

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Zinwave DAS3000

To: FCC Part 15.107 & 15.109

Test Report Serial No:
RFI-RPT1-RP74120JD01A

**This Test Report Is Issued Under The Authority
Of Steve Flooks, Service Leader:**

A handwritten signature in blue ink, appearing to read 'S Flooks', is written over a light blue horizontal line.

Checked By: Steve Flooks

A handwritten signature in blue ink, appearing to read 'S Flooks', is written over a light blue horizontal line.

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Issue Date: 21 October 2008

Test Dates: 06 October 2008 to 17 October 2008

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RFI GLOBAL SERVICES LTD

TEST REPORT

S.No. RFI-RPT1-RP74120JD01A

Page: 2 of 2

Issue Date: 21 October 2008

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

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Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Table of Contents

1. Customer Information 4

2. Equipment Under Test (EUT) 5

3. Test Results 7

4. Deviations from the Test Specification 8

5. Operation of the EUT during Testing 9

6. Summary of Test Results 10

7. Measurements, Examinations and Derived Results 11

8. Measurement Uncertainty 20

9. Measurement Methods 21

Appendix 1. Test Equipment Used 24

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

1. Customer Information

Company Name:	Zinwave Ltd
Address:	Harston Mill Harston Cambridge CB2 5GG
Contact Name:	Mr Andy Bell

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification of Equipment Under Test (EUT)

Brand Name:	Zinwave Ltd
Model Name or Number:	PHUB (Primary Hub)
Serial Number:	Hub06
Revision Number:	HUB-302-0001-3.10
Country of Manufacture:	England
Date of Receipt:	06 October 2008

Brand Name:	Zinwave Ltd
Model Name or Number:	SHUB
Serial Number:	Hub07
Revision Number:	HUB-302-0013-3.10
Country of Manufacture:	England
Date of Receipt:	06 October 2008

2.2. Description of EUT

The 3000 Hub and wideband remote unit is a bi-directional wide-band Repeater Station with a pass band of 136 – 2700 MHz currently.

2.3. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

2.4. Additional Information Related to Testing

Power Supply Requirement:	120 V dc 60 Hz
Intended Operating Environment:	Commercial / Light Industrial / Heavy Industrial
Equipment Category:	Base Station
Type of Unit:	DAS (Distributed Antenna System)

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

2.5. Port Identification

Port	Description	Type/Length	Applicable
1	Alarm Port	9 Pin D-Connector	N
2	RS232 Port	9 Pin D-Connector	N
3	Ethernet Port	CAT5	N
4	2 x USB Ports	USB	N
5	4 x Service Ports (I/O)	N-Type	N
6	8 x Optical Module Ports (I/O)	Fibre Optic Connectors	N

2.6. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Remote Unit (RU)
Brand Name:	Zinwave Ltd.
Revision Number	302-006-1.20 + NCR 0037
Serial Number:	RU668
Cable Length and Type:	Fibre Optic 4 metres
Connected to Port:	Fibre Optic I/O on SHUB

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

3. Test Results

Reference:	FCC Part 15.107 & 15.109
Title:	Code of Federal Regulations, Part 15.107 & 15.109 (Unintentional Radiators)

3.1. Methods and Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2003

Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2003)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)

Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

3.2. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

4. Deviations from the Test Specification

The testing has been performed in accordance with the following Project Plan:

Project Plan for DheaniSulis – End Customer Zinwave Ltd.

AmericanTCB Project Number: ATCB006596

Date of Issue: 01 October 2008

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

5. Operation of the EUT during Testing

5.1. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated.

- Idle mode

5.2. Configuration and Peripherals

The EUT was tested in the following configuration unless otherwise stated:

The EUT comprises of 3 separate units. Primary Hub, Secondary Hub and the Remote Unit. The primary hub was connected to the secondary hub via fibre optic cables. The secondary hub was connected to the remote hub via fibre optic cables. An input signal was fed into the primary hub and was measured from the output of the remote unit. The remote unit was operating at maximum output power with the maximum gain settings allowed.

For radiated emissions testing, the EUT was connected to 4 input signals into the separate input ports. The levels were adjusted to give a composite signal output level of +20.0 dBm. The antenna port on the remote unit was terminated for this testing.

For conducted testing, the EUT was connected to between 1 – 4 input signals. Depending on the test case, either a CW or a modulated signal was fed into the unit with the antenna port on the remote unit used as the measurement point.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Result
Idle Mode AC Conducted Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2005 Section 15.107	AC Mains	Complied
Idle Mode Radiated Spurious Emissions	C.F.R. 47 FCC Part 15: 2005 Section 15.109	Antenna	Complied

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.

6.2. Site Registration Number

FCC: 209735

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

7.2. Test Results

7.2.1. Idle AC Conducted Spurious Emissions: Section 15.107

The EUT was configured as for ac conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum emission levels present on the ac mains line of the EUT.

Results: - Hub 1

Quasi-Peak Detector Measurements on Live and Neutral Lines

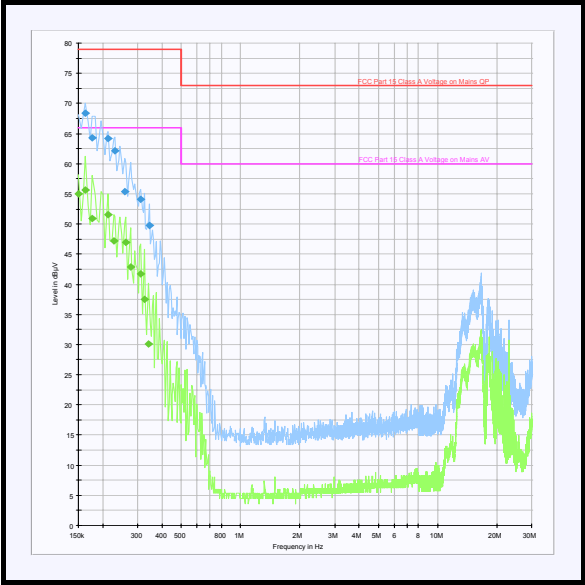
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.163500	Neutral	68.4	79.0	10.6	Complied
0.177000	Live 1	64.2	79.0	14.8	Complied
0.213000	Neutral	64.2	79.0	14.8	Complied
0.231000	Neutral	62.2	79.0	16.8	Complied
0.258000	Live 1	55.4	79.0	23.6	Complied
0.312000	Neutral	54.1	79.0	24.9	Complied
0.343500	Neutral	49.8	79.0	29.2	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150000	Neutral	55.0	66.0	11.0	Complied
0.163500	Neutral	55.6	66.0	10.4	Complied
0.177000	Live 1	50.9	66.0	15.1	Complied
0.213000	Neutral	51.5	66.0	14.5	Complied
0.226500	Live 1	47.2	66.0	18.8	Complied
0.262500	Neutral	47.0	66.0	19.0	Complied
0.276000	Live 1	42.9	66.0	23.1	Complied
0.312000	Neutral	41.7	66.0	24.3	Complied
0.325500	Live 1	37.5	66.0	28.5	Complied
0.339000	Live 1	30.1	66.0	35.9	Complied

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Idle AC Conducted Spurious Emissions: Section 15.107 (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

7.2.2. Idle AC Conducted Spurious Emissions: Section 15.107

The EUT was configured as for ac conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum emission levels present on the ac mains line of the EUT.

Results: - Hub 2

Quasi-Peak Detector Measurements on Live and Neutral Lines

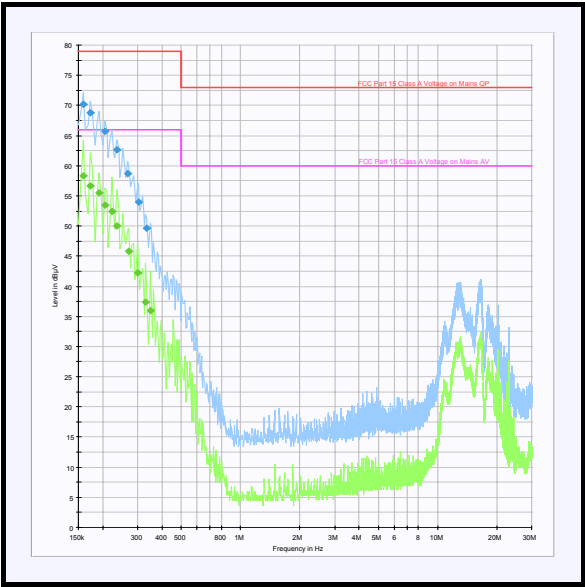
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.159000	Neutral	70.2	79.0	8.8	Complied
0.172500	Live 1	68.8	79.0	10.2	Complied
0.204000	Live 1	65.7	79.0	13.3	Complied
0.235500	Live 1	62.6	79.0	16.4	Complied
0.267000	Neutral	58.7	79.0	20.3	Complied
0.303000	Live 1	54.0	79.0	25.0	Complied
0.334500	Live 1	49.6	79.0	29.4	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.159000	Neutral	58.4	66.0	7.6	Complied
0.172500	Neutral	56.6	66.0	9.4	Complied
0.190500	Live 1	55.4	66.0	10.6	Complied
0.204000	Live 1	53.4	66.0	12.6	Complied
0.222000	Neutral	52.5	66.0	13.5	Complied
0.235500	Neutral	50.0	66.0	16.0	Complied
0.271500	Neutral	45.8	66.0	20.2	Complied
0.298500	Live 1	42.2	66.0	23.8	Complied
0.330000	Live 1	37.3	66.0	28.7	Complied
0.348000	Live 1	36.0	66.0	30.0	Complied

