849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR
352.472.5500
FAX: 352.472.2030
EMAIL:
INFO@TIMCOENGR.COM

FCC PART 95

GMRS TRANSCEIVER

TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE KANSAS CITY MISSOURI 64120 USA
FCC ID	MMAMXT400
PRODUCT DESCRIPTION	MOBILE GMRS TRANSCEIVER
FCC STANDARD APPLIED	47 CFR § 95 Personal Radio Service Subpart A – General Mobile Radio Service (GMRS)
DATE SAMPLE RECEIVED	8/3/2016
FINAL TEST DATE	8/29/2016
TESTED BY	Cory Leverett
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1536AUT16TestReport_	Rev1	Initial Issue	8/24/2016
	Rev2	Technical Update	8/29/2016

TABLE OF CONTENTS

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: 8/29/2016

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

Date: 8/29/2016

GENERAL INFORMATION
EUT Specification

EUT Description	MOBILE GMRS TRANSCEIVER
EUT Application	Portable short range communications
FCC ID	MMAMXT400
Serial Number	N/A
Operating Frequency	GMRS:462.5500-462.7250 MHz
Test Frequencies	GMRS: 462.5500, 467.7250 MHz
Type of Emission	10K2F3E
EUT Power Source	☐ 110–120Vac/50–60Hz (Optional AC power Adapter)
	☒ DC Power 13.6V
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☒ Mobile
	☐ Portable
Antenna	External 50 ohm connector
Test Conditions	The temperature was 26ºC with a relative humidity of 50-60%.
Modification to the EUT	None
Test Exercise	The EUT was placed in continuous transmit mode of operation and modulated as per standard
Applicable Standards	ANSI/TIA 603-D:2010
Test Facility	**Timco Engineering Inc.** **849 NW State Road 45** **Newberry, FL 32669 USA**.

TEST REPORT SUMMARY

Rule Part No.	Scope of Work	Status Pass/Fail/NA
2.1033(c)(4), 95.621(a), 95.631(a)	Emission Types & Frequencies	Pass
2.1046(a), 95.639(a)(1)	RF Power Output	Pass
2.1047(a)(b), 95.637(a)(b)	Modulation Characteristics	Pass
2.1049(c)(1),95.633(a), 95.635(b)(1)(3)(7)	Occupied Bandwidth	Pass
2.1051, 95.635(b)(7)	Antenna Conducted Emissions	Pass
2.1053, 95.635(b)(7)	Field Strength Spurious Emissions	Pass
2.1055 Part 95.621(b)	Frequency Stability	Pass

EMISSION TYPES AND FREQUENCIES

Rule Part No.: 2.1033(c)(4)(5), 95.621(a), 95.631(a)

Test Data: Type of Emission: 10K2F3E

Bn = 2M + 2DK
M = 3000
D = 2.1K
Bn = 2(3000) + 2(2100) = 10.2K

GMRS Authorized Bandwidth 20.0 kHz

GMRS Allowed Channel frequencies (MHz):

1. 462.5500	13. 462.7000
2. 462.5625	14. 462.7125
3. 462.5750	15. 462.7250
4. 462.5875	16. 467.5500
5. 462.6000	17. 467.5750
6. 462.6125	18. 467.6000
7. 462.6250	19. 467.6250
8. 462.6375	20. 467.6500
9. 462.6500	21. 467.6750
10. 462.6625	22. 467.7000
11. 462.6750	23. 467.7250
12. 462.6875	

Results: **Meets Requirements**

RF POWER OUTPUT

Rule Part No.: 2.1046(a), 95.639(a)(1)

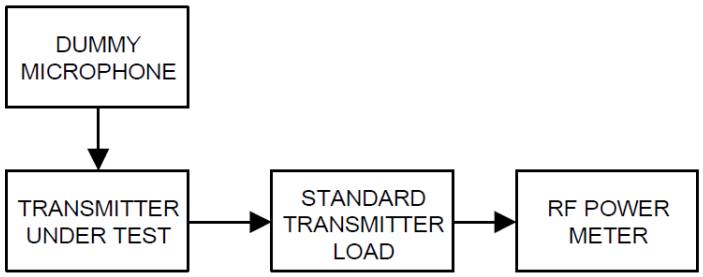
Requirements: No GMRS channel, under any condition of modulation, shall exceed:

1. 50W Carrier power (average TP during one modulated RF cycle) when transmitting emissions type A1D, F1D, G1D, A3E, F3E, or G3E.

2. 50W peak envelope TP when transmitting emission type H1D, J1D, R1D, H3E, J3E, or R3E.

Test Procedure: As listed above.

Test Diagram:



Test Data: Conducted Power Output Measurement Table

Tuned Freq. MHz	Power Output			
	High		Low	
	dBm	Watts	dBm	Watts
462.5500	45.57	36.06	35.90	3.89
467.7250	45.70	37.15	35.92	3.91

Rule Part No.: 2.1033 (C) (8) DC Input into the final amplifier

FOR HIGH POWER SETTING INPUT POWER: (13.6V) (7.2A) = 97.92Watts
FOR LOW POWER SETTING INPUT POWER: (13.6V) (2.5A) = 34 Watts

Results: Meets Requirements

MODULATION CHARACTERISTICS

Rule Part No.: 2.1047(a)(b), 95.637(a)(b)

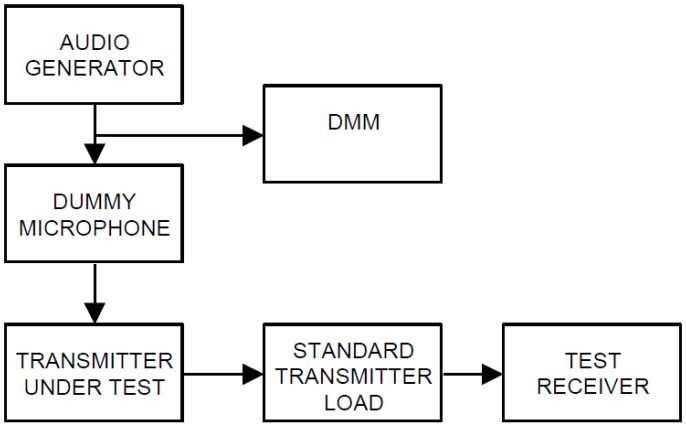
Requirements: A GMRS transmitter that transmits emission types F1D, G1D, or G3E must not exceed a peak frequency deviation of plus or minus 5 kHz. A GMRS transmitter that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 5 kHz

Each GMRS transmitter, except a mobile station transmitter with a power output of 2.5 W or less, must automatically prevent a greater than normal audio level from causing overmodulation. The transmitter also must include audio frequency low pass filtering.

The filter must be between the modulation limiter and the modulated stage of the transmitter. At any frequency (f in kHz) between 3 and 20 kHz, the filter must have an attenuation of at least 60 log10 (f/3) dB greater than the attenuation at 1 kHz. Above 20 kHz, it must have an attenuation of at least 50 dB greater than the attenuation at 1 kHz.

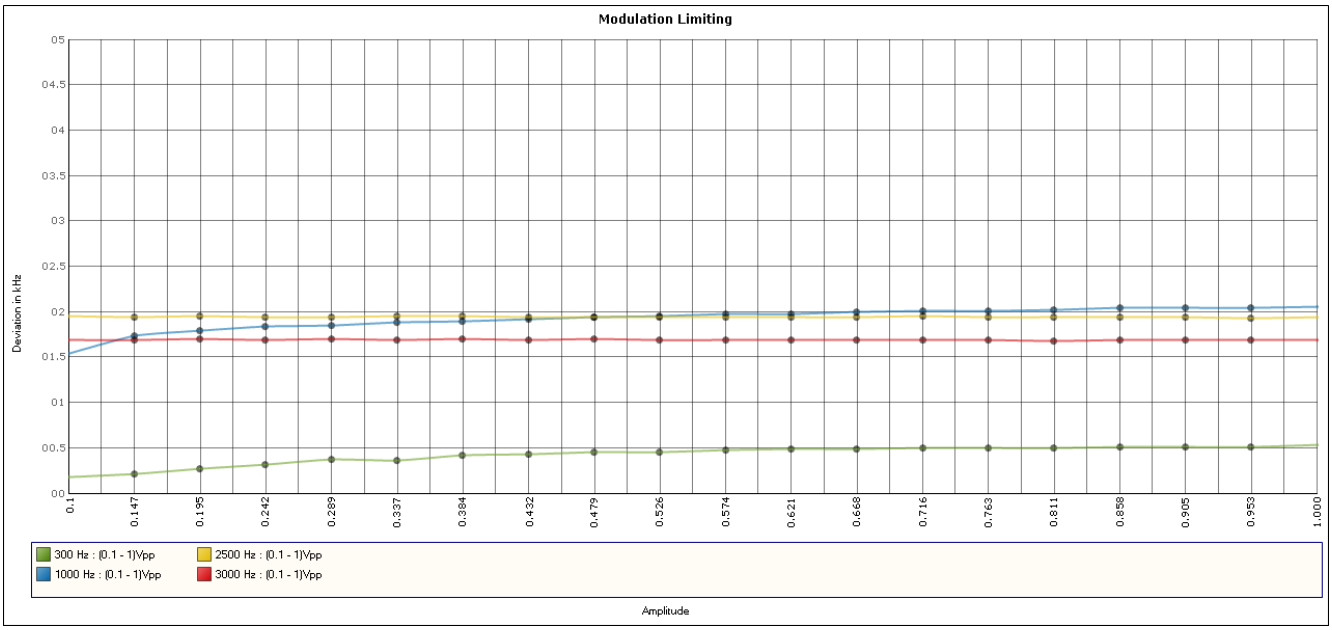
Test Procedure: TIA 603 section 2.2.3 Modulation Limiting
TIA 603 section 2.2.6 Audio Frequency Response
TIA 603 section 2.2.15 Audio Low Filter Response

Test Diagram:



MODULATION CHARACTERISITICS

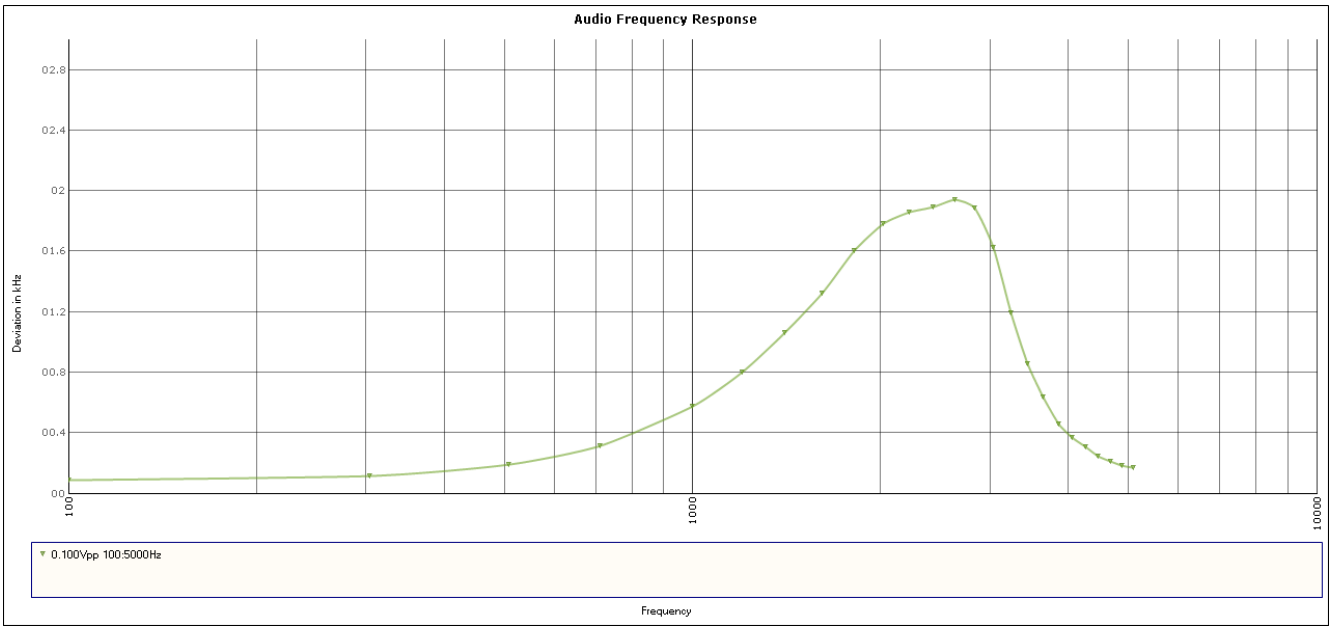
Test Data: 10K2F3E Modulation Limiting Plot



Results: Meets Requirements

MODULATION CHARACTERISITICS

Test Data: 10K2F3E Audio Frequency Response Plot



Results: Meets Requirements

MODULATION CHARACTERISITICS

Test Data: 10K2F3E Audio Low Filter Response Table

Audio Frequency (KHz)	Input Level (Vp-p)	Peak Deviation (+KHz)	Att. Level (dB)	Output Limit (dB)	Margin (dB)
1	1.9	2.10	0 dB Reference		
3	1.9	1.68	9.03	0.0	9.0
4	1.9	0.36	34.75	7.5	27.3
5	1.9	0.16	52.74	13.3	39.4
6	1.9	0.11	52.87	18.1	34.8
7	1.9	0.09	53.02	22.1	30.9
8	1.9	0.08	53.07	25.6	27.5
9	1.9	0.08	53.13	28.6	24.5
12	1.9	0.08	53.18	36.1	17.1
15	1.9	0.08	53.20	41.9	11.3
20	1.9	0.08	53.20	49.4	3.8
25	1.9	0.08	53.20	50.0	3.2
30	1.9	0.08	53.20	50.0	3.2
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.			

Results: Meets Requirements

OCCUPIED BANDWIDTH

Rule Part No.: 2.1049(c)(1), 95.633(a), 95.635(b)(1)(3)(7)

Requirements: The authorized bandwidth (maximum permissible bandwidth of a transmission) for emission type H1D, J1D, R1D, H3E, J3E or R3E is 4 kHz. The authorized bandwidth for emission type A1D or A3E is 8 kHz. The authorized bandwidth for emission type F1D, G1D, F3E or G3E is 20 kHz.

The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).

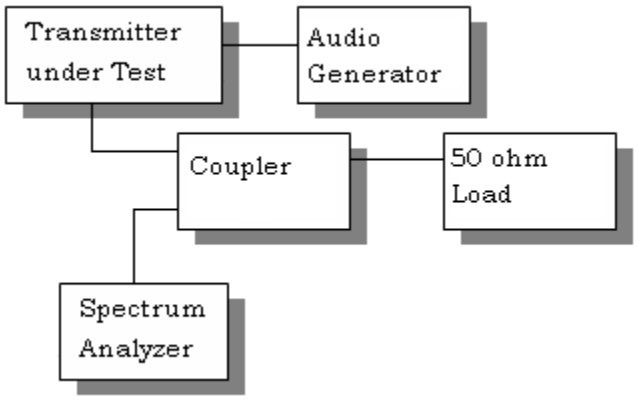
(1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

(3) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.

(7) At least 43 + 10 $\log_{10}$ (T) dB on any frequency removed from the center of the authorized bandwidth by more than 250%

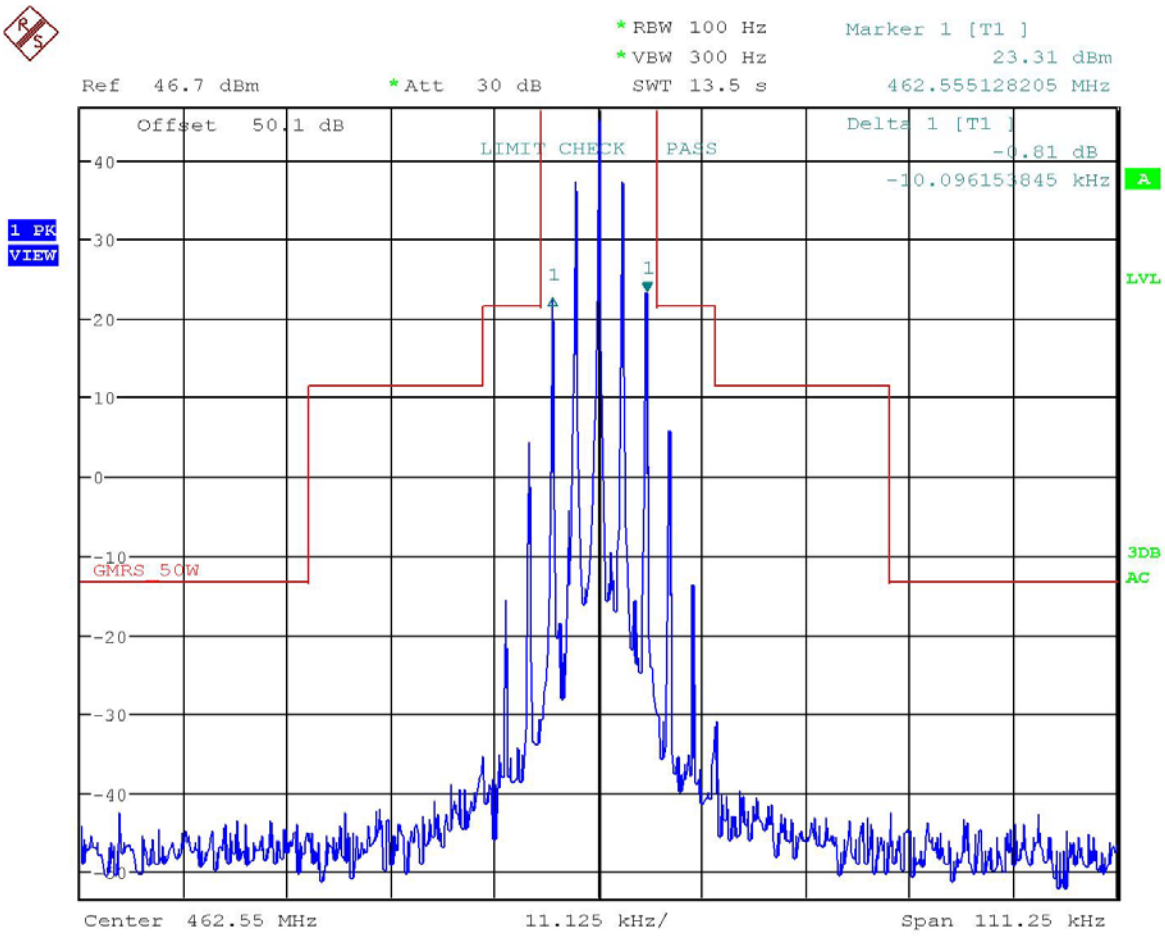
Test Procedure: TIA-603 section 2.2.11 Sideband Spectrum

Test Diagram:



OCCUPIED BANDWIDTH

Test Data: 10K2F3E High Power Plot

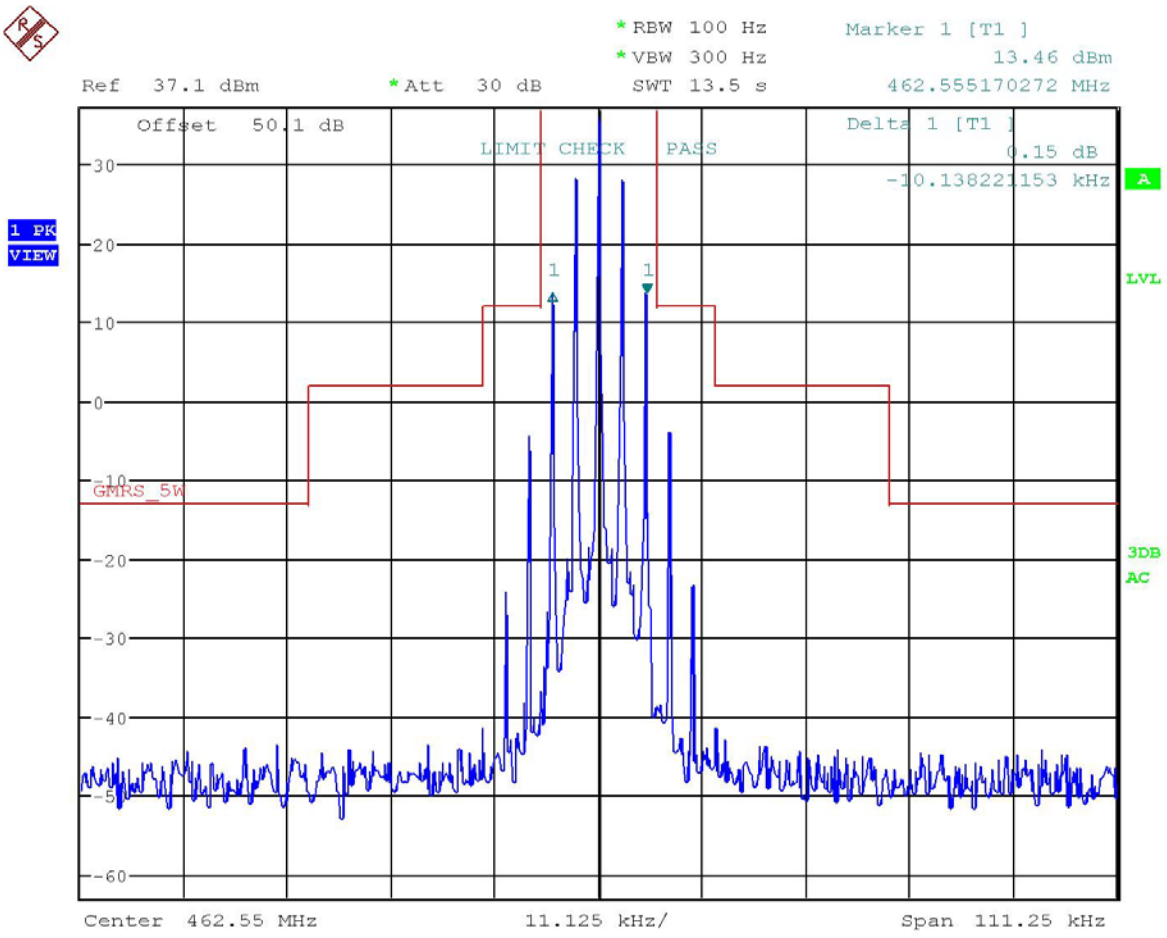


Date: 15.AUG.2016 15:08:26

Results: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: 10K2F3E Low Power Plot



Date: 15.AUG.2016 15:10:10

Results: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a), 95.635(b) (7)

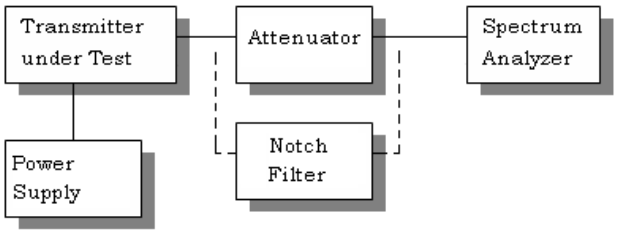
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).

(7) At least 43 + 10 $\log_{10}$ (T) dB on any frequency removed from the center of the authorized bandwidth by more than 250%

Test Procedure: TIA-603 section 2.2.13 Unwanted Emissions: Conducted Spurious
The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental.

Test Diagram:



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 10K2F3E High Power Low End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	45.57	36.06	58.57
	Frequency (MHz)	Level (dBc)	Margin (dB)
	462.55	0	0.0
	925.10	83.4	24.8
	1387.65	82.0	23.4
	1850.20	85.1	26.5
	2312.75	91.1	32.5
	2775.30	72.4	13.8
	3237.85	92.8	34.2
	3700.40	83.4	24.9
	4162.95	84.0	25.4
	4625.50	70.0	11.4

Note: * indicates Noise floor

Test Data: 10K2F3E Low Power Low End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	35.9	3.89	48.9
	Frequency (MHz)	Level (dBc)	Margin (dB)
	462.55	0	0.0
	925.10	66.2	17.3
	1387.65	69.9	21.0
	1850.20	79.9	31.0
	2312.75	85.4	36.5
	2775.30	63.4	14.5
	3237.85	82.6	33.7
	3700.40	75.6	26.7
	4162.95	74.4	25.5
	4625.50	65.1	16.2

Note: * indicates Noise floor

Results: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 10K2F3E High Power High End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	45.7	37.15	58.7
	Frequency (MHz)	Level (dBc)	Margin (dB)
	467.725	0	0.0
	935.450	77.9	19.2
	1403.175	79.8	21.1
	1870.900	87.3	28.6
	2338.625	77.8	19.1
	2806.350	68.8	10.1
	3274.075	88.2	29.5
	3741.800	81.0	22.3
	4209.525	81.5	22.8
	4677.250	71.2	12.5

Note: * indicates Noise floor

Test Data: 10K2F3E Low Power High End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	35.92	3.91	48.92
	Frequency (MHz)	Level (dBc)	Margin (dB)
	467.725	0	0.0
	935.450	66.1	17.2
	1403.175	70.8	21.9
	1870.900	83.6	34.7
	2338.625	78.1	29.2
	2806.350	61.3	12.4
	3274.075	80.2	31.3
	3741.800	68.7	19.8
	4209.525	76.8	27.9
	4677.250	61.7	12.7

Note: * indicates Noise floor

Results: Meets Requirements

FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: 2.1053, 95.635(b)(7)

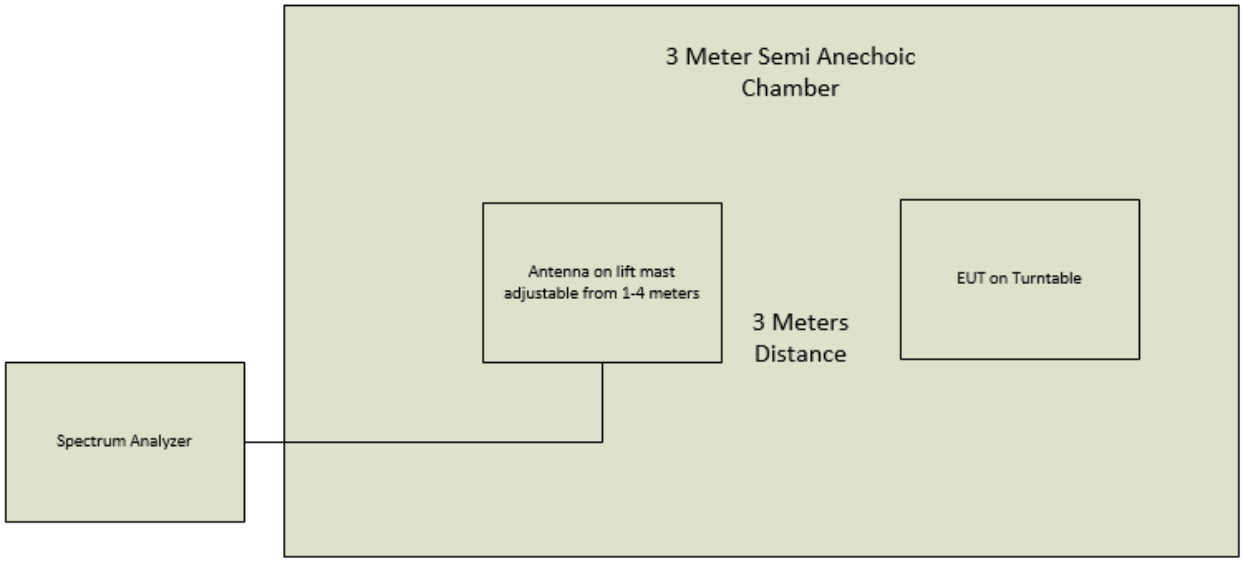
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).

(7) At least 43 + 10 $\log_{10}$ (T) dB on any frequency removed from the center of the authorized bandwidth by more than 250%

Test Procedure: TIA-603 section 2.2.12 Unwanted Emissions: Radiated Spurious
The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental.

Test Diagram:



FIELD STRENGTH OF SPURIOUS EMISSIONS

Note: All power levels and test frequencies were measured; the following results represent the worst case in regards to tuned frequency and power output level.

Test Data: 10K2F3E High Power Low End of Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement (dBc)	Bandwidth BW (kHz)
462.55	Hi	45.57	36.06	58.57	25.00

Emission Frequency (MHz)	Ant. Polarity	Below Carrier (dBc)	Margin (dB)
925.10	V	107.77	48.01
1387.65	V	106.26	46.50
1,850.20	H	103.75	43.99
2,312.75	V	98.06	38.30
2,775.30	H	99.62	39.86
3,237.85	V	95.71	35.95
3,700.40	V	77.79	18.03
4,162.95	H	76.66	16.90
4,625.50	H	86.05	26.29

These test results represent the worst case.

Results Meet Requirements

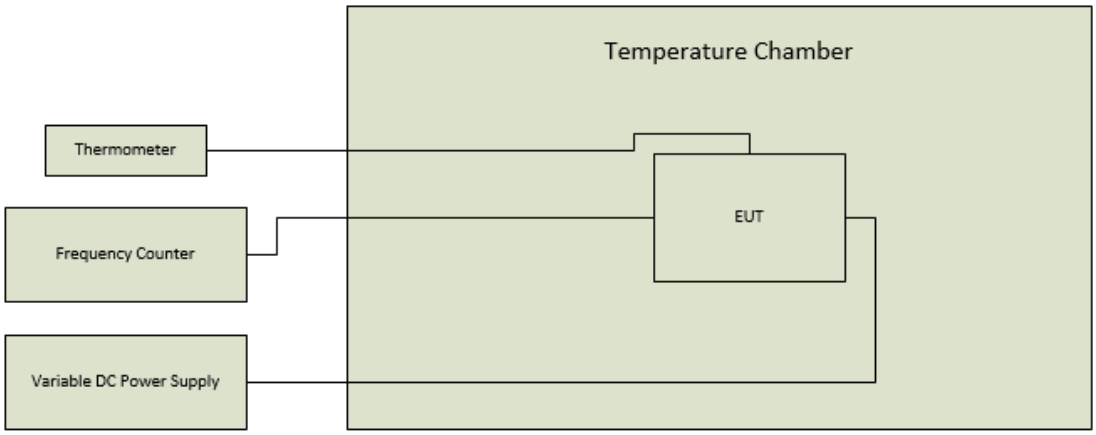
FREQUENCY STABILITY

Rule Parts. No.: 2.1055, 95.621(b)

Requirements: Each GMRS transmitter for mobile station, small base station and control station operation must be maintained within a frequency tolerance of 0.0005% (±5 ppm).

Test Procedure: TIA-603 section 2.2.2 Carrier Frequency Stability

Test Diagram:



Test Data: 10K2F3E High End of Band

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	462725063	0	0.000
-30°C	462725659	-596000000	-1.288
-20°C	462725306	-243000000	-0.525
-10°C	462724998	65000000	0.140
0°C	462725084	-21000000	-0.045
10°C	462725131	-68000000	-0.147
20°C	462725162	-99000000	-0.214
30°C	462725086	-23000000	-0.050
40°C	462725050	13000000	0.028
50°C	462725040	23000000	0.050
Battery Voltage	Frequency	Cycles	PPM
11.56	462725064	-1000000	-0.002
13.6	462725063	0	0.000
15.64	462725063	0	0.000

Results: Meets Requirements

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
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 409	Electro-Metrics	LPA-30	409	02/17/16	02/17/18
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	2213A14499	07/01/15	07/01/17
Frequency Counter Large Chamber	HP	5352B	2632A00165	07/01/15	07/01/17
CHAMBER	Panashield	3M	N/A	04/25/16	12/31/17
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	06/13/14	09/13/16
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	12/12/99	12/12/99
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
Attenuator N 10dB 20W DC-4G	Narda	766-10	0010 (#8)	05/18/15	05/18/17
Hygro-Thermometer	Extech	445703	0602	06/30/15	06/30/17
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17
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
Attenuator N 20dB 20W DC-12G	Narda	768-20-SP	344 (#6)	05/19/15	05/19/17
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01; KMKM-0670-00; KFKF-0198-01	08/08/16	08/08/18
Function Generator	Stanford	DS340	25200	02/02/16	02/02/18
Tunable Notch Filter 250-850 MHz	Eagle	TNF-200	250-850 MHz (#19)	06/26/15	06/26/17
DC Power Supply	HP	6286A	1744A03842	N/A	N/A
Digital Multi Meter	Fluke	77	35053830	10/21/15	10/21/17
Audio Analyzer	HP	8903B	3011A13084	1/23/16	1/23/18

*

EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT