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EMC COMPLIANCE REPORT
FCC Certification Test Report
In accordance with:
CFR47 FCC Part 15, Subpart B (Class A)

Tait Limited

TBCH3X

Base Station with receive only

REPORT: E1710-0976
DATE: November, 2017

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

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Certificate of Compliance
EMC Certification Compliance Report
EMC Bayswater Test Report: E1710-0976
Issue Date: November, 2017

Product(s): Base Station with receive only
Model No: TBCH3X
Serial No: 18262612
Variant(s): None

Client Details:
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Tait Limited
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New Zealand

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Test Specification: CFR47 FCC Part 15, Subpart B (Class A)

Results Summary:

Radiated Emissions – CFR47 FCC Part 15, section 15.109	***Complied (Class A)***
Conducted Emissions – CFR47 FCC Part 15, section 15.107	***Complied (Class A)***

Additional testing: Asymmetric Mode Conducted Emissions at analogue/digital data ports – EN 55032:2015 + AC: 2016[1] ***Complied (Class A & B)***

[1] *Additional testing of Asymmetric Mode Conducted Emissions at Ethernet port was requested by customer*

Test Date(s): 30th of October and the 1st of November, 2017

Test House (Issued By)
EMC Bayswater Pty Ltd
18/88 Merrindale Drive
Croydon South
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FCC Accredited Test Firm Registration number: 527798
FCC 2.498 Test Firm Registration number: 419968

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This is to certify that the necessary measurements were made by EMC Bayswater Pty Ltd, and that the Tait Limited, TBCH3X, Base Station with receive only (Serial No: 18262612), has been tested in accordance with requirements contained in the appropriate commission regulations.

Prepared & tested by:	Tested by:	Approved by:	
			09/11/2017 15:05
Alvin Tan (EMC Test Officer)	Fabio D'Amico (EMC Test Officer)	Clint Finch (Manager)	Date

EMC Compliance Report
for
Tait Limited

Contents

1. Introduction

Electromagnetic Compatibility (EMC) tests were performed on a Tait Limited, TBCH3X Base Station with receive only in accordance with the requirements of Title 47 of the standard CFR47 FCC Part 15, Subpart B (Class A).

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, 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 constitute fraud and shall nullify the document.

4. Summary of Results

The EUT complied with the CFR47 FCC Part 15, Subpart B, Class A, Conducted (section 15.107) and Radiated Emissions (section 15.109) requirements. Worst-case emissions are tabled as follows:

Test	Result
Radiated Emissions (Horizontal Antenna Polarisation)	Complied with quasi-peak limit by 10.2dB
	Complied with peak limit by >20.0dB
	Complied with average limit by 16.4dB
Radiated Emissions (Vertical Antenna Polarisation)	Complied with quasi-peak limit by 9.2dB
	Complied with peak limit by >20.0dB
	Complied with average limit by 28.2dB
Conducted Emissions (Active Line)	Complied with quasi-peak limit by 21.5dB
	Complied with average limit by 12.6dB
Conducted Emissions (Neutral Line)	Complied with quasi-peak limit by 21.5dB
	Complied with average limit by 12.7dB

Table 1: Summary of test results

5. Product Sample, Configuration & Modifications

5.1. Product Sample Details

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

Product:	Base Station with receive only
Model No:	TBCH3X
Variant:	None
Serial No:	18262612
Firmware:	Not stated
Software:	Not stated
Power Specifications	120AC, 60Hz single phase AC mains input
Dimensions:	50 cm x 60 cm x 30cm (Length x Width x Height)
Weight:	17kg
EUT Type:	Table Top i.e. not floor standing, wall mounted or suspended.
Orientation:	The EUT is typically used in one orientation only
Any incorporated radio transmitter, receiver or transceiver	FCC ID: CASTBCH3X ISED ID: 737ATBCH3X

(Customer supplied product information)

5.2. Product description

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

"Base Station with receive only"

(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 520MHz.

The EUT has been identified as class A digital device or peripheral by the customer. The following or similar warning shall be included in the instructions for use:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

5.3. Support Equipment

Support Equipment: 1	Description:	12V Automotive Battery
	Manufacturer:	Power Breed
	Model:	PBN70MFL
	Serial number:	Not stated
Support Equipment: 2	Description:	Router
	Manufacturer:	Netgear
	Model:	DEVG2020
	Serial number:	31P538BR00ADC
Support Equipment: 3	Description:	Dell Inspiron Laptop
	Manufacturer:	Dell
	Model:	PP12L
	Serial number:	31P538BR00ADC

5.4. Product operating modes

The customer described the products normal operation modes as the following:

The EUT can be configured to Channel 1 (470.1MHz) or Channel 2 (519.9MHz).

(Customer supplied product operating mode information)

5.5. Product operating mode for testing

The customer supplied information stating the

"Worst Configuration:
Channel 1 470.1MHz
Channel 2 519.9MHz"

(Customer supplied product operating mode information)

The customer provided instructions on how to configure EUT for testing using a login screen via a Ethernet and using a IP and the supplied credentials.

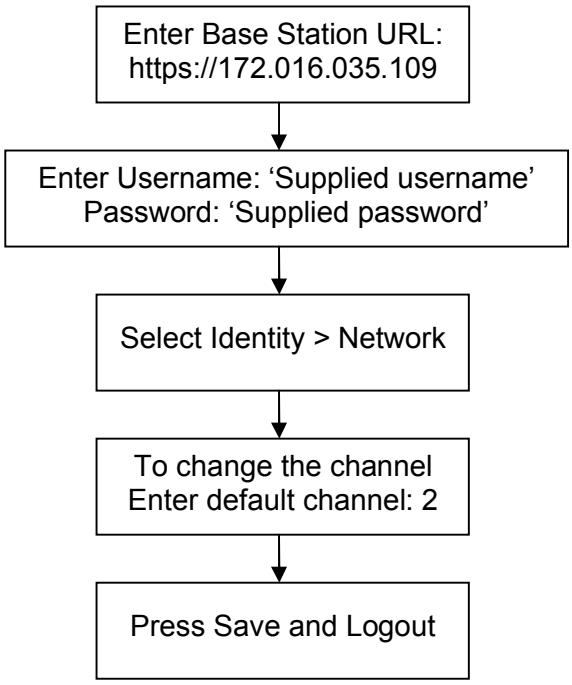
5.6. EUT Configuration

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

The EUT was powered via 120VAC, 60Hz AC Mains. The EUT was configured to the worst case configuration, Channel 2 using 519.9MHz. The EUT's ports, 1PPs and REF was terminated directly using 50Ω load. The EUT's receiving antenna port was terminated with 50Ω load using 1.9m coaxial cable. To setup the Channel 2 receiving frequency, the EUT was configured using customer instruction manual via Ethernet port. The customer instructed to left the 25 pin D-type connected un-terminated. The EUT's Serial port was terminated using a laptop's 2 pin RJ11 socket.

Radiated emissions (30MHz to 1GHz) pre-scans of the EUT using CH1 and CH2 were performed to determine the worst case configuration. Based on the measurement graphs in Appendix C, the worst configuration of the EUT was using CH2 as the receiving frequency. CH2 was used for all formal testing.

To setup the EUT using the EUT internal software with the laptop via the Ethernet connection, the following procedures were used to change the receiving frequency channel:



As per section 6.2.4 - EUT ports (or terminals) of ANSI C63.4 – 2014

a) Interconnecting cables or wires shall be connected to one of each type of functional port of the EUT, and shall be terminated in a device typical of actual usage. Where there are identical multiple ports, additional connecting cables or wires shall be added to these ports to determine the effect these cables or wires have on both radiated and conducted emissions from the EUT.

b) ANSI C63.4 implements the 2 dB rule for additional cables/wires.
Using the emission with the smallest margin of compliance to the applicable limit, additional cables shall be added to ensure the magnitude of the emission of interest does not increase by more than 2 dB and that additional cables don't cause a further increase in the emission. If the magnitude does increase with additional cables then these cables should be added. The configuration of cables that yield the highest emission shall be used to demonstrate compliance. The 2dB variation of emissions with a large margin of compliance with respect to the limit is allowed, because only emissions closest to the limit are relevant for demonstrating compliance.

The 2 dB rule also applies to the addition of identical modules to a EUT that accepts multiple modules (see section 6.2.7 of ANSI C63.4 – 2014).

NOTE - Typically, the loading of similar connectors, terminals, or ports is limited by the following:
— Availability of multiple loads (for large systems)
— Reasonableness of multiple loads representing a typical installation

The customer specified the worst-case configuration prior to testing and it is assumed that the additional cable/modules variation determination (when applicable)

with respect to the emissions was determined prior formal testing by the customer. The customer declared that where there were multiple interface ports of the same type, adding additional cables to those interface ports did not vary the emission by more than 2dB. At the request of the customer EMC Bayswater did not conduct testing with additional signal cables as specified with in section 6.2.4 - EUT ports (or terminals) of ANSI C63.4 – 2014.

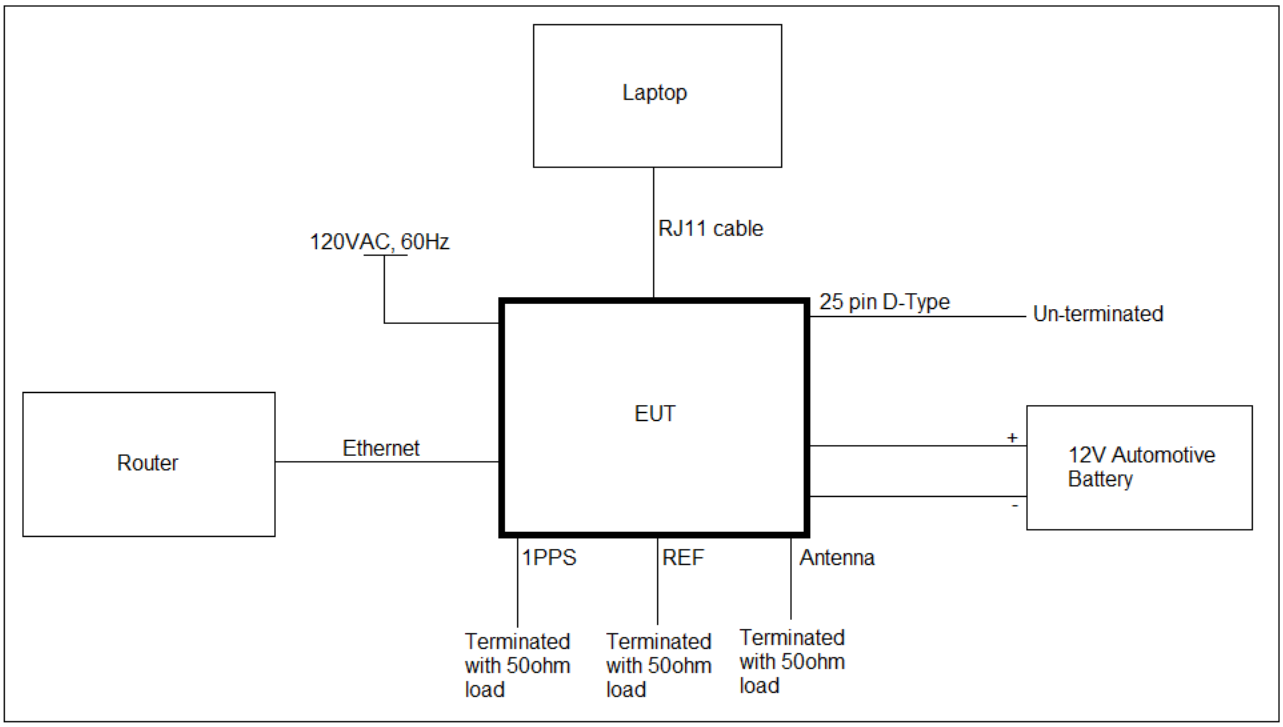


Table 2: Block diagram of EUT test configuration

Port	Cable type	Shielded	Length (m)	Cable Brand	Cable Model	Termination
1 x AC Mains input	3 core	No	2m	Not Stated	Not Stated	Mains
Aux 12VDC, 3.3A Output	2 core	No	10m	Not Stated	Not Stated	Automotive car battery
1PPS	BNC Coaxial	Yes	N/A	Not Stated	Not Stated	50ΩResistive load
REF	BNC Coaxial	Yes	N/A	Not Stated	Not Stated	50ΩResistive load
Antenna	BNC Coaxial	Yes	1.9m	Not Stated	Not Stated	50ΩResistive load
Ethernet	RJ45, Cat 5	No	10m	Not Stated	Not Stated	Internet Switch
Serial	RJ11	No	1m	Not Stated	Not Stated	Laptop
25 pin D-Type	Standard 25 pin D-Type	Yes	2.9m	Not Stated	Not Stated	Un-terminated*

**Customer confirmed/specified that un-terminated was acceptable for testing*

Table 3: List of ports, loads and cable lengths used for testing

5.7. Modifications

EMC Bayswater Pty Ltd did not modify the EUT.

6. Test Facility & Equipment

6.1. Test Facility

Conducted Emissions measurements were performed inside a shielded chamber at EMC Bayswater Pty Ltd, located at 18/88 Merrindale Drive, Croydon South, Victoria, 3136, Australia.

Radiated Emissions measurements were taken in the indoor Open Area Test Site (iOATS) facility at EMC Bayswater Pty Ltd, located at 18/88 Merrindale Drive, Croydon South, Victoria, 3136, Australia.

EMC Bayswater Pty Ltd's FCC Accredited Test Firm Registration number: 527798.

EMC Bayswater Pty Ltd's FCC 2.498 Test Firm Registration number: 419968.

6.2. Test Equipment

Refer to Appendix A for the measurement instrument list.

7. Referenced Standards

CFR47 FCC Part 15, Subpart B

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.

Test Plan
None supplied

8. Radiated Emissions

8.1. Test Procedure

Radiated Emissions 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 table, at a height of 0.8m above the ground plane.

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 1GHz to 6GHz 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 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 3 MHz. 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 1 second with a number of repetitions to ensure a minimum observation time of 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.

Horn	Frequency (GHz)	Degrees	Measuring Distance (m)	Illumination (m)	Measuring Distance (m	Illumination (m)
EMCO 3115	1 to 2	55.00	3	3.12	1	1.04
	2 to 4	50.00	3	2.80	1	0.93
	4 to 6	34.00	3	1.83	1	0.61

Table 1: Worst case Maximum size of measuring envelope for Horn antennas

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 1 to 5 in Appendix B for views of the test configuration)

8.2. Limits

The EUT shall meet the limits in the following table:

Frequency Range (MHz)	Measuring distance	Limits (dBµV/m)	
		Quasi-Peak	
30 to 88	3m	49.0	
88 to 216	3m	53.5	
216 to 960	3m	56.4	
960 to 1000	3m	59.5	
Frequency Range (GHz)	**Measuring distance**	**Limits (dBµV/m)**	
		Average	**Peak**
1 to 6	3m	59.5	79.5
NOTE The lower limit shall apply at the transition frequency.			

Table 4: Limits for Radiated Emissions of Class A equipment

8.3. Test Results

Radiated Emissions measurements are tabulated below. For below 1GHz measurements, Quasi-peak 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 CISPR 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 8 in Appendix C)

Frequency (MHz)	Result Quasi-peak (dBμV/m)	Limit Quasi-peak (dBμV/m)	Delta limit (dB)
245.728	46.2	56.4	**-10.2***
249.996	34.1	56.4	-22.3
300.000	30.9	56.4	-25.5
307.178	32.1	56.4	-24.3
368.627	27.8	56.4	-28.6

**Worst-case emission*

Table 5: Radiated Emissions – Horizontal Antenna Polarisation (<1GHz) – CH2

Peak Measurements				Average Measurements			
Frequency (MHz)	Result (dBμV/m)	Limit (dBμV/m)	Delta Limit (dB)	Frequency (MHz)	Result (dBμV/m)	Limit (dBμV/m)	Delta Limit (dB)
All Peak emissions were more than 20dB below the Peak Limit				1167.180	27.3	59.5	-32.2
				1374.920	30.0	59.5	-29.5
				1399.620	25.5	59.5	-35.9
				1720.200	31.2	59.5	-28.3
				2027.520	30.9	59.5	-28.6
				4129.920	43.1	59.5	**-16.4***

**Worst-case emission*

Table 6: Radiated Emissions – Horizontal Antenna Polarisation (>1GHz) – CH2

Frequency (MHz)	Result Quasi-peak (dBμV/m)	Limit Quasi-peak (dBμV/m)	Delta limit (dB)
40.088	22.6	49.0	-26.4
245.728	47.2	56.4	**-9.2***
249.996	34.6	56.4	-21.8
300.000	29.5	56.4	-26.9
307.226	30.1	56.4	-26.3

**Worst-case emission*

Table 7: Radiated Emissions – Vertical Antenna Polarisation (<1GHz) – CH2

Peak Measurements				Average Measurements			
Frequency (MHz)	Result (dBμV/m)	Limit (dBμV/m)	Delta Limit (dB)	Frequency (MHz)	Result (dBμV/m)	Limit (dBμV/m)	Delta Limit (dB)
All Peak emissions were more than 20dB below the Peak Limit				1720.200	30.6	59.5	-28.9
				2027.520	31.3	59.5	**-28.2***

**Worst-case emission*

Table 8: Radiated Emissions – Vertical Antenna Polarisation (>1GHz) – CH2

The measurement uncertainty was calculated as follows:

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

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:	19 - 20°C
Humidity:	42 - 43%
Atmospheric pressure:	1005.7hPa

Table 9: Climatic conditions

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

$$E = V_{QP/PK/AV} + AF - G_{Amp} + L_C$$

Where:

E	=	E-field in dBμV/m
$V_{QP/PK/AV}$	=	Measured Voltage (Quasi Peak, Peak or Average) in dBμV
AF	=	Antenna Factor in dB(/m)
L_C	=	Cable and attenuator Loss in dB
G_{Amp}	=	Pre Amplifier Voltage Gain in dB

Example calculation:

$E = V_{QP} + AF - G_{Amp} + L_C$
$E = 30dB\mu V + 12dB/m - 0dB + 2.3dB$
$E = 44.3\ dB\mu V/m$

Comments: All Radiated Emissions measurements were below the Class A limit.

Radiated emissions (30MHz to 1GHz) pre-scans of the EUT using CH1 and CH2 were performed to determine the worst case configuration. Based on the measurement graphs in Appendix C, the worst configuration of the EUT was using CH2 as the receiving frequency.

If the highest frequency generated or used within the device or on which the device operates or tunes is between 500MHz and 1000MHz, the upper frequency of measurement range should be 5000MHz.

The highest frequency of the EUT as specified by the customer is 520MHz as such measurements up to 6GHz were taken.

Assessment: The EUT complied with the Radiated Emissions requirements of CFR47 FCC Part 15, Subpart B (Class A) section 15.109.

9. Conducted Emissions

9.1. Test Procedure

The EUT was positioned 0.4m from the vertical ground reference plane (chamber wall) and 0.8m above a horizontal ground reference plane (chamber floor) with the mains cable connected to the power port of a LISN, located 0.8 metres away. The measuring port of the LISN was connected to the measuring receiver. In order to avoid unwanted ambient signals, power to the LISN was supplied via power line filters fitted to the shielded enclosure wall.

The mains flexible cord provided by the manufacturer is required to be 1m long for these measurements. If the manufacturer supplies a non-removable power lead, in excess of 1m, the cable in excess of 1m is folded at the centre into a bundle no longer than 0.4m in length.

Preview scan measurements were performed using a peak and an average detector of the EMI receiver with a resolution bandwidth of 9 kHz. The scan measurements frequency step size of the EMI receiver was set to less then half of the resolution bandwidth.The final quasi-peak and CISPR average measurements were performed at spot frequencies where the preview peak or average emission was close to, or exceeded the applicable limit line with a receiver bandwidth of 6dB and a resolution bandwidth of 9 kHz. The final measurements were performed using a measuring time of no less than 15 seconds.

Both the active and neutral lines were measured, in turn. Plots of the accumulated measurement data for both active and neutral terminals, 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 photograph 6 in Appendix B for a view of the test configuration)

9.2. Limits

The EUT shall meet the limits in the following table:

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-Peak	Average
0.15 to 0.50	79	66
0.5 to 30	73	60
NOTE 1 The lower limit shall apply at the transition frequencies.		

Table 10: Limits for Conducted Emissions at the mains ports of Class A equipment

9.3. Test Results

Conducted Emissions measurements are tabulated below. Quasi-peak or CISPR 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 1 & 2 in Appendix C)

Quasi - Peak Measurements				Average Measurements			
Frequency (MHz)	Result (dBµV)	Limit (dBµV)	Delta Limit (dB)	Frequency (MHz)	Result (dBµV)	Limit (dBµV)	Delta Limit (dB)
0.170	38.1	79.0	-40.9	0.226	33.7	66.0	-32.3
0.226	36.6	79.0	-42.4	0.282	20.5	66.0	-45.5
0.282	32.3	79.0	-46.7	0.334	40.3	66.0	-25.7
0.334	44.2	79.0	-34.8	0.394	19.8	66.0	-46.2
0.394	35.0	79.0	-44.0	0.446	45.9	66.0	-20.1
0.446	52.4	79.0	-26.6	0.506	23.0	60.0	-37.0
0.502	46.0	73.0	-27.0	0.558	47.4	60.0	**-12.6***
0.558	51.5	73.0	**-21.5***	0.670	37.2	60.0	-22.8
0.614	33.1	73.0	-39.9	0.782	39.4	60.0	-20.6
0.670	41.6	73.0	-31.4	0.894	38.2	60.0	-21.8
0.782	43.2	73.0	-29.8	0.226	33.7	66.0	-32.3
0.838	33.9	73.0	-39.1	0.282	20.5	66.0	-45.5
0.894	42.8	73.0	-30.2	0.334	40.3	66.0	-25.7

** Worst-case emissions*

Table 11: Conducted Emissions – Active Line

Quasi - Peak Measurements				Average Measurements			
Frequency (MHz)	Result (dBµV)	Limit (dBµV)	Delta Limit (dB)	Frequency (MHz)	Result (dBµV)	Limit (dBµV)	Delta Limit (dB)
0.170	39.2	79.0	-39.8	0.222	37.1	66.0	-28.9
0.222	39.8	79.0	-39.2	0.334	38.7	66.0	-27.3
0.278	31.5	79.0	-47.5	0.446	45.3	66.0	-20.7
0.334	42.9	79.0	-36.1	0.502	25.3	60.0	-34.7
0.390	36.8	79.0	-42.2	0.558	47.3	60.0	**-12.7***
0.446	51.9	79.0	-27.2	0.670	37.4	60.0	-22.6
0.502	45.9	73.0	-27.1	0.782	38.5	60.0	-21.5
0.558	51.5	73.0	**-21.5***	0.890	39.6	60.0	-20.4
0.614	34.0	73.0	-39.0	1.004	24.4	60.0	-35.6
0.670	41.3	73.0	-31.7				
0.778	44.2	73.0	-28.8				
0.838	34.3	73.0	-38.7				
0.890	44.0	73.0	-29.0				
1.004	29.1	73.0	-43.9				
9.984	20.6	73.0	-52.4				

** Worst-case emissions*

Table 12: Conducted Emissions – Neutral Line

The measurement uncertainty was calculated as follows:

Measurement frequency range	Calculated measurement uncertainty
0.15MHz to 30MHz	±2.88dB

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:	17 - 19°C
Humidity:	49-53%
Atmospheric pressure:	1019.2hPa

Table 13: Climatic Conditions

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

$$V = V_{QP/AV} + VLISN + L_C + L_T$$

Where:

V = Corrected Voltage Amplitude in dBµV
$V_{QP/AV}$ = Measured Voltage (Quasi Peak or Average) in dBµV
$VLISN$ = Line Impedance Stabilization Network Factor in dB
L_C = Cable/attenuator Loss in dB
L_T = Transient Protection Network Loss in dB

Example calculation:

$V = V_{QP} + VLISN + L_C + L_T$
V = 15 dBµV + 10.1dB + 11.5dB + 10.1dB
V = 46.7 dBµV

Comments: Conducted Emissions measurements were below the Class A limit.

Assessment: The EUT complied with the Conducted Emissions requirements of CFR47 FCC Part 15, Subpart B (Class A) section 15.107.

10. EN 55032: 2015 + AC: 2016 - Asymmetric Mode Conducted Emissions

The customer requested to perform conducted emissions testing of the wired port (Telecommunication port) in accordance with EN 55032: 2015 + AC: 2016. This is not required under the current scope of CFR47 FCC Part 15, Subpart B (Class A). The customer did not specify a limit, as such both limits have been included and the compliance statement made upon the Class B limit. If the EUT complies with the Class B requirements it is deemed to comply with the Class A requirements.

10.1. Test Procedure

Asymmetric Mode Conducted Emissions measurements are applicable to; wired network ports, optical fibre ports with metallic shield or tension members, broadcast receiver tuner ports and antenna ports.

The EUT was positioned 0.4m from the vertical ground reference plane (chamber wall) and 0.8m above a horizontal ground reference plane (chamber floor) with the primary power cable (if applicable) connected to the power port of an AMN located 0.8m away.

The mains primary power cable (if applicable) provided by the manufacturer is required to be 1m long for these measurements. If the manufacturer supplies a non-removable power lead, in excess of 1m, the cable in excess of 1m is folded at the centre into a bundle no longer than 0.4m in length.

Measurements were made at balanced unscreened wired network ports in accordance with C.4.1.6.2 of EN 55032: 2015 + AC: 2016.

Measurements were made at wired network ports using Asymmetric Artificial Networks (AANs) with longitudinal conversion losses as defined in table C.2 of the standard.

The limits are derived for use with an AAN which represents a common mode (asymmetrical mode) impedance of 150Ω to the port under test.

Measurements were then taken at each frequency with the selected AAN, for each cable in turn, and compared with the specified voltage limits.

Preview scan measurements were performed using a peak and an average detector of the EMI receiver with a resolution bandwidth of 9kHz. The scan measurements frequency step size of the EMI receiver was set to less then half of the resolution bandwidth.The final quasi-peak and CISPR average measurements were performed at spot frequencies where the preview peak or average emission was close to, or exceeded the applicable limit line with a receiver bandwidth of 6dB and a resolution bandwidth of 9kHz. The final measurements were performed using a measuring time of no less than 15 seconds.

Plots of the accumulated measurement data for each tested wired network port, 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).

Port type	Cable category	Data rate	Connector	AAN design as per Annex G	Total pairs	Active pairs
POE/Ethernet	CAT 5	10/100Mbps	RJ45	Figure G.3	4	Not specified

Table 14: Conducted Emissions at Telecommunication port – ISN, Port & Cable info

(Refer to photograph 7 in Appendix B for a view of the test configuration)

10.2. Limits

The EUT shall meet the limits in the following table.

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-Peak	Average
0.15 to 0.50	97 to 87	84 to 74
0.5 to 30	87	74
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.		

Table 15: Limits for asymmetric mode conducted emissions of class A equipment

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-Peak	Average
0.15 to 0.50	84 to 74	74 to 64
0.5 to 30	74	64
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.		

Table 16: Limits for asymmetric mode conducted emissions of class B equipment

10.3. Test Results

Conducted Emissions at wired network ports measurements are tabulated below. Quasi-peak or CISPR Average measurements were performed at spot frequencies where the peak or average emission was close to, or exceeded the applicable limit line.

(Refer to graph 9 in Appendix C)

Quasi - Peak Measurements				Average Measurements			
Frequency (MHz)	Result (dBμV)	Limit (dBμV)	Delta Limit (dB)	Frequency (MHz)	Result (dBμV)	Limit (dBμV)	Delta Limit (dB)
0.282	38.1	78.8	-40.6	0.282	37.6	68.8	-31.1
0.338	32.5	77.3	-44.7	0.338	31.1	67.3	-36.1
0.450	33.6	74.9	-41.2	0.450	31.9	64.9	-32.9
0.562	32.1	74.0	-41.9	0.562	28.3	64.0	-35.7
0.786	30.9	74.0	-43.1	0.786	25.7	64.0	-38.3
0.898	34.9	74.0	-39.1	0.898	28.5	64.0	-35.5
1.126	27.4	74.0	-46.6	1.126	23.6	64.0	-40.4
1.570	24.3	74.0	-49.7	1.570	19.6	64.0	-44.4
1.794	24.3	74.0	-49.7	1.794	19.6	64.0	-44.4
1.906	24.5	74.0	-49.5	1.906	19.8	64.0	-44.2
2.018	24.7	74.0	-49.3	2.018	19.5	64.0	-44.5
2.130	24.6	74.0	-49.4	2.130	19.3	64.0	-44.7
4.790	29.6	74.0	-44.4	4.790	24.6	64.0	-39.4
8.254	30.5	74.0	-43.5	8.218	30.7	64.0	-33.3
9.646	24.7	74.0	-49.3	9.638	18.3	64.0	-45.7
9.834	29.3	74.0	-44.7	9.850	19.1	64.0	-44.9
10.018	32.4	74.0	-41.6	10.046	28.4	64.0	-35.6
12.786	45.1	74.0	**-28.9***	12.786	40.7	64.0	**-23.3***
14.154	44.6	74.0	-29.4	14.154	39.5	64.0	-24.5
15.978	41.9	74.0	-32.1	15.982	36.7	64.0	-27.3

**Worst-case emission*

Table 17: Asymmetric Mode Conducted Emissions Measurements **(Class B)** – Ethernet Port

Measurement frequency range	Calculated measurement uncertainty
0.15MHz to 30MHz	±2.88dB

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:	17 - 19°C
Humidity:	49-53%
Atmospheric pressure:	1019.2hPa

Table 18: Climatic conditions

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

$$V = V_{QP/AV} + AAN_{vdf} + L_C + L_T$$

Where:

V = Corrected Voltage Amplitude in dBµV
$V_{QP/AV}$ = Measured Voltage (Quasi Peak or Average) in dBµV
AAN_{vdf} = Asymmetric Artificial Network Voltage Division Factor in dB
L_C = Cable/attenuator Loss in dB
L_T = Transient Protection Network Loss in dB

Example calculation:

$V = V_{QP} + AAN_{vdf} + L_C + L_T$
$V = 15\ dB\mu V + 10.1dB + 11.5dB + 10.1dB$
$V = 46.7\ dB\mu V$

Comments: Asymmetric Mode Conducted Emissions measurements were below the specified quasi-peak and average Class A and the Class B limits of EN 55032: 2015 + AC: 2016.

The customer was advised of the requirements for exercising the wired network port prior to testing. To ensure reliable and representative testing the data utilisation stipulated in EN 55032: 2015 + AC: 2016 of the wired network port is as follows:

- For ports supporting Ethernet traffic (for example 100Base-T, 1000Base-T), that can operate at multiple rates, measurements may be limited to mode in which the EUT operates at its maximum rate.
- When assessing an EUT transmitting 10Base-T Ethernet traffic, apply the following:

In order to make reliable emission measurements representative of high LAN utilization it is only necessary to create a condition of LAN utilization in excess of 10 % and sustain that level for a minimum of 250 ms. The content of the test traffic should consist of both periodic and pseudo-random messages in order to emulate realistic types of data transmission (Examples of pseudo-random messages: files that are compressed or encrypted, Examples of periodic messages: uncompressed graphic files, memory dumps, screen updates, disk images). If the LAN maintains transmission during idle periods measurements shall also be made during idle periods.

The EUT was powered via a 120VAC, 60Hz mains supply for all testing.

The customer configured via instructions, the Ethernet port of the EUT to be connected physically to the support equipment Ethernet port. The exact configuration of the LAN utilization was not declared at the time of testing by the customer. It is assumed that correct representative LAN utilisation was exercised during testing.

Assessment: The EUT complied with the Asymmetric Mode Conducted Emissions measurements requirements of EN 55032: 2015 + AC: 2016.

11. Conclusion

The Tait Limited, TBCH3X, Base Station with receive only (Serial No: 18262612) complied with the requirements of CFR47 FCC Part 15, Subpart B (Class A), sections 15.107 and 15.109.

The Tait Limited, TBCH3X, Base Station with receive only (Serial No: 18262612) complied with the Asymmetric Mode Conducted Emissions Class A and Class B requirements of 55032: 2015 + AC: 2016.

Appendix A – Test Equipment

Inv	Equipment	Make	Model No	Serial No	Calibration	
					Due	Type
Radiated Disturbance (Radiated Emissions) - 30MHz to 1000MHz						
1217	ANALYSER, EMI Receiver	Rohde & Schwarz	ESU40	100182	Mar-18	E
0932	CONTROLLER, Position	Sunol Sciences	SC104V-3	081006-1	-	V
0933	TURNTABLE	Sunol Sciences	SM46C	081006-2	-	V
0934	MAST, Antenna	Sunol Sciences	TLT2	081006-5	-	V
0935	ANTENNA, Biconilog	Sunol Sciences	JB5	A07116	Jan-19	E
0718	ATTENUATOR, 6dB	JFW	50FPE-006	-	Jan-20	I
1143	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287041	SN MY058/4PA	Jan-18	I
1145	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84279564	SN MY056/4PA	Jan-18	I
1155	HYGROMETER, Temp, Humidity	DigiTech	QM7312	-	Jun-19	I
0666	ENCLOSURE, Semi-Anechoic, No 1	RFI Industries	S800 iOATS	1229	Jul-18	I
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 8.53.0	N/A	N/A
Radiated Disturbance (Radiated Emissions) - 1000MHz to 6000MHz						
1217	ANALYSER, EMI Receiver	Rohde & Schwarz	ESU40	100182	Mar-18	E
0932	CONTROLLER, Position	Sunol Sciences	SC104V-3	081006-1	-	V
0933	TURNTABLE	Sunol Sciences	SM46C	081006-2	-	V
0934	MAST, Antenna	Sunol Sciences	TLT2	081006-5	-	V
1143	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287041	SN MY058/4PA	Jan-18	I
1145	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84279564	SN MY056/4PA	Jan-18	I
1146	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287043	SN MY054/4PA	Jan-18	I
0559	PRE-AMP, Microwave, 18GHz	Miteq	AFS8	605305	Nov-18	I
0633	ANTENNA, Double Ridge Horn	EMCO	3115	9712-5369	Aug-18	I
1155	HYGROMETER, Temp, Humidity	DigiTech	QM7312	-	Jun-19	I
0666	ENCLOSURE, Semi-Anechoic, No 1	RFI Industries	S800 iOATS	1229	Jul-18	I
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 8.53.0	N/A	N/A
Conducted Disturbances at Mains Terminal (Conducted Emissions)						
0954	ANALYSER, EMI Receiver	Rohde+Schwarz	ESCI 3	100196	Jun-18	E
0047	LISN, Single Phase, 50uH/50 Ohm	EMCO	3850/2	9010-1005	Jan-19	E
0724	ATTENUATOR, 10dB	JFW	50FPE-010	724	Oct-18	I
0048	LISN, Single Phase, 50uH/50 Ohm	EMCO	3850/2	9105-1006	Dec-17	E
1148	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287047	SN MY059/4PA	Jan-18	I
1149	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287049	SN MY053/4PA	Jan-18	I
0358	LIMITER, Transient, 9k-200M	Hewlett Packard	11947A	3107A01832	Jun-20	I
1154	HYGROMETER, Temp, Humidity	DigiTech	QM7312	-	Jun-19	I
0441	ENCLOSURE, Shielded, No 5	RFI Industries	TC800-20	933	-	V
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 6.30.0	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

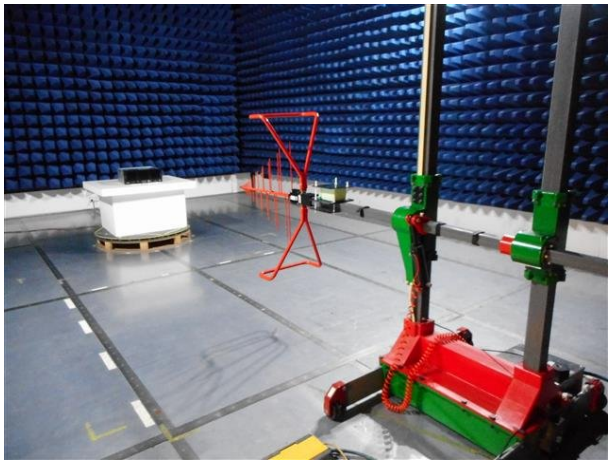
Test equipment list continued next page

Inv	Equipment	Make	Model No	Serial No	Calibration	
					Due	Type
Asymmetric Mode Conducted Emissions						
0954	ANALYSER, EMI Receiver	Rohde+Schwarz	ESCI 3	100196	Jun-18	E
1161	NETWORK, Couple/de-couple, signal line - T8	Teseq GmbH	ISN T800	42760	Mar-18	E
0358	LIMITER, Transient, 9k-200M	Hewlett Packard	11947A	3107A01832	Jun-20	I
0047	LISN, Single Phase, 50uH/50 Ohm	EMCO	3850/2	9010-1005	Jan-19	E
0724	ATTENUATOR, 10dB	JFW	50FPE-010	724	Oct-18	I
0048	LISN, Single Phase, 50uH/50 Ohm	EMCO	3850/2	9105-1006	Dec-17	E
1148	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287047	SN MY059/4PA	Jan-18	I
1149	CABLE, Coax, Sucoflex 104PA	Huber + Suhner	84287049	SN MY053/4PA	Jan-18	I
1154	HYGROMETER, Temp, Humidity	DigiTech	QM7312	-	Jun-19	I
0441	ENCLOSURE, Shielded, No 5	RFI Industries	TC800-20	933	-	V
SW007	EMC Measurement Software	Rohde & Schwarz	EMC 32	Version 8.53.0	N/A	N/A
General Equipment						
1130	Generator, Variable speed drive controller	Yaskawa electric mfg. Co., ltd	CIMR-H5.5G2-10	-	-	V
1131	Generator, AC Drive unit and AC generator	Mecc Alte Apa	CT 3-SB/2	658519	-	V

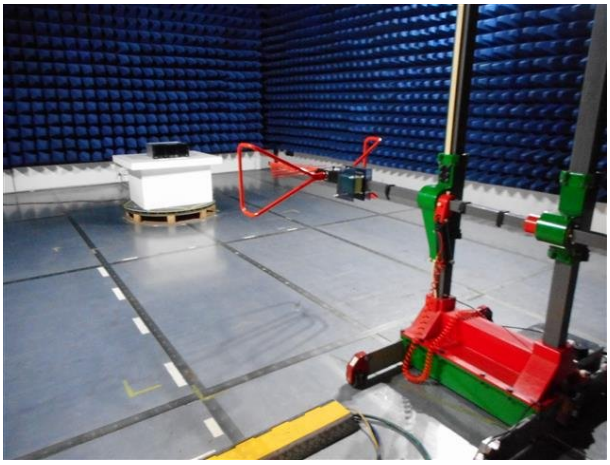
V: Verification of operation against an internal reference
I: Internal calibration against a traceable standard
E: External calibration by a NATA or MRA equivalent endorsed facility
N/A: Not Applicable

Appendix B – Photographs

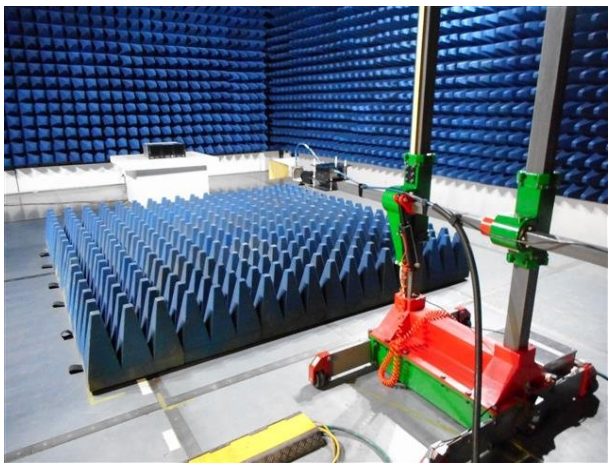
Number	Photograph Description
1	Radiated Emissions – Below 1GHz – Test configuration
2	
3	Radiated Emissions – Above 1GHz – Test configuration
4	Radiated Emissions – EUT configuration
5	Radiated Emissions – Support equipment in Annex
6	Conducted Emissions – Test configuration
7	Asymmetric Mode Conducted Emissions – Test configuration
8	EUT – External views
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	EUT – Internal views
19	
20	
21	
22	
23	
24	
25	AE – Router (Test Lab Equipment)
26	
27	AE – Dell Laptop (Test Lab Equipment)



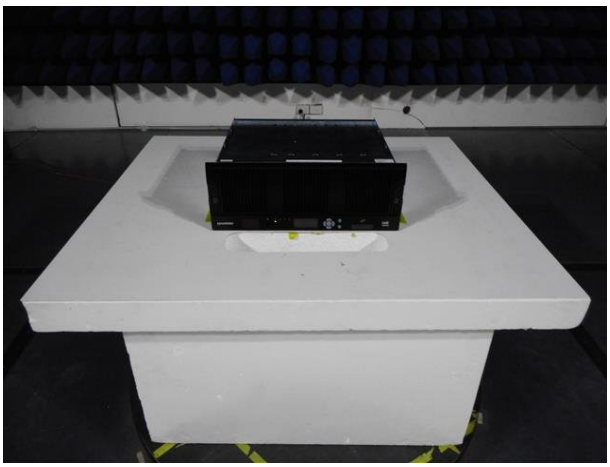
Photograph 1



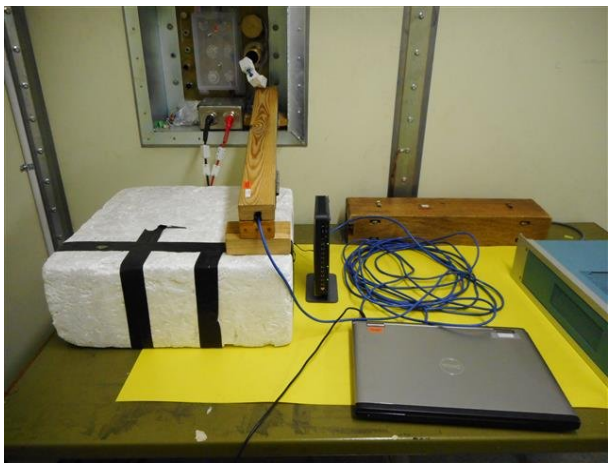
Photograph 2



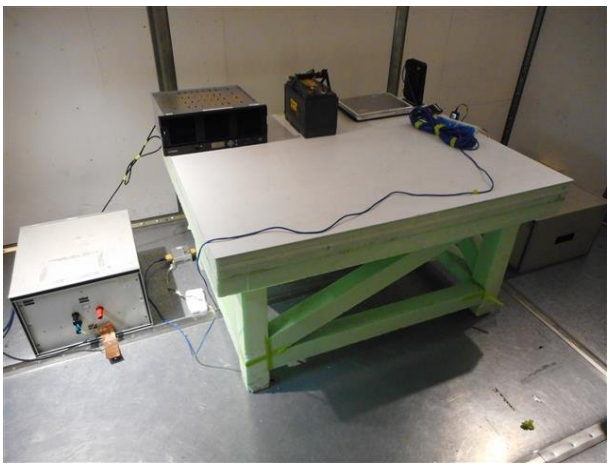
Photograph 3



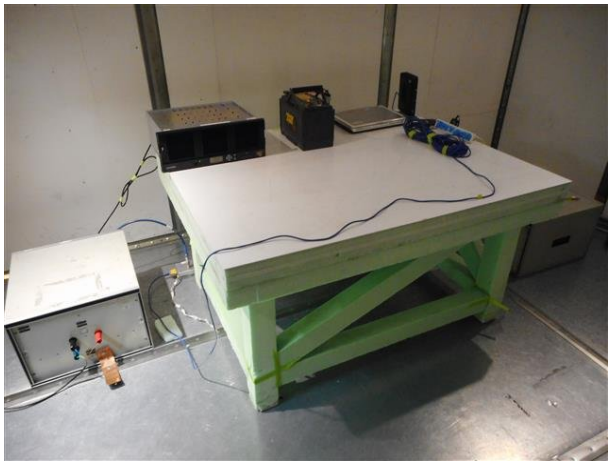
Photograph 4



Photograph 5



Photograph 6



Photograph 7

Photograph 8

Photograph 9

Photograph 10

Photograph 11

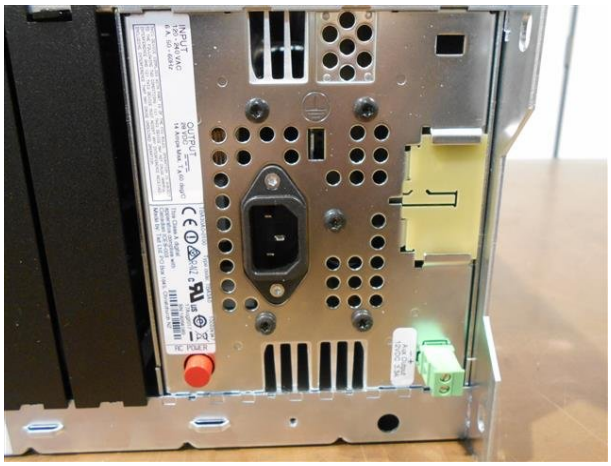
Photograph 12

Photograph 13

Photograph 14

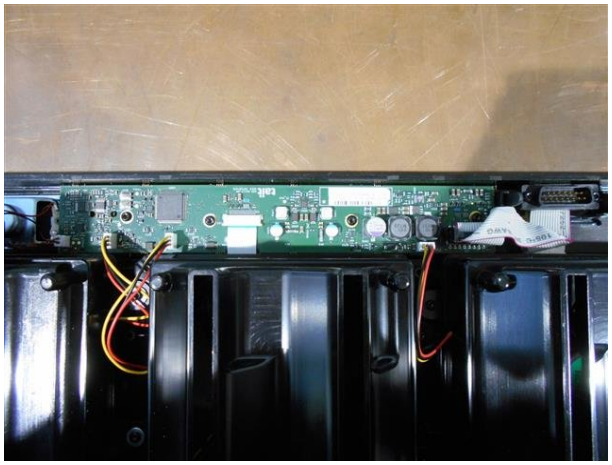
Photograph 15

Photograph 16



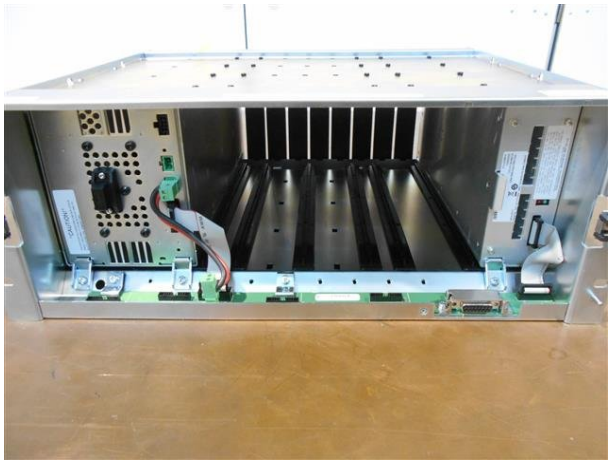
Photograph 17

Photograph 18



Photograph 19

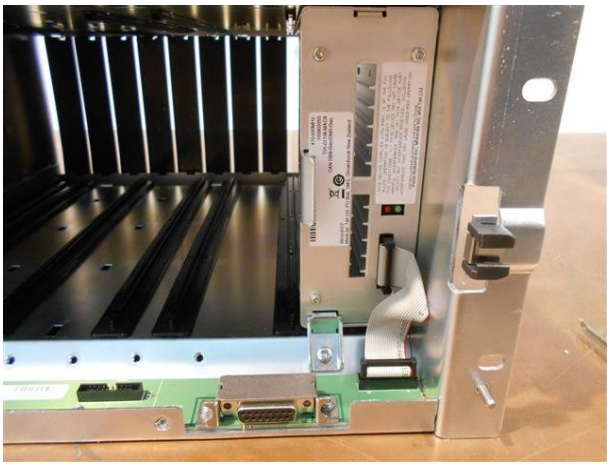
Photograph 20



Photograph 21

Photograph 22

Photograph 23



Photograph 24

Photograph 25

Photograph 26

Photograph 27

Appendix C – Measurement Graphs

No.	Test	Graph Description
1	CFR47 FCC Part 15, Subpart B, Class A Conducted Emissions	Active Line
2		Neutral Line
3	CFR47 FCC Part 15, Subpart B, Class A, Radiated Emissions	Horizontal Antenna Polarisation (30MHz to 1000MHz) – CH2
4		Horizontal Antenna Polarisation (1GHz to 6GHz) – CH2
5		Vertical Antenna Polarisation (30MHz to 1000MHz) – CH2
6		Vertical Antenna Polarisation (1GHz to 6GHz) – CH2
7		Horizontal Antenna Polarisation (30MHz to 1000MHz) – CH1
8		Vertical Antenna Polarisation (30MHz to 1000MHz) – CH1
9	EN 55032: 2015 + AC: 2016 Asymmetric Mode Conducted Emissions	Ethernet 10/100Mbps

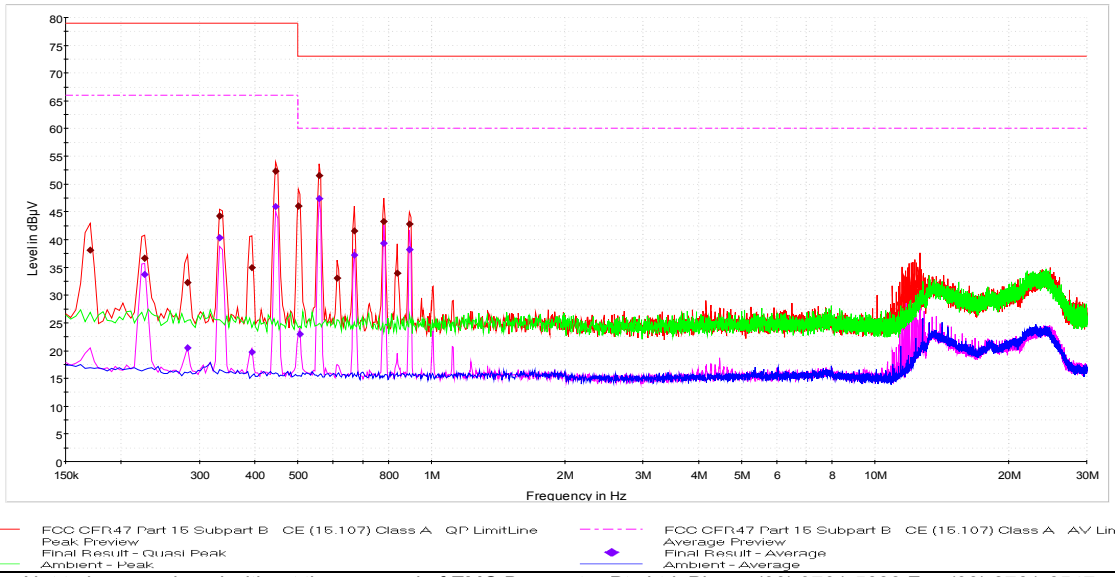
EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Conducted Emissions

Tait Limited - TBCH3X - Base Station with receive only

Active Line – Channel 2 - 519.9MHz

Job Number: E1710-0976
Test Engineer: CF / FD



Graph 1

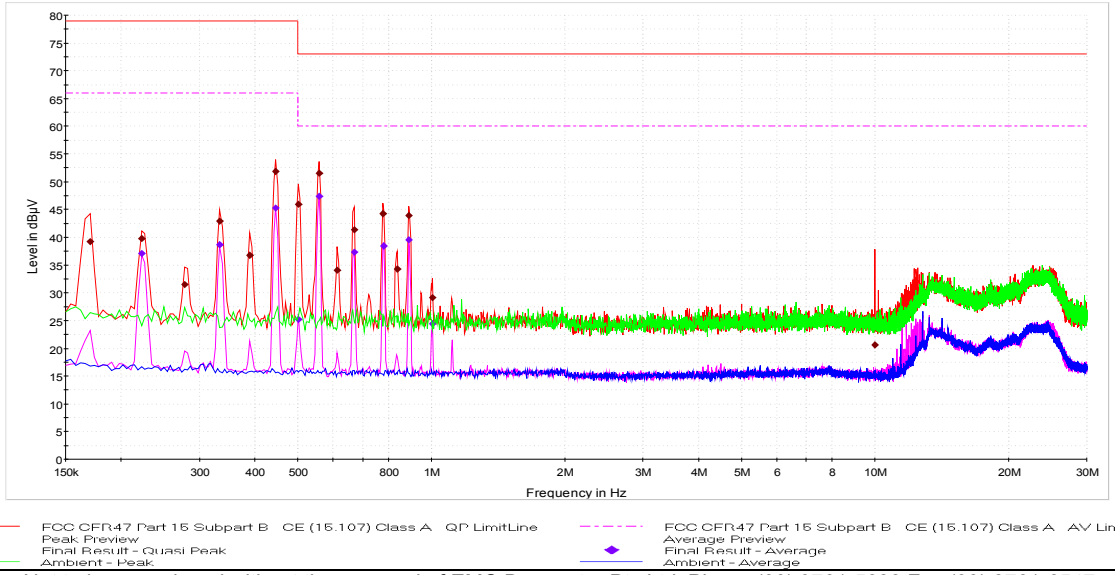
EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Conducted Emissions

Tait Limited - TBCH3X - Base Station with receive only

Neutral Line – Channel 2 - 519.9MHz

Job Number: E1710-0976
Test Engineer: CF / FD



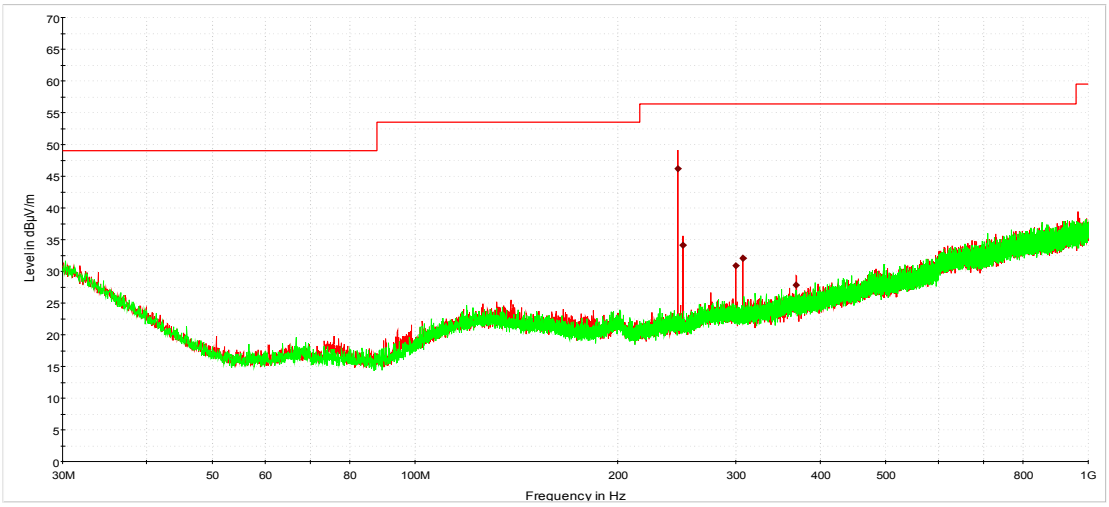
Graph 2

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Horizontal Antenna Polarisation – 30MHz to 1000MHz – Channel 2 - 519.9MHz



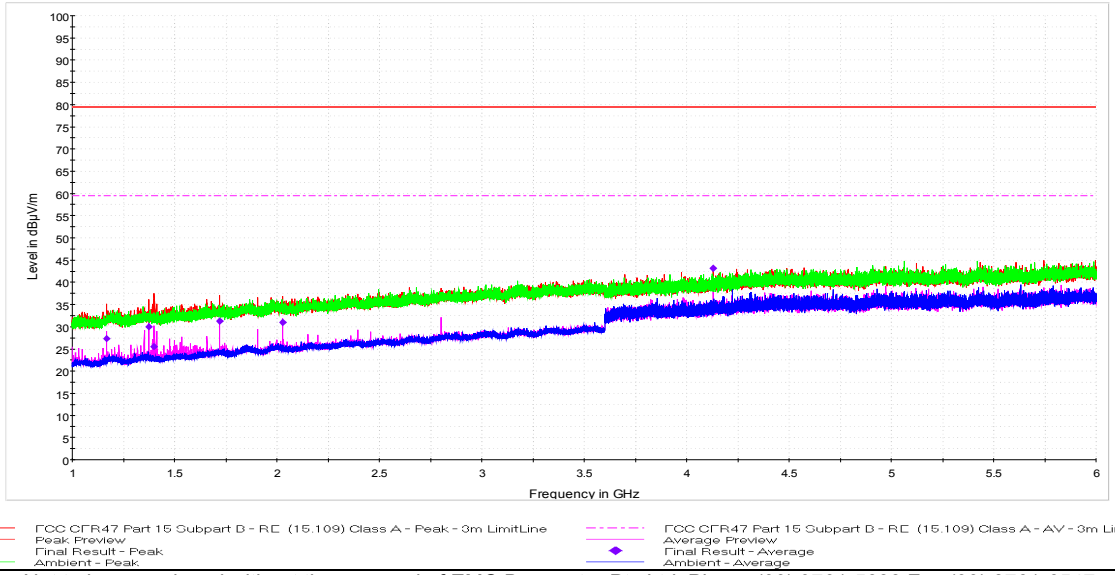
Graph 3

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Horizontal Antenna Polarisation – 1GHz to 6GHz – Channel 2 - 519.9MHz



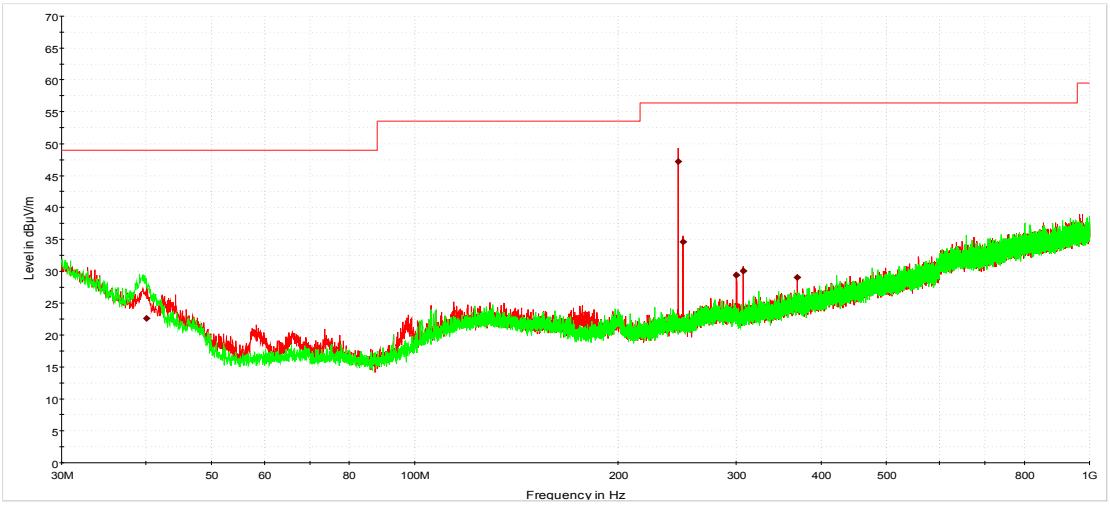
Graph 4

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Vertical Antenna Polarisation – 30MHz to 1000MHz – Channel 2 - 519.9MHz



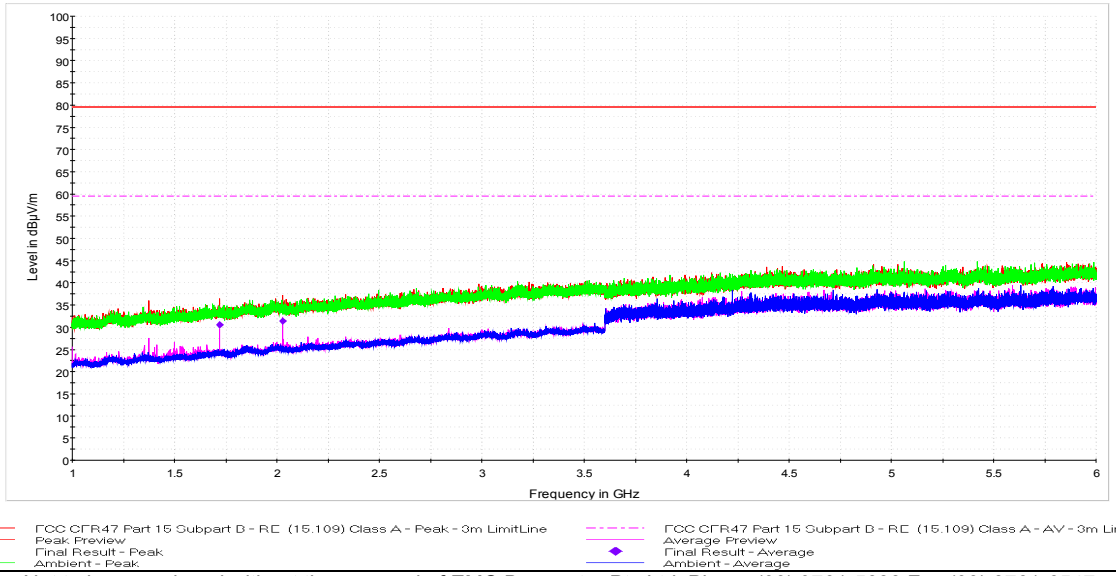
Graph 5

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Vertical Antenna Polarisation – 1GHz to 6GHz – Channel 2 - 519.9MHz



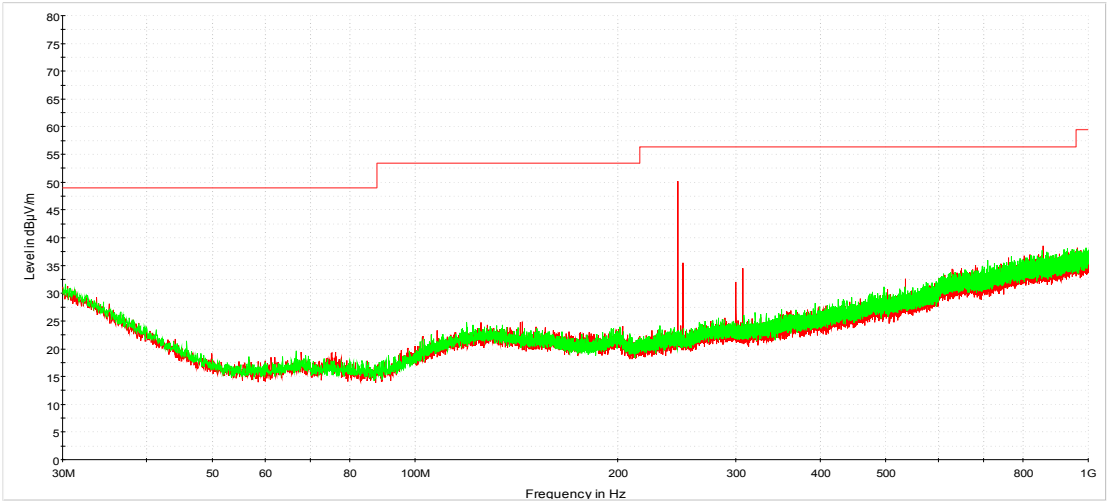
Graph 6

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Horizontal Antenna Polarisation – 30MHz to 1000MHz - Channel 1 - 470.1MHz



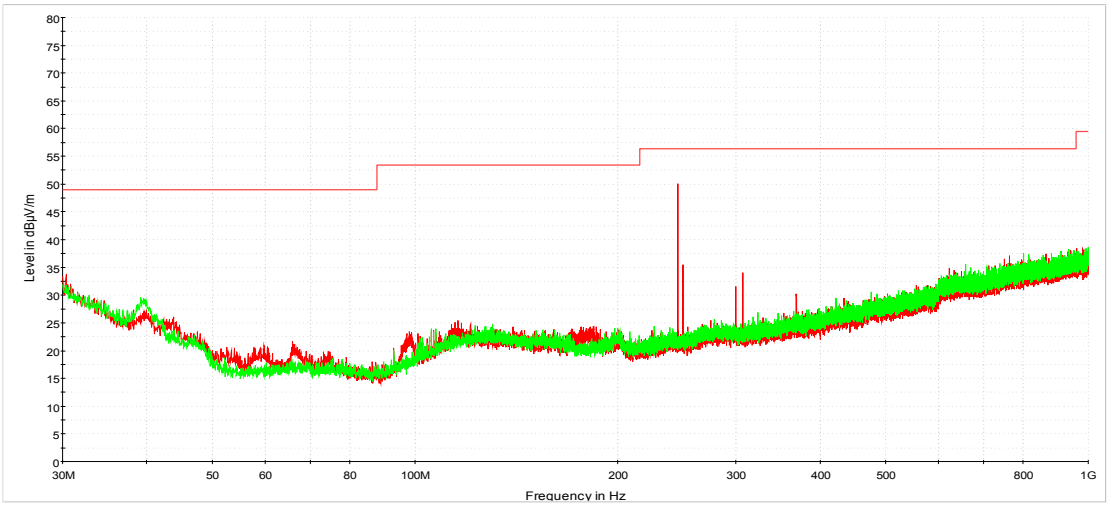
Graph 7

EMC Bayswater Pty. Ltd.

CFR47 FCC Part 15, Subpart B (Class A) - Radiated Emissions | Job Number: E1710-0976

Tait Limited - TBCH3X - Base Station with receive only | Test Engineer: AT

Vertical Antenna Polarisation – 30MHz to 1000MHz - Channel 1 - 470.1MHz



Graph 8

EMC Bayswater Pty. Ltd.

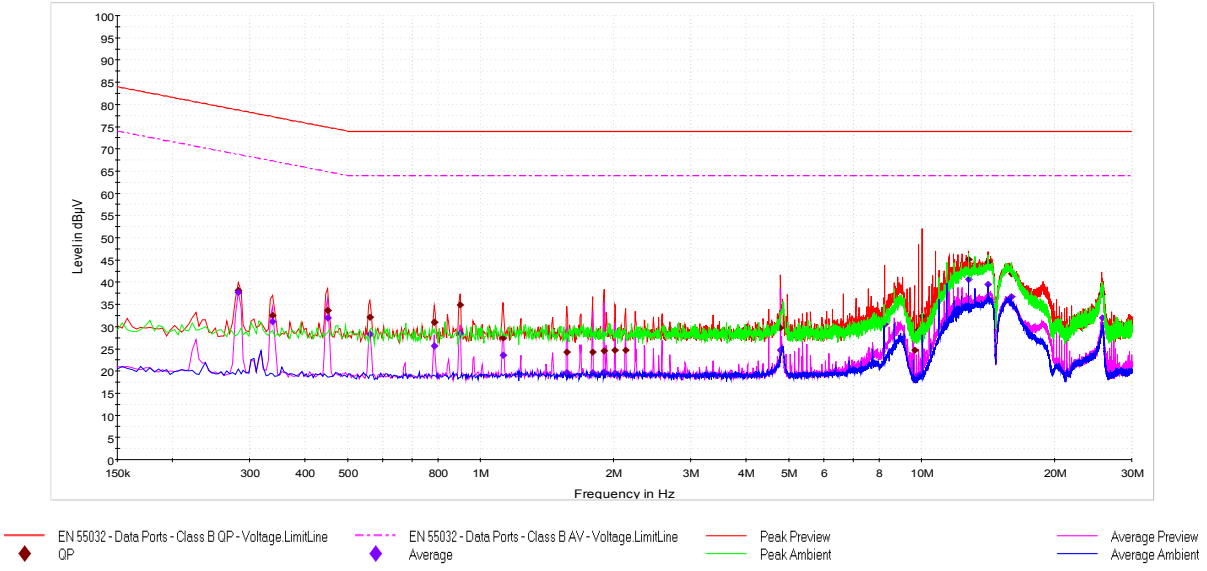
EN 55032: 2015 + AC: 2016 – Asymmetric Mode Conducted Emissions

Tait Limited - TBCH3X - Base Station with receive only

Ethernet port 10/100mB – Channel 2 - 519.9MHz

Job Number: E1710-0976

Test Engineer: CF / FD



Graph 9