TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Raytheon Marine Ltd.
Pathfinder R89RC

To: FCC Part 80: 1998
and FCC Part 2: 1998

[Leisure Marine Equipment]

Test Report Serial No:
RFI/EMCB2/RP40279B

This Test Report supersedes RFI Test Report No.:
RFI/EMCB1/RP40279B

This Test Report Is Issued Under The Authority Of Brian Watson Technical Director: 	**Checked By:** 
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Test Of: **Raytheon Marine Ltd.**
Pathfinder R89RC
To: **FCC Part 80: 1998**
and FCC Part 2: 1998

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This Test Report supersedes RFI Test Report No.: RFI/EMCB1/RP40279B.

1. Client Information

Company Name:	Raytheon Marine Ltd
Address:	Anchorage Park Portsmouth Hants PO3 5TD
Contact Name:	Mr C Bird

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:	Raytheon Marine Ltd
Model Name or Number:	'Pathfinder' R89RC (Comprising of a Scanner, Display and Array
Unique Type Identification:	Scanner: M92655 Display: M92673 Array: M92693
Serial Number:	Scanner: 006 Display: EMC004
Country of Manufacture:	England
FCC ID Number:	ASLMTX9
Date of Receipt:	26 November 1999

2.2. Description Of EUT

The equipment under test is a X-Band leisure marine radar. Comprising of:

Scanner unit: 10 kW X-band transmitter with 4 foot open array.
Display unit: 10 inch C.R.T. with HSB and chart facility.

2.3. Modifications Incorporated In EUT

The EUT has not been modified from what is described by the Model Name and Unique Type Identification stated above.

2.4. Additional Information Related To Testing

Power Supply Requirement:	Nominal 24 DC supply
Intended Operating Environment:	Leisure Marine Vessels
Weight:	Scanner: 24 kg Array: 6 kg Display: 6 kg
Dimensions:	Scanner: 300 x 420 x 320 mm Display: 278mm x 264mm x 316mm
Interface Ports:	Power and 2 x NMEA IN Seatalk NMEA OUT HSB, point-to-point

2.5. Support Equipment

No support equipment was required to exercise the EUT during testing.

3. Test Specification, Methods & Procedures

3.1. Test Specification

Reference:	FCC Part 80: 1998 and FCC Part 2: 1998
Title:	Code of Federal Regulations, Part 80 (47CFR): 1998 Stations in the maritime services Code of Federal Regulations, Part 2 (47CFR): 1998 Frequency Allocations and radio treaty matters; general rules and regulations
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of verification.

3.2. 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 (1992)
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 (1987)
Title: Specification for Radio Interference measuring apparatus and measurement methods.

3.3. 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.

4. Deviations From The Test Specification

2.1047(d) Modulation characteristics – *Other types of equipment*. No curves supplied.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

5.1.1. 9 kHz to 40 GHz: The EUT was located in a covered turntable site on the 3m open area test site environment for radiated emissions.

5.1.2. The EUT was located in a laboratory environment for all other tests.

5.1.3. During testing, the EUT was powered by a Nominal 24 V DC supply.

5.2. Operating Modes

The EUT was tested in the following operating modes:

5.2.1. Radiated emissions: Transmitting into a non-reflective load with the transmitter set to a 450ns pulse width, 1.6kHz PRF. This mode was defined by the client as being likely to be the worst case with regards EMC.

5.2.2. Variation of transmit frequency with voltage and temperature: The transmitter was set to the half nautical mile range and the six nautical mile range, 65ns and 1200ns pulse width.

5.2.3. For other testing, the pulse widths were: 65ns (0.5 mile range), 90ns (0.5 mile range), 150ns (0.75 mile range), 250ns (1.5 mile range), 350ns (1.5 mile range), 450ns (3 mile range), 600ns (3 mile range), 1200ns (6 mile range).

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

5.3.1. The Scanner Unit was connected to the Display Unit with standard cable of standard 15 m length. A transmit dummy load was connected to the Scanner Unit antenna port. All Display Unit interface ports were connected via dummy loads. A 24 V DC supply was connected to the Display Unit.

5.3.2. This mode was defined by the client as being likely to be the worst case with regards emissions.

5.3.3. Appendix 1 of this report contains a full list of test equipment used and Appendix 3 contains a schematic diagram of the test configuration.

6. Summary Of Test Results

6.1. Summary Of Tests

6.1.1. Radiated Spurious Emissions

Frequency Range	Specification Reference	Compliance Status
9kHz to 40GHz	2.1053 and 80.211(f)	Complied

6.1.2. Conducted Spurious Emissions

Frequency Range	Specification Reference	Compliance Status
9kHz to 40GHz	2.1051 and 80.211(f)	Complied

6.1.3. RF Power Output

6.1.3.1. Peak Power

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	2.1046(a) and 80.215(a)	Complied

6.1.3.2. Average Power

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	2.1046(a) and 80.215(a)	Complied

6.1.3.3. Pulse Width

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	2.1046(a) and 80.215(a)	Complied

6.1.3.4. PRF

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	2.1047(d) and 80.213(g)	Complied

6.1.4. Variation of Frequency with Voltage

6.1.4.1. 65ns

Nominal Pulse Width (ns)	Specification Reference	Compliance Status
65	2.1055(d)	Complied

6.1.4.2. 1200ns

Nominal Pulse Width (ns)	Specification Reference	Compliance Status
1200	2.1055(d)	Complied

6.1.5. Variation of Frequency with Temperature

6.1.5.1. 65ns

Nominal Pulse Width (ns)	Specification Reference	Compliance Status
65	2.1055(a and b)	Complied

6.1.5.2. 1200ns

Nominal Pulse Width (ns)	Specification Reference	Compliance Status
1200	2.1055(a and b)	Complied

6.1.6. Occupied Bandwidth

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	2.1049(i) and 80.205	Complied

6.1.7. Transmitter Frequency Tolerance

Nominal Pulse Width Range (ns)	Specification Reference	Compliance Status
65 to 1200	80.209(b)	Complied

6.1.8. Suppression of Interference Aboard Ships

80.217. When the radar in a standby mode of operation, the local oscillator is automatically turned off.

6.2. Location Of Tests

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

7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. The measurement uncertainties stated were calculated in accordance with the requirements of NAMAS Document NIS 81 with a confidence level of 95%. Please refer to Section 8 for details of measurement uncertainties.

7.1.3. The client declared the highest clock frequency of the EUT as 9.4 GHz. Consequently, the tests were performed up to 40 GHz.

7.2. Field Strength Measurements

7.2.1. Magnetic Field Strength Measurements: Frequency Range: 9 kHz to 30 MHz

7.2.1.1. Plots of the initial scans can be found in Appendix 4.

7.2.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector (The results incorporate antenna factors and cable losses):

7.2.1.1. Details of the limit calculation can be seen in Appendix 2.2.1.

Frequency (kHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
159.118	0°	87.3	119.0	31.7	Complied
190.927	0°	81.2	119.0	37.8	Complied
222.743	0°	74.8	119.0	44.2	Complied
254.586	90°	75.8	119.0	43.2	Complied

Note: Due to the presents of high level ambient signals, it was necessary to perform the above radiated emission field strength measurements at a distance of 1m. The limit was calculated by using the square of an inverse extrapolation factor (40dB/decade). i.e. 40 log (d1/d2).

7.2.2. Electric Field Strength Measurements: Frequency Range: 30 MHz to 1000 MHz

7.2.2.1. Plots of the initial scans can be found in Appendix 4.

7.2.2.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector (The results incorporate antenna factors and cable losses):

7.2.2.3. Details of the limit calculation can be seen in Appendix 2.2.1.

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
46.458	Vert.	39.7	99.9	60.2	Complied
59.124	Vert.	34.7	99.9	65.2	Complied
84.389	Vert.	25.8	99.9	74.1	Complied
114.008	Vert.	37.0	99.9	62.9	Complied
126.009	Vert.	26.1	99.9	73.8	Complied
156.730	Vert.	14.3	99.9	85.6	Complied
160.040	Vert.	13.9	99.9	86.0	Complied
160.370	Vert.	13.9	99.9	86.0	Complied
161.830	Vert.	13.8	99.9	86.1	Complied
184.868	Vert.	27.3	99.9	72.6	Complied
342.025	Horiz.	43.4	99.9	56.5	Complied
433.706	Vert.	36.3	99.9	63.6	Complied
456.032	Horiz.	34.0	99.9	65.9	Complied
494.035	Horiz.	39.0	99.9	60.9	Complied
570.040	Horiz.	34.4	99.9	65.5	Complied
608.043	Horiz.	40.5	99.9	59.4	Complied
912.064	Horiz.	38.6	99.9	61.3	Complied

7.2.3. Electric Field Strength Measurements: Frequency Range: 1 GHz to 40 GHz

7.2.3.1. The client declared the highest clock frequency of the EUT as 9.4 GHz. Consequently, the tests were performed up to 40 GHz.

7.2.3.2. Plots of the initial scans can be found in Appendix 4.

7.2.3.3. The following tables list frequencies at which emissions were measured using Peak detector functions, and were found to be less than 20dB from the reference limit line. Levels which were found to be greater than 20dB below the reference limit line were not measured.

