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FCC PART 80 AND IC RSS-182 TEST REPORT

APPLICANT	NAVICO AUCKLAND LTD
	3-5 OMEGA STREET ALBANY 0632 AUCKLAND NEW ZEALAND
FCC ID	RAYVHFLINK5
IC CERTIFICATION	4697A-VHFLINK5
MODEL NUMBER	LINK-5
PRODUCT DESCRIPTION	VHF MOBILE MARINE TRANSCEIVER WITH DSC
DATE SAMPLE RECEIVED	1/6/2012
DATE TESTED	2/8/2012
TESTED BY	Nam Nguyen
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	45AUT12TestReport.doc
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**



Certificate # 0955-01



TABLE OF CONTENTS

GENERAL REMARKS.....	3
GENERAL INFORMATION	4
TEST PROCEDURES	5
TECHNICAL DATA	6
RF POWER OUTPUT	7
MODULATION CHARACTERISTICS.....	8
AUDIO FREQUENCY RESPONSE	9
AUDIO LOW PASS FILTER.....	10
AUDIO INPUT VERSUS MODULATION	11
OCCUPIED BANDWIDTH	12
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED).....	15
FIELD STRENGTH OF SPURIOUS EMISSIONS.....	17
FREQUENCY STABILITY.....	19
EMC EQUIPMENT LIST	20

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:

- ☒ fulfill the general approval requirements as identified in this test report
☐ not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.



Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669



Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date: February/9/2012

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



GENERAL INFORMATION

DUT Specification

DUT Description	VHF MOBILE MARINE TRANSCEIVER
FCC ID	RAYVHFLINK5
IC Certification	4697A-VHFLINK5
Model Number	LINK-5
Operating Frequency	156.025-157.425 MHz
Test Frequencies	(156.05 and 157.425) MHz
Type of Emission	16K0G3E, 16k0G2B (DSC)
Modulation	FM
DUT Power Source	<input type="checkbox"/> 110-120Vac/50- 60Hz
	<input checked="" type="checkbox"/> DC Power 12V
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input type="checkbox"/> Portable
Test Conditions	Temperature was 26°C Relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in a continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 80, IC RSS-182 and RSS-GEN
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



TEST PROCEDURES

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C: 2004 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI C63.4-2004 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a micro volt at the output of the antenna.

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



TECHNICAL DATA

- 80.203 (b) **External Controls:** The transmitter is capable of changing frequency between 156.05 – 157.425 MHz by external control. The available channels are shown in the User Manual description Channel List. These channels are preprogrammed by the manufacturer and change of frequency is inaccessible to the station operator.
- 80.203 (c) Five minutes continuous transmission test. The antenna was connected to a dummy load and the radio was locked in a transmit PTT mode. An external timer digital clock was used to observe the duration of the un-modulated transmission. The transmitter turned off and the radio went to receive mode at 4 minutes, 58 seconds as displayed by the external digital clock.
- 80.203 (n) This radio complies with the requirement for DSC capability in the 156 – 162 MHz band and in accordance with 80.225.
- 80.873; 80.956 Transmitter G3E emission capability: The transmitter was connected to 50 ohm resistive wattmeter and the frequency was set to 156.300 and to 156.800 MHz. With normal modulation, the output power displayed was 25 Watts at the high power setting and 1 watt at low power setting, consistent with previous measurements.
- The transmitter has been demonstrated to be capable, with normal operating voltages applied, of delivering 25 watts of carrier power into a 50 ohm resistive load over the specified frequencies.
- 80.911 (a) 80.956 G3E Transmissions: This radio is capable of G3E emission on 156.300 and 156.800 MHz
- 80.911 (c) With 13.6 VDC applied and with the radio connected to a 50 ohm resistive wattmeter, the output power was measured at 156.300 and 156.800 MHz with a measured reading of 25 Watts under normal speech modulation.
- 80.911 (d)(2) 80.959 With the power supply set to 13.6 VDC, and the output of the transmitter terminated in a 50 ohm matching artificial load, the transmitter output power was monitored over a 10 minute continuous operational period while in full power. The output power varied from the nominal 25 Watts output power to 24.8 Watts output power

