



EMC Technologies Pty Ltd

A.C.N. 057 105 549

57 Assembly Drive

Tullamarine Victoria Australia 3043

Ph: + 613 9335 3333

Fax: + 613 9338 9260

email: melb@emctech.com.au

EMI TEST REPORT

**for
CERTIFICATION
of**

FCC PART 15.245 TRANSMITTER

FCC ID: O7B-BIRDDETER-245

Manufacturer: BirdDeter Pty. Ltd.

Test Sample: 2.4 GHz BirdDeter Transmitter

Report Number: M001204-Tx

Issue Date: 21st December 2000

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**EMI TEST REPORT FOR
CERTIFICATION
of
FCC PART 15.245 TRANSMITTER
FCC ID: O7B-BIRDDETER-245**

CERTIFICATION of COMPLIANCE with FCC PART 15 REGULATIONS.

EMC Technologies Report Number: M001204-TX

Issue Date: 21st December 2000

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**EMI TEST REPORT FOR CERTIFICATION
of
FCC PART 15.245 TRANSMITTER**

Report Number: M001204-TX

Test Sample: 2.4 GHz BirdDeter Transmitter

FCC ID: O7B-BIRDDETER-245

Manufacturer: BirdDeter Pty. Ltd.
PO Box 1056, Warwick, Queensland 4370 Australia

Phone: + 61(7) 4667 0491
Fax: + 61(7) 4667 0493

Responsible Party: John Muehlebach
Technical Manager
BirdDeter Pty. Ltd.

Equipment Type: Intentional Radiator, Low Power Transmitter

Test Standards: FCC Part 15 Section 245 Intentional Radiators.
ANSI C63.4-1992
OET Bulletin No. 63, October 1993

Tested for: BirdDeter Pty. Ltd.

Test Dates: 13-12- 2000

Test Officer: Chieu Huynh

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 Signature: 
Chris Zombolas
EMC Technologies Pty Ltd



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**EMI TEST REPORT FOR CERTIFICATION
of
FCC PART 15.245 REQUIREMENTS
on the
2.4 GHz BirdDeter Transmitter**

1.0 SUMMARY of RESULTS.

This report details the results of EMI tests and measurements performed on the **2.4 GHz BirdDeter Transmitter** in accordance with the Federal Communications Commission (FCC) regulations as detailed in **Title 47 CFR, Part 15 Rules for intentional radiators**. The results and photographs of all the EUT are detailed in this report. The EUT complied with requirements for fundamental frequencies and spurious emissions of section 15.245.

Transmitter Fundamental Frequency: 2444.35 MHz, Complied, margin of 11.2 dB.

Transmitter Spurious: Complied, worst case margin of 3.3 dB.

The measurement procedure was in accordance with ANSI C63.4-1992, and OET Bulletin No. 63. The instrumentation conformed to these requirements.

2.0 GENERAL INFORMATION

2.1 General Description of Test Setup

Test Sample: 2.4 GHz BirdDeter Transmitter

FCC ID: **O7B-BIRDDETER-245**

Equipment Type: Intentional Radiator, Low Power transmitter

2.2 Technical Specifications

- Center Frequency : 2.45 GHz
- Transmit Power : 9 dBm peak, 6dBm average
- Modulation : 2.048KHz, 50% duty cycle, pulsed on/off
- Modulation type : A.M
- Antenna : 4 element Yagi antenna
- Antenna 20 dB Beam-width : $E * H = 40 \text{ degrees} * 40 \text{ degrees}$
- Antenna Gain: 12 dBi nominal
- Enclosure : PVC Pipe
- Power Supply : 12 V lead acid battery @ approximately 115mA, supplied via under-voltage shutdown control box



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2.3 Test Sample Functional Description

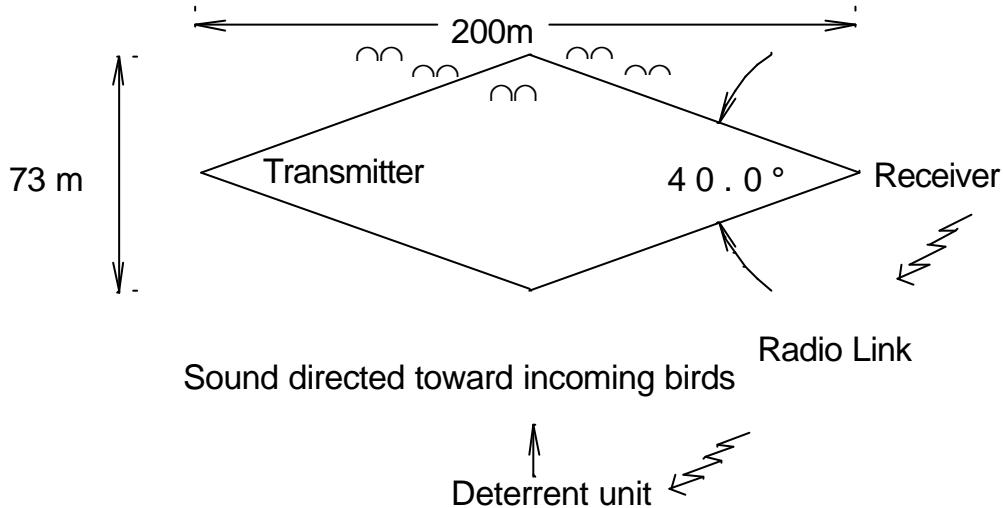
Purpose : Field disturbance sensor used to detect the presence of birds in an automated bird scaring system.

Transmitter Description:

The Bird Deter transmitter unit consists of a single circuit board forming the transmitter circuit and an integral antenna, housed in a protective PVC tubular radome. Power is supplied to it from an external battery. A partial shield for the circuit portion and DC power line filtering help reduce unwanted radiations.

The transmitter operates on a single fixed frequency near 2450 MHz, in the 2435-2465 MHz band. It is amplitude modulated using on-off keying at a 2 kHz rate with a 50% duty cycle. The power amplifier turn-on and turn-off times are controlled to limit out-of-band spectral components. The output frequency is generated directly, and no frequency translation is employed. Internal voltage regulation is linear, not switching. An output filter reduces unwanted harmonics of the transmitted frequency.

Fig 1.



Radar at work

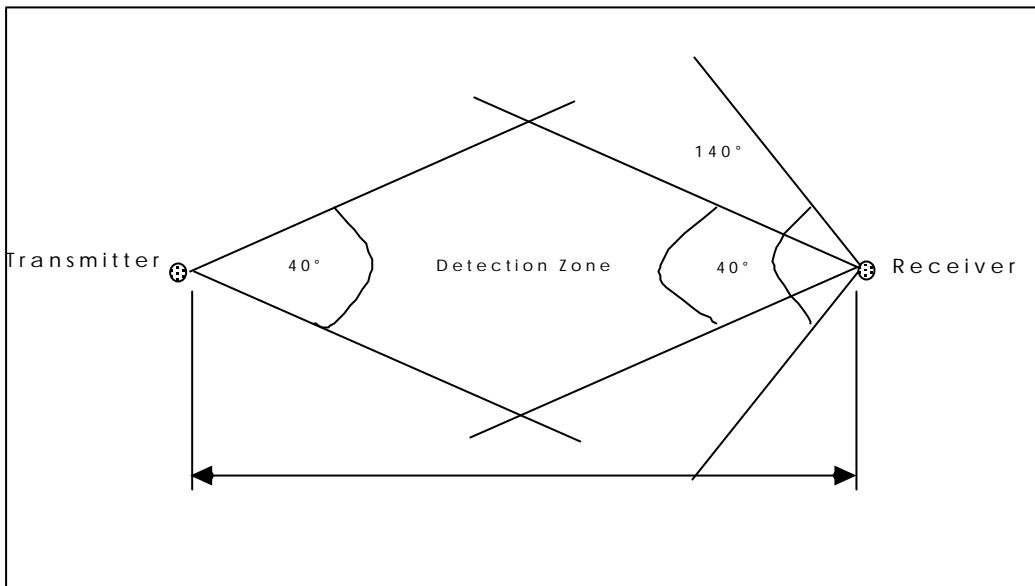
The radar technology utilised by BirdDeter is completely safe to both humans and birds. Radar units may be placed up to 500 metres apart, but the actual spacing required in a given situation will depend on local conditions.



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Fig 2.



The beam angle from both the transmitter and receiver is effectively 40 degrees.

In plan view, the detection area is diamond shaped, whereas in three dimensions, it consists of two cones being widest (and highest) in the middle of the detection zone. Any bird flying through the main forty-degree beam is detected at the radar receiver. However, some movements outside the main beam can be detected. To be completely 'invisible' to the radar system, an object (such as a passing truck on a nearby roadway) must be outside the 140 degree beam angle, as shown above. Radar receivers should face away from traffic.

The 49 MHz transmitter part of this system is also subjected to FCC part 15 approval submission simultaneously with this application.

2.4 Test Procedure

Radiated emissions measurements were performed in accordance with the procedures of ANSI C63.4-1992. Radiated emission tests were performed at an EUT distance of 10 metres. OET Bulletin 63 dated October 1993 was used for reference.

2.5 Test Facility

- **FCC Registration**

Radiated Emission measurements were performed at EMC Technologies open area test site (OATS) situated at Lerderderg Gorge, near the town of Bacchus Marsh, Victoria, Australia.

The above site has been fully described in a report submitted to the FCC office, and accepted in a letter dated June 24, 1999, **FCC Registration Number 90560**.

EMC Technologies Pty. Ltd. is also accredited by NATA (National Association of Testing Authorities) for FCC part 15 testing. NATA has Mutual Recognition Agreement (MRA) with A2LA and NVLAP.



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2.6 Units of Measurements

Radiated Emissions

Measurements are reported in units of dB relative to one microvolt per metre (dB μ V/m) at a distance of 3 metres from the EUT.

2.7 Test Equipment Calibration

All measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Hewlett-Packard Australia Limited. All equipment calibration is traceable to Australia national standards at the National Measurements Laboratory (NML). The reference antenna calibration was performed by NML and the working antennas (biconical, log-periodic and Horn) calibrated by the direct comparison method. The complete list of test equipment used for the measurements, including calibration dates and traceability, is contained in Appendix A of this report.

2.8 Ambients at OATS.

The OATS site is an area of low background ambient signals. No significant broadband ambients are present however commercial radio and TV signals exceed the limit in the FM radio, VHF and UHF television bands.

3.0 SYSTEM TEST CONFIGURATION

The transmitter was configured to continuously transmit during the tests.

4.0 RADIATED EMISSION MEASUREMENTS – 30 MHz to 25 GHz

4.1 Test Procedure

For the 1 – 25 GHz range, the EUT was set up on a post 4 metres high from the ground plane. The receiving Antennas were also mounted on a 6 metres high mast at 3 metres test distance inline with the EUT. The EMI Receiver was operated under software control via the PC Controller through the IEEE.488 Interface Bus Card Adapter. The 30 MHz to 25 GHz 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. For the 30-1000 MHz range, the EUT was slowly rotated with the Peak Detector set to Max-Hold. Each significant peak was then investigated and maximised by scanning the height of the antenna between 1 to 4 metres with the Average detector ON. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical antenna polarisation.



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4.2 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 dB μ V/m.

V = EMI Receiver Voltage in dB μ V. (measured value)

AF = Antenna Factor in dB(m⁻¹). (stored as a data array)

G = Preamplifier Gain in dB. (stored as a data array)

L = Cable insertion loss in dB. (stored as a data array of
Insertion Loss versus frequency)

Example Field Strength Calculation

Assuming a receiver reading of 34.0 dB μ V is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB.

The resulting Field Strength is therefore as follows:

$$34.0 + 9.2 + 1.9 - 20 = 25.1 \text{ dBmV/m}$$

5.0 RADIATED FIELD STRENGTH MEASUREMENT RESULTS

The transmitter was continuously transmitting during the tests.

5.1 30 – 1000 MHz Test Results

Result: No peaks were detected within 20 dB of the limit.

Refer to Appendix F for Graphs # 1 and 2

5.2 1 GHz – 25 GHz Test Results

Result: The highest radiated spurious emission was 3.3 dB below the limit at 4.888 GHz for Vertical Polarisation. The fundamental frequency was 11.2 dB below the specified limit at 2.444 GHz for Vertical Polarisation.

Table 1
Summary of Results

Antenna Polarisation	Frequency MHz	Average Level dBmV/m	Limit @ 3m dBmV/m	Result \pm dB
Vertical	2444.35	102.8	114	-11.2
Horizontal	2444.35	97.1	114	-16.9



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Worst case harmonics and spurious emissions are listed below

Antenna Polarisation	Frequency MHz	Average Level dBmV/m	Limit @ 3m dBmV/m	Result ±dB
SPURIOUS EMISSIONS				
Vertical	4888.70	50.7	54	- 3.3
Vertical	7333.05	49.3	54	- 4.7
Vertical	1706.00	43.1	64	-30.9
Vertical	9777.40	35.8	64	- 28.2
* Vertical – 5 th to 10 th Harmonics				
Horizontal	4888.70	43.0	54	- 11.0
Horizontal	7333.05	30.4	54	- 23.6
* Horizontal – 4 th to 10 th Harmonics				
* These harmonics were > 20 dB below the limits				

6.0 CONDUCTED EMISSION RESULTS

Conducted EMI Tests were not applicable as the transmitter is battery powered.

7.0 CONCLUSION

The 2.4 GHz BirdDeter Transmitter (FCC ID: **O7B-BIRDDETER-245**), complied with the requirements of the FCC Parts 2 and 15 Rules for low power transmitter when tested in accordance with 15.245. The results were as follows:

Transmitter Fundamental : complied, worst case margin of 11.2 dB.
 Transmitter Spurious : complied, worst case margin of 3.3 dB.



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APPENDIX A

MEASUREMENT INSTRUMENTATION DETAILS

EQUIPMENT TYPE	MAKE/MODEL SERIAL NUMBER	LAST CAL. DD/MM/YY	DUE DATE DD/MM/YY	CAL. INTERVAL
EMI RECEIVER	HP8574B CISPR Receiver Sn.3146A01297 including MIL-STD-462 Bandwidths	08/02/00	08/02/01	1 YEAR *2
	HP 8546A Sn. 3549A00290 EMI Receiver	24/08/00	24/08/01	1 YEAR *2
	HP 8593EM s/n 3412A00105	27/03/00	27/03/01	1 YEAR *2
ANTENNAS	EMCO 93110B BICONICAL	08/01/00	08/01/01	1 YEAR *3
	20 - 300MHz Sn. 9804-3094			
	EMCO 3146A LOG PERIODIC	24/02/00	24/02/01	1 YEAR *3
	300 -1000MHz Sn. 9208-1205			
	EMCO 3115 HORN ANTENNA	09/02/00	09/02/01	1 YEAR *3
	1 - 18 GHz Sn 3282			
	EMCO 3116 HORN ANTENNA	15/08/00	15/08/01	1 YEAR *3
	18 - 40 GHz sn 9512-2276			
Preamplifier	HP 8449B s/n 3008A01113	02/02/00	02/02/01	1 YEAR *3
	1 - 26.5 GHz			

Note *1. National Measurements Laboratory calibration.

Note *2. NATA calibration by Hewlett-Packard (Aust) Ltd

Note *3. In-house calibration. Refer to Quality Manual.

Note *4 Calibration not required

TEST SITES

Shielded Room Test Laboratory	Melbourne 11m x 8m x 4m Test Chamber – Semi anechoic 8.8m x 5.8m x 3.1m Test Chamber 3.4m x 6.1m x 2.5m Test Chamber 3.4m x 7.3m x 7.5m Test Chamber			
Open Area Test Site	Melbourne 3/10 Metre site. 1-4 metre antenna mast. 1.2 metre/400 kg Turntable. (Situated at Lerderderg Gorge, near Bacchus Marsh, Victoria)	31/07/00	31/07/01	1 Year *3



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APPENDIX B

PHOTOGRAPHS OF TEST SETUP SUBMITTED AS ATTACHMENT



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APPENDIX C

EXTERNAL PHOTOGRAPHS OF TEST SAMPLE SUBMITTED AS ATTACHMENT



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APPENDIX D

INTERNAL PHOTOGRAPHS OF TEST SAMPLE SUBMITTED AS ATTACHMENT



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APPENDIX E

TEST SAMPLE SCHEMATICS SUBMITTED AS ATTACHMENT



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APPENDIX F

TEST SAMPLE PCB LAYOUTS SUBMITTED AS ATTACHMENT



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APPENDIX G

FCC ID LABELLING SUBMITTED AS ATTACHMENT



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APPENDIX H

GRAPHS OF EMI MEASUREMENT

Graph 1: Vertical polarisation, 30 - 1000 MHz

Graph 2: Horizontal polarisation, 30 - 1000 MHz



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EMC Technologies Pty. Ltd. - Global Product Certification

FCC Class B

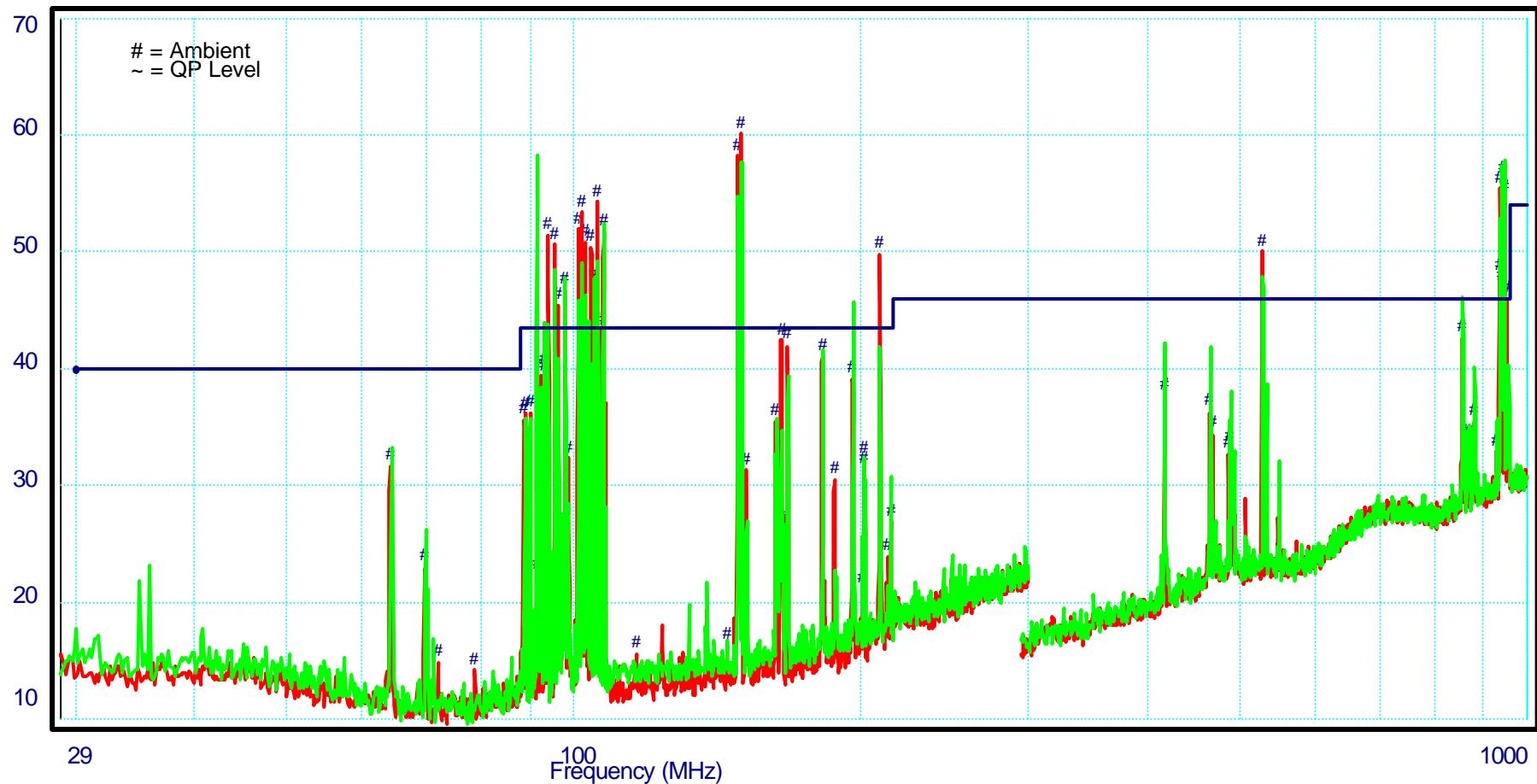
Electric Field Strength dBuV/m Peak

Project No:m001204

\\server\\plotting\\pcf\\01204_1.pcf

Test Date: 13-12-00

GRAPH No. 1



BirdDeter
2.4 GHz Transmitter

Vertical Polarity

Limits:
FCC-B3 FCC PT 15.209 CLASS B RAD 3M LIMITS

Legend:
— Vertical Ambients
— Vertical Emissions

Equipment: HP8546A TST 99B
Transducers: LCABLE a1100201 a1360100 NOPREAMP
Site ID: Lerderderg OATS1
Test Officer: Chieu Huynh

Source:
analdata 34 35 36 37 38 39
analdata 12 13 14 15 8 9

Melbourne- 57 Assembly Drv Tullamarine, 3043, Vic, Australia Ph+(613) 9335 3333 Fax+(613) 9338 9230
Sydney---- 16,6 Gladstone Rd Castle Hill, 2154, NSW, Australia Ph+(612) 9899 4599 Fax+(612) 9899 4010

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FCC Class B

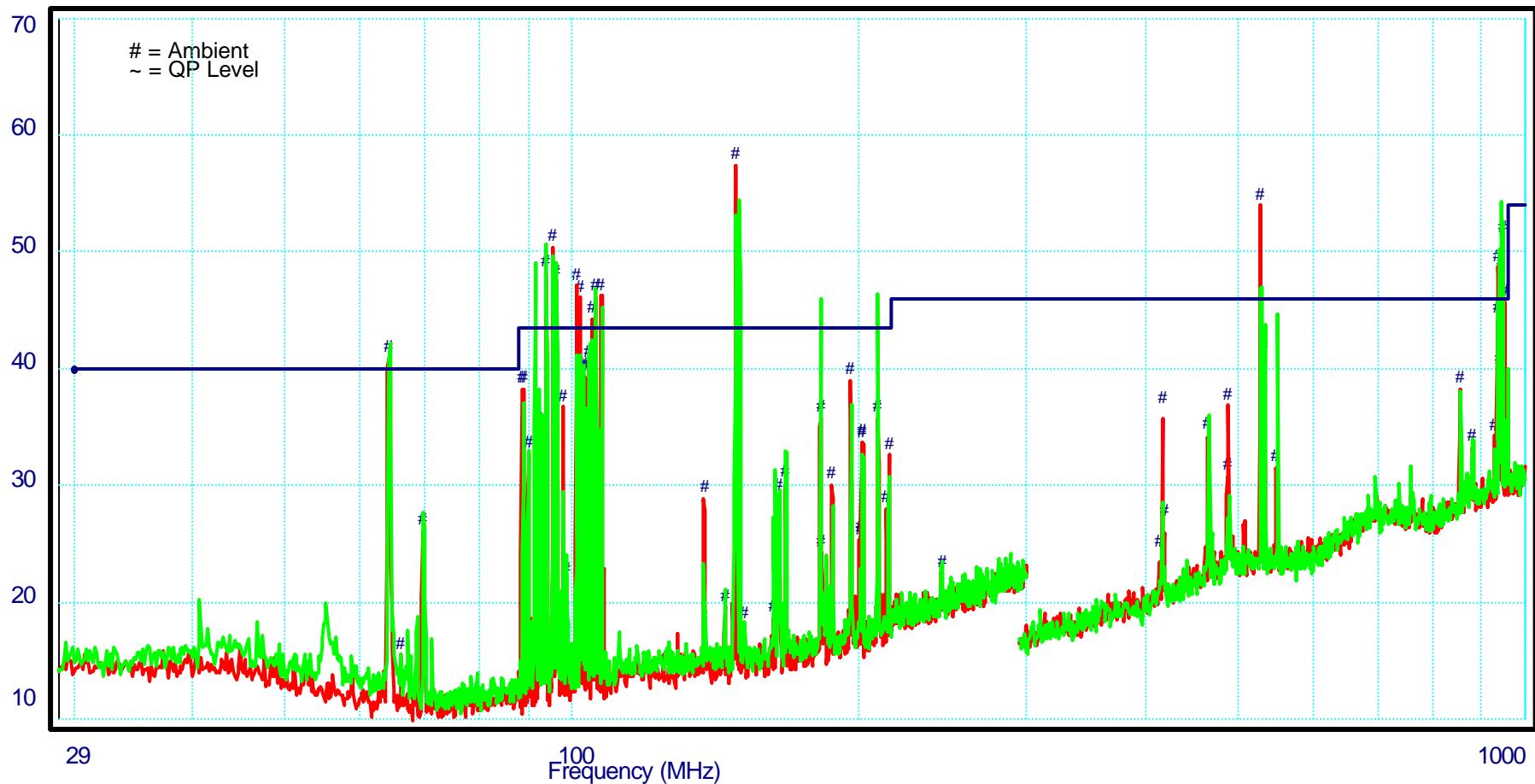
Electric Field Strength dBuV/m Peak

Project No:m001204

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Test Date: 13-12-00

GRAPH No. 2



BirdDeter
2.4 GHz Transmitter

Horizontal Polarity

Limits:
FCC-B3 FCC PT 15.209 CLASS B RAD 3M LIMITS

Legend:
— Vertical Ambients
— Horizontal Emissions

Equipment: HP8546A TST 99B
Transducers: LCABLE a1100201 a1360100 NOPREAMP
Site ID: Lerderderg OATS1
Test Officer: Chieu Huynh

Source:
analdata 30 31 32 33 40 41
analdata 16 17 18 19 10 11

Melbourne- 57 Assembly Drv Tullamarine, 3043, Vic, Australia Ph+(613) 9335 3333 Fax+(613) 9338 9230
Sydney---- 16,6 Gladstone Rd Castle Hill, 2154, NSW, Australia Ph+(612) 9899 4599 Fax+(612) 9899 4010

APPENDIX I

USER INSTRUCTIONS (MANUAL) SUBMITTED AS ATTACHMENT



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