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RADIO REPORT FOR CERTIFICATION
to
47 CFR Part 15 Subpart C (Section 15.247) and
RSS-247 Issue 2, February 2017
RSS-102 Issue 5, March 2015

Test Report Number: S200203-1 v6

FCC ID: S7R-BIRDIRRA
IC ID: 25706- BIRDIRRA

Tested For: Taggle Systems Pty Ltd
Device under Test: Birdirra 900MHz LPWAN Transmitter Module
Model Number: Birdirra
Serial Number: 131048

Issue Date: 28 May 2020

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, inferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.

RADIO REPORT
FOR CERTIFICATION

47 CFR Part 15 Subpart C (Section 15.247) and
RSS-247 Issue 2, February 2017
RSS-102 Issue 5, March 2015

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REVISION TABLE

Version	Sec/Para Changed	Change Made	Date
1		Initial issue of document	25/03/2020
2	2.5.1	Address of laboratory included	23/04/2020
3	1.3	RSS-Gen (6.6) Revised	07/05/2020
	3.1, 3.3	Amended clause	
	3.11	Bandwidth Corrected	
4	Page 2	Updated Contents Page	22/05/2020
	Page 9	Equipment Table updated	
	3.8	Inclusion of Conducted Emissions	
5	3.12, 3.13	Addition of FCC MPE/RSS-102 results	25/05/2020
6	3.12, 3.13	Addition of limits	28/05/2020

RADIO REPORT FOR CERTIFICATION

Device under Test:	Birdirra 900MHz LPWAN Transmitter Module
Model Number:	Birdirra
Serial Number:	131048
Manufacturer:	Taggle Systems Pty Ltd
FCC ID:	S7R-BIRDIRRA
ISED Cert. number IC:	25706-BIRDIRRA
Tested for:	Taggle Systems Pty Ltd
Address:	Level 1, 100 Sussex Street, Sydney, NSW, 2000 Austraila
Phone:	+61 2 8999 1919
Contact:	Richard Keaney
Email:	rkeaney@taggle.com.au
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 **RSS-247 Issue 2, February 2017** - *Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices* **RSS-Gen Issue 5, March 2019** - *General Requirements for Compliance of Radio Apparatus* **RSS-102 Issue 5, March 2015** - *Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)*
Test Dates:	14th February 2020 to 19th February 2020
Issue Date:	28 May 2020
Attestation:	I hereby certify that the Birdirra 900MHz LPWAN Transmitter module described herein was tested as described in this report and that the data included is that which was obtained during such testing.

Test Engineers:

Archana Sundramurthy

Rheyjane Zano

Authorised Signatory:

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RADIO REPORT FOR CERTIFICATION
to
47 CFR Part 15 Subpart C (section 15.247) and
RSS-247 Issue 2, February 2017

1.0 INTRODUCTION

Radio tests were performed on Birdirra 900MHz LPWAN Transmitter Module with Model Number: Birdirra in accordance with the applicable requirements of 47 CFR, Part 15 Subpart C – Section 15.247 and RSS-247 Issue 2 for a Digital Transmission System (DTS) operating within the band: 902 MHz to 928 MHz.

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

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna requirement	**Not applicable**
15.205	Restricted bands of operation	**Complied**
15.207	Conducted limits	**Complied**
15.209	Radiated emissions limits; general requirements	**Complied**
15.247 (a)	Channel Bandwidth	**Complied**
15.247 (b)	Peak Output Power	**Complied**
15.247 (c)	Antenna Gain > 6 dBi	**Not Applicable.** Antenna gain < 6 dBi
15.247 (d)	Out of Band Emissions	**Complied**
15.247 (e)	Peak Power Spectral Density	**Complied**
15.247 (f)	*Hybrid Systems	**Not Applicable.** Did not employ a hybrid system
15.247 (g)	Frequency Hopping System with Transmitter and Receiver	**Not Applicable.** Did not employ frequency hopping
15.247 (h)	Simultaneous occupancy of individual hopping frequencies	**Not Applicable.** Did not employ frequency hopping
15.247 (i)	Radio Frequency Hazard	**Complied**
2.1049	Occupied Bandwidth	**6.75 MHz**

* Hybrid systems are those that employ a combination of both frequency hopping and digital modulations technique.

1.3 Summary of RSS-247 Results

RSS	Test Performed	Results
RSS-Gen (6.8)	Antenna requirement	External antenna
RSS-Gen (8.8)	Conducted emissions limits	Complied
RSS-Gen (8.9)	Radiated Emission Limits (General requirements)	Complied
RSS-Gen (8.10)	Operation in restricted Band	Complied
RSS-247 (5.2(a))	DTS Bandwidth	Complied
RSS-247 (5.2(b))	Power Spectral Density	Complied
RSS-247 (5.4(d))	Peak Output Power	Complied
RSS-247 (5.5)	Out of Band Emissions	Complied
RSS-Gen (3.2) RSS-102	Radio Frequency Hazard	Complied
RSS-Gen (6.6)	Occupied Bandwidth	**6.75 MHz**

1.4 Modifications by EMC Technologies

No modifications were performed.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (Transmitter) Details

Radio:	
Frequency Band:	902MHz to 928MHz
Frequency Range:	922MHz
Modulation:	BPSK
Number of Channels:	1
Nominal Output Power:	15dBm
Antenna type and gain:	External, Monopole Whip Antenna, 2dBi
Rated Supply Voltage:	3.6V

2.2 EUT (Host) Details

Device under Test / PMN:	Birdirra 900MHz LPWAN Transmitter Module
Model Number / HVIN:	Birdirra
Manufacturer:	Taggle Systems Pty Ltd
Power Supply:	5V
Support Equipment:	Test Board, Antenna, USB cable, Host PC

Birdirra is a Low Power Wide Area Network (LPWAN) radio transmitter module designed to enable IoT devices to be connected to the Taggle network. The module operates in the 916-928MHz LIPD band in Australia/NZ and the 902-929.8MHz ISM band in North America.

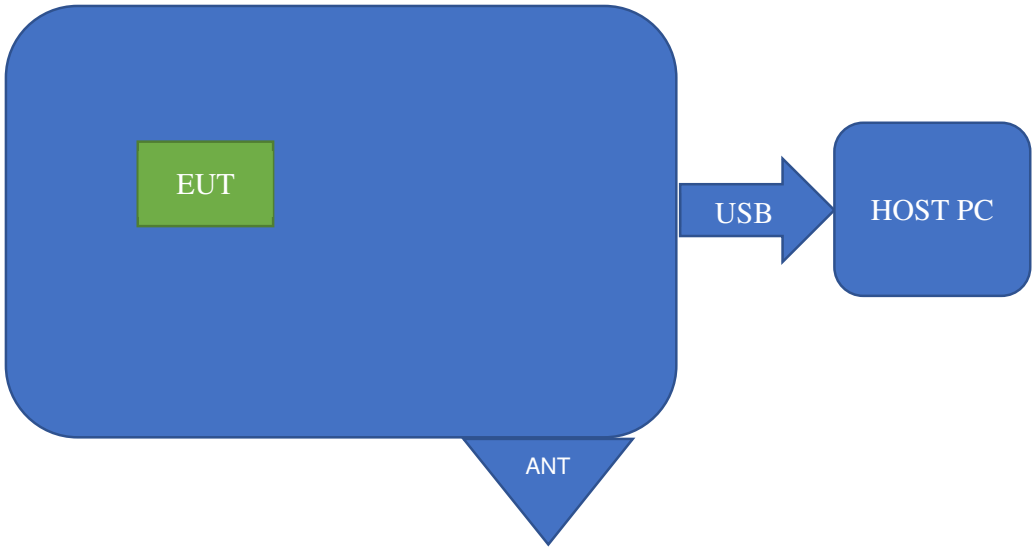
2.3 Test Configuration

Continuous modulated transmission mode is the only test mode required.

The module is transmit only. In normal mode of operation the device transmits 1 message per hour. Messages are ~0.45s in duration. The device will be shipped in test mode, which sets the module to transmit modulated output continuously. The device is a direct sequence spread spectrum (DSSS) transmitter with a data rate of 1172 bit/s, spread with a 4095 bit spreading code to yield a baud rate of 4.8Mbit/s. The modulation is BPSK, and the occupied bandwidth is 9.6MHz. The centre frequency is fixed at 922.0MHz

The module will be supplied on a test carrier board connected to a windows host computer via USB. The USB interface will power the module, and is used to enable/disable the test mode.

2.4 Block Diagram



2.5 Test Facility

2.5.1 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.

2.5.2 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	R038	Rohde & Schwarz EMI Receiver Model: ESU40 S/N: 100183 20Hz – 40GHz	11/04/20
	R029	Rohde & Schwarz EMI Test Receiver Model: ESCI S/N: 100012 9kHz – 3GHz	10/05/20
Antennas	A324	Double Ridged Horn Antenna 1-18GHz Model: EMCO 3115 S/N: 3823	29/01/21
	A430	Sunar RF Motion Model: JB1 S/N: A021318	08/03/21
Cables	SC028	13m RG214 N-Type, 0.1- 6000MHz	17/01/21
	SC041	Sucoflex 4m 10MHz - 18GHz Cable Model: SF104A/2x11N-47/4m	17/01/21

3.0 TEST RESULTS

3.1 §15.203/ RSS-Gen 8.3/ RSS-Gen 6.8 Antenna Requirement,

This test was not applicable as the antenna was considered support equipment according to customer's requirements. The antenna used was a Monopole Whip Antenna connected using an external connector with a gain of 2dBi.

No external RF power amplifiers were connected with the EUT radio apparatus during the test.

3.2 §15.205/RSS-Gen 8.10 Restricted Bands of Operation

The limits of §15.209 were applied across the applicable spectrum and therefore complied with the restricted band requirements.

3.3 §15.207/RSS-Gen 8.8 Conducted Limits

The limits given in §15.205 and §15.207 were applied.

3.4 §15.209/RSS-Gen 8.9 Radiated emission limits; general requirements

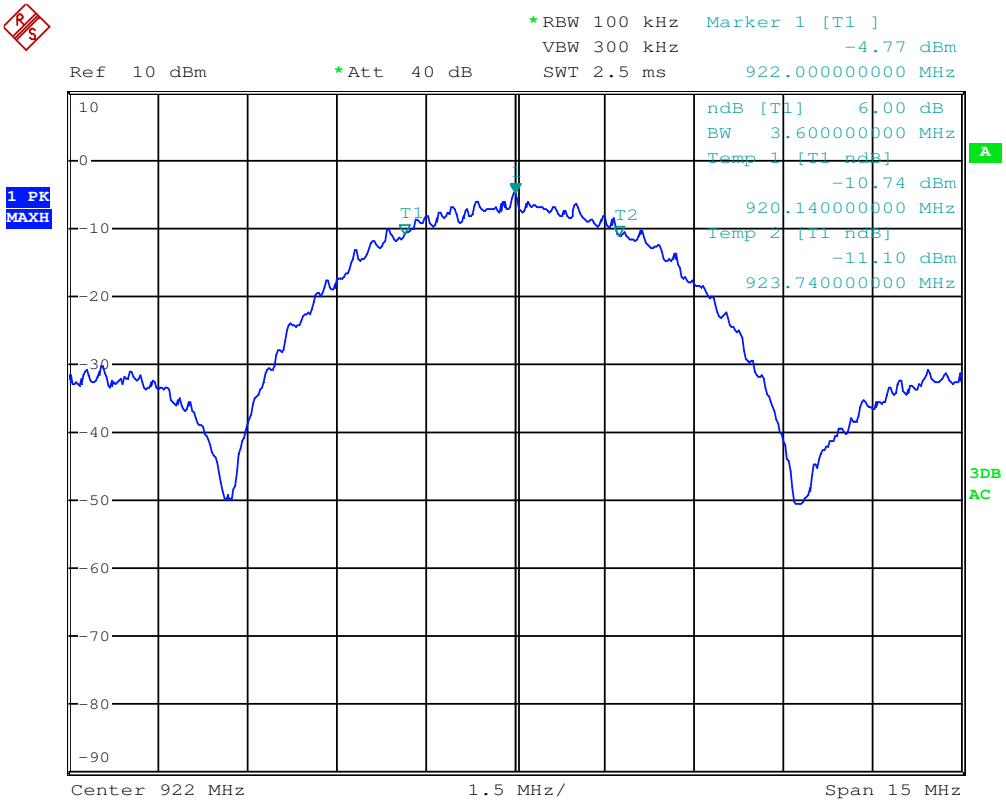
The limits given in §15.205, §15.209 and §15.247 were applied.

3.5 §15.247(a)/RSS-247 5.2(a) DTS Bandwidth

In the band 902 - 928 MHz, the minimum 6 dB bandwidth is to be at least 500 kHz. The 6 dB bandwidth was measured while the device was transmitting with typical modulation applied.

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised when measuring the bandwidth.

Centre Frequency [MHz]	Measured 6 dB Bandwidth [kHz]	Limit [kHz]	Result
922	3600	> 500	Complied



Date: 18.FEB.2020 09:36:26

3.6 §15.247(b)/RSS-247 5.4(d) Peak Output power

Testing was performed using a power meter. The limit for digital transmission systems operating in the 902-928MHz is 1 Watt.

1W=30dBm

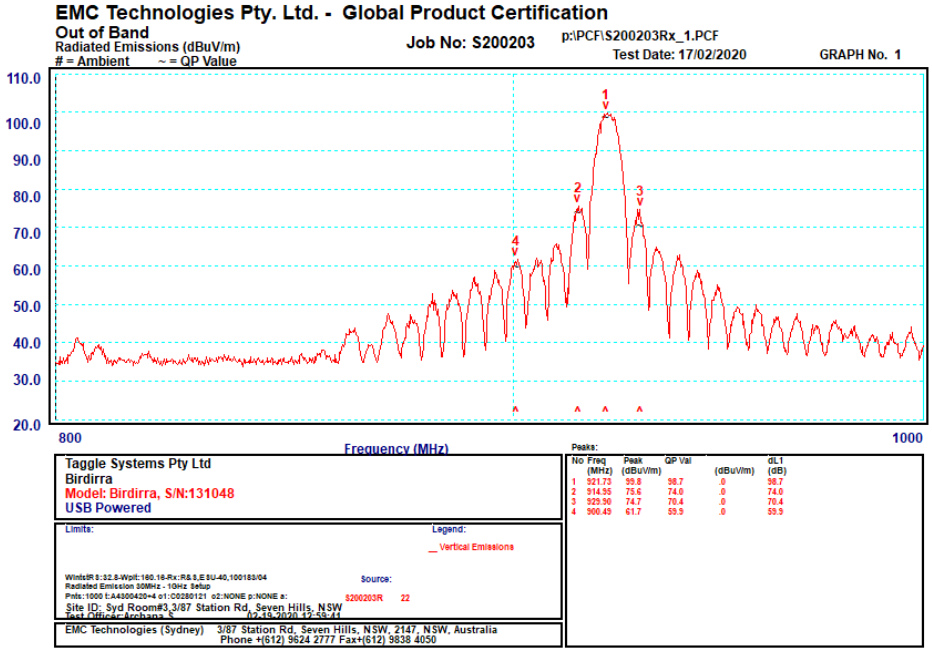
Centre Frequency [MHz]	Measured Peak Output Power [dBm]	Antenna Gain (dBi)	Result (dBm)	Limit	Result
922	13.9	2	15.9	30dBm	Complied

3.7 §15.247(d)/RSS-247 5.5 Out of Band Emissions

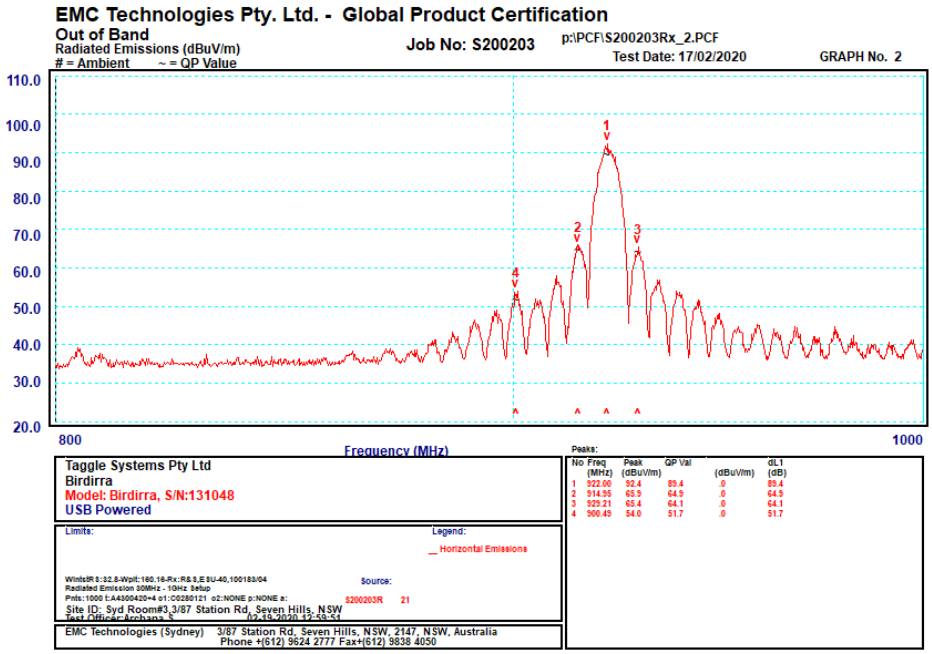
3.7.1 Band-Edge Emission Measurements

Emissions within 2 MHz of an authorised band edge were measured using the radiated method. All emissions above and below the edge of the authorised band were more than 20 dB below the in band intentional emission.

Graph 1 **Vertical Polarisation** **800 to 1000MHz**



Graph 2 **Horizontal Polarisation** **800 to 1000MHz**



3.8 CONDUCTED EMISSION MEASUREMENTS

The arrangement specified in ANSI C63.4: 2014 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: 2016 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. 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.

The various operating modes of the system were investigated. 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.

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$V_{EMI} = V_{Rx} + L$$

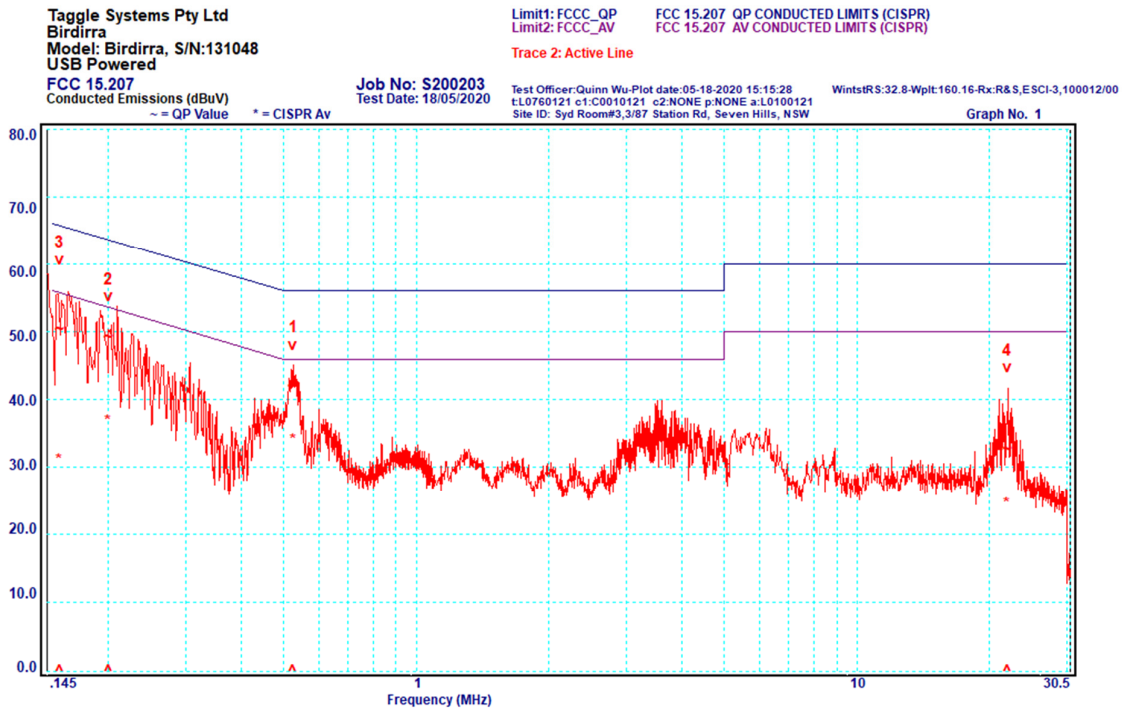
Where:
V_{EMI} = The Measured EMI voltage in dBµV to be compared to the limit.
V_{Rx} = The Voltage in dBµV read directly at the EMI receiver.
L = The insertion loss in dB of the LISN, cables and transient Limiter.

The measurement data pertaining to each frequency sub-range were concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph was subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

Frequency Band: 150 kHz - 30 MHz

The measurement of emissions between 150 kHz – 30MHz were made with a resolution bandwidth (RBW) of 9 kHz and the video bandwidth (VBW) of 30 kHz.

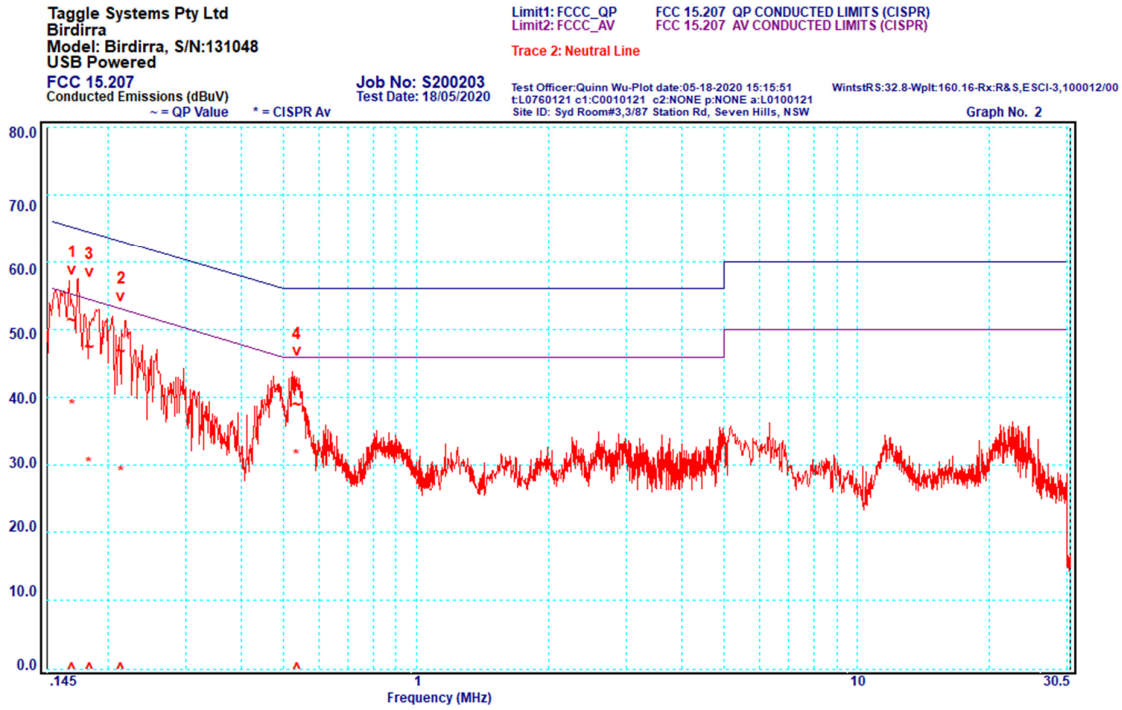
Graph 1 **Active Line** **150kHz to 30MHz**



Frequency [MHz]	Line	Quasi-Peak			Average		
		Level [dBµV]	Limit [dBµV]	Margin [±dB]	Level [dBµV]	Limit [dBµV]	Margin [±dB]
0.526	Active	42.1	56.0	-13.9	34.0	46.0	-12.0
0.20	Active	49.2	63.6	-14.4	36.8	53.6	-16.8
0.155	Active	50.4	65.7	-15.3	31.0	55.7	-24.7
21.92	Active	32.7	60.0	-27.3	24.5	50.0	-25.5

Complied with the limit by a margin greater than 10dB.

Graph 2 **Neutral Line** **150kHz to 30MHz**



Frequency [MHz]	Line	Quasi-Peak			Average		
		Level [dBµV]	Limit [dBµV]	Margin [±dB]	Level [dBµV]	Limit [dBµV]	Margin [±dB]
0.166	Neutral	51.3	65.2	-13.9	38.8	55.2	-16.4
0.214	Neutral	46.7	63.1	-16.4	28.9	53.1	-24.2
0.181	Neutral	47.3	64.4	-17.1	30.2	54.4	-24.2
0.537	Neutral	38.8	56.0	-17.2	31.4	46.0	-14.6

Complied with the limit by a margin greater than 10dB.

Conclusion

The spurious emissions complied with the general limits of FCC §15.205 and §15.207 by a margin more than 10dB.

3.9 Radiated Spurious Measurements

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 10 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

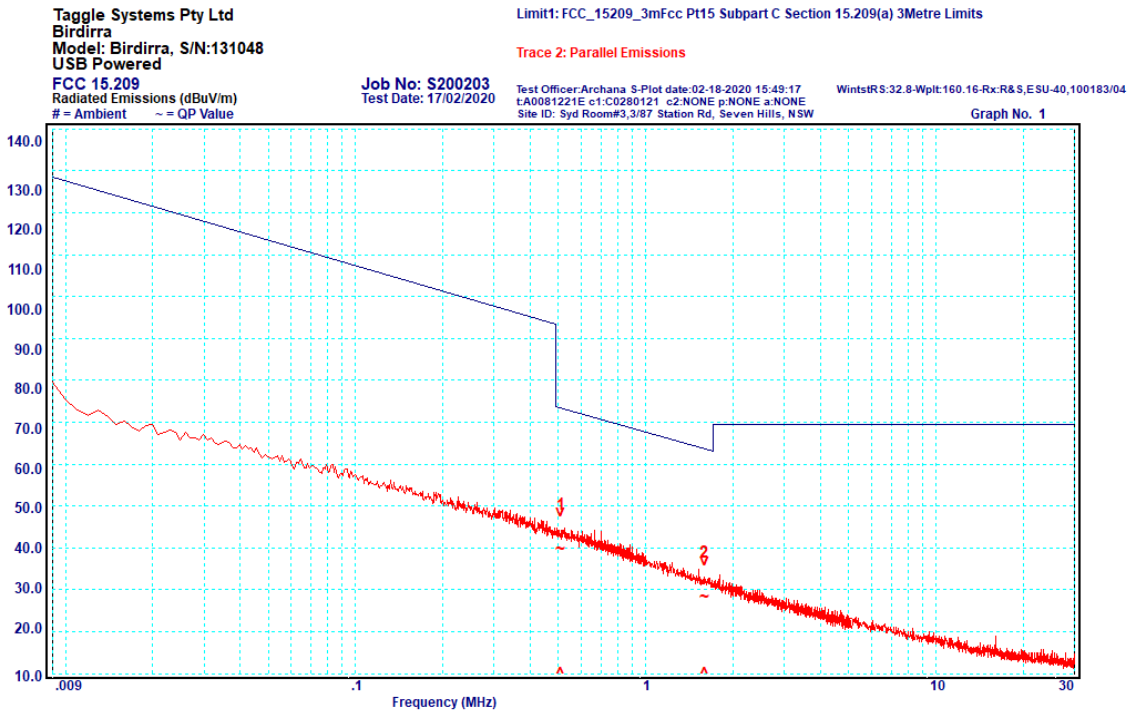
Where:

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.

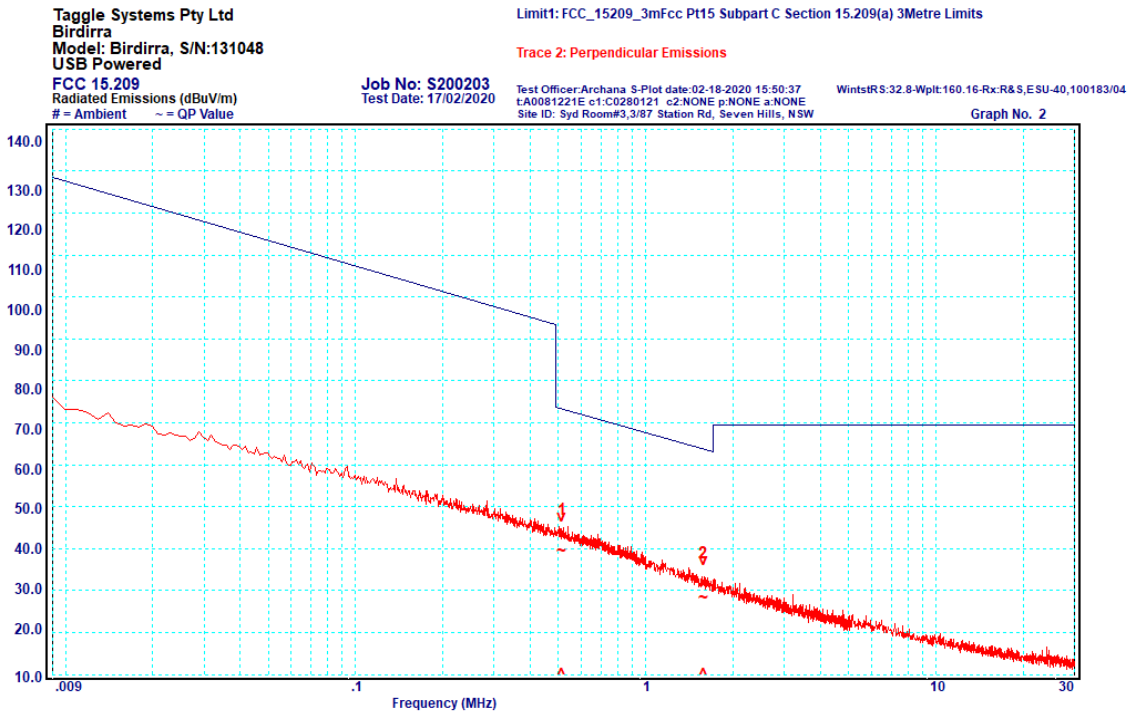
Graph 1 **Parallel Emissions** **9kHz to 30MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	0.51	Parallel	39.6	73.5	-33.9
2	1.59	Parallel	28.3	63.6	-35.3

Complied with the limit by a margin greater than 10dB.

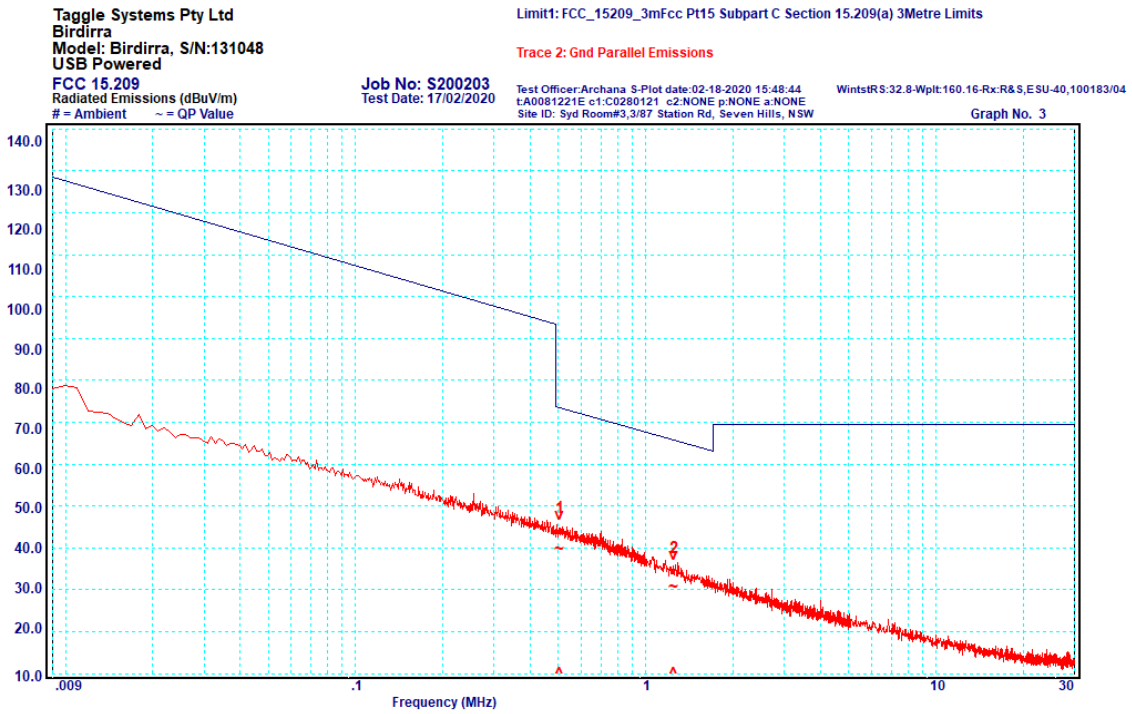
Graph 2 **Perpendicular Emissions** **9kHz to 30MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	0.516	Perpendicular	39.4	73.4	-34.0
2	1.576	Perpendicular	28.3	63.7	-35.4

Complied with the limit by a margin greater than 10dB.

Graph 3 **Ground Parallel Emissions** **9kHz to 30MHz**



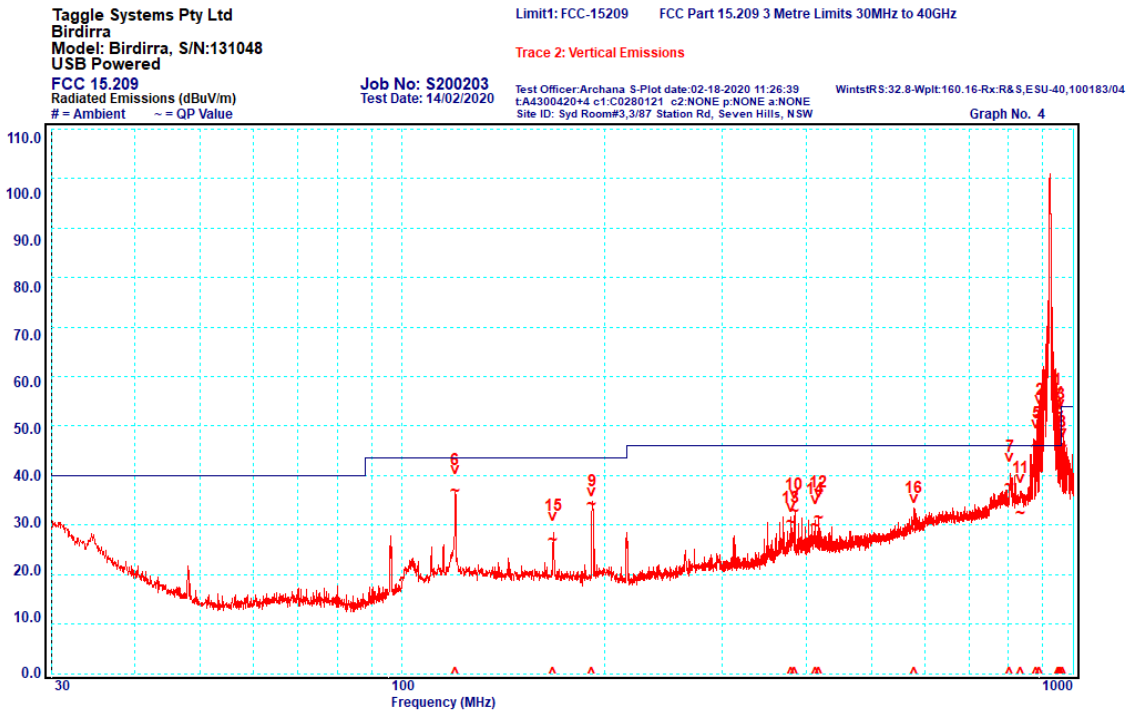
Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	0.506	Ground Parallel	39.6	73.5	-33.9
2	1.253	Ground Parallel	30.6	65.7	-35.1

Complied with the limit by a margin 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.

Graph 4 **Vertical Emissions** **30MHz to 1000MHz**

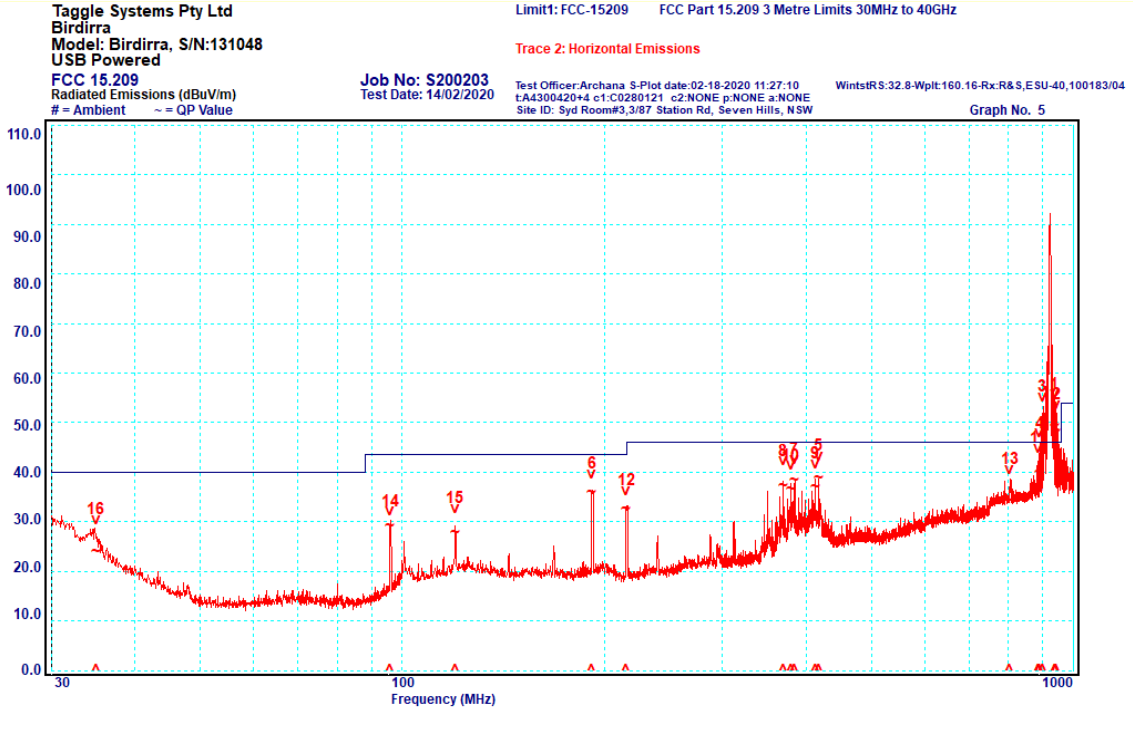


Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	948.14	Vertical	52.5	46.0	6.5**
2	890.88	Vertical	51.8	46.0	5.8**
3	957.74	Vertical	49.1	46.0	3.1**
4	953.08	Vertical	48.3	46.0	2.3**
5	881.18	Vertical	45.8	46.0	-0.2**
6	120.05	Vertical	36.8	43.5	-6.7
7	804.69	Vertical	37.9	46.0	-8.1
8	962.67	Vertical	45.8	54.0	-8.2
9	191.97	Vertical	34.0	43.5	-9.5
10	384.17	Vertical	32.8	46.0	-13.2
11	834.1	Vertical	32.3	46.0	-13.7
12	417.78	Vertical	31.3	46.0	-14.7
13	379.37	Vertical	30.5	46.0	-15.5
14	412.98	Vertical	29.9	46.0	-16.1
15	168.09	Vertical	26.9	43.5	-16.6
16	579.01	Vertical	28.9	46.0	-17.1

***This reading is caused by the intentional radiator.*

Complied with the limit by a margin of at least 6.7dB.

Graph 5 **Horizontal Emissions** **30MHz to 1000MHz**



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	938.87	Horizontal	49.4	46.0	3.4**
2	943.33	Horizontal	48.2	46.0	2.2**
3	900.12	Horizontal	47.5	46.0	1.5**
4	890.75	Horizontal	39.9	46.0	-6.1**
5	417.78	Horizontal	38.8	46.0	-7.2
6	192.04	Horizontal	35.8	43.5	-7.7
7	384.17	Horizontal	38.3	46.0	-7.7
8	369.76	Horizontal	37.3	46.0	-8.7
9	412.97	Horizontal	37.0	46.0	-9.0
10	379.37	Horizontal	36.6	46.0	-9.4
11	886.5	Horizontal	36.1	46.0	-9.9
12	215.88	Horizontal	32.4	43.5	-11.1
13	804.62	Horizontal	34.4	46.0	-11.6
14	96.04	Horizontal	29.1	43.5	-14.4
15	120.05	Horizontal	27.7	43.5	-15.8
16	35.02	Horizontal	24.0	40.0	-16.0

***This reading is caused by the intentional radiator.*

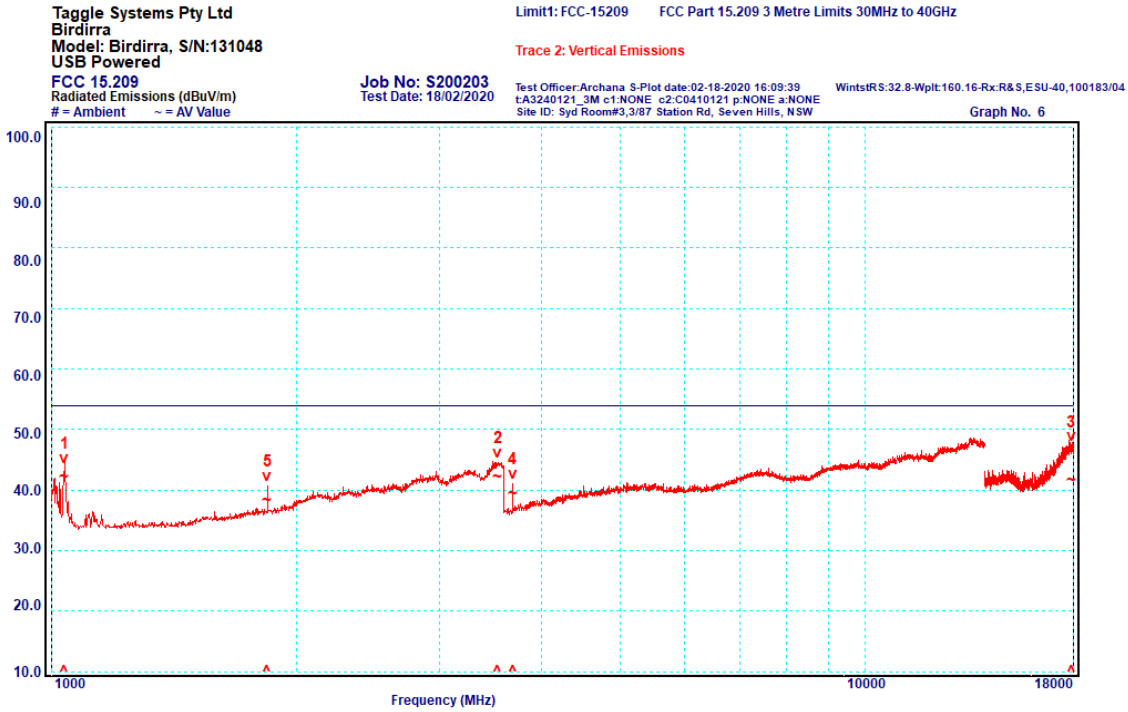
Complied with the limit by a margin of at least 7.2dB.

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.

Average Detector Emissions

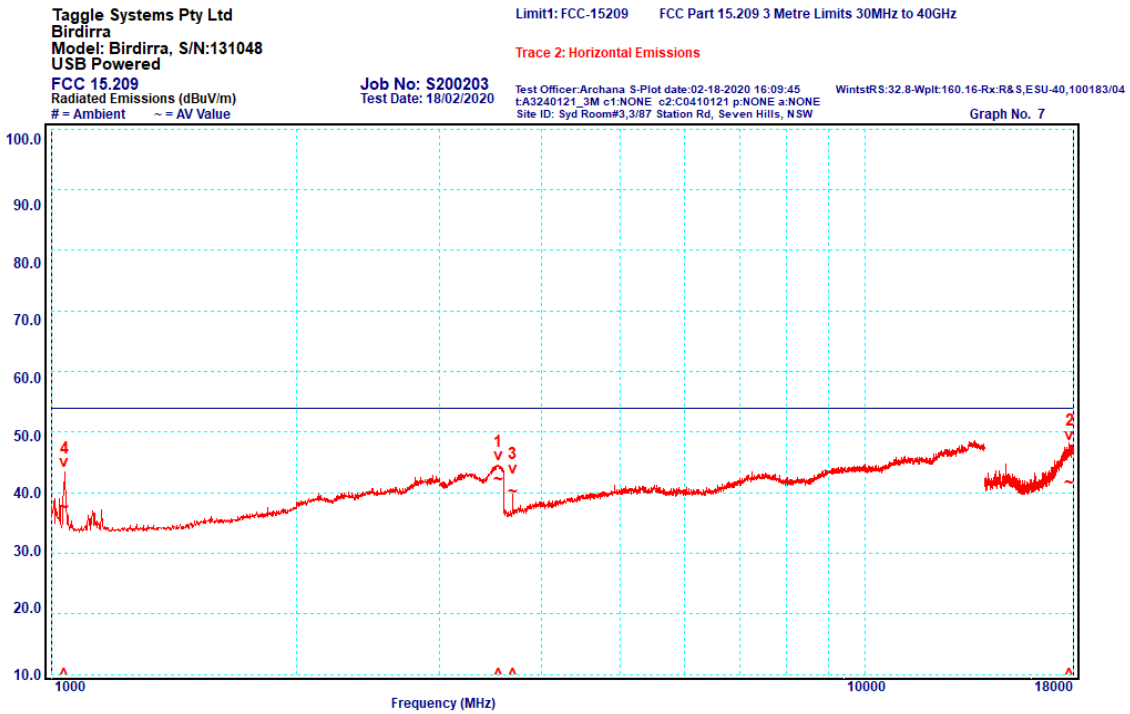
Graph 6 Vertical Emissions 1000MHz to 18000MHz



Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	1039.22	Vertical	42.2	54.0	-11.8
2	3534.58	Vertical	42.2	54.0	-11.8
3	17908.65	Vertical	41.6	54.0	-12.4
4	3688.02	Vertical	39.4	54.0	-14.6
5	1844.07	Vertical	38.3	54.0	-15.7

Complied with the limit by a margin of greater than 10dB.

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

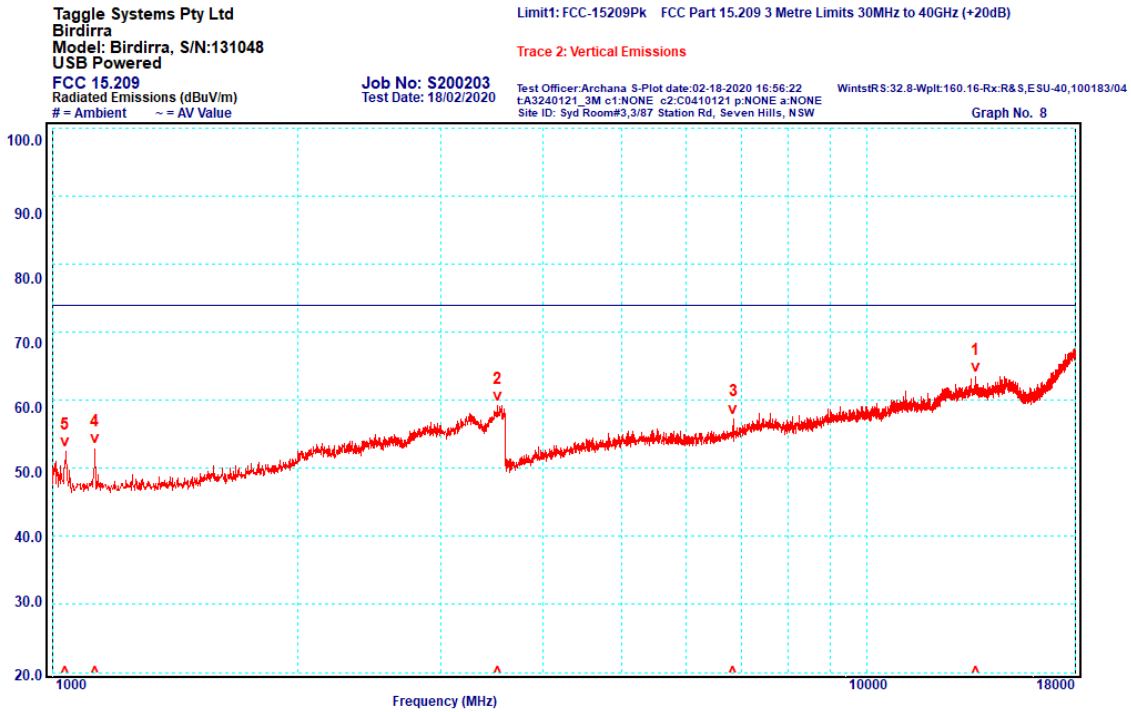


Peak	Frequency (MHz)	Antenna Polarisation	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	3541.05	Horizontal	42.2	54.0	-11.8
2	17821.13	Horizontal	41.6	54.0	-12.4
3	3687.95	Horizontal	40.2	54.0	-13.8
4	1039.18	Horizontal	37.6	54.0	-16.4

Complied with the limit by a margin greater than 10dB.

Peak Detector Emissions

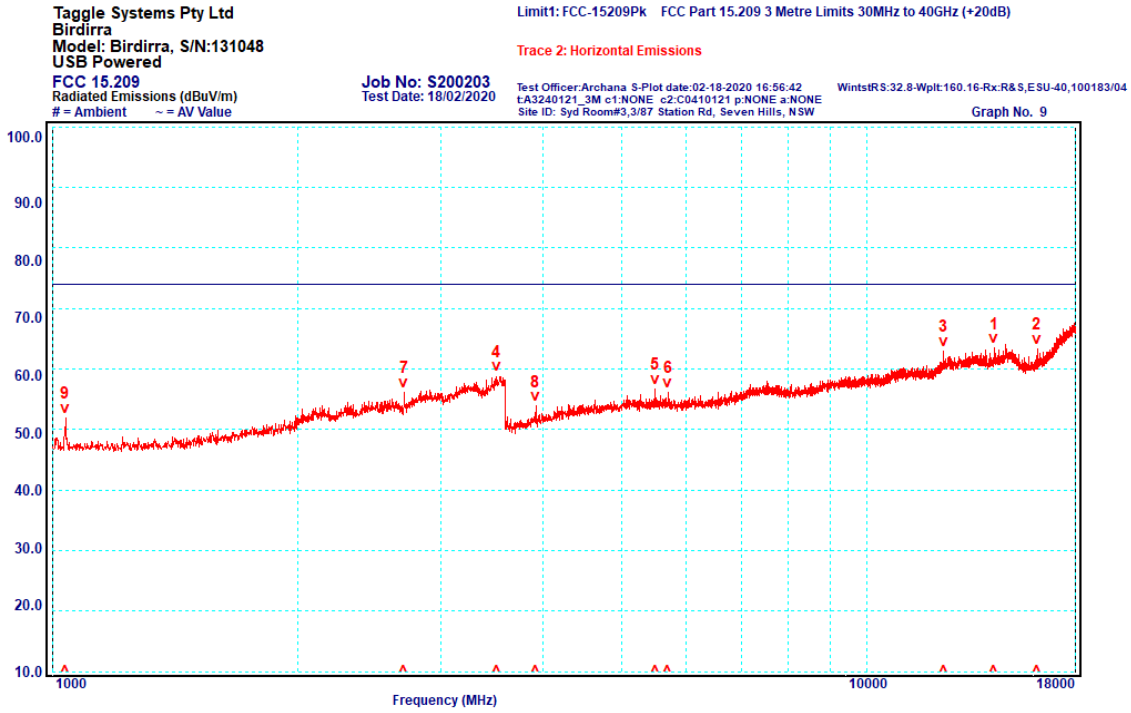
Graph 8 Vertical Emissions 1000MHz to 18000MHz



Peak	Frequency (MHz)	Antenna Polarisation	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	13581.38	Vertical	63.4	74.0	-10.6
2	3518.66	Vertical	59.2	74.0	-14.8
3	6851.38	Vertical	57.3	74.0	-16.7
4	1127.94	Vertical	53.0	74.0	-21.0
5	1037.98	Vertical	52.5	74.0	-21.5

Complied with the 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	14315.69	Horizontal	63.5	74.0	-10.5
2	16149.90	Horizontal	63.4	74.0	-10.6
3	12406.24	Horizontal	63.0	74.0	-11.0
4	3509.67	Horizontal	58.8	74.0	-15.2
5	5488.38	Horizontal	56.7	74.0	-17.3
6	5695.24	Horizontal	56.2	74.0	-17.8
7	2701.17	Horizontal	56.2	74.0	-17.8
8	3917.40	Horizontal	53.8	74.0	-20.2
9	1037.98	Horizontal	51.9	74.0	-22.1

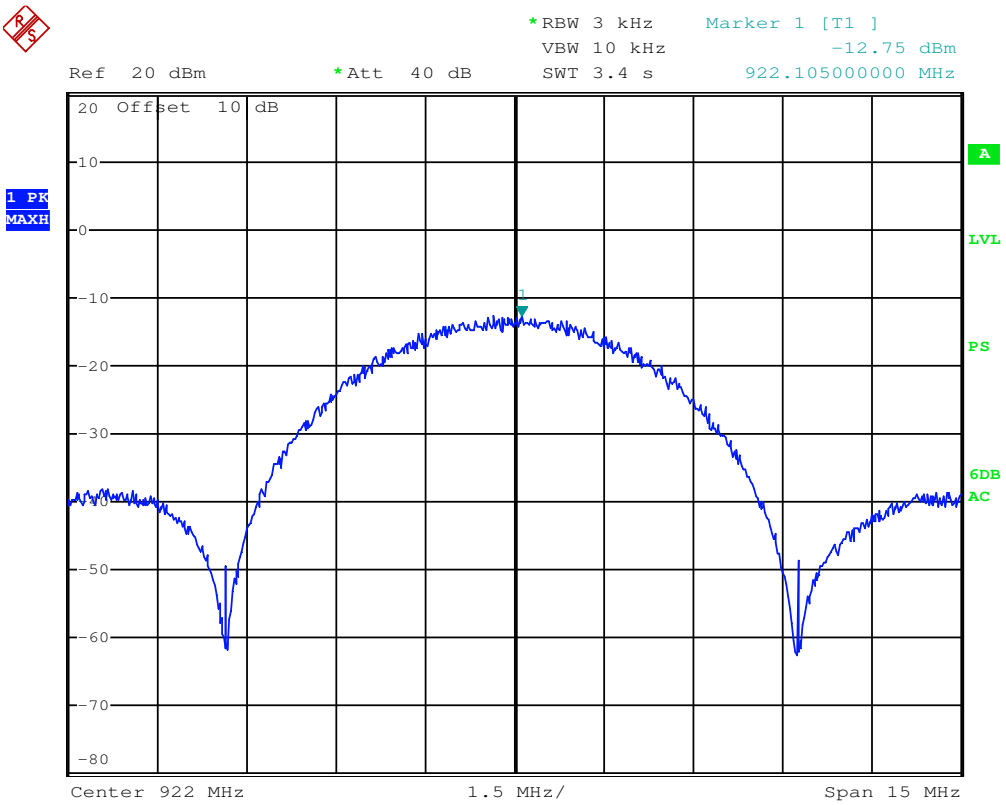
Complied with the limit by a margin of greater than 10dB.

Conclusion

The spurious emissions complied with the general limits of FCC §15.205 and §15.209 by a margin of 6.7 dB.

3.10 §15.247(e)/RSS-247 5.2(b) Power Spectral Density

Testing was performed via conducted method and the EUT was set to transmit in continuous transmission mode. Power spectral density is shown below, where the resolution bandwidth was 3 kHz.

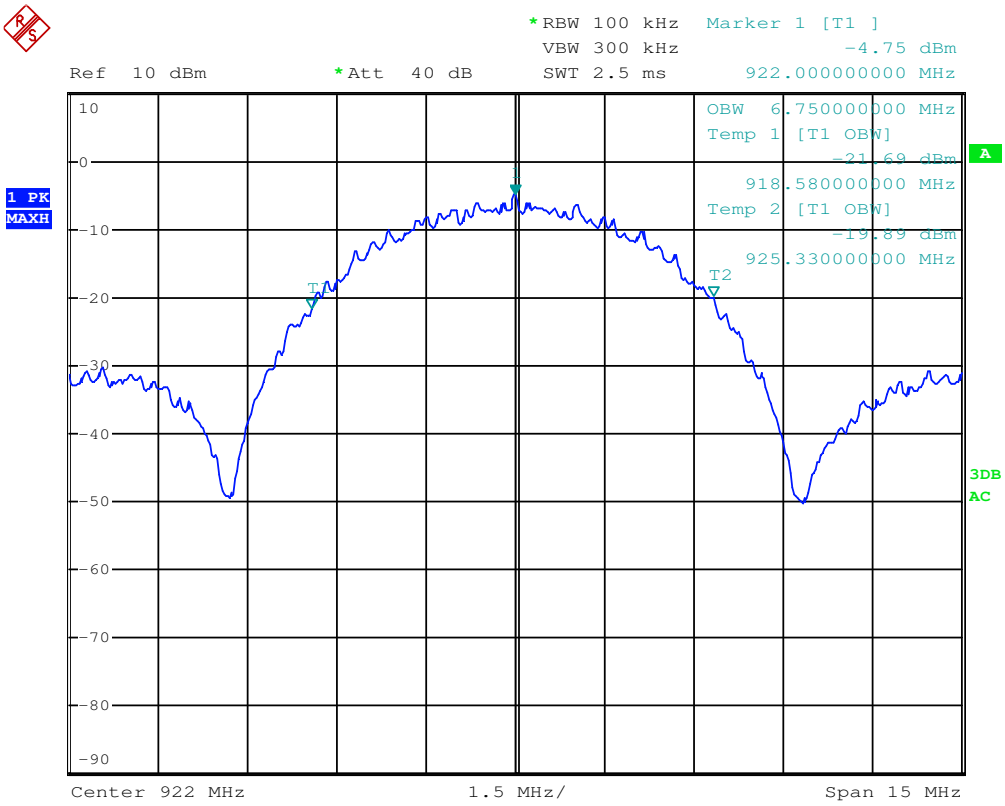


Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)	Result
922.105	-12.75	8.0	-20.75	Complied

3.11 §2.1049/RSS-Gen 6.6 Occupied bandwidth – 99% power

The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 section 6.9.

The 99% power bandwidth was **6.75 MHz**.



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3.12 §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 Permissible Exposure (MPE) limit defined in Table 1 for a transmitter operating at 922 MHz is:

MPE limit = $[f_{(MHz)}] \div 1500$ mW/cm^2
= $922 \div 1500$ mW/cm^2
= **0.61467 mW/cm^2 = 48.14 V/m** (V/m) = $\sqrt{(1200 \times \pi \times mW/cm^2)}$

Field strength = [$\sqrt{}$(30× transmitter EIRP, W)] ÷ [minimum separation distance, metres] **V/m**
= [$\sqrt{}$(30×0.0389)] ÷ 0.2m **V/m**
= **5.4 V/m = 0.0077 mW/cm^2** (mW/cm^2) = (V/m)^2 ÷ (1200×π)

As the calculated field strength generated by the transmitter is less than the limit, Birdirra 900MHz LPWAN Transmitter Module is deemed to comply with the radio frequency exposure requirements.

3.13 RSS-Gen 3.2/RSS-102 Maximum Permissible Exposure

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[Footnote21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

The Maximum Permissible Exposure (MPE) limit defined in Table 4 for a transmitter operating at 922 MHz is:

MPE limit = $3.142f^{0.3417}$ V/m=32.38 V/m
= $0.008335f^{0.3417}$ A/m=0.086 A/m
= $0.02619f^{0.6834}$ W/m²= 2.78W/m²

Field strength = [√(30× transmitter EIRP, W)] ÷ [minimum separation distance, metres] V/m
= [√(30×0.0389)] ÷ 0.2 V/m
= 5.4 V/m =0.0143 A/m= 0.077 W/m²

As the calculated field strength generated by the transmitter is less than the limit the Birdirra 900MHz LPWAN Transmitter Module is deemed to comply with the radio frequency exposure requirements.

According to RSS-102- section 2.5.2 **Exemption Limits for Routine Evaluation – RF Exposure Evaluation**: RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz.

Exemption Limit =1.31 x 10-2 f0.6834 W
=1.39 W

EIRP of EUT =0.0389W

As the EIRP generated by the transmitter is less than the limit the Birdirra 900MHz LPWAN Transmitter Module is deemed to comply with the Exemption Limits for Routine Evaluation. So Routine RF exposure Evaluation for the Birdirra 900MHz LPWAN Transmitter Module is exempt.

4.0 COMPLIANCE STATEMENT

The Birdirra 900MHz LPWAN Transmitter Module with Model Number: Birdirra tested on behalf of Taggle Systems Pty Ltd complied with all the applicable requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators) and RSS-247 Issue 2 for a Digital Transmission System (DTS) operating within the band: 902 MHz to 928 MHz.

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:

Conducted Emissions:	9 kHz to 30 MHz	±3.2 dB
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 Output Power:		±1.5 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%.