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RADIO TEST REPORT

REPORT NUMBER: M2105018-13

**TEST STANDARD: FCC PART 15 SUBPART C SECTION
15.247**

ISED RSS-247 SECTION 5.0

CLIENT: FLEET SPACE TECHNOLOGIES

DEVICE: U-BLOX WLAN MODULE (LILY-W131)

MODEL: LILY-W131

FCC ID: XPYLILYW1

IC: 8595A-LILYW1

DATE OF ISSUE: 19 JULY 2021

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REVISION TABLE

| Version | Sec/Para Changed | Change Made | Date |
|---------|------------------|---------------------------|------------|
| 1 | | Initial issue of document | 19/07/2021 |
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RADIO TEST REPORT

CERTIFICATE OF COMPLIANCE

Radio Module: u-blox WLAN module (LILY-W131)
FCC ID: XPYLILYW1
IC ID: 85955A-LILYW1
Manufacturer: u-Blox AG

Host Device: Fleet Portal
Model: FSPOR0201-2
Variant Model: FSPOR0201-3
Manufacturer: Fleet Space Technologies

Tested for: Fleet Space Technologies
Address: 8A, Myer Court, Beverly, SA 5009
Phone Number: +61(8) 7200 2633
Contact: Vigneshwaran Ganesan
Email: vigneshwaran.ganesan@fleet.space

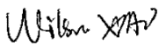

Standard: FCC Part 15, Subpart C, Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ISED RSS-247, Issue 2, Section 5 Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Result: The Fleet Portal complied with the applicable requirements of the above standards. Refer to Report M21058018-13 for full details.

Test Dates: 1 – 2 & 11, June 2021

Issue Date: 19 July 2021

Test Engineers: 
Wilson Xiao 
Ian Paul Ng

Attestation: *I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*

Authorised Signatory: 
Shabbir Ahmed
Lead Engineer – Radio

Issued by: EMC Technologies Pty. Ltd.,
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RADIO REPORT FOR CERTIFICATION

1 TEST SUMMARY

| Section | Description | FCC | ISED | Test Mode | Result(s) |
|---------|---------------------------------|---------------|----------------|-------------------|-----------|
| 6.1 | Antenna Requirement | §15.203 | RSS-Gen 6.8 | N/A | Complied |
| 6.1 | Conducted Limits | §15.207 | RSS-Gen 8.8 | Test Mode 4 | Complied |
| 6.2 | Peak Output Power | §15.247(b)(3) | RSS-247 5.4(d) | Test Mode 1,2 & 4 | Complied |
| 6.3 | Out-of-Band/Spurious Emissions | §15.247(d) | RSS-247 5.5 | Test Mode 4 | Complied |
| 6.4 | Band-Edge Emission Measurements | §15.247(d) | RSS-247 5.5 | Test Mode 3 & 5 | Complied |

| Test Mode | Description of Test Mode |
|-----------|--|
| 1 | 802.11b Continuous transmitting on Channel 6 (2437 MHz - CCK) with 1 Mbps data rate |
| 2 | 802.11g Continuous transmitting on Channel 6 (2437 MHz - OFDM) with 6 Mbps data rate |
| 3 | 802.11n Continuous transmitting on Channel 1 (2412 MHz - OFDM) with 6.5 Mbps data rate |
| 4 | 802.11n Continuous transmitting on Channel 6 (2437 MHz - OFDM) with 6.5 Mbps data rate |
| 5 | 802.11n Continuous transmitting on Channel 11 (2462 MHz - OFDM) with 6.5 Mbps data rate |

2 TEST FACILITY

2.1 General

EMC Technologies Pty Ltd is accredited by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies Pty Ltd has also been designated as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 and 18 of the FCC Commission’s rules – **Registration Number 494713 & Designation number AU0001.**


EMC Technologies Pty Ltd is also an ISED Canada recognized testing laboratory – **ISED company number: 3569B and CAB identifier number: AU0001.**

2.2 Test Laboratory/Accreditations

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system similar to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

All testing in this report has been conducted in accordance with EMC Technologies’ scope of NATA accreditation to ISO 17025 for both testing and calibration and ISO 17020 for Inspection – **Accreditation Number 5292.**

The current full scope of accreditation can be found on the NATA website: www.nata.com.au

| | |
|--|---|
|  <p style="font-size: small;">Accreditation No.5292</p> | <p>This document shall not be reproduced except in full.</p> |
|--|---|

3 TEST EQUIPMENT CALIBRATION

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Keysight Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI) or in-house. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

| Equipment Type | Make/Model/Serial Number | Last Cal. dd/mm/yyyy | Due Date dd/mm/yyyy | Cal. Interval |
|----------------------|--|----------------------|---------------------|----------------------|
| Chamber | Frankonia SAC-3-2 (R-144) | 10/08/2020 | 10/08/2023 | 3 Year ^{*1} |
| EMI Receiver | R&S ESW26 Sn: 101306 (R-143) | 05/06/2020 | 05/06/2021 | 1 Year ^{*2} |
| | R&S ESCI Sn:100011 (R-028) | 13/07/2020 | 13/07/2021 | 1 Year ^{*2} |
| Antennas | EMCO 6502 Active Loop Antenna Sn: 2021 (A-310) | 31/08/2020 | 31/08/2022 | 2 Year ^{*2} |
| | SUNOL JB1 Sn. A052518 (A-434) | 13/11/2020 | 13/11/2021 | 2 Year ^{*2} |
| | EMCO 3115 Horn Antenna Sn: 8908-3282 (A-004) | 16/01/2019 | 16/01/2022 | 3 Year ^{*1} |
| | ETS-Lindgren Horn Antenna Sn:66032 (A-307) | 12/06/2018 | 12/06/2021 | 3 Year ^{*2} |
| Cables ^{*3} | Huber & Suhner Sucoflex 104A Sn: 503055 (C-457) | 05/01/2021 | 05/01/2022 | 1 Year ^{*1} |
| | Huber & Suhner Sucoflex 104A Sn: 800448 (C-520) | 05/01/2021 | 05/01/2022 | 1 Year ^{*1} |
| | Huber & Suhner Sucoflex 102DC Sn: 27319/2 (C-273) | 06/01/2021 | 06/01/2022 | 1 Year ^{*1} |

Note *1. Internal NATA calibration.

Note *2. External NATA / A2LA calibration.

Note *3. Cables are verified before measurements are taken.

4 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

| | | |
|----------------------------|---------------------|---------|
| Radiated Emissions: | 9 kHz to 30 MHz | ±4.1 dB |
| | 30 MHz to 300 MHz | ±5.1 dB |
| | 300 MHz to 1000 MHz | ±4.7 dB |
| | 1 GHz to 18 GHz | ±4.6 dB |
| | 18 GHz to 40 GHz | ±4.6 dB |
| Peak Output Power: | | ±1.5 dB |

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Application of measurement uncertainty for this report:

The referenced uncertainty standard specifies that determination of compliance shall be based on measurements without taking into account measurement instrumentation uncertainty. However, the measurement uncertainty shall appear in the test report.

5 Device Details

(Information supplied by the Client)

The EUT is a certified modular approved transmitter (LILY-W131) from u-blox AG with a Blackhawk M2M Puck Antenna (BH-MM-101) in dedicated host device manufactured by Fleet Space Technologies.

5.1 EUT (Transmitter) Details

| | |
|-----------------------------|--|
| Radio: | u-blox WLAN module (LILY-W131) |
| Number of Channels: | 11 |
| Frequency Band: | 2400 – 2483.5 MHz Low Channel: 2412 MHz |
| Operating Frequency: | Mid Channel: 2437 MHz High Channel: 2462 MHz |
| Modulation: | 802.11b: CCK, DQPSK, DBPSK 802.11g: OFDM 802.11n: OFDM |
| Antenna: | Blackhawk M2M Puck Antenna (BH-MM-101) |
| Antenna Peak Gain: | 3 dBi @ 2400 – 2500 MHz |

5.2 EUT (Host) Details

| | |
|-----------------------|--|
| Test Sample: | Fleet Portal |
| Model: | FSPOR0201-2 |
| Variant Model: | FSPOR0201-3 |
| Supply Plug: | Meanwell AC/DC Switching Adaptor Model No: GST60A12 Input: 100-240VAC, 50/60Hz Output: 12VDC, 5.0A, 60W Max |

5.3 Test Configuration

Testing was performed with the transceiver set to transmit continuously at the specified channels as per Test Mode in Section 1.

Transmit Power Settings were set to maximum level.

5.4 Modifications

No modifications were required to achieve compliance.

5.5 Deviations from the Standard

No deviations from the standard.

6 RESULTS

6.1 §15.203 / §RSS-Gen 6.8 Antenna Requirement

The device has a SMA Female Connector and incorporates the following external antenna only:

Antenna: Blackhawk M2M Puck Antenna (BH-MM-101)

Antenna gain: 3 dBi @ 2400 – 2500 MHz

Antenna Connector: SMA Male Connector

Antenna port to antenna connection: SMA Female Connector

The above antenna will be installed by professional installers who have been trained by Fleet Space Technologies. Such installation shall be accomplished using only antennas and installation materials provided by Fleet Space Technologies. Fleet Space Technologies Said installation will preclude any unauthorized switching of antennas.

6.2 §15.207 / RSS-Gen 8.8 Conducted Limits

6.2.1 Test Procedure

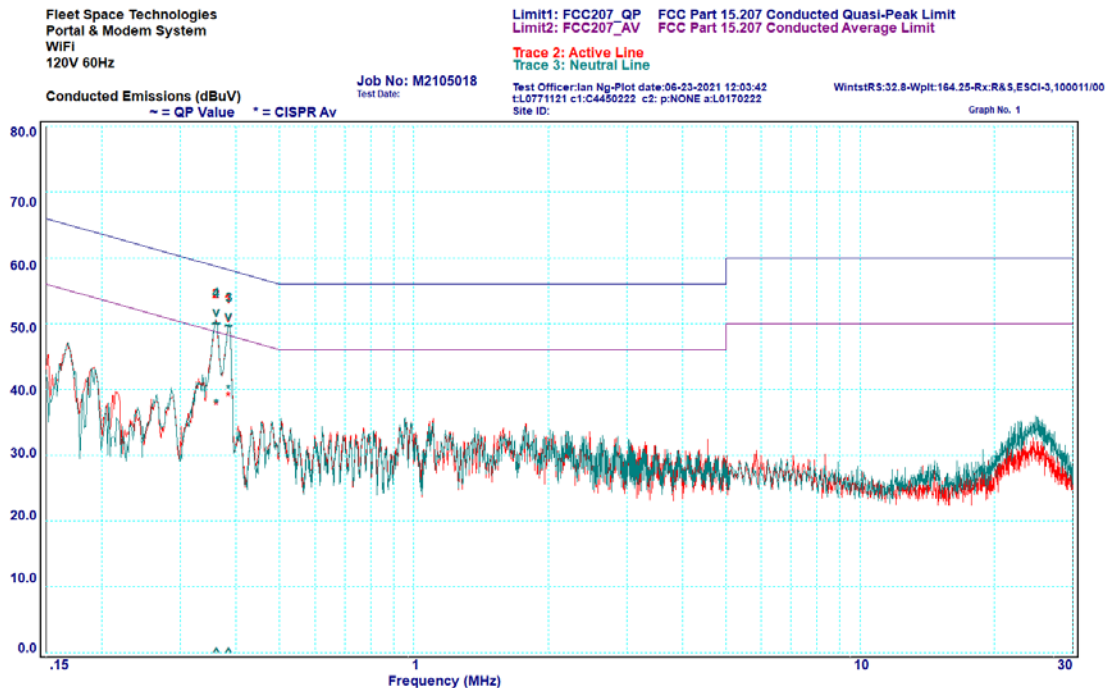
The arrangement specified in ANSI C63.10: 2013 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2: 2009 was used to perform the measurements.

The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

6.2.2 Limits

The limit applied was in accordance to the conducted limits defined in §15.207 / RSS-Gen 8.8.

6.2.3 Results



Graph 6-1: AC Conducted Emission

Table 6-1: AC Conducted Emission

| Peak | Frequency [MHz] | Line | Quasi-Peak | | | Average | | |
|------|-----------------|---------|--------------|--------------|-------------|--------------|--------------|-------------|
| | | | Level [dBµV] | Limit [dBµV] | Margin [dB] | Level [dBµV] | Limit [dBµV] | Margin [dB] |
| 1 | 0.384 | Active | 49.6 | 58.2 | -8.6 | 38.8 | 48.2 | -9.4 |
| 2 | 0.361 | Active | 49.9 | 58.7 | -8.8 | 37.5 | 48.7 | -11.2 |
| 3 | 0.385 | Neutral | 49.6 | 58.2 | -8.6 | 40 | 48.2 | -8.2 |
| 4 | 0.361 | Neutral | 49.9 | 58.7 | -8.8 | 37.8 | 48.7 | -10.9 |

6.3 §15.247(b)(3) / RSS-247 5.4(d) Peak Output Power

6.3.1 Test Procedure

The field strength of the fundamental transmitted frequency was measured inside a semi-anechoic chamber compliant with ANSI C63.4: 2014 in accordance to ANSI C63.10: 2013 clause 11.9.1.2.

The EUT was positioned on a test turn-table and rotated through 360° to determine the highest emissions. The measurement antenna was also varied between 1 and 4 metres height.

All measurements were made at 3 metres. Measurements on the worst EUT orientation and measurement antenna polarisation presented below.

6.3.2 Limits

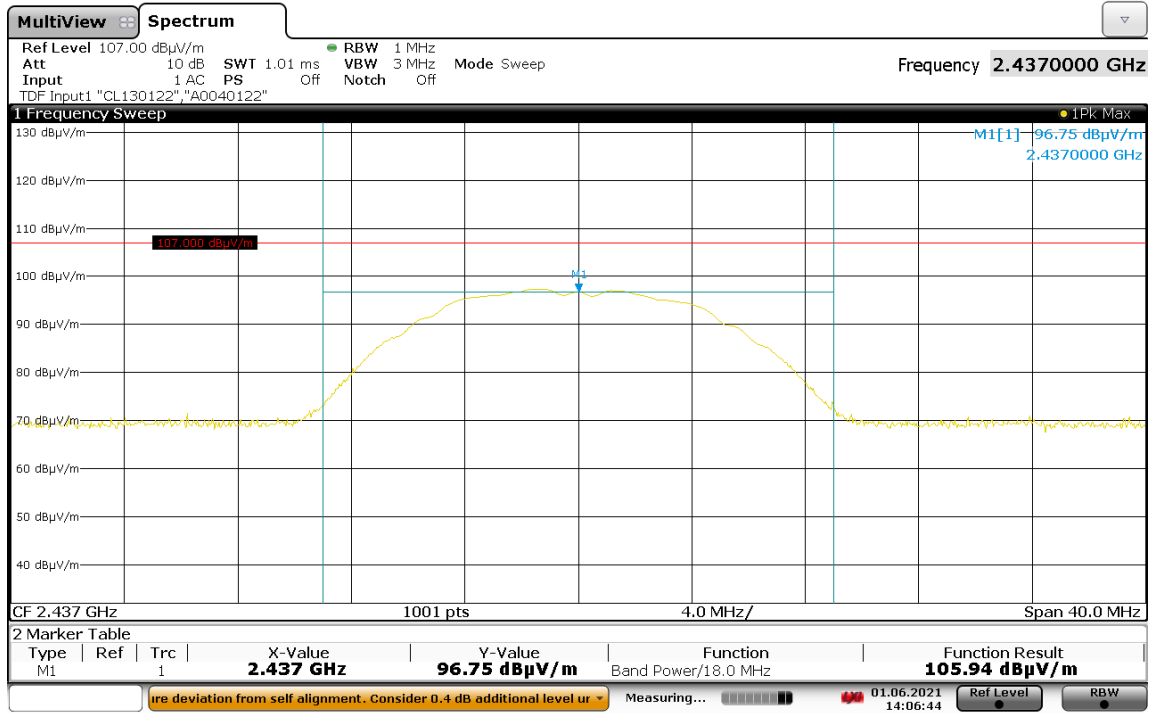
The maximum conducted output power at 2400 – 2483.5 MHz is 1 W or 30 dBm.

6.3.3 Results

The measured radiated field strength is converted to equivalent conducted output power for checking compliance (KDB 558074 D01 Section 3).

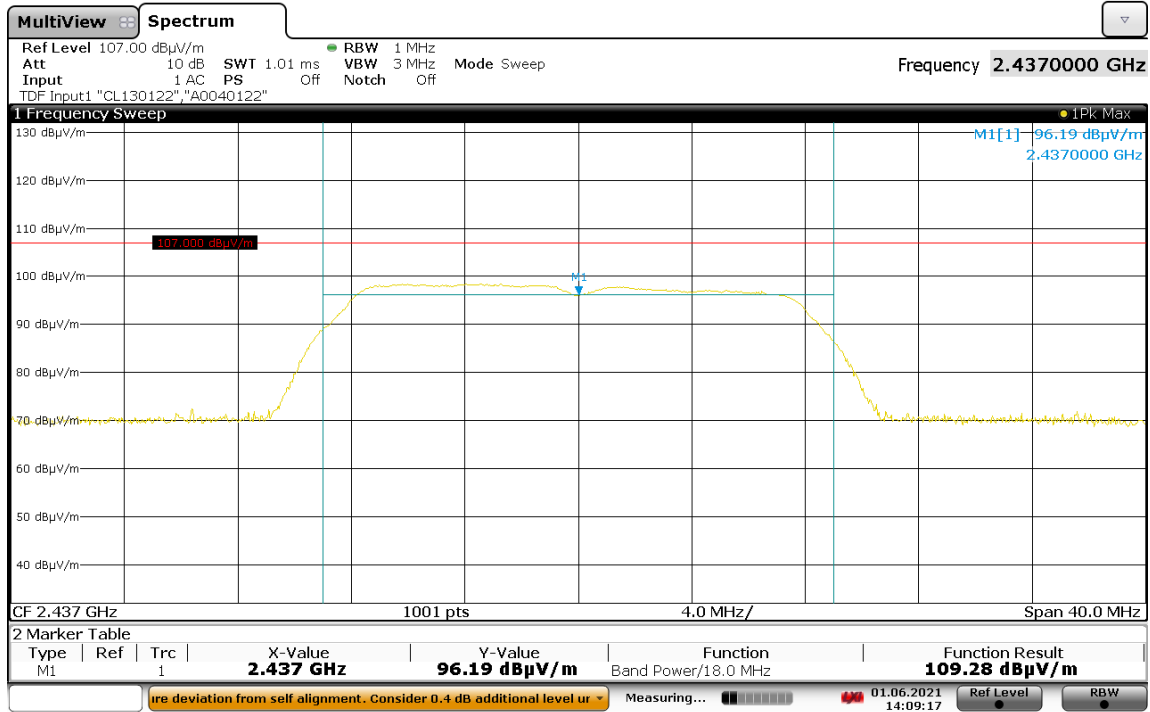
Table 6-2: Maximum EIRP

| Test Mode | Freq. [MHz] | E-Field@ 3 m dBuV/m | EIRP (dBm) | Antenna Gain (dBi) | Equivalent Conducted Output Power (dBm) | Limit (dBm) | Results |
|--------------|-------------|---------------------|------------|--------------------|---|-------------|----------|
| 1 (802.11 b) | 2437 | 105.94 | 10.71 | 3 | 7.71 | 30 | Complied |
| 2 (802.11g) | 2437 | 109.28 | 14.05 | 3 | 11.05 | 30 | Complied |
| 4 (802.11n) | 2437 | 109.41 | 14.18 | 3 | 11.18 | 30 | Complied |



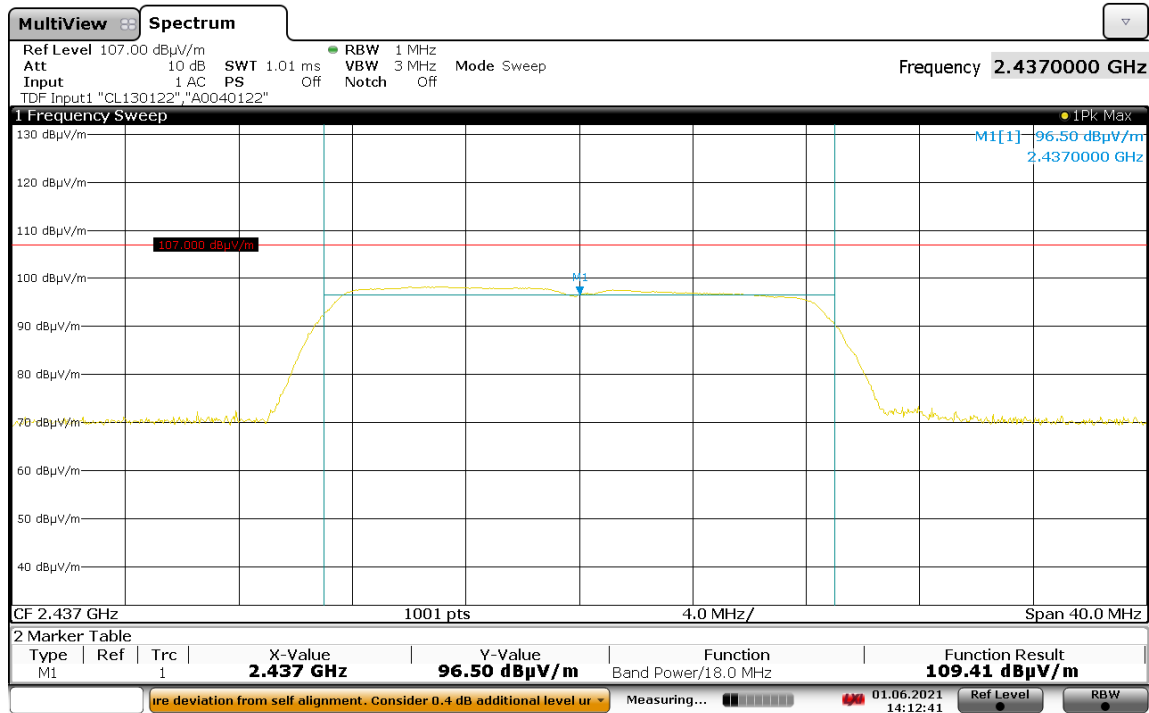
14:06:45 01.06.2021

Graph 6-2: Maximum EIRP, 802.11b 2437 MHz



14:09:17 01.06.2021

Graph 6-3: Maximum EIRP, 802.11g 2437 MHz



14:12:42 01.06.2021

Graph 6-4: Maximum EIRP, 802.11n 2437 MHz

6.4 §15.247(d) / RSS-247 5.5 Out-of-Band/Spurious Emissions

6.4.1 Test procedure

Radiated out-of-band/spurious emissions measurements were performed in a semi-anechoic chamber compliant with ANSI C63.4: 2014.

The test frequency range was sub-divided into smaller bands with the defined resolution bandwidths to permit reliable display and identification of emissions.

| Frequency range [MHz] | Measurement Bandwidth [kHz] | Measurement Distance [m] | Antenna |
|-----------------------|-----------------------------|--------------------------|---------------------------------|
| 0.009 to 0.150 | 0.2 | 3 | 0.6 metre loop antenna |
| 0.150 to 30 | 9 | 3 | |
| 30 to 1000 | 120 | 3 | Biconilog hybrid |
| 1000 to 18 000 | 1000 | 3 | Standard gain or broadband horn |
| 18 000 to 40 000 | 1000 | 1 | |

EUT was set at a height of 0.8 m for measurements below 1000 MHz and set at a height of 1.5 m for measurements above 1000 MHz.

The sample was slowly rotated with the spectrum analyser set to Max-Hold. This was performed for at least two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. For below 1000 MHz the emissions were measured with a Quasi-Peak detector, and for above 1000 MHz the emissions were measured with Peak and Average detectors.

The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical polarisations of the measurement antenna.

Measurements on the worst EUT orientation axis and data rate are presented below.

6.4.2 Limits

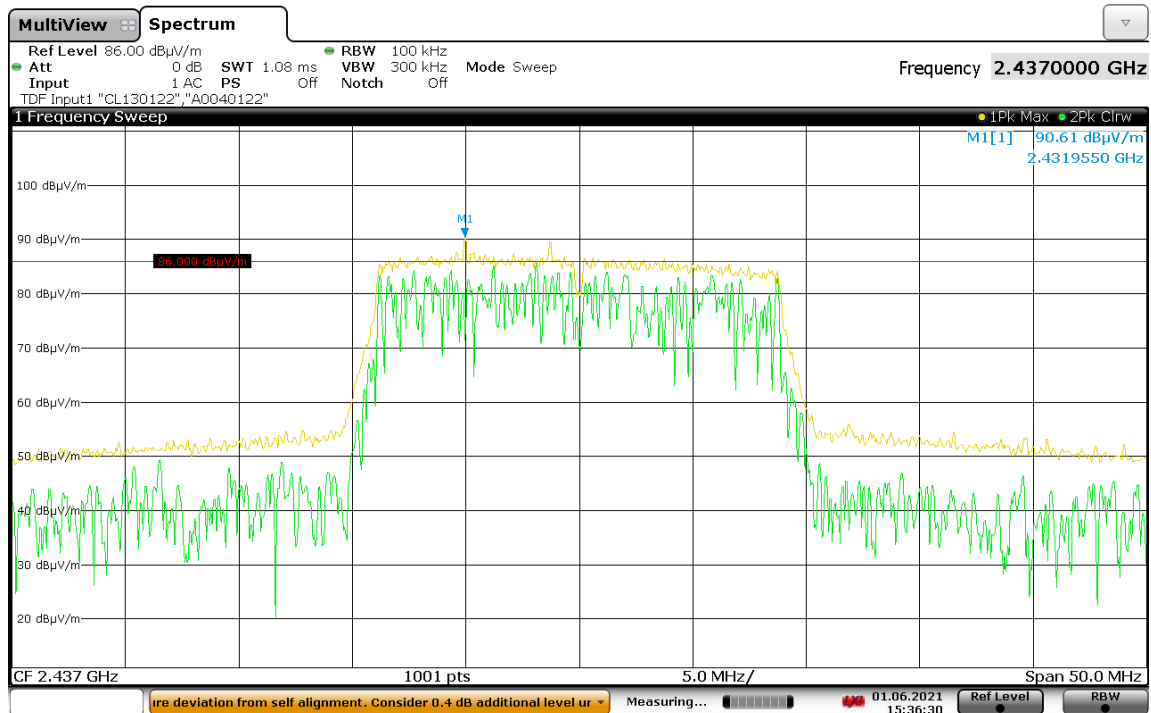
The limit applied is in accordance with the out-of-band/spurious emissions limit defined in §15.247(d).

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The in-band peak PSD in 100 kHz bandwidth were measured on all channels according to ANSI C63.10-2013 clause 11.11.2. The maximum PSD level was used to establish the limit for nonrestricted frequency bands. However, the general limits of §15.209 apply for the restricted bands of operation defined in §15.205. Attenuation below the general limits specified in § 15.209(a) is not required.

Table 6-3: 100 kHz reference level measurement, 802.11g 2437 MHz

| Freq. (MHz) | Peak at 3 m (dBµV/m) | Established Limit (dBµV/m) |
|-------------|----------------------|----------------------------|
| | | 9 kHz – 26 GHz |
| 2437 | 90.61 | As per §15.209 |

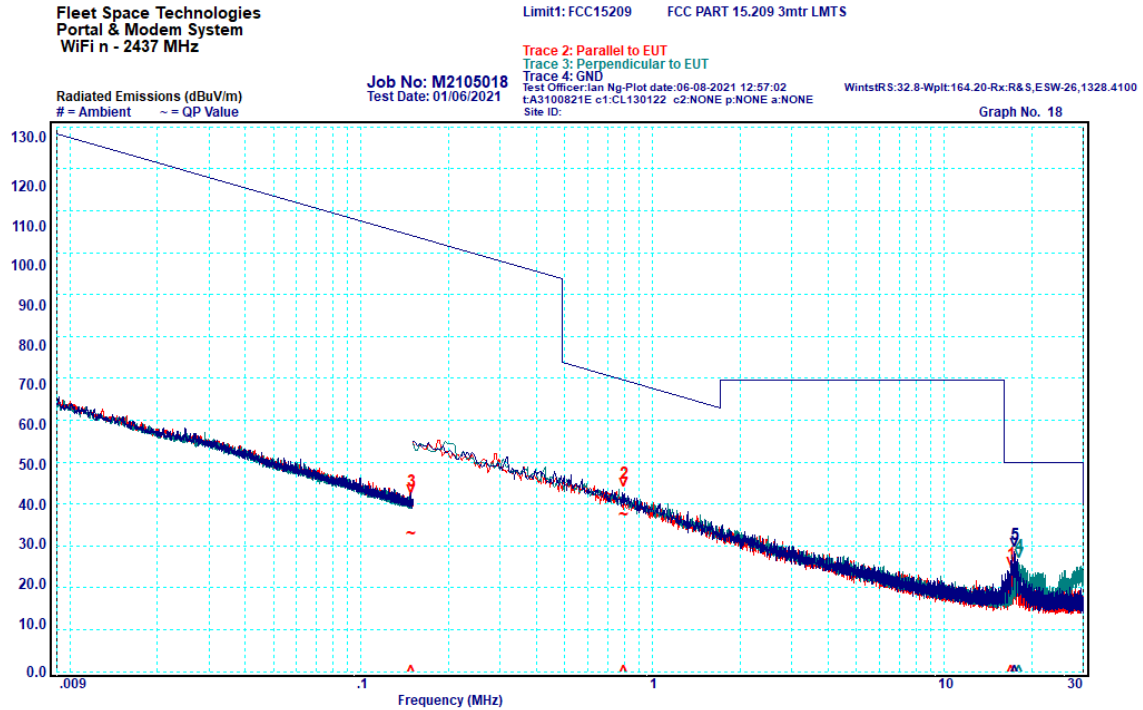


15:36:31 01.06.2021

Graph 6-5: 100 kHz reference level measurement, 802.11g 2437 MHz

6.4.3 Transmitter Spurious Emissions: 9 kHz to 30 MHz

All emissions measured in the frequency band 9kHz - 30MHz complied with the requirements of the standard.



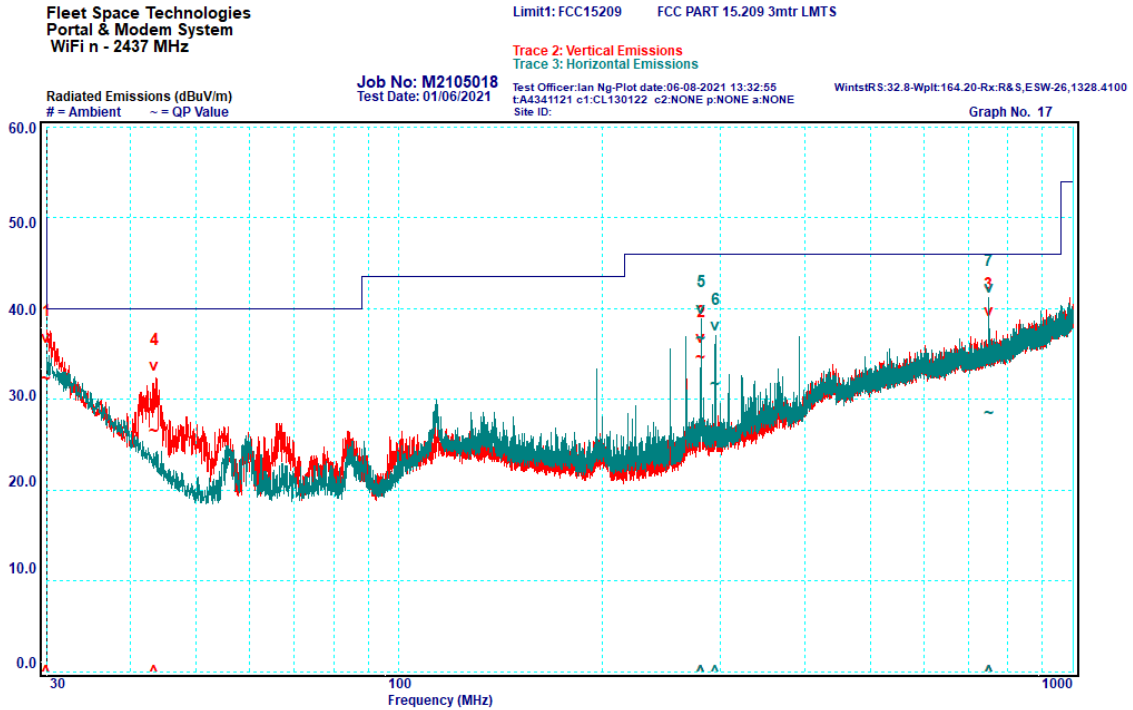
Graph 6-6: Transmitter Spurious Emissions, 9kHz – 30 MHz, 802.11n 2437 MHz

Table 6-4: Transmitter Spurious Emissions, 9kHz – 30 MHz, 802.11n 2437 MHz

| Peak | Frequency [MHz] | Polarisation | Quasi peak | | |
|------|-----------------|---------------|----------------------|----------------------|-------------|
| | | | Level [dB μ V/m] | Limit [dB μ V/m] | Margin [dB] |
| 1 | 17.04 | Parallel | 19.8 | 50 | -30.2 |
| 2 | 0.8 | Parallel | 37.4 | 69.6 | -32.2 |
| 3 | 0.149 | Perpendicular | 32.9 | 104.1 | -71.2 |
| 4 | 18.08 | Perpendicular | 22.1 | 50 | -27.9 |
| 1 | 17.04 | Ground | 25 | 50 | -25 |

6.4.4 Transmitter Spurious Emissions: 30 - 1000 MHz

All emissions measured in the frequency band 30 – 1000 MHz complied with the requirements of the standard.



Graph 6-7: Transmitter Spurious Emissions, 30 – 1000 MHz, 802.11n 2437 MHz

Graph 6-8: Transmitter Spurious Emissions, 30 – 1000 MHz, 802.11n 2437 MHz

| Peak | Frequency [MHz] | Polarisation | Quasi peak | | |
|------|-----------------|--------------|----------------|----------------|-------------|
| | | | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
| 1 | 30 | Vertical | 32.3 | 40 | -7.7 |
| 2 | 280.73 | Vertical | 34.6 | 46 | -11.4 |
| 3 | 750.05 | Vertical | 34 | 46 | -12 |
| 4 | 43.38 | Vertical | 26.5 | 40 | -13.5 |
| 5 | 280.55 | Horizontal | 36.6 | 46 | -9.4 |
| 6 | 294.58 | Horizontal | 31.6 | 46 | -14.4 |
| 7 | 750.11 | Horizontal | 28.5 | 46 | -17.5 |

6.4.5 Transmitter Spurious Emissions: 1 - 18 GHz

All emissions measured in the frequency band 1 – 18 GHz complied with the requirements of the standard.

Peak Measurements:

Fleet Space Technologies
Portal & Modem System
WIFI 802.11N 2437 MHz
PK

Limit1: FCC15209Pk FCC PART 15.209, 1-18GHz@3mtr, 18-40GHz@1mtr

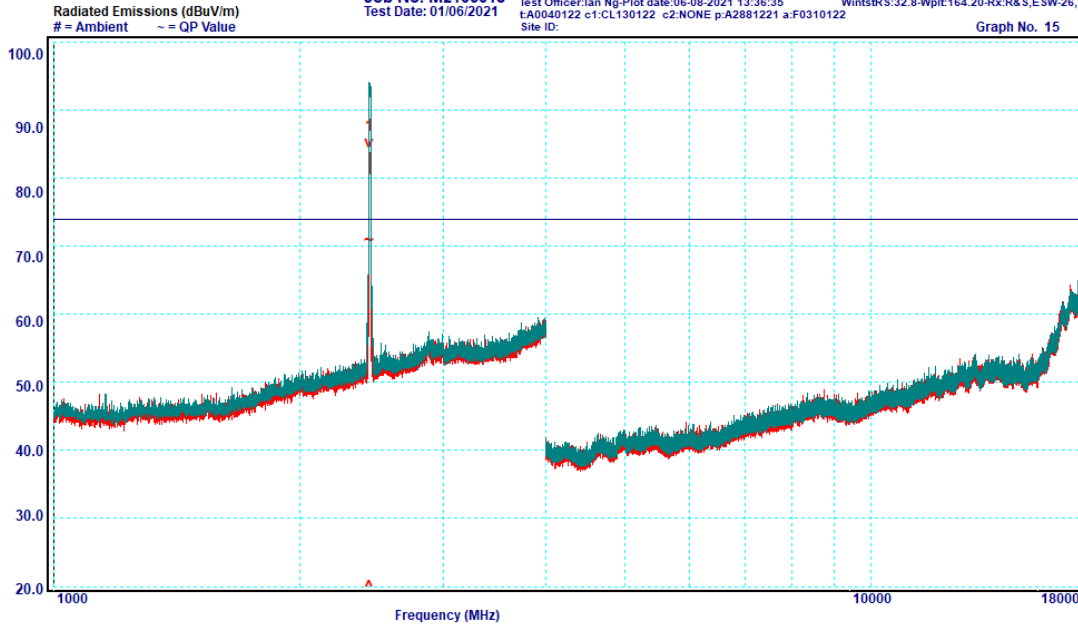
Trace 2: Vertical Emissions
Trace 3: Horizontal Emissions

Job No: M2105018

Test Date: 01/06/2021

Test Officer: Ian Ng-Plot date: 06-08-2021 13:36:35
LA0040122 c1:CL130122 c2:NONE p:A2881221 a:F0310122

WinstorRS:32.8-Wplt:164.20-Rx:R&S,ESW-26,1328.4100
Site ID:



Graph 6-9: Transmitter Spurious Emissions, 1 – 18 GHz, 802.11n 2437 MHz, Peak

*The Peak in the above plot is the fundamental transmission and is not subject to the spurious emissions limit of the standard.

Average Measurements:

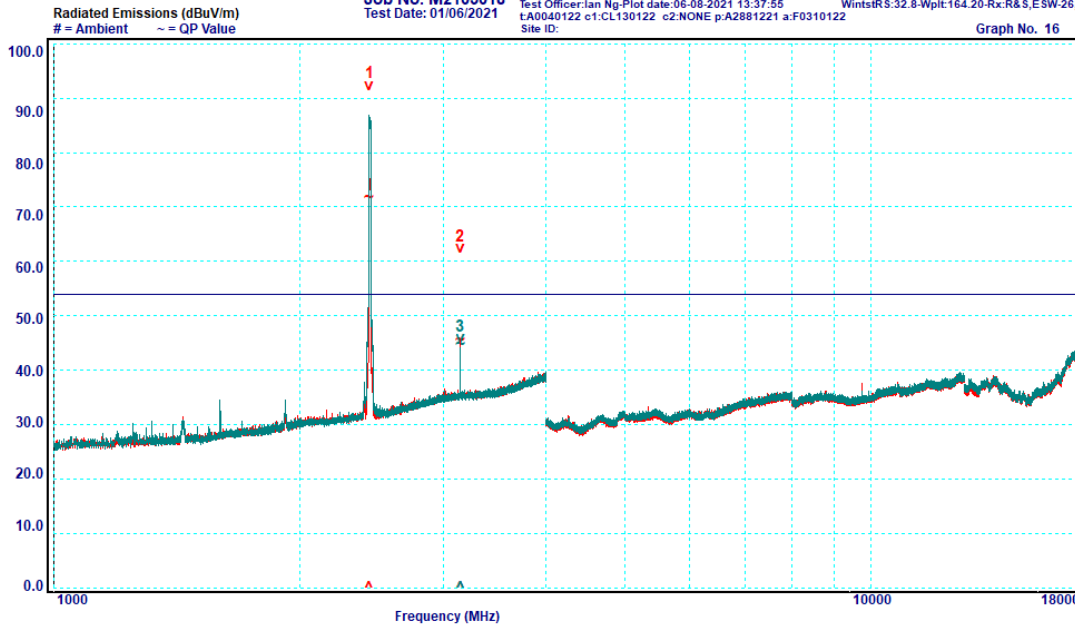
Fleet Space Technologies
Portal & Modem System
WIFI 802.11N 2437 MHz
AV

Limit1: FCC15209Av FCC PART 15.209, 1-18GHz@3mtr, 18-40GHz@1mtr

Job No: M2105018
Test Date: 01/06/2021

Trace 2: Vertical Emissions
Trace 3: Horizontal Emissions

Test Officer: Ian Ng Plot date: 06-08-2021 13:37:55 WinstatRS: 32.8-Wplt: 164.20-Rx: R&S, ESW-26, 1328.4100
t:A0040122 c1:CL130122 c2:NONE p:A2881221 a:F0310122
Site ID: Graph No. 16



Graph 6-10: Transmitter Spurious Emissions, 1 – 18 GHz, 802.11n 2437 MHz, Average

Table 6-5: Transmitter Spurious Emissions, 1 – 18 GHz, 802.11n 2437 MHz, Average

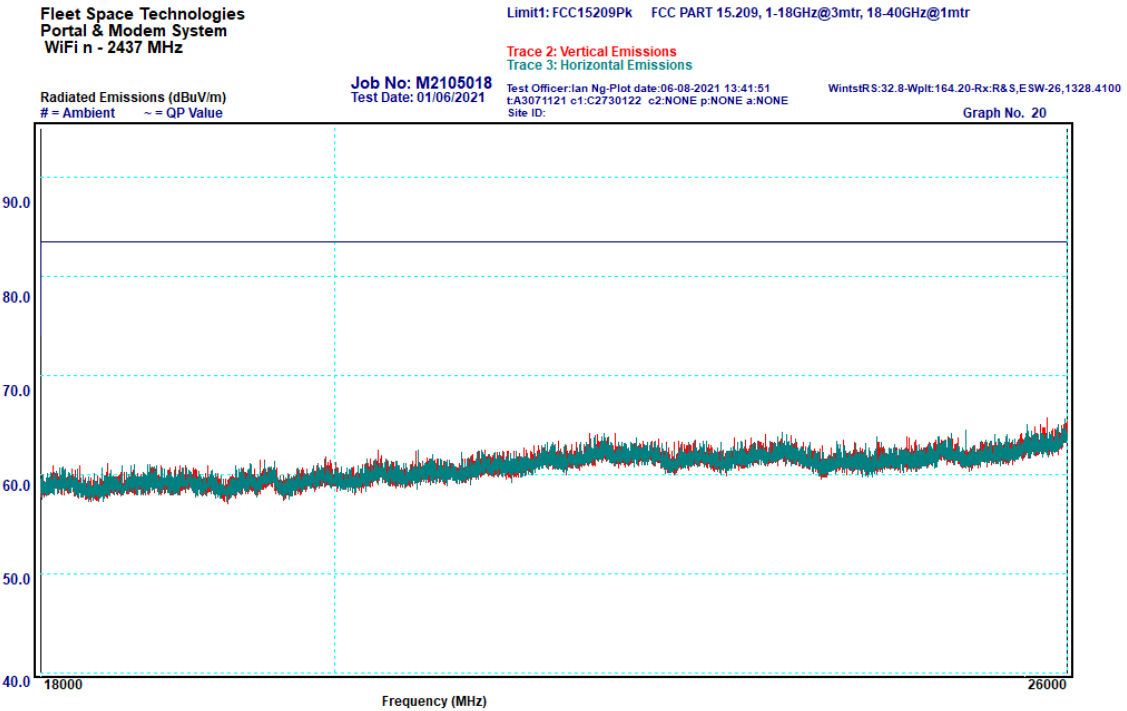
| Peak | Frequency [MHz] | Polarisation | Avg | | |
|------|-----------------|--------------|----------------|----------------|-------------|
| | | | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
| 1* | 2437 | Vertical | N/A | N/A | N/A |
| 2 | 3142.77 | Vertical | 45.6 | 54 | -8.4 |
| 3 | 3142.75 | Horizontal | 44.8 | 54 | -9.2 |

*Peaks 1 is the fundamental transmissions and is not subject to the spurious emissions limit of the standard.

6.4.6 Transmitter Spurious Emissions: 18 - 26 GHz

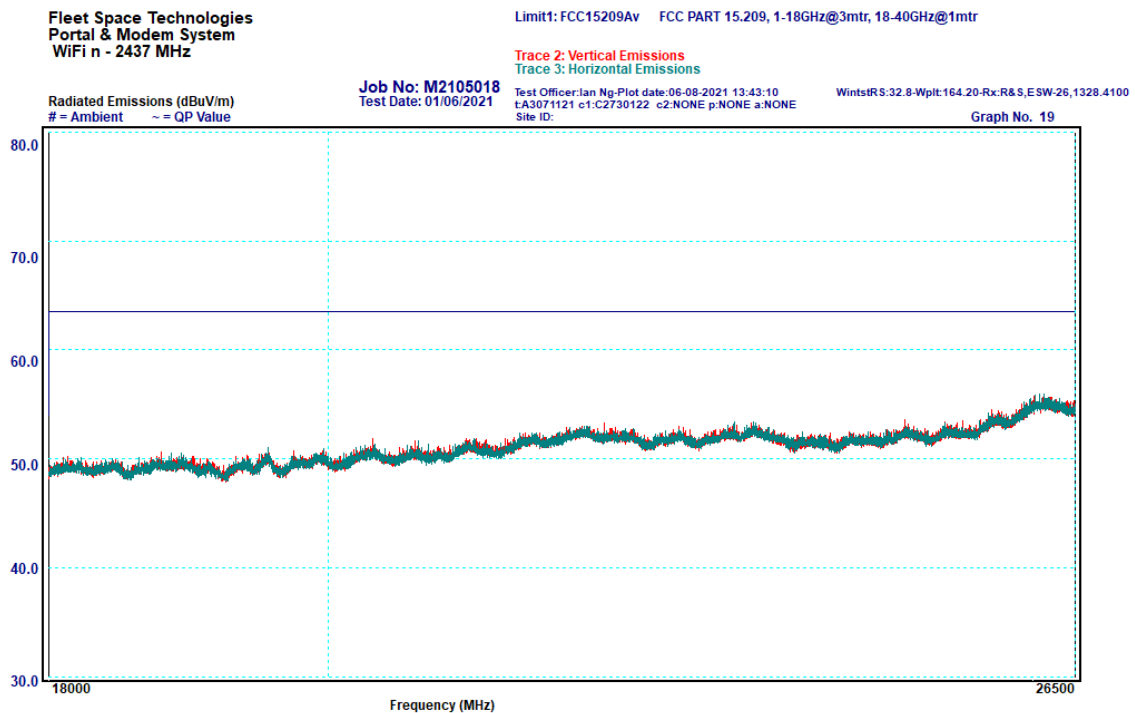
All emissions measured in the frequency band 18 – 26 GHz complied with the requirements of the standard. No peaks were measured within 10 dB of the limit.

Peak Measurements:



Graph 6-11: Transmitter Spurious Emissions, 18 – 26 GHz, 802.11n 2437 MHz, Peak

Average Measurements:



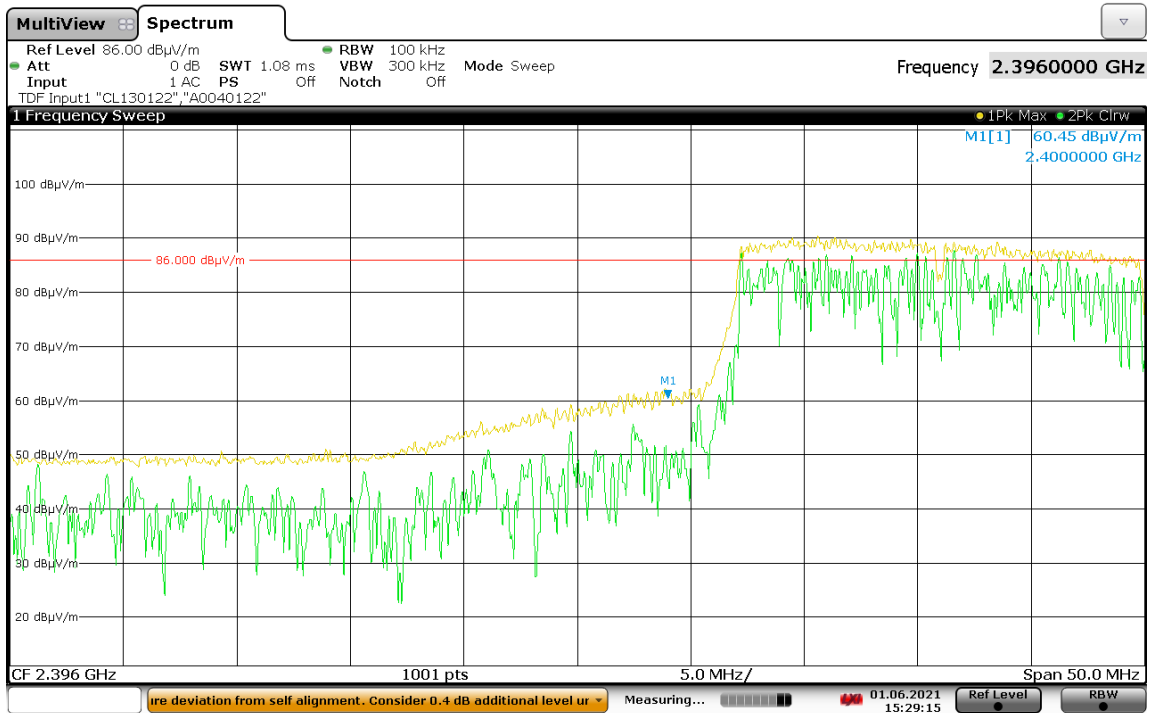
Graph 6-12: Transmitter Spurious Emissions, 18 – 26 GHz, 802.11n 2437 MHz, Average

6.5 §15.247(d) / RSS-247 5.5 Band Edge Emission Measurements

Band-edge measurements were done using radiated in accordance to ANSI C63.10 clause 11.13.1. All emissions measured near the lower and upper band edge complied with the requirements of §15.247 / RSS-247. Authorised-band band-edges were measured in the lower end and Restricted-band band-edges were measured in the upper end.

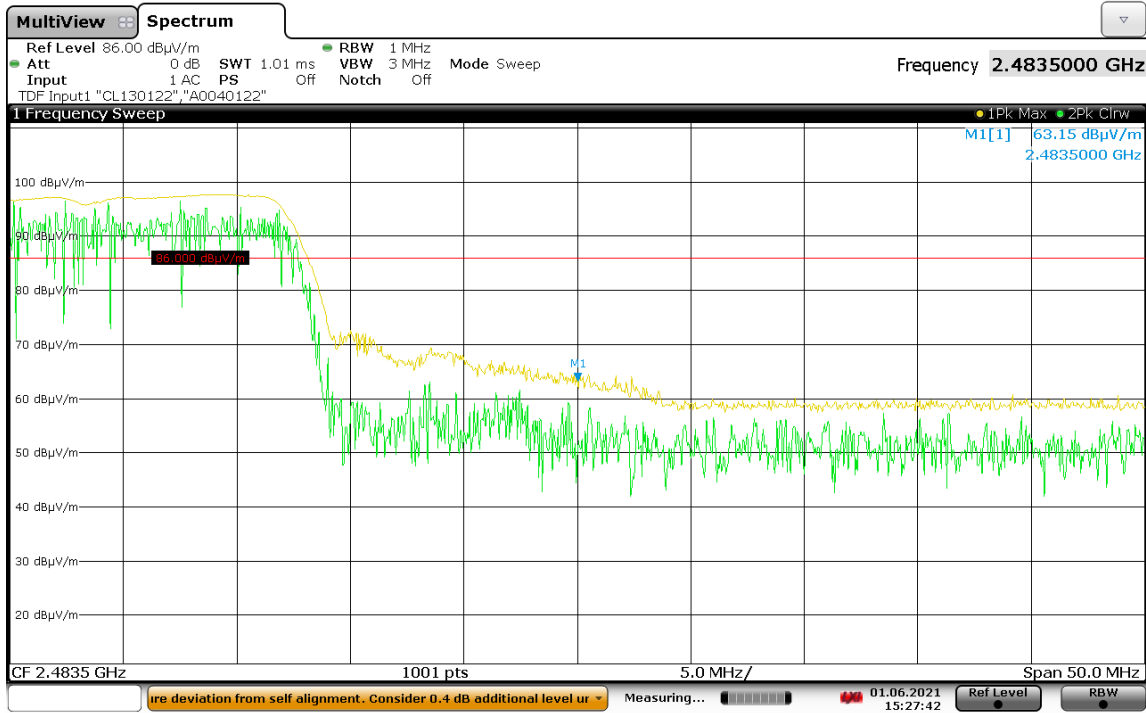
Table 6-6: Band Edge Measurement

| Test Mode | Measurement Type | Freq [MHz] | Measurement [dBuV/m] | Limit [dBuV/m] | Result |
|----------------|------------------|------------|----------------------|----------------|----------|
| 3 (802.11n) | Peak | 2400 | 60.45 | 74 | Complied |
| 5 (802.11n) | Peak | 2483.5 | 63.15 | 74 | Complied |
| | Average | 2483.5 | 49.03 | 54 | Complied |



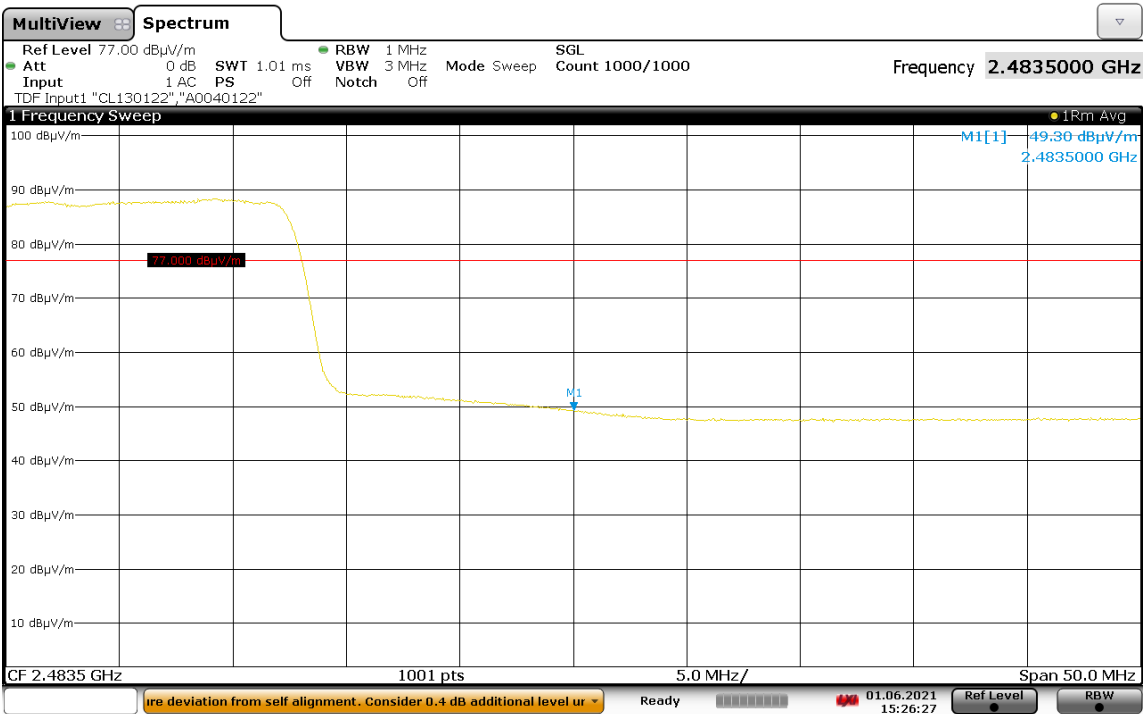
15:29:15 01.06.2021

Graph 6-13: Lower Band edge (Authorised-band), 802.1n 2412 MHz, Peak



15:27:42 01.06.2021

Graph 6-14: Upper Band edge (Restricted-band), 802.1n 2462 MHz, Peak



15:26:27 01.06.2021

Graph 6-15: Upper Band edge (Restricted-band), 802.1n 2462 MHz, Average

END OF REPORT