



## EMISSIONS TEST REPORT

Report Number: 3174909BOX-001a

Project Number: 3174909

Testing performed on the  
IO Controller and Remote Control

Model(s): 142624 and A340

To

FCC Part 15 Subpart C Section 15.249  
FCC Part 15 Subpart B  
Industry Canada RSS-210 Issue 7 June 2007  
RSS-GEN Issue 2 June 2007

For

Aqualisa Products Limited

Test Performed by:  
Intertek – ETL SEMKO  
70 Codman Hill Road  
Boxborough, MA 01719

Test Authorized by:  
Aqualisa Products Limited  
The Flyer's Way  
Westerham, Kent TN16 1DE

Prepared by: Vathana F. Ven Date: 04/08/09  
Vathana F. Ven

Reviewed by: Jeff Goulet Date: 04/09/09  
Jeff Goulet

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## 1.0 Job Description

### 1.1 Client Information

This EUT has been tested at the request of:

**Company:** Aqualisa Products Limited  
The Flyer's Way  
Westerham, Kent  
TN16 1DE  
**Contact:** Sue Ross  
**Telephone:** 01959 560719  
**Fax:** Not available  
**Email:** sue.ross@aqualisa.co.uk

### 1.2 Equipment Under Test

**Equipment Type:** IO Controller and Remote Control  
**Model Number(s):** 142624 and A340  
**Serial number(s):** BOX0902241216-003 and BOX0902241216-002  
**Manufacturer:** Aqualisa Products Limited  
**EUT receive date:** 02/24/2009  
**EUT received condition:** Production unit was received with no visible damage.  
**Test start date(s):** 03/09/2009  
**Test end date(s):** 04/08/2009

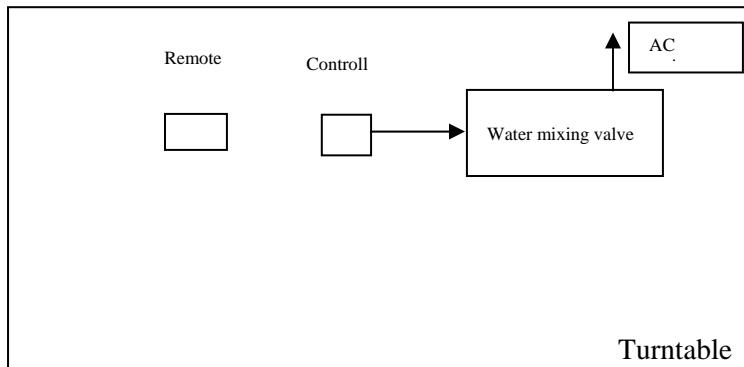
**1.3 Test Plan Reference:** ANSI 63.4C, Industry Canada RSS-210 Issue 7 June 2007  
RSS-GEN Issue 2 June 2007

### 1.4 Test Configuration:

#### 1.4.1 EUT Voltage Range:

EUT powers from 3VDC and 5VDC via valve.

#### 1.4.2 Block Diagram:



**1.4.3 Cables:**

Cable	Shielding	Connector	Length (m)	Qty.
AC Cord	None	Plastic	2	1

**1.4.4 Support Equipment:**

Name: Water mixing valve  
Model No.: Not available  
Serial No.: Not available

**1.5 Mode(s) of Operation:**

The EUT was programmed to transmit continuously.

**1.5a EUT Cycle Time:**

Continuous

## 2.0 Test Summary

TEST STANDARD	RESULTS	
FCC Part 15 Subpart C Section 15.249 FCC Part 15 Subpart B Industry Canada RSS-210 Issue 7 June 2007 RSS-GEN Issue 2 June 2007		
SUB-TEST	TEST PARAMETER	COMMENT
15.249(a) – Fundamental Field Strength A2.9(1) – Fundamental Field Strength	2400–2483.5 MHz: The field strength of emission within this band shall not exceed 50 (millivolts/meter) or 94 (dBuV/m) at a distance of 3 meters	Pass
15.249(a) – Harmonics Field Strength A2.9(1) – Harmonics Field Strength	The field strength of harmonics shall not exceed 0.5 (millivolts/meter) or 54 (dBuV/m) at a distance of 3 meters	Pass
15.249(d) – Spurious Field Strength A2.9(2) – Spurious Field Strength	Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the Table 2 limits, whichever is the lesser attenuation.	Pass
2(2.6) – General Field Strength	The receiver spurious emissions shall not exceed the limits specified in Table 2	Pass
AC Line-Conducted Emissions	Quasi-Peak Detector 0.15-0.5MHz 66 to 56* dBuV 0.5-5MHz 56 dBuV 5-30MHz 60 dBuV  Average Detector 0.15-0.5MHz 56 to 46* dBuV 0.5-5MHz 46 dBuV 5-30MHz 50 dBuV  * Decreases with the logarithm of the frequency.	Pass
20 dB Bandwidth	No limit	

### REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	Description of Change
04/08/09	3174909	Vathana Ven	1		Re-measured duty cycle

### 3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where  $FS$  = Field Strength in  $\text{dB}\mu\text{V}/\text{m}$

$RA$  = Receiver Amplitude (including preamplifier) in  $\text{dB}\mu\text{V}$

$CF$  = Cable Attenuation Factor in dB

$AF$  = Antenna Factor in dB

$AG$  = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0  $\text{dB}\mu\text{V}$  is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32  $\text{dB}\mu\text{V}/\text{m}$ . This value in  $\text{dB}\mu\text{V}/\text{m}$  was converted to its corresponding level in  $\mu\text{V}/\text{m}$ .

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

$$\text{Level in } \mu\text{V}/\text{m} = [10( 32 \text{ dB}\mu\text{V}/\text{m})/20] = 39.8 \mu\text{V}/\text{m}$$

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where  $NF$  = Net Reading in  $\text{dB}\mu\text{V}$

$RF$  = Reading from receiver in  $\text{dB}\mu\text{V}$

$LF$  = LISN Correction Factor in dB

$CF$  = Cable Correction Factor in dB

$AF$  = Attenuator Loss Factor in dB

To convert from  $\text{dB}\mu\text{V}$  to  $\mu\text{V}$  or  $\text{mV}$  the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

#### Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V}/20)} = 254 \mu\text{V}/\text{m}$$

### **3.1 Measurement Uncertainty**

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.

