
REPORT ON

Limited FCC Part 80 testing in support of the Application for Grant of Equipment
Authorisation of the Raymarine RAY240 VHF Marine Radio

COMMERCIAL-IN-CONFIDENCE

FCC ID: PJ5RAY240

Report No RM612205/04 Issue 1

June 2004



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Grant of Equipment Authorisation of the Raymarine RAY240 VHF
Marine Radio


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PREPARED FOR Raymarine Ltd.
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DATED 3rd June 2004

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BABT Copy 2
Copy No 1

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC Part 80. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer:

Andy Blagg
Radio Engineer





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SECTION 1

REPORT SUMMARY

Limited FCC Part 80 testing in support of the Application for Grant of Equipment
Authorisation of the Raymarine RAY240 VHF Marine Radio

**1.1 STATUS**

EQUIPMENT UNDER TEST	VHF Marine Radio
OBJECTIVE	To undertake measurements to determine the Equipment Under Test's (EUT's) compliance with the specification.
NAME AND ADDRESS OF CLIENT	Raymarine Ltd. Robinson Way Anchorage Park Portsmouth PO3 5TD
TYPE NUMBER	RAY240
SERIAL NUMBER	E420010540050
TEST SPECIFICATION / ISSUE / DATE	FCC Part 80
NUMBER OF ITEMS TESTED	One
SECURITY CLASSIFICATION OF EUT	Commercial In Confidence
DISPOSAL	Held pending disposal
REFERENCE NUMBER	Not Applicable
DATE	Not Applicable
ORDER NUMBER	N029170
DATE	15 th January 2004
START OF TEST	6 th May 2004
FINISH OF TEST	25 th May 2004
RELATED DOCUMENTS	ANSI C63.4 2001. Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. FCC Public Notice document (DA 00-705 released 30 March 2000)



1.2 INTRODUCTION

The information contained within this report is intended to show verification of compliance of the Raymarine RAY240 VHF Marine Radio to the requirements of limited parts of FCC Specification Part 80.

Testing was carried out in support of an application for Grant of Equipment Authorisation in the name of Raymarine Inc.

1.3 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out is shown below.

Test	Spec Clause	Test Description	Result	Comments
2.1	2.1049/80.205	Bandwidths	Pass	-
2.1.5	80.207	Class of Emission	N/A	Detailed on page 9
2.2	2.1055/80.209	Transmitter Frequency Tolerance	Pass	-
2.3	2.1047/80.213	Modulation Requirements	Pass	-
2.4	2.1047a	Modulation Characteristics	Pass	-
2.5	2.1046/80.215	Transmitter Power	Pass	-
2.6	80.217	Suppression of Interference Aboard Ships	Pass	-
2.7	1.1307(b)/80.227	MPE	Pass	-
-	2.1051/80.211	Emission Limitations (Conducted)	N/A	Manufacturer to perform
-	2.1053/80.211	Emission Limitations (Radiated)	N/A	Manufacturer to perform
-	80.225	Requirements for Selective Calling Equipment	N/A	Manufacturer's Declaration
-	80.203(b)(c)(n)	Authorisation of Transmitters for Licensing	N/A	Manufacturer's Declaration



1.4 OPINIONS AND INTERPRETATIONS

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



1.5 PRODUCT INFORMATION

1.5.1 Technical Description

The Raymarine RAY240 operates from a 13.6 Volt DC Supply, operating with a maximum output power of 25 Watts.

1.5.2 Modes of Operation

Applicable testing was carried out with the EUT transmitting at maximum power unless stated otherwise.

1.6 TEST CONDITIONS

The EUT was set-up simulating a typical user installation in the laboratory, and tested in accordance with the applicable specification.

For all tests, the EUT was powered by a 13.6V DC supply.

1.7 DEVIATIONS FROM THE STANDARD

Not Applicable

1.8 MODIFICATION RECORD

Not Applicable



SECTION 2

TEST DETAILS

Limited FCC Part 80 testing in support of the Application for Grant of Equipment
Authorisation of the Raymarine RAY240 VHF Marine Radio



2.1 BANDWIDTHS

2.1.1 FCC Part 80, Section 2.1049(c)(1)/80.205

2.1.2 Equipment Under Test
RAY240

2.1.3 Date of Test
6th May 2004

2.1.4 Test Equipment Used (See Section 3.1 for details)
1, 2, 3, 4, 7

2.1.5 Test Procedure

The EUT is declared as having a class of emission:- G3E, which dictates an emission designator of 16K0G3E, which from 80.205(a) equates to an authorised bandwidth of 20kHz.

Initially, the EUT was connected via a 30dB Attenuator to a Modulation Analyser, which was set to measure deviation. From the results in 80.213, the audio frequency for a set input level, which produces the highest level of deviation, was 2.5kHz. Thus, the Audio Analyser was set to supply the EUT with an audio tone of 2.5kHz at an amplitude which produced a deviation corresponding to 50% of the maximum permissible frequency deviation, (2.5kHz). The level was then increased on the Audio Analyser by 16dB. For the DSC channel, a dotting pattern was used for modulation.

The Modulation Analyser was then replaced with a Spectrum Analyser and the 99% Bandwidth was measured. The measurements were performed on channel 70 (DSC), bottom and top channels on both maximum and minimum power levels.

2.1.6 Test Results

Channel Number/Frequency	Power Level nominal (W)	Result (kHz)	Authorised Bandwidth (kHz)
60 / 156.025MHz	25	10.7597	20
60 / 156.025MHz	1	12.5026	20
88 / 157.425MHz	25	12.5764	20
88 / 157.425MHz	1	12.7587	20
70 / 156.525MHz	25	12.1060	20
70 / 156.525MHz	1	11.8475	20

The test result plots are shown in the following pages.