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Idle AC Conducted Spurious Emissions: Section 15.107 (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

7.2.3. Idle Radiated Spurious Emissions: Section 15.109

The EUT was configured as for radiated emission testing as described in section 9 of this report.

Tests were performed to identify the maximum Idle mode radiated emission levels.

Results:

Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

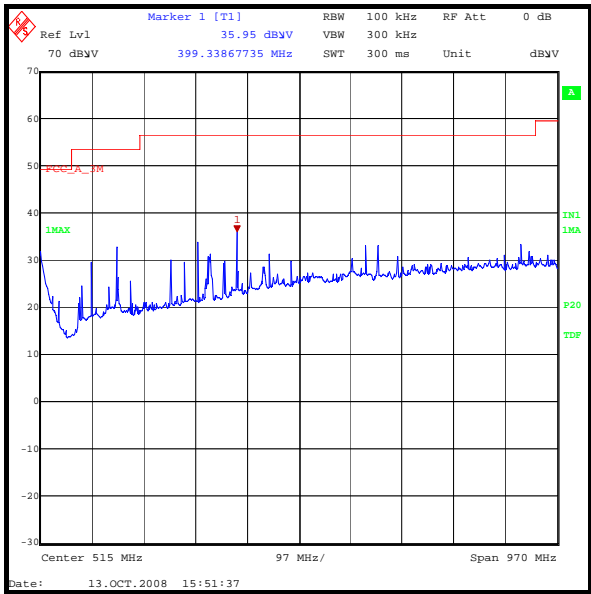
Frequency (MHz)	Antenna Polarity	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
399.339	Vertical	36.0	57.0	21.0	Complied

Note(s):

1. All other emissions were at least 20 dB below the limit.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Idle Radiated Spurious Emissions: Section 15.109 (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

7.2.4. Idle Radiated Spurious Emissions: Section 15.109**Results:****Electric Field Strength Measurements (Frequency Range: 1 to 18 GHz)****Highest Peak Level:**

Frequency (GHz)	Antenna Polarity	Detector Level (dB μ V)	Transducer Factor (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
17.726	Vertical	38.9	7.4	46.3	74.0	27.7	Complied

Highest Average Level:

