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EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.247)

FCC ID:	X4K-TRX02403
Test Sample:	Network Transceiver Module
Model:	NTR-1V1
Report Number:	M160424-1Rev3 (Replaces report M160424-1Rev2)
Tested for:	Automatic Technology Australia Pty Ltd
Issue Date:	26 July 2016

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.247)

EMC Technologies Report No. M160424-1Rev3

Issue Date: 26 July 2016

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Report Number: M160424-1Rev3
Issue Date: 26 July 2016

Test Sample: Network Transceiver Module
Model: NTR-1V1

FCC ID: X4K-TRX02403
Equipment Type: Intentional Radiator (Transceiver)

Manufacturer: Automatic Technology Australia Pty Ltd
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Contact: Nikolai Klepikov (nikolai.klepikov@ata-aust.com.au)
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Tested for: Automatic Technology Australia Pty Ltd

Test Standards: FCC Part 15 – Radio Frequency Devices
FCC Part 15 Subpart C – Intentional Radiators
Section 15.247 – Operation within the band 902 - 928 MHz

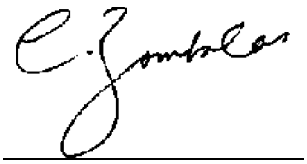
Test Dates: 28 April, 31 May, 17, 24, 27 and 28 June, 6 July 2016

Test Engineer:

Larry Phuah

Mahan Ghassempouri

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



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EMI TEST REPORT FOR CERTIFICATION
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FCC PART 15 Subpart C (Section 15.247)

1.0 INTRODUCTION

EMI testing was performed on the Network Transceiver Module, Model: NTR-1V1.

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

47 CFR, Part 15, Subpart C:	Rules for intentional radiators (particularly section 15.247)
Section 15.203:	Antenna requirements
Section 15.205:	Restricted bands of operation
Section 15.207:	Conducted Emission Limits
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.247:	Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.247.

The measurement procedure applied was in accordance with ANSI C63.10: 2013 and Public Notice DA-00705. The instrumentation conformed to the requirements of ANSI C63.2: 2009.

1.1 Summary of Results

FCC Part 15C Clauses	Test Performed	Results
15.203	Antenna Requirement	Complied
15.205	Operation in Restricted Band	Complied
15.207	Conducted Emissions	Complied
15.209	Radiated Emissions	Complied
15.247 (a)(1)	Hopping Protocol	Complied
15.247 (a)(1)(i)	Carrier Frequency Separation	Complied
15.247 (a)(1)(i)	20 dB Bandwidth	Complied
15.247 (a)(1)(i)	Number of hopping channels	Complied
15.247 (a)(1)(i)	Dwell time	Complied
15.247 (b)(2)	Peak Output Power	Complied
15.247 (c)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	Band-edge compliance	Complied
15.247 (d)	Spurious radiated emissions	Complied
15.247 (e)	Peak Power Spectral Density	Not applicable
15.247 (f)	Hybrid Systems	Not Applicable. EUT did not employ a hybrid system
15.247 (g)	Frequency Hopping Channels	Complied
15.247 (h)	Frequency Hopping Adaptivity	Not Applicable
15.247 (i)	Radio Frequency Hazard	Complied

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (Transmitter) Details

Model:	NTR-1V1
DC Supply voltage:	24 V_{dc}
Operating Frequency Range:	912.5 MHz – 926.9 MHz
Number of channels:	25
Low channel:	912.5 MHz
Middle channel:	919.7 MHz
High channel:	926.5 MHz
Modulation:	2GFSK, 40 kb/s
Antenna type:	Monopole: Wire length = 82 mm

2.1.1 EUT (Host) Details

Host:	Garage Door Openers
Model Number:	AM808 Advance and AM888 Elite
Serial Number:	13501989, 13501988
Microprocessors:	PIC18F4525T-I/PT
Crystal frequency(s):	10, 24, 30 MHz
Highest Operating Freq.:	928 MHz
Lowest Operating Freq.:	10 MHz
Input supply:	110 – 120 V_{ac}, 3 A 60 Hz

2.1.2 Operational Description

The NTR-1V1 was a radio transceiver which plugged into a garage door or gate controller. The connection provided power and allowed commands and status to be exchanged so that the garage door or gate could be controlled and monitored via the home network.

2.2 Test Configuration

The Network Transceiver Module was tested as a standalone device powered by 24 V, AC adaptor.

2.3 Test Facility

2.3.1 General

Measurements were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

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 47CFR 2.948 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 – **Registration Number 494713 and Designation number AU0001.**

EMC Technologies' indoor open area test site (iOATS) has been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen, Issue 4 - Industry Canada iOATS number - **IC 3569B**.

2.3.2 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), NPL (UK), NIST (USA) 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

It also includes a large number of emissions, immunity, SAR, EMR and Safety standards.

2.4 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd, Rohde and Schwarz, NMI, NPL or NIST. All equipment calibration is traceable to Australia national standards at the National Measurements Institute. The reference antenna calibration was performed by NPL and the working antennas (BiLog and horn) calibrated by EMC Technologies. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A

FCC Part 15 Subpart C (§15.247)

3.0 ANTENNA REQUIREMENT (§15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The EUT was provided with an SMA connector and specific antenna for testing. In practice, this antenna will be soldered directly to the PCB and was not intended for replacing.

4.0 OPERATION IN RESTRICTED BAND (§15.205)

The restricted band conformance was made during the spurious emission tests for section 15.247. No emissions exceeded the restricted band limits.

5.0 CONDUCTED EMISSIONS (§15.207)

5.1 Test procedure

The arrangement specified in ANSI C63.4: 2009 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2: 2009 was used to perform the measurements.

The 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:

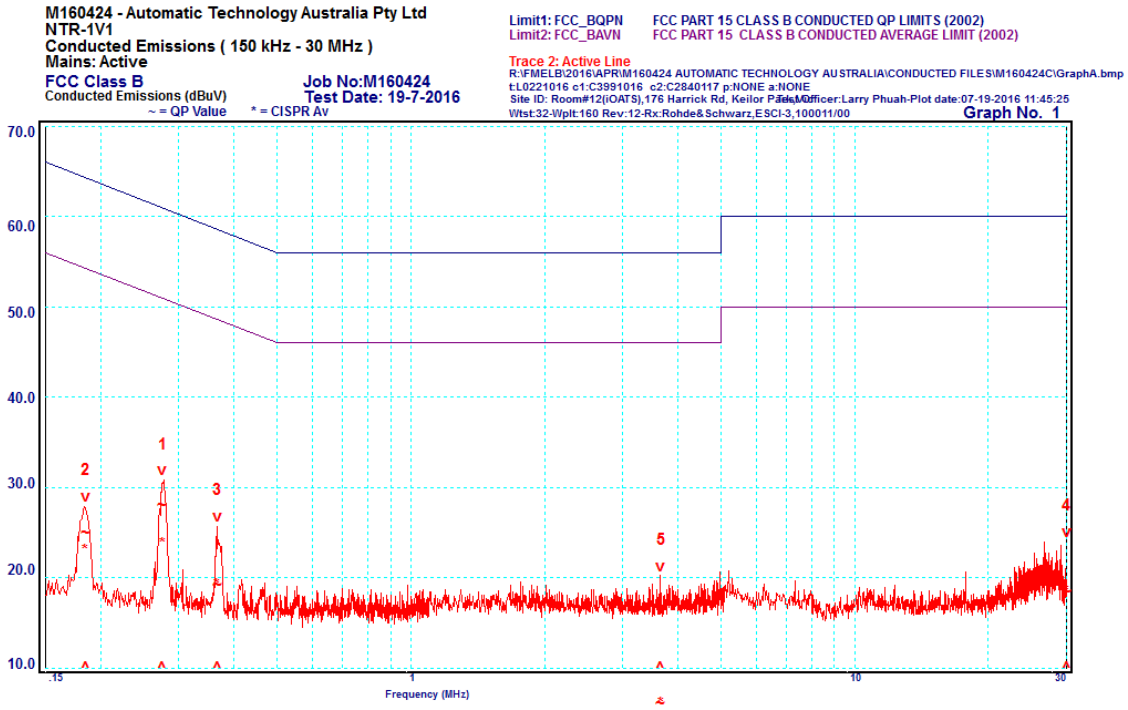
$$\mathbf{V_{EMI} = V_{Rx} + LBPF}$$

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.
LBPF = the insertion loss in dB of the cables and the Limiter and Band Pass Filter.

