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FCC PART 15.247 AND IC RSS-210
FHSS
TEST REPORT

APPLICANT	NAVICO AUCKLAND LIMITED
ADDRESS	3-5 OMEGA STREET, BUILDING A ALBANY 0632 AUCKLAND NEW ZEALAND
FCC ID	RAYVHF725US
IC	4697A-VHF725U
MODEL #	VHF-725U
PRODUCT DESCRIPTION	WIRELESS MARINE RADIO WITH BLUETOOTH
DATE SAMPLE RECEIVED	3/20/2008
DATE TESTED	5/15/2008
TESTED BY	NAM NGUYEN
APPROVED BY	MARIO DE ARANZETA
TIMCO REPORT NO.	553BUT8UT8TestReport.doc
TEST RESULTS	☒ PASS ☐ FAIL

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



Certificate # 0955-01

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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 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: Mario de Aranzeta



SIGNATURE:

FUNCTION: Lab Supervisor/ Test Engineer

DATE: 5/15/2008

Applicant: NAVICO AUCKLAND LIMITED

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REPORT SUMMARY

Disclaimer:	The test results relate only to the items tested.
Purpose of Test:	To demonstrate that the DUT is in 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:	No modification was made.
Supporting Accessories:	None

DUT DESCRIPTION

Applicant:	NAVICO AUCKLAND LIMITED
Product Description:	WIRELESS MARINE RADIO WITH BLUETOOTH
FCC ID:	RAYVHF725US
IC:	4697A-VHF725U
MODEL:	VHF-725U
Operating Frequency:	2402 – 2480 MHz
Power output	6.2 mW or 0.0062 Watts EIRP
Type of Modulation:	GFSK
EUT Power Source:	Primary Power – Any 3V dc source (battery)
	Secondary Power – N/A
Test Item:	Prototype
Type of Equipment	Mobile
Antenna	(Fixed) integral quarter wave wire
Antenna Connector	None

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3/10-Meter OATS	TEI	N/A	N/A	Listed 3/20/07	3/19/10
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/06	1/10/09
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 5/11/07	5/10/10
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 11/30/07	11/30/09
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 11/30/07	11/30/09
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 11/30/07	11/30/09
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 11/30/07	11/30/09
Antenna: Biconnical	Eaton	94455-1	1057	CAL 1/15/08	1/15/10
Antenna: Biconnical	Eaton	94455-1	1096	CAL 10/11/06	10/11/08
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 7/18/07	7/18/09
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 7/18/07	7/18/09
LISN	Electro-Metrics	ANS-25/2	2604	CAL 10/5/06	10/5/08
LISN	Electro-Metrics	EM-7820	2682	CAL 7/23/07	7/23/09
Antenna: Log-Periodic	Eaton	96005	1243	CAL 12/13/07	12/13/09

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TEST PROCEDURES

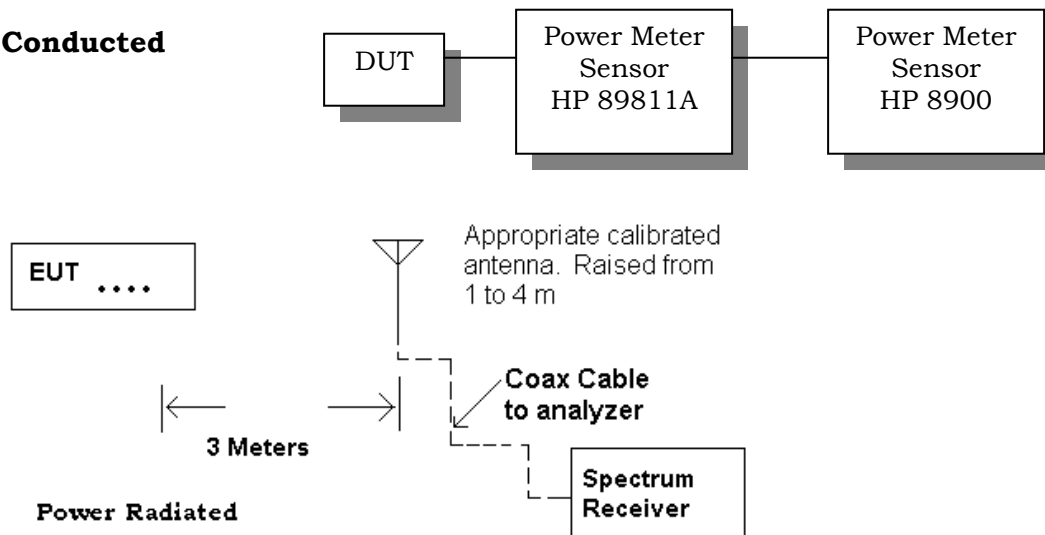
POWER LINE CONDUCTED INTERFERENCE: The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed with the DUT transmitting. The resolution bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

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.

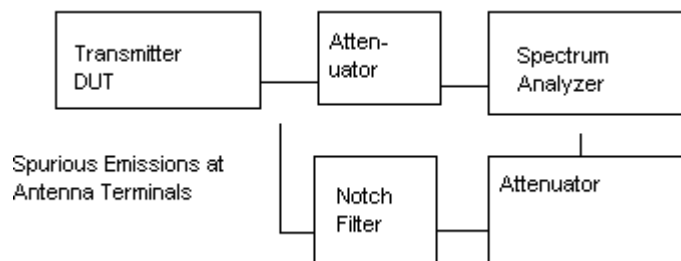
RF Power Output: The RF power output was measured one of two ways either at the antenna feed point using a peak power meter or radiated if the antenna can not be removed.

Output Power Test Setup Diagrams

Conducted



ANTENNA CONDUCTED EMISSIONS: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10 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.



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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.

POWER LINE CONDUCTED INTERFERENCE

RULES PART NO.: 15.207

REQUIREMENTS:

Emission Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak (QP)	Average (AV)
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50
* Decreases with the logarithm of the frequency.		

TEST DATA: Not applicable to this device. Battery operated.

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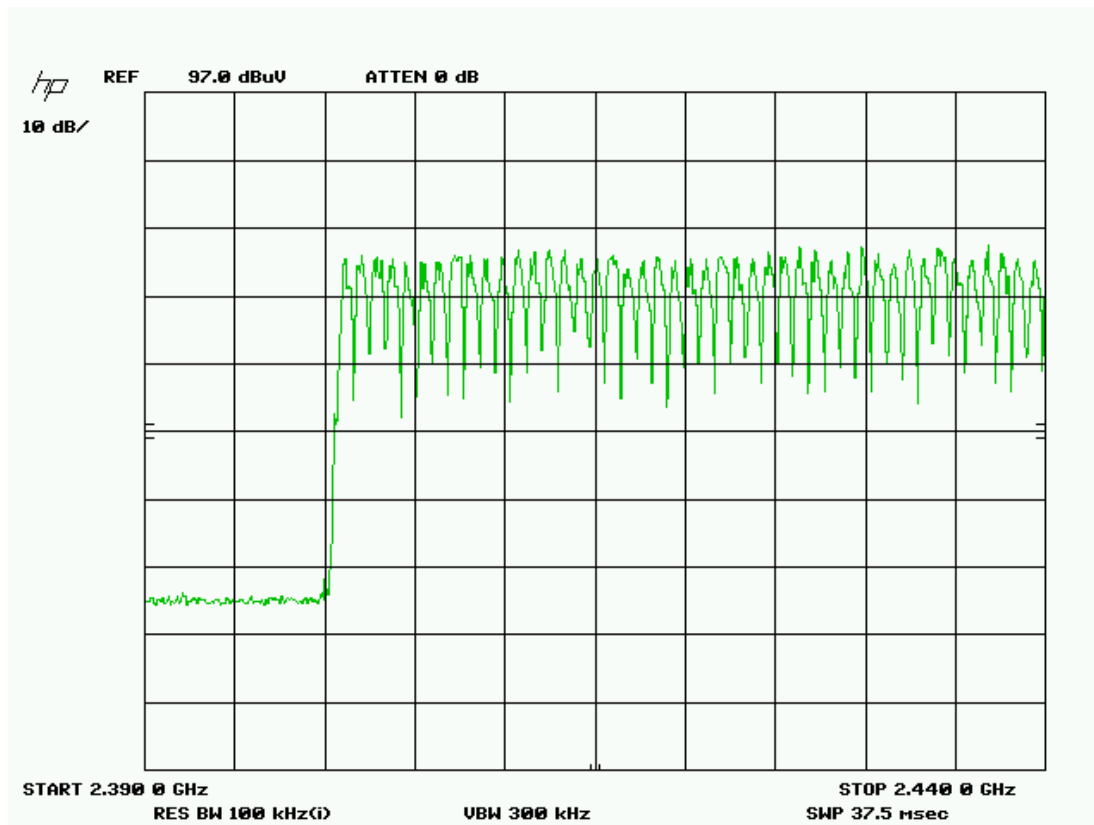
NUMBER OF HOPPING CHANNELS

Rules Part No.: 15.247(a)(1)

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

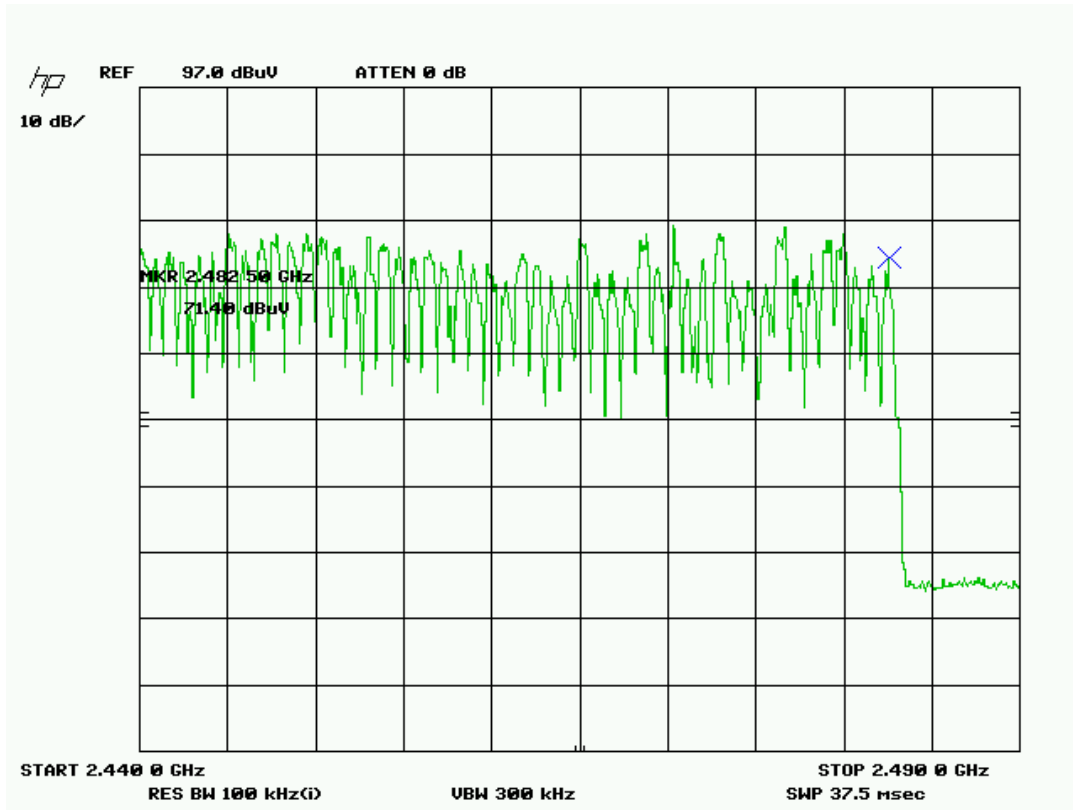
Test Data: There are 79 hopping channels



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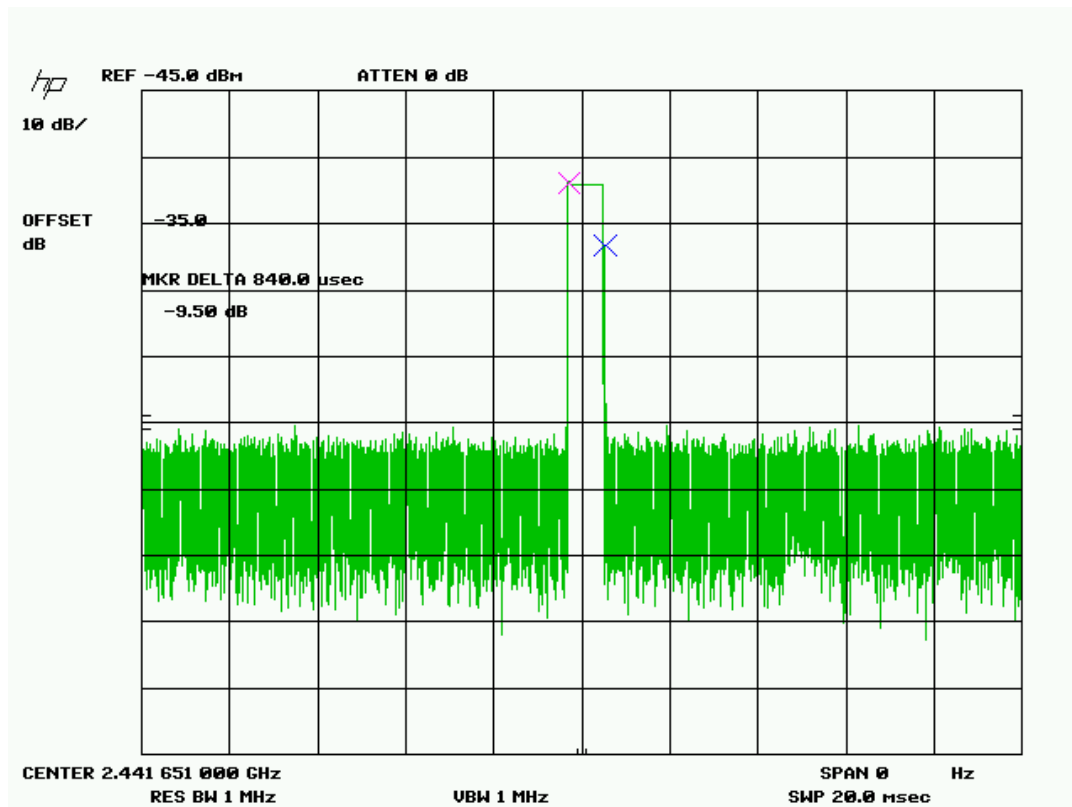
DWELL TIME OF A HOPPING CHANNEL

RULES PART NO.: 15.247(a)(1)(i)

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 625 microseconds per hop.
Three places in the band were measured and the worst case presented.



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20 dB BANDWIDTH

RULES PART NO.: 15.247(a)(2)

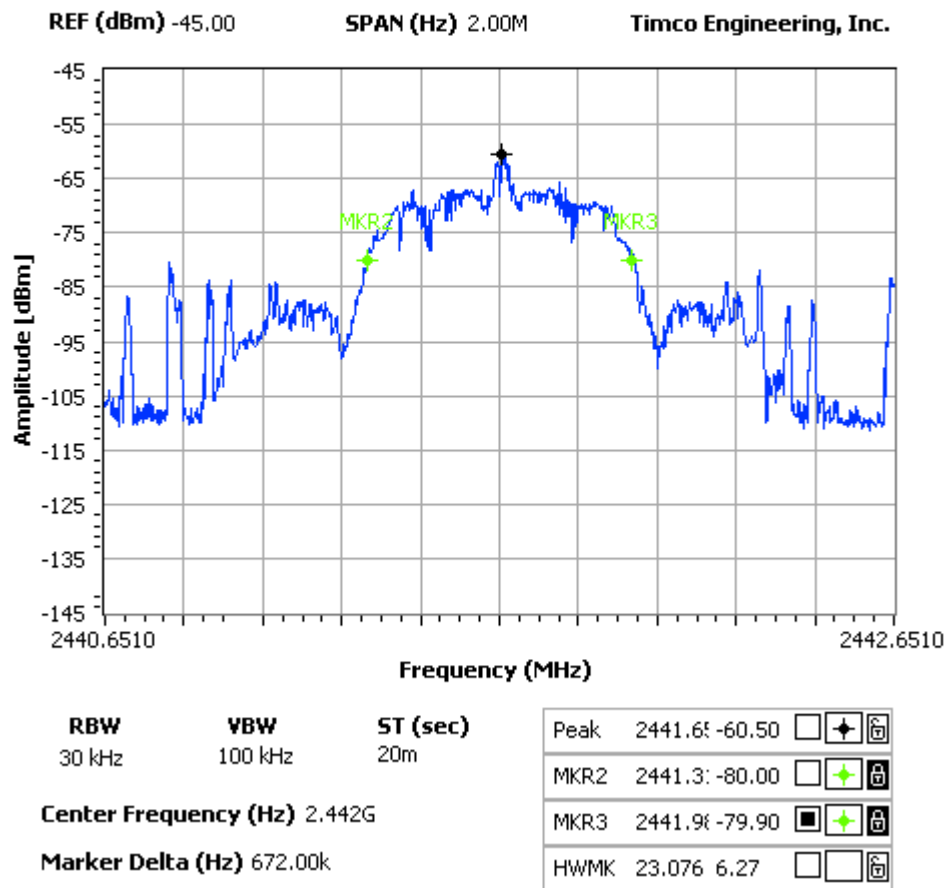
REQUIREMENTS: The 20 dB bandwidth must be less than 500 kHz.

TEST DATA: See the following plot(s)

Result: 700 kHz

NOTES:

NAVICO APAC LIMITED - FCC ID: RAYEVR-075U
20 dB Bandwidth



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

Applicant: NAVICO AUCKLAND LIMITED

FCC ID: RAYVHF725US

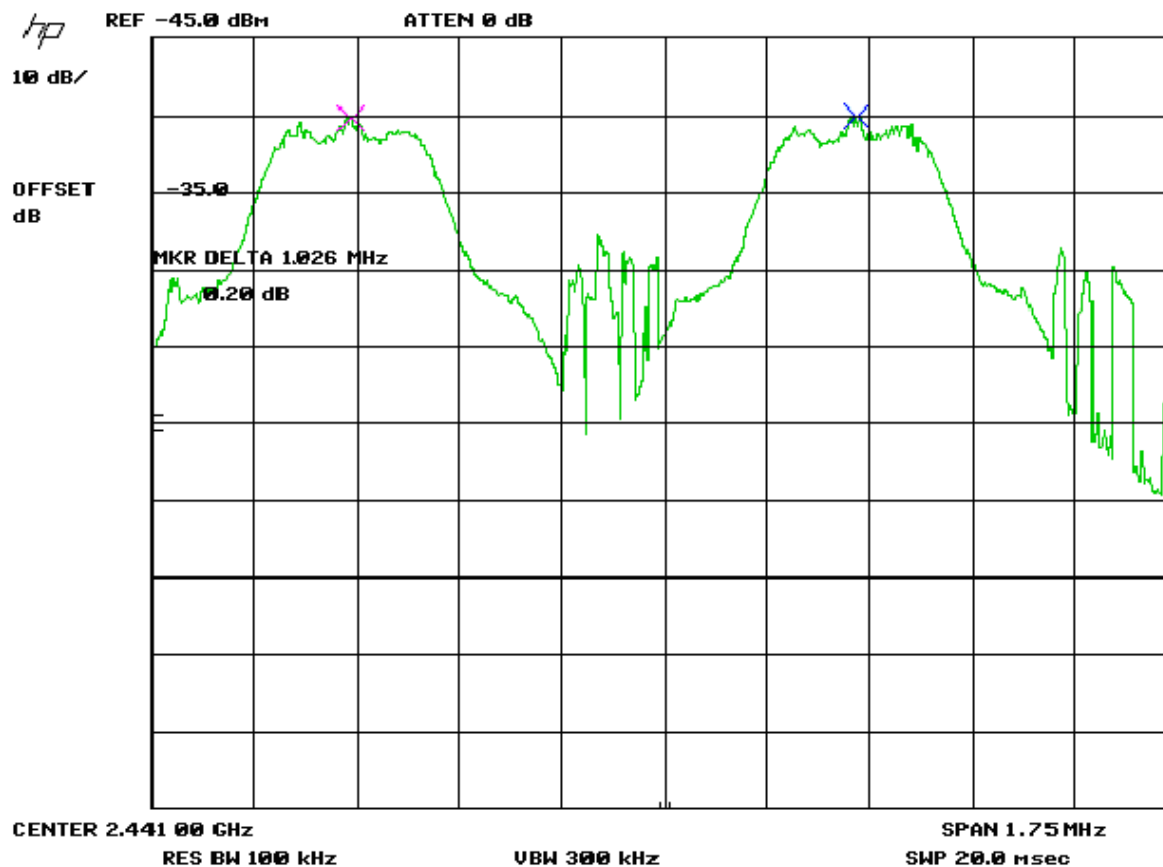
Report: Y:\N\NAVICO APAC_RAY\553BUT8\553BUT8TestReport.doc

CARRIER FREQUENCY SEPARATION

RULES PART NO.: 15.247(a)(2)

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 MHz



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POWER OUTPUT

Rules Part No.: 15.247(b)

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 and the power was measured on a radiated basis.

Frequency MHz	Power (EIRP) mW
2402	6
2441	5.4
2480	6.2

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

RULES PART NO.: 15.247(c)

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: The device under test has an integral antenna and the power was measured on a radiated basis.

FIELD STRENGTH OF SPURIOUS EMISSIONS

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

REQUIREMENTS:

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

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

Harmonics were measured to the 10th harmonic.

Test Data:

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dB μ V	Ant. Polarity	Coax Loss dB	Correction Factor dB	Field Strength dB μ V/m	Margin dB
2402	2,402	74.9	V	3.18	32.24	110.32	17.06
2402	2,402	77.2	H	3.18	32.24	112.62	14.76
2402	4,802	5.7	V	4.9	34.1	44.7	9.3
2402	4,802	6.5	H	4.9	34.1	45.5	8.5
2402	7,203	6.9	H	5.72	36.04	48.66	5.34
2402	7,203	8.1	V	5.72	36.04	49.86	4.14
2402	9,604	10.2	V	6.78	36.7	53.68	0.32
2402	9,604	10.3	H	6.78	36.7	53.78	0.22

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TEST DATA CONTD.

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBμV	Ant. Polarity	Coax Loss dB	Correction Factor dB	Field Strength dBμV/m	Margin dB
2,441	2,441	74.3	V	3.21	32.35	109.86	17.52
2,441	2,441	77.9	H	3.21	32.35	113.46	13.92
2,441	4,882	7	V	4.94	34.1	46.04	7.96
2,441	4,882	7.5	H	4.94	34.1	46.54	7.46
2,441	7,323	7.3	V	5.79	36.06	49.15	4.85
2,441	7,323	10.2	H	5.79	36.06	52.05	1.95
2,441	9,764	8.8	V	6.83	36.86	52.49	1.51
2,441	9,764	9.1	H	6.83	36.86	52.79	1.21
2,480	2,480	75.8	V	3.24	32.45	111.49	15.89
2,480	2,480	77.7	H	3.24	32.45	113.39	13.99
2,480	4,964	7.8	V	4.98	34.1	46.88	7.12
2,480	4,964	7.9	H	4.98	34.1	46.98	7.02
2,480	7,447	8.7	V	5.87	36.09	50.66	3.34
2,480	7,447	11.8	H	5.87	36.09	53.76	0.24
2,480	9,929	6.1	V	6.88	37.03	50.01	3.99
2,480	9,929	6.5	H	6.88	37.03	50.41	3.59

All readings are peak unless marked otherwise.

P= Peak

A= Average

R= Restricted band frequency

Harmonics were checked through the 10th harmonic.

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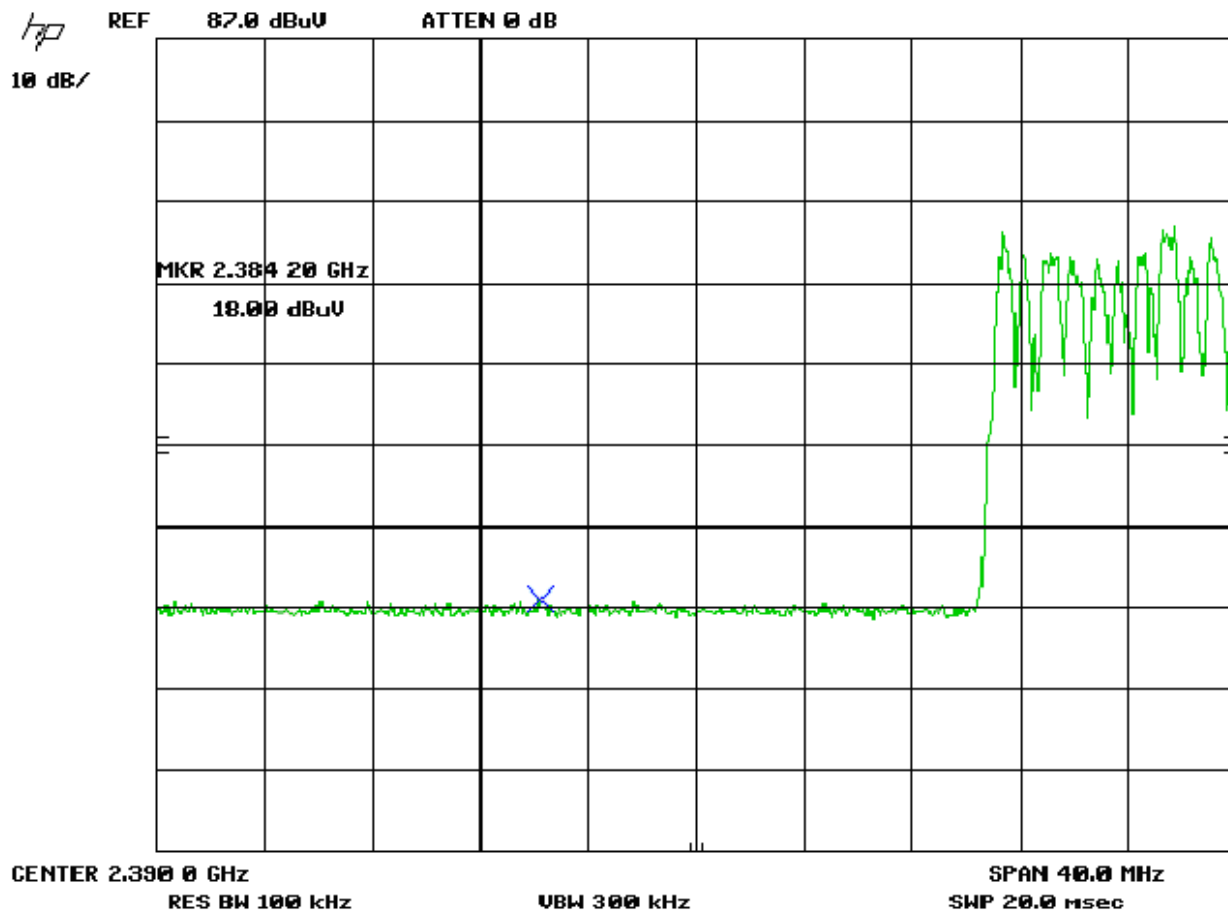
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RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND

REQUIREMENTS: 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.



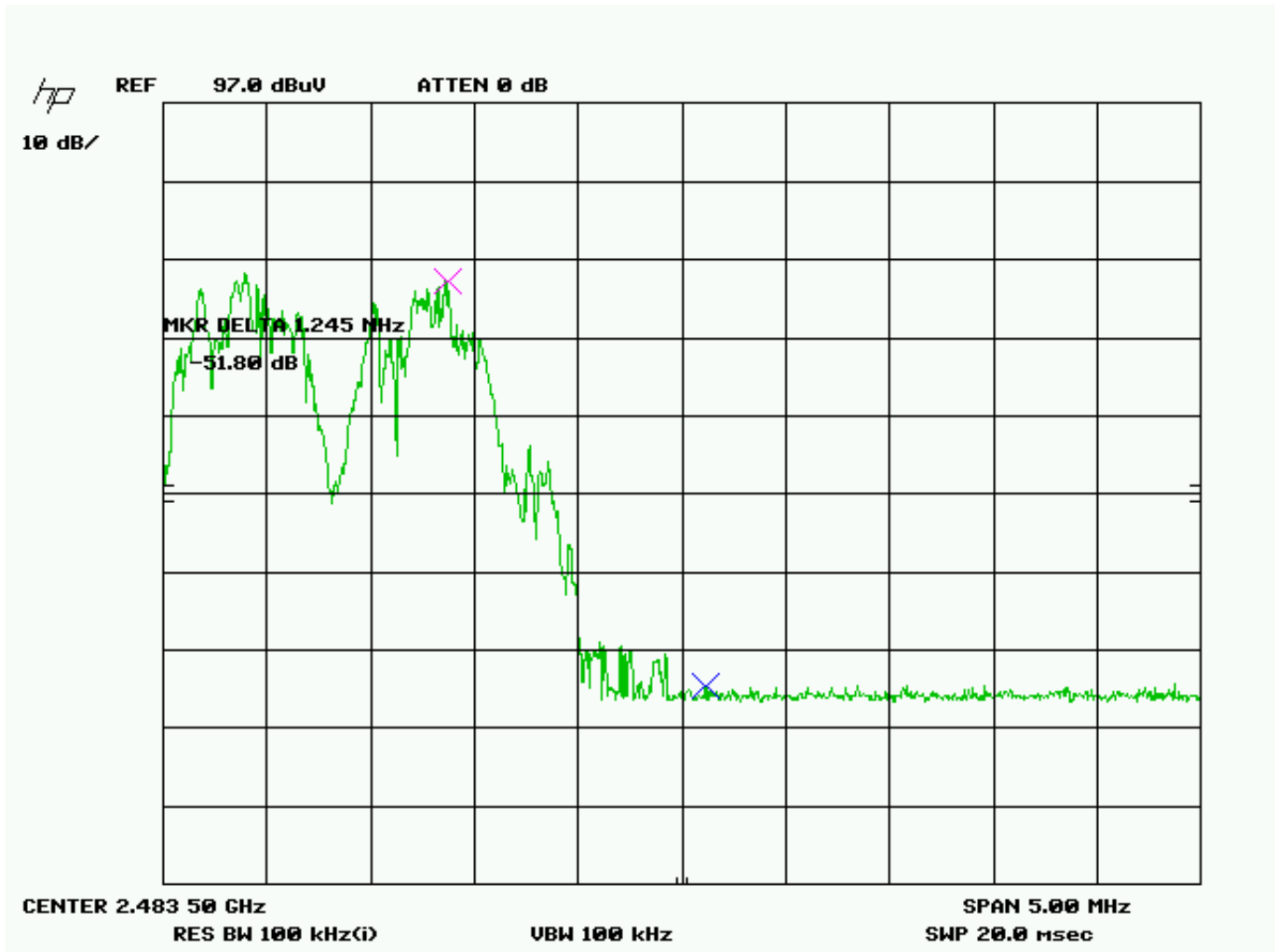
Frequency	Polarity	Peak or Average	Level in dB μ V/m
2384	H	P	53.1