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

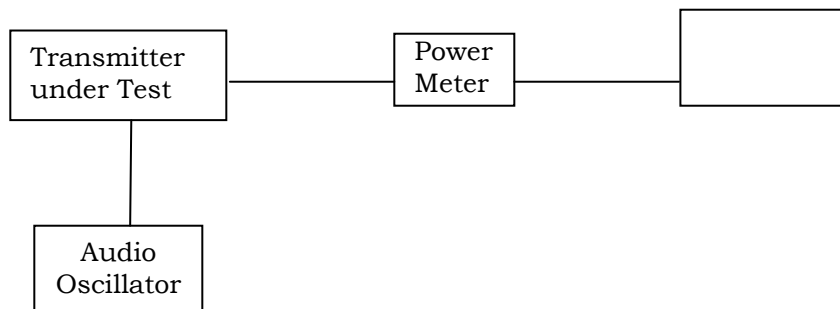
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), 80.215(e)(1), IC RSS-182

Test Requirements:

Method of Measurement: RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:



Test Data:

OUTPUT POWER: HIGH – 25.0 Watts
LOW - 1.0 Watts

Part 2.1033 (C)(8) DC Input into the final amplifier

FOR LOW POWER SETTING INPUT POWER: $(13.6V)(0.89A) = 12.10$ Watts
FOR HIGH POWER SETTING INPUT POWER: $(13.6V)(4.40A) = 59.84$ Watts

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



MODULATION CHARACTERISTICS

Part 2.1033(c) (4) Type of Emission: 16K0G3E, 16K0G2B

FCC Part 80.205(a)

RSS-182, RSS-GEN

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 4.6\text{kHz (Peak Deviation)}$$

$$K = 1$$

$$B_n = 2(3000) + 2(4.6K)(1) = 16.0K$$

80.205(a) ALLOWED AUTHORIZED BANDWIDTH – 20.00 kHz

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

AUDIO FREQUENCY RESPONSE

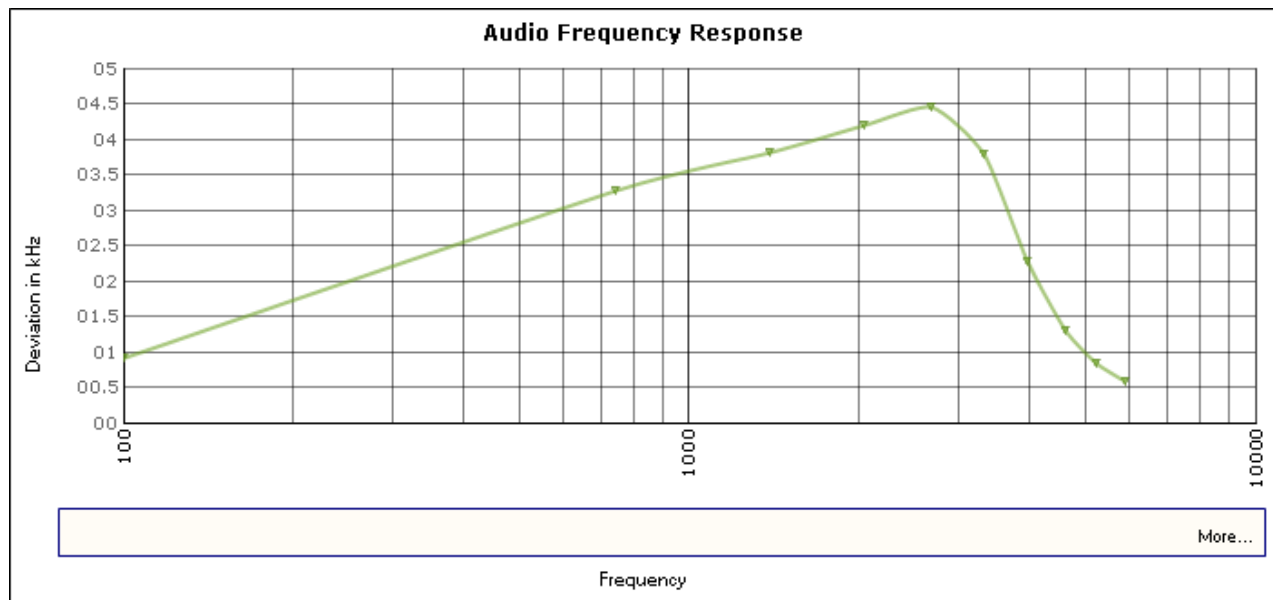
Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-182

Test Requirements:

Method of Measurement:

The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

AUDIO FREQUENCY RESPONSE PLOT



Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYVHFLINK5
 IC CERT #: 4697A-VHFLINK5
 Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

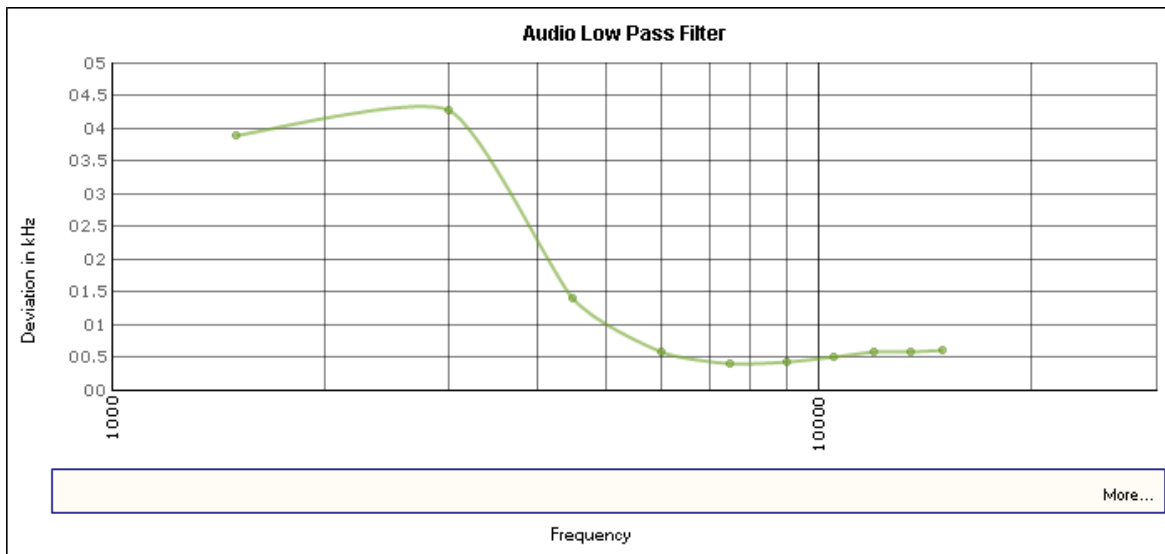
AUDIO LOW PASS FILTER

VOICE MODULATED COMMUNICATION EQUIPMENT

Rule Part No.: 2.1047(a)

For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

AUDIO LOW PASS FILTER



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 FCC ID: RAYVHFLINK5
 IC CERT #: 4697A-VHFLINK5
 Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

AUDIO INPUT VERSUS MODULATION

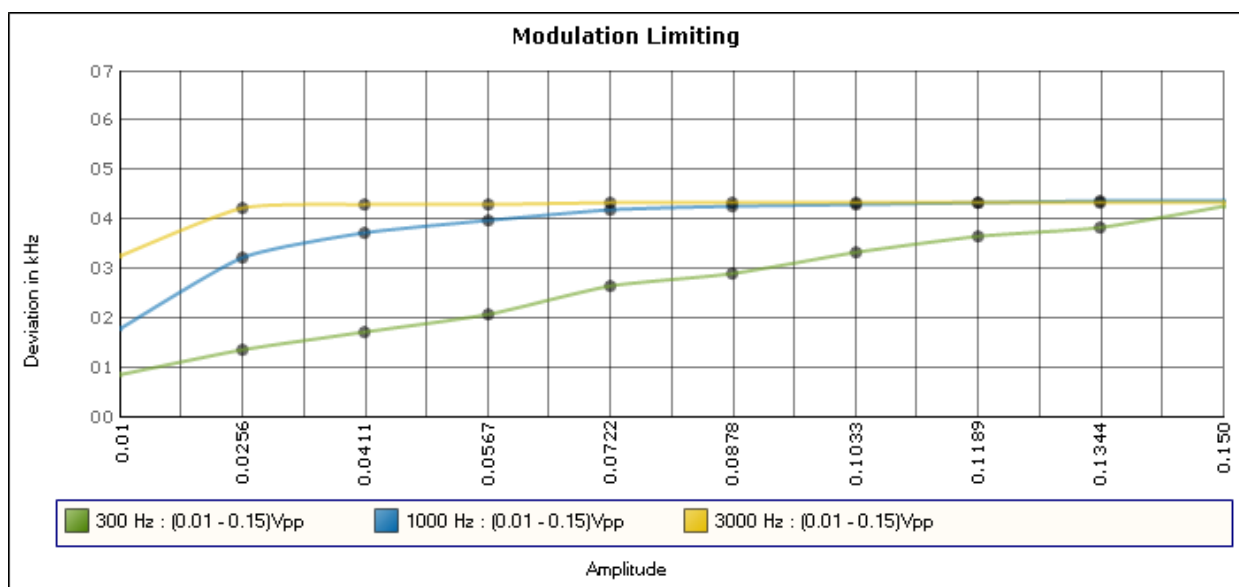
Rule Part No.: FCC Part 2.1047(b) & 80, IC RSS-182

Test Requirements: Modulation cannot exceed 100%.

Method of Measurement: The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C:2004. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

Test data:

Modulation Limiting Plot



Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYVHFLINK5
 IC CERT #: 4697A-VHFLINK5
 Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

OCCUPIED BANDWIDTH

FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH

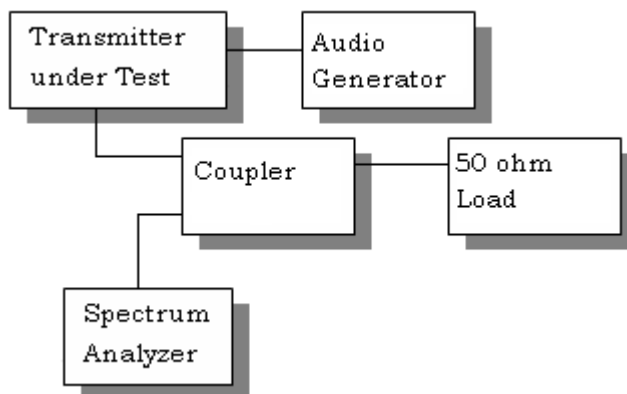
FCC Part 80.213(b) RSS-182

Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least $43 + 10\log(P)$ dB.

Method of Measurement: ANSI/TIA-603-C: 2004

Test Setup Diagram:

OCCUPIED BANDWIDTH MEASUREMENT

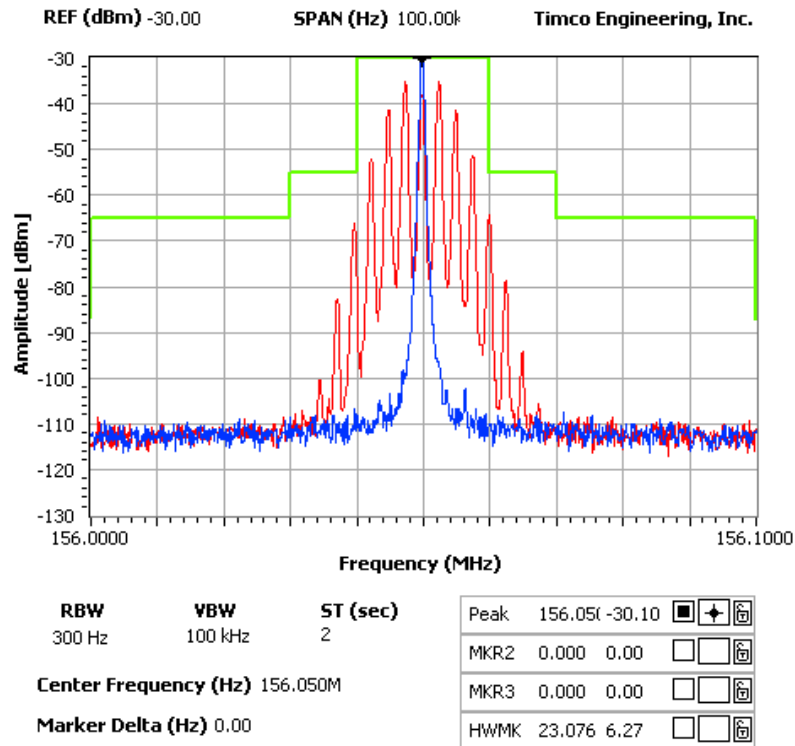


Test Data: See the plot below
Voice

NOTES:

