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FCC PART 80 AND IC RSS-182 TEST REPORT

| | |
|----------------------|--|
| APPLICANT | NAVICO APAC LIMITED |
| | 3-5 OMEGA STREET, BUILDING A ALBANY 0632 AUCKLAND NEW ZEALAND |
| FCC ID | RAYEVR100US |
| IC CERTIFICATION | 4697A-EVR100US |
| MODEL NUMBER | EVR-100 |
| PRODUCT DESCRIPTION | FIX MOUNT MARINE RADIO |
| DATE SAMPLE RECEIVED | 10/29/2007 |
| DATE TESTED | 11/12/2007 |
| TESTED BY | NAM NGUYEN |
| APPROVED BY | NAM NGUYEN |
| TIMCO REPORT NO. | 3459AUT7TestReport.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

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Applicant: NAVICO APAC LIMITED

FCC ID: RAYEVR100US

IC CERT: 4697A-EVR100US

Report: W:\N\NAVICO APAC_RAY\3459AUT7\3459AUT7TestReport.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*

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

Date: 11/12/2007

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GENERAL INFORMATION

DUT Specification

| | |
|--------------------------------|--|
| DUT Description | FIX MOUNT MARINE RADIO |
| FCC ID | RAYEVR100US |
| IC Certification | 4697A-EVR100US |
| Model Number | EVR-100 |
| Serial Number | N/A |
| Operating Frequency | 156.025-157.425 |
| No. of Channels | 53 |
| Type of Emission | 16K0G3E |
| Modulation | FM |
| DUT Power Source | <input type="checkbox"/> 110-120Vac/50- 60Hz |
| | <input checked="" type="checkbox"/> DC Power |
| | <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 type="checkbox"/> Fixed |
| | <input checked="" type="checkbox"/> Mobile |
| | <input type="checkbox"/> Portable |
| Antenna Connector | SO-239 (50 OHM) |
| Test Facility | Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA. |
| Test Condition | The DUT was tested in an environment with normal temperature and humidity. The temperature was 26°C with a relative humidity of 50%. |
| Modification to the DUT | None |
| Test Exercise | The DUT was placed in continuous transmit mode of operation. |
| Applicable Standards | ANSI/TIA 603-C: 2004, FCC CFR 47 Part 80 and PART 2, IC RSS-182 and RSS-GEN |

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EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---------------------------------------|-----------------------------|---------------|--------------------------|----------------|----------|
| Analyzer Tan Tower Spectrum Analyzer | HP | 8566B Opt 462 | 3138A07786 3144A20661 | CAL 12/7/05 | 12/7/07 |
| Analyzer Tan Tower RF Preselector | HP | 85685A | 3221A01400 | CAL 12/7/05 | 12/7/07 |
| Analyzer Tan Tower Quasi-Peak Adapter | HP | 85650A | 3303A01690 | CAL 12/8/05 | 12/8/07 |
| Analyzer Tan Tower Preamplifier | HP | 8449B-H02 | 3008A00372 | CAL 12/8/05 | 12/8/07 |
| Antenna: Biconnical | Electro-Metrics | BIA-25 | 1171 | CAL 7/18/07 | 7/18/09 |
| Antenna: Log-Periodic | Electro-Metrics | LPA-25 | 1122 | CAL 12/1/06 | 12/1/08 |
| 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 |
| Termaline Wattmeter | Bird Electronic Corporation | 611 | 16405 | CAL 3/15/07 | 3/15/09 |

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TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C: 2004 using a 50uH LISN. Both lines were observed with the UUT 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/TIA 603-C: 2004 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum ANSI/TIA 603-C: 2004 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.

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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 7 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 7 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 7 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 7 Watts output power to 6.8 Watts output power

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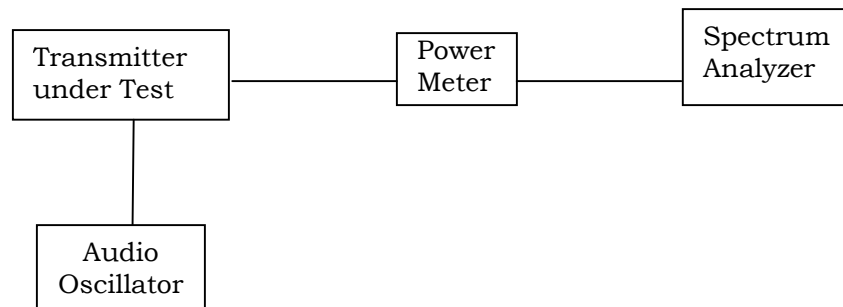
RF POWER OUTPUT

Rule Part No.: 2.1046(a), 80.215 (e)(1), 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: 7W CONDUCTED
LOW: 1W CONDUCTED

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

FOR LOW POWER SETTING INPUT POWER: $(13.8V)(0.38A) = 5.24 \text{ Watts}$
FOR HIGH POWER SETTING INPUT POWER: $(13.8V)(1.14A) = 15.73 \text{ Watts}$

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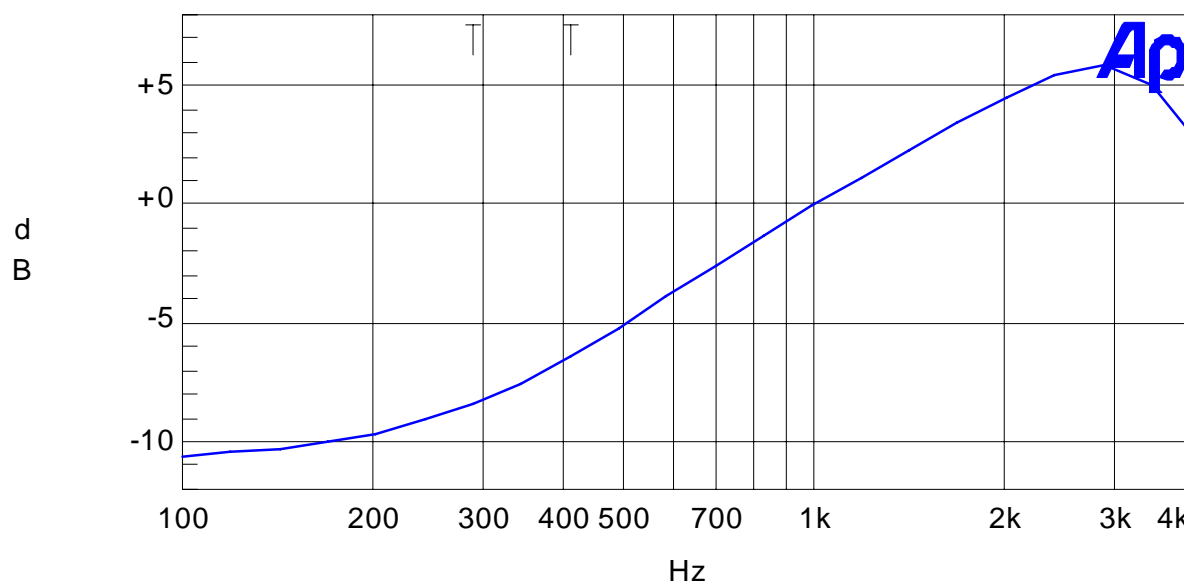
MODULATION CHARACTERISTICS

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

The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004 with no exception. 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

Audio Frequency Response Plot



| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|------------------------|------|
| Blue | Solid | 1 | Anlr.Level A!Normalize | Left |

MaxFreq.at1

Applicant: NAVICO APAC LIMITED

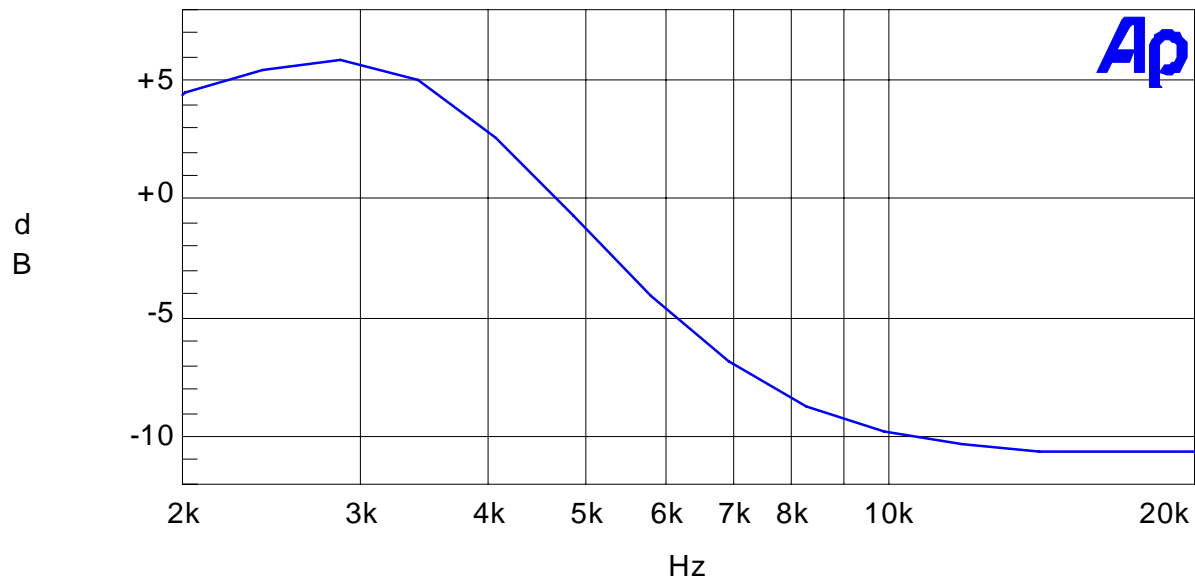
FCC ID: RAYEVR100US

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Part 2.1047(a), RSS-182 Voice modulated communication equipment: 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



| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|------------------------|------|
| Blue | Solid | 1 | Anlr.Level A!Normalize | Left |

MaxFreq.at1

Applicant: NAVICO APAC LIMITED

FCC ID: RAYEVR100US

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AUDIO INPUT VERSUS MODULATION

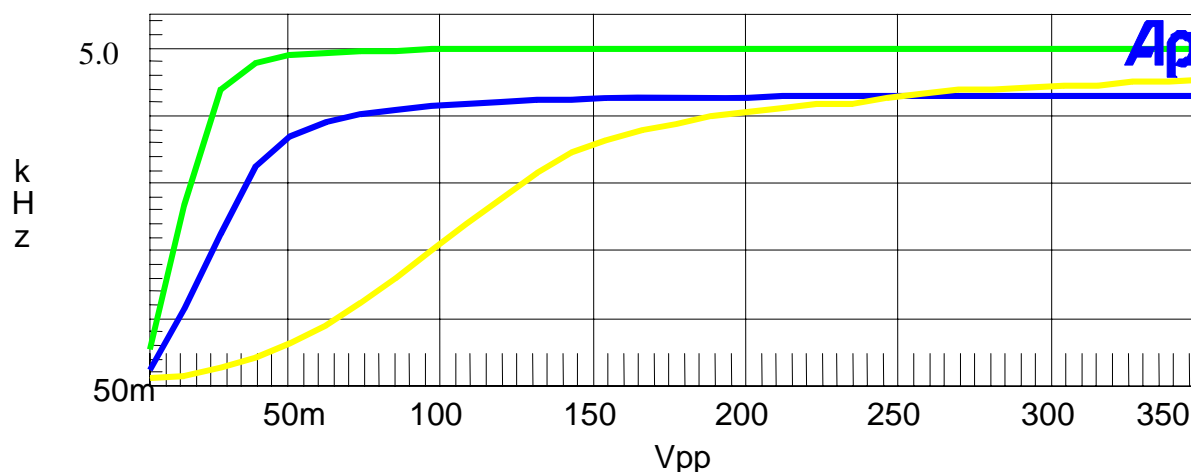
Rule Part No.: Part 2.1047(b) & 90, RSS-182

Test Requirements:

Method of Measurement: **Modulation cannot exceed 100%**, 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 Plots:
2.5 KHz (Green), 1.0 KHz (Blue), and 300 Hz



| Color | Line Style | Thick | Data | Axis |
|--------|------------|-------|--------------|------|
| Green | Solid | 3 | Anlr.Level A | Left |
| Blue | Solid | 3 | Anlr.Level A | Left |
| Yellow | Solid | 3 | Anlr.Level A | Left |

modulation limiting.at2

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IC CERT: 4697A-EVR100US

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OTHER MODULATION CHARACTERISTICS

Part 2.1033(c) (4) Type of Emission: 16K0G3E/16K0F3E
RSS-182, RSS-GEN

$$B_n = 2M + 2DK$$

$$M = 3000$$

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

$$K = 1$$

$$B_n = 2(3.0\text{K}) + 2(4.6\text{K})(1) = 6.0\text{K} + 10.0 = 16.0\text{K}$$

80.205 (a) ALLOWED AUTHORIZED BANDWIDTH = 20.00KHz.

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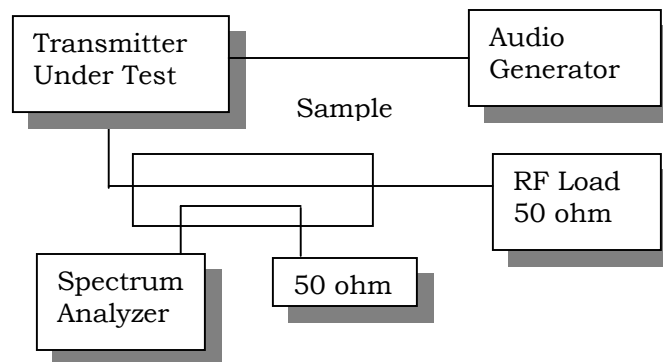
OCCUPIED BANDWIDTH

Part 2.1049(c) 80.213 (b) RSS-182, RSS-GEN

Data in the plots shows 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 35dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least $43 + \log(P)$ dB.

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

Test Setup Diagram:



Test Data: See the plot below

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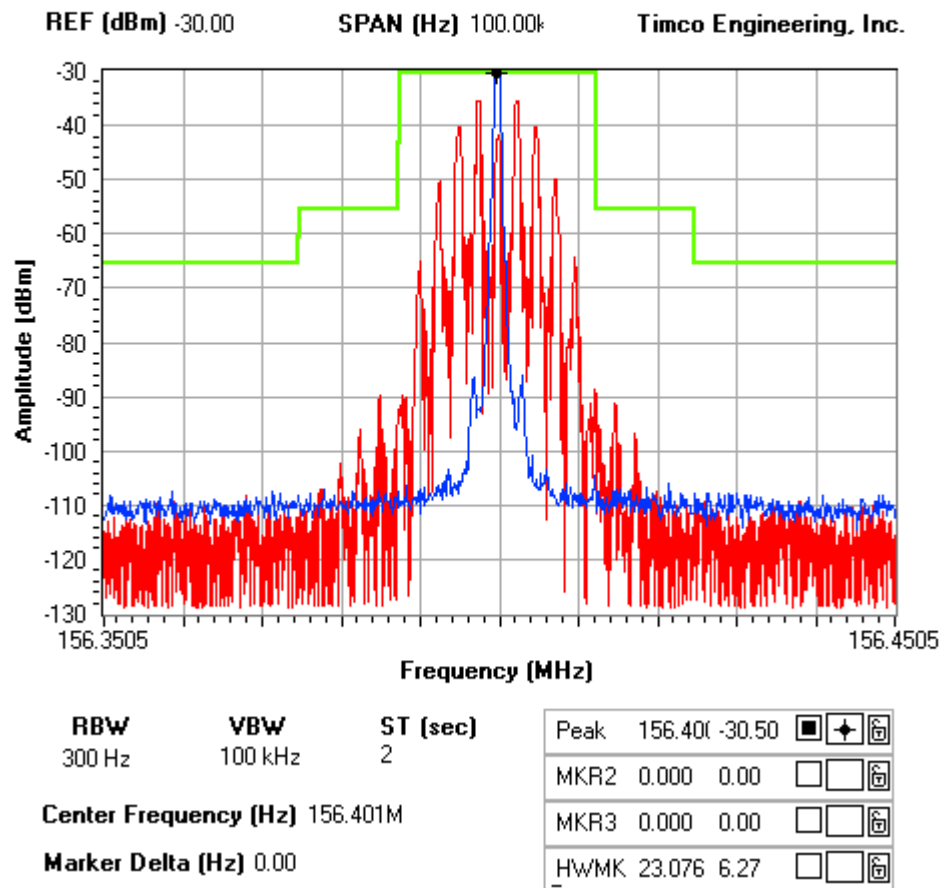
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OCCUPIED BANDWIDTH PLOT

NOTES:

NAVICO APAC LIMITED - FCC ID: RAYEVER-100
OCCUPIED BANDWIDTH PLOT



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FCC ID: RAYEVR100US

IC CERT: 4697A-EVR100US

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

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

HIGH POWER: $43 + 10\log(7) = 51.5$

LOW POWER: $43 + 10\log(1) = 43$

Method of Measurement: The carrier was modulated 100% using a 2500Hz 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 |
|---------------------|---------|---------------------|--|--------------------|---------|---------------------|
| 156.40 | 312.80 | 77 | | 156.40 | 312.80 | 72.8 |
| | 469.20 | 94.5 | | | 469.20 | 93.1 |
| | 625.60 | 107.5 | | | 625.60 | 99.9 |
| | 782.00 | 102.1 | | | 782.00 | 98.7 |
| | 938.40 | 107 | | | 938.40 | 98.2 |
| | 1094.80 | 99.1 | | | 1094.80 | 90.4 |
| | 1251.20 | 92.8 | | | 1251.20 | 89.7 |
| | 1407.60 | 94.1 | | | 1407.60 | 90.1 |
| | 1564.00 | 100.1 | | | 1564.00 | 89.9 |

| TF HIGH POWER | EF | dB below carrier | | TF LOW POWER | EF | dB below carrier |
|---------------------|---------|---------------------|--|--------------------|---------|---------------------|
| 157.43 | 314.85 | 79.5 | | 157.43 | 314.85 | 73.8 |
| | 472.28 | 96.1 | | | 472.28 | 91 |
| | 629.70 | 108.7 | | | 629.70 | NE |
| | 787.13 | 101.2 | | | 787.13 | 99.6 |
| | 944.55 | 104.5 | | | 944.55 | 97.6 |
| | 1101.98 | 99.1 | | | 1101.98 | 90.1 |
| | 1259.40 | 99.7 | | | 1259.40 | 88.9 |
| | 1416.83 | 94.5 | | | 1416.83 | NE |
| | 1574.25 | 99.2 | | | 1574.25 | NE |

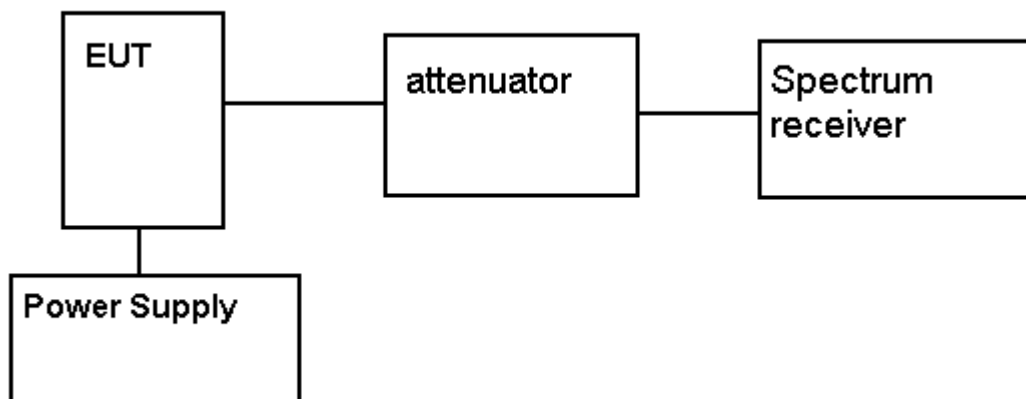
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METHOD OF MEASURING CONDUCTED SPURIOUS EMISSIONS



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004 without any exceptions. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

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FIELD STRENGTH OF SPURIOUS EMISSIONS

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

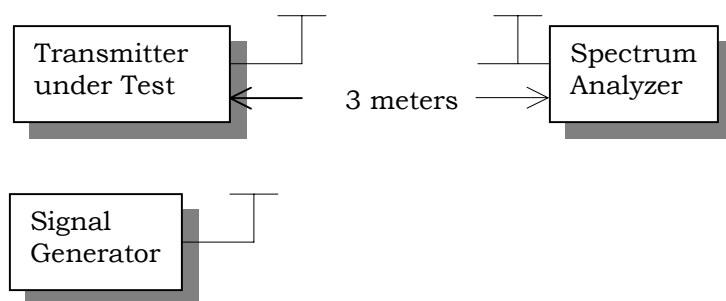
Requirements: Emissions must be $43 + 10\log(P_o)$ dB below the mean power output of the transmitter.

HIGH POWER: $43 + 10\log(7) = 51.5$

LOW POWER: $43 + 10\log(1) = 43$

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:



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Test Data:

| TF HIGH POWER | EF | Ant Polarity | dB below carrier | | TF LOW POWER | EF | Ant Polarity | dB below carrier |
|---------------------|---------|-----------------|---------------------|--|--------------------|---------|-----------------|---------------------|
| 156.4 | 312.80 | H | 55.30 | | 156.4 | 312.80 | H | 50.42 |
| | 469.20 | H | 54.57 | | | 469.20 | H | 55.29 |
| | 625.60 | H | 71.91 | | | 625.60 | H | 77.13 |
| | 782.00 | H | 90.88 | | | 782.00 | H | 83.50 |
| | 938.40 | H | 76.84 | | | 938.40 | H | 75.86 |
| | 1094.80 | H | 64.35 | | | 1094.80 | H | 70.97 |
| | 1251.20 | H | 54.06 | | | 1251.20 | H | 60.68 |
| | 1407.60 | H | 68.26 | | | 1407.60 | H | 74.08 |
| | 1564.00 | H | 71.27 | | | 1564.00 | H | 80.79 |
| | | | | | | | | |
| | | | | | | | | |
| TF HIGH POWER | EF | Ant Polarity | dB below carrier | | TF LOW POWER | EF | Ant Polarity | dB below carrier |
| 157.43 | 314.85 | H | 53.8 | | 157.43 | 314.85 | H | 49.85 |
| | 472.28 | H | 55.19 | | | 472.28 | H | 56.54 |
| | 629.70 | H | 70.18 | | | 629.70 | H | 76.23 |
| | 787.13 | H | 92.89 | | | 787.13 | H | 84.14 |
| | 944.55 | H | 74.23 | | | 944.55 | H | 71.58 |
| | 1101.98 | H | 62.81 | | | 1101.98 | H | 73.36 |
| | 1259.40 | H | 55.81 | | | 1259.40 | H | 63.66 |
| | 1416.83 | H | 66.11 | | | 1416.83 | H | 71.76 |
| | 1574.25 | H | 70.27 | | | 1574.25 | H | 80.82 |

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RECEIVER RADIATED SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 15.109, RSS-GEN 4.10, 6

Requirements:

| Frequency MHz | Limits |
|---------------|---------------------------------|
| 30 – 88 | 40.0 dBμV/m measured @ 3 meters |
| 80 – 216 | 43.5 dBμV/m measured @ 3 meters |
| 216 – 960 | 46.0 dBμV/m measured @ 3 meters |
| Above 960 | 54.0 dBμV/m measured @ 3 meters |

TEST DATA:

| Tuned Frequency MHz | Emission Frequency MHz | Meter Reading dBuV | Ant. Pol | Coax Loss dB | Correction Factor dB | Field Strength dBuV/m | Margin dB |
|---------------------|------------------------|--------------------|----------|--------------|----------------------|-----------------------|-----------|
| 156.4 | 135.04 | 22.0 | H | 0.69 | 12.90 | 35.59 | 7.91 |
| 156.4 | 135.04 | 24.4 | V | 0.69 | 12.70 | 37.79 | 5.71 |
| 156.4 | 270.08 | 8.8 | V | 1.04 | 13.30 | 23.14 | 22.86 |
| 156.4 | 270.08 | 13.9 | H | 1.04 | 13.50 | 28.44 | 17.56 |
| 156.4 | 405.12 | 8.5 | H | 1.21 | 16.15 | 25.86 | 20.14 |
| 156.4 | 405.12 | 8.7 | V | 1.21 | 15.80 | 25.71 | 20.29 |
| 156.4 | 540.16 | 6.4 | V | 1.42 | 18.10 | 25.92 | 20.08 |
| 156.4 | 540.16 | 6.5 | H | 1.42 | 18.30 | 26.22 | 19.78 |
| 156.4 | 675.20 | 6.6 | V | 1.68 | 20.50 | 28.78 | 17.22 |
| 156.4 | 675.20 | 6.7 | H | 1.68 | 20.86 | 29.24 | 16.76 |
| 157.4 | 140.65 | 21.4 | H | 0.69 | 13.07 | 35.16 | 8.34 |
| 157.4 | 140.65 | 24.2 | V | 0.69 | 13.08 | 37.97 | 5.53 |
| 157.4 | 281.30 | 10.2 | V | 1.06 | 13.64 | 24.90 | 21.10 |
| 157.4 | 281.30 | 10.5 | H | 1.06 | 13.83 | 25.39 | 20.61 |
| 157.4 | 421.95 | 7.4 | H | 1.22 | 16.26 | 24.88 | 21.12 |
| 157.4 | 421.95 | 9.9 | V | 1.22 | 16.02 | 27.14 | 18.86 |
| 157.4 | 562.60 | 7.7 | V | 1.49 | 18.13 | 27.32 | 18.68 |
| 157.4 | 562.60 | 7.8 | H | 1.49 | 18.77 | 28.06 | 17.94 |
| 157.4 | 703.25 | 7.4 | V | 1.71 | 20.57 | 29.68 | 16.32 |
| 157.4 | 703.25 | 7.5 | H | 1.71 | 21.00 | 30.21 | 15.79 |
| 163.3 | 141.91 | 21.7 | H | 0.69 | 13.19 | 35.58 | 7.92 |
| 163.3 | 141.91 | 24.0 | V | 0.69 | 13.23 | 37.92 | 5.58 |
| 163.3 | 283.76 | 10.5 | H | 1.07 | 13.88 | 25.45 | 20.55 |
| 163.3 | 283.76 | 10.9 | V | 1.07 | 13.71 | 25.68 | 20.32 |
| 163.3 | 425.64 | 8.2 | H | 1.23 | 16.37 | 25.80 | 20.20 |
| 163.3 | 425.64 | 8.9 | V | 1.23 | 16.06 | 26.19 | 19.81 |
| 163.3 | 567.52 | 5.6 | V | 1.50 | 18.18 | 25.28 | 20.72 |
| 163.3 | 567.52 | 7.1 | H | 1.50 | 18.72 | 27.32 | 18.68 |
| 163.3 | 709.40 | 7.0 | V | 1.72 | 20.51 | 29.23 | 16.77 |
| 163.3 | 709.40 | 8.9 | H | 1.72 | 21.00 | 31.62 | 14.38 |

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IC CERT: 4697A-EVR100US

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FREQUENCY STABILITY

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

Requirements: Temperature and voltage tests were performed to verify that the frequency remains within the .0010%, 10.0ppm specification limit, for 20kHz 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 worse 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 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: TIA/EIA 603.

Test Data:

| Assigned Frequency (Ref. Frequency) (MHz) | | 156.400 000 MHz |
|---|-----------------|---------------------------|
| Temperature (°C) | Frequency (MHz) | Frequency Stability (PPM) |
| -30 | 156.399 962 | 00.0 |
| -20 | 156.400 433 | 3.01 |
| -10 | 156.400 122 | 1.02 |
| 0 | 156.399 971 | 0.06 |
| +10 | 156.399 940 | -0.14 |
| +20 | 156.399 962 | 0.00 |
| +30 | 156.400 040 | 0.50 |
| +40 | 156.400 247 | 1.82 |
| +50 | 156.400 639 | 4.33 |

| Assigned Frequency (Ref. Frequency) (MHz) | | 156.399 967 |
|---|-----------------|---------------------------|
| % Battery | Frequency (MHz) | Frequency Stability (PPM) |
| -15% | 156.399 967 | 0.03 |
| 0 | | |
| +15% | | |

Applicant: NAVICO APAC LIMITED

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