




**Test Report for 4kW Digital Radome Radar**

**To EN 60945: 2002 - Maritime navigation & radiocommunication equipment & systems - General requirements - Methods of measurement & required test results**

**Section 12 Safety Precautions**

**Test Report Number: 698/1048**

Approved	Peter Bowen Compliance Manager		19/11/2008
Checked	Mike Thompson EMC Engineer		19/11/2008
Report	Andy Little Senior Compliance Engineer		19/11/2008
Report Date	19/11/2008	Test Date	10/11/2008

The test data and results contained within this report relate only to the items tested.

This report shall not be reproduced without the written approval of Raymarine Ltd.

Any reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95%. Any uncertainty evaluation has been carried out with reference to CISPR16-4:2002.

**1 Purpose of Tests**

To ascertain compliance with Section 12 of EN60945:2002. The two models (RD418D, RD424D) have an identical scanner core module; the only differences are the size of the antenna (18" or 24") and the enclosing radome. This report covers both models.

**2 Description of Equipment under Test (EUT)**

(To include all equipment being tested)

Date of Receipt:	23-9-2008
Client:	Navigation Systems
Brand Name:	Raymarine
Product Range:	Radar Scanners
Country of Manufacture:	Hungary
Operational voltage range:	12/24V nominal dc supplies.

**Unit 1**

Model Name or Number:	<b>RD424D</b>	<b>RD418D</b>
Unique Type Identification:	E92132	E92130
Serial Number:	EMC080925a	EMC080925b
Circuit Diagram Number(s) & Issue:	4698-004E 4698-002D	
PCB Assembly Number(s) & Issue:	4698-001D 4698-003D	
Software Version:	1.00 (IF) 21.02 (MOD/PSU)	
Modifications to Unit:	Mod/PSU pcb: C125,C126 changed to 10uF. C154, C155, C156 changed to No Fit. See Report 698/1032.	
Other Information:	A 10m combined power/Ethernet cable was used. This test is also valid for E92129 (RD418D with 10m cable) and E92131 (RD424D with 10m cable).	

**Unit 2**

Model Name or Number:	<b>18 inch antenna</b>
Serial Number:	EMC081119a
Modifications to Unit:	None

**Unit 3**

Model Name or Number:	<b>24 inch Antenna</b>
Serial Number:	EMC081119b
Modifications to Unit:	None

Other Information:	
--------------------	--

### 3 Description of Auxiliary Equipment

(To include all equipment associated with the EUT(s) which are NOT directly subjected to the test)

Item	Unique Type Identification & Serial Number
E120	Part Number E02013 S/No. EMC070122A
Seatalk <sup>HS</sup> Switch	Part Number E55058 S/No. EMC0811049

### 4 Protection against accidental access to dangerous voltages

#### EN60945 Section 12.1

The 4kW Digital Radome Radar is intended for outside installation and therefore meets stringent requirements for waterproofing under various climatic conditions. There are therefore no openings large enough to accept the probe specified in Section 12.1. Access to the interior of the equipment requires the use of a screwdriver. Warning labels, where appropriate, are displayed on the external cover (radome), within the equipment and on protective covers, and within the User Handbook and Service Manual.

### 5 Electromagnetic Radiofrequency Radiation

#### EN60945 Section 12.2

All Raymarine Leisure Marine Radar Owner's Handbooks and service Manuals include the following Safety statement:

#### Radio Frequency Radiation Hazard

The radar antenna emits electromagnetic radio frequency (RF) energy which can be harmful particularly to your eyes.

DO NOT look at the antenna at close range.

It is important that the radar is turned off whenever personnel are required to come close to the scanner assembly or associated equipment. It is recommended that the radar scanner is mounted out of range of personnel (above head height).

Distances from the face of the radar at which RF radiation levels of 100 W/m<sup>2</sup> and 10 W/m<sup>2</sup> exist are given below

Model	Distance to 100 W/m <sup>2</sup> point	Distance to 10 W/m <sup>2</sup> point
RD418D	Nil	Worst case 1.0m
RD424D	Nil	Worst case 1.0 M

When properly installed and operated, the use of this radar will conform to the requirements of:

- IEEE C95.1 - 2005 - Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300GHz.

- ICNIRP Guidelines 1998 - International Commission on Non-Ionising Radiation Protection: Guidelines for limiting exposure to time-varying electric, magnetic and electro-magnetic fields (up to 300GHz) 1998.

IEEE C95.1-2005 Table 9 (page 25) gives recommendations for maximum permissible exposure for uncontrolled environments. At 9.4GHz, the maximum is 10W/sq.m, averaged over approximately 16 minutes.

ICNIRP Guidelines 1998 Table 7 (page 18) similarly gives recommendations for maximum permissible exposure for uncontrolled environments. At 9.4GHz, the maximum is also 10W/sq.cm, averaged over 6 minutes.

The radar is fitted with software and hardware interlocks to prevent the radar transmitting with the antenna stationary, either due to software fault or a deliberate act by the operator. To transmit with the antenna stopped a hardware modification is required to the modulator PCB and special control software is required that is not available to the user.

When operating normally, rotation of the antenna reduces the effective power density (time averaged) by approximately 19dB, therefore with the antenna stationary the levels of 100W/m<sup>2</sup> and 10W/m<sup>2</sup> equate to 7943 W/m<sup>2</sup> and 794 W/m<sup>2</sup>.

The power density measurement was made with the antenna stationary and the probe scanned to obtain the minimum distances for 7943 W/m<sup>2</sup> and 794 W/m<sup>2</sup>.

The equivalent 7943 W/m<sup>2</sup> and 794 W/m<sup>2</sup> were not achieved, the maximum levels measured on the 18 and 24 inch units with the antenna stationary are shown in the following table:

Antenna	Maximum measured level (antenna Stationary)	Required test level (antenna Stationary)	Corrected measured level (antenna rotating)	Measurement point
18"	86 W/m <sup>2</sup>	794 W/m <sup>2</sup>	1.1 W/m <sup>2</sup>	Face of radome
24"	67 W/m <sup>2</sup>	794 W/m <sup>2</sup>	0.8 W/m <sup>2</sup>	Face of radome

Thus, for both U.S. and International recommendations, the power density produced in normal operation by the 4kW Digital Radome Radar, fitted with either a 18 inch or 24 inch antenna is substantially less than the maximum advised limits.

## 6 Emission from Visual Display Unit

### EN60945 Section 12.3

The 12kW SHD Digital Open Array Radar Scanner is a Radar Transceiver with no intrinsic display unit. This section therefore is not applicable.

## 7 X-Radiation

### EN60945 Para 12.4

There are extremely low levels of X-radiation emitted from magnetrons. The manufacturers of the magnetrons used in the 4kW Digital Radome Radar advise that these levels only present a safety risk when the operating voltage exceeds 10kV. The design is such that the maximum voltage applied to the magnetron cannot exceed 6kV.

## 8 Conclusion

The Raymarine 4kW Digital Radome Radar complies with the applicable requirements of Section 12 of the standard referenced on page 1 of this report.

## 9 List of Test Equipment

Test Equipment Type	Manufacturer and Type Number	Serial Number	Cal Due Date
Semi-Anechoic Chamber, Site 3	Global EMC	GE002	N/A
Electromagnetic Monitor	Narda 8716	12098	7/12/2008
Isotropic Probe	Narda 8721	13034	11/12/2008
Power Supply Unit	Palstar PS30M	92534722	N/A

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