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RADIO COMPLIANCE REPORT

Certification Test Report

In accordance with:
CFR47 FCC Part 15, Subpart C, 15.231

Atmo Biosciences

CAP010ZZ

Atmo Gas Capsule System - Capsule

FCC ID: 2BA23-AGC1

REPORT: E2301-1620-4

DATE: May, 2023



Accreditation Number: 18553
Accredited for compliance with ISO/IEC 17025 - Testing

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Certificate of Compliance

Certification Compliance Report

EMC Bayswater Test Report: E2301-1620-4
Issue Date: May, 2023

Test Sample(s): Atmo Gas Capsule System - Capsule
Model No: CAP010ZZ
Serial No: 3000220, 3000228
FCC ID: 2BA23-AGC1
Customer Details: Mr. Ian Sohn
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Test Specification: CFR47 FCC Part 15, Subpart C, 15.231

Results Summary: FCC 15.203 - Antenna Requirement
FCC 15.231(a) - Transmitter Deactivation
FCC 15.231(c) - Emission Bandwidth
FCC 15.231(e) - Field strength of fundamental
FCC 15.231(e), 15.209 - Field strength of spurious emissions
FCC 15.231(e) - Timing Requirements

Complied
Not Applicable*
Complied
Complied
Complied
Complied

**EUT periodic operation rate exceeds the rate specified in paragraph (a) of 15.231. The EUT transmit at regular interval (every 20 second).*

Test Date(s): 13th to 23rd of January, 2023

**Test House
(Issued By):** EMC Bayswater Pty Ltd
18/88 Merrindale Drive
Croydon South
Victoria 3136
Australia

FCC Accredited Test Firm Registration number: 527798
FCC Accredited Test Firm Designation number: AU0004

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This is to certify that the necessary measurements were made by EMC Bayswater Pty Ltd, and that the Atmo Biosciences, CAP010ZZ, Atmo Gas Capsule System - Capsule, has been tested in accordance with requirements contained in the appropriate commission regulations.

Prepared & tested by:



Adnan Zaman
(EMC Test Engineer)

Approved by:



Neville Liyanapatabendige
(Manager)

04/05/2023 17:20

Date

Radio Compliance Report for Atmo Biosciences

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1. Introduction

Electromagnetic Compatibility (EMC) tests were performed on an Atmo Biosciences, CAP010ZZ, Atmo Gas Capsule System - Capsule in accordance with the requirements of Title 47 of the standard CFR47 FCC Part 15, Subpart C, 15.231.

2. Test Report Revision History

None

3. Report Information

EMC Bayswater Pty Ltd reports apply only to the specific samples tested under the stated test conditions. All samples tested were in good operating condition throughout the entire test program unless otherwise stated. EMC Bayswater Pty Ltd does not in any way guarantee the later performance of the product/equipment. It is the manufacturer's responsibility to ensure that additional production units of the tested model are manufactured with identical electrical and mechanical components. EMC Bayswater Pty Ltd shall have no liability for any deductions, inference or generalisations drawn by the clients or others from EMC Bayswater Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Bayswater Pty Ltd. This report shall not be reproduced except in full (with the exception of the certificate on page 2) without the written approval of EMC Bayswater Pty Ltd. This document may be altered or revised by EMC Bayswater Pty Ltd personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by EMC Bayswater Pty Ltd will nullify the document.

4. Summary of Results

The EUT complied with applicable requirements of CFR47 FCC Part 15, Subpart C, 15.231. Worst-case results are tabled as follows:

FCC sections	Test	Result
15.203	Antenna Requirement	Complied [#]
15.231(e)	Field strength of fundamental	Complied by 14.5dB
15.231(e) 15.209	Field strength of spurious emissions	Complied Peak limit by > 20.0dB Complied Average limit by > 20.0dB
15.231(c)	Emission Bandwidth	Complied

^{#1}The Antenna is permanently attached, internal to the device

Table 1: Summary of test results

5. Product Sample Details

5.1. EUT Description

The EUT (Equipment Under Test), as supplied by the client, is described as follows:

Product:	Atmo Gas Capsule System - Capsule	
Model No:	CAP010ZZ	
Serial No:	3000220, 3000228	
Part No:	PI-0081103-A	
Firmware:	v3.3.1-0-g29063da	
Dimensions:	Ø11.2 x 28 mm	
Weight:	3.7g	
EUT Type:	Tested as table-top	
Power Specifications:	Battery powered 3x1.5V SR920 silver oxide	
Transmitter details:	Description:	Sub-1GHz RF transceiver
	Part Number:	S2-LPQTR
	Max Transmit Power:	+10dBm
	Modulation Scheme:	2-GFSK
	Channels:	One
	Antenna Details:	Custom integrated flex

(Customer supplied product information)

(Refer to photographs in Annex A & B for views of the EUT)

5.2. Product description

The EUT (Equipment Under Test) has been described by the customer as follows:

“The Atmo Motility Gas Capsule System comprises an ingestible Capsule, Data Receiver, Mobile Device and a Clinician Portal. The Capsule measures temperature, relative humidity, hydrogen concentration, carbon dioxide concentration, along with indicators of fermentation activity, capsule tumble, and antenna reflectance. Measurements are transmitted from the Capsule within the gastrointestinal tract via radiofrequency communication to a Receiver that is worn by the patient. A Mobile Device with an Atmo software application is subsequently used to transfer received data to the Cloud for analysis via an online Portal.”

(Customer supplied product description information)

The highest frequency generated or used in the device or on which the device operates or tunes as specified by the customer is 433.9MHz.

5.3. Support Equipment

None.

5.4. Product operating modes

As per the customer supplied test plan, the mode of operation is:

Workflow D – Capsule standard configuration

(Customer supplied product operating mode information)

5.5. Product operating mode for testing

As per the customer supplied test plan, the mode of operation for testing is:

Workflow A - Radiated Emissions - Maximum radio transmission

Note: The items below run concurrently, not sequentially.

Item #	Description	Test start time (Relative to start of cycle) (s)	Cycle time
1	SampleVoc + TransmitTemp + TransmitConfig + TransmitRunTime	1	-
2	TransmitVoc	2	-
3	TransmitVoc	3	-
4	TransmitVoc	4	-
5	TransmitVoc	5	-
6	TransmitVoc	6	-
7	TransmitVoc	7	-
8	TransmitVoc	8	-
9	TransmitVoc	9	-
10	TransmitVoc	10	-

(Customer supplied product operating mode for testing information)

5.6. Configuration

The EUT was either configured by the customer or configured using the customer's instructions.

The EUT was powered by an internal battery. Firmware was configured to transmit continuously. As per the customer supplied test plan, Configuration 4 – Capsule TX to air (No receiver present).



Figure 1: Block diagram of EUT test configuration

5.7. Modifications

EMC Bayswater Pty Ltd did not modify the EUT.

6. Test Facility & Equipment

6.1. Test Facility

Tests were performed at the indoor Open Area Test Site (iOATS) at EMC Bayswater Pty Ltd, located at 18/88 Merrindale Drive, Croydon South, Victoria, 3136, Australia.

EMC Bayswater Pty Ltd FCC Test Firm registration number is 527798.

EMC Bayswater Pty Ltd FCC Test Firm Designation number is AU0004.

6.2. Test Equipment

Refer to Appendix A for the measurement instrument list.

7. Referenced Standards

CFR47 FCC Part 15, Subpart C, 15.231

CFR47 FCC Part 15, Subpart B

ANSI C63.10 - 2013

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

ANSI C63.4 - 2014

American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

FCC KDB - 558074 D01 15.247 Meas Guidance v05r02

8. Referenced Documents

Test Plan

Atmo Biosciences

515 Finch EMC Test Plan

Revision: 03

Date: 16/12/2022

9. Antenna Requirement – FCC Part 15.203

9.1. Requirements

As per section 15.203 of CFR47 FCC Part 15, Subpart C, 15.231:

- An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

9.2. Result

The EUT uses permanent, internally attached antenna which is etched into the PCB. Therefore, the EUT complied with the antenna requirements of CFR47 FCC Part 15, Subpart C, 15.231 Section 15.203.

