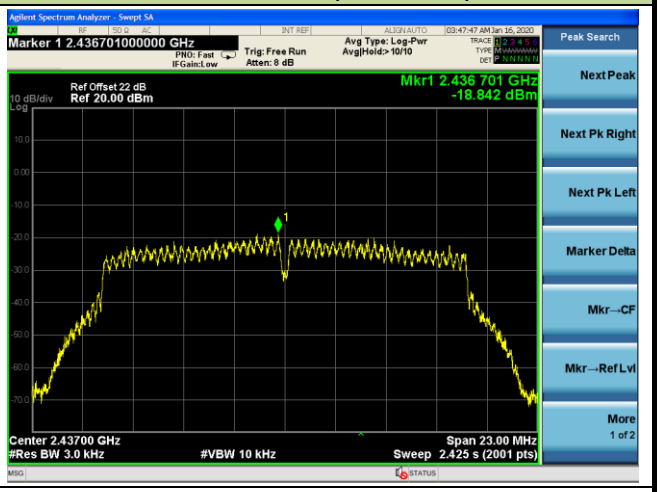
| 802.11b PKPSD - Ant 0 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

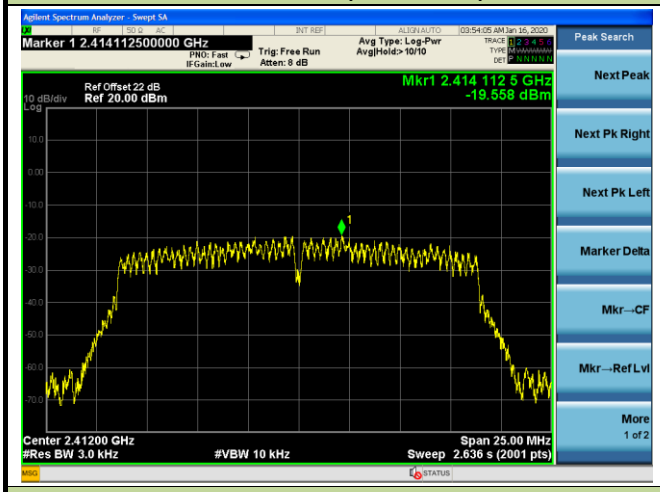
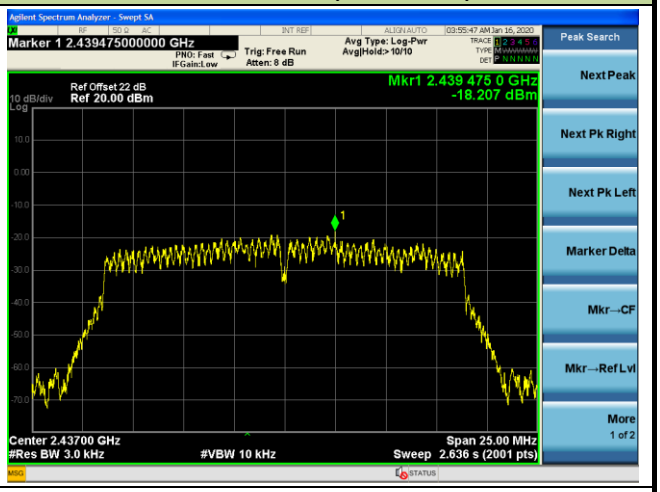
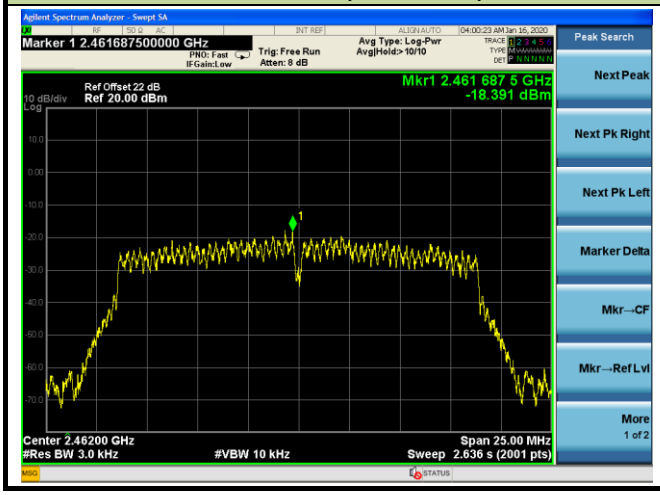
| 802.11g PKPSD - Ant 0 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

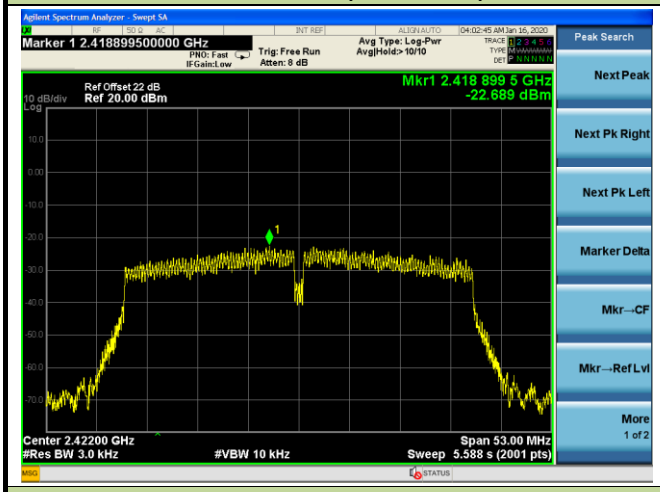
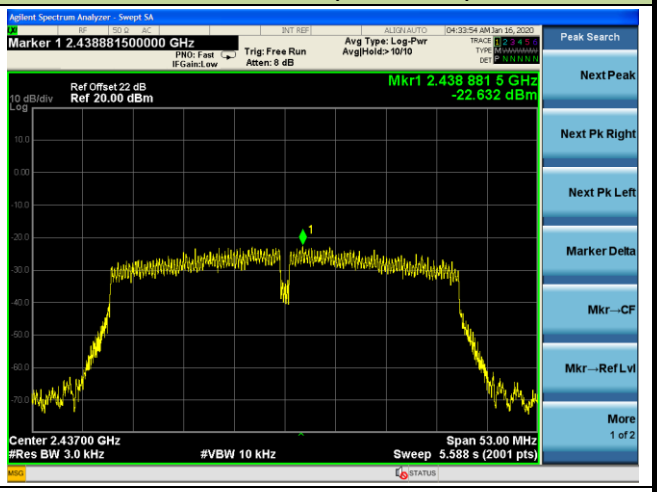
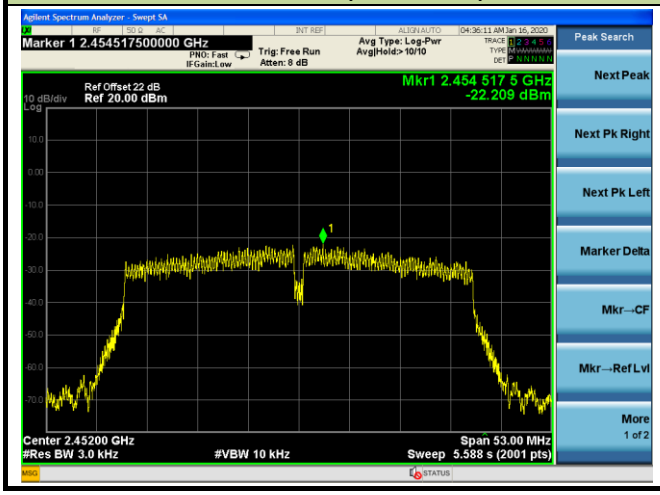
| 802.11n-HT20 PKPSD - Ant 0 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT40 PKPSD - Ant 0 / Ant 0 + 1 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

| 802.11b PKPSD - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11g PKPSD - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT20 PKPSD - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 11 (2462MHz) | |
|  | |

| 802.11n-HT40 PKPSD - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 03 (2422MHz) | Channel 06 (2437MHz) |
|  |  |
| Channel 09 (2452MHz) | |
|  | |

## 7.5. Conducted Band Edge and Out-of-Band Emissions

### 7.5.1.Test Limit

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

### 7.5.2.Test Procedure Used

ANSI C63.10 Section 11.11

### 7.5.3.Test Setting

**Reference level measurement**

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to ≥ 1.5 times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW ≥ 3 x RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow trace to fully stabilize

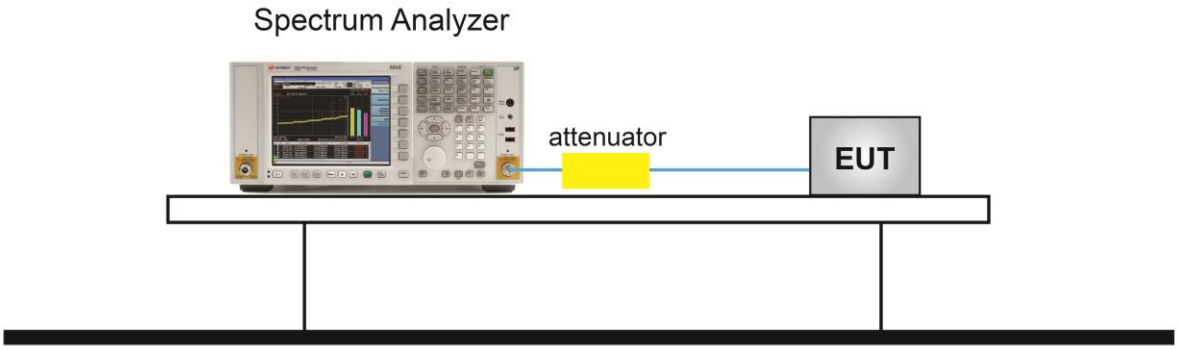
**Emission level measurement**

1. Set the center frequency and span to encompass frequency range to be measured
2. RBW = 1.3MHz
3. VBW = 4MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

**Test Notes**

1. RBW was set to 1.3MHz rather than 100 kHz in order to increase the measurement speed.
2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100 kHz bandwidth. However, since the traces in the following plots are measured with a 1.3MHz RBW, the display line may not necessarily appear to be 30dB below the level of the fundamental in a 1.3MHz bandwidth.
3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

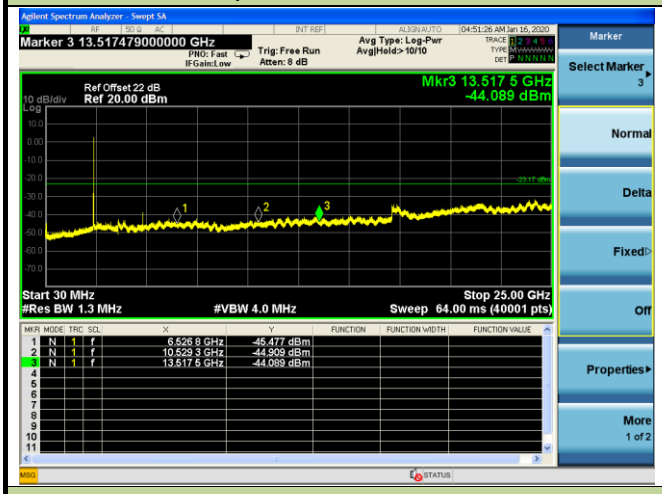
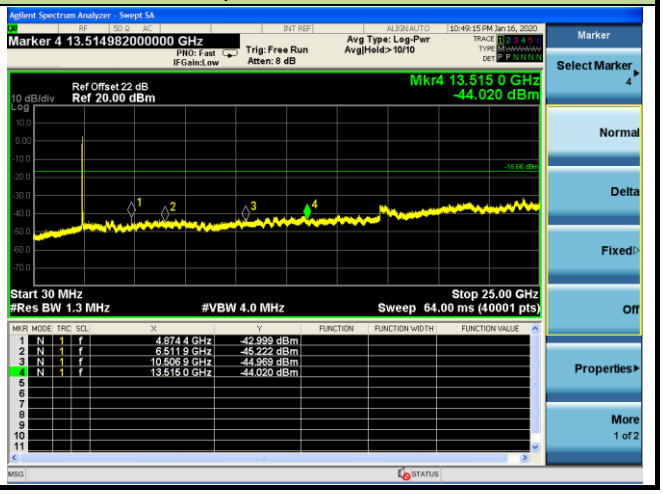
### 7.5.4.Test Setup

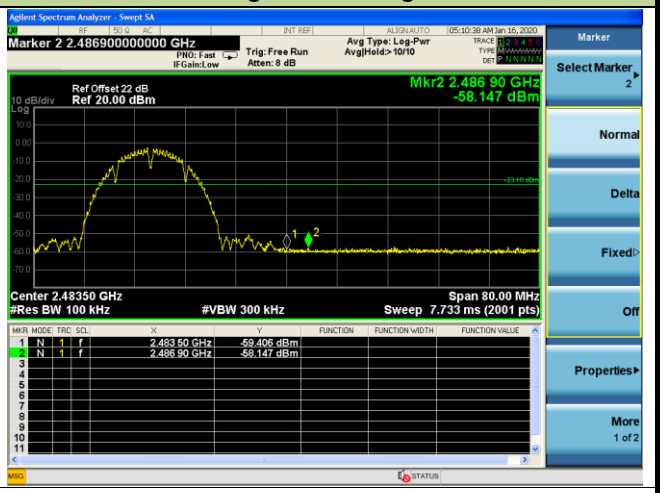
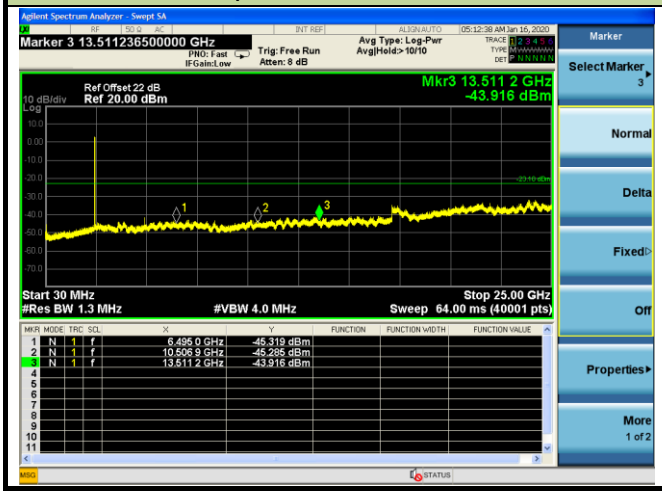


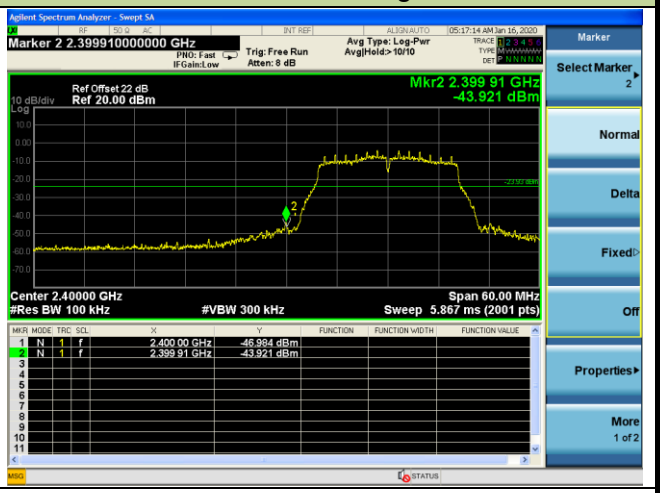
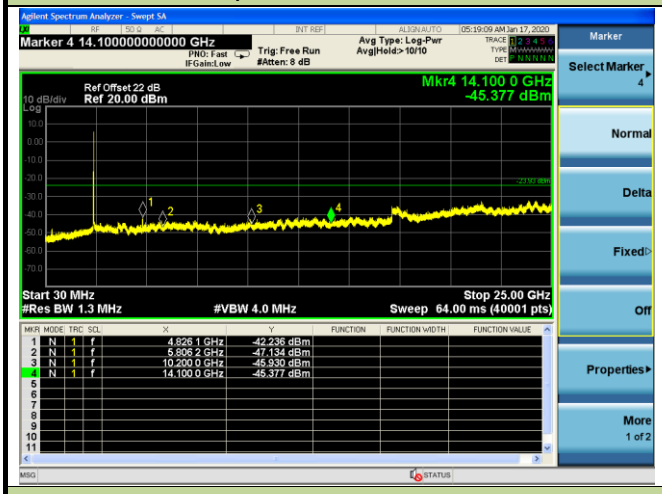
### 7.5.5.Test Result

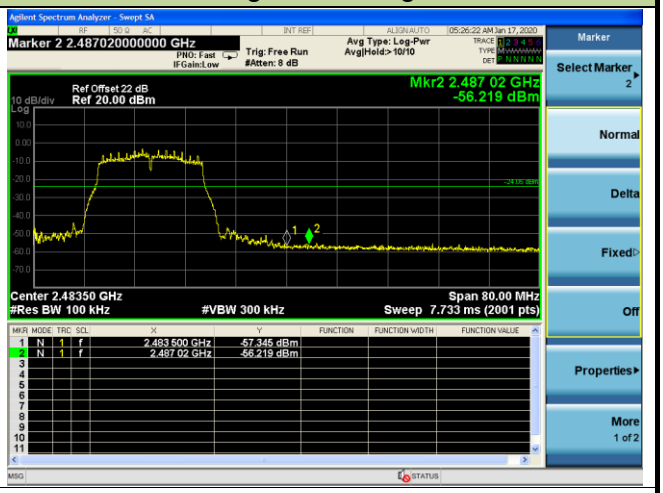
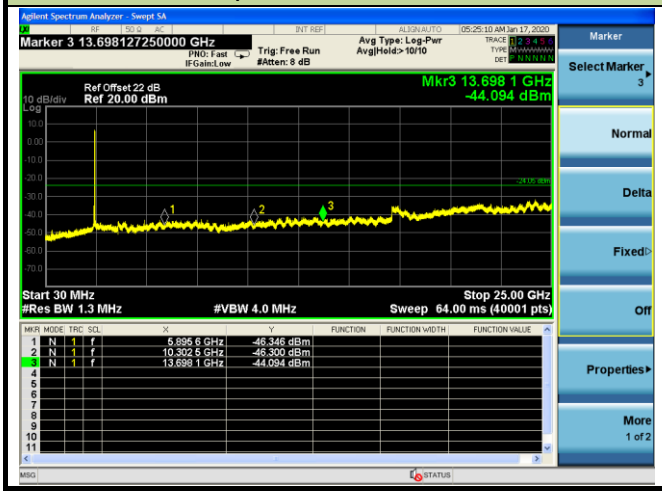
| Product | RANGEXTD USB Repeater | Temperature | 25°C |
|---|---|---|---|
| Test Engineer | Bacon Dong | Relative Humidity | 54% |
| Test Site | TR3 | Test Date | 2020/01/16 |

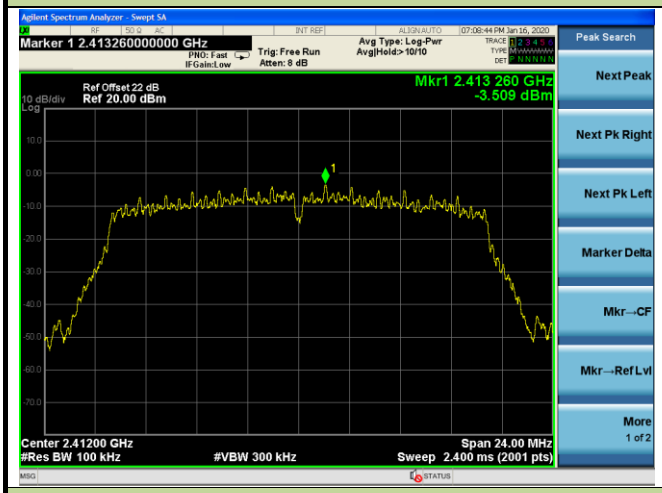
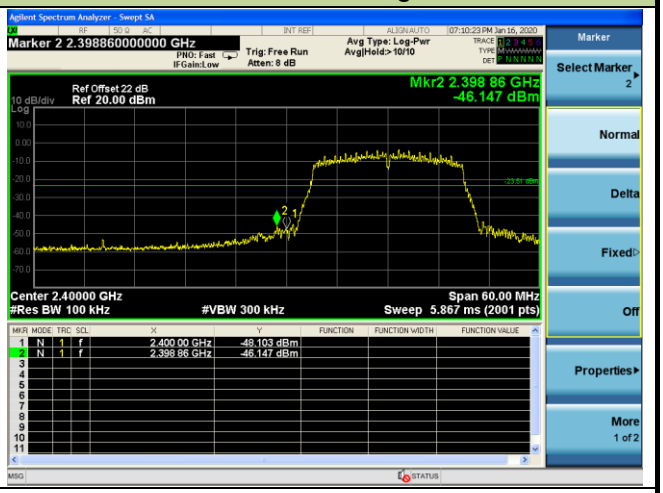
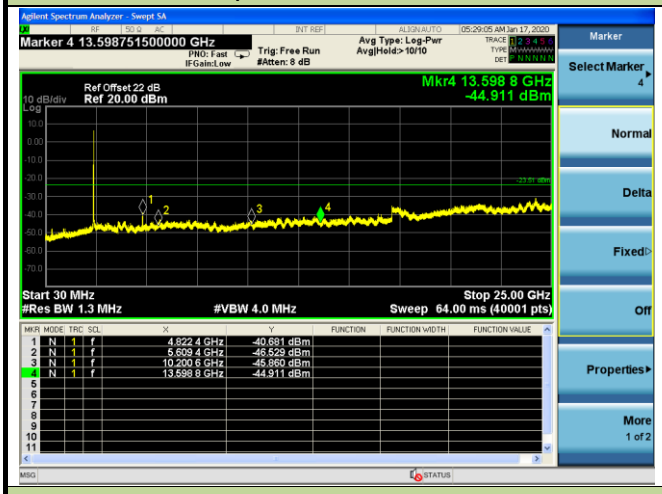
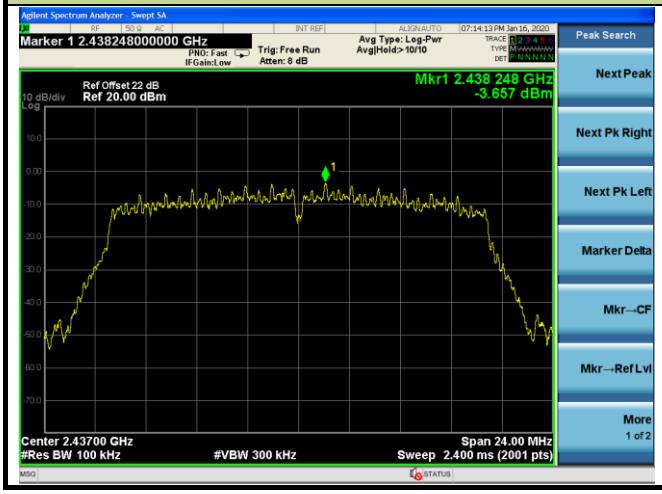
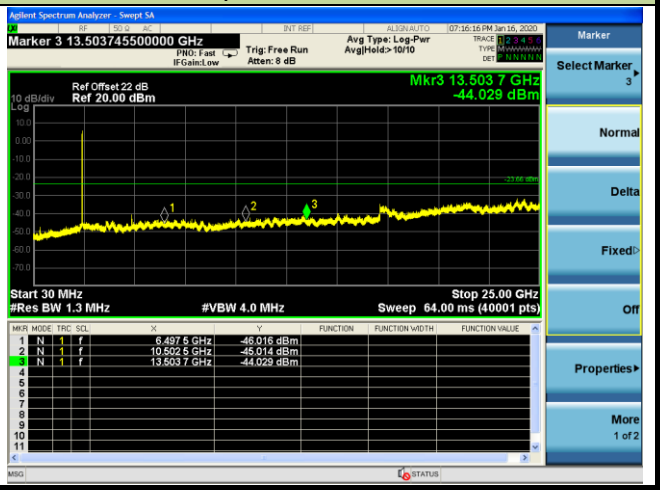
| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | Limit (dBc) | Result |
|---|---|---|---|---|---|
| Ant 1 / Ant 0 + 1 | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 20 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 20 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 20 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 20 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 20 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 20 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 20 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 20 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 20 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 20 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 20 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 20 | Pass |

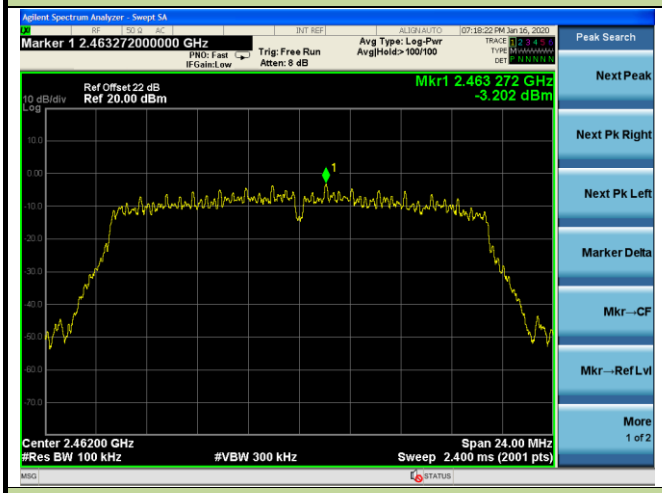
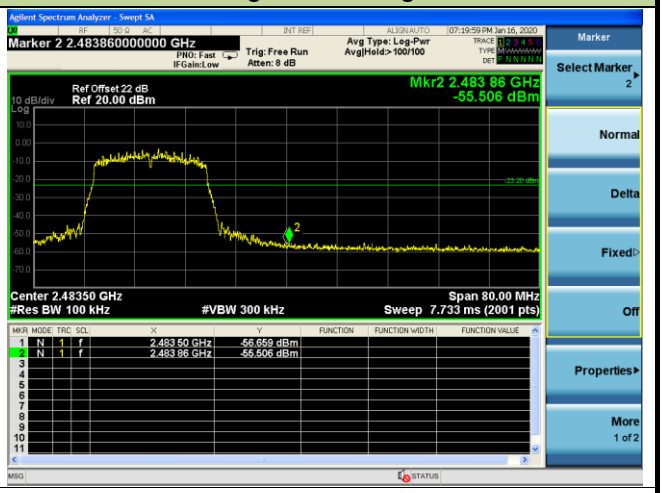
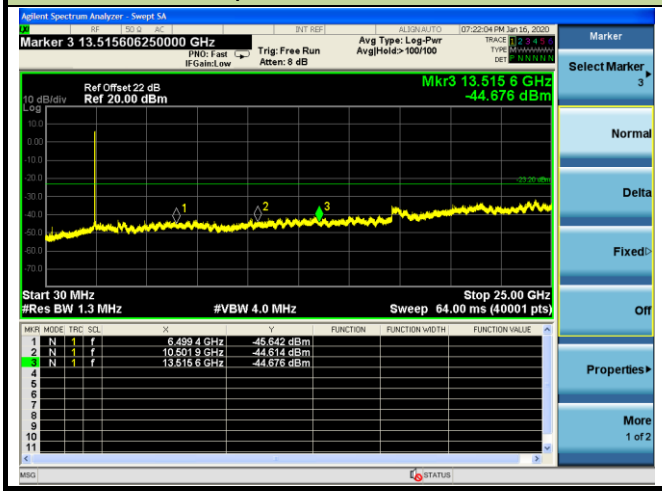
| 802.11b Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | |
| 100kHz PSD reference Level | Low Band Edge |
|  |  |
| Spurious Emission | |
|  | |
| Channel 06 (2437MHz) | |
| 100kHz PSD reference Level | Spurious Emission |
|  |  |

| 802.11b Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 11 (2462MHz) | |
| 100kHz PSD reference Level | High Band Edge |
|  |  |
| Spurious Emission | |
|  | |

| 802.11g Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | |
| 100kHz PSD reference Level | Low Band Edge |
|  |  |
| Spurious Emission | |
|  | |
| Channel 06 (2437MHz) | |
| 100kHz PSD reference Level | Spurious Emission |
|  |  |

| 802.11g Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 11 (2462MHz) | |
| 100kHz PSD reference Level | High Band Edge |
|  |  |
| Spurious Emission | |
|  | |

| 802.11n-HT20 Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 01 (2412MHz) | |
| 100kHz PSD reference Level | Low Band Edge |
|  |  |
| Spurious Emission | |
|  | |
| Channel 06 (2437MHz) | |
| 100kHz PSD reference Level | Spurious Emission |
|  |  |

| 802.11n-HT20 Out-of-Band Emissions - Ant 1 / Ant 0 + 1 | |
|---|---|
| Channel 11 (2462MHz) | |
| 100kHz PSD reference Level | High Band Edge |
|  |  |
| Spurious Emission | |
|  | |