Highest Peak Level:

Frequency (GHz)	Polarity	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Margin (dB)	Result
18.7744	Vert.	94.4	99.9	5.5	Complied

7.3. Conducted Emissions

7.3.1. Peak Detector Measurements On RF port

7.3.1.1. Plots of the scans can be found in Appendix 4.

7.3.1.2. The following table lists frequencies at which emissions or the highest noise floor were measured using a Peak detector.

7.3.1.3. Meaurements were performed from 4 GHz to 40 GHz with the EUT set to 450nS. With the EUT set to both 65nS and 1200nS, measurements were performed within and around the transmitter frequency allocation.

450ns Pulse

Frequency (GHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
8.9028	-15.2	-13.0	2.2	Complied
9.9196	-19.9	-13.0	6.9	Complied
8.7845	-15.6	-13.0	2.6	Complied
11.3572	-13.02	-13.0	0.02	Complied (Note 1)
39.2200	-18.3	-13.0	5.3	Complied
18.7650	-17.3	-13.0	4.3	Complied

65ns Pulse

Frequency (GHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
8.9059	-15.3	-13.0	3.3	Complied
9.9133	-19.5	-13.0	6.5	Complied

1200ns Pulse

Frequency (GHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
8.9038	-16.4	-13.0	3.4	Complied
9.9165	-19.2	-13.0	6.2	Complied

Note 1: The frequency range of 9.91 GHz to 12.3 GHz was remeasured with the test analyser set with a resolution bandwidth of 300 kHz. Measurements performed from this scan showed levels at least 7dB below the reference limit line.

Note 2: For plots around the transmitter band, please refer to graphical results in Apendix 4 of this test report.

Note 3: The design of the RF coupling from the magnetron to the antenna (a RF coupled stub inside the cavity to a tuned antenna) formed an effective high pass / bandpass filter arrangement. The peak energy level of radar requires considerable attenuation in order to prevent the analyser from going into compression. This limits the maximum dBc figure that can be obtained without changing the RBW of the analyser. Since the signal is wideband compared to the RBW, it is critical to the measurement accuracy that the RBW settings remain consistent throughout the testing where possible.

Note 4: Due to the use of waveguide on the antenna port, the lower frequency of measurement was increased to 4 GHz. ($0.7 \times f_{cut\text{-}off}$).

7.4. Peak Power

7.4.1. These measurements were performed with the HP Power Analyzer and sensor connected to the EUT via a coupler, in line Attenuator and microwave coax cable.

Pulse Width (ns)	Measured Power (dBm)	Corrected Power (kW)
65	65.45	3.508
90	67.75	5.957
150	69.11	8.147
250	69.83	9.616
350	70.06	10.139
450	70.28	10.666
600	70.28	10.666
1200	70.28	10.666

Note 1: The power at the shorter pulse widths has been delibrately reduced to enhance radar performance.

7.4.1. Pulse Width

7.4.1.1. Plots can be found in Appendix 4.

7.4.1.2. In order to determine the characteristics of the various pulses, a power analyzer was connected, through a HP detector and an attenuator to the test set up.

Nominal Pulse Width (ns)	Measured Pulse Width (ns)
65	67.864
90	93.812
150	150.699
250	250.499
350	349.302
450	451.098
600	604.791
1200	1201.600

7.5. PRF

7.5.1. Plots can be found in Appendix 4.

7.5.2. In order to determine the characteristics of the various pulses, an oscilloscope was connected, through an HP detector and an attenuator to the test set up.

Pulse Width (ns)	Measured P.R.F. (kHz)
65	3.0075
90	3.0075
150	3.0075
250	3.0075
350	2.0000
450	1.6000
600	1.2019
1200	0.7407

7.6. Average Power.

Pulse Width (ns)	Peak Power (kW)	P.R.F (kHz)	Pulse Width (ns)	Average Power (Watts)
65	3.508	3.0075	67.864	0.716
90	5.957	3.0075	93.812	1.684
150	8.147	3.0075	150.699	3.692
250	9.616	3.0075	250.499	7.244
350	10.139	2.0000	349.302	7.083
450	10.666	1.6000	451.098	7.698
600	10.666	1.2019	604.791	7.753
1200	10.666	0.7407	1201.600	9.493

The previous sub sections detail the results required to make the above calculation.

7.7. Variation of frequency with voltage

7.7.1. Plots can be found in Appendix 4.

7.7.2. The frequency of the EUT was measured at each voltage.

65ns

% of nominal Volts	Volts (dc)	Measured Frequency (GHz)
85 % of 24.0	20.4	9.396530
100 % of 24.0	24.0	9.396530
100 % of 32.0	32.0	9.396175
115 % of 32.0	36.8	9.395997

1200ns

% of nominal Volts	Volts (dc)	Measured Frequency (GHz)
85 % of 24.0	20.4	9.379440
100 % of 24.0	24.0	9.379440
100 % of 32.0	32.0	9.379440
115 % of 32.0	36.8	9.379440

Note: The equipment can be operated from 24 or 32 Volts sources without requiring any changes. Therefore the testing was performed at 85 % of the lowest to 115 % of the highest operating voltage

7.8. Variation of Frequency with Temperature

The EUT was situated in an environmental test chamber. Initially the EUT remained off. Yhe chamber was set to –20 °C. After a minimum of 30 minutes the EUT was turned on and allowed to stabilise until there was no measurable frequency change. The frequency was recorded. The EUT was then switched off, and the chamber temperature stepped up by 10 °C. This process was repeated until the EUT was at + 50 °C.

65 ns Pulse

Temperature ℃	Measured Frequency (GHz)
-20	9.39277
-10	9.39295
0	9.39255
+10	9.39211
+20	9.38973
+30	9.38751
+40	9.38777
+50	9.38897

1200ns Pulse

Temperature ℃	Measured Frequency (GHz)
-20	9.38411
-10	9.38331
0	9.38231
+10	9.38139
+20	9.37971
+30	9.37759
+40	9.37604
+50	9.37415

7.9. Occupied Bandwidth

7.9.1. Plots can be found in Appendix 4.

7.9.2.The storage mode of the R&S FSM spectrum analyser does not show internal detail of the pulse. Other analyser settings were attempted in order to obtain a more "dense" pattern. The one presented here proved to be the optimum.

7.9.3.The 99.5% power bandwidth was measured for each pulse mode using the special function option on the spectrum analyser.

Nominal Pulse Width (ns)	**99.5% Power Bandwidth (MHz)**
65	70.71110996
90	49.19999882
150	32.53333214
250	11.71111083
350	11.44444416
450	14.35555525
600	11.31111079
1200	9.39999971

7.10. Transmitter Frequency Tolerance

7.10.1.Specification: 80.209 (b) – "*When pulse modulation is used in land and ship radar stations operating in the bands above 2.4GHz the frequency at which maximum emission occurs must be within the authorised bandwidth and must not be closer than **1.5/T MHz** to the upper and lower limits of the authorised bandwidth where "T" is the pulse duration in microseconds*."

7.10.2. Calculation

Authorised Bandwidth: 9300MHz to 9500MHz

Specification Limits **[Lower]** 9300 + 1.5/T
[Upper] 9500 - 1.5/T

Transmitter Frequency Tolerances
FCC ID ASLMTX5

Nominal Pulse Width (ns)	Actual Pulse Width (µs)	Specification Limits (MHz)	
		Lower	Upper
65	0.067864	9322.10	9477.90
90	0.093812	9315.99	9484.01
150	0.150699	9309.95	9490.05
250	0.250499	9305.99	9494.01
350	0.349302	9304.29	9495.71
450	0.451098	9303.33	9496.67
600	0.604791	9302.48	9497.52
1200	1.201600	9301.25	9498.75

From examining the transmitter frequency data from Variation of Frequency with Voltage and Variation of Frequency with Temperature results pages, it can be seen that the transmitter is within the calculated specification.

8. Measurement Uncertainty

8.1. Company Policy, as based on the NAMAS Accreditation Standard, M10, paragraph 12.11 (o), states that Test Reports shall include estimated uncertainty of the calibration or test result (this information need only appear in test reports and test certificates where it is relevant to the validity or application of the test result, where a client's instructions so require or where uncertainty affects compliance to a specification or limit).

8.2. The global uncertainties have been calculated in accordance with NAMAS NIS 81 (Edition 1, May 1994) as follows:

Measurement Type	Confidence Level	Calculated Uncertainty
Radiated Emissions: Electric Field Strength 30 MHz to 1000 MHz	95%	+ 3.5 / -3.3 dB
Radiated Emissions: Electric Field Strength 1 GHz to 100 GHz	95%	± 4.2 dB
Conducted Power	95%	±0.5 dB
Frequency Accuracy	95%	±0.8 ppm

8.3. Measurement uncertainties have been applied in accordance with NAMAS document NIS 81 (edition 1, May 1994), and in the absence of any specification criteria, guidance, or code of practice, compliance has been judged on the basis of shared risk.

8.4. In the case of emissions tests, the measured value of the disturbance from the product sample shall be compared directly with the limits. If the measured value is equal to or less than the limit the product is deemed to pass the test.

8.5. In the case of immunity tests, the equipment is deemed to pass the test if it fulfils the stated performance criteria at the required or a higher severity level. The measurement uncertainty has been taken into account in the calibration procedures stated in the relevant basic standard.

8.6. The methods used to calculate the above uncertainties are in line with those used for calibration laboratories contained in NAMAS document NIS 3003 Edition 8 “The Expression of Uncertainty and Confidence in Measurement” May 1995, which align with international recommendations “Guide to the Expression of Uncertainty in Measurement” ISO/IEC/OIML/BIPM (Prepared by ISO/TAG 4: January 1993).

Appendix 1. Test Equipment Used

RFI Number	Device	Manufacturer	Model No	Serial No
M069	Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
A1050	Attenuator	Huber and Suhner AG	5061	6810.17.B
M152	WG22 Mixer	Rohde & Schwarz	FS-Z16	None
A366	WG 22 isolator	MRI	FRR-400	169
A334	WG 22 Attenuator	Quasar	QFA225QB442-442-B	21155-2
A1058	Waveguide to Coaxial	Flann Microwave	22094-KF20	2016
C1001	Cable	Rosenberger	LU7_150_2000	003
C462	Cable	Rosenberger	UFA210A-1-0787-300380	98H1162
A223	Diode Detector	Hewlett Packard	8474B	01841
C428	Cable	Not stated	Not stated	Not stated
M029	Oscilloscope	Tektronix	2440	0120850
G088	Power Supply Unit	Thurlby Thandar	CPX200	100700
E007	Environmental Chamber	Prolan	PV427H75F 30HV	None
M072	Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RF) & 863 912/048 (Display)
A439	WG 14 horn	Narda	642	8610
C230	Cable	Rosenberger	UFA210A-1-1181-70x70	None
A429	WG 16 horn	Flann	16240-20	561
A438	WG 18 horn	Narda	439	8508

Test Equipment Used (continued)

RFI Number	Device	Manufacturer	Model No	Serial No
A436	Transformer (Arc Welder)	Merlin	185	09983
A027	1-2 GHz Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Horn Antenna	Eaton	91889-2	557
A1005	WG16 to N adapter	Silver Lab	PM 7325X	None
G051	Signal Generator	Gigatronics	7100/.01-20	749472
M151	Power Meter	Boonton	4220	D207602BL
M150	Power Sensor	Boonton	51072	28473
Not applicable	Peak Power Analyser	HP	8991A	-

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

Appendix 2. Measurement Methods

A2.1. Radiated Emissions [9 kHz to 1 GHz]

A2.1.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for a Peak detector.

A2.1.2. Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.1.3. The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 20 dB below the specification limit and levels above the tolerance line were re-tested on the open area test site, at the appropriate distance, using a measuring receiver with a Peak detector.

A2.1.4. For the main (final) measurements the EUT was arranged on a non-conducting table on an open area test site, as detailed in the specification.

A2.1.5. All measurements on the open area test site were performed using broadband antennas.

A2.1.6. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

A2.2. Radiated Emissions [1 GHz to 95 GHz]

A2.2.1 Calculating Radiated Emissions Limit Line

A2.2.1. In defining the 99.9dBuV/m limit for the product, the product was placed on the open area test site table with the measuring equipment located at a distance of three metres.

A2.2.2. The 48 inch open array antenna was fitted as representative of normal operation and the magnetron disconnected. The magnetron was replaced with a waveguide to coaxial adaptor and connected to a signal generator.

A2.2.3. The signal generator was unable to reproduce the actual peak power output of the intentional radiator – measured as 10.666kW by conducted methods. Consequently, a level of 10.666mW was reproduced at the antenna port and the level on the spectrum analyser offset by +60dB.

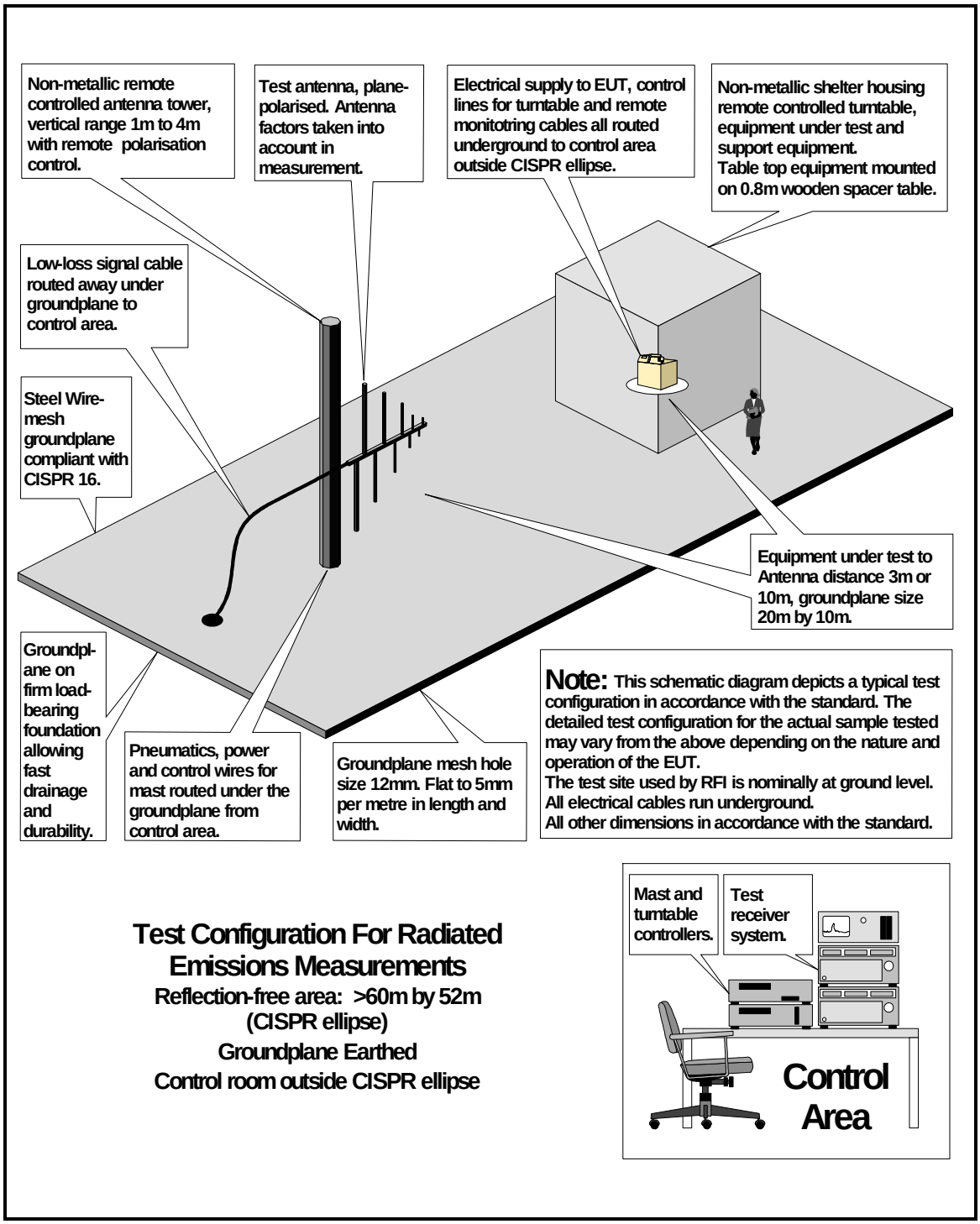
A2.2.4. The non-reflective load was then connected to the transmitter system and the substitution measurement performed.

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\40279JD01\EMIRAD	Test configuration for measurement of radiated electric field
DRG\40279JD01\001	Schematic of EUT and associated components for all conducted measurements
DRG\40279JD01\002	Diagram of the EUT and measurement antenna for frequencies above 1GHz

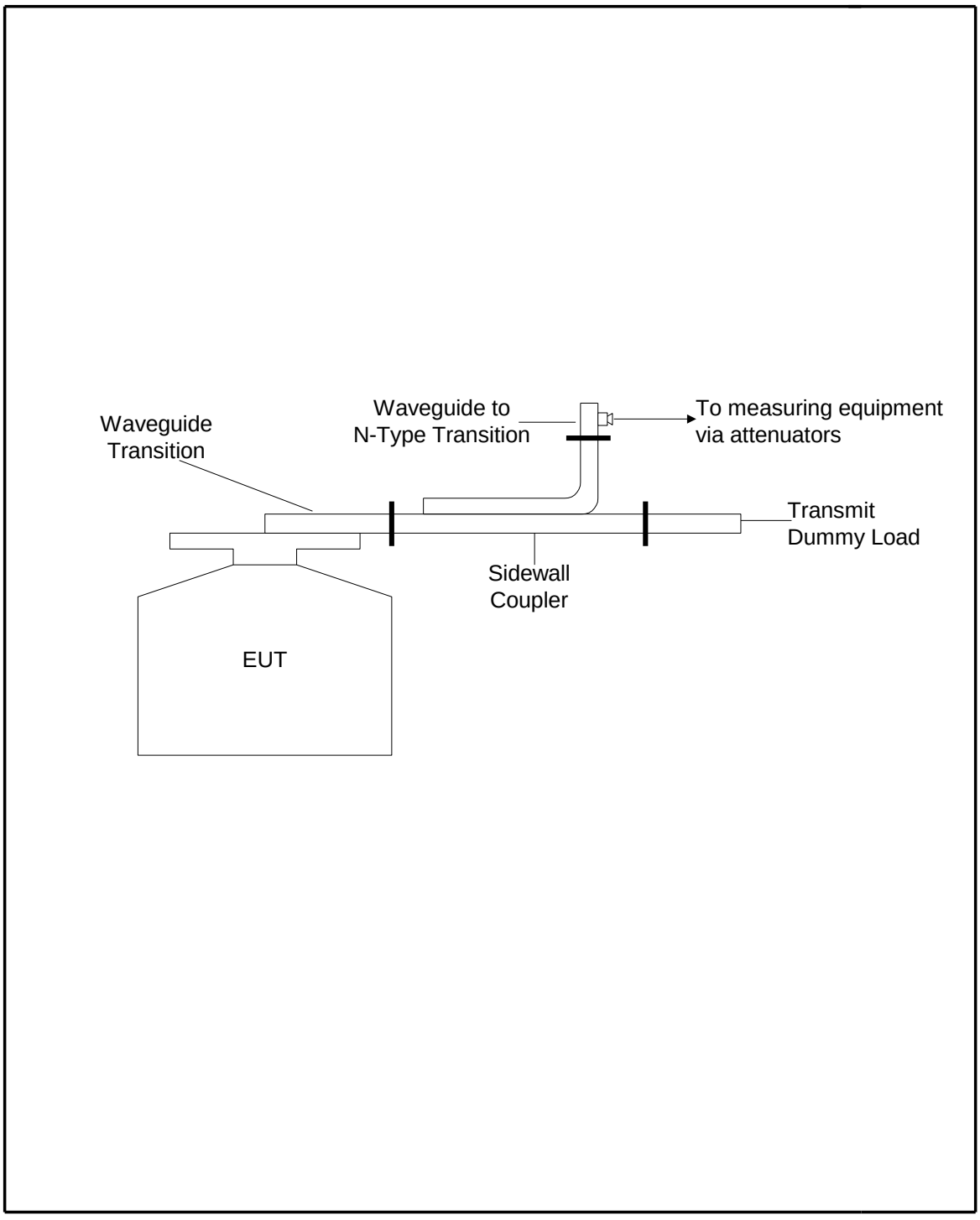
DRG\40279JD01\EMIRAD



Test Configuration For Radiated Emissions Measurements
Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse

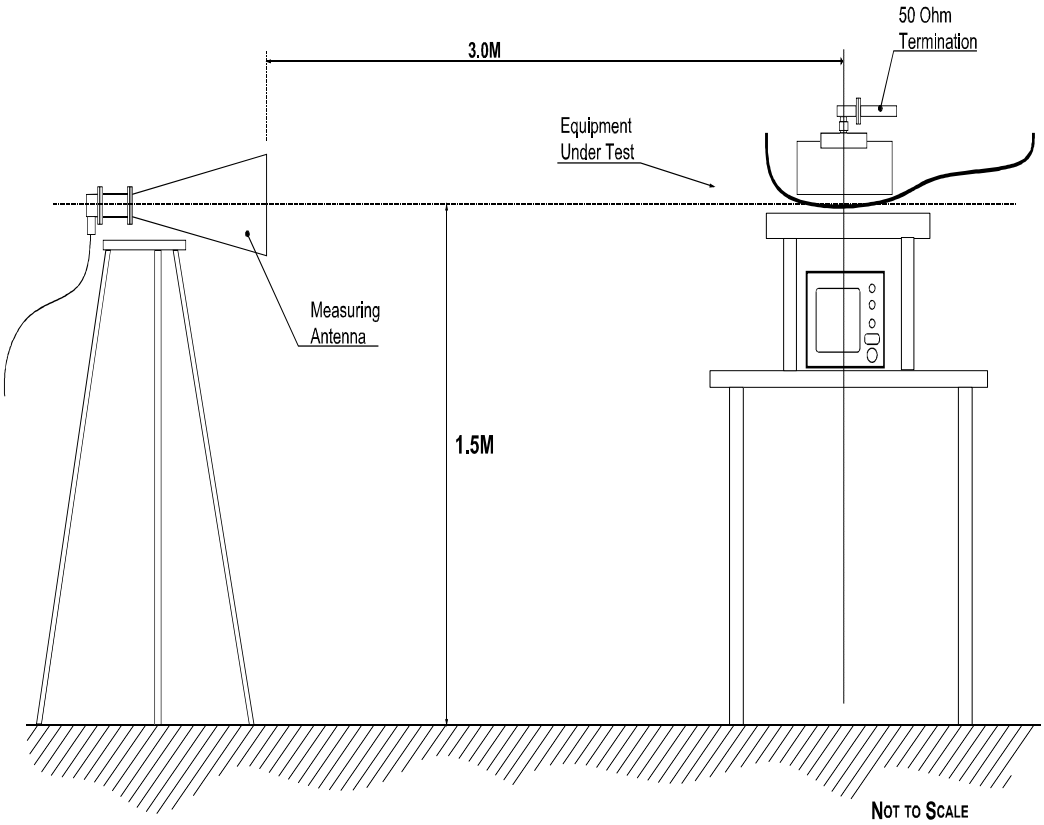
Test Of: **Raytheon Marine Ltd.**
Pathfinder R89RC
To: **FCC Part 80: 1998**
and FCC Part 2: 1998

DRG\40279JD01\001



Test Of: **Raytheon Marine Ltd.**
Pathfinder R89RC
To: **FCC Part 80: 1998**
and FCC Part 2: 1998

DRG\40279JD01\002



Appendix 4. Graphical Test Results

This appendix contains the following graphs:

Graph Reference Number	Title: Spurious Emissions
GPH/40279JD01/003	Radiated Emissions: 10 kHz to 150 kHz
GPH/40279JD01/002	Radiated Emissions: 150 kHz to 30 MHz
GPH/40279JD01/005	Radiated Emissions: 30 MHz to 1 GHz
GPH/40279JD01/126	Conducted Spurious Emissions: 4.0 GHz to 8.91 GHz 450 ns Pulse Width
GPH/40279JD01/122	Conducted Spurious Emissions: 8.9 GHz to 9.215 GHz 65 ns Pulse Width
GPH/40279JD01/121	Conducted Spurious Emissions: 8.9 GHz to 9.215 GHz 450 ns Pulse Width
GPH/40279JD01/120	Conducted Spurious Emissions: 8.9 GHz to 9.215 GHz 1.2 us Pulse Width
GPH/40279JD01/118	Conducted Spurious Emissions: 9.205 GHz to 9.165 GHz 65 ns Pulse Width
GPH/40279JD01/117	Conducted Spurious Emissions: 9.205 GHz to 9.165 GHz 450 ns Pulse Width
GPH/40279JD01/119	Conducted Spurious Emissions: 9.205 GHz to 9.165 GHz 1.2 us Pulse Width
GPH/40279JD01/123	Conducted Spurious Emissions: 9.605 GHz to 9.92 GHz 65 ns Pulse Width
GPH/40279JD01/124	Conducted Spurious Emissions: 9.605 GHz to 9.92 GHz 450 ns Pulse Width
GPH/40279JD01/125	Conducted Spurious Emissions: 9.605 GHz to 9.92 GHz 1.2 us Pulse Width
GPH/40279JD01/128	Conducted Spurious Emissions: 9.91 GHz to 12.3 GHz 450 ns Pulse Width
GPH/40279JD01/127	Conducted Spurious Emissions: 9.91 GHz to 18 GHz 450 ns Pulse Width
GPH/40279JD01/136	Conducted Spurious Emissions: 18.0 GHz to 26.5 GHz 450 ns Pulse Width
GPH/40279JD01/130	Conducted Spurious Emissions: 26.5 GHz to 40.0 GHz 450 ns Pulse Width

Graphical Test Results (continued)

Graph Reference Number	Title: Radiated Emissions
GPH/40279JD01/149	Radiated Emissions: 1 GHz to 2 GHz 450 ns Pulse Width
GPH/40279JD01/148	Radiated Emissions: 2 GHz to 4 GHz 450 ns Pulse Width
GPH/40279JD01/145	Radiated Emissions: 4 GHz to 5 GHz 450 ns Pulse Width
GPH/40279JD01/144	Radiated Emissions: 5 GHz to 6 GHz 450 ns Pulse Width
GPH/40279JD01/143	Radiated Emissions: 6 GHz to 8.2 GHz 450 ns Pulse Width
GPH/40279JD01/138	Radiated Emissions: 8.2 GHz to 8.91 GHz 450 ns Pulse Width
GPH/40279JD01/137	Radiated Emissions: 8.2 GHz to 12.5 GHz 450 ns Pulse Width
GPH/40279JD01/142	Radiated Emissions: 8.91 GHz to 9.91 GHz 65 ns Pulse Width (around band edge)
GPH/40279JD01/140	Radiated Emissions: 8.91 GHz to 9.91 GHz 450 ns Pulse Width (around band edge)
GPH/40279JD01/141	Radiated Emissions: 8.91 GHz to 9.91 GHz 1.2 us Pulse Width (around band edge)
GPH/40279JD01/139	Radiated Emissions: 9.91 GHz to 12.5 GHz 450 ns Pulse Width
GPH/40279JD01/146	Radiated Emissions: 12.5 GHz to 18 GHz 450 ns Pulse Width
GPH/40279JD01/147	Radiated Emissions: 18 GHz to 26.5 GHz 450 ns Pulse Width
GPH/40279JD01/150	Radiated Emissions: 26.5 GHz to 40 GHz 450 ns Pulse Width

These pages are not included in the total number of pages for this report.