2.1 BANDWIDTHS - Continued

Agilent 13:14:15 6 May 2004

<p>Ch Freq 156.025 MHz Trig Free</p> <p>Occupied Bandwidth</p>		<p>Measure</p>
		<p>Meas Off</p>
<p>Ref 50 dBm #Atten 30 dB</p> <p>Center 156 MHz Span 30 kHz</p> <p>#Res BW 300 Hz #VBW 3 kHz Sweep 1.344 s (401 pts)</p>		<p>Channel Power</p>
<p>Occupied Bandwidth 10.7597 kHz</p> <p>Occ BW % Pwr 99.00 %</p> <p>x dB -26.00 dB</p>		<p>Occupied BW</p>
<p>Transmit Freq Error -482.614 Hz</p> <p>x dB Bandwidth 15.697 kHz</p>		<p>ACP</p>
<p>A:\OBCH6001.GIF file saved</p>		<p>Multi Carrier Power</p>
		<p>Power Stat CCDF</p>
		<p>More 1 of 2</p>

99% Bandwidth – Channel 60 - 25W



2.1 BANDWIDTHS – Continued

Agilent 13:19:20 6 May 2004

Ch Freq 157.425 MHz	Trig Free								
Occupied Bandwidth									
Ref 50 dBm #Atten 30 dB #Peak Log 10 dB/ Offst 30.3 dB									
Center 157.4 MHz Span 30 kHz Res BW 300 Hz #VBW 1 kHz Sweep 1.344 s (401 pts)									
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Occupied Bandwidth</td> <td style="width: 50%;">Occ BW % Pwr 99.00 %</td> </tr> <tr> <td style="text-align: center;">12.5764 kHz</td> <td style="text-align: center;">x dB -26.00 dB</td> </tr> <tr> <td>Transmit Freq Error -1.377 kHz</td> <td></td> </tr> <tr> <td>x dB Bandwidth 15.542 kHz</td> <td></td> </tr> </table>		Occupied Bandwidth	Occ BW % Pwr 99.00 %	12.5764 kHz	x dB -26.00 dB	Transmit Freq Error -1.377 kHz		x dB Bandwidth 15.542 kHz	
Occupied Bandwidth	Occ BW % Pwr 99.00 %								
12.5764 kHz	x dB -26.00 dB								
Transmit Freq Error -1.377 kHz									
x dB Bandwidth 15.542 kHz									
A:\OBCH8801.GIF file saved									

Trace/View

Trace
1 2 3

Clear Write

Max Hold

Min Hold

View

Blank

More
1 of 2

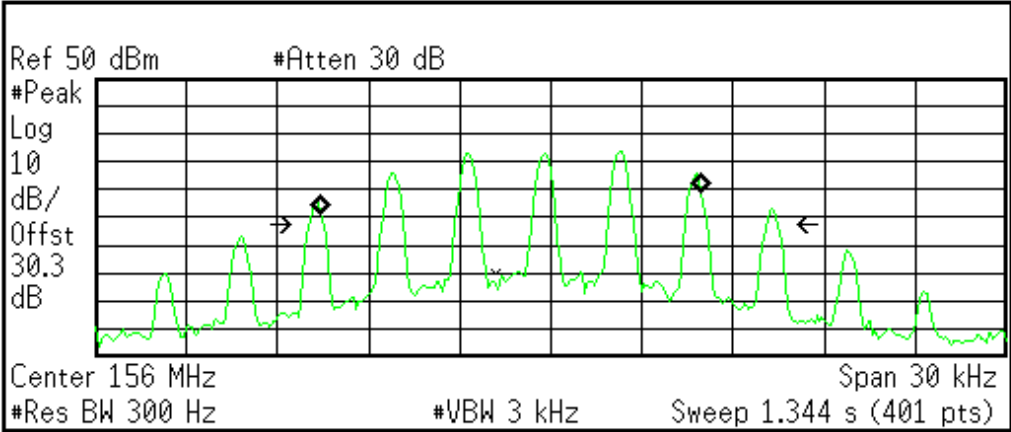
99% Bandwidth – Channel 88 - 25W



2.1 BANDWIDTHS – Continued

Agilent 13:12:48 6 May 2004

Ch Freq 156.025 MHz Trig Free
 Occupied Bandwidth



Occupied Bandwidth	Occ BW % Pwr	99.00 %
12.5026 kHz	x dB	-26.00 dB
Transmit Freq Error		-1.295 kHz
x dB Bandwidth		15.468 kHz

A:\SCREEN522.GIF file saved

- File
- Catalog>
- Save>
- Load>
- Delete>
- Copy>
- Rename>
- More
1 of 2

99% Bandwidth – Channel 60 - 1W



2.1 BANDWIDTHS – Continued

Agilent 13:17:09 6 May 2004

Ch Freq 157.425 MHz	Trig Free	Measure								
Occupied Bandwidth		Meas Off								
<div style="border: 1px solid black; padding: 5px;"> <p>Ref 50 dBm #Atten 30 dB</p> <p>#Peak</p> <p>Log</p> <p>10</p> <p>dB/</p> <p>Offst</p> <p>30.3</p> <p>dB</p> <p>Center 157.4 MHz Span 30 kHz</p> <p>Res BW 300 Hz #VBW 1 kHz Sweep 1.344 s (401 pts)</p> </div>		Channel Power								
		Occupied BW								
		ACP								
		Multi Carrier Power								
		Power Stat CCDF								
		More								
		1 of 2								
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Occupied Bandwidth</td> <td style="width: 50%;">Occ BW % Pwr 99.00 %</td> </tr> <tr> <td style="text-align: center;">12.7587 kHz</td> <td style="text-align: center;">x dB -26.00 dB</td> </tr> <tr> <td>Transmit Freq Error -1.155 kHz</td> <td></td> </tr> <tr> <td>x dB Bandwidth 15.532 kHz</td> <td></td> </tr> </table>			Occupied Bandwidth	Occ BW % Pwr 99.00 %	12.7587 kHz	x dB -26.00 dB	Transmit Freq Error -1.155 kHz		x dB Bandwidth 15.532 kHz	
Occupied Bandwidth	Occ BW % Pwr 99.00 %									
12.7587 kHz	x dB -26.00 dB									
Transmit Freq Error -1.155 kHz										
x dB Bandwidth 15.532 kHz										
<p style="color: green;">A:\OBCH6025.GIF file saved</p>										

99% Bandwidth – Channel 88 - 1W



2.1 BANDWIDTHS – Continued

Agilent 11:29:24 14 May 2004

Ch Freq 156.525 MHz		Trig Free	
Occupied Bandwidth			
Ref 41.83 dBm #Atten 20 dB #Peak Log 10 dB/ Offst 30.3 dB			
Center 156.5 MHz		Span 30 kHz	
#Res BW 300 Hz		#VBW 3 kHz Sweep 1.344 s (401 pts)	
Occupied Bandwidth		Occ BW % Pwr 99.00 %	
12.1060 kHz		x dB -26.00 dB	
Transmit Freq Error -303.683 Hz			
x dB Bandwidth 14.073 kHz			
A:\OBCH7001.GIF file saved			

