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FCC PART 80 AND IC RSS-182 (i5) TEST REPORT

APPLICANT	NAVICO AUCKLAND LTD
	3-5 OMEGA STREET ALBANY 0632 AUCKLAND NEW ZEALAND
FCC ID	RAYLINK2
IC CERTIFICATION	4697A-LINK2
MODEL NUMBER	LINK-2, HH36
PRODUCT DESCRIPTION	HANDHELD MARINE TRANSCEIVER
DATE SAMPLE RECEIVED	2/11/2013
DATE TESTED	2/14/2013
TESTED BY	JOE SCOGLIO
APPROVED BY	JOE SCOGLIO
TIMCO REPORT NO.	260AUT13TestReport.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.**



Testing Certificate 0955-01

TABLE OF CONTENTS

GENERAL REMARKS	3
GENERAL INFORMATION	4
TEST PROCEDURES.....	5
RF POWER OUTPUT	6
MODULATION CHARACTERISTICS.....	7
AUDIO FREQUENCY RESPONSE.....	8
AUDIO LOW PASS FILTER	9
AUDIO INPUT VERSUS MODULATION.....	10
OCCUPIED BANDWIDTH	11
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED).....	14
FIELD STRENGTH OF SPURIOUS EMISSIONS	16
FREQUENCY STABILITY.....	18
EMC EQUIPMENT LIST.....	19

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.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: 2005 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:

Joe Scoglio
Compliance Tech./ Project Manager

Date: **2/14/2013**

Applicant: NAVICO AUCKLAND LTD
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IC CERT #: 4697A-LINK2
Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

GENERAL INFORMATION

DUT Specification

DUT Description	HANDHELD MARINE TRANSCEIVER
FCC ID	RAYLINK2
IC Certification	4697A-LINK2
Model Number	LINK-2, HH36
Operating Frequency	156.025-157.425 MHz
Test Frequencies	156 MHz, 157.4 MHz
Type of Emission	16K0G3E, 16K0G2B
Modulation	FM
DUT Power Source	<input type="checkbox"/> 110-120Vac/50- 60Hz
	<input type="checkbox"/> DC Power 12V
	<input checked="" 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 type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input checked="" type="checkbox"/> Portable
Test Conditions	The temperature was 26°C Relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 80, IC RSS-182 (issue 5) and RSS-GEN (issue 3)
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.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.

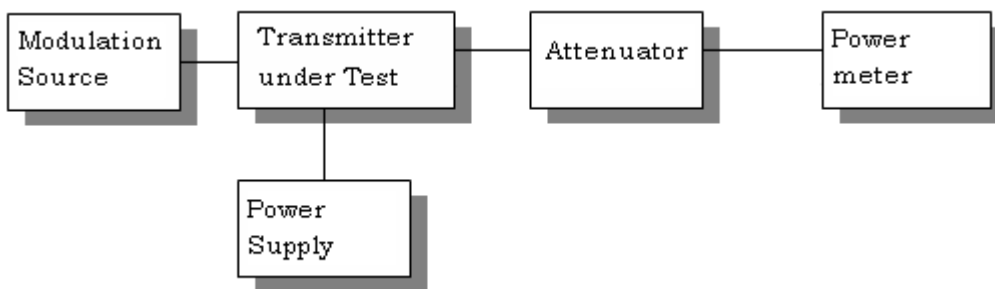
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), 80.215(e)(1), IC RSS-82

Test Requirements:

Method of Measurement: RF power is measured by connecting as per setup diagram. With a nominal voltage, and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:



Test Data:

OUTPUT POWER: HIGH – 5.0 watts
LOW - .63 watts

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

FOR LOW POWER SETTING INPUT POWER: $(7.2V)(0.67A) = 4.8$ Watts
FOR HIGH POWER SETTING INPUT POWER: $(7.2V)(1.56A) = 11.2$ Watts

Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYLINK2
IC CERT #: 4697A-LINK2
Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

MODULATION CHARACTERISTICS

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

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

The 99 % bandwidth for the DSC is 16 kHz. 16K0G2B

AUDIO FREQUENCY RESPONSE

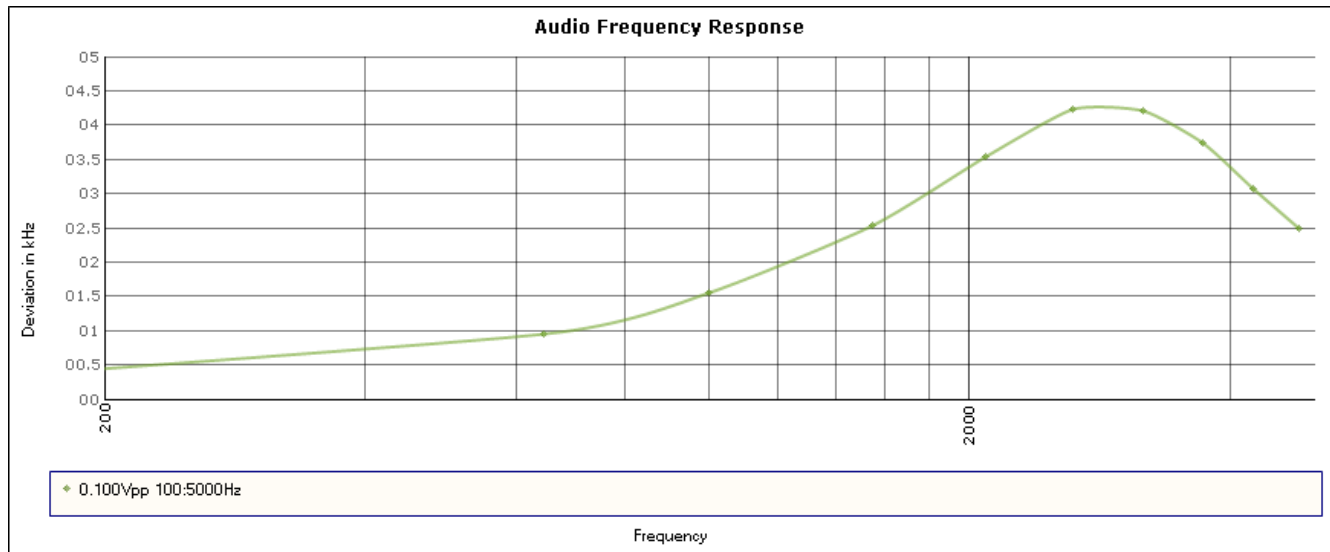
Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-182

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: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

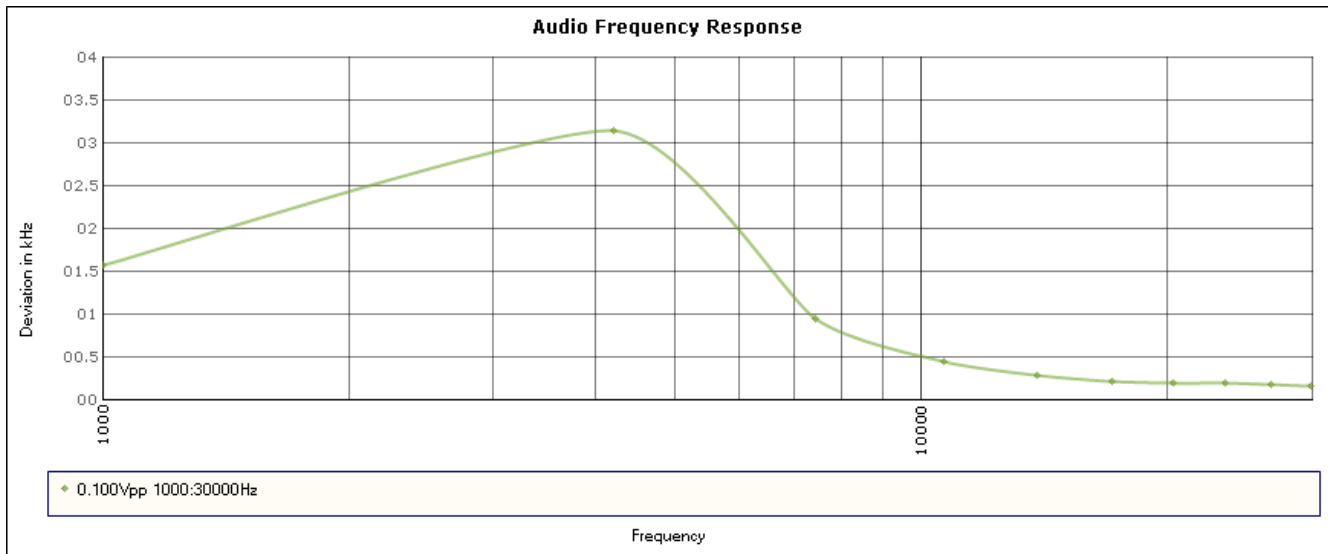
AUDIO LOW PASS FILTER

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: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

AUDIO INPUT VERSUS MODULATION

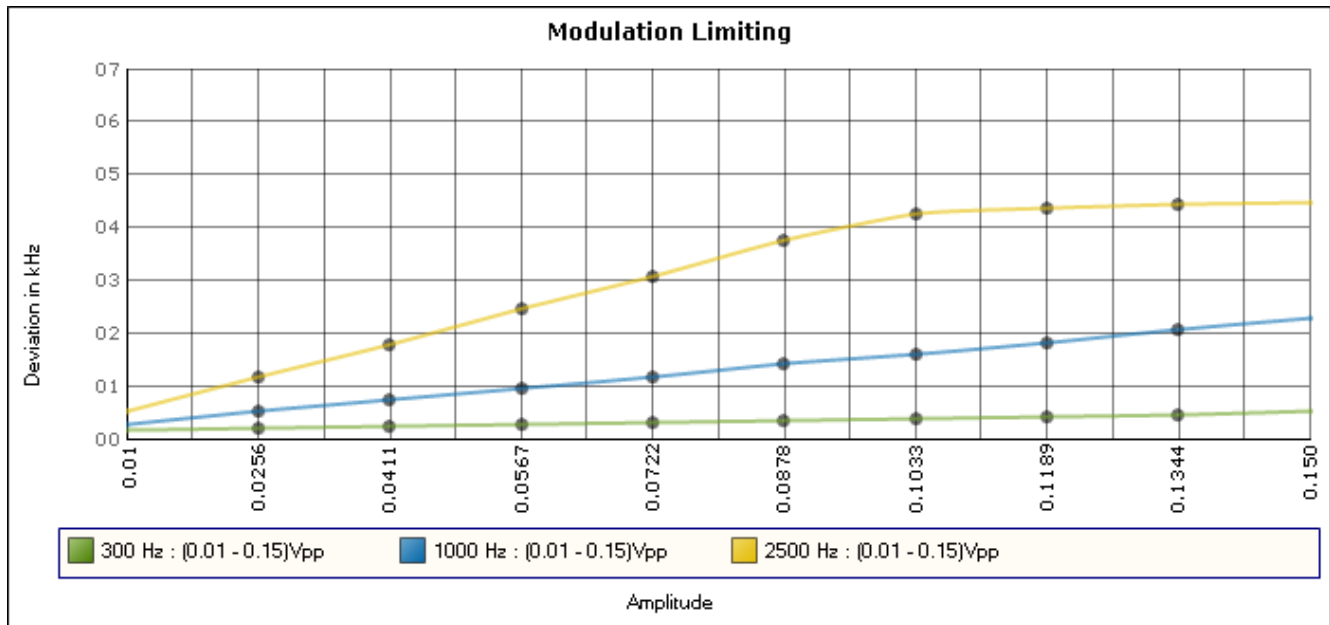
Rule Part No.: FCC Part 2.1047(b) & 80, IC RSS-182

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: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

OCCUPIED BANDWIDTH

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

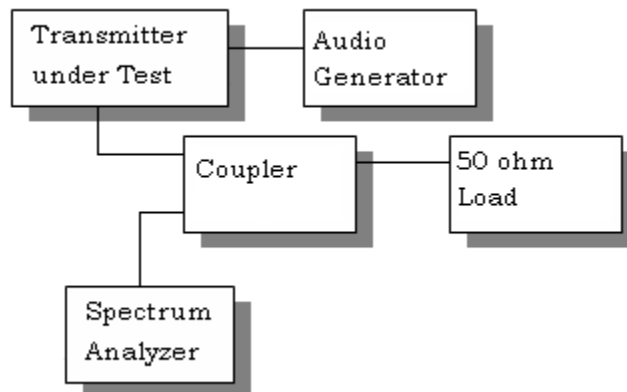
FCC Part 80.213(b) RSS-182

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:

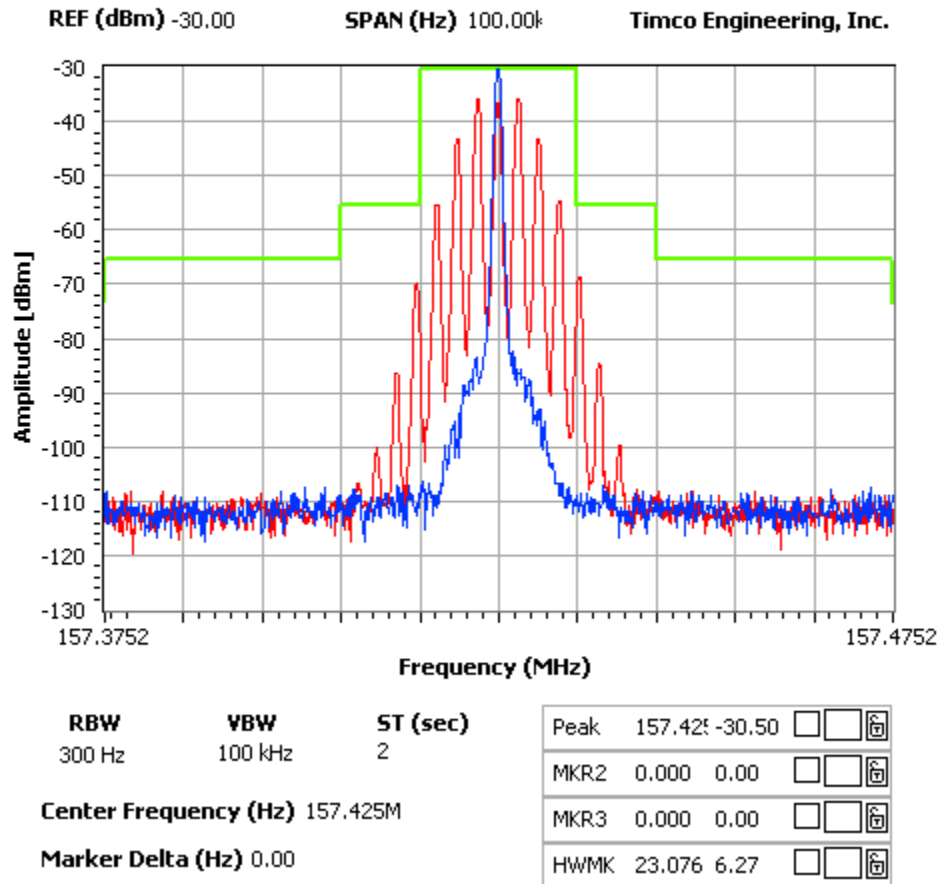
OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plot below

Occupied bandwidth audio

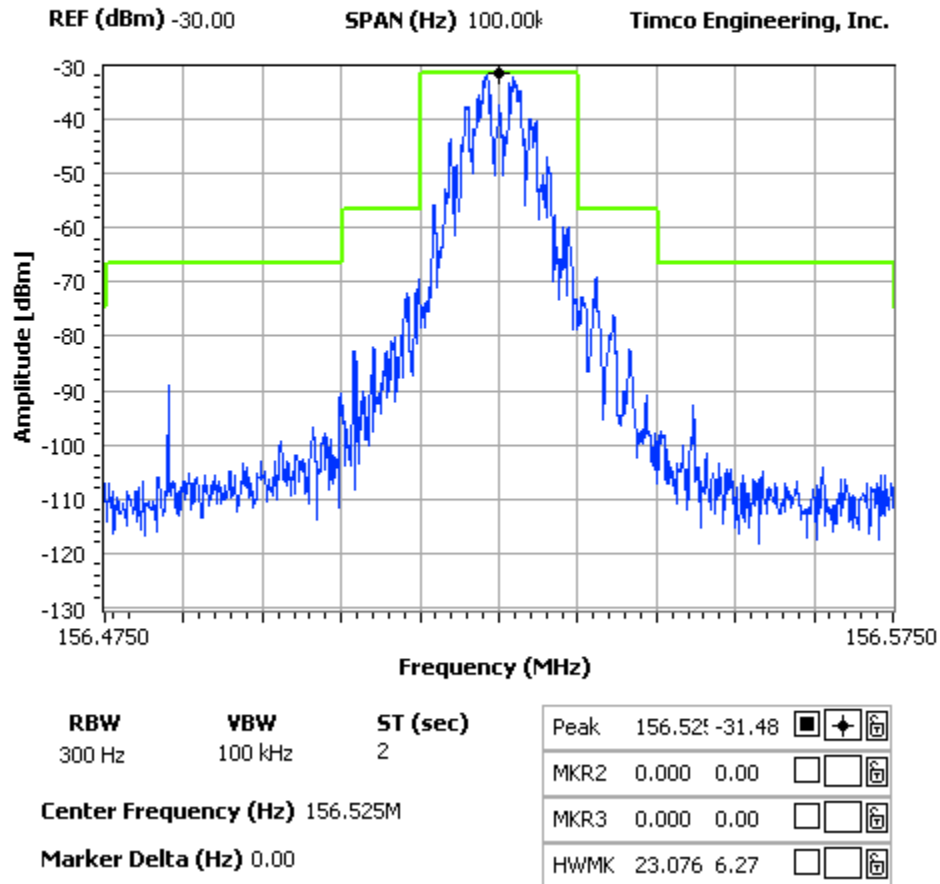
NOTES:



Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

Occupied BW DSC

NOTES:



Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

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

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.

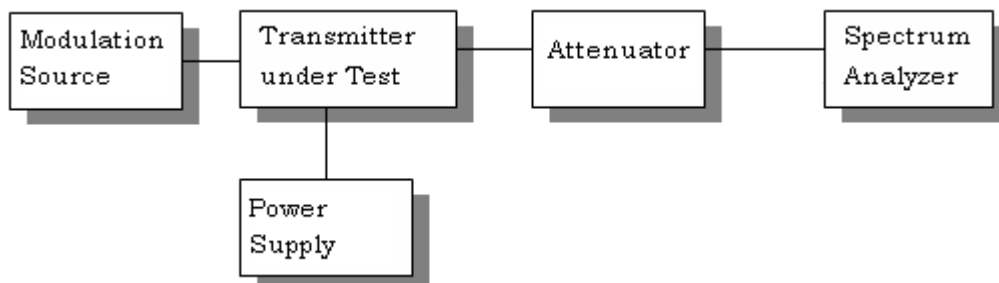
Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
156	156	0		156	156	0
	312.1	86.1			312.1	80.2
	468.1	104.6			468.1	90.3
	624.2	105.3			624.2	95.8
	780.2	103.3			780.2	96.2
	936.3	107			936.3	102.5
	1092.3	104.3			1092.3	101
	1248.4	107.9			1248.4	101.1
	1404.4	107.7			1404.4	101.7
	1560.5	108.3			1560.5	104

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
157.4	157.4	0		157.4	157.4	0
	314.8	86.1			314.8	80.7
	472.2	103.5			472.2	90.5
	629.7	105.8			629.7	95.3
	787.1	106.4			787.1	96.4
	944.5	105.7			944.5	102.1
	1101.9	103.9			1101.9	101.8
	1259.4	106.7			1259.4	101
	1416.8	106.7			1416.8	102.3
	1574.2	107.5			1574.2	103.5

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004.

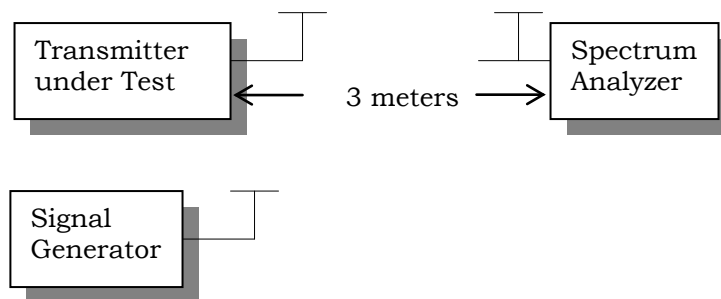
FIELD STRENGTH OF SPURIOUS EMISSIONS

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

Requirements: Emissions must be $43+10\log(\text{PO})$ 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:



Applicant: NAVICO AUCKLAND LTD
FCC ID: RAYLINK2
IC CERT #: 4697A-LINK2
Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

Test Data:

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
156.00	V	0
312.10	V	101.5
468.10	V	101.4
624.20	V	100.3
780.20	V	96.0
936.30	V	101.8
1248.40	H	92.4

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
157.40	V	0
314.80	V	95.0
472.20	V	100.9
624.20	V	100.5
780.20	V	95.5
936.30	V	99.5
1248.40	H	91.5

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
156.00	V	0
312.10	H	94.5
468.10	V	94.1
624.20	V	92.5
780.20	V	90.6
936.30	V	93.7

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
157.40	V	0
314.80	H	93.5
472.20	V	95.1
624.20	V	91.0
780.20	V	92.2
936.30	V	91.4

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)		
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	157.424966	-0.27
-20	157.424993	-0.10
-10	157.425021	0.08
0	157.425028	0.12
+10	157.425025	0.10
+20	157.425009	0.00
+30	157.424978	-0.20
+40	157.424973	-0.23
+50	157.424971	-0.24

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	Frequency (MHz)	Frequency Stability (PPM)
-15%	157.425003	-0.04
0	157.425009	0
+15%	157.424997	-0.08

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	10/28/11	10/28/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	10/28/11	10/28/13
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	06/13/12	06/13/14
Antenna: Biconnical	Eaton	94455-1	1096	05/04/11	05/04/13
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/04/11	05/04/13
Frequency Counter	HP	5352B	2632A00165	06/22/11	06/22/13
Frequency Counter	HP	5385A	2730A03025	08/17/11	08/17/13
Signal Generator	HP	8640B	2308A21464	02/23/12	02/23/14
Hygro-Thermometer	Extech	445703	0602	06/15/11	06/15/13
Digital Multimeter	Fluke	77	35053830	09/09/11	09/09/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	10/28/11	10/28/13
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/14/12	06/14/14
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	07/03/12	07/03/14
Frequency Counter	HP	5385A	3242A07460	06/22/11	06/22/13
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/11	12/31/13
Horn antenna	ETS-Lindgren	3117	35923	12/20/11	12/20/13

Applicant: NAVICO AUCKLAND LTD
 FCC ID: RAYLINK2
 IC CERT #: 4697A-LINK2
 Report: N\NAVICO AUCKLAND_RAY\260AUT13\260AUT13TestReport.doc