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# FCC PART 80 AND IC RSS-182
# TEST REPORT

| | |
|---|---|
| **APPLICANT** | YAESU MUSEN CO., LTD. |
| | TENNOZU PARKSIDE BUILDING<br>2-5-8 HIGASHI-SHINAGAWA,<br>SHINAGAWA-KU, TOKYO 140-0002 |
| **FCC ID** | K6630553X20 |
| **IC CERTIFICATION** | 511B-30553X20 |
| **MODEL NUMBER** | HX100 |
| **PRODUCT DESCRIPTION** | HANDHELD MARINE TRANSCEIVER |
| **DATE SAMPLE RECEIVED** | 7/11/2012 |
| **DATE TESTED** | 7/16/2012 |
| **TESTED BY** | Nam Nguyen |
| **APPROVED BY** | Mario de Aranzeta |
| **TIMCO REPORT NO.** | 1730AUT12TestReport.doc |
| **TEST RESULTS** | ☒ PASS ☐ FAIL |



ACCREDITED
Certificate # 0955-01

## TABLE OF CONTENTS

**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:** July/28/2012

## GENERAL INFORMATION

### DUT Specification

| | |
|---|---|
| **DUT Description** | HANDHELD MARINE TRANSCEIVER |
| **FCC ID** | K6630553X20 |
| **IC Certification** | 511B-30553X20 |
| **Model Number** | HX100 |
| **Operating Frequency** | 156.025-157.425 MHz |
| **Test Frequencies** | (156.40 and 157.425) MHz |
| **Type of Emission** | 16K0G3E |
| **Modulation** | FM |
| **DUT Power Source** | ☐ 110–120Vac/50– 60Hz |
| | ☐ DC Power 12V |
| | ☒ Battery Operated Exclusively (Ni-MH / FNB-125) (4.8 VDC / 700mAh / 3.4Wh) |
| **Test Item** | ☐ Prototype |
| | ☒ Pre-Production |
| | ☐ Production |
| **Type of Equipment** | ☐ Fixed |
| | ☐ Mobile |
| | ☒ Portable |
| **Antenna Connector** | Fixed antenna |
| **Test Conditions** | The temperature was 26°C<br>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 and RSS-GEN |
| **Test Facility** | Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. |

## 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 10$^{th}$ 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.

**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. |
| 80.873; 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 2.5 Watts at the high power setting and 1 watt at low power setting, consistent with previous measurements. |
| 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 4.8 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 2.5 Watts under normal speech modulation. |

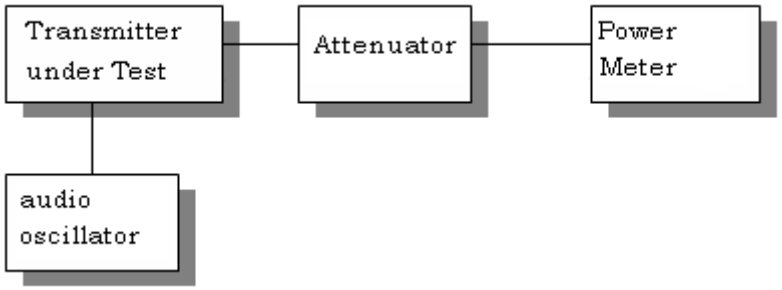
## RF POWER OUTPUT

**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 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 – 2.5 Watts Conducted
LOW – 1.0 Watts Conducted

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

FOR LOW POWER SETTING INPUT POWER: (4.8V)(0.8A) = 3.84 Watts
FOR HIGH POWER SETTING INPUT POWER: (4.8V)(1.1.A) = 5.28 Watts

**MODULATION CHARACTERISTICS**

**Part 2.1033(c) (4)** Type of Emission: 16K0G3E, 16K0F3E
**FCC Part 80.205(a)**
**RSS-182, RSS-GEN**

Bn = 2M + 2DK
M = 3000
D = 4.6kHz (Peak Deviation)
K =1
Bn = 2(3000)+2(4.6K)(1) = 16.0K

80.205(a) ALLOWED AUTHORIZED BANDWIDTH – 20.00 kHz

## AUDIO FREQUENCY RESPONSE

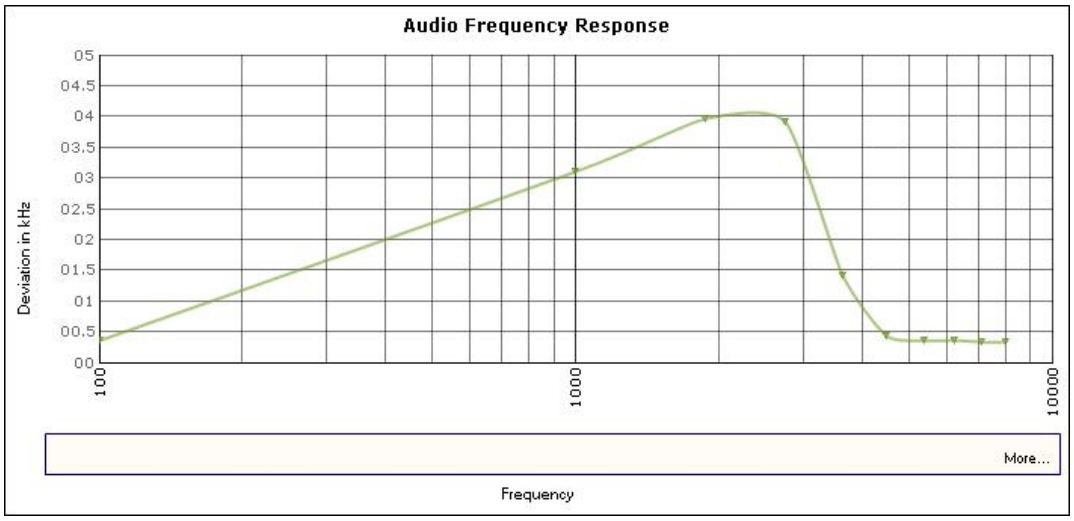
**Rule Part No.:** FCC Part 2.1047(a)(b), IC RSS-182

**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**



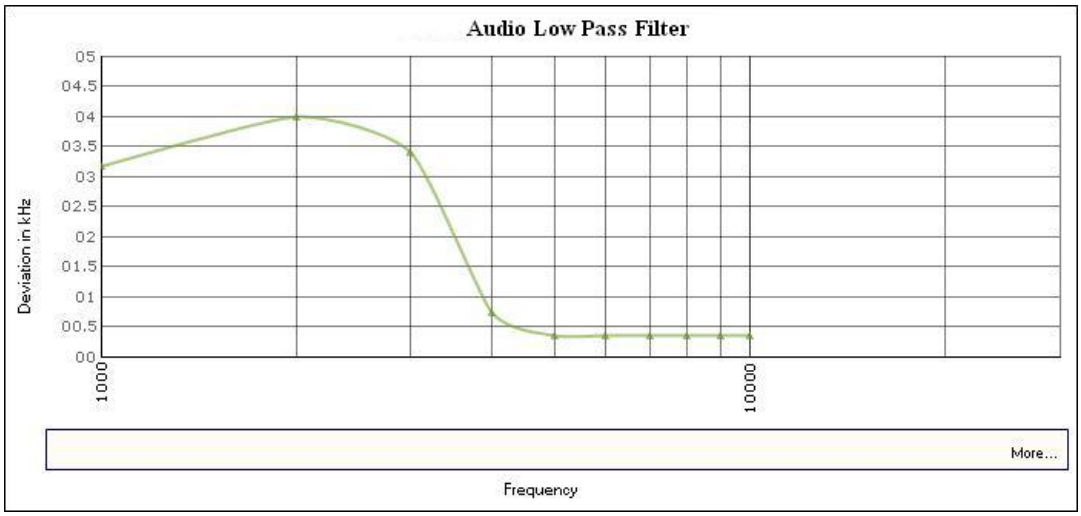
**AUDIO LOW PASS FILTER**

**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**



## AUDIO INPUT VERSUS MODULATION

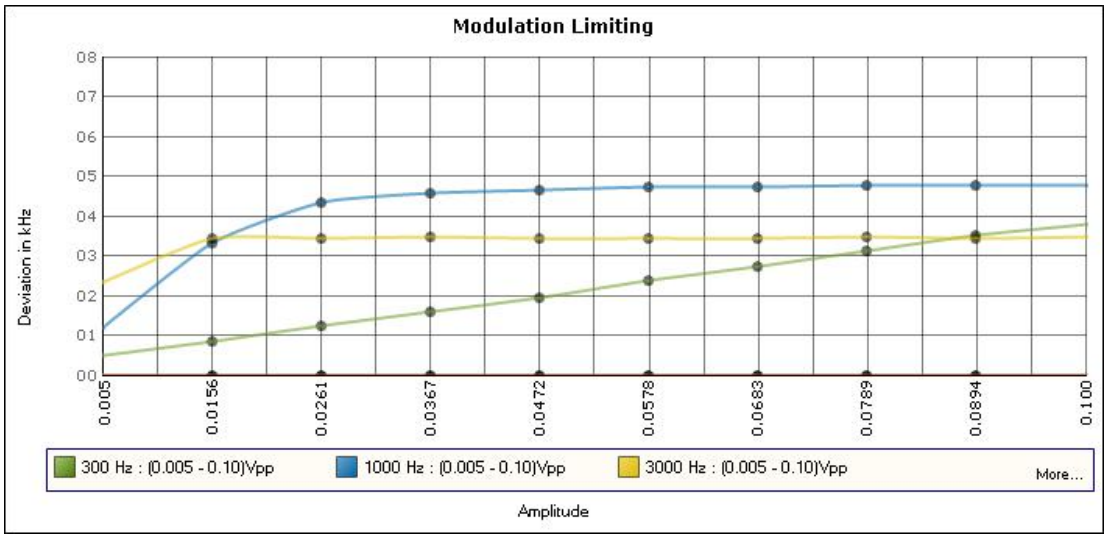
**Rule Part No.:** FCC Part 2.1047(b) & 80, IC RSS-182

**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



## OCCUPIED BANDWIDTH

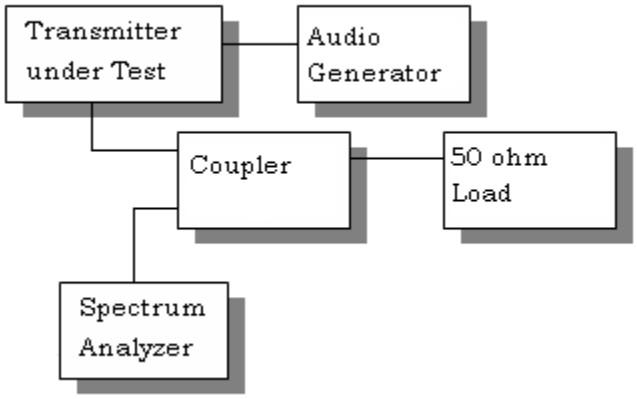
**FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH**
**FCC Part 80.213(b) RSS-182**

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 + 10log(P)dB.

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

**Test Setup Diagram:**

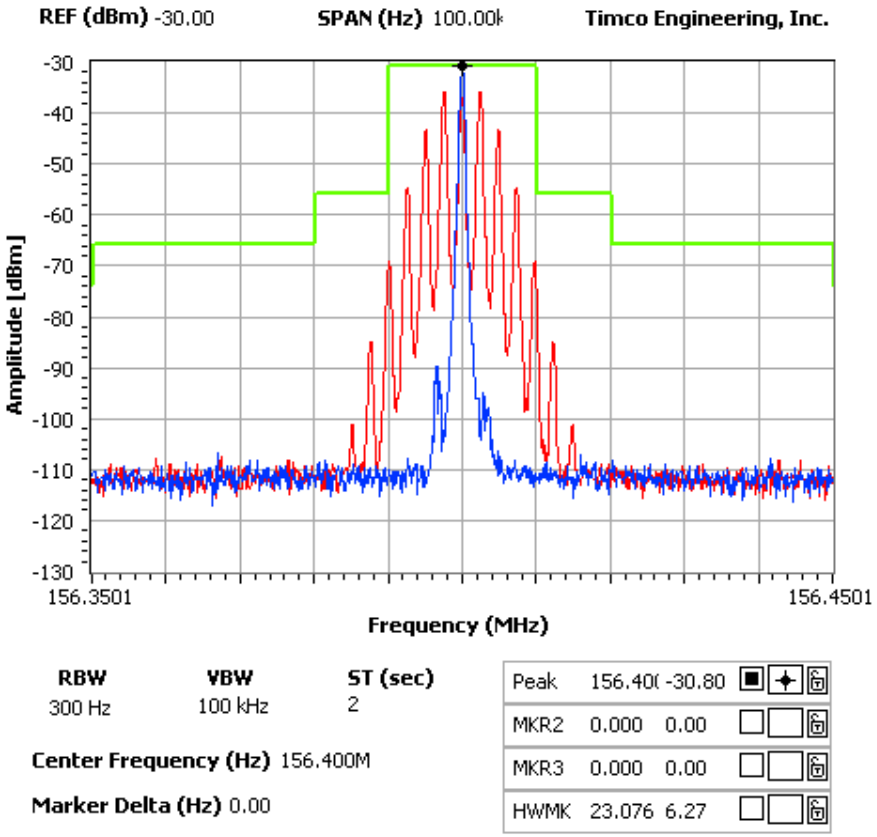
**OCCUPIED BANDWIDTH MEASUREMENT**




**Test Data:** See the plot below

**NOTES:**

YAESU MUSEN CO., LTD. - FCC ID: K6630553X20
OCCUPIED BANDWIDTH PLOT



## SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

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

Low power: 43+10log(2.5) = 47.0 dBc
High power: 43+10log(1.0) = 43 dBc

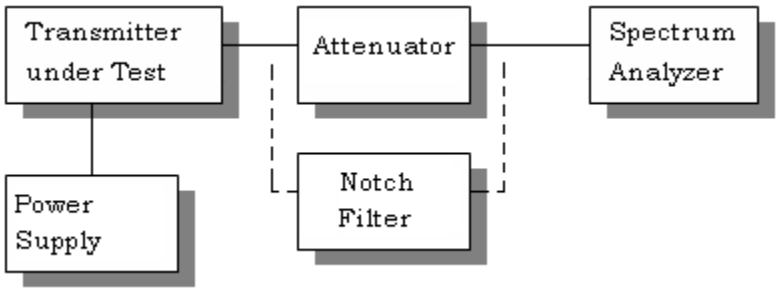
**Method of Measurement:** The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C: 2004.

**Test Data:**

| TF HIGH POWER | EF | dB below carrier | | TF LOW POWER | EF | dB below carrier |
|---|---|---|---|---|---|---|
| 156.40 | 312.80 | 63.8 | | 156.40 | 312.80 | 75.2 |
| | 469.20 | 77.5 | | | 469.20 | 69.7 |
| | 625.60 | 84.4 | | | 625.60 | 83.2 |
| | 782.00 | 80 | | | 782.00 | 81.3 |
| | 938.40 | 83.2 | | | 938.40 | 81.8 |
| | 1094.80 | 76.9 | | | 1094.80 | 74.6 |
| | 1251.20 | 75 | | | 1251.20 | 74.1 |
| | 1407.60 | 73.4 | | | 1407.60 | 71.8 |
| | 1564.00 | 72.8 | | | 1564.00 | 73.1 |
| | | | | | | |

| TF HIGH POWER | EF | dB below carrier | | TF LOW POWER | EF | dB below carrier |
|---|---|---|---|---|---|---|
| 157.43 | 314.85 | 65.8 | | 157.43 | 314.85 | 76.4 |
| | 472.28 | 76.8 | | | 472.28 | 70.4 |
| | 629.70 | 86.4 | | | 629.70 | 83.2 |
| | 787.13 | 78.9 | | | 787.13 | 81.4 |
| | 944.55 | 83.1 | | | 944.55 | 82.6 |
| | 1101.98 | 77.1 | | | 1101.98 | 74.9 |
| | 1259.40 | 75.4 | | | 1259.40 | 75.1 |
| | 1416.83 | 74 | | | 1416.83 | 71.7 |
| | 1574.25 | 74.8 | | | 1574.25 | 73.4 |
| | | | | | | |

**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.

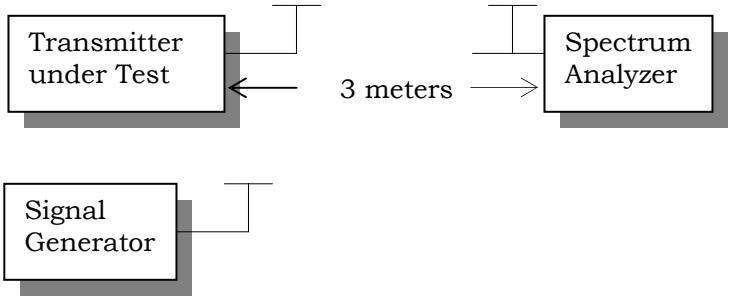
**FIELD STRENGTH OF SPURIOUS EMISSIONS**

**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 HIGH POWER | EF | Ant Polarity | dB below carrier | | TF LOW POWER | EF | Ant Polarity | dB below carrier |
|---|---|---|---|---|---|---|---|---|
| 156.4 | 312.80 | H | 73.6 | | 156.4 | 312.80 | H | 81.6 |
| | 469.20 | V | 65.7 | | | 469.20 | V | 58.0 |
| | 625.60 | V | 74.8 | | | 625.60 | H | 82.9 |
| | 782.00 | V | 70.2 | | | 782.00 | V | 79.6 |
| | 938.40 | V | 78.2 | | | 938.40 | V | 83.4 |
| | 1094.80 | V | 83.2 | | | 1094.80 | V | 81.7 |
| | 1251.20 | V | 81.8 | | | 1251.20 | V | 83.0 |
| | 1407.60 | V | 78.9 | | | 1407.60 | V | 76.3 |
| | 1564.00 | V | 77.9 | | | 1564.00 | V | 76.4 |

| TF HIGH POWER | EF | Ant Polarity | dB below carrier | | TF LOW POWER | EF | Ant Polarity | dB below carrier |
|---|---|---|---|---|---|---|---|---|
| 157.43 | 314.85 | H | 76.6 | | 157.43 | 314.85 | H | 84.7 |
| | 472.28 | V | 65.6 | | | 472.28 | V | 58.9 |
| | 629.70 | V | 73.8 | | | 629.70 | H | 85.7 |
| | 787.13 | V | 70.4 | | | 787.13 | V | 80.7 |
| | 944.55 | V | 81.8 | | | 944.55 | V | 85.6 |
| | 1101.98 | V | 83.8 | | | 1101.98 | V | 81.2 |
| | 1259.40 | V | 78.4 | | | 1259.40 | V | 82.0 |
| | 1416.83 | V | 77.6 | | | 1416.83 | V | 77.7 |
| | 1574.25 | V | 74.1 | | | 1574.25 | V | 74.9 |

**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)** | | 156.399983 |
|---|---|---|
| **Temperature (ºC)** | **Frequency (MHz)** | **Frequency Stability (PPM)** |
| -30 | 156.399790 | -1.23 |
| -20 | 156.399837 | -0.93 |
| -10 | 156.399906 | -0.49 |
| 0 | 156.399938 | -0.29 |
| +10 | 156.399943 | -0.26 |
| +20 | 156.399969 | -0.09 |
| +30 | 156.400070 | 0.56 |
| +40 | 156.400075 | 0.59 |
| +50 | 156.400087 | 0.66 |

| **Assigned Frequency (Ref. Frequency) (MHz)** | | |
|---|---|---|
| **% Battery (%)** | **Frequency (MHz)** | **Frequency Stability (PPM)** |
| -15% | 156.399988 | 0.03 |
| 0 | 156.399983 | 0.00 |
| +15% | 156.399995 | 0.08 |

**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 |
| Power Meter | Boonton Electronics | 4531 | 11793 | CAL 11/12/2010 | 11/12/2012 |
| EMI Receiver | Rohde & Schwarz | ESIB40 | 100274 | CAL 3/16/2012 | 3/16/2014 |
| 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 2/22/12 | 2/22/13 |
| 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 |