5.2 Results

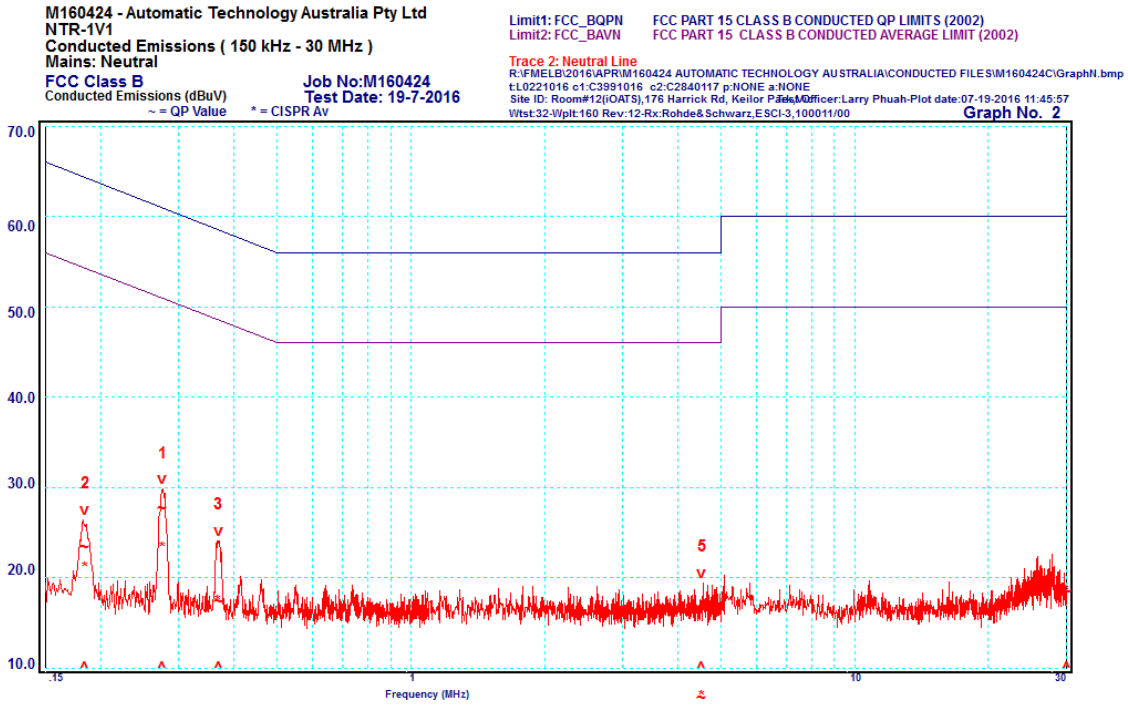
The measurement data pertaining to each frequency sub-range were concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph was subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak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

Active Line, 0.15 - 30 MHz



Peak	Frequency MHz	Line	Measured QP Level dBµV	QP Limit dBµV	ΔQP ±dB	Measured AV Level dBµV	AV Limit dBµV	ΔAV ±dB
1	0.276	Active	28.0	60.9	-32.9	23.7	50.9	-27.2
2	0.185	Active	24.9	64.2	-39.3	23.0	54.2	-31.2
3	0.367	Active	19.2	58.6	-39.4	19.2	48.6	-29.4
4	30.00	Active	18.4	60.0	-41.6	18.4	50.0	-31.6
5	3.656	Active	6.0	56.0	-50.0	6.0	46.0	-40.0

Neutral Line, 0.15 - 30 MHz



Peak	Frequency MHz	Line	Measured QP Level dBµV	QP Limit dBµV	ΔQP ±dB	Measured AV Level dBµV	AV Limit dBµV	ΔAV ±dB
1	0.276	Neutral	27.6	60.9	-33.3	23.2	50.9	-27.7
2	0.185	Neutral	23.3	64.3	-41.0	21.0	54.3	-33.3
3	0.369	Neutral	17.3	58.5	-41.2	17.3	48.5	-31.2
4	30.00	Neutral	18.4	60.0	-41.6	18.4	50.0	-31.6
5	4.526	Neutral	6.7	56.0	-49.3	6.7	46.0	-39.3

6.0 RADIATED EMISSIONS (§15.209)

The spurious emission conformance was made during the spurious emission tests for section 15.247. No emissions exceeded the limits in the restricted bands.

7.0 HOPPING PROTOCOL (§15.247 (a)(1))

The system hopped to channel frequencies that were selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The following frequency channels were utilised:

Operating channels (MHz)		
912.5	917.9	923.3
913.1	918.5	923.9
913.7	919.1	924.5
914.3	919.7	925.1
914.9	920.3	925.7
915.5	920.9	926.3
916.1	921.5	926.9
916.7	922.1	
917.3	922.7	

Each frequency was used equally on average by the transmitter. The frequencies were selected at random using the following code:

```
unsigned char random=5;                    //define and initialise random number generator

//random number gen function
unsigned char
timerIntRandom (unsigned char mod){
        // 61 is largest prime less than 256/4
        random *= 245;      // 4 * 61 + 1 = 245
        random += 251;      // 251 is the largest prime < 256
        return (random>>1) % mod;
}

//Main line code
While(1){
        ….
        //select channel to use
        ch = timerintRandom(25); // 25 = max number of channels used ( 0..24)
        …
}
```

The generator is based on a byte the sequence generated repeats every 256 calls to timerIntRandon(). The following list shows the sequence output from timerIntRandon().

Channel numbers:

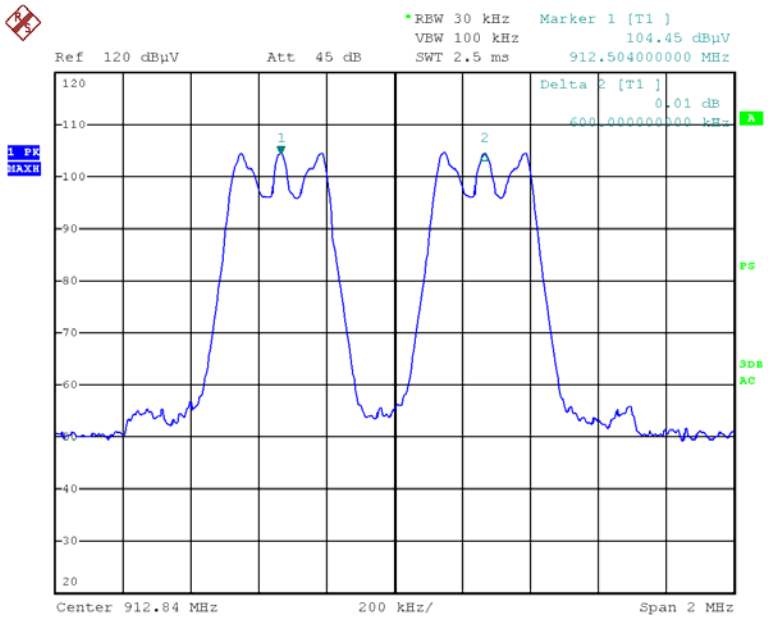
23	21	7	0	19	0	1	13	11	0	13	22	21	18
21	24	24	4	19	19	20	8	13	10	12	8	3	16
22	1	8	18	0	12	9	16	24	16	3	4	13	16
15	13	23	9	23	15	1	20	24	10	0	24	18	1
14	24	5	7	24	17	13	9	2	3	11	4	1	7
5	20	18	7	20	4	0	0	0	6	6	11	1	1
2	15	20	14	19	15	7	23	4	5	15	0	7	19
16	20	3	23	10	11	20	23	22	20	5	13	5	22
8	2	3	17	4	6	0	5	21	3	12	14	6	21
17	16	9	7	18	11	8	14	12	2	22	11	2	8
7	4	7	10	10	15	8	8	9	22	2	21	1	19
14	5	8	12	22	7	14	23	23	2	10	5	17	18
2	2	4	24	12	20	9	1	15	6	10	24	11	13
4	12	3	10	19	21	13	3	24	23	16	14	0	18
12	21	19	6	4	18	6	15	14	11	14	17	17	22
15	12	16	1	9	3	5	1	21	12	15	19	1	14
18	5	2	9	17	9	21	22	6	9	11	6	16	2
16	8	22	13	17	3	18	17	11	19	10	17	23	0
20	10	6	2										

The system receiver had input bandwidths that matched the hopping channel bandwidths of their corresponding transmitters and shifted frequencies in synchronization with the transmitted signals. The device was stabilized by a 30MHz crystal to 20 ppm.

8.0 CARRIER FREQUENCY SEPARATION (§15.247 (a)(1))

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Maximum 20 dB BW was measured as 340 kHz (refer section 6) so this value is used as the limit.

Measurements were performed on the first 2 channels.

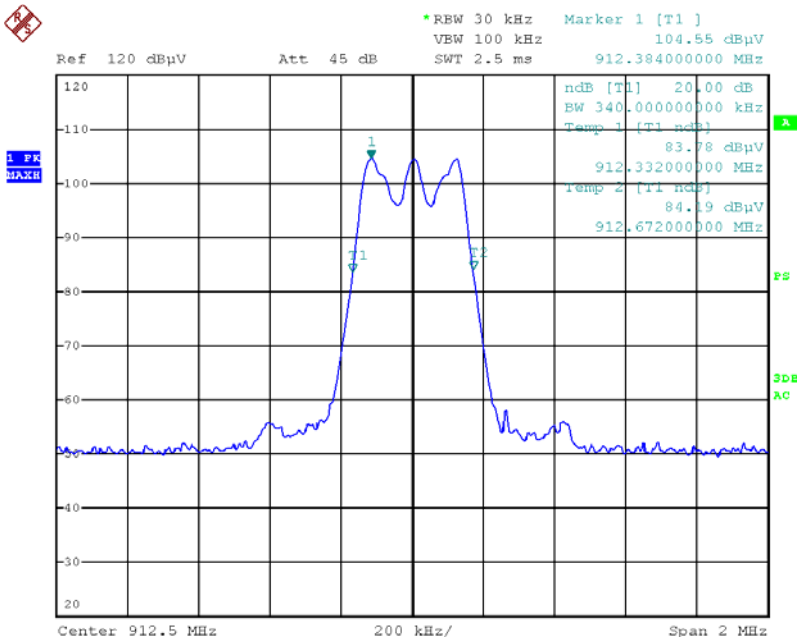


Channels	Separation (kHz)	Limit (kHz)	Result
1 & 2	600	> 340	Pass

Graph 1: Carrier frequency separation

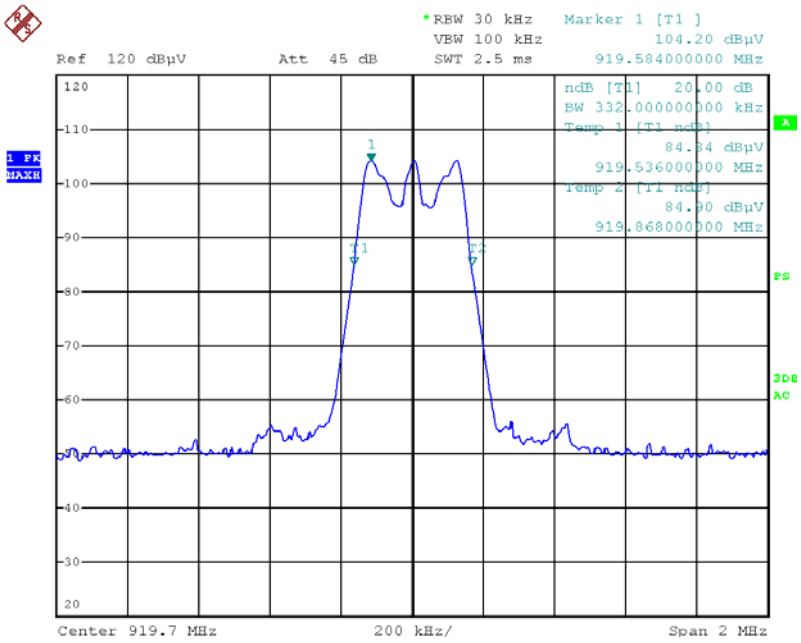
9.0 20 dB BANDWIDTH ((§15.247 (a)(1)(i))

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz. Measurements were performed on low, middle and high channel.



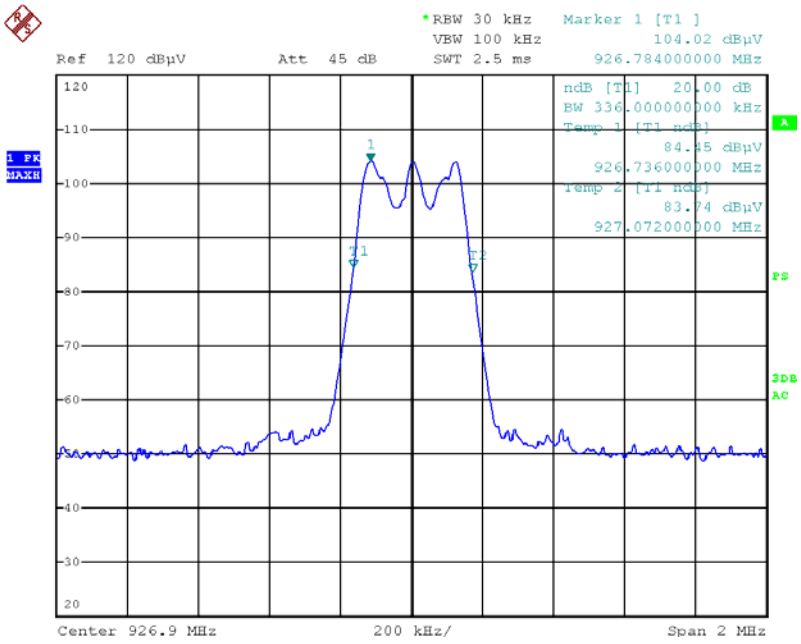
Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
Low	340	500	Pass

Graph 2: 20 dB bandwidth, low channel



Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
Middle	332	500	Pass

Graph 3: 20 dB bandwidth, middle channel

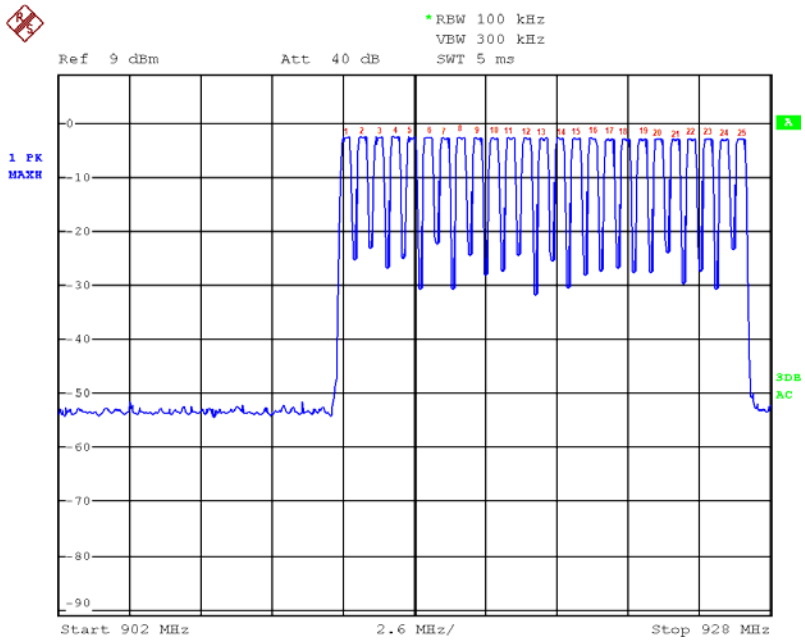


Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
Upper	336	500	Pass

Graph 4: 20 dB bandwidth, upper channel

10.0 NUMBER OF HOPPING FREQUENCIES (§15.247 (a)(1)(i))

As the measured 20 dB bandwidth was greater than 250 kHz, the EUT shall have at least 25 hopping frequencies.



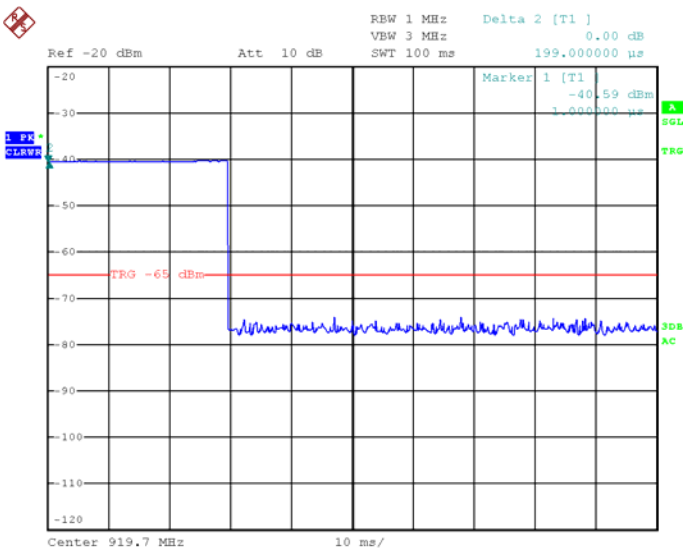
Number of hopping frequencies	Result
25	Pass

Graph 1: Number of hopping frequencies

11.0 DWELL TIME (§15.247 (a)(1)(i))

As the measured 20 dB bandwidth was more than 250 kHz, the average time of occupancy on any frequency had to be less than or equal to 0.4 seconds within a 10 second period. Measurements were performed using a spectrum analyser operating in zero span and tuned on a hopping frequency.

Channel	Dwell time (ms)
Middle	30



Graph 8: Duration of single pulse on

Conclusion:

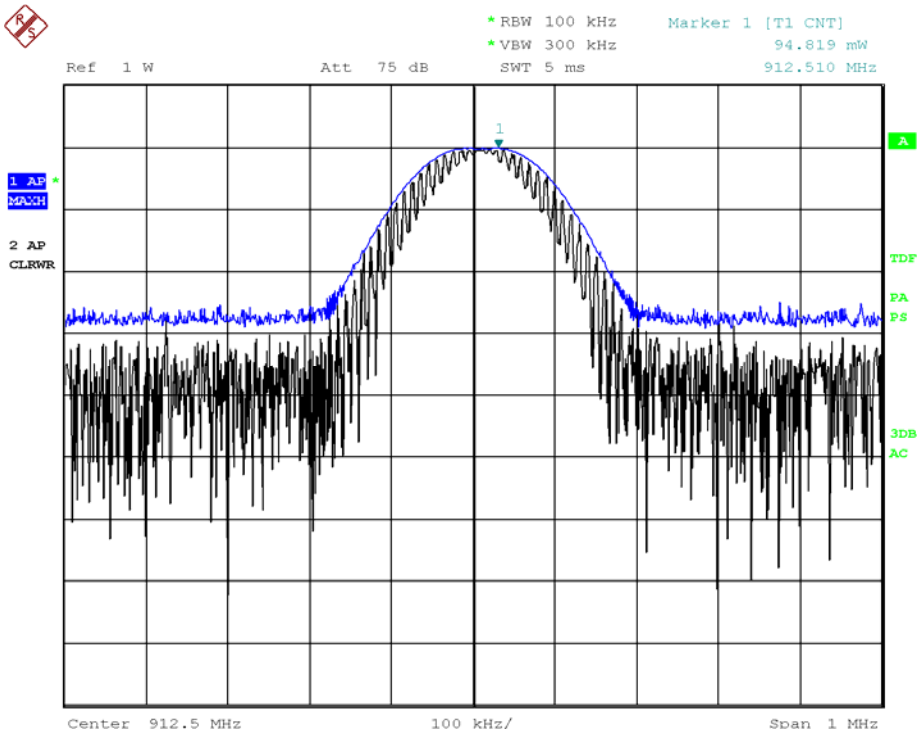
The transmitter hopped through the 25 channels in a random order. Total ON time for the transmitter to use all channels was 0.75 seconds. The most times a transmission would occur at a single channel in 10 seconds was therefore 13.33 times, giving a maximum ON time of one channel in the 10 seconds as 0.4 seconds.

12.0 PEAK OUTPUT POWER (§15.247 (b)(2))

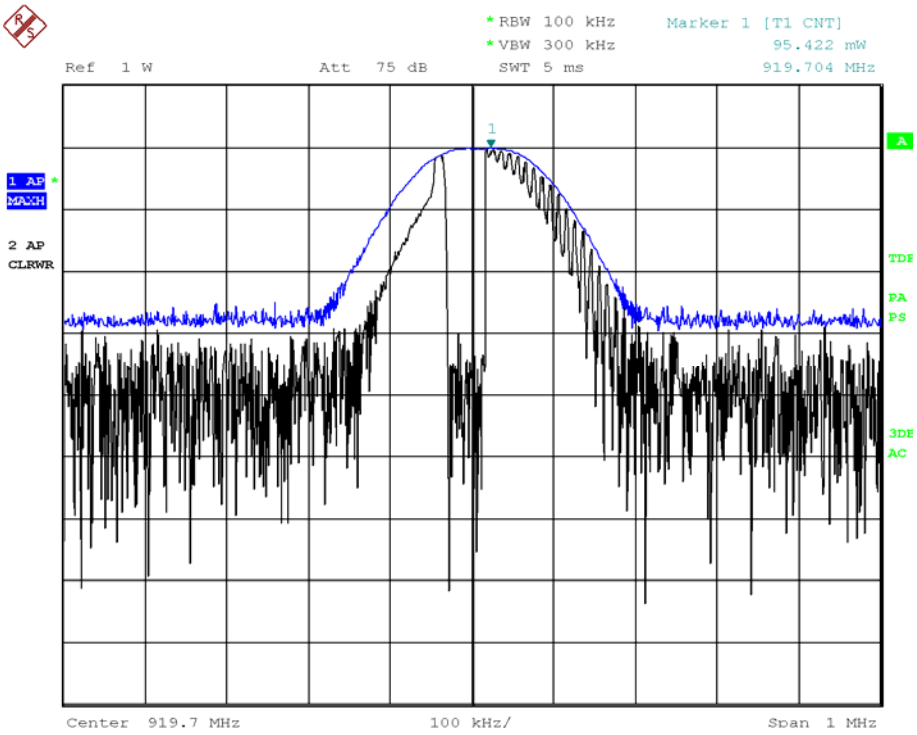
Peak conducted power was measured at the output of the transmitter. Cable loss between connector and spectrum analyser was accounted for in reading. The following spectrum analyser setting was used for the measurement.
Centre Frequency = Channel to be measured
Span = 1 MHz
RBW = 100 kHz
VBW = 300 kHz
Sweep = auto
Detector function = peak
Trace = max hold

Results are shown in the below table.

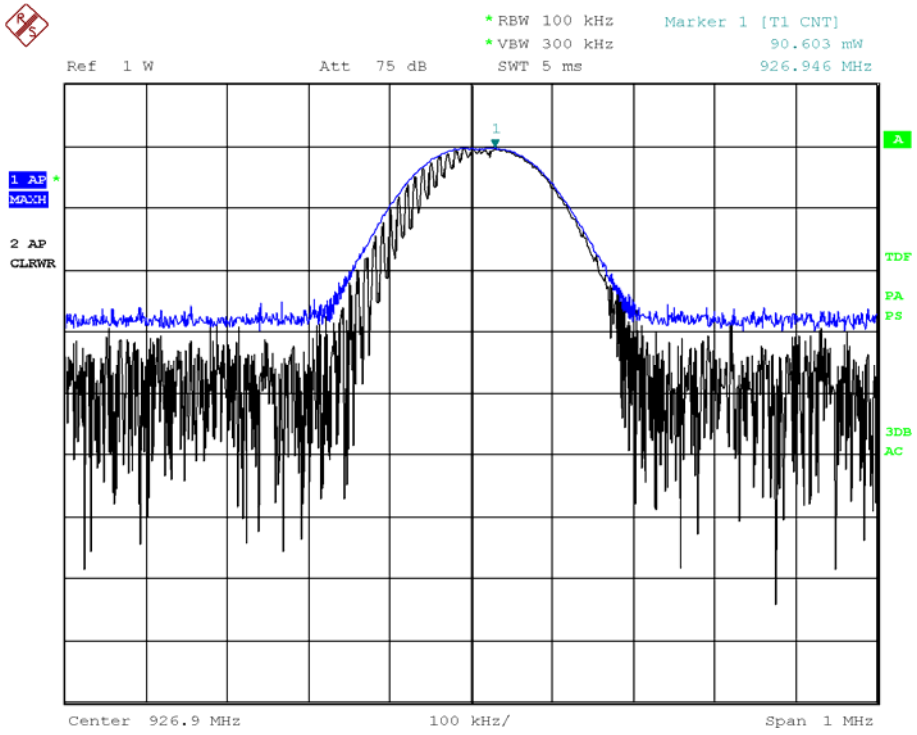
Channel	Conducted Power (mW)	Limit (mW)	Result
Low	94.819	250	Pass
Middle	95.422	250	Pass
High	90.603	250	Pass



Graph 9: Peak output power, lower channel



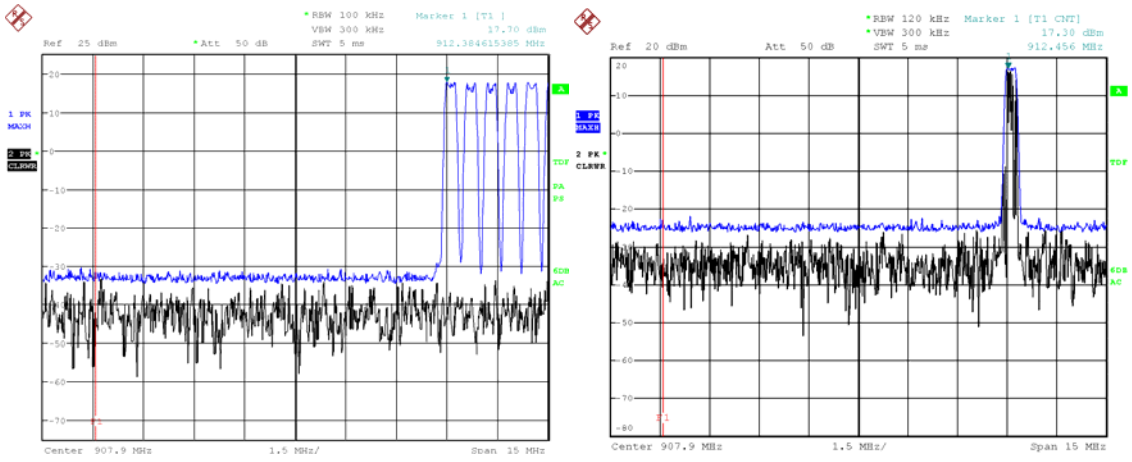
Graph 10: Peak output power, middle channel



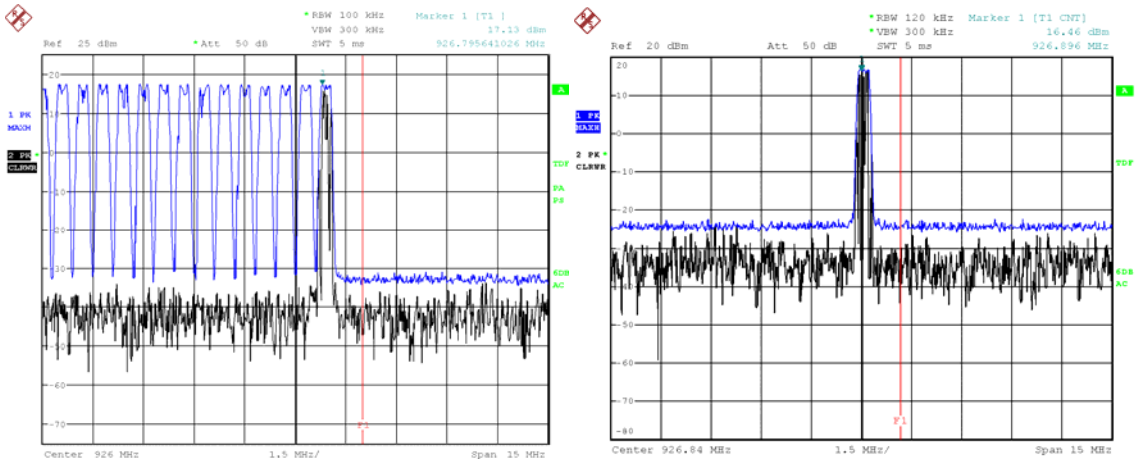
Graph 11: Peak output power, upper channel

13.0 BAND-EDGE COMPLIANCE (§15.247 (b)(2))

Band-edge emission was measured within the 902 – 928 MHz. The graphs below show compliance to this band.



Graph 12: Band-edge emission; lower edge



Graph 13: Band-edge emission; upper edge

Conclusion:

The limit at the band edges was 20 dB lower than the fundamental transmission. The conducted measurements shown above indicate compliance by more than 40 dB as shown by the vertical red lines drawn and the start and end of the allowed band.

14.0 SPURIOUS RADIATED EMISSIONS (§15.247 (d))

In order to ensure the compliance to the requirements of emission in restricted bands, radiated measurements were performed. Frequency range of 9 kHz to 10 GHz was investigated for any emission falling in restricted frequency bands. Provisions of FCC 15.35 were observed selecting the detector and bandwidth. Limits of FCC 15.205 and 15.209 were applied.

The EUT was placed 0.8 m and 1.5 m above the floor during the test for frequency range of below 1 GHz and above 1 GHz respectively. The EUT was checked in three orthogonal planes to determine maximum emission, only the worst case is reproduced for the report.

Radiated EMI tests were performed inside a compliant CISPR16-1-4 semi-anechoic chamber for a 2m x 2m x 2m test volume up to 18 GHz, at a test distance of 10 and 3. The EUT was set up on the table top (placed on turntable). The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. A calibrated loop antenna was used for measurements between 9 kHz and 30 MHz. A calibrated Biconilog antenna was used for measurements between 30 MHz and 1000 MHz. Calibrated horn antenna were used for measurements between 1 to 10 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurement of emissions above 1000 MHz was measured using a following setting:
Peak measurements setting: RBW = VBW = 1 MHz
Average measurements setting: RBW = 1 MHz and VBW = 10 Hz

The receiver bandwidth was set to 6 dB.

The EUT was slowly rotated with the Peak Detector 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 Quasi-peak, Peak or Average Detectors as appropriate. 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.

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)

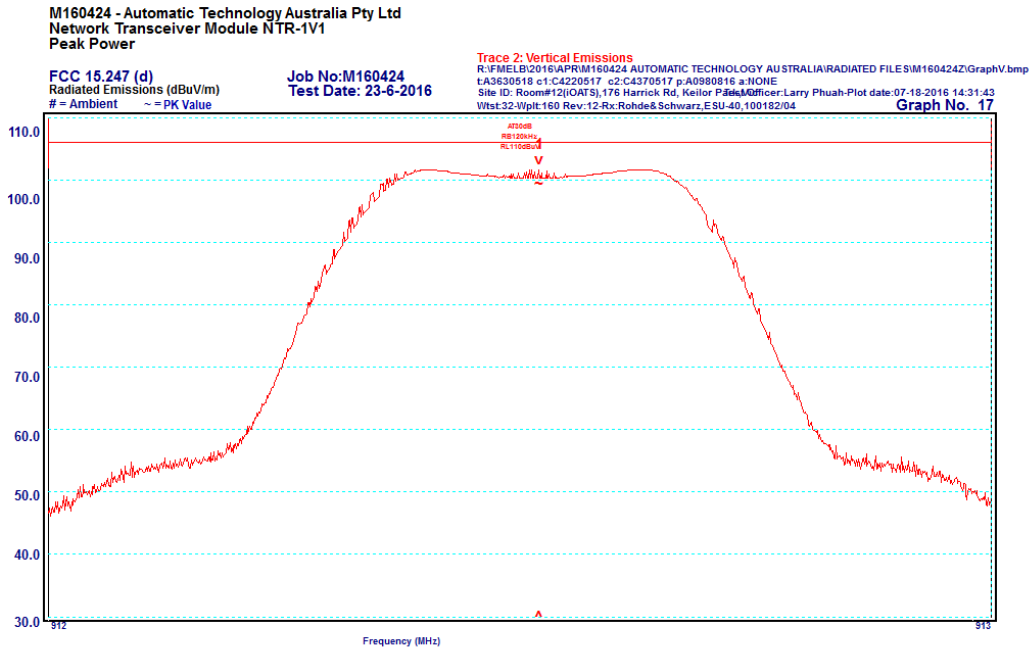
- **Example Field Strength Calculation**

Assuming a receiver reading of 34.0 dBµV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB (1/m). The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

34.0 + 9.2 + 1.9 - 20 = 25.1 dBµV/m

Determination of the limit:

The lower channel was used to determine the spurious emission limit applicable outside of the restricted bands.



Peak	Frequency (MHz)	Polarisation	Peak dBµV/m
1	912.52	Vertical	101.7

Graph 15: Radiated Peak Output Power

The out of restricted band emission limit is determined as 20 dB below this value.

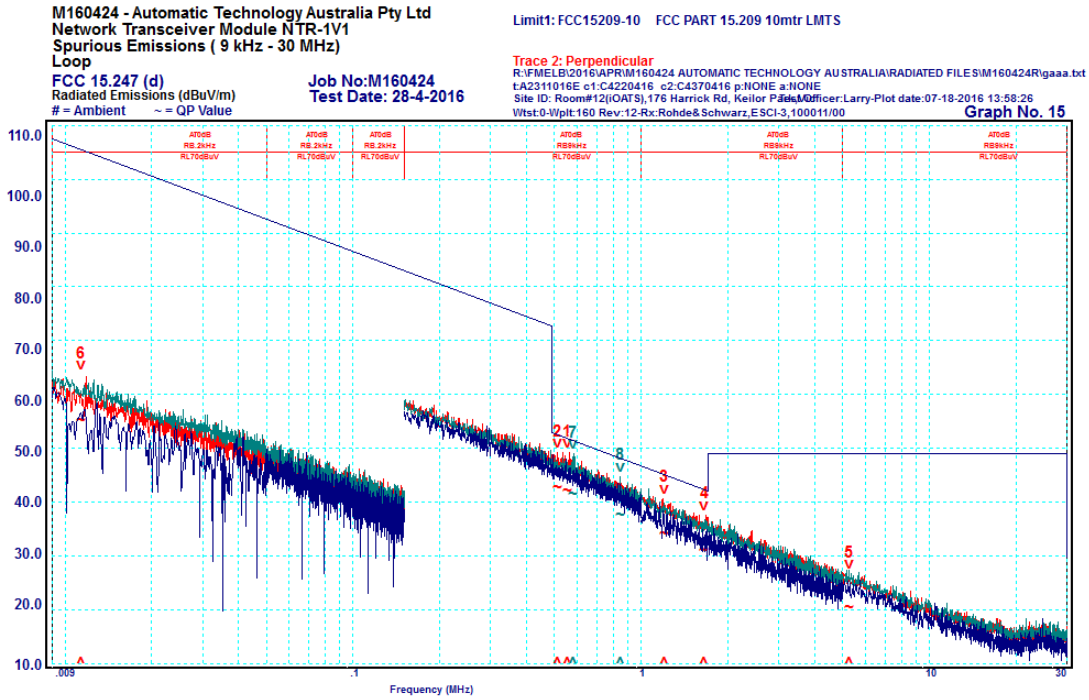
Limit: 101.7 – 20 dB = 81.7 dBµV/m (10 m)
= 92.2 dBµV/m (3 m)

Application of channels:

The spurious emission measurements were taken separately with the sample operating on the lower, middle and upper channels. The graphs on the following pages show the maximum levels from these measurements.

14.1 Frequency Band: 9 kHz - 30 MHz

Testing was performed at a distance of 10 metres. The measurement of emissions between 9 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 EUT and antenna orientated so three orthogonal axis were measured.

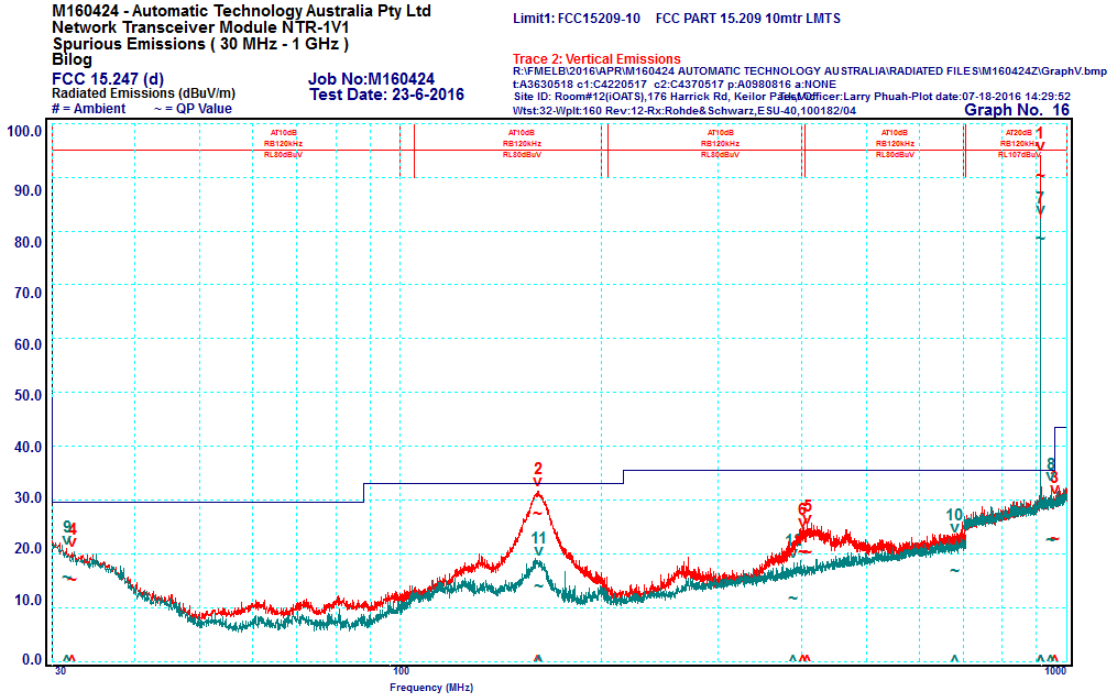


Graph 16: 9 kHz – 30 MHz radiated spurious emissions;

No emissions were detected above noise floor

14.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres. The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth (RBW) of 120 kHz and the video bandwidth (VBW) of 300 kHz. To simplify presentation the limits of § 15.209(a) were applied to the whole range.



Peak	Frequency (MHz)	Polarisation	Measured QP Level (dBµV/m)	QP Limit (dBµV/m)	ΔPeak ±dB
1	912.51	Vertical	-	-	-
2	161.00	Vertical	27.3	33.0	-5.7
3	959.84	Vertical	22.6	35.5	-12.9
4	32.26	Vertical	15.0	29.5	-14.5
5	409.17	Vertical	20.2	35.5	-15.3
6	401.63	Vertical	20.1	35.5	-15.4
7	912.52	Horizontal	-	-	-
8	947.67	Horizontal	22.4	35.5	-13.1
9	31.68	Horizontal	15.4	29.5	-14.1
10	679.49	Horizontal	16.7	35.5	-18.8
11	161.63	Horizontal	13.9	33.0	-19.1
12	389.24	Horizontal	11.6	35.5	-23.9

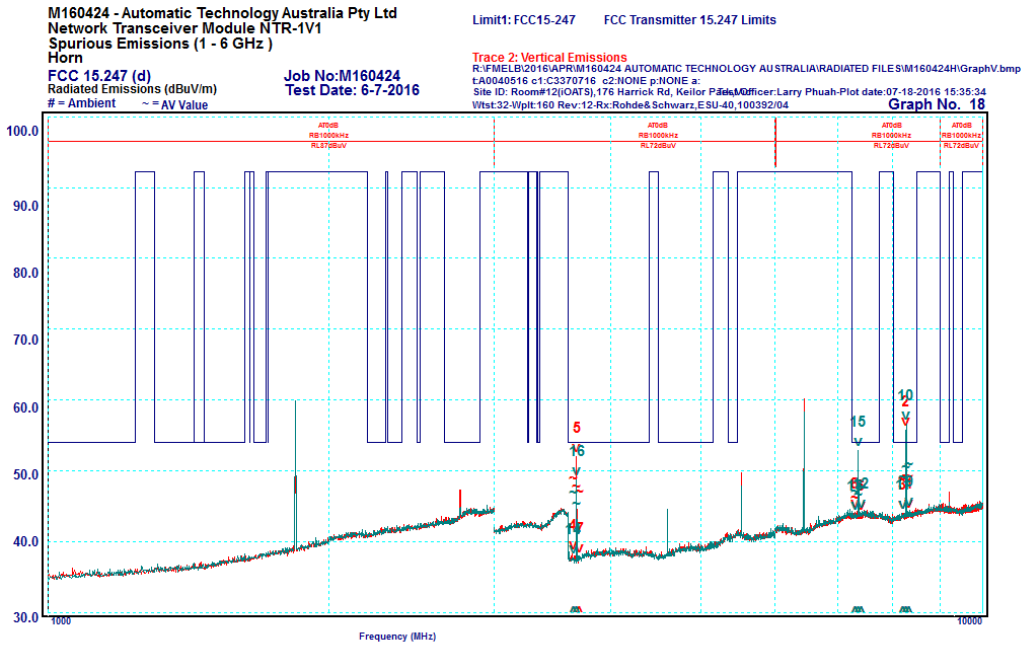
* Note: The peaks (1 and 7) exceeding the limit were the transmitted signal and not within the spurious frequency range.

Graph 17: 30 MHz – 1 GHz radiated spurious emissions

14.3 Frequency Band: 1000 - 10000 MHz

Testing was performed at a distance of 3 metres. The measurement of emissions above 1000 MHz was measured using a following setting:
Peak measurements: RBW = VBW = 1 MHz
Average measurements: RBW = 1 MHz and VBW = 10 Hz.

14.3.1 Average detector results

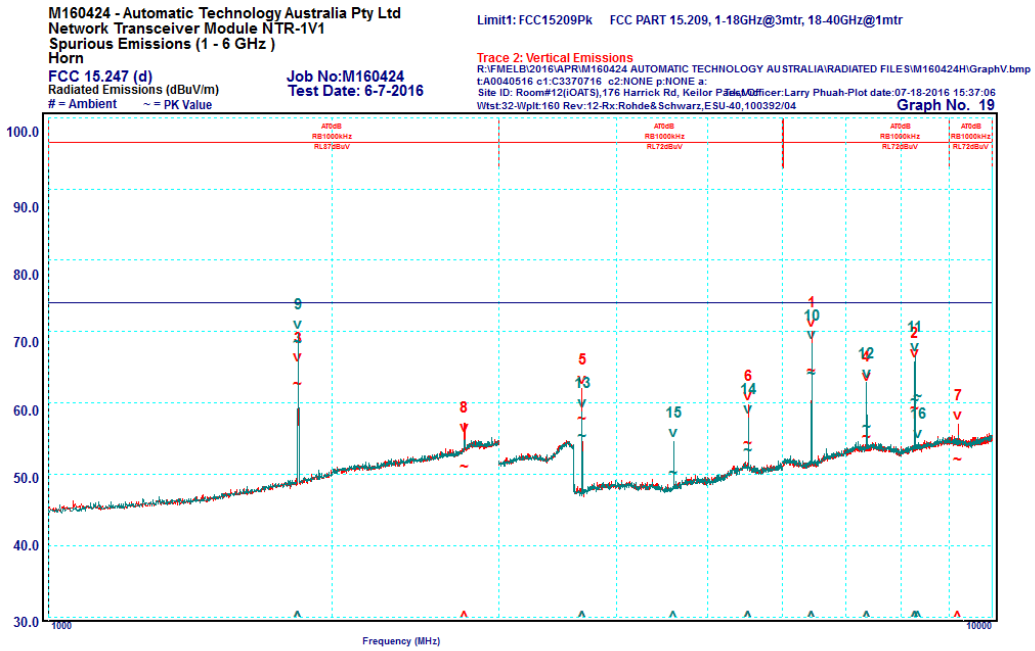


Peak	Frequency (MHz)	Channel Operating	Polarisation	Measured AV Level (dBµV/m)	AV Limit (dBµV/m)	ΔPeak (±dB)
1	8343.20	Upper	Vertical	49.2	54.0	-4.8
2	8278.42	Middle	Vertical	49.2	54.0	-4.8
3	8213.66	Lower	Vertical	48.9	54.0	-5.1
4	3650.50	Lower	Vertical	48.9	54.0	-5.1
5	3679.30	Middle	Vertical	47.7	54.0	-6.3
6	7416.22	Upper	Vertical	47.6	54.0	-6.4
7	3708.11	Upper	Vertical	46.9	54.0	-7.1
8	7301.03	Lower	Vertical	46.1	54.0	-7.9
9	8343.20	Upper	Horizontal	50.8	54.0	-3.2
10	8278.45	Middle	Horizontal	50.4	54.0	-3.6
11	8213.62	Lower	Horizontal	49.0	54.0	-5.0
12	7416.22	Upper	Horizontal	47.6	54.0	-6.4
13	7301.01	Lower	Horizontal	47.0	54.0	-7.0
14	3650.51	Lower	Horizontal	46.9	54.0	-7.1
15	7358.71	Middle	Horizontal	46.6	54.0	-7.4
16	3679.26	Middle	Horizontal	45.3	54.0	-8.7

Graph 18: 1 – 6 GHz radiated spurious emissions; average detector

*The limit shown is a combined limit FCC 15.209 and FCC 15.205.

14.3.2 Peak detector results



Peak	Frequency (MHz)	Channel Operating	Polarisation	Measured Peak Level (dBµV/m)	Peak Limit (dBµV/m)	ΔPeak (±dB)
1	6438.76	Middle	Vertical	70.1	74.0	-3.9
2	8278.42	Middle	Vertical	65.7	74.0	-8.3
3	1839.63	Middle	Vertical	65.1	74.0	-8.9
4	7358.63	Middle	Vertical	62.4	74.0	-11.6
5	3679.30	Middle	Vertical	62.0	74.0	-12.0
6	5518.90	Middle	Vertical	59.7	74.0	-14.3
7	9198.26	Middle	Vertical	57.0	74.0	-17.0
8	2759.45	Middle	Vertical	55.3	74.0	-18.7
9	1839.63	Middle	Horizontal	69.8	74.0	-4.2
10	6438.77	Middle	Horizontal	68.3	74.0	-5.7
11	8278.45	Middle	Horizontal	66.6	74.0	-7.4
12	7358.71	Middle	Horizontal	62.9	74.0	-11.1
13	3679.26	Middle	Horizontal	58.7	74.0	-15.3
14	5519.10	Middle	Horizontal	57.8	74.0	-16.2
15	4599.16	Lower	Horizontal	54.6	74.0	-19.4
16	8343.20	Upper	Horizontal	54.4	74.0	-19.6

Graph 19: 1 – 6 GHz radiated spurious emissions; peak detector

15.0 FREQUENCY HOPPING CHANNELS (§15.247 (g))

In normal operation the transmitter employed short bursts. The transmitter complied with the requirements for short bursts and continuous data transmission.

16.0 FREQUENCY HOPPING ADAPTIVITY (§15.247 (h))

The transmitter did not incorporate adaptive frequency hopping.

17.0 RADIO FREQUENCY HAZARD (§15.247 (i))

The transmitter was considered a mobile device as it was not intended to be used within 20 cm of the user or nearby person.

The maximum power limits are given in the following table (taken from KDB 447498):

MHz	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	
150	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	
300	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	
450	224	254	284	314	344	374	404	434	464	494	524	554	584	614	644	
835	164	220	275	331	387	442	498	554	609	665	721	776	832	888	943	
900	158	218	278	338	398	458	518	578	638	698	758	818	878	938	998	
1500	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	mW
1900	109	209	309	409	509	609	709	809	909	1009	1109	1209	1309	1409	1509	
2450	96	196	296	396	496	596	696	796	896	996	1096	1196	1296	1396	1496	
3600	79	179	279	379	479	579	679	779	879	979	1079	1179	1279	1379	1479	
5200	66	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466	
5400	65	165	265	365	465	565	665	765	865	965	1065	1165	1265	1365	1465	
5800	62	162	262	362	462	562	662	762	862	962	1062	1162	1262	1362	1462	

The maximum allowed power for this device is 998 mW. As the power of the sample tested did not exceed this level it was considered exempt form measurements and complied with the human exposure requirements.

18.0 COMPLIANCE STATEMENT

The Network Transceiver Module, Model: NTR-1V1 tested on behalf of Automatic Technology Australia, **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

Results were as follows:

FCC Subpart C, Section 15.247

FCC Part 15C Clauses	Test Performed	Results
15.203	Antenna Requirement	Complied
15.205	Operation in Restricted Band	Complied
15.207	Conducted Emissions	Complied
15.209	Radiated Emissions	Complied
15.247 (a)(1)	Hopping Protocol	Complied
15.247 (a)(1)(i)	Carrier Frequency Separation	Complied
15.247 (a)(1)(i)	20 dB Bandwidth	Complied
15.247 (a)(1)(i)	Number of hopping channels	Complied
15.247 (a)(1)(i)	Dwell time	Complied
15.247 (b)(2)	Peak Output Power	Complied
15.247 (c)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	Band-edge compliance	Complied
15.247 (d)	Spurious radiated emissions	Complied
15.247 (e)	Peak Power Spectral Density	Not Applicable
15.247 (f)	Hybrid Systems	Not Applicable. EUT did not employ a hybrid system
15.247 (g)	Frequency Hopping Channels	Complied
15.247 (h)	Frequency Hopping Adaptivity	Not Applicable
15.247 (i)	Radio Frequency Hazard	Complied

19.0 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%.

APPENDIX A

MEASUREMENT INSTRUMENT DETAILS

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yy	Due Date dd/mm/yy	Cal. Interval
Chamber	Frankonia SAC-10-2 (R-139)	08/01/2016	8/01/2017	1 Year, *1
EMI Receiver	R&S ESU40 20 Hz – 40 GHz Sn: 100392 (R-140)	19/11/2015	19/11/2016	1 Year, *2
	R&S ESU40 20 Hz – 40 GHz Sn: 100182 (R-037)	18/02/2016	18/02/2017	1 Year, *2
	R&S ESCI 9 kHz – 3 GHz Sn: 100011 (R-028)	25/05/2016	25/05/2017	1 Year, *2
Antennas	EMCO 6502 Active Loop A-231 9kHz – 30MHz Sn. 9311-2801	20/07/2015	20/07/2018	3 Year, *2
	SUNOL JB6 BICONILOG 30 – 6000 MHz Sn. A012312 (A-363)	26/05/2016	26/05/2018	2 Year, *2
	EMCO 3115 Broadband Horn 1 – 18 GHz Sn. 8908-3282	15/07/2016	15/07/2017	3 Year, *1
Cables	Room 12 inbuilt cable Panel 1 to 10m (C-422)	19/05/2016	19/05/2017	1 Year, *1
	Room 12 Antenna cable (C-437)	19/05/2016	19/05/2017	1 Year, *1
	Room 12 Antenna cable for 1 – 18 GHz 5m (C-337)	01/07/2015	01/07/2016	1 Year, *1

Note *1. Internal NATA calibration.
Note *2. External NATA / A2LA calibration