Meas Setup	
Avg Number	10
On	Off
Avg Mode	Repeat
Exp	
Max Hold	Off
On	
Occ BW % Pwr	99.00 %
OBW Span	30.0000000 kHz
x dB	-26.00 dB
Optimize Ref Level	

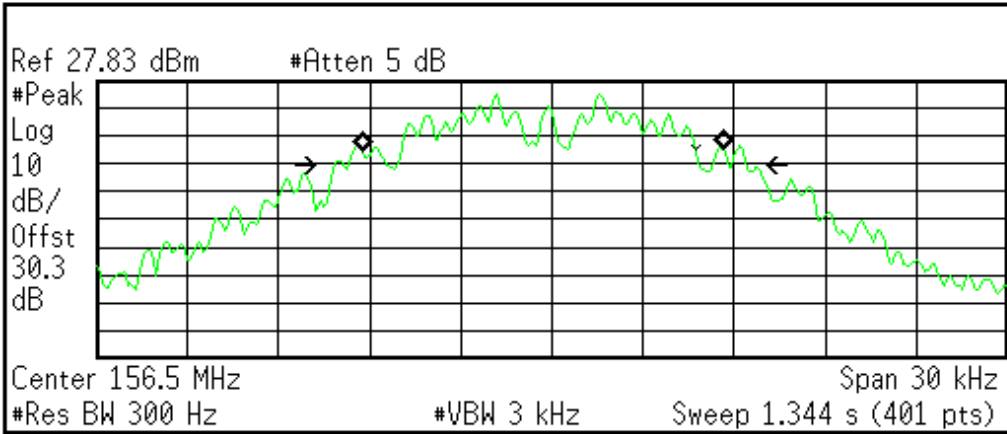
99% Bandwidth – Channel 70 - 25W – DSC



2.1 BANDWIDTHS - Continued

Agilent 11:43:42 14 May 2004

Ch Freq 156.525 MHz Trig Free
 Occupied Bandwidth



Occupied Bandwidth 11.8475 kHz
Occ BW % Pwr 99.00 %
x dB -26.00 dB
Transmit Freq Error -327.800 Hz
x dB Bandwidth 13.584 kHz

Meas Setup	
Avg Number	10
On	Off
Avg Mode	Repeat
Exp	
Max Hold	Off
On	
Occ BW % Pwr	99.00 %
OBW Span	30.0000000 kHz
x dB	-26.00 dB
Optimize Ref Level	

A:\SCREN544.GIF file saved

99% Bandwidth – Channel 70 - 1W – DSC



2.1 BANDWIDTHS - Continued

2.1.7 LIMITS

Limit	<20kHz
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Remarks

EUT complies with CFR 47 2.1049(c)(1) and 80.205(a) for G3E Class of Emission. The Authorised Bandwidth is less than 20kHz in all states of modulation.



2.2 TRANSMITTER FREQUENCY TOLERANCE

2.2.1 FCC Part 80, Section 2.1055/80.209

2.2.2 Equipment Under Test

RAY240

2.2.3 Date of Test

7th May 2004

2.2.4 Test Equipment Used (See Section 3.1 for details)

1, 2, 4, 5, 6

2.2.5 Test Procedure

The EUT was set to transmit on maximum power with no modulation. A Modulation Analyser was used to measure the Frequency Error. The results were recorded at each temperature and Voltage interval.

2.2.6 Test Results

Temperature Variation

Channel 60 – 156.025MHz

Temperature Interval(°C)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
- 20	156.050	-0.056	± 1.56
- 10	156.050	+0.007	± 1.56
0	156.050	+0.246	± 1.56
+ 10	156.050	+0.174	± 1.56
+ 20	156.050	-0.205	± 1.56
+ 30	156.050	-0.277	± 1.56
+ 40	156.050	-0.577	± 1.56
+ 50	156.050	-0.553	± 1.56

Channel 88 – 157.425MHz

Temperature Interval(°C)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
- 20	157.425	-0.080	± 1.57
- 10	157.425	+0.053	± 1.57
0	157.425	+0.267	± 1.57
+ 10	157.425	+0.130	± 1.57
+ 20	157.425	-0.196	± 1.57
+ 30	157.425	-0.344	± 1.57
+ 40	157.425	-0.612	± 1.57
+ 50	157.425	-0.564	± 1.57



2.2 TRANSMITTER FREQUENCY TOLERANCE - Continued

Voltage Variation

Channel 60 – 156.025MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	156.050	-0.230	± 1.56
13.60	156.050	-0.205	± 1.56
15.64	156.050	-0.192	± 1.56

Channel 88 – 157.425MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	157.425	-0.193	± 1.57
13.60	157.425	-0.196	± 1.57
15.64	157.425	-0.196	± 1.57

2.2.7 LIMITS

Limit	±1.56kHz or 10ppm
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Remarks

EUT complies with CFR 47 Part 80.209(a)(5)(ii). The EUT does not exceed ±1.56kHz at the measured frequency at any temperature interval across the measured range.

EUT complies with CFR 47 Part 80.209. The EUT does not exceed ±1.56kHz at the measured frequency either at nominal or voltage variation.



2.3 MODULATION REQUIREMENTS

2.3.1 FCC Part 80 Section 2.1047, 80.213

2.3.2 Equipment Under Test
RAY240

2.3.3 Date of Test

2.3.4 Test Equipment Used (See Section 3.1 for details)
1, 2, 3, 4, 5, 6, 8, 9, 10

2.3.5 Test Procedure

The carrier of the EUT is Frequency Modulated, (FM), when used for speech. The EUT utilises an audio low pass filter to limit the deviation.

The carrier of the EUT is Frequency Modulated, (FM), when in its DSC mode.

Clause 80.213(b)

The EUT was connected to a Modulation Analyser via a 30dB attenuator. An audio signal of varying frequency and amplitude was applied to the EUT microphone input using an Audio Analyser. To demonstrate compliance with the test limits, the test was conducted in two parts. The first to demonstrate a variety of input levels over a set frequency range and the second to demonstrate the limiting effect on the deviation when large signal levels are applied to its input.

2.3.6 Test Results

Channel 60 – Deviation vs Input Voltage/Frequency – 25W

The input voltage and frequency were varied across the range shown in the table below. This demonstrates the point at which the deviation limits for a given input voltage and frequency.

Audio Input Level To EUT (mV)	Peak Frequency Deviation (kHz)					Maximum Deviation Limit (kHz)
	100Hz	500Hz	1000Hz	3000Hz	5000Hz	
-	100Hz	500Hz	1000Hz	3000Hz	5000Hz	-
1	0.157	0.233	0.539	0.921	0.778	5.0
2	0.185	0.339	0.744	1.683	1.738	5.0
4	0.212	0.588	1.282	3.131	1.761	5.0
6	0.192	0.816	1.947	3.637	1.859	5.0
8	0.220	1.033	2.462	3.725	1.925	5.0
10	0.238	1.269	2.726	3.765	1.746	5.0
12	0.259	1.516	3.285	3.753	1.795	5.0
14	0.276	1.783	3.76	3.86	1.752	5.0
16	0.299	2.005	3.98	3.90	1.821	5.0
18	0.366	2.257	4.12	3.85	1.793	5.0
20	0.328	2.484	4.29	3.78	1.767	5.0
25	0.380	2.985	4.54	3.87	1.784	5.0
30	0.462	3.566	4.55	3.92	1.772	5.0
35	0.474	3.83	4.55	3.83	1.808	5.0
40	0.558	3.88	4.47	3.95	1.836	5.0
50	0.641	3.94	4.32	3.93	1.913	5.0



2.3 MODULATION REQUIREMENTS-Continued

Channel 88 – Deviation vs Input Voltage/Frequency – 25W

The input voltage and frequency were varied across the range shown in the table below. This demonstrates the point at which the deviation limits for a given input voltage and frequency.

Audio Input Level To EUT (mV)	Peak Frequency Deviation (kHz)					Maximum Deviation Limit (kHz)
	100Hz	500Hz	1000Hz	3000Hz	5000Hz	
-	100Hz	500Hz	1000Hz	3000Hz	5000Hz	-
1	0.147	0.231	0.386	0.854	0.698	5.0
2	0.153	0.347	0.651	1.538	1.475	5.0
4	0.162	0.587	1.142	3.177	1.762	5.0
6	0.203	0.818	1.716	3.605	1.823	5.0
8	0.208	1.039	2.262	3.745	1.881	5.0
10	0.241	1.286	2.775	3.843	1.915	5.0
12	0.248	1.524	3.286	3.90	1.862	5.0
14	0.256	1.794	3.765	3.87	1.900	5.0
16	0.277	2.037	3.816	3.88	1.902	5.0
18	0.294	2.257	3.835	3.90	1.912	5.0
20	0.319	2.522	3.90	3.89	1.872	5.0
25	0.375	3.032	4.06	3.90	1.883	5.0
30	0.422	3.67	4.00	3.87	1.885	5.0
35	0.494	3.88	4.00	3.88	1.882	5.0
40	0.542	3.95	4.01	3.91	1.899	5.0
50	0.650	3.97	4.01	3.92	1.934	5.0



2.3 MODULATION REQUIREMENTS-Continued

Channel 60 – Maximum Permissible Frequency Deviation – 25W

The EUT was connected as described in the tests above. Initially, an Audio signal of 1kHz was applied to the input and the amplitude varied to give a deviation of 3kHz, which in this case was 10.9mV. This level was then increased by 20dB to a level of 109mV. The maximum peak deviation was then measured across the frequency range 100Hz to 10kHz.

Modulating Frequency (kHz)	Peak Frequency Deviation (kHz)	Maximum Deviation Limit (kHz)
0.1	1.226	5.0
0.2	3.481	5.0
0.4	4.01	5.0
0.6	4.03	5.0
0.8	4.02	5.0
1.0	4.00	5.0
1.2	3.99	5.0
1.4	4.02	5.0
1.6	4.17	5.0
1.8	4.24	5.0
2.0	4.21	5.0
2.5	3.70	5.0
3.0	3.55	5.0
3.5	3.298	5.0
4.0	2.903	5.0
4.5	2.377	5.0
5.0	1.843	5.0
6.0	1.072	5.0
7.0	0.656	5.0
8.0	0.459	5.0
9.0	0.317	5.0
10.0	0.252	5.0



2.3 MODULATION REQUIREMENTS-Continued

Channel 88 – Maximum Permissible Frequency Deviation- 25W

Modulating Frequency (kHz)	Peak Frequency Deviation (kHz)	Maximum Deviation Limit (kHz)
0.1	1.253	5.0
0.2	3.561	5.0
0.4	4.07	5.0
0.6	4.08	5.0
0.8	4.07	5.0
1.0	4.06	5.0
1.2	4.04	5.0
1.4	4.09	5.0
1.6	4.24	5.0
1.8	4.32	5.0
2.0	4.28	5.0
2.5	3.726	5.0
3.0	3.558	5.0
3.5	3.365	5.0
4.0	2.954	5.0
4.5	2.418	5.0
5.0	1.878	5.0
6.0	1.087	5.0
7.0	0.675	5.0
8.0	0.442	5.0
9.0	0.317	5.0
10.0	0.256	5.0

2.3.7 Limits

Limit	≤5kHz
-------	-------

Remarks

EUT complies with CFR 47 2.1047 and 80.213(b). The EUT does not exceed 5kHz peak deviation at the measured frequencies.



