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

APPLICANT	YAESU MUSEN CO., LTD.
	TENNOZU PARKSIDE BUILDING 2-5-8 HIGASHI-SHINAGAWA, SHINAGAWA-KU, TOKYO 140-0002 JAPAN
FCC ID	K6630573X30
IC CERTIFICATION	511B-30573X30
MODEL NUMBER	HX870
PRODUCT DESCRIPTION	HANDHELD MARINE TRANSCEIVER
DATE SAMPLE RECEIVED	6/25/2014
DATES TESTED	7/7-18/2014
TESTED BY	Cory Leverett
APPROVED BY	Sid Sanders
TIMCO REPORT NO.	1083AUT14TestReport_Rev.docx
TEST RESULTS	☒ PASS ☐ FAIL

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



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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.

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:

Cory Leverett
Engineering Project Manager

Date: 7/21/2014

A handwritten signature in black ink is written over a circular purple stamp. The stamp contains the text 'TIMCO ENGINEERING INC.' around the perimeter.

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GENERAL INFORMATION

EUT Specification

EUT Description	HANDHELD MARINE TRANSCEIVER
FCC ID	K6630573X30
IC Certification	511B-30573X30
Model Number	HX870
Operating Frequency	156.025-157.425 MHz
Test Frequencies	Audio-156.050,157.425MHz & DSC-156.525
No. of Channels	All Allowed US marine and weather channels
Type of Emission	Voice-16K0G3E, DSC-16K0G2B
Modulation	FM
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power 12V
	☒ Battery Operated Exclusively 7.4VDC
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☐ Mobile
	☒ Portable
Antenna Connector	SMA
Test Conditions	The temperature was 26°C Relative humidity of 50%.
Modification to the EUT	None
Test Exercise	The EUT 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.

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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 EUT 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.

TEST RESULTS SUMMARY

Specification	RESULTS
FCC/IC Rule Part	Pass/Fail/NA
FCC 2.1045, 80.215, IC RSS-182 – RF Output Power	P
FCC 2.1047, IC RSS-182 – Audio Freq Response	P
FCC 2.1047, IC RSS-182 – Audio Low Pass Filter	P
FCC 2.1047, IC RSS-182 – Audio Input VS Modulation	P
FCC 2.1049, 80.21, IC RSS-182 – Occupied Bandwidth	P
FCC 2.1051, 80.211, IC RSS-182 – Antenna Conducted Emissions	P
FCC 2.1052, IC RSS-182 – Field Strength of Spurious Emissions	P
FCC 2.1055, 80.209, IC RSS-182 – Frequency Stability	P

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, 59 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 156.050 and to 157.425 MHz. With normal modulation, the output power displayed was 5.2 Watts at the high power setting and .74 watt at low power setting, consistent with previous measurements.
- The transmitter has been demonstrated to be capable, with normal operating voltages applied, of delivering 5.2 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 156.050 and 157.425 MHz
- 80.911 (c) With 7.4 VDC applied and with the radio connected to a 50 ohm resistive wattmeter, the output power was measured at 156.050 and 157.425 MHz with a measured reading shown later in this report under normal speech modulation.

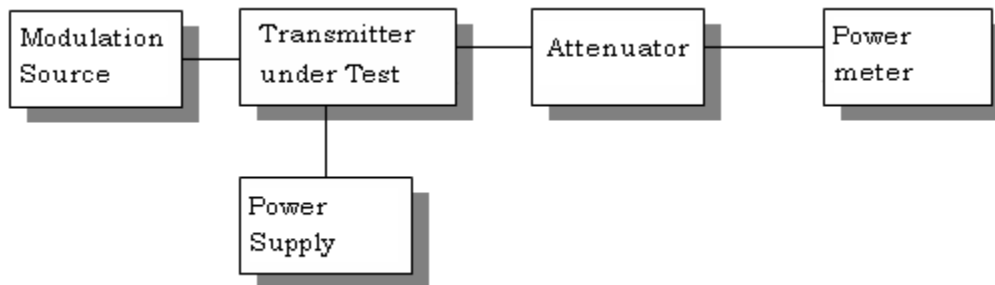
RF POWER OUTPUT

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 as per setup diagram. With a nominal voltage, and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:



Test Data:

OUTPUT POWER:

Channel Number	Nominal Frequency	Power Setting	Measured Level Watts
88A	157.425	High	6
1A	156.050	Low	.74

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

FOR LOW POWER SETTING INPUT POWER: $(7.4V)(0.53A) = 3.9 \text{ Watts}$

FOR HIGH POWER SETTING INPUT POWER: $(7.4V)(1.43A) = 10.6 \text{ Watts}$

MODULATION CHARACTERISTICS

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

$$\begin{aligned} B_n &= 2M + 2DK \\ M &= 3000 \\ D &= 4.6\text{kHz (Peak Deviation)} \\ K &= 1 \\ B_n &= 2(3000) + 2(4.6K)(1) = 16.0K \end{aligned}$$

80.205(a) ALLOWED AUTHORIZED BANDWIDTH – 20.00 kHz

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

AUDIO FREQUENCY RESPONSE

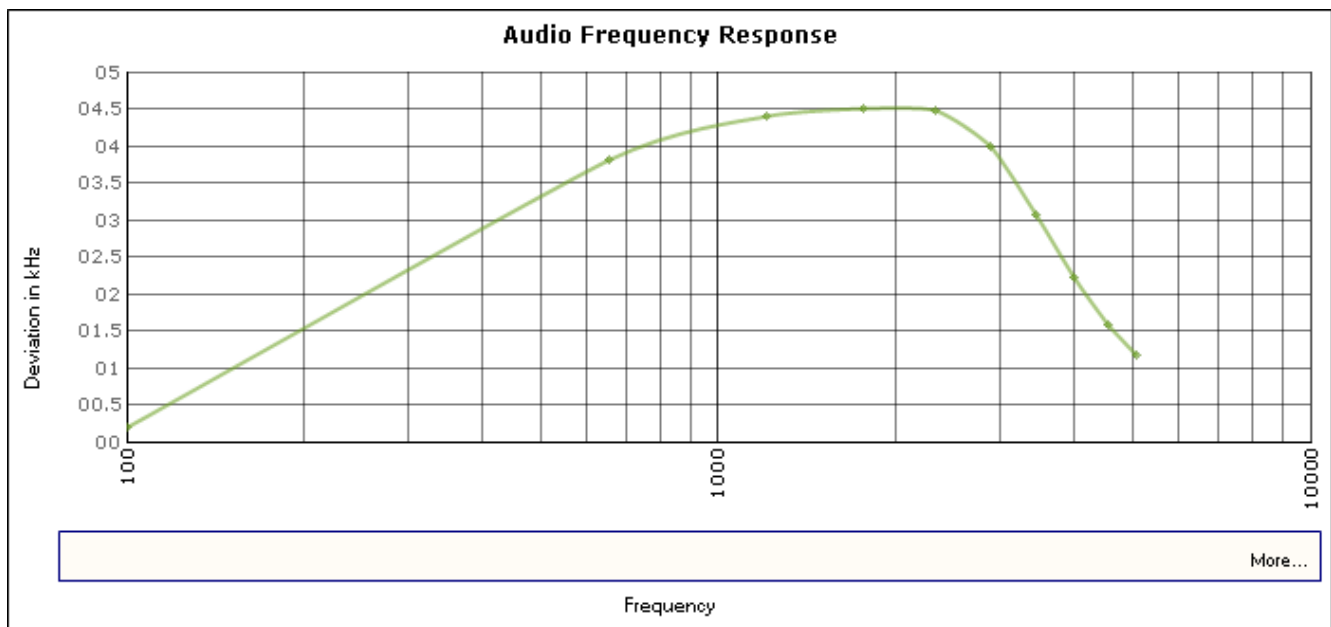
Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-182

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



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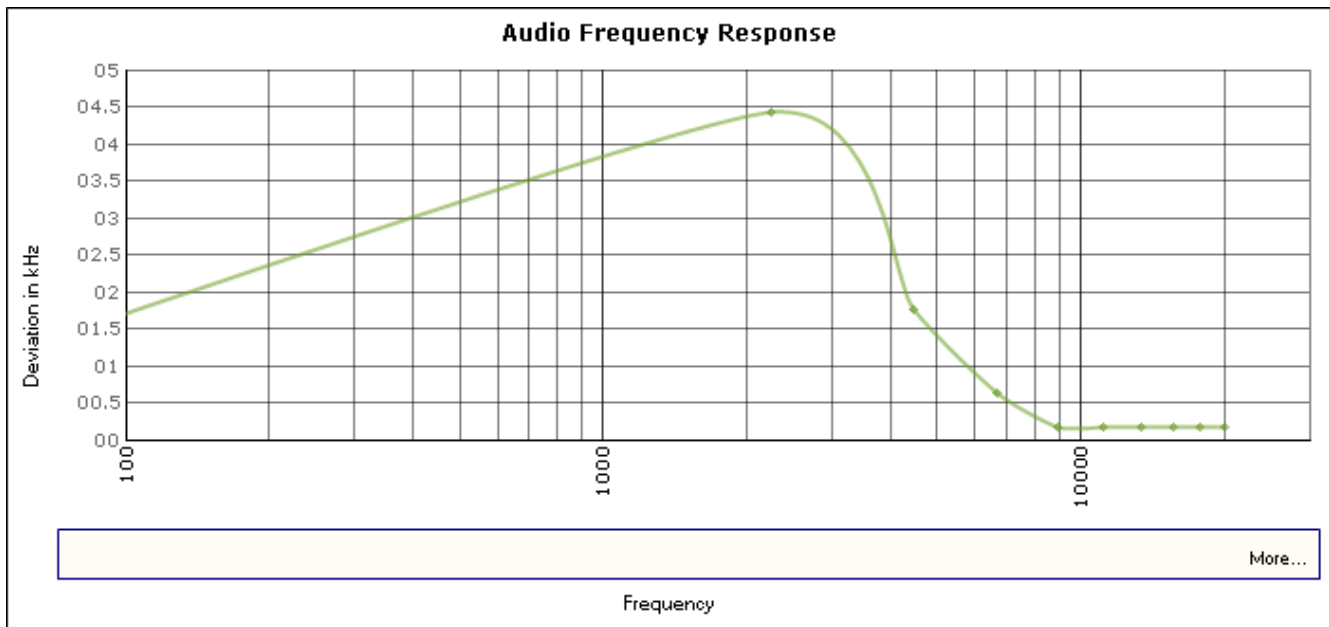
AUDIO LOW PASS FILTER

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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AUDIO INPUT VERSUS MODULATION

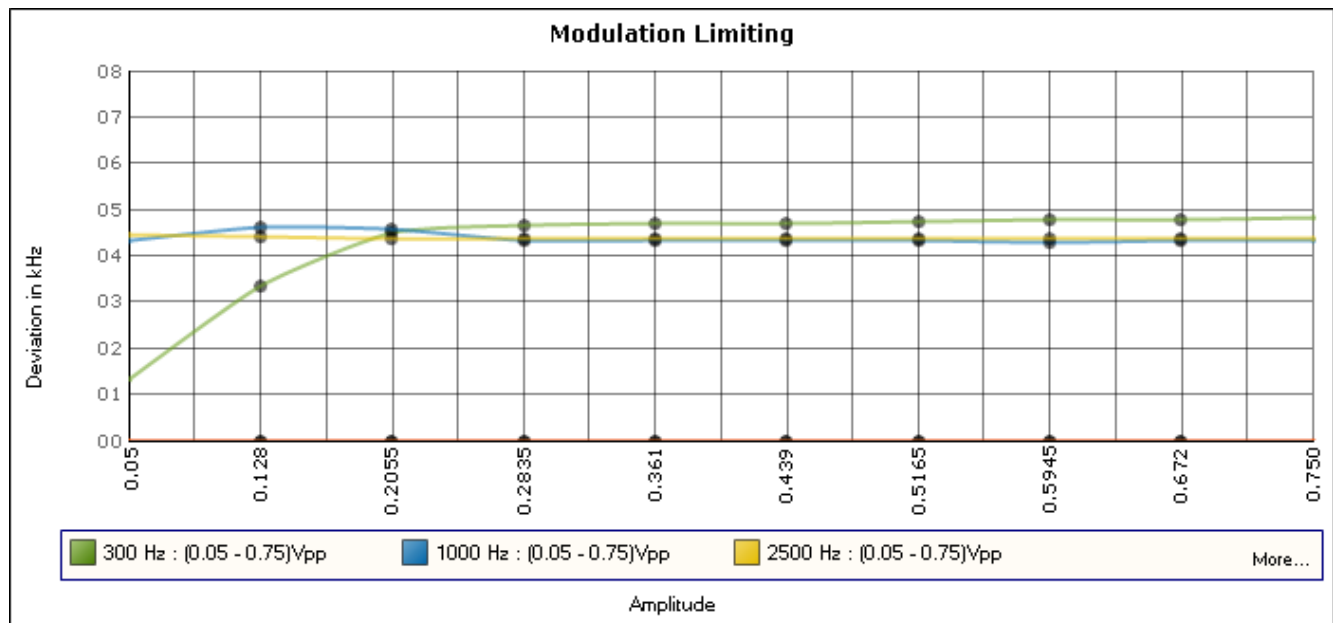
Rule Part No.: FCC Part 2.1047(b) & 80, IC RSS-182

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

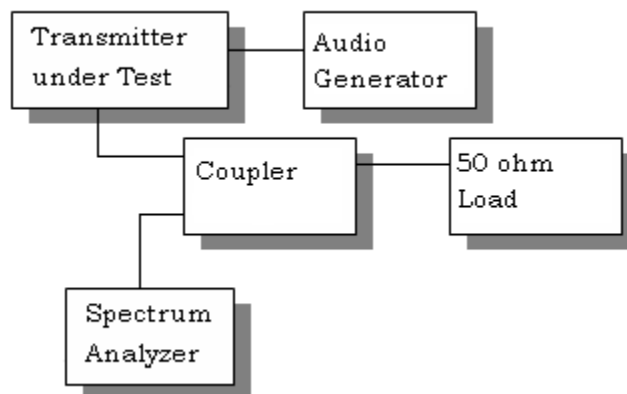
FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH
FCC Part 80.213(b) RSS-182

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 $43 + 10\log(P)$ dB.

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

Test Setup Diagram:

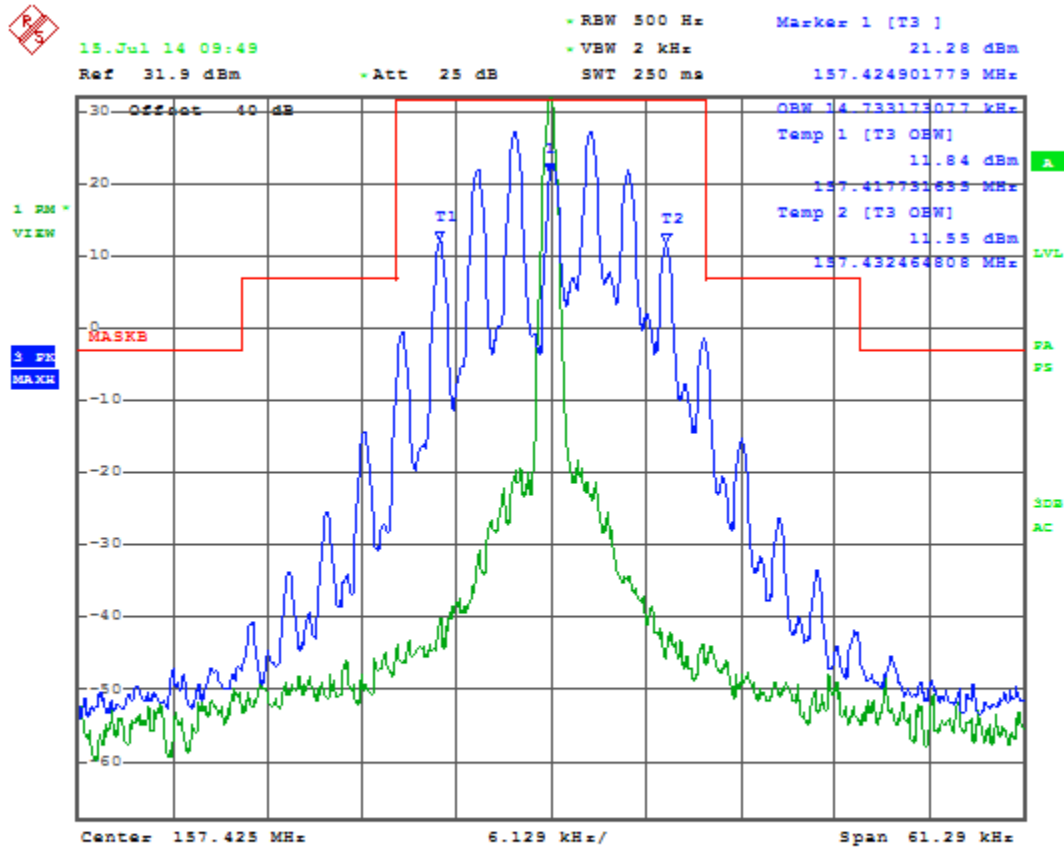
OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plot below

Occupied bandwidth audio Plot with FCC Mask B

99% Bandwidth = 14.73 KHz



Date: 15.JUL.2014 09:49:59

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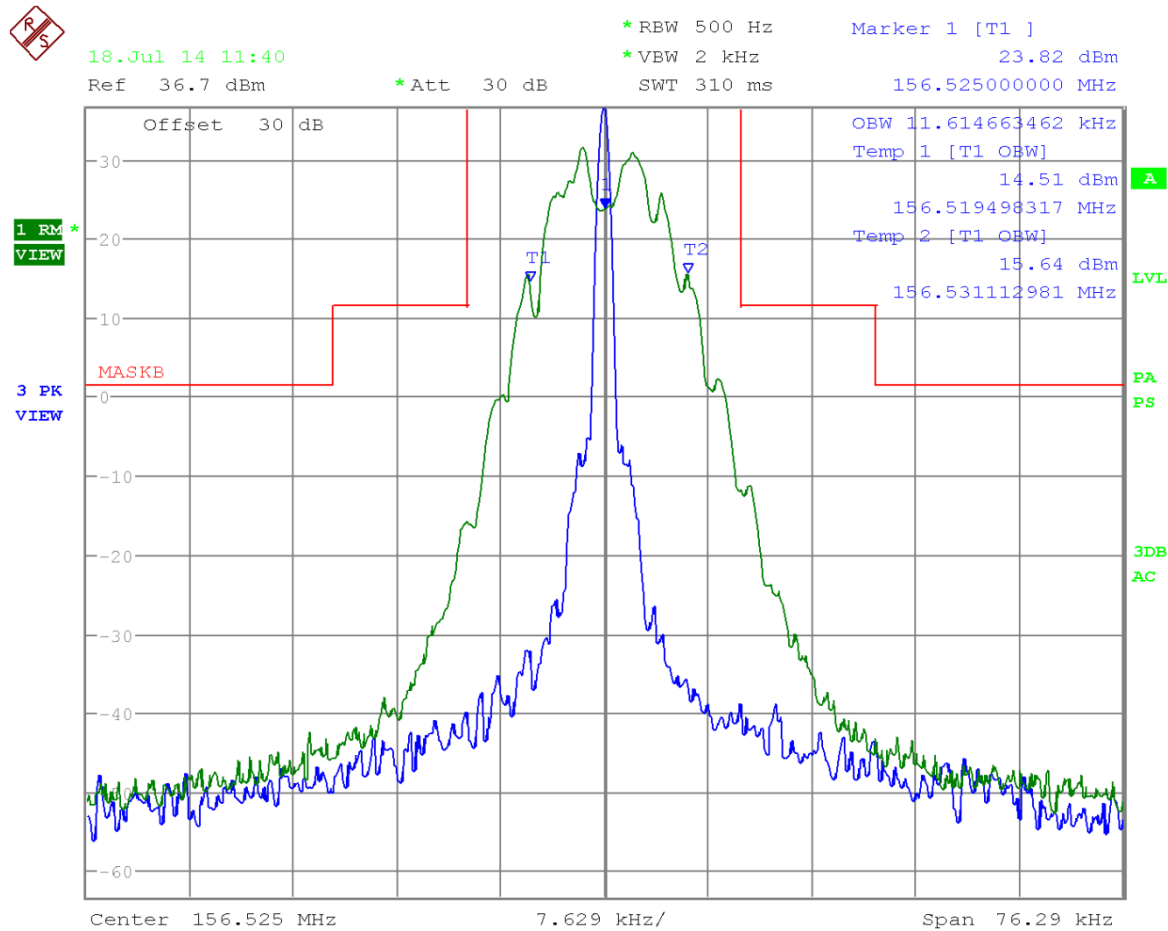
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Occupied BW DSC Plot with FCC Mask B

99% Occupied Bandwidth = 11.61 KHz



Date: 18.JUL.2014 11:40:04

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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: High Power 156.05MHz

Tuned Frequency	Power Output		
MHz	dBm	Watts	dBc Limit
156.05	37.78	6	50.78
Harmonic	Level	dBc	Margin
312.1	-30.68	68.46	17.68
468.15	-34.37	72.15	21.37
624.2	-38.49	76.27	25.49
780.25	-42.69	80.47	29.69
936.3	-45.52	83.3	32.52
1092.35	-46.62	84.4	33.62
1248.4	-47.22	85	34.22
1404.45	-47.24	85.02	34.24
1560.5	-48.6	86.38	35.60

Test Data: High Power 157.425MHz

Tuned Frequency	Power Output		
MHz	dBm	Watts	dBc Limit
157.425	37.78	6	50.78
Harmonic	Level	dBc	Margin
314.85	-33.37	71.15	20.37
472.275	-33.95	71.73	20.95
629.7	-37.71	75.49	24.71
787.125	-45.86	83.64	32.86
944.55	-52.4	90.18	39.40
1101.975	-55.48	93.26	42.48
1259.4	-52.8	90.58	39.80
1416.825	-53.17	90.95	40.17
1574.25	-53.04	90.82	40.04

Test Data: Low Power 156.05MHz

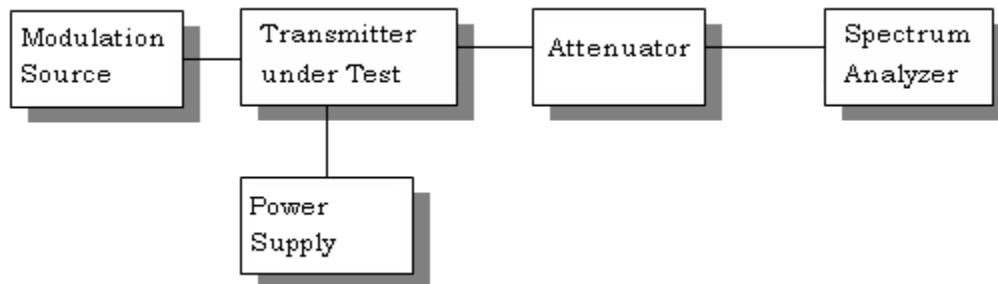
Tuned Frequency	Power Output		
MHz	dBm	Watts	dBc Limit
156.05	28.67	0.74	41.69
Harmonic	Level	dBc	Margin
312.1	-44.34	73.01	31.32
468.15	-60.55	89.22	47.53
624.2	-67.67	96.34	54.65
780.25	-67.56	96.23	54.54
936.3	-67.77	96.44	54.75
1092.35	-67.87	96.54	54.85
1248.4	-67.84	96.51	54.82
1404.45	-68.18	96.85	55.16
1560.5	-67.61	96.28	54.59

Test Data: Low Power 157.425MHz

Tuned Frequency	Power Output		
	MHz	dBm	Watts
	157.425	28.67	0.74
Harmonic	Level	dBc	Margin
314.85	-44.55	73.22	31.53
472.275	-60.77	89.44	47.75
629.7	-66.32	94.99	53.30
787.125	-67.58	96.25	54.56
944.55	-67.07	95.74	54.05
1101.975	-67.26	95.93	54.24
1259.4	-67.32	95.99	54.30
1416.825	-67.9	96.57	54.88
1574.25	-66.85	95.52	53.83

RESULTS: Meets Requirements

Method of Measuring Conducted Spurious Emissions



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

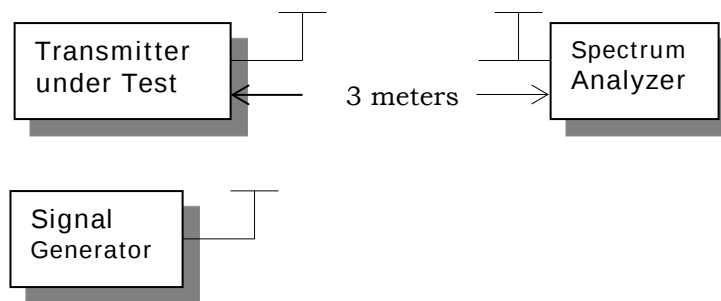
FIELD STRENGTH OF SPURIOUS EMISSIONS

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:



Test Data:

HIGH POWER: Low End of the Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
156.05	Hi	37.78	6	50.78	25.00
Emission Frequency (MHz)	Ant. Polarity		Below Carrier (dBc)	Margin	
312.10	V		101.57	50.79	
468.15	V		95.77	44.99	
624.20	V		97.82	47.04	
780.25	V		95.98	45.2	
936.30	V		94.84	44.06	
1,092.35	V		93.97	43.19	
1,248.40	V		94.17	43.39	
1,404.45	V		92.47	41.69	
1,560.50	H		94.61	43.83	

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HIGH POWER: High End of the Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
157.425	Hi	37.78	6	50.78	25.00
Emission Frequency (MHz)	Ant. Polarity		Below Carrier (dBc)	Margin	
314.85	V		100.39	49.61	
472.28	V		97.97	47.19	
629.70	V		105.48	54.7	
787.13	V		103.00	52.22	
944.55	V		100.61	49.83	
1,101.98	V		95.77	44.99	
1,259.40	H		95.58	44.8	
1,416.83	H		96.35	45.57	
1,574.25	H		96.43	45.65	

Low Power: Low End of the Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
156.05	Lo	28.67	.74	41.67	25.00
Emission Frequency (MHz)	Ant. Polarity		Below Carrier (dBc)	Margin	
312.10	V		93.03	51.36	
468.15	V		97.67	56.00	
624.20	H		100.82	59.15	
780.25	H		97.81	56.14	
936.30	H		95.65	53.98	
1,092.35	V		88.73	47.06	
1,248.40	H		85.46	43.79	
1,404.45	H		90.07	48.40	
1,560.50	H		89.70	48.03	

LOW POWER: High End of the Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
157.425	Lo	28.67	0.74	41.67	25.00
Emission Frequency (MHz)	Ant. Polarity		Below Carrier (dBc)	Margin	
314.85	H		103.18	61.51	
472.28	V		95.32	53.65	
629.70	H		100.33	58.66	
787.13	H		97.05	55.38	
944.55	H		94.52	52.85	
1,101.98	V		88.38	46.71	
1,259.40	H		88.01	46.34	
1,416.83	V		89.71	48.04	
1,574.25	H		89.44	47.77	

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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:

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	157.424907		
-30°C	157.424804	-103	-0.654
-20°C	157.424779	-128	-0.813
-10°C	157.424799	-108	-0.686
0°C	157.424848	-59	-0.375
10°C	157.424891	-16	-0.102
20°C	157.424903	-4	-0.025
30°C	157.424905	-2	-0.013
40°C	157.424895	-12	-0.076
50°C	157.424874	-33	-0.210
Battery Voltage	Frequency	Cycles	PPM
-15%	157.424909	2	0.010
15%	157.424906	-1	-0.020

Results : Meets All Requirements

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical	Eaton	94455-1	1096	05/10/13	05/10/15
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/09/13	05/09/15
Antenna: Dipole Kit	Electro-Metrics	TDA-30/1-4	152	NA	NA
Frequency Counter	HP	5352B	2632A00165	06/26/13	06/26/15
Hygro-Thermometer	Extech	445703	0602	06/20/13	06/20/15
Digital Multimeter	Fluke	77	35053830	08/22/13	08/22/15
Temperature Chamber Small	Thermotron Corp.	S1.2 Mini Max	25-1420-09	07/03/12	02/03/15
Signal Generator HP 8648C	HP	8648C	3623A02898	08/29/13	08/29/15
Software: Field Strength Program	Timco	N/A	Version 4.0	N/A	N/A
DC Power Supply	HP	6264B	2032A04119	05/06/13	05/06/15
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	10/05/12	10/05/14
*EMI Test Receiver R & S ESU 40	Rhode & Schwarz	ESU 40	100320	03/21/13	03/21/15
Frequency Counter	HP	5385A	3242A07460	06/16/13	06/16/15
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15

* EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

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