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**TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.249)**

FCC ID: Z4C-7000

Test Sample: Metal Detector
Model: Jupiter

Report Number: M140534-4

Tested for: Minelab Electronics Pty Ltd

Issue Date: 22nd September 2014

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.



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TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.249)
EMC Technologies Report No. M140453-4
Issue Date: 22nd September 2014

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TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.249)

Report Number: M140534-4

Sample: Metal Detector
Model: Jupiter

FCC ID: Z4C-7000
Equipment Type: Intentional Radiator (Transceiver)

Manufacturer: Minelab Electronics Pty Ltd
Address: 118 Hayward Avenue, Torrensville
SA 5031, AUSTRALIA
Contact: Mark Lawrie

Tested for: Minelab Electronics Pty Ltd

Standards: FCC Part 15 – *Radio Frequency Devices*
FCC Part 15 Subpart C – *Intentional Radiators*
Section 15.247: *2400 – 2483.5 MHz Operation Bands*
ANSI C63.4 – 2009
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 Dates: 19th June to 25th June 2014

Test Engineer:


Kevin Hansen

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.

Authorised Signatory:



Chris Zombolas
Technical Director
EMC Technologies Pty Ltd



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TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart C (Section 15.249)

1.0 INTRODUCTION

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 15.209: Radiated Emission Limits (General requirements)
 Section 15.249: Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

The sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.249.

The measurement procedure used was in accordance with ANSI C63.4-2009. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.1 Summary of Results

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna Requirement	Not Applicable
15.207	Conducted Emissions	Not Applicable
15.209	Radiated Emissions	Complied
15.249 (a)	Fundamental Field Strength	Complied
15.249 (a)	Harmonics Emissions	Complied
15.249 (b)	Fixed, point to point	Not Applicable
15.249 (c)	Field strength limits @ 3 meters	Noted
15.249 (d)	Spurious Emissions	Complied
15.249 (e)	20 dB Peak to Average	Complied

1.2 Modifications by EMC Technologies

No modifications were performed.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (Transmitter) Details

Wireless Radio:	2400-2483.5 MHz Wireless Link
Number of channels:	15
Bit Rate:	250 kbps
Duty cycle:	Approximately 14%
Antenna type:	Inverted F
Antenna gain:	3.3 dBi

2.2 EUT (Host) Details

Host:	Metal Detector
Model Number:	Jupiter
Serial Number:	PT01
Microprocessors:	M2S010-FGG484, IMX253, STM32F
Crystal frequency(s) MHz:	12.288MHz, 24MHz, 26MHz
Highest Operating Freq MHz:	266MHz
Lowest Operating Freq MHz:	1.2kHz
Input supply:	7.2VDC 0.8A

2.3 Test Configuration

The 2.4 GHz Wireless Link was transmitting and receiving continuously during the test.

2.4 Operational Description

The Wireless Audio Receiver Module receives audio information via the wireless communications link and generates audio either out of the integrated speaker, or headphones if connected. It is battery operated.

The wireless interface operates in the band 2.4 - 2.483 GHz with 1 of 15 discrete manually selected channels used at any one time.

The wireless electronics uses reference design for the CC2500 device from Texas Instruments in conjunction with an inverted-F PCB antenna. The same electronics and antenna design is used in the User Interface Pod and Wireless Audio Receiver Module.

The User Interface contains a wireless transceiver which transmits detected target audio data to the Wireless Audio Receiver Module. This data is transmitted as a packet every 10mS.



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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 & 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies open area test site (OATS) & indoor open area test site (iOATS) have been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional) - **Industry Canada iOATS number - IC 3569B**

Measurements in this report were performed at EMC Technologies' laboratory in Keilor Park, Victoria 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 (A²LA).

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.



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2.6 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 or the National Measurement Institute (NMI) or in-house. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

Equipment	Make/ Model/ Serial Number	Calibration Due dd/mm/yy	Calibration Interval
EMI Receivers	R&S ESU40 Sn: 100182 (R-037)	06/02/15	1 Year
	HP 8546A Sn: 3549A00290 (R-009)	12/09/14	1 Year
Antennas	Sunol JB6 (A-363) 30 - 6000 MHz Sn: A012312	16/05/15	1 Year
	EMCO 3115 (A-004) 1 – 18 GHz Sn: 8908-3282	16/01/15	3 Year
	ETS-Lindgren 3160-06 (A-259) 5.85 - 8.2 GHz Sn: 29322	12/11/15	3 Year
	ETS-Lindgren 3160-07 (A-261) 8.2 - 12.4 GHz Sn: 29251	12/11/15	3 Year
	ETS-Lindgren 3160-08 (A-263) 12.4 - 18 GHz Sn: 29447	09/11/15	3 Year
Pre-Amplifier	Electronic Development Sales SG18-B3015 (A-288) Sn: 1	27/02/15	1 Year
LISN	EMCO 3825/2 (L-022) 10 kHz - 100 MHz Sn: 9607-2567	07/09/14	2 Year
Limiter	HP 11947A Sn: 3107A02888 (L-017)	16/09/14	1 Year



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3.0 TEST RESULTS

3.1 §15.203 Antenna Requirement

An internal, permanently attached antenna was incorporated within the metal detector ensuring that it could not be replaced.

3.2 §15.207 Conducted Limits

Conducted emission testing was not applicable as the EUT is battery powered.

3.3 §15.209 Radiated emission limits; general requirements

The limits given in §15.249 applied, however attenuation below the general levels was not required.

3.4 §15.249(a) Fundamental and Harmonic Emissions

Radiated EMI tests were performed inside a fully compliant CISPR16-1-4 semi-anechoic chamber for a 2m x 2m x 2m test volume up to 18 GHz. The EUT was positioned on a test table of height 0.8 metres. The EUT was rotated through 360° on the turntable and the highest emissions were maximised by scanning the measurement antenna over the 1 to 4 metres height.

3.4.1 Fundamental

Channel	Frequency MHz	E(peak) dBµV/m	E(peak) mV/m	Limit(average) mV/m	Result
1	2411	89.2	28.8	50	Complies
8	2440	89.8	30.9	50	Complies
15	2471	91.3	36.8	50	Complies

All measurements were made at a distance of 3 metres. The fundamental emissions were measured using a peak detector and as the level did not exceed the average limit further measurements were not made.

3.4.1 Harmonics

Emissions measured with an average detector:

Channel	Frequency MHz	E(average) dBµV/m	E(average) µV/m	Limit(average) µV/m	Result
1	4822	40.2	102	500	Complied
8	4880	45.6	191	500	Complied
15	4942	47.3	232	500	Complied

Emissions measured with a peak detector:

Channel	Frequency MHz	E(peak) dBµV/m	E(peak) µV/m	Limit(peak) µV/m	Result
1	4822	54.9	556	5000	Complied
8	4880	53.4	468	5000	Complied
15	4942	54.5	531	5000	Complied

All measurements were made at a distance of 3 metres. No other harmonics were measured above the noise floor of the measurement equipment.



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3.5 §15.249(b) Fixed, Point to Point

Not a fixed, point to point radio device.

3.6 §15.249(c) Field strength limits at 3 metres

Field strength limits are specified at a distance of 3 metres. If required the limits were adjusted when measuring distances were different.

3.7 §15.249(d and e) Spurious Emissions

Radiated EMI tests were performed inside a fully 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 3 metres. The EUT was set up on the table top (placed on turntable) of total height 80 cm above the ground plane and operated as described in section 2 of this report. 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 Biconilog antenna was used 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.

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.

3.7.1 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)



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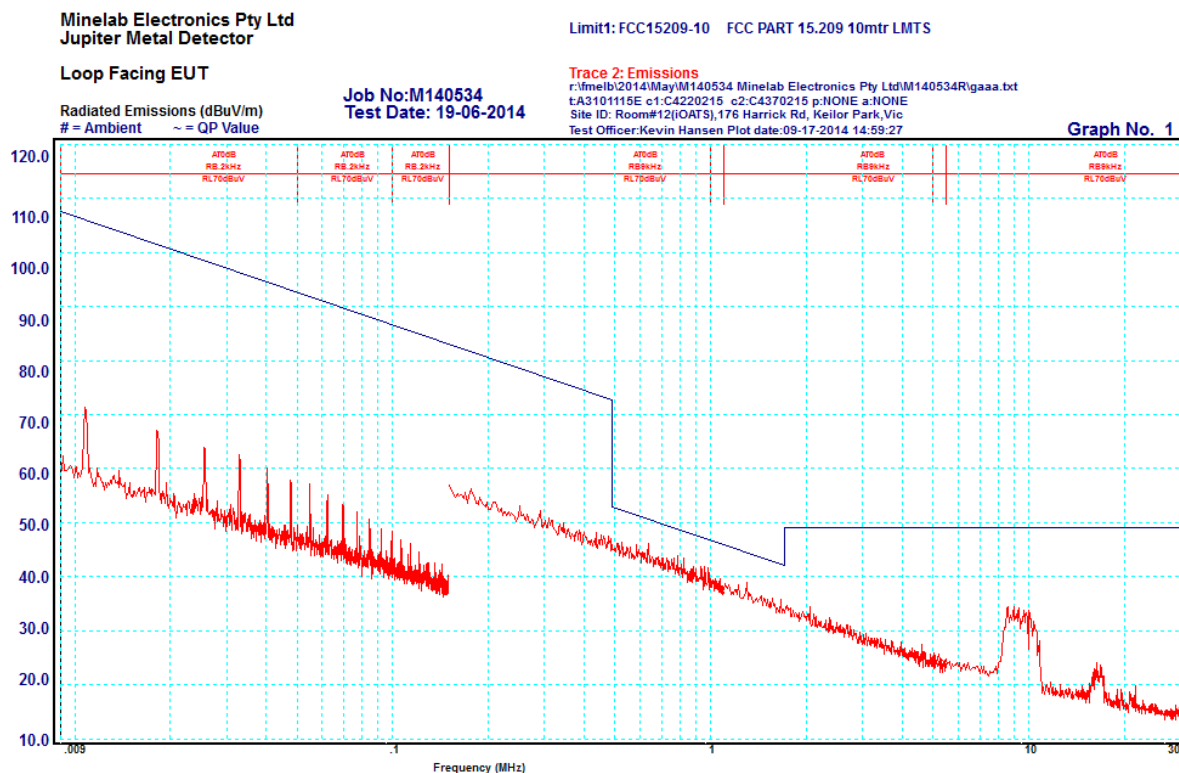
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3.7.2 Frequency Band: 9 kHz - 30 MHz

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.

3.7.2.1 Loop antenna parallel to EUT



No emissions exceeded the FCC 15.209 limits.



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3.7.2.2 Loop antenna perpendicular to EUT

Minelab Electronics Pty Ltd
Jupiter Metal Detector

Limit1: FCC15209-10 FCC PART 15.209 10mtr LMTS

Loop Perpendicular to EUT

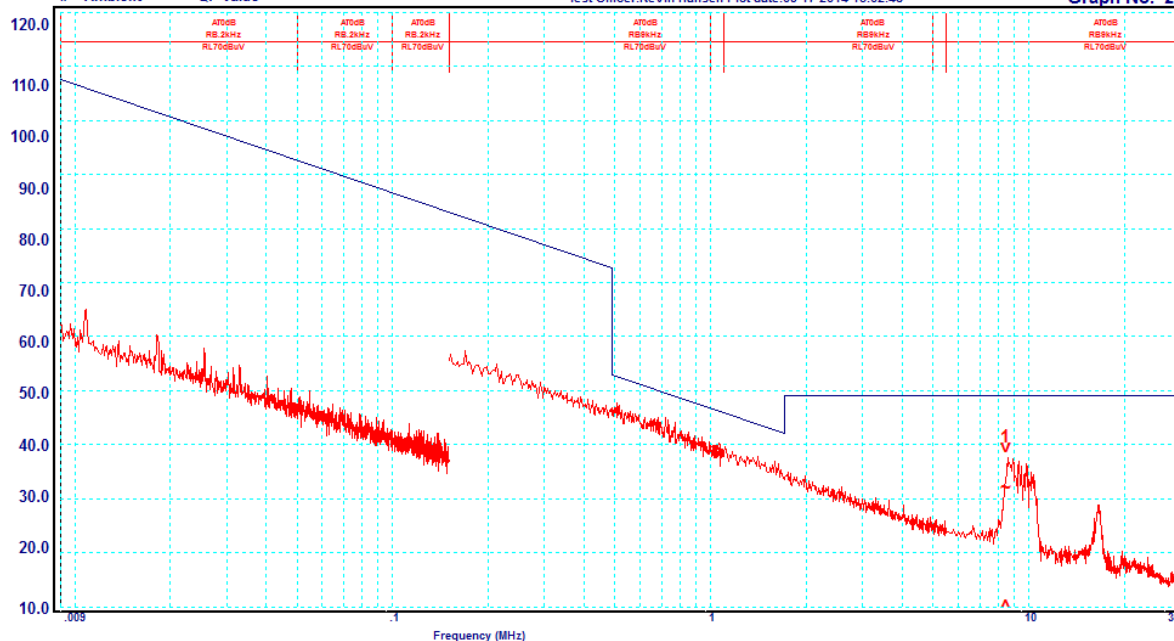
Job No: M140534
Test Date: 19-06-2014

Trace 2: Emissions

r:\melb\2014\May\M140534 Minelab Electronics Pty Ltd\M140534Rigaaa.txt
t:A3101115E c1:C4220215 c2:C4370215 p:NONE a:NONE
Site ID: Room#12(jOATS),176 Harrick Rd, Keilor Park, Vic
Test Officer: Kevin Hansen Plot date: 09-17-2014 15:02:48

Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Graph No. 2



Result:

Point	Frequency (MHz)	Antenna orientation	Emission (dBuV/m)	Limit (dBuV/m)	Difference (dB)
1	8.456	Perpendicular	32.0	49.0	-17.0

No emissions exceeded the FCC Part 15.209 limits.



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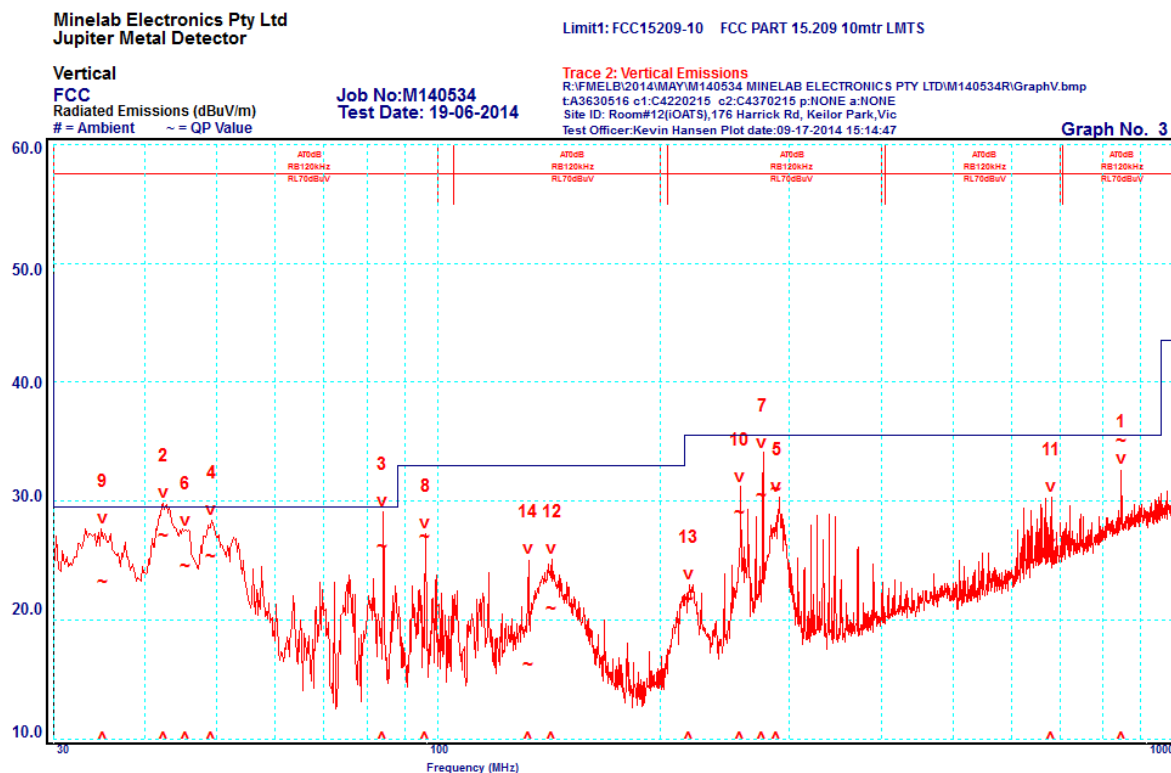
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3.7.3 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres. The measurement of emissions between 30 - 1000 MHz were made with the resolution bandwidth (RBW) of 120 kHz and the video bandwidth (VBW) of 300 kHz.

3.7.3.1 Vertical Polarisation



Point	Frequency (MHz)	Antenna orientation	Emission (dBμV/m)	Limit (dBμV/m)	Difference (dB)
1	846.74	Vertical	35.0	35.5	-0.5
2	42.38	Vertical	27.1	29.5	-2.4
3	84.01	Vertical	26.1	29.5	-3.4
4	49.20	Vertical	25.2	29.5	-4.3
5	288.22	Vertical	30.9	35.5	-4.6
6	45.33	Vertical	24.5	29.5	-5.0
7	275.51	Vertical	30.4	35.5	-5.1
8	96.00	Vertical	27.0	33.0	-6.0
9	34.99	Vertical	23.2	29.5	-6.3
10	256.53	Vertical	29.0	35.5	-6.5
11	680.94	Vertical	26.7	35.5	-8.8
12	142.73	Vertical	20.9	33.0	-12.1
13	218.90	Vertical	21.8	35.5	-13.7
14	132.37	Vertical	16.2	33.0	-16.8



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3.7.3.2 Horizontal Polarisation

Minelab Electronics Pty Ltd
Jupiter Metal Detector

Limit1: FCC15209-10 FCC PART 15.209 10mtr LMTS

Horizontal

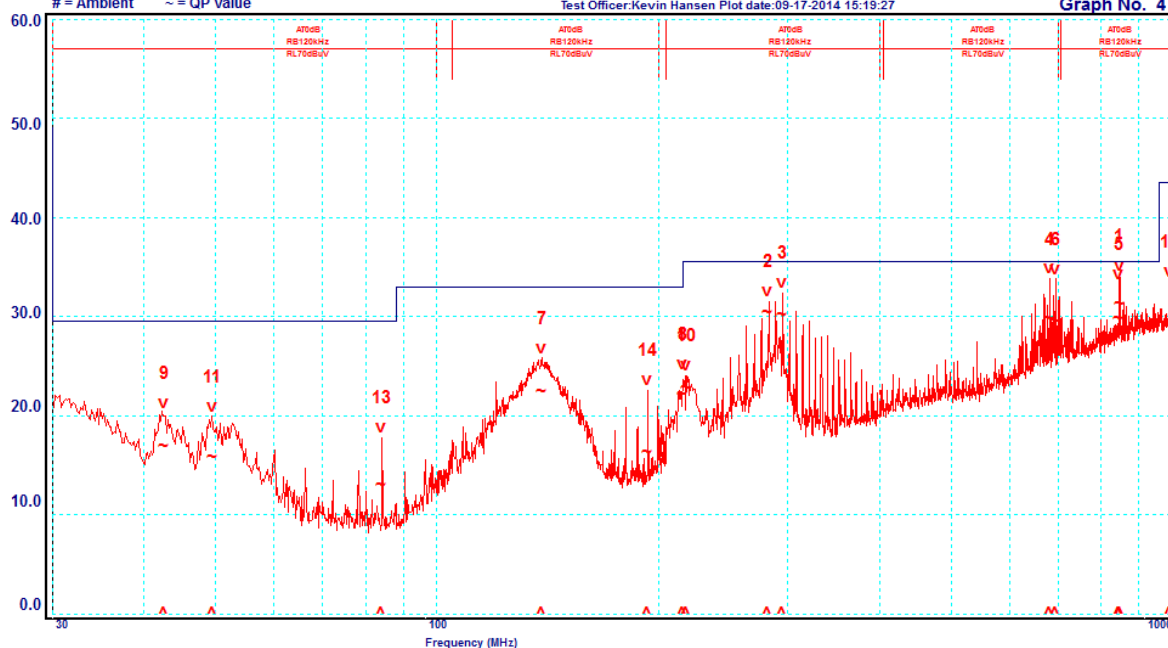
FCC
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Job No: M140534
Test Date: 19-06-2014

Trace 2: Horizontal Emissions

R:\FME\B\2014\MAY\M140534 MINELAB ELECTRONICS PTY LTD\M140534R\GraphH.bmp
t:A3630516 c1:C4220215 c2:C4370215 p:NONE a:NONE
Site ID: Room#12(iOATS),176 Harrick Rd, Keilor Park, Vic
Test Officer: Kevin Hansen Plot date: 09-17-2014 15:19:27

Graph No. 4



Point	Frequency (MHz)	Antenna orientation	Emission (dBuV/m)	Limit (dBuV/m)	Difference (dB)
1	846.72	Horizontal	31.2	35.5	-4.3
2	281.87	Horizontal	30.4	35.5	-5.1
3	294.56	Horizontal	30.1	35.5	-5.4
4	680.90	Horizontal	29.8	35.5	-5.7
5	844.83	Horizontal	29.7	35.5	-5.8
6	693.61	Horizontal	29.6	35.5	-5.9
7	138.99	Horizontal	22.4	33.0	-10.6
8	215.76	Horizontal	22.2	33.0	-10.8
9	42.55	Horizontal	16.9	29.5	-12.6
10	218.28	Horizontal	22.7	35.5	-12.8
11	49.56	Horizontal	15.8	29.5	-13.7
12	991.62	Horizontal	29.5	43.5	-14.0
13	84.02	Horizontal	13.0	29.5	-16.5
14	193.18	Horizontal	16.3	33.0	-16.7



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3.7.4 Frequency Band: 1 – 25 GHz

The upper frequency range was 10 times the highest operating frequency:
 $10 \times 2.4835 \text{ GHz} = 24.835 \text{ GHz}$

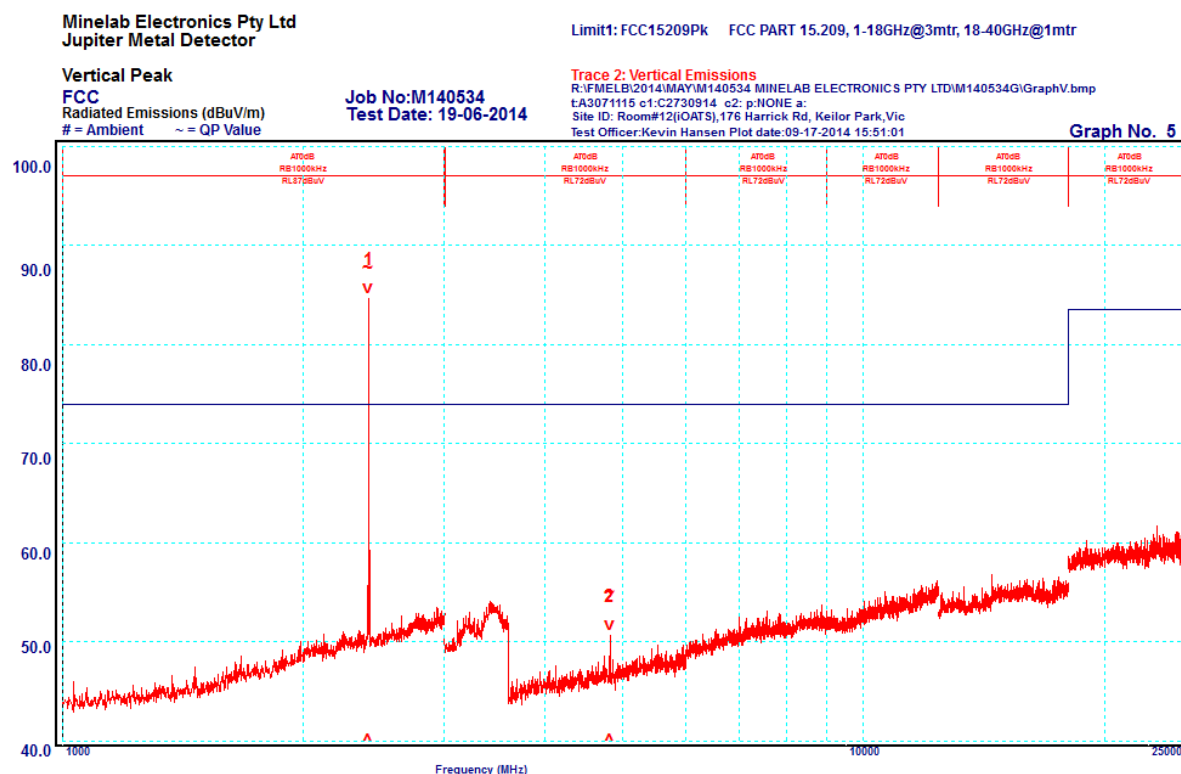
Measurements were made at a distance of 3 metres for frequencies 1 GHz to 18 GHz and 1 metre between 18 GHz and 25 GHz.

The measurement of average emissions between 1 GHz - 25 GHz was measured with the resolution bandwidth of 1000 kHz and the video bandwidth of 10 Hz.

The measurement of peak emissions between 1 GHz - 25 GHz was measured with the resolution and video bandwidth of 1000 kHz.

3.7.4.1 Channel 1, 2411 MHz

3.7.4.2 Vertical polarisation, peak detector emissions



Point 1 = fundamental

Point 2 = harmonic

No other emissions observed.

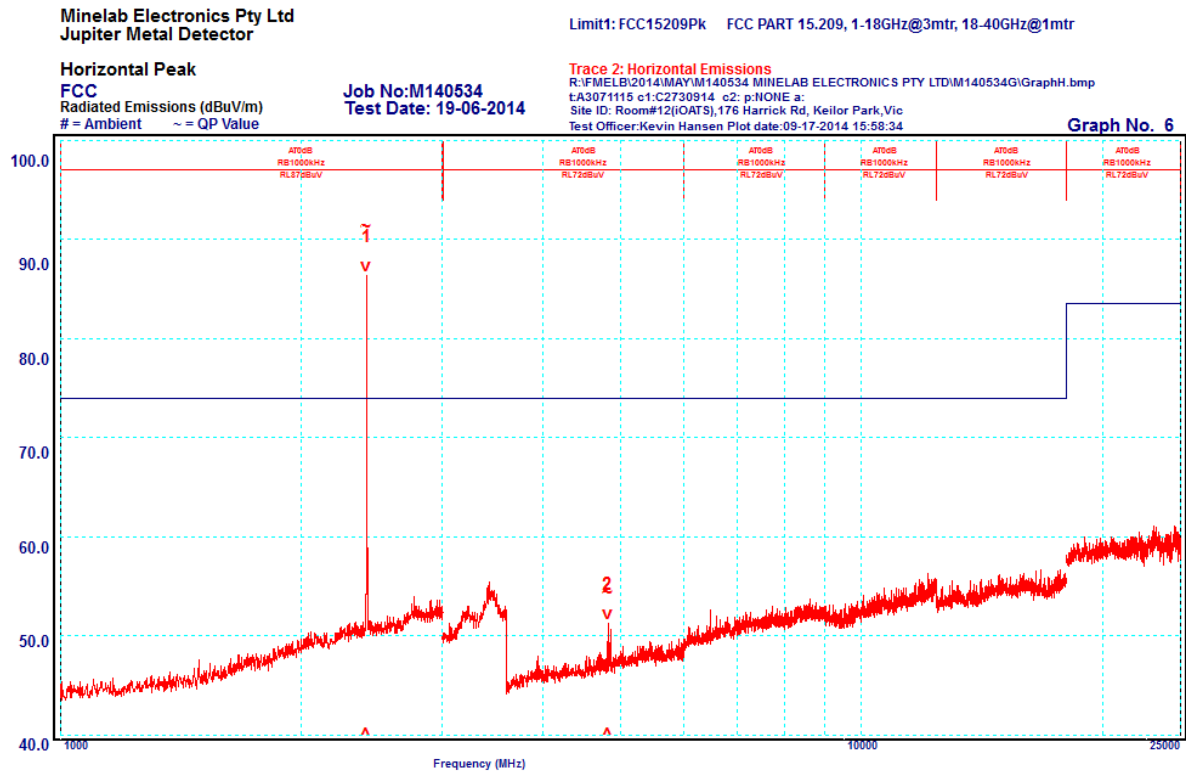


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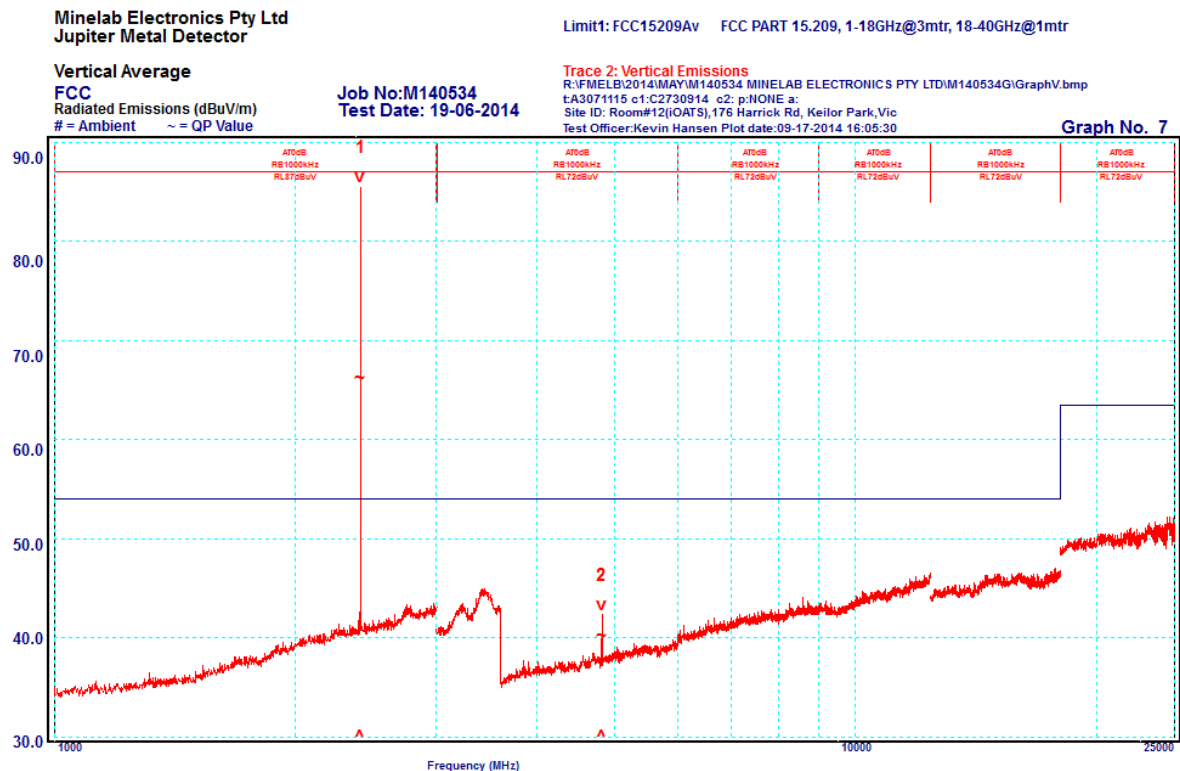
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3.7.4.3 Horizontal polarisation, peak detector emissions



Point 1 = fundamental
Point 2 = harmonic
No other emissions observed.

3.7.4.4 Vertical polarisation, average detector emissions



Point 1 = fundamental
Point 2 = harmonic
No other emissions observed.

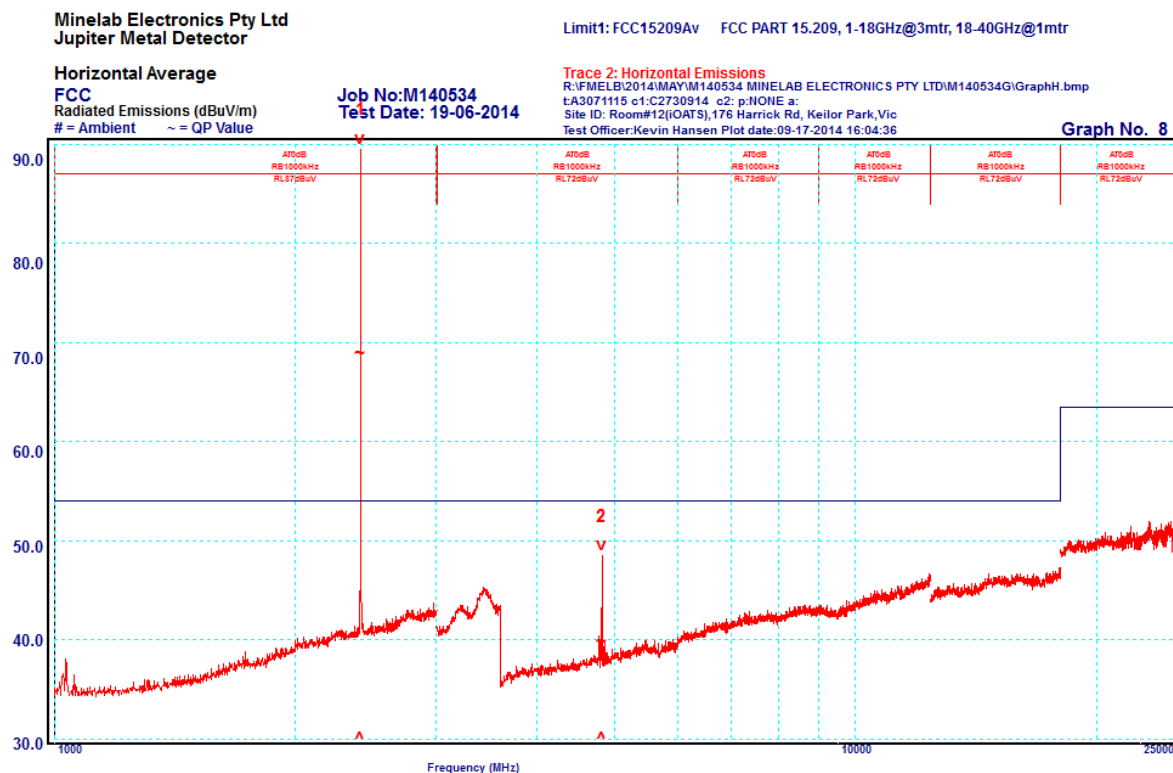


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3.7.4.5 Horizontal polarisation, average detector emissions



Point 1 = fundamental
Point 2 = harmonic
No other emissions observed.

3.7.4.6 Channels 8 and 15, 2420 MHz and 2470 MHz

The spurious emissions with the transmitter operating on channels 8 and 15 were verified not to exceed those measured while operating on channel 1.



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4.0 COMPLIANCE STATEMENT

The Jupiter Metal Detector tested on behalf of Minelab Electronics Pty Ltd **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.249 - Operation in the frequency band 2400 - 2483.5 MHz.

Results were as follows:

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna Requirement	Not Applicable
15.207	Conducted Emissions	Not Applicable
15.209	Radiated Emissions	Complied
15.249 (a)	Fundamental Field Strength	Complied
15.249 (a)	Harmonics Emissions	Complied
15.249 (b)	Fixed, point to point	Not Applicable
15.249 (c)	Field strength limits @ 3 meters	Noted
15.249 (d)	Spurious Emissions	Complied
15.249 (e)	20 dB Peak to Average	Complied

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%.



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