2.4 MODULATION CHARACTERISTICS

2.4.1 FCC Part 80 Section 2.1047a

2.4.2 Equipment Under Test
RAY240

2.4.3 Date of Test
10th May 2004

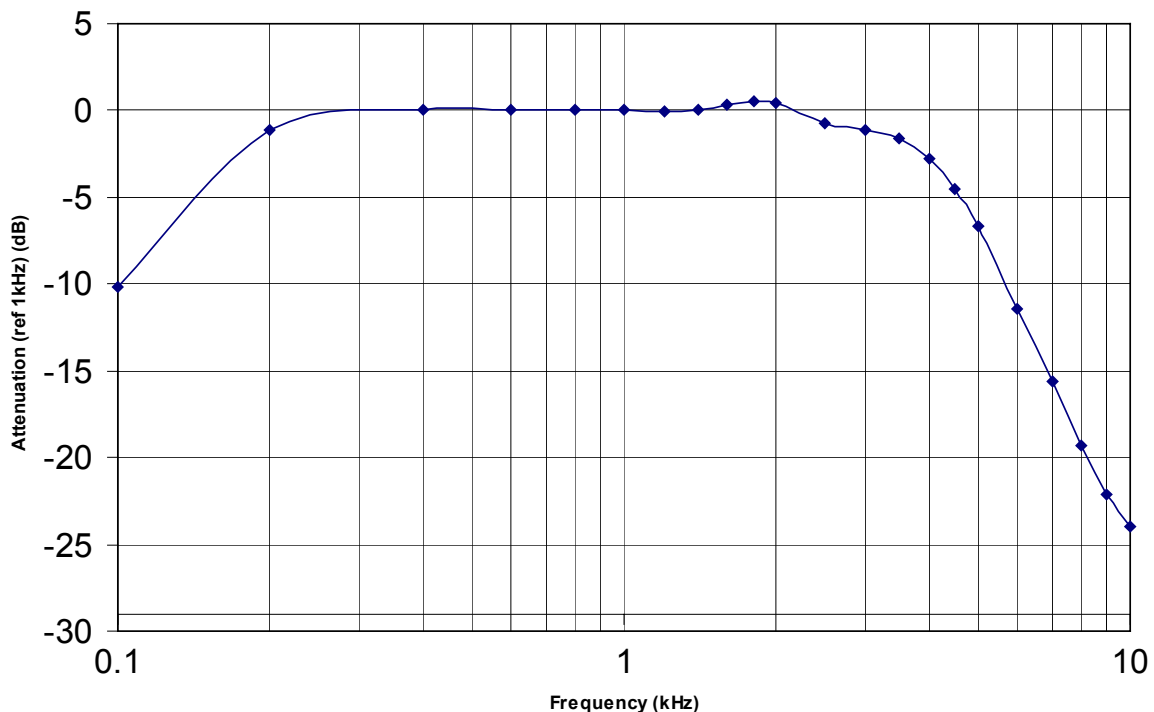
2.4.4 Test Equipment Used (See Section 3.1 for details)
1, 2, 3, 4, 5, 6, 8

2.4.5 Test Procedure

In accordance with 2.1047(a), a curve has been produced displaying the frequency response of the audio modulating circuit over a range of 100Hz to 5kHz. The plot shows the data for all of the circuitry installed between the modulation limiter and the modulated stage.

The EUT was connected to a Modulation Analyser via a 30dB Attenuator. An Audio Analyser was connected to the microphone input at a set voltage level and the frequency varied between 100Hz and 10kHz. The demodulated audio was measured and plotted as a graph, which is shown below.

2.4.6 Test Results



A Graph To Show The Frequency Response Of The Audio Modulating Circuit



2.5 TRANSMITTER POWER

2.5.1 FCC Part 80 Section 2.1046, 80.215(a)(2)(e)(1)

2.5.2 Equipment Under Test
RAY240

2.5.3 Date of Test
10th May 2004

2.5.4 Test Equipment Used (See Section 3.1 for details)
1, 2, 3, 4, 5, 6

2.5.5 Test Procedure

The EUT was connected via a 30dB attenuator to a power meter and sensor. The path loss between the EUT and the power sensor was measured and recorded. The power meter reading was recorded and adjusted by the path loss value.

The emission designator for the EUT is declared as G3E. In Clause 80.215(a)(2), the measurement of G3E designations is defined as being Carrier Power. In accordance with Clause 2.1, the Carrier Power was measured unmodulated.

The carrier power was measured on the top and bottom channels of the operating frequency band and at maximum and minimum power levels.

2.5.6 Test Results

Maximum Power – 25W

Frequency (MHz)	Output Power, (Uncorrected) (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
156.025	13.034	30.3	43.334	21.55
157.425	12.891	30.3	43.191	20.85

Minimum Power- 1W

Frequency (MHz)	Output Power, (Uncorrected) (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
156.025	-1.515	30.3	28.785	756
157.425	-1.637	30.3	28.663	735

2.5.7 Limits

Limit	≤25W or <+43.98dBm
-------	--------------------

Remarks

EUT complies with CFR 47 2.1046 and 80.215(e)(1). The EUT does not exceed 25W or +43.98dBm at the measured frequencies.



2.6 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.6.1 FCC Part 80 Section 80.217(b)

2.6.2 Equipment Under Test

RAY240

2.6.3 Date of Test

25th May 2004

2.6.4 Test Equipment Used (See Section 3.1 for details)

1, 2, 4, 7

2.6.5 Test Procedure

The EUT was connected to a Spectrum Analyser via an RF cable. 30dB of external attenuation was inserted. The emissions were measured from 9kHz to 2GHz.

The manufacturer declares a maximum antenna gain of 3dBi to be used with the EUT. Thus, in accordance with 80.217(b), the 3dBi gain and 30dB of external attenuation have been accounted for in the limit line and the derivation of the limits are shown in the table below.

Frequency Of Interfering Emissions (MHz)	Power To Artificial Antenna (μ W)	Power To Artificial Antenna (dBm)	Power To Artificial Antenna including Maximum Declared Antenna Gain (dBm)
<30	400	-4	-7
30 – 100	4000	6	3
100 – 300	40000	16	13
300 - 2000	400000	26	23

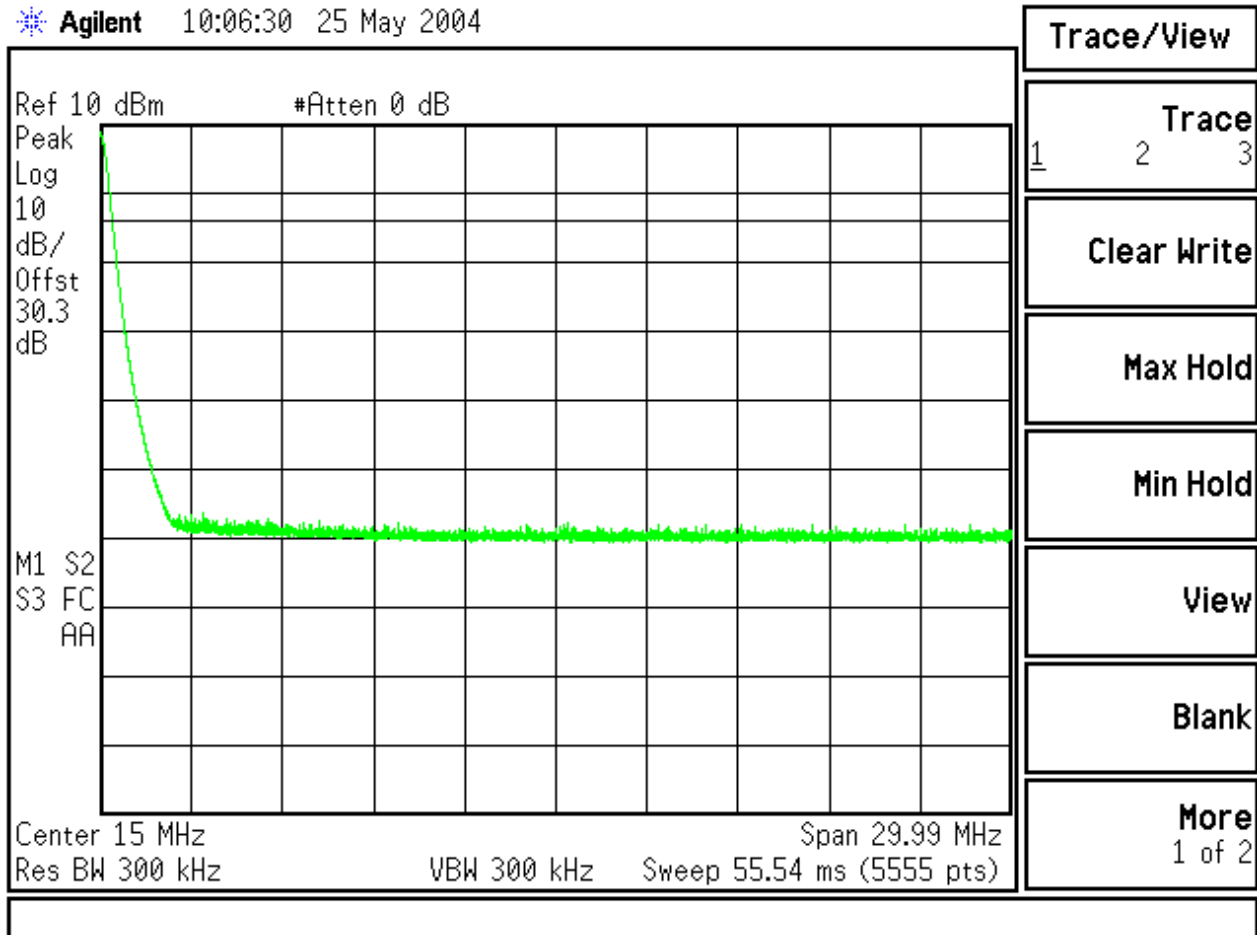
2.6.6 Results

The results plots are shown in the following pages.



2.6 SUPPRESSION OF INTERFERENCE ABOARD SHIPS-Continued

Agilent 10:06:30 25 May 2004

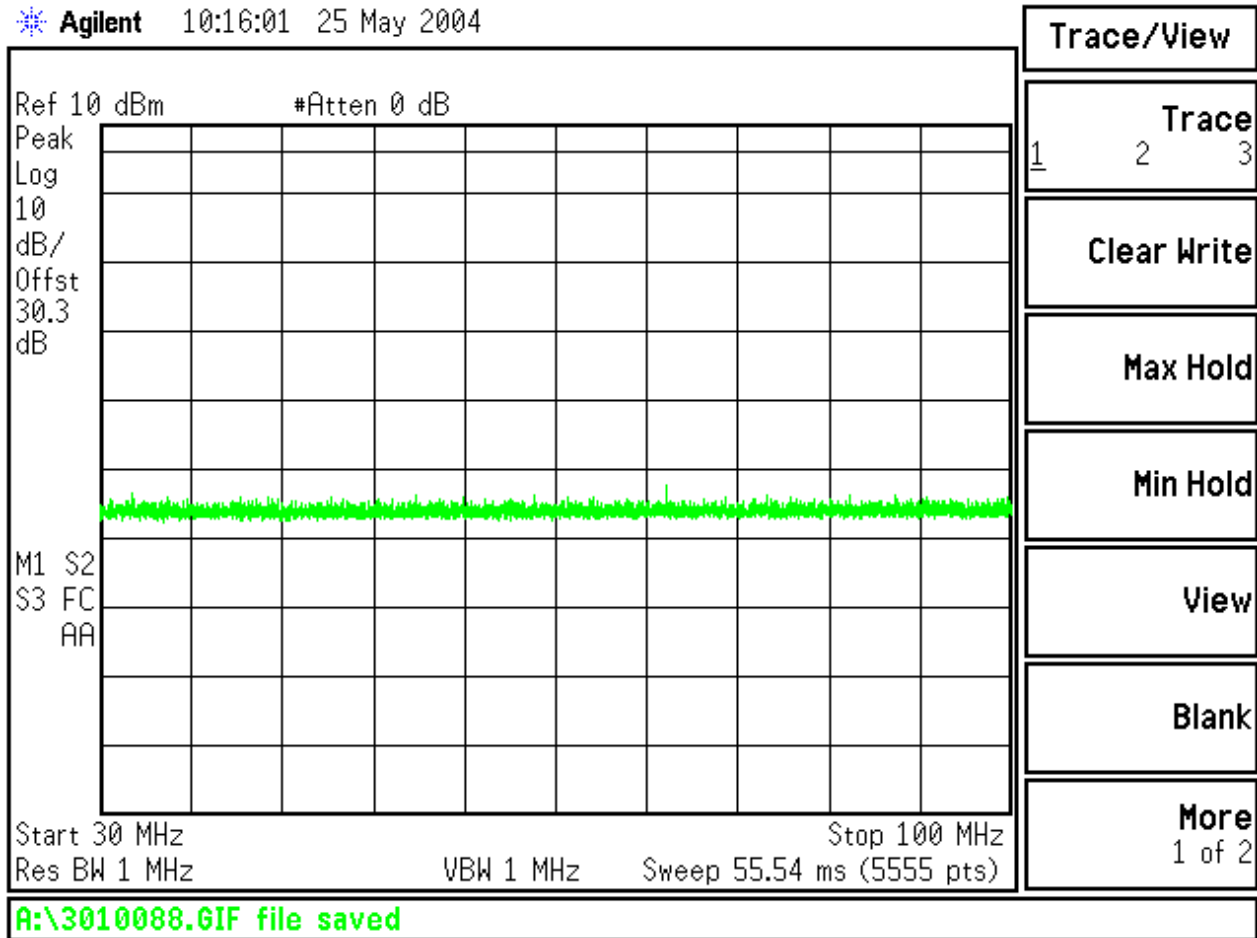


Channel 60 – Receive
9kHz – 30MHz



2.6 SUPPRESSION OF INTERFERENCE ABOARD SHIPS-Continued

Agilent 10:16:01 25 May 2004

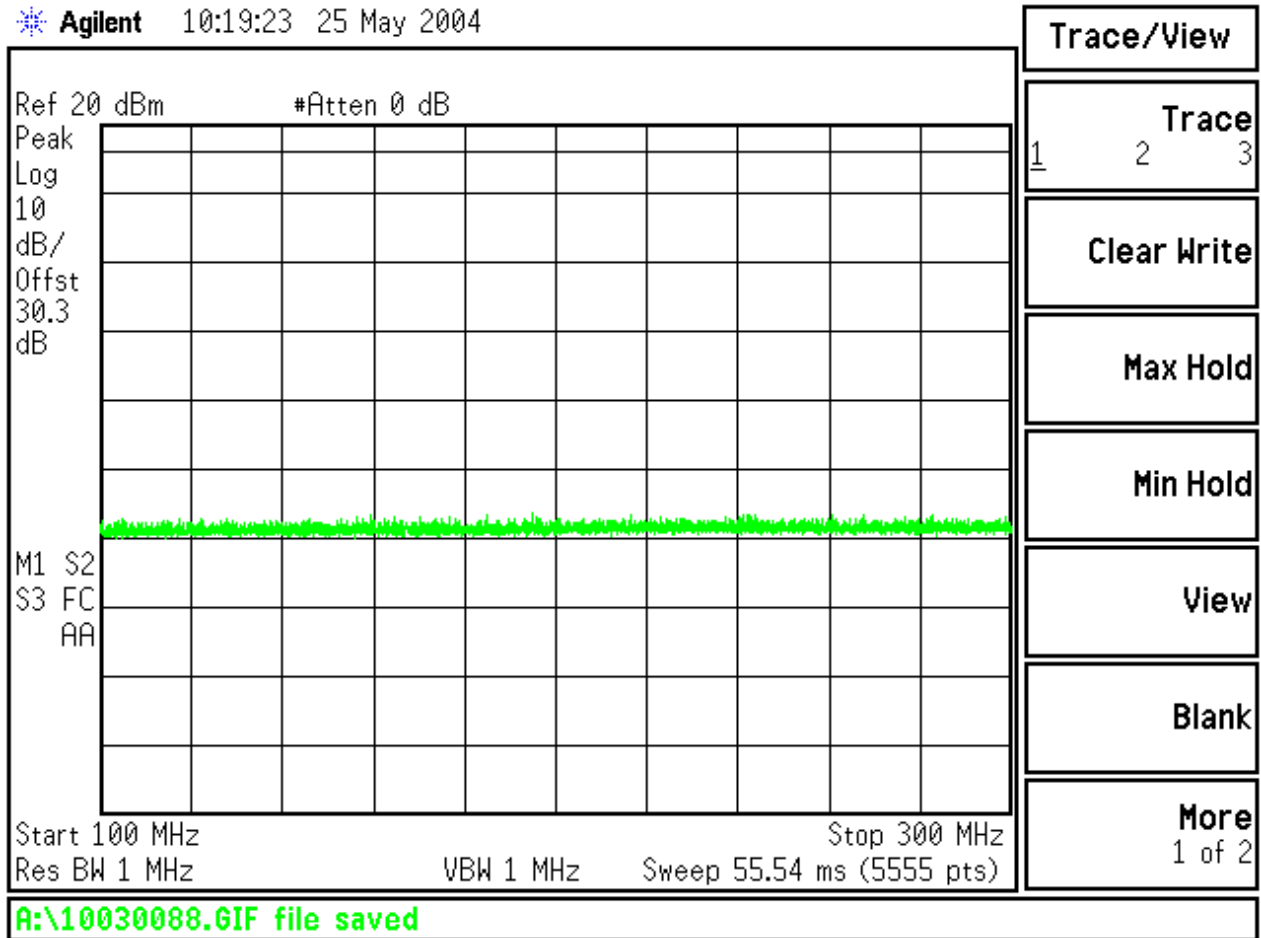


Channel 60 – Receive
30MHz – 100MHz



2.6 SUPPRESSION OF INTERFERENCE ABOARD SHIPS-Continued

Agilent 10:19:23 25 May 2004

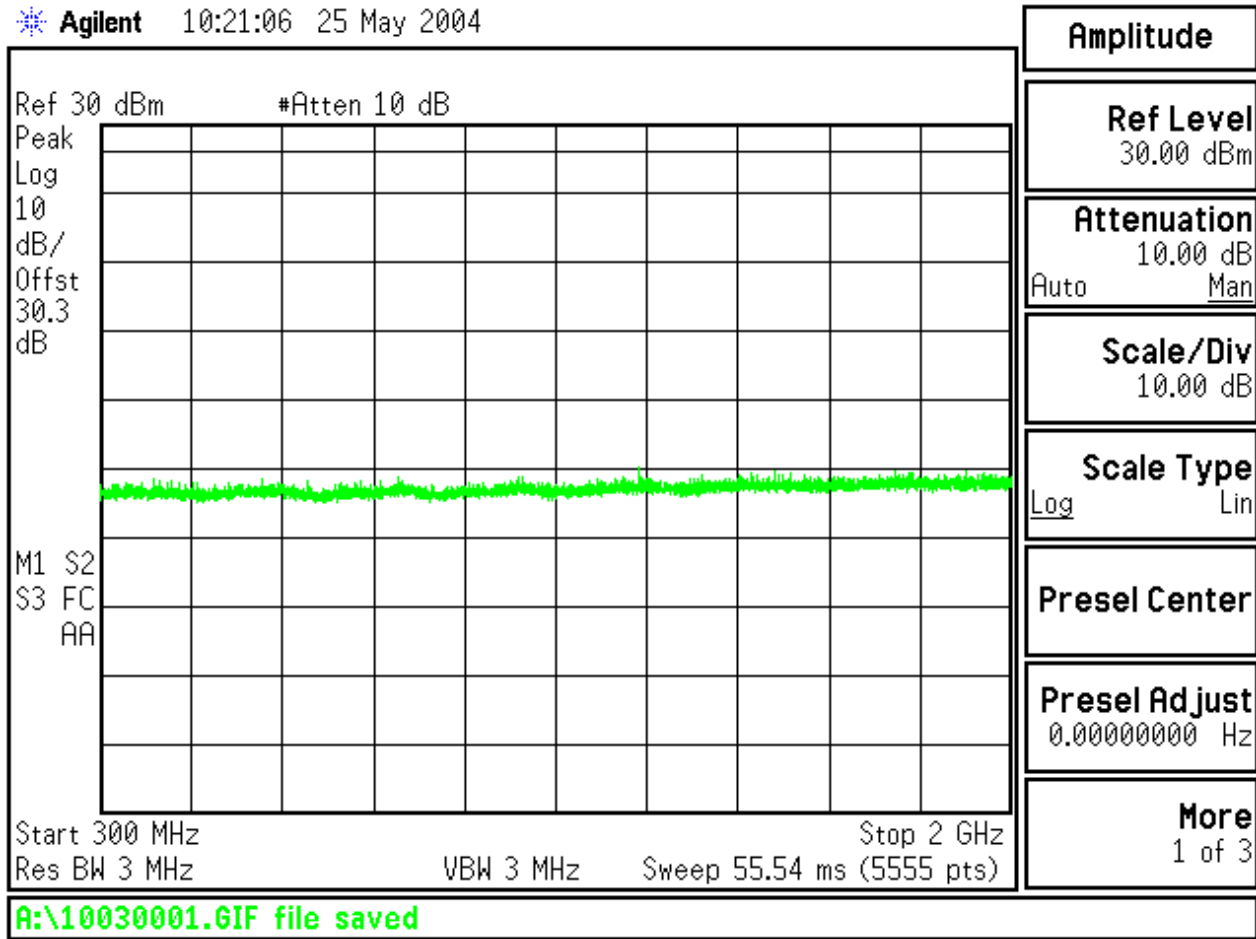


Channel 60 – Receive
100MHz – 300MHz



2.6 SUPPRESSION OF INTERFERENCE ABOARD SHIPS-Continued

Agilent 10:21:06 25 May 2004



Channel 60 – Receive
300MHz – 2GHz

2.6.7 Limits

Remarks

All emissions were below the requirements defined in 80.217(b).



2.7 MPE CALCULATION

2.7.1 FCC Part 80 Section 1.1307(b)/80.227

2.7.2 Equipment Under Test
RAY240

2.7.3 Date of Test
N/A

2.7.4 Test Equipment Used (See Section 3.1 for details)
N/A

2.7.5 MPE Calculation

A Raymarine device, RAY 240, has a maximum output power of 25 W. The manufacturer declares a duty cycle of 50% with a worst-case antenna gain of 3.0dBi. The equipment is proposed as meeting the OET65 requirements for use at 1.5m.

The wavelength of the equipment is:

$$\frac{3 \times 10^8}{156.025 \times 10^6} = 1.92\text{m}$$

Thus, the far field region is defined as being:

$$\frac{\lambda}{2\pi} = \frac{1.92}{6.283} = 0.306\text{m or } 30.60\text{cm}$$

Therefore, the formula below is applicable as any distance greater than 30.60cm is in the far field. Thus, at a distance of 1.5m from the antenna, the Power Density is calculated as:

$$S = \frac{P \times G}{4\pi R^2} = \frac{25000 \times 2.0}{12.57 \times 150^2} = 0.177\text{mW/cm}^2$$

where:

- P = power measured in mW
- G = antenna gain as numeric gain, (2.0 numeric / 3.0dBi)
- R = distance in cm

MPE for Occupational/Controlled Exposure at 156.025 MHz is 1mW/cm²

MPE for General Population/Uncontrolled Exposure at 156.025 MHz is 0.2mW/cm²

Therefore, the unit under test has a power density, which is less than both the General Population and Occupational exposure limits where a separation distance of 1.5m from the antenna exists. The table below shows the Power Density result for the bottom channel and manufacturer declared antenna configuration.

Frequency (MHz)	Measured Conducted Power (mW)	Antenna Gain		Power Density (mW/cm ²)
		dBi	Numeric	
156.025	25000	3.0	2.0	0.177



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

Item	Instrument	Type No	Manufacturer	Serial No	EMC / INV No	Cal. Due
1	Thermohygrograph	I1000	Rotronic	1826-15	INV3227	4/10/04
2	Power Supply dc	6267B	Hewlett Packard	2333A08844	EMC963	TU
3	DMM	79 mk3	Fluke	749730810	INV4267	13/1/05
4	Attenuator	8321	Bird	1312	INV3807	7/10/04
5	Sensor	17722A	Hewlett Packard	3111A04314	EMC1987	28/5/04
6	Modulation Analyser	8901B	Hewlett Packard	3005A02539	EMC1510	28/5/04
7	Spectrum Analyser	E4407B	Agilent	US41442853	EMC2783	22/3/05
8	Audio Analyser	8903B	Hewlett Packard	3011A08238	EMC1512	18/7/04
9	Signal Generator	SMY01	Rohde & Schwarz	842065-0037	EMC2256	23/3/05
10	Audio Load	8 Ohm	TUV	N/S	EMC1672	14/1/05



3.2 MEASUREMENT UNCERTAINTY

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

IN THE FREQUENCY RANGE 30MHz TO 1000MHz		
TEST	FREQUENCY	AMPLITUDE
For Occupied Bandwidth	$\pm 23.677\text{kHz}$	$\pm 0.5\text{dB}$
For Maximum Output Power	Not Applicable	$\pm 0.5\text{dB}$
For Spurious Conducted Emissions	Not Applicable	$\pm 1.8\text{dB}$
IN THE FREQUENCY RANGE 1GHz TO 20GHz		
TEST	FREQUENCY	AMPLITUDE
Transmitter Frequency Tolerance	$\pm 45\text{Hz}$	Not Applicable
Modulation Requirements	$\pm 0.6\text{dB}$ (of reading)	Not Applicable



SECTION 4

EUT PHOTOGRAPHS



4.1.1 EUT PHOTOGRAPHS



RAY240 VHF Marine Radio



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).

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APPENDIX A

TITCHFIELD FCC SITE COMPLIANCE LETTER



FEDERAL COMMUNICATIONS COMMISSION

**Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046**

October 18, 2002

Registration Number: 90987

TUV Product Service Ltd
Segensworth Road
Titchfield
Fareham, Hampshire, PO15 5RH
United Kingdom
Attention: Kevan Adsetts

Re: Measurement facility located at Titchfield
Anechoic chamber (3 meters) and 3 & 10 meter OATS
Date of Listing: October 18, 2002

Gentlemen:

Your request for registration of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC rules. The information has, therefore, been placed on file and the name of your organization added to the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Thomas W Phillips
Electronics Engineer