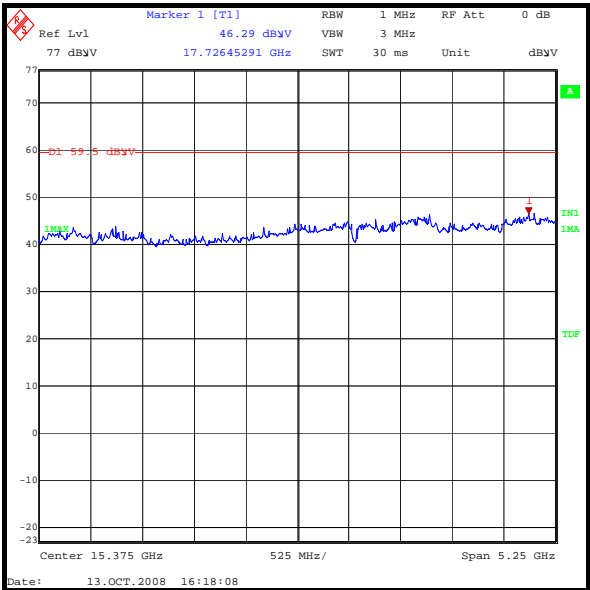
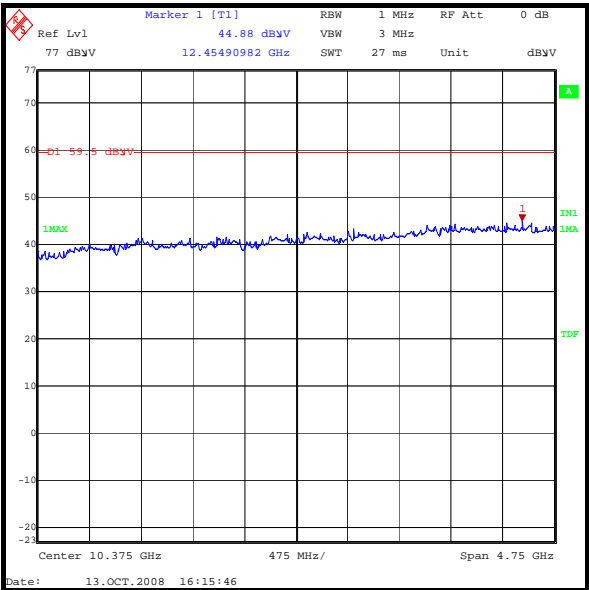
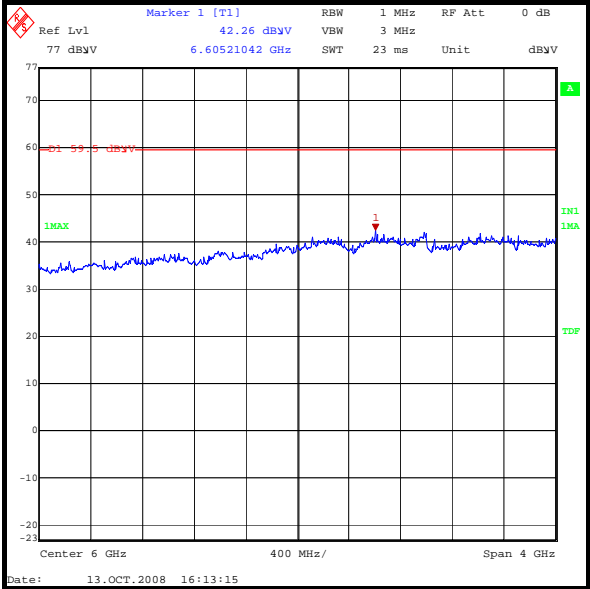
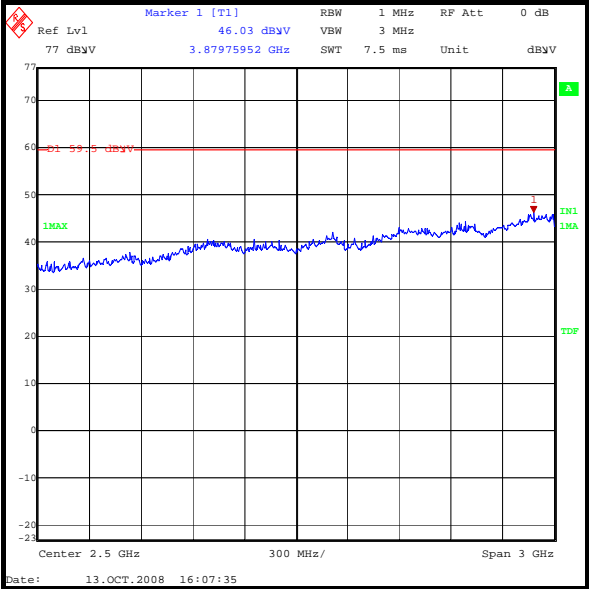
Frequency (GHz)	Antenna Polarity	Detector Level (dB μ V)	Transducer Factor (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
17.726	Vertical	38.9	7.4	46.3	54.0	7.7	Complied

Note(s):

1. All other emissions were at least 20 dB below the limit.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Idle Radiated Spurious Emissions: Section 15.109 (Continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.72 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±4.64 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

9. Measurement Methods

9.1. AC Mains Conducted Emissions

AC mains conducted emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane. The EUT was powered with 110V 60 Hz ac mains supplied via a line impedance stabilisation network (LISN).

Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)/Average
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz	9 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	>1 s
Observation Time:	Not applicable	>15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

9.2. Radiated Emissions

Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. Any emission within 20 dB of the limit were then measured on the open area test site, except in cases where the noise floor was within 20 dB of the limit, in these cases the highest point of the noise floor was measured.

Where an emission fell inside a restricted band, measurements were made at the appropriate test distance using a measuring receiver with a quasi peak detector for measurements below 1000 MHz and an average and peak detector for measurements above 1000 MHz. A peak detector was used for all other measurements.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2003 Clause 5.4.

All measurements on the open area test site were performed using broadband antennas in both vertical and horizontal polarisations.

On the open area test site, at each frequency where a signal was to be measured, the trace was maximised by rotating a turntable through 360°. The angle at which the maximum signal was observed was locked out. For frequencies below 1000 MHz the test antenna was varied in height between 1 m and 4 m in order to further maximise the target emission.

For frequencies above 1000 MHz where a horn antenna was used, height searching was performed to locate the optimal height of the horn with respect to the EUT. At this point the horn was locked off and the turntable was again rotated through 360° to maximise the target signal. It should be noted that the received signal from the EUT would diminish very quickly after it exits the beam width of the horn antenna, for this reason it may not be necessary to fully height search with the horns.

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Radiated Emissions (Continued)

At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

Scans were performed to the upper frequency limits as stated in section 15.33

The final field strength was determined as the indicated level in dB μ V plus cable loss and antenna factor.

The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements <1 GHz	Final Measurements ≥1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak / Average
Mode:	Max Hold	Not applicable	Max Hold
Bandwidth:	(120 kHz <1 GHz) (1 MHz ≥1 GHz)	120 kHz	1 MHz
Amplitude Range:	100 dB	100 dB	100 dB
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A004	Line Impedance Stabilization Network	Rohde & Schwarz	ESH3-Z5	890 604/027	19 May 2008	12
A1299	Antenna	Schaffner	CBL6143	5094	28 Jul 2008	12
A1738	Attenuator	Atlantic Microwave	BBS40-10	R1379	Calibrated before use	-
A1793	Pre Amplifier	A.H.Systems Inc.	PAM-0118	183	03 Jul 2008	12
A1818	Antenna	EMCO	3115	00075692	30 Aug 2008	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	16 Jan 2008	12
A259	Antenna	Chase	CBL6111	1513	25 Jul 2008	12
A435	Antenna	Flann	22240-20	400	21 Jul 2006	36
A436	Antenna	Flann	20240-20	330	24 Apr 2006	36
C1111	Cable	Semflex Inc.	X116BFSX10080	0337	Calibrated before use	-
C1142	Cable	HP	65474	1187396	Calibrated before use	-
C1164	Cable	Rosenberger Micro-Coax	FA210A1015007070	43188-1	20 Apr 2008	12
C1169	Cable	Microcoax	n/a	n/a	Calibrated before use	-
C1296	3m Cable	Rosenberger	FA210A0030005050	58940-02	10 Jul 2008	12
C1297	10m Cable	Rosenberger	FA210A0100005050	58941-01	10 Jul 2008	12
C1298	10m Cable	Rosenberger	FA210A0100005050	58941-02	10 Jul 2008	12
C1302	3m Cable	Rosenberger	FA210A1030005050	59153-01	04 Aug 2008	12
C1306	15m Cable	Rosenberger	FA210A0015005050	59152-01	01 Aug 2008	12
C363	Cable	Rosenberger	RG142	None	20 Apr 2008	12
E0518	Environmental Chamber	TAS	LTCL 1200	24000107	Calibration not required	-
G085	Continuous Wave Generator	Hewlett Packard	83650L	3614A00104	03 Nov 2006	24
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	19 Feb 2008	12

Test of: Zinwave DAS3000
To: FCC Part 15.107 & 15.109

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
M1242	Spectrum Analyser	Rohde & Schwarz, Inc.	FSEM30	845986/022	29 Nov 2007	12
M1249	Thermometer	Fluke	52II	88800049	09 Jul 2008	12
M1251	Digital Multimeter	Fluke	175	89170179	21 Dec 2007	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	06 Feb 2008	12
M1273	Test Receiver	Rhode & Schwarz	ESIB 26	100275	26 Feb 2008	12
M1348	Network Analyser Display	Agilent	8757E	3025A00346	26 Jun 2008	12
M1349	Network Analyser Detector	Agilent	85025D	01447	06 Jun 2008	12
M1391	Thermometer/Hygrometer	Oergon Scientific	BAR629HGU	N/A	18 Jun 2008	12
M1449	SMIQ03B	Rohde and Schwarz	SMIQ03B	100176	23 Jan 2008	12
M1501	Network Analyser 50GHz Sensor	Hewlett Packard	85025D	US38012297	28 Jun 2008	12
M166	Thermometer/B arometer/Hygrometer	EuroCom	None	None	18 Jun 2008	12
M259	SME03 Signal Generator	Rohde & Schwarz	1038.6002.03	827758/021	Calibrated before use	-
M260	SMP02 Signal Generator	Rohde & Schwarz	1035.5005.02	829076/008	N/A	12
M295	Spectrum Analyser	Hewlett Packard	8564E	3846A01561	13 Nov 2007	12

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.