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Test report No.:
KES-RF-15T0067
Page (1) of (32)

TEST REPORT

Part 95(A/B)

Equipment under test GMRS / FRS 2-way Radio

Model name LXT535PA

FCC ID MMALXT535PA

Applicant Midland Radio Corporation

Manufacturer Global Link Corporation Ltd.

Date of test(s) 2015.08.28~2015.09.02

Date of issue 2015.09.07

Issued to

Midland Radio Corporation

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Test and report completed by :	Report approval by :
	
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The test results in the report only apply to the tested sample.



Revision history

Revision	Date of issue	Test report No.	Description
-	2015.09.07	KES-RF-15T0067	Initial



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1. General information

Applicant: Midland Radio Corporation
Applicant address: 5900 Parretta Drive, Kansas City, Missouri United States 64120
Test site: KES Co., Ltd.
Test site address: C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
473-29, Gayeo-ro, Yeosu-si, Gyeonggi-do, 126-58, Korea
FCC rule part(s): FCC Part 95
Model: LXT535PA
FCC ID: MMALXT535PA
Test device serial No.: ☐ Production ☒ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test FRS / GMRS
Serial number N/A
Frequency range 462.562 5 MHz ~ 462.712 5 MHz (GMRS Channels 1 ~ 7)
467.562 5 MHz ~ 467.712 5 MHz (FRS Channels 8 ~ 14)
462.550 0 MHz ~ 462.725 0 MHz (GMRS Channels 15 ~ 22)
Type of Emission 11K0F3E
E.R.P. GMRS: 0.408 W(High power), 0.137 W(Low power) // FRS: 0.223 W
Number of channels 22
Power source Rechargeable Ni-MH battery pack(DC 4.8 V)

1.2. Test configuration

The GMRS / FRS 2-way Radio FCC ID: MMALXT535PA was tested per the guidance of ANSI C63.10-2009, ANSI/TIA 603D: 2010 was used to reference the appropriate EUT setup for radiated spurious emissions testing.

1.3. Frequency/channel operations

Mode	Ch.	Frequency (MHz)
GMRS	1	462.562 5
	2	462.587 5
	3	462.612 5
	4	462.637 5
	5	462.662 5
	6	462.687 5
	7	462.712 5
FRS	8	467.562 5
	9	467.587 5
	10	467.612 5
	11	467.637 5
	12	467.662 5
	13	467.687 5
	14	467.712 5
GMRS	15	462.550 0
	16	462.575 0
	17	462.600 0
	18	462.625 0
	19	462.650 0
	20	462.675 0
	21	462.700 0
	22	462.725 0

1.4. Information about derivative model

N/A

1.5. Device modifications

N/A

1.6. Conclusion of worst-case for each mode of representative channel respectively

The EUT has 2 type of mode (GMRS and FRS). Each conducted output power as following;

Mode	Channel No.	Frequency(MHz)	High / Low	Conducted output power	
				dBm	W
GMRS	1	462.562 5	High	28.01	0.632
			Low	23.35	0.216
	2	462.587 5	High	28.13	0.650
			Low	23.33	0.215
	3	462.612 5	High	28.13	0.650
			Low	23.36	0.217
	4	462.637 5	High	28.08	0.643
			Low	23.37	0.217
	5	462.662 5	High	27.98	0.628
			Low	23.34	0.216
	6	462.687 5	High	28.09	0.644
			Low	23.41	0.219
	7	462.712 5	High	28.10	0.646
			Low	23.47	0.222
FRS	8	467.562 5	N/A	23.36	0.217
	9	467.587 5		23.40	0.219
	10	467.612 5		23.34	0.216
	11	467.637 5		23.37	0.217
	12	467.662 5		23.39	0.218
	13	467.687 5		23.40	0.219
	14	467.712 5		23.41	0.219
GMRS	15	462.550 0	High	28.13	0.650
			Low	23.31	0.214
	16	462.575 0	High	28.16	0.655
			Low	23.34	0.216
	17	462.600 0	High	28.17	0.656
			Low	23.41	0.219
	18	462.625 0	High	28.16	0.655
			Low	23.45	0.221
	19	462.650 0	High	28.02	0.634
			Low	23.52	0.225
	20	462.675 0	High	28.15	0.653
			Low	23.46	0.222
	21	462.700 0	High	28.18	0.658
			Low	23.50	0.224
	22	462.725 0	High	28.20	0.661
			Low	23.55	0.226

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Therefore all applicable requirements were tested to the two channels, the 22th for GMRS and the 14th for FRS.

DC input into the final amplifier

Mode	Voltage(V)	Current(A)	Power(W)
GMRS(High power)	4.8	0.57	2.74
GMRS(Low power)	4.8	0.41	1.97
FRS	4.8	0.39	1.87

2. Summary of tests

Reference	Test description	Test results
95.639	RF output power	PASS
95.635	Radiated spurious emissions	PASS
95.637	Modulation limiting	PASS
2.1047	Audio frequency response	PASS
95.637	Low-pass filter response	PASS
2.1049, 95.633, 95.635	Occupied bandwidth and emission mask	PASS
2.1055, 95.621, 95.627	Frequency stability	PASS

Note:

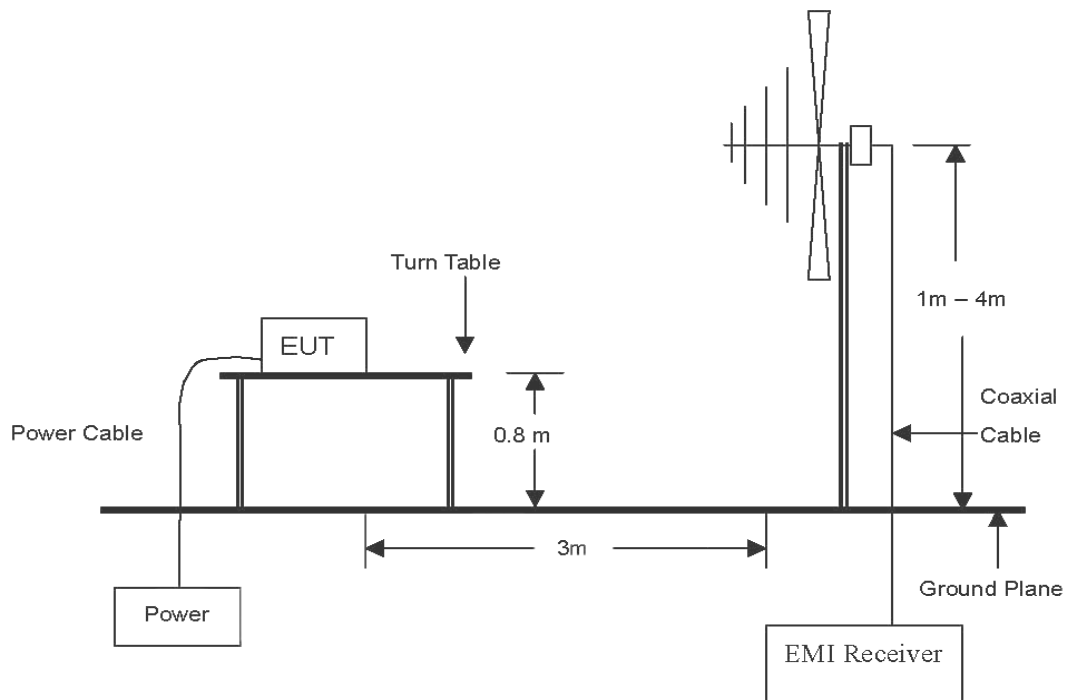
1. The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2009, ANSI/TIA 603D: 2010) were used in the measurement of the DUT.
2. All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.