10. Duty Cycle

Value	Declared by the manufacturer
Duty Cycle	Less than 10%

Table 2: Duty Cycle

Notes: The customer declared that the duty cycle is less than 10%.

The duty cycle correction factor was not used for any measured parameters (Field strength of fundamental and spurious emissions)

11. Timing Requirements – FCC Part FCC Part 15.231(e)

As specified in section 15.231(e) of CFR47 FCC Part 15, Subpart C, 15.231

“In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.”

The normal sample (Workflow D – Capsule standard configuration) measured timing values are tabulated below:

Parameter	Measured Value	Requirement	Result
Maximum Transmission ON time	350ms	Each transmission shall not be greater than one second	Complied
Transmission OFF time	19.65 seconds	No less than 10 seconds	Complied
OFF time/ON time	56.14	at least 30 times	

Table 3: Timing Requirements

Notes: Each transmission was not greater than one second therefore the EUT complied with the “duration of each transmission shall not be greater than one second” requirement.

the silent period between transmissions was greater than 30 times the duration of transmission and silent period was 19.65 seconds therefore the comply with the “silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds “requirement.

Assessment: The EUT complied with the Timing requirements of CFR47 FCC Part 15, Subpart C, 15.231(e).

12. Field strength of fundamental – FCC Part 15.231(e)

12.1. Test Procedure

The EUT was tested for Field strength of fundamental in accordance with FCC 47 CFR Part 15 Subpart C Radio frequency devices (Intentional Radiators).

Field strength of fundamental were measured 3 metres away from the EUT in the iOATS (indoor Open Area Test Site) facility, which is an ANSI C63.4 compliant semi-anechoic chamber with ground plane. The EUT was placed on a non-conductive support at a height of 0.8m above the ground plane.

For both horizontal and vertical antenna polarizations, the peak detector was set to MAX-HOLD and the range selected continuously scanned with 120kHz RBW and 300kHz VBW. The antenna height was varied from 1 to 4 metres and the turntable slowly rotated. The EUT was orientated in each of the X, Y and Z-axis, in-turn, to find the worst case emissions. The maximum emissions were recorded.

Plots of the accumulated measurement data for both horizontal and vertical antenna polarizations, including all transducer and other measuring system correction factors were produced using commercially available compliant software (as listed in the test equipment list of this report)

(Refer to photographs in Annex C for views of the test configuration)

12.2. Limits

The EUT shall meet the limits in the following table:

Fundamental frequency (MHz)	Field strength of fundamental ($\mu\text{V/m}$)
40.66 to 40.70	1,000 (60 dB $\mu\text{V/m}$)
70 to 130	500 (53.9 dB $\mu\text{V/m}$)
130 to 174	¹ 500 to 1,500 (63.9 to 63.5 dB $\mu\text{V/m}$)
174 to 260	1,500 (63.5 dB $\mu\text{V/m}$)
260 to 470	¹ 1,500 to 5000 (63.5 to 73.9 dB $\mu\text{V/m}$)
Above 470	5,000 (73.9 dB $\mu\text{V/m}$)

¹Linear interpolations.

Table 4: Limits for Field strength of fundamental at 3m distance

12.3. Test Results

Field strength of fundamental measurements are tabulated below:

(Refer to graphs 1 & 2 in Appendix C)

Measurement Antenna Polarisation	EUT Orientation	Frequency (MHz)	Result Peak (dBμV/m)	Limit Quasi-peak/Average (dBμV/m)	Delta Limit (dB)
Horizontal	Z	433.870	58.4	72.9	-14.5*
Vertical	X	433.870	57.8	72.9	-15.1

*Worst-case emissions

Table 5: Field strength of fundamental measurements

The measurement uncertainty was calculated as follows:

Measurement frequency range	Calculated measurement uncertainty
30MHz to 1000MHz	±4.65dB

The reported uncertainty is an expanded uncertainty calculated using a coverage factor of $k=2$ which gives a level of confidence of approximately 95%. The referenced uncertainty standard specifies that determination of compliance shall be based on measurements without taking into account measurement uncertainty. However, the measurement uncertainty shall appear in the test report.

Climatic Conditions	
Temperature:	20.9 to 22.3°C
Humidity:	43 to 44%
Atmospheric pressure:	1016.2 to 1019.3hPa

Table 6: Climatic conditions

Calculation: The above results are based upon the following calculation:

$$\begin{aligned}
 E \text{ (Peak)} &= V_{pk} + AF + L_C \\
 E \text{ (Average)} &= E \text{ (Peak)} - \text{Duty Cycle Correction Factor} \\
 \text{Where:} \\
 E &= \text{E-field in dB}\mu\text{V/m} \\
 V_{QP/PK/AV} &= \text{Measured Voltage (Peak) in dB}\mu\text{V} \\
 AF &= \text{Antenna Factor in dB/(m)} \\
 L_C &= \text{Cable and attenuator Loss in dB}
 \end{aligned}$$

Example calculation:

$$\begin{aligned}
 E \text{ (Peak)} &= V_{PK} + AF + L_C \\
 E \text{ (Peak)} &= 30\text{dB}\mu\text{V} + 12\text{dB/m} + 2.3\text{dB} \\
 E \text{ (Peak)} &= 44.3 \text{ dB}\mu\text{V/m} \\
 E \text{ (Average)} &= E \text{ (Peak)} - \text{Duty Cycle Correction Factor} \\
 E \text{ (Average)} &= 44.3 - 6 = 38.3 \text{ dB}\mu\text{V/m}
 \end{aligned}$$

Notes: The Field strength of fundamental measurements were below the specified limit.

Assessment: The EUT complied with the Field strength of fundamental requirements of CFR47 FCC Part 15, Subpart C, 15.231.

13. Field strength of spurious emissions – FCC Part 15.231(e)

13.1. Test Procedure

The Radiated Emissions were performed in accordance with the ANSI C63.10 - 2013.

Radiated Emissions were measured 3 metres (from 9kHz to 1GHz) away from the EUT in the iOATS (indoor Open Area Test Site) facility, which is an ANSI C63.4 compliant semi-anechoic chamber with ground plane. The EUT was placed on a non-conductive support at a height of 0.8m above the ground plane.

In the frequency range of 9kHz to 30MHz, an Active loop antenna was used. For X (parallel), Y (perpendicular) and Z (ground-parallel) antenna polarizations, the peak detector was set to MAX-HOLD and the range selected continuously scanned. The measuring antenna was positioned at 1m fixed height and the turntable slowly rotated. The peak preview measurements were performed with a resolution bandwidth of 200 Hz (9kHz to 150kHz), 9kHz (150kHz to 30MHz) and a video bandwidth of 30 kHz. Peak emissions that exceeded the limit or were close to the applicable limit were investigated further. The frequency of each emissions was then accurately determined. Each emission of interest was then in-turn maximised by using the turntable to rotate the EUT through 360 degrees to find the worst-case emission arrangement. Quasi peak measurements were then performed using a measuring time of no less than 15 seconds. The final quasi-peak measurements were performed using a receiver bandwidth of 6dB and a resolution bandwidth of 200 Hz (9kHz to 150kHz) and 9kHz (150kHz to 30MHz).

In the frequency range of 30MHz to 1GHz, a Biconilog antenna was used. For both horizontal and vertical antenna polarizations, the peak detector was set to MAX-HOLD and the range selected continuously scanned. The measuring antenna was positioned at 4 different fixed height positions and the turntable slowly rotated. The peak preview measurements were performed with a resolution bandwidth of 120 kHz and a video bandwidth of 300 kHz. Peak emissions that exceeded the limit or were close to the applicable limit were investigated further. The frequency of each emissions was then accurately determined. Each emission of interest was then in-turn maximised by using the turntable to rotate the EUT through 360 degrees and varying the height of the antenna between 1 and 4 metres to find the worst-case emission arrangement. Quasi peak measurements were then performed using a measuring time of no less than 15 seconds. The final quasi-peak measurements were performed using a receiver bandwidth of 6dB and a resolution bandwidth of 120 kHz.

