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TEST REPORT

WatchMate Vision Class B
AIS Transponder with built in display

tested to the specification

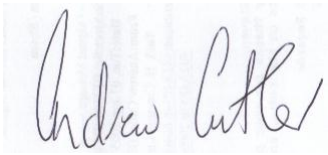
EN 60945: 2002

Maritime navigation and radio communication equipment and systems –

General requirements –
Methods of testing and required test results

for

Vesper Marine Ltd



This Test Report is issued with the authority of:

Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. STATEMENT OF COMPLIANCE

The **WatchMate Vision Class B AIS Transponder with built in display** complies with EN 60945: 2002.

2. RESULTS SUMMARY

Electromagnetic emission tests:

Clause	Application	Result
9.2	Conducted emissions 9 kHz – 30 MHz	Complies with a 1.3 dB margin at 0.513 MHz.
9.3	Radiated emissions 150 kHz – 30 MHz	Complies with a 4.0 dB margin at 24.830 MHz.
9.3	Radiated emissions 30 MHz – 2000 MHz	Complies with 2.1 dB margin at 159.000 MHz (Horizontal).

Electromagnetic immunity tests:

Clause	Application	Result
10.3	Conducted RF disturbance	Complies.
10.4	Radiated disturbance	Complies.
10.5	Fast transients (bursts)	Complies.
10.6	Slow transients (surges)	Not applicable. Device is DC powered
10.7	Power supply short term variations	Not applicable. Device is DC powered.
10.8	Power supply failure	Not applicable. Device is DC powered using an external battery.
10.9	Electrostatic discharge	Complies.

3. INTRODUCTION

This report describes the tests and measurements for the purpose of determining compliance with the specification under the following conditions:

The test sample was selected by the client.

This report relates only to the sample tested.

This report contains no corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

4. CLIENT INFORMATION

Company Name	Vesper Marine Ltd
Address	103 Westhaven Drive, St Marys Bay 1010
City	Auckland
Country	New Zealand
Contact	Carl Omundsen

5. DESCRIPTION OF TEST SAMPLE

Brand Name	WatchMate
Model	Vision
Product	Class B AIS Transponder with built in display
Manufacturer	Vesper Marine Ltd
Country of Origin	New Zealand
Serial Numbers	Sample not serialised

The sample tested was the WatchMate Vision which was tested with a built in display and a WiFi module.

The client advises that this report may also be applied to the following other model which are identical to the model that was tested except for the following differences which simplify the device:

- Model XB-8000. This model is identical to the Vision however it does not have a display
- Model XB-6000. This model is identical to the Vision however it does not have a display and it does not contain a WiFi module

The system tested is primarily an AIS Transponder that operates in the VHF Marine band between 156 – 165 MHz.

This system also contains a GPS receiver and a Wireless Access Point that operated in the 2.4 GHz band with a rated output power of 30 mW (+15 dBm).

The Wireless Access Point will allow access to various information contained within the AIS system using personal computers with appropriate software at various locations throughout the vessel that are away from the AIS Transponder.

The device has the following ports that were terminated as follows:

- AIS transmit / receive antenna port connected to a 50 ohm dummy load
- USB port was connected to USB power supply device using a 5 metre length of data cable
- GPS antenna port connected to a GPS antenna using a 10 metre length of data cable
- NMEA0183 port was connected to an unterminated 5 metre length of data cable
- NMEA2000 port was connected to a 10 metre length of cable that was terminated with a 12 Vdc battery

For testing purposes the device was operated sending AIS messages every 2 seconds

6. SETUPS AND PROCEDURES

Standard

The sample was tested in accordance with EN 60945: 2002.

Electromagnetic emissions:

Method	Protected	Limit
Conducted emissions	10 kHz – 150 kHz 150 kHz – 350 kHz 350 kHz – 30 MHz	96 dBuV- 50 dBuV 60 dBuV- 50 dBuV 50 dBuV
Radiated emissions	150 kHz – 300 kHz 300 kHz – 30 MHz 30 MHz – 2 GHz 156 MHz – 165 MHz	80 dBuV/m – 52 dBuV/m 52 dBuV/m – 34 dBuV/m 54 dBuV/m (120 kHz Bw) 24 dBuV/m Quasi-peak (9 kHz Bw) 30 dBuV/m Peak (9 kHz Bw)

Electromagnetic immunity:

Method	Standard	Criteria
Conducted disturbances 3V r.m.s. 150 kHz – 80 MHz, 10V r.m.s. spot frequencies	EN 61000-4-6, 2004	A
Radiated disturbances 10V/m 80 MHz – 2 GHz	EN 61000-4-3, 2003	A
Fast Transients (bursts) -±1kV common mode signal/ control ports -±2kV AC power ports	EN 61000-4-4, 2004	B
Slow transients (surges) -±1 kV line/earth -±0.5 kV line/line	EN 61000-4-5, 2005	B
Power supply short term variations -± 20% voltage for 1.5s, AC power ports -± 10% frequency for 5s, AC power ports	EN 61000-4-11, 2004	C
Power supply failure 60s interruption, AC and DC power ports	EN 61000-4-11,2004	C
Electrostatic discharge -±8 kV air -±6 kV contact discharges	EN 61000-4-2, 2001	B

Performance Criteria

Performance Criterion A:
The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specifications published by the manufacturer;

Performance Criterion B:
The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specifications published by the manufacturer. During the test, degradation or loss of function or performance which is self- recoverable is however, allowed, but no change of actual operating state or stored data is allowed

Performance Criterion C:
Temporary degradation or loss of function or performance is allowed during the test, provided the function is self-recoverable, or can be restored at the end of the test by the operation of the controls, as defined in the relevant equipment standard and in the technical specifications published by the manufacturer.

Test Set Up:
The device was powered from an external 12 Vdc lead acid battery.

Testing was carried out while the device was operating in AIS mode with the GPS activated and the Wireless Access Point was operating.

The VHF marine antenna port was terminated with either a marine VHF antenna or a length of coax cable and various attenuators depending upon the test being carried.

Testing was carried out with an AIS link established between the device under test and a remote unit where AIS messages were exchanged between each device every 2 seconds.

A video camera was used to monitor the screen of the device under test to ensure the transmitting and receiving of the AIS messages continued in the same sequence and at regular timing intervals during the various tests.

The client advised the device was allowed to miss 1 packet every 5 minutes which give a permissible error rate of less than 1 % (PER < 1%) providing the sequence and timing returned to normal by the next cycle of transmitting and receiving.

During the testing observations were also made to ensure that the WiFi and GPS device continued to operate correctly and that device continued to function correctly which included being able to actuate the touch screen.

A receiver exclusion zone between 1500 – 1650 MHz was applied to the GPS receiver based upon that expressed in EN 301 489-3 for Class 1 Receivers operating between 1 – 2 GHz.

7. TEST RESULTS

Conducted Emissions

Conducted emissions testing was carried out over the frequency range of 10 kHz to 30 MHz.

Testing for conducted emissions was carried out at the laboratory's MacKelvie Street premises in a screened room.

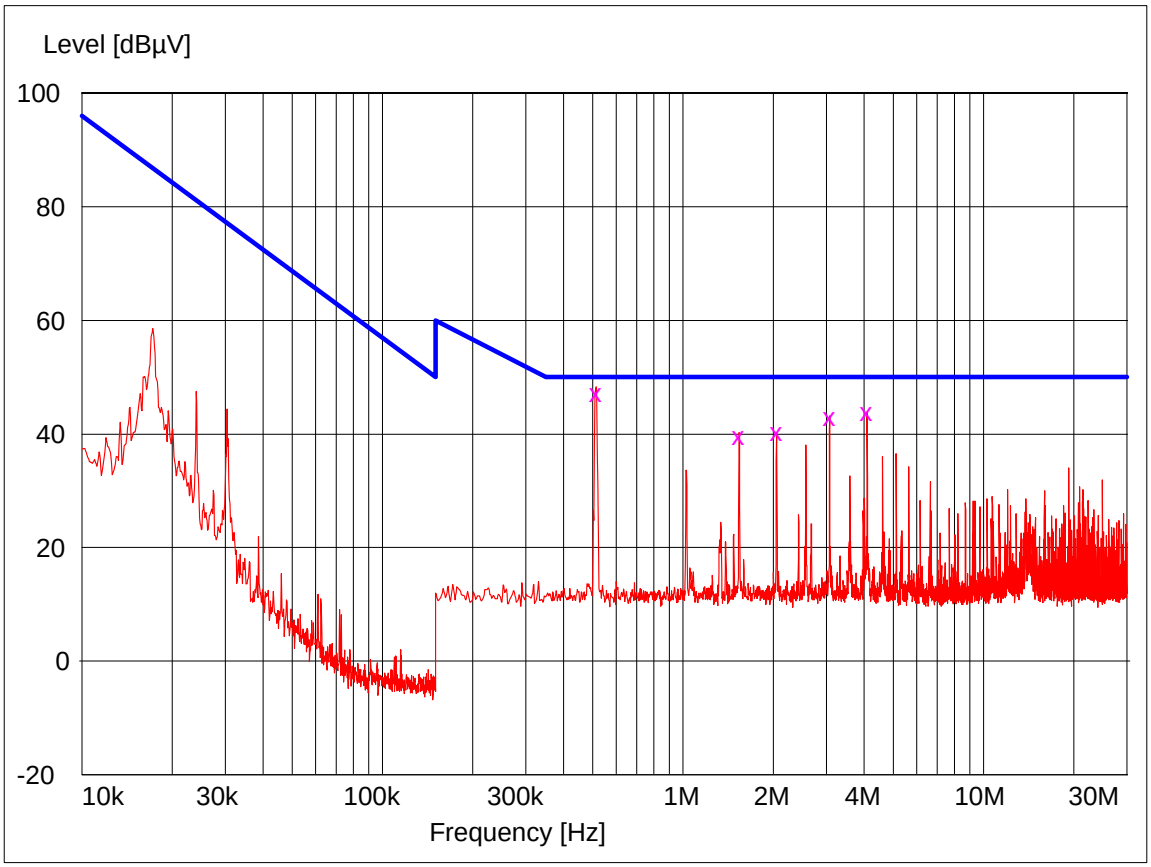
The device was placed 0.8 m away from the closest edge of the artificial mains terminal network on the emissions test table which is 1 m x 1.5 m, and is 0.1 m above the screened room floor which acts as the horizontal ground plane and is 0.6 m away from the screened room wall which acts as the vertical ground plane.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Mains terminal tests (0.01- 30 MHz) ± 2.2 dB

Conducted Emissions – DC input power Port

Setup:	Device tested when powered at 12 Vdc using a lead acid battery when displaying a GPS position and various AIS targets with the WiFi transmitter turned OFF.