NAVICO AUCKLAND LTD - VHF MOBILE MARINE TRANSCEIVER
OCCUPIED BANDWIDTH PLOT

FCC 80.213 Mask B

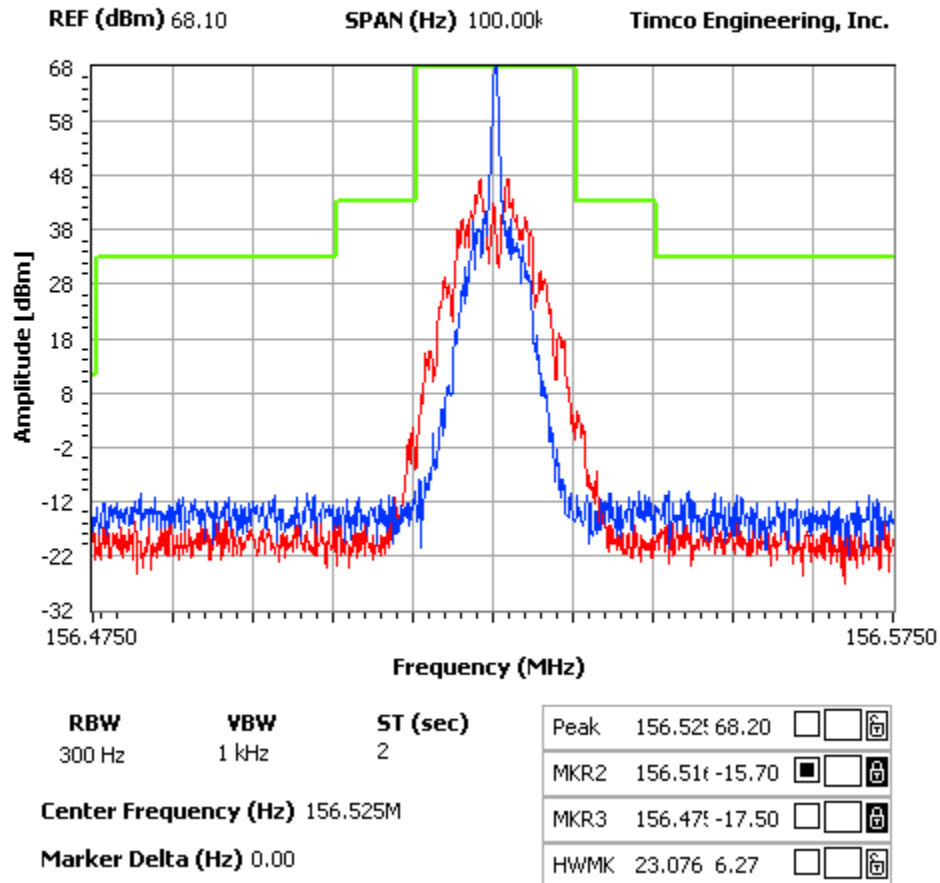


Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

DSC

NOTES:

FCC 90.210 Mask B



Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYVHFLINK5
 IC CERT #: 4697A-VHFLINK5
 Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), 80.211, RSS-182

Requirements: Emissions must be $43 + 10\log(\text{PO})$ dB below the mean power output of the transmitter.

High power; $43 + 10\log(25.0) = 57.0$ dB

Low power; $43 + 10\log(1.0) = 43.0$ dB

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C: 2004.

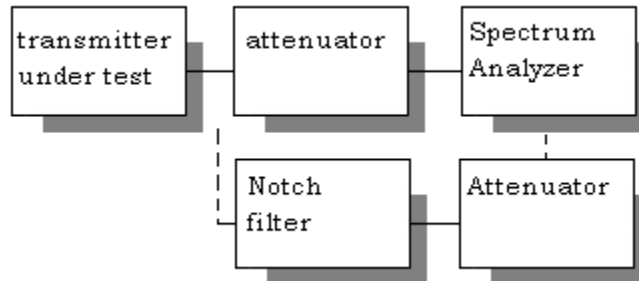
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
156.05	312.10	79.4		156.05	312.10	103.3
	468.10	70.2			468.10	82.2
	624.20	95.3			624.20	101.2
	780.20	88.1			780.20	100.4
	936.30	110.1			936.30	104.8
	1092.30	102.3			1092.30	102.3
	1248.40	109.2			1248.40	104.1
	1404.40	101.7			1404.40	104
	1560.50	106.4			1560.50	102

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
157.43	314.85	80.8		157.43	314.85	102.6
	472.28	77.2			472.28	80.4
	629.70	95.6			629.70	105.1
	787.13	87.2			787.13	98.5
	944.55	108.4			944.55	103.9
	1101.98	108.5			1101.98	105
	1259.40	109.9			1259.40	105.4
	1416.83	106.9			1416.83	104.8
	1574.25	107.3			1574.25	103.2

