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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	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 2 nd model	4/13/2017

**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



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 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-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.
- 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.

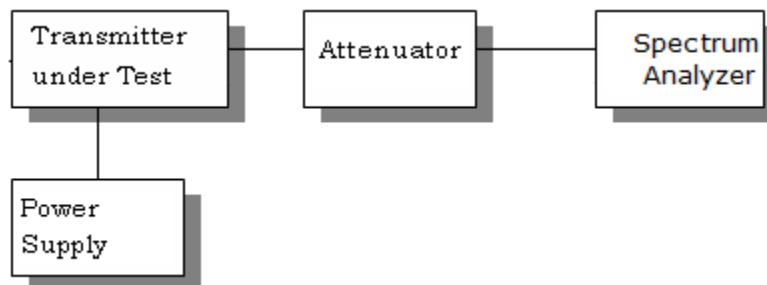
(1) Ship stations 156-162 MHz—25W⁶ ¹³

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

¹³The 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

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 4.6 \text{ kHz (Peak Deviation)}$$

$$K = 1$$

$$B_n = 2(3000) + 2(4.6K) (1) = 16.0K$$

80.205(a) ALLOWED AUTHORIZED BANDWIDTH – 20.00 kHz

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

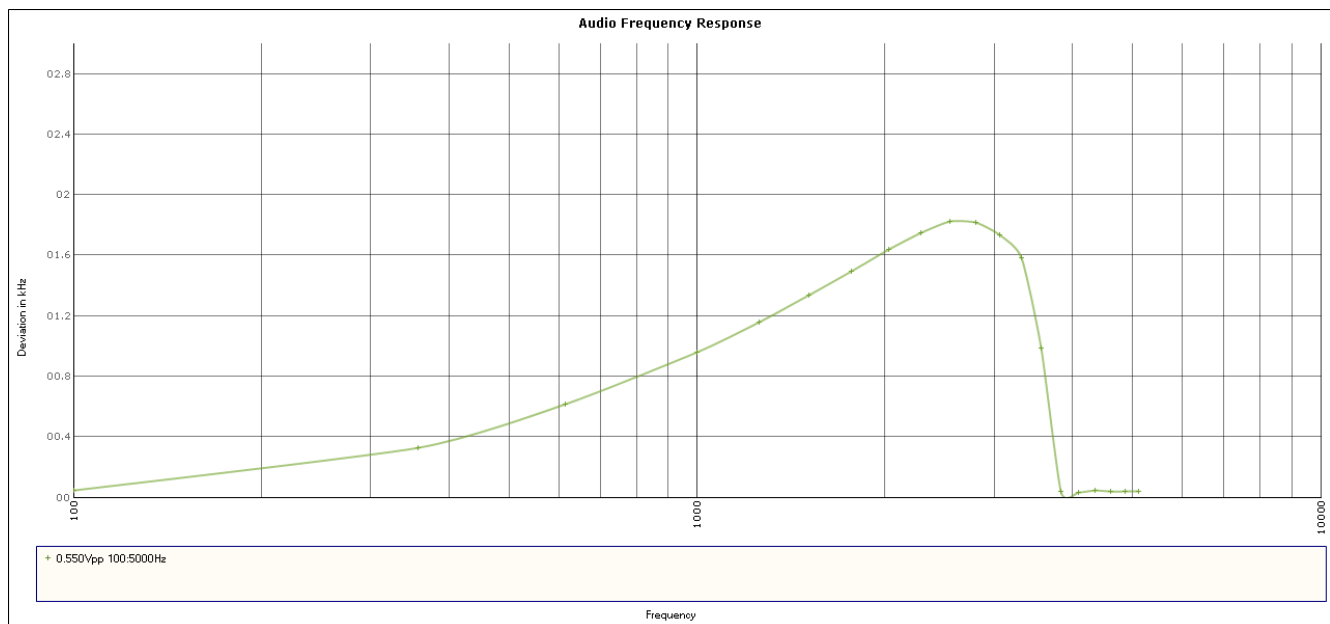
AUDIO FREQUENCY RESPONSE

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

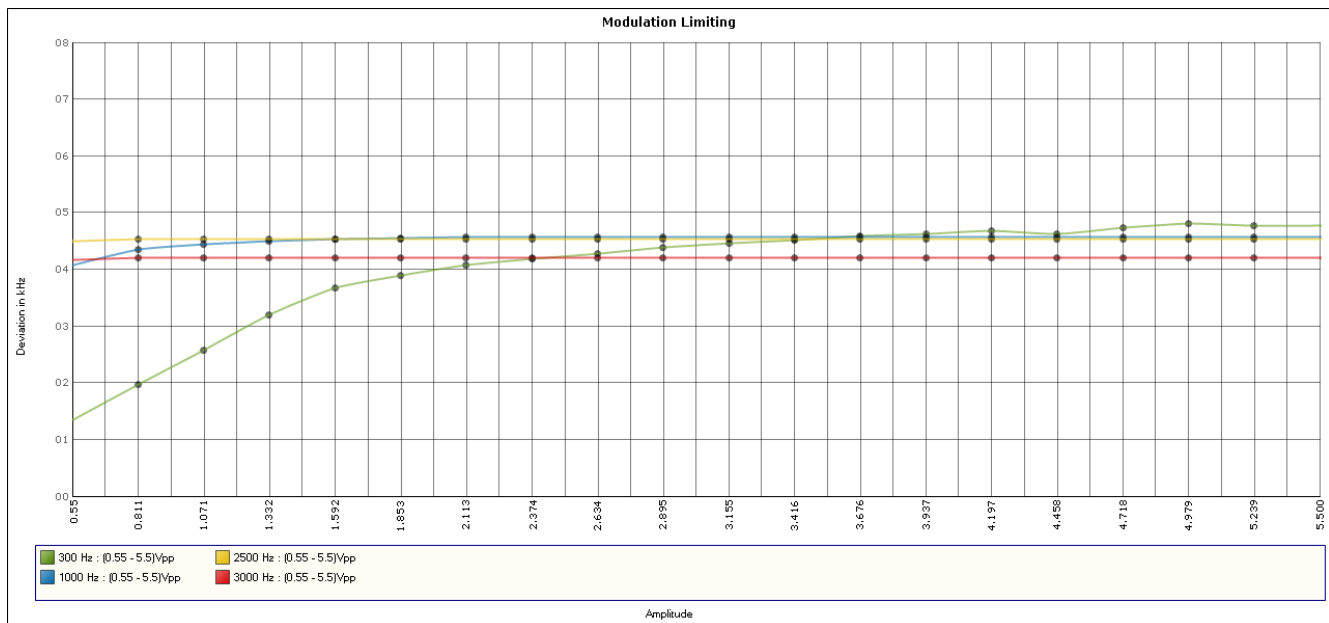
Rule Part No.: FCC Part 2.1047(b) & 80.213 (a)(2) & (b)

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)

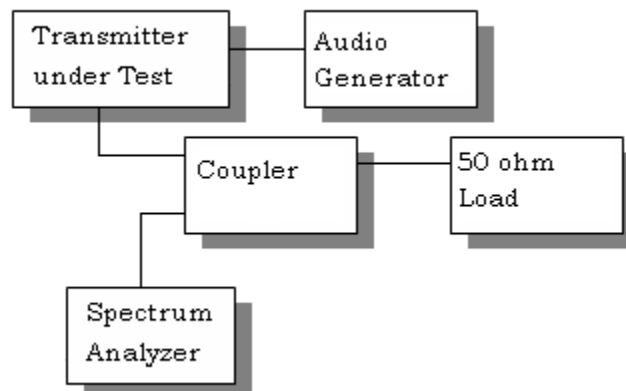
Requirements: (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(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:

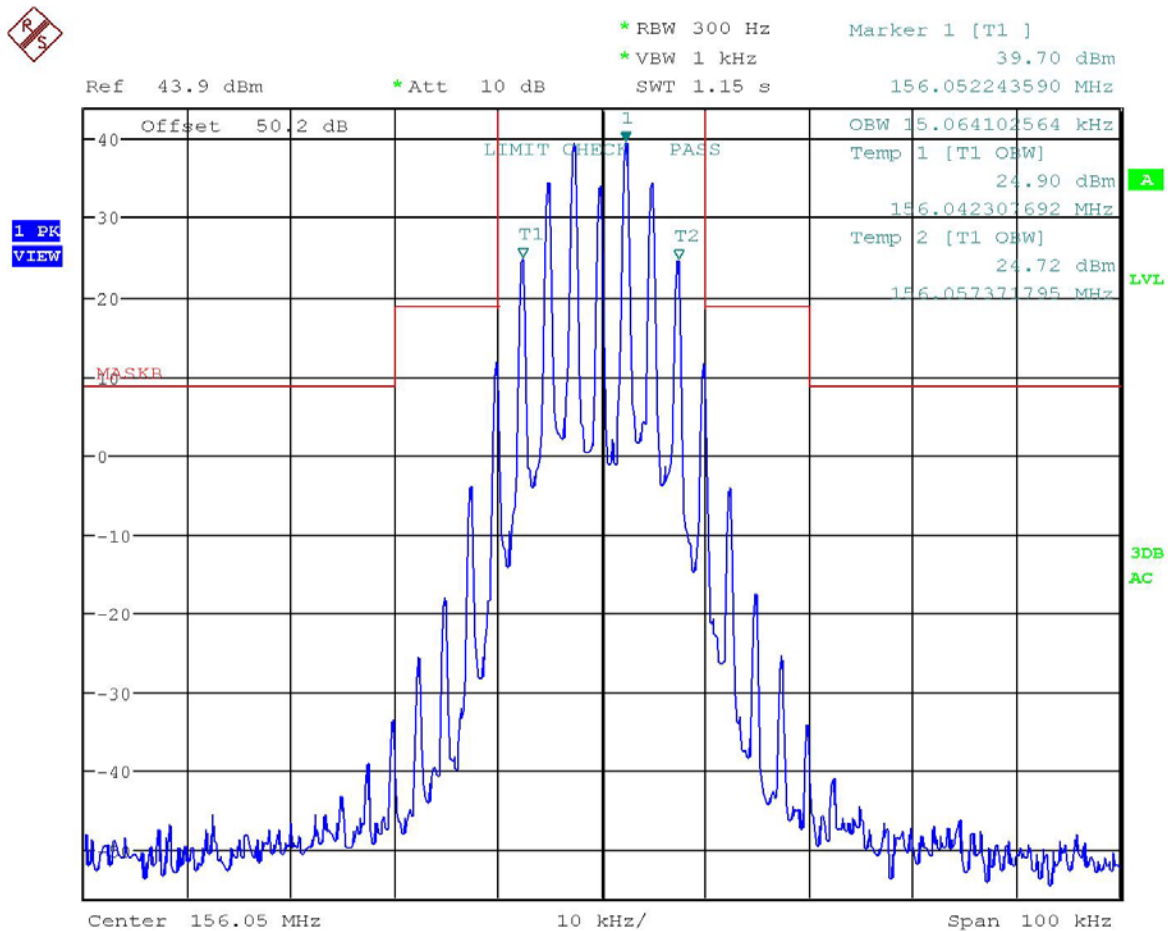
OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plot below

OCCUPIED BANDWIDTH

Test Data: 16K0G3E Voice



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

Results Meet Requirements

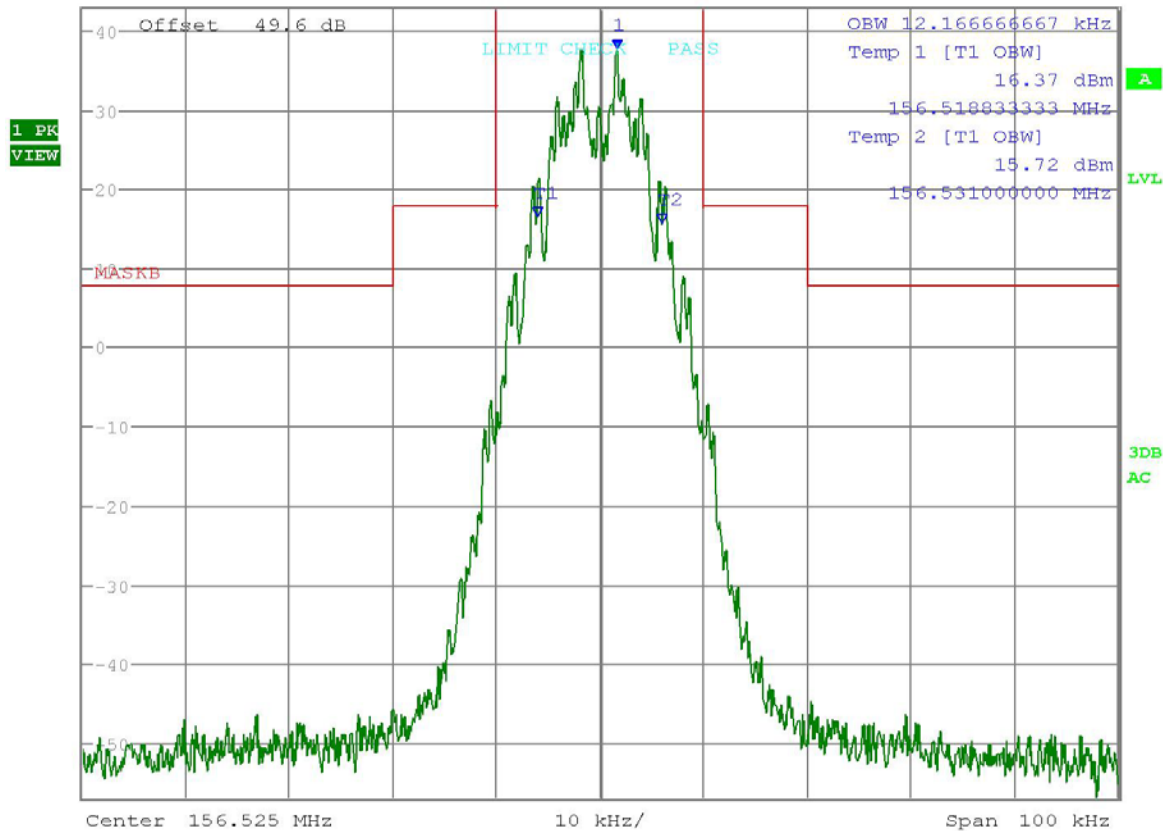
OCCUPIED BANDWIDTH

Test Data: 16K0G2B DSC

DOT pattern alternated 1300 Hz & 2100 Hz Tones



23.Aug 16 16:11
 Ref 43 dBm *Att 10 dB *RBW 300 Hz *VBW 1 kHz SWT 1.15 s
 Marker 1 [T1] 37.70 dBm
 156.526625000 MHz



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

Results Meet Requirements

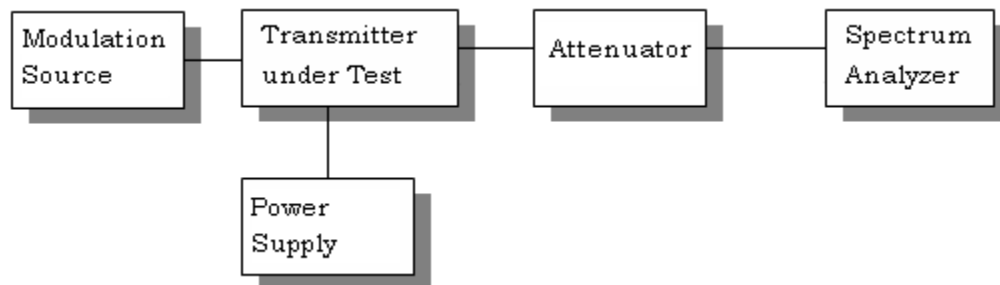
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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 $10\log_{10}$ (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

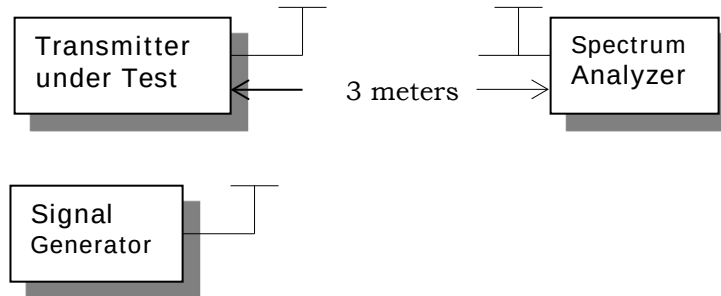
FIELD STRENGTH OF SPURIOUS EMISSIONS

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 $10\log_{10}$ (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: 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