
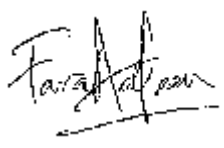



TEST REPORT FROM RFI GLOBAL SERVICES LTD

Partial Test of: Raymarine Ltd.
S100 Controller.

To: FCC Part 15.247

Test Report Serial No:
RFI/MPTE2/RP46813JD10B
Supersedes Test Report Serial No:
RFI/MPTE1/RP46813JD10B

<p>This Test Report Is Issued Under The Authority Of Andrew Brown, Operations Manager:</p> <div style="text-align: center; margin-top: 20px;">  pp </div>	
<p>Tested By: Fara Razally</p> <div style="text-align: center; margin-top: 10px;">  </div>	<p>Checked By: Nigel Davison</p> <div style="text-align: center; margin-top: 10px;">  </div>
<p>Report Copy No: PDF001</p>	
<p>Issue Date: 26 January 2005</p>	<p>Test Dates: 05 January 2005</p>

This report is issued in Adobe Acrobat portable document format (PDF). It is only a valid copy of the report if it is being viewed in PDF format with the following security options not allowed: Changing the document, Selecting text and graphics, Adding or changing notes and form fields. Furthermore, the date of creation must match the issue date stated above.

This report may be copied in full. The results in this report apply only to the sample(s) tested.

RFI Global Services Ltd

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire RG23 8BG

Telephone: +44 (0)1256 312000 Facsimile: +44 (0)1256 312001

Email: info@rfi-global.com Website: www.rfi-global.com

Registered in England and Wales. Company number:2117901

RFI GLOBAL SERVICES LTD

TEST REPORT
S.No. RFI/MPTE2/RP46813JD10B
Page 2 of 26
Issue Date: 26 January 2005

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

This page has been left intentionally blank.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

Table of Contents

1. Client Information 4
2. Equipment Under Test (EUT) 5
3. Test Results 8
4. Deviations from the Test Specification 9
5. Operation of the EUT During Testing 10
6. Summary of Test Results 11
7. Measurements, Examinations and Derived Results 12
8. Measurement Uncertainty 21
9. Measurement Methods 22
Appendix 1. Test Equipment Used 26

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

1. Client Information

Company Name:	Raymarine Ltd
Address:	Robinson Way Anchorage Park Portsmouth Hampshire PO3 5TD United Kingdom
Contact Name:	Mr Christopher Bird

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

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:	Raymarine
Model Name or Number:	S100 Controller
Unique Type Identification:	A18104
Serial Number:	D1
FCC ID Number:	PJ5S100
Country of Manufacture:	UK
Date of Receipt:	04 January 2005

2.2. Description of EUT

The equipment under test is a Handheld controller to be used with the S1000 Autopilot or the Base Station. Its function is to control the S1000 and existing wired Autopilots.

2.3. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

Test of: Raymarine Ltd.
 S100 Controller.
 To: FCC Part 15.247

2.4. Additional Information Related to Testing

Power Supply Requirement:	Internal battery supplied of 3.0 V DC Alkaline Battery		
Intended Operating Environment:	Maritime		
Equipment Category:	Short Range (Low Power)		
Type of Unit:	Mobile (Vehicular Use, powered via vehicle regulated supply) Maritime		
Interface Ports:	Enclosure Antenna		
Transmit Frequency Range:	2405 MHz to 2480 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	2405
	Middle	7	2440
	Top	15	2480
Receive Frequency Range:	2405 MHz to 2480 MHz		
Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	2405
	Middle	7	2440
	Top	15	2480
Maximum Power Output (EIRP)	1.2 dBm		

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

2.5. Support Equipment

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

Description:	Laptop
Brand Name:	Toshiba
Model Name or Number:	PA5401EA
Serial Number:	19018855
Cable Length and Type:	RS232, 1 meter
Connected to Port:	Communication

Description:	Communication Interface Board
Brand Name:	None Stated
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length and Type:	9 Pin Circular to RS232
Connected to Port:	Communication

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

3. Test Results

Reference:	FCC Part 15 Subpart C: 2003 (Section 15.247)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

3.1. Methods and Procedures

The methods and procedures used were as detailed in:

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.

DA00-705 (2000)

Title: Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

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: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

4. Deviations from the Test Specification

No emissions testing were performed at the request of the client.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

5. Operation of the EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by an Internal battery supply of 3.0 V DC Alkaline Battery.

5.2. Operating Modes

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

The EUT was transmitting continuously with modulation, Pseudo random data. Final measurements were performed on bottom, middle and top channel.

5.3. Configuration and Peripherals

The EUT was tested in the following configuration:

EUT was connected to the laptop PC via a 9 Pin circular connector interface, which is hard wired to the EUT.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Compliance Status
Transmitter Minimum 6 dB Bandwidth	C.F.R. 47 FCC Part 15: 2003 Section 15.247(a)(2)	Antenna Terminals	Complied
Transmitter 20 dB Bandwidth*	C.F.R. 47 FCC Part 2: 2003 Section 2.1049	Antenna Terminals	Complied
Transmitter Peak Power Spectral Density	C.F.R. 47 FCC Part 15: 2003 Section 15.247(e)	Antenna Terminals	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2003 Section 15.247(b)(3)	Antenna Terminals	Complied

**Industry Canada Requirement.*

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

7. Measurements, Examinations and Derived Results

7.1. General Comments

7.1.1. This section contains test results only.

7.1.2. 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: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

7.2. Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2)

7.2.1. The EUT was configured as for transmitter minimum bandwidth measurements as described in Section 9 of this report.

7.2.2. Tests were performed to identify the 6 dB bandwidth of the fundamental signal.

Results:

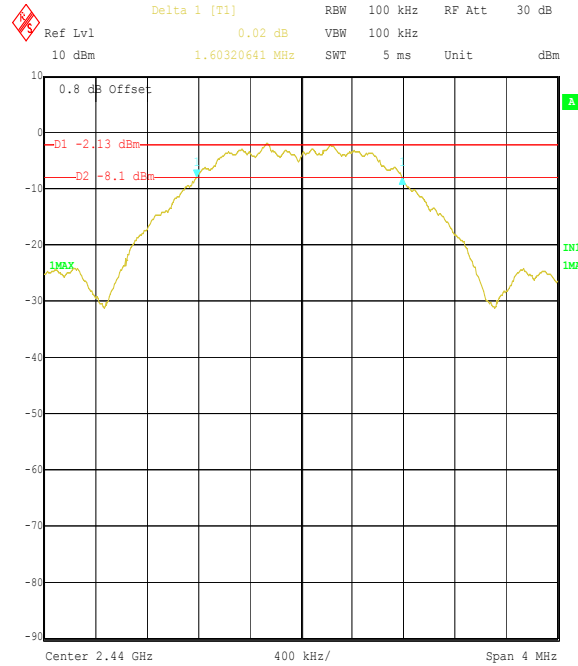
Channel	Transmitter 6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
Bottom	1.603	≥ 0.5	1.103	Complied
Middle	1.603	≥ 0.5	1.103	Complied
Top	1.595	≥ 0.5	1.095	Complied

Test of: Raymarine Ltd.
 S100 Controller.
 To: FCC Part 15.247

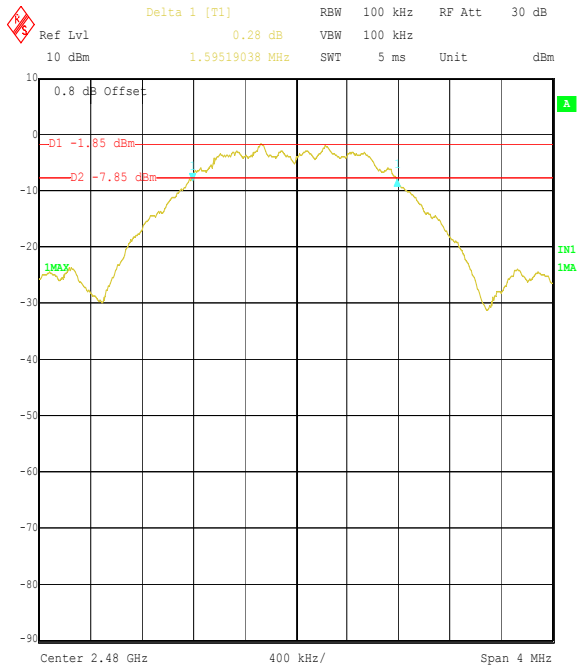
Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2) (Continued)



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 6 dB Bandwidth Bottom Channel
 Date: 4.JAN.2005 14:16:31



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 6 dB Bandwidth Middle Channel
 Date: 4.JAN.2005 14:14:43



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 6 dB Bandwidth Top Channel
 Date: 4.JAN.2005 14:18:57

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

7.3.Transmitter 20 dB Bandwidth: Section 2.1049

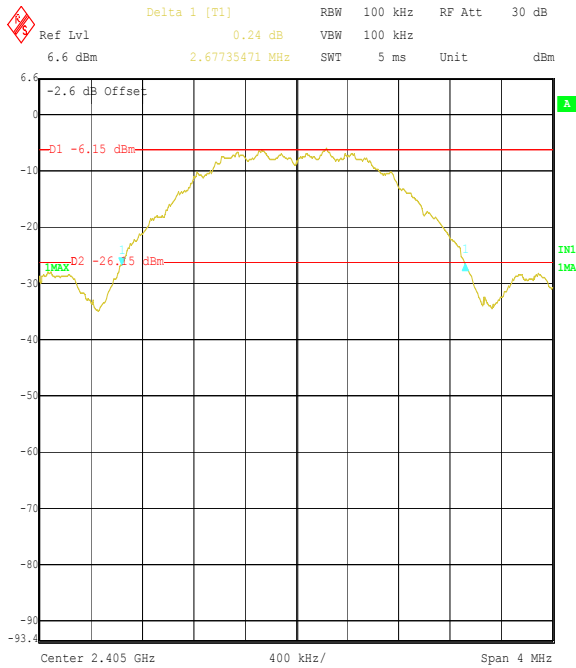
7.3.1. The EUT was configured as for 20 dB bandwidth measurements as described in Section 9 of this report.

7.3.2. Tests were performed to identify the 20 dB bandwidth.

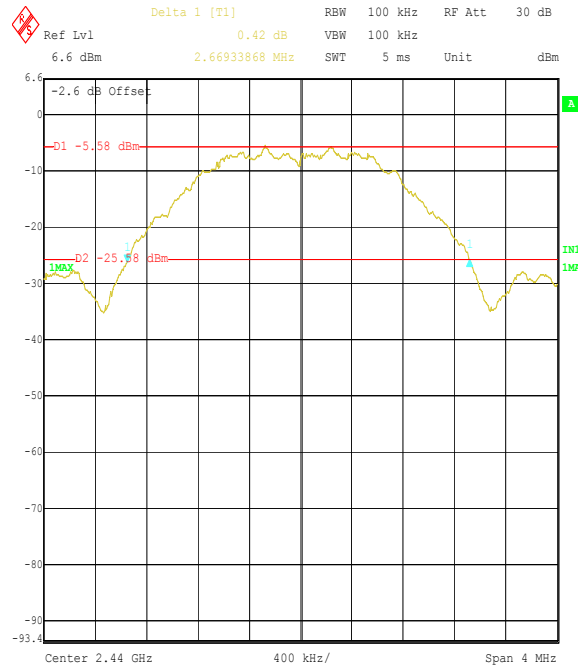
Channel	Transmitter 20 dB Bandwidth (kHz)
Bottom	2677.35471
Middle	2669.33868
Top	2478.65731

Test of: Raymarine Ltd.
 S100 Controller.
 To: FCC Part 15.247

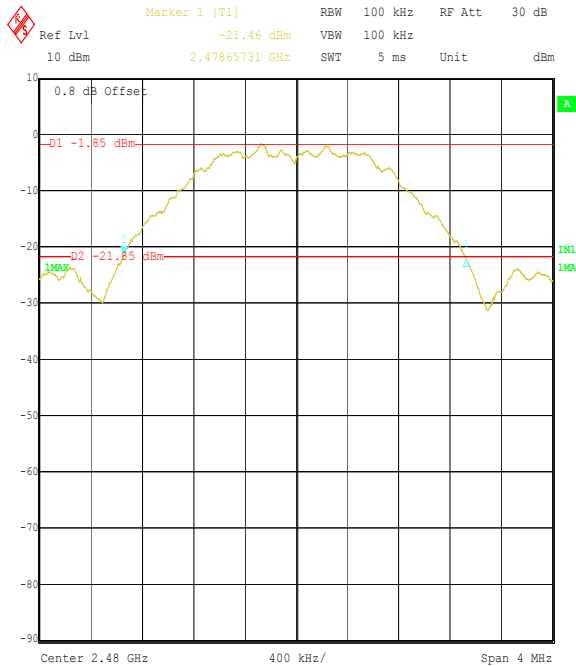
Transmitter 20 dB Bandwidth: Section 2.1049 (Continued)



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 20 dB Bandwidth Bottom Channel
 Date: 4.JAN.2005 14:26:18



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 20 dB Bandwidth Middle Channel
 Date: 4.JAN.2005 14:24:02



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
 Comment A: 20 dB Bandwidth Top Channel
 Date: 4.JAN.2005 14:21:45

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

7.4.Transmitter Peak Power Spectral Density: Section 15.247(e)

7.4.1. The EUT was configured as for transmitter peak power spectral density measurements as described in Section 9 of this report.

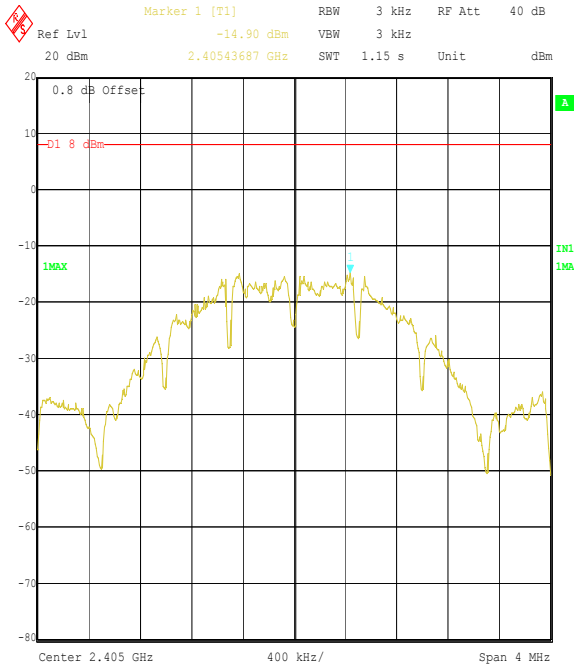
7.4.2. Tests were performed to identify the maximum peak power spectral density of the Fundamental.

Results:

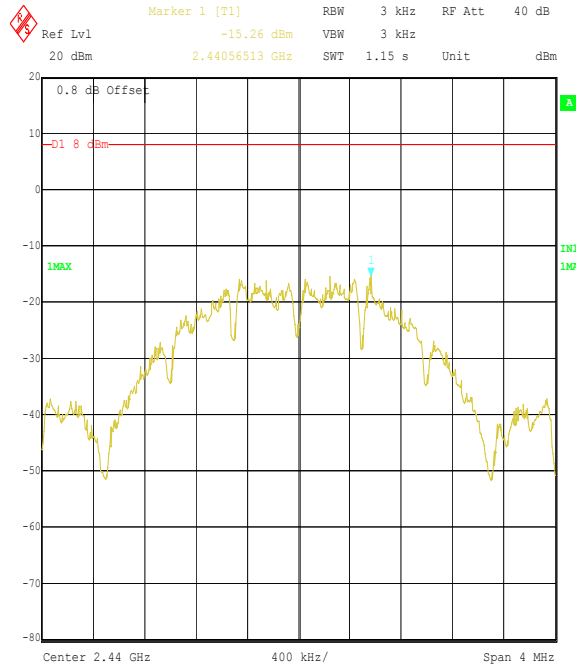
Channel	Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-14.9	8	22.9	Complied
Middle	-15.3	8	23.3	Complied
Top	-14.6	8	22.6	Complied

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

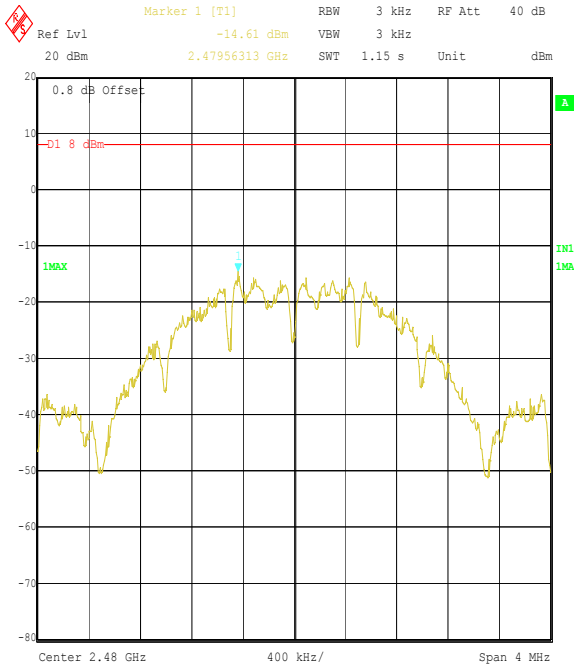
Transmitter Peak Power Spectral Density: Section 15.247(d) (Continued)



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Power Spectral Density Bottom Channel
Date: 4.JAN.2005 14:33:08



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Power Spectral Density Middle Channel
Date: 4.JAN.2005 14:34:23



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Power Spectral Density Top Channel
Date: 4.JAN.2005 14:35:21

Test of: Raymarine Ltd.
 S100 Controller.
 To: FCC Part 15.247

7.5. Transmitter Maximum Peak Output Power: Section 15.247(b)(3)

7.5.1. The EUT was configured as for transmitter peak output power measurements as described in Section 9 of this report.

7.5.2. Tests were performed to identify the transmitter maximum peak output power (EIRP) of the EUT.

7.5.3. The effective isotropic radiated power (EIRP) was calculated by adding the manufacturer's declared antenna gain to the figure measured for conducted RF output power.

Results:

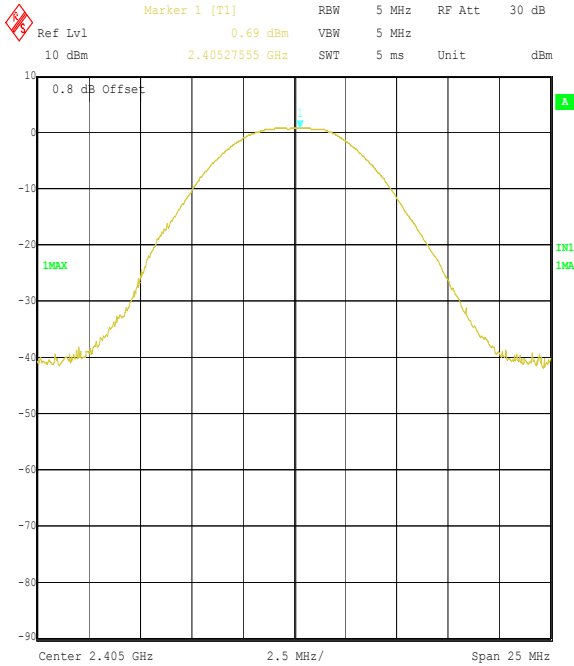
Battery Powered Devices

Channel	Conducted RF O/P Power (dBm)	Stated Antenna Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	0.7	0.0	0.7	30.0	29.3	Complied
Middle	0.8	0.0	0.8	30.0	29.2	Complied
Top	1.2	0.0	1.2	30.0	28.8	Complied

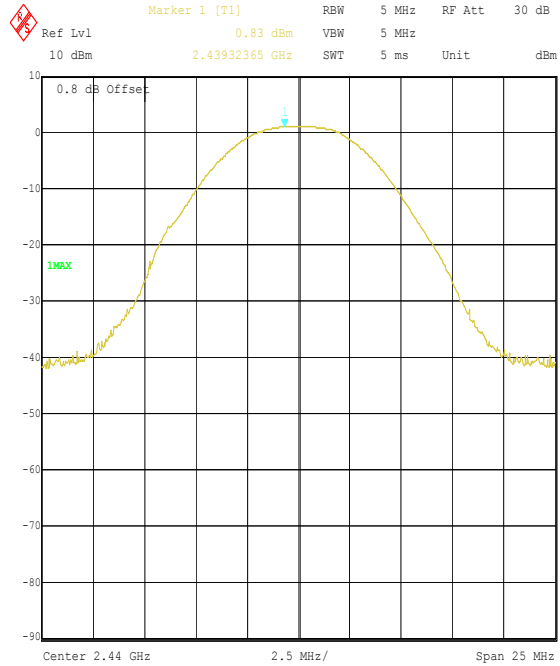
NOTE: As per the requirements of Public Notice DA 00-705, the stated antenna gain of the EUT is 0.0 dBi which, when added to the highest (worst case) measured conducted peak output power of 1.2 dBm (from the table above) gives a de facto EIRP of 1.2 dBm. This is in compliance with the requirements of Section 15.247(b)(3) for de facto EIRP limitation i.e. 1 Watt (30 dBm).

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

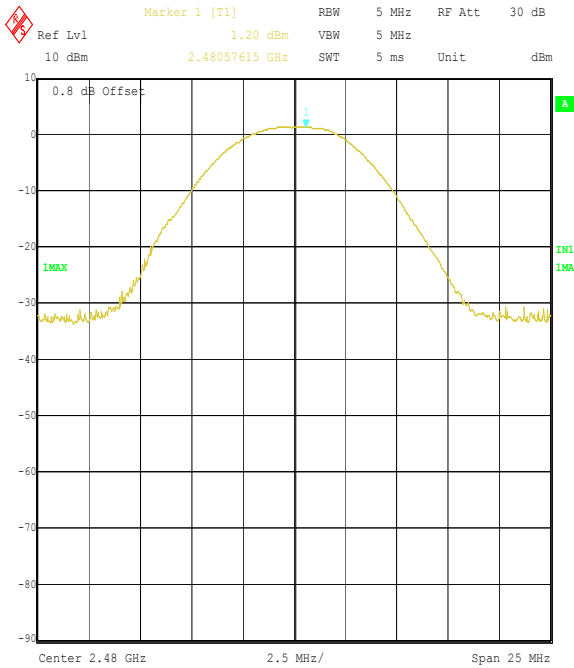
Transmitter Maximum Peak Output Power: Section 15.247(b)(3) (Continued)



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Output Power Bottom Channel
Date: 4.JAN.2005 14:38:51



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Output Power Middle Channel
Date: 4.JAN.2005 14:37:53



Title: Raymarine 46813JD10 EUT S100 Controller FCC P15.247
Comment A: Peak Output Power Top Channel
Date: 4.JAN.2005 14:37:01

Test of: Raymarine Ltd.
 S100 Controller.
 To: FCC Part 15.247

8. Measurement Uncertainty

8.1. 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.

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

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

8.4. 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
Transmitter Maximum Peak Output Power	Not applicable	95%	+/- 0.46 dB
Spectral Power Density	Not applicable	95%	+/- 1.2 dB
6 dB/20 dB Bandwidth	Not applicable	95%	+/- 0.12 %

8.5. 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: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

9. Measurement Methods

9.1. Minimum 6 dB Bandwidth

The EUT and spectrum analyser were configured as for conducted antenna port emissions measurements.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequencies. For each frequency the calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the losses in the measurement set up.

To determine the 6 dB bandwidth, a resolution bandwidth of 100 kHz was used, which is approximates to 1% of the 6 dB bandwidth. A video bandwidth of 300 kHz was used. The analyser was set to a span of greater than twice the 6 dB bandwidth and for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference established 6 dB below the peak level. The bandwidth was determined at the points where the 6 dB reference crossed the profile of the emission.

The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function via a suitable RF attenuator and cable calibrated for the required frequency range. The calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the losses in the measurement set up.

The 6 dB Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 75% (6 dB) of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e. RBW \geq 1% of occupied bandwidth. A value of 100 kHz was used.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

9.2. Transmitter 20 dB Bandwidth

The EUT and spectrum analyser was configured as for transmitter radiated emissions measurements.

To determine the occupied bandwidth, a resolution bandwidth of 100 kHz was used, which is greater than 1% of the 20 dB bandwidth. A video bandwidth of a least the same value was used. The analyser was set for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference line was drawn 20 dB below the peak level. The bandwidth was determined at the points where the 20 dB reference crossed the profile of the emission.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

9.3. Spectral Power Density

The EUT and spectrum analyser were configured as for conducted antenna port emissions measurements.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequencies. For each frequency the calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the losses in the measurement set up.

Prior to the measurement being taken the spectrum analyser was tuned to the fundamental frequency of the EUT.

A resolution bandwidth of 3 kHz was selected and the analyser was set to a span of greater than twice the 6 dB bandwidth. The trace was max held and a reading was taken at the peak point of the trace.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

9.4. Peak Output Power

The EUT and spectrum analyser were configured as for conducted antenna port measurements and as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequencies. For each frequency to be measured, the calibrated level of the attenuator and cable were entered as an offset into a spectrum analyser to compensate for the measurement set up.

To determine the transmitter output power, the EUT was operated at maximum power and a result was obtained from the spectrum analyser using the channel power function set up according the defined bandwidth and channel spacing of the EUT.

Test of: Raymarine Ltd.
S100 Controller.
To: FCC Part 15.247

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
M058	Multimeter	Fluke	79	54940691
M1124	ESIB26	Rohde & Schwarz	ESIB26	100046K
M1132	Thermo Hygro	RS	212-124	05A03
S011	D.C. PSU	INSTEK	PR-3010H	9401270

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