



849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA

PH: 888.472.2424 OR
352.472.5500

EMAIL: INFO@TIMCOENGR.COM
[HTTP://WWW.TIMCOENGR.COM](http://WWW.TIMCOENGR.COM)

FCC PART 80 TEST REPORT

APPLICANT	YAESU MUSEN CO., LTD.
	Tennozu Parkside Building 2-5-8 Higashi-Shinagawa, Shinagawa-ku Tokyo JAPAN 140-0002
FCC ID	K6630633X30
MODEL NUMBER	HX890
PRODUCT DESCRIPTION	HANDHELD MARINE TRANSCEIVER
DATE SAMPLE RECEIVED	3/23/2018
FINAL TEST DATE	4/2/2018
TESTED BY	Tim Royer
APPROVED BY	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
418AUT18TestReport_	Rev1	Initial Issue	04/02/2018

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.

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
Designation #: US1070



Sr. EMC Engineer
EMC-003838-NE



Tested by:

Name and Title: Tim Royer, Project Manager/Testing Engineer

Date: 4/6/2018

Reviewed and approved by:



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

Date: 04/06/2018

Applicant: YAESU MUSEN CO., LTD.
FCC ID: K6630633X30
Report: 418AUT18TestReport_Rev1

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GENERAL INFORMATION

EUT Specification

EUT Description	HANDHELD MARINE TRANSCEIVER
FCC ID	K6630633X30
Model Number	HX890
Operating Frequency	156.025-161.600 MHz
Maritime Device Type	SHIP STATION
Test Frequencies	156.025, 157.425, 161.6 MHz
Type of Emission	16K0G3E, 16K0G2B
Modulation	FM
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power (13.8 V)
	☒ Battery Operated Exclusively (7.4 VDC)
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. The EUT was operated in “Test Mode” for digital emissions tests.
Applicable Standards	ANSI/TIA 603-E:2016, ANSI C63.26-2015, FCC CFR 47 Part 2, Part 80
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070

RESULTS SUMMARY

Rule Part No.	Test Item	Results
80.203(b)	External Control Requirements	Pass
80.203(c)	< 5 min. Tx maximum	Pass
80.873, 80.956	G3E emission capability	Pass
80.911(a)	G3E on 156.3 & 156.8 MHz	Pass
80.911(c)	< 5 min. Tx maximum	Pass
2.1046(a), 80.215(e)(1)	RF Power Output < 25 W	Pass
2.1033(c)(4), 80.205(b), 80.213(a), 80.207	Modulation Characteristics	Pass
2.1047(a)(b)	Audio Frequency Response and Low Filter	Pass
2.1047(b), 80.213 (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(a), 80.211(f)(3)	Field Strength of Spurious Emissions	Pass
2.1055(a)(2), 80.209(a)	Frequency Stability < 5 ppm	Pass

TECHNICAL DATA

- 80.203 (b)** **External Controls:** The transmitter is capable of changing frequency between 156.025 – 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 Unmodulated transmission. The transmitter turned off and the radio went to receive mode at **5 minutes, 0 seconds** as displayed by an external digital clock.
- 80.203 (n)** This radio is not required to comply with the requirement for DSC capability in the 156 – 162 MHz band per 80.203(n).
- 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 25 Watts at the high power setting and 1 watt at low power setting, consistent with test measurements.
- The transmitter has been demonstrated to be capable, with normal operating voltages applied, of delivering 25 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, shown later in this report under normal speech modulation.

Result: Meets Requirements

RF POWER OUTPUT

FCC Rule Parts: FCC Part 2.1046(a), 80.215(e)(1)

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

(e) Ship stations frequencies above 27500 kHz. The maximum power must not exceed the values listed below.

(1) Ship stations 156-162 MHz—25W⁶

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

Method of Measurement: ANSI/TIA-603-E

Test Data: Power Measurement Table

Peak Output Power					
Tuned Freq. MHz	Channel	dBm		Watts	
		High	Low	High	Low
156.0250	60	37.55	29.24	5.69	0.84
156.3000	6	37.66	29.13	5.83	0.82
156.6500	13	29.21	29.08	0.83	0.81
156.8000	16	37.70		5.89	
157.4250	88	37.62	29.10	5.78	0.81
161.6000	2020	37.47	28.95	5.58	0.79

Note: Channel 16 "Distress" is not intended to operate at Low Power

80.211(f)(3) – 250 % of the Authorized Bandwidth may not exceed $43 + 10 \log(\text{Mean Power in Watts})$. The Mean Power Output was found equal to Peak in all test cases.

Result: Mean Power was found equal to Peak power at all test frequencies.

Part 2.1033 (c)(8) DC Input into Final Amplifier

FOR LOW POWER SETTING INPUT POWER: (7.4 V) (0.68A) = **5.032 Watts**

FOR HIGH POWER SETTING INPUT POWER: (7.4 V) (1.6 A) = **11.84 Watts**

Result: Meets Requirements

MODULATION CHARACTERISTICS OF 16K0G3E

FCC Rule Parts: Part 2.1033(c)(4), 80.205(a), 80.205(b)(1), 80.207(a)

Compliance with 80.207(a)

Types of stations	Classes of emission
Ship Stations¹	
Radiotelegraphy:	
156-162 MHz ²	F1B, F2B, F2C, F3C, F1D, F2D.
DSC	G2B.
Radiotelephony:	
27.5-470 MHz ⁶	G3D, G3E.

80.205(a) – Authorized Bandwidth

Class of emission	Emission designator	Authorized bandwidth (kHz)
G3E ⁸	16K0G3E	20.0

Note 8 – Not applicable to deviations below 5 kHz.

80.205(b)(1) – Maximum Authorized Frequency Deviation

(b) For land stations the maximum authorized frequency deviation for F3E or G3E emission is as follows:

(1) 5 kHz in the 72.0-73.0 MHz, 75.4-76.0 MHz and 156-162 MHz bands;

16K0G3E (Voice) Bandwidth Calculation

$$B_n = 2M + 2DK$$

$$B_n = 2(3000 \text{ Hz}) + 2(5 \text{ kHz})(1) = \mathbf{16.0 \text{ kHz}}$$

Where:

M = 3000 (Highest Modulation Frequency, Hz)

D = 5 kHz (Peak Deviation, kHz)

K = 1 (FM Constant)

RESULT: 80.205(a) AUTHORIZED BANDWIDTH for 16K0G3E = 20.00 kHz

AUDIO FREQUENCY RESPONSE & LOW PASS FILTER RESPONSE

FCC Rule Parts: FCC Part 2.1047(a)

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.

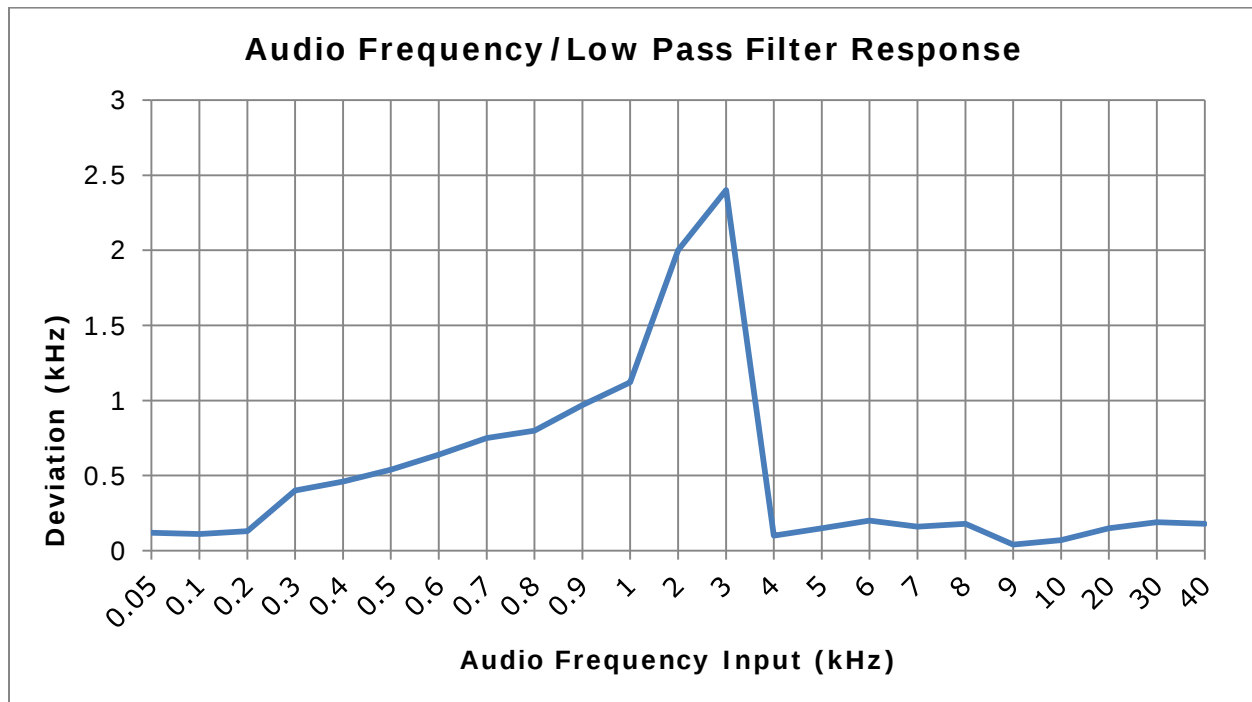
Method of Measurement: ANSI/TIA-603-E

FCC Rule Parts: 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-E

Test Data: Audio Frequency & Low Pass Filter Response



RESULT: Meets Requirements

AUDIO INPUT VERSUS MODULATION

FCC Rule Parts: FCC Part 2.1047(b), 80.213(a)

(a) Transmitters must meet the following modulation requirements:

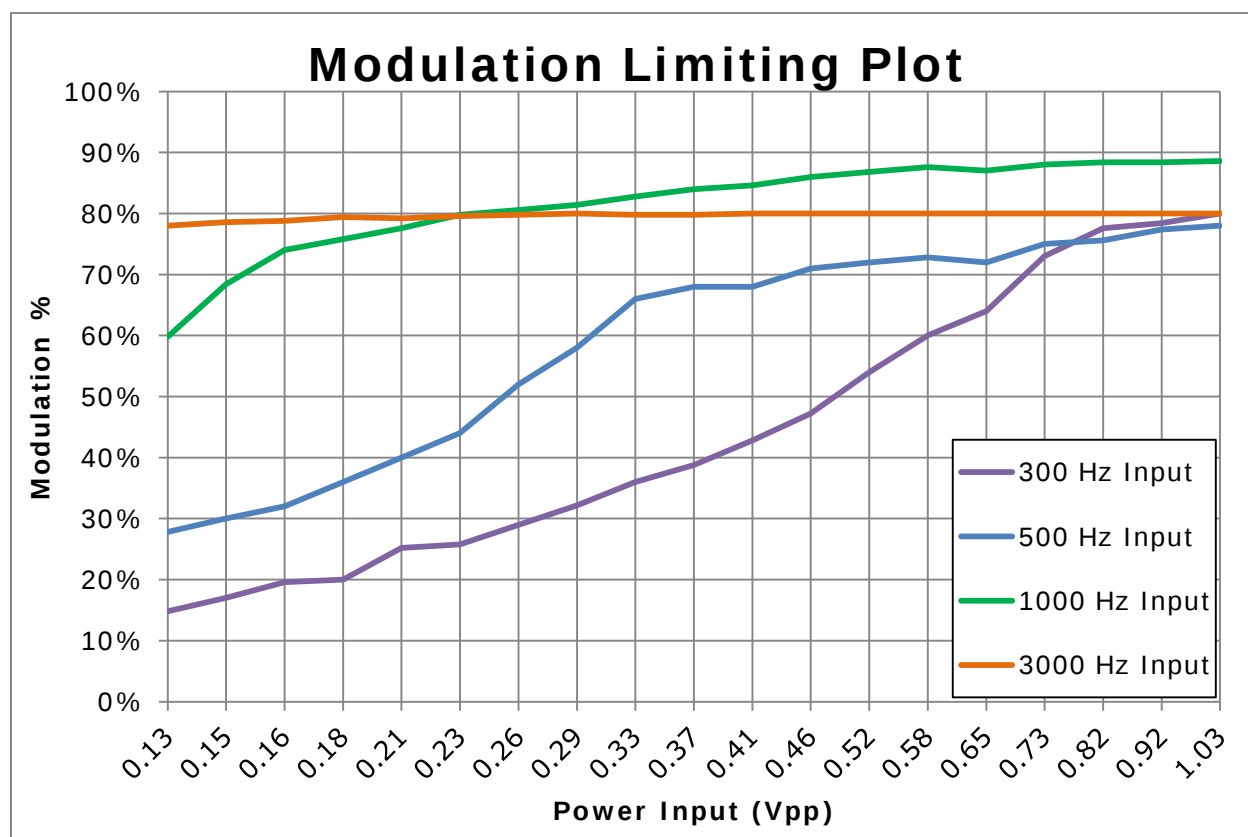
(2) When phase or frequency modulation is used in the 156-162 MHz band the peak modulation must be maintained between 75 and 100 percent. A frequency deviation of ± 5 kHz is defined as 100 percent peak modulation; and

(b) Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent. This requirement does not apply to survival craft transmitters, to transmitters that do not require a license or to transmitters whose output power does not exceed 3 watts.

(d) Ship and coast station transmitters operating in the 156-162 MHz and 216-220 bands must be capable of proper operation with a frequency deviation that does not exceed ± 5 kHz when using any emission authorized by §80.207.

Method of Measurement: ANSI/TIA-603-E

Test data: Modulation Limiting Plot



Note: 100% Modulation is defined as 5 kHz

RESULT: Meets Requirements

OCCUPIED BANDWIDTH

FCC Rule Parts: 2.1049 (c), 80.211(f)(1)(2)

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

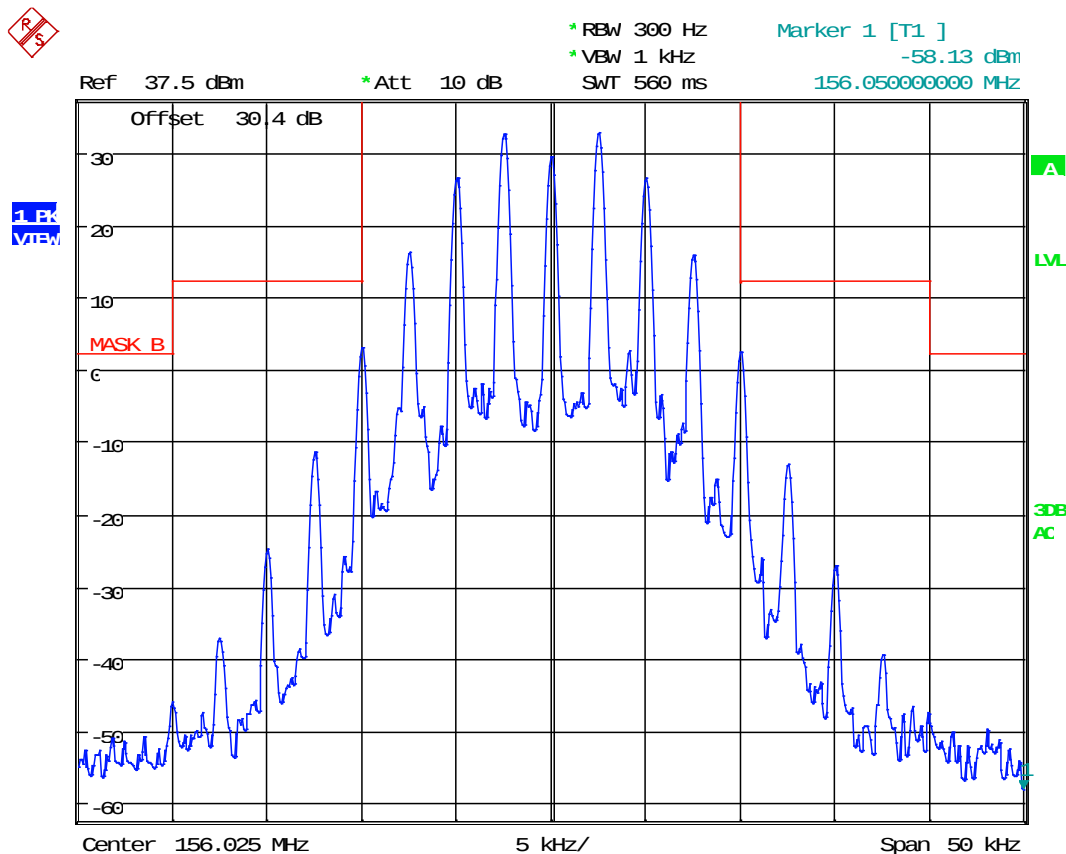
(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(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; and

Note: The emission mask specified is identical to FCC Pt. 90.210(b), or "Mask B" in plot data.

Method of Measurement: ANSI/TIA-603-E

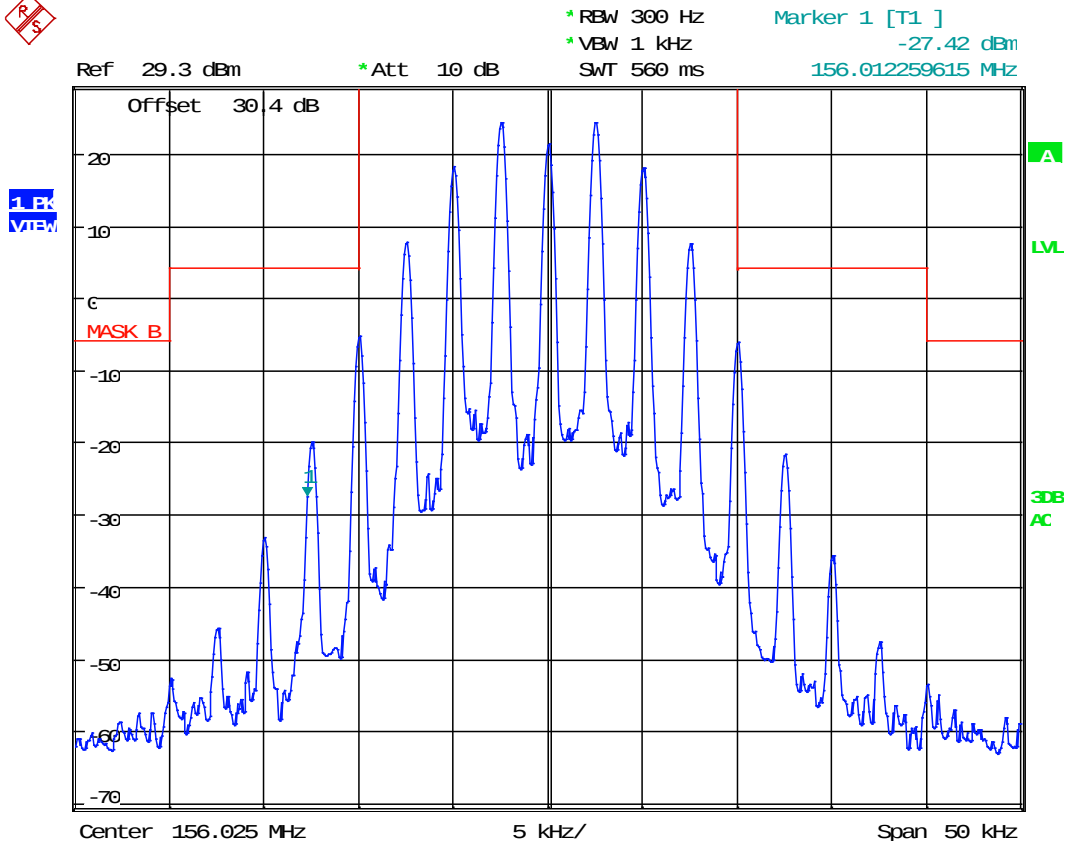
Test Data: 16K0G3E (Voice) – Low End of Band 156.025 MHz, High Power



Date: 28.MAR.2018 06:48:33

OCCUPIED BANDWIDTH

Test Data: 16K0G3E (Voice) – Low End of Band 156.025 MHz, Low Power



Date: 28.MAR.2018 06:43:21

OCCUPIED BANDWIDTH

Test Data: 16K0G3E (Voice) – Middle of Band 157.425 MHz, High Power



* RBW 300 Hz
* VBW 1 kHz
SWT 560 ms

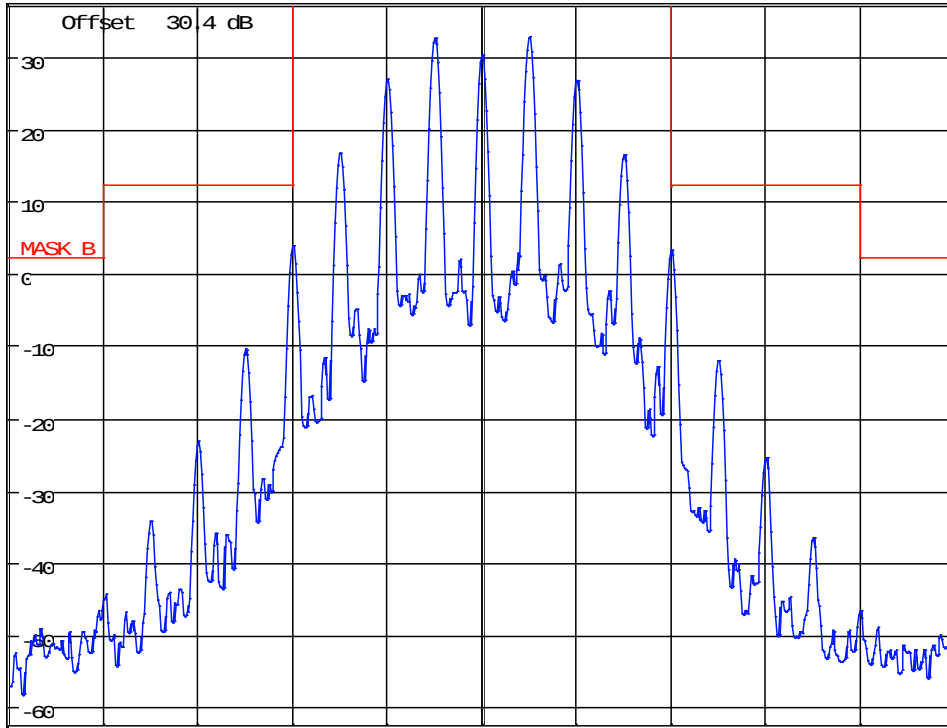
Marker 1 [T1]

-52.39 dBm

157.450000000 MHz

Ref 37.5 dBm

* Att 10 dB



Center 157.425 MHz

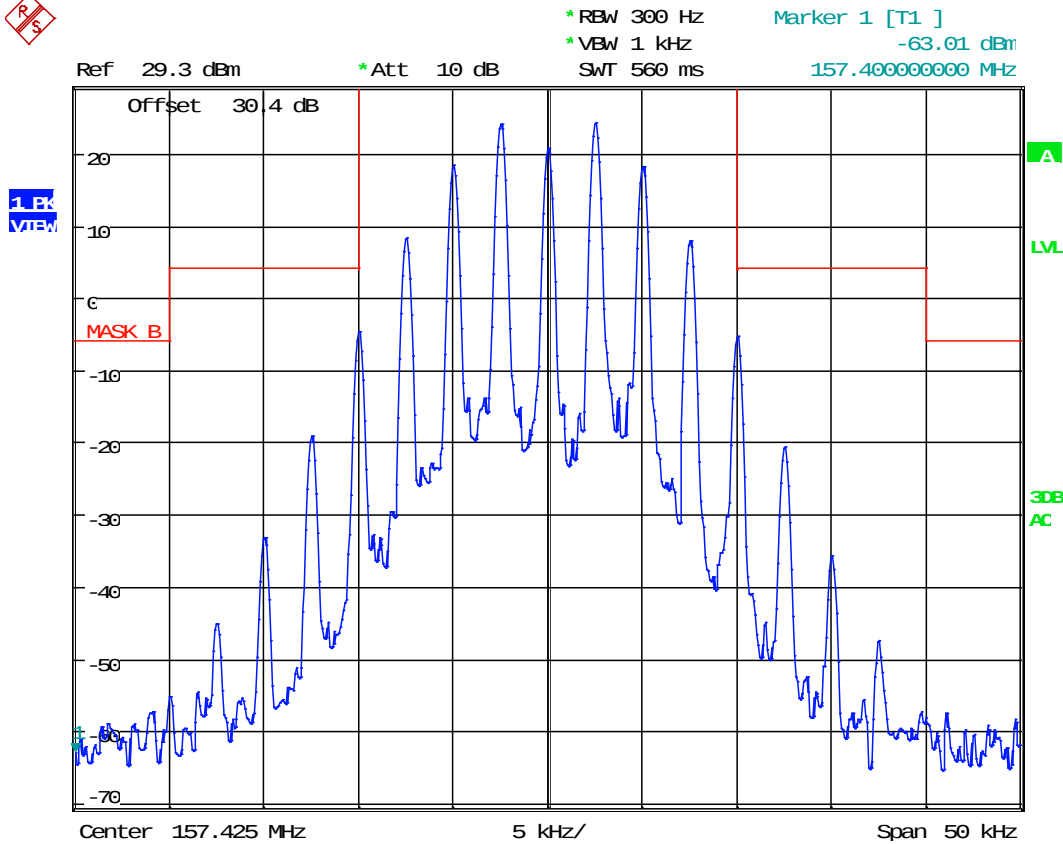
5 kHz/

Span 50 kHz

Date: 28.MAR.2018 06:47:40

OCCUPIED BANDWIDTH

Test Data: 16K0G3E (Voice) – Middle of Band 157.425 MHz, Low Power



Date: 28.MAR.2018 06:44:18

OCCUPIED BANDWIDTH

Test Data: 16K0G3E (Voice) – High End of Band 161.60 MHz, High Power



* RBW 300 Hz
* VBW 1 kHz
SWT 560 ms

Marker 1 [T1]

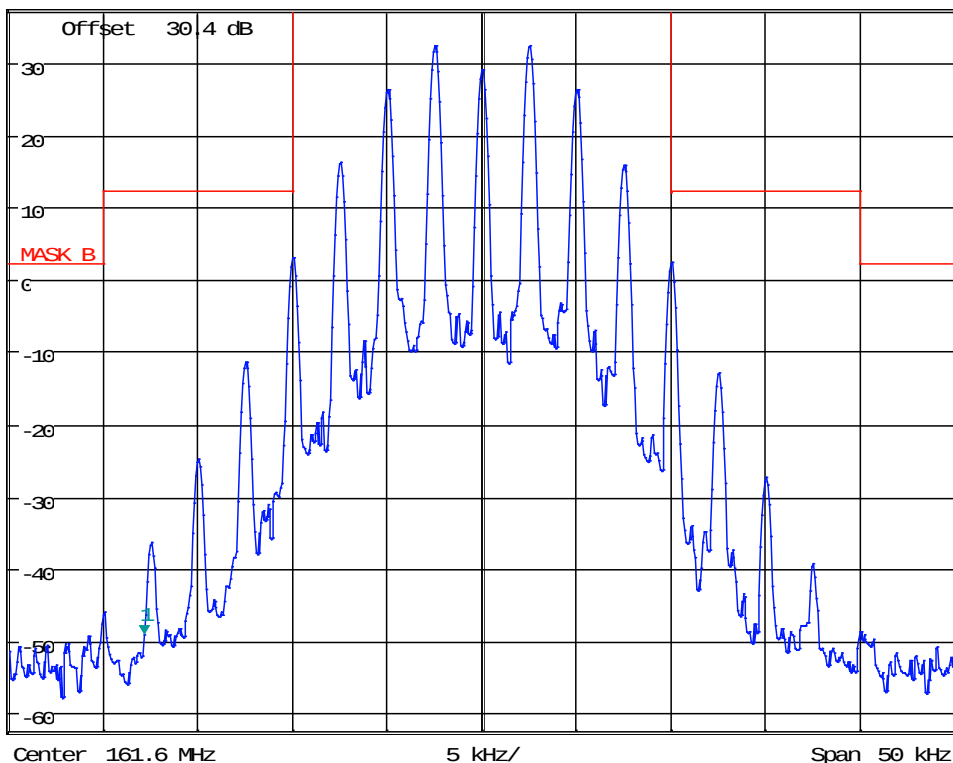
-49.16 dBm

161.582131410 MHz

Ref 37.5 dBm

* Att 10 dB

1.0k
VIEW



Date: 28.MAR.2018 06:46:41

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

FCC Rule Parts: FCC Part 2.1051(a), 80.211(f)(3)

Requirements: (3) On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: At least $43 + 10 \log$ (Mean Power in Watts) dB

Method of Measurement: ANSI/TIA-603-E

Test Data: 16K0G3E (Voice) – Low End of Band 156.025 MHz

	(dBm)	(Watts)	Limit (dBc)
Mean High Power (dBm)	37.55	5.69	50.55
Mean Low Power (dBm)	29.24	0.84	42.24

			High Power		Low Power	
Frequency			Peak (dBm)	Margin (dB)	Peak (dBm)	Margin (dB)
(fundamental)		156.025	0.00	0.00	8.31	0.00
2nd Harmonic		312.050	-37.02	24.02	-46.52	33.52
3rd Harmonic		468.075	-53.59	40.59	-61.22	48.22
4th Harmonic		624.100	-50.55	37.55	-67.86	54.86
5th Harmonic		780.125	-60.47	47.47	-71.42	58.42
6th Harmonic		936.150	-62.38	49.38	-76.97	63.97
7th Harmonic		1092.175	-69.23	56.23	* -77.89	64.89
8th Harmonic		1248.200	-64.44	51.44	* -77.89	64.89
9th Harmonic		1404.225	-65.79	52.79	* -77.89	64.89
10th Harmonic		1560.250	-60.16	47.16	-76.40	63.40

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 16K0G3E (Voice) – Middle of Band 157.425 MHz

	(dBm)	(Watts)	Limit (dBc)
Mean High Power (dBm)	37.62	5.78	50.62
Mean Low Power (dBm)	29.1	0.81	42.1

			High Power		Low Power	
Frequency			Peak (dBm)	Margin (dB)	Peak (dBm)	Margin (dB)
(fundamental)		157.425	0.00	0.00	8.52	0.00
2nd Harmonic		314.850	-47.51	34.51	-46.53	33.53
3rd Harmonic		472.275	-58.94	45.94	-47.15	34.15
4th Harmonic		629.700	-67.03	54.03	-53.15	40.15
5th Harmonic		787.125	-70.44	57.44	-56.34	43.34
6th Harmonic		944.550	-72.65	59.65	* -58.15	45.15
7th Harmonic	*	1101.975	-73.38	60.38	* -58.15	45.15
8th Harmonic	*	1259.400	-73.38	60.38	* -58.15	45.15
9th Harmonic	*	1416.825	-73.38	60.38	* -58.15	45.15
10th Harmonic	*	1574.250	-73.38	60.38	* -58.15	45.15

* Indicates Noise Floor of Measurement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 16K0G3E (Voice) – High End of Band 161.60 MHz (International)

	(dBm)	(Watts)	Limit (dBc)
Mean High Power (dBm)	37.47	5.58	50.47
Mean Low Power (dBm)	28.95	0.79	41.95

			High Power		Low Power	
Frequency			Peak (dBm)	Margin (dB)	Peak (dBm)	Margin (dB)
(fundamental)		161.600	0.00	0.00	0.00	0.00
2nd Harmonic		323.200	-48.15	35.15	-62.67	49.67
3rd Harmonic		484.800	-51.85	38.85	-59.71	46.71
4th Harmonic		646.400	-55.20	42.20	-63.64	50.64
5th Harmonic		808.000	-56.85	43.85	-69.00	56.00
6th Harmonic		969.600	-63.71	50.71	-73.19	60.19
7th Harmonic		1131.200	-67.49	54.49	-74.85	61.85
8th Harmonic	*	1292.800	-72.81	59.81	-75.58	62.58
9th Harmonic		1454.400	-68.06	55.06	-78.19	65.19
10th Harmonic		1616.000	-63.81	50.81	-73.04	60.04

* Indicates Noise Floor of Measurement

Worst-Case Emission Findings:

16K0G3E (Voice) – Low End of Band 156.025 MHz, Low Power

Result: Meets Requirements

FIELD STRENGTH OF SPURIOUS EMISSIONS

FCC Rule Parts: FCC Part 2.1053(a), 80.211(f)(3)

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

Method of Measurement: ANSI/TIA-603-E

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.

Note: The six (6) highest emissions or more of each worst-case settings of 16K0G3E (Voice) are represented below. Emissions below 20 dB below the limit are not required to be reported.

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 16K0G3E (Voice) – Low End of Band 156.025 MHz, High Power

Power Output			Limit	
dBm	Watts		dBc	dBm
37.55	5.69		50.55	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
156.02	936.00	V	-61.67	48.67
156.02	936.00	H	-61.67	48.67
156.02	780.00	H	-63.26	50.26
156.02	780.00	V	-63.26	50.26
156.02	624.00	V	-59.99	46.99
156.02	624.00	H	-62.20	49.20
156.02	468.00	H	-57.39	44.39
156.02	468.00	V	-56.09	43.09
156.02	312.00	V	-51.43	38.43
156.02	312.00	H	-53.23	40.23
156.02	1092.00	V	-66.45	53.45
156.02	1092.00	H	-60.19	47.19
156.02	1248.00	H	-60.99	47.99
156.02	1248.00	V	-64.27	51.27
156.02	1404.00	V	-61.52	48.52
156.02	1404.00	H	-65.44	52.44
156.02	1560.00	H	-64.51	51.51
156.02	1560.00	V	-58.47	45.47

Test Data: 16K0G3E (Voice) – Low End of Band 156.025 MHz, Low Power

Power Output			Limit	
dBm	Watts		dBc	dBm
29.24	0.84		42.24	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
156.02	312.00	H	-51.39	38.39
156.02	312.00	V	-57.56	44.56
156.02	468.00	V	-60.68	47.68
156.02	468.00	H	-65.94	52.94
156.02	624.00	H	-62.45	49.45
156.02	624.00	V	-66.65	53.65
156.02	780.00	V	-63.26	50.26
156.02	780.00	H	-63.26	50.26
156.02	936.00	H	-61.67	48.67
156.02	936.00	V	-61.67	48.67
156.02	1560.00	V	-64.47	51.47
156.02	1560.00	H	-62.43	49.43
156.02	1404.00	H	-64.88	51.88
156.02	1404.00	V	-64.41	51.41
156.02	1248.00	V	-66.08	53.08
156.02	1248.00	H	-64.69	51.69
156.02	1092.00	H	-64.51	51.51
156.02	1092.00	V	-67.77	54.77

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 16K0G3E (Voice) – Middle of Band 157.425 MHz, High Power

Power Output			Limit	
dBm	Watts		dBc	dBm
37.62	5.78		50.62	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
157.43	315.00	V	-53.422	40.4
157.43	315.00	H	-47.372	34.4
157.43	472.00	H	-61.245	48.2
157.43	472.00	V	-57.615	44.6
157.43	630.00	V	-63.457	50.5
157.43	630.00	H	-58.457	45.5
157.43	787.00	H	-64.190	51.2
157.43	787.00	V	-61.320	48.3
157.43	945.00	V	-56.587	43.6
157.43	945.00	H	-57.987	45.0
157.42	1574.00	V	-62.340	49.3
157.42	1574.00	H	-60.260	47.3
157.42	1417.00	H	-64.800	51.8
157.42	1417.00	H	-62.550	49.6
157.42	1259.00	H	-60.842	47.8
157.42	1259.00	V	-63.892	50.9
157.42	1102.00	V	-64.866	51.9
157.42	1102.00	H	-62.236	49.2

Test Data: 16K0G3E (Voice) – Middle of Band 157.425 MHz, Low Power

Power Output			Limit	
dBm	Watts		dBc	dBm
29.1	0.81		42.1	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
157.43	945.00	H	-58.75	45.75
157.43	945.00	V	-58.75	45.75
157.43	787.00	V	-61.24	48.24
157.43	787.00	H	-61.24	48.24
157.43	630.00	H	-63.63	50.63
157.43	630.00	V	-63.63	50.63
157.43	472.00	H	-61.26	48.26
157.43	472.00	V	-65.15	52.15
157.43	315.00	V	-56.89	43.89
157.43	315.00	H	-51.10	38.10
157.42	1102.00	V	-65.36	52.36
157.42	1102.00	H	-63.87	50.87
157.42	1259.00	H	-65.10	52.10
157.42	1259.00	V	-64.45	51.45
157.42	1417.00	V	-64.15	51.15
157.42	1417.00	H	-63.93	50.93
157.42	1574.00	H	-65.06	52.06
157.42	1574.00	V	-63.28	50.28

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 16K0G3E (Voice) – High End of Band 161.60 MHz, High Power

Power Output			Limit	
dBm	Watts		dBc	dBm
37.47	5.58		50.47	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
161.6	808.0	V	-60.00	47.0
161.6	808.0	H	-58.92	45.9
161.6	646.0	H	-63.82	50.8
161.6	646.0	V	-63.82	50.8
161.6	485.0	H	-57.74	44.7
161.6	485.0	V	-60.09	47.1
161.6	323.0	V	-51.44	38.4
161.6	323.0	H	-47.75	34.7
161.6	970.0	H	-54.34	41.3
161.6	970.0	V	-58.90	45.9
161.6	1131.0	H	-56.39	43.4
161.6	1293.0	H	-64.58	51.6
161.6	1454.0	H	-59.66	46.7
161.6	1616.0	H	-64.90	51.9
161.6	1616.0	V	-62.53	49.5
161.6	1454.0	V	-66.25	53.3
161.6	1293.0	V	-64.45	51.4
161.6	1131.0	V	-59.60	46.6

Test Data: 16K0G3E (Voice) – High End of Band 161.60 MHz, Low Power

Power Output			Limit	
dBm	Watts		dBc	dBm
28.95	0.79		41.95	-13.00
Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
161.6	323	V	-54.617	41.6
161.6	323	H	-51.137	38.1
161.6	485	H	-62.152	49.2
161.6	485	V	-65.062	52.1
161.6	646	V	-62.937	49.9
161.6	646	H	-62.027	49.0
161.6	808	H	-61.115	48.1
161.6	808	V	-61.115	48.1
161.6	1131	V	-64.749	51.7
161.6	1131	H	-64.509	51.5
161.6	1293	H	-63.907	50.9
161.6	1293	V	-64.167	51.2
161.6	1454	V	-66.881	53.9
161.6	1454	H	-65.751	52.8
161.6	1616	H	-66.065	53.1
161.6	1616	V	-63.615	50.6

RESULT: Meets Requirements

FREQUENCY STABILITY

FCC Rule Parts: FCC Part 2.1055(a)(2), Part 80.209(a)

Requirements: The frequency stability must remain within 10 ppm from -20 C to +50 C.

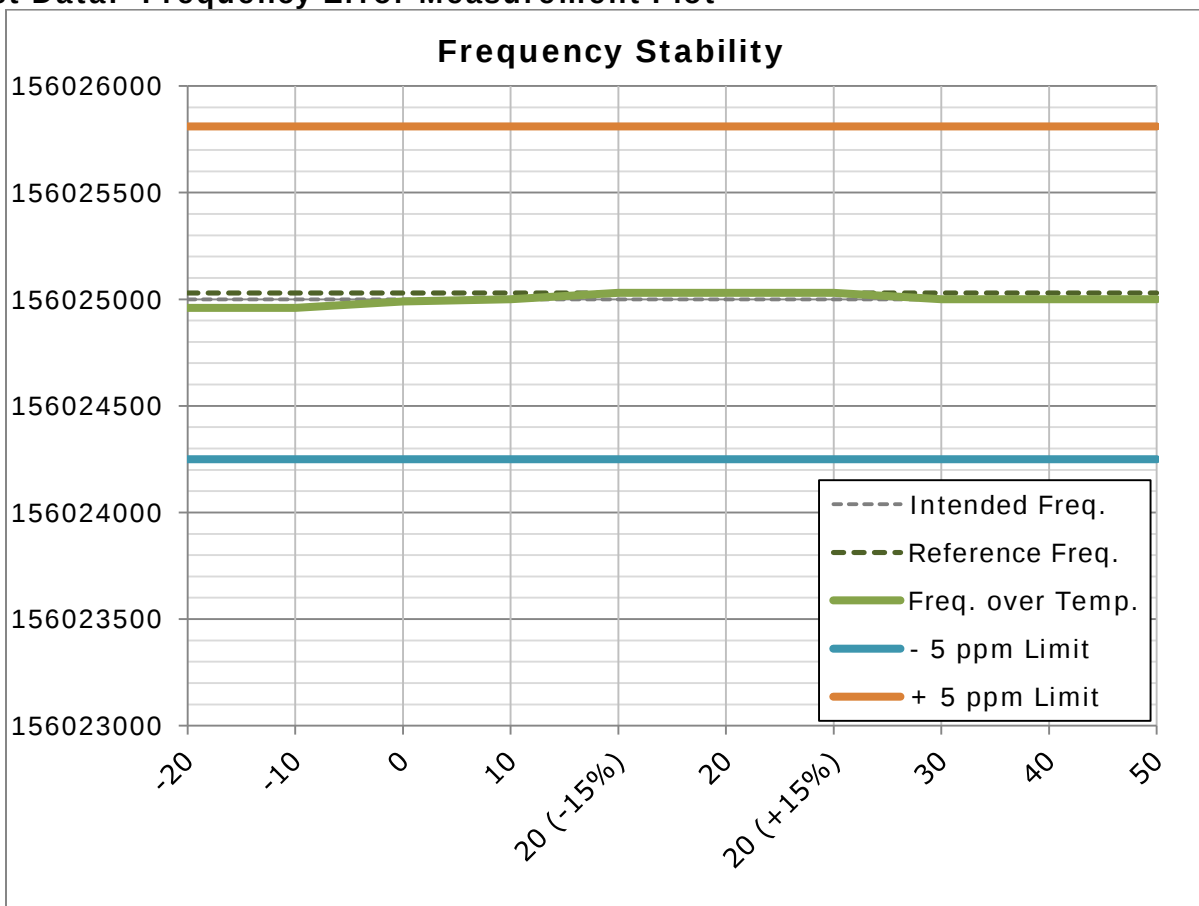
Compliance with 80.209(a)

Frequency bands and categories of stations	Tolerances ¹
(5) Band 156-162 MHz:	
(ii) Ship stations	10. ⁴

⁴For transmitters in the radiolocation and associated telecommand service operating on 154.584 MHz, 159.480 MHz, 160.725 MHz and 160.785 MHz the frequency tolerance is 15 parts in 10⁶.

Method of Measurements: ANSI/TIA 603-E

Test Data: Frequency Error Measurement Plot



FREQUENCY STABILITY

Test Data: Frequency Error Measurement Table

156.025 MHz High Power (Worst-case Settings)				
Limit:		5	ppm	
Temperature (°C)	Supplied Voltage (VDC)	Intended Frequency (Hz)	Measured Reference Frequency (Hz)	Deviation (Hz)
20°C (reference)	7.4	156025000	156025030	-30
@ 20°C (reference)				
Supplied Voltage (%)	Supplied Voltage (VDC)	Frequency (Hz)	Deviation (Hz)	PPM
-15%	6.29	156025030	0	0.000
15%	8.51	156025030	0	0.000
Temperature (°C)	Supplied Voltage (VDC)	Frequency (Hz)	Deviation (Hz)	PPM
50	7.4	156025000	30.00000	0.192
40	7.4	156025000	30.00000	0.192
30	7.4	156025000	30.00000	0.192
20	7.4	156025030	0.00000	0.000
10	7.4	156025000	30.00000	0.192
0	7.4	156024990	40.00000	0.256
-10	7.4	156024960	70.00000	0.449
-20	7.4	156024960	70.00000	0.449

RESULT: Meets Requirements

STATEMENT OF MEASUREMENT UNCERTAINTY

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	± 0.93 dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	± 1.86 dB	
Occupied Bandwidth	± 2.65 %	
Audio Frequency Response	± 1.86 dB	
Modulation limiting	± 1.88 %	
Radiated RF Power	± 1.4 dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq.	± 1.88 %	
Within 6kHz and 25kHz of audio Freq.	± 2.04 %	
Rad Emissions Sub Meth up to 26.5GHz	± 2.14 dB	
Adjacent channel power	± 1.47 dB	(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
Antenna: Biconical 1096	Eaton	94455-1	1096	08/01/17	08/01/19
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/19
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
Frequency Counter Small Chamber	HP	5385A	3242A07460	08/22/17	08/22/19
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 ; KMKM-0670-01; KFKF-0197-00	N/A	N/A
CHAMBER	Panashield	3M	N/A	04/25/16	05/31/18
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	03/01/17	03/01/19
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/11/17	11/11/19
Coaxial Cable #103 - KMKM-0180-01 Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	08/05/15	08/05/18
Type K J Thermometer	Martel	303	080504494	11/06/17	11/06/19
Modulation Analyzer	HP	8901A	3050A05856	04/13/17	04/13/19
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/19
Function Generator	Stanford	DS340	25200	02/21/18	02/21/20
Non Radiating 50 OHM Load	Sierra Elec	160B-600X	1038	09/13/16	09/13/18
Coaxial Cable - NMNM-0317-00 Black DC-4G	Belden		NMNM-0317-00	07/13/16	07/13/18
Attenuator K 3dB 2W DC-40G	Narda	4768-3	1023-2	11/19/17	11/19/19
Tunable Notch Filter 100-350 MHz	Eagle	220BFBF	100-350 MHz (#43)	11/19/2017	11/19/19
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT