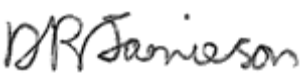
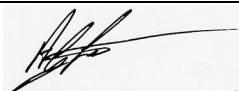

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Test Report for Quantum Express Marine Radar RADHAZ

To ICNIRP Guidelines for limiting exposure to time-varying electric,
magnetic, and electromagnetic fields (up to 300GHz) - 1998

Model Number	E70210		
Product Description	Maritime Radar		
Report Number	EMC2015/011		
Report Version	V1.03		
Report Author David Jamieson EMC Engineer		Date	16 th November 2015
Technical Check Mike Thompson Senior EMC Engineer		Date	21/12/2015
Approval Andrew Little Compliance Manager		Date	12 th January 2016

Test Date Range	11 th to 13 th November 2015
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Product Status	PASS
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The test data and results contained within this report relate only to the items tested.

1 Report History

Version	Date	Reason for change
1.00	As cover sheet	Initial Issue
1.01	16/11/2015	Measurement performed at 10cm
1.02	19/11/2015	Internal use only
1.03	26/11/2015	Added statement on Wi-Fi module simultaneous transmission.

2 RADHAZ Test Summary

Test Name	Section	Result
Exposure to time varying electric and magnetic fields	Table 7	For information only

3 Attestations

This equipment has been tested in accordance with the standards identified in this report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in these reports.

All measuring instruments used to determine the status of the product's compliance to the identified standards are calibrated regularly in accordance with UKAS requirements.

A comprehensive system of traceable calibration in accordance with ISO9001 is maintained.

Name/Position	Signature	Date
David Jamieson EMC Engineer		16 th November 2015

I attest that the necessary measurements were made, under my supervision at:

Raymarine UK Ltd, Marine House, Cartwright Drive, Fareham, PO15 5RJ.



Andy Little
Compliance Manager

Date: 12/01/2016

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4 Test Information

4.1 Test Facilities

Site 3	6m x 3m x 2.5m Screened Room	GND reference plane	1.25 x 2.5m 1.05m x 2.0m
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4.2 Overall Test Conditions

Date	Ambient Temperature (°C)	Relative Humidity (%)	Air Pressure (mbar)
11/11/2015	18.9	60	N/A
12/11/2015	18.4	60	N/A
13/11/2015	20.7	60	N/A

4.3 Test Methods

The objective of the report is to perform testing according to the below specifications:

Number	Standard Number	Document Title
1	International Commission on Non-Ionizing Radiation Protection Guidelines (1998)	Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz)

4.3.1 Deviations from Test Methods

None

5 EUT Information

5.1 Test Rationale

Full compliance

5.2 Description of Equipment under Test (EUT)

Date of Receipt:	07/09/2015
Client:	Paul Thomas
Brand Name:	Raymarine
Product Range:	Quantum Express Radar
Country of Manufacture:	Hungary
Operational voltage range:	12V to 24V

Unit 1

Model Name or Number:	Quantum Express Radar
Unique Type Identification:	E70210
Serial Number:	0750122 (EMC2015/001)
CCT Diagram Number(s) & Issue:	Main Board: 1003643 Issue 3 PSU Board: 1003653 Issue 5 Wired Extender: 1003493 Issue 2
PCB Assembly Number(s) & Issue:	Main Board: 1003644 Issue 3 PSU Board: 1003654 Issue 7 Wired Extender: 1003494 Issue 2
Software Version:	IF App: 0.78 PSU App: 0.29 FPGA Version: V2.63 Wired Extender: v1.0
Modifications to Unit:	None.
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	IEEE 802.11b: 11/5.5/2/1Mbps IEEE 802.11g: 54/48/36/24/18/12/9/6Mbps
Frequency Range	2400MHz - 2483.5MHz
Number of Channels	802.11b: 11 802.11g: 11

5.3 Additional information

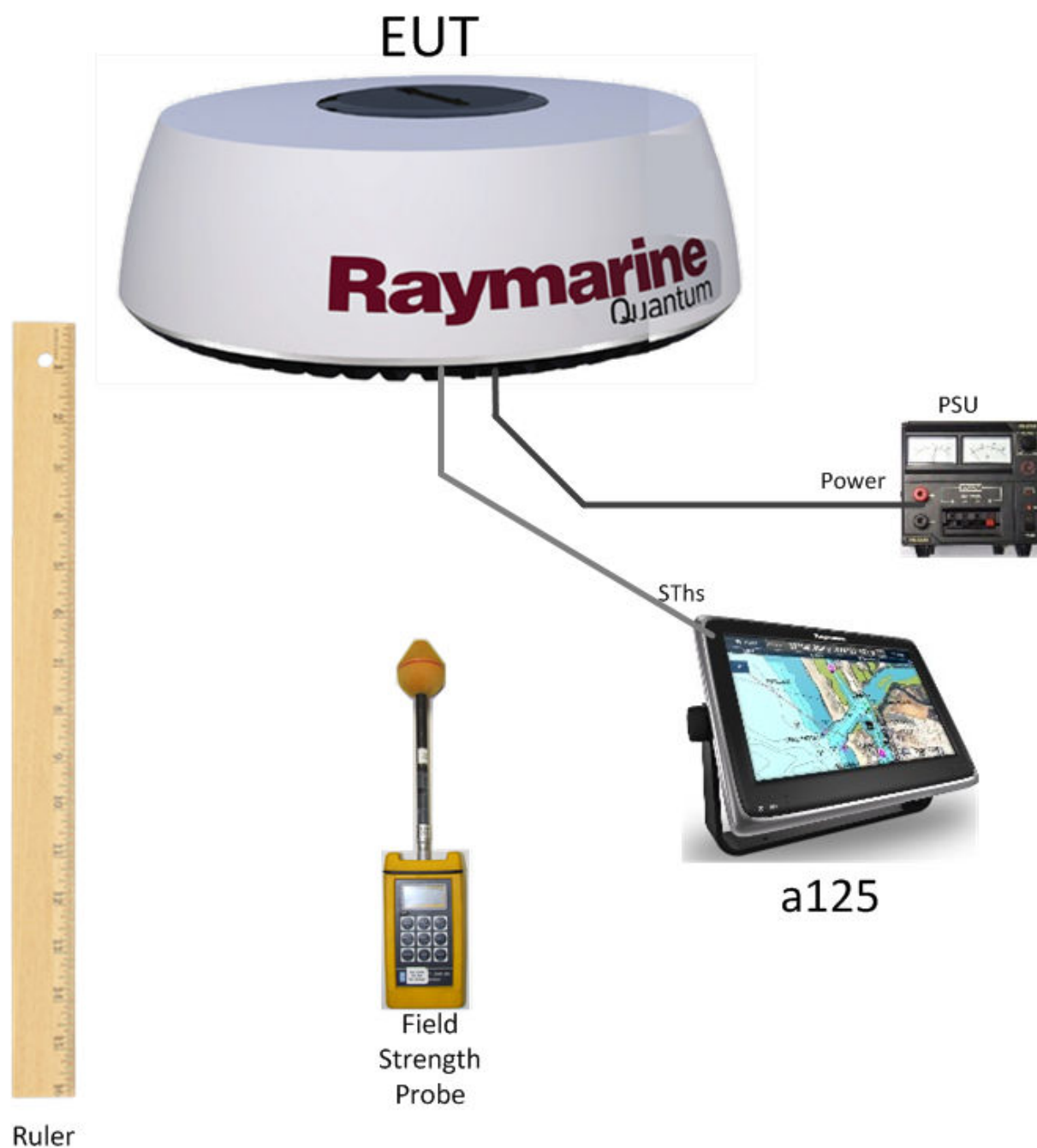
PSU board contains the Wi-Fi module TI (Texas Instruments) 3100. Wired extender board contains the Wi-Fi module Carambola.

5.4 Description of Auxiliary Equipment

Product Type	Part Number	Serial Number
Laptop	Compaq 6910p	CND83026CQ
a125	E70235	0640008

5.5 Test Configurations

5.5.1 9.4GHz Radar



Note: The Radar antenna and the Field Strength Probe were both at the same vertical height.

5.5.2 2.4GHz Wi-Fi (Single module)

The top rotating section was positioned to locate the PSU board Wi-Fi module antenna as far as possible from the Wired Extender board Wi-Fi module antenna. The probe tip was moved towards the PSU board Wi-Fi module antenna.

5.5.3 2.4GHz Wi-Fi (Simultaneous operation)

The top rotating section was positioned to locate the PSU board Wi-Fi module antenna as close as possible to the Wired Extender board Wi-Fi module antenna. The probe tip was inserted into the middle of the antennas.

5.5.4 Photos

5.5.4.1 RADHAZ measurement



5.6 Operating Modes

The EUT RADAR range was selected to give the maximum power density (W/m^2), which was set on the a125 MFD as the greatest range of 24nm.

The radar was set to transmit with rotation disabled.

The following two operating modes were selected depending on the area of test:

- 9.4GHz Radar & 2.4GHZ Wi-Fi (Simultaneous operation): Configured to transmit through the MFD. When the Radar is transmitting, both the Wi-Fi modules also transmit data.
- 2.4GHz Wi-Fi (Single Module): The Radar is set to standby. The Wired Extender is powered off. Only the PSU board Wi-Fi module Texas Instruments 3100 is transmitting through the use of a TI Radio Test Tool.

6 Test Results

6.1 RADHAZ Measurement

6.1.1 9.4GHz RADAR

Testing was focused on the 9.4GHz RADAR, with the maximum power found in the boresight of the antenna inside the 5° beamwidth.

Measured Fixed Antenna Equivalent Plane Wave Power Density	Distance ⁽¹⁾
230W/m ²	0.10m
100W/m ²	0.20m
10W/m ²	1.00m

Note (1): The distance measured is from the metallic centre front edge of the antenna to the centre of the field probe, given to the nearest centimetre. The centre of the front edge of the antenna is 10.5cm from the edge of the Raydome.

Under normal operation conditions the radar will be rotating and so the level will be reduced by a factor of $5/360 = 0.0139$.

The following table summarises the calculated rotational levels:

Calculated Rotational Antenna Equivalent Plane Wave Power Density	Distance ⁽¹⁾
3.20W/m ²	0.10m
1.39W/m ²	0.20m
0.139W/m ²	1.00m

Therefore the following statement can be made:

A time averaged power density level of 10 W/m² does not occur at any point outside of the raydome.

Comments: None.

Tested by: D. Jamieson

Test Date/s: 11th and 13th November 2015

Test Status: **Pass**

6.1.2 2.4GHz Wi-Fi (Single Module)

The PSU board Wi-Fi module (Ti3100) was set to the following:

Operation: Continuous

Type: 802.11b

Data Rate: 11Mbps

Channel: 1

Measured Fixed Antenna Equivalent Plane Wave Power Density	Distance ⁽¹⁾
2.7W/m ²	0.02m (Tip touching antenna)

With the probe tip touching the transmit antenna, a level of 10W/m² was not achieved even with the Wi-Fi transmitting at a much greater duty cycle than in normal operation.

Comments: None.

Tested by: D. Jamieson

Test Date/s: 12th November 2015

Test Status: For information only.

6.1.3 2.4GHz Wi-Fi (Simultaneous Operation)

With the probe tip inserted into the middle of the antennas, the power density did not increase above ambient (0.1W/m²).

Comments: None.

Tested by: D. Jamieson

Test Date/s: 12th November 2015

Test Status: For information only.

7 List of Test Equipment

Test Equipment Type	Manufacturer and Type Number	Serial Number	Cal No.	Cal Due
RADHAZ 10kHz to 18GHz Field Analyser	Wandel and Goltermann Handheld Unit: EMR-300 E-Field Probe: TYP-9.2	AF-0053 P-0007	1741 ⁽¹⁾	23/01/2018 ⁽²⁾
Power Supply Unit	Powerline LAB505	1603505X06	00467	Not Calibrated
Power Supply Unit	Palstar PS30M	G290775402	02021	Not Calibrated

Note (1): Item not Raymarine equipment. Item on loan from 'EMC Hire' and refers to their numbering scheme.

Note (2): NPL performed calibration on behalf of EMC Hire on a 5 year calibration cycle.

In accordance with UKAS requirements, all measuring equipment is on a calibration cycle.