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TEST REPORT

PER FCC PT 15.247 FHSS AND IC RSS-210(i8)

APPLICANT	NAVICO AUCKLAND LTD
ADDRESS	3-5 OMEGA STREET ALBANY 0632 AUCKLAND NEW ZEALAND
FCC ID	RAYHS35
IC	4697A-HS35
MODEL	HS35
PRODUCT DESCRIPTION	2.4 GHZ MODULE FOR MARINE TRANSCEIVER HANDSET
DATE SAMPLE RECEIVED	12/26/2012
DATE TESTED	1/12/2013
TESTED BY	John A. Day
APPROVED BY	Mario R. de Aranzeta
TIMCO REPORT NO.	170AUT13TestReport.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

ATTESTATION.....	3
REPORT SUMMARY	4
TEST ENVIRONMENT AND TEST SETUP	4
DUT DESCRIPTION.....	5
EMC EQUIPMENT LIST.....	6
TEST PROCEDURES.....	7
NUMBER OF HOPPING CHANNELS.....	9
DWELL TIME OF A HOPPING CHANNEL.....	10
DUTY CYCLE	11
6 dB BANDWIDTH	12
CARRIER FREQUENCY SEPARATION	13
POWER OUTPUT.....	14
SPURIOUS EMISSIONS AT ANTENNA TERMINALS	15
RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND.....	18
POWER SPECTRAL DENSITY.....	20

ATTESTATION

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

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.



Testing Certificate #0955-01

AUTHORIZED BY: John A. Day



SIGNATURE:

FUNCTION: Test Tech/ Project Manager

DATE: 02/12/2013

APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

REPORT SUMMARY

Disclaimer:	The test results relate only to the items tested.
Purpose of Test:	To demonstrate that the DUT is compliant with FCC Pt 15.247 requirements for a FHSS radio.
Applicable Standards:	FCC Pt 15.247, ANSI C63.4: 2003, ANSI TIA-603: 2004, FCC Pt 15.109, RSS-210, RSS-GEN
Related Reports:	N/A

TEST ENVIRONMENT AND TEST SETUP

Test Facilities:	All measurements were made at one or more of the test sites of TIMCO ENGINEERING INC. located at 849 N.W. State Road 45, Newberry, FL 32669.
Laboratory Test Conditions:	Temperature: 26°C, Humidity: 55%
Test Exercise:	The DUT was set in continuous transmit mode of operation.
Deviation to the Standards:	There was no deviation from the standard.
Modification to the DUT:	Test cable and connector was added for conducted measurements.
Supporting Accessories:	None

DUT DESCRIPTION

DUT Description	2.4 GHz MODULE FOR MARINE TRANSCEIVER HANDSET
FCC ID	RAYHS35
IC	4697A-HS35
Model Number	HS35
Maximum Output Power	.024W
Operating Frequency	2401-2480
DUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz
	<input type="checkbox"/> DC Power
	<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
Antenna	Internal
Antenna Connector	None

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IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.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
3/10-Meter OATS	TEI	N/A	N/A	12/31/11	12/31/13
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/11	12/31/13
Horn antenna	ETS Lindgren	3117	35923	12/07/2011	12/07/2013
Horn antenna	ETS Lindgren	3116	9011-2145	12/31/2011	12/31/2013

APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

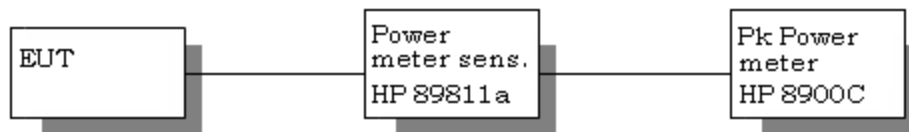
TEST PROCEDURES

POWER LINE CONDUCTED INTERFERENCE: The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed with the DUT transmitting. The resolution bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

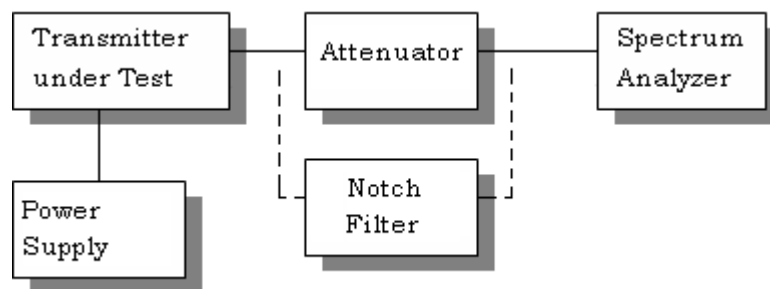
BANDWIDTH 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

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

Output Power Test Setup Diagram



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. Power was measured by disconnecting the antennas and measuring across a 50 ohm load as recommended by the manufacturer using a peak power meter. The antenna is non-directional and doesn't exceed 6 dBi gain. The power output was measured at three places in the band highest is reported below.



APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc



RADIATION INTERFERENCE: The test procedure used was ANSI C63.4-2003 using an Agilent spectrum receiver with preselector. 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 microvolt at the output of the antenna.

RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND: An in band field strength measurement of the fundamental emission using the RBW and detector function required by ANSI C63.4-2003 and the FCC rules.

APPLICANT: NAVICO AUCKLAND LTD
FCC ID: RAYHS35
IC: 4697A-HS35
REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

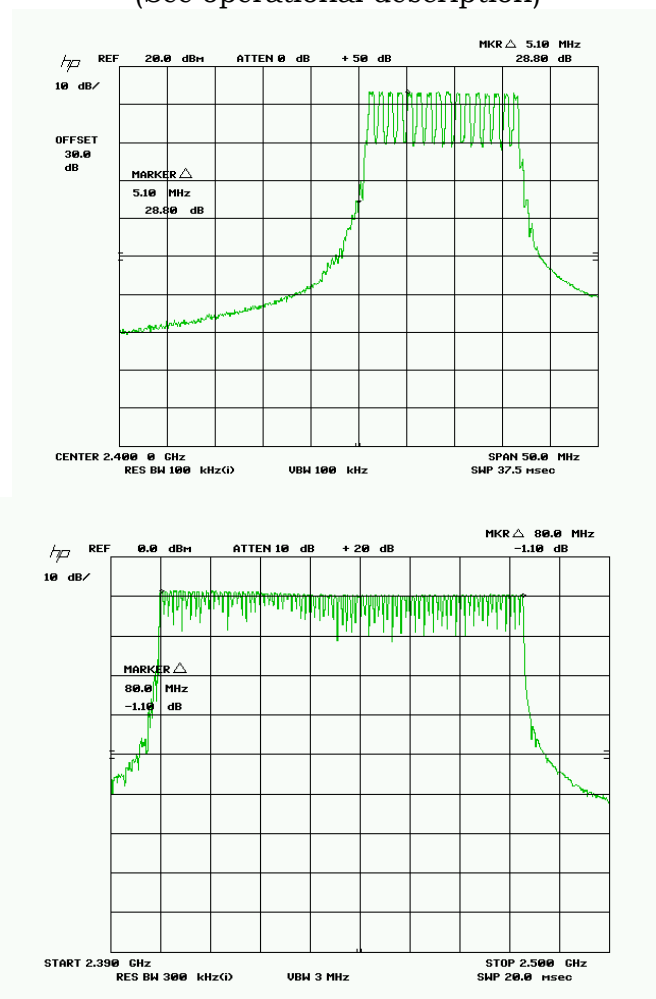
NUMBER OF HOPPING CHANNELS

Rules Part No.: 15.247(a)(1), RSS-210

Requirements:

902-928 MHz	If the 20 dB bandwidth is < 250 kHz, the system shall use at least 50 hopping frequencies.
	If the 20 dB bandwidth is 250 kHz or greater, the system shall use at least 25 hopping frequencies.
2400-2483.5 MHz	At least 15 channels
5725-5850 MHz	At least 75 channels

Test Data: There are 80 hopping channels
 16 Active Channels out of a pool of 80 channels
 (See operational description)



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IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

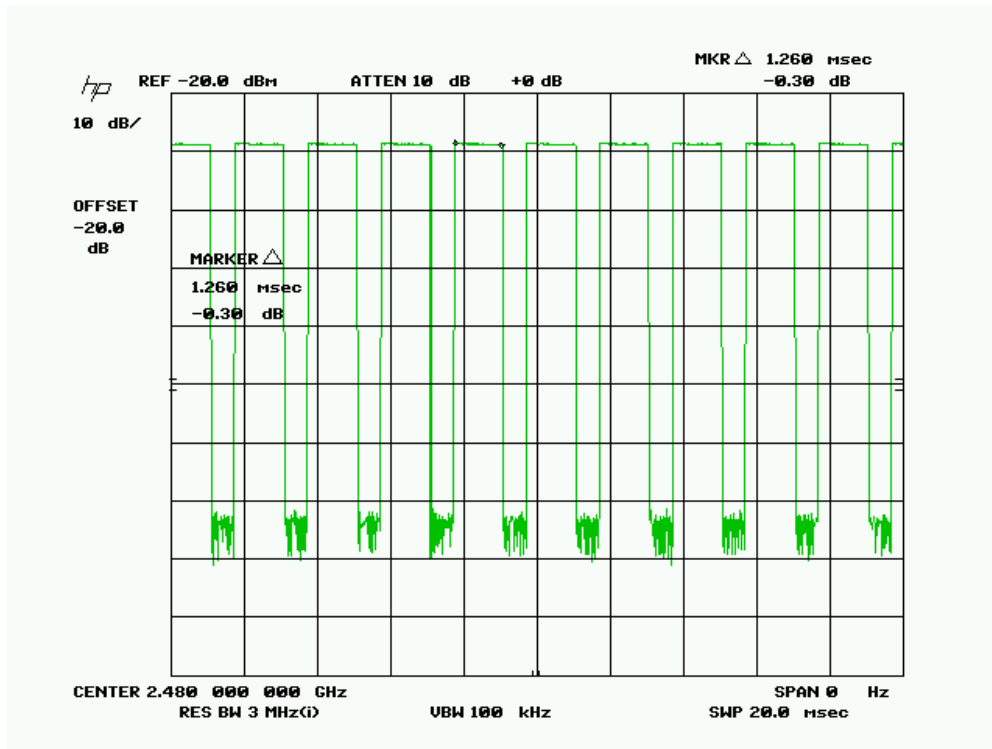
DWELL TIME OF A HOPPING CHANNEL

RULES PART NO.: 15.247(a)(1)(i), RSS-210, RSS-GEN

REQUIREMENTS:

902-928 MHz	If 20 dB bandwidth is < 250 kHz, average time of occupancy of any frequency shall not exceed 0.4 sec in 20 seconds.
	If 20 dB bandwidth is 250 kHz or greater, dwell time < = 0.4 seconds in a 10 second period.
2400-2483.5 MHz	< = 0.4 seconds in a 0.4 seconds multiplied the number of hopping channels employed.
5725-5850 MHz	< = 0.4 seconds in a 30 second period.

TEST DATA: The dwell time is 1.25 msec per hop.
Three places in the band were measured and the worst case presented.



APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

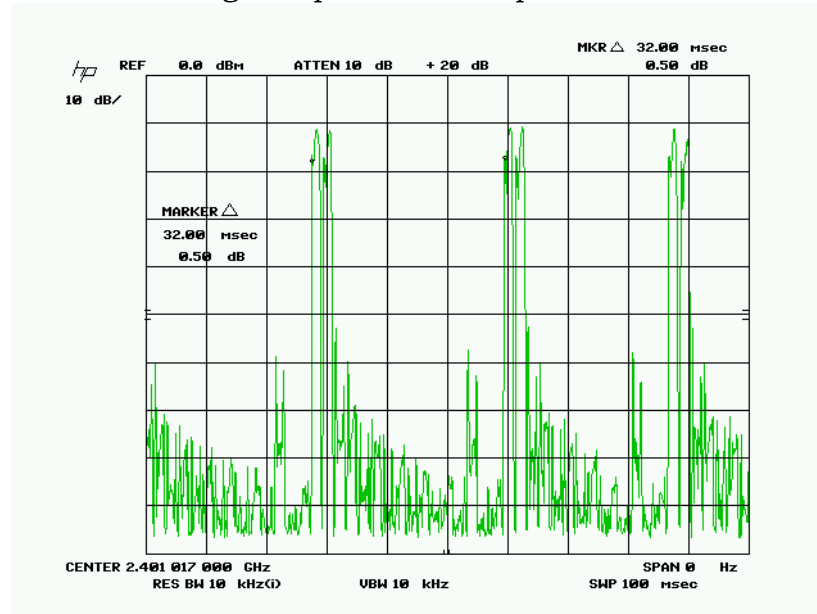
DUTY CYCLE

Total # of pulses: 6 in 32 ms

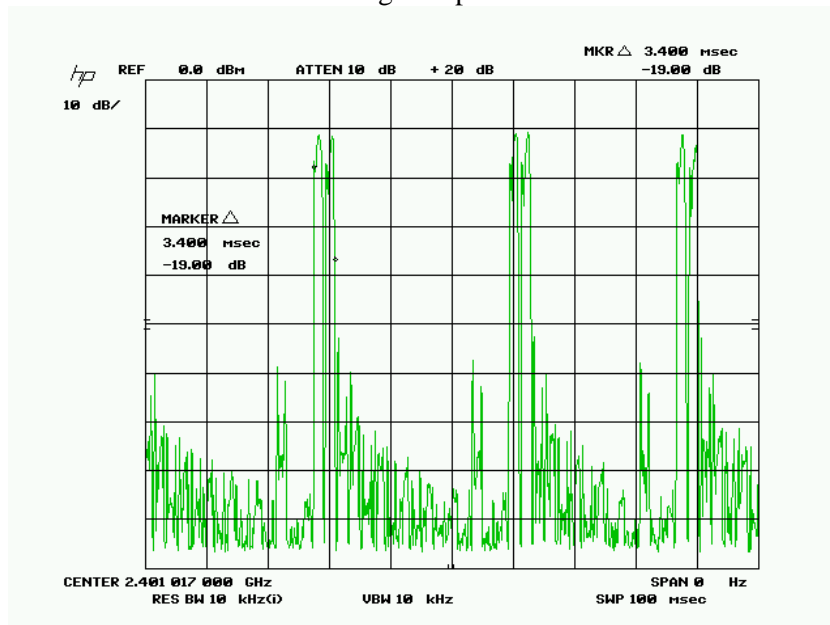
Duration of pulse: 1.25 ms maximum duration of pulse.

$$20 \cdot \log \left(\frac{6 \cdot 1.25}{32} \right) = 20 \cdot \log (0.23) = 12.6 \text{ dB}$$

Length of pulse train to pulse train



Length of pulse



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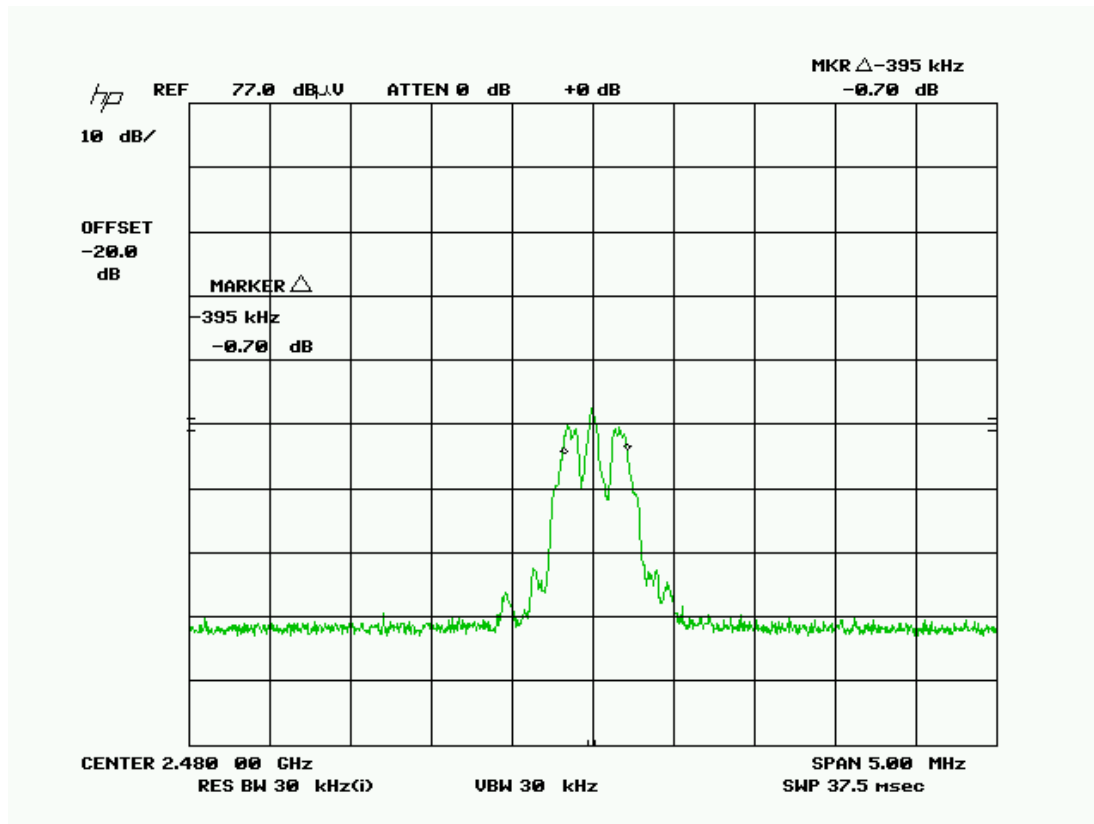
REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

6 dB BANDWIDTH

RULES PART NO.: 15.247(a)(2), RSS-210

REQUIREMENTS: The 6 dB bandwidth must be less than 500 kHz.

TEST DATA: See the following plot(s). 395 kHz



Three places in the band were measured and the worst case presented above.

APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

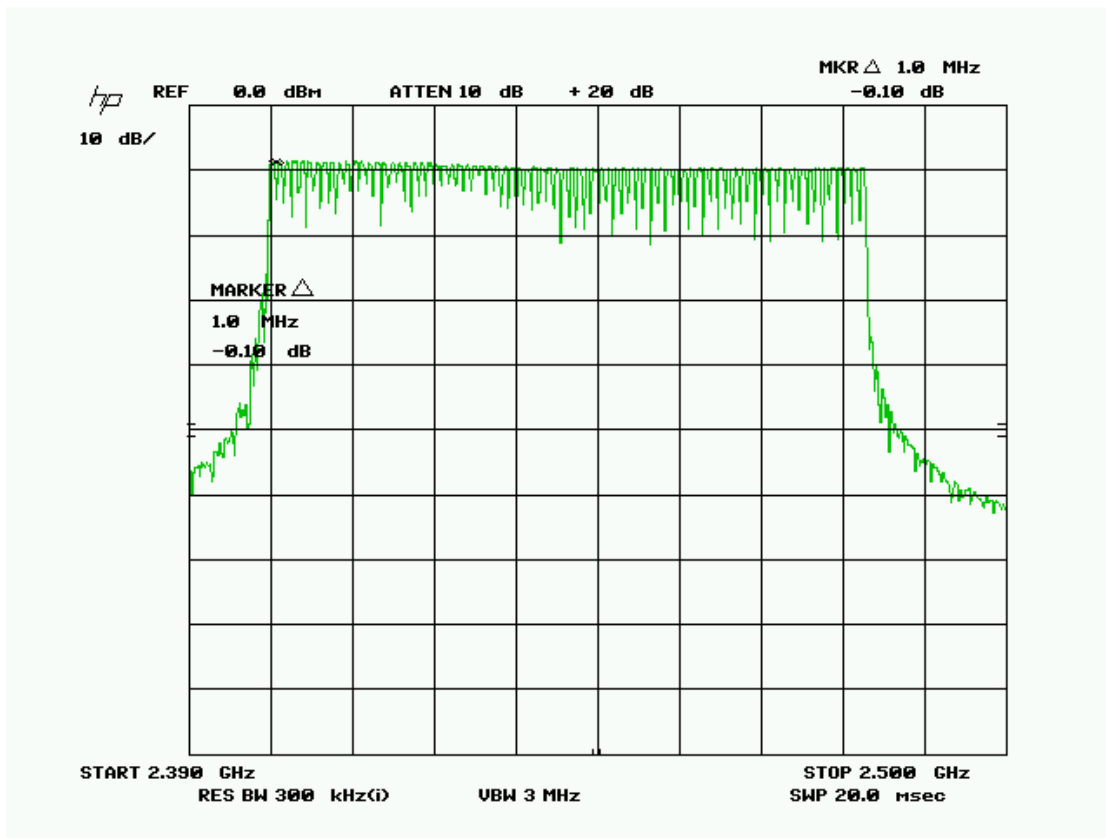
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CARRIER FREQUENCY SEPARATION

RULES PART NO.: 15.247(a)(2), RSS-210, RSS-GEN

REQUIREMENTS: The hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

TEST DATA: See the following plot. 1.0 MHz



APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

POWER OUTPUT

Rules Part No.: 15.247(b), RSS-210, RSS-GEN

Requirements: The maximum peak output power shall not exceed 1 watt (30 dBm). If directional transmitting antennas with a gain of more than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Data: The device under test has an integral antenna of < 6dBi gain

Test cable and connector was added for this test

Frequency MHz	Po Watts
2401	.024
2440	.023
2480	.020

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

RULES PART NO.: 15.247(c), RSS-210, RSS-GEN

REQUIREMENTS: Emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

Note: The spectrum was scanned to the tenth harmonic.

TEST DATA

Freq	dB Down
2401	0
4802	85.2
7203	80.4
9604	73.2
12005	56.4
14406	81.6
16807	81.5
19208	50.1
21609	76.3

Freq	dB Down
2440	0
4880	89.2
7320	78.3
9760	72
12200	76
14640	80.6
17080	81.5
19520	76.7
21960	77.5

Freq	dB Down
2480	0
4960	78.6
7440	81.2
9920	83.4
12400	78
14880	80.9
17360	81.6
19840	75.8
22320	75.3

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REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

FIELD STRENGTH OF SPURIOUS EMISSIONS

RULES PART NO.: 15.247(c), 15.205 & 15.209(b), RSS-210

REQUIREMENTS:

§15.247(c) & §15.205, RSS-210	
(Fundamental) Frequency	(Field Strength) Limits
902 – 928 MHz 2.4 – 2.4835 GHz	127.37 dBuV/m
§15.209, RSS-210	
30 - 88 MHz	40 dBμV/m @3M
88 - 216 MHz	43.5 dBμV/m @3M
216 - 960 MHz	46 dBμV/m @3M
ABOVE 960 MHz	54 dBμV/m

Emissions that fall in the restricted bands (15.205) must be less than or equal to 500 μV/m (54 dBμV/m). Spurious not in a restricted band must be 20 dBc.

Measurements were made from the lowest frequency generated or 9 kHz to the 10th harmonic.

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IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

Test Data:

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB Correction	Field Strength dBuV/m	Margin dB
2,401.00	2,401.00	71.4	V	3.18	32.4	12.6	94.38	32.98
2,401.00	2,401.00	77.7	H	3.18	32.4	12.6	100.68	26.68
2,401.00	4,802.00	14.2	H	4.9	34.38	12.6	40.88	13.12
2,401.00	4,802.00	14.4	V	4.9	34.38	12.6	41.08	12.92
2,401.00	7,203.00	11.9	H	5.72	36.16	12.6	41.18	12.82
2,401.00	7,203.00	12	V	5.72	36.16	12.6	41.28	12.72
2,401.00	9,604.00	12.8	V	6.78	36.72	12.6	43.7	10.3
2,401.00	9,604.00	16.7	H	6.78	36.72	12.6	47.6	6.4
2,440.00	2,440.00	70	V	3.21	32.48	12.6	93.09	34.27
2,440.00	2,440.00	77.4	H	3.21	32.48	12.6	100.49	26.87
2,440.00	4,880.00	17	H	4.94	34.43	12.6	43.77	10.23
2,440.00	4,880.00	18.8	V	4.94	34.43	12.6	45.57	8.43
2,440.00	7,320.00	13.6	V	5.79	36.14	12.6	42.93	11.07
2,440.00	7,320.00	13.9	H	5.79	36.14	12.6	43.23	10.77
2,440.00	9,760.00	11.3	V	6.83	36.91	12.6	42.44	11.56
2,440.00	9,760.00	16.1	H	6.83	36.91	12.6	47.24	6.76
2,480.00	2,480.00	68.9	V	3.24	32.56	12.6	92.1	35.26
2,480.00	2,480.00	74.6	H	3.24	32.56	12.6	97.8	29.56
2,480.00	4,960.00	18.1	H	4.98	34.48	12.6	44.96	9.04
2,480.00	4,960.00	18.8	V	4.98	34.48	12.6	45.66	8.34
2,480.00	7,440.00	12	H	5.86	36.11	12.6	41.37	12.63
2,480.00	7,440.00	14.6	V	5.86	36.11	12.6	43.97	10.03
2,480.00	9,920.00	10	V	6.88	37.1	12.6	41.38	12.62
2,480.00	9,920.00	12.5	H	6.88	37.1	12.6	43.88	10.12

All readings are peak unless marked otherwise.
P= Peak, A= Average, R= Restricted band frequency
Harmonics were checked through the 10th harmonic.

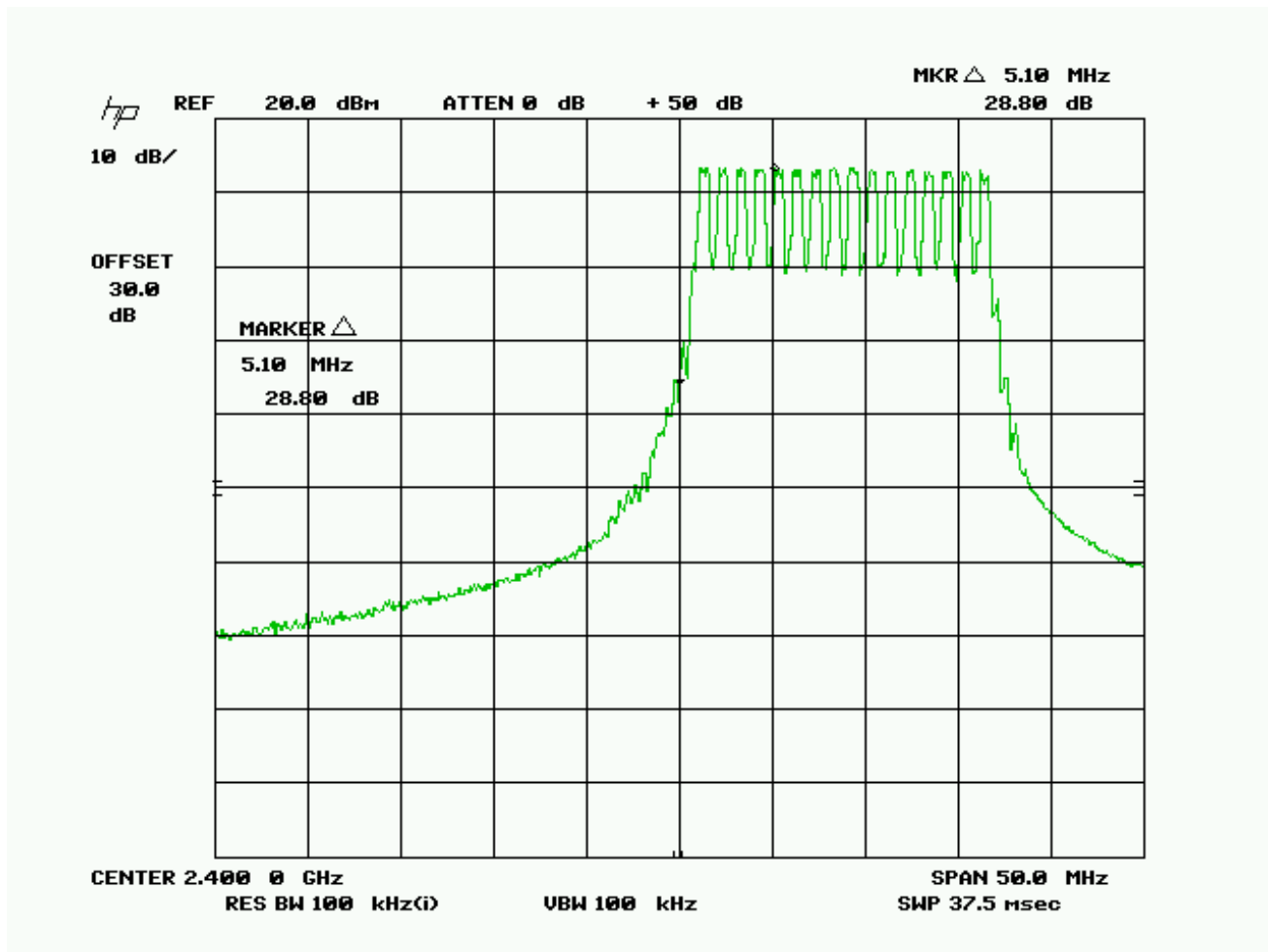
APPLICANT: NAVICO AUCKLAND LTD
FCC ID: RAYHS35
IC: 4697A-HS35
REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND

REQUIREMENTS: For emissions that fall in the restricted bands (15.205). These emissions must be less than or equal to 500 uV/m (54dBuV/m). Emissions not in the restricted band must be 20 dBc.

TEST DATA: The plots are presented below.

Lower bandedge Peak



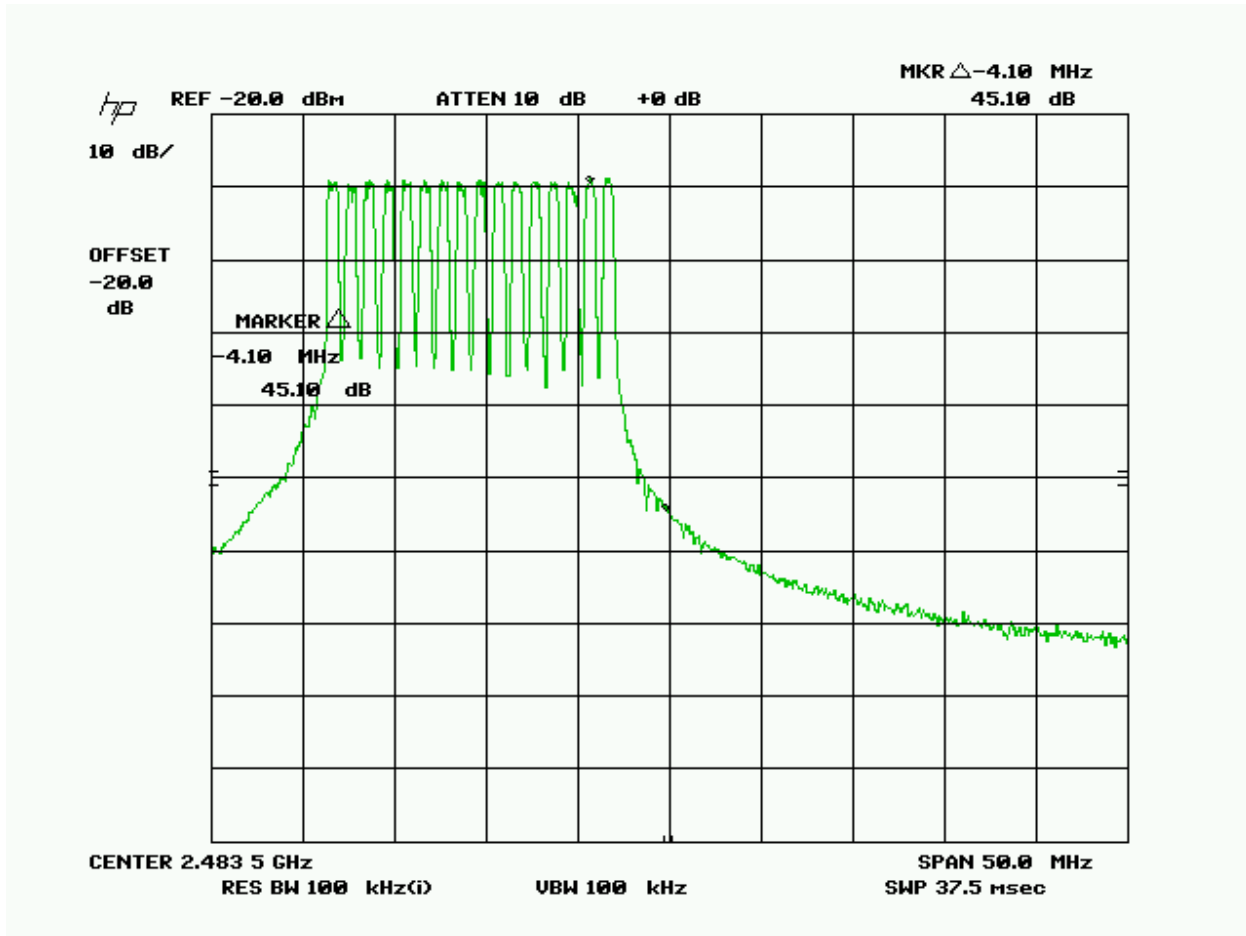
APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

Upper bandedge Peak



Freq.	Field Strength	2483.5	Field Strength
2480	97.8 dB μ V	45.1 dB	52.7 dB μ V

APPLICANT: NAVICO AUCKLAND LTD

FCC ID: RAYHS35

IC: 4697A-HS35

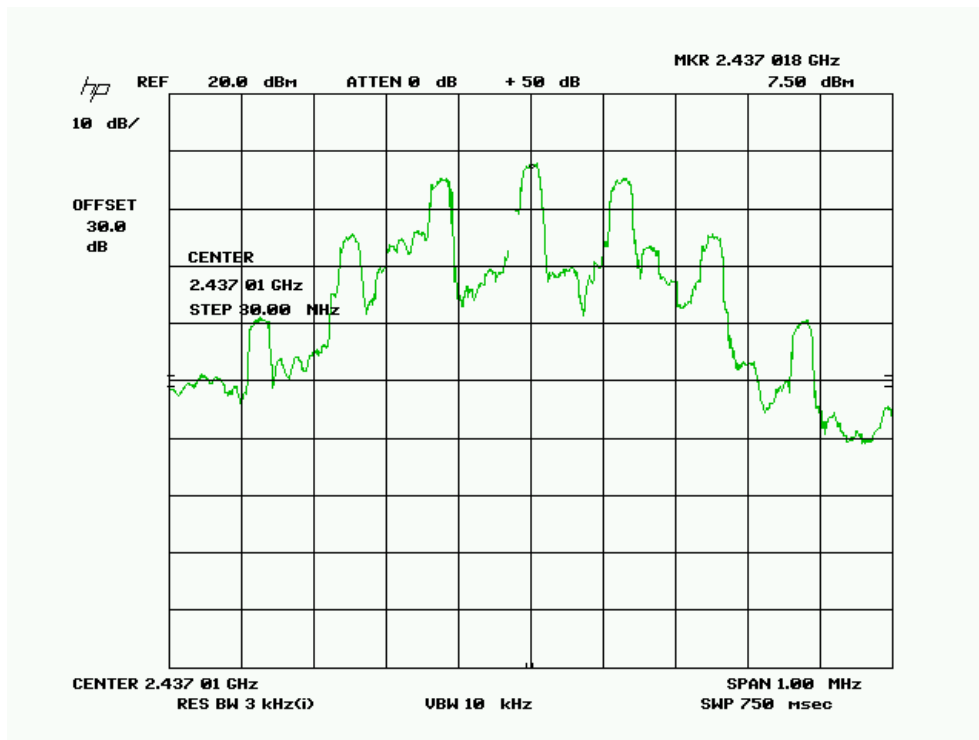
REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc

POWER SPECTRAL DENSITY

Rules Part No.: 15.247(d), RSS-210, RSS-GEN

Requirements: The peak level measured must be less than +8.0 dBm in a 3 kHz RBW.

Test Data: SEE THE FOLLOWING PLOT



+7.5 dBm is less than +8 dBm

Three places in the band were tested and the worst case presented.

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IC: 4697A-HS35

REPORT #: V:\N\NAVICO AUCKLAND_RAY\170AUT13\170AUT13TestReport.doc