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Report On

EMC Testing of the
Raymarine UK Ltd AIS650
Class B AIS

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Document 75913554 Report 02 Issue 1 May 2011

TÜV SÜD Product Service Ltd, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuvps.co.uk

REPORT ON

EMC Testing of the
Raymarine UK Ltd AIS650
Class B AIS

Document 75913554 Report 02 Issue 1

May 2011

PREPARED FOR

Raymarine UK Ltd
Marine House
5 Harbourgate
Southampton Road
Portsmouth
PO6 4BQ

PREPARED BY

PJ Harrison
EMC Engineer

APPROVED BY

K F Archer
Authorised Signatory

DATED 19 May 2011

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CONTENTS

SECTION 1

REPORT SUMMARY

EMC Testing of the
Raymarine UK Ltd AIS650
Class B AIS

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Raymarine UK Ltd AIS650, Class B AIS to the power line conducted, radiated electric and radiated magnetic field requirements of IEC 60945: 2002-08.

Objective	To perform Electromagnetic Compatibility (EMC) Qualification Approval Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Raymarine UK Ltd PLC
Model Number(s)	AIS650
Serial Number(s)	*Sample 4* (75913554 TSR-0010)
Software Version	040200.01.00.00
Hardware Version	V1.0
Number of Samples Tested	One
Test Specification/Issue/Date	IEC 60945: 2002-08
Incoming Release Date	Declaration of Build Status 09 May 2011
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	POR002061 08 April 2011
Start of Test	20 April 2011
Finish of Test	20 April 2011
Name of Engineer(s)	PJ Harrison
Related Document(s)	CISPR 16-1 : 1999

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results in accordance with IEC 60945: 2002-08 is shown below.

Configuration 1 - As supplied						
Section	Spec Clause	Test Description	Mode	Mod State	Result	Base Standard
2.1	Table 5, 9.2	Conducted Emissions (DC Power Port)	Tx (Autonomous)	0	Pass	CISPR 16-1
			Rx / Searching for GPS lock.	0	Pass	
	Table 5, 9.2	Conducted Emissions (AC Power Port)			N/A	CISPR 16-1
2.2	Table 5, 9.3	Enclosure Port Magnetic Emissions - Field Strength	Tx (Autonomous)	0	Pass	CISPR 16-1
2.3	Table 5, 9.3	Radiated Emissions (Enclosure Port)	Tx (Autonomous)	0	Pass	CISPR 16-1
	Table 6, 10.3	Immunity to Radio Frequency Common Mode (AC Power Port)			N/A	IEC 61000-4-6
	Table 6, 10.3	Immunity to Radio Frequency Common Mode (DC Power Port)			N/R	IEC 61000-4-6
	Table 6, 10.3	Immunity to Radio Frequency Common Mode (Signal, Control and Telecommunications Port)			N/R	IEC 61000-4-6
	Table 6, 10.4	Immunity to Radio Frequency Electromagnetic Field (Enclosure Port)			N/R	IEC 61000-4-3
	Table 6, 10.5	Immunity to Fast Transient Bursts Common Mode (AC Power Port)			N/A	IEC 61000-4-4
	Table 6, 10.5	Immunity to Fast Transient Bursts Common Mode (Signal, Control and Telecommunications Port)			N/R	IEC 61000-4-4
	Table 6, 10.6	Immunity to Surges (AC Power Port)			N/A	IEC 61000-4-5
	Table 6, 10.7	Immunity to Power Supply Short Term Variation (AC Power Ports)			N/A	IEC 61000-4-11
	Table 6, 10.8	Immunity to Interruptions (AC Power Port)			N/A	IEC 61000-4-11
	Table 6, 10.8	Immunity to Interruptions (DC Power Port)			N/R	IEC 61000-4-11
	Table 6, 11.2	Compass Safe Distance (Enclosure Port)			N/R	EN 60945
	Table 6, 10.9	Immunity to Electrostatic Discharge (Enclosure Port)			N/R	IEC 61000-4-2

N/A – Not Applicable; N/R – Not Requested

1.3 DECLARATION OF BUILD STATUS

Manufacturer	Raymarine UK Ltd UK Limited
Country of origin	United Kingdom
UK Agent	Raymarine UK Ltd UK Limited
Technical Description	Class B CSTDMA AIS Transponder
Model No	AIS650
Part No	414-0002
Serial No	Not serialized
Drawing Number	LD3566
Build Status	V1.0
Software Issue	040200.01.00.00
FCC ID	PJ5-AIS650

Signature Nathan Emery

Date 09 May 2010

Note: This document has been prepared to enable manufacturers with no mechanism for producing their own Declaration of Build Status, to declare the build state of the equipment submitted for test.

No responsibility will be accepted by TÜV SÜD Product Service as to the accuracy of the information declared in this document by the manufacturer.

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Raymarine UK Ltd AIS650, class B AIS as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

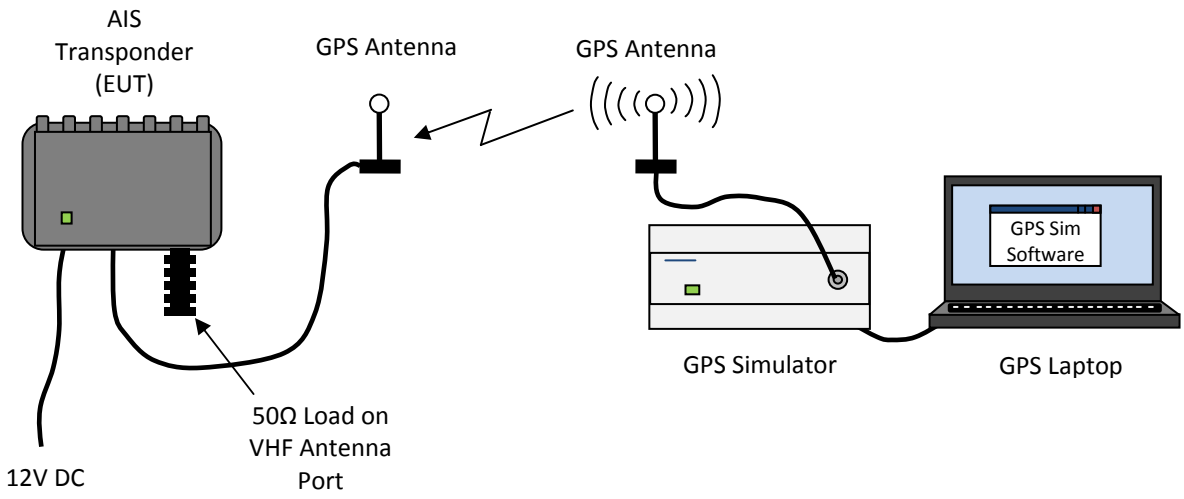
Equipment Under Test

1.4.2 Test Configuration

The EUT was set up with the VHF port connected to a load.

During Tx Mode (Mode 1) the EUT was provided with a simulated GPS position which it could transmit with its NMEA identifier.

Doing Rx Mode (Mode 2) the simulated GPS position data was removed.



Configuration 1: As supplied

The EUT was configured in accordance with IEC 60945.

1.4.3 EUT Cable / Port Identification

Port	Max Cable Length specified	Usage	Type	Screened	Notes
DC Power / Signal	N/A	DC Power and NMEA0183	Multicore	Yes	Connected during testing
Signal	N/A	Diagnostic	Multicore	Yes	Not connected during testing
Antenna	N/A	VHF Antenna	Coax	N/A	Connected during testing
Antenna	N/A	GPS Antenna	Coax	N/A	Connected during testing

1.4.4 Modes of Operation

Modes of operation of each EUT during testing were as follows:

Mode 1 – Tx (Autonomous)

Mode 2 – Rx / Searching for GPS lock.

Information on the specific test modes utilised are detailed in the test procedure for each individual test.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratories or an open test area as appropriate.

The EUT was powered from a 12V supply.

Test Results

EN 60945, Clause 5.3 states:

The measured test results shall be compared with the corresponding acceptable performance limits and the EUT shall pass the test only if the measured performance margin is favourable and greater than the measurement uncertainty. The test report shall show, for each test measurement, the test result, its associated measurement uncertainty, the acceptable performance limits, and the acceptable performance margin, as applicable.

The tests detailed in this report met the above test requirements.

1.6 DEVIATIONS FROM THE STANDARD

Limited testing, please refer to Section 1.2 for a list of applied tests

1.7 MODIFICATION RECORD

No modifications were made to the EUT during testing.

SECTION 2

TEST DETAILS

EMC Testing of the
Raymarine UK Ltd
AIS650

2.1 CONDUCTED EMISSIONS (DC POWER PORT)

2.1.1 Specification Reference

IEC 60945: Table 5, 9.2

2.1.2 Equipment Under Test

AIS650, S/N: “Sample 4”

2.1.3 Date of Test and Modification State

20 April 2011 - Modification State 0

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2

2.1.6 Environmental Conditions

	20 April 2011
Ambient Temperature	21.1°C
Relative Humidity	36%
Atmospheric Pressure	1011mbar

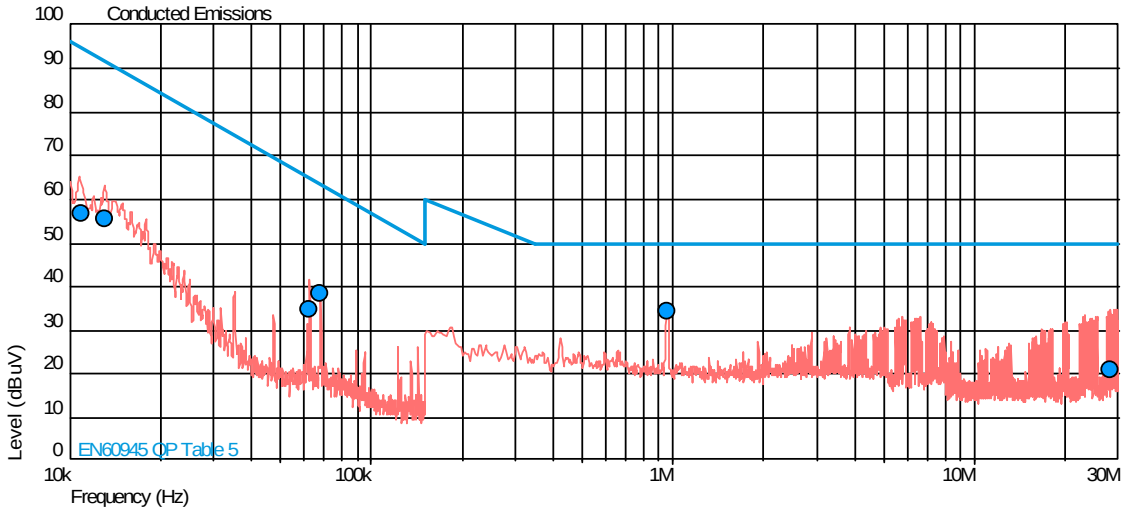
2.1.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Conducted Emissions (DC Power Port).

The test results are shown below.

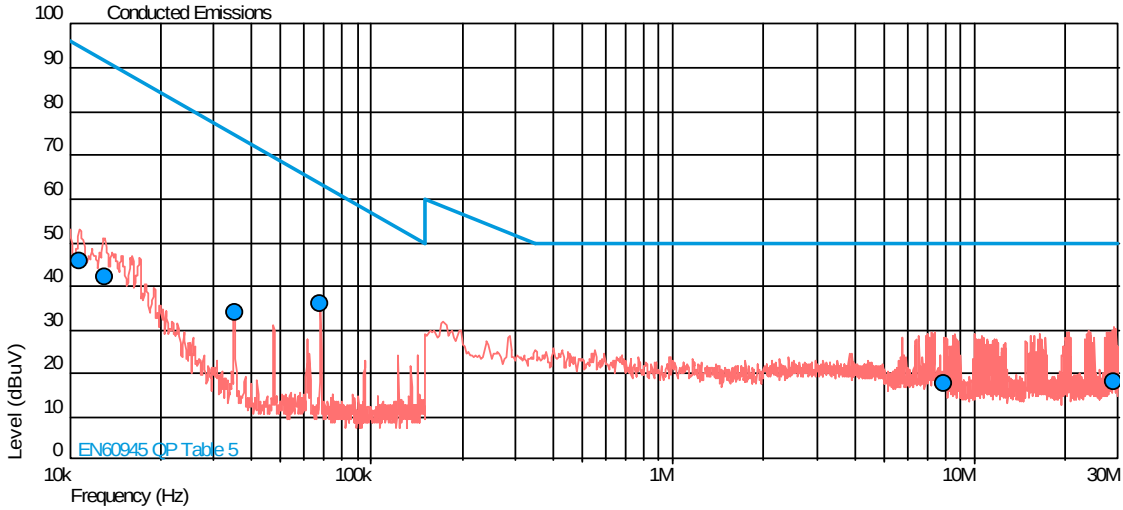
Configuration 1 - Mode 1

Positive Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.011	56.9	94.5	-37.7
0.013	55.5	91.5	-36.0
0.063	34.6	64.9	-30.3
0.068	38.5	63.5	-25.0
0.960	34.5	50.0	-15.5
28.246	20.9	50.0	-29.1

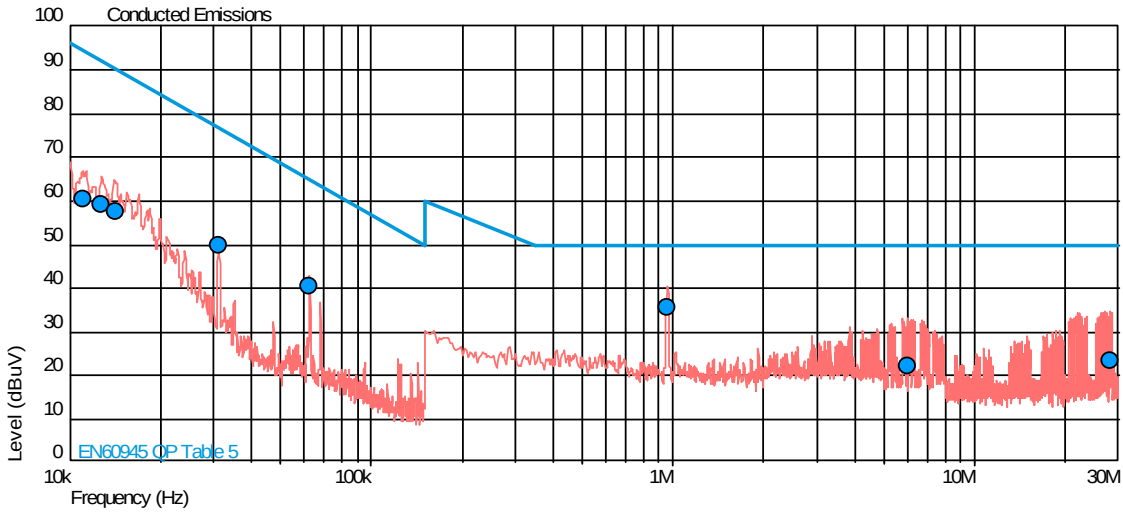
Negative Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.011	45.6	94.6	-49.0
0.013	42.0	91.5	-49.5
0.035	34.0	74.6	-40.6
0.068	35.9	63.5	-27.6
7.890	17.7	50.0	-32.3
29.128	18.1	50.0	-31.9

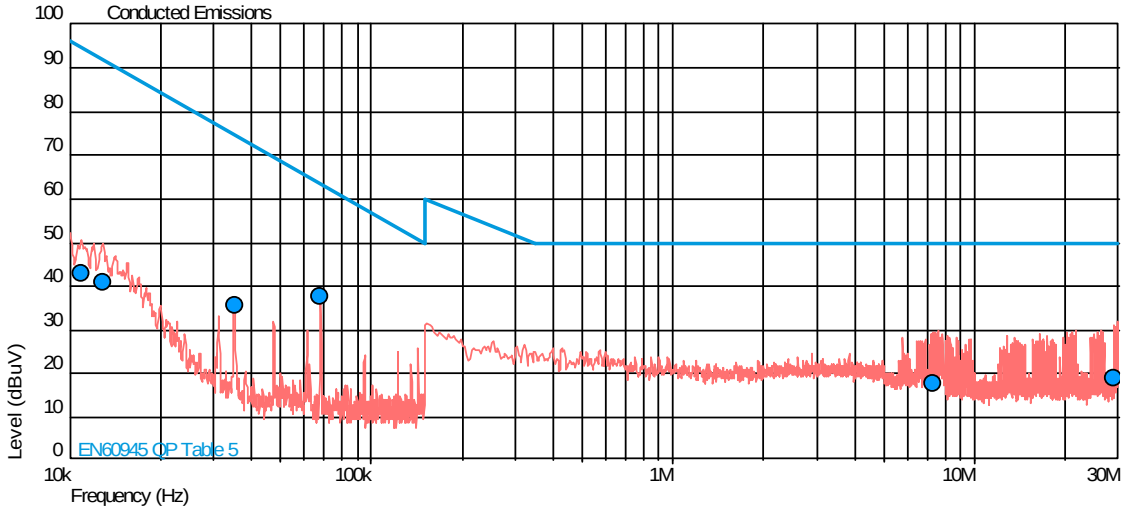
Configuration 1 - Mode 2

Positive Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.011	60.4	94.2	-33.9
0.013	59.0	91.8	-32.8
0.014	57.6	90.0	-32.4
0.031	49.6	76.7	-27.0
0.062	40.6	64.9	-24.3
0.959	35.5	50.0	-14.5
6.048	22.0	50.0	-28.0
28.322	23.5	50.0	-26.5

Negative Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.011	42.7	94.5	-51.8
0.013	40.8	91.6	-50.9
0.035	35.7	74.6	-38.9
0.068	37.6	63.5	-25.9
7.315	17.5	50.0	-32.5
29.163	18.9	50.0	-31.1

2.2 ENCLOSURE PORT MAGNETIC EMISSIONS (ENCLOSURE PORT)

2.2.1 Specification Reference

IEC 60945: Table 5, 9.3

2.2.2 Equipment Under Test

AIS650, S/N: “Sample 4”

2.2.3 Date of Test and Modification State

20 April 2011 - Modification State 0

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

2.2.6 Environmental Conditions

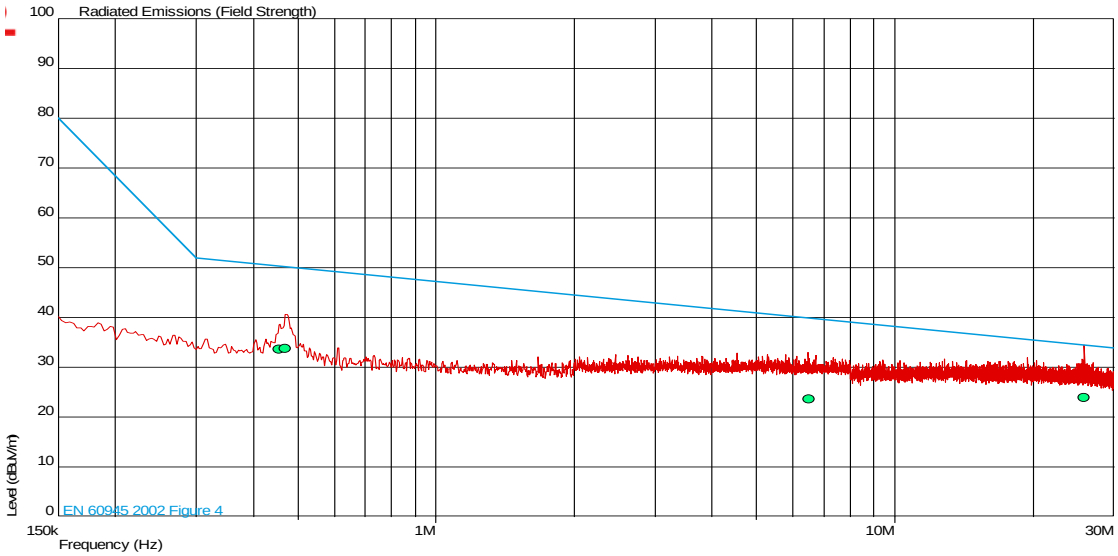
	20 April 2011
Ambient Temperature	21.1°C
Relative Humidity	36%
Atmospheric Pressure	1011mbar

2.2.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Enclosure Port Magnetic Emissions (Enclosure Port).

The test results are shown below.

Configuration 1 - Mode 2



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
0.455	33.7	50.4	-16.7	360	1.50	Face On
0.469	33.8	50.2	-16.4	162	1.50	Face On
6.485	23.7	40.0	-16.3	207	1.50	Edge On
25.861	24.0	34.6	-10.6	279	1.50	Edge On

2.3 RADIATED EMISSIONS (ENCLOSURE PORT)

2.3.1 Specification Reference

IEC 60945: Table 5, 9.3

2.3.2 Equipment Under Test

AIS650, S/N: “Sample 4”

2.3.3 Date of Test and Modification State

20 April 2011 - Modification State 0

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

2.3.6 Environmental Conditions

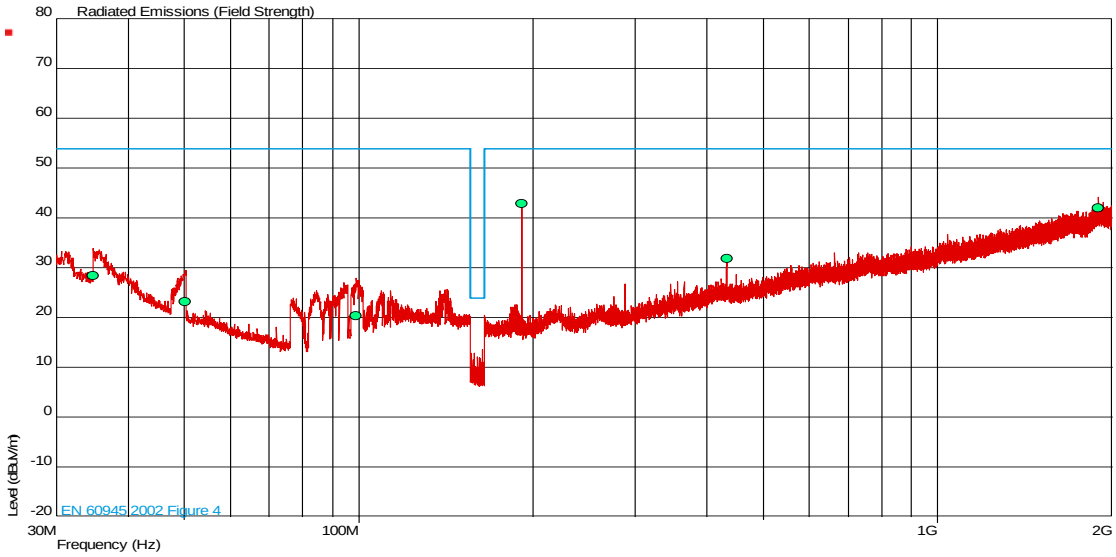
	20 April 2011
Ambient Temperature	21.1°C
Relative Humidity	36%
Atmospheric Pressure	1011mbar

2.3.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Radiated Emissions (Enclosure Port).

The test results are shown below.

Configuration 1 - Mode 2



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
34.799	28.4	54.0	-25.6	211	3.67	Vertical
50.080	23.1	54.0	-30.9	120	1.00	Vertical
98.867	20.4	54.0	-33.6	360	1.00	Vertical
191.283	42.9	54.0	-11.1	222	1.03	Vertical
431.992	31.9	54.0	-22.1	0	1.03	Vertical
1891.868	42.0	54.0	-12.0	360	1.00	Vertical

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 EMC - Conducted Emissions					
LISN	Rohde & Schwarz	ESH2-Z5	17	12	14-Jun-2011
Transient Limiter	Hewlett Packard	11947A	2378	12	22-Jun-2011
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
Section 2.2 EMC - Magnetic Emissions					
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Antenna (Active Loop, 9kHz-30MHz)	Rohde & Schwarz	HFH2-Z2	333	24	20-Sep-2012
Screened Room (5)	Rainford	Rainford	1545	24	3-Feb-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
Section 2.3 EMC - Radiated Emissions					
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
Screened Room (5)	Rainford	Rainford	1545	24	3-Feb-2014
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011

TU – Traceability Unscheduled

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.2dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Conducted Emissions, ISN	150kHz to 30MHz Amplitude	2.1dB
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
Discontinuous Interference	150kHz to 30MHz Amplitude	3.0dB*
Interference Power	30MHz to 300MHz Amplitude	3.0dB*
Radiated E-Field Susceptibility	10MHz to 6GHz Test Amplitude	2.0dB†
Conducted Susceptibility RF	50kHz to 1000MHz Amplitude EM Clamp Method of Test CDN Method of Test BCI Clamp Method of Test Direct Injection Method of Test	 3.1dB• 1.2dB• 1.1dB• 1.2dB•
Conducted Susceptibility LF	DC to 150kHz	1.0%†
Power Frequency Magnetic Field	50Hz/60Hz Amplitude	0.45%
Magnetic Emissions	9kHz to 30MHz Amplitude	3.4dB*
Magnetic Field/Flux iaw EN 50366	10Hz to 400kHz	2.64%
Harmonics and Flicker	The test was applied using proprietary equipment that meets the requirements of EN 61000-3-2 and EN 61000-3-3	—
Mains Voltage Variations and Interrupts	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11	—
Fast Transient Burst	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4	—
Electrostatic Discharge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2	—
Surge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-5	—
Vehicle Transients	The test was applied using proprietary equipment that meets the requirements of ISO 7637-1 and 2	—
Compass Safe Distance	Azimuth Accuracy	0.10°

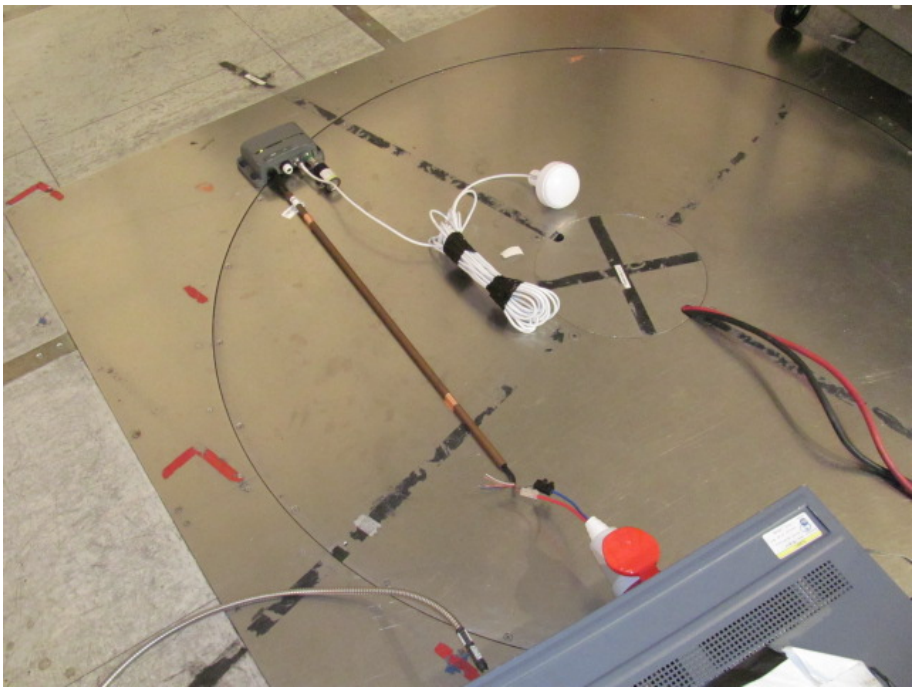
Worst case error for both Time and Frequency measurement 12 parts in 10^6.

* In accordance with CISPR 16-4-2
† In accordance with UKAS Lab 34
• In accordance with EN61000-4-6: 2009

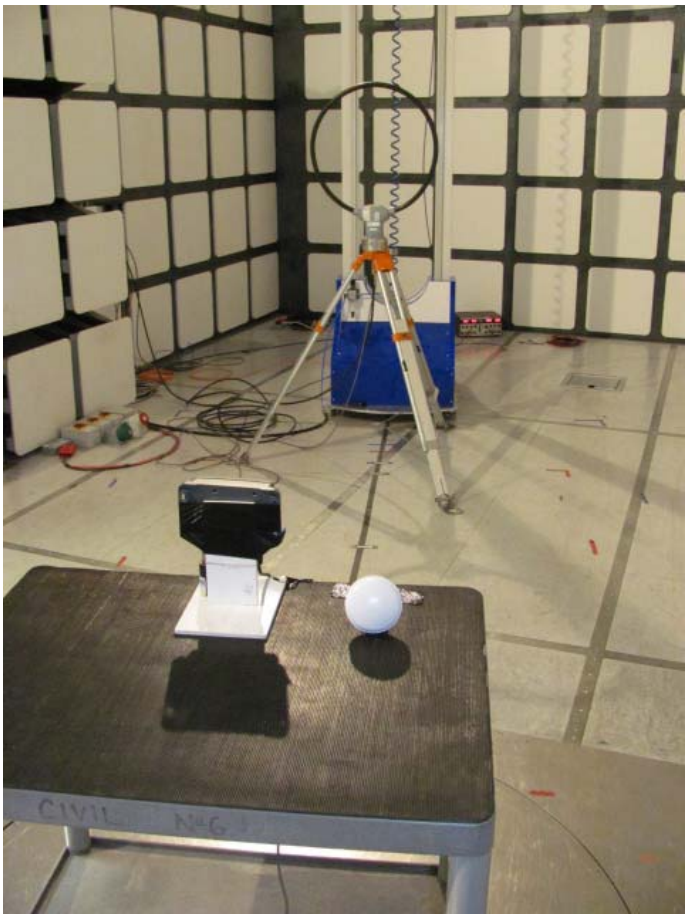
SECTION 4

PHOTOGRAPHS

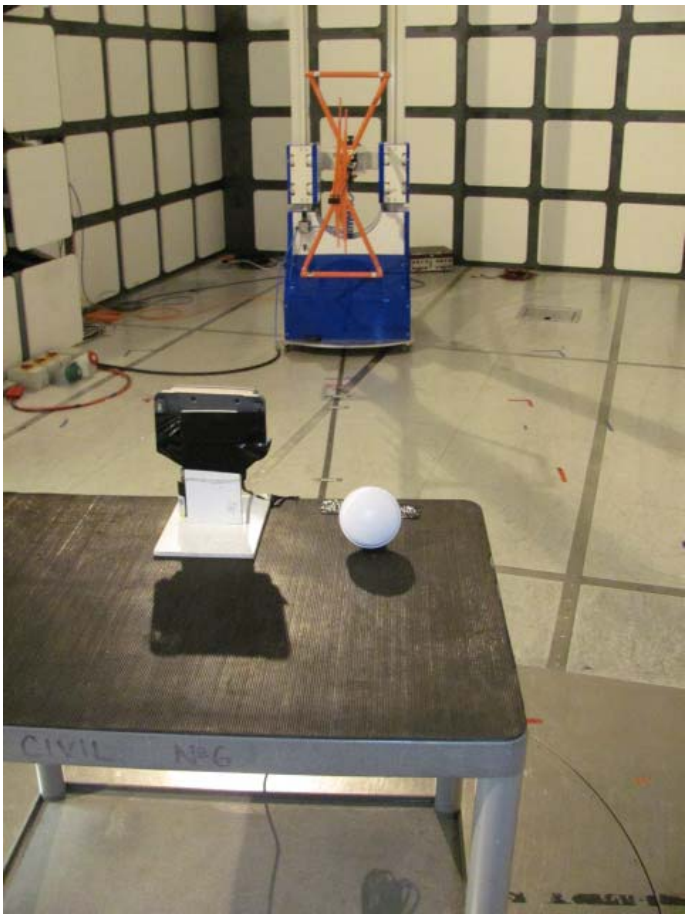
4.1 TEST SET UP PHOTOGRAPHS



Conducted Emissions (DC Power Port)



Enclosure Port Magnetic Emissions (Enclosure Port)



Radiated Emissions (Enclosure Port)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).