The expanded uncertainty ( $k = 2$ ) for radiated emissions from 30 to 1000 MHz has been determined to be:

$\pm 3.5$  dB at 10m,  $\pm 3.8$  dB at 3m

The expanded uncertainty ( $k = 2$ ) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

$\pm 2.6$  dB

The expanded uncertainty ( $k = 2$ ) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

$\pm 3.2$  for ISN and voltage probe measurements  
 $\pm 3.1$  for current probe measurements

### 3.2 Site Description

#### Test Site(s): 1 (Boxborough)

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

**Test Results:** Pass

**Test Standard:** FCC Part 15 Subpart C Section 15.249 and Industry Canada RSS-210 Issue 7 June 2007

**Test:** Fundamental Field Strength

**Performance Criterion:** Not Applicable

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	18/24	Humidity (%):	48/31	Pressure (hPa):	1004/1017
Pretest Verification Performed		Yes		Equipment under Test:		142624 and A340	
Test Engineer(s):	Vathana Ven				EUT Serial Number:		

**Maximum Test Disturbance Parameters:** Emissions below A2.9(1) and 15.249(a)

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
2	40GHz Cable	Megaphase	TM40-K1K1-197	7030801 001	06/05/2009
3	Digital 4 Line Barometer	Mannix	0ABA116	BAR3	06/01/2009
4	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009

**Software Utilized:**

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	3/07/07 Revision

**Test Details:**

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail	Comment
Around the EUT	Specified limits	Below specified limits	Pass	None

## Test Results:

### Fundamental Field Strength

Company: Aqualisa products limited	Antenna & Cables: HF Bands: N, LF, HF, SHF																																						
Model #: 142624 (Controller)	Antenna: Horn2 V3m 10-13-09.txt Horn2 H3m 10-13-09.txt																																						
Serial #: BOX0902241216-003	Cable(s): MEG001 06-05-09.txt MEG004.txt REA002 REA004																																						
Engineers: Vathana Ven	Barometer: BAR3																																						
Project #: 3174909 Date(s): 03/11/09	Location: Site 1																																						
Standard: FCC Part 15 Subpart C 15.249/RSS-210	Temp/Humidity/Pressure: 18 deg C 48% 1004 mB																																						
Receiver: R&S FSEK-30 (ROS001)	Limit Distance (m): 3																																						
PreAmp: PRE9 03-27-09.txt	Test Distance (m): 3																																						
PreAmp Used? (Y or N): Y	Voltage/Frequency: 5VDC via valve Frequency Range: 1 - 18 GHz																																						
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)																																							
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW																																							
<table border="1"> <thead> <tr> <th>Detector Type</th><th>Ant. Pol. (V/H)</th><th>Frequency MHz</th><th>Reading dB(uV)</th><th>Antenna Factor dB(1/m)</th><th>Cable Loss dB</th><th>Pre-amp Factor dB</th><th>AVERAGE Factor dB</th><th>Net dB(uV/m)</th><th>Limit dB(uV/m)</th><th>Margin dB</th><th>Bandwidth</th></tr> </thead> <tbody> <tr> <td>PK</td><td>H</td><td>2404.526</td><td>55.5</td><td>28.2</td><td>4.4</td><td>0.0</td><td>0.0</td><td>88.1</td><td>114.0</td><td>-25.9</td><td>1/3 MHz</td></tr> <tr> <td>AVG</td><td>H</td><td>2405.411</td><td>55.5</td><td>28.2</td><td>4.4</td><td>0.0</td><td>40.3</td><td>47.8</td><td>94.0</td><td>-46.2</td><td>1/3 MHz</td></tr> </tbody> </table>	Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	AVERAGE Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	PK	H	2404.526	55.5	28.2	4.4	0.0	0.0	88.1	114.0	-25.9	1/3 MHz	AVG	H	2405.411	55.5	28.2	4.4	0.0	40.3	47.8	94.0	-46.2	1/3 MHz	FCC	IC	Harmonic?
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	AVERAGE Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth																												
PK	H	2404.526	55.5	28.2	4.4	0.0	0.0	88.1	114.0	-25.9	1/3 MHz																												
AVG	H	2405.411	55.5	28.2	4.4	0.0	40.3	47.8	94.0	-46.2	1/3 MHz																												
No Pre-Amp																																							
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Company: Aqualisa products limited	Antenna & Cables: HF Bands: N, LF, HF, SHF																																						
Model #: A340 (Remote)	Antenna: Horn2 V3m 10-13-09.txt Horn2 H3m 10-13-09.txt																																						
Serial #: BOX0902241216-002	Cable(s): MEG001 06-05-09.txt MEG004.txt REA002 REA004																																						
Engineers: Vathana Ven	Barometer: BAR3																																						
Project #: 3174909 Date(s): 03/10/09	Location: Site 1																																						
Standard: FCC Part 15 Subpart C 15.249/RSS-210	Temp/Humidity/Pressure: 24 deg C 31% 1017 mB																																						
Receiver: R&S FSEK-30 (ROS001)	Limit Distance (m): 3																																						
PreAmp: PRE9 03-27-09.txt	Test Distance (m): 3																																						
PreAmp Used? (Y or N): Y	Voltage/Frequency: 3VDC Frequency Range: 1 - 18 GHz																																						
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)																																							
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW																																							
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Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	AVERAGE Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth																												
PK	H	2405.411	63.9	28.2	4.4	0.0	0.0	96.5	114.0	-17.5	1/3 MHz																												
AVG	H	2405.411	63.9	28.2	4.4	0.0	40.3	56.2	94.0	-47.2	1/3 MHz																												
No Pre-Amp																																							
No Pre-Amp																																							

Note: Average factor was calculated as  $20 * \log(693.4 \mu\text{S} / (100 * 10^3) \mu\text{S}) = 40.3 \text{ dB}$ , which was applied to the peak readings to get average reading.

**Test Results:** Pass

**Test Standard:** FCC Part 15 Subpart C Section 15.249, FCC Part 15, Subpart B, Industry Canada RSS-210 Issue 7 June 2007, and RSS-GEN Issue 2 June 2007

**Test:** Harmonics/Spurious Field Strength

**Performance Criterion:** Not Applicable

**Test Environment:**

Environmental Conditions During Testing:	Ambient (°C):	18/24	Humidity (%):	48/31	Pressure (hPa):	1004/1017
Pretest Verification Performed	Yes		Equipment under Test:	142624 and A340		
Test Engineer(s):	Vathana Ven			EUT Serial Number:	BOX0902241216-003 and BOX0902241216-002	

**Maximum Test Disturbance Parameters:** Readings below A2.9(1) and A2.9(2) and 15.249(a)(d)

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	ANTENNA	EMCO	3142	9701-1116	12/02/2009
2	3 Meter In floor cable for site 1	ITS	RG214B/U	S1 3M FLR	09/08/2009
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009
4	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
5	40GHz Cable	Megaphase	TM40-K1K1-197	7030801 001	06/05/2009
6	40 GHz Cable	Megaphase	TM40-K1K1-80	7030802 002	06/05/2009
7	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	12/10/2009
8	Digital 4 Line Barometer	Mannix	0ABA116	BAR3	06/01/2009
9	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
10	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/27/2010
11	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	03/27/2009

**Software Utilized:**

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	3/07/07 Revision

**Test Details:**

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail	Comment
Around the EUT	Specified limits	Below specified limits	Pass	None

## Test Results:

### Radiated Emissions From 30-1000MHz

#### Radiated Emissions

Company: Aqualisa products limited  
 Model #: 142624 (Controller)  
 Serial #: BOX0902241216-003  
 Engineers: Vathana Ven  
 Project #: 3174909 Date(s): 03/11/09  
 Standard: FCC Part 15 Subpart C 15.249/RSS-210  
 Receiver: R&S FSEK-30 (ROS001) Limit Distance (m): 3  
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3  
 PreAmp Used? (Y or N): N Voltage/Frequency: 5VDC via valve Frequency Range: 30-1000 MHz  
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC	RB	Harmonic?
QP	H	240.000	17.2	12.0	1.9	0.0	0.0	31.1	46.0	-14.9	120/300 kHz	RB			
QP	H	256.000	17.0	12.5	2.0	0.0	0.0	31.5	46.0	-14.5	120/300 kHz	RB			
QP	H	272.000	18.0	12.8	2.0	0.0	0.0	32.9	46.0	-13.1	120/300 kHz	RB			
QP	H	304.000	16.0	14.4	2.1	0.0	0.0	32.5	46.0	-13.5	120/300 kHz				
QP	H	336.000	14.6	15.2	2.2	0.0	0.0	32.0	46.0	-14.0	120/300 kHz				
QP	H	352.000	8.5	15.6	2.2	0.0	0.0	26.4	46.0	-19.6	120/300 kHz				

#### Radiated Emissions

Company: Aqualisa products limited  
 Model #: 142624 (Controller), A340 (Remote)  
 Serial #: BOX0902241216-002  
 Engineers: Vathana Ven  
 Project #: 3174909 Date(s): 03/10/09  
 Standard: FCC Part 15 Subpart C 15.249/RSS-210  
 Receiver: R&S FSEK-30 (ROS001) Limit Distance (m): 3  
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3  
 PreAmp Used? (Y or N): N Voltage/Frequency: 3VDC Frequency Range: 30-1000 MHz  
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC	RB	Harmonic?
QP	V	40.000	0.5	11.8	0.7	0.0	0.0	13.0	40.0	-27.0	120/300 kHz				Noise Floor
QP	V	150.000	0.8	8.8	1.4	0.0	0.0	11.0	43.5	-32.5	120/300 kHz	RB			Noise Floor
QP	V	250.000	3.4	12.7	1.9	0.0	0.0	18.0	46.0	-28.0	120/300 kHz				Noise Floor
QP	V	350.000	-3.3	15.2	2.2	0.0	0.0	14.1	46.0	-31.9	120/300 kHz				Noise Floor
QP	V	500.000	3.0	18.9	2.7	0.0	0.0	24.6	46.0	-21.4	120/300 kHz				Noise Floor
QP	V	700.000	-1.0	20.4	3.2	0.0	0.0	22.6	46.0	-23.4	120/300 kHz				Noise Floor

## Test Results Continued:

### Radiated Emissions From 1-18GHz

#### Radiated Emissions

Company: Aqualisa products limited  
 Model #: 142624 (Controller)  
 Serial #: BOX0902241216-003  
 Engineers: Vathana Ven  
 Project #: 3174909 Date(s): 03/11/09 04/04/09  
 Location: Site 1  
 Standard: FCC Part 15 Subpart C 15.249/RSS-210  
 Receiver: R&S FSEK-30 (ROS001) Limit Distance (m): 3  
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3  
 PreAmp Used? (Y or N): Y Voltage/Frequency: 5VDC Frequency Range: 1 - 18 GHz  
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS: NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	AVERAGE Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC	Harmonic?
PK	H	2404.526	55.5	28.2	4.4	0.0	0.0	88.1	114.0	-25.9	1/3 MHz			No Pre-Amp
AVG	H	2405.411	55.5	28.2	4.4	0.0	40.3	47.8	94.0	-46.2	1/3 MHz	RE002	RE004	No Pre-Amp
PK	H	4808.962	50.9	32.7	6.3	29.3	0.0	60.6	74.0	-13.4	1/3 MHz			
AVG	H	4808.962	50.9	32.7	6.3	29.3	40.3	20.4	54.0	-33.6	1/3 MHz	RB	RB	
PK	H	7216.433	44.0	35.7	8.0	28.4	0.0	59.2	74.0	-14.8	1/3 MHz			
AVG	H	7216.433	44.0	35.7	8.0	28.4	40.3	23.0	54.0	-31.0	1/3 MHz	RB	RB	
PK	H	9619.106	33.8	37.9	9.4	27.5	0.0	53.7	74.0	-20.3	1/3 MHz			Noise Floor
AVG	H	9619.106	22.8	37.9	9.4	27.5	0.0	42.7	54.0	-11.3	1/3 MHz	RB	RB	Noise Floor
PK	H	12022.630	34.7	39.5	10.9	27.4	0.0	57.6	74.0	-16.4	1/3 MHz			Noise Floor
AVG	H	12022.630	23.8	39.5	10.9	27.4	0.0	46.7	54.0	-7.3	1/3 MHz	RB	RB	Noise Floor
PK	H	14427.156	33.8	41.9	12.2	27.6	0.0	60.3	74.0	-13.7	1/3 MHz			Noise Floor
AVG	H	14427.156	23.2	41.9	12.2	27.6	0.0	49.7	54.0	-4.3	1/3 MHz	RB	RB	Noise Floor
PK	H	16831.682	34.8	39.7	13.5	28.1	0.0	59.9	74.0	-14.1	1/3 MHz			Noise Floor
AVG	H	16831.682	23.3	39.7	13.5	28.1	0.0	48.4	54.0	-5.6	1/3 MHz	RB	RB	Noise Floor
PK	H	2400.000	27.2	28.2	4.2	0.0	0.0	59.6	74.0	-14.4	1/3 MHz			Noise Floor
AVG	H	2400.000	16.7	28.2	4.2	0.0	0.0	49.1	54.0	-4.9	1/3 MHz	RB	RB	Noise Floor
PK	H	2483.500	24.9	28.4	4.3	0.0	0.0	57.6	74.0	-16.4	1/3 MHz			Noise Floor
AVG	H	2483.500	15.0	28.4	4.3	0.0	0.0	47.7	54.0	-6.3	1/3 MHz	RB	RB	Noise Floor
PK	H	2373.010	30.2	28.2	4.2	0.0	0.0	62.5	74.0	-11.5	1/3 MHz			No Pre-Amp
AVG	H	2373.010	28.0	28.2	4.2	0.0	40.3	20.1	54.0	-33.9	1/3 MHz	RB	RB	No Pre-Amp

#### Radiated Emissions

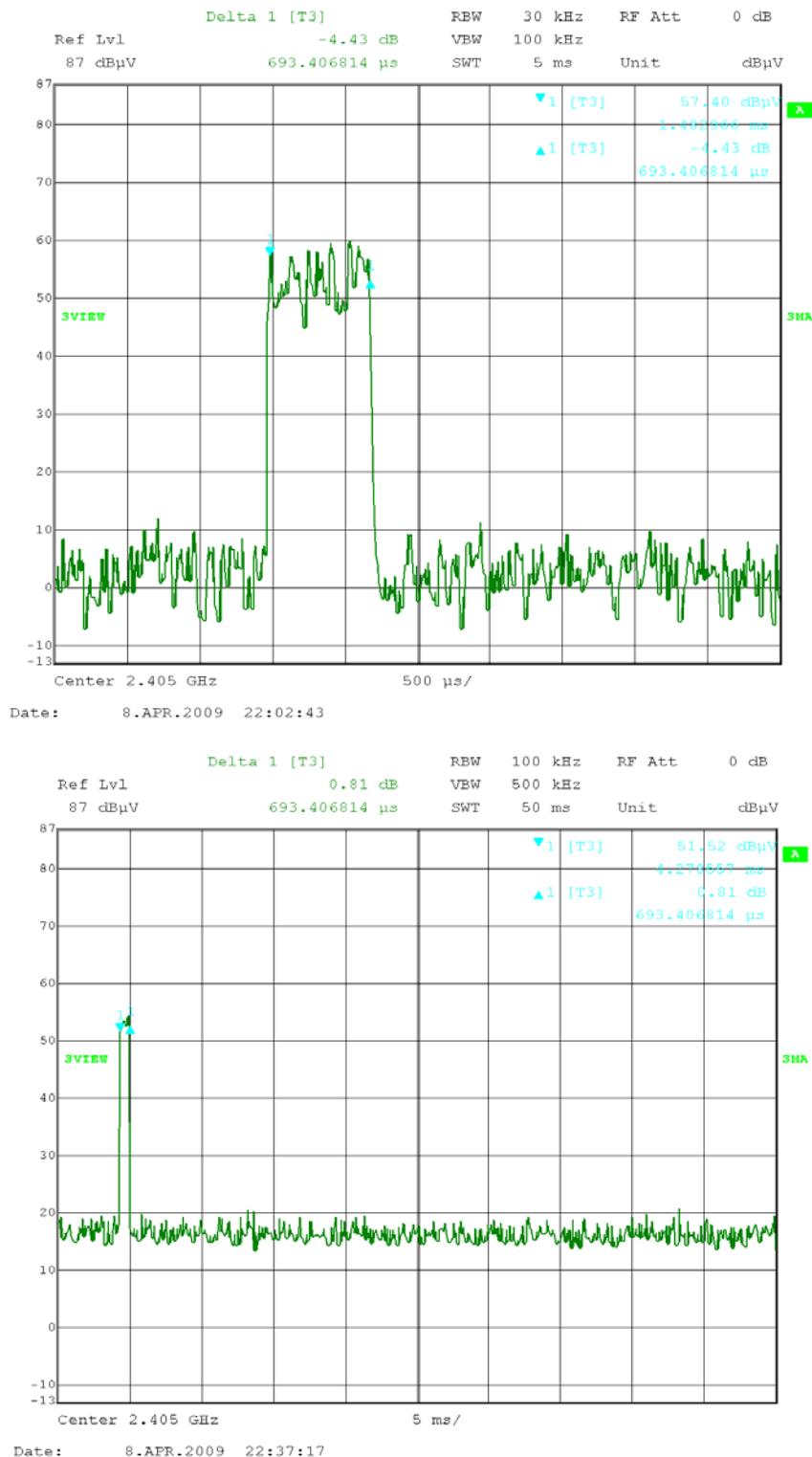
Company: Aqualisa products limited  
 Model #: A340 (Remote)  
 Serial #: BOX0902241216-002  
 Engineers: Vathana Ven  
 Project #: 3174909 Date(s): 03/10/09 04/04/09  
 Location: Site 1  
 Standard: FCC Part 15 Subpart C 15.249/RSS-210  
 Receiver: R&S FSEK-30 (ROS001) Limit Distance (m): 3  
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3  
 PreAmp Used? (Y or N): Y Voltage/Frequency: 3VDC Frequency Range: 1 - 18 GHz  
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)  
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS: NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	AVERAGE Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC	Harmonic?
PK	H	2405.411	63.9	28.2	4.4	0.0	0.0	96.5	114.0	-17.5	1/3 MHz			No Pre-Amp
AVG	H	2405.411	63.9	28.2	4.4	0.0	40.3	44.0	94.0	-50.0	1/3 MHz	RE002	RE004	No Pre-Amp
PK	H	4808.996	57.4	32.7	6.3	29.3	0.0	67.1	74.0	-6.9	1/3 MHz	RB	RB	
AVG	H	4808.996	57.4	32.7	6.3	29.3	40.3	16.6	54.0	-37.4	1/3 MHz	RB	RB	
PK	H	7216.601	47.2	35.7	8.0	28.4	0.0	62.4	74.0	-11.6	1/3 MHz			Noise Floor
AVG	H	7216.601	47.2	35.7	8.0	28.4	40.3	22.2	54.0	-31.8	1/3 MHz	RB	RB	Noise Floor
PK	H	9621.319	33.9	37.9	9.4	27.5	0.0	53.8	74.0	-20.2	1/3 MHz			Noise Floor
AVG	H	9621.319	22.9	37.9	9.4	27.5	0.0	42.8	54.0	-11.2	1/3 MHz	RB	RB	Noise Floor
PK	H	12027.060	35.2	39.5	10.9	27.4	0.0	58.1	74.0	-15.9	1/3 MHz			Noise Floor
AVG	H	12027.060	23.5	39.5	10.9	27.4	0.0	46.4	54.0	-7.6	1/3 MHz	RB	RB	Noise Floor
PK	H	14432.466	32.7	41.9	12.2	27.6	0.0	59.2	74.0	-14.8	1/3 MHz			Noise Floor
AVG	H	14432.466	23.0	41.9	12.2	27.6	0.0	49.5	54.0	-4.5	1/3 MHz	RB	RB	Noise Floor
PK	H	16837.877	32.5	39.7	13.5	28.1	0.0	57.6	74.0	-16.4	1/3 MHz			Noise Floor
AVG	H	16837.877	22.7	39.7	13.5	28.1	0.0	47.8	54.0	-6.2	1/3 MHz	RB	RB	Noise Floor
PK	H	2400.000	27.2	28.2	4.2	0.0	0.0	59.6	74.0	-14.4	1/3 MHz			Noise Floor
AVG	H	2400.000	16.7	28.2	4.2	0.0	0.0	49.1	54.0	-4.9	1/3 MHz	RB	RB	Noise Floor
PK	H	2483.500	25.2	28.4	4.3	0.0	0.0	57.9	74.0	-16.1	1/3 MHz			Noise Floor
AVG	H	2483.500	14.6	28.4	4.3	0.0	0.0	47.3	54.0	-6.7	1/3 MHz	RB	RB	Noise Floor
PK	H	2373.010	32.2	28.2	4.2	0.0	0.0	64.5	74.0	-9.5	1/3 MHz			No Pre-Amp
AVG	H	2373.010	32.2	28.2	4.2	0.0	40.3	24.3	54.0	-29.7	1/3 MHz	RB	RB	No Pre-Amp

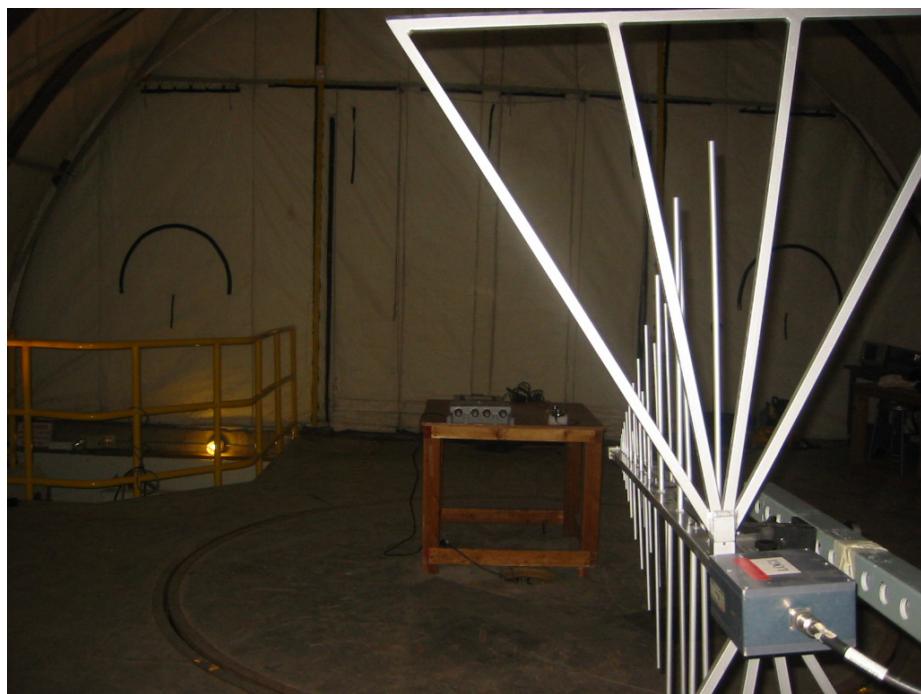
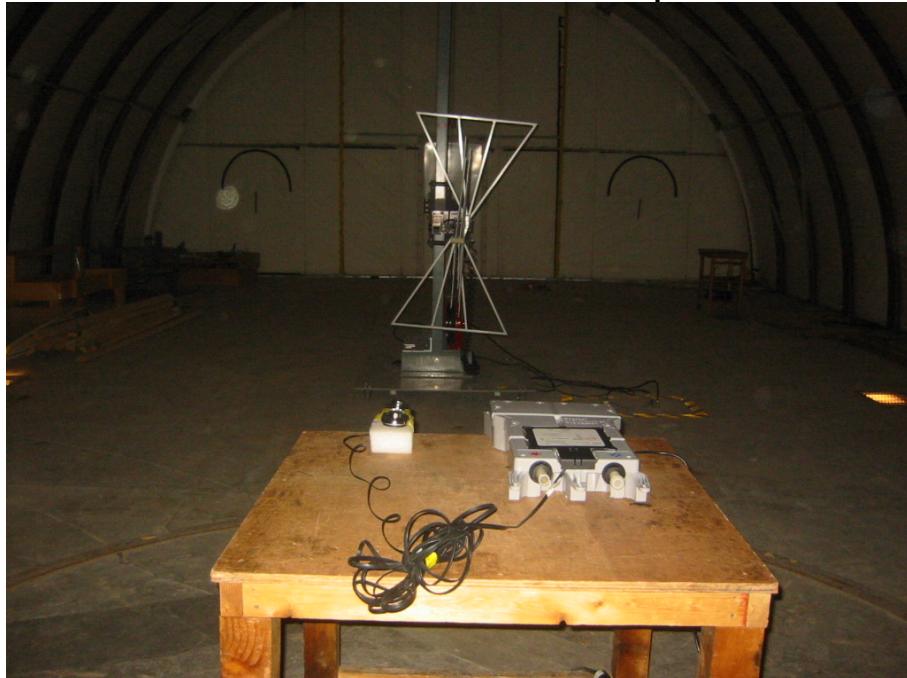
Note: Average factor was calculated as  $20 * \log(693.4 \mu\text{S} / (100 * 10^3) \mu\text{S}) = 40.3 \text{ dB}$ , which was applied to the peak readings to get average reading.



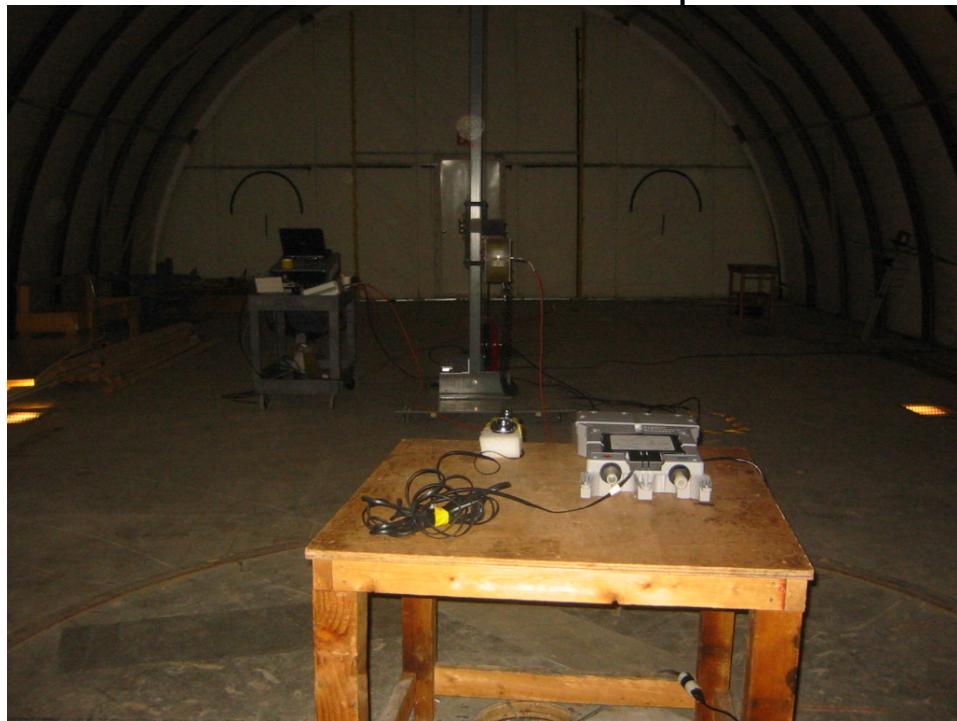
## Test Results Continued:



**Controller Radiated Emissions Setup Photo**

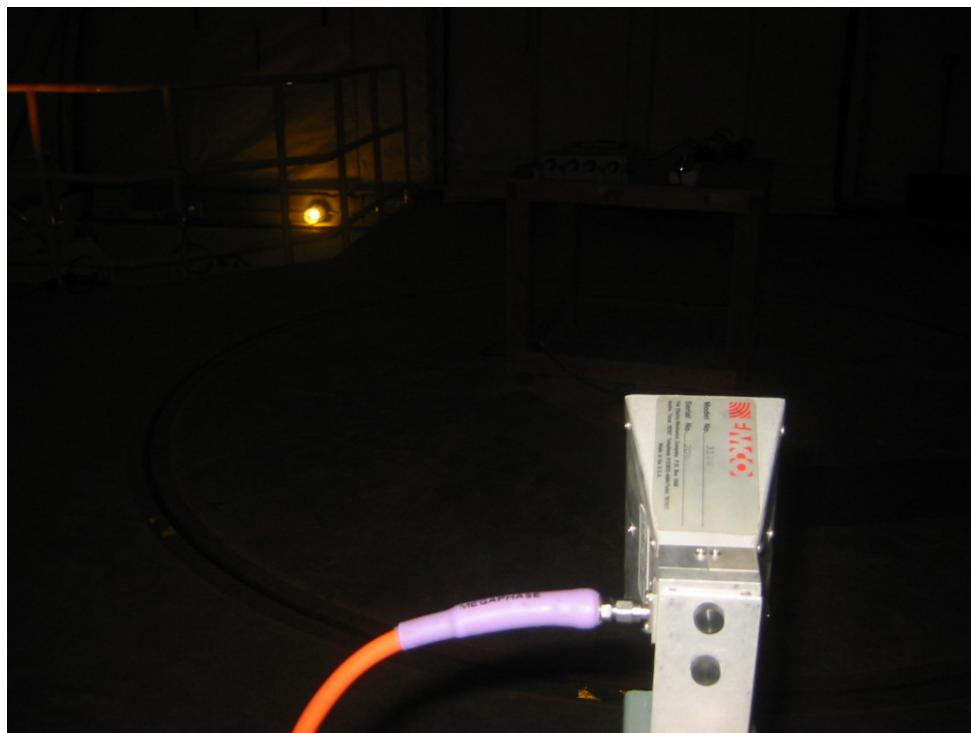


## Controller Radiated Emissions Setup Photo

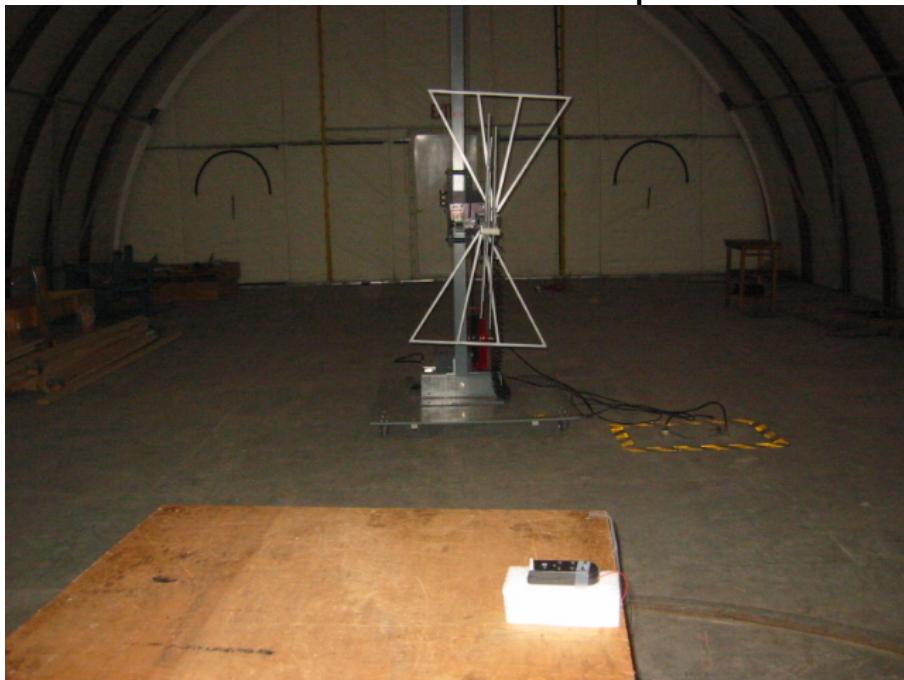


**1-18 GHz**

## Controller Radiated Emissions Setup Photo

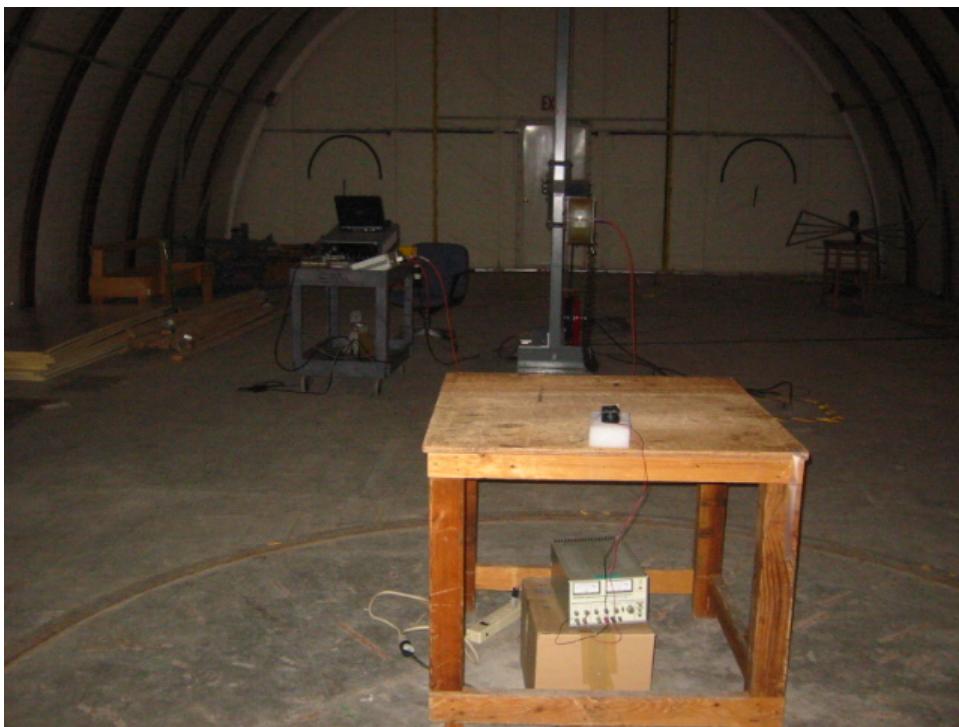


## Remote Radiated Emissions Setup Photo



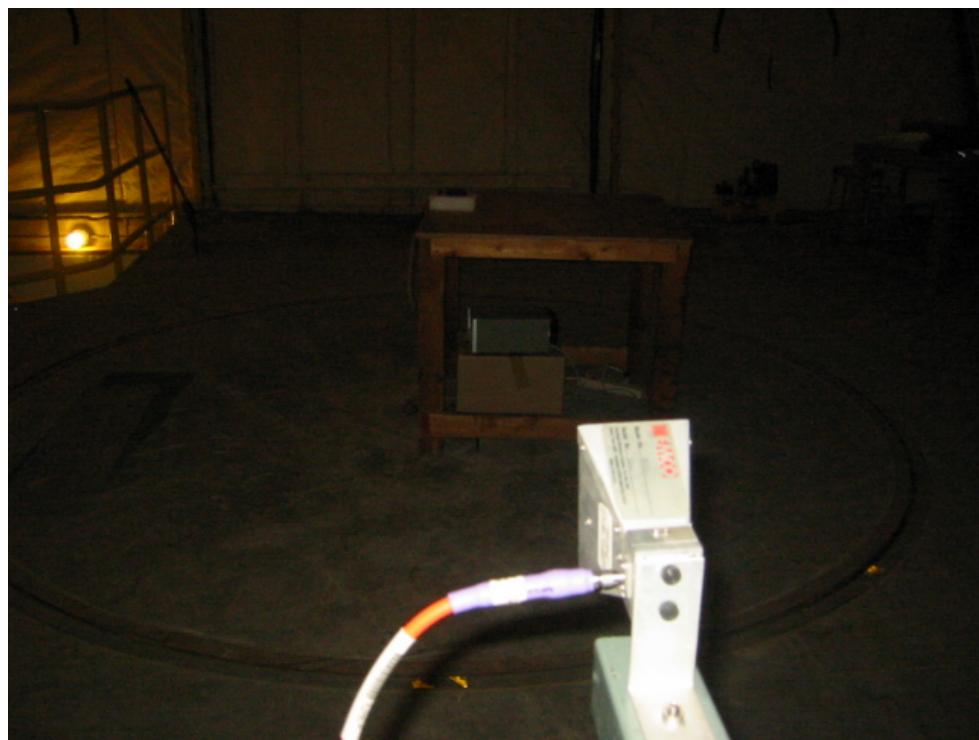
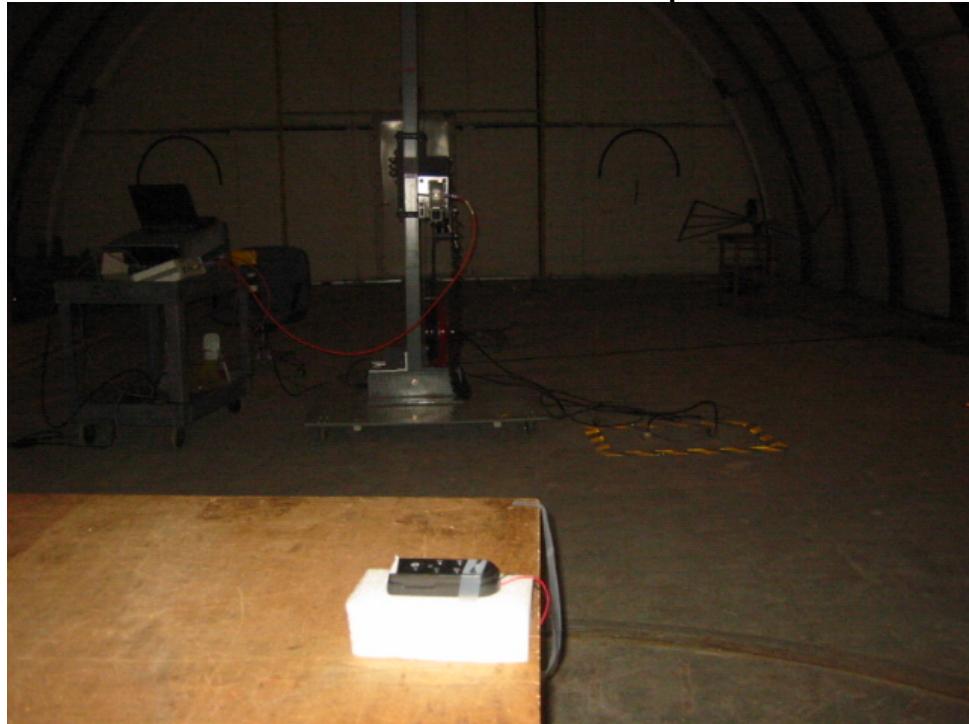
30 MHz-1GHz

## Remote Radiated Emissions Setup Photo



**1-18 GHz**

## Remote Radiated Emissions Setup Photo



**18-24.04 GHz**

**Test Results:** Pass

**Test Standard:** RSS-210 Issue 7 June 2007

**Test:** Receiver Spurious Field Strength

**Performance Criterion:** Not Applicable

**Test Environment:**

Environmental Conditions During Testing:	Ambient (°C):	18/24	Humidity (%):	48/31	Pressure (hPa):	1004/1017
Pretest Verification Performed	Yes		Equipment under Test:	142624 and A340		
Test Engineer(s):	Vathana Ven			EUT Serial Number:	BOX0902241216-003 and BOX0902241216-002	

**Maximum Test Disturbance Parameters:** Emissions below Table 2

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	ANTENNA	EMCO	3142	9701-1116	12/02/2009
2	3 Meter In floor cable for site 1	ITS	RG214B/U	S1 3M FLR	09/08/2009
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009
4	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
5	40GHz Cable	Megaphase	TM40-K1K1-197	7030801 001	06/05/2009
6	40 GHz Cable	Megaphase	TM40-K1K1-80	7030802 002	06/05/2009
7	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	12/10/2009
8	Digital 4 Line Barometer	Mannix	0ABA116	BAR3	06/01/2009
9	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
10	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/27/2010
11	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	03/27/2009

**Software Utilized:**

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	3/07/07 Revision

**Test Details:**

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail	Comment
Around the EUT	Specified limits	Below specified limits	Pass	None



**Test Results:** Pass

**Test Standard:** FCC Part 15 Subpart C Section 15.249, FCC Part 15, Subpart B, Industry Canada RSS-210 Issue 7 June 2007, and RSS-GEN Issue 2 June 2007

**Test:** Line-Conducted Emissions

**Performance Criterion:** Not Applicable

**Test Environment:**

Environmental Conditions During Testing:	Ambient (°C):	18	Humidity (%):	48	Pressure (hPa):	1004
Pretest Verification Performed	Yes		Equipment under Test:		142624 and A340	
Test Engineer(s):	Vathana Ven			EUT Serial Number:	BOX0902241216-003 and BOX0902241216-002	

**Maximum Test Disturbance Parameters:** Emissions below the specified limits.

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR3	06/01/2009
2	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
3	RG223 50ohm Coaxial Cable	Intertek	BNC-30	CBLBNC6	02/25/2010
4	Attenuator, 10dB	Mini Circuits	10dB, 50 ohm	DS11	02/25/2010
5	LISN, 50uH, .01 - 50MHz, 24A	Solar Electronics	9252-50-R-24-BNC	941713	10/06/2009

**Software Utilized:**

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	3/07/07 Revision

**Test Details:**

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail	Comment
AC Mains	Specified limits	Below specified limits	Pass	None

## Test Results:

### Conducted Emissions

Company: Aqualisa products limited  
 Model #: 142624 (Controller)  
 Serial #: BOX0902241216-003  
 Engineer(s): Vathana Ven  
 Project #: 3174909 Date: 03/11/09  
 Standard: FCC Part 15 Subpart C 15.249/RSS-210  
 Barometer: BAR3 Temp/Humidity/Pressure: 18 deg C 48% 1004 mB Attenuator: DS11 02-25-10.txt  
 Voltage/Frequency: 120V/60 Hz Frequency Range: 0.150-30 MHz

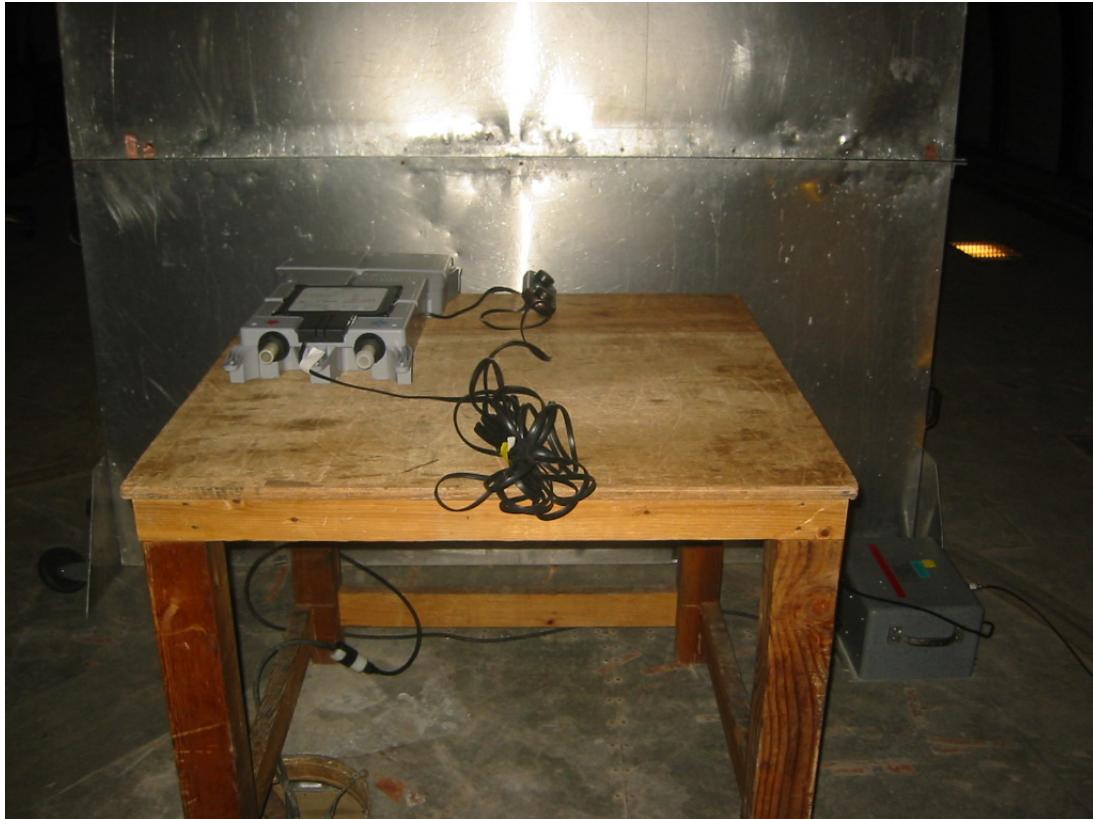
Net is the sum of worst-case lisn, cable, & attenuator losses, and initial reading, factors are not shown  
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
QP	0.150	16.0	16.0			26.3	66.0	-39.7	9/30 kHz
QP	0.180	19.5	20.0			30.5	64.5	-34.0	9/30 kHz
QP	0.530	36.2	37.8			48.5	56.0	-7.5	9/30 kHz
QP	1.069	32.4	32.7			43.5	56.0	-12.5	9/30 kHz
QP	2.069	33.5	33.1			44.3	56.0	-11.7	9/30 kHz
QP	2.889	33.3	33.8			44.6	56.0	-11.4	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
AVG	0.150	-3.0	-3.0			7.3	56.0	-48.7	9/30 kHz
AVG	0.180	-3.0	-3.0			7.5	54.5	-47.0	9/30 kHz
AVG	0.530	31.4	32.7			43.4	46.0	-2.6	9/30 kHz
AVG	1.069	23.0	23.3			34.1	46.0	-11.9	9/30 kHz
AVG	2.069	21.3	21.6			32.4	46.0	-13.6	9/30 kHz
AVG	2.889	20.0	19.9			30.8	46.0	-15.2	9/30 kHz

Note: Line-conducted emissions testing was performed on the valve's ac mains

**Line-Conducted Emissions Photo 1**



Line-Conducted Emissions Photo 2



**Test Results:** No limit

**Test Standard:** FCC Part 15, Subpart C, Section 15.249 and Industry Canada RSS-210 Issue 7 June 2007

**Test:** 20 dB Bandwidth

**Performance Criterion:** Not Applicable

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	18	Humidity (%):	48	Pressure (hPa):	1004
Pretest Verification Performed		Yes		Equipment under Test:		142624 and A340	
Test Engineer(s):	Vathana Ven			EUT Serial Number:		BOX0902241216-003 and BOX0902241216-002	

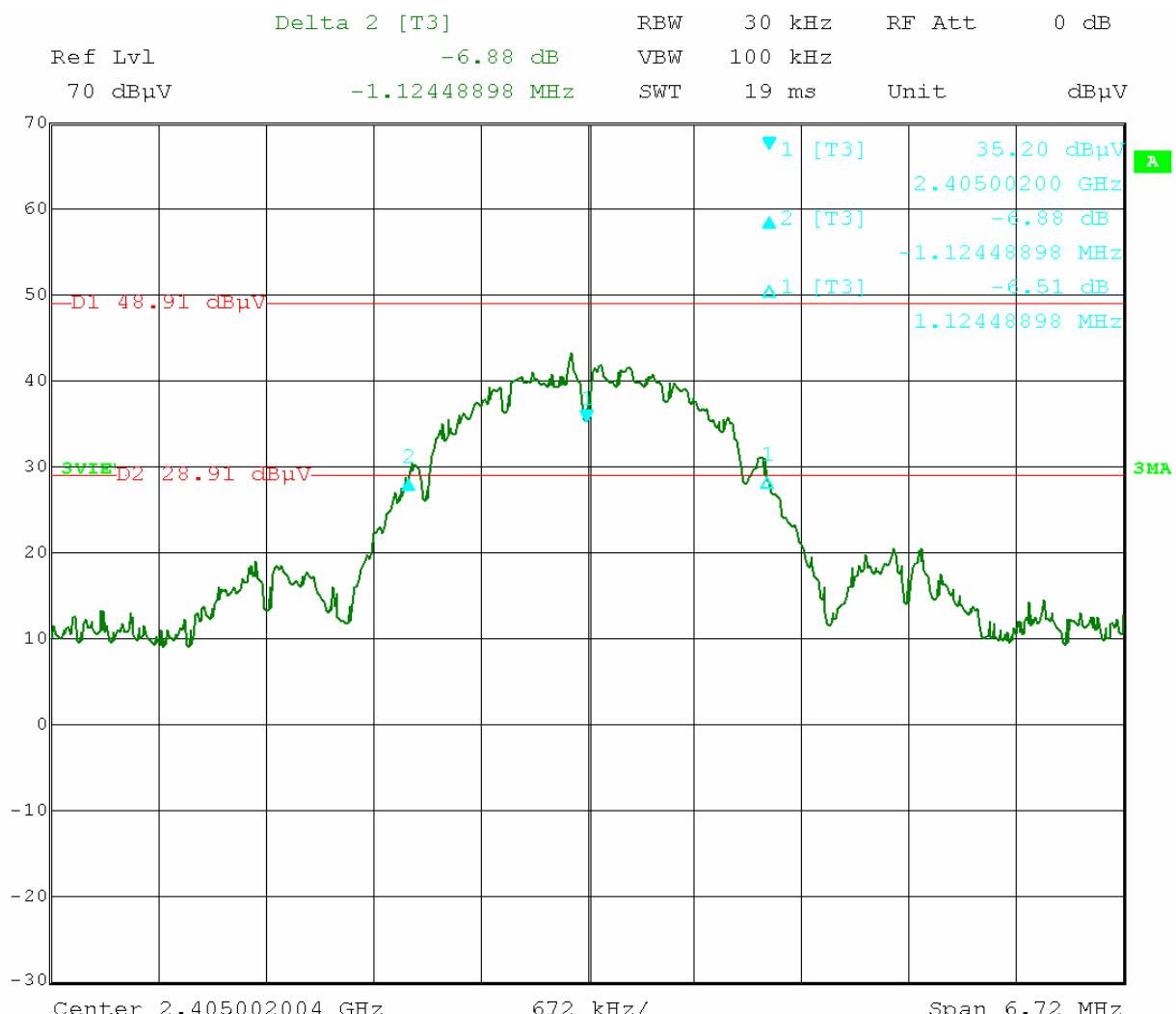
**Maximum Test Disturbance Parameters:** No limit

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
2	40 GHz Cable	Megaphase	TM40-K1K1-80	7030802 002	06/05/2009
3	Digital 4 Line Barometer	Mannix	0ABA116	BAR3	06/01/2009
4	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009

**Test Details:**

Test Point	Standard Limit (as published)	Compliance Level	Pass/Fail	Comment
Fundamental Frequency	No limit	No limit	No limit	None



Date: 2.APR.2009 21:34:01

Referenced 20dB bandwidth is 2.249 MHz