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FCC PART 95

GMRS TRANSCEIVER TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE KANSAS CITY MISSOURI 64120-2134 USA
FCC ID	MMAMXT275
PRODUCT DESCRIPTION	MOBILE GMRS TRANSCEIVER
FCC STANDARD APPLIED	47 CFR § 95 Personal Radio Service Subpart A – General Mobile Radio Service (GMRS)
DATE SAMPLE RECEIVED	8/9/2017
FINAL TEST DATE	8/29/2017
TESTED BY	Tim Royer
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1459AUT17TestReport	Rev1	Initial Issue	8/31/2017
	Rev2	Modulation Characteristics Updated and clerical changes.	9/15/2017
	Rev3	Modulation Characteristics, OBW updated and clerical changes pertaining to Low Pass filtering.	9/18/2017

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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: Tim Royer, Project Manager/Testing Engineer

Date: 9/15/2017



Reviewed and approved by:

Name and Title: Sid Sanders, Engineer

Date: 9/15/2017

GENERAL INFORMATION

EUT Specification

EUT Description	MOBILE GMRS TRANSCEIVER
EUT Application	Portable short range communications
FCC ID	MMAMXT275
Serial Number	N/A
Operating Frequency	GMRS:462.5500-462.7250 MHz, 467.5500-467.7250 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 13.8V
	☐ 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)(5)(6)(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**

$B_n = 2M + 2DK$

$M = 3000$

$D = 2.5K$

$B_n = 2(3000) + 2(2500) = \mathbf{11K}$

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	

Result: Meets Requirements

RF POWER OUTPUT

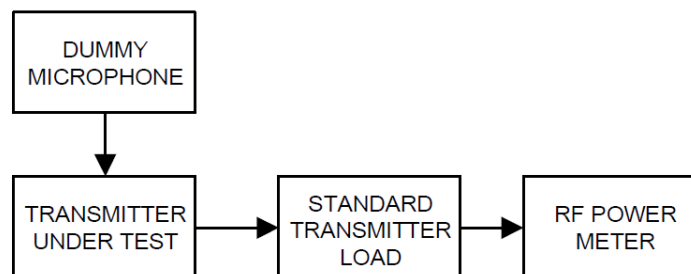
Rule Part No.: 2.1046(a), 95.639(a) (1)

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
462.550 *	X		37.69	5.87
467.725	42.44	17.54	37.71	5.90

*Device is not designed to transmit at High Power in Low-End of Band

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

FOR HIGH POWER SETTING INPUT POWER: (13.8V) (2.82A) = **38.916 Watts**

FOR LOW POWER SETTING INPUT POWER: (13.8V) (1.28A) = **17.664 Watts**

Result: Meets Requirements

MODULATION CHARACTERISTICS

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

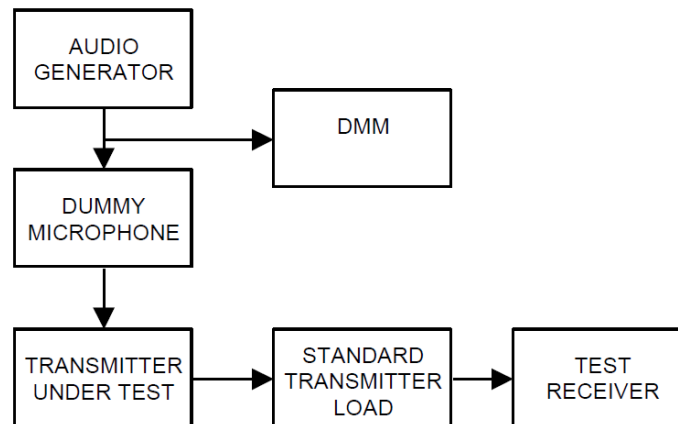
Requirements: A GMRS transmitter that transmits emission types F1D, G1D, or G3E must not exceed a peak frequency deviation of plus or minus 5 kHz. A GMRS transmitter that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 5 kHz

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.

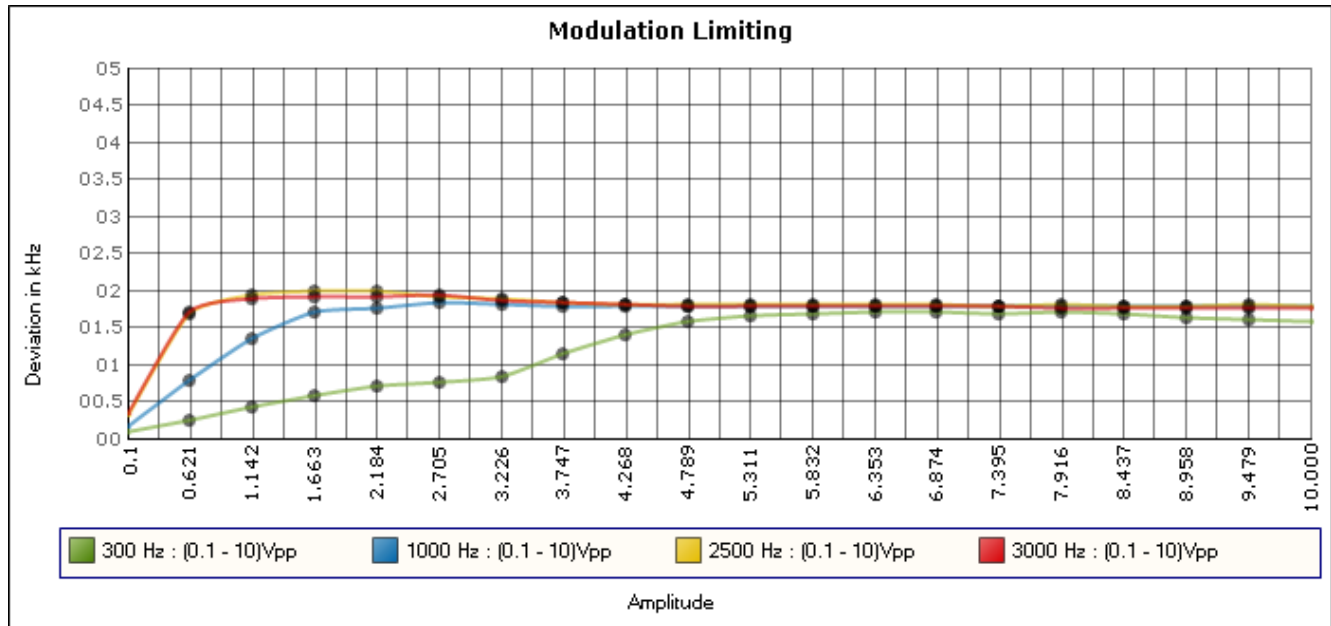
Test Procedure: TIA 603 section 2.2.3 Modulation Limiting
TIA 603 section 2.2.6 Audio Frequency Response
TIA 603 section 2.2.15 Audio Low Filter Response

Test Diagram:



MODULATION CHARACTERISTICS

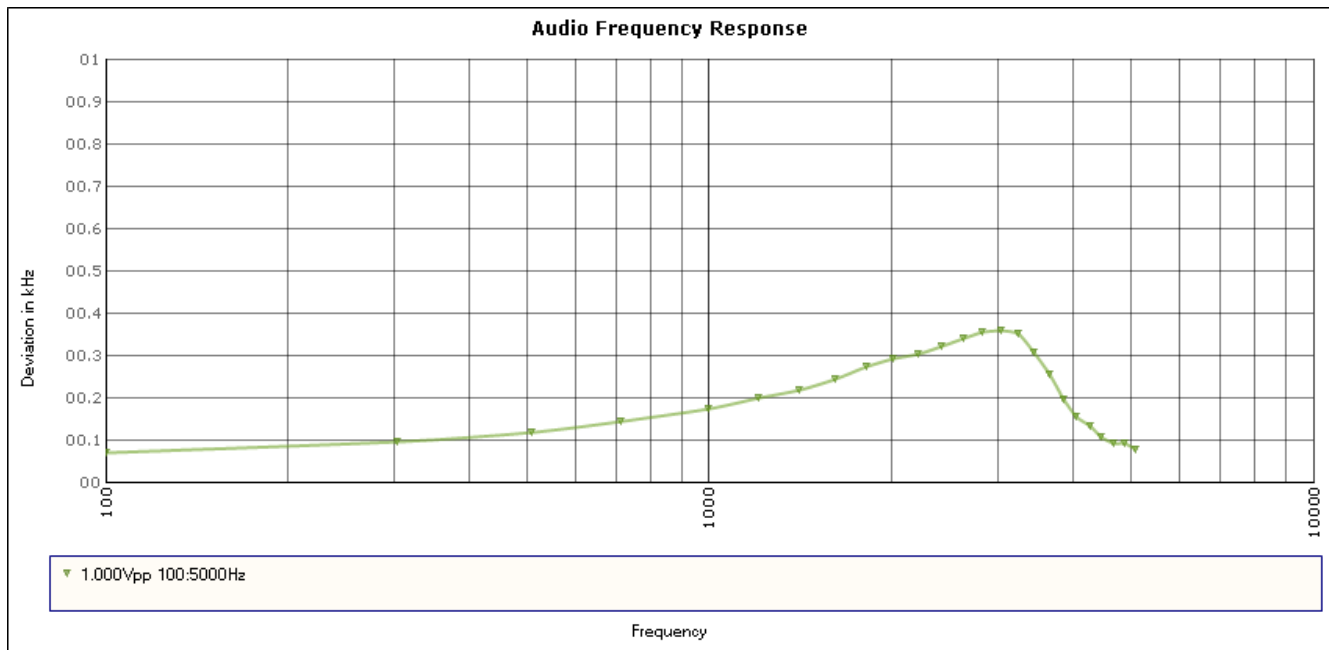
Test Data: 11K0F3E Modulation Limiting Plot



Result: Meets Requirements

MODULATION CHARACTERISTICS

Test Data: 11K0F3E Audio Frequency Response Plot



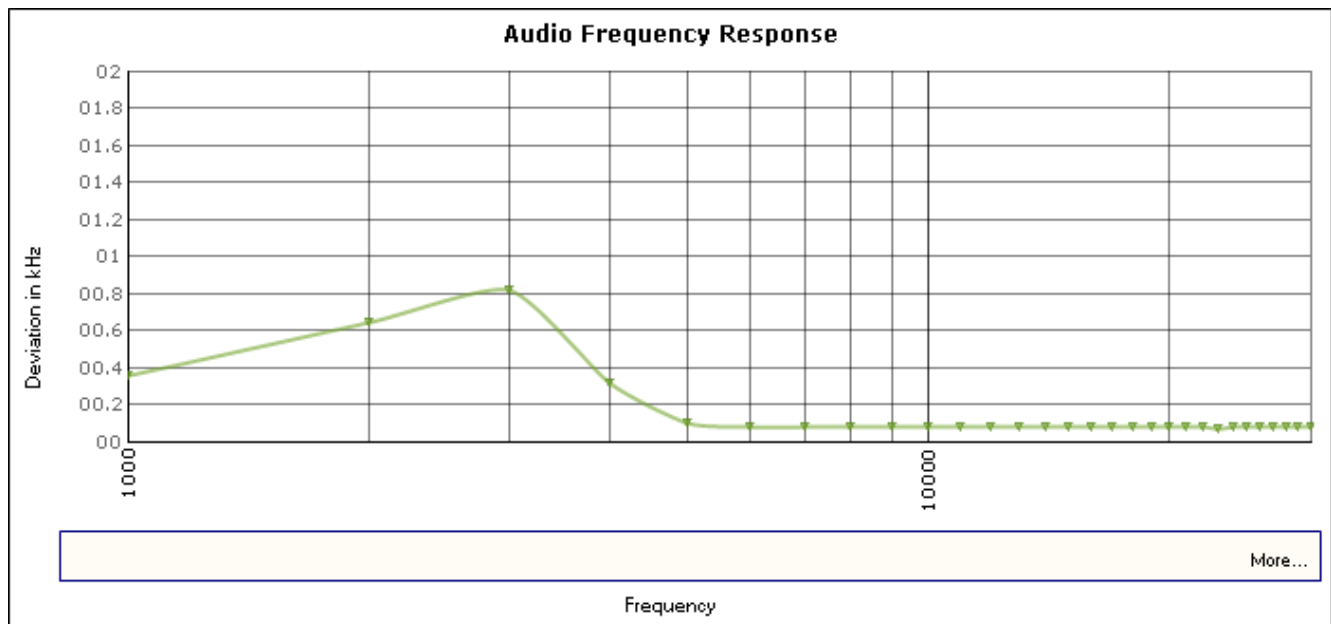
Result: Meets Requirements

MODULATION CHARACTERISTICS

Test Data: 11K0F3E Audio Low Pass Filter Response

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, unless it complies with the applicable paragraphs of §95.631 (without 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 Data: 11K0F3E Low Pass Filter Plot



NOTE: Data is for reporting only. Device complies with the applicable paragraphs of §95.631 (without filtering.)

OCCUPIED BANDWIDTH

Rule Part No.: 2.1049(c) (1), 95.633(a), 95.635(b) (5) (6) (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).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (7).

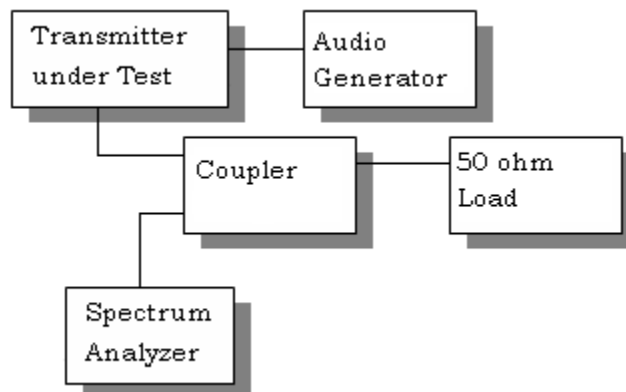
(5) At least $83 \log_{10} (f_d/5)$ dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz), of more than 5 kHz up to and including 10 kHz.

(6) At least $116 \log_{10} (f_d/6.1)$ dB, or if less, $50 + 10 \log_{10} (T)$ dB, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz), of more than 10 kHz 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%.

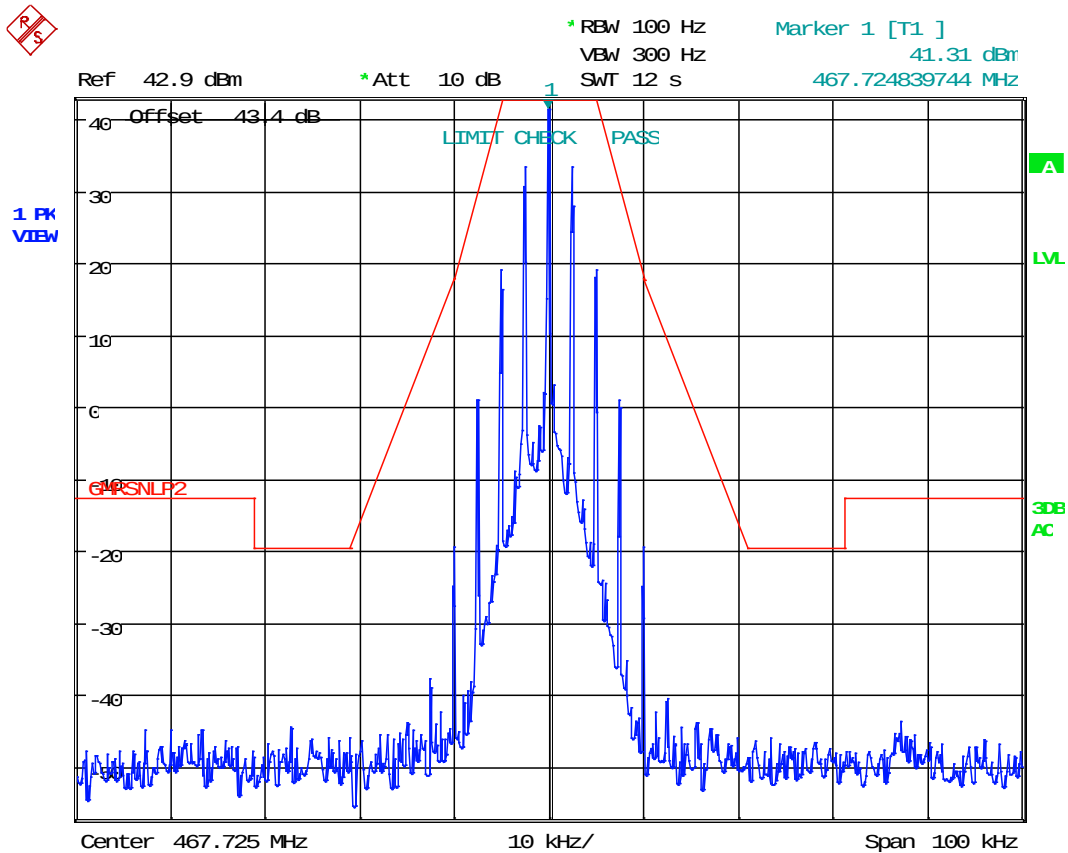
Test Procedure: TIA-603 section 2.2.11 Sideband Spectrum

Test Diagram:



OCCUPIED BANDWIDTH

Test Data: 11K0F3E High Power Plot

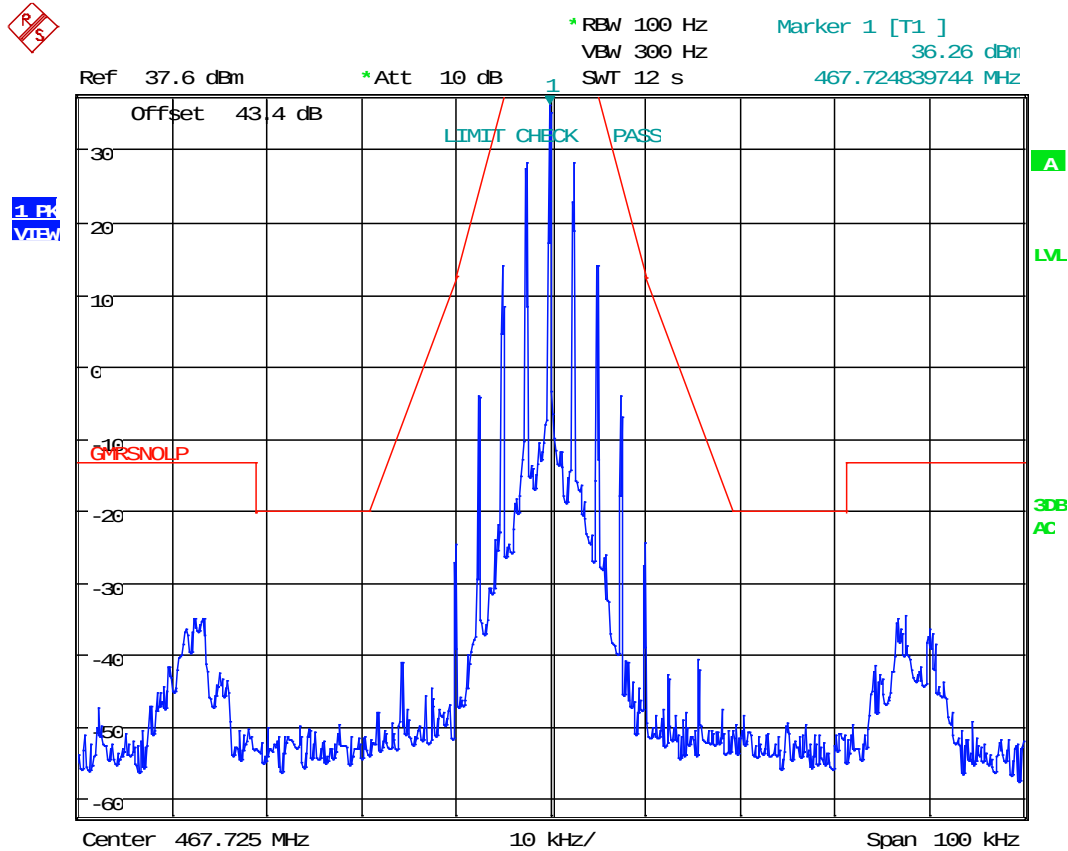


Date: 21.SEP.2017 11:40:25

Result: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: 11K0F3E Low Power Plot



Date: 21.SEP.2017 11:46:07

Result: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

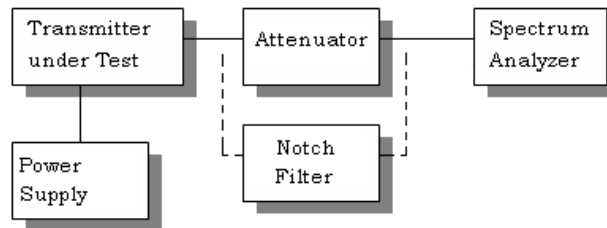
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (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 Low Power Low End of Band Measurement Table

Power Output	dBm		Watts	Limit (dBc)
	37.69		5.87	50.69

Frequency		dBc	Margin
462.550		0.00	0.00
925.100		58.51	7.82
1387.650		64.26	13.57
1850.200	*	67.48	16.79
2312.750	*	67.48	16.79
2775.300	*	67.48	16.79
3237.850	*	67.48	16.79
3700.400	*	67.48	16.79
4162.950	*	67.48	16.79
4625.500	*	67.48	16.79

Note: * indicates Noise floor

Result: Meets Requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

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

Power Output	dBm		Watts	Limit (dBc)
	42.44		17.54	55.44

Frequency		dBc	Margin
467.725		0.00	0.00
935.450		81.31	25.87
1403.175		80.75	25.31
1870.900	*	82.78	27.34
2338.625	*	88.11	32.67
2806.350	*	88.11	32.67
3274.075		78.97	23.53
3741.800	*	79.24	23.80
4209.525	*	85.90	30.46
4677.250		82.51	27.07

Note: * indicates Noise floor

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

Power Output	dBm		Watts	Limit (dBc)
	37.71		5.90	50.71

Frequency		dBc	Margin
467.725		0.00	0.00
935.450		77.09	26.38
1403.175		76.09	25.38
1870.900	*	80.04	29.33
2338.625	*	83.38	32.67
2806.350	*	83.38	32.67
3274.075		75.37	24.66
3741.800	*	77.77	27.06
4209.525	*	81.17	30.46
4677.250		78.98	28.27

Note: * indicates Noise floor

Result: Meets Requirements

Applicant: MIDLAND RADIO CORPORATION
 FCC ID: MMAMXT275
 Report: 1459AUT17TestReport_Rev3

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FIELD STRENGTH OF SPURIOUS EMISSIONS

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

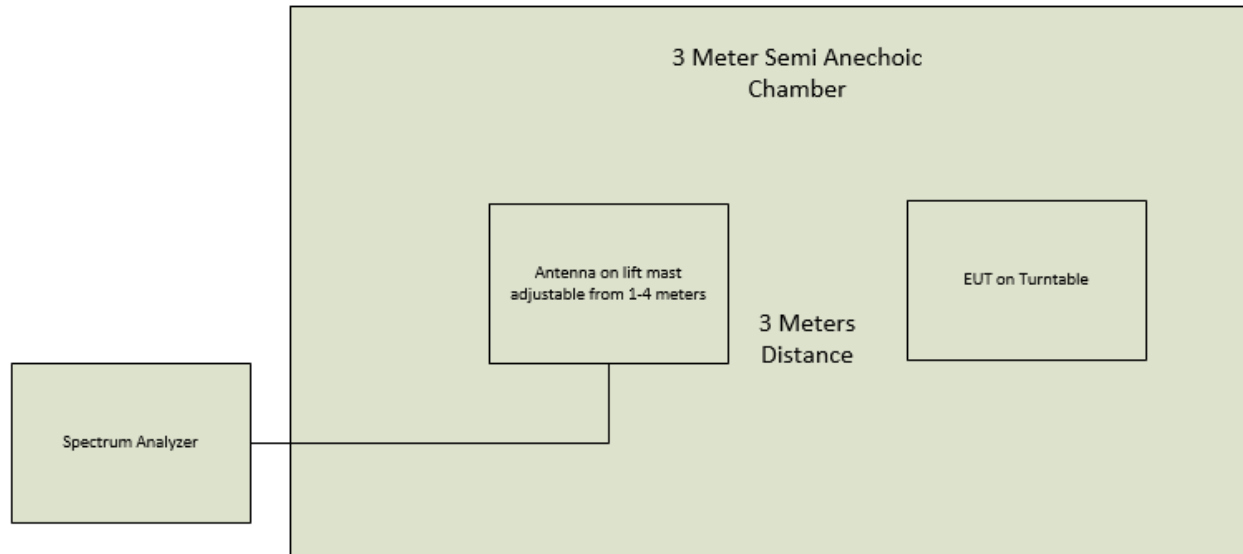
Requirements: The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (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 Low Power Low End of Band

Power Output	dBm	Watts	Limit (dB)
	37.69	5.87	50.69

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBm)	Margin
462.55	4625.50	H	-26.6994	13.70
462.55	4162.95	V	-27.6606	14.66
462.55	3237.85	V	-27.7445	14.74
462.55	3237.85	H	-27.9145	14.91
462.55	4625.50	V	-28.2894	15.29
462.55	2775.30	H	-28.3869	15.39
462.55	2775.30	V	-29.9669	16.97
462.55	3700.40	H	-30.1467	17.15
462.55	3700.40	V	-30.2367	17.24
462.55	4162.95	H	-31.0706	18.07
462.55	2312.75	H	-31.7307	18.73
462.55	2312.75	V	-32.4906	19.49
462.55	1850.20	H	-34.8272	21.83
462.55	1387.65	H	-35.0771	22.08
462.55	1387.65	V	-36.0171	23.02
462.55	1850.20	V	-36.1372	23.14
462.55	925.10	V	-41.8472	28.85
462.55	925.10	H	-44.3072	31.31

Note: These test results represent the worst case.

Result: Meets Requirements

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 High End of Band

Power Output	dBm	Watts	Limit (dB)
	42.44	17.54	55.44

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBm)	Margin
467.73	4677.30	H	-26.8731	13.87
467.73	3274.11	V	-27.1528	14.15
467.73	4209.57	V	-27.9186	14.92
467.73	2806.38	H	-27.9502	14.95
467.73	4677.30	V	-28.0531	15.05
467.73	3274.11	H	-28.1428	15.14
467.73	3741.84	H	-29.2970	16.30
467.73	4209.57	H	-29.3586	16.36
467.73	3741.84	V	-29.7270	16.73
467.73	2338.65	V	-30.9870	17.99
467.73	2806.38	V	-31.0902	18.09
467.73	1870.92	V	-32.1472	19.15
467.73	2338.65	H	-32.3670	19.37
467.73	1870.92	H	-33.2272	20.23
467.73	1403.19	H	-37.6921	24.69
467.73	935.45	V	-38.1018	25.10
467.73	935.45	H	-38.5518	25.55
467.73	1403.19	V	-38.8521	25.85

Note: These test results represent the worst case.

Result: Meets Requirements

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 Low Power Low End of Band

Power Output	dBm	Watts	Limit (dB)
	37.69	5.87	50.69

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBm)	Margin
467.73	935.45	H	-39.90	26.90
467.73	935.45	V	-39.23	26.23
467.73	4677.30	V	-26.50	13.50
467.73	4677.30	H	-27.19	14.19
467.73	4209.57	H	-28.01	15.01
467.73	4209.57	V	-29.40	16.40
467.73	3741.84	V	-29.73	16.73
467.73	3741.84	H	-28.87	15.87
467.73	3274.11	H	-28.92	15.92
467.73	3274.11	V	-27.28	14.28
467.73	2806.38	V	-30.36	17.36
467.73	2806.38	H	-29.76	16.76
467.73	2338.65	H	-32.64	19.64
467.73	2338.65	V	-30.94	17.94
467.73	1870.92	V	-35.62	22.62
467.73	1870.92	H	-33.37	20.37
467.73	1403.19	H	-39.51	26.51
467.73	1403.19	V	-38.91	25.91

Note: These test results represent the worst case.

Result: Meets Requirements

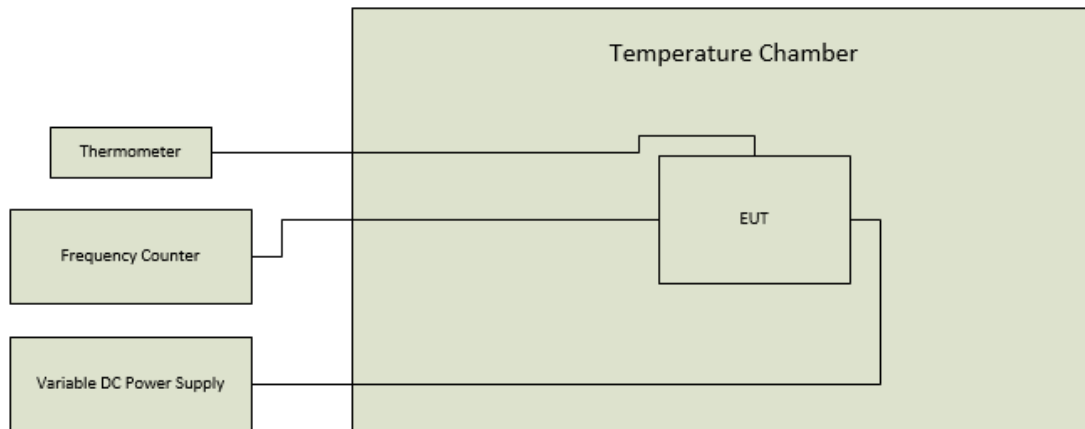
FREQUENCY STABILITY

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 Low End of Band

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	462.56193	0	0.000
-30°C	462.5618	130	0.281
-20°C	462.56195	-20	-0.043
-10°C	462.56201	-80	-0.173
0°C	462.56199	-60	-0.130
10°C	462.56181	120	0.259
20°C	462.56173	200	0.432
30°C	462.5616	330	0.713
40°C	462.56152	410	0.886
50°C	462.55984	2090	4.518

Battery Voltage	Frequency	Cycles	PPM
11.56	462.56192	10	0.022
13.6	462.56193	0	0.000
15.64	462.56193	0	0.000

Result: Meets Requirements

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal / Char Date	Due Date
Attenuator BNC 6dB 50Ohm DC- 2G	Mini-Circuits	HAT-6+	#53	07/14/17	07/14/19
Attenuator BNC 10dB 50Ohm DC- 2G	Mini-Circuits	HAT-10+	#55	07/14/17	07/14/19
Attenuator N 30dB 100W DC- 6G	Pasternack	PE7214-30	#109	05/24/17	05/23/19
Attenuator N 3dB 20W DC-4G	Narda	766-3	#5	07/10/17	07/10/19
Attenuator N 10dB 20W DC-4G	Narda	766-10	0010	05/17/17	05/17/19
Coaxial Cable #100 – NMNM- 0180-00 Aqua	Micro-Coax	UFB311A-0-0720- 50U50U	225362-001 (#100)	07/14/16	07/14/18
Coaxial Cable – BMBM-0131-00 Silver	Belden	N/A	BMBM-0131-00	02/17/17	02/17/19
Coaxial Cable – BMBM-0065-01 Black DC-2G	Belden	N/A	BMBM-0065-01	07/18/16	07/18/18
DC Power Supply	HP	6286A	1744A03842	N/A	N/A
Antenna: Biconical 1057	Eaton	94455-1	1057	11/18/15	11/18/17
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
DC Power Supply	HP	6286A	2411A09414	N/A	N/A
CHAMBER	Panashield	3M	N/A	04/25/16	12/31/17
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	11/18/15	11/18/17
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17
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	04/01/18
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01; KMKM-0670-00; KFKF-0198-01	08/09/16	08/09/18
Function Generator	Standford	DS340	25200	02/02/16	02/02/18
Terminator N 20W DC-18G	Narda	8205	#14	04/06/17	04/06/19
Tunable Notch Filter 250-850 MHz	Eagle	TNF-200	250-850 MHz (#19)	06/26/15	09/26/17

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT

Applicant: MIDLAND RADIO CORPORATION
 FCC ID: MMAMXT275
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