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# FCC PART 80
# TEST REPORT

| | |
|---|---|
| **APPLICANT** | YAESU MUSEN CO., LTD. |
| | TENNOZU PARKSIDE BUILDING<br>2-5-8 HIGASHI-SHINAGAWA,<br>SHINAGAWA-KU, TOKYO 140-0002 JAPAN |
| **FCC ID** | K6630593X3D |
| **MODEL NUMBER** | GX6000 |
| **PRODUCT DESCRIPTION** | MOBILE MARINE TRANSCEIVER |
| **DATE SAMPLE RECEIVED** | 8/11/2016 |
| **FINAL TEST DATE** | 8/23/2016 |
| **TESTED BY** | Cory Leverett |
| **APPROVED BY** | Sid Sanders |
| **TEST RESULTS** | ☒ PASS ☐ FAIL |

| Report Number | Version Number | Description | Issue Date |
|---|---|---|---|
| 1612AUT16TestReport_ | Rev.1 | Initial Issue | 8/23/2016 |
| 1612AUT16TestReport_ | Rev.2 | Removed 2nd model | 4/13/2017 |

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**

**Tested by:** _____
Name and Title: Cory Leverett Project Manager/Testing Technician

**Date: 8/19/2016**

**Reviewed and approved by:** _____
Name and Title: Sid Sanders, Engineer

**Date: 8/23/2016**

## GENERAL INFORMATION

### EUT Specification

| | |
|---|---|
| **EUT Description** | MOBILE MARINE TRANSCEIVER |
| **FCC ID** | K6630593X3D |
| **Model Number** | GX6000 |
| **Operating Frequency** | 156.025-157.425 MHz |
| **Test Frequencies** | 156.05, 156.30, 156.525, 156.80, 157.425 MHz |
| **Type of Emission** | 16K0G3E, 16K0G2B |
| **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** | SO-239 |
| **Test Conditions** | The temperature was 26ºC<br>Relative humidity of 50%. |
| **Modification to the EUT** | None |
| **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 156.025 – 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 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. |
| 80.203 (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 25 Watts at the high power setting and 1 watt at low power setting, consistent with previous measurements.<br><br>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. |

## 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.

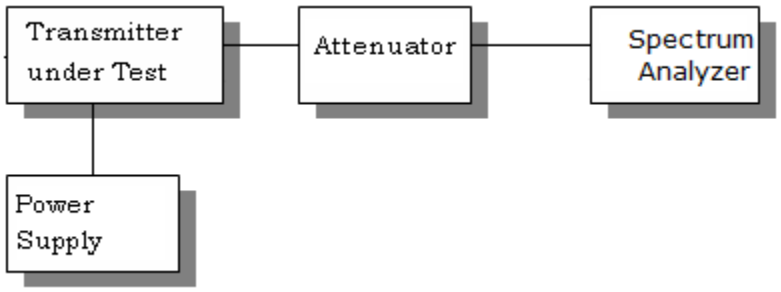
(1) Ship stations 156-162 MHz—25W[6] [13]

[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 | Measured Output Power | | | |
|---|---|---|---|---|
| | dBm | | Watts | |
| | High | Low | High | Low |
| 156.0500 | 43.90 | 29.03 | 24.55 | 0.80 |
| 156.3000 | 43.91 | 29.05 | 24.60 | 0.80 |
| 156.5250 | 43.90 | 29.04 | 24.55 | 0.80 |
| 156.8000 | 43.89 | 29.01 | 24.49 | 0.80 |

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

FOR LOW POWER SETTING INPUT POWER: (13.8V) (1A) = 13.8 Watts
FOR HIGH POWER SETTING INPUT POWER: (13.8V) (3A) = 41.4 Watts

## MODULATION CHARACTERISTICS

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

,

**Test Data:** **16K0G3E, 16K0F3E 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

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

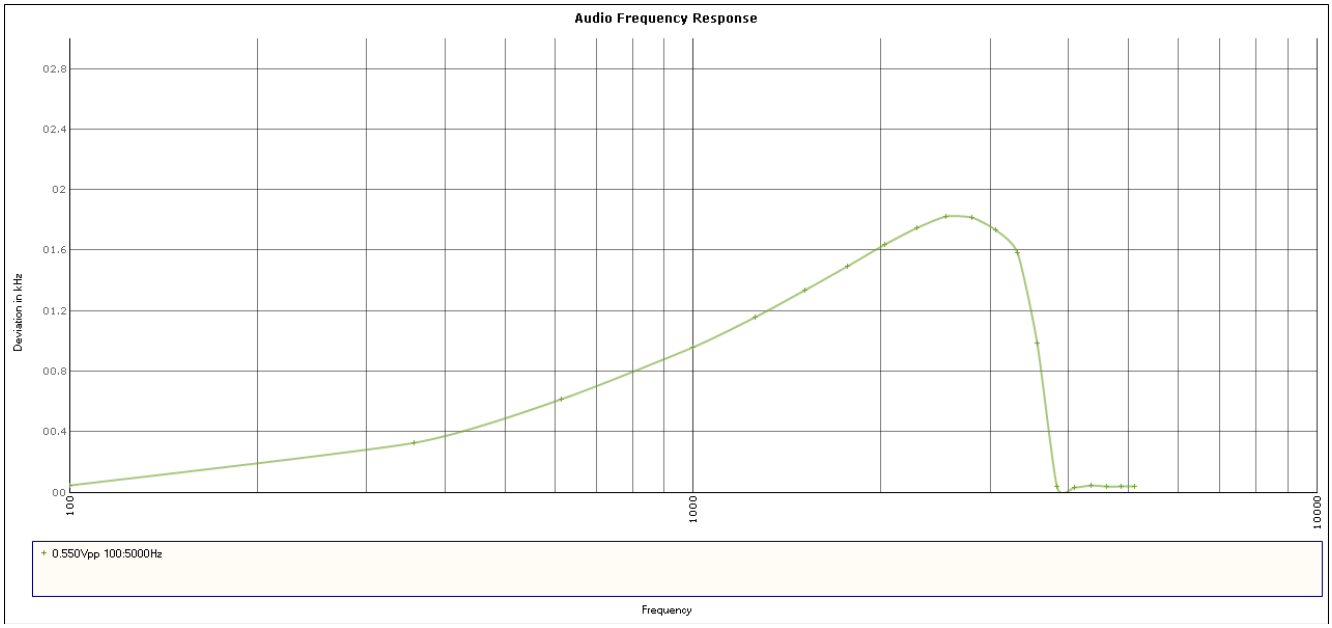
## AUDIO FREQUENCY RESPONSE

**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 Frequency (KHz) | Input Level (Vp-p) | Peak Deviation (+KHz) | Output Level (dB) | Att. Level (dB) | Output Limit (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| 1 | | | | 0 dB Reference | | |
| 3 | | | | 0.00 | 0.0 | 0.0 |
| 4 | | | | 0.00 | 7.5 | -7.5 |
| 5 | | | | 0.00 | 13.3 | -13.3 |
| 6 | | | | 0.00 | 18.1 | -18.1 |
| 7 | | | | 0.00 | 22.1 | -22.1 |
| 8 | | | | 0.00 | 25.6 | -25.6 |
| 9 | | | | 0.00 | 28.6 | -28.6 |
| 12 | | | | 0.00 | 36.1 | -36.1 |
| 15 | | | | 0.00 | 41.9 | -41.9 |
| 20 | | | | 0.00 | 49.4 | -49.4 |
| 25 | | | | 0.00 | 50.0 | -50.0 |
| 30 | | | | 0.00 | 50.0 | -50.0 |
| **Limit** | | **Freq > 3 KHz to < 20 KHz 60 $\log_{10}$ (f/3) dB** | | | | |
| | | **Freq > 20 KHz 50 dB greater than the att. at 1 kHz.** | | | | |

## AUDIO INPUT VERSUS MODULATION

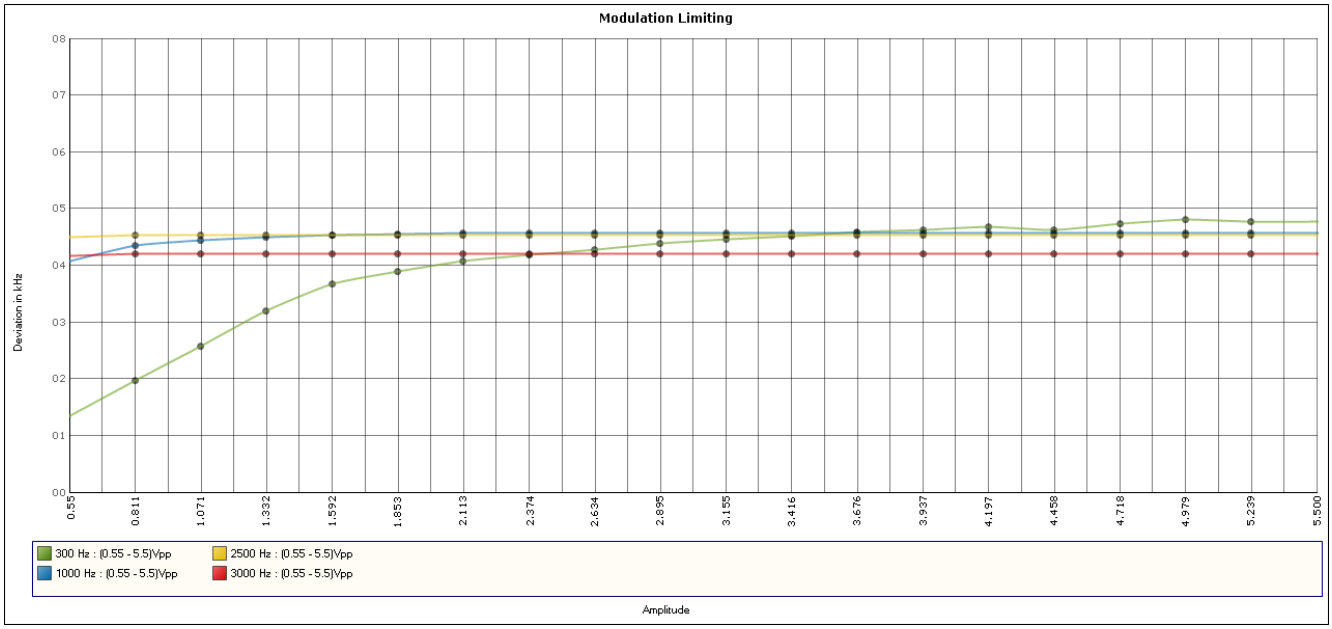
**Rule Part No.:** FCC Part 2.1047(b) & 80.213 (a)(2) & (b)

**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)

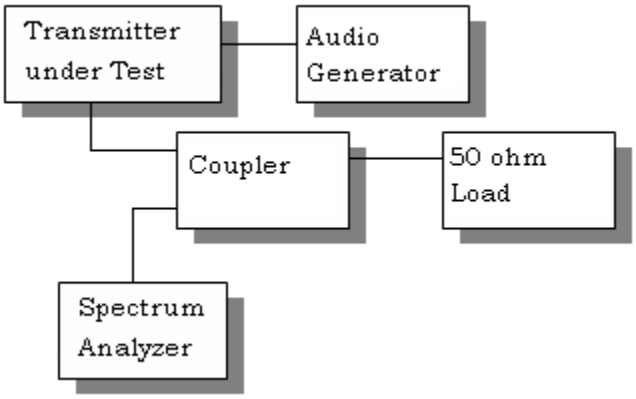
**Requirements:** (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(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; and

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

**Test Setup Diagram:**

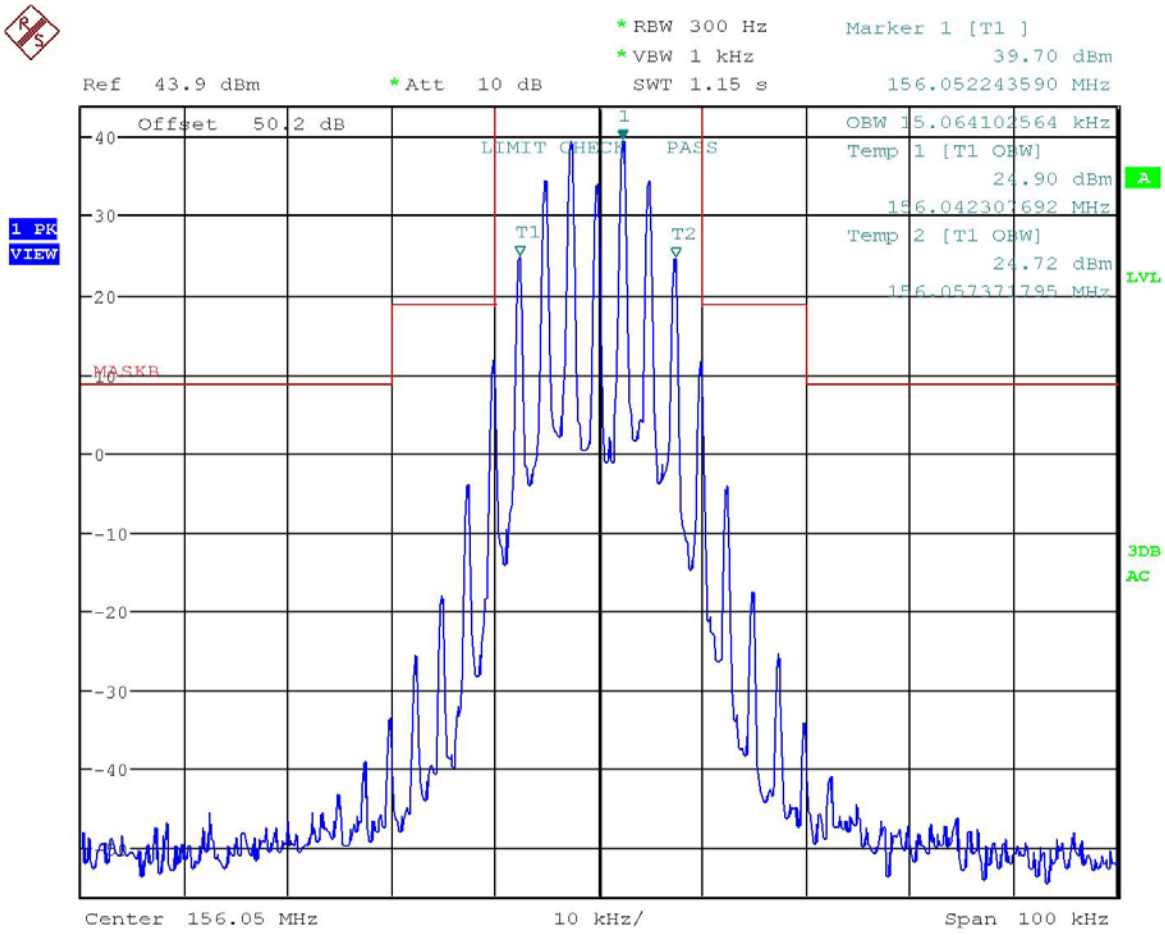
**OCCUPIED BANDWIDTH MEASUREMENT**




**Test Data:** See the plot below

## OCCUPIED BANDWIDTH

### Test Data: 16K0G3E Voice



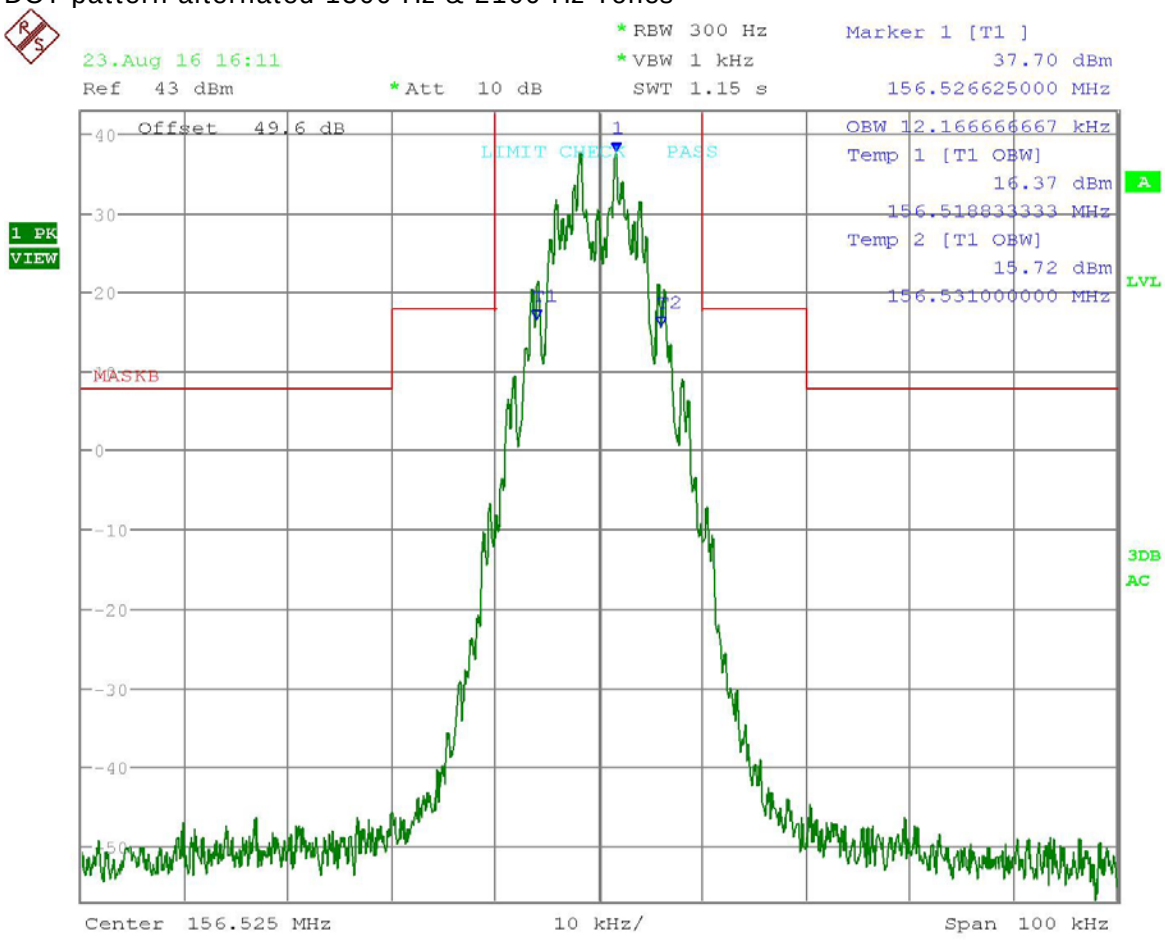

Date: 15.AUG.2016 10:14:52

**Results Meet Requirements**

## OCCUPIED BANDWIDTH

### Test Data: 16K0G2B DSC

DOT pattern alternated 1300 Hz & 2100 Hz Tones




Date: 23.AUG.2016 16:11:00

**Results Meet Requirements**

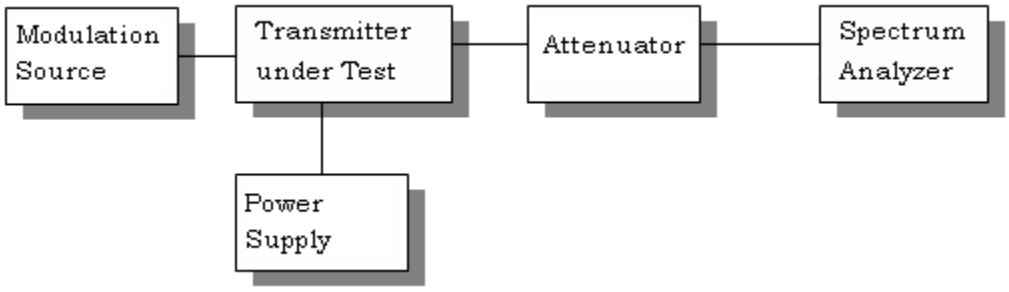
## SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

**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: High Power Low End of Band

| | dBm | Watts | Limit |
|---|---|---|---|
| Power Output | 43.9 | 24.55 | 56.9 |
| | | | |
| | Frequency | dBc | Margin |
| | 156.05 | 0 | 0.0 |
| | 312.10 | 102.9 | 46.0 |
| | 468.15 | 105.9 | 49.0 |
| | 624.20 | 111.8 | 54.9 |
| | 780.25 | 106.7 | 49.8 |
| | 936.30 | 110.4 | 53.5 |
| * | 1092.35 | 114.7 | 57.8 |
| * | 1248.40 | 114.3 | 57.4 |
| * | 1404.45 | 114.1 | 57.2 |
| * | 1560.50 | 114.0 | 57.1 |
| | | | |

*Indicates Noise Floor

### Test Data: Low Power Low End of Band

| | dBm | Watts | Limit |
|---|---|---|---|
| Power Output | 29.03 | 0.80 | 42.03 |
| | | | |
| | Frequency | dBc | Margin |
| | 156.05 | 0 | 0.0 |
| | 312.10 | 61.7 | 19.7 |
| | 468.15 | 73.3 | 31.3 |
| | 624.20 | 86.3 | 44.2 |
| | 780.25 | 78.4 | 36.4 |
| | 936.30 | 88.1 | 46.1 |
| | 1092.35 | 95.5 | 53.4 |
| | 1248.40 | 93.0 | 51.0 |
| | 1404.45 | 92.4 | 50.4 |
| | 1560.50 | 90.3 | 48.3 |
| | | | |

*Indicates Noise Floor

**Results Meet Requirements**

## SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### Test Data: High Power High End of Band

| | dBm | Watts | Limit |
|---|---|---|---|
| Power Output | 43.87 | 24.38 | 56.87 |
| | | | |
| | Frequency | dBc | Margin |
| | 157.425 | 0 | 0.0 |
| | 314.850 | 110.4 | 53.5 |
| | 472.275 | 103.3 | 46.5 |
| | 629.700 | 112.0 | 55.1 |
| | 787.125 | 108.7 | 51.9 |
| | 944.550 | 111.1 | 54.3 |
| * | 1101.975 | 116.8 | 59.9 |
| * | 1259.400 | 116.4 | 59.5 |
| * | 1416.825 | 116.3 | 59.4 |
| * | 1574.250 | 117.0 | 60.1 |
| | | | |

*Indicates Noise Floor

### Test Data: Low Power High End of Band

| | dBm | Watts | Limit |
|---|---|---|---|
| Power Output | 28.98 | 0.79 | 41.98 |
| | | | |
| | Frequency | dBc | Margin |
| | 157.425 | 0 | 0.0 |
| | 314.850 | 59.7 | 17.8 |
| | 472.275 | 71.7 | 29.7 |
| | 629.700 | 87.3 | 45.4 |
| | 787.125 | 78.7 | 36.8 |
| | 944.550 | 86.0 | 44.0 |
| | 1101.975 | 93.7 | 51.7 |
| | 1259.400 | 93.8 | 51.8 |
| | 1416.825 | 92.0 | 50.0 |
| | 1574.250 | 90.0 | 48.1 |
| | | | |

*Indicates Noise Floor

**Results Meet Requirements**

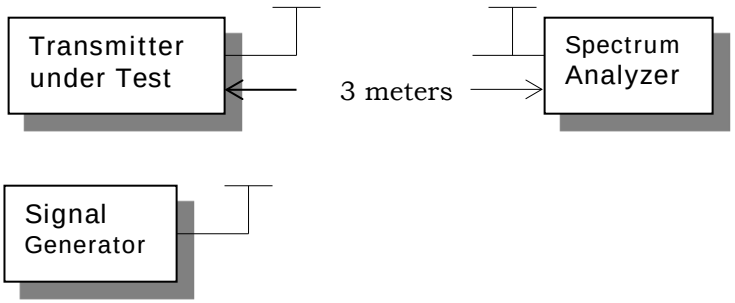
## FIELD STRENGTH OF SPURIOUS EMISSIONS

**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 freqencies tested.

### Test Data: High Power High End of Band

| Emission Frequency (MHz) | Power Mode | Power Output (dBm) | Power Output (Watts) | FCC Requirement dB | Bandwidth - BW - kHz |
|---|---|---|---|---|---|
| 157.42 | Hi | 43.87 | 24.38 | 56.87 | 25.00 |

| Emission Frequency (MHz) | Ant. Polarity | Below Carrier (dBc) | Margin |
|---|---|---|---|
| 314.85 | V | 113.00 | 56.13 |
| 472.28 | H | 112.97 | 56.10 |
| 629.70 | H | 116.13 | 59.26 |
| 787.13 | H | 117.30 | 60.43 |
| 944.55 | V | 112.91 | 56.04 |
| 1,101.98 | V | 105.34 | 48.47 |
| 1,259.40 | H | 104.43 | 47.56 |
| 1,416.83 | H | 104.31 | 47.44 |
| 1,574.25 | H | 102.95 | 46.08 |

## FREQUENCY STABILITY

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

**Requirements:** The frequency must remain within the .0010%, 10.0 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**

| Temperature | Frequency MHz | Cycles | PPM |
|---|---|---|---|
| 25°C (reference) | 157424907 | | |
| -20°C | 157425009 | 102000000 | 0.648 |
| -10°C | 157424965 | 58000000 | 0.368 |
| 0°C | 157424949 | 42000000 | 0.267 |
| 10°C | 157424921 | 14000000 | 0.089 |
| 20°C | 157424899 | -8000000 | -0.051 |
| 30°C | 157424895 | -12000000 | -0.076 |
| 40°C | 157424838 | -69000000 | -0.438 |
| 50°C | 157424789 | -118000000 | -0.750 |
| | | | |
| Battery Voltage | Frequency | Cycles | PPM |
| 11.56 | 157424907 | 0 | 0.000 |
| 13.60 | 157424907 | 0 | 0.000 |
| 15.64 | 157424907 | 0 | 0.000 |

## EMC EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---|---|---|---|---|---|
| 12 Volt Power Supply | Astron | RS-12A | 9312779 | N/A | N/A |
| Antenna: Biconical 1096 Chamber | Eaton | 94455-1 | 1096 | 07/14/15 | 07/14/17 |
| Antenna: Biconical 1057 | Eaton | 94455-1 | 1057 | 11/18/15 | 11/18/17 |
| Antenna: Log-Periodic 1122 | Electro-Metrics | LPA-25 | 1122 | 07/14/15 | 07/14/17 |
| Antenna: Log-Periodic 1243 | Eaton | 96005 | 1243 | 02/09/16 | 02/09/18 |
| Temperature Chamber LARGE | Tenney Engineering | TTRC | 11717-7 | 08/19/14 | 08/19/16 |
| AC Voltmeter | HP | 400FL | 2213A14728 | 10/24/15 | 10/24/17 |
| 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 | 02/25/15 | 02/25/17 |
| Software: Field Strength Program | Timco | N/A | Version 4.0 | N/A | N/A |
| Antenna: Active Loop | ETS-Lindgren | 6502 | 00062529 | 11/18/15 | 11/18/17 |
| Type K J Thermometer | Martel | 303 | 080504494 | 10/26/15 | 10/26/17 |
| Attenuator N 30dB 20W DC-11G | Narda | 766-30 | DC-11G | 08/01/13 | 08/01/15 |
| Modulation Analyzer | HP | 8901A | 3050A05856 | 04/16/15 | 04/16/17 |
| Attenuator N 30dB 150W DC-6G | Narda | 769-30 | 10267 | 06/26/15 | 06/26/17 |
| EMI Test Receiver R & S ESU 40 Chamber | Rohde & Schwarz | ESU 40 | 100320 | 04/01/16 | 04/01/18 |
| Coaxial Cable - Chamber 3 cable set (Primary) | Micro-Coax | Chamber 3 cable set (Primary) | KMKM-0244-00; KMKM-0670-00; KFKF-0198-00 | 12/05/15 | 12/05/17 |
| Function Generator | Standford | DS340 | 25200 | 02/02/16 | 02/02/18 |
| 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 |

***EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT