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FCC PART 80
TEST REPORT

APPLICANT	YAESU MUSEN CO., LTD.
	TENNOZU PARKSIDE BUILDING 2-5-8 HIGASHI-SHINAGAWA, SHINAGAWA-KU, TOKYO, 140-0002 JAPAN
FCC ID	K6630613X30
MODEL NUMBER	HX210
PRODUCT DESCRIPTION	HANDHELD MARINE TRANSCEIVER
DATE SAMPLE RECEIVED	6/9/2017
FINAL TEST DATE	6/21/2017
TESTED BY	FRANKLIN ROSE
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1038AUT17TestReport	Rev1	Initial Issue	6/25/2017
1038AUT17TestReport	Rev2	Updated OBW plots	8/2/2017

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

Summary

The device under test does:

☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.

☐ 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.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Tested by:

Name and Title: Franklin Rose, Project Manager/Testing Technician

Date: 06/21/2017

Reviewed and approved by: Sid Sanders
Name and Title: Engineer

Date: 7/5/17

GENERAL INFORMATION

EUT Specification

EUT Description	HANDHELD MARINE TRANSCEIVER
FCC ID	K6630613X30
Model Number	HX210
Operating Frequency	156.025-161.60 MHz
Test Frequencies	156.05, 156.30, 156.65, 156.80, 157.425 MHz
Type of Emission	16K0G3E
Modulation	FM
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power 12V
	☒ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☐ Mobile
	☒ Portable
Antenna Connector	SMA
Test Conditions	The temperature was 26ºC Relative humidity of 50%.
Modification to the EUT	The EUT was fitted with a battery eliminator. The EUT was re-aligned for power output using factory procedures.
Test Exercise	The EUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-D:2010,, FCC CFR 47 Part 80
Test Facility	**Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.**

RESULTS SUMMARY

Rule Part No.	Test Item	Results
2.1046(a), 80.215(e)(1)	RF Power Output	Pass
2.1033(c) (4), 80.205(a), 80.207	Modulation Characteristics	Pass
2.1047(a) (b)	Audio Frequency Response and Low Filter	Pass
2.1047(b) & 80.213 (a)(2) & (b)	Audio Input Vs Modulation	Pass
2.1049(c), 80.211 (f)(1)(2)	Occupied Bandwidth	Pass
2.1051(a), 80.211(f)(3)	Spurious Emissions at Antenna Terminals	Pass
2.1053, 80.211(f)(3)	Field Strength of Spurious Emissions	Pass
2.1055, Part 80.209(a)	Frequency Stability	Pass

TECHNICAL DATA

80.203 (b)	**External Controls:** The transmitter is capable of changing frequency between 156.050 – 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 **5** minutes, **0** seconds as displayed by the external digital clock.
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 6 Watts at the high power setting and 0.8 watts at low power setting, consistent with previous measurements. The transmitter has been demonstrated to be capable, with normal operating voltages applied, of delivering 6 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 7.40 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, shown later in this report under normal speech modulation.

RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), 80.215(e)(1)

Test Requirements: The maximum power must not exceed the values listed below.

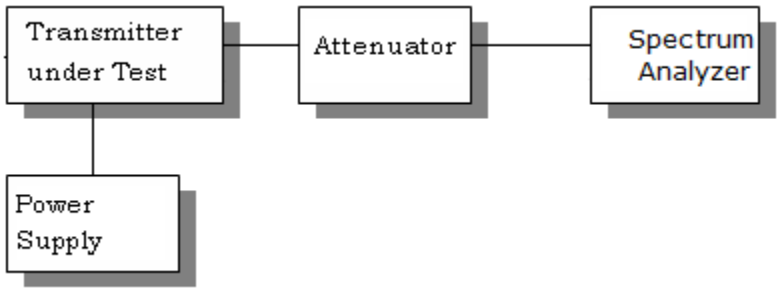
(1) Ship stations 156-162 MHz—25W[6] [13]

[6]Reducible to 1 watt or less, except for transmitters limited to public correspondence channels and used in an automated system.

[13]The frequencies 156.775 and 156.825 MHz are available for navigation-related port operations or ship movement only, and all precautions must be taken to avoid harmful interference to channel 16. Transmitter output power is limited to 1 watt for ship stations, and 10 watts for coast stations.

Method of Measurement: ANSI/TIA-603

Test Setup Diagram:



Test Data: **Measurement Table**

Tuned Freq. MHz	Channel #	Measured Output Power			
		dBm		Watts	
		High	Low	High	Low
156.0500	CH 1	37.74	29.15	5.94	0.82
156.3000	CH 6	37.71	29.17	5.90	0.83
156.6500	CH 13	37.73	29.08	5.93	0.81
156.8000	CH 16	37.76	29.11	5.97	0.81
157.4250	CH 88	37.71	29.17	5.90	0.83

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

FOR LOW POWER SETTING INPUT POWER: (7.4 V) (0.59 A) = 4.37 Watts
FOR HIGH POWER SETTING INPUT POWER: (7.4 V) (1.61 A) = 11.91 Watts

MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1033(c) (4), 80.205(a), 80.207

Test Data: **16K0G3E Bandwidth Calculation**

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

80.205(a) ALLOWED AUTHORIZED BANDWIDTH – 20.00 kHz

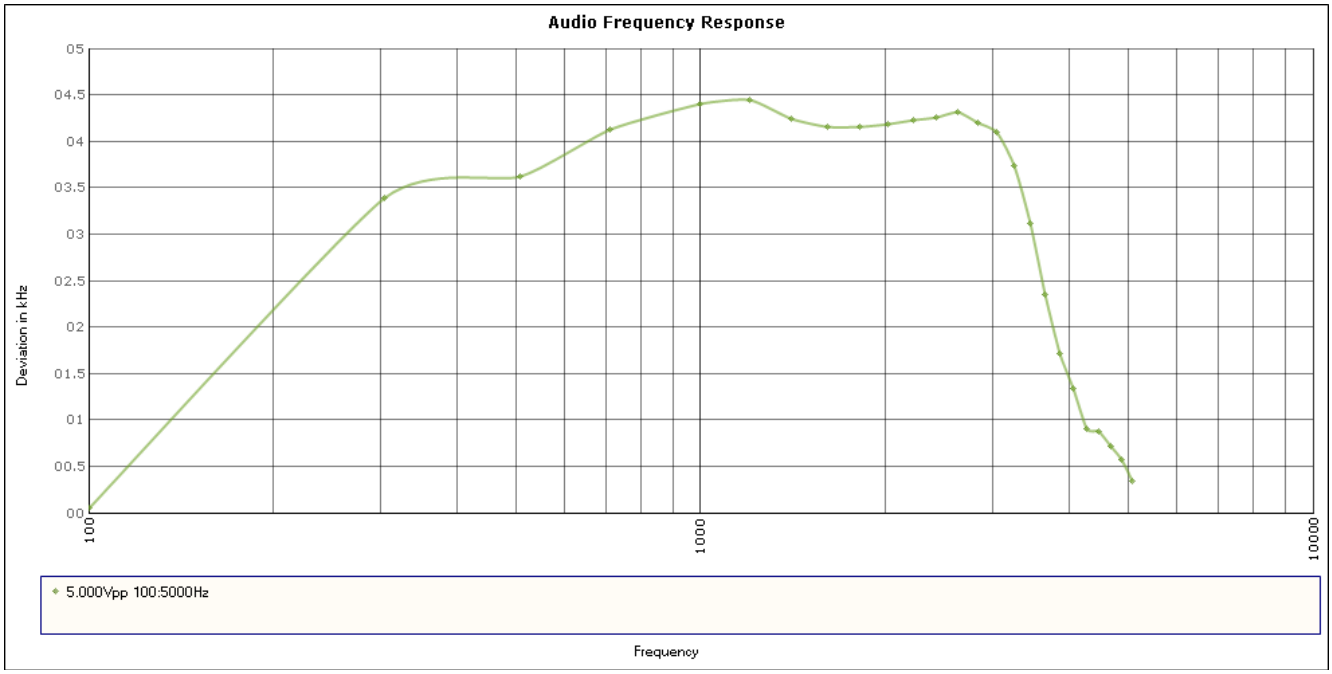
AUDIO FREQUENCY RESPONSE

Rule Part No.: FCC Part 2.1047(a) (b)

Test Requirements: A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted.

Method of Measurement: ANSI/TIA-603

Test Data: **0.1 – 5 KHz Audio Input Plot**



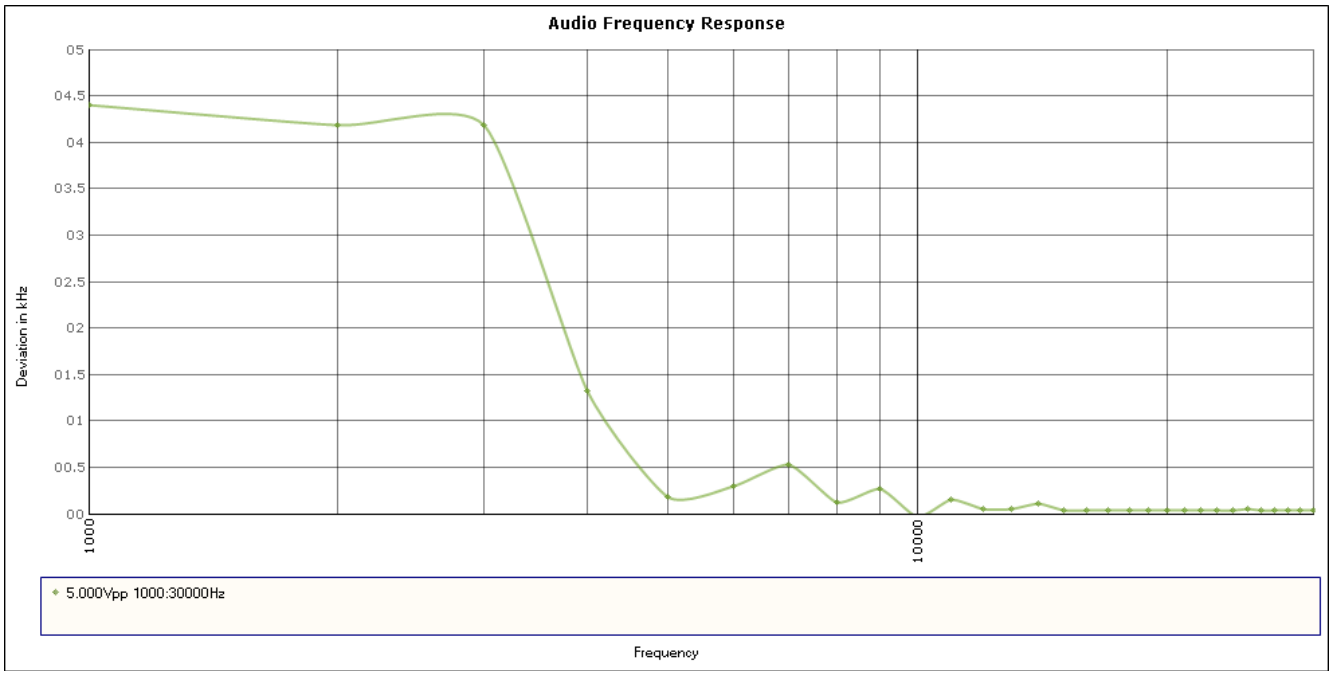
AUDIO LOW PASS FILTER

Rule Part No.: 2.1047(a)

Test Requirements: 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.

Method of Measurement: ANSI/TIA-603

Test Data: **1 – 30 KHz Audio Input Plot**



AUDIO INPUT VERSUS MODULATION

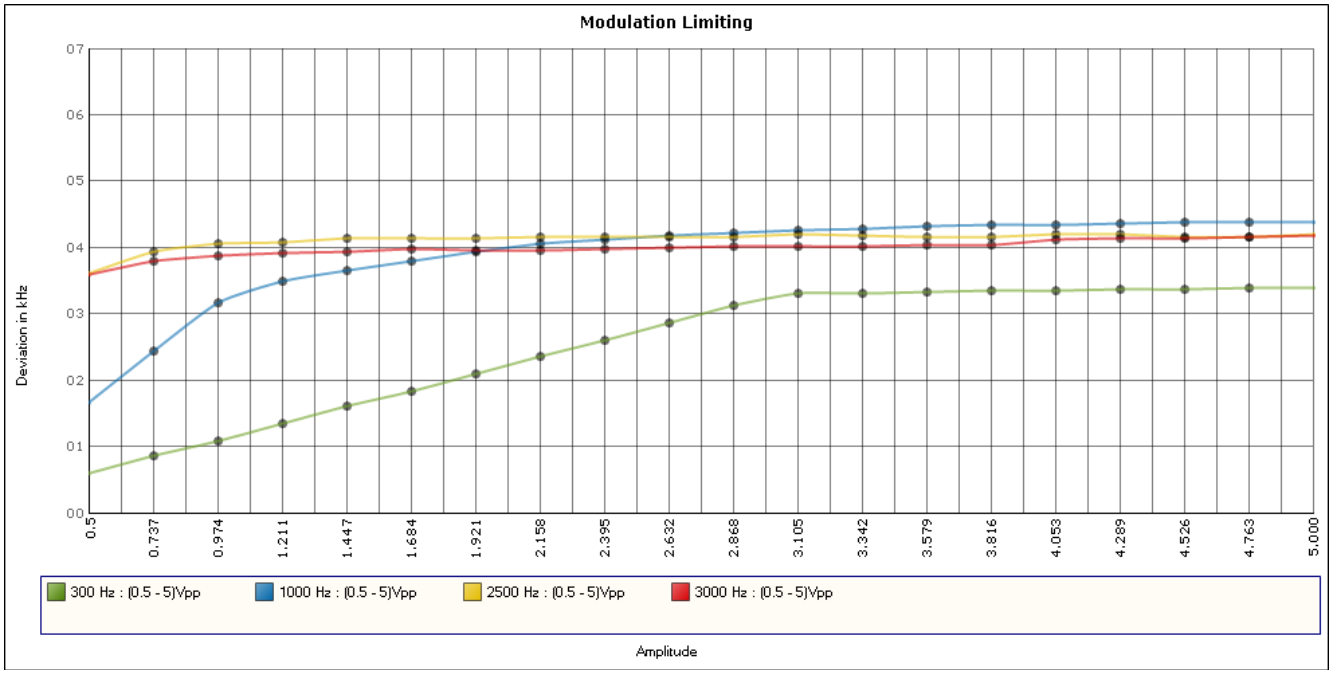
Rule Part No.: FCC Part 2.1047(b) & 80.213 (a)(2) & (b)

Test Requirements: The peak modulation must be maintained between 75 and 100 percent. A frequency deviation of ±5 kHz is defined as 100 percent peak modulation.

Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent.

Method of Measurement: ANSI/TIA-603

Test data: **Modulation Limiting Plot**



OCCUPIED BANDWIDTH

Rule Part No.: 2.1049(c), 80.211 (f)(1)(2)

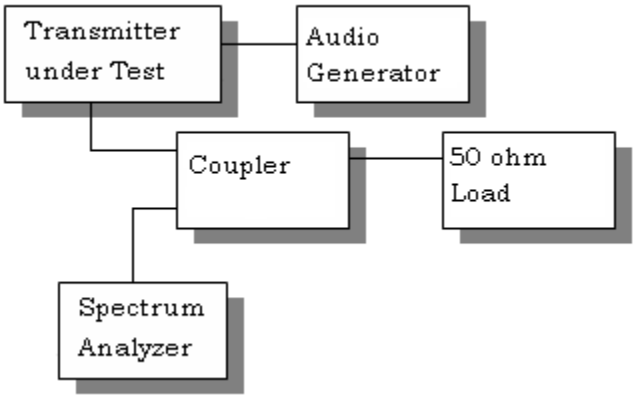
Requirements: (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB

Method of Measurement: ANSI/TIA-603

Test Setup Diagram:

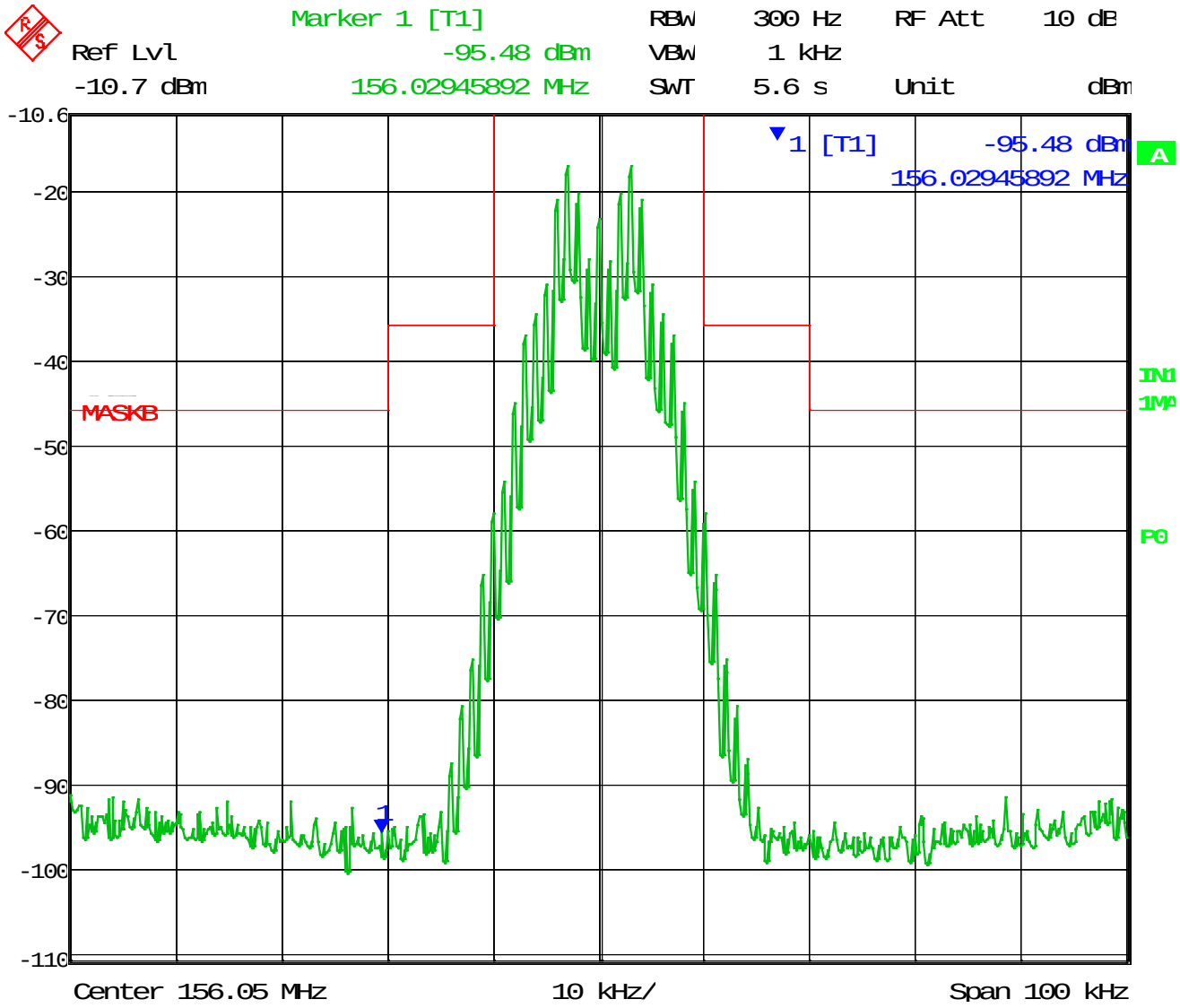
OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plot below

OCCUPIED BANDWIDTH MASK B

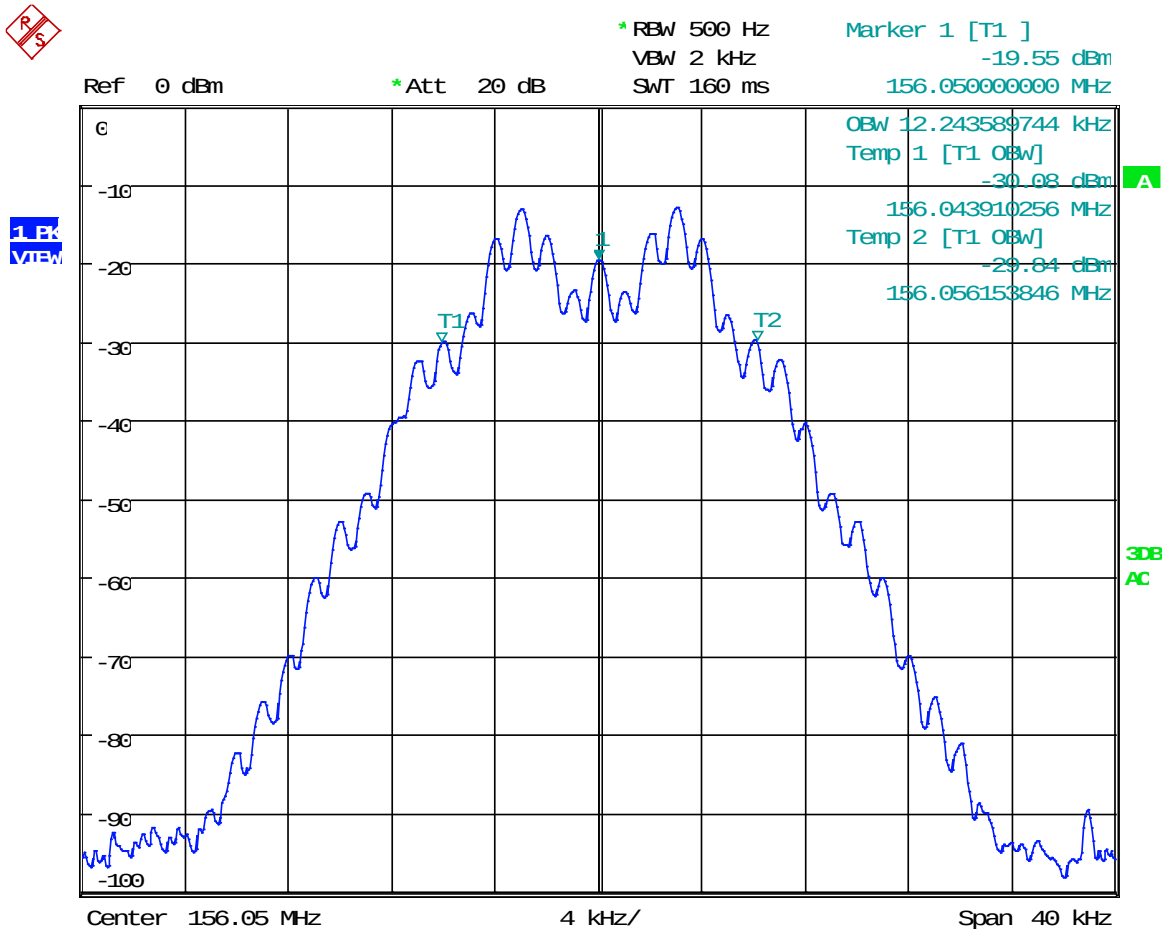
Test Data: 16K0G3E



Results Meet Requirements

OCCUPIED BANDWIDTH 99%

Test Data: 12K2G3E



Date: 22.JUN.2017 11:53:05

Results Meet Requirements

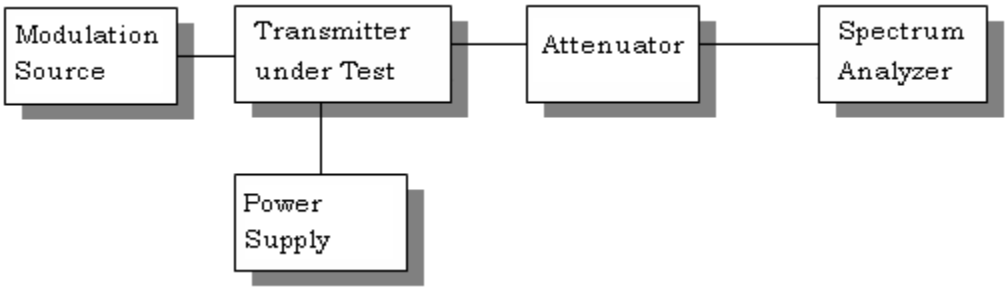
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), 80.211(f) (3)

Requirements: (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB

Method of Measurement: ANSI/TIA-603

Setup Diagram:



SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: CH 1 - High Power Low End of Band

Power Output	dBm	Watts	Limit (dB)
	37.74	5.94	50.74

	Frequency	dBc	Margin
	156.050	0.00	0.00
	312.100	81.71	30.97
	468.150	88.38	37.64
	624.200	88.90	38.16
	780.250	95.22	44.48
*	936.300	95.64	44.90
*	1092.350	92.15	41.41
*	1248.400	93.50	42.76
*	1404.450	92.68	41.94
*	1560.500	91.43	40.69

* Indicates Noise Floor

Test Data: CH 1 - Low Power Low End of Band

Power Output	dBm	Watts	Limit (dB)
	29.15	0.82	42.15

	Frequency	dBc	Margin
	156.050	0.00	0.00
	312.100	70.79	28.64
	468.150	88.69	46.54
	624.200	79.42	37.27
	780.250	87.27	45.12
	936.300	87.37	45.22
	1092.350	83.61	41.46
*	1248.400	84.43	42.28
	1404.450	81.76	39.61
	1560.500	82.37	40.22

* Indicates Noise Floor

Results Meet Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: CH 88 - High Power High End of Band

Power Output	dBm	Watts	Limit (dB)
	37.71	5.90	50.71

	Frequency	dBc	Margin
	157.425	0.00	0.00
	314.850	79.95	29.24
	472.275	98.01	47.30
	629.700	88.23	37.52
	787.125	96.64	45.93
	944.550	95.60	44.89
*	1101.975	92.89	42.18
*	1259.400	92.86	42.15
	1416.825	91.76	41.05
	1574.250	91.09	40.38

* Indicates Noise Floor

Test Data: CH 88 - Low Power High End of Band

Power Output	dBm	Watts	Limit (dB)
	29.17	0.83	42.17

	Frequency	dBc	Margin
	157.425	0.00	0.00
	314.850	71.49	29.32
	472.275	89.18	47.01
	629.700	80.04	37.87
	787.125	87.31	45.14
	944.550	85.92	43.75
*	1101.975	84.16	41.99
	1259.400	84.21	42.04
	1416.825	83.57	41.40
	1574.250	81.99	39.82

* Indicates Noise Floor

Results Meet Requirements

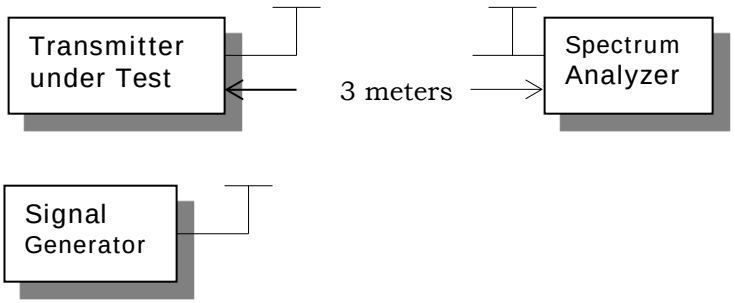
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, 80.211(f)(3)

Requirements: (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB

Method of Measurement: ANSI/TIA-603

Test Setup Diagram:



Note: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 9 KHz MHz to at least the tenth harmonic of the fundamental. This test was conducted in accordance with the standard listed above 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.**

The measurements below represent the worst case of all the frequencies tested.

Test Data: Low Power Low End of Band

Tuned Frequency		156.05 MHz		Mode		LOW PWR
Power Output (dBm)		29.15 dBm		Bandwidth		20 kHz
Power Output (W)		0.82 Watts				
Emission Freq. (MHz)	Polarity	Level (dBuV/m)	Detector	ERP	Limit (dBuV/m)	Margin (dBuV/m)
312.11	H	56.02	PK	-41.36	-13.00	28.36
780.26	V	58.46	PK	-38.92	-13.00	25.92
1092.35	V	64.50	PK	-32.88	-13.00	19.88
1248.4	V	65.72	PK	-31.66	-13.00	18.66
1404.45	V	66.77	PK	-30.61	-13.00	17.61
1560.5	H	66.47	PK	-30.91	-13.00	17.91

Test Data: High Power Low End of Band

Tuned Frequency		156.05 MHz		Mode		HIGH PWR
Power Output (dBm)		37.74 dBm		Bandwidth		20 kHz
Power Output (W)		5.94 Watts				
Emission Freq. (MHz)	Polarity	Level (dBuV/m)	Detector	ERP	Limit (dBuV/m)	Margin (dBuV/m)
468.14	V	52.95	PK	-44.43	-13.00	31.43
624.2	H	52.05	PK	-45.33	-13.00	32.33
1092.35	V	64.46	PK	-32.92	-13.00	19.92
1248.4	H	66.59	PK	-30.79	-13.00	17.79
1404.45	V	66.99	PK	-30.39	-13.00	17.39
1560.5	H	66.92	PK	-30.46	-13.00	17.46

Test Data: Low Power High End of Band

Tuned Frequency		157.425 MHz		Mode		LOW PWR
Power Output (dBm)		29.17 dBm		Bandwidth		20 kHz
Power Output (W)		0.83 Watts				
Emission Freq. (MHz)	Polarity	Level (dBuV/m)	Detector	ERP	Limit (dBuV/m)	Margin (dBuV/m)
314.84	H	56.55	PK	-40.83	-13.00	27.83
629.69	H	57.03	PK	-40.35	-13.00	27.35
1102.33	H	64.91	PK	-32.46	-13.00	19.46
1259.8	H	65.91	PK	-31.47	-13.00	18.47
1417.28	H	66.53	PK	-30.84	-13.00	17.84
1574.75	V	66.72	PK	-30.65	-13.00	17.65

Test Data: High Power High End of Band

Tuned Frequency		157.425 MHz		Mode		HIGH PWR
Power Output (dBm)		37.71 dBm		Bandwidth		20 kHz
Power Output (W)		5.90 Watts				
Emission Freq. (MHz)	Polarity	Level (dBuV/m)	Detector	ERP	Limit (dBuV/m)	Margin (dBuV/m)
472.28	V	53.02	PK	-44.36	-13.00	31.36
629.69	H	52.59	PK	-44.79	-13.00	31.79
1102.33	V	64.79	PK	-32.59	-13.00	19.59
1259.80	V	66.32	PK	-31.06	-13.00	18.06
1417.28	V	66.91	PK	-30.47	-13.00	17.47
1574.75	H	66.10	PK	-31.28	-13.00	18.28

FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 80.209(a)

Requirements: The frequency must remain within 5.0 ppm specification limit for 20 kHz spacing.

Method of Measurements: ANSI/TIA 603

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.

Test Data: **Measurement Table**

Reference Frequency (Hz)	156050031

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	PPM
-20°C	156049957	74	0.474
-10°C	156050032	-1	-0.006
0°C	156050029	2	0.013
10°C	156050004	27	0.173
20°C	156049992	39	0.250
30°C	156049976	55	0.352
40°C	156049964	67	0.429
50°C	156049969	62	0.397

Voltage	Frequency (MHz)	Deviation (Hz)	PPM
6.29	156050030	1	0.006
7.40	156050031	0	0.000
8.51	156050029	2	0.013

State of the measurement Uc

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: "Uncertainty in EMC Measurements" and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
RF Frequency Accuracy	± 49.5 Hz	(1)
RF Conducted Power	±0.93dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	±1.86dB	
Occupied Bandwidth	±2.65%	
Audio Frequency Response	±1.86dB	
Modulation limiting	±1.88%	
Radiated RF Power	±1.4dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	 ±1.88% ±2.04%	
Rad Emissions Sub Meth up to 26.5GHz	±2.14dB	
Adjacent channel power	±1.47dB	(1)
Transient Frequency Response	±1.88%	
Temperature	±1.0°C	(1)
Humidity	±5.0%	

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
DC Power Supply	HP	6286A	1744A03842	N/A	N/A
Antenna: Biconical 1096 Chamber	Eaton	94455-1	1096	07/14/15	07/14/17
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/14/15	07/14/17
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
Digital Multimeter	Fluke	77	35053830	10/21/15	10/21/17
Frequency Counter Large Chamber	HP	5352B	2632A00165	07/01/15	07/01/17
CHAMBER	Panashield	3M	N/A	04/25/16	12/31/17
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	03/01/17	03/01/19
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01; KMKM-0670-00; KFKF-0198-01	08/09/16	08/09/18
Coaxial Cable - NMNM-0300-00 Yellow	Insulated Wire Inc.		NMNM-0300-00	08/05/15	08/05/17
Hygro-Thermometer	Extech	445703	0602	06/30/15	06/30/17
Modulation Analyzer	HP	8901A	3050A05856	04/13/17	04/13/19
LISN (EMC)	Electro-Metrics	EM-7821	101	10/29/15	10/29/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18

Coaxial Cable - BMBM-0130-00 Black	Alpha Wire		BMBM-0130-00	05/24/16	05/24/18
Coaxial Cable - BMBM-0155-01 Black	BELDEN		BMBM-0155-01	06/01/16	06/01/18
Function Generator	Standford	DS340	25200	02/02/16	02/02/18
Non Radiating 50 OHM Load	Sierra Elec	160B-600X	1038	09/13/16	09/13/18
Tunable Notch Filter 100-350 MHz	Eagle	220BFBF	100-350 MHz (#43)	07/01/15	07/01/17
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	01/04/16	01/04/18

***EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3

End of Report