In the frequency range 1.0GHz to 4.5GHz a Horn antenna was used and an area of 3m x 3m was covered between the antenna and the EUT using RF absorbing material with a rated attenuation more than 20dB over the frequency range. The EUT was placed on a non-conductive support at a height of 1.5m above the ground plane. The height of the horn antenna was varied using the antenna bore-sighting technique and the turntable slowly rotated to maximise the emissions. For both horizontal and vertical antenna polarizations, the Peak and Average preview measurements were performed with a resolution bandwidth of 1 MHz and a video bandwidth of 3MHz. Peak and average emissions that exceeded the applicable limit or were close to the applicable limit were investigated further. Each emission of interest was then in-turn maximised by using the turntable to rotate the EUT through 360 degrees and the antenna height varied (if applicable, using the antenna bore-sighting technique) to find the worst-case emission

arrangement. Peak and CISPR Average measurements were then performed using a measuring time of no less than 15 seconds, the maximum emission level in the observed duration was recorded as the final result. The final peak and CISPR Average measurements were performed using a receiver bandwidth of 6dB and a resolution bandwidth of 1 MHz. Peak and Average measurements were performed at spot frequencies where the peak or average emission was close to, or exceeded the applicable limit line with the EUT rotation and antenna height varied (if applicable, using the antenna bore-sighting technique) to produce the highest emission.

Plots of the accumulated measurement data for both horizontal and vertical antenna polarizations, including all transducer and other measuring system correction factors were produced using commercially available compliant software (as listed in the test equipment list of this report).

(Refer to photographs in Annex C for views of the test configuration)

13.2. Limits

CFR47 FCC Part 15, Subpart C, 15.231 (e) is applicable as the EUT periodic operation rate exceeds the rate specified in paragraph (a) of 15.231.

As per section 15.231 (e), in addition to the provisions of 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following.

Fundamental frequency (MHz)	Field strength of fundamental ($\mu\text{V/m}$)	Field strength of spurious emissions ($\mu\text{V/m}$)
40.66 to 40.70	1,000 (60 dB $\mu\text{V/m}$)	100 (40 dB $\mu\text{V/m}$)
70 to 130	500 (53.9 dB $\mu\text{V/m}$)	50 (33.9 dB $\mu\text{V/m}$)
130 to 174	¹ 500 to 1,500 (63.9 to 63.5 dB $\mu\text{V/m}$)	¹ 50 to 150 (33.9 to 43.5 dB $\mu\text{V/m}$)
174 to 260	1,500 (63.5 dB $\mu\text{V/m}$)	150 (43.5 dB $\mu\text{V/m}$)
260 to 470	¹ 1,500 to 5000 (63.5 to 73.9 dB $\mu\text{V/m}$)	¹ 150 to 500 (43.5 to 53.9 dB $\mu\text{V/m}$)
Above 470	5,000 (73.9 dB $\mu\text{V/m}$)	500 (53.9 dB $\mu\text{V/m}$)

¹Linear interpolations.

Table 7: Limits for Radiated Spurious Emissions at distance of 3m – 15.231(e)

As per section 15.231(e), the limits on the field strength of the spurious emissions in the below table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in above table 6 or to the general limits shown in 15.209, whichever limit permits a higher field strength.

Frequency Range (MHz)	Limits at 3m (dB μ V/m)
0.009 to 0.490	128.5 to 93.8
0.490 to 1.705	73.8 to 62.9
1.705 to 30.0	69.5
30.0 to 88.0	40.0
88.0 to 216.0	43.5
216.0 to 960.0	46.0
Above 960	54.0
NOTE: The lower limit shall apply at the transition frequency.	

Table 8: Limits for Radiated Spurious Emissions at distance of 3m – 15.209

Frequency Range (MHz)	Limits at 3m (dB μ V/m)
30.0 to 4500.0	52.9
NOTE: The lower limit shall apply at the transition frequency.	

Table 9: Limits for Radiated Spurious Emissions at distance of 3m – 15.231(e) -20dB Field strength of Fundamental

13.3. Test Results

Radiated Emissions measurements are tabulated below. For below 1GHz measurements, Quasi-peak or Average measurements were performed at spot frequencies where the peak emission was close to, or exceeded the applicable limit line. For above 1GHz measurements, Peak or Average measurements were performed at spot frequencies where the peak or average emission was close to, or exceeded the applicable limit line.

(Refer to graphs 3 to 9 in Appendix C)

Measurement Antenna Polarisation	Frequency (MHz)	Result peak (dB μ V/m)	Limit Quasi-peak/ Average (dB μ V/m)	Delta limit (dB)
X	Peak preview emissions >20dB below limit or no significant emissions above the noise floor observed			
Y	Peak preview emissions >20dB below limit or no significant emissions above the noise floor observed			
Z	Peak preview emissions >20dB below limit or no significant emissions above the noise floor observed			

Table 10: Field strength of spurious emissions – 9kHz to 30MHz

Measurement Antenna Polarisation	EUT Orientation	Frequency (MHz)	Result Quasi-peak (dB μ V/m)	Limit Quasi-peak/Average (dB μ V/m)	Delta Limit (dB)
Horizontal	Z	37.760 [#]	20.0	40.0	-20.0
		613.261 [#]	27.7	46.0	-18.3*
		862.891	30.8	52.9	-22.1
		976.672 [#]	32.1	54.0	-21.9
Vertical	X	37.518 [#]	20.3	40.0	-19.7
		609.478 [#]	27.6	46.0	-18.4
		866.237	30.8	52.9	-22.1
		968.281 [#]	32.0	54.0	-22.0

**Worst-case emissions*

[#]Within the restricted band

Table 11: Field strength of spurious emissions – 30MHz to 1GHz

Measurement Antenna Polarisation	Peak Measurements				Average Measurements			
	Frequency (MHz)	Result (dB μ V/m)	Limit (dB μ V/m)	Delta Limit (dB)	Frequency (MHz)	Result (dB μ V/m)	Limit (dB μ V/m)	Delta Limit (dB)
Horizontal	Peak emissions were not above the measurements system noise floor or at least 20dB below the limit				Average emissions were not above the measurements system noise floor or at least 20dB below the limit			
Vertical	Peak emissions were not above the measurements system noise floor or at least 20dB below the limit				Average emissions were not above the measurements system noise floor or at least 20dB below the limit			

Table 12: Field strength of spurious emissions – 1GHz to 4.5GHz

The measurement uncertainty was calculated as follows:

Measurement frequency range	Calculated measurement uncertainty
0.009MHz to 30MHz	± 4.33 dB
30MHz to 1GHz	± 4.65 dB
1GHz to 6GHz	± 4.83 dB

The reported uncertainty is an expanded uncertainty calculated using a coverage factor of $k=2$ which gives a level of confidence of approximately 95%. The referenced uncertainty standard specifies that determination of compliance shall be based on measurements without taking into account measurement uncertainty. However, the measurement uncertainty shall appear in the test report.

Climatic Conditions	
Temperature:	20.9 to 22.3°C
Humidity:	43 to 44%
Atmospheric pressure:	1016.2 to 1019.3hPa

Table 13: Climatic conditions

Calculation: The above results are based upon the following calculation:

$$\begin{aligned} E (\text{Peak}) &= V_{pk} + AF + L_C \\ E(\text{Average}) &= E(\text{Peak}) - \text{Duty Cycle Correction Factor} \end{aligned}$$

Where:

$$\begin{aligned} E &= \text{E-field in dB}\mu\text{V/m} \\ V_{QP/PK/AV} &= \text{Measured Voltage (Peak) in dB}\mu\text{V} \\ AF &= \text{Antenna Factor in dB/(m)} \\ L_C &= \text{Cable and attenuator Loss in dB} \end{aligned}$$

Example calculation:

$$\begin{aligned} E (\text{Peak}) &= V_{pk} + AF + L_C \\ E (\text{Peak}) &= 30\text{dB}\mu\text{V} + 12\text{dB/m} + 2.3\text{dB} \\ E (\text{Peak}) &= 44.3 \text{ dB}\mu\text{V/m} \\ E (\text{Average}) &= E(\text{Peak}) - \text{Duty Cycle Correction Factor} \\ E (\text{Average}) &= 44.3 - 6 = 38.3 \text{ dB}\mu\text{V/m} \end{aligned}$$

Notes: All Spurious Emissions measurements were below the permissible Spurious and general intentional radiator limits for the Average/Quasi peak detector and the peak detector emissions were below the peak limit.

Assessment: The EUT complied with the Radiated Spurious Emissions requirements of CFR47 FCC Part 15, Subpart C, 15.231.

14. Emission Bandwidth – FCC Part 15.231(c)

14.1. Test Procedure

The 20dB Emission Bandwidth was performed in accordance with the section 6.9 of ANSI C63.10 - 2013.

The EUT was placed on a polystyrene support at a height of 0.8m above the ground reference plane. The measuring antenna was located at a distance of 3m from the EUT, using the spectrum analyser. The worst-case transmitter orientation, measurement antenna polarization were used for each measurement. The spectrum analyzer centre frequency was tuned to the fundamental (transmit frequency) of the transmitter with span range between two times and five times the OBW (-20dB bandwidth). The nominal IF filter bandwidth (RBW) was set to 1% to 5% of the OBW and video bandwidth (VBW) was set to three times the RBW. The peak detector was used with trace mode to max hold. The resultant bandwidth measurement was recorded.

(Refer to photographs in Annex C for views of the test configuration)

14.2. Requirements

As per CFR47 FCC Part 15, Subpart C, 15.231:

- The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Center Frequency: 433.870MHz

14.3. Test Results

Emission Bandwidth measurements are tabulated below:

(Refer to graph 10 in Appendix C)

Transmit center frequency (MHz)	Measured 20dB Bandwidth	Percentage of Measured Bandwidth with respect to Centre Frequency	Limit	Comment
433.870	0.1848MHz	0.04%	0.25%	Complied

Table 14: Results for 20dB Bandwidth

The measurement uncertainty was calculated as follows:

Measurement Parameter	Calculated measurement uncertainty
Operating Frequency	±10.5kHz
Bandwidth	±14.96kHz

The reported uncertainty is an expanded uncertainty calculated using a coverage factor of $k=2$ which gives a level of confidence of approximately 95%. The referenced uncertainty standard specifies that determination of compliance shall be based on

measurements without taking into account measurement uncertainty. However, the measurement uncertainty shall appear in the test report.

Climatic Conditions	
Temperature:	22.3°C
Humidity:	44%
Atmospheric pressure:	1019.3hPa

Table 15: Climatic conditions

Notes: The 20dB bandwidth of the emission was contained within 0.25% of 433.870MHz center frequency.

Assessment: The EUT complied with the Emission Bandwidth requirements of CFR47 FCC Part 15, Subpart C, 15.231(c).

15. Conclusion

The Atmo Biosciences, CAP010ZZ, Atmo Gas Capsule System - Capsule complied with the applicable requirements of CFR47 FCC Part 15, Subpart C, 15.231.

Appendix A – Test Equipment

Inv.	Equipment	Make	Model No.	Serial No.	Calibration		
					Interval	Due	Type
Field strength of fundamental & Emissions Bandwidth							
1217	ANALYSER, EMI Receiver	Rohde & Schwarz	ESU40	100182	1 year	Jun-23	E
0935	ANTENNA, Biconilog	Sunol Sciences	JB5	A071106	2 years	Feb-23*	E
0718	ATTENUATOR, 6dB	JFW	50FPE-006	-	1 year	Jan-24	I
0932	CONTROLLER, Position	Sunol Sciences	SC104V-3	081006-1	N/A	N/A	V
0933	TURNTABLE	Sunol Sciences	SM46C	081006-2	N/A	N/A	V
0934	MAST, Antenna	Sunol Sciences	TLT2	081006-5	N/A	N/A	V
0989	CABLE, Coax, Sucoflex 104A	Huber+Suhner	44454/4A	C357	1 year	Jan-24	I
1145	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84279564	SN MY056/4PA	1 year	Jan-24	I
1155	Hygrometer, Temp, Humidity	DigiTech	QM7312	-	2 years	Jul-23	I
0666	Enclosure, Semi-Anechoic, No 1	RFI Industries	S800 iOATS	1229	3 years	Aug-25	I
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 8.53.0	N/A	N/A	N/A
Field strength of spurious emissions 9kHz to 4500MHz							
1217	ANALYSER, EMI Receiver	Rohde & Schwarz	ESU40	100182	1 year	Jun-23	E
0935	ANTENNA, Biconilog	Sunol Sciences	JB5	A071106	2 years	Feb-23*	E
0718	ATTENUATOR, 6dB	JFW	50FPE-006	-	1 year	Jan-24	I
0633	ANTENNA, Double Ridge Horn	EMCO	3115	9712-5369	3 years	Aug-24	I
0559	PRE-AMP, Microwave, 18GHz	Miteq	AFS8	605305	1 year	Apr-23*	I
0932	CONTROLLER, Position	Sunol Sciences	SC104V-3	081006-1	N/A	N/A	V
0933	TURNTABLE	Sunol Sciences	SM46C	081006-2	N/A	N/A	V
0934	MAST, Antenna	Sunol Sciences	TLT2	081006-5	N/A	N/A	V
0989	CABLE, Coax, Sucoflex 104A	Huber+Suhner	44454/4A	C357	1 year	Jan-24	I
1145	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84279564	SN MY056/4PA	1 year	Jan-24	I
1238	CABLE, Coax, Sucoflex 126 E	Huber + Suhner	10422876	SN 8000495/126E	1 year	Jan-24	I
0024	ANTENNA, Active Loop	EMCO	6502	2620	2 years	Aug-23	I
1155	Hygrometer, Temp, Humidity	DigiTech	QM7312	-	2 years	Jul-23	I
0666	Enclosure, Semi-Anechoic, No 1	RFI Industries	S800 iOATS	1229	3 years	Aug-25	I
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 8.53.0	N/A	N/A	N/A

V: Verification of operation against an internal reference

I: Internal calibration against a traceable standard

E: External calibration by a NATA or MRA equivalent endorsed facility

N/A: Not Applicable

** Equipment calibration valid at the time of testing*

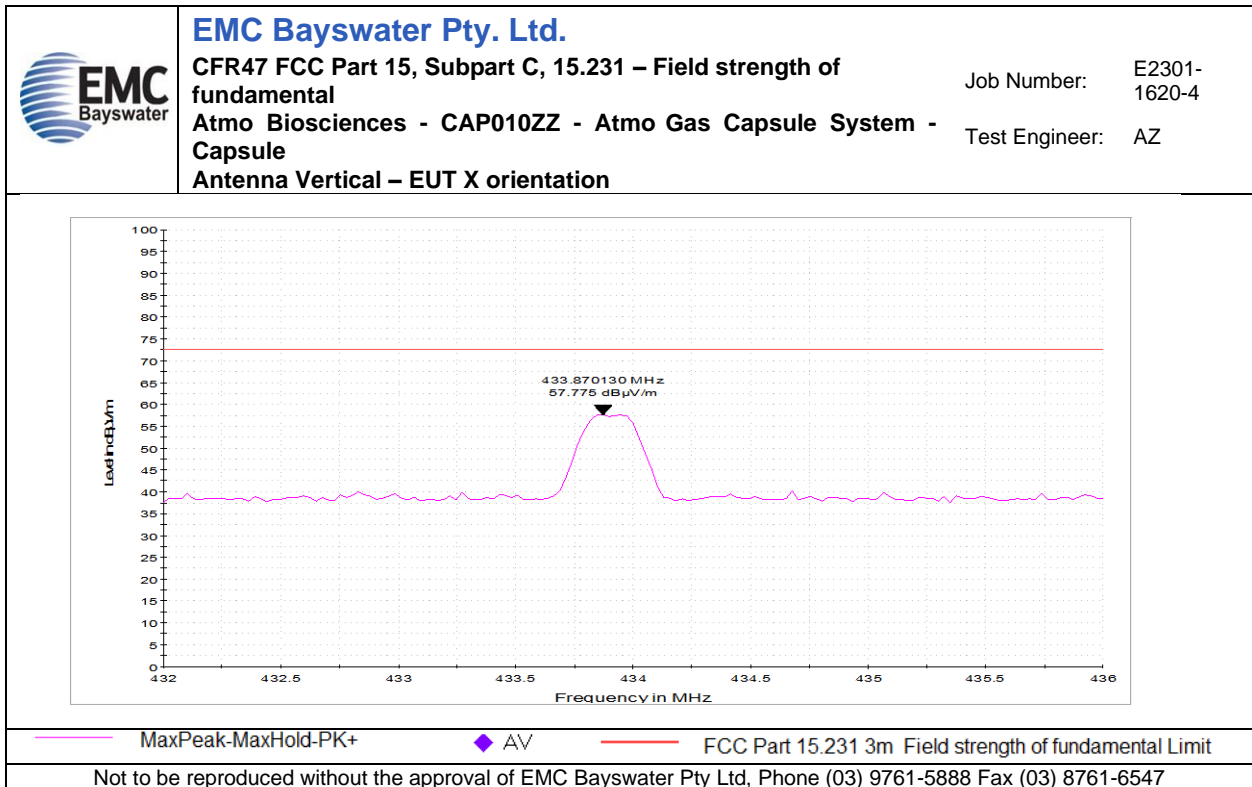
Appendix B – Photographs

Annex	Number	Photograph Description
A	1	EUT – External views
A	2	
A	3	
A	4	
A	5	
A	6	
B	1	EUT – Internal views
B	2	
B	3	
B	4	
B	5	
B	6	
B	7	
B	8	
B	9	
B	10	
C	1	EUT X orientation
C	2	EUT Z orientation
C	3	Field strength of fundamental and Emission Bandwidth – Test configuration
C	4	Field strength of spurious emissions – Test configuration – 30MHz to 1GHz
C	5	Field strength of spurious emissions – Test configuration – 9kHz to 30MHz
C	6	
C	7	
C	8	Field strength of spurious emissions – Test configuration – 1GHz to 4.5GHz
C	9	

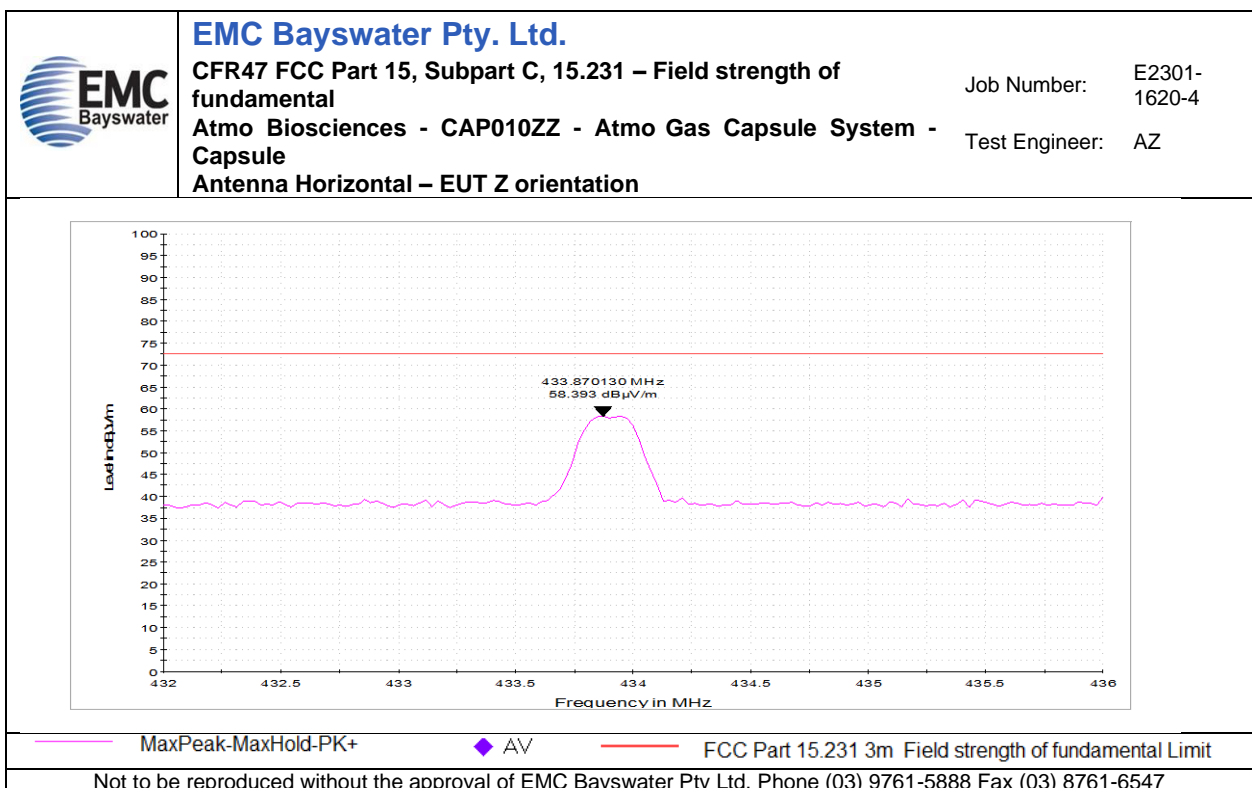
EUT External Photographs	EMC Bayswater Test Report E2301-1620-4 Annex A
EUT Internal Photographs	EMC Bayswater Test Report E2301-1620-4 Annex B
EUT Orientations & Test Configurations Photographs	EMC Bayswater Test Report E2301-1620-4 Annex C

Appendix C – Measurement Graphs

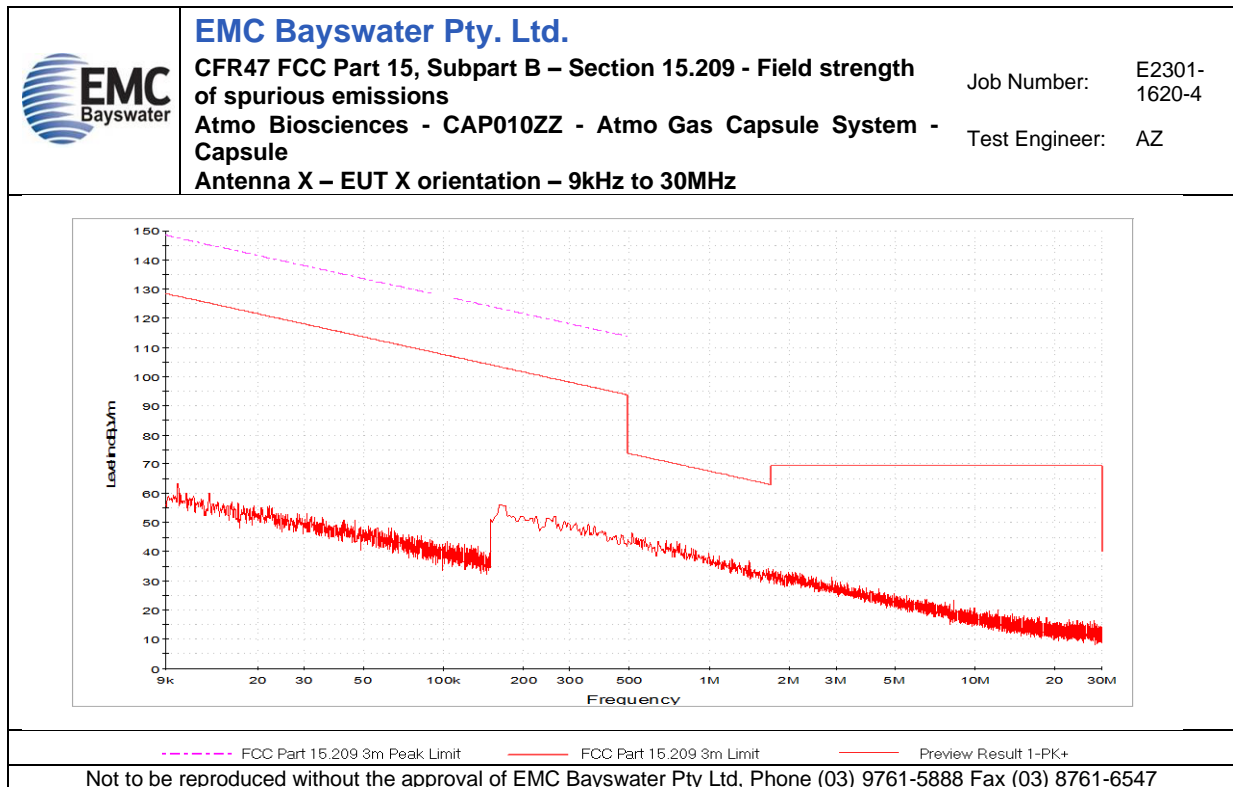
No.	Test	Graph Description
1	Field strength of fundamental	Antenna Vertical – EUT X orientation
2		Antenna Horizontal – EUT Z orientation
3	Field strength of spurious emissions	Antenna X – EUT X orientation – 9kHz to 30MHz
4		Antenna Y – EUT X orientation – 9kHz to 30MHz
5		Antenna Z – EUT X orientation – 9kHz to 30MHz
6		Vertical Antenna Polarisation – EUT X orientation – 30MHz to 1GHz
7		Vertical Antenna Polarisation – EUT X orientation – 1GHz to 4.5GHz
8		Horizontal Antenna Polarisation – EUT Z orientation – 30MHz to 1GHz
9		Horizontal Antenna Polarisation – EUT Z orientation – 1GHz to 4.5GHz
10	Emissions Bandwidth	



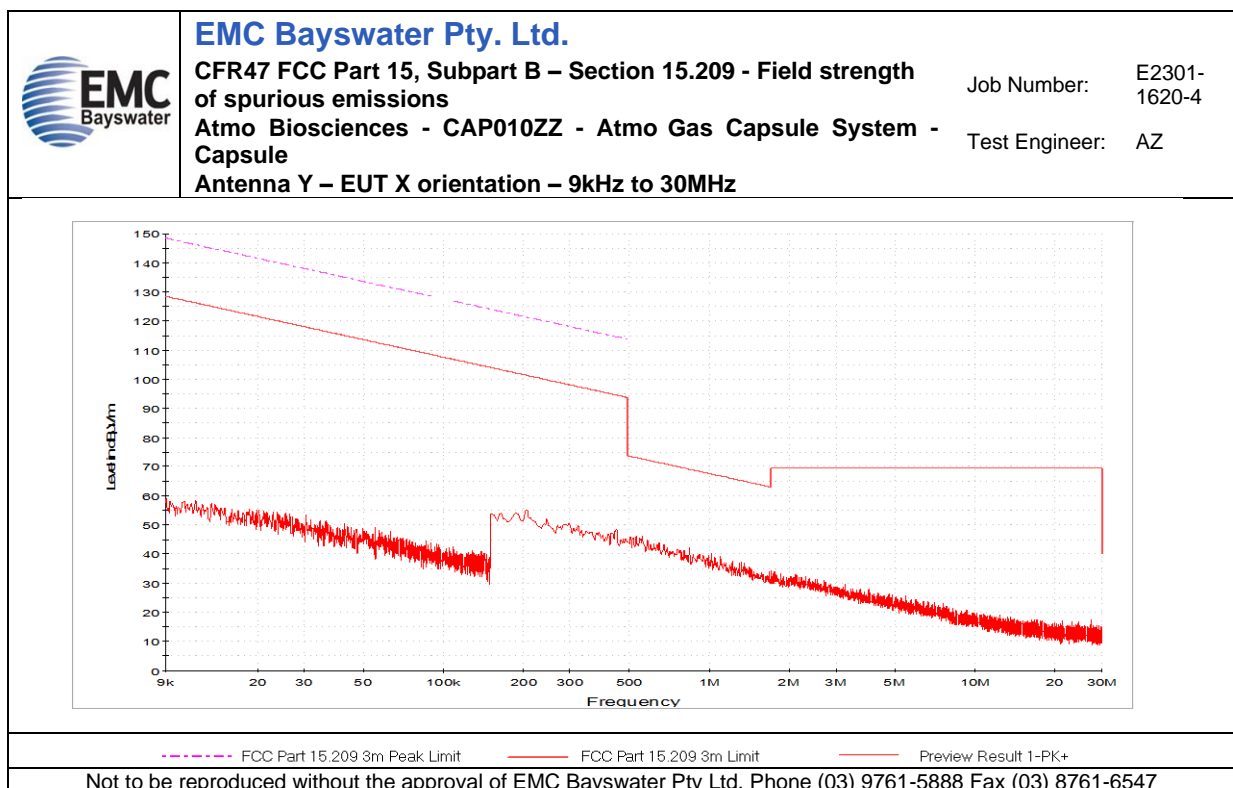
Graph 1



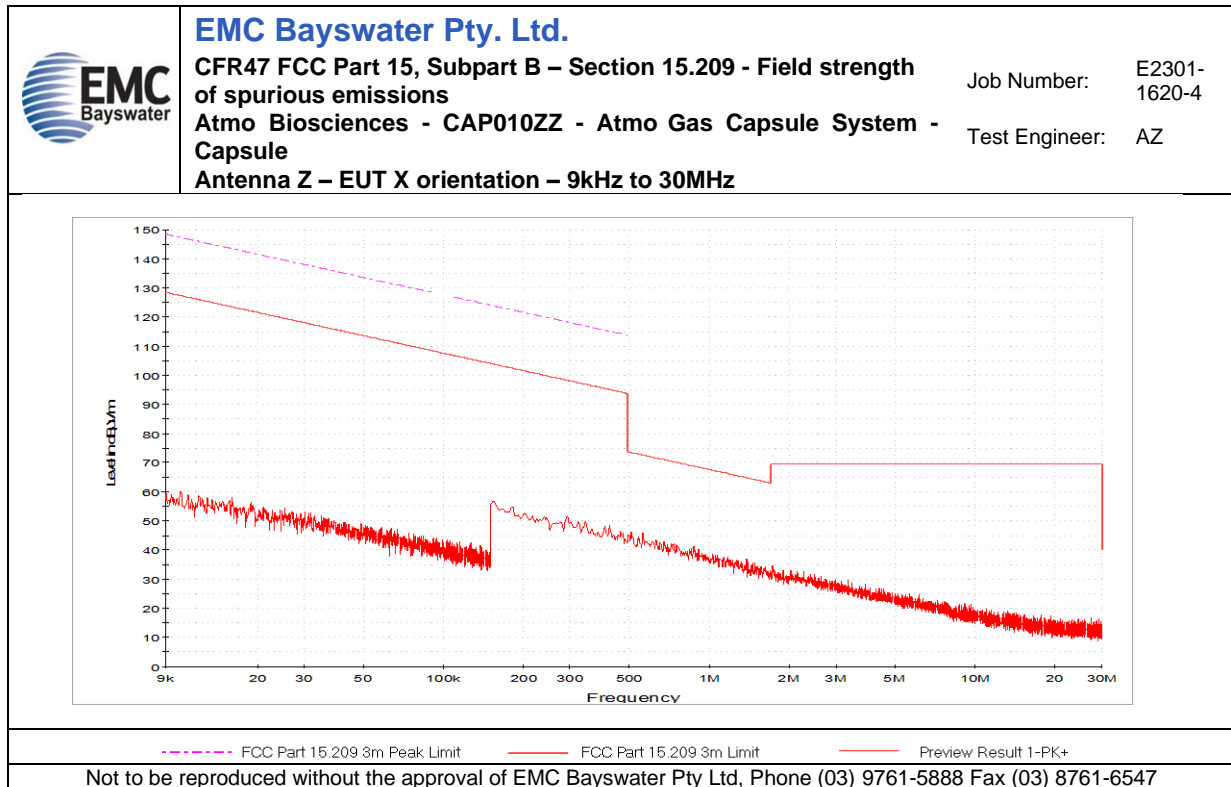
Graph 2



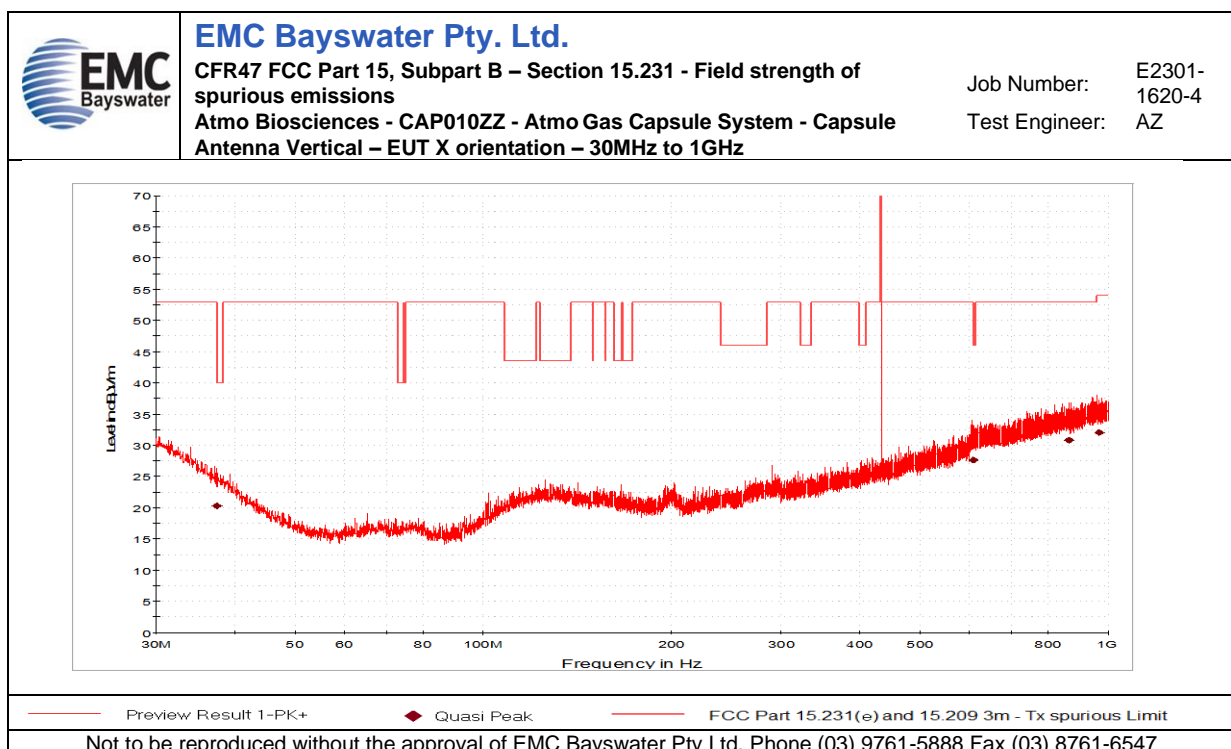
Graph 3



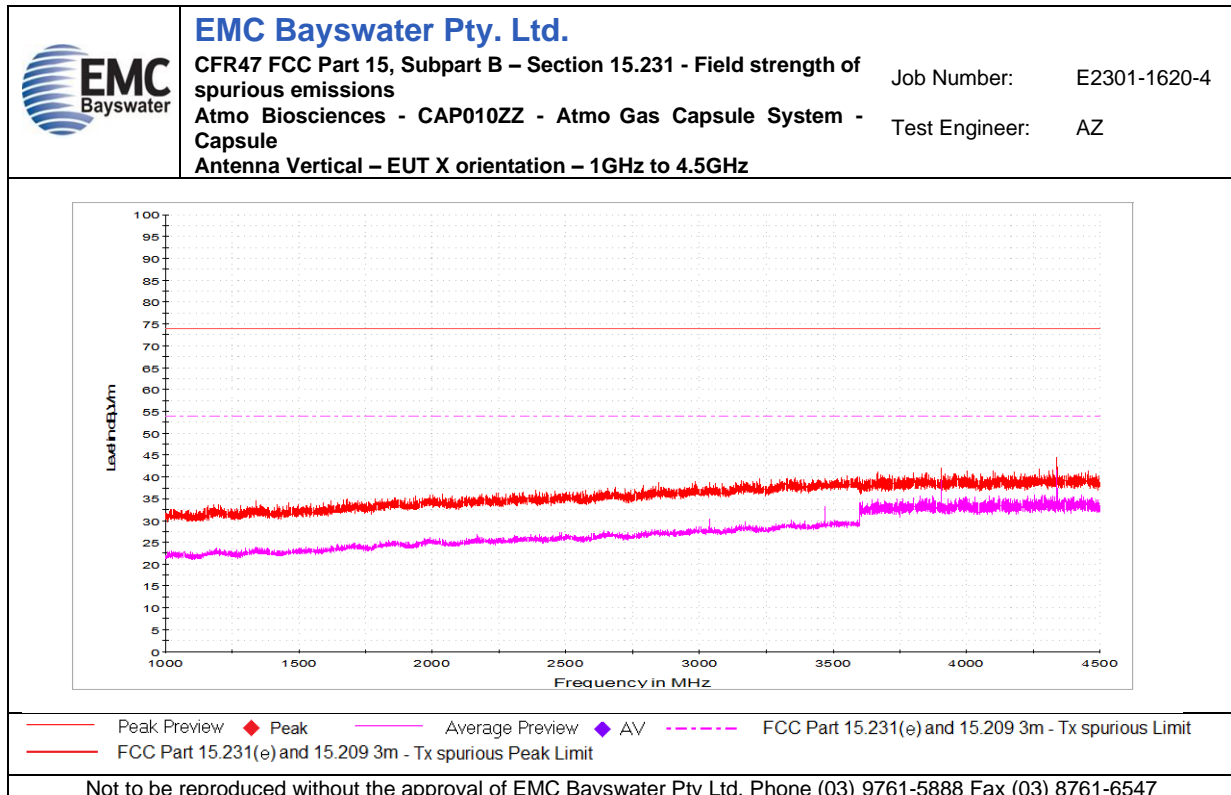
Graph 4



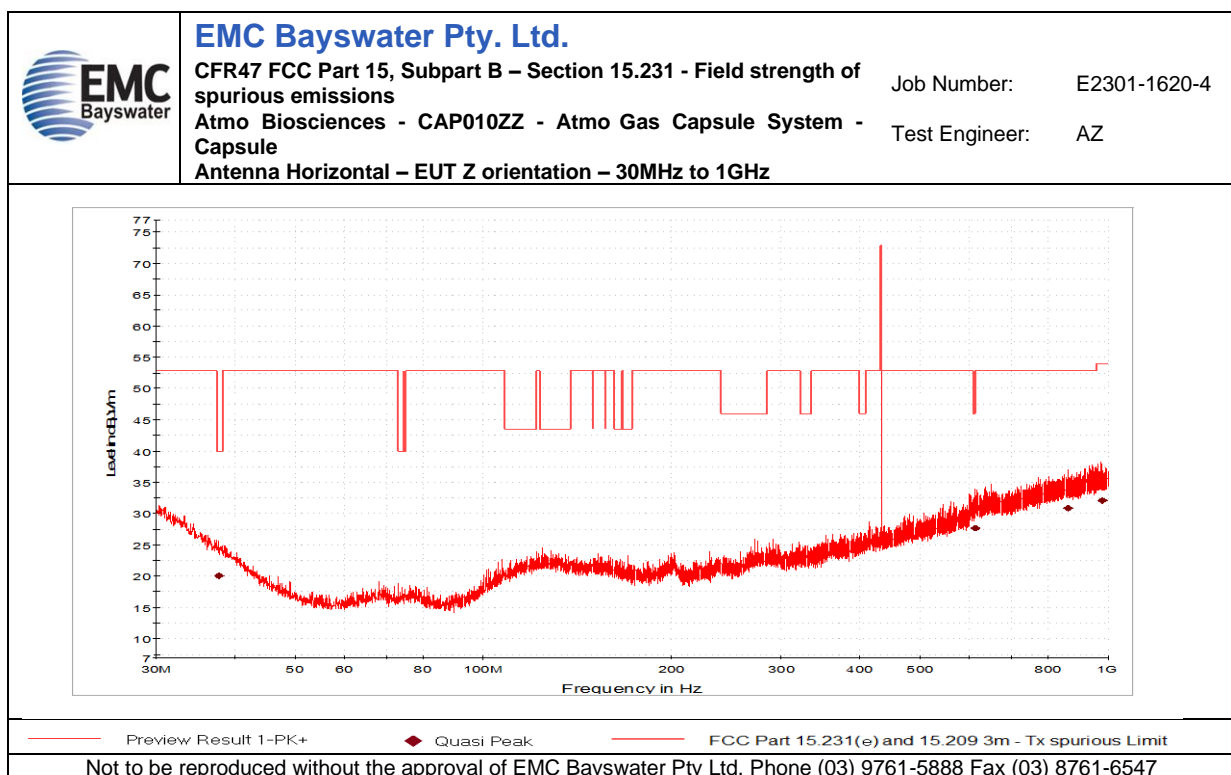
Graph 5



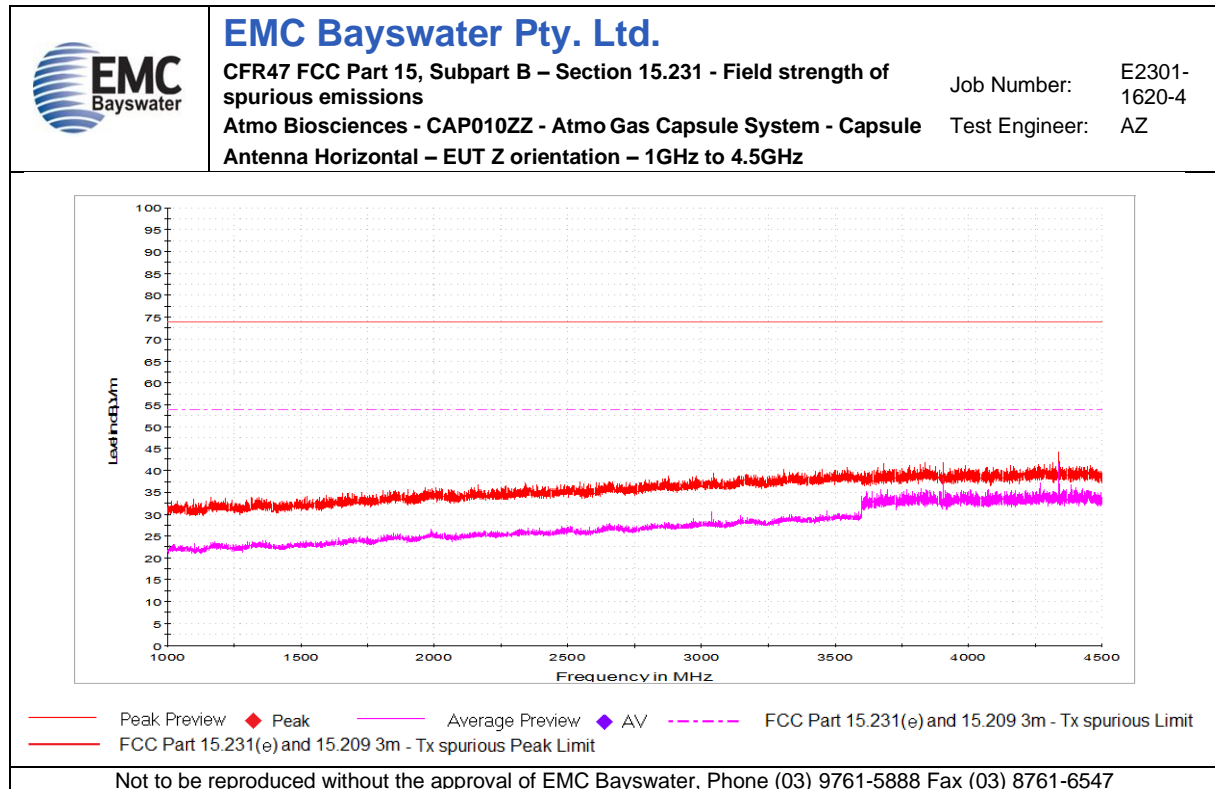
Graph 6



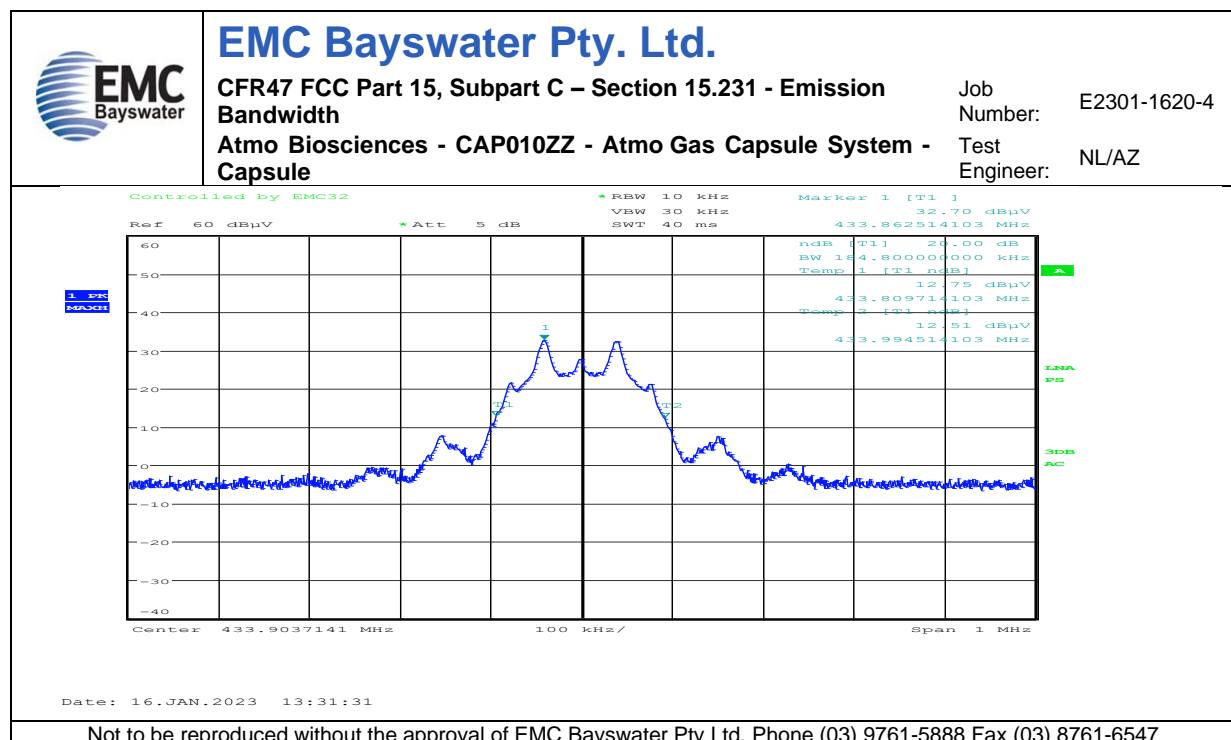
Graph 7



Graph 8



Graph 9



Graph 10