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Upper bandedge Peak



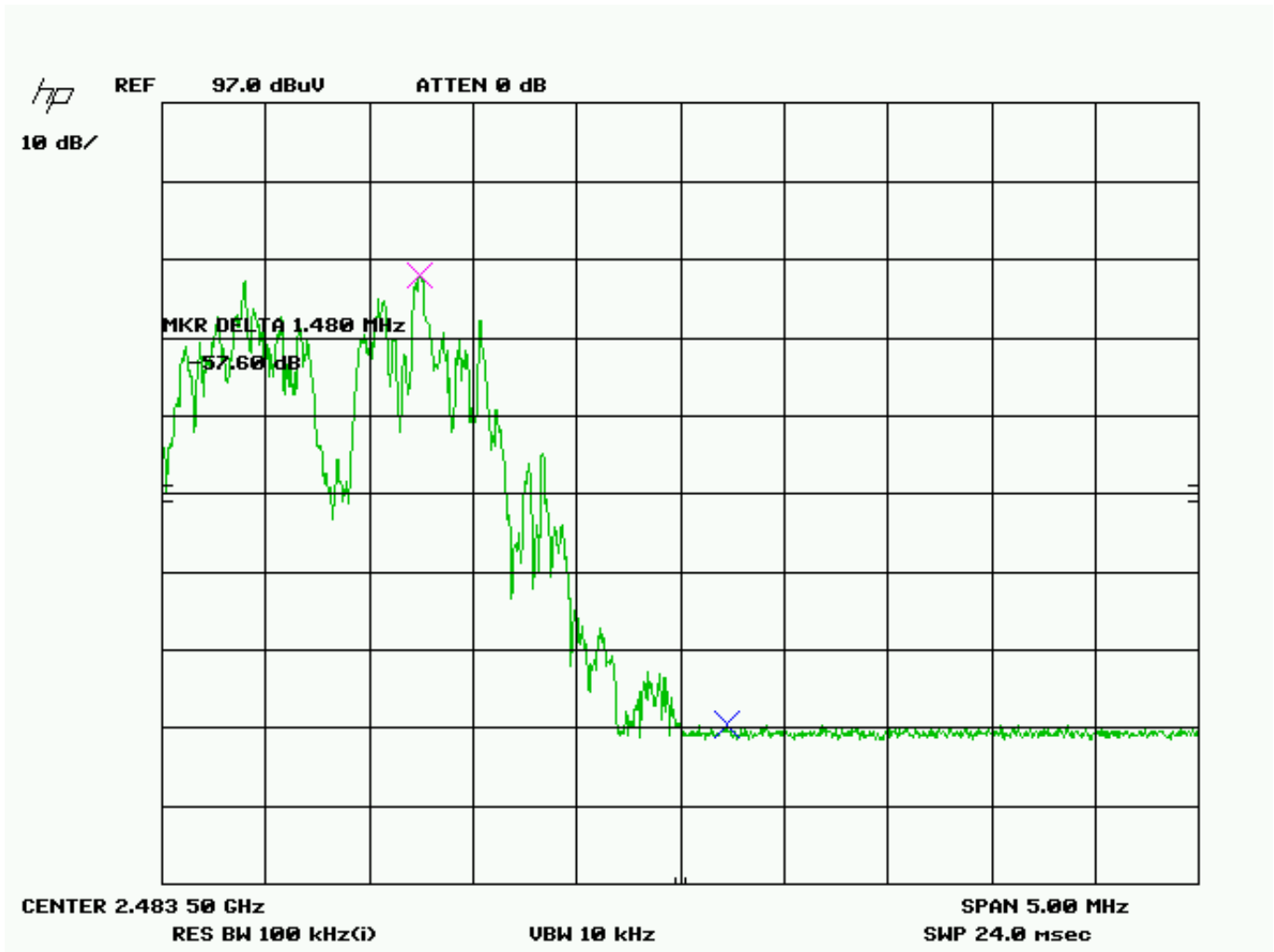
Tuned Freq (MHz)	Ant Polarity	Field Strength measurement (dBμV)	Avg or Peak	The Marker Frequency (MHz)	The Delta Marker measurement (dB)	Estimated level in Restricted band (dBm)
2480	H	111.49	P	2483.67	51	60.49
2480	H	109.59	A	2483.72	57.6	51.99

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Upper bandedge average



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