3. Test results

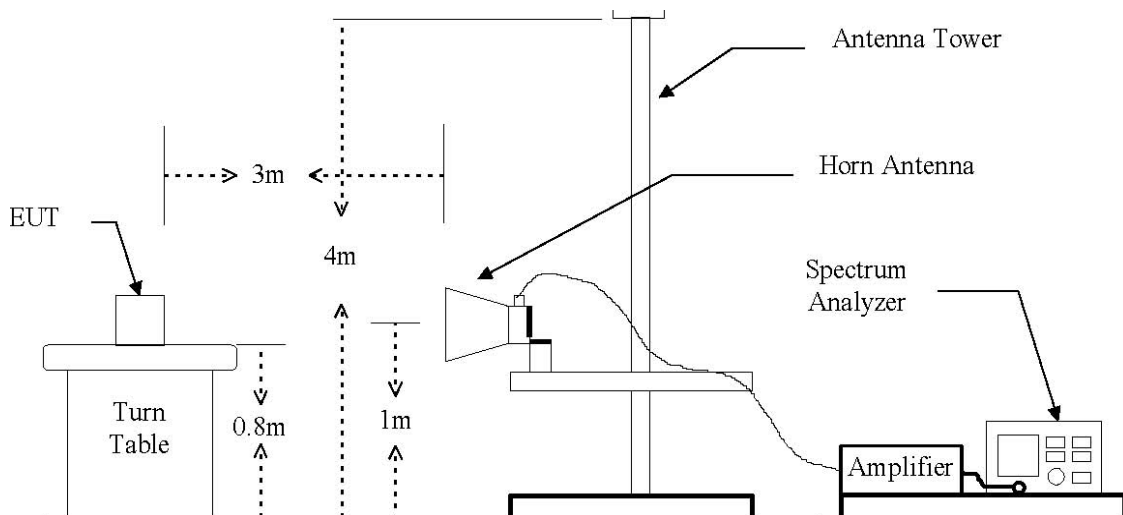
3.1. RF output power and radiated spurious emission

Test setup

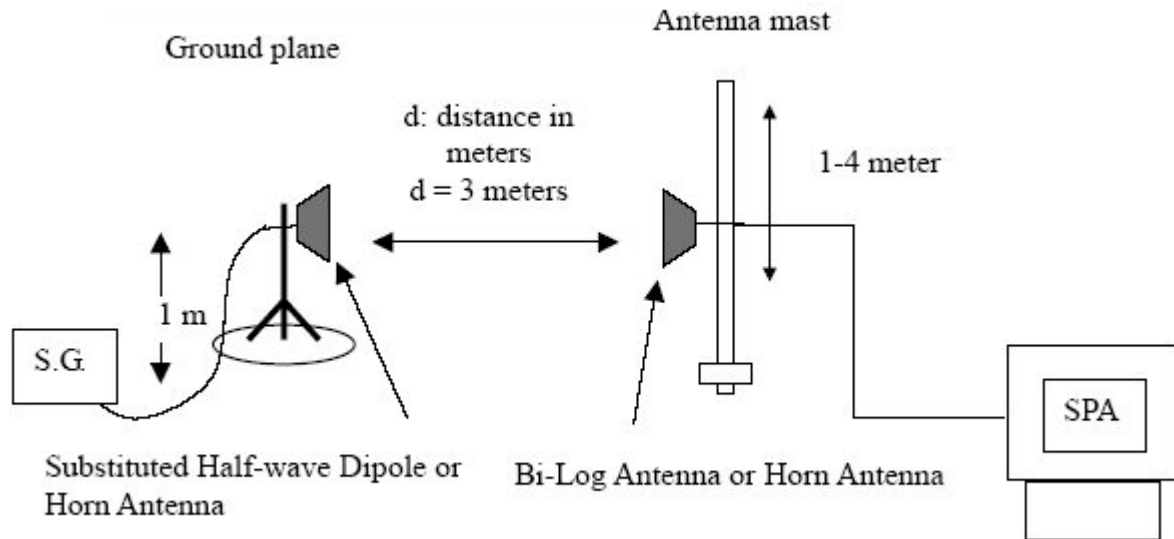
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 18 GHz Emissions.



The diagram below shows the test setup for substituted method



Test procedure: Based on ANSI/TIA 603D: 2010

RF output power & radiated spurious emissions

1. On a test site, the EUT shall be placed at 80 cm height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the fundamental frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used for the measurement.
4. During the measurement of the EUT, the resolution bandwidth was to 1 MHz and the video bandwidth was set to 1 MHz
5. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
6. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
7. The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
8. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
9. The maximum signal level detected by the measuring receiver shall be noted.
10. The EUT was replaced by half-wave dipole(below 1000 MHz) or horn antenna(above 1000 MHz) connected to a signal generator.
11. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
12. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
13. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
14. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
15. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

Limit

RF output power

§95.639

Power output shall not exceed 0.50 Watts effective radiated power for the FRS channels. There can be no provisions for increasing the power or varying the power.

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.

Radiated spurious emissions

§95.635

(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 results

RF output power

Mode: GMRS (High power)
Distance of measurement: 3 meter
Operating frequency: 462.725 0 MHz
Channel: 22

Frequency (MHz)	Ant. Pol. (H/V)	E.R.P.	
		(dBm)	(W)
462.725 0	H	16.15	0.041
462.725 0	V	26.11	0.408

Mode: GMRS (Low power)
Distance of measurement: 3 meter
Operating frequency: 462.725 0 MHz
Channel: 22

Frequency (MHz)	Ant. Pol. (H/V)	E.R.P.	
		(dBm)	(W)
462.725 0	H	12.34	0.017
462.725 0	V	21.38	0.137

Mode: FRS
Distance of measurement: 3 meter
Operating frequency: 467.712 5 MHz
Channel: 14

Frequency (MHz)	Ant. Pol. (H/V)	E.R.P.	
		(dBm)	(W)
467.7125	H	13.90	0.025
467.7125	V	23.49	0.223

Radiated spurious emissions

Mode: GMRS (High power)
Distance of measurement: 3 meter
Operating frequency: 462.725 0 MHz
Channel: 22

Frequency (MHz)	Ant. Pol. (H/V)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
925.450	H	57.33	39.11	18.22
925.450	V	57.13	39.11	18.02
1388.175	H	58.91	39.11	19.80
1388.175	V	51.15	39.11	12.04
1850.900	H	60.54	39.11	21.43
1850.900	V	52.62	39.11	13.51
2313.625	H	62.47	39.11	23.36
2313.625	V	67.65	39.11	28.54
2776.350	H	60.45	39.11	21.34
2776.350	V	60.01	39.11	20.90
3239.075	H	69.06	39.11	29.95
3239.075	V	69.23	39.11	30.12
3701.800	H	71.83	39.11	32.72
3701.800	V	66.79	39.11	27.68
4164.525	H	72.04	39.11	32.93
4164.525	V	71.97	39.11	32.86
4627.250	H	72.09	39.11	32.98
4627.250	V	72.84	39.11	33.73

Remark;

1. Spurious attenuation = EUT max. output power(dBm) - absolute level
2. Spurious attenuation limit in dB = $43 + 10\log(\text{power in watts})$

Mode: GMRS (Low power)
Distance of measurement: 3 meter
Operating frequency: 462.7250 MHz
Channel: 22

Frequency (MHz)	Ant. Pol. (H/V)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
925.450	H	60.71	34.38	26.33
925.450	V	60.42	34.38	26.04
1388.175	H	68.95	34.38	34.57
1388.175	V	62.65	34.38	28.27
1850.900	H	64.03	34.38	29.65
1850.900	V	56.40	34.38	22.02
2313.625	H	69.58	34.38	35.20
2313.625	V	65.88	34.38	31.50
2776.350	H	69.73	34.38	35.35
2776.350	V	72.54	34.38	38.16
3239.075	H	75.65	34.38	41.27
3239.075	V	76.76	34.38	42.38
3701.800	H	67.22	34.38	32.84
3701.800	V	61.63	34.38	27.25
4164.525	H	77.43	34.38	43.05
4164.525	V	76.18	34.38	41.80
4627.250	H	74.52	34.38	40.14
4627.250	V	74.38	34.38	40.00

Remark;

1. Spurious attenuation = EUT max. output power(dBm) - absolute level
2. Spurious attenuation limit in dB = 43 + 10log(power in watts)

Mode: FRS
Distance of measurement: 3 meter
Operating frequency: 467.7125 MHz
Channel: 14

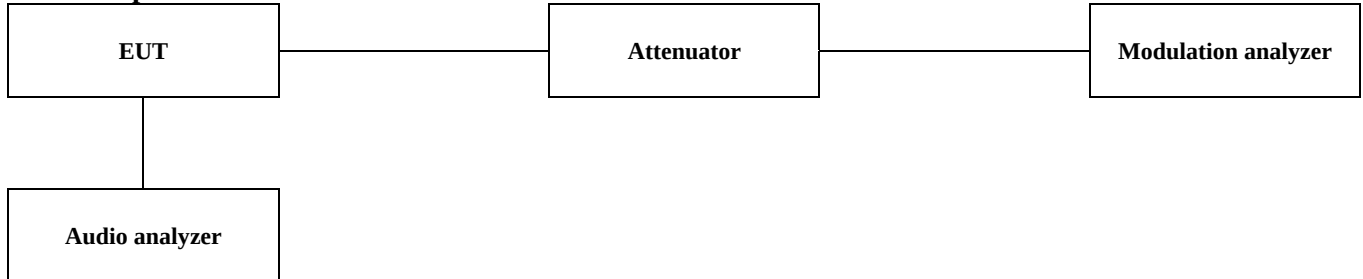
Frequency (MHz)	Ant. Pol. (H/V)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
935.425	H	64.89	36.49	28.40
935.425	V	62.45	36.49	25.96
1403.138	H	69.52	36.49	33.03
1403.138	V	66.20	36.49	29.71
1870.850	H	64.14	36.49	27.65
1870.850	V	59.83	36.49	23.34
2338.563	H	70.86	36.49	34.37
2338.563	V	67.53	36.49	31.04
2806.275	H	70.08	36.49	33.59
2806.275	V	71.62	36.49	35.13
3273.988	H	69.62	36.49	33.13
3273.988	V	71.98	36.49	35.49
3741.700	H	67.97	36.49	31.48
3741.700	V	63.04	36.49	26.55
4209.413	H	69.96	36.49	33.47
4209.413	V	70.46	36.49	33.97

Remark;

1. Spurious attenuation = EUT max. output power(dBm) - absolute level
2. Spurious attenuation limit in dB = 43 + 10log(power in watts)

3.2. Modulation limiting

Test setup



Test procedure

TIA/EIA-603-D

Limit

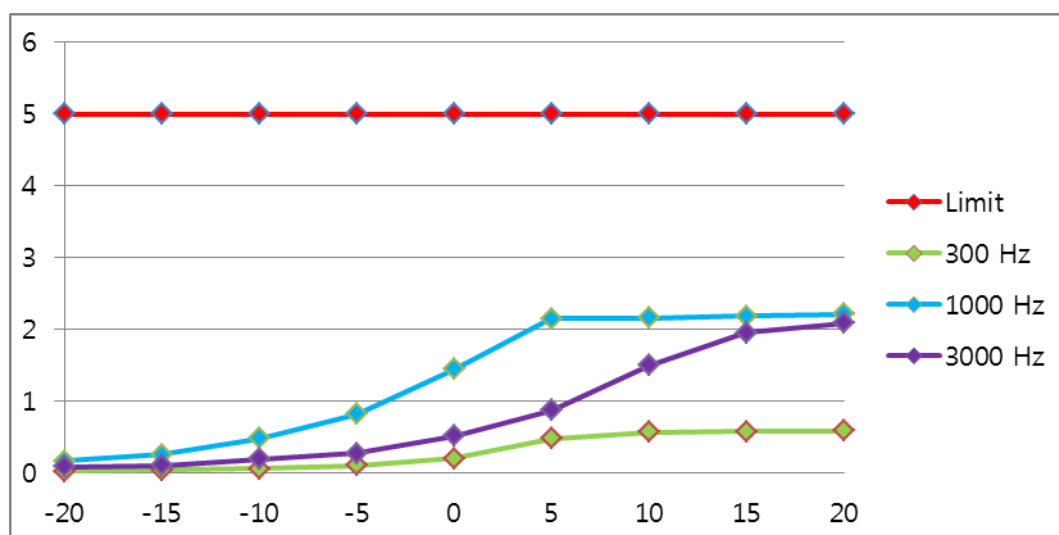
§95.637

(a) 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. A FRS unit that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 2.5 kHz, and the audio frequency response must not exceed 3.125 kHz.

Test results

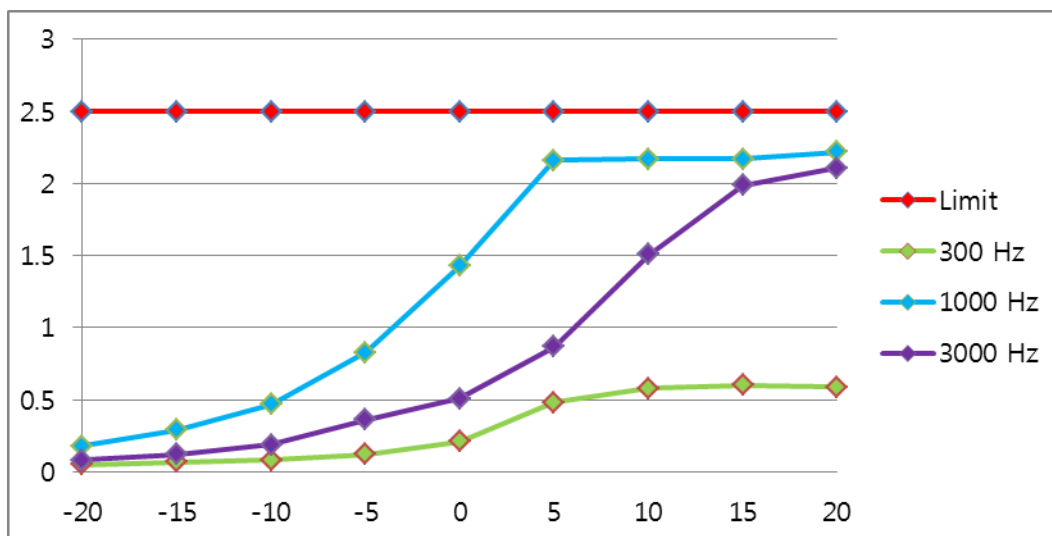
GMRS

Audio level (dB)	Deviation at 300 Hz	Deviation at 1 kHz	Deviation at 3 kHz	Limit (kHz)
-20	0.03	0.17	0.09	5
-15	0.05	0.26	0.11	5
-10	0.06	0.48	0.20	5
-5	0.11	0.82	0.28	5
0	0.21	1.45	0.52	5
5	0.48	2.15	0.88	5
10	0.57	2.16	1.50	5
15	0.58	2.19	1.96	5
20	0.59	2.22	2.09	5



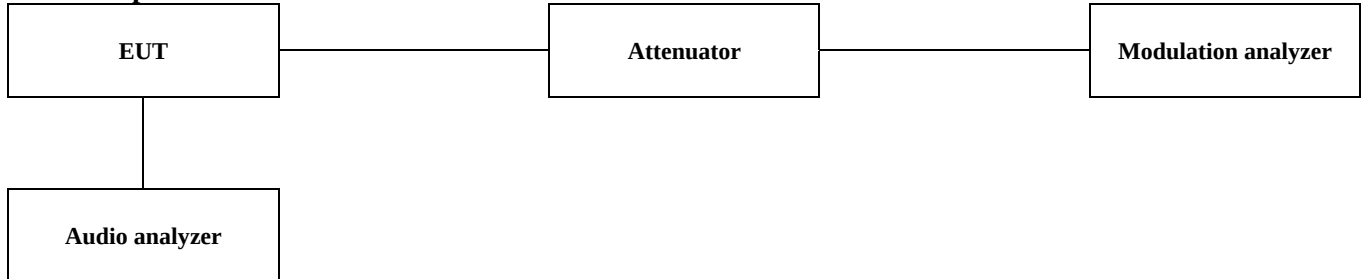
FRS

Audio level (dB)	Deviation at 300 Hz	Deviation at 1 kHz	Deviation at 3 kHz	Limit (kHz)
-20	0.05	0.18	0.08	2.5
-15	0.07	0.29	0.12	2.5
-10	0.08	0.47	0.19	2.5
-5	0.12	0.83	0.36	2.5
0	0.21	1.43	0.51	2.5
5	0.48	2.16	0.87	2.5
10	0.58	2.17	1.51	2.5
15	0.60	2.17	1.99	2.5
20	0.59	2.22	2.11	2.5



3.3. Audio frequency response

Test setup



Test procedure

TIA/EIA-603-D

Limit

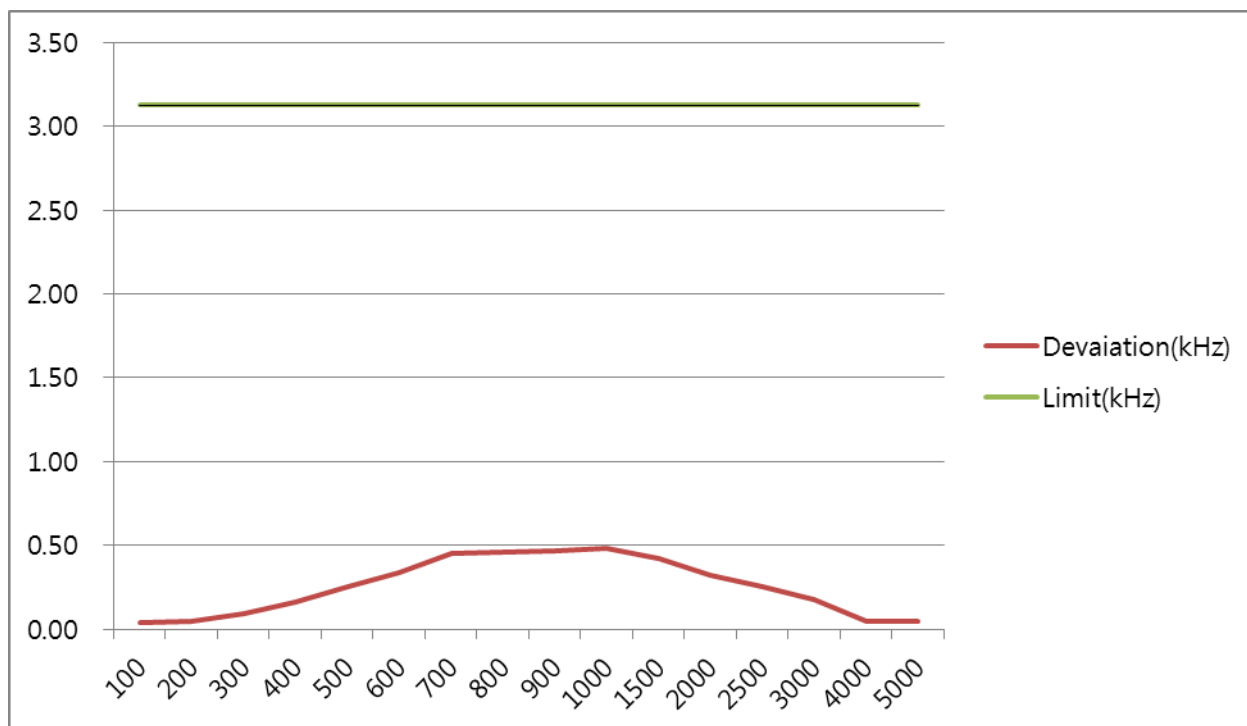
§2.1047

a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Test results

FRS

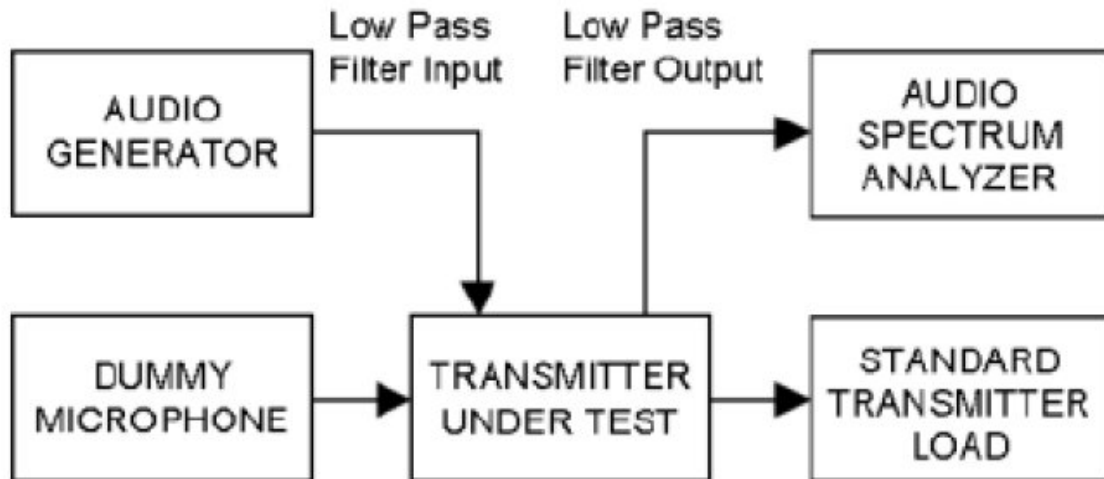
Audio frequency(Hz)	Deviation(kHz)	Limit(kHz)
100	0.04	3.125
200	0.05	3.125
300	0.09	3.125
400	0.16	3.125
500	0.25	3.125
600	0.34	3.125
700	0.45	3.125
800	0.46	3.125
900	0.47	3.125
1000	0.48	3.125
1500	0.42	3.125
2000	0.32	3.125
2500	0.25	3.125
3000	0.18	3.125
4000	0.05	3.125
5000	0.05	3.125



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3.4. Low-pass filter response

Test setup



Test procedure

TIA/EIA-603-D

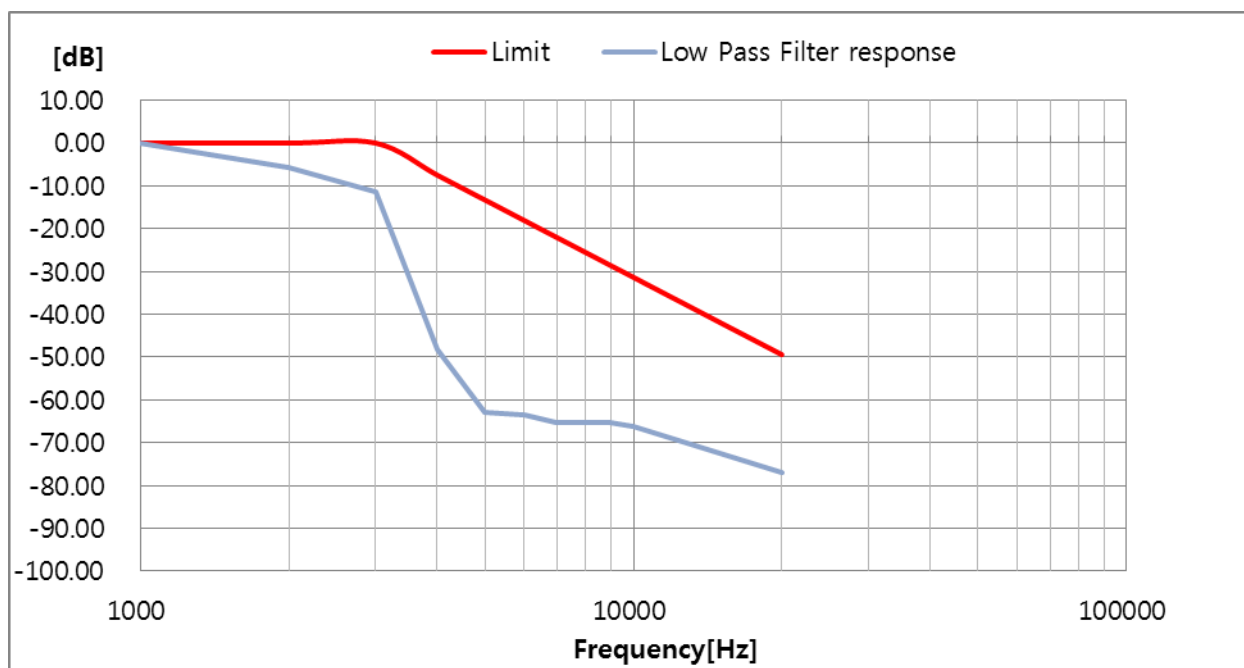
Limit

§95.637

(b) 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.

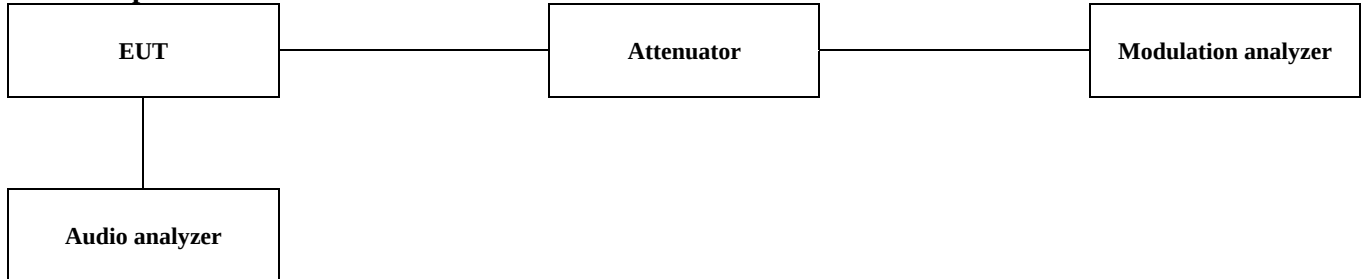
Test results

Audio frequency(Hz)	Response(dB)	Limit(dB)
1000	0.00	0.00
2000	-5.72	0.00
3000	-11.35	0.00
4000	-48.12	-7.50
5000	-62.89	-13.31
6000	-63.51	-18.06
7000	-65.17	-22.08
8000	-65.25	-25.56
9000	-65.36	-28.63
10000	-66.10	-31.37
20000	-76.84	-49.43



3.5. Occupied bandwidth and emission mask

Test setup



Test procedure

TIA/EIA-603-D section 2.2.11

(Modulate the transmitter with a 2 500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50 % of rated system deviation.)

Limit

§95.633

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 authorized bandwidth for emission type F3E or F2D transmitted by a FRS unit is 12.5 kHz.

§95.635

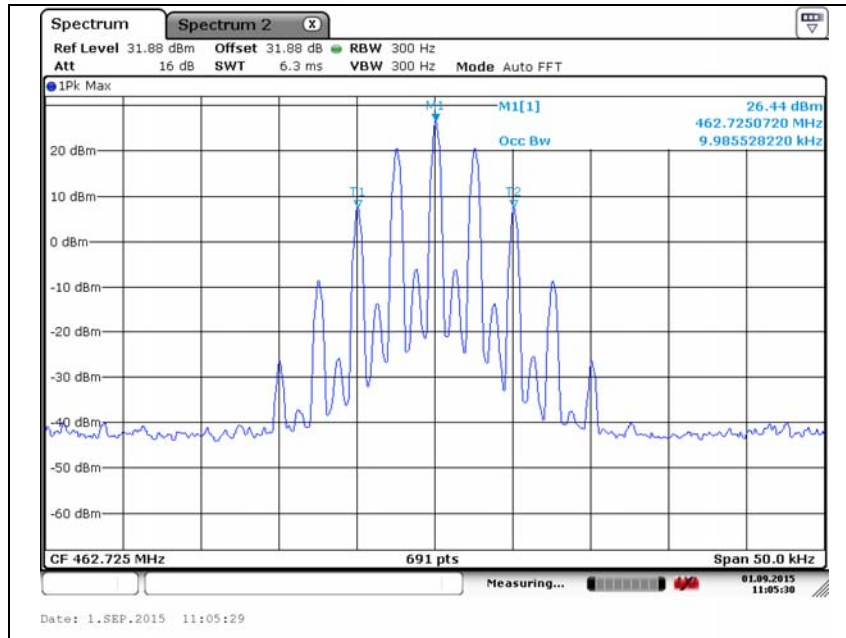
At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50 % up to and including 100 % of the authorized bandwidth.

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.

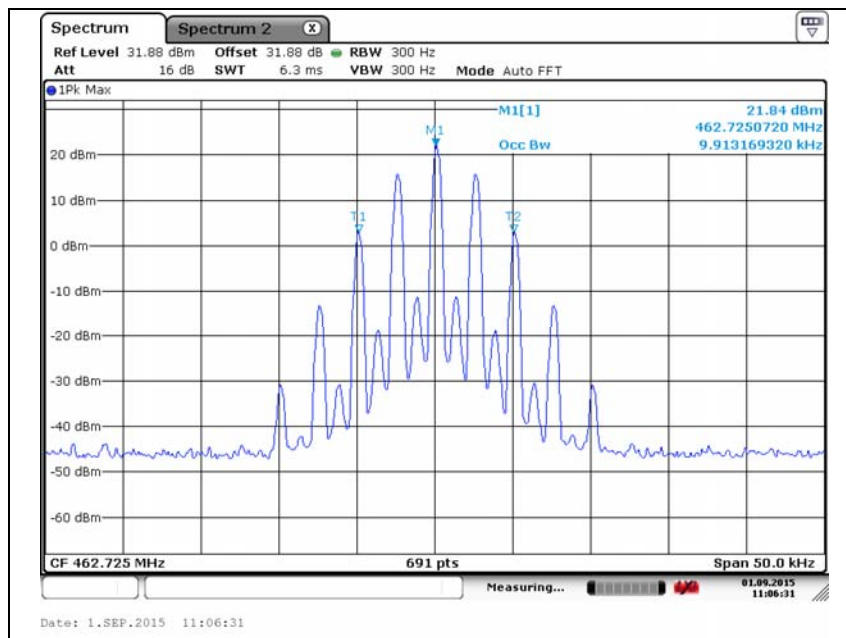
At least $43 + 10 \log_{10}(T)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250 %.

Test results

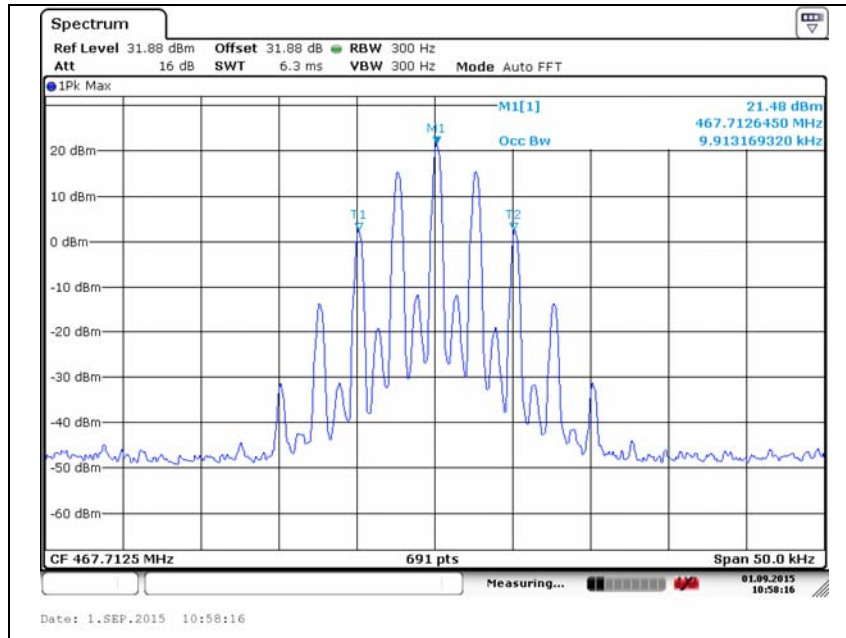
99 % bandwidth for GMRS (High power)



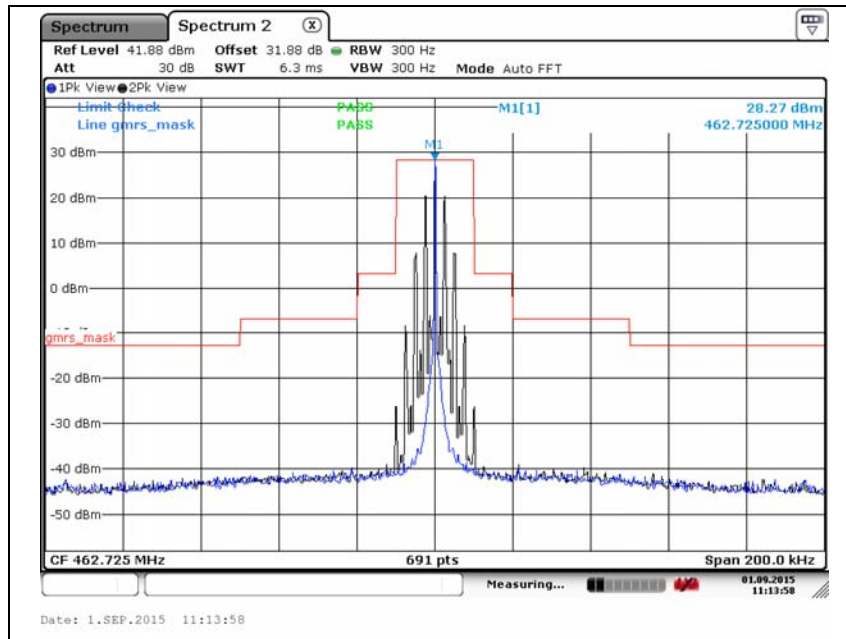
99 % bandwidth for GMRS (Low power)



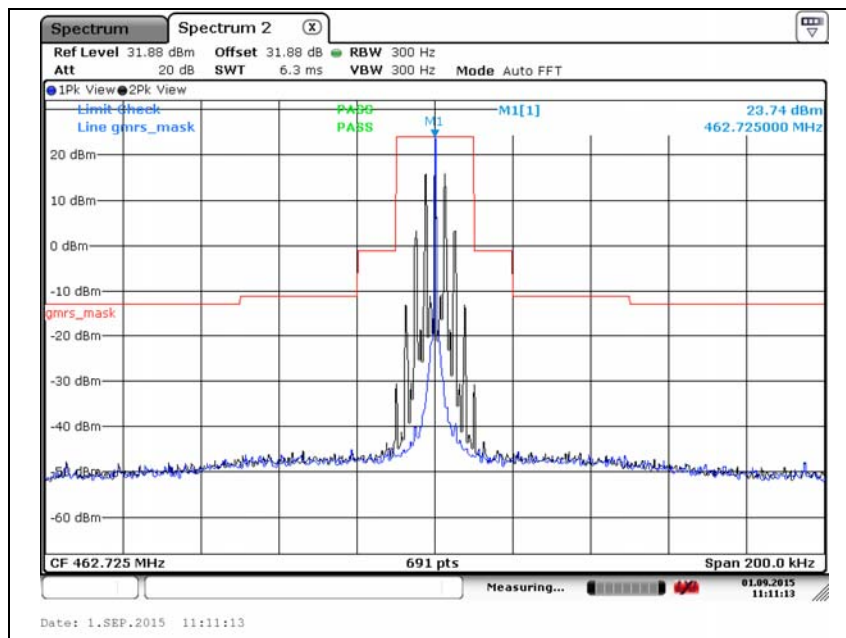
99 % bandwidth for FRS



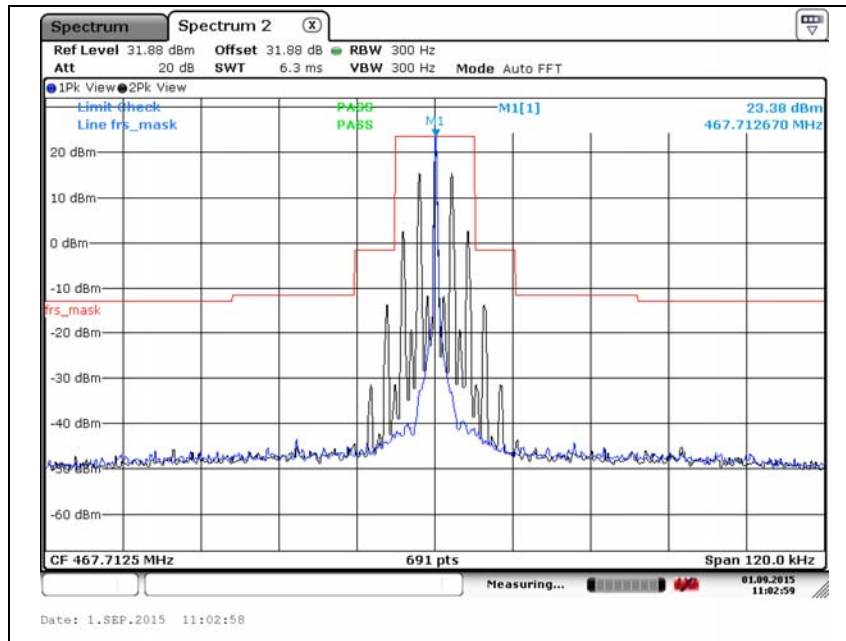
Emission mask for GMRS (High power)



Emission mask for GMRS (Low power)

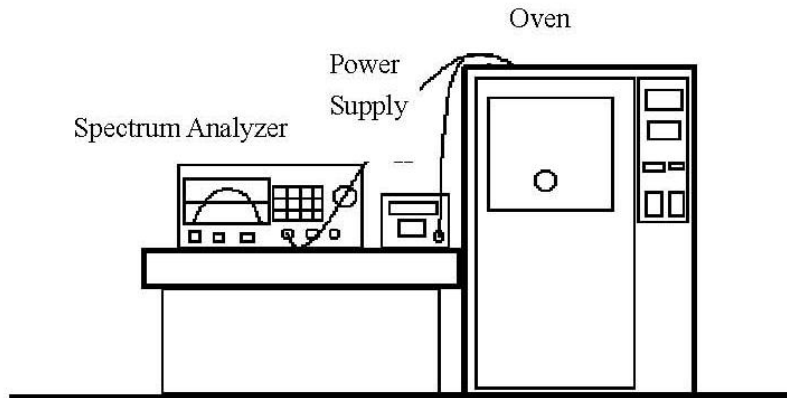


Emission mask for FRS



3.6. Frequency stability

Test setup



Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The transmission time was measured with the spectrum analyzer using RBW=1 kHz, VBW=1 kHz.
3. Set the temperature of chamber to -30°C. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10°C decreased per stage until the highest temperature 50°C is measured, record all measured frequencies on each temperature step.

Frequency stability vs voltage;

1. Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment
2. For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

The output frequency was recorded for each voltage.

Limit

§95.621

(b) Each GMRS transmitter for mobile station, small base station and control station operation must be maintained within a frequency tolerance of 0.000 5%. Each GMRS transmitter for base station (except small base), mobile relay station or fixed station operation must be maintained within a frequency tolerance of 0.000 25%.

§95.627

(b) Each FRS unit must be maintained within a frequency tolerance of 0.000 25%.

Test results

Assigned frequency (MHz): 462.725 0

Temperature (°C)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Frequency deviation (%)
-30	462.724 766	-234	-0.506	-0.000 051
-20	462.724 781	-219	-0.473	-0.000 047
-10	462.724 799	-201	-0.434	-0.000 043
0	462.724 856	-144	-0.311	-0.000 031
10	462.724 914	-86	-0.186	-0.000 019
20	462.725 036	36	0.078	0.000 008
30	462.725 158	158	0.341	0.000 034
40	462.725 297	297	0.642	0.000 064
50	462.725 334	334	0.722	0.000 072

Temperature (°C)	Voltage (V)	Measure frequency (MHz)	Frequency deviation (ppm)	Frequency deviation (%)
24	4.08	462.725 043	0.093	0.000 009
24	5.52	462.725 037	0.080	0.000 008

Assigned frequency (MHz): 467.712 5

Temperature (°C)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Frequency deviation (%)
-30	467.712 341	-159	-0.340	-0.000 034
-20	467.712 387	-113	-0.242	-0.000 024
-10	467.712 396	-104	-0.222	-0.000 022
0	467.712 411	-89	-0.190	-0.000 019
10	467.712 515	15	0.032	0.000 003
20	467.712 597	97	0.207	0.000 021
30	467.712 622	122	0.261	0.000 026
40	467.712 655	155	0.331	0.000 033
50	467.712 749	249	0.532	0.000 053

Temperature (°C)	Voltage (V)	Measure frequency (MHz)	Frequency deviation (ppm)	Frequency deviation (%)
24	4.08	467.712 560	0.128	0.000 013
24	5.52	467.712 594	0.201	0.000 020



Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2016.01.22
Wideband Power Sensor	R&S	NRP-Z81	1137.9009.02-101886-ds	1 year	2016.04.10
Vector signal generator	R&S	SMBV2100A	1407.6004K02	1 year	2016.07.23
Trilog-broadband antenna	Schwarzbeck	VULB 9168	9168-461	2 years	2017.04.03
Dipole antenna	R&S	VHAP	574	2 years	2017.05.15
Dipole antenna	R&S	VHA 9103	91032557	2 years	2016.07.10
Dipole antenna	R&S	UHA 9105	91052417	2 years	2016.07.10
Dipole antenna	R&S	UHAP	546	2 years	2017.05.15
Horn antenna	A.H.	SAS-571	414	2 years	2017.02.09
Horn antenna	A.H.	SAS-571	781	2 years	2017.05.07
Preamplifier	HP	8447F	2805A02570	1 year	2016.01.23
Preamplifier	Schwarzbeck	BBV 9721	9721-003	1 year	2016.04.03
Broadband preamplifier	Schwarzbeck	BBV 9718	9718-246	1 year	2015.10.23
Attenuator	HP	8494B	2630A12857	1 year	2016.01.22
Attenuator	BRID	8325	4676	1 year	2016.01.23
EMI Test Receiver	LIG NEX1	ISA-80	L0912K014	1 year	2015.11.14
High pass filter	Mini-circuits	NHP-800+	15542	1 year	2016.07.24
High pass filter	Weinschel	WHKX1.2/15G-6TT	1	1 year	2016.07.24
Modulation analyzer	HP	8901B	3538A05593	1 year	2016.07.24
Audio analyzer	HP	8903B	3413A14728	1 year	2016.07.23
DC power supply	Agilent	6632B	US36351824	1 year	2016.01.22
Temperature chamber	TABAI	MC711P	112000492	1 year	2016.01.23

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
N/A			