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FCC PART 95
GMRS TRANSCEIVER
TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE KANSAS CITY MISSOURI 64120 USA
FCC ID	MMAMXT115
PRODUCT DESCRIPTION	MOBILE GMRS TRANSCEIVER
FCC STANDARD APPLIED	47 CFR § 95 Personal Radio Service Subpart A – General Mobile Radio Service (GMRS)
DATE SAMPLE RECEIVED	10/4/2016
FINAL TEST DATE	11/22/2016
TESTED BY	Tim Royer
APPROVED BY	Cory Leverett
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1998AUT16TestReport	Rev1	Initial Issue	10/12/2016
	Rev2	Added Audio Test Data	11/23/2016
	Rev3	Typographical Update	11/28/2016

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

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GENERAL REMARKS

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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

A blue ink signature of Tim Royer is written over a circular purple stamp. The stamp contains the text 'TIMCO ENGINEERING, INC.' around the perimeter and 'TESTING ENGINEER' in the center.

Tested by:

Name and Title: Tim Royer Project Manager/Testing Engineer

Date: 11/22/2016

A blue ink signature of Cory Leverett is written over a circular red stamp. The stamp contains the text 'TIMCO ENGINEERING, INC.' around the perimeter and 'ENGINEERING TECHNICIAN' in the center.

Reviewed and approved by:

Name and Title: Cory Leverett, Engineering Technician

Date: 11/23/2016

GENERAL INFORMATION
EUT Specification

EUT Description	MOBILE GMRS TRANSCEIVER
EUT Application	Portable short range communications
FCC ID	MMAMXT115
Serial Number	N/A
Operating Frequency	GMRS:462.5500-462.7250 MHz
Test Frequencies	GMRS: 462.5500, 467.7250 MHz
Type of Emission	11K0F3E
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 26°C 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: 11K0F3E

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 2.5K$$

$$B_n = 2(3000) + 2(2500) = 11K$$

GMRS Authorized Bandwidth 12.5 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

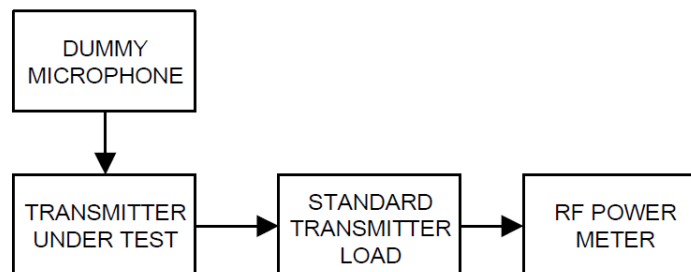
Rule Part No.: 2.1046(a), 95.639(a) (1)

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
462.5625	42.15	16.41	37.73	5.93
467.7250	41.94	15.63	37.92	6.19

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

FOR HIGH POWER SETTING INPUT POWER: (13.95V) (2.68A) = 37.39 Watts

FOR LOW POWER SETTING INPUT POWER: (13.95V) (1.28A) = 17.86 Watts

Results: Meets Requirements

MODULATION CHARACTERISTICS

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

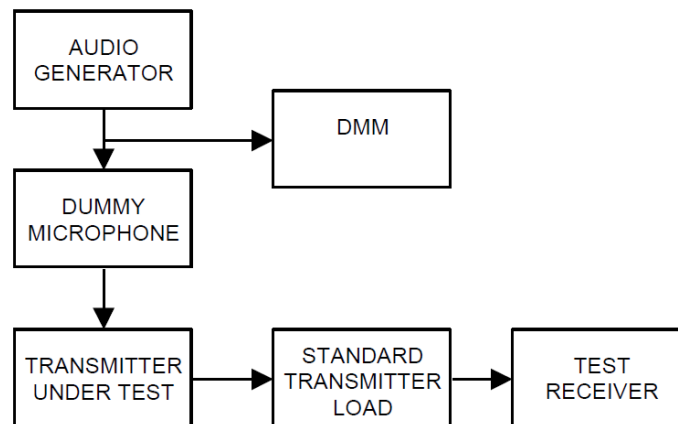
Requirements: A GMRS transmitter that transmits emission types F1D, G1D, or G3E must not exceed a peak frequency deviation of plus or minus 5 kHz. A GMRS transmitter that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 5 kHz

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 over modulation. 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 $60 \log_{10} (f/3)$ 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.

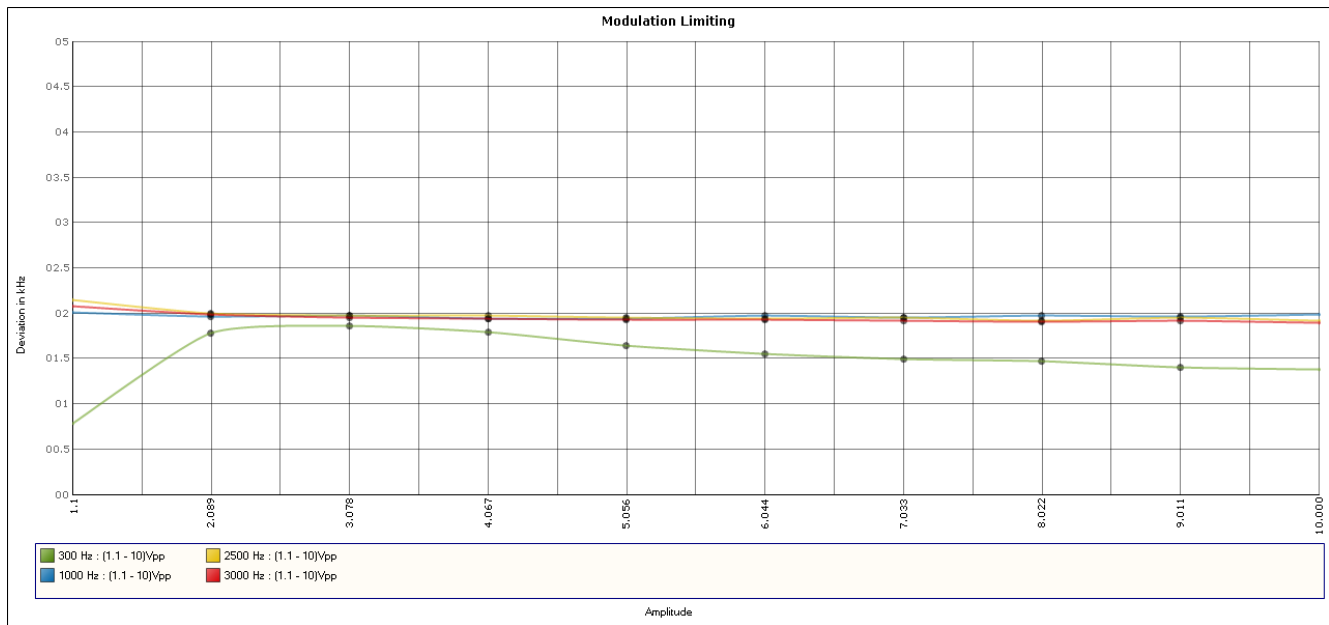
Test Procedure: TIA 603 section 2.2.3 Modulation Limiting
TIA 603 section 2.2.6 Audio Frequency Response
TIA 603 section 2.2.15 Audio Low Filter Response

Test Diagram:



MODULATION CHARACTERISTICS

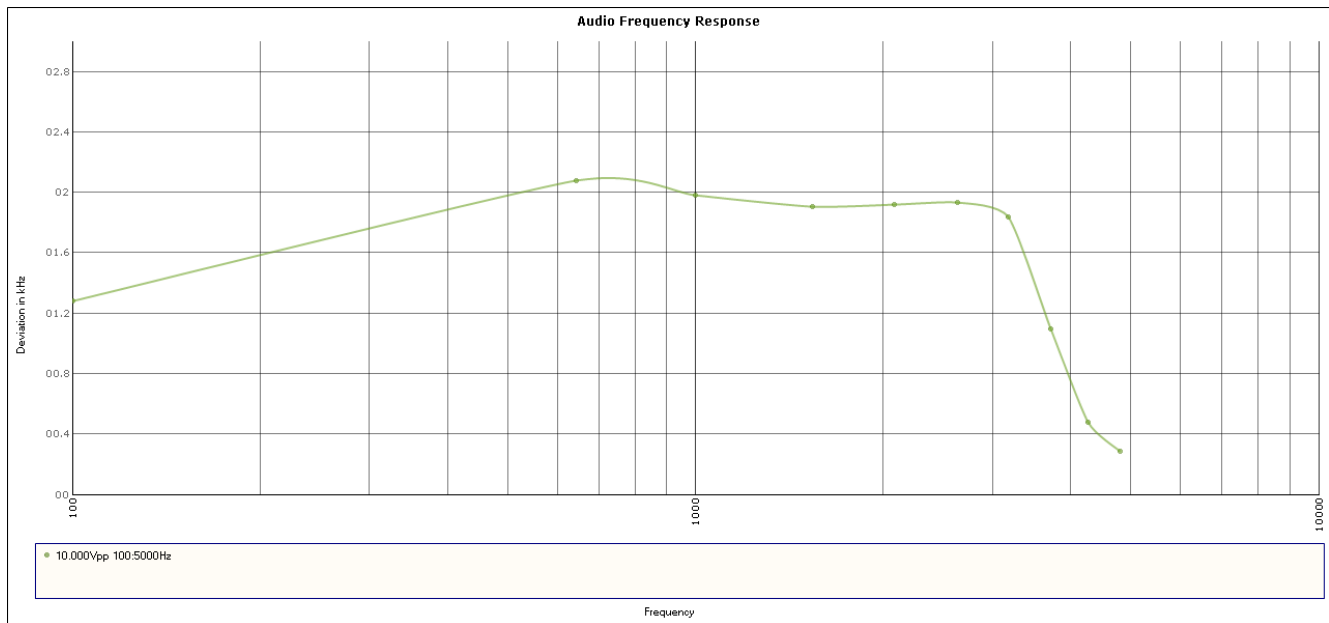
Test Data: 11K0F3E Modulation Limiting Plot



Results: Meets Requirements

MODULATION CHARACTERISTICS

Test Data: 11K0F3E Audio Frequency Response Plot



Results: Meets Requirements

MODULATION CHARACTERISITICS

Test Data: 11K0F3E Audio Low Filter Response Table

Audio Frequency (KHz)	Input Level (Vp-p)	Output Level (dB)	Att. Level (dB)	Output Limit (dB)	Margin (dB)
1	0.3	-11.26	0 dB Reference		
3	0.3	-18.21	6.95	0.0	7.0
4	0.3	-48.51	37.25	7.5	29.8
5	0.3	-51.65	40.39	13.3	27.1
6	0.3	-69.21	57.95	18.1	39.9
7	0.3	-69.21	57.95	22.1	35.9
8	0.3	-69.21	57.95	25.6	32.4
9	0.3	-69.21	57.95	28.6	29.3
12	0.3	-69.21	57.95	36.1	21.8
15	0.3	-69.21	57.95	41.9	16.0
20	0.3	-69.21	57.95	49.4	8.5
25	0.3	-69.21	57.95	50.0	8.0
30	0.3	-69.21	57.95	50.0	8.0
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.			

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).

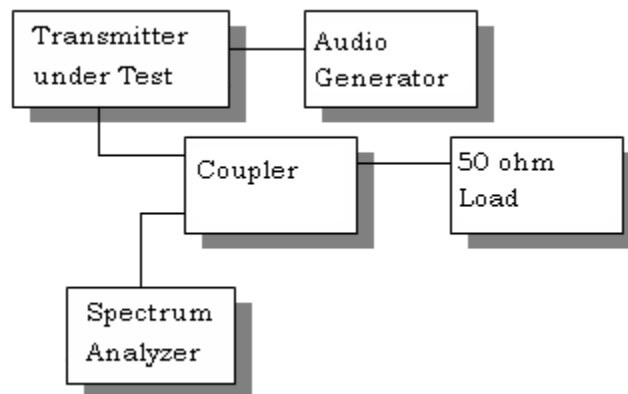
(1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

(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%

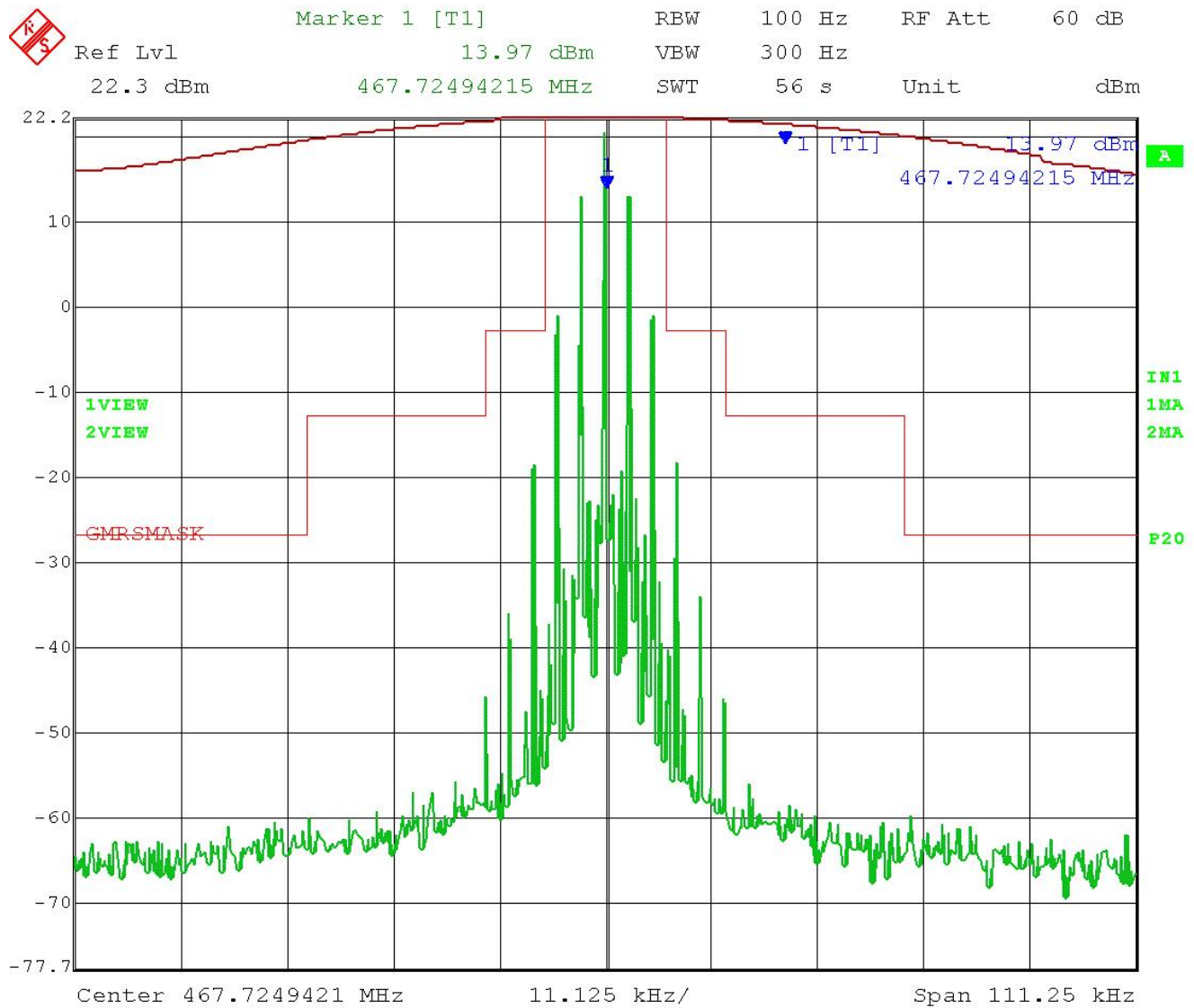
Test Procedure: TIA-603 section 2.2.11 Sideband Spectrum

Test Diagram:



OCCUPIED BANDWIDTH

Test Data: 11K0F3E High Power Plot

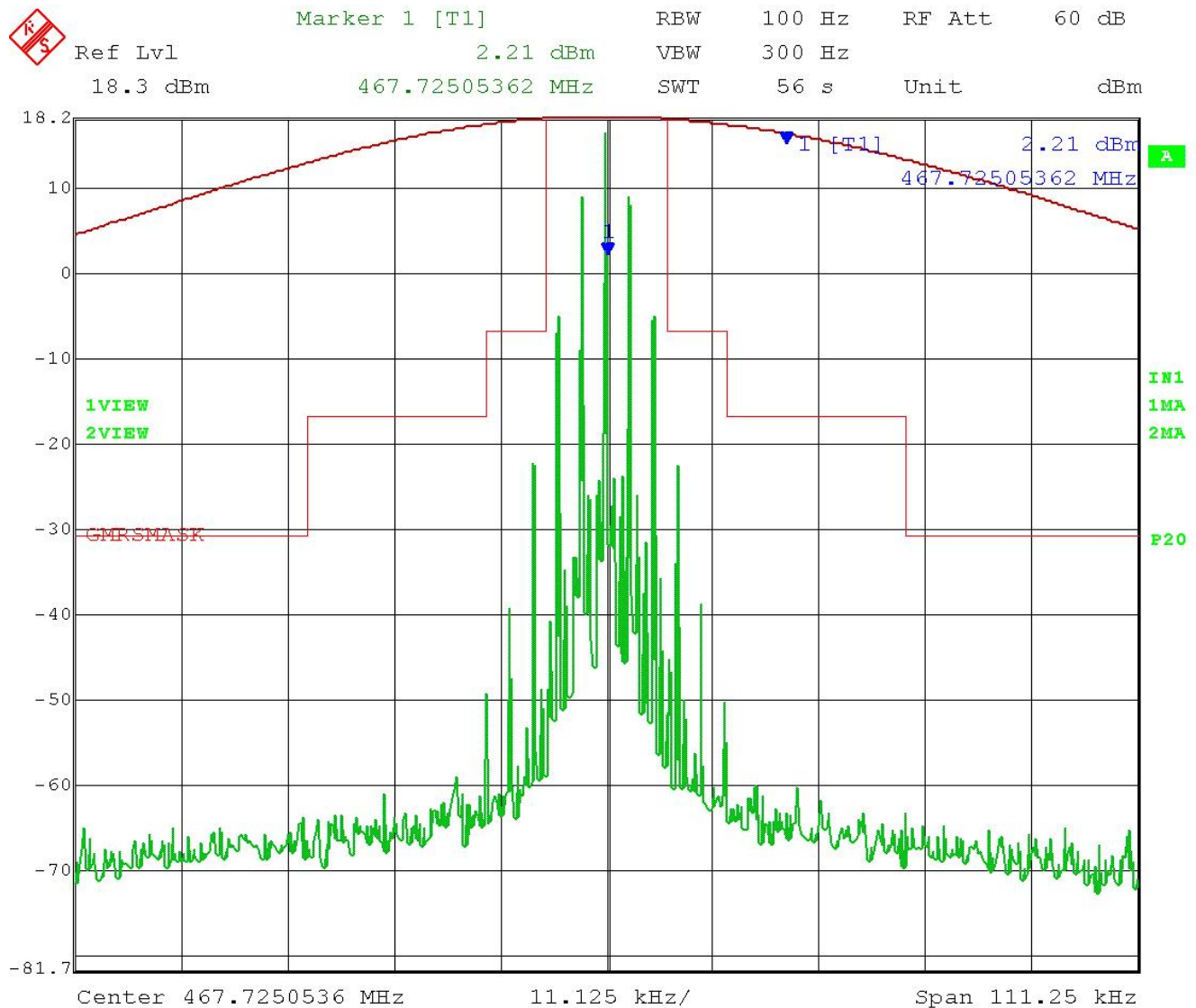


Date: 24.OCT.2016 13:11:48

Results: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: 11K0F3E Low Power Plot



Date: 24.OCT.2016 13:06:32

Results: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

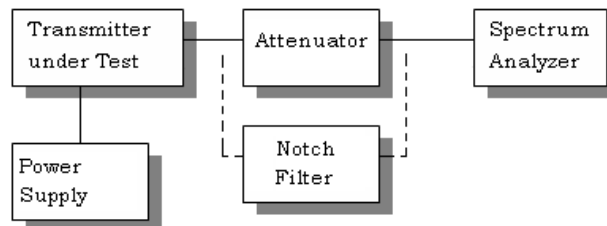
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

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: 11K0F3E High Power Low End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	41.06	12.76	54.06
	Frequency (MHz)	Level (dBc)	Margin (dB)
	462.56	0	0.0
	925.13	72.3	18.2
	1387.69	72.1	18.0
	1850.25	74.9	20.8
	2312.81	92.8	38.7
	2775.38	96.6	42.5
	3237.94	76.5	22.4
	3700.50	88.8	34.7
	4163.06	92.7	38.6
	4625.63	87.2	33.1

Note: * indicates Noise floor

Test Data: 11K0F3E Low Power Low End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	36.64	4.61	49.64
	Frequency (MHz)	Level (dBc)	Margin (dB)
	462.56	0	0.0
	925.13	70.7	21.1
	1387.69	78.2	28.6
	1850.25	76.7	27.1
	2312.81	102.1	52.5
	2775.38	99.3	49.7
	3237.94	85.2	35.6
	3700.50	96.8	47.2
	4163.06	96.8	47.2
	4625.63	89.7	40.1

Note: * indicates Noise floor

Results: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: 11K0F3E High Power High End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	41.51	14.16	54.51
	Frequency (MHz)	Level (dBc)	Margin (dB)
	467.73	0	0.0
	935.45	72.9	18.4
	1403.18	72.7	18.2
	1870.90	74.5	20.0
	2338.63	94.7	40.2
	2806.35	99.6	45.1
	3274.08	76.3	21.8
	3741.80	84.7	30.2
	4209.53	91.1	36.6
	4677.25	87.5	33.0

Note: * indicates Noise floor

Test Data: 11K0F3E Low Power High End of Band Measurement Table

	dBm	Watts	Limit (dBc)
Power Output	37.23	5.28	50.23
	Frequency (MHz)	Level (dBc)	Margin (dB)
	467.73	0	0.0
	935.45	71.5	21.3
	1403.18	79.3	29.1
	1870.90	80.1	29.9
	2338.63	99.8	49.6
	2806.35	98.1	47.9
	3274.08	87.2	37.0
	3741.80	93.7	43.5
	4209.53	94.5	44.3
	4677.25	87.9	37.7

Note: * indicates Noise floor

Results: Meets Requirements

FIELD STRENGTH OF SPURIOUS EMISSIONS

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

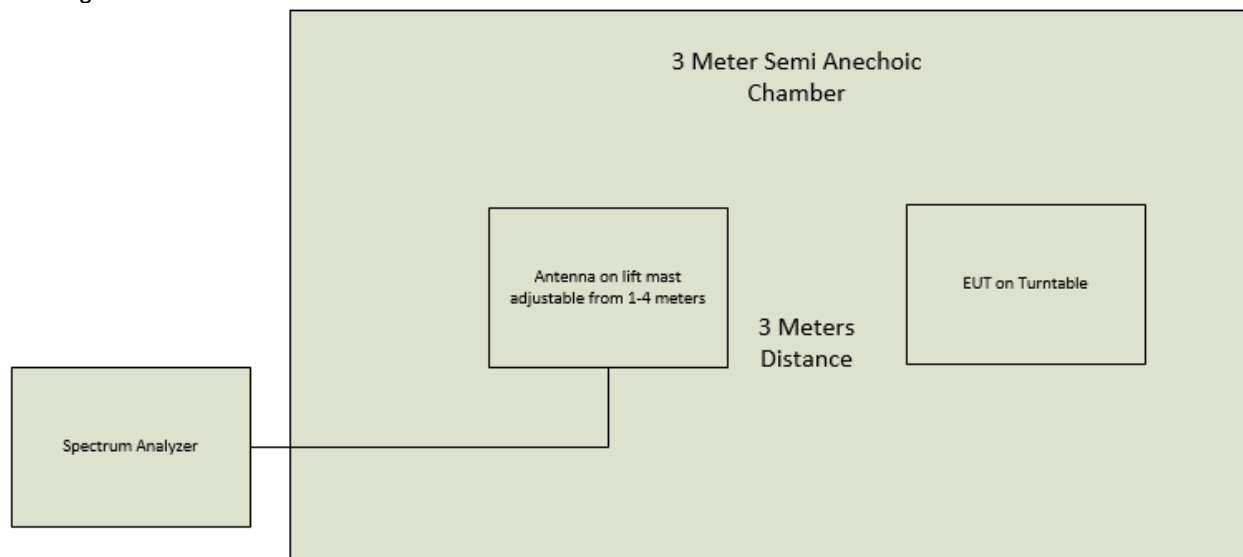
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

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: 11K0F3E High Power Low End of Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	FCC Requirement dB	Bandwidth - BW - kHz
467.72	Hi	41.51	14.16	54.51	25.00

Emission Frequency (MHz)	Ant. Polarity	Below Carrier (dBc)	Margin dB
935.45	V	97.03	42.52
1,403.18	H	75.30	20.79
1,870.90	H	70.55	16.04
2,338.63	V	87.10	32.59
2,806.35	H	87.03	32.52
3,274.08	V	68.99	14.48
3,741.80	H	59.20	4.69
4,209.53	H	68.27	13.76
4,677.25	V	62.80	8.29

These test results represent the worst case.

Results Meet Requirements

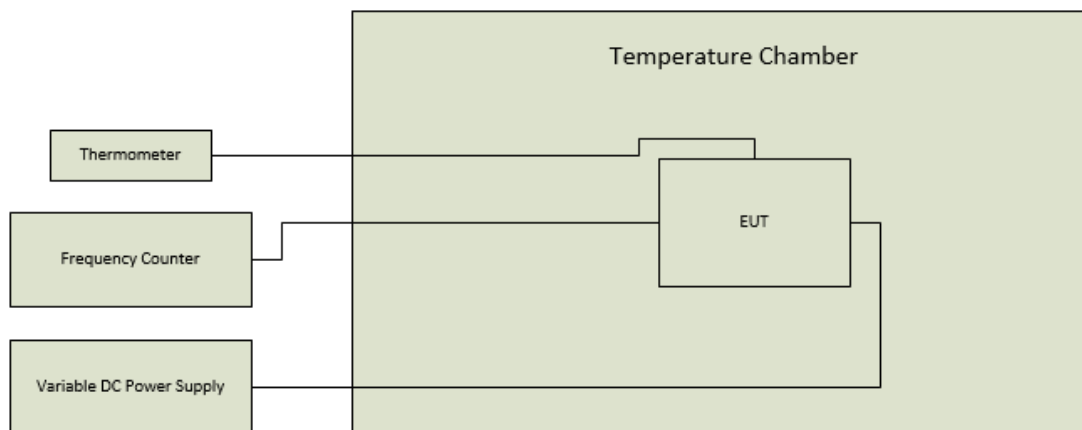
FREQUENCY STABILITY

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: 11K0F3E High End of Band

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	467725123	0	0.000
-30°C	467723660	1463000000	3.128
-20°C	467724190	933000000	1.995
-10°C	467724670	453000000	0.969
0°C	467725117	6000000	0.013
10°C	467725220	-97000000	-0.207
20°C	467725201	-78000000	-0.167
30°C	467725131	-8000000	-0.017
40°C	467725073	50000000	0.107
50°C	467724949	174000000	0.372
Battery Voltage	Frequency	Cycles	PPM
11.56	467725125	-2000000	-0.004
13.6	467725123	0	0.000
15.64	467725125	-2000000	-0.004

Results: Meets Requirements



EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
12 Volt Power Supply	Astron	VS-50M	9001191	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
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 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
Modulation Analyzer	HP	8901A	3050A05856	04/16/15	04/16/17
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-0244-01; KMKM-0670-00; KFKF-0198-01	08/08/16	08/08/18
Function Generator	Standford	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

EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT