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Issued date : 2022/1/12  
FCC ID : RYK-WUBT239ACND

## **RADIO TEST REPORT**

**Product** : 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Dongle  
**Model Name** : WUBT-239ACN(BT) Dongle  
**FCC ID** : RYK-WUBT239ACND  
**Test Regulation** : FCC 47 CFR Part 15 Subpart C (Section 15.247)  
**Received Date** : 2021/8/5  
**Test Date** : 2021/8/9 ~ 2021/10/25  
**Issued Date** : 2022/1/12

**Applicant** : SparkLAN Communications, Inc.  
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City  
11493, Taiwan (R.O.C.)

**Issued By** : Underwriters Laboratories Taiwan Co., Ltd.  
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,  
Zhudong Township, Hsinchu County, Taiwan



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Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

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## REVISION HISTORY

**Original Test Report No.: 4790038917B-US-R0-V0**

[illegible]

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## 1. Attestation of Test Results

**APPLICANT:** SparkLAN Communications, Inc.  
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493,  
Taiwan (R.O.C.)

**MANUFACTURER:** SparkLAN Communications, Inc.  
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493,  
Taiwan (R.O.C.)

**EUT DESCRIPTION:** 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Dongle

**BRAND:** SparkLAN

**MODEL:** WUBT-239ACN(BT) Dongle

**SAMPLE STAGE:** Engineering Verification Test sample

**DATE of TESTED:** 2021/8/9 ~ 2021/10/25

| APPLICABLE STANDARDS                          |              |
|-----------------------------------------------|--------------|
| STANDARD                                      | Test Results |
| FCC 47 CFR PART 15 Subpart C (Section 15.247) | PASS         |

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Sally Lu  
Project Handler

Date : 2022/1/12

Approved and Authorized By:

Waternil Guan  
Engineer

Date : 2022/1/12

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## 2. Summary of Test Results

| Summary of Test Results        |                                                 |        |
|--------------------------------|-------------------------------------------------|--------|
| FCC Clause                     | Test Items                                      | Result |
| 15.247(a)(2)                   | 6dB Bandwidth                                   | Note 1 |
| 15.247(b)                      | Conducted Output Power                          | PASS   |
| 15.247(e)                      | Power Spectral Density                          | Note 1 |
| 15.247(d)                      | Antenna Port Emission                           | Note 1 |
| 15.205 / 15.209 /<br>15.247(d) | Radiated Emissions and<br>Band Edge Measurement | PASS   |
| 15.207                         | AC Power Conducted Emission                     | PASS   |
| 15.203                         | Antenna Requirement                             | PASS   |

Note:

1. This prepared for FCC Spot Check Verification Report, the test items and spot-check test data are decided by applicant's engineering judgment, for more details please refer to note 1 and 2 of section 6.1.

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### 3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

### 4. Facilities and Accreditation

|                                  |                                                                                                       |
|----------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Test Location</b>             | Underwriters Laboratories Taiwan Co., Ltd.                                                            |
| <b>Address</b>                   | Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan |
| <b>Accreditation Certificate</b> | Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.                |

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## 5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor  $k=2$ .

| Measurement                                    | Frequency      | Uncertainty  |
|------------------------------------------------|----------------|--------------|
| Conducted disturbance at mains terminals ports | 150kHz ~ 30MHz | $\pm 3.1$ dB |
| RF Conducted                                   | 9 kHz - 40GHz  | $\pm 1.9$ dB |
| Radiated disturbance below 30MHz               | 9 kHz - 30 MHz | $\pm 1.9$ dB |
| Radiated disturbance below 1 GHz               | 30MHz ~ 1GHz   | $\pm 5.4$ dB |
| Radiated disturbance above 1 GHz               | 1GHz ~ 40GHz   | $\pm 4.7$ dB |

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## 6. Equipment under Test

### 6.1. Description of EUT

|                             |                                                                                                    |
|-----------------------------|----------------------------------------------------------------------------------------------------|
| <b>Product</b>              | 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Dongle                                             |
| <b>Brand Name</b>           | SparkLAN                                                                                           |
| <b>Model Name</b>           | WUBT-239ACN(BT) Dongle                                                                             |
| <b>Operating Frequency</b>  | 2412MHz ~ 2462MHz                                                                                  |
| <b>Modulation</b>           | CCK, DQPSK, DBPSK for DSSS<br>64QAM, 16QAM, QPSK, BPSK for OFDM                                    |
| <b>Transfer Rate</b>        | 802.11b: up to 11 Mbps<br>802.11g: up to 54 Mbps<br>802.11n: up to MCS15                           |
| <b>Number of Channel</b>    | 11 for 802.11b, 802.11g, 802.11n (HT20)<br>7 for 802.11n (HT40)                                    |
| <b>Maximum Output Power</b> | 802.11b: 23.20 dBm<br>802.11g: 27.80 dBm<br>802.11n (HT20): 28.03 dBm<br>802.11n (HT40): 22.20 dBm |
| <b>Normal Voltage</b>       | 5Vdc                                                                                               |
| <b>Sample ID</b>            | Conducted Test: 4197850<br>Radiated Test: 4197853                                                  |

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**Note:**

1. This spot check report was issued based on the re-used report with report number 4790038917A-US-R0-V0 / FCC ID: RYK-WUBT239ACNBT. The technical construction which included circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction are as same as the original device (Model: WUBT-239ACN(BT) [MU]), the differences are add outer case and use PCB antenna only. Therefore, only the output power and worst case of the emission was performed and recorded in this report.
2. The spot check verification data was following the table, and just shows the worst case of the radiated spurious and band edge emission.

| Band                  | Test Item | Test Limit | Original Model           |          |              | Spot Check Model        |          |              | Deviation |
|-----------------------|-----------|------------|--------------------------|----------|--------------|-------------------------|----------|--------------|-----------|
|                       |           |            | WUBT-239ACN(BT) [MU]     |          |              | WUBT-239ACN(BT) Dongle  |          |              |           |
|                       |           |            | FCC ID: RYK-WUBT239ACNBT |          |              | FCC ID: RYK-WUBT239ACND |          |              |           |
|                       |           |            | Mode                     | Channel  | Test Result  | Mode                    | Channel  | Test Result  |           |
| DTS<br>WLAN<br>2.4GHz | Band Edge | 54 dBuV/m  | 11b                      | 2412 MHz | 40.92 dBuV/m | 11b                     | 2412 MHz | 44.52 dBuV/m | 3.6 dB    |
|                       | RSE       | 74 dBuV/m  | 11b                      | 2437 MHz | 51.99 dBuV/m | 11b                     | 2437 MHz | 51.74 dBuV/m | -0.25 dB  |
|                       | Band Edge | 54 dBuV/m  | 11g                      | 2417 MHz | 39.56 dBuV/m | 11g                     | 2417 MHz | 44.82 dBuV/m | 5.26 dB   |
|                       | RSE       | 74 dBuV/m  | 11g                      | 2437 MHz | 52.47 dBuV/m | 11g                     | 2437 MHz | 52.33 dBuV/m | -0.14 dB  |
|                       | Band Edge | 54 dBuV/m  | 11n20                    | 2437 MHz | 39.6 dBuV/m  | 11n20                   | 2437 MHz | 43.53 dBuV/m | 3.93 dB   |
|                       | RSE       | 74 dBuV/m  | 11n20                    | 2437 MHz | 50.25 dBuV/m | 11n20                   | 2437 MHz | 50.25 dBuV/m | 0 dB      |
|                       | Band Edge | 54 dBuV/m  | 11n40                    | 2452 MHz | 40.27 dBuV/m | 11n40                   | 2452 MHz | 41.56 dBuV/m | 1.29 dB   |
|                       | RSE       | 74 dBuV/m  | 11n40                    | 2422 MHz | 38.66 dBuV/m | 11n40                   | 2422 MHz | 38.63 dBuV/m | -0.03 dB  |

Comparison of two models, all test results are under FCC Technical Limit.

3. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

| Modulation Mode | Tx,Rx Function |
|-----------------|----------------|
| 802.11b         | 2TX,2RX        |
| 802.11g         | 2TX,2RX        |
| 802.11n (HT20)  | 2TX,2RX        |
| 802.11n (HT40)  | 2TX,2RX        |

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

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## 6.2. Channel List

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

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

7 channels are provided for 802.11n (HT40):

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 3       | 2422            | 7       | 2442            |
| 4       | 2427            | 8       | 2447            |
| 5       | 2432            | 9       | 2452            |
| 6       | 2437            | -       | -               |

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### 6.3. Test Condition

| Test Item                          | Test Site No. | Environmental Condition | Input Power | Test Date                 | Tested by                 |
|------------------------------------|---------------|-------------------------|-------------|---------------------------|---------------------------|
| Antenna Port Conducted Measurement | SR4           | 23~26°C/<br>60~65%RH    | 5Vdc        | 2021/08/09~<br>2021/10/25 | Mike Cai                  |
| Radiated Spurious Emission         | 966-2         | 23~26°C/<br>60~65%RH    | 5Vdc        | 2021/09/06~<br>2021/10/22 | Patrick Kuan/<br>Mike Cai |
| AC power Line Conducted Emission   | SR1           | 23~26°C/<br>60~65%RH    | 5Vdc        | 2021/10/07~<br>2021/10/08 | Mike Cai                  |

FCC Test Firm Registration Number: 498077

### 6.4. Description of Available Antennas

| Ant. No. | Transmitter Circuit | Brand Name | Model Name | Ant. Type | Maximum Gain (dBi)         | Remark |
|----------|---------------------|------------|------------|-----------|----------------------------|--------|
| 1        | Chain (0)           | SparkLAN   | N/A        | PCB       | 2.4GHz: 0.7<br>5GHz: 4.24  | Ant L  |
|          | Chain (1)           | SparkLAN   | N/A        | PCB       | 2.4GHz: 0.25<br>5GHz: 3.83 | Ant R  |

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

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## 6.5. Test Mode Applicability and Tested Channel Detail

- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case).
- The fundamental of the EUT with PCB Antenna was investigated in three orthogonal axes X-Y/Y-Z/X-Z, it was determined that Y-Z plane was worst-case. Therefore, all final radiated testing was performed with the EUT in Y-Z plane.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

| Test Item                        | Mode      | Modulation Technology | Modulation Type | Available Channel | Test Channel | Data Rate |
|----------------------------------|-----------|-----------------------|-----------------|-------------------|--------------|-----------|
| Radiated Emissions (Above 1GHz)  | 802.11b   | DSSS                  | DBPSK           | 1 to 11           | 1,2,6,10,11  | 1 Mbps    |
|                                  | 802.11g   | OFDM                  | BPSK            | 1 to 11           | 1,2,6,10,11  | 6 Mbps    |
|                                  | 802.11n20 | OFDM                  | BPSK            | 1 to 11           | 1,2,6,10,11  | MCS0      |
|                                  | 802.11n40 | OFDM                  | BPSK            | 3 to 9            | 3,6,9        | MCS0      |
| Radiated Emissions (Below 1GHz)  | 802.11n20 | OFDM                  | BPSK            | 1 to 11           | 6            | MCS0      |
| AC Power Line Conducted Emission | 802.11n20 | OFDM                  | BPSK            | 1 to 11           | 6            | MCS0      |
| Conducted Output Power           | 802.11b   | DSSS                  | DBPSK           | 1 to 11           | 1,2,6,10,11  | 1 Mbps    |
|                                  | 802.11g   | OFDM                  | BPSK            | 1 to 11           | 1,2,6,10,11  | 6 Mbps    |
|                                  | 802.11n20 | OFDM                  | BPSK            | 1 to 11           | 1,2,6,10,11  | MCS0      |
|                                  | 802.11n40 | OFDM                  | BPSK            | 3 to 9            | 3,6,9        | MCS0      |

Simultaneously transmission condition:

| Condition | Technology            |                   |
|-----------|-----------------------|-------------------|
| 1         | WLAN (2.4GHz), Chain0 | Bluetooth, Chain1 |
| 2         | WLAN (5GHz), Chain0   | Bluetooth Chain1  |

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

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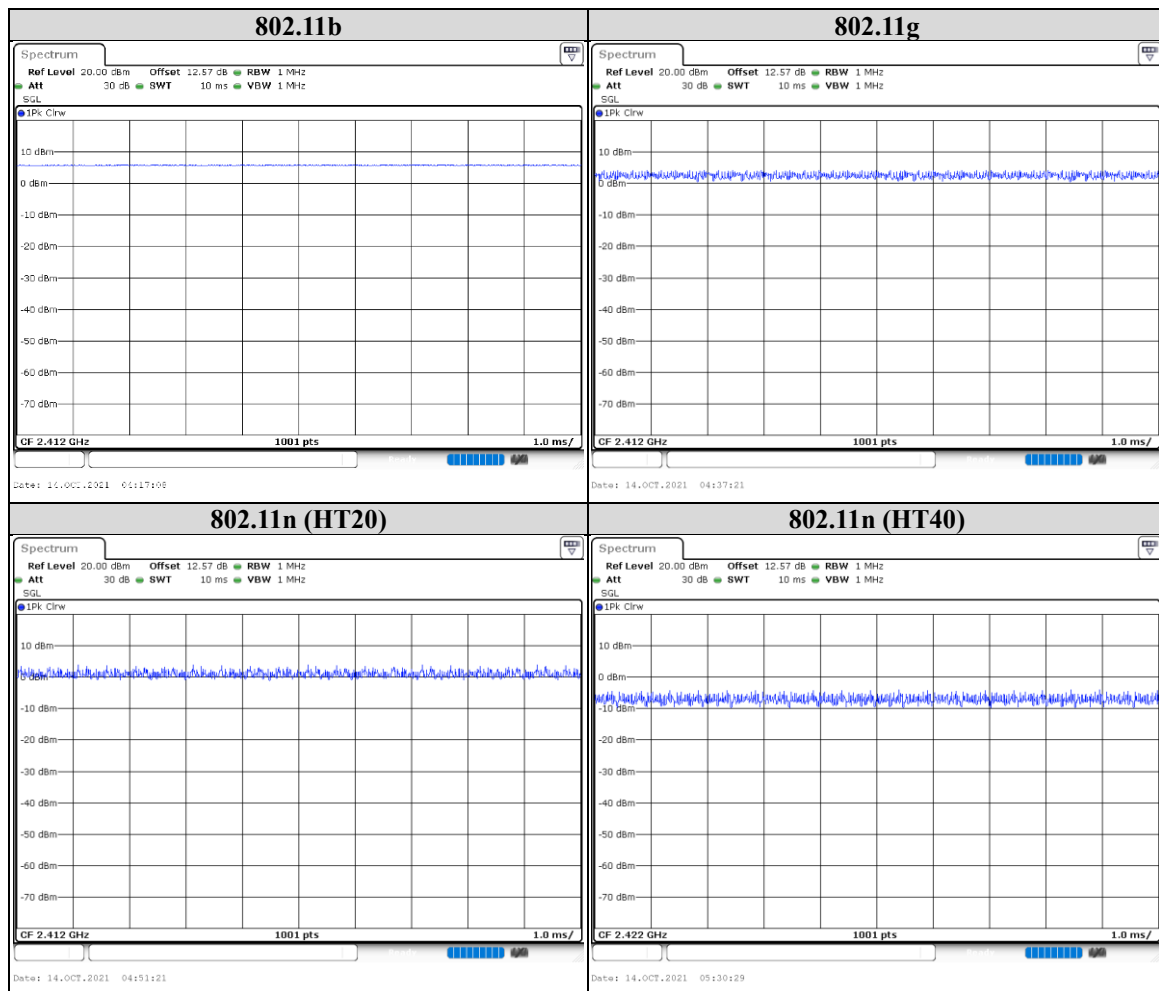
## 6.6. Duty cycle

802.11b: Duty cycle =  $1/1 = 100\%$ , duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

802.11g: Duty cycle =  $1/1 = 100\%$ , duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

802.11n(HT20): Duty cycle =  $1/1 = 100\%$ , duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

802.11n(HT40): Duty cycle =  $1/1 = 100\%$ , duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.





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## 7. Test Equipment

| Test Equipment List                          |                    |                         |                     |            |              |
|----------------------------------------------|--------------------|-------------------------|---------------------|------------|--------------|
| Equipment                                    | Manufacturer       | Model No.               | Serial No.          | Cal. Date  | Expired date |
| Radiated Spurious Emission                   |                    |                         |                     |            |              |
| Spectrum Analyzer                            | Keysight           | N9010A                  | MY56070827          | 2020/11/11 | 2021/11/10   |
| EMI Test Receiver                            | Rohde & Schwarz    | ESR7                    | 101754              | 2020/12/11 | 2021/12/10   |
| Loop Antenna                                 | ETS lindgren       | 6502                    | 00213440            | 2020/12/25 | 2021/12/24   |
| Trilog-Broadband Antenna with 5dB Attenuator | Schwarzbeck & EMCI | VULB 9168 & N-6-05      | 774 & AT-N0538      | 2021/1/13  | 2022/1/12    |
| Horn Antenna (1-18 GHz)                      | Schwarzbeck        | BBHA 9120 D             | 01690               | 2020/12/30 | 2021/12/29   |
| Horn Antenna (18-40 GHz)                     | Schwarzbeck        | BBHA 9170               | 781                 | 2020/12/30 | 2021/12/29   |
| Preamplifier (30-1000 MHz)                   | EMCI               | EMC330E                 | 980405              | 2021/6/8   | 2022/6/7     |
| Preamplifier (1-18 GHz)                      | EMCI               | EMC051835BE             | 980406              | 2021/2/3   | 2022/2/2     |
| Preamplifier (18-40GHz)                      | EMCI               | EMC184040SEE            | 980426              | 2021/5/19  | 2022/5/18    |
| Cables                                       | Hanyitek           | K1K50-UP0264-K1K50-2500 | 170214-4 & 170425-2 | 2021/1/22  | 2022/1/21    |
| Cables                                       | Hanyitek           | K1K50-UP0264-K1K50-2500 | 170214-1 & 170214-2 | 2021/1/22  | 2022/1/21    |

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| Test Equipment List                |                 |           |                          |            |              |
|------------------------------------|-----------------|-----------|--------------------------|------------|--------------|
| Equipment                          | Manufacturer    | Model No. | Serial No.               | Cal. Date  | Expired date |
| Antenna Port Conducted Measurement |                 |           |                          |            |              |
| Spectrum Analyzer                  | Keysight        | N9010A    | MY56070834               | 2020/11/6  | 2021/11/5    |
| Pulse Power Sensor                 | Anritsu         | MA2411B   | 1531202                  | 2020/12/21 | 2021/12/20   |
| Power Meter                        | Anritsu         | ML2495A   | 1645002                  | 2020/12/21 | 2021/12/20   |
| AC power Line Conducted Emission   |                 |           |                          |            |              |
| EMI Test Receiver                  | Rohde & Schwarz | ESR7      | 101753                   | 2020/11/17 | 2021/11/16   |
| Two-Line V-Network                 | Rohde & Schwarz | ENV216    | 102136                   | 2021/8/30  | 2022/8/29    |
| Impuls-Begrenzer Pulse Limiter     | Rohde & Schwarz | ESH3-Z2   | 102219-Qt                | 2021/8/26  | 2022/8/25    |
| Cables                             | TITAN           | CFD200    | T0732ACFD20<br>020A300-1 | 2021/3/2   | 2022/3/1     |

| UL Software                      |                         |                |
|----------------------------------|-------------------------|----------------|
| Description                      | Name                    | Version        |
| Radiated measurement             | e3                      | 6.191211 (V6)  |
| Conducted measurement            | RF Conducted Test Tools | ver 2.4.0.620b |
| AC power Line Conducted Emission | EZ_EMG                  | UL-3A1.2       |

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## 8. Description of Test Setup

### Support Equipment

| ID | Equipment | Brand Name | Model Name | S/N      | Remark         |
|----|-----------|------------|------------|----------|----------------|
| A  | Laptop    | Lenovo     | T460       | PC0FWU5Y | Provide by lab |

### I/O Cables

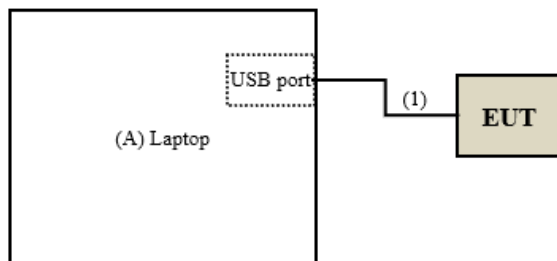
| ID | Equipment | Brand Name | Model Name | Length (m) | Remark         |
|----|-----------|------------|------------|------------|----------------|
| 1  | USB Cable | fujiei     | Z08145     | 1          | Provide by lab |

### Test Setup

Controlled using a bespoke application (RTL8822CU MP Diagnostic Program 0.0001.1020.2018) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.



### Setup Diagram for Radiated Spurious Emission Test



-----  
**Under Table**

-----  
**Remote Site**

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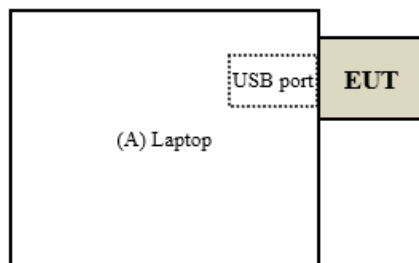
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**Setup Diagram for AC Power Line Conducted Emission Test**



**Under Table**

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## 9. Test Results

### 9.1. Conducted Output Power

#### Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

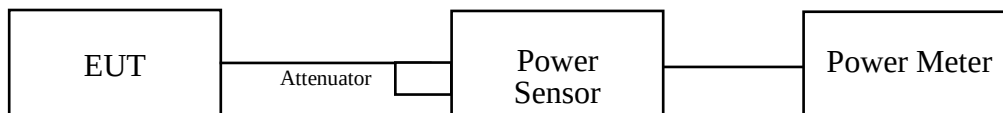
Note:

1. Directional Gain =  $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / N_{ANT}]$  dBi.  
N<sub>ant</sub>: Number of Transmit Antennas  
G1, G2,..., Gn: Gain of Individual Antennas
2. Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,  
Array Gain = 0 dB (i.e., no array gain) for  $N_{ANT} \leq 4$ ;  
Array Gain = 0 dB (i.e., no array gain) for channel widths  $\geq 40$  MHz for any  $N_{ANT}$ ;  
Array Gain =  $5 \log(N_{ANT}/N_{SS})$  dB or 3 dB, whichever is less for 20-MHz channel widths with  $N_{ANT} \geq 5$ .

#### Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

#### Test Setup



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.

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## Test Data

### Peak Power

#### 802.11b

| Channel | Frequency (MHz) | Peak Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|------------------|---------|------------------|-------------------|-------------|-------------|
|         |                 | Chain 0          | Chain 1 |                  |                   |             |             |
| 1       | 2412            | 15.06            | 14.51   | 60.256           | 17.80             | 30          | PASS        |
| 2       | 2417            | 17.59            | 16.34   | 100.462          | 20.02             | 30          | PASS        |
| 6       | 2437            | 20.98            | 19.23   | 208.93           | 23.20             | 30          | PASS        |
| 10      | 2457            | 16.44            | 15.02   | 75.858           | 18.80             | 30          | PASS        |
| 11      | 2462            | 15.45            | 14.03   | 60.395           | 17.81             | 30          | PASS        |

#### 802.11g

| Channel | Frequency (MHz) | Peak Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|------------------|---------|------------------|-------------------|-------------|-------------|
|         |                 | Chain 0          | Chain 1 |                  |                   |             |             |
| 1       | 2412            | 21.17            | 21.04   | 258.226          | 24.12             | 30          | PASS        |
| 2       | 2417            | 24.15            | 23.75   | 496.592          | 26.96             | 30          | PASS        |
| 6       | 2437            | 25.23            | 24.30   | 602.56           | 27.80             | 30          | PASS        |
| 10      | 2457            | 22.99            | 22.81   | 389.942          | 25.91             | 30          | PASS        |
| 11      | 2462            | 19.68            | 19.85   | 189.671          | 22.78             | 30          | PASS        |

#### 802.11n (HT20)

| Channel | Frequency (MHz) | Peak Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|------------------|---------|------------------|-------------------|-------------|-------------|
|         |                 | Chain 0          | Chain 1 |                  |                   |             |             |
| 1       | 2412            | 18.06            | 18.45   | 133.968          | 21.27             | 30          | PASS        |
| 2       | 2417            | 23.22            | 22.71   | 396.278          | 25.98             | 30          | PASS        |
| 6       | 2437            | 25.41            | 24.60   | 635.331          | 28.03             | 30          | PASS        |
| 10      | 2457            | 21.01            | 20.78   | 246.037          | 23.91             | 30          | PASS        |
| 11      | 2462            | 17.02            | 18.10   | 114.815          | 20.60             | 30          | PASS        |

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#### 802.11n (HT40)

| Channel | Frequency (MHz) | Peak Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|------------------|---------|------------------|-------------------|-------------|-------------|
|         |                 | Chain 0          | Chain 1 |                  |                   |             |             |
| 3       | 2422            | 17.02            | 17.18   | 102.565          | 20.11             | 30          | PASS        |
| 6       | 2437            | 18.86            | 19.50   | 165.959          | 22.20             | 30          | PASS        |
| 9       | 2452            | 16.18            | 16.58   | 86.896           | 19.39             | 30          | PASS        |

#### Average Power (Reference Only)

#### 802.11b

| Channel | Frequency (MHz) | Average Power (dBm) |         | Total Power (mW) | Total Power (dBm) |
|---------|-----------------|---------------------|---------|------------------|-------------------|
|         |                 | Chain 0             | Chain 1 |                  |                   |
| 1       | 2412            | 13.34               | 12.20   | 38.194           | 15.82             |
| 2       | 2417            | 15.25               | 14.72   | 63.096           | 18.00             |
| 6       | 2437            | 18.68               | 17.56   | 130.918          | 21.17             |
| 10      | 2457            | 14.56               | 13.12   | 49.091           | 16.91             |
| 11      | 2462            | 13.43               | 12.31   | 39.084           | 15.92             |

#### 802.11g

| Channel | Frequency (MHz) | Average Power (dBm) |         | Total Power (mW) | Total Power (dBm) |
|---------|-----------------|---------------------|---------|------------------|-------------------|
|         |                 | Chain 0             | Chain 1 |                  |                   |
| 1       | 2412            | 11.62               | 11.59   | 28.973           | 14.62             |
| 2       | 2417            | 14.73               | 14.18   | 55.847           | 17.47             |
| 6       | 2437            | 18.41               | 17.59   | 126.765          | 21.03             |
| 10      | 2457            | 13.44               | 13.28   | 43.351           | 16.37             |
| 11      | 2462            | 10.18               | 9.75    | 19.861           | 12.98             |

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#### 802.11n (HT20)

| Channel | Frequency (MHz) | Average Power (dBm) |         | Total Power (mW) | Total Power (dBm) |
|---------|-----------------|---------------------|---------|------------------|-------------------|
|         |                 | Chain 0             | Chain 1 |                  |                   |
| 1       | 2412            | 10.13               | 10.28   | 20.989           | 13.22             |
| 2       | 2417            | 14.27               | 13.90   | 51.286           | 17.10             |
| 6       | 2437            | 18.38               | 17.31   | 122.744          | 20.89             |
| 10      | 2457            | 12.48               | 12.16   | 34.119           | 15.33             |
| 11      | 2462            | 8.99                | 9.20    | 16.255           | 12.11             |

#### 802.11n (HT40)

| Channel | Frequency (MHz) | Average Power (dBm) |         | Total Power (mW) | Total Power (dBm) |
|---------|-----------------|---------------------|---------|------------------|-------------------|
|         |                 | Chain 0             | Chain 1 |                  |                   |
| 3       | 2422            | 8.84                | 9.33    | 16.218           | 12.10             |
| 6       | 2437            | 11.04               | 11.64   | 27.29            | 14.36             |
| 9       | 2452            | 8.26                | 8.52    | 13.804           | 11.40             |

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## 9.2. Radiated Spurious Emission

### Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

| Frequency(MHz) | Field strength<br>(microvolts/meter) | Measurement distance<br>(meters) |
|----------------|--------------------------------------|----------------------------------|
| 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. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

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## **Test Procedures**

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 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.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 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.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

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Note:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle  $< 98\%$ ) or 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.

| Configuration  | Average |      |
|----------------|---------|------|
|                | RBW     | VBW  |
| 802.11b        | 1MHz    | 10Hz |
| 802.11g        |         | 10Hz |
| 802.11n (HT20) |         | 10Hz |
| 802.11n (HT40) |         | 10Hz |

Note: Refer to section 6.6 for duty cycle.

- All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported.
- Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
- Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
- Test data of Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
- Test data of Notation "@" = Fundamental Frequency
- Test data of Notation "\*" = The peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

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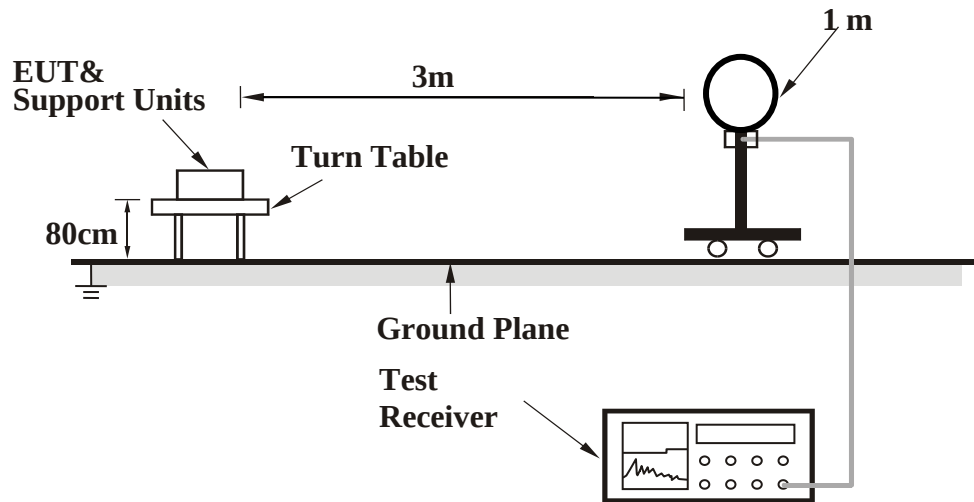
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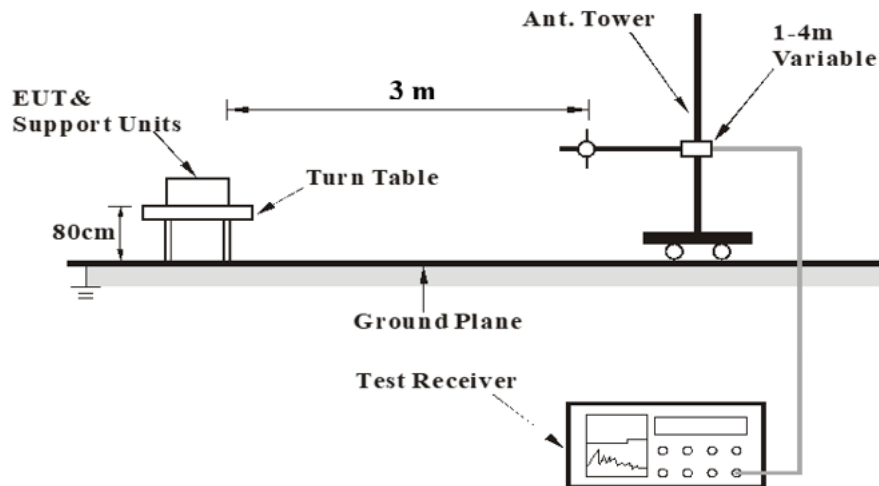
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## Test Setup

<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



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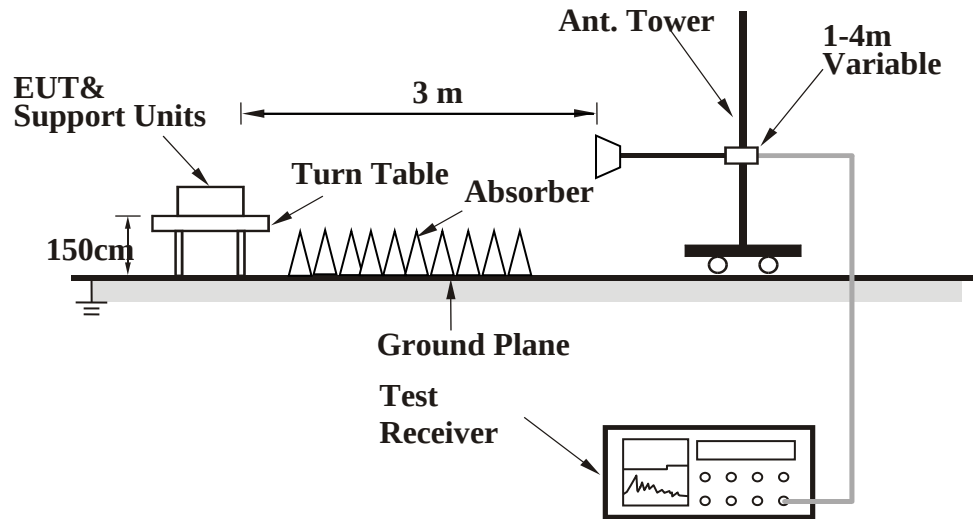
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<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

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## Test Data

### **Above 1G**

|      |         |         |   |
|------|---------|---------|---|
| Mode | 802.11b | Channel | 1 |
|------|---------|---------|---|

| Polarization | Notation | Frequency (MHz) | Reading (dBuV) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|--------------|----------|-----------------|----------------|----------------|-----------------|----------------|-------------|--------|
| Horizontal   |          | 2332.04         | 38.42          | 6.1            | 44.52           | 54             | -9.48       | AVG    |
|              |          | 2389.04         | 43.79          | 6.1            | 49.89           | 74             | -24.11      | PK     |
|              | @        | 2412            | 99.76          | 6.13           | 105.89          | N/A            | N/A         | PK     |
|              | @        | 2412            | 93.77          | 6.13           | 99.9            | N/A            | N/A         | AVG    |
|              | *        | 4824            | 35.43          | 2.55           | 37.98           | 74             | -36.02      | PK     |
| Vertical     |          | 2389.8          | 43.48          | 6.1            | 49.58           | 74             | -24.42      | PK     |
|              |          | 2389.99         | 37.64          | 6.1            | 43.74           | 54             | -10.26      | AVG    |
|              | @        | 2412            | 102.9          | 6.13           | 109.03          | N/A            | N/A         | PK     |
|              | @        | 2412            | 96.4           | 6.13           | 102.53          | N/A            | N/A         | AVG    |
|              | *        | 4824            | 35.19          | 2.55           | 37.74           | 74             | -36.26      | PK     |

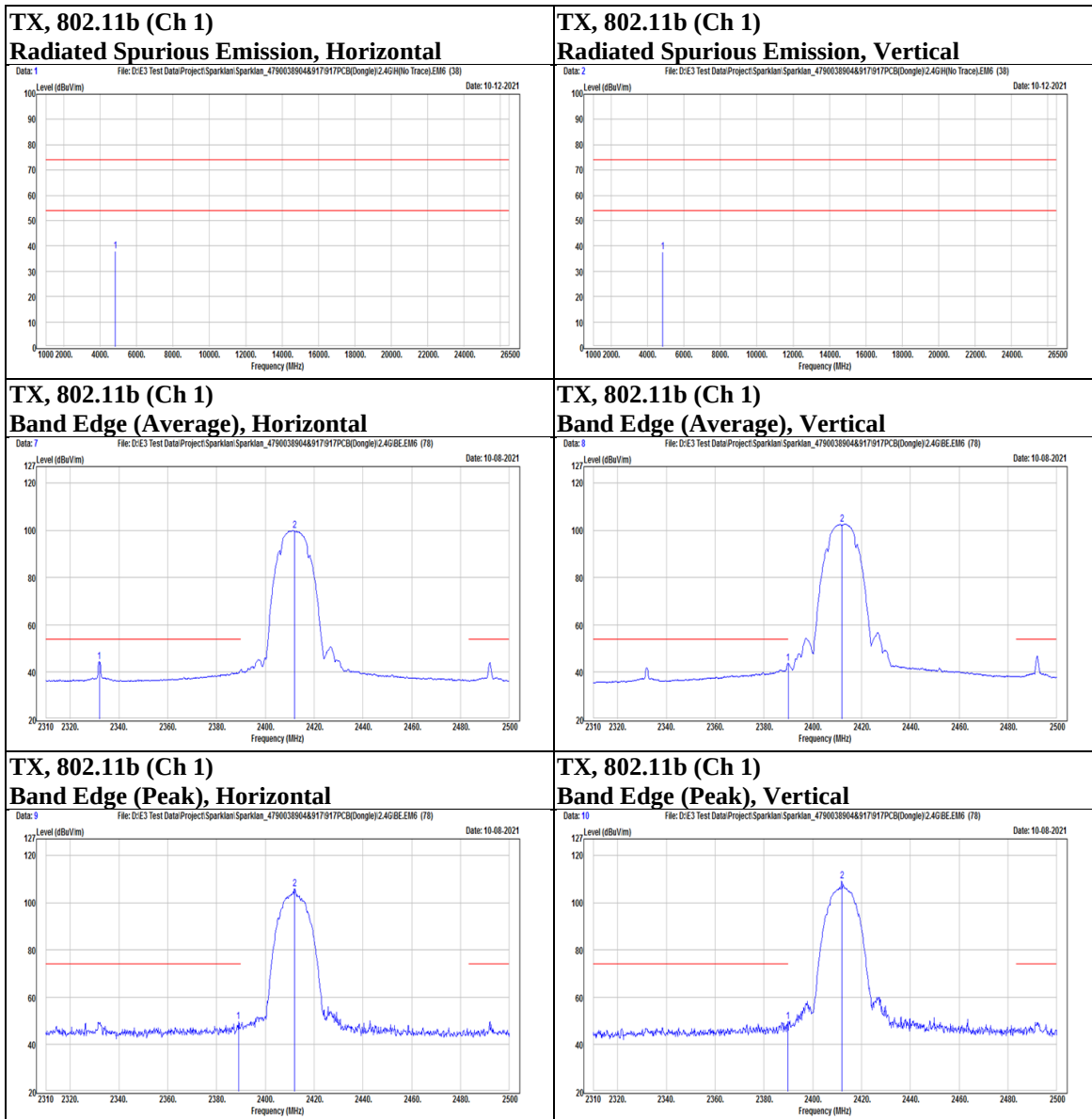
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|      |         |         |   |
|------|---------|---------|---|
| Mode | 802.11b | Channel | 2 |
|------|---------|---------|---|

| Polarization | Notation | Frequency | Reading | Correct | Result   | Limit    | Margin | Remark |
|--------------|----------|-----------|---------|---------|----------|----------|--------|--------|
|              |          | (MHz)     | (dBuV)  | (dB/m)  | (dBuV/m) | (dBuV/m) | (dB)   |        |
| Horizontal   |          | 2336.98   | 37.36   | 6.08    | 43.44    | 54       | -10.56 | AVG    |
|              |          | 2337.36   | 43.3    | 6.08    | 49.38    | 74       | -24.62 | PK     |
|              | @        | 2417      | 98.12   | 6.13    | 104.25   | N/A      | N/A    | PK     |
|              | @        | 2417      | 92.82   | 6.13    | 98.95    | N/A      | N/A    | AVG    |
|              | *        | 4834      | 34.99   | 2.61    | 37.6     | 74       | -36.4  | PK     |
| Vertical     |          | 2336.98   | 35      | 6.08    | 41.08    | 54       | -12.92 | AVG    |
|              |          | 2389.99   | 44.41   | 6.1     | 50.51    | 74       | -23.49 | PK     |
|              | @        | 2417      | 102.05  | 6.13    | 108.18   | N/A      | N/A    | PK     |
|              | @        | 2417      | 96.95   | 6.13    | 103.08   | N/A      | N/A    | AVG    |
|              | *        | 4834      | 34.96   | 2.61    | 37.57    | 74       | -36.43 | PK     |

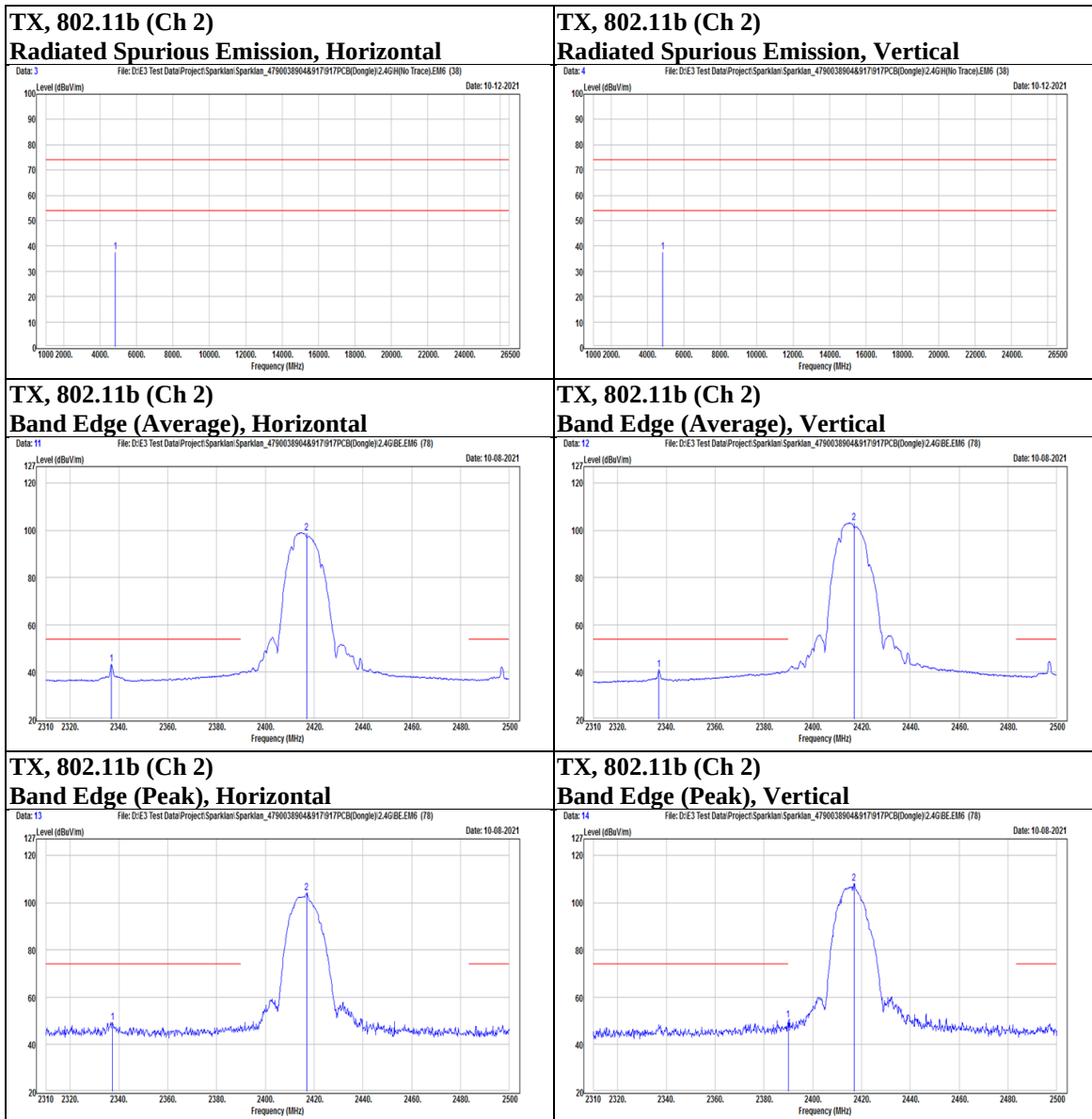
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|      |         |         |   |
|------|---------|---------|---|
| Mode | 802.11b | Channel | 6 |
|------|---------|---------|---|

| Polarization | Notation | Frequency | Reading | Correct | Result   | Limit    | Margin | Remark |
|--------------|----------|-----------|---------|---------|----------|----------|--------|--------|
|              |          | (MHz)     | (dBuV)  | (dB/m)  | (dBuV/m) | (dBuV/m) | (dB)   |        |
| Horizontal   |          | 2314.94   | 42.86   | 6.18    | 49.04    | 74       | -24.96 | PK     |
|              |          | 2356.93   | 35.21   | 6.04    | 41.25    | 54       | -12.75 | AVG    |
|              | @        | 2437      | 103.31  | 6.12    | 109.43   | N/A      | N/A    | PK     |
|              | @        | 2437      | 98.75   | 6.12    | 104.87   | N/A      | N/A    | AVG    |
|              |          | 2483.66   | 31.36   | 6.1     | 37.46    | 54       | -16.54 | AVG    |
|              |          | 2491.07   | 41.86   | 6.1     | 47.96    | 74       | -26.04 | PK     |
|              | *        | 4874      | 35.43   | 2.66    | 38.09    | 74       | -35.91 | PK     |
| Vertical     |          | 2356.93   | 42.47   | 6.04    | 48.51    | 74       | -25.49 | PK     |
|              |          | 2356.93   | 33.39   | 6.04    | 39.43    | 54       | -14.57 | AVG    |
|              | @        | 2437      | 105.68  | 6.12    | 111.8    | N/A      | N/A    | PK     |
|              | @        | 2437      | 100.71  | 6.12    | 106.83   | N/A      | N/A    | AVG    |
|              |          | 2484.99   | 33.13   | 6.1     | 39.23    | 54       | -14.77 | AVG    |
|              |          | 2488.22   | 42.63   | 6.1     | 48.73    | 74       | -25.27 | PK     |
|              | *        | 4874      | 35.55   | 2.66    | 38.21    | 74       | -35.79 | PK     |
|              | *        | 7311      | 41.12   | 10.62   | 51.74    | 74       | -22.26 | PK     |

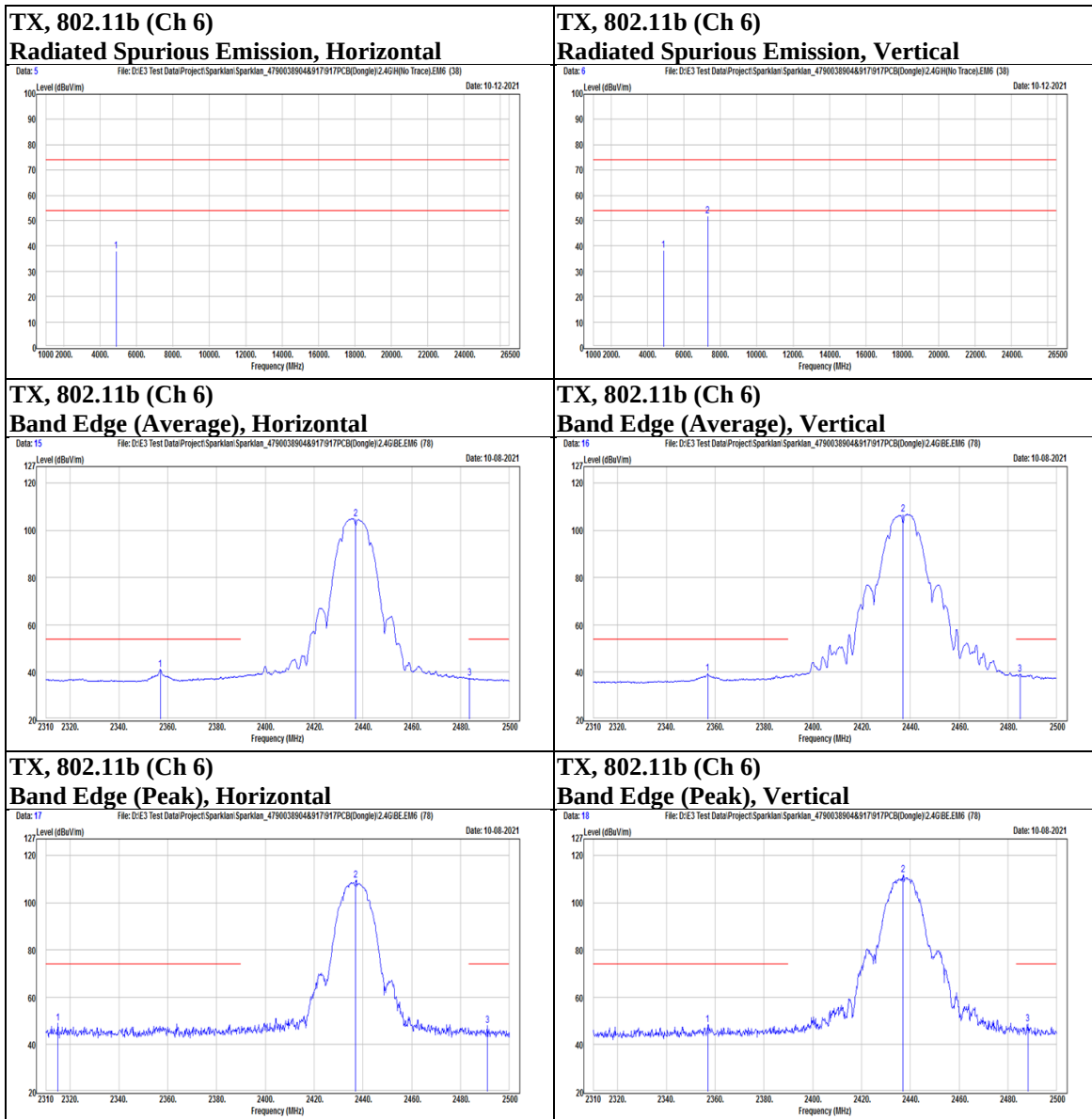
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|      |         |         |    |
|------|---------|---------|----|
| Mode | 802.11b | Channel | 10 |
|------|---------|---------|----|

| Polarization | Notation | Frequency | Reading | Correct | Result   | Limit    | Margin | Remark |
|--------------|----------|-----------|---------|---------|----------|----------|--------|--------|
|              |          | (MHz)     | (dBuV)  | (dB/m)  | (dBuV/m) | (dBuV/m) | (dB)   |        |
| Horizontal   | @        | 2457      | 98.2    | 6.12    | 104.32   | N/A      | N/A    | PK     |
|              | @        | 2457      | 92.85   | 6.12    | 98.97    | N/A      | N/A    | AVG    |
|              |          | 2487.27   | 32.09   | 6.11    | 38.2     | 54       | -15.8  | AVG    |
|              |          | 2487.65   | 41.56   | 6.1     | 47.66    | 74       | -26.34 | PK     |
|              | *        | 4914      | 35.81   | 2.63    | 38.44    | 74       | -35.56 | PK     |
| Vertical     | @        | 2457      | 101.41  | 6.12    | 107.53   | N/A      | N/A    | PK     |
|              | @        | 2457      | 95.74   | 6.12    | 101.86   | N/A      | N/A    | AVG    |
|              |          | 2484.61   | 34.35   | 6.1     | 40.45    | 54       | -13.55 | AVG    |
|              |          | 2490.12   | 44.63   | 6.1     | 50.73    | 74       | -23.27 | PK     |
|              | *        | 4914      | 35.35   | 2.63    | 37.98    | 74       | -36.02 | PK     |

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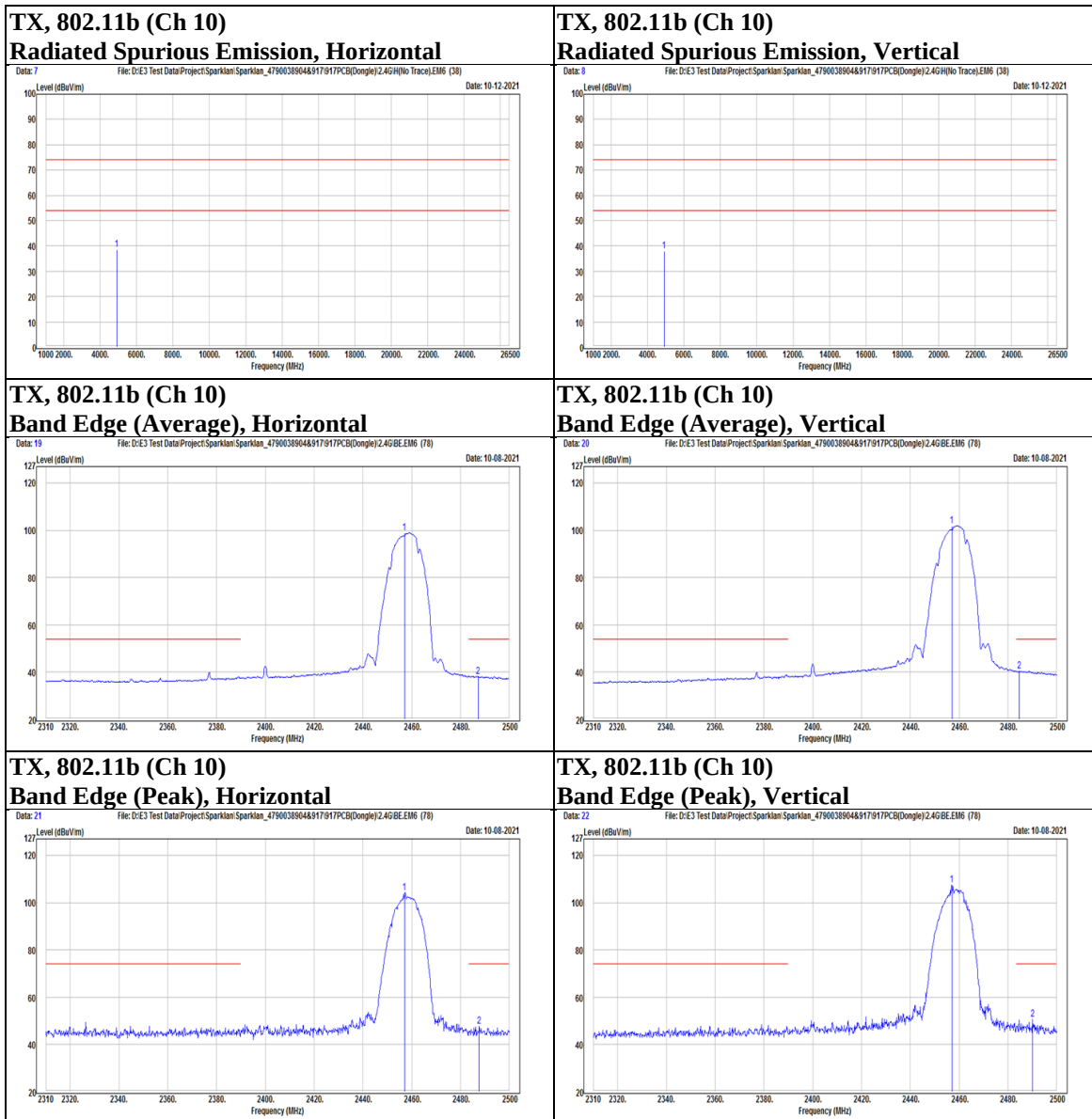
Telephone :+886-2-7737-3000

Facsimile (FAX ) :+886-3-583-7948

Doc No: 17-EM-F0876 / 6.0



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|      |         |         |    |
|------|---------|---------|----|
| Mode | 802.11b | Channel | 11 |
|------|---------|---------|----|

| Polarization | Notation | Frequency | Reading | Correct | Result   | Limit    | Margin | Remark |
|--------------|----------|-----------|---------|---------|----------|----------|--------|--------|
|              |          | (MHz)     | (dBuV)  | (dB/m)  | (dBuV/m) | (dBuV/m) | (dB)   |        |
| Horizontal   | @        | 2462      | 96.08   | 6.12    | 102.2    | N/A      | N/A    | PK     |
|              | @        | 2462      | 90.39   | 6.12    | 96.51    | N/A      | N/A    | AVG    |
|              |          | 2484.04   | 34.26   | 6.1     | 40.36    | 54       | -13.64 | AVG    |
|              |          | 2496.2    | 41.81   | 6.1     | 47.91    | 74       | -26.09 | PK     |
|              | *        | 4924      | 34.47   | 2.61    | 37.08    | 74       | -36.92 | PK     |
| Vertical     | @        | 2462      | 101.11  | 6.12    | 107.23   | N/A      | N/A    | PK     |
|              | @        | 2462      | 95.33   | 6.12    | 101.45   | N/A      | N/A    | AVG    |
|              |          | 2483.85   | 36.75   | 6.1     | 42.85    | 54       | -11.15 | AVG    |
|              |          | 2484.99   | 44.41   | 6.1     | 50.51    | 74       | -23.49 | PK     |
|              | *        | 4924      | 35.09   | 2.61    | 37.7     | 74       | -36.3  | PK     |

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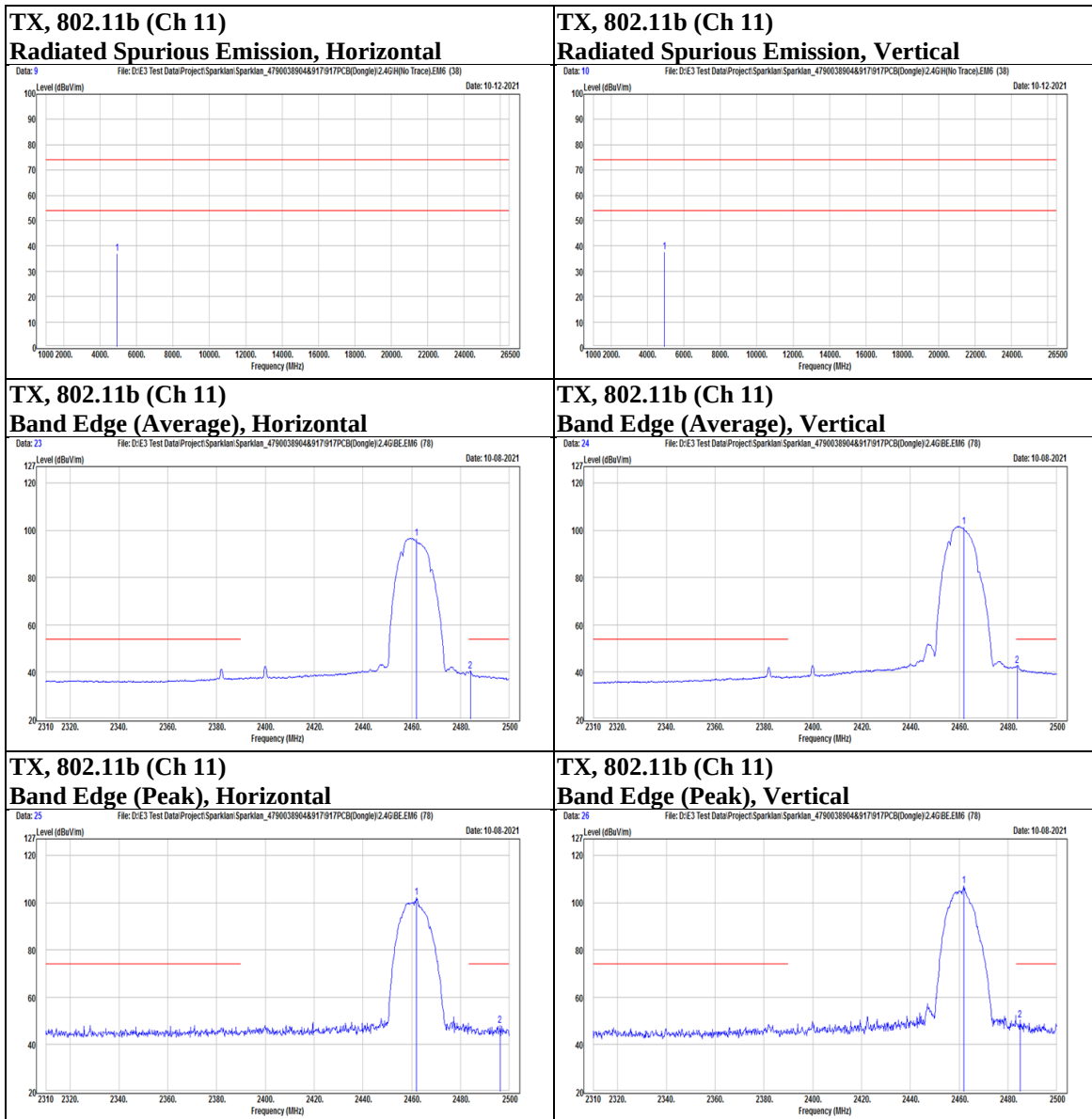
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