Peak ---	Average ---	Quasi Peak X

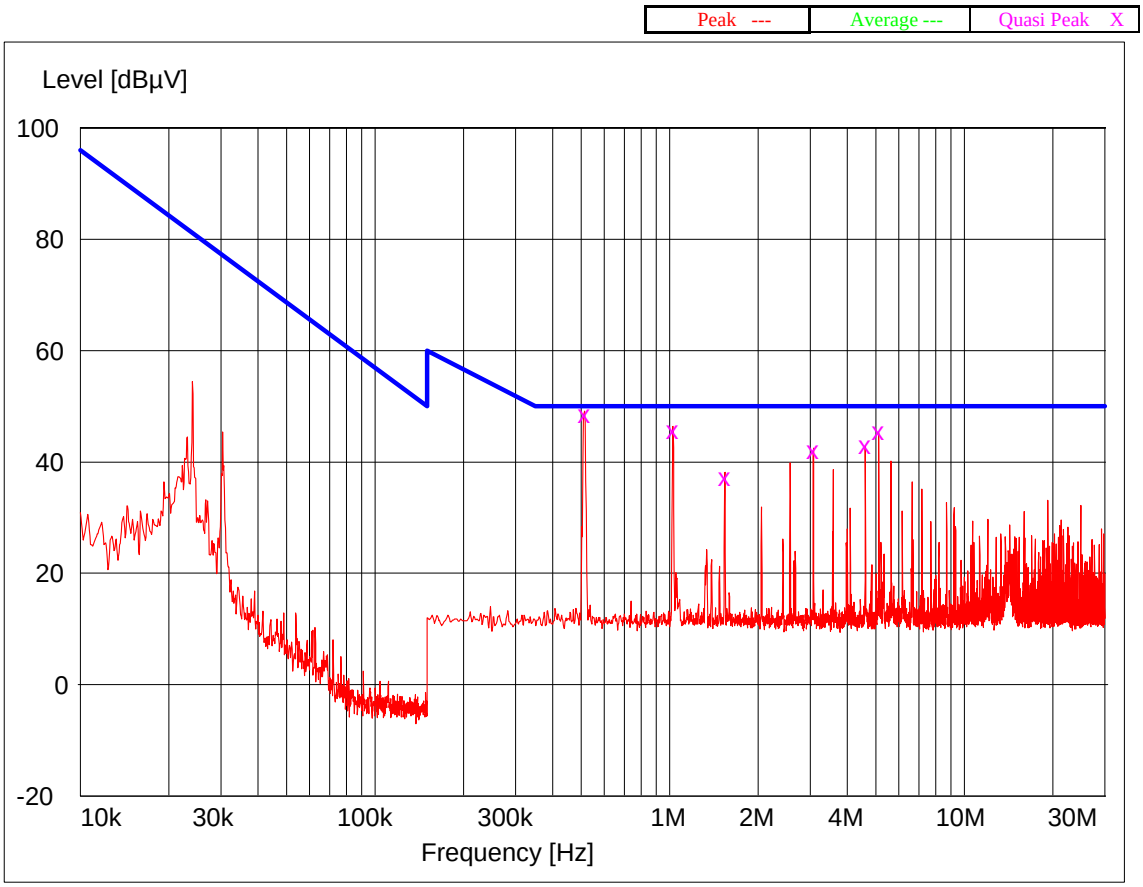


Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Rechecks dBµV
0.513000	47.20	50.0	2.8	46.9
1.536000	39.60	50.0	10.4	
2.049500	40.40	50.0	9.6	
3.075500	43.00	50.0	7.0	
4.097000	44.00	50.0	6.0	

Conducted Emissions – DC input power Port

Setup:	Device tested when powered at 24.0 Vdc using lead acid batteries when displaying a GPS position and various AIS targets with the WiFi transmitter turned ON.



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Rechecks dBµV
0.513000	48.70	50.0	1.3	49.2
1.026000	45.80	50.0	4.2	
1.539000	37.20	50.0	12.8	
3.075500	42.10	50.0	7.9	
4.610000	43.00	50.0	7.0	
5.123000	45.60	50.0	4.5	

Radiated Emissions (0.15 MHz to 2000 MHz)

Radiated emissions testing were carried out over the frequency range of 0.15 to 2000 MHz at the laboratory's open area test site - located at 670 Kawakawa-Orere Road, Orere Point, Auckland, New Zealand (Note: Site conforms to the requirements of CISPR 16, Part 1, Clause 16, and ANSI C63.4 - 2003).

Before testing was carried out, a receiver Self Test and Long calibration routine was undertaken. Additionally, a check of all connecting cables and programmed antenna factors was carried out.

The device was placed on the test tabletop, which was a total of 0.8 m above the test site ground plane.

Measurements of the radiated field were made with the antenna located at a 3 m horizontal distance from the boundary of the devices under test.

In addition measurements were made between 156.0 – 165.0 MHz with a quasi peak limit of 24 dBµV/m being applied (30 dBµV/m in peak).

Testing was carried out in the various modes in which the device operated. Any external cables were orientated for the worst-case emissions level.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower.

The emission is measured in both vertical and horizontal antenna polarisations above 30 MHz.

Between 0.15 – 30 MHz a loop antenna was used the centre of which was 1.5 metres above the test site ground plane.

During the test, a number of ambient emissions are identified (list of which can be provided upon request).

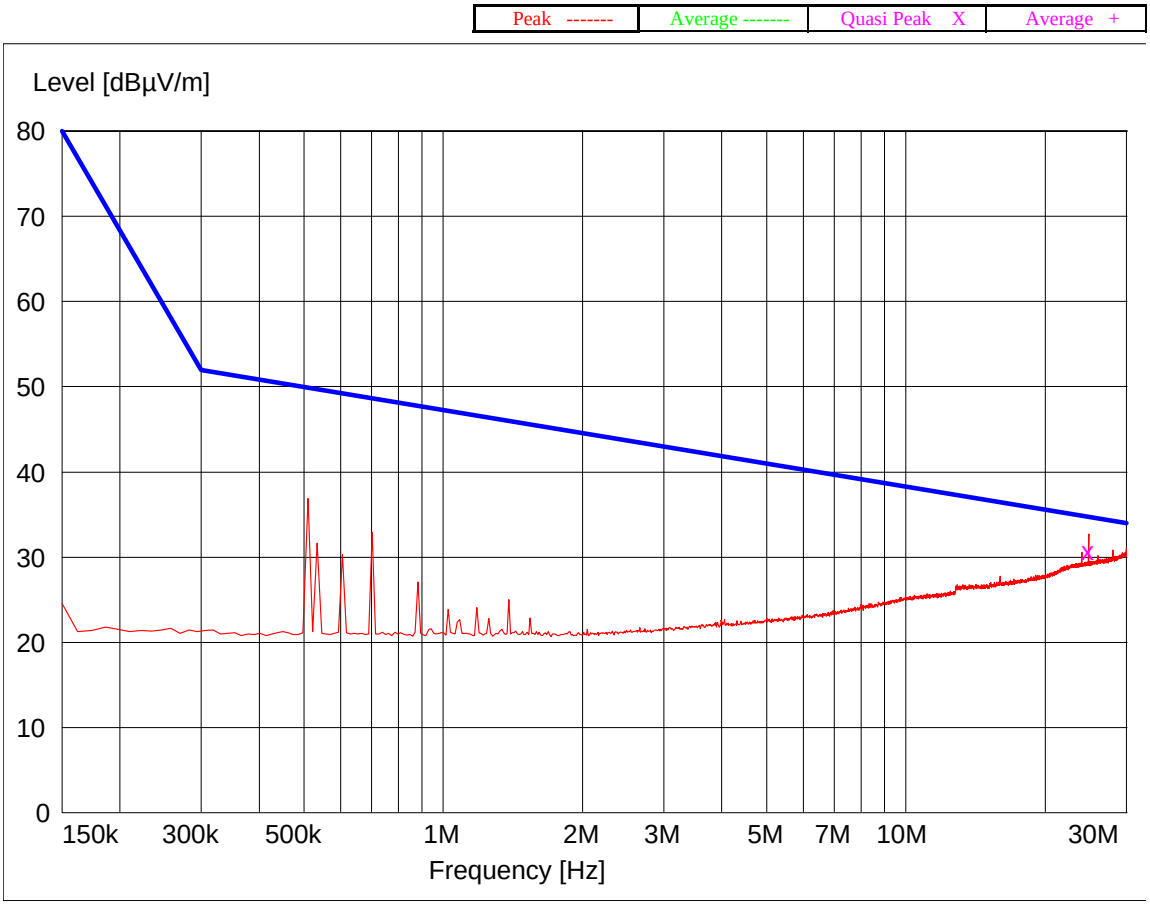
The emission level is determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB) + Coax Loss (dB)

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (0.15 - 2000 MHz) ± 4.5 dB

Radiated emissions (below 30 MHz)

Setup:	Device tested when powered at 12 Vdc when displaying a GPS position and various AIS targets with the WiFi transmitter activated.



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Rechecks dBµV/m
24.830000	30.70	34.7	4.0	

Radiated Emissions (30 – 2000 MHz)

The device was placed in the centre of the test table and was powered at 12 Vdc using a lead acid battery that was placed on test site ground plane.

Attached to the device were:

- a dummy load to the VHF AIS transmitter and receiver.

- GPS antenna to the GPS terminal which was placed to the left of the device under test.

- USB cable which was lead to a passive USB load that was approximately 5 metres from the device under test.

- A powered NEMA 2000 bus cable that was powered at 12 Vdc using a 2nd lead acid battery.

The device was placed upright with the display showing various targets.

A WiFi link was established with a laptop computer that was placed 10 metres from the device under test that was showing raw AIS and NMEA data (gibberish !).

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Antenna
33.600	24.5		54.0	29.5	Vertical
40.810	25.6		54.0	28.4	Vertical
44.545	28.5		54.0	25.5	Vertical
61.850	31.0		54.0	23.0	Vertical
63.500	31.8		54.0	22.2	Vertical
65.218	27.1		54.0	26.9	Vertical
72.190	17.6		54.0	36.4	Vertical
76.000	19.1		54.0	34.9	Vertical
99.940	25.1		54.0	28.9	Vertical
117.000	28.7	27.5	54.0	25.3	Vertical
124.136	37.2	32.5	54.0	16.8	Vertical
140.629	33.3		54.0	20.7	Vertical
148.962	33.1	35.2	54.0	18.8	Horizontal
156.000	17.1	21.2	24.0	2.8	Horizontal
157.500	17.2	21.5	24.0	2.5	Horizontal
159.000	18.3	21.9	24.0	2.1	Horizontal
160.496	17.1	21.5	24.0	2.5	Horizontal
162.000	17.0	21.2	24.0	2.8	Horizontal
163.500	17.0	21.2	24.0	2.8	Horizontal
173.793	31.8	33.5	54.0	20.5	Horizontal
192.000	25.1		54.0	28.9	Vertical
198.619	31.0		54.0	23.0	Vertical
223.450	28.1		54.0	25.9	Vertical
233.956	35.8	41.6	54.0	12.4	Horizontal
248.271	34.1	39.6	54.0	14.4	Horizontal
249.603	31.5		54.0	22.5	Vertical

Radiated Emissions continued

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Antenna
261.815	41.9	45.2	54.0	8.8	Horizontal
279.000	25.2		54.0	28.8	Vertical
288.000	32.6	39.1	54.0	14.9	Horizontal
297.926	33.2	41.5	54.0	12.5	Horizontal
323.954	39.8	45.9	54.0	8.1	Horizontal
392.721	41.3	43.2	54.0	10.8	Horizontal
523.632	43.4	42.0	54.0	10.6	Vertical
654.539	44.9	45.6	54.0	8.4	Horizontal
785.433	38.7	42.1	54.0	11.9	Horizontal
971.854	38.1	36.7	54.0	15.9	Vertical

No further emissions observed within 20 dB of the limit when measurements were attempted up to 2000 MHz when using vertical or horizontal polarizations

Radio Frequency Electromagnetic Field

RF Electromagnetic Field testing was required to be carried out at 10 V/m, between 80 - 2000 MHz, in 1% steps with a 5 second dwell time using a 1 kHz 80% AM modulated carrier.

Testing was carried out using a bilog antenna in both vertical and horizontal polarisations.

The device was required to meet performance criteria A.

The calibration uncertainties for Radiated Susceptibility to EN 61000-4-3 are:
80 - 2000 MHz ± 1.1 V/m

Pretesting of the device, over a period of time, was carried out into all four faces of the device which showed that the front face with display was the worst case face.

Final testing was carried out with the RF being injected into the front faces of the device

Testing was carried out with the AIS link being established using a 10 metre length of coax cable and several 30 dB attenuators.

Observations:

The GPS link was lost between approximately 1550 MHz – 1600 MHz.

The receiver exclusion zone was applied to this disturbance with the GPS link being restored in full by approximately 1630 MHz

A PER of < 1% was observed.

When an error was observed normal operations were observed to return by the next cycle of messages.

This was deemed to be an acceptable loss of performance by the client.

The WiFi link continued to operate correctly throughout the course of the test.

Result: Complies.

The device did not display susceptibility, except as described as above, to Radiated RF Electromagnetic Fields during the test and it did not change state or lose stored data.

The device operated normally after the test.

Conducted RF Susceptibility

Conducted RF susceptibility testing was carried out between 150 kHz and 80 MHz at $3V_{rms}$ with a 400 Hz tone 80% AM modulated.

Additional spot checks were carried out at 10 V_{rms} at 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz.

Testing was carried out in 1% steps with a dwell time of 5 seconds.

The device is required to meet performance criteria A.

Testing was carried out with the AIS link being established using VHF marine antennas attached to each device.

Described below are the calibration uncertainties for Radio frequency continuous conducted susceptibility to EN 61000-4-6:
0.15 – 80.0 MHz ± 1.42 dB

The following ports were tested:

Port Tested	Method	Result	Observation
DC input power port	DC CDN	Pass	A PER of < 1% was observed.
NMEA0183 port	Current Clamp	Pass	A PER of < 1% was observed.
NMEA2000 port	Current Clamp	Pass	A PER of < 1% was observed.

Testing was not carried out on the VHF antenna port or the GPS antenna port.

Result: Complies.

The device did not display susceptibility, except as described as above, to Radiated RF Electromagnetic Fields during the test and it did not change state or lose stored data.

The device operated normally after the test.

Electrical Fast Transients (EFT/B)

± 1.0 kV transients were injected on to the signal control cables using a capacitive clamp.

Testing was carried out for 3 minutes while the device was being operated.

Testing was carried out with the AIS link being established using VHF marine antennas attached to each device.

The device was required to meet performance criteria B.

Described below are the calibration uncertainties for Electrically Fast Transient Bursts to IEC 61000-4-4:

-Peak Output Voltage Upeak 3.0 %
-Rise Time tr 2.5 %
-Pulse Width tw 2.0 %
-Burst Frequency fb 1.0 %
-Burst Duration tb 1.0 %
-Burst Period trep 1.0 %

The following ports were tested:

Port Tested	Method	Result	Observation
DC input power port	Direct	Pass	No effects observed
NMEA0183 port	Clamp	Pass	No effects observed
NMEA2000 port	Clamp	Pass	No effects observed

Testing was not carried out on the VHF antenna port or the GPS antenna port.

Result: Complies.

The device did not display susceptibility to Electrical Fast Transient/Burst (EFT/B) during the test.

The device operated normally after the test.

Electrostatic Discharge (ESD)

ESD testing was required to be carried out with ±8 kV air discharges and ±6 kV contact discharges being applied.

Testing was carried out with the AIS link being established using VHF marine antennas attached to each device.

The device was required to meet performance criteria B.

The calibration uncertainties for Electrostatic Discharge to IEC 61000-4-2 are:

- DC Voltage 0.04%
- Peak Current 4%
- Rise Time 2.5%
- Curve decay points at 30 and 60 nS 5%

10x ± 6kV, Contact discharges were applied at one second intervals as follows:

Point of Contact	Observation	Result
Horizontal Coupling Plane	No effects observed	Pass
Vertical Coupling Plane	No effects observed	Pass
VHF Antenna port shell	No effects observed	Pass
GPS antenna port shell	No effects observed	Pass
NMEA cable shell	No effects observed	Pass
All of the case screws	No effects observed	Pass

10 x ± 8 kV Air discharges were applied at one second intervals as follows:

Point of Contact	Observation	Result
Four corners of the LCD screen	No effects observed	Pass
Centre of the LCD screen	No effects observed	Pass
Various other non conducting surfaces on the device	No effects observed	Pass

Result: Complies.

The device did not display susceptibility to Electrostatic Discharges throughout the test and continued to operate normally after the test.

8. EQUIPMENT USED

Instrument:	Manufacturer	Model	Serial No	Asset Ref
2m Triple Antenna	Rohde & Schwarz	HM020	843885/004	-
Loop Antenna	EMCO	6502	9003-2485	3798
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Anechoic Material	Rantec	ERP24 Cones	-	-
Anechoic Material	Rantec	Ferrite Tiles	-	-
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612
Bilog Antenna	EMCO	3141	9707-1071	E1596
Coax Cable	Sucoflex	104PA	2736/4PA	-
Log periodic Antenna	Schwarzbec	VUSLP 9111	9111-2801	3785
Measurement Receiver	Rohde & Schwarz	ESHS 10	838693/002	3800
Measurement Receiver	Rohde & Schwarz	ESIB-40	100171	R-27-1
Microwave RF Amplifier	Ophir	5162FE	1029	E3786
Power Amplifier	IFI	M75	B373-1098	RFS 3773
Power Amplifier	Amplifier Research	10W1000	8329	E1138
Signal Generator	Rohde & Schwarz	SMP04	1035 5005 04	E1560
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709
ESD Gun	Schaffner	NSG 435	1261	E1426

9. ACCREDITATIONS

The tests were carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ ISO 17025.

All measurement equipment was calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ ISO 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with a number of accreditation bodies in various economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

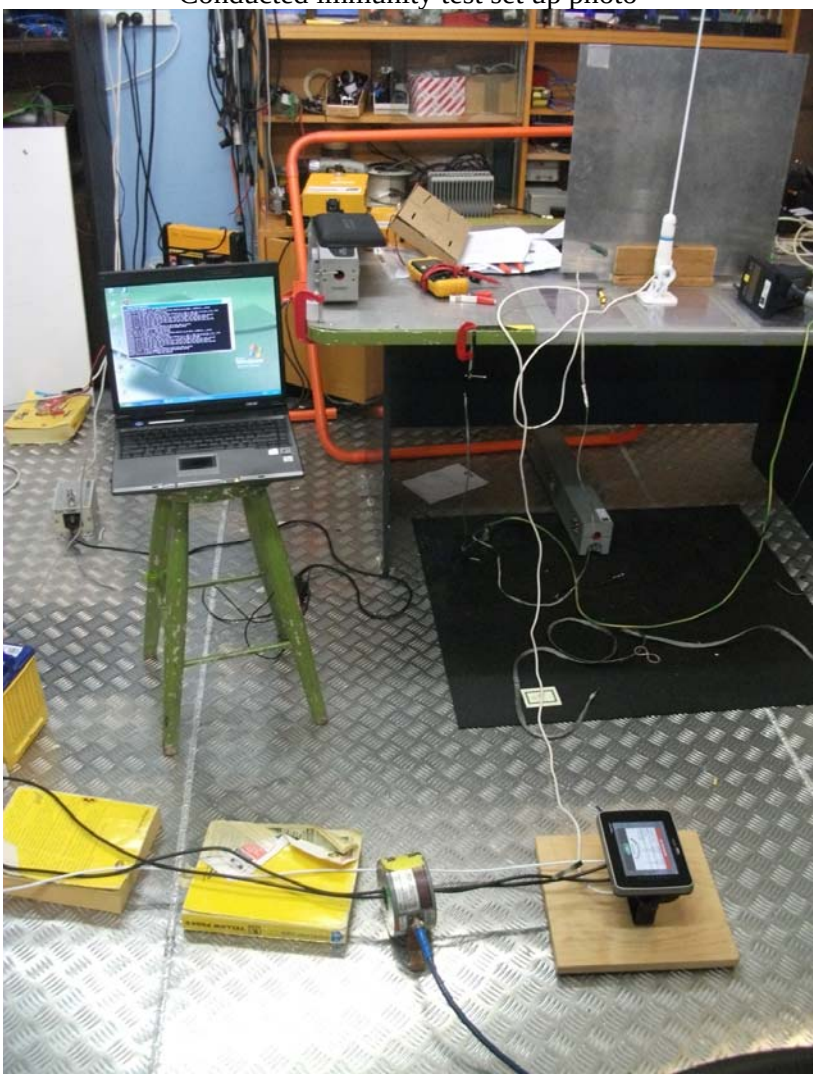
10. PHOTOGRAPHS

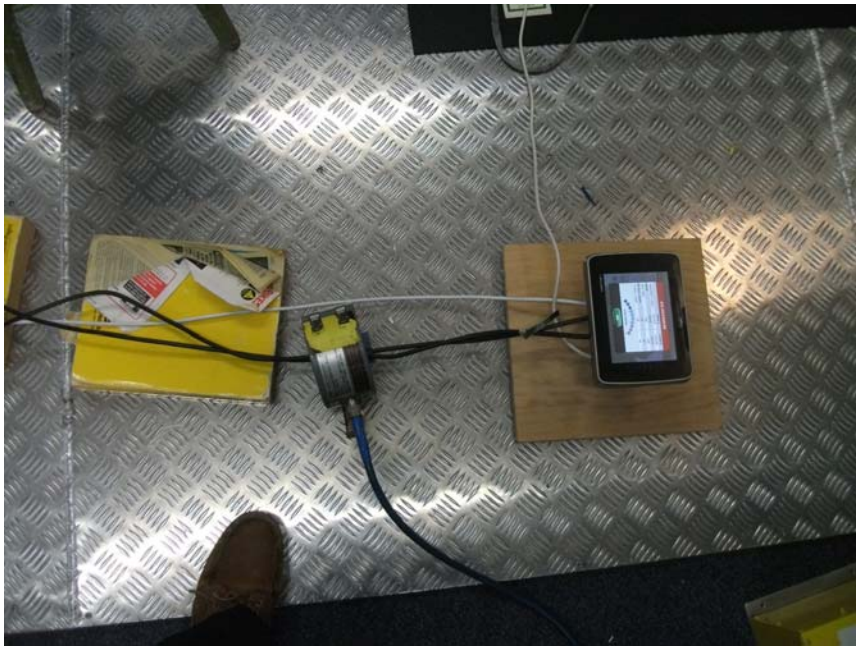
Device under test as submitted

Device under test and ancillary items as submitted

Radiated immunity test set up photos

Conducted immunity test set up photo





Radiated emissions test set up photos