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



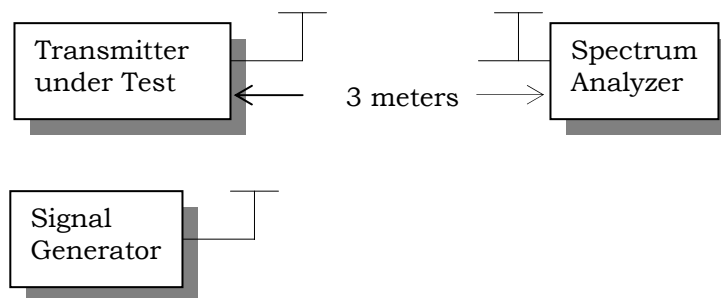
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, RSS-182

Requirements: Emissions must be 43+10log(PO) dB below the mean power output of the transmitter.

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-C: 2004 using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

Test Setup Diagram:



Test Data:

TF	EF	Ant Polarity	dB below carrier	TF	EF	Ant Polarity	dB below carrier
HIGH POWER				LOW POWER			
156.05	312.10	H	110.4	156.05	312.10	H	96.5
	468.10	H	112.2		468.10	H	102.6
	624.20	H	111.5		624.20	H	104.2
	780.20	H	110.1		780.20	H	101.4
	936.30	H	111.9		936.30	H	98.3
	1092.30	H	100.6		1092.30	H	87.6
	1248.40	H	99.8		1248.40	H	86.5
	1404.40	H	99.5		1404.40	H	85.5
	1560.50	H	99.7		1560.50	H	85.8

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc

**Test Data:**

TF	EF	Ant Polarity	dB below carrier
HIGH POWER			
157.43	314.85	H	110.9
	472.28	H	111.5
	629.70	H	104.8
	787.13	H	110.3
	944.55	H	111.9
	1101.98	H	101.1
	1259.40	H	100.2
	1416.83	H	98.8
	1574.25	H	98.6

TF	EF	Ant Polarity	dB below carrier
LOW POWER			
157.43	314.85	H	98.4
	472.28	H	103.
	629.70	H	104.5
	787.13	H	101.3
	944.55	H	98.2
	1101.98	H	87.3
	1259.40	H	86.7
	1416.83	H	84.9
	1574.25	H	85.3

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 80.209(a), RSS-182, RSS-GEN

Requirements: Temperature and voltage tests were performed to verify that the frequency remains within the .0010%, 10.0 ppm, specification limit, for 20 kHz spacing. The test was conducted as follows: The transmitter was placed in the temperature chamber at 25°C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worst-case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -20°C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute and was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute and again frequency readings were noted at 15 sec intervals. The worst-case number was recorded for temperature plotting. This procedure was repeated in 10-degree increments up to +50°C.

Method of Measurements: ANSI/TIA 603-C: 2004

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		156.049728
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	156.049372	-2.28
-20	156.049303	-2.72
-10	156.049430	-1.91
0	156.049641	-0.56
+10	156.049709	-0.12
+20	156.049733	0.03
+30	156.049684	-0.28
+40	156.049833	0.67
+50	156.050159	2.76

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	Frequency (MHz)	Frequency Stability (PPM)
-15%	156.049730	0.01
0	156.049728	0
+15%	156.049727	-0.01

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYVHFLINK5
IC CERT #: 4697A-VHFLINK5
Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc



EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 12/31/11	12/31/13
AC Voltmeter	HP	400FL	2213A14499	CAL 6/12/11	6/12/13
Antenna: Active Loop	ETS-Lindgren	6502	00062529	CAL 9/23/10	9/23/12
Frequency Counter	HP	5385A	2730A03025	CAL 8/17/11	8/17/13
Hygro-Thermometer	Extech	445703	0602	CAL 6/15/11	6/15/13
Modulation Analyzer	HP	8901A	3435A06868	CAL 7/18/11	7/18/13
Digital Multimeter	Fluke	FLUKE-77	35053830	CAL 9/9/11	9/9/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 10/28/11	10/28/13
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 10/28/11	10/28/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 10/28/11	10/28/13
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 4/25/12	4/25/14
Antenna	ETS	3117	35923	12/7/2011	12/7/2013
Antenna	Electro metrics	LPA-25	1122	5/04/2011	5/04/2013
Antenna	Electro metrics	BIA-25	1096	5/04/2011	5/04/2013

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYVHFLINK5
 IC CERT #: 4697A-VHFLINK5
 Report: N\NAVICO AUCKLAND_RAY\45AUT12\45AUT12TestReport.doc