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Global Product Certification
EMC-EMF Safety Approvals

RADIO REPORT FOR CERTIFICATION
to
47 CFR Part 15 Subpart C (Section 15.247)

Test Report Number: S210607-1 v2

FCC ID: 2A2XF-DC130

Tested For: Imaxeon Pty Ltd
Manufacturer: Silicon Laboratories Finland OY
Device under Test: WGM160p WIFI module
Model Number: WGM160P22N
Serial Number: 418070010

Issue Date: 30th August 2021

RADIO REPORT
FOR CERTIFICATION

47 CFR Part 15 Subpart C (Section 15.247)

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REVISION TABLE

Version	Change Made	Date
1	Initial issue of document	08/07/2021
2	Summary table updated and updated FCC ID	30/08/2021

RADIO REPORT FOR CERTIFICATION

Device under Test:	WGM160p WIFI module
Model Number:	WGM160P22N
Serial Number:	418070010
Manufacturer:	Silicon Lavoratories Finland Oy, Alberga Business Park, Bertel Hungin aukio 3, 02600 Espoo, Finland
FCC ID:	2A2XF-DC130
Tested for:	Imaxeon Pty Ltd
Address:	Unit 1, 38-46 South St, Rydalmere, Austraila, 2116
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Contact:	Gopi Parthasarathi
Email:	gopinath.parthasarathi@bayer.com
Standards:	**47 CFR Part 15 –** Radio Frequency Devices **Subpart C –** Intentional Radiators **Section 15.247 –** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
Test Dates:	7 June 2021 to 9 June 2021
Issue Date:	30th August 2021
Attestation:	I hereby certify that the Test Sample described herein was tested as described in this report and that the data included is that which was obtained during such testing.
Test Engineers:	**Dong Feng**
Authorised Signatory:	**Quinn Wu** **EMC Lead Engineer** **EMC Technologies Pty Ltd**

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RADIO REPORT FOR CERTIFICATION
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47 CFR Part 15 Subpart C (section 15.247)

1.0 INTRODUCTION

Radio tests were performed on WGM160p WIFI module with Model Number: WGM160P22N, in accordance with the applicable requirements of 47 CFR, Part 15 Subpart C – Section 15.247.

1.1 Test Procedure

Radio measurements were performed in accordance with the appropriate procedures of ANSI C63.10: 2013 and KDB 558074 v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

The measurement instrumentation conformed to the requirements of ANSI C63.2: 2016.

1.2 Summary of 47 CFR Part 15 Subpart C Results

Section	FCC Part 15 Subpart C	Test Performed	Test Mode	Results
3.1	**15.247 (d)**	Authorised and Restricted band Bandedge Emissions	**1, 2**	**Complied**
3.2	**15.247 (d)**	Radiated spurious emissions	**3**	**Complied**
3.3	**15.247 (i)**	Radio Frequency Hazard	**NA**	**Complied**

Test Mode	
1	802.11n Continuous transmitting on Channel 2 (2412MHz)
2	802.11n Continuous transmitting on Channel 11 (2462MHz)
3	802.11g Continuous transmitting on Channel 2 (2417MHz)

1.4 Modifications

No modifications were performed on EUT in order to comply with the standard.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (Transmitter) Details

FCC ID:	QOQWGM160P
Manufacturer:	Silicon Laboratories Finland OY
Device under Test:	Wi-Fi bgn wireless radio module with embedded full stack
Model Number:	WGM160P22N
Serial Number:	418070010
Microprocessor:	32-bit ARM® Cortex-M4
Highest Internal Frequency:	2.4GHz
Frequency Band:	2400-2483.5MHz
Operating Frequency:	Low Channel: 2412MHz Mid Channel: 2442MHz High Channel: 2462MHz
Number of Channels:	14
Nominal Output Power:	16dBm
Antenna gain:	Max 3dBi
Antenna type:	Dipole
Rated Supply Voltage:	3.3V

2.2 EUT Description

The EUT is a Wi-Fi bgn wireless radio module with embedded full stack

2.3 Test Sample Operation Mode

The EUT was in the below operation mode for testing:

- Power switched on and the Wi-Fi in reception mode.
- EUT was in continous transmission mode.
- Connected to a PC by USB Cable.
- Tabletop configuration.
- External Power supply: 3.3V. Auxiliary PC powered by 115Vac.

2.4 Antenna Details

Antenna gain:	Max 3dBi
Antenna type:	Dipole

2.4 Test Facility

2.4.1 General

EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited 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 – **Designation number AU0002.**

EMC Technologies indoor open are test site (iOATS) located at Unit 3, 87 Station Road, Seven Hills, NSW, Australia, 2147 has been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen, Issue 8 - **Industry Canada iOATS number - IC 4207A.**

Measurements in this report were performed at EMC Technologies' laboratory located at Unit 3, 87 Station Road, Seven Hills, New South Wales, Australia.

2.4.2 NATA Accreditation

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 to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A^2LA).

EMC Technologies is accredited in Australia by the National Association of Testing Authorities (NATA). All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation.

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

2.6 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

Equipment Type	Asset No:	Make/Model/Serial Number	Due Date dd/mm/yy
EMI Receiver	R-038	Rohde & Schwarz EMI Receiver Model: ESU40 S/N: 100183 20Hz – 40GHz	01/04/2022
Antennas	A-324	Double Ridged Horn Antenna 1-18GHz Model: EMCO 3115 S/N: 3823	04/02/2024
	A-430	Sunar RF Motion Model: JB1 S/N: A021318	14/04/2024
	A-008	EMCO Model: 6502 SN: 9108-2660	12/12/2021
	A-305	Horn Antenna 18-26.5GHz, MN: 3160-09, SN: 00066033	30/04/2024
Pre-amplifier	A-138	1-26.5 GHz, 30 dB Gain MN: HP 8449B, SN: 3008A1113	18/01/2022
Cables	C-413	Microwave Cable 36 inch – 18-40GHz MN: PE319-36, SN: 0063308	24/06/2022
	C-414	Microwave Cable 36 inch – 18-40GHz MN: PE319-36, SN: 0083308	24/06/2022
	SC-043	Sucoflex 3m, 10MHz - 18GHz	05/01/2022
	SC-028	13m RG214 N-Type, 0.1- 6000MHz	11/01/2022
	SC-041	Sucoflex 4m 10MHz - 18GHz Cable Model: SF104A/2x11N-47/4m	21/05/2022

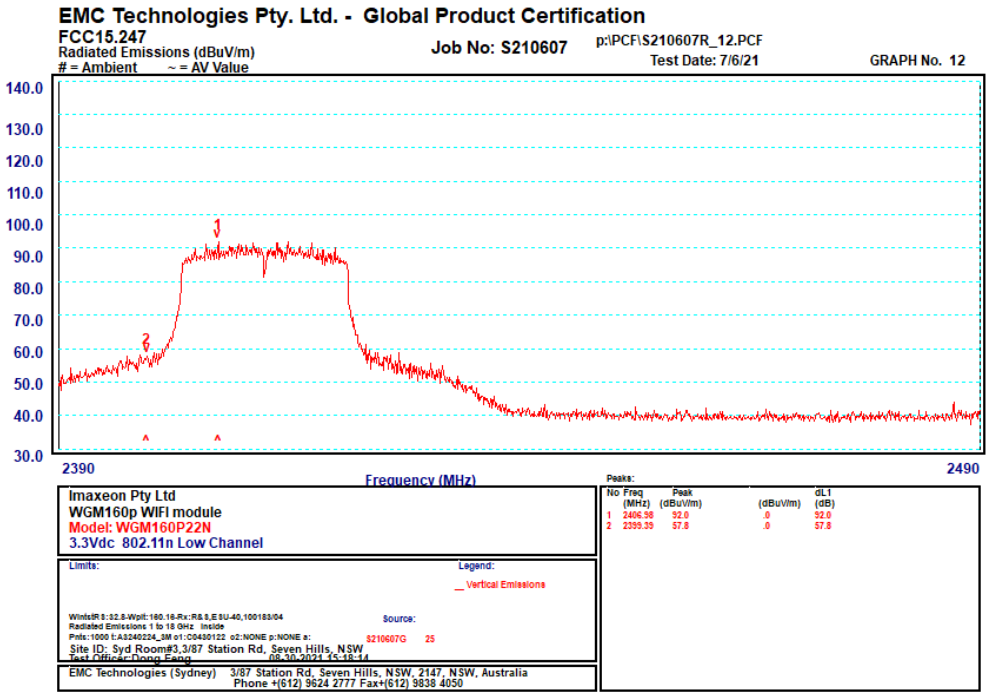
3.0 TEST RESULTS

3.1 §15.247(d) Out of Band Emissions – Bandedge emissions

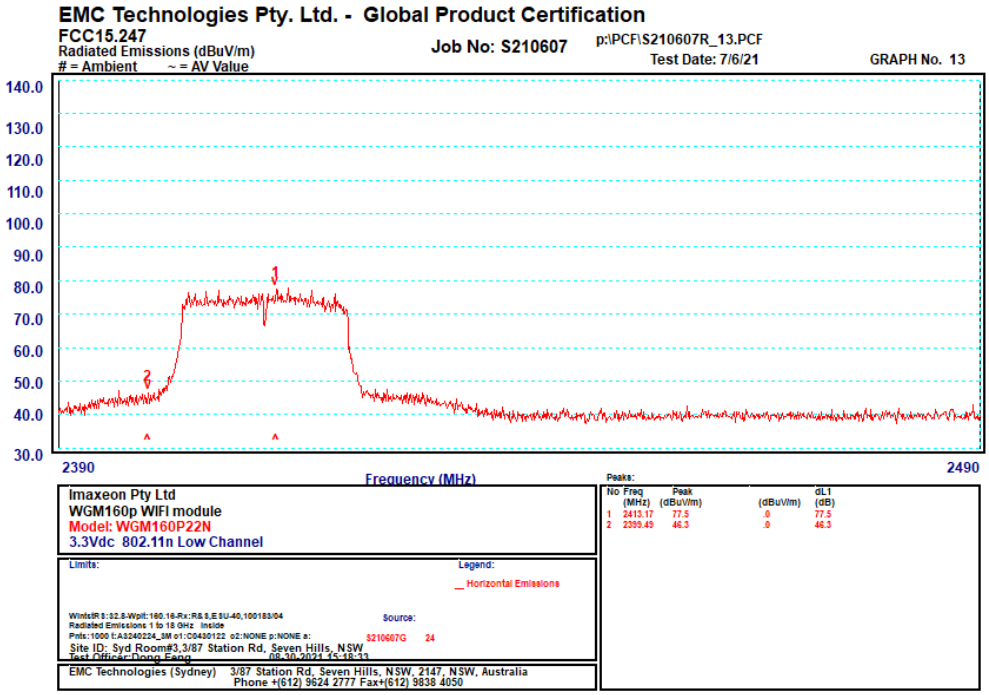
3.1.1 Authorised-band Bandedge Emissions

Emissions edge were measured using the radiated method. Measurements were made with the transmitter setting of 802.11n, Channel 2, as it was the worst-case scenario from previous report.
All emissions above and below the edge of the authorised band were more than 20 dB below the in band intentional emission.

Graph 12 Low Channel Vertical Polarisation 2390 to 2460MHz



Graph 13 Low Channel Horizontal Polarisation 2390 to 2460MHz



3.1.2 Restricted-band Bandedge Emissions

This was done by radiated measurement according to C63.10 Clause 6.10.5

The peak measurements were made with a resolution bandwidth (RBW) of 1000 kHz and the video bandwidth (VBW) of 1000 kHz, The average measurement were made with a resolution bandwidth (RBW) of 1000kHz and the video bandwidth(VBW) of 10kHz. Measurements were made with the transmitter setting of 802.11n, Channel 11, as it was the worst-case scenario from previous report.

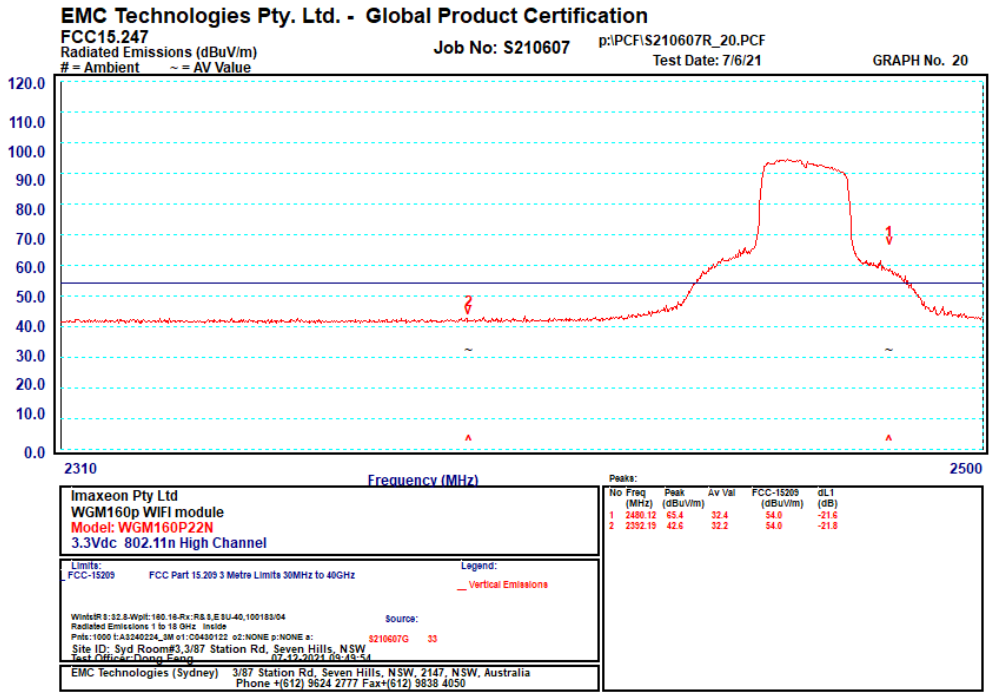
Results:

Channel 11, Top Band Edge:

Marks being set to around 2390MHz and 2483.5MHz

Channel 11 Average Measurement

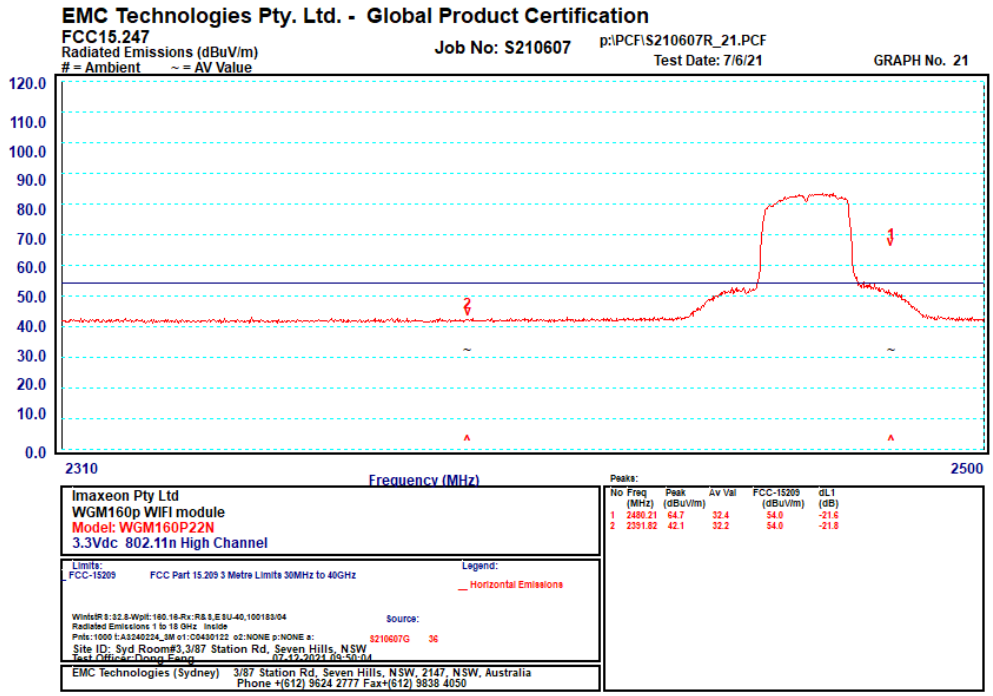
Graph 20 Vertical Polarisation 2310 to 2500MHz



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2480.12	Vertical	32.4	54.0	-21.6
2	2392.19	Vertical	32.2	54.0	-21.8

All measured frequencies complied with the average limit by a margin of greater than 10dB.

Graph 21 Horizontal Polarisation 2310 to 2500MHz

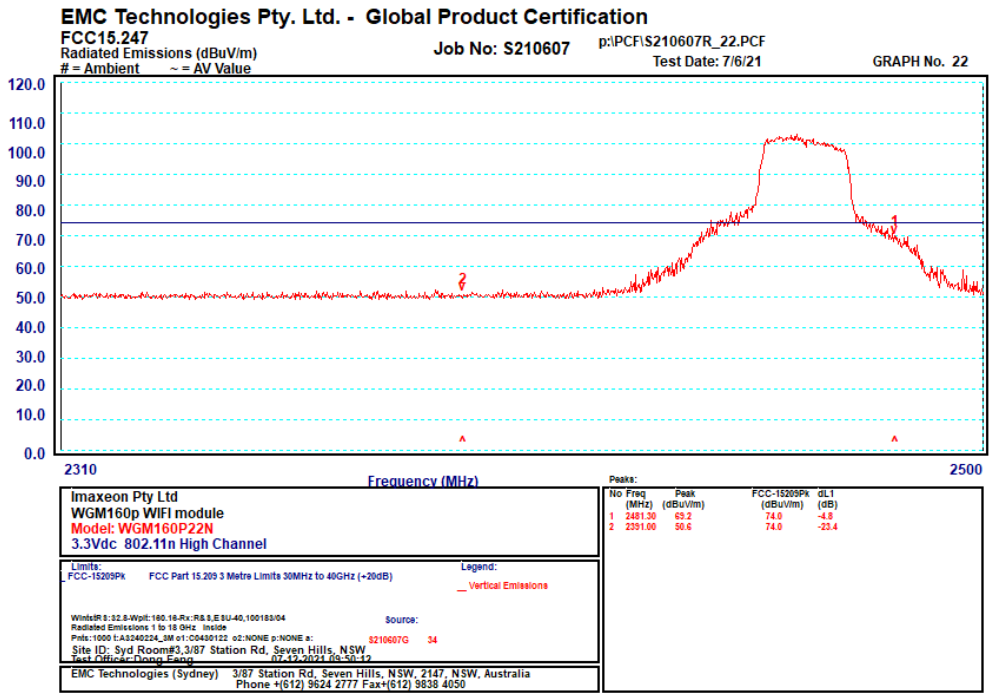


Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2480.21	Horizontal	32.4	54.0	-21.6
2	2391.82	Horizontal	32.2	54.0	-21.8

All measured frequencies complied with the average limit by a margin of greater than 10dB.

Channel 11 Peak Measurement

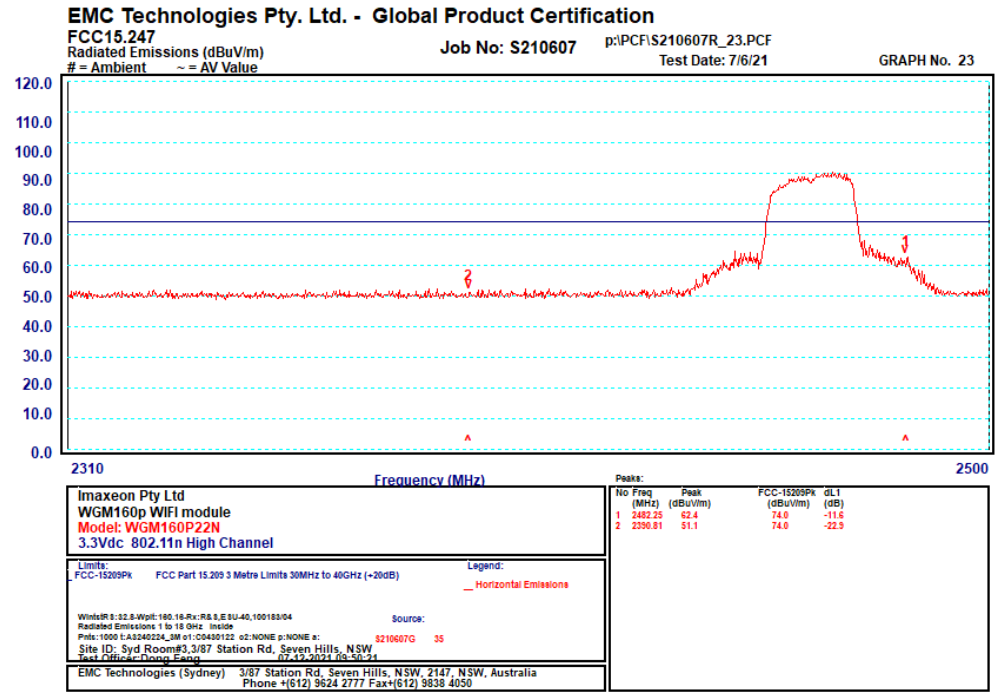
Graph 22 Vertical Polarisation 2310 to 2500MHz



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2481.3	Vertical	69.2	74.0	-4.8
2	2391.0	Vertical	50.6	74.0	-23.4

All measured frequencies complied with the peak limit by a margin of at least 4.8dB.

Graph 23 Horizontal Polarisation 2310 to 2500MHz



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2482.25	Horizontal	62.4	74.0	-11.6
2	2390.81	Horizontal	51.1	74.0	-22.9

All measured frequencies complied with the peak limit by a margin of greater than 10dB.

3.2 §15.247(d) Out of Band Emissions – Radiated Spurious Emissions

Radiated EMI tests were performed in a semi-anechoic chamber compliant with ANSI C63.4 2014.

The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks. Measurements between 9 kHz and 30 MHz were made at 3 metres using a 0.6 metre loop antenna and calibrated Biconilog antenna for measurements between 30 MHz and 1000 MHz. Calibrated EMCO 3115, EMCO 3116 and ETS standard gain horn antennas were used for measurements between 1 to 25 GHz as applicable.

The EUT was slowly rotated with the spectrum analyser was set to Max-Hold. This was performed for 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. The procedure was repeated with the device orientated in three orthogonal axis to further maximise the emission.

Each significant peak was investigated with the Peak/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 antenna polarisations.

Calculation of field strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

E = V + AF - G + L

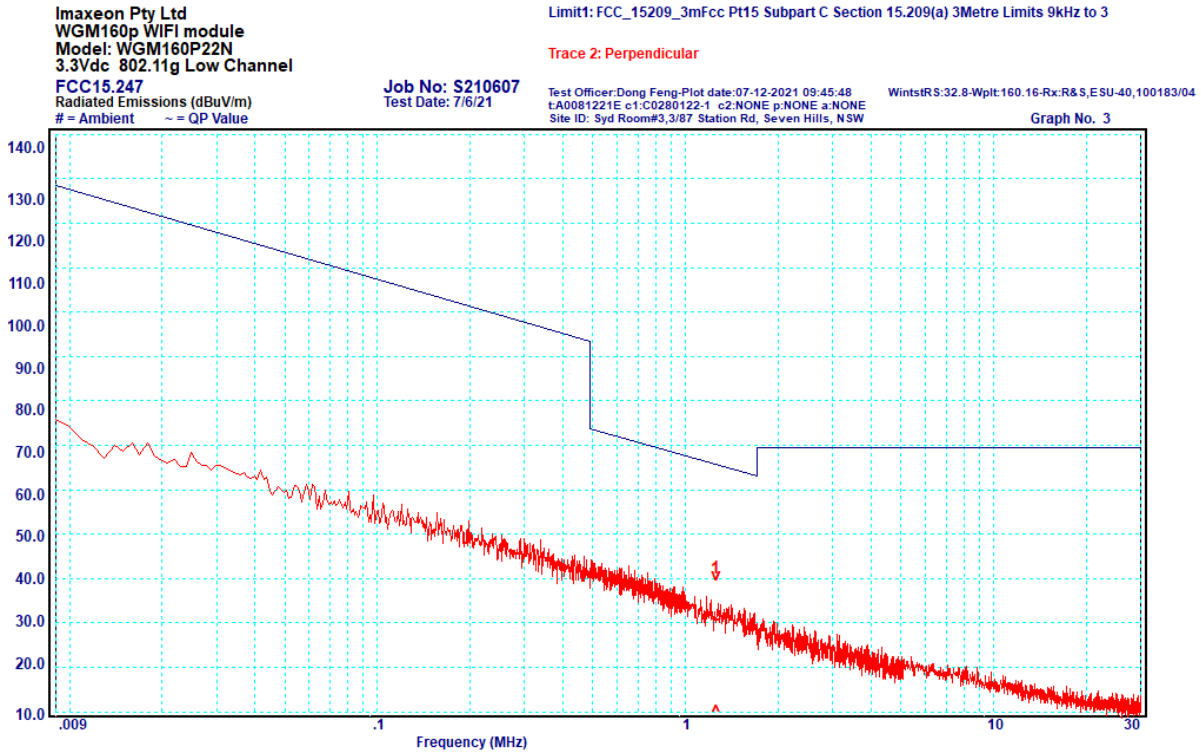
Where:

E	=	Radiated Field Strength in dBµV/m.
V	=	EMI Receiver Voltage in dBµV. (measured value)
AF	=	Antenna Factor in dB. (stored as a data array)
G	=	Preamplifier Gain in dB. (stored as a data array)
L	=	Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

Frequency Band: 9 kHz - 30 MHz

Measurements were made at a distance of 3 metres. The measurement of emissions between 9 kHz – 150 kHz were made with a resolution bandwidth (RBW) of 200 Hz and the video bandwidth (VBW) of 3 kHz, 150 kHz – 30 MHz were measured with the resolution bandwidth (RBW) of 9 kHz and the video bandwidth (VBW) of 30 kHz. Measurements were made with the transmitter setting of 802.11g, CH2, as it was the worst-case scenario from previous report.

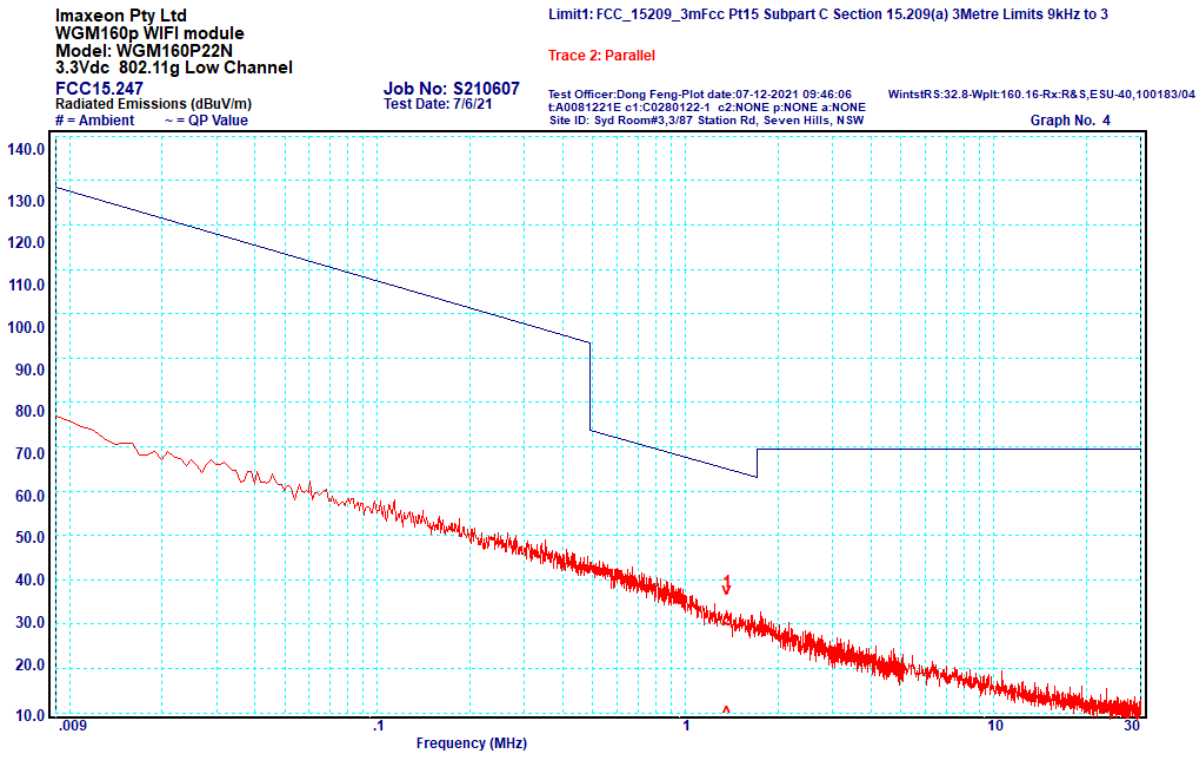
Graph 3 **Perpendicular Emissions** **9kHz to 30MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	1.258	Perpendicular	30.6	65.7	-35.1

All measured frequencies complied with the quasi peak limit by a margin of greater than 10dB.

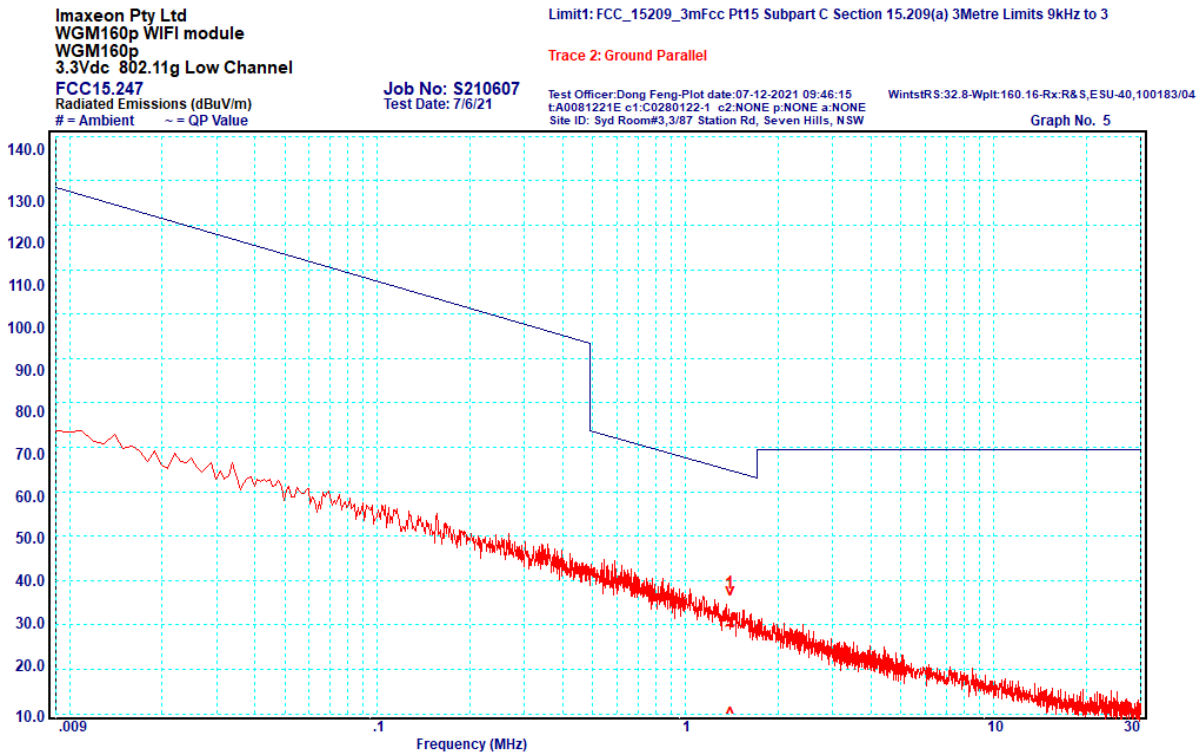
Graph 4 Parallel Emissions 9kHz to 30MHz



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	1.366	Parallel	29.8	64.9	-35.1

All measured frequencies complied with the quasi peak limit by a margin of greater than 10dB.

Graph 5 Ground Parallel Emissions 9kHz to 30MHz



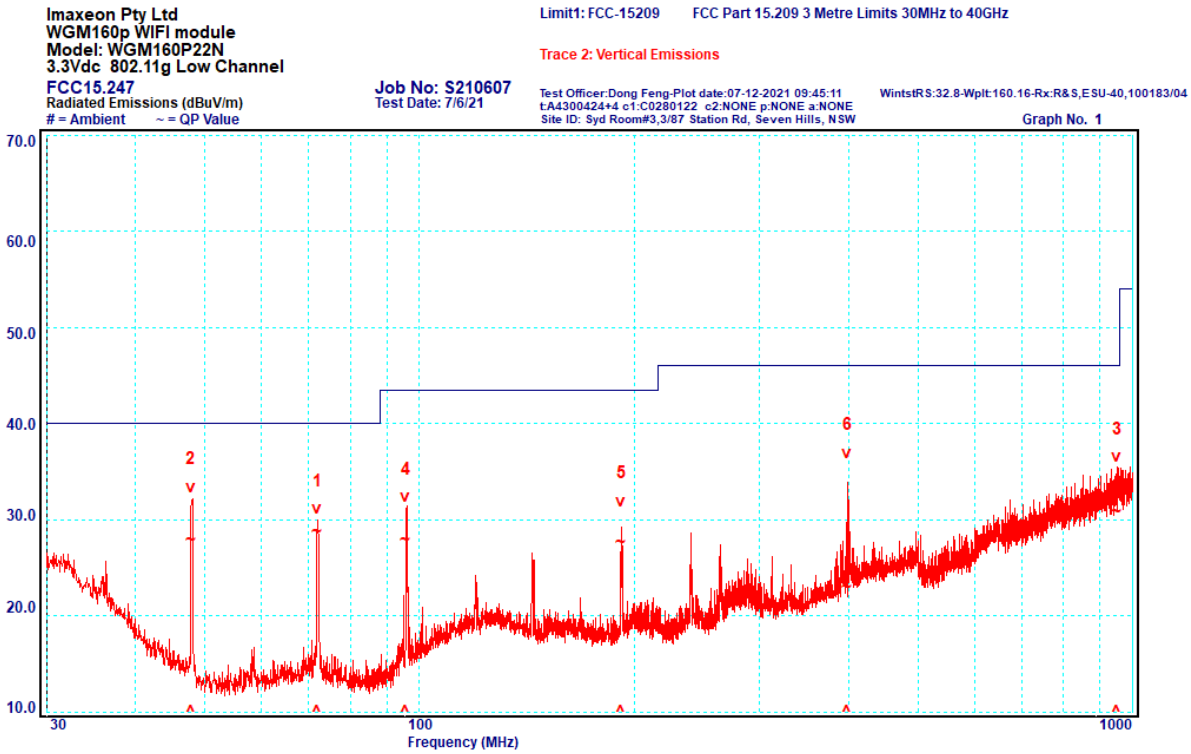
Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	1.394	Ground Parallel	29.7	64.8	-35.1

All measured frequencies complied with the quasi peak limit by a margin of greater than 10dB.

Frequency Band: 30 - 1000 MHz

Measurements were made at a distance of 3 metres. The measurement of emissions between 30 - 1000 MHz were made with a resolution bandwidth (RBW) of 100 kHz and the video bandwidth (VBW) of 300 kHz. Measurements were made with the transmitter setting of 802.11g, CH2, as it was the worst-case scenario from previous report.

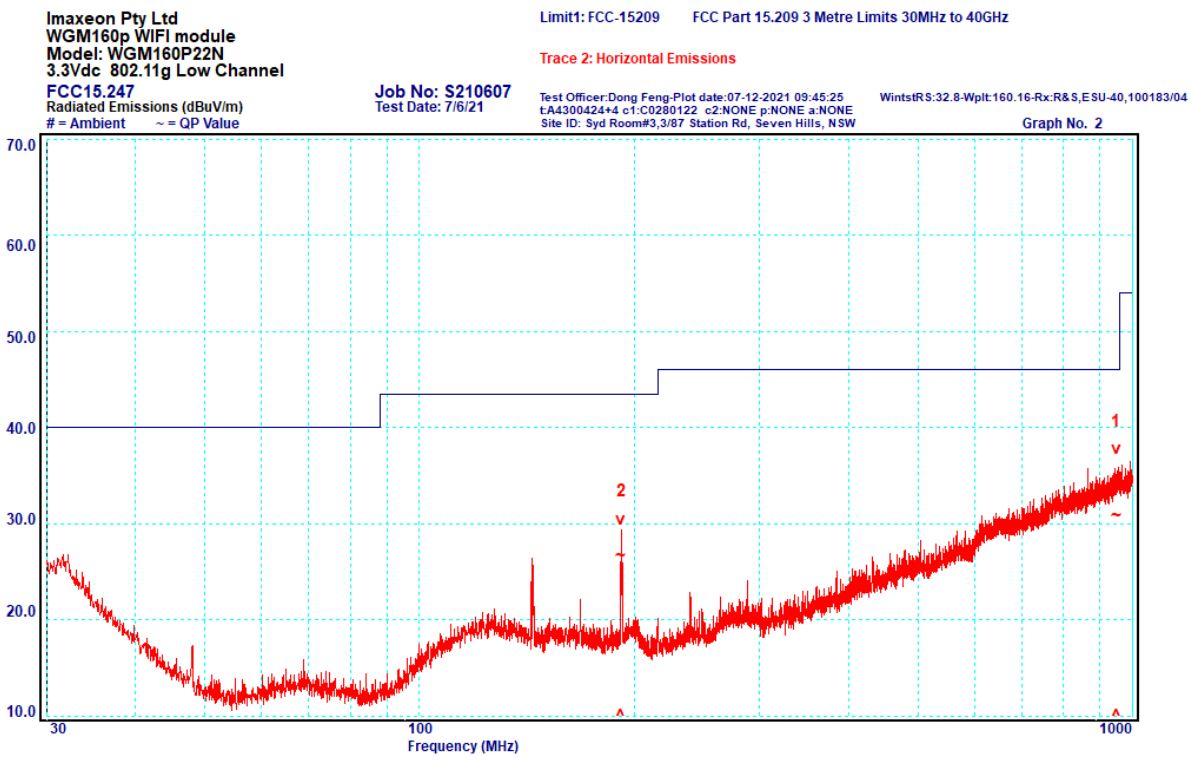
Graph 1 **Vertical Emissions** **30MHz to 1000MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	72.00	Vertical	28.8	40.0	-11.2
2	47.78	Vertical	27.8	40.0	-12.2
3	951.41	Vertical	30.8	46.0	-15.2
4	95.73	Vertical	27.9	43.5	-15.6
5	192.04	Vertical	27.6	43.5	-15.9
6	397.93	Vertical	23.0	46.0	-23.0

All measured frequencies complied with the quasi peak limit by a margin of greater than 10dB.

Graph 2 **Horizontal Emissions** **30MHz to 1000MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	948.86	Horizontal	30.8	46.0	-15.2
2	192.01	Horizontal	26.6	43.5	-16.9

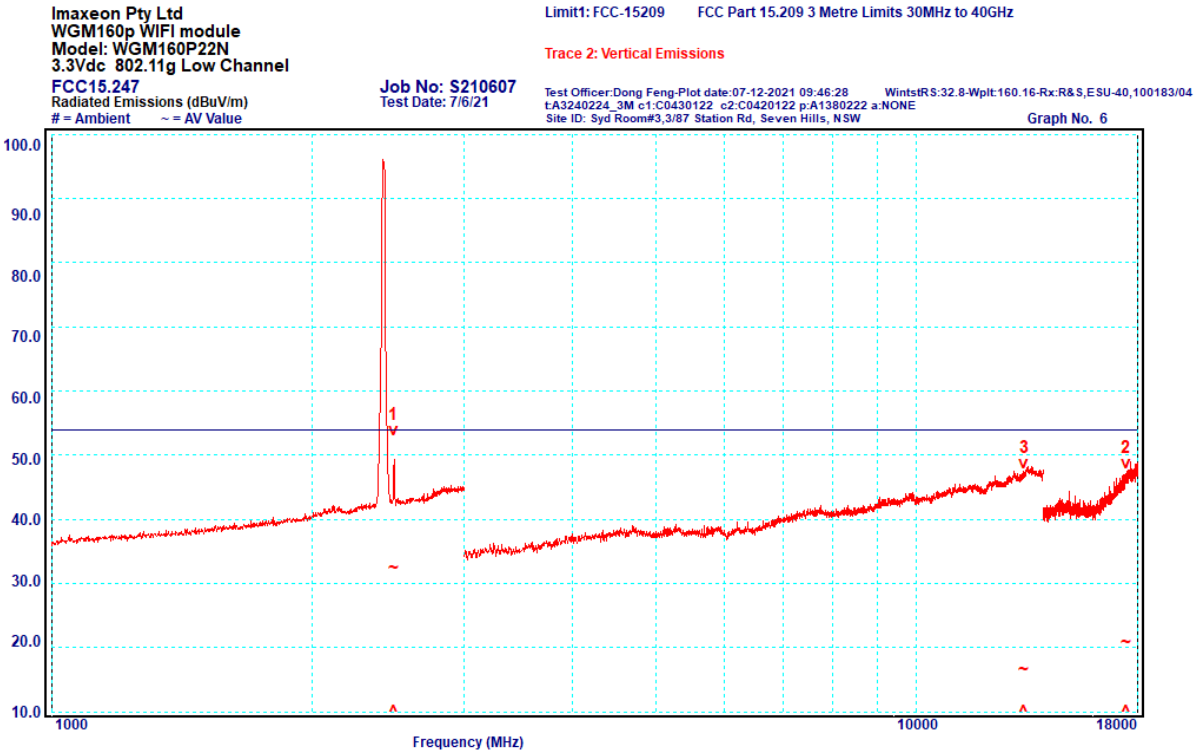
All measured frequencies complied with the quasi peak limit by a margin of greater than 10dB.

Frequency Band: 1000 – 18000 MHz

Measurements were made at a distance of 3 metres. The measurement of emissions between 1000 - 18000 MHz were made with a resolution bandwidth (RBW) of 1000 kHz and the video bandwidth (VBW) of 3000 kHz for peak and a video bandwidth (VBW) of 10 Hz for average. Measurements were made with the transmitter setting of 802.11g, CH2, as it was the worst-case scenario from previous report.

Average Detector Emissions

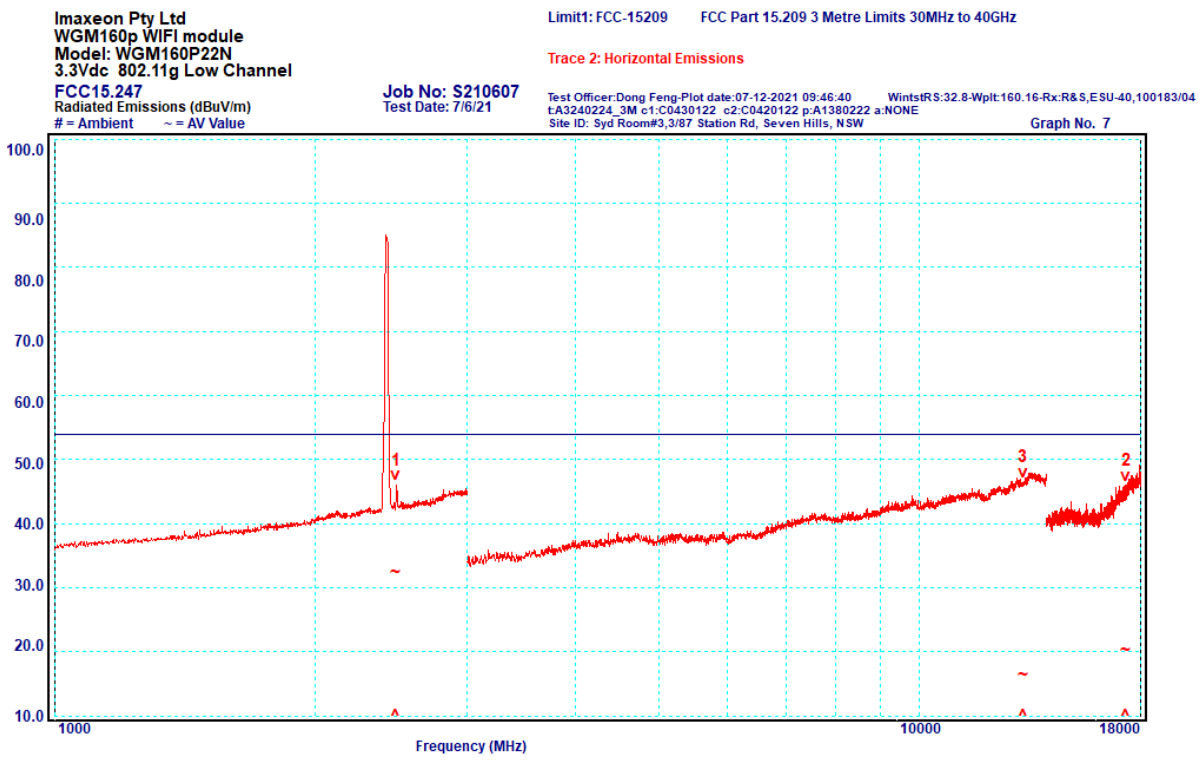
Graph 6 Vertical Emissions 1000MHz to 18000MHz



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2484.76	Vertical	32.4	54.0	-21.6
2	17450.13	Vertical	20.7	54.0	-33.3
3	13308.25	Vertical	16.6	54.0	-37.4

All measured frequencies complied with the average limit by a margin of greater than 10dB.

Graph 7 **Horizontal Emissions** **1000MHz to 18000MHz**

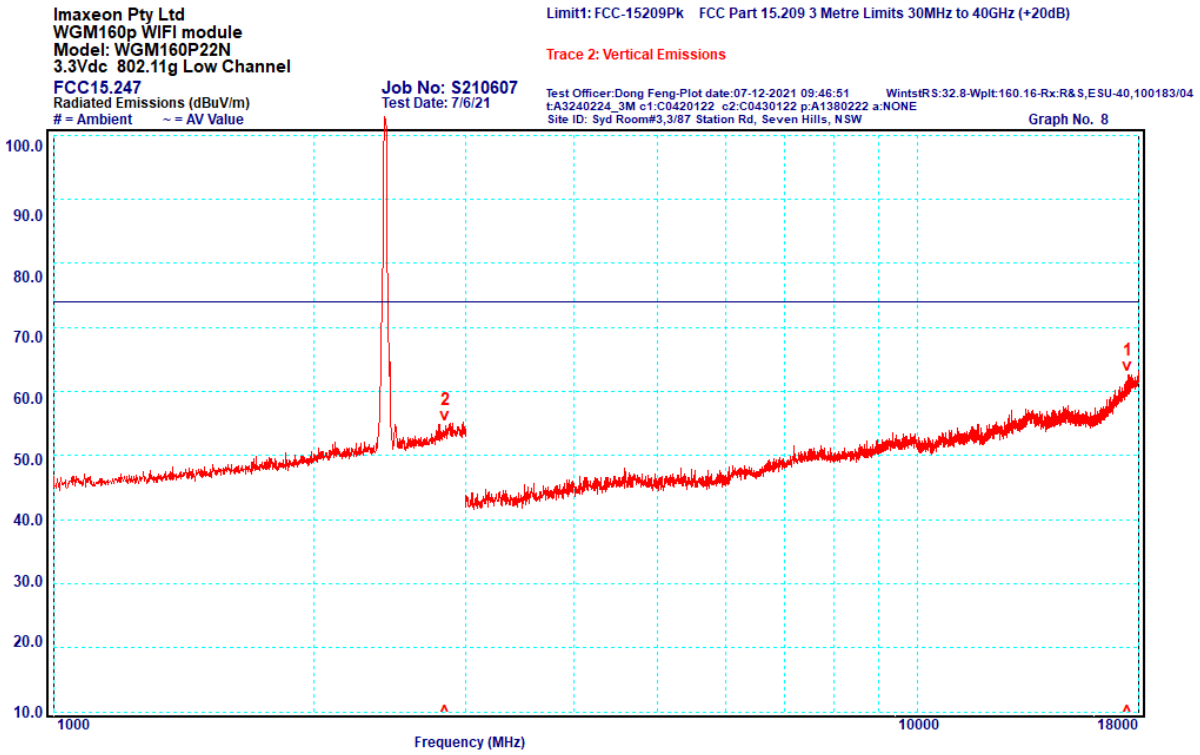


Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2482.17	Horizontal	32.4	54.0	-21.6
2	17310.45	Horizontal	20.2	54.0	-33.8
3	13171.13	Horizontal	16.4	54.0	-37.6

All measured frequencies complied with the average limit by a margin of greater than 10dB.

Peak Detector Emissions

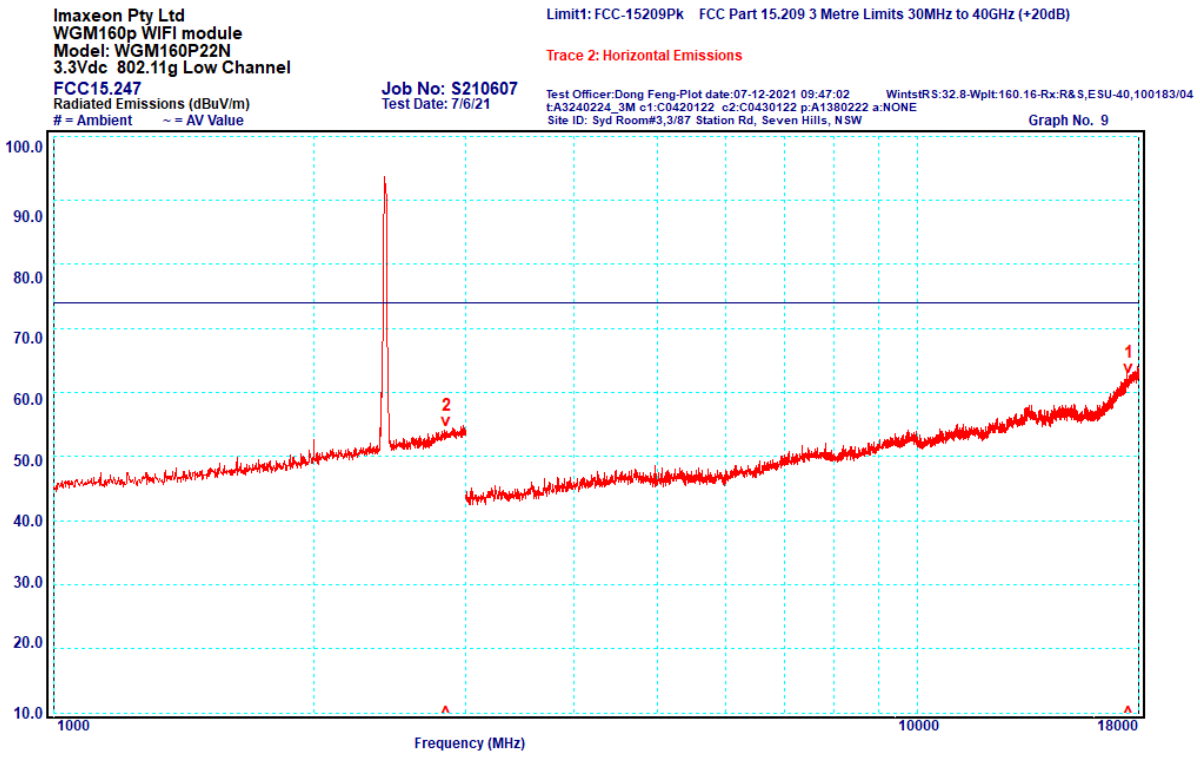
Graph 8 Vertical Emissions 1000MHz to 18000MHz



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	17488.59	Vertical	62.4	74.0	-11.6
2	2842.2	Vertical	54.7	74.0	-19.3

All measured frequencies complied with the peak limit by a margin of greater than 10dB.

Graph 9 Horizontal Emissions 1000MHz to 18000MHz



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	17540.54	Horizontal	62.3	74.0	-11.7
2	2850.19	Horizontal	53.9	74.0	-20.1

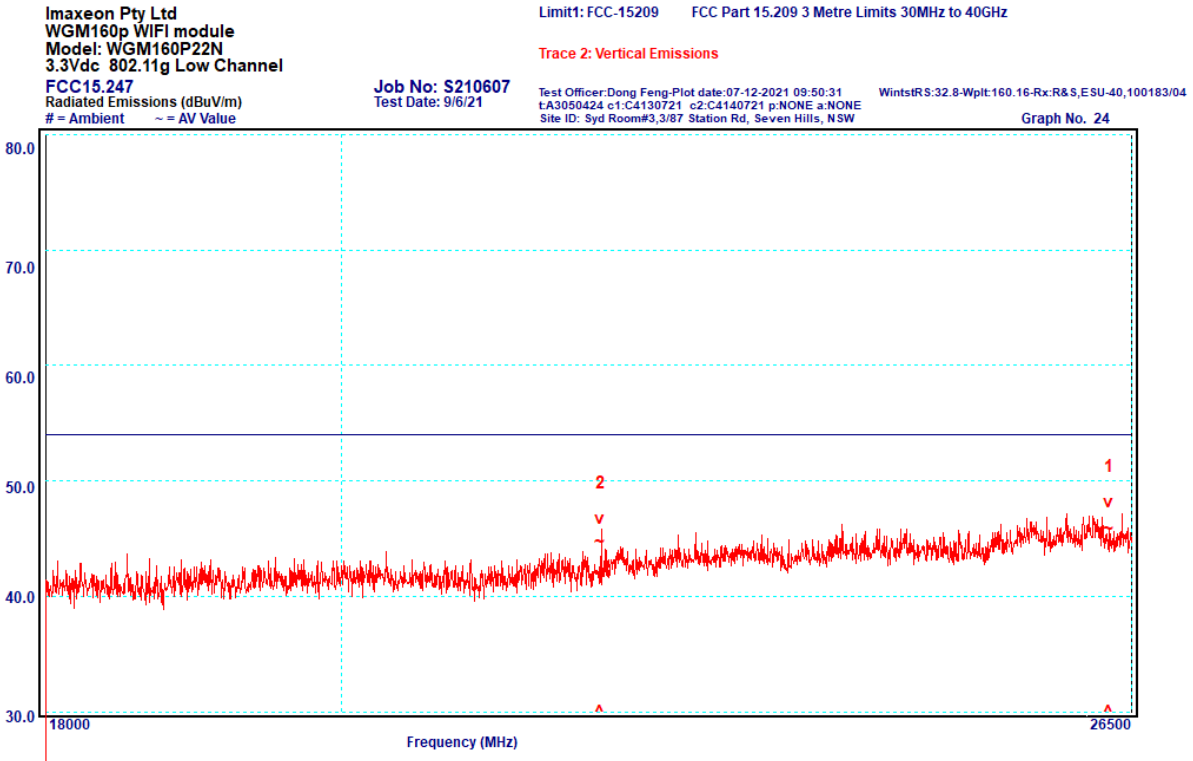
All measured frequencies complied with the peak limit by a margin of greater than 10dB.

Frequency Band: 18000 - 26500 MHz

Measurements from 18 to 26.5GHz were made at a distance of 1 metres. The average measurements were made with a resolution bandwidth (RBW) of 1000 kHz and the video bandwidth (VBW) of 10kHz. Measurements were made with the transmitter setting of 802.11g, CH2, as it was the worst-case scenario from previous report.

Average Measurements

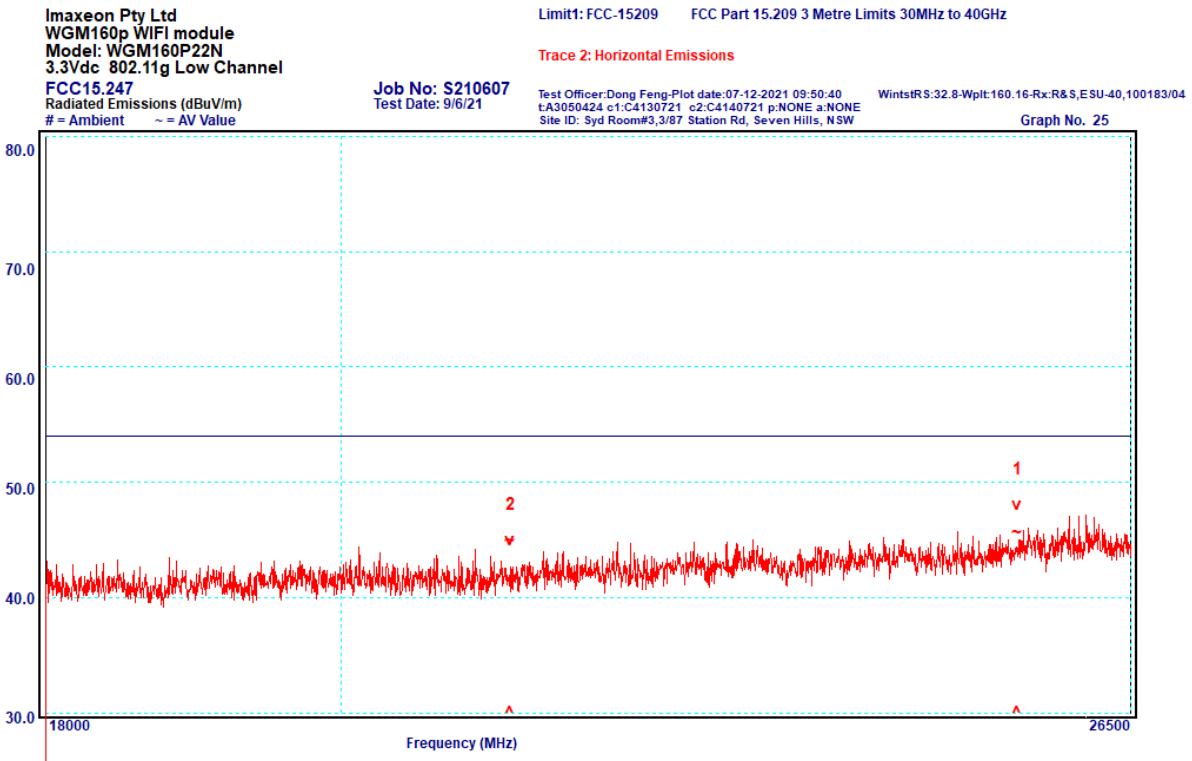
Graph 24 Vertical Polarisation 18000 to 26500MHz



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	26286.51	Vertical	45.8	54.0	-8.2
2	21929.8	Vertical	44.7	54.0	-9.3

All measured frequencies complied with the average limit by a margin of at least 8.2dB.

Graph 25 **Horizontal Polarisation** **18000 to 26500MHz**

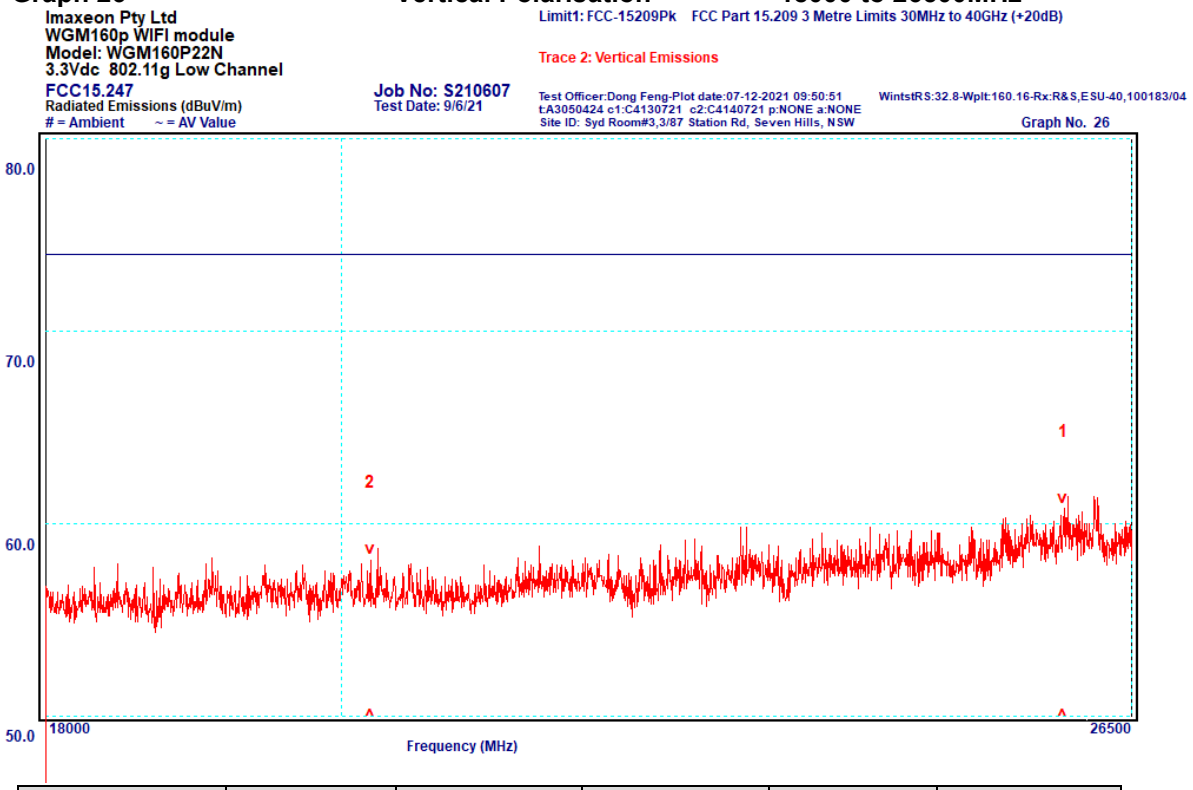


Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	25450.53	Horizontal	45.6	54.0	-8.4
2	21241.35	Horizontal	44.8	54.0	-9.2

All measured frequencies complied with average limit by a margin of at least 8.4dB.

Peak Measurements

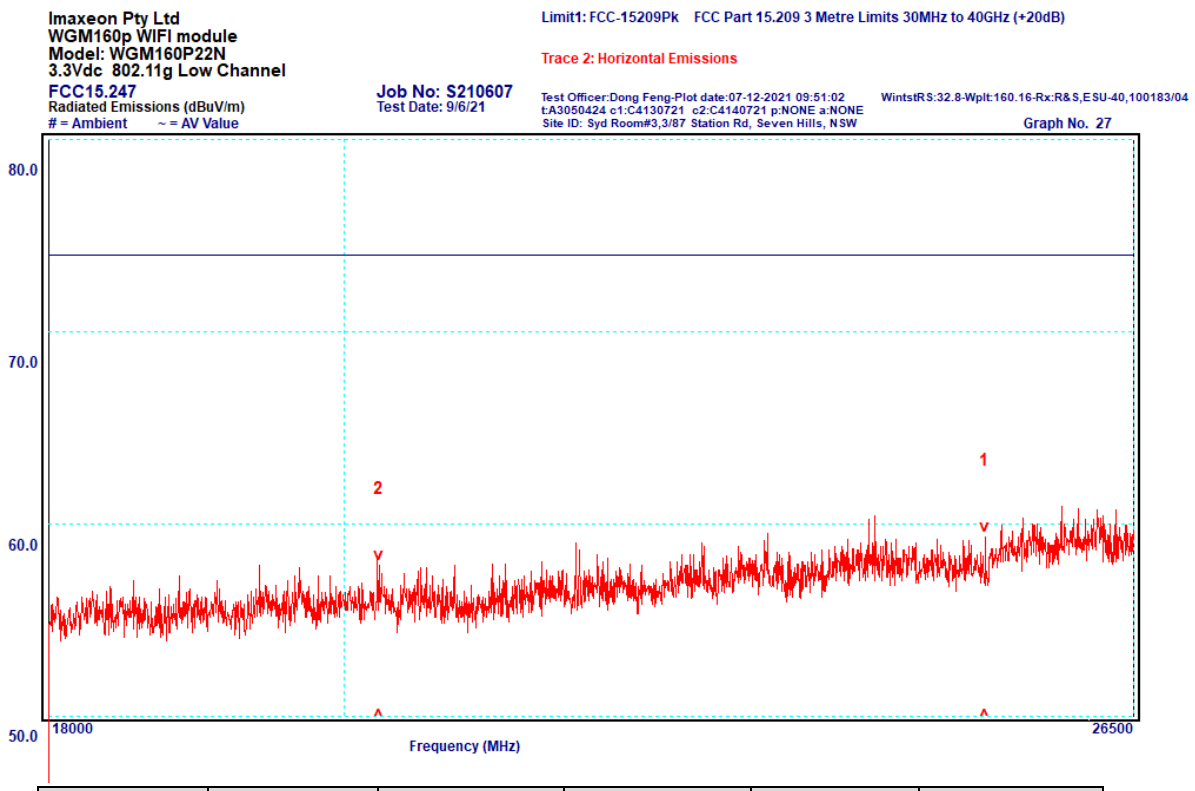
Graph 26 **Vertical Polarisation** **18000 to 26500MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	25862.15	Vertical	60.8	74.0	-13.2
2	20205.84	Vertical	58.1	74.0	-15.9

All measured frequencies complied with the peak limit by a margin of greater than 10dB.

Graph 27 Horizontal Polarisation 18000 to 26500MHz



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	25129.28	Horizontal	59.3	74.0	-14.7
2	20245.80	Horizontal	57.8	74.0	-16.2

All measured frequencies complied with the peak limit by a margin of greater than 10dB.

Conclusion

The spurious emissions complied with the general limits of FCC §15.209 by a margin of at least 8.2dB.

3.3 §15.247(i) Maximum Permissible Exposure

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f2	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f2	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

The Maximum Conducted is 18.82dBm at 2437MHz according to the preious report.

The declared antenna gain is 3 dBi, max EIRP = 21.82dBm

The Maximum Permissible Exposure (MPE) limit defined in Table 1 for a transmitter operating at 2437 MHz is:

MPE limit 1 mW/cm^2
= 61.39 V/m (V/m) = $\sqrt{(1200\times\pi\times mW/cm^2)}$

Field strength = [$\sqrt{(30\times$ transmitter EIRP, W)] ÷ [minimum separation distance, metres] **V/m**
= [$\sqrt{(30\times0.1521)}$] ÷ 0.2m **V/m**
= **10.68 V/m = 0.0303 mW/cm²** (mW/cm^2) = $(V/m)^2 \div (1200\times\pi)$

As the calculated field strength generated by the transmitter is less than the limit, WGM160p WIFI module is deemed to comply with the radio frequency exposure requirements.

4.0 COMPLIANCE STATEMENT

The WGM160p WIFI module with Model Number: WGM160p22N tested on behalf of Imaxeon Pty Ltd complied with all the applicable requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators) operating within the band: 2400 MHz to 2483.5MHz.

5.0 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
Peak Power Spectral Density:		±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%.